Ford
75th ANNIVERSARY

1978 Car Shop Manual

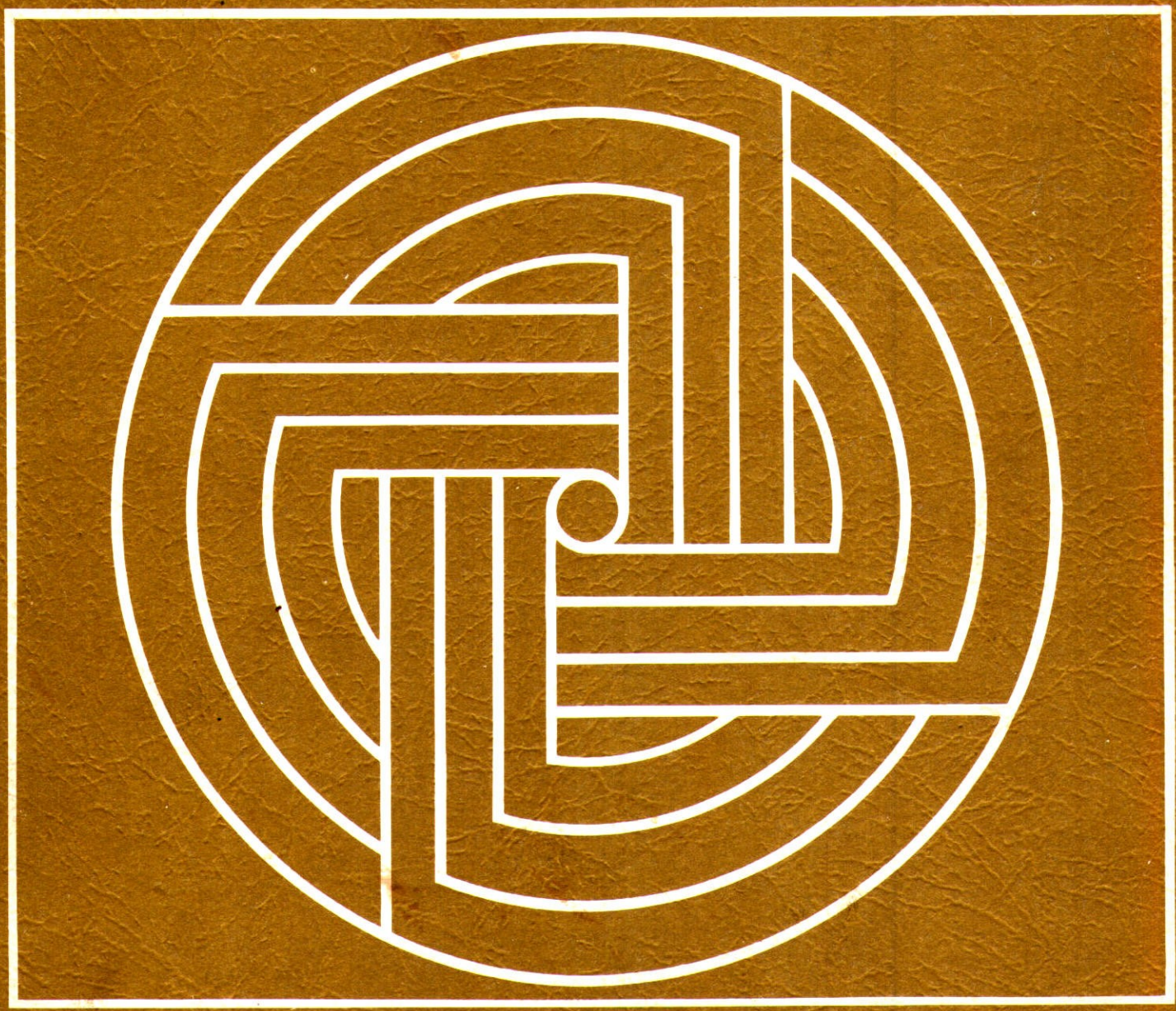
Volume 1 & 2

Chassis and Engine



Ford
75TH ANNIVERSARY

1978 Car Shop Manual Volume 1 Chassis



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IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

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IDENTIFICATION CODES
GROUP 10

WHEELS, TIRES, HUBS AND BEARINGS
GROUP 11 (1000)

BRAKES
GROUP 12 (2000)

STEERING
GROUP 13 (3000)

SUSPENSION
GROUP 14 (3000-5000)

DRIVING AXLES AND DRIVESHAFTS
GROUP 15 (4000)

CLUTCH AND MANUAL TRANSMISSION
GROUP 16 (7000)

AUTOMATIC TRANSMISSION
GROUP 17 (70000)

NOISE, VIBRATION AND HARSHNESS
GROUP 18

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IDENTIFICATION CODES

GROUP 10

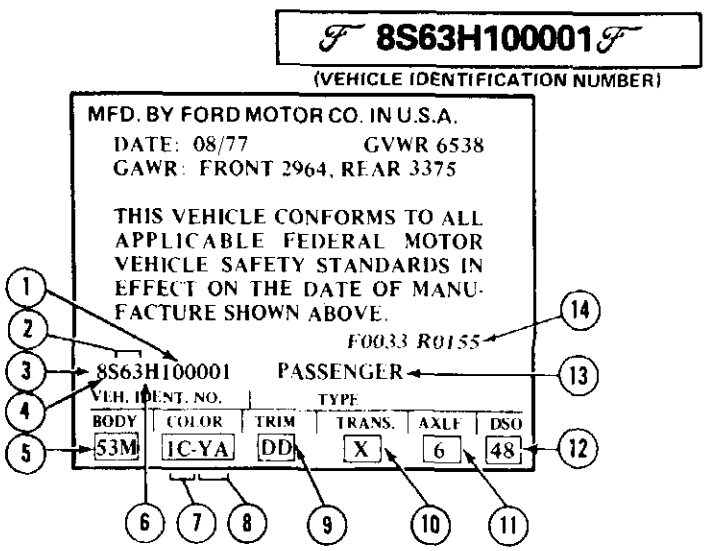
Vehicle Identification

PART 10-01

GENERAL DESCRIPTION

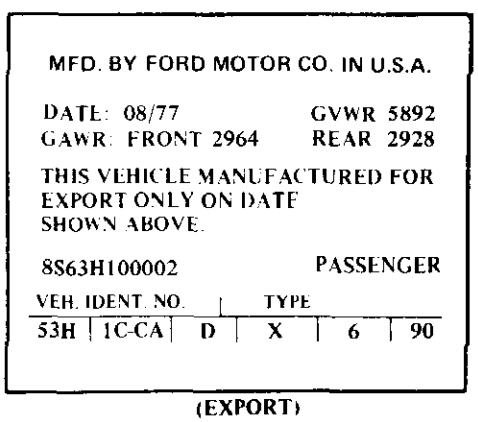
OFFICIAL VEHICLE IDENTIFICATION NUMBER

The official Vehicle Identification Number (VIN) (Fig. 1) for title and registration purposes is stamped on a metal tab that is fastened to the instrument panel close to the windshield on the driver's side of the car and is visible from outside.

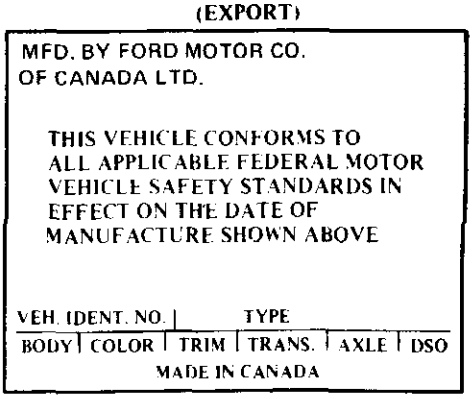


(UNITED STATES)

1. CONSECUTIVE UNIT NO.**
2. BODY SERIAL CODE
3. MODEL YEAR CODE
4. ASSEMBLY PLANT CODE
5. BODY TYPE CODE
6. ENGINE CODE
7. BODY COLOR CODE
8. VINYL ROOF TYPE/COLOR
9. TRIM CODE (First Letter = Type of Trim; Second Letter = Color)
10. TRANSMISSION CODE
11. REAR AXLE CODE
12. DISTRICT – SPECIAL EQUIPMENT
13. VEHICLE TYPE*
14. ACCESSORY RESERVE LOAD



(EXPORT)



(CANADA)

*1978 BUILD MODELS DESIGNATED 1977 MODELS WILL HAVE "PASS 1977" IN THIS SPACE.

**1978 BUILD MODELS DESIGNATED 1977 MODELS WILL HAVE ALTERED CONSECUTIVE NUMBERING AS FOLLOWS:

PINTO/MUSTANG II – 400001 THRU 499999

BOBCAT – 750001 THRU 799999

Y1410-2K

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DETROIT IRON

VEHICLE CERTIFICATION LABEL

The Vehicle Certification Label (V.C. Label) (Fig. 1) is affixed on the left front door lock face panel or door pillar. The upper half of the label contains the name of manufacturer, month and year of manufacture, Gross Vehicle Weight Rating (GVWR), Gross Axle Weight Rating (GAWR), and the certification statement.

The V.C. label also contains the Vehicle Identification Number. This number is also used for warranty identification of the vehicle. The first number indicates the model year. The letter following the model year number indicates the manufacturing assembly plant. The next two numbers designate the Body Serial Code followed by a letter expressing the Engine Code.

The last six digits of the Vehicle Identification Number indicate the Consecutive Unit Number of each unit built at each assembly plant. The Consecutive Unit Numbers begin as follows:

100,001—Ford, LTD II, Ranchero, Mustang II, Thunderbird, Granada, Fairmont and Pinto.

500,001—Mercury, Cougar, Zephyr, Monarch and Mercury Bobcat.

800,001—Lincoln Continental and Continental Mark V.

The remaining information on the V.C. Label consists of the following vehicle identification codes:

The BODY code is two numerals and a letter identifying the body style.

The COL (color) code is a number and letter indicating the exterior paint color code and vinyl roof type and color (if equipped).

The TRIM code consists of a two-letter or a letter-number combination designating the interior trim.

The AXLE code is a number or letter indicating the rear axle ratio and standard or locking type axles.

The TRNS. code is a number or letter indicating the type of transmission.

The DSO code, consisting of two numbers, designates the district in which the car was ordered and may appear in conjunction with a Domestic Special Order or Foreign Special Order number when applicable. Ford of Canada DSO codes consist of a letter and number.

The following charts provide the various codes and their respective identification:

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IDENTIFICATION CODES

ASSEMBLY PLANT CODES

Code Letter	District
A	Atlanta
B	Oakville (Canada)
E	Mahwah
F	Dearborn
G	Chicago
H	Lorain
J	Los Angeles
K	Kansas City
P	Twin Cities
R	San Jose
S	Allen Park (Pilot)
T	Metuchen
U	Louisville
W	Wayne
X	St. Thomas
Y	Wixom
Z	St. Louis

ENGINE CODES

Codes	No. of Cyls.	Displacement Litres	CID
A	8	7.5	460-4V
C	8	7.5	460-4V (Police Interceptor)
F	8	5.0	302-2V
H	8	5.8	351-2V
L	6	4.1	250-1V
S	8	6.6	400-2V
T	6	3.3	200-1V
Y	4	2.3	139-2V (2.3L)
Z	6	2.8	169-2V (2.8L)

TRANSMISSION CODES

Codes	Type
	MANUAL
1	3 Speed
5	4 Speed Overdrive
6	4 Speed @
7	4 Speed (b)
	AUTOMATIC
V	XP (C-3)
W	XP (C-4)
X	FMX
U	XPL (C-6)
Z	XPL (Special)

@ Borg-Warner (b) Hummer

DISTRICT CODES LINCOLN-MERCURY

Code	District
00	Special
11	Boston
15	New York
16	Philadelphia
17	Washington
21	Atlanta
22	Dallas
23	Jacksonville
26	Memphis
31	Buffalo
32	Cincinnati
33	Cleveland
34	Detroit
41	Chicago
42	St. Louis
46	Twin Cities
51	Denver
52	Los Angeles
53	Oakland
54	Seattle
84	Home Off. Reserve
90's	Export

FORD OF CANADA

Mercury Code	Region	Ford Code
A1	Central	B1
A2	Eastern	B2
A3	Atlantic	B3
A4	Midwestern	B4
A6	Western	B6
A7	Pacific	B7
12	Export	12

REAR AXLE RATIO CODES

Conventional	Lock	Ratio
Y		3.08
B		2.47
1	J	2.50
8		2.73
2		2.75
3		2.79
6	Ø	3.00
4		3.18
7		3.40

DISTRICT CODES FORD

Code	District
00	Special
11	Boston
12	Buffalo
13	New York
14	Pittsburgh
15	Newark
16	Philadelphia
17	Washington
21	Atlanta
22	Charlotte
23	Memphis
24	Jacksonville
25	Richmond
26	New Orleans
28	Louisville
41	Chicago
42	Cleveland
43	Milwaukee
45	Lansing
46	Indianapolis
47	Cincinnati
48	Detroit
52	Dallas
53	Kansas City
54	Omaha
55	St. Louis
56	Davenport
57	Houston
58	Twin Cities
71	Los Angeles
72	San Jose
73	Salt Lake City
74	Seattle
75	Phoenix
76	Denver
83	Government
84	Home Off. Reserve
85	American Red Cross
86	Recreational Veh. Pool
87	Body Company
89	Transportation Services
90's	Export

EXTERIOR PAINT COLOR CODES

Code	Ref. #	Color
1C	1724	Black
1G	5299	Silver Met.
1N	5476	Dove Gray
1P	5523	Med. Gray Met. (Two Tone only)
1Q	5527	Med. Silver Met.
2M	3413	Dark Red
2R	5440	Brt. Red
2U	5455	Lipstick Red
3G	5094	Brt. Dk. Blue Met.
3U	5467	Lt. Blue
31	5499	Midnight Blue
34	5041	Med. Blue
46	5328	Dk. Jade Met.
47	5404	Lt. Green
4V	5233	Dk. Yellow Green Met.
5Q	5477	Dk. Brown Met.
6E	5080	Brt. Yellow
6P	5406	Cream
6U	5441	Lt. Tan
7Q	5479	Lt. Aqua Mt.
7S	5489	Dk. Emerald Met.
8G	5466	Vista Orange
8H	5470	Tan
8K	5486	Brt. Saddle Met.
8N	5496	Dk. Cordovan Met.
8P	5471	Lt. Cordovan
8Y	5494	Champagne Met.
83	5524	Chamois
84	5525	Dk. Cordovan
9D	5418	White

(RPO) UNIQUE COLORS (NON POLISH) "D"

2Y	5492	Rose Met.
3V	5480	Brt. Blue Met.
6V	5298	Tan Met.
	5460	Med. Gold Met.
7H	5482	Brt. Aqua Met.
7L	5483	Lt. Jade Met.
7T	5490	Med. Emerald Met.
8J	5484	Med. Tan Met.
8W	5491	Chamois Met.

(RPO) DIAMOND BRIGHT (POLISH) "W"

2S	5444	Dk. Red Met.
2G	5070	Med. Red Met.
32	5511	Med. Blue Met.
8V	5495	Med. Ember Met.
8Z	5510	Med. Nectarine Met.
1R	5512	Lt. Silver Met.

(RPO) DIAMOND FLARE (POLISH) "G"

1J	5411	Silver Met.
1L	5472	Black Met.
2T	5462	Rose Met.
6Y	5461	Brt. Yellow Gold Met.
7B	5463	Crystal Jade Met.

CY1411-2L

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BODY SERIAL AND STYLE CODES

Vehicle	Body Serial Code	Body Style Code	Body Type	Model
PINTO	10	62B	2-Dr. Sedan	Base
	11	64B	3-Dr. Sedan	Base
	12	73B	Wagon	Base
BOBCAT	20	64H	3-Dr. Sedan	U.S.A. & Canada
	22	73H	Wagon	U.S.A. & Canada
	23	62B	2-Dr. Sedan	Canada Only
	24	64B	3-Dr. Sedan	Canada Only
	25	73B	Wagon	Canada Only
MUSTANG II	02	60F	2-Dr.	Base
	03	69F	3-Dr.	Base
	04	60H	2-Dr.	Ghia
	05	69R	3-Dr.	Mach I
GRANADA	82	54H	4-Dr. Sedan	Base
	81	66H	2-Dr. Sedan	Base
MONARCH	34	54H	4-Dr. Sedan	Base
	33	66H	2-Dr. Sedan	Base
VERSAILLES	84	54M	4-Dr. Sedan	Base
LTD II	25	65B	2-Dr. Hardtop	LTD II S
	27	53B	4-Dr. Pillar Hardtop	LTD II S
	30	65D	2-Dr. Hardtop	LTD II
	31	53D	4-Dr. Pillar Hardtop	LTD II
	43	71K	LTD II Squire	Wagon
	47	97D	500	LTD II
	48	97R	GT	Ranchero
	49	97K	Squire	
FAIRMONT	92	54B	4-Dr. Sedan	Base
	91	66B	2-Dr. Sedan	Base
	93	66R	2-Dr. Sedan	Sport Coupe
	94	74B	Wagon	

Vehicle	Body Serial Code	Body Style Code	Body Type	Model
COUGAR	92	53D	4-Dr. Pillar Hardtop	Cougar
	91	65D	2-Dr. Hardtop	Cougar
	93	65L	2-Dr. Hardtop	Cougar XR-7
THUNDERBIRD	87	60H	2-Dr. Pillar Hardtop	Base
FORD	52	60D*	2-Dr. Pillar Hardtop	Custom 500
	53	53D	4-Dr. Pillar Hardtop	Custom 500
	62	60H	2-Dr. Pillar Hardtop	LTD
	63	53H	4-Dr. Pillar Hardtop	LTD
	64	53L	4-Dr. Pillar Hardtop	LTD Landau
	65	60L	2-Dr. Pillar Hardtop	LTD Landau
	72	71D	Custom 500/LTD II	Wagon
	74	71H	LTD	Wagon
MERCURY	62	53H	4-Dr. Pillar Hardtop	Marquis (FLD)
	61	65H	2-Dr. Hardtop	Canada Only
	66	53L	4-Dr. Pillar Hardtop	Grand Marquis
	65	65L	2-Dr. Hardtop	Grand Marquis
	64	53K	4-Dr. Pillar Hardtop	Marquis Brougham
	63	65K	2-Dr. Hardtop	Marquis Brougham
	74	71K	Marquis**	Wagon
CONTINENTAL MARK V	89	65D	2-Dr. Hardtop	Base
LINCOLN CONTINENTAL	81	60B	2-Dr. Pillar Hardtop	Base
	82	53B	4-Dr. Pillar Hardtop	Base
ZEPHYR	32	54D	4-Dr. Sedan	Base
	31	66D	2-Dr. Sedan	Base
	35	36R	2-Dr. Sedan	Sport Coupe
	36	74D	Wagon	

CY1615-2E

VINYL ROOF TYPE AND COLOR IDENTIFICATION

Code	Vinyl Type	Code	Vinyl Type
W	Lugano Full	Z	Valino Front Half
X	Lugano Half	T	Valino Coach
K	Lugano Front Half	B	Crosshatch Full
M	Lugano Coach	R	Crosshatch Half
D	Milano Full	S	Levant Full
E	Milano Half	E	Levant Half Rear (Mustang Dev.)
F	Milano Halo	G	Odense Full
Q	Cayman Full	N	Odense Half
U	Cayman Half	A	Odense Front Half
V	Valino Full		
Y	Valino Half		

Code	Vinyl Color	Code	Vinyl Color
A	Black	F	Cordovan
B	Blue, Medium	K	Cordovan, Light
S	Blue, Midnight		Gold, Galveston
5	Blue, Wedgewood	E	Gray, Dove
T	Brown, Dark	R	Jade, Dark
V	Camel, Lt.	M	Jade, Light
Y	Camel, Medium	4	Jade, Medium
U	Chamois	3	Jade, Wedgewood
6	Champagne, Light	D	Red/Russet
J	Champagne, Midnight	P	Silver
		W	White

When a Vinyl Roof is installed the type and color codes will be reflected after the two digit Exterior Paint Color Code.
Example: Code – 1CYA = 1C–Black Car, YA–Valino Black Half Roof.

CY1615-2E1

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WHEELS AND TIRES

GROUP 11

PART TITLE	PART NO.
General Wheel and Tire Service	11-01
Wheels and Tires – Drop Center Rim	11-02
Wheel Hubs and Bearings – Front	11-10
Wheel Hubs and Bearings – Rear – Refer to Rear Axles, Parts 15-02, 15-03, 15-06 or 15-10	

CF2508-2B

General Wheel and Tire Service

PART 11-01

Applies to All Models

SUBJECT	PAGE
ADJUSTMENTS	
Front Wheel Bearing Maintenance	01-1
Tire Sizes	01-1
Wheel Balancing	01-1
CLEANING AND INSPECTION	
Tire Inspection	01-3
Wheel Inspection	01-3
SPECIFICATIONS	01-4

CF2509-2A

ADJUSTMENTS

WHEEL BALANCING

Use the instructions provided with the Rotunda Wheel Balancer or equivalent dynamic type wheel balancer.

Be sure brakes are not dragging before spinning the wheels. On vehicles equipped with disc brakes, push the brake shoes into the caliper to free the rotor.

FRONT WHEEL BEARING MAINTENANCE

Wheel bearings can be adjusted to correct bearing and spindle shoulder wear. Long bearing life depends on proper adjustment and correct lubrication.

If bearings are too tight, they will overheat and wear rapidly. Loose bearings can cause pounding and contribute to uneven tire wear, steering difficulties, and inefficient braking.

Check bearing adjustment at regular inspection intervals. Refer to Part 11-10 for front wheel bearing service instructions.

TIRE SIZES

It is mandatory to use only the tire sizes recommended on the tire chart attached to the vehicle. **Larger or smaller tires can damage the vehicle and affect durability and may require changing the speedometer drive gears.** Be sure wheel size and offsets match those recommended for the tire in use (Fig. 1 and 2).

Be sure all tires (including snow tires) and wheels on the vehicle are the same size, type, and load-carrying capacity. Never mix radial, belted, and conventional-type tires.

Use Rotunda Tire Changer 35-0010 or equivalent to install tires.

Follow the instructions provided with the changer.

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Car Line	Code	Color/Style	Wheel Size	No. of Bolts	Bolt Circle Dia.	Offset	Tire Usage	Size
Pinto/Bobcat Mustang II	GM	Yellow-Yellow	13 x 5	4	4.25	.62	A70, A78, B78, BR78, BR70	-13
	MH	Styled-Steel Orange-Violet	13 x 5	4	4.25	.62	A70, A78, B78, BR78, BR70	-13
	SH	Alum.-Forged	13 x 5.5	4	4.25	.39	A78, B78, BR78, BR70	-13
Pinto/Bobcat/ Mustang II	RW	Alum.-Forged Painted White	13 x 5.5	4	4.25	.39	BR70, B78, BR78, CR70, A78	-13
Bobcat	MH	Pink-Pink Styled-Steel	13 x 5	4	4.25	.62	A78, B78, BR78, BR70	-13
Mustang II	GM	Yellow-Yellow	13 x 5	4	4.25	.62	B78, BR78, BR70	-13
	MH	Styled-Steel Pink-Pink	13 x 5	4	4.25	.62	B78, BR78, BR70	-13
	CD	White-White	13 x 5.5	4	4.25	.39	195/70R	-13
	MS	Styled-Steel Green-Violet	13 x 5.5	4	4.25	.39	195/70R	-13
	BB	Alum.-Forged	13 x 5.5	4	4.25	.39	B78, BR78, BR70, 195/70R	-13
	CS	Alum.-Cast	13 x 5.5	4	4.25	.39	B78, BR78, BR70, 195/70R	-13
	RF	Alum.-Cast White	13 x 5.5	4	4.25	.39	B78, BR78, BR70, 195/70R	-13
	RF	Alum.-Cast Tan	13 x 5.5	4	4.25	.39	B78, BR78, BR70, 195/70R	-13
Fairmont/Zephyr	MF	Brown-Brown	14 x 5	4	4.25	1.12	B78, BR78, C78, CR78, DR78	-14
		Alum.-Cast	14 x 5.5	4	4.25	1.12	C78, CR78, DR78, B78, BR78	-14
Granada/Monarch	JG	Green-Violet	14 x 6	5	4.50	.00	DR78, ER78, FR78, D78*	-14
	KZ	Styled-Steel Orange-Orange	14 x 6	5	4.50	.00	DR78, ER78, FR78	-14
	BZ	Alum.-Cast	14 x 6	5	4.50	.00	DR78, ER78, FR78	-14
	WP	Alum.-Cast White	14 x 6	5	4.50	.00	DR78, ER78, FR78	-14
Versailles	MM	Alum.-Forged	14 x 6	5	4.50	.00	FR78	-14
	JG	Green-Violet	14 x 6	5	4.50	.00	FR78, F78*	-14
Ranchero	HG	Styled-Steel White-Red	14 x 7	5	4.50	.25	G78, H78, G70, H70, HR78	-14
	GK	White-Brown	14 x 6	5	4.50	.25	G70, G78, H70, H78, HR78	-14
LTD II – Cougar	EI	Pink-Pink	15 x 6	5	4.50	.45	HR78, H78	-15
	AK	Pink-Green	15 x 6.5	5	5.00	.45	Police INTERCEPTOR	-15
	AD	Pink-White	14 x 5.5	5	4.50	.25	HR78, H78*	-14
LTD II – Taxi	ZN	Brown-Violet	15 x 6.5	5	5.00	.45	HR78	-15
LTD II – Cougar – Cougar XR-7 – Thunderbird	AL	Alum.-Cast	15 x 6.5	5	4.50	.45	HR78, HR70	-15
Cougar XR-7 – Thunderbird	EI	Pink-Pink	15 x 6	5	4.50	.45	HR78	-15
	FA	Gray-Gray	15 x 6.5	5	4.50	.45	HR70	-15
	GG	Red-Brown	15 x 6	5	4.50	.45	HR78	-15
	GC	Yellow-Brown	15 x 6	5	4.50	.45	H70, HR70	-15
	AL	Alum.-Cast	15 x 6.5	5	4.50	.45	HR70, HR78	-15
Cougar XR-7	GG	Red-Violet	15 x 6	5	4.50	.45	HR78	-15

F1820-2M1

FIG. 1 Car Tire/Wheel Combinations

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Car Line	Code	Color/Style	Wheel Size	No. of Bolts	Bolt Circle Dia.	Offset	Tire Usage	Size
Cougar Sedans/LTD II 2-Door Spt. Sedan Option	HG	Styled-Steel White-Red	14 x 7	5	4.50	.25	HR78	-14
Ford/Mercury	Y8	Orange-Orange	15 x 6	5	5.00	.45	HR78, JR78, GR78†	-15
	ZN	Brown-Violet	15 x 6.5	5	5.00	.45	HR78, JR78, LR78	-15
	AK	Pink-Green	15 x 6.5	5	5.00	.45	Police Interceptor	-15
	AT	Alum.-Forged	15 x 6	5	5.00	.45	HR78, JR78, LR78, GR78†	-15
Lincoln/Mark V	YA	Red-Green	15 x 6	5	5.00	.45	JR78, 225, LR78, 230, L78*	-15
	AD	Alum.-Forged	15 x 6	5	5.00	.45	JR78, 225, LR78, 230	-15
	EW	Alum.-Cast	15 x 6	5	5.00	.45	JR78, 225, LR78, 230	-15
	XA	White-Yellow	15-5.5	5	5.00	.45	J76*	-15

*Collapsible Spare
† Ford Only

F1820-2M2

FIG. 2 Car Tire/Wheel Combinations

CLEANING AND INSPECTION

WHEEL INSPECTION

Inspect the hub nuts and torque to specification. Loose hub nuts can cause shimmy and vibration, and may also distort the stud holes in the wheels.

Be sure wheels and hubs are clean. Stones wedged between the wheel and rotor or rear drum or lumps of mud and grease can unbalance the wheel.

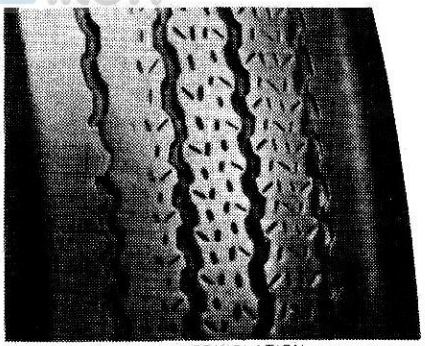
Check for wheel damage. Wobble or shimmy caused by a damaged wheel will eventually damage the bearings. Inspect the rims for dents that could leak air.

Inspect the front hubs and bearings whenever the hubs are removed, or at regular inspection intervals.

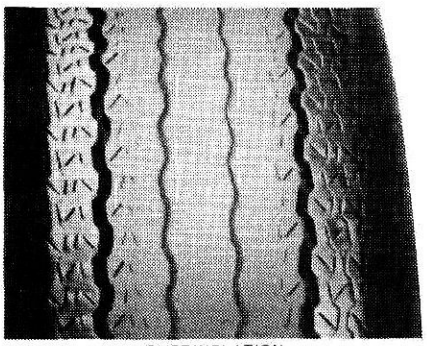
TIRE INSPECTION

Inspect tires for wear. Abnormal or excessive wear may be caused by incorrect wheel alignment, wheel/tire imbalance, or improper tire pressure. Figure 3 shows typical wear patterns.

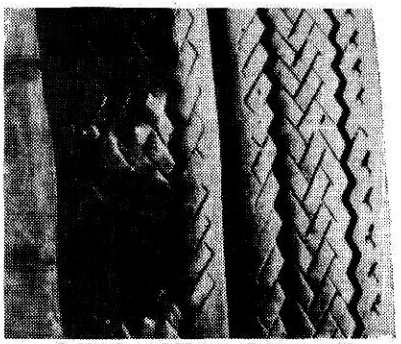
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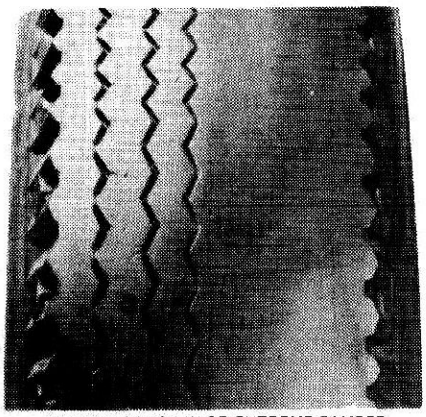
UNDERINFLATION



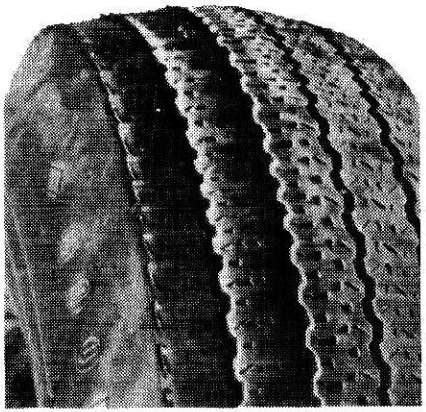
OVERINFLATION



CUPPING—UNDERINFLATION AND/OR MECHANICAL IRREGULARITIES SUCH AS OUT-OF-BALANCE CONDITION OF WHEEL AND/OR TIRE, AND BENT OR DAMAGED WHEEL.
POSSIBLE LOOSE OR WORN STEERING TIE-ROD OR STEERING IDLER ARM.
POSSIBLE LOOSE, DAMAGED OR WORN FRONT SUSPENSION PARTS.



INCORRECT TOE-IN OR EXTREME CAMBER



FEATHERING DUE TO MISALIGNMENT

F1467-2E

FIG. 3 Tire Wear Conditions

SPECIFICATIONS

TORQUE LIMITS – FT-LB

Wheel Attaching Nuts – All Cars	70-115

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Wheels and Tires—Drop Center Rim

PART 11-02

Applies to All Vehicles

SUBJECT	PAGE
DESCRIPTION	
Collapsible Spare Tire	02-1
Front Wheel Assembly	02-1
Rear Wheel Assembly	02-1
REMOVAL AND INSTALLATION	
Hoisting Instructions	02-2
REMOVAL AND INSTALLATION (Cont'd.)	
Removing and Installing Tire	02-2
Wheel and Tire Installation	02-2
Wheel and Tire Removal	02-2

CF2510-2B

DESCRIPTION

COLLAPSIBLE SPARE TIRE

The Collapsible Spare Tire, for Thunderbird, Continental Mark V, Lincoln Continental, Granada, Monarch, Versailles, LTD II, Cougar and Cougar XR-7 is installed on the wheel in a deflated condition and protrudes barely beyond the rim of the wheel.

The collapsible space saver spare tire is designed to provide more luggage room. A can of tire inflation propellant is provided with the tire, and is located in the luggage compartment. **Be sure to read all instructions on can and collapsible spare tire before use. Do not use this tire for extended mileage or for speeds above 50 mph. Do not exceed the vehicle maximum load rating. Do not use tire chains with this tire. Do not exceed 35 psi air pressure.**

Directions For Use

1. If temperature is 10°F or below, warm inflator before use. Place inflator over defroster outlet of car, set heater for "defrost" at highest temperature and run blower at highest setting for a minimum of *10 minutes.*
2. Bolt Collapsible Spare Tire and wheel assembly on car with air valve at bottom before inflating tire (see diagram on inflator bottle).
3. Remove plastic cap from inflator and valve cap from tire. Push inflator onto valve stem until sound of gas entering tire can be heard.

   While inflating, keep hands off the metal parts of the inflator, since it becomes extremely cold during discharge. **When completely used, the inflator will fill the tire within specifications.**
4. One minute after sound stops, remove inflator and replace valve cap. When first filled or after car has been standing for a considerable length of time, the tire may not appear fully inflated. In this case, drive slowly for the first mile; this will increase the pressure in the tire.
5. Dispose of the inflator in a safe waste receptable. Do not incinerate or puncture.
6. Remove the Collapsible Spare Tire as soon as the conventional tire can be repaired or replaced. The Collapsible Spare Tire is not designed for use as a conventional tire. To deflate Collapsible Spare Tire, remove valve core. Flatten tire and replace core and cap.
7. The tire inflator is not rechargeable. If you must use it, be sure to obtain a replacement for the next emergency use.
8. For Granada and Monarch use Ford Part D5DA-19F514-AA or equivalent. For Thunderbird, Continental Mark V, Cougar XR7 and Lincoln Continental use D6OA-19F514-AA or equivalent. For LTD II and Cougar use D6OA-19F514-AA or equivalent. For Versailles, use D5OA-19F514-AA or equivalent.

   Ordinarily, a vehicle is operated with only the original spare in the trunk. In the event that the *original spare and the Collapsible Spare Tire are* stored together, the Collapsible Spare Tire must be considered as luggage weight of 50 pounds when utilizing the rated luggage load information.

FRONT WHEEL ASSEMBLY

Each front wheel is bolted to the hub and rotor assembly. Two opposed and tapered roller bearings and a grease retainer, to prevent leakage onto the braking surface, are installed in the hub.

An adjusting nut, nut lock, and cotter pin attach the front wheel assembly including the hub and rotor to the spindle (Figs. 1 and 2, Part 11-10).

REAR WHEEL ASSEMBLY

The rear wheel brake drum or disc brake rotor is attached to studs on the rear axle shaft hub flange. The

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wheel and tire mounts on the same rear axle shaft flange studs and is held against the hub and drum or rotor by the wheel nuts. The rear wheel bearing is pressed onto the axle shaft just inside the shaft flange, and the entire assembly is held in the rear axle housing by the bearing retainer plate or disc brake axle adapter which is bolted to the housing flange or by C-locks which retain the axle shaft in the differential case.

REMOVAL AND INSTALLATION

HOISTING INSTRUCTIONS

Incorrect hoisting can damage steering linkage components and front-end suspension struts.

On two-post hoists, place the adaptors under the lower arms, or (except Pinto and Mustang) the No. 1 crossmember. **Make sure the adaptors do not rest on the steering linkage.** If the adaptors are placed under the crossmember, place a block of wood 2 x 4 x 16 inches on the hoist channel between the adaptors to prevent damage to the struts.

WHEEL AND TIRE REMOVAL

1. Remove the wheel cover. Loosen, but do not remove, the hub nuts.
2. Raise the vehicle until the tire clears the floor.
3. Remove the hub nuts and pull the wheel off the hub.

WHEEL AND TIRE INSTALLATION

1. Clean all dirt from the hub mounting surface.
2. Place the wheel on the hub. Install the hub nuts and tighten them alternately to draw the wheel evenly against the hub.
3. Lower the vehicle and torque the hub nuts to specification.

REMOVING AND INSTALLING TIRE

Follow the instructions provided with Rotunda Tire Changer 35-0010 or equivalent. Additional information about this tire changer can be found under Adjustments, Part 11-01.

Whenever a radial ply tire is removed from a wheel, it should be marked so it cannot be installed in a reversed position.

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Wheel Hubs and Bearings—Front

PART 11-10

Applies to All Models

SUBJECT	PAGE
ADJUSTMENTS	
Front Wheel Bearing Adjustment	10-2
Hoisting Instructions	10-2
DESCRIPTION	
Front Wheel Assembly	10-1
REMOVAL AND INSTALLATION	
Front Wheel Grease Seal and Bearing Replacement and Lubrication	10-2
Front Hub and Rotor Assembly	10-4
Hoisting Instructions	10-2
SPECIAL TOOLS	10-3

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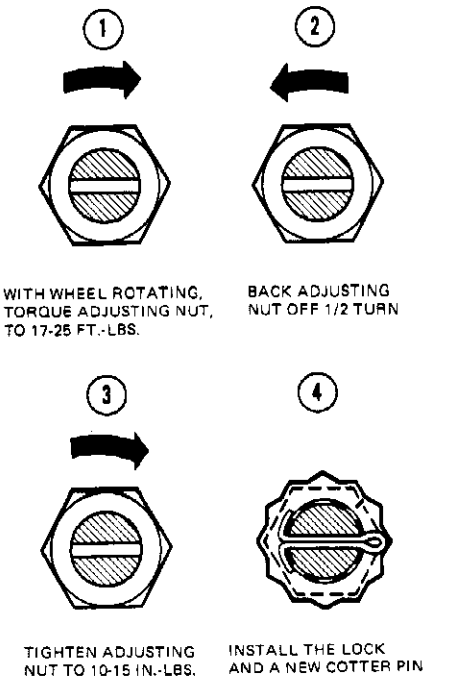
DESCRIPTION

FRONT WHEEL ASSEMBLY

Each front wheel is bolted to the hub and rotor assembly. Two opposed and tapered roller bearings and a grease retainer, to prevent leakage onto the rotor, are also installed in the hub.

An adjusting nut, nut lock, and cotter pin attach the assembly to the spindle (Fig. 2).

The front wheel spindle has a dog-nosed outer end fastened by a smaller, copper-colored nut lock and a heavier cotter pin. **These parts cannot be used on models built prior to 1974.**



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FIG. 1 Front Wheel Bearing Adjustment

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ADJUSTMENTS

HOISTING INSTRUCTIONS

Refer to Part 11-02 for Hoisting Instructions.

FRONT WHEEL BEARING ADJUSTMENT

If the wheel is loose on the spindle or does not rotate freely, adjust the front wheel bearings as follows:

1. Raise the vehicle until the tire clears the floor.
2. Remove the wheel cover. Remove the grease cap from the hub.
3. Wipe the excess grease from the end of the spindle. Remove the cotter pin and nut lock.
4. Loosen the adjusting nut three turns and rock the wheel, hub and rotor assembly in and out several times to push the shoe and linings away from the rotor.
5. While rotating the wheel, hub, and rotor assembly, torque the adjusting nut to 17 to 25 ft-lb, to seat the bearings. (Fig. 1).
6. Loosen the adjusting nut one-half turn, then retighten to 10 to 15 in-lb, using a torque wrench.
7. Place the nut lock on the adjusting nut so the castellations on the lock are in line with the cotter pin hole in the spindle.
8. Install a new cotter pin and bend the ends around the castellated flange of the nut lock.
9. Check front wheel rotation. If the wheel rotates properly, reinstall the grease cap and wheel cover. If rotation is noisy or rough, follow the inspection, lubrication and replacement procedures given under Removal and Installation in this Part.
10. Before driving the vehicle, pump the brake pedal several times to restore normal brake pedal travel.

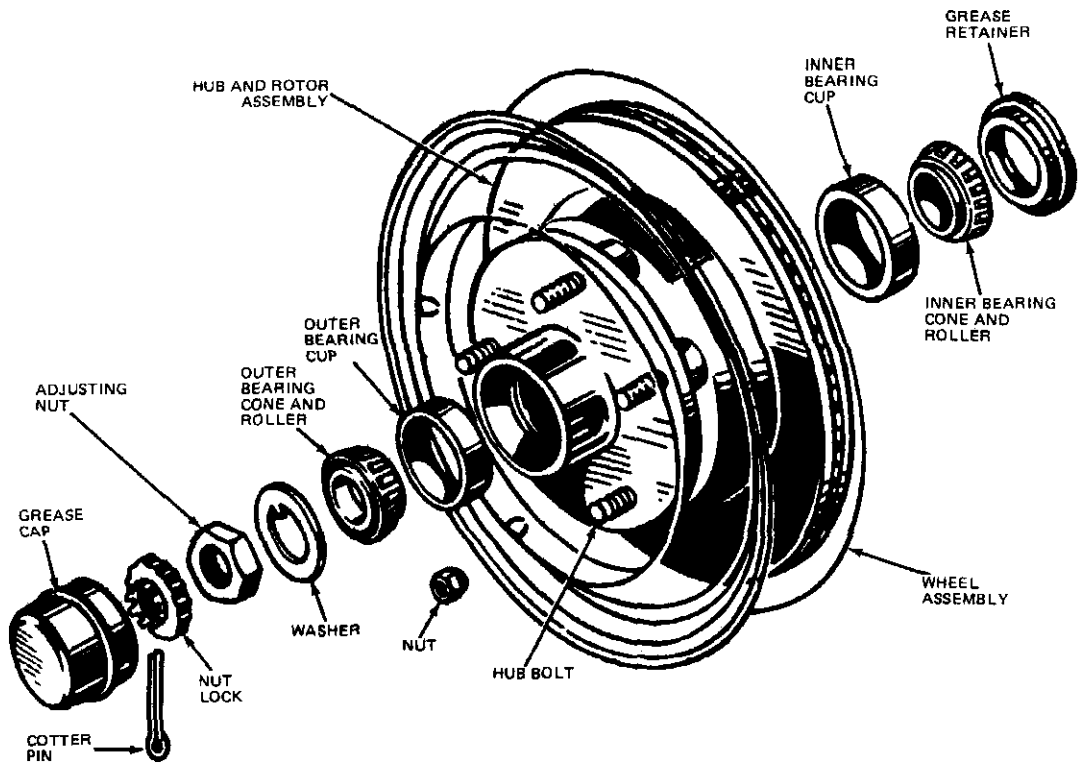


FIG. 2 Front Hub, Bearing and Grease Retainer—Disc Brakes

REMOVAL AND INSTALLATION

HOISTING INSTRUCTIONS

Refer to Part 11-02 for Hoisting Instructions.

FRONT WHEEL GREASE SEAL AND BEARING REPLACEMENT AND LUBRICATION

1. Raise the vehicle until the tire clears the floor and remove wheel from hub and rotor.
2. Remove the caliper from the anchor plate, as outlined in Group 12 and wire it to the underbody to prevent damage to the brake hose.
3. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly. (Fig. 2).
4. Pull the hub and rotor assembly off the spindle.

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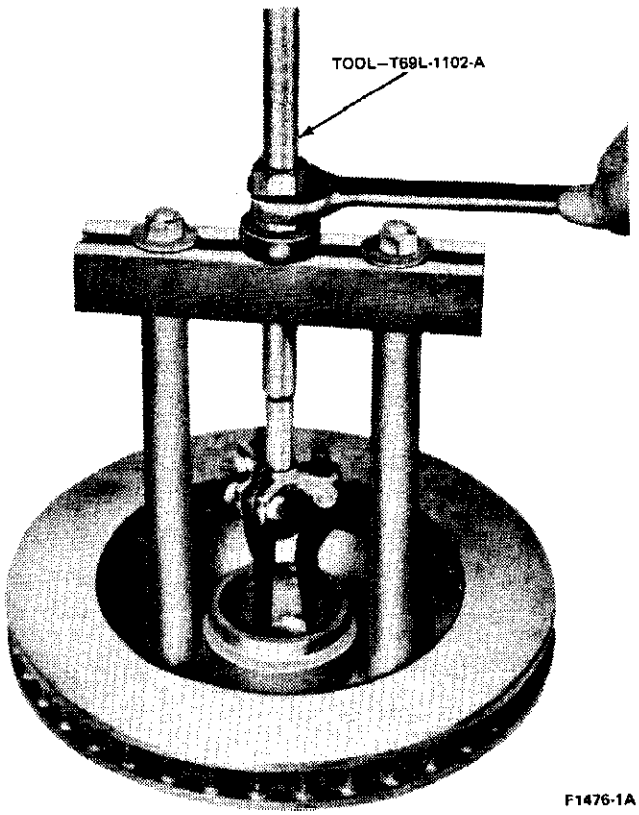


FIG. 3 Removing Front Wheel Bearing Cups

5. Using Tool 1175AC remove and discard the grease retainer. Remove the inner bearing cone and roller assembly from the hub.
6. Clean the inner and outer bearing cups with solvent. Inspect the cups for scratches, pits, excessive wear, and other damage. If the cups are worn or damaged, remove them with Tool T69L-1102-A (Fig. 3).
7. Wipe out all old lubricant from the spindle and the inside of the hub. Cover the spindle with a clean cloth, and brush all loose dust and dirt from the dust shield. **Carefully remove the cloth from the spindle, to prevent dirt from falling on it.**
8. If the inner or outer bearing cups were removed, install replacement cups using the tools or equivalent shown in Fig. 4. **Be sure to seat the cups properly in the hub.**
9. Thoroughly clean all old grease from the surrounding surfaces.
10. Using a bearing packer, pack the bearing cone and roller assemblies with the specified grease. If a packer is not available, work as much grease as possible between the rollers and cages. Grease the cone surfaces.
11. Place the inner bearing cone and roller assembly in the inner cup. Apply a light film of grease to the lips of a new grease retainer and install the retainer with Tool 1175-AH shown in Fig. 5. Be sure the retainer is properly seated.
12. Install the hub and rotor assembly on the spindle. **Keep the hub centered on the spindle to prevent damage to the retainer and the spindle threads.**

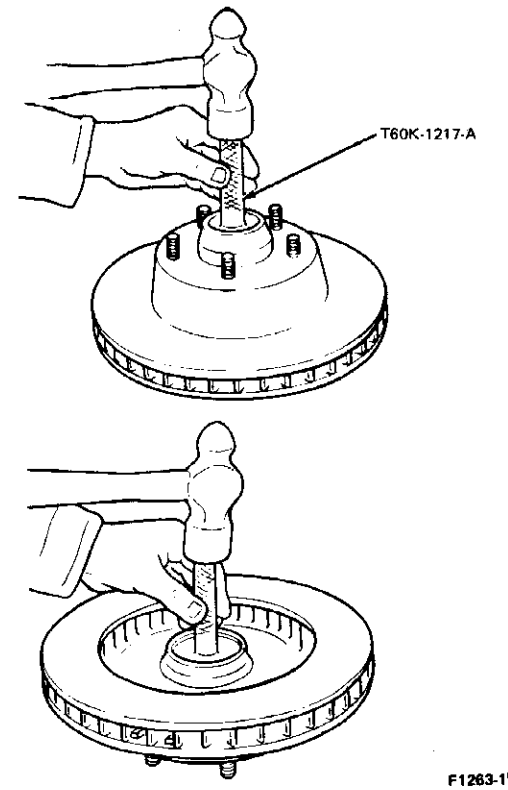


FIG. 4 Installing Front Wheel Bearing Cups

13. Install the outer bearing cone, roller assembly, and flat washer on the spindle. Install the adjusting nut finger tight (Fig. 2). Adjust wheel bearings as outlined in this Part.

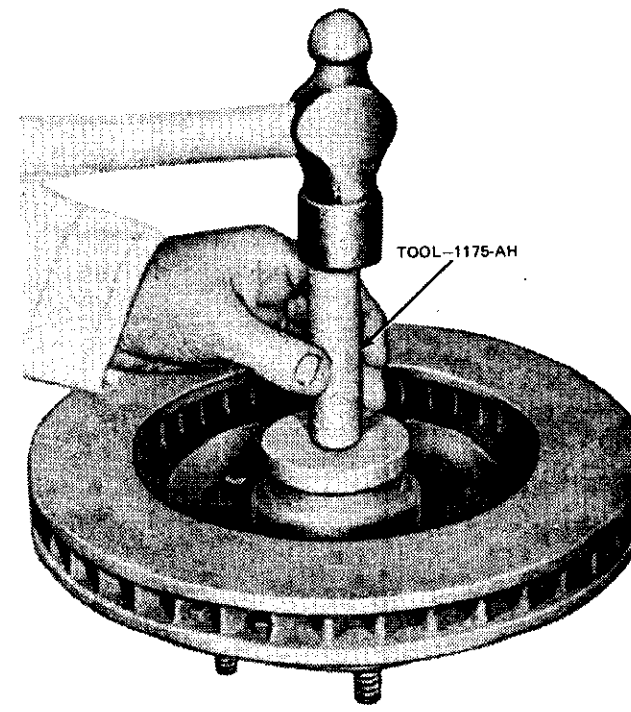


FIG. 5 Installing Grease Retainer—Disc

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14. Install the caliper to the anchor plate, as detailed in Group 12.
15. Install the wheel and tire on the hub.
16. Lower the vehicle and torque the lug nuts to specification (70-115 ft-lbs.). Reinstall the wheel cover.
17. Before driving the vehicle, pump the brake pedal several times to restore normal brake pedal travel.

FRONT HUB AND ROTOR ASSEMBLY—REMOVAL AND INSTALLATION

A new grease retainer must be installed when the hub and rotor assembly is replaced.

1. Raise the vehicle until the tire clears the floor. Remove wheel cover. Remove the wheel and tire from the hub and rotor assembly.
2. Remove the caliper from the anchor plate as outlined in Group 12, and wire it to the underbody to prevent damage to the brake hose.
3. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly (Fig. 2).
4. Pull the hub and rotor off the spindle.
5. Remove the protective coating from the new hub and rotor with carburetor degreaser.
6. Using a bearing packer, force new grease into the bearing cone and roller assemblies. If a packer is not available, work as much grease as possible between the rollers and cages. Grease the cone surfaces.
7. Place the inner bearing cone and roller assembly in the inner cup. Apply a light film of grease to a new grease retainer and install the retainer with Tool 1175-AH. (Fig. 5) **Be sure the retainer is properly seated.**
8. Install the new hub and rotor assembly to the wheel spindle. **Keep the hub centered on the spindle to prevent damage to the retainer.**
9. Install the outer bearing cone roller assembly, and flat washer on the spindle. Install the adjusting nut. Adjust the bearings as outlined in this Part.
10. Install the caliper to the spindle and tighten the bolts to specification, as detailed in Group 12.
11. Place the wheel and tire on the new hub and rotor. Install the hub nuts and tighten them alternately to draw the wheel evenly against the hub and rotor.
12. Lower the vehicle and torque the wheel nuts to specification.
13. Before driving the vehicle, pump the brake pedal several times to restore normal brake pedal travel.

SPECIAL SERVICE TOOLS

Tool No.	Description	Tool No.	Description
Tool-1175-AC	Grease Seal Remover	Tool-1217-K	*Front Wheel Bearing Cup (Inner) Installer-Disc
T69L-1102-A	Front Wheel Bearing Remover		
T60K-1217-A	Front Wheel Bearing Cup (Outer) Installer-Disc	Tool-1175-AH	Grease Seal Installer-Disc

*Pinto, Bobcat, Mustang II, Versailles, Fairmont, Zephyr, Granada and Monarch Only.

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BRAKES

GROUP 12 (2000)

PART TITLE	PART NO.
Disc Brakes – Single Piston, Sliding Caliper	12-20
Drum Brakes – Single Cylinder, Dual Piston	12-02
General Hydraulic Brake Service	12-01
Hydraulic Brake Booster	12-51
Parking Brakes – Cable Actuated, Rear Wheels	12-70
Vacuum Brake Booster	12-50

General Hydraulic Brake Service

PART 12-01

Applies To All Cars

SUBJECT	PAGE
ADJUSTMENTS	
Centralizing the Pressure Differential Valve	01-20
Hydraulic System Bleeding	01-18
Vacuum Power Brake Master Cylinder – Push Rod Adjustment	01-18
CLEANING AND INSPECTION	
Brake Booster	01-32
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DESCRIPTION	
Control Valve Assembly	01-2
Dual Brake System	01-2
Pressure Differential and Proportioning Valve	01-2
DIAGNOSIS AND TESTING	
Brake Control Valve Diagnosis Guide	01-12
Brake Pedal Free Height Measurements	01-15
DIAGNOSIS AND TESTING (Cont'd.)	
Brake Pedal Travel Measurement	01-15
Diagnostic Techniques	01-14
General Brake System Diagnosis	01-3
General Brake System Diagnosis Guide	01-4
Hydro-Boost Power Brake Diagnosis Guide	01-13
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DESCRIPTION

DUAL BRAKE SYSTEM

A dual brake system, incorporated in all models, provides increased safety. The system consists of a dual master cylinder and a brake control valve assembly. The control assembly may consist of a pressure differential valve, a metering valve and a proportioning valve. A switch on the differential valve activates a brake warning light on the instrument panel if unequal hydraulic pressure occurs.

The master cylinder reservoir closest to the dash panel is used to supply brake fluid to the front wheel brakes. The reservoir closest to the radiator is used to supply brake fluid to the rear wheels.

CONTROL VALVE ASSEMBLY—(PRESSURE DIFFERENTIAL, METERING, AND PROPORTIONING VALVES)

The brake control valve assembly (Fig. 1) may consist of a pressure differential valve, a metering valve, and a proportioning valve. These valves are housed within a single cast-iron valve body (housing). The pressure differential and metering valves are located in the central bore of the valve body. The proportioning valve is located in a separate angular or vertical bore.

Pressure Differential Valve

The pressure differential valve (Fig. 1) senses unbalanced pressure between the front and rear brakes. A pressure loss in either the front or rear brake system, upon pedal application, will move the piston off center, causing the warning light to come on. After repairs are made, and the brake system properly bled, the piston will center itself upon brake application and the warning light will shut off.

The brake warning light switch is mounted on the top of the valve body casting. When the piston is in the centralized position, the spring-loaded switch plunger fits into the tapered shoulder groove, and the switch contacts are open.

Metering Valve

The metering valve is located in the front end of the control valve central bore between the front brake system inlet port and the front brake outlet ports. Its function is to regulate the hydraulic pressure to the front disc brakes. The metering valve location at the front end of the housing center bore provides easy accessibility to the valve bleeder rod during bleeding of the front brake system (see Brake System Bleeding—this Part).

Proportioning Valve

The proportioning valve assembly is installed in a separate angular or vertical bore at the bottom of the valve body casting between the rear brake system inlet and outlet ports. The proportioning valve functions to regulate rear brake system hydraulic pressure.

PRESSURE DIFFERENTIAL AND PROPORTIONING VALVE

Pressure Differential Valve

The brake warning light switch is mounted at the center of the valve body with the spring-loaded plunger fitting into a tapered shoulder groove in the center of the piston. With the piston in a centralized position the switch contacts remain open.

Should there be a loss of pressure in either the front or rear brake system, when the brake pedal is applied, the piston will move off center, closing the switch contacts and turning on the warning light.

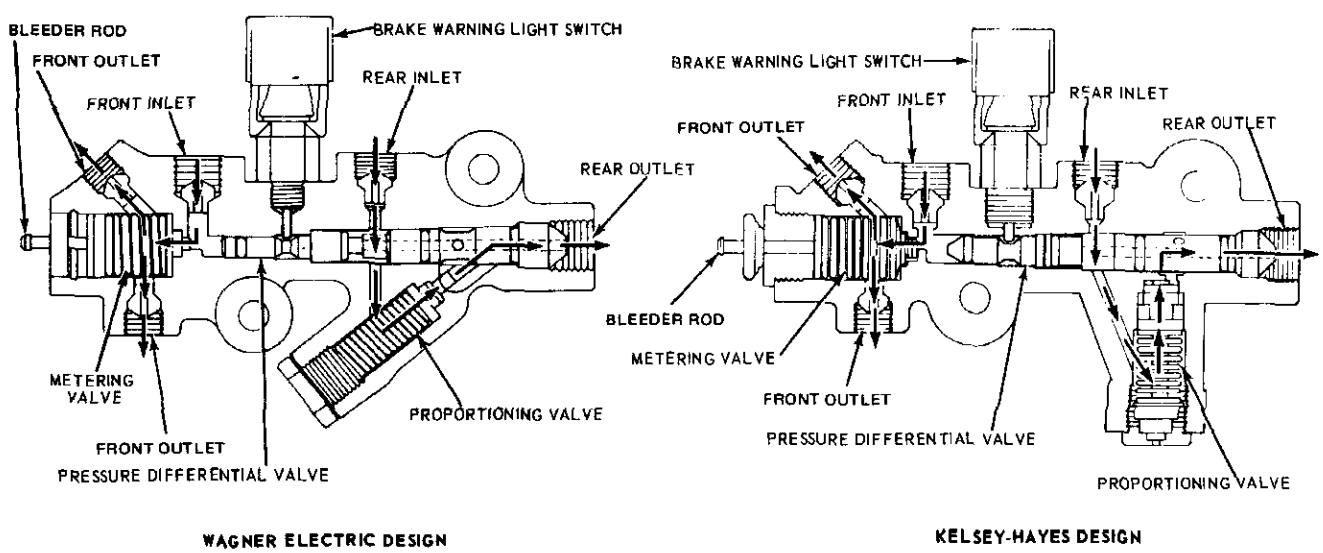


FIG. 1 Control Valve Assembly—Disc/Drum Brakes

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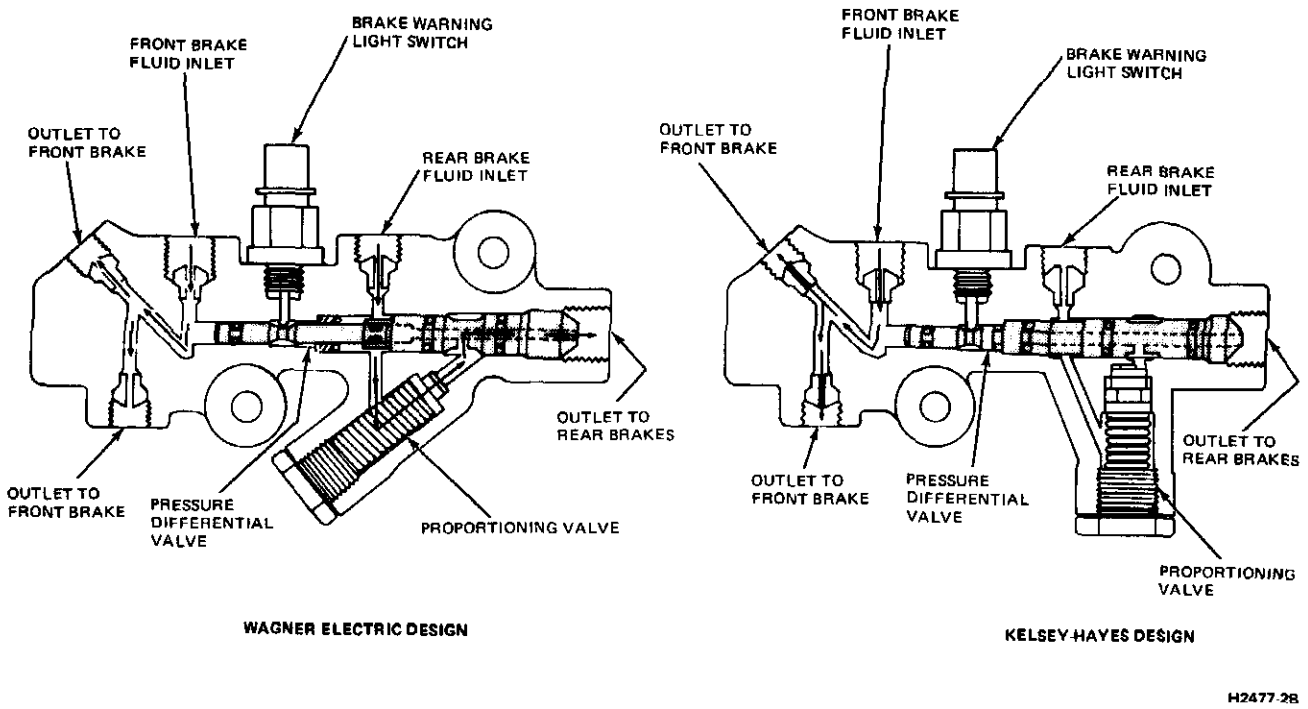


FIG. 2 Control Valve Assembly—4-Wheel Disc Brakes

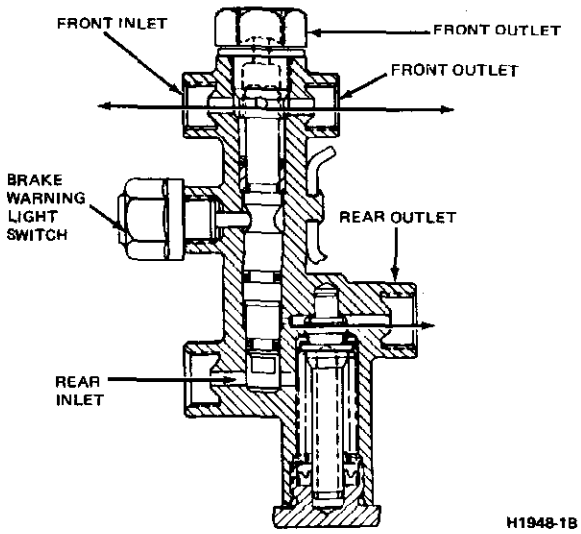


FIG. 3 Pressure Differential and Proportioning Valve

After repairs are made and the brake system bled, the piston will center itself upon brake application and the switch contacts will open, turning off the warning light.

Proportioning Valve

The proportioning valve regulates the rear brake system hydraulic pressure and is located between the rear brake system inlet and outlet ports (Fig. 3).

When the brake pedal is applied, the full rear brake fluid pressure passes through the proportioning valve to the rear brake hydraulic system until the valve split point is attained. Above the split point, the proportioning valve reduces hydraulic pressure to the rear brakes for balanced braking. The proportioning split point and slope are listed in the Specification Section of this Part.

DIAGNOSIS AND TESTING

GENERAL BRAKE SYSTEM DIAGNOSIS

Diagnosis of the combined mechanical and hydraulic problems associated with the brake system is covered in the General Brake System Diagnosis Guide in this Section.

In addition to the General Brake System Diagnosis Guide, further specific Diagnosis Guides are furnished for the Master Cylinder, Brake Control Valve and the Hydro-Boost Power Brake.

Always check the fluid level in the master cylinder before performing the test procedures. If the fluid level is not within 1/4 inch of the top of the master cylinder reservoirs, add Brake Fluid – Ford Part No. C6AZ-19542-A or DOT 3 equivalent for all brake applications.

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GENERAL BRAKE SYSTEM DIAGNOSIS GUIDE

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• Brakes do not apply.	• Insufficient brake fluid. • Binding or damaged brake pedal linkage. • Binding or damaged brake booster linkage.	• Add fluid, bleed system, check for leaks. • Repair as required. • Repair as required.
• Excessive pedal travel or pedal goes to floor.	• Air in system. • Malfunctioning master cylinder. • Drum brakes – improperly adjusted. • On disc brakes, misaligned anchor plate.	• Bleed system. • See Master Cylinder Diagnosis Guide. • Check adjustment. Inspect brakes. Repair as required. • Check anchor plate.
• Excessive pedal effort to stop car.	• Binding or damaged pedal linkage. • Engine vacuum loss. • Booster or hydro-boost inoperative. • Malfunctioning master cylinder. • Worn linings. • Brake system.	• Inspect. Repair as required. • Check engine vacuum, and vacuum at check valve to booster. Repair as required. • Perform power brake function test. • See Master Cylinder Diagnosis Guide. • Inspect. Replace if necessary. • Inspect wheel cylinders or caliper pistons, restricted lines or hoses, contaminated brake fluid, improper operation of proportioning or metering valve. Repair as necessary.
• Spongy pedal.	• Air in system. • Loose or improper brake pedal, pedal support, booster, master cylinder attachment. • Brake system.	• Bleed system. • Repair as required. • Inspect for damaged or distorted parts in brake caliper assemblies, cracked brake drums, mis-machined anchor plates.

CH2561-2B

FIG. 4 General Brake System Diagnosis Guide

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GENERAL BRAKE SYSTEM DIAGNOSIS GUIDE

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• Brakes drag, slow or incomplete release.	• Parking brake cable out of adjustment or binding.	• Check cables for correct adjustment or bind.
	• Front wheel bearings out of adjustment.	• Check bearings for adjustment, wear, damage or bind.
	• Blocked master cylinder compensator ports.	• See Master Cylinder Diagnosis Guide.
	• Brake adjustment (rear).	• Check and adjust.
	• Restriction in hydraulic system.	• Check and repair.
	• Wheel cylinders or caliper piston seizure.	• Check and repair.
	• Brake system.	• Inspect and repair.
• Noise at wheels when brakes are applied – snap or clicks.	• On drum brakes in 3 places – brake shoes binding at backing plate ledges.	• Lubricate.
	• On drum brakes in 3 places – backin plate ledges worn.	• Replace, and lubricate ledges.
	• On disc brake – rust on front edge of inboard shoes.	• Inspect. Lubricate, replace if necessary.
	• On disc brakes – loose or missing anti-rattle clip.	• Replace.
	• Other brake system components: Loose outer shoe crimping, defective caliper support spring or retaining key, cracked welds at shoe web.	• Inspect. Repair or replace.
	• Loose outer shoe retaining clip.	• Inspect, Repair or Replace.
• Noise at wheels when brakes are applied – scrape or grind.	• Worn brake linings.	• Replace. Refinish drums or rotors if heavily scored.
	• Brake shoe interference with back of drum. Binding at backing plate guide ledges.	• Inspect. Replace as necessary. Lubricate.
	• Caliper to wheel or rotor interference.	• Replace as required.
	• Other brake system components: Warped or bent brake backing plate or splash shield, cracked drums or rotors.	• Inspect and repair.
	• Tires rubbing against chassis or body.	• Inspect and repair.

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FIG. 5 General Brake System Diagnosis Guide Cont'd.

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GENERAL BRAKE SYSTEM DIAGNOSIS GUIDE

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• Noise at wheels when brakes are *applied – squeaks, squeals, or* chatter. NOTE: Brake friction materials inherently generate noise and heat in order to disipate energy. As a result, occasional squeal is normal, and is aggravated by severe environmental conditions such as cold, heat, wetness, snow, salt, mud, etc. *This occasional squeal is not a* functional problem and does not indicate any loss of brake effectiveness.	• Brake drums and linings, rotors and *pads worn or scored.* • On disc brakes – missing or damaged brake pad insulators. • On disc brakes – burred or rusted *calipers.* • Dirty, greased or glazed linings. • Improper lining parts. • On drum brakes – loose lining rivets, weak, damaged or incorrect shoe retracting springs, loose or damaged shoe retaining pins, springs and clips, and grooved backing plate ledges.	• Inspect, repair or replace. • Replace. • Clean or deburr. • Clean or replace. • Inspect for correct usage. Replace. • Inspect, repair or replace.

• Noise at wheels, brakes not applied – squeak or squeal.	• Wheel cover attachment.
	• Loose wheel attaching lug nuts.
	• Bent or warped backing plate causing interference with drum or rotor.
	• Improper machining of drum, causing interference with backing plate or shoe.
	• Other brake system components:
	  • Loose or extra parts in brakes.
	  • Drum or rear disc brake adjustment too tight causing lining to glaze.
	  • Worn, damaged, or insufficiently lubricated wheel bearings.
	  • On drum brakes – weak, damaged *or incorrect shoe retracting springs.*
	  • On drum brakes – grooved backing plate ledges.
	  • Improper positioning of shoe in *caliper.*
	  • Outside diameter of rotor rubbing caliper housing.
	  • Lack of correct lubricant on disc *brake caliper slides.*
	  • Improper installation of rear disc brake anti-rattle clip.
		• Seat covers with a rubber mallet. Repair flanges or replace cover.
		• Tighten to correct torque. Replace wheel if stud holes are damaged.
		• Repair or replace.
		• Replace drum.
		• Inspect, repair, replace as required.

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FIG. 6 General Brake System Diagnosis Guide Cont'd.

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GENERAL BRAKE SYSTEM DIAGNOSIS GUIDE

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• Noise at wheels, brakes not applied – growling, click or rattle.	• Stones or foreign material trapped inside wheel covers.	• Remove stones, etc.
	• Loose grease cap.	• Repair or replace.
	• Loose wheel lug nuts.	• Tighten to correct torque. Replace if stud holes are elongated.
	• Disc brake caliper – loose or missing anti-rattle clips and support spring, or crimping on outer shoe.	• Inspect, repair or replace.
	• Drum brakes – loose or extra parts.	• Inspect, remove or repair.
	• Worn, damaged or dry wheel bearings.	• Inspect, lubricate or replace.
• Brakes pull to one side.	• Unequal air pressure in tires.	• Inflate tires to correct pressure.
	• Grease or fluid on linings. Glazed linings.	• Replace.
	• Loose or missing disc brake caliper attaching bolts.	• Replace missing bolts. Tighten to proper torque.
	• Improper size or type lining on one wheel.	• Replace with correct brake lining in axle sets.
	• Stuck or seized wheel cylinders or calipers.	• Repair or replace.
	• Restricted brake lines or hoses.	• Repair or replace.
	• Other brake system components: • Improper adjustment of drum or rear disc brakes. • Improper positioning of disc brake shoe and lining in the caliper. • Improperly adjusted, damaged or worn wheel bearings. • Distorted drum brake linings. • Missing, broken or stretched retracting or retaining springs and clips in drum brakes.	• Inspect, repair or replace as required.

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FIG. 7 General Brake System Diagnosis Guide—Cont'd.

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GENERAL BRAKE SYSTEM DIAGNOSIS GUIDE

COMPLAINT	POSSIBLE CAUSE	RESOLUTION

• Brakes grab or lock-up when applied.	• Tires worn or incorrect pressure.
	• Grease or fluid on linings – damaged linings.
	• Improper size or type of linings.
	• Other brake system components:
	  • Bolts for caliper attachment loose or missing.
	  • Worn, damaged or dry wheel bearings.
	  • Improperly adjusted parking brake.
		• Inflate tires to correct pressure. Replace tires with worn tread.
		• Inspect, repair or replace.
		• Replace with correct brake in axle sets.
		• Inspect, repair or replace as required.

• Brake warning light on.	• Hydraulic system. • Shorted light circuit. • Parking brake not returned. • Brake warning switch.	• See Master Cylinder Diagnosis Guide. • Correct short in warning circuit. • See "Parking brake will not release or fully return" below. • Replace.
• Intermittent loss of pedal.	• Stop light switch.	• Perform Master Cylinder Diagnosis test. • Perform steps under "Excessive pedal travel or pedal travel goes to floor".
• Rough engine/idle or stall, brakes applied – power brakes only.	• Vacuum leak in neutral switch. • Vacuum booster.	• Check lines for leaks. Repair or replace as required. • Check vacuum booster for internal leaks. Replace if required.
• Parking brake control will not latch (manual release).	• Kinked or binding release cable. • Control assembly.	• Inspect, repair or replace. • Inspect, repair or replace.
• Parking brake control will not latch (automatic release).	• Vacuum leak. • Vacuum switch. • Control assembly.	• Repair as required. • Test. Replace if necessary. • Repair or replace.
• Parking brake will not release or fully return (manual release).	• Cable disconnected. • Control assembly binding. • Parking brake linkage binding. • Rear brakes.	• Connect cable or replace. • Repair or replace. • Repair or replace. • Check rear brakes shoe retracting springs and parking brake levers. On rear disc brakes verify levers return fully to released position. Adjust cables or repair caliper as required.
• Parking brake will not release or fully return (automatic release).	• Vacuum line leakage or improper connections. • Neutral switch. • Control assembly.	• Inspect and repair. • Adjust or replace. • Repair or replace.

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FIG. 8 General Brake System Diagnosis Guide–Cont'd.

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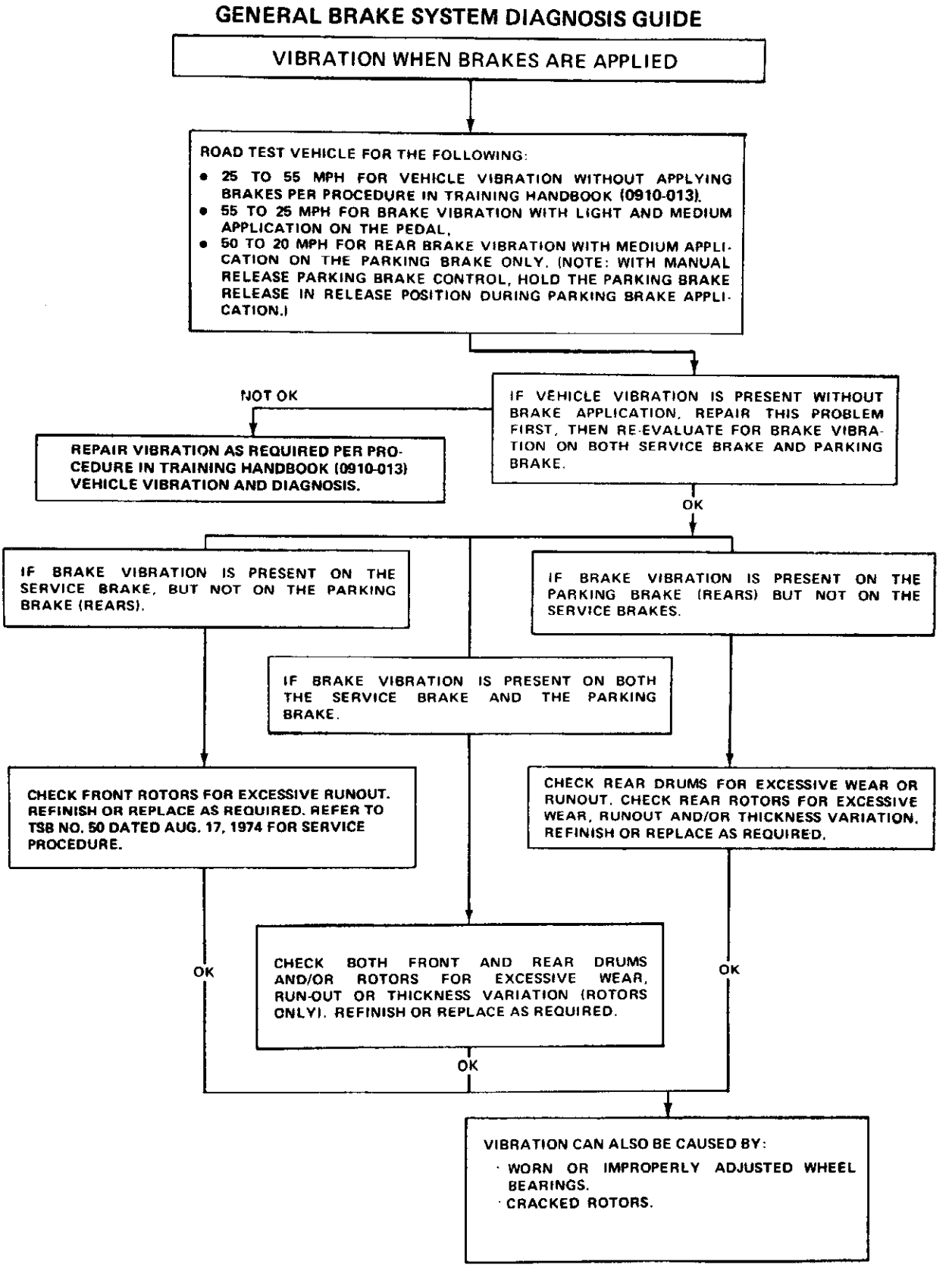


FIG. 9 General Brake System Diagnosis Guide—Cont'd.

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MASTER CYLINDER DIAGNOSIS GUIDE

Brake Pedal Feel Conditions	Diagnostic Action
Condition 1 – Pedal goes down fast and brake light comes on.	Pump brake pedal rapidly: If the brake pedal height builds up and holds, check for the presence of air. (Use Diagnostic Technique No. 1.) If the brake pedal height builds up and then sinks down, check for an external leak (Use Diagnostic Technique No. 4) or a master cylinder by-pass (Use Diagnostic Technique No. 2.) If the brake pedal height fails to build up, check the fluid level in the master cylinder reservoir: If a reservoir is empty, add fluid; bleed the system; and check for external leak. (Use Diagnostic Techniques No. 3 and No. 4.) If the reservoirs are full, check for a gross master cylinder by-pass. (Use Diagnostic Technique No. 2).
Condition 2 – Pedal eases down slowly and brake light comes on.	This condition could be caused by an external leak in the brake system or an internal by-pass in the master cylinder. Apply the brakes several times while observing the fluid levels in the reservoirs: If the net fluid level in a reservoir eases down with each stroke cycle, check for an external leak. (Use Diagnostic Technique No. 4). If the fluid level in a reservoir rises while the pedal eases down and drops when the pedal is released, but the net fluid level remains unchanged, then repair or replace the master cylinder for a fluid by-pass condition. NOTE: All master cylinders in warranty must be replaced.
Condition 3 – Pedal is low and brake light does not come on.	This condition may be caused by: air in the hydraulic system, or no fluid in one reservoir. If the reservoir is empty, add fluid, bleed, and check the system for external leaks. (See Diagnostic Technique Nos. 3 and 4). If the reservoir is full, check for the presence of air in the hydraulic system. (Use Diagnostic Technique No. 1). If this condition happens occasionally on a disc brake equipped car, check the front wheel bearings for looseness. (Loose front wheel bearings allow the disc rotor to knock the caliper piston back, creating excess lining clearance.)

CH2294-2B

FIG. 10 Master Cylinder Diagnosis Guide

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MASTER CYLINDER DIAGNOSIS GUIDE (Cont'd.)

Brake Pedal Feel	Diagnostic Action
Condition 4 – Pedal feels spongy.	This may be normal as modern brake systems are not designed to produce as hard a pedal as in the past. To verify this, compare the pedal feel with another like car. Check for the presence of air in the hydraulic system. (Use Diagnostic Technique No. 1).
Condition 5 – Pedal goes down fast and brake light does not come on.	Prior to diagnosing, verify that the brake system warning light is functional. Pump the brake pedal rapidly: If the brake pedal height fails to build up, check the fluid level in the master cylinder reservoirs: If both reservoirs are empty, add fluid, bleed the system, and check for external leaks. (Use Diagnostic Techniques No. 3 and No. 4). If the reservoirs are full, check for air in the hydraulic system. (Use Diagnostic Technique No. 1). Or check for brake pedal reserve. (Use Diagnostic Technique No. 5). If the brake pedal height builds up, check for insufficient drum brake adjustment.
Condition 6 – Pedal erratic – no light.	This may be caused by imcomplete brake release, loose wheel bearings, incorrect parking brake adjustment or blocked compensator holes in the master cylinder. To verify, check wheel rotation and bearing free play, parking brake tension and refer to Diagnostic Technique No. 6 for master cylinder compensator hole check.
Condition 7 – Pedal effort excessive – no light.	This may be caused by a bind or obstruction in the pedal/linkage, insufficient booster vacuum or hydroboost pressure. To verify, detach master cylinder from dash or booster and stroke pedal fully. Check vacuum or hydroboost pressure per procedure.

CH2295-2B

FIG. 11 Master Cylinder Diagnosis Guide–Cont'd.

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BRAKE CONTROL VALVE DIAGNOSIS GUIDE

Complaint	Diagnosis and Resolution
1. Premature front brake lock-up on wet or icy road during light pedal application and cold engine fast idle operation.	1. Check tires and tire pressures. 2. Check brake linings for fluid, grease or other contamination. 3. Check and adjust engine idle for normal driving. 4. On vehicles equipped with a metering valve, check it *by installing pressure gauges in front and rear bleed* screws. Apply 200 psi to the system. Front brake system should read 100 to 150 psi while rear system reads 200 psi. 5. Replace the brake pressure control valve if out of specification.
2. Rear brake lock-up during light brake pedal force.	1. Check tires and tire pressures. 2. Check brake linings for fluid, grease or other contamination. 3. Install pressure gauges in the front and rear bleeder screw ports and apply 1,000 psi to the front brake system. The rear brake system pressure must be approximately 550 to 750 psi. 4. Replace brake pressure control valve assembly if rear brake pressure is not within specification.
3. No rear brake lock-up under heavy brake pedal force.	1. Check tires and tire pressures. 2. Check brake linings for fluid, grease or other contamination. 3. Install pressure gauges in the front and rear wheel cylinder bleeder screw ports and apply 1,000 psi to the front brake system. The rear brake system pressure must be approximately 550 to 750 psi. 4. If no pressure is obtained, check for damaged tubing. 5. Replace the brake pressure control valve assembly if rear brake pressure is not within specifications.

CH2296-2C

FIG. 12 Brake Control Valve Diagnosis Guide

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HYDRO-BOOST POWER BRAKE DIAGNOSIS GUIDE

Complaint	Possible Causes	Resolution
Excessive Brake Pedal Effort (Poor power steering assist in both directions also) at idle speed.	1. Loose or broken steering pump belt. 2. Power steering fluid reservoir low or empty. 3. Power steering hose leaking. 4. Leaking at tube fittings – power steering or booster connections. 5. Low idle speed. 6. Restriction in pressure hose to booster. 7. Low power steering pump pressure.	1. Tighten or replace belt. 2. Fill reservoir and check for leaks. 3. Replace hose. 4. Tighten fitting. If it still leaks, check tube flare. Replace hose if flare is damaged. Check tube seat, repair if damaged. 5. Adjust idle speed to specification. 6. Replace hose. 7. Perform pump pressure test.
Excessive Brake Pedal Effort (Power steering normal in both directions at idle speed).	1. Binding in pedal and/or pedal linkage. 2. Contamination. 3. Nicked/burred spool valve.	1. Repair and lubricate as required. 2. Hold steering wheel against stop (maximum five (5) seconds) and apply brake pedal sharply several times. If contamination is dislodged, flush system. 3. Replace hydro-boost.
Slow or Incomplete Brake Pedal Return.	1. Binding in the pedal and/or pedal linkage. 2. Restriction in return line from booster to pump reservoir. 3. Internal restriction in the hydro-boost fluid return system.	1. Repair and lubricate as required. 2. Replace return hose. 3. Replace the hydro-boost.
Brake Pedal Chatter, Pulsation	1. Power steering pump belt slipping. 2. Power steering pump reservoir fluid low. 3. Power steering pump. 4. Spool valve dimensional error.	1. Tighten belt. 2. Fill reservoir, check for leaks. 3. Repair pump. 4. Replace hydro-boost.
Oversensitive Braking	1. Binding in the pedal and/or pedal linkage. 2. Faulty spool action.	1. Repair and lubricate as required. 2. Replace hydro-boost.
Noise	1. Power steering pump fluid level low or empty. 2. Power steering fluid aerated. 3. Power steering pump belt loose. 4. Restriction in hoses.	1. Fill reservoir. 2. Bleed system. 3. Tighten belt. 4. Replace hose.

CH2259-2C

FIG. 13 Hydro-Boost Power Brake Diagnosis Guide

If a brake is locked and the vehicle must be moved, open a bleeder screw on front and rear wheels to let out enough fluid to relieve the pressure. This bleeding operation will release the brakes but will not correct the cause of trouble.

HYDRAULIC SYSTEMS DIAGNOSIS

There is only one major problem which occurs in the hydraulic brake system and that is **LEAKS,** internal or external. Hydraulic brake systems, including master cylinder and valves, **DO NOT** cause pulling, grabbing, vibrations, pulsating pedals, squeaks, squeals, clunks, or, in most cases, dragging brakes.

It is therefore a good policy to first check the entire system for leaks when diagnosing a brake problem.

MASTER CYLINDER DIAGNOSIS AND TESTING

Pedal feel is usually the first indicator that something is wrong in the brake system. The Master Cylinder Diagnosis Guide (Figs. 10 and 11) use the brake pedal feel, the warning light and the brake fluid level as the indicators in diagnosing master cylinder conditions.

Note that the procedures refer to the use of diagnostic techniques. These techniques (Numbers 1 through 5) follow the diagnostic procedures.

Normal Conditions —The following conditions are considered normal and are not indications that the master cylinder is in need of service:

Condition 1—Unequal brake fluid levels in master cylinder reservoirs on disc brake vehicles. This condition is caused by displacement of fluid from the reservoir into the calipers to compensate for normal lining wear. Top off the reservoirs.

Condition 2—A momentary or slight squirt of brake fluid from one or both master cylinder reservoir chambers upon application of the brake pedal. This condition is caused by the fluid displacement through the reservoir compensating port(s)

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as the master cylinder pistons move forward in the bore when the brakes are applied.

Condition 3—A slight turbulence in the reservoir fluid occurring when the brake pedal is released. Turbulence occurs as brake fluid returns to the master cylinder after releasing the brakes.

Condition 4—A trace of brake fluid exists on booster shell below the master cylinder mounting flange. This condition results from the lubricating action of the master cylinder wiping seal.

Abnormal Conditions —Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. The following diagnostic procedures and techniques use brake pedal feel, the warning light illumination and brake fluid level, as indicators in diagnosing brake system complaints.

NOTE: Prior to performing any diagnosis, make certain that the brake system warning light is functional.

DIAGNOSTIC TECHNIQUE NO. 1

Air Entrapment in Brake System

1. Check the fluid level in the master cylinder. Fill the reservoir if it is low or empty.
2. Place the cap loosely on the master cylinder.
3. With one technician acting as an observer at the master cylinder, and another technician applying the brakes, pump the brakes **rapidly** 20 times.
4. On the final application, hold the pedal in the applied position.
5. Remove the cap and observe the fluid in the reservoirs. Quickly release the brake pedal. A geyser up to six (6) inches high will spout from the reservoir of a system with air in it.

   NOTE: Pumping the brake pedal compresses trapped air. When the brake pedal is released, the compressed air expands, forcing brake fluid back into the master cylinder with sufficient force to form a geyser.
6. Bleed the system in which the geyser occurs.

DIAGNOSTIC TECHNIQUE NO. 2

Procedure for Checking a Master Cylinder By-pass Condition

1. Remove the master cylinder reservoir cap and verify that both reservoir chambers are filled with fluid.
2. With the reservoir cap removed, observe the fluid levels in both chambers when the brake pedal is slowly depressed for one stroke and then quickly released.

   a. If the fluid level in a reservoir rises while the pedal goes down and drops when the pedal is released, but the net (overall) fluid level in the reservoir remains unchanged, the master cylinder is by-passing. *Replace such a master cylinder.*

DIAGNOSTIC TECHNIQUE NO. 3

Checking the Cause of an Empty Reservoir Without an External Pressure Leak

An empty reservoir condition may be caused by two types of non-pressure external leaks.

Type 1 —*An external leak may occur at the master* cylinder reservoir cap due to improper positioning of the gasket and cap or a rust formation, between the cap gasket and the reservoir sealing surfaces. Replace the cover and gasket assembly. Remove any rust formations from the master cylinder.

Type 2 —An external leak may occur at the mounting end of the master cylinder due to a bore end seal leak. Replace such a master cylinder.

DIAGNOSTIC TECHNIQUE NO. 4

Checking for External Fluid Leaks in the Brake System

It is possible that all evidence of fluid leakage may have been washed off, if the vehicle has been operated in rain or snow, as brake fluid is water soluble. Refill the system, bleed, and apply the brakes several times. Examine the system to verify that the reservoir level is *actually dropping. Locate and correct the external leak.*

DIAGNOSTIC TECHNIQUE NO. 5

Checking for Brake Pedal Reserve—Vacuum-Power Brake Equipped Car Lines

On vacuum-power brake equipped vehicles where a low pedal or the feel of a bottomed out condition exists, check for brake pedal reserve using the following procedure:

1. Operate the engine at idle with the transmission in either Park or Neutral position.
2. Apply the brake pedal until it stops moving downward or increased resistance to the pedal travel occurs.

   NOTE: A clunk may be felt as the pedal reaches this point.
3. Hold the pedal in the applied position and raise the engine speed to approximately 2,000 RPM.
4. Release the accelerator pedal and observe that the brake pedal moves downward as the engine returns to idle speed.

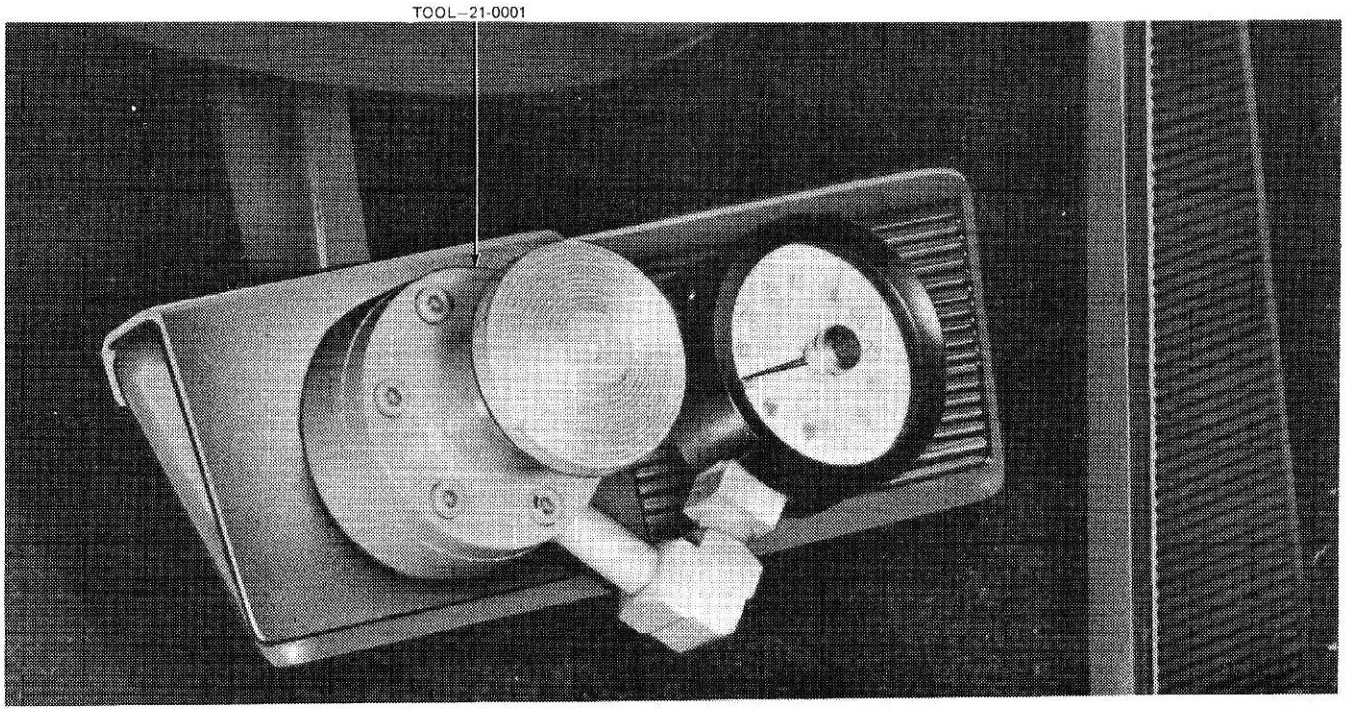
   NOTE: The additional movement of the brake pedal is the result of the increased engine manifold vacuum which exerts more force on the brake booster during engine run down. This means that additional stroke is available in the master cylinder, and the brake *system is not bottoming out as a customer may* believe.

DIAGNOSTIC TECHNIQUE NO. 6

Checking the Master Cylinder for Open Compensator Port(s)

1. Push brake pedal and observe fluid in master cylinder reservoirs.
2. A small geyser or ripple should appear in one or *both reservoirs upon brake application.*
3. If no geyser or ripple appears, loosen the master cylinder attaching bolts 1/4 inch, hold the master cylinder out and check for open compensator port(s) as above.
4. If compensation now occurs, verify booster pushrod length per procedure and adjust if required (except

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H1525-2A

FIG. 14 Brake Pedal Effort Gauge Installed

Fairmont and Zephyr). If not, replace master cylinder.

5. If the booster push rod length is incorrect on Fairmont/Zephyr, using the push rod gauge, replace the booster.

BRAKE PEDAL FREE HEIGHT MEASUREMENTS

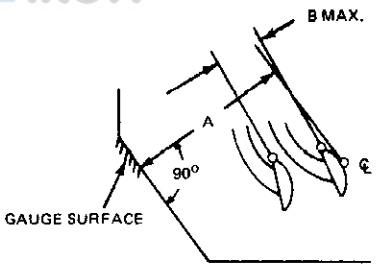
With the engine running for full power brake operation and the parking brake fully released, measure the brake pedal free height, and check the brake pedal travel with the use of the Brake Pedal Pressure Gauge, Tool 21-0001 (Fig. 14) as follows:

1. Insert a slender, sharp-pointed prod through the carpet and sound deadener to the dash panel metal, and measure the distance to the center on top of the brake pedal (Fig. 15) pad.
2. If the position of the pedal is not within specification, check the brake pedal for missing, worn, or damaged bushings, or loose attaching bolts, and replace them, if required.
3. If the pedal free height is still out of specification, check the brake pedal, booster or master cylinder to be sure the correct parts are installed. Replace the worn or damaged parts as necessary.

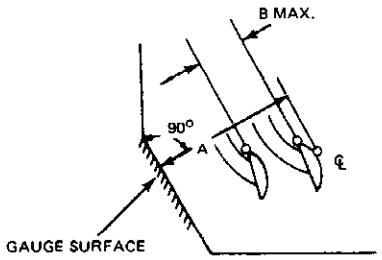
BRAKE PEDAL TRAVEL MEASUREMENT

1. Install a Brake Pedal Effort Gauge (21-0001) on the brake pedal pad (Fig. 14).
2. Hook a steel measuring tape to the brake pedal as in Fig. 15. Measure and record the distance from the brake pedal free height position to the reference point, which is at the six o'clock position on the steering wheel rim.
3. With the steel tape still hooked to the brake pedal, depress the brake pedal by pressing downward on the brake pedal effort gauge. Apply a 25-pound load to the center of the pedal. While maintaining the pedal load, measure the distance from the brake pedal to the fixed reference point on the steering wheel rim parallel to the centerline of the steering column.
4. The difference between the brake pedal free height and the depressed pedal measurement under a 25-pound load should be within the specified maximum pedal travel service specification B in Fig. 15.
5. On self-adjusting drum brakes, if the pedal travel is more than the maximum, as specified in Fig. 15, dimension B, make several reverse stops with a forward stop before each. Move the vehicle in reverse and forward for approximately ten feet; then, apply the brakes and hold the brake pedal down until the vehicle is completely stopped. This will actuate the brake self-adjusters. If these stops do not bring the brake pedal travel within specification, make several additional forward and reverse stops as outlined above.
6. On self-adjusting drum brakes, if the second series of stops does not bring brake pedal travel within specification, remove brake drums and check the brake adjusters to make sure they are functioning. Check brake linings for wear or damage. Repair or replace all worn or damaged parts and non-functioning adjusters. Adjust the brake lining

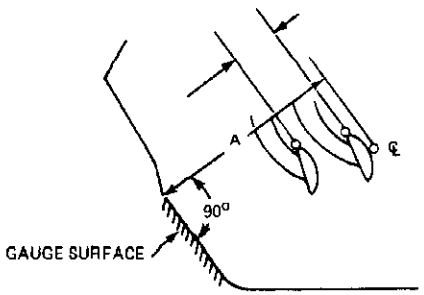
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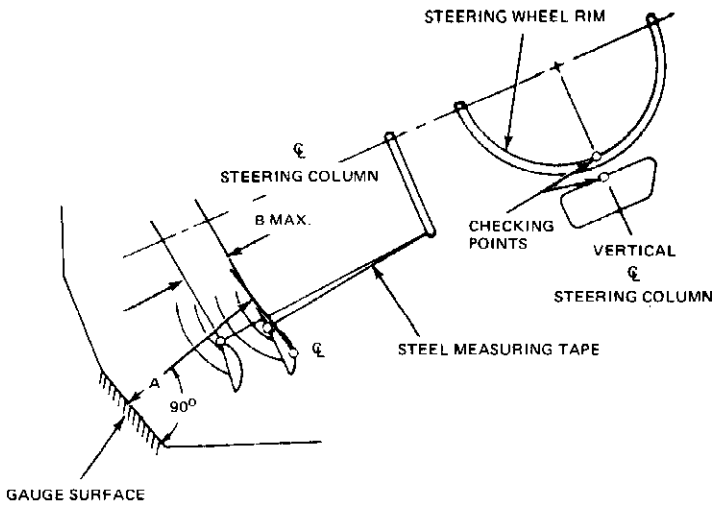
LTD II – COUGAR – MARK V – THUNDERBIRD
MEASURED FROM CENTERLINE OF CURVED PEDAL TO FLOOR PANEL AT EDGE OF WIRING TROUGH (ACCELERATOR SIDE)



FAIRMONT – ZEPHYR – PINTO – BOBCAT – MUSTANG II



GRANADA – MONARCH – VERSAILLES



FORD – MERCURY – LINCOLN

NOTE: "A" DIMENSION TO BE MEASURED TO SHEET METAL FROM TOP CENTER OF PAD.

"B" DIMENSION TO BE MEASURED PARALLEL TO THE VERTICAL CENTERLINE OF THE STEERING COLUMN WITH A 25 LB. LOAD APPLIED TO THE CENTERLINE OF THE BRAKE PEDAL PAD. (CHECKS ON POWER BRAKE VEHICLES MADE WITH ENGINE RUNNING).

Vehicle	Type	Pedal Free Height "A" (Inches) Max.	Min.	Maximum Pedal Travel (Inches) "B"
Pinto, Bobcat	Power Disc	7.3	6.4	2-1/4
Pinto, Bobcat	Non-Power Disc	9.0	7.75	2-3/4
Fairmont, Zephyr	Power Disc	7.0	6.0	2.0
Fairmont, Zephyr	Non-Power Disc	8.8	7.6	3.0
Mustang II	Power Disc	7.4	6.6	2-1/4
Mustang II	Non-Power Disc	8.8	7.5	203/4
Granada, Monarch	Power Disc	7.5	6.6	2-3/8
Granada, Monarch	Non-Power Disc	9.1	7.8	2-1/2
Granada, Monarch	4-Wheel Disc	7.5	6.7	2-1/4
LTD II, Cougar	Power Disc	7.8	7.0	2-1/2
LTD II, Police	Power Disc	8.0	7.2	2-1/2
Thunderbird	Power Disc	7.8	7.0	2-1/2
Ford, Mercury	Disc/Drum (Vacuum)	8.7	7.8	2-1/2
Ford, Mercury	Disc/Drum (Hydro-Boost)	8.6	7.6	2-1/4
Ford, Mercury	4-Wheel Disc	8.6	7.6	2-1/2
Continental Mark V	4-Wheel Disc	7.8	6.9	2-1/2
Lincoln	Disc/Drum	9.1	8.2	2-1/4
Lincoln	4-Wheel Disc	9.1	8.2	2-1/2
Versailles	4-Wheel Disc	7.5	6.7	2-1/4

NOTE: Vehicles close to the maximum pedal travel specification may be improved by bleeding the brake system.

H1630-2Q

FIG. 15 Brake Pedal Height and Travel Measurements

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outside diameter to the approximate inside diameter of the brake drum with Rotunda Tool 11-0001 or equivalent described in Part 12-02.

7. If all the drum brake adjusters, brake drums and brake shoe linings are functional, and the brake travel is not within specifications, check the pedal assembly for missing or worn bushings, or loose attachments.
8. If the above actions do not bring the brake travel within specifications, bleed the brake system.

POWER BRAKE FUNCTIONAL TEST—VACUUM BOOSTER

When performing the vacuum power brake functional checks a minimum of 12 inches of vacuum (Hg) should be available at the brake booster hose (check valve connection end), with the engine at idle speed and the transmission in gear. Use Rotunda Vacuum Tester 21-0014 or equivalent.

If the vacuum supply is below 12 inches (Hg) check the vacuum available at the engine manifold, with the engine at idle speed and the transmission in gear. If the vacuum supply at the manifold is 12 inches (Hg) or above, there is a leak or blockage in the vacuum supply system.

Inspect all hoses and connections. All unused vacuum connectors should be capped, hose connections properly secured, and hoses in good condition with no holes and no collapsed areas. Inspect the check valve on the power unit for damage.

If the vacuum supply at the manifold is below 12 inches (Hg) perform the necessary engine adjustments to bring the manifold vacuum up to a minimum of 12 inches of Mercury (Hg) check the booster operation as follows:

1. Check the hydraulic brake system for leaks or insufficient fluid.
2. With the transmission in neutral, stop the engine and apply the parking brake. Depress the brake pedal several times to exhaust all vacuum in the system.
3. With the engine shut off and all vacuum in the system exhausted, depress the pedal, and hold it in the applied position. Start the engine. If the vacuum system is operating, the pedal will tend to fall away under foot pressure and less pressure will be required to hold the pedal in the applied position. If no action is felt, the vacuum booster system is not functioning.
4. Remove the vacuum hose from the brake booster check valve connection. Manifold vacuum should be available at the check valve end of the hose with the engine at idle speed and the transmission in neutral. Be sure that all unused vacuum outlets are properly capped, hose connectors properly secured, and that vacuum hoses are in good condition. When it is established that manifold vacuum is available to the booster, connect the vacuum hose to the booster and repeat Step 3. If no downward movement of the brake pedal is felt, replace the brake booster.
5. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine and let the vehicle stand for 10 minutes; then, depress the brake pedal with approximately 20 pounds of force. The pedal feel (brake application) should be the same as that noted with the engine operating. If the pedal feels hard (no power assist), replace the brake booster.

If the brake pedal movement feels spongy, bleed the hydraulic system to remove air from the system. Refer to Hydraulic System Bleeding, in this Part.

POWER BRAKE FUNCTIONAL TEST—HYDRO-BOOST

The hydro-boost assembly is only one component in the braking system, therefore, servicing of the hydro-boost may involve the power steering hydraulic circuit, the service brakes, or both.

Before performing any testing of the hydro-boost, check and eliminate the following sources that could affect proper operation of the brakes. Figs. 19, 20, 21 and 22 show hydro-boost power brake systems.

Preliminary Checks

Verify the condition by driving the vehicle and comparing to a known quality vehicle for both steering and braking.

The hydro-boost cannot cause noisy brakes, a fading brake pedal, or pulling brakes. If one of these conditions exists, components of the brake system other than the hydro-boost may be the cause.

Check the fluid level in the master cylinder. If the fluid level is not within 1/4 inch of the top of the master cylinder reservoirs, add Brake Fluid—(ESA-M6C25-A) service part No. (C6AZ-19542-A) or DOT-3 equivalent.

Check the power steering pump fluid level with the engine off and the fluid at operating temperature. The fluid level must show on the dipstick. Insufficient fluid will affect both steering and braking power assist.

Check power steering pump belt tension and adjust if required. Also inspect the belt for excessive wear or glazing.

Inspect all power steering system hoses for leaks and kinks. If the fluid smells burned, check hoses or cooler for restrictions.

Check the engine idle speed and adjust to specification.

Check the power steering hydraulic fluid for aeration (shown by bubbles in the fluid). If there is air in the system, bleed the system as follows:

Fill the reservoir to specification (the fluid must be at normal operating temperature—165° to 175°F), turn the steering wheel through its full travel three or four times. Do not hold the wheels against their stops. Recheck the fluid level.

After completing preliminary checks without finding the source of the condition, check the function of the hydro-boost by performing the Hydro-Boost Functional Test covered in this Section.

If the hydro-boost is operating correctly, refer to the Diagnosis Section for service brakes and check those areas in the system that might cause the condition.

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DETROIT IRON

If the hydro-boost is not functioning, verify that the power steering is operating normally by performing the Power Steering Pump Flow and Pressure Test procedure detailed in Part 13-01 of this Manual.

If power steering operation is normal, and the hydro-boost is suspect, refer to the Hydro-Boost Diagnosis Guide in this Section and check those items that might cause the problem. If the hydro-boost is not functioning, replace the hydro-boost as a complete assembly.

Hydro-Boost Functional Test

1. Check the hydraulic brake system for leaks or insufficient fluid in the master cylinder reservoir.
2. With the transmission in neutral, stop the engine and apply the brake pedal several times to deplete all accumulator reserve.
3. Hold the pedal depressed with medium pressure (25-35 lbs.), and start the engine. If the unit is operating correctly, the brake pedal will fall slightly and then push back against the foot. If no action is felt, the indication is that the hydraulic booster system is not functioning.

Accumulator Leakdown Test

1. Start the engine and operate at idle speed. Turn the steering wheel to the stop. Hold for a maximum of five seconds. Return the steering wheel to center and turn off the engine.
2. Depress and release the brake pedal. Repeat this procedure until a hard pedal is obtained. There should be at least two (2) power assisted brake applications with 20-25 lbs. applied to the brake pedal.
3. Re-start the engine and let it idle. Turn the steering wheel to the stop. There should be a light hissing sound as the accumulator is charged. Hold lightly against stop for a maximum of five seconds. Return the steering wheel to center and turn off the engine.
4. Wait one hour and apply brake pedal (do not re-start the engine). There should still be at least two (2) power mounted brake applications at 20-25 lbs. pedal load before a hard pedal is encountered.

ADJUSTMENTS

BRAKE VACUUM BOOSTER PUSHROD-TO-MASTER CYLINDER

The vacuum booster has an adjustable push rod (output rod) which is used to compensate for dimensional variations in an assembled booster. The push rod length is adjusted after each booster power unit has been assembled in production. **A properly adjusted pushrod that remains within the booster with which it was assembled in production, should never require a service adjustment.**

A booster that is suspected of having an improper pushrod length will indicate either of the following:

1. A pushrod which is too long will prevent the master cylinder piston from completely releasing hydraulic pressure and eventually cause the brakes to drag.
2. A pushrod which is too short will increase brake pedal travel and cause a clunk noise from the booster and master cylinder assembly.

If necessary, a booster pushrod length can be verified with a pushrod gauge (see Fig. 6) using the following procedure:

1. Without disconnecting the brake tubes, disconnect the master cylinder and set it away from the booster power unit. The master cylinder must be supported to prevent damaging the brake tubes.
2. With the engine running, gauge and adjust the pushrod length as shown in Fig. 7. (A force of approximately 5 pounds applied to the pushrod with the gauge will assure that the pushrod is seated within the power unit.
3. Install the master cylinder on the power unit and alternate tightening the retaining nuts gradually to the torque specified in Part 12-01.
4. With the engine running and the master cylinder reservoir cover removed, observe the fluid surface in the reservoirs when the brake pedal is applied rapidly. **Some fluid movement should occur in the forward reservoir. If fluid surface movement did not occur, the pushrod is adjusted too long and the procedure must be repeated to prevent eventual brake drag.**
5. **Fairmont/Zephyr Only** —Fairmont/Zephyr vehicles have the vacuum booster to master cylinder push rod manufactured to a specific length. There is no screw adjustment as found on other vehicle booster installations. No adjustment can therefore be made. However, the length of the push rod can be checked using the gauge shown in Fig. 17. If not within limits, the booster must be replaced.

HYDRAULIC SYSTEM BLEEDING

When any part of the hydraulic system has been disconnected for repair or replacement, air may enter the system and cause spongy pedal action. Bleed the hydraulic system after it has been properly connected, to be sure that all air is expelled.

Manual Bleeding

The primary and secondary (front and rear) hydraulic brake systems are individual systems and are bled separately. Bleed the longest line first on the individual system being serviced. During the complete bleeding operation DO NOT allow the reservoir to run dry. Keep the master cylinder reservoirs filled with Brake Fluid—Extra Heavy Duty (ESA-M6C25-A) Ford Part No. C6AZ-19542 or DOT 3 equivalent. Never re-use brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

1. **Do not use the secondary piston stop screw (located on the bottom of some master**

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cylinders) to bleed the brake system. Loosening or removing this screw could result in damage to the secondary piston or stop screw.

2. To bleed the brake system, position a suitable box wrench on the bleeder fitting on the brake wheel cylinder. Attach a rubber drain tube to the bleeder fitting. **The end of the tube should fit snugly around the bleeder fitting.**
3. Submerge the free end of the tube in a container partially filled with clean brake fluid, and loosen the bleeder fitting approximately 3/4 turn.
4. Have a second person push the brake pedal down slowly through its full travel. Close the bleeder fitting, then return the pedal to the full-released position. Repeat this operation until air bubbles cease to appear at the submerged end of the bleeder tube.
5. *When the fluid is completely free of air bubbles,* secure the bleeder fitting and remove the bleeder tube.
6. Repeat this procedure at the brake wheel cylinder on the opposite side. Refill the master cylinder reservoir after each wheel cylinder is bled and install the master cylinder cover and gasket. **Be sure the diaphragm-type gasket is properly positioned in the master cylinder cover. When the bleeding operation is completed, the fluid level should be filled to full or within 1/4 inch of the top of the reservoirs on level master cylinders and within 1/8 inch on angled master cylinders.**
7. If the primary (front brake) system is to be bled, repeat Steps 2 through 6 at the right front brake caliper or cylinder and ending at the left front brake caliper or cylinder.
8. On disc brake equipped models, be sure that disc brake pistons are returned to their normal positions, and that shoe and lining assemblies are properly seated by depressing the brake pedal several times until normal pedal travel is established.

Pressure Bleeding—All Models

For pressure bleeding, use a bladder-type bleeder tank only. This type bleeder separates the brake fluid from the pressurized air charge with a rubber diaphragm.

Bleed the longest lines first. The bleeder tank should contain enough new brake fluid to complete the bleeding operation. Use Ford Brake Fluid—Extra Heavy Duty (ESA-M6C25-A) Ford Part No. C6AZ-19542-A or DOT-3 equivalent for all brake applications. Never re-use brake fluid that has been drained from the hydraulic system. The tank should be charged with approximately 10 to 30 pounds of air pressure. Never exceed 50 pounds pressure.

1. *Clean all dirt from the master cylinder reservoir* cover.
2. Remove the master cylinder reservoir cover and rubber gasket, and fill the master cylinder reservoir with the specified brake fluid. Install the pressure bleeder adapter tool to the master cylinder, and attach the bleeder tank hose to the fitting on the adapter. **Master cylinder pressure bleeder adapter tools can be obtained from various manufacturers.** Follow the instructions of the manufacturer when installing the adapter.
3. ***Do not use the secondary piston stop screw, located on the bottom of some master cylinders, to bleed the master cylinder.***
4. If the rear wheel cylinders (the secondary brake system), are to be bled, use a 3/8-inch box wrench on the bleeder fitting on the right rear brake wheel *cylinder, and attach a bleeder tube* **snugly around the bleeder fitting.**
5. Open the valve on the bleeder tank to admit pressurized brake fluid to the master cylinder reservoir.
6. Submerge the free end of the tube in a container *partially filled with clean brake fluid,* and loosen the bleeder fitting.

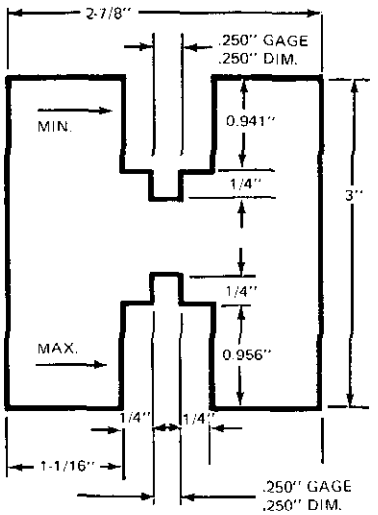


FIG. 16 Push Rod Gauge Dimensions

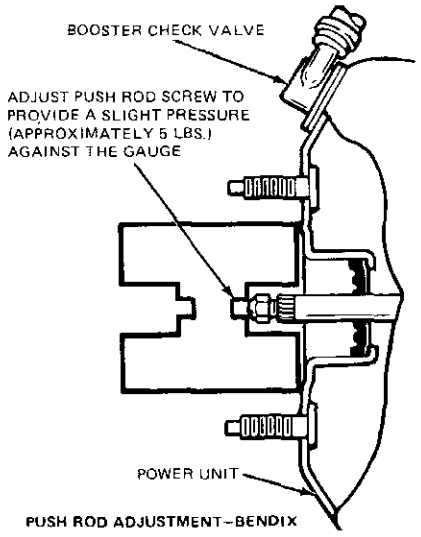


FIG. 17 Brake Booster Push Rod Measurement—Typical

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7. When air bubbles cease to appear in the fluid at the submerged end of the bleeder tube, close the bleeder fitting and remove the tube.
8. Repeat Steps 4 through 7 at the left rear wheel cylinder.
9. If the vehicle is equipped with **disc brakes** repeat Steps 4 through 7, starting at the right front disc caliper and ending at the left front disc caliper. On all models with metering valves the release rod must be pulled outward and held a minimum of 1/16 inch (Fig. 18) while bleeding the primary brake system. Remove the tool after bleeding.
10. When the bleeding operation is completed, close the bleeder tank valve and remove the tank hose from the adapter fitting.
11. On disc brake-equipped vehicles, be sure that disc brake pistons are returned to their normal positions, and that shoe and lining assemblies are properly seated by depressing the brake pedal several times until normal pedal travel is established.
12. Remove the Pressure Bleeder Adapter Tool. Fill the master cylinder reservoirs to full or within 1/4 inch of the top. Install the master cylinder cover and gasket. **Be sure the diaphragm-type gasket is properly positioned in the master cylinder cover.**

CENTRALIZING THE PRESSURE DIFFERENTIAL VALVE

After any repair or bleeding of the primary (front brake) or secondary (rear brake) system, the dual-brake warning light switch should be centralized.

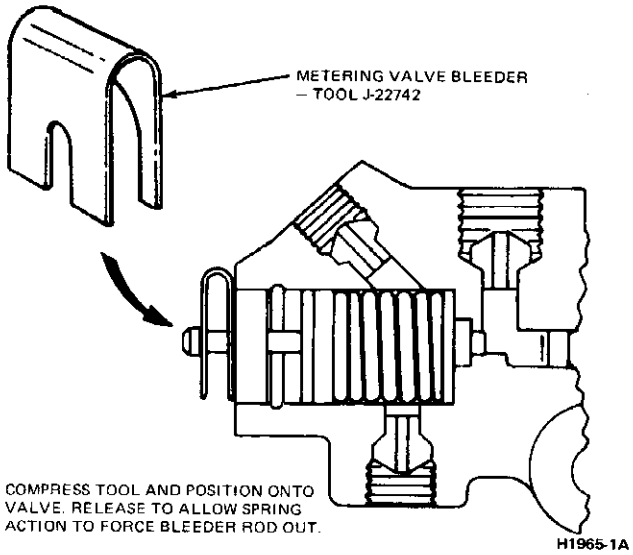


FIG. 18 Disc Brake Metering Valve Bleeding Tool

To centralize the pressure differential valve and turn off the warning light after a repair operation:

1. Turn the ignition switch to the ACC or ON position.
2. Depress the brake pedal and the piston will center itself, causing the brake warning light to go out (if it was illuminated).
3. Turn the ignition switch to the OFF position.
4. Before driving the vehicle, check operation of the brakes and be sure that a firm pedal is obtained.

REMOVAL AND INSTALLATION

DUAL MASTER CYLINDER

Removal—Non-Power Brakes

Refer to Figs. 19 through 22.

1. Disconnect the negative battery cable.
2. Disconnect the stoplight switch wires at the connector. Remove the spring retainer. Slide the stop light switch off the brake pedal pin just far enough to clear the end of the pin, then remove the switch from the pin. **Use care to avoid switch damage during removal.**
3. Loosen the master cylinder attaching nuts or bolts from the inside of the engine compartment and slide the master cylinder push rod and the nylon washers and bushings off the brake pedal pin.
4. Remove the brake tubes from the primary and secondary outlet ports of the master cylinder.
5. Remove the lock nuts or cap screws and lockwashers that secure the master cylinder to the dash panel and lift the cylinder forward and upward from the vehicle.

Installation—Non-Power Brakes

1. Carefully insert the master cylinder push rod and boot through the dash panel opening and position the master cylinder on the panel.
2. Install the lock nuts or cap screws at the dash panel and leave loose.
3. Coat the nylon bushings with **SAE 10W40 oil.** Install the nylon washer and bushing on the brake pedal pin.
4. Position the stop light switch and master cylinder push rod on the brake pedal pin, install the nylon bushing and washer and secure them in position with the spring retainer.
5. Connect the wires at the stop light switch connector.
6. Tighten the master cylinder attaching nuts or bolts and connect the brake lines to the master cylinder.
7. Fill the master cylinder with the specified brake fluid to full or within 1/4 inch of the top of the dual reservoirs. Use Brake Fluid—Extra Heavy Duty (ESA-M6C25-A) Ford Part No. C6AZ-19542-A or DOT-3 equivalent for all drum brake applications.
8. Bleed the dual master cylinder and the primary and secondary brake systems. Centralize the pressure differential valve. Refer to Hydraulic System Bleeding and Centralizing of the Differential Valve for proper procedure.
9. Operate the brakes several times, then check for external hydraulic leaks.

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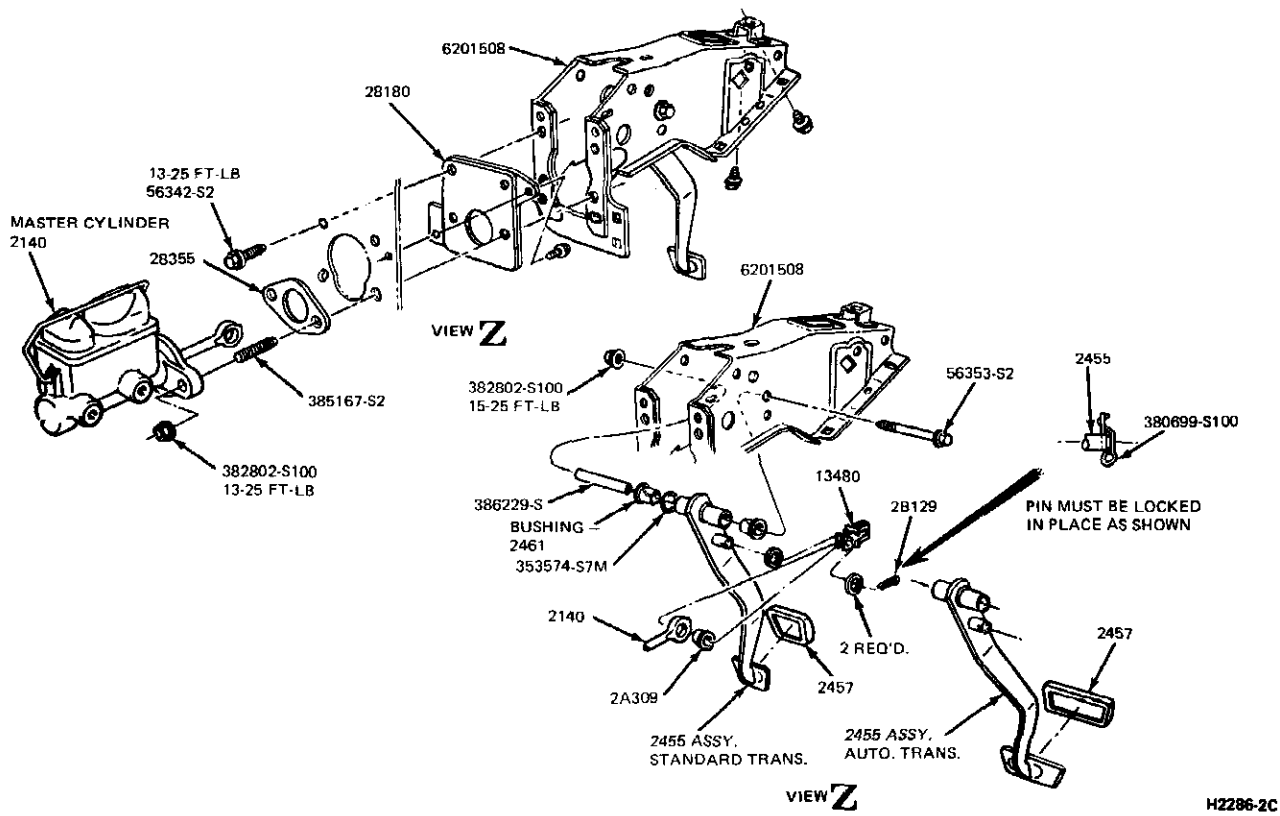


FIG. 19 Master Cylinder and Brake Pedal Installation—Non-Power—Pinto and Bobcat

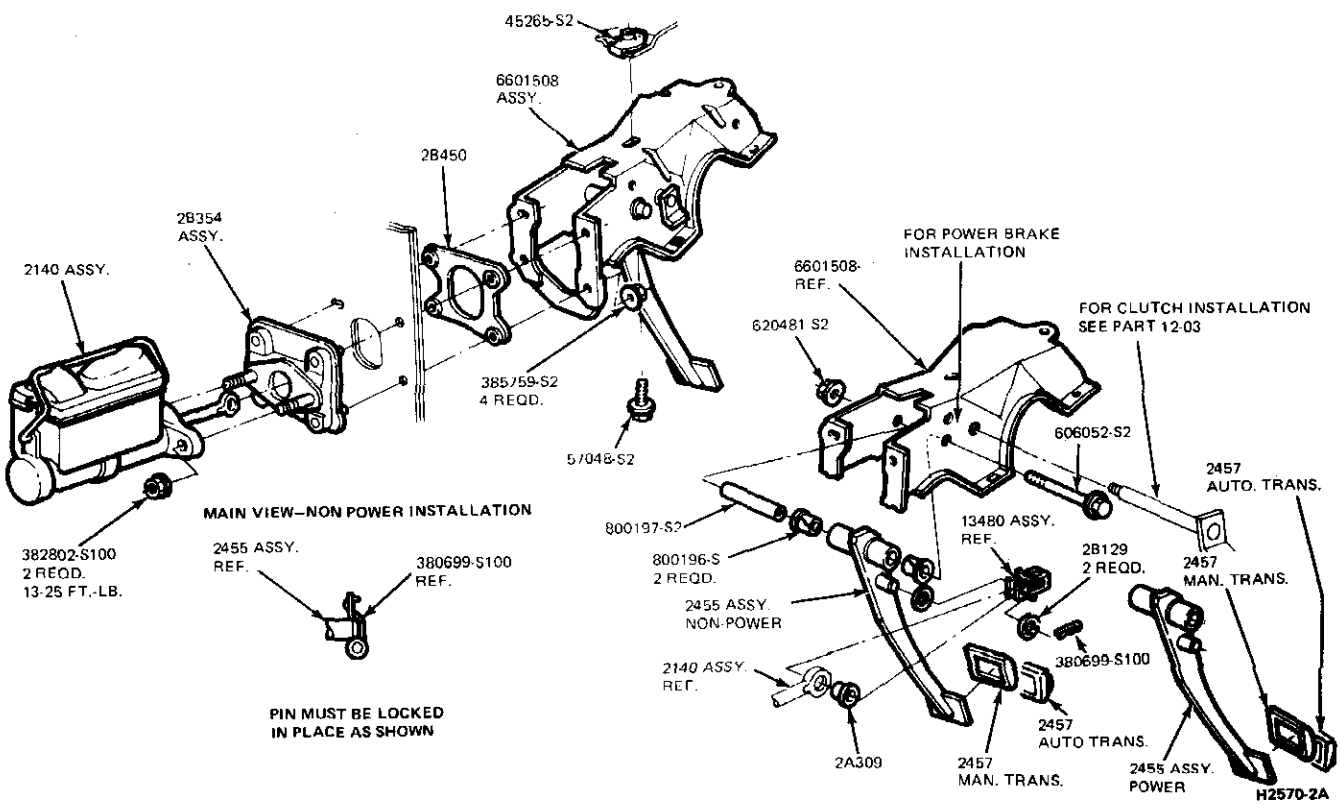


FIG. 20 Master Cylinder and Brake Pedal Installation—Non Power—Fairmont and Zephyr

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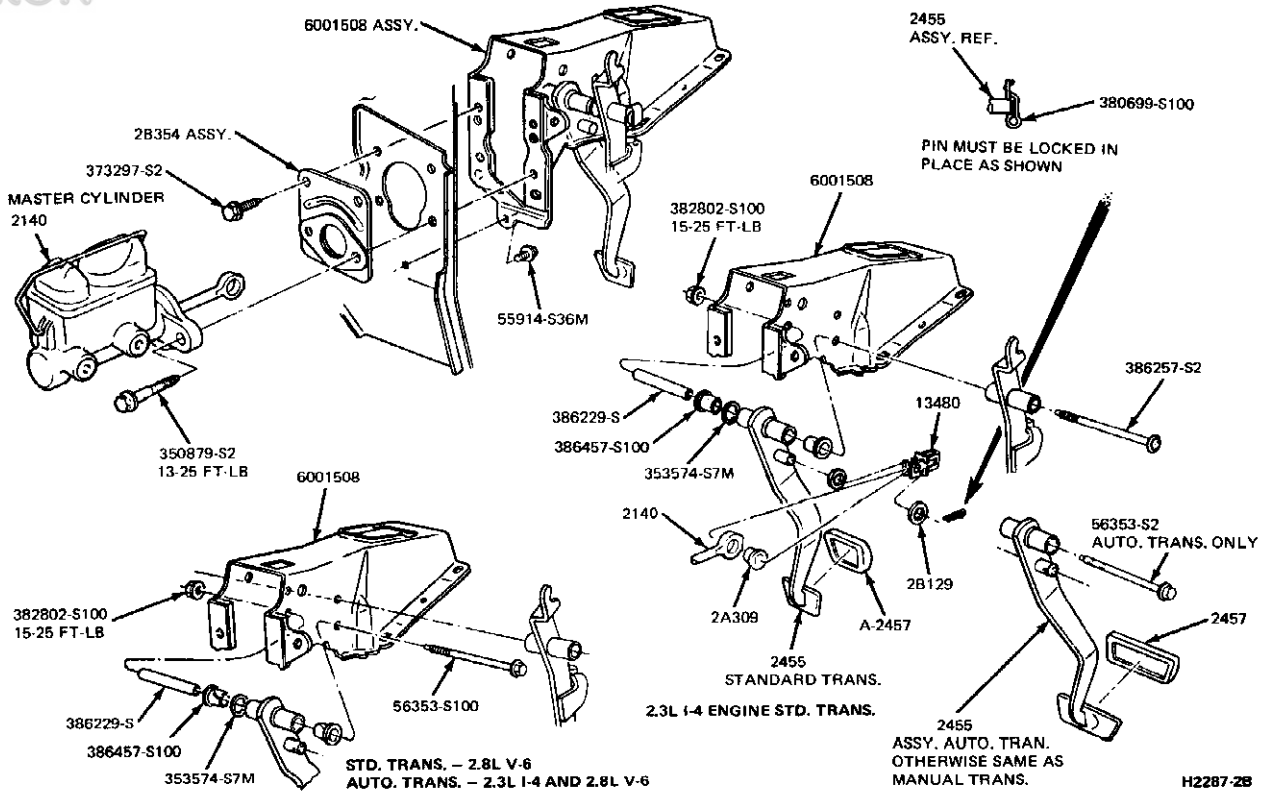


FIG. 21 Cylinder and Brake Pedal Installation—Non-Power—Mustang II

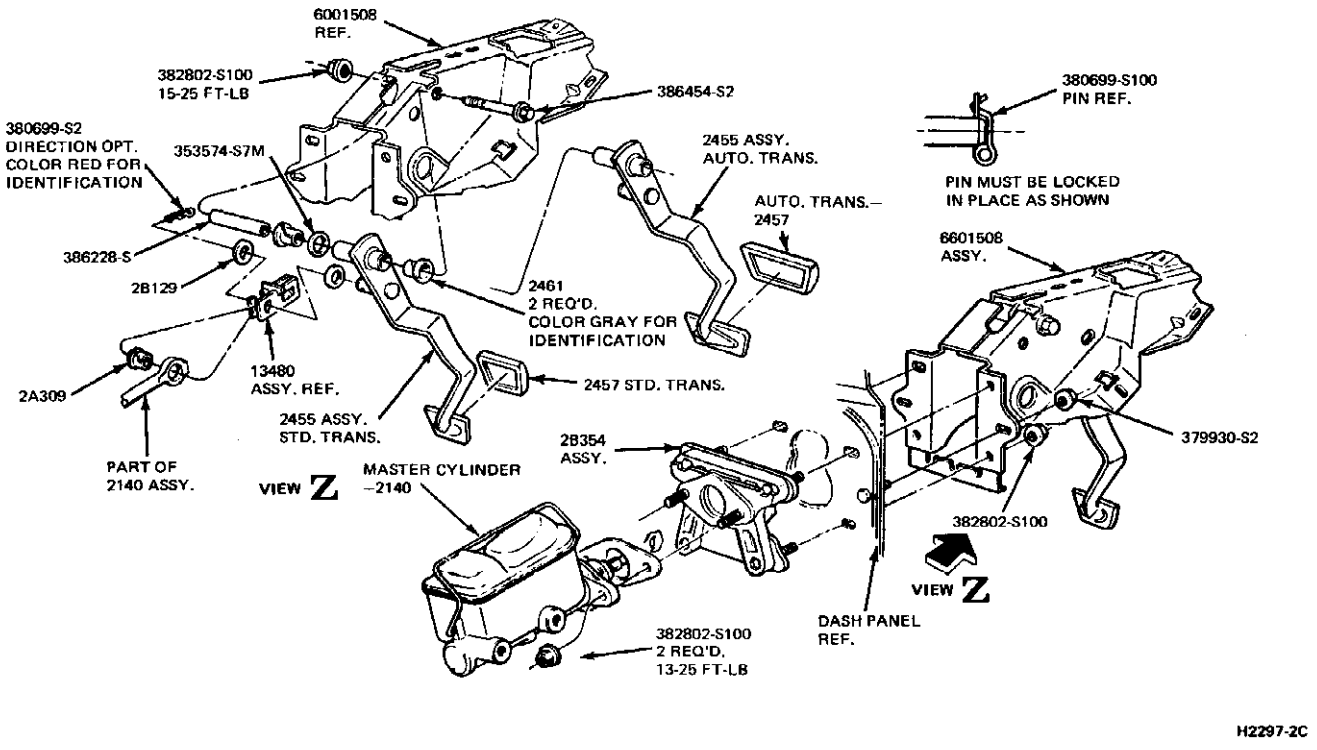


FIG. 22 Master Cylinder and Brake Pedal Installation—Non-Power—Granada and Monarch

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Removal—Power Brakes

Refer to Figs. 23 through 32.

1. Remove the brake tubes from the primary and secondary outlet ports of the master cylinder.
2. Remove the two nuts attaching the master cylinder to the brake booster assembly.
3. Slide the master cylinder forward and upward from the vehicle.

Installation—Power Brakes

1. Position the master cylinder assembly over the booster push rod and onto the two studs on the booster assembly (Figs. 23 thru 32).
2. Install the attaching nuts and torque them to specifications.
3. Install the front and rear brake tubes to the master cylinder outlet fittings.
4. Fill the master cylinder with the specified brake fluid to full or within 1/4 inch of the top of the dual reservoirs on level master cylinders and 1/8 inch on angled master cylinders. Use Brake Fluid—Extra Heavy Duty (ESA-M6C25-A) Ford Part No. C6AZ-19542-A or equivalent (DOT-3) for all brake applications.
5. Bleed the dual master cylinder and the primary and secondary brake systems. Centralize the pressure differential valve. Refer to Hydraulic System Bleeding and Centralizing of the Differential Valve for the proper procedure.
6. Operate the brakes several times, then check for external hydraulic leaks.

BRAKE CONTROL VALVE ASSEMBLY

Removal

1. Disconnect the brake warning light switch wire harness connector from the warning light switch.
2. Disconnect the front brake system inlet tube and the rear system inlet tube from the brake control valve assembly.
3. Disconnect the left and right front brake outlet tubes from the brake control valve assembly.
4. Disconnect the rear system outlet tube from the brake control valve assembly.
5. Remove and discard the two bolts that retain the brake control valve assembly on the frame mounting bracket or the two nuts that retain the valve on the fender apron and remove the assembly from the car.

NOTE: The brake control valve assembly is serviced as an assembly only. Do not attempt to repair this unit.

Installation

1. Position the brake control valve assembly on the frame mounting bracket or at the fender apron holes and install two mounting screws for frame mounting or two nuts for fender apron mounting and tighten to specified torque. Refer to the Specification Section for torques **and mounting bolt precautions.**
2. Connect the rear brake outlet tube to the control valve assembly and tighten the tube nut to Specification.

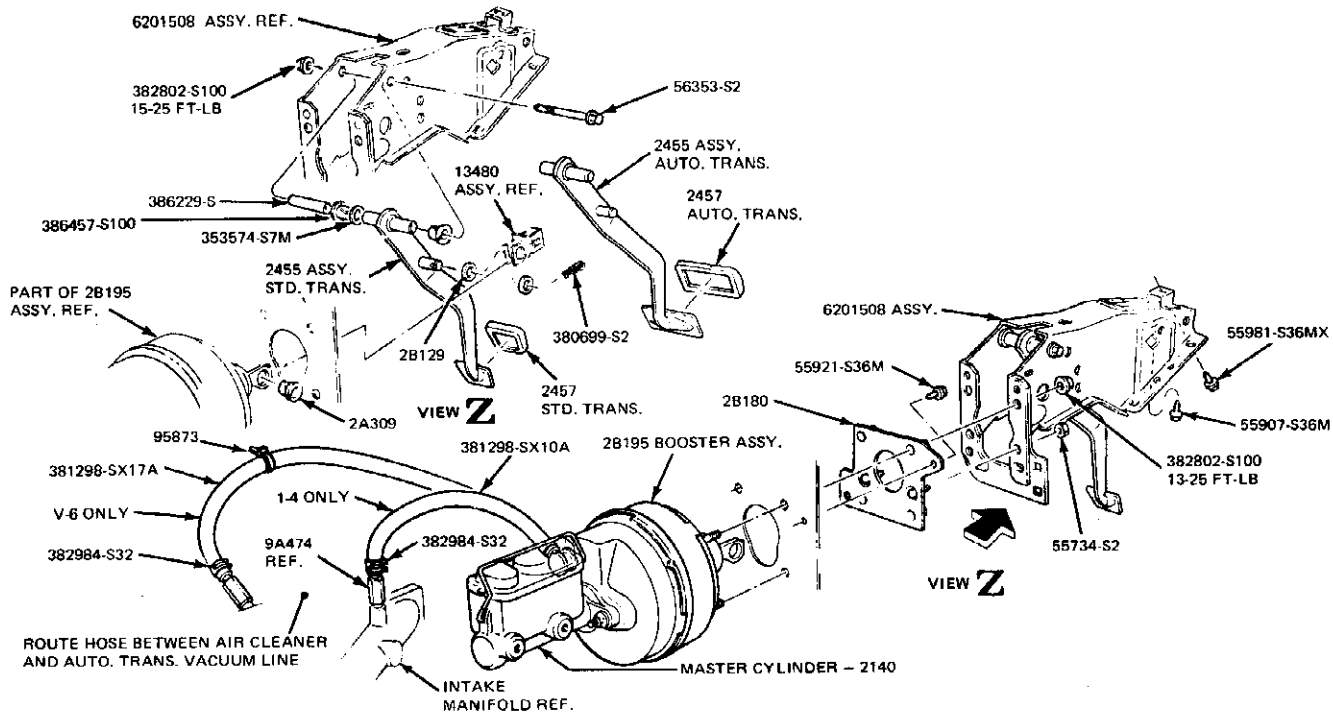


FIG. 23 Master Cylinder and Brake Pedal Installation—Vacuum-Power—Pinto and Bobcat

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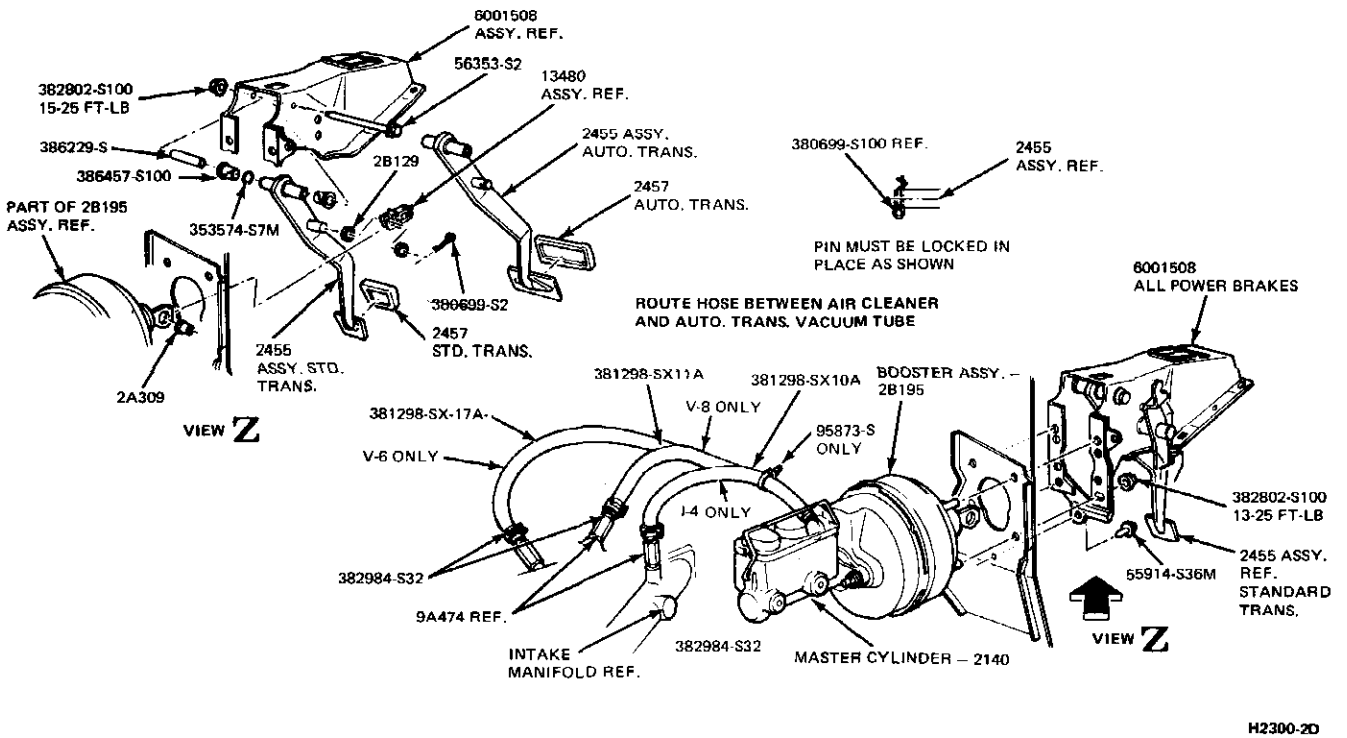


FIG. 24 Master Cylinder and Brake Pedal Installation—Vacuum-Power—Mustang II

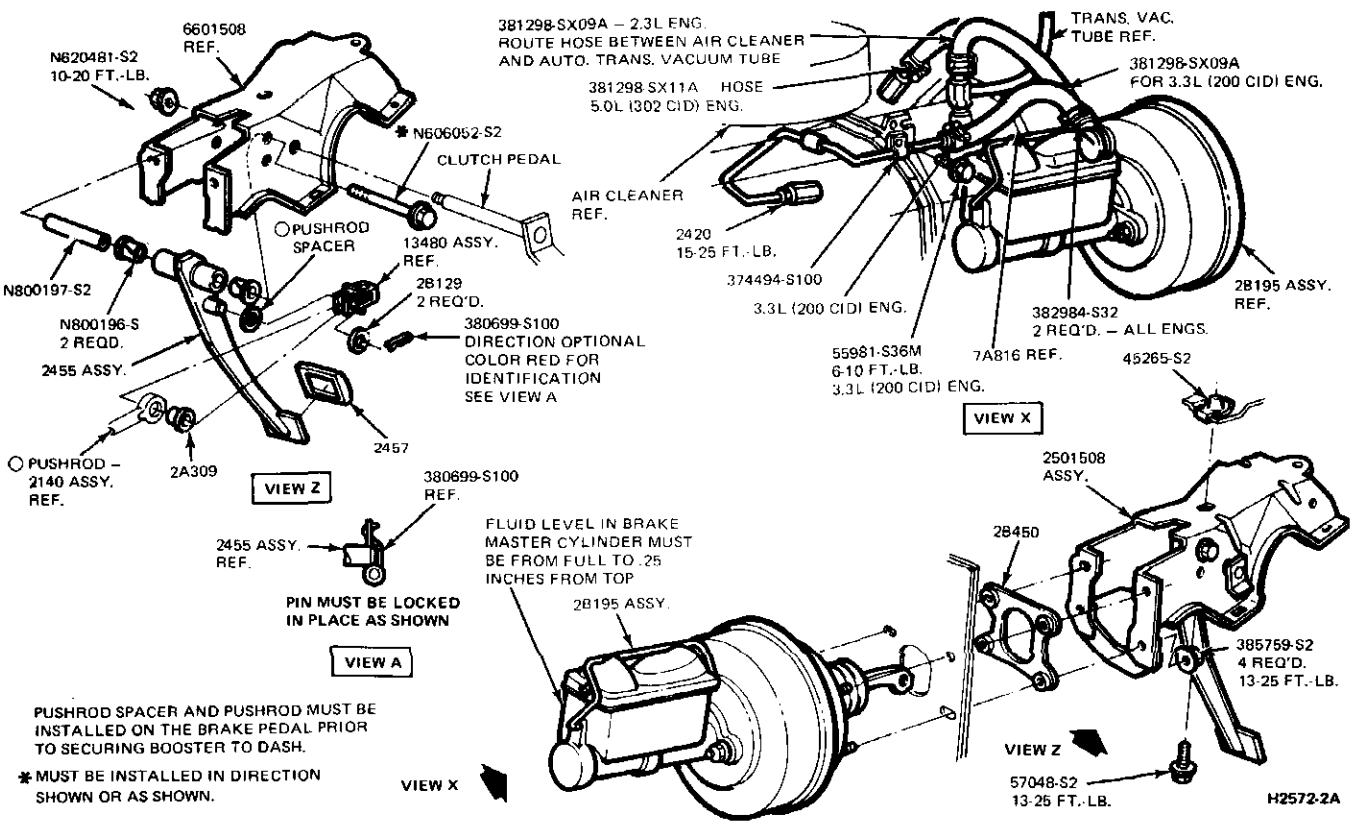


FIG. 25 Master Cylinder and Brake Pedal Installation—Vacuum Power—Fairmont and Zephyr

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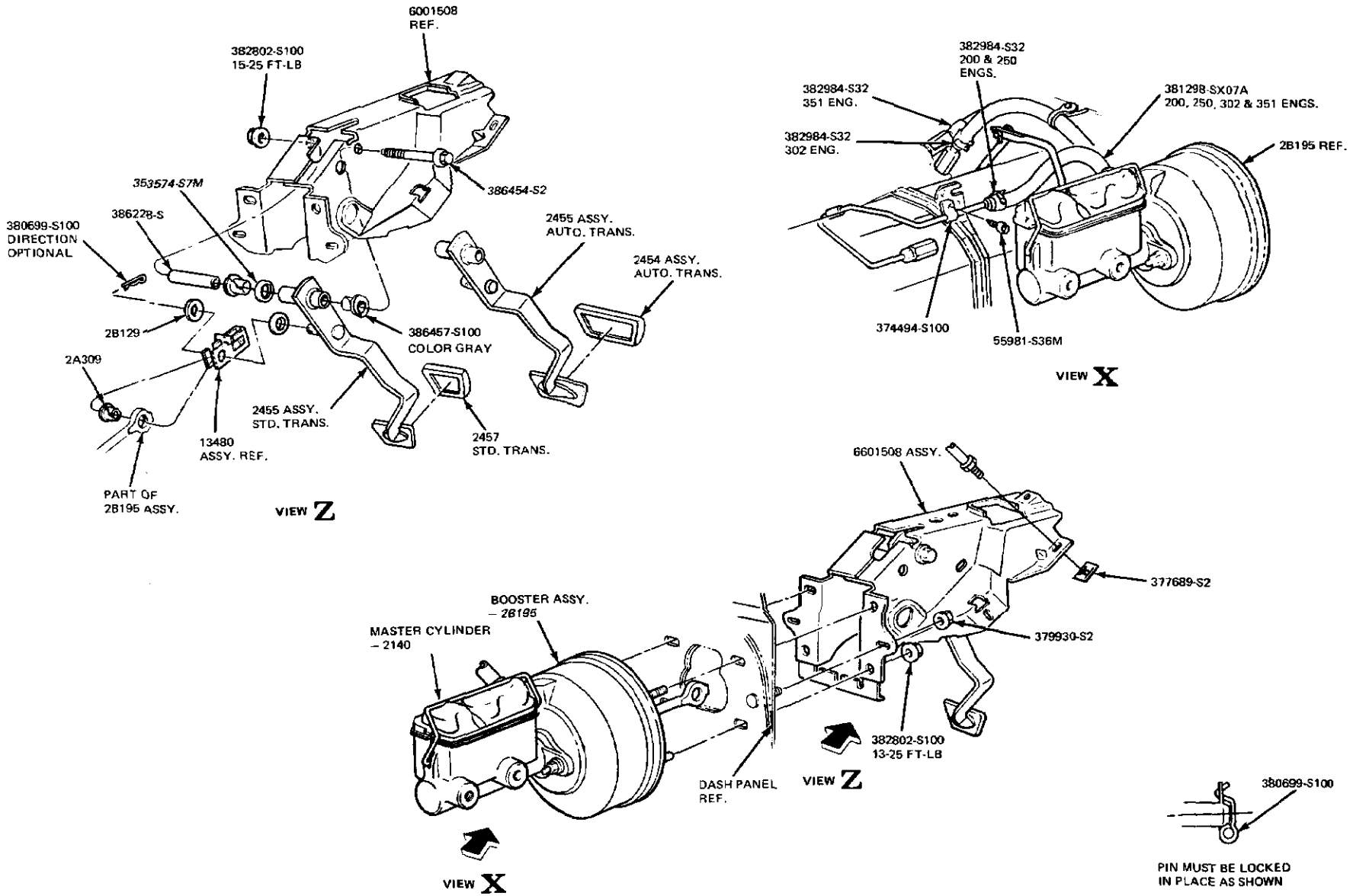


FIG. 26 Master Cylinder and Brake Pedal Installation—Vacuum-Power—Granada and Monarch

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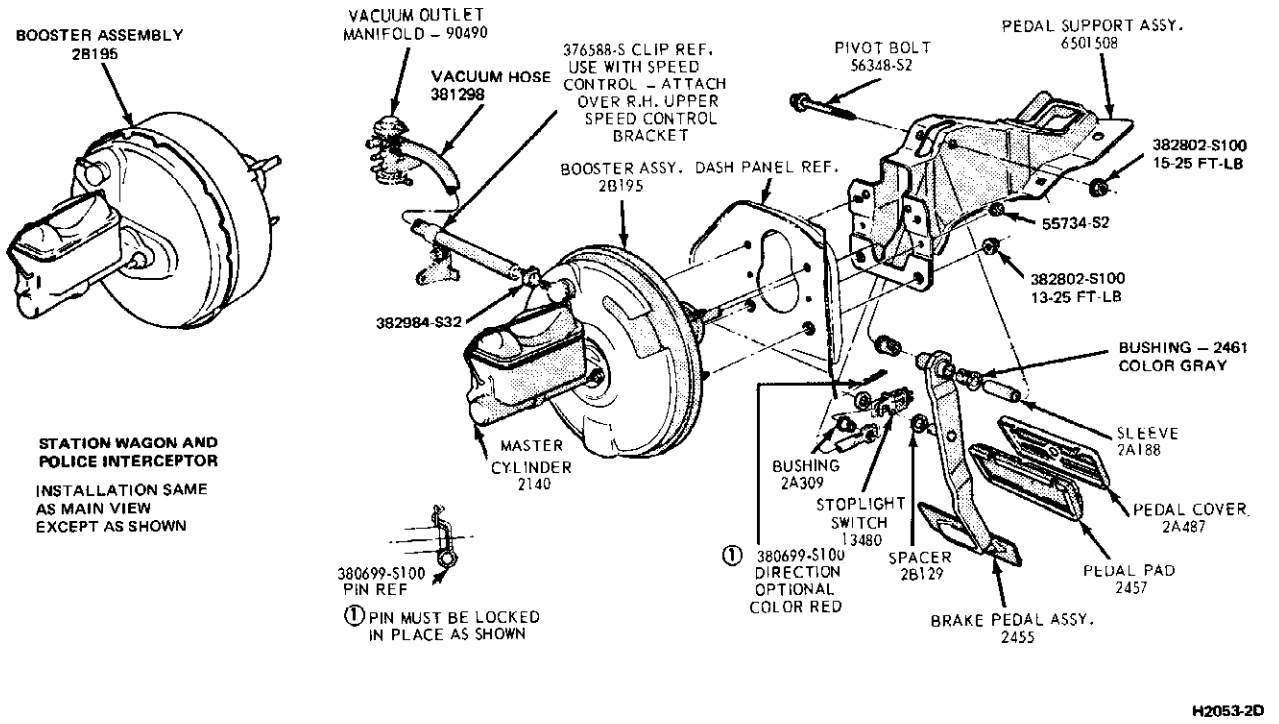


FIG. 27 Master Cylinder and Brake Pedal Installation—Vacuum-Power—LTD II, Cougar and Thunderbird

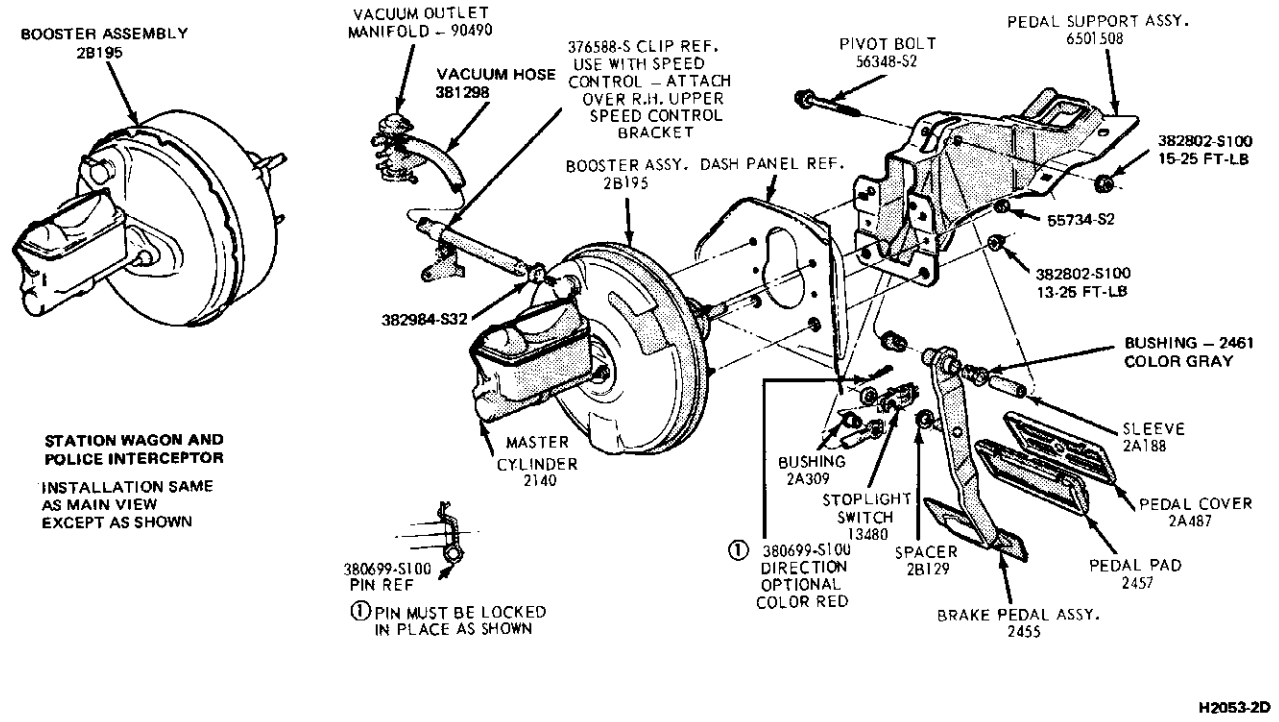


FIG. 28 Master Cylinder and Brake Pedal Installation—Vacuum-Power—Ford and Mercury

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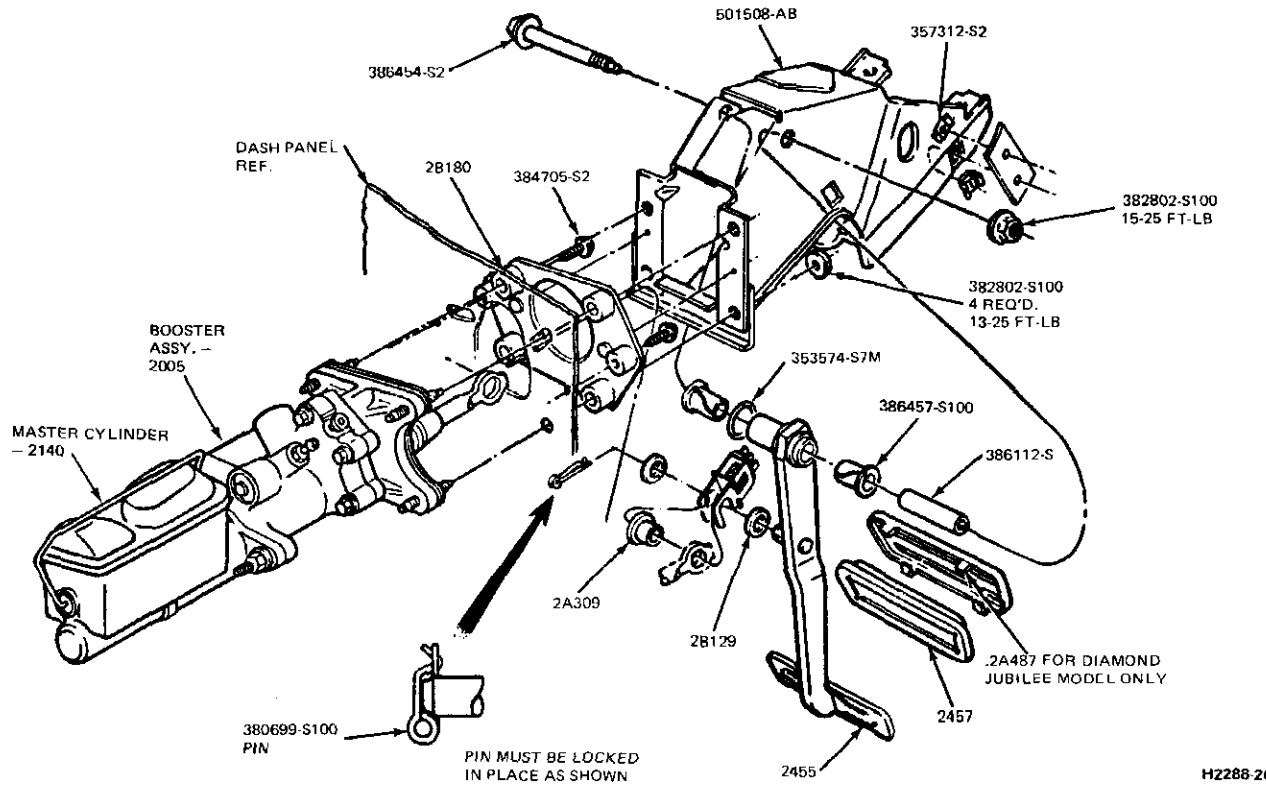


FIG. 29 Master Cylinder and Brake Pedal Installation—Hydro-Boost Power Brake—Continental Mark V

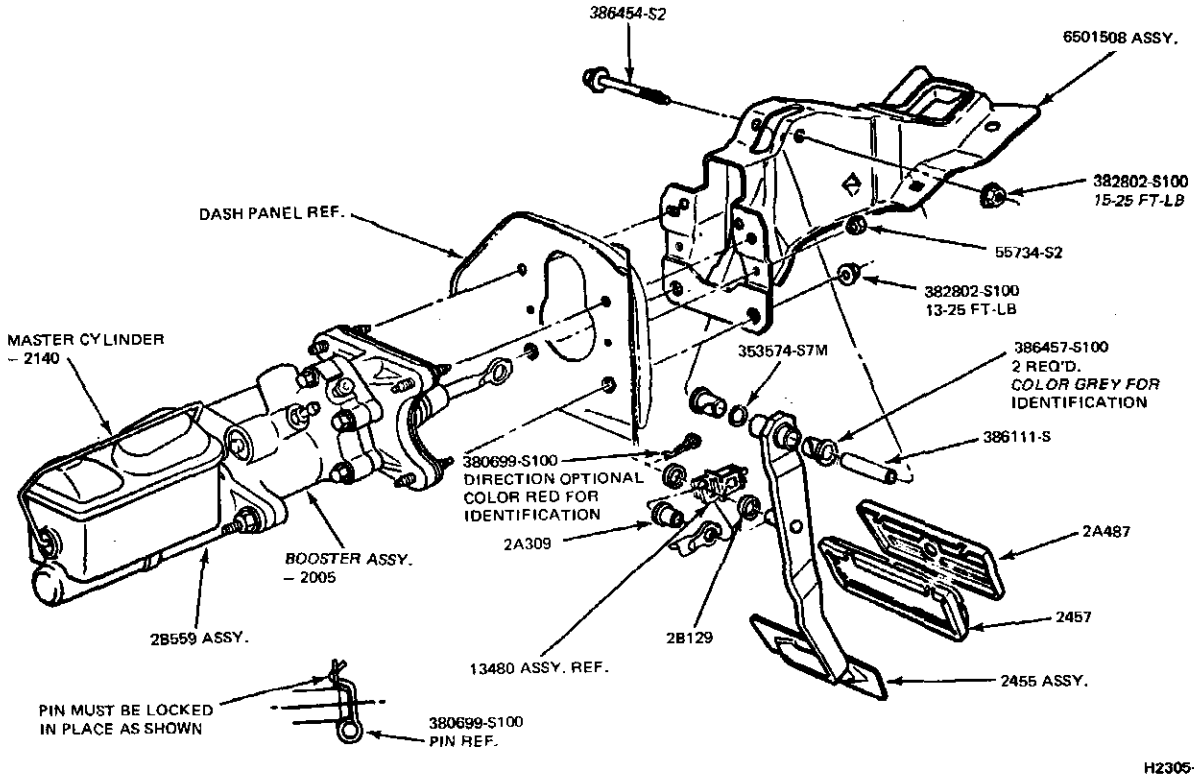


FIG. 30 Master Cylinder and Brake Pedal Installation—Hydro-Boost Power Brake—Mercury and Ford

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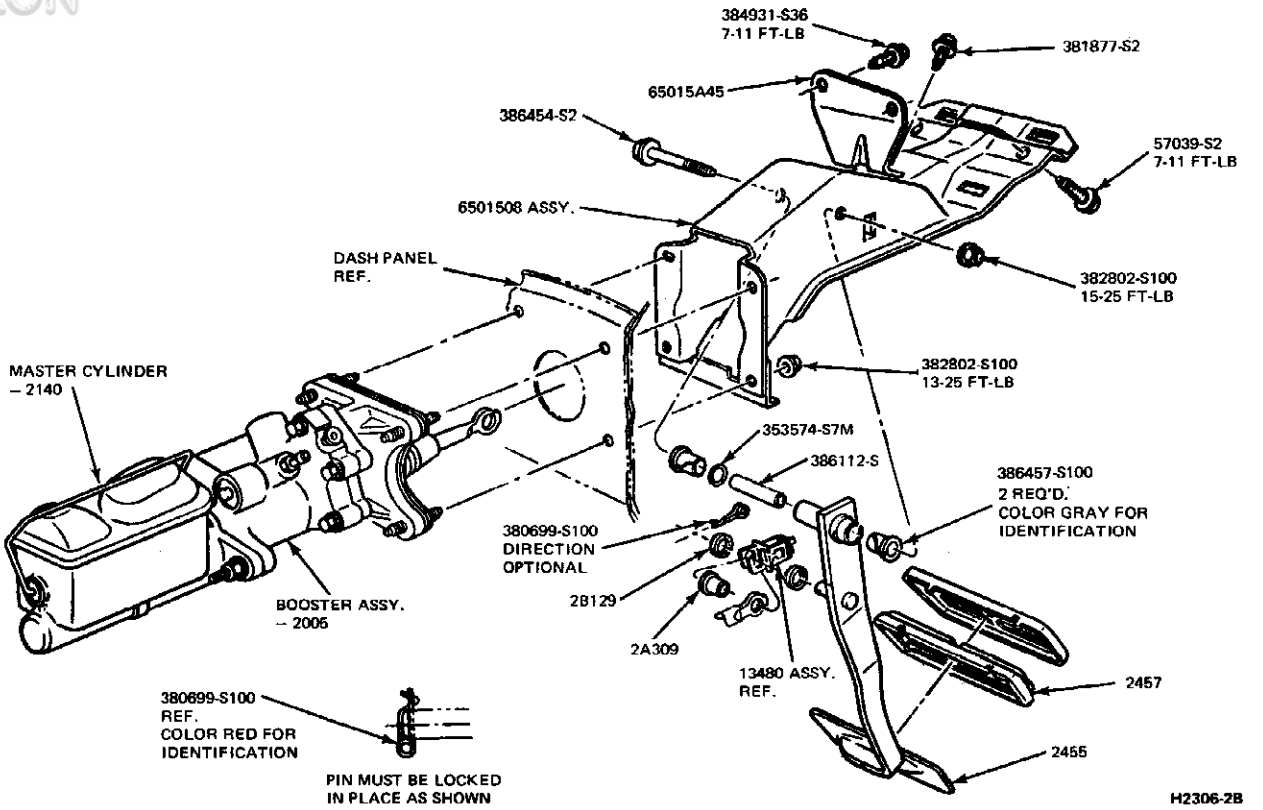


FIG. 31 Master Cylinder and Brake Pedal Installation—Hydro-Boost Power Brake—Lincoln Continental

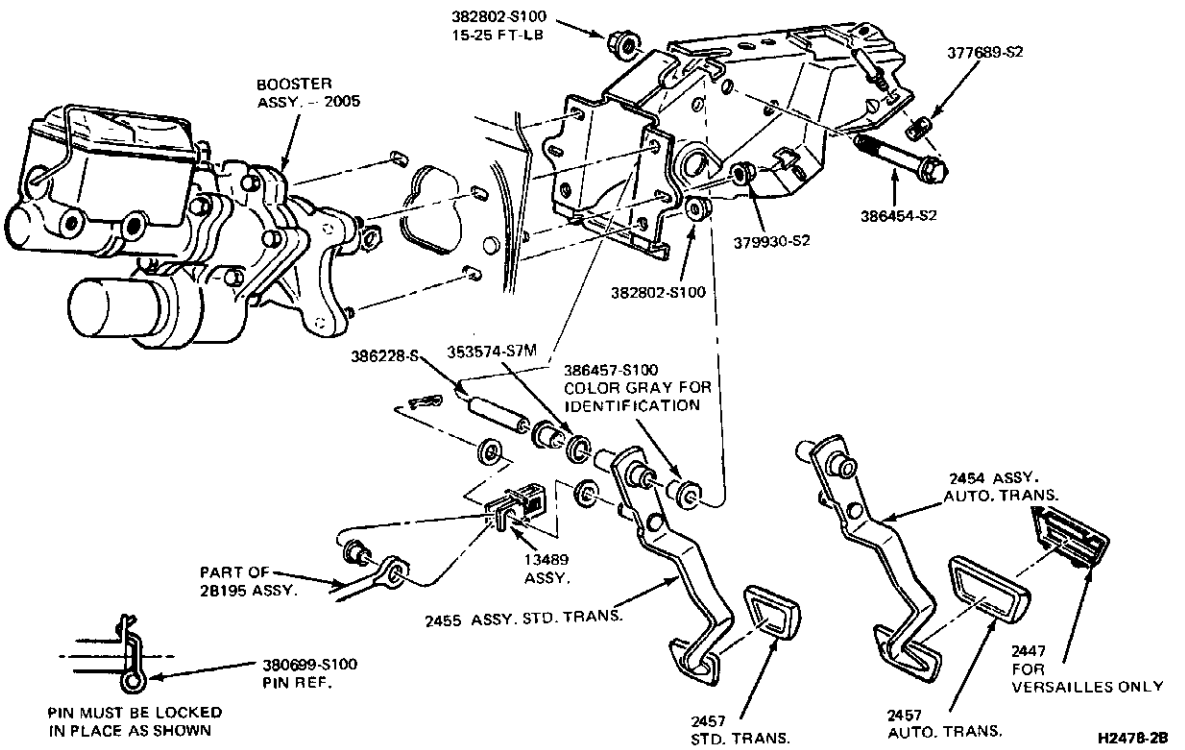


FIG. 32 Master Cylinder and Brake Pedal Installation—Hydro-Boost Power Brake—Granada, Monarch and Versailles

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3. Connect the rear brake inlet tube to the control valve assembly and tighten the tube nut to Specification.
4. Connect the right front brake outlet tube to the brake control valve assembly and tighten the tube nut to specified torque.
5. Connect the left front brake outlet tube to the brake control valve assembly and tighten the tube nut to Specification.
6. Connect the front brake inlet tube to the brake control valve assembly and tighten the tube nut to Specification.
7. Connect the brake warning light switch wiring harness connector to the brake warning light switch. Verify connection by turning ignition switch to start position, light must come on.
8. Bleed the brake system and centralize the pressure differential valve.

NOTE: During the brake system bleeding operation on vehicles equipped with a metering valve, the metering valve bleeder rod must be pulled outward a minimum of 1/16th inch.

BRAKE PEDAL

All Car Lines W/Automatic Transmission—Granada, Monarch, Pinto, Bobcat, Fairmont and Zephyr—All Transmissions

Removal (Refer to appropriate illustration)

1. Disconnect the negative battery cable.
2. Disconnect the stop light switch wire connector from the switch.
3. Loosen the booster nuts approximately 1/4 inch at the pedal support, remove the push rod retainer and nylon washer and slide the stop light switch outboard along the brake pedal pin just far enough for the outer hole of the switch frame to clear the pin. Remove the switch by sliding it downward. Remove the black stop light switch bushing from the push rod.
4. Loosen the master cylinder bolts in the engine compartment or booster nuts at the pedal support and slide the pushrod and nylon washer off the pedal pin.
5. Remove the lock nut and then remove the pivot bolt, brake pedal, pivot spacer, anti-rattle spring washer and bushings from the pedal support.

Installation (Refer to appropriate illustration)

1. Apply a coating of SAE 10W30 engine oil to the bushings. Slide the anti-rattle spring washer over one bushing. Locate bushings and pivot spacer in the brake pedal hub.
2. Position the brake pedal assembly in the pedal support and install the pivot bolt. Install the lock nut and washer. Torque the nut to 15-25 ft-lb.
3. Install the inner nylon washer, the master cylinder push rod, and the black stop light switch bushing on the brake pedal pin. Position the stop light switch so that it straddles the pushrod, with the slot on the pedal pin, and the switch outer frame hole just clearing the pin. Slide the switch upward onto the pin and push rod. Slide the assembly inboard toward the brake pedal arm. Install the outer nylon washer and the push rod retainer. Lock the retainer securely.
4. Tighten the master cylinder attaching bolts or the booster attaching nuts (13-25 ft-lb).
5. Connect the stop light switch wire to the switch.
6. Apply SAE 10W30 engine oil to the clutch clevis shaft. Position the clutch cable to the clutch pedal. Install the clevis shaft and clevis retainer.
7. Connect the negative battery cable.
8. Check the Brake Pedal Free Height and Travel Measurements (Fig. 5).

Mustang II W/Manual Transmission

Removal (Refer to Fig. 21)

1. Disconnect the negative battery cable.
2. Remove the clutch cable clevis from the clutch pedal. Refer to Part 16-03 for procedure.
3. Disconnect the stop light switch wire connector from the switch.
4. Remove the pushrod retainer and nylon washer and slide the stop light switch outboard along the brake pedal pin just far enough for the outer hole of the switch frame to clear the pin. Remove the switch by sliding it downward. Remove the black stop light switch bushing from the push rod.
5. Loosen the master cylinder bolts in the engine compartment or booster nuts at the pedal support and slide the push rod and nylon washer off the pedal pin.
6. Remove the lock nut and then remove the pivot bolt, brake pedal, pivot spacer, anti-rattle spring washer and bushings from the pedal support. **NOTE: Cars equipped with 4-cylinder engines and without power brakes have clutch pedal, clutch pivot spacer and bushings attached with a common pivot bolt and lock nut.**

Installation (Refer to Fig. 21)

1. Apply a coating of SAE 10W30 engine oil to the bushings. Slide the anti-rattle spring washer over one bushing. Locate bushings and pivot spacer in the brake pedal hub.
2. **Non-power and 4-cylinder engines only** apply a coating of SAE 10W30 engine oil to the bushings and locate bushings, spacer and pivot bolt in the clutch pedal hub.
3. Position brake pedal assembly in the pedal support and install the pivot bolt on the pivot and clutch pedal assembly. Install lock nut washer and torque to 15-25 ft-lb.
4. Install the inner nylon washer, the master cylinder push rod and the black stop light switch bushing on the brake pedal pin. Position the stop light switch so that it straddles the push rod with the slot on the pedal pin, the switch outer frame hole just clearing the pin. Slide the switch upward onto the pin and push rod. Slide the assembly inboard toward the brake arm. Install the outer nylon washer and the push rod retainer. Lock the retainer securely.

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5. Tighten the master cylinder attaching bolts or the booster attaching nuts (13-25 ft-lb).
6. Connect the stop light switch wire to the switch.
7. Attach the clutch cable clevis to the clutch pedal. Refer to Part 16-02 for installation and adjustment procedure.
8. Connect the negative battery cable.
9. Adjust the clutch pedal free play (Part 16-02).
10. Check the Brake Pedal Height and Travel Measurements (Fig. 15).

OVERHAUL

DUAL MASTER CYLINDER

When a repair is necessary on the master cylinder, it is required practice during the warranty period to replace the cylinder as a unit instead of overhauling the cylinder with a service kit.

Disassembly

1. Clean the outside of the master cylinder and remove the filler cover and diaphragm. Drain and discard any brake fluid that remains in the cylinder.
2. Remove the secondary piston stop bolt from the bottom or inside the reservoir (Fig. 33), if so equipped.
3. Depress the primary piston and remove snap ring from retaining groove at the rear of the master cylinder bore (Fig. 34).
4. Remove push rod and primary piston assembly from the master cylinder bore. **Do not remove the screw that secures the primary return spring retainer, return spring, primary cup and protector on the primary piston. This assembly**

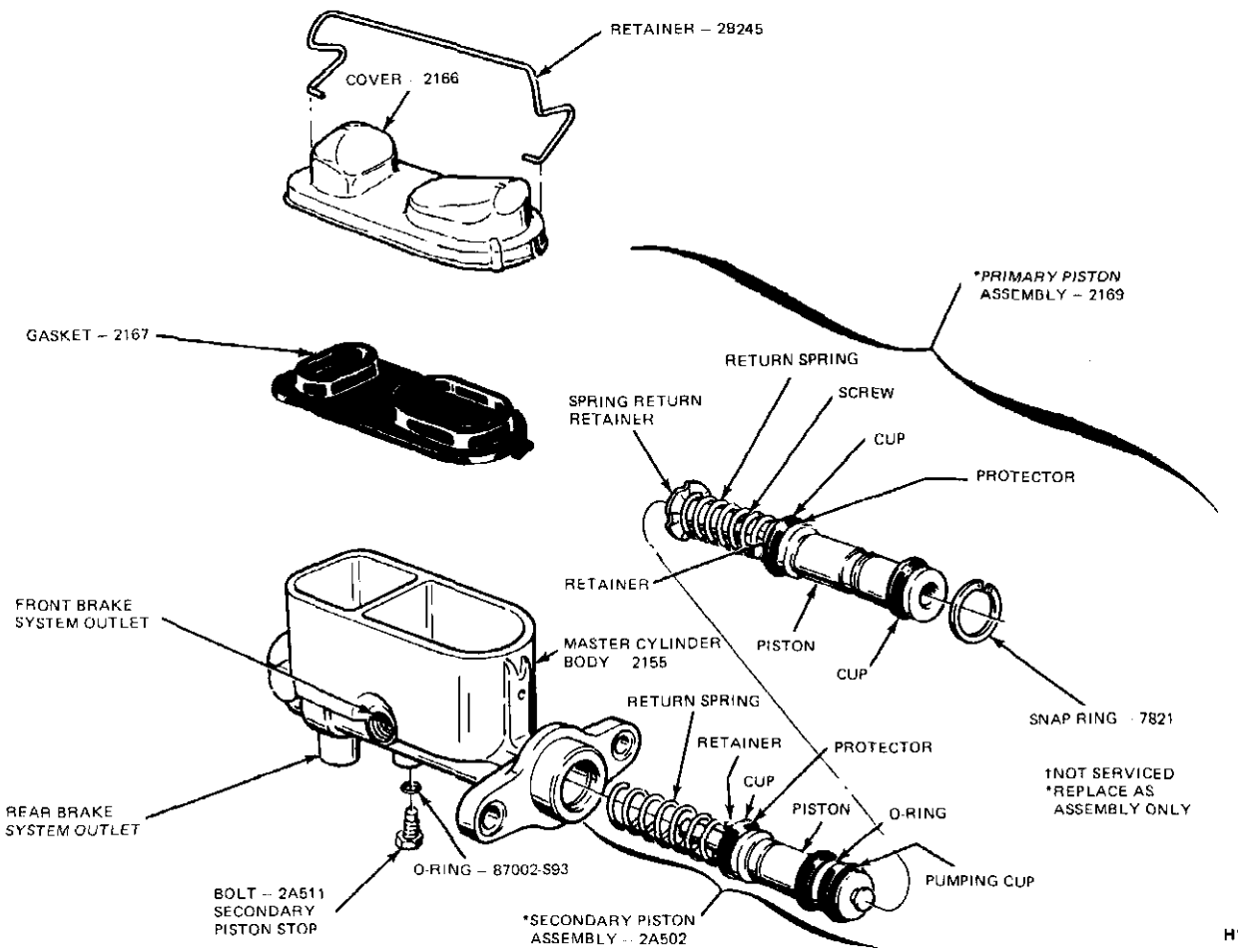


FIG. 33 Dual Master Cylinder—Disassembled

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is factory pre-adjusted and should not be disassembled.

5. Remove the secondary piston assembly (Fig. 33). **Do not remove the outlet tube seats from the master cylinder body.**
6. Clean all parts in clean isopropyl alcohol, and inspect the parts for chipping, excessive wear or damage. **When using a master cylinder repair kit, install all the parts supplied.**
7. Be sure that all recesses, openings and internal passages are open and clean. Place all parts on a clean pan or paper.
8. Inspect the master cylinder bore for signs of etching, pitting, scoring or rust. If necessary to hone the master cylinder bore to repair damage, do not exceed allowable hone specifications.

Assembly

1. Dip all parts except the master cylinder body in clean brake fluid (ESA-M6C25-A) Ford Part No. C6AZ-19542-A *or DOT-3 equivalent.*
2. Carefully insert the complete secondary piston and return spring assembly in the master cylinder bore (Fig. 33).
3. Install the primary piston assembly in the master cylinder bore.
4. *Depress the primary piston and install the snap ring* in the cylinder bore groove.
5. Install the push rod, boot and retainer on the push rod, if so equipped. Install the push rod assembly into the primary piston. **Make sure the retainer *is properly seated and holding* the push rod securely.**
6. Position the inner end of the push rod boot (if so equipped) in the master cylinder body retaining groove.
7. Install the secondary piston stop bolt, if used, with an O-ring if screw is on bottom outside of master cylinder casting.
8. Install the bleed screw (if so equipped). Install the *gasket (diaphragm) in the master cylinder filler* cover. Position the gasket as shown in Fig. 33. **Make sure the gasket is securely seated.**
9. Install the cover and gasket on the master cylinder and secure the cover into position with the retainer.

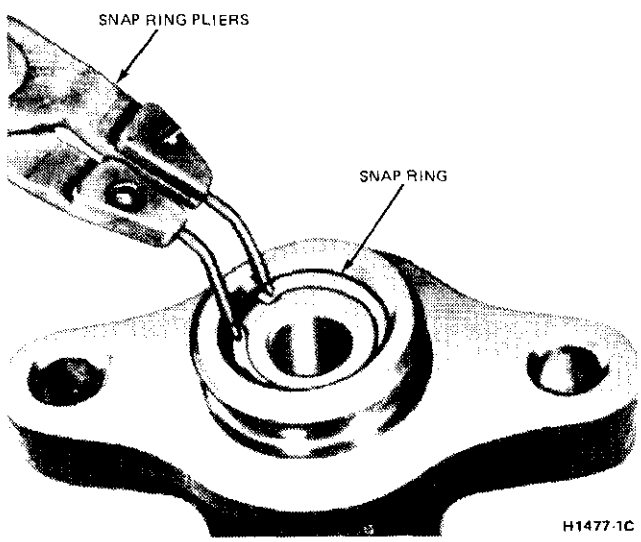


FIG. 34 Removing Snap Ring—Typical

CLEANING AND INSPECTION

DISC BRAKES

1. Remove the wheel and tire from the hub and rotor.
2. Inspect brake shoes and lining for wear. If the lining is worn to within 1/8 inch of the shoe, replace all (4) shoe and lining assemblies (complete axle set) on front or rear wheels as appropriate. On Fairmont/Zephyr, the rubber caliper insulators and the plastic sleeves must be replaced when linings *are replaced.*
3. Visually check the caliper. If the caliper housing is leaking, it should be replaced. If a seal is leaking, the caliper must be disassembled and new seals

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installed. If a piston is seized in the bore, a new caliper housing is required.

Refer to Part 12-20 for disc brake rotor resurfacing procedure.

DISC BRAKE SERVICE PRECAUTIONS

1. Grease or any other foreign material must be kept off the linings surfaces of the rotor, and external surfaces of the hub during service operations. In handling the rotor and caliper assemblies, avoid deformation of the brake rotor and nicking or scratching of brake linings.
2. If a caliper piston is removed for any reason, the piston seal must be replaced.
3. During removal and installation of a wheel assembly, exercise care not to interfere with and damage the caliper splash shield or the bleeder screw fitting.
4. Front wheel bearing end play is critical and must be within specifications.
5. Be sure the vehicle is centered on the hoist before servicing any front end components, to avoid bending or damaging the rotor splash shield on full right or left wheel turns.
6. Riding of the brake pedal (common on left-foot applications) must be avoided during vehicle operation.
7. The wheel and tire must be removed separately from the brake rotor, unlike drum brakes where the wheel, tire and drum can be removed as a unit.
8. Do not attempt to clean or restore oil or grease-soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets.
9. On Fairmont/Zephyr only, always replace rubber caliper insulators and plastic sleeves when replacing linings. **Do not lubricate the slide pins.**

DRUM BRAKES

1. Remove the wheel from the drum, and remove the drum as outlined in Part 12-02.
2. Use an industrial vacuum cleaner to remove all dust from the backing plates and interior of the brake drums.
3. Inspect the brake shoes for excessive lining wear or shoe damage. If the lining is worn within 1/32 inch of the rivet heads or if the shoes are damaged, they must be replaced. Replace any lining that has been contaminated with oil, grease or brake fluid. Replace lining in axle sets. Prior to replacement of lining, the drum diameter should be checked to determine that the brake drum braking surface diameter is within specification. If the braking surface diameter exceeds specification, the drum must be replaced.
4. Check the condition of brake shoes, retracting springs, hold-down springs, and drum for signs of overheating. If the shoes have a slight blue coloring, indicating overheating, the retracting and hold-down springs should be replaced. **Overheated springs lose their pull and could cause the new lining to wear prematurely, if not replaced. If the brake drums are heat spotted, indicating an overheated condition, they should be replaced.**
5. Inspect all other brake parts and replace any that are worn or damaged.
6. Inspect the brake drum and, if necessary, refinish. **The maximum inside braking surface diameter is shown on each brake drum (Fig. 33).** If the maximum inside braking surface diameter shown on the drum is exceeded either by wear or refinishing, the drum must be replaced. Refer to Part 12-02 for refinishing.

BRAKE BOOSTER

Check the booster operation as noted under Power Brake Functional Test. If the brake booster is damaged or inoperative, replace it with a new booster. **The brake booster is serviced only as an assembly, including the check valve.**

BRAKE TUBING

If a section of the brake tubing becomes damaged, the entire section should be replaced with tubing of the same type, size, shape and length. **Copper tubing should not be used in a hydraulic system.** When bending brake tubing to fit underbody or rear axle contours, be careful not to kink or crack the tube.

HYDRAULIC LINES

Double wall steel tubing is used throughout the brake system with the exception of the flexible hoses at the front wheels and at the rear axle housing brake tube connection.

Always bleed the applicable primary or secondary brake system after primary or secondary brake system hose or line replacement. Centralize the pressure differential valve after bleeding the system.

All brake tubing should be double flared properly to provide good leakproof connections. Clean the brake tubing by flushing with clean brake fluid before installation.

When connecting a tube to a hose, tube connector, or brake cylinder, tighten the tube fitting nut to specified torque with Milbar Tool 1112-144 or equivalent.

BRAKE HOSE

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. On all vehicles except Fairmont/Zephyr, place a new copper gasket over the hose fitting and thread the hose assembly into the front wheel cylinder or caliper. Fairmont/Zephyr front hose does not require a copper gasket and is reusable. Engage the opposite end of the hose to the bracket on the frame. The white stripe on the hose should show no evidence of twisting. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

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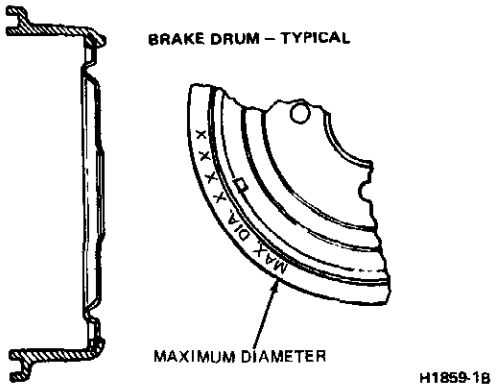


FIG. 35 Location of Brake Drum Maximum Inside Braking Surface Markings

A rear brake hose should be installed so that it does not touch adjacent chassis parts or body. The white stripe on the hose should show no evidence of twisting. On rear drum brake vehicles, position the hose junction block on the axle and attach with a bolt and lockwasher. Connect the rear brake tubes to the junction block. On rear disc brake vehicles, attach the hoses to the calipers. Engage the front end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

SPECIAL SERVICE TOOLS

Tool No.	Description	Tool No.	Description
Rotunda 21-0001	Brake Pedal Effort Gauge	T71P-1102-A	Ball and Bar Gauge
Rotunda 21-0014	Vacuum Tester	Rotunda 10-0010	Brake Drum Micrometer
Rotunda 10-0011	Diaphragm Type Bleeder	Rotunda 54-0021	Disc Brake Lathe
Tool-4201-C	Universal Dial Indicator and Bracket	Milbar 1112-144	Inch Pound Torque Wrench

CH1860-2C

SPECIFICATIONS

BRAKE HYDRAULIC SYSTEM TORQUE LIMITS – FT. LBS.

		Fairmont, Zephyr	Ford-Mercury	LTD II, Thunderbird, Cougar, Granada, Monarch, Versailles	Mustang II Pinto-Bobcat	Continental Mark V	Lincoln Continental
Master Cylinder to Dash Panel Screw		13-25	13-25	13-25	13-25		
Master Cylinder to Booster		13-25	13-25	13-25	13-25	13-25	13-25
Booster to Dash Panel		13-25	13-25	13-25	13-25	13-25	13-25
Pressure Differential Valve Bracket Bolts and Nuts		7-11	7-11	7-11	7-11	7-11	7-11
Wheel Cylinder Bleeder Screw		7.5-15 ②	7.5-15	7.5-15	110-160 in-lb	7.5-15	7.5-15
Caliper Bleeder Screw		6-15	6-15	6-15	6-15	6-15	6-15
Brake Hose Connection to Caliper			20-30	20-30	20-30	20-30	20-30
Brake Line Connection to Rear Axle Housing:	Removable Carrier	–	30-40	25-35	12-19	30-40	30-40
	Integral Type	12-19	25-33	12-19	12-19		
Hydraulic Tube Connections ①							
	3/8 x 24	10-18	10-18	10-18	10-18	10-18	10-18
	7/16 x 24	10-18	10-18	10-18	10-18	10-18	10-18
	1/2 x 20	10-18	10-18	10-18	10-18	10-18	10-18
	9/16 x 18	10-18	10-18	10-18	10-18	10-18	10-18
Brake Pedal Pivot Shaft Nut		15-25	15-25	15-25	15-25	15-25	15-25

① All hydraulic lines must be tightened to the specific torque value and be free of fluid leakage.
② Sedans – 32-65 in-lb.

CH2289-2D

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BRAKE BOOSTER APPLICATIONS

Booster Type and Size	Car Line(s)	Comments
Vacuum – 7.5" Diameter Tandem Diaphragm	Pinto/Bobcat	R.P.O.
	Mustang II	Standard for all 5.0L (302 CID) and 2.8L Engines. Standard for 2.3L Engines with any of the following: P/S, A/C, Sun Roof or Locking Axle.
Vacuum – 9.0" Diameter Single Diaphragm	Granada/Monarch/ Versailles	Standard for 5.0L/5.8L (302/351M CID) Engines. R.P.O for 4.1L (250 CID)
Vacuum – 9.0" Diameter	Ford/Mercury Sedan, Police Sedan, LTD II, Cougar, Sta. Wagons	Standard
Vacuum – 11½" Diameter Single Diaphragm	Thunderbird	Standard
	Ranchero, LTD II, Cougar	Standard on Sedans
Hydro-Boost	Lincoln Continental	Standard
	Continental Mark V	Standard
	Ford/Mercury Sedan Granada/Monarch	R.P.O – Required with rear disc brakes.
	Ford/Mercury Sta. Wagon	Standard
Vacuum – 220mm (9" equiv.) Single Diaphragm	Fairmont/Zephyr	Std. on 5.0 Litre (302 CID) R.P.O. all other engines.

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BRAKE CONTROL VALVE USAGE CHART

Brake System			Control Valve Assembly				Valve Fluid Port Dimensions			
			Type and	Pressure		Proportioning	Primary		Secondary	
Front	Rear	Car Line/s	Housing	Differential	Metering	Split/Slope	In	Out (2)	In	Out
Disc	Drum	Pinto (Sedan), Mustang II, Bobcat	2 Way Brass	X	–	300/.28	3/8	3/8	7/16	3/8
Disc	Drum	Pinto (Station Wagon), Bobcat	2 Way Brass	X	–	300/.43	3/8	3/8	7/16	7/16
Disc	Drum	LTD II, Thunderbird, Cougar	3 Way	X	X	400/.43	1/2	3/8	3/8	9/16
Disc	Drum	Ford/Mercury (Station Wagon), Police (Station Wagon) and Lincoln	Cast Iron			500/.58	7/16	3/8	3/8	9/16
Disc	Drum	Ford/Mercury, Police Sedan	3 Way Cast Iron	X	X	400/.58	1/2	3/8	7/16	9/16
Disc	Disc	Ford/Mercury Sedan, Lincoln and Mark V	2 Way Cast Iron	X	–	300/.43	1/2	3/8	7/16	5/8
Disc	Disc	Ford/Mercury (Station Wagon)	2 Way Cast Iron	X	–	500/.58	7/16	3/8	3/8	5/8
Disc	Disc	Granada/Monarch/Versailles	2 Way Brass	X	–	300/.43	3/8	3/8	3/8	3/8
Disc	Drum	Fairmont/Zephyr Sedan	2-Way Alum.	X		300/.43	3/8	3/8	7/16	7/16
Disc	Drum	Fairmont/Zephyr Sta. Wagon	2-Way Brass	X		400/.43	3/8	3/8	7/16	3/8

CH2307-2E

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BRAKE CONTROL VALVE MOUNTING TORQUES

SIZE	FT-LB
5/16 – 18 Nut	7-11
1 5/16 – 18 J-Lock Bolt	12-20
1 When bolts are removed or turned in either direction after 30 minutes of installation, they must be replaced with new bolts.	

CH2308-2A

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Drum Brakes — Single Cylinder, Dual Piston

PART 12-02

Applies To All Cars Except Lincoln Versailles and Continental Mark V

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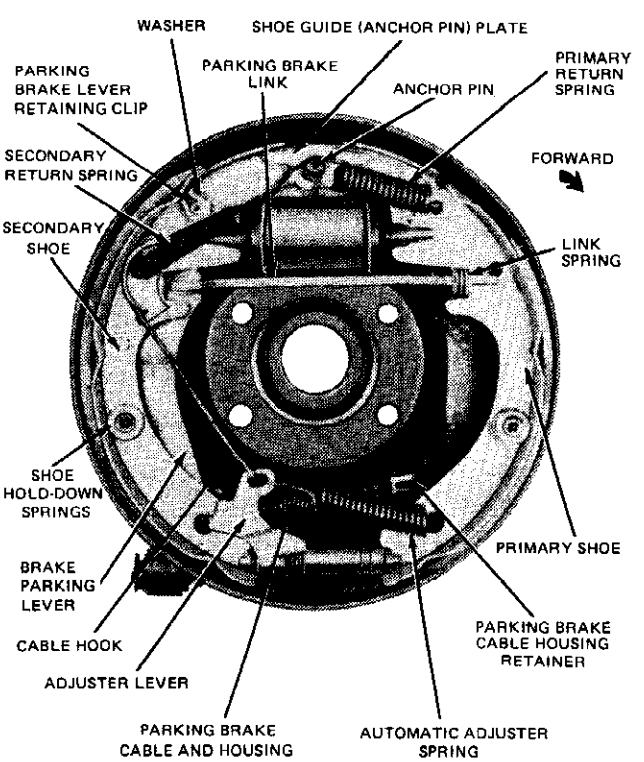
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DESCRIPTION

DUAL BRAKE SYSTEM

The rear wheel drum brake system employs single anchor, internal expanding, and self-adjusting brake assemblies.

The self-adjusting brake mechanism consists of a cable, cable guide, adjusting lever, adjusting screw assembly, and adjuster spring (Figs. 1 and 2). The cable is hooked over the anchor pin at the top, and is connected to the lever at the bottom. The cable is routed along the web of the secondary brake shoe by the cable guide. The adjuster spring is hooked to the primary brake shoe and to the lever. The automatic adjuster is actuated only when the brakes are applied while the vehicle is moving rearward, and only when the secondary shoe is free to move toward the drum beyond a predetermined point.



H1649-1E

FIG. 1 Self-Adjusting Drum Brake Assemblies—Typical

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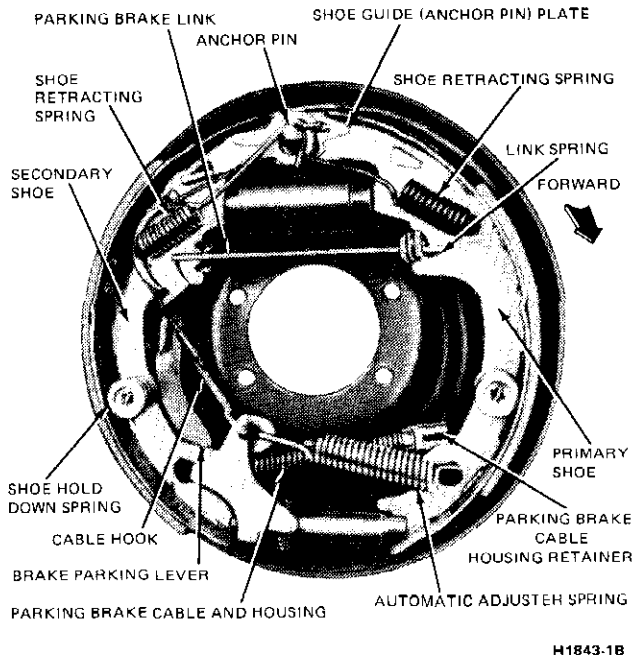


FIG. 2 Self-Adjusting Drum Brake Assembly Pinto, Bobcat and Mustang

ADJUSTMENTS

BRAKE SHOES

After any brake service work, obtain a firm brake pedal before moving the vehicle. Adjusted brakes must not drag; wheels must turn freely.

The hydraulic drum brakes are self-adjusting and require a manual adjustment only after the brake shoes have been relined, replaced, or when the length of the adjusting screw has been changed while performing some other service operation. The manual adjustment is performed with the drums removed, using the tool and the procedure detailed below.

When adjusting the rear brake shoes, check the parking brake cables for proper adjustment. Make sure that the equalizer operates freely with the shoes centered on the backing plate.

Make sure that the upper ends of the brake shoes are seated on the anchor pin. The parking brake link should have 0.005 to 0.025 inch end play after overcoming the load of the parking brake link anti-rattle spring.

To adjust the brake shoes:

1. Determine the inside diameter of the drum braking surface, using Rotunda Tool 11-0001 or equivalent (Fig. 3).
2. Adjust the brake shoe diameter to fit the gauge, as indicated in Fig. 3. Hold the automatic adjusting lever out of engagement while rotating the adjusting screw, to prevent burring the screw slots. Make sure the adjusting screw rotates freely. If necessary, lubricate the screw threads with a thin, uniform coating of lubricant C1AZ-19590-B or equivalent.

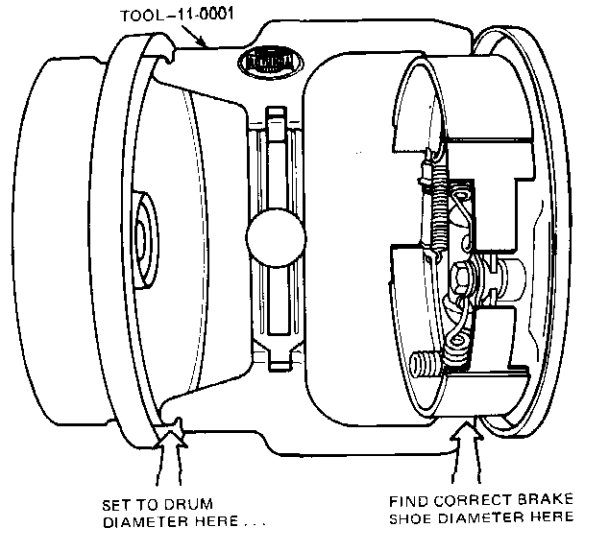


FIG. 3 Adjusting Brake Shoes Using Tool 11-0001

3. Rotate Tool 11-0001 or equivalent around the brake shoes to be sure of the setting.
4. Apply a small quantity of high temperature grease C0AZ-19553-A or equivalent to the points where the shoes contact the backing plate,

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being careful not to get the lubricant on the linings.

5. Install the drums. Install the drum retaining nuts and tighten securely.
6. Install the wheels on the drums and tighten the nuts to specification.
7. Complete the adjustment by applying the brakes several times with a minimum of 50 lbs. pressure on the pedal (non-power brakes) or 25 lbs. pressure (power brakes) while backing the vehicle. After each stop, the vehicle must be moved forward.
8. After the brake shoes have been properly adjusted, check the operation of the brakes by making several stops from varying forward speeds.

REMOVAL AND INSTALLATION

BRAKE DRUMS

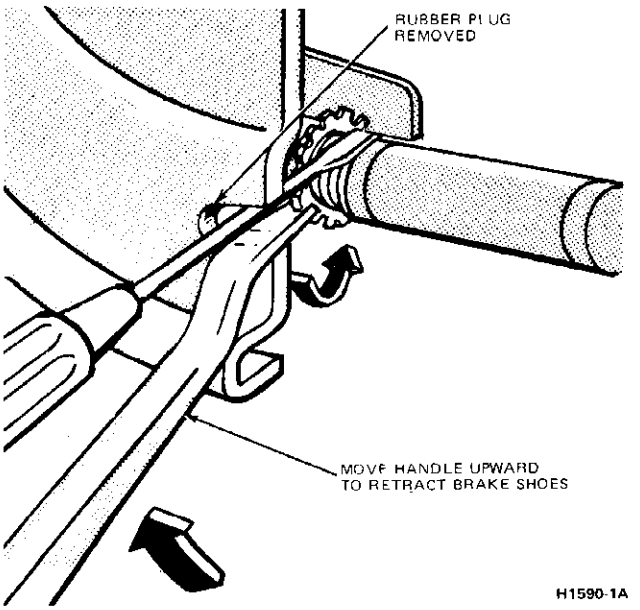


FIG. 4 Backing Off Brake Adjustment

Removal—Rear

1. Raise the vehicle so that the tire is clear of the floor.
2. Remove the wheel cover and wheel.
3. Remove the three drum retainer nuts and remove the brake drum. If the drum will not come off, pry the rubber plug from the backing plate. Insert a narrow screwdriver through the hole in the backing plate, and disengage the adjusting lever from the adjusting screw (Fig. 4).

   While holding the adjustment lever away from the screw, back off the adjusting screw with the brake adjusting tool (Fig. 4).

Be very careful not to burr, chip, or damage the notches in the adjusting screw; otherwise the self-adjusting mechanism will not function properly.

Installation—Rear

1. Remove the protective coating from a new drum with carburetor degreaser. Sand drum lightly and wipe with a cloth soaked with denatured alcohol.
2. Adjust the brakes as outlined under Brake Shoe Adjustments. Place the drum over the brake assembly and into position.
3. Install the three drum retainer nuts and tighten securely. Install the wheel on the axle shaft flange studs against the drum, and tighten the attaching nuts to specification. Install wheel cover.

BRAKE SHOES

Removal

1. With the wheel and drum removed, install a clamp over the ends of the brake cylinder as shown in Fig. 5.

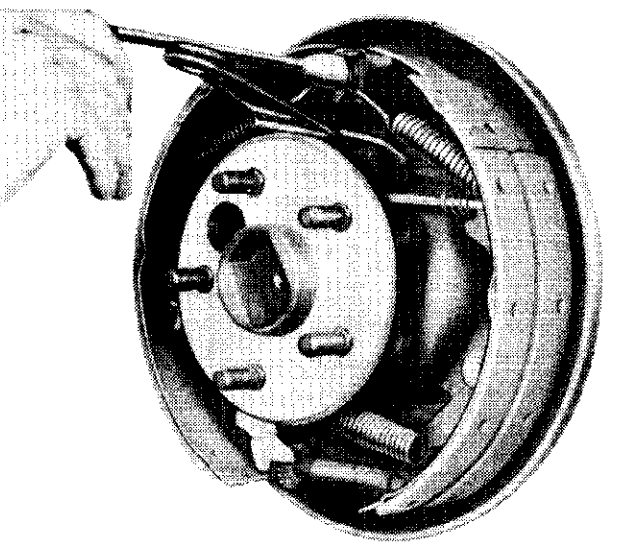


FIG. 5 Retracting Spring Removal

2. Remove the shoe-to-anchor springs, with the tool shown in Fig. 5, and unhook the cable eye from the anchor pin.
3. Remove the shoe guide (anchor pin) plate (Figs. 1 and 2).
4. Remove the shoe hold-down springs, shoes, adjusting screw, pivot nut, socket and automatic adjustment parts.
5. Remove the parking brake link, spring and retainer. Disconnect the parking brake cable from the parking brake lever.
6. After removing the rear brake secondary shoe, disassemble the parking brake lever from the shoe by removing the retaining clip and spring washer (Figs. 1 and 2).

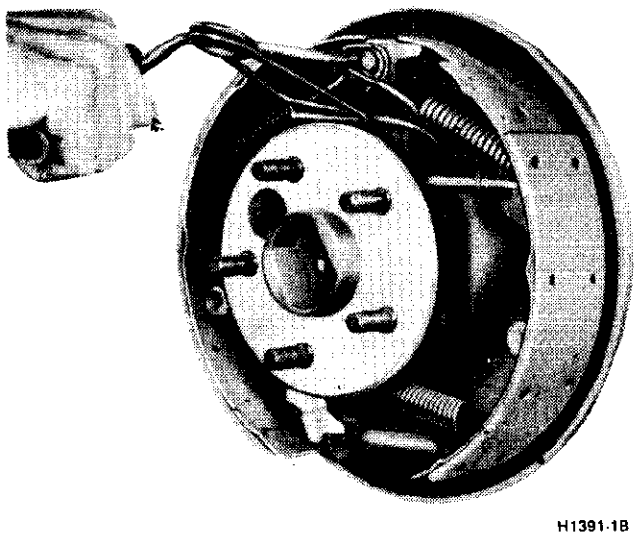
Installation

1. Before installing the rear brake shoes, assemble the parking brake lever to the secondary shoe and secure with the spring washer and retaining clip

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(Figs. 1 and 2). A tang on the parking brake lever engages the secondary shoe on 9-inch brakes.

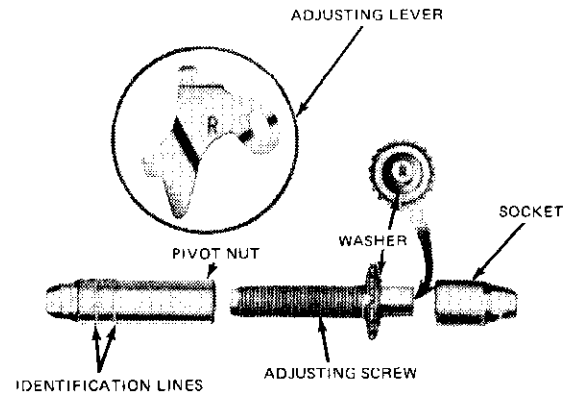
2. Apply a light coating of high temperature grease C0AZ-19553-A or equivalent at the points where the brake shoes contact the backing plate.
3. Position the brake shoes on the backing plate. The primary shoe with the short lining faces toward the front of the car. The secondary shoe (long lining) faces rearward. Secure the assembly with the hold down springs. Install the parking brake link, spring and retainer. Back off the parking brake adjustment; then, connect the parking brake cable to the parking brake lever (Figs. 1 and 2).
4. Install the shoe guide (anchor pin) plate on the anchor pin.
5. Place the cable eye over the anchor pin with the crimped side toward the drum.
6. Install the primary shoe to anchor spring. See Fig. 6.



H1391-1B

FIG. 6 Retracting Spring Installation

7. Install the cable guide on the secondary shoe web with the flanged hole fitted into the hole in the secondary shoe web. Thread the cable around the cable guide groove (Figs. 1 and 2). **It is imperative that the cable be positioned in this groove and not between the guide and the shoe web.**
8. Install the secondary shoe-to-anchor spring with the tool shown in Fig. 6. **Be certain that the cable eye is not cocked or binding on the anchor pin when installed. All parts should be flat on the anchor pin.**
9. Remove the brake cylinder clamp after both shoe-to-anchor springs have been installed.
10. Apply a thin, uniform coat of lubricant (C1AZ-19590-B or equivalent) to the threads and the socket end of the adjusting screw. Turn the adjusting screw into the adjusting pivot nut (Figs. 1 and 2) to the limit of the threads and then back off 1/2 turn. **Interchanging the brake shoe adjusting screw assemblies from one side of the vehicle to the other would cause the brake shoes to retract rather than expand each time the automatic adjusting mechanism operated. To prevent installation on the wrong side of the vehicle, the socket end of the adjusting screw is stamped with an R or L (Fig. 7).**



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FIG. 7 Adjusting Screw and Lever Identification

11. Place the adjusting socket on the screw and install this assembly between the shoe ends with the adjusting screw toothed wheel nearest the secondary shoe.
12. Hook the cable hook into the hole in the adjusting lever. The adjusting levers are stamped with an R or L to indicate their installation on right or left brake assembly (Fig. 7).
13. Position the hooked end of the adjuster spring completely into the large hole in the primary shoe web. Connect the loop end of the spring to the adjuster lever hole.
14. Pull the adjuster lever, cable and automatic adjuster spring down and toward the rear to engage the pivot hook in the large hole in the secondary shoe web (Figs. 1 and 2).
15. After installation, check the action of the adjuster by pulling the cable between the cable guide and the adjuster lever, toward the secondary shoe web, far enough to lift the lever past a tooth on the adjusting screw wheel. The lever should snap into position behind the next tooth, and release of the cable should cause the adjuster spring to return the lever to its original position. This return action of the lever will turn the adjusting screw one tooth.

    If pulling the cable does not produce the action described, or if the lever action is sluggish instead of positive and sharp, check the position of the lever on the adjusting screw toothed wheel (Fig. 4).

    With the brake in a vertical position (anchor at the top), the lever should contact the adjusting wheel 3/16 inch (plus or minus 1/32 inch) above the centerline of the screw. If the contact point is below this centerline, the lever will not lock on the teeth in the adjusting screw wheel, and the screw will not be turned.

    To determine the cause of this condition:

    a. Check to be sure that the upper or anchor pin end of the cable is pulled toward the shoe guide as far

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DETROIT IRON

as possible and that the end fitting is pointing toward the shoe guide.

b. Check the cable end fittings. The cable should completely fill or extend slightly beyond the crimped section of the fittings. If it does not meet this specification, possible damage is indicated and the cable assembly should be replaced.

c. Check the cable length. Measure from the inside edge of the hook to the far edge of the anchor hole. The cable length for 11-inch brakes is 11-1/8 inches. For 10-inch brakes it is 9-3/4 inches. For 9-inch brakes, the length is 8-7/16 inches. The tolerance on cable length is plus or minus 1/64 inch.

d. Check the cable guide for damage. The cable groove should be parallel to the shoe web, and the body of the guide should lie flat against the web. Replace the guide if it shows damage.

e. Check the pivot hook on the lever. The hook surfaces should be square with the body of the lever for proper pivoting. Replace the lever if the hook shows damage.

f. See that the adjusting screw socket is properly seated in the notch in the shoe web.

16. Be sure that the upper ends of the brake shoes are seated against the anchor pin and that the shoes are centered on the backing plate. If they are not seated, back off the parking brake system adjustment to obtain 0.005-0.025 inch play after overcoming the load of the parking brake link spring.

WHEEL CYLINDER

Removal

1. Remove the wheel and the drum.
2. Remove the brake shoe assemblies, following procedures outlined in this Part.
3. Disconnect the brake tube from the brake cylinder at the backing plate. The tube will separate from the cylinder when the cylinder is removed from the backing plate.
4. Remove the wheel cylinder attaching bolts and lock washers and remove the cylinder.

Installation

Wipe the end(s) of the hydraulic line to remove any foreign matter before making connections.

1. Position the cylinder on the backing plate and finger tighten the brake tube to the cylinder.
2. Secure the cylinder to the backing plate by installing the attaching bolts and lock washers. Torque bolts to specification.
3. Tighten the tube fitting nut to specification with Tool 1112-144 (Tube Nut Wrench).
4. Install the links (10 and 11-inch brakes) in the ends of the wheel cylinder and install the shoes and adjuster assemblies.
5. Adjust the brakes as described in this Part. Install the brake drum and wheel. Bleed the brakes.

BRAKE BACKING PLATE

Removal

1. Remove the wheel and brake drum. Disconnect the brake line from the brake cylinder.
2. Remove the brake shoes adjuster assemblies and the wheel cylinder as outlined in this section.
3. Refer to Group 15 for procedure and remove the axle shaft.
4. Remove the backing plate.

Installation

1. The rear backing plate is mounted on the axle housing flange with four bolts. Torque to specification.
2. Refer to Group 15 for procedure and install the rear axle shaft, seal, if required, and the new backing plate.
3. Install the wheel cylinder and connect the brake line as indicated in preceding Steps.
4. Install the brake shoes adjuster assemblies as outlined in this Part. Connect the parking brake cable to the lever.
5. Adjust the brake shoes as outlined, and install the brake drums and wheels. Bleed the brake system and centralize the differential valve as outlined in Part 12-01.

DUAL MASTER CYLINDER

Refer to Part 12-01 for Removal and Installation of Dual Master Cylinder.

PRESSURE DIFFERENTIAL, METERING, AND PROPORTIONING VALVES

Refer to Part 12-01 for Description, Removal and Installation of Pressure Differential, Metering, and Proportioning Valves.

BRAKE PEDAL

Refer to Part 12-01 for Removal and Installation of Brake Pedal.

OVERHAUL

BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with sandpaper. Do not refinish drums to remove score marks. A drum surface which is highly polished can cause the brake to lock-up. This polished condition should be removed either with sandpaper or by refinishing the drum. A drum that is out of round sufficient to cause vehicle vibration when braking should be refinished. Remove only enough stock to true up the drum. Brake drum maximum inside diameter is shown on each drum (Part 12-01). If the maximum inside

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diameter shown on the drum is exceeded either through wear or refinishing, the drum must be replaced.

Check the inside diameter of the brake drum with a brake drum micrometer (Tool 10-0010).

After a drum is refinished, wipe the refinished surface with a cloth soaked in clean denatured alcohol. If one drum is refinished, the opposite drum on the same axle should also be refinished to the same diameter.

BRAKE SHOES

Relining

Brake linings that are worn to within 1/32 inch of a rivet head or have been contaminated with brake fluid, grease or oil must be replaced. Failure to replace worn linings will result in a scored drum. **When it is necessary to replace linings, they must also be replaced on the wheel on the opposite side of the vehicle. Inspect brake shoes for distortion, cracks, or looseness. If this condition exists, the shoe must be discarded. Do not attempt to repair a damaged brake shoe.**

1. Wash the brake shoes thoroughly in a clean solvent. Dry thoroughly. Remove all burrs or rough spots from the shoes.
2. Check the inside diameter of the brake drum with a brake drum micrometer (Tool 10-0010).
3. Position the new lining on the shoe. Starting in the center, insert and secure the rivets, working alternately towards each end. **Replacement linings are ground and no further grinding is required.**
4. Check the clearance between the shoe and lining. The lining must seat tightly against the shoe with not more than 0.008 inch clearance between any two rivets.

WHEEL CYLINDERS

Wheel cylinders should not be disassembled unless they are leaking. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive fluid at this point indicates leakage past piston cups and a need for wheel cylinder overhaul. **NOTE: A slight amount of fluid is nearly always present and acts as a lubricant for the piston.** It is not necessary to remove the brake cylinder from the backing plate to disassemble, inspect, or hone and overhaul the cylinder. Removal is necessary only if the cylinder is damaged or scored beyond repair.

Disassembly

1. Remove the links (10 and 11-inch brakes) and the rubber boots from the ends of the brake cylinder. Remove the pistons, cups, and return spring and expander assembly from the cylinder bore (Fig. 8).
2. Remove the bleeder screw from the cylinder.
3. Discard all rubber parts and wash all other parts in clean denatured alcohol.
4. Inspect piston for scratches, scoring or other visible damage. Replace if necessary. Always replace the rubber cups and dust boots.
5. Inspect the cylinder bore for score marks or rust. If either condition is present, the cylinder bore must be honed. **However, the cylinder should not be honed more than 0.003 inch beyond its original diameter.**
6. Wash the cylinder with clean denatured alcohol after honing and dry it with compressed air.
7. Check the bleeder hole to be sure that it is open.

Assembly

Use all parts in the wheel cylinder repair kit.

1. Apply a light coating of heavy duty brake fluid to all internal parts.
2. Thread the bleeder screw into the cylinder and tighten securely.
3. Insert the return spring and expander assembly, cups, and pistons into their respective positions in the cylinder bore (Fig. 8). Place a boot over each end of the cylinder.

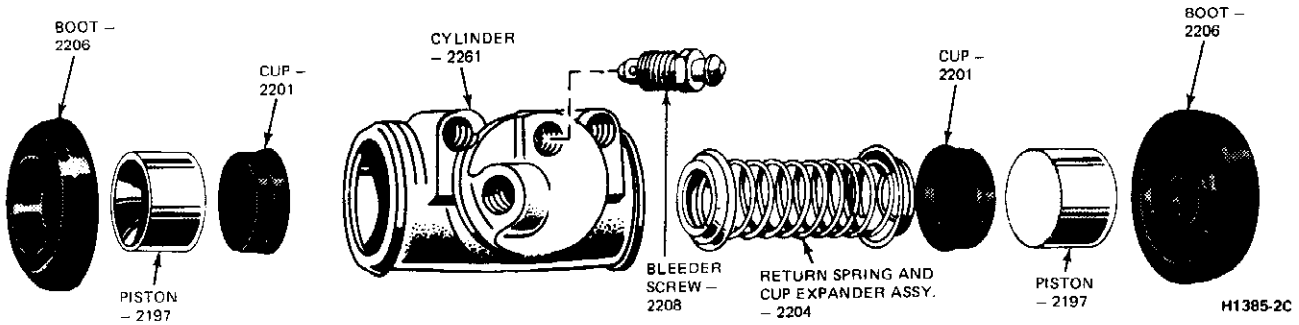


FIG. 8 Brake Wheel Cylinder—Typical

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SPECIFICATIONS AND SPECIAL TOOLS

DRUM BRAKE LINING DIMENSIONS (INCHES)

FORD-MERCURY

MODELS	POSITION	COLOR CODE	BRAKE SIZE	LINING SIZE	
				FRONT	REAR
All Ford, Mercury, Station Wagons and Sedans (includes Police)	Primary	Black-Black	11	N/A	2.50 x 9.38
	Secondary	Blue-Blue	11	N/A	2.50 x 12.12
LTD II, COUGAR AND THUNDERBIRD					
All Sedans and Rancheros	Primary	Black-Black	11	N/A	2.25 x 9.38
	Secondary	Blue-Blue	11	N/A	2.25 x 12.12
Taxi and Police Sedans	Primary	Black-Black	11	N/A	2.50 x 9.38
	Secondary	Blue-Blue	11	N/A	2.50 x 12.12
PINTO-MUSTANG-BOBCAT					
All Models	Primary	Black-Black	9	N/A	1.75 x 6.12
	Secondary	Blue-Blue	9	N/A	1.75 x 8.63
FAIRMOUNT–ZEPHYR					
Fairmont/Zephyr - Sedans	Primary	Red	9	N/A	1.75 x 6.12
	Secondary	White	9	N/A	1.75 x 8.63
Fairmont/Zephyr Station Wagons	Primary	Black-Black	10	N/A	1.75 x 8.55
	Secondary	Blue-Blue	10	N/A	1.75 x 10.45
GRANADA-MONARCH					
All Models	Primary	Black-Black	10	N/A	2.00 x 8.55
	Secondary	Blue-Blue	10	N/A	2.00 x 10.45
LINCOLN CONTINENTAL					
All Models	Primary	Black-Black	11	N/A	2.50 x 9.38
	Secondary	Blue-Blue	11	N/A	2.50 x 12.12
THUNDERBIRD					
All Models	Primary	Black-Black	11	N/A	2.50 x 9.38
	Secondary	Blue-Blue	11	N/A	2.50 x 12.12

CH2054-2J

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BORE DIAMETERS – BRAKE DRUM, WHEEL CYLINDER AND MASTER CYLINDER

Car Line	Models	Brake Drum		Wheel Cylinder Bore Diameter		Master Cylinder Bore Diameter	
		Inside Diameter	Boring Limit (Max.) ①	Front ②	Rear ②	With Power Brake	Less Power Brake
Ford, Mercury	All	11.030	11.090	N/A	1.000	1.000	–
LTD II, Thunderbird, and Cougar	Sedan exc. Police and Taxi	11.030	11.090	N/A	0.9375	1.000	1.000
LTD II, Cougar	Police and Taxi	11.030	11.090	N/A	1.000	1.000	1.000
Pinto, Bobcat, Mustang	All	9.000	9.060	N/A	0.875	0.938	0.938
Fairmont, Zephyr	Sedans	9.000	9.060	N/A	0.8125	0.875	0.875
	Station Wagons	10.000	10.060	N/A	0.8125	0.875	0.875
Granada, Monarch	All	10.000	10.060	N/A	0.9375	0.938	0.938
Lincoln Continental	All	11.030	11.090	N/A	1.000	1.000	–

① Max. Runout 0.007 ② Max. Allowable Hone 0.003

CH1864-2L

DRUM BRAKE TORQUE LIMITS – FT-LBS

	Ford, Mercury	LTD II, Cougar, Granada, Monarch	Fairmont, Zephyr		Mustang, Bobcat, Pinto	Thunderbird	Lincoln Continental
			Sedan	Sta. Wgn.			
Wheel Cylinder to Backing Plate Screws	10-20	10-20	110-160 (In-Lbs)	10-20	110-160 (In-Lbs)	10-20	10-20
Rear Brake Backing Plate to Axle Housing – Removable Carrier	50-75	20-40	–	–	20-40	20-40	50-75
Rear Brake Backing Plate to Axle Housing – Integral Type	20-40	20-40	20-40	20-40	20-40	20-40	
Wheel Cylinder Bleeder Screw	7.5-15	7.5-15	32-65 (In-Lbs)	7.5-15	32-65 (In-Lbs)	7.5-15	7.5-15
Wheel to Hub and Drum	70-115	70-115	70-115	70-115	70-115	70-115	70-115

SERVICE TOOLS

Tool No.	Description	Tool No.	Description
Rotunda 11-0001	Brake Adjusting Gage	Tool 7000-DE	Rubber Tipped Air Nozzle
BL-41-A (Snap-on)	Brake Cylinder Retaining Clamp	Tool 33621	Internal Snap Ring Pliers
B3404-B (Snap-on)	Brake Adjusting Tool	Milbar 1112-144	Tube Nut Wrench
2162	Adapter Cap		Inch Pound Torque Wrench
BT-11 (Snap-on)	Brake Shoe R & R Spring	Rotunda 10-0010	Axle Shaft Remover Brake Drum Micrometer

CH1865-2H

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Disc Brakes—Single Piston—Sliding Caliper

PART 12-20

Applies to All Models

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SUBJECT	PAGE
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CH2557-2B

DESCRIPTION

ALL CARS EXCEPT FAIRMONT/ZEPHYR

Front disc brakes are standard on all models. Drum brakes are used on the rear wheels of most models.

Rear disc brakes are standard on Continental Mark V and Versailles, optional on Lincoln Continental, Ford, Mercury, Granada and Monarch.

The disc brake consists of a ventilated rotor and sliding caliper assembly (Fig. 1).

SLIDING CALIPER ASSEMBLY FRONT

The caliper assembly is made up of a sliding caliper housing assembly and an anchor plate (Fig. 2).

The anchor plate is bolted to the wheel spindle by two bolts. Two angular machined surfaces on the upper end of the caliper housing contact the mating machine surfaces of the anchor plate. A plated steel key and a caliper support spring are fitted between the angular machined surfaces of the lower end of the caliper and the machined surface of the anchor plate. The caliper is held in position against the mating surfaces of the anchor plate by means of the caliper support spring. A brake shoe anti-rattle spring clip is provided on the lower end of the inner brake shoe and lining assembly. The brake linings are riveted to the brake shoes and insulator gaskets are bonded to the back of each brake shoe. The inner and outer brake shoe and lining assemblies are not interchangeable.

NOTE: Brake friction materials inherently generate noise and heat in order to dissipate energy. As a result, occasional squeal is normal, and is aggravated by severe environmental conditions such as cold, hot, wet, snow, salt, mud, etc.

The sliding caliper contains a single cylinder and a piston with a molded rubber dust boot to seal the cylinder bore from contamination. A square section rubber piston seal is positioned in a groove in the cylinder bore to provide sealing between the cylinder and the piston.

ROTOR—FRONT

The cast iron disc is of the ventilated rotor-type, incorporating non-directional cooling fins, and is integral with the wheel hub. A splash shield bolted to the spindle is used to prevent road contaminants from contacting the inboard rotor surface and to direct cool

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air to the brakes. The wheel provides protection for the outboard surface of the rotor.

FAIRMONT AND ZEPHYR FRONT DISC BRAKE (SEE FIG. 3)

CALIPER ASSEMBLY

The caliper assembly consists of a pin slider caliper housing, inner and outer shoe and lining assemblies and a single piston. The caliper assembly slides on two locating pins which also act as the attaching bolts between the caliper and the combination anchor plate and spindle.

The caliper housing contains a single piston similar to those used on existing disc brake calipers. The piston has a molded rubber dust boot on its outer end that attaches to a cylinder bore groove for prevention of contamination in the cylinder. There is also a rectangular section rubber piston seal located in the cylinder bore to provide sealing between the cylinder and piston (See Fig. 3).

The outer brake shoe and lining assembly is longer than the inner shoe and lining assembly. Both inner and outer shoe lining assemblies are attached to the caliper by spring clips riveted to the shoe surfaces. The inner shoe is attached to the caliper by installing the spring clip to the inside of the caliper piston. The outer shoe clips directly to the caliper housing (See Fig. 11). A metal wear indicator is attached to the outer shoe and lining assembly. This indicator emits a noise when the lining is worn to a point where replacement is necessary. The inner and outer shoes are right and left hand and must not be interchanged. Two rubber insulators with plastic inner sleeves are installed in the caliper attaching holes. The insulators and sleeves prevent metal-to-metal contact between the locating pins and the caliper.

ANCHOR PLATE

The anchor plate design for Fairmont/Zephyr vehicles is an all new design in that it is an integral part of the spindle. This combination spindle and anchor plate bolts to the modified MacPherson strut. The

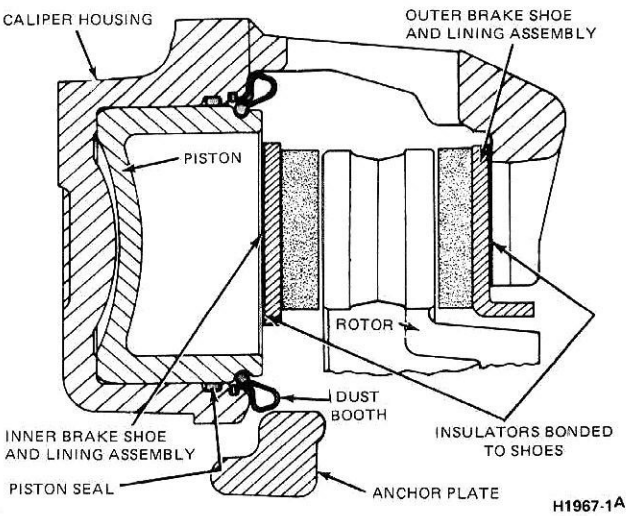


FIG. 2 Sliding Caliper Assembly Sectional View Front—All Models except Fairmont/ Zephyr

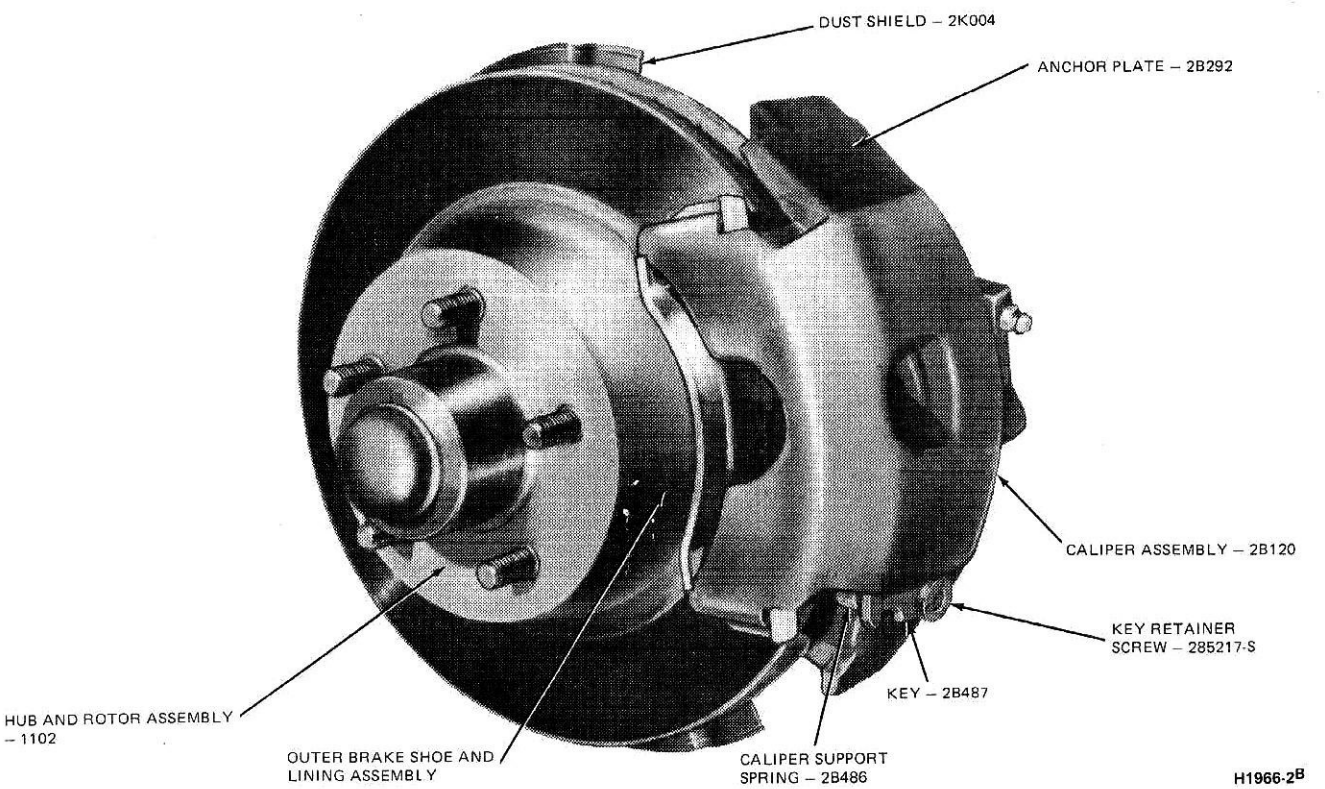
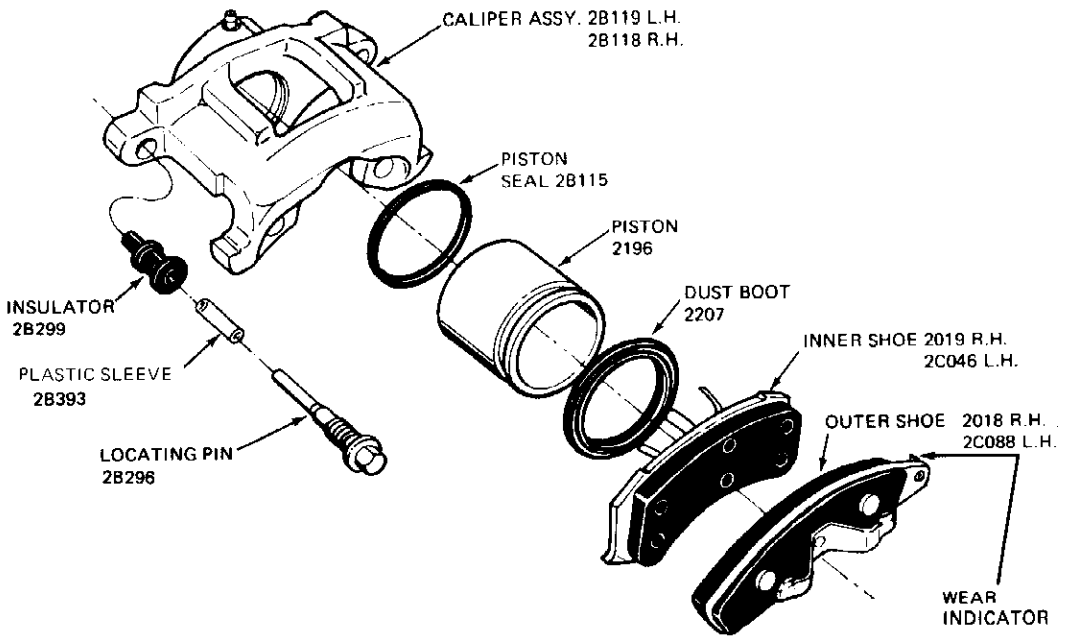
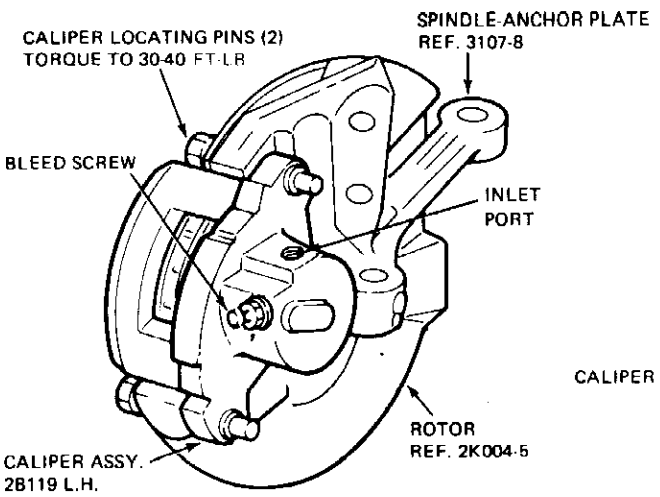


FIG. 1 Disc Brake Assembly—Front—Except Fairmont/Zephyr

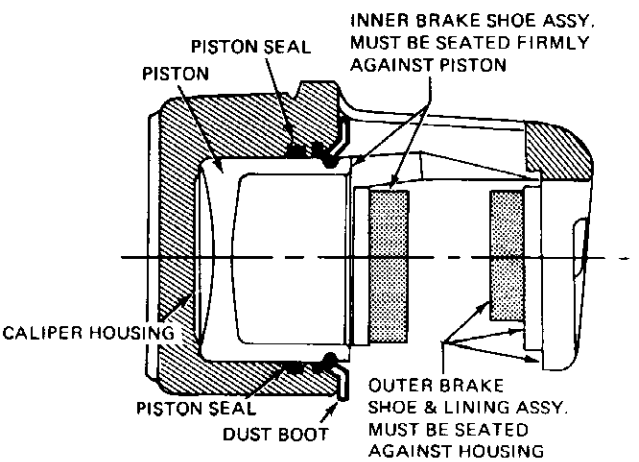
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PIN SLIDER CALIPER ASSEMBLY – DISASSEMBLED
R.H. SIDE SHOWN



CALIPER ASSEMBLY INSTALLED
L.H. SIDE SHOWN



CALIPER SECTIONAL VIEW (TYPICAL)

H2579-2A

FIG. 3 Component Parts—Pin Slider Caliper—Fairmont/Zephyr

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spindles are right or left hand and not interchangeable (see Fig. 12).

ROTOR AND SPLASH SHIELD

The rotor is a cast iron disc design, similar to existing designs, which attaches to the combination spindle/anchor plate in the same manner as existing front disc rotors. The splash shield is new, but retains the design similarities of existing shields. Attachment of the shield to the spindle is accomplished using three bolts as on current installations.

REAR DISC BRAKES

A hydraulically-powered brake booster provides the power assist for the four-wheel disc brake system.

A dual master cylinder attaches to, and is actuated by, the hydraulic booster. A two-way pressure control valve provides balanced braking action between the front and rear brakes.

Except for the parking brake mechanism, the rear caliper assembly is basically similar to the large size front brake caliper in present use. The added parking brake lever on the back of the caliper is cable-operated by the parking brake pedal located below the instrument panel, similar to rear drum brake installations. The parking brake is self-adjusting.

The component parts of the housing assembly are shown in Fig. 4. A square section rubber seal in the cylinder bore groove provides sealing between the housing and the piston. A rubber O-ring seal is positioned in a groove in the thrust screw bore in the housing. A molded lip seal is pressed into the outboard side of the end retainer to prevent entry of water and contaminants between the operating shaft and end retainer. A rubber O-ring on the end retainer prevents entry of water into the caliper through the end retainer threads. The components in the parking brake mechanism cavity in the back of the caliper housing are lubricated with silicone grease.

The parking brake lever is secured to the operating shaft by a nylon-patched screw. When the parking brake is applied, the cable rotates the lever and operating shaft. The three (3) steel balls, located in pockets on the opposing heads of the operating shaft and thrust screw, roll between ramps formed in these ball pockets. The balls force the thrust screw away from the operating shaft, driving the piston and shoe-lining assembly against the rotor and thus creating the braking force.

An automatic adjuster in the piston moves on the thrust screw to compensate for lining wear and maintain proper clearance in the parking brake mechanism.

The caliper is similar in design and function on all car lines, except that the piston and cylinder on the Granada/Monarch/Versailles calipers are smaller than in the large cars. Also, the location of the hose inlet and bleeder ports differ as shown in Fig. 4. On Lincoln Continental, Ford and Mercury, the hose fitting screws into the caliper and points forward, directly over the axle tube. On Continental Mark V vehicles, the hose fitting points almost directly upward and is attached to the caliper by a hollow bolt. On Granada/Monarch/Versailles, the fitting is attached by a hollow bolt and is located by a pin on the fitting which engages a hole in the caliper.

ROTOR—REAR

The rear disc brake rotors (Fig. 5) are cast iron units of ventilated design. Ventilation is provided by curved fins between the braking surfaces, which cause the rotor to act as an air pump. As the rotor fins are designed to take advantage of the forward motion of the vehicle, they are not interchangeable. They are identified by RIGHT or LEFT cast inside the hat section of the rotor.

The rotor attaches to the rear axle flange in the same manner as a rear brake drum. A splash shield (Fig. 6) bolted to the forged axle adapter protects the rotor inboard surface from road splash and contaminants. The wheel protects the outboard surface of the rotor.

REMOVAL AND INSTALLATION

DISC BRAKE CALIPER ASSEMBLY—FRONT—ALL EXCEPT FAIRMONT/ZEPHYR

After any service work, obtain a firm brake pedal before moving the vehicle. Riding the brake pedal (common on left-foot application) must be avoided when driving the vehicle.

Removal

1. Raise the car and install safety stands under the car. Block both rear wheels if a jack is used.
2. Remove the wheel and tire assembly from the hub.
3. Disconnect the flexible brake hose from the caliper. To disconnect the hose, loosen the tube fitting which connects it to the brake tube at its bracket on the frame. Remove the horseshoe-type retaining clip from the hose and bracket, disengage the hose from the bracket; then unscrew the entire hose assembly from the caliper.
4. Remove the retaining screw from the caliper retaining key (Fig. 7-1).
5. Drive the caliper retaining key and support spring either inward or outward from the anchor plate. Use a hammer and drift, if necessary, to remove the key and caliper support spring. Use care to avoid damaging the key and spring (Fig. 7-2 and 7-3).
6. Lift the caliper assembly away from the anchor plate by pushing the caliper downward against the anchor plate, and working the upper end upward and out of the anchor plate (Fig. 7-4).
7. Remove the inner shoe and lining assembly from the anchor plate. The brake shoe anti-rattle clip (inner shoe only) may become displaced at this time and, if so, reposition it on the inner shoe. Tap lightly on the outer shoe and lining assembly to free it from the caliper.
8. Clean the caliper, anchor plate and rotor assemblies and inspect them for signs of brake fluid

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DETROIT IRON

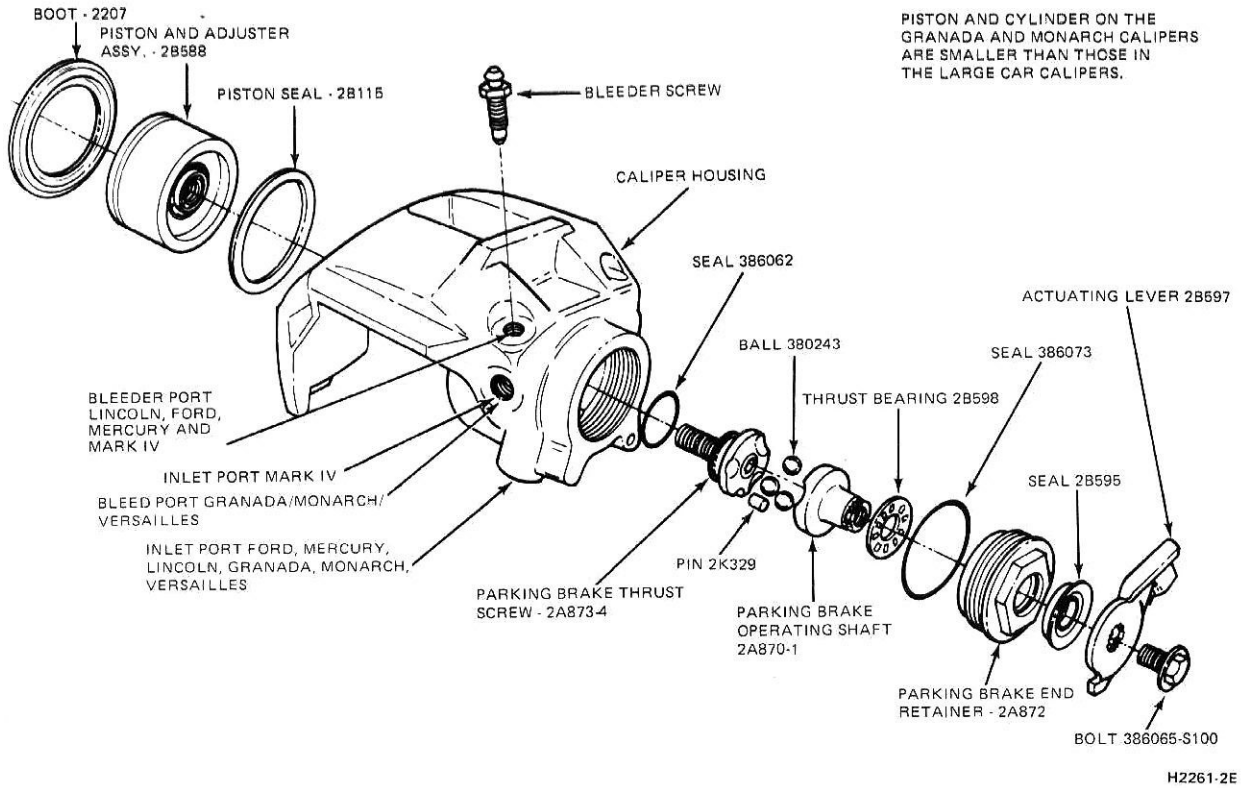


FIG. 4 Rear Disc Brake Housing Assembly

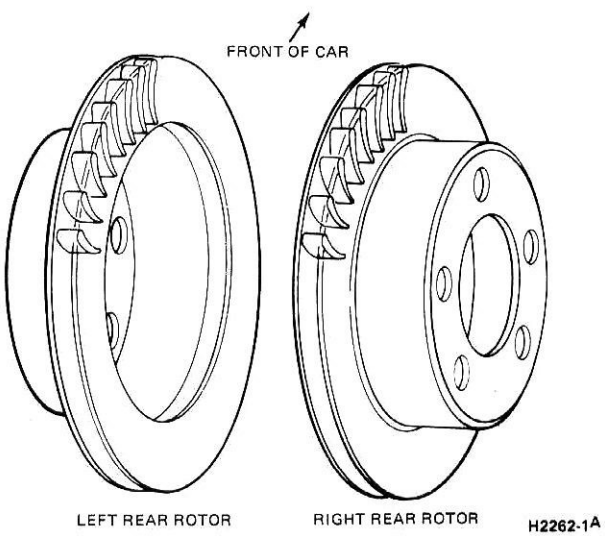


FIG. 5 Rear Disc Brake Rotor Identification

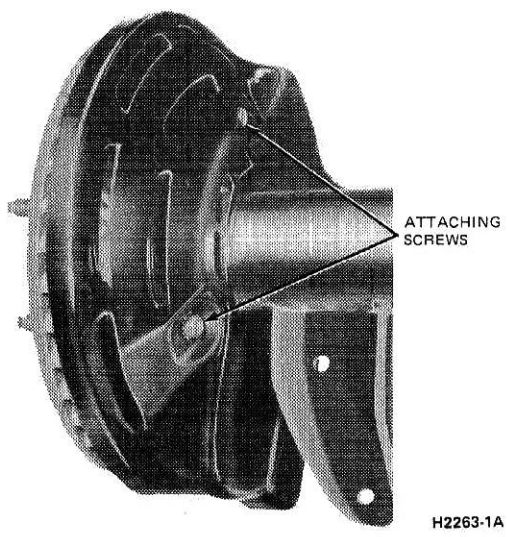


FIG. 6 Rear Disc Brake Rotor Splash Shield—Typical

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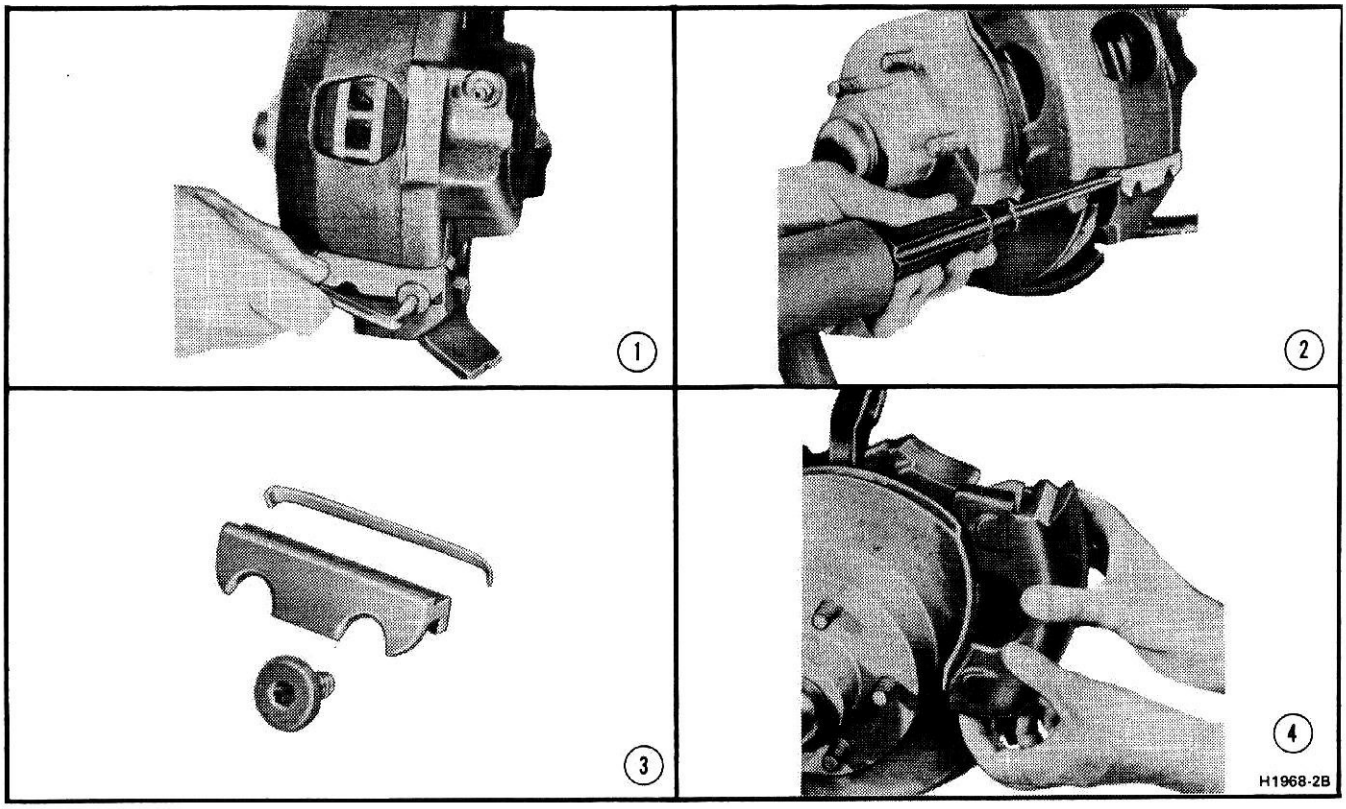


FIG. 7 Removing Front Caliper Assembly—Except Fairmont/Zephyr

leakage, excessive wear or damage. Lightly sand or wire brush any rust or corrosion from the caliper and anchor plate sliding surfaces and the inner brake shoe abutment surfaces. Inspect the brake shoes for wear. If either lining is worn to within 1/8 inch of the shoe surface, both shoe and lining assemblies must be replaced. Also, if shoes and lining are replaced on one wheel, they must be replaced on both wheels in order to maintain equal brake action.

Installation

1. Apply a thin film of (Spec. M1C172-A) grease to the V grooves in the caliper where it slides on the anchor plate (Fig. 8). Use only specified grease because a lower temperature grease may melt out and contaminate pads. Use care not to get grease where pads mount to caliper or anchor plate.
2. If new shoe and lining assemblies are to be installed, use a 4 inch C-clamp and a block of wood 1-3/4 inches x 1 inch and approximately 3/4 inch thick to seat the caliper hydraulic piston in its bore. This must be done to provide clearance for the caliper to fit over inner shoe and rotor when installed.
3. Remove the C-clamp, if used, from the caliper (the caliper piston will remain seated in its bore).
4. Be sure that the brake shoe anti-rattle clip is in place on the lower end of the inner brake shoe with the loop of the clip away from the rotor and the tab section in the shoe slot. Position the inner brake shoe and lining assembly on the anchor plate with the lining toward the rotor (Fig. 8).
5. Install the outer brake shoe with the lower flange ends against the caliper leg abutments and the brake shoe upper flanges over the shoulders on the caliper legs (Fig. 9). The shoe upper flanges fit tightly against the shoulder machined surfaces. If the same brake shoe and lining assemblies are reused, be certain the shoes are installed in their original positions as marked for identification prior to removal.
6. Position the caliper housing lower V-groove on the anchor plate lower abutment surface (Fig. 9, Step 1).

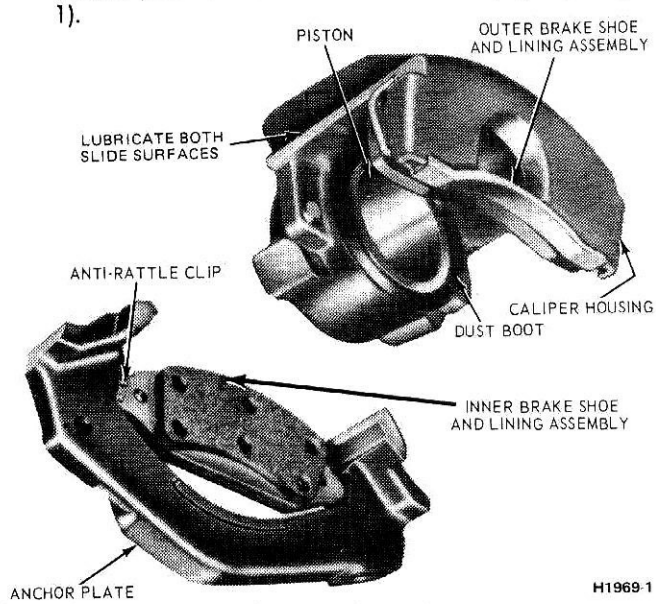


FIG. 8 Caliper and Outer Shoe Removal From Anchor Plate—Except Fairmont/Zephyr

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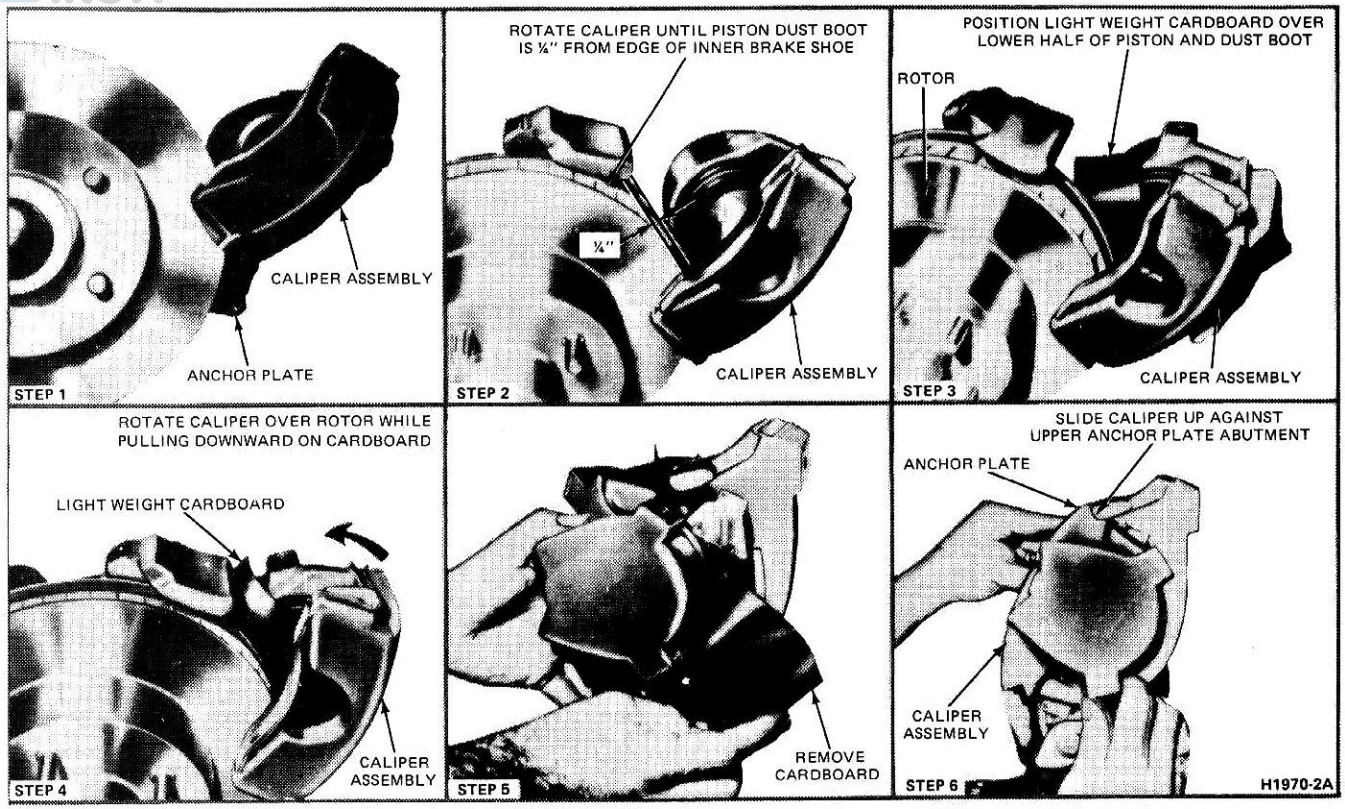


FIG. 9 Installing Front Caliper Assembly—Except Fairmont/Zephyr

7. Pivot the caliper housing upward toward the rotor until the outer edge of the piston dust boot is approximately 1/4 inch from the upper edge of the inboard brake shoe (Fig. 9, Step 2).
8. To prevent pinching the dust boot between the piston and the inboard shoe during caliper installation to the rotor and anchor plate, position clean light-weight cardboard between the inboard brake shoe and over the lower half of the piston dust boot (Fig. 9, Step 3).
9. Rotate the caliper housing toward the rotor until a slight resistance is felt.
10. Pull the cardboard downward toward the rotor centerline while rotating the caliper over the rotor (Fig. 9, Step 4).
11. Remove the cardboard and rotate the caliper completely down over the rotor (Fig. 9, Step 5).
12. Slide the caliper up against the anchor plate upper abutment surfaces and center the caliper over the lower anchor plate abutment (Fig. 9, Step 6).
13. Position the caliper support spring and key in the key slot and drive them into the opening between the lower end of the caliper and the lower anchor plate abutment. Align the semi-circular slot in the key with the threaded hole in the anchor plate (Fig. 10).
14. Install the key retaining-screw and tighten, 12 to 16 ft-lb. torque.
15. Thread the flexible brake hose and gasket into its fitting on the caliper. Torque the hose fitting to 12 to 20 ft-lb.

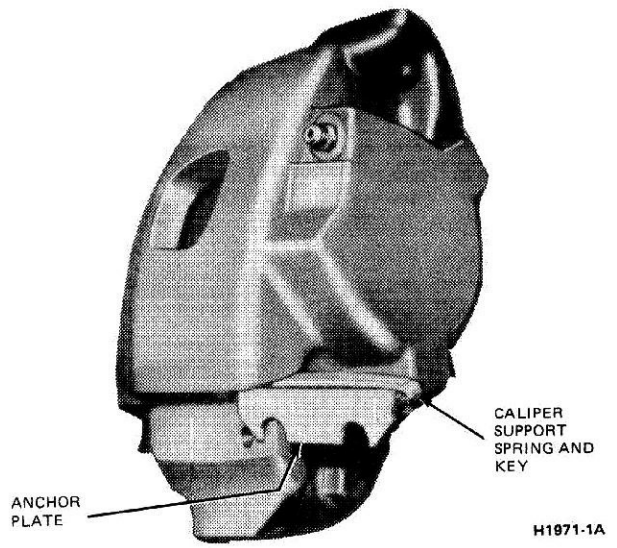


FIG. 10 Installing Front Caliper Support Spring and Retaining Key—Except Fairmont/Zephyr

16. Position the upper end of the flexible brake hose in its bracket and install the retaining clip. Do not twist the hose. Remove the plug from the brake tube. Connect the brake tube to the hose with the tube fitting nut and tighten to 10 to 15 ft-lb.
17. Bleed the brake system. Apply the brakes several times to properly position the caliper and brake shoes.

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18. Install the wheel and tire assembly. Torque the wheel lug nuts to 70 to 115 ft-lb. Install the wheel cover. Remove the safety stands and lower the car.
19. Pump the brake pedal until a firm brake pedal application is obtained, then road test the car for proper brake operation.

DISC BRAKE CALIPER ASSEMBLY—FRONT—FAIRMONT/ZEPHYR

Removal

1. Remove the wheel and tire assembly from the hub. Use care to avoid damage or interference with the bleeder screw fitting during removal.
2. Disconnect the flexible brake hose from the caliper (Fig. 13). To disconnect the hose, loosen the tube fitting which connects it to the brake tube at its bracket on the frame and plug the brake tube. Remove the horseshoe-type retaining clip from the hose and bracket, disengage the hose from the bracket; then unscrew the entire hose assembly from the caliper. Mark the left and right caliper assemblies with chalk prior to removal from the vehicle.
3. Remove the caliper locating pins (Fig. 3).
4. Lift the caliper from the integral spindle and anchor plate and rotor.

Installation

1. Install the caliper assembly over the rotor with the outer brake shoe against the rotor braking surface during installation in the integral spindle and anchor plate to prevent pinching the piston boot between the inner brake shoe and the piston. Check that the correct caliper is installed on the correct anchor plate as marked during disassembly.
2. Connect the locating pins to the integral spindle/anchor plate and the caliper insulators. Be sure the locating pins are free of oil, grease or dirt.
3. Torque the caliper locating pins 30-40 ft-lb.
4. Thread the flexible brake hose into its fitting on the caliper. This is a special self-sealing fitting that **does not require a gasket.** Torque hose fitting to 20-30 ft-lb. (See Fig. 13).

   NOTE: When hose is correctly torqued there should be 1 or 2 threads of the fitting still showing at the caliper. It is not necessary for the hose fitting to be flush with the caliper for sealing; therefore, do not overtorque.
5. Position the upper end of the flexible brake hose in its bracket and install the retaining clip. Do not twist the hose. **Remove the plug from the brake tube.** Connect the brake tube to the hose with the tube fitting nut and tighten to 10-18 ft-lb.
6. Bleed the brake system and centralize the brake pressure differential valve using existing Shop Manual procedures.
7. Fill the master cylinder as required to within 1/4" of the top of the reservoir.
8. Install the wheel and tire assembly and torque the wheel nuts to specifications.
9. Apply the brake pedal prior to moving the vehicle to position the brake linings.
10. Road test vehicle.

DISC BRAKE SHOE AND LINING—FRONT—ALL EXCEPT FAIRMONT/ZEPHYR

Removal

1. Raise the car and install safety stands. Block both rear wheels if a jack is used.
2. Remove the wheel and tire assembly from the hub.
3. Remove the retaining screw from the caliper retaining key (Fig. 1).
4. Slide the caliper retaining key and support spring either inward or outward from the anchor plate. Use a hammer and drift, if necessary, and be careful to avoid damaging the key and spring.
5. Lift the caliper assembly away from the anchor plate by pushing the caliper downward against the plate, and rotating the upper end upward and out of the anchor plate. **Use care so that the flexible brake hose is not stretched or twisted.**
6. Remove the inner shoe and lining assembly from the anchor plate. If the brake shoe anti-rattle clip (inner shoe only) becomes displaced, re-position it on the lower end of the inner shoe with the loop of the clip away from the rotor and the tab section in the shoe slot. Tap lightly on the outer shoe and lining assembly to free it from the caliper.
7. Clean the caliper, anchor plate and rotor assemblies, and inspect for signs of brake fluid leakage, excessive wear or damage. Inspect the brake shoe and lining assemblies for wear. If either lining is worn to within 1/8 inch of the shoe, both shoe and lining assemblies must be replaced. **Also, if necessary to replace the shoes and lining on one wheel, they must be replaced on both wheels in order to maintain equal brake action.**

Installation

Follow previous instructions under Disc Brake Caliper Assembly: Installation—Steps 1-14, and return to this Section for Steps 15-17.

Remove the master cylinder cover during this operation to avoid a residual overfill of the reservoir.

15. Depress the brake pedal several times to properly position the caliper and brake shoe assemblies. Check the fluid level in the master cylinder and install the reservoir cover. Check for signs of brake fluid leaks around the caliper and flexible brake hose. Perform repairs if necessary.
16. Install the wheel and tire assembly. Torque the wheel lug nuts, 70 to 115 ft-lb. Install wheel cover, remove safety stands, and lower the car.
17. Be sure a firm brake pedal application is obtained and then road test the car for proper brake operation.

DISC BRAKE SHOE AND LINING—FRONT—FAIRMONT/ZEPHYR

Removal

1. Remove the master cylinder cap and check the fluid level in the primary (large) reservoir. Remove brake fluid until the reservoir is half full. Discard this fluid.

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2. Remove the wheel and tire assembly from the hub. Be careful to avoid damage or interference with the caliper splash shield or bleeder screw fitting.
3. Remove the caliper locating pins (See Fig. 3).
4. Lift the caliper assembly from the integral spindle anchor plate and rotor. Remove the outer shoe from the caliper assembly (See Fig. 11).
5. Remove the inner shoe and lining assembly and *inspect both rotor braking surfaces* (See Fig. 12). Minor scoring, or build-up of lining material does not require machining or replacement of the rotor.
6. Suspend the caliper inside the fender housing with a wire hooked through the outer leg button hole of the caliper. Be careful not to damage the caliper or stretch the brake hose.
7. Remove and discard the plastic sleeves that are located inside the caliper locating pin insulators (See Fig. 11). These parts **must not** be reused.
8. Remove and discard the caliper locating insulators (See Fig. 11). These parts **must not** be reused.

Installation

1. Use a 4" C-clamp and a block of wood 2 3/4" x 1" and approximately 3/4" thick to seat the caliper hydraulic piston in its bore. This must be done to provide clearance for the caliper assembly to fit over the rotor when installed. Remove the C-clamp from the caliper (the caliper piston will *remain seated in its bore).*
2. Install new locating pin insulators and plastic sleeves in the caliper housing. Check to see that both insulator flanges straddle the housing holes and that the plastic sleeves are bottomed in the insulators as well as slipped under the upper lip (See Fig. 11 for proper installation and an installation tool that can help with insulator installation).
3. Install the correct inner shoe and lining assembly in the caliper piston(s). **The inner shoes are marked LH or RH and must be installed in the proper caliper.** Also, care should be taken not to bend the shoe clips too far during installation in the piston or distortion and rattles can result.
4. Install the correct outer brake shoe and lining assembly (RH/LH), also making sure that the clip and buttons located on the shoe are properly seated. The outer shoe can be identified as right hand or left hand by the wear indicator which must always be installed toward the front of the vehicle (See Fig. 11). Refill master cylinder.
5. Install the wheel and tire assembly and torque the wheel nuts to specifications.
6. Pump the brake pedal prior to moving the vehicle to position the brake linings.
7. Road test the vehicle.

HUB AND ROTOR—FRONT—EXCEPT FAIRMONT/ZEPHYR

Removal

1. Remove the caliper and brake shoes. **Refer to Brake Shoe and Lining Removal.** If no repair is necessary on the caliper assembly, it is not necessary to disconnect the flexible brake hose from the caliper. The caliper can be temporarily secured to the upper suspension arm. **Do not remove the anchor plate. Be careful not to stretch or twist the flexible brake hose.**
2. Remove the grease cap from the hub.
3. Remove the cotter key, nut lock, and adjusting nut.
4. Grasp the hub and rotor assembly and pull it outward far enough to loosen the washer and outer wheel bearing. Push the hub and rotor back onto the spindle and remove the washer and outer wheel bearing.
5. Then, slide the wheel hub and rotor assembly off the wheel spindle.

Installation

1. If the rotor is being replaced, remove the protective coating from the new rotor with carburetor degreaser. Flush bearings with specified grease (C1AZ-19590-A or equivalent), and install the inner bearing cone and roller assembly in the inner cup. Apply a film of grease between the lips of a new grease seal and install the seal.
2. If the original rotor is being installed, make sure that the inner bearing and grease seal are lubricated and in good condition, and that the rotor braking surfaces are clean.
3. Slide the hub and rotor assembly onto the spindle. Keep the assembly centered on the spindle to prevent damage to the inner grease retainer or the *spindle threads.*
4. Place the outer wheel bearing and the flat washer on the spindle and start the wheel bearing adjusting nut.
5. Adjust the wheel bearings as outlined in Part 11-10.
6. Install the caliper, brake shoes and linings. **Refer to preceding Brake Shoe and Lining Installation.**
7. Install the wheel and tire assembly. Remove the safety stand(s), lower the car, and torque the wheel stud nuts to 70 to 115 ft-lb.
8. Install the hub cap or wheel cover.
9. Apply the brakes several times to properly position the brake shoe and lining assemblies; then, test the car for proper brake operation.

HUB AND ROTOR—FRONT—FAIRMONT/ ZEPHYR

Refer to Fig. 12

Removal

1. Remove the wheel and tire from the hub. Be careful to avoid damage or interference with the bleeder screw fitting and caliper splash shield.
2. Remove the caliper assembly from the spindle and the rotor. If the caliper does not require servicing, it is not necessary to disconnect the brake hose or remove the caliper from the vehicle. Position the caliper out of the way and support it with a wire to avoid damaging the caliper or stretching the hose. Insert a clean cardboard spacer between the linings to prevent the piston from coming out of the cylinder bore while the caliper is removed.

   Handle the rotor and caliper assemblies in such a way as to avoid deformation of the rotor and

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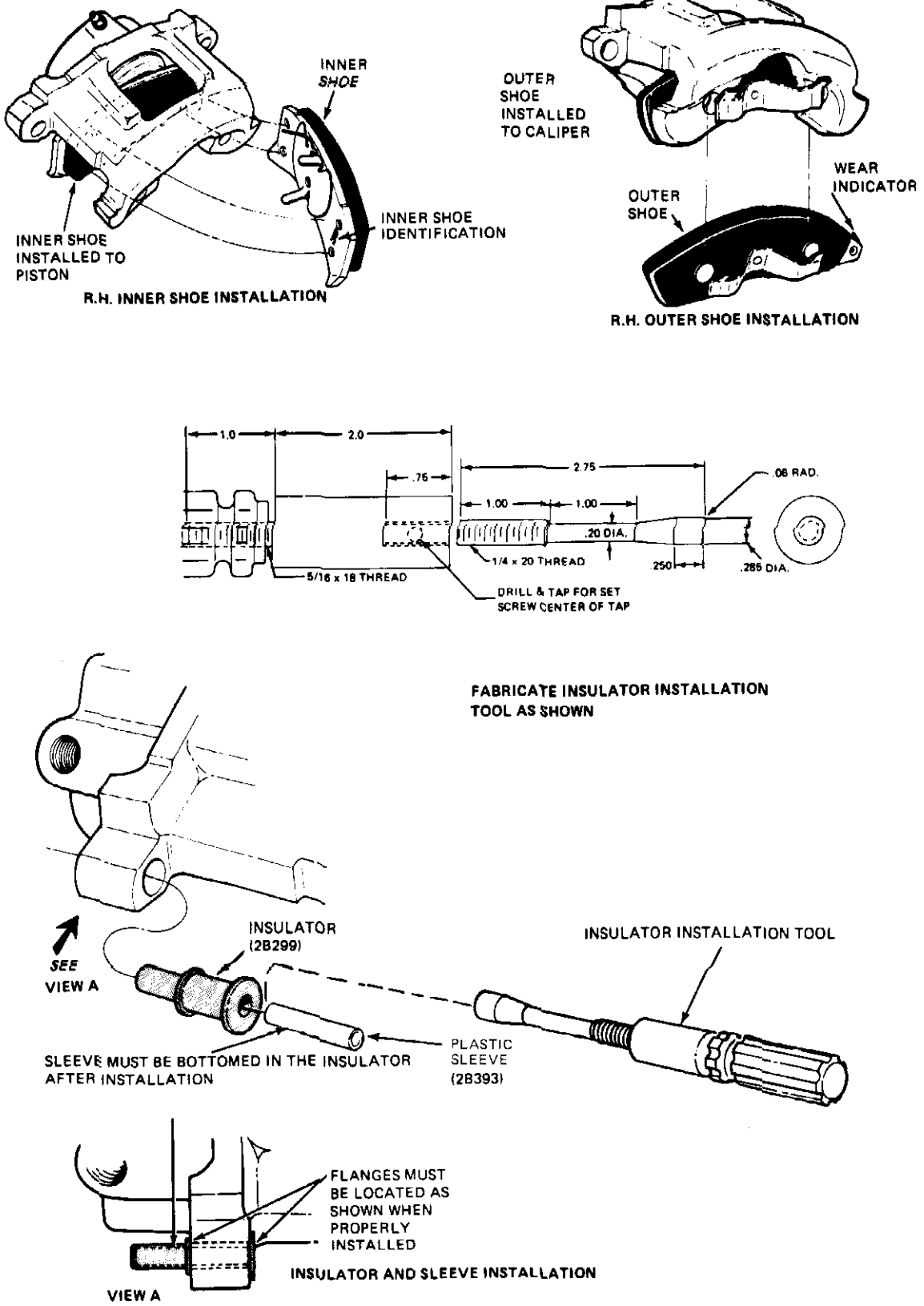
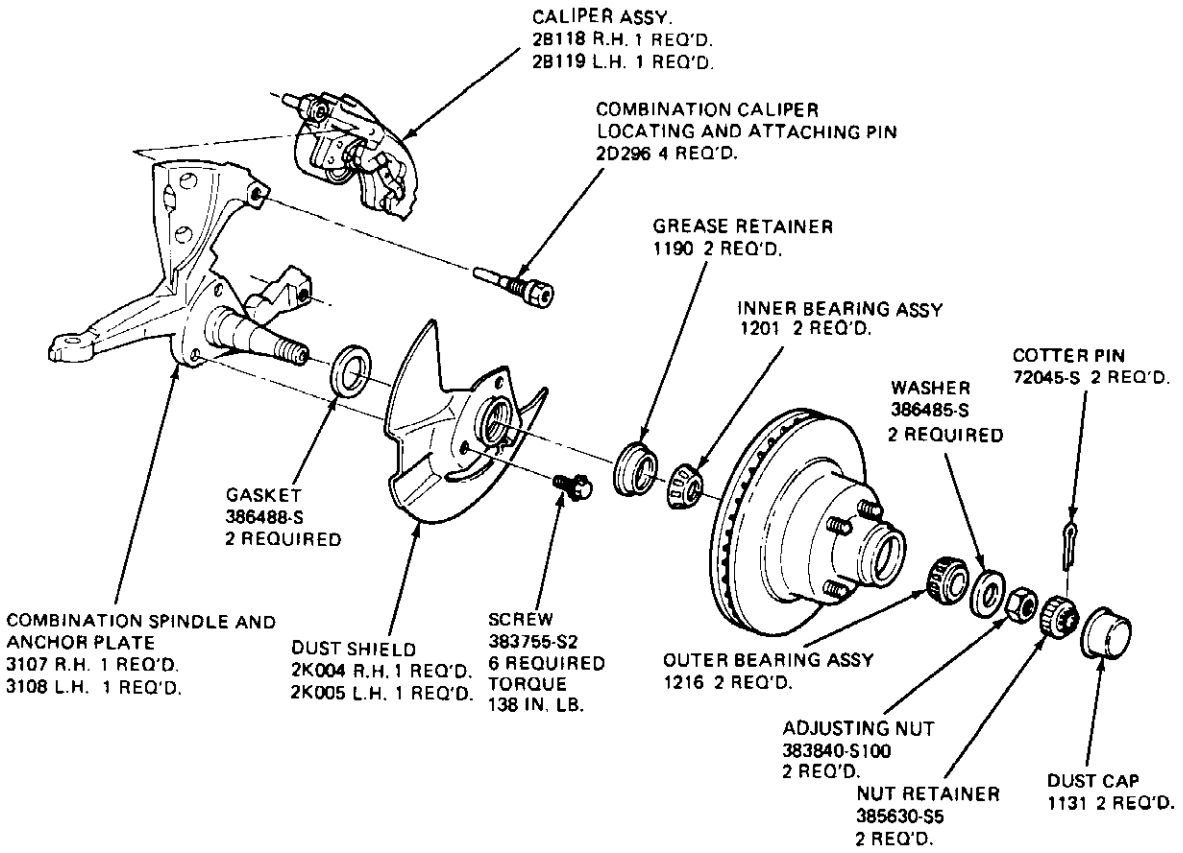


FIG. 11 Servicing Pin Slider Caliper—Fairmont/Zephyr

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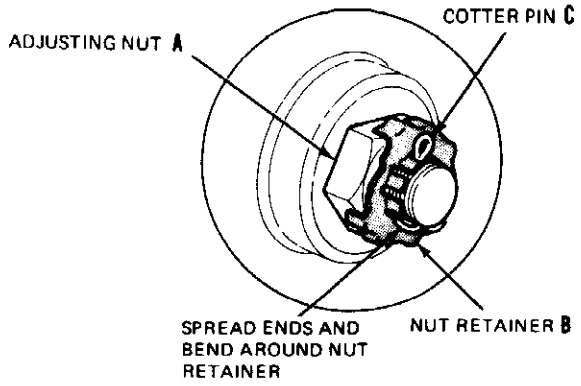
DETROIT IRON



BEARING ADJUSTMENT

TIGHTEN ADJUSTING NUT **A** WHILE ROTATING HUB AND ROTOR ASSY. TO 17-25 FOOT POUNDS TORQUE. BACK OFF ADJUSTING NUT 1/2 TURN. RETIGHTEN TO 10-15 IN-LB (FINGER TIGHT)

SELECTIVELY POSITION NUT RETAINER **B** ON ADJUSTING NUT SO THAT A SET OF SLOTS ARE IN LINE WITH COTTER PIN HOLE. ADJUSTING NUT MUST NOT BE ROTATED IN THIS OPERATION. LOCK ADJUSTING NUT AND NUT RETAINER WITH COTTER PIN **C** .



H2625-2A

FIG. 12 Caliper, Shield and Rotor—Pin Slider Caliper

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nicking, scratching or contamination of the brake linings.

3. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and flat washer from the spindle. Remove the outer bearing cone and roller assembly (Fig. 12).
4. Remove the hub and rotor assembly from the spindle.

Installation:

1. If the rotor is being replaced, remove the protective coating from the new rotor with carburetor degreaser. Pack a new set of bearings with specified grease (C1AZ-19590-A or equivalent), and install the inner bearing cone and roller assembly in the inner cup. Pack grease lightly between the lips of a new grease seal and install the seal.

   If the original rotor is being installed, make sure that the grease in the hub is clean and adequate, that the inner bearing and grease seal are lubricated and in good contition, and that the rotor braking surfaces are clean.
2. Install the hub and rotor assembly on the spindle.
3. Lubricate and install the outer wheel bearing, washer and adjusting nut.
4. Adjust the wheel bearings to specification, and then *install the nut lock, cotter pin, and grease cap.* **The wheel bearing adjustment is especially important with disc brakes.**
5. Mount the caliper assembly on the spindle following the the Fairmont/Zephyr Disc Brake Caliper Assembly Installation procedure in this Part.

ANCHOR PLATE—FRONT—ALL EXCEPT FAIRMONT/ZEPHYR

Removal

1. Remove the caliper assembly. **Refer to Disc Brake Caliper Assembly—Removal.**
2. Remove and discard both the upper and lower anchor plate-to-spindle mounting bolts. Remove the anchor plate.

Installation

1. Clean all foreign material and locking compound residue from the mating surfaces of the spindle and anchor plate.
2. Position the anchor plate on the spindle. Install new upper and lower mounting bolts finger tight.
3. Tighten the upper mounting bolt to 90 to 120 ft-lb.
4. Tighten the lower mounting bolt, 90 to 120 ft-lb. on LTD II, Cougar, Ford, Mercury, Continental Mark V, *and Lincoln Continental; 55 to 75 ft-lb. on Pinto,* Bobcat, Mustang II, Granada, Monarch, and Versailles. The upper anchor plate-to-spindle mounting bolt must be tightened first to prevent anchor plate distortion and to ensure proper brake operation.

NOTE: Fairmont/Zephyr vehicles are not equipped with a separate anchor plate.

DISC BRAKE ROTOR SPLASH SHIELD—FRONT—ALL EXCEPT FAIRMONT/ZEPHYR

Removal

1. Remove the caliper and the hub and rotor assembly as outlined in preceding instructions. (It is not necessary to disconnect hydraulic lines.)
2. Remove bolts that attach splash shield to spindle, and discard the gasket.

Installation

1. Install a new splash shield to spindle gasket.
2. If the shield is bent, straighten it out before installation. Position the shield to the mounting bracket, install attaching bolts and nuts, and torque, 9 to 14 ft-lb.
3. Install hub and rotor assembly and the caliper.

DISC BRAKE ROTOR SPLASH SHIELD— FRONT—FAIRMONT/ZEPHYR

Removal: Refer to Fig. 12

1. Remove the caliper and the hub and rotor assembly as outlined under Removal in the foregoing procedures (it is not necessary to disconnect hydraulic connections).
2. Remove the three bolts that attach the splash shield to the spindle, and remove the shield.
3. Remove and discard the splash shield to spindle gasket.

Installation

1. Install a new splash shield to spindle gasket.
2. If the shield is bent, straighten it out before installation. Position the shield on the mounting bracket, install the attaching bolts, nuts and torque them to specification.
3. *Install the hub and rotor assembly and the caliper* as outlined under Installation in the foregoing procedure.

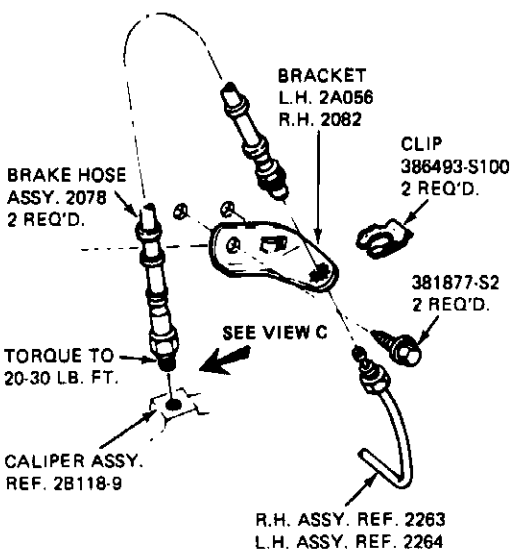
DISC BRAKE CALIPER ASSEMBLY—REAR

After any service work, obtain a firm brake pedal before moving the vehicle. Riding the brake pedal (common on left foot application) must be avoided when driving the vehicle.

Removal

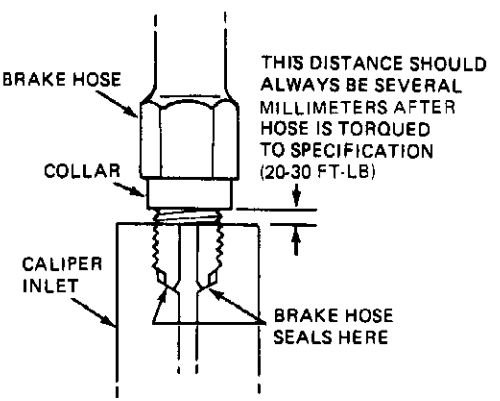
1. Raise the car and install safety stands. Block both front wheels if a jack is used.
2. Remove the wheel and tire assembly from the axle.
3. Remove the flexible hose from the caliper. To remove the brake hose, first disconnect the fitting on the rear brake tube from the hose end fitting at the frame or axle-mounted bracket. Plug the end of the brake tube to prevent loss of fluid and entry of air into the system. Remove the horseshoe-shaped retaining clip from the hose fitting and disengage the hose from the bracket. On Granada, Monarch and Versailles models, disconnect the hose bracket from the axle spring seat. On Lincoln Continental, Ford and Mercury cars, unscrew the hose end fitting from the caliper. On Continental Mark V, Granada, Monarch and Versailles cars,

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VIEW B

FRONT BRAKE HOSE TO CALIPER CONNECTION



SECTIONAL VIEW C

FRONT CALIPER TO BRAKE HOSE CONNECTION

H2626-2A

FIG. 13 Hydraulic Connections—Pin Slider Caliper—Fairmont/Zephyr

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remove the hollow retaining bolt that connects the hose fitting to the caliper.

4. Disconnect the parking brake cable from the lever (Fig. 14). Use care to avoid kinking or cutting the cable or return spring.
5. Remove the retaining screw from the caliper retaining key (Fig. 15).
6. Slide the caliper retaining key and support spring from the anchor plate (Fig. 15). Use a hammer and a soft metal drift, if necessary. Use care to avoid damaging the key or sliding ways or hitting the parking brake lever.
7. Lift the caliper assembly away from the anchor plate by pushing the caliper downward against the anchor plate and then rotating the upper end out of the anchor plate.
8. If rust build-up on the outer edge of the rotor braking surface prevents removal of the caliper, scrape the loose scale from the edges with a putty knife or other blunt tool, being careful not to gouge or mar the braking surfaces. When rotor wear or scoring prevents removal of the caliper even after removing the ridge of rust and scale, it is necessary to loosen the caliper end retainer 1/2 turn maximum, to allow the piston to be forced back into its bore. To loosen the end retainer, remove the parking brake lever, then mark or scribe the end retainer and caliper housing to be sure that the end retainer is not loosened more than 1/2 turn. Force the piston back in its bore (Fig. 15), move the caliper back and forth to center the rotor and then remove the caliper.

CAUTION: If the retainer must be loosened more than 1/2 turn, the seal between the thrust screw and the housing may be broken and brake fluid may leak into the parking brake mechanism chamber. In this case, the end retainer must be removed and the internal parts cleaned and lubricated (see Caliper Disassembly and Assembly).

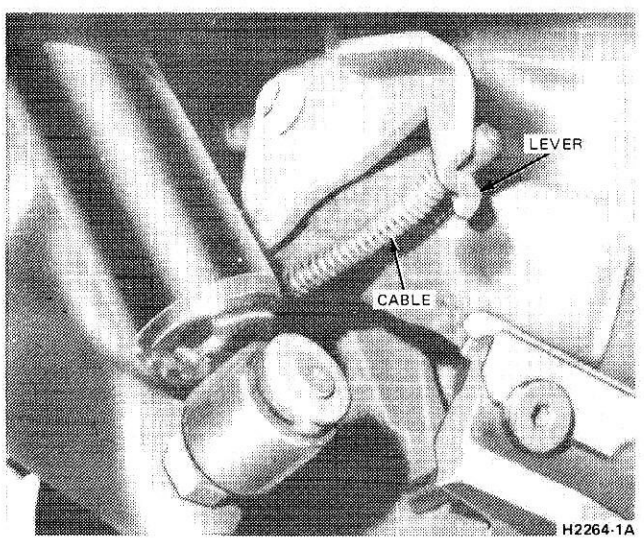


FIG. 14 Parking Brake Lever and Cable Installation—Typical

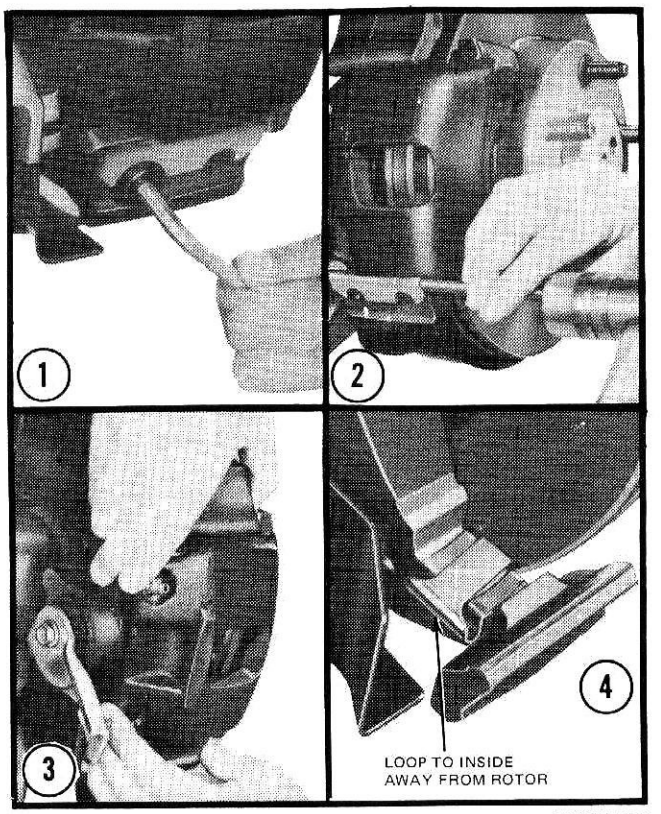


FIG. 15 Removing Rear Caliper Assembly

9. Remove the inner shoe and lining assembly from the anchor plate. The brake shoe anti-rattle clip (Fig. 15) (inner shoe only) may become displaced. If so, reposition it to the anchor plate. Tap lightly on the outer shoe and lining assembly to free it from the caliper. Mark each shoe for identification if it is to be reinstalled.
10. Clean the caliper, anchor plate, and rotor assemblies and inspect for signs of brake fluid leakage, excessive wear, or damage. The caliper must be inspected for leakage both in the piston boot area and at the operating shaft seal area. Lightly sand or wire brush any rust or corrosion from the caliper and anchor plate sliding surfaces and the inner brake shoe abutment surfaces in the anchor plate. Inspect the brake shoes for wear. If either lining is worn to within 1/8 inch of the shoe surface, both shoe and lining assemblies must be replaced. Also, if necessary to replace the shoes and linings on one wheel, they must be replaced on both wheels in order to maintain equal brake action.

Installation

1. If the end retainer has been loosened only 1/2 turn, reinstall the caliper in the anchor plate, using the key, but without shoe and lining assemblies. Torque the end retainer to 75-95 ft-lbs. Install the parking brake lever on its keyed spline. The lever arm must point down and rearward. The parking brake cable will then pass freely under the axle. Torque the retainer screw to 16-22 ft-lbs. The parking brake lever must rotate freely after torquing the retainer screw. Remove the caliper from the anchor plate.

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2. If new shoe and lining assemblies are to be installed, the piston must be screwed back into the caliper bore using Tool T75P-2588-B to provide installation clearance. Remove the rotor and install the caliper, less shoe and lining assemblies, in the anchor plate with the key only. While holding the shaft, rotate the tool handle counterclockwise until the tool is seated firmly against the piston (Fig. 16). Now, loosen the handle about 1/4 turn. While holding the handle, rotate the tool shaft clockwise until the piston is fully bottomed in its bore (the piston will continue to turn even after it becomes bottomed). When there is no further inward movement of the piston and the tool handle is rotated until there is firm seating force, the piston is bottomed. Remove the caliper from the mounting plate and reinstall the rotor.
3. Be sure that the brake shoe anti-rattle clip is in place in the lower inner brake shoe support on the anchor plate with the loop of the clip toward the inside of the anchor plate (Fig. 16). Position the inner brake shoe and lining assembly on the anchor plate with the lining toward the rotor.
4. Install the outer brake shoe with the lower flange ends against the caliper leg abutments and the brake shoe upper flanges over the shoulders on the caliper legs. The shoe upper flanges fit tightly against the machined shoulder surfaces. If the same brake shoe and lining assemblies are re-used, be certain the shoes are installed in their original positions as marked for identification before removal.
5. Lubricate caliper and anchor plate sliding ways with ESA-M1C172-A (Spec.) grease. Use only specified grease because a lower temperature type lubricant may melt out and contaminate the brake pads. Use care to prevent any lubricant from getting on the braking surfaces.
6. Position the caliper housing lower V-groove on the anchor plate lower abutment surface.
7. Rotate the caliper housing until it is completely over the rotor. Use care so that the piston dust boot is not damaged.
8. Pull the caliper outboard until the inner shoe and lining is firmly seated against the rotor. Measure the clearance between the outer lining and rotor. The clearance must be 1/16 inch or less (Fig. 17). If it is greater, remove the caliper and readjust the piston outward to narrow the gap. Follow the procedure given in Step 2 and rotate the shaft **counterclockwise** (1/4 turn of the piston moves it approximately 1/16 inch). **CAUTION: A clearance greater than 1/16 inch may allow the adjuster to be pulled out of the piston when the service brake is applied.** This will cause the parking brake mechanism to fail to adjust. It is then necessary to replace the piston/adjuster assembly following the procedures detailed in the Overhaul section.
9. Hold the caliper against the anchor plate upper abutment surfaces and center the caliper over the lower anchor plate abutment.
10. Position the caliper support spring and key in the key slot and slide them into the opening between the lower end of the caliper and the lower anchor plate abutment until the key semi-circular slot is centered over the retaining screw threaded hole in the anchor plate.

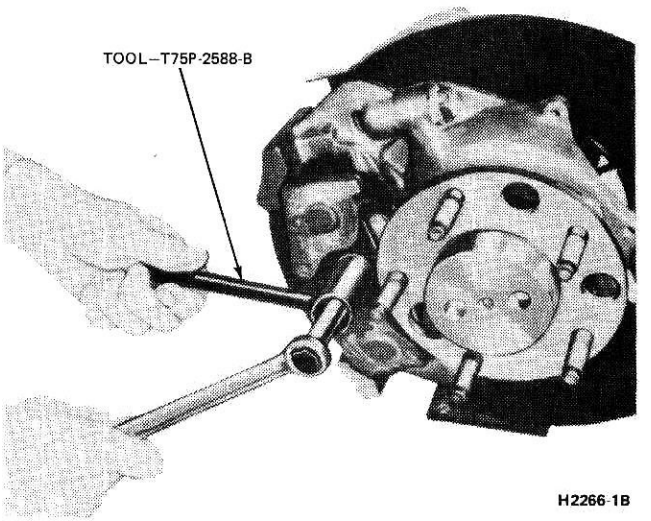


FIG. 16 Adjusting Piston Depth—Rear Disc Brake

11. Install the key retaining screw and tighten to 12-16 ft-lbs torque.
12. Reinstall the brake hose on the caliper. On Lincoln Continental, Ford and Mercury cars, place a new gasket on the fitting and screw the fitting into the inlet port. Torque the fitting to 20-30 ft-lbs. On Continental Mark V, Granada, Monarch and Versailles cars, place a new gasket on each side of the fitting outlet and insert the attaching bolt through the washers and fitting and torque to 17-25 ft-lbs. On Granada/Monarch/Versailles be sure to engage the pin in the hose fitting in the mating hole in the caliper before tightening the bolt.
13. Position the upper end of the flexible hose in its bracket and install the retaining clip (or, on Granada/Monarch/Versailles attach the hose bracket to the axle spring seat). **DO NOT TWIST OR COIL THE HOSE.** The stripe on the hose must be kept straight. Remove the plug from the brake

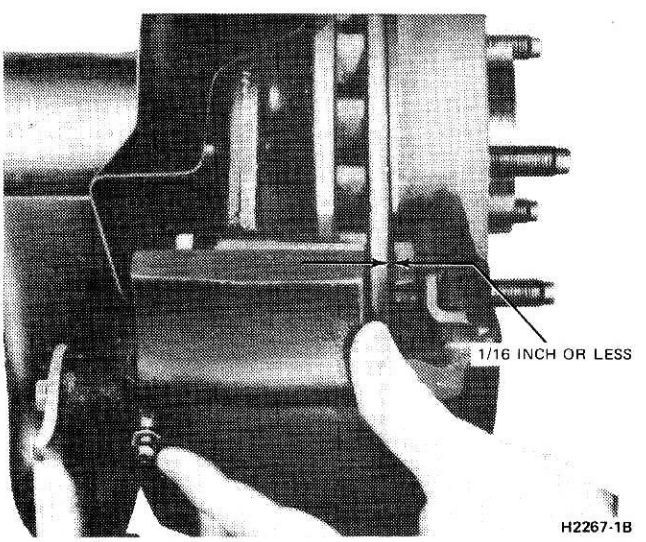


FIG. 17 Checking Lining Clearance

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tube. Connect the brake tube to the hose and *torque the fitting nut to* 10-15 ft-lbs.

14. Connect the parking brake cable to the lever on the caliper.
15. Bleed the brake system. Then, with the engine running, pump the service brake lightly about 40 times. Allow at least one (1) second between pedal applications. As an alternative, with the engine off, pump the service brake lightly (approximately 17 lb. pedal effort) about 10 times, to discharge the accumulator. Then pump firmly about 30 times. Now check the parking brake for excessive travel or very light effort. In either case, repeat pumping the service brake, or if necessary, check the parking brake cable for proper tension. The caliper levers must return to the OFF position when the parking brake is released (See Part 12-70).
16. Install the wheel and tire assembly. Torque the wheel lug nuts to 70-115 ft-lbs. Install the wheel cover. Remove the safety stands and lower the car.
17. *Be sure a firm brake pedal application is obtained,* and then road test for proper brake operation, including parking brakes.

DISC BRAKE SHOE AND LININGS—REAR

Removal

1. Follow the procedure given in Rear Disc Brake Caliper Assembly Removal. Omit Step 3, as it is not necessary to disconnect the flexible hose from the caliper in this operation. **Support the caliper with a wire hook or other means, so that the flexible hose is not stretched or twisted.** Inspect the brake shoes for wear. If either lining is worn to within 1/8 inch of the shoe, both shoe and lining assemblies must be replaced. Also, if necessary to replace the shoe and lining assemblies on one wheel, they must be replaced on both wheels in order to maintain equal brake action.

Installation

1. Follow the procedure given in Rear Disc Brake Caliper Assembly Installation. Review Steps 12 thru 15 to be sure of proper parking brake adjustment.

ROTOR—REAR

Removal

1. Remove the caliper assembly from the anchor plate. If no repair is necessary to the caliper assembly, it is not necessary to disconnect the flexible brake hose. The caliper can be temporarily secured to the frame. **Do not remove the anchor plate. Be careful not to stretch or twist the flexible brake hose.**
2. If corrosion makes identification difficult, mark the hat sections of the rotors to distinguish right from left before they are removed. On Versailles, mark the rotor orientation on the axle shaft prior to removal so that rotor can be installed in original position.
3. Remove the two (2) retainer nuts and remove the rotor from the axle shaft.

Installation

1. *If the rotor is being replaced, remove the protective* coating from the new rotor with carburetor degreaser.
2. Properly identify right and left rotors before installation. RIGHT and LEFT are cast into the inner surfaces of the rotor hat-sections. Install the right and left rotors on their corresponding axle shaft flanges. Versailles vehicles have a blue dot on the outside of the rotor hat section indicating the heavy side of the rotor. When the rotor is installed on the axle shaft, this blue dot should be located as close as possible to the hole in the axle shaft flange. Install the two (2) retainer nuts securely. **CAUTION: The vanes on the outer edge of the rotors must point in the direction of forward rotation (Fig. 5).**
3. Mount the caliper assembly on the anchor plate slides. Refer to the procedure given in Rear Disc Brake Caliper Assembly Installation.

ANCHOR PLATE—REAR

Removal

1. **NOTE: Do not remove the anchor plate unless it is being replaced.**
2. Refer to Rear Disc Brake Caliper Assembly Removal and remove the caliper assembly. Omit Step 3 of the Removal procedure, as it is not necessary to disconnect the flexible hose. Secure the caliper to the frame.
3. *Remove the splash shield by removing the two bolts* that attach the shield to the axle adapter.
4. Remove and DISCARD both the upper and lower anchor plate-to-axle adapter mounting bolts. Remove the anchor plate.

Installation

1. Clean all foreign material and locking compound residue from the mating surfaces of the axle adapter and anchor plate.
2. *Position the anchor plate on the axle adapter* and install new upper and lower mounting bolts finger-tight.

   NOTE: Anchor plates are not interchangable from right to left.
3. Tighten both bolts to 90-120 ft-lbs. (The tightening order is not important.)
4. Install the splash shield. Refer to Rear Disc Brake Rotor Splash Shield Installation for procedure.
5. *Install the caliper assembly.* Refer to Rear Disc Brake Caliper Assembly Installation for procedure.

DISC BRAKE ROTOR SPLASH SHIELD—REAR

Removal

1. Remove the two bolts that attach the splash shield to the axle adapter (Fig. 6).
2. Remove the splash shield.

Installation

1. If the shield is bent, straighten it before installation.
2. Position the shield to the axle adapter, install the mounting screws and torque them to 9-14 ft-lbs.

   NOTE: Left and right side shields are interchangeable on the Lincoln Continental,

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Ford, Mercury and Granada-Monarch-Versailles car lines. On Continental Mark V, the left and right shields are unique and cannot be interchanged.

DUAL MASTER CYLINDER

Refer to Part 12-01 for Removal, Installation and Overhaul of Dual Master Cylinder.

PRESSURE DIFFERENTIAL, METERING, AND PROPORTIONING VALVES

Refer to Part 12-01 for Removal and Installation of Pressure Differential, Metering, and Proportioning Valves.

BRAKE BOOSTER

Refer to Part 12-50 or 12-51 for Removal and Installation of Brake Booster.

OVERHAUL

After any service work, pump the brake pedal to obtain a firm brake pedal before moving the vehicle. Riding the brake pedal (common on left-foot application) must be avoided when driving the vehicle.

DISC BRAKE CALIPER—FRONT

Disassembly

1. Remove the caliper assembly from the vehicle as outlined in Caliper Removal. Place a cloth over the piston before applying air pressure to prevent damage to the piston.
2. Apply air pressure to the fluid port in the caliper with a rubber-tipped nozzle (Tool 7000-DD) as shown in Fig. 18 to remove the piston. If the piston is seized and cannot be forced from the caliper, tap lightly around the piston while applying air pressure. **Use care because the piston can develop considerable force from pressure build-up.**
3. Remove the dust boot from the caliper assembly.
4. Remove the rubber piston seal from the cylinder and discard it.

Cleaning And Inspection

Clean all metal parts with isopropyl alcohol. Then, clean out and dry the grooves and passageways with compressed air. Make sure that caliper bore and component parts are thoroughly clean.

Check the cylinder bore and piston for damage or excessive wear. Replace the piston if it is pitted, scored, or the chrome plating is worn off.

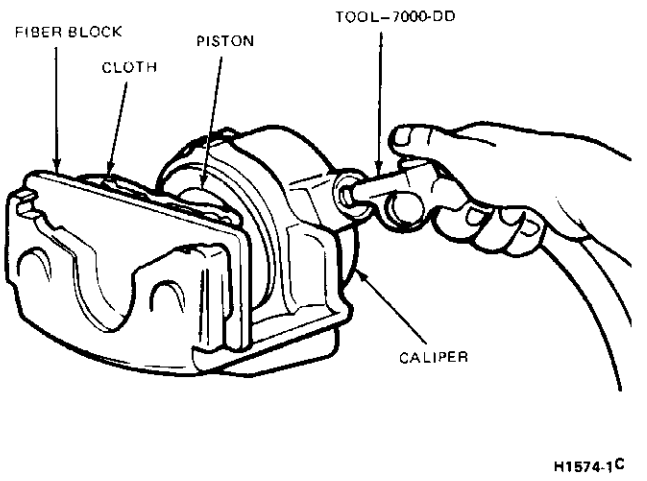


FIG. 18 Removing Piston From Caliper—Typical

Assembly

1. Apply a film of clean brake fluid to the new caliper piston seal and install it in the cylinder bore. Be sure the seal does not become twisted and that it is firmly seated in the groove.
2. Install a new dust boot by setting the flange squarely in the outer groove of the caliper bore.
3. Coat the piston with brake fluid and install the piston in the cylinder bore. Spread the dust boot over the piston as it is installed. Seat the dust boot in the piston groove.
4. Install the caliper over the rotor as outlined under Disc Brake Caliper Assembly.

DISC BRAKE CALIPER—REAR

Disassembly (Refer to Figs. 19 and 20)

1. Remove the caliper assembly from the vehicle as outlined in Rear Disc Brake Caliper Assembly Removal.
2. Remove the caliper end retainer.
3. Lift out the operating shaft, thrust bearing, and balls.
4. Remove the thrust screw anti-rotation pin with a magnet or tweezers.

   NOTE: Some anti-rotation pins may be difficult to remove with a magnet or tweezers. In that case, use the following procedure:

   a. Adjust the piston out from the caliper bore using Piston Adjusting Tool T75P-2588-B. The piston should protrude from the housing at least one inch.
   b. Push the piston back into the caliper housing with the adjusting tool. With the tool in position on the caliper, hold the tool shaft in place and rotate the handle counterclockwise until the thrust screw clears the anti-rotation pin. Remove the thrust screw and the anti-rotation pin.
5. Remove the thrust screw by rotating it counterclockwise with a 1/4 inch Allen wrench.

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6. Remove the piston/adjuster assembly by installing Tool T75P-2588-A through the back of the caliper housing and pushing the piston out.

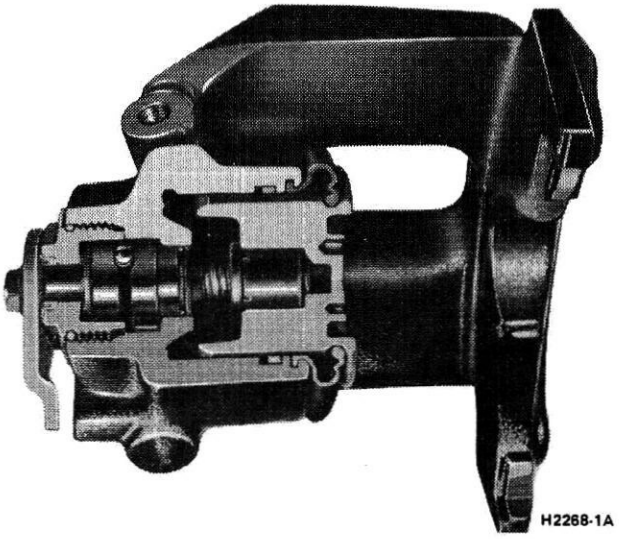


FIG. 19 Rear Disc Brake Caliper Housing—Sectional View

CAUTION: Use care not to damage the polished surface in the thrust screw bore and do not press or attempt to move the adjuster can. It is a press fit in the piston.

7. Remove and discard the piston seal, boot, thrust screw O-ring seal, end retainer, O-ring seal, and the end retainer lip seal.

Cleaning and Inspection

1. Clean all metal parts with isopropyl alcohol. Use clean, dry, compressed air to clean out and dry the grooves and passages. Be sure the caliper bore and component parts are completely free of any foreign material.
2. Inspect the caliper bores for damage or excessive wear. The thrust screw bore must be smooth and free of pits. If the piston is pitted, scored, or the chrome plating is worn off, replace the piston/adjuster assembly.
3. The adjuster can must be bottomed in the piston to be properly seated and provide consistent brake function. If the adjuster can is loose in the piston, appears high in the piston, or is damaged, or if brake adjustment is regularly too tight, too loose or nonfunctioning, replace the piston/adjuster assembly.

NOTE: Do not attempt to service the adjuster at any time: when repair is necessary, replace the piston/adjuster assembly.

4. Check adjuster operation by first assembling the thrust screw into the piston/adjuster assembly, pulling the two pieces apart by hand approximately 1/4 inch and then releasing them (Fig. 21). When pulling on the two pieces, the brass drive ring must

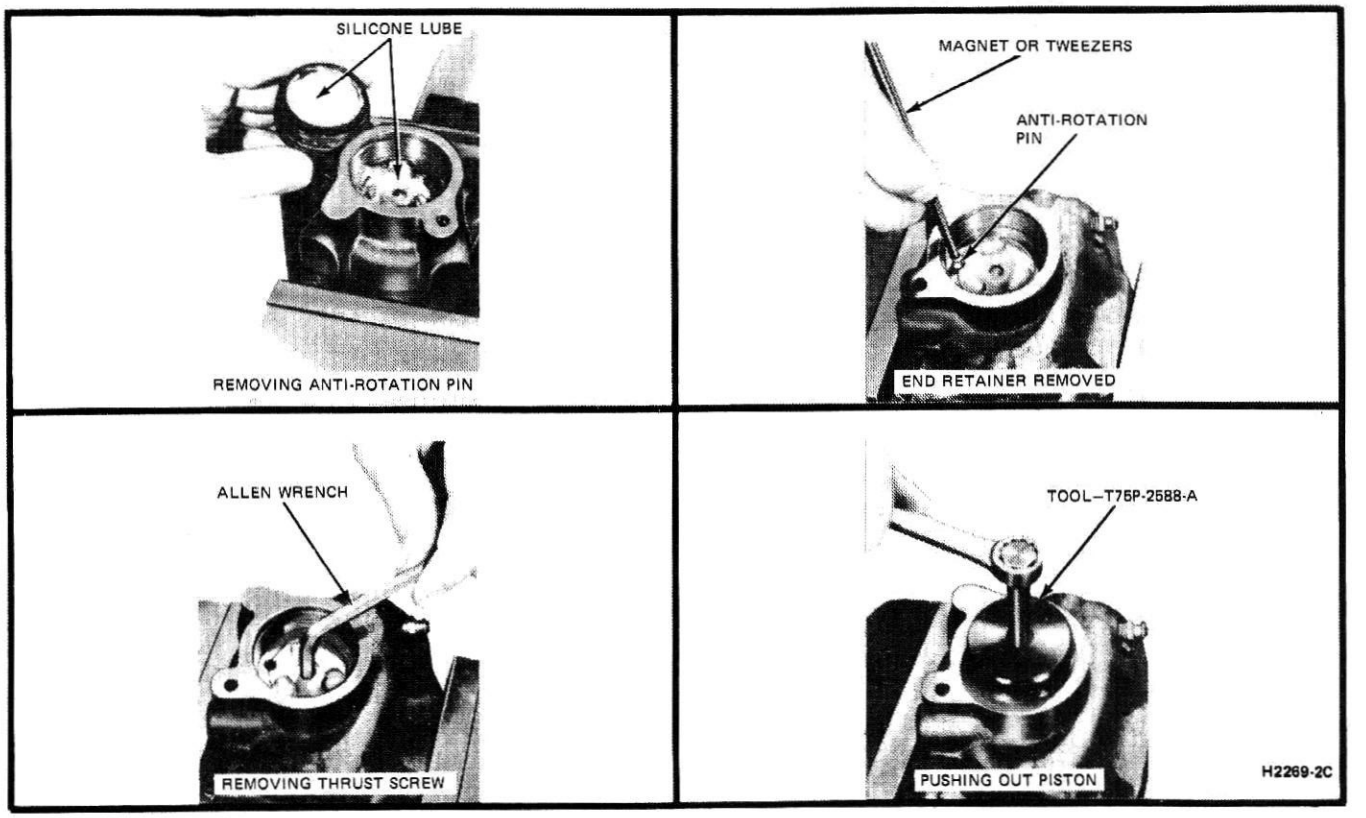


FIG. 20 Disassembling Rear Disc Brake Caliper Housing

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DETROIT IRON

remain stationary, causing the nut to rotate. When releasing the two parts, the nut must remain stationary and the drive ring must rotate. If the action of the components does not follow this pattern, replace the piston/adjuster assembly.

5. Inspect ball pockets, threads, grooves, and bearing surfaces of the thrust screw and operating shaft for wear, pitting, or brinnelling. Inspect balls and anti-rotation pin for wear, brinnelling or pitting. Replace operating shaft, balls, thrust screw and anti-rotation pin if any of these parts are worn or damaged. A polished appearance on the ball paths is acceptable if there is no sign of wear into the surface.
6. Inspect the thrust bearing for corrosion, pitting or wear. Replace if necessary.
7. Inspect the bearing surface of the end plug for wear or brinnelling. Replace if necessary. A polished appearance on the bearing surface is acceptable if there is no sign of wear into the surface.
8. Inspect the lever for damage. Replace if necessary.

Assembly

1. Apply a coat of clean brake fluid to the new caliper piston seal and install it in the cylinder bore. Be sure that the seal is not twisted and that it is seated fully in the groove.
2. Install a new dust boot by seating the flange squarely in the outer groove of the caliper bore.
3. Coat the piston/adjuster assembly with clean brake fluid and install it in the cylinder bore. Spread the dust boot over the piston as it is installed. Seat the dust boot in the piston groove.
4. Install the caliper in a vise as shown in Fig. 22 and fill the piston/adjuster assembly with clean brake fluid to the bottom edge of the thrust screw bore.
5. Coat a new thrust screw O-ring seal with clean brake fluid and install it in the groove in the thrust screw.
6. Install the thrust screw by turning it into the piston/adjuster assembly with a 1/4 inch Allen wrench until the top surface of the thrust screw is flush with the bottom of the threaded bore. Use care to avoid cutting the O-ring seal. Index the thrust screw so that the notches on the thrust screw and caliper housing are aligned. Then install the anti-rotation pin.

   NOTE: The thrust screw and operating shaft are not interchangeable from side to side, due to the ramp direction in the ball pockets. The pocket surface of the operating shaft and the thrust screw are stamped with the proper letter (R or L), indicating part usage.
7. Place a ball in each of the three (3) pockets of the thrust screw and apply a liberal amount of silicone grease (ESEM1C 171-A) D7AZ-19A331-A or equivalent on all components in the parking brake mechanism.
8. Install the operating shaft on the balls.
9. Coat the thrust bearing with silicone grease (ESEM1C 171-A) D7AZ-19A331-A or equivalent and install it on the operating shaft.
10. Install a new lip seal and O-ring on the end retainer.
11. Coat the O-ring seal and lip seal with a light film of silicone grease and install the end retainer in the caliper. Hold the operating shaft firmly seated against the internal mechanism while installing the end retainer to prevent mislocation of the balls. If the lip seal is pushed out of position, re-seat the seal. Torque the end retainer to 75-95 ft-lbs.
12. Install the parking brake lever on its keyed spline. The lever arm must point down and rearward. The parking brake cable will then pass freely under the axle. Torque the lever retaining screw to 16-22 ft-lbs. The parking brake lever must rotate freely after torquing.
13. Arrange the caliper in a vise as shown in Fig. 23 and bottom the piston with Tool T75P-2588-B.
14. Install the caliper on the vehicle as detailed in Rear Disc Brake Caliper Assembly Installation.

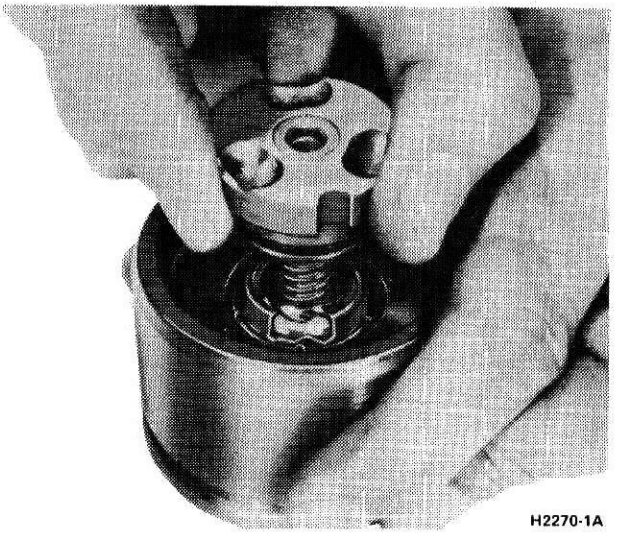


FIG. 21 Checking Parking Brake Adjuster Operation

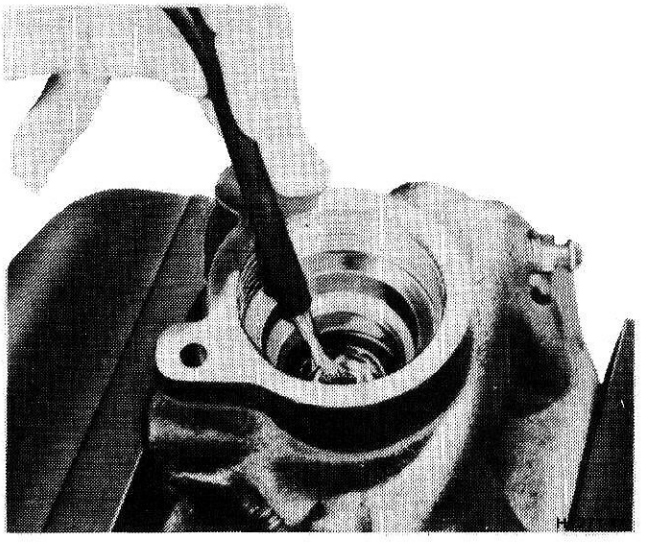


FIG. 22 Filling Piston/Adjuster Assembly

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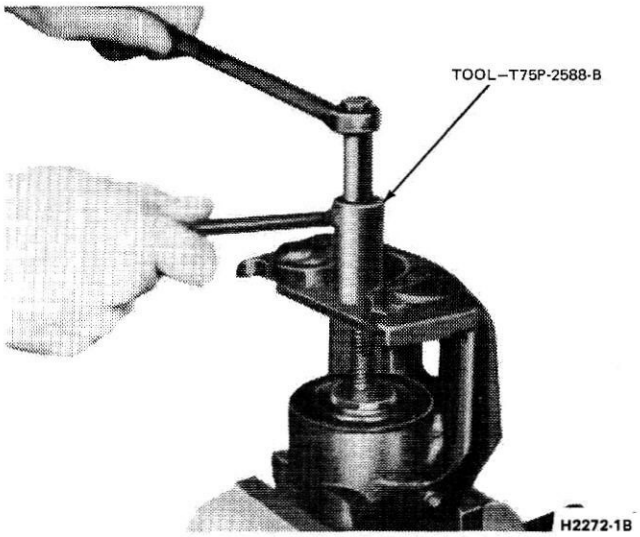


FIG. 23 Bottoming Piston

ROTOR REFINISHING

All Models Equipped With Disc Brakes

Refer to Brake Diagnostic Procedures in Part 12-01 for conditions necessitating rotor refinishing.

Disc Brake Lathe 54-0020 or equivalent should be used to refinish disc brake rotors.

Front Rotor

Rotor minimum thickness must not be less than shown in Fig. 24, nor less than the number cast on the inside of the rotor after refinishing. Lateral runout of the braking surfaces must not exceed 0.003 inch and the surface finish is to be in the 80/15 micro-inch range.

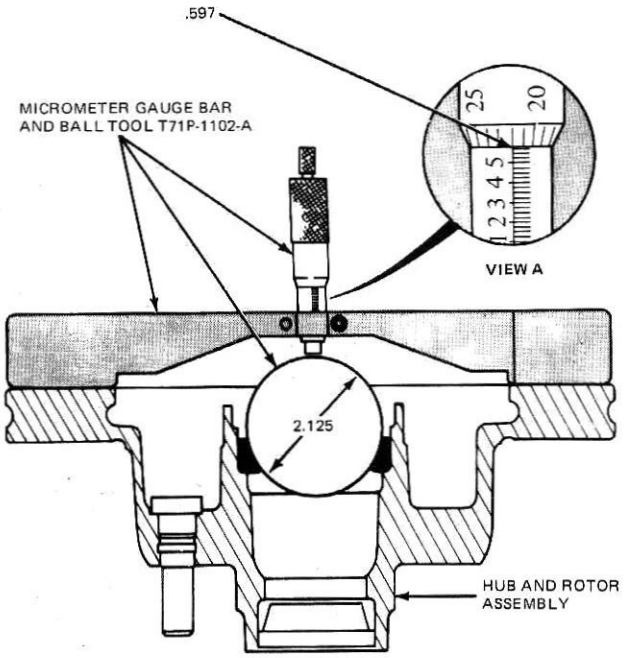
Maximum allowable stock removal of the inner rotor braking surface is determined by the use of a micrometer gauge bar and ball tool (Tool T71P-1102-A) (Fig. 25) as follows:

Car Model	Base Line Setting		Rotor Minimum Thickness ①
	2.25 Ball	2.125 Ball	
LTD II, Cougar, Thunderbird	.035	–	1.12
Continental Mark V	.035	–	1.12
Ford, Mercury, Lincoln Continental	.035	–	1.12
Mustang II, Pinto, Bobcat	–	.597	0.81
Granada, Monarch, Versailles	–	.350	0.81
Fairmont, Zephyr	–	.244	0.81

① Rotors having a thickness less than shown here must be replaced regardless of the micrometer gauge bar and ball measurement.

CH1963-1E

FIG. 24 Front Rotor Micrometer Gauge Bar Base-Line Setting—Front Rotor Minimum Thickness



H1961-1C

FIG. 25 Gauging Front Rotor Inner Braking Surface (Mustang II, Pinto, Bobcat, Fairmont and Zephyr Shown)

1. Remove the inner grease retainer and bearing assembly from the hub and rotor assembly. Wipe the inner and outer bearing cups clean.
2. Carefully place the gauge ball in the inner bearing cup **(do not drop).**
3. Set the micrometer to the base line setting dimension shown in Fig. 24.
4. Position the micrometer gauge bar on the rotor inner braking surface with the micrometer centered over the ball (Fig. 25). To measure the distance between the micrometer base-line setting and the ball, turn the micrometer down to touch the top of the ball, and calculate the difference between that reading and the base line setting. This distance is equal to the maximum allowable stock removal from the inside braking surface only. If the micrometer end, at the base-line setting, touches the ball, no additional stock removal is allowed.

   If the micrometer must be retracted from the base-line setting to allow the legs to set on the rotor surface, the rotor has had more than allowable stock removed and the rotor assembly must be replaced.
5. Check the rotor for the maximum amount of stock that can be removed from the rotor thickness. Measure actual rotor thickness with micrometer and subtract minimum allowable thickness (cast in individual rotor and shown in shop manual). Total material removal (combination of both sides) must not exceed this amount. **If the rotor thickness is less than the minimum (Fig. 24), the rotor must be replaced regardless of the gauge bar and**

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ball measurement. Rotor minimum thickness is also shown on each rotor.

6. Position the rotor in the lathe arbor. Never use a lathe that cuts only one face of the rotor at a time; it must be a simultaneous straddle cut. Install a dial indicator to read rotor lateral run-out near the center of the rotor face. If run-out is 0.002 or below, proceed to machine rotor. If run-out is over 0.002, loosen rotor on the arbor and rotate the rotor 90 degrees. Re-read the run-out and if it is below 0.002, proceed to machine the rotor. If run-out is still over 0.002, again loosen the rotor and rotate it an additional 90 degrees. Re-check the run-out. If run-out is 0.002 or less, proceed to machine the rotor. If the run-out still exceeds 0.002, return the rotor to the best run-out position obtained. If the rotor run-out can be brought below 0.005, proceed to machine the rotor. If the rotor cannot be brought below 0.005 run-out, it must be replaced.
7. Set the cutting tool to just contact the high spots on the rotor, then adjust the cutting tool to the minimum depth required to clean up the rotor face.

Do not exceed the allowable stock removal for the inner braking surface or total rotor thickness. Before installing the rotor on the spindle, clean all chips from the rotor and flush new grease through the bearing with a bearing packing tool.

REAR ROTOR

Refinishing of the rear disc brake rotor is basically the same procedure as that used with the front disc brake rotor. The primary difference is in the gauge used to determine the maximum allowable stock removal on the inner braking surface. Because of the difference in shape between the two rotor hat-sections (there is no bearing cup in the rear hat-section) a special tool (Fig. 26) is required to gauge the rear rotor inner braking surface.

The critical factor in refinishing a rotor is whether or not the thickness of the braking surface will be within specifications when the resurfacing operation is completed. The minimum allowable thickness dimension is cast into each rotor and must be followed when refinishing.

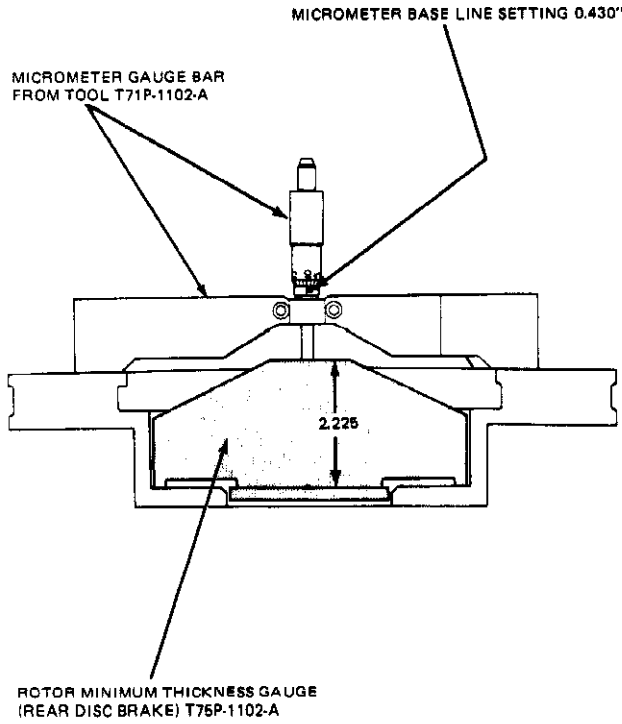
Lateral runout of the braking surfaces must not exceed 0.004 inch and the surface finish is to be in the 80/15 micro-inch range.

Maximum allowable stock removal of the inner rotor braking surface is determined by the use of the micrometer gauge bar (Tool T71P-1102-A) used on the front disc brake rotor, plus a rear disc rotor minimum thickness gauge (Tool T75P-1102-A or T75P-1102-B).

To check the rotor:

1. Carefully place the thickness gauge in the inner hat section of the rotor (do not drop). Make sure that the area of gauge contact is clean and free of rust or contamination.
2. Set the micrometer to the baseline setting dimension shown in Fig. 27.
3. Position the micrometer gauge bar on the rotor inner braking surface with the micrometer centered over the thickness gauge (Fig. 27). To measure the distance between the micrometer base line setting and the thickness gauge, turn the micrometer down to touch the top of the thickness gauge and calculate the difference between that reading and the original setting. This distance is equal to the maximum allowable stock removal from the inside braking face only. If the micrometer end, at the base line setting, touches the thickness gauge, no additional stock removal is allowed.

   If the micrometer must be retracted from the baseline setting to allow the legs to set on the rotor surface, the rotor has had more than allowable stock removed and must be replaced.
4. Check the rotor for the maximum amount of stock that can be removed from the rotor thickness. Measure actual rotor thickness with the micrometer



H2273-1B

FIG. 26 Gauging Rear Rotor Inner Braking Surface—Ford, Mercury, Thunderbird, Continental Mark V and Lincoln Continental Shown

Car Model	Base Line Setting T75P-1102-A (2.225 Gauge)	Base Line Setting T75P-1102-B (2.475 Gauge)	Rotor Minimum Thickness ①
Mark V, Lincoln, Ford, Mercury	.430	–	.895
Monarch, Granada, Versailles	–	.351	.895

① Rotors having a thickness less than shown here must be replaced regardless of the micrometer gauge and bar measurement.

CH2292-1D

FIG. 27 Rear Rotor Micrometer Gauge Bar Base-Line Setting—Rotor Minimum Thickness

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and subtract the minimum allowable thickness (cast into the rotor). Total material removal (combination of both sides) must not exceed this amount. If the rotor thickness is less than the minimum the rotor must be replaced, regardless of the gauge bar and thickness gauge measurement.

5. *Position the rotor in the lathe arbor. Determine the* rotor runout by following the procedure given in Step 6 under Front Rotor Refinishing.

6. Set the cutting tool to just contact the high spots on the rotor, then adjust the cutting tool to the minimum depth required to clean up the rotor face. If runout exceeds 0.004 inch after resurfacing, replace the rotor.

Do not exceed either the allowable stock removal *from the inner braking surface or the total rotor* thickness. Clean all cuttings and chips from the rotor before installing it on the axle.

SPECIFICATIONS

FRONT DISC BRAKE DIMENSIONS AND SPECIAL SERVICE TOOLS

Component	Ford, Mercury	Lincoln Continental, Continental Mark V	LTD II, Cougar, Thunderbird	Pinto, Bobcat Mustang II	Fairmont, Zephyr	Granada, Monarch, Versailles
Lining Material	Riveted	Riveted	Riveted	Riveted	Riveted	Riveted
Lining Size	6.40 x 1.80 outer 5.16 x 1.90 inner	6.40 x 1.80 outer 5.16 x 1.90 inner	6.40 x 1.80 outer 5.16 x 1.90 inner	5.0 x 1.4 outer 5.0 x 1.4 inner	5.92 x 1.97 outer 4.74 x 2.32 inner	6.0 x 1.9 outer 5.24 x 1.9 inner
Lining Wear Limit (From Shoe Surface)	1/8	1/8	1/8	1/8	1/8	1/8
Lining to Rotor Clearance (Brakes Released)	0.000-0.010	0.000-0.010	0.000-0.010	0.000-0.010	0.000-0.010	0.000-0.010
Caliper Cylinder Bore Dia.	3.100	3.100	3.100	2.6	2.36	2.6
Master Cylinder Bore Dia.	1.000	1.000 ④	1.000	0.938	0.9750	0.938 ⑤
Front Rotor Nominal *Thickness*	1.180	1.180	1.180	0.870	0.870	0.870
Front Rotor Minimum Thickness ①	1.120	1.120	1.120	0.810	0.810	0.810
Front Rotor Diameter	11.80 outside 7.785 inside	11.80 outside 7.785 inside	10.720 outside ② 6.785 inside ②	9.3 outside 6.24 inside	10.08 outside 6.24 inside	11.03 outside 7.03 inside
Front Rotor Allowable Runout	0.003	0.003	0.003	0.003	0.003	0.003
Front Rotor Finish (Micro-inches)	15-80	15-80	15-80	15-80	15-80	15-80
Front Rotor Thickness Variation	0.0005 ③	0.00025	0.0005	0.0005	0.0005	0.0005
Gauge Bar Micro-meter Base-Line Setting	See Overhaul Section					

① Minimum Safe Thickness is shown on each Rotor.
② "Same As Ford" on Police Vehicles.
③ 0.0004 on Mercury.
④ 1.125" Dia. Std. on Mark V, Also used with Disc Brake option for Lincoln.
⑤ 1.00" Dia. used with Rear Disc Brake option.

CH1973-2H

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DETROIT IRON

REAR DISC BRAKE DIMENSIONS AND SPECIAL SERVICE TOOLS

Component	Mercury and Ford	Lincoln and Mark V	Granada, Monarch and Versailles
Lining Material	Riveted	Riveted	Riveted
Lining Size	6.02 x 1.90 Inner & Outer	6.02 x 1.90 Inner & Outer	6.02 x 1.90 Inner & Outer
Lining Wear Limit (From Shoe Surface)	1/8	1/8	1/8
Caliper Cylinder Bore Diameter	2.6	2.6	2.1
Rear Rotor Nominal Thickness	.945	.945	.945
Rear Rotor ① Minimum Thickness	.895	.895	.895
Rear Rotor Diameter	11.50 Outside 7.26 Inside	11.50 Outside 7.26 Inside	10.66 Outside 6.33 Inside
Rear Rotor Allowable Runout	.004	.004	.004
Rear Rotor Finish (Micro-Inches)	15-80	15-80	15-80
Rear Rotor Thickness Variation	0.0005	0.0004	0.0005

① Minimum safe thickness is shown on each rotor.

SPECIAL SERVICE TOOLS

Tool No.	Description	Tool No.	Description
Tool 7000 DE	Rubber Tipped Air Nozzle	2162	Adapter Cap
T71P-1102-A	Ball and Gage Bar Kit	J22742	Bleeder Valve Spring Clip
T75P-1102-A	Rotor Micrometer Gage Bar		
T75P-1102-B	Rotor Micrometer Gage Bar		
T75P-2588-B	Piston Turning Tool		
T75P-2588-A	Piston Removing Tool		
54-0020	Disc Brake Rotor Lathe	Milbar 1112-144	Inch Pound Torque Wrench

CH2293-2D

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Vacuum Brake Booster—Dash Mounted

PART 12-50

Applies to All Car Lines

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DIAGNOSIS AND TESTING	
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CH2485-28

DESCRIPTION

The diaphragm-type brake booster is a self-contained vacuum-hydraulic braking unit mounted on the engine side of the dash panel.

The brake booster is of the vacuum suspended-type, which utilizes engine intake manifold vacuum and atmospheric pressure for its power. **Adjustment of the push rod is the only service permitted on the brake booster. Excepting for Fairmont/Zephyr vehicles, which can only be checked using the MAX-MIN push rod gauge (Fig. 1). If the push rod is not within the prescribed limits, a new booster must be installed.**

If any brake booster is damaged or inoperative, replace it with a new booster. The brake booster (including the check valve) is serviced only as an assembly.

ADJUSTMENTS

BRAKE BOOSTER-TO-MASTER CYLINDER PUSH ROD

Adjustment

Except for Fairmont/Zephyr vehicles, the vacuum booster has an adjustable push rod (output rod) which is used to compensate for dimensional variations in an assembled booster. The push rod length is adjusted after each booster power unit has been assembled in production. **A properly adjusted push rod that remains assembled to the booster with which it was matched in production should never require a service adjustment.**

A booster that is suspected of having an improper push rod length will indicate either of the following:

1. A push rod which is too long will prevent the master cylinder piston from completely releasing hydraulic pressure and eventually cause the brakes to drag.
2. A push rod which is too short will increase brake pedal travel and cause a clunk noise from the booster and master cylinder assembly.

If necessary, a booster push rod length can be verified with a push rod gauge (See Fig. 1) using the following procedure:

1. Without disconnecting the brake tubes, disconnect the master cylinder and set it away from the booster power unit. The master cylinder must be supported to prevent damaging the brake tubes.
2. With the engine running, gauge and adjust the push rod length as shown in Figure 2. (A force of approximately 5 pounds applied to the push rod with the gauge will assure that the push rod is seated within the power unit.)

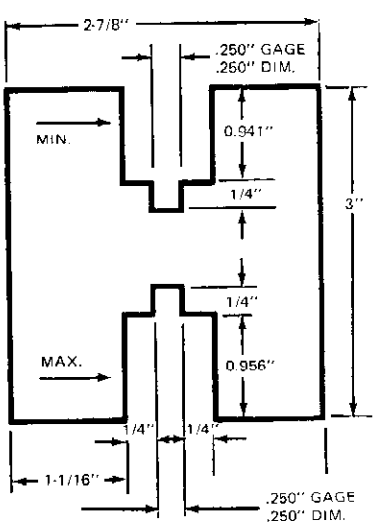


FIG. 1 Push Rod Gauge Dimensions

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3. Install the master cylinder on the power unit and alternate tightening the retaining nuts gradually to the torque specified in Part 12-01.

4. With the engine running and the master cylinder reservoir cover removed, observe the fluid surface in the reservoirs when the brake pedal is applied rapidly. **Some fluid movement should occur in the forward reservoir. If fluid surface movement did not occur, the push rod is adjusted too long and the procedure must be repeated to prevent eventual brake drag.**

Fairmont/Zephyr Vehicles

Fairmont/Zephyr vehicles have the vacuum booster to master cylinder push rod manufactured to a specific length. The screw adjuster found on other vehicles has been eliminated and adjustments are not necessary. However, the push rod gauge length can be checked to determine if the length is within limits.

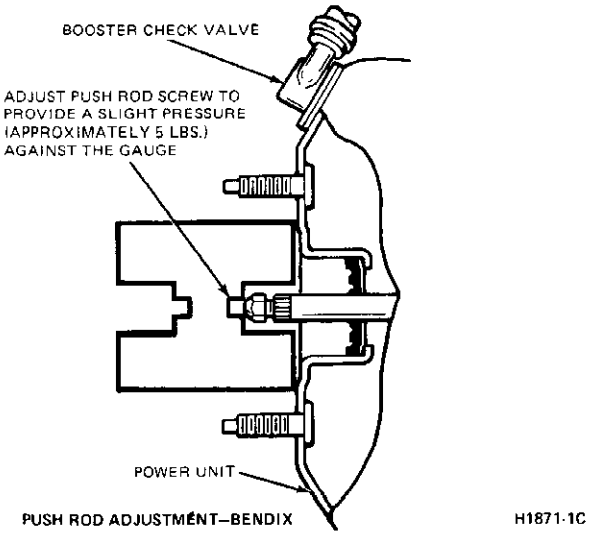


FIG. 2 Brake Booster Push Rod Measurement

DIAGNOSIS AND TESTING

VACUUM POWER BRAKE FUNCTION TEST

The vacuum booster may be tested for proper operation by following the procedure in Part 12-01 under Power Brake Function Test.

REMOVAL AND INSTALLATION

BRAKE BOOSTER—VACUUM

Pinto, Bobcat, Mustang II, Granada and Monarch, (Refer to Fig. 3.)

Removal (Same for all above vehicles except as noted)

1. Working inside the vehicle below the instrument panel, remove the stoplight switch wiring connector from the switch. Remove the hair pin retainer and outer nylon washer from the pedal pin. Slide the stoplight switch off the brake pedal pin just far enough for the outer arm to clear the pin. Remove the switch. Be careful not to damage the switch during removal. Slide the booster push rod, bushing and the inner nylon washer off the brake pedal pin.

   a. **Pinto and Bobcat**
   Working in engine compartment, remove air cleaner from carburetor on all engines. Then perform the following steps on 4-cylinder engines only: Disconnect accelerator cable from carburetor. Remove screw that secures accelerator cable to accelerator shaft bracket and remove cable from bracket. Remove two (2) screws that secure accelerator shaft bracket to manifold and rotate bracket toward engine. Remove screw that secures heater outlet tube clip to rocker arm cover and remove clip. Remove hose from inlet port of automatic choke water cover and move tube up and toward engine away from work area. Remove vacuum hose or hoses from solenoid on fender apron. Remove screw that secures solenoid to fender apron and move away from area.

   b. **Mustang II (4-cylinder and 6-cylinder engines only)**
   Remove air cleaner from carburetor. Perform the following steps on 4-cylinder engine only: Remove accelerator cable from carburetor. Remove two (2) screws that secure accelerator cable bracket to engine and move bracket toward engine. Disconnect choke thermostat water inlet hose from the thermostat cover, and secure hose up out of booster area. Remove vacuum hose from EGR vacuum reservoir.

2. Disconnect manifold vacuum hose from booster.

3. Remove the brake tubes from the primary and secondary outlet ports of the master cylinder and cap lines. Also, plug ports in master cylinder.

4. Remove two (2) nuts attaching master cylinder to brake booster assembly and remove master cylinder.

5. Working inside car, remove the booster-to-dash panel attaching nuts. From the engine compartment, move booster forward until push rod clears dash panel, rotate front of booster up 90 degrees and remove booster by raising up until clear.

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Installation (Same for all above vehicles except as noted)

1. Place booster in position on dash panel with check valve in upper right side.
2. Working inside vehicle, install inner nylon washer, booster push rod, and bushings on brake pedal pin. Secure booster to dash panel with self-locking nuts and torque to 13-25 ft-lbs. Position stoplight switch so that it straddles booster push rod with switch slot toward pedal blade and hole just clearing pin. Slide switch completely onto pin. **Be careful not to bend or deform switch.** Install nylon washer on pin and secure all parts to pin with hair pin retainer. Make sure retainer is fully installed and locked over pedal pin. Install stoplight switch wiring connector on stoplight switch.
3. Connect the manifold vacuum hose to the booster using hose clamp.
4. Position master cylinder assembly over booster push rod and onto two (2) studs on booster assembly. Install attaching nuts and torque to 13-25 ft-lbs.
5. Remove caps from brake tubes and plugs from master cylinder outlet ports and install brake tube fittings into ports and torque to specification.
   a. **Pinto and Bobcat (4-cylinder engines only)** Place heater outlet tube in position on engine and install tube end hose on automatic choke water cover. Secure hose to cover with hose clamp. Secure tube to rocker arm cover with clip and screw. Place accelerator shaft bracket in position on engine and secure with two (2) screws. Route accelerator cable to shaft bracket and secure cable bracket to shaft bracket with a screw. Connect accelerator cable to carburetor. Position vacuum solenoid on fender apron and install screw. Install vacuum hose on solenoid. Install air cleaner on 4-cylinder and 6-cylinder engines.
   b. **Mustang II (4-cylinder engines only)** Place heater outlet tube in position on engine and install tube end hose on automatic choke water cover. Secure hose to cover with a hose clamp. Secure tube to rocker arm cover with clip and screw. Place accelerator shaft bracket in position on engine and secure with two (2) screws. Connect accelerator cable to carburetor. Install vacuum hose on EGR vacuum reservoir. Install air cleaner on 4-cylinder and 6-cylinder engines.
6. Bleed the brake system. Refer to Hydraulic System Bleeding, Part 12-01.
7. Start engine and check power brake function.

FAIRMONT/ZEPHYR

Removal

1. Working in engine compartment, remove air cleaner from carburetor on all engines. Then perform the following steps on 2.3 Litre engines only: Disconnect accelerator cable from carburetor. Remove the screw that secures the accelerator cable to accelerator shaft bracket and remove cable from bracket. Remove two (2) screws that secure accelerator shaft bracket to manifold and rotate bracket toward engine.
2. Disconnect manifold vacuum hose from booster.
3. Remove the brake tubes from the primary and secondary outlet ports of the master cylinder and cap lines.

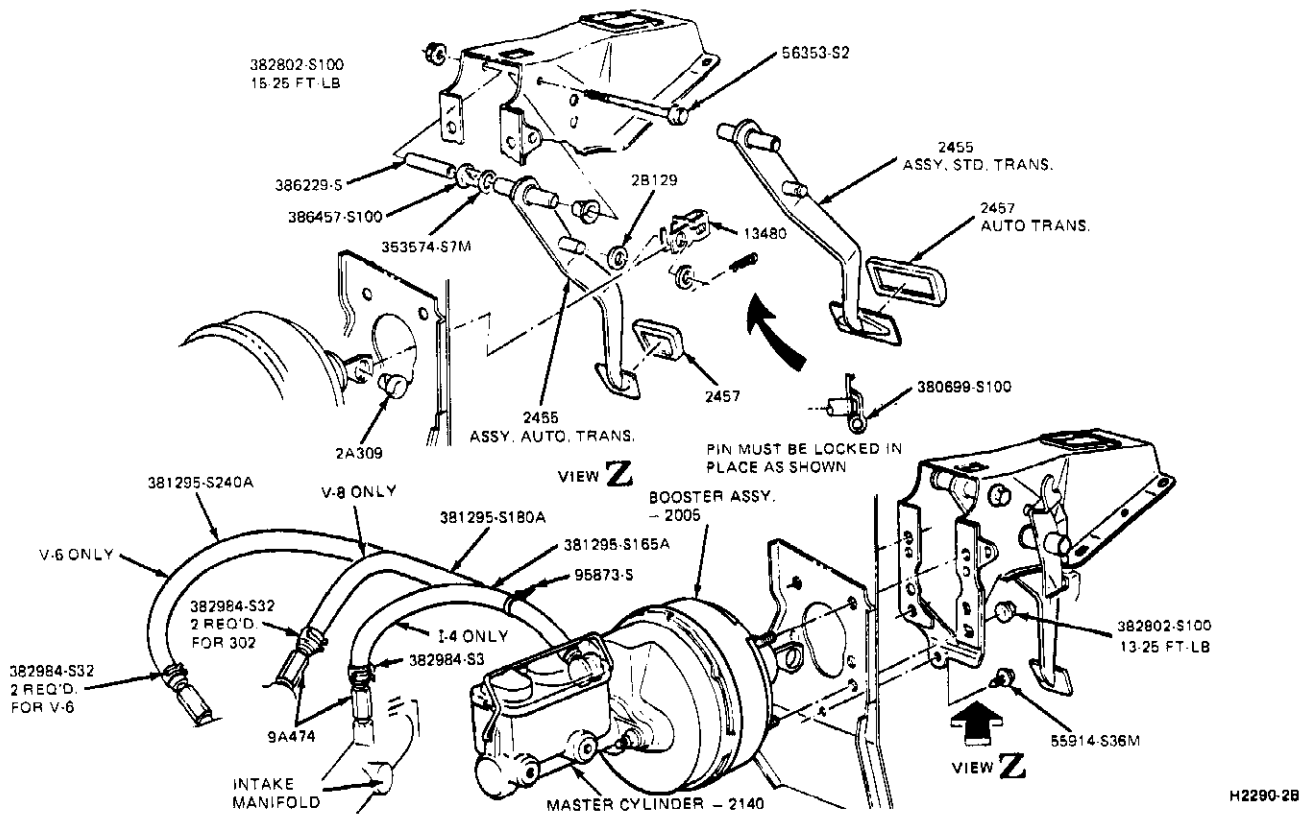


FIG. 3 Typical Vacuum Booster Installation—Mustang II Shown

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4. Remove two (2) nuts attaching master cylinder to brake booster assembly and remove master cylinder.
5. Working inside the vehicle below the instrument panel, remove the stoplight switch wiring connector from the switch. Remove the hairpin retainer and outer nylon washer from the pedal pin. Slide the stoplight switch off the brake pedal pin just far enough for the outer arm to clear the pin. Remove the switch. Be careful not to damage the switch during removal. Remove the booster to dash panel attaching nuts. Slide the booster push rod, bushing and the inner nylon washer off the brake pedal pin.
6. Inside the engine compartment, move booster forward until the booster studs clear the dash panel, then rotate front of booster inboard (toward engine) and remove booster by raising up until clear.

Installation

1. Place booster in position on dash panel with check valve in upper right side. Do not install the booster to dash panel attaching nuts.
2. Working inside vehicle, install inner nylon washer, booster push rod and bushings on brake pedal pin. Secure the booster to dash panel attaching nuts and torque to 13-25 ft-lbs. Position stoplight switch so that it straddles booster push rod with switch slot toward pedal blade and hole just clearing pin. Slide switch completely onto pin. Be careful not to bend or deform switch. Install nylon washer on pin and secure all parts to pin with hairpin retainer. Make sure retainer is fully installed and locked over pedal pin. Install stoplight switch wiring connector on stoplight switch.
3. Connect the manifold vacuum hose to the booster using hose clamp.
4. Position master cylinder assembly over booster push rod and onto two (2) studs on booster assembly. Install attaching nuts and torque to 13-25 ft-lbs.
5. Remove caps from brake tube and plugs from master cylinder outlet ports and install brake tube fittings into ports and torque to specifications.
6. On 2.3 Litre engines, place accelerator shaft bracket in position on engine and secure with two (2) screws. Route accelerator cable bracket to shaft bracket with a screw. Connect accelerator cable to carburetor. Install the air cleaner on all engines.
7. Bleed the brake system using existing shop manual procedures.
8. Start engine and check power brake function.

LTD II, COUGAR, FORD, MERCURY AND THUNDERBIRD (REFER TO FIG. 4)

Removal (Same for all above vehicles except as noted)

1. Working inside the vehicle below the instrument panel, remove the stoplight switch wires at the connector. Remove the switch retaining pin. Slide the stoplight switch off from the brake pedal pin just far enough for the outer plate of the stoplight switch to clear the pin and then remove the switch from the pin. Be careful not to damage the switch during removal. Slide the booster push rod, nylon washers and bushing off the brake pedal pin.

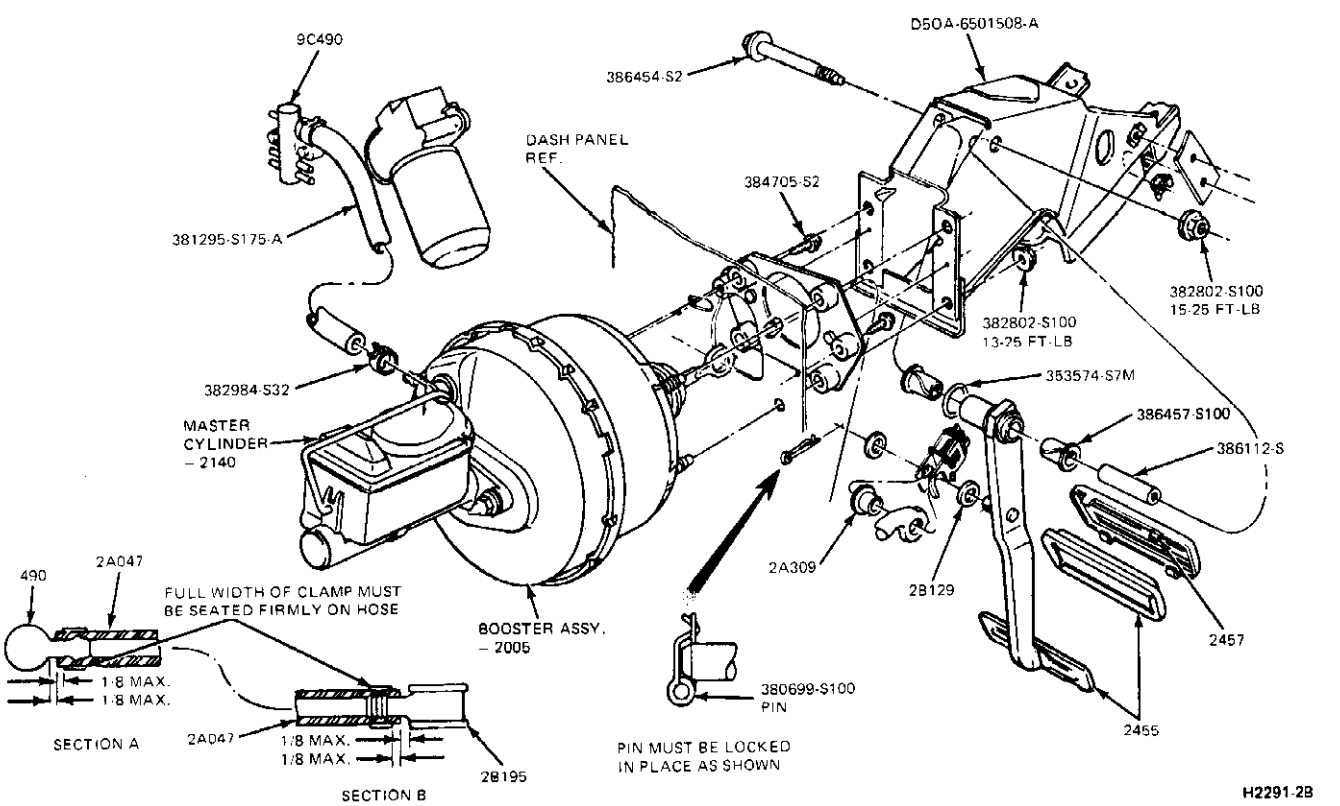


FIG. 4 Typical Vacuum Booster Installation—Thunderbird Shown

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a. **LTD II and Cougar (Cars equipped with speed control only).**
Working in engine compartment, remove left cowl screen. Remove three (3) nuts that retain speed control servo mounting bracket to dash panel and move servo away from working area.

2. Working in engine compartment remove the master cylinder from the booster. Set it aside without disturbing the hydraulic lines. It is not necessary to disconnect the brake lines but care should be taken that the brake lines are not deformed. Deformation of brake lines can lead to tube damage.
3. Disconnect the manifold vacuum hose from the booster unit.
4. Remove the booster-to-dash panel attaching nuts. Remove the booster assembly from the dash panel, sliding the push rod out from the engine side of the dash panel.

Installation (Same for all above vehicles except as noted)

1. Place booster in position on dash panel with check valve in upper right side.
2. Working inside vehicle, install inner nylon washer, booster push rod, and bushing on brake pedal pin. Secure booster to dash panel with self-locking nuts and torque to 13-25 ft-lbs. Position stoplight switch so that it straddles booster push rod with switch slot toward pedal blade and hole just clearing pin. Slide switch completely onto pin. **Be careful not to bend or deform switch.** Install nylon washer on pin and secure all parts to pin with hair pin retainer. Make sure retainer is fully installed and locked over pedal pin. Install stoplight switch wiring connector on stoplight switch.
3. Connect the manifold vacuum hose to the booster using hose clamp.
4. Install the master cylinder to the booster studs and torque the attaching nuts to 13-25 ft-lbs.

a. **LTD II and Cougar (Cars equipped with speed control only).**
Place speed control servo bracket in position on dash panel and secure with three (3) nuts.

5. Start engine and check power brake function.

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DETROIT IRON

Hydro-Boost Brake Booster

PART 12-51

Applies to Ford, Mercury, Lincoln Continental, Continental Mark V, Granada, Monarch and Versailles

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OPERATION (Cont'd.)	
Braking Position	51-3
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CH2556-2B

GENERAL INFORMATION

The power steering pump provides the fluid pressure to operate both the hydraulically-powered brake booster (hydro-boost) and the power steering gear (Fig. 1).

The hydro-boost assembly contains an open center spool valve which controls pump pressure magnitude during braking, a lever mechanism to control the position of the valve, and a boost piston to provide the force necessary to operate a conventional master cylinder which is attached to the front end of the booster. The hydro-boost also has a reserve system (compressed gas accumulator) which is designed to store *sufficient fluid under pressure to provide at least two* (2) brake applications in the event that the fluid flow from the power steering pump is not available. The brakes can also be applied manually if the reserve system is depleted. Fig. 2 shows a typical hydro-boost power section.

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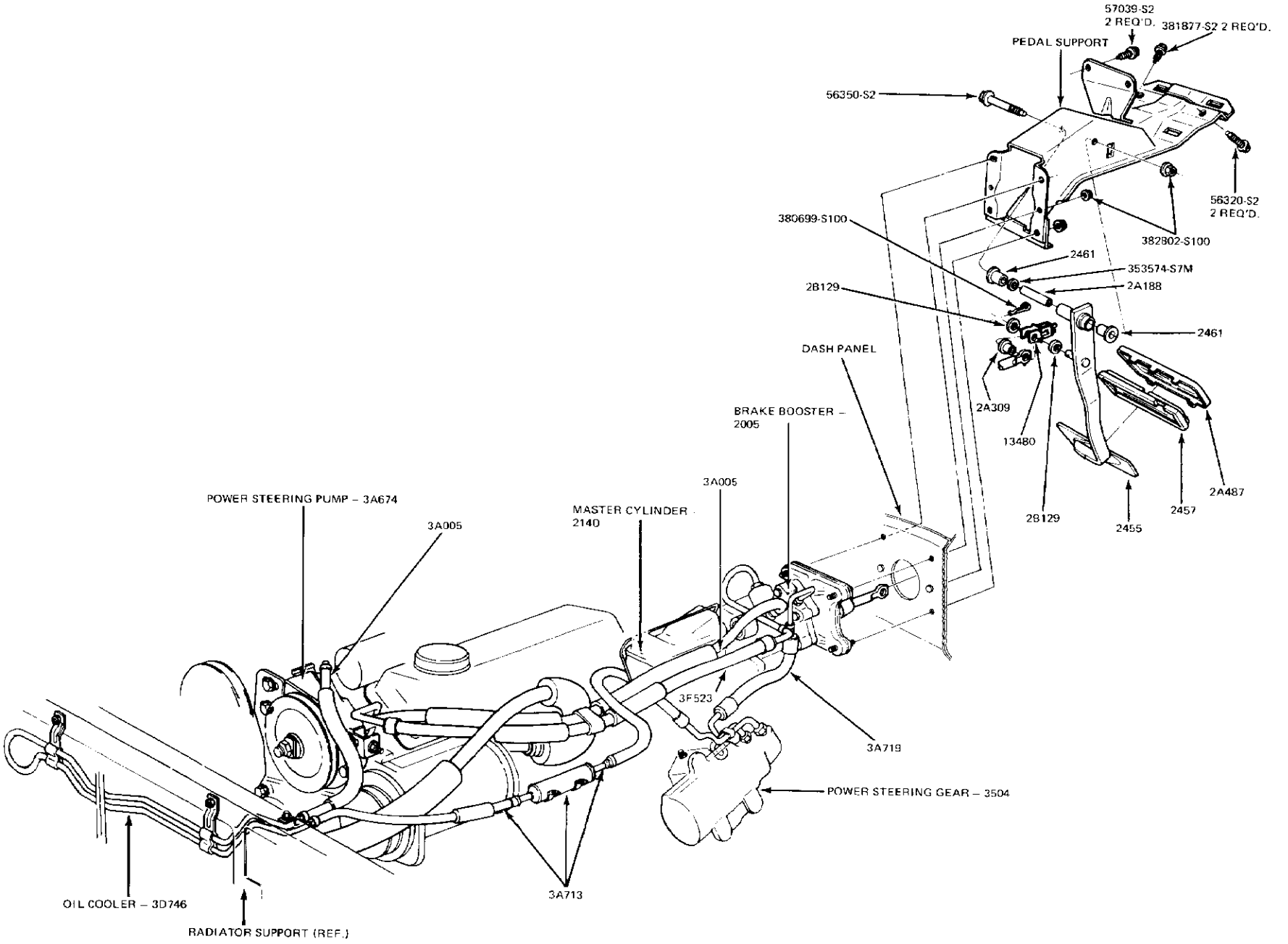


FIG. 1 Hydro-Boost Installation—Typical

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DETROIT IRON

OPERATION

RELEASED POSITION—NO BRAKING (REFER TO FIG. 2)

When the brake pedal is in released position (no braking), the spool valve return spring holds the spool valve open. In the open position, the spool valve provides an unrestricted fluid flow between the power steering pump and the power steering gear. Fluid pressure is blocked from entering the boost pressure chamber by lands on the spool valve. Therefore, as fluid pressure increases with steering demand, it has no effect on the boost pressure chamber. The boost pressure chamber is vented through the spool valve, to the pump return port and, back to the power steering pump.

BRAKING POSITION

As the brake pedal is depressed, it moves the pedal rod and initiates movement of the spool valve. This preliminary movement of the valve closes the fluid return port to the pump from the boost chamber and admits fluid into the boost chamber from the pressure port. Additional valve movement restricts fluid flow between the pump and steering gear, causing the power steering pump to increase fluid pressure to maintain essentially the same flow rate to the power steering gear. As the fluid pressure increases in the boost chamber, it forces the piston forward, actuating the master cylinder piston and resulting in brake application.

If, while braking, fluid pressure is required for steering, pump pressure will rise and the spool valve will shift in an open direction allowing more fluid to flow to the steering gear. Even under extremes of braking, the fluid flow to the steering gear is fully sufficient for steering the car.

RESERVE SYSTEM

The reserve braking system consists of a charging valve, an accumulator valve and a compressed gas accumulator. The system is open to the pressure port of the hydro-boost.

The charging valve has an orifice and a check valve. Fluid from the pump passes around the check valve into the accumulator if the pump pressure exceeds the pressure in the accumulator. The charging rate is controlled by the orifice to minimize its effect on fluid flow to the steering gear. The check valve prevents reverse flow when the accumulator pressure is greater than pump pressure.

The accumulator valve is a small poppet type valve held closed by the pressure stored in the accumulator. An actuator on the spool valve sleeve opens the accumulator valve when a stop with no pump pressure is made that requires use of the reserve system pressure.

Fluid pressure can also enter the accumulator from the boost chamber through the accumulator valve. This condition occurs whenever boost chamber pressure momentarily exceeds accumulator pressure.

A pressure relief valve vents the accumulator to the pump pressure port whenever pressure in the accumulator exceeds approximately 1,400 psi.

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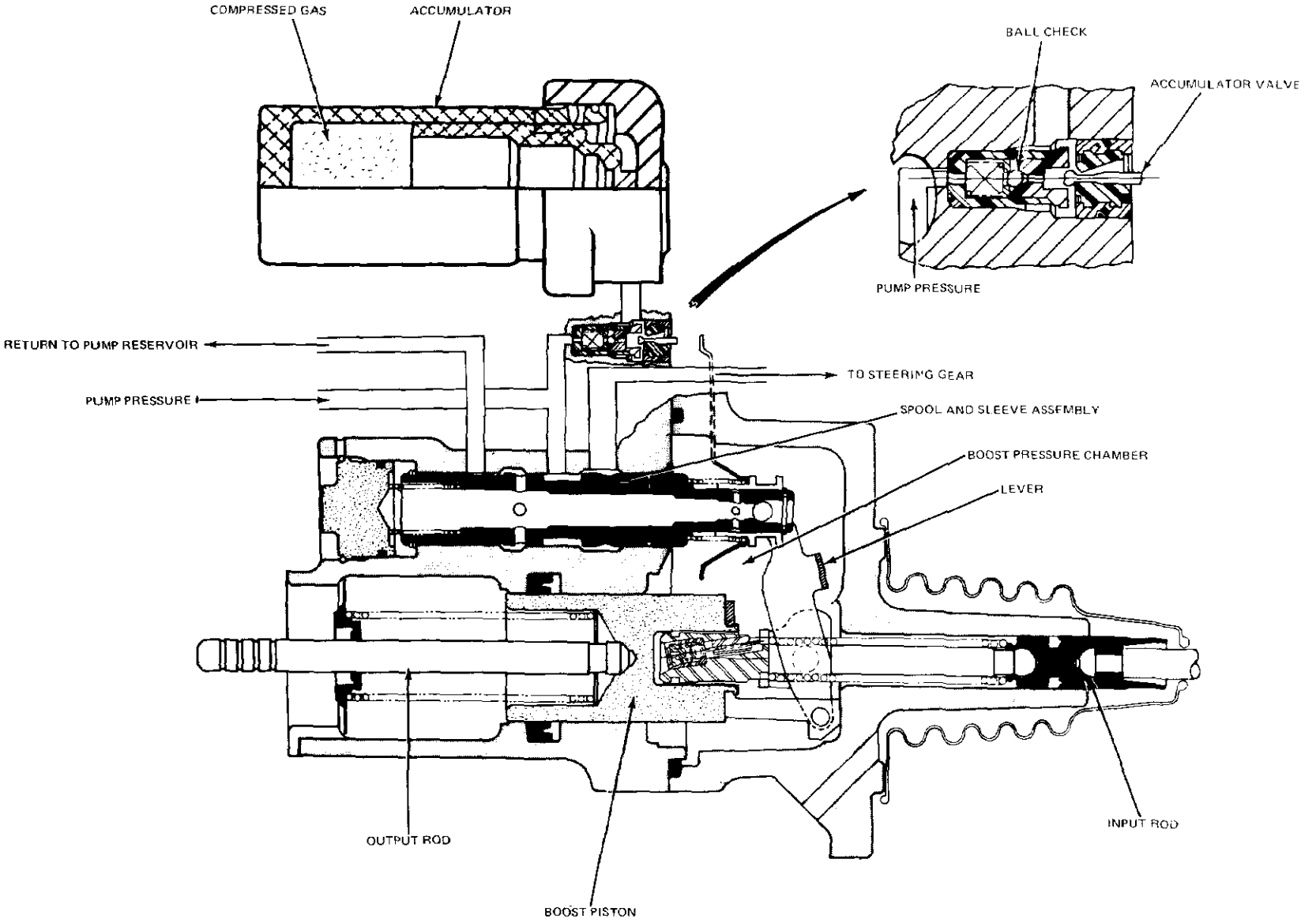


FIG. 2 Hydro-Boost—Sectional View

H2258-2C

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DETROIT IRON

DIAGNOSIS AND TESTING

Diagnosis and testing procedures for the Hydro-Boost system are covered in General Hydraulic Brake Service, Part 12-01.

REMOVAL AND INSTALLATION

REFER TO FIG. 3 OR 4

The hydro-boost is serviced as an assembly only. If the cause of the complaint is determined to exist in the booster, the unit should be replaced. Before removing the hydro-boost, discharge the accumulator by making several brake applications until a hard pedal is obtained. **NOTE: Do not disassemble the hydro-boost.** Following is the procedure for replacement.

Removal

1. Open the hood and remove the two nuts or bolts attaching the master cylinder to the brake booster. Remove the master cylinder from the hydro-boost. Secure it to one side without disturbing the hydraulic lines. It is not necessary to disconnect the brake lines, but care should be taken that the brake lines are not deformed. Permanent deformation of brake lines can lead to tube damage.
2. Disconnect the pressure, steering gear and return lines from the booster. Plug the lines and the ports in the hydro-boost to prevent entry of dirt.
3. Working from inside the vehicle below the instrument panel, disconnect the hydro-boost push rod from the brake pedal assembly. To do this, proceed as follows:

   Disconnect the stoplamp switch wires at the connector. Remove the hairpin retainer. Slide the stoplamp switch off from the brake pedal pin just far enough for the switch outer hole to clear the pin, and then remove the switch from the pin. Be careful not to damage the switch during removal. Loosen the hydro-boost to dash panel attaching locknuts (Fig. 1). Slide the hydro-boost push rod and the nylon washers and bushing off the brake pedal pin (Fig. 1).
4. Remove the hydro-boost-to-dash panel attaching nuts (Fig. 1). Remove the hydro-boost assembly from the dash panel, sliding the push rod link out from the engine side of the dash panel.

Installation

1. Mount the hydro-boost assembly to the dash panel by inserting the push rod and boot through the hole in the dash panel. **Loosely install the hydro-boost to dash panel attaching lock nuts** (Fig. 1).
2. Working from inside the vehicle below the instrument panel, connect the hydro-boost push rod to the brake pedal assembly. To do this, proceed as follows:

   Install the inner nylon washer, the hydro-boost push rod, and the bushing on the brake pedal pin. Position the switch so that it straddles the push rod with the switch slot on the pedal pin and the switch outer hole just clearing the pin. Slide the switch completely onto the pin and install the nylon washer as shown in Fig. 1. Be careful not to bend or deform the switch. Secure these parts to the pin with the hair-pin retainer. Connect the stoplamp switch wires to the connector, and install the wires in the retaining clip. Tighten the hydro-boost to dash panel attaching locknuts.
3. Install the master cylinder on the booster and secure with nuts or bolts. Torque attaching nuts or bolts to specification.
4. Remove the plugs and connect the fluid pressure, steering gear and return line fittings to the hydro-boost (Fig. 1). Torque fittings to specifications.
5. Remove the coil wire so the engine will not start. Fill the power steering pump reservoir and, while engaging the starter, apply the brakes with a pumping action. Do not cycle the steering wheel until all residual air has been purged from the hydro-boost.

   Check the fluid level and add as required. Install the coil wire, start the engine and apply the brakes with a pumping action. Cycle the steering wheel. Check for fluid leaks.

   If a whine type noise should result following the installation of a hydro-boost, fluid aeration may be suspected. To correct this condition, refer to Purging (Devac) Power Steering System instructions detailed in Part 13-01, General Steering Service.

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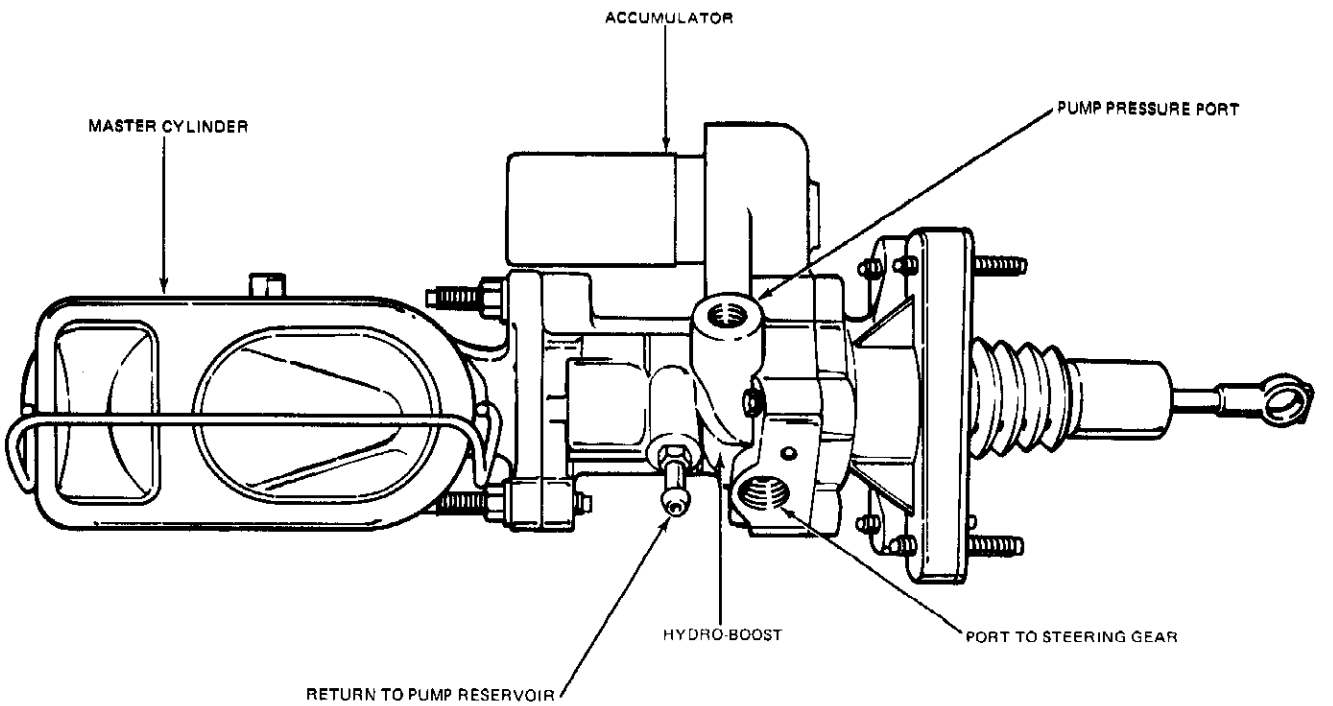


FIG. 3 Hydro-Boost Assembly—Ford, Mercury, Lincoln Continental, Continental Mark V

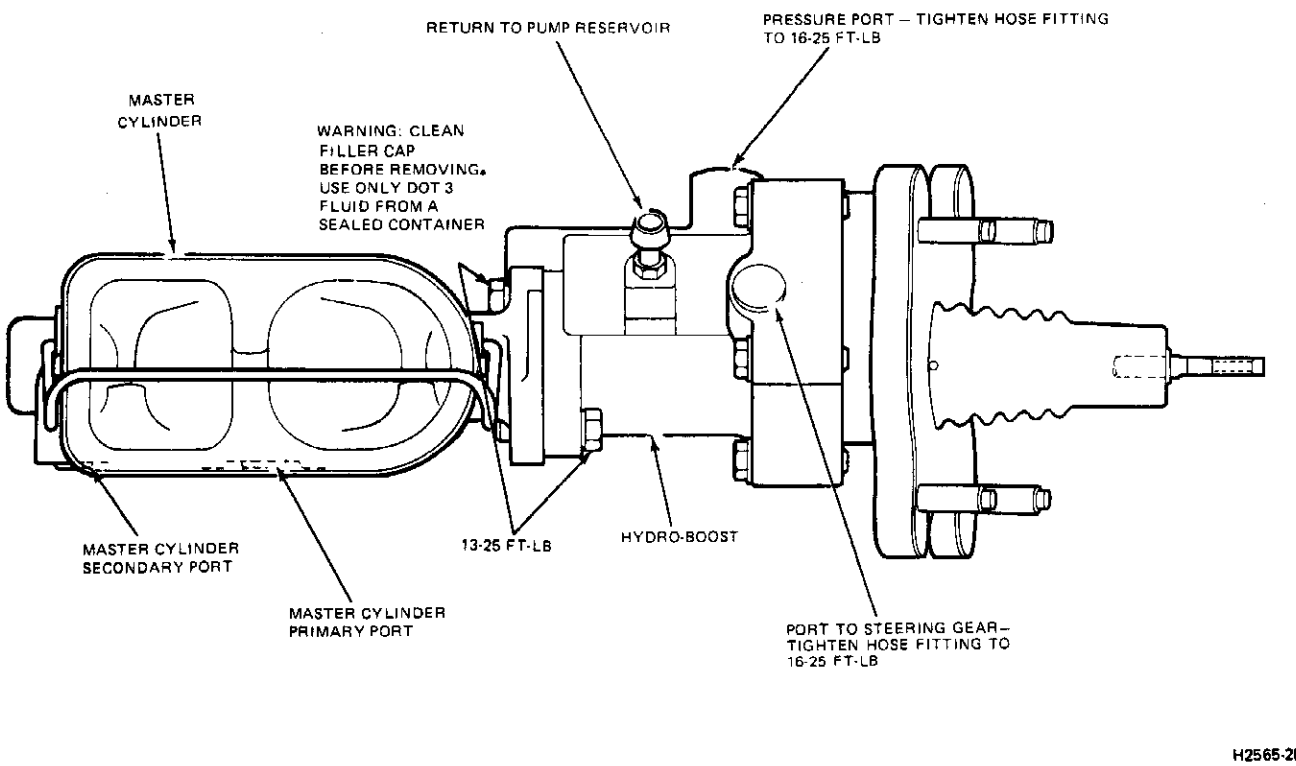


FIG. 4 Hydro-Boost Assembly—Granada, Monarch, Versailles

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DETROIT IRON

Parking Brake—Cable Actuated—Rear Wheels

PART 12-70

Applies To All Cars

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CC3525-2A

DESCRIPTION

The various parking brake systems for 1978 cars are shown in Figs. 7 through 17. The various parking brake control assemblies are shown in Figs. 1 through 6.

CONTROL ASSEMBLIES

On Pinto/Bobcat/Mustang II vehicles, an independent hand-operated parking brake control, mounted on the tunnel between the front seats (Fig. 1) actuates the rear wheel brake shoes through cables. When the handle is pulled upward, the primary and secondary brake shoes are forced against the rear brake drums. The handle is held in the applied position by engagement of a spring-loaded pawl and ratchet. The brakes are released by pulling upward on the control and depressing the plunger in the end of the control assembly handle (Fig. 1).

On all vehicles except Pinto, Bobcat and Mustang II, an independent foot-operated parking brake control actuates the rear wheel brake shoes through a cable system (Figs. 2, 3, 4, 5, 6 and 7).

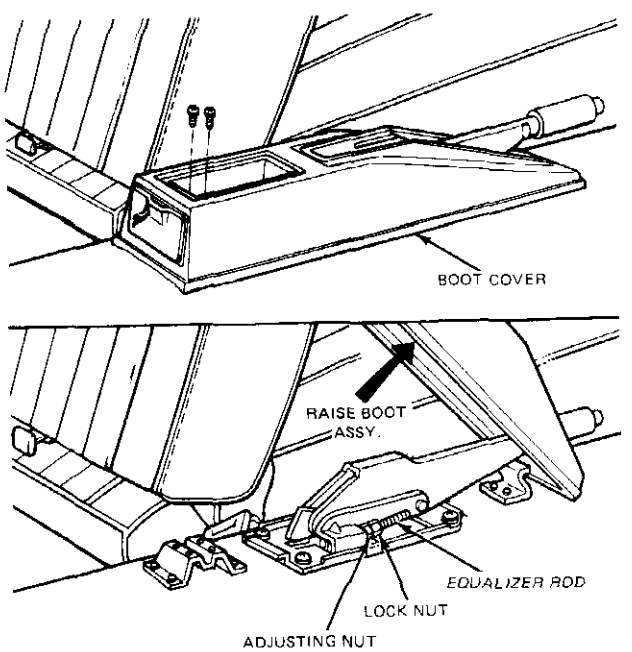
A parking brake warning light is part of the system, indicating to the driver whether the parking brake is applied or released.

The automatic (vacuum) release type is either standard or optional equipment on all foot-operated parking brake systems except Fairmont and Zephyr, on which only the manual release system is available.

On the automatic-type, the vacuum power unit with mounting bracket is bolted to the control assembly. The vacuum-actuated piston within the unit is connected by a rod to the upper end of the release lever.

The vacuum motor is actuated to release the parking brake whenever the engine is running and the transmission is in either a reverse or forward driving gear.

The lower end of the release lever extends out for alternate manual release, in the event of vacuum power failure or for optional manual release at any time.

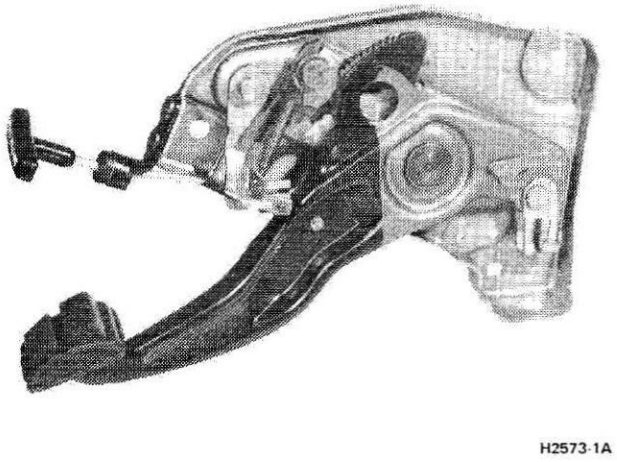


H1962-1C

FIG. 1 Parking Brake Control Assembly—Pinto and Mustang II

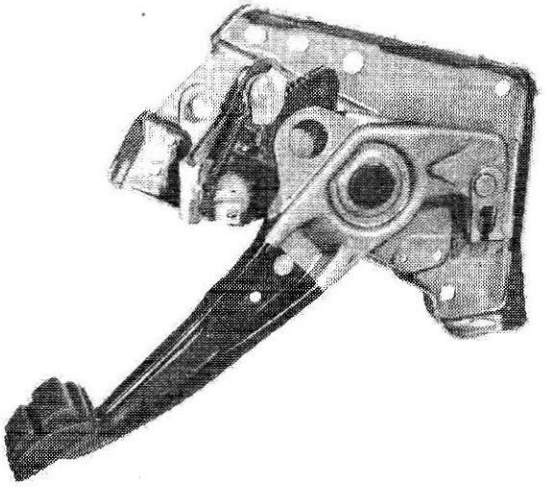
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Hoses connect the power unit and the engine manifold to a vacuum release valve on the back-up light switch.



H2573-1A

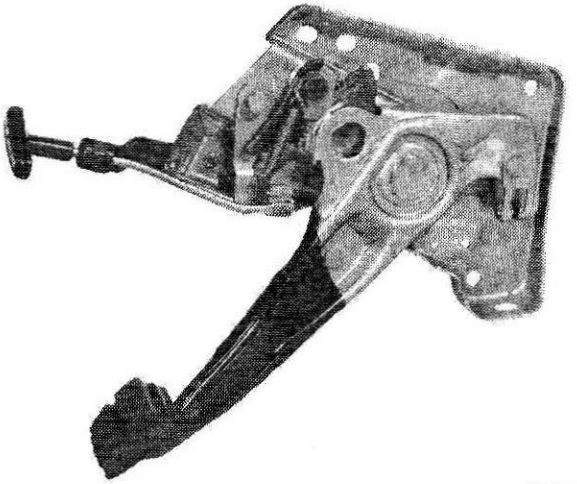
FIG. 2 Parking Brake Control Assembly—Manual Release—Fairmont/Zephyr



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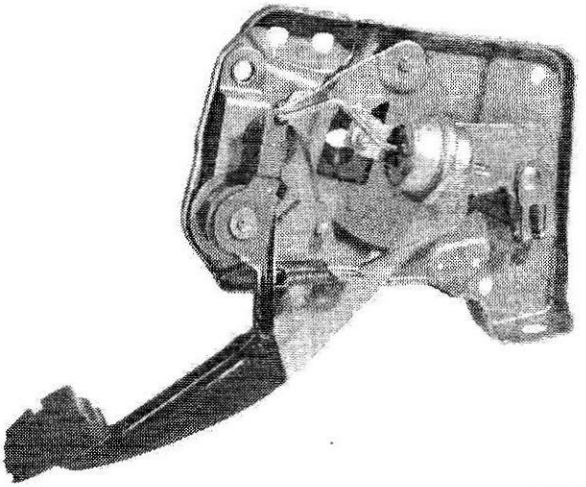
FIG. 3 Parking Brake Control Assembly—Manual Release—Ford, LTD II, Cougar and Thunderbird

On the manually-released type, a T-handle extends from under the left side of the instrument panel. Pulling this handle releases the foot applied parking brake.



H2575-1A

FIG. 4 Parking Brake Control Assembly—Manual Release—Granada, Monarch and Versailles



H2576-1A

FIG. 5 Parking Brake Control Assembly—Vacuum Release—Ford/Mercury

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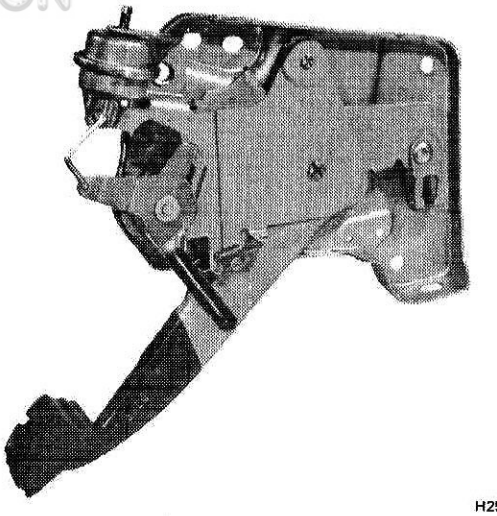


FIG. 6 Parking Brake Control Assembly—Vacuum Release—Granada, Monarch, Versailles, LTD II, Cougar, Thunderbird and Mark V

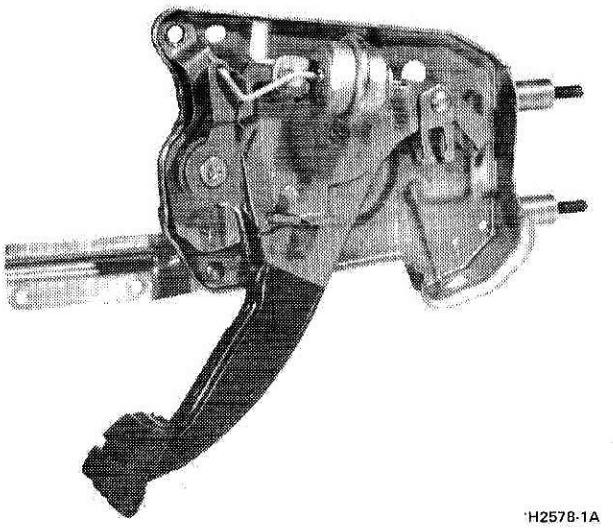


FIG. 7 Parking Brake Control Assembly—Vacuum Release—Lincoln Continental

DIAGNOSIS AND TESTING

VACUUM TESTS—VACUUM RELEASE PARKING BRAKES

Closely look at the operation of the brake linkage as the brake pedal is depressed. Then, check the operation of the brake linkage when the manual release lever is activated. These checks will indicate whether the manual parking brake control linkage is operating properly or requires repair or adjustment due to inability of the parking brake to hold against moderate vehicle movement. Perform tests of the parking brake system and controls after making certain the linkage and manual controls operate properly.

When testing a parking brake vacuum release system, a minimum of 10 inches of vacuum (Hg) should be available at all points where vacuum is applied. This can be checked with a gauge such as Rotunda Vacuum Tester (21-0014) or equivalent.

Failure to maintain 10 inches of vacuum (Hg) during vacuum system tests could be caused by a loose hose connection, resulting in a vacuum leak. When checking for vacuum between two points, trace the hose along the entire routing to be sure it is not crossed with another hose and connected to the wrong connection.

All of the vacuum parking brake control checks are to be performed with the engine running at idle speed.

To detect leaks in the parking brake hoses or a disconnected or improperly connected hose, listen for a hissing sound along the hose routings. **However, do not apply air pressure to the vacuum system under any circumstances, as the actuator diaphragm in the parking brake vacuum motor may be damaged.**

1. Start the engine and run it at idle speed. With the transmission shift control in neutral, depress the parking brake pedal to apply the parking brake. Move the transmission shift control to D range and observe the parking brake sector to see that the sector returns to its zero travel position as the parking brake releases. If the parking brake releases, the parking vacuum control is working properly.

2. If the parking brake does not release, test for vacuum at the vacuum line to the parking brake release vacuum motor. This can be accomplished by removing the hose from each component and attaching it to the vacuum gauge. Connect two distributor tester vacuum hose adapters together with a coupling as a connector to attach the gauge. A minimum of ten inches of vacuum is required to actuate the parking brake vacuum motor. If a minimum reading is not present when checking each of the aforementioned components, they must be replaced.

PARKING BRAKE OPERATION TEST

Check the operation of the parking brake with the vehicle on a hoist and the parking brake fully released. If there is any slack in the cables, or if the rear brakes drag when the wheels are turned, adjust as required.

On rear disc brake installations, verify that the parking brake levers on the rear calipers are fully returned to the stop by attempting to pull them rearward.

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ADJUSTMENTS

PARKING BRAKE LINKAGE ADJUSTMENT

Rear Drum Brakes

1. Make sure that the parking brake is fully released.
2. Place the transmission in neutral. Raise the vehicle on an axle-type hoist.
3. Tighten the adjusting nut against the cable equalizer, to cause rear wheel brake drag. (Refer to the appropriate illustration for location of the adjusting nut.) Then, loosen the adjusting nut until the rear brakes are fully released. There should be no brake drag. If brake cables are replaced in any system having a foot-operated control assembly, stroke the parking brake control with approximately 100 lb pedal effort, then release control and repeat Step 3.
4. Lower the vehicle and check the operation of the parking brake.

Rear Disc Brake

1. Make sure that the parking brake is fully released.
2. Place transmission in neutral. Raise vehicle on an axle-lift type hoist.
3. Tighten the adjuster nut until the levers on the calipers just begin to move. Loosen the nut just enough to obtain full return to the off position. If brake cables are replaced in any system having a foot-operated control assembly, stroke the parking brake control with approximately 100 lb. pedal effort then release control and repeat Step.
4. The lever is in the off position when a 0.25 inch diameter pin can be freely inserted past the side of the lever into the 0.25 inch diameter holes in the cast iron housing.
5. Apply and release the parking brake control. Then apply and release the service brake pedal with moderate force. Check the parking brake levers on the calipers to determine if they are fully returned to the off position. **NOTE: If the 0.25 inch pin cannot be freely inserted, the cable adjustment is too tight.** Repeat adjustment procedure.

NOTE: If levers do not return to off position, parking and service brake function will be affected as mileage is accumulated.

REMOVAL AND INSTALLATION

PARKING BRAKE CONTROL ASSEMBLY

All Cars Except Pinto, Bobcat, Mustang II and Lincoln Continental

Removal

Refer to the appropriate illustration.

1. Fully release the parking brake.
2. Remove all tension from the rear cables by backing off the adjusting nut from the equalizer or adjuster. (See appropriate illustration for location of the equalizer or adjuster.)
3. Disconnect the release cable (if used) from the control assembly.
4. Disconnect the vacuum hose from the vacuum release motor, when so equipped.
5. Disconnect the wiring connector from the parking brake warning light switch.
6. Remove the three screws attaching the control assembly to the cowl side panel.
7. Remove the front cable assembly hairpin clip from the control assembly housing and disconnect the cable end fitting from the control.
8. Remove the control assembly from the vehicle.

Installation

1. Position the control assembly in the vehicle.
2. Fit the cable assembly through its mounting hole and install the retaining clip. Connect the cable end fitting to the control retainer.
3. Install the attaching screws to the cowl side bracket. Tighten the screws to 12-24 ft-lb.
4. Connect the release cable to the control assembly (if so equipped).
5. Connect the vacuum hose to the vacuum release actuator (if so equipped).
6. Connect the wiring connector to the parking brake warning light switch.
7. Check the operation of the parking brake. Adjust the parking brake as required.

Lincoln Continental

Removal

Refer to Figs. 17 and 18.

1. Fully release the parking brake and loosen cable adjustment.
2. Remove the two nuts from the control assembly mounting studs on the engine compartment side of the dash panel.
3. Working under the instrument panel, remove the screw that attaches control assembly to mounting bracket.
4. Disconnect the vacuum hose from the automatic release vacuum servo motor. Also disconnect wiring connector from parking brake warning light system.
5. Remove the hairpin clip from the cable housing at the control assembly.
6. Disconnect the control cable cylinder end from the control assembly.
7. Remove the control assembly from the vehicle.

Installation

1. Connect the vacuum hose to the automatic release vacuum servo motor.
2. Install the control assembly mounting studs through the holes in the dash panel and against the body mounting bracket.

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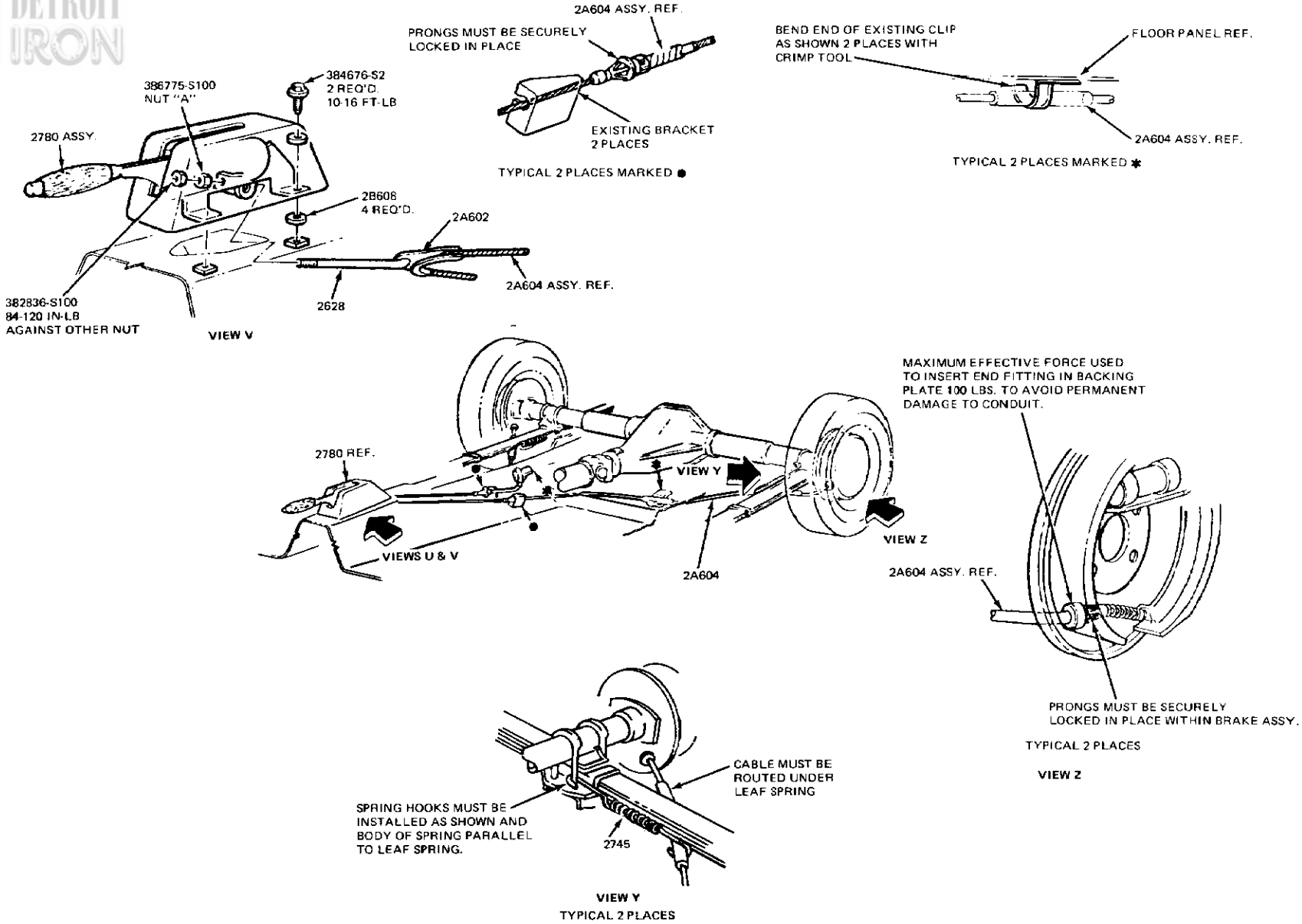


FIG. 8 Parking Brake System—Pinto and Bobcat Sedan and Station Wagon

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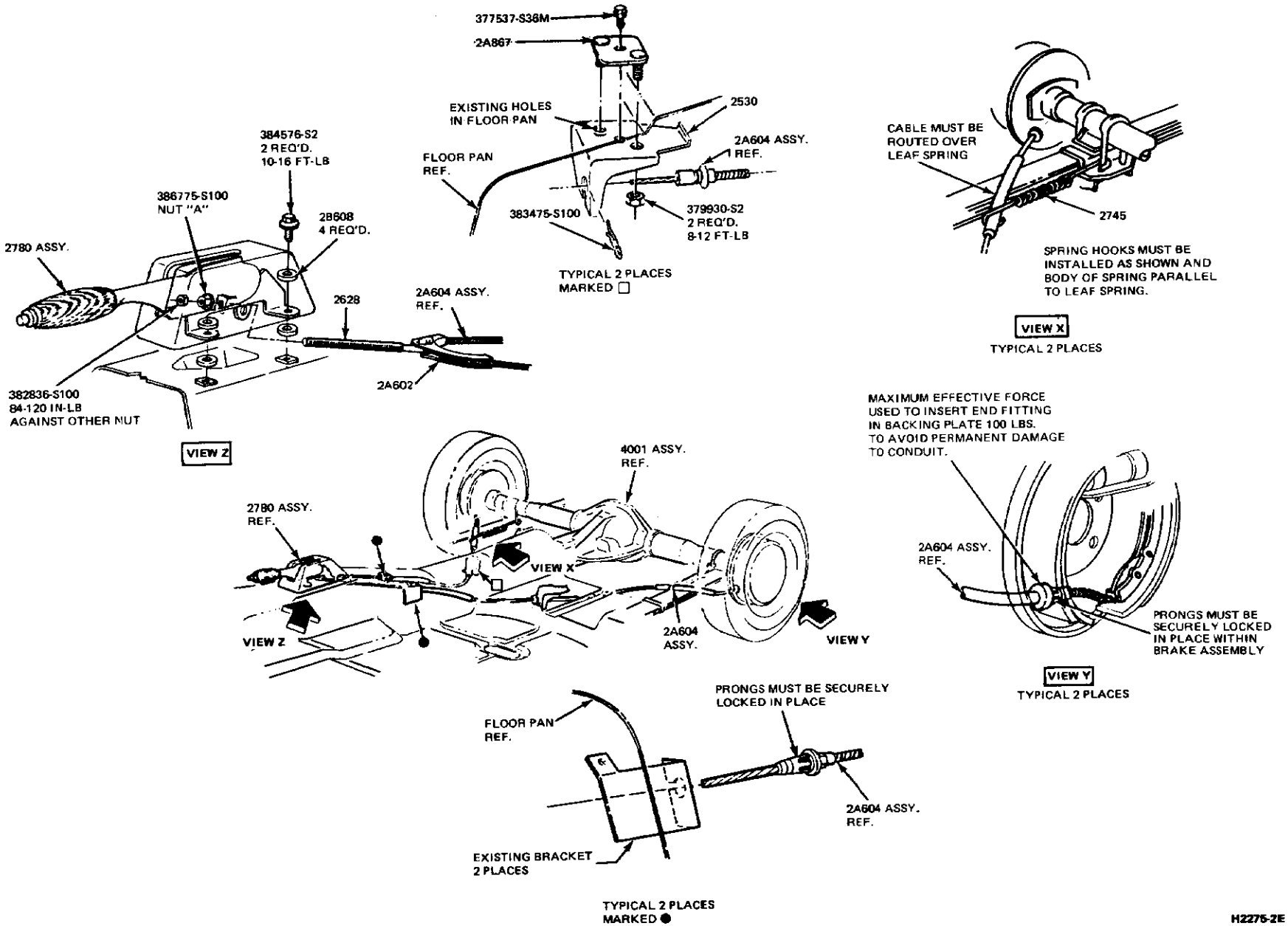


FIG. 9 Parking Brake System—Mustang II

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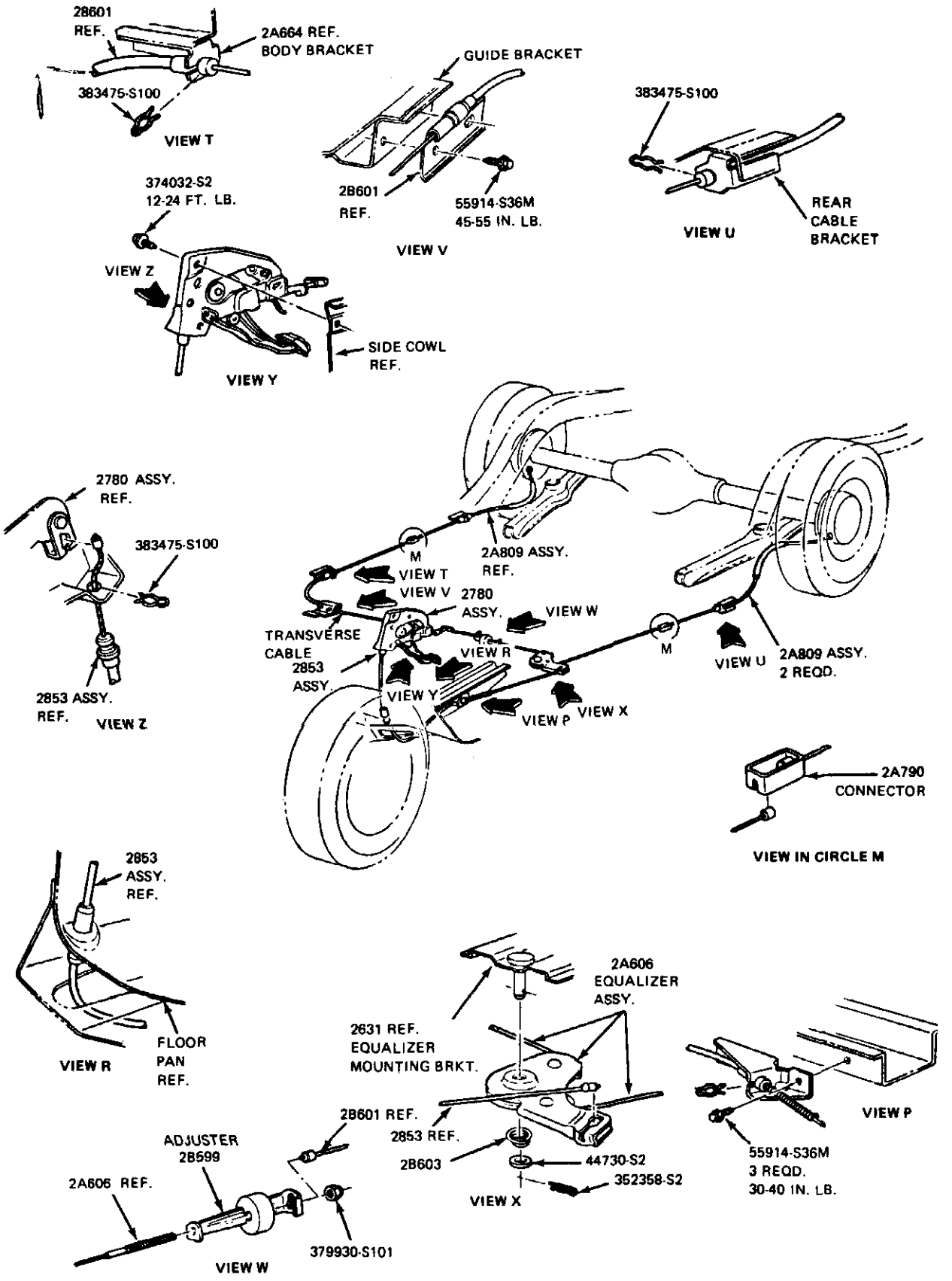


FIG. 10 Parking Brake System—Fairmont and Zephyr

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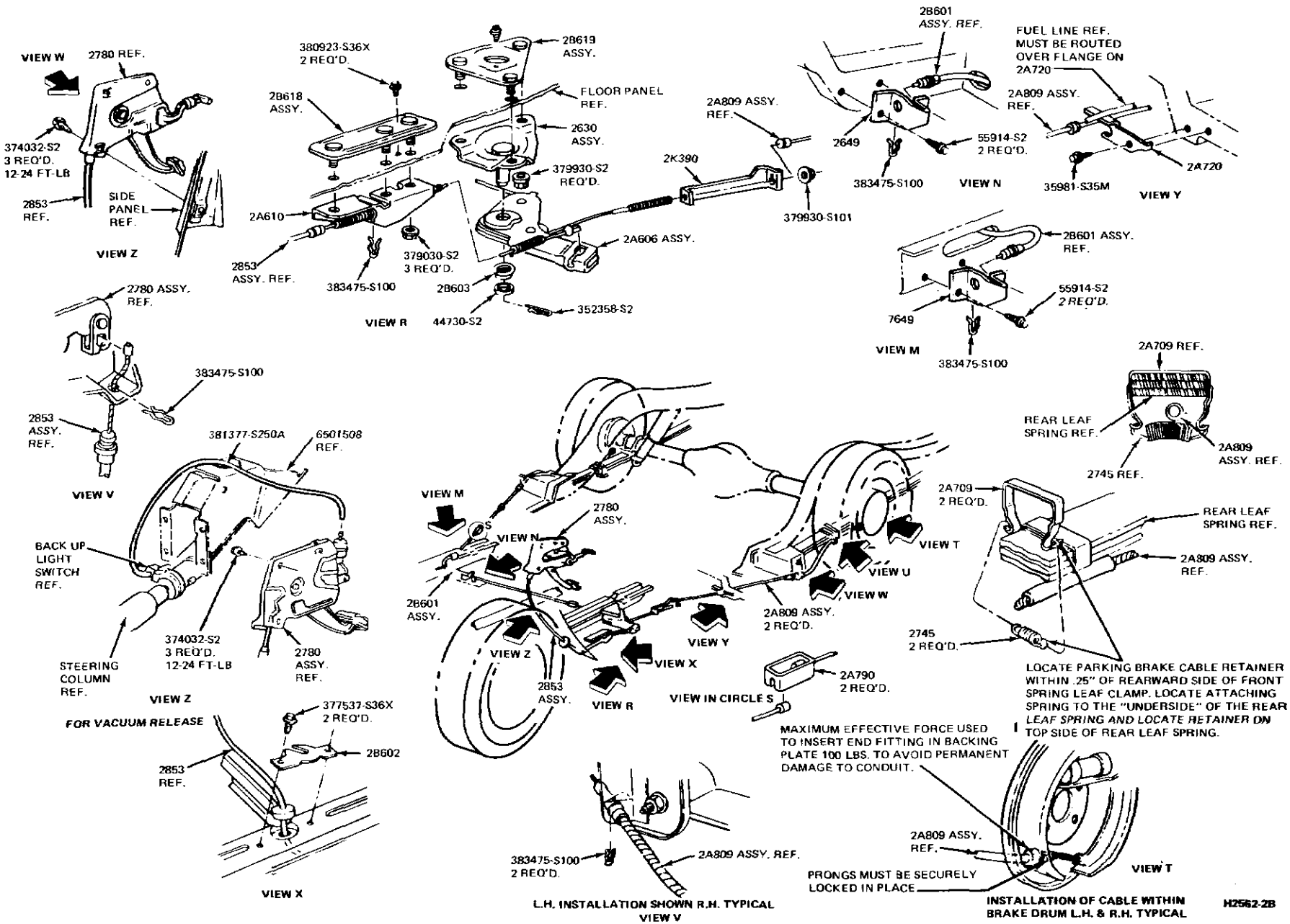


FIG. 11 Parking Brake System—Granada and Monarch

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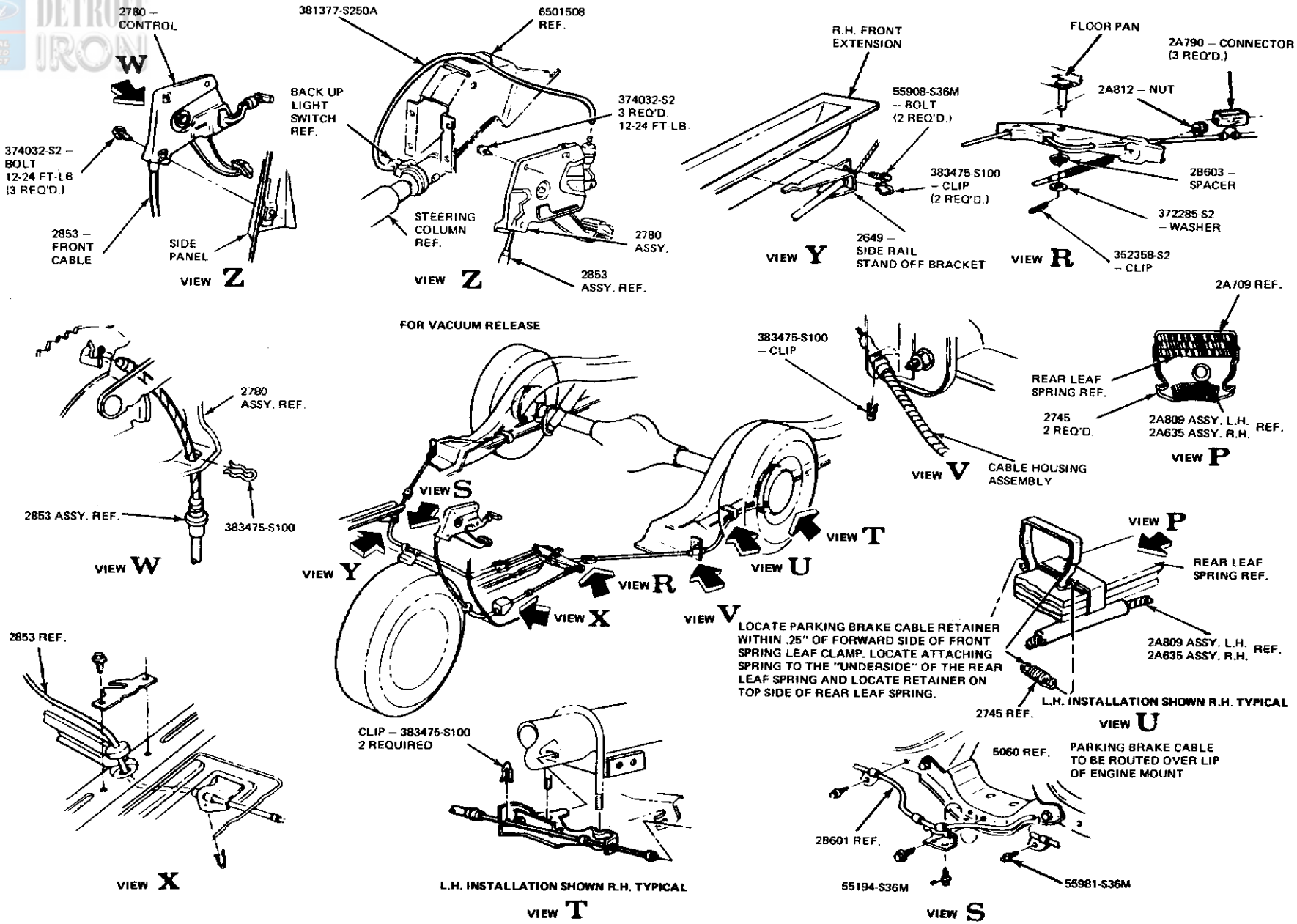


FIG. 12 Parking Brake System—Granada, Monarch and Versailles (Disc Rear Brakes)

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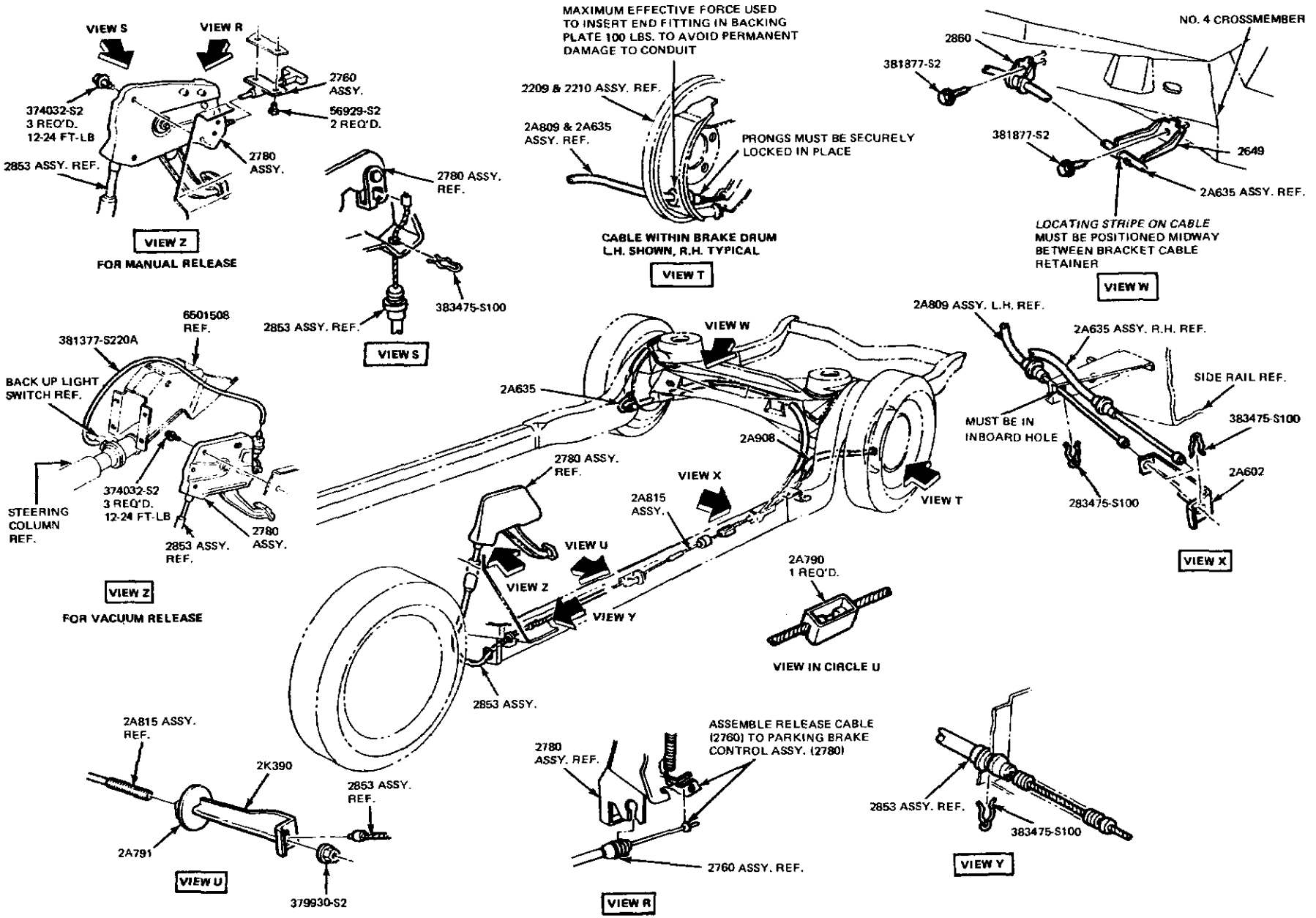


FIG. 13 Parking Brake System—LTD II, Thunderbird and Cougar

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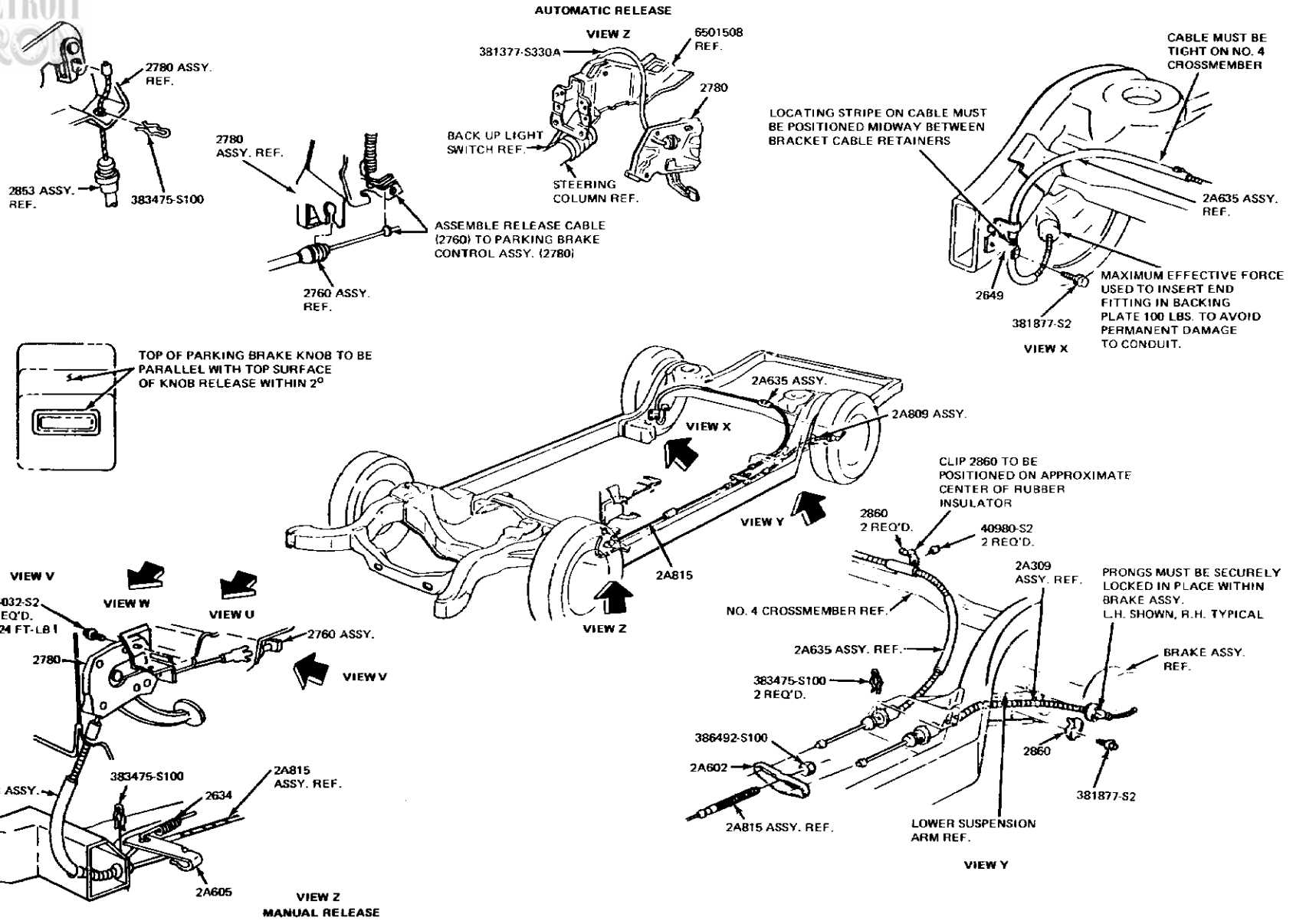


FIG. 14 Parking Brake System—Ford and Mercury (Drum Rear Brakes)

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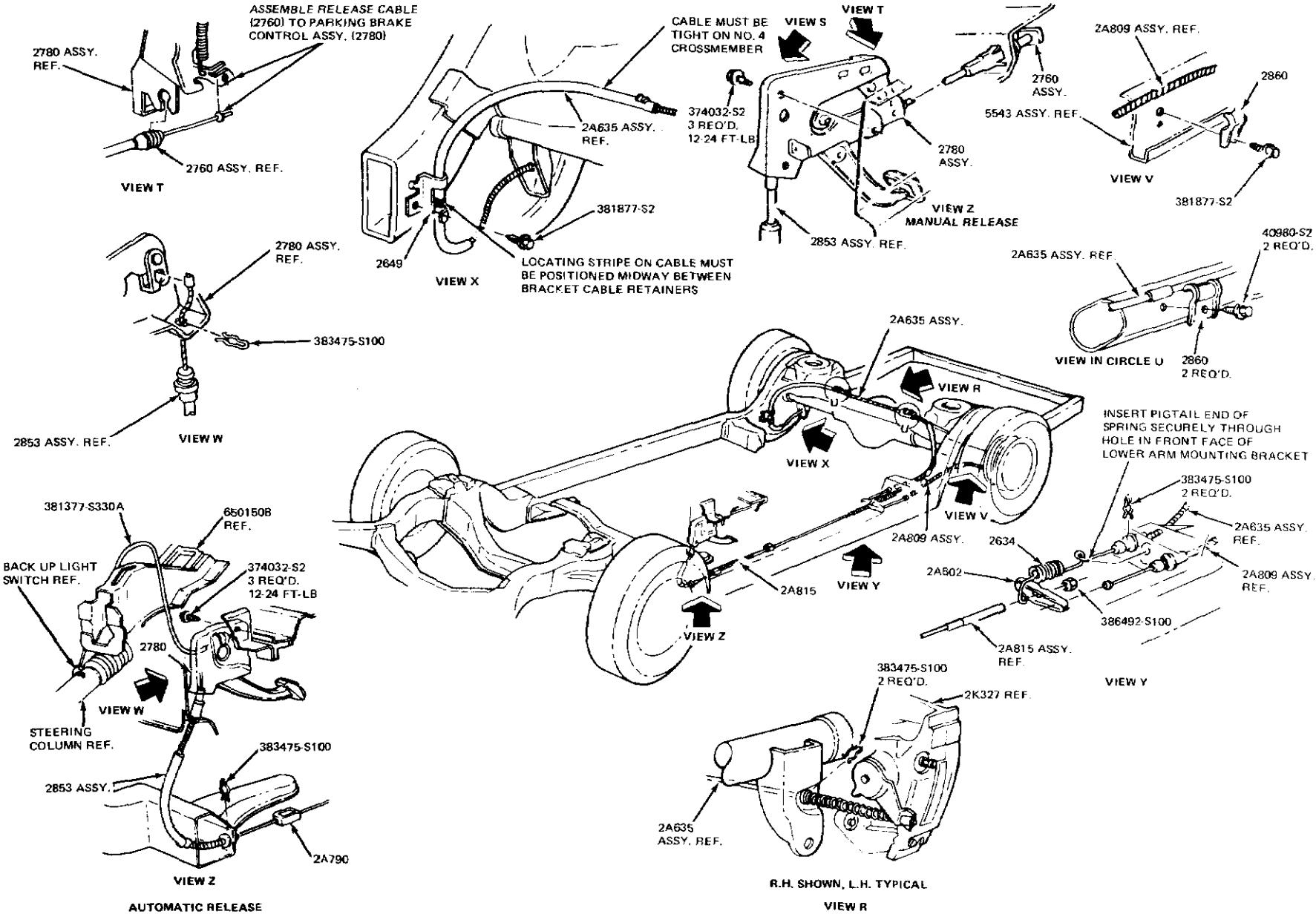


FIG. 15 Parking Brake System (Disc Rear Brakes) Ford and Mercury

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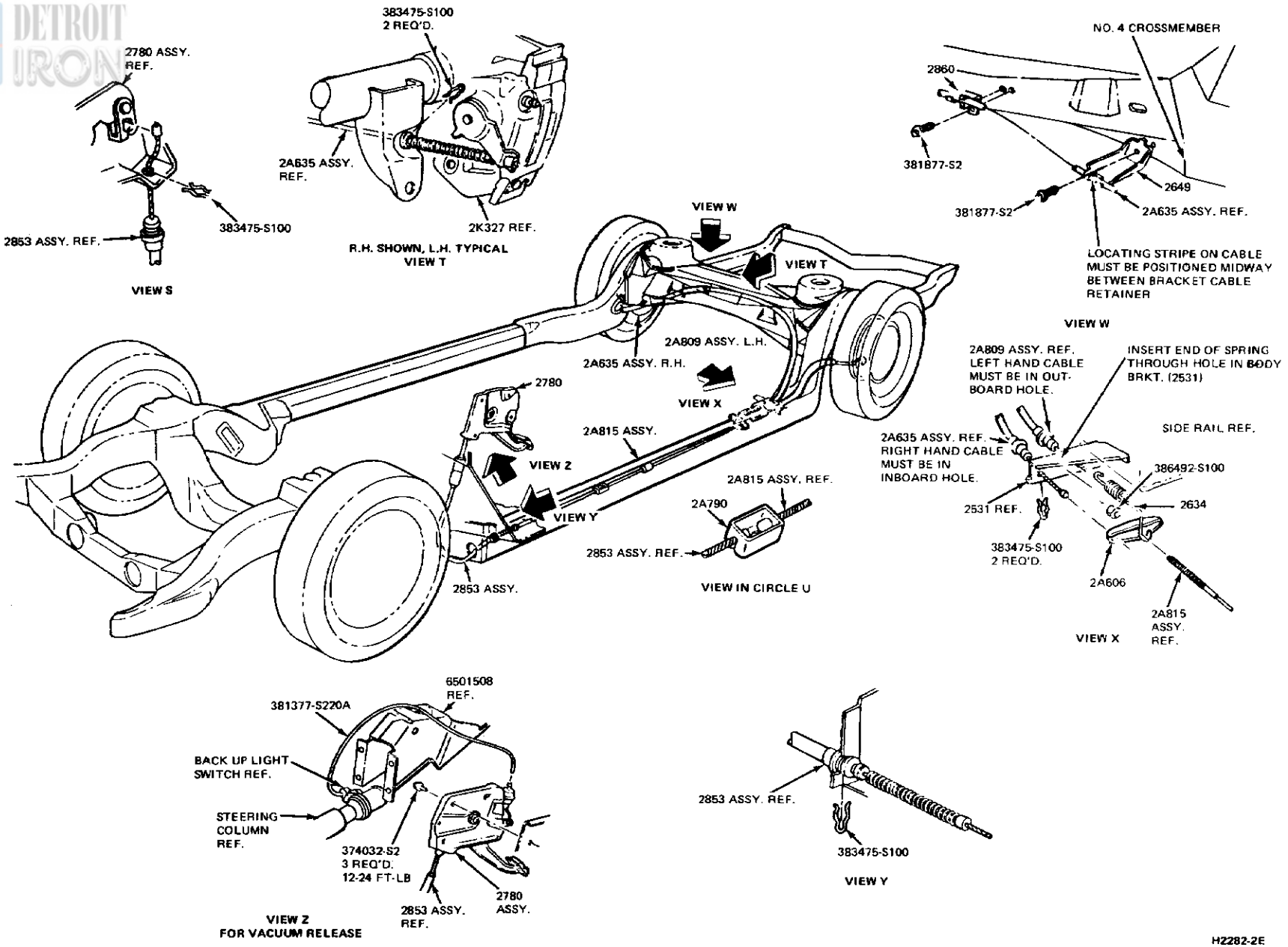


FIG. 16 Parking Brake System—Continental Mark V (Disc Rear Brakes)

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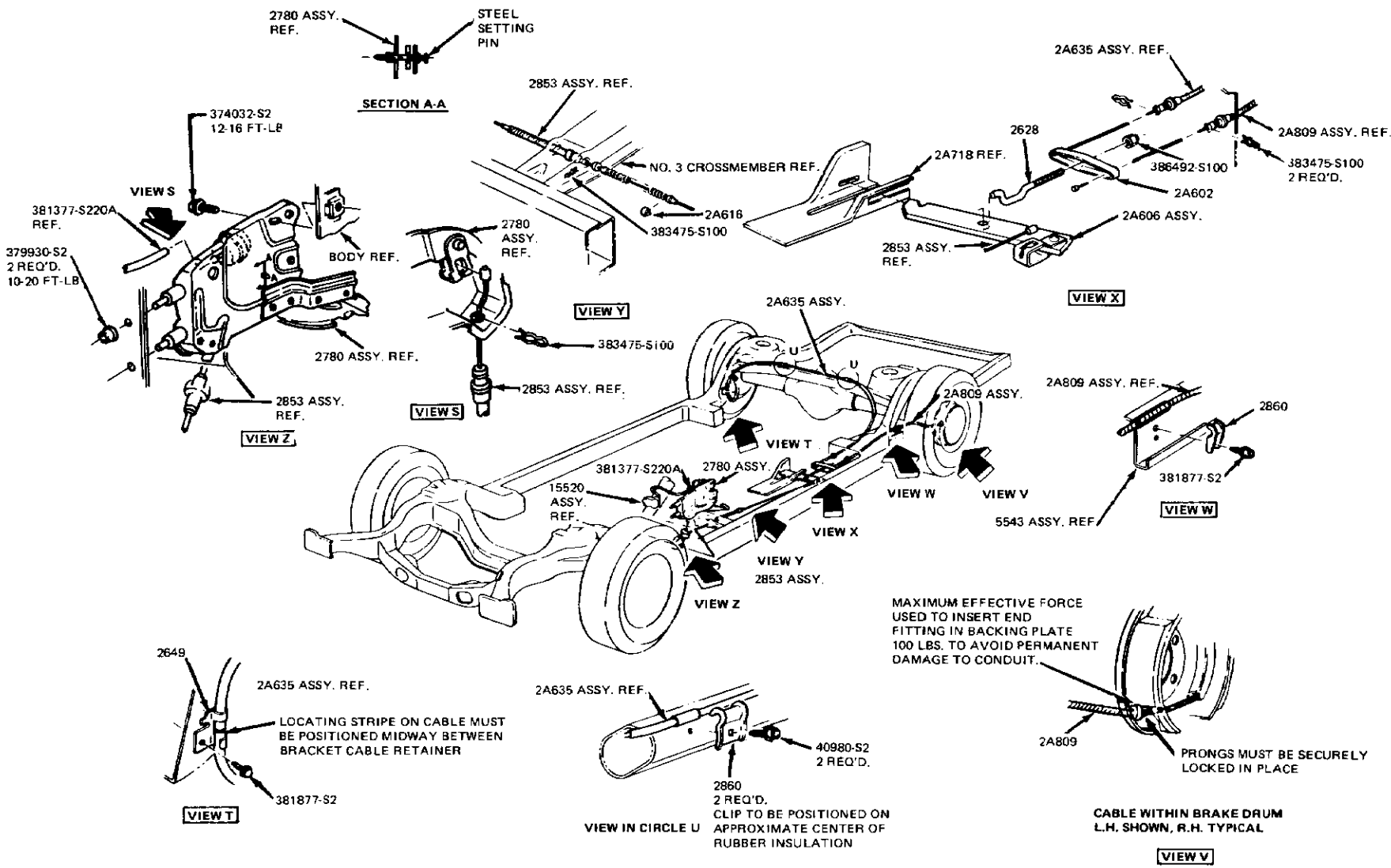


FIG. 17 Parking Brake System—Lincoln Continental (Drum Rear Brakes)

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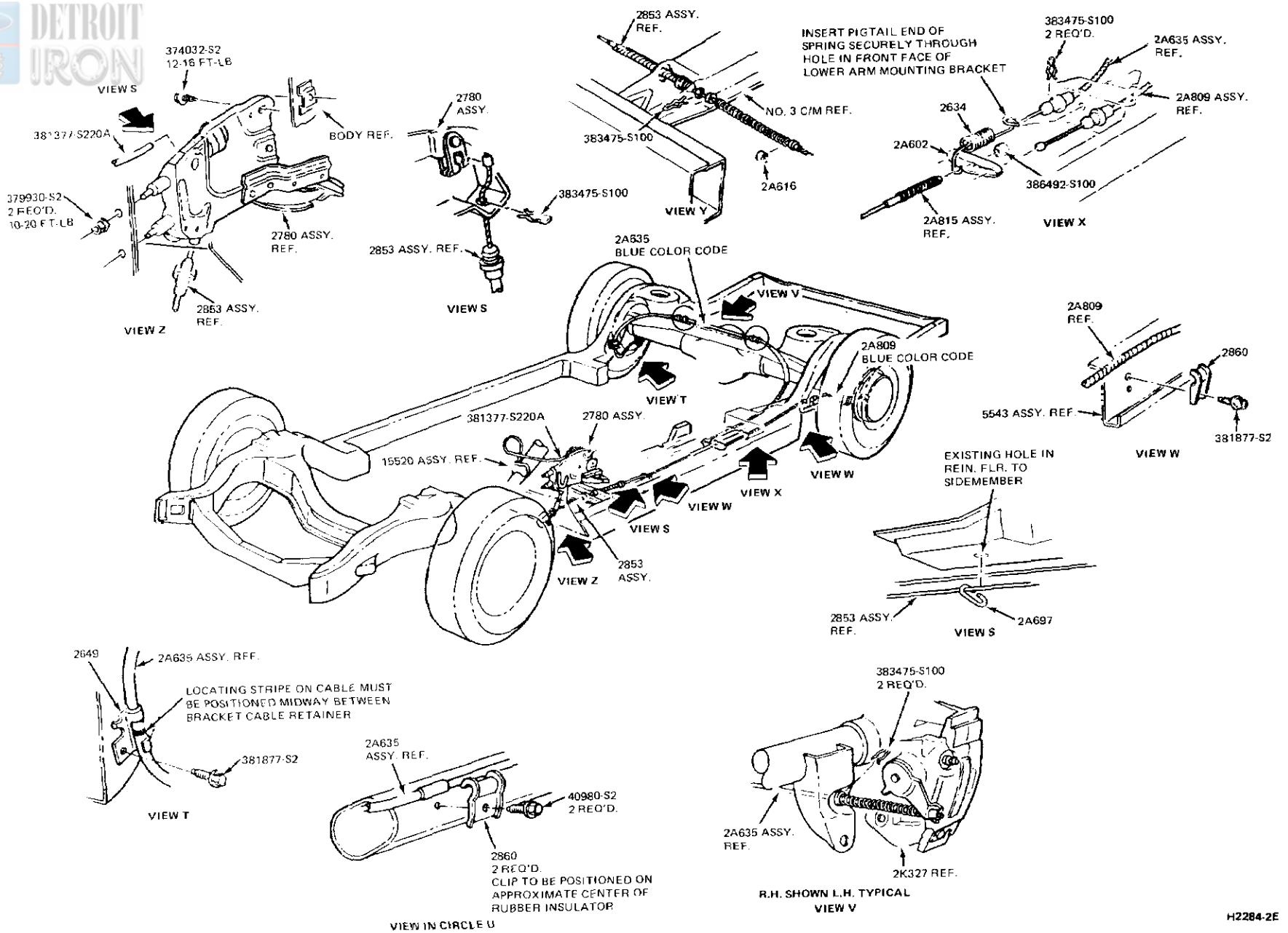


FIG. 18 Parking Brake System—Lincoln Continental (Disc Rear Brakes)

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3. Install the front cable cylindrical end in the control assembly sector cable attachment hole.
4. Install the cable hairpin clip at the control assembly. Connect wiring connector at warning light switch.
5. Install the control assembly to mounting bracket retaining bolt and torque to 12 to 18 ft-lb.
6. Install the nuts on the control assembly mounting studs on the engine side of the dash panel and torque, 10 to 20 ft-lb.
7. Check for correct operation of the parking brake system and adjust.

Pinto, Bobcat and Mustang II

Removal

1. Remove the locking and barrel adjusting nut from the equalizer rod (Figs. 8 and 9).
2. Remove the two screws that attach the control assembly to the tunnel.
3. Disconnect the brake light and ground wire from control.
4. Remove control assembly from the vehicle.

Installation

1. Position the control assembly on the tunnel, install the attaching screws and tighten, 12 to 24 ft-lb torque.
2. Connect the brake light switch and ground wire to the control.
3. Position the equalizer rod in the control assembly and install the adjusting nut and locknut.
4. Adjust the parking brake. Refer to Parking Brake Linkage Adjustment.
5. Install the locknut in back of adjusting barrel nut.

PARKING BRAKE FRONT CABLE

FORD AND MERCURY

Removal

1. Raise the vehicle on a hoist.
2. Loosen the adjusting nut at the equalizer (Figs. 14 and 15).
3. Disconnect the cable from the clevis on the multiplier lever. On rear disc brake cars, disconnect the cable coupling that is used in place of the multiplier lever.
4. Remove spring clip from clevis to remove cable end button from control.
5. Remove hairpin clip that retains the cable to the frame. Remove four screws that retain the fender apron to the frame seal and remove seal.
6. From inside the passenger compartment, remove hairpin clip that retains the cable to the parking brake control. Disconnect the cable from the control assembly.
7. Remove the cable assembly from inside the vehicle.

Installation

1. Insert cable through the provided openings, and place in the approximate installation position.
2. Install hairpin clip on cable at the frame crossmember. Install fender apron to frame seal.
3. Connect the end of cable to parking brake control. Install conduit-to-control hairpin clip and spring clip.
4. Install the front cable cylindrical end in the control assembly sector cable attachment hole. Connect the cylinder end to the multiplier lever.
5. Adjust the parking brake.
6. Lower vehicle on hoist.

LTD II, Cougar, Thunderbird, Continental Mark V, Granada and Monarch

Removal

Refer to pertinent illustration.

1. Partially raise the vehicle.
2. Remove the adjusting nut at the equalizer, and remove the equalizer from the cable.
3. Remove clip that holds the cable assembly to the frame or body bracket. Remove the screws that retain front fender apron to the frame seal and remove seal.
4. Attach a length of wire to the control cable.
5. Remove hairpin clip retaining cable assembly to the control. Disconnect the cable from the control assembly.
6. Pull the cable up through opening in dash panel, and remove the cable from the length of wire.

Installation

1. Attach control cable to the length of wire and pull cable down through the opening in the dash panel.
2. Position the upper end of the control cable to the control. Install the front cable cylindrical end in the control assembly sector cable attachment hole. Install conduit to control hairpin clip.
3. Remove the length of wire from the cable assembly and position the cable in the frame bracket. Install the retainer. Install the front fender apron to the frame seal.
4. Place the lever return spring on the cable, re-assemble the equalizer on the cable, and install the adjusting nut.
5. Adjust the parking brake.

FAIRMONT/ZEPHYR

Removal

1. Raise the vehicle on a hoist.
2. Loosen the adjusting nut at the adjuster assembly.
3. Disconnect the front cable from the equalizer lever assembly.
4. Remove the hairpin clip that retains the cable to the body bracket.
5. From inside the passenger compartment, remove the hairpin clip that retains the cable to the parking brake control. Disconnect the cable from the control assembly.
6. Remove the cable assembly from inside the vehicle.

Installation

1. Insert the cable through the provided openings in the floor pan, and place in the approximate installation position.

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2. Position the upper end of the front cable to the control assembly with the cable cylindrical end through the control assembly attachment hole. Install the hairpin retaining clip.
3. Install the cable to the body bracket with hairpin clip.
4. Under the vehicle, install the cable to the equalizer lever assembly.
5. Adjust the parking brake.

PARKING BRAKE EQUALIZER TO CONTROL CABLE

Lincoln Continental

Removal

Refer to Figs. 17 and 18.

1. Fully release the parking brake.
2. Raise the vehicle.
3. Loosen the parking brake cable adjusting nut at the multiplier lever. Compress cable return spring and remove bell-shaped retainer.
4. Lower the vehicle.
5. Remove the cable housing hairpin clip, and disconnect the control cable end from the control assembly clevis.
6. Raise the vehicle.
7. Pull the cable and housing downward through the dash panel opening.
8. Remove the hairpin clip from the cable housing at the Number 3 crossmember.
9. Disconnect the cable cylinder end from the parking brake cable clevis at the multiplier lever.
10. Pull the parking brake cable forward through the holes in the Number 3 crossmember and remove the cable and housing assembly from the vehicle.

Installation

1. Push the rear end of the parking brake cable rearward through the holes in the Number 3 crossmember.
2. Connect the cable end to the parking brake cable clevis at the multiplier lever.
3. Install the hairpin clip on the cable housing at the Number 3 crossmember.
4. Push the forward end of the cable and housing upward through the dash panel opening.
5. Lower the vehicle.
6. Connect the cable end to the control assembly clevis and install the hairpin clip.
7. Raise the vehicle and compress the cable return spring and assemble the bell-shaped retainer and cable.
8. Adjust the parking brake. Refer to the Parking Brake Adjustment Procedures in this manual.
9. Lower the vehicle.
10. Check for correct operation of the parking brake.

PARKING BRAKE INTERMEDIATE CABLE

Ford, Mercury, LTD II, Cougar, Continental Mark V and Thunderbird

Removal

Refer to pertinent illustration.

1. Raise the vehicle on a hoist.
2. Remove the adjusting nut which retains the cable to the equalizer.
3. Remove the cable end from the equalizer.
4. Unhook the cable from the multiplier lever, and remove from the vehicle. On rear disc brake equipped vehicles, disconnect the cable from the coupling that replaces the multiplier lever.

Installation

1. Insert new cable end into actuator.
2. Insert cable end into equalizer and tighten the adjusting nut snug.
3. Adjust the parking brake.
4. Lower the vehicle.

PARKING BRAKE EQUALIZER-TO-REAR WHEEL CABLES

Ford and Mercury With Rear Drum Brakes

Removal

1. Raise the vehicle and loosen the equalizer nut. Disconnect the equalizer from the rear cables (Fig. 14).
2. Remove the hairpin clip that retains the L.H. cable to the suspension arm bracket. Pull the cable through the left side bracket.
3. Remove the hairpin clip that retains the R.H. cable to the suspension arm bracket. Remove the clips retaining the right cable to the frame crossmember and right hand sidemember.
4. Remove the rear wheel cover and wheel. Remove the three nuts that hold brake drum in place and remove the drum.
5. Working on the wheel side of the rear brake, remove the brake automatic adjuster spring. Compress the prongs on the parking brake cable retainer so that they can pass through the hole in the brake backing plate. Draw the cable retainer through the hole.
6. With the spring tension off the parking brake lever, lift the cable out of the slot in the lever and remove the cable through the backing plate hole.

Installation

1. Pull enough of the parking brake cable through the housing so that the end of the cable can be inserted over the slot in the parking brake lever on the rear brake shoe.
2. Pull the excess slack from the cable, and insert the cable housing into the brake backing plate access hole so that the retainer prongs expand. **The prongs must be securely locked in place.** Install the automatic brake adjuster spring.
3. Position the right-hand cable and the two retaining clips and screws on the rear crossmember. Insert the cable end through the suspension arm bracket and install the hairpin retainer. Be sure the locating stripe on the cable is midway between the retaining clips, and tighten all retaining clip screws.
4. Position the left cable, retaining clip and screw on the left lower suspension arm. Insert the cable end

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through the suspension arm bracket and install the hairpin retainer.

5. Insert the ball ends of the cables into the equalizer assembly.
6. Install the rear drum(s) and tighten the three nuts that secure the drum. Install the wheel and tire and the wheel cover.
7. Adjust the parking brake cables.

Ford, Mercury, Continental Mark V and Lincoln Continental With Rear Disc Brakes

Removal

1. Raise the vehicle and remove the parking brake equalizer rod adjusting nut. Disconnect the equalizer from the rear cables (Figs. 15, 16 and 18).
2. Remove the hairpin clip that retains the cable to the suspension arm bracket. Pull the cable through the left side bracket.
3. Remove the hairpin clip that retains the cable to the suspension arm bracket. Remove the clips retaining the right cable to the No. 4 frame crossmember and right hand sidemember.
4. With the spring tension off the parking brake lever on the caliper, lift the cable out of the slot in the lever and remove the hairpin clip retaining the rear cable in the shock absorber bracket.

Installation

1. Retain the rear end of each rear axle cable in the shock absorber bracket with a hairpin clip.
2. Pull enough of the parking brake cable through the housing so that the end of the cable can be inserted over the slot in the parking brake lever on the rear caliper.
3. Position the right-hand cable and the two retaining clips and screws on the rear crossmember. Insert the cable end through the suspension arm bracket and install the hairpin retainer. Be sure the locating stripe on the cable is midway between the retaining clips, and tighten all retaining clip screws.
4. Position the left cable, retaining clip and screw on the left lower suspension arm. Insert the cable end through the suspension arm bracket and install the hairpin retainer.
5. Insert the ball end of each rear cable into the equalizer.
6. Adjust the parking brake cable system, making sure there is no wheel drag.

LTD II, Cougar, Thunderbird, Granada and Monarch (All With Rear Drum Brakes)

Removal

1. Refer to the appropriate illustration. Remove the equalizer adjusting nut and equalizer.
2. With the cables slack, disconnect the ball ends from the connector or adjuster. On Granada and Monarch vehicles, the left rear cable connects to the equalizer cable and the right rear cable connects to the transverse cable.
3. Remove the cable from the retainer hooks, if required.
4. Remove the hairpin lock retaining the cable housing to the side rail bracket or rear torque box bracket.
5. Remove the wheel cover, wheel and tire and the rear brake drum as outlined in Part 12-02.
6. Remove self-adjuster springs to allow clearance to remove cable retainer from the backing plate. Disconnect the rear end of the cable from the parking brake lever on the brake shoe. Compress the pronged retainer at the brake backing plate and pull the cable from the vehicle.
7. Slide the cable and housing out of the side rail bracket.

Installation

1. Insert the rear end of the cable through the side rail bracket or rear torque box bracket and pull the cable and housing into position.
2. Insert the rear end of the cable and housing through the hole in the backing plate from the inboard side.
3. Connect the cable to the parking brake lever on the brake shoe. Push the cable rear end through the hole on the backing plate hole until the cable retaining prongs are securely positioned in the backing plate cable hole.
4. Install the self-adjuster springs. Position the cable housing in the side rail bracket and install the hairpin type retainer.
5. Install rear drum, wheel and tire assemblies and wheel cover as outlined in Part 12-02.
6. Position the cable retainer hooks in the underbody guide and install the connector, thus hooking the two cables together.
7. Insert the cable into the equalizer and install the equalizer and adjusting nut to the front parking brake control cable.
8. Adjust the parking brake.

Granada/Monarch/Versailles With Rear Disc Brakes (Fig. 12)

Removal

1. Completely release the parking brake.
2. Raise the vehicle on a hoist.
3. Loosen the adjusting nut on the adjusting rod until the cables are slack.
4. Remove the cable ends from the connectors. The left hand cable connects to the adjuster bracket. The right hand cable connects to the end of the transverse cable on the right side of the car.
5. Remove the cable from the rear disc caliper lever.
6. Unsnap the plastic grommet from the cable retaining bracket located at the rear spring "U"-bolt. Remove the hairpin clip holding the cable housing to this same bracket and remove the cable assembly from the bracket.
7. Remove the hairpin clip retaining the cable housing in a bracket located at the rear spring front attaching point.
8. Pull the cable assembly rearward until it is clear of the spring bracket and the retainer located on the rear spring. Remove the cable assembly from the vehicle.

Installation

1. Thread the cable assembly through the retainer on the rear spring and through the hole in the bracket

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at the rear spring front attachment. Install the hairpin clip to the cable housing.

2. Attach the rear portion of the cable to the rear caliper parking brake lever.
3. Snap the plastic grommet into the cable bracket at the spring "U" bolt and place the cable housing in the forward end of the bracket. Install the hairpin clip.
4. Attach the front of the cable to the adjuster bracket on the left side or to the right connector at the end of the transverse cable as required.
5. Adjust the parking brake system as outlined in this section.
6. Lower the car.

Lincoln Continental With Rear Drum Brakes

Removal

Refer to Fig. 17.

1. Raise the vehicle.
2. Remove the parking brake adjustment nut and disconnect the rear brake cables from the equalizer.
3. Remove the left rear cable retaining clips and pull the cable through the left frame suspension arm mounting bracket.
4. Remove the retaining clip that attaches the left rear cable to the lower left trailing arm.
5. Remove the clips that retain the right rear cable to the Number 4 crossmember and at the right frame side rail.
6. Remove the rear wheel covers, and the tire and wheel assemblies. Remove the drum retaining nuts and remove the rear drums.
7. Remove the brake automatic adjuster spring.
8. Relieve the spring tension and lift the cable end from the parking brake lever.
9. Compress the parking brake cable housing retainer prongs, and pull the retainer through the backing plate hole.
10. Remove the parking brake cable from the backing plate.

Installation

1. Position the parking brake cable through the hole in the backing plate.
2. Relieve the spring tension and install the cable ball end in the parking brake lever slot. Securely seat the retainer prongs in the hole in the backing plate.
3. Install the brake automatic adjuster spring.
4. Install the brake drum and the drum retaining nuts. Install the wheel and tire assembly and wheel cover.
5. Install the clips that attach the right rear cable to the Number 4 crossmember. Install clip that retains the cable at the right frame side rail.
6. Install cable clip that attaches left rear cable to the left lower arm.
7. Position the cables through the left frame suspension arm support, and install the hairpin clips.
8. Install the cable ends in the equalizer lever.
9. Adjust the parking brakes. Refer to the Parking Brake Adjustment procedures in this manual.
10. Lower the vehicle.

Pinto, Bobcat and Mustang II with Rear Drum Brake

Removal

Refer to Figs. 8 and 9.

1. Completely release the parking brake and loosen the lock and adjusting nut.
2. Raise the vehicle.
3. Remove the rear wheel parking brake cable from the equalizer.
4. Compress the retainer prongs and pull the cable rearward through the cable brackets sufficiently to release the cable.
5. Open the ends of the floor pan cable clips and remove the cable (Pinto and Bobcat only), or remove the retaining clip that attaches the cable to the bolt on the bracket (Mustang II).
6. Remove the rear wheel covers, wheel and tire assemblies and rear brake drums.
7. Remove the self-adjuster springs and remove the cable retainers from the backing plates.
8. Disconnect the ends of the cables from the parking brake levers on the secondary brake shoes.
9. Compress the cable retainer prongs and pull the cable ends from the backing plates.
10. Remove the cable retainers on the rear springs (Pinto and Bobcat only), and remove the cable from the vehicle.

Installation

Refer to Figs. 8 and 9.

1. Insert the cable ends through the backing plates and pull into the brake assemblies until the retainer prongs are securely seated in the backing plate holes.
2. Connect the cable ends to the parking brake levers on the secondary brake shoes.
3. Install the cable retainers and the self adjuster springs on the rear brake assemblies.
4. Position the cable in the retainers on the rear suspension leaf springs (Pinto and Bobcat on top, Mustang II underneath), install the retainer spring.
5. Position the cable in the floor pan clips and bend to retain the cable securely (Pinto and Bobcat only), or in the bolt-on brackets and insert the retaining clips (Mustang II).
6. Position the cable in retainer brackets and pull the cable forward until the retainer prongs are securely seated in the bracket holes.
7. Connect the cable at the equalizer.
8. Install the rear brake drums, wheel and tire assemblies, and wheel covers.
9. Lower the vehicle.
10. Adjust the parking brake as outlined under Parking Brake Linkage Adjustment.

FAIRMONT/ZEPHYR

Removal

Refer to Fig. 10.

1. Remove the adjusting nut at the adjuster assembly.
2. With the cables slack, disconnect the rear cables from the right and left rear cable connectors. The

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left hand cable connects to end of the intermediate cable. The right hand cable connects to the transverse cable.

3. If the equalizer assembly or transverse cable is to be removed, the attaching brackets should be removed at this point, along with the connection at the adjuster assembly.
4. If the rear cable(s) is to be removed, disconnect the cable(s) from the body bracket(s) at the rear of the vehicle.
5. Remove the affected wheel, tire and brake drum using existing procedures.
6. Remove the rear brake self-adjuster spring to allow clearance to remove the cable end from the parking brake lever and the pronged cable retainer from the backing plate.
7. Slide the cable out of the brake backing plate and remove cable from the vehicle.

Installation

1. Install the rear cable(s) to the body bracket with the hairpin clip.
2. Insert the rear end of the cable(s) through the hole in the backing plate and attach the cable to the parking brake lever on the brake shoe.
3. Push the cable through the hole in the backing plate until the cable retaining prongs are securely positioned on the backing plate.
4. Install the rear brake self-adjuster spring and attach the forward end of the rear cable(s) to the connector. If the equalizer assembly or transverse cable(s) have been removed they should be installed at this time and attached to the connectors at the rear cable(s) to complete the system.
5. Install the affected rear brake drum, wheel and tire assemblies per existing Shop Manual Procedures.
6. Install the adjusting nut to the adjuster assembly and adjust the parking brake.

SPECIFICATIONS

TORQUE LIMITS – GENERAL – FT-LBS.

	Ford-Mercury Meteor	Granada/Monarch, Versailles, LTD II, Cougar, Thunderbird	Fairmont/ Zephyr	Continental Mark V	Lincoln Continental
Parking Brake Control Assembly Mounting Nuts and Cap Screws	Cap Screw 12-24	Cap Screws 12-24	Cap Screws 12-24	Cap Screws 12-24	Cap Screw 12-18 Nuts 10-20

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DETROIT IRON

STEERING

GROUP 13

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General Steering Service

PART 13-01

Applies to All Cars

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DIAGNOSIS

LOOSE STEERING

Drive vehicle and confirm condition exists. Check the following and repair as required.

Manual and Power Steering

1. Check steering linkage connections and idler arm for looseness or damage.

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2. Check front wheel bearing adjustment.
3. Check steering gear adjustments.
4. Check to see if flexible coupling is fractured.
5. Check steering wheel to column shaft for looseness.

Power Steering Only

1. Check for loose cylinder rod frame bracket or improper riv-nut crimp (non-integral power steering).
2. Check control valve centering spring adjustment (non-integral power steering).
3. Check control valve length adjustment (non-integral power steering).

PULLS TO ONE SIDE

Drive vehicle and confirm condition exists. Check the following and repair as required.

1. Check tire sizes of each wheel to be sure they are the same size and type.
2. Check tire pressure.
3. Check to see if vehicle is unevenly loaded.
4. Check brake adjustment.
5. Check front wheel bearing adjustment.
6. Check for broken or sagging springs on front and/or rear suspension.
7. Check for bent rear axle housing and/or loose, worn or damaged spring, shock absorber and suspension arm attaching points.
8. Check control valve centering spring adjustment (non-integral power steering).
9. Check for sticking control valve spool bolt (non-integral power steering).
10. Check front wheel alignment.

TIRE PULL (RADIAL PLY ONLY)

1. Cross switch front tire/wheel assemblies.
2. If vehicle pulls to opposite side, cross switch front tire/wheel assemblies to the rear. Switch tire/wheel assemblies that were on the rear to same side on the front.
3. If, in Step 2, vehicle pull direction is not changed, check front suspension and front end alignment.

RETURNABILITY POOR

Drive vehicle and confirm condition exists. Check the following and repair as required.

Manual and Power Steering

1. Check tire pressure.
2. Check front wheel alignment.
3. Check steering column alignment.
4. Check for steering wheel to column interference.
5. Check steering linkage and ball joints for lack of lubrication or evidence of binding.
6. Check idler arm bushings and positioning.
7. Check steering gear adjustment.

Power Steering Only

1. Check power steering control valve for spool binding or out of adjustment (non-integral power steering).
2. Check for bent valve spool bolt (non-integral power steering).
3. Check bent cylinder rod (non-integral power steering).
4. Check for kinked return hose or tube.
5. Check for obstruction within steering gear or lines.

WANDERS TO ONE SIDE

1. Check tire sizes of each wheel to be sure they are all the same size and type.
2. Check tire pressure.
3. Check to see if vehicle is overloaded or unevenly loaded.
4. Check front wheel bearing adjustment.
5. Check steering gear adjustments.
6. Check ball stud adjustment (non-integral power steering).
7. Check control valve centering spring adjustment (non-integral power steering).
8. Check for steering gear valve binding (integral power steering).
9. Check control valve length adjustment (non integral power steering).
10. Check for broken or sagging spring.
11. Check steering linkage connections and idler arm for wear, looseness or damage.
12. Check front wheel alignment.

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DETROIT IRON

DIAGNOSIS GUIDE – STEERING GEAR

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Leakage at valve and cylinder ports. Non-integral power steering.	• Hose tube nuts not tight. • Damaged hose O-ring.	• Tighten tube nuts to specifications: Pressure Hose: 14-18 ft-lb. Return Hose: 21-30 ft-lb. Valve-to-Cylinder Hose: 15-19 ft-lb. • Replace mating hose assembly: Basic part numbers (-3A714-) (-3A719-) (-3E601-) (-3A717-) (-3A713-).
• Leakage at ends of control valve casting or at ball stud boot seal. Non-integral power steering.	• Leaking seals.	• Install new valve body seals and reaction limiting seals (Kit No. C3AZ-3A650-B).
• Leakage through control valve body or past ball plugs on bottom of control valve. Non-integral power steering.	• Porous or damaged control valve casting.	• Replace control valve assembly (-3A730-).
• Power steering pump leaks.	• Fluid, cap and dipstick. • Poor brazing of reservoir at filler neck or return tube or damaged reservoir. • Loose or damaged hose fittings. • Leakage at pump shaft seal area. • Damaged rotor shaft. • Pump assembly. • Damaged reservoir O-ring	• Check for indications of false leakage – overfilled reservoir, improperly installed, damaged or lose cap or dipstick. • Replace reservoir. • Repair or replace. • Replace seal. • Replace. • Check for plugged seal drainback hole and/or worn shaft bushing. Partially disassemble pump and clean drain back hole. If hole is not drilled through or shaft bushing worn, replace the housing plate and bushing assembly. • Replace O-ring
	Rattle	
• Steering column noise.	• Loose attachment brackets. • Looseness of ball bearings or insufficient lube. • Steering shaft insulators cracked.	• Tighten to specification. • Lube or replace bearings. • Replace or lube insulators as required.
	Squeak or Creaks	
	• Dry bushings. • Steering shaft grounding. • Socket casting rubbing against shroud or turn signal switch wiring. • Steering wheel rubbing against flange casting. • Dry shift lever grommets. • Insufficient lube on horn brush slip rings. • Upper or lower bearing sleeve out of position.	• Lube shaft seal and shift tube seal. • Align shaft. • Reposition shroud and/or reroute turn signal switch wiring. • Replace flange or steering wheel as required. • Lube grommets. • Lube slip rings. • Reposition sleeve or replace.

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DIAGNOSIS GUIDE – STEERING GEAR

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Feedback rattle, knock in gear (Rack and Pinion Power Steering Gear).	• Loose outer ball joints.	• Tighten. Replace worn or broken parts.
	• Gear housing loose on crossmember.	• Tighten mounting bolts to specifications.
	• Flexible coupling on column out of alignment.	• Align as required.
	• Loose mounting bracket on gear housing tube.	• Replace housing.
	• Deteriorated shock absorbers.	• Replace shock absorbers.
	• Tie rod ball socket preload out of adjustment.	• Adjust preload to specifications.
	• Loose pinion ball bearing plug or locknut.	• Replace bearing if necessary. Tighten plug and locknut to specifications.
	• Rack yoke bearing preload out of adjustment.	• Check for broken spring. Tighten preload to specifications.
	• Oversize pinion shaft bushing.	• Replace housing.
	• Gear assembly.	• Replace gear assembly.
• Front end wander (Rack and Pinion Power Steering Gear).	• Loose outer ball joints.	• Replace worn or broken parts. Tighten ball joints as required.
	• Steering gear housing loose on crossmember.	• Tighten mounting bolts to specification.
	• Flexible coupling in column out of alignment.	• Align as required.
	• Loose mounting bracket on gear housing tube.	• Replace housing.
	• Front end out of alignment.	• Adjust as required.
	• Deteriorated shock absorbers.	• Replace shock absorbers.
	• Rack yoke bearing preload out of adjustment.	• Check spring. Adjust to specifications.
	• Rod ball socket preload out of adjustment.	• Adjust to specification.
	• Loose pinion ball bearings.	• Replace and/or tighten as required.
	• Steering gear assembly.	• Remove gear and disassemble. Check for: • Loose pins in input shaft and valve assembly. • Worn pinion bushing. • Worn bushing in right side of housing. Repair or replace parts as required.
• Vibration when at static park and at low speed – immediately after filling system with power steering fluid (Rack and Pinion Power Steering Gear) only.	• Air in system.	• Drive vehicle slowly and cycle steering wheel stop-to-stop 40 to 50 times or until vibration stops. Do not hold wheel against the stops.
• Poor returnability, sticky feel (Rack and Pinion Power Steering Gear).	• Broken gear housing, bent gear housing tube, bent or broken No. 2 crossmember.	• Inspect. Repair or replace damaged parts.
	• Excessive lash in the rod ends and binding in ball joints.	• Adjust socket preload on tie rod ball. Replace worn or improper parts.
	• Misaligned steering column.	• Align as required.
	• Improper tires or wheels on car.	• Replace with correct parts.
	• Front end out of alignment.	• Adjust as required.
	• Damaged engine mounts.	• Inspect. Repair or replace damaged parts as required.
	• Loose or broken valve housing bolts, loose pinion bearing locknut, and failed pinion bearing.	• Repair or replace as required.
	• Steering gear.	• Remove gear. Disassemble, repair and replace damaged or binding parts.
• Noise (Power Rack and Pinion Steering Gear).	• Grounded column causing intermittent hiss.	• Adjust column for flex coupling flatness.
	• Low fluid in system.	• Add power steering fluid and check for leakage.
	• Severe control valve hiss.	• Replace control valve.

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DETROIT IRON

TESTING

POWER STEERING—PRELIMINARY TESTS

Make the following preliminary tests before disassembling power steering:

Air Bleeding

If bubbles are present in the power steering fluid, bleed the system as follows:

1. Fill the reservoir to specification.
2. Run the engine until the fluid reaches normal operating temperature (165 degrees to 175 degrees F).
3. Turn the steering wheel all the way to the left and right several times. **Do not hold the wheel in the far left or right position.**
4. Recheck the fluid level.
5. If air is still trapped in the system, refer to the procedures covered under Purging Power Steering System of Air.

Fluid Level Check—Ford Pump

1. Run the engine until the fluid reaches normal operating temperature (165 degrees to 175 degrees F).
2. Turn the steering wheel all the way to the left and right several times. Turn off the engine.
3. Check the fluid level in the power steering reservoir. If the level is low, add Automatic Transmission Fluid C1AZ-19582-A, C or D (ESW-M2C33-F) **Do not overfill the reservoir.**

Fluid Level Check—Saginaw Pump

1. Run the engine until the fluid reaches normal operating temperature (approximately 165°-175°F).
2. Turn the steering wheel all the way to the left and right several times. Turn off the engine.
3. Check the fluid level. If the level is low, add Power Steering Fluid D5AZ-19582-A (M2C128-C) on Lincoln and Mark V, or A.T.F. C1AZ-19582-A, (ESW-M2C33-F) on Ford and Mercury, to the **COLD** mark on the dipstick.
4. Start the engine and run it at fast idle. Recheck the fluid level. Add fluid, if necessary, to reach the **COLD** mark.
5. Bleed the system by turning the steering wheel from side to side several times without hitting the stops. This will restore normal steering action.

   Return the wheels to the center position and run the engine for an additional two or three minutes. Turn off the engine.
6. Road test the vehicle to be sure the steering functions normally and is free from noise.
7. Repeat Steps 1 and 2. The fluid should be at the **HOT** mark on the dipstick after the car has reached normal operating temperature.

Pump Belt Check

Replace and adjust broken, glazed, or worn pump belts. Refer to Part 13-50 for adjustment procedure.

Fluid Leak Check

1. With the engine idling, turn the steering wheel left to right several times. Check all possible leakage points.
2. Torque all loose fittings to specification. Replace damaged lines and seats.
3. Check hoses for cut tube O-rings.

Turning Effort Check

Be sure front wheels are properly aligned and tire pressures correct before checking turning effort.

1. Park vehicle on dry concrete and set the parking brake.
2. Idle the engine for two to three minutes. Turn the steering wheel to the left and right several times to warm the fluid.
3. With the engine running, attach a pull scale to the rim of the steering wheel. Measure the pull required to turn the wheel one complete revolution in each direction. See the chart at the end of this Part for acceptable measurements.

POWER STEERING PUMP FLOW AND PRESSURE TESTS

Prior to performing the pump flow and pressure test, the following checks, for conditions which could cause loss of power assist, must be performed and corrective action taken if necessary.

1. Check pump reservoir for proper fluid level.
2. Check tires for correct air pressure.
3. Check pump belt for proper tension.
4. Check pump for correct model and vehicle application.
5. Check for correct size pulleys on pump and engine.
6. Check entire system for damage, replacing parts as necessary.

If the above items are to specifications, or have been corrected, and the loss of assist still exists, test the power steering pump flow and pressure to determine whether the trouble is in the pump, power steering gear, control valve, or in the hydro-boost valve if so equipped.

TEST EQUIPMENT

1. Engine tachometer.
2. Thermometer—0° to 300°F.
3. Rotunda Flow/Pressure Analyzer.
4. Set of adapter fittings.

The test procedure used in conjunction with the Rotunda Flow/Pressure Power Steering Analyzer provides a method for checking the complete power steering system. The Rotunda Flow/Pressure Power Steering Analyzer can be used on integral or non-integral power steering systems to determine the cause of hard steering and/or lack of assist problems.

The Analyzer provides readouts for the following:

A. System Backpressure

B. Pump Flow

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C. Steering Gear Internal Leakage

D. Power Steering Control Valve & Cylinder Internal Leakage

The interpretation of the above readouts will determine which of the following conditions or components are the cause of the problem.

a. Restriction in Hoses or Fittings

b. Control Valve & Cylinder

c. Sticking Gear Valve

d. Inefficient Pump Cam Pack

e. Sticking Relief Valve

f. Binding in Suspension

TEST PROCEDURE

1. To connect the analyzer into the steering system, remove the pressure fitting from the pump and connect it into the appropriate adapter of the analyzer.
2. Thread the other adapter of the analyzer into the pump.
3. Connect the analyzer to the adapters and tighten both connections to 15 foot pounds maximum.

   NOTE: The adapter on the analyzer may be switched so that the connection is made at alternate locations between the pump and gear (Fig. 1).
4. Add power steering fluid to the pump if required. Start the engine and run it for approximately (2) two minutes with the idle set at manufacturer's specifications.
5. Record the following:

   A Flow (gallons/min. at 170° ± 5°F)

   B Pressure (PSI at 170° ± 5°F) at idle with the gate valve fully open.

   (a) If flow (A) is below two (2) gallons/min., the pump may require repair, however, at this point continue the diagnosis. Check chart on page 5 for flow and relief pressure against the model pump being tested.

   (b) If pressure (B) is above 150 PSI, check hoses for restrictions and check the steering gear for poppet valve restrictions (Saginaw Gears Only), 200 PSI for hydroboost vehicles.

   NOTE: On non-integral power steering, jiggle the steering wheel to insure that the spool valve is centered prior to test.
6. Partially close the gate valve to build up 625 PSI. Observe and record flow.

   C (gallons/min. at 170° ± 5°F)

   (a) If flow (C) drops to a level lower than the value on chart I (A), disassemble the pump and replace the cam pack. If the pressure plates are cracked or worn, replace them. Continue with the diagnosis.
7. Completely close and partially open the gate valve three times. (Do not allow the valve to remain closed for more than five (5) seconds). Observe and record pressure (D), (PSI).

   (a) Check the attached chart for the pressure specification listed for the applicable pump model. If the pressure recorded (D) is 100 PSI lower than the specification listed, replace the flow control valve in the pump.

   (b) If the pressure recorded (D) is above the specification listed by more than 50 PSI, the flow control valve in the pump should be removed and cleaned or replaced.
8. Increase the engine speed from idle to approximately 1500 RPM. Observe and record flow (E) (gallons/min.).

   (a) If flow (E) varies more than (1) one gallon/min. from flow (A) the flow control valve in the pump should be removed, and cleaned or replaced.
9. Check idle speed and set to specification if necessary. With the engine at idle, turn (or have someone turn) the steering wheel to the left and right stops. Record the pressure and flow at stops (F) (L.T. pressure PSI, flow gallons/min.; R.T. pressure PSI, flow gallons/min.).

   (a) Pressure developed at both stops should be nearly the same as maximum pump output pressure (D). At the same time, the flow should drop below 1 gallon/min. for integral power steering and for non-integral the flow should drop below 1/2 gallon. If the pressure does not reach maximum output or the flow does not drop below 1 gallon/min. for integral and 1/2 gallon/min. for non-integral, excessive internal leakage is occurring. Remove and disassemble the steering gear on integral power steering and remove the control valve and cylinder on non-integral power steering. Replace damaged or broken parts. Pay particular attention to the rack piston and valve seals for damage.
10. Turn (or have someone turn) the steering wheel slightly in both directions and release quickly while watching the pressure gage. The needle should move from the normal backpressure reading and snap back as the wheel is released. If it comes back slowly, or sticks, the rotary valve in the steering gear is sticking on integral power steering or the control valve is sticking on non-integral power steering.

    Remove, disassemble and clean the rotary vlave on integral power steering and on non-integral power steering, disassemble and clean the control valve spool. If the system is severely contaminated both gear hoses, control valve, and pump must be completely disassembled and cleaned before reassembly.

    NOTE: If problem still exists, check ball joints, linkage, "etc.". (See Service Manual for Steering Diagnosis)

PURGING POWER STEERING SYSTEM OF AIR

Air trapped in the power steering system, which causes a whine-type noise between 20-45 mph on light acceleration, can be removed by using a power steering pump air evacuator assembly (DEVAC Tool) or the VACUUM FILL PROCESS.

Devac System

Fabricate a DEVAC purging tool as shown in Fig. 3 for Ford pump or as in Fig. 4 for Saginaw pump.

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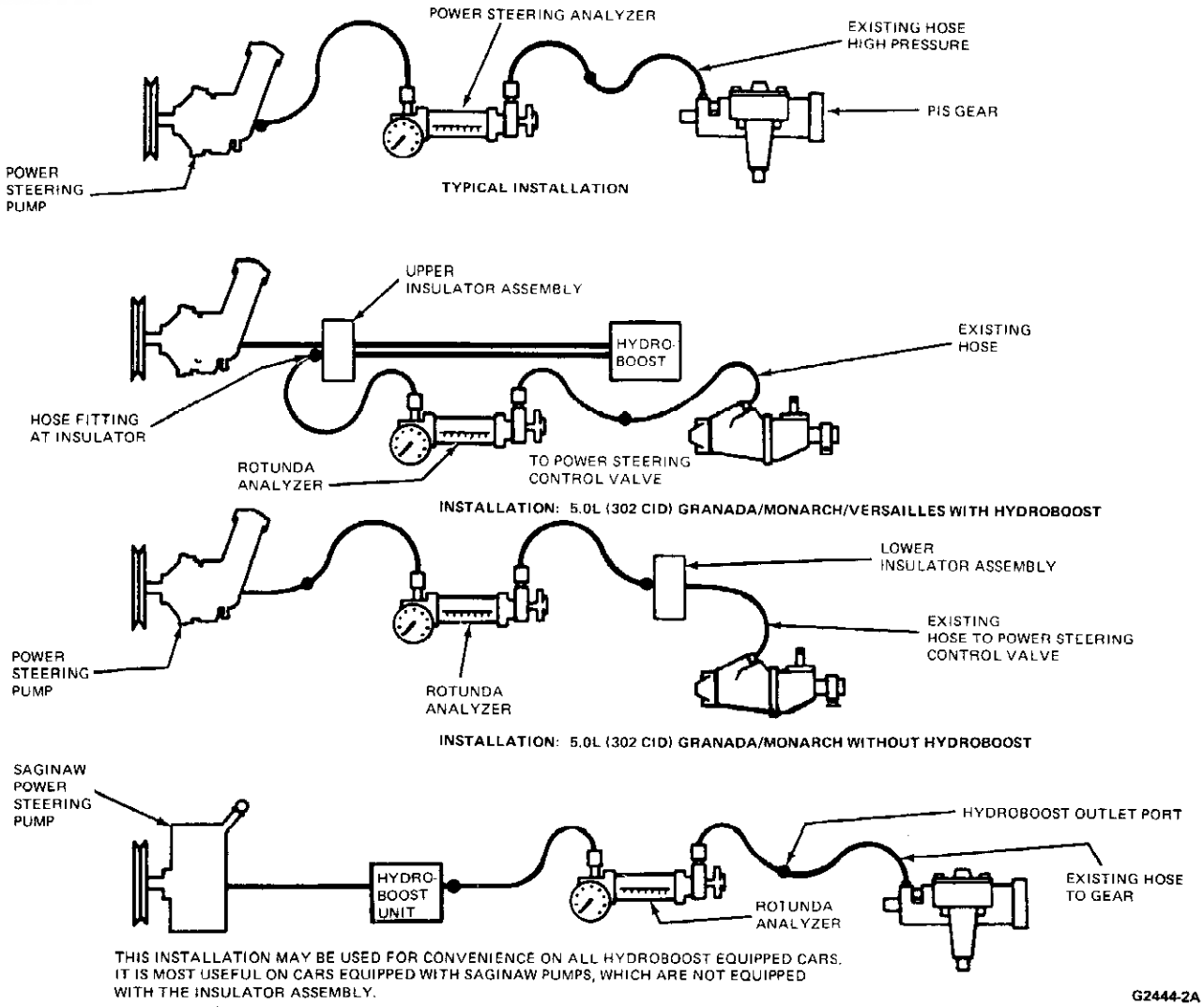


FIG. 1 Using Power Steering Analyzer

The procedure for removing entrapped air is as follows:

1. Check the pump reservoir oil level to make certain the fluid level is correct (add fluid if low, siphon out fluid if level is above full mark).
2. Insert the rubber stopper end of the air evacuator assembly tightly into the filler tube.
3. Connect a suitable length of hose from the other end of the air evacuator to a distributor machine or air-conditioner vacuum motor. **Do Not Use Engine Vacuum.**
4. Let the engine idle for approximately 15 minutes. Turn steering wheel one full cycle every five minutes. (Do not hit the stops.) This assists in removing air trapped in the system.
5. Disconnect and remove the evacuator and reinstall the filler tube dipstick.

Vacuum Fill Process

This procedure is to be used primarily for vehicles that have hydro-boost brake systems. The method should be used whenever the pump, gear, or hydro-boost is removed, serviced and reinstalled into the power steering hydraulic system.

A. Material Required

1. A vacuum pump with gauge, capable of pulling 25 inches of vacuum. The vacuum source sould be one of the following:
   a. Distributor test machine vacuum pump.
   b. Vacuum motor from an air conditioning charging system.
   c. The manifold vacuum source from another vehicle.
2. Special power steering pump cap assembly with a tee connection, shut off valves and a remote fluid reservoir (Fig. 5). The DEVAC tool (Fig. 3) can be used on Ford Pumps. For Saginaw pumps, fabricate a special cap as shown in Fig. 4.
3. List of materials required to construct a vacuum fill system (Fig. 5).

B. Preparation

1. Assemble the vacuum fill system as shown in Fig. 5.
2. Install the vacuum fill system on the vehicle. If the steering gear, pump or hydroboost have been

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FORD P/S PUMPS

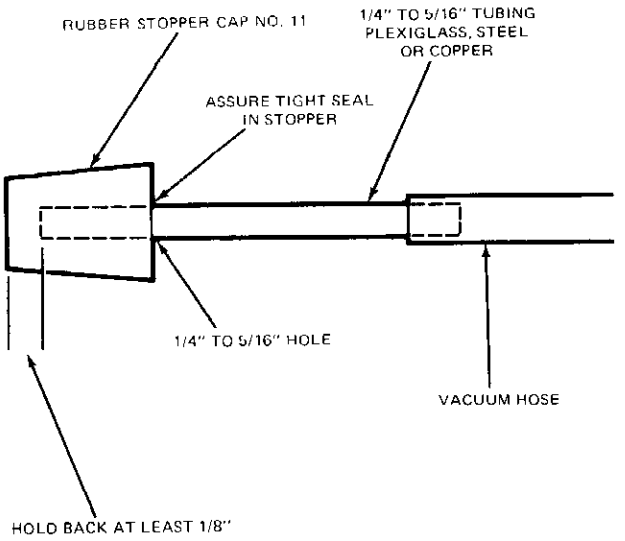
Pump Model	Min. Flow G.P.M.	Min. Relief Pressure PSI
HBC-W	1.9	1050
HBC-V	1.9	1050
HBC-U	1.9	1200
HBC-T	1.9	1300

SAGINAW P/S PUMPS

HBA-GS	2.0	1350
HBA-GR	2.0	1350
HBA-GT	2.0	1350

G2445-1A

FIG. 2 G.P.M. Flow and Pressure Chart



G2122-1B

FIG. 3 Power Steering System Purging Tool (For Ford Pump)

changed or flushed, allow old fluid to drain from the system.

3. Tighten all steering system and vacuum-fill connections.

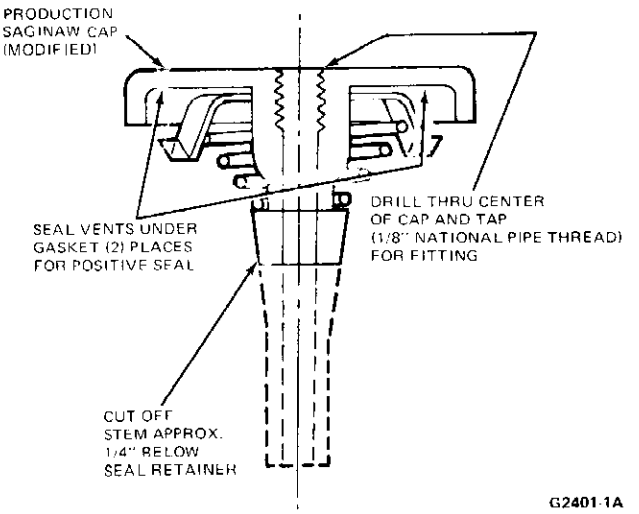
C. Fill Procedure

1. Close all valves.
2. Pour enough steering fluid in the remote reservoir to exceed the amount required for filling the system.
3. Open Valve No. 1 and allow the power steering fluid to bleed through the power steering pump filler cap. Close Valve No. 1 after bleeding.
4. Install the cap on the power steering pump fill neck.
5. Open Valve No. 2 and No. 3. Start the vacuum pump. Operate the pump until a gauge reading 25-30 inches of vacuum is obtained.
6. Close Valve No. 3 and shut off the vacuum pump. Watch the gauge for approximately 30 seconds; if the vacuum reading drops more than 1 inch, there is a leak in the power steering or filling system that must be corrected.
7. Restart the vacuum pump; open Valve No. 3. Operate the pump until a gauge reading of 25-30 inches is obtained.
8. Close Valve No. 2 and shut off the pump. Open Valve No. 1 to fill the steering system with fluid. The remote fill reservoir should be elevated higher than the steering pump.
9. When fluid stops draining from remote fill reservoir, close Valve No. 1 and remove cap from steering pump.
10. Adjust fluid level in pump to correct level. There will be a slight drop in the level when the engine is first started and the steering cycled.
11. Operate the engine at an idle for 15 minutes; then inspect for leaks. It will not be necessary to de-vac the system unless there is evidence of air in the steering pump which could cause noise or affect performance.

LUBRICANT CHECKING PROCEDURE

Manual Steering Gear

1. Center the steering wheel.
2. Remove the gear housing filler plug.
3. Remove the lower cover-to-housing attaching bolt.
4. With a clean punch or similar tool, remove or push inward any loose lubricant in the filler plug hole and cover-to-housing attaching bolt hole.
5. Slowly turn the steering wheel all the way to the left. The lubricant should rise within the lower cover bolt hole. Turn the steering wheel all the way to the right. The lubricant should rise in the filler plug hole.



G2401-1A

Fig. 4 - Modified Pump Reservoir Cap—Saginaw Pump

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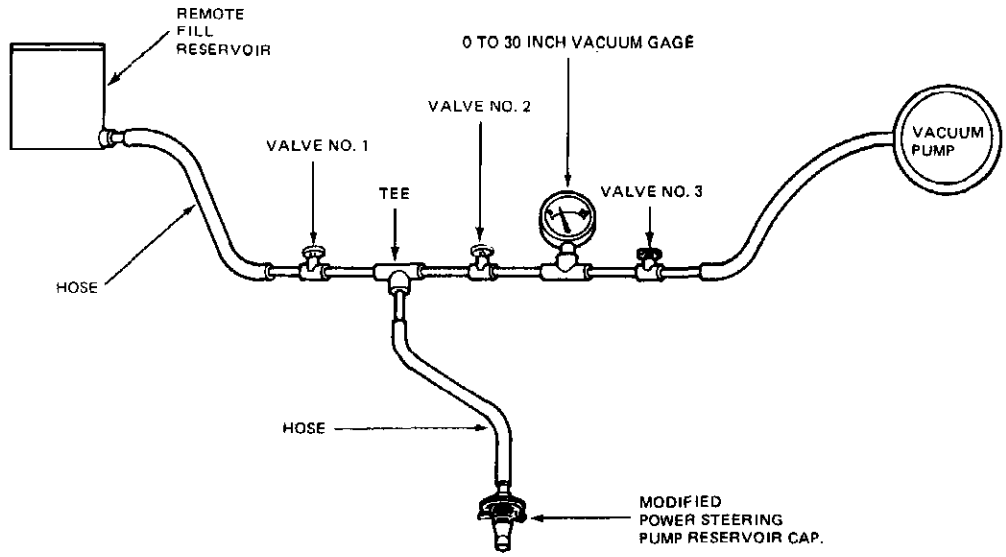


Fig. 5 - Vacuum Fill System Assembled

If lubricant does not rise in both holes, add lubricant and recheck.

6. Reinstall the lower cover-to-housing attaching bolt and the filler plug.

START-UP PROCEDURE AFTER POWER STEERING PUMP OR GEAR OVERHAUL

After engine start up, follow these steps to eliminate excessive steering system noise due to air trapped in the system during repair:

1. Disconnect the coil wire.
2. Fill the reservoir.
3. Crank the engine with the starter and add fluid until the level remains constant.
4. While cranking the engine, rotate the steering wheel from stop to stop. **Front wheels must be off the floor during stop-to-stop rotation of the steering wheel.** Recheck the fluid level, and add fluid, if necessary.
5. Reconnect the coil wire.
6. Start the engine and allow it to run for several minutes.
7. Rotate the steering wheel from far left to far right.
8. Turn off the engine and recheck the fluid level. Add fluid, if necessary.

REMOVAL AND INSTALLATION

IGNITION LOCK CYLINDER ASSEMBLY

THE FOLLOWING PROCEDURE PERTAINS TO VEHICLES THAT HAVE FUNCTIONAL LOCK CYLINDERS: IGNITION KEYS ARE AVAILABLE OR THE IGNITION KEY NUMBERS ARE KNOWN AND THE PROPER KEY CAN BE MADE.

Fixed Steering Column

Removal

1. Disconnect the battery ground cable.
2. Remove the steering wheel trim pad and the steering wheel as described in Parts 13-03 and 13-04.
3. Place the gear shift in PARK (with automatic transmission or in any position with manual transmission and turn the lock cylinder with the ignition key to ON position.
4. Place 1/8 inch diameter wire pin or small drift punch in the hole located inside the column near the base of the lock cylinder housing and depress the retaining pin while pulling out on the lock cylinder to remove it from the column housing.

Installation

1. To install the lock cylinder, turn the lock cylinder to the ON position and depress the retaining pin, then insert the lock cylinder into its housing in the flange casting. Assure that the cylinder is fully seated and

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aligned into the interlocking washer before turning the key to the OFF position. This action will permit the cylinder retaining pin to extend into the cylinder cast housing hole.

2. Using the ignition key rotate the lock cylinder to insure correct mechanical operation in all positions.
3. Install the steering wheel and trim pads as described in Parts 13-03 and 13-04.
4. Connect the battery ground cable.
5. Check for proper start in Park or Neutral. Also check to make certain that the start circuit cannot be actuated in the Drive and Reverse positions.

Tilt Steering Column

Removal

1. Disconnect the battery ground cable.
2. Place the gear shift in PARK position and turn the lock cylinder with the ignition key to the ON position.
3. Insert a 1/8 inch diameter wire pin or a small drift punch in the hole located on the outside of the steering column casting adjacent to the hazard flasher button (Fig. 6).
4. Depress the drift punch or wire pin and pull out on the lock cylinder to remove the lock cylinder from the steering column housing.

Installation

1. To install the lock cylinder, turn the lock cylinder to the ON position and depress the retaining pin, then insert the lock cylinder into its housing in the flange casting. Assure that the lock cylinder is fully seated and aligned into the interlocking washer before turning the key to the OFF position. This action will permit the cylinder retaining pin to extend into the cylinder cast housing hole.
2. Using the ignition key rotate the lock cylinder to insure correct mechanical operation in all positions.
3. Connect the battery ground cable.
4. Check for proper start in Park and Neutral. Also check to make certain that the start circuit cannot be actuated in the Drive and Reverse positions.

THE FOLLOWING PROCEDURE APPLIES TO VEHICLES WHERE THE IGNITION LOCK IS INOPERATIVE AND THE LOCK CYLINDER *CANNOT BE ROTATED DUE TO A LOST OR* BROKEN IGNITION KEY; THE KEY NUMBER NOT KNOWN; OR THE LOCK CYLINDER CAP IS DAMAGED AND/OR BROKEN TO THE EXTENT THAT THE LOCK CYLINDER CANNOT BE ROTATED.

Fixed Steering Column

Removal

1. Disconnect the battery ground cable.
2. Remove the steering wheel and pad assembly as described earlier in this section.
3. Remove the turn signal lever from the steering column.
4. To gain access to the ignition switch on the Granada, Monarch, Pinto, Bobcat, Mustang II, Ford, Mercury, Lincoln Continental, Fairmont and Zephyr, remove the steering column trim shrouds from the steering column. Detach and lower the steering column assembly from the brake pedal support bracket as described earlier in this Part. To gain access to the ignition switch on the LTD II, Cougar, Ranchero, Thunderbird and Continental Mark V, remove the steering column trim shrouds and the instrument cluster as described in Part 33-50.

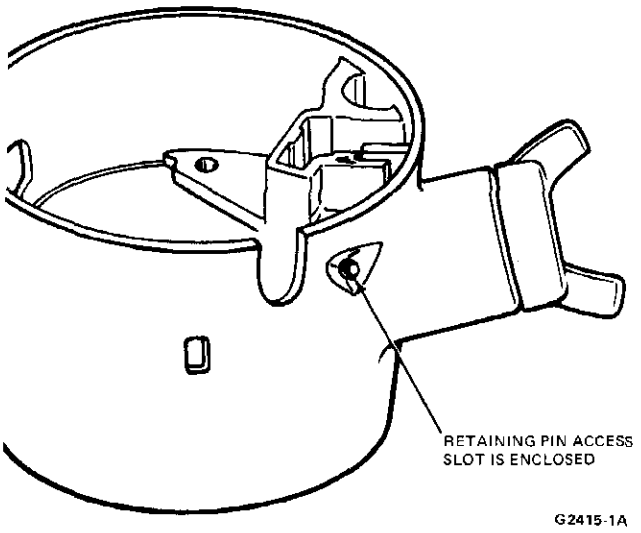


FIG. 6 Lock Retaining Pin Access Slot

5. Remove the ignition switch and pin it in the LOCK position as described in Part 33-70 (Fig. 7).
6. Remove the turn signal switch from the column assembly as described in Part 13-03.
7. Remove the upper bearing snap ring and the (2) "T"-bolt retaining nuts that secure the flange casting to the outer tube. Remove the entire flange casting assembly, the upper shaft bearing, the lock cylinder assembly, the ignition switch actuator and the ignition switch actuator rod by pulling the *assembly over the end of the steering column shaft* (Fig. 8).
8. Replace the above assembly with a new assembly consisting of:
   a. (1) 3511 Flange
   b. (1) 11582 Lock Cylinder Assembly
   c. (1) 3E717 Lock Gear, Steering Column Lock
   d. (1) 3E700 Bearing, Steering Column Lock
   e. (1) 3C610 Retainer, Steering Column Upper Bearing
   f. (1) 3E723 Actuator Assembly, Steering Column Lock

   NOTE: Retain the ignition switch actuating rod from the removed casting assembly and use it with the new flange casting assembly.

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DETROIT IRON

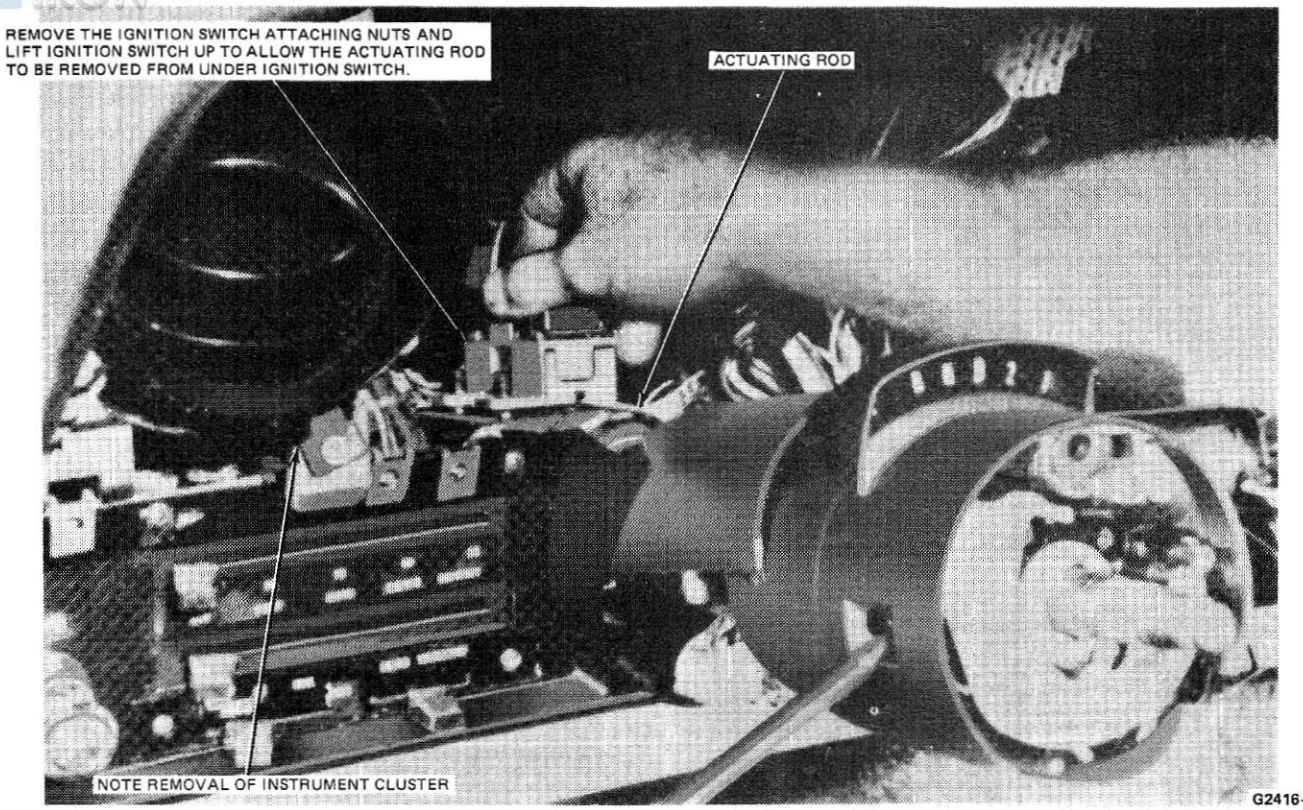


FIG. 7 Removing Ignition Switch

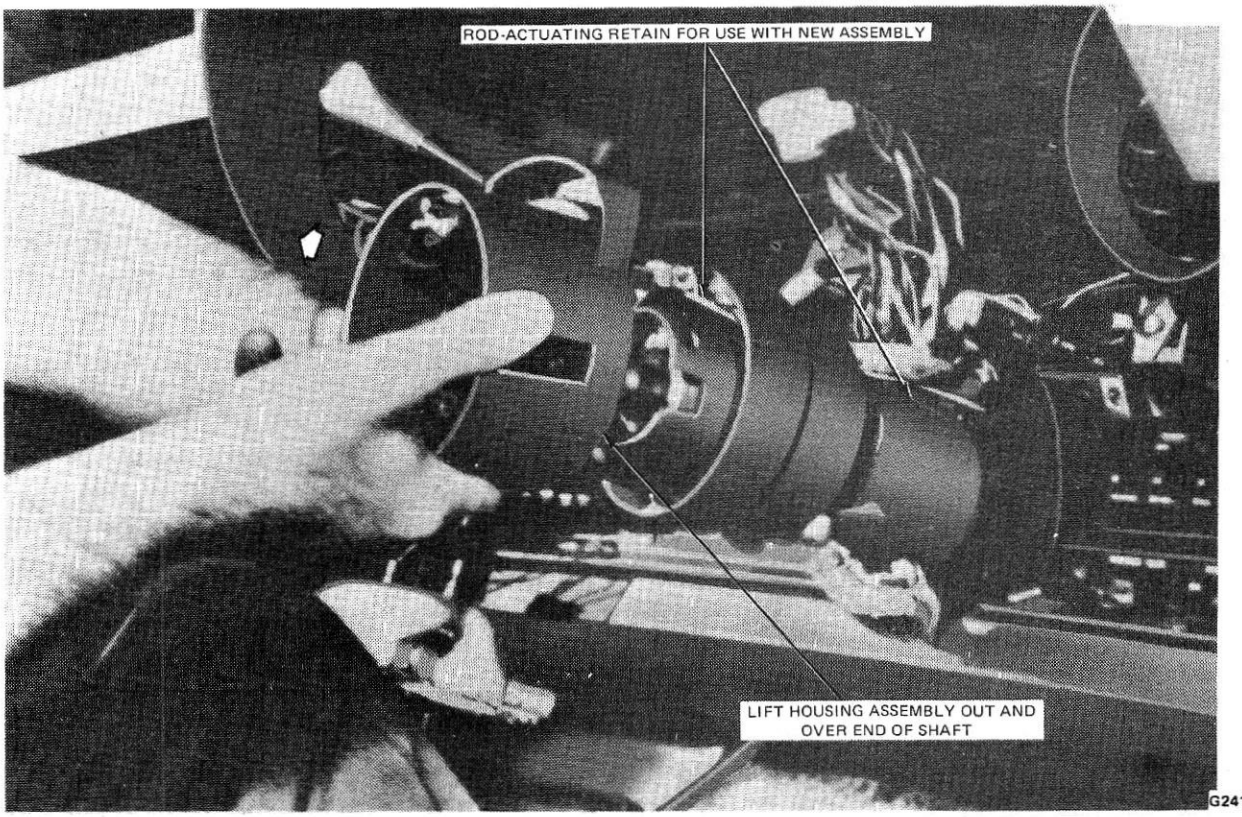


FIG. 8 Removing Flange Casting

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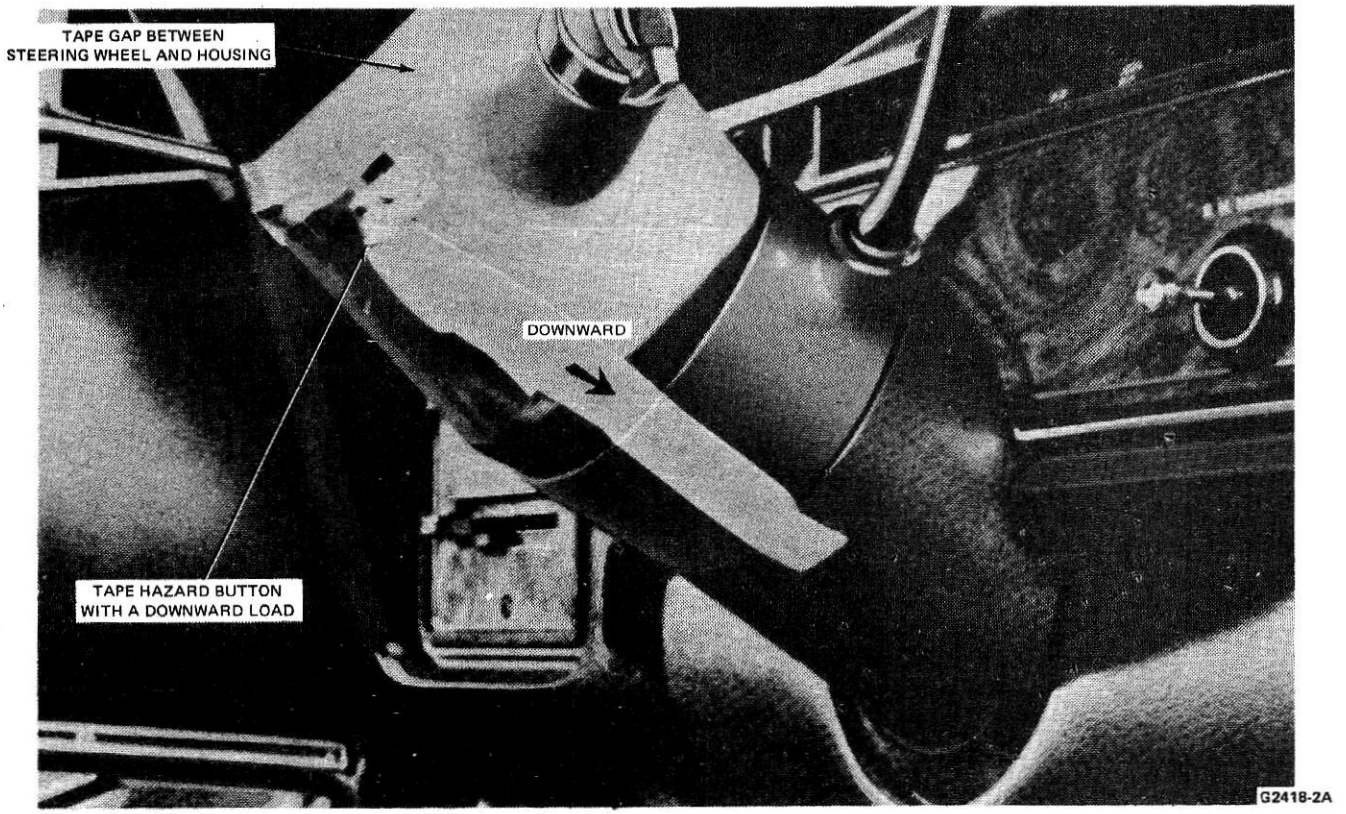


FIG. 9 Taping Hazard Switch

Installation

1. Reassemble the above parts, install a new upper shaft bearing (3517) and set the actuator to drive gear as described earlier in this Part.
2. Install the turn signal switch as described earlier in this Part.
3. Install the ignition switch, check and/or adjust for proper function as specified in Part 33-70.
4. On the LTD II, Cougar, Ranchero, Thunderbird and Continental Mark V, install the instrument cluster as described in Part 33-50.
5. Install the steering column trim shrouds, steering wheel and pad assembly as specified earlier in this Part.
6. Install the turn signal lever.
7. Using the ignition key rotate the lock cylinder to insure correct mechanical operation in all positions.
8. Connect the battery ground cable.
9. Check for proper start in Park and Neutral. Also check to make certain that the start circuit cannot be actuated in the Drive and Reverse positions.

Tilt Steering Column

Removal

1. Disconnect the battery ground cable.
2. Remove the steering column trim shrouds as described earlier in this section.
3. Tape the gap between the steering wheel hub and the cover casting. Cover the entire circumference of the casting, also cover the adjacent seat and floor area with a suitable covering to protect the surrounding upholstery interior. Pull out the hazard flasher switch and tape it down toward the floor as shown in Fig. 9 to provide clearance for drilling out the lock cylinder retaining pin.
4. The tilt column lock cylinder retaining pin is located on the outside of the steering column cover casting adjacent to the hazard flasher button. Tilt the steering column to the full up position and prepunch the lock cylinder retaining pin with a prick punch. Using a 1/8 inch diameter drill with a right angle drive drill out the retaining pin, going no deeper than 1/2 inch (Fig. 10).

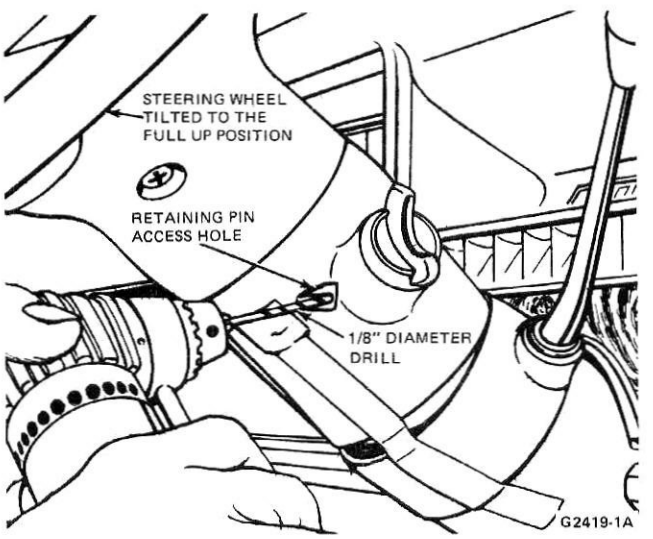


FIG. 10 Drilling Out The Lock Retaining Pin

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DETROIT IRON

NOTE: When drilling out the retaining pin use care not to damage the cover cast housing or the hazard flasher switch.

5. Tilt the steering column to the full down position. Place a chisel at the base of the ignition lock cylinder cap and using a hammer strike the chisel with sharp blows to break the cap away from the lock cylinder (Fig. 11).
6. Using a 3/8 inch diameter drill, drill down the middle of the ignition lock key slot approximately 1 3/4 inch until the lock cylinder breaks loose from the steering column cover casting. Remove the lock cylinder, and the drill shavings from the base of the cover cast housing (Fig. 12).
7. Remove the steering wheel and pad as described earlier in this Part.
8. Remove the turn signal lever from the column and then remove the (2) attaching screws from the turn

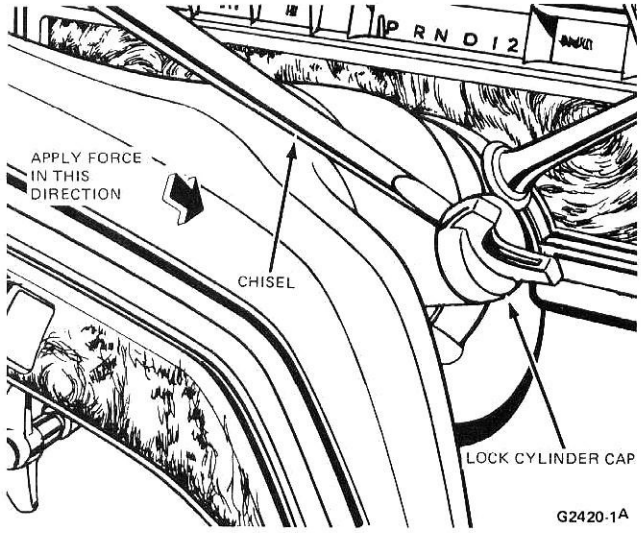


FIG. 11 Breaking the Cap Away From the Lock Cylinder

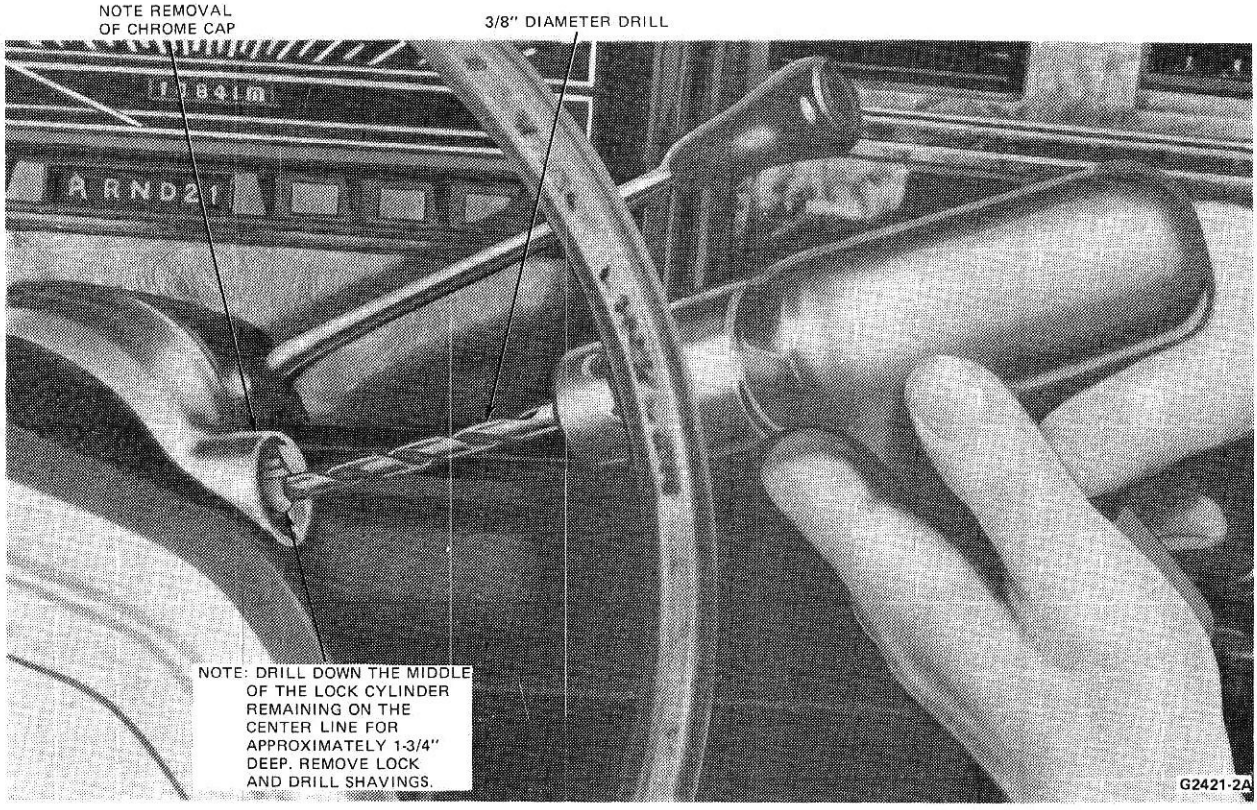


FIG. 12 Drilling Out The Lock Cylinder

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signal switch and (1) attaching screw from the key warning buzzer terminal. Lift the turn signal switch up and over the end of the steering shaft but do not disconnect it from the wiring harness.

9. Remove the (4) attaching screws from the cover casting and lift the casting over the end of the steering shaft allowing the turn signal switch to pass through the cover casting. The removal of the cover casting will expose the upper actuator (3E723). Remove the upper actuator.
10. Remove the drive gear, snap ring and washer from the cover casting along with the upper actuator mentioned above. Thoroughly clean the components in an acceptable cleaning solution. Carefully inspect all components for any damage resulting from the drilling operation. If any of the components show signs of damage they must be replaced. Clean the removed cover casting with compressed air to remove any drill shavings or foreign particles and carefully inspect it for damage. If the cover casting is damaged, replace it with a new one primed and painted to match the existing column.

Installation

1. Attach the upper actuator to the lower actuator and lubricate the upper actuator. Reassemble the cover casting, upper actuator, turn signal switch and lever, lock drive gear, lock cylinder, steering wheel and pad, and the steering column trim shrouds as described earlier in this Part.
2. Using the ignition key, rotate the lock cylinder to insure correct mechanical operation in all positions.
3. Connect the battery ground cable.
4. Check for proper start in Park or Neutral. Also check to make certain that the start circuit cannot be actuated in the Drive and Reverse positions.

CLEANING AND INSPECTION

POWER STEERING GEAR

CLEANING

1. Use a clean work bench and tools.
2. Clean the exterior of the gear with solvent. If necessary, drain off excess hydraulic fluid.
3. Handle the parts carefully to avoid nicks, burrs, scratches and dirt. Do not use solvent on seals.

INSPECTION

1. Check the sector shaft contact surface in the cover for wear. If the surface is worn, replace the cover.
2. Inspect the input shaft bearing. Check the fit of the bearing on the input shaft. Replace the bearing, if necessary.
3. Inspect the valve housing for wear, scoring, or burrs.
4. Inspect the tube seats in the pressure and return ports for nicks. Replace them if necessary.
5. Check the sector shaft contact surface in the housing for wear. If the surface is worn, replace the housing.
6. Check the fluid passages for obstruction or leakage.
7. Inspect the gear housing for cracks and stripped threads, and the mating surfaces for burrs. Inspect the piston bore for scoring or wear. If necessary, replace the housing.
8. Be sure the input shaft bearing rotates freely.
9. Check the input shaft for freedom of movement in the sleeve. If movement is impaired, inspect the valve spool for burrs and remove. **Stone the input shaft in a radial direction only.** Recheck for freedom of movement.
10. Inspect the piston rack and sector shaft teeth for nicks and burrs.

FLUSHING THE POWER STEERING GEAR

Always flush the power steering gear when replacing the pump due to fluid contamination. Follow the steps below:

1. Remove the pump and pulley, and repair the pump as outlined in Parts 13-50 and 13-52.
2. Install the pulley on the repaired pump. Install the pump. Flush the pressure line before installing. **Connect only the pressure hose.**
3. Place the fluid return line from the gear in a container, and plug the reservoir return line.
4. Fill the reservoir with ATF C1AZ-19582-A, -C or -D (ESW M2C33-F) except Lincoln and Mark V which require D5AZ-19582-A (ESW-M2C128-D).
5. Disconnect the coil wire and raise the front wheels off the ground.
6. While adding approximately two quarts of fluid, turn on the ignition (using the ignition key) and crank the engine with the starter while turning the steering wheel from left to right.
7. When all the fluid has been added, turn off the ignition and attach the coil wire.
8. Remove the plug from the reservoir return line, and attach the line to the reservoir.
9. Check the fluid level. Add fluid, if necessary. **Do not overfill** the reservoir.
10. Lower the vehicle.
11. Turn the steering wheel from side to side without hitting the stops to expel any trapped air.

FLUSHING THE POWER STEERING PUMP

If dirt is found in the power steering gear, flush the pump as follows:

1. Making sure all other hoses are connected, disconnect the pressure line at the gear.
2. Place the line in a container.

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3. Fill the reservoir with ATF C1AZ-19582-A, -C, or -D (ESW-M2C33-F) except Lincoln and Mark V, which require D5AZ-19582-A (ESW-M2C128-D).
4. Disconnect the coil wire.
5. While adding approximately two quarts of fluid, turn on the ignition and crank the engine with the starter. As soon as all fluid has been added, turn off the ignition.
6. Attach the pressure hose at the gear.
7. Check the fluid level.
8. Crank the engine with the starter and add fluid until the level remains constant.
9. Lower the vehicle and attach the coil wire.
10. Start the engine and turn the steering wheel from side to side to expel any air trapped in the system. This will restore normal steering action.

CLEANING THE POWER STEERING PUMP

Wash all parts except seals in a chlorinated solvent and dry with compressed air.

INSPECTION (FORD)

To determine when to replace power steering pump components, follow these guidelines. **Some components must be replaced regardless of condition.**

1. Re-use the outlet fitting if the corners are not rounded and the threads intact.
2. Replace all seals except the rotor shaft seal. Re-use the rotor shaft seal if it does not leak.
3. Re-use the reservoir assembly if the reservoir seal areas are not damaged. Check for a broken or missing baffle.
4. Re-use the housing or housing assembly if the O-ring and snap ring surfaces are not damaged.
5. Re-use the upper and lower pressure plates if there is no scoring on the wear surface. Polish the phosphate coating, if necessary but do not remove it.
6. Re-use the rotor and cam assembly if wear is limited to removal of the phosphate coating on the cam contour. Do not disassemble the unit. Push the rotor part way through the cam insert, being careful not to dislodge the slippers and springs. Check the cam ID for scoring or burring. Check the rotor faces and OD for scoring and chipping. **Do not repair or refinish the upper and lower pressure plates, cam or rotor assembly. If wear or burring is evident, replace them with new components.**
7. Install a new rotor and cam assembly if the slippers are worn. Replace the springs if they are bent or broken.
8. Re-use the rotor shaft if the thrust faces, bushing diameter, and shaft seal diameter are not excessively worn or scored.
9. Re-use the housing and bushing assembly if all of the threaded holes are not damaged beyond repair, and the bushing diameter is not scored or worn .0005 inch over the .6897 inch maximum. Repair threaded holes by drilling out the damaged threads and installing helicoil inserts. If the bushing is scored or excessively worn, install a new housing and bushing assembly.
10. Re-use valve body if valve bore is free of nicks and scoring. Valve must fall freely in valve bore. Replace valve housing and/or valve if valve sticks in bore.

INSPECTION (SAGINAW PUMP)

To determine when to replace power steering pump components follow these guidelines. **Some components must be replaced regardless of condition.**

1. Replace all seals except the rotor shaft seal. Re-use the rotor shaft seal if it does not leak.
2. Re-use the flow control valve assembly if it is free of scores and burrs.
3. Re-use the housing assembly if there are no scratches or burrs on machined surfaces, especially mating surfaces on O-ring seats. If the shaft bushing in the pump housing is scored or excessively worn, replace the pump housing assembly.
4. Re-use the pressure plate if the V-shaped notches at the edges of the discharge ports are not damaged. These notches must be clean to cushion hydraulic shock and prevent pump noise.
5. Re-use the cam ring if it is not cracked or scored. The ring is treated for wear resistance with a material which leaves a light grey finish on the wear surface. A wavy grain appearance inside the ring is normal.
6. Remove the vanes from the rotor and examine them for wear. Re-use them if they are not damaged.
7. Re-use the rotor shaft if the splines, bearing, and seal surfaces are not damaged.

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SPECIFICATIONS

Tool No.	Description
Rotunda 97-0001 or Equivalent	Flow/Pressure Analyzer

CG1847-1G

POWER STEERING PUMP RELIEF PRESSURE – FORD/TRW PUMP	
VEHICLE	**MIN. RELIEF PRESSURE**
Granada and Monarch	1050 PSI
LTD II, Cougar, Thunderbird Ford 5.8L/6.6L (351M/400 CID) Mercury 5.8L (351M CID) Mustang II, Pinto, Bobcat	1125 PSI
SAGINAW PUMP	
Ford 7.5L (460 CID) Mercury 6.6L/7.5L (400/460 CID)	1350 PSI
Continental Mark V, Lincoln Continental	1350 PSI

CG2120-1E

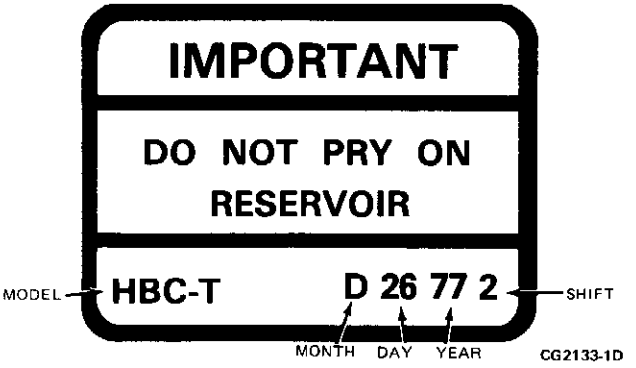
POWER STEERING PUMP MODEL IDENTIFICATION

The power steering pumps have a service identification tag to identify assemblies for service purposes. Tags are located and contain information as shown below:

Tag Location: On Reservoir Body. **Ford Built:** SERVICE MODEL IDENTIFICATION

SAGINAW STEERING PUMPS

The prefix HBC of the Serial Number HBC-T will be omitted from the identification label fastened to the outboard side of the reservoir with adhesive.



CG2133-1D

STATIC STEERING WHEEL TURNING EFFORTS (Lbs.)		
Vehicle	**Power**	**Manual**
FORD, MERCURY, LINCOLN, MARK V, THUNDERBIRD	5.0	
LTD II, THUNDERBIRD, COUGAR	5.0	
FAIRMONT/ZEPHYR	N.A.	N.A.
GRANADA, MONARCH	7.0	3.3L/4.1L (200/250 CID) 29.0 5.0L/5.8L (302/351 CID) 31.0
PINTO, BOBCAT MUSTANG II	5.0 5.0	30.0 34.0

CG2121-1E

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DETROIT IRON

Steering Columns—Conventional (Convoluted Absorber Type)

PART 13-03

Applies To Ford/Mercury, Lincoln Continental

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CG2422-2B

DESCRIPTION

STEERING COLUMN

If an accident occurs, the tube collapses approximately six inches at the bellows on hard impact. The shift tube and the steering shaft collapse in proportion to the outer tube.

Once the steering column is collapsed, a new column and brackets must be installed.

The tilt column features five driving positions (two up, two down, and a center position). Both fixed and tilt columns feature an emergency warning flasher control, a turn signal indicating switch with a lane changer position, and are equipped with an anti-theft locking device which locks the transmission linkage and steering system.

ADJUSTMENTS

STEERING WHEEL SPOKE POSITION

When the steering gear is on the high point, the front wheels should be in the straight-ahead position, and the steering wheel spokes in their normal position with the Pitman arm pointing directly forward. If the spokes are not in their normal position when the front wheels are straight, adjust the steering wheel as outlined in Part 14-01.

TRANSMISSION SELECTOR INDICATOR—FORD AND MERCURY

Before adjusting the transmission selector indicator, adjust the manual linkage to correspond to insert stop without regard to indicated setting. Adjust indicator in the following steps below.

The PRND21 mechanism features a slip clutch which is automatically adjusted when the shift lever is shifted

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to "1" or "S". **If the steering column is removed for service, reset the slip clutch as outlined in Group 33, Part 50.**

SELF-ADJUSTING TRANSMISSION SELECTOR INDICATOR

1. Shift the transmission selector to "P". **Never adjust the selector with the lever in the "1" or "S" position.**
2. Place the loop on the indicator assembly over the retainer pin on the socket casting. Place the column mounting bracket in the "T" slot and secure with a screw. Torque the screw to 20 in-lb minimum.
3. Shift the column selector lever firmly against the stop to either the "1" or "S" position.
4. Shift the selector to "D" and check the indicator setting: The pointer must fall within the letter "D" when viewed parallel to the centerline of the column from the driver position.
5. Place the indicator cable in the tab of the shroud retainer clip on the column.
6. In all other positions, the indicator must touch the shift position letters or numerals.

PRE-SET CLUTCH ADJUSTMENT- PRND21 FOLLOWING COLUMN OR CLUSTER REMOVAL

1. Remove the cluster assembly from the instrument panel.
2. Turn the assembly to expose the PRND21 adjustment mechanism at the bottom of the backplate (Fig. 1).
3. Pre-set the mechanism by inserting a scratch awl or similiar tool into the hole at the bottom of the connector pin. Slide the pin and spring assembly to the left until it bottoms against the pointer slot. (Fig. 1).

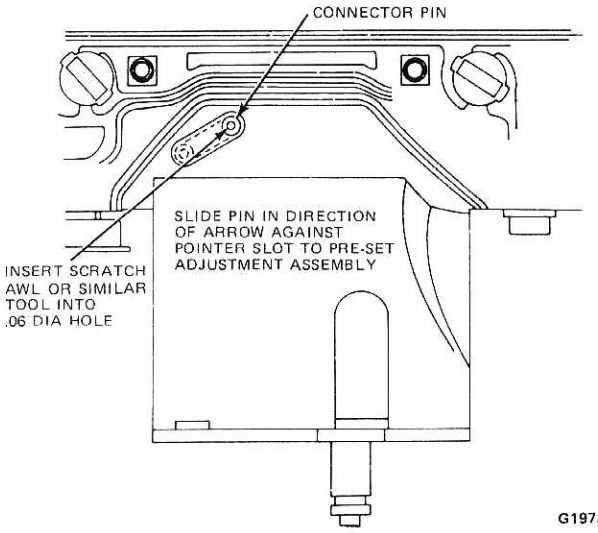


FIG. 1 Bottom View—Instrument Cluster Assembly

4. Re-install the cluster assembly.
5. Repeat the self-adjusting transmission selector indicator adjustments.
6. Adjust linkage as required.

REMOVAL AND INSTALLATION

STEERING WHEEL

Removal

1. Disconnect the negative battery cable from the terminal.
2. Remove the steering wheel horn cover.
3. Disconnect the horn and speed control wires (if equipped). Remove the steering wheel locknut. **Do not re-use locknut.**
4. Using Tool T67L-3600-A, remove the steering wheel (Fig. 2).

   Do not hammer the end of the steering column uppershaft or use a knock-off type steering wheel puller. Either procedure will damage the steering column.

Installation

1. Place the steering wheel on the steering column upper shaft, so that the mark on the wheel is in line with the mark on the shaft. **Be sure the front wheels are straight ahead when the steering wheel is in the normal position.**
2. **Install a new steering wheel lock nut.** Torque the nut to 30 to 40 ft-lb.
3. Connect the horn and speed control wires (if equipped).

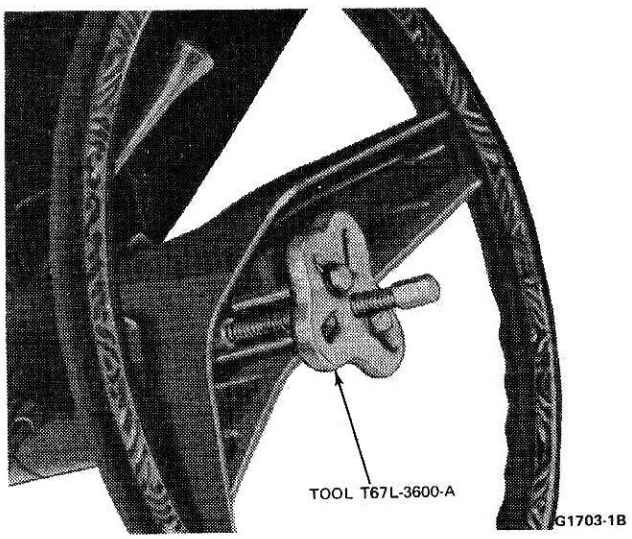


FIG. 2 Removing Steering Wheel

4. Install the steering wheel horn cover pad. Torque the screws to 13 to 20 in-lb.
5. Connect the negative battery cable to the terminal.
6. Test the steering column for proper operation.

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UPPER SHAFT BEARING

Fixed Column

Removal

1. Disconnect the negative battery cable from the terminal.
2. Remove the steering wheel as detailed in this Part.
3. Disconnect the electrical connections to the steering column.
4. Remove the turn indicator lever.
5. Remove the screws from the turn indicator switch and lift the switch over the end of the steering column upper shaft.
6. Remove the turn indicator switch and wiring harness from the steering column.
7. Remove the snap ring from the top of the steering column upper shaft.
8. Loosen the flange-to-steering column tube retaining nuts, and remove the T-bolts from the tube.
9. Raise the flange while tapping lightly on the steering shaft with a plastic hammer to free the bearing and flange from the shaft.
10. Remove the bearing and insulator from the flange.

Installation

1. Place the flange on the steering column tube.
2. Install the T-bolts and retaining nuts. Torque the nuts to 60-75 in-lb.
3. Prick punch the shaft serration diameter to insure an interference fit to the inner race. Place the bearing and insulator on the shaft, working them as far down the shaft as possible. Place a piece of pipe 3/4 ID x 2 1/8 inch long over the end of the shaft.
4. Install the steering wheel attaching nut (Fig. 3). Tighten the nut until the bearing is seated in the flange. Remove the nut and pipe from the shaft.

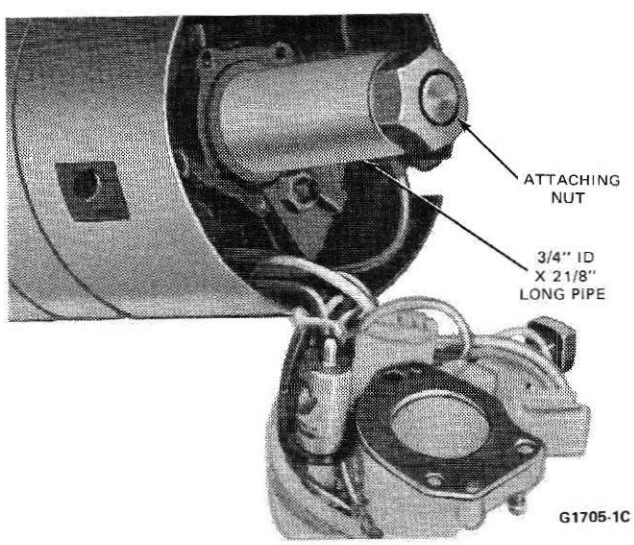


FIG. 3 Installing Upper Bearing— Fixed Columns

5. Install the snap ring in the groove on the shaft.
6. Install the turn indicator switch on the flange. Torque the screws to 20 to 30 in-lb.
7. Install the turn indicator lever.
8. Connect the electrical connections to the steering column.
9. Install the steering wheel as outlined in this Part.
10. Connect the negative battery cable to the terminal.
11. Test the steering column for proper operation.

TILT COLUMN

Removal

1. Remove the column as described later in this Part.
2. Place the flange casting on a bench with the smaller bearing facing down.
3. With a small pick, lightly tap on the outer race of the small bearing at each slot. **Never drive or apply pressure of any kind to the inner race of the bearing.**
4. Invert the flange casting and place it on a bench with the large upper bearing face down.
5. With a small pick, lightly tap on the outer race of the large bearing at each slot. **Never drive or apply pressure of any kind to the inner race of the bearing.**

Installation

1. Position the flange casting on a bench with the large bearing seat facing upward.
2. Select a socket wrench that is the same diameter as the outer race of the large upper bearing.
3. Position the large upper bearing over its bearing seat with the open side facing inward.
4. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place. **Be careful not to contact the bearing inner race as damage will result.**
5. Invert the flange casting and place it on a bench with the small bearing seat facing upward.
6. Select a socket wrench that is the same diameter as the outer race of the small bearing.
7. Position the small bearing over its bearing seat with the open side facing inward.
8. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place. **Be careful not to contact the bearing inner race as damage will result.**
9. Install the tilt column mechanism as described earlier in this Part.

STEERING COLUMN ASSEMBLY

Manual and automatic transmission linkage systems make use of oil impregnated plastic grommets to connect various rods or levers. To assure satisfactory retention of the connecting links and overall system operation, the grommets must be replaced and not reused when a grommet-type connection (as in a steering column replacement) is changed. Grommet removal and installation procedures are detailed in Group 17-02.

FORD/MERCURY

Removal

1. Disconnect the negative battery cable from the terminal.

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2. Remove the steering wheel as outlined in this Part.
3. Remove the lower instrument panel.
4. Remove the steering column trim shroud by pulling the shroud tabs out of the steering column clips.
5. Disconnect the electrical connections to the steering column.
6. Disconnect the PRND21 cable from the outer tube.
7. Remove the toe plate from the dash panel by removing four nuts from the engine compartment side of the dash panel, and one nut from the driver compartment side (Fig. 4).
8. Disconnect the transmission control rod and remove the nuts that attach the flexible coupling to the flange on the steering column shaft.
9. Remove the nuts that secure the steering column to the brake pedal support bracket.
10. Remove the steering column.

Installation

1. Install the electrical wiring harness bracket to Bracket "B" (if removed).
2. Loosen the bolts joining Bracket "A" and Bracket "B". Leave the square necks of the bolts in the slots.
3. Loosen the toe plate clamp and slide the cover back.
4. Insert the steering column assembly through the opening in the dash panel.
5. On fixed column steering wheels, place the flange on the shaft against the flexible coupling. Insert a 1/4 inch diameter rod between the flexible coupling fabric and the flange. Install the nuts and torque to 10 to 22 ft-lb. **Do not distort the flexible coupling when torquing the nuts or removing the rod.**

   On tilt column wheels, place the shaft against the flexible coupling. Insert a 1/4 inch diameter rod between the flexible coupling fabric and the flange. Install the grade 8 bolt (385970-S100) and torque to 20-30 ft-lb. **Do not distort the flexible coupling when torquing the bolt or removing the rod.**

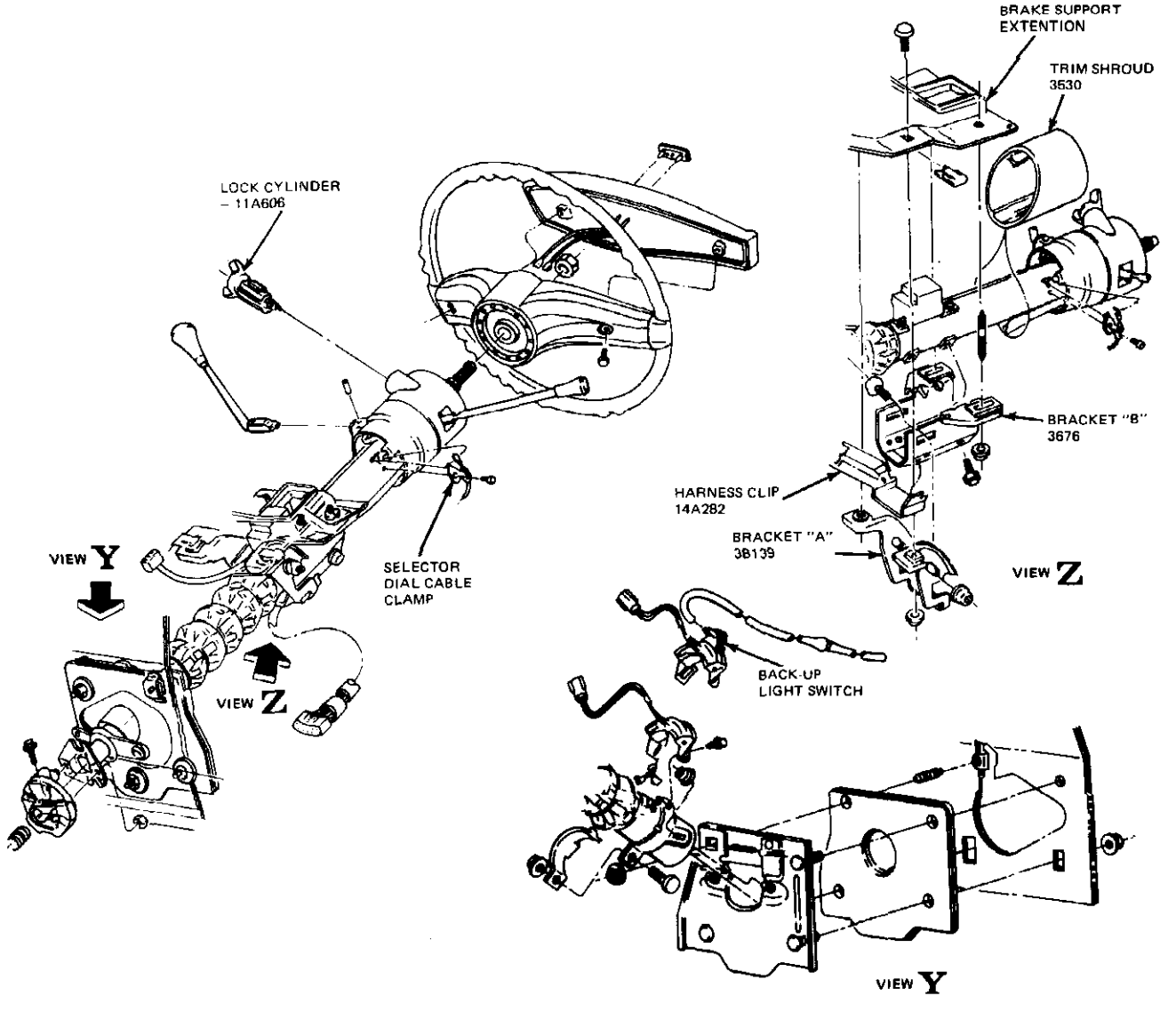


FIG. 4 Fixed Steering Column Installation—Ford, Mercury (Tilt Similar)

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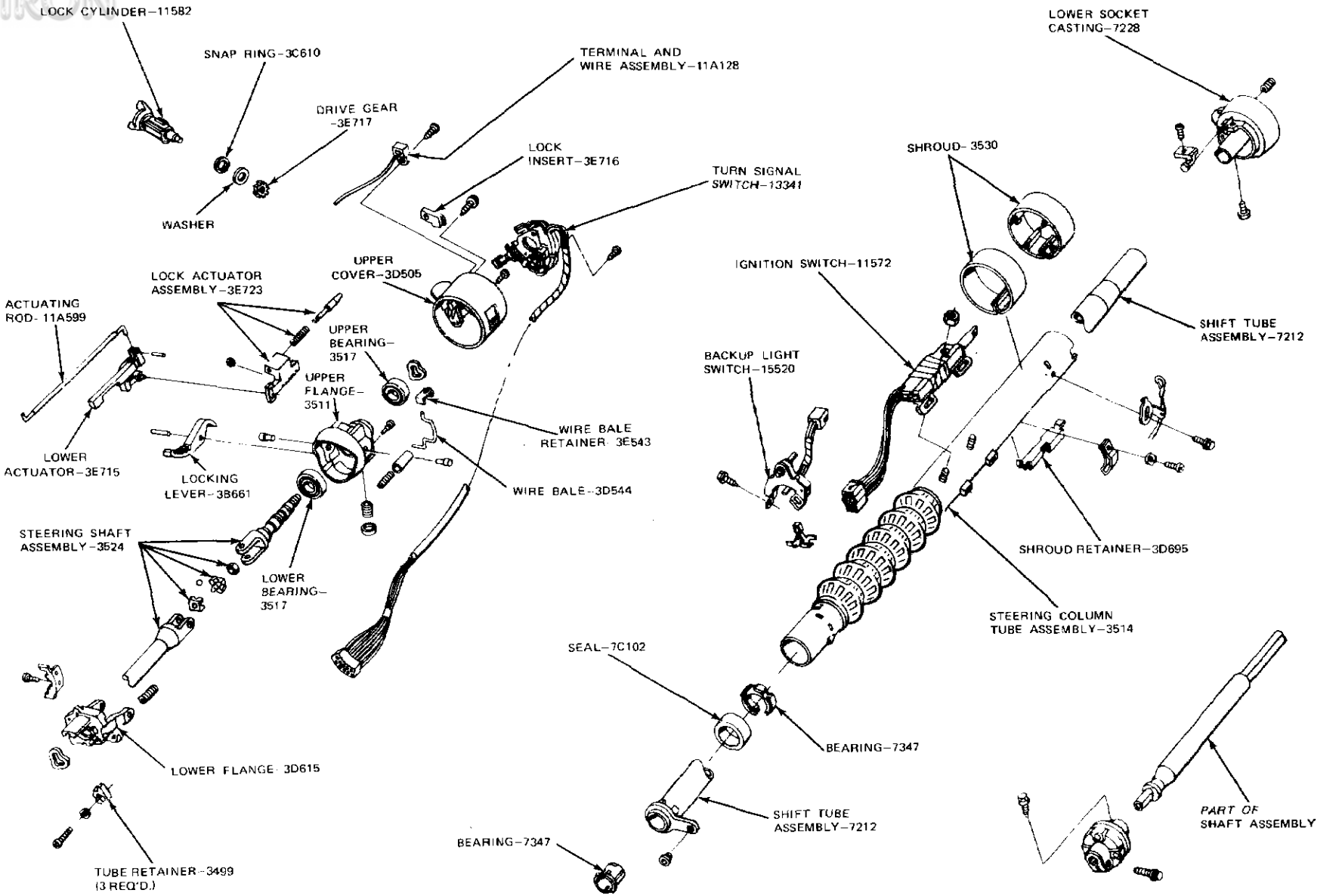


FIG. 5 Typical Tilt Column Disassembled

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6. Install the column on the two rear studs of the brake pedal support bracket and finger-start the two nuts. Slide bracket "A" over the two forward bolts and finger-start the two nuts. Torque the nuts to 13 to 27 ft-lb, starting with the nuts on Bracket B.
7. Push the toe plate against the dash panel. Center the shift tube on the input shaft to prevent grounding and torque the nut on the passenger side to 8-14 ft-lbs. Torque the nuts that attach Bracket "A" to Bracket "B" to 13-27 ft-lbs.
8. Torque the toe plate nuts on the engine side to 8-14 ft-lbs.
9. Torque the toe plate clamp bolt to 5 to 12 ft-lb.
10. Torque the two nuts on the column clamps to toe plate 8-14 ft-lbs.
11. Remove the rod from between the flexible coupling and the flange.
12. Connect and adjust the transmission control rod.
13. Connect and adjust the PRND21 cable.
14. Connect the electrical connections to the column.
15. Install the trim shroud and inspect for clip damage. Replace the shroud if necessary.
16. Install the lower instrument panel.
17. Install the steering wheel.
18. Connect the negative battery cable to the terminal.
19. Test the steering column for proper operation.

LINCOLN CONTINENTAL (TILT AND FIXED COLUMN)

Removal

1. Disconnect the negative battery cable from the terminal.
2. Remove the steering wheel as outlined in this Part.
3. Remove the lower instrument panel.
4. Remove the trim shroud.
5. Disconnect the electrical connections to the steering column.
6. Disconnect the PRND21 cable.
7. Remove the toe plate.
8. Disconnect the transmission control rod and remove the bolt that attaches the flexible coupling to the steering column shaft.
9. Remove the nuts that attach the column support bracket to the brake pedal support bracket (Fig. 6).
10. Remove the steering column.

Installation

1. Install the electrical wiring harness bracket to Bracket "B" (if removed).
2. Loosen the bolts holding Bracket "A" to Bracket "B". Insure square necks of the bolts are in the slots.
3. Loosen the toe plate clamp and slide the cover back.
4. Insert the steering column assembly through the opening in the dash panel.
5. Place the steering shaft against the flexible coupling. Insert a 1/4 inch diameter rod between the flexible coupling fabric and the flange on the shaft. Install the grade 8 bolt (385970-S100) and torque to 20-30 ft-lb. **Do not distort the flexible coupling when torquing the bolt or removing the rod.**

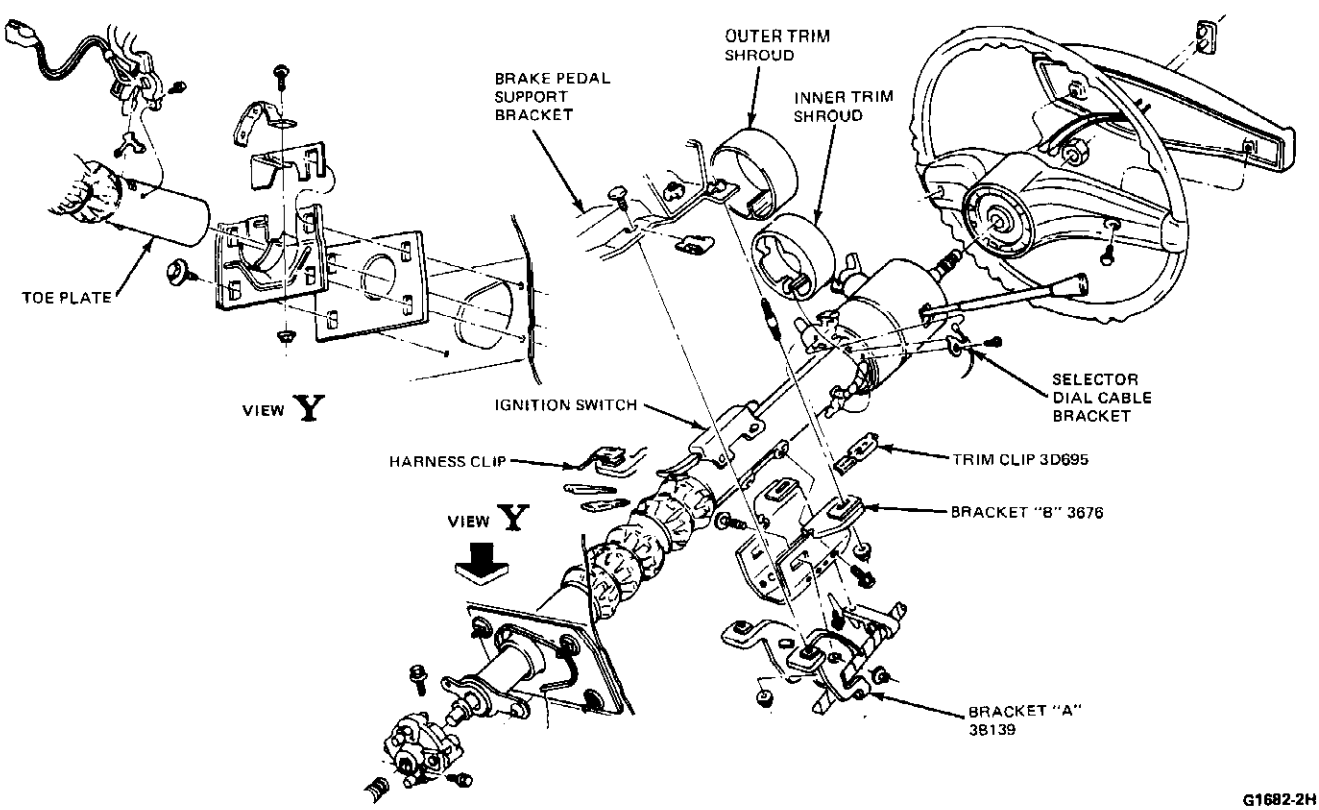


FIG. 6 Tilt Steering Column Installation—Lincoln (Fixed similar)

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6. Install the column on the two rear studs of the brake pedal support bracket and install the two nuts. Slide bracket "A" over the two forward bolts and secure with nuts. Torque the rear nuts to 13 to 27 ft-lb.
7. Push the toe plate against the dash panel. Center the shift tube on the shaft to prevent grounding.
8. Torque the toe plate screws to 5 to 15 ft-lb.
9. Torque the toe plate clamp bolt to 5 to 12 ft-lb.
10. Torque the nuts that attach Bracket "A" to Bracket "B" to 13 to 27 ft-lb.
11. Remove the rod from between the flexible coupling and the shaft.
12. Connect and adjust the transmission control rod.
13. Connect and adjust the PRND21 cable.
14. Connect the electrical components to the column.
15. Install the lower instrument panel.
16. Install the column trim shroud and inspect for clip damage. Replace the shroud, if necessary.
17. Install the steering wheel.
18. Connect the negative battery cable to the terminal.
19. Test the steering column for proper operation.

TILT COLUMN MECHANISM—FORD/ MERCURY, LINCOLN

Removal

1. Disconnect the negative battery cable from the terminal.
2. Place the steering wheel in the full "UP" position and remove. Be sure full "UP" position is attained.
3. Remove the trim shroud.
4. Remove the section of instrument panel beneath the steering column.
5. Disconnect the electrical connections to the steering column. Remove the wires from the hardshell plastic coupler, **noting the position and color code of each wire in the coupler.**
6. Remove the lock drive gear as detailed in this Part.
7. Remove the turn signal lever.
8. Remove the screws securing the turn signal switch and warning buzzer terminal (Fig. 7). Remove the wiring harness-to-steering column tube clips (if required). Remove the turn signal switch and wiring harness from the steering column.
9. Remove the cover casting screws. Lift the cover casting up and over the steering column upper shaft, and remove the casting from the column. Unhook the upper actuator from the lower actuator and remove.
10. Loosen the toe plate from the dash panel. Remove the nuts securing the column brackets to the brake support bracket. Lower the steering column to expose the ignition switch.
11. Remove and discard the screws that attach the lower flange to the outer tube.
12. Loosen the ignition switch nut and washer assemblies and remove the ignition rod from the switch end.
13. Remove the spring clips holding the wire bale which acts as a release lever for the locking lever. Remove the wire bale (Fig. 8).
14. With a small drift, drive out the pin holding the locking lever. Remove the lever and spring. Use a C-clamp to relieve tension on the pin if necessary.
15. Remove the column upper shaft snap ring.
16. The upper and lower flange castings can now be separated by removing the two pivot pins located in the side of the casting assembly with either Tool T67P-3D739-B or Tools T70P-3D739-A and T67P-3D739-C (Fig. 9). **Do not use the pivot pins again if the press fit is loose in the lower flange.**

Installation

1. Install the lower actuator with the ignition switch rod attached.
2. Install the upper and lower flange with the two pivot pins (Fig. 9). Be sure the column position spring is properly seated between the upper and lower flange, and the wavy thrust washer is positioned properly between the lower flange and the socket. **Do not re-use loose pivot pins.**
3. Install the column upper shaft snap ring.
4. Assemble the locking lever and spring, and insert the pin that holds the lever. Use C-clamp to relieve the tension on the pin, if necessary (Fig. 10).
5. Place the wire bale on the upper casting and install the spring clips that hold the bale in place (Fig. 8).
6. Connect the ignition switch rod to the switch. Do not tighten the nuts.
7. Tighten the three Allen head screws, washers, and retainers holding the flange to the outer tube. Torque the screws to 50 to 60 in-lb. **Always use new Allen head screws to be sure the epoxy cement bonds properly.**
8. Connect the upper and lower actuators. Install the cover on the column. Torque the screws to 40 to 50 in-lb.
9. Install the turn signal switch and wiring harness in the steering column. Attach the wiring harness-to-steering column tube clips (if required). Install the two screws that attach the turn signal switch to the flange casting and the one screw that attaches the warning buzzer terminal. Torque the screws to 20 to 30 in-lbs for the turn signal switch and 15-25 ft-lbs for the buzzer terminal.
10. Install the turn signal lever.
11. Install the lock drive gear.
12. Install the lock cylinder with the key in the "ON" position. Install the retaining pin flush with the cylinder. Turn key to the "OFF" position.
13. Adjust the ignition switch as explained in Group 33, Part 70.
14. Attach the vacuum lines (if equipped). Reassemble the wires in the plastic coupler. **Be sure to connect the color-coded wires in the correct positions.** To install the steering column in the vehicle, follow Steps 1 through 19 under Ford/Mercury Column Installation in this Part.

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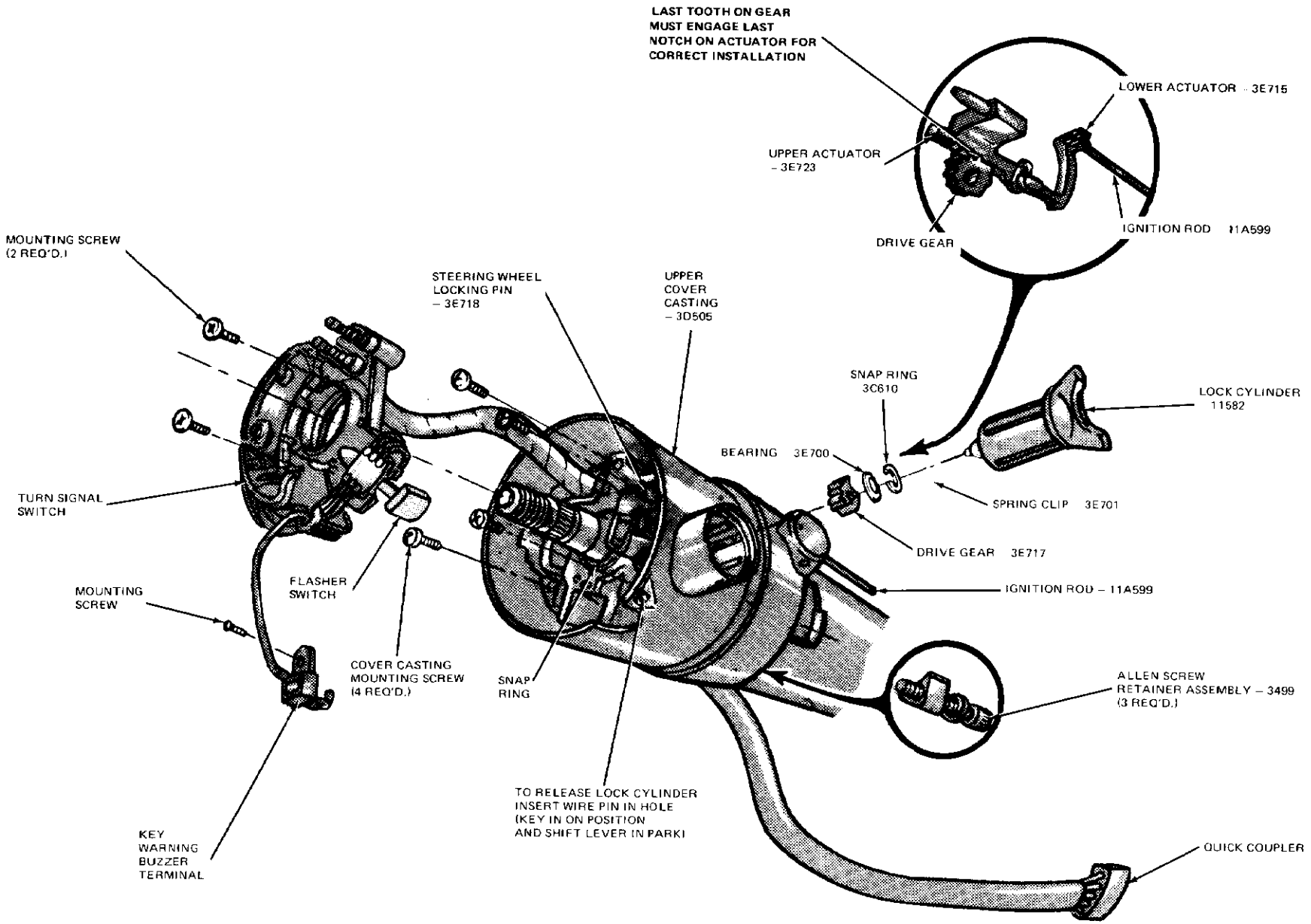


FIG. 7 Tilt Column Mechanism

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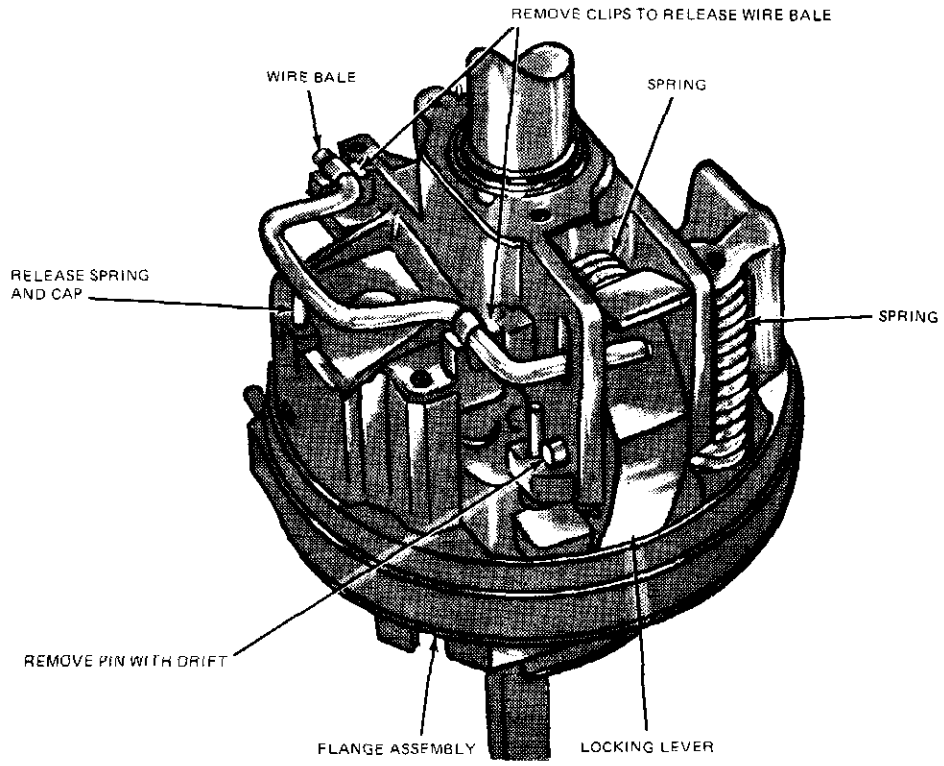


FIG. 8 Removing Wire Bale and Tilt Locking Lever

15. Connect the electrical connections to the column.
16. Install lower instrument panel. Connect the speedometer cable, wire harness, the PRND21 cable (if required), and Bowden wire cables to the heat/air panel, to the instrument cluster. Install the cluster in the instrument panel. Install the instrument cluster trim cover.
17. Install the trim shroud.
18. Install the steering wheel as outlined in this Part.
19. Connect the negative battery cable to the terminal.
20. Test the steering column for proper operation.

IGNITION LOCK ACTUATOR AND STEERING WHEEL LOCK PIN

FIXED COLUMN

Removal

1. Remove the steering column shroud.
2. Remove the lock drive gear as detailed in this Part.
3. Disconnect the PRND21 cable.
4. Remove the attaching nuts that hold the steering column to brake pedal support.
5. Loosen the ignition switch attaching nuts and remove the ignition rod from the switch end.
6. Remove the upper shaft bearing as detailed in this Part.
7. Remove the ignition lock actuator rod and steering wheel lock pin assembly (Fig. 11).
8. Remove and discard the retaining clip at the lower end of the steering wheel lock pin. Remove the steering wheel lock pin and lock pin spring from the ignition switch actuator. **Do not lose the spring.**

Installation

1. Install a new lock pin and clip, and the old lock pin spring in the actuator casting.
2. Place the actuator and steering wheel lock pin in the steering column.
3. Engage actuator rod into ignition switch. Do not tighten switch retaining nuts.
4. Install the lock drive gear, bearing and snap ring.
5. Install the lock cylinder with the key in the ON position. Install with the retaining pin flush with cylinder. Turn key to the OFF position.
6. Install the upper shaft bearing as detailed in this Part.
7. Adjust the ignition switch as explained in Part 33-70.
8. Secure the steering column to the brake pedal support.
9. Connect the PRND21 cable.
10. Install the trim shroud.

FLANGE AND/OR SOCKET CASTING (FIXED AND TILT COLUMNS)

Removal

1. On fixed columns, remove the actuator assembly as detailed in this Part.

   On tilt columns, remove the tilt column mechanism as detailed in this Part.
2. Remove the flexible coupling as described in this Part (tilt only).

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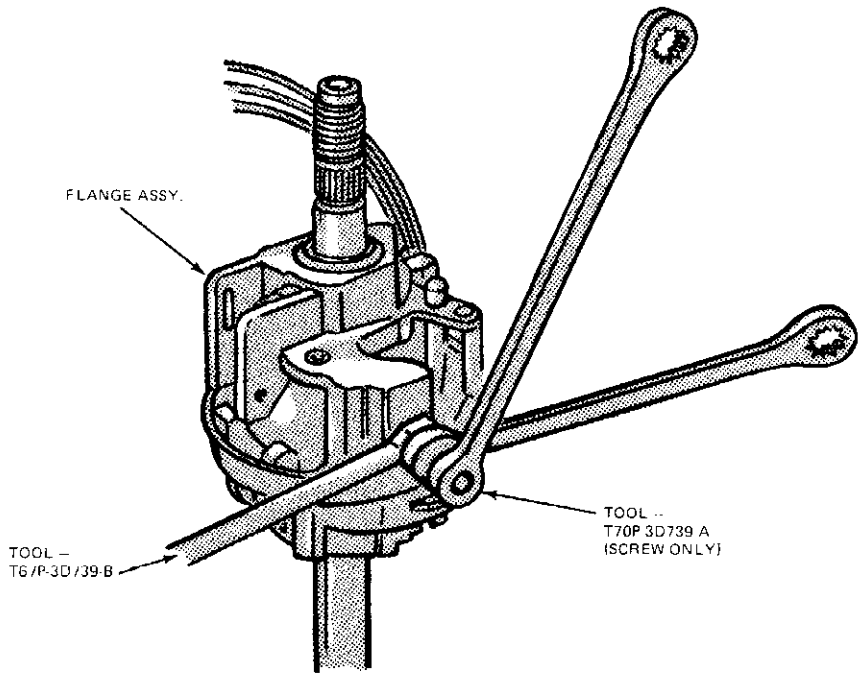


FIG. 9 Removing Pivot Pin

3. Remove the steering shaft from the top of the column (tilt only).
4. Rotate the column inner tube and socket casting to expose the socket casting retaining bolt (automatic shift vehicles).
5. Remove the gear shift lever (manual shift vehicles).
6. Remove the socket casting retaining bolt and lift the casting off of the column inner tube (automatic shift vehicles).

Installation

1. Place the socket casting on the column inner tube. Align the retaining bolt hole and install the retaining bolt.
2. Install the gear shift lever, if removed. Working from the top, install the steering shaft assembly in the column (tilt only).
3. Install the flexible coupling (tilt only).
4. On fixed columns install the ignition switch actuator and steering wheel lock pin assembly.

   On tilt columns, install the tilt column mechanism.

STEERING COLUMN SHIFT TUBE

FIXED COLUMN

Removal

1. Remove the steering column assembly as detailed in this Part.
2. Secure the steering column assembly in a vise.
3. Remove the back-up lamp switch.
4. Remove the upper shaft bearing as detailed in this Part.
5. Working from the bottom of the column, remove the steering shaft.
6. Remove the gear shift lever (manual shift vehicles).
7. Remove the bolt holding the shift tube to the socket casting (automatic only).
8. Remove 3 screws holding the lower bearing to the outer tube (manual only). Remove the tube and bearing from the column.

Installation

1. Install the shift tube in the socket casting through the bottom of the outer tube. Torque the retaining bolt to 35 to 50 in-lb.
2. Install the shift tube and lower bearing into the socket casting and outer tube and secure with 3 screws. Torque to 20-25 in-lbs (column-shift manual).
3. Working from the bottom, insert the steering shaft in the column.
4. Install the upper shaft bearing.
5. Install the back-up lamp switch.
6. Install the steering column assembly as detailed in this Part.

TILT COLUMN

Removal

1. Remove the steering column assembly as detailed in this Part.
2. Secure the assembly in a vise.
3. Remove the back-up lamp switch. **It is not necessary to remove the turn indicator switch and wiring harness from the steering column.**

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DETROIT IRON

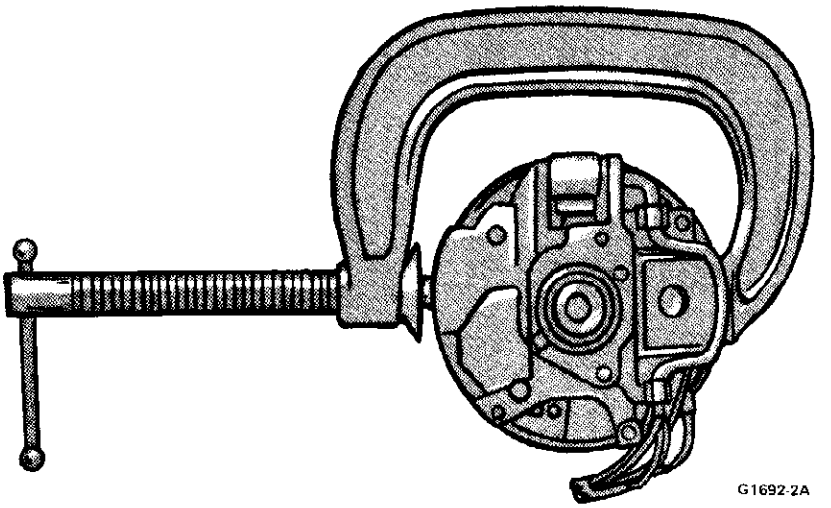


FIG. 10 Installing Flange Assembly Pivot Pins

4. Remove bolt that attaches the shift tube to the socket casting. Remove the shift tube from the housing.

Installation

1. Install the shift tube in the socket casting. Torque the retaining bolt to 40 to 45 in-lb.
2. Install the back-up lamp switch.
3. Install the steering column assembly as detailed in this Part.

STEERING SHAFT AND ANTI-RATTLE CLIPS

FIXED COLUMN

Removal

1. Remove the steering column assembly as detailed in this Part.
2. Secure the steering column assembly in a vise.
3. Remove the back-up lamp switch.
4. Remove the upper shaft bearing as detailed in this Part.
5. Working from the bottom of the column, remove the steering shaft.
6. Draw a mark on the lower shaft where the upper and lower steering shaft sections form a joint line.
7. Separate the upper and lower steering shaft sections.

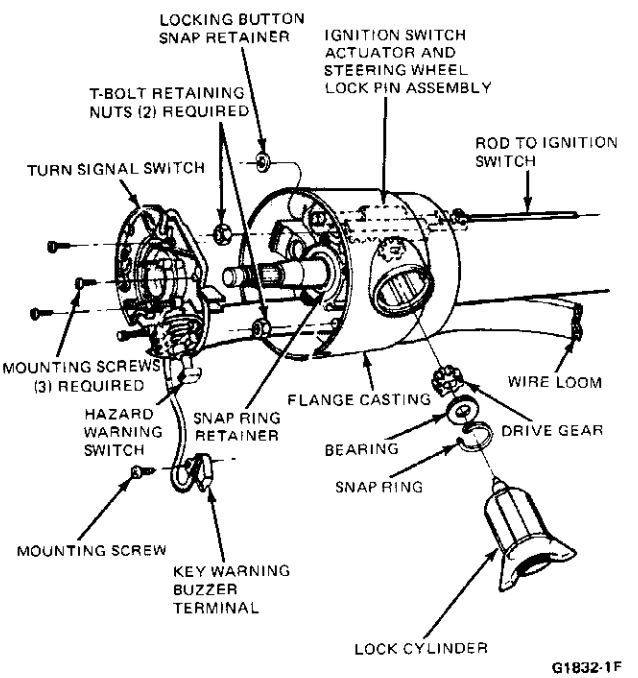


FIG. 11 Fixed Column Mechanism

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8. Remove and discard the two steel anti-rattle clips.

Installation

1. Install new anti-rattle clips. **Be sure both are installed in the same direction.**
2. Liberally lubricate the lower six inches of the end of the upper shaft.
3. Secure the lower shaft in a vise. Install the upper shaft to the mark on the lower shaft.
4. Working from the bottom of the column, install the shaft into the column from the bottom.
5. Install the upper shaft bearing.
6. Install the back-up lamp switch.
7. Install the steering column assembly as detailed in this Part.

TILT COLUMN

Removal

1. Remove the steering column assembly as detailed in this Part.
2. Secure the steering column assembly in a vise.
3. Remove the back-up lamp switch. **It is not necessary to remove the turn indicator switch and wiring harness from the steering column.**
4. Working from the top of the column, remove the steering shaft and tilt mechanism.
5. Draw a mark on the lower column where the upper and lower steering shafts form a joint line.
6. Separate the upper and lower steering shafts.
7. Remove and discard the two steel anti-rattle clips.

Installation

1. Install new anti-rattle clips. **Be sure both are installed in the same direction.**
2. Lubricate the lower end of the upper shaft.
3. Secure the lower shaft in a vise and install the upper shaft to the mark on the lower shaft.
4. Install the steering shaft assembly and the tilt mechanism.
5. Install the back-up lamp switch.
6. Install the steering column assembly as detailed in this Part.

IGNITION LOCK CYLINDER ASSEMBLY

Common instructions for replacing all ignition lock cylinders are contained in Part 13-01.

IGNITION SWITCH LOCK DRIVE GEAR—FIXED OR TILT COLUMNS

Removal (Refer to Fig. 7)

1. Remove the lock cylinder assembly as detailed in Part 13-01.
2. Insert a flat bladed screwdriver in the recess of the drive gear at the bottom of the lock cylinder housing. Turn the lock drive gear counterclockwise three notches.
3. Remove the snap ring, washer and lock drive gear from the lock cylinder housing. **Note the position of the drive gear to the rack teeth.**

Installation (Refer to Fig. 7)

1. Install the lock drive gear in the housing in the same position as noted during removal. Installation is correct if the last tooth on the drive gear is meshed with the last tooth on the rack. Install the washer and snap ring.
2. Using the screwdriver blade, turn the drive gear clockwise three notches.
3. Install the lock cylinder.

FLEXIBLE COUPLING

Removal

1. **Fixed Column (Except Lincoln)**

   Remove the two nuts that attach the flexible coupling to the flange on the steering column shaft assembly.

   Tilt Column (Including Lincoln Fixed Column)

   Remove the two bolts retaining the flexible coupling to the steering column shaft assembly.
2. Loosen the steering gear bolts. Back out the three bolts to clear the gear, leaving the bolts in the frame rail. Disengage gear from the coupling frame and lower gear on this bolt to support weight of gear. Do not disconnect any steering linkage or power steering hoses.
3. Remove the flexible coupling from the vehicle.

Installation

1. Position the flexible coupling on the steering gear input shaft to the flange on the steering column shaft assembly.
2. Assemble a new flange and insulator assembly to the steering gear input shaft. Move the steering gear into position while piloting the steering shaft into the coupling upper flange.
3. Install the one bolt retaining the flexible coupling to the steering gear input shaft. Torque the bolt to 20-30 ft-lb.
4. **Fixed Column (Except Lincoln)**

   Insert a 1/4 inch diameter rod (flexible coupling spacer) between the flexible coupling fabric on the flange on the steering column shaft assembly. Install the two nuts that attach the flexible coupling to the flange on the steering column assembly. Torque the nuts to 10-20 ft-lb. **The flexible coupling must not be distorted when the attaching nuts are torqued, and the flexible coupling spacer has been removed.**

   Tilt Column (Including Lincoln Fixed Column)

   Insert a 1/4 inch diameter rod (flexible coupling spacer) between the flexible coupling fabric and the flange on the steering column shaft assembly. Install the one bolt that attaches the flexible coupling to the steering column shaft assembly. Torque the bolt to 20-30 ft-lb. **The flexible coupling must not be distorted when the bolt is torqued and the flexible coupling spacer has been removed.**

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SPECIAL SERVICE TOOLS

Tool No.	Description
T67L-3600-A	Steering Wheel Remover
T67P-3D739-B	Pivot Pin Remover
T67P-3D739-A	Pivot Pin Remover Kit
T67P-3D739-C	Pivot Pin Remover Handle

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Steering Columns — Mini (Extruded Absorber Type)

PART 13-04

Applies To LTD II, Cougar, Thunderbird, Mustang, Pinto, Bobcat, Granada, Monarch, Versailles and Continental Mark V

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CG2423-2B

DESCRIPTION

STEERING COLUMN

MUSTANG, PINTO, AND BOBCAT

This steering column has been designed to improve safety and reliability, eliminate alignment problems and simplify service. The column is a fixed type. See Fig. 1.

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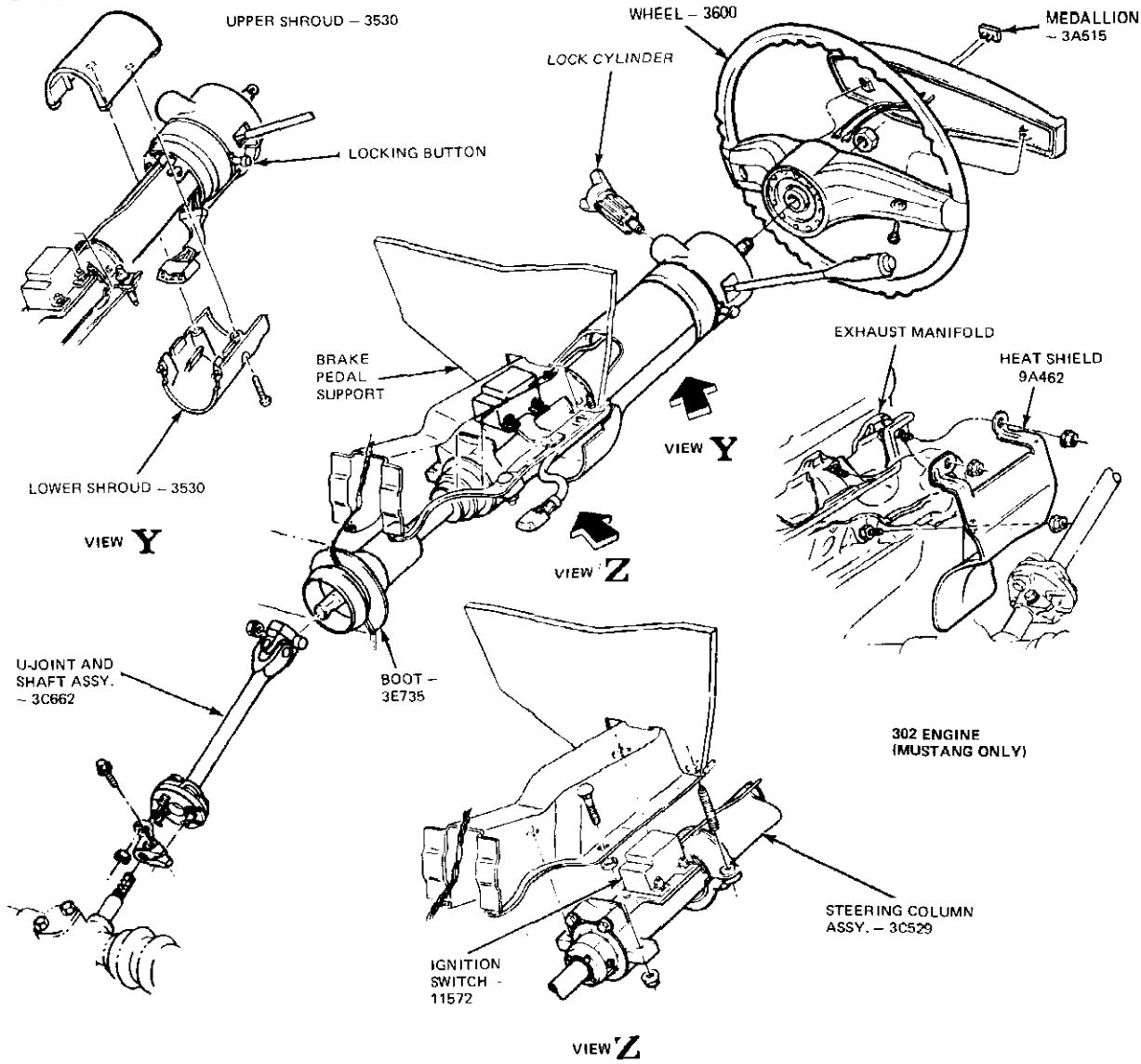


FIG. 1 Steering Column Installation—Mustang, Pinto, and Bobcat

The locking mechanism is actuated by depressing the push button located below the turn signal lever. This prevents inadvertent locking of the steering wheel by blocking the actuator out of the lock position.

The outer column tube terminates just below the attachment to the brake support bracket. The energy absorbing convolutions at the lower end of the tube have been deleted. Energy absorption is accomplished by the lower column mounting bracket. There is no shift tube in this assembly.

The steering shaft has a machined bar for the upper part with grooves in the lower half designed to accept two steel clips. The lower shaft is a formed tube which fits over the upper shaft. A shaft and U-joint assembly attaches to the lower steering shaft and to the steering gear at the other end.

The column is attached to the brake support bracket by two collar type brackets bolted to flanges on the brake support. The lower column attaching collar is a sintered iron ring with protrusions within the ring. The protrusions act as a die which deforms the outer tube as the column collapses. Any extension of the iron ring die grooves beyond the original installation requires that the outer tube and mounting brackets be replaced as a unit.

LTD II, COUGAR, THUNDERBIRD, AND CONTINENTAL MARK V

This column is available as fixed or tilt on LTD II, Cougar, Thunderbird and Continental Mark V (Fig. 3).

On floor shift vehicles, the push button mechanism must be depressed to lock the steering wheel. It is located on the left side of the steering column.

The outer column tube utilizes collar attaching brackets which provide a column collapsing system. The lower end of the tube is modified to accept a shift tube when applicable. The lower steering shaft bearing is mounted at the end of the tube (Fig. 4).

The upper steering shaft is a solid steel bar with two grooves to accept clips. The lower shaft is a formed steel tube which fits over the upper shaft. A coupling and U-joint assembly connect the tubular lower steering shaft to the steering gear.

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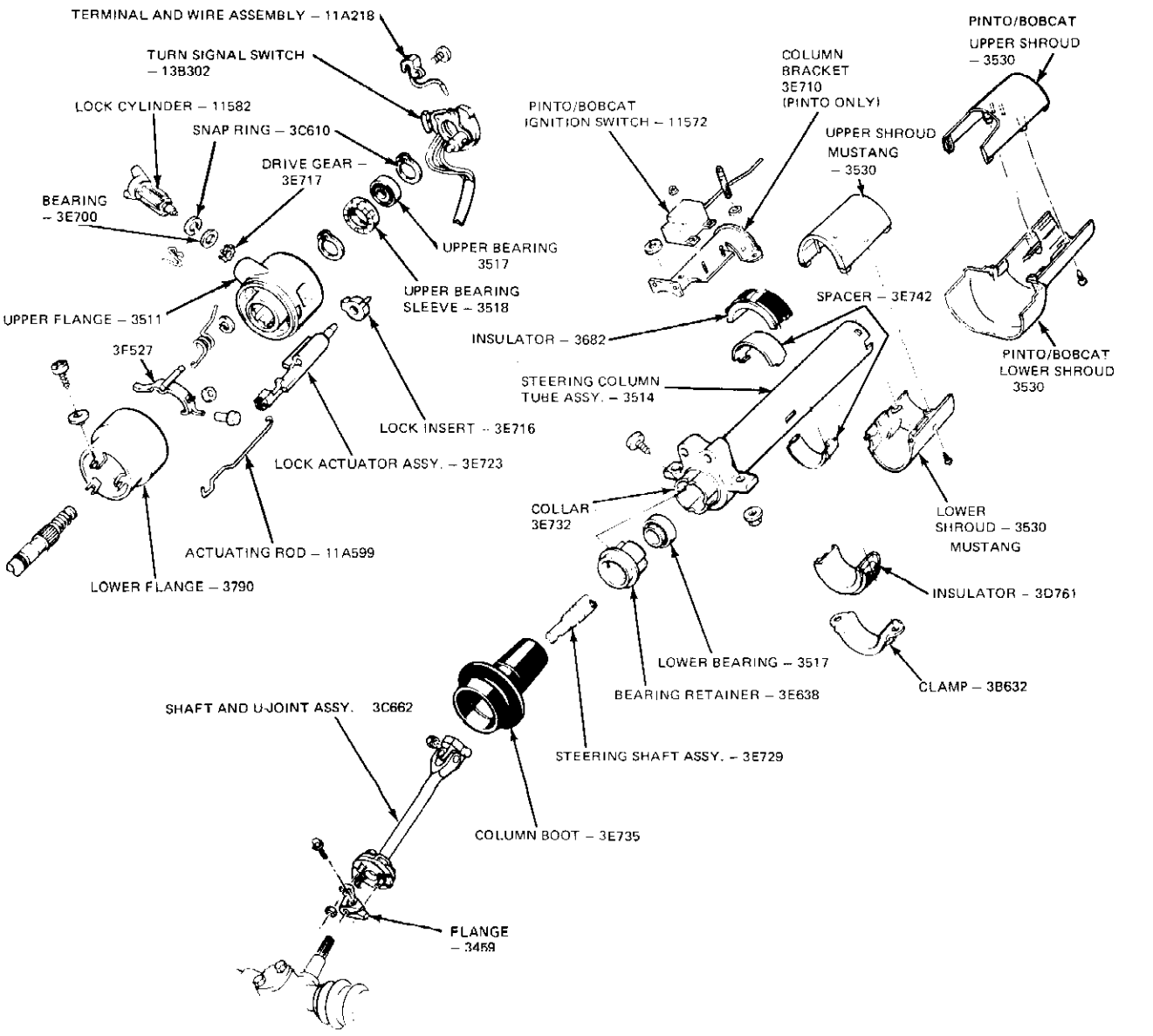


FIG. 2 Steering Column Disassembled—Mustang II, Pinto and Bobcat

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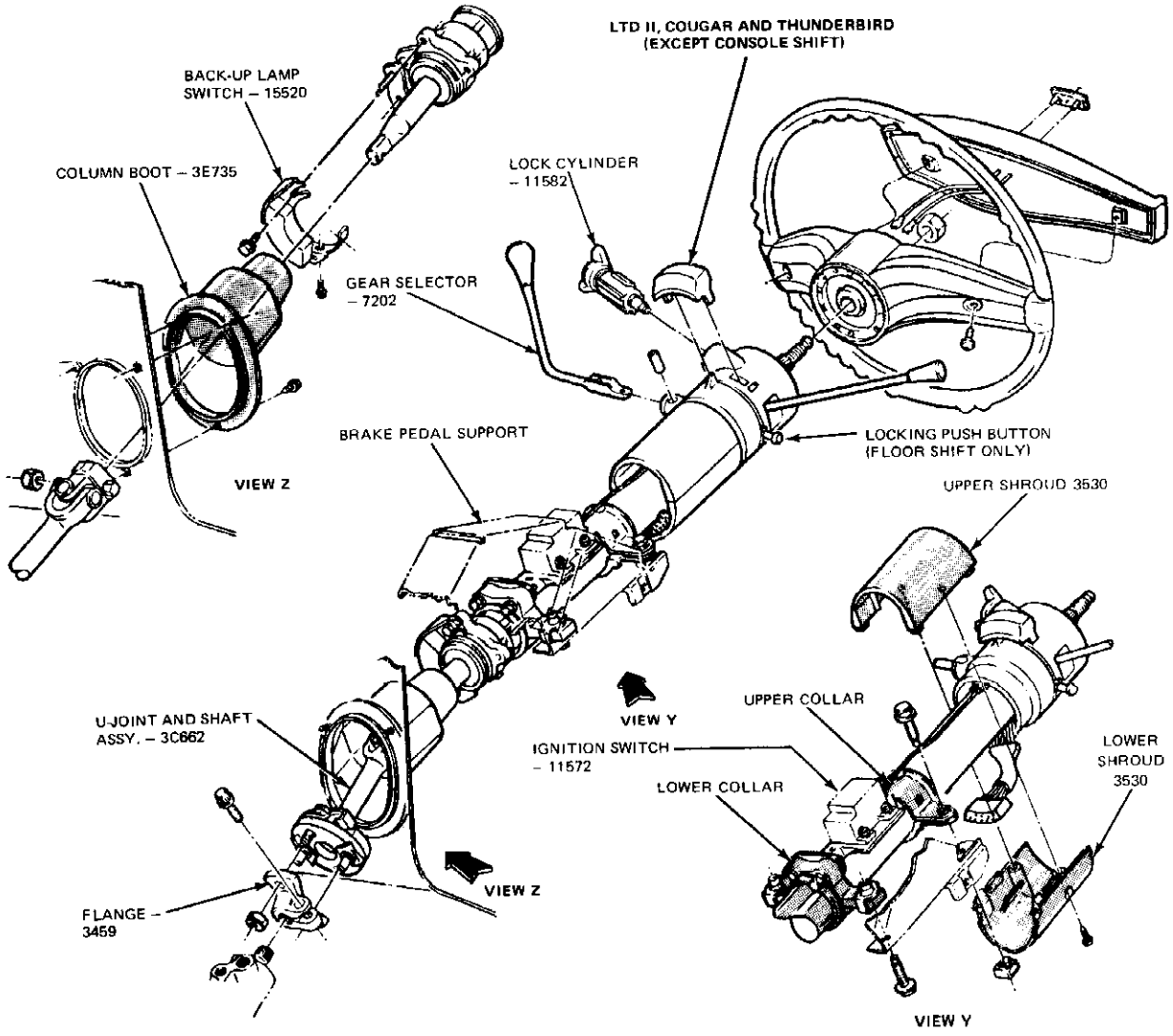


FIG. 3 Steering Column Installation—LTD II, Cougar, Thunderbird, and Continental Mark V

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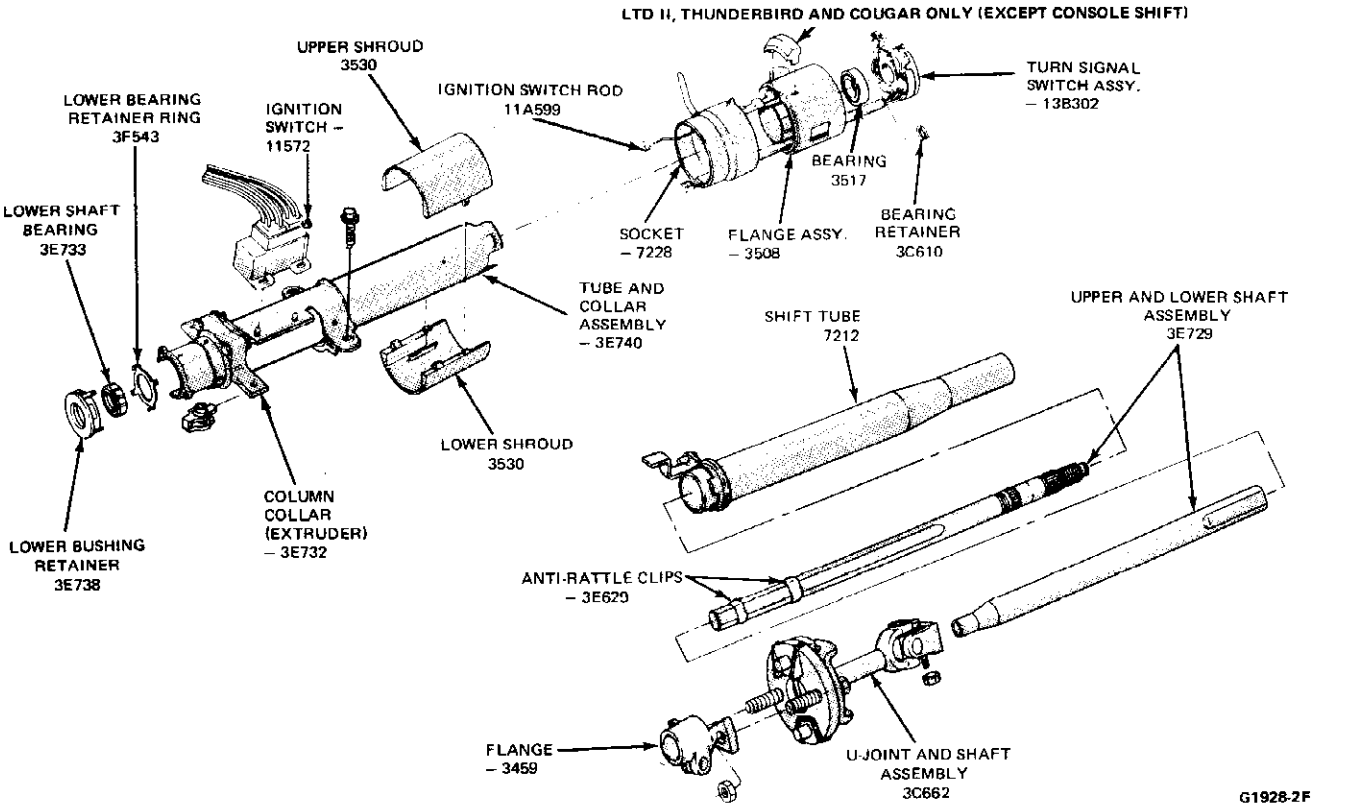


FIG. 4 Steering Column Disassembled—LTD II, Cougar, Thunderbird, and Continental Mark V

The column attaches to the brake pedal support bracket with two collar type brackets.

GRANADA/MONARCH/VERSAILLES

This column is available in three types: column-mounted automatic shift, floor shift (Monarch/Granada only) and tilt column. On the Monarch/Granada floor shift models, a push button mechanism is used to lock the steering wheel.

The outer column tube utilizes collar attaching brackets which provide a column collapsing system. The lower end of the tube is modified to accept a shift tube when applicable.

The upper steering shaft is a solid machined steel bar with two grooves to accept clips. The lower shaft is a formed steel tube which fits over the upper shaft. A flange and coupling assembly connect the tubular lower shaft to the steering gear.

The column attaches to the brake pedal support bracket with two collar type brackets.

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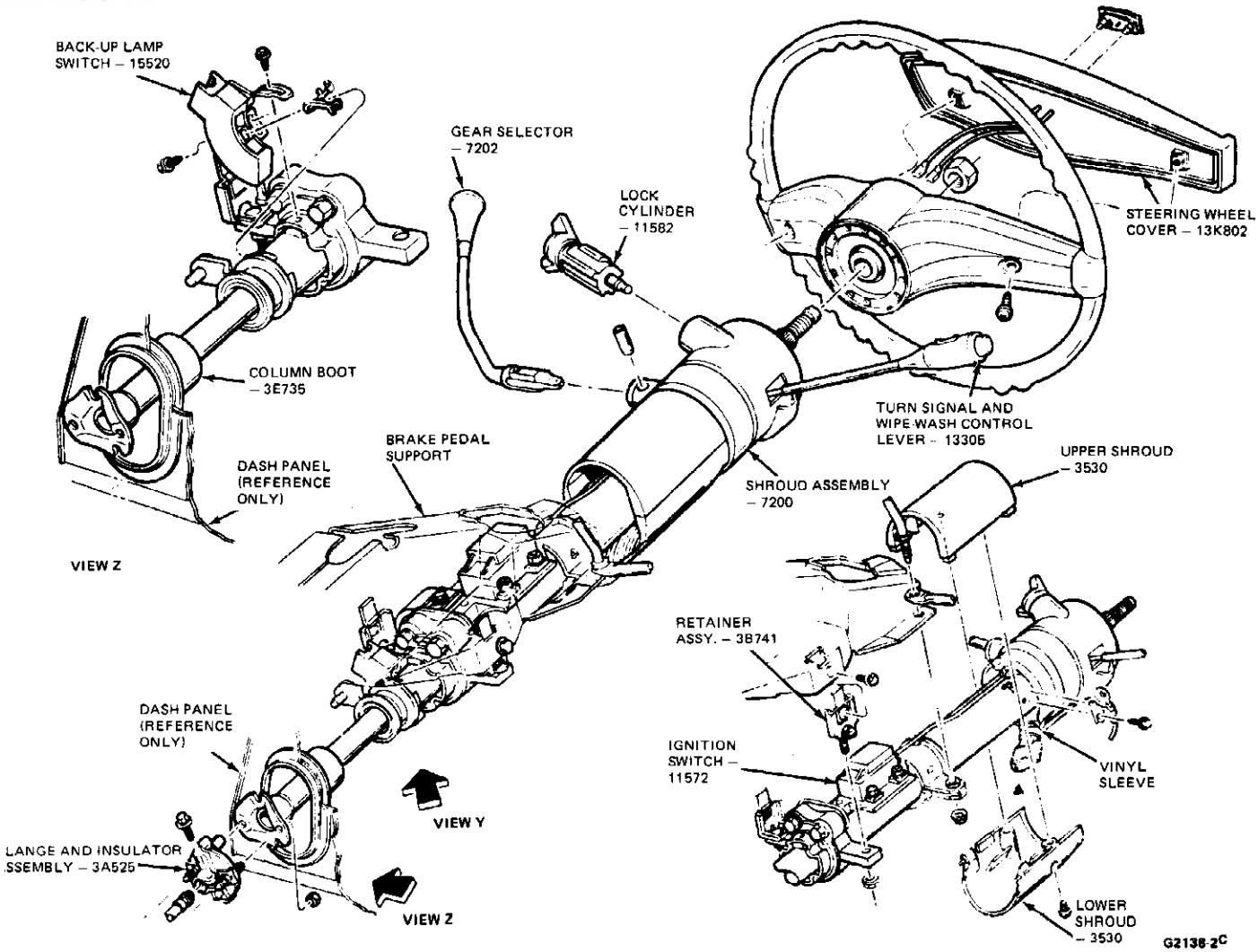


FIG. 5 Steering Column Installation—Granada, Monarch and Versailles

ADJUSTMENTS

STEERING WHEEL SPOKE POSITION ADJUSTMENT (EXCEPT PINTO, MUSTANG II, BOBCAT, FAIRMONT AND ZEPHYR)

When the steering gear is on the high point, the front wheels should be in the straight-ahead position and the steering wheel spokes should be in their normal position with the Pitman arm pointing directly forward. If the spokes are not in their normal position, they can be adjusted as outlined in Part 14-01. This adjustment may be made only when the steering gear is on the high point and the spokes are not in the normal position.

REMOVAL AND INSTALLATION

STEERING WHEEL

Removal

1. Disconnect the negative battery cable (ground) from the battery.
2. From the underside of the steering wheel, remove the two screws that attach the steering wheel horn cover to the steering wheel.

   On steering wheels with a center hub, rotate the center hub counterclockwise and remove. The hub will rotate less than 1/2 turn.
3. Lift the steering wheel horn cover up and disconnect the speed control (if equipped) and the horn blowing terminals.

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4. Remove the steering wheel attaching nut.
5. Using Tool T67L-3600-A (Fig. 6), remove the steering wheel from the upper shaft. **Do not use a knock-off type steering wheel puller or strike the end of the steering column upper shaft with a hammer or damage will occur to the bearing or the collapsible steering column.**

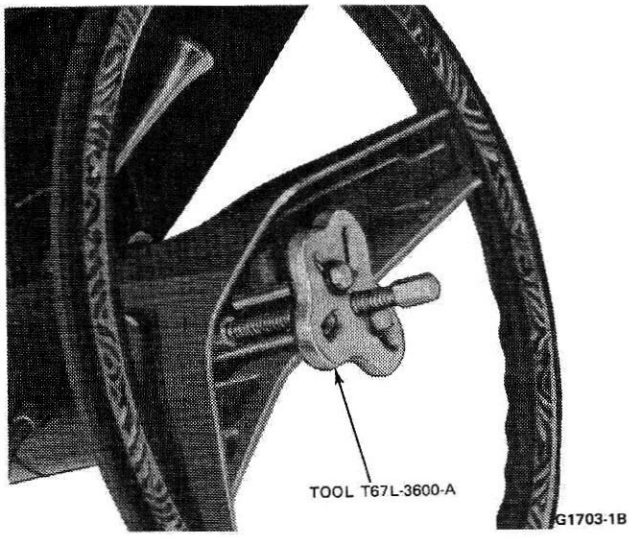


FIG. 6 Removing Steering Wheel

Installation

1. Position the steering wheel on the end of the steering wheel shaft. Align the mark on the steering column upper shaft with the mark on the steering wheel. **Make sure that the straight ahead steering wheel position corresponds to the straight ahead position of the front wheels.**
2. Install a new service wheel nut. Torque the nut to 30-40 ft-lb.
3. Connect the speed control (if equipped) and the horn terminals to the steering wheel.
4. Position the steering wheel horn cover or the center hub in the steering wheel.
5. Install the horn cover or center hub. If equipped with a horn cover, torque the screws to 13-20 in-lbs.
6. Connect the negative battery cable (ground) to the battery terminal.
7. Check the steering column for proper operation.

STEERING COLUMN ASSEMBLY

Manual and automatic transmission linkage systems make use of oil impregnated plastic grommets to connect various rods or levers. To assure satisfactory retention of the connecting links and overall system operation, the grommets must be replaced and not re-used when a grommet-type connection (as in a steering column replacement) is changed. Grommet removal and installation procedures are detailed in Group 17-02.

LTD II, COUGAR, THUNDERBIRD, AND CONTINENTAL MARK V

Removal

1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the steering wheel as described earlier in this Part.
3. Remove the screws that attach the instrument cluster trim cover to the instrument cluster. Remove the trim cover.
4. Remove the trim shrouds that cover the steering column at the instrument panel.
5. Disconnect the PRND21 cable from the steering column (Thunderbird and Continental Mark V only).
6. Remove the instrument cluster as outlined in Part 33-50.
7. Disconnect all electrical connections (quick-couplers) to the steering column. Disconnect all vacuum hose connections, if equipped.
8. Disconnect the transmission cable on the column shift automatics.
9. Remove the three screws that attach the dust boot to the dash panel. Disengage the dust boot at the base of the column.
10. Remove the two nuts that attach the flexible coupling to the flange on the steering input shaft. Disengage the safety strap and the bolt assembly from the flexible coupling.
11. Through the opening in the instrument panel, remove the two upper collar attaching bolts on the brake pedal support bracket. On LTD II and Cougar, it will be necessary to remove or rotate the vibration brace on the right side.
12. Under the instrument panel, remove the two bolts that attach the lower collar to the brake support bracket.

Installation

1. Install the steering column by inserting it through the openings in the instrument and dash panels. **Be careful not to damage components.**
2. Under the instrument panel, install two bolts that attach the lower collar to the brake pedal support bracket. Tighten fingertight.
3. Through the instrument panel opening, install two upper collar attaching bolts on the brake support bracket. On LTD II and Cougar, install vibration brace on the right side. Torque bolts to 20-37 ft-lb.
4. Torque the two bolts that attach the lower collar to the brake pedal support bracket to 20-37 ft-lb.
5. Connect the ignition switch blade connector.
6. Connect the speedometer cable, the wire harness connections, and the cables to the heat/air panel. Position the instrument cluster in the instrument panel.
7. Install the instrument cluster as outlined in Group 33 Part 50.
8. Engage the safety strap and bolt assembly to the flange on the steering gear input shaft. Install the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft. Torque the nuts to 20-37 ft-lb. **The safety strap must be properly positioned to prevent metal to metal contact after torquing nuts. The flexible coupling must not be distorted when the nuts are torqued.** Pry

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steering shaft up or down with a suitable pry bar to achieve plus or minus 1/8 inch coupling insulator flatness.

9. Engage the dust boot at the base of the steering column to the dash panel opening. Install the three screws that attach the dust boot to the dash panel.
10. Connect and adjust the transmission cable on column shift automatics.
11. Connect all electrical connections to the steering column. Connect all vacuum hoses, if equipped.
12. Connect and adjust the PRND21 cable as outlined in Group 33, Part 50 (Thunderbird and Continental Mark V only.
13. Install the trim shrouds that cover the steering column at the instrument panel.
14. Install the screws that attach the instrument cluster trim cover to the instrument cluster.
15. Install the steering wheel as described earlier in this Part.
16. Connect the negative battery cable to the battery terminal.
17. Check the steering column for proper operation.

GRANADA, MONARCH AND VERSAILLES

Removal

1. Disconnect the negative battery cable (ground) from the battery.
2. Remove the steering wheel using procedures described earlier in this Part.
3. Remove the section of instrument panel below the steering column.
4. Remove the trim shrouds covering the steering column at the instrument panel.
5. Disconnect the PRND21 cable from the steering column (automatic transmission only).
6. Disconnect the turn signal wiring and back-up lamp switch wiring.
7. Disconnect the transmission cable on column shift automatics or the transmission control bellcrank on column shift manual transmission.
8. Disengage the dust boot at the base of the steering column from the dash panel opening.
9. Remove the two nuts attaching the steering shaft to the flex coupling.
10. Remove the four (4) nuts attaching the steering column support brackets to the brake pedal support.
11. Lower the steering column and disconnect the ignition switch wiring.
12. Remove the steering column by withdrawing it from beneath the dash panel. **Be careful not to damage components.**

Installation

1. Loosen the bolts attaching the column adjustment brackets to the brake pedal support.
2. Insert the steering column lower shaft through the opening in the dash panel. Place the flange of the shaft against the flex coupling. Insert a 1/4 inch diameter rod between the flexible coupling fabric and the flange. Install the attaching nuts and torque to 10-22 ft-lb. Do not distort the flex coupling when torquing the nuts or removing the 1/4 inch rod. Pry steering shaft up or down with a suitable pry bar to achieve desired coupling insulator flatness.
3. Connect the ignition switch wiring.
4. Position the steering column over the four (4) studs in the brake pedal support and install the attaching nuts. Torque the nuts to 20-37 ft-lb.
5. Center the shift tube on the steering shaft to prevent grounding.
6. Torque the bolts securing the column adjustment brackets to the brake pedal support 20-37 ft-lbs.
7. Remove the rod from between the flexible coupling and the flange.
8. Connect and adjust the transmission cable on the column shift automatics.
9. Install the column boot at the dash panel. Push lip of boot into column-opening until boot is fully seated.
10. Connect the turn signal switch and back-up lamp switch wiring.
11. Connect and adjust the PRND21 cable (column shift automatics).
12. Install the column trim shrouds at the instrument panel.
13. Install the section of instrument panel beneath the steering column.
14. Install the steering wheel per instruction in this Part.
15. Connect the negative battery cable.
16. Check the steering column for proper operation.

MUSTANG II, PINTO AND BOBCAT

Removal

1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the steering wheel as described earlier in this Part.
3. Remove the trim shrouds that cover the steering column at the instrument panel.
4. Remove the section of the instrument panel that is located beneath the steering column (Mustang only).
5. Disengage the dust boot at the base of the steering column from the dash panel opening.
6. Remove the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft. Disengage the safety strap and bolt assembly from the flange.
7. Remove the four nuts that attach the steering column support bracket to the brake pedal support.
8. Disconnect all electrical connections (quick-couplers) to the steering column.
9. Remove the steering column by withdrawing it from beneath the dash panel. **Be careful not to damage components.**

Installation

1. Install the steering column by inserting it through the dash panel opening. **Be careful not to damage components.**

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2. Connect ignition switch to the blade connector.
3. Position the steering column over the four bolts and install the four nuts that attach the steering column support bracket to the brake pedal support bracket. Tighten nuts fingertight.
4. Connect turn signal switch.
5. Install the trim shrouds that cover the steering column (Mustang).
6. Torque the steering column bracket-to-brake pedal support bracket nuts to 20-37 ft-lb. Make sure that the carriage bolts are correctly seated into their square holes.
7. Engage the safety strap and bolt assembly to the flange on the steering gear input shaft. Install the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft. Torque the nuts to 20-37 ft-lb. **The safety strap must be properly positioned to prevent metal to metal contact after torquing nuts. The flexible coupling must not be distorted when the nuts are torqued.** Pry steering shaft up or down with a suitable pry bar to achieve plus or minus 1/8 inch flatness of coupling insulator.
8. Install the dash boot at the base of the steering column into the dash panel opening.
9. Install the section of the instrument panel that locates beneath the steering column (Mustang only).
10. Install the trim shrouds that cover the steering column at the instrument panel (Pinto and Bobcat only).
11. Install the steering wheel as described earlier in this Part.
12. Connect the negative battery cable to the battery terminal.
13. Check the steering column for proper operation.

UPPER SHAFT BEARING

FIXED COLUMN

Removal

1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the steering wheel as described earlier in this Part.
3. Disconnect all electrical connections (quick-couplers) to the steering column.
4. Remove the turn indicator actuating lever.
5. Remove the turn indicator switch attaching screws. Lift the turn indicator switch over the end of the steering column upper shaft.
6. Remove the turn indicator switch and wiring harness from the steering column.
7. Remove the snap ring from the top of the steering column upper shaft.
8. Loosen the two flange-to-steering column tube retaining nuts. Disengage the two flange-to-steering column tube bolts (T-bolts) from the tube.
9. Raise the flange upward while tapping the steering column upper shaft lightly with a plastic hammer in order to free the bearing and flange from the steering column upper shaft.
10. Remove the bearing and insulator from the steering column flange.

Installation

1. Position the steering column flange on the steering column tube.
2. Engage the two flange-to-steering column tube bolts (T-bolts) in the steering column tube. Torque the retaining nuts to 60-75 in-lb.
3. **Prick punch the steering column upper shaft serration diameter sufficiently to insure an interference fit between the bearing inner race and the steering column upper shaft.** Position the bearing and insulator on the steering column upper shaft. Work the bearing and insulator as far down the steering column upper shaft as possible, then place a piece of pipe (.75 inch inside diameter x 2.125 inch) over the end of the steering column upper shaff and install the steering wheel attaching nut (Fig. 7).

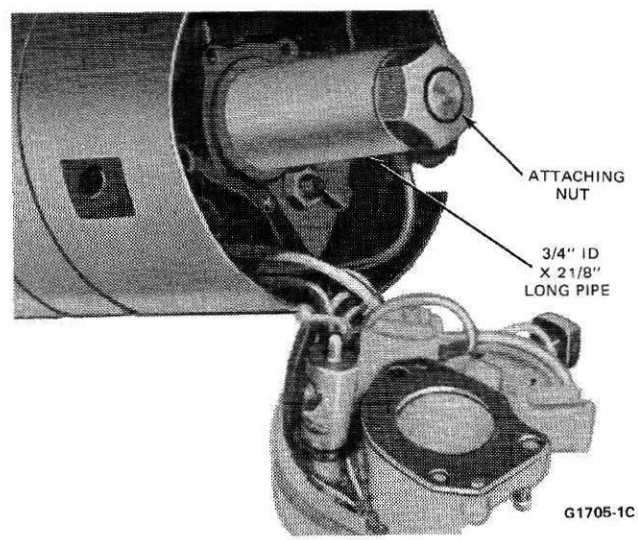


FIG. 7 Installing Upper Bearing—Fixed Columns

4. Tighten the steering wheel attaching nut until the bearing is seated in the flange.
5. Remove the steering wheel attaching nut and the piece of pipe from the steering column upper shaft.
6. Install the snap ring in the groove at the top of the steering column upper shaft above the bearing.
7. Lift the turn indicator switch over the end of the steering column upper shaft and position it in the flange.
8. Install the turn indicator switch and wiring harness to the steering column.
9. Install the turn indicator switch attaching screws. Torque the screws to 15-25 in-lb.
10. Install the turn indicator actuating lever.
11. Connect all electrical connections (quick-couplers) to the steering column.
12. Install the steering wheel as described earlier in this Part.

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13. Connect the negative battery cable (ground) to the battery terminal.
14. Check the steering column for proper operation.

TILT COLUMN

Removal

1. Remove the tilt column mechanism as described later in this Part.
2. Place the flange casting on a bench with the smaller bearing facing down.
3. With a small pick, lightly tap on the outer race of the small bearing at each slot. **Never drive or apply pressure of any kind to the inner race of the bearing.**
4. Invert the flange casting and place it on a bench with the large upper bearing facing down.
5. With a small pick, lightly tap on the outer race of the large bearing at each slot. **Never drive or apply pressure of any kind to the inner race of the bearing.**

Installation

1. Position the flange casting on a bench with the large bearing seat facing upward.
2. Select a socket wrench that is the same diameter as the outer race of the large upper bearing.
3. Position the large upper bearing over its bearing seat with the open side facing inward.
4. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place. **Be careful not to contact the bearing inner race as damage will result.**
5. Invert the flange casting and place it on a bench with the small bearing seat facing upward.
6. Select a socket wrench that is the same diameter as the outer race of the small bearing.
7. Position the small bearing over its bearing seat with the open side facing inward.
8. Place the socket wrench on the outer race of the bearing and lightly tap on the socket wrench until the bearing is in place. **Be careful not to contact the bearing inner race as damage will result.**
9. Install the tilt column mechanism as described below in this Part.

TILT COLUMN MECHANISM

LTD II, COUGAR, THUNDERBIRD, CONTINENTAL MARK V, GRANADA, MONARCH AND VERSAILLES

Removal

(Remove the steering column assembly on Granada/Monarch vehicles as detailed earlier in this Part.)

1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the steering wheel as described earlier in this Part. The steering wheel must be in the full "up" position.
3. Remove the trim shroud that covers the steering column at the instrument panel.
4. Remove the screws that attach the instrument cluster trim cover to the instrument cluster. Remove the instrument cluster trim cover from the vehicle. Remove the screws that attach the instrument cluster to the instrument panel. Remove the instrument cluster from the vehicle. Separate the instrument cluster from the main instrument panel. Disconnect the speedometer cable, the wire harness connections, the PRND21 cable (as required) and the wire cables to the heat/air panel from the instrument cluster from the vehicle.
5. Disconnect all electrical connections (quick-couplers) to the steering column (Fig. 8). Remove the wires from the hard-shell plastic coupler. **Carefully note the position and color code of each wire in the coupler.**

The following operations are common to Granada, Monarch, LTD II, Cougar, Thunderbird, Continental Mark V and Versailles.

6. Remove the lock drive gear as described later in this Part.
7. Remove the turn signal actuating lever.
8. Remove the two screws that attach the turn signal switch to the flange casting and the one screw that attaches the warning buzzer terminal. Remove the wiring harness-to-steering column tube clips (if required). Remove the turn signal switch and wiring harness from the steering column.
9. Remove the four screws on the cover casting. Lift the cover casting up and over the steering column upper shaft and remove it from the steering column. The upper actuator will come out at this point. Unhook the upper actuator from the lower actuator.
10. Remove and discard the three screws that attach the lower flange casting to the steering column outer tube. These screws are located under the socket casting near the outer tube. **Do not re-use these screws.**
11. Loosen the ignition switch nut and washer assemblies and remove the ignition switch rod from the switch end only.
12. Remove the two spring clips holding wire bale which act as a release lever for the locking lever. Remove the wire bale (Fig. 9).
13. With a small drift, drive out the pin holding the locking lever. Remove the locking lever and spring. (A C-clamp may be used to relieve the tension on the pin during removal, if necessary.)
14. Remove the steering column upper shaft snap ring (Fig. 8).
15. The upper and lower flange castings can now be separated by removing the two pivot pins located in the side of the casting assembly with either Tool T70P-3D739-A or Tools T70P-3D739-A and T67P-3D739-C (Fig. 10). **Do not re-use the pivot pins if the press fit is loose in the lower flange.**

Installation

1. Install the lower actuator with the ignition switch rod attached.
2. Assemble the upper and lower flange castings by installing the two pivot pins located in the side of the casting assembly. Be sure that the steering column position spring is properly seated between the upper and lower flange casting. Be sure that the wavy thrust washer is located properly between

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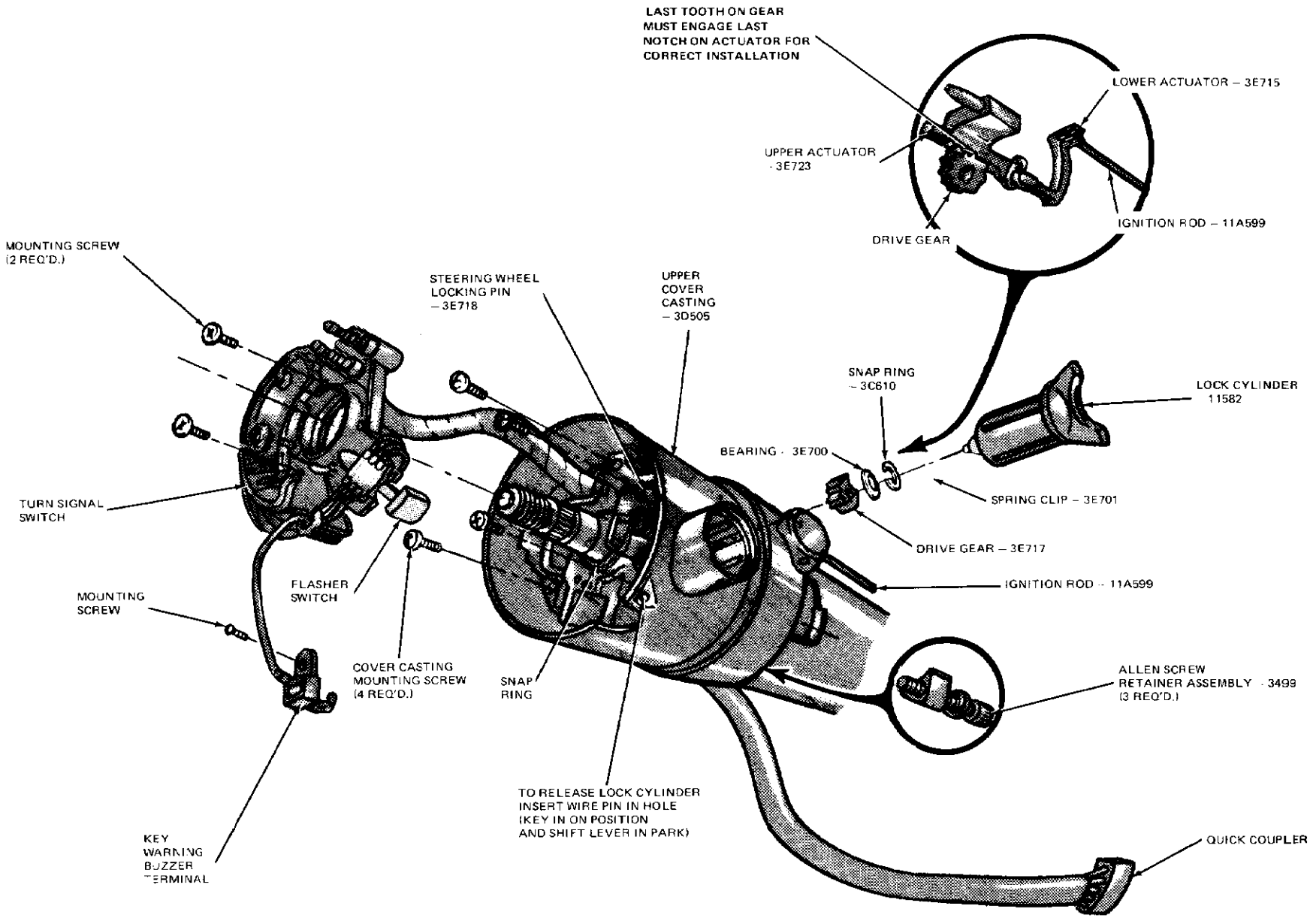


FIG. 8 Tilt Column Mechanism

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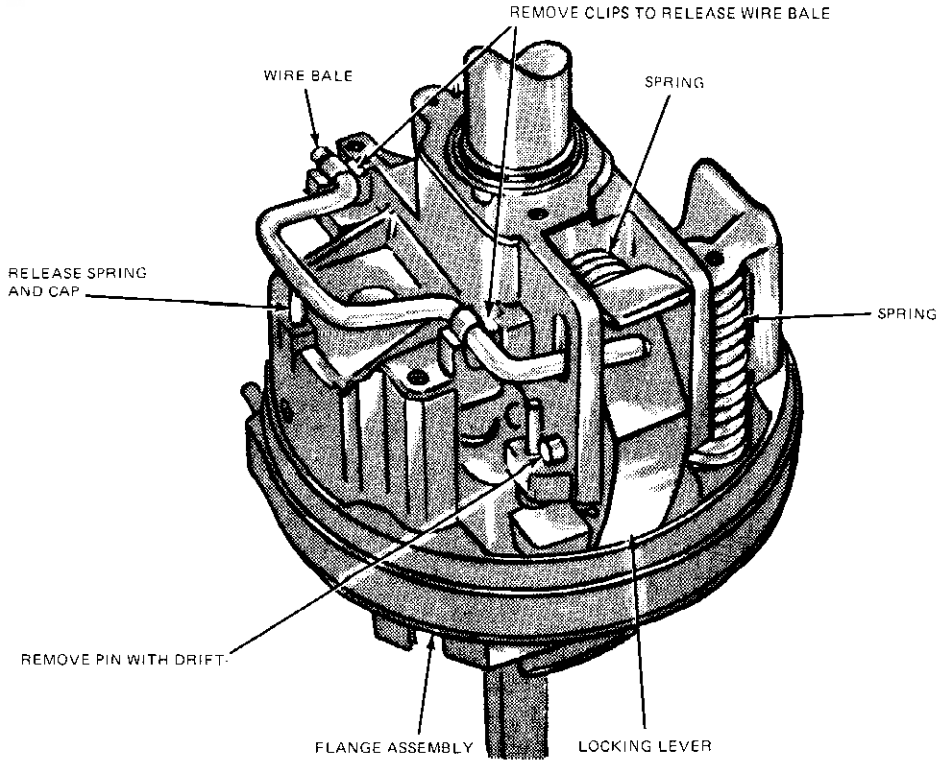


FIG. 9 Removing Wire Bale and Tilt Locking Lever

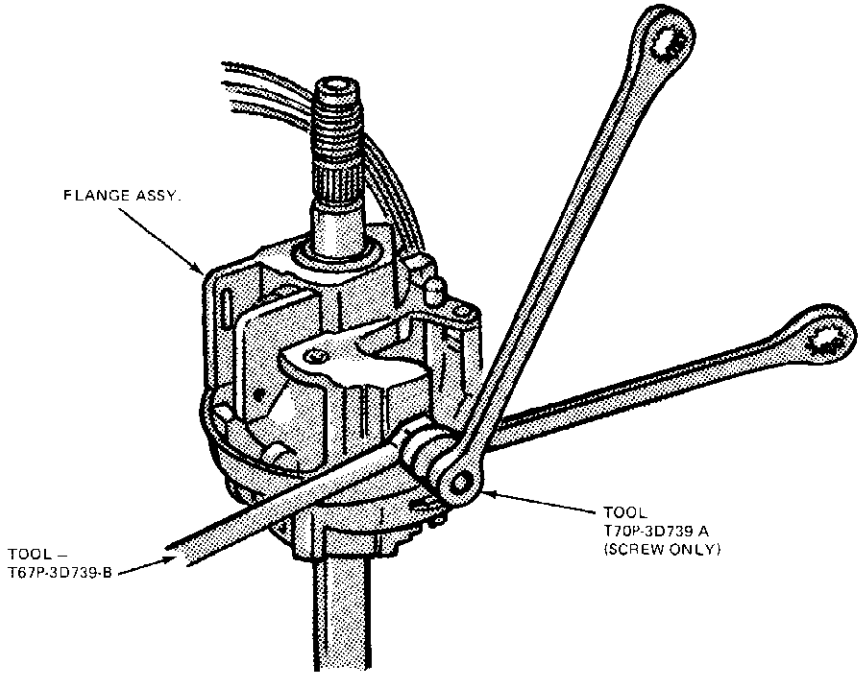


FIG. 10 Removing Pivot Pin

the lower flange casting and the socket casting. **Do not re-use the pivot pins if the press fit is loose in the lower flange.**

3. Install the steering column upper shaft snap ring.
4. Assemble the locking lever and spring. Insert the pin that holds the locking lever. A C-clamp may be used

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to relieve the tension on the pin during assembly, if necessary (Fig. 11).

5. Position the wire bale on the upper casting and install the two spring clips that hold the wire bale in place.
6. Connect the ignition switch rod to the ignition switch, leave the ignition switch attaching nuts loose.
7. Install the three screws, washers and retainers that attach the flange assembly to the steering column outer tube. Torque the screws to 50-68 in-lb. **New screws, washers and retainers must be used to insure that the epoxy cement on the screws will bond properly.**
8. Connect the upper and lower actuators. Position the cover casting on the steering column and install the four attaching Phillips head screws. Torque the screws to 40-50 in-lb.
9. Install the turn signal switch and wiring harness in the steering column. Attach the wiring harness-to-steering column tube clips (if required). Install the two screws that attach the turn signal switch to the flange casting and the one screw that attaches the warning buzzer terminal. Torque the screws to 20-30 in-lb for the turn signal switch and 15-25 in-lbs for the buzzer terminal.
10. Install the turn signal actuating lever.
11. Install the lock drive gear as described later in this Part.
12. Install the lock cylinder assembly as described later in this Part.
13. Adjust the ignition switch.
14. Attach all vacuum lines (if equipped). Reassemble the wires in the hard-shell plastic coupler. **Carefully locate the correct color-coded wire in the correct position in the plastic coupler.**
15. Connect all electrical connections (quick-couplers) to the steering column.
16. Install the steering column assembly as described earlier in this Part.
17. Connect the speedometer cable, the wire harness connections, the PRND21 cable (as required), and the wire cables to the heat/air panel to the instrument cluster. Position the instrument cluster in the instrument panel and install the screws that attach it to the instrument panel. Position the instrument cluster trim cover on the instrument cluster and install the screws that attach it to the instrument cluster.
18. Install the trim shroud that covers the steering column at the instrument panel.
19. Install the steering wheel as described earlier in this Part.
20. Connect the negative battery cable (ground) to the battery terminal.
21. Check the steering column for proper operation.

IGNITION LOCK CYLINDER ASSEMBLY

Common instructions for replacing all ignition lock cylinders are contained in Part 13-01.

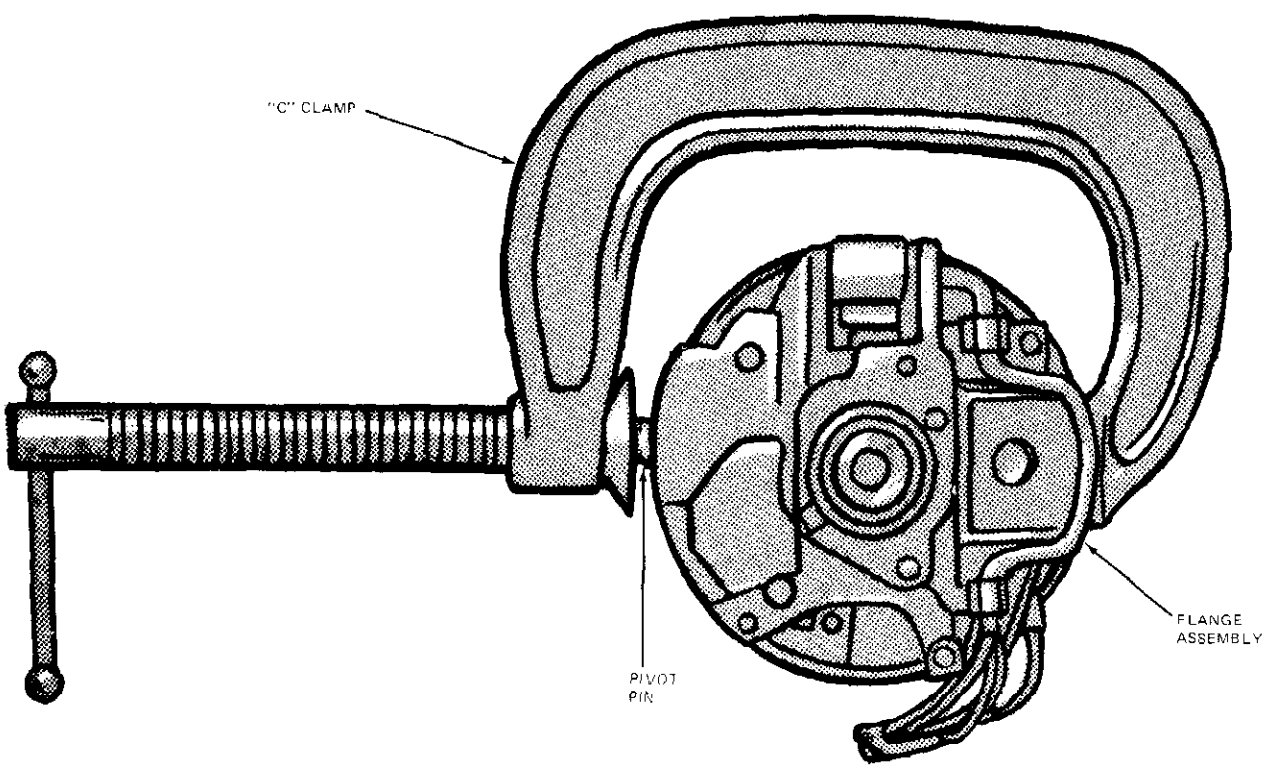


FIG. 11 Installing Flange Assembly Pivot Pins

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IGNITION LOCK DRIVE GEAR

FIXED AND TILT COLUMNS

Removal

1. Remove the lock cylinder assembly as described earlier in Part 13-01.
2. Using a flat bladed screwdriver inserted into the recess of the drive gear at the bottom of the lock cylinder housing, turn the lock drive gear three notches counterclockwise.
3. Remove the snap ring, washer and lock drive gear from the lock cylinder housing. **Carefully note the relationship of the lock drive gear to the position of the rack teeth.**

Installation

1. Position the lock drive gear in the base of the lock cylinder housing in the same position as that noted during the removal procedure. **The position of the lock drive gear is correct if the last tooth on the drive gear is meshed with the last tooth on the rack (Fig. 8).**

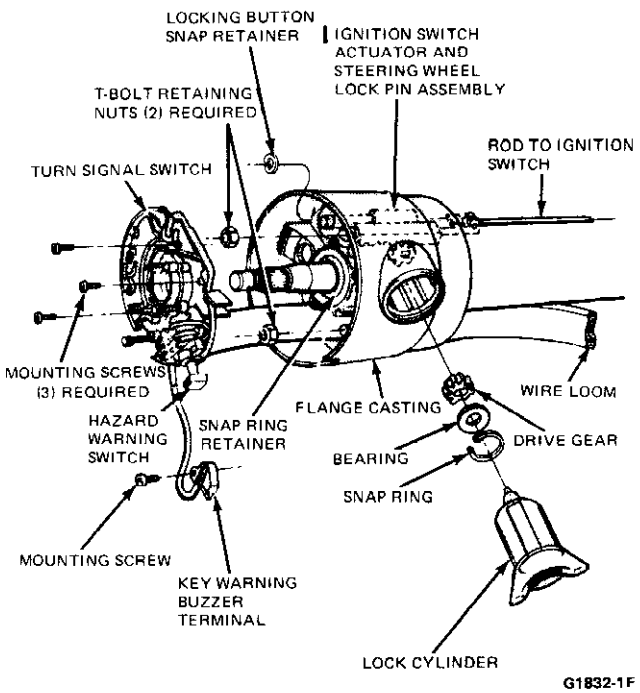


FIG. 12 Fixed Column Mechanism

2. Install the washer and the snap ring.
3. Using a flat bladed screwdriver inserted into the recess of the lock drive gear at the bottom of the lock cylinder housing, turn the drive gear three notches in a clockwise direction.
4. Install the lock cylinder assembly as described earlier in this Part.

IGNITION LOCK ACTUATOR AND STEERING WHEEL LOCK PIN ASSEMBLY

FIXED COLUMN

Removal

1. Remove the trim shroud that covers the steering column at the instrument panel.
2. Remove the lock drive gear as described earlier in this Part.
3. **Continental Mark V**

   Disconnect the PRND21 cable from the steering column.
4. **Mustang/Pinto/Bobcat**

   Remove the section of instrument panel that is located beneath the steering column.

   LTD II/Cougar, Thunderbird

   Continental Mark V

   Remove the screws that attach the instrument cluster trim cover to the instrument cluster. Remove the instrument cluster trim cover from the vehicle. Remove the screws that attach the instrument cluster to the instrument panel. Remove the instrument cluster from the vehicle. Separate the instrument cluster from the main instrument panel. Disconnect the speedometer cable, the wire harness connections, the PRND21 cable (as required), and the wire cables to the heat/air panel from the instrument cluster. Remove the instrument cluster from the vehicle.
5. **Mustang/Pinto/Bobcat**

   Remove the attaching nuts that hold the steering column brackets to the brake support bracket. Lower the steering column to expose the ignition switch.

   LTD II/Cougar,

   Thunderbird/Continental Mark V

   This step is not required.
6. Loosen the ignition switch attaching nuts and remove the ignition rod from the switch end.
7. Remove the upper shaft bearing as described earlier in this Part.
8. Remove the ignition lock actuator rod and steering wheel lock pin assembly from the steering column.
9. Remove the retaining clip at the lower end of the steering wheel lock pin and discard. Remove the steering wheel lock pin and lock pin spring from the ignition switch actuator. **A new lock pin and retaining clip must be used each time the steering wheel lock pin is removed from the ignition switch actuator.**

Installation

1. Insert the new steering wheel lock pin and lock pin spring into the ignition lock actuator. Install a new retaining clip on the lower end of the steering wheel lock pin. **A new lock pin and retaining clip must be used each time the steering wheel lock pin is removed from the ignition lock actuator (Fig. 12).**
2. Position the ignition lock actuator rod and steering wheel lock pin assembly in the steering column.

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3. Engage the actuator rod into the ignition switch. Do not tighten the ignition switch retaining nuts.
4. Install the lock drive gear, bearing and snap ring.
5. Install the lock cylinder with the key in the ON position. Install with the retaining pin flush with the lock cylinder. Turn the key to the OFF position.
6. Install the upper shaft bearing, as described earlier in this Part.
7. *Adjust the ignition switch as described in Part 33-70.*
8. **Mustang/Pinto/Bobcat**

   Raise the steering column into position and attach the nuts that hold the steering column brackets to the brake support bracket. Torque the nuts to 20-37 ft-lb.

   LTD II/Cougar,

   Thunderbird/Continental Mark V

   This step is not required.
9. **LTD II/Cougar,**

   Thunderbird/Continental Mark V

   Connect the speedometer cable, the wire harness connections and the wire cables to the heat/air panel to the instrument cluster. Position the instrument cluster in the instrument panel. Install the screws that attach the instrument cluster to the instrument panel. Position the instrument cluster *trim cover on the instrument cluster and install the* screws that attach it to the instrument cluster.
10. **Thunderbird/Continental Mark V**

    Connect the PRND21 cable to the steering column.
11. Install the trim shroud that covers the steering column at the instrument panel.

TILT COLUMN

Removal

1. Remove the Tilt Column Mechanism (as required) as described earlier in this Part.

Installation

1. Install the Tilt Column Mechanism (as required) as described earlier in this Part.

FLANGE AND/OR SOCKET CASTING

FIXED AND TILT COLUMNS

Removal

1. **Fixed Column**

   Remove the actuator assembly as described earlier in this Part.

   Tilt Column

   Remove the tilt column mechanism as described earlier in this Part.
2. Disconnect the transmission control rods.
3. Remove the flexible coupling as described in this Part (Tilt Only).
4. Remove the steering column shaft assembly from the top of the steering column (tilt only).
5. Rotate the steering column inner tube and socket casting to expose the socket casting retaining bolt.
6. Remove the socket casting retaining bolt and lift the socket casting off of the steering column inner tube.

Installation

1. Position the socket casting (install the gear shift lever if removed) on the steering column inner tube. Align the retaining bolt hole and install the retaining bolt.
2. Install the steering column shaft assembly in the steering column from the top (tilt only).
3. Install the flexible coupling as described in this Part (Tilt Only).
4. Connect the transmission control rods.
5. **Fixed Column**

   Install the actuator assembly and steering wheel lock pin assembly as described earlier in this Part.

   Tilt Column

   Install the tilt column mechanism as described earlier in this Part.

STEERING COLUMN SHIFT TUBE

FIXED COLUMN—LTD II, COUGAR, THUNDERBIRD, CONTINENTAL MARK V, GRANADA, MONARCH AND VERSAILLES

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Place the steering column assembly in a vise and secure it in place.
3. Remove the back-up lamp switch.
4. Remove the upper shaft bearing as described earlier in this Part.
5. Remove the steering shaft assembly from the bottom end of the column.
6. Remove the bolt retaining shift tube to the socket casting (automatic transmission).
7. Remove the lower bearing retainer screws (3) from the outer tube (all except Granada and Monarch manual transmission).
8. Remove the retainer and tube assembly from the column (all except Granada and Monarch manual transmission).
9. Remove the three (3) screws attaching the bearing to the retainer and remove the bearing and shift tube from the retainer (all except Granada and Monarch manual transmission).
10. Remove the lower bearing housing and shift tube from the outer tube (Granada, Monarch and Versailles).

Installation

1. Insert the shift tube into the bearing retainer. Insert the bearing into the retainer and attach with (3) *screws (all except* Granada and Monarch).
2. Insert the retainer and tube assembly into the column. Install the (3) screws attaching the bearing retainer to the outer tube (all except Granada and Monarch).
3. Insert the shift tube into the socket casting. Align the retaining bolt holes and install the retaining bolt. Torque the bolt to 35-50 in-lbs.

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4. Insert the steering column shaft assembly into the column from the bottom.
5. Install the upper shaft bearing as described earlier in this Part.
6. Install the back-up lamp switch.
7. Install the steering column assembly as described earlier in this Part.

TILT COLUMN

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Place the steering column assembly in a vise and secure it in place.
3. Remove the back-up lamp switch. **It is not necessary to remove the turn indicator switch and wiring harness from the steering column.**
4. Remove the three screws that attach the lower bearing casting to the outer tube. Remove the lower bearing casting from the outer tube.
5. Remove the bolt retaining the shift tube to the socket casting and remove the shift tube from the housing.

Installation

1. Insert the shift tube into the socket casting. Align the retaining bolt holes and install the retaining bolt. Torque the retaining bolt to 35-50 in-lb.
2. Position the lower bearing casting in the outer tube. Install the three screws that attach the lower bearing casting to the outer tube. Torque the screws to 20-25 in-lb. **ESA-M4G129-A (Loctite) or equivalent must be applied to the threads before installation.**
3. Install the back-up lamp switch.
4. Install the steering column assembly as described earlier in this Part.

U-JOINT ASSEMBLY

Removal

1. Remove the nut from the U-joint assembly bolt.
2. Push the bolt outward, disengaging the groove in the steering column lower shaft. **The bolt will not come completely out of the U-joint assembly because it is pinned in.**
3. Remove the two nuts that attach the flexible coupling to the flange (forging) on the steering gear input shaft. Disengage the safety strap and bolt assembly from the flexible coupling.
4. Slide the U-joint assembly off of the steering column lower shaft.

Installation

1. Hold the bolt back and slide the U-joint assembly onto the end of the steering column lower shaft until the bolt can be pushed inward engaging the groove in the steering column lower shaft. (A gap of at least .040 inch must exist under the head of the bolt. If a gap is less than .040 inch, the steering column lower shaft must be replaced.)
2. Engage the safety strap and bolt assembly to the flexible coupling. Install the two nuts that attach the flexible coupling to the flange (forging) on the steering gear input shaft. **The safety strap must be properly positioned to prevent metal-to-metal contact after the final torquing of attaching nuts to 20-37 ft-lbs. The flexible coupling must not be distorted when the attaching nuts are torqued.**
3. Install one nut to the U-joint assembly bolt. Torque to 25-35 ft-lbs.

STEERING WHEEL LOCKING BUTTON

LTD II, COUGAR, GRANADA, MONARCH, MUSTANG, PINTO, AND BOBCAT WITH FLOOR SHIFT

Removal

1. Remove the flange casting as described earlier in this Part.
2. From inside the flange casting, remove the snap ring from the locking button pivot shaft. **Discard the snap ring.**
3. Remove the locking button assembly from the flange casting.
4. Remove the return spring from the lock button pivot shaft.

Installation

1. Assemble the return spring to the lock button pivot shaft.
2. Place the lock button assembly in position with the pivot shaft through the hole in the flange casting. **Be sure the spring is retained in the lever and against the flange casting to provide for the automatic return of the lever (Fig. 13).**

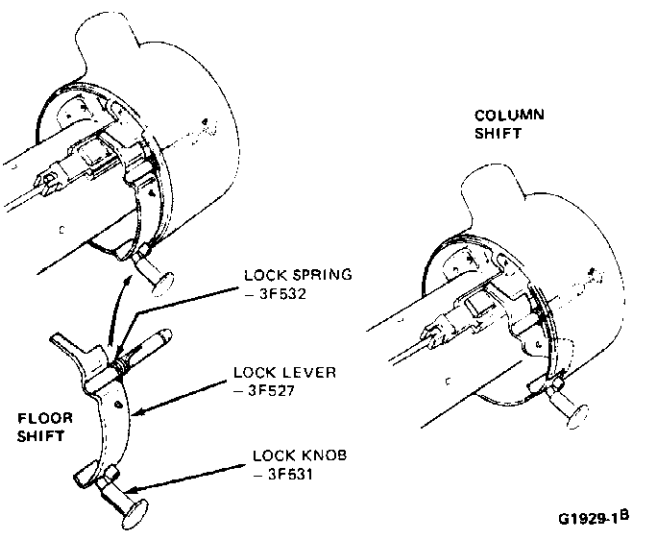


FIG. 13 Locking Button Installation

3. Install a new snap ring to the end of the pivot shaft.
4. Install the flange casting as described earlier in this Part.

LOWER SHAFT BEARING

FIXED AND TILT COLUMNS

Removal

1. Remove the steering column assembly as described earlier in this Part.

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2. Remove the back-up lamp switch.
3. Remove the three screws that secure the lower bearing retainer assembly to the end of the steering column lower flange casting and remove the bearing assembly.
4. The steering column lower shaft bearing may now be snapped out of the plastic retainer.

Installation

1. Position a new bearing assembly, installed in the plastic retainer, in the lower end of the steering column lower flange casting.
2. Install the three screws that secure the lower bearing retainer to the steering column lower flange casting. Torque the screws to 12-20 in-lb.
3. Install the back-up lamp switch.
4. Install the steering column assembly as described earlier in this Part.

STEERING SHAFT AND ANTI-RATTLE CLIPS

FIXED COLUMN

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Place the steering column assembly in a vise and secure it in place.
3. Remove the back-up lamp switch.
4. Remove the upper shaft bearing as described earlier in this Part.
5. Remove the steering shaft assembly from the bottom end of the column.
6. Scribe a mark where the upper and lower steering shaft sections form a joint line.
7. Separate the upper and lower steering shaft sections.
8. Remove the two steel anti-rattle clips and discard.

Installation

1. Install two new steel anti-rattle clips in the grooves on the steering column upper shaft; **both clips must be installed in the same direction.**
2. Lubricate the lower six inches of the steering column upper shaft with a liberal amount of chassis lubricant.
3. Place the steering column lower shaft in a vise and install the steering column upper shaft to the scribed mark on the steering column lower shaft.
4. Insert the steering shaft assembly into the column from the bottom.
5. Install the upper shaft bearing as described earlier in this Part.
6. Install the back-up lamp switch.
7. Install the steering column assembly as described earlier in this Part.

TILT COLUMN

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Place the steering column assembly in a vise and secure it in place.
3. Remove the back-up lamp switch. **It is not necessary to remove the turn indicator switch and wiring harness from the steering column.**
4. Remove the steering shaft assembly and tilt mechanism, as described earlier in this Part, into the column from the top.
5. Scribe a mark where the upper and lower steering shaft sections form a joint line.
6. Separate the upper and lower steering shaft sections.
7. Remove the two steel anti-rattle clips and discard.

Installation

1. Install two new steel anti-rattle clips in the grooves on the steering column upper shaft, **both clips must be installed in the same direction.**
2. Lubricate the lower six inches of the steering column upper shaft with a liberal amount of chassis lubricant.
3. Place the steering column lower shaft in a vise and install the steering column upper shaft to the scribed mark on the steering column lower shaft.
4. Install the steering shaft assembly and the tilt mechanism, as described later in this Part, into the column from the top.
5. Install the back-up lamp switch.
6. Install the steering column assembly as described earlier in this Part.

FLEXIBLE COUPLING

ALL EXCEPT GRANADA, MONARCH AND VERSAILLES

Removal

1. Remove the U-joint assembly as described earlier in this Part. **The flexible coupling is riveted to the U-joint assembly. The U-joint assembly must be replaced when flexible coupling replacement is necessary.**

Installation

1. Install a new U-joint assembly as described earlier in this Part.

GRANADA, MONARCH AND VERSAILLES

Removal

1. Remove the steering column as detailed previously in this Part.
2. Remove the bolt attaching the coupling to the steering gear.
3. Remove the coupling.

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Installation

1. Position the stub shaft of the steering gear by locating the notch on the lower flange of the coupling to the missing spline on the shaft.
2. Install the bolt by hand starting 3 threads. Torque the bolts to 20-30 ft-lbs.
3. Install the steering column as outlined previously in this Part.

SPECIAL SERVICE TOOLS

Tool No.	Description
T67L-3600-A	Steering Wheel Remover
T67P-3D739-B	Pivot Pin Remover
T67P-3D739-A	Pivot Pin Remover Kit
T67P-3D739-C	Pivot Pin Remover Handle

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Steering Columns — Modular I (Extruded Absorber Type)

PART 13-06

Applies To Fairmont/Zephyr

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PRND21 Indicator – (See Column Installation)	06-6
Steering Wheel Spoke Position	06-6
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Steering Column With Floor Shift	06-4
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Flexible Coupling	06-17
Ignition Lock Actuator and Steering Wheel Lock Pawl	06-16
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CG2657-2A

DESCRIPTION

STEERING COLUMN—COLUMN SHIFT

Fairmont/Zephyr

This steering column has been designed to maximize safety and reliability, reduce weight and improve and simplify service. The column is the fixed type (Fig. 1).

The column is of a modular construction and features easy to service electrical switches and shift systems. The switches contained on the column are the wash/wipe switch, and the turn signal/hazard/horn/dimmer switch, attached with self tapping screws, and the ignition switch attached with break-off head bolts which must be removed with an "Easy Out" or other means. The service of the switches can be performed by removing the four screws holding the color keyed shroud in place.

The column tube terminates just below the attachment to the brake pedal support bracket. Energy absorption is accomplished by the lower column mounting bracket. The shift system is attached external to the column tube by a "C" clip at the upper end and two nuts and bolts at the lower column mounting bracket.

The column locking mechanism is actuated by placing the column shift control in the park position and turning the key lock cylinder to Lock.

The upper steering shaft is a machined rod with a turn signal cancel cam and lock ring pressed and staked on and two steel insulator clips. The lower shaft is a formed tube which fits over the upper shaft and insulator clips. An intermediate shaft and U-joint assembly attaches to the lower steering shaft and to the steering gear at the other end.

The column is attached to the brake pedal support bracket by two collar type brackets bolted to flanges on the brake support. The lower column attaching collar is a sintered iron ring with protrusions within the ring. The protrusions act as a die which deforms the outer tube as the column collapses. Any extension of the iron ring die requires that the outer tube and mounting brackets be replaced as a unit. Refer to Figs. 2 and 2A for part numbers and nomenclature.

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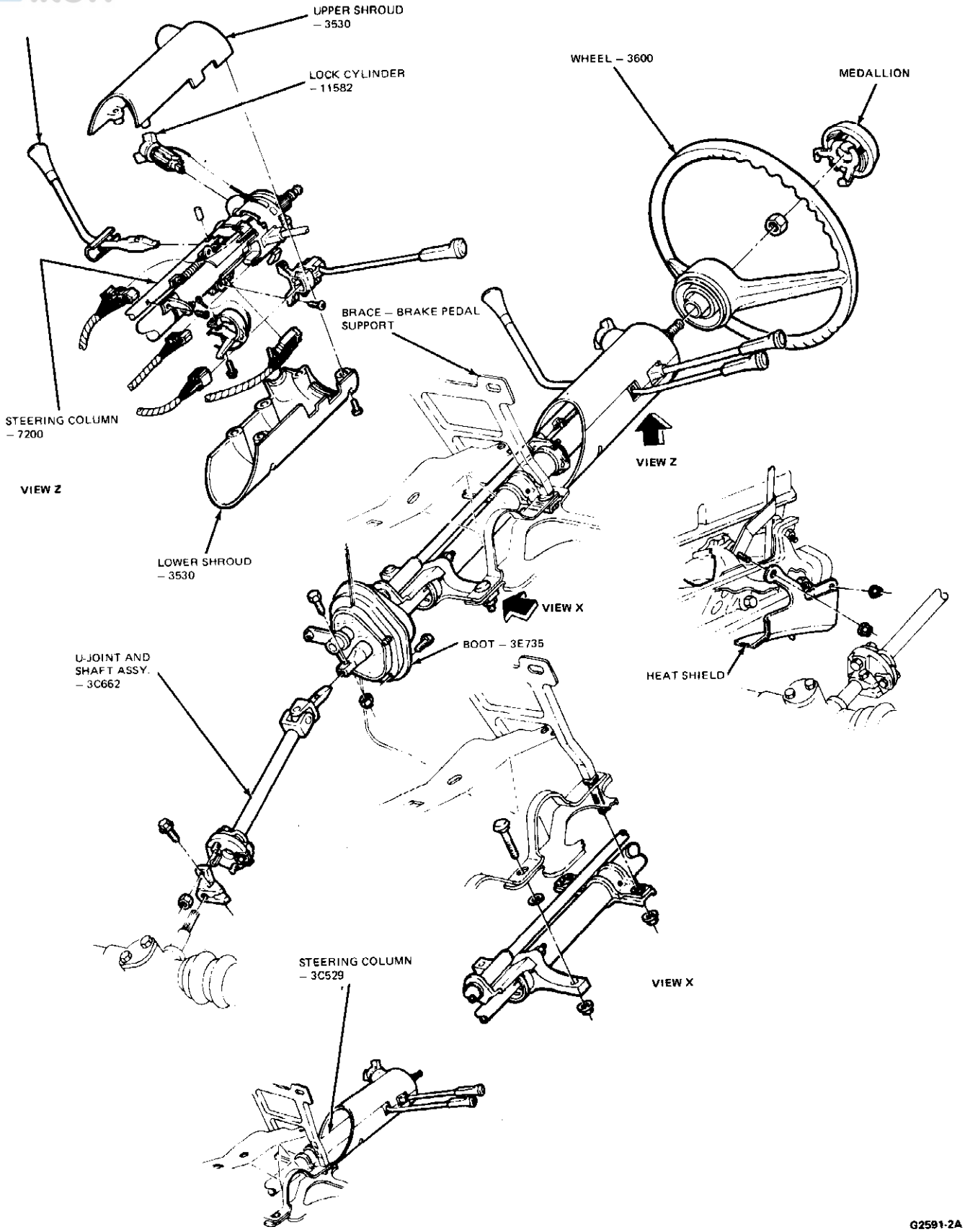
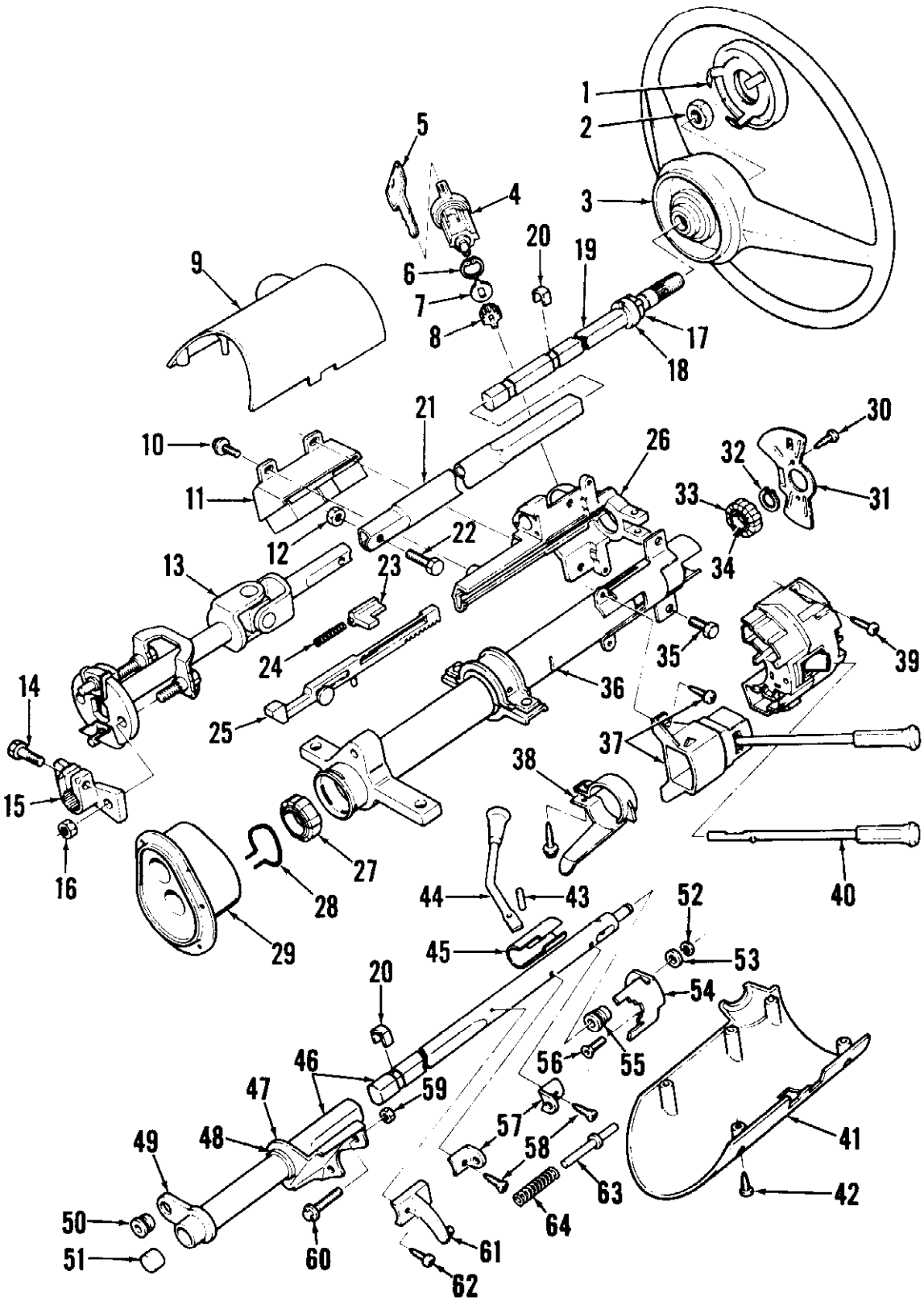


FIG. 1 Steering Column—Modular I—Column and Floor Shift (Extruded Absorber Type)

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G2592-2A

FIG. 2 Steering Columns—Modular I—Column Automatic (Extruded Absorber Type)

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DETROIT IRON

1. 3A515 - EMBLEM ASSY.
2. 33850-S2 - NUT 5/8 - 18 HEX
3. 3600 - WHEEL ASSY - STNG
4. LOCK CYL - (BODY)
5. KEY - (BODY)
6. N800205-S100 - RING
7. 3E700 - BEARING
8. 3E717 - GEAR - STNG COL LOCK
9. 3530 - SHROUD - UPPER
10. *N800207-S100 - BOLT (BREAK OFF HEAD) (2 REQ'D)*
11. 11572 - SWITCH ASSY. - IGNITION
12. 34977-S2 - NUT 3/8-16 HEX LOCK
13. 3C662 - SHAFT ASSY - STNG COL LOWER
14. 385970-S100 - BOLT - 3/8 - 24 x 1.22
15. 3459 - FLANGE - STNG SHAFT LOWER
16. 34977-S2 - NUT 3/8-16 HEX LOCK
17. 13318 CAM - TURN SIG TURN OFF
18. 3B767 - LOCK - STNG COL POSITION
19. *3A527 - SHAFT - STNG GEAR UPPER*
20. 3E629 ANTI-RATTLE CLIPS
21. 3E628 - SHAFT - STNG GEAR LOWER
22. 304741-S2 - BOLT 3/8-16 x 1 3/8 HEX
23. 3E691 - PAWL - STNG COL LOCK
24. 3E696 - SPRING - STNG COL LOCK
25. 3E723 - ACTUATOR ASSY - STNG COL LOCK
26. 3E643 - HOUSING - STNG COL LOCK CYL
27. 3E733 - BEARING ASSY - STNG GEAR SHAFT LOWER
28. 3F543 - RING - STNG GEAR SHAFT LOWER BEARING RETAINER
29. 3E735 - BOOT ASSY - STNG COL
30. 52794-S2 - SCREW NO. 8-18 x .62 PAN HD. TAP (2 REQ'D)
31. 3610 - RETAINER - STNG COL UPPER BEARING
32. 3C610 - RETAINER - STNG COL UPPER BEARING
33. *3518 - SLEEVE - STNG COL UPPER BEARING*
34. 3517 - BEARING ASSY - STNG COL UPPER
35. N605531-S2 - BOLT - M8 x 1.25 HEX HD (2 REQ'D)
36. 3A617 - TUBE ASSY COL OUTER
37. WASH/WIPE SWITCH & SCREWS (BODY)
38. 3E363 - BRACKET & CABLE ASSY - TRANS CONT SEL (BODY)
39. 52794-S2 - SCREW NO. 8-18 x .62 PAN HD TAP (2 REQ'D)
40. 13305 - HANDLE & SHANK ASSY - TURN SIG SWITCH
41. 3530 - SHROUD - STNG COL LOWER
42. 55928-S2 - SCREW NO. 8-18 x .75 PAN HD TAP (4 REQ'D)
43. *N100198 - PIN 5 MM SPRING COILED*
44. 7202 - LEVER ASSY - TRANS CONT SELECTOR
45. 7C369 - COVER - TRANS CONT SEL LEVER OPENING
46. 7212 - TUBE ASSY - TRANS CONT SELECTOR
47. 7K738 - BRACKET - TRANS GEAR SHIFT SUPPORT
48. 7K189 - BUSHING - TRANS GEAR SHIFT SHAFT
49. 7346 - ARM - TRANS CONT SELECTOR
50. 3E629 - INSULATOR - STNG GEAR SHAFT
51. 3B361 - SEAL - STNG GEAR SHAFT
52. 388021-S2 - RING - 5/16 RETAINER (EXTERNAL)
53. N800178-S2 - WASHER - 8.23 FLAT
54. 7A216 - INSERT - TRANS CONTROL SELECTOR POSITION
55. 7225 - BEARING - TRANS GEAR SHIFT LEVER SOCKET
56. N800164-S100 - SCREW - M5 - 0.8 x 12.5 FLAT HEAD (3 REQ'D)
57. 3E543 - RETAINER - STNG COL LEVER (2 REQ'D)
58. N800210-S2 - SCREW 4 MM - 0.7 x 12.7 TYPE "D" OVAL (2 REQ'D)
59. 34976-S2 - NUT 5/16 - 18 HEX PREVAIL TORQUE (2 REQ'D)
60. 56724-S2 - BOLT 5/16-18 x 1.50 FLG PILOT (2 REQ'D)
61. 7449 - LEVER - TRANS GEAR SHIFT SELECTOR
62. 382002-S2 - SCREW NO.8 - 32 x .50 HX WSHR HD
63. 7361 - PLUNGER - TRANS CONTROL SELECTOR LEVER
64. 7B071 - SPRING - TRANS CONTROL SELECTOR LEVER RETURN

CG2593-2A

FIG. 2A Component Parts—Column Automatic

STEERING COLUMN—FLOOR SHIFT

Fairmont/Zephyr

The floor shift columns are identical to the column shift columns except for the lack of the external shift cane unit, a different dash panel boot, shroud and the addition of the key release button (Fig. 1).

The locking mechanism is actuated by depressing the push button located on the lower left side of the column below the turn signal lever and rotate the key lock cylinder to the "Lock" position. This prevents inadvertant locking of the steering shaft by blocking the lock actuator out of the lock position unless the button is intentionally depressed. Refer to Figs. 3 and 3A for part numbers and nomenclature.

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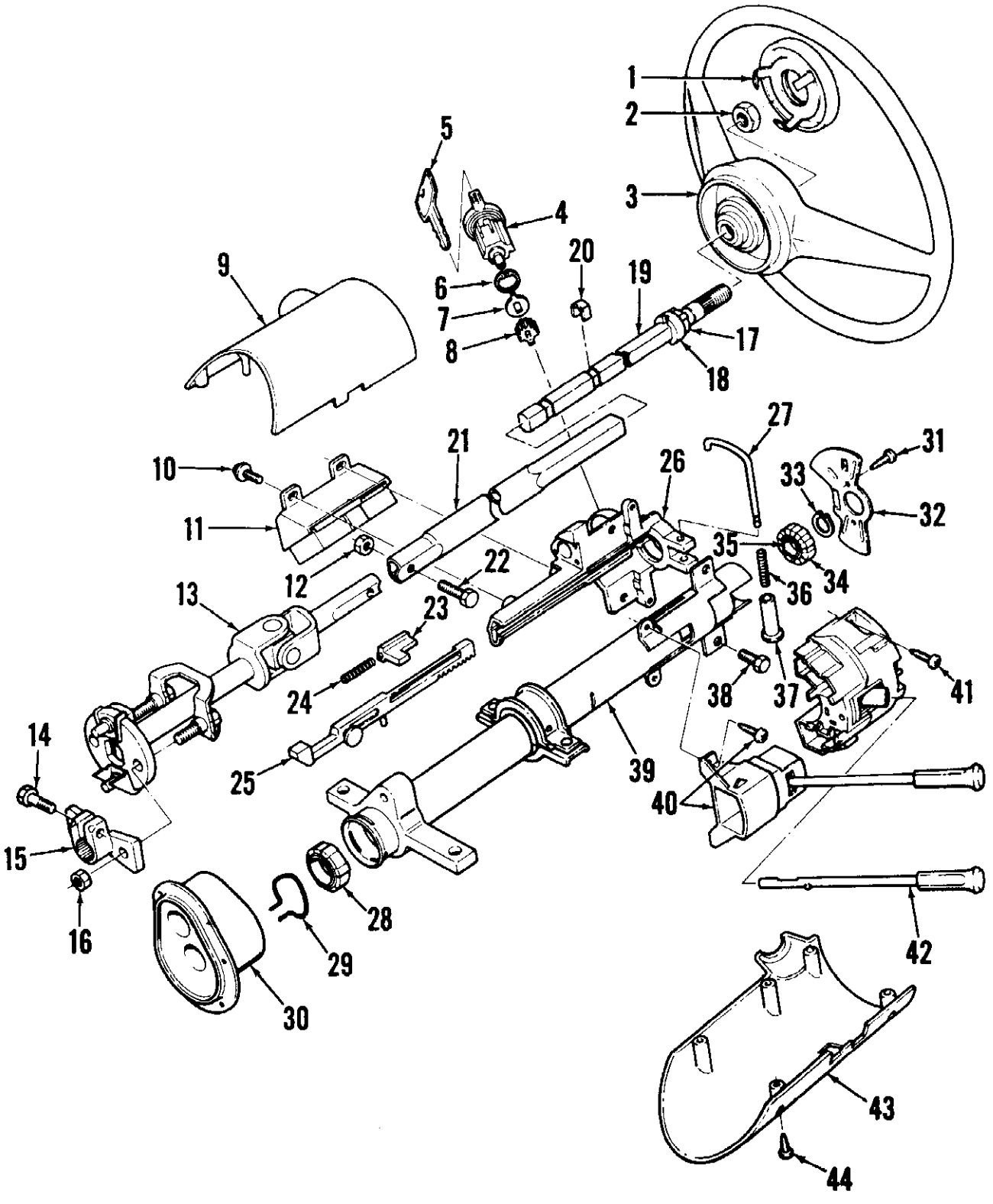


FIG. 3 Steering Columns—Modular I—Floor Shift (Extruded Absorber Type)

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18. 3B767 - LOCK - STNG COL POSITION
19. 3A527 - SHAFT - STNG GEAR UPPER
20. 3E629 ANTI-RATTLE CLIPS
21. 3E628 - SHAFT - STNG GEAR LOWER
22. 304741-S2 - BOLT 3/8-16 x 1 3/8 HEX
23. 3E691 - PAWL - STNG COL LOCK
24. 3E696 - SPRING - STNG COL LOCK
25. 3E723 - ACTUATOR ASSY - STNG COL LOCK
26. 3E643 - HOUSING - STNG COL LOCK CYL
27. 3F528 - LEVER - STNG COL LOCK ACTUATOR
28. 3E733 - BEARING ASSY - STNG GEAR SHAFT LOWER
29. 3F543 - RING - STNG GEAR SHAFT LOWER BEARING RETAINER
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35. 3517 - BEARING ASSY - STNG COL UPPER
36. 3E696 - SPRING - STNG COL LOCK
37. KNOB - STNG COL LOCK ACTUATOR
38. N605531-S2 - BOLT - M8 x 1.25 HEX HD (2 REQ'D)
39. 3A617 - TUBE ASSY COL OUTER
40. WASH/WIPE SWITCH & SCREWS (BODY)
41. 52794-S2 - SCREW NO. 8-18 x .62 PAN HD TAP (2 REQ'D)
42. 13305 - HANDLE & SHANK ASSY - TURN SIG SWITCH
43. 3530 - SHROUD - STNG COL LOWER
44. 55928-S2 - SCREW NO. 8-18 x .75 PAN HD TAP (4 REQ'D)

CG2595-2A

FIG. 3A Component Parts—Floor Shift Column

ADJUSTMENTS

STEERING WHEEL SPOKE

POSITION ADJUSTMENT

When the blocked tooth on the steering gear input shaft is in the 12 o'clock position, the front wheels should be in the straight-ahead position and the steering wheel spokes should be in their normal position. If the spokes are not in their normal position, they can be adjusted by changing the toe adjustment (Part 14-01). This adjustment may be made only when the steering wheel 12 o'clock mark is aligned with the steering shaft 12 o'clock mark. Adjusting the wheel so that the marks do not align will result in improper turn signal switch cancel function.

PRND21 ADJUSTMENT (SEE STEERING COLUMN INSTALLATION)

IGNITION SWITCH ADJUSTMENT (SEE IGNITION SWITCH INSTALLATION)

REMOVAL AND INSTALLATION

STEERING WHEEL

Removal

1. Remove the steering wheel hub cover by pulling outwards to overcome the force of the retention springs.
2. Remove and discard the steering wheel attaching nut.
3. Using Tool T67L-3600-A, remove the steering wheel from the upper steering shaft. Do not use a knock-off type steering wheel puller or strike the end of the steering column upper shaft with a hammer or damage will occur to the bearing of the collapsible steering column (Fig. 4).

Installation

1. Position the steering wheel on the end of the steering wheel shaft. Align the mark on the steering wheel with the marks on the shaft to assure that the straight ahead steering wheel position corresponds to the straight ahead position of the front wheels.
2. Install a new service wheel nut. Torque the nut to 30-40 ft-lbs.
3. Position the steering wheel hub cover so that the three retainer springs align with the three slots in the center of the steering wheel and push downward until the hub cover snaps into position.
4. Check the steering column for proper operation.

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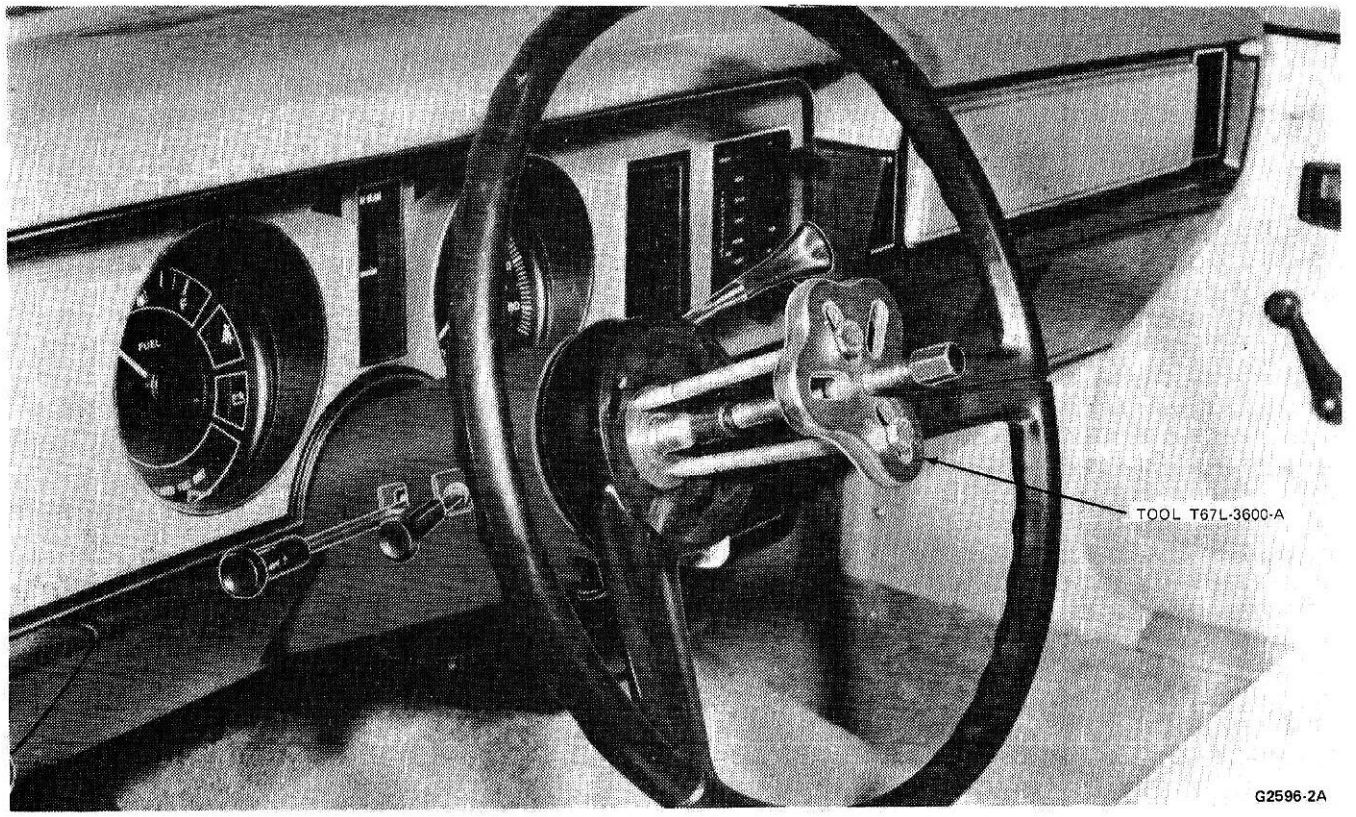


FIG. 4 Removing Steering Wheel

Steering Column Assembly—Column Automatic

The column automatic transmission linkage system utilizes oil impregnated plastic grommets to connect various rods and levers. To assure satisfactory retention of the connecting links and overall system operation, the grommets must be replaced when a grommet-type connection (as in a steering column replacement) is changed. Grommet removal and installation procedures are detailed in Part 17-02 of this manual.

Removal

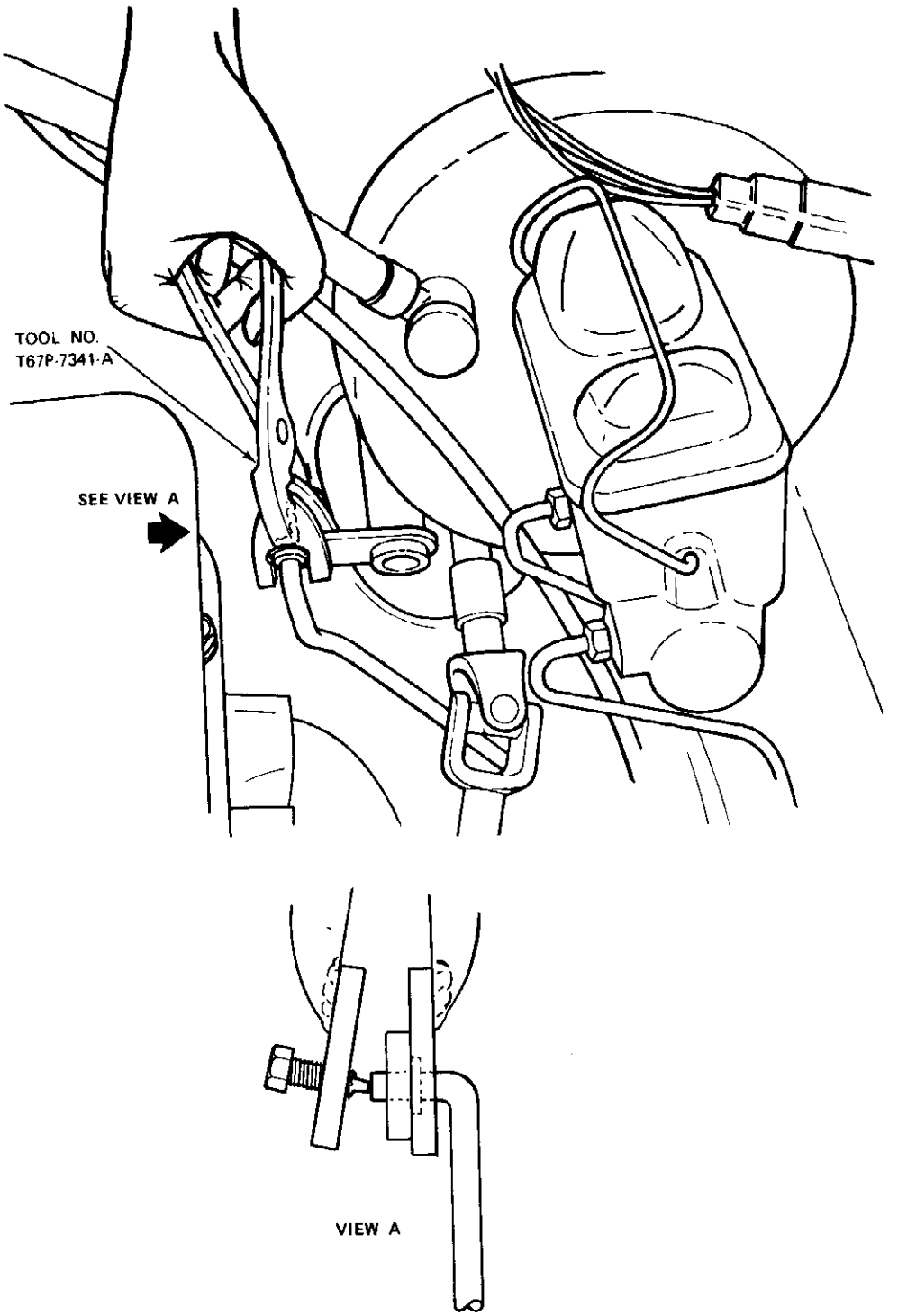
1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the two nuts that attach the flexible coupling to the flange on the steering input shaft. Disengage the safety strap and the bolt assembly from the flexible coupling. Disconnect the transmission shift rod from the transmission control selector lever.
3. Using Tool No. T67P-7341-A, remove the grommet and replace with a new one. (Fig. 5)
4. Remove the steering column trim shrouds by loosening four screws.
5. Remove the steering column cover and hood release mechanism directly under the column.
6. Disconnect all electrical connections (quick-couplers) to the steering column switches (turn signal, wash/wipe, ignition and key warning buzzer).
7. Loosen the four nuts holding the column to the brake pedal support allowing the column to be lowered enough for access to the PRND21 lever and cable assembly. **Care must be exercised to assure the column is not lowered too far so that the plastic lever or cable is damaged due to weight of the column.**
8. Reach between the steering column and instrument panel and gently lift the PRND21 cable off the cleat on the PRND21 lever (Fig. 6).
9. Remove the PRND21 cable clamp from the steering column tube.
10. Remove the four screws that attach the dust boot to the dash panel.
11. Remove the four attaching nuts holding the column to the brake pedal support. Lower the column to clear the four mounting bolts and pull the column out so that the U-joint assembly passes through the clearance hole in the dash panel.

Installation

1. Install the steering column by inserting the U-joint assembly and lower shift cane through the opening in the dash panel.
2. Align the four bolts on the brake pedal support with the mounting holes on the column collar and bracket. Attach the nuts loosely so that the column hangs with clearance between the column and the instrument panel.
3. Loosely assemble the PRND21 cable clamp to the steering column outer tube.
4. Reach between the steering column and instrument panel and attach the PRND21 cable onto the PRND21 lever by slipping the loop on the cable over the cleat on the lever (Fig. 6).

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FIG. 5 Removing or Installing Shift Linkage Grommet

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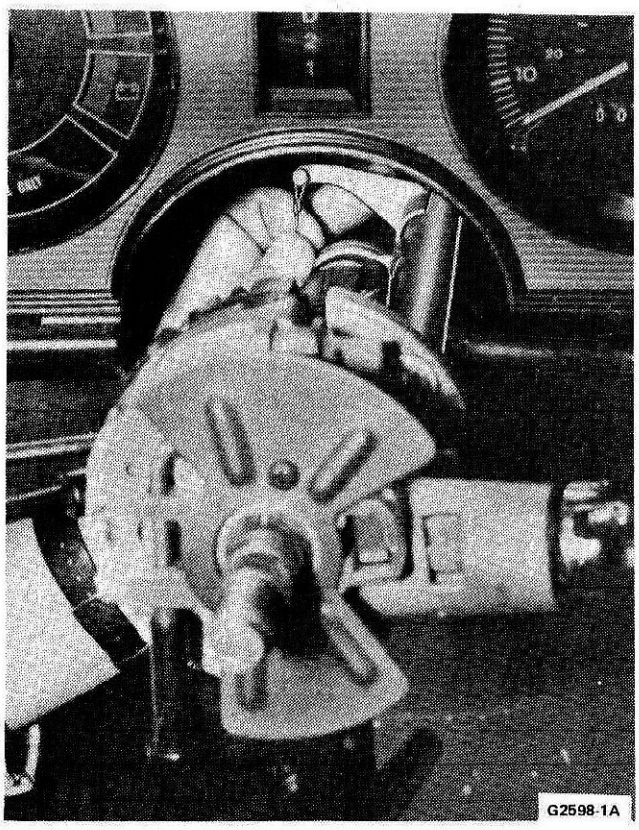


FIG. 6 Disconnecting or Connecting PRND21 Cable

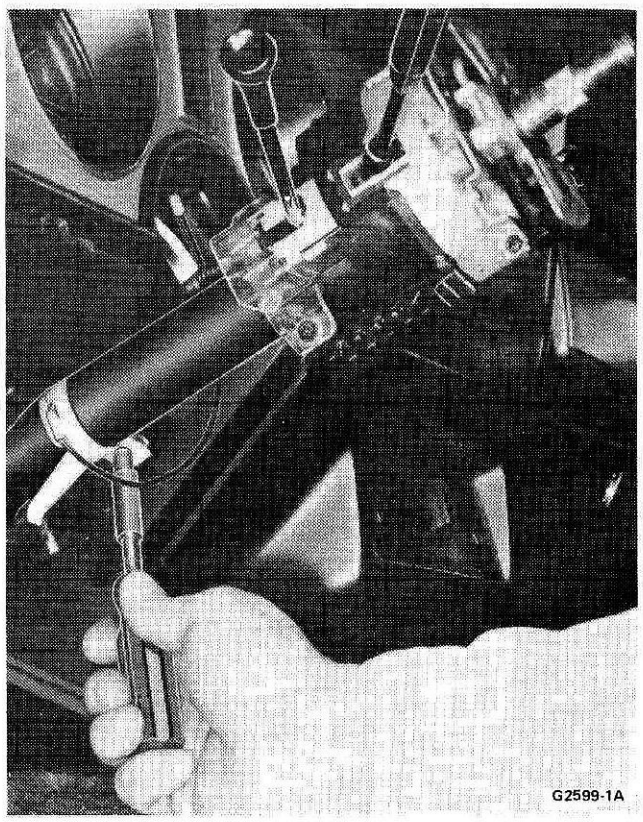


FIG. 7 Adjusting PRND21 Indicator

5. Torque the four nuts that attach the column to the brake pedal support to 20-37 ft-lbs.
6. Move the shift selector into the Drive position against the drive stop on the insert plate. Rotate the PRND21 bracket located approximately midpoint on the steering column outer tube clockwise or counter-clockwise until the PRND21 pointer in the instrument cluster aligns with D. Tighten the nut on the bracket (Fig. 7).
7. Connect the ignition switch, turn signal and wash/wipe switch connectors.
8. Engage the safety strap and bolt assembly to the flange on the steering gear input shaft. Install the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft. Torque the nuts to 20-37 ft-lb. The safety strap must be properly positioned to prevent metal to metal contact after torquing nuts. The flexible coupling must not be distorted when the nuts are torqued. Pry steering shaft up or down with a suitable pry bar to achieve plus or minus 1/8" (3.175mm) coupling insulator flatness.
9. Connect the shift rod to the shift lever on the lower end of the steering column in the engine compartment using Tool No. T67P-7341-A (Fig. 5). Make sure the grommet has been replaced.
10. Raise the vehicle and loosen the adjustment nut on the automatic transmission shift rod. Move the transmission manual lever to the drive position by rotating it towards the rear of the vehicle until it stops; then rotate forward two detent positions. Make sure the shift lever handle on the steering column is in the Drive position. A weight of six pounds **maximum** should be hung on the shift selector to assure the lever is located firmly against the drive detent. Tighten the adjustment nut on the transmission shift rod.
11. Lower the vehicle.
12. Engage the dust boot at the base of the steering column to the dash panel opening. Install the four screws that attach the dust boot to the dash panel.
13. Attach the trim shrouds that cover the steering column upper end with four self tapping screws.
14. Install the hood release mechanism and the steering column cover beneath the steering column.
15. Install the steering wheel as described earlier in this Part.
16. Connect the negative battery cable to the battery terminal.
17. Check the steering column for proper operation.

Steering Column Assembly Floor Shift

Removal

1. Disconnect the negative battery cable (ground) from the battery terminal.
2. Remove the two nuts that attach the flexible coupling to the flange on the steering input shaft. Disengage the safety strap and the bolt assembly from the flexible coupling.
3. Remove the steering column trim shrouds, fastened by four self-tapping screws.
4. Remove the steering column cover and hood release mechanism directly under the column.

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5. *Disconnect all electrical connections (quick-*couplers) from the steering column switches (turn signal, wash/wipe, ignition, key warning buzzer connecting wire).
6. Remove the four screws that attach the dust boot to the dash panel.
7. Remove the four attaching nuts holding the column to the brake pedal support. Lower the column to clear the four mounting bolts and pull the column *out so that the U-joint assembly passes through the* clearance hole in the dash panel.

Installation

1. Install the steering column by inserting the U-joint assembly through the opening in the dash panel.
2. Under the instrument panel, align the four bolts on the brake pedal support with the mounting holes on the column collar and bracket. Attach the nuts and torque to 20-37 ft-lb.
3. Connect the ignition switch, turn signal, key warning buzzer connector wire and wash/wipe switch connectors.
4. Engage the safety strap and bolt assembly to the flange on the steering gear input shaft. Install the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft. Torque the nuts to 20-37 ft-lbs. The safety strap must be properly positioned to prevent metal to metal contact after torquing nuts. The flexible coupling must not be distorted when the nuts are torqued. Pry steering shaft up or down with a suitable pry bar to achieve plus or minus 1/8" coupling insulator flatness.
5. Engage the dust boot at the base of the steering column to the dash panel opening. Install the four screws that attach the dust boot to the dash panel.
6. Attach the steering column trim shrouds by *installing four self-tapping screws.*
7. Install the hood release mechanism and the steering column cover beneath the steering column.
8. Connect the negative battery cable to the (ground) battery terminal.
9. Check the steering column for proper operation.

Steering Column Shift Cane Assembly

Removal

1. Remove the steering column assembly as described earlier in this part.
2. Remove the two nuts and bolts which connect the transmission gear shift shaft support bracket to the steering column collar.
3. Remove the C clip retainer at the upper end of the shift cane assembly and pull the assembly down and out of the bearing and washer located in the *lock cylinder housing and detent plate.*
4. Inspect the bearing; if damaged or excessively worn, remove and replace using Tool No. T67P-7341-A.
5. Pull the plastic transmission control selector lever opening cover from the upper shaft and allow to hang on the shift selector lever.
6. *Use a small drift to remove the roll pin connecting* the gear shift selector lever to the shift cane upper shaft.
7. The gear shift selector lever spring and plunger assembly can be removed and replaced if damaged or excessively worn by removing two screws on the upper shift cane shaft.
8. The PRND21 lever can be removed and replaced if damaged or excessively worn by removing one screw on the upper shift cane shaft.
9. Scribe a mark on the upper shaft where the upper and lower shafts form a joint. **Also, scribe marks on the upper and lower shafts on one side only to assure that the two shafts will not be reassembled 180 degrees out of position.**
10. Separate the upper and lower shift cane sections.
11. Slide the lower shift cane support bracket off the lower shaft and replace the bushing if damaged or excessively worn.
12. Remove and discard the two steel anti-rattle clips.

Installation

1. Install two new steel anti-rattle clips in the grooves on the shift cane upper shaft. **Both clips must be installed in the same direction.** Install the lower *shift cane support bracket onto the lower shaft,* with bushing installed in the bracket.
2. Lubricate the lower six inches of the shift cane upper shaft with a liberal amount of chassis lubricant.
3. Place the lower shift cane shaft in a vice and install the upper shaft into the lower shaft to the scribed mark on the upper shaft. Care must be taken not to damage the upper end of the shaft cane during assembly of the lower shaft. Check the scribed marks on the upper and lower shafts made earlier to determine that the two shaft sections are not installed 180 degrees out of position.
4. Install the plastic transmission control selector lever opening cover loosely on the shift selector lever. Insert the selector lever through the slot in the upper shaft and install a new roll pin. The tip of the selector lever should protrude through the upper shaft on the side of the plunger and spring *assembly.*
5. Install the plastic transmission control selector lever opening cover on the upper shaft.
6. Insert the upper end of the shift cane into the bearing and washer in the lock cylinder housing and install the C-clip retainer. Make sure the shift selector lever mates correctly with the detent plate on the lock cylinder housing.
7. Align the lower support bracket with the two holes *in the steering column collar and fasten with the two* nuts and bolts to 14.5 to 22 ft-lbs torque.
8. Check the shift cane for smooth rotational action. Lubricate the selector lever, plunger, spring and detent plate with chassis lubricant.
9. Install the steering column assembly as described earlier in this section.

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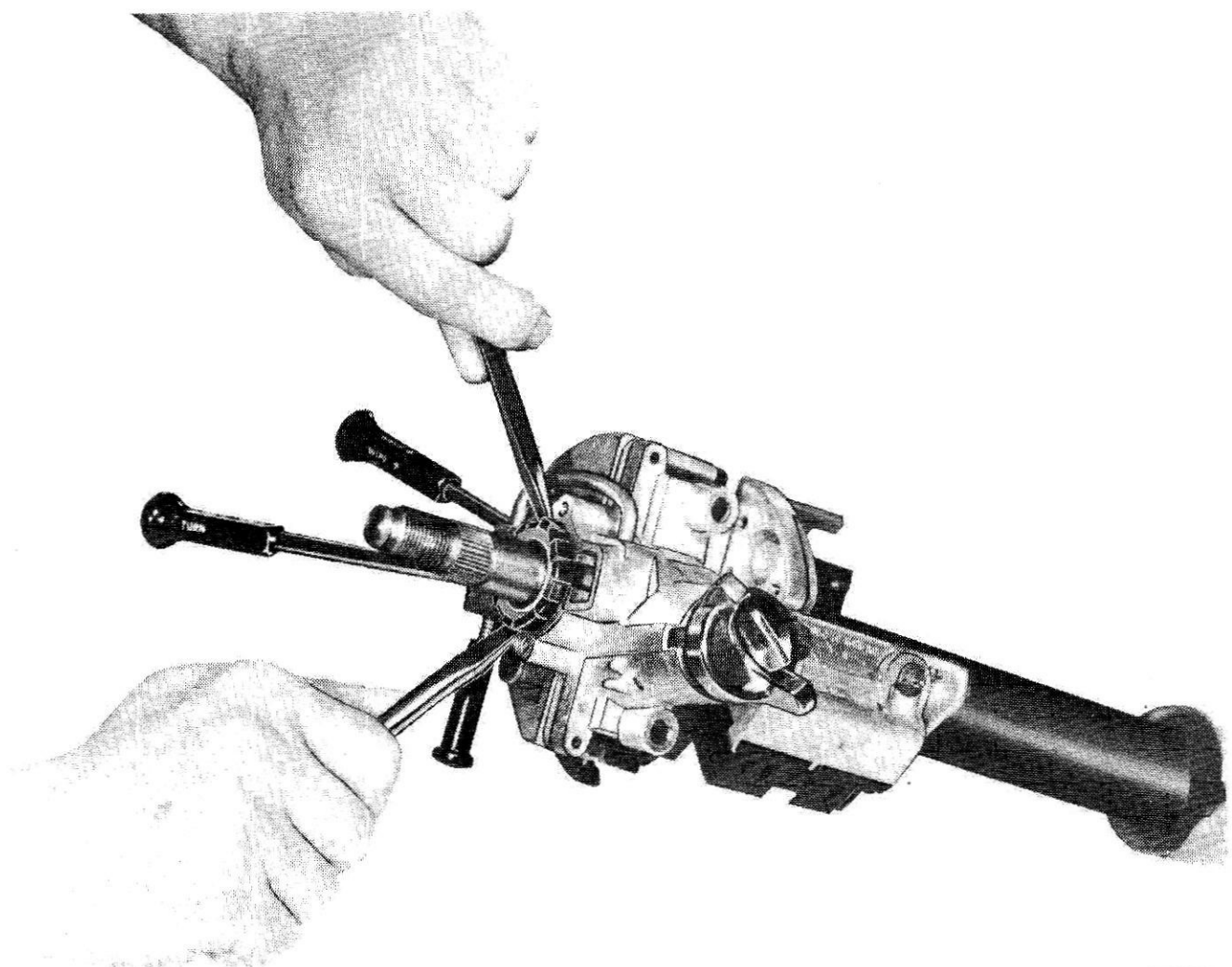
Upper Shaft Bearing

Removal

1. Remove the steering wheel as described earlier in this section.
2. Remove the two trim shroud halves by removing four screws.
3. Remove the upper bearing retainer plate.
4. Remove the two nuts that attach the steering column lower shaft and U-joint assembly to the flange on the steering gear input shaft.
5. Using a snap ring pliers, remove the snap ring holding the upper bearing onto the steering shaft.
6. Pull outward on the steering shaft. The shaft will move approximately one quarter of an inch, carrying the upper bearing and sleeve with it. This movement of the bearing will allow the blades of two screwdrivers or similar tools to be inserted under the bearing by using the two ramps in the casting provided for this purpose. With the blades of the screwdrivers under the bearing, pry it gently off the knurl on the steering shaft (Fig. 8).

Installation

1. Prick punch the steering column upper shaft serration diameter sufficiently to insure an interference fit between the bearing inner race and the steering column upper shaft.
2. Position the bearing and insulator on the steering column upper shaft. Work the bearing and insulator as far down the steering column upper shaft as possible, then place a piece of pipe .75" inside diameter x 1.5" over the end of the steering column upper shaft and install the steering wheel attaching nut (Fig. 9).
3. Tighten the steering wheel attaching nut until the bearing is seated on the steering shaft.
4. Remove the steering wheel attaching nut and the piece of pipe from the steering column upper shaft.
5. Install the snap ring in the groove at the top of the steering column upper shaft above the bearing.
6. Install the upper bearing retainer plate.
7. Engage the safety strap and bolt assembly to the flange on the steering gear input shaft. Install the two nuts that attach the steering column lower shaft

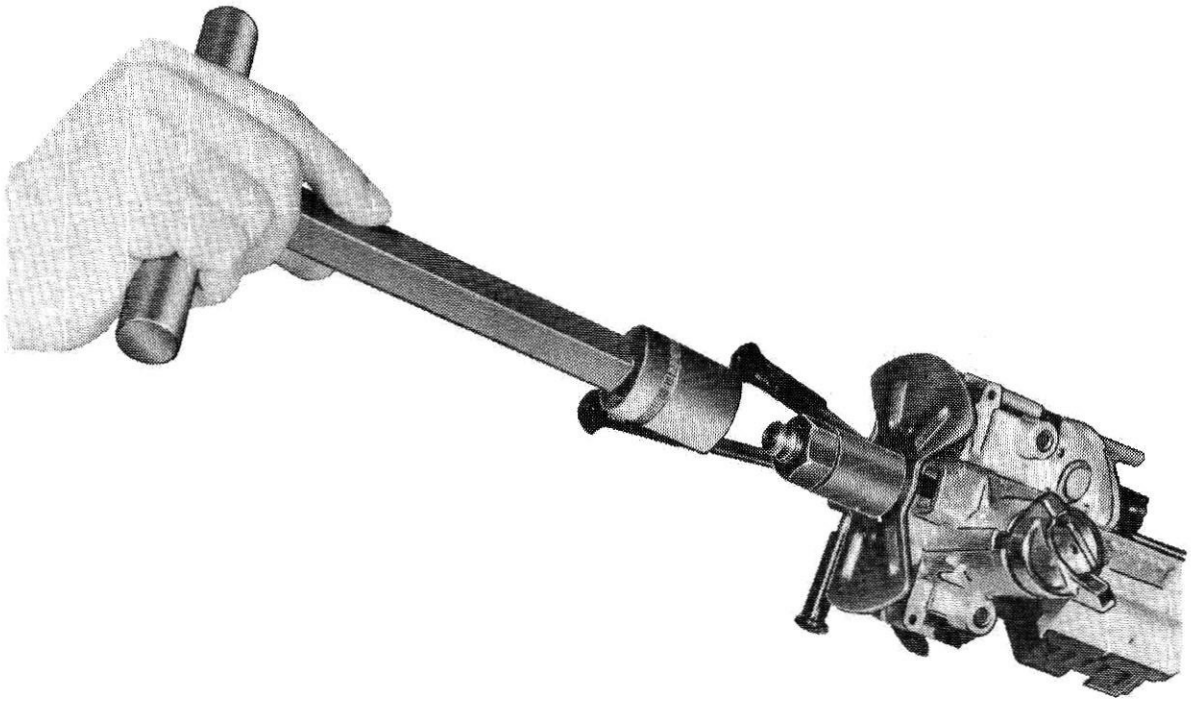


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FIG. 8 Removing Upper Shaft Bearing

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FIG. 9 Installing Upper Shaft Bearing

and U-joint assembly to the flange on the steering gear input shaft. Torque the nuts to 20-37 ft-lbs. The safety strap must be properly positioned to prevent metal to metal contact after torquing nuts. Pry steering shaft up or down with a suitable pry bar to achieve plus or minus 1/8" (3mm) coupling insulator flatness.

8. Install the trim shroud and tighten the four attaching screws.
9. Install the steering wheel as described earlier in this section.
10. Check the steering column for proper operation.

Lock Cylinder Housing

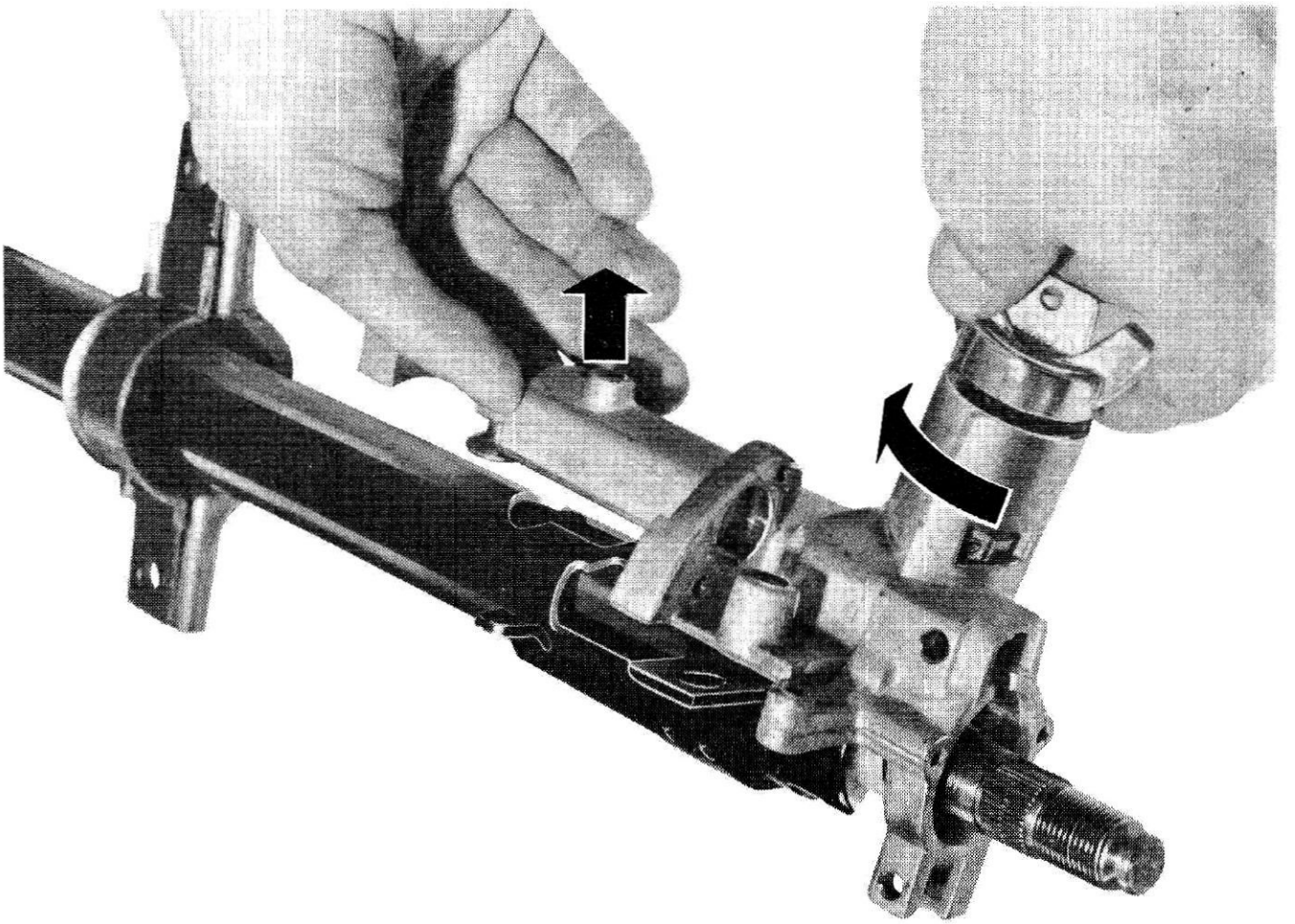
Removal

1. Remove the steering column assembly as described earlier in this section.
2. Remove the shift cane assembly (column shift only) as described earlier in this section.
3. Remove the two screws attaching the turn signal switch to the lock cylinder housing and remove the switch.
4. Remove the wash/wipe switch by removing two screws.
5. Remove the upper steering shaft bearing as described earlier in this section.
6. Remove the two bolts connecting the lock cylinder housing to the outer tube flange bracket. Rotate the ignition key to Start Position and pull the actuator interlock out of the clearance hole in the tube. Lift the casting off the upper steering shaft (Fig. 10).
7. Remove and replace the shift selector detent plate if damaged or excessively worn (column shift only).

Installation

1. Install the upper steering shaft bearing and sleeve in the lock cylinder housing and install the upper bearing retainer plate.
2. Prick punch the steering column upper shaft serration diameter sufficiently to insure an interference fit between the bearing inner race and steering column upper shaft. Place the lock cylinder housing onto the steering column flange bracket with the upper steering shaft protruding through the upper bearing. Turn the ignition key to the Start

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FIG. 10 Removing Lock Cylinder Housing

position to locate the actuator interlock through the clearance hole in the outer tube. Install and torque the two bolts holding the lock cylinder housing to the bracket to 12-21 ft-lb.

3. Place a piece of pipe (.75" inside diameter x 1.5") over the end of the steering column upper shaft and install the steering wheel attaching nut (Fig. 9).
4. Tighten the steering wheel attaching nut until the steering shaft is drawn up into the bearing enough to allow the installation of the snap ring in the groove on the shaft. Remove the steering wheel attaching bolt and piece of pipe.
5. Install the snap ring in the groove on the upper shaft.
6. Install the turn signal switch with two self-tapping screws.
7. Install the wash/wipe switch with two self-tapping screws.
8. Install the shift cane as described earlier in this Part (column shift only).
9. Install the steering column as described earlier in this Part.

Turn Signal Switch

Removal

1. Remove the steering column trim shroud by removing four self-tapping screws.
2. Remove the turn signal switch lever by grasping the lever and by using a pulling and twisting motion of the hand while pulling the lever straight out from the switch.
3. Peel back the foam sight shield from the turn signal switch.
4. Disconnect the two turn signal switch electrical connectors.
5. Remove the two self-tapping screws that attach the turn signal switch to the lock cylinder housing, and disengage the switch from the housing.

Installation

1. Align the turn signal switch mounting holes with the corresponding holes in the lock cylinder housing and install two self-tapping screws until tight.
2. Stick the foam sight shield to the turn signal switch.

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3. Install the turn signal switch lever into the switch manually by aligning the key on the lever with the keyway in the switch and pushing the lever toward the switch to full engagement.
4. Install the two turn signal switch electrical connectors to full engagement.
5. Install the steering column trim shrouds.

IGNITION SWITCH

Removal

1. Disconnect the negative battery cable (ground) from the battery terminal. Remove the steering column trim shroud by removing four self-tapping screws.
2. Disconnect the ignition switch electrical connector.
3. Drill out the break-off head bolts that connect the switch to the lock cylinder housing using a 1/8" drill.
4. Remove the two bolts using an Ex-3 easy-out tool or equivalent.
5. Disengage the ignition switch from the actuator pin.

Installation

1. Adjust the ignition switch by sliding the carrier to the switch Lock position. Insert a 7/16" drill bit or similar tool through the switch housing and into the carrier thereby preventing movement of the carrier with respect to the switch housing. It may be necessary to move the carrier slightly back and forth to align the carrier and housing adjustment holes.

   NOTE: A new replacement switch assembly includes an adjusting pin already installed.
2. Rotate the ignition key to the "Lock" position.
3. Install the ignition switch on the actuator pin.
4. Install the new "break-off head" bolts and torque until the heads break off.
5. Remove the adjustment drill bit or adjusting pin.
6. Connect the electrical connector to the ignition switch.
7. Connect the negative battery cable to the battery terminal. Check the ignition switch for proper start in Park or Neutral. Also, make certain that the start circuit cannot be actuated in the Drive or Reverse positions and that the column is locked in the lock position.
8. Install the steering column trim shrouds.

Ignition Lock Cylinder Assembly

The following procedure pertains to vehicles that have functional lock cylinders. Ignition keys are available for these vehicles, or the ignition key numbers are known and the proper key can be made.

Removal

1. Remove the trim shroud by removing four self-tapping screws. Remove the electrical connector from the key warning switch.
2. Place the gear shift lever in Park (column shift only) and turn the ignition key to the Run position.
3. Place 1/8" (3.175mm) diameter wire pin or small drift punch in the hole in the casting surrounding the lock cylinder and depress the retaining pin while pulling out on the lock cylinder to remove it from the column housing (Fig. 11).

Installation

1. To install the lock cylinder, turn it to the Run position and depress the retaining pin. Insert the lock cylinder into its housing in the lock cylinder casting. Assure that the cylinder is fully seated and aligned in the interlocking washer before turning the key to the Off position. This action will permit the cylinder retaining pin to extend into the cylinder cast housing hole.
2. Using the ignition key, rotate the lock cylinder to insure correct mechanical operation in all positions. Install the electrical connector onto the key warning switch.
3. Check for proper start in Park or Neutral. Also make certain that the start circuit cannot be actuated in the Drive and Reverse positions and that the column is locked in the Lock position.
4. Install the trim shroud onto the steering column.

The following procedure applies to vehicles in which the ignition lock is inoperative and the lock cylinder cannot be rotated due to a lost or broken ignition key; the key number not known; or the lock cylinder cap is damaged and/or broken to the extent that the lock cylinder cannot be rotated.

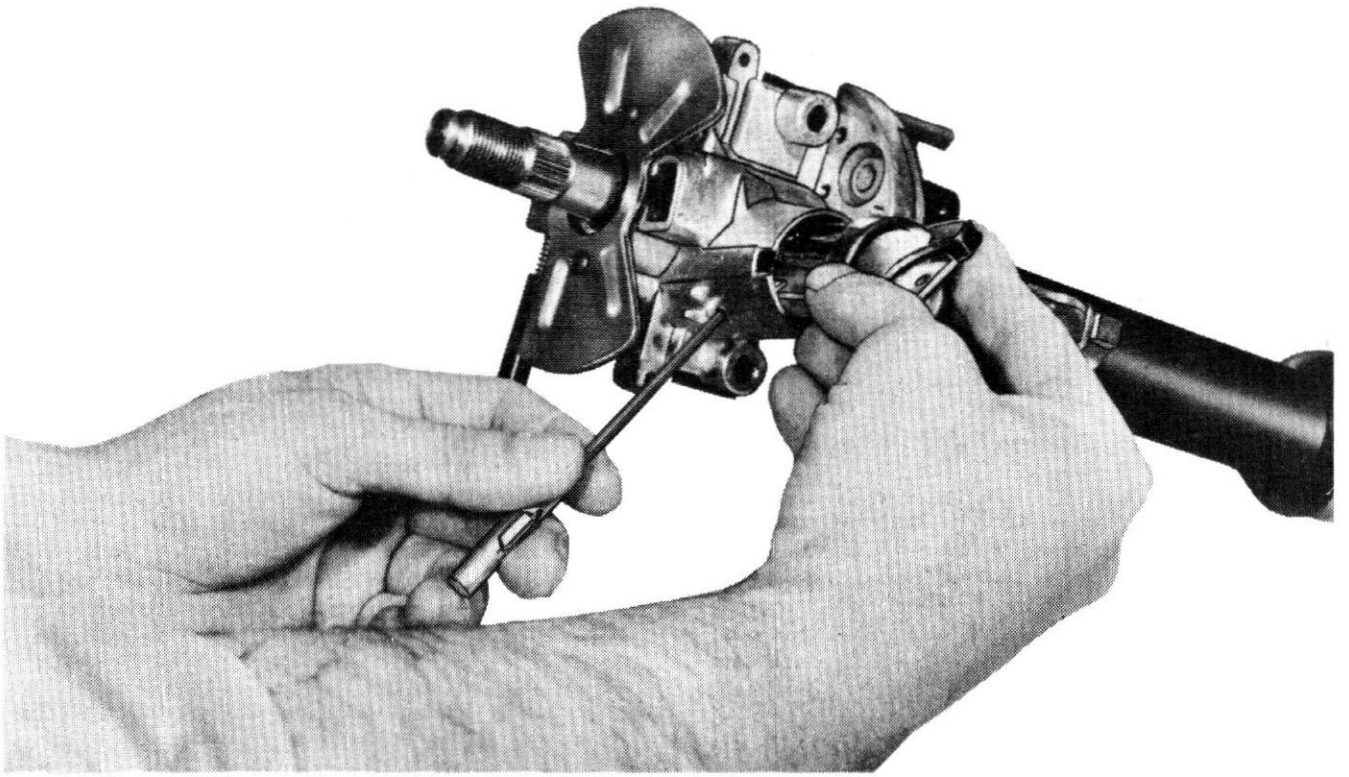
Removal

1. Remove the steering column as described earlier in this Part.
2. Remove the shift cane (column shift only) and lock cylinder housing as described earlier in this Part.
3. From the lock cylinder housing with the damaged lock cylinder, remove the ignition switch as described earlier in this section. Remove the washer from the top of the shift cane seat and the shift lever detent plate (column shift only). Retain these components for use on the new lock cylinder housing assembly.
4. Replace the following components:
   a. 1) lock cylinder housing 3F643
   b. 1) gear, steering column lock 3E717
   c. 1) retaining ring N800205
   d. 1) actuator assembly—steering column lock 3E723
   e. 1) pawl panel—steering column lock 3E691
   f. 1) spring—steering column lock 3E696
   g. 1) bearing—shift cane 7225 (column shift only)
   h. 1) lock cylinder and key assembly
   i. 2) break-off head bolts M6-1.0 x 10 N800207
   j. 1) bearing, steering column lock housing 3E700

Installation

1. To the new lock cylinder housing, install the actuator assembly, lock pawl and spring as described in the Ignition Lock Actuator and Steering Wheel Lock Pawl section of this Part.
2. Install the new gear, bearing, retaining ring and lock cylinder assembly as described in the Ignition Lock Drive Gear section of this Part.
3. Install the new shift cane bearing into the detent plate retained from the damaged lock cylinder housing.

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FIG. 11 Removing Lock Cylinder Assembly

4. On vehicles with column shift, install the shift lever detent plate which was retained from the housing with the damaged lock cylinder and install the new lock cylinder housing.
5. Adjust the ignition switch retained from the housing with the damaged lock cylinder and install onto the new lock cylinder housing as described earlier in the Ignition Switch section of this Part.
6. Install the new lock cylinder housing assembly as described earlier in this Part.
7. Install the shift cane assembly (column shift only) and upper bearing as described earlier in this Part.
8. Install the steering column as described earlier in this section.
9. Check for proper start in Park or Neutral. Also check to make certain that the start circuit cannot be actuated in the Drive and Reverse positions and that the column is locked in the Lock position.

Ignition Lock Drive Gear

Removal

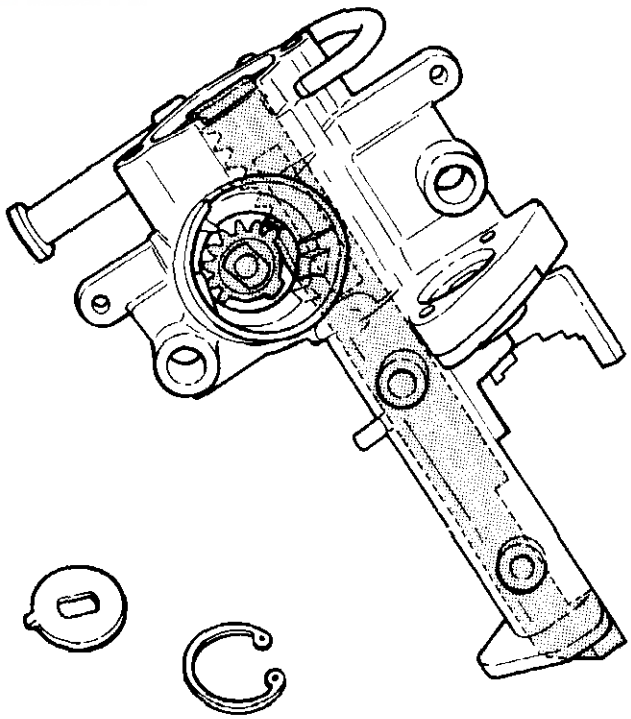
1. Remove the lock cylinder assembly as described earlier in this section.
2. Insert a flat bladed screwdriver into the recess of the drive gear at the bottom of the lock cylinder housing, and turn the lock drive gear three notches counter-clockwise.
3. Remove the snap ring, washer and lock drive gear from the lock cylinder housing. **Carefully note the relationship of the lock drive gear to the position of the rack teeth** (Fig. 12).

Installation

1. Position the lock drive gear in the base of the lock cylinder housing in the same position as that noted during the removal procedure. **The position of the lock drive gear is correct if the last tooth on the drive gear is meshed with the last tooth on the rack** (Fig. 12).
2. Install the washer and the snap ring.
3. Insert a flat bladed screwdriver into the recess of the lock drive gear at the bottom of the lock cylinder housing, and turn the drive gear three notches in a clockwise direction.
4. Install the lock cylinder assembly as described earlier in this Part.

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FIG. 12 Removing or Installing Ignition Lock Drive Gear

Ignition Lock Actuator and Steering Wheel Lock Pawl

Removal

1. Remove the lock cylinder housing from the steering column as described earlier in this Part.
2. Remove the ignition switch, lock cylinder assembly and ignition lock drive gear as described earlier in this Part.
3. Slide the actuator assembly out the rear of the track in the lock cylinder housing.
4. Remove the lock pawl and spring.

Installation

1. Install the lock pawl and spring on the actuator assembly.
2. Install the actuator assembly into the track on the lock cylinder housing and install the lock drive gear and lock cylinder assembly as described earlier in this Part.
3. Install the ignition switch as described earlier in this Part.
4. Install the lock cylinder housing onto the steering column as described earlier in this Part.

U-Joint Assembly

Removal

1. Remove the nut from the U-joint assembly bolt.
2. Push the bolt completely out of the assembly.
3. Remove the two nuts that attach the flexible coupling to the flange on the steering gear input shaft. Disengage the safety strap and bolt assembly from the flexible coupling.
4. Slide the U-joint assembly off the steering column lower steering shaft (Fig. 3).

Installation

1. Slide the U-joint assembly into the lower steering shaft until the bolt can be passed through both the steering shaft and U-joint assembly. Torque the nut on the bolt to 30-45 ft-lb.
2. Engage the safety strap and bolt assembly to the flexible coupling. Install the two nuts that attach the flexible coupling to the flange on the steering gear input shaft. **The safety strap must be properly positioned to prevent metal to metal contact after the final torquing of the attaching nuts to 20-37 ft-lbs. The flexible coupling must not be distorted when the attaching nuts are torqued.**

Steering Shaft

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Remove the shift cane, (column shift only) turn signal and wash/wipe switches, upper steering shaft bearing and lock cylinder housing as described earlier in this Part.
3. *Remove the U-joint assembly as described earlier* in this Part and pull the steering shaft assembly out of the outer tube from the top of the tube. Remove the lower bearing and lower bearing retaining ring.
4. Scribe a mark on the upper steering shaft where the upper and lower steering shaft sections form a joint line.
5. Separate the upper and lower steering shaft sections.
6. *Remove and discard the two insulator clips* (Fig. 13).

Installation

1. Install two new steel insulator clips in the grooves on the steering column upper shaft. **Both clips must be installed facing the same direction.**
2. Lubricate the lower six inches of the steering column upper shaft with a liberal amount of Chassis Lubricant.
3. Place the steering column lower shaft in a vise and *install the upper shaft into the lower shaft* to the scribed mark on the steering column lower shaft.
4. Install the upper steering column bearing and retainer plate in the lock cylinder housing as described earlier in this section and fasten the lock cylinder housing on the outer tube flange bracket loosely.
5. Insert the steering shaft into the outer tube from the bottom of the tube so that the upper end of the shaft protrudes through the lock cylinder housing.
6. Install the steering shaft to the lock cylinder housing as described earlier in this Part, and tighten the two bolts to secure the housing to the outer tube.
7. Install the lower bearing by sliding the bearing and sleeve onto the lower steering shaft and seat into the outer tube. Install the lower bearing retaining ring.

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FIG. 13 Removing or Installing Insulator Clips

8. Install the turn signal and wash/wipe switches and the shift cane assembly (column shift only) as described earlier in this Part.
9. Install the U-joint assembly as described earlier in this Part.
10. Install the steering column assembly as described earlier in this Part.

Flexible Coupling

Removal

1. Remove the U-joint assembly as described earlier in this Part. **The flexible coupling is riveted to the U-joint assembly. Therefore, the U-joint assembly must be replaced when flexible coupling replacement is necessary.**

Installation

1. Install a new U-joint assembly as described earlier in this Part.

LOWER STEERING COLUMN SHAFT BEARING

Removal

1. Remove the steering column assembly as described earlier in this Part.
2. Remove the shift cane (column shift only) upper bearing, lock cylinder housing and steering shaft as described earlier in this Part.
3. Remove the lower bearing retainer ring.
4. Pull the lower steering shaft bearing and sleeve out of the outer tube lower end.

Installation

1. Install the steering shaft, lock cylinder housing and upper bearing as described earlier in this Part.
2. Slide the lower steering shaft bearing and sleeve onto the lower shaft and seat into the outer tube. Lube the sleeve with Chassis Lubricant to ease the installation.
3. Install the lower bearing retainer ring.
4. Install the shift cane as described earlier in this Part.
5. Install the turn signal and wash/wipe switch and install the steering column as described earlier in this Part.

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SPECIFICATIONS

SPECIAL SERVICE TOOLS

Tool Number	Description
T67L-3500-A	Steering Wheel Remover
T67P-7341-A	Shift Rod Grommet – Bearing Installation/Removal Tool

CG2656-1A

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Steering Linkage

PART 13-20

Applies To All Models Except Mustang II/Pinto/Bobcat/Fairmont/Zephyr

SUBJECT	PAGE
DESCRIPTION	
Steering Linkage	20-1
REMOVAL AND INSTALLATION	
Adjusting Sleeve	20-4
Center Link	20-4
Idler Arm and Bracket Assembly	20-5
Pitman Arm	20-5
Spindle Connecting Rod Assembly	20-4
SPECIFICATIONS	20-6

CG2425-2B

DESCRIPTION

STEERING LINKAGE

The steering linkage (Figs. 1 - 5) consists of the Pitman arm, the Pitman arm-to-idler arm (center link), the idler arm and bracket assembly, and the spindle connecting sleeve and end assemblies (tie rods). **Never straighten bent linkage. Use new parts.**

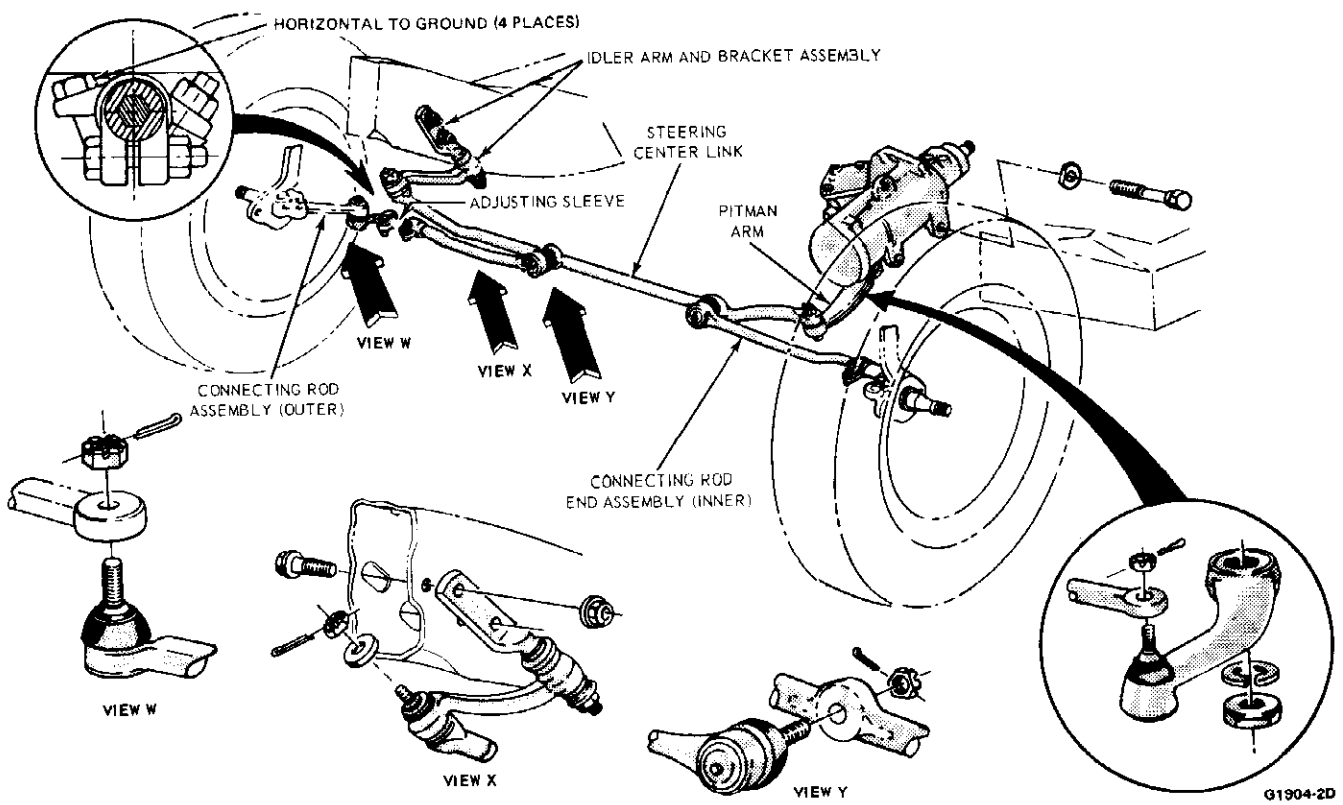


FIG. 1 Manual or Power Steering Linkage—LTD II, Cougar, Thunderbird, and Continental Mark V

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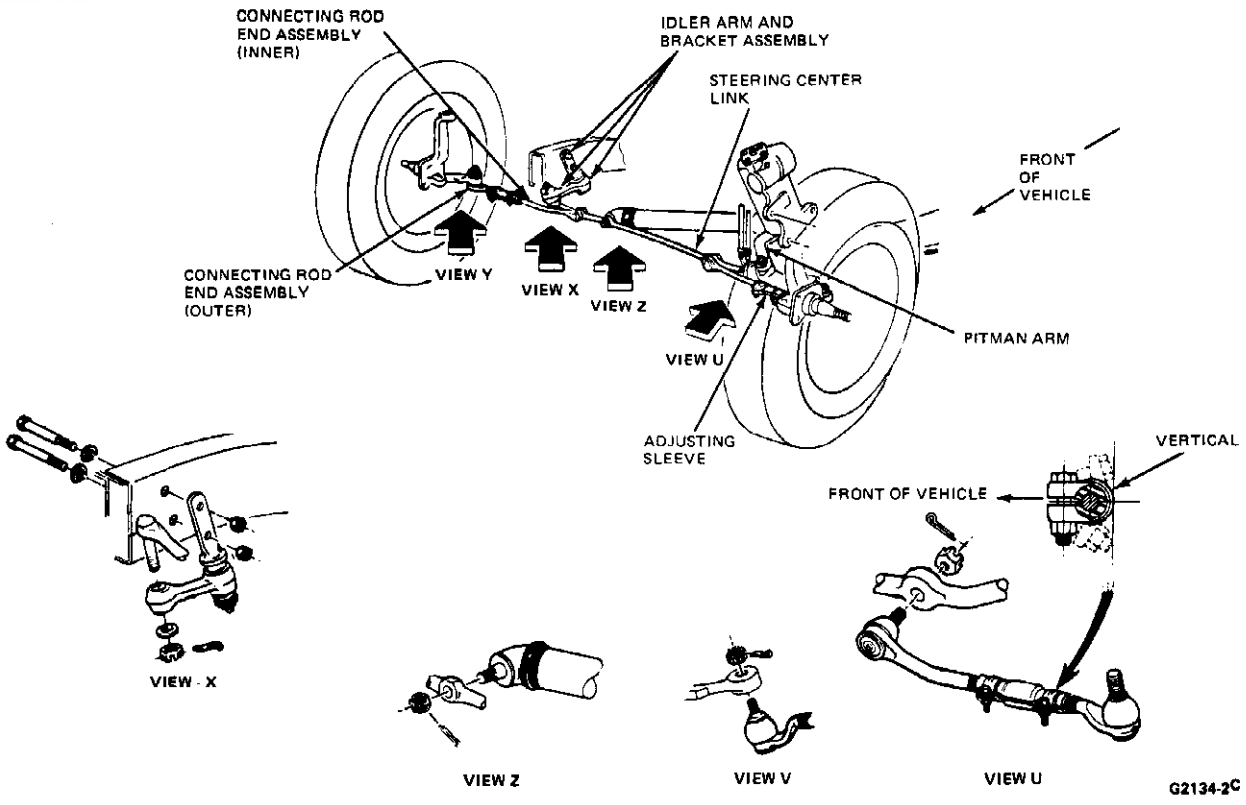


FIG. 2 Non-Integral Power Steering Linkage—Granada, Monarch, Versailles

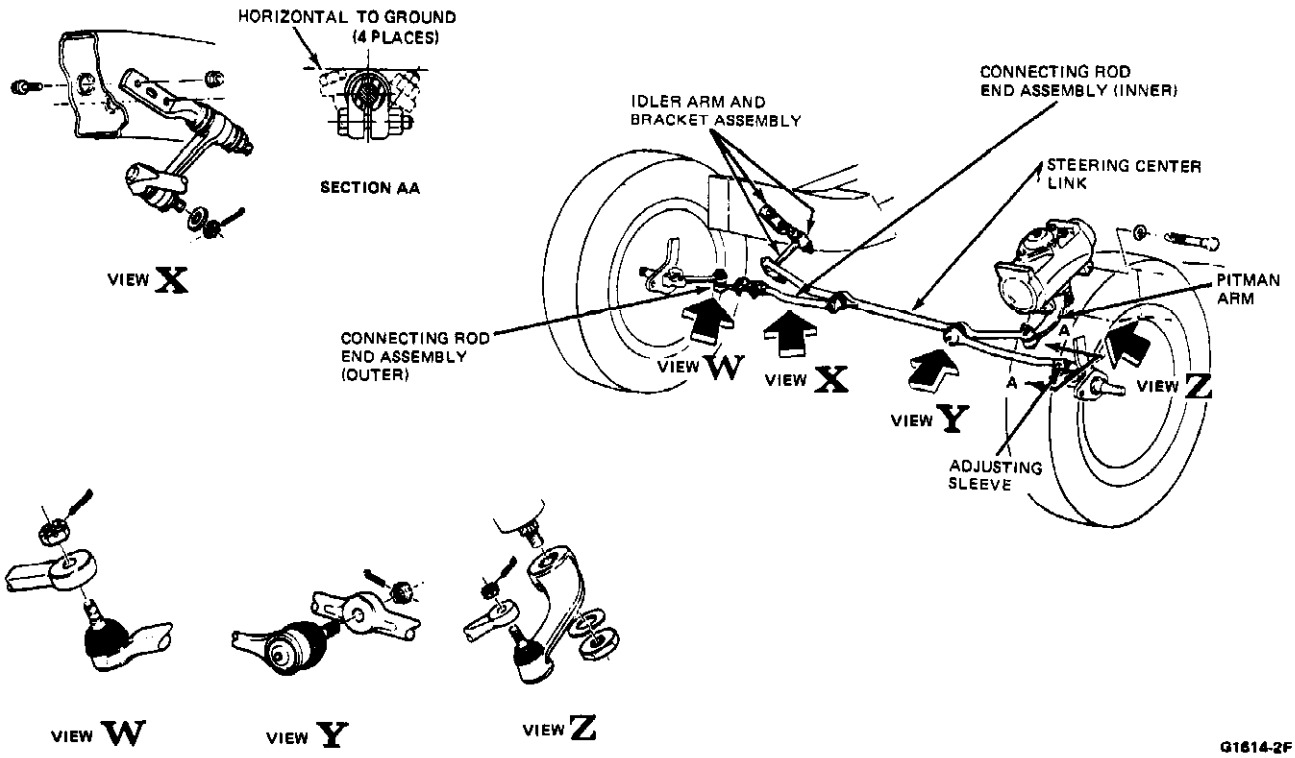


FIG. 3 Manual or Power Steering Linkage—Ford and Mercury

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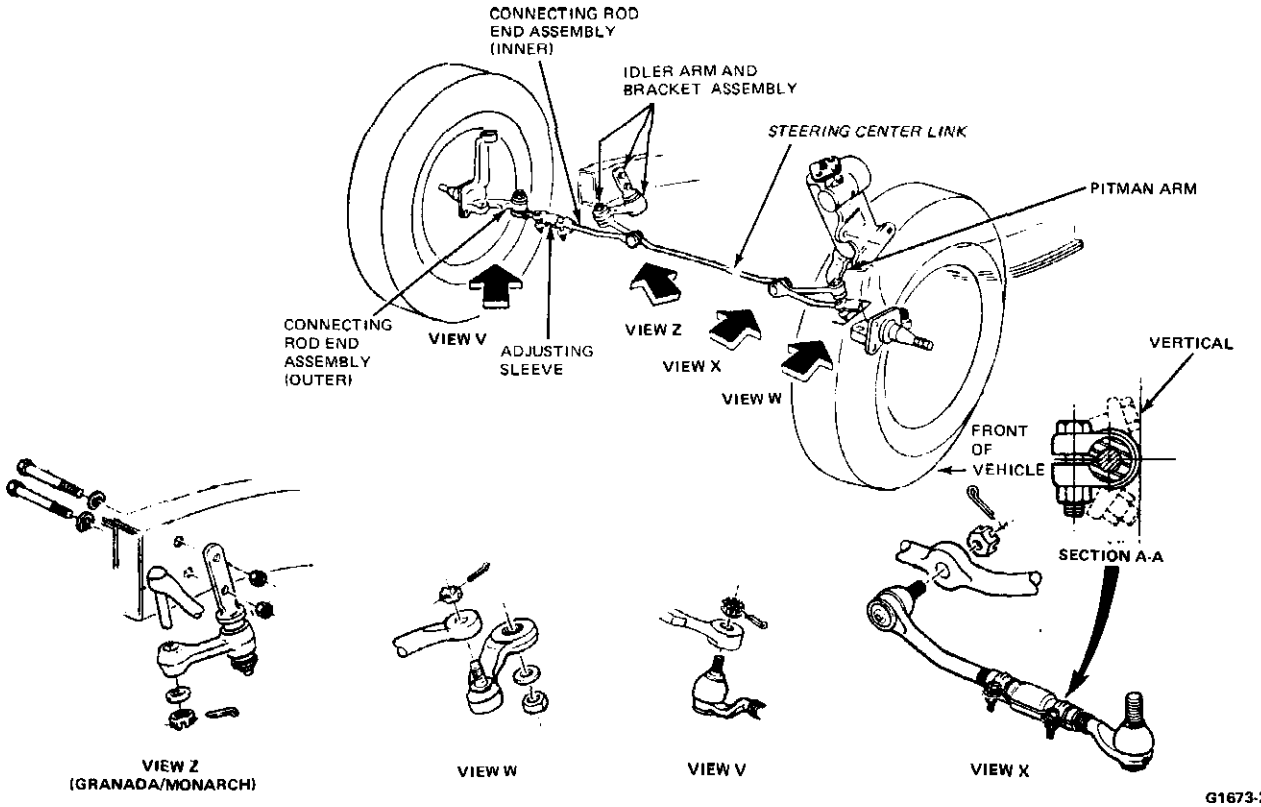


FIG. 4 Manual Steering Linkage—Granada, Monarch

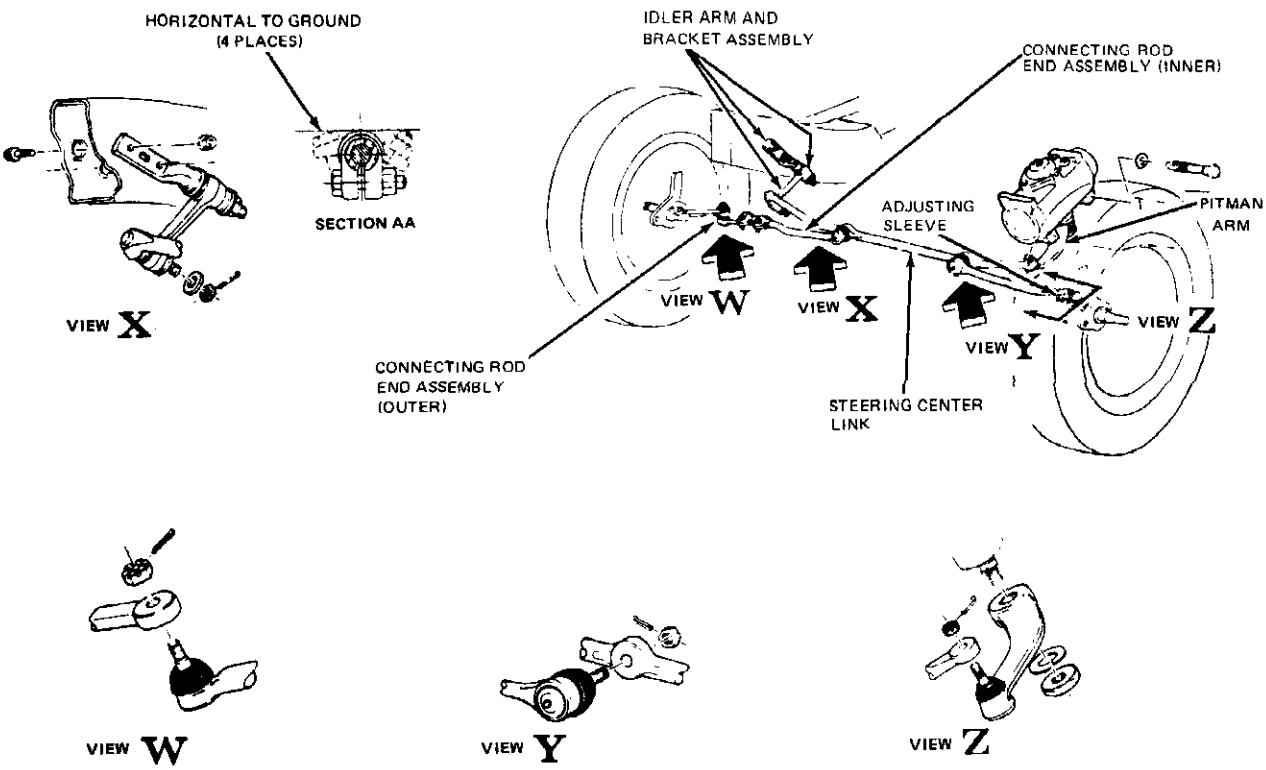


FIG. 5 Steering Linkage—Lincoln Continental

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REMOVAL AND INSTALLATION

Refer to Group 11-02 for hoisting instructions.

SPINDLE CONNECTING ROD ASSEMBLY (INNER AND OUTER ENDS)

GRANADA, MONARCH AND VERSAILLES

Removal and Installation

The spindle connecting rod ends, threaded into the adjusting sleeves, have non-adjustable, ball studs. When the ball studs become loose, replace each end or the entire assembly as follows:

1. Remove, and discard the cotter pin and nut from the worn rod end ball stud.
2. Disconnect the rod end from the spindle arm or center link as shown in Figs. 2 and 4.
3. Loosen the connecting rod sleeve clamp bolts, and turn the rod to remove the assembly from the sleeve. Count the number of turns required. **Discard all parts removed from the sleeve.**
4. Thread a new rod end into the sleeve, turning it the number of turns required for removal noted in Step 3. Do not tighten the sleeve clamp bolts.
5. Install a new stud and stud nut and torque to specification. Install a new cotter pin.
6. Check toe and adjust, if necessary (Part 14-01). Loosen the clamps from the sleeve. Oil the sleeve, clamps, bolts and nuts. Tighten the clamp nut to specification. Install the sleeve clamps as shown in Figs. 2 and 4 to prevent interference with the side rail and power steering valve.

FORD, MERCURY, LTD II, COUGAR, THUNDERBIRD, CONTINENTAL MARK V, AND LINCOLN CONTINENTAL

Removal and Installation

1. Raise the front end and install safety stands. Remove the cotter pin and nut from the worn rod end ball stud (Figs. 1, 3 and 5).
2. Loosen the connecting rod sleeve clamp bolts, and remove the rod end from the spindle arm center link using Tool 3290-C (Fig. 6).

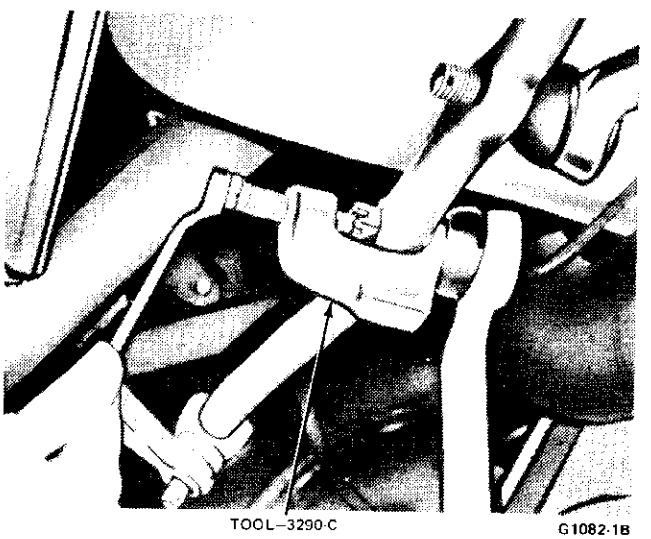


FIG. 6 Removing Ball Stud—Typical

3. Remove the rod end assembly from the sleeve, counting the number of turns required. **Discard all parts removed from the sleeve.**
4. Thread a new rod end into the sleeve, turning it the number of turns required for removal, noted in Step 3. Do not tighten the sleeve clamp bolts.
5. Install a new seal on a new rod end ball stud. Install the stud and stud nut and torque to specification. Install a new cotter pin.
6. Check toe and adjust, if necessary. Loosen the clamps from the sleeve and oil the sleeve, clamps, bolts and nuts. Position the clamps (Figs. 1, 3 and 5) and torque the nuts to specification.

ADJUSTING SLEEVE

Removal and Installation

Replace a worn or damaged adjusting sleeve as follows (Figs. 1 - 5): **Never attempt to straighten a damaged sleeve.**

1. Remove the spindle connecting rod end assemblies as described in this Part.
2. Screw the spindle rod end assembly into the new sleeve using the same number of turns required for removal. **Do not tighten the clamp bolts.**
3. Position the sleeve and end assembly on the center link and spindle arm. Install the attaching nut and torque to specification. Install the cotter pin.
4. Check toe and adjust, if necessary (Part 14-01). Loosen the clamps from the sleeve and oil the sleeve, clamps, bolts and nuts. Position the clamps (Figs. 1 - 5 and torque the clamp nuts to specification.

CENTER LINK

Replace the center link connecting the Pitman arm and the idler arm when it becomes damaged or worn at the ball studs (Figs. 1 - 5).

Removal

1. Raise the vehicle on a hoist and install safety stands.
2. Remove the cotter pins and nuts that attach the inner connecting rod ends to the center link (Figs. 1 - 5).
3. Disconnect the inner connecting rod ends from the center link using Tool 3290-C (Fig. 6).
4. Remove the cotter pin and nut that attach the idler arm to the center link.
5. Remove the cotter pin and nut that attach the Pitman arm to the center link. Disconnect the Pitman arm from the center link using Tool 3290-C, and remove the center link. On vehicles equipped with the non-integral power steering system, remove the center link from the control valve as described in Part 13-40.

Installation

1. Install new rubber seals on the spindle connecting rod ends, if required.
2. Position the center link to the Pitman arm and idler arm and loosely install the attaching nuts. Place the idler arm and the front wheels in the straight ahead

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position to maintain steering wheel alignment and prevent bushing damage. Torque the nuts to the lower specification. Continue to torque the nuts until the slots in the nuts align with the holes in the stud. Install new cotter pins.

3. Place the spindle connecting rod ends on the center link and install the attaching nuts. Torque the nuts to the lower specification. Continue to torque the nuts until the slots in the nuts align with the holes in the stud. Install a new cotter pin.
4. Remove the safety stands and lower the vehicle. Check toe and adjust if necessary (Part 14-01).

IDLER ARM AND BRACKET ASSEMBLY

Removal

If the idler arm bushings are worn replace the idler arm assembly as follows:

1. Remove the cotter pin, nut and washer attaching the steering center link to the idler arm (Figs. 1 - 5).
2. Remove the bolts, nuts and washers (if equipped) that attach the idler arm and bracket assembly to the frame.

Installation

1. Loosely attach the center link to a new idler arm.
2. *Install the bolts, nuts and washers that hold the idler* arm and bracket assembly to the frame (Figs. 1 - 5).
3. Place the idler arm and front wheels in the straight ahead position to maintain steering wheel alignment and prevent bushing damage.
4. Install the idler arm rod nut and washer and torque to specification. Install a new cotter pin.

PITMAN ARM

Removal

1. Remove the cotter pin from the castellated nut that attaches the steering center link to the Pitman arm. Remove the castellated nut.
2. Using Tool 3290-C disconnect the steering center link from the Pitman arm.
3. Remove the Pitman arm attaching nut and lock washer.
4. Position the front wheels in the straight ahead position and remove the Pitman arm using Tool T64P-3590-F (Fig. 7).

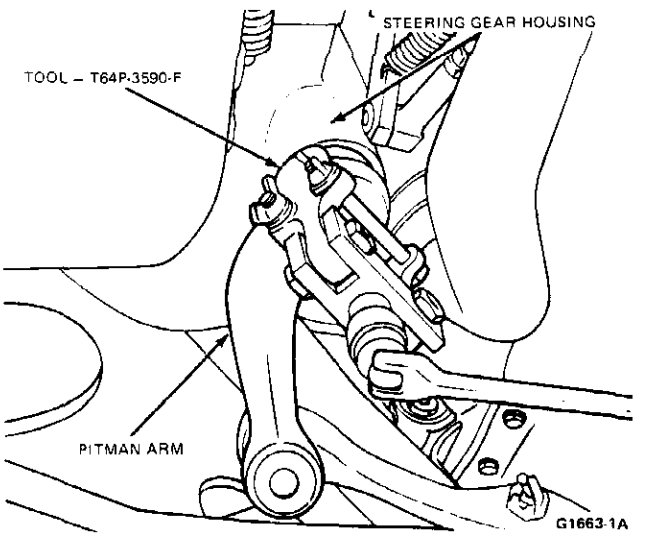


FIG. 7 Removing Pitman Arm—Typical

Installation

1. With the front wheels in the straight ahead position, place the Pitman arm, pointing forward, on the sector shaft. Align the blind tooth on the Pitman arm with the blind tooth on the sector shaft of the steering gear.
2. Install the nut and lock washer and torque to specification.
3. Install the castellated nut that attaches the steering center link to the Pitman arm and torque to specification. Install the cotter pin. **Always tighten the nut to the next castellation to align cotter pin holes.**

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SPECIFICATIONS

STEERING LINKAGE TORQUE LIMITS (FT-LB)

Description		Granada/Monarch, Versailles	Other Car Lines
Power Cylinder to Center Link		43-47	
Power Cylinder to Bracket		18-24	
Power Cylinder to Bracket Lock Nut		3-5	
Cylinder Mounting Bracket	Side Hole	36-40	
to Underbody or Frame	Bottom Hole	40-43	
Pitman Arm to Control Valve		43-47 ①	
Connecting Rod End (Outer) to Spindle Arm		43-47 ①	43-47 ①
Center Link to Idler Arm		77-85 ①	53-70 ①
Pitman Arm to Center Link		43-47 ①	43-47 ①
Connecting Rod End (Inner) to Center Link		43-47 ①	43-47 ①
Pitman Arm to Sector Shaft		200-225	236-250
Steering Gear to Side Rail or Frame		60-65	60-65
Idler Arm Bracket to Frame or Underbody		60-65	45-50
Connecting Rod Clamp to Adjusting Sleeve		20-22	20-22

① Torque to low limit of specification; then, tighten the nut to the nearest cotter pin slot and insert the cotter pin.

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL-3290-C	Tie Rod Ball Ends and Control Valve Ball Stud Remover
T64P-3590-F	Steering Pitman Arm Remover

CG1852-2E

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Manual Steering Gear— Worm and Recirculating Ball

PART 13-30

Applies To Granada/Monarch/Versailles

SUBJECT	PAGE
ADJUSTMENT	
Worm and Sector	30-2
DESCRIPTION	
Steering Gear	30-1
DISASSEMBLY AND ASSEMBLY	
Steering Gear	30-3
REMOVAL AND INSTALLATION	
Steering Gear	30-2
SPECIFICATIONS	30-5

CG2407-2A

DESCRIPTION

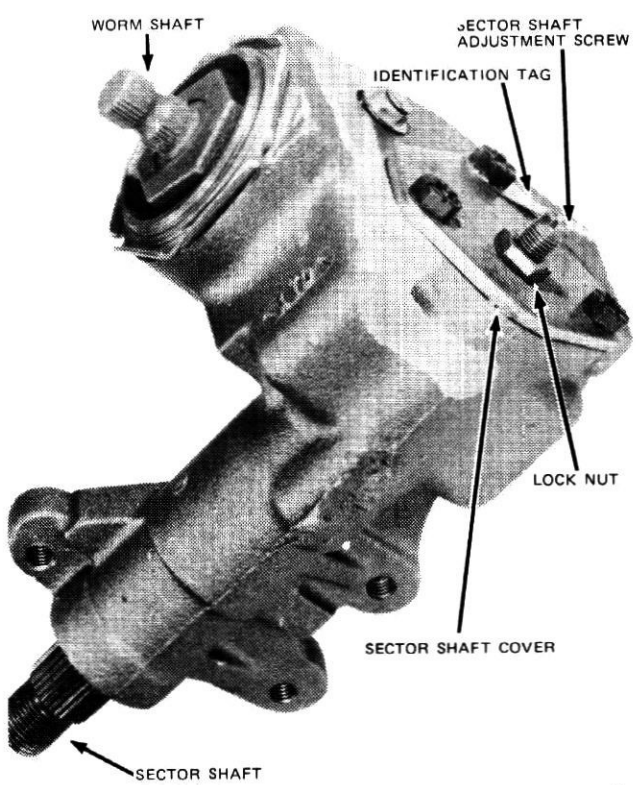
STEERING GEAR

The steering gear (Fig. 1) is of the worm and recirculating ball type. The sector shaft is mounted between two needle roller bearings in the housing below the gear.

Worm bearing preload is controlled by a large adjusting nut threaded into the housing. Sector shaft mesh load is controlled by an adjusting screw in the housing cover.

The steering linkage consists of the Pitman arm, steering-arm-to-idler arm rod, idler arm, and spindle connecting rods (tie rods).

The steering gear identification tag is attached under the middle cover-to-housing attaching bolt.



G1625-1C

FIG. 1 Manual Steering Gear

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ADJUSTMENTS

WORM AND SECTOR

The ball nut assembly and sector gear must be properly adjusted to steering shaft end play (a factor of preload adjustment) and backlash between the sector gear and ball nut. Only two adjustments can be made. Perform these operations in the following order to avoid damage to the gear.

1. Disconnect the linkage from the gear by removing the Pitman arm from the sector shaft (Fig. 4).
2. Loosen the nut that locks the sector adjusting screw (Fig. 2), and turn the screw counterclockwise.

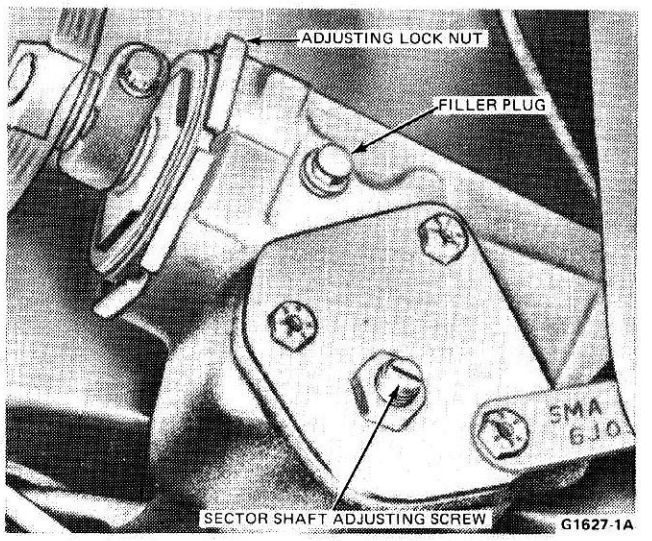


FIG. 2 Steering Gear Adjustments—Typical

Remove the horn pad from the steering wheel.

3. Measure worm bearing preload by attaching an in-lb. torque wrench to the steering wheel nut (Fig. 3). With the steering wheel off center, measure the pull required to rotate the input shaft approximately one and one-half turns to either side of center.
4. If preload is out of specification, loosen the worm shaft bearing adjuster lock nut and tighten or loosen the bearing adjuster (Fig. 1) (as required) to bring the preload within the specified limits.
5. Tighten the worm shaft bearing adjuster lock nut to 60-80 ft-lb. and recheck preload.
6. Turn the steering wheel slowly to one stop. **Turn gently against the stop to avoid damage to the ball return guides. Rotate the wheel to center the ball nut. Check the number of turns specified in the chart at end of this Part. Divide by two to determine the center position.** The blind tooth on the gear input shaft should be at the 12 o'clock position when centered.
7. Torque the sector adjusting screw clockwise until resistance is felt. Using an in-lb torque wrench, recheck the center mesh load by rotating the steering shaft approximately 90 degrees either way across center. If the meshload is not within specification, turn sector shaft adjusting screw until meshload is within specification. Hold the sector shaft adjusting screw and torque the locknut to 32-40 ft-lb.
8. Re-check preload adjustment by turning the steering wheel one and one-half turns from center.
9. Connect the Pitman arm to the sector shaft.

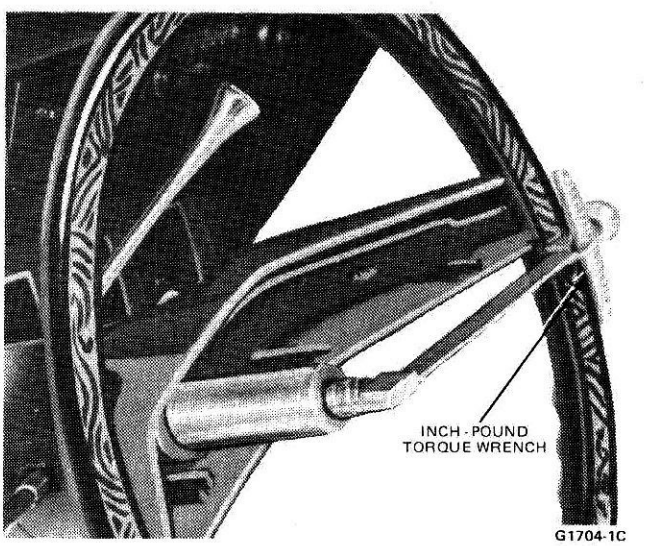


FIG. 3 Checking Steering Gear Preload—Typical

REMOVAL AND INSTALLATION

STEERING GEAR

Removal

1. Remove the bolt(s) that retains the flex coupling to the steering shaft.
2. Remove the nut and lock washer that secures the Pitman arm to the sector shaft. On vehicles equipped with power steering, the power cylinder mounting bracket must be removed and the power cylinder assembly lowered to provide access for the removal tool. Using Tool T64P-3590-F (Fig. 4), remove the Pitman arm from the sector shaft. **Do not hammer on the end of the puller as this can damage the steering gear.**
3. On vehicles with standard transmissions it may be necessary to disconnect the clutch linkage to obtain clearance. On 8-cylinder models, it may be necessary to lower the exhaust system.
4. Remove the bolts that attach the steering gear to the side rail. Remove the gear.

Installation

1. Position the steering gear and flex coupling on the steering shaft. Be sure that the missing tooth on the spline of the gear input shaft is pointing straight up and aligns with the blind tooth on the flex coupling. Install steering gear-to-side rail bolts and torque to specification (50-60 ft-lb).
2. Install the clutch linkage if disconnected. Reposition the exhaust system if it was lowered.

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3. Place the Pitman arm on the sector shaft and install the attaching nut and lock washer. Align the blind tooth on the Pitman arm with the blind tooth on the steering sector shaft. Torque the nut to specification (200-225 ft-lb).
4. Install the flex coupling attaching nut(s) and torque to specification (Parts 13-03 and 13-04).
5. Install the power cylinder mounting bracket and power cylinder assembly to the frame side rail (if removed).

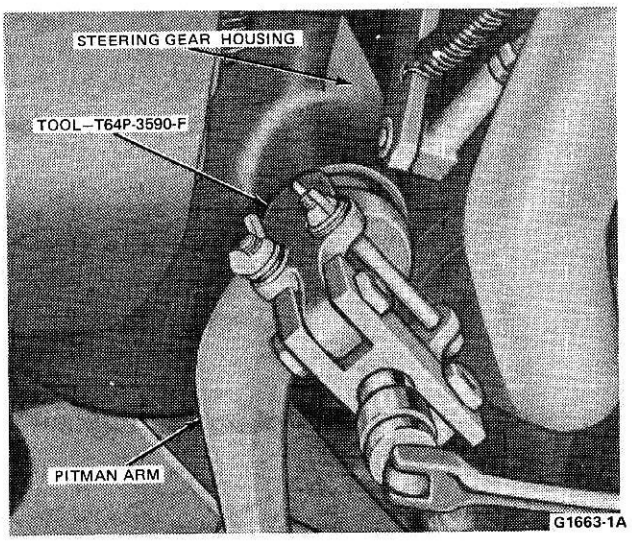


FIG. 4 Removing Pitman Arm

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

Disassembly

1. Rotate the worm shaft to the center position.
2. Remove the sector adjusting screw locknut and housing cover bolts (Fig. 5). Remove the sector shaft with the cover. Remove the cover from the shaft by turning the screw clockwise. **Keep the shim with the screw.**

   NOTE: Gear will normally be filled with lubricant.

3. Loosen the worm bearing adjuster locknut, and remove the adjuster assembly and worm shaft upper bearing (Fig. 6).
4. Carefully pull the worm shaft and ball nut assembly from the housing, and remove the worm shaft lower bearing. **To avoid damaging the ball return guides, keep the ball nut from running down to either end of the worm. Disassemble the ball nut only if there is binding or tightness.**
5. Remove the ball return guide clamp and ball return guides from the ball nut. Several of the balls may stay in the guides, so use caution when separating the two pieces of each guide to prevent the balls from falling out. **Keep the ball nut clamp side up until ready to remove the balls.**
6. Turn the ball nut over. Holding the ball nut over a clean pan, rotate the worm shaft from side to side until all the balls drop out of the nut. Slide the ball nut off the worm.
7. Remove the upper bearing cup from the bearing adjuster and the lower cup from the housing. It may be necessary to tap the housing or adjuster with a block of wood to jar the bearing cups loose.
8. If preliminary inspection of the sector shaft bearing journals or needle bearings shows damage, press the sector shaft bearing and oil seal from the housing using tool number T62F-3576-A and press ram (Fig. 7).

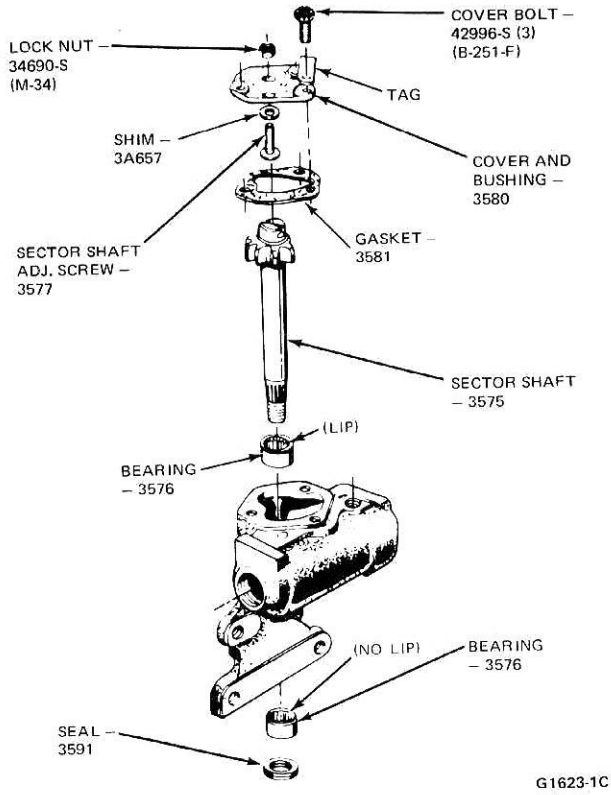


FIG. 5 Sector Shaft and Housing Disassembled

Assembly

1. If the sector shaft bearing and oil seal were removed, press a new bearing into the housing and install a new oil seal. Do not clean the seal with

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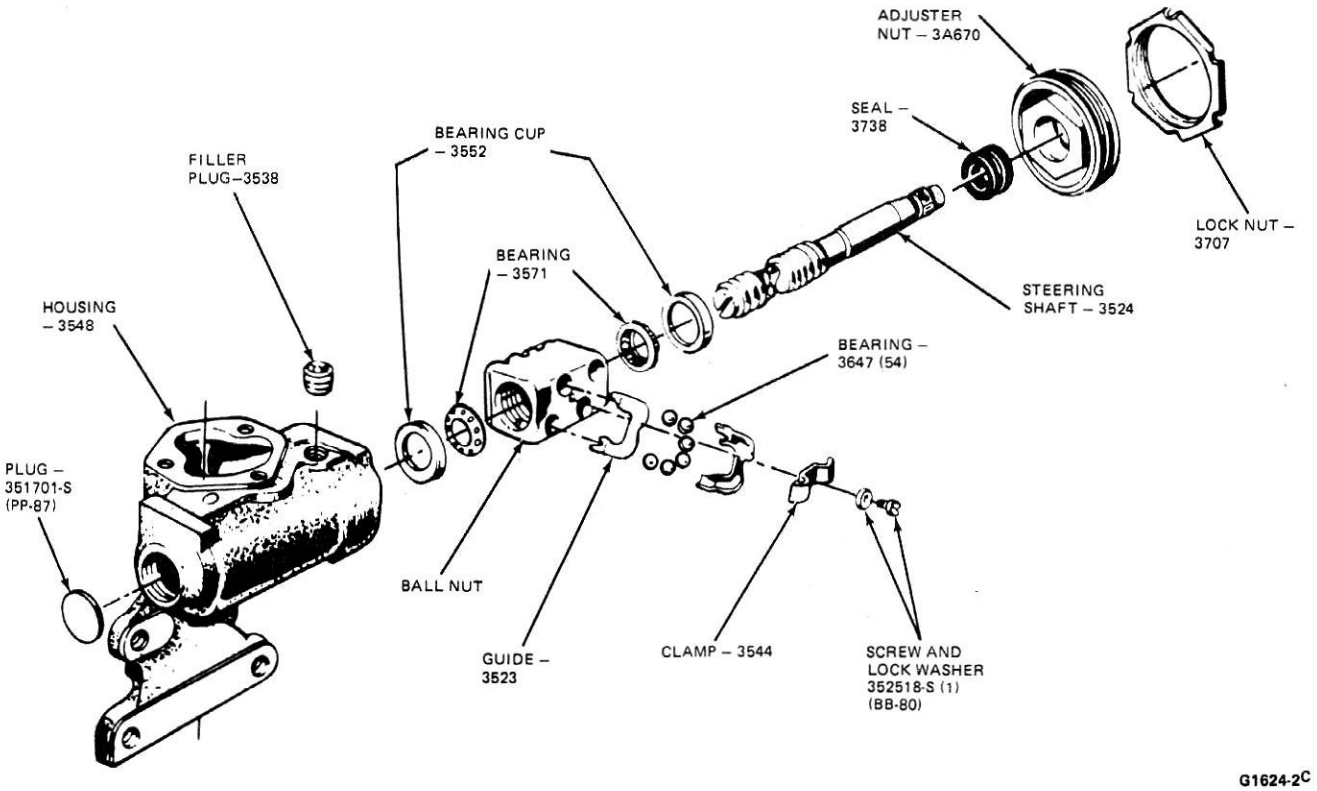


FIG. 6 Steering Shaft and Related Parts Disassembled

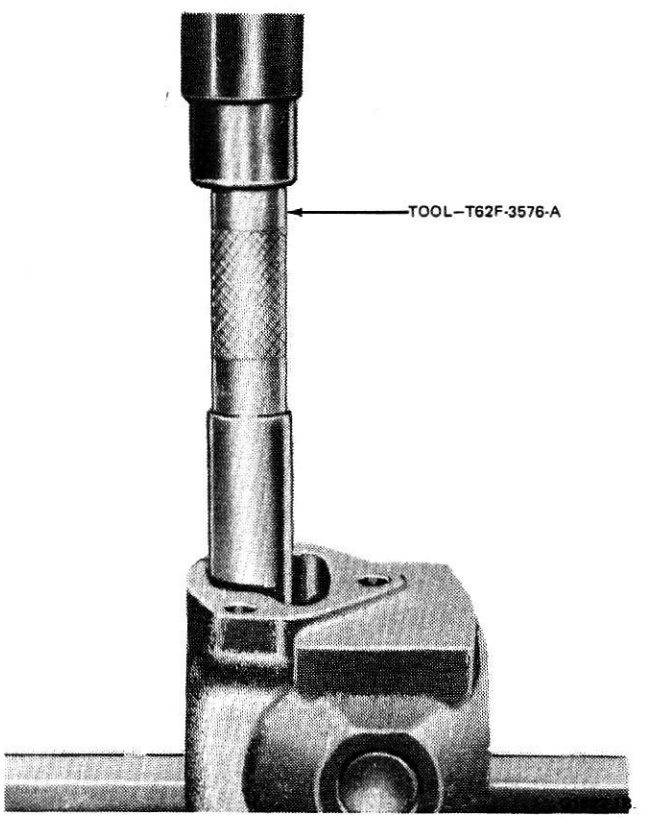


FIG. 7 Removing Oil Seal and Bearing

solvent (Fig. 6). Lubricate the bearing and seals with the recommended lubricant.

2. Install one bearing cup in the lower end of the housing, and the other in the adjuster.
3. If the seal in the bearing adjuster was removed, install a new seal and lubricate.
4. Slide ball nut over worm and check for proper alignment of the V-shaped spaces, as they will be mated with the sector teeth. The larger dimension of the ball nut gear teeth should be at the bottom. Insert the ball guides into the holes in the ball nut, tapping them lightly with the wood handle of a screw driver, if necessary.
5. Insert half of the balls into the hole in the top of each ball guide. It may be necessary to rotate the shaft slightly one way, then the other to distribute the balls in the circuit. A total of 50-54 balls is required per assembly.
6. After the balls are installed, install the ball guide clamp. Torque the screws to specification. Check the worm shaft to be sure that it rotates freely.
7. Coat the worm bearings, sector shaft bearings, and gear teeth with steering gear lubricant.
8. Clamp the housing in a vise, with the sector shaft bore horizontal, and place the worm shaft lower bearing in its cup.
9. Place the worm shaft and ball nut assemblies in the housing.
10. Place the worm shaft upper bearing on the top of the worm, and install the worm shaft bearing adjuster and adjuster nut, and bearing cup. Do not tighten the locknut.
11. Using an in-lb. torque wrench, adjust the worm bearing preload (Fig. 8). Refer to the table at the end of this Part.
12. Position the sector adjusting screw and adjuster shim, and check clearance between the screw head

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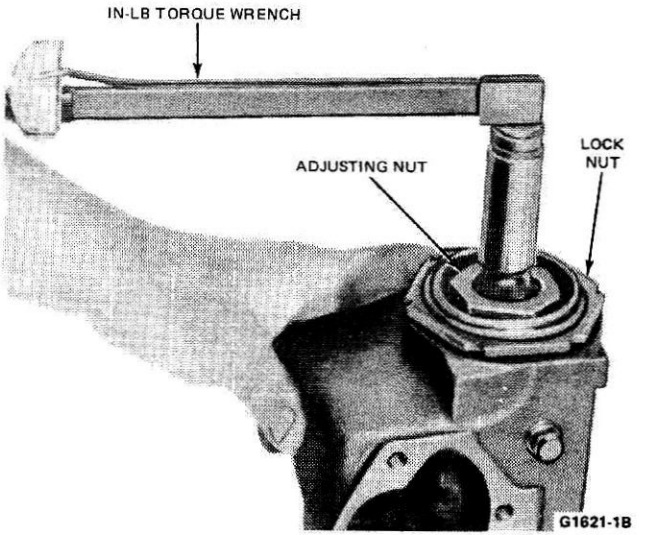


FIG. 8 Checking Steering Shaft Bearing Preload

and the end of the sector shaft to be sure it does not exceed 0.004 inch. If clearance is greater than 0.004 inch, add enough shims to reduce end play to within the 0.004 inch tolerance.

13. Start the sector shaft adjusting screw in the housing cover.
14. Install a new gasket on the housing cover.
15. Tilting the housing so the ball nut tips toward the housing cover opening, rotate the steering shaft until the ball nut teeth are in position to mesh with sector gear.
16. Lubricate the sector shaft journal and install the sector shaft and cover. When assembling, align the sector center tooth with the ball nut center space.
17. With the housing cover turned out of the way, fill the gear with the specified amount of gear lubricant. Push the housing cover and sector shaft assemblies into place, and install the top housing cover bolts. **Do not tighten the cover bolts until there is some lash between the ball nut and sector gear teeth. Hold or push the cover away from the ball nut, and torque the bolts to specification.**
18. Loosely install the sector shaft adjusting screw lock nut, and adjust sector shaft mesh load to specification. Tighten the adjusting screw lock nut.

SPECIFICATIONS

MANUAL STEERING GEAR SERVICE SPECIFICATIONS

Description	Granada/Monarch, Versailles	
Model	SMA-Y	SMA-F
Gear Ratio	16:1	22:1
Turns (Lock to Lock) 1	4	5½
Lube Type	ESW-M1C87-A	
Lube Capacity (Lb.)	.70 ± .07	
Warm Bearing Preload (In-Lb) 2	2-4	3-8
Total Center Meshload (In-Lb) 3	5-7	10-16
Minimum Meshload over Preload (In-Lb)	2	
Adjustments (All Models)	Adjusting screw to bottom of sector shaft T. Slot clearance: .000-.004	

(1) Gear only – not attached to Pitman arm.
(2) Torque required to rotate input shaft at approximately 1½ turns either side of center (gear out of vehicle or Pitman arm disconnected).
(3) Required to rotate input shaft and worm assembly past the center point.
(4) Minimum of one thread must remain exposed when installed.

MANUAL STEERING GEAR TORQUE LIMITS (FT-LB)

Description	Granada/Monarch, Versailles
Sector Shaft Cover Bolt	17-25
Ball Return Guide Clamp Screw	SMA-Y18-4Z (In-Lb)
Preload Adjuster Locknut	60-80
Meshload Adjusting Screw Locknut	32-40
Lubricant Fill Plug and Vent	3-9 (4)
Steering Gear to Side Rail	50-60
Pitman Arm to Sector Shaft	150-225

SPECIAL SERVICE TOOLS

Tool No.	Description
T64P-3590-F	Steering Pitman Arm Remover
T62F-3576-A	Sector Shaft Bushing Remover and Replacer

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DETROIT IRON

Manual Steering Gear—Rack And Pinion

PART 13-32

Applies To Mustang II/Pinto/Bobcat, Fairmont/Zephyr

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CG2408-2B

DESCRIPTION

STEERING GEAR

The steering gear is of the rack and pinion type (Fig. 1). The gear input shaft is connected to the steering shaft by a U-joint shaft and flexible coupling. A pinion gear, machined on the input shaft, engages the rack, and rotation of the input shaft pinion causes the rack to move laterally.

Tie rods, attached at each end of the rack joint, move with the action of the front suspension. The gear is sealed at each end with a rubber bellows. The Pinto, Bobcat and Mustang steering gear is filled with approximately 7 oz. of lubricant D2AZ-19580-B or equivalent at initial assembly and need not be checked unless leakage is evident or the unit is drained for repair. The Fairmont and Zephyr steering gear lubricant is a fluid type. If the unit is drained for repair, refill with 5 oz. of the specified lubricant.

Couplings attaching the tie rods are pinned to the rack and can be disassembled for service on Pinto, Bobcat and Mustang. The Fairmont and Zephyr ball housings and tie rods are not adjustable for preload and feature a simple torquing and pinning service procedure.

Do not turn the steering wheel quickly or forcefully from lock to lock when the front wheels of the vehicle are off the ground. This could cause a build-up of hydraulic pressure within the gear, which could damage or blow off the bellows.

With the front suspension and linkage in good condition and the gear in proper adjustment, there should be no more than 3/8 inch of free play at the rim of the steering wheel.

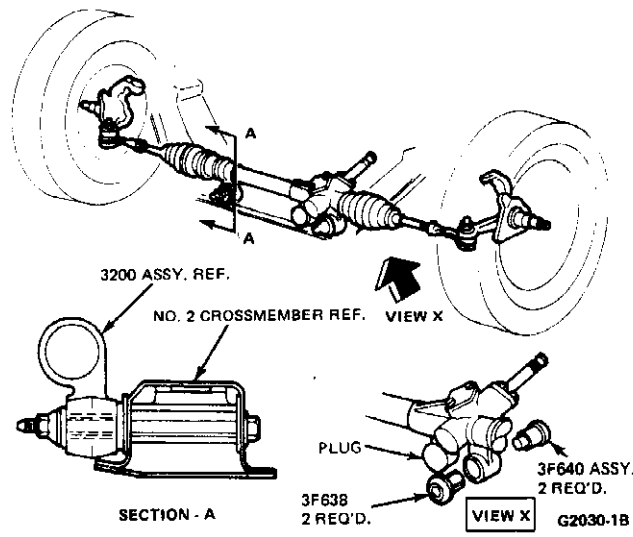


FIG. 1 Typical Rack and Pinion Steering Gear and Linkage

In a stationary vehicle, there should be no knock in the steering gear when the steering wheel is turned from stop to stop. If a knock is experienced, check adjustment of rack preload and pinion bearing preload. A faint knock produced by the steering gear while driving on an extremely rough road is acceptable, and in no way affects the proper functioning of the gear.

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ADJUSTMENTS

The rack and pinion gear provides two means of service adjustment. The gear must be removed from the vehicle to perform both adjustments.

SUPPORT YOKE TO RACK

1. Clean the exterior of the steering gear thoroughly and mount the gear, by installing two long bolts and washers through the mounting boss bushings and attaching to Bench Mounted Holding Fixture, Tool T57L-500-B.
2. Remove the yoke cover, gasket, shims, and yoke spring (Fig. 2).
3. Clean the cover and housing flange areas thoroughly.
4. Reinstall the yoke and cover, omitting the gasket, shims, and the spring.
5. Torque the cover bolts lightly until the cover just touches the yoke.
6. Measure the gap between the cover and the housing flange. **With the gasket,** add selected shims (3F518) to give a combined pack thickness .005-.006 inch greater than the measured gap.
7. Remove the cover.
8. Assemble the gasket next to the housing flange, then the selected shims, spring, and cover.
9. Install cover bolts, sealing the threads with ESW-M46-132A or equivalent and torque to specification.
10. Check to see that the gear operates smoothly without binding or slackness.

PINION BEARING PRELOAD

1. Clean the exterior of the steering gear thoroughly and place the gear in the bench mounted holding fixture as outlined under Support Yoke to Rack Adjustment.
2. Loosen the bolts of the yoke cover to relieve spring pressure on the rack.
3. Remove the pinion cover and gasket and clean the cover flange area thoroughly.
4. Remove the spacer and shims (Fig. 3).
5. Install a new gasket and fit shims (3595), between the upper bearing and the spacer, until the top of the spacer is flush with the gasket. Check with a straightedge, using light pressure.
6. Add one .005 inch shim to the pack in order to preload the bearings. The spacer must be assembled next to the pinion cover.
7. Install the cover and bolts. Torque the bolts to specification.

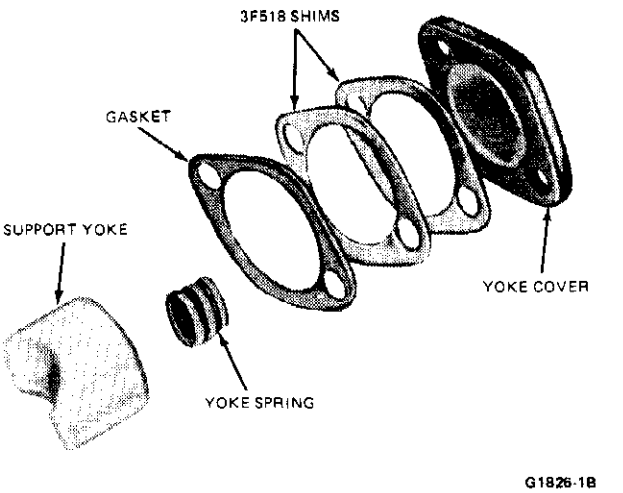


FIG. 2 Support Yoke Arrangement

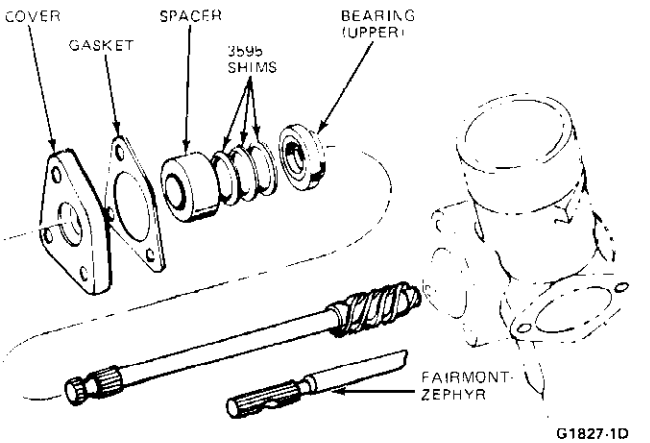


FIG. 3 Pinion Bearing Cover and Shim Arrangement

TIE ROD ARTICULATION EFFORT—FAIRMONT/ZEPHYR

1. Install hook end of pull scale, Tool T74P-3504-Y through the hole in the tie rod end stud. Effort to move the tire rod should be 1 to 5 lb. NOTE: Do not damage tie rod neck.
2. Replace ball joint/tie rod assembly if effort falls outside this range. Save the tie rod end for use on the new tie rod assembly.

REMOVAL AND INSTALLATION

STEERING GEAR

Removal

1. Disconnect the negative battery cable from the battery.
2. Remove the one bolt retaining the flexible coupling to the input shaft.
3. Leave the ignition key in the ON position and raise the vehicle on a hoist.

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4. Remove the two tie rod end retaining cotter pins and nuts. Separate the studs from the spindle arms, using the ball joint separator tool. **Do not use a hammer** or similar tool as this may damage spindle arms or rod studs.
5. Support the steering gear and remove the two nuts, insulator washers and bolts retaining the steering gear to the No. 2 crossmember.

   On the Mustang II, the No. 2A crossmember must be removed to allow access to the retaining nuts.
6. Remove the steering gear assembly from the vehicle.

Installation

1. Insert the input shaft into the flexible coupling and position the steering gear to the No. 2 crossmember. Install the two bolts, insulator

   On the Mustang II reinstall the No. 2A crossmember.

   On the Mustang reinstall the No. 2A crossmember.
2. Connect the tie rod ends to the spindle arms and install the two retaining nuts. Torque the nuts to specifications and install the two cotter pins.
3. Lower the vehicle and install the one bolt retaining the flexible coupling to the input shaft. Torque the bolt to specifications.
4. Turn the ignition key to the OFF position.
5. Connect the negative battery cable to the battery.
6. Check the toe and reset if necessary. Refer to Group 14.

DISASSEMBLY AND ASSEMBLY

All disassembly must be performed with the gear removed from the vehicle.

TIE ROD ENDS, BELLOWS AND TIE ROD BALL JOINT SOCKETS

Pinto/Bobcat/Mustang II

Disassembly

1. Clean the exterior of the gear thoroughly and place the gear in the bench mounted holding fixture as described under "Adjustments."
2. Loosen the jam nuts on the outer ends of the tie rods adjacent to the tie rod ends.
3. Remove the tie rod ends and jam nuts.
4. Remove the four clamps, retaining the bellows to the gear housing and the tie rods. Drain the lubricant and remove the bellows. **Use care so as not to damage or contaminate the inside of the bellows.**
5. The lock pin drill fixture, Tool T74P-3504-AA, (Fig. 4) doesn't have a depth gauge used to set the stop on the drill. Use the gauge on Tool T74P-3504-Z to set the drill stop. Insert the 5/32 inch drill in the depth gauge, butt the stop against the tool and secure firmly with the set screw.
6. Tape cloths around the rack end on both sides of the ball socket, to prevent chip contamination. Install Tool T74P-3504-AA on the ball socket. Position the fixture so that the pin in the ball socket is in line with the guide hole in the drill fixture. The cone points of the alignment and locking screws are to be positioned between the locknut and the ball socket and tightened firmly (Fig. 5).
7. Place the drill in the fixture guide hole and drill out the retaining pin. The drill guide prevents the hole from being drilled too deep (Fig. 5). (Both right and left tie rods and sockets are removed in this manner.)
8. Remove the tie rod and ball socket with the ball housing wrench, Tool T74P-3504-CC.

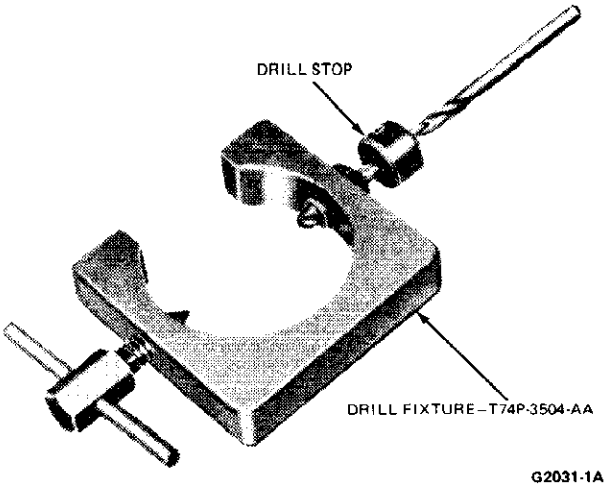


FIG. 4 Setting Drill Stop

9. Remove the locknut, inner thrust bearing (seat) and the rack spring from the recess in the end of the rack, and discard.
10. All of the removed components must be examined and replaced if worn or damaged.

Assembly

1. Install a new rack spring in the recess in the end of the rack.
2. Assemble the ball socket to the tie rod.
3. Install a new inner thrust bearing (seat) in the ball socket.
4. Apply D2AZ-19580-B lubricant or equivalent to the spring, thrust bearing, tie rod ball and the ball socket.
5. Thread the ball joint locknut on the end of the rack.
6. Thread the ball socket onto the rack until the tie rod articulation becomes stiff.
7. Before measuring tie rod articulation effort, the rod must be rotated at least seven times to obtain a true reading.

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8. Install a tie rod end on the tie rod. Place the hook of the pull scale Tool T74P-3504-Y through the hole in the threaded area of the ball joint.
9. With the tie rod in the mid-position of its range of articulation, parallel to the rack, adjust the position of the ball socket on the rack with Tool T74P-3504-CC, until the effort required to move the tie rod, measured on the pull scale, is 4-6 lbs (Fig. 6).
10. Secure the unit by holding the ball housing with Tool T74P-3504-CC, and tighten the locknut against the ball socket with the locknut torque adapter, Tool T74P-3504-BB, to 35-40 ft-lb.

    The ball housing wrench is equipped with a locking screw which must be located in the hole in the ball socket (Fig. 7).
11. Remove the spanner wrenches and using the procedure contained under disassembly, install the drill fixture on the ball socket. Drill the hole on the line of contact of the locknut and the ball socket. **A new hole must be drilled even if the halves of the existing holes align.**

    A total of only two drilled holes are allowed on one end of the rack. If further removal of the ball socket is necessary, then the ball socket, locknut and rack must be replaced.
12. Insert the retaining pin into the drilled hole and tap it in flush with the ball housing and locknut surfaces. With Tool T74P-3504-X, stake the metal of the ball housing and the locknut over the pin to secure the tie rod adjustment. The staking tool has four points which perform the staking in one operation (Fig. 8).

    Thoroughly clean the rack and housing bores of any metal chips, shavings or any foreign material.
13. To test the pinning operation, use Tool T74P-3504-BB, to apply a reverse torque of 35 ft-lb on the

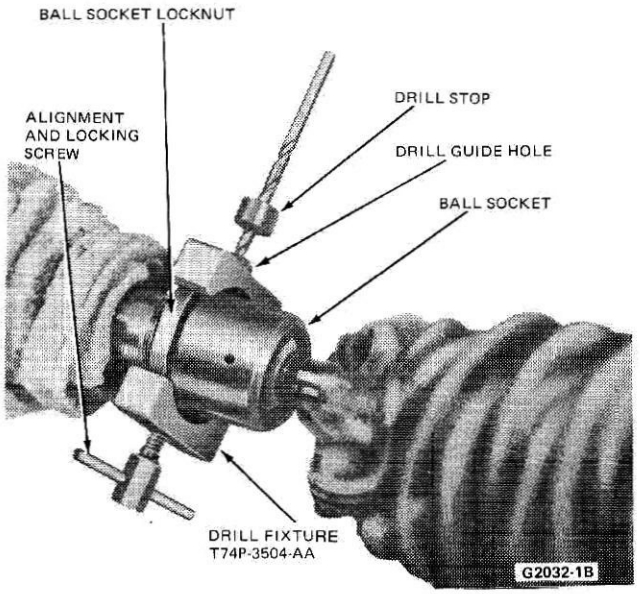


FIG. 5 Drilling Out Retaining Pin - Pinto/Bobcat/ Mustang II

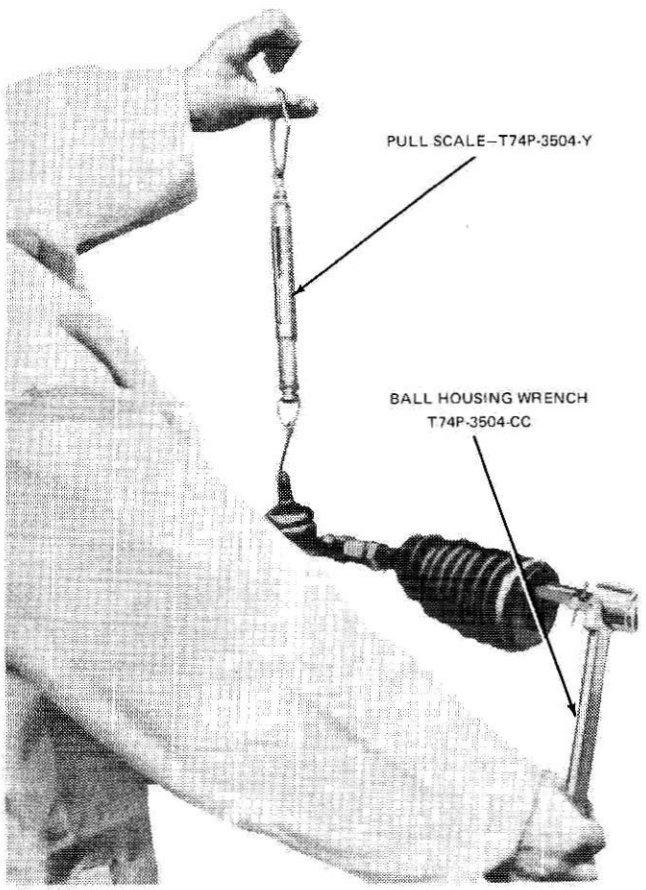


FIG. 6 Adjusting Tie Rod

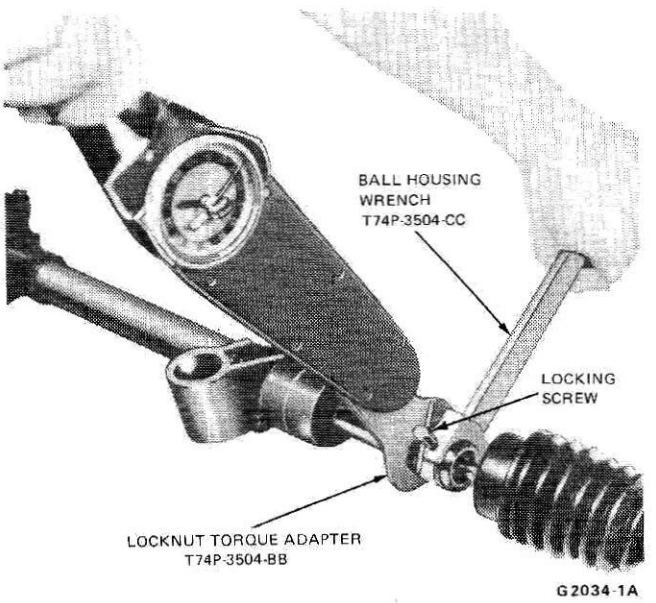


FIG. 7 Securing Ball Socket—Pinto/Bobcat/ Mustang II

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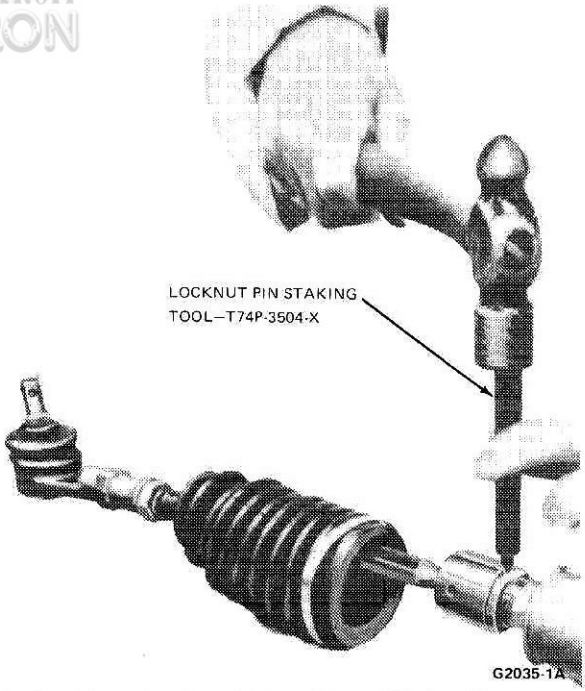


FIG. 8 Staking Locknut Pin—Pinto/Bobcat/ Mustang II Only

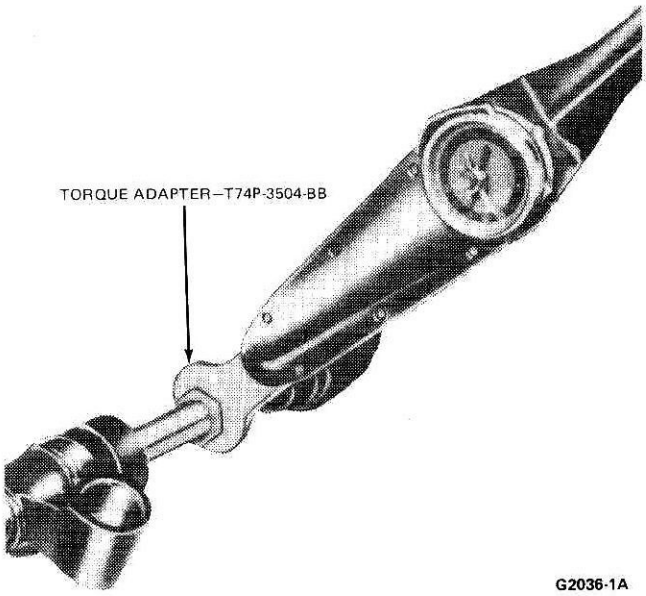


FIG. 9 Testing Locknut Pin

locknut. The joint must not loosen under this torque application (Fig. 9). Remove the tie rod ends.

14. Install the bellows. Install the clamps retaining the bellows to the tie rod. Install right bellows to housing clamp.
15. Install 7 ounces of D2AZ-19580-B (Spec. M2E105-B) lubricant or equivalent through the left bellows, and install the clamp retaining the bellows to the gear housing.
16. Install the jam nuts and tie rod ends on the tie rods.

FAIRMONT/ZEPHYR

Disassembly

1. Clean the exterior of the gear thoroughly and place the gear in the bench mounted holding fixture as described under "Adjustments."
2. Loosen the jam nuts on the outer ends of the tie rods adjacent to the tie rod ends.
3. Remove the tie rod ends and jam nuts.
4. Remove the four clamps, retaining the bellows to the gear housing and the tie rods. Drain the lubricant and remove the bellows. **Use care so as not to damage or contaminate the inside of the bellows.**
5. Remove spiral pin from ball housing with Tool T78P-3504-N (Fig. 10).
6. Install ball housing torque adapter, Tool T78P-3504-AA on ball housing. Locate the point of the locking screw in the large hole midway along the length of the housing and tighten firmly (Fig. 11).
7. Attach a standard 1/2 inch drive ratchet handle to the tool. Expose enough rack teeth to install an adjustable wrench over the flat formed by the tops of the rack teeth. Loosen the ball housing tie rod assembly by holding the adjustable wrench and turning the ball housing torque adapter tool T78P-3504-AA (Fig. 11).

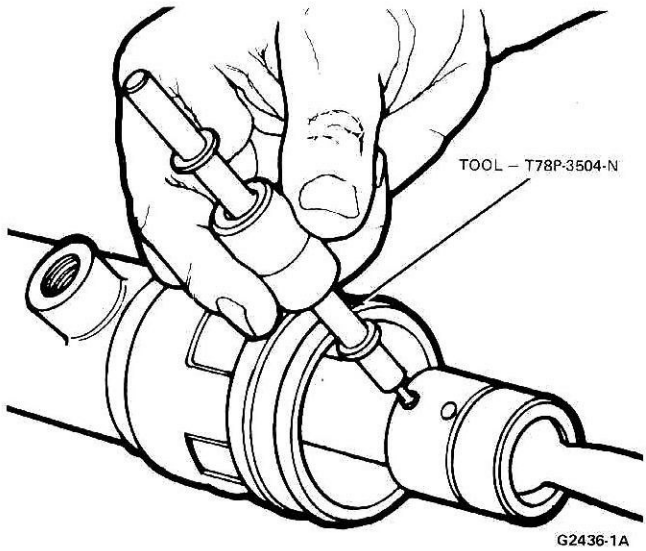


FIG. 10 Removing Spiral Pin From Ball Housing—Fairmont/Zephyr

Caution: If the rack is not restrained by the adjustable wrench, the pinion will be damaged.

Assembly

1. Clean and inspect the condition of the threads on the rack and in the ball housing socket.
2. Thread the tie rod assembly onto the end of the rack.
3. Install ball housing torque adapter tool on the ball housing. Locate the point of the locking screw in the large hole midway along the length of the housing and tighten firmly.
4. Hold rack with an adjustable wrench on the flat of the rack teeth, as near the end of the rack as possible. If pinion has not been removed, use care not to load the pinion during torquing. Holding the rack with the adjustable wrench, torque ball

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housing to 45-60 ft-lb by turning the torque adapter tool with a 1/2 inch drive torque wrench (Fig. 11).

5. Rotate the tie rod at least 10 times before measuring the articulation effort. If articulation effort is not to specification, replace with a new tie rod. See procedure for articulation effort check described earlier in this Part.
6. Insert the spiral retaining pin into the small hole in the ball housing and tap lightly with a hammer until seated. Do not tap hard enough to deform the pin as this would make it difficult to remove the pin should it become necessary to do so.
7. Apply specified lube to the tie rods in undercut where bellows will be clamped. This will prevent the bellows from twisting during toe adjustment. Install the small bellows clamps. Install the large bellows clamp on the right side only (opposite end from pinion).
8. Place gear in a vertical position with the pinion end of gear up. Fill housing with 5 oz. of the specified fluid lubricant. Install left large bellows clamp, fastening the bellows to the gear housing.
9. Install jam nuts and tie rod ends on the tie rods.

INPUT SHAFT SEAL

Disassembly and Assembly

1. Clean the input shaft and seal area thoroughly. Do not scratch or damage the pinion shaft. Pry the pinion seal from its bore and discard.
2. Lubricate a new pinion seal with C1AZ-19590-B lubricant or equivalent and install the seal over the shaft.
3. Use a piece of tubing to engage the outer flange of the seal, and press or tap the seal into its bore until flange is flush with the shoulder of the bore. **If the outer edge of the seal is not engaged when assembling, the seal will be damaged.**

RACK SUPPORT YOKE, SPRING, GASKET, SHIMS AND COVER

Disassembly

1. Clean the exterior of the gear thoroughly and place the gear in the bench mounted holding fixture as described under Adjustments earlier in this Part.
2. Remove the yoke cover, shims, gasket and yoke spring.
3. Discard the gasket.

Assembly

1. Clean the cover and cover flange areas thoroughly.
2. Assemble the yoke and yoke spring.
3. Assemble a new gasket next to the housing flange. If necessary, adjust the yoke to rack spring tension or if new shims are to be installed, see Adjustments earlier in this Part.
4. Assemble the shim pack and cover.
5. Add sealant ESW-M46-132-A or equivalent to the cover bolt threads and torque the bolts to specification.

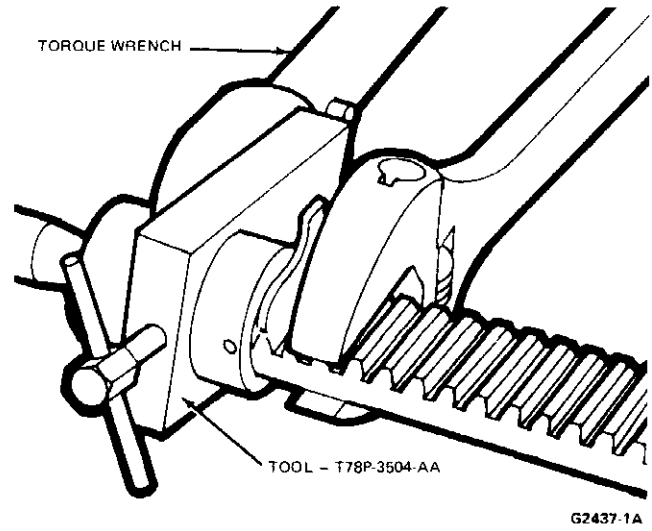


FIG. 11 Removing or Installing Tie Rod Ball Housing Assembly—Fairmont/Zephyr

PINION COVER, GASKET, PINION SHAFT, SPACER, SHIMS, UPPER BEARING, RACK, LOWER BEARING AND HOUSING

PINTO/BOBCAT/MUSTANG

Disassembly

1. Clean the exterior of the gear thoroughly.
2. Place the gear in the bench mounted holding fixture as described under Adjustments.
3. Remove the bolts, yoke cover, gasket, shims, spring and yoke from the bushing.
4. Remove one or both tie rods and sockets from the ends of the rack as described earlier.
5. Move the rack to either lock and note the position of the flat on the input shaft. It is important that when subsequent assembly of the pinion shaft is made, that the flat be aligned in this same position. **If the pinion is not assembled in the same position, the steering wheel will not be in the straight ahead position.**
6. Remove the pinion cover bolts, pinion cover, gasket, pinion shaft, spacer, shims and upper bearing.
7. Remove the rack from the housing.
8. Remove the lower bearing through the pinion shaft bore. Access to the bearing is easiest through the support yoke bore.

Assembly

1. Install the lower bearing in the pocket at the bottom of the housing.
2. Install the rack in the housing.
3. With the rack moved to one lock (Step 5 under Disassembly), install the pinion shaft. Be sure the pinion shaft gear end is engaged in the lower bearing I.D.
4. Install the upper pinion bearing, shims, spacer, gasket and pinion cover and bolts. Torque the bolts to specification.

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DETROIT IRON

If bearing preload needs to be altered, or a new shim pack is to be installed, see Adjustments earlier in this Part.

5. Install one or both tie rods and sockets on the ends of the rack as described earlier.
6. Install the support yoke, spring, shims, gaskets, yoke cover and bolts, using sealant ESW-M46-132A or equivalent on the bolt threads. Torque the bolts to specification. Adjust the yoke preload as described under Adjustments.

FAIRMONT/ZEPHYR

Disassembly

1. Clean the exterior of the gear thoroughly.
2. Place the gear in the bench mounted holding fixture as described under Adjustments.
3. Remove the bolts, yoke cover, gasket, shims, spring and yoke from the bushing.
4. Remove the right ball housing/tie rod assembly from the rack as described earlier in this Part.
5. Move the rack to the right turn stop and note the position of the D-shaped groove in the input shaft (Fig. 3). It is important that the groove be in the same position in subsequent assembly. Otherwise, the steering gear will not be centered (i.e; unequal number of turns in right and left directions).
6. Remove the pinion cover bolts, pinion cover, gasket, pinion shaft, spacer, shims and upper bearing.
7. Remove the rack from the housing.
8. Remove the lower bearing through the pinion shaft bore. Access to the bearing is easiest through the support yoke bore.

Assembly

1. Clean the interior of the gear thoroughly.
2. Install the lower bearing in the pocket at the bottom of the housing.
3. Install the rack in the housing.
4. With the rack moved to one lock (Step 5 under Disassembly), install the pinion shaft. Be sure the pinion shaft gear end is engaged in the lower bearing I.D.
5. Install the upper pinion bearing, shims, spacer, gasket and pinion cover and bolts. Torque the bolts to specification. If bearing preload needs to be altered, or a new shim pack is to be installed, see Adjustments earlier in this Part.
6. Install the right ball housing/tie rod assembly on the end of the rack as described earlier in this Part.
7. Install the support yoke, spring, shims, gaskets, yoke cover and bolts. Torque the bolts to specification. Adjust the yoke preload as described under Adjustments.

SPECIFICATIONS

RACK AND PINION STEERING GEAR SPECIFICATIONS AND TORQUES–PINTO/MUSTANG II/BOBCAT

Type	Rack and Pinion
Gear Ratio	24.2 At straight ahead position and 18.34 at full turn
Number of Turns (Within Gear)	4.15
Lubricant Capacity	7 oz. (Approx. 0.44 pts.)
Effort Required to Sustain Input Shaft Rotation (Gear Filled with Lubricant)	Pinto/Bobcat 5-15 in-lbs.
	Mustang II 7-17 in-lbs.
Weight (Dry)	14.0 Lbs. approx.
Tie Rod Articulation Effort (As measured on Pull Scale)	4-6 lbs.

① Tighten to nearest cotter pin slot after torquing to specification.

Type	Rack and Pinion
Steering Gear Lubricant	D2AZ-19580-B
Pinion Seal Lubricant	C1AZ-19590-B
Bolt and Lockwasher . . . Support Yoke Cover to Cover Housing	15-20 ft-lbs.
Bolt and Lockwasher . . . Pinion Cover to Gear Housing	15-20 ft-lbs.
Steering Gear to Crossmember	80-100 ft-lbs.
Connecting Rod End to Spindle Arm	35-47 ft-lbs. ①
Connecting Rod End to Inner Tie Rod	35-50 ft-lbs.
Pinion Shaft to Flex Coupling Bolts	20-37 ft-lbs.

SPECIAL SERVICE TOOLS

Tool No.	Description
T74P-3504-AA	Lock Pin Drill Fixture
T74P-3504-BB	Lock Pin Torque Adapter
T74P-3504-CC	Ball Housing Wrench
T74P-3504-X	Locknut Pin Staking Tool
T74P-3504-Y	Pull Scale
T74P-3504-Z	Drill Fixture with Depth Gauge

CG1828-2G

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RACK AND PINION STEERING GEAR SPECIFICATIONS AND TORQUES – FAIRMONT/ZEPHYR

Type	Rack and Pinion
Gear Ratio	24.9 At straight ahead position and 21.7 at full turn
Number of Turns (Within Gear)	4.15
Lubricant Capacity	7 oz. (Approx. 0.44 pts.)
Effort Required to Sustain Input Shaft Rotation (Gear Filled with Lubricant)	5-17 (In-Lb)
Weight (with Lube)	13 Lbs. Approx.
Tie Rod Articulation Effort (as measured on Pull Scale	1-5 Lbs.
Steering Gear Lubricant	ESA-M1C175-A
Pinion Seal Lubricant	C1AZ-19590-B

Type	Rack and Pinion
Bolt and Lockwasher . . . Support Yoke Cover to Cover Housing	15-20 Ft-Lb
Bolt and Lockwasher . . . Pinion Cover to Gear Housing	15-20 Ft-Lb
Steering Gear to Crossmember	80-100 Ft-Lb
Connecting Rod End to Spindle Arm	35-47 Ft-Lb (1)
Connecting Rod End to Inner Tie Rod	35-50 Ft-Lb
Pinion Shaft to Flex Coupling Bolts	20-37 Ft-Lb
Ball Housing to Rack	40-60 Ft-Lb

(1) Tighten to nearest cotter pin slot after torquing to specification.

SPECIAL SERVICE TOOLS

Tool No.	Description
T78P-3504-AA	Ball Housing Torque Adapter
T78P-3504-N	Spiral Pin Remover

Tool No.	Description
T74P-3504-Y	Pull Scale

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DETROIT IRON

Non-Integral Power Steering System—Ford

PART 13-40

Applies to Granada/Monarch/Versailles

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Power Steering Pump to Control Valve Hose	40-6
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CG2409-2A

DESCRIPTION

NON-INTEGRAL POWER STEERING SYSTEM

The Non-Integral Power Steering System (Fig. 1) is *a hydraulically controlled linkage-assist type steering* system which includes an integral pump and fluid reservoir, a control valve, a power cylinder, connecting fluid lines, and the steering linkage. The hydraulic pump, which is belt driven from the engine crankshaft, draws fluid from the reservoir and provides pressure for the system. A pressure relief valve regulates the system in the pump according to the varying conditions of operation. Once fluid has passed from the pump to the control valve and the power cylinder, it returns to the reservoir.

Refer to Volume 5—Maintenance and Lubrication for hoisting instructions. For Removal and Installation of the steering gear and power steering pump, refer to the appropriate Part.

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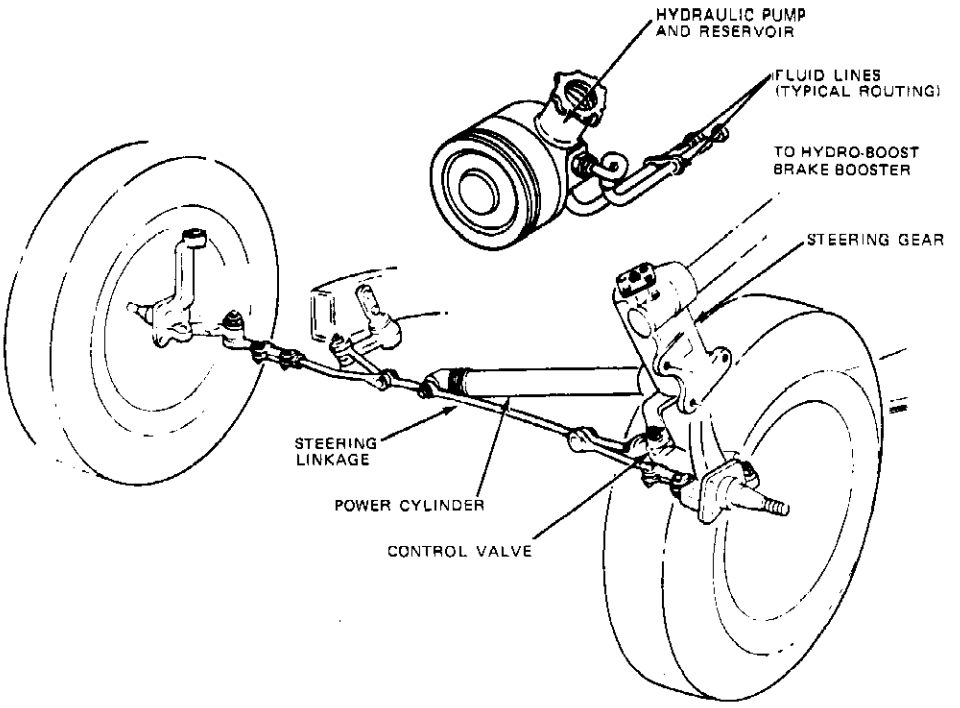


FIG. 1 Non-Integral Power Steering System

ADJUSTMENTS

CONTROL VALVE CENTERING

1. Raise the vehicle and remove two spring cap attaching screws and lock washer assemblies (Fig. 2). Remove the spring cap and discard the spring cap gasket. **Never start the engine with the spring cap removed.**
2. Torque the centering spring adjusting nut to 90-100 in-lb. **Do not tighten beyond specification.** Loosen the same spring adjusting nut 1/4 turn.

NOTE: Because the control valve spool bolt and nut may turn together slightly, be sure that only the nut-relative-to-bolt movement is counted.

3. Lubricate spring cap and gasket and position on valve housing. Lubricate and install the two screw and washer assemblies. Torque to 72-100 in-lb.
4. Lower the vehicle.

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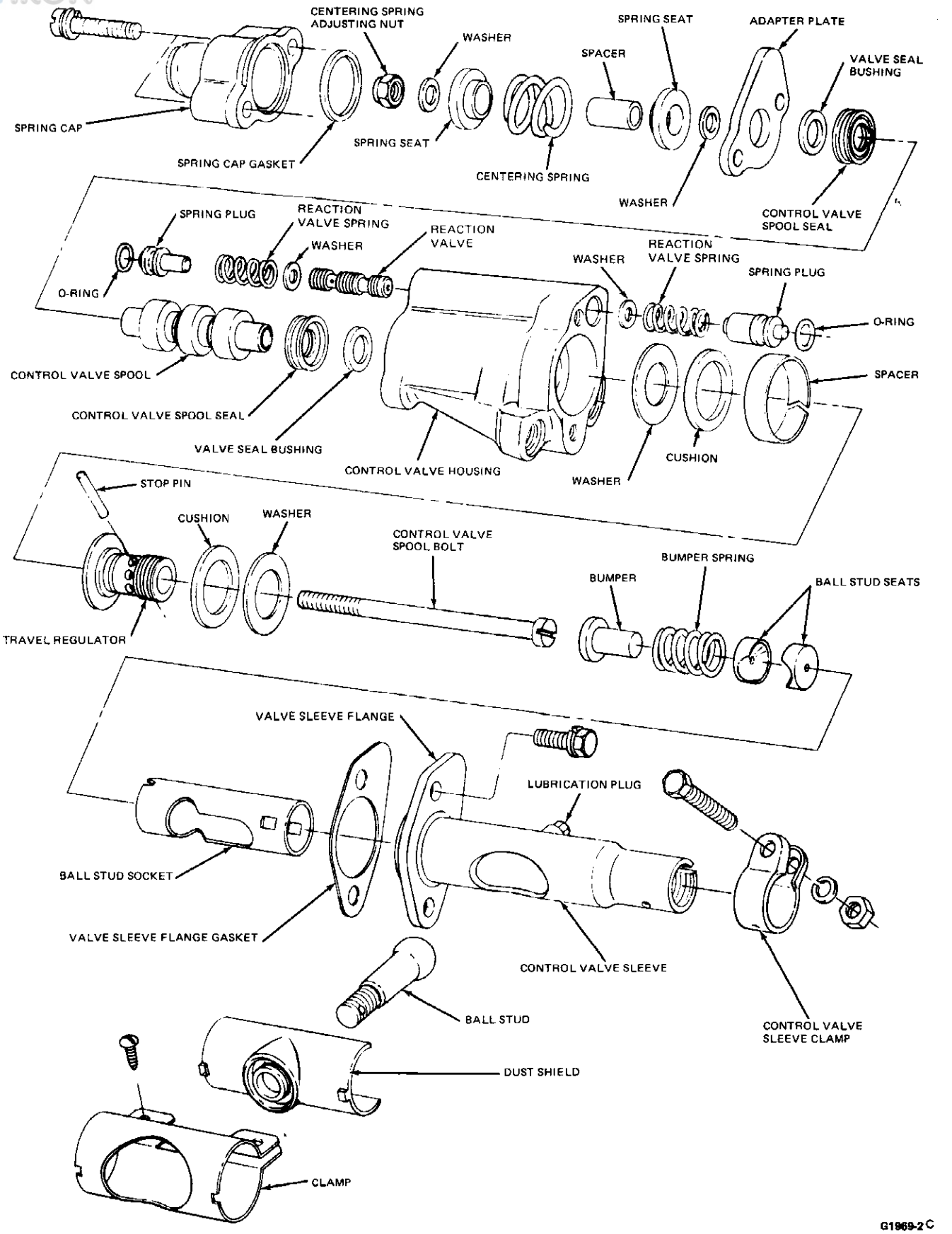


FIG. 2 Control Valve Disassembled—Granada/Monarch/Versailles

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REMOVAL AND INSTALLATION

CONTROL VALVE

Removal

1. Raise the vehicle and remove the worm-screw hose clamp that secures the fluid lines to the outside of the control valve body.
2. Disconnect the four fluid line fittings at the control valve and drain the fluid from the lines. Turn the front wheels to the left and right several times to force all of the fluid from the system.
3. Loosen the clamping nut and bolt at the end of the control valve sleeve.
4. Remove the roll pin from the steering arm-to-center link through the slot in the control valve sleeve.
5. Remove the cotter pin and the control valve ball stud nut. Remove the ball stud from the sector shaft arm (Pitman Arm). **When removing the ball stud from the sector shaft arm, it is necessary to use the control valve ball stud removing tool, No. 3290-C (Fig. 3). Use of other tools will result in damage to the control valve assembly.**
6. Remove valve assembly from the centerlink by turning counter-clockwise until the valve assembly is free of the centerlink.

Installation

1. Thread the valve onto the center link until approximately four threads are still visible on the link.
2. Position the ball stud in the sector shaft arm.

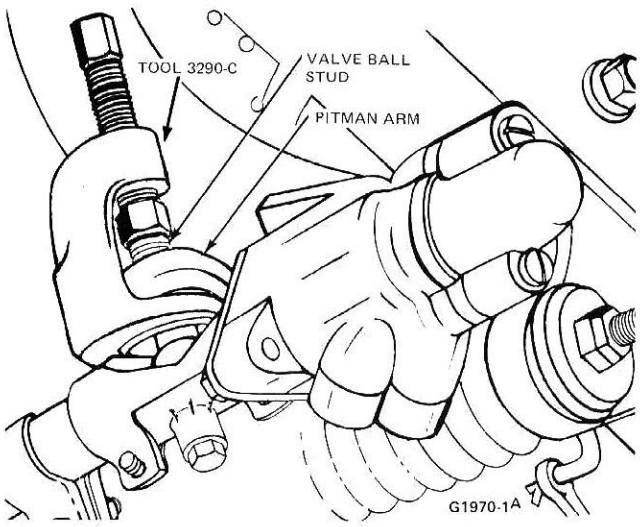


FIG. 3 Removing Control Valve Ball Stud

3. Measure the distance between the center of the left spindle connecting rod hole in the center link to the end of the control valve (Fig. 4). This distance **must** be 2.65-2.55 inches. If the distance is not correct, disengage the ball stud from the sector shaft arm and turn the valve on the center link to increase or decrease the distance.
4. Once the ball stud is correctly positioned in the sector shaft arm, align the hole in the steering arm-to-center link with the slot near the end of the valve sleeve. Install the roll pin to lock the valve in position on the rod.
5. Torque the valve sleeve clamp nut to 13-17 ft-lb.
6. Install the nut on the ball stud. Torque the nut to 35-47 ft-lb. and install a new cotter pin.
7. Connect the return and pressure lines from the pump to the control valve, finger tight. Install the worm-screw hose clamp to secure the lines to the outside of the control valve. Torque the clamp to 36-60 in-lb. Torque the return line tube nut (5/8" hex) to 16-25 ft-lb and the pressure line tube nut (1/2" hex) to 15-19 ft-lb. **Do not tighten beyond specification.** Connect the unmarked end of the shorter control valve-to-power cylinder hose to valve port "C" (Fig. 5). Connect the other hose to valve port "A". Hold each tube so that the bend parallels the surface of the valve and torque each nut to 15-19 ft-lb. **Do not tighten beyond specification.**

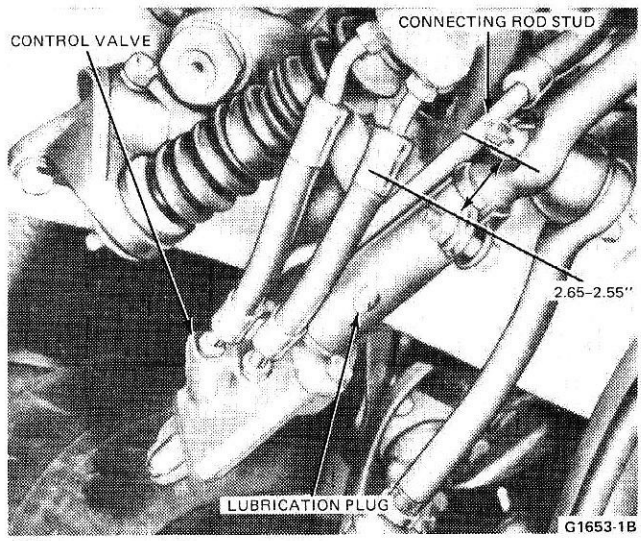


FIG. 4 Control Valve Installation Measurements

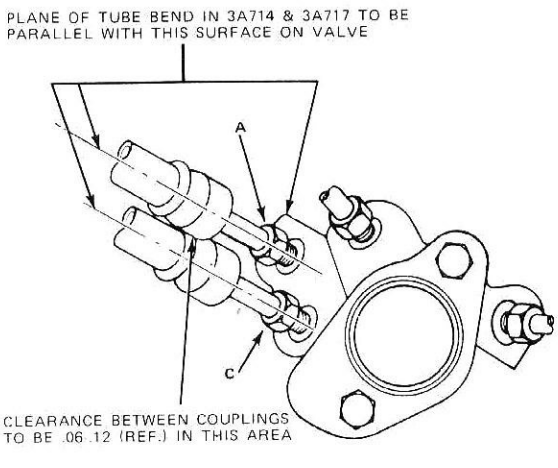


FIG. 5 Power Steering Hose Installation

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8. Lower the vehicle and fill the fluid reservoir with fluid per Start Up Procedure given in Part 13-01.
9. With the engine running at idle speed, check the position of the steering wheel when the front wheels are in the straight-ahead position. **Do not make any adjustments until the toe is checked.**
10. Keep the engine running, check the toe. If either the toe or the steering wheel position is not correct, make the necessary adjustments as described in Group 14, Part 01.
11. Check the effort to turn the front wheels. It should be about equal in each direction.

POWER CYLINDER

Removal

1. Raise the vehicle and disconnect the two fluid lines from the power cylinder and drain the lines.
2. Remove the pal crimp nut, washer, and the insulator from the end of the power cylinder rod. When removing the crimp nut, cylinder rod must be held at the flat on the end of the rod to prevent rotation.

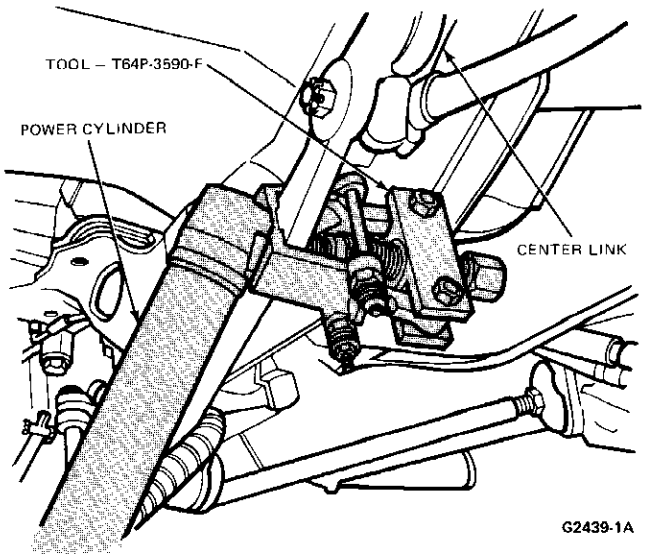


FIG. 6 Disconnecting Power Cylinder Stud

3. Remove the cotter pin and castellated nut that secures the power cylinder stud to the centerlink.
4. Disconnect the power cylinder stud from the centerlink. It is necessary to use the steering arm remover tool, No. T64P-3590-F (Fig. 6). **Use of any other tool will result in damage to the power cylinder.**

NOTE: It is necessary to lower the linkage to install the T64P-3590-F removal tool. If the control valve has been removed from the pitman arm for service, it is possible to lower the linkage as shown in Fig. 7, View A.

If only the power cylinder is to be removed, remove the nuts, washers and bolts that attach the idler arm and lower the linkage as shown in Fig. 7, View B.

5. Remove the insulator sleeve and washer from the end of the power cylinder rod. Remove the cylinder rod boot and discard the clamp.
6. Reconnect idler arm bracket to side rail, if disconnected above. Torque attaching bolts to 50-65 ft-lb.

Installation

1. Install the cylinder rod boot with a new clamp.
2. Install the washer, sleeve, and the insulator on the end of the power cylinder rod.
3. Extend the rod as far as possible. Insert the rod in the bracket on the frame and compress the rod, if necessary, to insert the stud in the centerlink. Secure the stud with a castellated nut and a cotter pin. Torque the nut to 35-47 ft-lb.
4. Secure the power cylinder rod with an insulator, washer, nut, and pal nut. Torque the hex nut to 18-24 ft-lb. and the pal nut to 3-5 ft-lb. Distance across washers must be 1-1/4-1-3/8 inches.
5. Connect the two fluid lines into the correct power cylinder ports. Position the lines so that they are parallel to each other, and tighten. Torque the tube nuts to 15-19 ft-lb.
6. Lower the vehicle and fill the fluid reservoir with fluid (C1AZ-19582-A, C, D) per Start Up Procedure in Part 13-01.

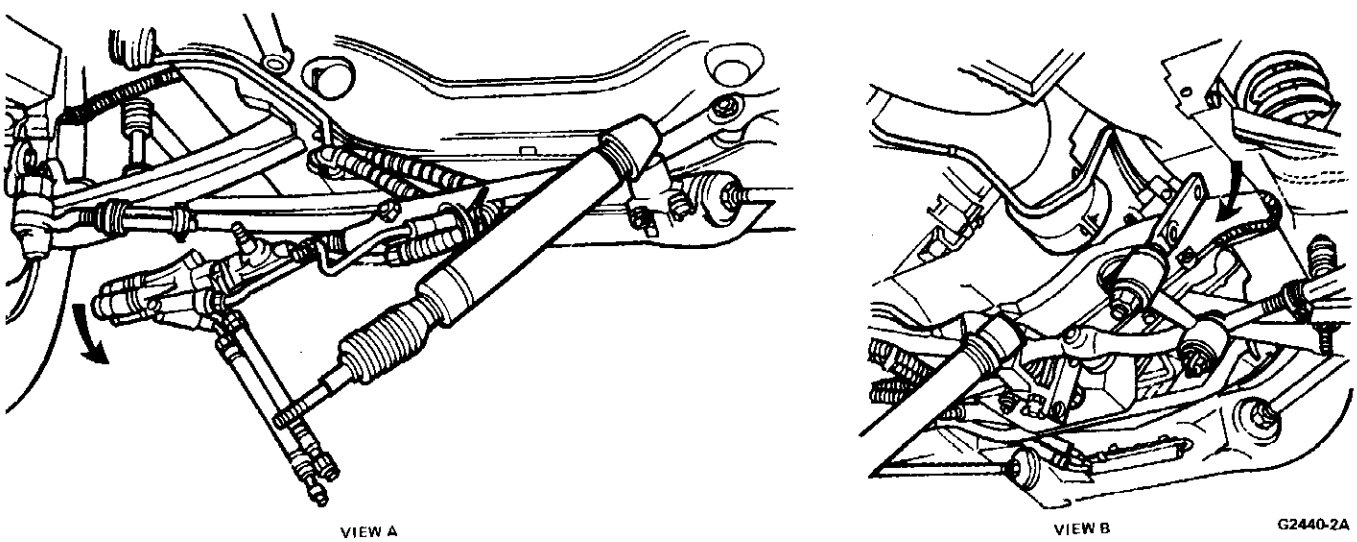


FIG. 7 Lowering Steering Linkage

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CONTROL VALVE TO POWER STEERING CYLINDER HOSE

Removal

1. Raise the vehicle and disconnect the control valve-to-power cylinder hoses from the power cylinder and allow the fluid to drain.
2. Disconnect the control valve-to-power cylinder hoses from the control valve.

Installation

1. Connect the unmarked end of the shorter control valve-to-power cylinder hose to port valve "C" (Fig. 5). Connect the other hose to port "A". Hold the tube so that the bend is parallel to the surface of the valve. Torque the tube nut (1/2" hex) to 15-19 ft-lb. Connect the opposite end to the lower port in the power cylinder. Hold the tube while tightening to prevent the tube from twisting. Torque the nut to 15-19 ft-lb. **Do not tighten beyond specification.** Connect the other tube to port "A". Make sure the tubes are parallel and torque the nut to 15-19 ft-lb. Connect the opposite end to the upper port of the power cylinder and torque to 15-19 ft-lb. **Do not tighten beyond specification.**
2. Lower the vehicle and fill the fluid reservoir with fluid per Start Up Procedure in Part 13-01.

POWER STEERING PUMP TO CONTROL VALVE HOSE

Removal

1. Remove the fluid from the reservoir with a clean suction gun.
2. Raise the vehicle on a hoist.
3. Remove the worm-screw hose clamp that secures the fluid lines to the outside of the control valve and drain the lines.
4. Lower the vehicle and disconnect the fluid return hose from the reservoir.
5. Disconnect the fluid pressure hose from the pump outlet fitting.
6. On 5.0/5.8L (302/351 CID) only, remove the bolts and clips attaching the hoses, insulator, and retainer and remove the hoses, insulator and retainer as an assembly.
7. Remove the pressure and return hoses from the retainer and insulator.

Installation

1. On 5.0/5.8L (302/351 CID) only, install the pressure and return hoses in the insulator and retainer. The paint stripe on the pressure hose must align with the slot on the insulator. The paint or tape band on the return hose must center in insulator. Position the assembly at the original location and install the attaching bolts.
2. Place a hose clamp on the fluid return hose and install the hose on the power steering pump reservoir return fitting.
3. Torque the hose clamp to 12-24 in-lb. Connect the pressure hose to the outlet fitting and torque the tube nut to specification (16-25 ft. lbs.). **Do not tighten beyond specification.**
4. Raise the vehicle and connect the pressure and return lines to the control valve, finger tight.
5. Install the worm-screw clamp on the lines and torque to 36-60 in-lb, now torque the tube nuts in Step 4; the return hose nut (5/8" hex) to 16-25 ft-lb, and the pressure hose nut (1/2" hex) to 15-19 ft-lb. **Do not tighten beyond specification.**
6. Lower the vehicle and fill the fluid reservoir with fluid per Start Up Procedure in Part 13-01.

POWER CYLINDER SEAL

Removal

1. Remove the power cylinder and clamp it in a vise. **Be careful not to damage the cylinder in the vise and do not clamp onto the ball stud or the tube.**
2. Remove the snap ring.

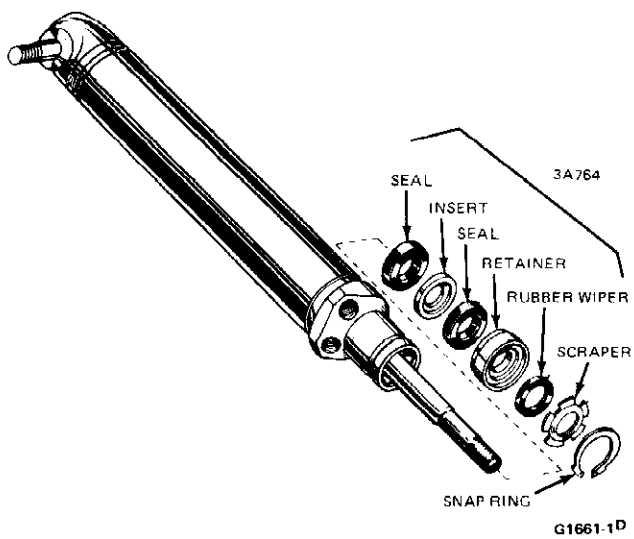


FIG. 8 Power Cylinder

3. Pull the piston rod out to remove the scraper, rubber wiper, retainer, and seals. If necessary, use a pick to remove seals. **Do not damage the shaft or seal seat with the pick.**

Installation

1. When replacing seals, use all the parts in the repair kit. Coat the new seals and the piston rod with lubricant (COAZ-19553-A) and install repair kit parts (Fig. 8). Make sure that the garter spring on the seal is toward the bottom of the seal cavity and that the flat side of the plastic retainer is toward the inner seal.
2. Push the rod all the way in and install the parts in the cylinder with a long reach socket wrench that is slightly smaller than the cylinder opening, or a piece of electrical conduit that is 15/16" OD x 6" (Fig. 9). **Exercise care, when assembling the seals on the rod, particularly at the rod shoulder.**
3. Replace the snap ring.

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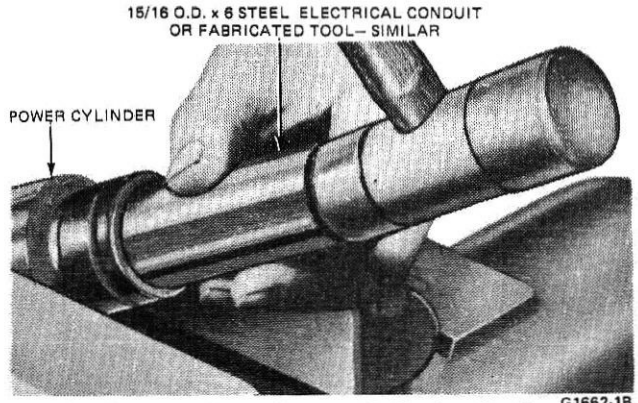


FIG. 9 Installing Power Cylinder Seals

DISASSEMBLY AND ASSEMBLY

CONTROL VALVE

Disassembly

1. Remove the control valve as described in this Part and wipe all loose dirt and fluid from the outside.
2. Remove the control valve spring cap and spring cap gasket from the valve housing (Fig. 2). **For disassembly, use a soft-jawed vise and clamp the valve around the sleeve flange to prevent damage to the housing, spool, or sleeve.**
3. Remove the centering spring adjusting nut from the end of the control valve spool bolt. Remove the two washers, two spring seats, the spacer, and the centering spring, from the spool bolt. Remove the adapter plate.
4. Remove the two bolts that hold the control valve housing and valve sleeve together. Slide the valve housing from the sleeve.
5. Use a finger to push the valve spool toward the **spring cap end** of the housing and remove the seal and bushing.
6. Push the valve spool from the spring cap end of the housing to the sleeve end, forcing the other seal and bushing, plus the spacer, cushion, and washer to fall out. Remove the control valve spool. **Note the direction the spool is removed from the valve housing as it must be assembled in the same direction.**
7. Remove the spring plug and O-ring from the actuator end of the control valve housing with pliers. Remove the washer and spring from the same hole.
8. Invert the valve housing and repeat Step 7.
9. Remove the reaction limiting valve (Fig. 10).
10. Remove the control valve sleeve-to-control valve housing gasket from the housing end of the control valve sleeve.
11. Remove the two dust shield clamp screws, and remove the dust shield. Inspect the shield for damage in the garter spring area (Fig. 11).
12. Tilt the ball stud toward the clamp end of the sleeve. Pull the control valve spool bolt as far out as possible; the stop-pin will fall out or can easily be pushed out with a cotter pin (Fig. 12). (Remove grease to locate stop-pin, if necessary.)

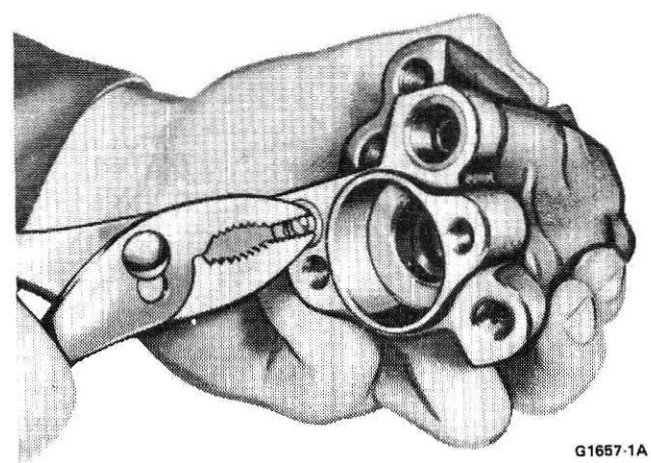


FIG. 10 Removing Reaction Valve

13. Unscrew the travel regulator on the flats with the proper wrench and lay the regulator and the control valve spool bolt aside.
14. Slide the ball stud toward the clamp end as far as possible to move the ball stud socket to that end of the valve sleeve (Fig. 13, Step A). Remove the ball stud by moving it toward the housing end and pulling it straight out (Fig. 13, Step B). Remove the ball stud socket, the bumper, the bumper spring, and the two ball stud seats.

Assembly

1. Coat all parts of the control valve, except the seals with ATF fluid (C1AZ-19582-A, C, D or equivalent). Coat the seals with COAZ-19553-A or equivalent.
2. Install the reaction valve, two washers, the two springs, and the two spring plug and O-ring assemblies. **Inspect the O-rings for damage and replace, if necessary. Make sure the reaction valve cavity is free of dirt.**

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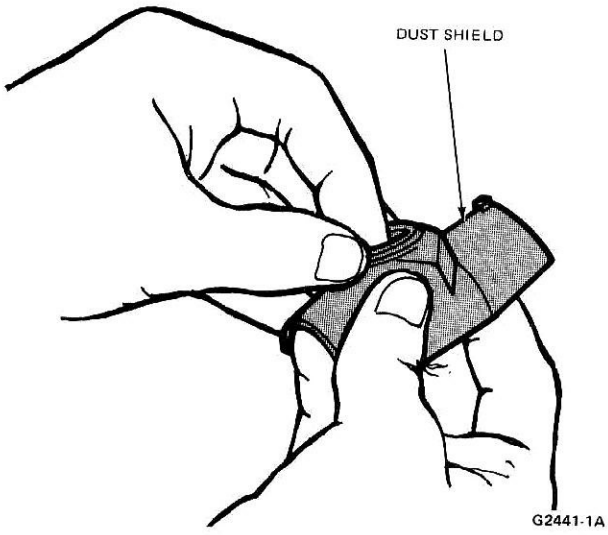


FIG. 11 Inspecting Dust Shield

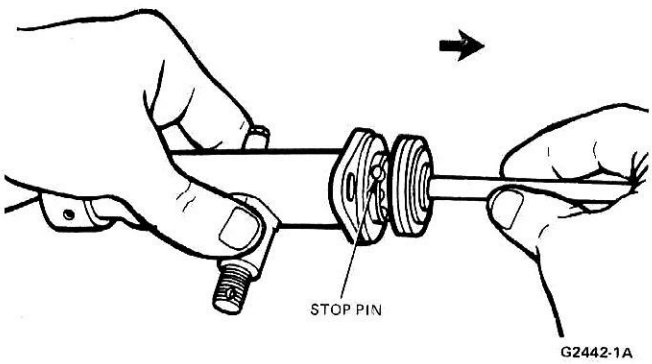


FIG. 12 Removing Stop Pin

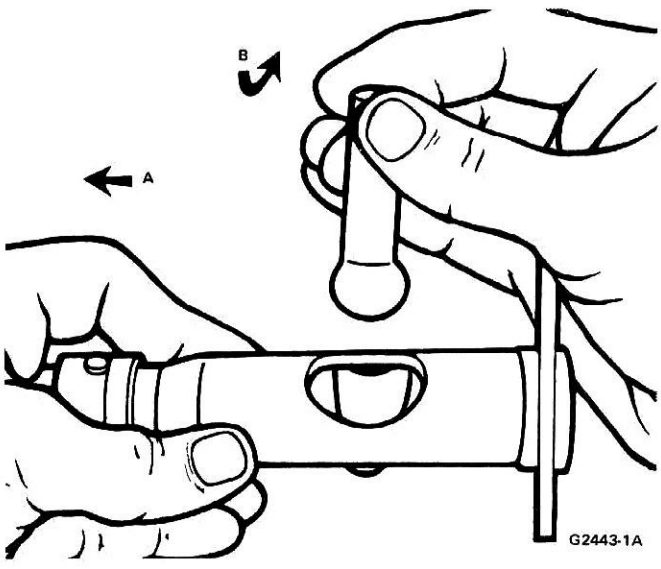


FIG. 13 Removing Ball Stud

3. Insert one of the ball stud seats, flat end first, into the ball stud socket (Fig. 14). Place the ball stud socket into the control valve sleeve as far as possible with the threaded end towards the flange. Insert the ball stud through the openings in the valve sleeve and the ball stud socket (Fig. 14). Pull the socket out as far as possible and hold it on the socket at the ball stud opening (Fig. 10). Insert the remaining seat, round side toward stud. Install the bumper and the bumper spring. Assemble the travel regulator and spool bolt. Install cushion and washer onto regulator and thread regulator into ball stud socket. Using the proper wrench on the flats of the regulator, torque the travel regulator to 5-10 ft-lb. Then loosen the regulator until the nearest hole is aligned with the slots, at least 1/2 a hole but no more than 1-1/2 hole. Insert the pin. It may be necessary to rotate spool bolt to allow slot in head to align with pin. Tilt the ball stud toward the housing end to retain the pin. Place nut onto stud to protect threads. Using an in-lb torque wrench, measure the torque required to rotate the ball stud. If rotational torque exceeds 35 in-lb, verify proper assembly and adjustment. It may be necessary to loosen the regulator to the 1-1/2 hole location. Lay assembly aside.

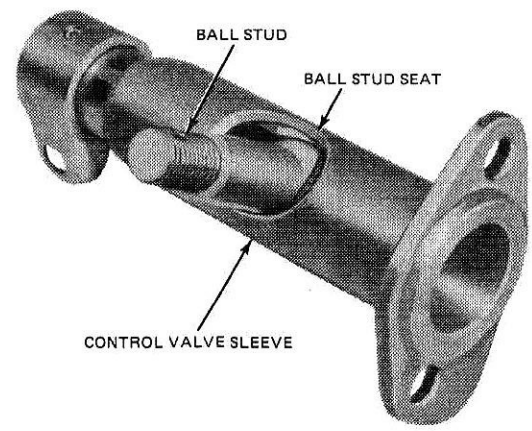


FIG. 14 Installing Ball Socket, Seal and Bracket

4. Install the spool seal, seal bushing, washer, cushion and spacer into the sleeve end of the housing and place on a flat surface. Carefully rotate the spool into the housing (with the large groove nearest the cap end, Fig. 15) until contact with the spool seal is felt. Pick up the housing and press on the cushion at the sleeve end while rotating the spool through the seal. Position the spool so it just protrudes through the seal bushing and install the seal over the spool at the cap end. Place the sleeve end on a flat surface. Using a small blunt screwdriver, work the seal into the housing. Do not scratch the spool, seal, or housing. Install the seal bushing.
5. Install the gasket on the sleeve assembly and attach to the housing. Torque the bolts to 12-19 ft-lb.
6. Move the ball stud laterally to see if it moves freely for about 0.20 inches.
7. Assemble the washer, spacer, adapter, spring seat, control valve centering spring, the other spring seat and washer, and the control valve spool bolt nut.

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Torque nut to 90-100 in-lb, then loosen the nut with respect to the spool bolt 1/4 turn (Fig. 16). The ball stud socket will turn first. The 1/4 turn applies after the stud has hit the sleeve window and the spool bolt has turned to its stop.

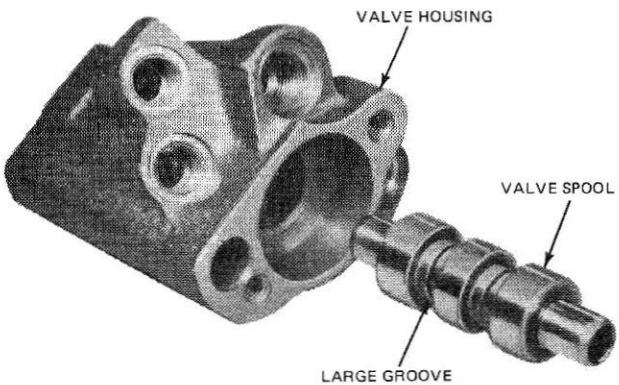


FIG. 15 Inserting Valve Spool

8. While holding the adapter plate to the housing, move the stud back and forth to check freedom of travel (Fig. 17).
9. Lubricate and install the spring cap gasket and the spring cap. Torque the screws to 72-100 in-lb.
10. Install the boot and clamp over the stud. Make sure the boot garter spring is attached. Loosely assemble the screws. Move the stud sideways to determine the center position and hold there. Position the clamp against the grease fitting. Tighten the screws until the clamp is secure.
11. Remove the grease plug and grease unit with .35-.55 oz. of lube ESA-M1C47-A or equivalent (Fig. 17). **Do not fill beyond specification.**

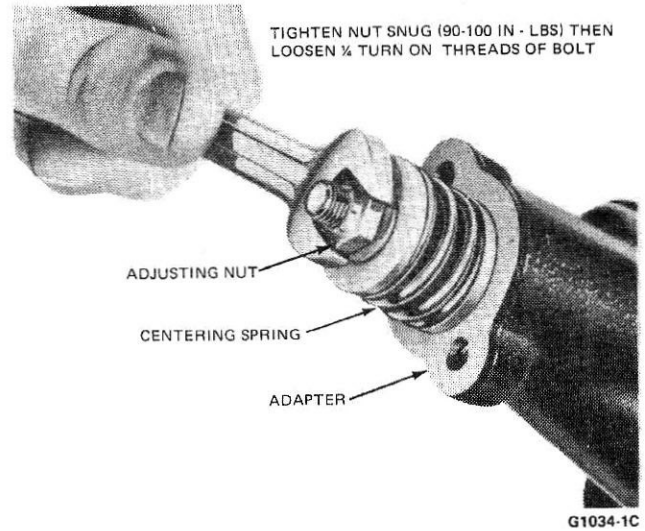


FIG. 16 Adjusting Centering Spring

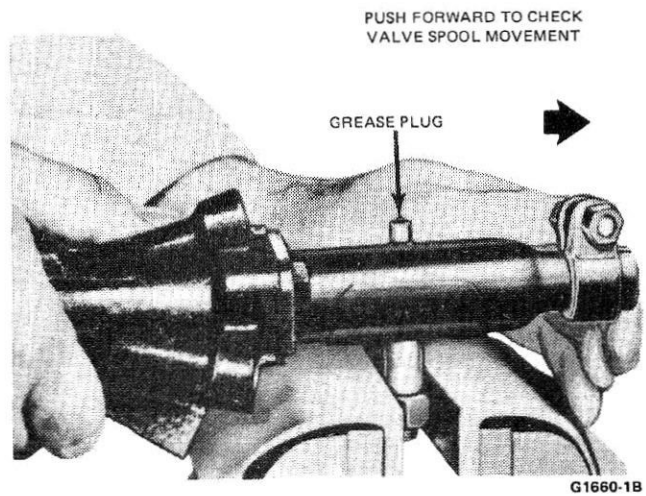


FIG. 17 Inspecting Valve Spool Movement

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SPECIFICATIONS

POWER ASSIST STEERING GEAR SPECIFICATIONS

Description	Granada/Monarch, Versailles
Model	SMA-Y
Gear Ratio	16:1
Turns of Strg. Gr. (Lock to Lock) (1)	4
Lube Type	*ESW-M1C87-A
Lube Capacity (Lb.)	.70 ± .07
Worm Bearing Preload (In-Lb) (2)	2-4
Total Center Meshload (In-Lb) (3)	5-7
Adjustment	Adjusting Screw to bottom of sector shaft slot clearance: .000-.004"
Minimum Meshload Over Preload (In-Lb)	2

(1) Gear only – not attached to Pitman Arm

(2) Torque required to rotate input shaft at approximately 1½ turns either side of center (gear out of vehicle or Pitman arm disconnected).

(3) Required to rotate input shaft and worm assembly past the center high point.

*Steering Gear Grease C3AZ-19578-A or equivalent.

POWER ASSIST STEERING GEAR TORQUE LIMITS (FT-LB)

Description	Torque Limit
Sector Shaft Cover Bolts	17-25
Mesh Load Adjusting Screw Lock Nut	32-40
Ball Return Guide Clamp Screw	18-42 (In-Lb)
Preload Adjuster Lock Nut	60-80
Lubricant Fill Plug and Vent	3-9 (1)
Valve-to-Cylinder Hose	15-19
Pressure Hose-to-Valve	15-19
Return Hose-to-Valve	16-25
Pressure Hose-to-Insulator Assy. (8-Cyl. Only)	15-19
Hose Clamps	1-2
Pressure Hose-to-Pump (8-Cyl.)	16-25
Centering Spring Adjusting Nut	90-100 (In-Lb)
Spring Cap Attaching Screws	72-100 (In-Lb)
Valve Sleeve Clamp Bolt	13-17
Ball Stud Nut	35-47
Idler Arm Bracket to Side Rail Bolts	50-65
Power Cylinder Rod Attaching Nut	18-24
Worm Screw Hose Clamp	36-47 (In-Lb)

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL-3290-C	Tie Rod Ball Ends and Control Valve Ball Stud Remover

Tool No.	Description
T64P-3590-F	Steering Pitman Arm Remover

CG1849-2H

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Integral Power Steering Gear—Ford

PART 13-41

Applies To Ford/Mercury, LTD II, Cougar, Thunderbird, Lincoln Continental, and Continental Mark V

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CG2426-2B

DESCRIPTION

STEERING GEAR

The steering unit (Fig. 1) is a torsion-bar type of hydraulic assisted system. The system furnishes power to reduce the amount of effort required to turn the steering wheel. It also reduces road shock and vibration.

The torsion bar power steering unit includes a worm and one-piece rack piston which is meshed to the gear teeth on the steering sector shaft. The unit also includes a hydraulic rotary valve sleeve assembly, input shaft and torsion bar assembly which are mounted on the end of the worm shaft and operated by the twisting action of the torsion bar.

The torsion-bar type of power steering gear is designed with the one piece rack-piston, worm and sector shaft in one housing and the rotary valve sleeve assembly in an attaching housing (Fig. 1). This makes possible internal fluid passages between the rotary valve sleeve and cylinder, eliminating all external lines and hoses, except the pressure and return hoses between the pump and gear assembly.

The power cylinder is an integral part of the gear housing. The piston is double acting: Fluid pressure may be applied to either side of the piston.

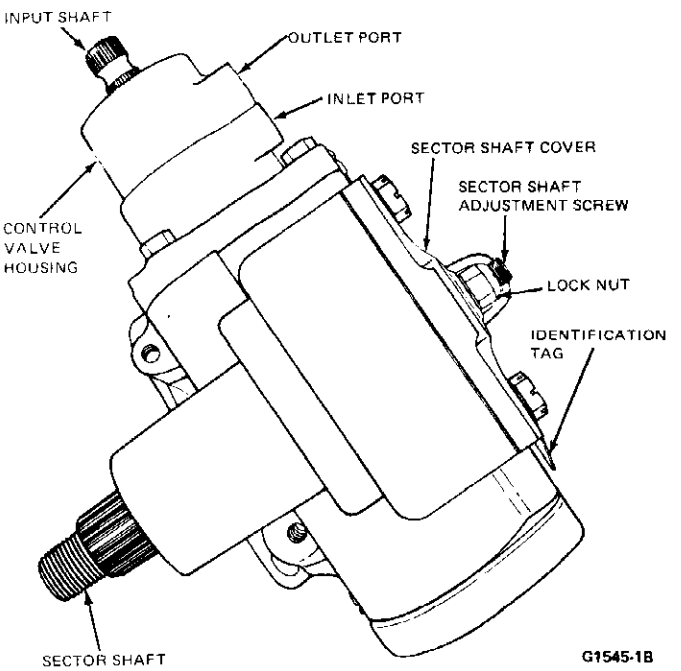


FIG. 1 Ford Integral Power Steering Gear

OPERATION

The control valve is a unique rotary valve sleeve design which uses relative rotational motion of the input shaft and valve sleeve to direct fluid flow. The relative motion is accomplished by deflecting a torsion bar which is attached to the worm with a pin.

In a neutral (straight-ahead) position, where no power assist is required, the valve spool is held in a central position by the torsion bar. The fluid flows from the inlet port through the valve to the outlet port and back to the pump. No area of the steering gear is under high pressure in this position.

The valve, and housing cylinder are always full of power steering fluid, which dampens road shock that otherwise would be transmitted to the driver through the steering wheel.

When the steering wheel is turned, resistance of the wheels and the weight of the vehicle cause the torsion bar to deflect. This deflection changes the relative position of the valve spool and sleeve ports, directing fluid under pressure to the appropriate end of the piston in the gear housing.

The difference in pressure forces on the piston helps move the sector shaft, thus assisting in the turning effort. The oil in the opposite end of the gear housing is forced out through the return outlet of the control valve and back to the pump reservoir. With higher

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steering efforts, increased valve displacement will give the driver proportionately higher assisting pressure. The driver will have a smooth hydraulic assist at all times.

When the driver stops applying steering effort, the valve is forced back to a centered position by the torsion bar. When this occurs, pressure is equalized on both sides of the piston. The steering geometry will tend to return the front wheels to the straight-ahead position.

NOTE: A hissing noise is a normal characteristic of rotary valve steering gear and in no way affects steering. Do not replace the shaft and control assembly unless the hissing noise is extremely objectionable. A replacement valve will also exhibit slight noise, and is not always a cure for the complaint. Any metal-to-metal contacts at the flexible steering shaft coupling (due to column misalignment) will transmit valve hissing noise into the passenger compartment.

The only service that can be performed on the control valve assembly is replacement of the four (4) teflon seals on the valve sleeve.

There is no provision for adjusting the steering or turning effort. Refer to Adjustments for instructions.

ADJUSTMENTS

MESH LOAD

During the vehicle breaking-in period, some factory adjustments may change. These changes will not necessarily affect operation of the steering gear assembly, and need not be adjusted unless there is excessive lash or other malfunctioning.

Adjustment in Vehicle

Adjust the total-over-center position load to eliminate excessive lash between the sector and rack teeth as follows:

1. Disconnect the Pitman arm from the sector shaft.
2. Disconnect the fluid return line at the reservoir and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from left to right to discharge the fluid from the gear.
4. Turn the steering wheel to 45 degrees from the left stop.
5. Using an in-lb torque wrench on the steering wheel nut, determine the torque required to rotate the shaft slowly approximately 1/8 turn from the 45 degree position.
6. Turn the steering wheel back to center, and determine the torque required to rotate the shaft back and forth across the center position. Loosen the nut, and turn the adjuster screw (Fig. 2) until the reading is 14 to 18 in-lb greater than the torque measured at 45 degrees from the stop. Tighten the nut while holding the screw in place.
7. Recheck the readings and replace the Pitman arm and steering wheel hub cover.
8. Connect the fluid return line to the reservoir and fill the reservoir as specified in Part 13-01. **Do not pry against the reservoir to obtain proper belt load. Pressure may deform the reservoir causing it to leak.**
9. Recheck belt tension and adjust, if necessary. Torque the bolts and nut to 30 to 40 ft-lb.

ROTARY VALVE CENTERING CHECK

1. Install a 0-2000 PSI pressure gauge (Tool T56L-33610-D) in the pressure line between the power steering pump outlet port and the integral steering gear inlet port. **Be sure that the valve on the gauge is fully open.**

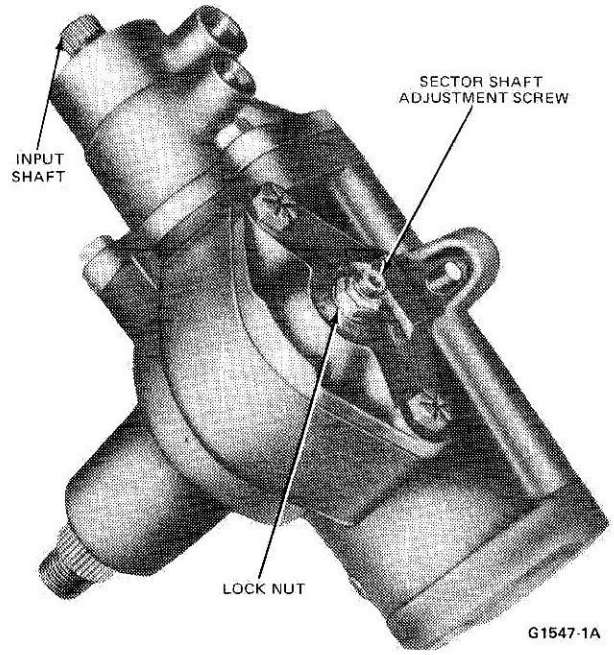


FIG. 2 Adjusting Mesh Load

2. Check the fluid level in the reservoir and add fluid if necessary.
3. Start the engine and turn the steering wheel from stop-to-stop to bring the steering lubricant to normal operating temperature. Turn off the engine and recheck the fluid level. Add fluid, if necessary.
4. With the engine running at approximately 1000 rpm and the steering wheel centered, attach an in-lb torque wrench to the steering wheel nut. Apply sufficient torque in each direction to get a gauge reading of 250 PSI.
5. The torque wrench readings should be the same in both directions at 250 PSI. If the difference between the readings exceeds 4 in-lbs, remove the steering gear and replace the shaft and control assembly.
6. When performing the valve spool centering check outside the vehicle, use the procedures described above, except take the torque and pressure readings at the right and left stops instead of either side of center.

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REMOVAL AND INSTALLATION

STEERING GEAR

Removal

1. Tag the pressure and return lines for future identification.
2. Disconnect the pressure and return lines from the steering gear. Plug the lines and ports in the gear to prevent entry of dirt.
3. Remove the bolts that secure the flexible coupling to the steering gear and column.
4. Raise the vehicle and remove the sector shaft attaching nut.
5. Remove the Pitman arm from the sector shaft with Tool T64P-3590-F. Remove the tool from the Pitman arm. **Do not damage the seals.**
6. On vehicles with standard transmissions, remove the clutch release lever retracting spring to provide clearance for removing the steering gear.
7. Support the steering gear. Remove the steering gear attaching bolts.
8. Remove the clamp bolt that holds the flexible coupling to the steering gear. Work the gear free of the flex coupling and remove.
9. If the flex coupling did not come off with the gear, lift it off the shaft.

Installation

1. Slide the flex coupling into place on the steering shaft assembly. Turn the steering wheel so the spokes are in the normal position.
2. Center the steering gear input shaft.
3. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the attaching bolts and torque to specification.
4. Be sure the wheels are in the straight ahead position. Then install the Pitman arm on the sector shaft. Install and tighten the sector shaft and attaching bolts. Torque the bolts to specification.
5. Move the flex coupling into place on the input and steering column shaft. Install the attaching bolts and torque to specification.
6. Connect the pressure and the return lines to the steering gear. Tighten the lines.
7. Fill the reservoir as described in Part 13-01. Turn the steering wheel from stop-to-stop to distribute the fluid.
8. Recheck the fluid level and add fluid, if necessary.
9. Start the engine and turn the steering wheel from left to right. Inspect for fluid leaks.

DISASSEMBLY AND ASSEMBLY

Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the unit with solvent. Drain off excess hydraulic oil, if necessary.
3. **Handle all parts carefully to avoid nicks, burrs, scratches and dirt.**
4. **Do not use solvent on seals.**

STEERING GEAR

Disassembly

1. Hold the steering gear upside down over a drain pan and turn the input shaft from left to right several times to drain the fluid from the gear.
2. Using mounting pads for support, secure the gear in a Bench Mounted Holding Fixture T57L-500-A.
3. Remove the lock nut from the adjusting screw.
4. Turn the input shaft to either stop, then back approximately one and three-quarter turns to center the gear.
5. Remove the sector shaft cover bolts, brake line bracket, and identification tag.
6. Tap the lower end of the sector shaft with a soft-hammer to loosen it, then lift the cover and shaft as an assembly from the housing. Discard the O-ring.
7. Turn the sector shaft cover counterclockwise to remove the cover from the adjuster screw.
8. Remove the valve housing attaching bolts. Hold the piston to keep it from spinning off the shaft and separate the valve housing from the steering gear housing. Remove the valve housing and control valve seals. Discard the seals.
9. Stand the valve body and piston on end with the piston end down. Rotate the input shaft counterclockwise out of the piston allowing the ball bearings to drop into the piston.
10. Place cloth over the open end of the piston and turn it upside down to remove the balls.
11. Remove the screws that attach the ball guide clamp (Fig. 5) to the ball nut. Remove the clamp and the guides.
12. Install the valve body assembly in the bench mounted holding fixture Tool T57L-500-A, and loosen the Allen head face nut screw in the valve housing. Remove the worm bearing race nut (Fig. 3).
13. Carefully slide the input shaft, worm, and valve assembly out of the valve housing. Due to the close fit between the valve sleeve and housing, the slightest cocking of the spool may jam it in the housing and damage the sleeve and the rings on the sleeve.

Assembly

1. Mount the valve housing in the bench mounted holding fixture Tool T57L-500-A, with the flanged end up.
2. Apply a light coat of gear lubricant to the valve sleeve rings on the valve sleeve.
3. Carefully install the worm and valve in the housing.
4. Install the race nut in the housing and torque it to specification (Fig. 4). Refer to special torque procedure in Specifications Section.

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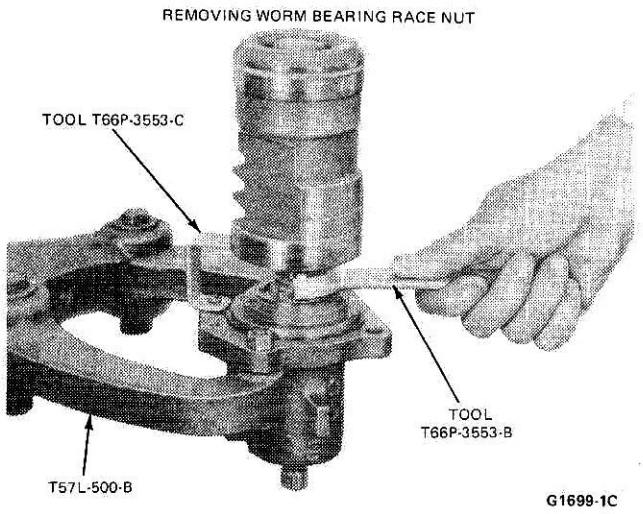


FIG. 3 Removing Worm Bearing Race Nut

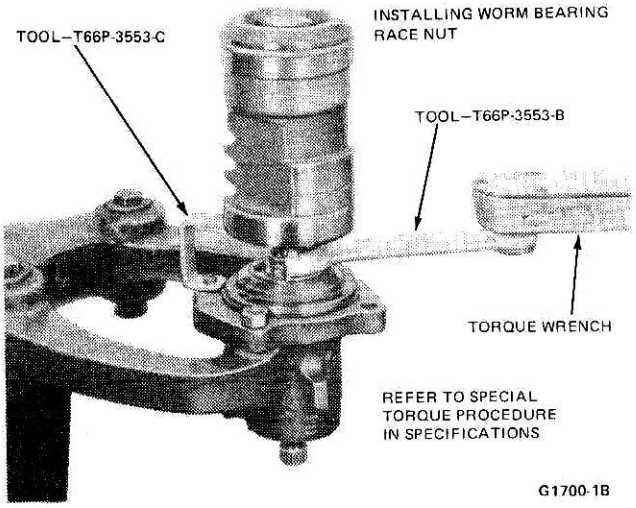


FIG. 4 Installing Worm Bearing Race Nut

5. Install the Allen head race nut set screw through the valve housing and torque to specification.
6. Place the piston on the bench with the ball guide holes up. Insert the worm shaft into the piston so the first groove is in line with the hole nearest the center of the piston (Fig. 6).

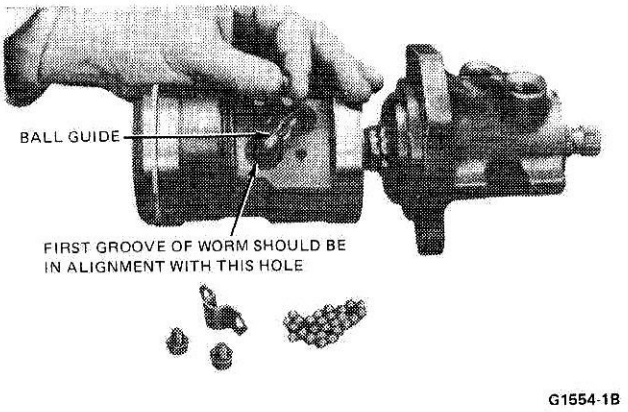


FIG. 6 Assembling Piston on Worm Shaft

7. Place the ball guide in the piston. Turning the worm clockwise, as viewed from the input end of the shaft, place 27 to 29 balls, depending on the piston design, in the ball guide (Fig. 6). If all the balls have not been inserted upon reaching the right stop, rotate the input shaft in one direction then the other while inserting the remaining balls. Once the balls are inserted, do not rotate the input shaft or piston more than three and one-half turns off the right stop, or the balls will fall out of the circuit.
8. Secure the guides in the ball nut with the clamp (Fig. 6).
9. Apply petroleum jelly to the seal on the piston.
10. Place new control valve seals on the valve housing.
11. Slide the piston and valve into the gear housing. **Do not damage the seal.**
12. Align the lube passage in the valve housing with the passage in the gear housing. Install **but do not tighten** the attaching bolts.
13. Rotate the ball nut so the teeth are in the same plane as the sector teeth. Torque the valve housing bolts to specification.
14. Install the sector shaft cover O-ring in the steering gear housing. Turn the input shaft to center the piston.
15. Apply petroleum jelly to the sector shaft journal. Position the sector shaft and cover assembly in the gear housing. Install the brake line bracket, steering

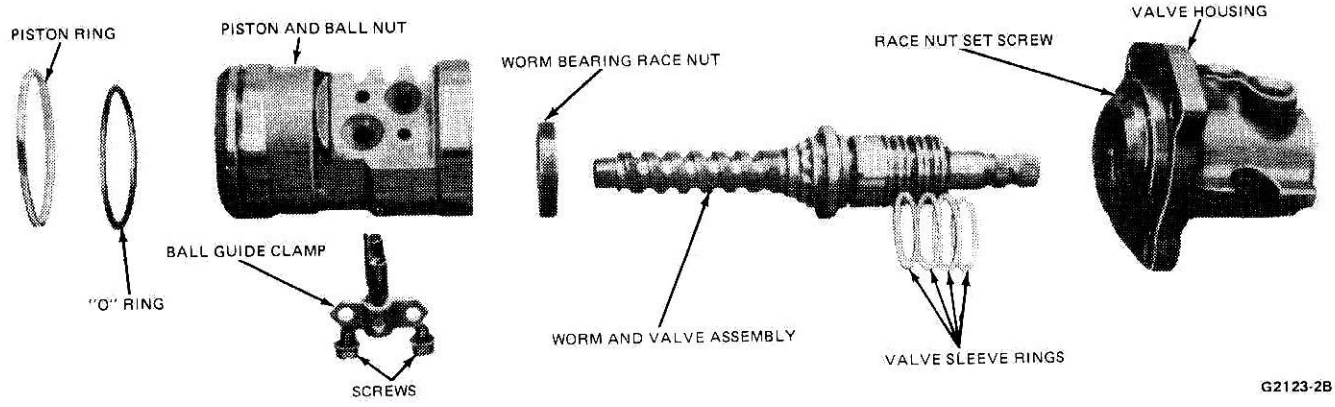


FIG. 5 Ball Nut and Housing Disassembled—Rotary Valve Type

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identification tag and sector shaft cover bolts. Torque the bolts to specification.

16. Using an in-lb torque wrench, adjust the gear input shaft meshload to specification.

STEERING GEAR HOUSING

Disassembly and Assembly

1. Remove the snap ring from the lower end of the housing (Fig. 8).
2. Remove the lower seal from the housing (Fig. 7).

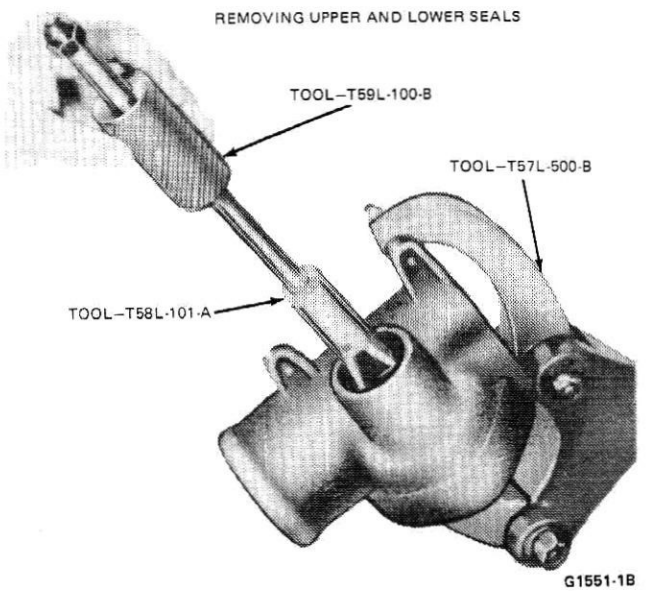


FIG. 7 Removing Upper and Lower Seals

3. Remove the upper seal from the housing.
4. Lubricate both new sector shaft seals with clean lubriplate or equivalent.
5. Apply lubriplate or equivalent to the sector shaft seal bore in the housing.
6. Place the dust seal on tool T77L-3576-A so the raised lip of the seal will fit into the seal driver tool. Then slide the pressure seal onto the tool. The flat back side of the seal should be against the flat side of the dust seal (Fig. 8).
7. Insert the seal driver tool into the sector shaft bore, carefully aligning the seals with the bore. Slowly drive on the tool until the seals are seated in the bore.
8. Install the snap ring in the gear housing, seating the snap ring in its groove.

VALVE HOUSING

Disassembly and Assembly

1. Remove the dust seal (Fig. 9) from the rear of the valve housing, using Tools T59L-100-B and T58L-101-A. Discard the seal.
2. Remove the snap ring from the valve housing.
3. Turn the fixture so the valve housing is upside down.
4. Insert Tool T65P-3524-A2 and A3 in the valve body assembly opposite the seal and gently tap the bearing and seal out of the housing (Fig. 10). Discard the seal. **Do not damage the valve bore in the housing when inserting and removing the tool.**
5. Remove the fluid inlet and outlet tube Seats with Tube Seat Remover T74P-3504-L if they are damaged.

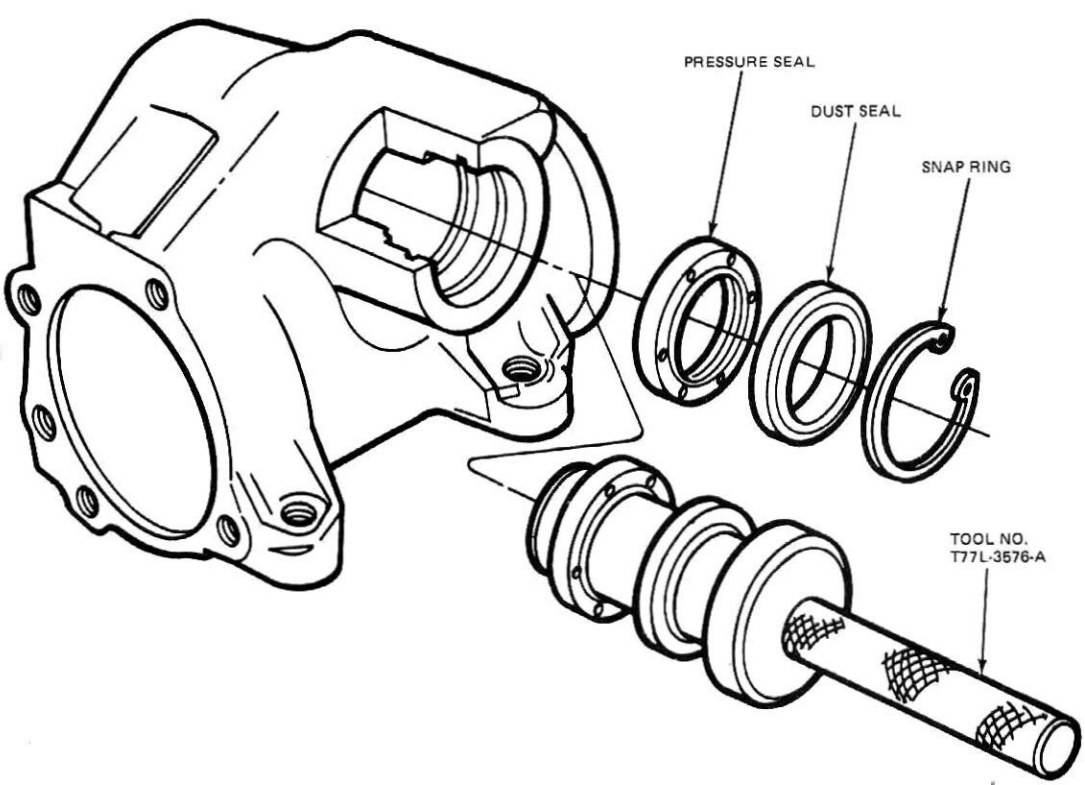


FIG. 8 Installing Sector Shaft Seals

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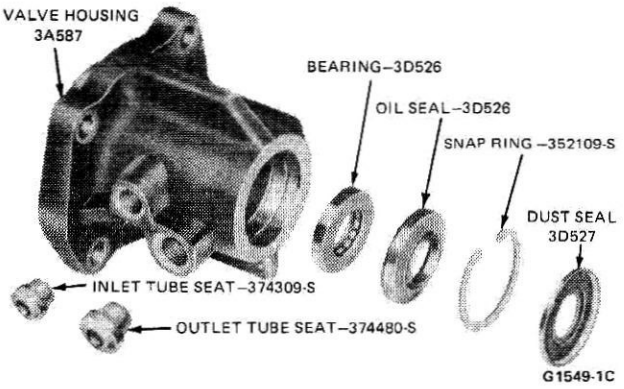


FIG. 9 Valve Housing Disassembled

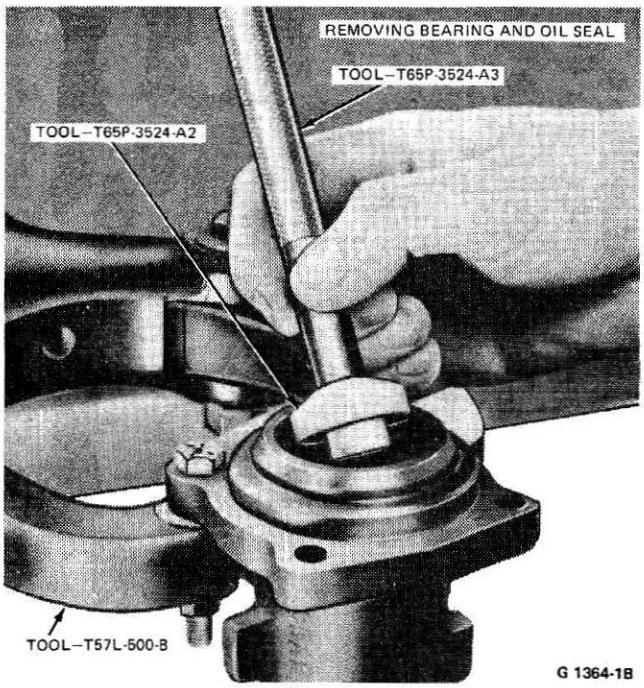


FIG. 10 Removing Bearing and Oil Seal

6. Coat the fluid inlet and outlet tube seats with petroleum jelly and install them in the housing with Tube Seat Replacer T74P-3504-M.
7. Coat the bearing and seal surface of the housing with petroleum jelly.
8. Install the bearing in the valve housing and seat the bearing as shown in Fig. 11. Be sure the bearing rotates freely.
9. Dip a new oil seal in gear lubricant and place it in the housing with the metal side facing outward. Drive the seal into the housing until the outer edge does not quite clear the snap ring groove (Fig. 12).
10. Place the snap ring in the housing and drive the snap ring until ring seats in its groove (Fig. 12).
11. Place the dust seal in the housing **with the rubber side facing out.** Drive the seal until it seats behind the undercut in the input shaft.

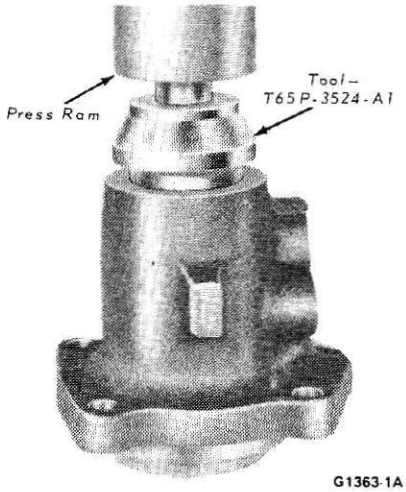


FIG. 11 Installing Valve Housing Bearing

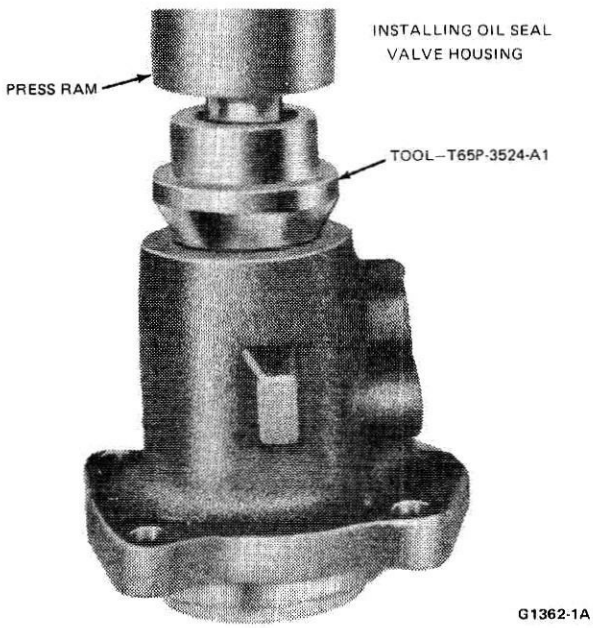


FIG. 12 Installing Oil Seal in Valve Housing

WORM AND VALVE SLEEVE

Disassembly and Assembly

1. Remove valve sleeve rings from sleeve by inserting the blade of a small pocket knife under them and cutting them off (Fig. 13).
2. Mount the worm end of the worm and valve sleeve assembly into a soft jawed vise (Fig. 14).
3. Install mandrel Tool T75L-3517-A1 over the sleeve; slide one valve sleeve ring over the tool (Fig. 15).
4. Slide the pusher Tool T75L-3517-A2 over the mandrel; rapidly push down on the pusher tool, forcing the ring down the ramp and into the fourth

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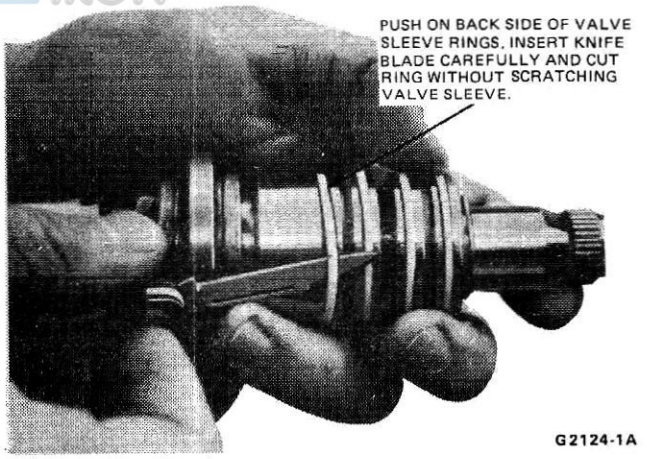


FIG. 13 Removing Valve Sleeve Rings

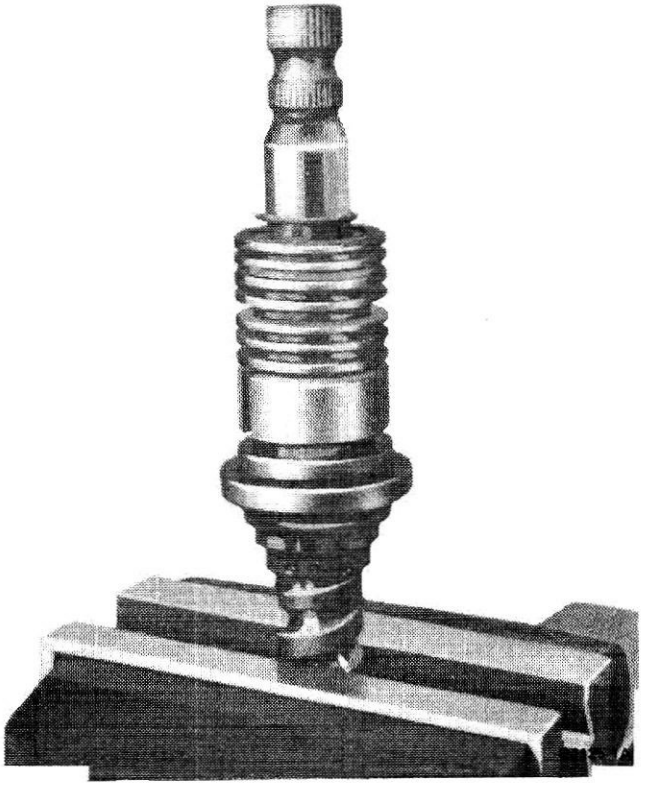


FIG. 14 Worm and Sleeve With Ring Removed

groove of the valve sleeve. Repeat this step three more times, and each time add one of the spacers, Tool T75L-3517-A3, under the mandrel tool. By adding the spacer each time, the mandrel tool will line up with the next groove of the valve sleeve (Figs. 16 and 17).

5. After installing the four valve sleeve rings, apply a light coat of gear lubricant to the sleeve and rings.
6. Install one spacer over the input shaft as a pilot for installing the sizing tube. Slowly install the sizing tube, Tool T75L-3517-A4, over the sleeve valve end of the worm shaft onto the valve sleeve rings. Make sure that the rings are not being bent over as the tube is slid over them (Figs. 18 and 19).

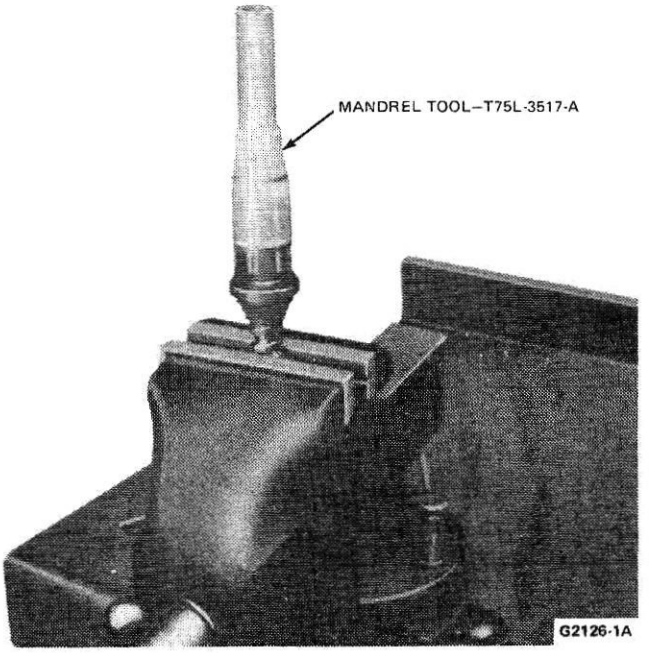


FIG. 15 Mandrel Installed on Sleeve

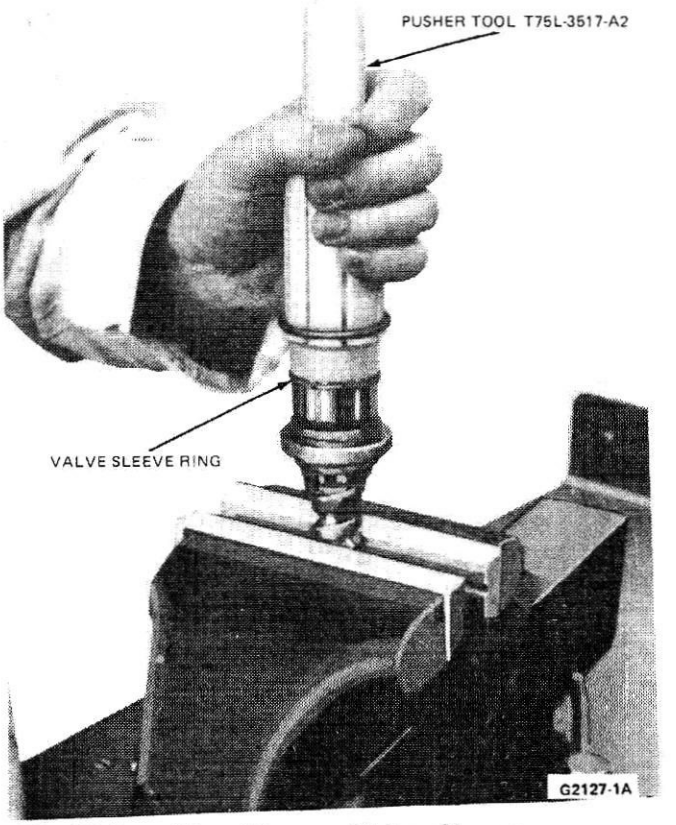


FIG. 16 Installing Ring on Valve Sleeve

7. Remove the sizing tube and check the condition of the rings. Make sure that the rings turn freely in the grooves.
8. Fig. 20 shows the complete set of tools needed to perform the above operations. The tool Kit Number for the complete set is T75L-3517-A.

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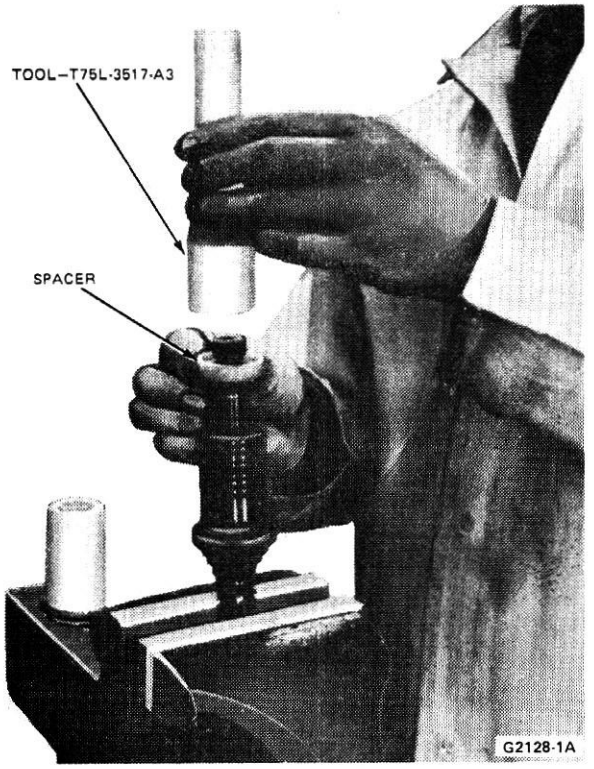


FIG. 17 Adding Spacer to Install Next Ring

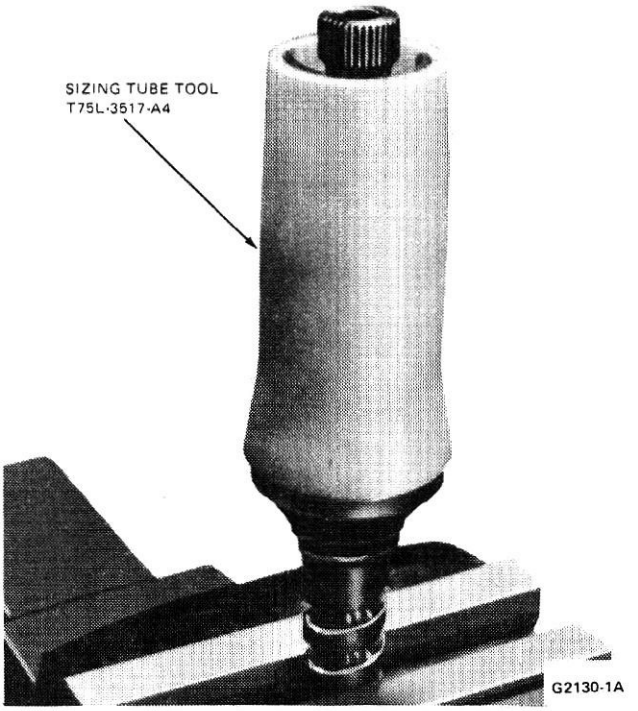


FIG. 19 Sizing Rings—Step 2

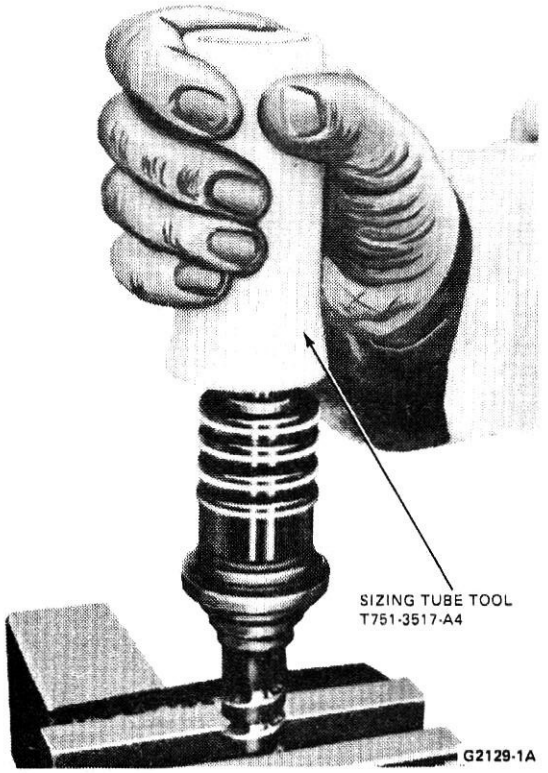


FIG. 18 Sizing Rings—Step 1

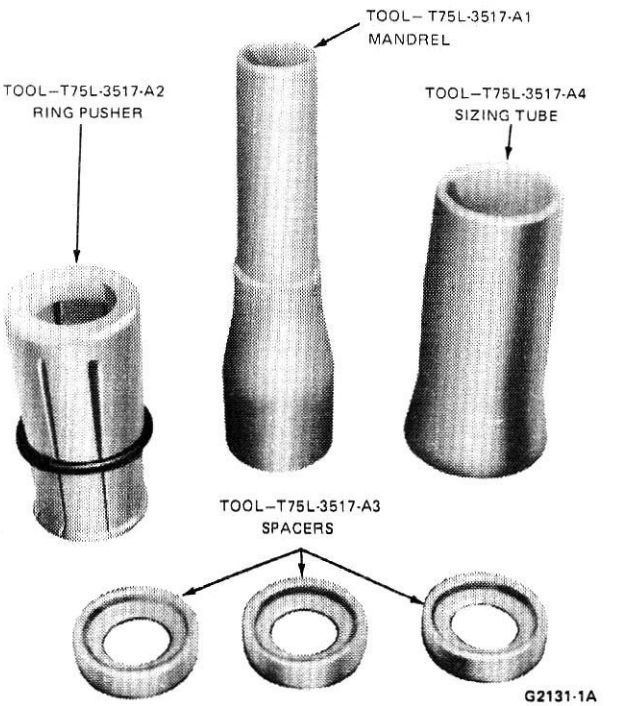


FIG. 20 Rotary Valve Tool Kit T75L-3517-A

PISTON AND BALL NUT

Disassembly and Assembly

1. Remove the plastic ring and the O-ring (Fig. 5) from the piston and ball nut.
2. Dip a new O-ring in gear lubricant and install it on the piston and ball nut.
3. Install a new plastic ring on the piston and ball nut being careful not to stretch it any more than necessary.

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FORD INTEGRAL POWER STEERING GEAR SPECIFICATIONS

Description	
Type	Recirc. Ball Torsion Bar
Ratio	17:1
Turns of Steering Wheel (Lock to Lock – Linkage Disconnected)	4
Fluid Capacity (Included in Pump Reservoir Fill)	1.6 Pints (Approximate)
Fluid Specification—Lincoln, Mark V	D2AZ-19582-A
Worm Bearing Preload	4-9 In-Lb
Total Meshload Over Mechanical Center	17 In-Lb (Maximum)
Total Meshload Over Worm Bearing Preload	14-18 In-Lb
Fluid Specification—All Except Lincoln and Mark V	C1AZ-19582-A,C, D-ATF Type F

FORD INTEGRAL POWER STEERING GEAR TORQUE LIMITS (FT-LB)

Description	Torque
Sector Shaft Cover Bolts	55-70
Mesh Load Adjusting Screw Lock Nut	35-45
Ball Return Guide Clamp Screw	42-70 In-Lb
Valve Housing to Gear Housing Screw	35-50
Race Retaining Nut	50①
Set Screw-Race Nut	15-25 In-Lb.
Piston End Cap	70-110
Pressure Hose to Gear	16-25
Return Hose to Gear	25-34
Hose Clamps	1-2

① Specified Torque – Because the length of the tool required to torque the nut will affect the observed torque reading on the torque wrench, the torque reading should be computed using the length of the torque wrench and the nominal specified torque as follows:

$$\left.\begin{array}{l}\text{Torque (using tool}\\ \text{T66P-3553-B}\end{array}\right\} = \frac{\text{Length of Torque Wrench} \times 72\ \text{Ft-Lb}}{\text{Length of Torque Wrench} + 5.5\ \text{Inches}}$$

Example: With 13 inch torque wrench –

$$\frac{13\ \text{In.} \times 72\ \text{Ft-Lb}}{13\ \text{In.} + 5.5\ \text{In.}} = \frac{13 \times 72\ \text{Ft-Lb}}{18.5} = 0.703 \times 72 = 50\ \text{Ft-Lb}$$

SPECIAL SERVICE TOOLS

Tool No.	Description
T56L-33610-D	Pressure Testing Gauge Assembly
T64P-3590-F	Steering Pitman Arm Remover
T57L-500-B	Bench Mounted Holding Fixture
T66P-3553-C	Spacer
T66P-3553-B	Spanner Wrench
T59L-100-B	Slide Hammer – Short
T58L-101-A	Puller Attachment
T65P-3524-A1, A2, A3	Bearing Remover and Installer
T74P-3504-L	Tube Seat Remover
T74P-3504-M	Tube Seat Replacer
T74P-3517-A	Coupling
T74P-3517-B	Pressure Gauge
T74P-3504-L	Brass Tube Seat Remover
T77L-3576-A	Sector Shaft Seal Replacer

Tool No.	Description
T74P-3504-M	Brass Tube Seat Replacer
T74P-3504-R	Pinion Shaft Torque Adapter
T74P-3504-S	Inner Ball Joint Spanner Wrench
T74P-3504-T	Ball Joint Locknut Spanner Wrench
T74P-3504-U	Pinion Housing Yoke Plug Nut Wrench
T74P-3504-W	Pinion Yoke Plug Spanner Wrench
T74P-3504-X	Locknut Pin Staking Tool
T74P-3504-Y	Spring Scale (0-10 lbs)
T74P-3504-Z	Drill Bushing Fixture
T57L-500-B	Bench Mount
T71P-19703-C	O-Ring Remover
T74P-3517-C	Pressure Gauge
T75L-3517-A	Rotary Valve Tool Kit

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Integral Power Steering Gear — Saginaw

PART 13-42

Applies To LTD II, Cougar, XR7, Thunderbird, Ranchero 5.0/5.8L (302/351WCID) (Except Police and Taxi)

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Adjuster Plug	42-10
Rack-Piston	42-11
Steering Gear	42-6
Steering Gear Housing	42-9
DISASSEMBLY AND ASSEMBLY (Cont'd.)	
Stub Shaft and Rotary Valve Assembly	42-10
REMOVAL AND INSTALLATION	42-5
SPECIFICATIONS AND SPECIAL TOOLS	42-14

DESCRIPTION

STEERING GEAR

The Rotary Valve Safety power steering gear displaces fluid to provide hydraulic fluid pressure assists when turning. The gear assembly is always filled with fluid and all internal components of the gear are immersed in fluid, making periodic lubrication unnecessary. In addition, the fluid acts as a cushion to absorb road shocks. All fluid passages are internal except the pressure and return hoses between the gear and pump.

The rotary valve provides smooth steering with a minimal effort. A torsion bar transmits road feel to the driver.

A one-piece rack-piston nut is geared to the sector shaft. An adjusting screw on the end of the shaft gear maintains preload between the sector shaft and rack-piston nut (Fig. 1).

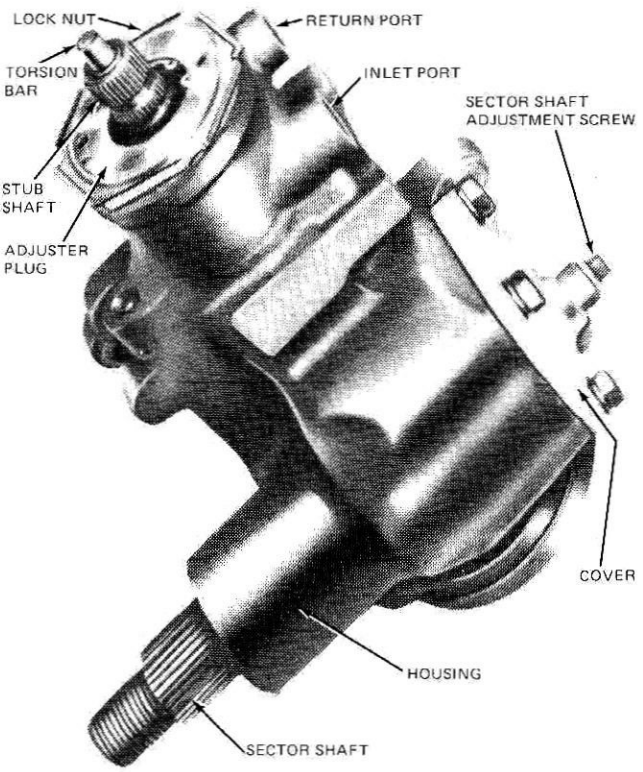


FIG. 1 Saginaw Steering Gear—Exterior View

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ADJUSTMENTS

Only the over-center mesh load may be adjusted with the steering gear in the vehicle. Other adjustments require removal of the gear.

THRUST BEARING ADJUSTMENT—GEAR REMOVED

Saginaw power steering gears used on LTD II, Cougar, SR-7, Thunderbird and Ranchero vehicles feature conical races on the input shaft lower thrust bearing. The races are essentially axial spring washers which prevent loss of thrust bearing preload (See Fig. 2).

1. Drain the power steering fluid from the gear by rotating the stub shaft full travel in both directions several times.
2. Loosen and remove the adjuster plug lock nut (see Figs. 3 and 4).
3. Turn the adjuster plug in (clockwise) until the plug and thrust bearing are firmly bottomed, approximately 20 ft-lbs. (see Fig. 5).
4. Mark the housing even with one of the holes in the adjuster plug (see Fig. 6).
5. Measure back (counterclockwise direction) 3/16 to 1/4 inch and remark the housing (see Fig. 7).
6. Rotate the adjuster (counterclockwise) until the hole in the adjuster is in line with the second mark (see Fig. 8).
7. Tighten the lock nut securely. Hold (or have held) the adjuster plug to maintain alignment of the hole with the mark (see Fig. 9).
8. Using a 3/4 inch twelve point deepwell socket and an in-lb torque wrench, turn the stub shaft to the right stop and then back 1/4 turn. Measure the torque. Reading should be taken with the beam of the torque wrench near vertical while turning counterclockwise at an even rate (see Fig. 10). If the reading is less than 4, or more than 10 in-lbs, use the alternate adjustment procedure shown below.

ALTERNATE THRUST BEARING ADJUSTMENT PROCEDURE

1. Drain the gear by rotating the stub shaft from stop to stop several times.
2. Loosen the Pitman shaft preload adjuster screw lock nut and turn the preload adjuster screw 1-1/2 turns counterclockwise. Retighten the locknut (see Fig. 11). (If when turning the preload screw counterclockwise it bottoms, turn back clockwise 1/2 turn.)
3. Loosen (but do not remove) the adjuster plug lock nut (see Fig. 3).
4. Loosen the adjuster plug one turn counterclockwise (see Fig. 12).
5. Turn the stub shaft to the right stop and then back 1/4 turn. Measure the drag torque, using an in-lb torque wrench (see Fig. 10). Bottom the adjuster plug firmly (approximately 20 ft-lbs) by turning it clockwise (see Fig. 13) then back it off until the total-torque reading is 3-4 in-lbs in excess of the drag torque (i.e., drag torque reading 3 in-lbs, total torque reading with adjuster plug tightened 6-7 in-lbs).
6. Tighten the adjuster plug lock nut securely (Fig. 9).

NOTE: Preload torque tends to drop off when the lock nut is tightened. Therefore, the torque reading must be rechecked with the lock nut tight, and the torque must still be 3-4 in-lbs in excess of the seal drag.

NOTE: It is not possible to properly adjust the thrust bearing preload unless the adjuster plug is firmly bottomed out and the torque set while the adjuster plug is being loosened. Never attempt to adjust the thrust preload while tightening or advancing the adjuster plug into the gear assembly.

MESH LOAD—GEAR REMOVED

1. Turn the stub shaft from stop to stop, counting the total number of turns. Divide this number by 2. Starting at either stop, turn the stub shaft 1/2 turn the total number of turns. This is the "center" of the gear. (The flat on the stub shaft is normally up and parallel with the side cover when the gear is "on center" (see Fig. 13) and the block tooth on the Pitman shaft is in line with the over-center preload adjuster (see Fig. 14).
2. Rotate the torque wrench approximately 45 degrees each side of the center, and "read" near or on center (highest reading)—See Fig. 10. Loosen the lock nut and turn the preload adjusting screw clockwise until the correct "0" center torque, in excess of the reading just taken, is obtained (see Fig. 15).

   NOTE: Limits for "new" and "used" gears differ as follows:

   a. "New" gear over-center torque to be 4-8 in-lbs additional torque, but total over-center torque must not exceed 18 in-lbs.

   b. "Used" gear (400 or more miles). Over-center torque to be 4-5 in-lbs additional torque, but total over-center must not exceed 14 in-lbs.

   Tighten the lock nut to 35 ft-lbs while holding the preload adjuster screw. Recheck the over-center adjustment.

MESH LOAD—IN VEHICLE

Adjust the total over-center position load (mesh load) to eliminate excessive lash between the sector shaft and rack teeth as follows:

1. Disconnect the Pitman arm from the sector shaft. Remove the steering wheel hub.
2. Disconnect the fluid return line at the reservoir, and cap the reservoir return line pipe.
3. Place the end of the return line in a clean container and turn the steering wheel from left to right to discharge the fluid from the gear
4. Turn the gear one-half turn off center in either direction. Using a 24 in-lb torque wrench on the steering wheel nut, determine the torque required to rotate the shaft slowly through a 20 degree arc.
5. Turn the gear back to center and repeat Step 4. Loosen the adjuster lock nut and turn the screw

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inward using a 7/32-inch Allen wrench, until the reading is 6 in-lb greater than the reading taken in Step 4. Retighten the lock nut while holding the screw in place.

6. Recheck the readings and replace the Pitman arm and steering wheel hub.
7. Connect the fluid return line to the reservoir and fill the reservoir with C1AZ-19582-A, C, or -D or equivalent to specification.

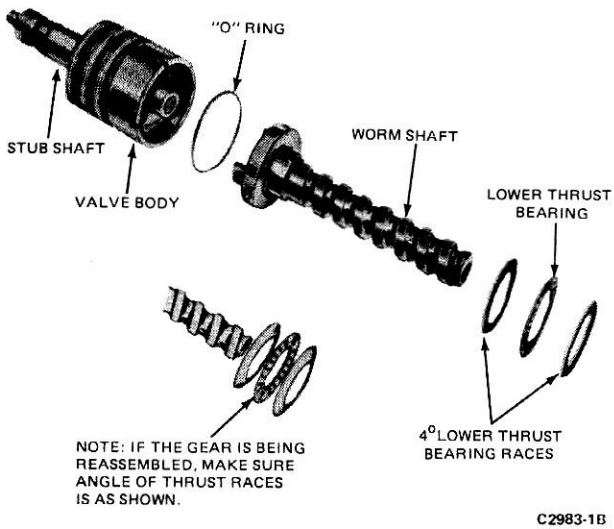


FIG. 2 Conical Thrust Races

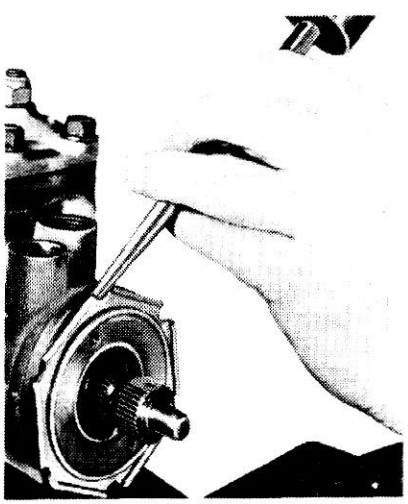


FIG. 3 Loosening Adjuster Plug Lock Nut

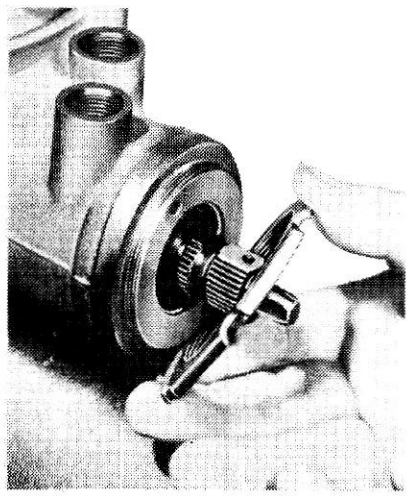


FIG. 4 Removing Adjuster Plug Lock Nut

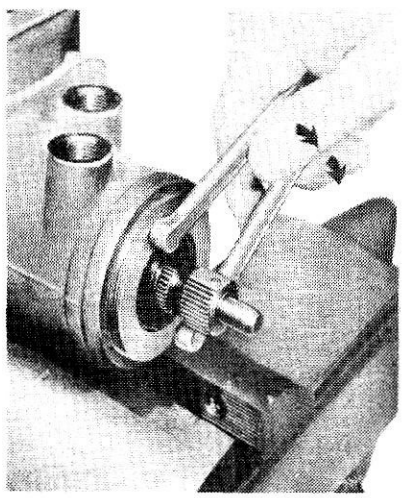


FIG. 5 Bottoming Adjuster Plug

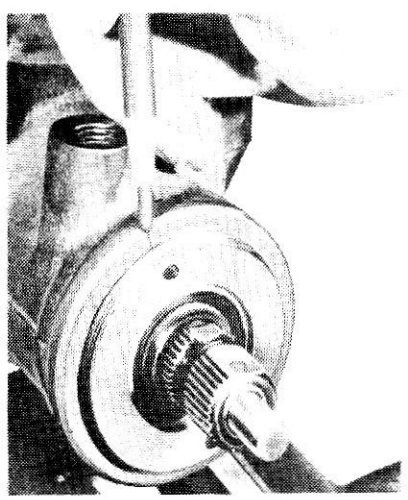
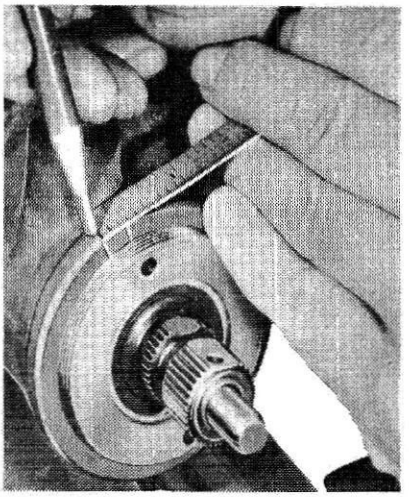


FIG. 6. Marking Housing with Adjuster Plug Bottomed

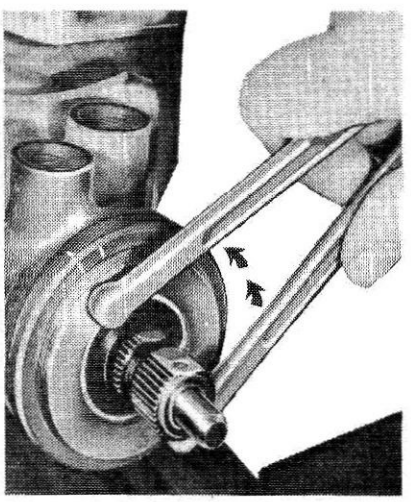
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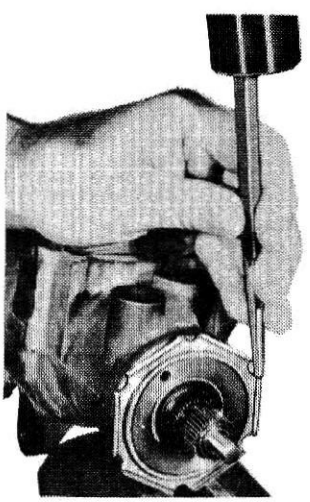
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FIG. 7. Marking Housing 3/16 Inch Counterclockwise from Bottomed Position



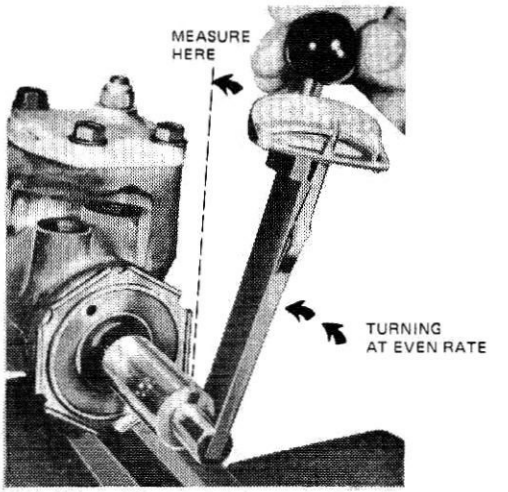
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FIG. 8 Rotating Adjuster to Second Mark



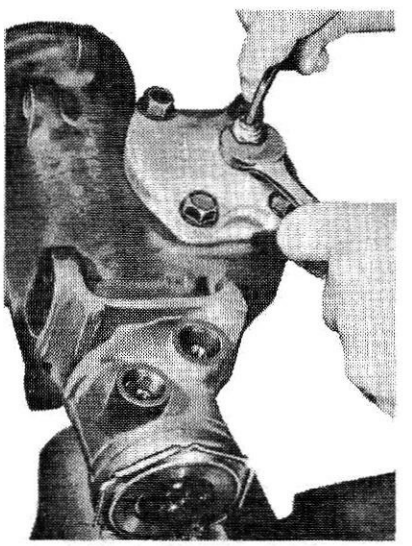
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FIG. 9 Tightening Lock Nut



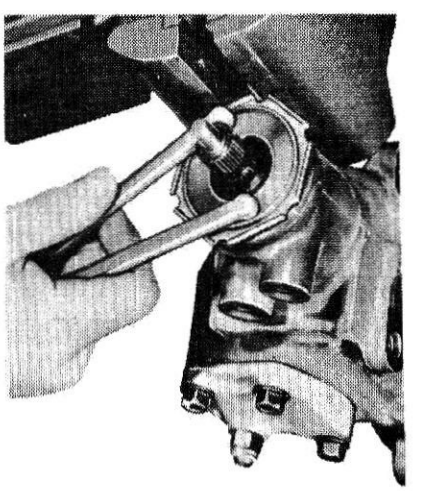
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FIG. 10 Checking Rotational Torque



C2993-1A

FIG. 11 Loosening Pitman Shaft Preload Adjusting Screw



C2994-1A

FIG. 12 Loosening Adjuster Nut One Turn

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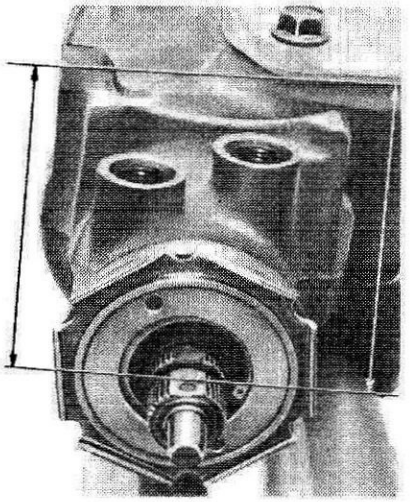


FIG. 13 Aligning Stub Shaft Flat

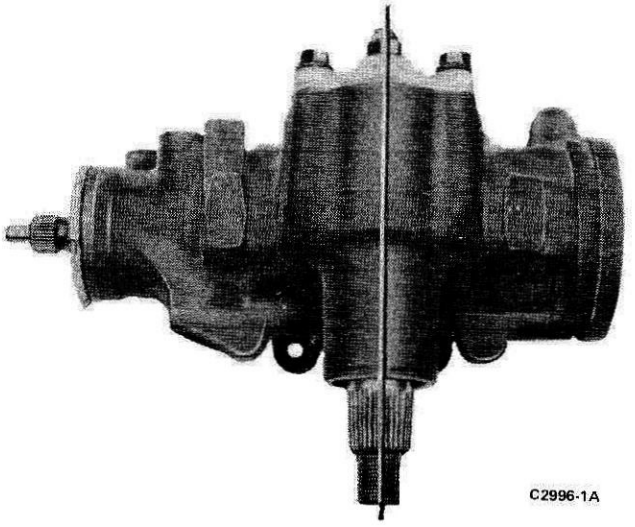


FIG. 14 Aligning Pitman Shaft Block Tooth

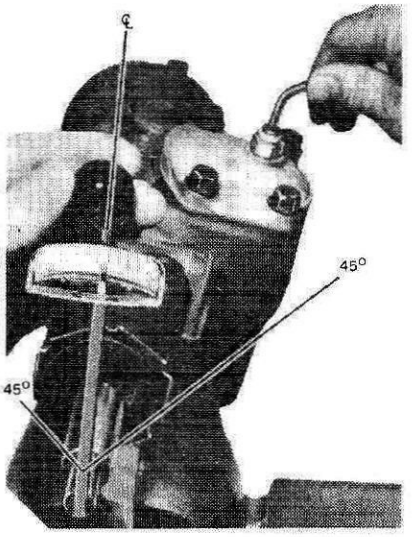


FIG. 15 Checking Over-Center Rotational Torque

REMOVAL AND INSTALLATION

STEERING GEAR

Removal

1. Remove the catalytic coverter on V-8 engined vehicles so equipped. Refer to Group 26, for information.
2. Disconnect the pressure and return lines from the steering gear. Plug the lines and ports in the gear to prevent entry of dirt.
3. Remove the bolts that secure the flex coupling to the steering gear and column.
4. Raise the vehicle and remove the Pitman arm attaching nut and lock washer.
5. Using Tool T64P-3590-F, remove the Pitman arm from the sector shaft. **Do not hammer on the end of the tool when pulling the Pitman arm from the shaft. Damage to the gear or cover could result.** Remove the tool from the Pitman arm.
6. On vehicles with standard transmissions, remove the clutch release lever retracting spring to provide clearance for removing the steering gear.
7. Support the steering gear. Remove the steering gear attaching bolts.
8. Work the steering gear free of the flex coupling and remove.
9. Lift the flex coupling off the shaft if it did not come off with the gear.

Installation

1. Slide the flex coupling into place on the steering shaft. Turn the steering wheel so that the spokes are in their normal position.
2. Center the steering gear input shaft.

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3. Slide the steering gear input shaft into the flex coupling and into place on the frame side rail. Install the attaching bolts and torque to specification.
4. **Be sure that the wheels are in the straight-ahead position.** Then install the Pitman arm on the sector shaft. Install the sector shaft attaching nut and torque to specification.
5. Move the flex coupling into place on the input shaft and steering column shaft. Install the attaching bolts and torque to specification.
6. Connect the pressure and the return lines to the steering gear. Tighten the lines.
7. Install the catalytic converter, if so equipped.
8. Disconnect the coil wire. Fill the pump reservoir with Automatic Transmission Fluid C1AZ-19582-A, -C, or -D or equivalent. Crank the engine with the starter and continue adding fluid until the level remains constant. Turn the steering wheel from side to side without hitting the stops. Turn off the ignition and recheck the fluid level. Add fluid, if necessary.
9. Reconnect the coil wire. Start the engine and allow it to run for several minutes. Turn the steering wheel from stop to stop.
10. Turn off the engine and recheck the fluid level. Add fluid, if necessary.

DISASSEMBLY AND ASSEMBLY

Take the following precautions when servicing the steering gear.

1. **Use a clean workbench and tools.**
2. Thoroughly clean the exterior of the gear with solvent. Drain off excess hydraulic fluid, if necessary.
3. **Handle all parts carefully to avoid nicks, burrs, scratches and dirt.**
4. **Do not use solvent on seals.**

STEERING GEAR

Disassembly

1. Using mounting pads for support, secure the steering gear in a bench mounted holding fixture T57P-500-A.
2. Rotate the end plug retaining ring so one end of the ring is opposite the hole in the housing.
3. Working through the hole in the housing (Fig. 16), unseat the retaining ring and work it out of the groove with a screwdriver.
4. Using a 3/4 inch, 12-point socket wrench, rotate the input shaft counterclockwise and force the end plug out of the housing. **Do not rotate the shaft any more than necessary to remove the plug. Further rotation will allow the balls to fall from their circuit causing the rack-piston to become disengaged from the sector shaft.** Remove the O-ring from the housing and discard.
5. Rotate the input shaft clockwise one-half turn to draw the piston inward.
6. Using a 1/2-inch drive extension, turn the end plug (Fig. 17) counterclockwise out of the piston.
7. Remove the lock nut from the sector shaft adjustment screw. Discard the nut.
8. Remove the cover attaching screws. Rotate the sector shaft adjustment screw with an Allen wrench until the cover is free of the housing. Remove the cover and the O-ring. Discard the O-ring.
9. Turn the input shaft to center the sector shaft teeth in the housing.
10. Tap the end of the sector shaft with a soft-faced hammer to free it from the housing.
11. Remove the adjuster plug lock nut.
12. Remove the adjuster plug using spanner wrench T65P-3A537-A (Fig. 18).
13. Insert Tool T65P-3D517-A into the end of the rack-piston until it contacts the worm shaft. Rotate the stub shaft counterclockwise until the worm is free of the rack-piston. Hold the tool all the way inside the piston to avoid dropping the balls, and withdraw the rack-piston from the housing. **Do not disassembly the rack-piston.**
14. Pull the stub shaft and valve assembly out of the housing.
15. Lift the worm, lower thrust bearing and races out of the housing.

Assembly

1. Using mounting pads for support secure the steering gear housing in bench mounted holding fixture T57L-500-A.
2. Lubricate the worm shaft, lower thrust bearing, and races with steering gear fluid and position the thrust bearing and races on the worm.
3. Align the valve body drive pin on the worm, with the narrow pin slot in the valve body. Install the

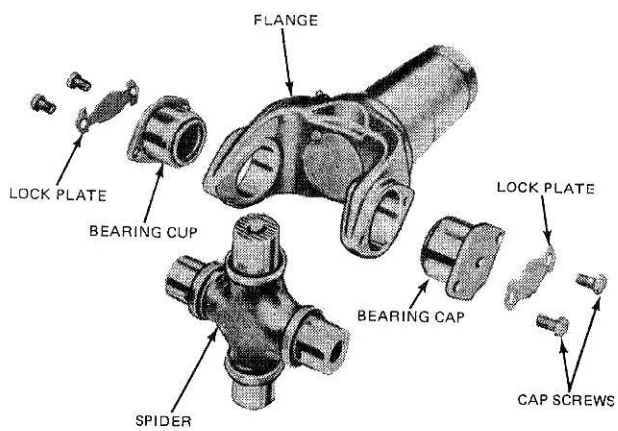


FIG. 16 Removing End Plug Retaining Ring

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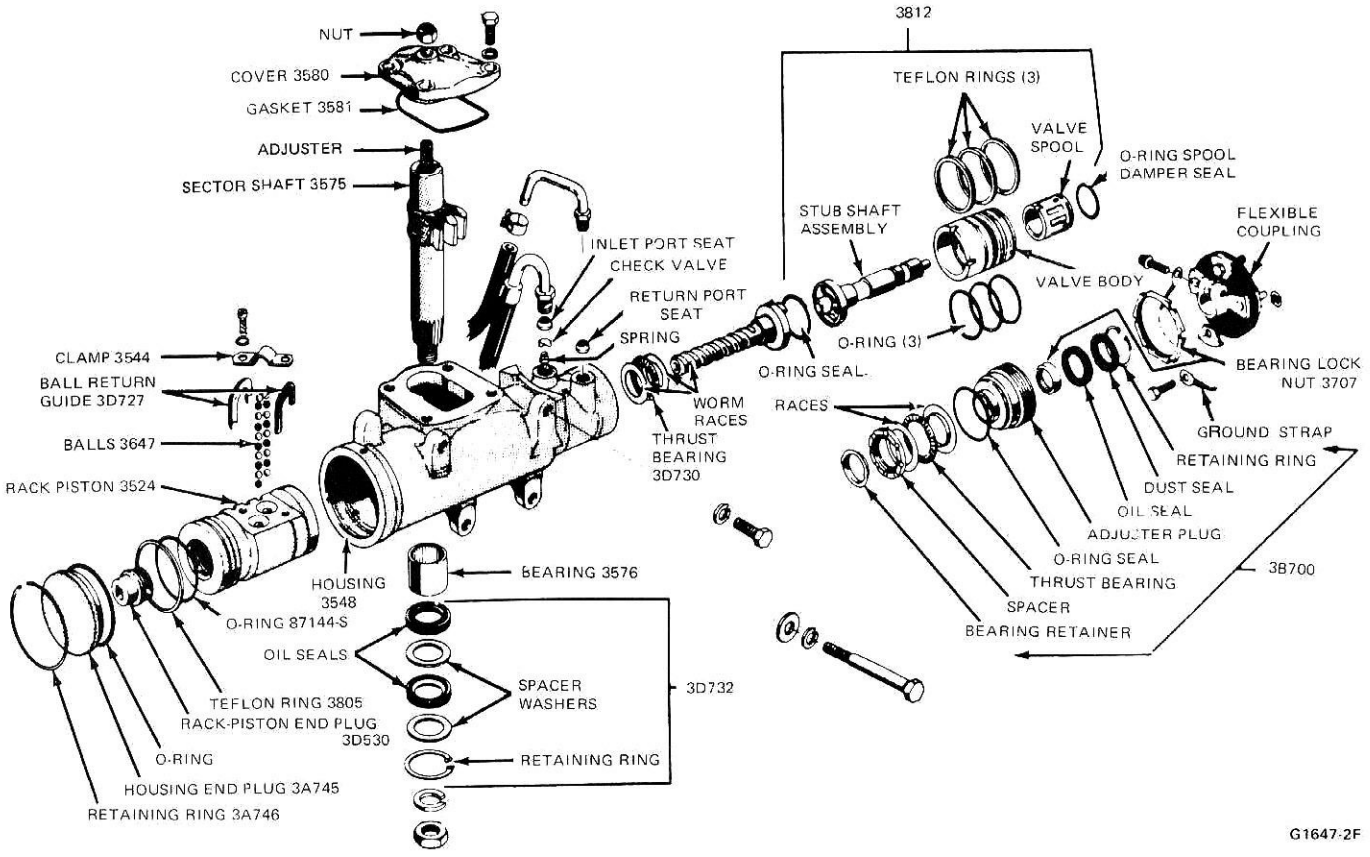


FIG. 17 Steering Gear Disassembled

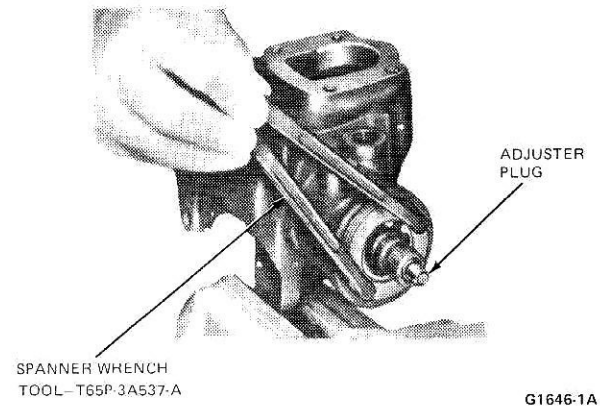


FIG. 18 Removing Adjuster Plug

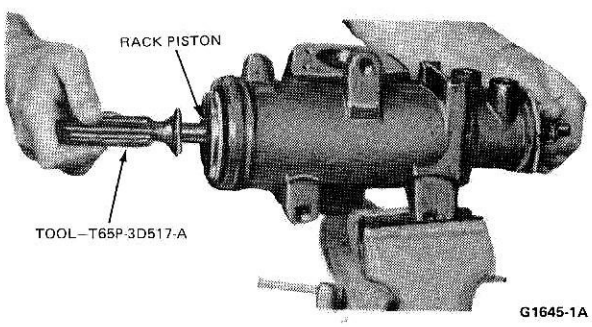


FIG. 19 Removing Rack Piston

O-ring seal between the valve body and the worm head. Lubricate the Teflon ring and lower cap O-ring with power steering fluid.

4. Position the valve assembly and worm shaft as a unit in the housing (Fig. 20). **Do not push against the stub shaft. Pressure on the shaft may cause the shaft and cap to pull out of the valve body, allowing the spool seal to slip into valve body fluid grooves.** Install the assembly by pushing with finger tips on the outer diameter of the valve body housing. Be sure the Teflon rings do not bind inside the housing. The valve assembly is correctly seated when the fluid return hole in the gear housing is fully visible.
5. Place Tool T65P-3A537-B over the end of the stub shaft (Fig. 21).
6. Lubricate a new adjuster plug O-ring with power steering fluid and install it in the adjuster plug groove.
7. Install the adjuster plug over the end of the stub shaft and tighten it just enough to be sure all parts are properly seated. Remove Tool T65P-3A537-B.
8. Install the adjuster plug locknut loosely on the plug.
9. Adjust the input shaft preload according to the procedure given under Adjustments in this Part.
10. Install Tool T65P-3805-A in the steering gear housing. Position the rack-piston as shown in Fig. 22. Be sure that Tool T65P-3D517-A is contacting the worm shaft. Push the rack-piston inward until it contacts the worm shaft, keeping pressure applied to Tool T65P-3D517-A. Turn the stub shaft clockwise until the middle rack groove is aligned

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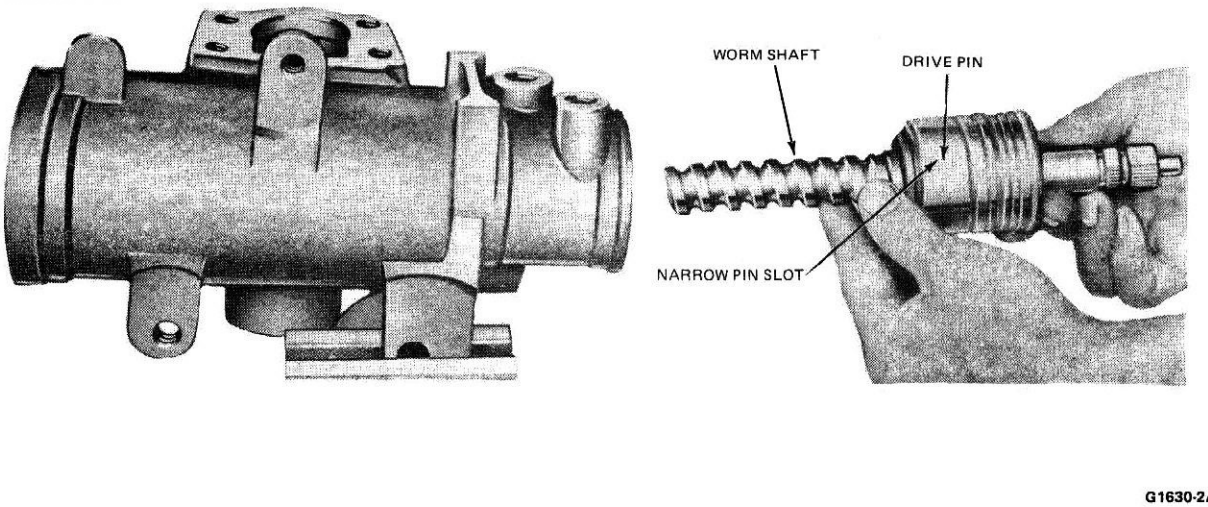


FIG. 20 Installing Valve and Worm Shaft in Housing

with the center of the sector shaft roller bearing. Remove the tool from the housing.

11. Lubricate a **new** O-ring with power steering fluid and place it in the sector shaft cover.
12. Thread the sector shaft cover on the adjusting screw until it bottoms, then loosen it one and one-half turns.
13. Install the sector shaft so the center gear tooth meshes with the center groove in the rack-piston.

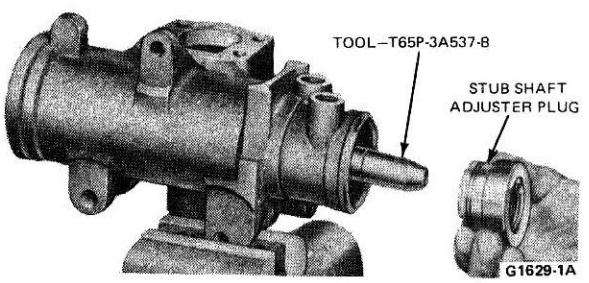


FIG. 21 Installing Adjuster Plug

Be sure the cover O-ring is in place before pushing the cover down on the housing.

14. Install the cover screws and lock washers. Torque to 30 to 35 ft-lbs.
15. Install a new adjuster lock nut and tighten halfway on the adjuster screw.
16. Install the end plug in the rack-piston. Torque the plug to 50 to 100 ft-lbs.
17. Lubricate a new housing end plug O-ring and install it in the housing.
18. Place the end plug in the gear housing and seat it against the O-ring seal. It may be necessary to tap the end plug lightly with a soft-faced mallet to seat it properly.
19. Snap the retainer ring in place. Tap lightly on the ring to be sure it seats securely in the housing.
20. Adjust the over-center mesh load of the sector according to the procedure given under Adjustments in this Part.

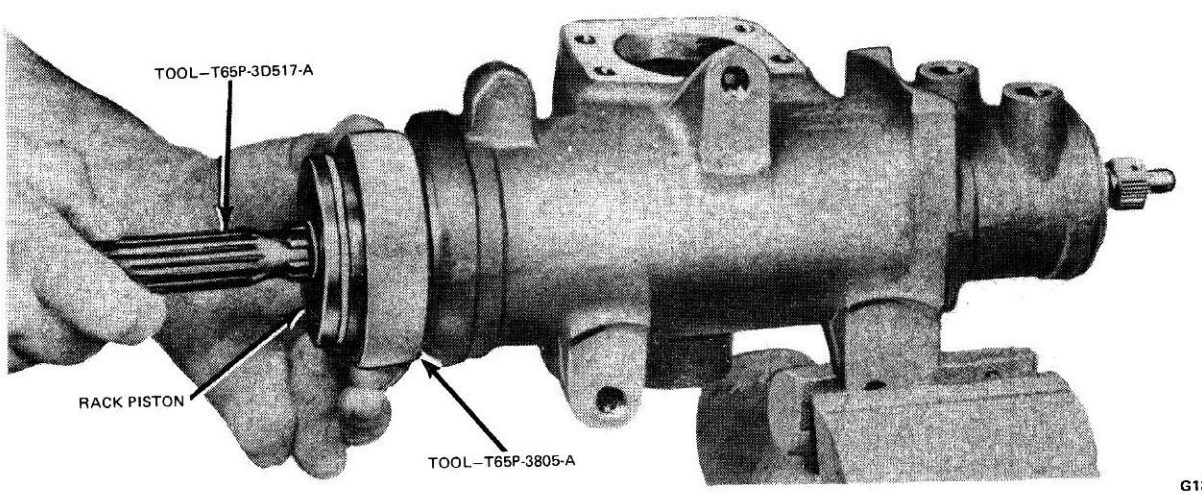


FIG. 22 Installing Rack Piston

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21. After obtaining proper mesh load, torque the sector shaft adjustment screw lock nut to 27 to 37 ft-lbs.

STEERING GEAR HOUSING

Disassembly and Assembly

1. Remove the snap ring (Fig. 23) that secures the sector shaft seals in the lower end of the housing. Remove the lower spacer washer.
2. Remove the lower seal (double lip), spacer washer and upper seal (single lip) using Tools T58L-101-A and T59L-100-B (Fig. 24).
3. Check the housing bearing for wear and damage and remove, if necessary. Working from the lower end of the housing (Fig. 25) press the bearing out of the housing. Discard the bearing.
4. Working from the upper end of the housing, press in a new bearing until the upper end is 0.030 inch below the housing bore. Press the bearing, on the stamped end only.
5. Lubricate **new** sector shaft seals (Fig. 23) in power steering fluid. Install the single lip seal first, then a back-up washer. Using Tool T65P-3D642-A (Fig. 26), drive the seal and washer far enough into the housing to provide clearance for the other seal and back-up washer and the retaining ring. **Do not let the seal bottom on the end of the counterbore.**
6. Install the double lip seal and second back-up washer. Using Tool T65P-3D642-A, drive the seal and back-up washer into the housing only far enough to provide clearance for the retaining ring. Install the retaining ring with snap ring pliers. **Be sure the ring seats properly.**

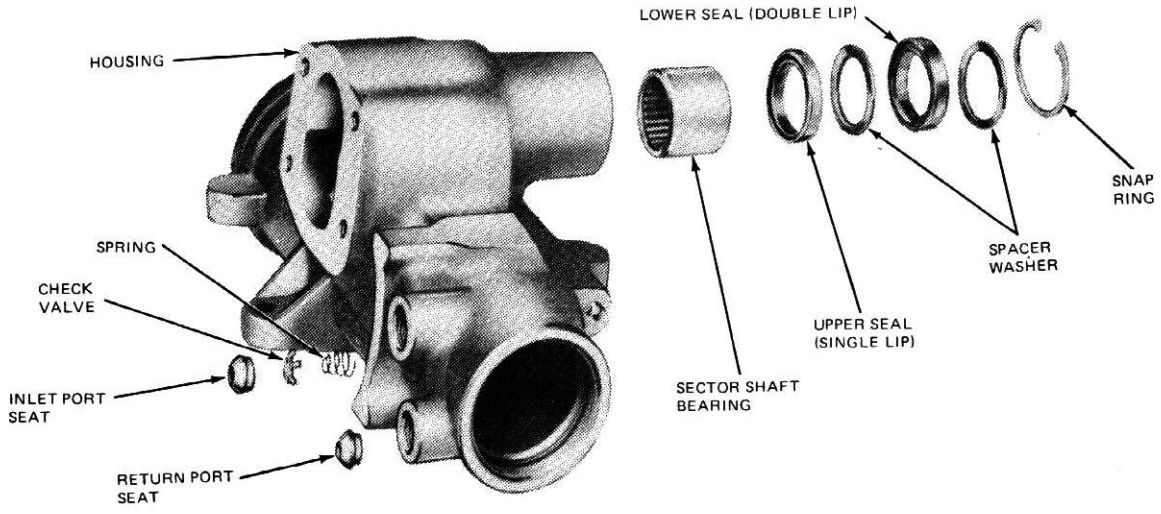


FIG. 23 Steering Gear Housing Disassembled

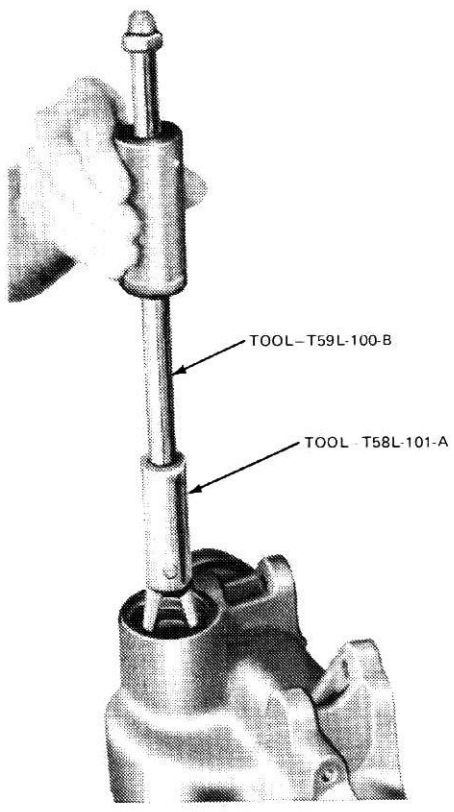


FIG. 24 Removing Sector Shaft Seals

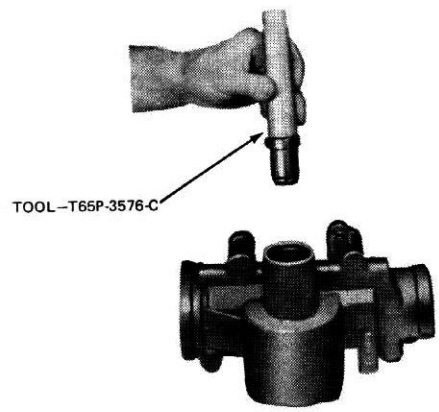


FIG. 25 Removing Sector Shaft Bearings

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7. To remove a damaged port seat, turn it two turns into the seat with a 5/16-18 inch U.S. thread (coarse) tap. Coat the end of the tap with petrolatum to prevent chips from entering the passage.
8. Install a bolt and nut with a flat washer into the tapped hole (Fig. 27).
9. Hold the bolt to keep it from turning and tighten the nut to extract the seat. Discard the seat.
10. Remove the check valve and spring from the inlet port.
11. Install the spring, check valve and a new seat in the inlet port. Use Tool T65P-3548-A to drive the seat into place (Fig. 28).
12. Install the outlet port seat as described in Step 11.
13. Do not remove the stop ring from the piston bore. Damage to the ring will necessitate replacing the housing assembly.

ADJUSTER PLUG

Disassembly and Assembly

1. Remove the adjuster plug from the stub shaft (Fig. 17).
2. Pry the thrust bearing retainer off the adjuster plug as shown in Fig. 29. **Do not score the needle bearing bore.** Discard the retainer.
3. Remove the spacer, thrust bearing, races, and O-ring from plug (Fig. 17). Discard the O-ring.
4. If it is necessary to replace the roller bearing, remove the dust seal retaining ring. Working from the spacer end of the adjuster plug, remove the roller bearing, oil seal and dust seal as shown in Fig. 31. Do not remove the roller bearing if it is not damaged. Pry the dust seal and oil seal from the adjuster plug with a screwdriver.
5. Place a new roller bearing on Tool T65P-3D525-A with the bearing manufacturer's identification facing toward the tool.
6. Insert the bearing and tool in the bore. Drive the bearing into the plug until it is flush with the bottom surface of the stub shaft seal bore.

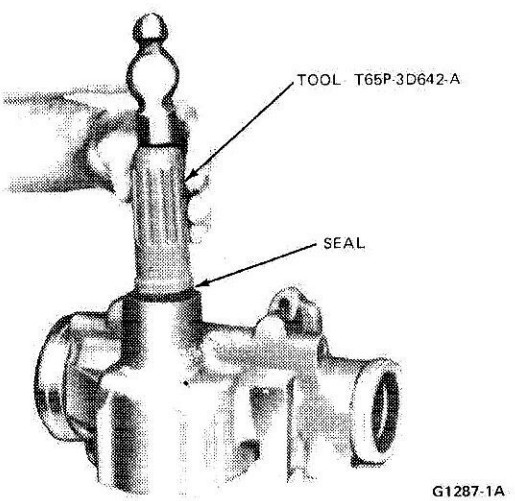


FIG. 26 Installing Sector Shaft Seal

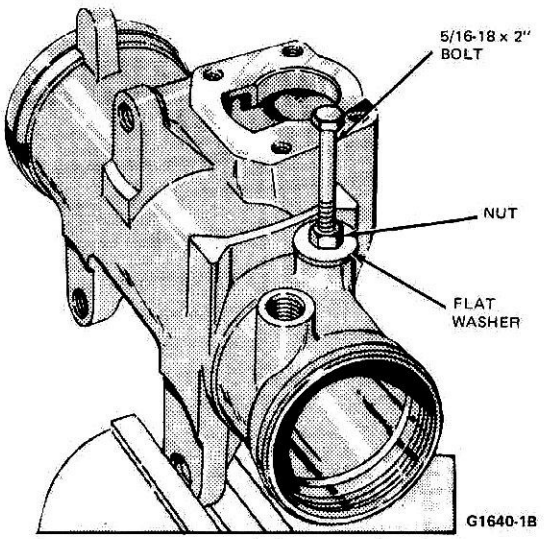


FIG. 27 Removing Port Seat

7. Lubricate a new oil seal with power steering fluid and install the seal with Tool T65P-3D526-A, pressing it into the plug far enough to provide clearance for the dust seal and the snap ring (Fig. 32).
8. Lubricate a new dust seal with power steering fluid and install it with its smooth rubber surface facing out.
9. Install the snap ring. **Be sure the ring is properly seated.**
10. Lubricate a new O-ring seal with Vaseline and install it on the adjuster plug.
11. Install the thrust bearing outer race, thrust bearing inner race, and thrust bearing spacer on the adjuster plug (Fig. 30).
12. Install a new bearing retainer by carefully tapping on the flat surface of the retainer (Fig. 33).

STUB SHAFT AND ROTARY VALVE ASSEMBLY

Disassembly

Do not disassemble the valve (Fig. 34) unless the components are contaminated or the dampener O-ring must be replaced.

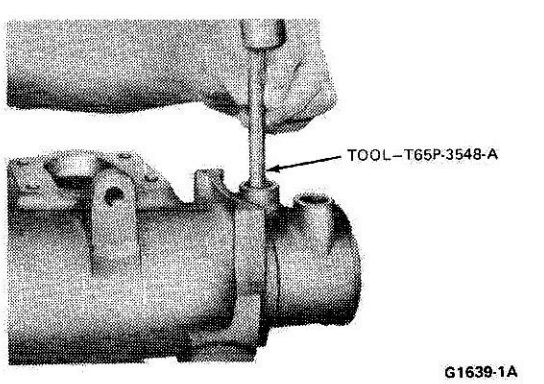


FIG. 28 Installing Inlet Port Seat

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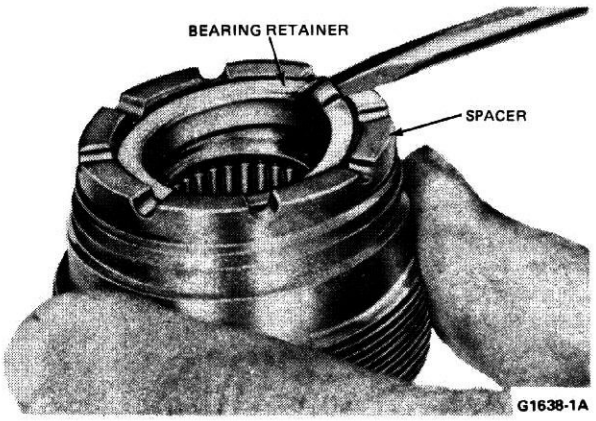


FIG. 29 Removing Thrust Bearing Retainer

1. Place the valve upside down on the workbench and tap the torsion bar end until the torsion bar cap separates from the valve body (Fig. 35). Discard the cap-to-body O-ring.
2. Grasp the stub shaft and push it down through the valve body until the drive pin hole is visible.
3. Tilt the stub shaft so the drive pin disengages from the spool. Remove the stub shaft from the valve body and spool assembly.
4. Slide the spool out through the top of the valve body. **Removing the spool through the bottom may jam or damage it.**

Assembly

Only the O-ring and Teflon Seals can be replaced.

1. Dip the dampener O-ring in power steering fluid and install it on the spool. Insert the spool into the body using a turning motion.
2. Push the spool all the way to the bottom of the valve body. Depress the dampener O-ring with fingertips to prevent it from being cut. Be sure the spool drive pin hole is located directly opposite the deep valve body notch. This will correctly position the cap notch to the body pin.
3. Insert the stub shaft into the spool with the drive pin in line with the mating spool hole.
4. Insert the drive pin into the hole and pull the assembly into the valve body, keeping the cap slot and body pin aligned. When the cap seats correctly in the valve body, the top surface of the cap should be at least 3/32 inch below the deep body notch.
5. Replace the cap-to-body O-ring.

RACK PISTON

Disassembly and Assembly

1. Cut the Teflon ring and O-ring from the piston.
2. Place the assembly on a clean, lint-free cloth and remove the screws that attach the ball return guide clamp to the rack piston. Remove the clamp (Fig. 36).
3. Remove the ball return guides from the rack-piston.
4. Remove Tool T65P-3D517-A from the piston and extract the remaining balls.
5. Thoroughly clean all parts with solvent.
6. Lubricate a **new** O-ring and Teflon ring. Install the O-ring on the piston being careful not to twist it. Slide the Teflon ring into place being careful not to stretch it any more than is necessary.
7. Slide the worm (Fig. 37) all the way into the rack-piston. Slowly rotate the worm counterclockwise and feed 17 balls, alternating black with silver balls, into the hole nearest the Teflon ring.

   Apply petrolatum liberally to one of the ball return guides and install both halves of the guide on the rack-piston. Install the remaining 5 balls alternating black with silver balls through the holes in the rack-piston. Install the ball return guide clamp with screws and lock washers. Torque the screws to specification.
8. The worm groove has a high point in the center. When the rack-piston passes over this high point, preload must equal 1 to 4 in-lb. To adjust preload, clamp the rack-piston in a soft-jawed vise with the worm shaft pointing up. Do not make the vise too tight or it will distort the assembly.
9. Place the valve assembly on the worm, engaging the worm drive pins. Rotate the worm until it

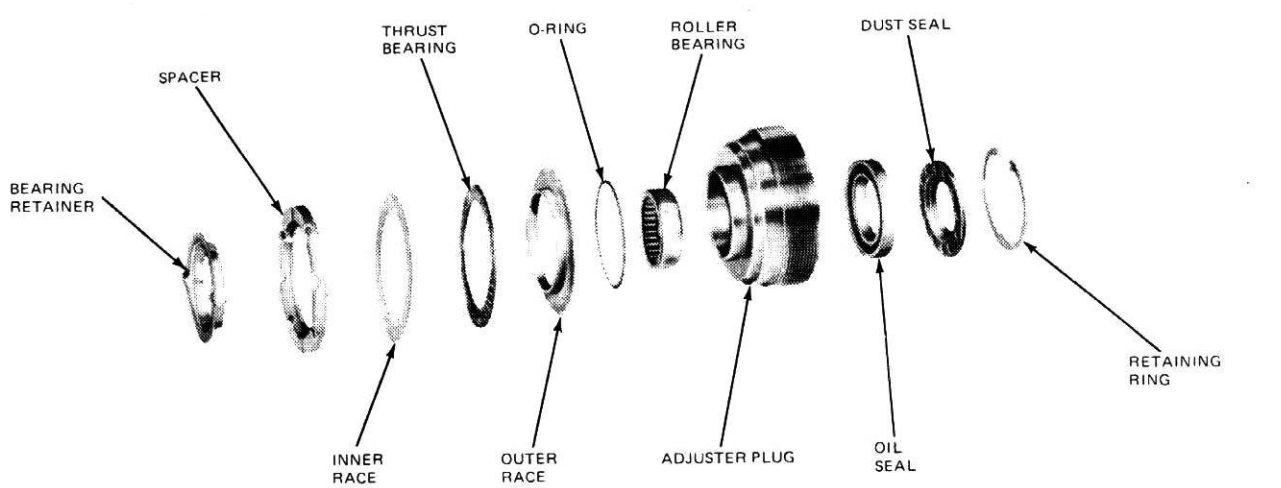


FIG. 30 Adjuster Plug Disassembled

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DETROIT IRON

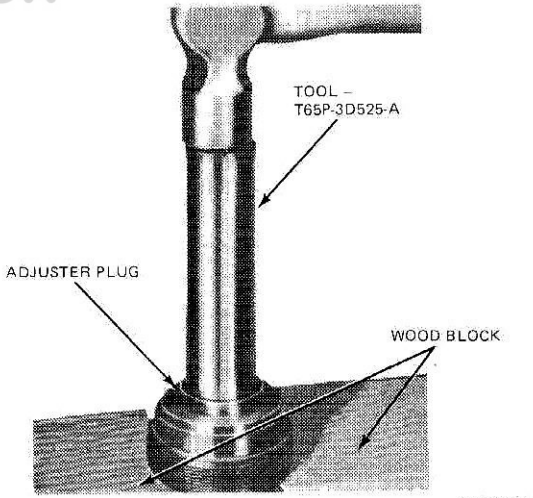


FIG. 31 Removing or Installing Roller Bearing

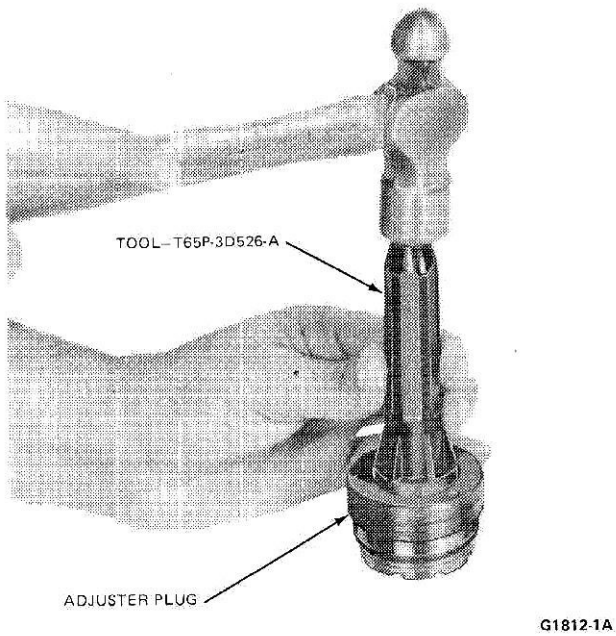


FIG. 32 Installing Oil Seal in Adjuster Plug

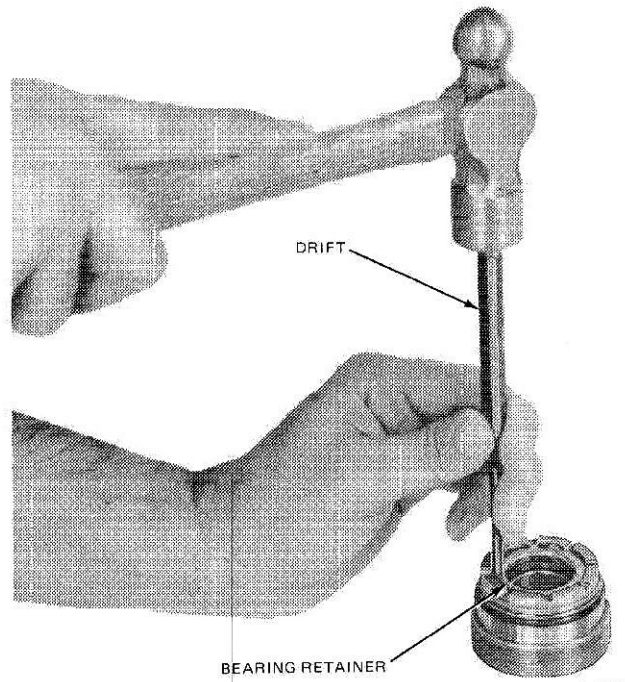


FIG. 33 Installing Thrust Bearing Retainer

extends one and one-quarter inches from the rack piston to the thrust bearing face. **This is the center position.**

10. Place an in-lb torque wrench with a 3/4-inch deep wall 12-point socket on the stub shaft, and rotate the shaft through an arc of approximately 60 degrees in both directions several times. Take a torque reading. The highest average reading obtained with the worm rotating should be between 1 to 4 in-lb.
11. If the reading is too high or too low, install a new worm and rack piston to obtain a suitable reading.
12. Remove the valve assembly from the worm and the rack-piston from the vise.
13. Insert Tool T65P-3D517-A into the plug end of the rack and piston until it contacts the worm shaft (Fig. 38). Apply pressure on the tool while rotating the worm shaft out of the piston and rack. Leave the tool in place until the piston is installed in the housing.

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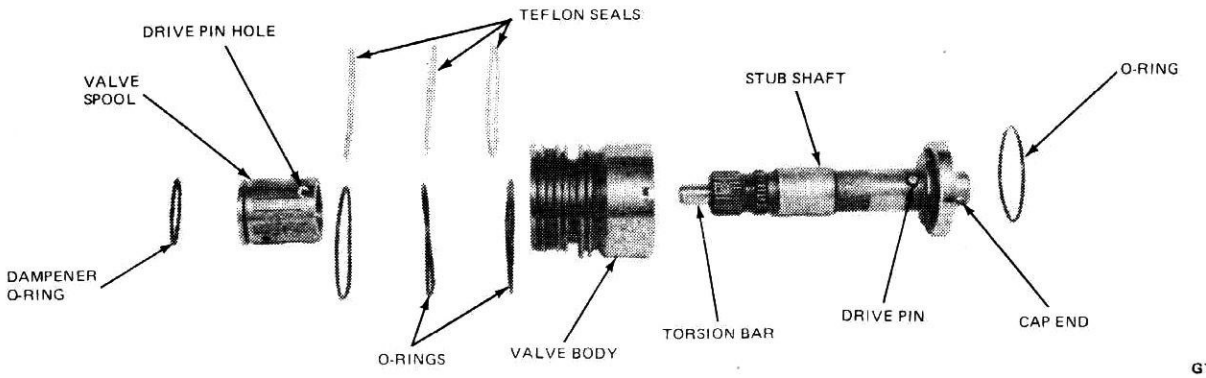


FIG. 34 Rotary Valve Disassembled

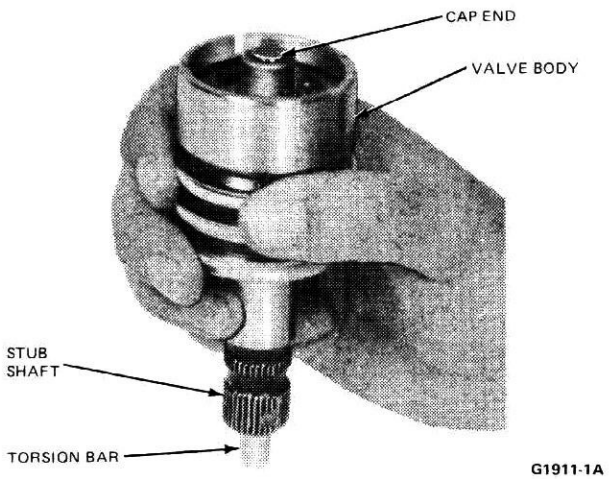


FIG. 35 Removing Spool from Rotary Valve

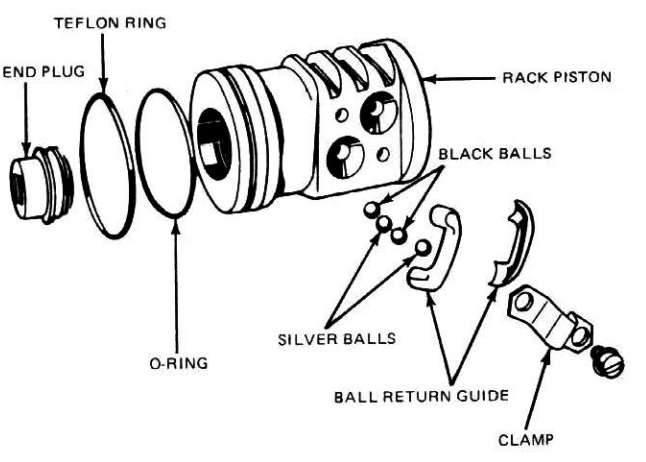


FIG. 36 Rack Piston Disassembled

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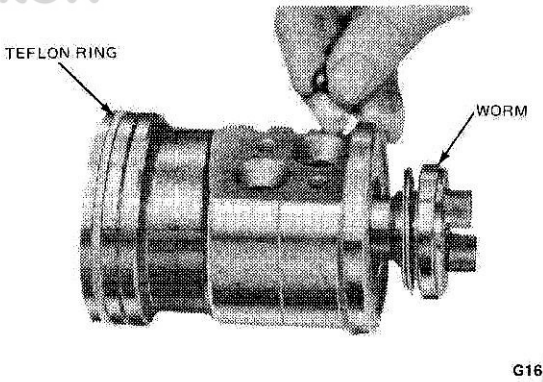


FIG. 37 Assembling Rack Piston

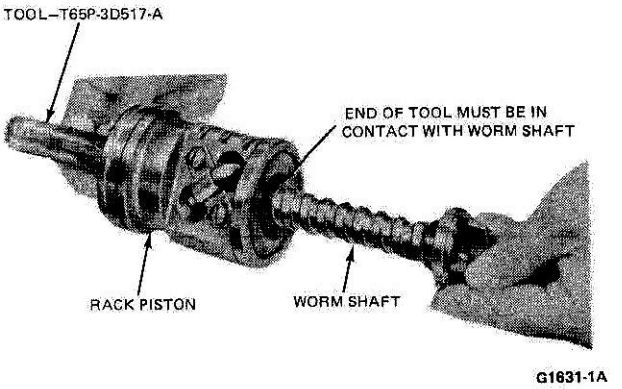


FIG. 38 Installing Tool in Rack Piston

SAGINAW INTEGRAL POWER STEERING GEAR TORQUE LIMITS (FT-LB)

Description	Torque Limit	Description	Torque Limit
Sector Shaft Cover Bolts	30-45	Piston End Cap	50-100
Mesh Load Adjusting Screw Lock Nut	27-37	Pressure and Return Hoses to Gear	25-34
Ball Return Guide Clamp Screw	3-6	Hose Clamps	1-2
Preload Adjusting Lock Nut	50-110		

SAGINAW INTEGRAL POWER STEERING GEAR SPECIFICATIONS

Description	Constant Ratio
Type	Recirculating Ball Torsion Bar
Ratio	17.5:1
Turns of Steering Wheel (Lock to Lock-Linkage Disconnected)	4
Fluid Specification	C1AZ-19582-A, -C or -D
Fluid Capacity (Included in Reservoir Fill)	1.6 Pt. (Approx.)
Total Meshload Over Worm Bearing Preload	4-8 In-Lb
Total Meshload Over Mechanical Center	18 In-Lb (Max)
Worm Bearing Preload	9 In-Lb (Max)
Worm to Piston Preload	0.5-4.5 In-Lb

SAGINAW INTEGRAL POWER STEERING GEAR SPECIAL SERVICE TOOLS

Tool No.	Description	Tool No.	Description
T59L-100-B	Impact Slide Hammer	T65P-3D525-A	Adjuster Plug Bearing Remover and Installer
T58L-101-A	Puller Attachment	T65P-3D526-A	Adjuster Plug Seal Installer
T65P-3548-A	Oil Line Connector Seat Installer	T65P-3A537-A	Bearing Preload Spanner Wrench
T65P-3576-C	Sector Needle Bearing Remover and Installer Adapter	T65P-3A537-B	Adjuster Plug Seal Protector
T65P-3805-A	Piston Rack Ring Compressor	T65P-3D642-A	Sector Shaft Seal Installer
T65P-3D516-A	Rack Piston Arbor		

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Integral Power Rack and Pinion Steering Gear - Ford

PART 13-46

Applies To Fairmont/Zephyr

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DESCRIPTION

STEERING GEAR

The 1978 Ford integral power rack and pinion gear features variable ratio steering. The gear housing and valve housing are combined into a one-piece aluminum die casting, where previously, the valve housing was bolted on. The new gear design incorporates quick connect fittings for the pressure and return lines which allow the lines to swivel. This is normal and does not indicate undertorqued fittings. If the fittings leak, do not torque the nut, but remove the fittings and replace the O-rings. Upon reassembly, be careful not to overtorque the fittings. The torque specification is 10-15 ft-lb.

The gear is a hydraulic-mechanical unit, which uses an integral piston and rack design to provide power assisted vehicle steering control. Internal valving directs pump flow and controls pressure, as required, to reduce steering effort during operation. The unit contains a rotary hydraulic fluid control valve integrated to the input shaft and a boost cylinder integrated with the rack (see Figs. 1 and 2).

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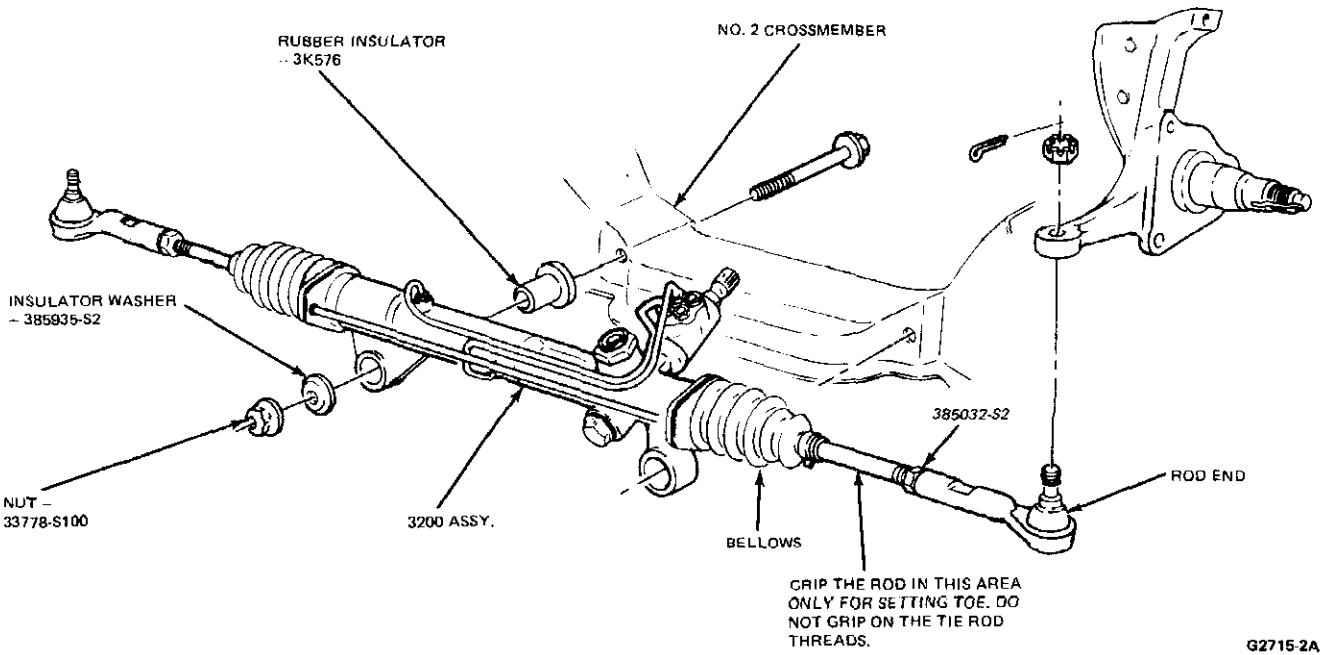


FIG. 1 Power Steering Gear Installation—Ford Rack and Pinion

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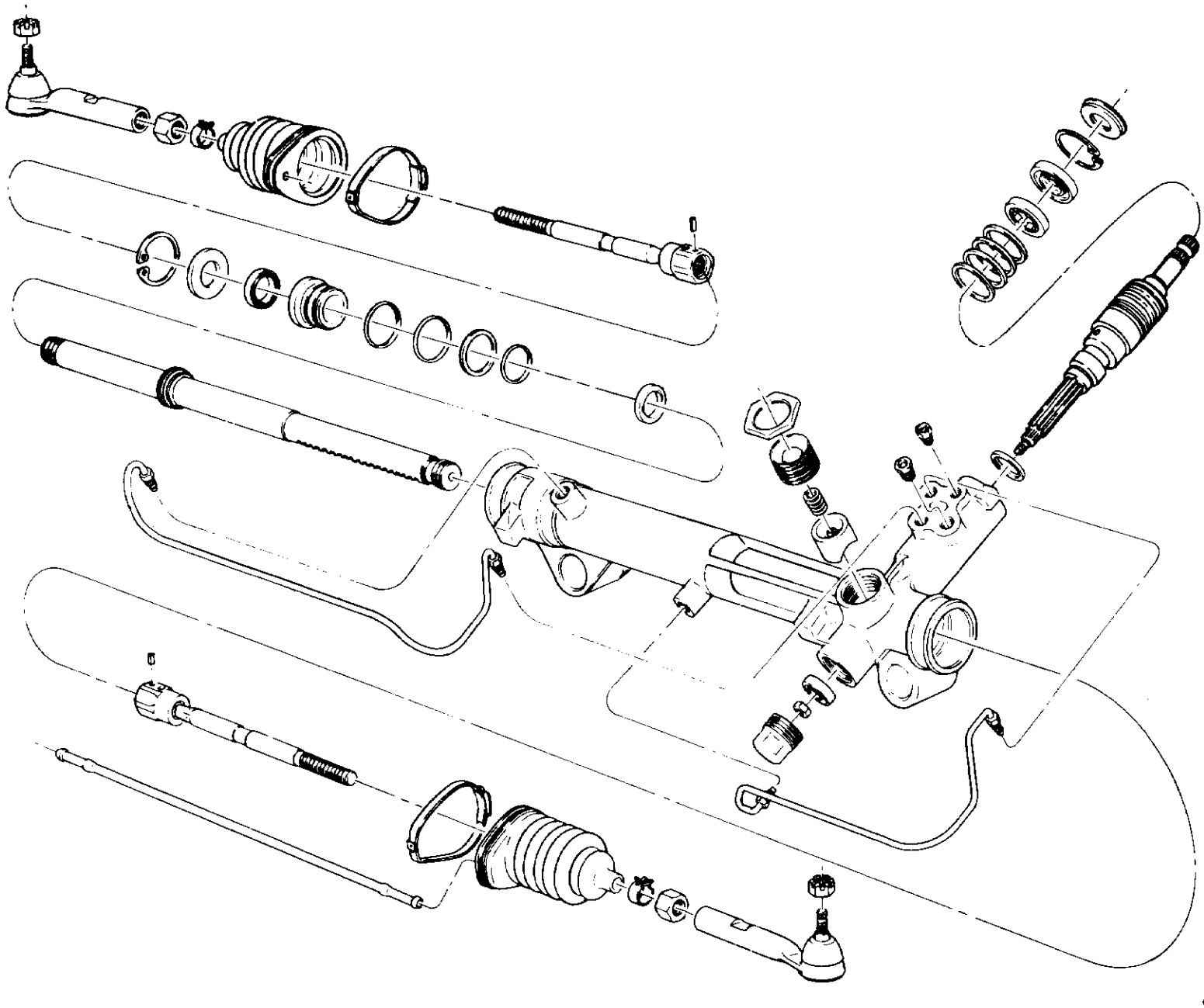


FIG. 2 Exploded View of Ford Power Rack and Pinion Gear

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OPERATION

ROTARY VALVE

The rotary design control valve uses relative rotational motion of the input shaft and valve sleeve to direct fluid flow.

When the steering wheel is turned, resistance of the wheels and the weight of the vehicle cause a torsion bar to deflect. This deflection changes the position of the valve spool and sleeve ports, directing fluid under pressure to the appropriate end of the power cylinder. The difference in pressure forces on the piston helps move the rack to assist turning effort. The piston is attached directly to the rack, and the housing functions as the power cylinder. The oil in the opposite end of the power cylinder is forced to the control valve and back to the pump reservoir.

When the driver stops applying steering effort, the valve is forced back to a centered position by the torsion bar. When this occurs, pressure is equalized on both sides of the piston and the front wheels tend to return to a straight ahead position. Fig. 3 illustrates the hydraulic fluid flow assisting rack movement.

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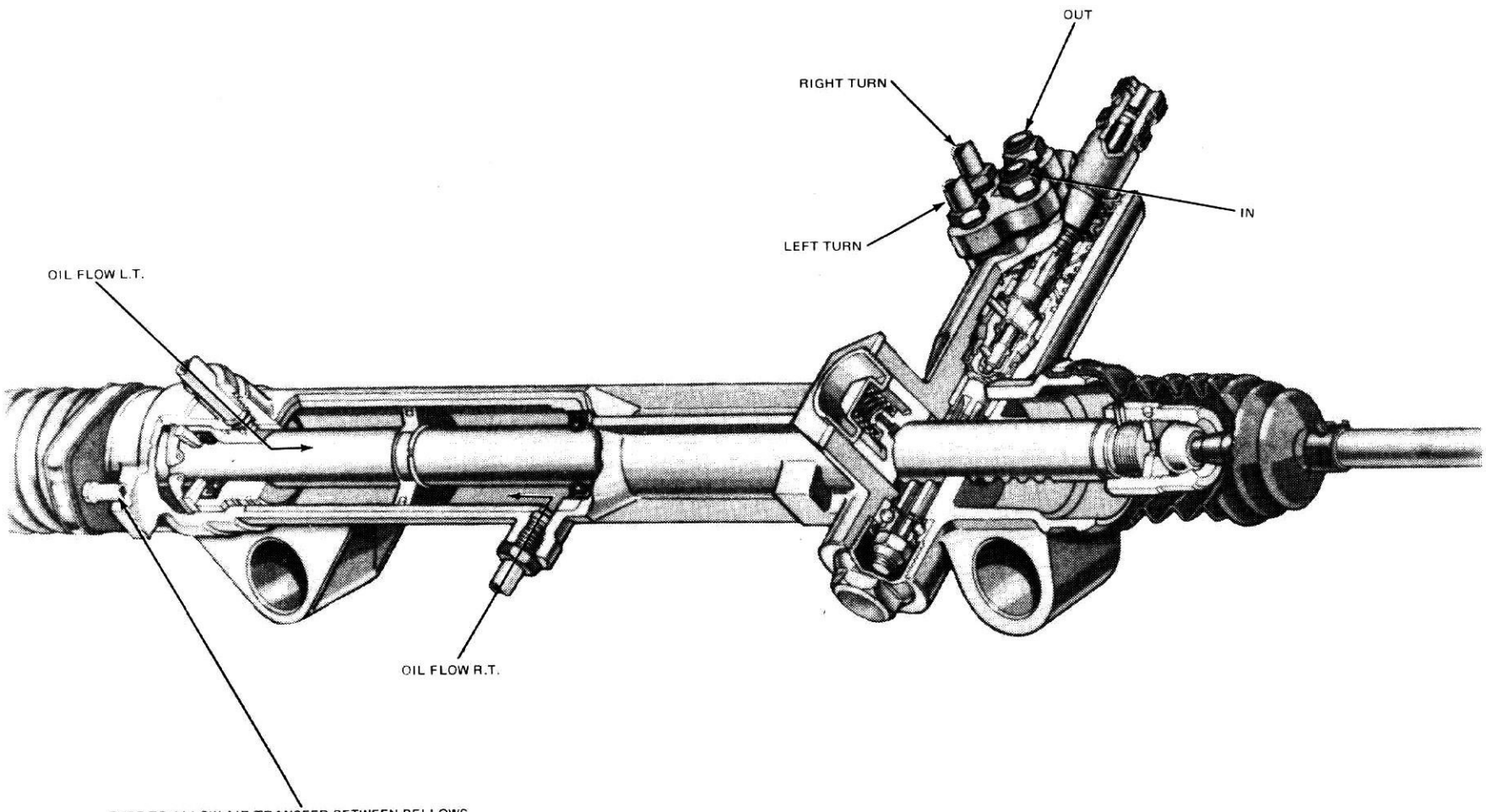


FIG. 3 Rack Movement

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DIAGNOSIS

Before any internal service is performed to the rack and pinion power steering, diagnosis must be performed. Make sure that tire size is correct with matched tires (front and rear) inflated to specifications. The following conditions, possible causes and resolutions will assist in performing the proper repairs:

DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Front End Wander** Front end wander is a condition that is noticed when the car is driven in a straight ahead position with the wheel held in a firm position, but the car wanders to either the right or left side. Front end alignment should be checked before any gear service is made.	• Tie rod ball socket loose/worn.	• Replace the tie rod/ball socket assembly.
	• Gear housing loose on No. 2 crossmember.	• Tighten mounting bolt nuts (2) to specifications.
	• Worn pinion bushing in gear housing.	• Replace gear housing.
	• Loose pinion ball bearing.	• Replace pinion ball bearing.
	• Worn right hand aluminum rack bushing.	• Replace aluminum rack bushing.
	• Loose outer ball joints.	• Replace tie rod end assembly.

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DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Feedback (Rattle, Chuckle, Knocking Noises in Steering Gear)** Feedback is a condition that is noticed when a car is driven over rough pavement and this roughness is felt in the steering wheel by the driver. In addition, if the gear is not adjusted properly, excessive rattle, knocking and/or chuckle noises can be heard inside the car.	• Loose/worn tie rod ball socket.	• Replace tie rod/ball socket assembly.
	• Tie rod thrust bearing broken or worn.	• Replace tie rod/ball socket assembly.
	• Oversize pinion shaft bushing in the gear housing.	• Replace gear housing.
	• Gear housing loose on No. 2 crossmember.	• Tighten mounting bolt nuts (2) to specifications.
	• Worn rack bushing.	• Replace rack bushing.
	• Loose pinion bearing locknut.	• Tighten pinion bearing locknut to specification.
	• Loose pinion bearing cap.	• Tighten pinion bearing cap to specifications.
	• Loose yoke bearing.	• Adjust yoke bearing preload to specifications.
	• Broken yoke bearing spring.	• Replace yoke bearing spring.
	• Loose yoke bearing plug.	• Adjust yoke bearing preload to specification.
	• Deteriorated shock absorbers.	• Replace shock absorbers.

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DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Heavy Steering Efforts, Poor Assist** A heavy effort and poor assist condition is recognized by the driver while turning corners and especially while parking. A road test can verify the condition.	• Leakage/loss of fluid due to leaking rack, pinion and/or input shaft seals.	• Replace rack seals, pinion seals, and/or input shaft seals.
	• Low steering system fluid level.	• Add steering fluid to proper level.
	• Damaged/worn plastic piston O-ring.	• Replace plastic piston O-ring.
	• Bent rack assembly.	• Replace rack and piston assembly.
	• Loose rack piston.	• Replace rack and piston assembly.
	• Loose/missing rubber backup piston O-ring.	• Replace/install rubber backup piston O-ring.
	• Undersize pinion shaft bushing in the gear housing.	• Replace gear housing.
	• Rack bushing O-ring and/or rack seal leak.	• Replace O-ring and rack seal.
	• Valve assembly internal leakage.	• Replace input shaft and valve assembly.
	• Valve plastic O-rings cut or twisted.	• Replace plastic O-rings.
	• Rack bushing snap ring broken or backed out.	• Replace rack bushing snap ring.

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DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Poor Returnability–Sticky Feeling** Poor returnability is a condition that is noticed when the vehicle is in a turn and returns to center with effort from the driver. In addition, when the driver returns the steering wheel to center, it may have a sticky or catchy feel.	• Yoke bearing plug too tight.	• Adjust yoke bearing preload to specification.
	• Binding in valve assembly.	• Replace input shaft and valve assembly.
	• Undersize pinion shaft bushing in the gear housing.	• Replace gear housing.
	• Bent rack assembly.	• Replace rack assembly.
	• Broken gear housing.	• Replace gear housing.
	• Damaged/failed input shaft support bearing.	• Replace input shaft support bearing.
	• Damaged/failed pinion bearing.	• Replace pinion bearing.
	• Misaligned steering column.	• Align steering column.
	• Excessive lash in tie rod ends.	• Replace as required.
	• Binding or looseness in ball joints.	• Replace as required.
	• Deformed engine mounts (results in damage to the steering gear).	• Inspect and replace as required.
	• Bent or broken No. 2 crossmember.	• Inspect and replace as required.

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DETROIT IRON

DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Loss of Power Assist** When loss of power assist occurs, heavy steering effort is required by the driver to steer the car.	• Piston disengaged from rack or improper depth of piston ring groove.	• Replace rack assembly.
	• Gear housing oil seal leak.	• Replace gear housing oil seals.
	• Damaged gear housing tube.	• Replace gear housing.
	• Valve seals cut, twisted.	• Replace valve seals.
	• Rack piston seal cut, twisted.	• Replace rack piston seal.
	• Input shaft oil seal failure.	• Replace input shaft oil seal.
	• Rack bushing snap ring broken.	• Replace rack bushing snap ring.
	• Leakage from hose fittings.	• Tighten hose fittings to specification (10-15 ft.-lbs) and check for crossed or stripped threads. CAUTION: It is normal for the new design fittings to allow hose swivel. Overtightening may cause permanent damage to the pump, gear and hose fittings.

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DIAGNOSIS GUIDE – FORD INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **External Leakage** One of the most common conditions causing repeat repairs is fluid leaks. Make sure you clean off the steering gear first before any steering gear external leakage checks are performed.	• O-rings on rack bushing damaged or missing.	• Replace O-rings.
	• Oil seals damaged or improperly installed: Pinion seal. Rack bushing seal. Input shaft seal.	• Replace oil seals as required.
	• Rack bellows twisted, cut, clamps missing, clamps loose or damaged.	• Repair, replace as required.
	• Pressure line O-rings damaged or missing. Pressure fittings not torqued properly.	• Replace O-rings and torque to specifications.
	• Right and left turn P/S lines damaged/ broken.	• Replace power steering lines.
• **Hissing Sound** There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and the performance of the steering gear.	• Hiss may be expected when the steering wheel is at the end of travel or when turning it at standstill.	• Hiss is a normal characteristic of rotary steering gears and in no way affects steering. Do not replace the input shaft and valve assembly unless the hiss is extremely objectionable. A replacement valve will also exhibit a slight noise and is not always a cure for the condition. Investigate for a grounded column or a loose boot at the dash panel. Any metal to metal contact will transmit valve hiss into the passenger compartment through the steering column. Verify clearance between flexible coupling components. Be sure steering column shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates.

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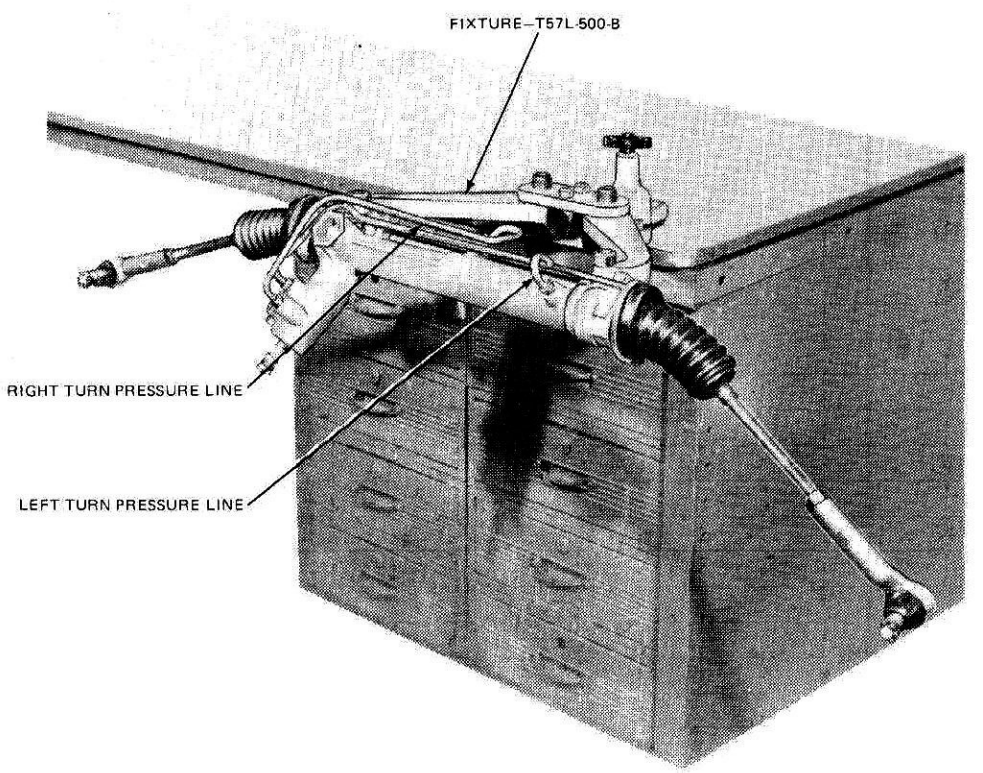
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ADJUSTMENTS

The power rack and pinion steering gear provides for only one service adjustment. The gear must be removed from the vehicle to perform this adjustment. Refer to section on Gear Removal.

RACK YOKE BEARING PRELOAD

1. Clean the exterior of the steering gear thoroughly.
2. Install two long bolts and washers through the bushings and attach to the bench mounted holding fixture, Tool T57L-500-B (Fig. 4).
3. Remove external pressure lines from gear to allow access to yoke plug locknut.
4. Drain the power steering fluid by rotating the input shaft lock-to-lock twice using Tool T74P-3504-R. (Cover ports on valve housing with shop cloth while draining gear).
5. Insert an in-lb torque wrench (max. capacity 30-60 in-lbs) into the input shaft torque adapter, Tool T74P-3504-R. Position the adapter and wrench on the input shaft splines.
6. Loosen the yoke plug locknut with wrench, Tool T78P-3504-H (Fig. 5).
7. Loosen yoke plug with a 3/4" socket wrench.
8. With the rack at the center of travel, tighten the yoke plug to 45-50 in-lb (Fig. 6). Clean the threads of the yoke plug prior to torquing to prevent a false reading.
9. Back off the yoke plug approximately 1/8 turn (42 degrees min.-45 degrees max.) until the torque required to initiate and sustain rotation of the input shaft is 7-18 in-lbs.
10. Place Tool T78P-3504-H on the yoke plug locknut. While holding the yoke plug, torque the locknut to specification (Fig. 5). DO NOT ALLOW THE YOKE PLUG TO MOVE WHILE TORQUING OR THE PRELOAD WILL BE AFFECTED. Recheck input shaft torque after tightening locknut.
11. Remove all tools and reinstall the external pressure line assemblies, making sure the O-rings are in good shape. Torque the fittings to specifications.



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FIG. 4 Holding Fixture, Tool T57L-500-B

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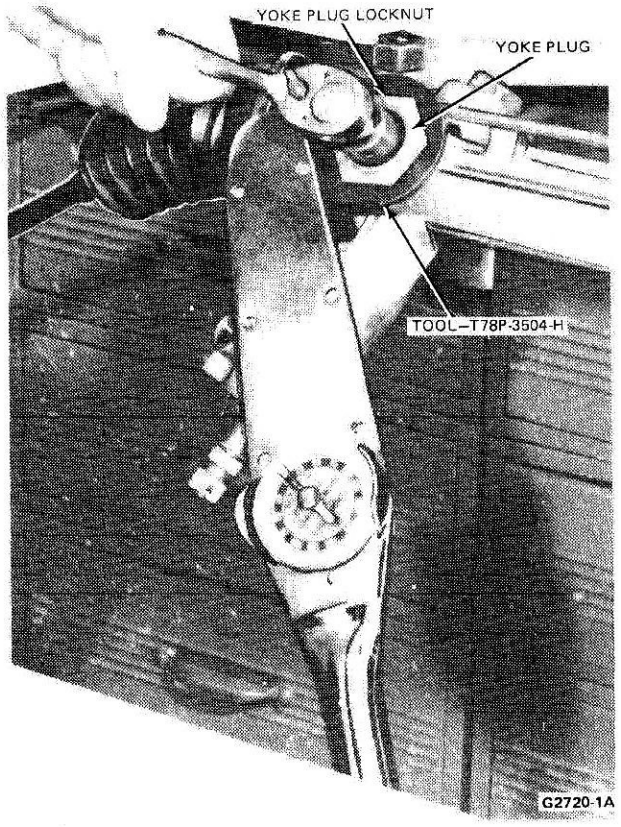


FIG. 5 Loosening/Tightening Yoke Plug Locknut

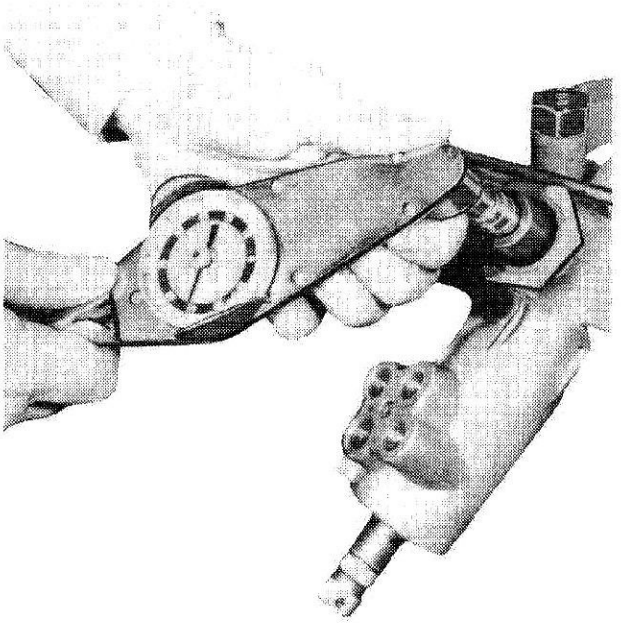


FIG. 6 Adjusting Yoke Bearing Preload

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DETROIT IRON

REMOVAL AND INSTALLATION

STEERING GEAR

Removal

1. Disconnect the negative battery cable from the battery.
2. Remove the one bolt retaining the flexible coupling to the input shaft.
3. Leave the ignition key in the ON position and raise the vehicle on a hoist.
4. Remove the two tie rod end retaining cotter pins and nuts. Separate the studs from the spindle arms, using the ball joint separator tool.
5. Support the steering gear and remove the two nuts, insulator washers and bolts retaining the steering gear to the No. 2 crossmember (Fig. 1). Lower the gear slightly to permit access to the pressure and return line fittings.
6. Disconnect the pressure and return lines from the steering gear valve housing. PLUG THE LINES AND PORTS IN THE VALVE HOUSING TO PREVENT ENTRY OF DIRT.
7. Remove the steering gear assembly from the vehicle.

Installation

1. Support the steering gear and position it so that the pressure and return line fittings can be connected to the valve housing. Torque the fittings to specification (10-15 ft-lb). The 1978 design allows the hoses to swivel when torqued properly. Do not attempt to eliminate looseness by overtightening, since this can cause damage to the fittings.
2. THE RUBBER INSULATORS (3K576 in Fig. 1) MUST BE PUSHED COMPLETELY INSIDE THE GEAR HOUSING BEFORE THE INSTALLATION OF THE GEAR HOUSING ON NO. 2 CROSSMEMBER. No gap is allowed between the insulator and the face of the gear boss. A rubber lube such a Ruglyde or equivalent should be used to facilitate proper installation of the insulators in the gear housing. Insert the input shaft into the flexible coupling and position the steering gear to the No. 2 crossmember. Install the two bolts, insulator washers and nuts. Torque the two nuts to specifications.
3. Connect the tie rod ends to the spindle arms and install the two retaining nuts. Torque the nuts to specifications and install two new cotter pins.
4. Lower the vehicle and install the one bolt retaining the flexible coupling to the input shaft. Torque the bolt to specifications.
5. Turn the ignition key to the OFF position.
6. Connect the negative battery cable to the battery.
7. Remove the coil wire.
8. Fill the power steering pump reservoir.
9. Engage the starter and cycle the steering wheel to distribute the fluid. Check the fluid level and add as required.
10. Install the coil wire, start the engine and cycle the steering wheel. Check for fluid leaks.
11. If the tie rod ends were loosened, check the wheel alignment as outlined in Part 14-01 and reset if necessary.

DISASSEMBLY AND ASSEMBLY

STEERING GEAR

Take the following precautions when servicing the steering gear:

1. Use a clean workbench and tools.
2. Thoroughly clean the exterior of the unit with solvent. Drain off excess hydraulic fluid.
3. Handle all parts carefully to avoid nicks, burrs, scratches and dirt.
4. Do not use solvent on seals.
5. Impact tools must not be used during any of the following operations:

TIE ROD ENDS, BELLOWS AND TIE ROD BALL JOINT SOCKETS

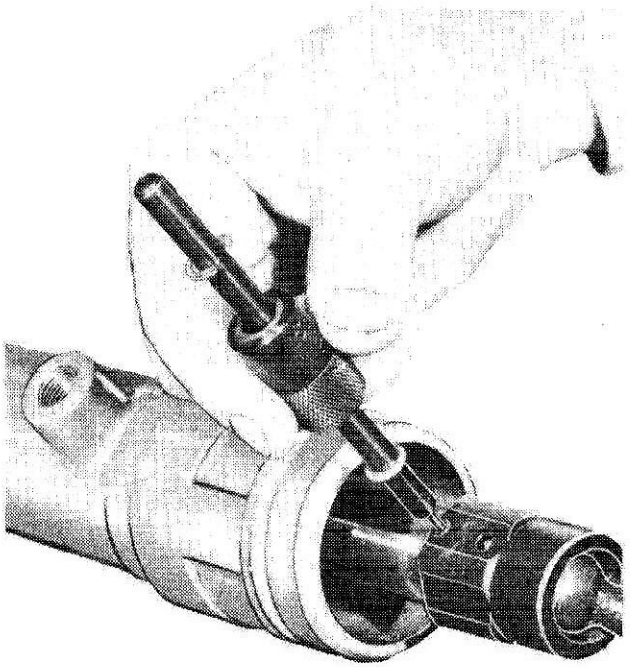
Disassembly

1. Install two long bolts and washers through the bushings and attach to Tool T57L-500-B (Fig. 4).
2. Loosen the jam nuts on the outer ends of the tie rods adjacent to the tie rod ends and remove the ends and jam nuts.
3. Remove the four clamps, retaining the bellows to the gear housing and the tie rods. Discard the clamps.
4. Drain the lubricant and remove the bellows along with the breather tube. Use care not to damage the bellows.
5. If pinion requires removal, remove pinion before proceeding. Follow procedure described in the Input Shaft and Valve Assembly section.
6. Thread point of the roll pin remover Tool, T78P-3504-N, into roll pin in ball joint nut and tighten the tool finger tight only. Use extreme care when using this tool since the point is fragile. Pull pin by working the slide hammer. Refer to Fig. 7 for illustration.
7. If pinion was not removed in Step 5, remove housing from the holding fixture and lay on the bench before preceeding. This prevents gear teeth damage from rack twisting when removing the tie rods in Step 8.
8. Position rack so that several rack teeth are exposed. Hold rack with an adjustable wrench on the end teeth only, while loosening ball joint nuts with Tool, T74P-3504-U (Fig. 8).

Assembly

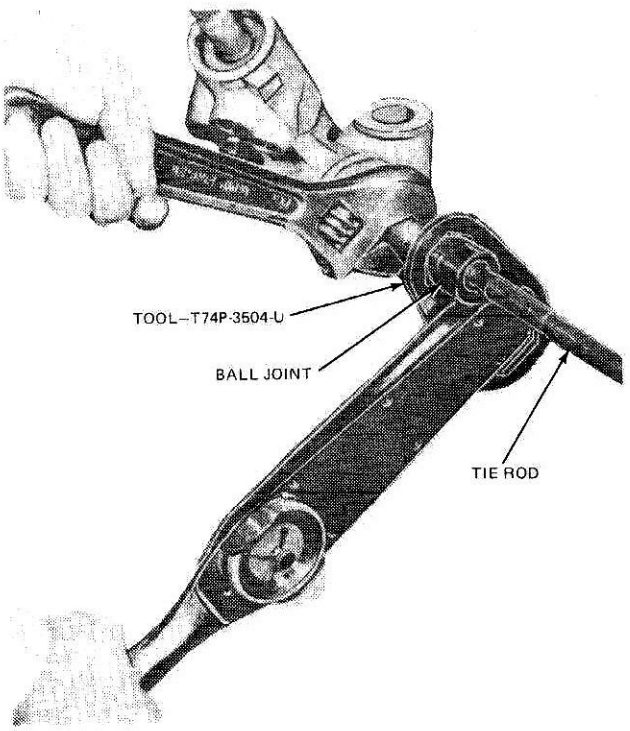
If pinion is assembled to the housing, Step 1 must be performed with the gear removed from the holding fixture to prevent gear teeth damage.

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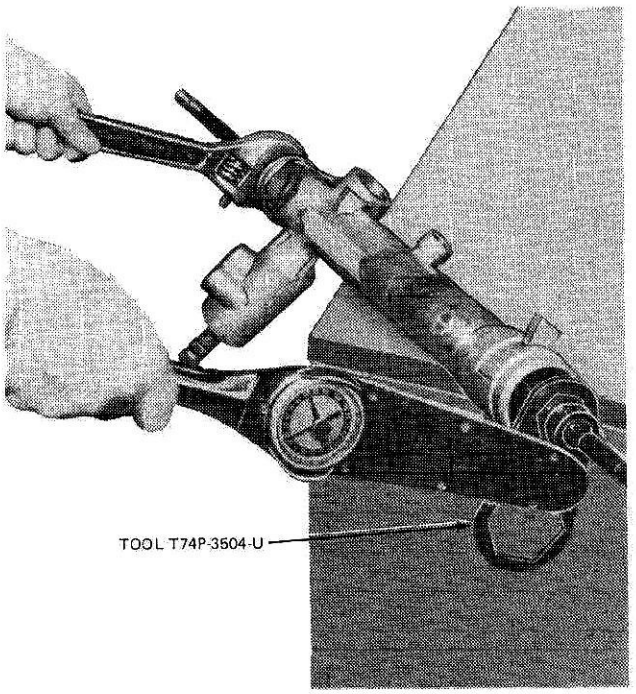
FIG. 7 Removing Roll Pin With Tool T78P-3504 or Equivalent



G2723-1A

FIG. 8 Removing/Installing Tie Rod Ball Joint Assembly

1. Install tie rods. Hold one ball joint nut with a 1-5/16" open end or box wrench while torquing the other nut to specification with Tool, T74P-3504-U or equivalent (Fig. 9). Both ends are torqued simultaneously by this method.
2. Support the ball housing with a block of wood. Install new roll-pins in the tie rod ball housing by tapping lightly with a plastic hammer (Fig. 10).



G2724-1A

FIG. 9 Torquing Both Tie Rod Ball Joints Simultaneously

3. If pinion was removed, install pinion as described in the Input Shaft and Valve Assembly section.
4. Thoroughly clean the rack and housing bore of any foreign material. Any abrasive material is extremely harmful to the high pressure oil seals.
5. Apply specified lube to under cut in the rods where the bellows clamp to the tie rod. This allows for toe-in adjustment without twisting the bellows.
6. Install bellows and breather tube. Install new clamps retaining the bellows to the gear housing. Orient bellows, tube and clamps as illustrated in Fig. 11. Use existing Tool, T63P-9171-A or equivalent, to secure the clamps properly (Fig. 12).
7. Install new clamps retaining the bellows to the tie rods.
8. Install the jam nuts and tie rod ends on the tie rods.

INPUT SHAFT AND VALVE ASSEMBLY

Disassembly

1. Thoroughly clean the areas of the input shaft valve housing, yoke locknut and plug, and pinion bearing plug.

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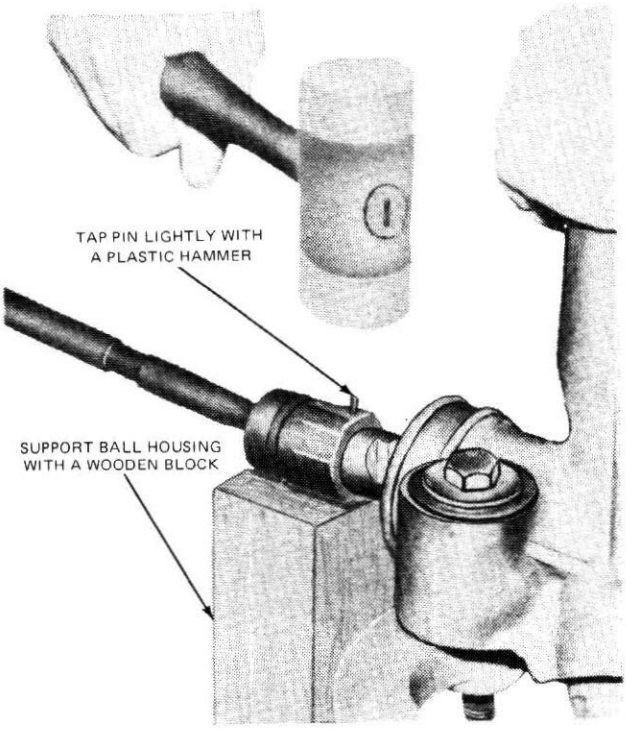


FIG. 10 Installing Roll Pin In Tie Rod Ball Joint

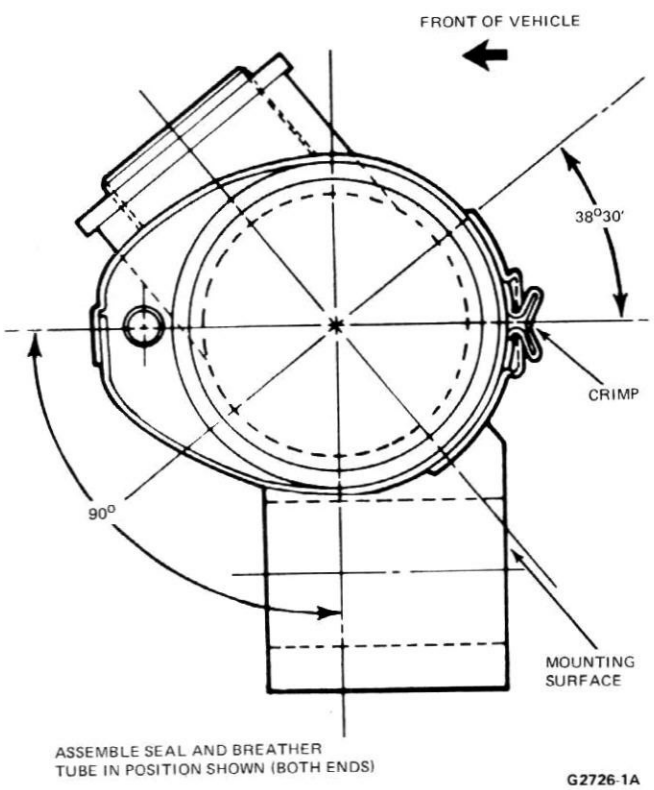


FIG. 11 Bellows, Breather Tube, and Clamp Orientation

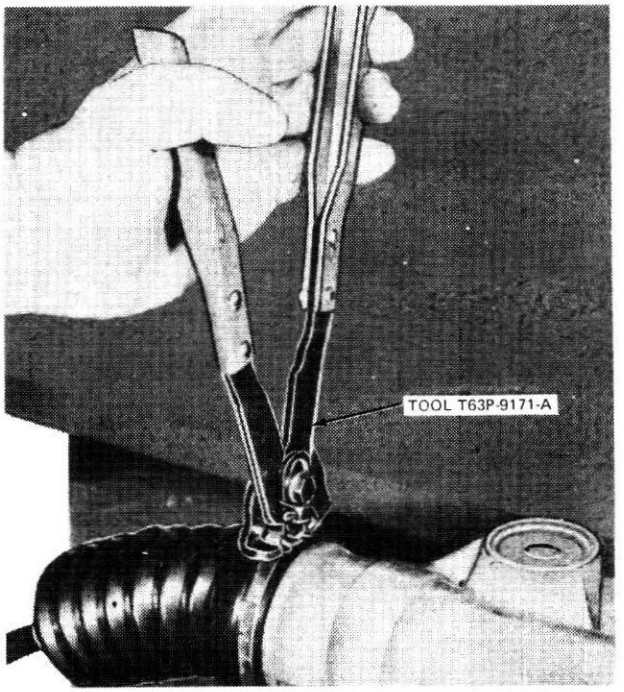
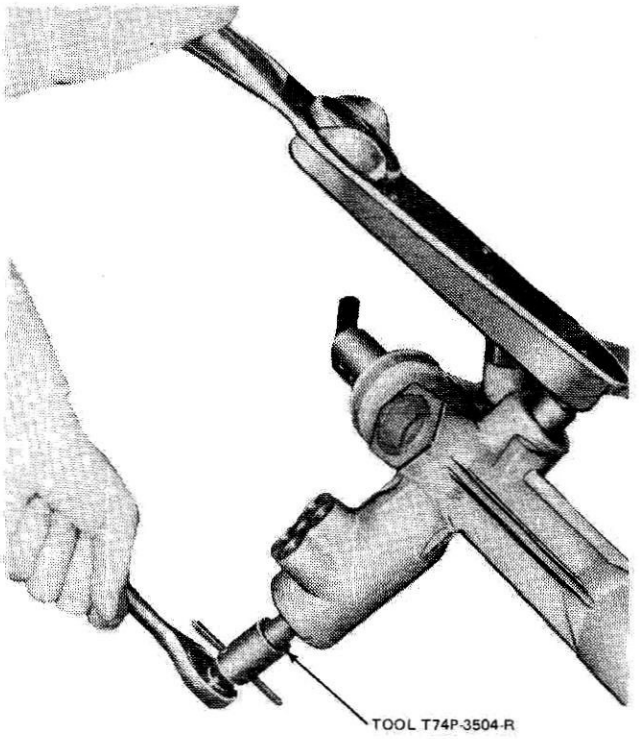


FIG. 12 Installing Bellows Clamp

2. Mount gear in the bench mounted holding fixture, Tool, T57L-500-B (Fig. 4).
3. Remove the external pressure lines from the gear housing.
4. Loosen the yoke plug locknut and the yoke plug to relieve the preload on the rack.
5. Remove the pinion bearing plug.
6. Install Tool, T74P-3504-R, on the input shaft. Hold the input shaft and remove the pinion bearing locknut with an 11/16" socket (Fig. 13). Discard the locknut.
7. Pry the input shaft dust seal out of the valve housing with a small, sharp chisel (Fig. 14). Use care not to damage any of the valve housing surfaces.
8. Remove snap ring located beneath the dust seal, from the valve housing (Fig. 15).
9. Attach input shaft and valve body puller Tool, T78P-3504-B, to input shaft (Fig. 16). Turn nut to remove valve. Input shaft seal and bearing will come out with the valve body.
10. To remove the lower pinion shaft seal, insert Tool T78P-3504-E until it bottoms along with the spacer collet. Activate the expander with a pair of wrenches (Fig. 17) by holding the large nut and turning the small nut until expander fully tightens. Pull tool and seal with slide hammer T50T-100-A (Fig. 18).
11. Remove the pinion bearing from the gear housing with slide hammer, Tool T50T-100-A and attachment Tool, T58L-101-A (Fig. 19).

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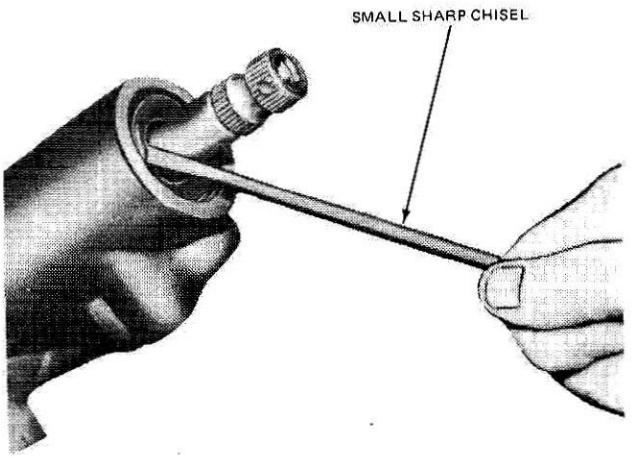
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FIG. 13 Removing/Installing Pinion Bearing Locknut



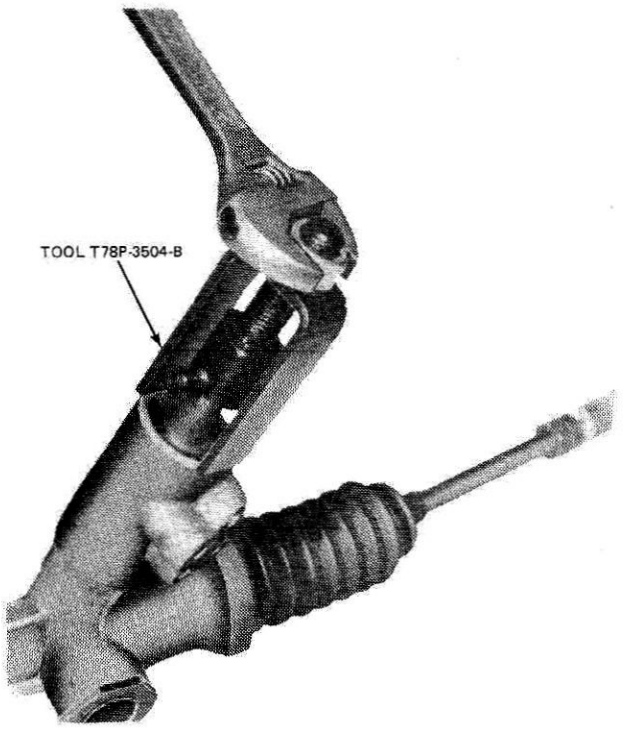
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FIG. 15 Removing/Installing Snap Ring



G2729-1A

FIG. 14 Removing Input Shaft Dust Seal



G2731-1A

FIG. 16 Removing Input Shaft/Control Valve Assembly From Valve Housing

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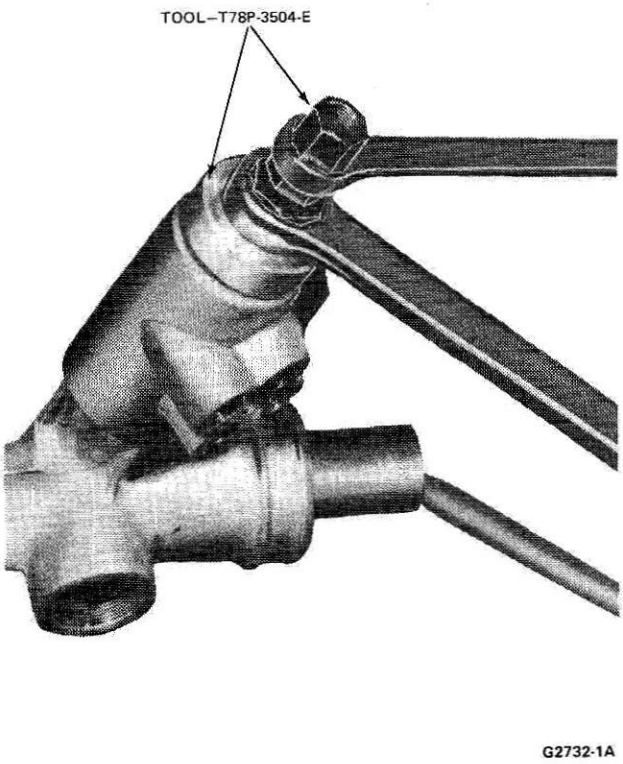


FIG. 17 Activating Expander of Pinion Seal Remover Tool T78P-3504-E

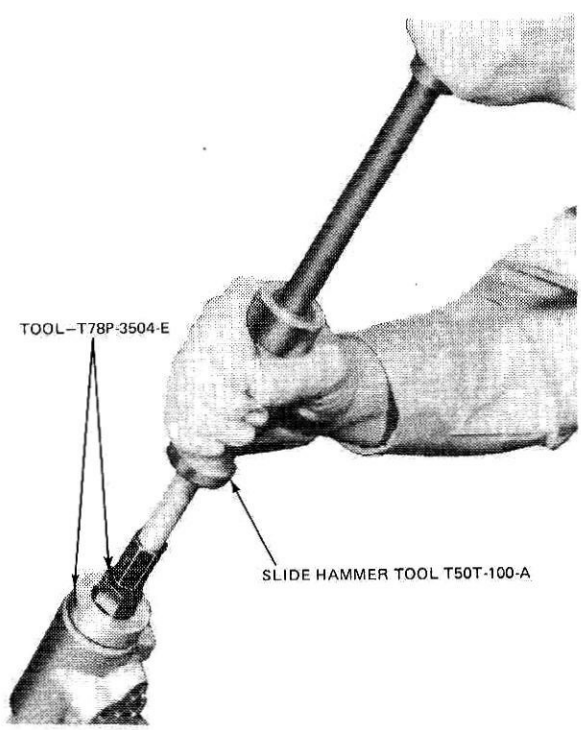


FIG. 18 Removing Lower Pinion Shaft Seal

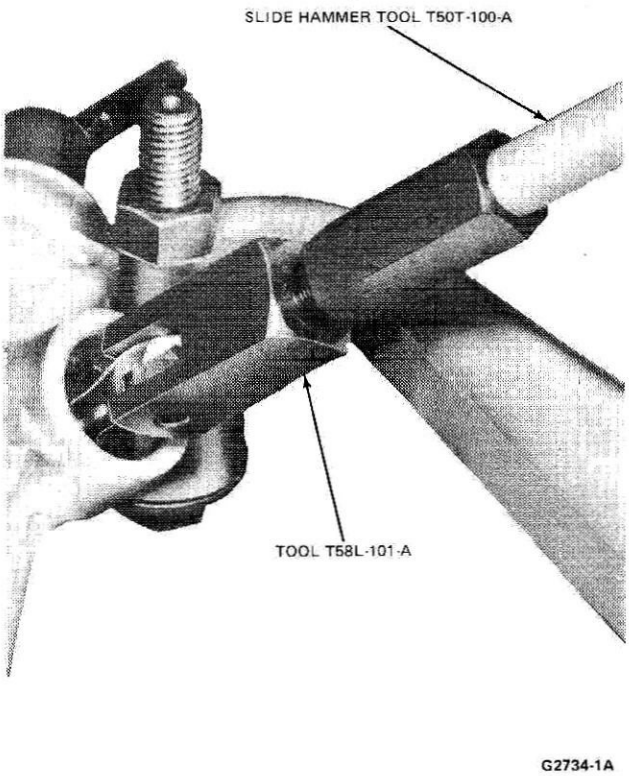


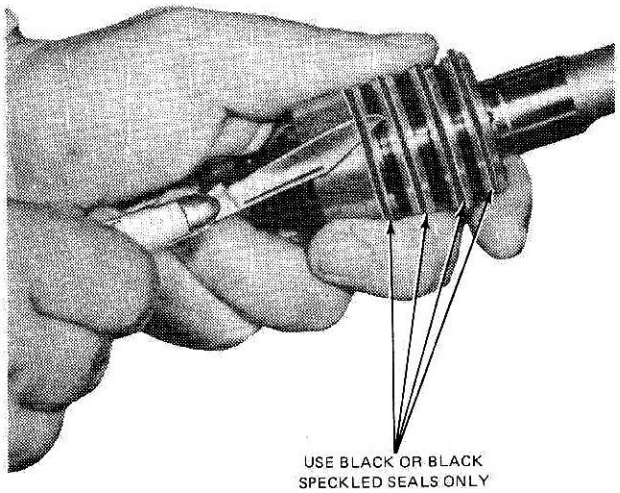
FIG. 19 Removing Pinion Bearing

12. The only serviceable components of the input shaft and valve assembly are the four plastic O-rings. Remove the O-rings by pushing the rings to one side and inserting a small pointed pocket knife under each ring and cutting it off (Fig. 20). Use care not to scratch the valve sleeve.

Assembly

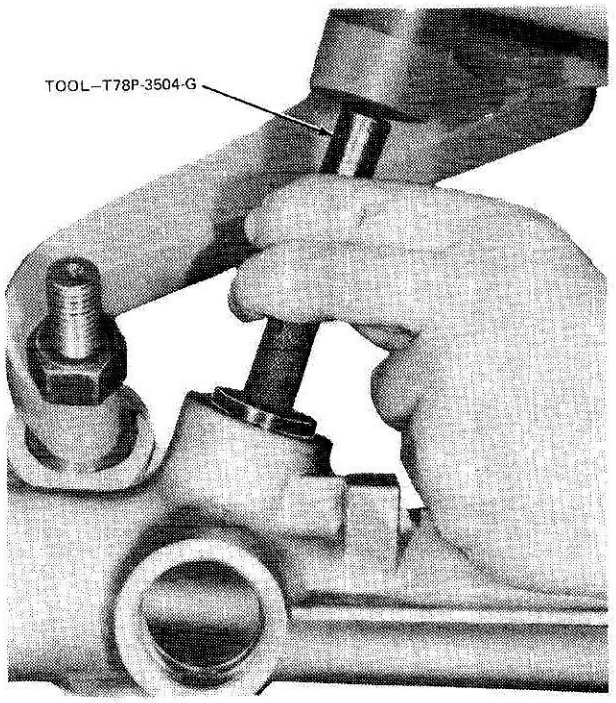
1. Install steering gear pinion bearing in gear housing using installation Tool, T78P-3504-G (Fig. 21). Seat the bearing against the shoulder in the bore (Fig. 22). Support valve housing with a wooden block when seating pinion bearing.
2. Apply grease to pinion oil seal and place on installation Tool, T78P-3504-F with seal lip towards tool (Fig. 23). Install seal in the valve bore, seating it against shoulder.
3. Mount the pinion end of the valve assembly into a soft jawed vise.
4. Install mandrel Tool, T75L-3517-A1 over the sleeve; slide one valve sleeve ring over the tool (Fig. 24).
5. Slide the pusher Tool, T75L-3517-A2 over the mandrel; rapidly push down on the pusher tool, forcing the ring down the ramp and into the fourth groove of the valve sleeve. Repeat this step three more times, and each time, add one of the spacers, Tool T75L-3517-A3, under the mandrel tool. By adding the spacer each time, the mandrel tool will line up with the next groove of the valve sleeve.
6. After installing the four valve sleeve rings, apply a light coat of gear lubricant to the sleeve and rings.

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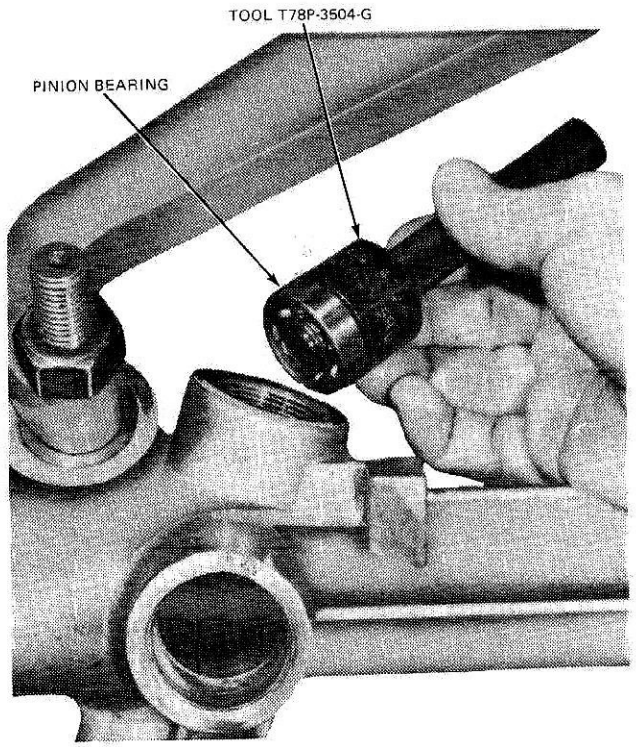
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FIG. 20 Removing Valve Sleeve Rings



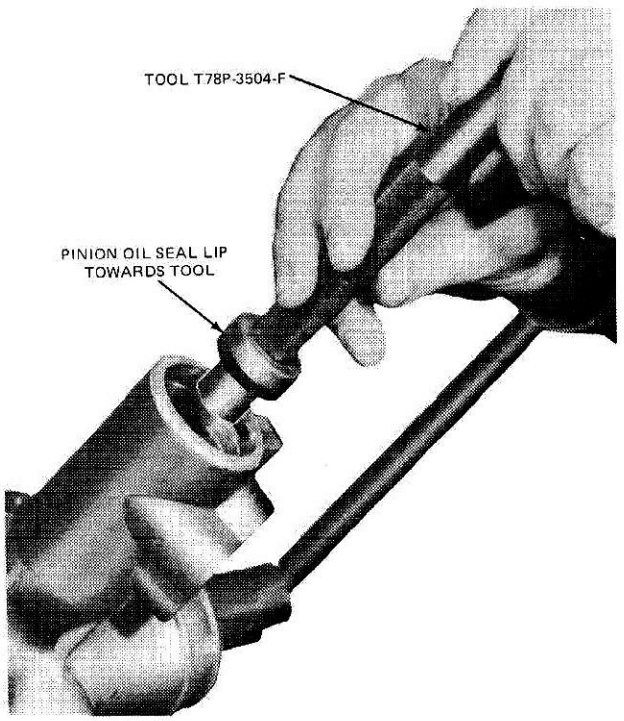
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FIG. 22 Seating Pinion Bearing



G2736-1A

FIG. 21 Installing Pinion Bearing



G2738-1A

FIG. 23 Installing Pinion Oil Seal

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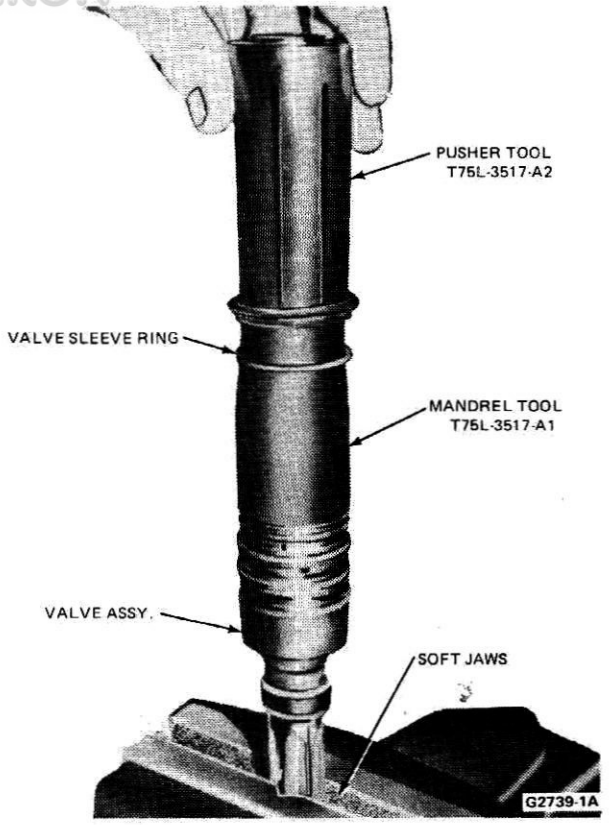


FIG. 24 Installing Valve Sleeve Rings

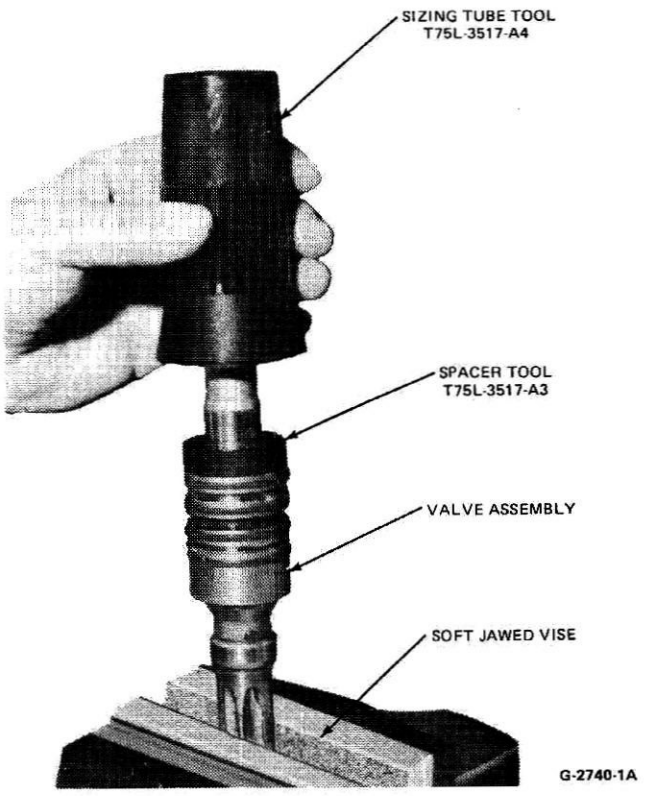


FIG. 25 Sizing the Plastic Valve Sleeve Rings

7. Install one spacer over the input shaft as a pilot for installing the sizing tube. Slowly install the sizing tube, Tool T75L-3517-A4, over the sleeve valve end of the input shaft onto the valve sleeve rings. Make sure that the rings are not being bent over as the tube is slid over them (Figs. 25 and 26).

8. Remove the sizing tube and check the condition of the rings. Make sure that the rings turn freely in the grooves.

9. Fig. 27 shows the complete set of tools needed to perform the above operations. The tool kit number for the complete set is T75L-3517-A.

   NOTE: If only the valve was serviced and the rack was not moved while the valve was out, Step No. 10 may be omitted.

10. If rack was removed and marked with paint, position rack so that paint mark is centered in valve bore. If rack was not removed, position rack in the housing so that the right end protrudes 1/4 inch more than the left end.

11. Line up the blocked tooth on the input shaft with the yoke plug hole center and insert valve assembly into the bore (Fig. 28). The blocked tooth must point straight up when the gear is installed in the vehicle with the gear on center (straight ahead position). Rotate input shaft slightly side to side if necessary to mesh the pinion to the rack teeth. Push valve assembly in by hand until seated properly.

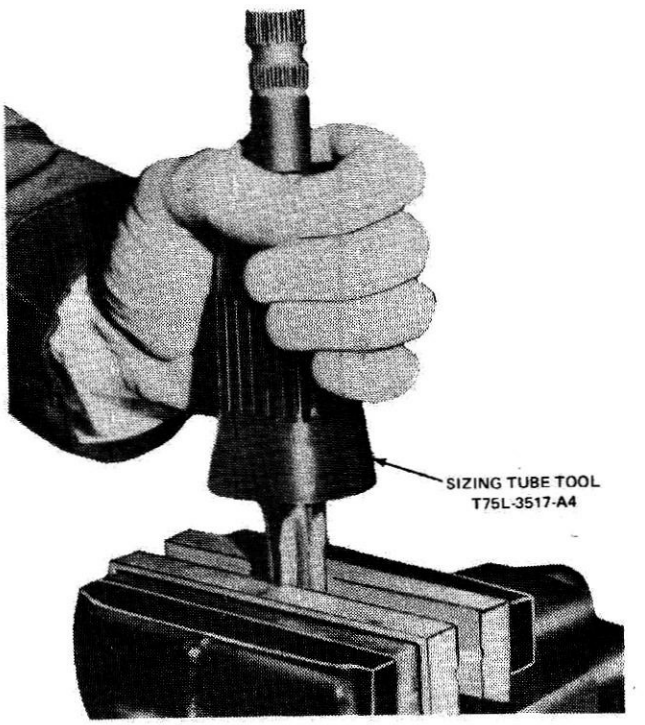


FIG. 26 Sizing the Plastic Valve Sleeve Rings

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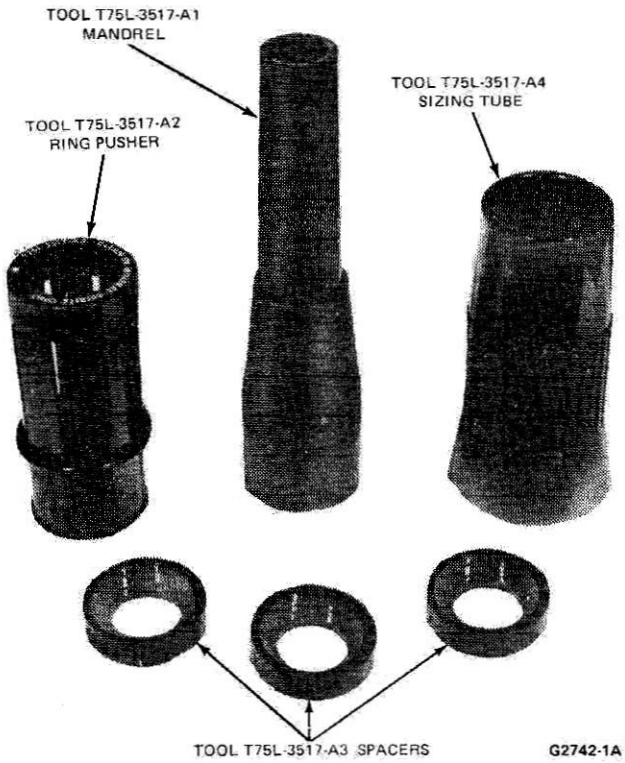


FIG. 27 Rotary Valve Tool Kit T75L-3517-A

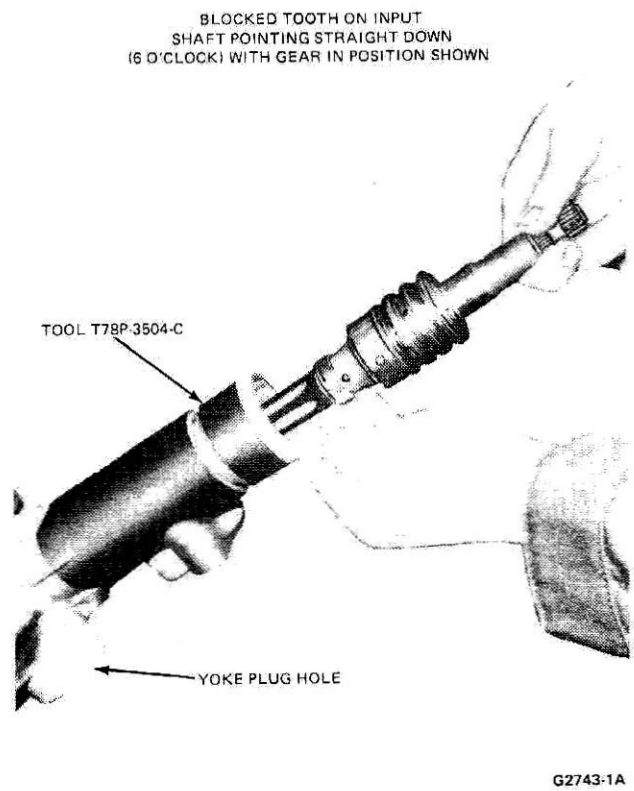


FIG. 28 Installing Valve Assembly

12. Using Tool, T74P-3504-R, to turn input shaft, check if pinion is centered by counting the number of turns from center to each stop (approximately 1 1/2 turns). If the number of turns is unequal, pull the valve assembly out far enough to free the pinion teeth. Rotate input shaft 60 degrees (one tooth) in direction which required less turns. Reinsert valve assembly and check if on center. Repeat procedure if necessary.
13. Install nut on pinion end of valve assembly. Holding the input shaft with Tool, T74P-3504-R, torque the nut to specification (Fig. 13). The rack must be away from the stops during this operation.
14. Apply gear lube to the input shaft bearing assembly. Install bearing in valve bore and seat with Tool, T78P-3504-D (Figs. 29 and 30).
15. Apply a film of gear lube to the input shaft seal and install with lip toward valve. Seat seal with Tool, T78P-3504-D (refer to Fig. 31 for illustration).
16. Install retaining snap ring in valve bore (Fig. 15).
17. Coat input shaft with lubriplate or equivalent in the dust seal area install input shaft dust seal and seat with Tool, T78P-3504-D (Figs. 32 and 33).
18. Install steering gear housing cap and torque to spec. (Fig. 34).
19. Fill yoke housing with a 2 oz. of gear lube. Install plastic yoke. Yoke must seat against the rack with finger pressure. If yoke hangs up, check for burrs in yoke housing (Fig. 35).
20. Install yoke thrust spring (Fig. 35).
21. Install yoke plug. Refer to adjustment section for yoke bearing preload adjustment.
22. Install yoke plug lock nut. Prior to torquing the lock nut, set the rack yoke bearing preload as outlined under Adjustments in this Part.

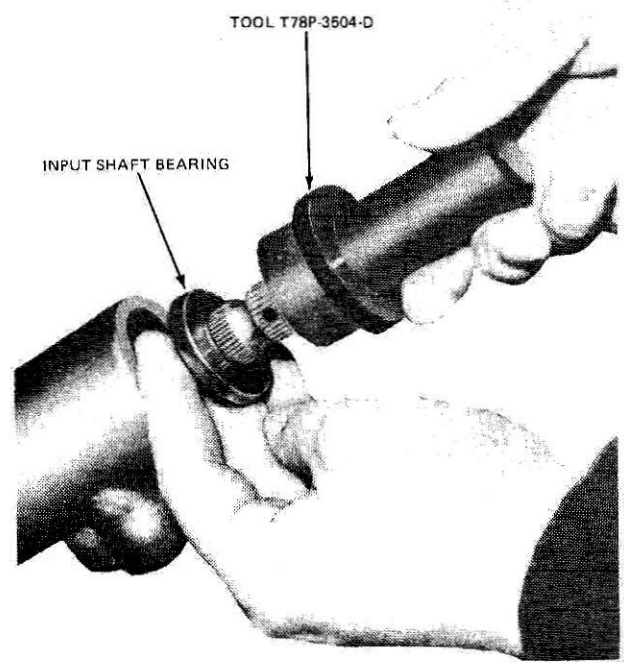
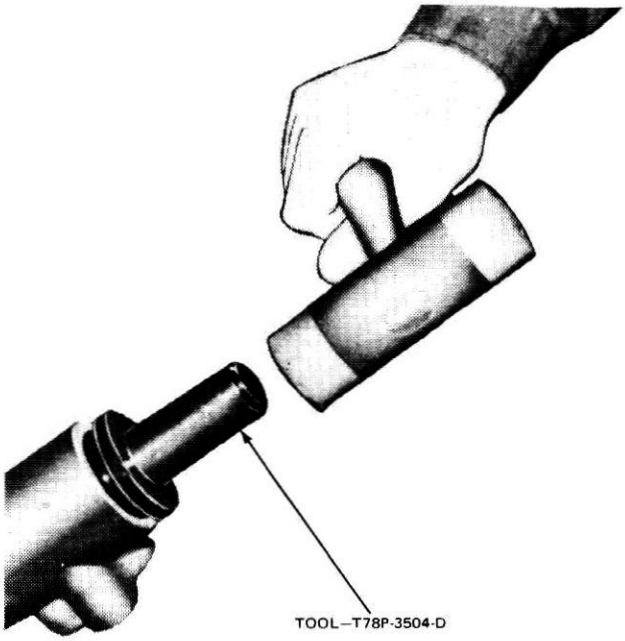


FIG. 29 Installing Input Shaft Bearing

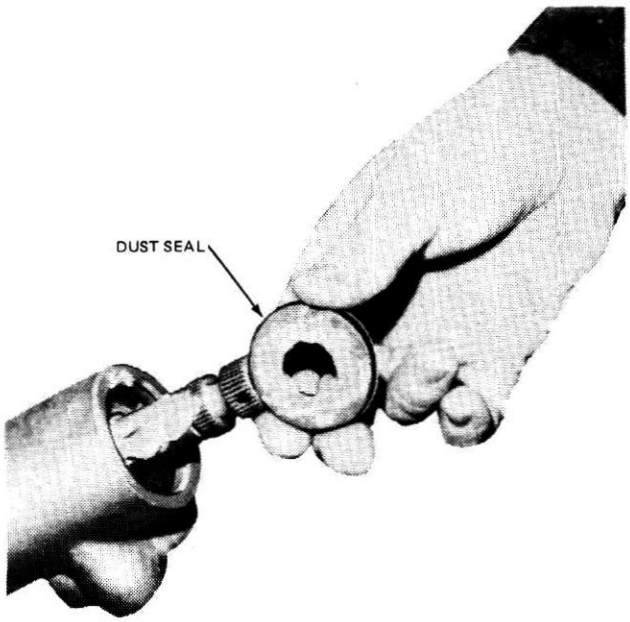
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23. Install the external pressure lines, making sure the O-rings are good and torqued to specification.



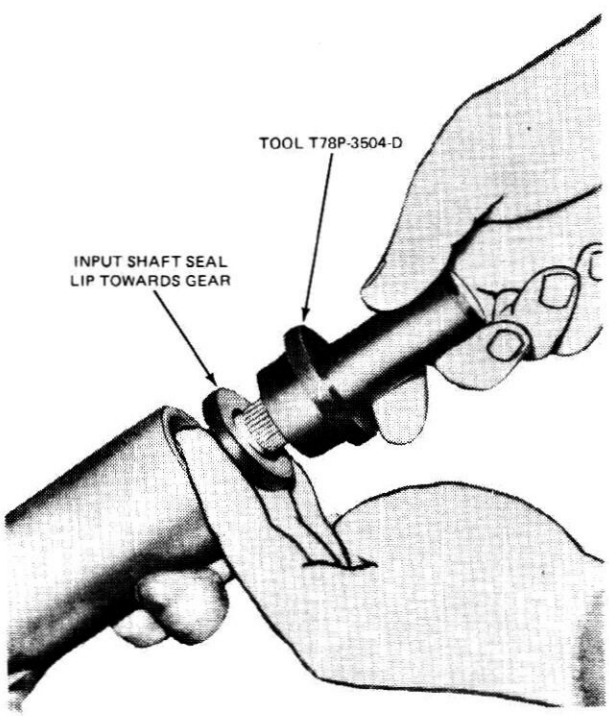
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FIG. 30 Seating Input Shaft Bearing



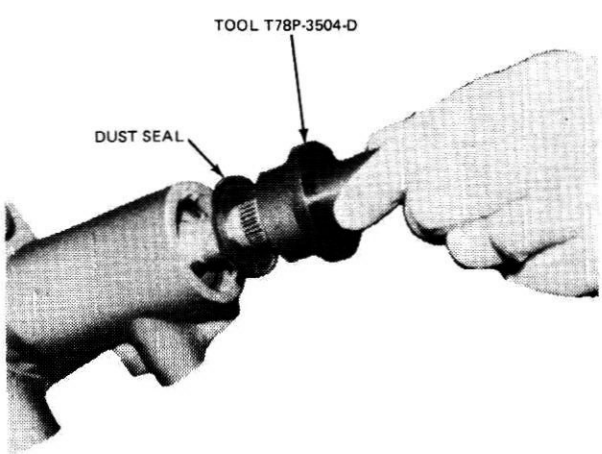
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FIG. 32 Applying Lubriplate Or Equivalent To Shaft And Dust Seal



G2746-1A

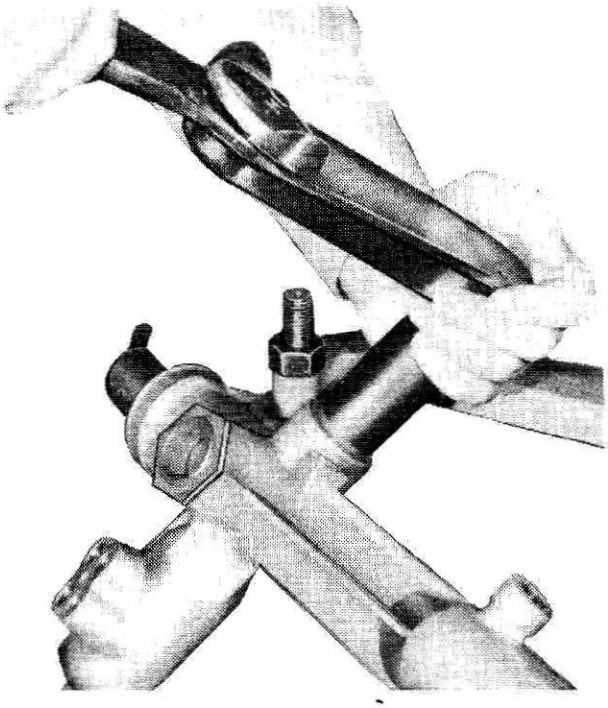
FIG. 31 Installing Input Shaft Seal



G2748-1A

FIG. 33 Installing Input Shaft Dust Seal

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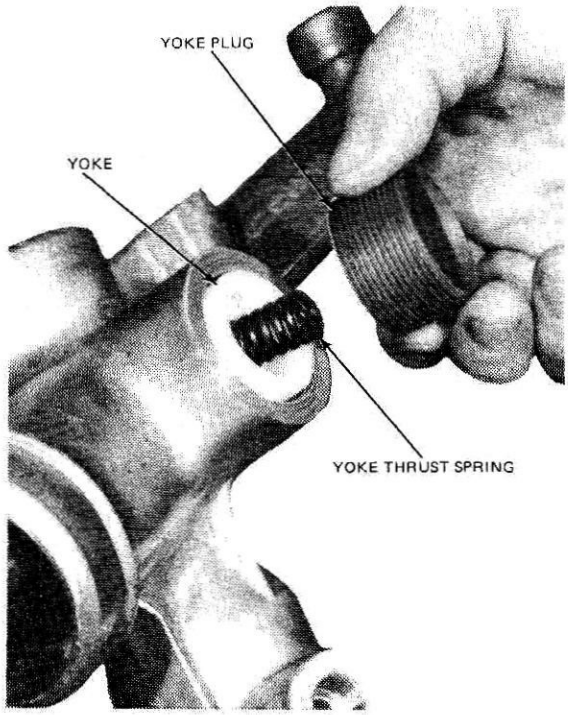
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FIG. 34 Torquing Steering Gear Housing Cap

GEAR HOUSING, RACK YOKE BEARING, RACK ASSEMBLY, RACK BUSHING AND OIL SEALS

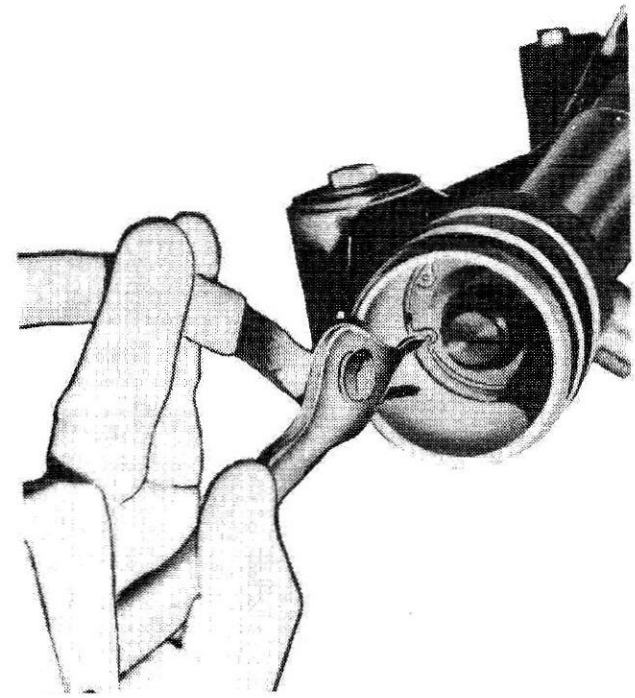
Disassembly

1. Remove the tie rod and socket assemblies from both ends of the rack and the input shaft and valve assembly as previously outlined in this Part.
2. Remove the yoke plug lock nut with Tool, T78P-3504-H. Remove the yoke plug with a 3/4" socket wrench.
3. Remove the yoke spring and the yoke bearing from the gear housing. The yoke bearing may be gripped by the spring guide post with a pair of pliers.
4. Working from the right side of the gear (opposite pinion end), push the rack in until it bottoms.
5. Remove snap ring from right end of housing (Fig. 36).
6. Slowly pull the rack out of the right side of the housing until the rack piston contacts the aluminum rack bushing. Apply pulling effort **(Do Not Hammer)** on the rack until the bushing is withdrawn from the housing. Remove the rack from the housing (Fig. 37).
7. To remove the internal high pressure rack oil seal, insert Tool, T78P-3504-J, into the housing until it bottoms (Fig. 38). Activate the expander with a wrench (Fig. 39) until the expander fully tightens. Remove the tool with the oil seal from the housing



G2750-1A

FIG. 35 Installing Yoke, Thrust Spring and Yoke Plug



G2751-1A

FIG. 36 Removing/Installing Rack Bushing Retaining Ring

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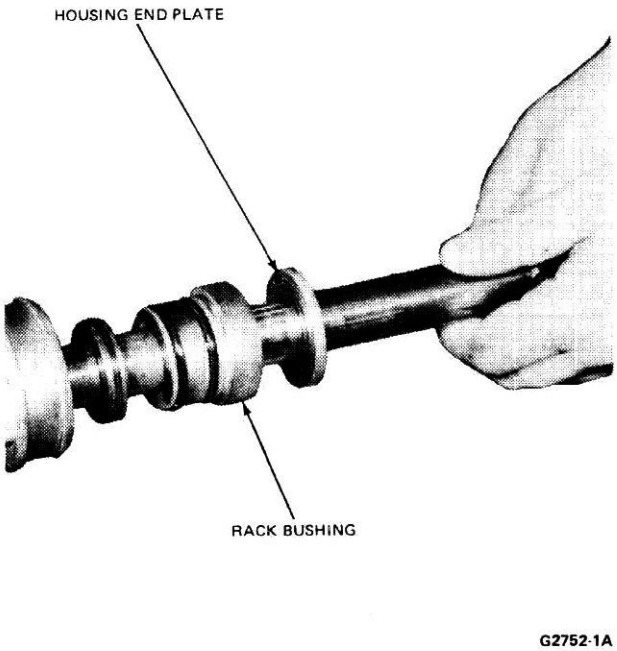


FIG. 37 Removing Rack And Rack Bushing From Gear Housing

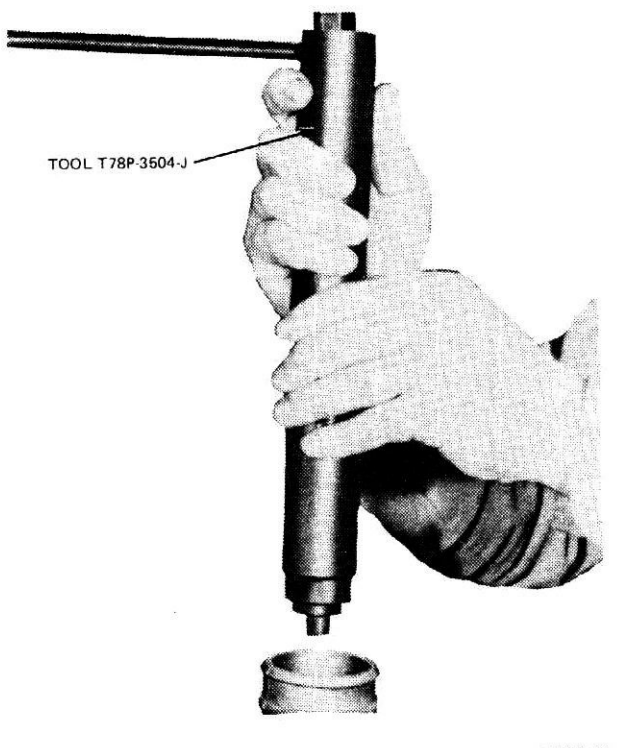


FIG. 38 Inserting Rack Oil Seal Remover Into Gear Housing

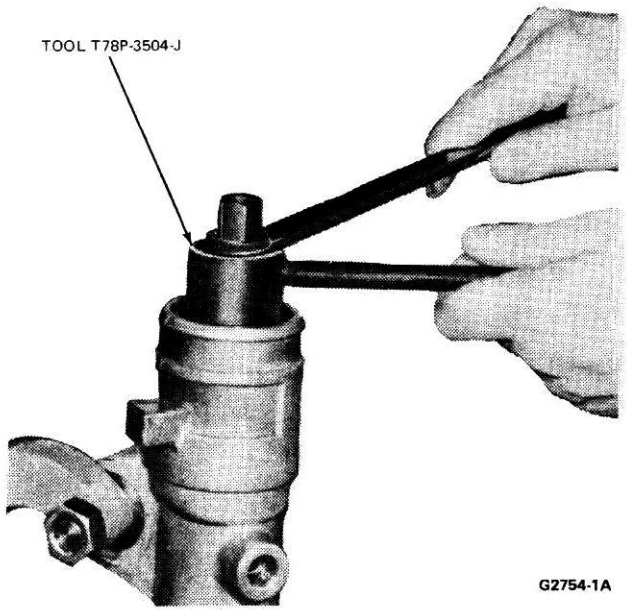


FIG. 39 Activating Expander On Rack Oil Seal Remover

with slide hammer T50T-100-A threaded into the expander end (Fig. 40). Discard the seal. **Note:** On the first attempt, the nylon ring may pull out of the seal, leaving the seal in the gear. Repeat the procedure and the seal will come out.

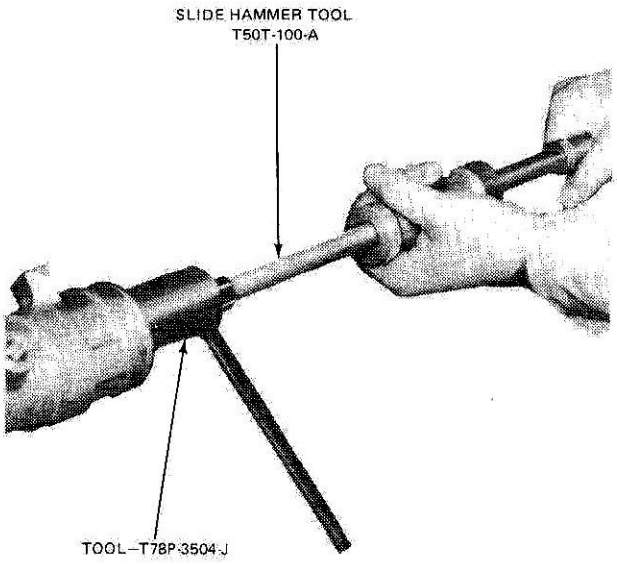
8. Remove the plastic O-ring and the rubber O-ring from the rack piston with Tool, T71P-19703-C.
9. Insert the rack bushing into the rack bushing holding Tool, T78P-3504-L, seal end first. Place the tool and bushing in vise. With Tool, T78P-3504-J, and slide hammer, T50T-100A, remove the seal (Fig. 41).
10. Remove the rubber O-rings from the bushing with Tool, T71P-19703-C (Fig. 42).

Assembly

Be sure that the pilot nose of Tool, T78P-3504-K, is completely free of nicks or burrs before placing a seal on the tool. If necessary, polish the tool as required, finishing with 600 grit wet/dry sandpaper and oil. This is equally important for Tool, T74P-3504-K, used in Step 5.

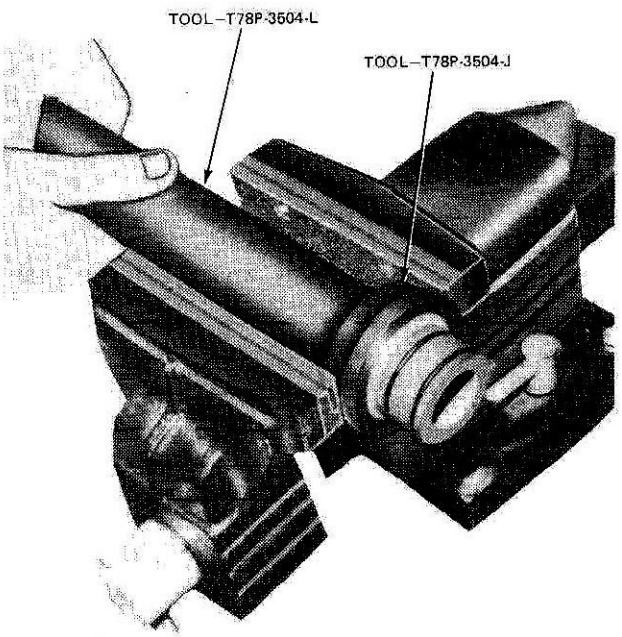
1. Apply grease to the high pressure oil seal and place on the inner rack oil seal replacer, Tool T78P-3504-K, with the lip spring facing the tool (Fig. 43). With the gear housing in a vertical position, insert the replacer into the right side bore of housing. Tap on the handle of the tool until the seal bottoms. **Do not cock the handle during this operation.**

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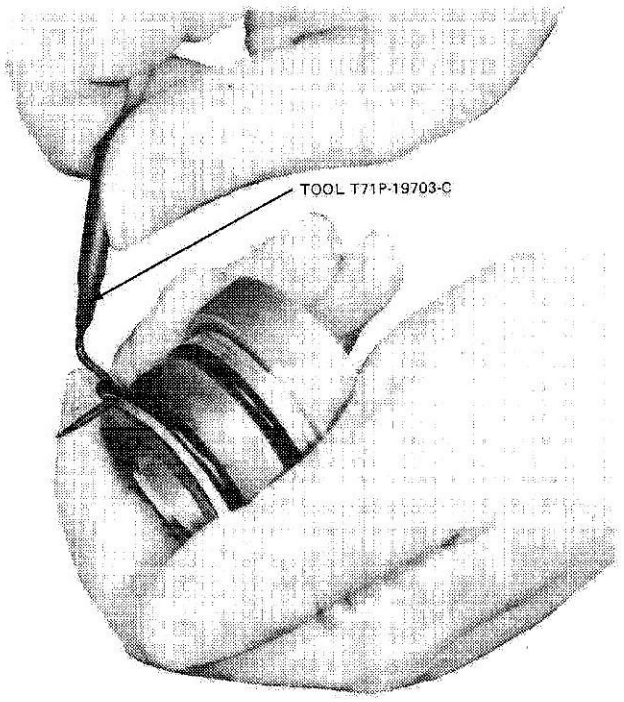
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FIG. 40 Removing Rack Seal From Gear Housing



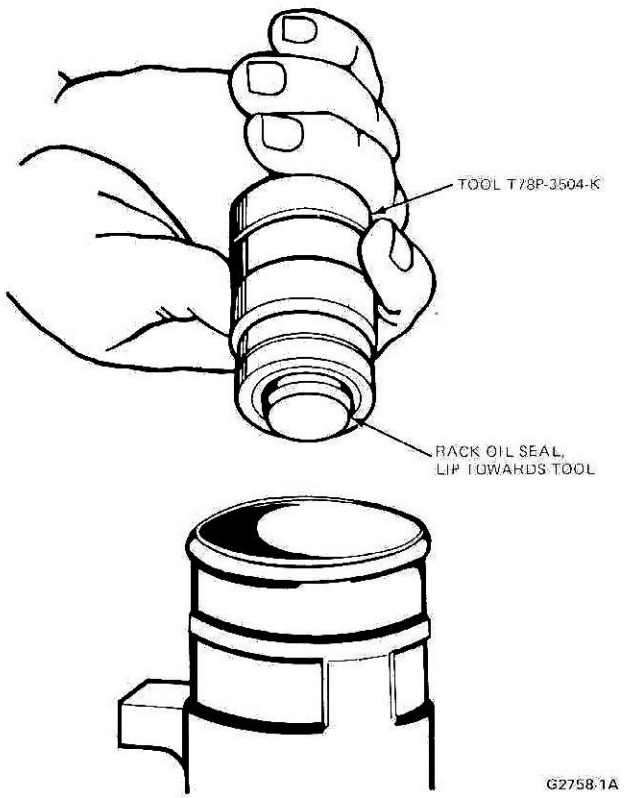
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FIG. 41 Removing Rack Seal From Rack Bushing



G2757-1A

FIG. 42 Removing O-Ring Seals From Rack Bushing



G2758-1A

FIG. 43 Installing Inner Rack Oil Seal

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2. Mark the center tooth space on the rack where it will be visible through the valve bore to facilitate valve replacement. Use a quick drying paint stick (Fig. 44).
3. Install the rubber O-ring in the groove of the rack piston.
4. Place a plastic O-ring on replacer Tool, T74P-3504-G. Slide the tool and O-ring on the rack until it is adjacent to the piston. Slide the plastic O-ring off the tool into the piston groove over the rubber O-ring (Fig. 45).
5. Pack rack teeth with specified grease. Apply a light coat of specified grease opposite the rack teeth (Yoke Bearing Area). Place the long protective sleeve, Tool T74P-3504-K, over the rack gear teeth (Fig. 46). This is required to protect the internal oil seal from the rack teeth (See note preceeding Step 1).
6. Thread the short protective sleeve, Tool T74P-3504-J, over the threads on the right side of the rack (Fig. 46).
7. Lubricate the plastic O-ring and the protective sleeve with power steering fluid.
8. Install the smaller diameter end of sizing Tool, T78P-3504-M, into the right side opening of the gear housing.
9. Place the rack, gear tooth end first, into the sizing tool. Carefully push the rack into the housing until the leading end engages the internal oil seal properly. Position the sizing tool so that it compresses the plastic O-ring properly, and guides it into the housing bore (Fig. 47). Push the rack in until the long protective sleeve protrudes from the left side of the gear. Remove the sizing tool and the long protecting sleeve from the end of the rack.

   Install tie rod on the left end of the rack to prevent the rack teeth from damaging the internal oil seal.

   Important Note: Do not allow rack to move too far from center until the tie rod end is installed since excessive rack travel can cause the rack teeth to cut the left (inner) oil seal.

10. Install the two rubber O-rings on the aluminum rack bushing.
11. Apply gear lube to the outer rack oil seal. With outer rack oil seal replacer, Tool T74P-3504-F, install the high pressure oil seal in the rack bushing (Fig. 48). The lip spring must face the inside of the bushing.
12. Lubricate the short protective sleeve on the rack end, and the rubber O-rings on the rack bushing with gear lube.
13. Start the bushing, seal facing out, on the rack. Pass the bushing and seal over the protecting sleeve and into the housing bore. Place end plate against the rack bushing. With sizing Tool T78P-3504-M apply hand pressure to the end plate and rack bushing until the bushing seats in the gear housing. If the rack bushing will not seat with hand pressure, a 1 1/8" deep socket (or larger) and a plastic mallet may be used to tap bushing in place. Install retaining ring (snap ring) (Fig. 36). Remove protective sleeve.

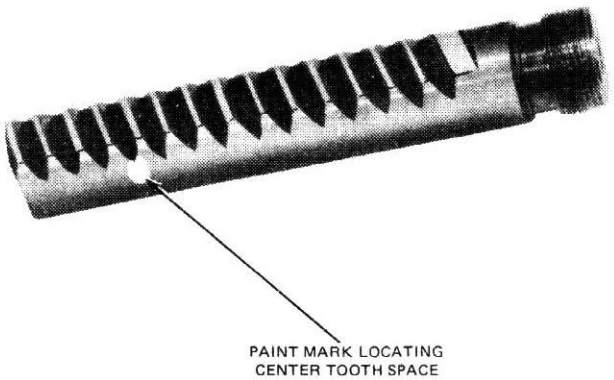


FIG. 44 Marking Center Tooth Space On Rack

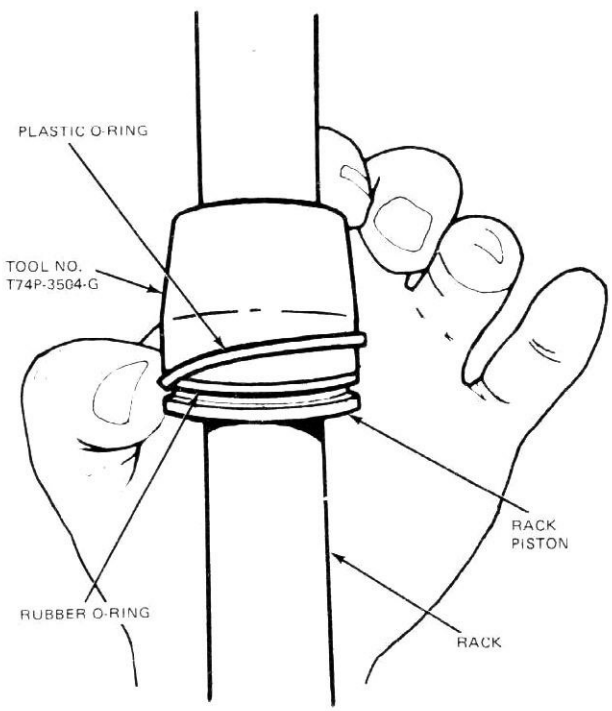


FIG. 45 Installing Plastic O-Ring

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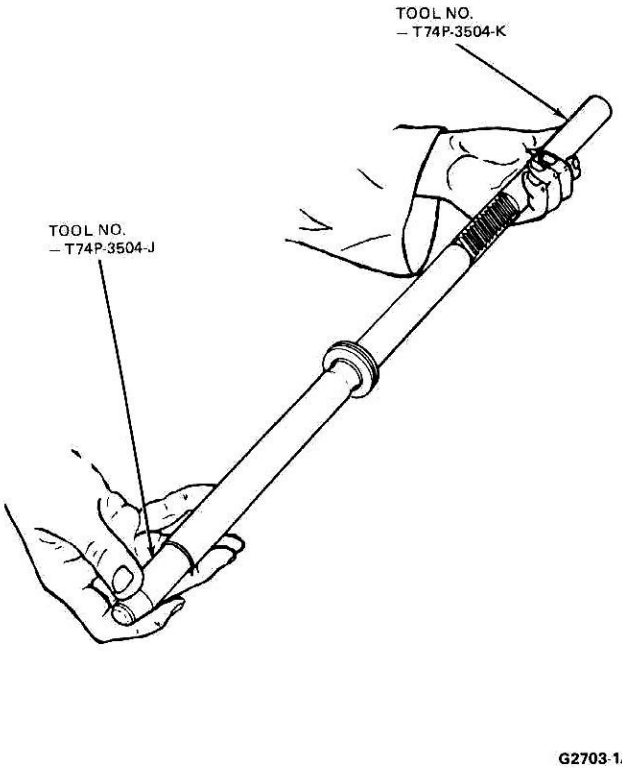


FIG. 46 Installing Long and Short Protective Sleeve Tool

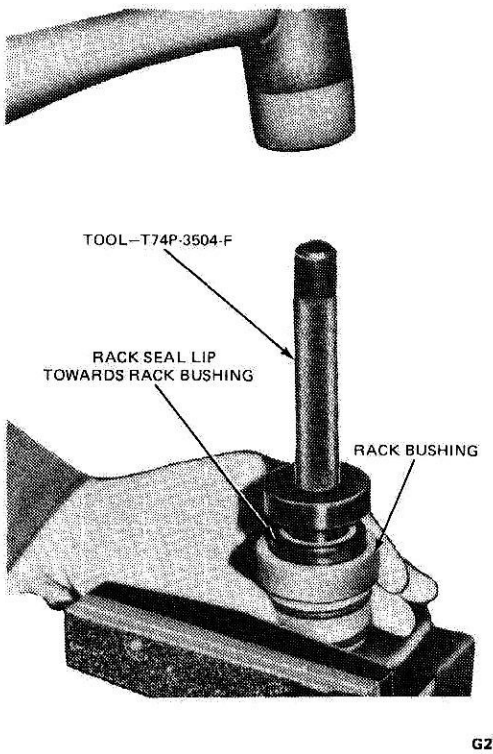


FIG. 48 Installing Rack Seal In Rack Bushing

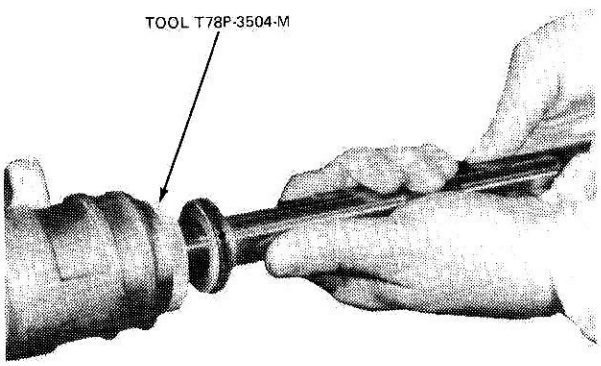


FIG. 47 Installing Rack Into Gear Housing

14. Install the rod assemblies. Torque both tie rod ball joint nuts simultaneously to specification by holding one and turning the other (Fig. 9) as outlined earlier in the Tie Rod Section.
15. Install roll pins in ball joint nuts by lightly tapping with hammer until seated (Fig. 10).
16. Install the input shaft and valve assembly as outlined earlier in this part.
17. Fill yoke plug hole with 2 oz. specified lube. Insert plastic yoke, spring, plug and locknut. Adjust yoke bearing preload as outlined in the Adjustment portion of this part.
18. Install the external pressure lines, making sure the O-rings are good. Torque to specification.
19. Apply specified lube to under-cut in tie rods where the bellows clamp to the tie rods. This is required to keep the bellows from twisting during toe-in adjustment.
20. Install bellows and pressure equalizer tube. Install new clamps retaining the bellows to the gear housing. Use Tool T63P-9171-A to secure the clamps properly (Fig. 12).
21. Install clamps retaining the bellows to the tie rods.
22. Install jam nuts and tie rod ends on the tie rods.

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SPECIFICATIONS

SPECIFICATION CHART – RACK & PINION – FORD

Gear Ratio	20.1 on Center 14.2 at Stops
Number of Turns	3.05
Pinion, Rack Lubricant Capacity	23-27 Grams
Power Steering Fluid Capacity (Including Steering Pump)	2.5 Pints
Pinion, Rack and Pinion Bearing Lubricant	ESB-M1C119-A
Seal Lubricant (Cavity under Dust Seal)	ESA-M1C45-A
Power Steering Fluid (ATF)	C1AZ-19582-A, C, D
Effort Required to Initiate Proper Input Shaft Rotation (Power Cylinder drained and gear removed from Vehicle)	7-18 In-Lb
Tie Rod Articulation Effort (On Pull Scale)	1-6 Lbs.

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TORQUE CHART – RACK & PINION – FORD

Torque	Ft-Lb	Torque	Ft-LB
Pressure Line Fitting (Pump-to-Gear 1/2 Hex)	10-15	Yoke Plug Locknut	44-66
Return Line Fitting	10-15	Pressure Line Fittings at Valve	14-20
Gear-to-Crossmember Mounting Bolt Nut	80-100	Pressure Line Fittings at Power Cylinder (Gear Housing)	14-20
Tie Rod End-to-Spindle Arm Nut	35-47 ①	Pinion Bearing Locknut	23-34
Tie Rod End-to-Tie Rod Jam Nut	35-50	*Pinion Bearing Plug*	40-60
Steering Flex Coupling Bolt	20-30	Tie Rod Ball Socket Assembly to Rack	55-60

① Tighten to nearest cotter pin slot after torquing to specification.

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Tool No.	Description	Tool No.	Description
T74P-3504-F	Outer Rack Oil Seal Replacer	T78P-3504-B	Valve Body Puller
T74P-3504-G	Plastic Ring Replacer	T78P-3504-K	Inner Rack Oil Seal Replacer
T74P-3504-J	Rack Seal Protecting Sleeve (Short)	T78P-3504-H	Pinion Housing Yoke Nut Wrench
T74P-3504-K	Rack Seal Protecting Sleeve (Long)	T78P-3504-G	Pinion Bearing Replacer
T74P-3504-R	Pinion Shaft Torque Adapter	T78P-3504-J	Rack Oil Seal Remover
T74P-3504-U	Pinion Housing Yoke Plug Nut Wrench	T78P-3504-C	Valve Body Insertion Tool
T74P-3504-Y	Spring Scale (0-10 Lbs.)	T78P-3504-D	Pinion Bearing & Seal Replacer
T50T-100-A	Slide Hammer	T78P-3504-M	Plastic Ring Sizing Tool
T57L-500-B	Bench Mount	T78P-3504-E	Pinion Seal Remover
T58L-101-A	Attachment	T78P-3504-N	Pin Remover
T71P-19703-C	O-Ring Remover	T63P-9171-A	Crimp Tool
T78P-3504-L	Rack Bushing Holding Tool	T75L-3517-A	Rotary Valve Tool Kit
T78P-3504-F	Pinion Seal Replacer		

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DETROIT IRON

Integral Power Rack and Pinion Steering Gear - TRW

PART 13-47

Applies To Mustang II/Pinto/Bobcat, Fairmont/Zephyr

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DESCRIPTION

1978 TRW-built

The integral power rack and pinion gear (Fig. 1) features:

- Variable ratio steering
- A new yoke and yoke adjuster plug
- Deletion of the tube bracket previously used.
- *Encapsulated tie rod and ball housing assembly* with spiral locking pin feature to eliminate the drilled pin previously used.
- Use of grease for gear and bearing lubrication in place of previously used oil.

The integral power rack and pinion steering gear is a hydraulic mechanical unit, which uses an integral piston and rack design to provide power assisted vehicle steering control.

Internal valving directs pump flow and controls pressure, as required, to reduce steering effort during operation.

The unit contains a rotary hydraulic fluid control valve integrated to the input shaft and a boost cylinder integrated with the rack (Fig. 2).

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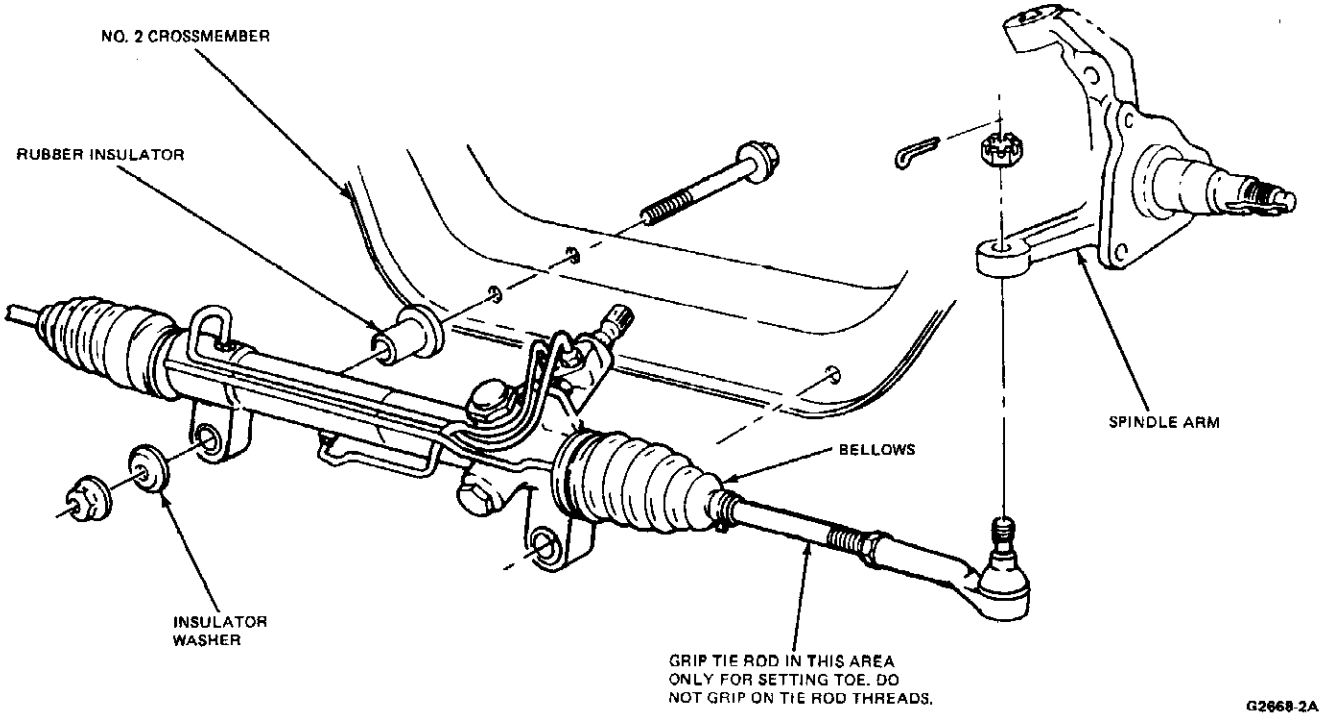


FIG. 1 Power Steering Gear Installation—TRW

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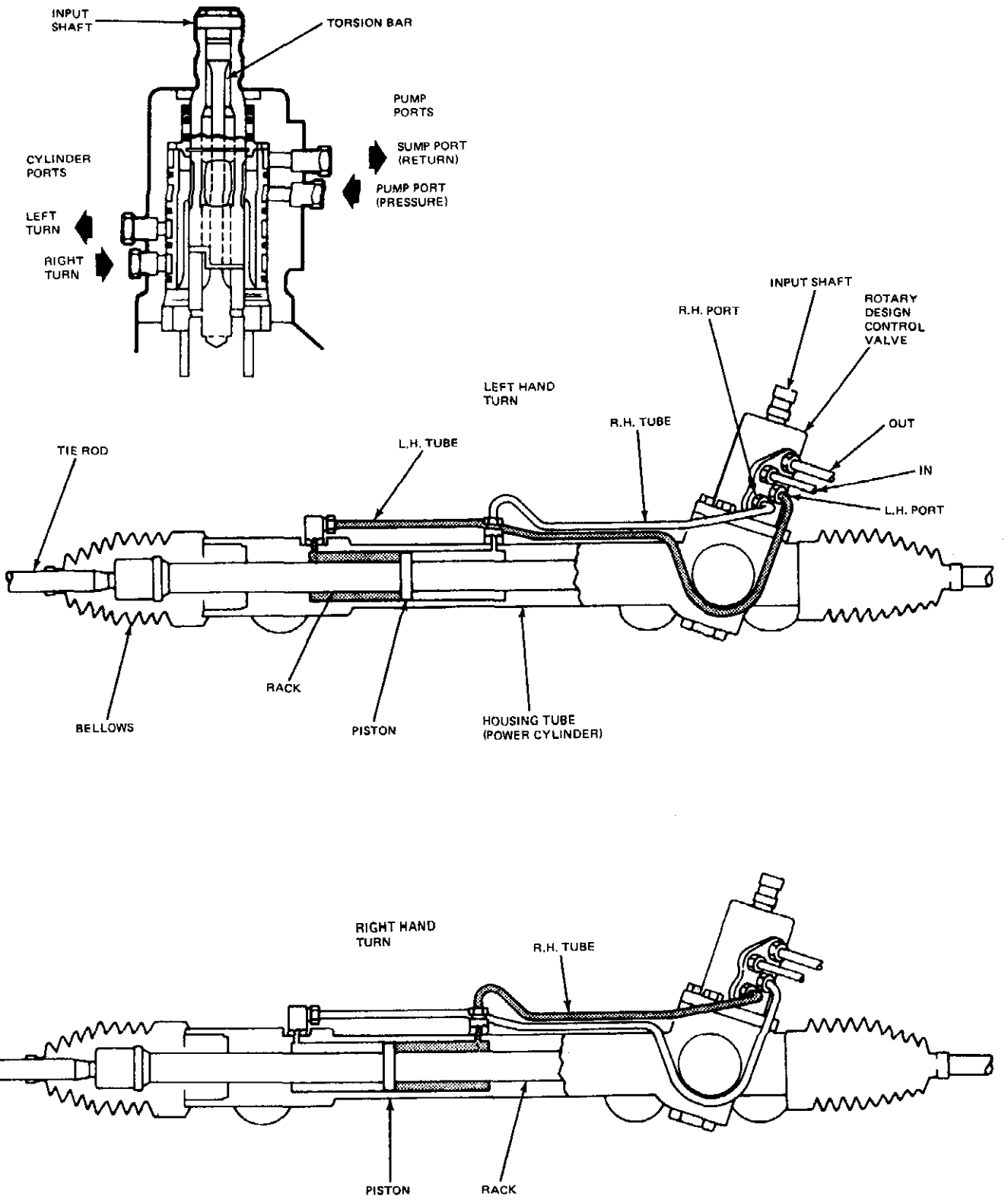


FIG. 2 Rack Movement and Oil Flow—TRW

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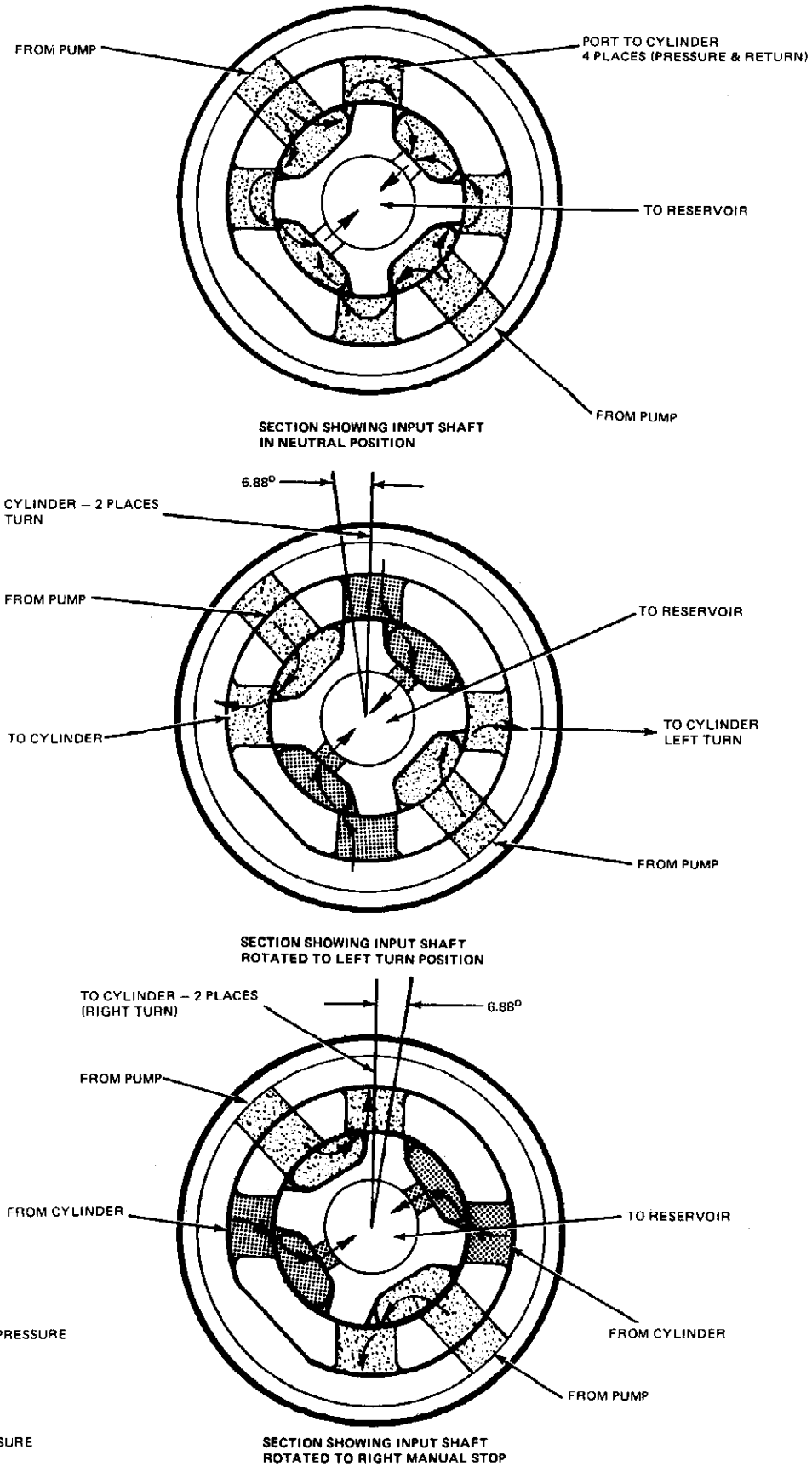


FIG. 3 Power Rack and Pinion Steering Gear Rotary Valve Operation—TRW

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OPERATION

ROTARY VALVE:

The rotary design control valve uses relative rotational motion of the input shaft and valve sleeve to direct fluid flow.

When the steering wheel is turned, resistance of the wheels and the weight of the vehicle cause a torsion bar to deflect. This deflection changes the position of the valve spool and sleeve ports, directing fluid under pressure to the appropriate end of the power cylinder. The difference in pressure forces on the piston helps move the rack to assist turning effort. The piston is attached directly to the rack, and the housing tube functions as the power cylinder. The oil in the opposite end of the power cylinder is forced to the control valve and back to the pump reservoir.

When the driver stops applying steering effort, the valve is forced back to a centered position by the torsion bar. When this occurs, pressure is equalized on both sides of the piston and the front wheels tend to return to a straight ahead position. Refer to illustration (Figs. 2 and 3) showing path of oil flow during turns.

DIAGNOSIS

Before any internal service is performed to the rack and pinion power steering, diagnosis must be performed. Make sure that tire size is correct with matched tires (front and rear) inflated to specifications. The following conditions, possible causes and resolutions will assist in performing proper repairs.

DIAGNOSIS GUIDE — TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Front End Wander** Front end wander is a condition that is noticed when the car is driven in a straight ahead position with the wheel held in a firm position, but the car wanders to either the right or left. Front end alignment should be checked before any gear service is made.	• Tie rod ball socket loose/worn.	• Replace tie rod/ball socket assembly.
	• Gear housing loose on No. 2 crossmember.	• Tighten mounting bolt nuts (2) to specification.
	• Loose Pins in the input shaft and valve assembly.	• Replace the input shaft and valve assembly.
	• Worn pinion bushing in gear housing.	• Replace gear housing.
	• Loose pinion ball bearing.	• Replace pinion ball bearing.
	• Worn right hand gear housing aluminum housing.	• Replace aluminum bushing.
	• Loose outer ball joints.	• Replace outer ball joints.

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DIAGNOSIS GUIDE – TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Feedback (Rattle, Chuckle, Knocking Noises in Steering Gear)** Feedback is a condition that is noticed when a car is driven over rough pavement and this roughness is felt in the steering wheel by the driver. In addition, if the gear is not adjusted properly, excessive rattle, knocking and/or chuckle noises can be heard inside the car.	• Loose/worn tie rod ball socket.	• Replace tie rod/ball socket assembly.
	• Tie rod thrust bearing broken or worn.	• Replace tie rod/ball socket assembly.
	• Oversize pinion shaft bushing in the gear housing.	• Replace gear housing.
	• Mounting bracket loose on gear housing tube.	• Replace gear housing.
	• Gear housing loose on No. 2 crossmember.	• Tighten mounting bolt nuts (2) to specifications.
	• Worn rack bushing.	• Replace rack bushing.
	• Loose pinion bearing locknut.	• Tighten pinion bearing locknut to specification.
	• Loose pinion bearing plug.	• Tighten pinion bearing plug to specifications.
	• Loose yoke bearing.	• Adjust yoke bearing preload to specifications.
	• Broken yoke bearing spring.	• Replace yoke bearing spring.
	• Loose yoke bearing plug.	• Adjust yoke bearing preload to specification.
	• Deteriorated shock absorbers.	• Replace shock absorbers.

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DIAGNOSIS GUIDE – TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Heavy Steering Efforts, Poor Assist** A heavy effort and poor assist condition is recognized by the driver while turning corners and especially while parking. A road test can verify the condition.	• Loose valve housing bolts causing leakage.	• Tighten valve housing bolts to specification.
	• Leakage/loss of fluid due to leaking rack, pinion and/or input shaft seals.	• Replace rack seals, pinion seals, and/or input shaft seals.
	• Low steering system fluid level.	• Add steering fluid to proper level.
	• Loose rack piston.	• Replace rack and piston assembly.
	• Bent rack assembly.	• Replace rack and piston assembly.
	• Damaged/worn plastic piston O-ring.	• Replace plastic piston O-ring.
	• Loose/missing rubber backup piston O-ring.	• Replace/install rubber backup piston O-ring.
	• Undersize pinion shaft bushing in the gear housing.	• Replace gear housing.
	• Rack bushing O-ring and/or rack seal leak.	• Replace O-ring and/or rack seal.
	• Valve assembly internal leakage.	• Replace input shaft and valve assembly.
	• Valve plastic O-rings cut or twisted.	• Replace plastic O-rings.
	• Rack bushing locknut broken or backed out.	• Replace rack bushing locknut or torque to specification.

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DIAGNOSIS GUIDE – TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Poor Returnability–Sticky Feeling** Poor returnability is a condition that is noticed when the vehicle is in a turn and returns to center with effort from the driver. In addition, when the driver returns the steering wheel to center, it may have a sticky or catchy feel.	• Yoke bearing plug too loose or too tight.	• Adjust yoke bearing preload to specification.
	• Binding in valve assembly.	• Replace input shaft and valve assembly.
	• Bent gear housing tube.	• Replace gear housing.
	• Broken gear housing.	• Replace gear housing.
	• Damaged/failed input shaft support bearing.	• Replace input shaft support bearing.
	• Loose/broken valve housing bolts.	• Torque valve housing bolts to specifications/ replace.
	• Damaged/failed pinion bearing.	• Replace pinion bearing.
	• Loose pinion bearing locknut.	• Torque locknut to specifications.
	• Misaligned steering column.	• Align steering column.
	• Excessive lash in tie rod ends.	• Replace as required.
	• Binding or looseness in tie rod ball joints.	• Replace as required.
	• Deformed engine mounts (results in damage to the steering gear).	• Inspect and replace as required.
	• Bent or broken No. 2 crossmember.	• Inspect and replace as required.

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DIAGNOSIS GUIDE — TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Loss of Power Assist** When loss of power assist occurs, heavy steering effort is required by the driver to steer the car.	• Piston disengaged from rack or improper depth of piston ring groove.	• Replace rack assembly.
	• Gear housing oil seal leak.	• Replace gear housing oil seals.
	• *Damaged gear housing tube.*	• *Replace gear housing.*
	• Valve rings cut, twisted.	• Replace valve rings.
	• Rack piston ring cut, twisted.	• Replace rack piston ring.
	• Input shaft oil seal failure.	• Replace input shaft oil seal.
	• Rack bushing locknut cracked.	• Replace rack bushing locknut.
	• Leakage from pump hose fittings.	• Tighten hose fittings to specification (10-15 lbs.) and check for crossed/or stripped threads. CAUTION: Do not overtighten hose fitting. It is normal for the hose to be free to swivel in the fitting on 1978 pumps. Excessive torque may result in damage to the tube nut.

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DIAGNOSIS GUIDE – TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **External Leakage** One of the most common conditions causing repeat service is fluid leaks. Make sure you clean off the steering gear first before any steering gear external leakage checks are performed.	• O-rings, in the following areas, out or missing: Pressure cylinder joint next to rivets. Rack Bushing.	• Replace O-rings as necessary. Gear housing must be replaced for L.H. inner O-ring failure (joint next to rivets).
	• Oil seals damaged or improperly installed: Valve housing. Rack. Input shaft dust.	• Replace oil seals as required.
	• Rack bellows twisted, cut, clamps missing, clamps loose or damaged.	• Repair, replace as required.
	• Pressure line or flare gasket failures only or Pressure fittings not torqued properly, cross threaded or damaged.	• Torque to specifications or replace pressure lines, seats and flare gaskets as required. NOTE: Fairmont/Zephyr use "quick connect" fittings on the gear. Refer to last item under "Loss of Power Assist" Condition listed previously.

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DIAGNOSIS GUIDE – TRW INTEGRAL POWER RACK AND PINION STEERING GEAR

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• **Hissing Sound** There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. There is no relationship between this noise and the performance of the steering gear.	• "Hiss" may be expected when the steering wheel is at the end of travel or when turning it at standstill.	• Hiss is a normal characteristic of rotary valve steering gears and in no way affects steering. Do not replace the input shaft and valve assembly unless the hiss is extremely objectionable. A replacement valve will also exhibit a slight noise and is not always a cure for the condition. Investigate for a grounded column or a loose boot at the dash panel. Any metal to metal contacts will transmit valve hiss into the passenger compartment through the steering column. Verify clearance between flexible coupling components. Be sure steering column shaft and gear are aligned so flexible coupling rotates in a flat plane and is not distorted as shaft rotates.

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ADJUSTMENTS

The power rack and pinion steering gear provides for only one service adjustment. The gear must be removed from the vehicle to perform this adjustment.

RACK YOKE BEARING PRELOAD:

1. Clean the exterior of the steering gear thoroughly.

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2. Remove the power steering fluid from the power cylinder by removing the external pressure line assemblies from the gear, and draining the fluid out through the openings.
3. Install two long bolts and washers through the bushings, and attach to the bench mounted holding fixture (Tool No. T57L-500-B) (Fig. 4).
4. Insert a in-lb torque wrench (max. capacity 30 to 60 in-lbs) into the input shaft torque adapter, T74P-3504-R. Position the adapter and wrench on the input shaft splines.
5. Loosen the yoke plug locknut with wrench T74P-3504-U (Fig. 5).
6. Insert the Rack Bushing Lockring Tool, T77P-3504-A, with a in-lb torque wrench into the slots in the yoke plug (Fig. 6).
7. With the rack at the center of travel, tighten the yoke plug until a reading of 45-50 in-lbs is observed on the torque wrench. If the threads of the yoke plug are dirty or corroded, clean them prior to torquing to prevent a false reading.
8. Back off the yoke plug (maximum of 45 degrees) until the torque required to initiate and sustain rotation of the input shaft is 7-15 in-lbs. Input torque should be checked with the gear in a horizontal position so that the weight of the rack doesn't affect the torque reading.
9. Place the yoke plug locknut wrench, T74P-3504-U, on the yoke plug locknut. While holding the yoke plug firmly with wrench, torque the locknut to specification. **No** movement of the yoke plug is to be allowed during this torquing operation, or the preload will be affected. Recheck input shaft torque after tightening locknut.
10. Remove all tools from the gear and reinstall the external pressure line assemblies. Torque the fittings to specifications.

NOTE: Make sure the copper flare gaskets are replaced and in place when reinstalling the external pressure lines.

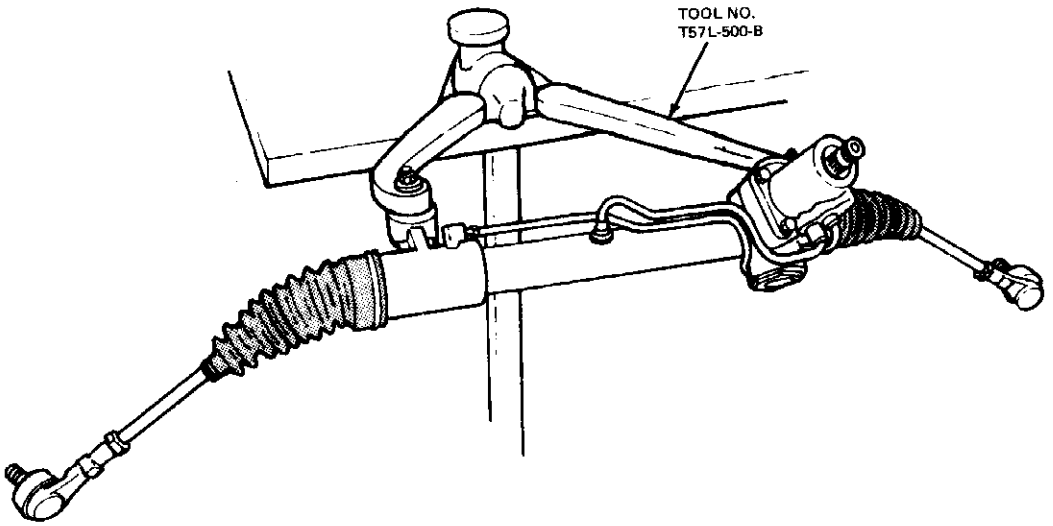


FIG. 4 Gear Mounted in Bench Holding Fixture

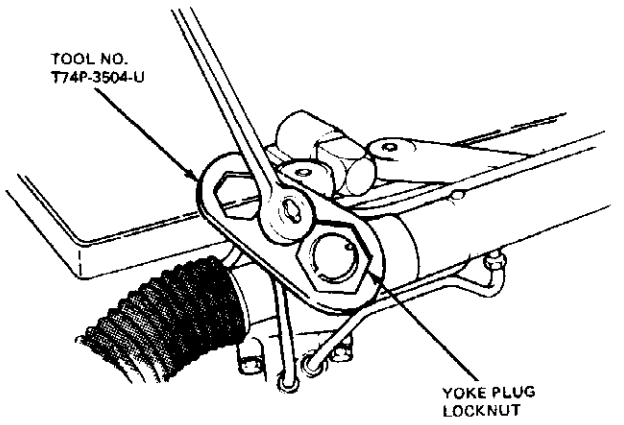
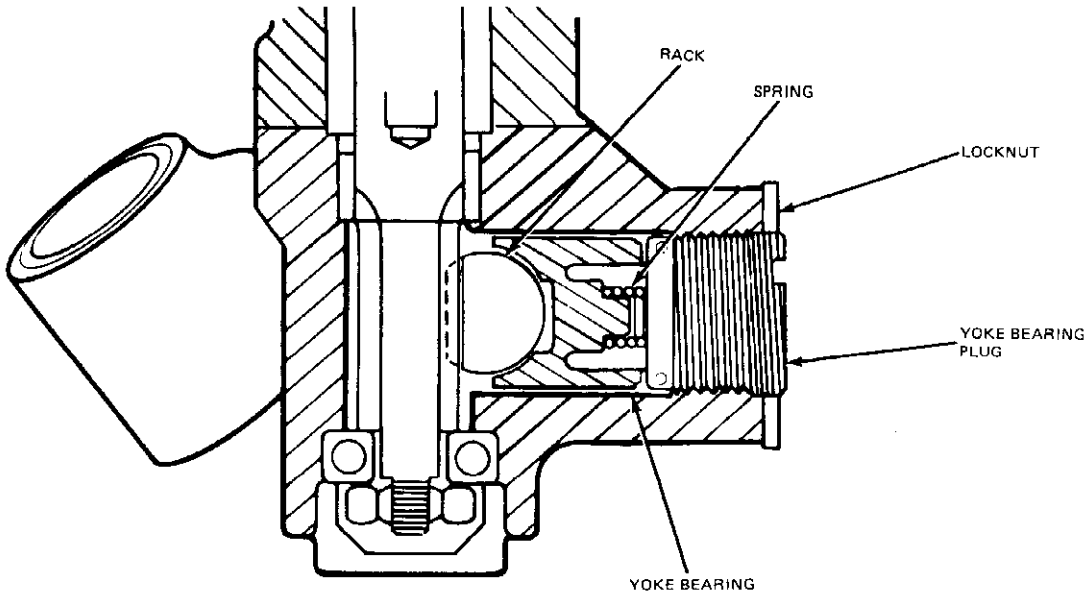


FIG. 5 Loosening/Tightening Yoke Plug Locknut

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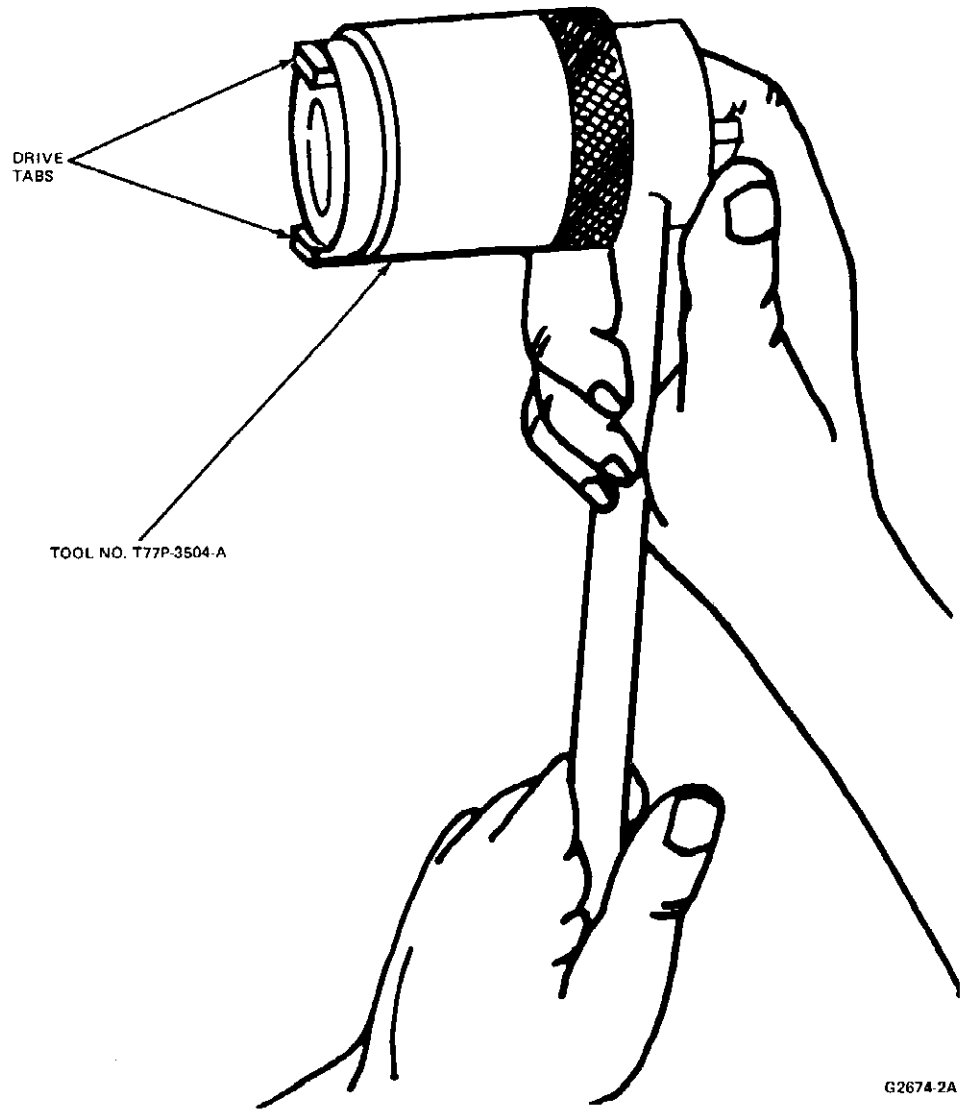


FIG. 6 Loosening or Adjusting Yoke Bearing Plug

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REMOVAL AND INSTALLATION

STEERING GEAR

Removal:

1. Disconnect the negative battery cable from the battery.
2. Remove the one bolt retaining the flexible coupling to the input shaft.
3. Leave the ignition key in the ON position and raise the vehicle on a hoist.
4. Remove the two tie rod end retaining cotter pins and nuts. Separate the studs from the spindle arms, using the ball joint separator tool.
5. On Mustang II only, remove the 2A crossmember behind the No. 2 corrossmember to allow removal of steering gear attaching bolts. Support the steering gear and remove the two nuts, insulator washers and bolts retaining the steering gear to the No. 2 crossmember. Lower the gear slightly to permit easier access to the pressure and return line fittings. Refer to Fig. 1 for illustration.
6. Remove the clip attaching the power steering hose to the gear line. Disconnect the pressure and return lines from the steering gear valve housing. Plug the lines and ports in the valve housing to prevent entry of dirt.
7. Remove the steering gear assembly from the vehicle.

Installation:

1. Support the steering gear and position it so the the pressure and return line fittings can be connected to the valve housing. Torque the fittings to specification. On Fairmont/Zephyr, hose swivel is normal when torqued to specification. Do not overtighten hoses.
2. Install the clip attaching the power steering hose to the gear line.
3. Insert the input shaft into the flexible coupling and position the steering gear to the No. 2 crossmember. Install the two bolts, insulator washers and nuts and torque the nuts to specification. On Mustang II only, install 2A crossmember.
4. Connect the tie rod ends to the spindle arms and install the two retaining nuts. Torque the nuts to specifications and install the two cotter pins.
5. Lower the vehicle and install the one bolt retaining the flexible coupling to the input shaft. Torque the bolt to specification.
6. Turn the ignition key to the OFF position.
7. Connect the negative battery cable to the battery.
8. Remove the coil wire. Fill the power steering pump reservoir and, while engaging the starter, cycle the steering wheel to distribute the fluid. Check the fluid level and add as required. Install the coil wire, start the engine and cycle the steering wheel. Check for fluid leaks.
9. Check the wheel alignment and reset toe if necessary. Before setting the toe, be sure to remove small bellows clamp to avoid bellows twisting and possible damage. Replace clamp after toe adjustment has been made. Do not grip tie rod in area of threads. See Fig. 1 for illustration.
10. Inspect gear for twisted bellows and improperly installed clamps. Correct as necessary.

TIE ROD ENDS AND BELLOWS

In-Chassis Bellows Removal:

1. Remove the tie rod outer end retaining cotter pin and nut. Separate the stud from the spindle arm, using the joint separator tool.
2. To avoid resetting the toe, mark the position of the tie rod and locknut with tape or paint as shown in Fig. 7. Remove the tie rod end and locknut and check the tie rod for nicks and burrs. Clean the tie rod of rust and dirt to ensure that no damage will occur to the new bellows.
3. Both clamps of the defective bellows are then removed followed by the removal of the bellows.

Installation:

1. Install the bellows and insert the breather tube. Install new clamps on the bellows and position as shown in Fig. 8. Use Tool No. T63P-9171-A to crimp the large clamp (Fig. 9). Note that no bellow fluid is required for the 1978 gear.
2. Install the tie rod end and locknut, loosely, to the original position on the tie rod. Attach the tie rod end to the spindle and torque the tie rod locknut to specification. If necessary to reset the toe, remove the small clamp to avoid twisting and damaging the bellows. Replace clamp after toe adjustment.

TIE ROD ARTICULATION TORQUE CHECK

The tie rod articulation effort can be measured with the gear on or off the vehicle. Disconnect the tie rod end from the wheel spindle and place the hook of the pull scale (Tool No. T74P-3504-Y) through the hole in the threaded area of the ball joint. The effort to move the tie rod, measured on the scale should be within 1 to 6 lbs. (Refer to Fig. 10). If the effort exceeds specification, then the tie rod/ball socket assembly must be replaced because the torque cannot be adjusted.

Caution: Make sure the new tie rod is the same length as the original tie rod.

DISASSEMBLY AND ASSEMBLY

Other than the tie rod ends and bellows, all disassembly must be performed with the gear removed from the vehicle. Fig. 11 shows a breakdown of the 1978 TRW power rack and pinion steering gear.

TIE ROD BALL SOCKETS:

Removal

1. Locate steering gear in bench mounted holding fixture, Tool No. T57L-500-B, shown in Fig. 4.
2. Remove tie rod outer ends and locknuts.
3. Remove bellow clamps, bellows and breather tube. Use care so as to not damage the bellows. Discard the clamps.

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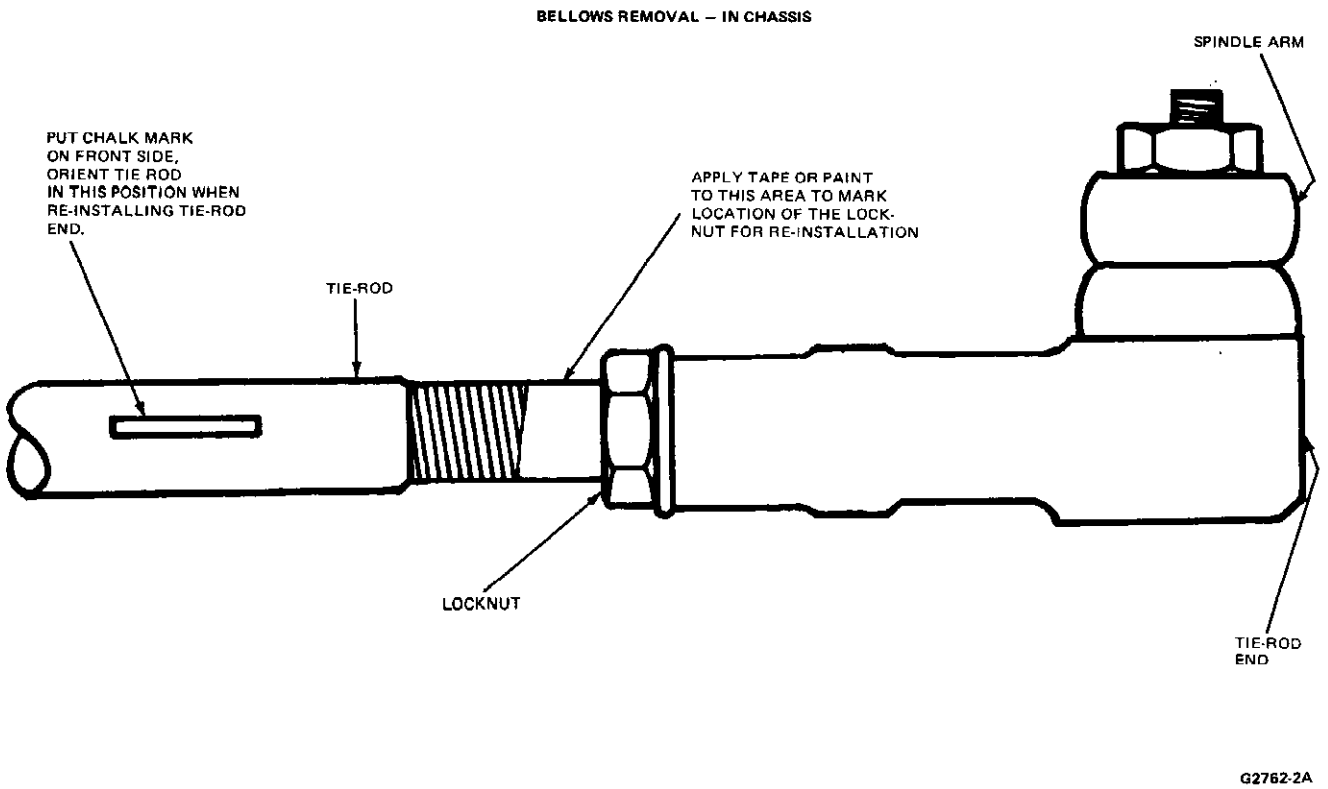


FIG. 7 Marking Tie Rod to Maintain Toe Adjustment

4. Using a left-hand threaded easy-out tool, remove the spiral pin which locks each tie rod socket to the rack. Save the pins for reinstallation. Refer to Fig. 12 for pin and socket removal.
5. Socket removal requires the usage of Tool No. T74P-3504-U and a torque wrench for the socket; and a crescent wrench to restrain the rack from rotating (see Fig. 12). If the rack is not held, then the rack teeth and/or pinion teeth can be damaged, resulting in additional repairs. Retain the tie rod assemblies for reinstallation unless the articulation torque was not within specification.

Installation

1. Install and tighten tie rod ball sockets on rack until sockets are hand tight. Use a crescent wrench to restrain the rack from rotating, while torquing the left socket to 50-75 ft-lbs, using Tool No. T74P-3504-U and a torque wrench. Note that if the rack is not restrained from rotating, then the rack teeth and/or pinion teeth can be damaged, resulting in additional repairs (see Fig. 12). If new tie rods are used, make certain the length is the same as the original tie rods.
2. Install the left spiral pin using pliers and a small hammer. The flared head must be oriented away from the hole to install the pin properly.
3. Restrain the left tie rod ball socket while torquing the right socket to specification.
4. Install the right pin in the socket.
5. NOTE: **This new tie rod/ball socket is not to be used for past model service.**
6. Install the bellows and the breather tube. Install new clamps (Figs. 8 and 9), retaining the bellows to the gear housing. Use existing Tool, T63P-9171-A, to secure the clamps properly.
7. Install the tie rod ends and lock nuts on the outer end of the tie rods.

VALVE AND VALVE HOUSING

Removal and Disassembly:

1. Thoroughly clean the areas of the input shaft, valve housing, yoke locknut and plug, and the pinion bearing plug.
2. Mount the gear in the bench mounted holding fixture, Tool No. T57L-500-B, attaching the gear as previously outlined.
3. Remove the external pressure lines from the valve and the gear housing. Remove the four small flare gaskets from the ports.
4. Loosen the yoke plug locknut and the yoke plug to relieve the preload on the rack. (Illustrated in Figs. 5 and 6.)
5. Remove the pinion bearing plug, using a 1 1/8" socket.
6. Install the pinion shaft torque Tool, T74P-3504-R, on the input shaft. Hold the input shaft and remove the pinion bearing locknut with a suitable 11/16" socket (Fig. 13). Discard the locknut.
7. Remove the three bolts and washers retaining the valve housing to the gear housing.
8. Move the rack to the left stop (rack teeth exposed). With a file or chalk, mark the relative position of

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the flat (blocked tooth) on the input shaft splines to the valve housing face (Fig. 14). It is important that when subsequent assembly of the input shaft is made, that the flat (blocked tooth) be aligned in the same position.

9. The valve housing cannot be removed as a single component because of the new pinion seal design. To service the valve housing, valve assembly or the pinion seal, the complete valve housing and valve assembly must be removed as a unit. **Note that the pinion bearing locknut must be removed before attempting to remove the valve housing.**
10. Carefully work the valve housing and valve assembly as a unit, out and away from the gear assembly.
11. Hand-hold the removed unit by the valve housing and using a nonmetallic hammer, tap the input shaft to remove assembly. Refer to Fig. 15 for an illustration of pinion seal and valve assembly removal. Discard the oil pinion seal and any other damaged or worn parts. Fig. 16 shows the disassembled components.
12. Remove the pinion bearing from the gear housing with slide hammer T50T-100-A, and attachment Tool No. T58L-101-A (Fig. 17). Note that the bearing to gear housing O-ring seal has been deleted beginning with the 1978 model gear.
13. The only serviceable components of the input shaft and valve assembly are the four plastic O-rings. Remove the O-rings with O-ring remover, Tool No. T71P-19703-C, taking care not to damage the lands and grooves (Fig. 18).
14. Using the slide hammer, T50T-100-A, and attachment Tool T58L-101-A, remove the input shaft support bearing from its bore in the valve housing (Fig. 19). Remove the input shaft oil seal from the same bore with the fingers.

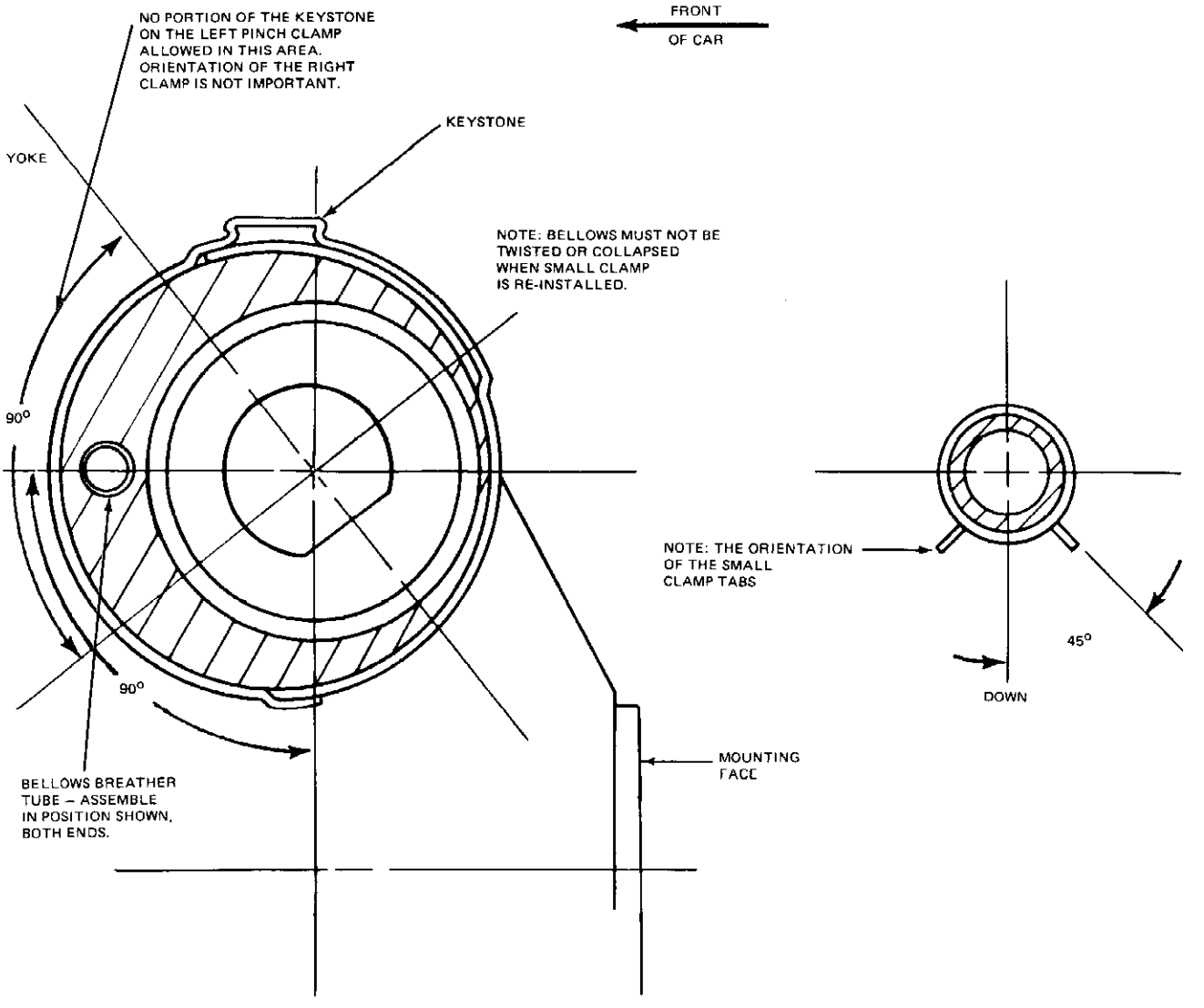


FIG. 8 Bellows and Clamp Orientation

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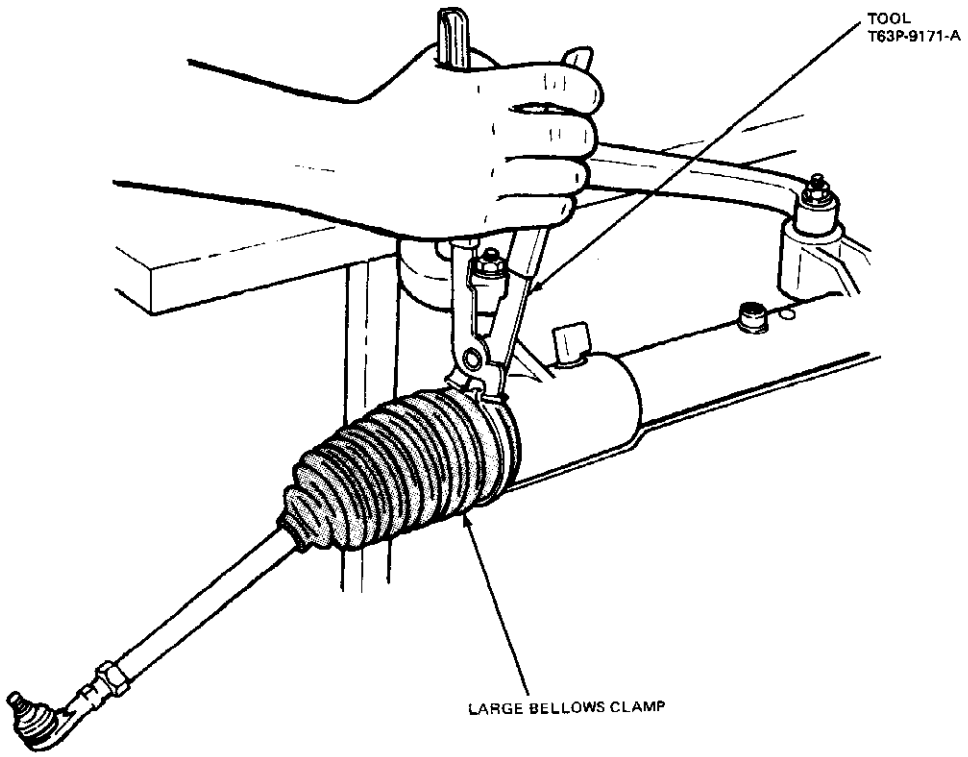


FIG. 9 Installing Large Bellows Clamps

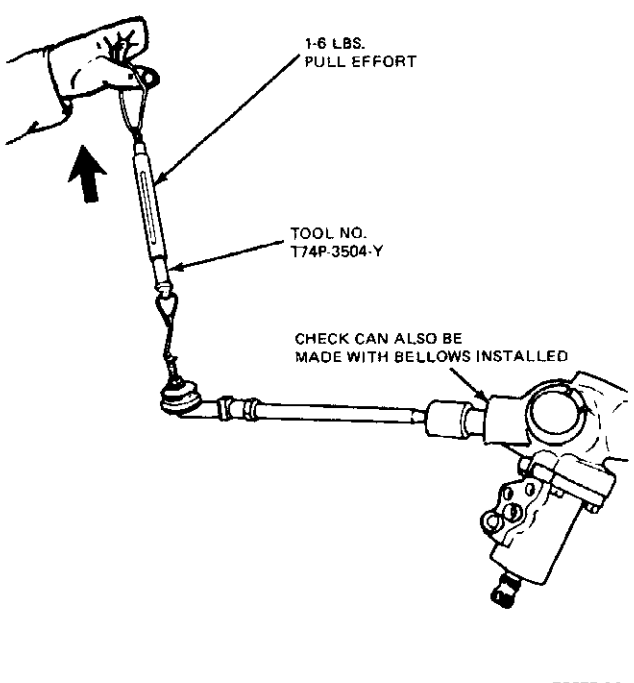


FIG. 10 Checking Articulation Effort

15. Pry the input shaft dust seal out of the valve housing with a small sharp chisel. Prevent damage to any of the surfaces on the valve housing.

Assembly and Installation:

1. Install the input shaft oil seal in the valve housing, pressing it in firmly with a finger. The seal must be installed with the lip facing the inside of the housing (refer to Fig. 20 and 21). The seal must bottom in its bore to avoid contact with the input shaft support bearing.
2. Fill the input shaft dust seal bore in the valve housing with ESA-M1C45-A or equivalent lubricant. Install the dust seal with replacer Tool, T74P-3504-N (Fig. 22).
3. Lubricate the input shaft support bearing with power steering fluid and install it in the valve housing with input shaft bearing replacer T74P-3504-P. The tool will control the installation depth of the bearing to avoid contact with the oil seal (Fig. 23).
4. Install the four plastic O-rings in the grooves on the valve assembly. Using plastic ring replacer T74P-3504-G, start the O-rings onto the valve. With O-ring remover T71P-19703-C, carefully work the O-rings into the grooves. The last O-ring will snap into the outboard groove directly off the O-ring installer (Fig. 24).
5. Lubricate the thrust washer with power steering fluid and install over the input shaft. Refer to Fig. 16 for illustration.

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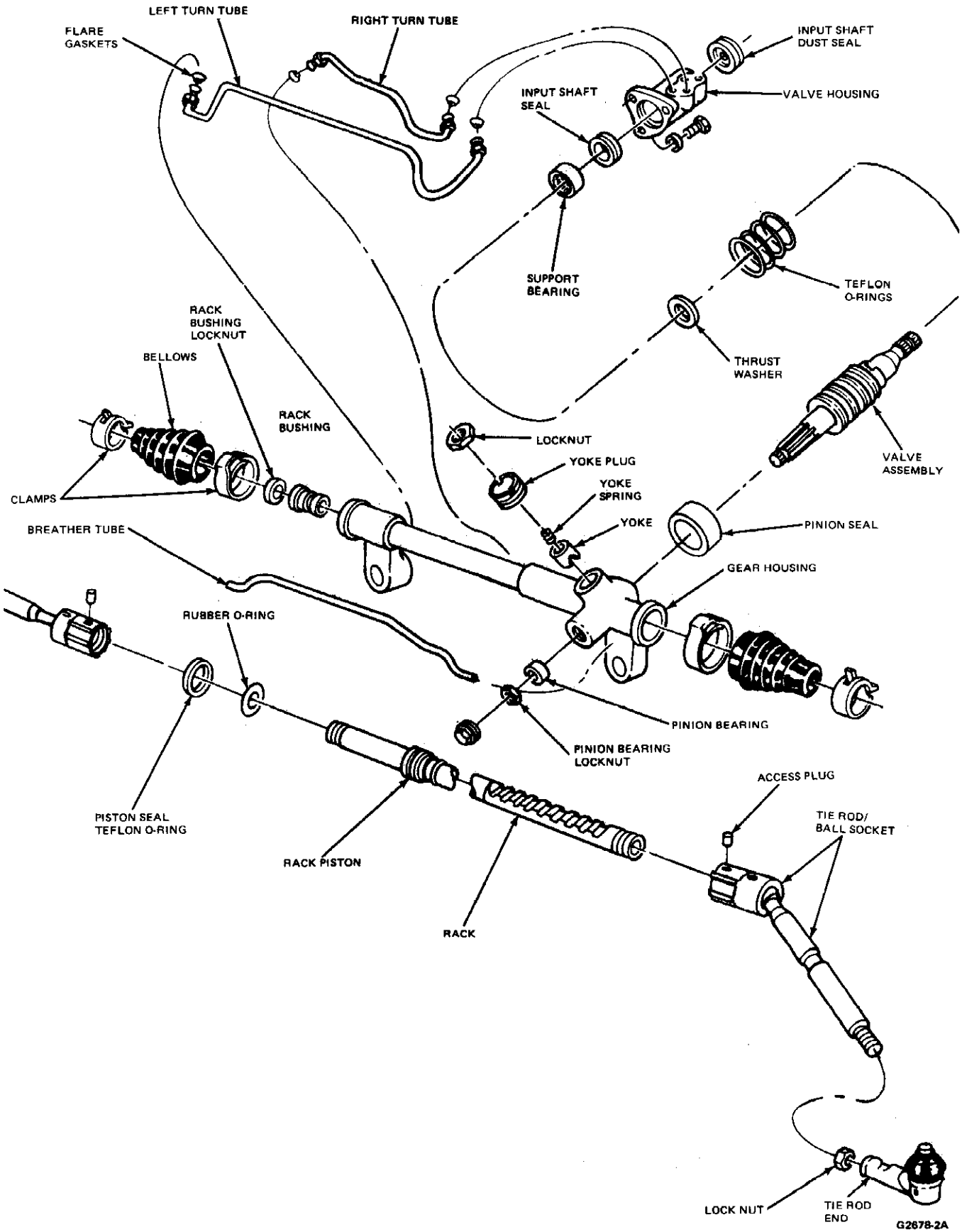


FIG. 11 TRW Power Rack and Pinion Exploded View

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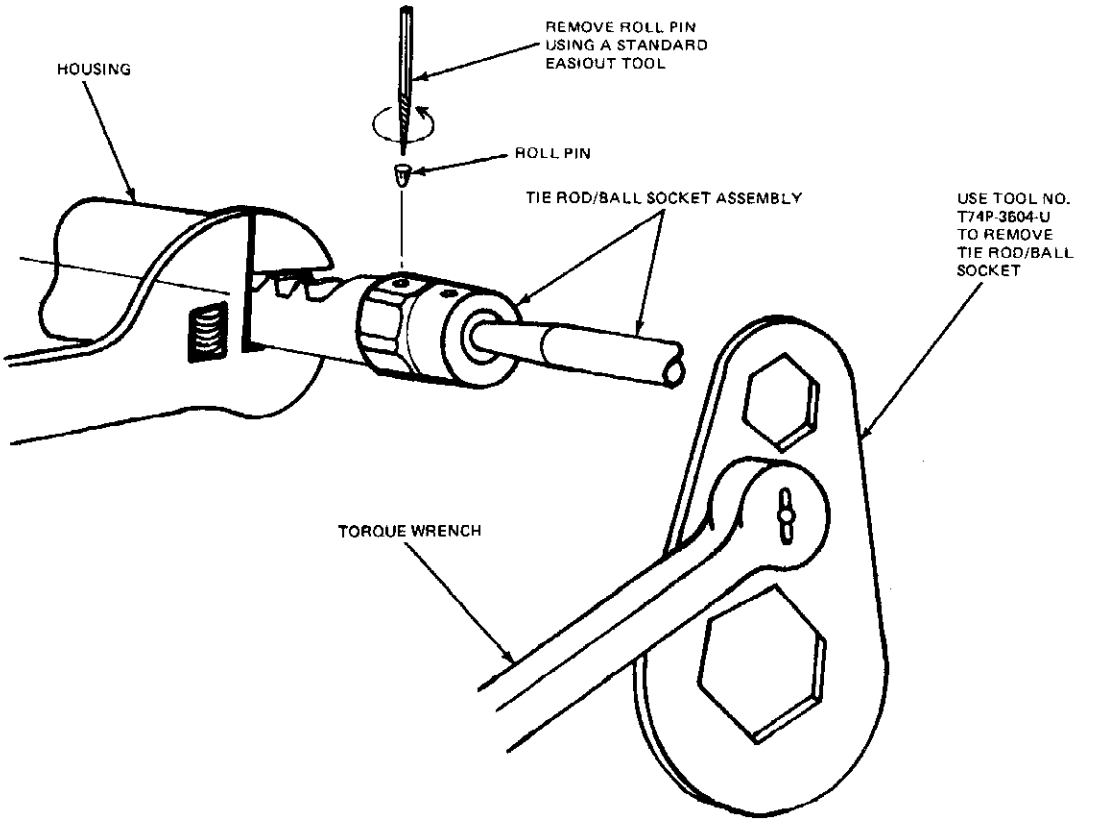


FIG. 12 Removing/Installing Tie Rod Ball Housing

6. Lubricate the O-rings and valve liberally with power steering fluid. Insert the assembly, splined end first, into the larger opening of the plastic ring sizing Tool, T74P-3504-H. Position the unit over the valve bore of the housing (Fig. 25). Push the unit through until it bottoms and the full spline passes through the dust seal. Remove the sizing tool.

7. Carefully place the pinion seal on the pinion shaft and slide the seal on the shaft until it contacts the valve housing as shown in Fig. 26. Note that the cup shape of the pinion seal must face toward the valve housing with the seal lip outermost from the valve housing. Note that the valve housing O-ring has been deleted beginning with the 1978 model gear.

8. Install the pinion bearing in the lower gear housing, through the plug bore with the pinion bearing replacer, Tool No. T78P-3504-G (Fig. 27). Note that the bearing O-ring seal has been deleted beginning with the 1978 model gear.

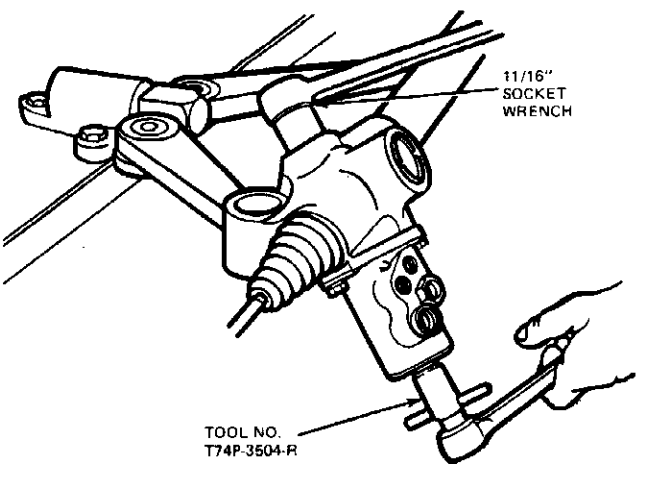


FIG. 13 Installing/Removing Pinion Bearing Locknut

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9. Prior to installing the valve and valve housing, apply grease lubricant (ESA-M1C45-A or equivalent) to the pinion bushing, pinion bearing, and to the pinion teeth.
10. Move the rack to the left stop (rack teeth exposed). Install the valve and valve housing assembly in the gear housing bore. The flat (blocked tooth) on the input shaft splines must be in the same relative position with the file or chalk mark that was noted before disassembly.
11. Install the three bolts and washers retaining the valve housing to the gear housing and tighten until finger tight. Using a wrench, tighten each bolt one turn at a time in rotation until the pinion seal is fully seated and the valve housing retaining bolts are torqued to specification.
12. Install the pinion shaft torque adapter, T74P-3504-R, on the input shaft splines.
13. Install the pinion bearing locknut on the pinion shaft. While hooding the input shaft, torque the locknut to specifications (Fig. 13). The rack should be away from the stop during this operation.
14. Install the pinion bearing plug using a torque wrench with a 1 1/8" socket. Torque the plug to specification. Note that no plug staking is required beginning with the 1978 model gear.
15. Install new flare gaskets in the line fittings on both gear housing and control valve housing except on the two P.S. pump hose fittings on Fairmont/Zephyr which are quick connect. Install pressure lines and torque to specification.
16. Install the yoke plug locknut. Prior to torquing the locknut, set the rack yoke bearing preload, as outlined in the Adjustment portion of this procedure.

GEAR HOUSING, RACK YOKE BEARING, RACK ASSEMBLY, RACK BUSHING AND OIL SEALS

Disassembly:

1. Remove the tie rod and socket assemblies from both ends of the rack, and the input shaft and valve assembly as previously outlined in this procedure.
2. Remove the yoke plug locknut with Tool No. T74P-3504-U. Remove the yoke plug with Tool No. T77P-3504-A. Remove the yoke spring and the yoke bearing from the gear housing (Refer to Figs. 28 and 6).
3. Working from the right side of the gear (opposite pinion end), push the rack in until it bottoms.
4. Insert rack bushing locknut Tool No. T74P-3504-B over the exposed end of the rack and into the housing bore. Position the tool so that the two drive tabs engage the slots in the rack bushing locknut and remove the locknut (Fig. 29).
5. Slowly pull the rack out of the right side of the housing until the rack piston contacts the aluminum rack bushing. Apply pulling effort (do not hammer) on the rack until the bushing is withdrawn from the housing. Remove the rack from the housing.
6. To remove the internal high pressure rack oil seal, insert the seal remover, Tool No. T74P-3504-C, into the housing until it bottoms (Fig. 30). Activate the expander with a wrench, as shown in Fig. 31 until the expander fully tightens. Remove the tool and the oil seal from the housing, with slide hammer

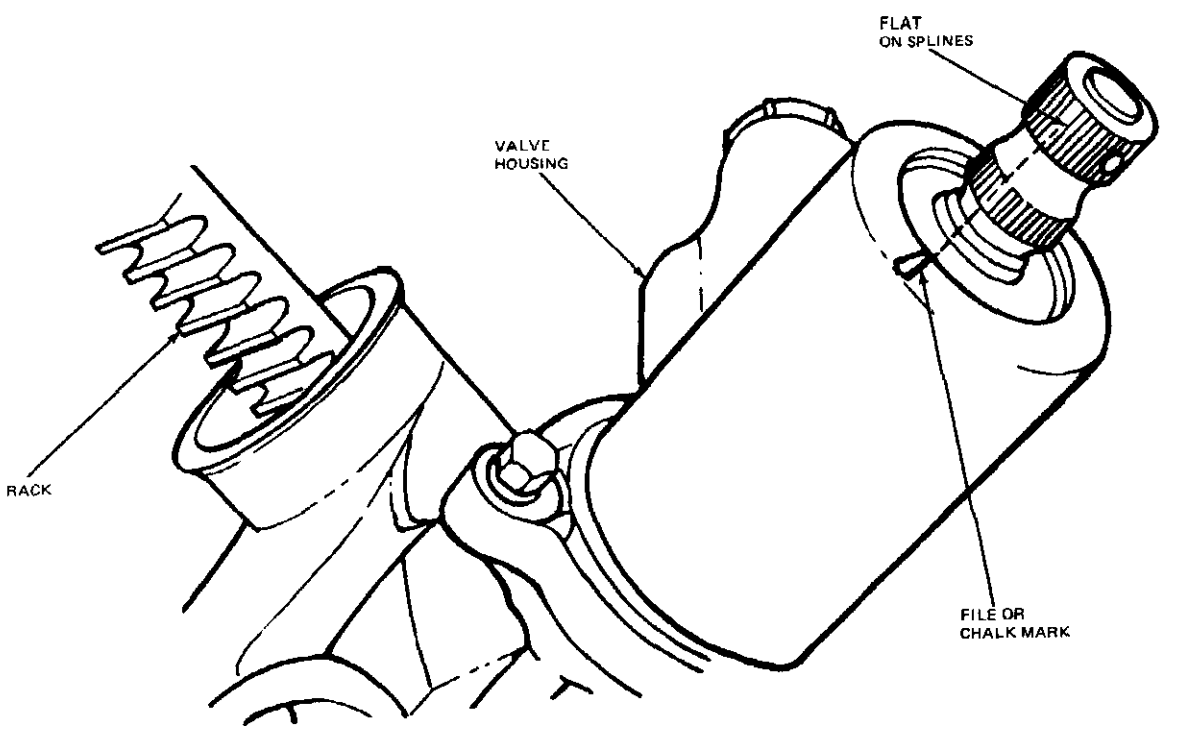
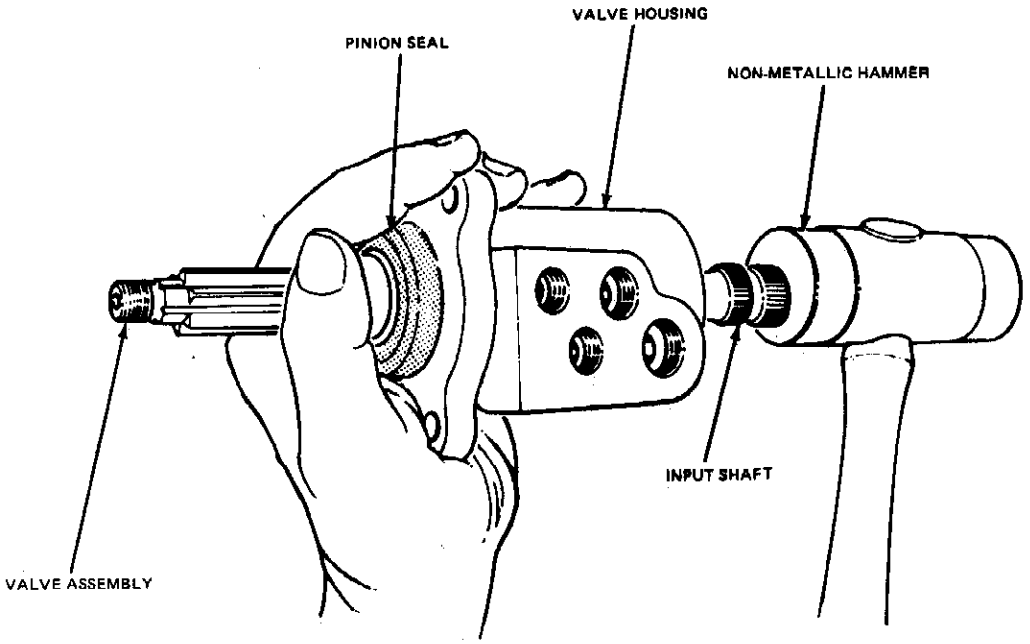


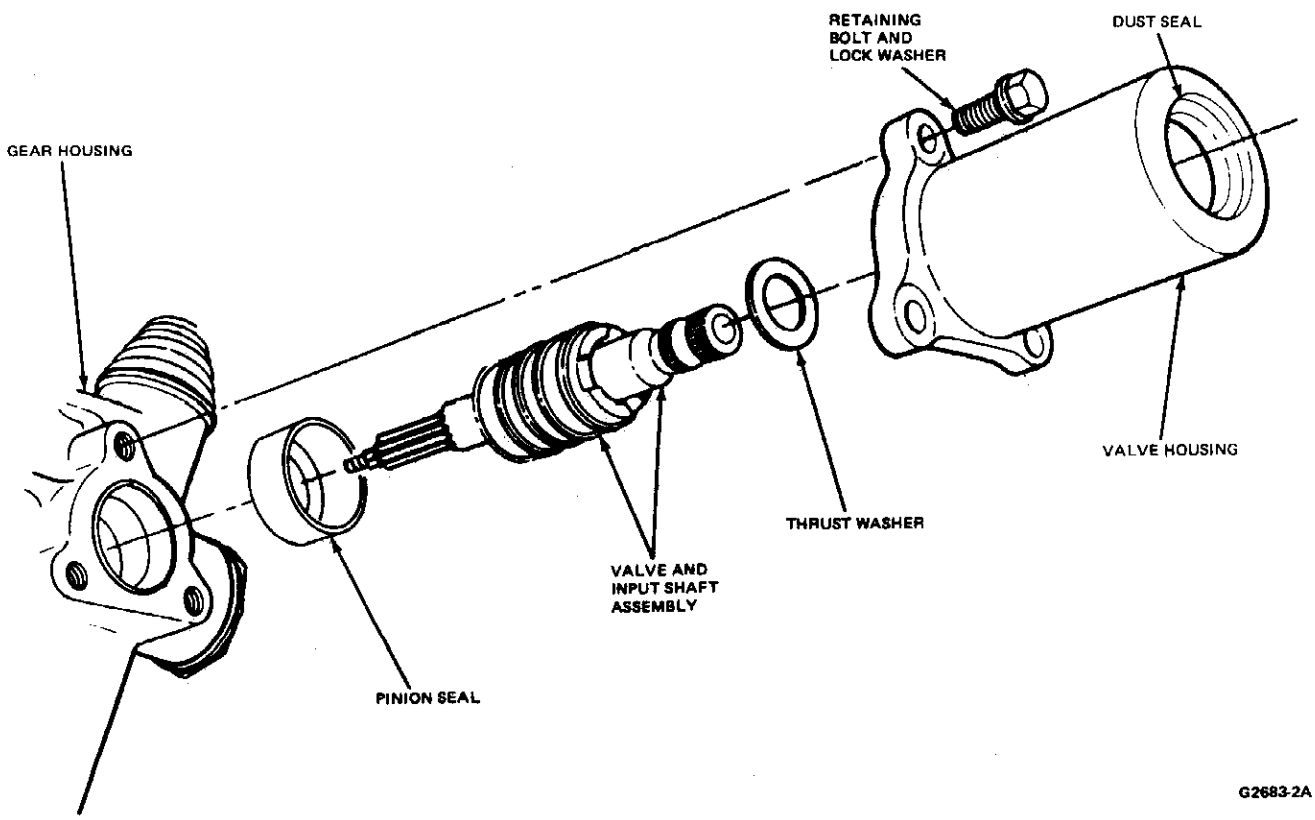
FIG. 14 Marking Input Shaft Position

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G2682-2A

FIG. 15 Removing Valve Assembly From Valve Housing



G2683-2A

FIG. 16 Valve Housing Disassembled

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DETROIT IRON

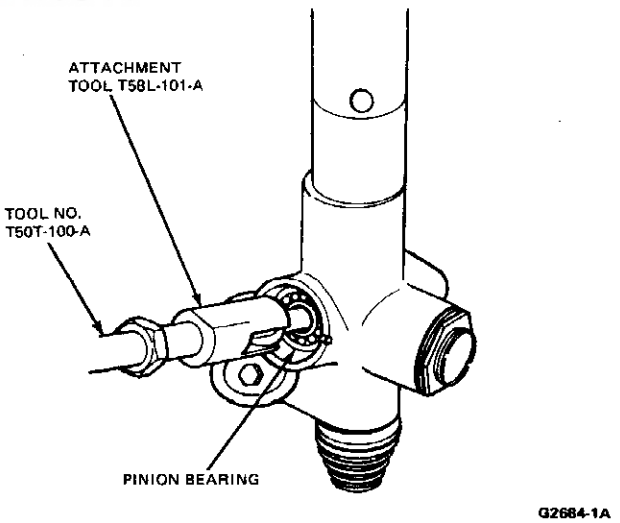


FIG. 17 Removing Pinion Bearing

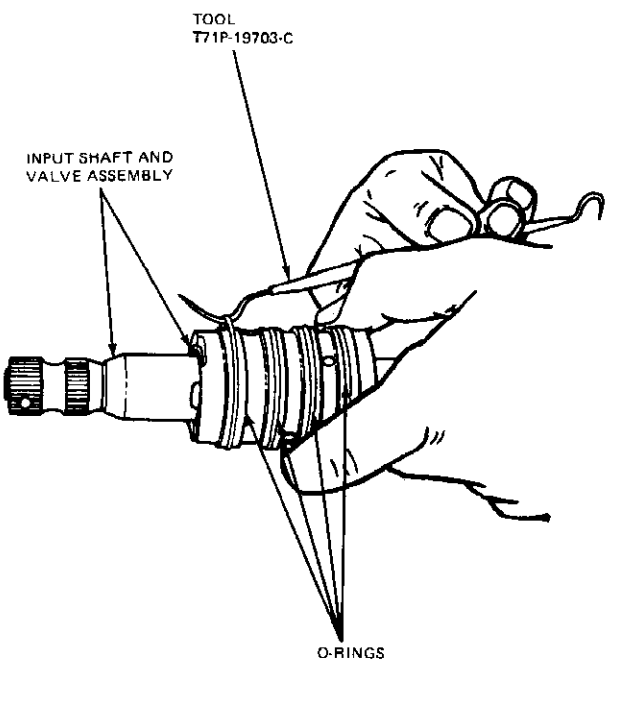


FIG. 18 Removing Plastic O-Rings

T50T-100-A threaded into the expander end (Fig. 32). Discard the seal.

7. Remove the plastic O-ring and the rubber O-ring from the rack piston.
8. Remove the rack bushing oil seal by placing the bushing in holding Tool T74P-3504-E, and in a vise. Remove the oil seal with rack oil seal remover T74P-3504-C, and slide hammer T50T-100-A (Fig. 33). Remove the rubber O-ring from the bushing.

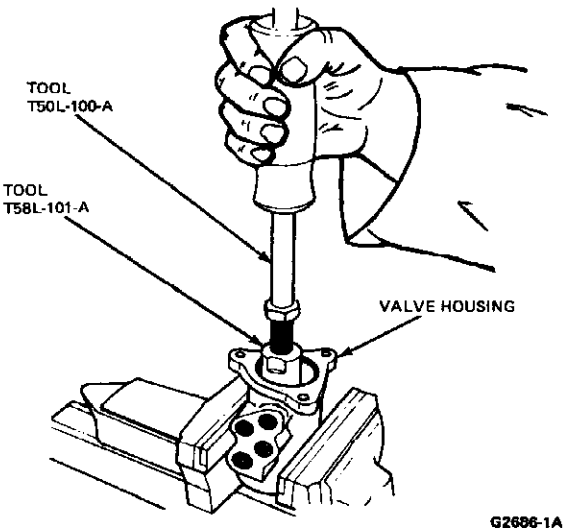


FIG. 19 Removing Input Shaft Support Bearing

Assembly

1. Place a high pressure oil seal on the inner rack oil seal replacer, T74P-3504-D, with the lip spring facing the tool (Fig. 34). With the gear housing in a vertical position, insert the replacer into the right side bore of housing (Fig. 34). Tap on the handle of the tool until the seal bottoms. Do not cock the handle during this operation.

   NOTE: If the replacer Tool, T74P-3504-D, binds in the area of the left turn pressure port, align the flat on the tool with the pressure port. (A scribe mark on the tool handle aids in aligning the flat with the pressure port). A slight undersize condition at the pressure port may cause the binding condition.
2. Install the rubber O-ring in the groove of the rack piston.
3. Place a plastic O-ring on replacer Tool No. T74P-3504-G. Slide the tool and O-ring on the rack until it is adjacent to the piston. Slide the plastic O-ring off the tool into the piston groove over the rubber O-ring (Fig. 35).
4. Apply grease lubricant (ESA-M1C45-A or equivalent) to rack teeth and to the rack surface that contacts the long protective sleeve.
5. Place the long protecting sleeve, Tool No. T74P-3504-K, over the rack gear teeth (Fig. 36). This is required to protect the internal oil seal from the rack teeth.
6. Thread the short protecting sleeve, Tool No. T74P-3504-J, over the threads on the right side of the rack (Fig. 35).
7. Lubricate the plastic O-ring and the protective sleeve with power steering fluid.
8. Install the larger end of sizing Tool No. T74P-3504-H onto the rack tooth end of the rack. Carefully position the sizing tool so that it compresses the plastic O-ring properly (see Fig. 37).
9. Place the rack, gear tooth end first, into the housing and carefully push the rack into the housing until

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the leading end engages the internal oil seal properly. Position the sizing tool against the housing so that the plastic O-ring is accurately aligned with the housing bore (Fig. 37). Push the rack in until the long protective sleeve protrudes from the left side of the gear. Remove the sizing tool and the long protective sleeve from the end of the rack. Place a ball housing socket on the left end of the rack to prevent the rack from damaging the internal oil seal (Fig. 38).

10. Install the rubber O-ring on the aluminum rack bushing.
11. With outer rack oil seal replacer, T74P-3504-F, install the high pressure oil seal in the rack bushing. The lip spring must face the inside of the bushing (Fig. 39).
12. Lubricate the short protective sleeve on the rack end, and the rubber O-ring on the rack bushing with power steering fluid.
13. Start the bushing, seal facing out, on the rack. Pass the bushing and seal over the protective sleeve and into the housing bore until the locknut threads in the housing bore are visible (Fig. 40). Remove the protective sleeve.
14. Place the rack bushing locknut over the rack and start it into the threads in the housing bore.
15. Insert rack bushing locknut wrench Tool T74P-3504-B, over the exposed end of the rack and into the housing bore (Fig. 30). Engage the tool drive tabs in the slots on the locknut and torque to specification.
16. Install the tie rod ball socket assemblies as outlined earlier in this procedure.
17. Install the input shaft and valve assembly as outlined earlier in this procedure. Install the pinion bearing plug.
18. Install the yoke bearing, spring, plug, and locknut. Prior to torquing the locknut, set the rack yoke bearing preload as outlined in the Adjustment portion of this procedure.
19. Install the bellows as outlined earlier in this procedure.
20. Install tie rod ends as outlined earlier in this procedure.

NOTE: Impact tools must not be used during any of the preceding operations.

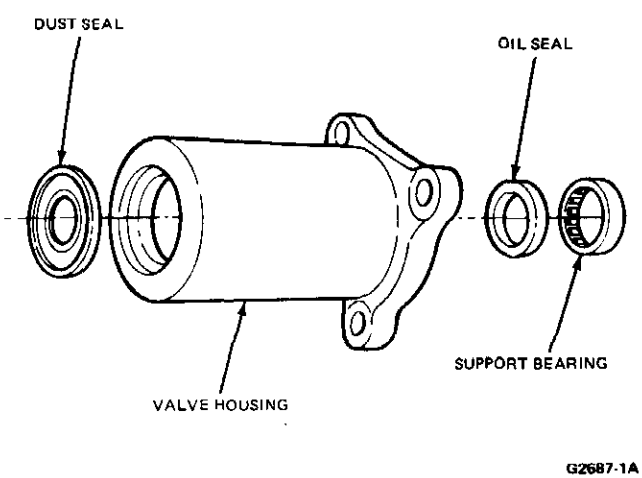


FIG. 20 Seals and Bearing Removed

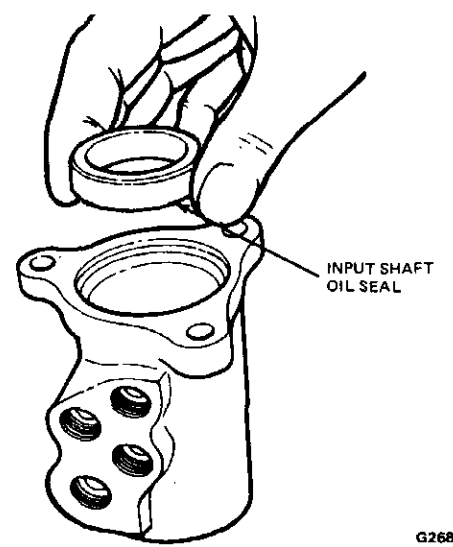


FIG. 21 Installing Input Shaft Oil Seal

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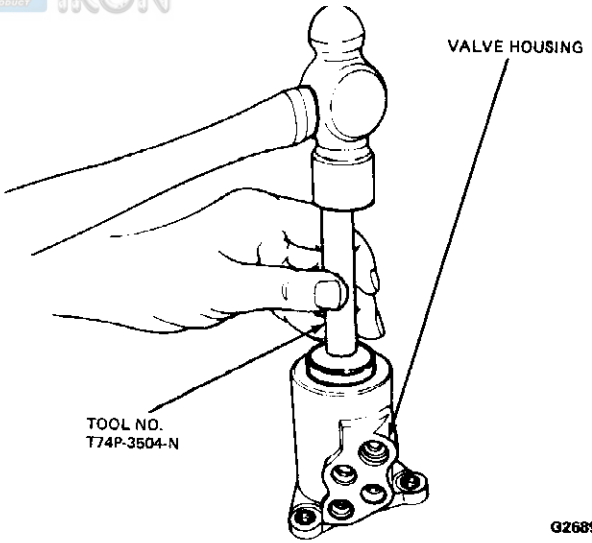


FIG. 22 Installing Input Shaft Dust Seal

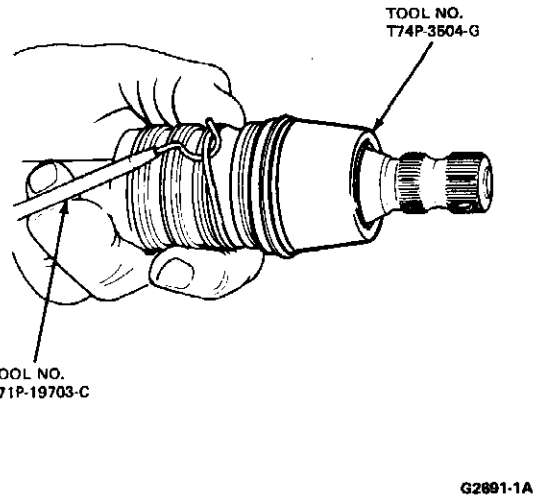


FIG. 24 Installing Plastic O-Rings

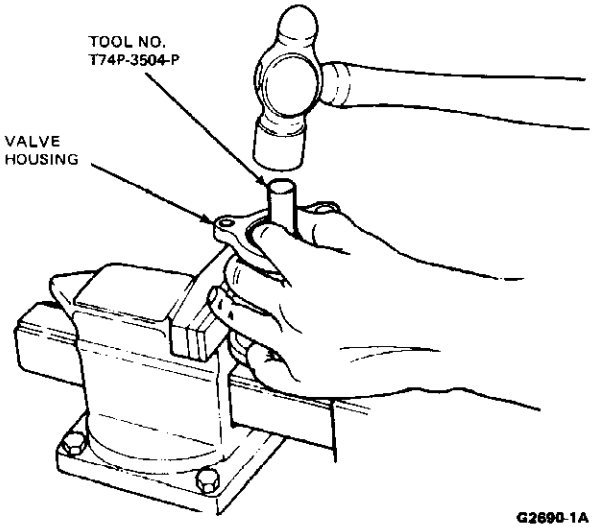


FIG. 23 Installing Input Shaft Support Bearing

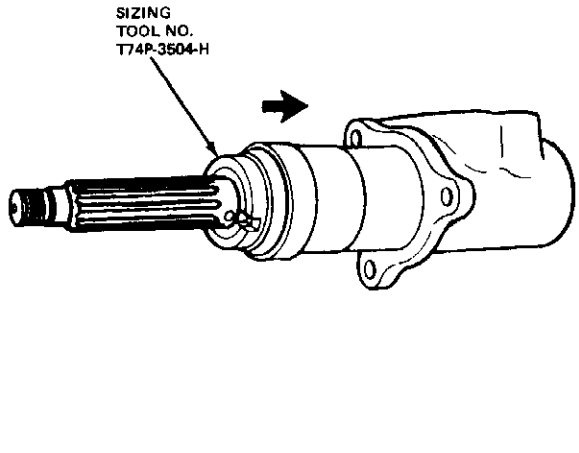


FIG. 25 Installing Valve Assembly into Valve Housing

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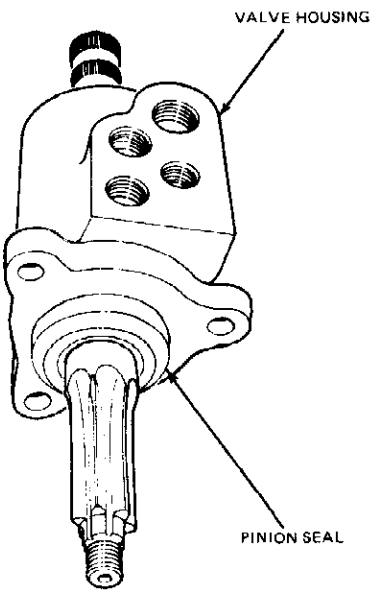


FIG. 26 Installation of Pinion Seal

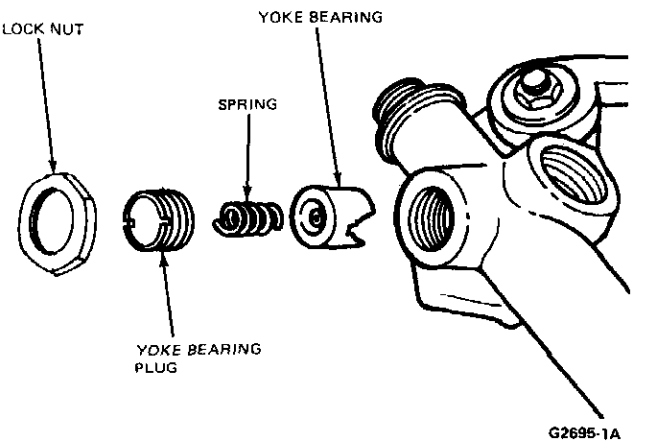


FIG. 28 Yoke Bearing Assembly

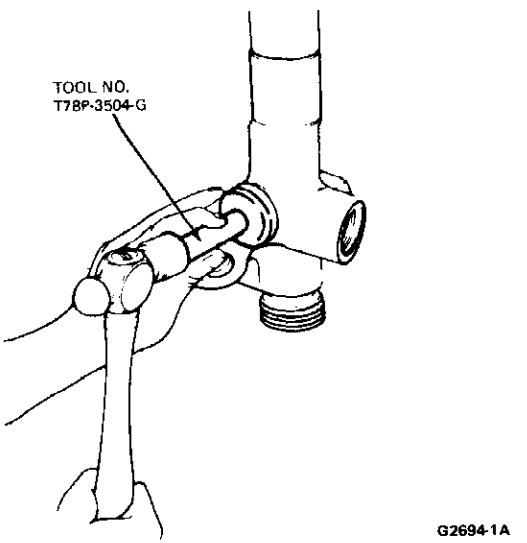


FIG. 27 Installing Lower Pinion Bearing

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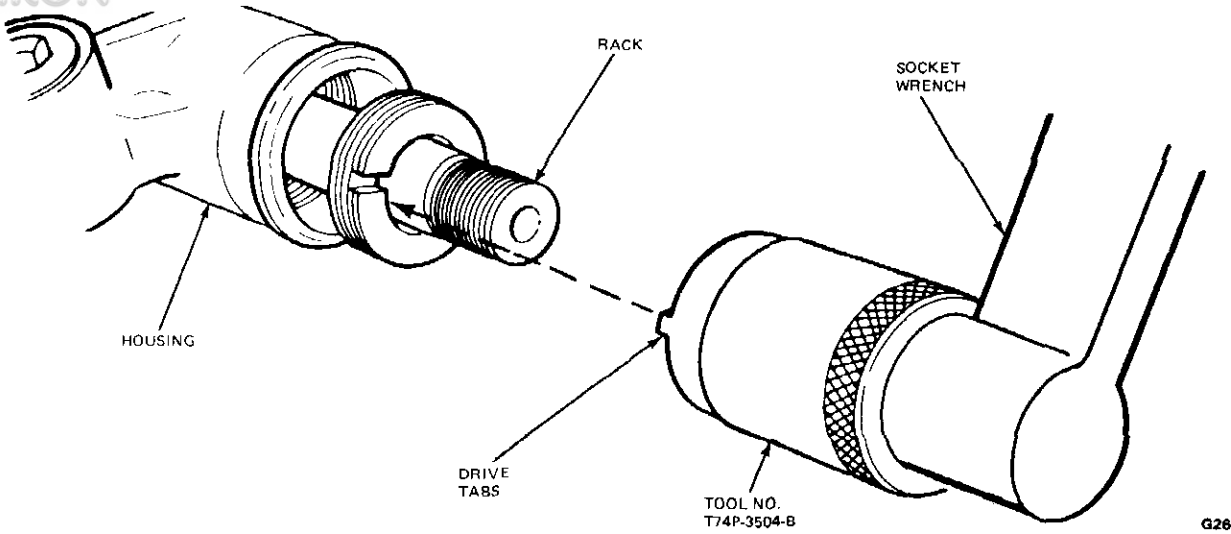


FIG. 29 Removing Rack Bushing Lockring

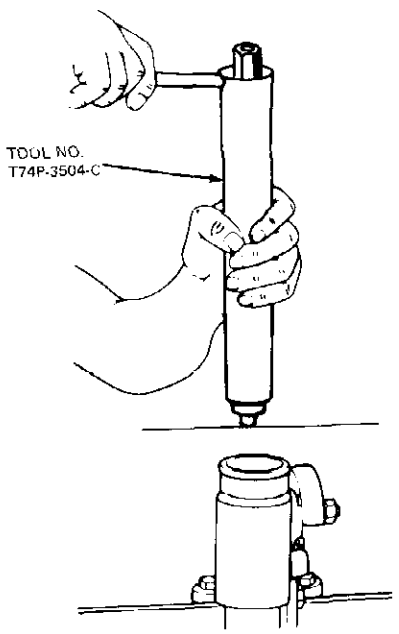


FIG. 30 Inserting Inner Rack Oil Seal Remover

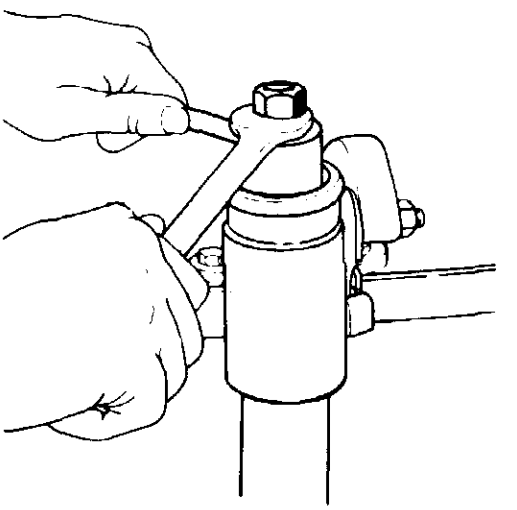


FIG. 31 Activating Expander of Inner Rack Oil Seal Remover

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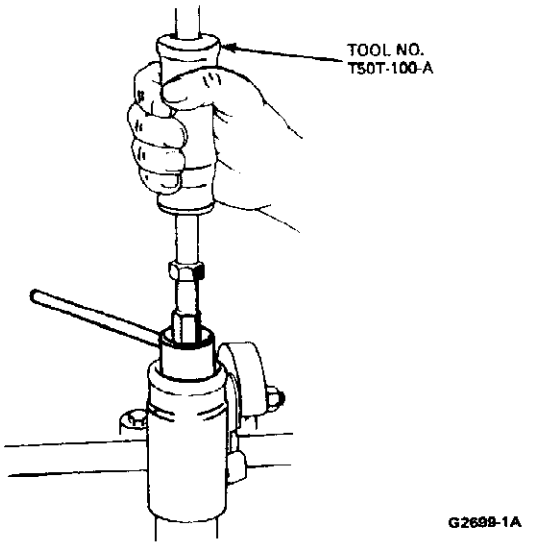


FIG. 32 Removing Inner Rack Oil Seal

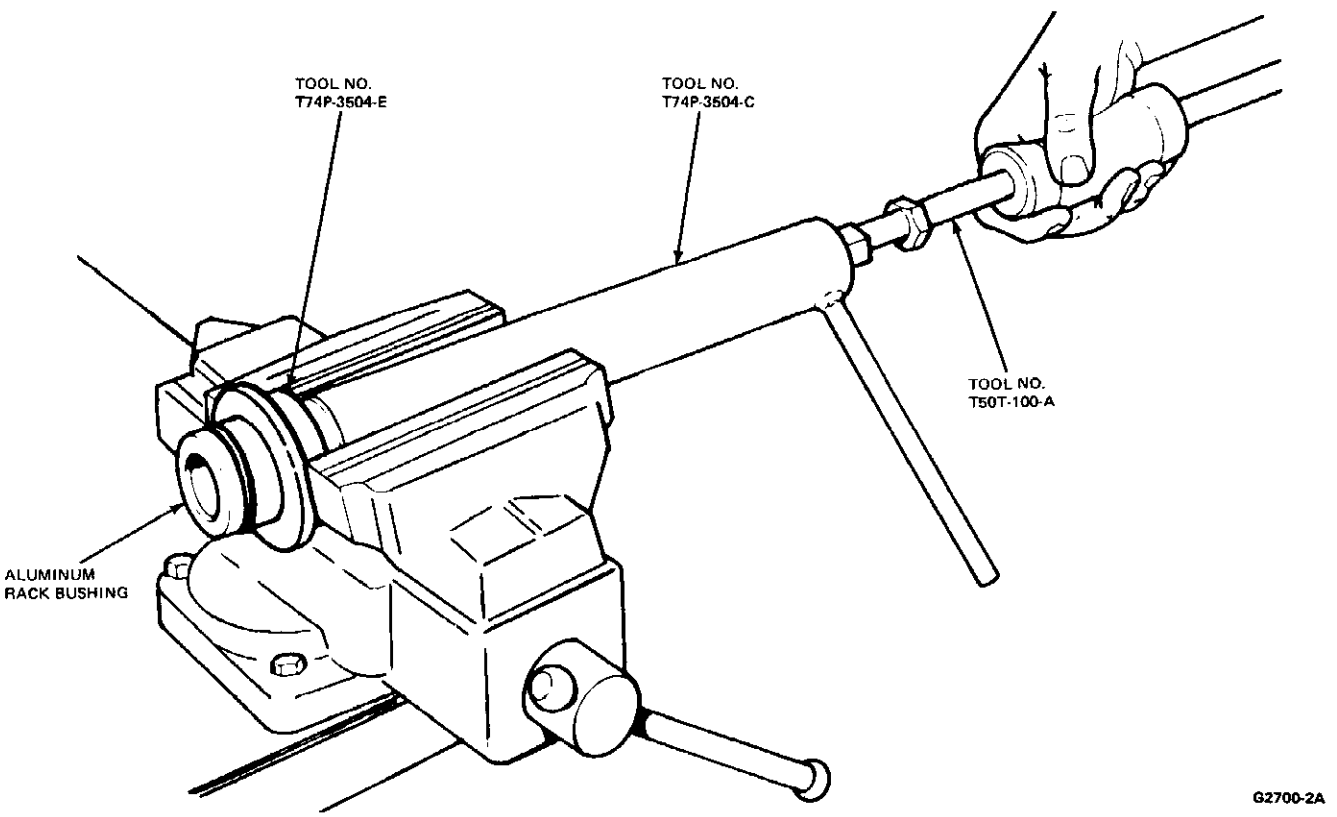


FIG. 33 Removing Oil Seal From Rack Bushing

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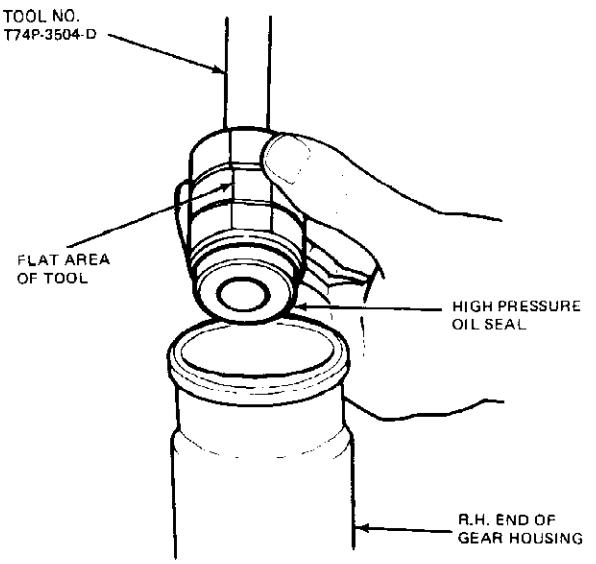


FIG. 34 Installing Inner Rack Oil Seal

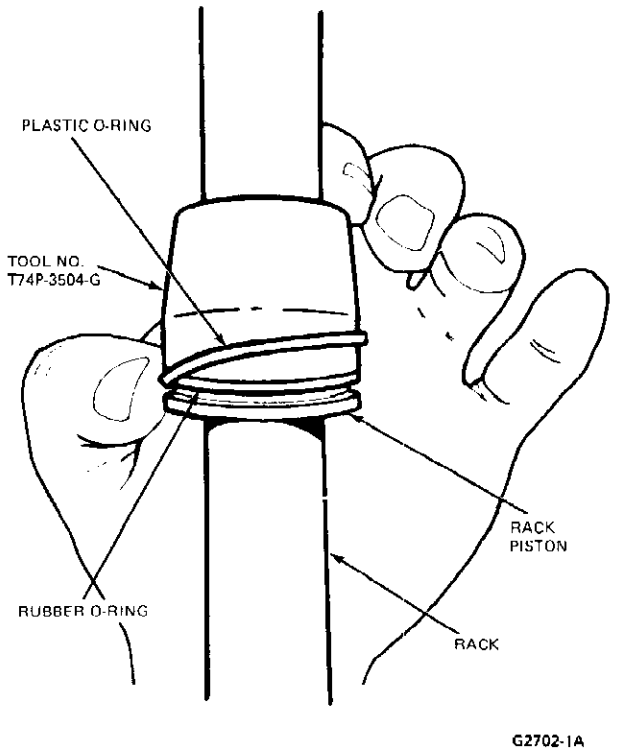


FIG. 35 Installing Rack Piston Seal

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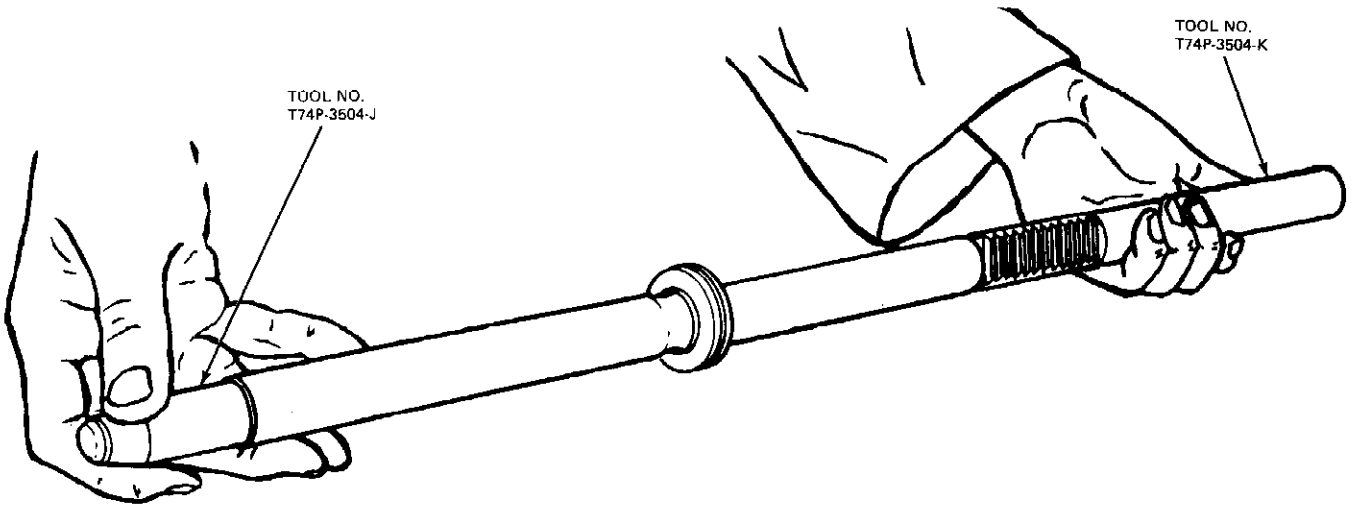


FIG. 36 Installing Protective Sleeves on Rack

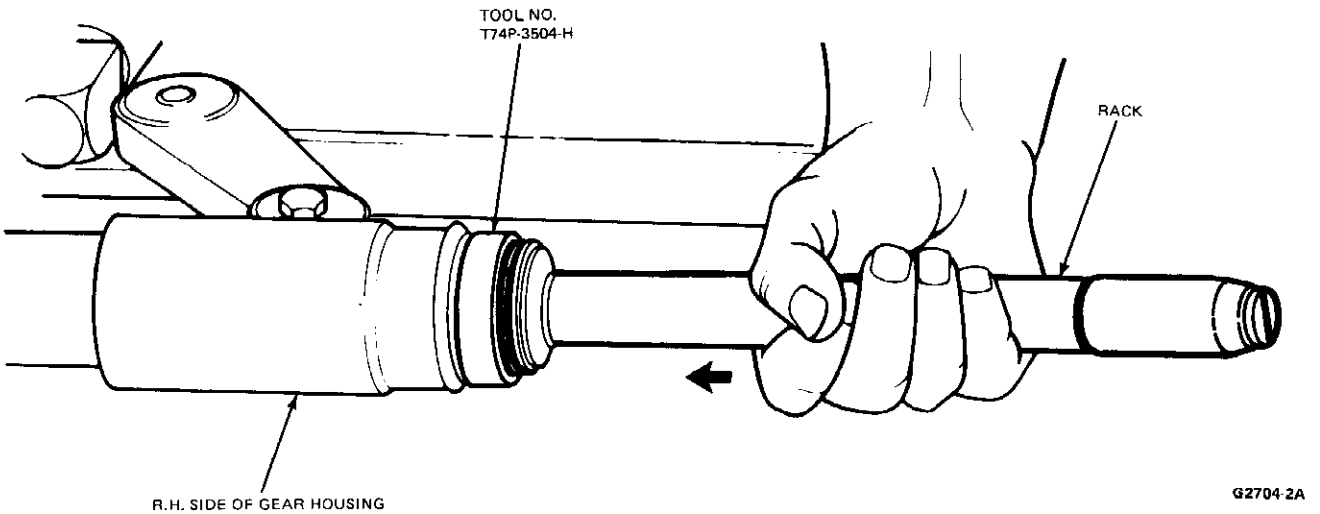


FIG. 37 Installing Rack in Gear Housing

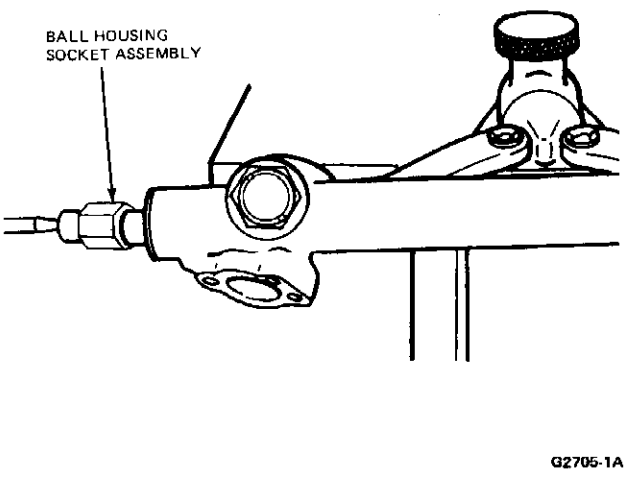


FIG. 38 Installing Ball Housing to Prevent Rack From Damaging Oil Seal

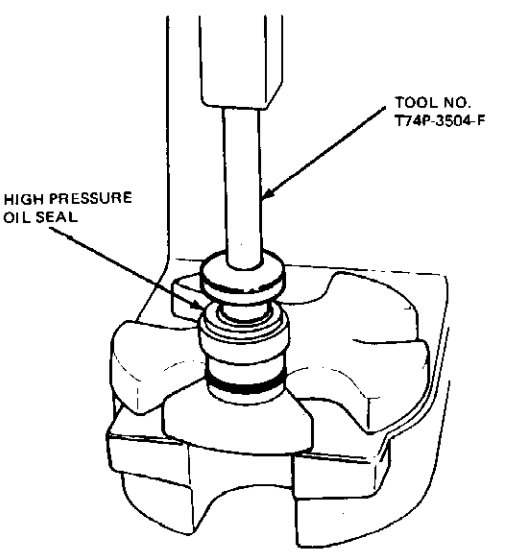


FIG. 39 Installing Oil Seal in Rack Bushing

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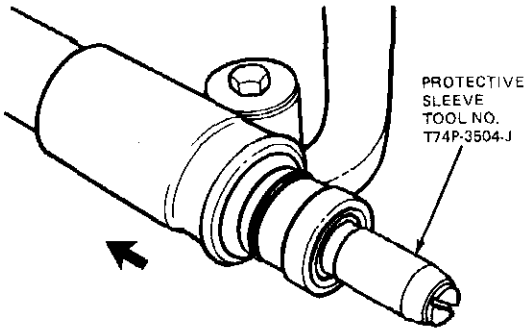


FIG. 40 Installing Rack Bushing

SPECIFICATIONS

POWER RACK AND PINION STEERING GEAR – TRW

Gear Ratio	18.2 on Center 14.3 at Stops
Number of Turns	3
Pinion & Rack Lubricant Capacity	23-27 Grams
Power Steering Fluid Capacity (Including Steering Pump)	2.44 Pints
Pinion, Rack Tie Rod Inner Ball Socket Lubricant	TMS-L-10053
Seal Lubricant (Cavity under Dust Seal)	ESA-M1C45-A
Power Steering Fluid (ATF)	*C1AZ-19582-A, C, D*
Effort Required to Initiate Proper Input Shaft Rotation (Power Cylinder Drained and Gear Removed from Vehicle)	7-15 In-Lb
Tie Rod Articulation Effort (On Pull Scale)	1-6 Lbs.

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TORQUE CHART – POWER RACK AND PINION STEERING GEAR – TRW

Torque	Ft-Lb	Torque	Ft-Lb
Pressure Line Fitting	10-15	Valve Housing to Gear Housing Bolts	10-15
Return Line Fitting	10-15	Pinion Bearing Locknut	20-35
Gear-to-Crossmember Mounting Bolt Nut	80-100	Pinion Bearing Plug	35-55
Tie Rod End-to-Spindle Arm Nut	35-47 (1)	Rack Bushing Locknut	80-120
Steering Flex Coupling Bolt	20-30	Tie Rod Ball Socket Locknut	25-35
Yoke Plug Locknut	44-66	Tie Rod End-to-Tie Rod Jam Nut	35-50
Pressure Line Fittings at Valve	10-15	Tie Rod Ball Sockets-to-Rack	55-65
Pressure Line Fittings at Power Cylinder (Gear Housing)	10-15		

(1) Tighten to nearest cotter pin slot after torquing to specification.

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Tool No.	Description	Tool No.	Description
T74P-3504-C	Rack Oil Seal Remover	T74P-3504-R	Pinion Shaft Torque Adapter
T74P-3504-D	Inner Rack Oil Seal Replacer	T74P-3504-U	Pinion Housing Yoke Plug Nut Wrench
T74P-3504-E	Rack Bushing Holding Tool	T74P-3504-Y	Spring Scale (0-10 Lbs.)
T74P-3504-F	Outer Rack Oil Seal Replacer	T50T-100-A	Slide Hammer
T74P-3504-G	Plastic Ring Replacer	T57L-500-B	Bench Mount
T74P-3504-H	Plastic Ring Sizing Tool	T58L-101-A	Attachment
T74P-3504-J	Rack Seal Protecting Sleeve (Short)	T71P-19703-C	O-Ring Remover
T74P-3504-K	Rack Seal Protecting Sleeve (Long)	T63P-9171-A	Clamp Crimp Tool
T77P-3504-A	Rack Bushing Lockring Tool	T78P-3504-G	Pinion Bearing Replacer
T74P-3504-N	Input Shaft Dust Seal Replacer	T74P-3504-B	Rack Bushing Locknut Wrench
T74P-3504-P	Input Shaft Needle Bearing Replacer		

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DETROIT IRON

Power Steering Pump—Ford Model CII

PART 13-51

Applies To All Cars, Except Lincoln Continental and Mark V

SUBJECT	PAGE
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DISASSEMBLY AND ASSEMBLY	51-13
REMOVAL AND INSTALLATION	
Power Steering Pump	51-5
REMOVAL AND INSTALLATION (Cont.'d)	
Power Steering Pump Reservoir	51-6
Rotor Shaft Seal	51-6
SPECIFICATIONS AND SPECIAL SERVICE TOOLS	51-22
TEST PROCEDURE	51-3

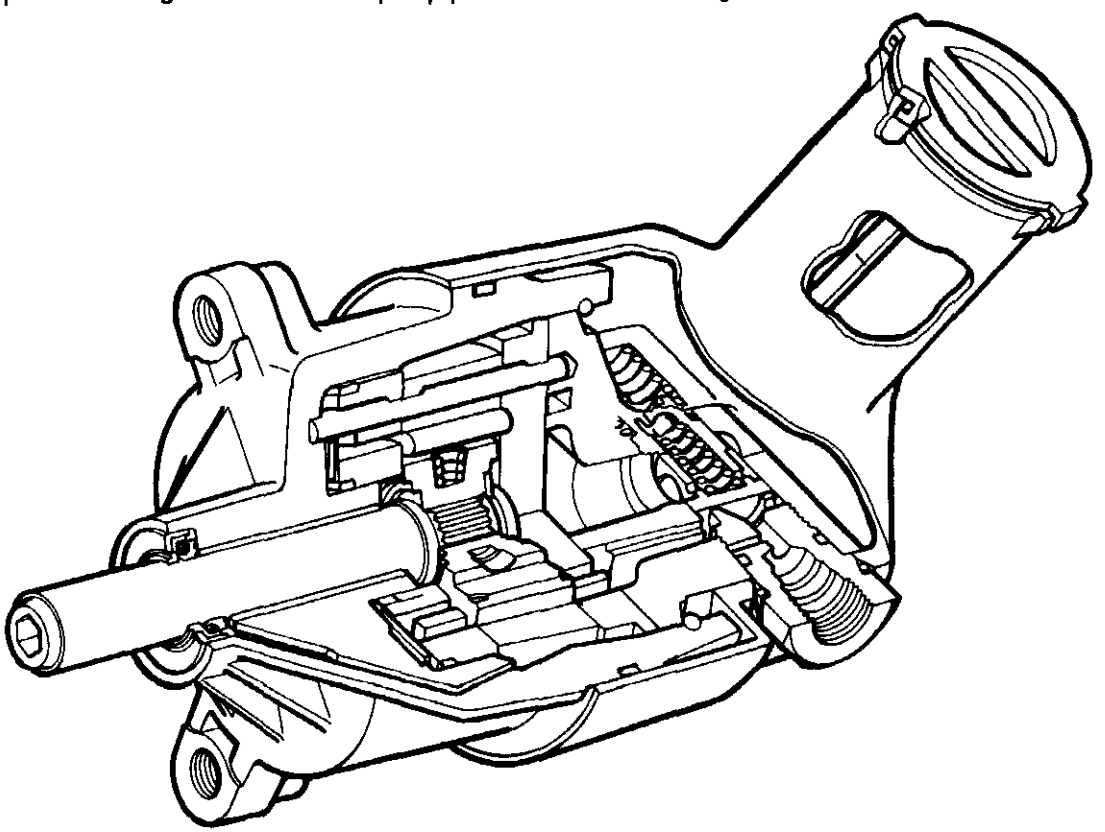
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DESCRIPTION

POWER STEERING PUMP

The Ford Model C II power steering pump is a belt driven ten-slipper type pump which is integral with a fiberglass nylon reservoir (Fig. 1). The reservoir is attached to the rear side of the aluminum pump housing and the pump body is encased within the housing and reservoir (Fig. 2). The new pump design concorporates a pump pressure fitting which allows the pump pressure line to swivel; this is normal and does not indicate an undertorqued fitting.

A pressure sensitive identification tag is attached to the reservoir body. This tag indicates the basic model number (HBC) and the suffix. Always use these model codes on the tag when requesting service parts in case of any differences in internal components. A facsimile of this tag is shown in Part 13-01.



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FIG. 1 Ford Model C II Power Steering Pump—Sectional View

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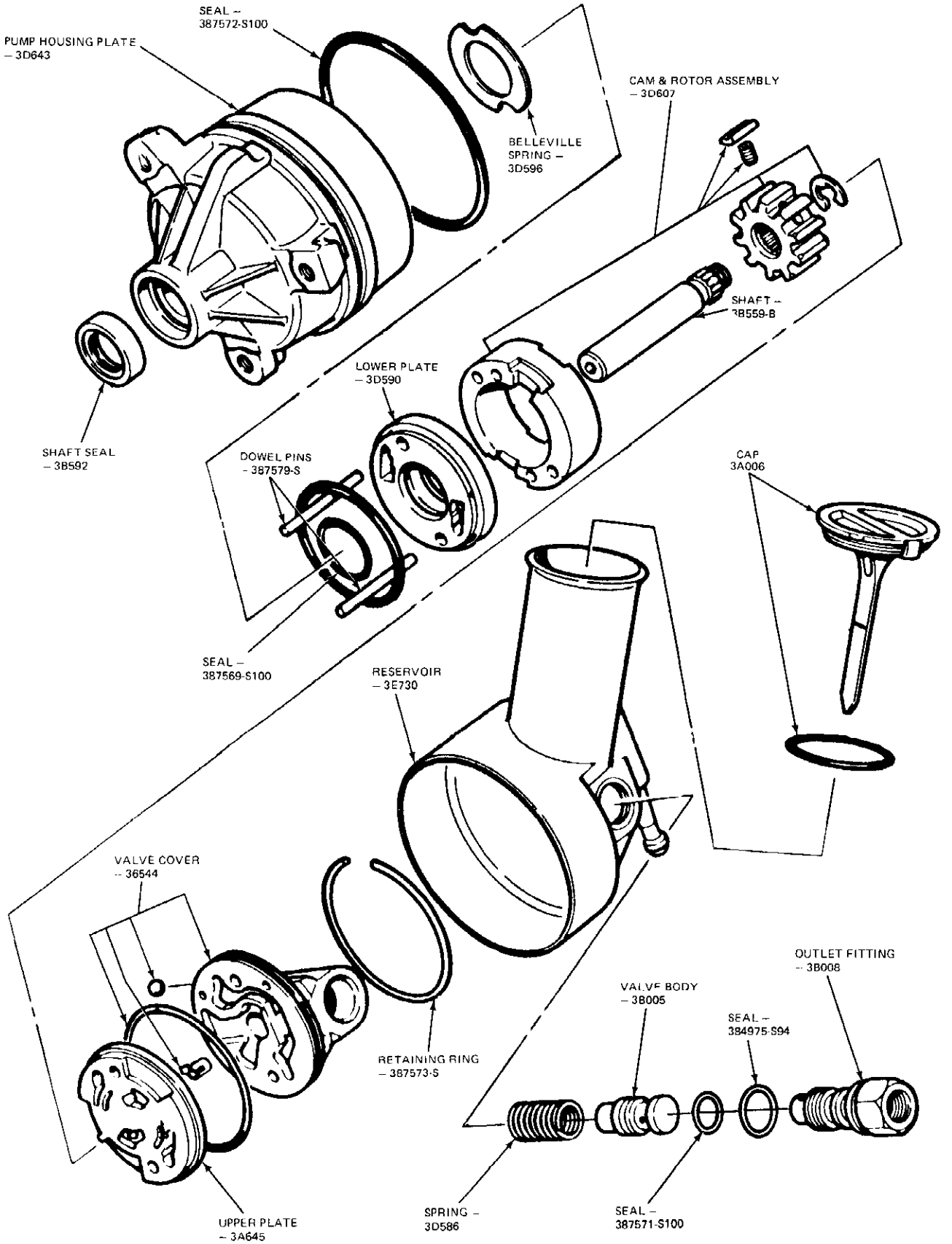


FIG. 2 Ford Model C II Power Steering Pump—Exploded View

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TEST PROCEDURE:
ROTUNDA FLOW/PRESSURE POWER STEERING PUMP ANALYZER OR EQUIVALENT

The test procedure using the Rotunda Flow/Pressure Power Steering Analyzer (Special Tool No. 970-001 or equivalent) provides a method for checking the complete power steering system. The Rotunda Flow/Pressure Power Steering Analyzer or equivalent can be used on integral or non-integral power steering systems to determine the cause of hard steering and/or lack of assist problems.

The analyzer provides readouts for the following:
- System Backpressure
- Pump Flow

The interpretation of the above readouts will determine which of the following conditions or components are the cause of the problem:
- Restriction in Hoses or Fittings
- Inefficient Pump Cam Pack
- Sticking Relief Valve
- Binding in Suspension

The following procedure should be followed when using the Rotunda Flow/Pressure Analyzer or equivalent:

1. To connect the analyzer into the steering system, remove the pressure line from the pump and thread it into the appropriate adapter of the analyzer.
2. Thread the other adapter of the analyzer into the pump.
3. Connect the analyzer to the adapters and tighten all connections to a maximum of 15 ft-lbs.

   NOTE: The adapter on the analyzer may be switched so that the connection is made at alternate locations between the pump and gear (See Fig. 3).
4. Add power steering fluid to the pump if required. Start the engine and run it for approximately two minutes with the idle set at manufacturer's specifications.
5. Record the following at idle with the gate valve fully open:
   A. Flow (_____ gallons/min. at 170±5°F)
   B. Pressure (_____ psi at 170±5°F)
   (a) If flow (A) is below two gallons/min., the pump may require repair; however, at this point continue the diagnosis. Check chart for flow and relief pressure against the model pump being tested.
   (b) If pressure (B) is above 150 psi, check hoses for restrictions.

   NOTE: On non-integral power steering, jiggle the steering wheel to insure that the spool valve is centered prior to test.
6. Partially close the gate valve to build up 750 psi. Observe and record flow.
   C. (_____ gallons/min. at 170±5°F)
   (a) If flow (C) drops to a level lower than the value on Chart I disassemble the pump and replace the cam pack. If the pressure plates are cracked or worn replace them. Continue with the diagnosis.
7. Completely close and partially open the gate valve three times. (Do not allow the valve to remain closed for more than five seconds.) Observe and record pressure (D), (_____ psi).
   (a) Check the attached chart for the pressure specification listed for the applicable pump model. If the pressure recorded (D) is 100 psi **lower** than the specification listed, replace the flow control valve in the pump.
   (b) If the pressure recorded (D) is **above** the specification listed by more than 50 psi, the flow control valve in the pump should be removed and either cleaned or replaced with a new valve.
8. Increase the engine speed from idle to approximately 1500 rpm. Observe and record flow (E) (_____ gallons/min.).
   (a) If flow (E) varies more than one gallon/min. from flow (A) the flow control valve in the pump should be removed and either cleaned or replaced.

   If the system is severely contaminated, both hoses and pumps must be completely disassembled and cleaned before reassembly; and the steering gear should be flushed after reassembly.

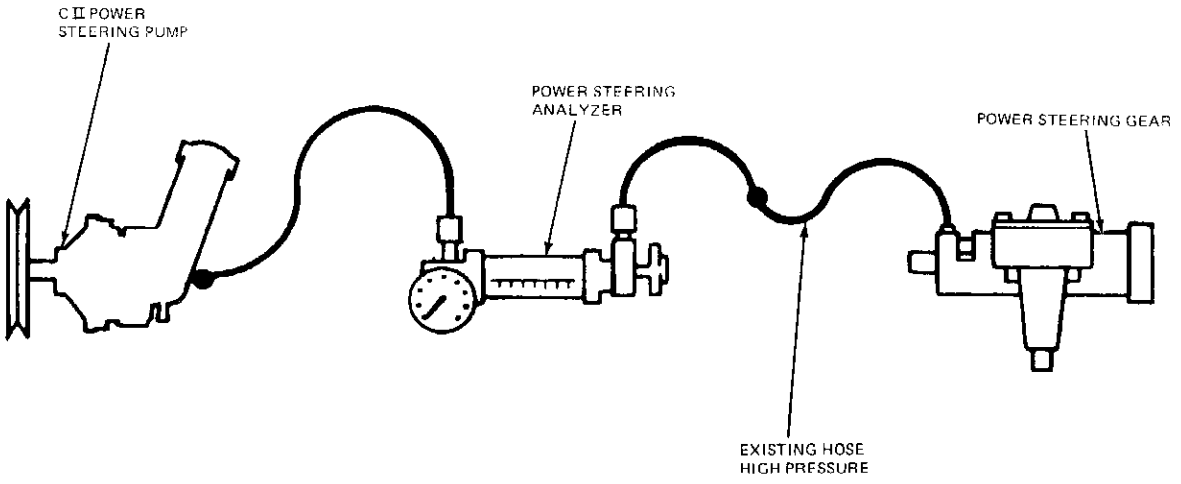
NOTE: *If problem still exists, check steering gear,* ball joints, linkage (See Steering Diagnosis).

CHART I – FLOW AND PRESSURE

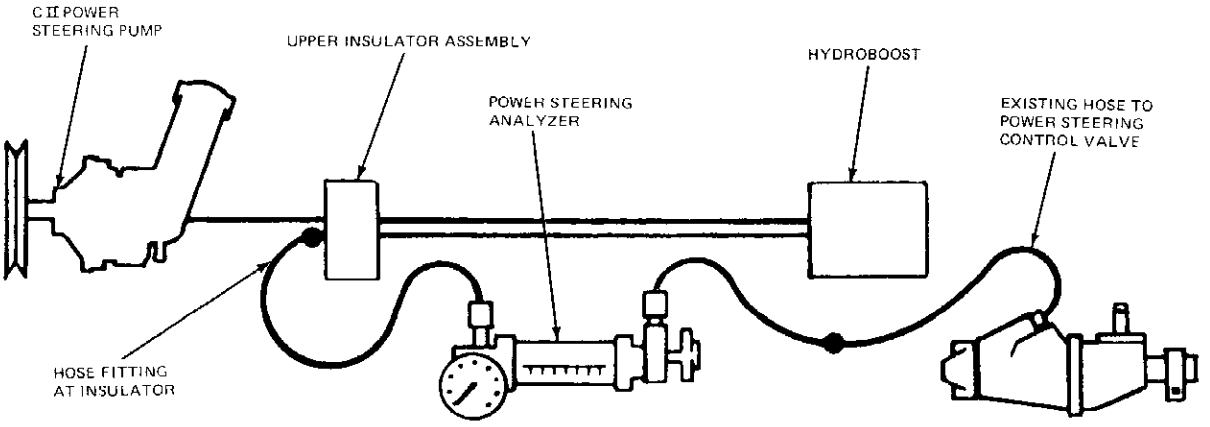
Pump Model	Min. Flow GPM @ 170 ± 5°F.	Min. Relief Pressure	Max. Relief Pressure
HBC-W	1.9	1050 PSI	1200 PSI
HBC-V	1.9	1050 PSI	1200 PSI
HBC-U	1.9	1200 PSI	1350 PSI
HBC-T	1.9	1300 PSI	1450 PSI

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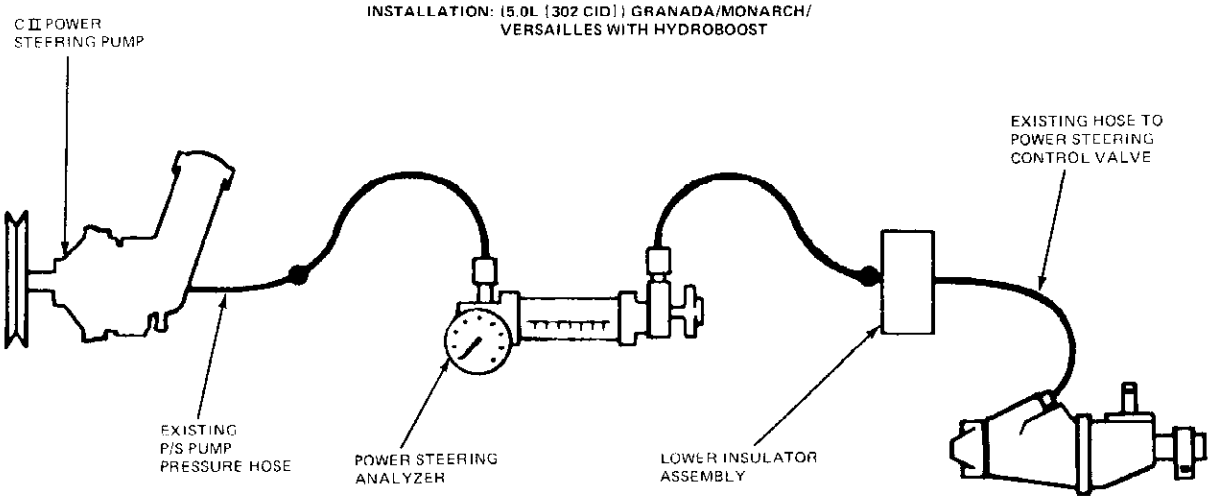
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TYPICAL INSTALLATION



INSTALLATION: (5.0L [302 CID]) GRANADA/MONARCH/
VERSAILLES WITH HYDROBOOST



INSTALLATION: (5.0L [302 CID]) GRANADA/MONARCH/
WITHOUT HYDROBOOST

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FIG. 3 Connection Points—Power Steering Analyzer

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ADJUSTMENTS

PUMP BELT TENSION

Pump drive belt tension cannot be checked accurately using the thumb pressure or belt deflection methods. The adjustment must be made with a belt tension gauge.

1. Check the belt tension with a belt tension gauge Tool T63L-8620-A. For a new belt, or a belt that has been run for less than 15 minutes, tension should be 120 to 150 lbs for a belt that has been run for longer than 15 minutes, tension *should be 90 to 120 lbs.*
2. Pivot System Adjustment: Loosen the pivot bolts and insert a tool into the square hole in the pivot bracket. Lift the pivot bracket up to obtain the proper belt tension and tighten the pivot bolts. Torque all bolts to the specifications listed in Attachment I.
3. Slider System Adjustment: The proper belt tension may be obtained by tightening or loosening the slider bracket adjusting nut.

NOTE: Do not pry against the reservoir to obtain proper belt tension. Pressure on the fiberglass reservoir may crack the reservoir.

Removal:

1. Drain as much fluid as possible from the pump through the reservoir neck.
2. *Install a* 3/8-16 inch cap screw in the end of the pump shaft to prevent damage to the shaft end by the tool screw.
3. Install pulley remover Tool T69L-10300-A, on the pulley hub, and place the tool and pump in a vise.
4. Hold the pump and rotate the tool nut counterclockwise to remove the pulley. Do not apply in an out pressure on the pump shaft. Pressure will damage the internal thrust areas.

Installation:

1. Place the pulley on the pump shaft and install Tool T65P-3A733-C.
2. Hold the pump and rotate the tool nut clockwise to install the pulley on the shaft. The pulley face must be flush within 0.010 inch of the end of the pump shaft. Do not apply in and out pressure on *the shaft. Pressure will damage the internal thrust* areas.
3. Remove the tool.

QUICK CONNECT POWER STEERING FITTING --SERVICE

The quick connect power steering fitting, under certain conditions may leak and/or result in improper *engagement. The leak can be caused by a cut O-ring,* imperfections in the outlet fitting ID, or improperly machined O-ring groove. Improper engagement can be caused by an improperly machined tube end, tube nut, snap ring, outlet fitting or gear port.

If a leak occurs, the O-ring should be replaced with quick connect O-rings (3/8 tube end: 87006-S100; 5/16 tube end: 87004-S100). The O-rings that are used on the tube-O power steering fitting should not be used on the quick connect fitting because of dimensional and material changes. If O-ring replacement does not solve the leak problem, outlet fitting replacement and, lastly, hose replacement should be made.

If improper engagement occurs, the entire hose assembly (snap ring, O-ring, hose, and tube nut) should be replaced. The system should then be properly *filled, the engine started, and the steering wheel* cycled from lock-to-lock to test for positive engagement.

When the quick connect tube nut is tightened or loosened, a tube nut wrench, not an open end wrench, is recommended. An open end wrench may result in tube nut deformation under excessive torque conditions. Care must be taken not to overtorque the tube nut (the spec. is 10-15 ft-lb). Swivel and/or end play of the quick connect fittings is normal and does not indicate an undertorqued fitting.

Quick connect hose assemblies for service will have tube nuts, snap rings, and O-rings already attached. The snap rings and tube nuts will not be a service item.

REMOVAL AND INSTALLATION

POWER STEERING PUMP

Removal:

1. Refer to the appropriate illustration (Figs. 4 through 9). To remove the power steering fluid from the pump reservoir, disconnect the fluid return hose at the reservoir and drain the fluid into a container.
2. *Remove the pressure hose from the pump fitting.*

   NOTE: Do not remove the fitting from the pump.
3. Remove the mounting bracket. Disconnect the belt from the pulley and remove the pump.

Installation:

NOTE: Prior to pump installation, remove the shipping tube nut from the pressure fitting.

1. Place the pump on the mounting bracket and install the bolts at the front of the pump. Torque to specifications.
2. Place the belt on the pulley and adjust belt tension as described in this part.
3. Install the pressure hose to the pump fitting. Tighten the tube nut with a tube nut wrench rather than with an open end wrench. *Do not overtorque this fitting* (spec. is 10-15 ft-lbs). Swivel and/or end play of the fitting is normal and does not indicate an undertorqued fitting.

NOTE: Overtorquing the tube nut can collapse the tube nut wall, resulting in a leak and requiriring replacement of the entire

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pressure hose assembly. Use of an open end wrench to tighten the nut can deform the tube nut hex which may result in improper torque and may make further servicing of the system difficult.

4. Connect the return hose to the pump and tighten the clamp. Raise vehicle on hoist and connect lower return line (hydroboost only).
5. Fill the reservoir with specified power steering fluid.

   NOTE: Use start-up procedure after power steering pump or gear overhaul as outlined in General Steering Service, Part 13-01.
6. Check for leaks and recheck the fluid level. Add fluid if necessary.

ROTOR SHAFT SEAL

Removal:

1. Remove the pump pulley from the rotor shaft as described in this part.
2. Place the pump assembly in a holding fixture, Tool No. T57L-500-B, or on the assembled adapter plate, Tool No. T69P-3A674-A, with the pulley end of the shaft up.
3. Clean any rust or dirt from the pulley end of the rotor shaft.
4. To prevent scoring of the rotor shaft, wrap .005 shim stock (free of burrs) around the shaft and push this shim stock into the ID of the seal until it contacts the bushing.
5. Using a sheet metal punch, or a similar tool, carefully pierce the metal portion of the seal body face, and pry the old seal out.

NOTE: Do not damage the bushing, housing, or the rotor shaft.

Installation:

1. Remove the shim stock from the rotor shaft.
2. Apply Motorcraft adhesive No. D5AZ-19554-A (Loctite No. 242 or 271) or equivalent, to the outside diameter of the new seal and apply Motorcraft D0AZ-19554-B primer (Locquic NF or T) or equivalent, to the housing seal bore. Place the new rotor shaft seal on the seal protector Tool T68P-3B592-B.
3. Place the seal protector tool and the rotor shaft seal on the rotor shaft.
4. Using seal installation Tool T68P-3B592-A and a plastic or rubber mallet, tap on the end of the tool until the seal is flush with the end of the seal bore.
5. Remove the tools.
6. Install the pulley on the rotor shaft as described in this part.

POWER STEERING PUMP RESERVOIR

Take the following precautions when servicing the power steering pump reservoir:

1. Use a clean work bench and tools.
2. Plug the inlet and outlet openings of the pump with plugs or masking tape.
3. Thoroughly clean the exterior of the pump with solvent.

Removal:

1. Place the pump assembly in a bench vise with soft jaws (Fig. 10) and remove the outlet fitting, flow

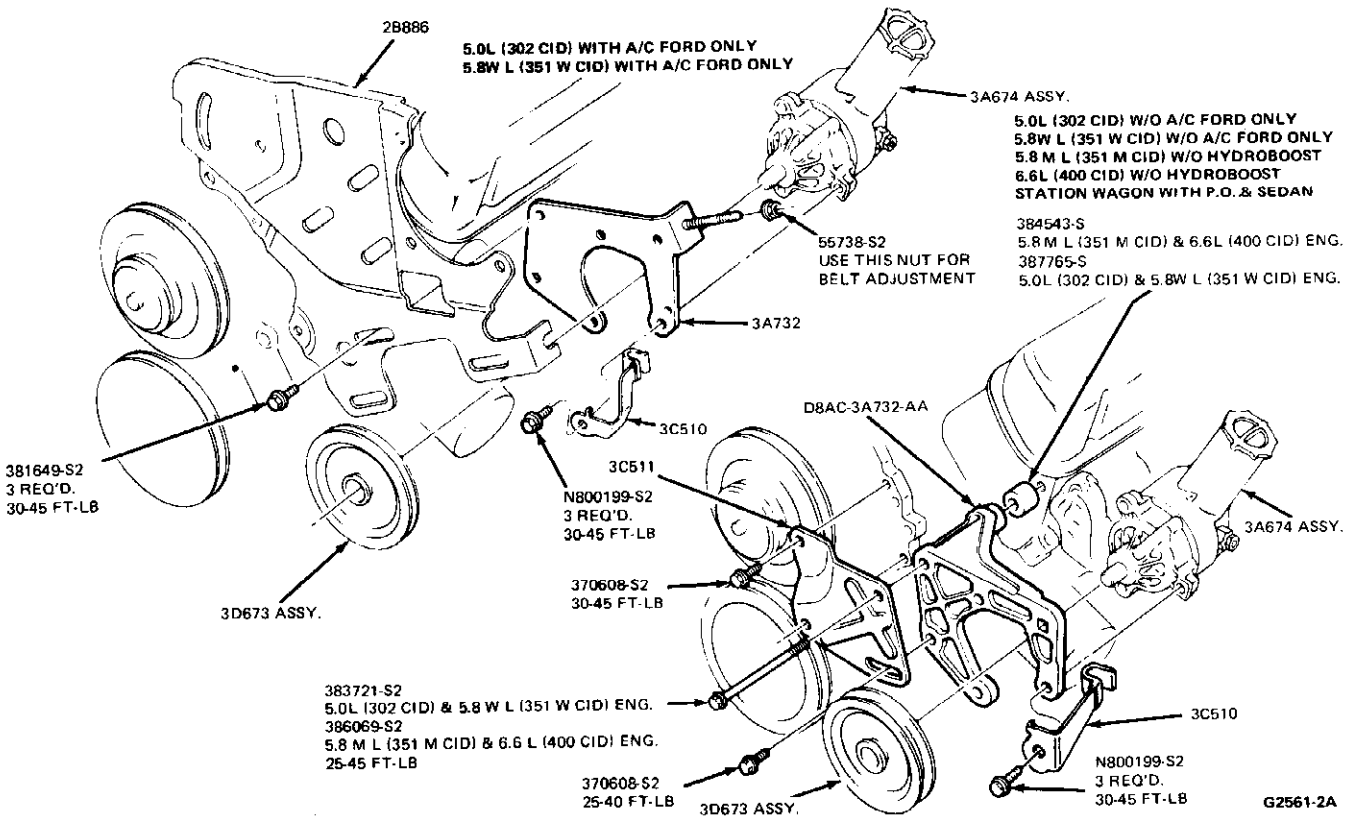


FIG. 4 Model C II Power Steering Pump Installation—Ford and Mercury

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control valve and spring. Discard all seals (Fig. 11).

2. Remove the fiberglass reservoir (Figs. 12-13).
3. Discard O-ring seal on pump housing (Fig. 14).

NOTE: Do not hammer on the reservoir.

Installation:

1. Install a new O-ring seal on the pump housing.
2. Apply petroleum jelly to the reservoir O-ring seal and the inside edge of the reservoir. Do not twist the O-ring seal (Fig. 15).
3. Place the reservoir over the pump and align the outlet fitting hole in the reservoir with the hole in the valve cover.
4. Place new O-ring seals on the outlet fitting. Install the flow control spring, flow control valve and outlet fitting into the reservoir and valve cover. Torque the fitting to proper torque specifications.

NOTE: If the valve is cocked, it may become stuck in the valve cover. Do not force the valve forward; forcing the valve may shear off metal and carry the metal chips into the valve bore.

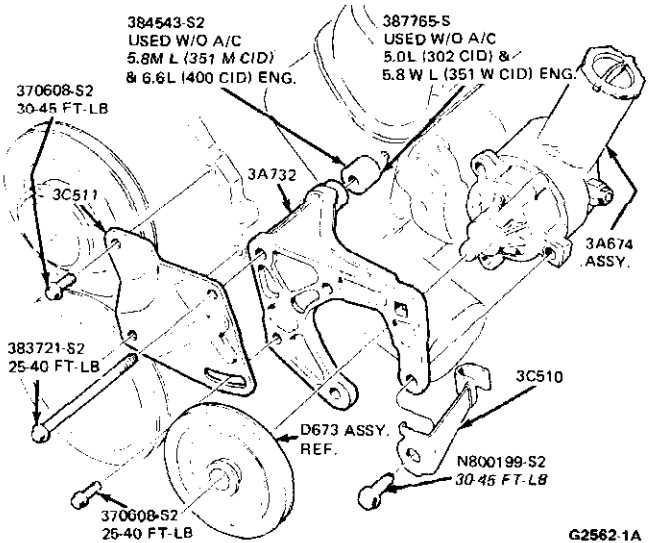
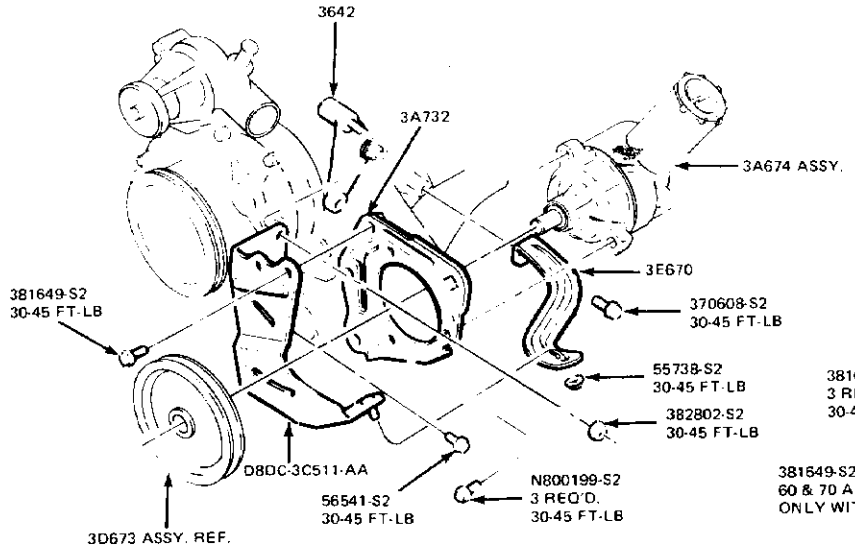
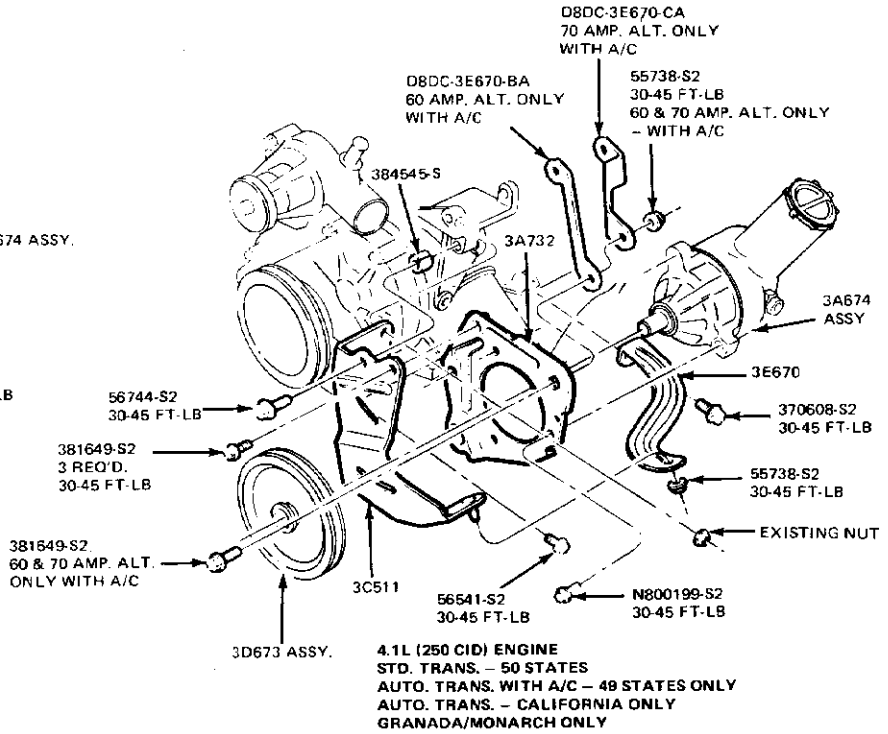
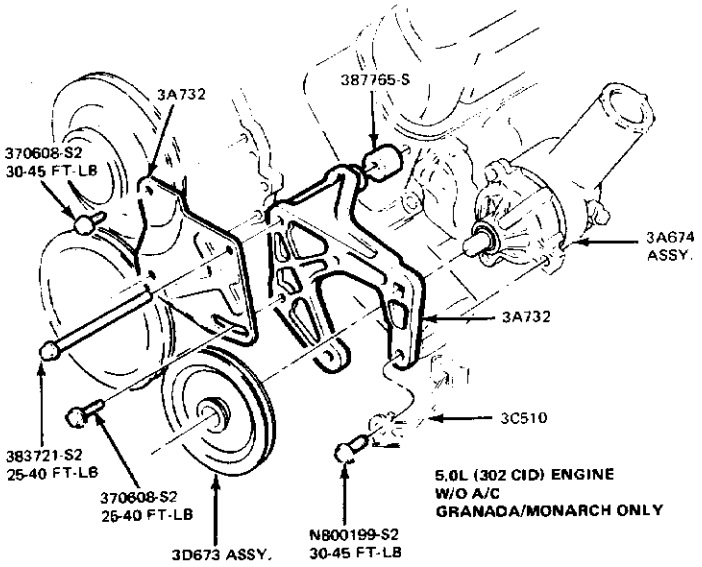


FIG. 5 Model C II Power Steering Pump Installation—LTD II, Cougar, Thunderbird and Cougar XR-7

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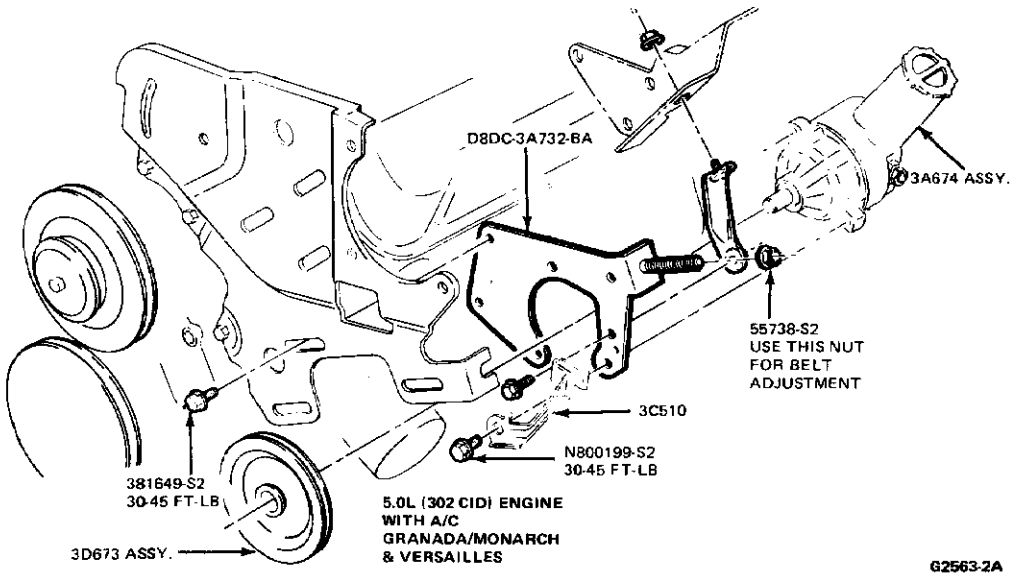


FIG. 6 Model C II Power Steering Pump Installation—Granada, Monarch and Versailles

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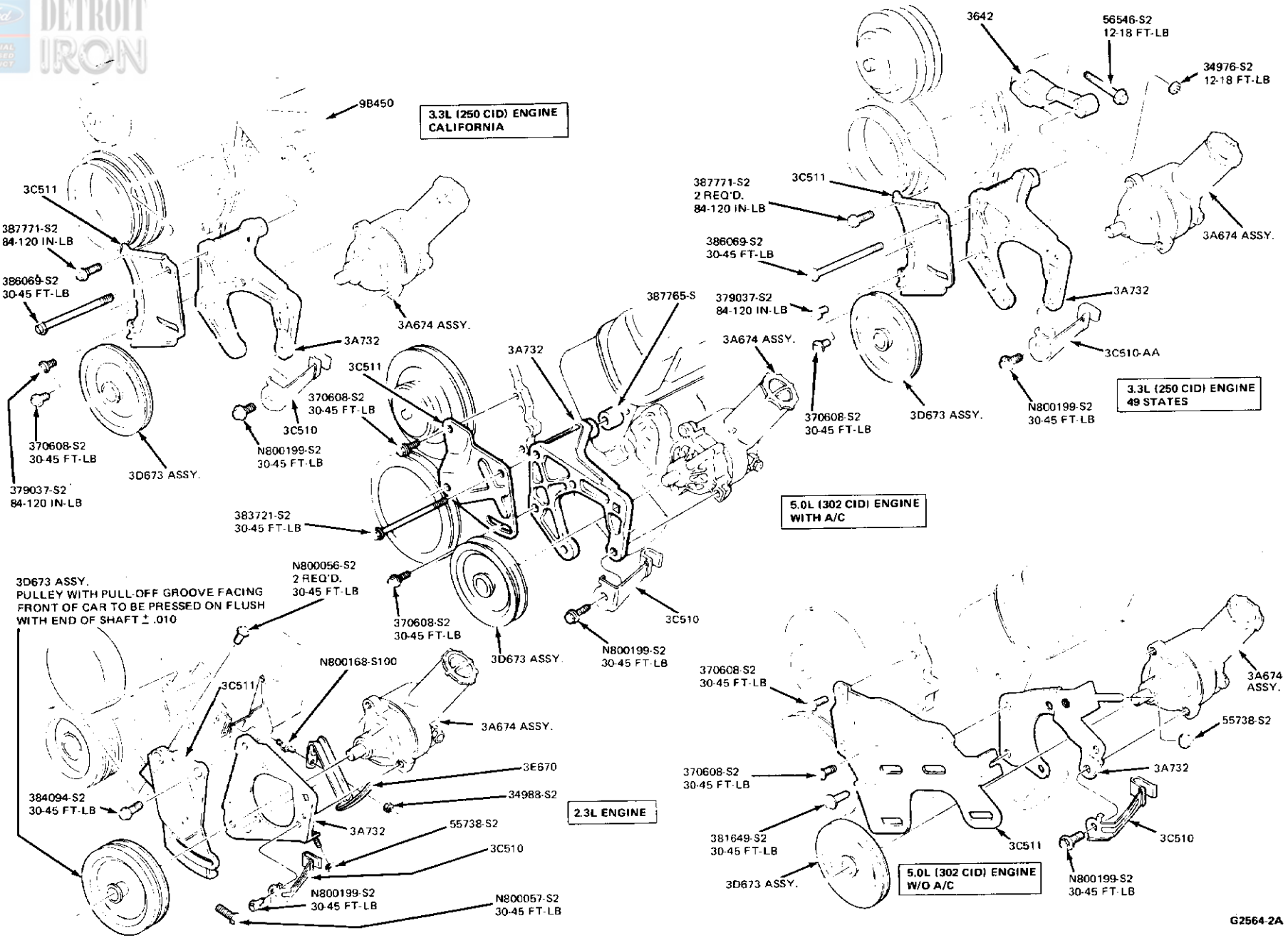


FIG. 7 Model C II Power Steering Pump Installation—Fairmont and Zephyr

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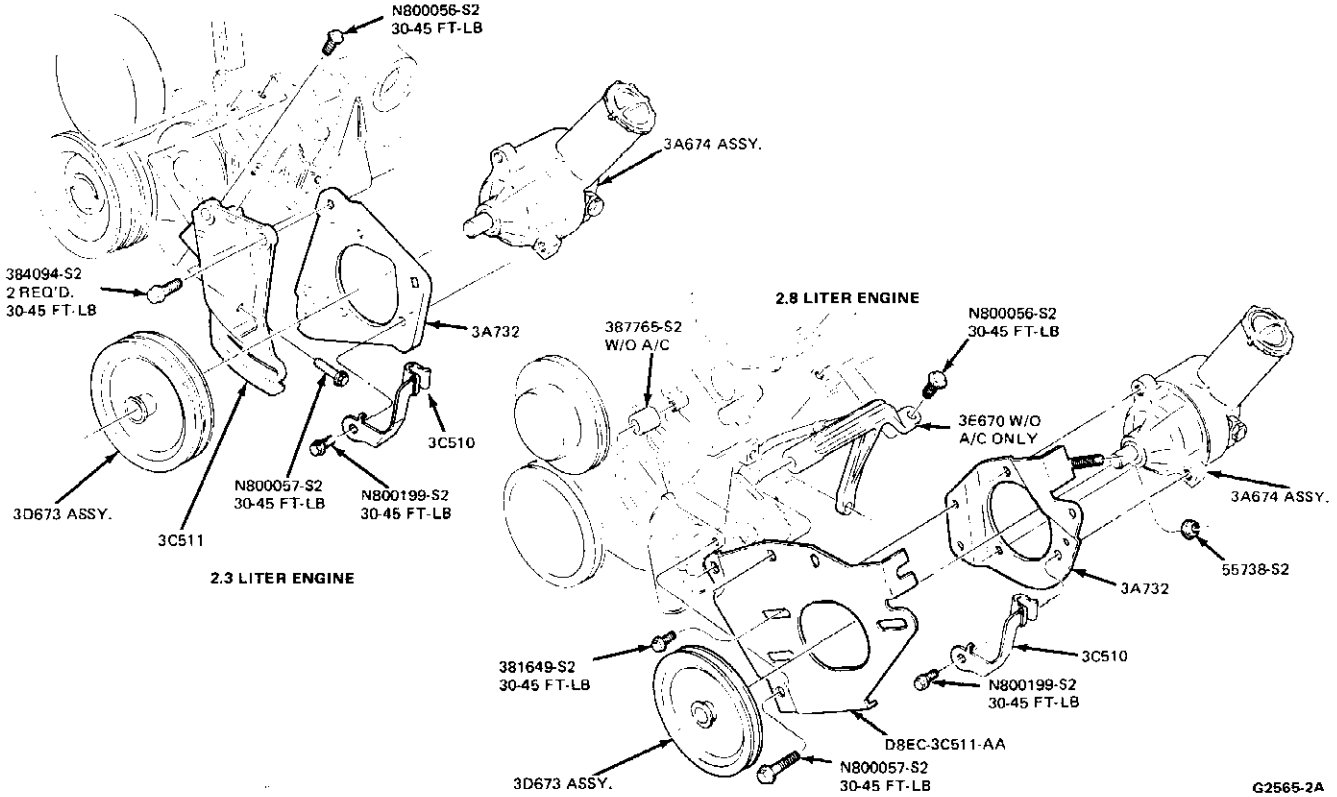


FIG. 8 Model C II Power Steering Pump Installation—Pinto and Bobcat

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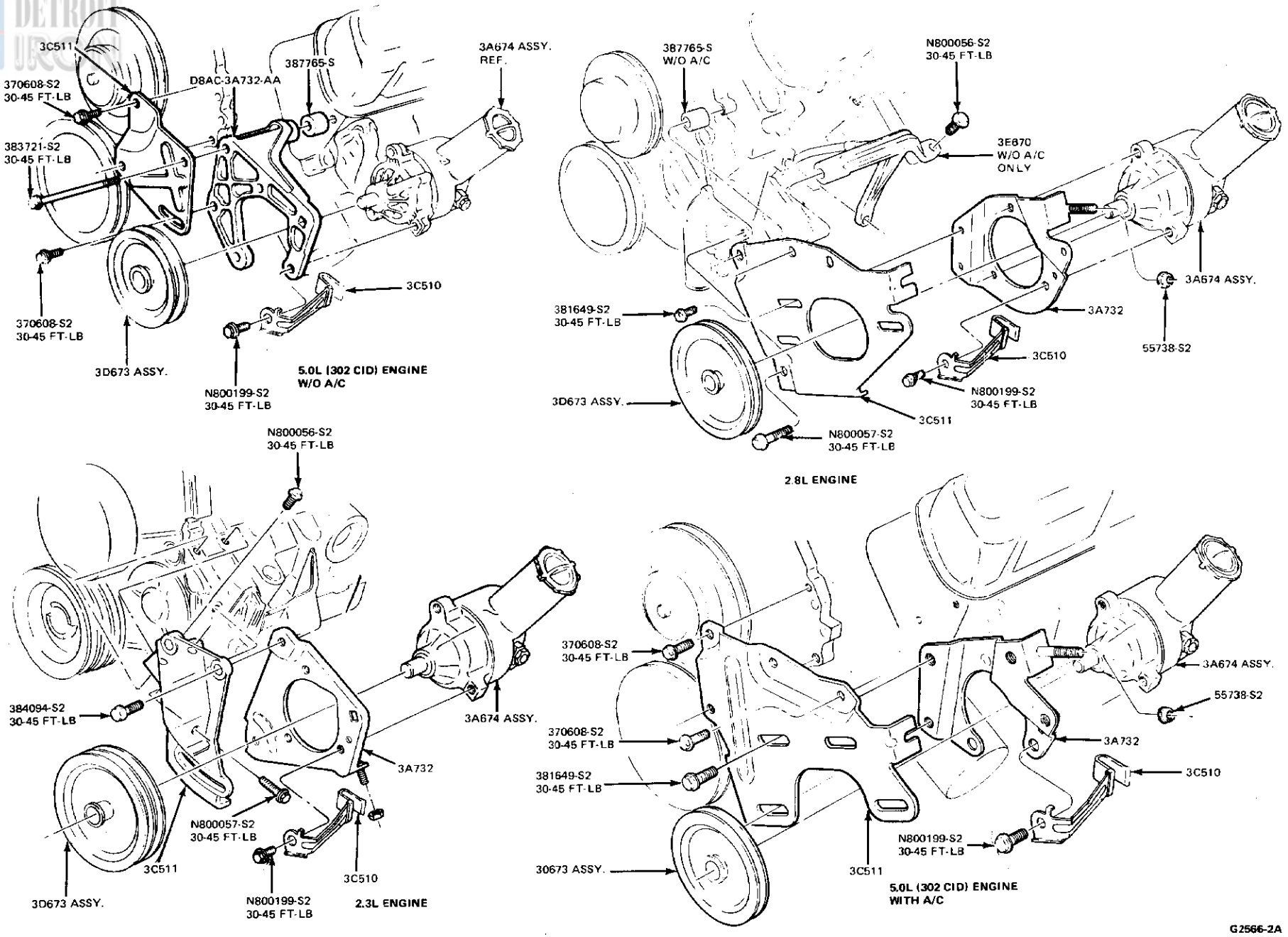


FIG. 9 Model C II Power Steering Pump Installation—Mustang

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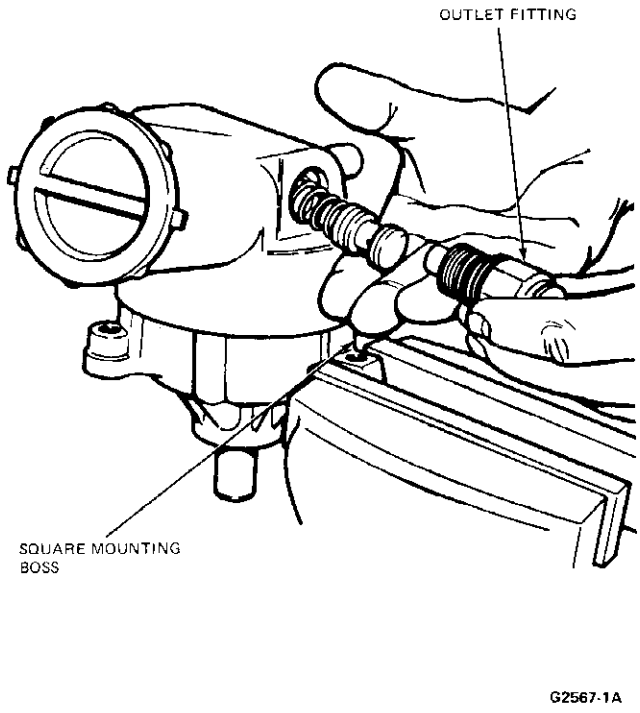


FIG. 10 Removing Outlet Fitting, Flow Control Valve and Spring

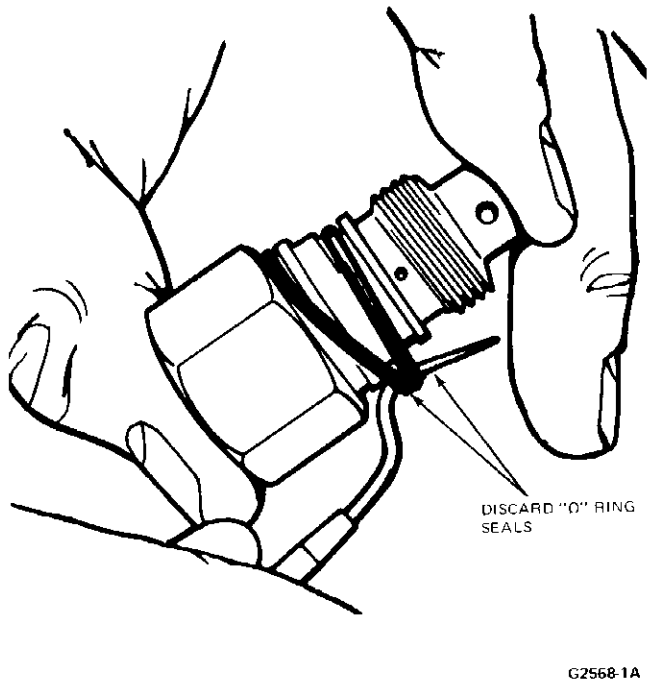


FIG. 11 Removing Seals

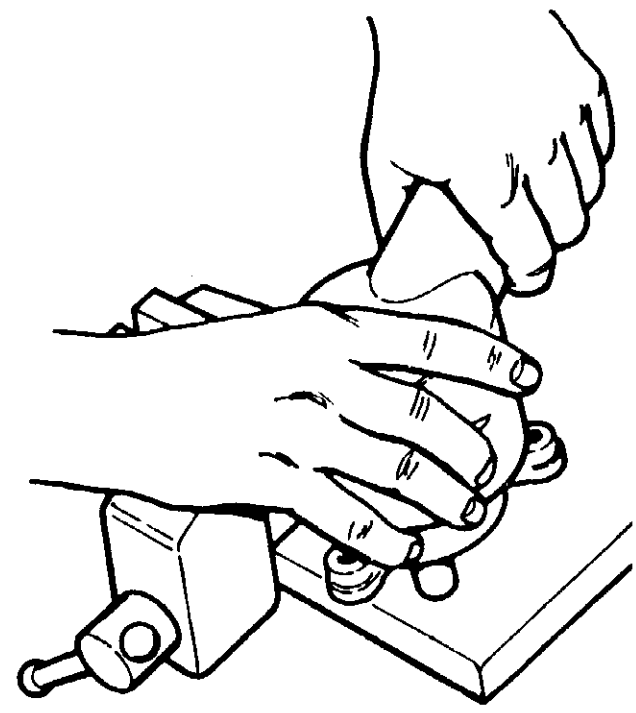


FIG. 12 Loosening Reservoir

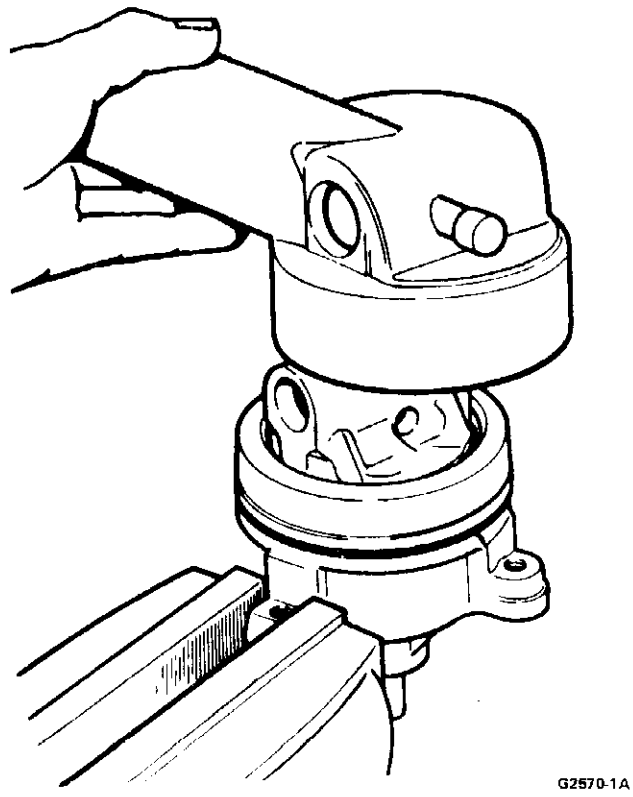


FIG. 13 Removing Reservoir

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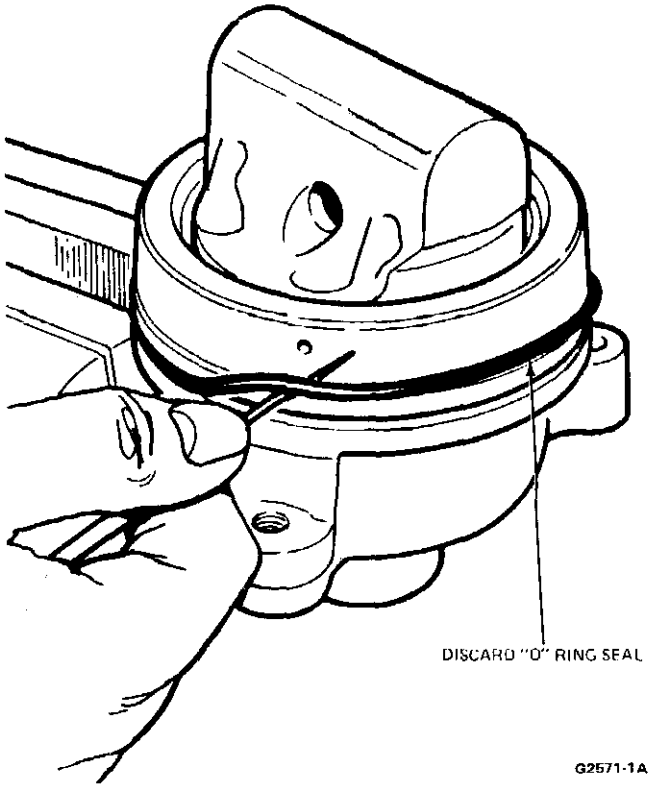


FIG. 14 Removing O-Ring

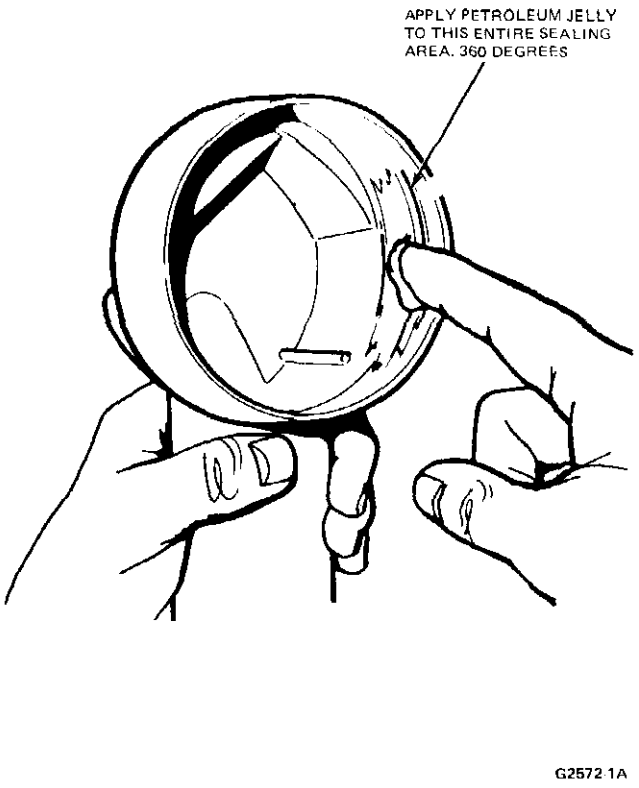


FIG. 15 Applying Petroleum Jelly

DISASSEMBLY AND ASSEMBLY:

POWER STEERING PUMP

The following precautions must be observed when servicing the power steering pump:

1. Use a clean work bench and tools.
2. Thoroughly clean the exterior of the unit with solvent. Drain as much fluid from the pump as possible.
3. If only the reservoir is to be removed, clean as detailed under Reservoir Removal.
4. If only the rotor shaft seal is to be removed, clean as detailed under Reservoir Removal.
5. Do not use cleaning solvents on the seal.

Disassembly:

1. Remove the pump pulley as outlined under Pump Pulley Removal in this Part.
2. Remove the outlet fitting, flow control valve, and flow control spring from the pump and remove the pump reservoir.
3. Place C clamp (Tool No. T74P-3044-A1) in a bench vise.
4. Place the lower support plate (Tool No. T78P-3733-A2) over the pump rotor shaft (Fig. 16).
5. Install the upper compressor plate (Tool No. T78P-3733-A1) into the upper portion of the C clamp.
6. Holding the upper compressor tool, place the pump assembly into the C clamp with the rotor shaft facing down (Fig. 17).
7. Tighten the C-clamp until a slight bottoming of the valve cover is felt.
8. In the side of the pump housing is a small hole. Through this hole insert a small drift or suitable tool and push inward on the valve cover retaining ring. While applying inward pressure on the retaining ring, place screwdriver under the edge of the retaining ring and remove the ring (Fig. 18).
9. Loosen the C-clamp; remove the upper compressor plate; and remove the pump assembly.
10. Remove the pump valve cover. Discard the O-ring seal.
11. Push on the rotor shaft to remove the rotor shaft, upper plate, rotating group assembly and two dowel pins (Fig. 19).
12. The lower plate and the Belleville spring will remain in the pump housing. To remove, place the pump housing on a flat surface. Raise slightly and slam the housing down flat until the lower plate and the Belleville spring fall out. Discard the O-ring seals (Fig. 20).
13. Remove the rotor shaft seal by prying out with a screwdriver (Fig. 21).

NOTE: This method is used only when the pump is disassembled.

Assembly:

If the rotating group was disassembled for cleaning and/or inspection, reassemble as follows:

1. Place the rotor on the rotor shaft splines with the triangle detent in the rotor counterbore facing upwards.

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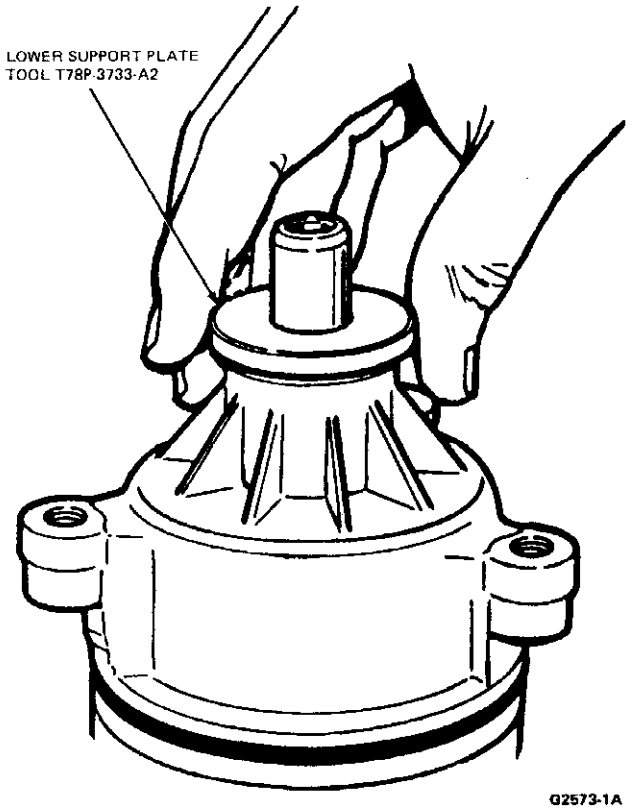


FIG. 16 Installing Lower Support Plate

2. Install the retaining ring in the groove at the end of the rotor shaft.
3. Place the insert cam over the rotor. Be sure that the recessed notch on the insert cam faces up.
4. With the rotor extended upward approximately half way out of the cam, insert a spring into a rotor spring pocket. Work in the rotor cavity directly beneath the recessed flats on the cam (Fig. 22).
5. Use one of the slippers to compress the spring and install the slipper with the groove facing the cam profile. Repeat Steps 4 and 5 on the slipper cavity beneath the opposite inlet recess (Fig. 23).
6. Holding the cam stationary, index the rotor either right or left one space and install another spring and slipper until all ten rotor cavities have been filled. Turn the rotor carefully so that the springs and slippers already installed do not fall out (Fig. 24).
7. Apply Motorcraft adhesive No. D5AZ-19554-A (Loctite No. 242 or 271) or equivalent to the outside diameter of the new seal and apply Motorcraft D0AZ-19554-B primer (Locquic NF or T) or equivalent to the housing seal bore. Install the new rotor shaft seal using seal driver Tool No. T78P-3733-A3. Using a plastic mallet, drive the seal into the bore until a bottoming is felt (Fig. 25).
8. Place the pump housing plate on a flat surface with the pulley side facing down.
9. Insert the two dowel pins and the Belleville spring into the housing (Fig. 26).

   NOTE: The Belleville spring must be inserted with the dished surface upward.

10. Lubricate the inner and outer O-ring seals with the specified power steering fluid and install these seals on the lower pressure plate (Fig. 27).
11. Insert the lower pressure plate with the O-ring seals toward the front of the pump into the pump housing (Fig. 28) and over the dowel pins. Place the entire assembly on the C-clamp. Place driver Tool No. T78P-3733-A3 into the rotor shaft hole (Fig. 29) and press on the lower plate lightly until it is felt to bottom into the pump housing. This operation will seat the outer O-ring seal (Fig. 30).
12. Install the cam, rotor and slippers, and rotor shaft assembly into the pump housing over the dowel pins (Fig. 31).

    NOTE: When installing this assembly into the pump housing, the stepped holes must be used for the dowel pins, and the recessed notch in the cam insert must face toward the reservoir and approximately 180 degrees opposite the square mounting lug on the aluminum housing.

13. Place the upper pressure plate over the dowel pins (Fig. 32) with the recess directly over the recessed notch on the cam insert and approximately 180 degrees opposite the square mounting lug.
14. Place a new O-ring seal on the valve cover. Lubricate this seal with the specified power steering fluid (Fig. 33).

    NOTE: Be sure that the plastic baffle is securely in place in the valve cover. If the baffle is loose, apply a coating of petroleum jelly on the baffle and install it into location on the valve cover.

15. Insert this valve cover over the dowel pins. Be sure the outlet fitting hole in the valve cover is directly in line with the square mounting lug of the aluminum housing (Fig. 34).
16. Place the entire assembly in the C-clamp tool and compress the valve cover into the pump housing, until the retaining ring groove is exposed in the pump housing.
17. Install the valve cover retaining ring with the ends near the access hole in the pump housing (Fig. 35).
18. Remove the pump assembly from the C-clamp tool.
19. Place a new O-ring seal on the pump housing. Lubricate this O-ring seal with the specified power steering fluid.
20. Install the power steering reservoir.
21. Install the flow control spring and the flow control valve into the valve cover.
22. Place new O-ring seals on the outlet fitting, lubricate these seals with the specified power steering fluid.
23. Install the outlet fitting into the valve cover and torque to 25-34 ft-lbs (Fig. 36).

NOTE: If the flow control valve is cocked, it may become stuck in the valve cover. Do not force the valve forward; forcing the valve may shear off metal and carry the metal chips into the valve bore.

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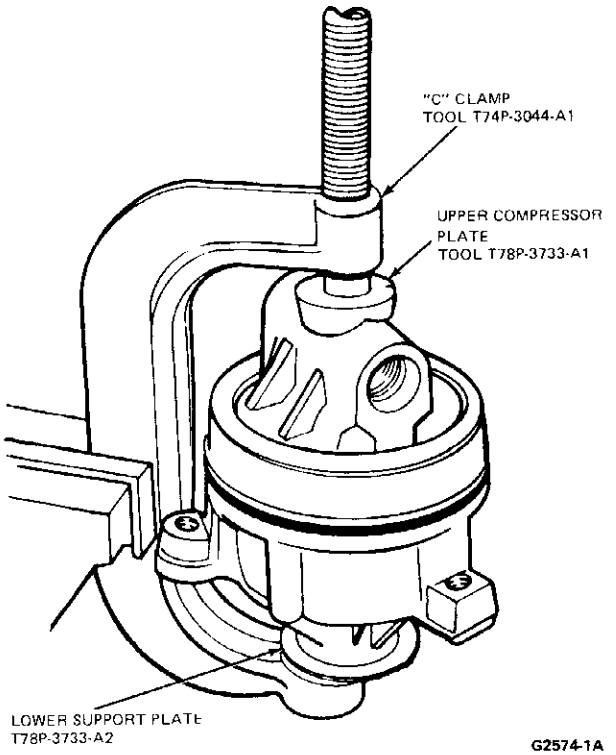


FIG. 17 Positioning Pump in C-Clamp

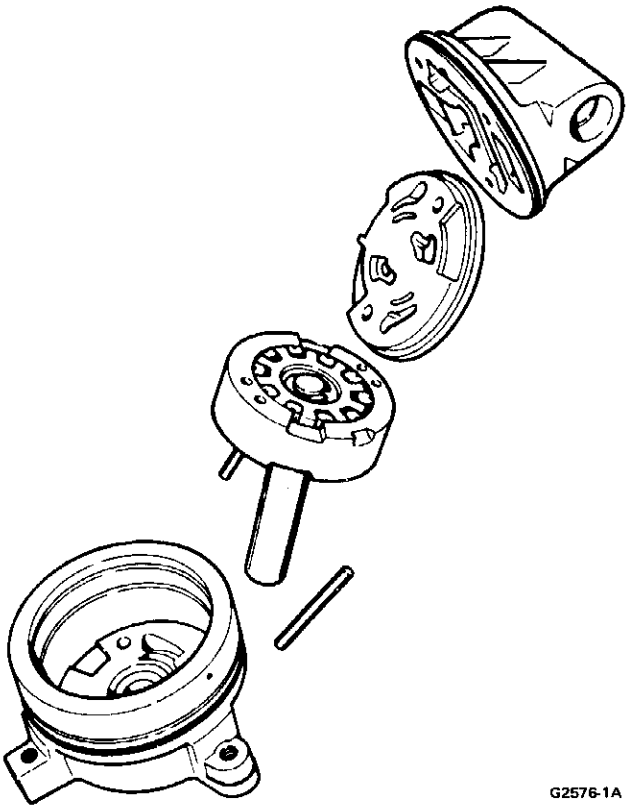


FIG. 19 Disassembling Pump

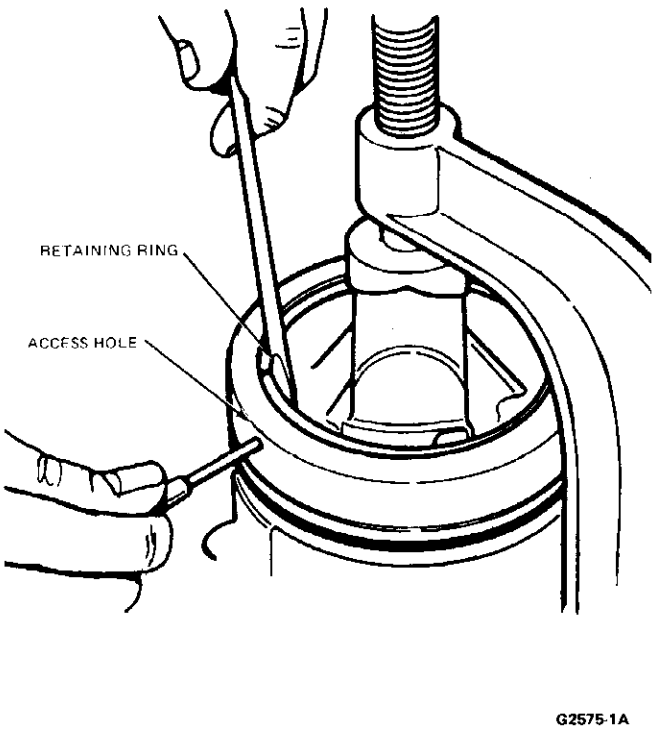


FIG. 18 Removing Valve Cover Retaining Ring

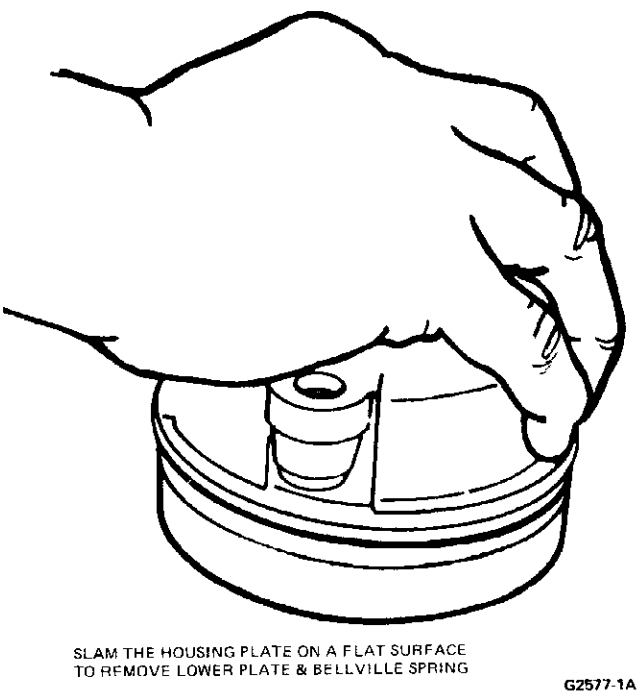


FIG. 20 Removing Lower Plate

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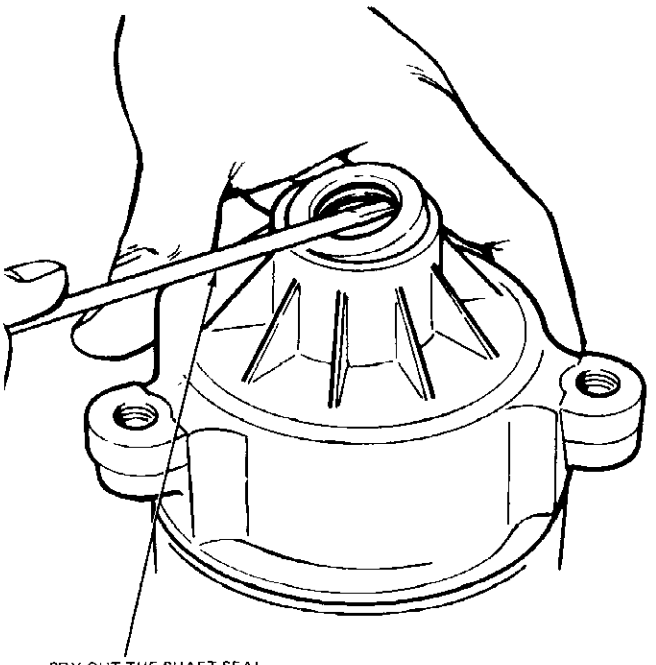


FIG. 21 Removing Shaft Seal

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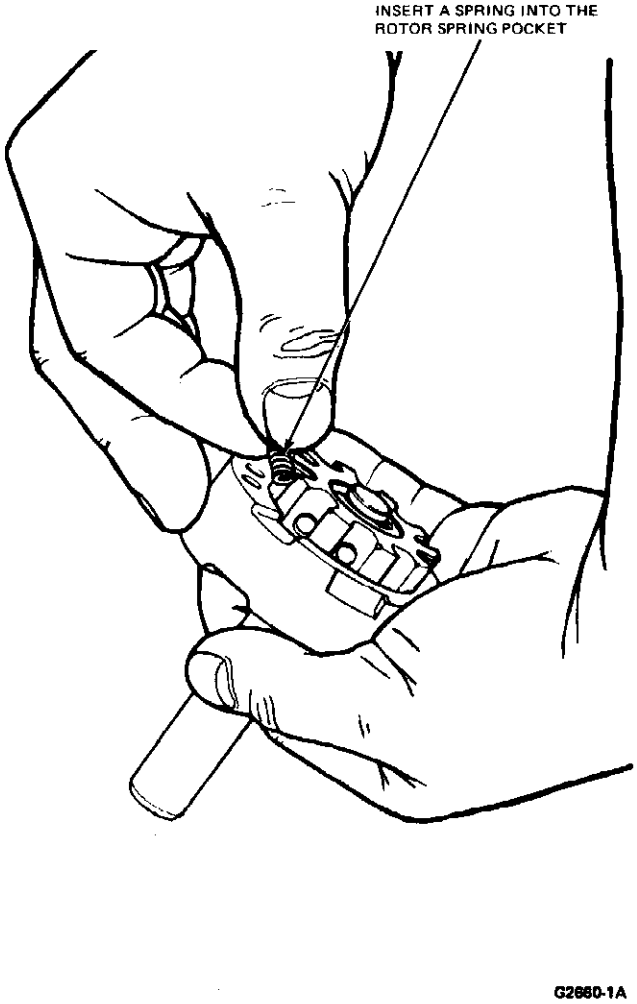


FIG. 22 Inserting Spring

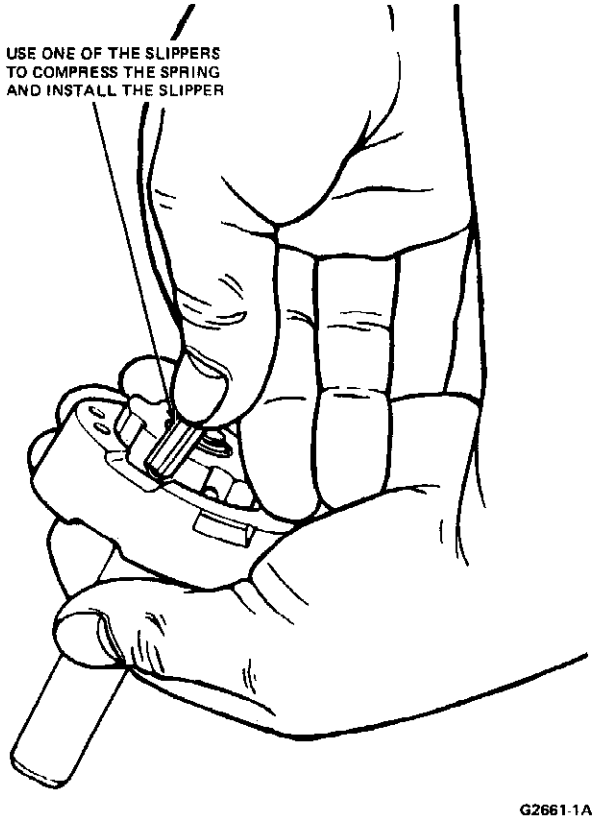


FIG. 23 Installing Slipper

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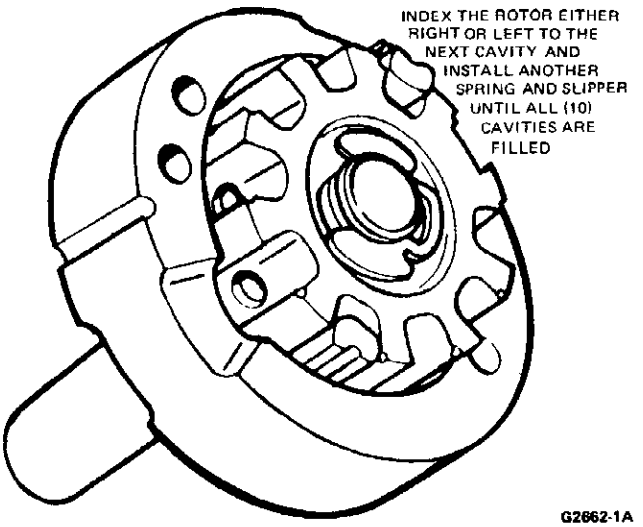


FIG. 24 Assembling Slippers and Springs

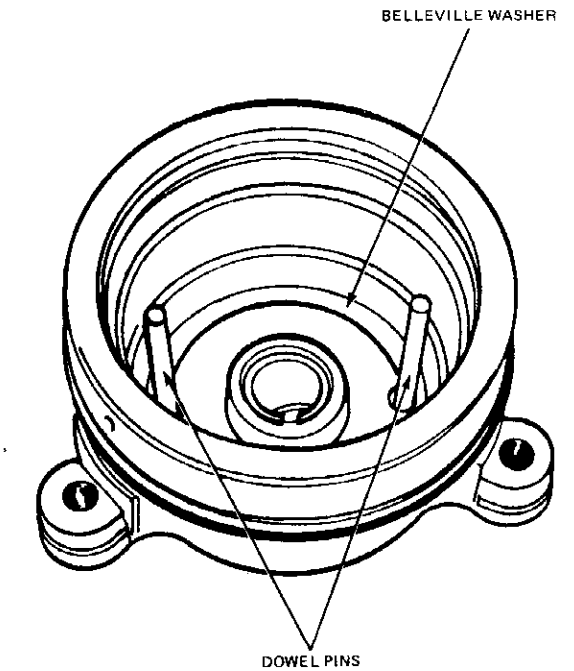


FIG. 26 Installing Spring and Dowel Pins

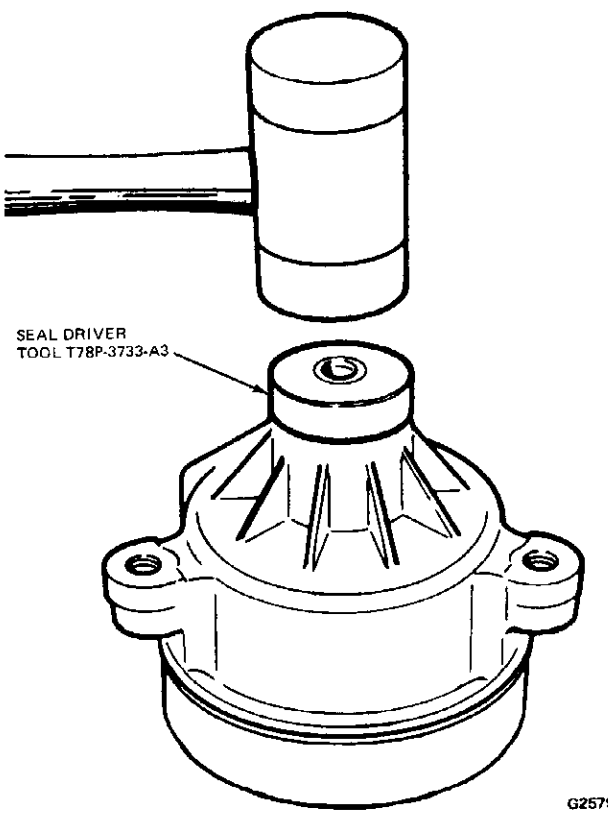


FIG. 25 Installing Rotor Shaft Seal

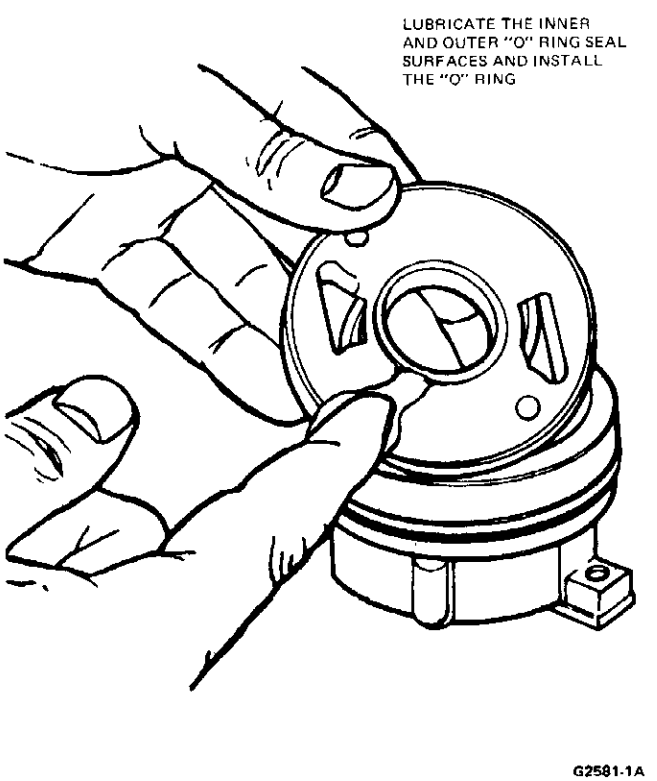


FIG. 27 Installing O-Rings

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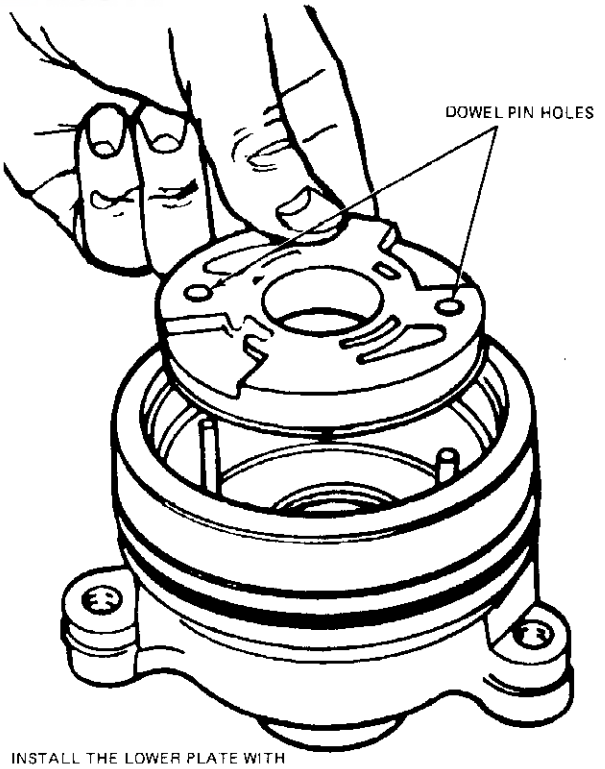


FIG. 28 Installing Lower Pressure Plate

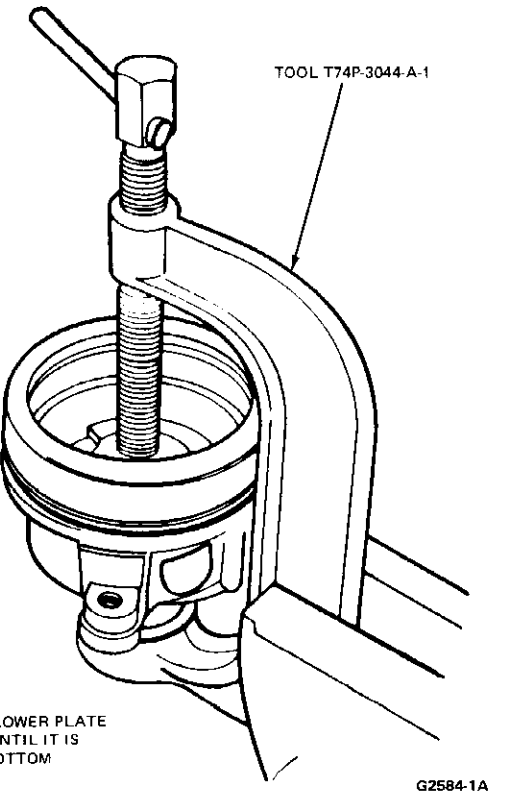


FIG. 30 Pressing Lower Plate Into Position



FIG. 29 Positioning Driver Tool

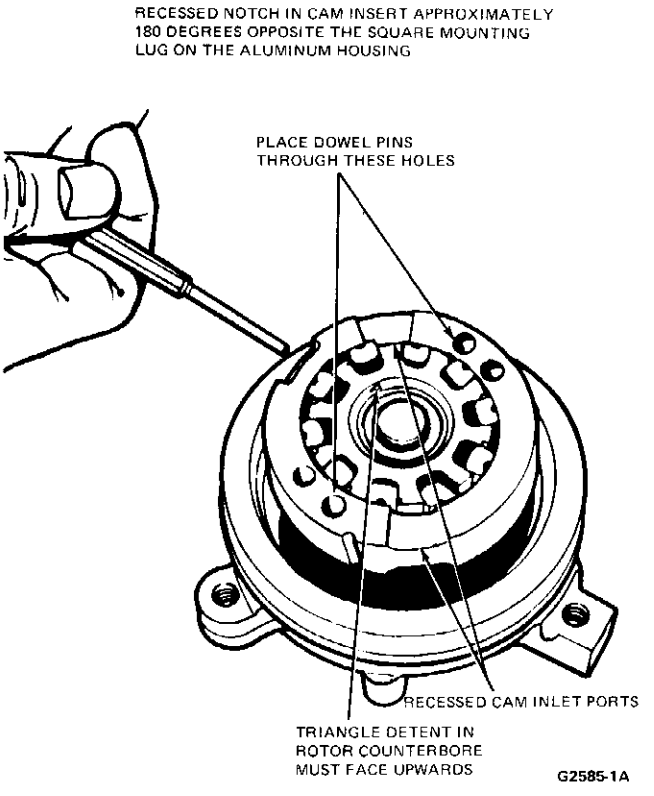


FIG. 31 Assembling Cam, Rotor and Slippers

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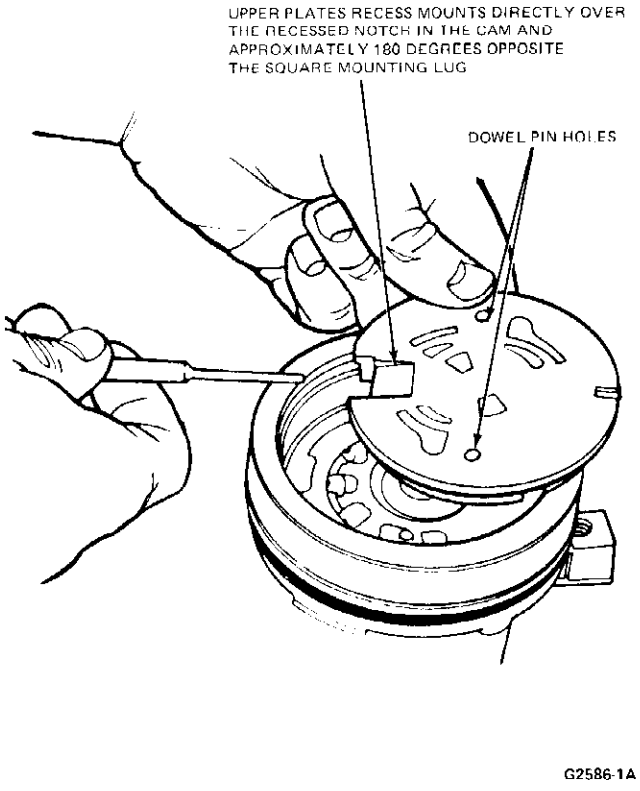


FIG. 32 Installing Upper Pressure Plate

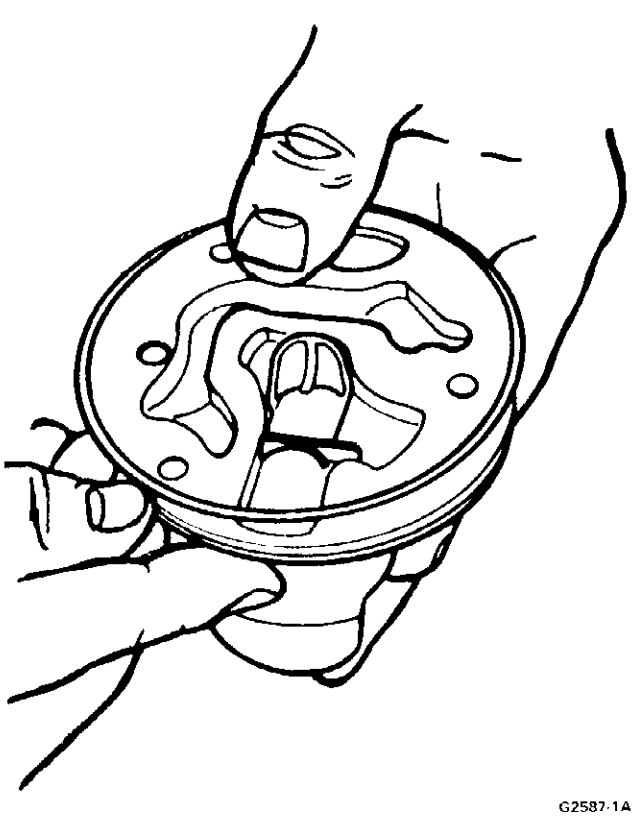


FIG. 33 Installing O-Ring

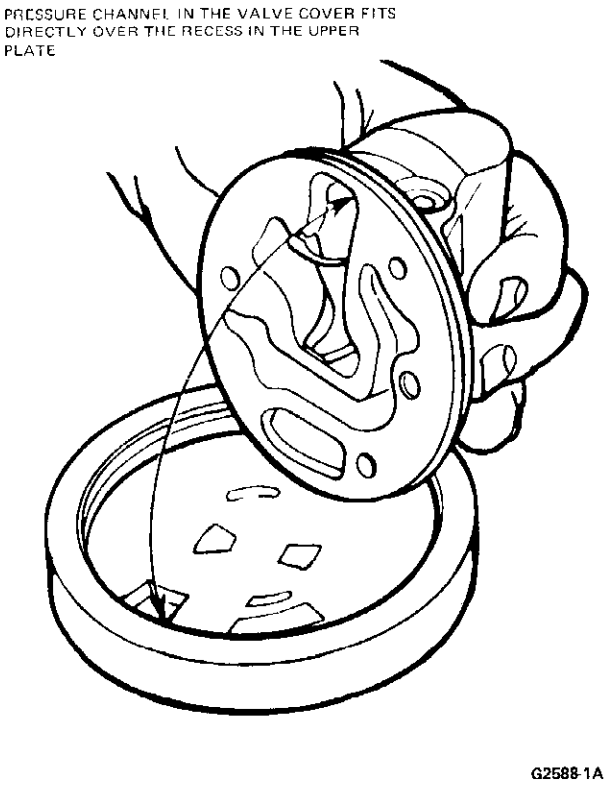


FIG. 34 Installing Valve Cover

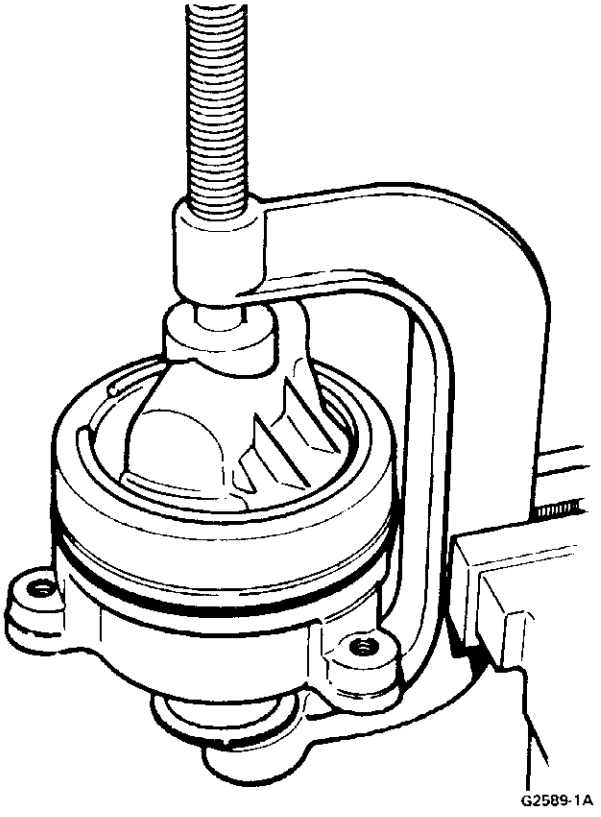


FIG. 35 Installing Valve Cover Retaining Ring

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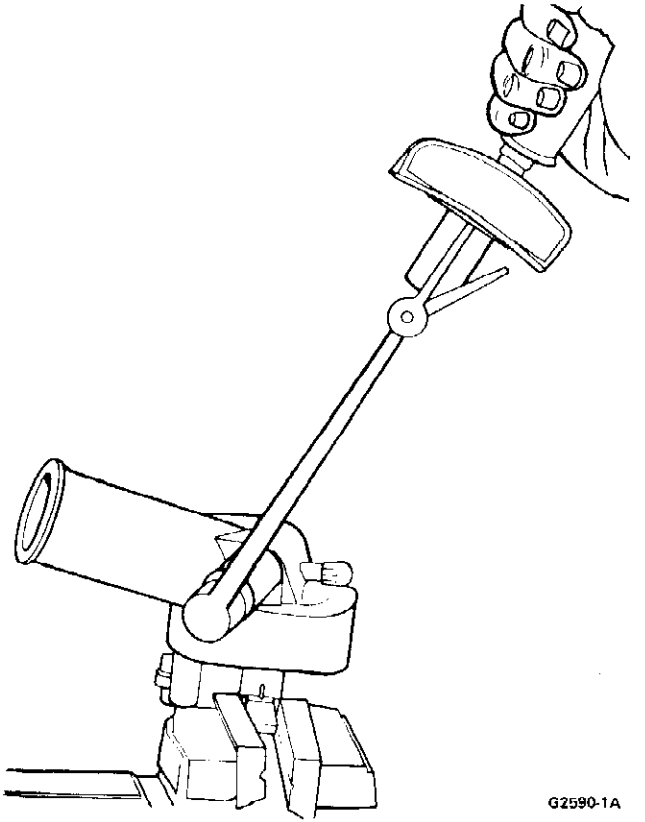


FIG. 36 Installing Outlet Fitting

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SPECIFICATIONS

MODEL C-II PUMP TORQUE SPECIFICATIONS

Engine Application	2.3L	2.8L	3.3L (200 CID)	4.1L (250 CID)	5.0L (302 CID)	5.7LW (351W CID)	5.7LM (351M CID)	6.6L (400 CID)
Pivot Bolt (Ft-Lb)	30-45	–	30-45	30-45	30-45	30-45	30-45	30-45
Front Bolts to Support Bracket (Ft-Lb)	30-45	30-45	30-45	30-45	30-45	30-45	30-45	30-45
Support Bracket to Engine (Ft-Lb)	30-45	30-45	30-45	30-45	30-45	30-45	30-45	30-45
Support Bracket to Water Pump Housing (Ft-Lb)	–	30-45	84-120 In-Lb	–	30-45	30-45	30-45	30-45
Pump to Bracket (Ft-Lb)	30-45	30-45	30-45	30-45	30-45	30-45	30-45	30-45
Belt Adjusting Nut (Slider)			Adjust to proper belt tension.					
Pressure Hose Tube Nut to Pump Pressure Fitting (Ft-Lb)	12-15	12-15	12-15	12-15	12-15	12-15	12-15	12-15
Return Hose to Pump (Hose Clamp) (In-Lb)	12-24	12-24	12-24	12-24	12-24	12-24	12-24	12-24

CG2663-2A

SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS—MODEL C II PUMP

SPECIAL SERVICE TOOLS – MODEL C II PUMP

Tool No.	Description
T74P-3044-A1	C-Frame and Clamp Assembly
T78P-3733-A1	Upper Support Plate
T78P-3733-A2	Lower Support Plate
T78P-3733-A3	Seal Driver
970-001	Rotunda Power Steering Analyzer

CG2864-1A

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DETROIT IRON

Power Steering Pump—Saginaw

PART 13-52

Applies to Ford, Mercury, Continental Mark V and Lincoln Continental

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DESCRIPTION

POWER STEERING PUMP

The power steering pump (Fig. 1) is a constant displacement vane type providing hydraulic pressure for the steering system and on some vehicles, the hydraulic brake booster and/or skid control. The housing and internal parts of the pump are inside the reservoir so the pump parts operate submerged in oil. The reservoir is sealed against the pump housing, leaving the housing face and the shaft hub exposed. The reservoir has a filler neck with a cap.

The drive shaft is fitted with a pulley and is belt driven from the crankshaft. The rotor is loosely splined to the drive shaft and secured with a retaining ring. Ten vanes are mounted in radial slots in the rotor.

An identification label showing the pump model number is located on the outboard side of the pump reservoir.

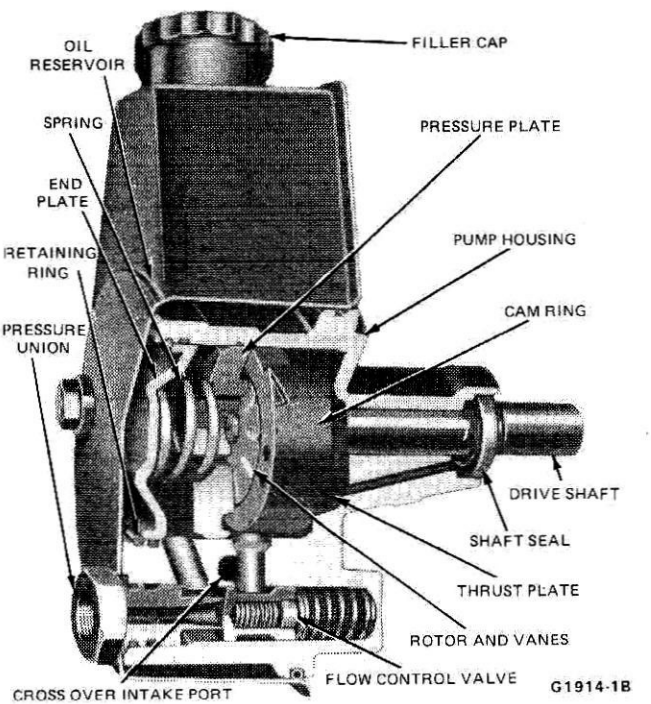


FIG. 1 Power Steering Pump—Sectional View

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ADJUSTMENTS

PUMP BELT TENSION ADJUSTMENT

Pump drive belt tension cannot be checked accurately using the thumb pressure or belt deflection methods. The adjustment must be made with a belt tension gauge.

1. Check the belt tension with belt tension gauge Tool T63L-8620-A. For a new belt, or a belt that has been run for less than 15 minutes, tension should be 120 to 150 lbs. For a belt that has been run for longer than 15 minutes, tension should be 90 to 120 lbs.
2. *Loosen the three (3) bolts covering the slotted holes* in the engine mounting bracket (Figs. 2 and 3).
3. Increase belt tension by rotating the adjusting nut (Figs. 2 and 3) in a clockwise direction.
4. Decrease belt tension by rotating the adjusting nut in a counter-clockwise direction.
5. Tighten the three mounting bolts and check the belt tension. When tension is correct, torque the mounting bolts to 30-45 ft-lb.

REMOVAL AND INSTALLATION

POWER STEERING PUMP

Removal

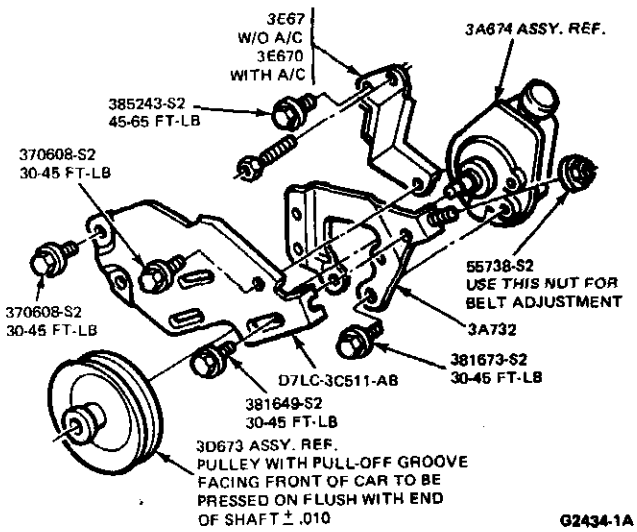


FIG. 2 Power Steering Pump Installation — Lincoln Continental, Continental Mark V, Ford and Mercury with 5.8L/6.6L (351/400 CID) V-8 Engines

1. Disconnect the pressure and return lines from the pump and plug them to prevent loss of fluid or entrance of dirt into the system (Figs. 2 and 3).
2. Loosen the belt tension *adjusting nut all the way.*
3. Remove the bolts attaching the pump mounting bracket to the air conditioning bracket (if equipped).
4. Remove the pump, mounting bracket, and pulley assembly.

Installation

1. Install the pump, bracket and pulley assembly and *loosely attach the bolts that secure the pump* mounting bracket to the air conditioning bracket (if equipped).
2. Install the drive belts on the pulley.
3. Loosely install the belt tension adjusting nut.
4. Torque the adjusting nut until the correct tension is acquired.
5. Torque all attaching bolts to specification.
6. Connect the pressure and return lines to the pump.
7. Fill the reservoir with the specified power steering fluid as described in Part 13-01. Bleed the air from the system by turning the steering wheel from left to right several times. Vehicles equipped with Hydro-Boost brake booster should be vacuum-filled as described in Part 13-01. Inspect for leaks.

POWER STEERING PUMP PULLEY

Removal

1. With the pump removed from the vehicle, drain as much fluid as possible through the filler tube.
2. *Clamp the mounting bracket in a vise with the pump* attached.
3. Install the pulley remover, Tool T75L-3733-A, on the pulley hub.

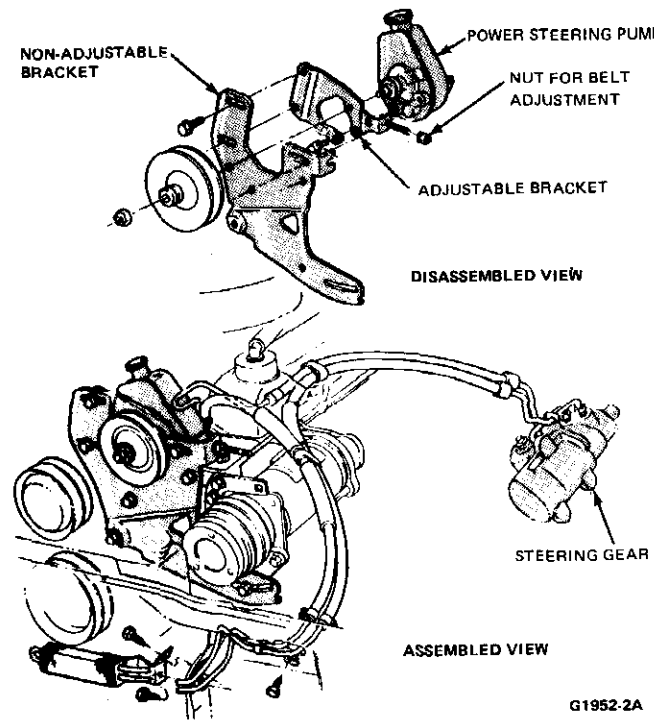


FIG. 3 Power Steering Pump Installation — Lincoln Continental, Continental Mark V, Ford, Mercury with 7.5L (460 CID) Engine and A/C

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4. Rotate the tool nut counterclockwise to remove the pulley. **Do not hammer the tool. This could damage the pulley and the snap ring at the inner end of the shaft.** If the snap ring is damaged, disassemble the pump, as outlined in this Part, and replace the ring.

Installation

1. Install the pulley on the shaft using the Pulley Installer Tool T75L-3733-A.

ROTOR SHAFT SEAL

To replace the rotor shaft seal, remove the pump as outlined in this Part.

Removal

1. Drain as much fluid as possible through the filler tube.
2. Remove the pulley from the pump following the procedures described in this Part.
3. Insert a sharp tool between the rotor shaft seal and the pump housing. Pry out the seal. **Do not pry against the shaft or housing bore.**

Installation

1. Remove the pump and bracket from the vise and lay it flat on the workbench.
2. Place a **new** rotor shaft seal on the shaft with the metal backing facing the pulley end of the shaft.
3. Install the seal (Fig. 4).
4. Install the pulley.

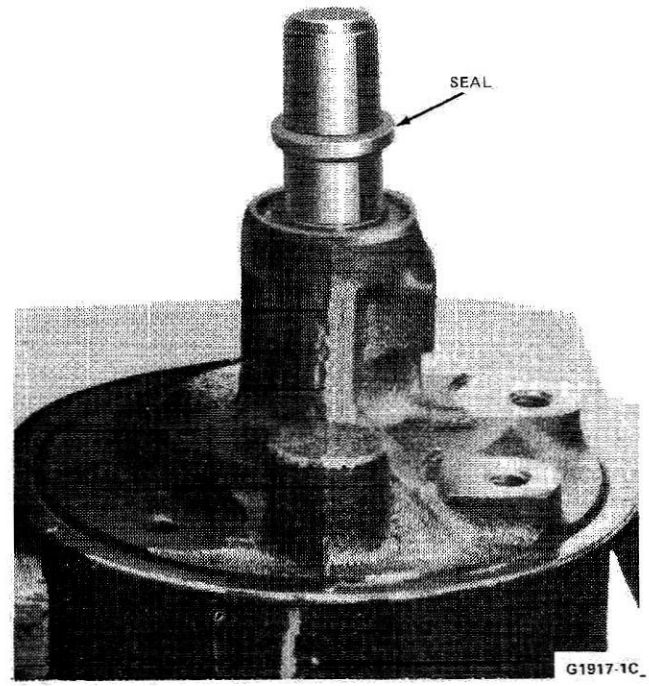


FIG. 4 Rotor Shaft Seal

DISASSEMBLY AND ASSEMBLY

POWER STEERING PUMP

Take the following precautions when servicing the power steering pump:

1. **Use a clean work bench and tools.**
2. Clean the exterior of the unit with solvent. Drain as much fluid as possible.
3. If only the rotor shaft seal is being replaced, follow the procedures under Rotor Shaft Seal Removal and Installation in this Part.

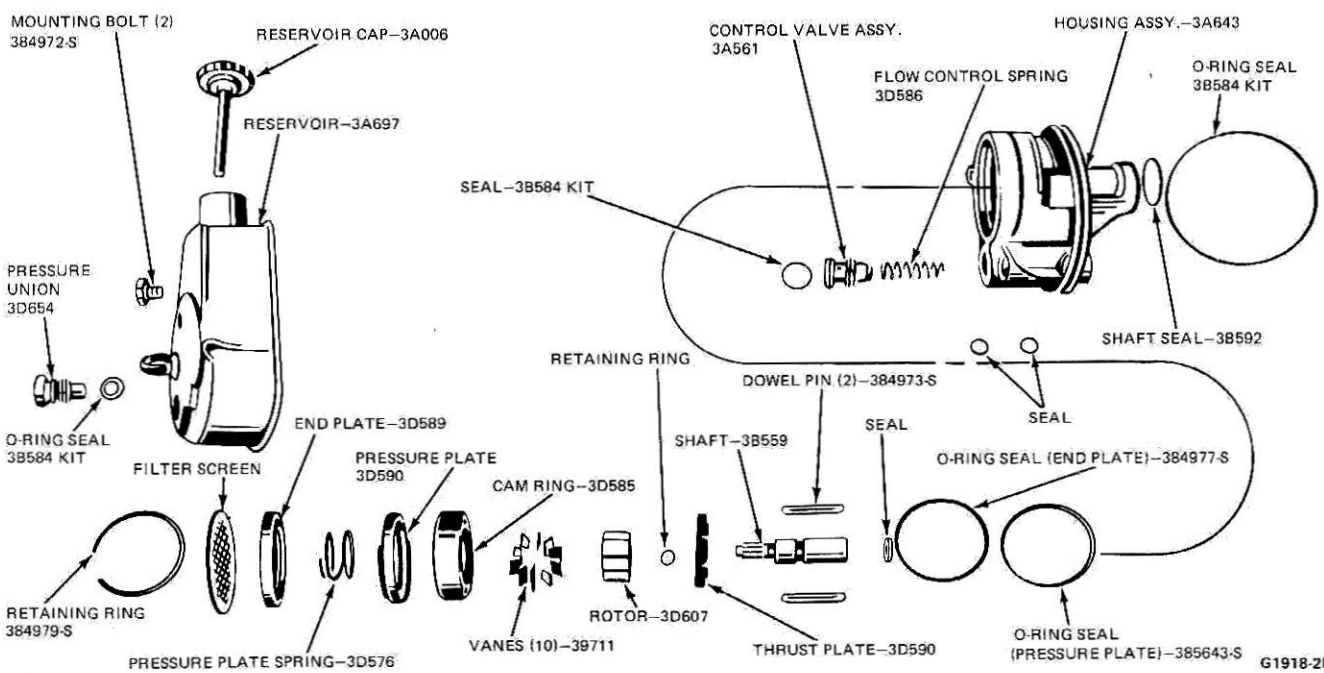


FIG. 5 Power Steering Pump Disassembled

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4. **Do not use solvent on seals.**

Disassembly

1. Remove the bracket and pulley from the pump.
2. Clamp the front hub of the pump in a vise so the extending portion of the shaft points down. **Do not clamp the pump too tightly or bearing damage may result.**
3. Remove the pressure union, O-ring assembly, and both mounting bolts from the back of the reservoir. Discard all seals and O-rings.
4. Rock the reservoir slightly back and forth to unseat the O-ring seal. Remove the O-ring and discard. Remove the reservoir.
5. Remove the mounting bolt and pressure union seals from the counterbored spaces in the pump housing. Discard the seals.
6. Rotate the end plate retaining ring so that one end of the ring is over the hole in the housing. Insert a small punch in the 1/8 inch diameter hole in the housing side opposite the flow control valve hole. Compress the retaining ring with the punch and remove the ring by twisting a screwdriver under the ring (Fig. 6).

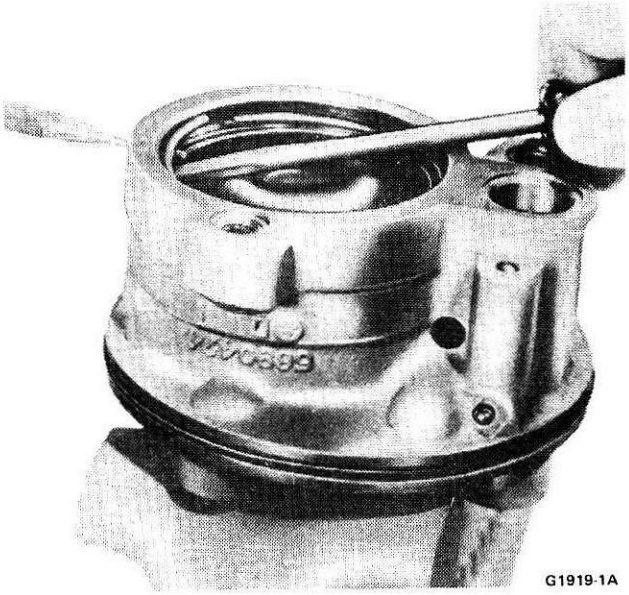


FIG. 6 Removing the End Plate Retaining Ring

7. Remove the end plate. The end plate is spring loaded and will generally sit above the housing level for easy removal. If the plate sticks, rock it back and forth lightly to free it.
8. Remove the pressure plate spring.
9. Remove the pump from the vise and turn it over allowing the flow control valve and its spring to fall out. Do not disassemble the flow control valve. Service it as a unit.
10. With the end plate O-ring removed, tap very lightly on the end of the shaft until the pressure plate falls free.
11. Remove the cam ring, vanes and rotor (Fig. 7).
12. Remove the cam ring and vanes from the rotor.
13. Remove the retaining ring by clamping the shaft in a soft-jawed vise and prying the ring off the shaft with a pair of long nose pliers or a screwdriver. Do not damage the shaft with the vise jaws. Discard the retaining ring.
14. Remove the rotor and thrust plate from the shaft.
15. Remove both dowel pins from the housing.
16. Remove the pressure plate and end plate O-ring seals from the housing bore and discard them.
17. Remove the shaft seal only if it is defective. Removal will destroy the seal.

Assembly

1. Clean all metal parts with solvent.
2. If the shaft seal was removed, install a **new** seal following the instructions under Rotor Shaft Seal Removal and Installation in this Part.
3. Lubricate a **new** pressure plate O-ring seal with power steering fluid and install it in the third groove from the rear of the housing.
4. Clamp the end hub of the housing in a vise so the extending portion of the shaft points down. Do not clamp the bearing too tightly or damage may occur.
5. Insert both dowel pins.
6. Install the thrust plate on the drive shaft with the ported face toward the splined end of the shaft.
7. Install the rotor on the shaft with the counterbored end toward the thrust plate.
8. Clamp the shaft in a soft-jawed vise. Install a new retaining ring on the splined end of the shaft by prying the ring open and sliding it down over the shaft until it seats in the ring groove. **Do not damage the shaft.**
9. Insert the shaft in the housing, making certain the thrust plate slides properly on the dowel pins.

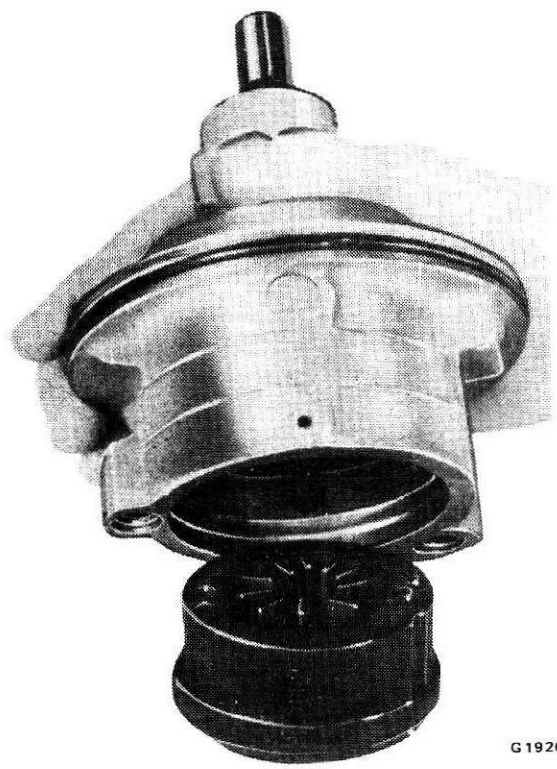


FIG. 7 Removing the Cam Ring, Vanes and Rotor

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10. Install the cam ring on the dowel pins with the rotation arrow toward the rear of the housing (Fig. 8).

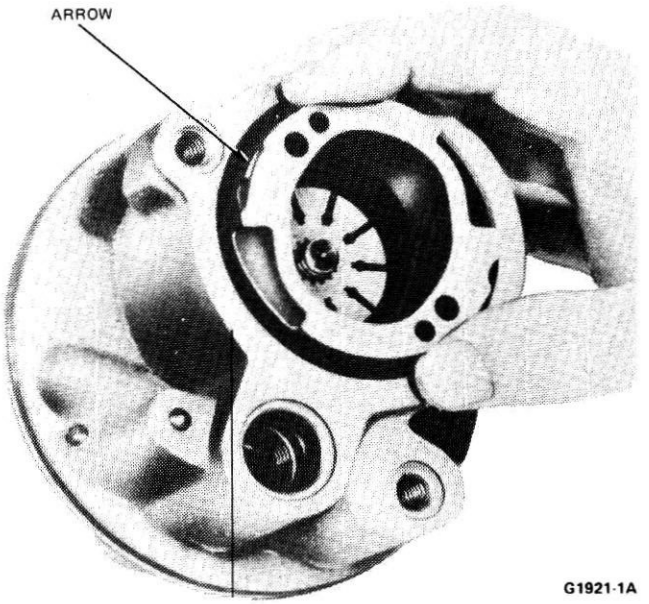


FIG. 8 Installing the Cam Ring

11. Install the vanes in the rotor slots with the rounded edge of the vanes outward. Be sure the vanes slide freely (Fig. 9).

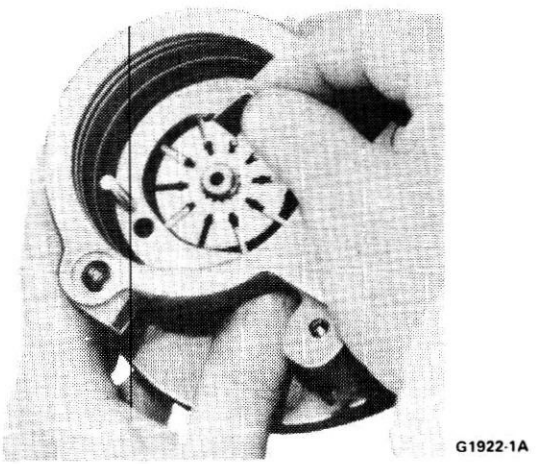


FIG. 9 Installing the Vanes in the Rotor

12. Lubricate the pressure plate with power steering fluid to prevent damage to the pressure plate O-ring seal.
13. Install the pressure plate on the dowel pins with the circular spring depression toward the rear of the housing (Fig. 10). The narrow slots in the plate should engage the dowel pins. To seat pressure plate press it about 1/16 inch over the O-ring.
14. Lubricate a new end plate O-ring with power steering fluid and install it in the second groove from the rear of the housing.
15. Install the pressure plate spring in the groove in the pressure plate.

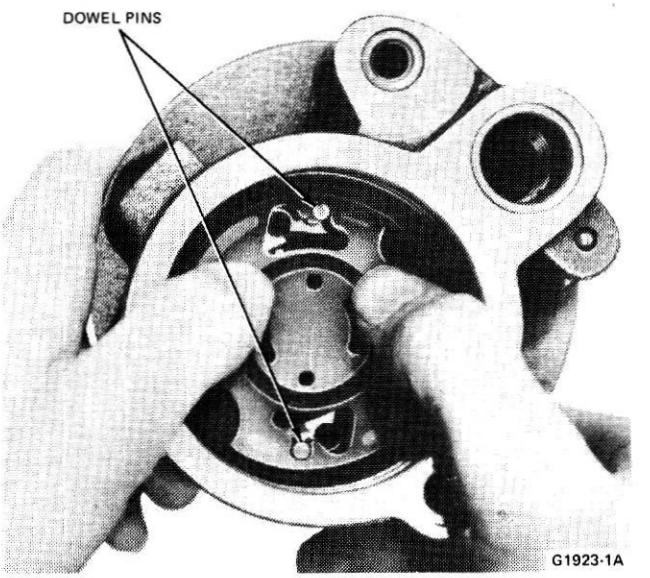


FIG. 10 Installing the Pressure Plate

16. Lubricate the end plate with power steering fluid to prevent damage to the O-ring, and press it into the housing with an arbor press (Fig. 11). Depress the end plate only far enough to allow installation of the retaining ring in its groove.

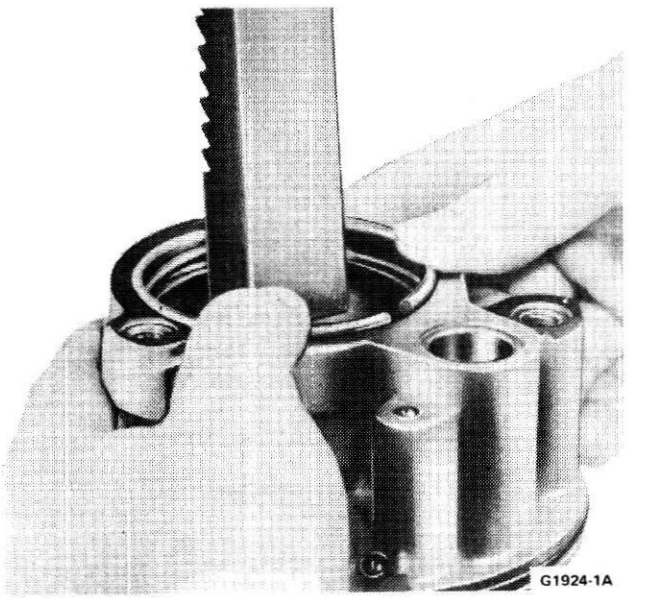


FIG. 11 Installing the End Plate Retaining Ring

17. Install the end plate retaining ring. Release the arbor press.
18. Place the control valve spring in its hole and insert the control valve with the screened end towards the front of the housing.
19. Install new mounting bolt and pressure union seals in the countersunk holes. Lubricate a new reservoir O-ring seal with power steering fluid and install it on the housing.
20. Lubricate the inside edge of the reservoir with power steering fluid and install it on the housing. Align the holes in the reservoir and housing.

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Replacement reservoirs do not have an identification number. If a new reservoir is installed, imprint the model number of the defective reservoir on the new part for future identification.

21. Insert the mounting bolts and torque to specification.
22. Lubricate a new O-ring with power steering fluid, *and install it on the pressure union in the groove* next to the head hex. Insert the pressure union in the flow control valve hole in the back of the reservoir and torque to specification.
23. Attach the mounting bracket and pulley to the pump.

SPECIFICATIONS

SAGINAW POWER STEERING PUMP TORQUE LIMITS (FT-LB)

Description	Torque
Reservoir Mounting Bolt	25-50
Pressure Union	35
Bracket Nuts	30-45
Pressure Line to Pump Nut	25-34

SPECIAL SERVICE TOOLS

Tool No.	Description
T69L-10300-A	Pulley Remover
T68P-3B592-B	Seal Protector
T72P-3B592-A	Seal Installer
T65P-3A733-C	Pulley Installer

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SUSPENSION

GROUP 14 (3000 & 5000)

PART TITLE	PART NO.
Front Suspension – Single Lower Arm	14-05
Front Suspension – Spring on Upper Arm	14-04
Front Suspension – Spring on Lower Arm	14-03
General Suspension Service	14-01
Manual Fill Load Leveler System – Air Sleeve Rear Shock Absorbers	14-45
Rear Suspension – Coil Springs	14-32
Rear Suspension – Leaf Springs	14-30

General Suspension Service

PART 14-01

Applies To All Models

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Shock Absorber Checks	01-11
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Caster	01-2
Equipment Installation	01-1
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Front Wheel Turning Angle	01-3
Toe	01-3

TESTING

FRONT WHEEL ALIGNMENT CHECKS

Do not attempt to check and adjust front wheel alignment without first making a preliminary inspection of the front-end parts

Check all the factors of front wheel alignment except the turning angle before making any adjustments. Check the turning angle only after caster, camber, and toe have been adjusted to specifications. Check the front wheel alignment under the following curb load conditions:

1. Gasoline tank and radiator filled and oil level to specification.
2. Spare tire, wheel, jack and jack handle in design position.
3. Front seats in rearmost position.
4. All other loading removed.
5. All tires inflated to specified pressure (cold).
6. All excessive mud, dirt and road deposit accumulation removed from chassis and underbody.

The front wheel alignment specifications are given in the Specifications Section of this Part.

EQUIPMENT INSTALLATION

Equipment used for front wheel alignment inspection must be accurate. Whenever possible, front wheel alignment checks should be performed on stationary wheel aligning equipment. In the absence of such equipment, portable equipment may be used and the

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work performed on a level floor. The floor area should be level within 1/4 inch from front to rear of the vehicle and within 1/8 inch from side to side.

1. Check the runout of each front wheel and tire using a dial indicator against the rim outer band. If the runout exceeds 1/8 inch, correction may be made by rotating the wheel on the drum. When the minimum runout has been obtained, mark the point of greatest runout so the wheels can be positioned as shown in Fig. 1 when checking the front end alignment. Hold a piece of chalk against the wheel rim or the tire sidewall while spinning the wheels. The chalk will mark the rim or tire at the point of greatest runout.

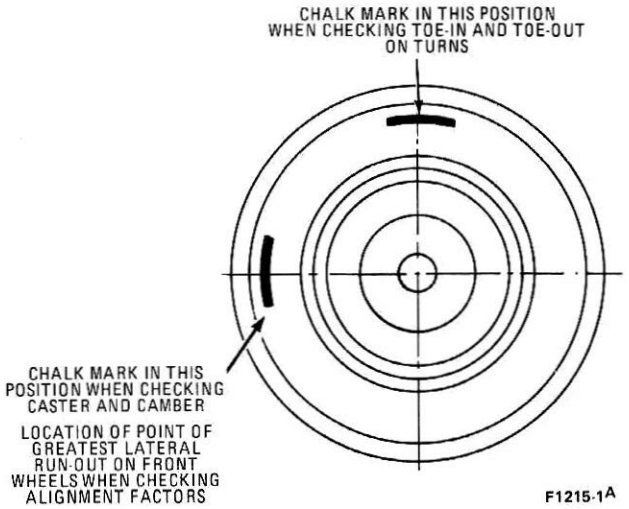


FIG. 1 Front Wheel Position for Checking Alignment

2. Drive the vehicle in a straight line far enough to establish the straight-ahead position of the front wheels, and then mark the steering wheel hub and the steering column collar (Fig. 2). **Do not adjust the steering wheel spoke position at this time.** If the front wheels are turned at any time during the inspection, align the marks to bring the wheels back to the straight-ahead position.

The maximum caster difference (side-to-side) is specified at the end of this Part.

CAMBER

Camber is the amount the front wheels are tilted at the top (Fig. 3). If a wheel tilts outward, camber is positive. If the top of a wheel tilts inward, camber is negative. For correct camber angle, see Specifications at end of this Part.

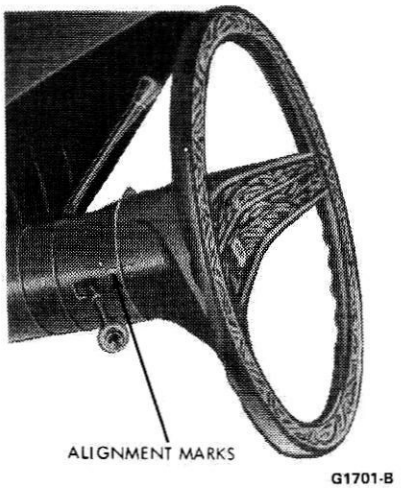


FIG. 2 Straight-Ahead Position Marks—Typical

3. Install the wheel alignment equipment on the vehicle, and follow the installation and inspection instructions provided by the equipment manufacturer.

CASTER

The caster is the forward or rearward tilt of the top of the front wheel spindle (Fig. 3). If the top of the spindle tilts to the rear, caster is positive. If the top of the spindle tilts to the front, caster is negative. For correct caster angle, or tilt, see Specifications at end of this Part.

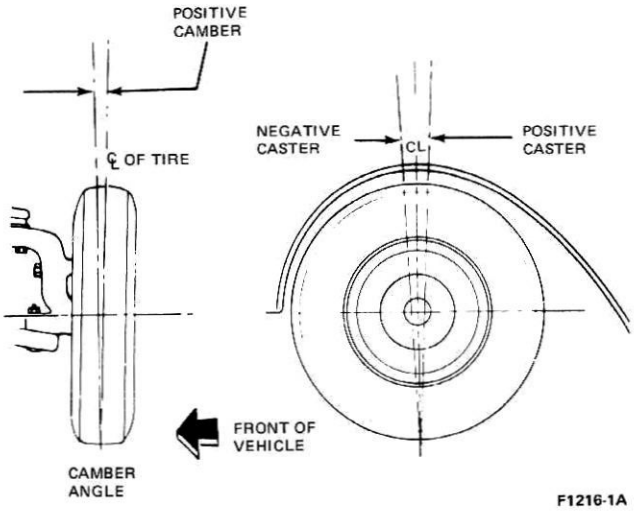


FIG. 3 Caster and Camber Angles

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The maximum camber difference (side-to-side) is specified at the end of this Part.

TOE

Toe should only be checked and adjusted after the caster and camber have been adjusted to specifications.

Check the toe with the front wheels in the straight-ahead position. *Run the engine so that the power* steering control valve will be in the center (neutral) position (if equipped). Measure the distance between the extreme front and also between the extreme rear of both front wheels. The difference between these two distances is the toe-in or toe-out.

Correct toe-in setting, or inward pointing of both front wheels, is given in the Specifications at the end of this Part.

FRONT WHEEL TURNING ANGLE

When the inside wheel is turned 20 degrees, the turning angle of the outside wheel should be as specified in the Specifications at end of this Part. The turning angle cannot be adjusted directly, because it is *a result of the combination of caster, camber, and toe* adjustments and should, therefore, be measured only after these adjustments have been made. If the turning angle does not measure to specifications, check the spindle or other suspension or steering parts for a bent condition.

ADJUSTMENTS

NOTE: On Fairmont/Zephyr vehicles, the caster and camber are set at the factory and cannot be changed only the toe is adjustable.

After front wheel alignment factors have been checked, make the necessary adjustments. **Do not attempt to adjust front wheel alignment by bending the suspension or steering parts.**

CASTER AND CAMBER ADJUSTMENTS

All Except Versailles, Fairmont, Zephyr, Granada, Monarch, Mustang II, Pinto, and Bobcat

See Fig. 5.

Special tools (T69P-3000-A) are used in order to accurately adjust caster and camber.

Using these special tools and three Alignment Charts allow the inter-related caster/camber adjustments to be made as a single operation. Both angles are set at one time.

The Alignment Charts indicate the "hex flats" to be counted while rotating the hex nuts (on the alignment tools) to adjust caster and camber within specifications.

A "hex flat" is 1/6 of a full turn. Do not interpret it as a full turn.

A portion of the Front Wheel Alignment Chart used *in adjusting the camber and caster on frame-body units* is shown in Fig. 5. This chart does not apply to unit-body vehicles. In the following explanation, the paragraph numbers refer to the circled numbers on the chart in Fig. 5.

1. Caster readings . . . shown top of Chart.
2. Camber readings . . . for left and right wheels shown on left side of Chart.
3. Front . . . indicates "front" alignment tool (T69P-3000-A) and the numbers across are "hex flats" to be counted while rotating the hex nuts (on alignment tools) to adjust caster and camber within specifications.
4. Rear . . . indicated "rear" alignment tool and the number of "hex flats" to be rotated.
5. Plus sign (+) . . . in front means number of "hex flats" to be rotated to tighten the alignment tool.
6. Minus sign (—) . . . indicates tool must be loosened that number of "hex flats."

See Fig. 6.

In Fig. 6 parallel lines have been drawn on the Chart to represent two theoretical alignment readings. The point of intersection of the parallel horizontal lines and the parallel vertical lines indicates whether or not adjustment is required. In this case, Example No. 2 is *out of tolerance, while Example No. 3 is within* tolerance because the lines intersect inside the colored block on the Chart. The paragraphs in the explanation below are number-keyed to the Chart shown in Fig. 6.

1. Minimum to maximum tolerances . . . of caster and camber alignment are represented by colored block within body of each Chart.
2. Out-of-specification . . . if caster and camber readings intersect outside the colored block (tolerance range), caster and camber adjustment is required.
3. Within specification . . . if caster and camber readings intersect within the colored block on tolerance range, caster and camber adjustment is not usually required.
4. Nominal setting . . . occasionally, a vehicle within specifications may require alignment adjustment to the nominal setting (zero degrees) because side-to-side setting is out-of-specification and must be corrected.

   NOTE: Maximum caster difference between wheels (left minus right) to be within 3/4° to +3/4° with caster set to specification.

   Maximum camber difference between wheels (left minus right) to be within 1/2° to -1° with camber set to specification.

The Front Wheel Alignment Charts should be used whenever current model frame-body units are brought in for front-end alignment. Use the following general procedure.

Be sure alignment equipment is calibrated and in good working condition in order to obtain accurate and acceptable results.

Check caster and camber as outlined in the Shop Manual.

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Record and compare these caster/camber readings with the nominal specifications on the chart to determine if adjustment is required.

See Fig. 7.

Fig. 7 shows the recorded readings and adjustment required in a theoretical case that will be used as an example in the following instruction. Using the example shown in Fig. 7, note the nominal specification listed.

Using the chart in Fig. 8:

Locate the specification for both LEFT and RIGHT CASTER (+2°) at the top of the chart.

Locate the specification for both LEFT CAMBER (+1/2°) and RIGHT CAMBER (+1/4°) at the left side of the chart.

Where these lines intersect in the chart (zero degrees) indicates that these alignment readings are the NOMINAL SETTING for this vehicle.

Next . . . note how caster and camber adjustments for the RIGHT WHEEL are determined to bring the vehicle to the nominal setting, using the example readings:

Locate the specification recorded for RIGHT CASTER (+1/4°) at the top of the chart.

Locate the specification recorded for RIGHT CAMBER (+1 1/4°) at the left side of the chart.

Where these lines intersect in the chart indicates adjustments (FRONT—11 and REAR—26) required on the right wheel.

FRONT—11 means that front alignment tool must be loosened 11 "hex flats" or 1-5/6 full turns to adjust RIGHT CASTER to nominal specification.

REAR—26 means that rear alignment tool must be loosened 26 "hex flats" or 4-2/6 full turns to adjust RIGHT CAMBER to nominal specification.

NOTE: When chart indicates loosening the alignment tools, back-off the hex nuts 3 additional "hex flats" more than shown on the chart. Then retighten the hex nuts (3), "hex flats" so that tools remain in tension at end of adjustment operation.

Finally . . . note how caster and camber adjustments for the LEFT WHEEL are determined to bring the vehicle to the setting, using the example readings:

Locate the specification for LEFT CASTER (+3/4°) at the top of the chart.

Locate the specification for LEFT CAMBER (– 1/2°) at the left side of the chart.

Where these lines intersect in the chart indicates adjustments (FRONT+24 and REAR+13) required on left wheel.

FRONT +24 means that front alignment tool must be tightened 24 "hex flats" or 4 full turns to adjust LEFT CASTER to nominal specification.

REAR +13 means that rear alignment tool must be tightened 13 "hex flats" or 2-1/6 full turns to adjust LEFT CAMBER to nominal specification.

See Fig. 9

Remembering the previous instructions on use of the special Tool T69P-3000-A (Fig. 9) and the Front Wheel Alignment Charts, use the following procedure in correcting alignment on current frame-body units. **The alignment equipment must be calibrated and in good working condition for accurate and acceptable results.**

1. Check caster and camber and record the readings.
2. Compare camber and caster readings with nominal specifications on appropriate chart (depending on car line) to determine if adjustment is required to bring vehicle to nominal setting.

   NOTE: As mentioned earlier, a vehicle within the minimum to maximum tolerances may require alignment adjustment to the nominal setting (zero degrees) because side-to-side setting is out-of-specification and must be corrected.

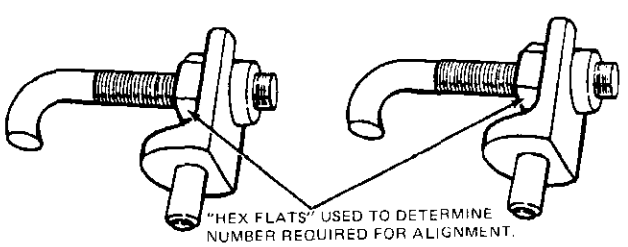
   Maximum caster difference between wheels (left minus right) to be within –3/4° to+3/4° with caster set to sepcification.

   Maximum camber difference between wheels (left minus right) to be within –1/2° to+1° with camber set to specification.
3. If adjustment is required, insert alignment tools into frame holes and "snug" the tool hooks fingertight against the upper arm inner shaft. Then tighten hex nut of each alignment tool 4 additional "hex flats."
4. Loosen upper arm inner shaft-to-frame attaching bolts so that lockwashers on bolts are unloaded. Then firmly tap bolt heads to assure loosening of the lower assemblies.
5. Adjust camber and caster on each wheel as determined by the alignment chart.
6. Torque upper arm inner shaft-to-frame attaching bolts to 120-140 ft-lbs. It is not necessary to recheck caster and camber after this adjustment procedure is performed.
7. Check toe-in and steering wheel spoke position and adjust both (as required) at the same time.

GRANADA, MONARCH AND VERSAILLES

Caster

Caster is controlled by the front suspension strut (Fig. 10). To obtain positive caster, loosen the strut rear nut and tighten the strut front nut against the bushing. To obtain negative caster, loosen the strut front nut and tighten the strut rear nut against the bushing.



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FIG. 4 Camber and Caster Adjusting Tools

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DETROIT IRON

FRONT WHEEL ALIGNMENT CHART

CASTER READING IN DEGREES

CAMBER READING IN DEGREES	LEFT CAMBER	RIGHT CAMBER		-½°	-¼°	0°	+¼°	+½°	+¾°	+1°	+1¼°	+1½°	+1¾°	+2°	+2¼°	+2½°	+2¾°	+3°	+3¼°	+3½°	+3¾°
	+2¾°	+2½°	Front	-33	-34	-34	-35	-36	-37	-38	-39	-40	-42	-43	-44	-45	-46	-48	-49	-50	-51
			Rear	-54	-53	-52	-51	-49	-48	-47	-46	-45	-44	-43	-42	-41	-40	-39	-38	-37	-36
	+2½°	+2¼°	Front	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40	-42	-43	-44	-45	-47
			Rear	-50	-48	-47	-46	-45	-43	-42	-41	-40	-39	-38	-37	-36	-35	-34	-33	-32	-32
	+2¼°	+2°	Front	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-36	-37	-38	-39	-41	-42
			Rear	-45	-43	-42	-41	-40	-39	-37	-36	-35	-34	-33	-32	-31	-30	-29	-28	-28	-27
	+2°	+1¾°	Front	-18	-19	-20	-21	-22	-23	-24	-25	-26	-27	-28	-30	-31	-32	-33	-35	-36	-3
			Rear	-40	-39	-37	-36	-35	-34	-33	-32	-31	-29	-28	-27	-26	-26	-25	-24	-23	-2
	+1¾°	+1½°	Front	-14	-15	-15	-16	-17	-18	-19	-20	-21	-23	-24	-25	-26	-27	-28	-30	-31	-3
			Rear	-35	-34	-33	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	-1
	+1½°	+1¼°	Front	- 9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-25	-26	
			Rear	-31	-29	-28	-27	-26	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	
	+1¼°	+1°	Front	- 4	- 5	- 6	- 7	- 8	- 9	-10	-11	-12	-13	-14	-15	-17	-18	-19	-20	-22	
			Rear	-26	-24	-23	-22	-21	-20	-18	-17	-16	-15	-14	-13	-12	-11	-10	-10	- 9	
	+1°	+¾°	Front	0	0	- 1	- 2	- 3	- 4	- 5	- 6	- 7	- 8	- 9	-11	-12	-13	-14	-16	-17	
			Rear	-21	-20	-18	-17	-16	-15	-14	-13	-12	-10	- 9	- 8	- 8	- 7	- 6	- 5	- 4	
	+¾°	+½°	Front	- 5	- 4	- 3	- 3	- 2	- 1	0	- 1	- 3	- 4	- 5	- 6	- 7	- 8	-10	-11	-12	
			Rear	-17	-15	-14	-13	-11	-10	- 9	- 8	- 7	- 6	- 5	- 4	- 3	- 2	- 1	0	+ 1	
	+½°	+¼°	Front	+10	+ 9	+ 8	+ 7	+ 6	+ 5	+ 4	+ 3	+ 2	+ 1	0	- 1	- 2	- 4	- 5	- 6	- 7	
			Rear	-12	-10	- 9	- 8	- 7	- 5	- 4	- 3	- 2	- 1	0	- 1	- 2	- 3	- 4	- 5	+ 6	
	+¼°	0°	Front	+15	+14	+13	+12	+11	+10	+ 9	+ 8	+ 7	+ 6	+ 5	+ 4	+ 2	+ 1	0	- 1	- 3	
			Rear	- 7	- 6	- 4	- 3	- 2	- 1	0	+ 2	+ 3	+ 4	+ 5	+ 6	+ 7	+ 8	+ 9	+ 9	+10	
	0°	-¼°	Front	+19	+19	+18	+17	+16	+15	+14	+13	+12	+11	+ 9	+ 8	+ 7	+ 6	+ 5	+ 3	+ 2	
			Rear	- 2	- 1	0	+ 2	+ 3	+ 4	+ 5	6	+ 7	+ 8	+ 9	+10	+11	+12	+13	+14	+15	
	-¼°	-½°	Front	+24	+23	+22	+21	+20	+19	+18	+17	+16	+15	+14	+13	+12	+11	+ 9	+ 8	+ 7	
			Rear	- 3	- 4	+ 5	+ 6	+ 8	+ 9	+10	+11	+12	+13	+14	+15	+16	+17	+18	+19	+20	
	-½°	-¾°	Front	+29	+28	+27	+26	+25	+24	+23	+22	+21	+20	+19	+18	+17	+15	+14	+13	+12	
			Rear	- 7	- 9	+10	+11	+12	+14	+15	+16	+17	+18	+19	+20	+21	+22	+23	+24	+24	
	-¾°	-1°	Front	+34	+33	+32	+31	+30	+29	+28	+27	+26	+25	+24	+22	+21	+20	+19	+18		
			Rear	-12	+13	+15	+16	+17	+18	+19	+20	+22	+23	+24	+25	+26	+26	+27	+28		
	-1°	-1¼°	Front	+38	+37	+36	+36	+35	+34	+33	+32	+31	+29	+28	+27	+26	+25	+24	+22		
			Rear	+17	+18	+19	+21	+22	+23	+24	+25	+26	+27	+28	+29	+30	+31	+32	+33		
	-1¼°	-1½°	Front	+43	+42	+41	+40	+39	+38	+37	+36	+35	+34	+33	+32	+31	+30	+28	+27		
			Rear	+22	+23	+24	+25	+26	+28	+29	+30	+31	+32	+33	+34	+35	+36	+37	+38		
	-1½°	-1¾°	Front	+48	+47	+46	+45	+44			+41	+40	+39	+38	+37	+35					
			Rear									+36			+39	+40					

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FIG. 5 Front Wheel Alignment Chart—Sample No. 1

Camber

Camber is controlled by the eccentric cam located at the lower arm attachment to the side rail (Fig. 10).

To adjust the camber, loosen the camber adjustment bolt nut at the rear of the body bracket. **Spread the body bracket at the camber adjustment bolt area just enough to permit lateral travel of the arm when the adjustment bolt is turned.** Rotate the bolt and eccentric as required to increase or decrease camber.

After the caster and camber have been adjusted to specification, torque the lower arm eccentric bolt nut and the strut front nut to specification.

PINTO, BOBCAT AND MUSTANG II

1. Working from inside the front wheel housing, install the special service Tool T74P-3000, one at each end of the upper arm inner shaft (Fig. 11). Turn special tool bolts inward until the bolt ends contact the body metal.
2. Loosen the two upper arm inner shaft-to-body attaching nuts. The upper arm inner shaft will then move inboard until stopped by the special tool bolt ends.
3. Turn the special tool bolt(s) inward or outward until caster and camber are within specifications. Tightening the special tool bolts forces the arm outward; while loosening the adjustment bolts on the special tool permits the arm and inner shaft to move inboard due to weight force.
4. When caster and camber specifications are attained, torque the upper arm inner shaft-to-body attaching nuts to 95 to 120 ft-lb.
5. Loosen the special tool bolts and remove tools.

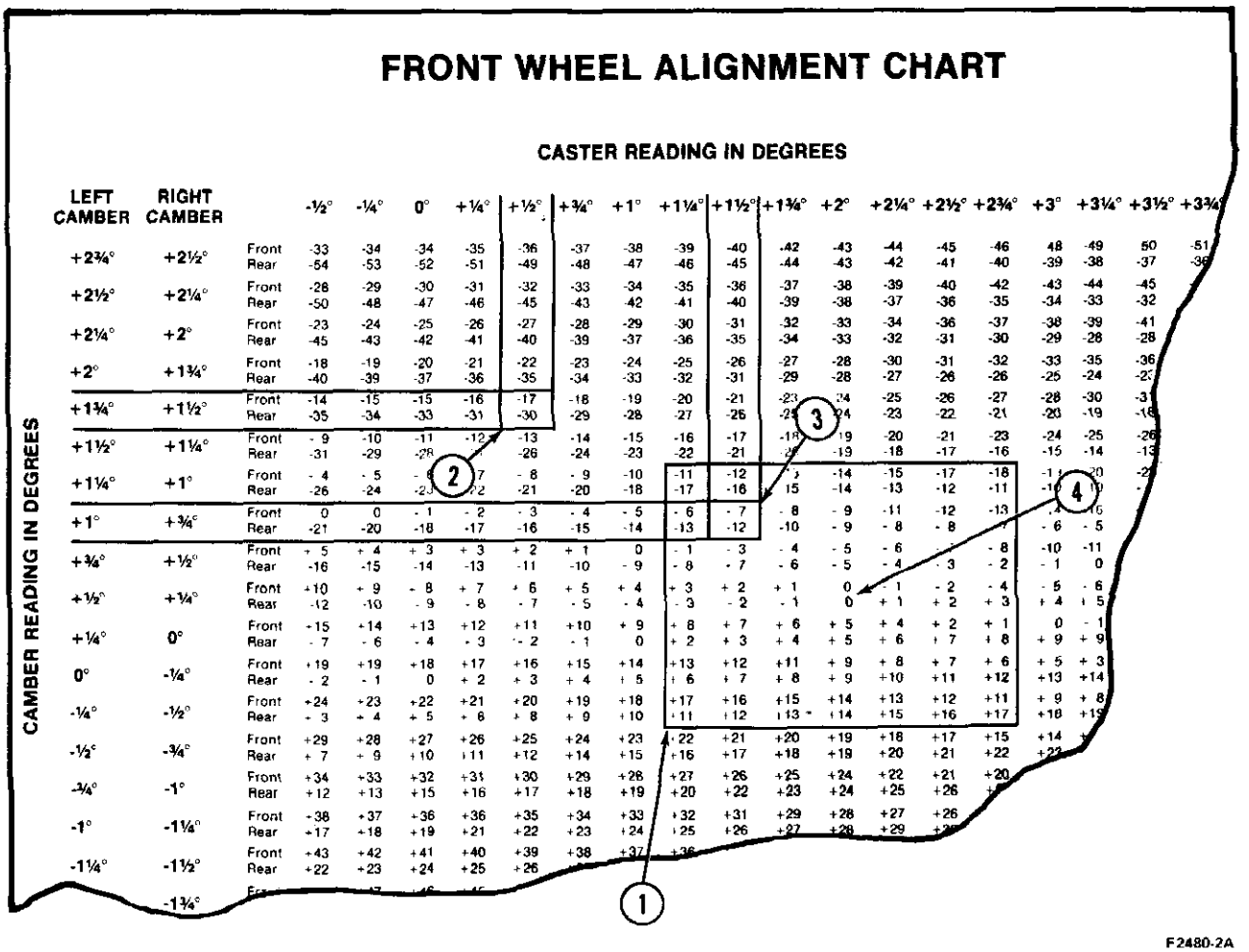
TOE AND STEERING WHEEL SPOKE POSITION ADJUSTMENTS

All Car Lines Except Pinto, Bobcat and Mustang II

After adjusting caster and camber, check the steering wheel spoke position with the front wheels in straight-ahead position. If the spokes are not in their normal position, they can be properly adjusted while toe is being adjusted.

1. Loosen the two clamp bolts on each spindle connecting rod sleeve (Fig. 12).
2. Adjust toe. If the steering wheel spokes are in their normal position, lengthen or shorten both rods

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FRONT WHEEL ALIGNMENT CHART

CASTER READING IN DEGREES

CAMBER READING IN DEGREES

LEFT CAMBER	RIGHT CAMBER		-½°	-¼°	0°	+¼°	+½°	+¾°	+1°	+1¼°	+1½°	+1¾°	+2°	+2¼°	+2½°	+2¾°	+3°	+3¼°	+3½°	+3¾°
+2¾°	+2½°	Front	-33	-34	-34	-35	-36	-37	-38	-39	-40	-42	-43	-44	-45	-46	-48	-49	-50	-51
		Rear	-54	-53	-52	-51	-49	-48	-47	-46	-45	-44	-43	-42	-41	-40	-39	-38	-37	-36
+2½°	+2¼°	Front	-28	-29	-30	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40	-42	-43	-44	-45	
		Rear	-50	-48	-47	-46	-45	-43	-42	-41	-40	-39	-38	-37	-36	-35	-34	-33	-32	
+2¼°	+2°	Front	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-33	-34	-36	-37	-38	-39	-41	
		Rear	-45	-43	-42	-41	-40	-39	-37	-36	-35	-34	-33	-32	-31	-30	-29	-28	-28	
+2°	+1¾°	Front	-18	-19	-20	-21	-22	-23	-24	-25	-26	-27	-28	-30	-31	-32	-33	-35	-36	
		Rear	-40	-39	-37	-36	-35	-34	-33	-32	-31	-29	-28	-27	-26	-26	-25	-24	-23	
+1¾°	+1½°	Front	-14	-15	-15	-16	-17	-18	-19	-20	-21	-23	-24	-25	-26	-27	-28	-30	-31	
		Rear	-35	-34	-33	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-19	-18	
+1½°	+1¼°	Front	- 9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-25	-26	
		Rear	-31	-29	-28	-27	-26	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	
+1¼°	+1°	Front	- 4	- 5	- 6	- 7	- 8	- 9	-10	-11	-12	-13	-14	-15	-17	-18	-19	-20	-22	
		Rear	-26	-24	-23	-22	-21	-20	-18	-17	-16	-15	-14	-13	-12	-11	-10	- 9	- 8	
+1°	+¾°	Front	0	0	- 1	- 2	- 3	- 4	- 5	- 6	- 7	- 8	- 9	-11	-12	-13	-14	-16		
		Rear	-21	-20	-18	-17	-16	-15	-14	-13	-12	-10	- 9	- 8	- 8		- 6	- 5		
+¾°	+½°	Front	+ 5	+ 4	+ 3	+ 3	+ 2	+ 1	0	- 1	- 3	- 4	- 5	- 6		- 8	-10	-11		
		Rear	-16	-15	-14	-13	-11	-10	- 9	- 8	- 7	- 6	- 5	- 4	- 3	- 2	- 1	0		
+½°	+¼°	Front	+10	+ 9	+ 8	+ 7	+ 6	+ 5	+ 4	+ 3	+ 2	+ 1	0	- 1	- 2	- 4	- 5	- 6		
		Rear	-12	-10	- 9	- 8	- 7	- 5	- 4	- 3	- 2	- 1	0	+ 1	+ 2	+ 3	+ 4	+ 5		
+¼°	0°	Front	+15	+14	+13	+12	+11	+10	+ 9	+ 8	+ 7	+ 6	+ 5	+ 4	+ 2	+ 1	0	- 1		
		Rear	- 7	- 6	- 4	- 3	- 2	- 1	0	+ 2	+ 3	+ 4	+ 5	+ 6	+ 7	+ 8	+ 9	+ 9		
0°	-¼°	Front	+19	+19	+18	+17	+16	+15	+14	+13	+12	+11	+ 9	+ 8	+ 7	+ 6	+ 5	+ 3		
		Rear	- 2	- 1	0	+ 2	+ 3	+ 4	+ 5	+ 6	+ 7	+ 8	+ 9	+10	+11	+12	+13	+14		
-¼°	-½°	Front	+24	+23	+22	+21	+20	+19	+18	+17	+16	+15	+14	+13	+12	+11	+ 9	+ 8		
		Rear	- 3	+ 4	+ 5	+ 6	+ 8	+ 9	+10	+11	+12	+13	+14	+15	+16	+17	+18	+19		
-½°	-¾°	Front	+29	+28	+27	+26	+25	+24	+23	+22	+21	+20	+19	+18	+17	+15	+14			
		Rear	+ 7	+ 9	+10	+11	+12	+14	+15	+16	+17	+18	+19	+20	+21	+22	+23			
-¾°	-1°	Front	+34	+33	+32	+31	+30	+29	+28	+27	+26	+25	+24	+22	+21	+20				
		Rear	+12	+13	+15	+16	+17	+18	+19	+20	+22	+23	+24	+25	+26					
-1°	-1¼°	Front	+38	+37	+36	+36	+35	+34	+33	+32	+31	+29	+28	+27	+26					
		Rear	+17	+18	+19	+21	+22	+23	+24	+25	+26	+27	+28	+29						
-1¼°	-1½°	Front	+43	+42	+41	+40	+39	+38	+37	+36										
		Rear	+22	+23	+24	+25	+26													
	-1¾°	Front																		

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FIG. 6 Front Wheel Alignment Chart—Sample No. 2

EXAMPLE:

Alignment Readings			Nominal Specifications		Adjustment Required	
	Left	Right	Left	Right	Left	Right
Caster	+¾°	+¼°	+2°	+2°	Front +24	Front −11
Camber	−½°	+1¼°	+½°	+¼°	Rear +13	Rear −26

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FIG. 7 Finding Adjustment Required

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DETROIT IRON

FRONT WHEEL ALIGNMENT CHART

CASTER READING IN DEGREES

CAMBER READING IN DEGREES

LEFT CAMBER	RIGHT CAMBER		-½	-¼	0	+¼°	+½	+¾°	+1	+1¼	+1½	+1¾	+2°	+2¼	+2½	+2¾	+3°	+3¼°
+2¾	+2½	Front	-31	-32	-33	-34	-35	-36	-37	-38	-39	-40	-42	-43	-44	-45	-47	-48
		Rear	-52	-51	-50	-49	-48	-47	-46	-45	-44	-43	-42	-41	-40	-39	-38	-37
+2½	+2¼	Front	-26	-27	-28	-29	-30	-31	-32	-34	-35	-36	-37	-38	-39	-41	-42	-43
		Rear	-48	-47	-45	-44	-43	-42	-41	-40	-39	-38	-37	-36	-35	-34	-33	-33
+2¼	+2	Front	-22	-23	-24	-25	-26	-27	-28	-29	-30	-31	-32	-34	-35	-36	-37	-39
		Rear	-43	-42	-41	-40	-38	-37	-36	-35	-34	-33	-32	-31	-31	-30	-29	-28
+2	+1¾	Front	-17	-18	-19	-20	-21	-22	-23	-24	-25	-27	-28	-29	-30	-31	-33	-34
		Rear	-38	-37	-36	-35	-34	-33	-32	-31	-30	-29	-28	-27	-26	-25	-24	-23
+1¾	+1½	Front	-13	-13	-14	-15	-16	-17	-19	-20	-21	-22	-23	-24	-26	-27	-28	-29
		Rear	-34	-33	-31	-30	-29	-28	-27	-26	-25	-24	-23	-22	-21	-20	-20	-19
+1½	+1¼°	Front	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-20	-21	-22	-23	-25
		Rear	-29	-28	-27	-26	-25	-23	-22	-21	-20	-19	-18	-18	-17	-16	-15	-14
+1¼	+1	Front	-3	-4	-5	-7	-8	-9	-10	-12	-13	-14	-15	-15	-16	-18	-19	-20
		Rear	-25	-23	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	11	-10	-10
+1	+¾	Front	-1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-12	-13	-14	-16
		Rear	-20	-19	-18	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-7	-6	-5
+¾	+½	Front	-6	-5	-4	-3	-2	-1	0	-1	-2	-3	-5	-6	-7	-8	-10	-11
		Rear	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6		-4	-3	-2	-1	0
+½°	+¼°	Front	-10	-10	-9	-8	-7	-6	-5	-3	-2	-1	0	-1	-2	-4	-5	-6
		Rear	-11	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	-1	-2	-3	-3	-4
+¼	0	Front	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-3	-2	-1	0	-2
		Rear	-6	-5	-4	-3	-1	0	-1	-2	-3	-4	-5	-6	-6	-7	-8	-9
0	-¼	Front	-20	-19	-18	-17	-16	-15	-14	-13	-12	-10	-9	-8	-7	-6	-4	-3
		Rear	-1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14
-¼	-½	Front	-24	-23	-22	-21	-20	-19	-18	-17	-16	-15	-14	-13	-11	-10	-9	-8
		Rear	-3	-4	-6	-7	-8	-10	-11	-12	-13	-14	-15	-16	-16	-17	-17	-18
-½°	-¾	Front	-29	-28	-27	-26	-25	+24	-23	-22	-21	-20	-18	-17	-16	-15	-13	-12
		Rear	-8	-9	-10	-11	-12	+13	-14	-16	-17	-17	-18	-19	-20	-21	-22	
-¾	-1	Front	-33	-33	-32	-31	-30	-29	-28	-26	-25	-24	-23	-22	-21	-19		
		Rear	-12	-14	-15	-16	-17	-18	-19	-20	-21	-22	-23	-24	-25	-26		
-1	-1¼	Front	-38	-37	-36	-35	-34	-33	-32	-31	-30		-28	-26	-25			
		Rear		-18	-19		-22	-23	-24	-25	-26			-28	-29			

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FIG. 8 Front Wheel Alignment Chart—Sample No. 3

equally to obtain correct toe (Fig. 12). If the steering wheel spokes are not in their normal position, make the necessary rod adjustments to obtain correct toe and steering wheel spoke alignment (Fig. 13).

3. Recheck toe and the steering wheel spoke position. If toe is correct and the steering wheel spokes are still not in their normal position, turn both connecting rod sleeves upward or downward the same number of turns to move the steering wheel spokes (Fig. 12).
4. When toe and the steering wheel spoke position are both correct, lubricate clamp, bolts, and nuts and torque the clamp bolts on both connecting rod sleeves to specification. **The sleeve position should not be changed when the clamp bolts are tightened.**

Pinto, Bobcat, Mustang II, Fairmont and Zephyr

1. Check to see that the steering shaft and steering wheel marks are in alignment and in the top position.
2. Loosen the clamp screws on the tie rod bellows and free the seals on the rods, to prevent twisting of the bellows during Step 4.
3. Use an open-end wrench on the flats of the tie rod socket that will prevent the socket from turning while loosening the tie rod jam nut.
4. Use suitable pliers to turn both tie rod inner end to get toe within specifications (Fig. 14). **Do not position the pliers on the tie rod threads.** Turning to reduce the number of threads showing will increase toe. Turning in the opposite direction will reduce toe.
5. When toe is properly set and the steering wheel is in the straight-ahead position, use an open-end wrench on the flats of the tie rod socket, to hold the sockets from turning while tightening the tie rod jam nuts to 35 to 50 ft-lb. Tighten the bellows clamp screws securely. This procedure applies to both left and right tie rod ends.

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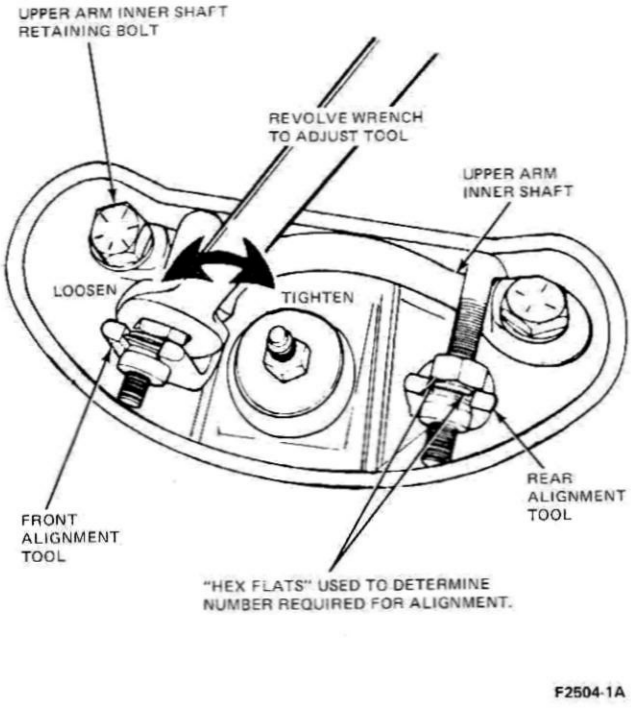


FIG. 9 Using Special Tool No. T69P-3000-A

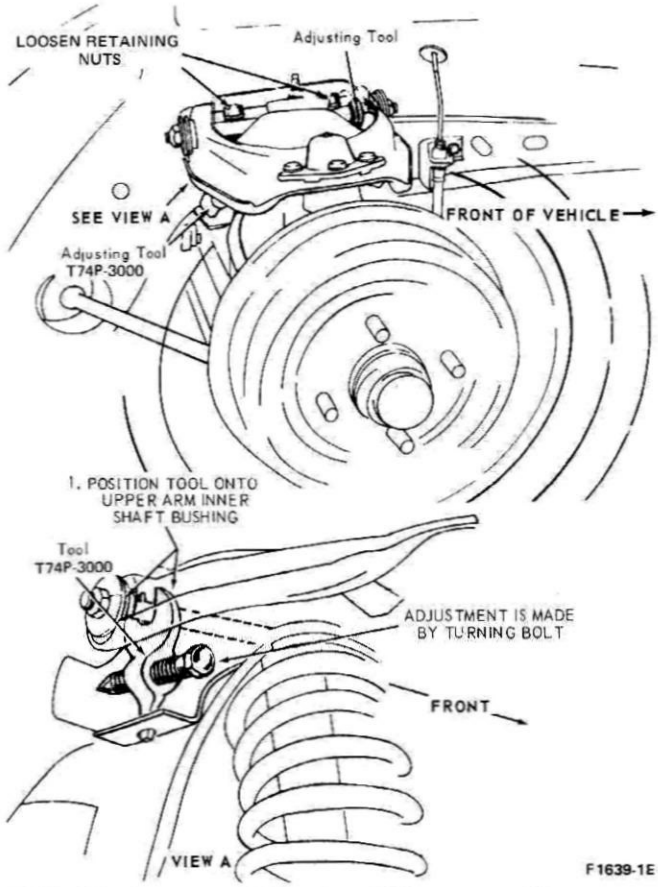


FIG. 11 Caster and Camber Adjustment—Pinto, Bobcat and Mustang II

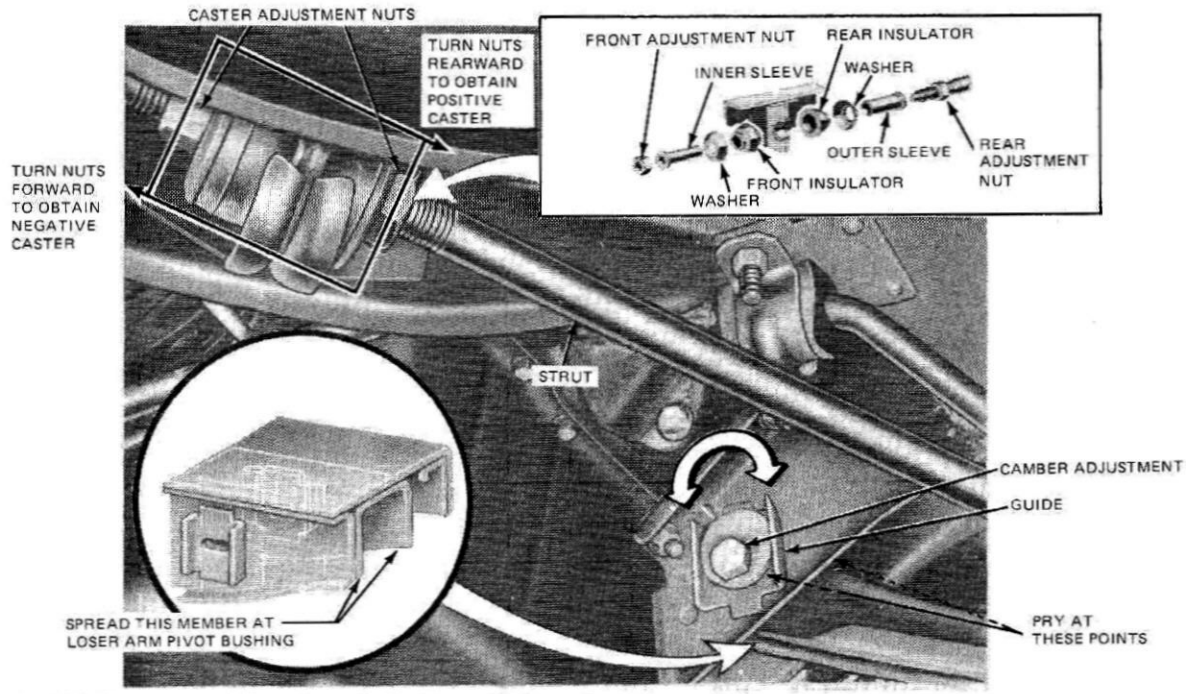


FIG. 10 Caster and Camber Adjustment Procedures

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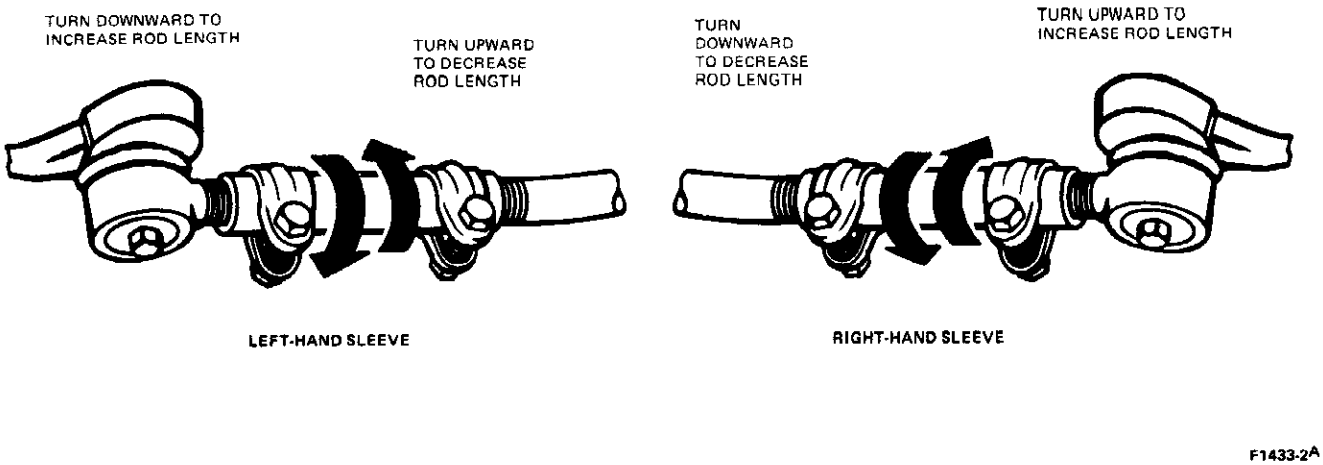


FIG. 12 Spindle Connecting Rod Adjustment (Looking Forward)

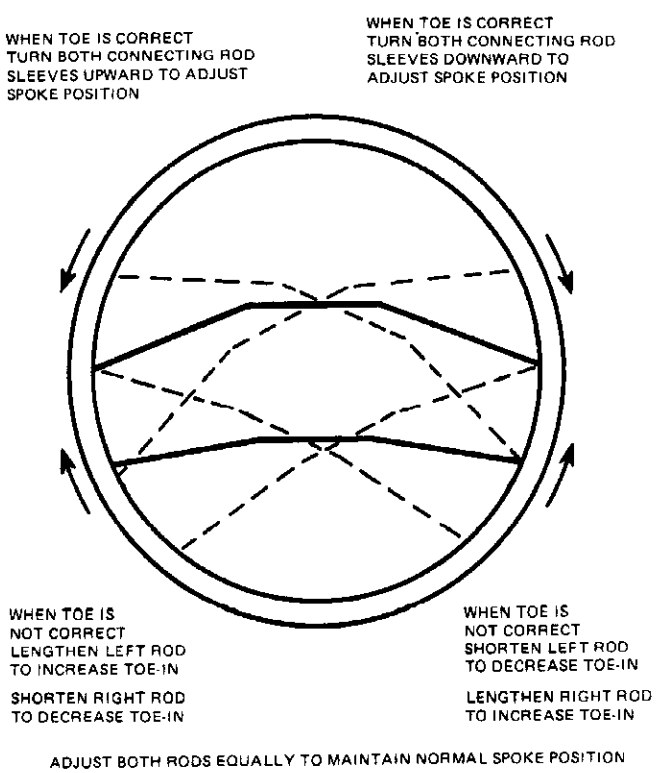


FIG. 13 Toe and Steering Wheel Spoke Alignment Adjustments—Ford, Mercury, LTD II, Cougar, Thunderbird, Continental Mark V and Lincoln Continental

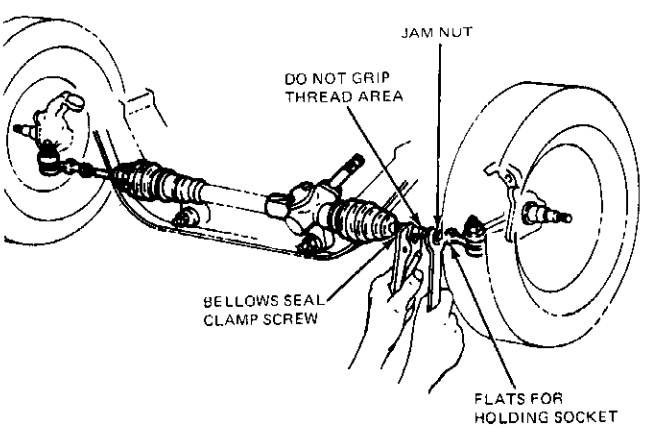


FIG. 14 Toe Adjustment—Pinto, Bobcat, Mustang II, Fairmont and Zephyr

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CLEANING AND INSPECTION

FRONT-END GENERAL INSPECTION

Do not check and adjust front wheel alignment without first making the following inspection for front-end damage, or wear.

1. Check for specified air pressures in all four tires.
2. Raise the front of the vehicle off the floor. Grasping the upper and lower surfaces of the tire, shake each front wheel to check for worn bearings. Check the front suspension ball joints and mounts for looseness, wear, and damage. Check the brake backing plate mountings. Torque all loose nuts and bolts to specification. Replace all worn parts as outlined in Parts 14-03 and 14-04.
3. Check the steering gear mountings and all steering linkage connections for looseness. Torque all mountings to specifications. If any of the linkage is worn or bent, replace the parts as outlined in Part 13-20.
4. Check the front wheel bearings. If any in-and-out free play is noticed, adjust the bearings to specifications. Replace worn or damaged bearings as outlined in Part 11-10.
5. Spin each front wheel with a wheel spinner, and check and balance each wheel as required.
6. Check the action of the shock absorbers. If the shock absorbers are not in good condition, the vehicle may not settle in a normal/level position, and front wheel alignment may be affected.

UPPER BALL JOINT INSPECTION

Ford, Mercury, LTD II, Cougar, Thunderbird, Continental Mark V, Lincoln Continental, Mustang II, Pinto and Bobcat

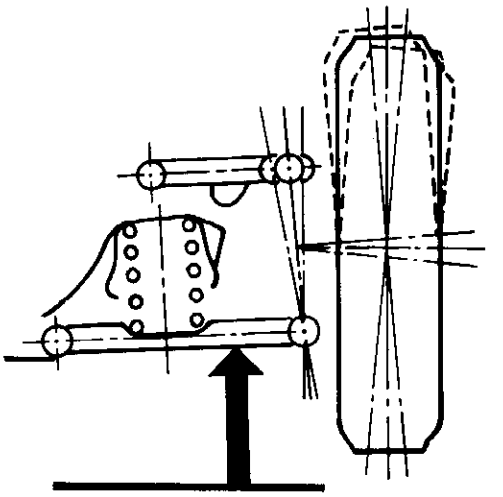
Prior to performing any ball joint inspection, adjust the front wheel bearings as described in Part 11-10.

1. Raise the vehicle and place floor jacks beneath the lower suspension arms (Fig. 15).
2. Ask an assistant to grasp the lower edge of the tire and move the wheel in and out.
3. While the wheel is being moved observe the upper end of the spindle and the upper suspension arm. (Any movement between the upper end of the spindle and the upper suspension arm indicates abnormal ball joint wear.)
4. If any such movement is observed, install new upper suspension arm.

Granada, Monarch and Versailles

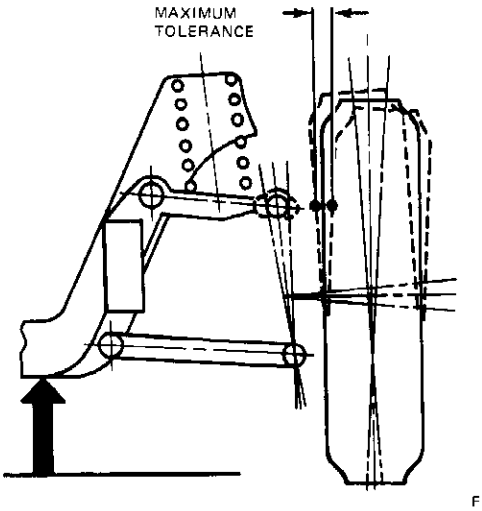
1. Raise the vehicle on a frame contact hoist or by floor jacks placed beneath the underbody until the wheel falls to the full-down position as shown in Fig. 16.
2. Ask an assistant to grasp the tire at the top and bottom and slowly move the tire in and out (Fig. 16).
3. While the wheel is being moved, observe the upper end of the spindle and the upper suspension arm. (Any movement between the upper end of the spindle and the upper suspension arm indicates abnormal ball joint wear.) See Fig. 16.
4. If any such movement is observed, install new upper suspension arm.

NOTE: Granada and Monarch upper ball joints have polyethylene liners and do not require lubrication, therefore, no grease fitting is provided.



F2505-1A

FIG. 15 Upper Ball Joint Inspection



F1500-1C

FIG. 16 Measuring Upper Ball Joint Radial Play

LOWER BALL JOINT INSPECTION

Ford, Mercury, LTD II, Cougar, Thunderbird, Continental Mark V, Lincoln Continental, Mustang II, Pinto, Bobcat, Fairmont and Zephyr

1. Raise the vehicle and place jacks under the lower suspension arms as shown in Fig. 17. This will unload the lower ball joints.
2. Attach a dial indicator to the lower suspension arm and position the indicator so that the plunger rests against the inner side of the wheel rim adjacent to the lower ball joint.
3. Grasp the tire at the top and bottom and slowly move the tire in and out (Fig. 17). Note the reading

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DETROIT IRON

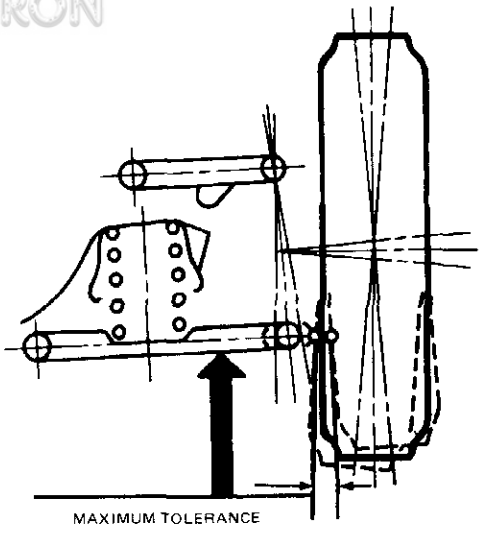


FIG. 17 Measuring Lower Ball Joint Radial Play

(radial play) on the dial indicator. If the reading exceeds specifications, replace the lower suspension arm.

Granada, Monarch and Versailles

1. Raise the vehicle on a frame contact hoist or by floor jacks placed beneath the underbody, until the *wheel falls to the full down position (Fig. 18).*
2. Ask an assistant to grasp the lower edge of the tire and move the wheel in and out.
3. As the wheel is being moved in and out, observe the lower end of the spindle and the lower suspension arm. (Any movement between the lower end of the spindle and the lower arm indicates abnormal ball joint wear.)
4. If any such movement is observed, install new lower suspension arm.

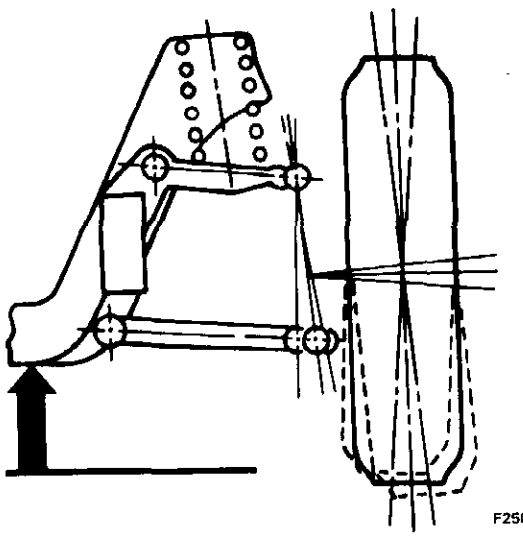


FIG. 18 Lower Ball Joint Inspection

FAIRMONT/ZEPHYR

1. Support the vehicle in normal driving position, with both ball joints loaded.
2. Wipe the grease fitting and checking surface so they are free of dirt and grease. The checking surface is the round boss into which the grease fitting is threaded (Fig. 19).
3. The checking surface should project outside the cover (Fig. 19). If the checking surface is inside the cover (Fig. 19), replace the lower arm assembly.

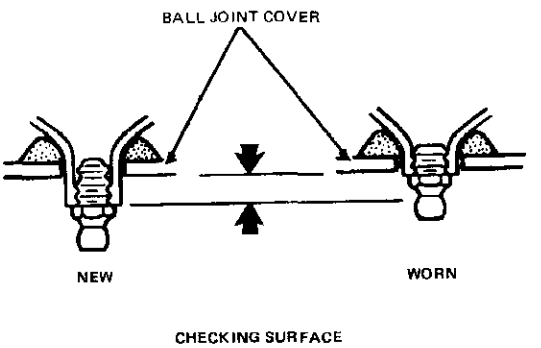


FIG. 19 Checking Lower Ball Joint—Fairmont/ Zephyr

SHOCK ABSORBER CHECKS—EXCEPT FAIRMONT/ZEPHYR

NOTE: Fairmont and Zephyr front shock absorbers are part of the front shock tower and require disassembly of the front suspension in order to replace. This procedure is covered in Part 14-05.

All vehicles are equipped with hydraulic shock absorbers of the direct-acting type and are nonadjustable and nonrefillable. They cannot be repaired.

Before replacing a shock absorber, check the action of the shock absorbers as follows:

On Vehicle Tests

1. Check the shock absorber to be sure it is securely *and properly installed. Check* the shock absorber insulators for damage and wear.

   Replace any defective insulators and tighten attachments to the specified torque (on a shock absorber which incorporates integral insulators, replace the shock absorbers).
2. Inspect the shock absorber for evidence of fluid leakage. (A light film of fluid is permissible. Be sure any fluid observed is not from sources other than the shock absorber.)

   Replace the shock absorber if leakage is severe.
3. Disconnect the lower end of the shock absorber. Extend and compress the shock absorber as fast as possible, using as much travel as possible.

   Action should become smooth and uniform throughout each stroke. Higher resistance on

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extension than on compression is a normal condition. Faint swish noises are also normal.

Remove the shock absorber for a bench test if action is erratic. If the action is smooth, but the shock absorbers are suspected of being weak, follow Step 4:

4. Repeat Step 3 on the mating shock absorber on the opposite side of the vehicle, and compare results of both tests. If the action is similar, it is unlikely that either shock absorber is defective. Reconnect both shock absorbers.

Replace the shock absorber having the lower resistance. Ensure that the part number of the replacement is the same as that of the original shock absorber. The replacement shock absorber resistance will appear to be higher than either original due to initial friction of the rod seal.

Bench Test

With the shock absorber right side up (as installed in vehicle), extend it fully. Then turn the shock absorber upside down and fully compress it. Repeat this procedure at least three times to ensure that any entrapped air has been expelled. Now place the shock absorber right side up in a vise, and hand stroke the shock absorber as described in On Vehicle Tests, Step 3. If action is not now smooth and uniform, install a new shock absorber.

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SPECIFICATIONS

WHEELBASE AND TREAD WIDTH – INCHES

Vehicle		Wheelbase	Tread Width Front	Tread Width Rear
Pinto/Bobcat		94.2	55.0	55.8
Fairmont/Zephyr		105.5	56.4	57.0
Monarch/Granada		109.9	58.5	57.7
Mustang II		96.2	55.6 ①	55.8 ①
Cougar XR7		114.0	63.4	63.5
Thunderbird		114.0	63.0	63.1
LTD II	2-Door	114.0	63.4	63.5
	4-Door	118.0	62.8	62.9
Cougar (Except XR7)	2-Door	114.0	63.4	63.5
	4-Door	118.0	63.4	63.5
Ford (All)		121.0	64.1	64.3
Mercury	2-Door	124.0	64.1	64.3
	4-Door	124.0	64.1	64.3
	Sta. Wag.	121.0	64.1	64.3
Continental Mark V		120.4	62.9	62.8
Lincoln Continental		127.2	64.3	64.3

① Add 0.3 for 0.45" optional offset wheel usage. Optional tread standard on Mustang II 302-V8 models.

FRONT WHEEL ALIGNMENT

Vehicle Model	Alignment Factors	Nominal	Minimum	Maximum
Ford Mercury	Caster ①	+2°	+1-1/4°	+2-3/4°
	Camber	L +1/2° R +1/4°	L −1/4° R −1/2°	L +1-1/4° R +1°
	Toe-inches	3/16"	1/16"	5/16"
LTD II Thunderbird Cougar	Caster ①	+4°	+3-1/4°	+4-3/4°
	Camber	L +1/2° R +1/4°	L −1/4° R −1/2°	L +1-1/4° R +1°
	Toe-inches	1/8"	0"	1/4"
Mark V	Caster ①	+4°	+3¼°	+4¾°
	Camber	L +1/2° R +1/4°	L −1/4° R −1/2°	L +1-1/4° R +1°
	Toe-inches	3/16"	1/16"	5/16"
Lincoln	Caster ①	+2°	+1-1/4°	+2-3/4°
	Camber	L +1/2° R +1/4°	L −1/4° R −1/2°	L +1-1/4° R +1°
	Toe-inches	1/8"	0"	1/4"
Monarch Granada Versailles	Caster ②	−1/2°	-1-1/4°	+1/4°
	Camber	+1/4°	−1/2°	+1°
	Toe-inches	1/8"	0"	1/4"
Mustang II	Caster ②	+7/8°	+1/8°	+1-5/8°
	Camber	+1/2°	−1/4°	+1-1/4°
	Toe-inches	1/8"	0"	1/4"
Pinto Bobcat (Sedan)	Caster ②	+1°	+1/4°	+1-3/4°
	Camber	+1/2°	−1/4°	+1-1/4°
	Toe-inches	1/8"	0"	1/4"
Pinto Bobcat (Wagon)	Caster ②	+1/4°	−1/2°	+1°
	Camber	+1/2°	−1/4°	+1-1/4°
	Toe-inches	1/8"	0"	1/4"
Fairmont ③ Zephyr	Caster	+7/8°	+1/8°	+1-5/8°
	Camber	+3/8°	−3/8°	+1-1/8°
	Toe-Inches	5/16	3/16	7/16

① Maximum caster difference between wheels (left minus right) to be within −3/4° to +3/4° with caster set to specification. Maximum camber difference between wheels (left minus right) to be within −1/2° to 1° with camber set to specification.

② Maximum caster and camber difference between wheels (left minus right) to be within −3/4° to +3/4° with caster and camber set to specification.

③ Caster and Camber is factory-set and cannot be adjusted.

SPECIAL SERVICE TOOLS

Tool No.	Description
T69P-3000-A (Except Mustang II/Pinto/Bobcat)	Caster and Camber Adj. Tools
T74P-3000	Caster and Camber Adj. Wrenches
T74P-3000-A1	Mustang II Left Front
T74P-3000-A2	Mustang II Right Front
T74P-3000-A3	Mustang II/Pinto/Bobcat Left Rear
T74P-3000-A4	Mustang II/Pinto/Bobcat Right Rear
T74P-3000-A5	Pinto/Bobcat Right Front
T74P-3000-A6	Pinto/Bobcat Left Front

FRONT WHEEL TURNING ANGLE

Vehicle Model	Turning Angle Of Outside Wheel With Inside Wheel Turned 20°
Ford/Mercury	18.72°
LTD II Thunderbird Cougar	18.06°
Continental Mark V	18.09°
Lincoln Continental	18.16°
Fairmont/ Zephyr	With P/S 19.74° Without P/S
Granada/Monarch/ Versailles	With P/S 18.20° Without P/S 18.43°
Mustang II/Pinto/Bobcat	18.84°

BALL JOINTS – RADIAL PLAY

Vehicle Model	Description	Radial Play – Max. Allowable
Ford/Mercury LTD II/Thunderbird/ Cougar Mark V, Lincoln, Mustang II/ Pinto/Bobcat	Lower Ball Joint	0.250 Inch
	Upper Ball Joint	Replace the arm if ball joint is perceptibly loose.
Granada/Monarch/ Versailles	Lower Ball Joint	Replace the arm if ball joint is perceptibly loose.
	Upper Ball Joint	

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Front Suspension— Spring On Lower Arm

PART 14-03

Applies To All Cars Except Granada/Monarch/Versailles/Fairmont/Zephyr

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DESCRIPTION	
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Ball Joint Seal – Lower	03-8
Ball Joint Seal – Upper	03-8
Front Shock Absorber	03-7
Front Spring	03-4
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Front Wheel Spindle	03-6
Lower Arm	03-4
Lower Arm Strut and/or Bushing	03-4
Stabilizer Bar End Bushing	03-3
Stabilizer Bar Insulator	03-3
Upper Arm	03-6
Upper Arm Bushings	03-7
SPECIFICATIONS	03-9

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DESCRIPTION

FRONT SUSPENSION

Each front wheel rotates on a spindle. The upper and lower ends of the spindle are attached to ball joints, which are mounted onto an upper and lower arm. The upper arm pivots on a bushing and shaft assembly which is bolted to the Number 2 crossmember. The lower arm pivots on a bolt in the Number 2 crossmember (Figs. 1 and 2). A coil spring seats between the lower arm and the top of the spring housing. A double action shock absorber is bolted to the arm and the top of the spring housing.

Lower suspension arms must always be replaced as a unit. Ball joints and other subcomponents should not be installed in a used suspension arm.

Upper arm bushings may be replaced, but ball joints cannot be replaced. Ball joint seals on Mustang II, Pinto and Bobcat lower arms cannot be replaced.

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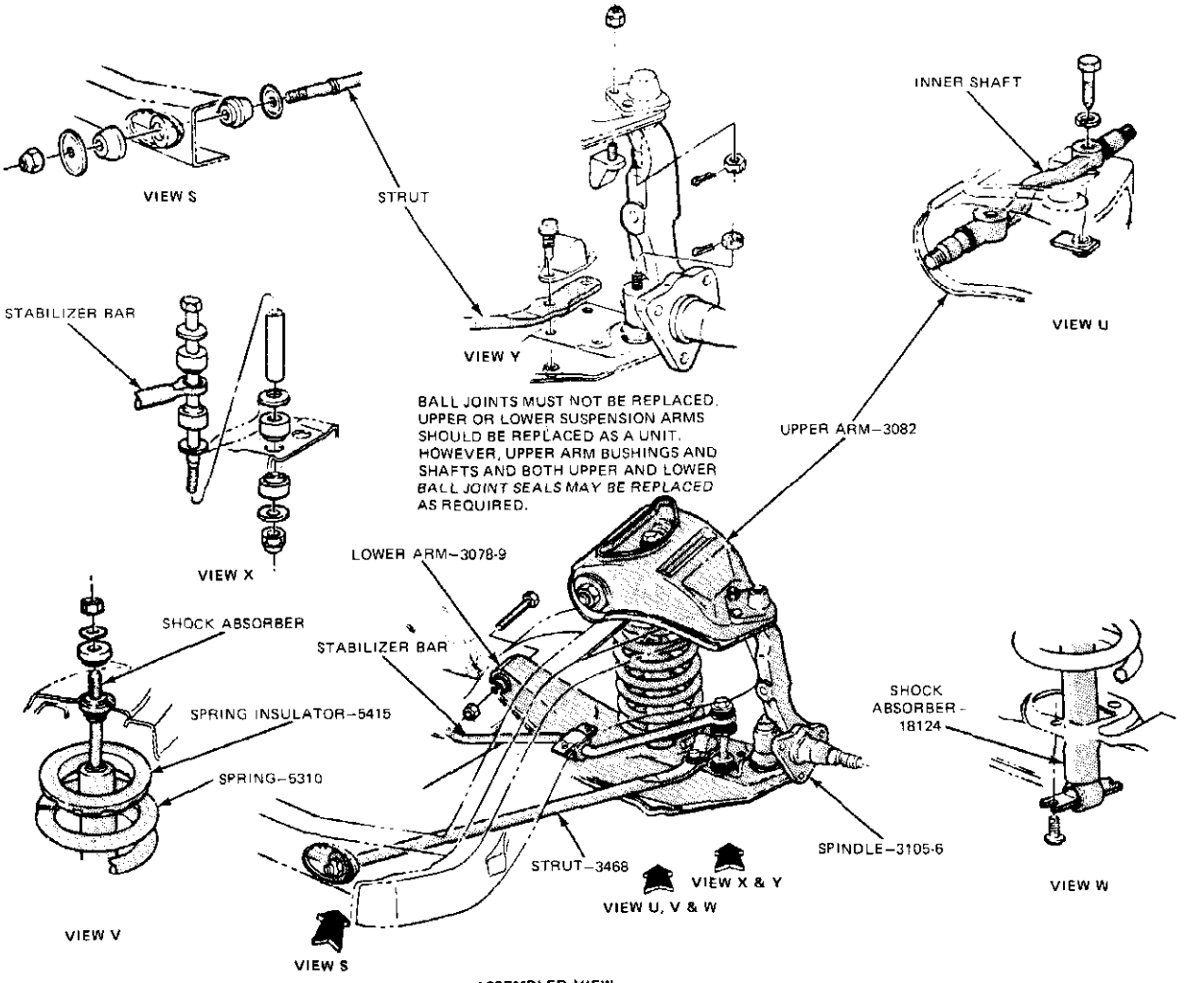


FIG. 1 Front Suspension—Typical Ford/Mercury, LTD II/Cougar, Thunderbird/Continental Mark V and Lincoln Continental

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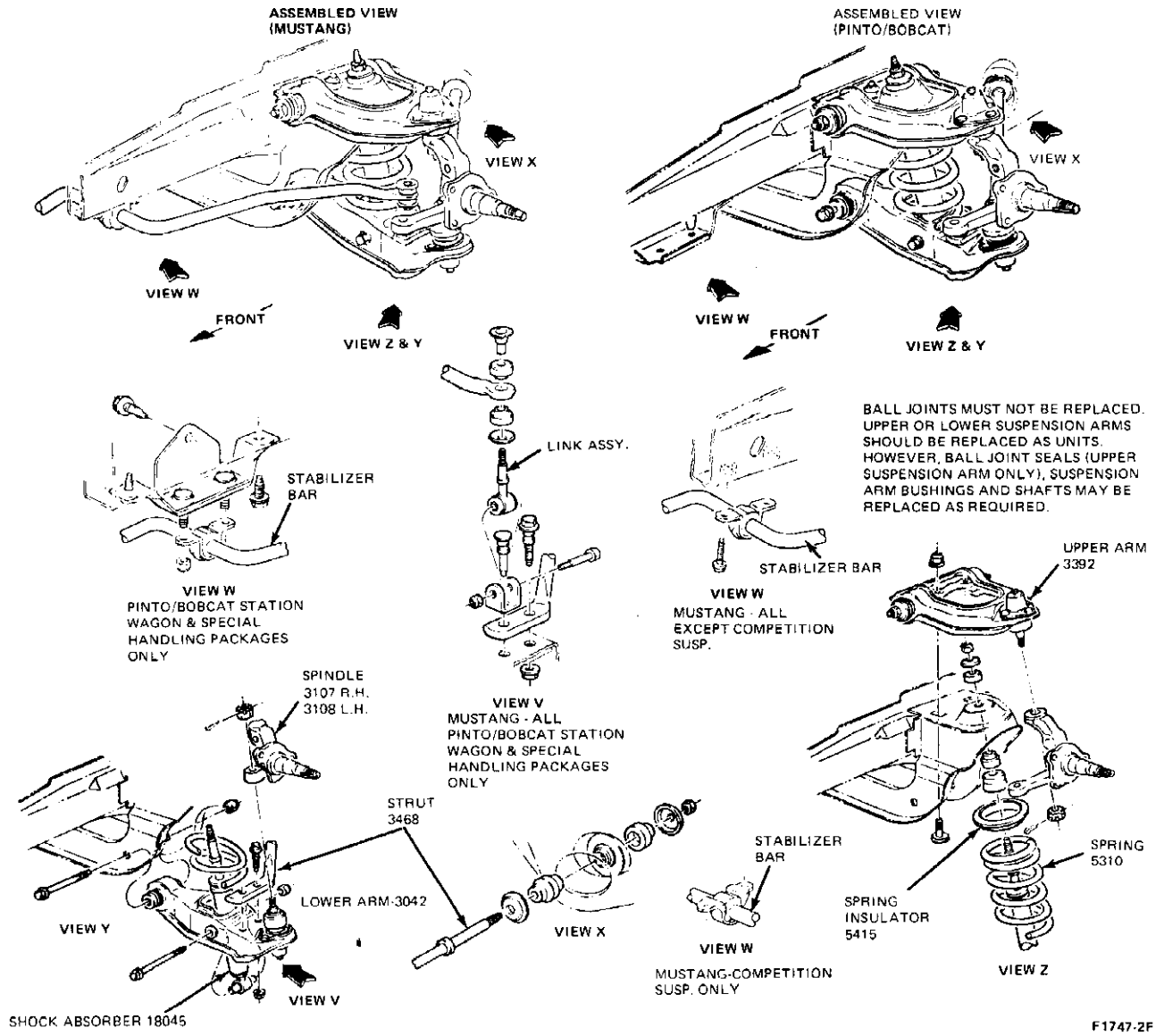


FIG. 2 Front Suspension—Pinto/Bobcat/Mustang II

REMOVAL AND INSTALLATION

STABILIZER BAR END BUSHING

Removal and Installation

To replace the end bushings on each stabilizer link, use the following procedure:

1. Raise the vehicle on a hoist.
2. Remove the nut, washer, and insulator T from the lower end of the stabilizer bar attaching bolt.

Pinto/Bobcat/Mustang II Only

3. Remove the nut attaching the stabilizer bar to the link assembly.
4. Remove the bolt and the remaining washers, insulators, and spacer.

Remove the bushing at the top and bottom of the stabilizer bar.

5. Wire brush and oil the stabilizer bar bolt.
6. Install stabilizer bar end bushing by reversing the above steps.
7. Torque a new attaching nut to specification.

STABILIZER BAR INSULATOR

Removal and Installation

1. Raise the vehicle high enough to provide working space, and place supports under both front wheels.
2. Disconnect the stabilizer from each link, both stabilizer attaching brackets, and remove the stabilizer.
3. Coat the necessary parts of the stabilizer with RUGLYDE or a comparable lubricant, and slide new insulators onto the stabilizer.

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4. Using a **new** nut and bolt, secure each end of the stabilizer bar to the lower suspension arm making sure that the bolt head is at the top to eliminate interference with the brake hose using new fasteners, secure stabilizer attaching brackets to frame. Remove the supports and lower the vehicle.

Pinto/Bobcat/Mustang II

Using a **new** nut, secure each end of the stabilizer bar to the link assembly using new fasteners, secure stabilizer attaching brackets to body side rail. Remove the support and lower the vehicle.

LOWER ARM STRUT AND/OR BUSHING

Removal and Installation

1. Remove the nut from the lower arm strut at the frame and remove the washer and bushing from the strut.
2. Remove the nuts, washers, and bolts attaching the strut and rubber bumper to the lower arm. (Pinto, Mustang and Bobcat vehicles do not have a rubber bumper at this point.)
3. Pull the strut from the frame.
4. Remove the other bushing and washer from the strut.
5. Install strut by reversing the above steps.
6. To install bolts attaching the strut and rubber bumper to the lower arm, hold the bolt head and draw the serrated bolt head into the strut and lower arm by tightening the nut. The bolt head must be held to prevent spinning during tightening.

FRONT SPRING

Removal

1. Raise the vehicle and position safety stands.
2. Disconnect the lower end of the shock absorber from the lower arm. It may be necessary to use a suitable pry bar to free the lower end of the shock absorber. On Pinto, Bobcat and Mustang, remove the nut that retains the shock absorber to the crossmember and remove the shock absorber.
3. Place a jack under the lower arm to support it.
4. Remove the bolts that attach the strut and the jounce bumper to the lower arm. (Pinto, Bobcat and Mustang vehicles do not have a jounce bumper at this point.)
5. If so equipped, disconnect the lower end of the sway bar stud from the lower arm.
6. Remove the nut and bolt that secures the inner end of the lower arm to the crossmember.
7. **Carefully and slowly, lower the jack to relieve the spring pressure on the lower arm,** then remove the spring (Fig. 3). A pry bar may be used to remove a tight spring.

Installation

1. Place the spring upper insulator on the spring and secure with tape.
2. Position the spring on the lower arm so that the lower end properly engages the seat. **The end of the spring must be no more than 1/2 inch from the end of the depression in the arm.**

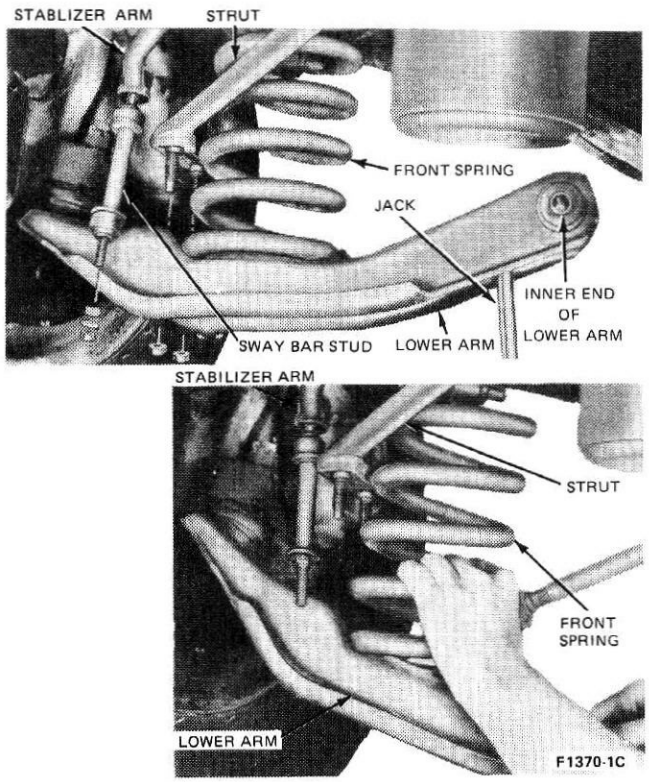


FIG. 3 Removing or Installing Front Spring—All Cars (Mustang/Pinto/Bobcat Similar)

3. Raise the lower arm carefully with a jack while guiding the inner end to align with the bolt hole in the crossmember. Insert the attaching bolt in the crossmember and through the lower arm. Loosely attach the nut on the lower arm inner pivot bolt. **DO NOT TORQUE THE NUT TO SPECIFICATION AT THIS TIME.**
4. Secure the lower end of the shock absorber to the lower arm with the two attaching bolts (Pinto/Bobcat/Mustang models have one bolt). Lower the floor jack.
5. Press the strut to lower arm attaching bolts into the strut and jounce bumper. (Pinto, Bobcat and Mustang do not have a jounce bumper installed at this point.)
6. Secure the strut and the jounce bumper to the lower arm with the two attaching bolts. Torque the nuts to specification. (Pinto, Bobcat and Mustang do not have a jounce bumper installed at this point.)
7. If so equipped, connect the sway bar to the lower arm using a new nut and bolt with the attaching washer and insulators. Torque the nut to specification.
8. Remove the jack stands and lower the vehicle.

After the vehicle has been lowered to the floor and at curb height, torque the lower arm inner pivot nut to specification.

LOWER ARM

Removal

1. Raise the front of the vehicle and position safety stands under both sides of the frame just back of the lower arms, and remove wheel and tire.

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2. Disconnect the lower end of the shock absorber, and push it up to the retracted position. On Pinto, Bobcat and Mustang, remove the nut that attaches the shock absorber to the crossmember and remove the shock absorber downward.
3. If so equipped, disconnect the stabilizer bar link from the lower arm.
4. Remove the cotter pin from the lower ball joint stud nut.
5. Remove nuts attaching the strut to the lower arm (Fig. 1 or Fig. 2), and remove the strut and bolts from the arm as a unit.
6. Loosen the lower ball joint stud nut one or two turns. **Do not remove the nut from the stud at this time.**
7. Install Tool T57P-3006-B (for all except Pinto, Bobcat and Mustang II) or T74P-3006-A (for Pinto, Bobcat and Mustang II) between the upper and lower ball joint studs (Fig. 4). **The tool should be seated firmly against the ends of both studs and not against the stud nuts.** See tool application at the end of this Part under Specifications.

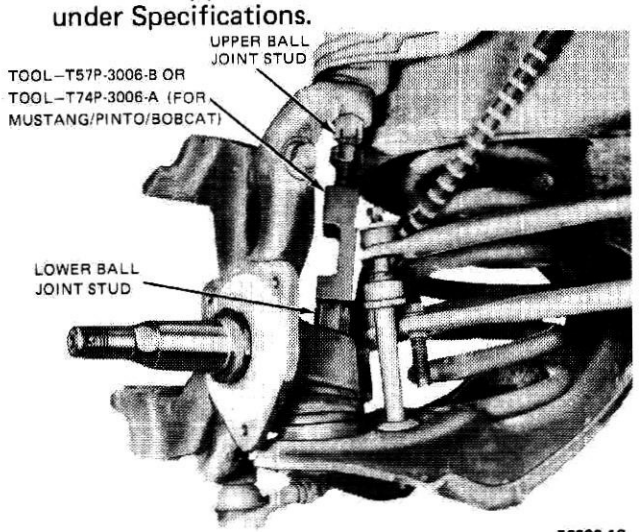


FIG. 4 Loosening Lower Ball Joint Stud — All Cars

8. With a wrench, turn the adapter screw until the tool places the stud under compression. Tap the spindle near the lower stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud from the spindle with tool pressure only. Do not contact the boot seal with the hammer.**
9. Position a floor jack under the lower arm (Fig. 5).
10. Remove the ball joint nut and use the jack to lower the arm from the spindle.
11. Remove the spring and insulator.
12. Remove the nut and bolt attaching the lower arm to the No. 2 crossmember and remove the arm.

Installation

1. Position the lower arm to the No. 2 crossmember using a new pivot bolt and nut. Loosely attach the nut on the lower arm inner pivot bolt. **DO NOT TORQUE THE NUT TO SPECIFICATION AT THIS TIME.**

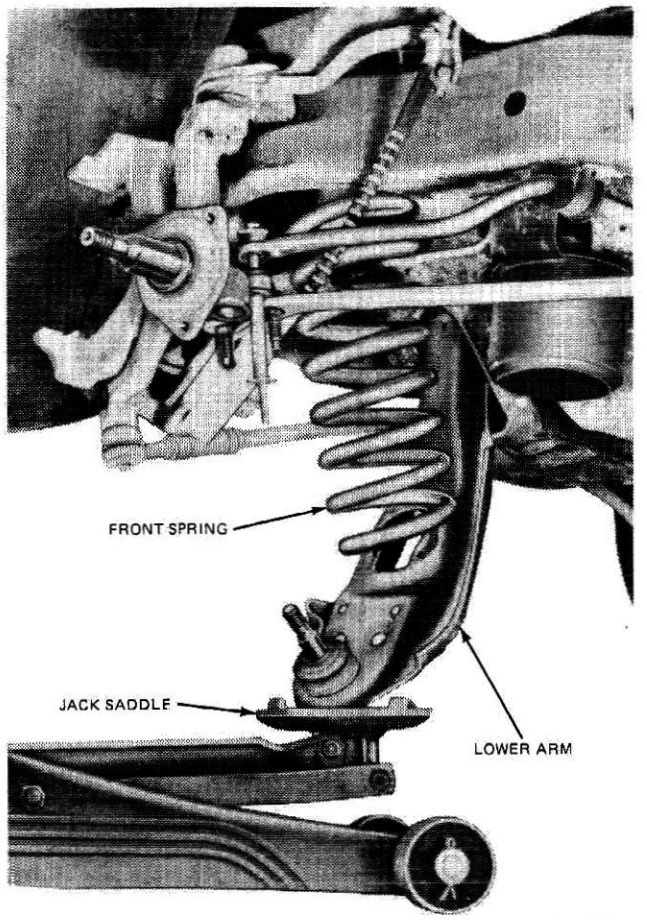


FIG. 5 Removing Front Spring—Lower Arm Replacement—All Cars

2. Position the spring and insulator to the upper spring pad and lower arm. The lower end of the spring must be no more than 1/2" from the end of the depression in the lower arm. Using a floor jack, raise the control arm to align the ball stud in the lower tapered hole of the spindle.
3. Install the ball joint stud attaching nut and torque to specification. Continue to tighten the nut until the cotter pin hole is in line with the nut slots. Install a cotter pin in the lower ball joint stud and lower the jack.
4. Pull the shock absorber down and connect it to the lower arm. On Pinto, Bobcat and Mustang, attach the shock absorber to the crossmember first, and then connect it to the lower arm.
5. Press the strut bolts into the strut and jounce bumper. (Pinto, Bobcat and Mustang II do not have a jounce bumper at this location.)
6. Secure the strut and jounce bumper to the lower arm using the Procedure in Step 6 under Strut Installation. (Pinto, Bobcat and Mustang II do not have a jounce bumper at this location.)
7. If so equipped, position the stabilizer bar link to the lower arm and install new bolts and the attaching nuts.
8. Install the wheel, tire and hub cap or wheel cover.
9. Remove the safety stands and lower the vehicle. After the vehicle has been lowered to the floor and

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DETROIT IRON

at curb height, torque the lower arm inner pivot nut to specification.

10. If the lower arm is being replaced due to accidental damage, check the caster, camber, and toe-in and adjust as required (Part 14-01).

UPPER ARM

Removal

1. Raise the front of the vehicle and position safety stands under both sides of the frame just back of the lower arm.
2. Remove the hub cap or wheel cover.
3. Remove the wheel and tire from the hub. See Group 11.
4. Remove the cotter pin from the upper ball joint stud nut.
5. Loosen the upper ball joint stud nut one or two turns. **Do not remove the nut from the stud at this time.**
6. Install Tool T57P-3006-B (for all except Pinto, Bobcat and Mustang) or T74P-3006-A (for Pinto, Bobcat and Mustang) between the upper and lower ball joint studs with the adapter screw on top (Fig. 4). See tool application at the end of this Part under Specifications. **The tool should be seated firmly against the ends of both studs and not against the nuts or lower stud cotter pin.**
7. With a wrench, turn the adapter screw until the tool places the stud under compression. Tap the spindle near the upper stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud from the spindle with tool pressure only. Do not contact the boot seal with the hammer.**
8. Remove the tool from between the ball joint studs and place a floor jack under the lower arm.
9. Raise the floor jack to relieve the pressure from the upper ball joint stud nut and remove the nut.
10. Remove the upper arm inner shaft attaching bolts. Remove the upper arm inner shaft as an assembly.
11. Remove the bumper from the upper arm. (Pinto, Bobcat and Mustang do not have a bumper at this location)

Installation

1. Position the bumper (except Pinto, Bobcat and Mustang) to the upper arm and install the nut. Torque the nut to specification.
2. Position the upper arm inner shaft to the frame bracket, and install the two attaching bolts and washers to a snug fit. (Pinto, Bobcat and Mustang are not equipped with washers.)
3. Connect the upper ball joint stud to the spindle and install the attaching nut. Torque the nut to specification and **continue to tighten** the nut until the cotter pin hole in the stud is in line with the nut slots. Then, install the cotter pin.
4. Install the wheel and tire on the hub and adjust the wheel bearings as outlined in Part 11-10.
5. Install the hub cap or wheel cover.
6. Remove the safety stands and lower the front of the vehicle.
7. Adjust caster, camber, and toe-in to specification.

FRONT WHEEL SPINDLE

Removal

1. Raise the vehicle and position safety stands.
2. Remove the two bolts attaching the caliper anchor plate assembly to the spindle. Remove the caliper anchor plate assembly from the rotor (Group 12) and wire it to the underbody to prevent damage to the brake hose.
3. Remove the grease cap from the hub; then, remove the cotter pin, nut lock, adjusting nut, washer, and outer bearing cone and roller assembly.
4. Pull the hub and rotor assembly off the wheel spindle (Group 11).
5. Remove the three caliper shield attaching bolts and remove the shield.
6. Disconnect the spindle connecting rod end from the spindle arm using Tool-3290-C.
7. Remove the cotter pins from both ball joint stud nuts, and loosen the nuts one or two turns. Do not remove the nuts from the studs at this time.
8. Position the ball joint remover tool between the upper and lower ball joint studs. **The tool should seat firmly against the ends of both studs and not against the stud nuts.**
9. Turn the tool with a wrench until the tool places the studs under considerable compression, and, with a hammer, sharply hit the spindle near the studs to break them loose in the spindle. **Do not loosen the studs in the spindle with tool pressure alone. Do not contact the boot seal with the hammer.**
10. Position a floor jack under the lower arm.
11. Remove the upper and lower ball joint stud nuts, lower the jack and remove the spindle.

Installation

1. Position the spindle on the lower ball joint stud and install the stud nut (Fig. 2). Torque the nut to specification and install a new cotter pin.

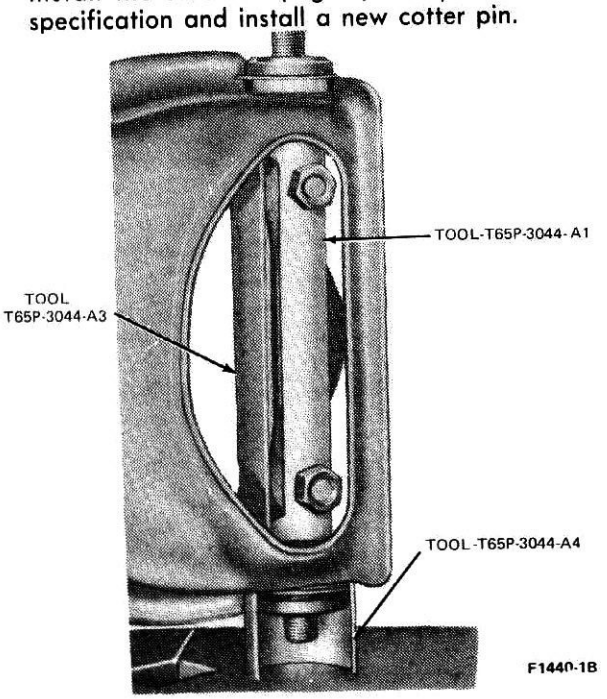


FIG. 6 Removing Upper Arm Bushings—Typical

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2. Raise the lower arm, and guide the upper ball joint stud into the spindle. Install the stud nut.
3. Torque the nut to specifications and install a new cotter pin. Remove the floor jack.
4. Connect the spindle connecting rod end to the spindle arm and install the attaching nut. Torque the nut to specification and install a new cotter pin.
5. Position the caliper splash shield to the spindle and install the attaching bolts and nuts. Torque the nuts and bolts to specification.
6. Install the hub and rotor on the spindle.

   Position the caliper anchor plate assembly to the rotor and spindle and install the attaching bolts.(Group 12). Torque the bolts to specification and install the safety wire.

   Install the wheel and tire on the hub and adjust the wheel bearing (Group 11).
7. Install the hub cap or wheel cover.
8. Remove the safety stands, and lower the vehicle.
9. If the spindle is being replaced due to accidental damage, check and adjust caster, camber and toe-in as required.

FRONT SHOCK ABSORBER

All Vehicles Except Pinto, Bobcat and Mustang II

Removal and Installation

1. Remove the nut, washer, and bushing from the shock absorber upper end.
2. Raise the vehicle on a hoist and install safety stands.
3. Remove the two thread-cutting screws attaching the shock absorber to the lower arm and remove the shock absorber. Lightly wire brush the shock studs free of rust, oil or corrosion.
4. Place a washer and bushing on the shock absorber top stud and position the shock absorber inside the front spring. Install the thread-cutting screws and torque them to specifications. If the threads in the lower arm become stripped or damaged, the removed thread-cutting screws should be re-used, along with 5/16-18 lock nuts which are not supplied in the service kit. Torque to the same specifications as when thread cutting screws are secured directly to the lower arm.
5. Remove the safety stands and lower the vehicle.
6. Place a bushing and washer on the shock absorber top stud and install **a new attaching nut.** Torque it to specification.

Pinto, Bobcat and Mustang II

Removal and Installation

1. Remove the nut, washer and bushing from the shock absorber upper end.
2. Raise the vehicle on a hoist and install safety stands.
3. Remove the bolt attaching the shock absorber to the lower arm. Lightly wire brush the shock studs free of rust, oil or corrosion.
4. Place the retainer cup and bushing on the shock absorber top stud and position the shock absorber inside the front spring with the mounting stud in the hole in the crossmember. Install the bolt attaching the shock absorber to the lower arm. Torque to specification.
5. Remove the safety stands and lower the vehicle.
6. Place a bushing and washer on the shock absorber top stud and install a new attaching nut. Torque to specification.

ADJUSTABLE SHOCK ABSORBERS (MUSTANG II)

Mustangs with competition suspension or Rallye Package options have adjustable shock absorbers which have been initially installed in the regular (R) control position. When changing from regular (R) to the firm (F) or extra firm (XF) position, it will be necessary to remove the shock absorber from the car. Then, because adjustment can only be accomplished by fully compressing the shock absorber, the rubber jounce cushion must be removed from the piston rod. With the shock absorber compressed, a dog on the end of the piston engages with a slot in the base valve. Rotate the piston rod to the next position until a definite click is heard and a definite movement to a detent position is noticeable. At this point, the notch in the upper piston rod head with be lined up with the control setting that is dialed. The jounce cushion must be re-assembled to the rod in the original position and the installation instructions follow as above for non-adjustable shock absorbers.

UPPER ARM BUSHINGS

All Vehicles Except Pinto/Bobcat/Mustang II

Removal and Installation—Arm Removed

1. Remove the nuts and washers from both ends of the upper arm inner shaft.
2. Install Tool T65P-3044-A1 on the inner shaft and place Tool T65P-3044-A3 inside the upper arm around the inner shaft (Fig. 6).
3. Position the upper arm in an arbor press on Tool T65P-3044-A4 (Fig. 6), and press the lower bushing out of the upper arm. See tool application at the end of this Part under Specifications.
4. Remove the bushing from the inner shaft; turn the assembly over and remove the bushing from the other side of the arm. **It may be necessary to remove Tool T65P-3044-A1 from the inner shaft and remove the shaft from the arm to remove the bushing. Then, install the tool on the shaft and remove the other bushing.**
5. Using tool as shown in Figure 7, position the shaft and bushings to the upper arm and install the bushings and inner shaft in the upper arm. Be sure that the inner pivot shaft is positioned so that the serrated side will contact the frame.
6. Install a washer and new nut on each end of the inner shaft and torque to specification.

Pinto/Bobcat/Mustang II

Removal and Installation

1. Remove the upper arm from the vehicle as described earlier in this part. Remove nuts and washers from both ends of the upper arm inner shaft.

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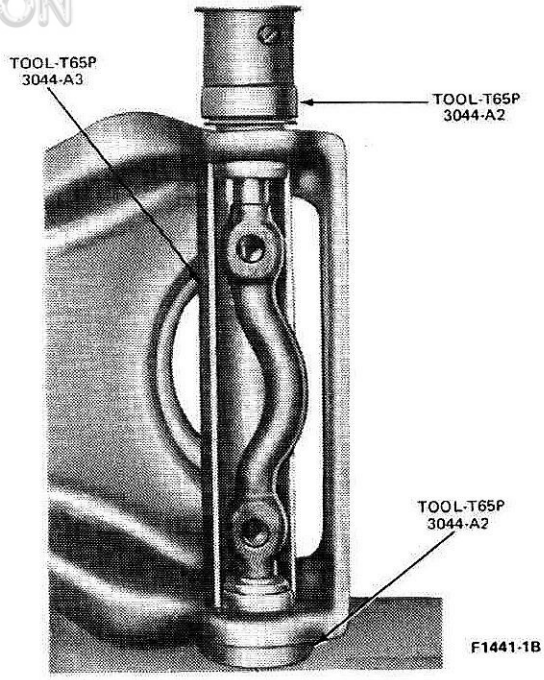


FIG. 7 Installing Upper Arm Shaft Bushing—Typical

2. Using Tool Kit T74P-3044-A, install the shaft locator on the shaft to keep the shaft from turning.
3. Position the Remover Adapter, Remover Receiver and C-Frame Assembly on the end of the shaft and remove the bushing.
4. Repeat Steps 2 and 3 for the other bushing.
5. Slide the shaft out of the upper arm.

Installation

1. Slide the shaft into the upper arm. Be sure that the shaft is positioned so that the serrated side will contact the frame.
2. Install the shaft locator on the shaft to keep the shaft from turning.
3. Position the Replacer Adapter, C-Frame Assembly and bushing on the end of the shaft and install the bushing.
4. Repeat Steps 2 and 3 for the other bushing.
5. Install the upper arm in the vehicle as described earlier in this part.

BALL JOINT SEAL REPLACEMENT—UPPER

Ford/Mercury, LTD II/Cougar/Thunderbird/Continental Mark V, Lincoln Continental, Mustang II/Pinto/Bobcat

Removal

1. Raise the front of the vehicle and position safety stands under both sides of the frame just back of the lower arms, and remove the wheel and tire.
2. Disconnect the upper end of the shock absorber, and push it down to the retracted position.
3. Remove the cotter pin from the upper ball joint stud nut.
4. Loosen the upper ball joint stud nut one or two turns. **Do not remove the nut from the stud at this time.**
5. Install Tool T57P-3006-B (for all except Mustang/Pinto/Bobcat) or T74P-3006-A (for Mustang/Pinto/Bobcat) between the upper and lower ball joint studs. **The tool should be seated firmly against the ends of both studs and not against the stud nuts.**
6. With a wrench, turn the adapter screw until the tool places the stud under compression. Tap the spindle near the upper stud with hammer to loosen the stud in the spindle. **Do not loosen the stud from the spindle with tool pressure only. Do not contact the boot seal with the hammer.**
7. Position a floor jack under the lower arm.
8. Remove the ball joint stud nut and use the jack to lower the arm and the spindle. Remove the spring.
9. Using a screwdriver, pry the ball joint seal off.
10. Wipe off any remaining lubrication from the ball joint stud and the lubrication plug located on the topside of the ball joint. The socket must be completely free of lubricant to be sure that the boot seats properly.

Installation

1. Position a new ball joint seal on the ball joint stud.
2. Install Tool T75P-3082-B using the ball joint stud nut.
3. Tighten the nut until the ball joint seal is firmly seated. Remove the nut and tool.
4. Using a floor jack, position the lower arm, spindle and spring to the upper arm. The lower end of the spring must be no more than 1/2" from the end of the depression in the lower arm.
5. Install the ball joint stud attaching nut and torque to specification. Continue to tighten the nut until the cotter pin hole is in line with the nut slots. Install a cotter pin in the upper ball joint stud.
6. Pull the shock absorber up and connect it to the frame using a new attaching nut. Torque to specifications.
7. Remove the lubrication plug using a 3/16-inch socket wrench.
8. Use a hand-operated, low-pressure grease gun fitted with a rubber tip and loaded with Multi-purpose Long Life Lubricant (or equivalent).
9. Force the lubricant into the joint only until the ball joint seal can be felt or seen to swell, indicating that the seal is full of lubricant. **Do not lubricate until the lubricant escapes from the seal, because this destroys the weather-tight seal.**
10. Install the lubrication plug.
11. Install the wheel and tire. Remove the safety stands and lower the vehicle.

BALL JOINT SEAL REPLACEMENT—LOWER

Ford/Mercury, LTD II/Thunderbird/Cougar, Continental Mark V, Lincoln Continental

Removal

1. Raise the front of the vehicle and position safety stands under both sides of the frame just back of the lower arms, and remove the wheel and tire.
2. Disconnect the lower end of the shock absorber, and push it up to the retracted position.

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3. If so equipped, disconnect the stabilizer bar link from the lower arm.
4. *Remove the cotter pin from the lower ball joint stud* nut.
5. Remove the bolts and nuts that attach the strut to the lower arm.
6. Loosen the lower ball joint stud nut one or two turns. **Do not remove the nut from the stud at this time.**
7. *Install Tool T57P-3006-B between the upper and* lower ball joint studs. **The tool should be seated firmly against the ends of both studs and not against the stud nuts.**
8. With a wrench, turn the adapter screw until the tool places the stud under compression. Tap the spindle near the lower stud with a hammer to loosen the *stud in the spindle.* ***Do not loosen the stud from*** **the spindle with tool pressure only. Do not contact the boot seal with the hammer.**
9. Position a floor jack under the lower arm.
10. Remove the ball joint stud nut and use the jack to lower the arm from the spindle. Remove the spring.
11. Using a screwdriver, pry the ball joint seal off.
12. Wipe off any remaining lubrication from the ball joint stud and the lubrication plug located on the underside of the ball joint. The socket must be completely free of lubricant to be sure the boot seal seats properly.

Installation

1. *Position a new ball joint seal on the ball joint stud.*
2. Install Tool T75P-3006-B using the ball joint stud nut.
3. Tighten the nut until the ball joint seal is firmly seated. Remove the nut and tool.
4. Using a floor jack, position the lower arm and spring to the spindle.
5. Install the ball joint stud attaching nut and torque to specification. Continue to tighten the nut until the cotter pin hole is in line with the nut slots. Install a cotter pin in the lower ball joint stud.
6. Pull the shock absorber down and connect it to the *lower arm.*
7. Position and secure the strut to the lower arm. Install the nuts and torque to specification.
8. If equipped, position the stabilizer bar link to the lower arm and install a new bolt and attaching nut. Torque to specification.
9. Remove the lubrication plug using a 3/16-inch *socket wrench.*
10. Use a hand-operated, low-pressure grease gun fitted with a rubber tip and loaded with Multi-purpose Long-Life Lubricant (or equivalent).
11. Force the lubricant into the joint only until the ball joint seal can be felt or seen to swell, indicating that the seal is full of lubricant. **Do not lubricate until the lubricant escapes from the seal, because this destroys the weather-tight seal.**
12. Install the lubrication plug.
13. Install the wheel and tire.
14. Remove the safety stands and lower the vehicle.

Pinto/Bobcat/Mustang II

The Pinto/Bobcat/Mustang lower arm ball joint seal is not replaceable. If the seal has failed, the lower arm assembly must be replaced.

SPECIFICATIONS

TORQUE LIMITS—FRONT SUSPENSION (FT-LB)

Description	Mustang II/Pinto	Ford/Mercury LTD II/Thunderbird	Mark V	Lincoln
Lower Arm to No. 2 Crossmember	95-120	95-110		
Upper Arm to Frame	95-120	120-140 (2)		
Upper Arm Bumper	–	15-18		
Stabilizer Bar to Lower Arm	10-18	6-12		
Ball Joint to Spindle (Upper and Lower)	75-90 (1)	75-120 (1) — Lower 105-120; Upper 75-90		
Strut to Lower Arm	40-60	80-115		
Stabilizer Bar to Frame	14-21	14-26		
Shock Absorber Upper Attachment	22-30	22-30		
Shock Absorber to Lower Arm	60-80	12-18		
Brake Splash Shield (Disc) to Spindle	–	9-14		
Caliper to Spindle (Disc) - Upper Bolt		110-140 (90 120 LTD II/Thunderbird/Cougar)		
Caliper to Spindle (Disc) - Lower Bolt	–	90-120		
Brake Backing Plate and Cylinder Assembly to Spindle (Drum)	20-35	24-45	–	–
Strut to Frame	70-80	95-105		

(1) Torque to minimum specification, then, tighten the nut to the nearest cotter pin slot and insert the cotter pin.
(2) Ford/Mercury Police and Taxi – 130-150 Ft-Lb

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL 3290-C	Tie Rod Ball Stud Remover
T57P-3006-B	Ball Joint Remover Press
T65P-3044-A	Upper Arm Bushing Overhaul Kit
T74P-3006-A	Spindle Ball Joint Press
T74P-3044-A	Upper Arm Bushing Replacement Kit
T75P-3042-B	Ball Joint Seal Replacer (Lower)
T75P-3082-B	Ball Joint Seal Replacer (Upper)

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Front Suspension— Spring On Upper Arm

PART 14-04

Applies to Granada/Monarch/Versailles

SUBJECT	PAGE
DESCRIPTION	
Front Suspension	04-1
REMOVAL AND INSTALLATION	
Front Shock Absorber	04-6
Front Spring	04-3
Front Wheel Spindle	04-5
REMOVAL AND INSTALLATION (Cont'd.)	
Lower Arm	04-3
Lower Arm Strut and/or Insulators	04-2
Stabilizer Bar End Bushing	04-2
Stabilizer Bar Insulator	04-2
Upper Arm	04-5
SPECIFICATIONS	04-6

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DESCRIPTION

FRONT SUSPENSION

Each front wheel rotates on a spindle. The upper and lower ends of the spindle are attached to ball joints, which are mounted to an upper and lower arm. The upper arm pivots on a bushing and shaft assembly, which is bolted to the frame. The lower arm pivots on a bolt in the Number 2 crossmember (Fig. 1). A coil spring seats between the upper arm pivot seat and the top of the spring housing. A double-action shock absorber is attached to the pivot seat and the top of the spring housing.

Upper or lower suspension arms must always be replaced as a unit. Ball joints and other subcomponents should not be installed in a used suspension arm.

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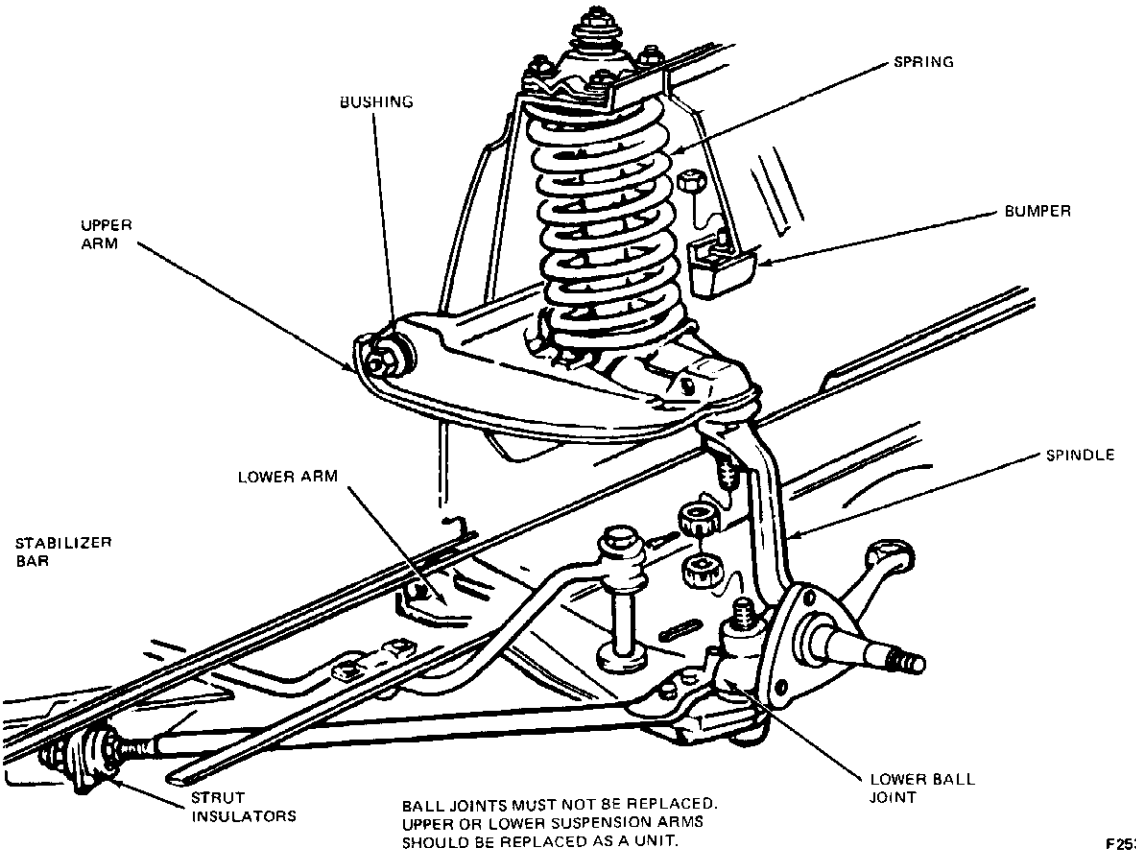


FIG. 1 Front Suspension—Granada/Monarch—Versailles Similar

REMOVAL AND INSTALLATION

STABILIZER BAR END BUSHING

Removal and Installation

To replace the end bushings on each stabilizer link, *use the following procedure.*

1. Raise the vehicle on a hoist.
2. Remove the nut, washer, and insulator from the lower end of the stabilizer bar attaching bolt.
3. Remove the bolt and the remaining washers, insulators, and the spacer.
4. Assemble a cup washer and a new insulator on the bolt.
5. Insert the bolt through the stabilizer bar, then install a new insulator and cup washer.
6. Install the spacer, cup washer, and another new insulator on the bolt (Fig. 6).
7. Insert the bolt through the lower arm and install a new insulator and cup washer. Install and torque the attaching nut to specification.

STABILIZER BAR INSULATOR

Removal and Installation

1. Raise the vehicle high enough to provide working space, and place supports under both front wheels.
2. Disconnect the stabilizer from each link. Disconnect both stabilizer attaching brackets and remove the stabilizer.
3. Coat the necessary parts of the stabilizer with RUGLYDE or a comparable lubricant, and slide new insulators onto the stabilizer.
4. Secure each end of the stabilizer bar to the lower *arm making sure that the bolt head is at the top* (Fig. 1) to eliminate interference with the brake hose.
5. Remove the supports and lower the vehicle.

LOWER ARM STRUT AND/OR INSULATORS

Removal and Installation

1. Position wood blocks under the upper arm as shown in Fig. 2.
2. Raise the vehicle, position safety stands.
3. Remove the nut from the front of the strut.
4. Remove the two nuts attaching the strut to the lower arm. Tap the strut upward to loosen the bolt serrations in the lower arm. Remove the strut.
5. With two pry bars approximately 18 inches long, one at each side at the rear of the front washer, pry it forward to separate the inner sleeve from the outer sleeve. Remove insulators, washers, inner and outer sleeves from the No. 1 crossmember (Fig. 4).
6. Install outer sleeve, rear washer (large I.D.) and rear insulator bushing on the forward end of the strut rod.

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7. Position the strut into the crossmember and to the lower suspension arm. Install the strut-to-arm attaching bolts and nuts, and torque them to specification.
8. Install the forward insulator washer (small ID), inner sleeve, and adjustment nut on the forward end of the strut. NOTE: Remove 1/4 inch from the inner sleeve prior to assembly.
9. Remove the safety stands, and lower the vehicle. Remove the wood blocks from under the upper arm.
10. Adjust the caster and camber to specification.

FRONT SPRING

Removal

1. Remove the shock absorber and upper mounting bracket as an assembly. Position wood blocks (Fig. 2).
2. Raise the vehicle on a hoist, install safety stands, and remove the wheel cover or hub cap.
3. Remove the grease cap from the hub. Remove the cotter pin, nut lock, adjusting nut, and outer bearing from the hub.
4. Remove the wheel, tire, rotor and caliper assembly from the spindle. To remove disc brake assembly see Group 12-20.
5. Install the spring compressor tool as shown in Fig. 3 and compress the spring.
6. Remove two upper arm-to-spring tower attaching nuts and swing the upper arm outboard from the spring tower (Fig. 4).
7. Release the spring compressor tool and remove the tool from the spring. Remove the spring from the vehicle.

Installation

1. Place the spring upper insulator on the spring and secure in place with tape.
2. Position the spring in the spring tower. Install the spring compressor (Fig. 3) and compress the spring.
3. Swing the upper arm inboard and insert the bolts through the holes in the side of the spring tower. Install the attaching nuts and lockwasher and torque them to specification.
4. Release the spring pressure and guide the spring into the upper arm spring seat. **The end of the spring must be no more than 1/2 inch from the tab on the spring seat.**
5. Remove the spring compressor and position the wheel, tire, and hub and drum on the spindle (Group 11). To install disc brake assembly see Group 12-20.
6. Install the bearing, washer, adjusting nut, and lock nut. Adjust the wheel bearing as outlined in Part 11-10 and install the cotter pin, grease cap, and hub cap or wheel cover.
7. Lower the vehicle and install the shock absorber and upper mounting bracket. Remove wood blocks.

LOWER ARM

Removal

1. Position wood blocks as shown in Figure 2.

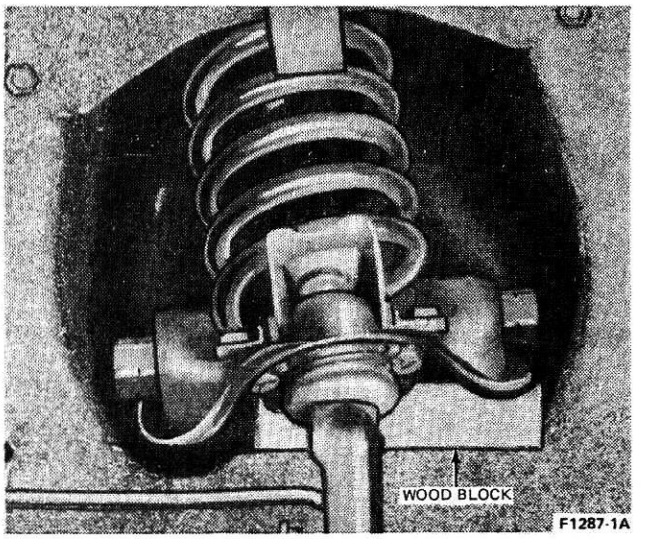


FIG. 2 Upper Arm Support

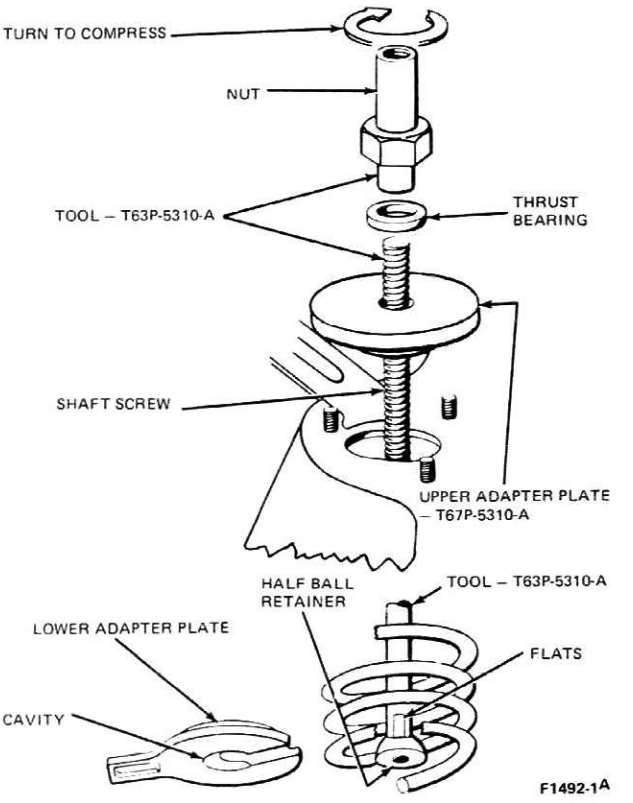
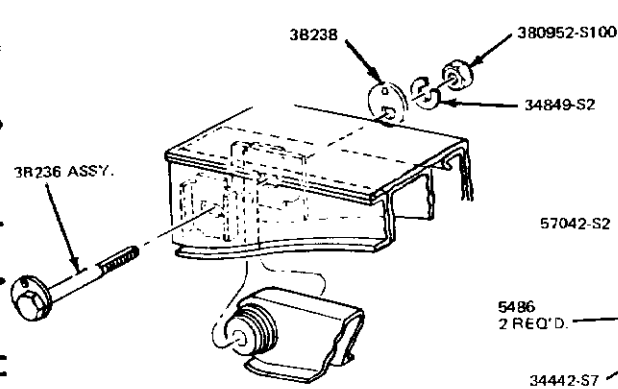


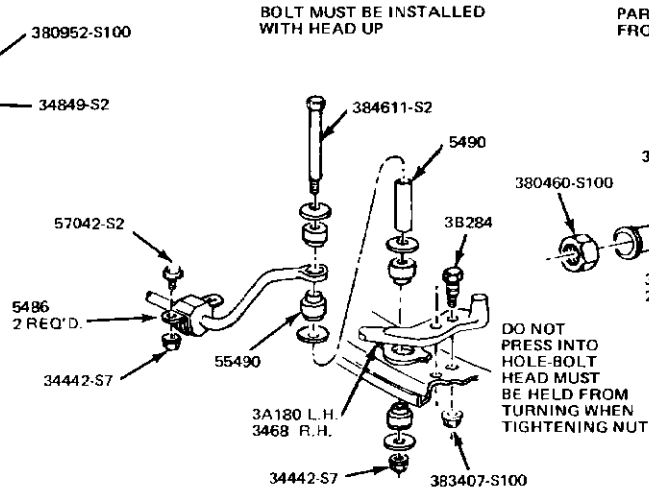
FIG. 3 Spring Compressor Tool—Installation

2. Raise the vehicle, position safety stands, and remove the wheel and tire. See Group 11.
3. Remove the stabilizer bar and link attaching nut (Fig. 4). Disconnect the bar from the link and remove the link bolt.
4. Remove the strut to lower arm attaching nuts and bolts.
5. Remove the cotter pin from the lower ball joint stud nut.
6. Loosen the lower ball joint stud nut one to two turns. **Do not remove the nut from the stud at this time.**

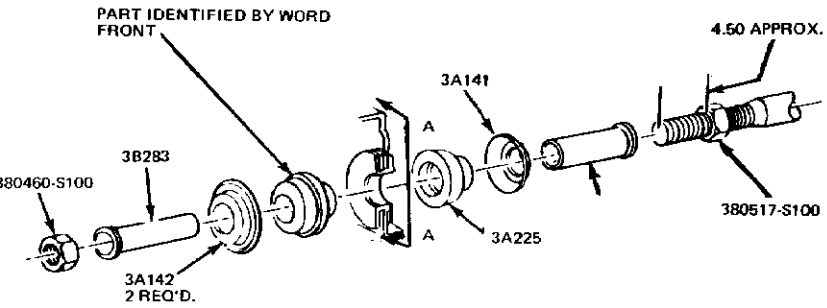
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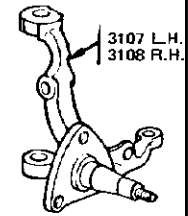
LOWER ARM ATTACHMENT



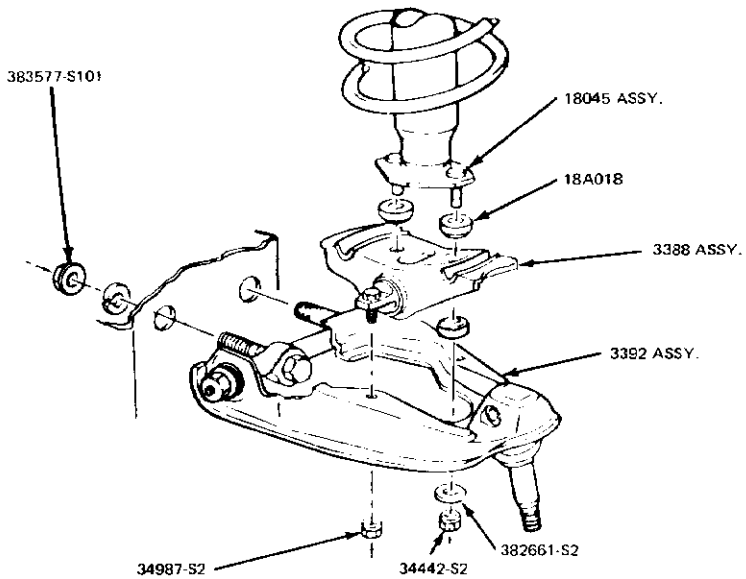
STRUT AND STABILIZER ATTACHMENT TO LOWER ARM



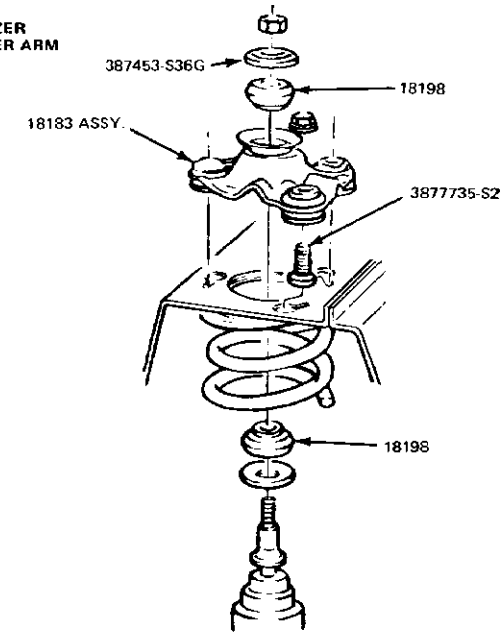
STRUT-TO-FRAME ATTACHMENT



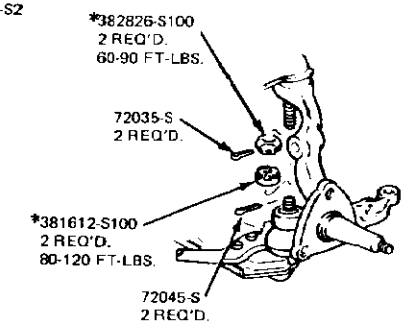
SPINDLE



UPPER ARM ATTACHMENT



SHOCK ABSORBER UPPER ATTACHMENT



SPINDLE ATTACHMENT

*NOTE:
GRANADA AND MONARCH USE 382826-S100

FIG. 4 Front Suspension Assembly—Granada, Monarch and Versailles

F2539-2B

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7. Install Tools T71P-3006-A and T60K-3006-A between upper and lower ball joint studs, against ends of studs, not nuts.
8. With a wrench, turn the adapter screw until the tool places the stud under compression. Tap the spindle near the lower stud with a hammer to loosen the stud in the spindle. **Do not loosen the stud from the spindle with tool pressure only.**
9. Remove the nut from the lower ball joint stud and lower the arm.
10. Remove the lower arm to underbody cam bolt, nut, and lock washer. Remove the lower arm.

Installation

1. Position the lower arm to the underbody bracket and install the cam bolt, lock washer, and nut loosely.
2. Raise the lower arm, guide the lower ball joint stud into the spindle bore, and install the stud attaching nut loosely.
3. Install the stabilizer link bolt, washer, bushings, and spacer. Connect the stabilizer bar to the link. Install the attaching nut and torque to specification (Fig. 6).
4. Position the strut to the lower arm. Install the attaching bolts and nuts, and torque to specification.
5. Torque the lower ball joint stud nut to specification, continue to tighten the nut until the next slot aligns with the cotter pin hole, and install a new cotter pin.
6. While holding the head of the bolt with a wrench, torque the lower arm-to-underbody pivot bolt and nut to specification.
7. Remove the safety stands and lower the vehicle.
8. Remove the wood blocks.
9. Adjust caster, camber, and toe to specification.

UPPER ARM

Upper arm shaft and bushing may not be disassembled on these vehicles. The entire upper arm assembly must be replaced as a unit.

Removal

1. Position wood blocks (Fig. 2). Raise the vehicle, position safety stands under the frame and lower the vehicle slightly.
2. Remove the wheel and tire. See Group 11.
3. Remove the shock absorber lower attaching nuts and washers.
4. Remove the shock absorber upper mounting bracket attaching nuts and remove the shock absorber and bracket as an assembly (Fig. 4).

   On all 8-cylinder vehicles, remove the air cleaner to obtain access for tool installation.
5. Install the spring compressor tool and compress the spring (Fig. 3).
6. Position a safety stand under the lower arm.
7. Remove the cotter pin from the nut on the upper ball joint stud, and loosen the nut one or two turns. **Do not remove the nut from the stud at this time.**
8. Position the appropriate ball joint remover tool between the upper and lower ball joint studs. **The tool should seat firmly against the ends of both studs and not against the stud nuts.**
9. Turn the tool with a wrench until the tool places the studs under considerable compression; then, hit the spindle sharply near the upper stud with a hammer to break the stud loose in the spindle. **Do not loosen the stud in the spindle with tool pressure only.**
10. Remove the nut from the upper stud and lift the stud out of the spindle.
11. Remove the upper arm inner shaft attaching nuts from the engine compartment and remove the upper arm.
12. Wipe off all loose dirt from the upper arm parts. **Do not wash the ball joint with a solvent.**

Installation

1. Position the upper arm and spring seat assembly to the spring tower and install the nuts on the two inner shaft attaching bolts. Torque the nuts to specification.
2. Position the upper ball joint stud in the top of the wheel spindle, and install the stud nut. Torque the nut to specification, and continue to tighten it until the next slot aligns with the cotter pin hole. Install a new cotter pin.
3. Release the coil spring, remove the tool, and install the front shock absorber and the wheel and tire (Group 11).
4. Remove safety stands and lower vehicle. Remove wood blocks.
5. If the upper arm is being replaced due to accidental damage, check caster, camber and toe and adjust as required (Part 14-01).

FRONT WHEEL SPINDLE

Removal

1. Position wood blocks between the upper arm and frame (Fig. 2), then raise the vehicle and position safety stands.
2. Remove the two bolts attaching the caliper to the spindle. Remove the caliper from the rotor (Group 12) and wire it to the underbody to prevent damage to the brake hose.
3. Remove the grease cap from the hub, then remove the cotter pin, nut lock, adjusting nut, washer, and outer bearing cone and roller assembly.
4. Pull the hub and rotor assembly off the wheel spindle (Group 11).
5. Remove the three caliper shield attaching bolts and remove the shield.
6. Disconnect the spindle connecting rod (tie rod) end from the spindle arm using Tool-3290-C.
7. Remove the cotter pins from both ball joint stud nuts, and loosen the nuts one or two turns. **Do not remove the nuts from the studs at this time.**
8. Position the appropriate ball joint remover tool between the upper and lower ball joint studs. **The tool should seat firmly against the ends of both studs and not against the stud nuts.**

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9. Turn the tool with a wrench until the tool places the studs under considerable tension, and, with a hammer, sharply hit the spindle near the studs to break them loose in the spindle. **Do not loosen the studs in the spindle with tool pressure alone.**
10. Position a floor jack under the lower arm.
11. Remove the upper and lower ball joint stud nuts, lower the jack and remove the spindle.

Installation

1. Position the spindle on the lower ball joint stud and install the stud nut (Fig. 4). Torque the nut to specification. Continue tightening until the next slot aligns with the cotter pin hole and install a new cotter pin.
2. Raise the lower arm, and guide the upper ball joint stud into the spindle. Install the stud nut.
3. Torque the nut to specifications and install a new cotter pin. Remove the floor jack.
4. Connect the spindle connecting rod (tie rod) end to the spindle arm and install the attaching nut. Torque the nut to specification and install a new cotter pin.
5. Position the caliper splash shield to the spindle and install the attaching bolts and nuts. Torque the nuts and bolts to specification.
6. Install the hub and rotor on the spindle. Position the caliper to the rotor and spindle and install the attaching bolts (Group 12). Torque the bolts to specification. Install the wheel and tire on the hub and adjust the wheel bearing (Group 11).
7. Install the hub cap or wheel cover.
8. Remove the safety stands, and lower the vehicle.
9. Remove the wood blocks from between the upper arm and frame.
10. If the spindle is being replaced due to accidental damage, check and adjust caster, camber and toe-in as required.

FRONT SHOCK ABSORBER

Removal

1. Raise the hood and remove three shock absorber upper mounting bracket-to-spring tower attaching nuts. Position wood blocks (Fig. 2).
2. Raise the front of the vehicle and place safety stands under the lower arms.
3. Remove the shock absorber lower attaching nuts, washers and insulators.
4. Lift the shock absorber and upper bracket from the spring tower (Fig. 4) and remove the bracket from the shock absorber. Remove the insulators from the lower attaching studs.

Installation

1. Install the upper mounting bracket on the shock absorber and torque to specification. Install the insulators on the lower attaching studs.
2. Position the shock absorber and upper mounting bracket in the spring tower, making sure the shock absorber lower studs are in the pivot plate holes.
3. Install the two nuts on the shock absorber lower studs, and torque to specification.
4. Install the three shock absorber upper mounting bracket-to-spring tower attaching nuts, and torque to specification. Then, remove the safety stands and lower the vehicle. Remove wood blocks (Fig. 2).

TORQUE LIMITS – FRONT SUSPENSION (FT-LB)

Description	
Shock Absorber Upper Attachment	10-16
Shock Absorber Upper Bracket to Body	32-48
Front Suspension Compression Bumper to Body	12-20
Brake Backing Plate to Spindle – Disc	9-14
Upper Arm to Body	110-130
Spring Seat to Upper Arm	25-40
Shock Absorber to Spring Seat	8-12
Ball Joint to Spindle (Upper and Lower)	75-90 (1) (2)
Wheel Bearing Adjusting Nut	Refer to Part 11-10
Strut to Lower Arm	90-115
Lower Arm to Underbody	85-100
Stabilizer Bar Mounting Bracket to Underbody	6-12
Strut to Underbody	70-80
Stabilizer Bar to Lower Arm	6-12
Caliper to Spindle (Disc Brake) – Upper	90-120
– Lower	90-120

(1) Torque to minimum specification, then tighten nut to nearest cotter pin slot and insert cotter pin.
(2) Versailles lower ball joint to spindle torque – 80-120 ft-lb.

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL-3290-C	Tie Rod Ball Stud Remover
T63P-5310-A	Front Coil Spring Assembly Remover and Replacer
T67P-5310-A	Front Coil Spring Remover and Replacer Adapter
T60K-3006-A	Spindle Ball Joint Press Adapter Screw
T71P-3006-A	Ball Joint Press

CF1679-2E

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Front Suspension - Single Arm

PART 14-05

Applies To Fairmont/Zephyr

SUBJECT	PAGE
ADJUSTMENTS	
Non-Adjustable Suspension.	
Refer to Parts 13-32 or 13-45	
For Toe Adjustment.	
DESCRIPTION	05-1
REMOVAL AND INSTALLATION	
Ball Joint	05-3

SUBJECT	PAGE
REMOVAL AND INSTALLATION (Cont'd.)	
Front Spring	05-2
Lower Suspension Arm	05-4
Shock Strut	05-3
Shock Strut Dust Shield	05-4
Spindle Assembly	05-3
Stabilizer Bar Link Insulators	05-2
Stabilizer Bar and/or Insulator	05-2

CF2654-2A

DESCRIPTION

This front suspension (Fig. 1) is a modified MacPherson strut design. The design utilizes shock struts with coil springs mounted between the lower arm and a spring pocket in the No. 2 crossmember. The shock struts are non-repairable and must be replaced as a unit. The ball joints and lower suspension arm bushings are not separately serviced and must be replaced as a suspension arm, bushing and ball joint assembly. The ball joint seal is available for service, however, and can be replaced.

ADJUSTMENTS

Caster and Camber angles of this suspension are set at the factory and cannot be adjusted in the field. Toe is adjusted similar to Pinto/Mustang II/Bobcat, using the procedure given in Part 14-01.

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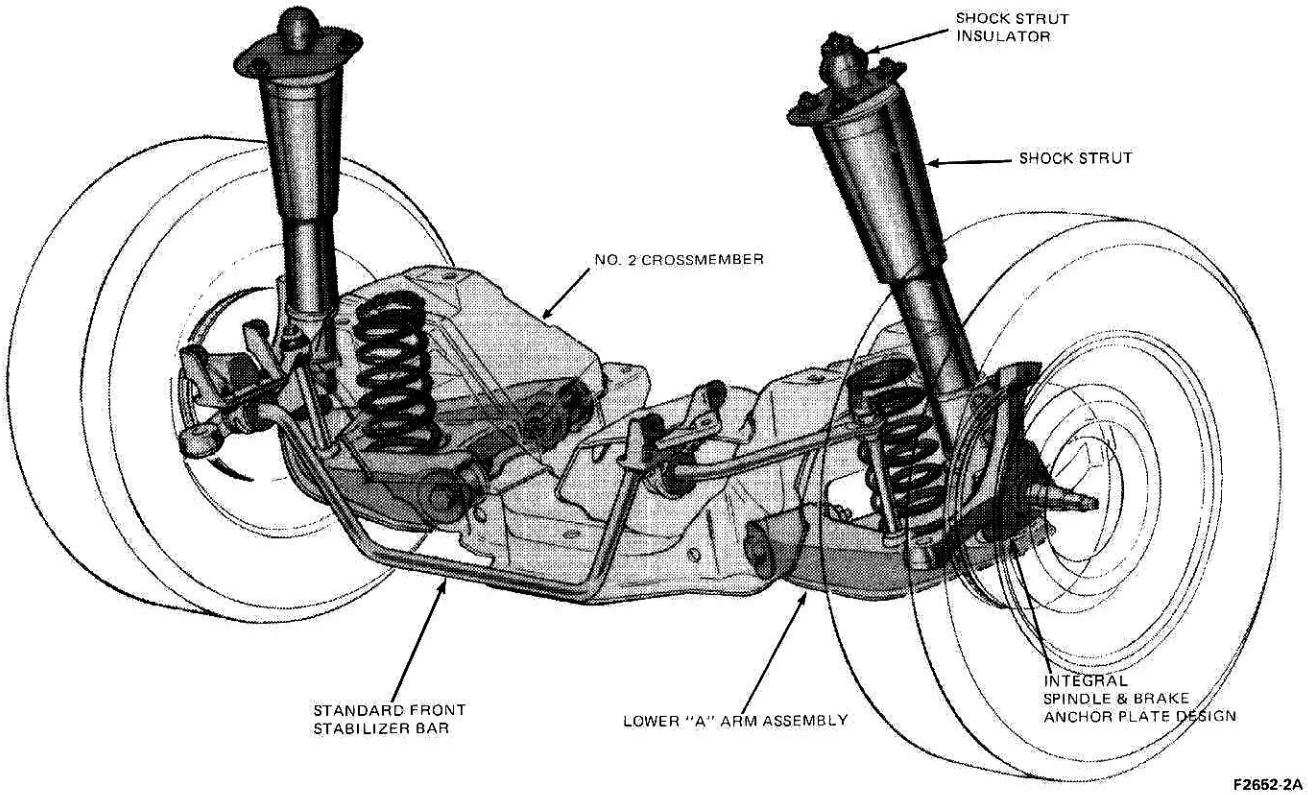


FIG. 1 Single Arm Front Suspension

REMOVAL AND INSTALLATION

(REFER TO FIG. 2)

STABILIZER BAR LINK INSULATORS

Removal

To replace the link insulators on each stabilizer link, use the following procedure:

1. Raise the vehicle on a hoist.
2. Remove the nut, washer and insulator from the upper end of the stabilizer bar attaching bolt.
3. Remove the bolt and the remaining washers, insulators and spacer.

Installation

1. Install the stabilizer bar link insulators by reversing the above steps.
2. Torque the attaching nut to 9-12 ft-lbs.

STABILIZER BAR AND/OR INSULATOR

Removal

1. Raise the vehicle on a hoist, and place jack stands under the lower arm.
2. Disconnect the stabilizer from each stabilizer link, both stabilizer insulator attaching clamps and remove the stabilizer bar assembly.
3. Cut the worn insulators and plastic sleeves from the stabilizer bar.

Installation

1. Coat the necessary parts of the stabilizer bar with Ruglyde or an equivalent lubricant; install new plastic sleeves with the flange inboard and slide insulators onto the stabilizer bar and over sleeves.
2. Using a new nut and bolt, secure each end of the stabilizer bar to the lower suspension arm making sure the bolt head is at the bottom. Torque these nuts to 9-12 ft-lbs.
3. Using new fasteners, clamp the stabilizer bar to the attaching brackets on the side rail. Torque these bolts to 20-26 ft-lb.
4. Remove the supports and lower the vehicle.

FRONT SPRING

Removal

1. Raise the front of the vehicle and position safety stands under both sides at the jack pads just back of the lower arms. Remove the wheel and tire assembly.
2. Disconnect the stabilizer bar link from the lower arm.
3. Remove the disc brake caliper rotor assembly dust shield as outlined in Part 12-20.
4. Place a floor jack under the lower arm at the bushing area supporting the arm under both

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DETROIT IRON

bushings. Remove the steering gear bolts and move the steering gear out of the way.

5. Remove the two lower arm to crossmember bolts and nuts.
6. Lower the floor jack slowly to relieve spring tension and remove the spring.

Installation

1. Place the upper spring insulation on the spring and secure with tape.
2. Install the spring damper inside the spring.
3. Install the rubber hose over the last coil.
4. Position the coil spring in the upper spring pocket. Be sure the end of the spring is properly positioned in the depression of the lower arm; i.e., between the two holes in the arm.
5. Carefully raise the lower arm with the floor jack until the lower arm can be attached to the crossmember.
6. Install the lower arm to crossmember bolts and nuts (2).
7. Install the steering gear bolts and torque to specifications.
8. Remove the floor jack.
9. Install the brake dust shield, rotor and caliper assembly as outlined in Part 12-20.
10. Install the stabilizer bar link, torque nut to 9-12 ft-lb.
11. Install the wheel and tire assembly.
12. Remove the safety stands and lower the vehicle.
13. Torque lower arm nuts to 200-220 ft-lb with front suspension in curb position.

SHOCK STRUT

Removal

1. Raise the front of the vehicle and position safety stands under both sides at the jacking pads just back of the lower arms.
2. Remove wheel and tire assembly.
3. Place a floor jack under the lower arm.
4. Raise the jack to compress the coil spring.
5. Remove the two lower shock strut bolts and nuts that attach the shock strut to the spindle. Leave the shock strut in position at this time.
6. From the engine compartment remove the three upper shock strut mounting nuts.
7. Compress the shock strut to clear the upper mounting and remove the shock strut.

Installation

1. Place the lower portion of the shock strut into the spindle, and extend the strut until the upper strut retaining bolts are in position at the upper mounting in the body.
2. Install the three upper shock strut retaining nuts and torque to 60-75 ft-lb.
3. Install the two lower shock strut retaining bolts and nuts and torque to 150-180 ft-lb.
4. Lower the floor jack and remove from the working area.
5. Install the wheel and tire assembly.
6. Remove the safety stands and lower the vehicle.

SPINDLE ASSEMBLY

Removal

1. Raise the front of the vehicle and position safety stands under both sides at the jacking pads just back of the lower arms.
2. Remove the wheel and tire assembly.
3. Remove the brake caliper, rotor and dust shield, as outlined in Part 12-20.
4. Remove the stabilizer link from the lower arm assembly.
5. Remove the tie-rod end from the spindle with Tool 3290-C.
6. Remove the cotter pin from the ball joint stud nut, and loosen the ball joint nut one or two turns.

CAUTION: DO NOT REMOVE THE NUT FROM THE BALL JOINT STUD AT THIS TIME.

7. Tap the spindle boss smartly to relieve the stud pressure.
8. Place a floor jack under the lower arm, compress the coil spring and remove the stud nut.
9. Remove the two bolts and nuts that attach the spindle to the shock strut. Compress the shock strut until working clearance is obtained.
10. Remove the spindle assembly.

Installation

1. Place the spindle on the ball joint stud and install the stud nut. Do not torque at this time.
2. Lower the shock strut until the attaching holes are in line with the holes in the spindle. Install the two bolts and nuts.
3. Torque the ball joint stud nut to 100-120 ft-lb and install the cotter pin.
4. Torque the shock strut to spindle attaching nuts to 150-180 ft-lb.
5. Lower the floor jack from under the suspension arm and remove the jack.
6. Install the stabilizer link and torque the attaching bolt and nut to 9-12 ft-lb.
7. Attach the tie-rod end and torque the retaining nut 35-47 ft-lb.
8. Install the disc brake dust shield, rotor, and caliper as outlined in Part 12-20.
9. Install the wheel and tire assembly.
10. Remove the safety stands, and lower the vehicle.

BALL JOINT SEAL

Removal

1. Raise the front of the vehicle and position safety stands under both sides at the jacking pads just back of the lower arms.
2. Remove the wheel and tire assembly.
3. Remove the brake caliper, rotor and dust shield, as outlined in Part 12-20.
4. Remove the tie-rod end from the spindle with Tool 3290-C.

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5. Remove the cotter pin from the ball joint stud nut, and loosen the ball joint nut one or two turns.

CAUTION: DO NOT REMOVE THE NUT FROM THE BALL JOINT STUD AT THIS TIME.

6. Tap the spindle boss smartly to relieve the stud pressure.
7. Place a floor jack under the lower suspension arm and compress the coil spring.
8. Remove the ball joint stud nut and raise the spindle off of the ball joint.
9. Using a screwdriver, pry the ball joint seal off.
10. Wipe off any remaining lubricant from the ball joint stud. The ball joint socket must be completely free of lubricant to be sure the new seal seats properly.

Installation

1. Insert the new seal into the seal installer, Tool No. T74P-3082-B.
2. Place the tool and seal on the ball joint stud, and install the stud nut.
3. Tighten the nut until the ball joint seal is firmly seated. Remove the nut and tool.
4. Place the spindle on the ball joint.
5. Install the ball joint stud nut and torque to 100-120 ft-lb. Install the cotter pin. Remove the floor jack.
6. Connect the tie-rod end, and install the nut. Torque to 35-47 ft-lb. Install the cotter pin.
7. With a hand operated low pressure grease gun, force the specified lubircant into the joint only until the ball joint seal can be felt or seen to swell slightly. Do not over-inflate seal with lubricant.
8. Install the brake dust shield, rotor and caliper as outlined in Part 12-20.
9. Install the wheel and tire assembly.
10. Remove the safety stands and lower the vehicle.

LOWER SUSPENSION ARM

Removal

1. Raise the front of the vehicle and position safety stands under both sides at the jack pads, just back of the lower arms.
2. Remove the wheel and tire assembly.
3. Disconnect the stabilizer bar link from the lower arm.
4. Remove the disc brake caliper rotor and dust shield as outlined in Part 12-20.
5. Remove the steering gears bolts and position out of way.
6. Remove the tie-rod end from the spindle with Tool 3290-C. Place floor jack under lower arm, supporting arm at both bushings. Remove both lower arm bolts, lower jack and remove coil spring as outlined in Front Spring Removal Procedure.
7. Remove the cotter pin from the ball joint stud nut, and loosen the ball joint nut one or two turns.
8. Tap the spindle boss smartly to relieve the stud pressure. Loosen steering gear bolts, shift gear to allow access to suspension arm bolts.
9. Remove ball joint nut and remove arm assembly.

Installation

1. Place the new arm assemlby into spindle and torque ball joint nut to 80-120 ft-lb. Install cotter pin.
2. Position the coil spring in the upper spring pocket. Be sure the insulator is on top of the spring, and the lower end (pigtail) is properly positioned (between two holes) in the depression of the lower arm.
3. Carefully raise the lower arm with the floor jack until the bushings are properly positioned in the crossmember.
4. Install the lower arm bolts and nut.
5. Install the steering gear bolts and torque to specification.
6. Connect the tie-rod end, and install the nut. Torque to 35-47 ft-lb.
7. Connect the stabilizer link bolt and nut. Torque to 9-12 ft-lb.
8. Install the brake dust shield, rotor and caliper as outlined in Part 12-20.
9. Install the wheel and tire assembly.
10. Remove the safety stands and lower the vehicle. After the vehicle has been lowered to the floor and at curb height, torque the lower arm nuts to 200-220 ft-lb.

SHOCK STRUT DUST SHIELD

Removal

1. Raise the front of the vehicle, and place safety stands under both sides at the jacking pads.
2. Remove the wheel and tire assembly.
3. Remove the disc brake caliper, rotor and dust shield as outlined in Part 12-20.
4. Place a floor jack under the lower arm to compress the coil spring when the shock strut is disconnected.
5. Remove the three upper shock strut retaining nuts and compress the shock strut.
6. Remove the two lower shock strut mounting bolts and nuts that attach the shock strut to the spindle and remove the shock strut.
7. Remove the nut at the top of the shock strut. It may be necessary to place a screwdriver in the slot at the top of the rod while turning the nut.
8. Remove the conical washers, insulators and mounting bracket.
9. Remove the dust shield clamp and slide the dust shield over the top of the shock strut.

Installation

1. Place the new dust shield over the top of the shock strut and install a new retaining clamp.
2. Position the mounting bracket over the shock rod, and install the conical washers and insulators.
3. Place the nut on the shock rod and tighten.
4. Place the lower portion of the shock strut into the spindle and install the retaining bolts and nuts.
5. Extend the shock until the upper mounting bolts are in place, and install the the retaining nuts.
6. Torque the upper retaining nuts to 40-75 ft-lb.
7. Torque the lower retaining nuts to 150-180 ft-lb.

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8. Lower the floor jack and remove from the work area.
9. Install the disc brake dust shield, rotor, and caliper assembly as outlined in Part 12-20.
10. Install the wheel and tire assembly.
11. Remove the safety stands and lower the vehicle.

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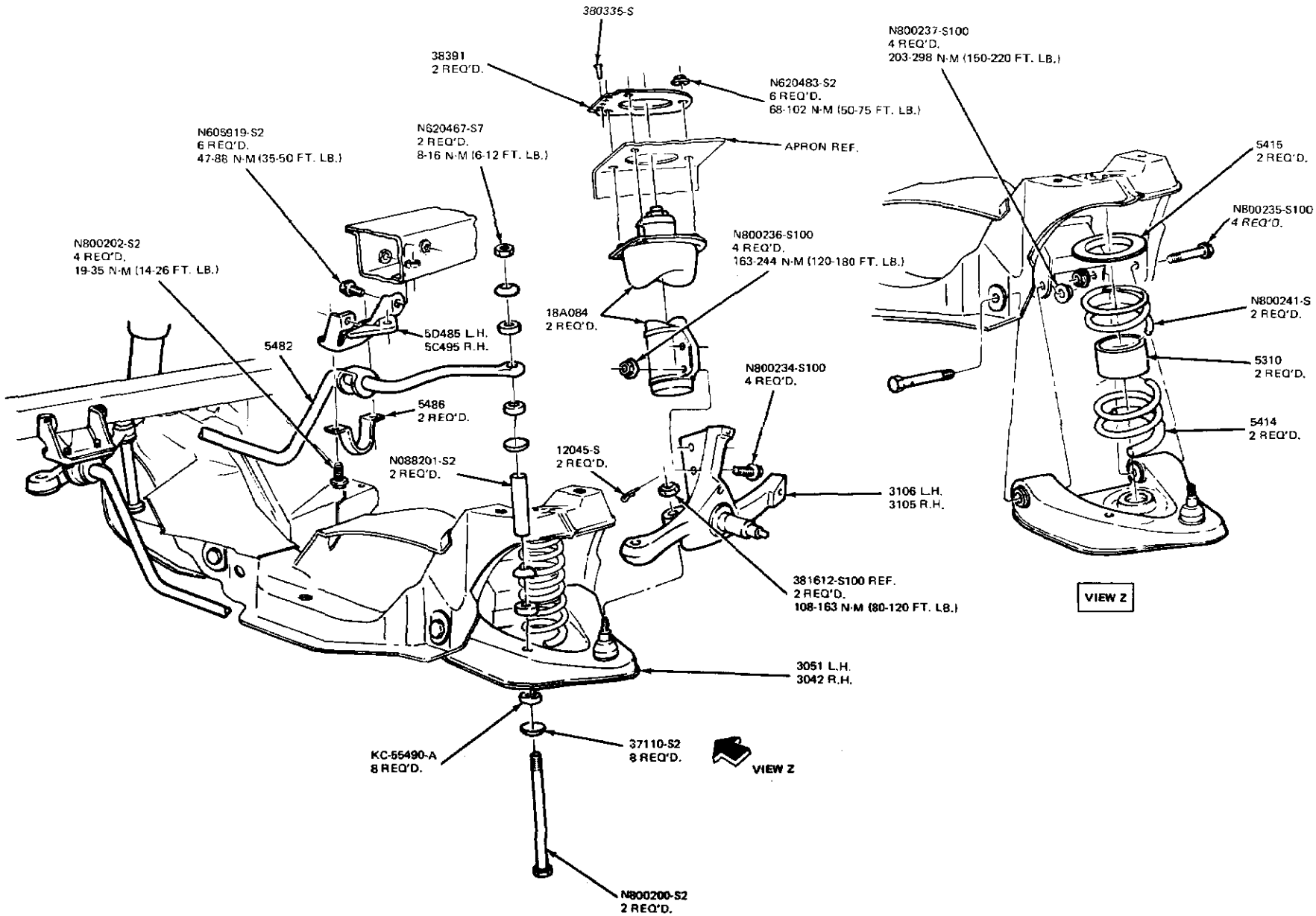


FIG. 2 Single Arm Front Suspension—Exploded View

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DETROIT IRON

Rear Suspension — Leaf Springs

PART 14-30

Applies To Granada/Monarch/Versailles, Mustang II/Pinto/Bobcat

SUBJECT	PAGE
DESCRIPTION	
Rear Suspension	30-1
REMOVAL AND INSTALLATION	
Rear Shock Absorber	30-1
Rear Spring	30-2
SPECIFICATIONS AND SPECIAL TOOLS	30-9

CF2523-2B

DESCRIPTION

REAR SUSPENSION

Each rear wheel, hub and brake drum assembly is bolted to the rear axle shaft flange. The wheel and axle shaft assembly rotates in the rear axle housing. Two spring pads, integral with the axle housing, rest on two leaf spring assemblies. The axle housing is fastened to the center of the springs by spring clips (U-bolts), retainers, and nuts (Figs. 1, 2, 3, 4, and 5). Each spring assembly is attached to the underbody side rail by hanger and shackle assemblies at the rear and bolted to a bracket at the front. The integral mounting stud at the upper end of each shock absorber is attached through insulators to the crossmember or a bracket bolted to the crossmember. The lower end is mounted through insulators to the U-bolt plate.

REMOVAL AND INSTALLATION

REAR SHOCK ABSORBER

Granada, Monarch and Versailles

Removal and Installation

All used nuts and bolts must be discarded and replaced with new parts when replacing a rear suspension shock absorber.

1. Remove the lower end of the shock absorber from the U-bolt plate.
2. Remove the nut that fastens the upper end of the shock absorber to the mounting bracket (Figs. 1 and 2).
3. Compress the shock absorber and remove it from the vehicle.
4. Transfer the washers and bushings to the new shock absorber. Insert the stud on the upper end of the shock absorber through the mounting bracket. Install the new attaching nut finger tight.
5. Compress the shock absorber and assemble the lower end to the U-bolt plate together with the washers and bushings. Torque the new attaching nut to specification.
6. Torque the upper attaching nut to specification.

Mustang II/Pinto/Bobcat Sedan

Removal and Installation

1. Disconnect the lower end of the shock absorber from the U-bolt plate.

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2. Remove the bolts retaining the mounting bracket at the upper end of the shock absorber (Figs. 3 and 4).
3. Compress the shock absorber and remove it from the vehicle. Remove the attaching bracket, nut, bushings and washers from the shock absorber studs.
4. Transfer the washers, bushings, and attaching bracket to the new shock absorber. Torque the new upper nut to specification.
5. Attach the mounting bracket at the upper end of the shock absorber to the underbody with the three new attaching bolts. Torque to specification.
6. Install the lower end of the shock absorber with bushings and washers to the U-bolt plate Torque the new lower nut to specification.

Pinto/Bobcat—Station Wagon

Removal and Installation

1. Disconnect the lower end of the shock absorber from the U-bolt plate
2. Remove the 2 bolts retaining the shock absorber on the upper end to the body member (Fig. 5).
3. Compress the shock absorber and remove it from the vehicle. Remove the attaching nuts, bushings, and washers from the stud end of the shock absorber.
4. Transfer the washers and bushings to the new shock absorber. Torque the 2 new upper attaching bolts to specification.
5. Install the lower end of the shock absorber to the U-bolt plate along with bushings and washers. Torque the new lower nut to specification.

Mustang II—Rear Stabilizer Bar

Removal and Installation

1. Raise the vehicle with a floor jack at the axle housing.
2. Remove the nuts attaching the stabilizer bar assembly to the rear bracket and link assemblies at both sides (Fig. 6).
3. Remove the bolts attaching the bracket assembly to the rear spring "U" bolt plates on both sides.
4. Remove the stabilizer bar from the vehicle.
5. Place new insulators on the stabilizer bar and position the stabilizer bar in the vehicle. The color-coded end of the bar must be on the left-hand side.
6. Install the bolts retaining the bracket assemblies to the rear spring "U" bolt plates, both sides. Torque to specification.
7. Install the nuts retaining the stabilizer bar assembly to the rear bracket and link assemblies at both sides. Torque to specification.
8. Lower the vehicle.

REAR SPRING

Removal

1. Raise the vehicle on a hoist and place supports beneath the underbody and under the axle.
2. Disconnect the lower end of the shock absorber from the U-bolt plate and push the shock out of the way. Remove the supports from under the axle.
3. Remove the U-bolt plate nuts from the "U" bolts; then, remove the plate (Figs. 1 tru 5). Raise the rear axle just enough to remove the weight from the spring.
4. Remove the two attaching nuts, and rear shackle bar, and the two shackle inner bushings.
5. Remove the rear shackle assembly and the two outer bushings.
6. Remove the front hanger bolt and nut from the eye at the forward end of the spring. Lift out the spring assembly.
7. If the front bushings is being replaced, assemble the special tool combination to the bushing in the spring front eye as shown in Fig. 7.
8. While holding nut, tighten the bolt against thrust washer, adapter, and detail A1. This operation will force the bushing out of the spring eye into detail A4 of the tool as shown (Fig. 7).

Installation

When replacing a rear suspension leaf spring assembly, all used attaching parts must be discarded and replaced with new parts.

1. Assemble the bushing and the special tool combination to the spring front eye (Fig. 7).
2. While holding the tool nut, tighten the bolt against the thrust washer, adapter and detail A4 to force the bushing into the spring eye as shown.

   On all vehicles the front eye bushing must be staked in place after installation. Bushing assembly to be installed in spring front eye with scallop and S identification symbol in line with main leaf of spring, where applicable. Stake in four places on each side as shown (Fig. 8) to prevent bushing movement.
3. Position the spring under the rear axle and insert the shackle assembly into the rear hanger bracket and the rear eye of the spring.
4. Install the shackle inner bushings, (after lubricating them with B6A-19853-A lubricant or equivalent) the shackle plate, and the locknuts. Tighten the locknuts fingertight.
5. Position the spring front eye in the front hanger. Install retainer and insulators on spring (if so equipped). Lubricate isoclamp insulators with B6A-19853-A lubricant or equivalent or soap and water solution prior to installation. From the inboard side, insert the bolt through the hanger and eye. Install the locknut on the hanger bolt fingertight.

   NOTE: Do not use oil or grease to lubricate rubber bushings or isoclamp insulators as these lubricants will cause rubber deterioration.
6. Lower the rear axle until it rests on the spring. Position the U-bolt plate on the U-bolts. Install the U-bolt nuts and torque to specification.
7. Connect the lower end of the shock absorber to the U-bolt plate using a new nut.
8. Place safety stands under the rear axle, lower the vehicle until the spring is in the approximate curb load position, and then torque the front hanger bolt head to specification.
9. Torque the rear shackle locknuts to specification.
10. Remove the safety stands and lower the vehicle.

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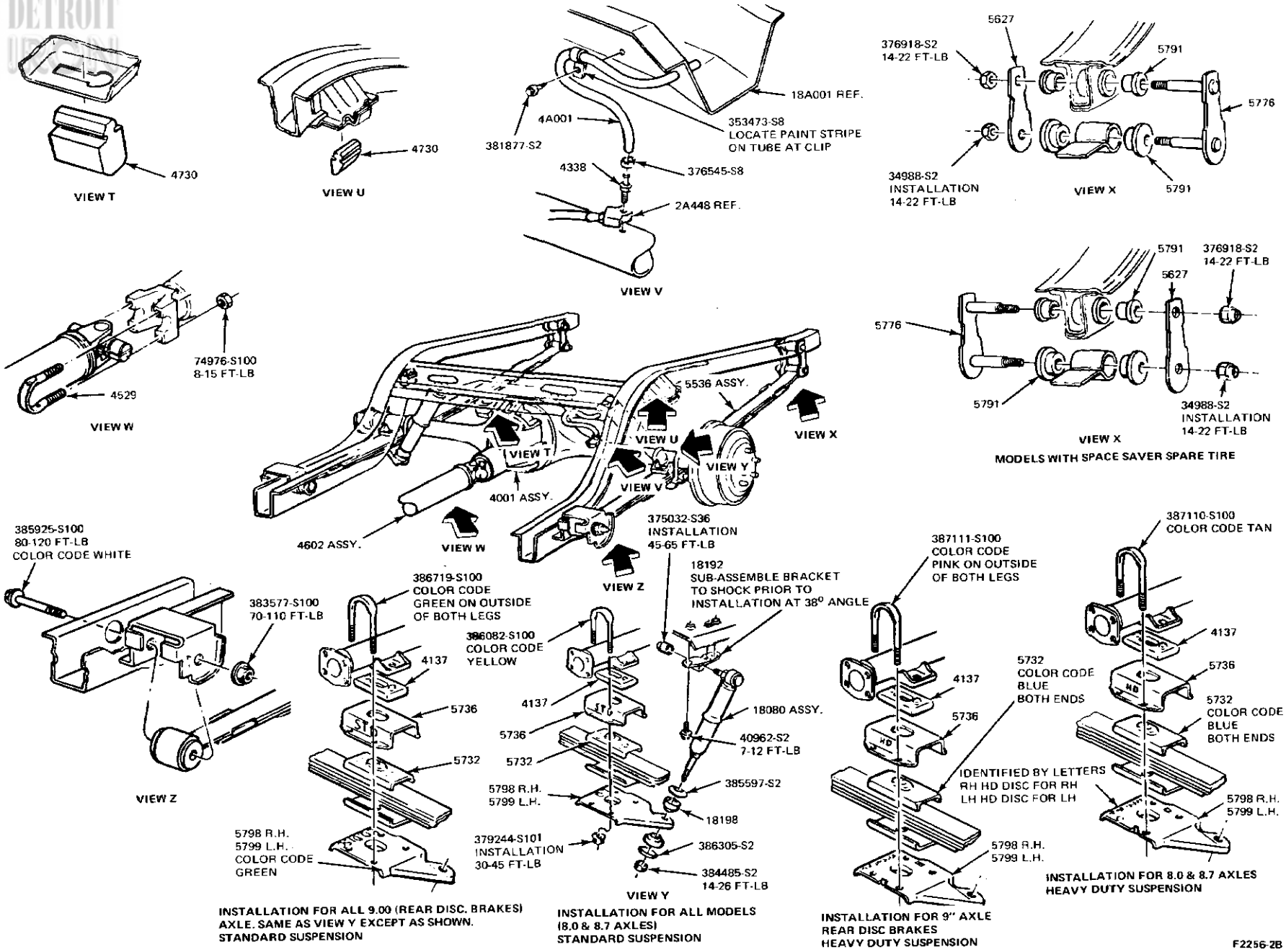


FIG. 1 Rear Suspension—Versailles

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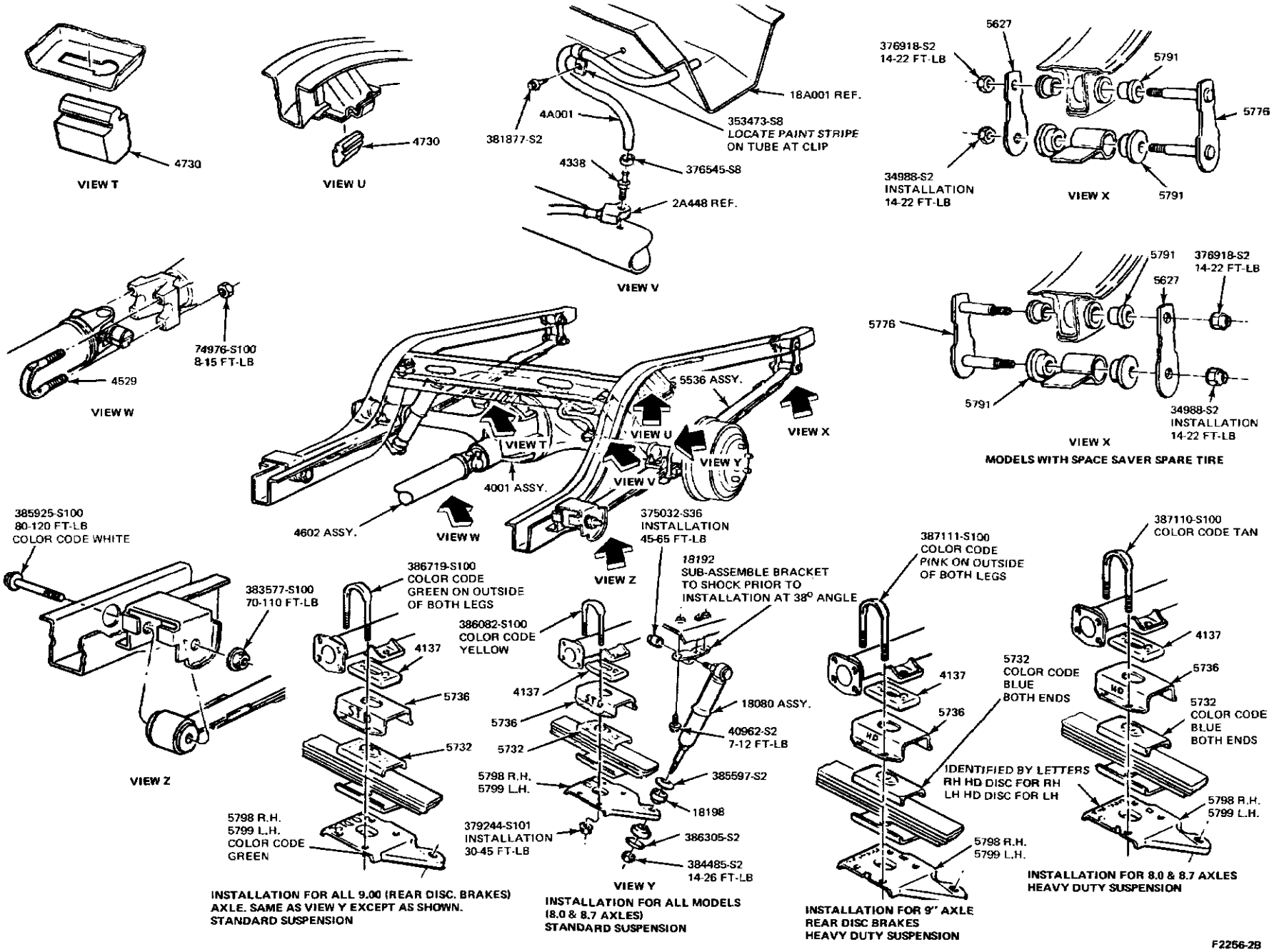


FIG. 2 Rear Suspension—Granada and Monarch

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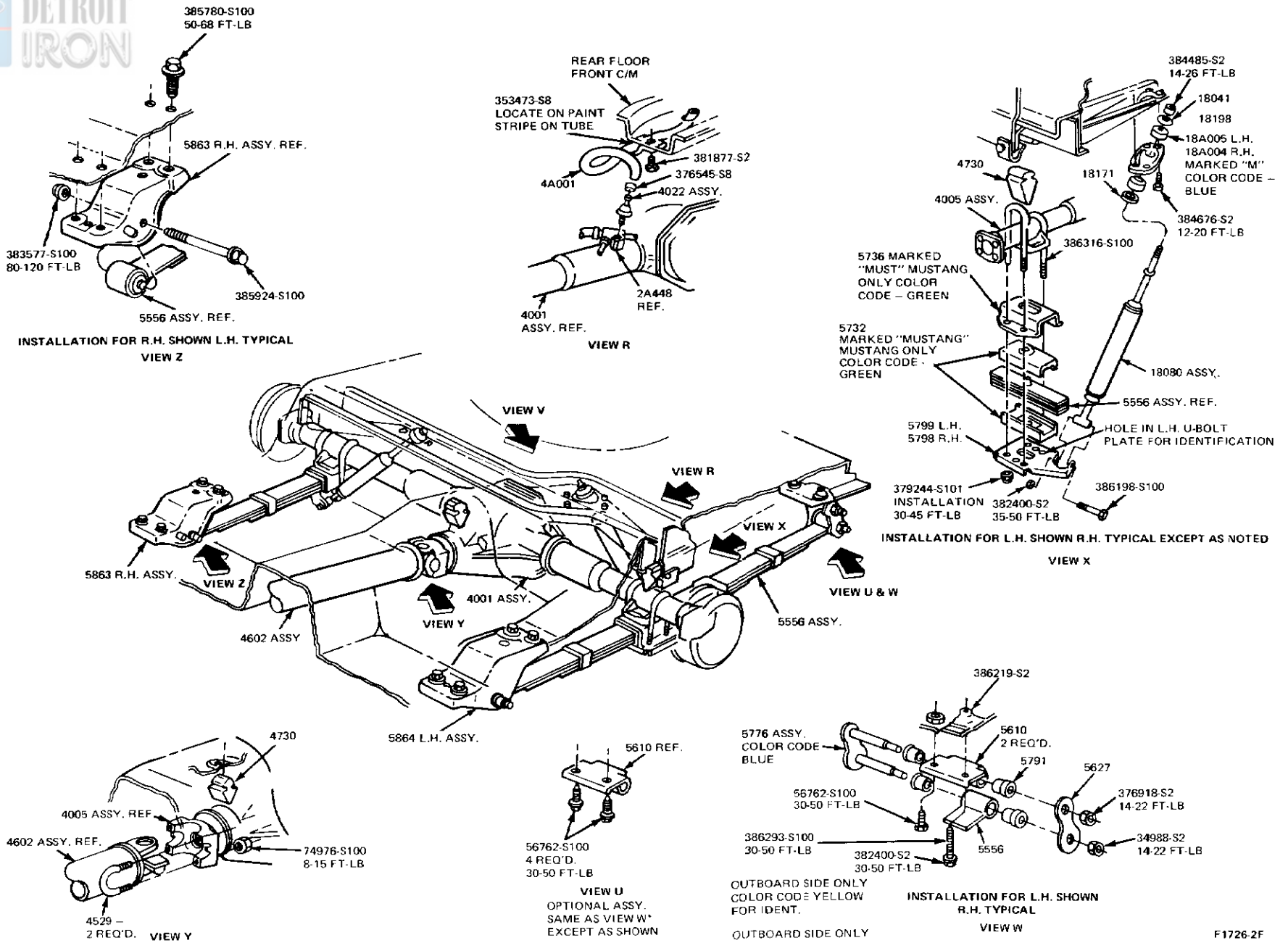


FIG. 3 Rear Suspension—Mustang II

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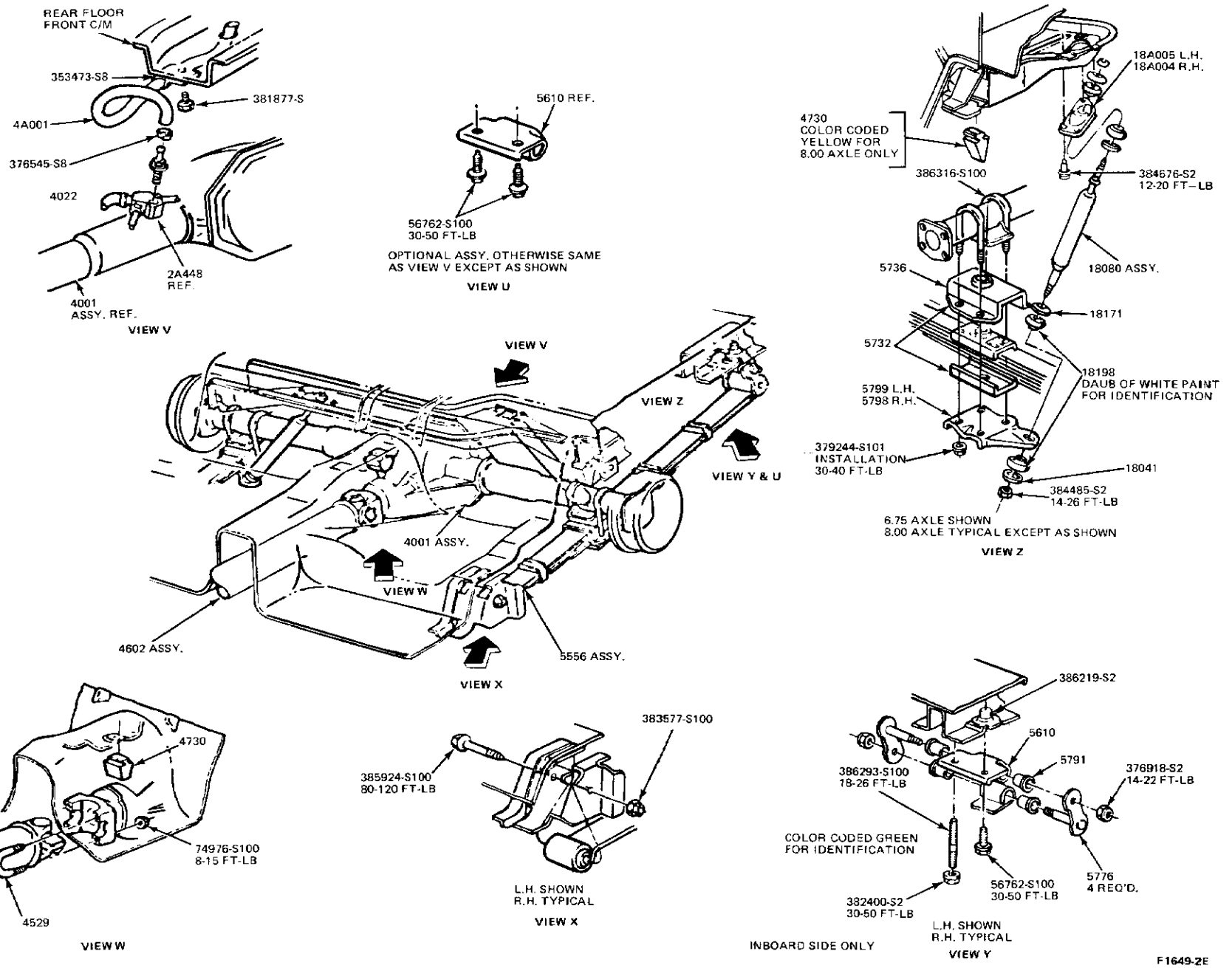


FIG. 4 Rear Suspension—Pinto and Bobcat Sedan

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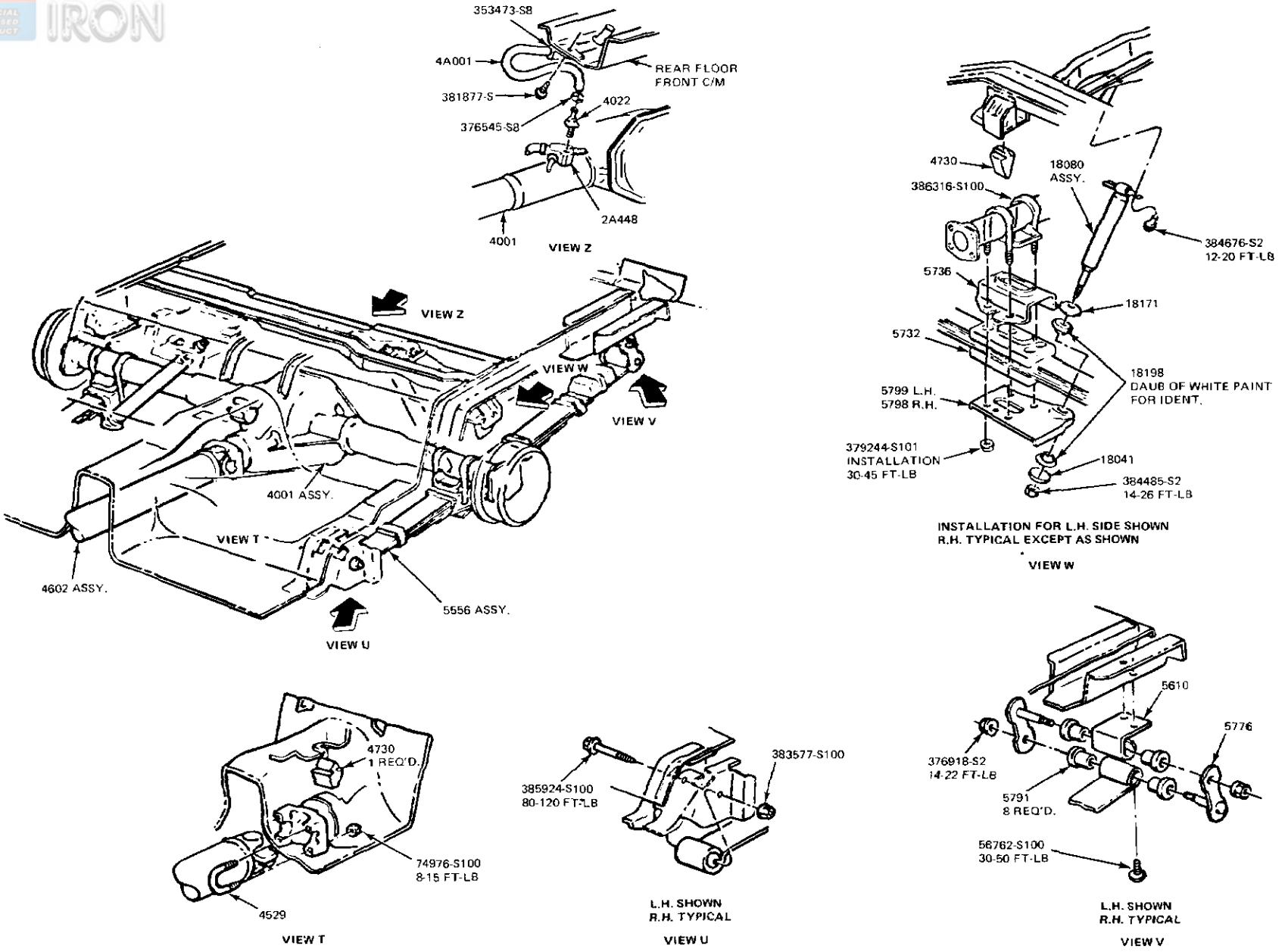


FIG. 5 Rear Suspension—Pinto/Bobcat Station Wagon

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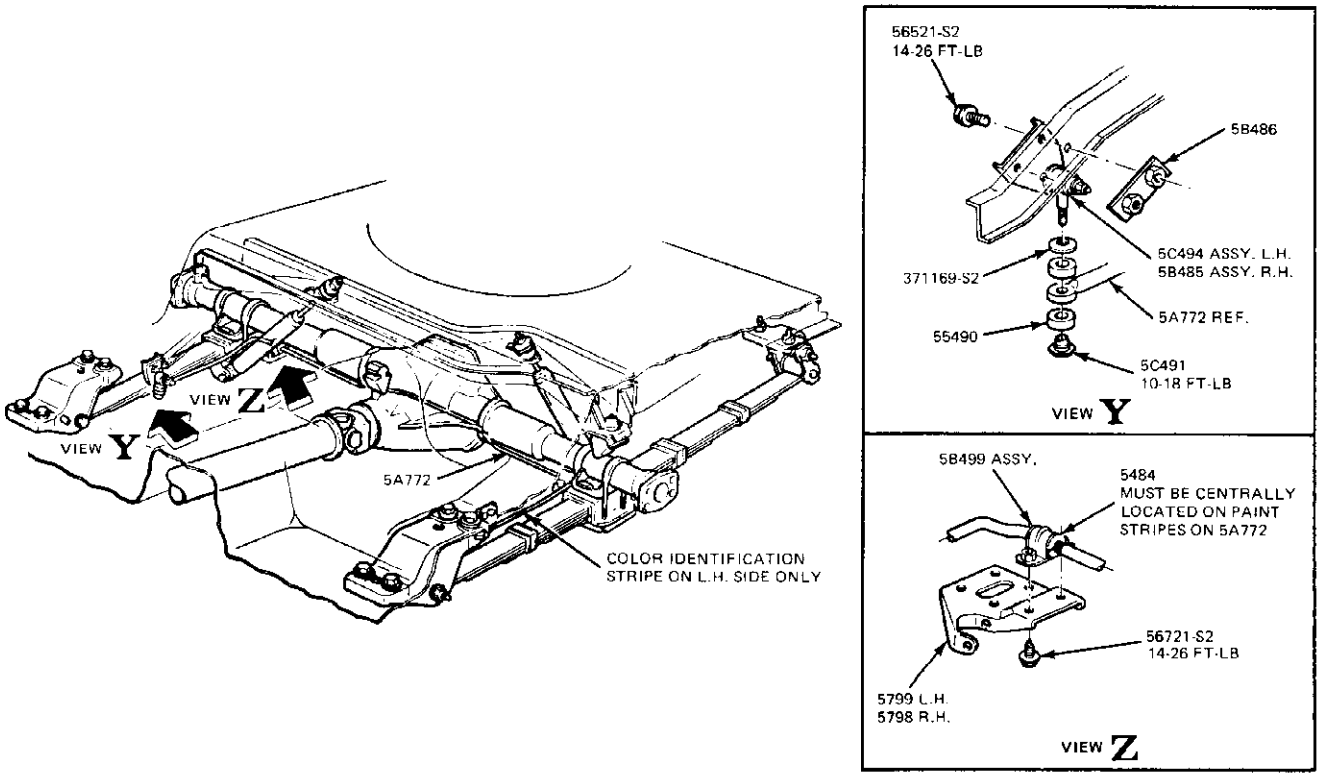


FIG. 6 Rear Stabilizer Bar Installation—Mustang II

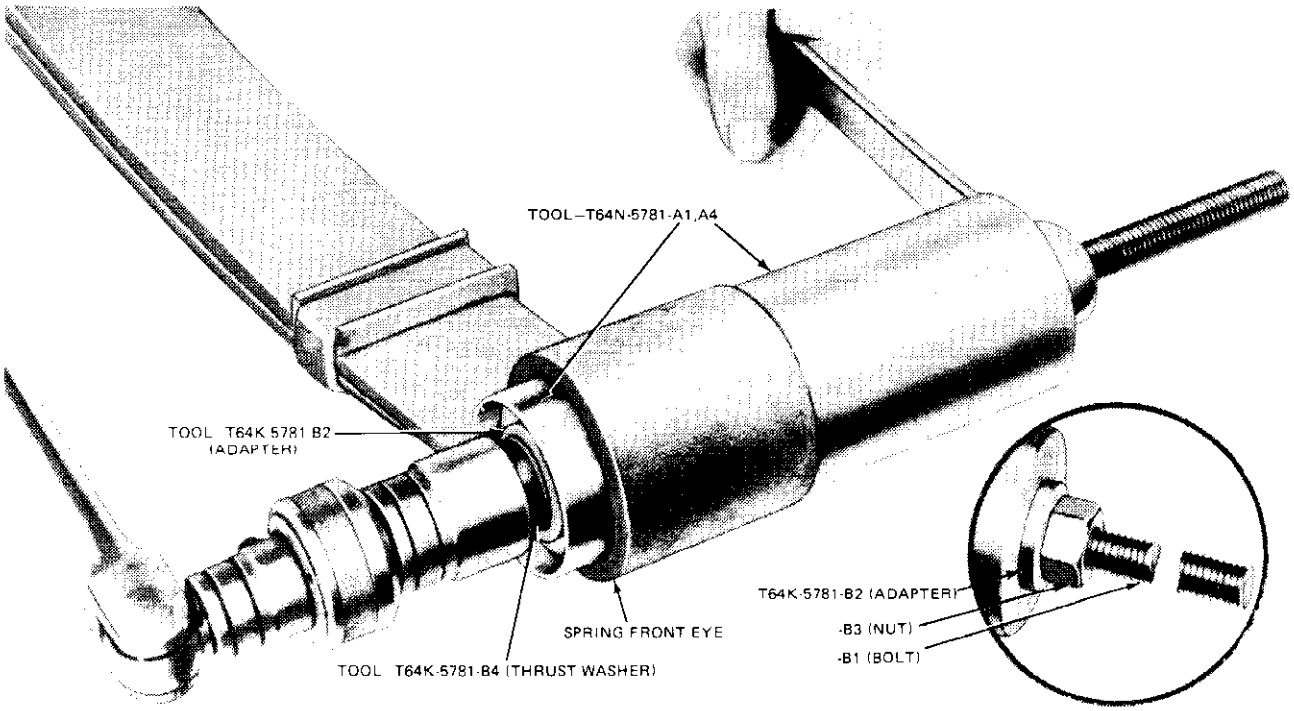


FIG. 7 Rear Spring Front Bushing Removal—Typical

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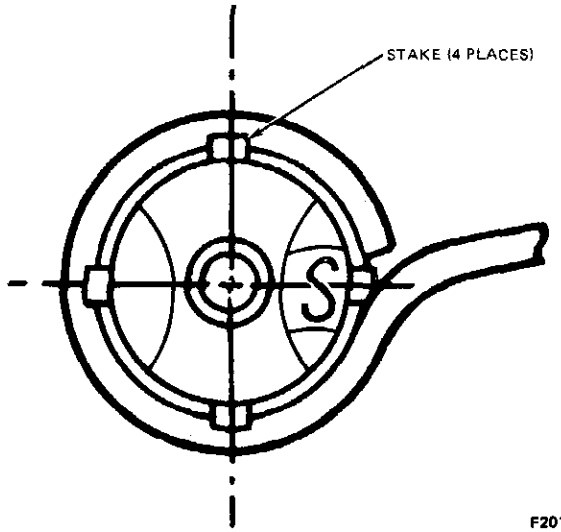


FIG. 8 Rear Spring Front Bushing Installation—Typical

SPECIFICATIONS

TORQUE LIMITS – REAR SUSPENSION (FT-LB)

Description	Mustang/Pinto/ Bobcat	Granada/Monarch Versailles
Spring Shackle Bars to Body and Spring	14-22	14-22
Shock Absorber to Upper Mounting Bracket	14-26	45-65
Shock Absorber to Spring U-Bolt Plate	30-50 (Mustang) 14-26 (Pinto/ Bobcat)	14-26
Spring to Axle U-Bolt Nut	30-45	30-45
Wheel Lug Nut 5-Lug Wheel	70-115	70-115
Spring to Spring Front Hanger - Bolt	80-120	80-120
Universal Joint U-Bolt Nut	8-15	8-15
Brake Backing Plate and Bearing Retainer to Axle	*20-40*	*20-40*
Front Eye Bracket-To-Body	50-58 (Mustang)	–
Shackle Hanger-To-Body	30-50	–
Shock Upper Mounting Bracket to Body Bolts	12-20	7-12

SPECIAL SERVICE TOOLS

Tool No.	Description
T64N-5781-A	Rear Spring Front Eye Bushing Remover and Installer
T64K-5781-B	Rear Spring Bushing Adapter

CF1681-2J

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Rear Suspension — Coil Springs

PART 14-32

Applies To All Cars Except Mustang II/Pinto/Bobcat

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DESCRIPTION

REAR SUSPENSION — (EXCEPT FAIRMONT/ZEPHYR)

The rear axle housing is suspended from the frame by upper and lower arms and a shock absorber at each side of the vehicle. LTD II, Cougar, Thunderbird, and Continental Mark V vehicles are equipped with four arms (two upper and two lower) (Fig. 1), as are the Fairmont and Zephyr cars, (Fig. 3). Ford, Mercury, and Lincoln Continental units (Fig. 2) are equipped with three arms (one upper and two lower) and a track bar. These arms pivot in the frame members and rear axle housing brackets.

Each coil spring is mounted between a lower seat which is welded to the axle housing, and an upper seat which is integral with the frame.

The shock absorbers are attached to the spring upper seat at the top, and bolted at the bottom to a bracket on the axle housing.

On single upper arm units (Ford, Mercury, Lincoln Continental), the arm attaches to the right side of the axle housing through an eccentric pivot bolt and a bracket welded to the top of the housing. The forward end is connected by a pivot bolt to the frame crossmember.

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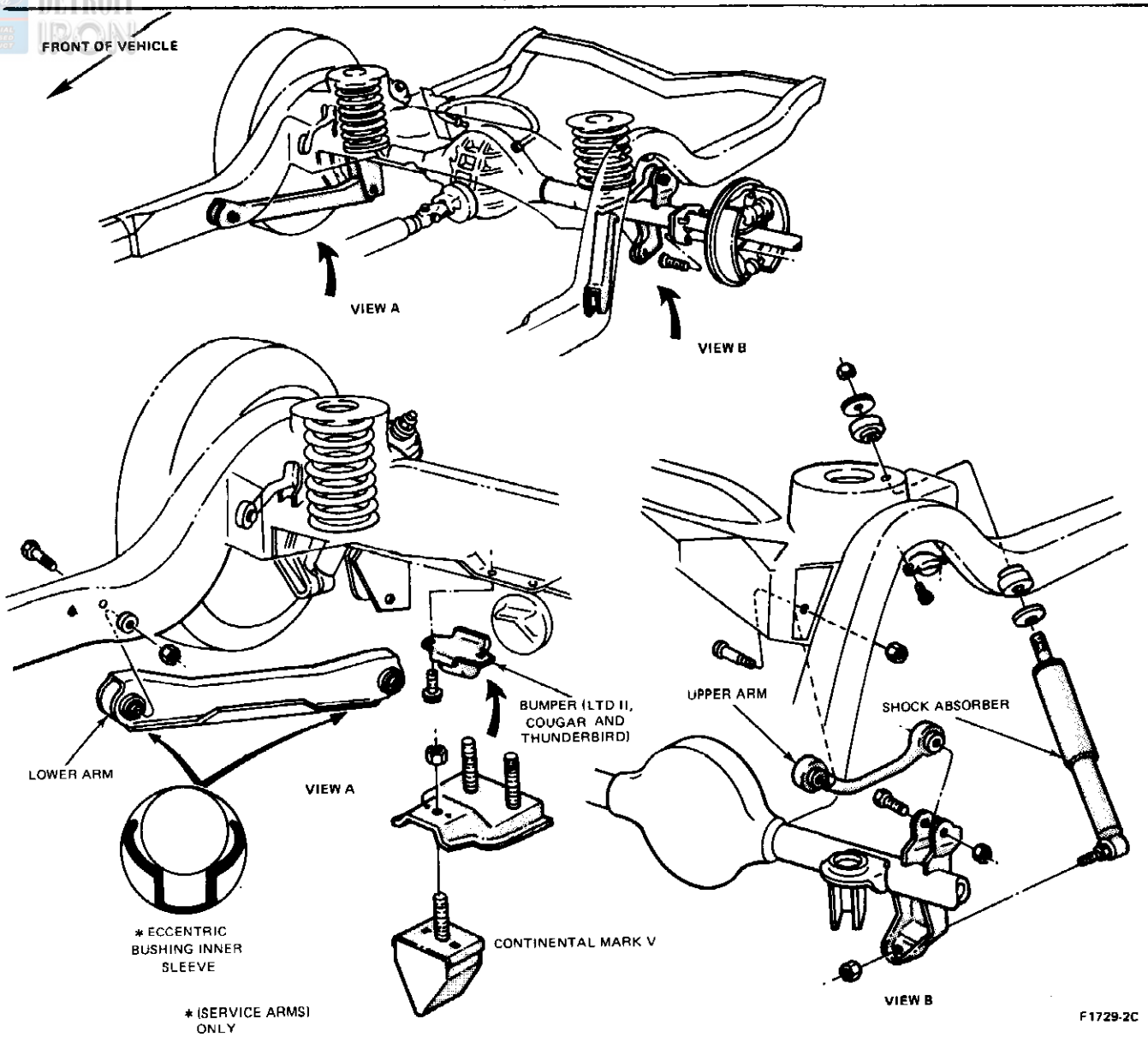


FIG. 1 Rear Suspension—LTD II/Cougar/Thunderbird/Continental Mark V

On LTD II, Cougar, Thunderbird, and Continental Mark V units, two upper arms (which are not interchangeable) attach at the rear to brackets near the outer ends of the axle housing. The forward ends are connected to frame crossmember brackets.

All lower arms attach similarly to the frame side members and axle brackets.

On Ford, Mercury, and Lincoln Continental vehicles, a track bar is connected between the upper arm bracket on the axle housing and a mounting bracket on the left frame side rail.

A rear stabilizer bar is standard on all Continental Mark V, Thunderbird and Cougar XR-7 vehicles, but available only on LTD II, Cougar and Ranchero with handling option. It is attached to left- and right-side brackets and two axle brackets (Fig. 14).

The rear suspension is a four link coil spring suspension design. The rear axle is suspended from the body by two upper arms which control side to side movement and two lower arms which control forward and rearward movement. Shock absorbers are located on each side. Each coil spring is mounted between an upper seat which is welded to the body and a lower seat which is part of the lower arm assembly. The shock absorbers are attached to an upper shock bracket welded to the body and the lower shock bracket which is welded to the rear axle tubes. (Fig. 3)

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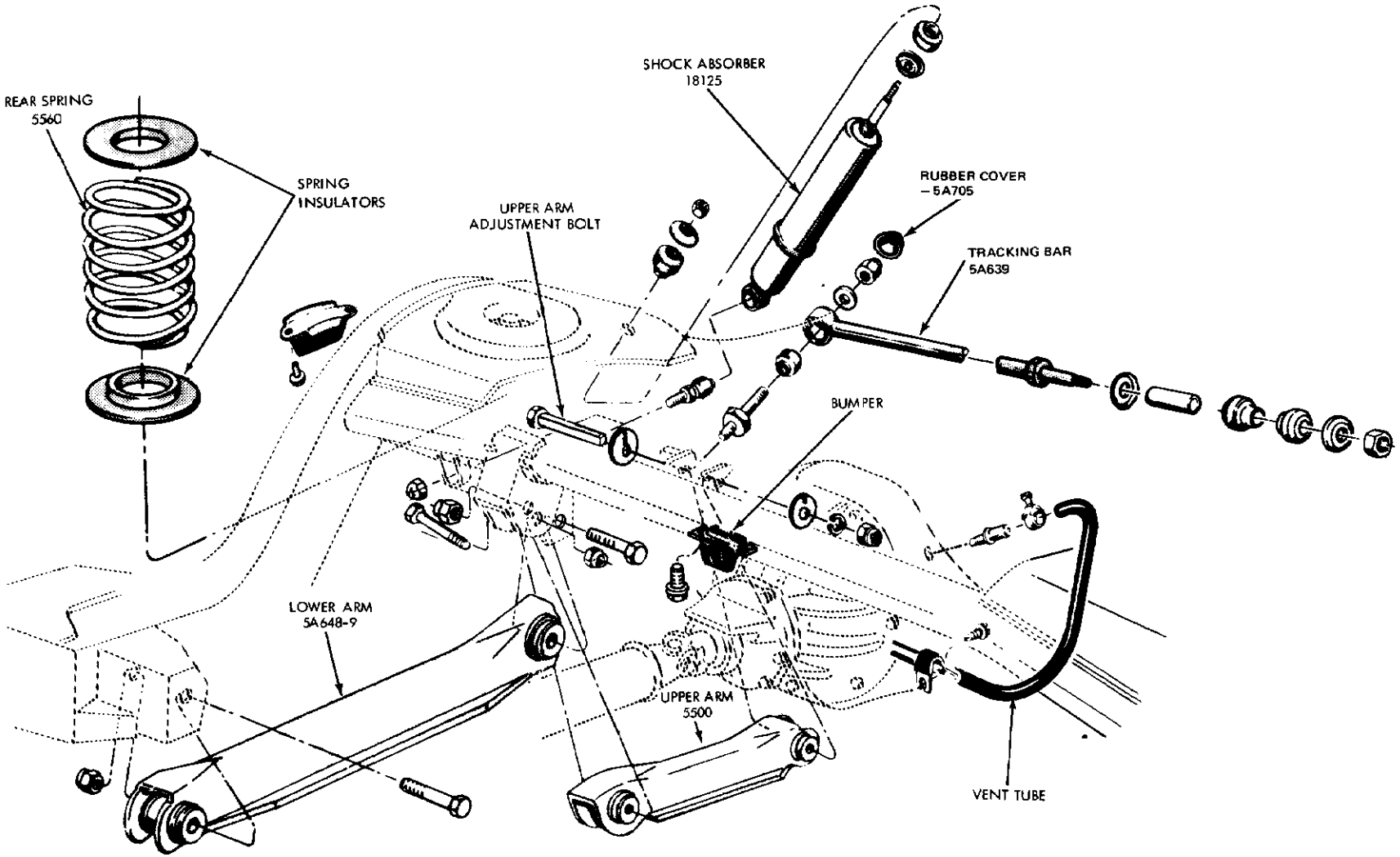


FIG. 2 Rear Suspension—Ford/Mercury/Lincoln Continental

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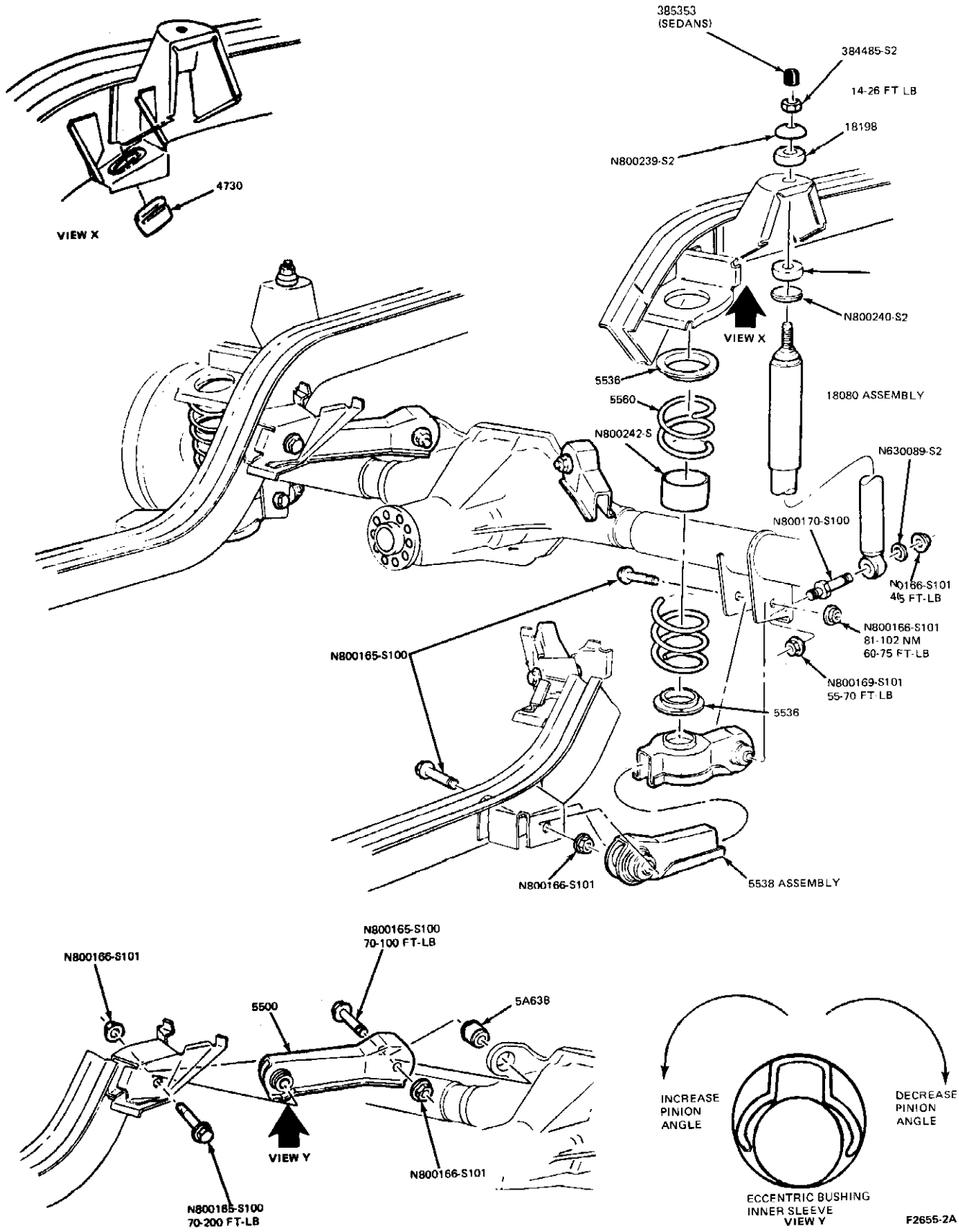


FIG. 3 Rear Suspension—Fairmont/Zephyr

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ADJUSTMENTS

DRIVE SHAFT—PINION ANGLE

The pinion drive shaft working angle must be checked and adjusted to specification whenever the rear axle has been removed.

CHECKING PROCEDURE

On LTD II, Cougar, Thunderbird and Continental Mark V vehicles, a load must be applied to attain a height of 4.82 inches, measured from the top of the axle housing to a point on the frame side rail, adjacent to the jounce bumper rear mounting bolt head. On Ford, Mercury, and Lincoln Continental units, loading is required to attain a controlled height of 5.70 inches, measured as described above. See the illustration in the Specifications section at the end of this Part.

1. Position the vee-magnet (part of Tool T68P-4602-A) on the drive shaft away from welds and balance weights (Fig. 3).
2. From the left side of the vehicle, position the magnetized Tool T68P-4602-A on the vee-magnet with the adjusting screw to the left (Fig. 4). Adjust the dial on the tool with the adjusting screw until the left-hand edge of the bubble is exactly on the zero line.
3. Now, position the magnetized tool on a U-joint bearing cap as shown in Figure 5, with the tool in the same relative position as it was on the Vee-magnet (Fig. 4).
4. Read the position of the bubble's lefthand edge on the scale to determine the drive shaft pinion angle. Compare to the degree specification in the chart at the end of the Part. If adjustment is necessary, adjust to within plus or minus 30 minutes.

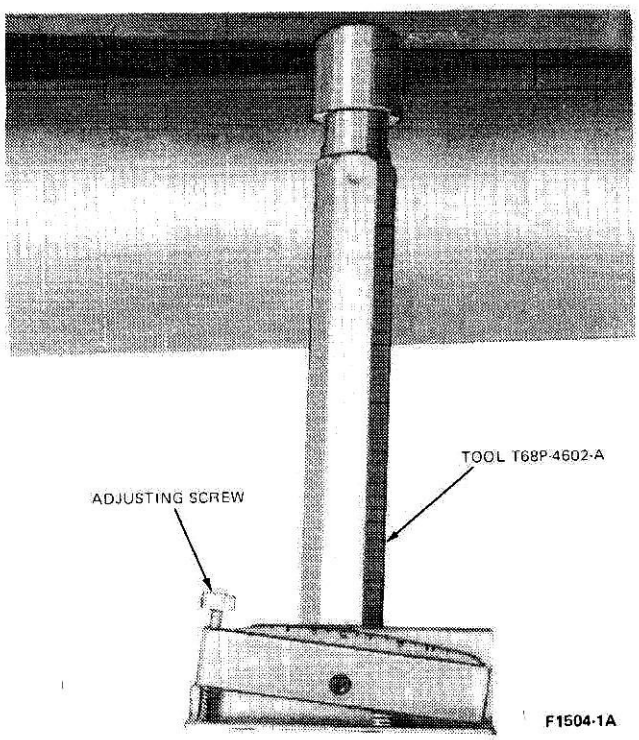


FIG. 4 Positioning Tool on Vee-Magnet

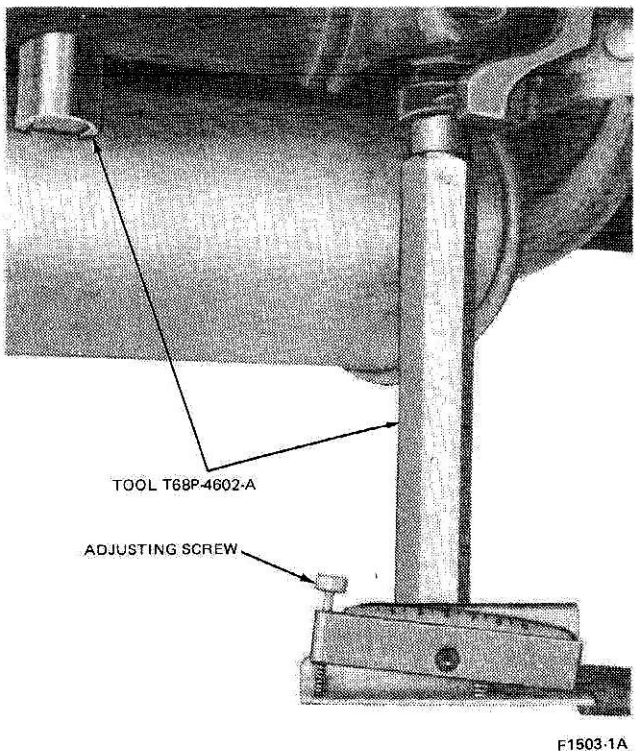


FIG. 5 Measuring Pinion Angle

SINGLE UPPER ARM

If the pinion angle is not within specifications, adjust the pinion angle as follows:

The upper arm-to-axle housing bolt and two eccentric washers form an adjusting cam mechanism (Fig. 6) which will tilt the axle housing to the required angle.

1. Raise the vehicle on a hoist and loosen the upper arm pivot nut at the axle attachment.
2. Replace with new bolt, nut, and lock washers.

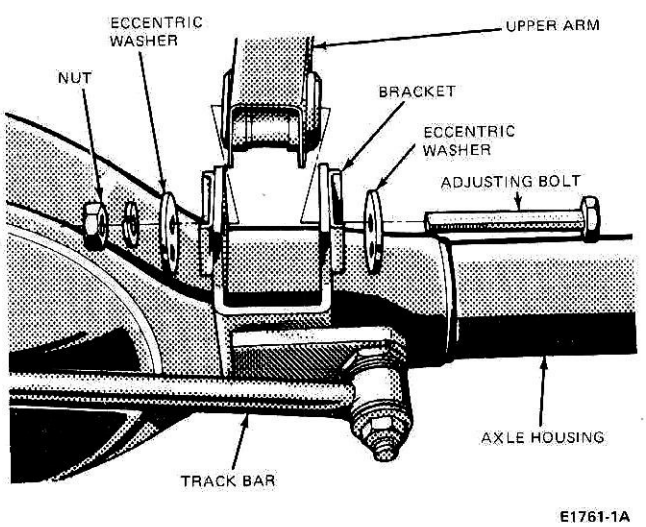


FIG. 6 Pinion Angle Adjustment

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3. If the angle is less than specifications, rotate the adjusting cam, so as to move bolt forward, and recheck the angle. If the angle is more than specification adjust accordingly and recheck the angle.
4. When the axle housing is adjusted in such a way that the driveshaft angle reading is within specifications, torque the nut to specifications.
5. Lower the vehicle and road test for proper axle operation.

DOUBLE UPPER ARMS (EXCEPT FAIRMONT/ZEPHYR)

If the pinion angle is not within specifications, adjust the pinion angle as follows:

1. Raise the vehicle on a hoist.
2. Place safety stands under the frame side rails and lower the rear axle hoist sufficiently to unload the axle.
3. Place a jacking stand under the rear axle pinion housing and raise it to unload the arm bushings.
4. Remove the lower arm front and rear attaching bolts from both arms.
5. Remove the arms from the car.
6. LTD II, Thunderbird, and Cougar models require a service arm kit, that contains new arms and adjusting cams. Continental Mark V models require replacement of nonserrated inner sleeve of the lower arm bushings, with adjusting cam from service kit D20Z-5K751-B.
7. Use Tool T72P-5538-A to insert in the slot in the eccentric inner sleeve (accessible through the hole from which the attaching bolt was removed).
8. Now rotate the eccentric bushing clockwise or counterclockwise to raise or lower the pinion nose angle to specification (Fig. 6).

If further adjustment is required to get the angle within specification, the eccentric bushing at the rear of each arm may also be adjusted by following the front eccentric procedure.

9. Install new nuts and bolts. Flanged nuts and bolts are required at frame attachment.
10. When the necessary adjustment has been made, lower the hoist to load the arms and torque the nuts to specification while holding the bolt heads with a wrench.

DOUBLE UPPER ARMS (FAIRMONT/ZEPHYR)

On the Fairmont/Zephyr vehicle a load must be applied to attain a curb height of 5.55" on sedans, and 5.88" on the station wagon. This height is measured from the top of the axle housing tube to the jounce bumper bracket on the bottom of the side rail (See Specifications).

1. Position the vee-magnet (part of tool T68P-4602-A) on the driveshaft away from welds and balance weights (Fig. 4).
2. From the left side of the vehicle, position the magnetized tool T68P-4602-A on the vee-magnet with the adjusting screw to the left (Fig. 4). Adjust the dial on the tool until the left hand edge of the bubble is exactly on the zero line.
3. Position the magnetized tool on a "U" joint bearing cap as shown in (Fig. 5) with the tool in the same relative position as it was on the vee-magnet.
4. Read the position of the bubble's left hand edge on the scale to determine the driveshaft pinion angle. Compare to the pinion angle specification at the end of this Part.

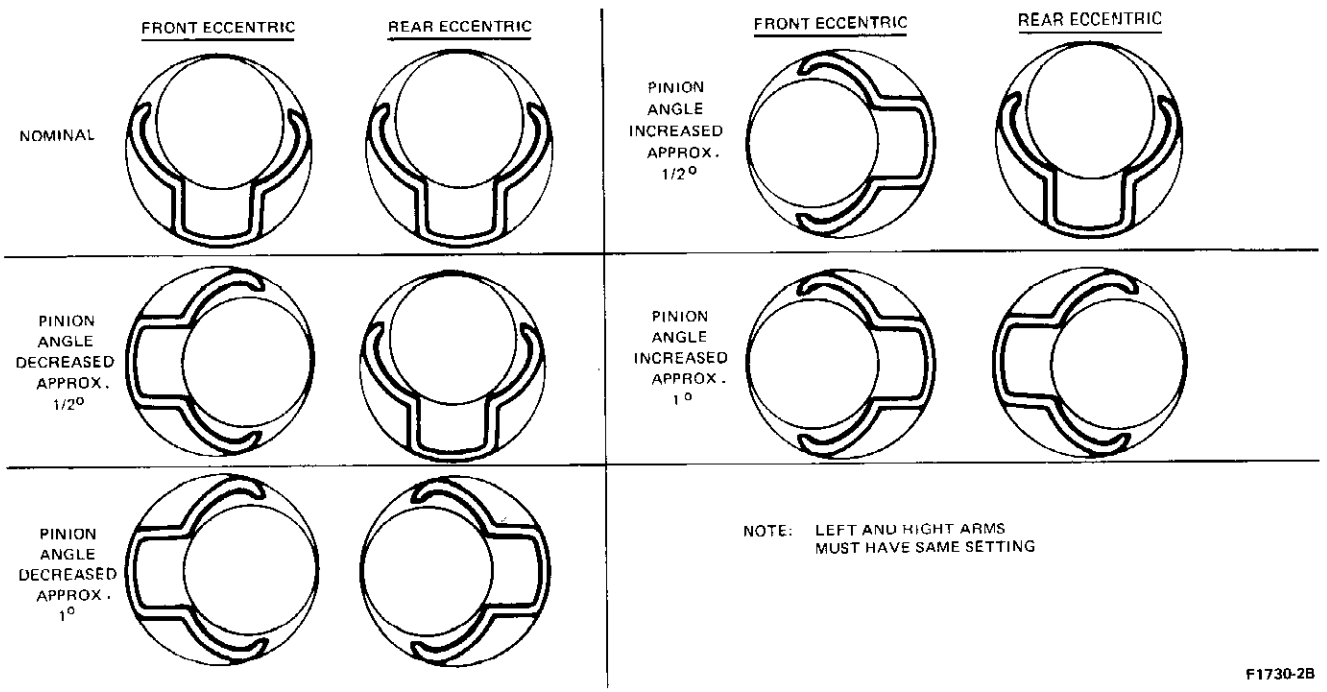


FIG. 7 Eccentric Bushing Inner Sleeve Positions

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If the pinion angle is not within specifications, adjust the pinion angle as follows:

1. Remove the upper arms as outlined in Upper Arm Removal.
2. Using a fabricated tool as shown in Fig. 8, insert the tool in the slot in the eccentric inner sleeve (accessible through the hole from which the attaching bolt was removed). NOTE: If the cam appears to be rusty, tap the cam with a drift to remove the rust so the cam will rotate.
3. Now rotate the eccentric bushing clockwise or counter-clockwise to raise or lower the pinion nose angle to Specification (given at the end of this Part).
4. After the adjustment is performed install the upper arms as outlined in Upper Arm Installation.

REMOVAL AND INSTALLATION

REAR SHOCK ABSORBER — (EXCEPT FAIRMONT/ZEPHYR)

Removal and Installation

1. Raise the vehicle on a hoist.
2. Remove the shock absorber attaching nut, washer, and insulator from the stud on the upper side of the spring upper seat. Compress the shock absorber to clear the hole in the spring seat, and remove the inner insulator and washer from the upper attaching stud.
3. Remove the self-locking attaching nut, and disconnect the shock absorber lower stud from the mounting bracket on the rear axle housing (Figs. 1 and 2).

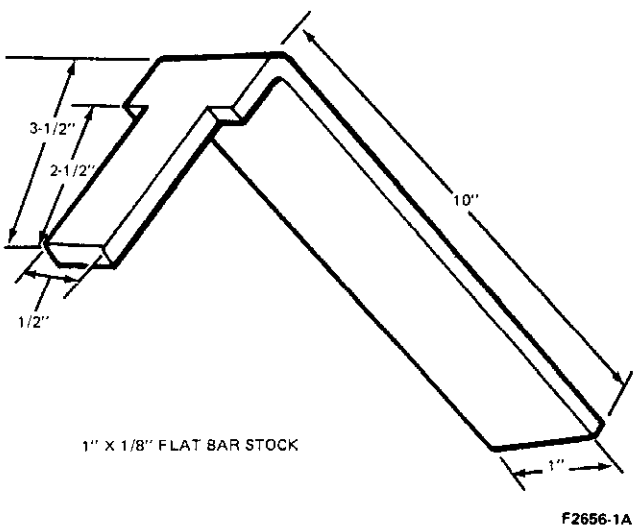


FIG. 8 Fabricated Cam Adjuster Tool — Fairmont/Zephyr

4. Expel all air by performing Step 3, On Vehicle Tests (See: Shock Absorber Checks.), in Part 14-01.
5. Place the inner washer and insulator on the upper attaching stud, and position the shock absorber so that the upper attaching stud enters the hole in the spring upper seat. While holding the shock absorber in this position, install the outer insulator, washer, and a new stud nut on the upper side of the spring upper seat. Torque the nut to specifications.
6. Extend the shock absorber and place the lower stud in the mounting bracket hole on the rear axle housing. Install a new self-locking attaching nut and torque to specification.

FAIRMONT/ZEPHYR

Removal (Refer to Fig. 3)

1. Open the trunk (sedan) or remove side panel trim covers (station wagon) to gain access to the upper shock attachment.
2. Remove rubber cap from shock absorber stud (sedans).
3. Remove shock absorber attaching nut, washer and insulator.
4. Raise vehicle on hoist supporting rear axle.
5. Compress the shock absorber to clear the hole in the upper shock tower.
6. Remove the lower shock absorber nut and washer from the shock mounting stud, and remove the shock absorber.

Installation (Refer to Fig. 3)

1. Expel all air from the new shock absorber. See: Shock Absorber Checks in Part 14-01.
2. With shock absorber in compressed position place the lower shock mounting eye over the stud in the lower mounting bracket and install washer and new self-locking attaching nut. Do not torque at this time.
3. Place the inner washer and insulator on the upper attaching stud.
4. Extend shock absorber and position upper stud into hole in upper shock.
5. While holding shock in this position, torque lower attaching nut to 40-55 ft-lb.
6. Lower vehicle and install insulator, outer washer and a new nut to upper shock stud. Torque the nut to 14-26 ft-lb. Install side panel trim covers on station wagons and rubber cap on sedans.

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REAR SPRING — (EXCEPT FAIRMONT/ZEPHYR)

Removal

1. Position a hoist under the rear axle housing and raise the vehicle. Place jack stands under the frame side rails.
2. Disconnect the lower studs of the two rear shock absorbers from the mounting brackets on the axle housing.
3. On Ford, Mercury, and Lincoln Continental vehicles only, disconnect the rear of the front-to-rear brake tube from the rear brake hose (or hoses on rear disc brake vehicles) at the Number 4 crossmember bracket. Remove the brake hose-to-bracket clip.
4. Lower the hoist and axle housing until the coil springs are released (Fig. 9).
5. Remove the springs and the insulators from the vehicle.

Installation

1. Position the spring in the upper and lower seats with an insulator between upper end of spring and frame seat.
2. Raise the hoist and axle housing with the spring in position and connect the lower studs of the rear shock absorbers to the mounting brackets on the axle housing. Install new attaching nuts, and torque to specifications.
3. On Ford, Mercury, and Lincoln Continental vehicles only, position the rear brake hose in the Number 4 crossmember bracket and secure it with the brake hose-to-bracket clip. Connect the rear of the front-to-rear brake tube to the rear brake hose. Torque to 10 to 18 ft-lb. Bleed the brakes.
4. Remove the jack stands and lower the vehicle.

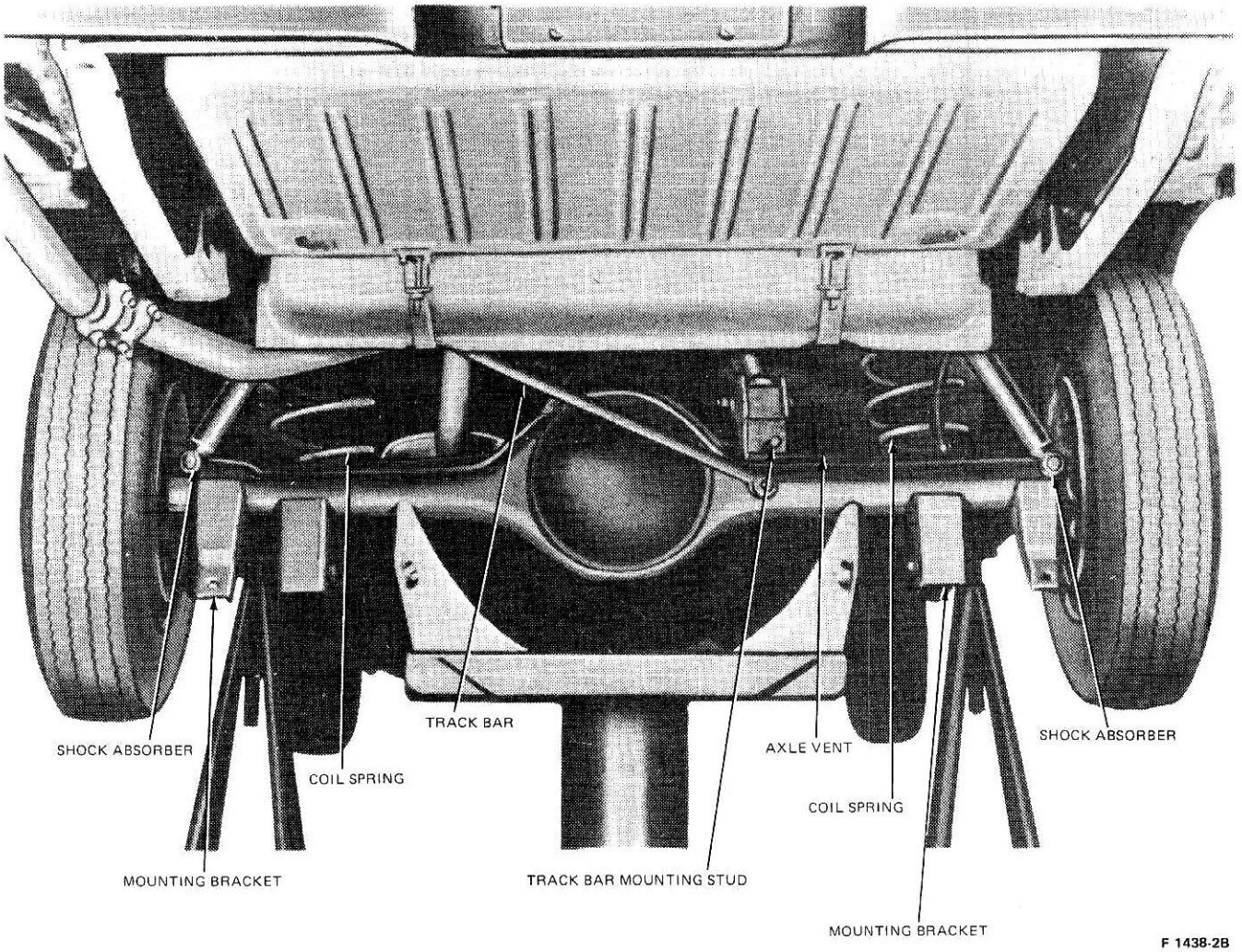


FIG. 9 Removing or Installing Rear Spring—Typical

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FAIRMONT/ZEPHYR

Removal (Refer to Fig. 3)

If one spring requires replacement, replace the other spring also. Note: If vehicle is equipped with a rear stabilizer bar, remove the bar per procedure given under Rear Stabilizer Bar — Removal.

1. Raise the vehicle and support the body at the rear body crossmember.
2. Lower the hoist until the rear shocks are fully extended. Note: **The axle must be supported by the hoist, or a transmission jack, or jack stands.**
3. Place a transmission jack under the lower arm pivot bolt and remove the bolt and nut. Lower the transmission jack slowly until the coil spring load is relieved.
4. Remove the coil spring and insulators from the vehicle.

Installation (Refer to Fig. 3)

1. Place the upper spring insulator into spring seat in the body. Tape in place if necessary.
2. Place the lower spring insulator on the lower arm. Install the internal damper into the spring.
3. Position the coil spring on the lower arm spring seat. Slowly raise the transmission jack until the arm is in position. Insert a new rear pivot bolt and nut, with the nut facing outwards. Do not torque at this time.
4. Lower the transmission jack. Raise the axle to curb height. Torque the lower arm pivot bolt to 70-100 ft-lb.
5. If vehicle was equipped with a rear stabilizer bar, install bar per procedure given under Rear Stabilizer Bar — Installation.
6. Remove crossmember supports and lower the vehicle.

LOWER ARM — (EXCEPT FAIRMONT/ZEPHYR)

Removal

If one arm requires replacement, replace the other arm also.

1. Raise the vehicle on a hoist and place jack stands under the frame side rails.
2. On vehicles equipped with track bar (Ford, Mercury and Lincoln Continental vehicles only), remove the attaching nut and bolt from the frame track bar mounting bracket, and disconnect the bar from the stud (Figs. 1 and 2).
3. Lower the axle enough to relieve spring pressure.
4. Support axle under differential pinion nose as well as under axle.
5. Remove the lower arm pivot bolt and nut from the axle bracket. Then, disengage the lower arm from the bracket.
6. Remove the pivot bolt and nut from the frame bracket and remove the lower arm from the vehicle.

Installation

The rear suspension lower arms are interchangeable side-to-side and end-for-end. They can be identified by color codes (Fig. 10).

1. Position the lower arm in the bracket on the frame side rail. Install a new pivot bolt and new nut (Fig. 9). Do not tighten the nut at this time.
2. Position the lower arm to the axle bracket and install a new bolt and new nut (Fig. 9). Do not tighten the nut at this time.
3. Raise the axle.
4. Torque the lower arm pivot bolts and nuts to specification.
5. If equipped, connect the track bar to the frame bracket with a new nut. Torque the nut to specification.
6. Remove the jack stands and lower the vehicle.

FAIRMONT/ZEPHYR

Removal (Refer to Fig. 3)

If one arm requires replacement, replace the other arm also. Note: If vehicle is equipped with rear stabilizer bar, remove bar per procedure given under Rear Stabilizer Bar — Removal.

1. Raise the vehicle and support body at the rear body crossmember.
2. Lower the hoist until the rear shocks are fully extended. **Note: the axle must be supported by the hoist, or a transmission jack, or jack stands.**
3. Place a transmission jack under the lower arm rear pivot bolt and remove the bolt and nut. Lower the transmission jack slowly until the coil spring can be removed.
4. Remove the lower arm front pivot bolt and nut and remove the lower arm assembly.

Installation (Refer to Fig. 3)

1. Position the lower arm assembly into the front arm bracket and insert a new front pivot bolt and nut, with nut facing outwards. Do not torque at this time.
2. Install coil spring per procedure given under Rear Spring — Installation. Holding the spring in position, use the transmission jack under the rear of the lower arm. Raise the jack until the arm is in position. Insert a new rear pivot bolt and nut with nut facing outwards. Do not torque at this time.
3. Lower the transmission jack. Raise the axle with the hoist to curb height. Torque the lower arm front and rear pivot bolt heads to 70-100 ft-lb.
4. If vehicle was equipped with rear stabilizer bar, install bar per procedure given under Rear Stabilizer Bar — Installation.
5. Remove crossmember supports and lower vehicle.

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DETROIT IRON

Carline	Suspension Arm	Side Arm Used On	Color Code	Approximate Lg. (Inches Measured at Bushing ℄)	Approximate Body Diameter of Bushing Outer Sleeve	
					Frame	Body
Ford/Mercury/ Lincoln Ford/Mercury (Police, Taxi, Trailer Tow.)	Upper	–	Unpainted	12-5/8"	2-7/16"	
Ford/Mercury/ Lincoln	Lower	Left & Right	Black	22-9/16"	1-7/8"	
Ford/Mercury (Police, Taxi, Trailer Tow.)	Lower	Left & Right	Black–White Daub	22-9/16"	1-7/8"	
LTD II/Cougar/ Cougar XR-7/ Thunderbird	Upper	Left Right	Unpainted ① Unpainted ①	12-1/2"	2-3/16"	1-7/8"
LTD II/Cougar Police, Taxi	Upper	Left Right	Unpainted ① Unpainted ①	12-1/2"	1-9/16"	1-9/16"
LTD II/Cougar/ Cougar XR-7/ Thunderbird LTD II/Cougar Police, Taxi, Trailer Tow.	Lower	Left & Right	Black–White & Blue Daub	20"	1-7/8"	
Mark V	Upper Upper	Left Right	Unpainted ① Yellow & Maroon Stripe Unpainted ① Green & Maroon Stripe	12-3/8"	2-3/16"	1-7/8"
Mark V	Lower	Left & Right	Black	20"	2-3/16"	

① Service left arm inscribed Left-Hand–Underside in yellow paint or tape. Service right arm inscribed Right-Hand–Underside in green paint or tape.

CF1713-2F

FIG. 10 Rear Suspension Color Code Identification

UPPER ARM — (EXCEPT FAIRMONT/ZEPHYR)

Removal

On LTD II, Cougar, Thunderbird and Continental Mark V vehicles, if one arm requires replacement, replace the other arm also.

1. Raise the vehicle and support the frame side rails with jack stands.
2. Support the rear axle. On units so equipped, disconnect the track bar from the frame bracket.
3. Lower the axle and support the axle under differential pinion nose, as well as under axle.
4. Remove the nut and bolt that attach the upper arm to the axle housing. Disconnect the arm from the housing.
5. Remove the nut and bolt that secures the upper arm to the crossmember and remove the arm.

Installation

Upper suspension arms are identified in Figure 8.

1. Hold the upper arm in place on the crossmember and install a new attaching bolt, and a new self-locking nut. Do not tighten the nut at this time.
2. Secure the upper arm to the axle housing with new attaching bolts and nuts. Do not tighten the bolts at this time.
3. On units so equipped, connect the track bar to the frame bracket with a new self-locking nut. Raise the axle and torque the nut to specifications.

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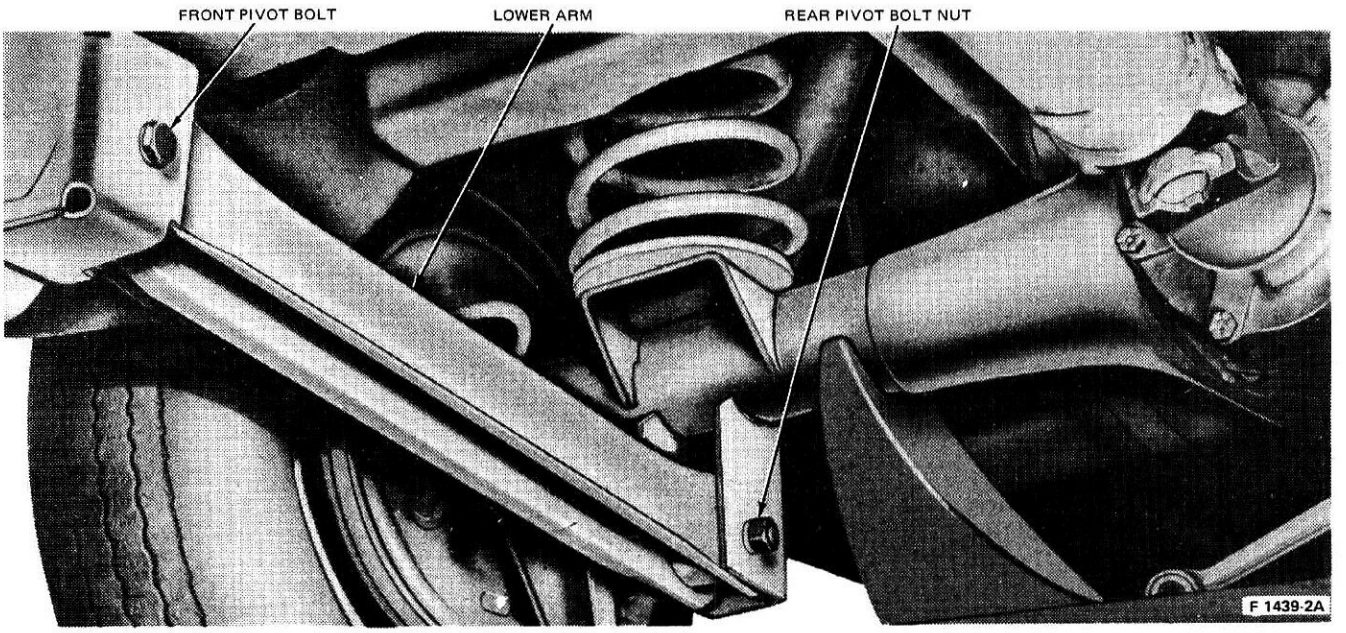


FIG. 11 Rear Suspension Lower Arm Installed—Typical

4. Torque all upper arm front bolts to specification. On LTD II, Cougar, Thunderbird, and Continental Mark V vehicles, torque the bolt head of the upper arm at the axle attachment to specification. Remove the jack stands.
5. On Ford, Mercury, and Lincoln Continental adjust the pinion angle and torque the rear nut to specification.
6. Lower the vehicle.

Fairmont/Zephyr

If one arm requires replacement, replace the other arm also.

1. Raise vehicle on hoist and support body at rear crossmember.
2. Remove upper arm rear pivot bolt and nut.
3. Remove front pivot bolt and nut. Remove upper arm from vehicle.

If upper arm rear bushing is to be replaced, service tool T78P-5638-A must be used, and the following procedure adhered to:

1. Place the upper arm rear bushing remover tool in position as shown in Fig. 12.
3. Remove upper arm rear pivot bolt and nut.
3. Remove front pivot bolt and nut. Remove upper arm from vehicle.
4. Using the installer tool as shown in Fig. 13, install the bushing assembly into the bushing ear of the rear axle.

1. Place the upper arm into the bracket of body side rail. Insert a new front upper arm pivot bolt and nut, with nut facing outboard. Do not torque at this time.
2. Raise the suspension with hoist until upper arm rear pivot hole is in position with hole in axle bushing. Install a new pivot bolt and nut with nut facing inboard. Do not torque at this time.
3. Connect lower shock absorber to the lower shock bracket and torque a new nut to 40-55 ft-lb.
4. Raise the suspension to curb height and torque both the front and rear upper arm pivot bolt heads to 70-100 ft-lb.

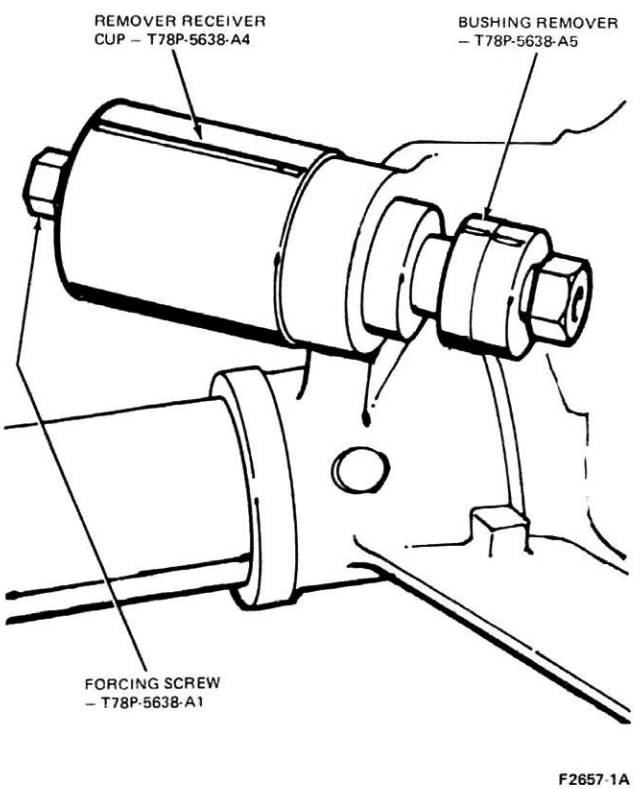


FIG. 12 Bushing Removal

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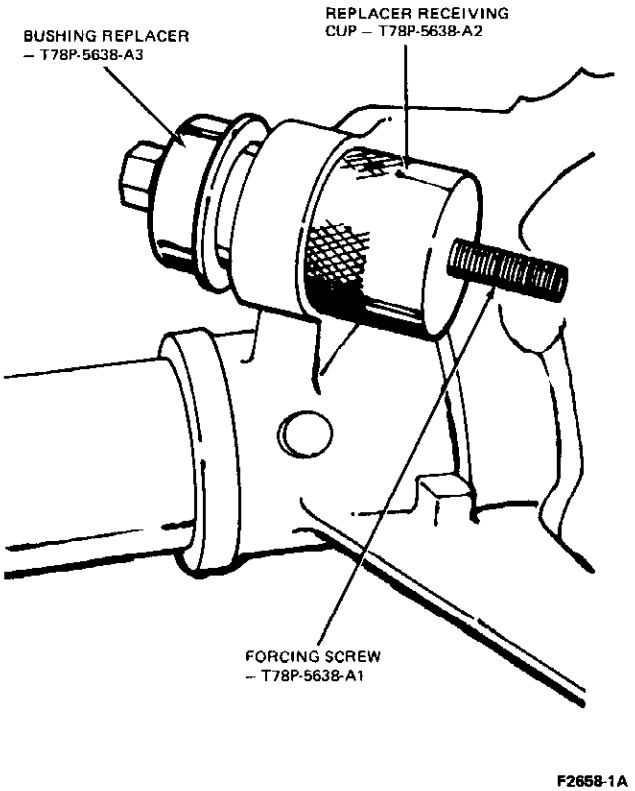


FIG. 13 Bushing Installation

TRACK BAR — Ford/Mercury, Lincoln Continental

Removal and Installation

1. Raise the vehicle on an axle contact hoist.
2. Remove rubber cover at the axle attachment on the track bar.
3. *Remove the nut and flat washer attaching* the track bar to the upper arm bracket and disengage the track bar from the mounting stud (Fig. 7).
4. Remove the nut attaching the track bar to the frame side rail and remove the track bar.
5. Position the track bar washer spacer sleeves, and insulators on the track bar. Position the track bar in the frame side rail bracket, and install outer insulator and washer. Install a new self-locking nut.
6. Position the track bar on the upper arm bracket mounting stud and install a new flat washer and a new attaching nut. Torque the track bar attaching nuts to specification. Lubricate the rubber cover with synthetic rubber lubricant and insert it over the end of the stud onto the washer. Then, lower the vehicle.

STABILIZER BAR — LTD II/Cougar, Thunderbird/Continental Mark V

Removal and Installation

1. Raise the vehicle with a floor jack at the axle housing.
2. Remove the bolts and nuts that fasten the stabilizer bar assembly to the rear link assemblies at both sides (Fig. 14).
3. Remove the nuts that fasten mounting bracket to the U-bolts (two nuts each side).
4. Remove the stabilizer bar from the vehicle.
5. Place new axle insulators on the stabilizer bar and position the stabilizer bar in the vehicle. The color coded end of the bar must be on the left-hand side.
6. Install four new nuts retaining the mounting brackets to the U-bolts (both sides of axle housing). Torque to specification.
7. Install new bolts and nuts retaining the rear link assemblies to the stabilizer bar assembly. The bolts must be installed from the outboard side of the vehicle. Torque the nuts to specification.
8. Lower the vehicle.

FAIRMONT/ZEPHYR

Removal (Refer to Fig. 15)

1. Raise vehicle on hoist.
2. Remove four bolts attaching stabilizer bar to brackets in lower arms.
3. Remove stabilizer bar from vehicle.

Installation (Refer to Fig. 15)

1. Align four holes in stabilizer bar with holes in brackets in lower arms.
2. Install four new bolts and torque to 30-40 ft-lb.
3. Lower vehicle.

STABILIZER BAR BRACKETS — Fairmont/Zephyr

Removal

1. Raise vehicle on hoist and support body at rear crossmember.
2. Remove stabilizer bar as outlined in Stabilizer Bar — Removal.
3. Disconnect the shock absorbers at the lower shock bracket.
4. Slowly lower the suspension until the front bracket to arm bolt clears the body side rail.

   Note: Do not stress the brake hose when lowering the suspension.

5. Remove both bracket to arm bolts and nuts and remove bracket from the arm.

Installation

1. Insert the bracket into the arm and align holes in arm and bracket. Install new bolts and nuts. Torque the nut to 55-70 ft-lb.
2. Raise the suspension, connect the shock absorber and torque a new attaching nut to 40-55 ft-lb.
3. Install stabilizer bar as outlined in Stabilizer Bar — Installation.
4. Remove crossmember supports and lower the vehicle.

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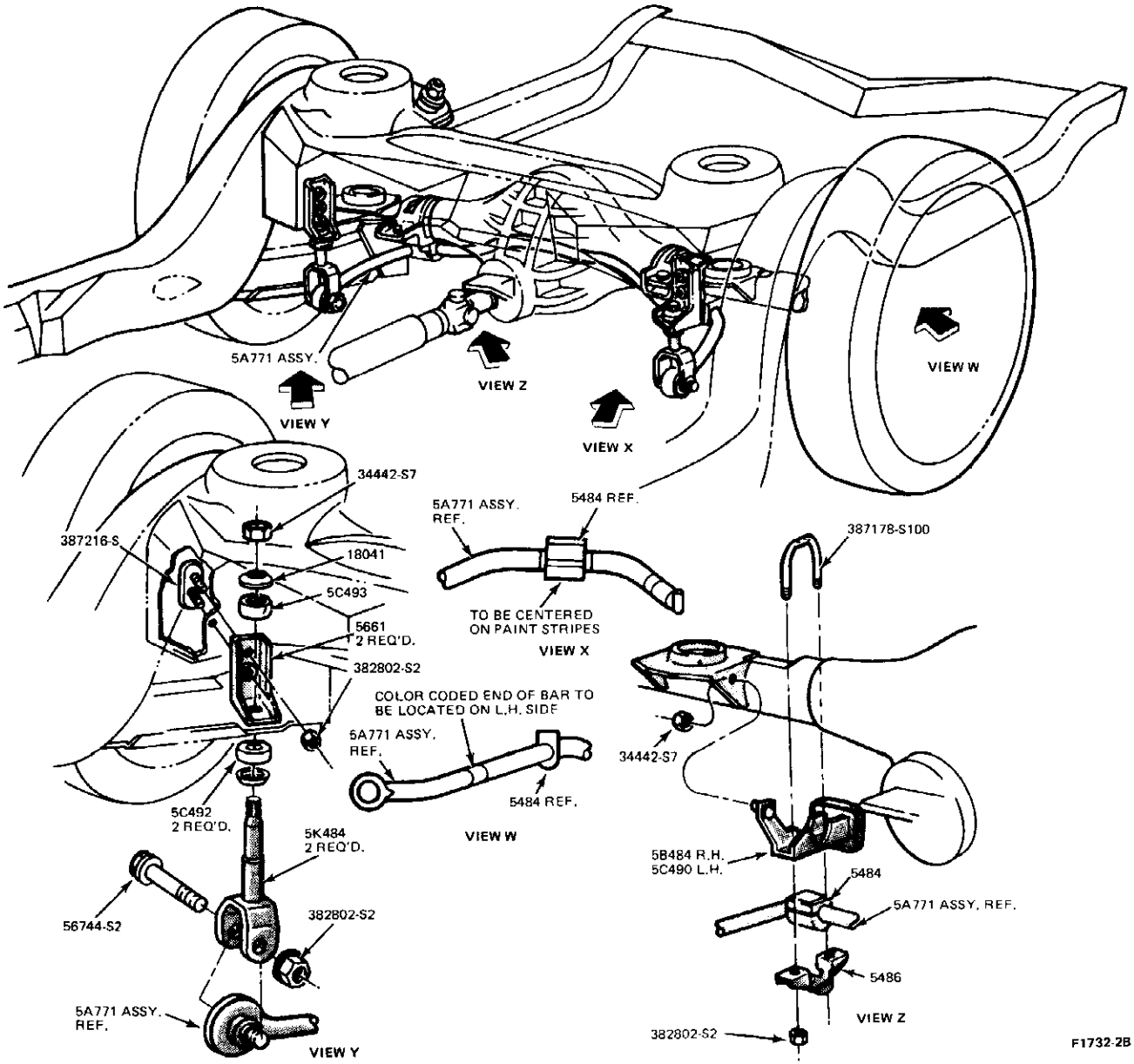


FIG. 14 Stabilizer Bar Installation — LTD II, Thunderbird (Max. Handling), Cougar, Continental Mark V (Similar)

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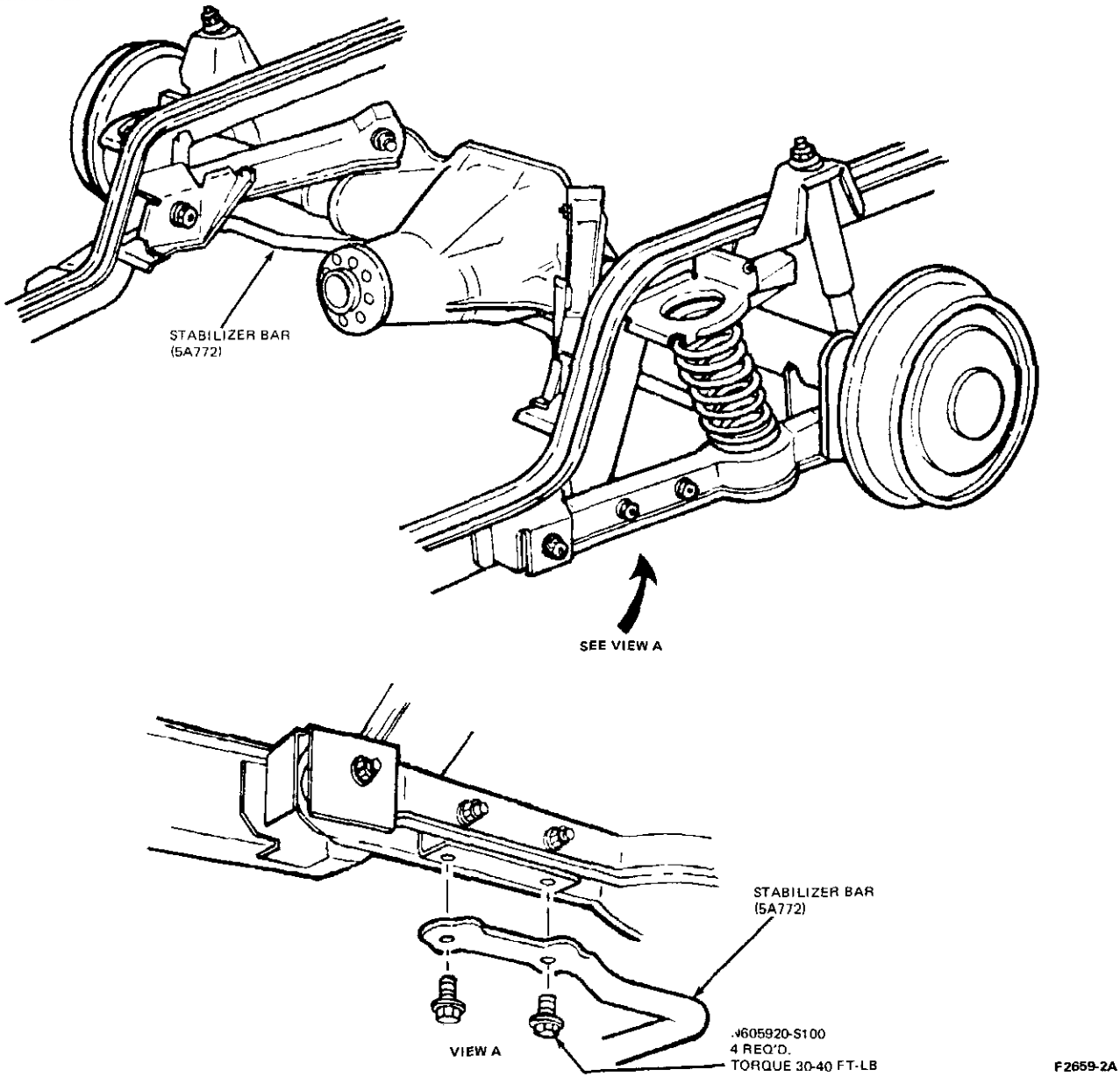


FIG. 15 Stabilizer Bar Installation — Fairmont/Zephyr

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SPECIFICATIONS

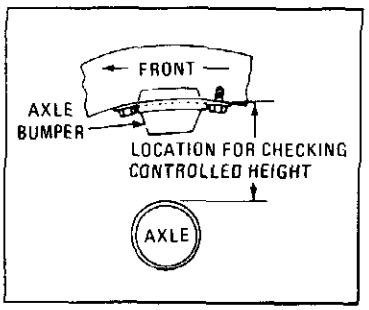
TORQUE LIMITS – REAR SUSPENSION (FT-LB)

Description	Ford/ Mercury	Lincoln Continental	Thunderbird/ Mark V, LTD II/ Cougar	Fairmont/ Zephyr
Shock Absorber to Frame (Upper Attachment)	20-26		*	14-26
Upper Arm to Frame	120-130		–	70-100
Upper Arm to Axle	120-130 (Nut)		120-130 (Bolt)	70-100
Track Bar to Axle Track Bar Stud	75-85 (Nut)		–	
Track Bar Stud to Axle	140-150 (Stud)		–	
Track Bar to Frame (Nut Torque)	50-70		–	
Wheel Lug Nut	80-110			
Shock Absorber to Axle (Lower Attachment)	65-85			40-55
Shock Stud to Axle Bracket	50-70			
Lower Arm to Axle – Nut	120-130		120-130	70-100
Upper Arm to Frame – Bolt	120-130			
Lower Arm to Frame – Bolt	120-130 (Bolt)		120-130 (Nut)	70-100
Bumper Assembly to No. 4 Crossmember	Self-Tapping		15-25 Mark V	
Stabilizer Bar Bracket to Frame (Nut)	–		18-20	
Rear Link Assembly to Bracket (Nut)	–		10-12	
Upper Mounting Clamp to Lower Mounting Clamp (Nut)	–		16-20	
Mounting Bracket to U-Bolt (Nut)	–		16-20	
Upper Mounting Clamp to Axle (Nut)			16-20	
Stabilizer Bar to Rear Link (Nut)	–		16-20	
Stabilizer Bar to Lower Arm	50-55			30-40

*Thunderbird/Mark V and Lincoln Continental: torque to 22 to 30 ft.-lbs.

DRIVESHAFT – PINION ANGLE DEGREE SPECIFICATION

Vehicle	Axle	Degree	Controlled Height For Checking Angle
Cougar, LTD II, Thunderbird 2-Door	9 In.	2°33' ± 45'	
LTD II, Cougar – 4-Door	9 In.	2°28' ± 45'	4.82 In.
LTD II, Cougar – Station Wagon	9 In.	1° 7' ± 45'	
Ranchero	9 In.	1° 7' ± 45'	
Fairmont/Zephyr – Sedan	7.5 In.	0.01° (.6') ↑	5.55"
Fairmont/Zephyr – Station Wagon	7.5 In.	0.13° (8') ↑	5.88"
Mark V	–	2°47' + 30' – 45'	4.82 In.
Lincoln	–	8° 4' ± 50'	5.70 In.
Ford/Mercury	–	2°48' ± 50'	



SPECIAL SERVICE TOOLS

Tool No.	Description
T68P-4602-A	Pinion Angle Level Gauge
T72P-5538-A	Suspension Adjusting Tool
T78P-5638-A	Bushing Remover and Installer Tool
T78P-5638-A1	Forcing Screw
T78P-5638-A2	Replacer Receiving Cup
T78P-5638-A3	Bushing Replacer
T78P-5638-A4	Remover Receiving Cup
T78P-5638-A5	Bushing Remover

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Manual Fill Load Leveler System—Air Sleeve Rear Shock Absorbers

PART 14-45

Applies to Ford/Mercury

SUBJECT	PAGE
DESCRIPTION	
Manual Fill Load Leveler System	45-1
REMOVAL AND INSTALLATION	
Air Line Assembly	45-3
Air Sleeve Shock Absorber	45-3
TESTING	
Leak Test	45-3
System Functional Check	45-3

CF2514-2A

DESCRIPTION

MANUAL FILL LOAD LEVELER SYSTEM

The manual fill load leveler system (Fig. 2) is designed to level the rear of the vehicle under various load conditions. The rear shock absorbers can be inflated or deflated, as required, at the fill valve, located under the hood on the left fender apron, to bring the vehicle back to its normal design ride height.

The system consists of an air fill valve, a flexible nylon air line assembly and two air sleeve rear shock absorbers (Fig. 1). The air fill valve is of the conventional tire valve type. The flexible nylon air line assembly uses 1/4" diameter tubing with brass fittings and rubber O-rings.

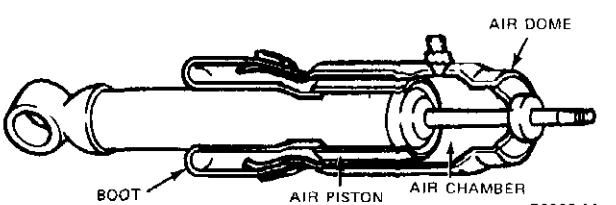


FIG. 1 Air Sleeve Rear Shock Absorber

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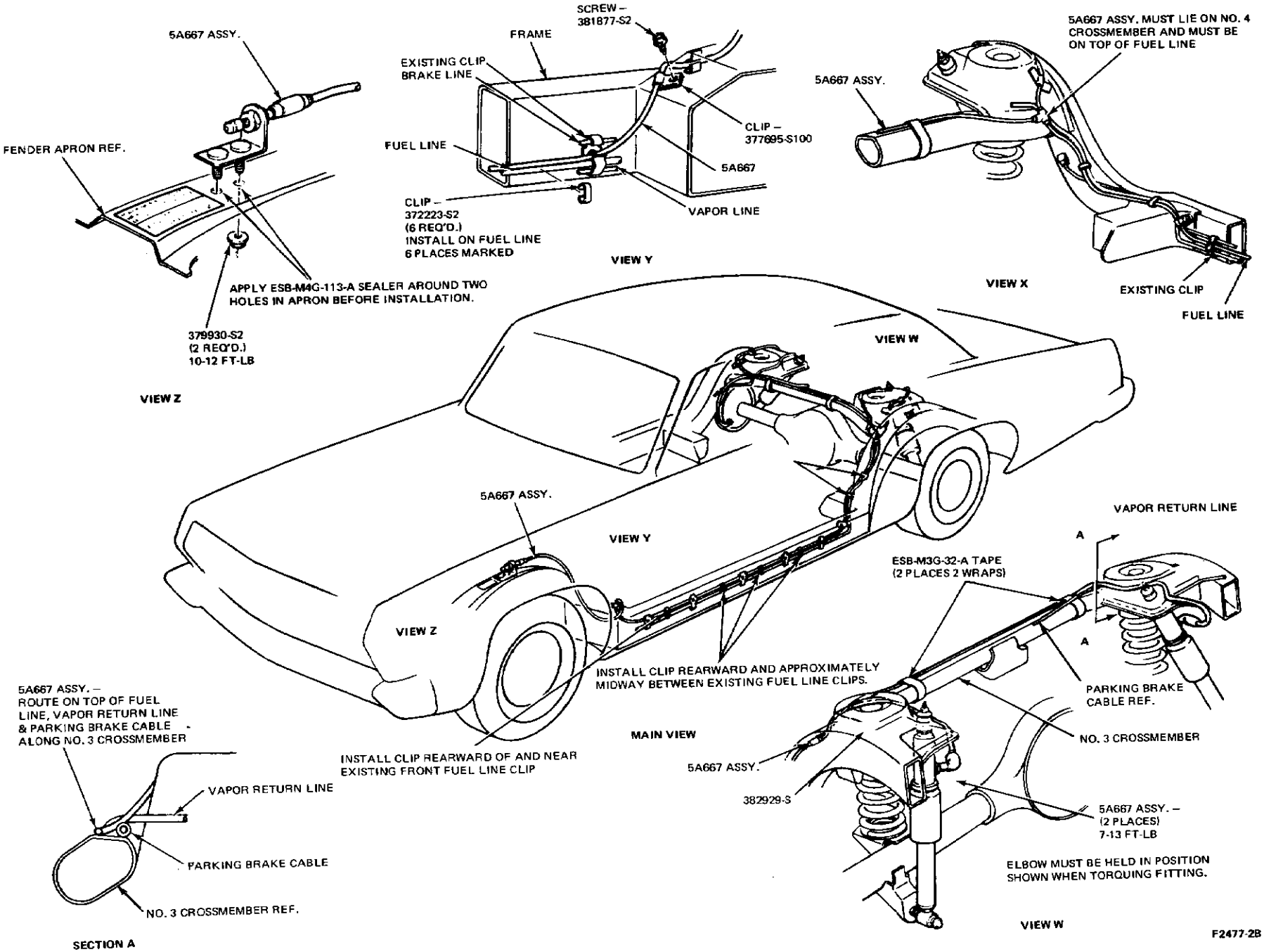


FIG. 2 Manual Fill Load Leveler System

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TESTING

SYSTEM FUNCTIONAL CHECK

1. Place the unloaded vehicle on a level surface. Make sure that all tires are at the recommended pressure.
2. Measure and record the distance from the rear fender opening to the ground with 18-20 psi pressure in the system.
3. Load the vehicle.
4. Pressurize the system through the fill valve until the vehicle looks level, then check the rear fender opening to ground distance. Add or bleed air from the system until the fender opening to ground distance is the same as recorded in Step 2, above. Do not pressurize over 90 psi.
5. The system should maintain the vehicle at this level without sagging due to loss of pressure. If this occurs, perform the leak test described in the next part.

LEAK TEST

1. Pressurize the system to 90 psi and apply soap solution to the fittings and shock sleeves and inspect for leaks. Decrease the pressure to 20 psi and again apply the soap solution to the fittings and the shock sleeves and inspect for leaks.
2. If leakage is detected at the air fill valve, check the valve stem for damage. Replace if required. (Conventional tire valve.) If leakage is detected at the elbow fittings, at the shock absorbers, check the fittings for the presence of, or damaged rubber "O" rings (Fig. 3). Replace the "O" rings (87004-S94) if required. Leaks anywhere else in the air line assembly require replacement of the entire air line assembly.

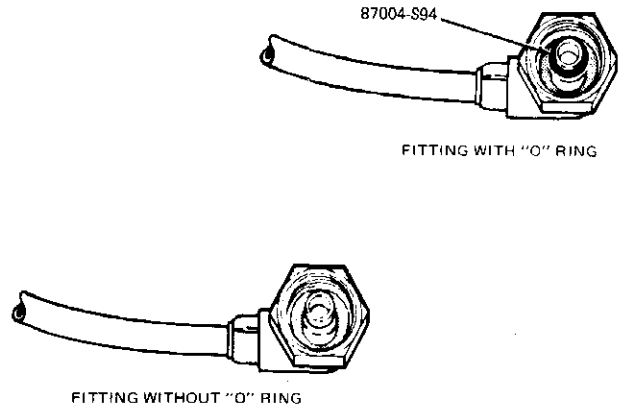


FIG. 3 Installing O-Ring 87004-S94

REMOVAL AND INSTALLATION

AIR LINE ASSEMBLY

Removal

1. Discharge the system completely by bleeding air through the air fill valve.
2. Remove the two 379930-S2 nuts that secure the air line assembly bracket to the left fender apron.
3. Remove the clips securing the line to the vehicle frame and the 382929-S clips holding the lines to the spring towers.
4. Remove the elbow fittings from the rear shock absorbers.

Installation

1. Apply ESB-M4G-113A sealer or equivalent around the two holes in the left fender apron and install the air line assembly bracket, securing it with the two 379930-S2 nuts. Torque the nuts to 10-12 lb-ft.
2. Secure the air line to the frame with the clips removed in Steps 3 and 4 in Removal above. Tape the line to the #4 crossmember to prevent sagging. The air line must be routed over all fuel and brake lines to prevent pinching.
3. Install the elbow fittings on the rear shock absorbers. Torque the fittings to 7-13 lb-ft. Be extremely careful to avoid breaking the elbows when tightening the fittings to the shocks.

AIR SLEEVE SHOCK ABOSRBER

Removal

1. Discharge the system completely by bleeding air through the fill valve.
2. Disconnect the flexible plastic lines from the air sleeve rear shock absorbers.
3. Refer to Part 14-32 for shock absorber Removal Procedure.

Installation

1. Install the air sleeve rear shock absorbers in the vehicle following the procedure given in Part 14-32.
2. Connect the flexible plastic lines to the rear shock absorbers. Torque the fitting nuts to 7-13 ft-lb.
3. Pressurize the system to 90 psi, using an external air source applied to the bleed valve. Apply leak detection fluid to the fittings and check for leaks.

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Driving Axles and Drive Shafts

GROUP 15

PART TITLE	PART NO.
Drive Shaft – Double Cardan Type U-Joint	15-66
Drive Shaft – Single Cardan Type U-Joint	15-60
General Driving Axle and Drive Shaft Service	15-01
Integral Carrier Axle – Conventional	15-02
Integral Carrier Axle – Ford (WER)	15-03
Integral Carrier Axle – Ford (WGX)	15-06
Removable Carrier Axle – Ford	15-10
Traction-Lok Limited Slip Differential – Ford	15-40

CF2516-2B

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: 08/77 GVWR 6508
GAWR: FRONT 32222 REAR 3375
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE
F0012/R0165
8S63H100001 PASSENGER

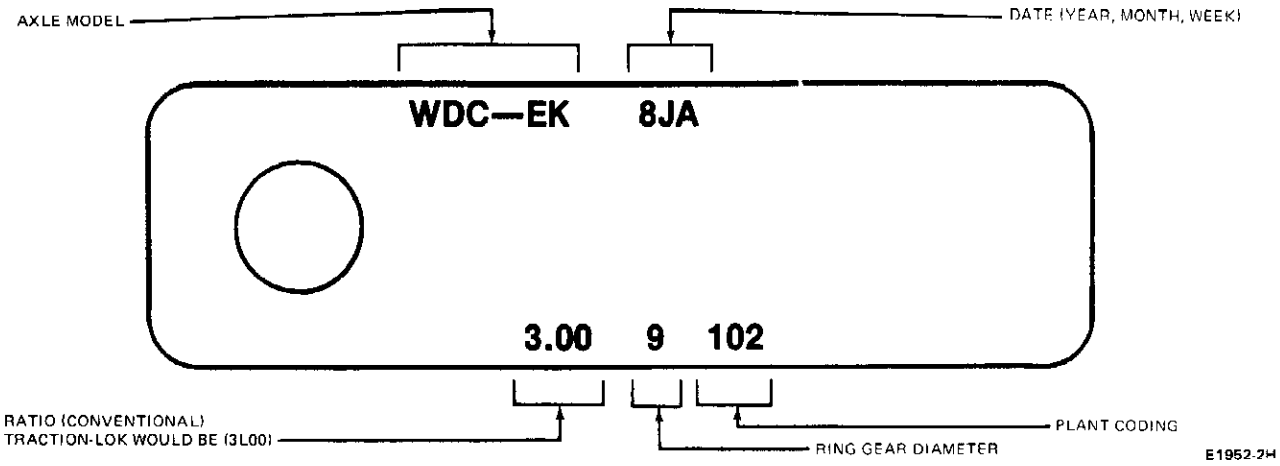
VEH. IDENT. NO. | TYPE

BODY	COLOR	TRIM	TRANS.	AXLE	DSO
53H	1C-YA	DD	X	6	48

CONVENTIONAL	TRACTION-LOK	RATIO
1	J	2.50:1
2	K	2.75:1
3	L	2.79:1
4		3.18:1
5	E	3.07:1
6	Ø	3.00:1
7		3.40:1
8		2.73:1
9	R	3.25:1
A	S	3.50:1
B		2.47:1
G	X	3.55:1

E1917-2H

FIG. 1 Vehicle Certification Label—Rear Axle Identification



E1952-2H

FIG. 2 Rear Driving Axle Model Identification Tag—Typical

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General Driving Axle and Drive Shaft Service

PART 15-01

Applies To All Cars

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Acceptable Tooth Contact Patterns (All Axles)	01-4
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Traction-Lok Differential Operation Check	01-3

CF2517-2A

DIAGNOSIS

Follow the Diagnosis Charts to isolate rear axle noise.

REAR AXLE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Excessive Rear Axle noise	• Differential carrier	• Road test vehicle to assure problem is rear axle noise rather than other system noise. Refer to General *Diagnostic Procedure. Repair and re*place parts as required.
• Loud "Clunk" in the drive shaft when shifting from reverse to forward	• Drive shaft	• Raise vehicle, rotate driveshaft by hand to isolate problem as driveshaft or rear axle problem. Repair or replace as required.
	• Rear axle shafts or carrier	• Remove and inspect. Repair as necessary.
• Limited-slip or Traction-Lok axle does not work in snow, mud or on ice	• Differential	• *Perform Traction-Lok Differential* Operation Check in this Part. Repair as required.
• On turns, the rear axle has a high *pitched chattering noise* (Limited-slip or Traction-Lok axles only)	• Lubricant	• Roadtest vehicle – Drive car in tight circles – 5 clockwise and 5 counter-clockwise. If chatter is still evident, flush and replace lubricant.
	• Differential	• Remove differential, repair as required.

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GENERAL DIAGNOSTIC PROCEDURE

CONDITION	POSSIBLE CAUSE
• Noise is the same on drive or coast	• Road noise. • Tire noise. • Front wheel bearing noise
• Noise changes with type of road	• Road noise. • Tire noise.
• Noise tone lowers as car speed is lowered	• Tire noise.
• Similar noise is produced with car standing and driving	• Engine noise. • Transmission noise.
• Vibration	• Refer to N.V.H., Part 18-01.
• Noise most pronounced on turns	• Differential side gears and pinion
• Drive noise, coast noise, or float noise	• Wheel Bearings. • Ring and pinion gear.
• Clunk on acceleration or deceleration	• Worn differential cross shaft in case

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TESTING

TRACTION-LOK DIFFERENTIAL OPERATION CHECK

A Traction-Lok differential can be checked for proper operation without removing the carrier from the axle housing.

Jack up one rear wheel and remove the wheel cover. Install the tool on the axle shaft flange studs as shown in Fig. 1.

Using a torque wrench of at least 200 ft-lb. capacity, rotate the axle shaft. **Be sure that the transmission is in neutral, one rear wheel is on the floor, and the other rear wheel is raised off the floor.** The breakaway torque required to start rotation should be at least 40 ft-lb. The initial breakaway torque may be higher than the continuous turning torque, but this is normal. The axle shaft should turn with even pressure throughout the check without slipping or binding. If the torque reading is less than specified, check the differential for improper assembly. **A vehicle equipped with a Traction-Lok differential will always have both wheels driving. If, while the vehicle is being serviced, only one wheel is raised off the floor and the rear axle is driven by the engine, the wheel on the floor could drive the vehicle off the stand or jack.**

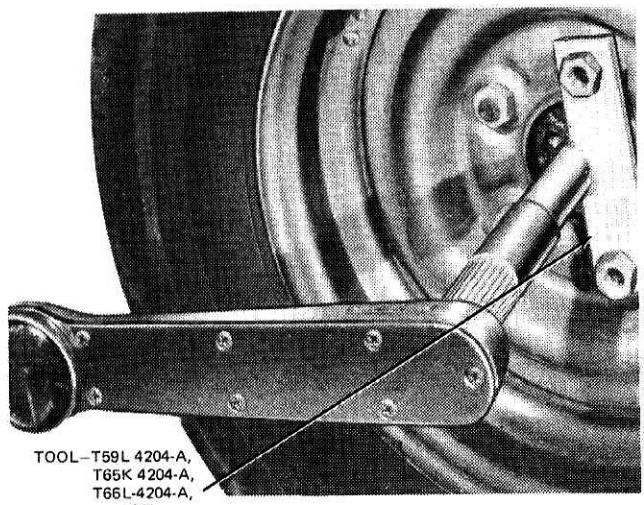


FIG. 1 Traction-Lok Differential Check

GEAR TOOTH CONTACT PATTERN CHECK

Note: It is not necessary to roll a tooth pattern if special Tool T76P-4020-A is used to set pinion depth. See appropriate Part for use in specific axle.

When rolling a tooth pattern, use the special compound (tube) packed with each service ring gear and pinion set. Paint all gear teeth and roll a pattern as described in Cleaning and Inspection. After diagnosing the tooth pattern as explained here, make the appropriate adjustments as outlined in Adjustments. In making a final gear tooth contact pattern check, it is necessary to recognize the fact that there are three different types of gear sets: hunting, nonhunting and partial nonhunting. Each type is determined by the number of teeth in the gears. The nonhunting and partial nonhunting types can be identified by the paint timing marks on the pinion and ring gear teeth (Fig. 2).

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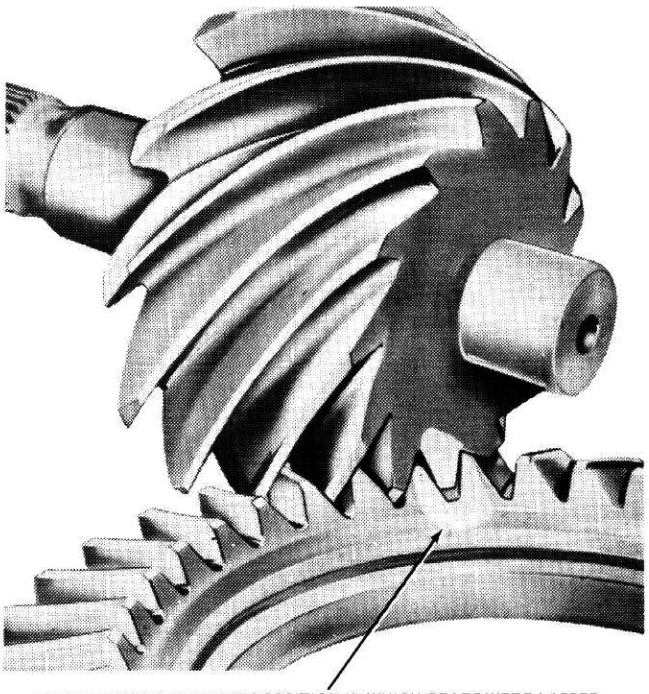


FIG. 2 Gear Set Timing Marks

ACCEPTABLE TOOTH PATTERNS (ALL AXLES)

Fig. 3 shows acceptable tooth patterns for all axles. In general, desirable tooth patterns should have the following characteristics:

1. The drive pattern should be fairly well centered on the tooth.
2. The coast pattern should be fairly well centered on the tooth.
3. Some clearance between the pattern and the top of the tooth is desirable.
4. There should be no hard lines where the pressure is high.

The individual gear set need not conform exactly to the ideal pattern to be acceptable. **Any combination of drive and coast patterns shown in Fig. 3 is acceptable.**

Hunting Gear Set

In a hunting-type gear set, any one pinion gear tooth comes into contact with all ring gear teeth. In this type, several revolutions of the ring gear are required to make all possible gear combinations.

Any combination of drive and coast patterns shown in Fig. 3 will be acceptable.

Nonhunting Gear Set

In a nonhunting-type gear set, any one pinion gear tooth comes into contact with only a few ring gear teeth. In this type, only one revolution of the ring gear is required to make all possible tooth contact combinations. Any combination of drive and coast patterns shown in Fig. 3 will be acceptable.

Partial Nonhunting Gear Set

In a partial nonhunting-type gear set, any one pinion tooth comes into contact with only part of the ring gear teeth, but more than one revolution of the ring gear is required to make all possible gear tooth combinations. Any combination of drive and coast patterns shown in Fig. 3 will be acceptable.

SHIM AND BACKLASH CHANGES

Since each gear set rolls a characteristic pattern, the patterns shown in Fig. 3 are considered acceptable and should be used as a guide. The drive pattern is rolled on the convex side of the tooth, and the coast pattern is rolled on the concave side.

The movement of tooth contact patterns with changes in shimming can be summarized as follows:

REMOVABLE CARRIER-TYPE AXLE

On removable carrier axles, the pinion locating shim is located between the pinion retainer and the carrier housing.

1. Thicker shim, with the back lash set to specification, moves the pinion further from the ring gear:
2. Thinner shim, with the back lash set to specification, moves the pinion closer to the ring gear:

If the patterns are not correct, make the changes as indicated by the pattern. The pinion need not be disassembled to change a shim. Just remove the pinion, bearing, and retainer assembly and install a different shim. When reinstalling the pinion and retainer assembly of a nonhunting or partial nonhunting gear set, be sure that the marked tooth on the pinion indexes between the marked teeth on the ring gear (Fig. 2).

INTEGRAL CARRIER-TYPE AXLE

On integral carrier axles, the pinion locating shim is located immediately behind the pinion gear and the ring gear and pinion must be removed in order to change a shim.

1. Thinner shim, with the back lash set to specification, moves the pinion away from the ring gear.
2. Thicker shim, with the back lash set to specification, moves the pinion closer to the ring gear.

If the patterns are not correct, make the changes as indicated by the pattern. The differential case and drive pinion will have to be removed from the carrier casting to change a shim. When reinstalling the pinion and ring gear of a nonhunting or partial nonhunting gear set, be sure that the marked tooth on the pinion indexes between the marked teeth on the ring gear (Fig. 2).

REAR AXLE COMPANION FLANGE RUNOUT CHECK

The specified total runout for each type of rear axle companion flange is given in the appropriate Part of this Manual covering that axle type.

All Axles Except Thunderbird, Lincoln Continental, Continental Mark V, Versailles, Fairmont and Zephyr

1. Raise the vehicle on a hoist that supports the rear axle (twin-post hoist).

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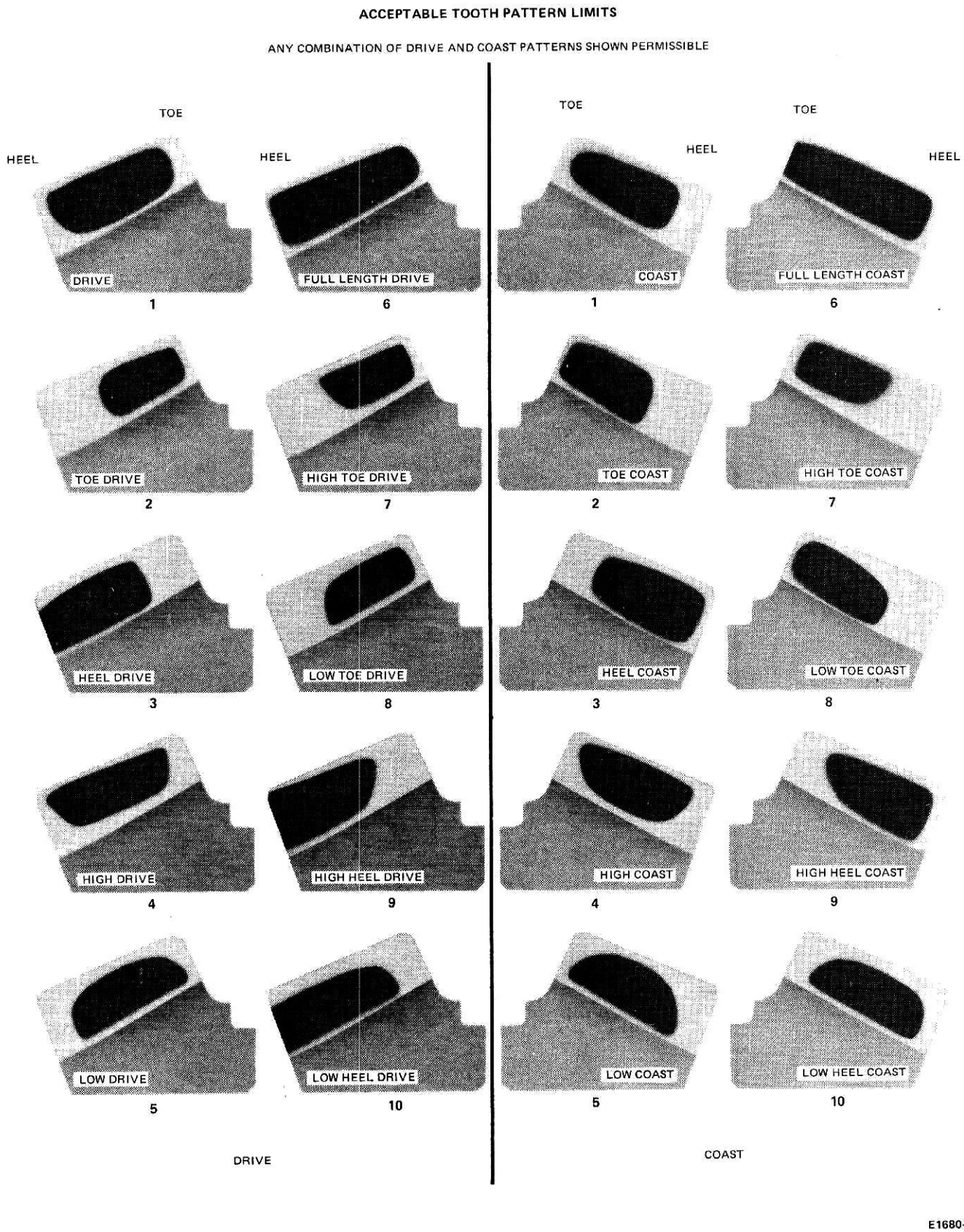


FIG. 3 Acceptable Tooth Pattern Limits

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2. Remove the driveshaft assembly (Part 15-60).
3. Check for companion flange damage to the universal joint bearing locating lugs. If the lugs on the companion flange are shaved (worn) or damaged, replace the companion flange (Fig. 4).

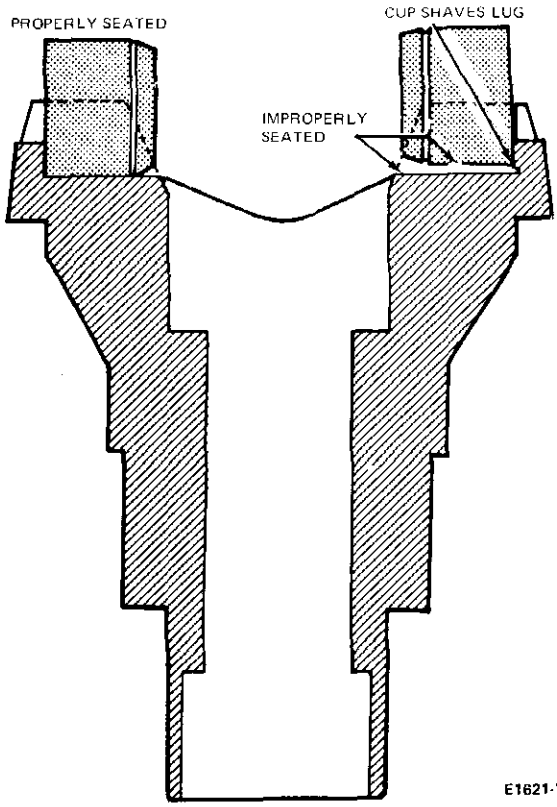


FIG. 4 Checking Companion Flange

4. The rear axle companion flange runout is checked with a modified universal joint (checking tool) dial indicator with 1.000 inch minimum travel, and a cup-shaped dial indicator adapter tool (Fig. 5). **To fabricate the checking tool, modify a universal joint assembly by removing two bearing cups that are opposite each other, and cutting or grinding off one of the universal joint bearing flanges (Fig. 5).**
5. Install the cup-shaped adapter on the dial indicator stem. Install the dial indicator on the pinion retainer or pinion nose bumper bracket. Position the indicator to allow an indication at the ends of the universal joint bearing cups and the remaining exposed journal of the cross-shaft.
6. Turn the companion flange so that the dial indicator cup-type adapter rests on the machined surface of the bearing cup (Fig. 5). Rotate the companion flange side-to-side slightly, to obtain a reading indicating that the bearing cup surface is perpendicular to the indicator cup-type adapter. **This will be the point at which the dial indicator cup is closest to the center of companion flange rotation. It is also the point at which the dial indicator hand will reverse direction as the companion flange is turning. Set the dial indicator to zero.**

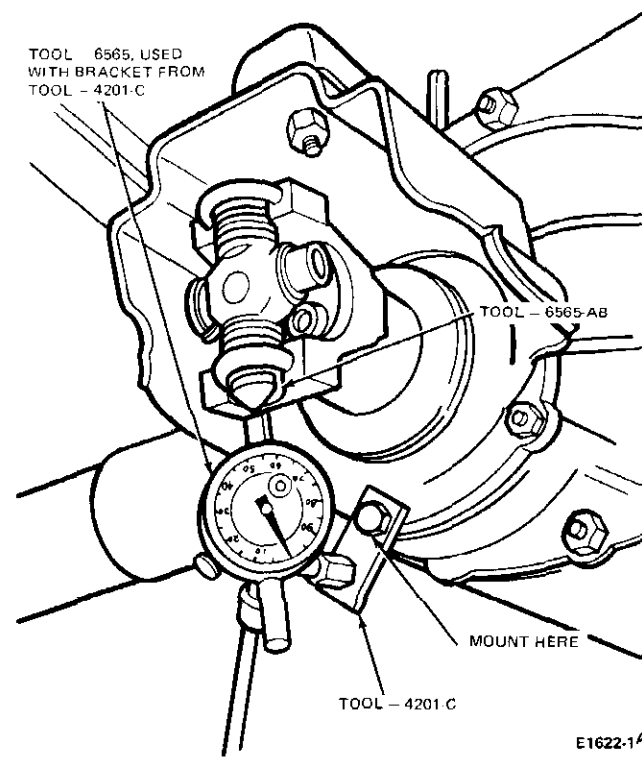


FIG. 5 Flange Bearing Cup Runout Check—Typical

7. Carefully retract the dial indicator stem and rotate the companion flange 180 degrees, to position the machined surface of the opposite universal bearing under the dial indicator adapter tool. Slightly rotate the flange side-to-side, to position the bearing perpendicular to the dial indicator adapter. At this point, the indicator hand will reverse direction as the flange is rotated. Record the flange bearing cup runout reading obtained from the indicator (Fig. 6).

Indicator Reading	Flange Bearing Cup Runout—Inch	Driveshaft Universal Cross-Shaft Runout—Inch
1	0.004	0.005
2	0.002	0.004
3	0.003	0.003
Average	0.003	0.004

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FIG. 6 Flange Bearing Cup and Cross-Shaft Runout Averaging Chart—Typical Readings

Rotate the companion flange 90 degrees and position the dial indicator adapter on the machined end of the exposed journal (Fig. 7). **Be sure the end surface of the exposed journal is perpendicular to the indicator cup-type adapter.** This requires that the cross-shaft be

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moved fore and aft on the flange bearing cups. **Note the point at which the indicator hand reverses direction.** Rotate the flange assembly side-to-side until the cross-shaft is perpendicular to the pinion shaft axis, and the indicator hand reverses direction. Zero the dial indicator and check the zero point again by slightly moving the cross-shaft fore and aft, then rotate the companion flange from side-to-side.

8. With the indicator at zero, carefully retract the dial stem and rotate the flange 180 degrees. Rotate the cross-shaft 180 degrees on the flange bearing cups to position the exposed journal under the dial indicator adapter. Rock the cross-shaft fore and aft and the companion flange side-to-side to establish the point at which the indicator hand reverses direction. This will determine the driveshaft universal cross-shaft run-out. Record this reading (Fig. 7).
9. Repeat Steps 5 through 8 at least three times and average the indicator readings obtained (Fig. 6).
10. To determine the total (combined) companion flange runout, it will be necessary to use the combined runout chart (Fig. 8). Position a straight edge at the amount of flange bearing cup runout indicated on the left-hand column of the chart. Position another straight edge vertically, at the amount of the universal cross-shaft runout indicated on the top of the chart. The point at which the straight edges cross the chart indicates the combined rear axle flange runout. For example:

    With an indicated 0.003 inch flange bearing cup runout and an indicated 0.004 inch universal cross-shaft runout (Fig. 8), the combined companion flange runout will be 0.005 inch as indicated in the square on the chart (Fig. 8).
11. If the reading obtained in Step 10 exceeds specifications, reposition the companion flange 180 degrees on the pinion shaft and repeat Steps 1 through 10.
12. If the repeat readings still exceed specifications, re-position the flange an additional 90 degrees on the pinion shaft and check the runout (Steps 4 through 10).
13. If the runout is still excessive, replace the companion flange and check the runout. If necessary, rotate the new flange on the pinion shaft until an acceptable runout is obtained.

    If excessive runout is still evident after replacement of the companion flange, it will be necessary to replace the ring and pinion gear, and repeat the above checks until runout is within specifications.
14. Install the driveshaft assembly (Part 15-60). **Make sure the universal joint bearing cups are properly positioned between the companion flange lugs.**
15. Lower the vehicle and road test. If drive shaft vibrations are evident, remove the driveshaft from the companion flange and rotate it 180 degrees. Road test the vehicle again.

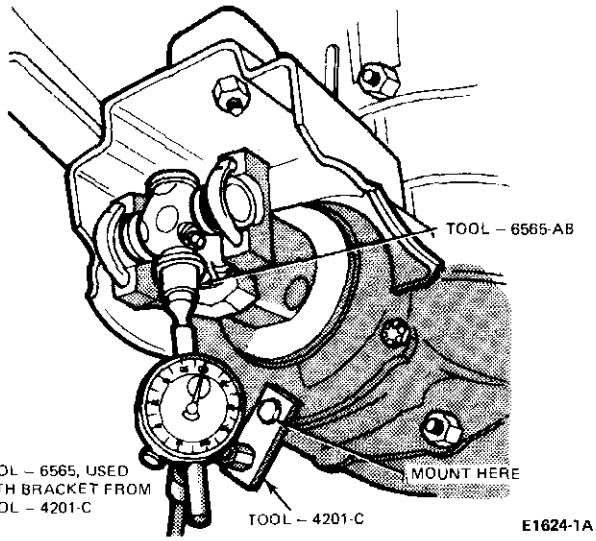


FIG. 7 Cross-Shaft Runout Check—Typical

Lincoln Continental, Continental Mark V, Versailles, Fairmont and Zephyr

1. Raise the vehicle on a hoist that supports the rear axle (twin-post hoist).

Flange Bearing Cup Runout	Drive Shaft Universal Cross-Shaft Runout–Inch								
	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008
0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008
0.001	0.001	0.0013	0.0022	0.0032	0.0042	0.0051	0.0061	0.0071	0.0081
0.002	0.002	0.0022	0.0027	0.0037	0.0045	0.0053	0.0062	0.0072	0.0082
0.003	0.003	0.0032	0.0036	0.0042	0.005	0.0058	0.0067	0.0077	0.0085
0.004	0.004	0.0042	0.0045	0.005	0.0057	0.0064	0.0072	0.0081	0.009
0.005	0.005	0.0051	0.0053	0.0058	0.0063	0.0071	0.0078	0.0087	0.0094
0.006	0.006	0.0061	0.0062	0.0068	0.0072	0.0078	0.0085	0.0092	0.010
0.007	0.007	0.0071	0.0073	0.0075	0.0081	0.0087	0.0093	0.0099	0.0103
0.008	0.008	0.0081	0.0082	0.0087	0.009	0.0094	0.010	0.0104	0.011

The total (combined) companion flange runout is located in the square where the columns containing the flange bearng cup runout and universal cross shaft runout readings intersect.

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FIG. 8 Companion Flange Combined Runout Chart

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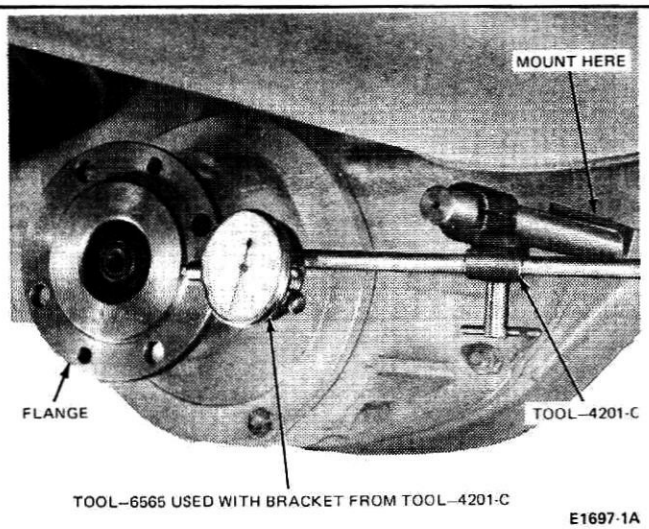


FIG. 9 Checking Companion Flange Radial Runout—Lincoln Continental and Continental Mark V—Typical Versailles, Fairmont and Zephyr

2. Remove the driveshaft assembly (Part 15-66).
3. Check the companion flange for damage.
4. To check radial runout, set up dial indicator as shown in Fig. 9.
5. Rotate the companion flange with the dial indicator in place. If the runout exceeds specifications, remove the flange and reinstall it 180 degrees from original position. Follow the procedure in Part 15-66 for companion flange installation.
6. If the runout is still excessive, remove and reinstall the flange an additional 90 degrees and re-check the runout.
7. To check lateral (face) runout, set up the dial indicator as shown in Fig. 10. Repeat Steps 5 and 6.
8. If the runout is still excessive, replace the companion flange and check the runout. If necessary, rotate the new flange on the pinion shaft until an acceptable runout is obtained.

   If excessive runout is still evident after replacement of the companion flange, it will be necessary to replace the ring and pinion gear, and repeat the above checks until runout is within specifications.
9. Install the driveshaft assembly (Part 15-66).

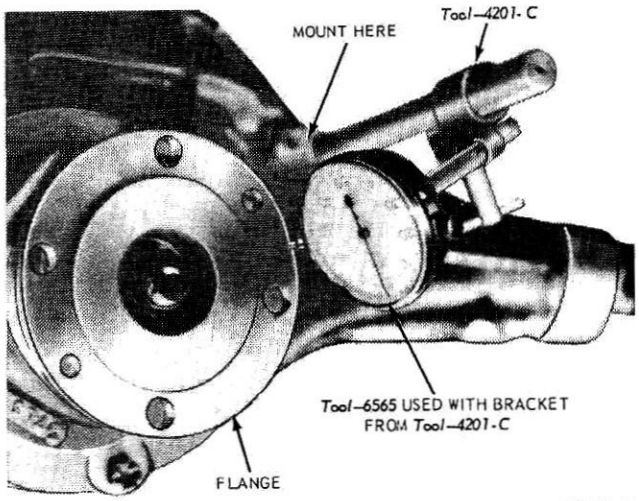


FIG 10. Checking Companion Flange Lateral Runout—Lincoln Continental and Continental Mark V—Typical Versailles, Fairmont and Zephyr

ADJUSTMENTS

Certain rear axle and drive line trouble symptoms are also common to the engine, transmission, wheel bearing, tires, and other parts of the vehicle. For this reason, be sure that the cause of the trouble is in the rear axle before adjusting, repairing or replacing any of the parts.

PINION AND RING GEAR TOOTH CONTACT ADJUSTMENT

Two separate adjustments affect pinion and ring gear tooth contact. They are pinion location and backlash (Figs. 11 and 12).

Individual differences in matching the differential housing and the gear set require the use of shims to locate the pinion for correct contact with the ring gear.

When adjusting either type axle, shim thickness should be increased or reduced only as indicated by the tooth pattern check described on preceding pages.

If the tooth pattern check indicates a change in backlash only, follow the procedure under Backlash and Differential Bearing Preload Adjustments. If the tooth pattern indicates a change in shim thickness, follow the procedure for the removable or the integral carrier-type axle, which follows.

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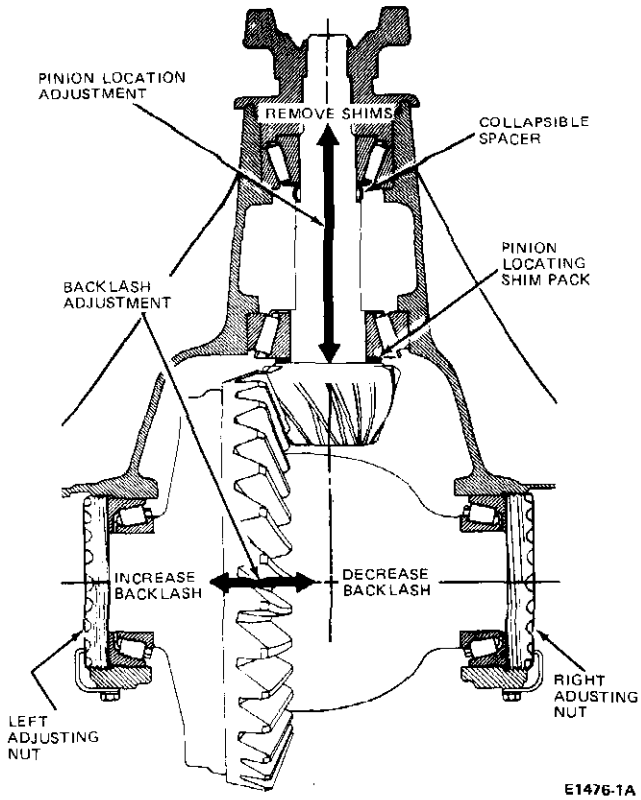


FIG. 11 Pinion and Ring Gear Tooth Contact Adjustment—Integral Carrier-Type Axles

REMOVABLE CARRIER-TYPE AXLE

The shim location for the removable carrier-type axle is between the pinion retainer and the carrier (Fig. 12). When adjusting this type carrier, reducing shim thickness will move the pinion toward the ring gear; increasing shim thickness will move the pinion away from the ring gear (Fig. 12).

INTEGRAL CARRIER-TYPE AXLE

The shim location for the integral carrier-type axle, is between the pinion gear and the pinion rear bearing cone (Fig. 11). When adjusting this type axle, increasing shim thickness moves the pinion toward the ring gear; reducing shim thickness moves the pinion away from the ring gear (Fig. 11).

BACKLASH AND DIFFERENTIAL BEARING PRELOAD ADJUSTMENTS

On a WER axle, it is necessary to remove the rear axle shaft prior to performing the adjustment procedures. Refer to Rear Axle Shaft Wheel Bearing and Oil Seal Replacement—WER Axle, Part 11-11. **To secure a more uniform control of differential side bearing preload in service repairs, a dial indicator set-up is used such as shown in Fig. 13. In both types of axle (Figs. 11 and 12), the ring gear is moved away from or toward the pinion, as described in the following procedure.**

1. Remove the adjusting nut locks, loosen the differential bearing cap bolts, then torque the bolts to 15 ft-lb. on integral carrier-type axle; 20 ft-lb. on removable carrier-type axles before making adjustments.
2. **The left adjusting nut is on the ring gear side of the carrier. The right nut is on the pinion side.** Loosen the right nut until it is away from the cup. Tighten the left nut until the ring gear is just

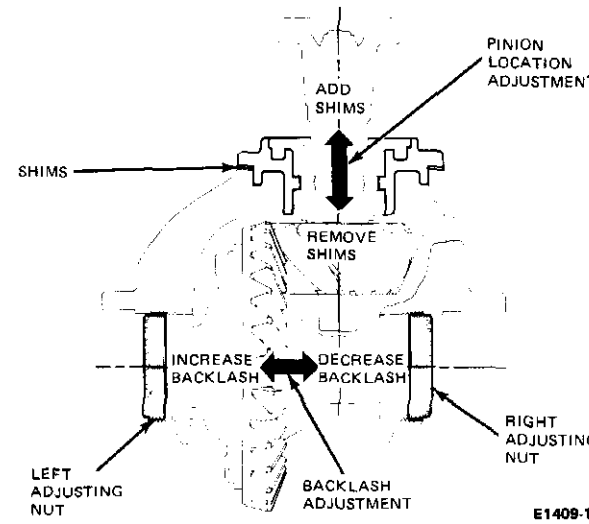


FIG. 12 Pinion and Ring Gear Tooth Contact Adjustment—Removable Carrier Axles

forced into the pinion with 0.000 backlash, then rotate the pinion several revolutions to be sure no binding is evident. (Recheck the right nut at this time to be sure that it is still loose.) **Tightening the left nut moves the ring gear into the pinion to decrease backlash, and tightening the right nut moves the ring gear away.**

3. Install a dial indicator as shown in Fig. 13.
4. Tighten the right nut until it first contacts the bearing cup. Then, preload the bearings from 0.008 to 0.012-inch case spread. Turn the pinion gear several times in each direction to seat the bearings in the cups and be sure no bind is evident. **This step is important.**
5. Torque the differential cap bolts to specification.
6. Measure the backlash on several teeth around the ring gear. If the measurements vary more than 0.003 inch (both integral and removable carrier), there is excessive runout in the gears or their mountings, which must be corrected to obtain a satisfactory unit. If the backlash is out of specification, loosen one adjusting nut and tighten the opposite nut an equal amount, to move the ring gear away from or toward the pinion. **When moving the adjusting nuts, the final movement should always be made in a tightening direction. For example, if the left nut had to be loosened one notch, loosen the nut two notches, then tighten it one. This insures that the nut is contacting the bearing cup, and that the cup cannot shift after being put in service.** After all such adjustments, check to be sure that the case spread remains as specified for the new or original bearings used.

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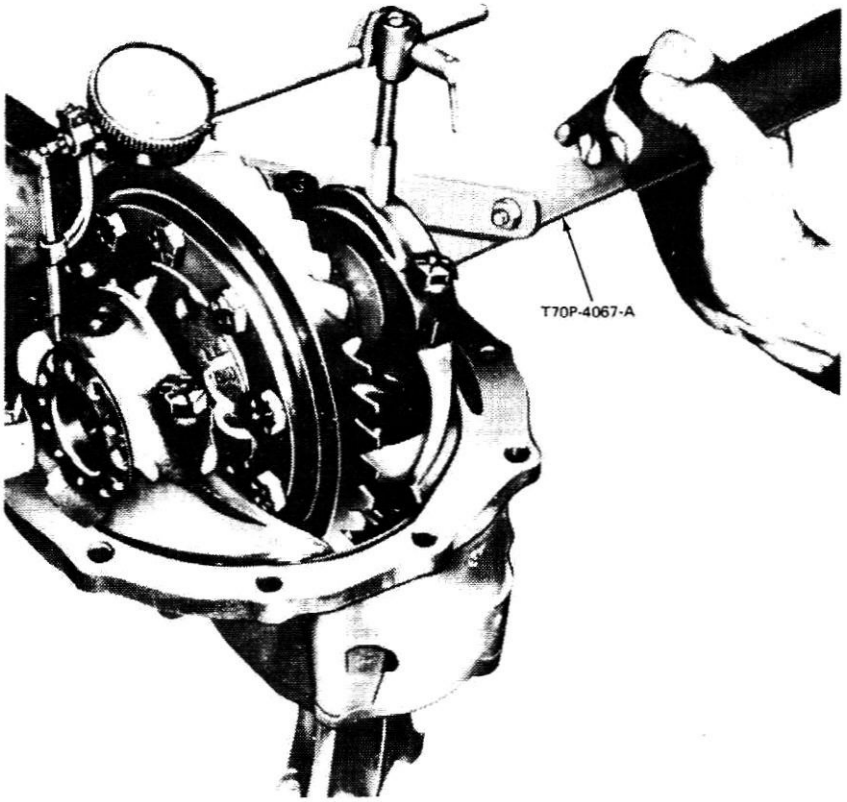


FIG. 13 Adjusting Side Bearing Preload—Typical

7. Again check the tooth contact pattern. If the pattern is still incorrect, a change in pinion location (shim thickness) is indicated. If this is so, refer to Major Repair, under the removable carrier or integral carrier axle involved for the necessary steps.

CLEANING AND INSPECTION

INSPECTION BEFORE DISASSEMBLY OF CARRIER (ALL AXLES)

The differential case or carrier should be inspected before any parts are removed from it. These inspections can help to find the cause of the trouble and to determine the corrections needed.

Mount the carrier in the holding fixture shown in Fig. 14. Wipe the lubricant from the internal working parts, and visually inspect the parts for wear or damage.

Rotate the gears to see if there is any roughness which would indicate damaged bearings or chipped gears. Check the gear teeth for scoring or signs of abnormal wear. Set up a dial indicator (Fig. 15) and check the backlash at several points around the ring gear. Backlash should be within specifications.

If no obvious defect is noted, check the gear tooth contact.

To check the gear tooth contact, paint the gear teeth with the special compound furnished with each ring gear and pinion. A mixture that is too wet will run and smear. Too dry a mixture cannot be pressed out from between the teeth. As shown in Fig. 16 rotate the ring gear (use a box wrench on the ring gear attaching bolts for a

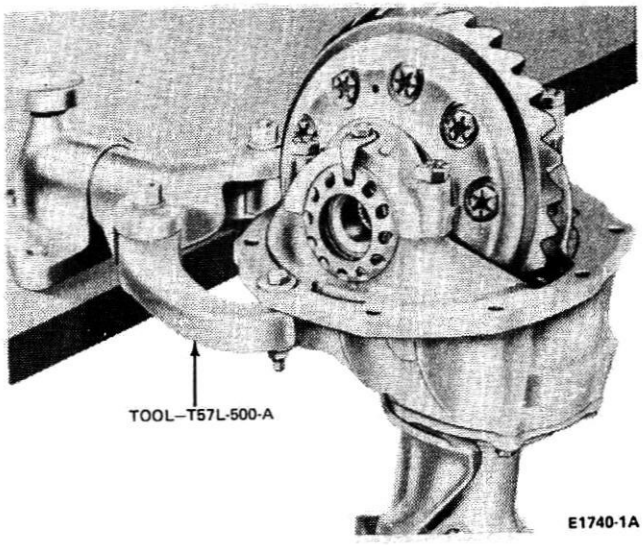


FIG. 14 Bench Fixture for Removable Carrier Overhaul—Typical

lever) five complete revolutions in both directions or until a clear tooth contact pattern is obtained.

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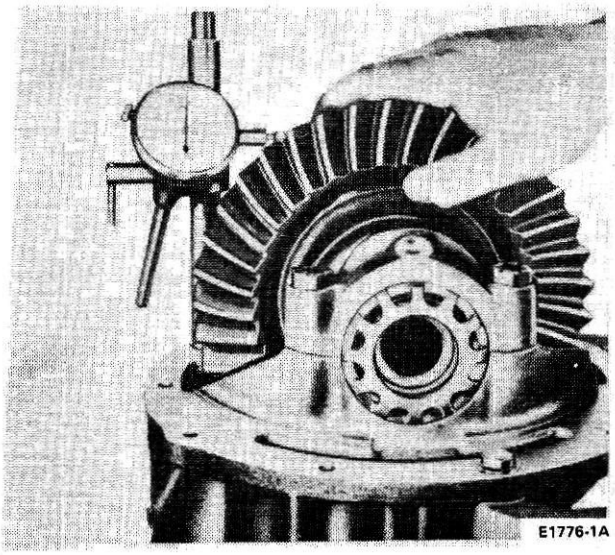


FIG. 15 Backlash Check—Typical

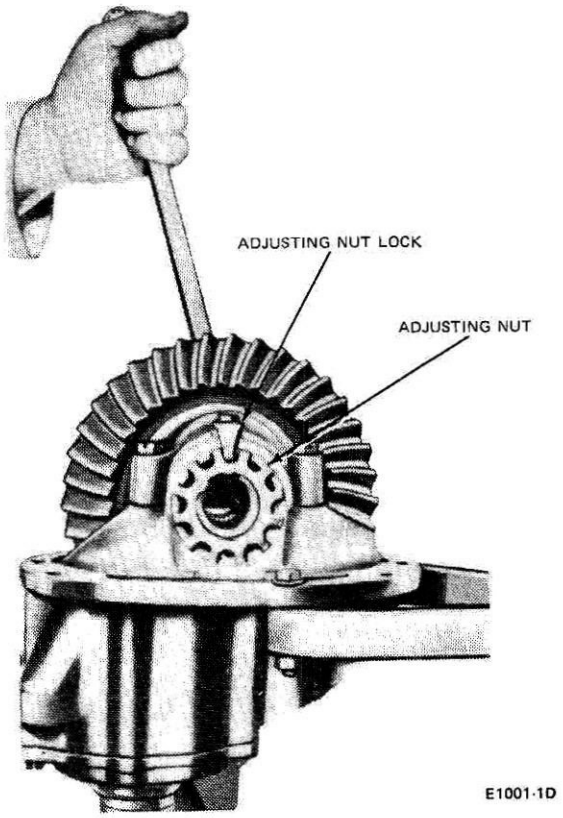


FIG. 16 Checking Gear Tooth Contact—Typical

Certain types of gear tooth contact patterns on the ring gear indicate incorrect adjustment. Noise caused by incorrect adjustment can often be corrected by readjusting the gears. Acceptable patterns and the necessary corrections are explained under Tooth Contact Pattern Check at the beginning of this Part.

Gear tooth runout can sometimes be detected by an erratic pattern on the teeth. However, a dial indicator should be used to measure the runout of the back face of the ring gear as shown in Fig. 17. If this runout exceeds specifications, disassemble the carrier and replace necessary parts as indicated in Part 15-02, Assembly and Disassembly.

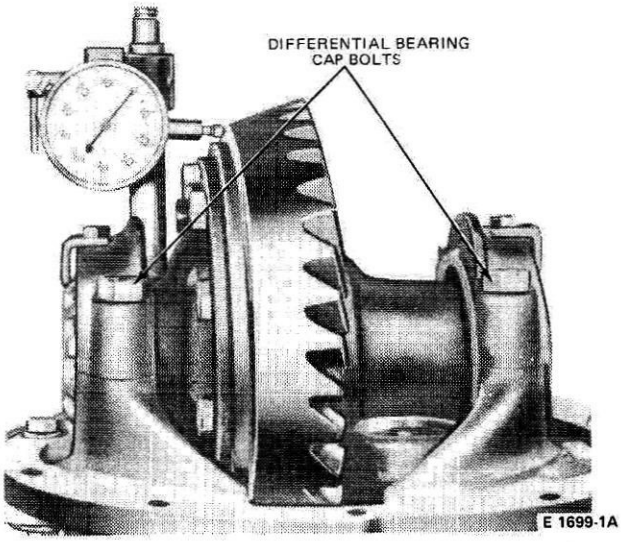


FIG. 17 Checking Ring Gear Runout—Typical

Loosen the differential bearing cap bolts, and then torque them to 25 ft-lb. Remove the adjusting nut locks. Carefully loosen one of the adjusting nuts to determine if any differential bearing preload remains. If any preload remains, the differential bearings may be re-used, provided they are not pitted or damaged.

INSPECTION AFTER DISASSEMBLY OF CARRIER (ALL AXLES)

Thoroughly clean all parts. Synthetic seals must not be cleaned, soaked or washed in cleaning solvents. Always use clean solvent when cleaning bearings. Oil the bearings immediately after cleaning, to prevent rusting. Inspect the parts for defects. Clean the inside of the carrier before rebuilding it. **When a scored gear set is replaced, the axle housing should be washed thoroughly and steam cleaned. This can only be done effectively if the axle shafts and shaft seals are removed from the housing. Inspect individual parts as outlined below.**

GEARS

Examine the pinion and ring gear teeth for scoring or excessive wear. **Extreme care must be taken not to damage the pilot bearing surface of the pinion. The pattern taken during disassembly should be helpful in judging if gears can be re-used. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring is the result of excessive shock loading or the use of an incorrect lubricant. Scored gears cannot be reused. Examine the teeth and thrust surfaces of the differential gears. Wear on the hub of the differential gear can cause a chucking noise known as chuckle when the vehicle is driven at low speeds. Wear of splines, thrust surfaces, or thrust washers, can contribute to excessive drive line backlash.**

BEARING CUPS AND CONE AND ROLLER ASSEMBLIES

Check bearing cups for rings, scores, galling, or excessively worn wear patterns. Pinion cups must be solidly seated. Check by attempting to insert a 0.0015-inch feeler between these cups and the bottoms of their bores.

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When operated in the bearing cups, cone and roller assemblies must turn without roughness. Examine the roller ends for wear. Step-wear on the roller ends indicates that bearings were not preloaded properly, or that the rollers were slightly misaligned.

If inspection reveals either a worn bearing cup or a worn cone and roller assembly, **both parts should be replaced to avoid damage.**

DIFFERENTIAL BEARING ADJUSTING NUTS

Temporarily install the bearing caps and test the fit of the adjusting nuts in their threads. The nuts should turn easily when the caps are tightened to 25 ft-lb. The faces of the nuts that contact the bearing cups must be smooth and square. Replace the nuts or examine the threads in the carrier if their fit is not proper. Be sure that the bearing caps and adjusting nuts are on the side they were machined to fit. Observe the punch marks and scribe marks made during disassembly.

U-Joint Flange

Be sure that the ears of the flange have not been damaged in removing the drive shaft or in removing the flange from the axle. The end of the flange that contacts the front pinion bearing inner race, as well as the flat surface of the pinion nut counterbore, must be smooth. Polish these surfaces if necessary. Roughness aggravates backlash noises and causes wear of the flange and pinion nut—with a resultant loss in pinion bearing preload.

PINION RETAINER

Be sure that the pinion bearing cups are seated. Remove any chips or burrs from the mounting flange. Clean the groove for the O-ring seal and all lubricant passages. If the cups were removed, examine the bores carefully. Any nicks or burrs in these bores must be removed to permit proper seating of bearing cups.

CARRIER HOUSING

Make sure that the differential bearing bores are smooth and the threads are not damaged. Remove any nicks or burrs from the mounting surfaces of the carrier housing.

DIFFERENTIAL CASE

Make sure that the hubs where the bearings mount are smooth. Carefully examine the differential case bearing shoulders, which may have been damaged when the bearings were removed. The bearing assemblies will fail if they do not seat firmly against the shoulders. Check the fit (free rotation) of the differential side gears in their counterbores. Be sure that the mating surfaces of the two parts of the case are smooth and free from nicks or burrs.

TRACTION-LOK DIFFERENTIAL PARTS

Inspect the clutch plates for uneven or extreme wear. The dog-eared clutch plates must be free from burrs, nicks or scratches which could cause excessive or erratic wear to the bonding material of the internally splined clutch plates. The internally splined clutch plates should be inspected for condition of the bond, bonding material, and wear. Replace the bonded plates if their thickness is less than 0.085 inch or if the bonded material is scored or badly worn. Inspect the bonded plate internal teeth for wear. Replace them, if excessive wear is evident. **Bonded plates should be replaced as a set only. Examine all thrust surfaces and hubs for wear. Abnormal wear on these surfaces can contribute to a noisy axle.**

SPECIAL TOOLS

Tool Number	Description		Tool Number	Description
Tool 6565 with Tool 4201-C bracket. T70P-4067-A	Flange Bearing Cup Runout Checker Differential Bearing Preload Adjuster		T57L-500-A T59L-4204-A, T65K-4204-A T66L-4204-A or Tool 44211-A	Bench Fixture For Carrier Overhaul Adapter For Traction-Lok Differential Check w/Torque Wrench

CE2316-2C

ATTACHING TORQUE SPECIFICATIONS

Description	Torque Ft-Lb
Driveshaft To Axle Companion Flange U-Bolt Nut	
All Vehicles Except Lincoln Continental, Continental Mark V, Fairmont, Zephyr, Versailles	8 - 15
Lincoln Continental, Continental Mark V, Fairmont, Zephyr, Versailles	70 - 90

CE2588-2B

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Integral Carrier Axle—Conventional

PART 15-02

Applies To Mustang/Pinto/Bobcat

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CF2528-2A

DESCRIPTION

The rear axle assembly is an integral-type housing, hypoid design, with the centerline of the pinion set below the centerline of the ring gear (Fig. 1).

The semi-floating axle shafts are retained in the housing by bearing retainers at the axle housing outer ends.

The differential assembly is mounted on two opposed tapered roller bearings. The bearings are retained in the housing by removable caps. Differential bearing preload and drive gear backlash is adjusted by nuts located behind each differential bearing cup.

The drive pinion assembly is mounted on two opposed tapered roller bearings. Pinion bearing preload is adjusted by a collapsible spacer on the pinion shaft. Pinion and ring gear tooth contact is adjusted by shims between the rear bearing cone and the pinion gear.

A cover on the rear of the differential housing provides access for inspection and removal and installation of the differential assembly and drive pinion.

An identification tag is attached to one of the rear cover-to-housing retaining bolts (Part 15-01). It is important to use the axle model designation if necessary to obtain correct replacement parts.

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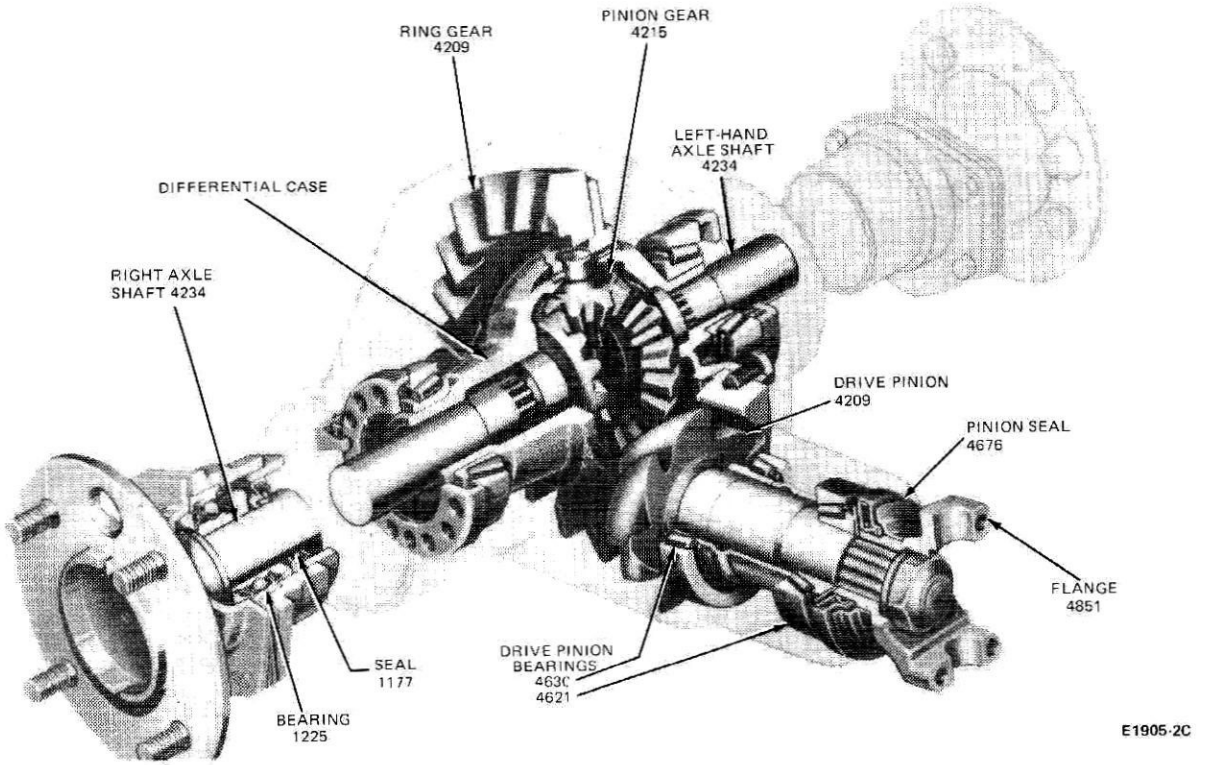


FIG. 1 Typical Rear Axle Assembly

REMOVAL AND INSTALLATION

REAR AXLE SHAFT, WHEEL BEARING AND OIL SEAL

Removal and insertion of rear axle shafts must be performed with caution. The entire length of the shaft (including spline) up to the seal journal must pass through the seal without contact. Any roughing or cutting of the seal element during axle removal or installation will result in seal failure.

The rear axle shafts, wheel bearings, and oil seal can be replaced without removing the differential assembly from the axle housing. Removal of the wheel bearings from the axle shafts make them unfit for further use.

Removal

1. Remove the wheel cover, wheel and tire from the brake drum.
2. Remove the speed nuts that secure the brake drum to the axle housing flange, and then remove the drum from the flange.
3. Working through the hole provided in each axle shaft flange, remove the nuts that secure the wheel bearing retainer plate. Then pull the axle shaft assembly out of the axle housing (Fig. 2). Remove the brake backing plate and attach it to the frame rail with a piece of wire.
4. If the rear wheel bearing is to be replaced, loosen the inner retainer ring by nicking it deeply with a cold chisel in several places (Fig. 3). It will then slide off easily.

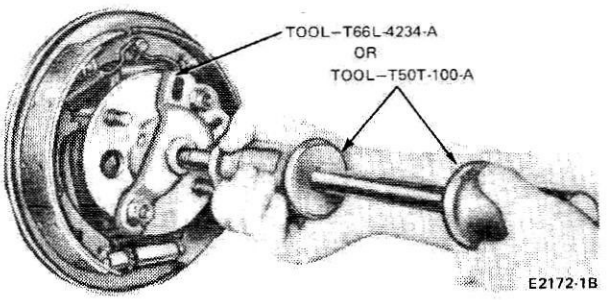


FIG. 2 Removing Axle Shaft

5. Remove the bearing from the axle shaft with the tool shown in Fig. 4. **Never apply heat to make it easier to remove the bearing retainer ring or the bearing. This will weaken the axle shaft bearing journal area.**
6. Whenever a rear axle shaft is replaced the oil seal must be replaced. Remove the seal with the tools shown in Fig. 5.

Installation

1. Inspect the machined surfaces of the axle shaft and the axle housing for rough spots or other

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irregularities which would affect the sealing action of the oil seal. Check the axle shaft splines for burrs, wear or damage. Carefully remove any burrs or rough spots. Replace worn or damaged parts.

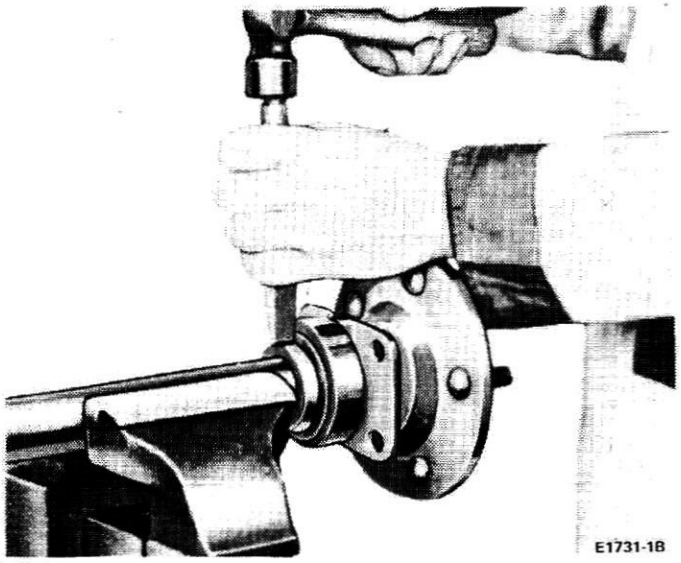


FIG. 3 Removing Rear Wheel Bearing Retainer Ring

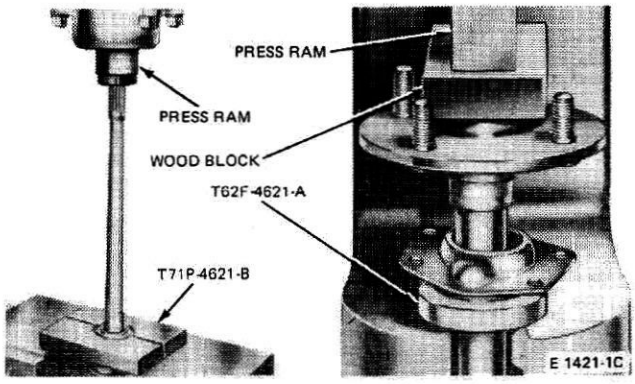


FIG. 4 Removing and Installing Rear Wheel Bearing

2. Place the retainer plate and a new bearing on the axle shaft, and press the new wheel bearing on the shaft with the tool shown in Fig. 4. **The bearing should seat firmly against the shaft shoulder. Do not attempt to press on both the bearing and the inner retainer ring at the same time.**
3. Using the bearing installation tool, press the bearing inner retainer ring on the shaft until the retainer seats firmly against the bearing. **Never apply heat to make it easier to install the bearing retainer ring or the bearing. This will weaken the axle shaft bearing journal area.**
4. Wipe all lubricant from the inside of the axle housing in the area of the oil seal before installing the new seal.
5. Install the new oil seal with the tools shown in Fig. 5. **Installation without use of the proper tool will distort the seal and cause leakage.** Install a new gasket on the housing flange and install the brake backing plate.
6. Carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the side gear, and push the shaft in until the bearing bottoms in the housing.
7. Install the bearing retainer plate on the mounting bolts at the axle housing, and install the attaching nuts. Torque the nuts to specification.
8. Install the brake drum and the drum retaining nuts.
9. Install the wheel and tire on the drum, and install the wheel cover.

DRIVE PINION OIL SEAL

Synthetic seals must not be cleaned, soaked or washed in cleaning solvent.

Replacement of the pinion oil seal involves removal and installation of only the pinion shaft nut and the universal joint flange. However, this operation disturbs the pinion bearing preload, and this preload must be carefully reset when assembling.

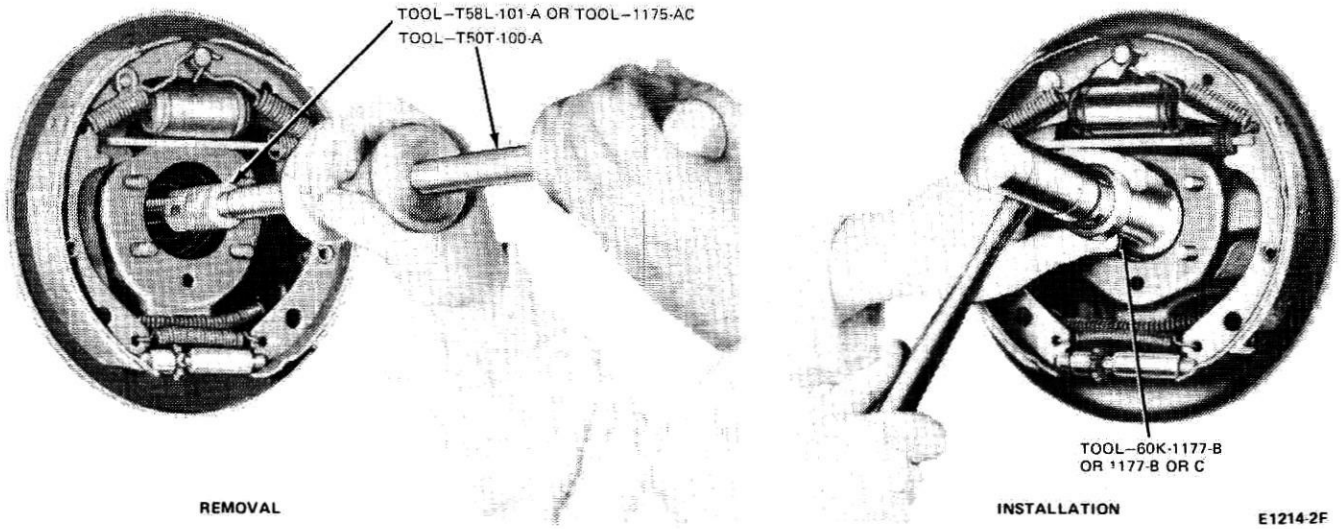


FIG. 5 Removing and Installing Axle Shaft Seal

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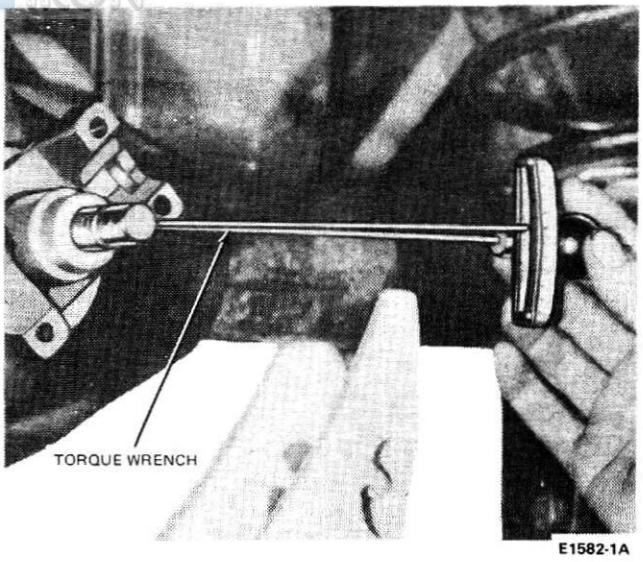


FIG. 6 Checking Pinion Bearing Preload

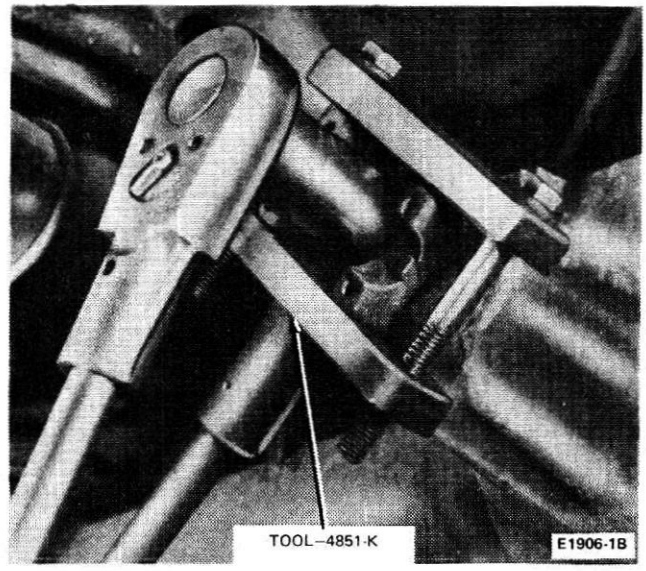


FIG. 7 Removing or Installing Drive Pinion Nut

Removal

1. Raise the vehicle and install safety stands. Remove the rear wheels and brake drums.
2. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly. Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the Transmission Group for the appropriate tool.
3. Install an in-lb torque wrench on the pinion nut (Fig. 6). Record the torque required to maintain rotation of the pinion shaft through several revolutions.
4. While holding the flange with the tool shown in Fig. 7, remove the integral pinion nut and washer.
5. Clean the pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear. Punch or scribe marks on the U-joint flange in relation to the pinion stem.
6. Using the tool shown in Fig. 8, remove the pinion U-joint flange.
7. Using the tool shown in Fig. 9, remove the drive pinion oil seal.
8. Clean the oil seal seat.

Installation

1. Pinion oil seals have pre-applied oil-resistant sealer. Install the seal in the retainer using the tool shown in Fig. 10.
2. Check splines on the pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in a circular motion. Wipe the pinion shaft clean.
3. Apply a small amount of lubricant to the U-joint splines.

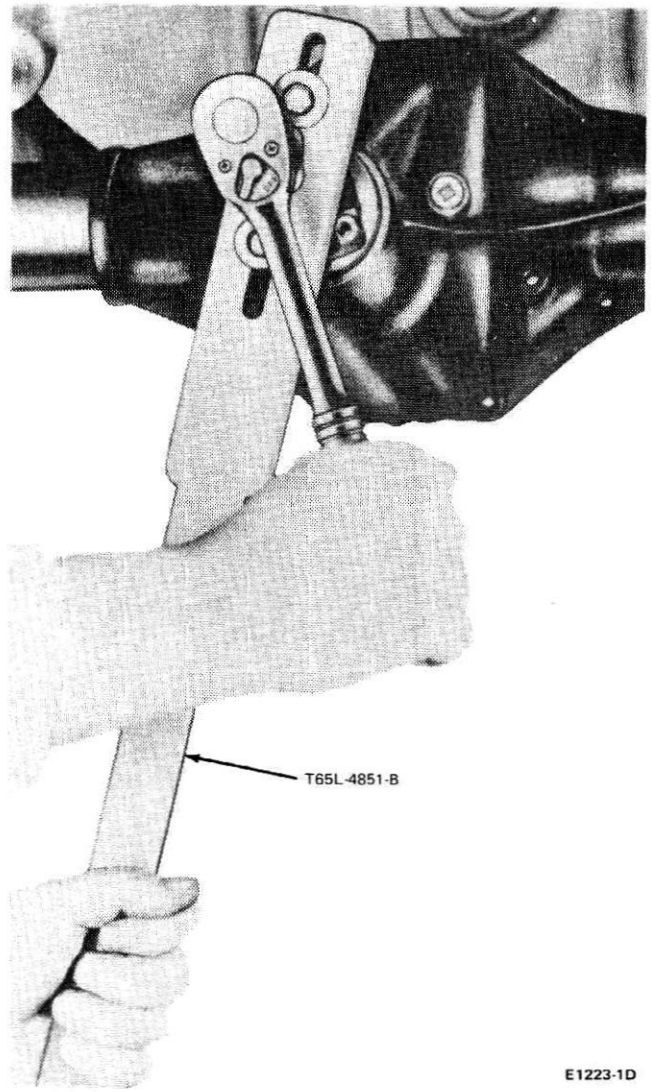


FIG. 8 Typical Drive Pinion Flange Removal

4. Align the punch or scribe mark on the U-joint flange with the mark on the end of the pinion shaft, and install the flange.

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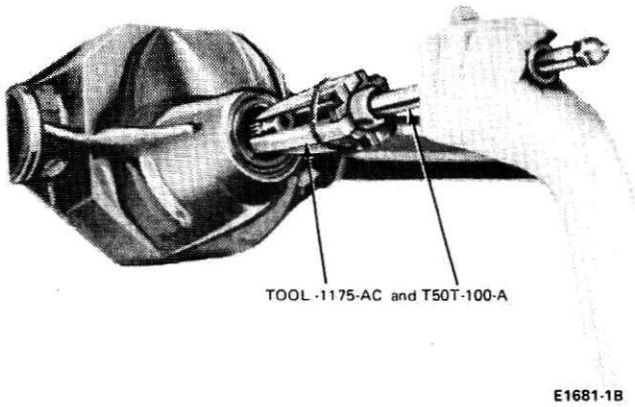


FIG. 9 Removing Pinion Seal

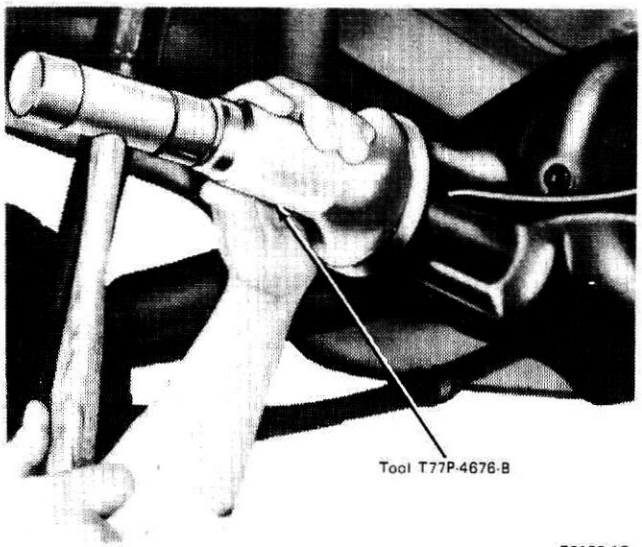


FIG. 10 Typical Drive Pinion Flange Seal Installation

5. Install a new integral nut and washer on the pinion shaft. (Apply a small amount of lubricant on the washer side of the nut.)
6. Hold the flange with the tool shown in Fig. 7, while tightening the nut.
7. Tighten the pinion shaft nut, rotating the pinion occasionally to insure proper bearing seating, and take frequent preload readings (Fig. 6) until the preload is at the original recorded reading established in Step 3 under Removal.
8. If the recorded preload is less than specification, tighten to specification as outlined at the end of this Part. If the preload is higher than specification, tighten to original reading as recorded in Step 3 of Removal. Under no circumstances should the pinion nut be backed-off to lessen preload. If this is done, a new pinion bearing spacer must be installed. In addition, the U-joint flange must never be hammered on, or power tools used.
9. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.
10. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the punch marks made on the drive shaft end yoke and the axle U-joint flange.
11. Check the lubricant level. Make sure the axle is in running position. Add whatever amount of specified lubricant is required to reach the lower edge of the filler plug hole, located in the carrier casting.
12. Install the rear wheels and brake drums. Lower the vehicle and torque the wheel attaching nuts to specification. Install hub caps or wheel covers.

REMOVAL AND INSTALLATION OF THE ORIGINAL U-JOINT FLANGE

Use procedure as outlined under drive pinion oil seal replacement.

INSTALLATION OF A NEW UNIVERSAL JOINT FLANGE

1. Raise the vehicle and install safety stands. Remove the rear wheels and brake drums.
2. Disconnect the drive shaft U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the Transmission Group for the appropriate tool.
3. Install an in-lb torque wrench on the pinion nut (Fig. 6). Record the torque required to maintain rotation of the pinion shaft through several revolutions.
4. While holding the flange with the tool shown in Fig. 7, remove the integral pinion nut and washer.
5. Clean the pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear.
6. Using the tool shown in Fig. 8, remove the pinion U-joint flange.
7. Check splines on the pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in circular motion. Wipe the pinion shaft clean.
8. Apply a small amount of lubricant to U-joint splines.
9. Install the U-joint flange.
10. Install a new integral nut and washer on the pinion shaft. (Apply a small amount of lubricant on the washer side of the nut.)
11. Hold the flange with the tool shown in Fig. 7, while tightening the nut.
12. Tighten the pinion shaft nut, rotating the pinion occasionally to insure proper bearing seating, and take frequent preload readings (Fig. 6) until the preload is at the original recorded reading established in Step 3 under Removal.
13. If the recorded preload is less than specification, tighten to specification as outlined at the end of this Part. If the preload is higher than specification, tighten to original reading as recorded in Step 3 of Removal. Under no circumstances should the

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pinion nut be backed off to lessen preload. If this is done, a new pinion bearing spacer must be installed. In addition, the U-joint flange must never be hammered on, or power tools used.

14. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.
15. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange.
16. Check the lubricant level. Make sure the axle is in running position. Add whatever amount of specified lubricant is required to reach the lower edge of the filler plug hole, located in the carrier casting or the housing cover.

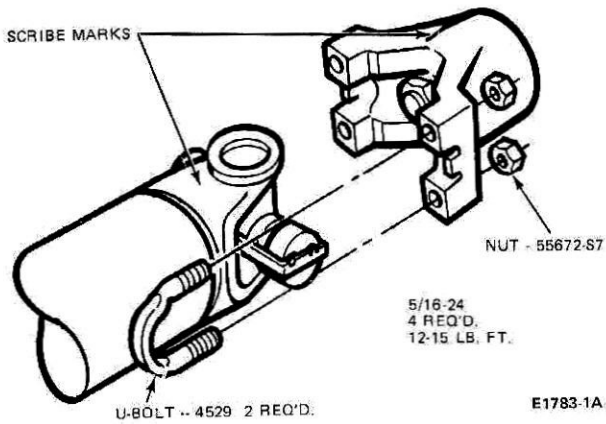


FIG. 11 Drive Shaft-to-Axle U-Joint Connection

17. Install the rear wheels and brake drums. Lower the vehicle and torque the wheel-attaching nuts to specification. Install hub caps or wheel covers.

AXLE HOUSING

Removal

1. Raise the vehicle and support it with safety stands under the rear frame member.
2. Drain the lubricant from the axle.
3. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly (Fig. 11). Disconnect the drive shaft at the drive pinion flange.
4. Disconnect the lower end of the shock absorbers.
5. Remove the wheels, brake drums and both axle shafts as outlined under Rear Axle Shaft Wheel Bearing and Oil Seal Removal.
6. Remove vent hose front vent tube (Corbin clamp), then remove vent tube from brake tube junction and axle housing.
7. Remove the hydraulic brake T-fitting from the axle housing. **Do not open the hydraulic brake system lines. Remove the hydraulic brake line from its retaining clip on the axle housing.**
8. Remove both axle shaft oil seals with the tools shown in Fig. 5.
9. Remove both brake backing plates from the axle housing and suspend them above the housing with mechanic's wire. The hydraulic brake lines and the parking brake cables are still attached to the brake carrier plates.
10. Support the rear axle housing on a jack, and then remove the spring clip (U-bolt) nuts. Remove the U-bolts and plates (Fig. 12).
11. Lower the axle housing and remove it from under the vehicle.

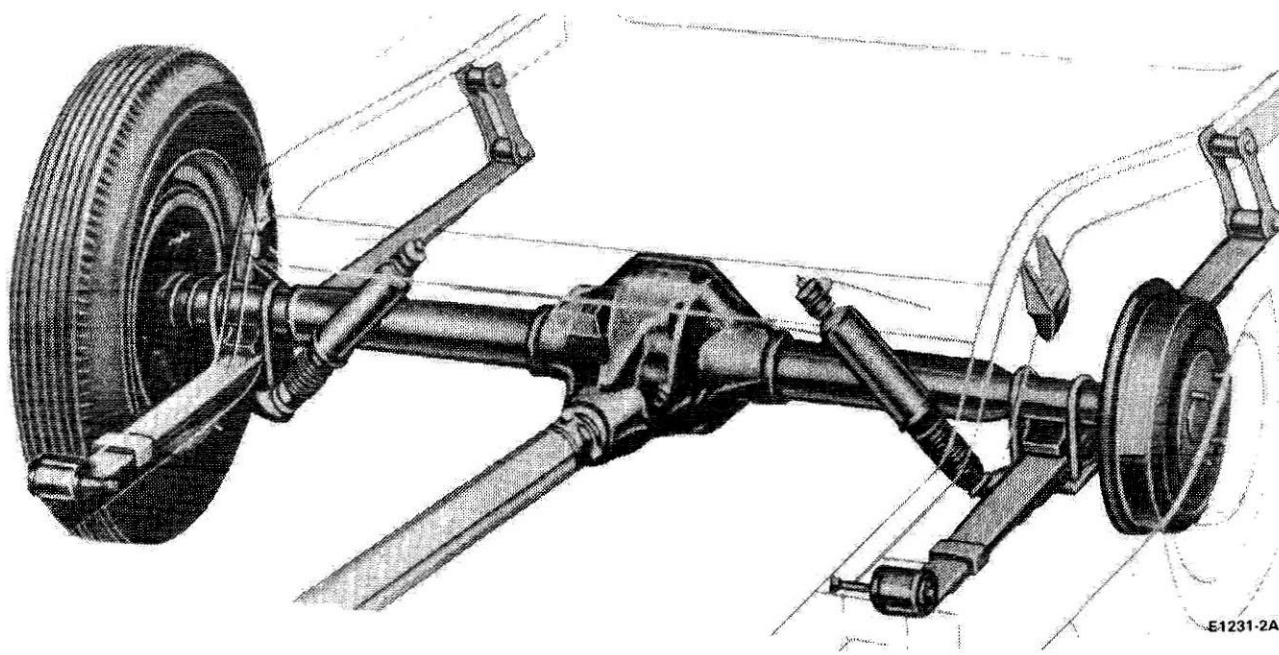


FIG. 12 Rear Axle Installation—Typical

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12. If the axle housing is being replaced, transfer all the differential and pinion parts to the new housing.

Installation

1. Raise the axle housing into position so that the spring clip (U-bolt) plates can be installed. Torque the spring clip (U-bolt) nuts to specification.
2. Place the brake backing plates in their normal position on the axle housing. Use new gaskets on each side of the brake backing plates.
3. Install new axle shaft oil seals with the tool shown in Fig. 5. **Installation without use of the proper tool will distort the seal and cause leakage.** Coat the outside edges of the new oil seal with a nonhardening type of sealer such as Permatex No. 2 or its equivalent.
4. Install the axle shafts, brake drums and wheels as outlined in Part 11-11.
5. Attach the hydraulic brake line of T-fitting to the axle housing, and secure the hydraulic brake line in its retainer on the axle housing.
6. Install vent tube to brake tube junction and install vent hose to vent tube.
7. Raise the axle housing and connect the shock absorbers.
8. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange (Fig. 11).
9. Fill the axle with the proper grade and amount of lubricant. Install the filler plug.
10. Road test the vehicle.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY OF AXLE

All service operations on the differential case assembly and the drive pinion assembly can be performed with the housing in the vehicle.

DIFFERENTIAL CASE AND DRIVE PINION

Removal

1. Raise the vehicle and support it on the underbody, so that the rear axle drops down as far as the springs and shock absorbers permit.
2. Remove the cover from the carrier casting rear face, and drain the lubricant.
3. Perform the inspection before disassembly of carrier as directed in Part 15-01, Cleaning and Inspection.
4. Remove both rear wheels.
5. Remove the brake drums.
6. Working through the hole provided in the axle shaft flange, remove the nuts that attach the wheel bearing retainers to the axle housing.
7. Pull the axle shafts with the tool shown in Fig. 2. **Care must be exercised to prevent damage to the oil seals.** Remove the brake backing plate and wire it to the frame rail. Remove both seals with the tool shown in Fig. 5.
8. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly (Fig. 11). Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the Transmission Group for the appropriate tool.
9. Remove the differential bearing adjusting nut locks (Fig. 13).
10. Mark one differential bearing cap and the case (Fig. 14) to help position the parts properly during assembly.
11. Remove the differential bearing cap bolts and bearing caps. **Hold the differential case assembly in the housing after the caps are removed.**
12. Remove the differential case and bearing cups (Fig. 15).
13. Hold the drive pinion flange and remove the pinion nut (Fig. 7).
14. Remove the pinion flange (Fig. 8).
15. With a soft-faced hammer, drive the pinion out of the front bearing cone and remove it through the rear of the carrier casting.
16. Remove the pinion seal and front bearing cone out of the front of the carrier casting.
17. To remove and install the pinion rear bearing cone use the tools in Figs. 16 and 17.
18. Measure the shim which is found under the bearing cone with a micrometer. Record the thickness of the shim.

DIFFERENTIAL CASE

Disassembly

1. If the differential bearings are to be removed, use the tools shown in Fig. 18. Mark the differential case, cover, and ring gear for assembly in the original position.
2. Remove the bolts that attach the ring gear to the differential case and discard them. Press the ring gear from the case or tap it off with a soft-faced hammer. Remove the left side of the differential case.
3. With a drift, drive out the differential pinion shaft lock pin (Fig. 19).
4. Drive out the pinion shaft with a brass drift. Remove the gears and thrust washers.

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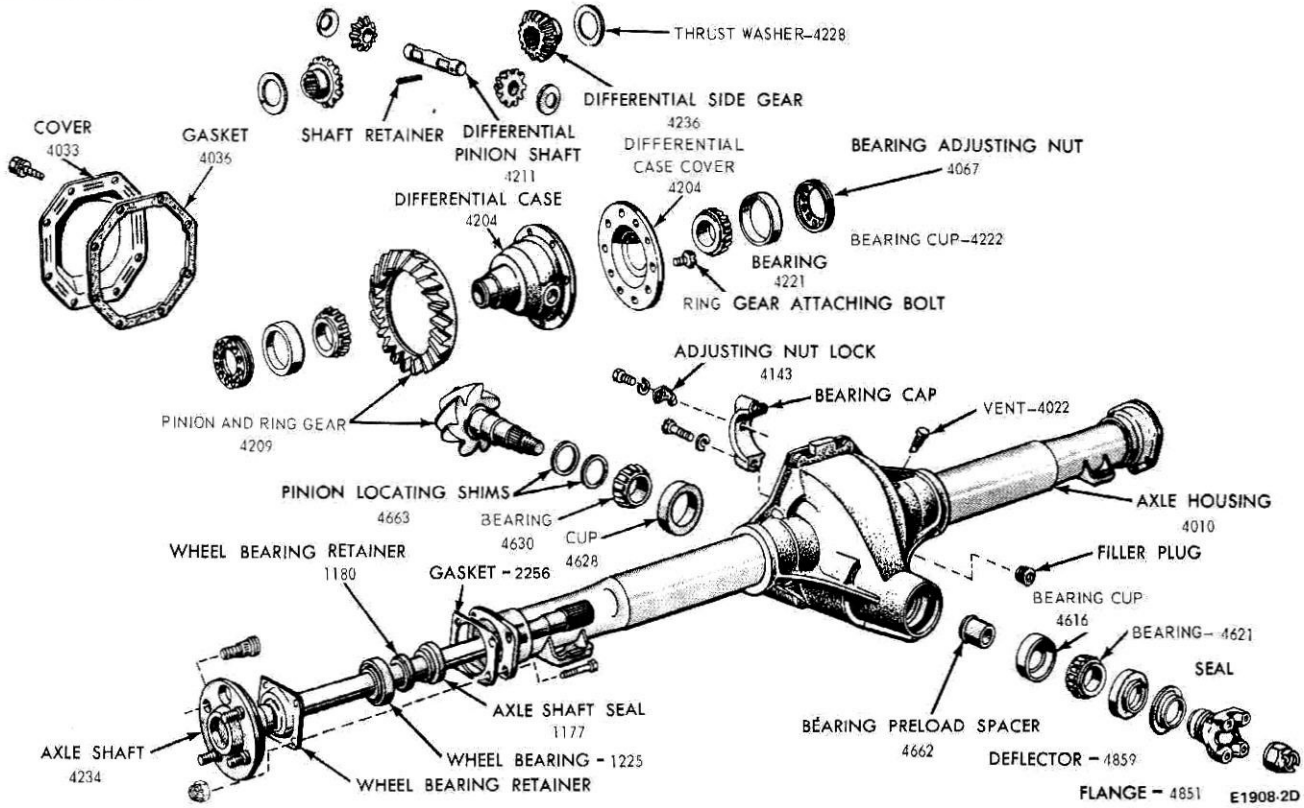


FIG. 13 Disassembled Typical Intergral Carrier Axle

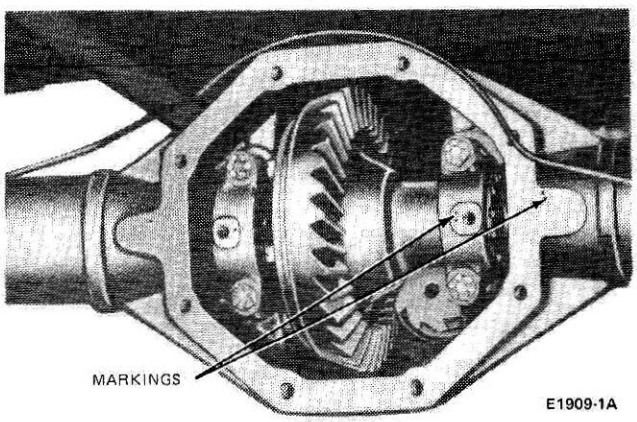


FIG. 14 Typical Differential Bearing Cap Marking

PARTS REPAIR OR REPLACEMENT

Clean and inspect all the parts as outlined under Cleaning and Inspection in Part 15-01. Before assembling the carrier, repair or replace all parts as indicated by the inspection.

In addition to the replacement procedures which follow, see DISASSEMBLY AND ASSEMBLY on preceding pages in this Part.

PINION BEARING CUPS

Do not remove the pinion bearing cups from the carrier casting unless the cups are worn or damaged.

If the pinion bearing cups are to be replaced, drive them out of the carrier casting with a drift. Install the new cups with the tool shown in Fig. 20. Make sure the cups are properly seated in their bores. If a 0.0015-inch feeler gauge can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not properly seated.

Whenever the cups are replaced, the cone and roller assemblies should also be replaced.

DRIVE PINION AND GEAR SET

Individual differences in machining the carrier casting and the gear set require a shim between the pinion rear bearing cone and the pinion gear, to locate the pinion for correct tooth contact with the ring gear.

When replacing a ring gear and pinion, note that the **original** factory installed shim is of the correct thickness to adjust for individual variations in both the carrier casting dimension and in the original gear set dimension. Therefore, to select the correct shim thickness for the new gear set to be installed, follow these steps:

1. With a micrometer, measure the thickness of the original shim removed from the axle, and use the same thickness upon installation of the replacement carrier assembly or drive pinion.
2. If further shim change is necessary, it will be indicated in the tooth pattern check.
3. If the original shim is lost, substitute a nominal shim, and use the tooth pattern check to determine if further shim changes are required. Nominal shim thickness is 0.030. Shims are available from 0.015 to 0.030 inch. When more than 0.030 is required, a combination of shims can be used.

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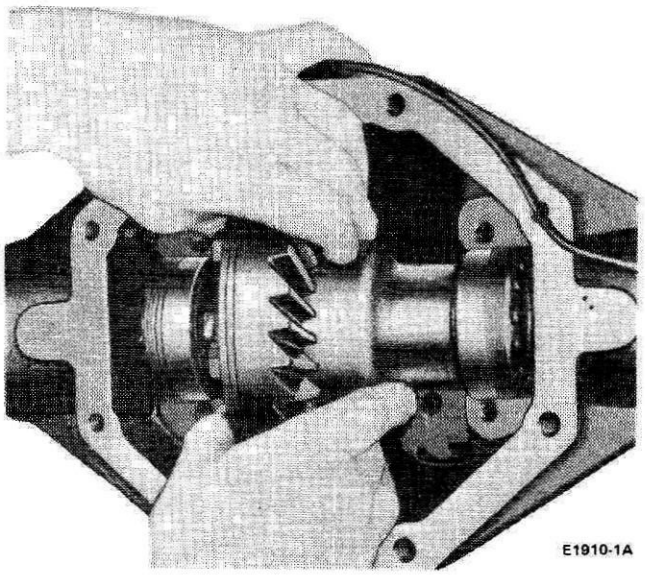


FIG. 15 Differential Case Removal or Installation

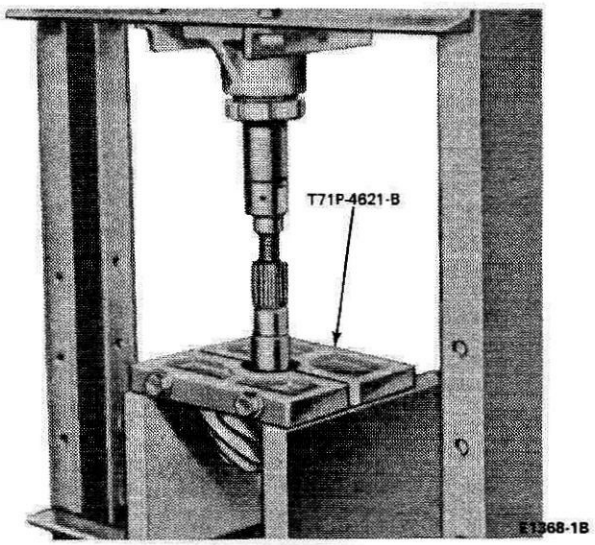


FIG. 16 Removing Pinion Rear Bearing Cone

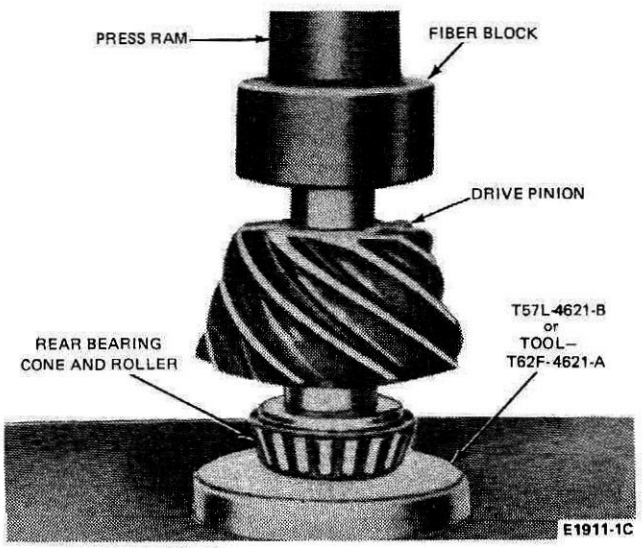


FIG. 17 Installing Pinion Rear Bearing Cone

A new ring gear and pinion should always be installed in an axle as a matched set (never separately). Be sure the same identifying (matching) number, painted in white, appears on the bolt hole face of the ring gear and on the head of the drive pinion (Fig. 21).

4. After determining the correct shim thickness as explained in the foregoing steps, install the new pinion and ring gear as outlined under ASSEMBLY OF AXLE.

DRIVE PINION AND GEAR SET (ALTERNATE PROCEDURE USING TOOL T70P-4020-A)

1. Using pinion depth gauge set, Tool T70P-4020-A, select the correct aligners (they are marked to correspond with the correct axle) to fit the front and rear pinion bearing I.D. Screw these on the threaded shaft to the correct position (Fig. 22) and then screw on the correct dummy pinion head (also marked).
2. Place the rear pinion bearing over the aligner and against the dummy pinion head. Insert this assembly in the rear bearing cup.
3. Place the front bearing over the aligner and into the front bearing cup simultaneously. Spin the adjusting nut on the threaded shaft until it contacts the front bearing. Hand tighten until both bearings are securely seated (approx. 5-20 in-lb). When this operation is completed, both bearings should rotate freely but snugly.
4. Align and place the dummy differential bearing inserts into the differential bearing bores making sure they do not contact the threads behind the bore. Install the bearing caps. The crossbar should now slide freely within the inserts.
5. Check to see that the indicator arm is attached securely to the gauge block. The spring washers

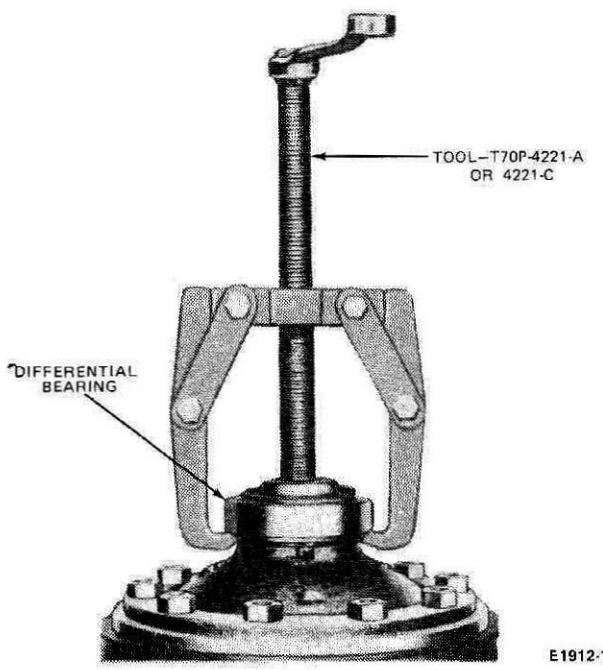


FIG. 18 Differential Bearing Removal

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should hold it flatly to the gauge block when the shoulder screw is fully bottomed.

6. Securely attach a standard indicator (Tool-4201-C, Tool 6565 or equivalent) to the indicator arm. Set the indicator to zero while the indicator pointer is on the gauge block.
7. Place the gauge block on the dummy pinion head and rotate the indicator over the crossbar. The correct reading will be obtained when the indicator is at top dead center over the crossbar (readings are usually 0.020-0.040). Because of the necessary dial indicator position the use of a mirror will simplify reading the results.

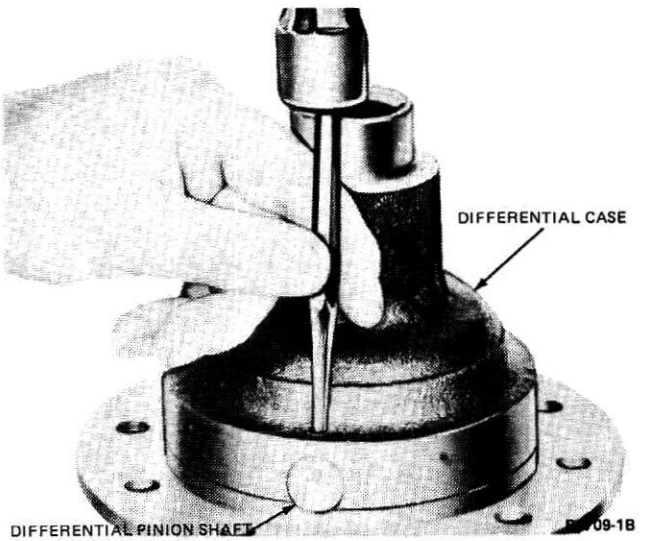


FIG. 19 Removing Differential Pinion Shaft Lock Pin

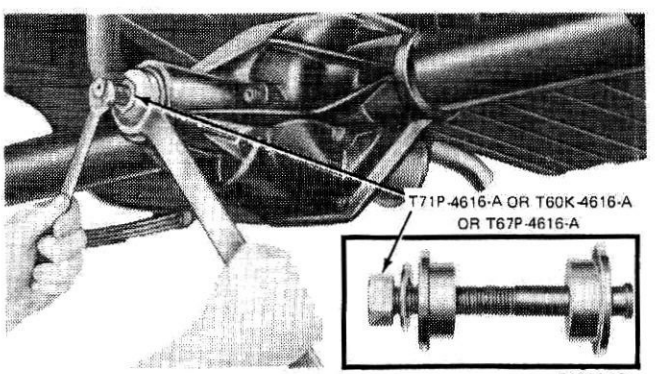


FIG. 20 Pinion Bearing Cup Removal or Installation

8. Inspect the pinion gear that will be used for this buildup. It will have ONE of THREE markings:
   a. plus (+) marking (+.002)
   b. minus (-) marking (-.001)
   c. or no marking

   Subtract the plus marking from the reading obtained in Step 7 for the correct shim thickness.

   Add the minus marking to the reading obtained in Step 7 for the correct shim thickness.
9. After making the correct shim selection remove the Tool T70P-4020-A from the carrier. Place the shim(s) on the pinion shaft and press on the rear bearing.

DRIVE PINION AND GEAR SET (ALTERNATE PROCEDURE USING TOOL T75P-4020-A)

1. Refer to Fig. 23 and assemble the appropriate aligning adapter, gauge disc and gauge block to the screw as shown on the illustration.
2. Place the rear pinion bearing (new, or used if in good condition) over the aligning disc and insert into the pinion bearing cup of the carrier. Place the front bearing into the bearing cup and assemble the tool handle onto the screw and hand tighten (Fig. 24).
3. Center the gauge tube into the differential bearing bore. Install the bearing caps and tighten the bolts to specification (Fig. 24).
4. Using a feeler gauge tool, select the thickest feeler blade that will enter between the gauge tube and the gauge block (Fig. 24). Insert the feeler blade directly along the gauge block to insure a correct reading. The feeler blade fit should be a slight drag-type feeling.
5. After the correct feel is obtained, check the reading. This is the thickness of the shim required, providing the replacement pinion has no plus or minus readings shown on it.

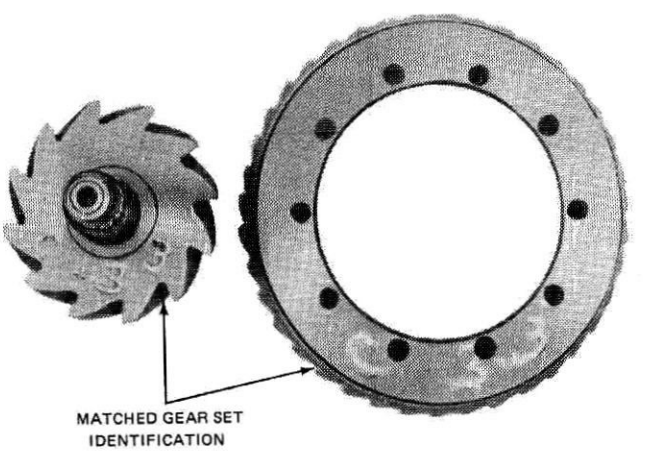


FIG. 21 Pinion and Ring Gear Marking

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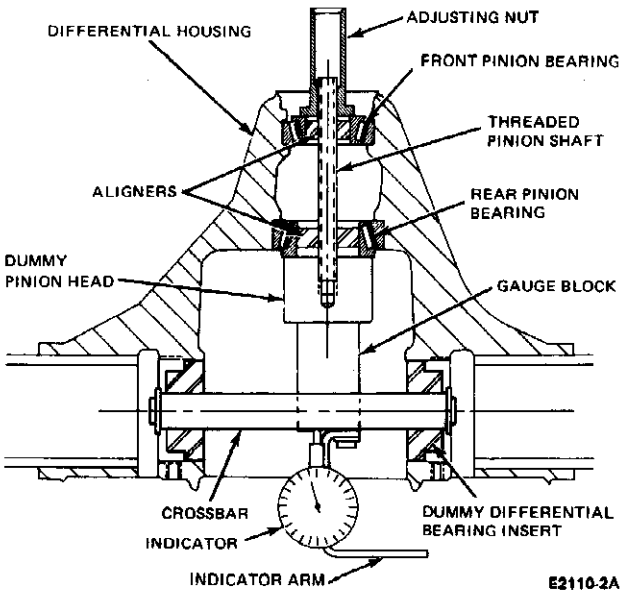


FIG. 22 Pinion Depth Gauge Application (T70P-4020-A)

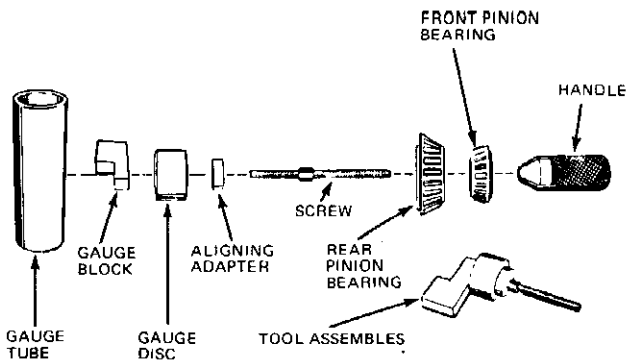


CHART I

Dash Number	Description	Integral Carriers		
		6.75	8.5	8.7
-A1	Aligning Adapter (1.300 O.D.)	X		
-A	Aligning Adapter (1.612 O.D.)		X	X
-A4	Gauge Disc (.458 thick)	X		
-A6	Gauge Disc (1.314 thick)		X	X
-A7	Gauge Tube (2.563 O.D.)	X		
-A8	Gauge Tube (2.892 O.D.)		X	X
-A9	Screw	X	X	X
-A10	Gauge Block (1.700 thick)	X	X	X
-A11	Handle	X	X	X

F2527-1A

FIG. 23 Rear Axle Pinion Depth Gauge Tool (T75P-4020-A)

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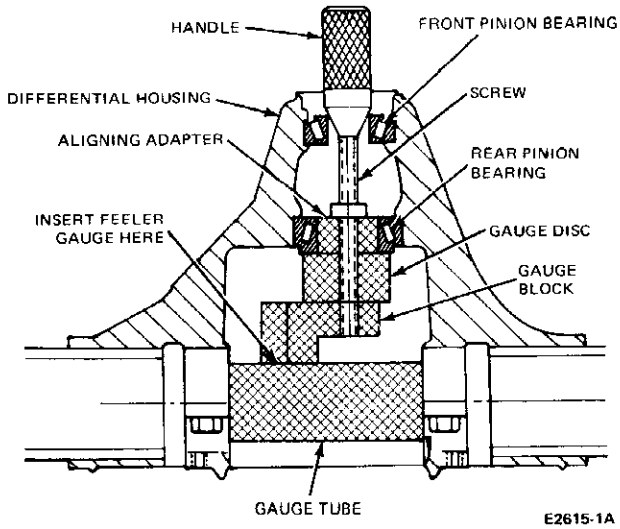


FIG. 24 Using Pinion Depth Gauge Tool T75P-4020-A

6. If the replacement pinion gear is marked with a plus (+) reading, the amount shown as a plus must be **subtracted** from the thickness dimension obtained in Step 5.
7. If the replacement pinion gear is marked with a minus (-) reading, the amount shown must be **added** to the thickness dimension obtained in Step 5.

   NOTE: THE SAME REAR PINION BEARING USED IN THIS PROCEDURE MUST BE USED IN THE FINAL ASSEMBLY OF THE AXLE.
8. Place the selected shim(s) on the pinion shaft and press on the pinion bearing.
9. **A tooth pattern check with the gear marking compound supplied with the ring and pinion set is not required when this tool is used.**

DIFFERENTIAL CASE, BEARINGS, AND RING GEAR

If the ring gear runout check (before disassembly) exceeded specifications, the condition may be caused by a warped gear, a bent case, or excessively worn differential bearings.

To determine the cause of excessive runout, proceed as follows:

1. Assemble the two halves of the differential case together without the ring gear, and press the two differential side bearings on the case hubs.
2. Place the cups on the bearings and set the differential case in the carrier.
3. Install the bearing caps and adjusting nuts as outlined in Steps 11 thru 14 under Differential Case and Drive Pinion Installation.
4. Tighten the right nut two notches beyond the position where it first contacts the bearing cup. Rotate the differential case several revolutions in each direction while the bearings are loaded, to seat the bearings in their cups. **This step is important.**
5. Now, loosen the right nut to release the preload. Check to see that the left nut contacts the bearing cup. Using the dial indicator set-up, adjust the preload to 0.004 to 0.008 case spread for new bearings, or 0.003 to 0.005 for the original bearings, if re-used.
6. Check the runout of the differential case flange with a dial indicator. **If the runout does not now exceed specification, install a new ring gear. If the runout still exceeds specification, the ring gear is true, and the trouble is due to either a defective case or worn bearings.**
7. Remove the differential case from the carrier and remove the side bearings from the case.
8. Install new bearings on the case hubs, and place the differential assembly in the carrier **without** the ring gear.
9. Check the case runout with the new bearings. If the runout is now within limits, the old bearings were excessively worn. Use the new bearings for assembly. If the runout is still excessive, the case is damaged and should be replaced.

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ASSEMBLY OF AXLE

Refer to Part 15-01 for Cleaning and Inspection before starting assembly operations.

DIFFERENTIAL CASE

Assembly

1. Lubricate all the differential parts with axle lubricant, before they are installed in the case.
2. Place the side gears and thrust washers in the case.
3. Place the two pinion gears and thrust washers exactly opposite each other in the case openings, and in mesh with the side gears.
4. Turn the pinions and thrust washers until the holes in the pinion gears align with the pinion shaft holes in the case.
5. Start the pinion shaft into the differential case. Carefully align the shaft lock pin hole with the pin hole in the case. Drive the shaft into place and install the lock pin. Position the left-hand case on the right-hand case. Align the marks and press the two halves together.
6. Place the ring gear on the differential case. If the new bolts to be used show a green coating over approximately 1/2-inch of the threaded area, install as is. If not coated, apply a small amount of Loctite (Part Number C3AZ-19554-A) or equivalent. Torque to specifications. **It is mandatory that bolts used once should not be used again.**
7. If the differential bearings have been removed, press them on as shown in Fig. 25.

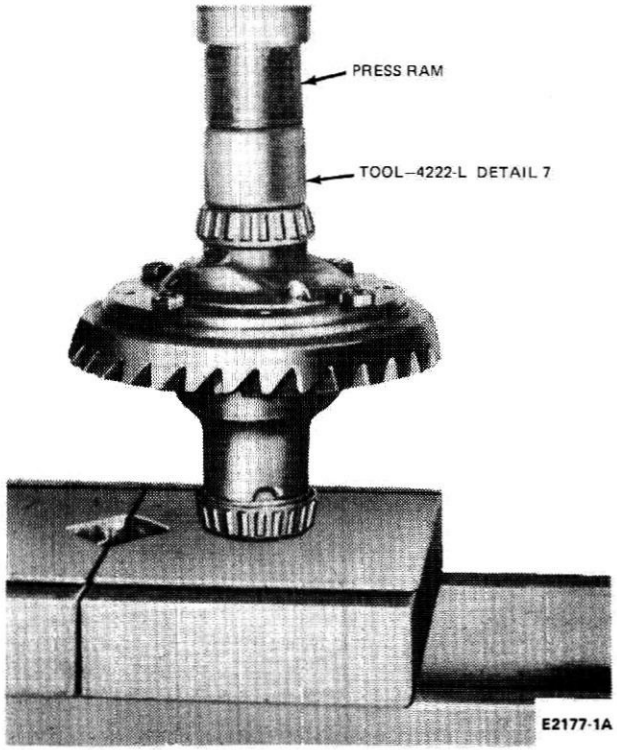


FIG. 25 Differential Bearing Installation

DIFFERENTIAL CASE AND DRIVE PINION

Installation

1. Place the shim and pinion rear bearing cone on the pinion shaft. Press the bearing and shim firmly against the pinion shaft shoulder (Fig. 17).
2. Place a new pinion bearing preload spacer on the pinion shaft. The end with the largest diameter (the shortest end) should go on the pinion shaft first. **Failure to do this will cause loss of preload.**
3. Lubricate the pinion rear bearing with axle lubricant.
4. Lubricate the pinion front bearing cone and place it in the housing.
5. Install a new pinion oil seal in the carrier casting (Fig. 10).
6. Insert the drive pinion shaft flange into the seal and hold it firmly against the pinion front bearing cone. From the rear of the carrier casting, insert the pinion shaft into the flange.
7. Start a new pinion shaft nut. Hold the flange with the tool shown in Fig. 8 and tighten the pinion shaft nut. As the nut is tightened, the pinion shaft is pulled into the front bearing cone and into the flange.

   As the pinion shaft is pulled into the front bearing cone, pinion shaft end play is reduced. While there is still end play in the pinion shaft, the flange and bearing cone will be felt to bottom on the collapsible spacer.

   From this point, a much greater torque must be applied to turn the pinion shaft nut, since the spacer must be collapsed. Very slowly, tighten the nut, but check the pinion shaft end play often, to see that the pinion bearing preload does not exceed the limits (Fig. 6).

   If the pinion shaft nut is tightened to the point that pinion bearing preload exceeds the limits, the pinion shaft must be removed and a new collapsible spacer installed. **Do not decrease the preload by loosening the pinion shaft nut.** This will remove the compression between the pinion front and rear bearing cones and the collapsible spacer and may permit the front bearing cone to turn on the pinion shaft.
8. As soon as there is preload on the bearings, **turn the pinion shaft in both directions several times to set the bearing rollers.**
9. Adjust the bearing preload to specification. Measure the preload with the tool shown in Fig. 6.
10. Apply a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.
11. Place the cups on the bearings and set the differential case assembly in the carrier casting (Fig. 15).

    If the gear set is of the **nonhunting or partial nonhunting** type, assemble the differential case and ring gear assembly in the carrier so that the marked tooth on the pinion indexes between the marked teeth on the ring gear as shown in Fig. 26.

    Be sure to match gears as indicated. When assembled out of time, noise, excessive wear, and possible failure may result.

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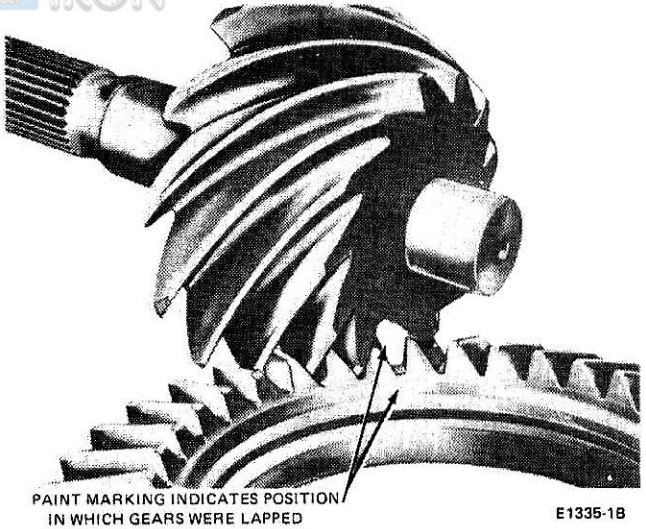


FIG. 26 Typical Gear Set Timing Marks

When installing the hunting-type gear set (no timing marks), place the differential case and ring gear assembly in the carrier without regard to the matching of any particular gear teeth.

12. Slide the case assembly along the bores until a slight amount of backlash is felt between the gear teeth. Hold the differential case in place.
13. Set the adjusting nuts in the bores so that they just contact the bearing cups.
14. Carefully position the bearing caps on the carrier casting. Match the marks made when the caps were removed.
15. Install the bearing cap bolts and lockwashers. As the bolts are tightened, turn the adjusting nut with the tool shown in Fig. 27.

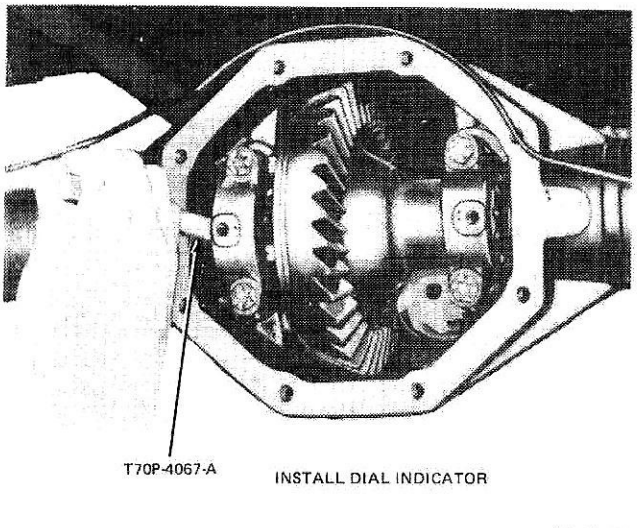


FIG. 27 Backlash and Bearing Preload Adjustment

16. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and inspect for damaged threads or incorrectly positioned caps. Tighten bolts to the specified torque, to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 5 ft-lbs before making adjustments. Refer to Part 15-01 for backlash and bearing preload adjustment procedures.

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SPECIFICATIONS

DRIVING AXLE IDENTIFICATION (INTEGRAL CARRIER) – CONVENTIONAL

Ident. Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type	Ident. Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type
WGF-K1	3.18:1	6 3/4	C2	WGF-AA	3.18:1	6 3/4	C2
WGF-U1	3.18:1	6 3/4	C2	WGF-AJ	2.73:1	6 3/4	C2

ADJUSTMENT TORQUE SPECIFICATIONS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Torque In. Lb.	Torque Ft. Lb.
Minimum torque required to tighten pinion flange nut to obtain correct pinion bearing preload	–	140 ①
Pinion Bearing Preload – (Collapsible spacer) ② Original Bearings – 6 3/4 inch	6-12	–
New Bearings – 6 3/4 inch	17-27	

① If pinion bearing preload exceeds specifications before this torque is obtained, install a new spacer

② With Oil Seal

CLEARANCE, TOLERANCE AND ADJUSTMENTS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Inches	Description	Inches
Maximum Runout of Backface of Ring Gear	0.003	Nominal Pinion Locating Shim	0.030
Differential Side Gear Thrust Washer Thickness	0.030-0.032	Available Pinion Gear Shims in Steps of 0.001	
Differential Pinion Gear Thrust Washer Thickness	0.030-0.032	–6 3/4 inch	0.021-0.037
Differential Bearing Preload (Case spread across Differential) New Bearings – 6 3/4 inch	0.004-0.008	Backlash between ring gear and pinion teeth	0.008-0.012
		Maximum backlash variation between teeth	0.003
Original Bearings – 6 3/4 inch	0.003-0.005	Maximum radial runout of U-joint flange in Assembly	0.012 T.I.R.

ATTACHING TORQUE SPECIFICATIONS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Torque Ft.-Lb.	Description	Torque Ft.-Lb.
Differential Bearing Cap Bolt 6 3/4 inch	40-55	Rear Cover Screw and Washer Assemblies	25-35
		Oil Filter Plug	25-50
Differential Bearing Adjustment Nut Lock Bolt	12-25	Rear Axle Shaft Bearing Retainer Bolt Nuts	20-40
Ring Gear Attaching Bolts 6 3/4 inch ①	45-60		

① Using Loctite

LUBRICANT CAPACITIES AND CHECKING PROCEDURES (INTEGRAL CARRIER) – CONVENTIONAL

Vehicle	Engine	Axle	U.S. Measure Capacity (Pints) ①	Imperial Capacity (Pints) ①
Pinto/Bobcat	2.3L	6 3/4 Inch Ring Gear	2.2 ②	1.8 ②
Mustang	2.3L, 2.8L	6 3/4 Inch Ring Gear	3.0	2.5

① All conventional axles use ESW-M2C-105-A lubricant.

② Approximate refill capacity – Actual lubricant capacities are determined by filling to 1/4 inch below bottom of filler plug hole.

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DETROIT IRON

SPECIAL TOOLS

Tool Number	Description
T50T-100-A	Impact Slide Hammer
TOOL-1175-AC or TOOL-1175-AE	Grease Seal Remover (Use with Slide Hammer T50T-100-A)
T65F-1177-A	Axle Shaft Oil Seal Replacer
T60K-1177-B	Rear Wheel Bearing Oil Seal Replacer
T70P-4020-A	Pinion Depth Gauge Set
T75P-4020-A	Pinion Depth Gauge Set
T70P-4067-A	Differential Bearing Adjuster Wrench
TOOL-4201-C -4201-D	Differential Backlash and Runout Gauge, with Universal Bracket Dial Indicator and Bracket
T57L-4220-A	Differential Bearing Assembly Remover
T57L-4221-A	Differential Side Bearing Cone Replacer
TOOL-4221-C	Differential Side Bearings Remover
T70P-4221-A	Differential Side Bearings Remover
TOOL-4222-L	Differential Bearing Cones Replacer
TOOL-4222-H	Differential Bearing Cones Replacer
T66L-4234-A T71P-4234-A	Rear Axle Shaft Assembly Remover Adapter (Use with T50T-100-A)
TOOL-OTC-951	Pinion Rear Bearing Remover
T68P-4602-A	Pinion Angle Level Gauge
T68P-4602-AA	Frame

Tool Number	Description
T70P-4067-A	Differential Bearing Adjuster Nut Wrench
T68P-4602-AB	Vial
T68P-4602-AC	Magnet
TOOL-4615-G	Drive Pinion Front Bearing Cup Remover
T60K-4616-A	Pinion Bearing Cups Replacer (Inner and Outer)
T67P-4616-A	Pinion Bearing Cups Replacer
T53T-4621-C	Drive Pinion Bearing Installer
T62F-4621-A	Rear Wheel Bearing
T71P-4621-B	Remover and Installer
T55P-4676-A	Drive Pinion Oil Seal Replacers
T58L-4676-A	
T62F-4676-A	
T71P-4676-A	
T65L-4851-A	Flange (Universal Joint) Axle End Remover
TOOL-4851-K	Universal Joint Flange Holder
T68P-4946-A	Locking Differential Gauge (Traction-Lok Clutch Pack
TOOL T60K-7697-B	Rear Axle Shaft Bearing Installer
TOOL T66L-12132-B	Thread Reducing Adapter

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Integral Carrier Axle — Ford — (WER)

PART 15-03

Applies To Ford/Mercury, Granada/Monarch

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Disassembly Of Axle	03-8
Disassembly Of Differential Case	03-11
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CF2529-2A

DESCRIPTION

An integral-carrier rear axle assembly (Fig. 1) is used in passenger vehicles equipped with 5.8L(351) and 6.6L(400) engines in the Ford/Mercury cars, and 4.1L(250), 5.0L(302) and 5.8L(351) in the Granada/Monarch lines. The WER axle incorporates the following features:

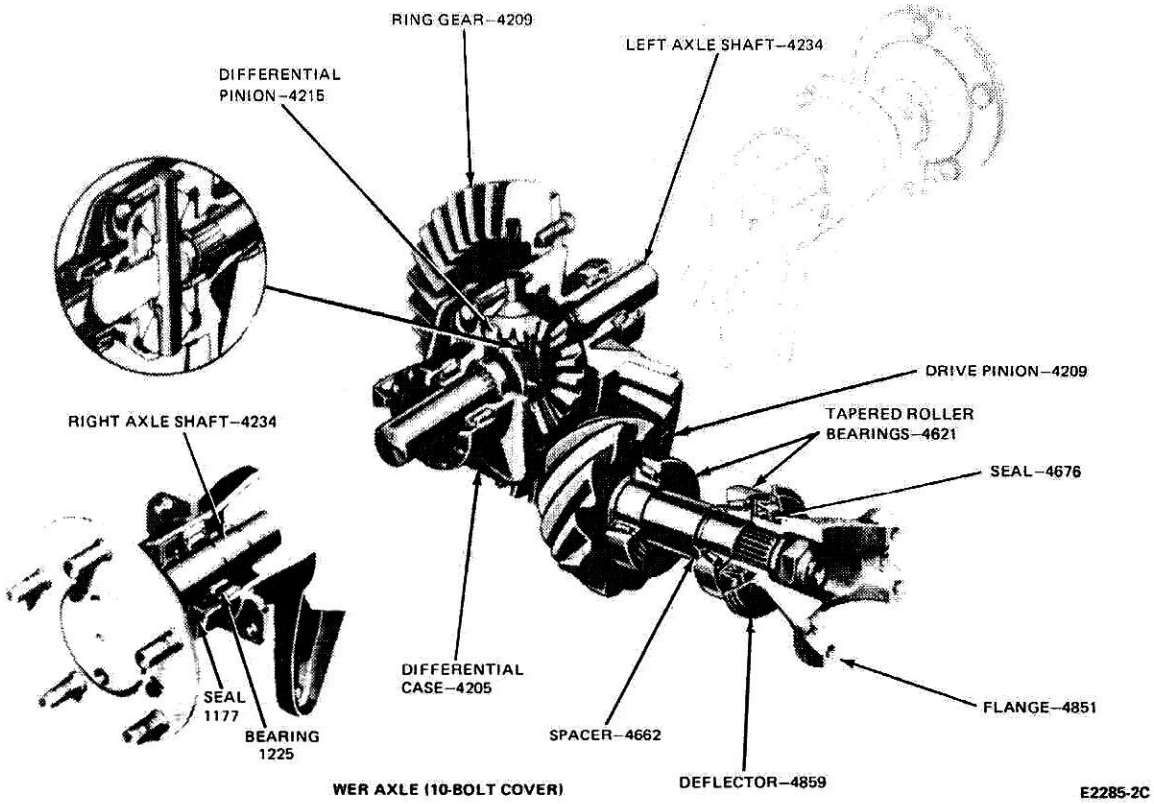


FIG. 1 Rear Axle Assembly—(WER) Axle

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DETROIT IRON

The hypoid gear set consists of an 8.7-inch diameter ring gear and an overhung drive pinion, which is supported by two opposed tapered roller bearings. A drive pinion pilot bearing is not used in this axle.

The differential carrier is the nonremovable type, with a stamped bolt-on cover. The filler hole is tapped in the front portion of the carrier casting and uses a 1/2-14 tapered pipe plug with a 3/8-inch square female drive. A bumper pad is machined on the pinion nose portion of the carrier. The rubber bumper is mounted on the vehicle underbody.

The differential case is a one-piece design, with openings allowing assembly of the internal components and lubricant flow. The differential pinion shaft is retained with a threaded bolt (lock) assembled to the differential case.

The axle housing assembly consists of tube assemblies pressed and welded into the differential casting. The brake backing plate retainer is welded inboard of the outer edges of the tubes, and allows assembly of the backing plate, independent of the axle shafts.

The roller-type wheel bearings have no inner race, and contact the bearing journals of the axle shafts.

The axle shafts do not use an inner or outer bearing retainer. They are held in the axle by means of C-locks, positioned in a slot on the splined end. These C-locks also fit into a machined recess in the differential side gears within the differential case. There is no retainer bolt access hole in the axle shaft flange.

An identification tag is attached to one of the rear cover-to-housing retainer bolts (Part 15-01). It is important to use the axle model designation if necessary to obtain correct replucement parts.

REMOVAL AND INSTALLATION

REAR AXLE SHAFT, WHEEL BEARINGS AND OIL SEAL

Removal

Synthetic wheel bearing seals are used for production and as service replacements. Removal and insertion of rear axle shafts must be performed with caution. The entire length of the shaft (including spline) up to the seal journal must pass through the seal without contact. Any roughing or cutting of the seal element during axle removal or installation will result in early seal failure.

1. Raise the vehicle on a hoist.
2. Remove the wheel(s) and tire(s) from the brake drum(s).
3. Position a drain pan and loosen the cover-to-differential housing retaining bolts. Drain the housing.
4. Remove the attaching nuts that secure the brake drum(s) to the axle shaft flange(s), and then remove the drum(s).
5. Remove the differential housing cover bolts, cover and gasket. Discard the gasket. Remove the drain pan.
6. Position safety stands under the rear frame member. Lower the hoist and allow the axle to lower as far as possible.
7. Working through the differential case opening, loosen the pinion shaft lock bolt and remove the pinion shaft (Fig. 2).
8. Push the axle shaft(s) inward toward the center of the axle housing. Remove the C-lock(s) (Fig. 3) from the inner end of the axle(s). Remove the axle shaft(s) from the housing. **Extreme care must be used to avoid contact of the axle shaft seal lip with any portion of the axle shaft except the seal journal.**
9. Remove the oil seal and bearing from the housing as shown in Fig. 4.

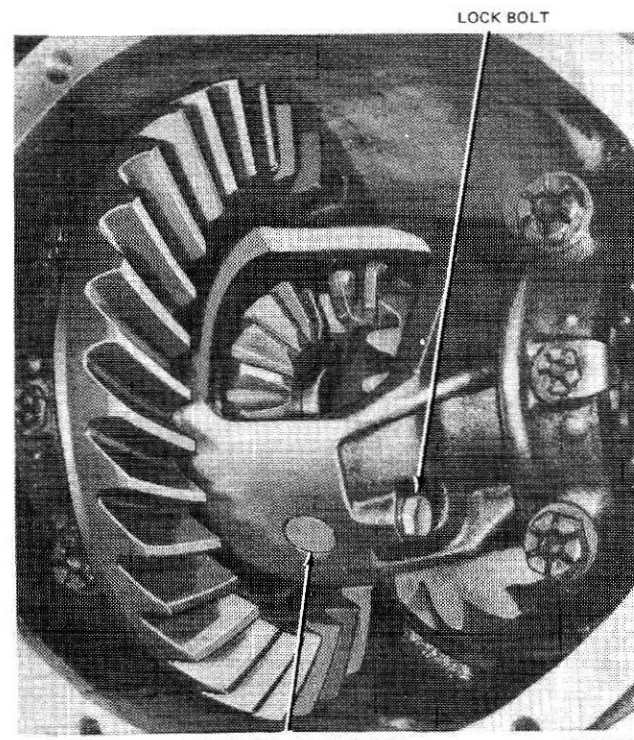


FIG. 2 Differential Pinion Shaft and Lock Bolt

10. Two types of bearings are used (Fig. 5). One requires a snug press fit in the housing flanges. The other has a ground race, and a loose fit is acceptable. Therefore when removing these bearings if a loose-fitting bearing is encountered it does not indicate excess wear or damage.
11. Inspect the machined surface of the axle shaft housing for rough spots or other irregularities that would affect the sealing action of the oil seal or the rolling action of the wheel bearing. Check the axle shaft splines for burrs, wear or damage. Carefully remove any burrs or rough spots. Replace worn or damaged parts. A brownish yellow color

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on the bearing journal of the shaft is normal and the shaft need not be replaced. Slight pitting and wear is also normal.

Installation

1. Lightly coat the wheel bearing rollers with axle lubricant. Install the bearings in the axle housing with the tool shown in Fig. 6.
2. Wipe all lubricant from the oil seal bore before installing the seal. **The new seals are pre-packed with lubricant and do not require an oil soak before installation.**
3. Install the oil seal with the tool shown in Fig. 7. **Installation without the use of the proper tool will distort the seal and cause leakage.**
4. Replace the O-ring in the C-lock groove on the axle shaft.
5. Slide the axle shaft(s) into place in the axle housing. **Exercise care that splines or any portion of the axle shaft(s) do not damage the oil seal(s) and that they engage with the splines of the differential side gear(s).**
6. Install the axle shaft C-lock(s) on the inner end of the shaft(s) (Fig. 3) and push the shaft(s) outward so that the shaft locks seat in the counterbore(s) of the differential side gear(s).
7. Position the differential pinion gears and thrust washers 180 degrees apart to the differential side gears. Revolve the gear assembly until the holes in the differential case are aligned with the pinion gears.
8. Position the differential pinion shaft through the case and pinions, aligning the hole in the shaft with the lock bolt hole. Torque the lock bolt to specification.
9. Install the brake drum and tighten the attaching nuts.
10. Install the wheel and tire on the brake drum.
11. Clean the gasket mounting surfaces of the rear axle differential housing and the cover. Install a new cover gasket, cover, and the attaching bolts. Torque the bolts to specification.
12. Raise the rear axle. **Make sure the rear axle is in running position. Add the amount of specified lubricant required to reach the bottom of the filler plug hole. Install the filler plug and torque it to specification.**
13. Remove the safety support stands and lower the vehicle.

DRIVE PINION OIL SEAL

Synthetic seals must not be cleaned, soaked or washed in cleaning solvent.

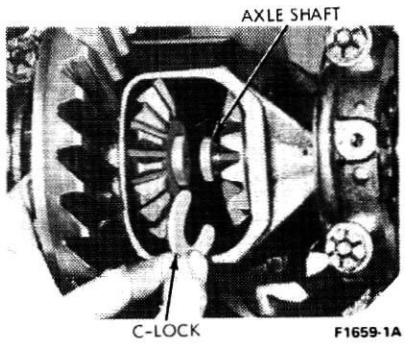


FIG. 3 Removal and Installation of C-Locks and Axle Shaft

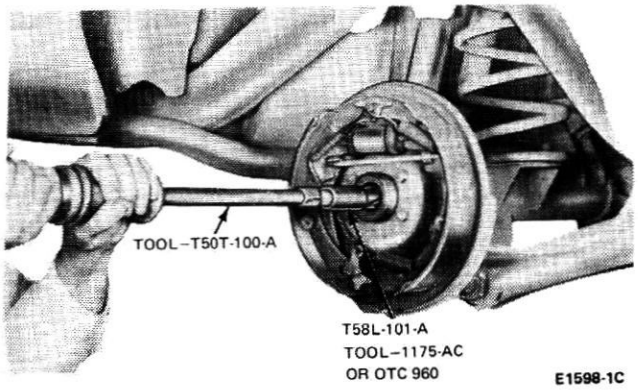


FIG. 4 Removal of Axle Seal or Bearing

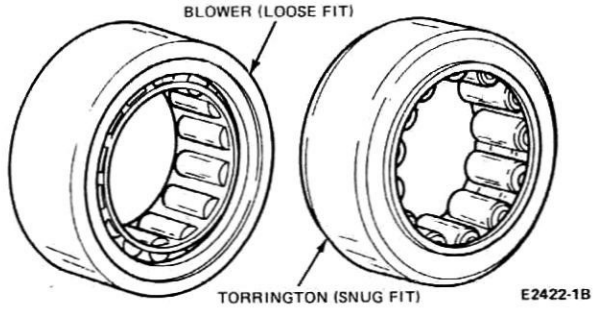


FIG. 5 Bearing Assemblies

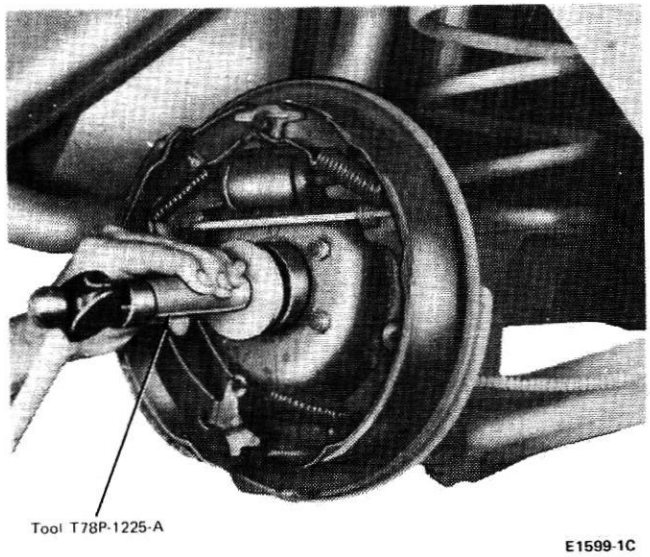


FIG. 6 Installation of Axle Shaft Bearing

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Replacement of the pinion oil seal involves removal and installation of only the pinion shaft nut and the universal joint flange. However, this operation disturbs the pinion bearing preload, and this preload must be carefully reset when assembling.

Removal

1. Raise the vehicle and install safety stands. Remove the rear wheels and brake drums.
2. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly (Fig. 8). Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the transmission group for the appropriate tool.

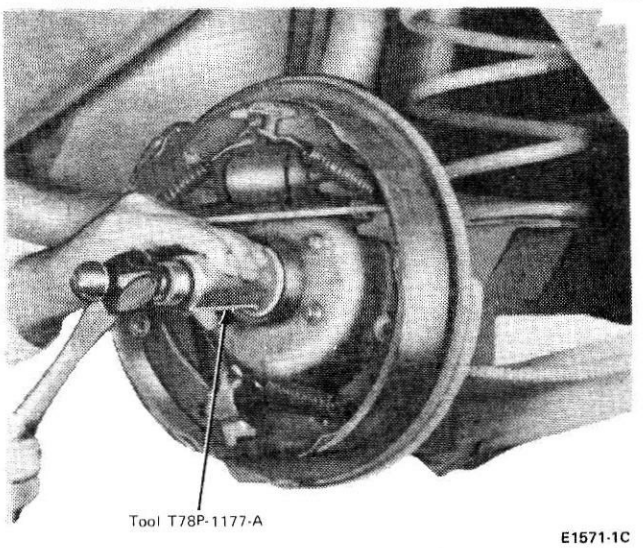


FIG. 7 Rear Axle Shaft Bearing Seal

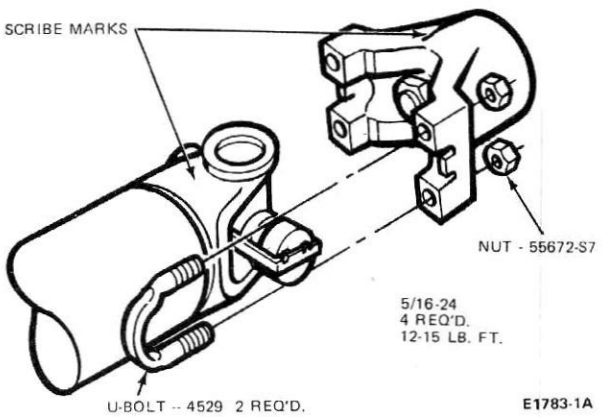


FIG. 8 Drive Shaft-to-Axle U-Joint Connection

3. Install an in-lb. torque wrench on the pinion nut (Fig. 9). Record the torque required to maintain rotation of the pinion shaft through several revolutions.

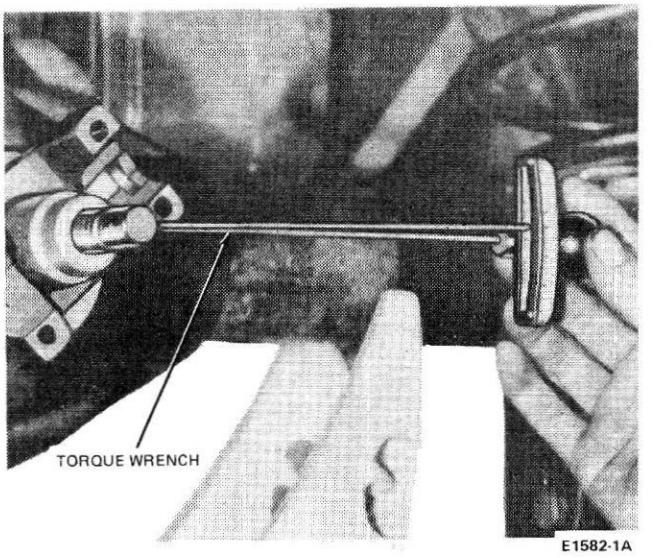


FIG. 9 Checking Pinion Bearing Preload

4. While holding the flange with the tool shown in Fig. 10, remove the integral pinion nut and washer.

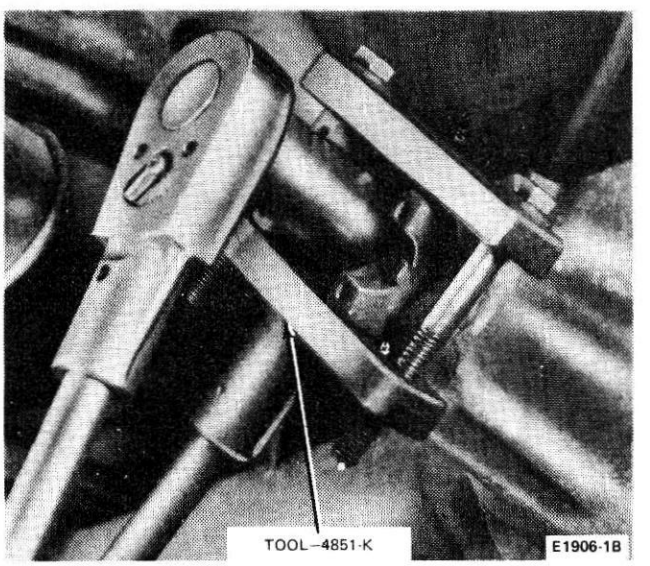


FIG. 10 Removing or Installing Drive Pinion Nut

5. Clean the pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear. Using a center punch or scribe, mark the U-joint flange in relation to the pinion stem.
6. Using the tool shown in Fig. 11, remove the pinion U-joint flange.
7. Using the tool shown in Fig. 12, remove the drive pinion oil seal.
8. Clean the oil seal seat.

Installation

1. Pinion oil seals have pre-applied oil resistant sealer. Install the seal in the retainer using the tool shown in Fig. 13.

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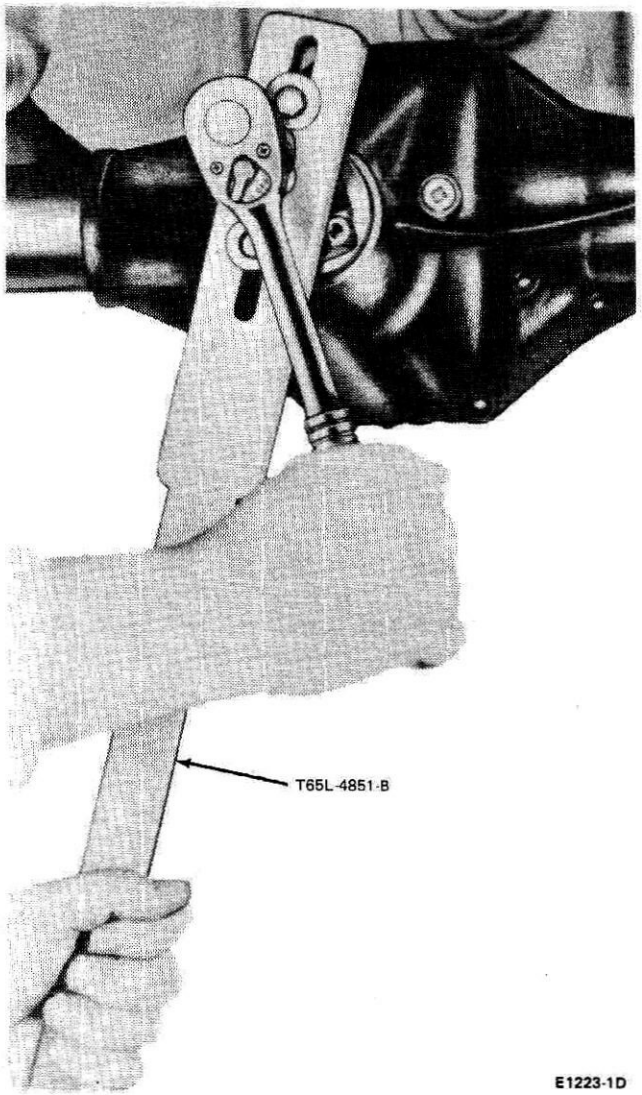


FIG. 11 Typical Drive Pinion Flange Removal

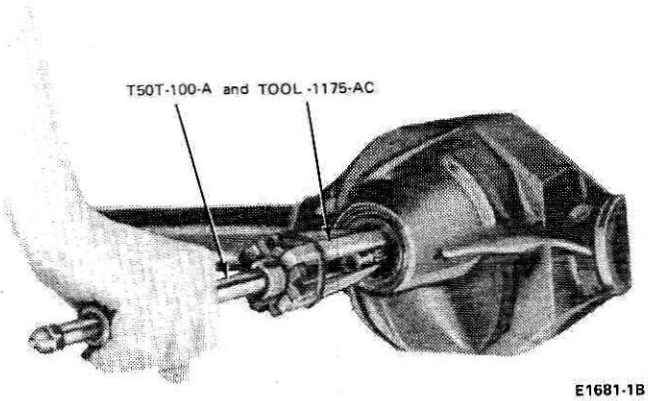


FIG. 12 Removing Pinion Seal

2. Check splines on the pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in a rotational motion. Wipe the pinion shaft clean.
3. Apply a small amount of lubricant to the U-joint flange splines.

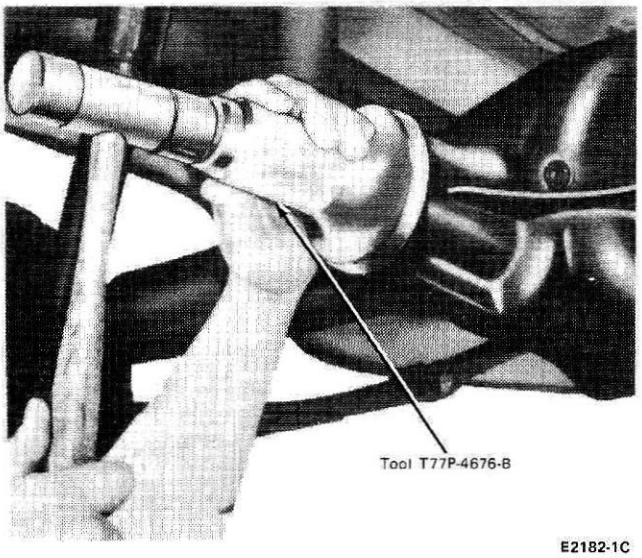


FIG. 13 Typical Drive Pinion Flange Seal Installation

4. Align the punch or scribe mark on the U-joint flange with the mark on the end of the pinion shaft, and install the flange.
5. Install a new integral nut and washer on the pinion shaft. (Apply a small amount of lubricant on the washer side of the nut.)
6. Hold the flange with the tool shown in Fig. 10, while tightening the nut.
7. Tighten the pinion shaft nut, rotating the pinion occasionally to insure proper bearing seating, and take frequent preload readings (Fig. 9) until the preload is at the original recorded reading established in Step 3 under Removal.
8. If the recorded preload is less than specification, tighten to specification as outlined at the end of this Part. If the preload is higher than specification, tighten to original reading recorded in Step 3 of Removal. **The preload should not exceed the amount indicated above, or bearing** damage **may result.** Under no circumstances should the pinion nut be backed-off to lessen preload. If this is done, a new pinion bearing spacer must be installed. In addition, the U-joint flange must never be hammered on, or power tools used.
9. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.
10. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the punch or scribe marks made on the drive shaft end yoke and the axle U-joint flange (Fig. 8).
11. Check the lubricant level. Make sure the axle is in running position. Add whatever amount of specified lubricant is required to reach the lower edge of the filler plug hole, located in the carrier casting.

REMOVAL AND INSTALLATION OF THE ORIGINAL U-JOINT FLANGE

Use procedure as outlined under Drive Pinion Oil Seal Replacement, omitting replacement of the seal.

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INSTALLATION OF A NEW UNIVERSAL JOINT FLANGE

Use procedure as outlined under Drive Pinion Oil Seal Replacement, omitting replacement of the seal.

AXLE HOUSING

REMOVAL

Coil or Leaf Spring Suspension

1. Raise the vehicle on a hoist.
2. Remove the wheels and tires from the brake drums.
3. Position a drain pan and loosen the rear axle cover to housing attaching bolts. Drain the housing.
4. Remove the drums after removing the shakeproof fasteners.
5. Remove the axle housing cover bolts, cover and gasket. Discard the gasket. Remove the drain pan.
6. Mark drive shaft and flange for identification. Disconnect the drive shaft at the drive pinion companion flange. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission housing to prevent leakage. Refer to the transmission group for the appropriate tool.
7. Loosen the pinion shaft lock bolt and remove the pinion shaft (Fig. 2), then remove the differential pinion gears and thrust washers.
8. Push the axle shaft(s) inward toward the center of the axle housing. Remove the C-locks from the inner ends of the axles (Fig. 3). Remove the axle shafts from the housing. **Extreme care must be used to avoid contacting the axle shaft seal lip with any portion of the axle shaft other than the seal journal.**
9. Disconnect the vent hose from the rear vent tube and remove all brake lines from the axle housing retaining clips.
10. Remove the brake backing plate attaching nuts and the plates from the axle housing. Suspend the plates above the axle housing with mechanic's wire. **The hydraulic brake lines and the parking brake cables will remain attached to the brake backing plates.**
11. Position safety stands under the rear frame members. Lower the vehicle with the hoist and allow the axle to lower far enough to relieve rear spring tension.
12. Disconnect the lower end of the shock absorbers at the mounting brackets.

Leaf Spring Suspension

1. Remove the U-bolts (spring clips) attaching the axle housing to the springs and remove the axle housing and spring insulators from the vehicle.

Coil Spring Suspension

1. Disconnect the track bar from the axle housing stud. If the axle housing is to be replaced, transfer the stud to the new housing.
2. Remove the nuts, washers and pivot bolts that connect the suspension lower arms to the axle housing. Disconnect both arms from the axle housing.
3. Disconnect the upper suspension arm from the axle housing by removing the pivot bolt, nut, lock washer, and two eccentric washers.
4. Lower the rear axle to the floor with the jack and remove the axle from under the vehicle, along with the right and left rear springs and insulators.

Coil or Leaf Spring Suspension

1. Remove the wheel bearings and oil seals with the tool shown in Fig. 4.
2. If the axle housing is being replaced, transfer all the differential and pinion parts to the new housing and install as outlined in this Part.

INSTALLATION

1. Lightly coat the wheel bearing rollers with axle lubricant. Install wheel bearings in the axle housing with the tool shown in Fig. 6. The bearings should seat firmly against the shoulder.
2. Wipe all lubricant from the oil seal bore before installing the seal. **If axle housing is being replaced, new seals must be installed. New seals are prepacked with lubricant and do not require an oil soak.**
3. Install the seal with the tool shown in Fig. 7. ***Installation without the use of the proper tool will distort the seal and cause leakage. New seals are color coded and marked right and left side.***
4. Raise the rear axle into position under the vehicle with a hoist or floor jack.

Leaf Spring Suspension

1. Position the axle housing on the springs and install the spring insulators and U-bolts. Torque the U-bolt nuts to specifications. Connect the rear shock absorbers and torque the attaching nuts to specifications.

Coil Spring Suspension

1. Connect the suspension lower arms to their mounting brackets on the axle housing with pivot bolts and nuts. Do not tighten the mounting bolts at this point.
2. Place the rear coil springs and insulators into position in the pockets provided. Raise the rear axle until the coils are under tension.
3. Position the suspension upper arm in its mounting bracket on the axle housing and install the adjusting bolt, eccentric washers, lockwasher and nut. Do not tighten the mounting bolt at this point.

Coil or Leak Spring Suspension

1. Place the brake backing plates on the axle housing flanges. Install four attaching bolts and nuts and torque them to specifications.
2. Position the brake lines to the axle housing and secure them with the retaining clips. If the axle housing is new, install a new vent. When installing the new axle vent, apply a small amount of Loctite (C5AZ-19554-B) or equivalent to prevent oil leakage between vent and axle housing. Connect the vent tube to the vent.
3. Install the pinion gears and thrust washer. Install axle shaft O-ring on shaft.

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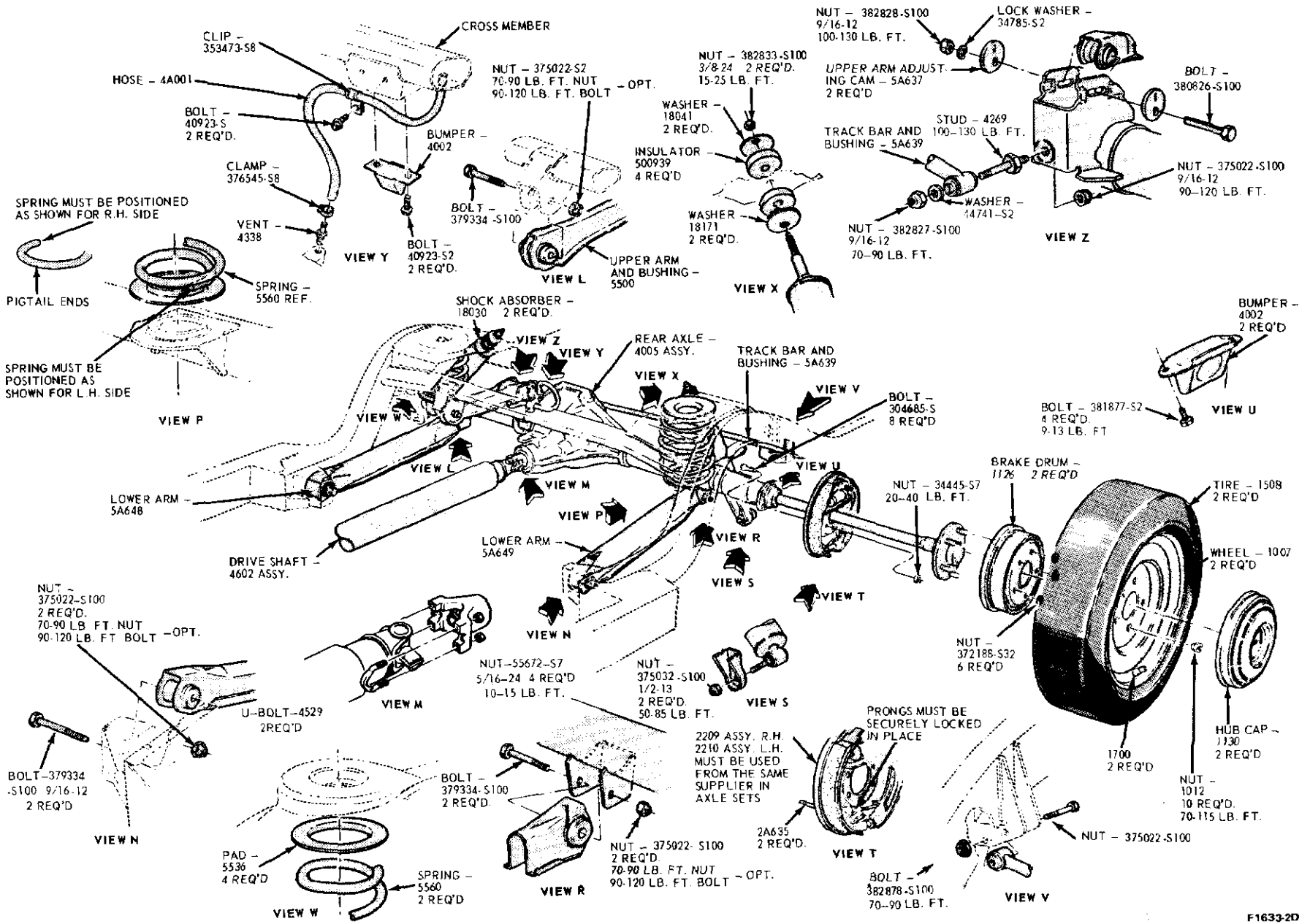


FIG. 14 Typical Rear Axle Installation–WER Axle

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4. *Slide the axle shafts into place in the axle housing.* **Exercise care that splines or any portion of the *axle shafts do not damage the oil seals and* that they engage with the splines of the differential side gears.**
5. Install the axle shaft C-lock on the inner end of each shaft, and push the shafts outward so that the shaft lock seats in the counterbore of the differential side gear.
6. Position the pinion differential gears and thrust washers 180 degrees apart to the differential side gears. Turn the gear assembly until the holes in the differential case are aligned with the pinion gears.
7. Position the differential pinion shaft through the case and pinions, aligning the hole in the shaft with the lock bolt hole. Tighten the lock bolt to specification.
8. Clean the gasket mounting surface of the rear axle housing and the cover. Install a new cover gasket, cover, and attaching bolts. Torque the bolts to specification.

Coil Spring Suspension

1. Raise the rear axle on a hoist and remove the safety stands.
2. Connect the track bar to the mounting stud (Fig. 14). Install the washer and nut. Torque the nut to specification.
3. Connect the two rear shock absorbers to the mounting brackets on the axle housing and torque the attaching nuts to specification.
4. Make sure that both the front and rear pivot bolts of the upper and the two lower arms are loose, then raise the axle assembly to the controlled height (Fig. 15). Hold the axle at the controlled height by placing blocks or pieces of steel pipe between the axle housing and the bumper rear screw on the side rail.
5. With the axle at controlled height, torque the suspension upper and lower arm front pivot bolts and nuts to specification. Torque the lower arm to the axle housing pivot bolts and nuts to specification.
6. Adjust the pinion angle to specification.

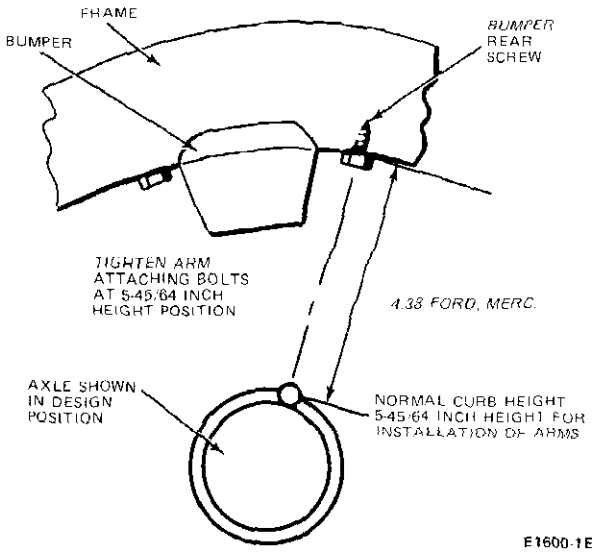


FIG. 15 Axle Normal Curb Height and Controlled Height for Arm Installation

Coil or Leaf Spring Suspension

1. Remove the oil seal replacer from the transmission extension housing. *Install the drive shaft in the extension housing.* Align the scribe marks on the cups, flange and drive shaft, and connect the drive shaft at the drive pinion flange. Torque the attaching bolts to specification.
2. Install the brake drum and attaching shakeproof retainers.
3. Install the wheel and tire on the brake drum. Install the wheel covers.
4. Add the amount of specified lubricant required to *reach to the bottom of the filler plug hole.* ***Make sure the rear axle is in running position. Install the filler plug and torque it to specification.***
5. Lower the vehicle.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY OF AXLE

The rear axle components are shown in Figs. 16 and 17.

All service operations on the differential case assembly can be performed with the axle housing in the vehicle.

1. Raise the vehicle on a hoist.
2. Position the drain pan under the axle housing. Loosen the housing cover attaching bolts. Drain the lubricant from the housing.
3. Make scribe marks on the drive shaft end yoke and the rear axle shaft companion flange to insure proper position of the drive shaft at assembly. Disconnect the drive shaft from the rear axle companion flange. **Be careful to avoid dropping the loose universal joint bearing cups.** Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are reassembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission leakage. Refer to the transmission group for the appropriate tool.
4. Raise the vehicle and place jack-type stands under the rear frame crossmember. Lower the vehicle on a hoist and allow the axle to lower as far as possible.
5. Remove the axle housing cover and gasket. Discard the gasket.
6. Perform the Inspection before Disassembly of Carrier as outlined in Part 15-01. Remove rear wheels.

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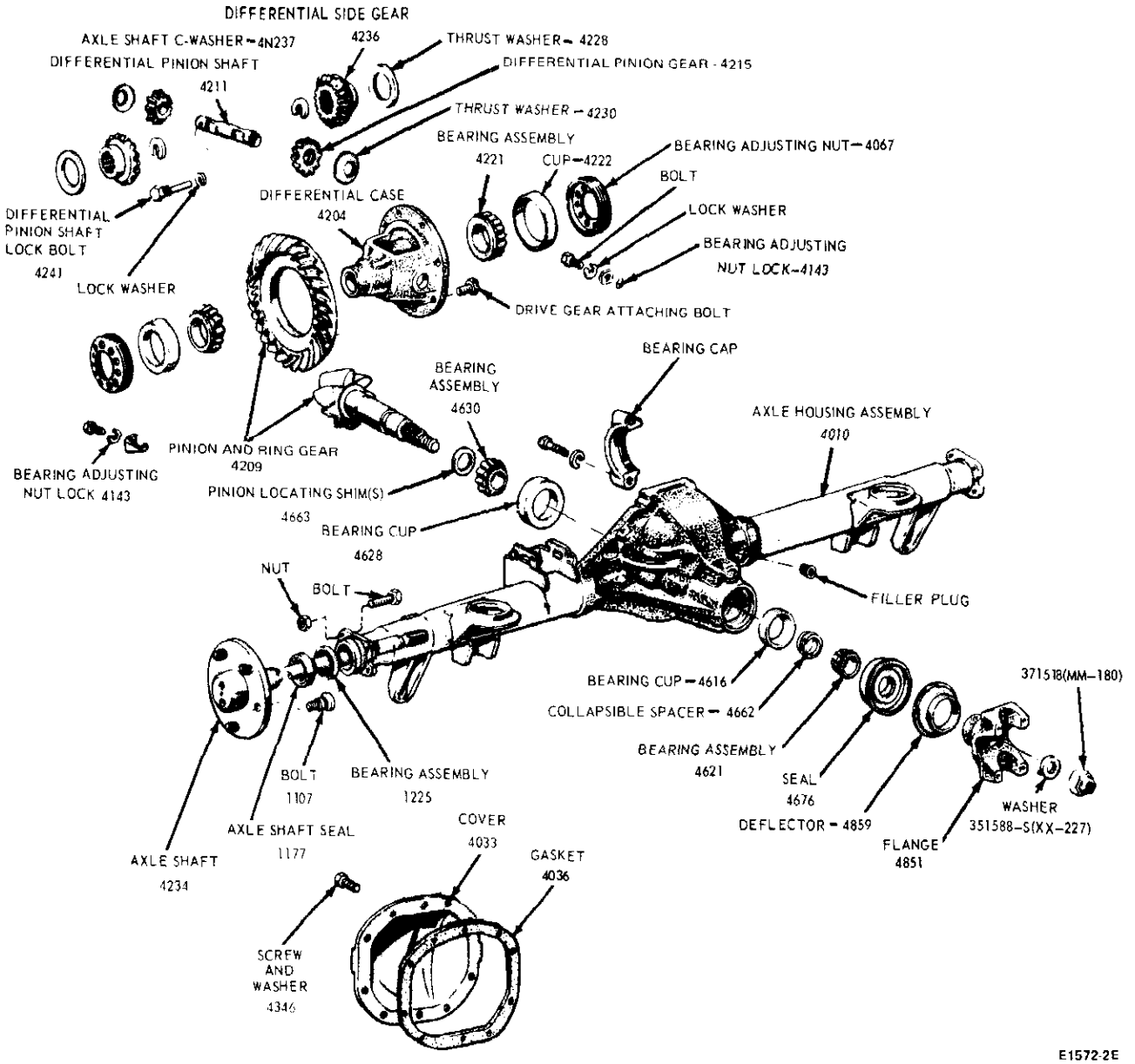
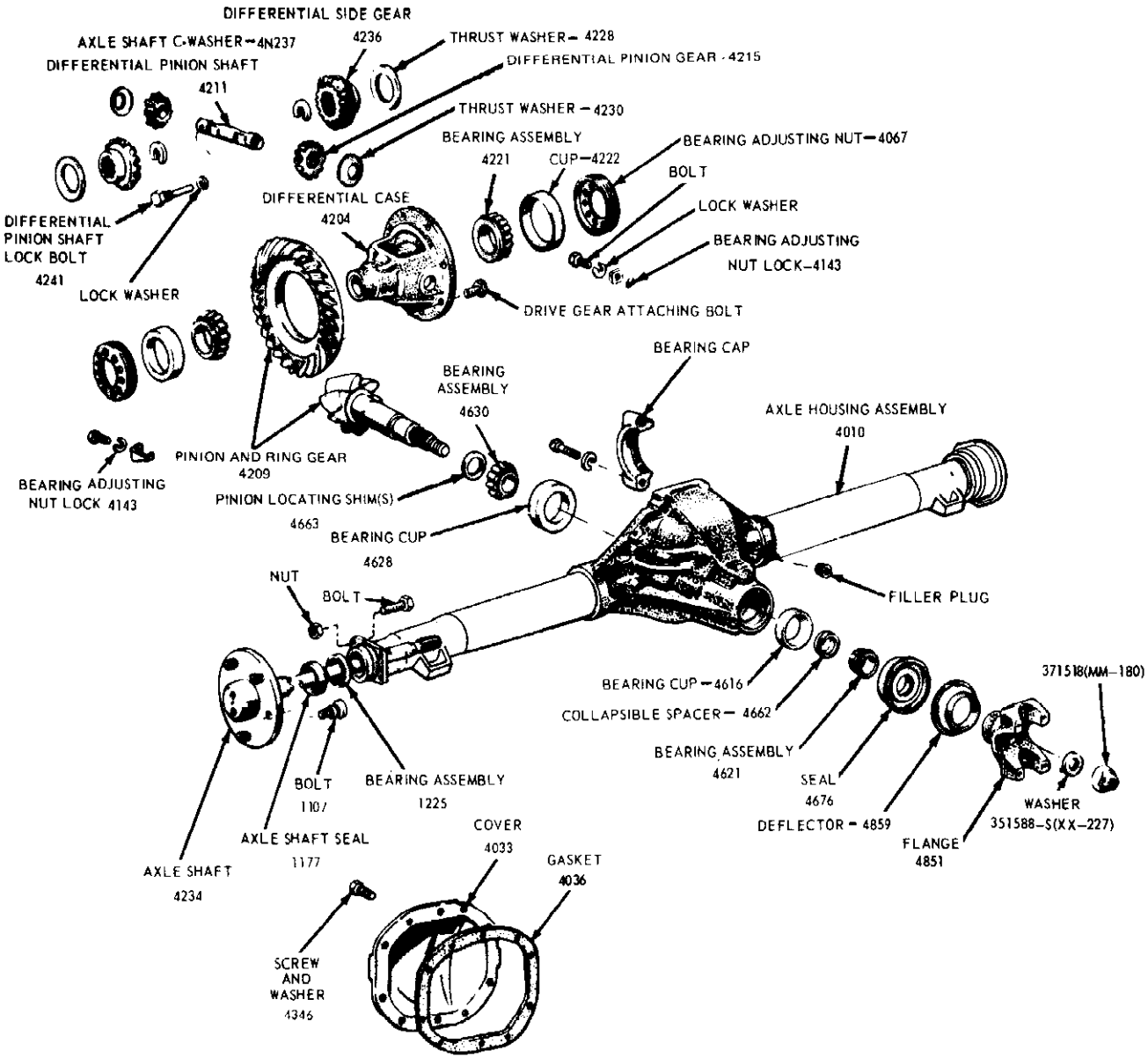


FIG. 16 Disassembled WER Rear Axles—Coil Spring Suspension—Ford and Mercury

7. Remove the attaching shakeproof retainers that secure the rear brake drums to the axle shaft flanges, and then remove the drums.
8. Working through the differential case opening, loosen the differential pinion shaft lock bolt and remove the differential pinion shaft (Fig. 2).
9. Push the axle shafts inward toward the center of the axle housing. Remove the C-locks (Fig. 3) from the inner ends of the rear axles. Remove the axle shafts from the housing. **Extreme care must be used to avoid contacting the axle shaft seal lip with any portion of the axle shaft except the seal journal.**
10. Remove the oil seal and bearings from the axle housing as shown in Fig. 4.
11. Remove both side bearing adjusting nut locks (bolts).
12. Install a dial indicator (Fig. 18), and check and record the backlash and ring gear runout.
13. Mark one differential bearing cap and the case to help in positioning the parts properly during assembly.
14. Remove the bearing cap retaining bolts. Remove the bearing caps, cups, adjusting nuts and case assembly.
15. Hold the drive pinion flange and remove the pinion nut (Fig. 19). Discard the nut.
16. Remove the pinion flange (Fig. 20).
17. Drive the pinion out of the front bearing cone and remove it from the carrier housing. Remove and discard the bearing spacer.
18. With a hammer and drift, remove the pinion shaft oil seal out through the front of the carrier housing.
19. Remove the pinion rear bearing from the drive pinion shaft (Fig. 21).
20. Measure the shim which is found under the bearing cone with a micrometer. Record the thickness of the shim.

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FIG. 17 Disassembled WER Rear Axle—Leaf Spring Suspension—Granada and Monarch

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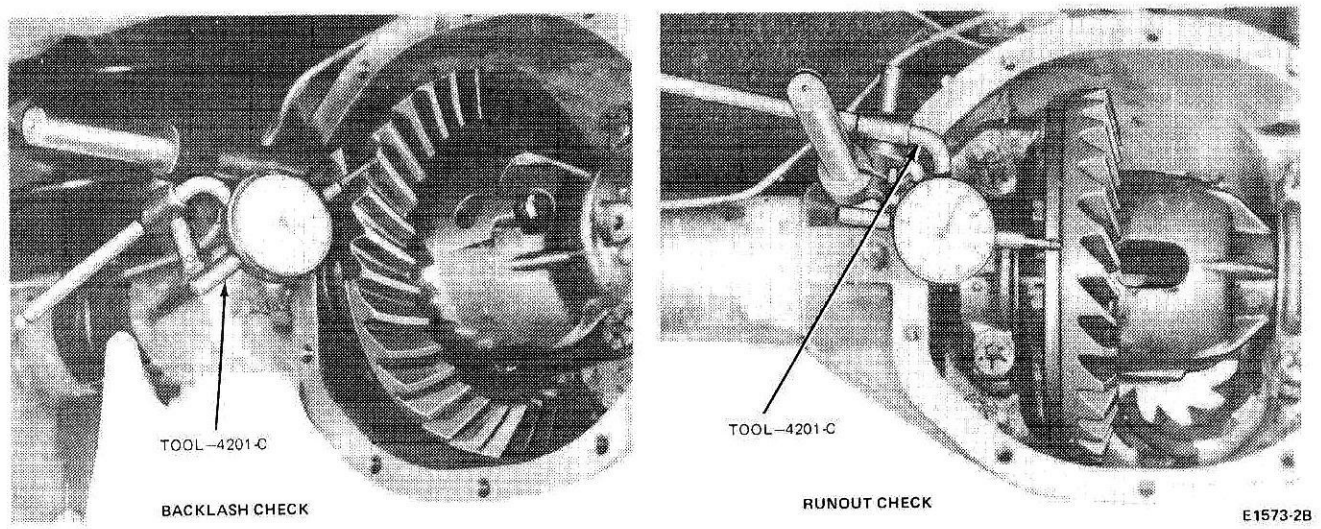


FIG. 18 Checking Backlash and Runout—WER Axle

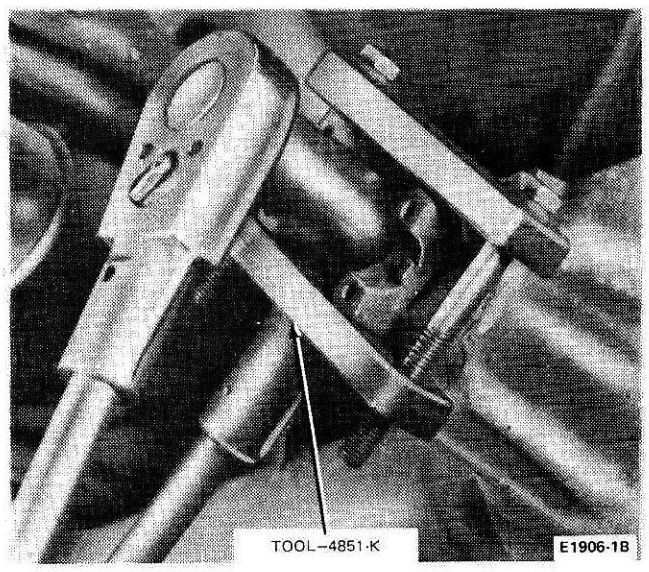


FIG. 19 Drive Pinion Shaft Nut Removal

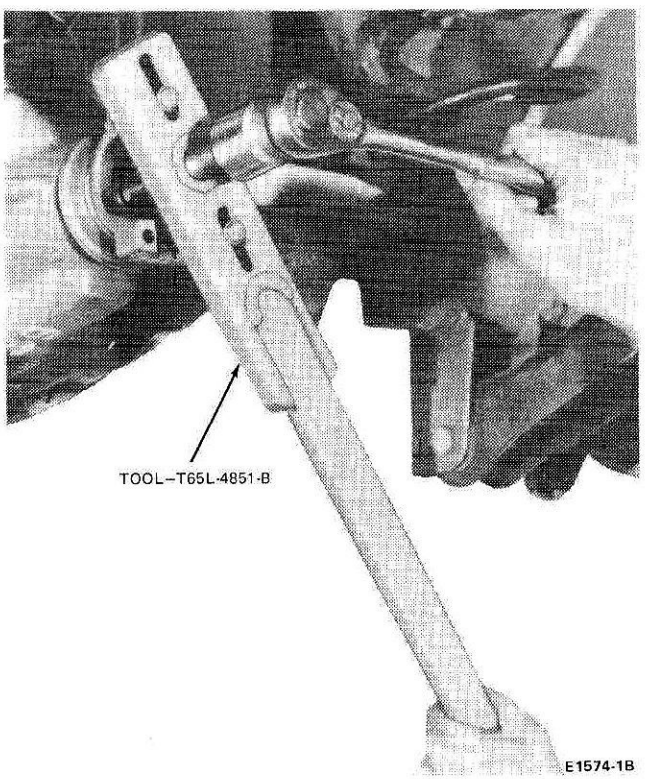


FIG. 20 Drive Pinion Flange Removal

DISASSEMBLY OF DIFFERENTIAL CASE

1. If the two differential side bearings are to be removed from the differential case, use the tool shown in Fig. 22.
2. Remove and discard the bolts that attach the ring gear to the differential case. Press the ring gear from the case or tap it off with a soft-faced hammer.

PARTS REPAIR OR REPLACEMENT

Clean and inspect all the parts as outlined in Cleaning and Inspection, Part 15-01, of this manual. Before assembling the carrier, repair or replace all parts as indicated by the inspection. The principle replacement operations are covered in the following procedures. All other repair or replacement operations are outlined in Cleaning and Inspection, Part 15-01, or under Assembly of Differential Case in this Part.

PINION BEARING CUPS

Do not remove the pinion bearing cups from the carrier casting unless the cups are worn or damaged.

If the pinion bearing cups are to be replaced, drive them out of the carrier casting with a drift. Tap on the side opposite the cup. Use care to prevent the cups from cocking in the carrier. Install the new cups with the tool shown in Fig. 23. Make sure the cups are properly seated in their bores. If a 0.0015-inch feeler gauge can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not properly seated.

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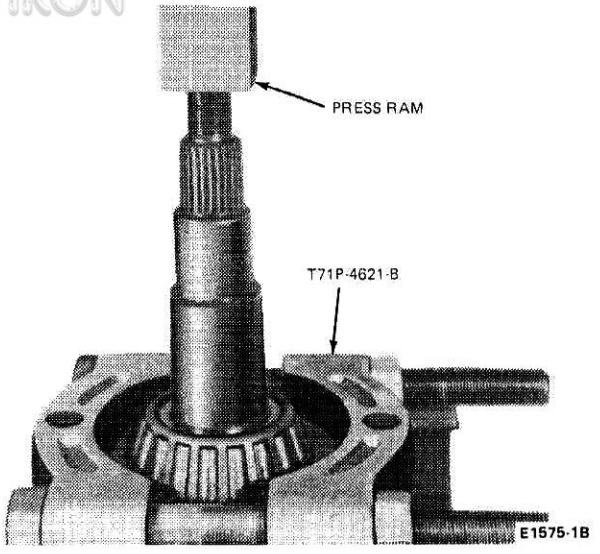


FIG. 21 Pinion Rear Bearing Removal

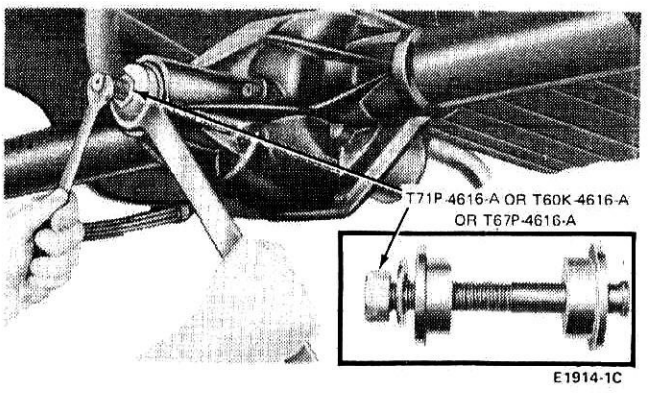


FIG. 23 Pinion Bearing Cup Installation—Typical

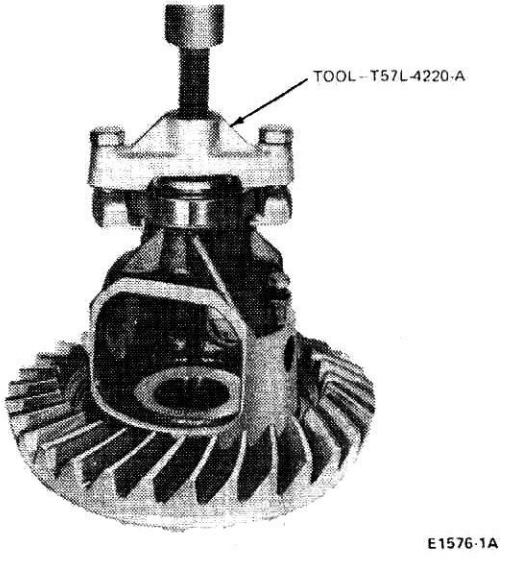


FIG. 22 Differential Bearing Removal

Whenever the cups are replaced, the cone and roller assemblies should also be replaced.

DRIVE PINION AND GEAR SET

Individual differences in machining the carrier casting and the gear set require a shim between the pinion rear bearing cone and the pinion gear to locate the pinion for correct tooth contact with the ring gear.

When replacing a ring gear and pinion, note that the original factory-installed shim is of the correct thickness to adjust for individual variations in both the carrier casting dimension and in the original gear set dimension. Therefore, to select the correct shim thickness for the new gear set to be installed, follow these steps:

1. Use a micrometer to measure the thickness of the original shim removed from the axle and use the same thickness upon installation of the replacement carrier assembly or drive pinion. If further shim change is necessary, it will be indicated in the tooth pattern check.
2. If the original shim is lost, substitute a nominal shim for the original and use the tooth pattern check to determine if further shim changes are required. Nominal shim thicknesses are indicated in Part 15-07, Specifications.

   A new ring gear and pinion should always be installed in an axle as a matched set (never separately). **Be sure the same identifying (matching) number, painted, appears on the bolt hole face of the ring gear and on the head of the drive pinion (Fig. 24).**

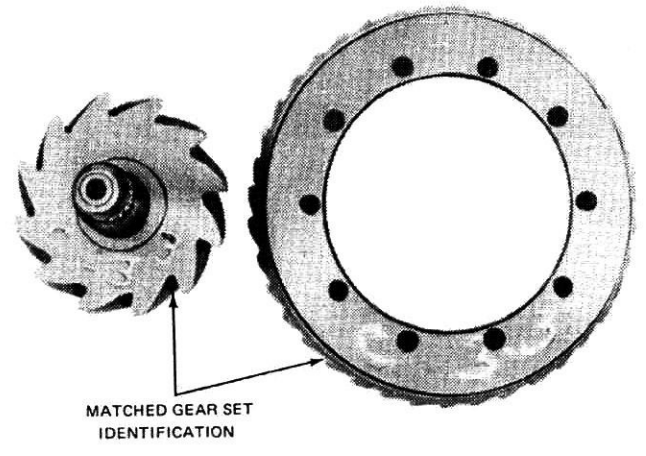


FIG. 24 Pinion and Ring Gear Markings

3. After determining the correct shim thickness as explained in the foregoing steps, install the new pinion and ring gear as outlined under Assembly of Differential Case, to follow.

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DRIVE PINION AND GEAR SET (ALTERNATE PROCEDURE)

1. Using pinion depth gauge set, Tool T70P-4020-A, select the correct aligners (they are marked to correspond with the correct axle) to fit the front and rear pinion bearing I.D. Screw these on the threaded shaft to the correct position (Fig. 25) and then screw on the correct dummy pinion head (also marked).

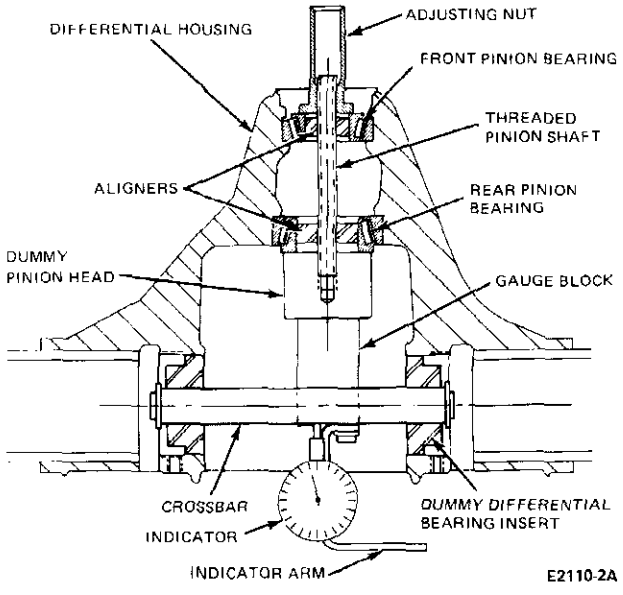


FIG. 25 Pinion Depth Gauge Application—Tool T70P-4020-A

2. Place the rear pinion bearing over the aligner and against the dummy pinion head. Insert this assembly in the rear bearing cup.
3. Place the front bearing over the aligner and into the front bearing cup simultaneously. Spin the adjusting nut on the threaded shaft until it contacts the front bearing. Hand tighten until both bearings are securely seated (approx. 5-20 in-lb). When this operation is completed, both bearings should rotate freely but snugly.
4. Align and place the dummy differential bearing inserts into the differential bearing bores making sure they do not contact the threads behind the bore. Install the bearing caps. The crossbar should now slide freely within the inserts.
5. Check to see that the indicator arm is attached securely to the gauge block. The spring washers should hold it flatly to the gauge block when the shoulder screw is fully bottomed.
6. Securely attach a standard indicator (Tool-4201-C, Tool 6565 or equivalent) to the indicator arm. Set the indicator to zero while the indicator pointer is on the gauge block.
7. Place the gauge block on the dummy pinion head and rotate the indicator over the crossbar. The correct reading will be obtained when the indicator is at top dead center over the crossbar (readings are usually 0.020-0.040). Because of the necessary dial indicator position the use of a mirror will simplify reading the results.
8. Inspect the pinion gear that will be used for this buildup. It will have ONE of THREE markings:
   a. plus (+) marking (+.002)
   b. minus (-) marking (-.001)
   c. or no marking

   Subtract the plus marking from the reading obtained in Step 7 for the correct shim thickness.

   Add the minus marking to the reading obtained in Step 7 for the correct shim thickness.
9. After making the correct shim selection remove the Tool T70P-4020-A from the carrier. Place the shim(s) on the pinion shaft and press on the rear bearing.

DRIVE PINION AND GEAR SET (ALTERNATE PROCEDURE USING TOOL T75P-4020-A)

1. Refer to Fig. 26 and assemble the appropriate aligning adapter, gauge disc and gauge block to the screw as shown in the illustration.
2. Place the rear pinion bearing (new, or used if in good condition) over the aligning disc and insert into the pinion bearing cup of the carrier. Place the

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front bearing into the bearing cap and assemble the tool handle onto the screw and tighten to 20 ft-lbs (Fig. 27).

3. Center the gauge tube into the differential bearing bore. Install the bearing caps and torque the bolts to specification (Fig. 27).
4. Using a feeler gauge tool, select the thickest feeler blade that will enter between the gauge tube and the gauge block (Fig. 27). Insert the feeler gauge blade directly along the gauge block to insure a correct reading. The feeler gauge fit should be a slight drag-type feel.
5. After the correct feeler gauge feel is obtained, check the reading. This is the thickness of the shims required, providing the replacement pinion has no plus or minus readings shown on it.
6. If the replacement pinion gear is marked with a plus (+) reading, the amount shown as a plus must be **subtracted** from the thickness dimension obtained in Step 5.
7. If the replacement pinion gear is marked with a minus (-) reading, the amount shown must be **added** to the thickness dimension obtained in Step 5.

NOTE: The same rear pinion bearing used in this procedure MUST be used in final assembly of the axle.

8. Place the selected shim(s) on the pinion shaft and press on the pinion bearing.
9. **A tooth pattern check with the gear marking compound supplied with the ring and pinion set is not required when this tool is used.**

DIFFERENTIAL CASE, BEARINGS AND RING GEAR

If the ring gear runout check (before disassembly) exceeded specification, the condition may be caused by a warped gear, a defective case, or excessively worn differential bearings.

To determine the cause of excessive runout, proceed as follows:

1. Remove the ring gear, then press the original bearings on the one-piece differential case hubs.
2. Place the differential bearing cups on the bearing cone and roller, and set the differential case in the carrier.
3. Install the matched (marked) bearing caps and adjusting nuts as outlined in Steps 11 through 14 under Installation of Drive Pinion and Differential Case, which follows under next heading.
4. Tighten the left adjuster nut until it just touches the bearing cup, then tighten the nut two notches beyond the point where it first contacts the bearing cup. Turn the differential case several revolutions in each direction while the bearings are loaded, to seat the bearings in their cups. This step is important.
5. Again loosen the right nut to release the preload. Check to see that the left nut contacts the bearing cup. Using the dial indicator set-up shown in Fig. 17, Part 15-01, adjust the preload to 0.008 to 0.012 case spread for new bearings or 0.006 to 0.010 for the original bearings, if re-used.
6. Check the runout of the differential case flange with a dial indicator. **If the runout does not now**

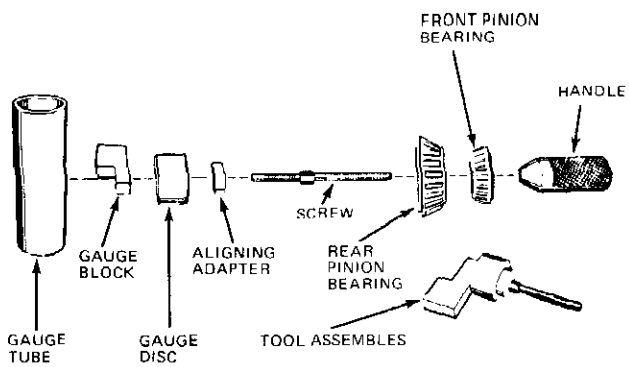


CHART I

Dash Number	Description	Integral Carriers		
		6.75	8.5	8.7
-A1	Aligning Adapter (1.300 O.D.)	X		
-A3	Aligning Adapter (1.612 O.D.)		X	X
-A4	Gauge Disc (.458 thick)	X		
-A6	Gauge Disc (1.314 thick)		X	X
-A7	Gauge Tube (2.563 O.D.)	X		
-A8	Gauge Tube (2.892 O.D.)		X	X
-A9	Screw	X	X	X
-A10	Gauge Block (1.700 thick)	X	X	X
-A11	Handle	X	X	X

F2527-1A

FIG. 26 Rear Axle Pinion Depth Gauge Tool (T75P-4020-A)

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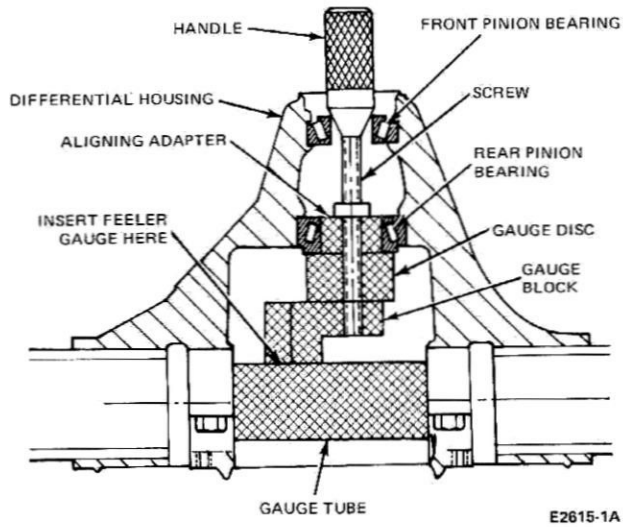


FIG. 27 Using Pinion Depth Gauge Tool T75P-4020-A

exceed specifications, install a new ring gear. If the runout still exceeds specifications, the ring gear is true and the trouble is due to either a damaged casting or worn bearings.

7. Remove the differential case from the carrier and remove the side bearings from the case.
8. Install new bearings on the case hubs, and again install the differential assembly in the carrier without the ring gear.
9. Check the case runout again with the new bearings. If the runout is now within limits, the old bearings were excessively worn. Use the new bearings for assembly. If the runout is still excessive, the case is damaged and should be replaced.

ASSEMBLY OF AXLE

Refer to Part 15-01 of this manual for Cleaning and Inspection procedures before starting assembly operations.

ASSEMBLY OF DIFFERENTIAL CASE

Carefully clean the tapped holes in the ring gear in a suitable solvent. Dry thoroughly.

1. Place the ring gear in the differential case. If the new bolts to be used show a green coating over approximately 1/2-inch of the threaded area, install as is. If not coated, apply a small amount of Loctite (Part Number C3AZ-19554-A) or equivalent. Torque to specification. **It is mandatory that bolts used once, should not be used again.**
2. If the differential bearings were removed, press them on as shown in Fig. 28.

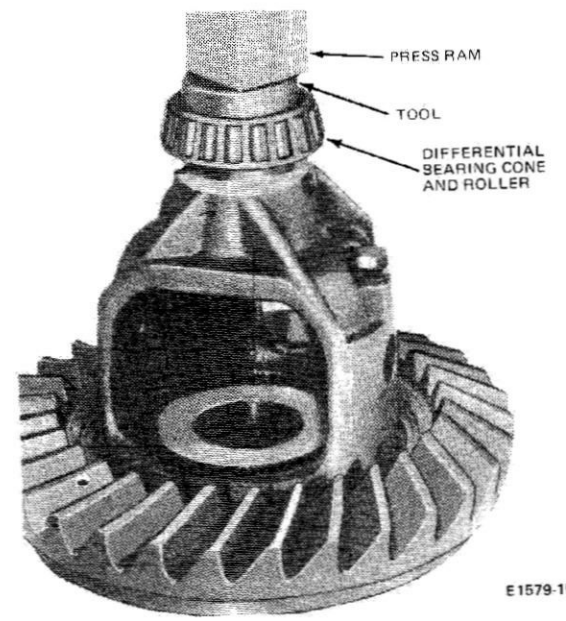


FIG. 28 Differential Bearing Installation

3. Insert the pinion gear shaft lock bolt into the case (loosely).

INSTALLATION OF DRIVE PINION AND DIFFERENTIAL CASE

1. Place the shim(s) and pinion rear bearing cone on the pinion shaft. Press the bearing and shim(s) firmly against the pinion shaft shoulder (Fig. 29).
2. Place a new pinion bearing preload (collapsible) spacer on the pinion shaft.

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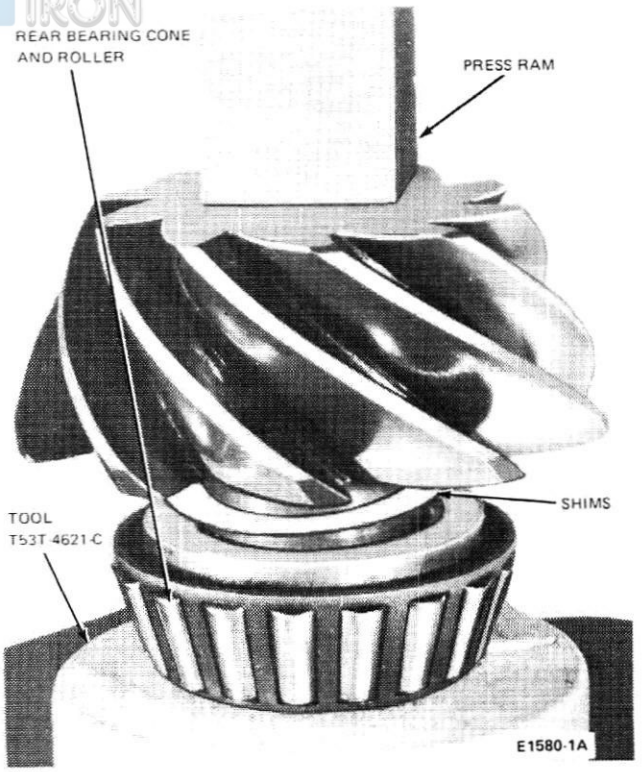


FIG. 29 Drive Pinion Bearing Installation

3. Lubricate the pinion rear bearing with axle lubricant.
4. Lubricate the pinion front bearing with axle lubricant. Lubricate the pinion front bearing cone, and place it in the carrier housing.
5. Install a new pinion oil seal in the carrier casting (Fig. 30).

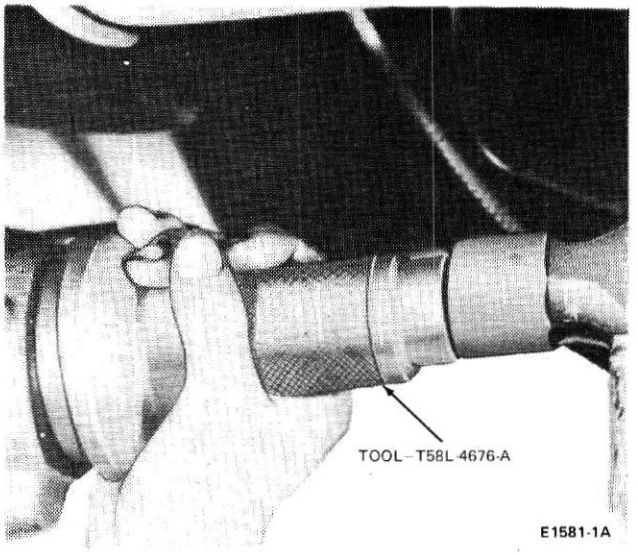


FIG. 30 Installing Pinion Seal

6. Insert the drive pinion shaft (U-joint) flange into the pinion seal and hold it firmly against the pinion front bearing cone. From the rear of the carrier casting, insert the pinion shaft into the flange.
7. Apply a small amount of lubricant to the washer side of the flange nut and start the nut. **Use a new nut. Hold the flange with the tool shown in Fig. 20 and tighten the pinion shaft nut. As the pinion shaft nut is tightened, the pinion shaft is pulled into the front bearing cone and into the flange.**

   As the pinion shaft is pulled into the front bearing cone, pinion shaft end play is reduced. While there is still end play in the pinion shaft, the flange and bearing cone will be felt to bottom on the collapsible spacer.

   From this point, a much greater torque must be applied to turn the pinion shaft nut, since the spacer must be collapsed. Very slowly, tighten the nut and check often to see that the pinion bearing preload does not exceed the specified limits.

   If the pinion shaft nut is tightened to the point that pinion bearing preload exceeds the limits, the pinion shaft must be removed and a new collapsible spacer installed. Do not decrease the preload by loosening the pinion shaft nut. This will remove the compression between the pinion front and rear bearing cones and the collapsible spacer, and result in the front bearing cone turning on the pinion shaft.
8. As soon as there is preload on the bearings, **turn the pinion shaft in both directions several times to seat the bearing rollers.**
9. Adjust the bearing preload to specification. Measure the preload with the tool shown in Fig. 31.

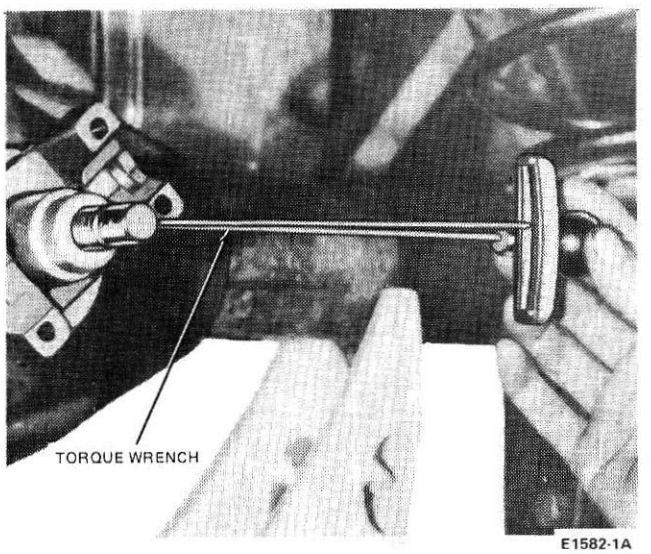


FIG. 31 Checking Pinion Bearing Preload

10. Apply a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.
11. Place the cups on the bearings and set the differential case assembly in the carrier casting.

    If the gear set is of the **nonhunting or partial nonhunting** type, assemble the differential case and ring gear assembly in the carrier so that the marked tooth on the pinion indexes between the marked teeth on the ring gear as shown in Fig. 32.

    Be sure to match gears as indicated. When assembled out of time, noise, excessive wear, and possible failure may result.

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When installing the hunting-type gear set (no timing marks), place the differential case and ring gear assembly in the carrier without regard to the matching of any particular gear teeth.

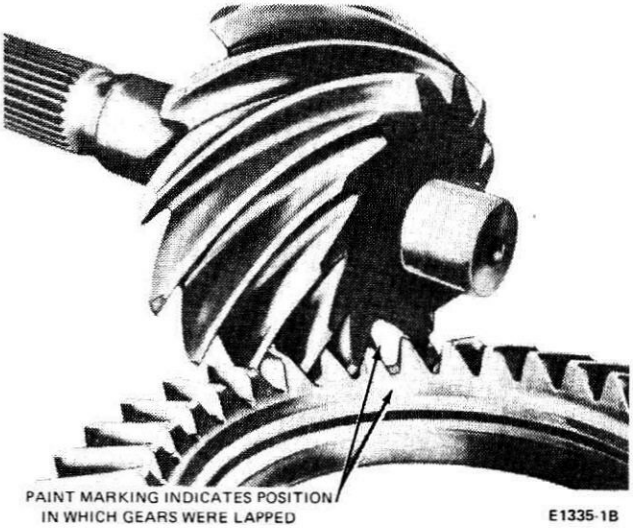


FIG. 32 Typical Gear Set Timing Marks

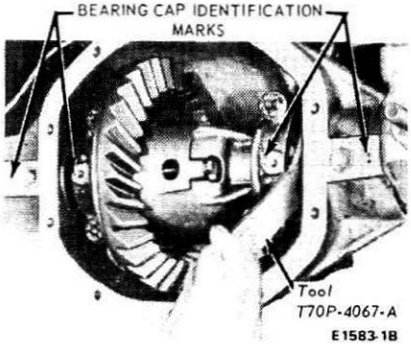


FIG. 33 Bearing Cap Installation

12. Slide the case assembly along the bores until a slight amount of backlash is felt between the gear teeth. Hold the differential case in place.
13. Set the adjusting nuts in the bores so that they just contact the bearing cups.
14. Carefully position the bearing caps on the carrier casting. Match the marks made when the caps were removed (Fig. 33).
15. Install the bearing cap bolts and lockwashers. As the bolts are tightened, turn the adjusting nut with the tool shown in Fig. 33.
16. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and inspect for damaged threads or incorrectly positioned caps. Tighten the bolts to the specified torque to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 5 ft-lbs before making adjustments. Refer to Part 15-01, for backlash and bearing preload adjustment procedures.
17. Clean the marking compound from the gear teeth.
18. Install both side bearing adjusting nut locks (bolts) and torque to specification.
19. Install the differential side gears and thrust washers.
20. Install the rear wheel bearings, seals, rear axle shafts, wheels and tires, and the axle carrier cover as outlined under Rear Axle Shaft, Wheel Bearing and Oil Seal Replacement.
21. Raise the axle all the way up. Remove the safety support stands.
22. Connect the track bar to the mounting stud, if so equipped. Install the washer and retaining nut, and torque the nut to specification.
23. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft. Align the scribe marks on the cups, flange and drive shaft, and connect the rear end of the drive shaft to the axle U-joint flange. Torque the retaining bolts to specification.
24. Refill the axle with the specified lubricant. Vehicle must be level.
25. Lower the vehicle.

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DETROIT IRON

SPECIFICATIONS

DRIVING AXLE IDENTIFICATION (INTEGRAL CARRIER) – WER

Ident. Tag	Ratio	Ring Gear Dia. (Inches)	Diff. Type ①
WER–AA	2.47:1	8.7	C2
WER–AB	2.47:1	8.7	C2
WER–AC	2.47:1	8.7	C2

① Type: C2 – Conventional Differential – 2 Pinion

ADJUSTMENT TORQUE SPECIFICATIONS (INTEGRAL CARRIER) –WER

Description	Torque In. Lb.	Torque Ft. Lb.
Minimum torque required to tighten pinion flange nut to obtain correct pinion bearing preload		140 ①
Pinion Bearing Preload – (Collapsible spacer) ② Original Bearings – 8.7 inch	8-14	
New Bearings – 8.7 inch	17-27	

① If pinion bearing preload exceeds specification before this torque is obtained, install a new spacer.
② With Oil Seal.

CLEARANCE, TOLERANCE AND ADJUSTMENTS (INTEGRAL CARRIER) – WER

Description	Inches	Description	Inches
Maximum Runout of Backface of Ring Gear	0.003	Nominal Pinion Locating Shim	0.030
Differential Side Gear Thrust Washer Thickness	0.030-0.032	Available Pinion Gear Shims in Steps of 0.001 – 8.7 inch	0.022-0.038
Differential Pinion Gear Thrust Washer Thickness	0.030-0.032		
Differential Bearing Preload (Case Spread Across Differential) New Bearings – 8.7 inch	0.008-0.012	Backlash between ring gear and pinion teeth	0.008-0.012
		Maximum backlash variation between teeth	0.003
Original Bearings – 8.7 inch	0.006-0.010	Maximum radial runout of U-joint flange in Assembly	0.010 – T.I.R.

ATTACHING TORQUE SPECIFICATIONS (INTEGRAL CARRIER) – WER

Description	Torque Ft. Lb.	Description	Torque Ft. Lb.
Differential Bearing Cup Bolt 8.7 inch	70-85	Rear Cover Screw and Washer Assemblies	25-35
		Oil Filler Plug	25-50
Differential Bearing Adjustment Nut Lock Bolts	12-25	Rear Axle Shaft Bearing Retainer Bolt Nuts	20-40
Ring Gear Attaching Bolts 8.7 inch ①	70-85		

① Using Loctite

LUBRICANT CAPACITIES AND CHECKING PROCEDURES (INTEGRAL CARRIER) – WER

Vehicle	Engine (C.I.D.)	Axle	U.S. Measure Capacity (Pints) ①	Imperial Capacity (Pints) ①
Ford, Mercury, Granada, Monarch	351, 400	8.7 Inch Ring Gear	4.0 ②	3-3/8 ②

① All conventional axles use ESW-M2C-105-A lubricant.
② Approximate refill capacity – actual lubricant capacities are determined by filling to 1/2 inch below bottom of filler plug hole.

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SPECIAL TOOLS

Tool Number	Description
T50T-100-A	Impact Slide Hammer
TOOL-1175-AC or TOOL-1175-AE	Grease Seal Remover (Use with Slide Hammer T50T-100-A)
T78P-1177-A	Axle Shaft Oil Seal Replacer
T60K-1177-B	Rear Wheel Bearing Oil Seal Replacer
T70P-4020-A	Pinion Depth Gauge Set
T75P-4020-A	Pinion Depth Gauge Set
T70P-4067-A	Differential Bearing Adjuster Wrench
TOOL-4201-C -4201-D	Differential Backlash and Runout Gauge, with Universal Bracket Dial Indicator and Bracket
T57L-4220-A	Differential Bearing Assembly Remover
T57L-4221-A	Differential Side Bearing Cone Replacer
TOOL-4221-C	Differential Side Bearings Remover
T70P-4221-A	Differential Side Bearings Remover
TOOL-4222-L	Differential Bearing Cones Replacer
TOOL-4222-H	Differential Bearing Cones Replacer
T66L-4234-A T71P-4234-A	Rear Axle Shaft Assembly Remover Adapter (Use with T50T-100-A)
TOOL-OTC-951	Pinion Rear Bearing Remover
T68P-4602-A	Pinion Angle Level Gauge
T68P-4602-AA	Frame

Tool Number	Description
T70P-4067-A	Differential Bearing Adjuster Nut Wrench
T68P-4602-AB	Vial
T68P-4602-AC	Magnet
TOOL-4615-G	Drive Pinion Front Bearing Cup Remover
T60K-4616-A	Pinion Bearing Cups Replacer (Inner and Outer)
T67P-4616-A	Pinion Bearing Cups Replacer
T53T-4621-C	Drive Pinion Bearing Installer
T62F-4621-A	Rear Wheel Bearing
T71P-4621-B	Remover and Installer
T77P-4676-B	Drive Pinion Oil Seal Replacers
T58L-4676-A	
T71P-4676-A	
T65L-4851-A	Flange (Universal Joint) Axle End Remover
TOOL-4851-K	Universal Joint Flange Holder
T68P 4946-A	Locking Differential Gauge (Traction-Lok Clutch Pack)
TOOL T78P-1225-A	Rear Axle Shaft Bearing Installer
TOOL T66L-12132-B	Thread Reducing Adapter

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DETROIT IRON

Integral Carrier Axle – Ford – (WGX)

PART 15-06

Applies To Fairmont/Zephyr

SUBJECT	PAGE
CLEANING AND INSPECTION	06-3
DESCRIPTION	06-1
MAJOR REPAIR OPERATIONS	
Differential Case and Drive Pinion	06-8
Differential Bearing Preload and Ring Gear Backlash Adjustment	06-11
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DESCRIPTION

The rear axle assembly (Fig. 1) is an integral type housing, hypoid gear design with the centerline of the pinion set below the centerline of the ring gear.

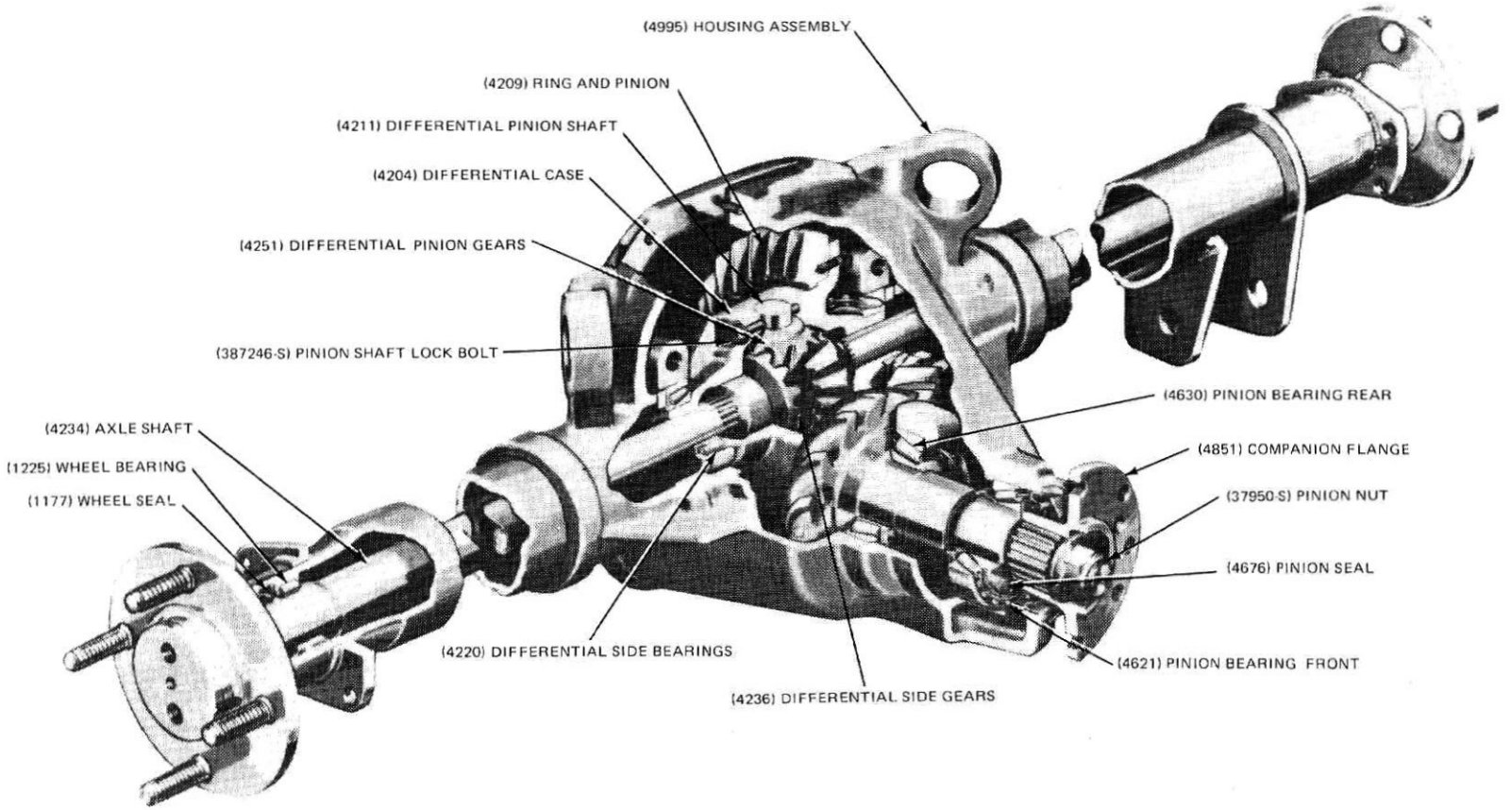
The hypoid gear set consists of a 7.5 inch diameter ring gear and an overhung drive pinion which is supported by two opposed tapered roller bearings. Pinion bearing preload is maintained by a collapsible spacer on the pinion shaft and adjusted by the pinion nut.

The housing assembly consists of a cast center section with integral cast suspension attaching 'ears', two steel tube assemblies and a stamped rear cover. The cover uses a silicone sealant rather than a gasket.

The differential case is a one-piece design with two openings to allow for assembly of the internal components and lubricant flow. The differential pinion shaft is retained with a threaded bolt assembled to the case. The differential case assembly is mounted in the carrier between two opposed tapered roller bearings. The bearings are retained in the carrier by removable bearing caps.

- **Differential Bearing Preload and Ring Gear Backlash are adjusted by the use of shims located between the Differential Bearing Cup/Races and the Carrier Housing.**
- **The use of a Hypoid Shim Gage in conjunction with a Differential Shim Gage is required for proper gear set adjustment.**
- **The Semi-Floating Axle Shafts are held in the Housing by C - washer locks positioned in a slot on the Axle Shaft Splined End. These C - washers also fit into a machined recess in the differential side gears within the differential case.**

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FIG. 1 Axle Assembly—WGX

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CLEANING AND INSPECTION

INSPECTION BEFORE DISASSEMBLY OF CARRIER

The differential case assembly and drive pinion should be inspected before they are removed from the carrier casting. These inspections can find the cause of the complaint and determine the resolution needed.

1. Wipe the lubricant from the internal working parts and visually inspect the parts for wear and/or damage.
2. Rotate the gears to see if there is any roughness which would indicate defective bearings or gears.
3. Check the ring gear teeth for signs of scoring, abnormal wear or nicks/chips.
4. Set up a dial indicator as shown in Figs. 31 and 32, and check ring gear backlash and ring gear backface runout. Refer to the specification section for allowable conditions.
5. Do not check for gear tooth contact pattern. A contact pattern is not an acceptable guide to check for noise. Proper gear set assembly must be checked using the pinion depth gage tool T76P-4020-A which shows correct pinion shim required to assure acceptable running condition. See section on Drive Pinion and Gear Set.

INSPECTION AFTER DISASSEMBLY

Thoroughly clean all parts. Always use new solvent when cleaning bearings. Do not spin dry bearing with compressed air. Oil the bearings immediately to prevent rusting. Inspect the parts for any major defects. Clean the inside of the housing before rebuilding. When a scored or chipped gear set is replaced, (4209), the axle housing must be washed thoroughly. Inspections of individual parts are outlined below.

GEARS

Examine the pinion and ring gear teeth for scoring, excessive wear, nicks and chipping. Worn, scored and damaged gears cannot be rebuilt to correct a noisy condition.

BEARING CUPS

Check bearing cups for deep scores, galling, or spalling. If a .0015" feeler gage can be inserted between a cup and the bottom of its bore at any point around the cup, the cup must be re-seated.

CONE & ROLLER ASSEMBLIES

When operated in the cups, bearing rollers must turn without roughness. Examine the roller ends for step wear. If inspection reveals either a damaged cup or a damaged cone and roller assembly, both parts should be replaced.

DRIVE PINION FLANGE

Be sure that the surfaces of the flange have not been damaged in removing the driveshaft or in removing the flange from the pinion. The end of the flange that contacts the bearing cone as well as the nut counterbore and seal surface must be smooth and free of nicks.

CARRIER HOUSING

Make sure that the differential bearing bores are smooth. Remove any nicks or burrs from the mounting surfaces of the carrier housing.

DIFFERENTIAL CASE

Make sure that the hubs where the bearings mount are smooth. Carefully examine the differential case bearing shoulders, which may have been damaged when the bearings were removed. The bearing assemblies will fail if they do not seat firmly against the shoulders. Check the fit (free rotation) of the differential side gears in their counterbores.

REMOVAL AND INSTALLATION

AXLE SHAFT REMOVAL

1. Raise vehicle to the desired working height, and remove the rear wheel and tire assembly. Remove the brake drums.
2. Clean all dirt from area of carrier cover with a wire brush and/or cloth.
3. Drain rear axle lubricant by **REMOVING THE HOUSING COVER.**
4. Remove differential pinion shaft lock screw and differential pinion shaft. (Fig. 2)

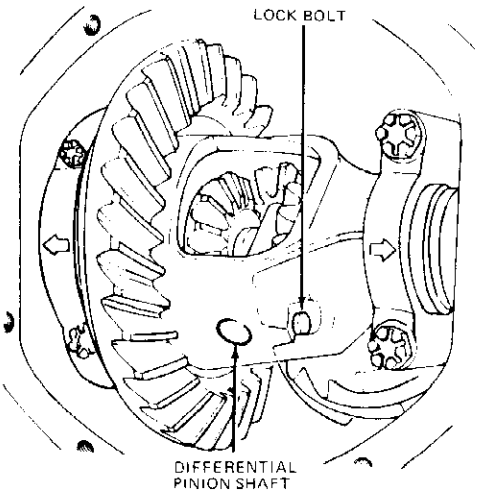
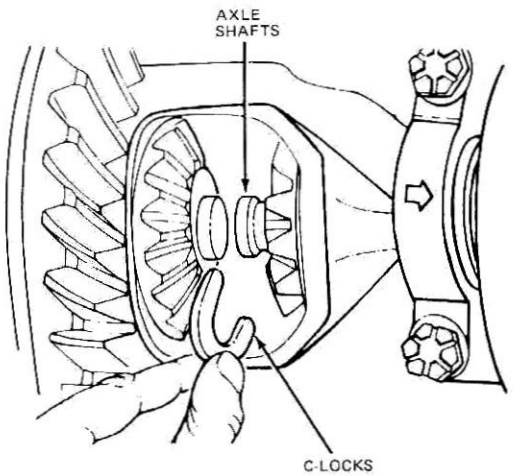


FIG. 2 Differential Pinion Shaft and Lock Bolt

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5. Push flanged end of the axle shafts toward the center of the vehicle and remove the C - lock from the button end of the axle shaft. (Fig. 3)
6. Remove axle shaft from the housing, being careful not to damage the oil seal.

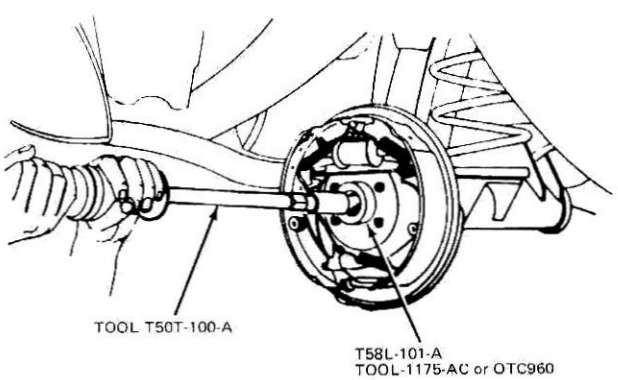


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FIG. 3 Removal and Installation of C-Locks and Axle Shafts

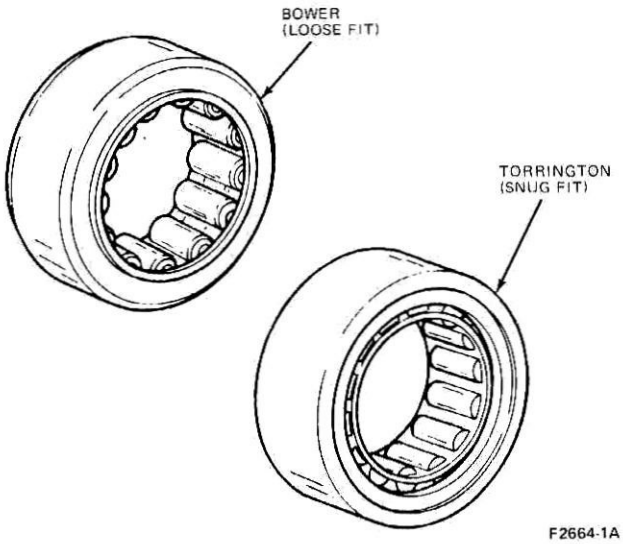
AXLE SHAFT SEAL AND/OR BEARING REPLACEMENT

1. Insert the tool shown in Fig. 4 in the bore and position it behind the bearing so that the tangs on the tool engage the bearing outer race. Remove the bearing and seal as a unit, using the slide hammer tool T50T-100-A as shown in Fig. 4.



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FIG. 4 Removal of Axle Seal or Bearing

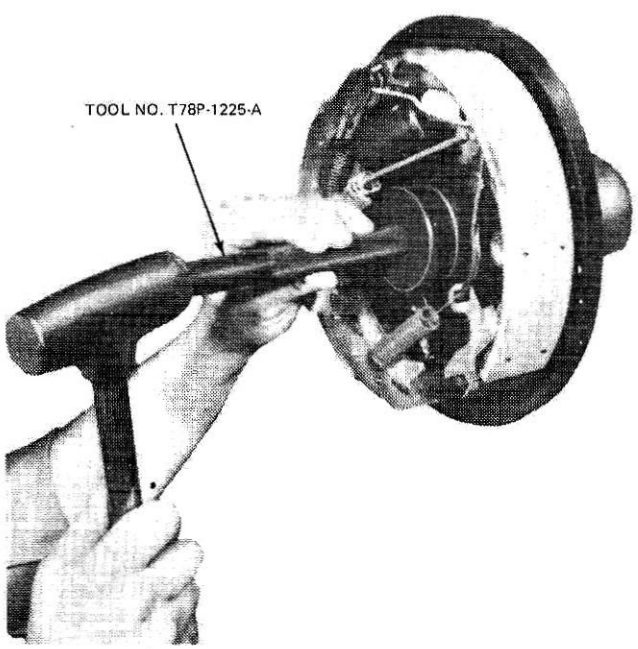


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FIG. 5 Bearing Assemblies

2. Lubricate the new bearing with rear axle lubricant and install the bearing into the housing bore using tool T78P-1225-A as shown in Fig. 6.

NOTE: TWO TYPES OF AXLE SHAFT BEARINGS ARE USED IN SERVICE. BOTH ARE ACCEPTABLE. SEE FIG. 5.



F2665-1A

FIG. 6 Installation of Wheel Bearing (1225)

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Install the axle shaft seal using tool T78P-1177-A as shown in Fig. 7.

NOTE: INSTALLATION OF THE BEARING OR SEAL ASSEMBLY WITHOUT THE PROPER TOOL MAY RESULT IN AN EARLY BEARING OR SEAL FAILURE. IF SEAL BECOMES COCKED IN THE BORE DURING INSTALLATION, REMOVE IT AND INSTALL A NEW ONE.

INSTALLATION

AXLE SHAFT

1. Carefully slide the axle shaft into the axle housing, without damaging bearing assembly. Start the splines into the side gear and push firmly until the button end of the axle shaft can be seen in the differential case.

   CAUTION: Care must be taken so as not to let the axle shaft splines damage the oil seal or bearing assembly.

2. Install the C - lock on the button end of the axle shaft splines, then push the shaft outboard until the shaft splines engage and the C - lock seats in the counterbore of the differential side gear.
3. Position the differential pinion shaft through the case and pinion gears, aligning the hole in the shaft with the lock screw hole. Install lock screw and torque to proper specifications. (Fig. 2)
4. Using silicone sealant #D6AZ-19562-B as shown in **Fig. 8,** install cover and torque bolts to proper specification.

   CAUTION: Make sure machined surfaces on both cover and carrier are clean before installing the new silicone sealant. Inside of axle must be covered when cleaning the machined surface to prevent axle contamination. Torque the cover bolts in a cross-wise pattern to insure uniform draw on cover.

   NOTE: COVER ASSEMBLY MUST BE INSTALLED WITHIN 15 MINUTES OF APPLICATION OF THE SILICONE OR NEW SEALANT MUST BE REAPPLIED.

REMOVAL AND REPLACEMENT OF PINION OIL SEAL

Replacement of the pionion oil seal involves removal and installation of only the pinion shaft nut and the companion flange.

CAUTION: However, this operation disturbs the pinion bearing preload, and this preload must be carefully reset when assembling.

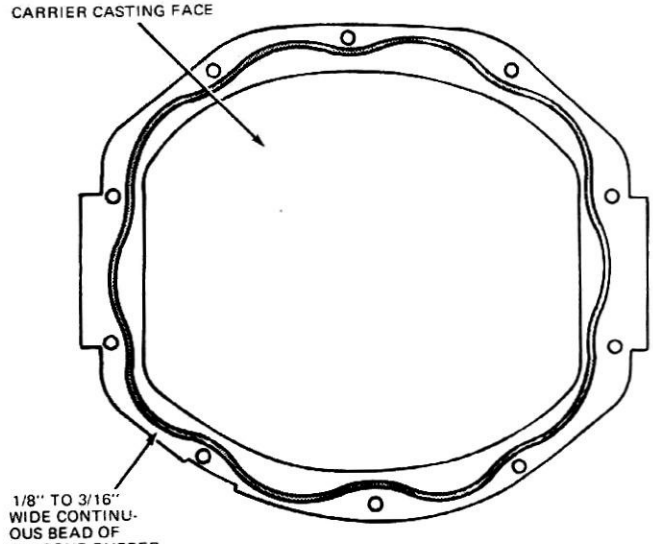
1. Raise the car and install safety stands. Remove the rear wheels and brake drums.
2. Make scribe marks on the driveshaft axle end yoke and the axle companion flange to insure proper position of the driveshaft at assembly (Fig. 9). Disconnect the driveshaft from the rear axle companion flange. Remove the driveshaft from the



INSTALLATION OF WHEEL BEARING SEAL (1177)

F2666-1A

FIG. 7 Installation of Wheel Bearing Seal (1177)



TYPICAL BEAD INSTALLATION. PARTS MUST BE ASSEMBLED WITHIN 1/4 HOUR AFTER APPLICATION OF SEALANT. GASKET SURFACE OF HOUSING AND CARRIER MUST BE FREE OF OIL.

F2667 1A

FIG. 8 Installing Gasket

transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent oil leakage.

3. Install an inch pound torque wrench on the pinion nut. Record the torque required to maintain rotation of the pinion through several revolutions (Fig. 10).
4. While holding the companion flange with tool T78P-4851-A, remove the pinion nut. (Fig. 11)

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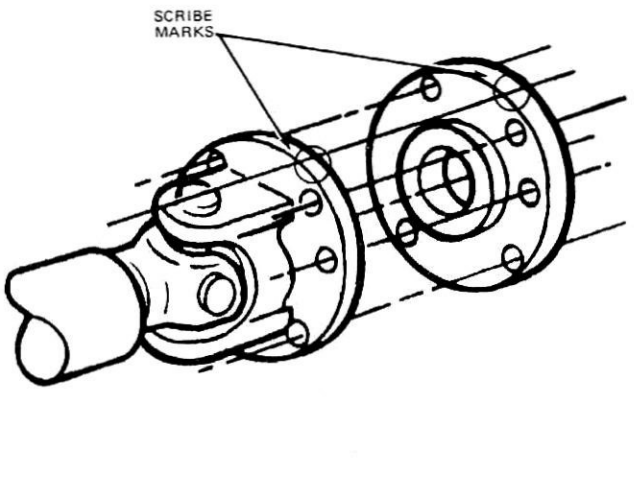


FIG. 9 Drive Shaft to Axle U-Joint Connection

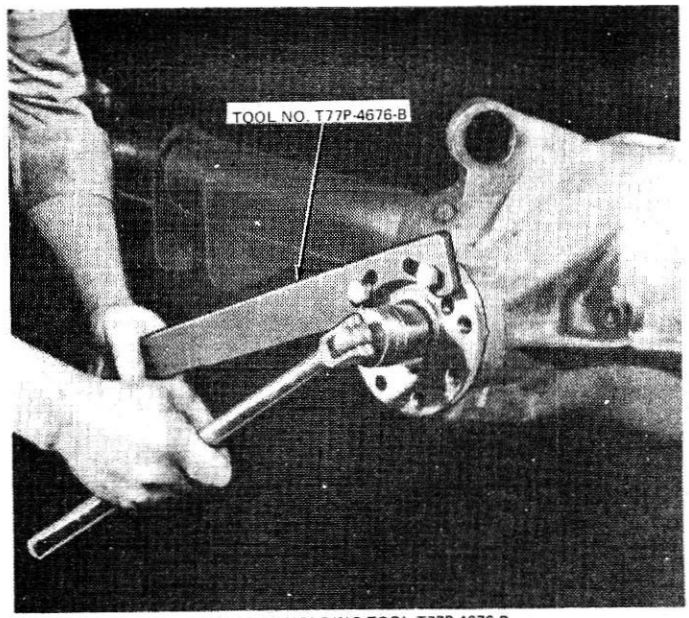


FIG. 11 Companion Flange Holding Tool T77P-4676-B

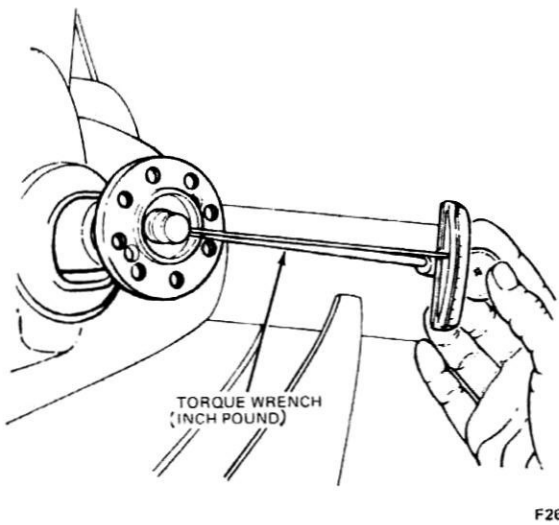


FIG. 10 Checking Pinion Bearing Preload

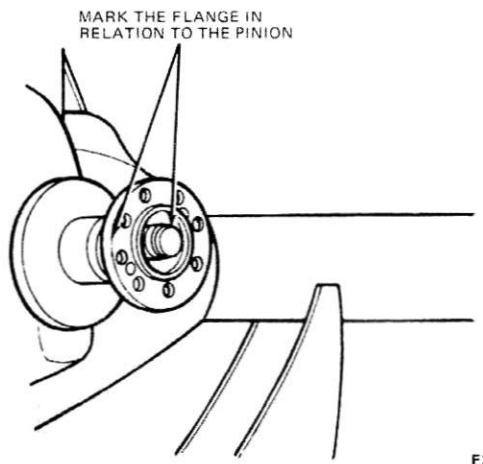


FIG. 12 Marking Flange

5. Clean the area around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear.
6. Mark the companion flange in relation to pinion shaft so flange can be reinstalled in the same position. (Fig. 12)
7. Using tool T78P-4851-A remove the rear axle companion flange. (Fig. 13)
8. Using tool shown in **Fig. 14**, tap out the pinion seal.
9. Clean the oil seal seat surface.
10. Install the seal in the carrier using tool T77P-4676-B. (Fig. 15)

CAUTION: Installation without the proper tool may result in early seal failure. If seal becomes cocked during installation, remove it and install new one.

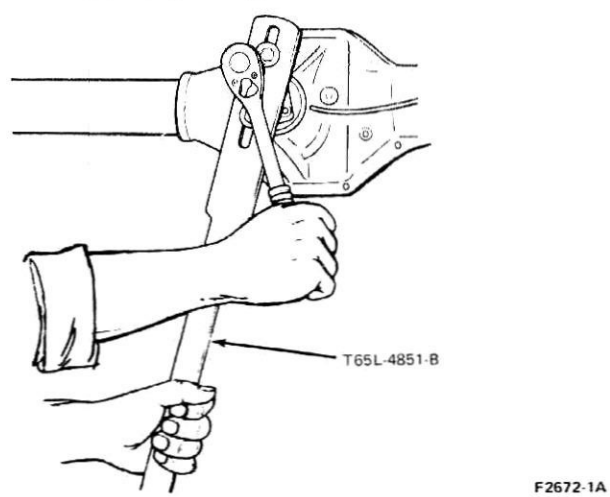


FIG. 13 Typical Drive Pinion Flange Removal

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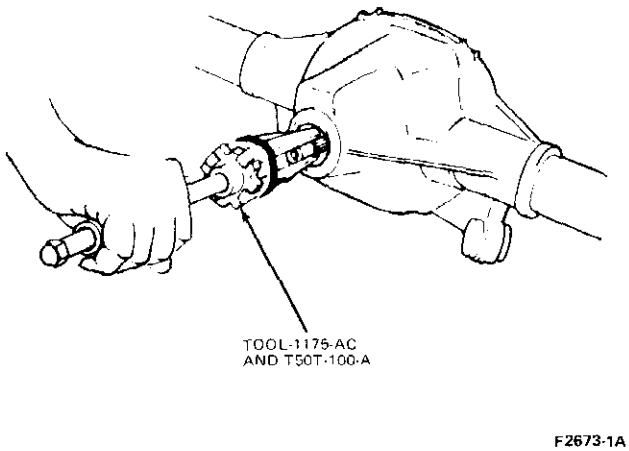


FIG. 14 Removing Pinion Seal

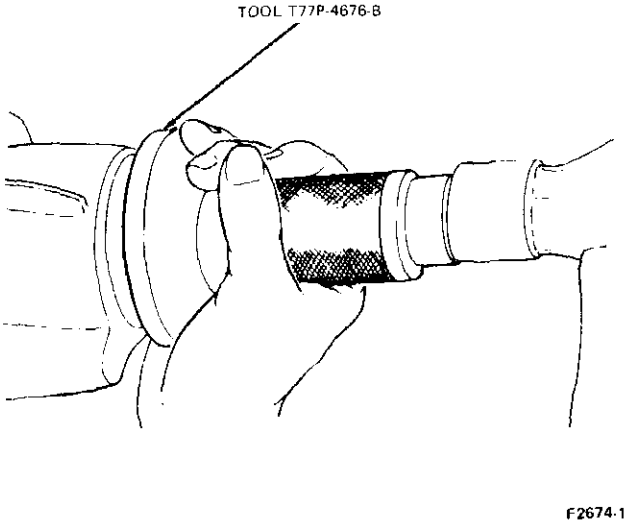


FIG. 15 Pinion Seal Installation

11. Check splines on the pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in a rotational motion. Wipe the pinion clean.
12. Apply a small amount of lubricant to the companion flange splines.
13. Align the mark on the companion flange with the mark on the pinion shaft.
14. Install a new integral nut and washer on the pinion shaft (apply a small amount of lubricant on the washer side of the nut).
15. Hold the companion flange with tool T78P-4851-A while tightening the nut (Fig. 13).
16. *Tighten the pinion nut; rotating the pinion occasionally to insure proper bearing seating. Also, take frequent pinion bearing torque preload readings until the original recorded preload reading is obtained.*
17. If the original recorded preload is less than specification, tighten to specification. If the preload is higher than specification, tighten to original reading as recorded.

    Under no circumstances should the pinion nut be backed off to reduce preload. If reduced preload is required, a new collapsible pinion spacer and pinion nut must be installed. In addition, the companion flange must never be hammered on, or assembled with power tools.
18. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the driveshaft on the transmission output shaft.
19. Connect the rear end of the driveshaft to the axle companion flange, aligning the scribe marks on the driveshaft and rear axle companion flange.

    NOTE: NEW REAR AXLE TO DRIVESHAFT ATTACHING BOLTS AND NUTS MUST BE USED FOR PROPER INSTALLATION: REFER TO PART 15-60 FOR THE SERVICE BOLTS, NUTS AND TORQUE SPECIFICATIONS.
20. Add lubricant until 1-1/4" from the bottom of the filler hole with the axle in running position. **Do Not Exceed This Level.** Refer to the Specification section under Lubricant Level Checking Procedure.

INSTALLATION OF NEW COMPANION FLANGE

Follow procedures as outlined under Pinion Oil Seal Replacement except install a new companion flange.

NOTE: THE COMPANION FLANGE NEED NOT BE MARKED IN RELATION TO THE PINION SHAFT WHEN INSTALLING A NEW FLANGE.

AXLE HOUSING

Removal

1. Raise the vehicle on a hoist, position safety stands under the rear frame crossmember.
2. *Drain the lubricant from the axle by removing the* cover.
3. Remove the wheels and brake drums.
4. Remove lock pin from the pinion shaft and remove the shaft. (Fig. 2)
5. Push the axle shafts inward to remove "C" locks. (Fig. 3)
6. Remove the axle shafts.
7. Remove the four retaining nuts from each backing plate and wire the backing plate to underbody.
8. Disconnect the driveshaft at the companion flange and wire it to the underbody.
9. Support the axle housing with jack stands or a hoist.
10. Disengage the brake line from the clips that retain the line to the axle housing.

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11. Disconnect the vent from the rear axle housing.

NOTE: THE AXLE VENT IS SECURED TO THE HOUSING ASSEMBLY THROUGH THE BRAKE JUNCTION BLOCK. AT ASSEMBLY, LOCTITE OR EQUIVALENT IS APPLIED TO THE THREAD TO INSURE RETENTION. UPON INSTALLATION, LOCTITE COMPOUND PART NUMBER C3AZ-19554-A OR EQUIVALENT MUST BE REAPPLIED.

12. Disconnect the lower shock absorber studs from the mounting brackets on the axle housing. (Fig. 16)
13. Remove the retaining nut and bolts and disconnect the upper arms from the mountings on the axle housing ear brackets. (Fig. 16)
14. Lower the axle housing assembly until the coil springs are released. Lift out the coil springs.
15. Remove the nuts, and bolts that connect the suspension lower arms to the axle housing. Disconnect both arms from the axle housing. (Fig. 16)
16. Lower the axle housing and remove it from the car.

Installation

1. Transfer all components from the old housing to the new housing and make the necessary adjustments to backlash and preload. Install the axle vent.
2. Transfer the axle shaft bearings from the old to the new axle housing. Install two new wheel seals with tools shown in Figs. 6 and 7.
3. Position the new axle housing under the vehicle and raise the axle with a hoist or jack. Connect the suspension lower arms to their mounting brackets on the axle housing. (Do not tighten the bolts and nuts at this point).
4. Position the rear coil springs in the area provided.
5. Raise the housing into position.
6. Connect the upper arms to the mounting ears on the housing. Install the bolts and retaining nuts, and torque to specification. Torque all attaching bolts to specification.
7. Position the brake lines to the axle housing and secure with the retaining clips.
8. Install the brake backing plates on the axle housing flanges (no gaskets required).
9. Connect the lower shock absorber studs to the mounting bracket on the axle housing. Install the attaching nuts and torque to specification. (Fig. 16).
10. Connect the driveshaft to the companion flange, install the **new service bolts and nuts** and torque to specification. (Fig. 9).
11. Slide the rear axle shafts into the housing until the splines enter the side gear.

CAUTION: Do not damage wheel bearing seal.

12. Push the axle shafts at the flange inward, and install the C - lock at the end of each shaft spline. Pull the shafts outboard until each C - lock enters the recess in the side gears. (Fig. 3)
13. Install the pinion shaft and the pinion shaft lock bolt. Torque to specification. (Fig. 2)
14. Install the rear brake drums.
15. Install the wheels and tires.
16. Install the carrier cover using the new silicone sealant gasket material and torque to specification. (Fig. 8)
17. Fill the axle to 1-1/4" below the bottom of the filler hole with the specified lubricant. Be sure that the axle is in its operating position.
18. Road test the vehicle.

MAJOR REPAIR OPERATIONS

Disassembly: All service operations on the differential case assembly and the drive pinion assembly can be performed with the axle housing in the car.

DIFFERENTIAL CASE AND DRIVE PINION REMOVAL

1. Raise the vehicle and place jack stands under the rear frame crossmember. Lower the hoist so that the axle drops down far enough for working ease.
2. Remove the cover from the carrier casting rear face and drain the lubricant.
3. **Perform the Inspection Before Disassembly** — Refer to the section under Cleaning and Inspection.
4. Remove the rear wheels and brake drums.
5. Working through the cover opening remove the pinion shaft lock bolt and remove the pinion shaft and pinion gears. (Fig. 2)
6. Push the axle shaft inward until the C-locks at the button end of the shaft are clear of the side gear recess. (Fig. 3)
7. Remove the C-locks and pull the axle shafts out of the housing. (Fig. 3)

CAUTION: Care should be taken not to damage the wheel seals when removing the axle shafts from the axle housing. In addition, the axle shafts should be completely removed from the axle housing.

8. Make scribe marks on the driveshaft and yoke and the rear axle companion flange to insure proper alignment at assembly. Disconnect the driveshaft from the rear axle companion flange. (Fig. 9) Remove the driveshaft assembly from the vehicle. Insert an oil seal replacement tool in the transmission extension housing to prevent leakage.
9. Mark one differential bearing cap to help position the caps properly during assembly. (Fig. 17)
10. Loosen the differential bearing cap bolts and bearing caps. (**NOTE:** The direction of arrows on bearing caps must be noted. When re-assembled the arrows must be pointing in the same direction as before removal.)
11. Pry the differential case, bearing cups and shims out until they are loose in the bearing caps. (Fig. 18) Remove the bearing caps & remove the differential assembly out of the carrier.
12. Mark the companion flange in relation to the pinion shaft. Hold the rear axle companion flange with the proper tool and remove the pinion nut (Fig. 12). If a new gear set (4209) is being installed, the companion flange need not be marked.

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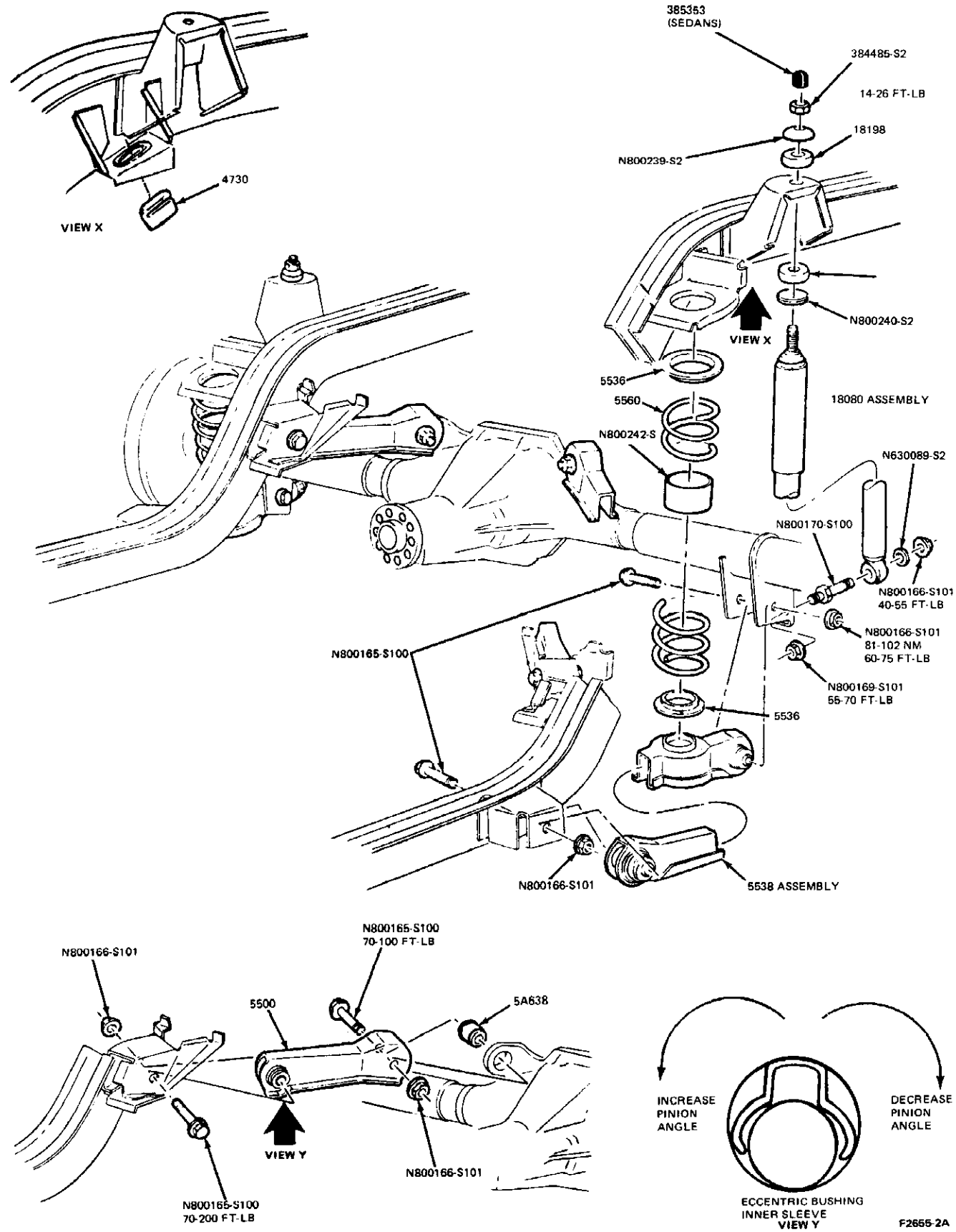


FIG. 16 Rear Suspension—Fairmont/Zephyr

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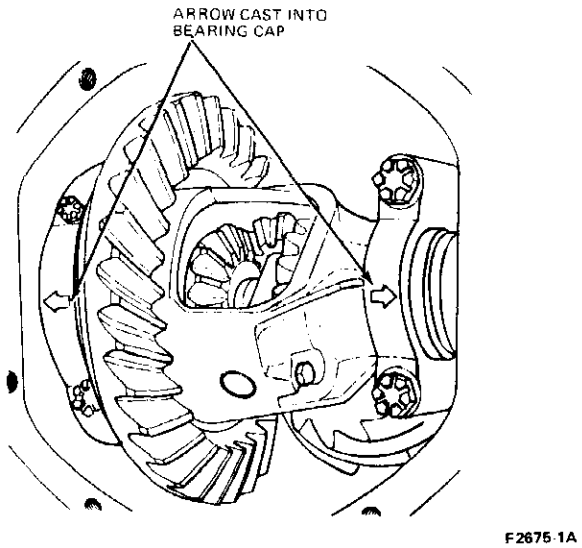


FIG. 17 Differential Bearing Cap Markings

13. Remove the companion flange with the tool shown in Figure 13.
14. With a soft-faced hammer, drive the pinion out of the front bearing cone and remove it through the *rear of the carrier casting*.
15. Remove the drive pinion oil seal with the tool shown in Figure 14. Remove the front pinion bearing cone and roller from the carrier casting.
16. To remove and install the pinion rear cone and roller assembly, use the tools shown in Fig. 19 and 20.
17. Measure the shim, which is found under the bearing cone, with a micrometer and record the thickness.

PINION BEARING CUPS

NOTE: DO NOT REMOVE THE PINION BEARING CUPS FROM THE CARRIER CASTING UNLESS THE CUPS ARE DAMAGED.

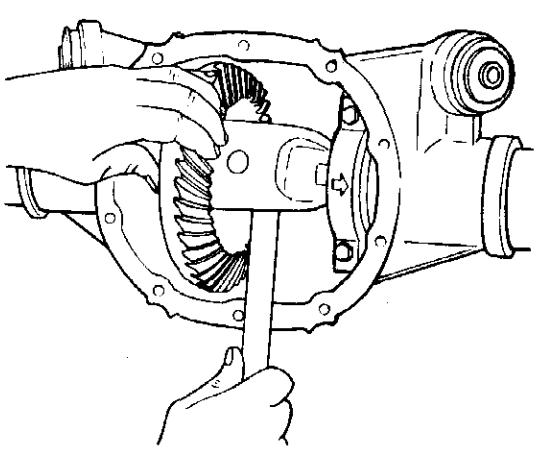


FIG. 18 Removing Carrier

If the pinion bearing cups are to be replaced, tap alternately (with a brass drift of suitable length) on the opposite side of the cups during removal to prevent cups from cocking in the casting.

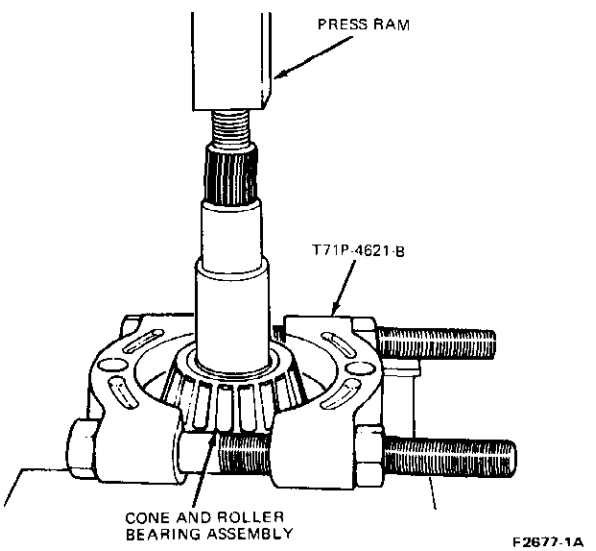


FIG. 19 Pinion Rear Bearing Removal

Install the new cups with the tool shown in Fig. 21. *Make sure the cups are properly seated in their bores.* If a .0015 inch feeler gauge can be inserted between a cup and the bottom of its bore at any point around the cup, the cup is not properly seated. Whenever the cups are replaced, the cone and roller assembly should also be replaced.

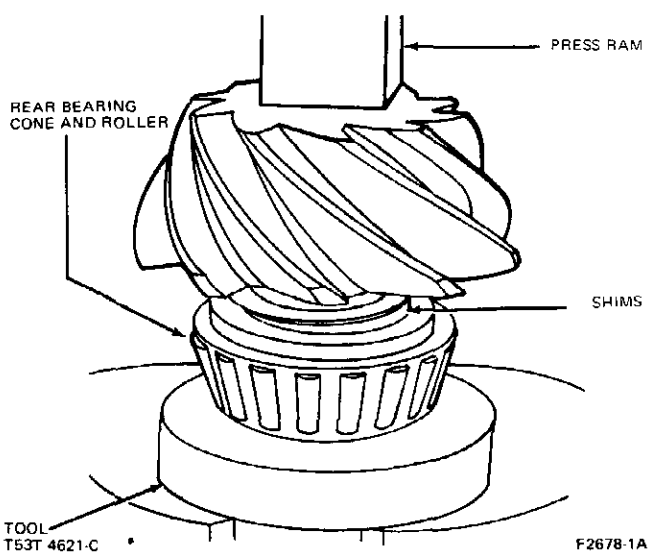


FIG. 20 Drive Pinion Bearing Installation

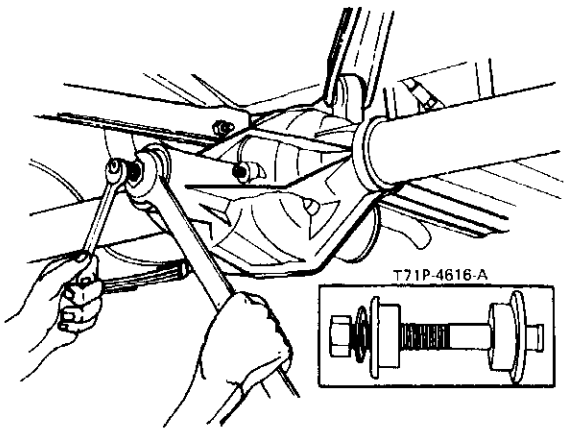
DIFFERENTIAL CASE BEARINGS AND RING GEAR

If the ring gear runout check (before disassembly) exceeds specification, the condition may be caused by a warped ring gear, a damaged case, or excessively worn differential bearings. To determine the cause of excessive runout proceed as follows:

1. Remove the bolts that attach the ring gear to the differential case. Press the ring gear from the case or tap it off with a soft-faced hammer.

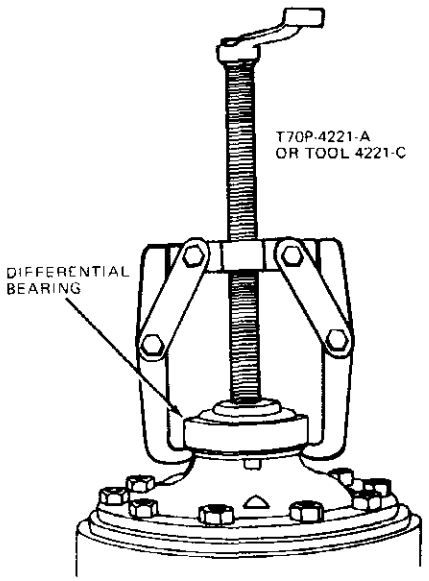
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F2679-1A

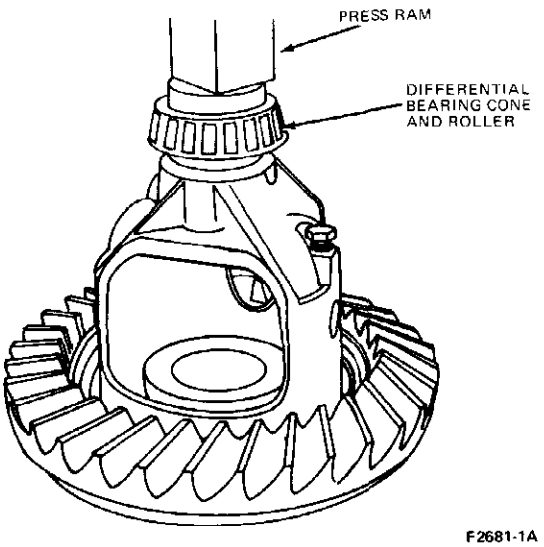
FIG. 21 Pinion Bearing Cup Installation



F2680-1A

FIG. 22 Differential Bearing Removal

2. Place the differential bearing cups on the differential bearing cone and roller and place the differential assembly in the carrier casting.
3. Install the differential gauge disc .200 in. thick on left side (T78P-4136-B1) and .300 in. thick (T78P-4136-B2) on the right side and bearing caps (match the marks on caps before removal).
4. Torque the bearing cap bolts to 15-20 ft-lb. Install tool T78P-4136-A adjuster into the left axle shaft tube and torque to 30 in-lb. (Figs. 25 and 26)
5. Rotate the differential case several revolutions in each direction while the bearings are loaded to insure proper seating (This step is important)
6. Check the runout of the differential case flange with a dial indicator. If the runout is within specification, install a new ring and pinion gear. If the runout exceeds specification, the ring gear is true and the trouble is due to either a damaged case or worn bearings.
7. Remove the differential case from the carrier and remove the differential bearings from the case (Fig. 22).
8. Install **new** differential bearings on the case hubs and install the differential assembly in the carrier **without** the ring gear (Fig. 23).
9. Check the case runout again with the new bearings. If the runout is **now** within limits, use the new bearings for assembly. If the runout is still excessive, the case is damaged and should be replaced.



F2681-1A

FIG. 23 Differential Bearing Installation



F2682-1A

FIG. 24 Positioning Preload Disc

DIFFERENTIAL BEARING PRELOAD AND RING GEAR BACKLASH ADJUSTMENT

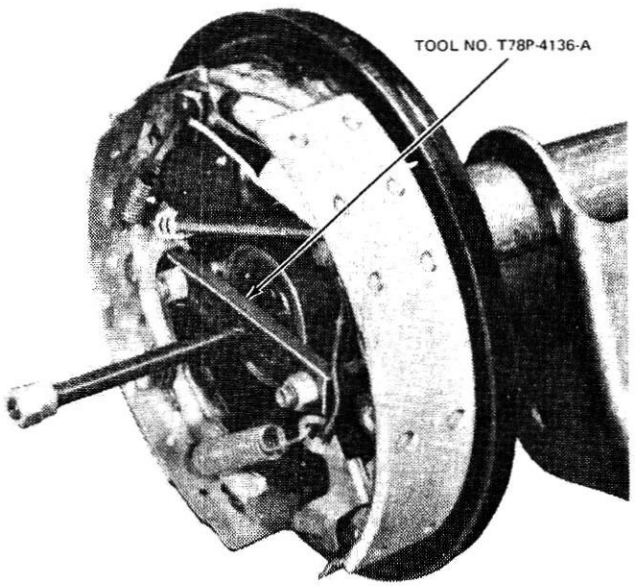
Assembly of Differential Case into Housing

1. With the pinion gear installed as outlined under Drive Pinion and Gear Set Installation procedure, place the differential assembly into the carrier bores. Install one (1) T78P-4136-B1 .200 gauge disc spacer in the ring gear side (L.H.) between

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bearing cup and case (Fig. 24). Install the T78P-4136-B2 .300 gauge disc spacer on the pinion gear side (R.H.). Install the bearing caps and torque to 30 in-lb.

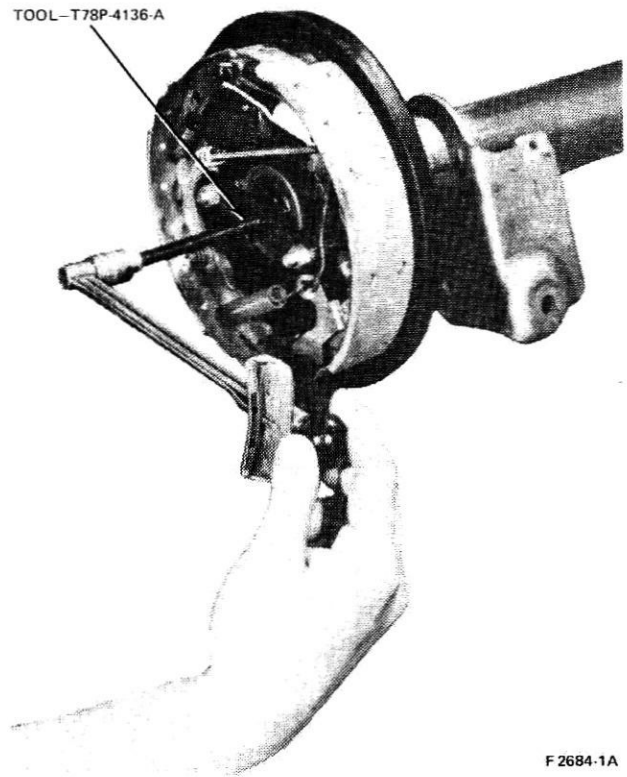
NOTE: BEARING CAPS TO BE INSTALLED WITH ARROWS IN THE SAME DIRECTION AS THEY WERE WHEN REMOVED.



F2683-1A

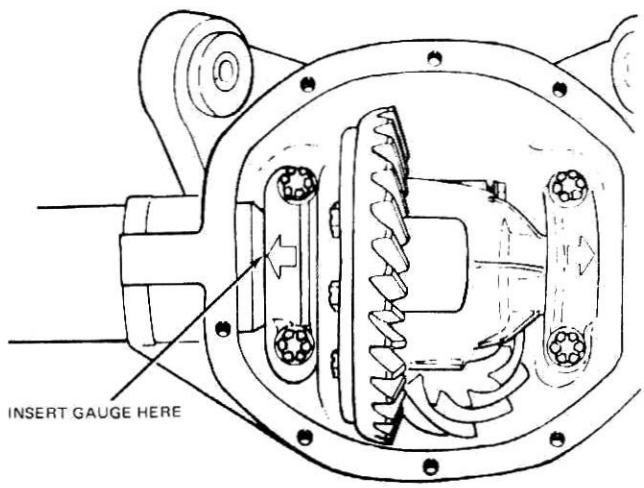
FIG. 25 Installation of Carrier Adjustment Tool

2. Install the T78P-4135-A adjuster rod into the ring gear side (L.H.) of the axle tube. Torque the adjuster nut to 40 in-lb. (Figs. 25 and 26). This moves the differential assembly all the way towards the pinion gear side (R.H.). Rotate the ring gear several revolutions to insure proper seating on the differential bearings. Re-check the torque on the adjuster rod, it must read 40 in-lb.
3. Using a feeler gauge tool, select the thickest feeler blade that will enter between the gauge disc and the carrier bore ring gear side (L.H.) Fig. 27) The feeler gauge fit should be a slight drag-type feel. Record the feeler gauge thickness.
4. Add .500 in. to the feeler gauge recorded reading. (See example in step 11)
5. Back the adjuster rod sufficiently to allow removal of the .300 in. gauge disc spacer.
6. Remove the right bearing cap and remove the T78P-4136-B2 .300 in. gauge disc spacer.
7. Install the bearing preload spacer disc **T78-4135-B3** into the pinion gear side (R.H.) between the bearing cup and carrier bore (Fig. 28).
8. Install the bearing cap and torque the bearing cap bolts to 30 in-lb. Cap to be installed with arrow pointing outboard.
9. Use a back and forth motion of the ring gear using your right hand, while tightening the rod with the left hand until zero backlash is obtained.



F2684-1A

FIG. 26 Torquing the Carrier Adjustment Tool to 40 In.-Lb.

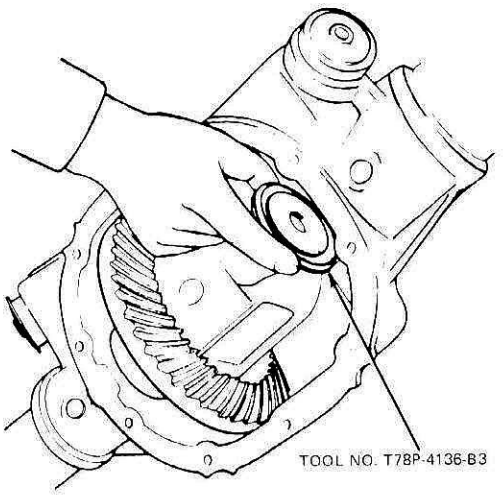


F2685-1A

FIG. 27 Inserting Feeler Gauge

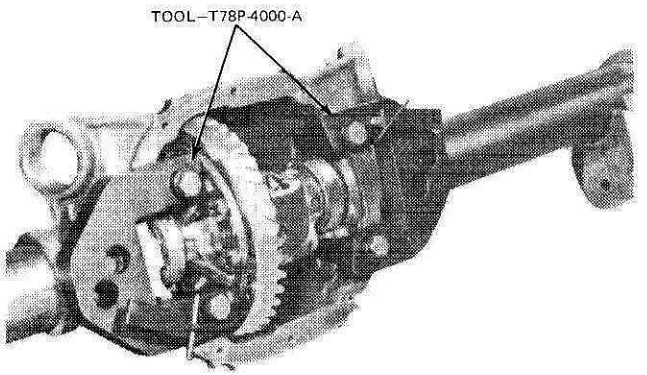
10. Using a feeler gauge tool, select the thickest feeler blade that will enter between the gauge disc and the carrier bore ring gear side (L.H.), (Fig 27). The feeler gauge fit should be a slight drag-type feel. Record the feeler gauge reading.
11. Add .200 in. to the feeler gauge recorded reading. See example below. The left shim thickness is the total reading minus .008 in., then subtract the total of the .200 in. plus the feeler gauge reading in Step 11 from Step 4 and add .016 in. to obtain the thickness for the pinion gear side (R.H.) shim.

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F2686-1A

FIG. 28 Installation of Differential Bearing Preload Disc



F2687-1A

FIG. 29 Installation of Differential Carrier Spreader Adapters

EXAMPLE —

Step 4 — Feeler Gauge Reading	.040 in.
Add	.500 in.
Total Clearance	.540 in.

EXAMPLE —

Step 11 — Feeler Gauge Reading	.086 in.
Plus	.200 in.
Total	.286 in.
Ring Gear Side Shim L.H.	.286 in.
Subtract	.008 in.
Correct Shim Size Ring Gear Side (L.H.) (Fig. 28)	.278 in.

Total Clearance	.540 in.
	Obtained in Step 4
Subtract Ring Gear Side L.H.	.286 in.
	Obtained in Step 11
	.245 in.
Add	.016 in.
CORRECT SHIM SIZE PINION GEAR SIDE (R.H.) (Fig. 33)	.270 in.

12 Remove the adjuster rod tool T78P-4136-A from the housing assembly.

13. Remove the bearing caps — two (2).

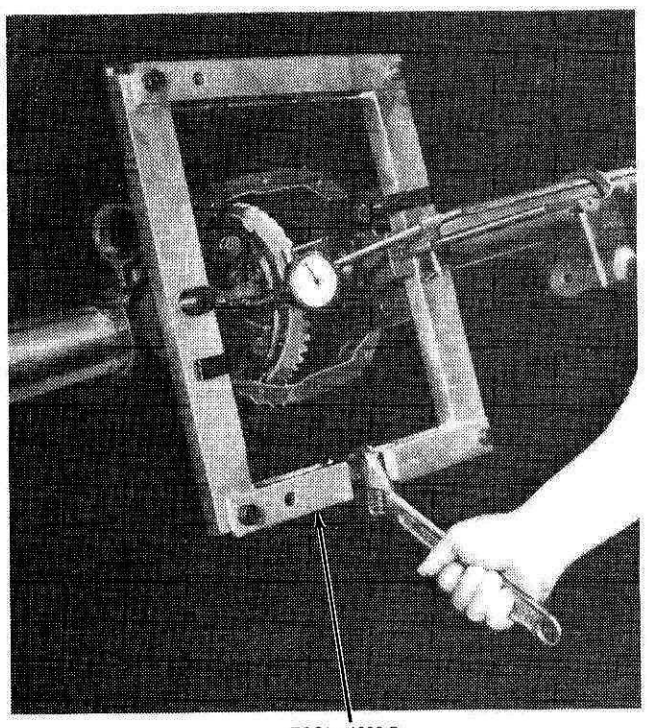
14. Remove the .200 in. gauge disc spacer tool T78P-4136-B1 and the bearing preload spacer disc T78P-4136-B3.

15. Install the carrier spreader adapters T78/-4000-A and spreader tool T78P-4000-E as shown in Figures 29 and 30.

16. Install a dial indicator (Tool 4201-C) to determine the housing spread as shown in Fig. 30.

17. Spread the housing to a value of .016 in. Do not exceed this dimension at the top of the case opening. Remove the dial indicator.

18. Install the shim on the ring gear side (L.H.) as determined in Step 11 and push the differential case and bearing cup as far left as possible.



F2688-1A

FIG. 30 Spreading the Differential Carrier

19. Install the shim on the pinion gear side (R.H.) as determined in Step 11. Use a plastic hammer and tap the shim in until it is seated.

20. Release the spreader and remove it from the housing.

21. Install the bearing caps and torque them to specification (70-85 ft-lb.) making sure that the punch marks are aligned.

NOTE: CAP ARROWS TO BE POINTED OUTBOARD.

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22. Determine backlash readings at service teeth around the ring gear. (Specification .008-.012). However, the variance of the readings must not exceed .004 (Fig. 31).

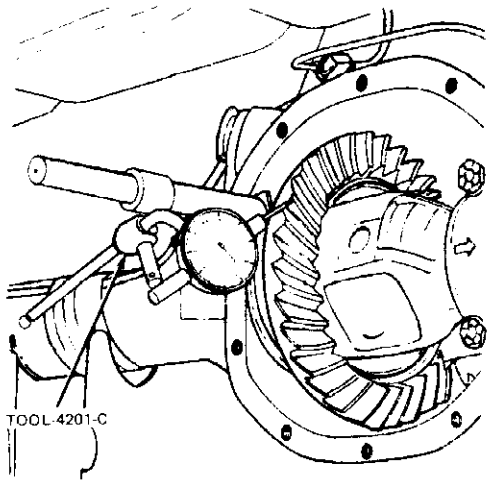


FIG. 31 Checking Ring and Pinion Gear Backlash

23. Install the pinion side gears and thrust washers. Install axle shaft O-rings on the axle shafts.
24. Slide the axle shafts into place in the axle housing. Exercise care so that the splines or any portion of the axle shafts do not damage the oil seals.
25. Install the axle shaft C-locks on the inner end of the axle shafts and push the shafts outward so that the shaft lock seats in the counterbore of the differential side gear. (Fig. 3).
26. Position the pinion differential gears and thrust washers 180° apart to the differential side gears. Turn the gear assembly until the holes in the differential case are aligned with the pinion gears.
27. Position the differential pinion shaft through the case and pinions, aligning the hole in the shaft with the lock bolt hole. Tighten the lock bolt to specification. (Fig. 2).

    Clean the gasket mounting surface of the rear axle housing and cover. Install a new bead of silicone sealant and install the cover and attach bolts. Torque the bolts to specification (Fig. 8).
28. Remove the oil seal replacer from the transmission extension housing. Install the driveshaft in the extension housing. Align the scribe marks on the flange and driveshaft and connect the driveshaft at the drive pinion flange. Torque the attaching bolts to specification (Fig. 9).
29. Install the brake drum and attaching shakeproof retainers.
30. Install the wheel and tire on the brake drum. Install the wheel covers.

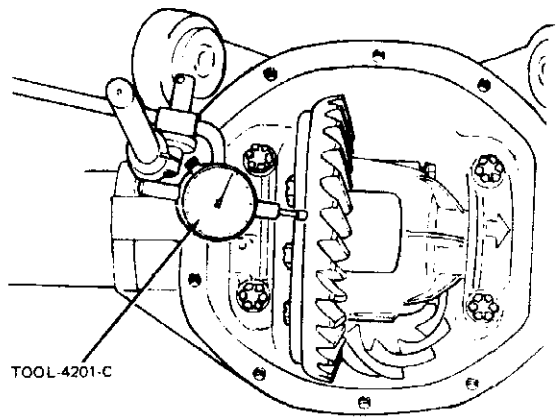


FIG. 32 Checking Ring Gear Runout

31. Add the amount of specified lubricant to rear axle. **Make sure the rear axle is in the running position. Install the filler plug and torque it to specification.**

    NOTE: REFER TO THE SPECIFICATION SECTION UNDER LUBRICANT CHECKING PROCEDURE FOR THE SPECIFICATION.
32. Lower the vehicle.

DRIVE PINION AND GEAR SET

Individual differences in machining the carrier casting and the gear set and variation in bearing widths require a shim between the pinion rear bearing and pinion head, in order to locate the pinion for correct tooth contact with the ring gear. To adjust the shim pack to the correct thickness for a given gear set, each service pinion gear is marked with an adjustment number such as **+2 or −1.** When replacing a ring and pinion gear the correct shim thickness for the new gear set to be installed, is determined by following procedure using tool T76P-4020-A.

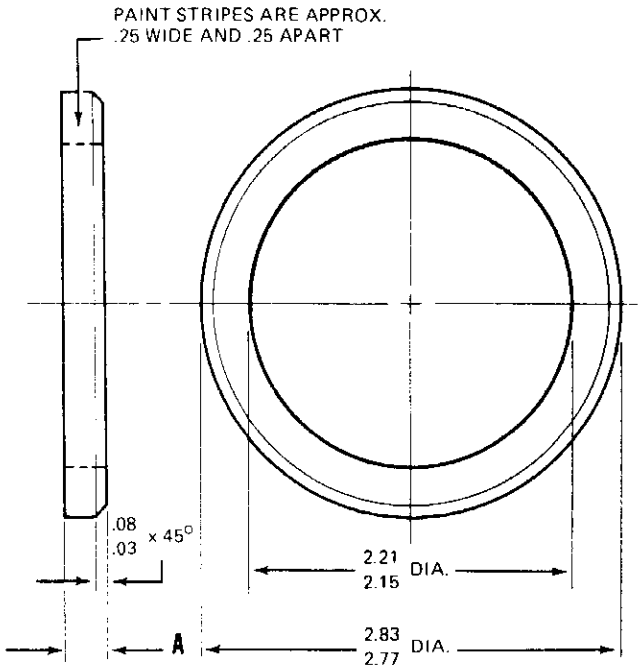
PROCEDURE USING TOOL T76P-4020-A

1. Refer to Fig. 34 and, assemble the appropriate aligning adapter, gauge disc and gauge block to the screw.
2. Place the rear pinion bearing (new, or used if in good condition) over the aligining disc and insert into the pinion bearing cup of the carrier. Place the front bearing into the bearing cap and assemble the tool handle into the screw and tighten to 20 ft-lb.

    NOTE: THE GAUGE BLOCK MUST BE OFF-SET (FIG. 35) TO OBTAIN AN ACCURATE READING.

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NUMBER OF STRIPES AND COLOR CODE	PART NO. SUFFIX (BASIC PART NO. OF D8BW-4067-)	DIM. A
5 – BLU	AH1A/AH2A	.3030 – .3035
4 – BLU	AG1A/AG2A	.3010 – .3015
3 – BLU	AF1A/AG2A	.2990 – .2995
2 – BLU	AE1A/AE2A	.2970 – .2975
5 – PINK	AC1A/AC2A	.2930 – .2935
4 – PINK	AB1A/AB2A	.2910 – .2915
3 – PINK	AA1A/AA2A	.2890 – .2895
2 – PINK	Z1A/Z2A	.2870 – .2875
1 – PINK	Y1A/Y2A	.2850 – .2855
5 – GRN	X1A/X2A	.2830 – .2835
4 – GRN	V1A/V2A	.2810 – .2815
3 – GRN	U1A/U2A	.2790 – .2795
2 – GRN	T1A/T2A	.2770 – .2775
1 – GRN	S1A/S2A	.2750 – .2755
5 – WH	R1A/R2A	.2730 – .2735
4 – WH	P1A/P2A	.2710 – .2715
3 – WH	N1A/N2A	.2690 – .2695
2 – WH	M1A/M2A	.2670 – .2675
1 – WH	L1A/L2A	.2650 – .2655
5 – YEL	K1A/K2A	.2630 – .2635
4 – YEL	J1A/J2A	.2610 – .2615
3 – YEL	H1A/H2A	.2590 – .2595
2 – YEL	G1A/G2A	.2570 – .2575
1 – YEL	F1A/F2A	.2550 – .2555
5 – ORNG	E1A/E2A	.2530 – .2535
4 – ORNG	D1A/D2A	.2510 – .2515
3 – ORNG	C1A/C2A	.2490 – .2495
2 – ORNG	B1A/B2A	.2470 – .2475
1 – ORNG	A1A/A2A	.2450 – .2455

CF2691-2A

FIG. 33 Shim Sizes Chart—Differential Side

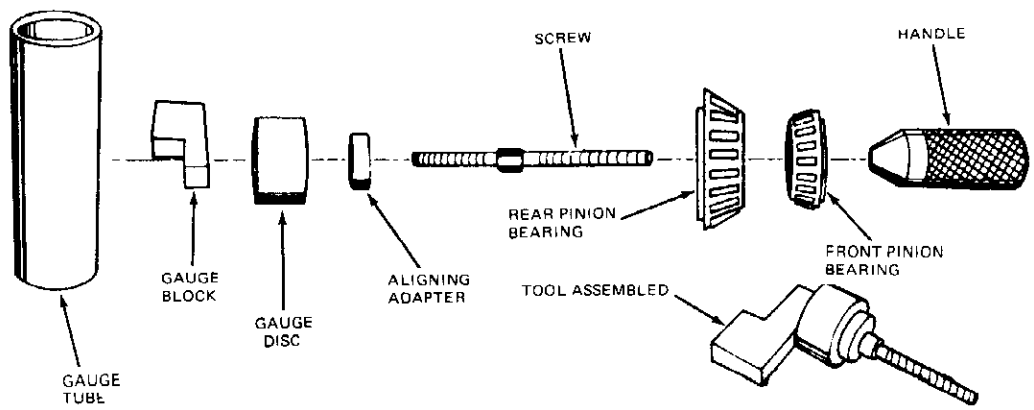


CHART 1

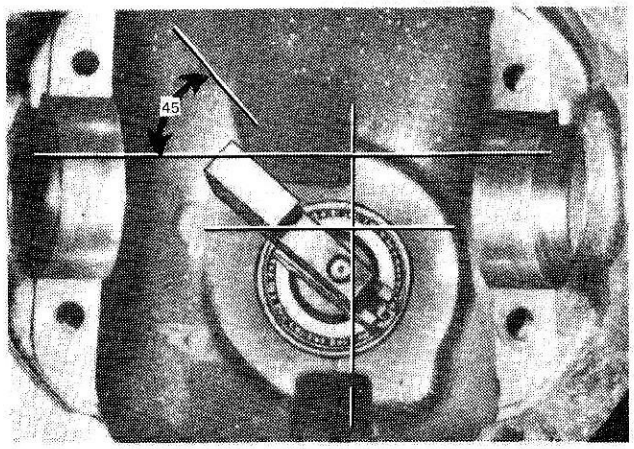
Dash Number	Description	Integral Carriers 6.75"	8.5"	8.7"	7.6"
–A1	Aligning Adapter (1.300 O. D.)	X			
–A3	Aligning Adapter (1.612 O. D.)		X	X	X
–A4	Gauge Disc. (.458 thick)	X			
–A6	Gauge Disc (1.314 thick)		X	X	
–A9	Screw	X	X	X	X
–A10	Gauge Block (1.700 thick)	X	X	X	X
–A11	Handle	X	X	X	X
T78P-4020-A	Gauge Disc (.894 thick)				X

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FIG. 34 Rear Axle Pinion Depth Gauge Tool

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T76P-4020-A11



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FIG. 35 Installation of Pinion Depth Gauge Block in 7.5 Axle

3. Center the gauge tube into the differential bearing bore. Install the bearing caps and torque the bolts to specification. (Caps to be installed with the arrows pointing outboard).
4. Using a feeler gauge tool, select the thickest feeler blade that will enter between the gauge tube and the gauge block and then insert the feeler gauge blade directly along the gauge block to insure a correct reading. The feeler gauge fit should be a slight drag-type feel.
5. After the correct feeler gauge feel is obtained, check the reading. This is the thickness of the shim required, providing the replacement pinion has no plus or minus reading shown on it.
6. If the replacement pinion gear is marked with a plus (+) reading, the amount shown as a plus must be **subtracted** from the thickness dimension obtained in Step 5.
7. If the replacement pinion gear is marked with a minus (−) reading, the amount shown must be **added** to the thickness dimension obtained in Step 5.

NOTE: THE SAME REAR PINION BEARING USED IN THIS PROCEDURE MUST BE USED IN FINAL ASSEMBLY OF THE AXLE.

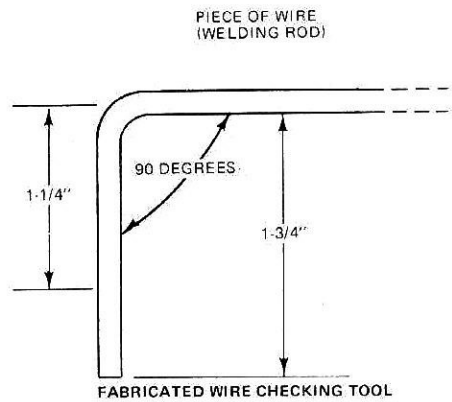
8. Place the selected shim(s) on the pinion shaft and press the pinion bearing until firmly seated on the shaft.

NOTE: A TOOTH PATTERN CHECK WITH THE MARKING COMPOUND SUPPLIED WITH THE RING AND PINION SET IS NOT REQUIRED WHEN TOOL T76P-4020-A IS USED, AND ROAD TESTING IS NOT REQUIRED.

LUBRICANT CHECKING PROCEDURE 7.5 INCH RING GEAR

Using a clean, straight piece of wire (such as welding rod), bend it at a 90° angle approximately 1-3/4″ down on one end (Fig 36) and insert it approximately 1-1/2″ into the axle filler hole. Rest it on the lower edge of the hole. Remove the wire and measure the distance from the bend to the lubricant line on the wire. With the axle in a normal curb attitude, the lubricant level should be 1-1/4″ below the bend. If the level is within the mentioned specification, the axle contains the correct amount of lubricant. (Overfill of the axle can result in lubricant leakage at the axle vent).

NOTE: THE LUBRICANT LEVEL MUST BE 1-1/4″ BELOW THE FILLER HOLE.



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FIG. 36 Fabricated Wire Checking Tool

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SPECIFICATIONS

DRIVING AXLE IDENTIFICATION (INTEGRAL CARRIER) – CONVENTIONAL

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential Type
WGX-A	2.73:1	7-1/2	C2
WGX-B	3.08:1	7-1/2	C2
WGX-C	2.47:1	7-1/2	C2

ADJUSTMENT TORQUE SPECIFICATIONS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Torque In. Lb.	Torque Ft. Lb.
Minimum torque required to tighten pinion flange nut to obtain correct pinion bearing preload	–	140 1/
Pinion Bearing Preload – (Collapsible spacer) 2/		
Original Bearings – 7.5 inch	8-14	–
New Bearings – 7.5 inch	17-27	
1/ If pinion bearing preload exceeds specification before this torque is obtained, install a new spacer.		
2/ With Oil Seal		

CLEARANCE, TOLERANCE AND ADJUSTMENTS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Inches	Description	Inches
Maximum Runout of Backface of Ring Gear	0.003	Nominal Pinion Locating Shim	0.030
Differential Side Gear Thrust Washer Thickness	0.030-0.032	Available Pinion Gear Shims in Steps of 0.001 – 7.5 Inch	0.021-0.037
Differential Pinion Gear Thrust Washer Thickness	0.030-0.032	Backlash between ring gear and pinion teeth	0.008-0.012
		Maximum backlash variation between teeth	0.003
Differential Carrier Spread	0.016	Maximum radial runout of companion flange in assembly	0.010 T.I.R.

ATTACHING TORQUE SPECIFICATIONS (INTEGRAL CARRIER) – CONVENTIONAL

Description	Torque Ft. Lb.	Description	Torque Ft. Lb.
Differential Bearing Cap Bolt – 7.5 Inch	70-85	Rear Cover Screw and Washer Assemblies	25-35
Differential Pinion Shaft Lock Bolt	15-22	Oil Filler Plug	25-50
Ring Gear Attaching Bolts – 7.5 Inch 1/	70-85	Brake Backing Plate Bolts and Nuts	20-40
1/ Using Loctite (or Equivalent)			

LUBRICANT CAPACITIES AND CHECKING PROCEDURES (INTEGRAL CARRIER) – CONVENTIONAL

Vehicle	Engine	Axle	U.S. Measure Capacity (Pints) 1/	Imperial Capacity (Pints) 2/
Fairmont/Zephyr	All	7-1/2 Inch Ring Gear	3.50/3.75	2.8/3.0

1/ All conventional axles use ESW-M2C-105-A lubricant.

2/ The lubricant level must be 1-1/4 inches below the filler hole, checked with a wire gauge such as shown in Figure 36.

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SPECIAL TOOLS

Tool Number	Description
T50T-100-A	Impact Slide Hammer
TOOL-1175-AC or TOOL-1175-AE	Grease Seal Remover (Use with Slide Hammer T50T-100-A)
T76P-4020-A	Pinion Depth Gauge
TOOL-4201-C -4201-D	Differential Backlash and Runout Gauge with Universal Bracket Dial Indicator and Bracket
T57L-4220-A	Differential Bearing Assembly Remover
T57L-4221-A	Differential Side Bearing Remover
TOOL-4221-C	Differential Side Bearing Remover
T70P-4221-A	Differential Side Bearing Remover
TOOL-4222-L	Differential Bearing Cones Replacer
TOOL-4222-H	Differential Bearing Cones Replacer
T66L-4234-A T71P-4234-A	Rear Axle Shaft Assembly Remover Adapter (Use with T50T-100-A)
TOOL-OTC-951	Pinion Rear Bearing Remover
T68P-4602-A	Pinion Angle Level Gauge
T68P-4602-AA	Frame
T68P-4602-AB	Vial
T68P-4602-AC	Magnet
TOOL-4615-G	Drive Pinion Front Bearing Cup Remover
T60K-4616-A	Pinion Bearing Cups Replacer (Inner and Outer)
T67P-4616-A	Pinion Bearing Cups Replacer
T53T-4621-C	Drive Pinion Bearing Installer
T78P-1225-A	Wheel Bearing Installer
T78P-1177-A	Wheel Seal Installer
T78P-4851-A	Companion Flange Holder
T77P-4676-B	Pinion Seal Installer
T78P-4136-A	Differential Adjuster Rod
T78P-4136-B1	Differential Gauge Disc (.200" Thick)
T78P-4136-B2	Differential Gauge Disc (.300" Thick)
T78P-4136-B3	Differential Bearing Preload Spacer
T78P-4000-A	Differential Carrier Spreader Adapters
T78P-4000-E	Differential Carrier Spreader

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DETROIT IRON

Removable Carrier Axle — Ford

PART 15-10

Applies To All Cars Except Fairmont/Zephyr

SUBJECT	PAGE
DESCRIPTION	
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F2520-2B

DESCRIPTION

CONVENTIONAL AXLE

The rear axle is of the banjo housing, hypoid gear-type using an 8, or 9-inch ring gear, in which the centerline of the pinion is mounted below the centerline of the ring gear (Fig. 1). The 9-inch ring gear axle features an optional single sensor (Sure-Track) brake control system. The Sure-Track rotor unit is located on the rear axle companion flange, with the sensor mounted in the pinion bearing retainer. The retainer to carrier attaching stud (in the 10 o'clock position) holds the wiring harness bracket.

The pinion gear and the pinion bearings are assembled in a pinion retainer, which is bolted to the carrier. The pinion is straddle mounted; that is, supported by bearings both in front of and to the rear of the pinion gear. Two opposed tapered roller bearings support the pinion shaft in front of the pinion gear with a collapsible spacer. A straight roller (pilot) bearing supports the pinion shaft at the rear of the pinion gear. Pinion and ring gear tooth contact is adjusted by adding or removing shims from between the pinion retainer and the carrier housing.

The differential assembly is mounted on two opposed tapered roller bearings, which are retained in the carrier by removable caps. The entire carrier assembly is bolted to the axle housing.

Ball bearing assemblies (rear wheel bearings) are pressed onto the outer ends of the axle shafts and set in the outer ends of the axle housing.

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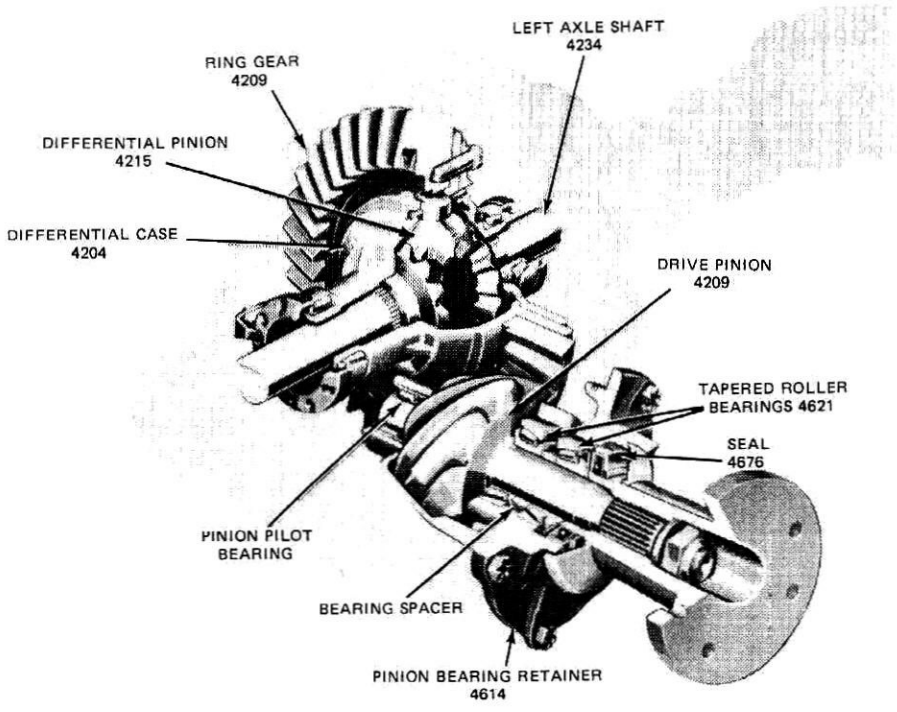


FIG. 1 Rear Axle Assembly—Removable Carrier Type—Typical

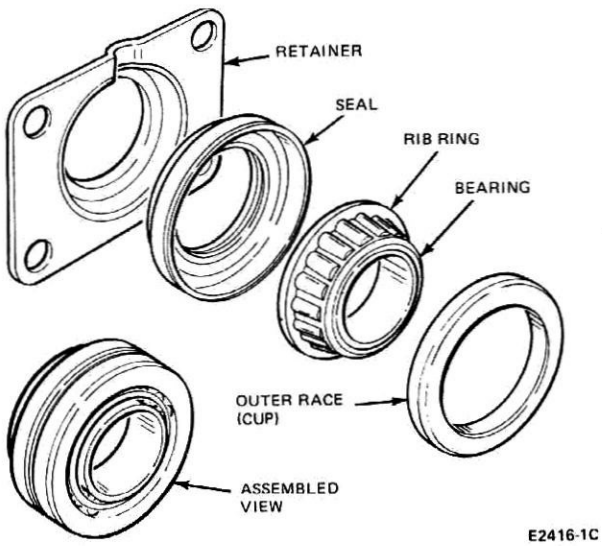


FIG. 2 Tapered Roller Bearing Assembly

Certain vehicles are equipped with tapered roller bearings, with which a different type of oil seal is used (Fig. 2). These bearings support the semi-floating axle shafts at the outer ends. The inner ends of the shafts spline to the differential side gears. Bearing retainer plates or disc brake adapters (when disc brake equipped) hold the shafts in the housing. The left and right axle shafts are not interchangeable, the left shaft being shorter than the right. An identification tag is secured to the axle assembly by one of the carrier-to-housing bolts.

It is important to use the axle model designation to obtain correct replacement parts.

IN-VEHICLE ADJUSTMENTS AND REPAIRS

REAR AXLE SHAFT, WHEEL BEARING AND OIL SEAL REPLACEMENT—(BALL BEARING EQUIPPED)

The rear axle shafts, wheel bearings, and oil seal can be replaced without removing the differential assembly from the axle housing.

AXLE SHAFT

Removal

Synthetic wheel bearing seals are used. Removal and insertion of rear axle shafts must be performed with caution. The entire length of the shaft (including spline) must pass through the seal without cutting the seal element or early seal failure will result.

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1. Remove the wheel cover, wheel and tire from the brake drum.
2. Remove the nuts that secure the brake drum to the axle shaft flange, then remove the drum from flange.
3. Working through the hole provided in each axle shaft flange, remove the nuts that secure the wheel bearing retainer plate. Then pull the axle shaft assembly out of the axle housing (Fig. 3). Remove the brake backing plate and secure it to the frame rail by wire.

REAR WHEEL BEARING AND SEAL

Removal

Synthetic seals must not be cleaned, soaked or washed in cleaning solvents. Removal of the wheel bearings from the axle shaft makes them unfit for further use.

1. Loosen the inner retainer ring by nicking it deeply with a cold chisel in several places (Fig. 4). It will then slide off easily.

   On Ford and Mercury models, it is necessary to first drill a 1/4-inch hole **not more than 5/16 inch deep in the retainer ring surface before using the cold chisel.**
2. Remove the bearing from the axle shaft with the tool shown in Fig. 5. Never apply heat to make it easier to remove the bearing retainer ring, or the bearing. This will weaken the axle shaft bearing journal area.
3. Whenever a rear axle shaft is replaced, the oil seal must be replaced. Remove the seal with Tool 1175-AB and a slide hammer (Fig. 6).

REAR WHEEL BEARING AND SEAL

Installation

1. Inspect the machined surface of the axle shaft and the axle housing for rough spots or other irregularities which would affect the sealing action of the oil seal. Check the axle shaft splines for burrs, wear or twist. Carefully remove any burrs or rough spots. Replace worn or damaged parts.
2. Place the bearing retainer plate on the axle shaft; then, press the new wheel bearing on the shaft with the tool shown in Fig. 7. **Do not attempt to press on both the bearing and the inner retainer ring at the same time.**
3. Using the bearing installation tool (Tool 4621-A or T75L-1165-D), press the bearing inner retainer ring on the shaft until the retainer seals firmly against the bearing. **On Ford and Mercury models, before assembling the retainer onto the axle shaft, the shaft journal and the inside diameter of the retainer should be wiped clean with a dry cloth. These parts must not be degreased or lubricated. Never use heat to make it easier to install the bearing retainer ring, or the bearing. This will weaken the axle shaft bearing journal area.**
4. Install the new oil seal with the tools shown in Fig. 8. Wipe a small amount of oil-resistant sealer on the outer edge of the seal before it is installed. **Do not put sealer on the sealing lip.**

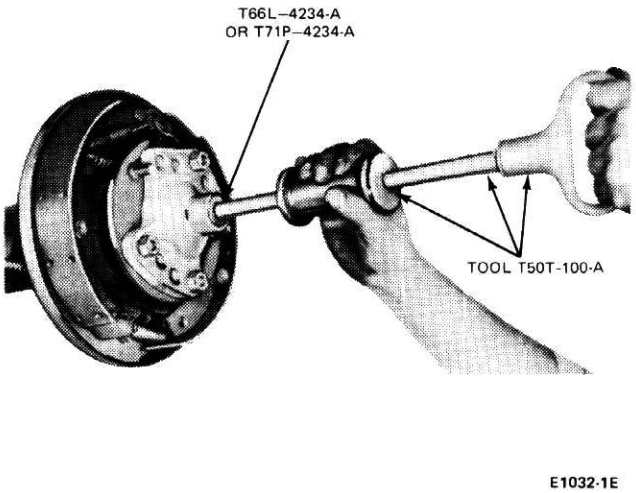


FIG. 3 Removing Axle Shaft

5. Install a new brake backing plate gasket.
6. Install the brake backing plate.

AXLE SHAFT

Installation

1. Carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the side gear, and push the shaft in until the bearing bottoms in the housing.
2. Install the bearing retainer plate and the nuts that secure it. Torque the nuts to specification.
3. Install the brake drum and the drum attaching nuts.
4. Install the wheel and tire on the drum. Install the wheel cover.

REAR AXLE SHAFT, WHEEL BEARING AND OIL SEAL REPLACEMENT (TAPERED ROLLER BEARING EQUIPPED)

AXLE SHAFT

Removal

If the vehicle is equipped with rear disc brakes, remove the neccessary brake parts; then slide off the brake rotor. Refer to Group 12, Part 20 for brake parts removal. When installing the brake parts, **new bolts must be used on the anchor plate.**

Remove the axle shaft retainer nuts and bolts from the housing. The tapered bearing cup will normally stay in place in the axle housing when the axle shaft is removed. **The bearing cup must be removed from the axle housing.** A standard slide-hammer-type puller can be used (Fig. 9). On replacements other than bearing and seal, remove the axle shaft carefully so as not to damage the outer seal rubber. On installation, the outer cup **must be placed on the shaft, mated to the bearing as a unit and carefully placed in the housing. Under no condition should it be left in the housing bore before assembly or damage to the outer seal will result.**

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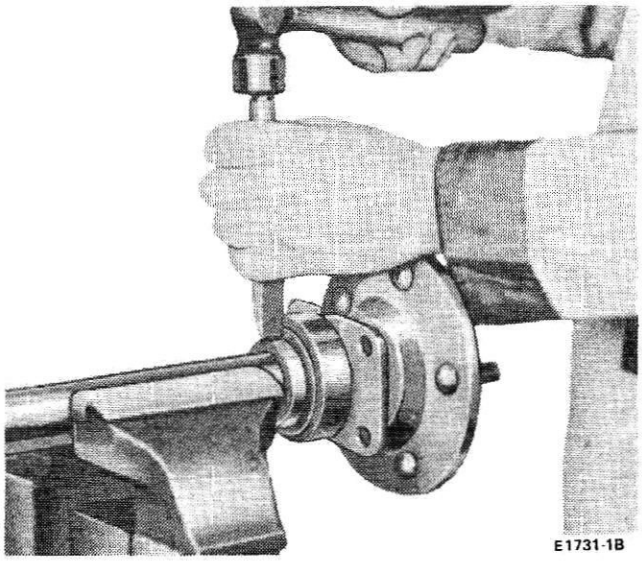


FIG. 4 Removing Rear Wheel Bearing Retainer Ring

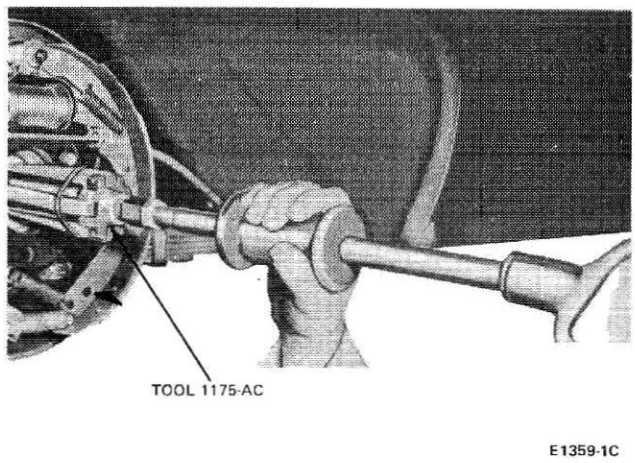


FIG. 6 Removing Rear Wheel Bearing Oil Seal

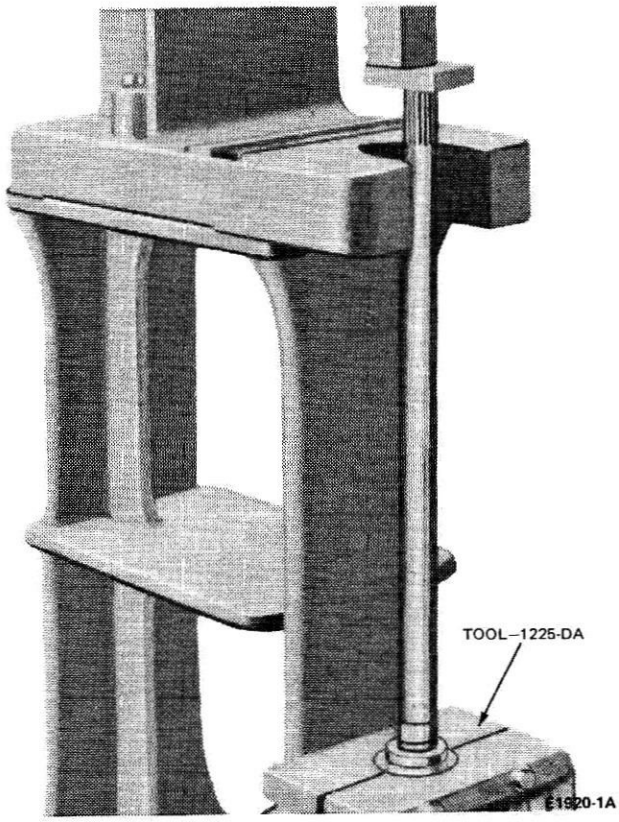


FIG. 5 Removing Wheel Bearing

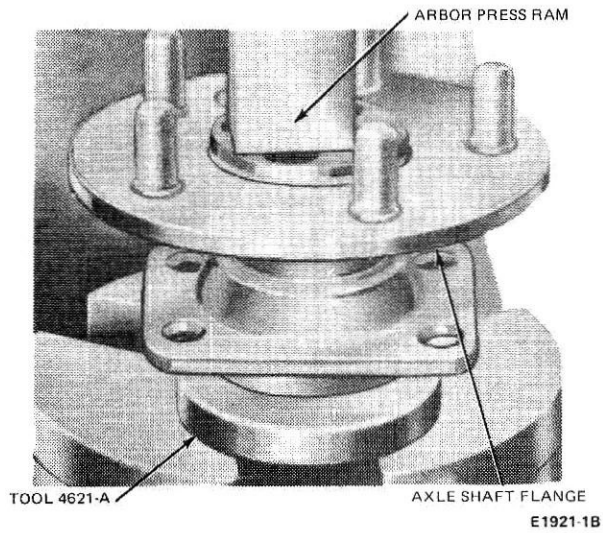


FIG. 7 Installing Wheel Bearing

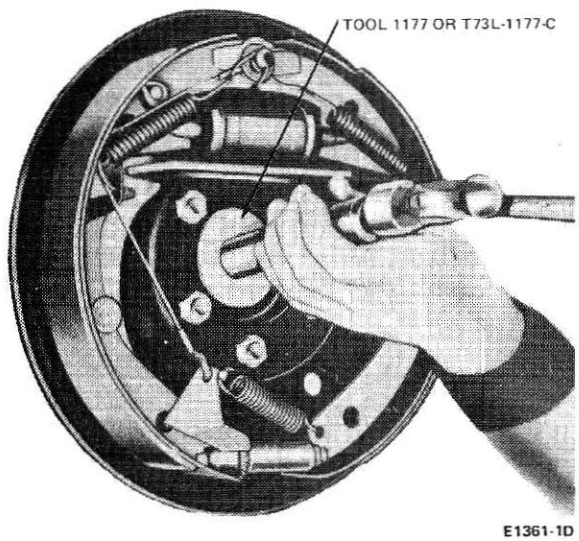


FIG. 8 Installing Rear Wheel Bearing Oil Seal—(Ball Bearing)

TAPERED BEARING AND SEAL

Removal

1. Drill a 1/4-inch hole in the outside diameter of the inner retainer to a depth approximately three-quarters of the thickness of the retainer ring. Do not drill all the way through the retainer ring because the drill could damage the axle shaft (Fig. 10).
2. After drilling the retainer ring use a chisel positioned across the drilled hole and strike sharply

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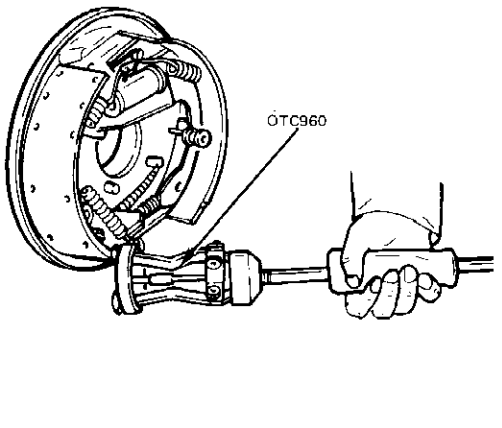


FIG. 9 Removing Tapered Bearing Cup

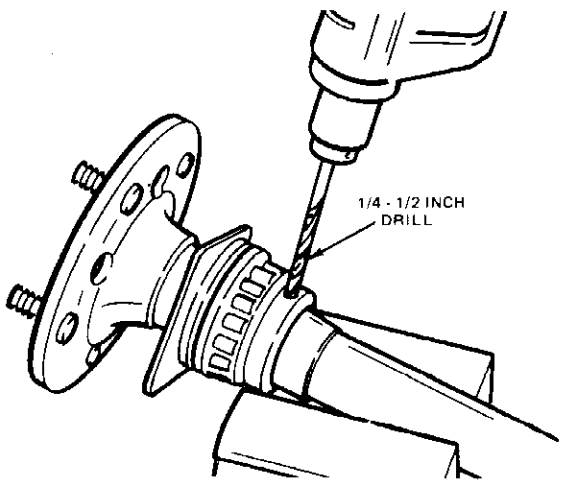


FIG. 10 Drilling Retainer Ring

to break the retainer ring (Fig. 11). **Retainers are not re-usable after having once been installed and must be scrapped after removal.** Remove the retainer.

Although the retainer must be scrapped, the tapered bearing can be reused provided the proper tooling (see Step 4) is used. If the tooling is not used, the bearing must be scrapped.

3. Remove the outer race from the housing bore, (Fig. 9) and place it on the axle shaft assembly.
4. Place the axle shaft in the tool (T75L-1165-A, B, C) as shown in Fig. 12.
5. Assemble the two halves of the Remover Collet and tighten the bolts.
6. Press the bearing assembly off the shaft. **Never use heat as this would damage the axle shaft.**
7. If the vehicle is equipped with disc brakes, assemble Tool T75L-1165-B, T75L-1165-C and T76P-1165-E to the disc brake adapter as shown in Fig. 13.
8. Press the bearing assembly off the shaft using the procedure shown in Fig. 13.

Installation

1. For a vehicle equipped with drum brakes, install the outer retainer plate (if it had been removed) making sure it is not put on backwards. For a vehicle equipped with rear disc brakes install the disc brake adapter (if it had been removed) which takes the place of the retainer plate used with drum brakes.

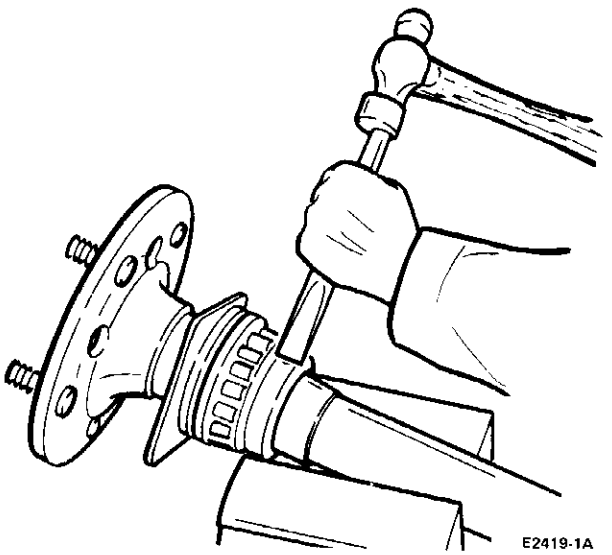


FIG. 11 Removing Rear Wheel Bearing Retainer Ring

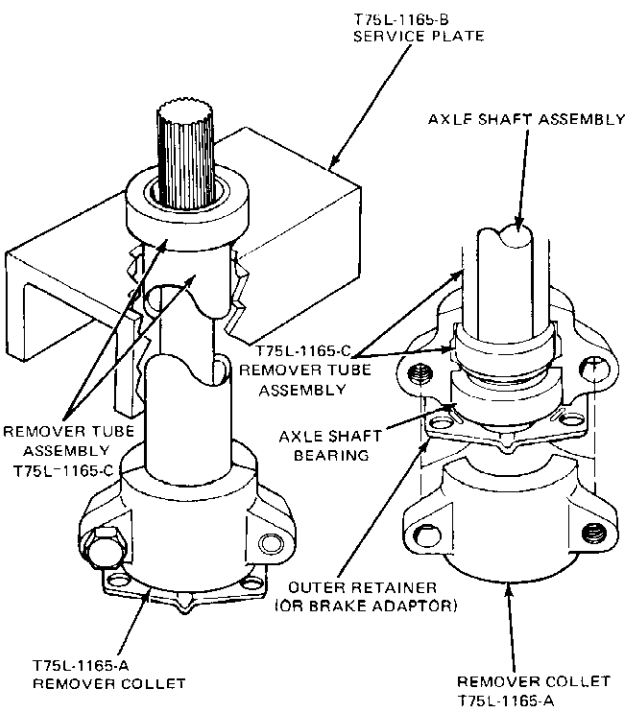


FIG. 12 Removing Bearing Cone Assembly

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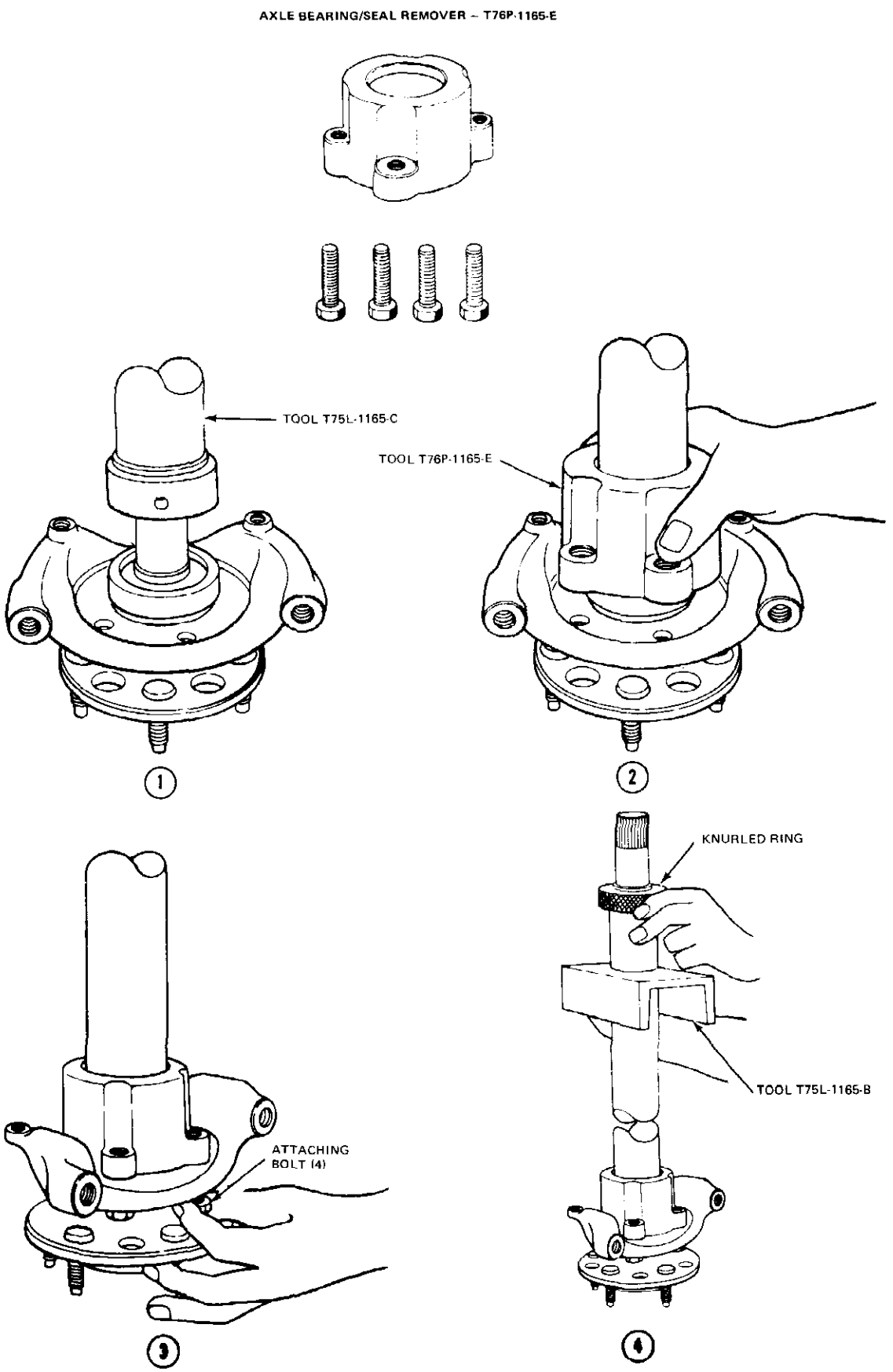


FIG. 13 Removing Bearing Cone Assembly—Disc Brakes

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2. Place the lubricated seal and bearing on the axle shaft making sure the cup rib ring is facing the axle flange. It should be noted that the lubricated seal of the bearing assembly used on drum brake vehicles is of a different length than that used on rear disc brake equipped vehicles. **They are not interchangeable.** To prevent seal failure, examine the outer rim of the seal. Those for use with drum brakes have a gray metal appearance. Those for use with disc rear brakes have a black oxide appearance.
3. Press the tapered bearing and seal assembly onto the axle shaft. Apply sufficient pressure to seat the bearing against the axle shaft shoulder. Do not attempt to press on the bearing retainer at the same time.
4. Position a **new** bearing retainer on the shaft, then press it into position firmly against the bearing. Fig. 14 illustrates the shaft after the bearing has been pressed on, and with the bearing retainer in position ready to be pressed on.
5. Before sliding the shaft assembly into the axle housing, position the bearing cup on the bearing and apply lubricant to the outer diameter of the cup and the seal.

DRIVE PINION OIL SEAL REPLACEMENT

COLLAPSIBLE SPACER

Synthetic seals must not be cleaned, soaked or washed in cleaning solvent. The drive pinion oil seal can be replaced without removing the differential carrier assembly from the axle housing.

1. Raise the vehicle and install safety stands. Remove both rear wheels and brake drums.
2. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position of the drive shaft at assembly. Disconnect the drive shaft from the axle U-joint flange. **Be careful to avoid dropping the loose universal joint bearing cups. Hold the cups on the spider with tape. Mark the cups so that they will be in their original position in relation to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the transmission extension housing to prevent transmission fluid leakage. Refer to the Transmission Group 17 for the appropriate tool.**
3. Install an in-lb torque wrench on the pinion nut. Record the torque required to maintain rotation of the pinion shaft through several revolutions.
4. Scribe the pinion shaft and the U-joint flange inner surface for assembly realignment. While holding the flange with the tool shown in Figs. 25, 26, or 27, remove the integral pinion nut and washer.
5. Clean the pinion bearing retainer around the oil seal. Place a drain pan under the seal, or raise the front of the vehicle higher than the rear.
6. Using the tool shown in Fig. 28, remove the U-joint flange.

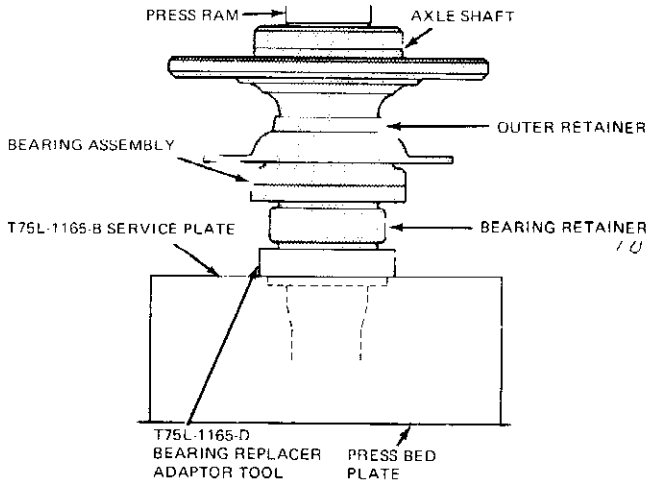


FIG. 14 Installing Seal and Bearing

7. Using the tool shown in Fig. 29, remove the drive pinion oil seal.
8. Clean the oil seal seat.
9. Install the new seal in the retainer, using the applicable tool shown in Fig. 46.
10. Check splines on the pinion shaft to be sure they are free of burrs. If burrs are evident, remove them by using a fine crocus cloth, working in a rotational motion. Wipe the pinion shaft clean.
11. Apply a small amount of lubricant to U-joint splines. Align scribe marks on U-joint flange and pinion shaft.
12. Install the U-joint flange using the tool shown in Fig. 47.
13. Install a new integral nut and washer on the pinion shaft. (Apply a small amount of lubricant on the washer side of the nut.)
14. Hold the flange with the tool shown in Figs. 25, 26, or 27, while tightening the nut.
15. Tighten the pinion shaft nut, rotating the pinion occasionally to insure proper bearing seating, and take frequent preload readings.
16. If the recorded preload is less than specification, as outlined at the end of this Part, tighten to specification. If the preload is higher than specification, tighten to original reading. Under no circumstances should the pinion nut be backed off to lessen preload. If this is done, a new pinion bearing spacer must be installed. In addition, the U-joint flange must never be hammered on, or pneumatic tools used.
17. Remove the oil seal replacer tool from the transmission extension housing. Install the front end of the drive shaft on the transmission output shaft.
18. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange.
19. Check the lubricant level. **Make sure the axle is in running position.** Add whatever amount of

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specified lubricant is required to reach the lower edge of the filler plug hole.

ORIGINAL U-JOINT FLANGE (IN-VEHICLE REPLACEMENT)

Use procedure as outlined under Drive Pinion Oil Seal Replacement. **Synthetic seals must not be cleaned, soaked or washed in cleaning solvent.**

DRIVE SHAFT PINION ANGLE ADJUSTMENT

Refer to Group 14 for this procedure.

REMOVAL AND INSTALLATION

CARRIER ASSEMBLY

Removal

1. Raise the vehicle on a hoist and remove the two rear wheels and tires.
2. Remove the two brake drums (three shakeproof retainers at each drum) from the axle shaft flange studs. If difficulty is experienced in removing the drums, remove the brake adjuster knockout slug or rubber plug (if so equipped) and back off the brake shoes following the procedure under Removal and Installation in Part 12-02 of this Manual. If the vehicle is equipped with rear disc brakes, remove the neccessary brake parts; then slide off the brake rotor. Refer to Group 12, Part 20 for brake part removal. When installing the brake parts, **new bolts must be used on the anchor plate.**
3. Working through the hole provided in each axle shaft flange, remove the nuts that secure the rear wheel bearing retainer plate or disc adaptors (when disc brake equipped). Pull each axle shaft assembly out of the axle housing using axle shaft remover, Tool-4235-C (Fig. 3). **Care must be exercised to prevent damage to the oil seal. Any roughing or cutting of the seal element during removal or installation can result in early seal failure.**
4. **Remove the brake backing plate and secure it to the frame rail with wire. Remove and discard the gasket, if so equipped, and remove the seals with Tool 1175AB.**
5. Make scribe marks on the drive shaft end yoke and the axle U-joint flange to insure proper position at assembly. Disconnect the drive shaft at the rear axle U-joint. Hold the cups on the spider with tape. Mark the cups so that they will be in their original position relative to the flange when they are assembled. Remove the drive shaft from the transmission extension housing. Install an oil seal replacer tool in the housing to prevent transmission leakage. Refer to Transmission Group 17 for the appropriate tool.
6. Clean area around carrier to housing surfaces with a wire brush and wipe clean, to prevent dirt entry into the housing. Place a drain pan under the carrier and housing, remove the carrier attaching nuts and washers, and drain the axle. If so equipped, unplug the anti-skid sensor connection (Fig. 15). Remove the carrier assembly from the axle housing.

Installation

Synthetic-type wheel bearing seals **must not be cleaned, soaked or washed in cleaning solvent.**

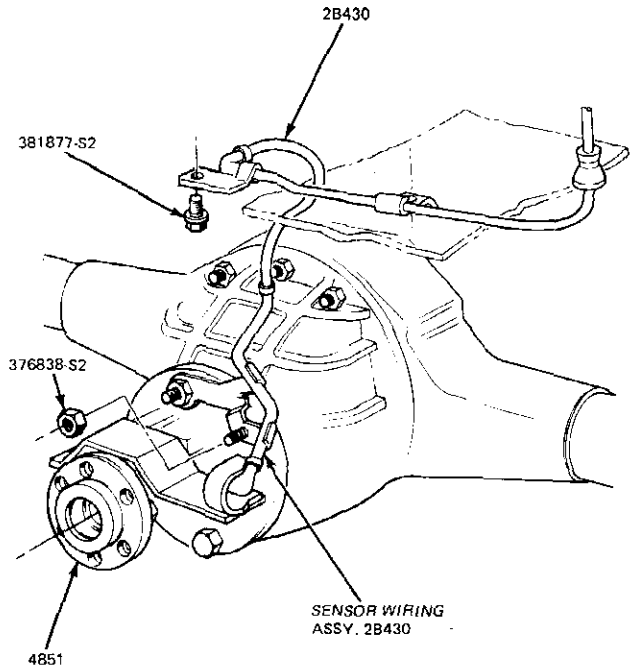


FIG. 15 Anti-Skid Sensor Installation

1. Clean the axle housing and shafts using kerosene and swabs. To avoid contamination of the grease in the sealed ball bearings, do not allow any quantity of solvent directly on the wheel bearings. Clean the mating surfaces of the axle housing and carrier.
2. Position the differential carrier on the studs in the axle housing, using a new gasket between carrier and housing. Install the carrier-to-housing attaching washers and nuts, and torque them to specification. If so equipped, plug in the anti-skid connection (Fig. 15).
3. Remove the oil seal replacer tool from the transmission extension housing. Position the drive shaft so that the front U-joint slip yoke splines to the transmission output shaft.
4. Connect the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft

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end yoke and the axle U-joint flange during the removal procedure. Install the U-bolts and nuts and torque to specifications.

5. Wipe a small amount of an oil resistant sealer on the outer edge of each seal before it is installed. **Do not put any of the sealer on the sealing lip. Install the oil seals in the ends of the rear axle housing with one of the tools shown in Fig. 8. (Use the proper tool so that pressure is applied only to the outer edge of the seal.)**
6. **Install a new gasket, if so equipped, and place the brake backing plate in position.**
7. Install the two axle shaft assemblies in the axle housing. Care must be exercised to prevent damage to the oil seals. The shorter shaft goes into the left side of the housing.

   Carefully slide the axle shaft into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the differential side gear, and push the shaft in until the bearing bottoms in the housing.
8. Install the bearing retainers on the attaching bolts on the axle housing flanges. Install the nuts on the bolts and torque to specification.
9. If the rear brake shoes were backed off, adjust the brakes as outlined in Part 12-02 and install rubber plugs in the adjuster slots.
10. Install the two rear brake drums and the drum shakeproof retainers.
11. Install the rear wheels and tires.
12. Fill the rear axle with specified lubricant.

AXLE HOUSING (COIL SPRING SUSPENSION)—FORD, MERCURY AND LINCOLN CONTINENTAL

Removal

1. Remove the carrier assembly from the axle housing as outlined in Differential Carrier Removal and Installation.
2. Position safety stands under the frame rear members, and support the axle housing with either a floor jack or hoist.
3. Disengage the brake line from the clips that retain the line to the axle housing.
4. Disconnect the vent tube from the rear axle housing.
5. Disconnect the lower studs of the two rear shock absorbers from the mounting brackets on the axle housing (Fig. 18).
6. Remove the attaching nut and washer, and disconnect the track bar from the mounting stud on the axle housing bracket. The axle housing bracket to which the track bar is attached has two mounting holes. For Ford and Mercury vehicles the track bar should be attached to the upper hole. For Lincoln Continental only, the track bar should be attached to the lower hole (Fig. 16).
7. Lower the axle housing until the coil springs are released. Lift out the coil springs and insulators.
8. Remove the nuts, washers and pivot bolts that connect the suspension lower arms to the axle housing. Disconnect both arms from the axle housing.
9. Disconnect the upper suspension arm from the axle housing by removing the pivot bolt, nut, lock washer and the two eccentric washers (Fig. 18).
10. Lower the axle housing and remove it from under the vehicle.

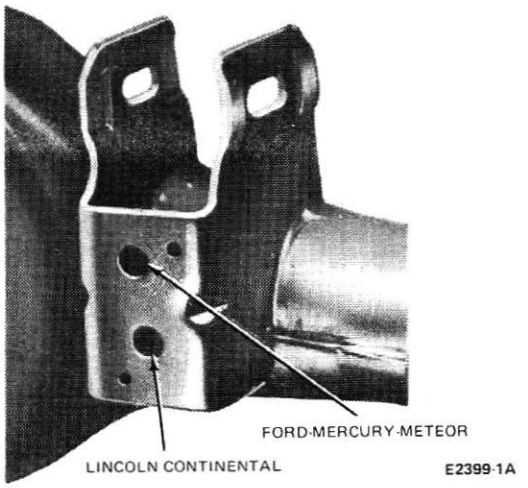


FIG. 16 Axle Housing Bracket

Installation

1. Transfer the track bar mounting stud from the old to the new housing. If the axle housing is new, install a new vent. The hose attaching portion must face toward the front of the vehicle.
2. Wipe a small amount of an oil-resistant sealer on the outer edge of each wheel seal before it is installed. **Do not put any of the sealer on the sealing lip. Install the oil seals in the ends of the axle housing with one of the tools shown** in Fig. 8 (except tapered roller bearing **equipped).**
3. Position the replacement axle housing under the vehicle, and raise the axle with a hoist or floor jack. Connect the suspension lower arms to their mounting brackets on the axle housing with pivot bolts and nuts. **Do not tighten the bolts and nuts at this point.**
4. Position the rear coil springs and insulators in the pockets provided.
5. Position the suspension upper arm in its mounting bracket on the axle housing, and install the adjusting bolt, eccentric washers, lock washer and nut. **Leave the bolt and nut loose at this point.**
6. Connect the track bar to the mounting stud, install the washer and attaching nut, and torque to specification. (Refer to Step 6 under Removal, to assure correct assembly.)
7. Connect the lower studs of the two rear shock absorbers to the mounting brackets on the axle housing. Install the attaching nuts, and torque to specification.
8. Position the brake lines to the axle housing, and secure with the retaining clips.
9. Connect the vent tube to the vent on the housing. **If axle housing is new, install a new vent.**

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10. Clean the mating surfaces of the axle housing and differential carrier. Position the carrier on the mounting studs on the housing, using a new gasket between carrier and housing. Install the copper washers and the carrier-to-housing attaching nuts, and torque to specification.
11. Make sure that both the front and rear pivot bolts of the upper and the two lower arms are loose, and then raise the axle assembly to controlled curb height (Fig. 17). Hold the axle at controlled curb height by placing blocks or pieces of steel pipe between the axle housing and the bumper rear screw on the side rail.
12. With the axle at controlled curb height, torque the suspension upper and lower arm front pivot bolts and nuts to specification. Torque the lower arm-to-axle housing pivot bolts and nuts to specification.
13. Remove the oil seal replacer tool from the transmission extension housing. Position the drive shaft so that the front U-joint slip yoke splines to the transmission output shaft.
14. Connect the drive shaft to the U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange during the removal procedure. Install the U-bolts and nuts and torque to specification.
15. Position gaskets and brake backing plates to the axle housing and slide the mounting bolts into place.
16. Carefully slide the two axle shaft assemblies in the axle housing. The shorter shaft goes into the left side of the housing. Use care in sliding the axle shafts into the housing so that the rough forging of the shaft will not damage the oil seal. Start the axle splines into the differential side gear, and push the shaft in until the rear wheel bearing bottoms in the housing.
17. Install the rear wheel bearing retainers on the attaching bolts on the axle housing flanges. Install the nuts on the bolts and torque to specification.

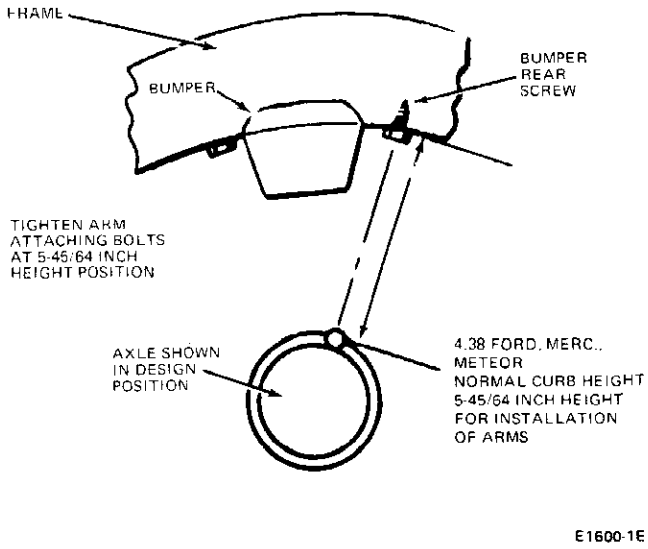


FIG. 17 Axle Normal Curb Height and Controlled Height for Arm Installation

18. If the rear brake shoes were backed off, adjust the brakes as outlined in Part 12-02 and install rubber plugs in the adjuster slots.
19. Install the two rear brake drums and the drum-attaching shakeproof retainers.
20. Install the rear wheels and tires.
21. Fill the rear axle to the bottom of the filler plug hole located in either the carrier casting or housing cover with specified lubricant. Be sure that the axle is in operating position.
22. Road test the vehicle to be sure that pinion and driveshaft angles are correct. Any shudder during heavy acceleration, or deceleration may require a pinion and driveshaft angle re-adjustment as detailed in Driveshaft and Pinion Angle Adjustment, Part 14-32.

AXLE HOUSING (COIL SPRING SUSPENSION)—LTD II, COUGAR, THUNDERBIRD AND CONTINENTAL MARK V

Removal

1. If equipped with anti-skid system, disconnect the sensor wire, and the bracket attaching the sensor wiring assembly to the carrier. Remove the wiring assembly from the axle (Fig. 15).
2. Remove the carrier assembly from the axle housing as outlined under Carrier Assembly, Removal and Installation (be sure to mark the drive shaft and companion flange for correct re-assembly).
3. Disconnect the rear stabilizer bar on models so equipped.
4. Remove the lower retaining nuts from the shock absorbers and position them aside (Fig. 19).
5. Loosen the brake lines by prying up on the retaining clips from the axle housing and remove the brake line juction block retaining screw.
6. Position support stands under the rear frame.
7. Position a transmission jack under the axle housing to prevent tilting when removing the upper and lower control arms.
8. Disconnect the lower control arms from the axle housing and position them downward.
9. Disconnect the upper control arms from the axle housing and position them upward.
10. Disconnect the air vent line.
11. Lower the axle slightly, remove the coil springs and insulators and wire up the backing plates using care not to strain the brake lines.
12. Lower the axle housing to the floor, and remove the jack.

Installation

1. Raise the axle housing. Position the transmission jack.
2. Attach the lower arms to the axle. Do not tighten the bolts and nuts yet.
3. Lower the transmission jack and install the coil springs and insulators. Raise the jack and connect the upper arm to the axle.

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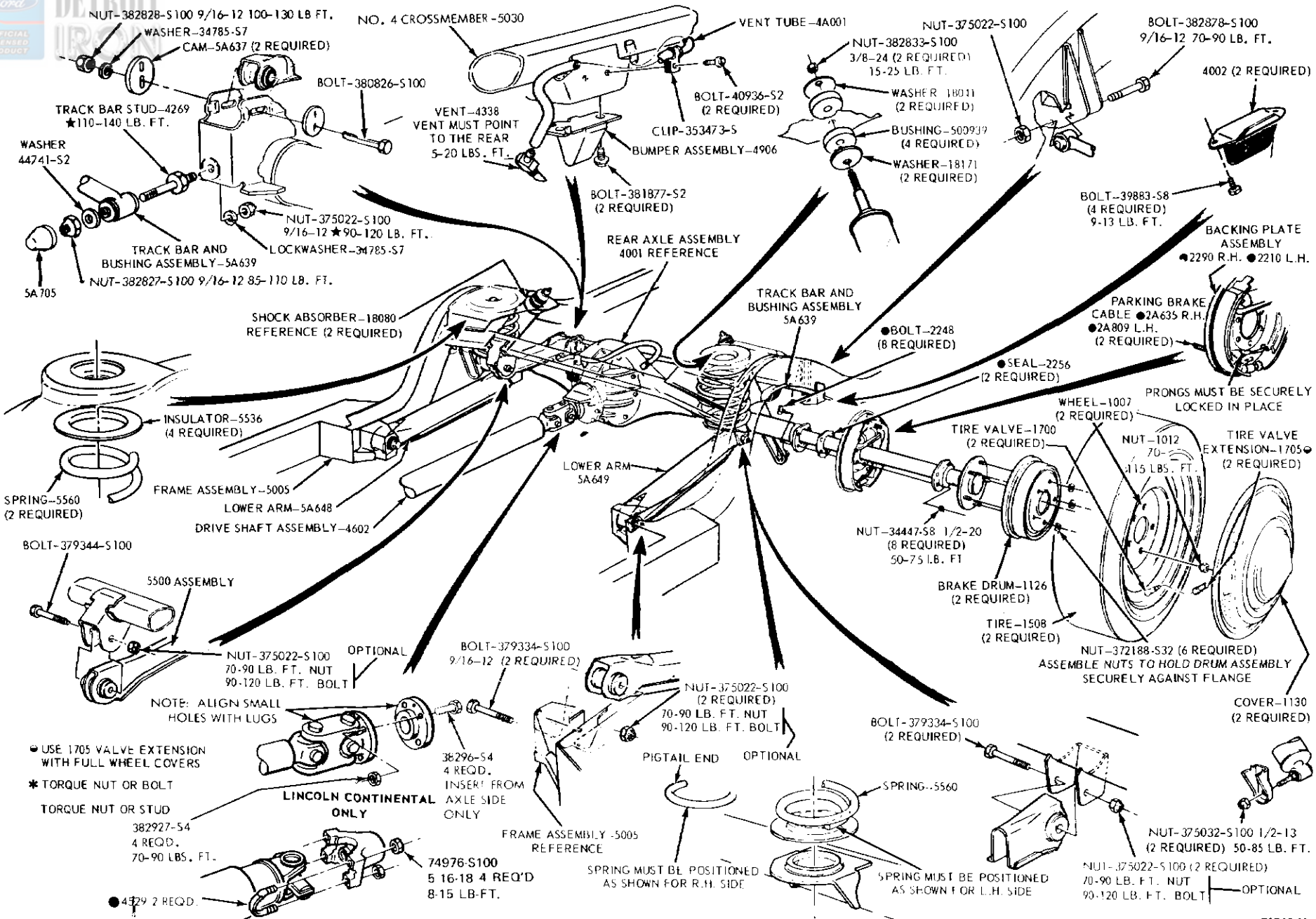


Fig. 18 Rear Axle Installation Coil Spring Suspension (Ford, Mercury and Lincoln Continental)

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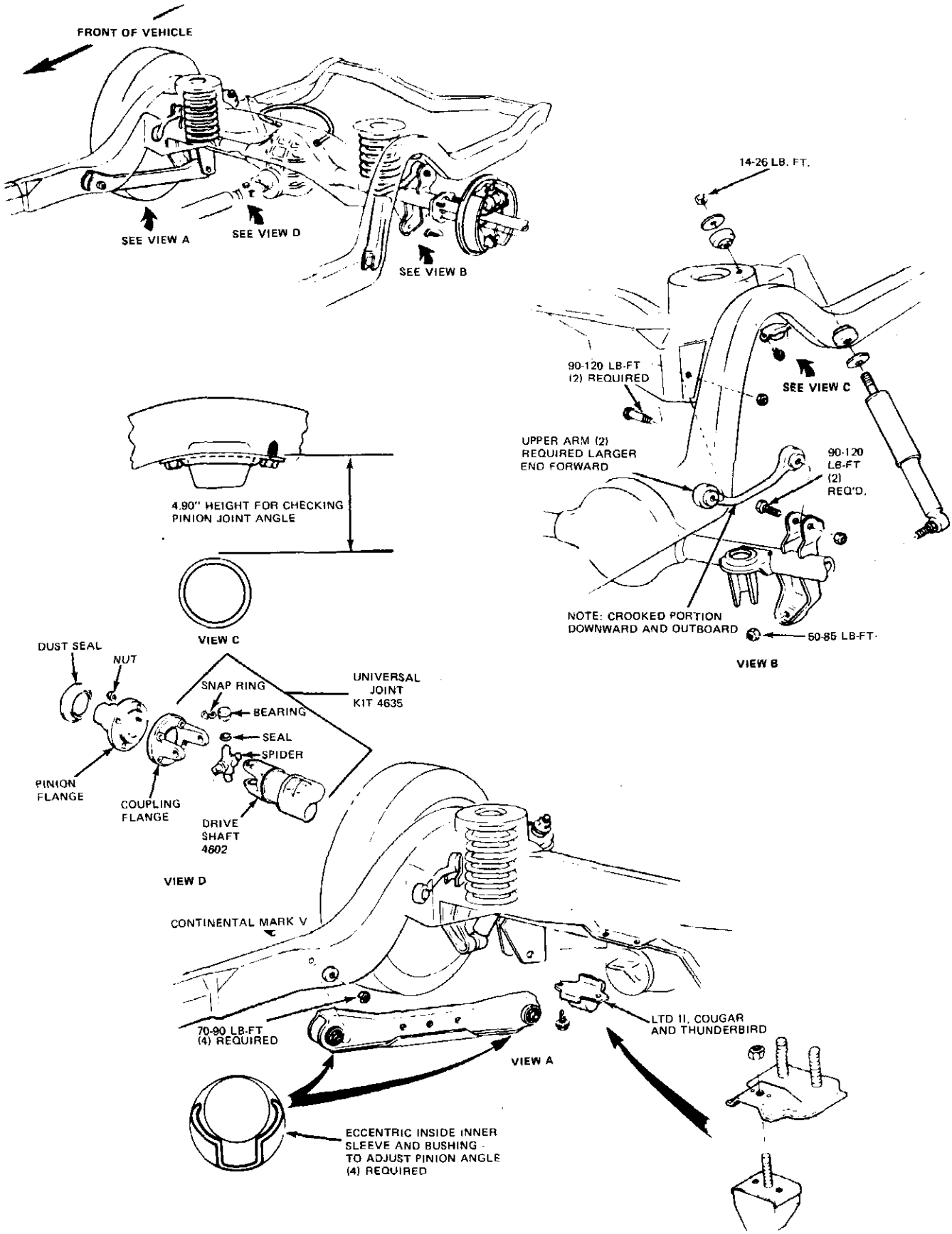


FIG. 19 Rear Axle Installation Coil Spring Suspension (LTD II, Cougar, Thunderbird and Continental Mark V)

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4. Position the backing plates to the axle housing bolts.
5. Position the brake lines. Bend down retaining clip as required.
6. Position the brake line junction to the axle housing and install the retaining bolt.
7. Position the vent tube to the vent fitting and attach the clamp.
8. Position the shock absorbers to the lower axle brackets, install and torque the retaining nuts to specification.
9. Connect the rear stabilizer bar on models so equipped.
10. Install the carrier assembly and torque the nuts to specification. If equipped with anti-skid system, position and install the sensor wiring and bracket (Fig. 15). Connect the sensor wire. With the axle at controlled curb height (Fig. 17), torque the upper and lower arm retaining nuts to specification. Install the new seals, axle shafts, brake drums and wheels as outlined in Removal and Installation—Carrier Assembly, in this Part.
11. After installing the drive shaft, check the pinion angle. If adjustment is required, refer to Part 14-32.
12. Road test the vehicle.

AXLE HOUSING (LEAF SPRING SUSPENSION)

Removal

1. Raise the vehicle and support it with safety stands under the rear frame member. Disconnect the drive shaft at the drive pinion flange.
2. Disconnect the lower end of the shock absorbers.
3. Remove the wheels, brake drums and both axle shafts as outlined in Part 11-11.
4. Remove vent hose front vent tube (Corbin clamp). Then, remove vent tube from brake tube junction and axle housing.
5. Remove the hydraulic brake lines from the axle housing. **Do not open the hydraulic brake system lines. Remove the hydraulic brake line from its retaining clip on the axle housing.**
6. Remove both axle shaft oil seals with the tool shown in Fig. 6.
7. Remove both brake backing plates from the axle housing and suspend them above the housing with mechanic's wire. The hydraulic brake lines and the parking brake cables are still attached to the brake backing plates.
8. Support the rear axle housing on a jack, and then remove the spring clip nuts. Remove the spring clip plates (Fig. 20).
9. Lower the axle housing and remove it from under the vehicle.
10. If the axle housing is being replaced, transfer all the differential and pinion parts to the new housing.

Installation

1. Raise the axle housing into position so that the spring clip plates can be installed. Torque the spring clip nuts to specification. **Install new gaskets on the housing flanges.**
2. Install new axle shaft oil seals with the tool shown in Fig. 8. **Installation without use of the proper tool will distort the seal and cause leakage. Coat the outside edges of the new oil seal with a non-hardening-type sealer such as Permatex No. 2 or its equivalent.**
3. Place the brake backing plates in their normal position on the axle housing.
4. Install the axle shafts, brake drums and wheels as outlined in Part 11-11.
5. Attach the hydraulic brake line fitting to the axle housing, and secure the hydraulic brake line in its retainer on the axle housing.
6. Install vent tube to brake tube junction and install vent hose to vent tube.
7. Raise the axle housing and connect the shock absorbers.
8. Connect the rear end of the drive shaft to the axle U-joint flange, aligning the scribe marks made on the drive shaft end yoke and the axle U-joint flange.
9. Fill the axle with the proper grade and amount of lubricant.
10. Road test the vehicle.

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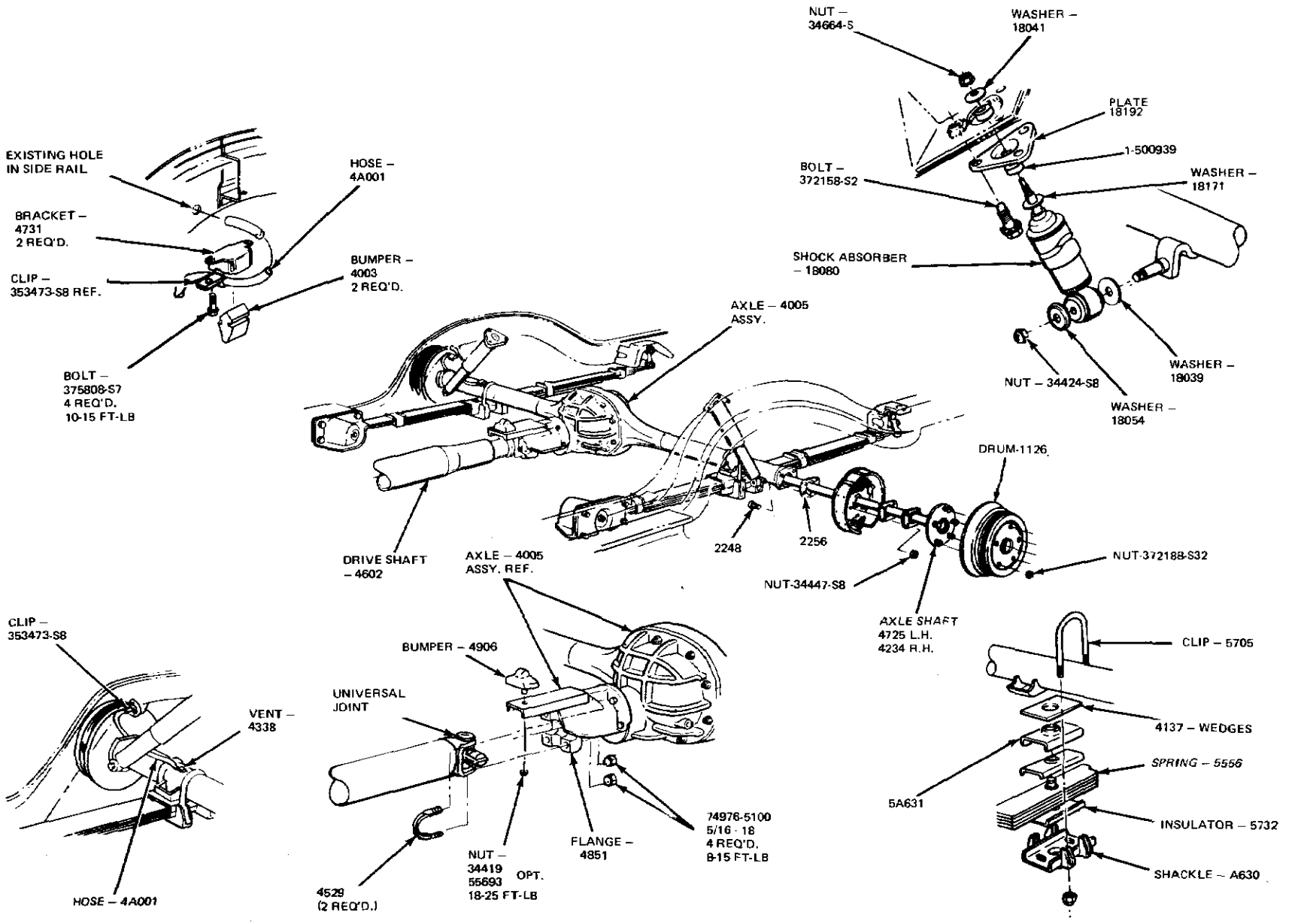


Fig. 20 Rear Axle Installation — Typical Leaf Spring Suspension

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DISASSEMBLY AND ASSEMBLY

DIFFERENTIAL CARRIER

Disassembly

A disassembled view of the rear axle assembly is shown in Fig. 21.

After mounting the carrier in a holding fixture, disassemble the carrier as outlined in the following procedures:

1. Mark one differential bearing cap and the mating bearing support with punch marks, to help position the parts properly during assembly of the carrier. Also, mark one of the bearing adjusting nuts and the carrier with scribe marks, for proper location during assembly.
2. Remove the adjusting nut locks, bearing caps, and adjusting nuts. Then lift the differential case assembly out of the carrier. (Remove the bearing caps by tapping the caps lightly with a soft mallet.)
3. Remove the differential bearings with the tools shown in Fig. 22. On assemblies with an 8-inch ring gear, bearing cups are identified with a black oxide coating. **This does not indicate a burned or failed condition. Closer inspection of the cups is required to determine wear or damage.**
4. Mark the differential case, cover, and ring gear for assembly in the original position.
5. Remove the bolts that attach the ring gear to the differential case and discard them. Press the gear from the case or tap it off with a soft-faced hammer.
6. Separate the two-piece differential case, then, with a drift, drive out the differential pinion shaft lock pin (Fig. 23).
7. Drive out the pinion shaft with a brass drift (Fig. 24).
8. Remove the gears and thrust washers (Fig. 49).

DRIVE PINION AND BEARING RETAINER

Removal and Disassembly

1. Position the carrier assembly and remove the pinion shaft nut (Figs. 25, 26 and 27).
2. Remove the U-joint flange from the pinion shaft (Fig. 28).
3. Remove the pinion seal (Fig. 29).
4. Remove the pinion, bearing, and retainer assembly from the carrier housing. With a micrometer, measure the original shim thickness, and record it. If a new gear set is installed, a new shim must also be installed. The original shim thickness is one of the factors necessary in determining the new shim thickness. **Extreme care must be taken not to damage the mounting surfaces of the retainer and carrier.**
5. Place a protective sleeve (hose) on the pinion pilot bearing surface. Press the pinion shaft out of the pinion front bearing cone with the tool shown in Fig. 30.
6. Press the pinion shaft out of the pinion rear bearing cone and roller (Fig. 31).

PILOT BEARING

1. Remove the pilot bearing as shown in Fig. 32. Drive out the pilot bearing and the bearing retainer together. Alternately, use puller T58L-101-A and slide hammer T50T-100-A.

PINION BEARING CUPS

Do not remove the pinion bearing cups from the retainer unless the cups are worn or damaged. The flange and pilot of the retainer are machined during manufacture, by locating on these cups after they are installed in their bores. If cups are worn or damaged, remove them as shown in Figs. 33, 34 and 35. Install cups as shown in Figs. 36 and 37.

After the new cups are installed, make sure they are seated in the retainer by trying to insert a 0.0015-inch feeler gauge between the cup and the bottom of the bore.

Whenever the cups are replaced, the cone and roller assemblies should also be replaced.

DRIVE PINION AND RING GEAR SET

When replacing a ring gear and pinion, note that the original factory-installed shim is of the correct thickness to adjust for individual variations in both the carrier housing dimension and in the original gear set dimension. Therefore, to select the correct shim thickness for a new gear set, follow these steps:

1. Use a micrometer to measure the thickness of the original shim removed from the axle. Use the same thickness when installing the replacement carrier assembly or drive pinion. If further shim change is necessary, it will be indicated in the tooth pattern check.
2. If the original shim is lost, substitute a nominal shim for the original, and use the tooth pattern check to determine if further shim changes are required. Nominal shim thicknesses are indicated in Specifications.

   A new ring gear and pinion should always be installed in an axle as a matched set (never separately). **Be sure the same identifying** (matching) number appears on the bolt hole **face of the ring gear and on the head of the drive pinion (Fig. 38).**
3. After determining the correct shim thickness as explained in the foregoing steps, install the new pinion and ring gear as outlined under Assembly.

DRIVE PINION AND GEAR SET (ALTERNATE PROCEDURE USING TOOL T75P-4020-A)

NOTE: A tooth pattern check using the gear marking compound supplied with the ring and pinion gear kit is not required when this tool is used.

1. Refer to the chart shown in Fig. 39 and select the proper rear pinion bearing Aligning Adapter and Gauge Disc, corresponding to the axle size (8 or 9 inch ring gear). Slide these adapters over the screw or threaded shaft shown in Fig. 39. Install the Gauge Block on the threaded shaft and tighten securely as shown in Step 1 on the illustration.
2. Place this assembly, along with a **new** pinion bearing, into the pinion bearing retainer assembly.

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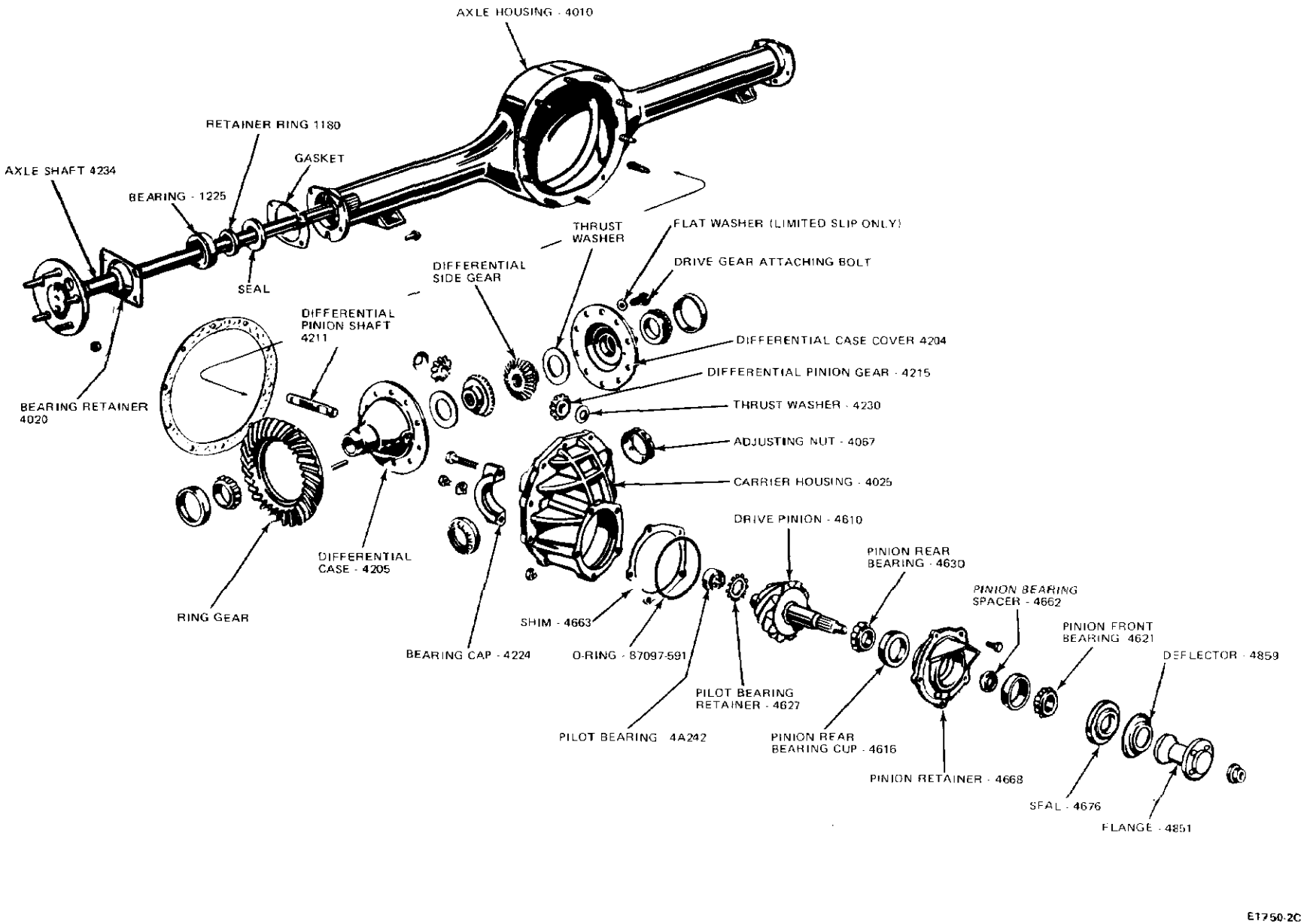


Fig. 21 Rear Axle Disassembled — Typical Removable Carrier With Conventional Differential

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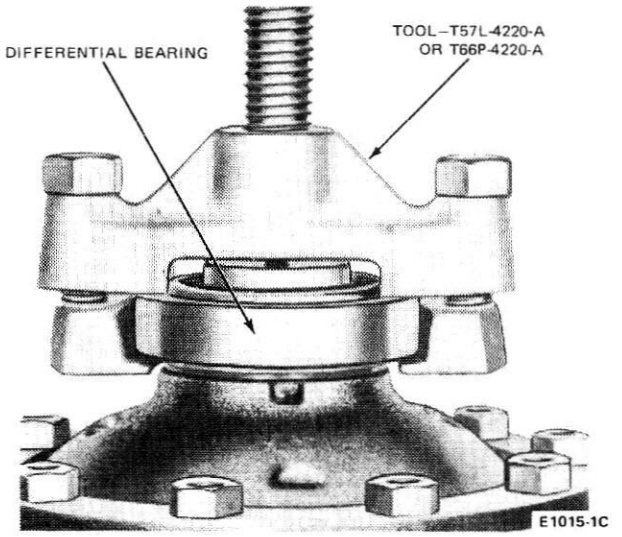


FIG. 22 Removing Differential Bearing

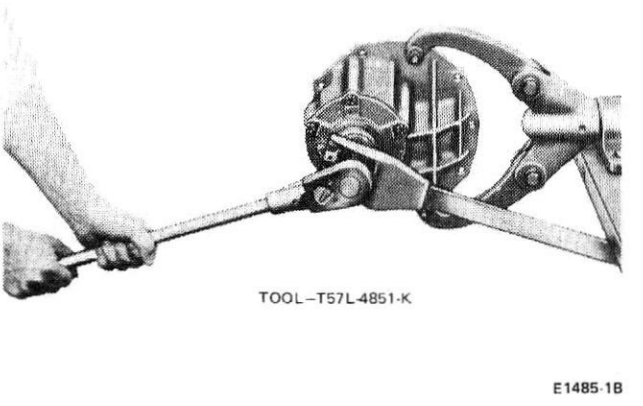


FIG. 25 Removing Pinion Nut Shaft

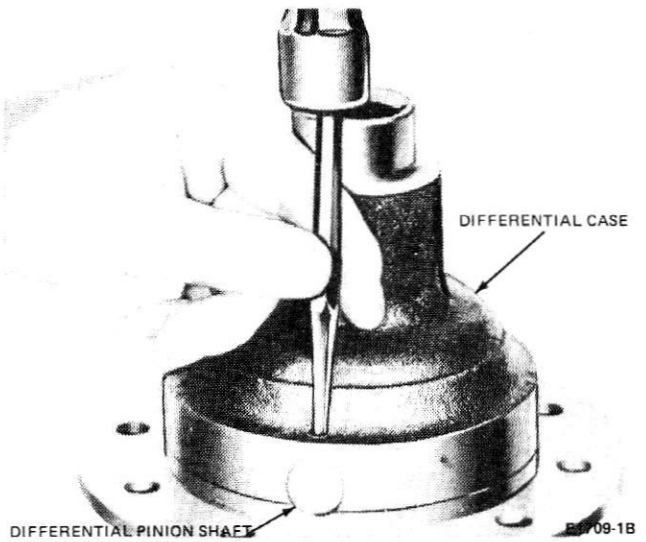


FIG. 23 Removing Differential Pinion Lock Pin

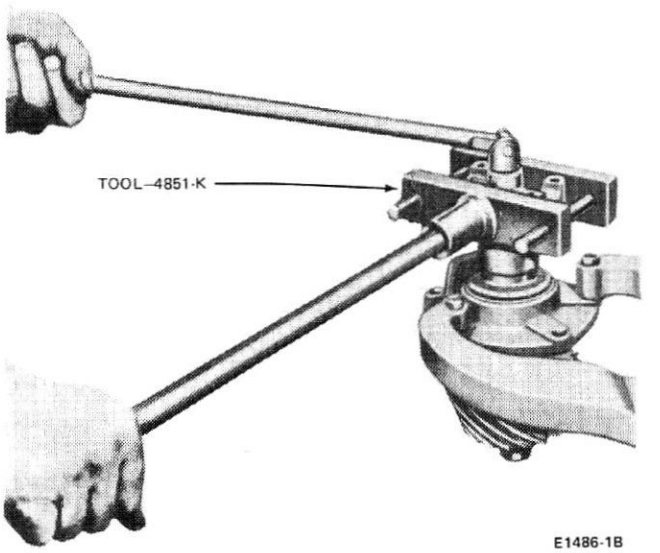


FIG. 26 U-Joint Flange Holding Tool

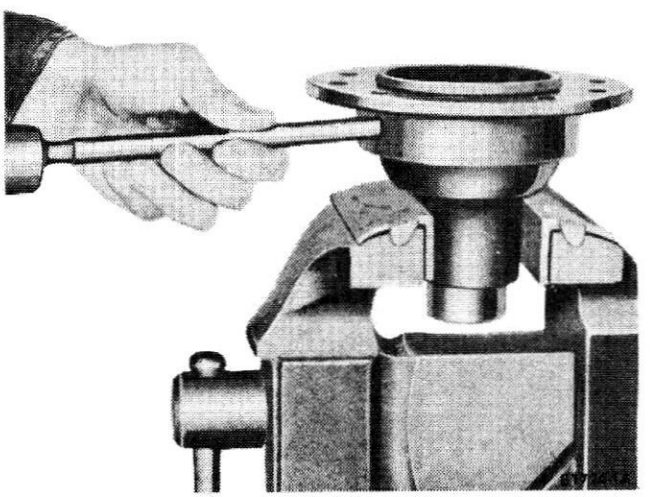


FIG. 24 Driving Out Differential Pinion Shaft

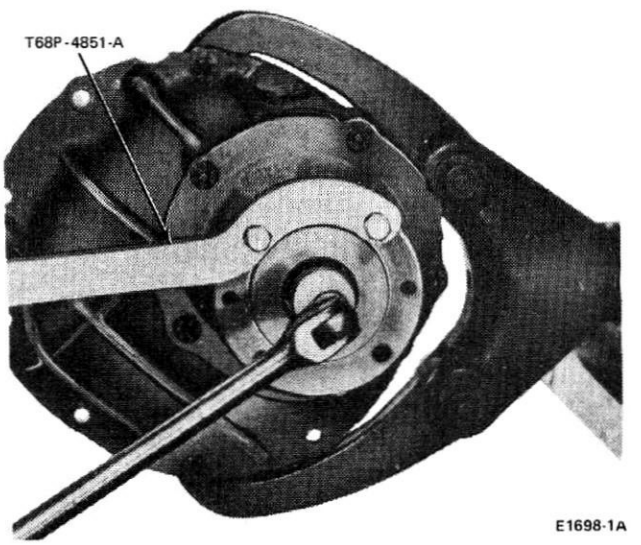


FIG. 27 Companion Flange Holding Tool (Circular Flange)

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Install the front pinion bearing (new or used if in good condition) and screw the handle onto the threaded shaft, with the tapered end into the front pinion bearing (See Steps 1 and 2 in Fig. 40). The flat end of the handle has a 3/8 inch square hole broached in it. This is designed so that an in-lb torque wrench may be used to obtain proper pinion bearing preload. (See Specification Section.)

3. Install the pinion bearing assembly into the carrier (without a pinion shim) and tighten the attaching bolts to 30-45 ft-lbs torque.
4. Rotate the Gauge Block so that it rests against the pilot boss (Step 3 in Fig. 40).

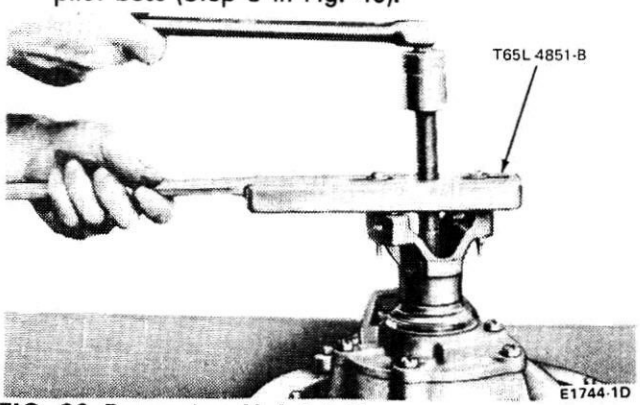


FIG. 28 Removing U-Joint Flange

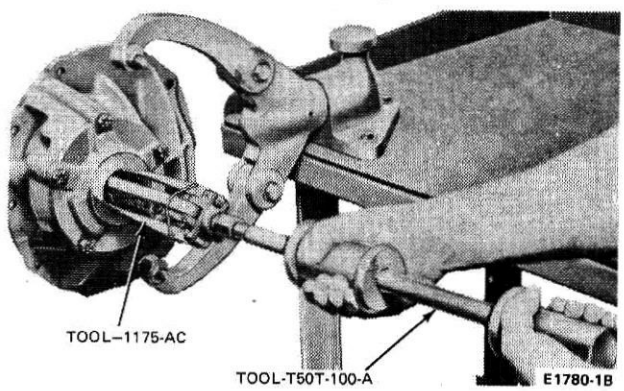


FIG. 29 Removing Pinion Seal

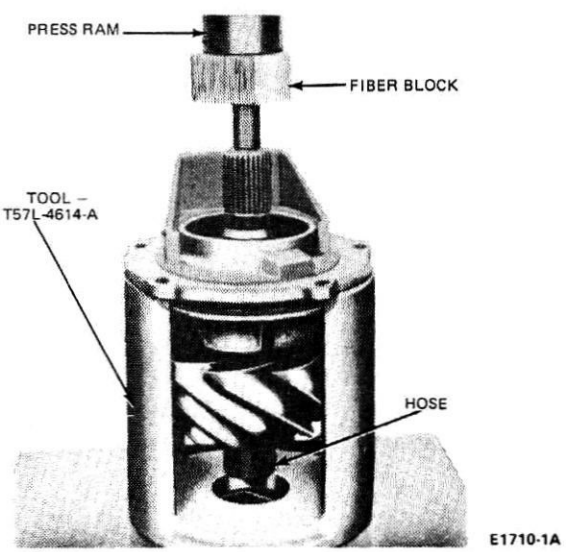


FIG. 30 Removing Pinion Front Bearing

5. Place the differential Gauge Tube into the differential bearing bore and tighten the bearing caps to the specified torque (Step 4 in Fig. 40). **On the 8-inch axle only, check for clearance between the Gauge Tube and the pilot bearing boss casting. Remove material from the casting if necessary. Be sure to clean out any loose materail.**
6. Using a feeler gauge tool, select the thickest feeler blade that will enter the space between the differential bearing Gauge Block and Gauge Tube (Step 4 in Fig. 40). (Insert the feeler blade directly along the Gauge Block top to ensure a correct

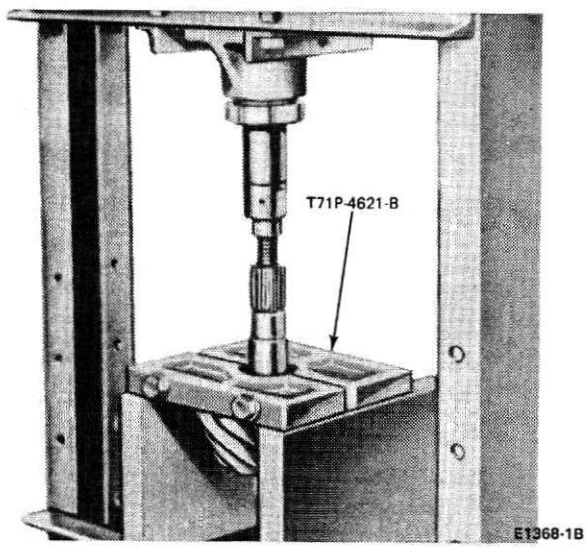


FIG. 31 Removing Pinion Rear Bearing Cone

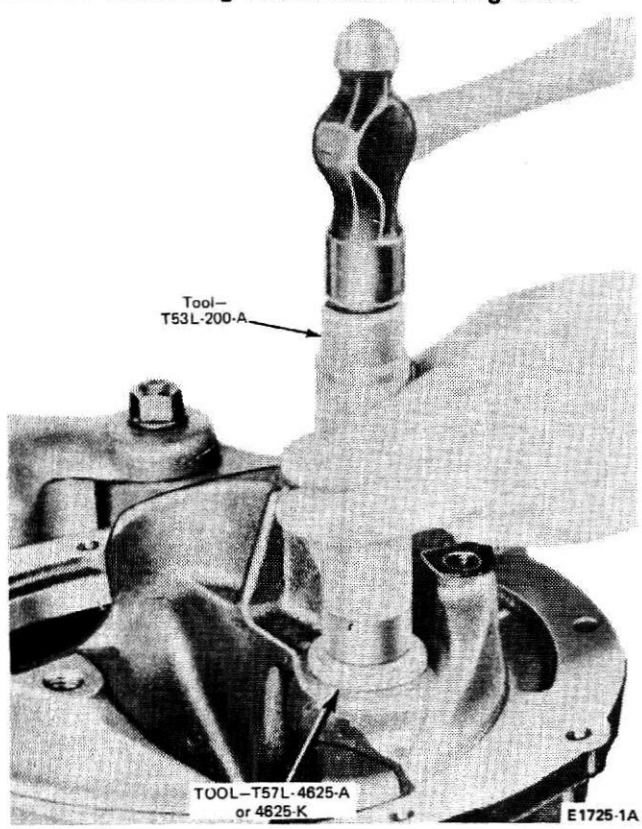


FIG. 32 Removing Pilot Bearing

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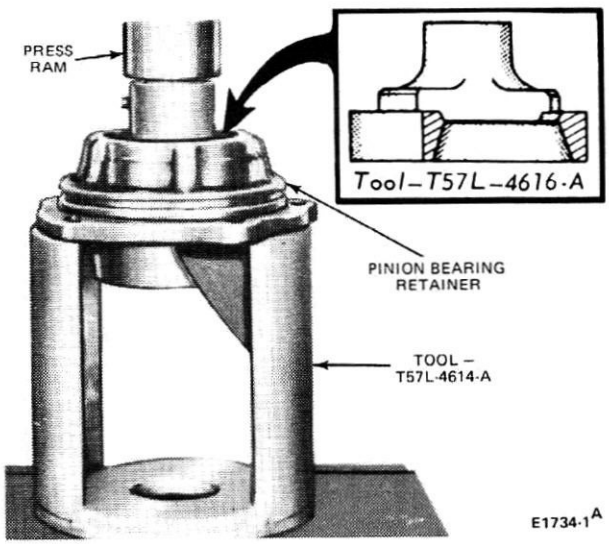


FIG. 33 Removing Pinion Front Bearing Cup

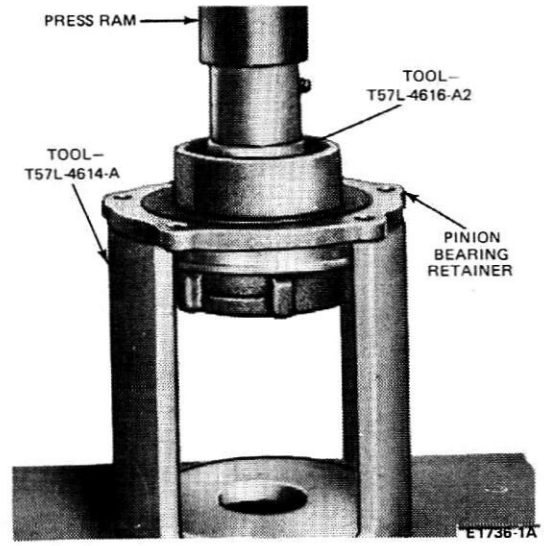


FIG. 36 Installing Pinion Front Bearing Cup

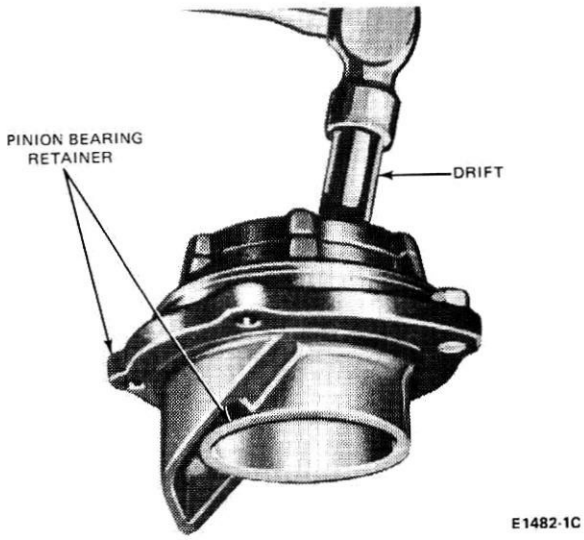


FIG. 34 Removing Pinion Front Bearing Cup

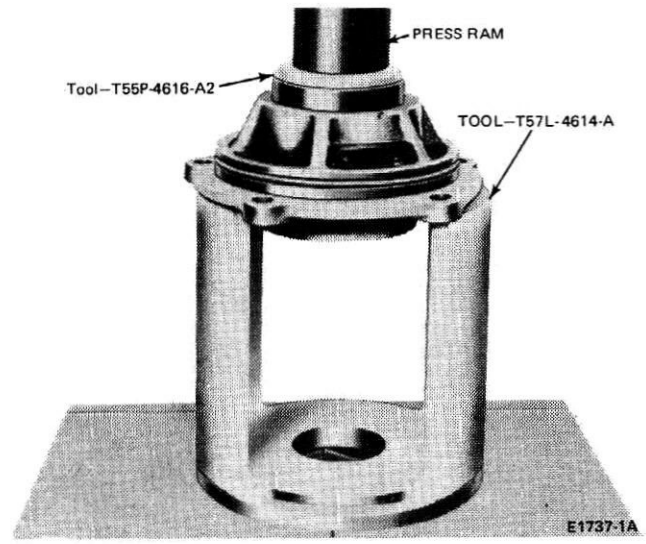


FIG. 37 Installing Pinion Rear Bearing Cup

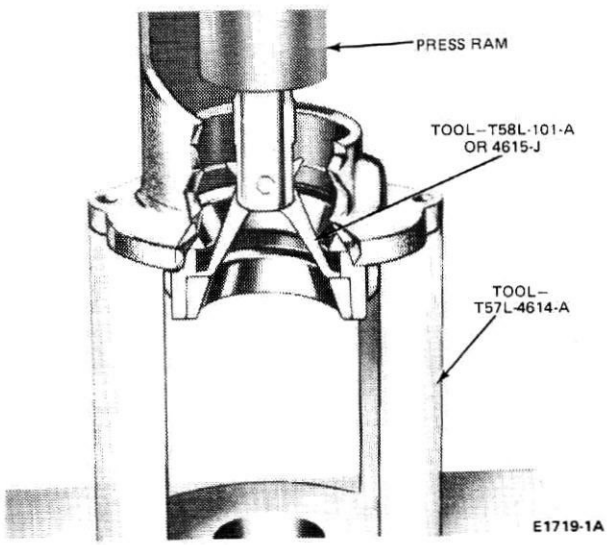


FIG. 35 Removing Pinion Rear Bearing Cup

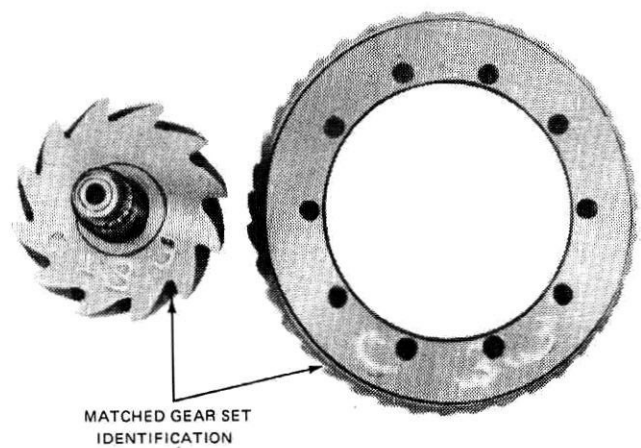


FIG. 38 Pinion and Ring Gear Markings

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reading.) The fit should be a slight drag-type feeling.

7. After the correct feeler gauge feel is obtained, check the reading in the conversion chart in Fig. 40. The chart indicates the shim thickness required according to the feeler gauge reading.

   NOTE: Inspect the service pinion gear that will be used for this build-up. If the pinion head is marked with a plus (+) or a minus (-) number, the amount shown as plus must be added and the amount shown as minus must be subtracted from the shim thickness as determined above. In addition, the same new rear pinion bearing used in determinig shim thickness must be used in final assembly.

8. After determining the correct shim thickness as explained in the fore-going steps, install the new pinion and ring gear as outlined under Assembly.

DIFFERENTIAL CASE BEARINGS AND RING GEAR TEST

If the ring gear runout check (before disassembly) exceeded specifications, the condition may be caused by a warped gear, a damaged case, or excessively worn differential bearings.

To determine the cause of excessive runout proceed as follows:

1. Assemble the two halves of the differential case together **without** the ring gear, and press the two differential side bearings on the hubs.
2. Place the cups on the bearings and set the differential case in the carrier.
3. Install the bearing caps and adjusting nuts as outlined in Steps 11 thru 14 under Assembly and Installation of Conventional Differential Case which follows in this Part of the manual.
4. Tighten the right nut two notches beyond the position where it first contacts the bearing cup. Turn the differential case several revolutions in each direction while the bearings are loaded, to seat the bearings in the cups. **This step is important.**
5. Now, loosen the right nut to release the preload. Check to see that the left nut contacts the bearing cup. Using the dial indicator set-up shown in Fig. 13, Part 15-01, adjust the preload to 0.008 to 0.012 case spread for new bearings or 0.005 to 0.008 for the original bearings, if re-used.
6. Check the runout of the differential case flange with a dial indicator. If the runout does **not now exceed specification, install a new ring gear. If the runout still exceeds specification, the ring gear is true and the trouble is due to either a damaged case or worn bearings.**
7. Remove the differential case from the carrier and remove the side bearings from the case.
8. Install new bearings on the case hubs, and place the differential assembly in the carrier without the ring gear.
9. Check the case runout again with the new bearings. If the runout is now within limits, the old bearings were excessively worn. Use the new bearings for assembly. **If the runout is still excessive, the case is damaged and should be replaced.**

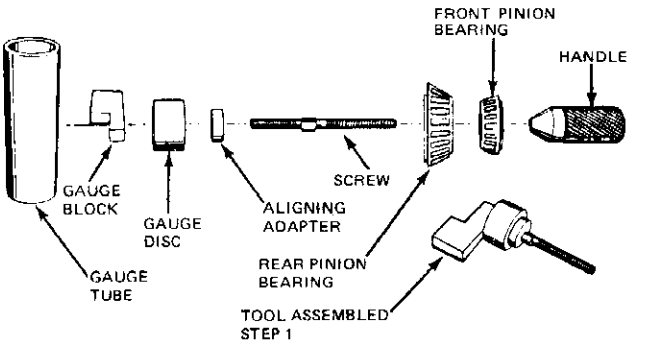


CHART I

Dash Number	Description	Removable Carriers	
		8.0	9.0
-A1	Aligning Adapter (1.300 O.D.)		X
-A8	Gauge Tube (2.892 O.D.)	X	X
-A9	Screw	X	X
-A10	Gauge Block (1.700 Thick)	X	X
-A11	Handle	X	X
-A12	Gauge Disc (.820 Thick)	X	
-A13	Gauge Disc (1.189 Thick)		X
-A14	Aligning Adapter (1.175 O.D.)	X	

F2517-1A

FIG. 39 Rear Axle Pinion Depth Gauge Tool (T75P-4020-A).

DIFFERENTIAL CARRIER ASSEMBLY

Pilot Bearing Installation

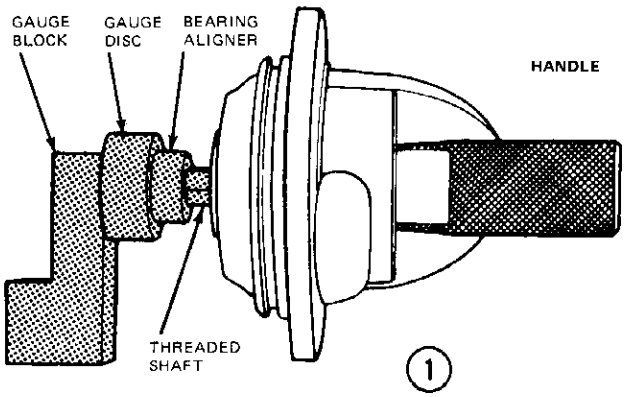
1. Drive the new pilot bearing inward until it bottoms. See Fig. 41.
2. Using the same tool shown in Fig. 41, install the new pilot bearing retainer with the concave side up.

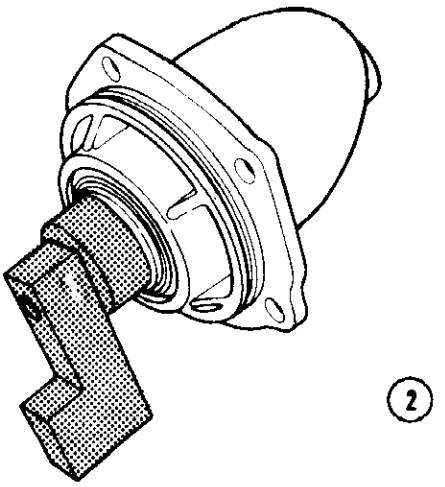
Collapsible Pinion Bearing Spacer Installation

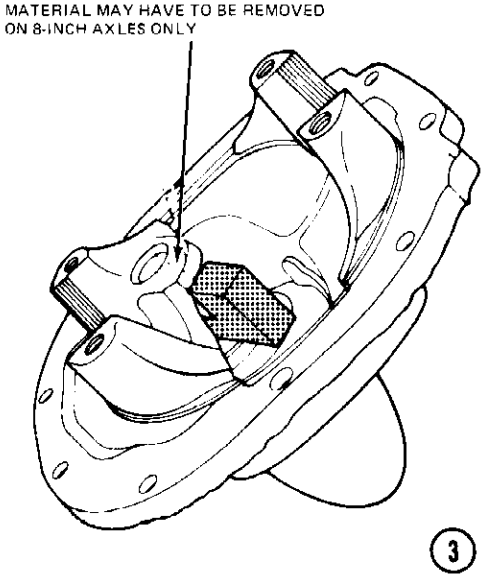
1. Install the drive pinion rear bearing cone and roller on the pinion shaft (Fig. 42). Place a new spacer on the pinion shaft (Fig. 43).
2. Place the bearing retainer on the pinion shaft, install the front bearing cone and roller, and press into position (Fig. 44). Be careful not to crush the bearing spacer.
3. Lubricate the O-ring with axle lubricant and install it in its groove in the pinion retainer. Be careful not to twist it. Snap the O-ring into position.
4. Place the proper shim on the carrier housing and install the pinion and retainer assembly, being careful not to pinch the O-ring.
5. Install the pinion attaching bolts, and torque to specification.
6. Place the slinger over the pinion shaft and against the front bearing.
7. Install a new seal in the bearing retainer (Fig. 46).
8. Install the U-joint flange (Fig. 47).
9. Start a new integral nut and washer on the pinion shaft.

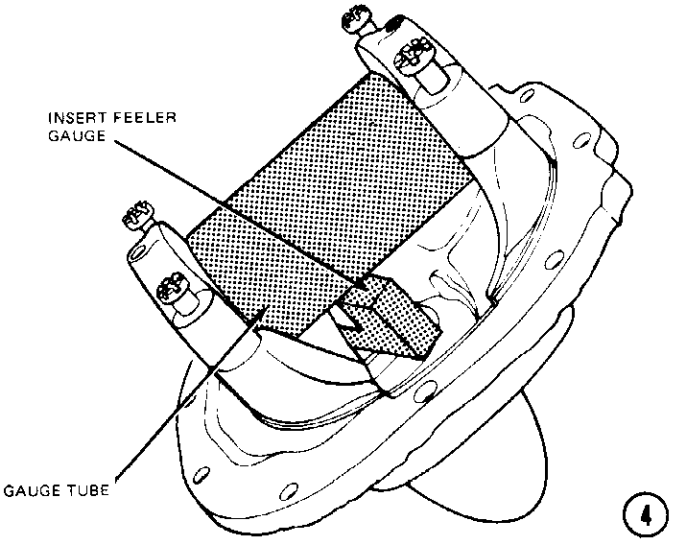
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DETROIT IRON









Feeler Gauge Reading	Shim Required	Feeler Gauge Reading	Shim Required	Feeler Gauge Reading	Shim Required
.035	.005	.023	.017	.011	.029
.034	.006	.022	.018	.010	.030
.033	.007	.021	.019	.009	.031
.032	.008	.020	.020	.008	.032
.031	.009	.019	.021	.007	.033
.030	.010	.018	.022	.006	.034
.029	.011	.017	.023	.005	.035
.028	.012	.016	.024	.004	.036
.027	.013	.015	.025	.003	.037
.026	.014	.014	.026	.002	.038
.025	.015	.013	.027		
.024	.016	.012	.028		

F2518-2A

FIG. 40 Using Pinion Depth Gauge Tool T75P-4020-A

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10. Hold the flange with the tool shown in Figs. 25, 26 or 27 and torque the pinion shaft nut to 175 ft-lb. **Do not exceed 175 ft-lb at this time.**
11. Check the pinion bearing preload as shown in Fig. 46. Correct preload will be obtained when the torque required to rotate the pinion in the retainer is to specification.

    If the torque required to rotate the pinion is less than specified, tighten the pinion shaft nut a little at a time until the proper preload is established. **Do not overtighten the nut.** If excessive preload is obtained as a result of overtightening, replace the collapsible bearing spacer.

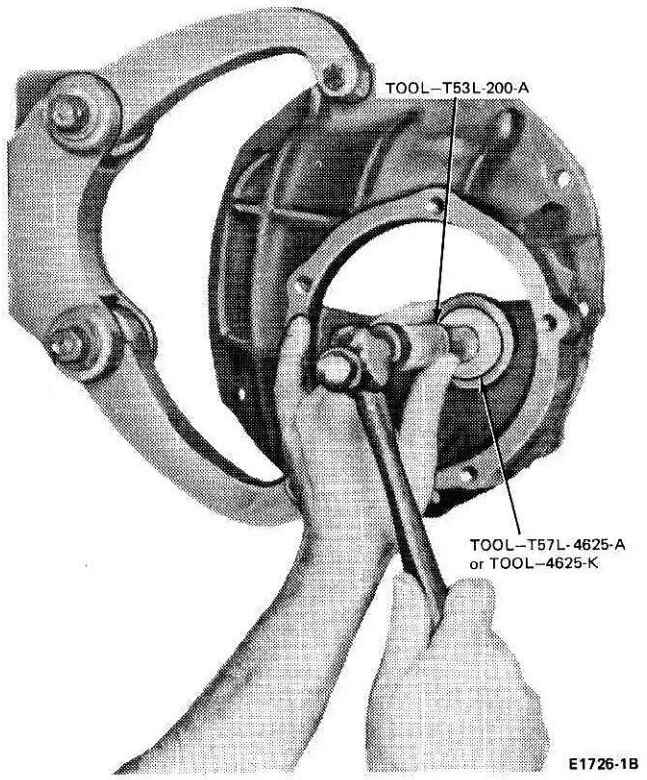


FIG. 41 Installing Pilot Bearing

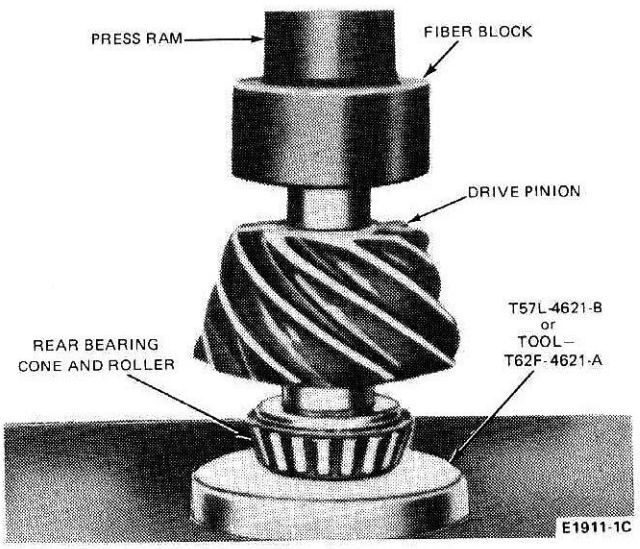


FIG. 42 Installing Pinion Rear Bearing Cone

Do not back off the pinion shaft nut to establish pinion bearing preload. If the torque on the pinion shaft nut is less than 175 ft-lb after bearing preload is established, a new collapsible spacer must be used.

Assembly and Installation of Differential Case

1. Place a side gear and thrust washer in the differential case bore (Fig. 49). **Lubricate all differential parts liberally with axle lubricant during assembly.**
2. With a soft-faced hammer, drive the differential pinion shaft into the case only far enough to retain a pinion thrust washer and pinion gear.
3. Place the second pinion and thrust washer in position, and drive the pinion shaft into place. **Carefully line up the pinion shaft lock pin holes.**
4. Place the second side gear and thrust washer in position (Fig. 49), and install the cover on the differential case. Install the pinion shaft lock pin. Insert pinion or axle shaft spline in the side gear spline to check for free rotation of the differential gears.
5. Clean the tapped holes in the ring gear with a suitable solvent. Insert two 7/16 (N.F.) bolts, two inches long, through the differential case flange, and thread them three or four turns into the ring gear as a guide in aligning the ring gear bolt holes. Press or tap the ring gear into position.
6. If the new bolts to be used show a green coating of approximately 1/2-inch or over of the threaded area, use as is; if not coated, apply a small amount of Loctite C3AZ-19554-A or equivalent. Torque to specification. **It is mandatory that bolts used once should not be used again.**
7. If the differential bearings have been removed, press them on as shown in Fig. 50.
8. Wipe a thin coating of lubricant on the bearing bores so that the differential bearing cups will move easily.
9. Place the cups on the bearings. If the gear set is of the **nonhunting or partial nonhunting** type, assemble the differential case and ring gear assembly in the carrier so that the marked tooth on the pinion indexes between the marked teeth on the ring gear as shown in Fig. 51.

   Be sure to match marked gears as indicated. When assembled out of time, the result is noise and improper mating.

   When installing the hunting type gear set (no timing marks), assemble the differential case and ring gear assembly in the carrier without regard to the matching of any particular gear teeth.
10. Slide the assembly along the bores until a slight amount of backlash is felt between the gear teeth.
11. Set the adjusting nuts in the bores so that they just contact the bearing cups. The nuts should be engaged about the same number of threads on each side.
12. Carefully position the bearing caps on the carrier. Match the marks made when the caps were removed.

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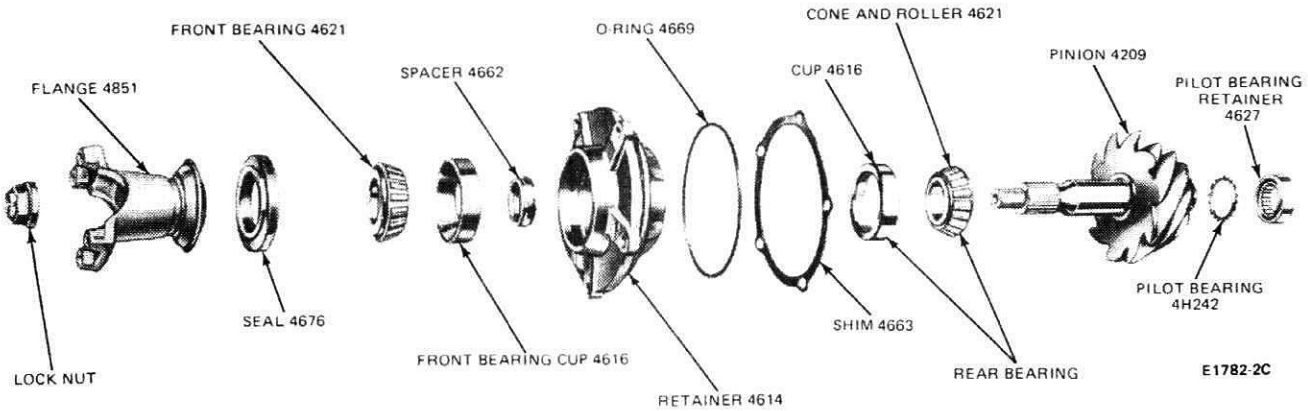


FIG. 43 Parts Arrangement—Pinion Assembly

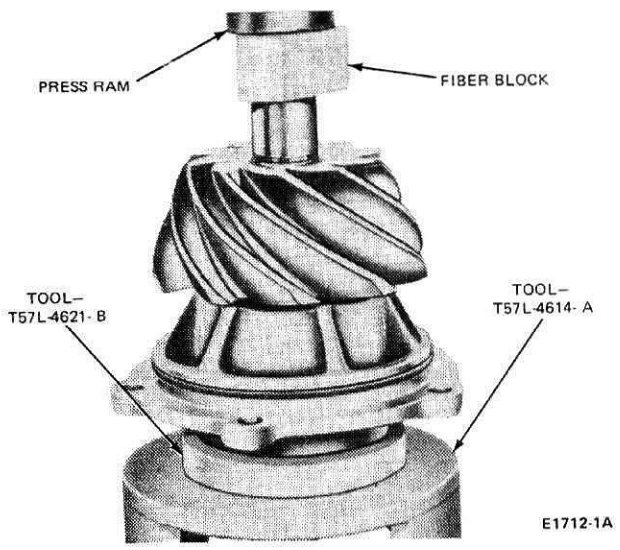


FIG. 44 Installing Pinion Front Bearing

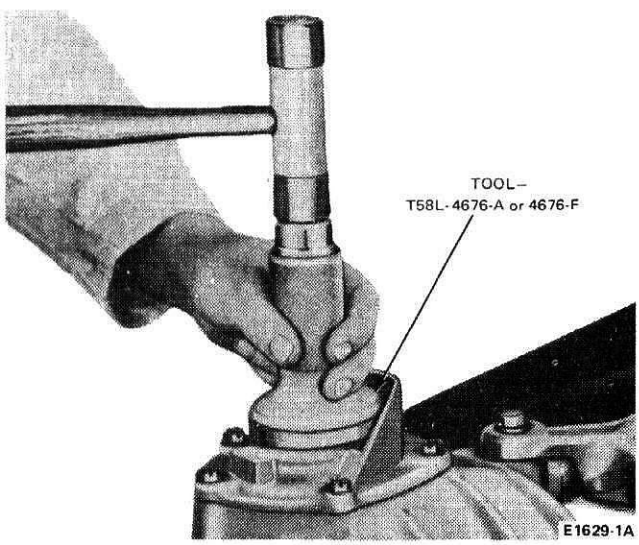


FIG. 46 Installing Oil Seal

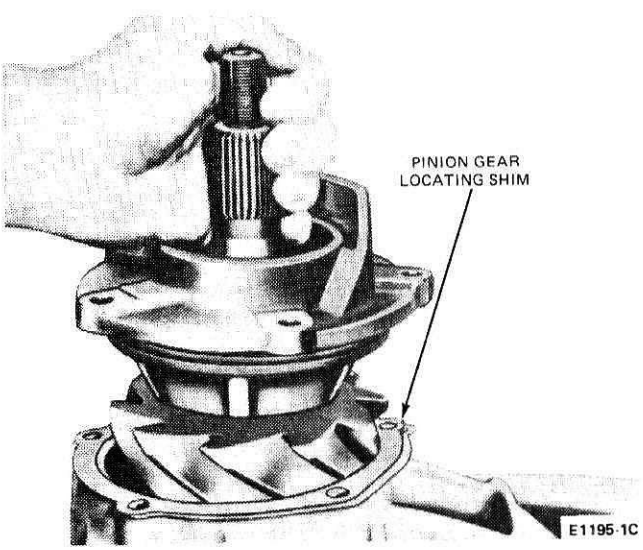


FIG. 45 Removing or Installing Pinion and Retainer Assembly

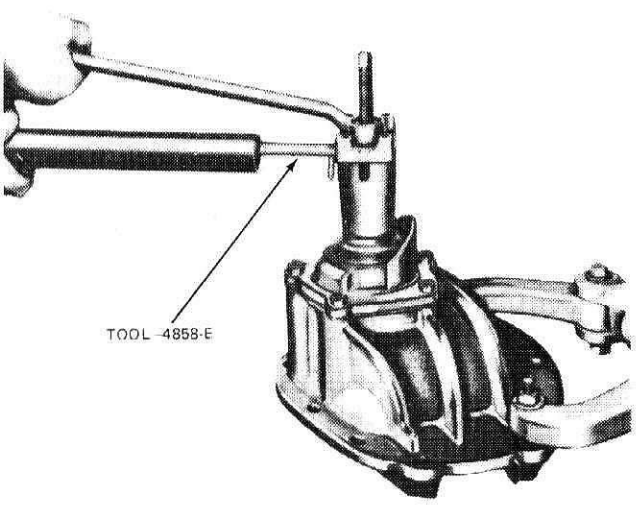


FIG. 47 Installing U-Joint Flange

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13. Install the bearing cap bolts and alternately torque them to specification.
14. If the adjusting nuts do not turn freely as the cap bolts are tightened, remove the bearing caps and again inspect for damaged threads of incorrectly positioned caps. Tighten bolts to the specified torque to be sure that the cups and adjusting nuts are seated. Loosen the cap bolts, and torque them to only 25 ft-lb before making adjustments.
15. Adjust the backlash between the ring gear and pinion as outlined in Part 15-01.
16. Be sure to make a final tooth pattern check before installing the carrier assembly in the axle housing.

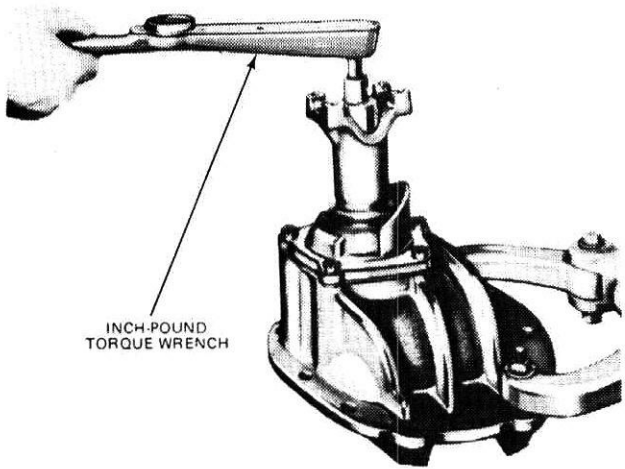


FIG. 48 Checking Pinion Bearing Preload

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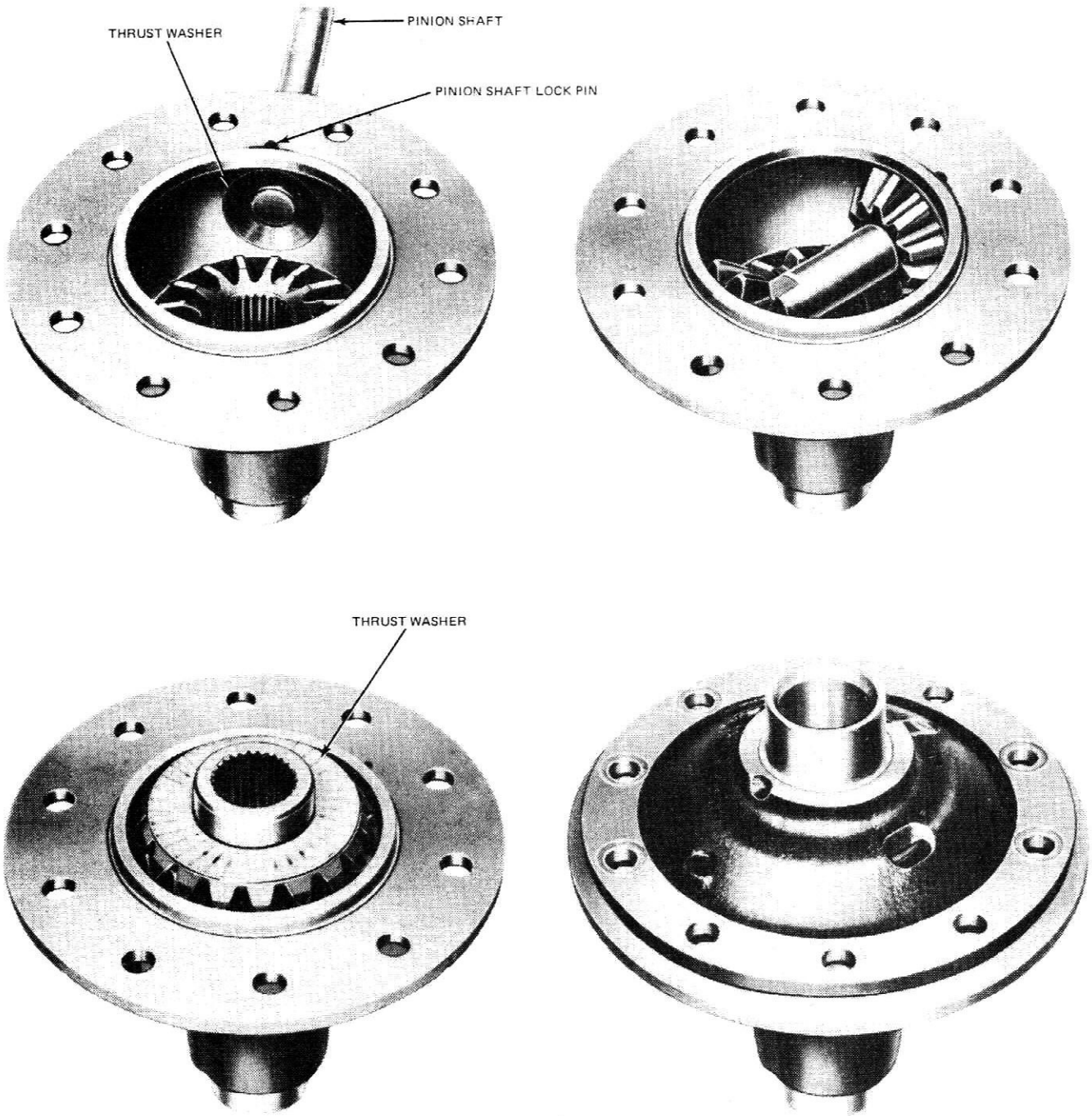


FIG. 49 Assembling Differential Case

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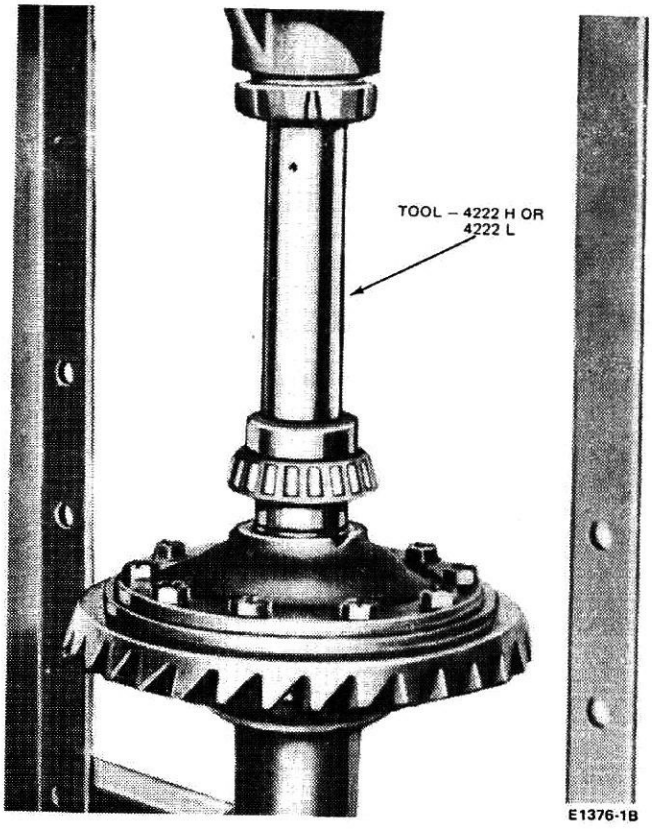


FIG. 50 Installing Differential Bearing

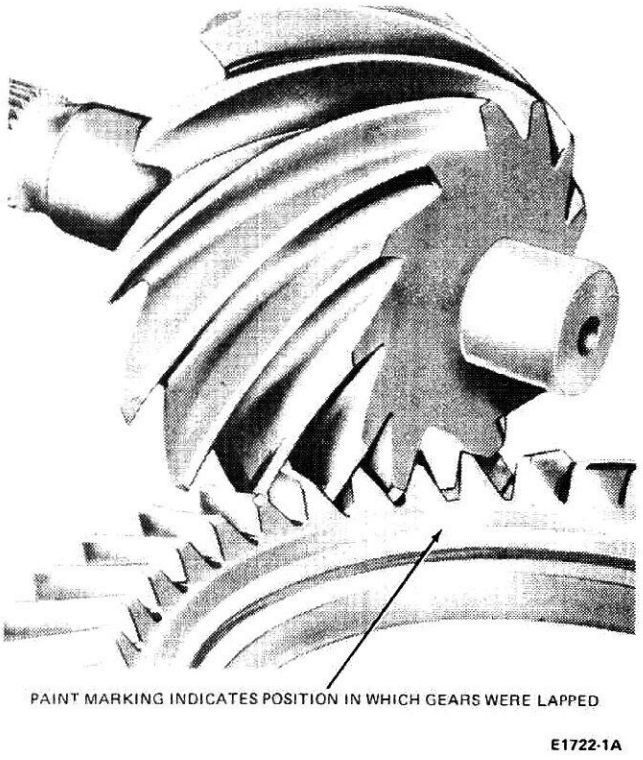


FIG. 51 Gear Set Timing Marks

SPECIFICATIONS

DRIVING AXLE IDENTIFICATION – LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type		Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type
WGB-V	2.75:1	9	C2		WGC-K	2.50:1	9	C2
WGB-W	3.00:1	9	C2		WGC-N	2.75:1	9	C2
WGB-AB	2.50:1	9	C2		WFV-T	2.75:1	9	T4
WGB-AD	2.75:1	9	C2		WFY-A	2.75:1	9	T4
WGC-A	2.75:1	9	C2		WFY-K	3.00:1	9	T4

① **Type:** C4 – Conventional 4-Pinion T4 – Traction-Lok 4-Pinion

CE2579-2E

DRIVING AXLE IDENTIFICATION – FORD AND MERCURY

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type		Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type
WDC-DW	2.75:1	9	C2		WDC-EL	2.50:1	9	C2
WDC-EB	2.75:1	9	C2		WDC-EM	2.50:1	9	C2
WDC-EE	3.00:1	9	C2		WFG-AL	3.00:1	9	T4
WDC-EH	2.75:1	9	C2		WFG-AA	2.75:1	9	T4
WDC-EK	3.00:1	9	C2		WFG-BJ	2.75:1	9	T4

① **Type:** C4 – Conventional 4-Pinion C2 – Conventional 2-Pinion
T4 – Traction-Lok 4-Pinion T2 – Traction-Lok 2-Pinion

CE2580-2D

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DRIVING AXLE IDENTIFICATION – LTD II, COUGAR AND THUNDERBIRD

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type		Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type
WEB-BF	2.50:1	9	C2		WFA-AA	3.00:1	9	T4
WEB-BK	3.00:1	9	C2		WFA-AH	3.00:1	9	T4
WEB-BM	2.75:1	9	C2		WFA-AL	2.75:1	9	T4

① **Type:** C4 – Conventional 4-Pinion C2 – Conventional 2-Pinion
T4 – Traction-Lok 4-Pinion T2 – Traction-Lok 2-Pinion

CE2581-2E

DRIVING AXLE IDENTIFICATION–MUSTANG II, PINTO, BOBCAT, GRANADA, MONARCH AND VERSAILLES

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type		Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential ① Type
WDW-AB	2.79:1	8	C2		WDY-S	3.40:1	8	C2
WDW-Z	3.00:1	8	C2		WDY-W	3.40:1	8	C2
WDX-E	2.75:1	9	C2		WFB-G	2.50:1	9	T4
WDY-AA	3.00:1	8	C2		WFB-K	2.50:1	9	T4
WDY-AH	3.40:1	8	C2					

① **Type:** C4 – Conventional 4-Pinion C2 – Conventional 2-Pinion
T2 – Traction-Lok 2-Pinion T4 – Traction-Lok 4-Pinion

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ATTACHING TORQUE SPECIFICATIONS (REMOVABLE CARRIER)

Description	Torque (Ft-Lb)
Differential Bearing Cap Bolts – 8.9 Inch	70-85
Differential Bearing Adjusting Nut Lock Bolts (All)	12-25
Carrier to Housing Stud Nuts (All)	25-40
Pinion Retainer to Carrier Bolts (All)	30-45
Ring Gear Attaching Bolts (All) Except 6¾ Using Loctite	70-85
Oil Filler Plug (All)	25-50

Description	Torque (Ft-Lb)
Rear Axle Shaft Bearing Retainer Bolt Nuts:	
Mustang, Pinto, Bobcat, Granada and Monarch	20-40
LTD II, Thunderbird and Cougar	20-40
Ford, Meteor, Mercury, Lincoln Continental and Continental Mark V	50-70
Universal Joint to Drive Pinion Companion Flange Bolt Nuts All Except Circular Flange:	8-15
Circular Flange:	70-90

ADJUSTMENT TORQUE SPECIFICATIONS (REMOVABLE CARRIER)

Description	Torque In-Lb	Torque Ft-Lb
Minimum torque required to tighten pinion flange nut to obtain correct pinion bearing preload		
8.9 (collapsible spacer)		170 (1)
Pinion Bearing Preload (collapsible spacer) (2)		
Original Bearings 8.9	8-14	
New Bearings 8.9	17-27	

Description	Torque In-Lb	Torque Ft-Lb
Pinion Bearing Preload	13-33	
Rotating Torques required during bench check after assembly or in vehicle with one wheel on the ground.		
Original Clutch Plates Traction-Lok and Borg Warner Locker (All)		40 Min.
New Clutch Plates Traction-Lok and Borg Warner Locker (All)		100-250 (3)

(1) If pinion bearing preload exceeds specification before this torque is obtained, install a new spacer.
(2) With Oil Seal
(3) Rotating torque may fluctuate up to 40 Ft-Lbs.

CLEARANCE, TOLERANCE AND ADJUSTMENTS SPECIFICATIONS (REMOVABLE CARRIER)

Description	Inches
Maximum Runout of Backface of Ring Gear (All)	0.003
Differential Side Gear Thrust Washer Thickness (All)	0.030-0.032
Differential Pinion Gear Thrust Washer Thickness (All)	0.030-0.032
Drive Pinion Bearing Solid Spacers –	
6 spacers in increments of 0.002	0.466-0.476
14 spacers in increments of 0.001	0.477-0.490
Differential Bearing Preload (Case spread across Differential)	
New Bearings (All) Except Mustang and Pinto	0.008-0.012
Original Bearings Mustang and Pinto	0.004-0.008
6¾ Ring Gear	0.003-0.005
8, 9 Ring Gear	0.005-0.008

Description	Inches
Nominal Pinion Locating Shim	
9 Ring Gear	0.015
8 Ring Gear	0.022
Available Pinion Gear Shims in steps of 0.001	
8, 9	0.010-0.029
Backlash between Ring Gear and Pinion Teeth (All)	0.008-0.012
Maximum Backlash Variation Between Teeth (All)	0.003
Maximum Radial Runout of U-joint Flange in Assembly All Except Circular Piloted Flange:	0.012 T.I.R.
Circular Piloted Flange:	0.005 T.I.R.
Circular Piloted Flange Lateral Runout	0.005 T.I.R.

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DETROIT IRON

SPECIAL TOOLS

Tool Number	Description	Usage
T50T-100-A	Impact Slide Hammer	(1)
T57L-500-A	Bench Mounted Holding Fixture	(1)
TOOL-1175-AB	Grease Seal Remover (Use with Slide Hammer T50T-100-A	(1)
T60K-1225-A	Rear Axle Shaft Bearing Remover and Replacer	(5)
TOOL-1225-DA	Axle Shaft Bearing Remover	(3)
T75P-1165-A, -B, -C, -D	Axle Shaft Bearing (Tapered) and Seal – Remover and Replacer	(8)
T76P-1165-E	Axle Bearing Seal Remover	(8)
T75P-4020-A	Rear Axle Pinion Depth Gauge Tool	(3)
T57L-4067-A	Differential Bearing Adjuster Wrench	(1)
T60K-4067-A	Differential Bearing Adjuster Nut Wrench	(5)
TOOL-4201-C	Differential Backlash and Runout Gauge, With Universal Bracket Dial Indicator and Bracket	(1)
T57L-4220-A	Differential Bearing Assembly Remover	(2) (5)
T66P-4220-A	Remover – Differential Bearing Assembly	(3) (6)
T57L-4221-A	Differential Side Bearing Cone Replacer	(1)
TOOL-4221-AF	Differential Bearing Cone Remover – Pilot (Use with TOOL-4221-C)	(1)
TOOL-4221-AH	Differential Bearing Cone Remover – Conventional Axle	(3)
TOOL-4221-AJ	Differential Bearing Cone Remover	(3)
TOOL-4221-AL	Differential Bearing Cone Remover – Pilot (Use with 4221-C)	(5)
TOOL-4221-C	Differential Side Bearings Remover	(1)
TOOL-4222-H	Differential Bearing Cones Replacer	(3)
TOOL-4222-L	Differential Side Bearing Cones Replacer	(3)
T66L-4234-A	Rear Axle Shaft Assembly Remover Adapter (Use with T50T-100-A)	(1)
T73L-1177-C	Rear Wheel Bearing Oil Seal Replacer	(6)
TOOL-1177	Rear Wheel Bearing Oil Seal Replacer	(7)
T68P-4602-A	Pinion Angle Level Gauge	(1)
T68P-4602-AA	Frame	(1)
T90P-4067-A	Differential Bearing Adjuster Nut Wrench	(1)
T68P-4602-AB	Vial	(1)
T68P-4602-AC	Magnet	(1)
T57-4614-A	Pinion Front Bearing Remover	(1)
T55P-4616-A2	Drive Pinion Bearing Cup Remover and Replacer	
T56T-4616-A	Drive Pinion Bearing Cup Replacer Adapters	(2)
T57-4616-A use with TOOL T57L-4614-A	Drive Pinion Bearing Cup Remover and Replacer	(3)
T60K-4616-A	Pinion Bearing Cups Replacer (Inner and Outer)	(5)
T67P-4616-A	Pinion Bearing Cups Replacer	(2) (5)
TOOL-4621-A	Wheel Bearing Installer	(1)
T71P-4621-B or T69P-4621-A	Pinion Bearing Cone Replacer	(1)
T57L-4625-A use with TOOL T53L-200-A	Drive Pinion Pilot Bearing and Retaining Ring Remover and Replacer	(3) (6)
T62F-4625-A	Drive Pinion Pilot Bearing and Retaining Ring Remover and Replacer	(5)
TOOL-4625-AA	Drive Pinion Bearing Cup – Rear Remover	(5)
TOOL-4625-AB	Drive Pinion Bearing Cup – Rear Replacer	(5)
TOOL-4625-K	Drive Pinion Pilot Bearing – Remover and Replacer	(3)
TOOL-4625-L	Drive Pinion Rear Bearing Cup Remover	(5)
T55P-4676-A	Companion Flange Oil Seal Replacer	(5)
T58L-4676-A or 4676-F	Companion Flange Oil Seal Replacer	(1)
T62F-4676-A	Drive Pinion Oil Seal Replacer	(5)
T65L-4851-A or T65L-4851-B	Flange (Universal Joint) Remover	(1)
T68P-4851-A	Universal Joint – Flange Holder – (circular)	(4)
TOOL-4851-K	Universal Joint – Flange Holder	(2) (5)
TOOL-4858-E	Companion Flange and Pinion Bearing Replacer	(3)

(1) All
(2) Ford, Mercury
(3) Ford, Mercury, Lincoln Continental, Continental Mark V
(4) Lincoln Continental, Continental Mark V
(5) Mustang II, LTD II, Thunderbird, Cougar, Granada, Monarch, Versailles
(6) Continental Mark V
(7) Ford, Mercury, Lincoln Continental
(8) Vehicles with Tapered Axle Shaft Bearings

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LUBRICANT CAPACITIES AND CHECKING PROCEDURES (REMOVABLE CARRIER)

Vehicle	Engine (C.I.D.)	Axle	U.S. Measure-Capacity (Pints)	Imperial Capacity (Pints)
Pinto, Bobcat, Mustang II (1)	2.8L	8 inch	4.0	3-3/8
Granada, Monarch, Versailles (1)	3.3/4.1L (200/250 CID) 5.0L (302 CID)	All	4.0	3-3/8
Ford, Mercury, LTD II, Thunderbird, Cougar (2)	5.8L (351 CID) 6.6L (400 CID)	All	5.0	4.0
Lincoln Continental and Continental Mark V (2)	7.5L (460 CID)	All	5.0	4.0

All conventional axles use ESW-M2C-105-A lubricant. All limited slip axles use ESW-M2C-119-A lubricant.

(1) Approximate refill capacity—Actual lubricant capacities are determined by filling to 3/8 inch below filler plug hole.

(2) 1/2 inch below bottom of filler hole.

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DETROIT IRON

Traction—Lok Limited Slip Differential—Ford

PART 15-40

Does Not Apply to Vehicles with Integral Carrier Axles

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CF2515-2A

DESCRIPTION

The axle assembly, except for the differential case and its internal components, is identical to the *conventional* axle.

The Traction-Lok differential (Fig. 1) employs a multiple disc clutch to control differential action. The side gear mounting distance is controlled by 9 plates; 4 steel, 4 friction, and one composite plate (steel on one side, friction material on the other). These plates are stacked on the clutch hub and along with 4 ear guides are housed in the differential cover. Also located in the differential case, between the side gears, is a one-piece pre-load plate and block and four calibrated pre-load springs, which apply an initial force to the clutch pack. Additional clutch capacity is derived from the side gear thrust loads. The four friction plates are splined to the clutch hub which in turn is splined to the left axle-shaft, and the eared steel plates are dogged to the case; thus, the clutch is always engaged.

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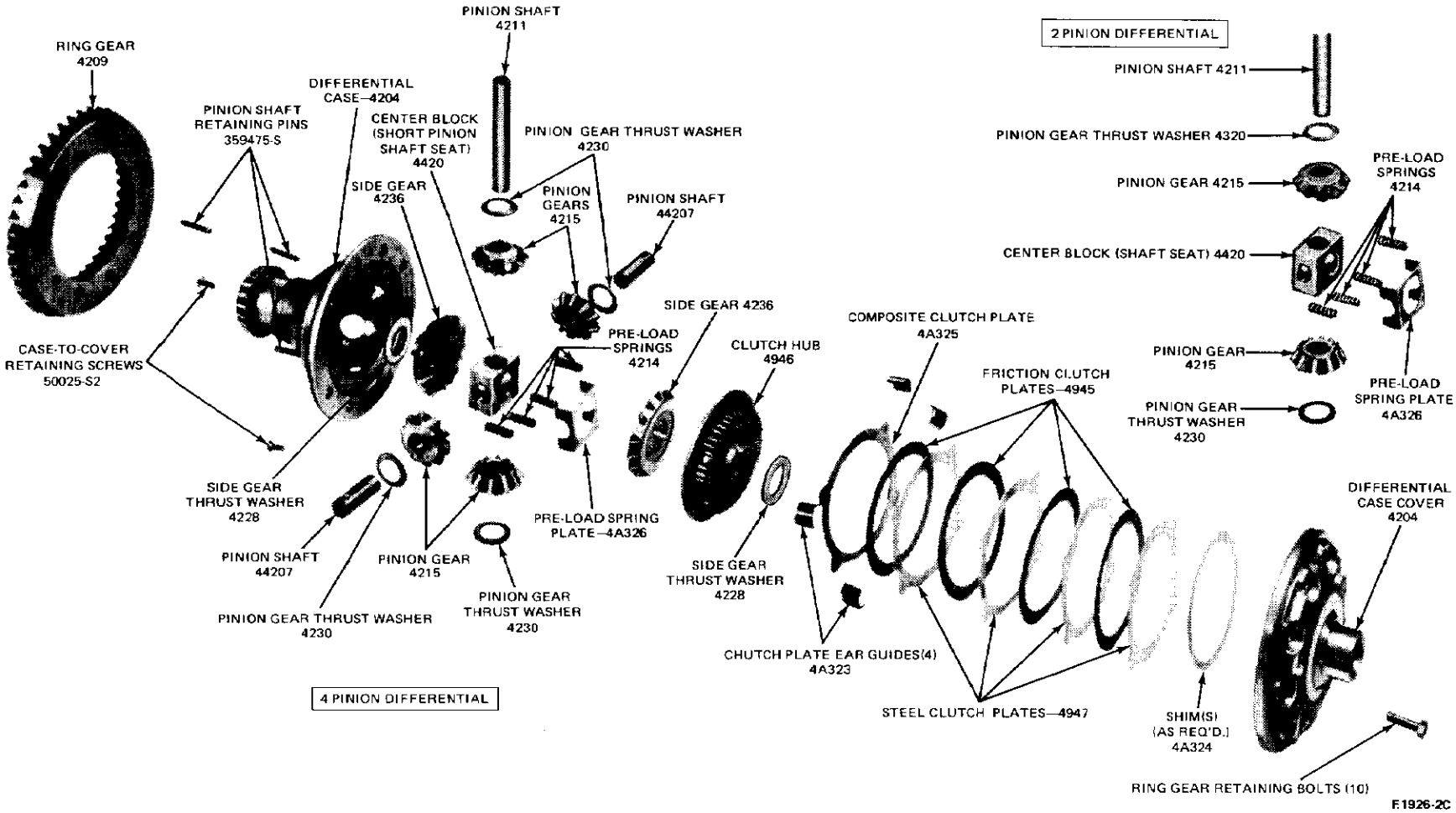


FIG. 1 Traction-Lok Differential

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DETROIT IRON

OPERATION

In operation, the clutch will transfer power to whichever wheel is not dipping in cases where one wheel is on ice or a slippery surface. In other words, resistance to rotating increases the clutch action.

On a totally icy surface, both wheels can be made to rotate together by lightly applying the hand brake. Once again, resistance to rotation increases the clutch action.

TESTING

Test procedures for the Traction-Lok differential are given in Part 15-01.

ADJUSTMENTS

No in-vehicle adjustments are possible on this unit. Refer to Part 15-10 for adjustments to the axle in which it is installed.

REMOVAL AND INSTALLATION

Refer to Part 15-10 for removal of this differential, which is removed and installed in the same manner as a conventional differential.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

1. Remove **and discard** the ten bolts and flat washers securing the ring gear to the differential case assembly. The ring gear must be removed in order to separate the case halves.
2. Remove the ring gear by tapping the gear with a soft hammer or press the gear from the case.
3. Place the differential case in a press to load the case at the bearing journals so that the pre-load of the springs is overcome (approx. 1,500 lbs). **If a press is not available, two 7/16-inch bolts and nuts can be used in the ring gear mounting holes (one on each side) to compress the case halves together and overcome preload spring tension.** Then, while the case is still under pressure, loosen the two Allen or Phillips head screws, which hold the case halves together, until one or two threads of the screw remain engaged. Remove the case assembly from the press. Tap on the cover to spring it loose; then, remove both screws.
4. With the cover facing down, lift off the case. Remove the pre-load spring plate and four pre-load springs.
5. From the cover, remove the side gear, four clutch plate car guides, clutch hub, friction and steel clutch plates and shims.
6. With a suitable drift, drive out the pinion shaft lock pins from the case.
7. With a brass drift, drive out the long pinion shaft from the case. Drive from the end opposite the lock pin hole.
8. Remove the two short pinion shafts using a drift, driving each shaft from the center outward. Lift out the center block, then remove the pinion gears, thrust washers and side gear and thrust washer.
9. If the differential bearings are removed, the bearings can be installed in one of the following ways:
   a. With the differential case and cover completely assembled.
   b. On the case or cover when disassembled. However, when pressing the bearing on the cover, a block of wood or fiber must be used as shown in Fig. 2 in order to avoid damage to the cover.

ASSEMBLY

1. Lubricate all parts with C9AZ-19580-A lubricant (or equivalent) during assembly.
2. Mount the differential case in a soft jaw vise and place a side gear thrust washer and side gear in the counterbore of the case.
3. Install the pinion thrust washers and place the pinion gears on the side gear aligning the holes in the washers and gears with the holes in the case.
4. Install the center block so that the shaft holes are aligned with the holes in the pinion gears and case. **The center block has two machined sides and two rough sides.**
5. With a brass drift, drive in the long pinion shaft from the outside of the case, aligning the lock pin holes in the shaft with the holes in the case. **The**

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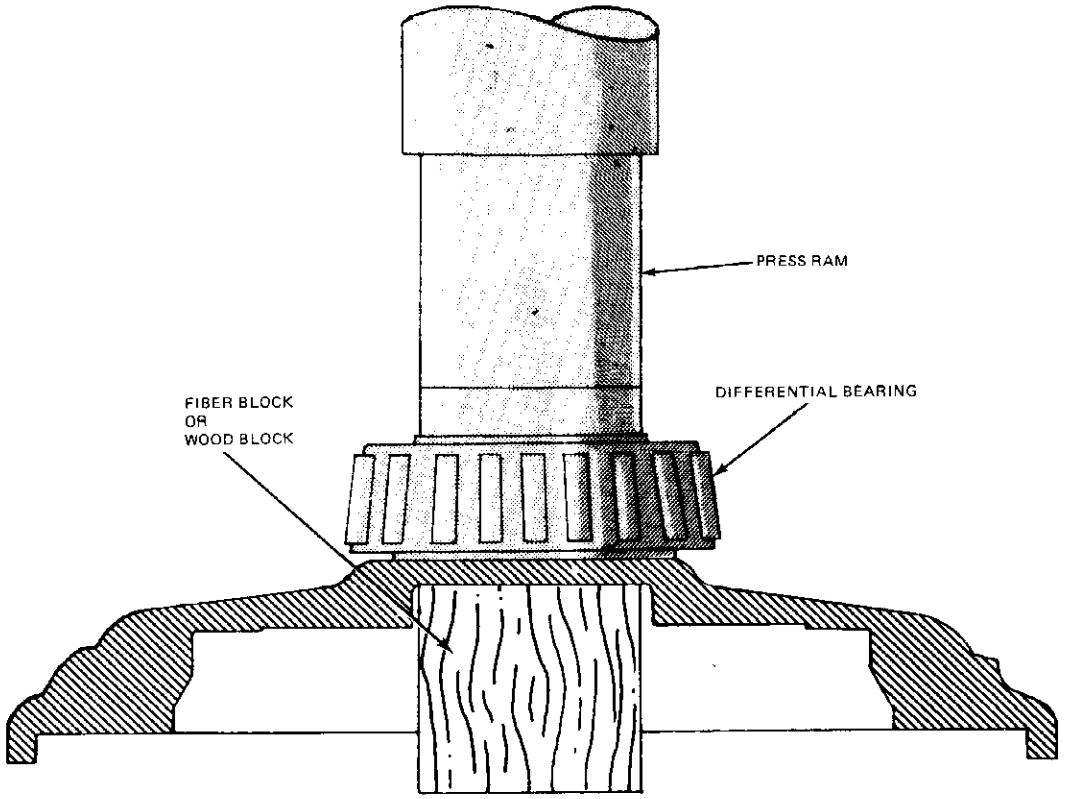


FIG. 2 Installing Differential Bearing

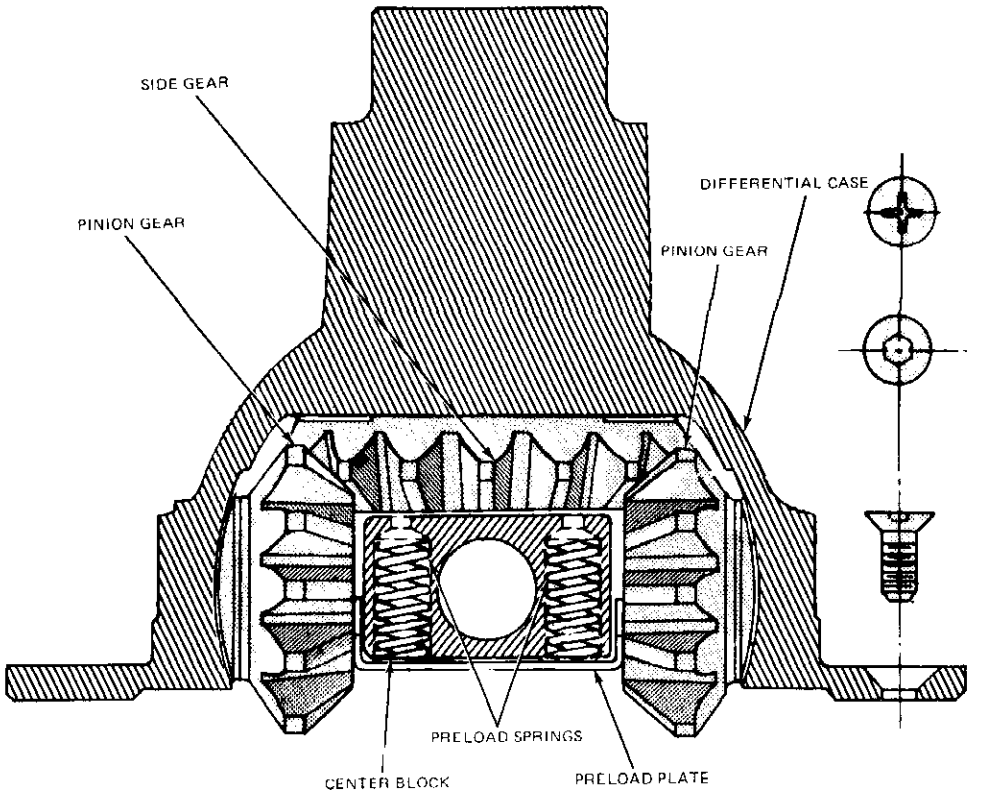


FIG. 3 Center Block and Pre-load Springs Installation

center block should be positioned so the long shaft is driven through the rough side and short shafts driven through the machined side (Fig. 3).

6. With a suitable drift, install the shaft lock pins. Make sure the pinion and side gears move freely.
7. Place the four pre-load springs in the holes provided in the center block.

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8. Position the pre-load plate over the four springs, making sure the springs are properly seated. The preload plate straddles the center block over its narrower or machined width.
9. Mount the differential cover in a soft jawed vise or holding fixture.
10. Insert shim(s) of 0.050 total thickness in the cover cavity.
11. Install the composite plate (friction material on one side and steel on the opposite) on the back side of the clutch hub with the friction material against the hub; next, install a friction plate, then steel, friction, steel, friction, steel, friction, and lastly a steel plate (Figures 1 and 4). **When new clutch plates are used, soak the plates in Ford Hypoid Lubricant** (C9AZ-19580-A or equivalent) for approximately 30 minutes before installation.
12. Place the clutch hub with the clutch plates into the clutch ear cavities in the differential cover. Make sure that the splines on the last friction plate are engaged on the hub.
13. Obtain locally a 5/8" x 2-1/2" or 9/16" x 2-1/2" bolt, a nut and two 1-1/2" outside diameter flat washers approx. 1/8" in thickness. These parts are required to compress the clutch pack in order to obtain the proper shim selection. Install a flat washer on the bolt, and place the bolt through the clutch hub. Hold the bolt in position and turn the cover over. Place a flat washer on the bolt and then install the nut. Be sure the washers are centered, and torque the nut 10 or 15 ft-lb. (Fig. 5).
14. Place the shim template tool (T68P-4946-A) in the clutch hub (Fig. 5), allowing some clearance between the shim tool and the cover-to-case mating surface. **Using a feeler gauge, determine the exact amount of clearance.** The shim pack thickness chart will indicate the correct amount of shims to subtract from the 0.050 shim originally installed. **In order to correctly select the proper shim(s), the shim template tool and the chart must be used. Refer to Specifications.**
15. After the proper shim selection is determined, remove the bolt, nut and flat washers. If it is necessary to revise the shim thickness, remove the clutch hub and clutch plates.
16. Install the selected shim(s) in the cover cavity, reinstall the components as outlined in Steps 11 and 12.
17. Install the four steel clutch ear guides and side gear.
18. Place both assemblies in a press, and press the two halves together; then, insert the two Allen head or Phillips head screws, and tighten evenly until tight. If a press is not available, use any two stock bolts and nuts, opposite each other in the ring gear retaining holes, to compress both halves.
19. Clean tapped holes in the ring gear with a suitable solvent. If the new bolts to be used show a green coating over approximately 1/2-inch of the threaded area, use as is. If not coated, apply a small amount of Loctite (Part Number C3AZ-19554-A or equivalent). Torque to specification. **It is mandatory that bolts used once should not be used again.**
20. Prior to installation of the torque sensitive-locking differential into a vehicle, a bench torque check must be made. With currently released locker tools, check the torque required to rotate one side gear

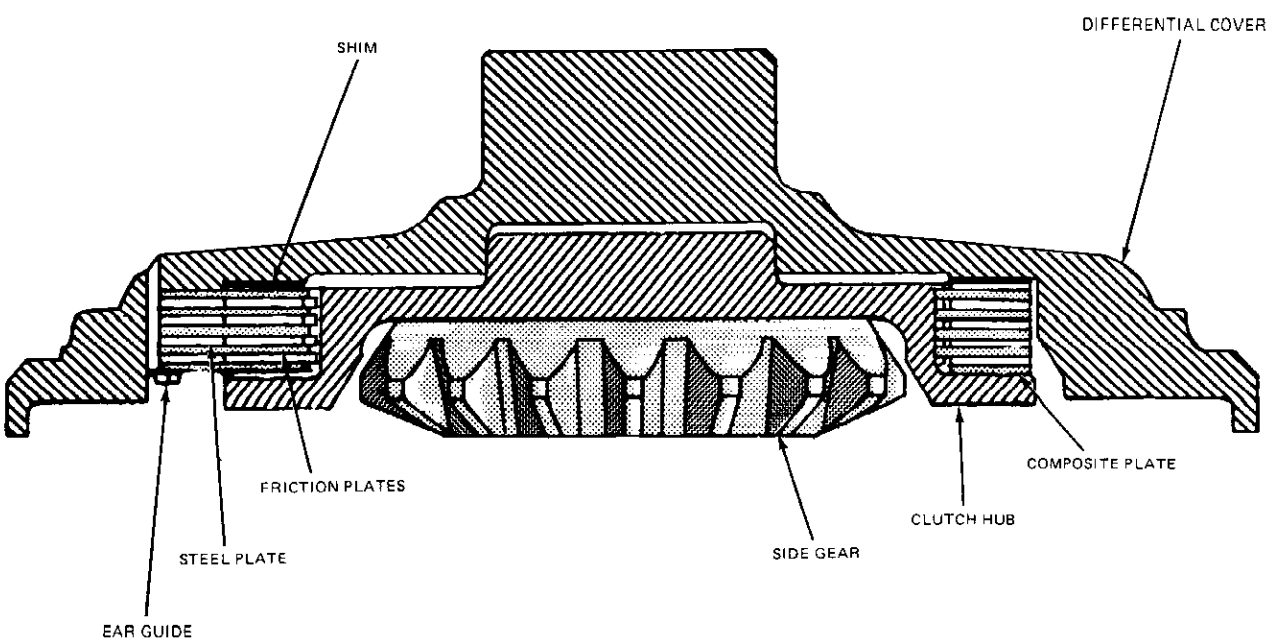


FIG. 4 Clutch Pack Installation

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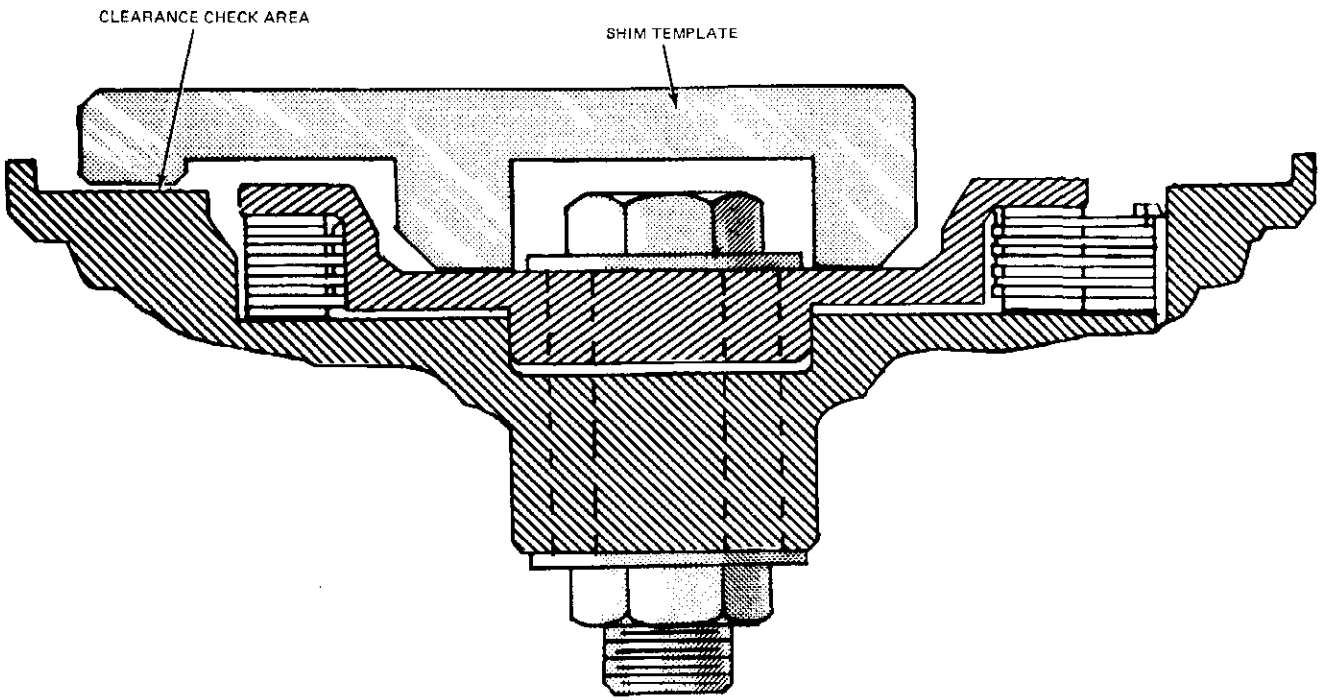


FIG. 5 Shim Template Tool Application

while the other is held stationary. The initial break-away torque, if the original clutch plates are used, should be no less than 40 ft-lb. If new clutch plates are used, the break-away torque should run from 100-250 ft-lb. The rotating torque required to keep the side gear turning with new clutch plates may fluctuate up to 40 ft-lb.

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DETROIT IRON

SPECIFICATIONS

GRANADA, MONARCH, VERSAILLES

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential Type
WFB-G	2.50:1	9	T4
WFB-K	2.50:1	9	T4

LTD II, COUGAR, THUNDERBIRD

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential Type
WFA-AA	3L00:1	9	T4
WFA AH	3.00:1	9	T4
WFA AL	2.75:1	9	T4

LINCOLN CONTINENTAL, CONTINENTAL MARK V

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential Type
WFV-I	2.75:1	9	T4
WFY-A	2.75:1	9	T4
WFY K	3.00:1	9	T4

FORD, MERCURY

Identification Tag	Ratio	Ring Gear Diameter (Inches)	Differential Type
WFG-AL	3.00:1	9	T4
WFG-AA	2.75:1	9	T4
WFG-BJ	2.75:1	9	T4

SPECIAL TOOLS

Tool No.	Description	Usage
T59L-4204-A	Locking Differential Torque Check	(1) (2) (3)
T65K-4204-A	Locking Differential Torque Check	(2) (3)
T66L-4204-A	Locking Differential Torque Check	(1)
T68P-4946-A	Locking Differential Gauge	

(1) Ford, Mercury, Lincoln Continental, Continental Mark V
(2) LTD II, Cougar, Thunderbird
(3) 9-Inch Ring Gear

TRACTION-LOK DIFFERENTIAL SHIM PACK THICKNESS CHART

Feeler Gauge Reading (Inches) (1)	Remove Shim(s) From Nominal	Total Req'd. Shim Pack Thickness (Inches) (2)	Feeler Gauge Reading (Inches) (1)	Remove Shim(s) From Nominal	Total Req'd. Shim Pack Thickness (Inches) (2)
0.001-0.002	None	0.050	0.028-0.032	0.030	0.020
0.003-0.007	0.005	0.045	0.033-0.037	0.035	0.015
0.008-0.012	0.010	0.040	0.038-0.042	0.040	0.010
0.013-0.017	0.015	0.035	0.043-0.047	0.045	0.005
0.018-0.022	0.020	0.030	0.048-0.050	0.050	0.000
0.023-0.027	0.025	0.025			

(1) With clutch hub, shims and clutch plates compressed 10-15 ft-lbs.
(2) Service shims are available in 0.010 inch and 0.005 inch thicknesses.

CE2200-2H

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Drive Shaft — Single Cardan Type U-Joint

PART 15-60

Applies To All Models Except Lincoln Continental and Versailles

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Drive Shaft Runout Check	60-2

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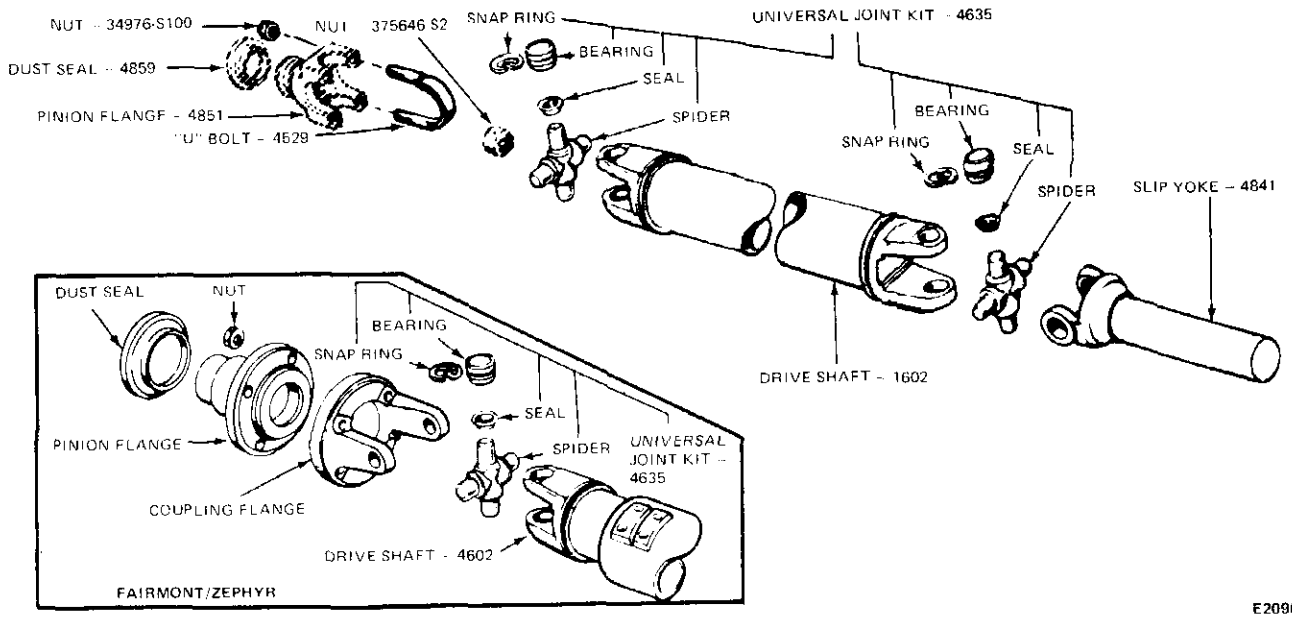
DESCRIPTION

The drive shaft is the means of transferring power from the engine, through the transmission, to the differential in the rear axle, which transmits it to the rear wheels.

The drive shaft incorporates two universal joints and a slip yoke (Fig. 1).

The splines in the yoke and on the transmission output shaft permit the drive shaft to move forward and rearward as the axle moves up and down. This provides smooth operation under all driving conditions.

All drive shafts are balanced. If the vehicle is to be undercoated, cover the drive shaft and universal joints to prevent application of the undercoating material.



E2096-2F

FIG. 1 Drive Shaft and Universal Joints Disassembled

TESTING

DRIVE LINE BALANCE CHECK

If detailed parts of the drive shaft are replaced and shaft vibration is encountered after installation, disconnect the shaft at the slip yoke. Rotate the slip yoke 180 degrees; then, reconnect the shaft to the slip yoke. If the vibration persists, disconnect the shaft at the rear axle companion flange. Rotate the companion flange 180 degrees and reconnect the shaft to the flange.

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DRIVE LINE ANGLE CHECK

Vibration or shudder which is noticeable either on fast acceleration, when coasting, or when using the engine for braking, may be caused by the rear axle housing being loose on the rear springs or by improper pinion angle. Refer to Group 14, for pinion angle checking procedures. If the rear axle U-bolts (Pinto/ Bobcat/Mustang, Granada/Monarch/ only) are loose, torque the nuts to specification.

DRIVE SHAFT RUNOUT CHECK

Using a dial indicator, check the runout at each end and in the middle of the drive shaft. The rear check should be made on the small tube section of the shaft between the balance weights and the yoke welds. Drive shaft runout should not exceed 0.035 inch at any one point.

ADJUSTMENTS

DRIVE SHAFT BALANCING

Without Using Special Equipment

If an out-of-balance condition exists and if the vehicle has been undercoated, any such excess material should first be cleaned off the drive shaft.

The vehicle should then be road tested. If the problem still exists, the driveshaft should be rotated 180 degrees and the vehicle road tested again.

If rotating the drive shaft 180 degrees does not eliminate vibration, the drive shaft may be balanced using the following procedure:

1. Place the vehicle on a twin-post hoist so that the rear of the vehicle is supported on the rear axle housing with the wheels free to rotate. Remove the rear wheels to eliminate any tire unbalance.
2. With the drive shaft rotating at a speedometer speed of 40-50 mph, carefully bring a crayon or colored pencil up until it just barely contacts the rear end of drive shaft (Fig. 2). The mark made by the crayon or pencil will indicate the heavy side of the shaft. **Care should be exercised when working near the balance weights to prevent injury to the hands.**

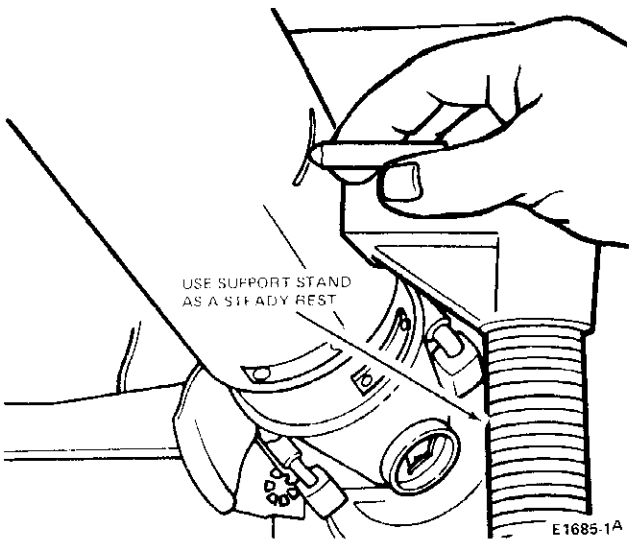


FIG. 2 Marking Drive Shaft

3. Install two hose clamps (screw-drive type) on the drive shaft so that the heads are located 180 degrees from the chalk marking (Fig. 3). Tighten the clamps.

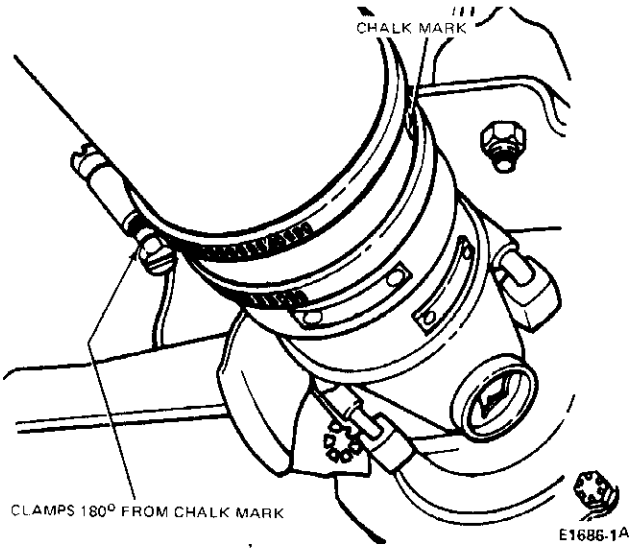


FIG. 3 Installing Screw-Drive Clamps

4. Run the vehicle up to 65-70 mph speedometer speed. If no vibration is felt, lower the vehicle and road test. If unbalance still exists, rotate the clamp heads approximately 45 degrees away from each other and test for vibration (Fig. 4).

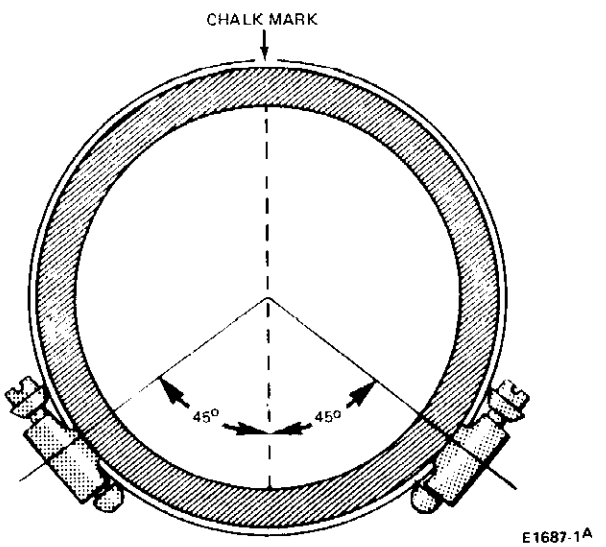


FIG. 4 Rotating Screw-Drive Clamps

5. Continue to rotate the clamp heads apart in smaller amounts until vibration is eliminated. To prevent overheating, do not run the vehicle on the hoist for an extended period.
6. Reinstall the wheels and road test the vehicle.

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DRIVE SHAFT BALANCING

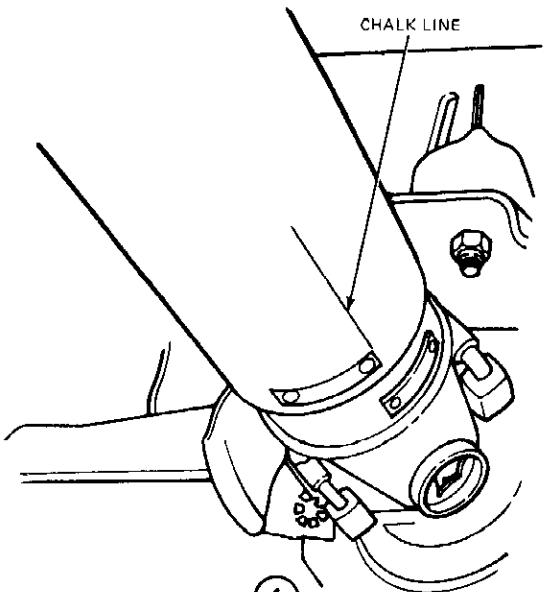
Using Special Equipment

1. Road test the vehicle. Evaluate and record road speed at which vibration occurs.
2. Raise vehicle on a frame contact hoist, and re-evaluate, by accelerating to the indicated speeds at which vibration was most severe during the road test. Allowing the rear axle to suspend makes the driveline more sensitive to vibration.
3. Rotate the driveshaft 180 degrees relative to the companion flange and evaluate by again running the driveline at the vibration speed. Install the driveshaft in the best position. **NOTE: In some cases, rotating the driveshaft 180 degrees may decrease the vibration to an acceptable level, and no further work is necessary.** If no improvement is noted, proceed to Step 4.
4. A vehicle is more sensitive to excessive unbalance and/or runout at the rearward end of the driveshaft. Therefore, locate the heavy side of the driveshaft by use of the strobe light and transducer furnished with the Rotunda Dynamic Wheel Balancer (or equivalent) equipment, using the following procedure: Remove rear wheels and tires, reinstall all wheel lug nuts in reverse. Scribe an axial chalk line (at any radial location) approximately 4 inches long at the rear of the driveshaft (Step 1, Fig. 5). Locate the transducer on the bottom side of the carrier (Step 2, Fig. 5) and secure it in place. Run the vehicle at the worst vibration speed and visually note the position of the chalk line by use of the strobe light. This provides a starting point for initial location of the hose clamps.
5. Stop the vehicle and rotate the driveshaft so that the chalk line is in the same location as it was noted under the strobe light.
6. Install two screw-drive (stainless steel) hose clamps on the driveshaft. Position the clamps 180 degrees from the transducer and tighten (Step 3, Fig. 5).
7. Run the vehicle through the speed range. If no vibration is felt, proceed to Step 9. However, if any vibration still exists, the combined weight of the two hose clamps may be in excess. To reduce this excess weight, rotate the clamp heads away from each other approximately 15 degrees (one each way from the original position). Run the vehicle and note if the vibration has been reduced (Step 4, Fig. 5).

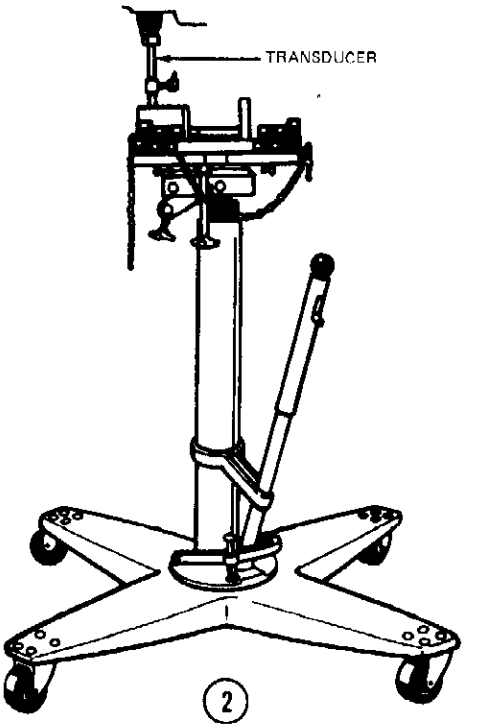
CAUTION: Do not run the vehicle on the hoist for extended periods due to the danger of overheating the engine and/or transmission.

8. Continue to rotate the clamp heads apart in smaller angular increments until the vehicle feel for balance (vibration) is best. At this point, the vehicle should be road tested to determine the actual degree of improvement. If satisfactory improvement has been obtained, proceed with Step 9. If no improvement has been obtained, **the clamps must be removed** and diagnosis should be redirected to other areas, such as wheels, tires, driveline angle and companion flange runout.
9. When the vehicle has been corrected to a satisfactory level, as determined by a road test evaluation, tighten the clamps securely. Clean thoroughly with lacquer thinner, and spray the clamps with a commercially available black paint for a finished appearance.

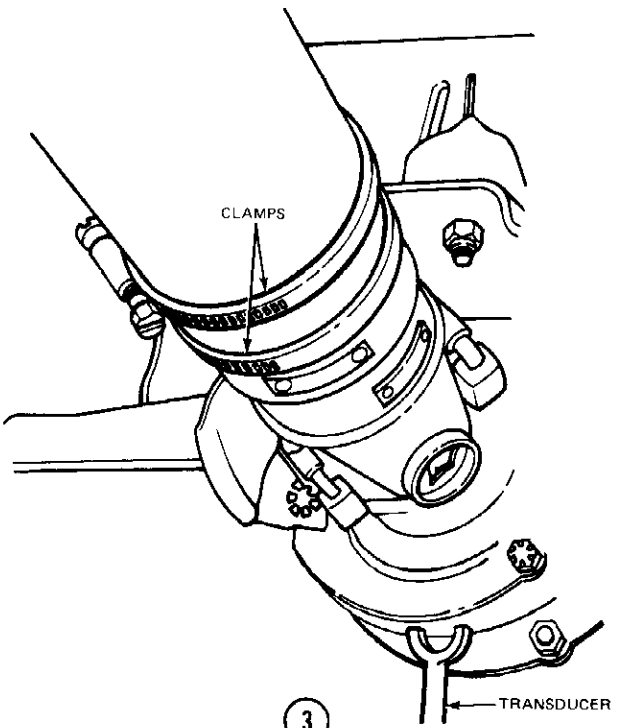
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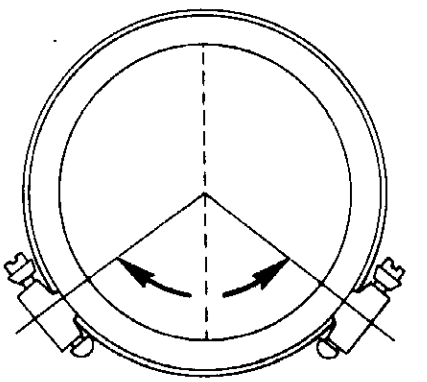
1
SCRIBE AN AXIAL CHALK LINE APPROXIMATELY 4" LONG



2
SUPPORT OF/AND POSITION OF TRANSDUCER



3
INSTALLATION OF SCREW-DRIVE CLAMPS AND POSITION OF TRANSDUCER



4
ROTATING CLAMPS

E2614-2B

FIG. 5 Balancing Driveshaft Using Special Equipment

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REMOVAL AND INSTALLATION

STANDARD DRIVE SHAFT

Removal

1. To maintain drive line balance, mark the rear drive shaft yoke and the drive pinion flange of the axle (if the yellow alignment marks are not visible), in relation to the shaft, so that they may be installed in their original positions.
2. Disconnect the rear U-joint from the companion flange. Tape the loose bearing caps to the spider to prevent loss. Pull the drive shaft toward the rear of the vehicle until the slip yoke clears the transmission extension housing and the seal. Install the appropriate tool in the extension housing to prevent lubricant leakage.

Installation

1. If the seal in the end of the transmission extension housing is damaged, replace the seal or seals as required. Also, if the lugs on the axle pinion flange are shaved or distorted so that the bearings slide, replace the flange.
2. Lubricate the yoke spline with B8A-19589-A lubricant or equivalent. This spline is sealed so that the transmission fluid does not wash away the spline lubricant. Remove the tool from the extension housing. Install the yoke on the transmission output shaft. Do not allow the yoke assembly to bottom on the output shaft with excessive force.

   Install the drive shaft so index marks or the yellow mark (if visible) on the yoke (light side) is in line with the yellow mark on the companion flange. This prevents vibration, which occurs when the shaft and the axle pinion flange become out ot balance. If a vibration exists, the drive shaft should be disconnected from the axle, rotated 180 degrees and reinstalled.
3. Install the U-bolts and nuts that attach the U-joint to the drive pinion flange. Torque the U-bolt nuts to 8-15 ft-lbs.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

1. Place the drive shaft in a vise being careful not to damage it.
2. Remove the snap rings that retain the bearings in the slip yoke and in the drive shaft.
3. Position the tool shown in Fig. 6 on the shaft and press the bearing out of the slip yoke. If the bearing cannot be pressed all the way out of the yoke, remove it with vise grip or channel lock pliers.
4. Reposition the tool to press on the spider and remove the bearing from the opposite side of the yoke.
5. Remove the yoke from the spider.
6. Remove the bearings and spider from the drive shaft in the same manner.
7. Clean all foreign matter from the yoke area at each end of the drive shaft.

ASSEMBLY

1. Start a new bearing into the yoke at the rear of the drive shaft.
2. Position the spider in the rear yoke and press the bearing 1/4 inch below the surface (Fig. 7).
3. Remove the tool and install a new snap ring.
4. Start a new bearing into the opposite side of the yoke.
5. Install the tool and press on the bearing until the opposite bearing contacts the snap ring.
6. Remove the tool and install a new snap ring. It may be necessary to grind the facing surface of the snap ring to permit easier entry.
7. Reposition the drive shaft and install the new spider and two new bearings in the same manner as the rear yoke.

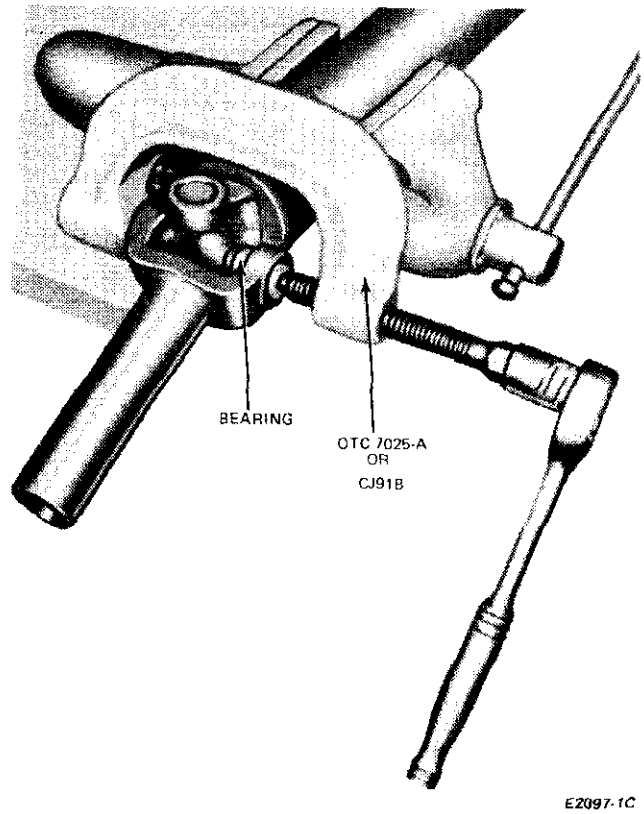


FIG. 6 Removing Universal Joint Bearing

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8. Position the slip yoke on the spider and install two new bearings and snap rings.
9. Check the joint for freedom of movement. If bind has resulted from misalignment during the foregoing procedures, a sharp rap on the yokes with a brass hammer will seat the bearing needles and usually provide freedom of movement. Take care to support the shaft end during this operation, and do not strike the bearings themselves. Be sure the universal joints are free to move easily without binding before installing the drive shaft.

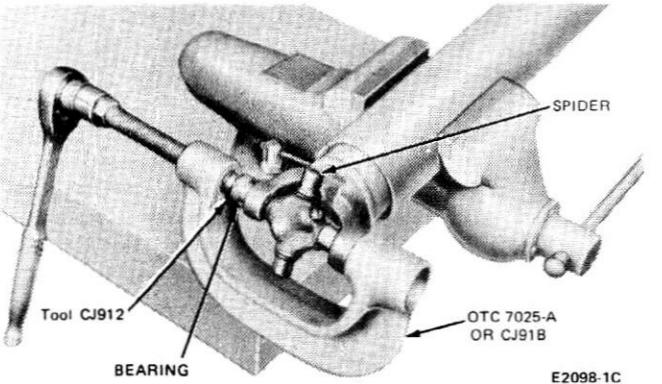


FIG. 7 Installing Universal Joint Bearing

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Drive Shaft — Double Cardan Type U-Joints

PART 15-66

Applies To Lincoln Continental and Versailles

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DISASSEMBLY AND ASSEMBLY	
Double Cardan Joint — Versailles	*66-3*
Double Cardan Joint — Lincoln Continental	66-3
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TESTING	
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Drive Shaft Runout Check	*66-2*

CF2521-2B

DESCRIPTION

The drive shaft is the means of transferring power from the transmission to the differential in the rear axle.

The Versailles drive shaft incorporates one Cardan-type universal joint and a slip yoke in front and a double Cardan-type universal joint and a circular flange in the rear. (Fig. 1.)

The Lincoln Continental drive shaft is equipped with double Cardan-type universal joints at both the front and the rear of the drive shaft.

Information on repairing the Versailles front universal joint is contained in Part 15-60.

The double Cardan type universal joint used at the rear of the Versailles drive shaft is of a different design *and manufacture from the double Cardan joints used* at both ends of the Lincoln Continental drive shaft.

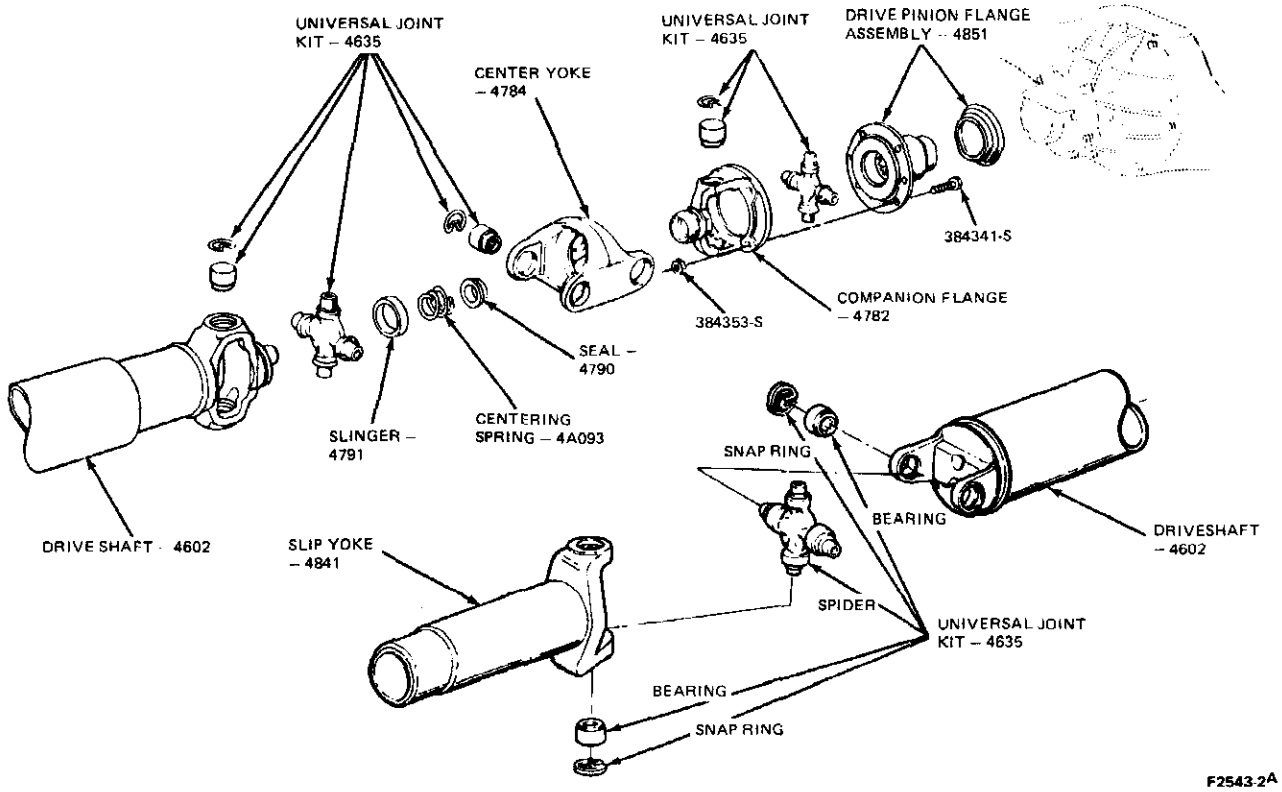


FIG. 1 Driveshaft and Universal Joints—Disassembled—Versailles

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TESTING

DRIVE LINE BALANCE CHECK

If detailed parts of the drive shaft are replaced and shaft vibration is encountered after installaion, disconnect the shaft at the slip yoke. Rotate the slip yoke 180 degrees; then, reconnect the shaft to the slip yoke. If the vibration persists, disconnect the shaft at the rear axle companion flange. Rotate the companion flange 180 degrees and reconnect the shaft to the flange.

DRIVE LINE ANGLE CHECK

Vibration or shudder which is noticeable either on fast acceleration or when coasting, using the engine for a brake, may be caused by the rear axle housing being loose on the rear springs or by improper pinion angle. Refer to Part 14-01 for pinion angle checking procedures.

DRIVE SHAFT RUNOUT CHECK

Using a dial indicator, check the runout at each end and in the middle of the drive shaft. The rear check should be made on the small tube section of the shaft between the balance weights and the yoke welds. Drive shaft runout should not exceed 0.335 inch at any one point.

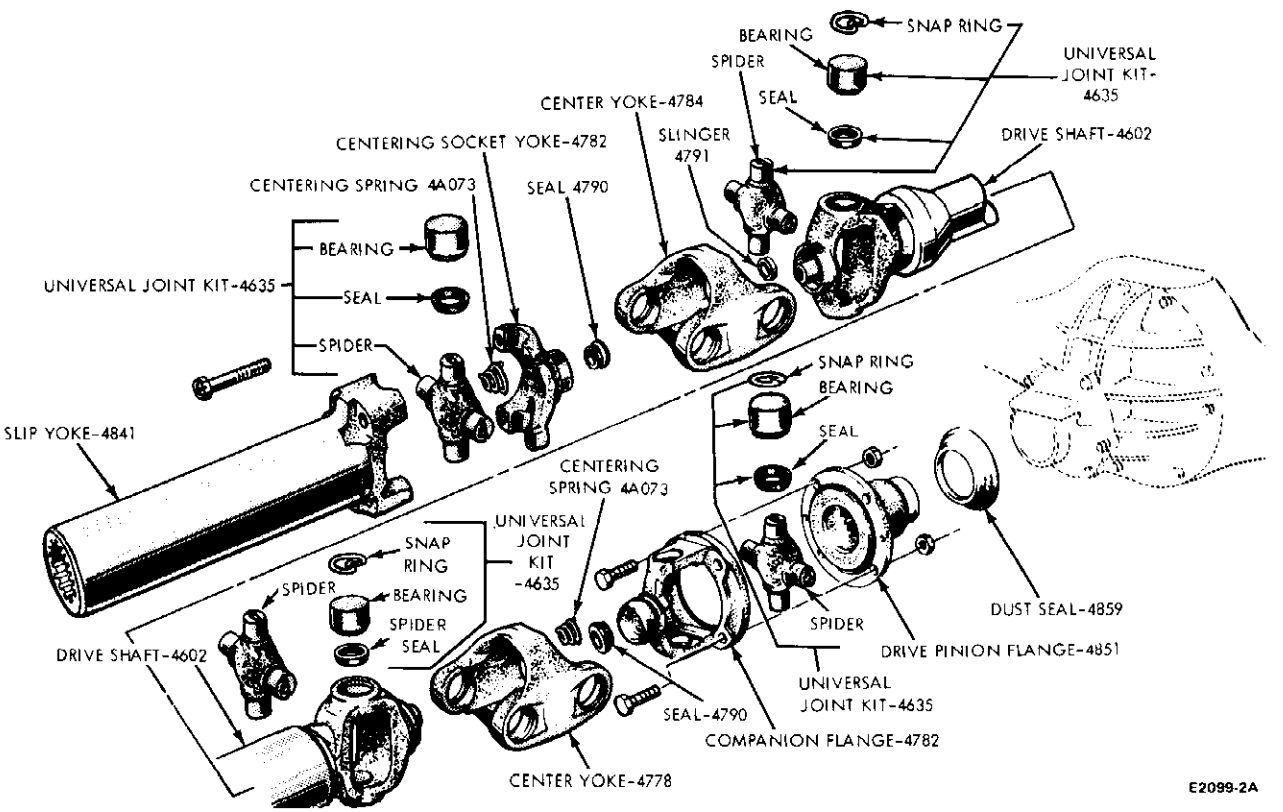


FIG. 2 Drive Shaft and Universal Joints Disassembled—Lincoln Continental

REMOVAL AND INSTALLATION

Removal

1. To maintain drive line balance, mark the rear drive shaft yoke and the drive pinion flange of the axle (if the alignment marks are not visible), in relation to the shaft, so that they may be installed in their original positions.
2. Disconnect the drive shaft from the circular companion flange. Pull the drive shaft toward the rear of the vehicle until the slip yoke clears the transmission extension housing and the seal. Install the appropriate tool in the extension housing to prevent lubricant leakage.

Installation

1. If either the rubber seal on the output shaft or the seal in the end of the transmission extension housing is damaged, replace the seal or seals as required.
2. Lubricate the yoke spline with B8A-19589-A lubricant. This spline is sealed so that the transmission fluid does not wash away the spline lubricant. Remove the tool from the extension housing. Install the yoke on the transmission output shaft. Do not allow the yoke assembly to bottom on the output shaft with excessive force.

Install the drive shaft so index marks or the yellow mark (if visible) on the yoke (light side) is in line with the yellow mark on the companion flange. This prevents vibration, which occurs when the shaft and the axle pinion flange become out of balance. If a vibration exists, the drive shaft should be

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disconnected from the axle, rotated 180 degrees and reinstalled.

3. Install the bolts and nuts that attach the yoke to the drive pinion flange. Torque the nuts to 70 to 90 ft-lbs.

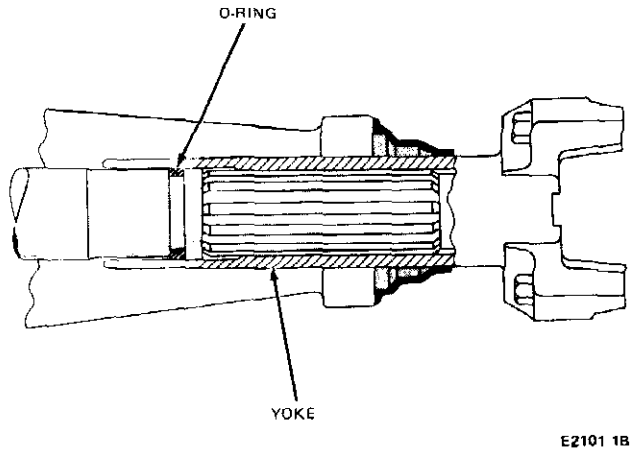


FIG. 3 Output Shaft Spline Seal

DISASSEMBLY AND ASSEMBLY

DOUBLE CARDAN JOINT—VERSAILLES

VERSAILLES REAR

Disassembly

1. Working at the rear axle end of the shaft, mark the position of the spiders, the center yoke, and the centering socket yoke as related to the companion flange. The spiders must be assembled with the bosses in their original position to provide proper clearances.
2. Position Tool CJ91B as shown in Fig. 4. Thread the tool clockwise until the bearing protrudes approximately 3/8 inch out of the yoke.
3. Remove the driveshaft from the vise.
4. Tighten the bearing in the vise and tap on the yoke to free the bearing from the center yoke. Do not tap on the drive shaft tube.
5. Reposition Tool CJ91B on the yoke and force the opposite bearing outward and remove it.
6. Position the tool on one of the remaining bearings and force it outward approximately 3/8 inch.
7. Grip the bearing in the vise and tap on the weld yoke to free the bearing from the center yoke. **Do not tap on the driveshaft tube.**
8. Reposition the tool on the yoke to press out the remaining bearing.
9. Remove the spider from the center yoke.
10. Remove the bearings from the drivesahft yoke as outlined above and remove the spider from the yoke.
11. Insert a screwdriver into the centering ball socket located in the companion flange and pry out the rubber seal. Remove the retainer, three piece ball seat, washer and spring from the ball socket.

Assembly

1. Inspect the centering ball socket assembly for worn or damaged parts. If any damage is evident replace the entire assembly.
2. Insert the spring, washer, three piece ball seat and retainer into the ball socket.
3. Using a suitable tool, install the centering ball socket seal.
4. Position the spider in the driveshaft yoke. Make sure the spider bosses are in the same position as originally installed. Press in the bearing cups with Tool CJ91B. Install the internal snap rings provided in the repair kit.
5. Position the center yoke over the spider ends and press in the bearing cups. Install the snap rings.
6. Install the spider in the companion flange yoke. Make sure the spider bosses are in the position as originally installed. Press on the bearing cups and install the snap rings.
7. Position the center yoke over the spider ends and press on the bearing cups. Install the snap rings.

LINCOLN CONTINENTAL DOUBLE CARDAN JOINTS

UNIVERSAL JOINT

Disassembly

1. Mark the position of all the yokes before disassembly so that they can be reassembled in their original relationship to retain driveshaft balance (Fig. 5).
2. Support the driveshaft in a horizontal position in a vise. Never clamp the driveshaft tubing in a vise, always clamp on one of the yokes. Position the tool as shown in (Fig. 6), and tighten the tool clockwise until the plastic retaining the bearing is sheared, and the bearing protrudes approximately 3/8" out of the yoke.
3. Remove the driveshaft from the vise.
4. Grip the bearing in the vise, and drive on the center yoke as shown in (Fig. 7) to remove the bearing.
5. Reposition the tool on the yoke, and move the remaining bearing in the opposite direction so that it protrudes approximately 3/8" out of the yoke.
6. Grip the bearing in a vise. Drive on the center yoke to free it from the bearing (Fig. 7).

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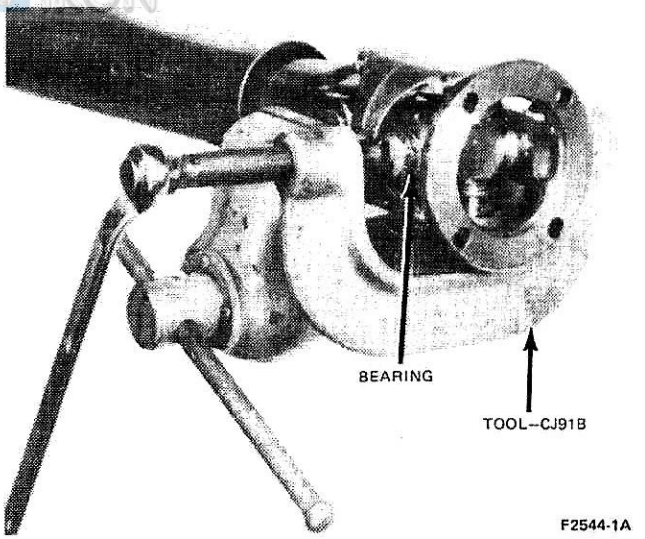


FIG. 4 Partially Pressing Bearing From Center Yoke

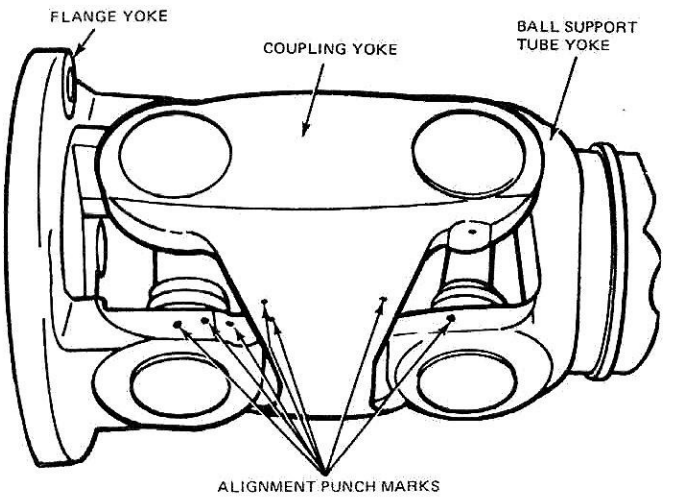


FIG. 5 Punching Alignment Marks

7. Remove all of the remains of the sheared plastic retaining rings from the grooves in the yokes. The sheared plastic may prevent the bearing cups from being pressed into place and thus prevent the retaining rings from being properly seated. It is usually easier to remove the plastic if a small pin or punch is driven through the injection holes.

Assembly

1. Making sure that the alignment marks are correctly positioned, install one of the bearing cups part way into one side of the yoke, and turn this yoke ear to the bottom.
2. Insert the spider into the yoke so that the journal seats freely into the bearing cup (Fig. 8).
3. Install the opposite cup part way. Be sure that both spider journals are started strainght into both bearing cups (Fig. 9).
4. Using Tools OTC-7025-A, or CJ91B press against both the bearing cups. Work the spider constantly for free movement of the journals in the bearings. If any binding is felt, stop pressing immediately, and check the needle bearings. A probability may exist where one or more of the rollers have been trapped under the end of the spider journals.
5. As soon as one of the retaining ring grooves clears the inside of the yoke, stop pressing and snap the retaining ring into place.
6. Continue to press until the opposite retaining ring can be snapped into place. If any difficulty is encountered, strike the yoke firmly with a hammer to aid in seating the retaining rings. This springs the yoke ears slightly. Figs. 10, 11 and 12 indicate the areas that may be tapped slightly with a hammer to relieve a binding condition.

CENTERING BALL

Disassembly

1. Mark the position of all yokes before disassembly so that they can be reassembled in their original relationshaip to retain driveshaft balance. (Fig. 5).
2. Support the driveshaft in a horizontal position in a vise. Never clamp the driveshaft tubing in a vise,

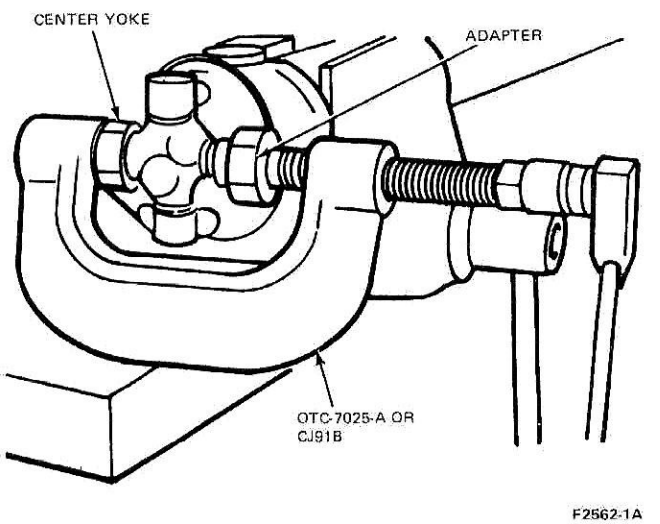


FIG. 6 Shearing Plastic Retainer

always clamp on one of the yokes. Position the tool as shown in (Fig. 6) and tighten the tool clockwise until the plastic retaining the bearing is sheared and the bearing protrudes approximately 3/8" out of the yoke.

3. Remove the driveshaft from the vise.
4. Grip the bearing in the vise, and drive on the center yoke as shown in (Fig. 7) to remove the bearing.
5. Reposition the tool on the yoke and move the remaining bearing in the opposite direction so that it protrudes approximately 3/8" out of the yoke.
6. Grip the bearing in a vise. Drive on the center yoke to free it from the bearing (Fig. 7).
7. Remove the spider from the flange yoke, and the flange yoke from the coupling yoke. The centering ball is part of the ball support yoke which is welded to the tube (Fig. 13).
8. Using ball remover tool, Part No. J-23996-4, place the fingers of the tool under the ball as shown in (Fig. 14).
9. Place outer cylinder of tool, Part No. J-23996-4, over the outside of the ball (Fig. 15).

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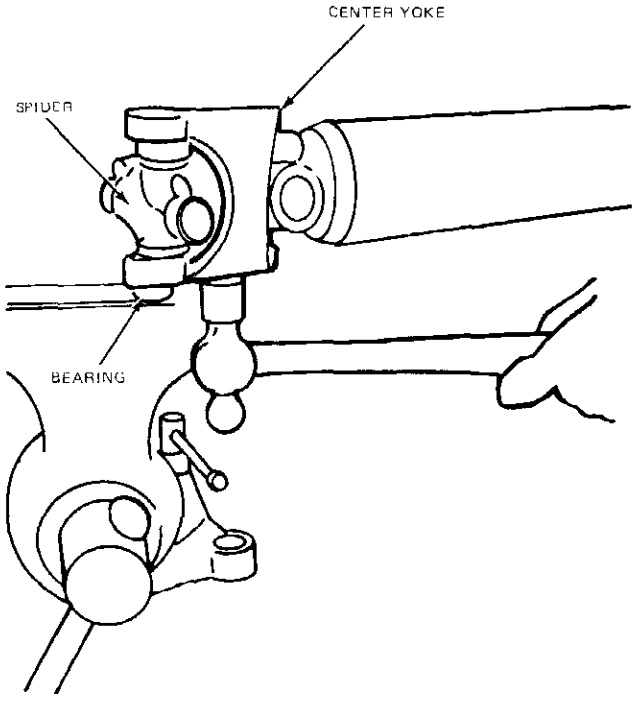


FIG. 7 Removing Bearings

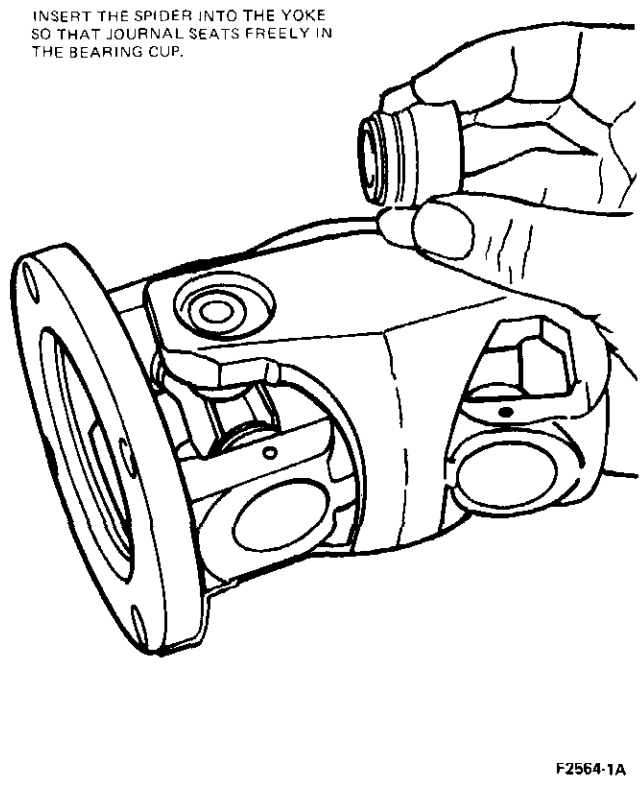


FIG. 8 Inserting Spider into Yoke

10. Thread nut on tool, Part No. J-23996-4, and draw the ball off the stud using wrench as shown in (Fig. 16).

Assembly

1. Place service replacement ball on stud by hand as shown in (Fig. 17).
2. Using tool, Part No. J-23996-1, drive the ball onto the stud as shown in (Fig. 18). Drive until the ball can be seen to seat firmly against the shoulder at the base of the stud.

BALL SEAT AND SEAL

Disassembly

1. Pry the seal from the centering ball cavity and remove the washers, spring, and the three (3) ball seats as shown in (Fig. 19).
2. *Clean and inspect the ball seat insert bushing for* wear. If the bushing is worn, replace the flange yoke assembly.
3. Clean and inspect the seal and ball seats along with the spring and washers. If any parts show any signs of excessive wear or are broken, replace the entire set with a service kit.

   NOTE: Whenever the seal is removed to inspect the ball seat parts, it should be discarded and *replaced with a new seal.*

Assembly

1. Using the grease provided in the ball seat kit, lubricate all parts and insert them into the clean ball seat cavity in the following order: spring, washer (5m OD), (3) ball seats, with the largest opening outward to receive the ball, washer (large OD) and lastly the seal.
2. Lubricate the seal lip and install the seal flush into the flange yoke, using tool, Part No. J-23694 as shown in (Fig. 20). The sealing lip should tip inward.

SLIP YOKE ASSEMBLY

Disassembly

1. Support the driveshaft in a horizontal position in a vise. *Position* Tools OTC-7025-A or CJ91B (as shown in Fig. 5), and tighten the tool clockwise until the plastic retaining the bearing is sheared, and the bearing protrudes approximately 3/8" out of the slip yoke.

   NOTE: Never clamp driveshaft tubing in a vise, always clamp on one of the yokes.
2. Remove the driveshaft from the vise.
3. Grip the bearing in the vise, and drive on the center *yoke as shown in (Fig. 6) to remove the bearing.*
4. Reposition the tool on the yoke and move the remaining bearing in the opposite direction so that it protrudes approximately 3/8" out of the yoke.
5. Grip the bearing in a vise. Drive on the center yoke to free it from the bearing.
6. Remove all of the remains of the sheared plastic retaining rings from the grooves in the yoke. The sheared plastic may prevent the bearing cups from *being pressed into place,* and thus preventing the retaining rings from being properly seated. It is usually easier to remove the plastic if a small pin or punch is driven through the injection holes.

Assembly

1. The new slip yoke assembly is serviced with (1) universal joint, (2) bearing cups and (2) retaining rings.

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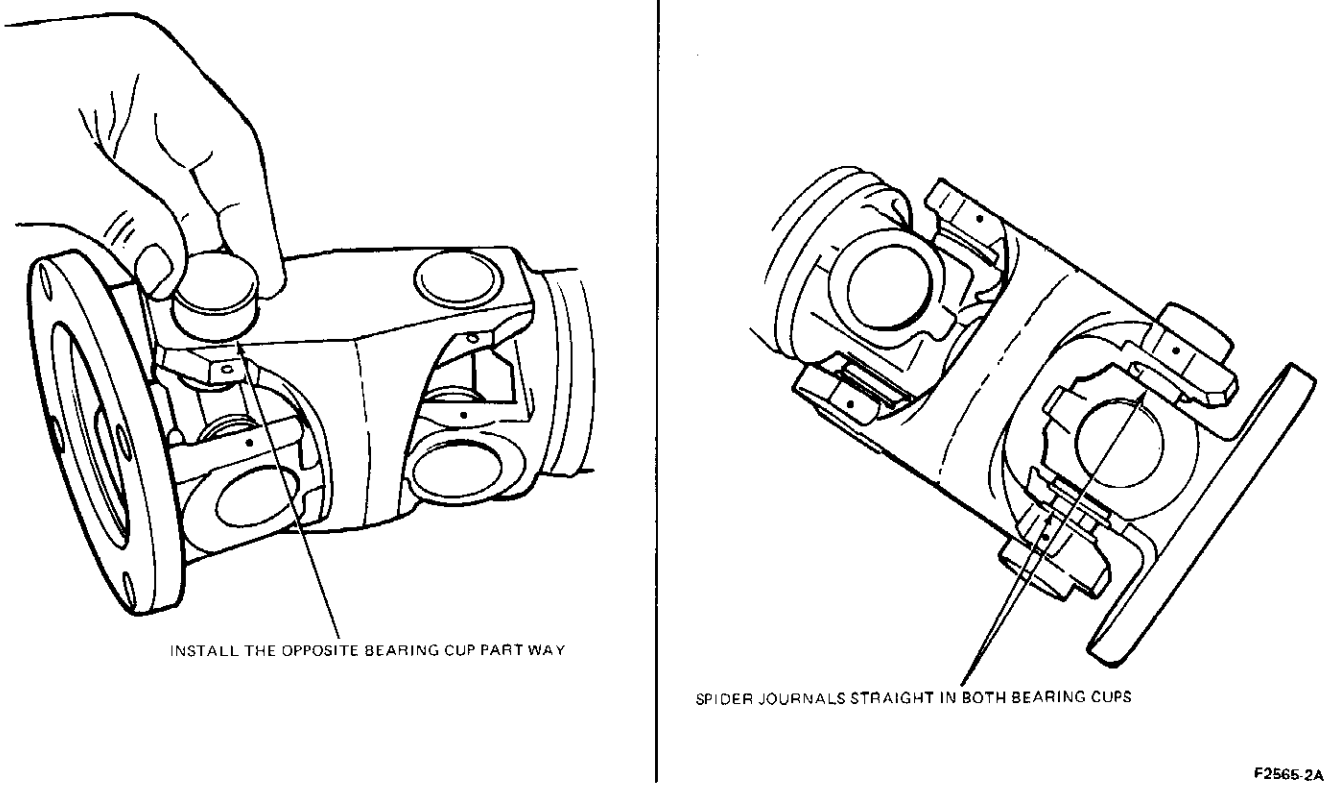


FIG. 9 Aligning Bearing Cups and Journals

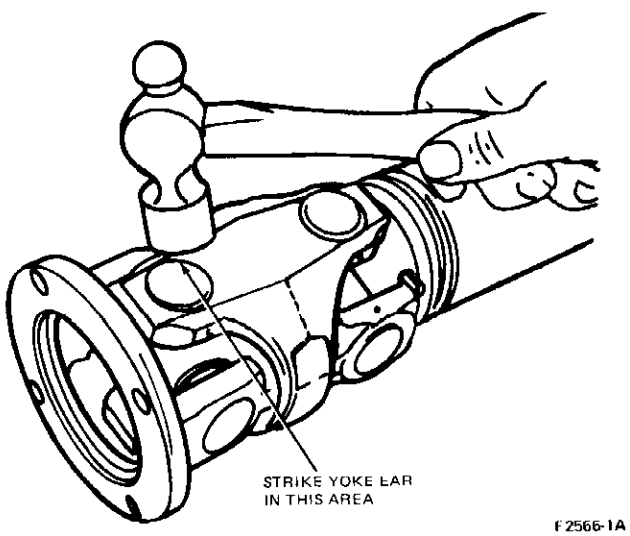


FIG. 10 Relieving Binding Condition—A

2. Install one bearing cup part way into one side of the coupling yoke, then turn this yoke ear to bottom.
3. Insert the slip yoke spider into the yoke so that the spider journal seats freely into the bearing cup.
4. Install the opposite bearing cup part way. Be sure that both spider journals are started straight and true into both bearing cups.
5. Using Tools OTC-7025-A, or CJ91B press against opposite bearing cups and work the spider constantly for free movement of the journals in the bearings. If any binding is felt, stop pressing immediately and check the needle bearings, a possibility may exist where one or more of the rollers have been trapped under the end of the spider journal.
6. As soon as one of the retaining ring grooves clears the inside of the yoke, stop pressing and snap the retaining ring into place.
7. Continue to press until the opposite retaining ring can be snapped into place.
8. If any difficulty is encountered, strike the slip yoke ears firmly with a hammer to aid in seating the retaining rings. This springs the slip yoke ears slightly.

NOTE: All tools with a "J" prefix used in the above service procedure can be purchased commercially from:
Kent-Moore Tool Company
1501 S. Jackson St.
Jackson, Michigan 49202
Phone (517) 784-8561
or and equivalent supplier.

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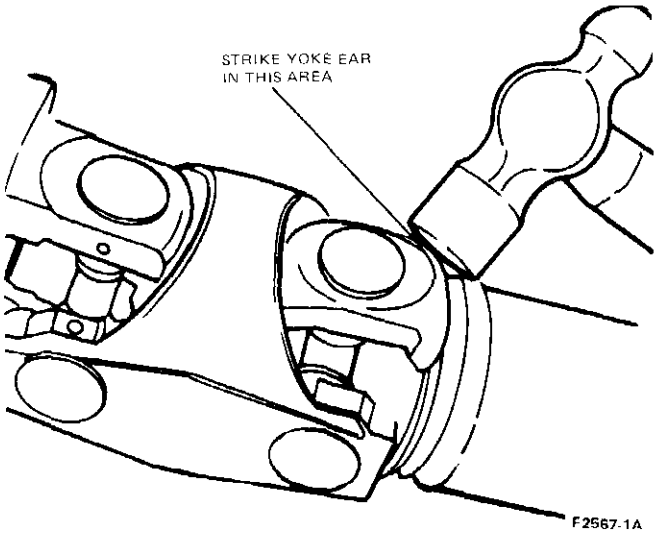


FIG. 11 Relieving Binding Condition—B

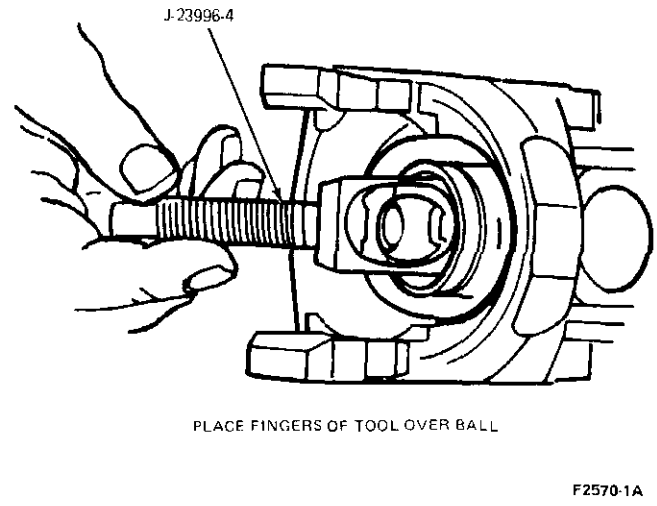


FIG. 14 Installing Ball-Remover Tool

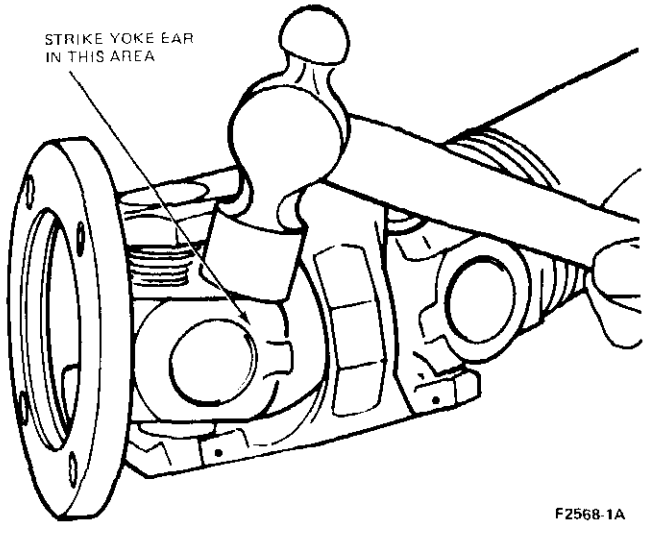


FIG. 12 Relieving Binding Condition—C

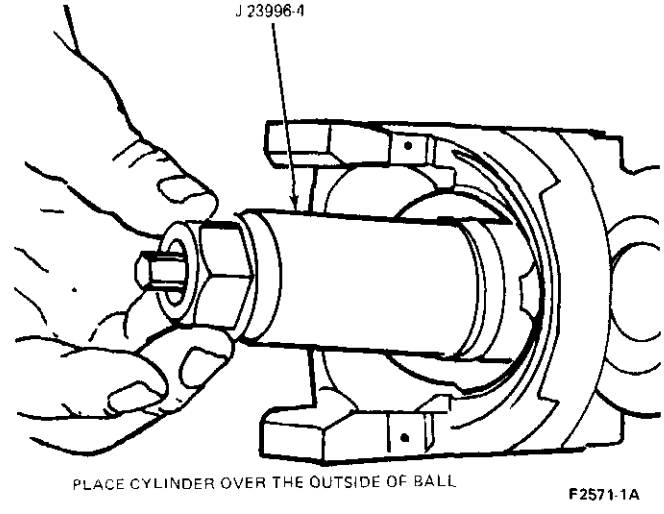


FIG. 15 Positioning Outer Tool Cylinder

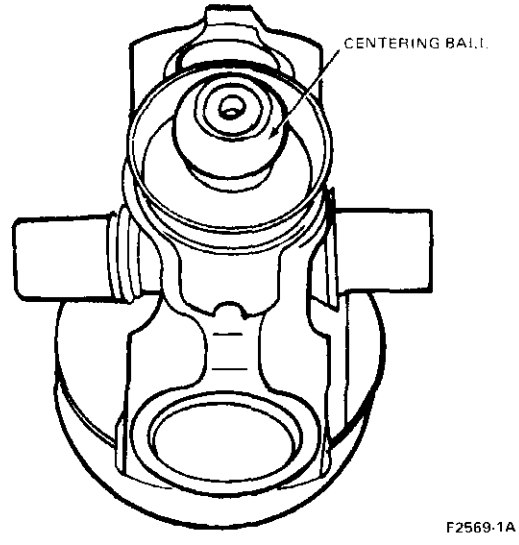


FIG. 13 Centering Ball Location

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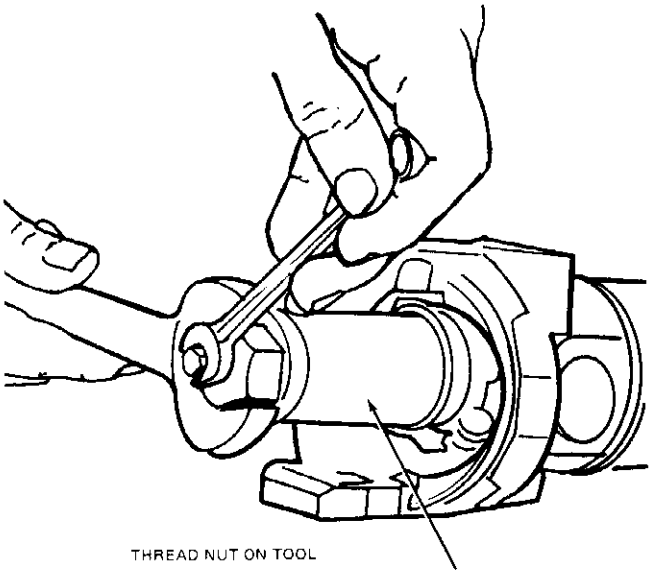


FIG. 16 Removing Ball from Stud

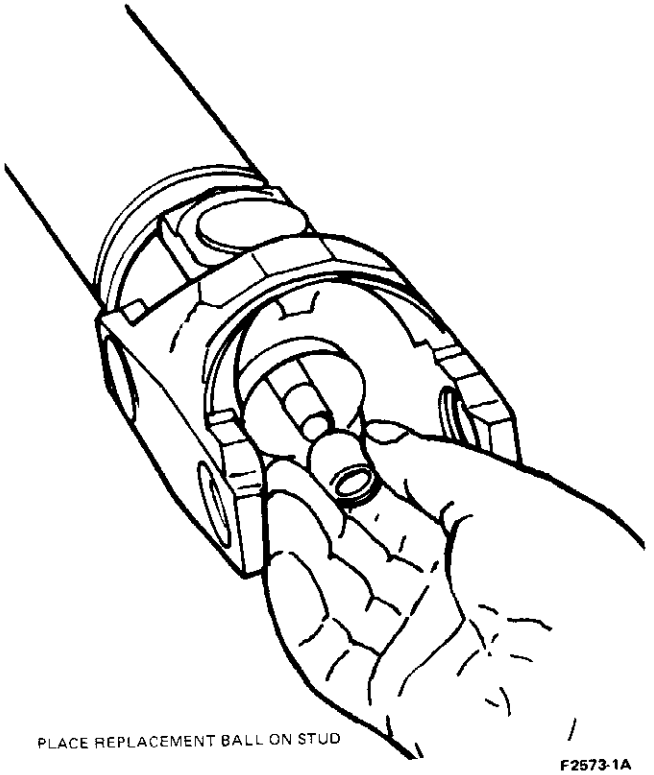


FIG. 17 Positioning Replacement Ball on Stud

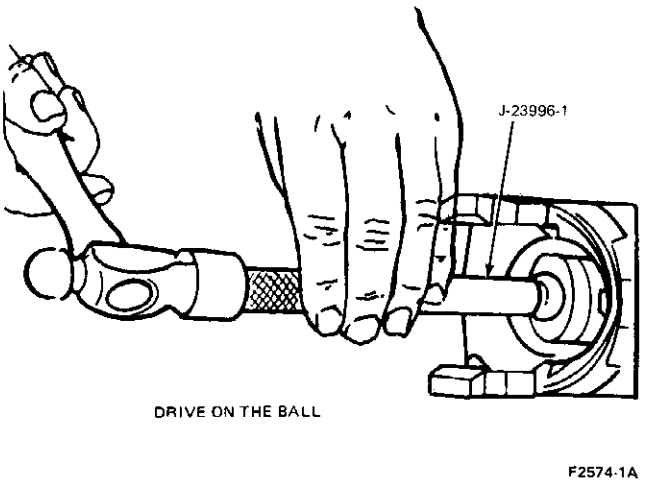


FIG. 18 Driving Ball Into Position

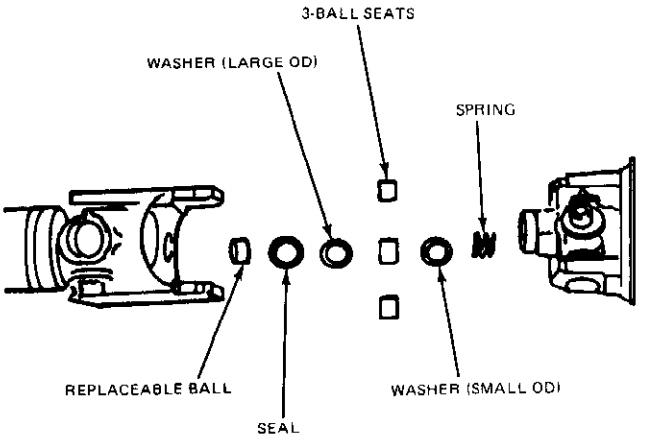


FIG. 19 Replacement Parts

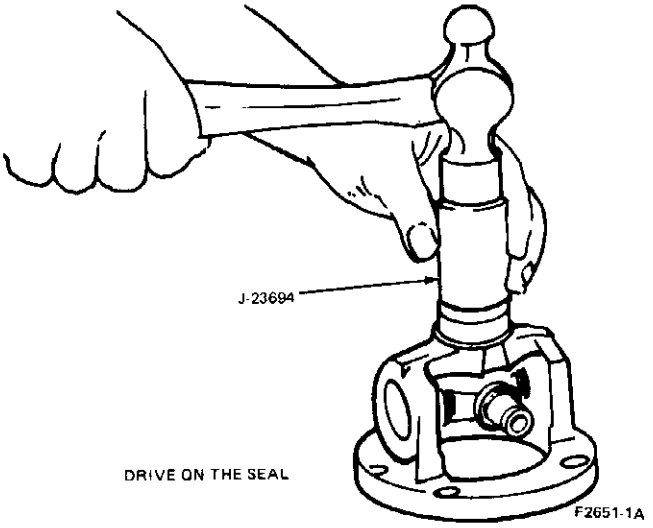


FIG. 20 Installing Seal

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Clutch and Manual Transmission

GROUP 16

PART TITLE	PART NO.
Clutch	16-02
Ford Three-Speed Transmission	16-11
Ford Four-Speed Overdrive Transmission	16-30
General Clutch Service	16-01
General Manual Transmission Service	16-10
Mechanical Clutch Linkage	16-03
Model RAD Four-Speed Transmission	16-28
Model 78ET Four-Speed Transmission	16-29

CC3013-2B

General Clutch Service

PART 16-01

Applies to Pinto, Bobcat, Mustang, Fairmont, Zephyr, Granada and Monarch

SUBJECT	PAGE
ADJUSTMENTS	
Flywheel Housing Alignment	01-3
CLEANING AND INSPECTION	
Clutch	01-4
DIAGNOSIS	01-1
REMOVAL AND INSTALLATION	
Clutch Pilot Bearings	01-7
Dowels – Flywheel and Engine	01-7

CC3014-2B

DIAGNOSIS

Refer to the following Clutch Diagnosis Chart for diagnosis.

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DETROIT IRON

CLUTCH DIAGNOSIS

COMPLAINT	POSSIBLE CAUSE	RESOLUTION
• Clutch "squeaks" or "scrubs" when the pedal is in motion	• Clutch release linkage and/or cable – lack of lubrication, binding, interference, worn or kinked	• Lubricate, repair or replace as required.
	• Lack of lubrication on the clutch release lever pivot and lever tips	• Remove transmission and release bearing. Lubricate accordingly.
	• Lack of lubrication for the clutch release bearing bore and the transmission bearing retainer	• Lubricate accordingly.
	• Improperly installed welsh plugs	• Inspect. Welsh plugs should be flush or below front face of transmission case.
	• Flywheel housing out of alignment	• Check alignment after ascertaining that housing is properly positioned on dowels, and attaching bolts are properly torqued. Replace housing if necessary.
• Clutch is noisy after pedal free-travel is taken up. Noise continues as long as the pedal is held down	• Damaged release bearing	• Remove transmission and replace release bearing. Inspect the release fingers and replace the pressure plate assy. as required.
	• Flywheel housing out of alignment	• Check flywheel housing to engine crankshaft alignment. Replace housing if necessary.
	• Improper engagement between transmission pilot and flywheel housing	• Check for proper pilot engagement into flywheel housing. Repair or replace as required.
• Clutch slips after the pedal is fully released	• Improper clutch pedal free travel	• Adjust. (Part 16-03).
	• Release linkage outside flywheel housing binding	• Lubricate. Repair or replace linkage parts as required. (Part 16-03).
	• Damaged internal components	• Remove transmission. Repair or Replace release lever, release bearing, transmission input shaft bearing retainer. Check pressure plate and clutch disc for wear and contamination. Replace as required.
• Clutch does not disengage properly	• Improper clutch pedal free travel	• Adjust. (Part 16-03).
	• Release linkage outside flywheel housing worn, cracked or bent	• Repair or replace linkage parts as required. (Part 16-03).
	• Damaged internal components	• Remove transmission. Check for damaged or worn clutch, pressure plate, release bearing, release lever or release lever pivot. Check for warped or contaminated clutch disc. Check engine crankshaft pilot bushing for lack of lubrication, damage or binding condition with input shaft. Check clutch disc hub spline for free movement on input shaft spline – lubricate. Repair or replace as required.
• Clutch chatters during engagement	• Improper clutch pedal free travel	• Adjust (Part 16-03).
	• Loose engine mounts and number 3 crossmember installation	• Repair as required. Tighten bolts and nuts to specifications.
	• Oil on clutch disc. Burned or glazed	• Install new clutch disc and correct leak. (Part 16-02).

CC3020-28

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ADJUSTMENTS

FLYWHEEL HOUSING ALIGNMENT

Inspection and/or alignment of the flywheel housing is indicated when symptoms exist of excessive transmission gear wear, transmission jumping out of gear, driveline vibration, clutch pedal vibration or scrubby pedal feel, pilot bearing noise, release bearing noise, or excessive clutch spin time. Common complaint areas or obvious misadjustment should always be checked and corrected prior to checking alignment, to be sure that the basic system is in proper working order.

Inspection And Alignment Procedure—All Models

1. Remove the transmission and flywheel housing from the vehicle using existing Ford Car Shop Manual procedures. On Mustangs with Model RAD transmission, and on Pinto and Bobcat vehicles, separate the flywheel housing from the transmission after removal of the assembly.
2. Inspect, clean and/or remove all nicks, burrs, paint and other foreign material from the following:
   a. Front and rear face of flywheel housing.
   b. Flywheel housing bore surface.
   c. Rear face of engine block.
   d. Rear engine plate.
   e. Flywheel and engine block dowels (missing or damaged dowels must be replaced). See Removal and Installation Section of this Part for procedure.
3. Install the flywheel housing and rear engine plate to the engine less the transmission and tighten the mounting bolts to specification.
4. Install alignment tool post assembly (Tool T75L-6392-A), with dial indicator base post attached (Fig. 1) through the flywheel housing bore into the clutch disc. Tighten the nut on the end of the post assembly until the clamp (split collet) on the opposite end of the assembly grips the clutch disc splined hub tightly (Fig. 2). Up, down, or side movement of the post assembly must not be evident during the bore and runout test procedure. If any movement is detectable, the nut should be further tightened until movement is stopped, otherwise erratic readings will result. To facilitate installation of the collet to the clutch disc hub, place a short piece of masking tape halfway around the collet to hold it at its smallest diameter until it can be inserted and tightened (Fig. 1).
5. To check face runout, install a dial indicator on the base post using the universal bracket and short extension bar (Tool T75L-4201-B) provided with the alignment kit (Fig. 1). Position the dial indicator so that the indicator button contacts a circumference just outside the transmission pilot hole. Tighten the universal clamp securely (Fig. 3).
6. Push the crankshaft rearward to remove any end play. Set the dial indicator to zero.
7. Holding the crankshaft in the rearward position, rotate the crankshaft through one complete revolution by using a wrench on the crankshaft pulley attaching nut. The dial indicator should return to zero after one revolution unless end play or a loose alignment post has affected the reading.

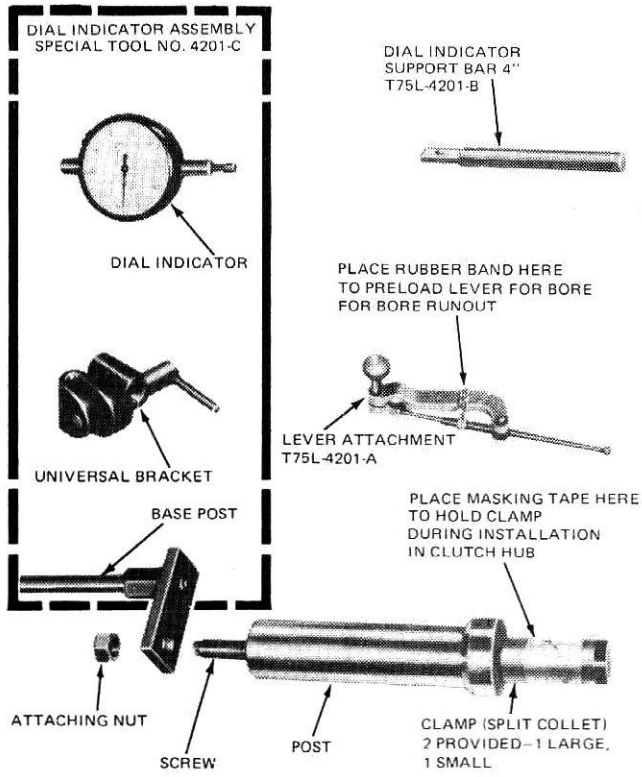


FIG. 1 Special Tools—Flywheel Housing Inspection and Alignment

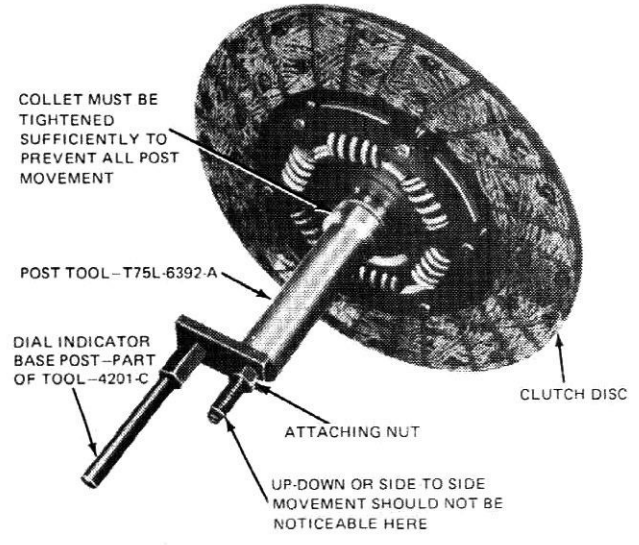


FIG. 2 Installation of Post Assembly

8. During Step 7, the greatest variation between indicator readings for one revolution should be recorded. A small mirror will be necessary during this procedure to enable reading the indicator through its complete rotation.
9. To verify the reading in Step 8, the procedure should be repeated a second time.
10. After completion of the face runout check, install the dial indicator lever attachment to the dial indicator (Fig. 1) and position the assembly to check

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bore runout (Fig. 4). The rubber band shown attached to the lever (Figs. 1 and 4) must be installed as indicated, prior to installation of the lever, to preload the dial indicator for bore readings.

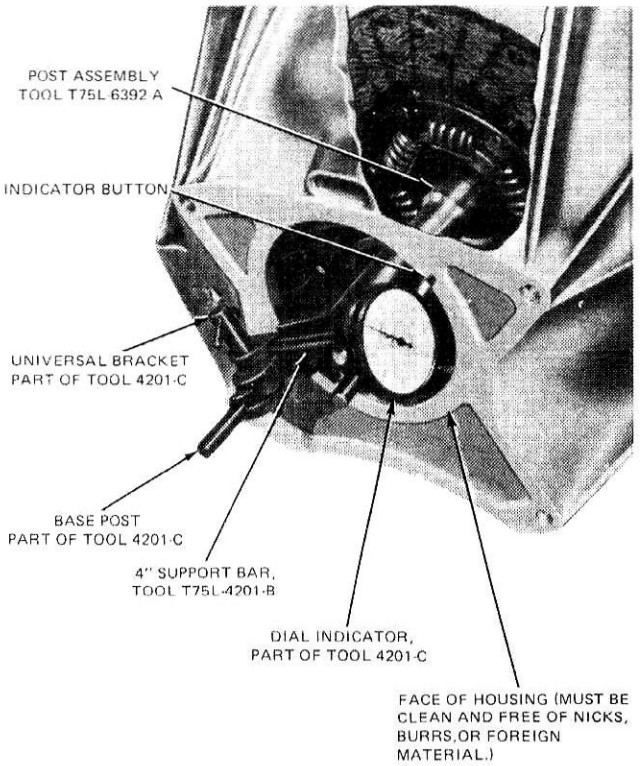


FIG. 3 Installing Dial Indicator For Face Runout Check

NOTE: The rubber band should be installed just snug enough to provide a light pressure of the lever tip on the bore of the housing. If the rubber band is too tight, it may bind the dial indicator or distort the reading.

11. Zero the dial indicator and rotate the crankshaft through one revolution as in Step 7. Record the greatest variation between the indicator readings for the complete crankshaft revolution. The reading should be verified by repeating the procedure a second time.

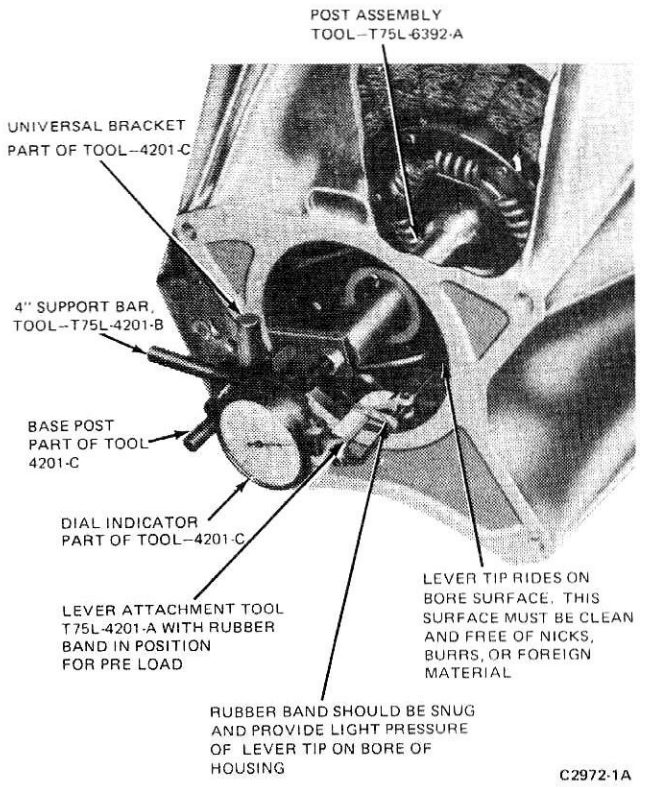


FIG. 4 Installing Dial Indicator For Bore Runout Check

12. If the maximum variation measurements obtained in Steps 8 and 11 show that face runout exceeds 0.010 inch and/or the bore runout exceeds 0.015 inch, the flywheel housing should be replaced.

Before re-assembly of the transmission to the flywheel housing, the front mounting face of the transmission should be inspected and cleaned. Any nicks, burrs, paint or foreign material must be removed to be sure of alignment between these components. Transmission Welsh plugs should also be checked for proper installation. If dowels on the flywheel or rear face of the engine are missing or damaged, refer to Dowel Removal and Installation in this Part for instructions.

CLEANING AND INSPECTION

CLUTCH

Release Bearing

Wipe all oil and dirt off the release bearing. The bearing is prelubricated and should not be cleaned with solvent.

Inspect the release bearing assembly for burrs which may cause the assembly to drag on the transmission bearing retainer. If burrs are found, inspect the transmission input shaft bearing retainer for evidence of scoring. Polish out burrs and scoring with a crocus pad.

Apply a thin film of lithium base grease (C3VY-19586-A or equivalent) to the bearing retainer, both sides of the release lever fork where it contacts the release bearing hub and retaining springs, and to the release bearing surface that contacts the pressure plate fingers.

Carefully fill the grease groove inside the bearing hub with the lithium base grease (no polyethylene). Be sure to clean all excess grease from the bore of the bearing hub. Excess grease will be forced into the spline by the transmission input shaft bearing retainer and will contaminate the clutch disc. Also, care must always be exercised when applying lubri-

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cants to the release bearing, release bearing hub and the release lever fork, as excessive lubricant would contaminate the clutch disc.

Hold the bearing inner race and rotate the outer race while applying pressure. If rotation is rough or noisy, replace the bearing.

Undue bearing wear is usually caused by an improper clutch linkage free play setting or where the clutch pedal does not return against rubber stop. If the clutch linkage does not have enough free travel, the release bearing will constantly touch the release fingers and spin whenever the engine is running. Misalignment between the engine and transmission can also cause release bearing wear and damage.

Pressure Plate and Cover

Inspect the surface of the pressure plate for burn marks, scores, ridges, and warpage (Fig. 6). Generally, pressure plate resurfacing is not recommended, but minor burn marks or scores can be removed with a crocus pad. If it is badly heat-checked, warped or deeply scored, replace the pressure plate and cover assembly. Clean pressure plate and flywheel surfaces with a suitable solvent, such as alcohol to be sure the surfaces are free from any oil film. **Do not use cleaners with petroleum base, and do not immerse the pressure plate in the solvent.**

If a substantial difference in finger wear exists (see Fig. 6), the heavily worn finger is binding. Replace the pressure plate.

On all models except Pinto, Bobcat and Mustang II, the pressure plate should be lubricated with a lithium base grease between the driving lugs and the edges of the pressure plate openings as shown in Fig. 5. Depress the pressure plate fingers fully, apply the lubricant, and then move the fingers up and down until the lubricant is worked in. Do not apply excessive lubricant.

Clutch Disc

Inspect the clutch disc facings for oil or grease. Eliminate the source of any oil or grease before replacing the disc.

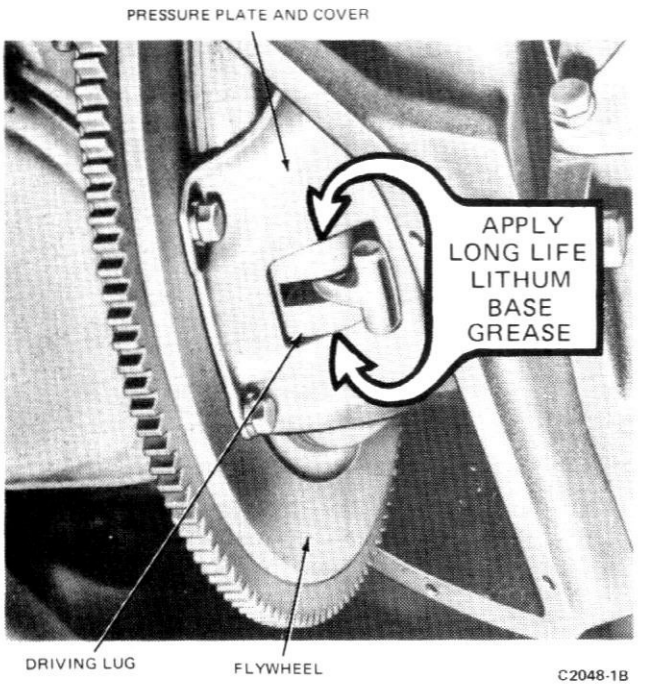
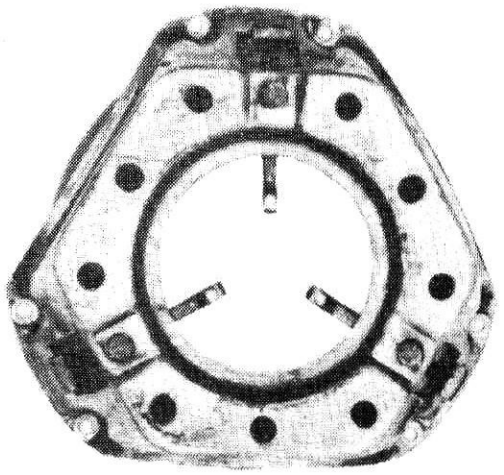


FIG. 5 Pressure Plate Lubrication Points

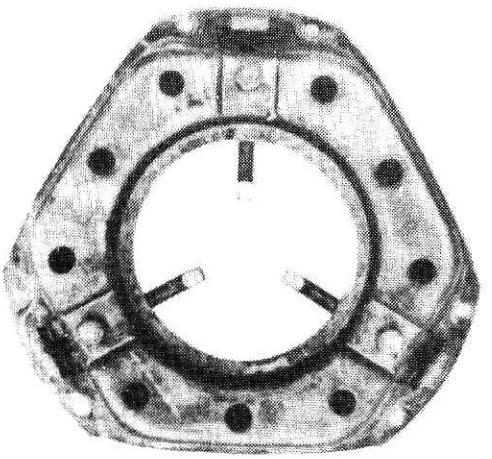
Any excessive amount of lubricant on the pilot bearing or release bearing hub will find its way to the disc facings. Too much lubricant in the transmission or a plugged transmission vent will force the transmission lubricant out the input shaft and onto the disc facings. Also, rear main bearing oil seal leaks or oil leaks from the flywheel mounting bolts can contaminate the clutch disc.

Inspect the clutch disc for worn or loose facings, distortion, loose rivets at the hub, and for broken springs. **Springs loose enough to rattle will not cause noise when the car is operating. Replace the disc assembly if any of these defects are present. Be especially careful when installing a new disc to avoid dropping it or contaminating it with oil or grease.**

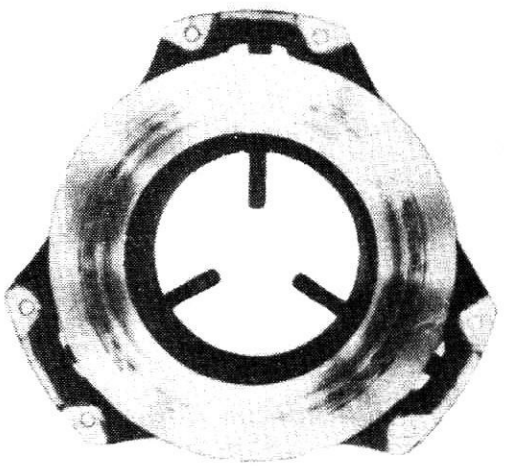
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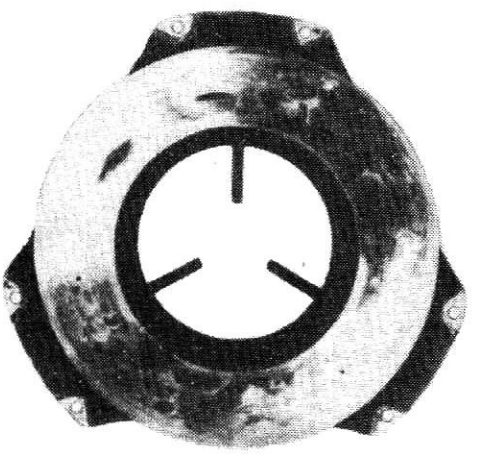
NORMAL FINGER WEAR



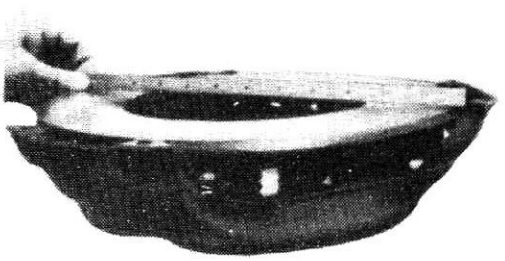
EXCESSIVE FINGER WEAR



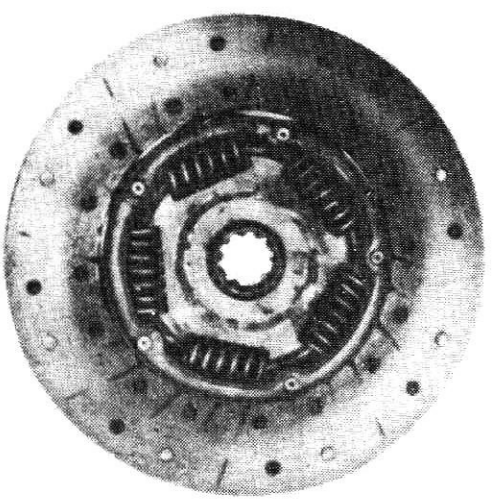
SLIGHT CHATTER MARKS



EXCESSIVE BLUEING AND CHATTER



EXCESSIVE WARPAGE



WEAR PATTERN FROM
WARPED PRESSURE PLATE

C2579-2A

FIG. 6 Clutch Inspection

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REMOVAL AND INSTALLATION

DOWELS—FLYWHEEL AND ENGINE

Removal

Dowels can be removed by using a drift pin where the dowel is installed in a drilled hole and vise grip pliers where the dowel is installed in a blind hole. They should be pulled or driven from their seat, taking care not to damage the surface area around the dowel during removal.

Installation

1. **Solid Type Dowels**

   All solid-type dowels can be installed by driving them into place using a brass or plastic mallet. Again, care should be exercised to drive the dowel squarely into place until fully seated and not to damage the surrounding surface area.

2. **Hollow Dowels**

   This type dowel is used on the rear face of the engine block on Pinto, Bobcat and Mustang II vehicles. Installation can be easily accomplished by fabricating a simple tool from steel or brass dowel stock (Fig. 7). Insert the tool into the dowel, and with the dowel squarely in position, drive it into the hole in the engine block until it is fully seated.

CLUTCH PILOT BEARINGS

A needle roller bearing is used as a clutch pilot bearing on all vehicles (Fig. 8). It is inserted directly into the crankshaft on Pinto, Bobcat and Mustang vehicles. A bearing and adaptor are used on the other vehicles (Fig. 9) with the adaptor and bearing comprising an assembly that cannot be serviced separately. The Pinto, Bobcat and Mustang II clutch pilot bearings must always be installed with the seal end of the bearing facing the transmission. The adapter type bearing, used on the other car lines, can only be installed in the proper direction. The bearing and seal are pre-greased and do *not require additional lubrication.* A new bearing must be installed whenever a bearing is removed.

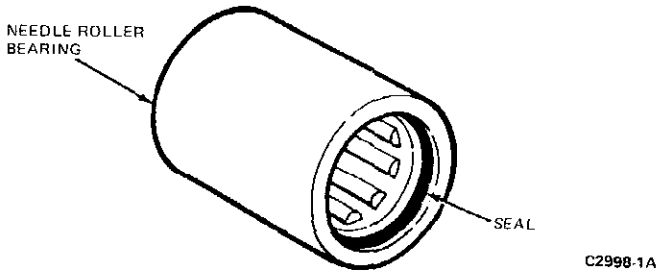


FIG. 8 Needle Pilot Bearing—Pinto, Bobcat And Mustang II (2.3L and 2.8L)

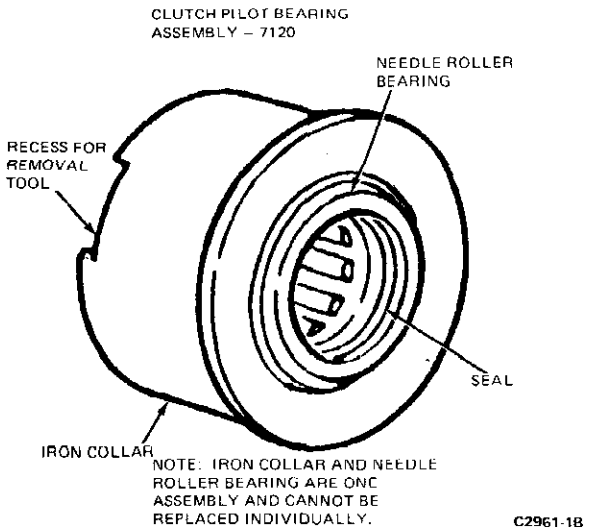


FIG. 9 Needle Pilot Bearing And Adaptor—All Vehicles Except Pinto, Bobcat And Mustang II (2.3L and 2.8L)

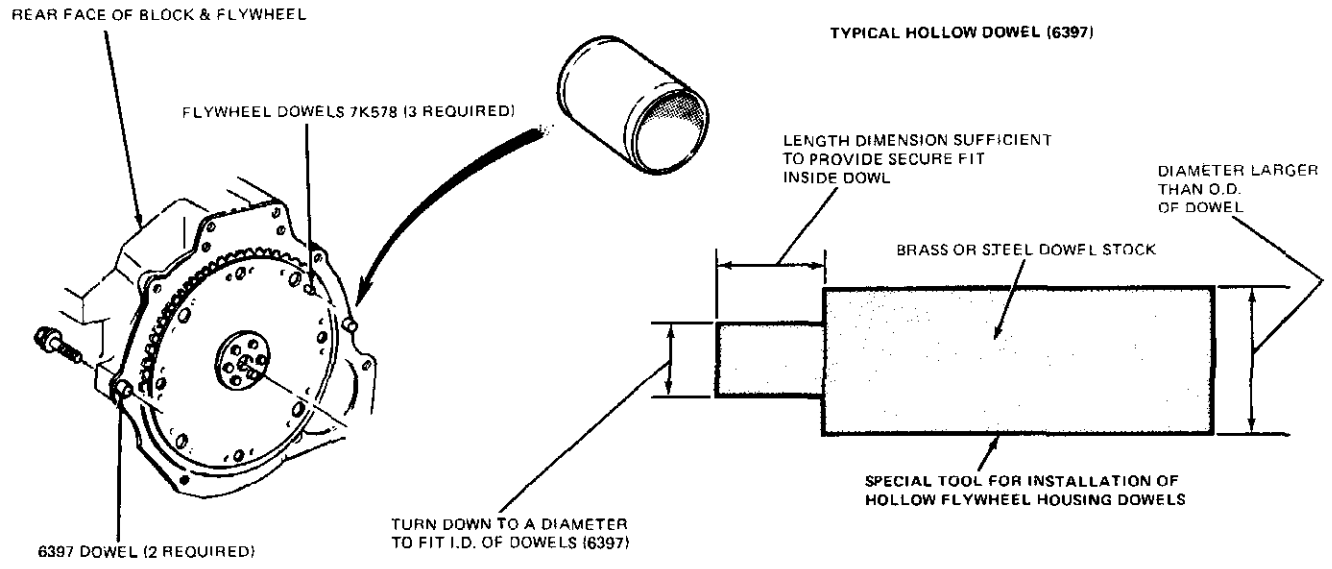


FIG. 7 Installing Dowels

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Clutch Pilot Bearing

Removal—All Models

1. Remove the transmission, clutch pressure plate and disc following procedures described in the pertinent sections of the Shop Manual.
2. Pull the bearing from the crankshaft using a slide-hammer such as Tool T50T-100A or Tool T59L-100B and a puller attachment such as Tool T58L-101-A.

Installation—Pinto, Bobcat, Mustang II (2.3 and 2.8L), Fairmont and Zephyr (2.3L)

1. Coat the pilot bearing bore in the crankshaft with a small quantity of lithium base grease. Avoid using too much lubricant as it may be thrown on the clutch disc when the clutch revolves.
2. Using the proper replacer tool, carefully install the pilot bearing with the seal facing the transmission.

Installation—Mustang II 5.0L (302 CID), Monarch, Granada, Fairmont and Zephyr 3.3L (200 CID)

1. Coat the pilot bearing bore in the crankshaft with a small quantity of lithium base grease. Avoid using too much lubricant as it may be thrown on the clutch disc when the clutch revolves.
2. Using a 1 inch, 12 point socket and short extension, carefully tap the extension with a hammer to drive the bearing SQUARELY into the bore until the bearing seats in the crankshaft. The socket must not contact the needle bearing assembly at any time while the bearing is being driven into the crankshaft. Be sure that the needle bearing is not damaged or repositioned in the adaptor-collar.

Note: Care must be taken not to damage the bearing during transmission installation while the transmission input shaft is being inserted in the bearing.

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Clutch

PART 16-02

Applies To Pinto/Bobcat Mustang II, Fairmont/Zephyr, Granada/Monarch

SUBJECT	PAGE
DESCRIPTION	
Granada/Monarch	02-1
Pinto/Bobcat/Mustang II – Fairmont/Zephyr	02-1
REMOVAL AND INSTALLATION	
Clutch and/or Release Lever	
Granada/Monarch	02-3
REMOVAL AND INSTALLATION (Cont'd.)	
Fairmont/Zephyr	02-1
Mustang II (2.3L and 5.0L [302 CID])	02-6
Mustang II (2.3L V-6)	02-6
Pinto/Bobcat	02-8
SPECIFICATIONS	02-11

CC3015-2B

DESCRIPTION

For 1978, the passenger cars using clutch and manual transmission consist of Mustang II/Pinto/Bobcat, Fairmont/Zephyr, Monarch and Granada.

PINTO, BOBCAT AND MUSTANG II

Pinto/Bobcat/Mustang II and Fairmont/Zephyr vehicles use a cable-operated clutch system.

GRANADA AND MONARCH

The linkage and clutch pedal are unique to this vehicle. Clutch pedals use a bolt-on assembly system, like the Pinto. The clutch pilot bearing is the type shown in Fig. 1. Manual transmission and clutch are available on the 4.1 Litre (250 CID-6) and 5.0 Litre (302 CID V-8) engines.

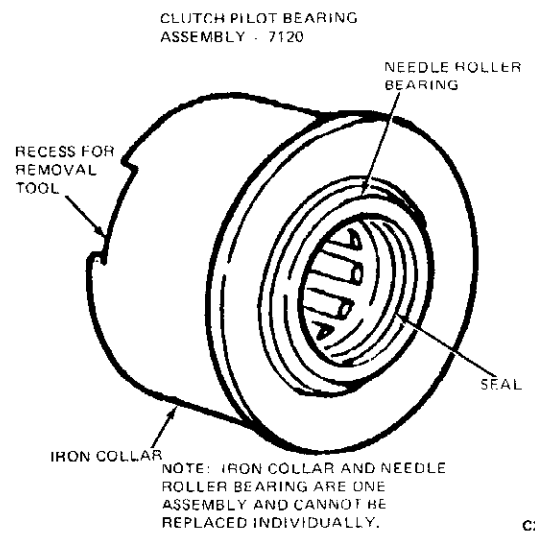


FIG. 1 Needle-Roller Pilot Bearing

REMOVAL AND INSTALLATION

CLUTCH AND/OR RELEASE LEVER

Fairmont/Zephyr 2.3 Litre Engine

Removal (Refer to Fig. 3)

1. Raise the vehicle on a hoist.
2. Remove the release lever return spring and dust shield.
3. Loosen the clutch cable lock and adjusting nut and disconnect the cable from the release lever.
4. Remove the retaining clip and remove the clutch cable from the flywheel housing.
5. Remove the starter electrical cable and the starter motor from the flywheel housing.
6. Remove the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
7. Remove the transmission and flywheel housing. Refer to Part 16-29, Model 78ET Four-Speed Transmission.
8. Remove the clutch release lever from the housing by pulling it through the window in the housing until the retainer spring is disengaged from the pivot. Inspect clutch release bearing and replace if required from owner report.
9. Loosen the six (6) pressure plate cover attaching bolts evenly to release the spring tension gradually and avoid distorting the cover. If the same pressure plate and cover are to be reinstalled, mark the cover and flywheel so that the pressure plate can be reinstalled in its original position. Remove the pressure plate and clutch disc from the flywheel.

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Installation

1. Install the clutch release lever if it was removed.
2. Position the clutch disc and pressure plate assembly on the flywheel. The three (3) dowl pins on the flywheel must be properly aligned with the pressure plate. Bent, damaged or missing dowels must be replaced. Start the cover attaching bolts but do not tighten them. Avoid touching the clutch disc face, dropping parts or contaminating parts with oil or grease.
3. Align the clutch disc using the proper alignment tool (same as Pinto) inserted in the pilot bearing. Alternately tighten the cover bolts to specification. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B) to (1) the outside diameter of the transmission front bearing retainer, (2) the release lever fork and anti-rattle spring where they contact the release bearing hub, and (3) to the release bearing surface that contacts the pressure plate release fingers. Then, fill the grease groove of the release bearing hub with the same grease. Clean all excess grease from inside the bore of the bearing hub, otherwise, excess grease will be forced onto the spline by the transmission input shaft bearing retainer, and will contaminate the clutch disc.
5. Attach the clutch release bearing to the release lever.
6. Attach the release lever and release bearing to the flywheel housing.
7. Inspect the flywheel housing dowel holes for misalignment and wear.
8. Make certain that the flywheel housing and cylinder block mounting surfaces are clean and that the dowels are in good condition. MISSING OR DAMAGED DOWELS MUST BE REPLACED.
9. Install the flywheel housing and transmission. Refer to Part 16-29, Model 78ET Four-Speed Transmission.
10. Install the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
11. Connect the clutch cable to the flywheel housing and connect the retaining clip.
12. Install the starter motor and starter electrical cable.
13. Connect the clutch cable and return spring to the release lever and reinstall the dust shield and return spring to the rear crossmember.
14. Adjust the clutch pedal free travel following instructions given in Part 16-03.

3.3 LITRE (200 CID 6)

Removal (Refer to Fig. 3)

1. Raise the vehicle on a hoist.
2. Refer to Part 16-11, Ford Three-Speed Transmission, for instructions on the removal of the transmission.
3. Remove the dust shield.
4. Loosen the clutch adjusting nut to provide slack in the clutch cable and disengage the clutch cable from the release lever.
5. Disengage the clutch cable from the flywheel housing.
6. Remove the starter electrical cable, then the starter motor from the flywheel housing.
7. Remove the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
8. Remove the bolts that attach the housing to the cylinder block.
9. Move the housing back just far enough to clear the pressure plate, and remove.
10. Remove the clutch release lever from the housing by pulling it through the window in the housing until the retainer spring is disengaged from the pivot.
11. Loosen the six (6) pressure plate cover attaching bolts evenly to release the spring tension without distorting the cover. If the same pressure plate and cover assembly is to be installed after the clutch is removed, mark the cover and flywheel so that the pressure plate can be reinstalled in the same position.
12. Remove the pressure plate and clutch disc from the flywheel.

Installation

1. Install the clutch release lever.
2. Place the clutch disc and pressure plate assembly in position on the flywheel. Start the cover attaching bolts to hold the pieces in place, but do not tighten them. Avoid touching the clutch disc facing, dropping the parts or contaminating them with oil or grease as clutch chatter may result.
3. Align the clutch disc using a transmission input shaft from an older model Maverick/Comet. To avoid distorting the pressure plate cover, alternately tighten the bolts, a few turns at a time, until they are all snug. Then, torque the six (6) pressure plate cover bolts to specification. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B) to (1) the outside diameter of the transmission front bearing retainer, (2) both sides of the release lever fork where it contacts the release bearing spring clips and (3) to the release bearing surface that contacts the pressure plate release fingers. Then, fill the grease groove of the release bearing hub with the same lithium base grease. Clean all excess grease from inside the bore of the bearing hub, otherwise, excess grease will be forced onto the spline by the transmission input shaft bearing retainer, and will contaminate the clutch disc. Place the release bearing on the release lever and make certain that the flywheel housing and the cylinder block mounting surfaces are clean. Check to see that the dowels are in good condition. **MISSING OR DAMAGED DOWELS MUST BE REPLACED.** Position the housing on the dowels in the cylinder block. Install and alternately torque the attaching bolts to specification.
5. Connect the clutch cable to the flywheel housing.
6. Install the starter motor and starter electrical cable.
7. Connect the clutch cable to the release lever and reinstall the dust shield.

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8. Install the transmission following instructions contained Part 16-11, Ford Three-Speed Transmission.
9. Adjust the clutch pedal free travel following instructions given in Part 16-03.

GRANADA AND MONARCH (REFER TO FIG. 4)

Removal

1. Raise the vehicle on a hoist.
2. Refer to the Transmission Part for instructions on the removal of the transmission.
3. Disconnect the clutch release lever retaining spring from the release lever.
4. Loosen the clutch rod adjusting nuts and remove the adjusting rod.
5. Remove the starter electrical cable then the starter motor from the flywheel housing.
6. Remove the bolts that attach the engine rear plate to the front lower part of the flywheel housing.
7. Remove the bolts that attach the flywheel housing to the cylinder block and the clutch equalizer bar pivot bracket to the flywheel housing.
8. Move the housing back just far enough to clear the pressure plate and remove the housing. Be careful not to disturb the clutch linkage.
9. Remove the clutch release lever from the housing by pulling it through the window in the housing until the retainer spring is disengaged from the pivot.
10. Loosen the six (6) pressure plate cover attaching bolts evenly to release the spring tension without distorting the cover. If the same pressure plate and cover assembly is to be reinstalled, mark the cover and flywheel so that the pressure plate can be reinstalled in the same position.
11. Remove the pressure plate and clutch disc from the flywheel.

Installation (See Fig. 2)

1. Install the clutch release lever if it was removed.
2. Position the clutch disc and pressure plate assembly on the flywheel. Start the cover attaching bolts to hold the pieces in place, but do not tighten. Avoid touching the clutch disc facing, dropping the parts or contaminating them with oil or grease, as clutch chatter may result.
3. Align the clutch disc using a transmission input shaft from an older model. To avoid distorting the pressure plate, alternately tighten the bolts, a few turns at a time, until they are all snug. Then, torque the six (6) pressure plate cover bolts to specification. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B or equivalent) to (1) the outside diameter of the transmission front bearing retainer, (2) for 3.3L (200 CID) only, both sides of the release lever fork where it contacts the release bearing spring clips; for 4.1L/5.0L (250/302 CID) the release lever fork and anti-rattle spring where they contact the release bearing hub, (3) to the release bearing surfaces that contact the pressure plate release fingers, and (4) to the release lever pivot. Then, fill the grease groove of the release bearing with the same lubricant. Clean all excess lubricant from inside the bore of the bearing hub.
5. If removed, install the release lever to flywheel housing by sliding the clip retainer onto the pivot ball stud.
6. Make certain that the flywheel housing, starter plate and the cylinder block mounting surfaces are clean, and that the dowels are in good condition. **Missing dowels must be replaced.** Position the housing on the dowels in the cylinder block and hand-start the five (5) attaching bolts, omitting the one bolt at the clutch equalizer bar pivot bracket. Position the clutch equalizer bar pivot bracket in place and install the attaching bolts. Alternately torque the housing attaching bolts and bracket bolt to specification. For 3.3L (200 CID) engines: alternately tighten all attaching bolts to specification. Then install the clutch equalizer bar pivot bracket in place and tighten the attaching bolts to specification.
7. Install the starter motor and connect the cable.
8. Install the engine rear plate bolts.
9. Place the release bearing on the release lever.
10. Install the transmission following instructions contained in the transmission installation Part of this manual.
11. Install the clutch adjusting rod and retaining spring. Set the clutch pedal free travel following the instructions in Part 16-03 of this Manual.

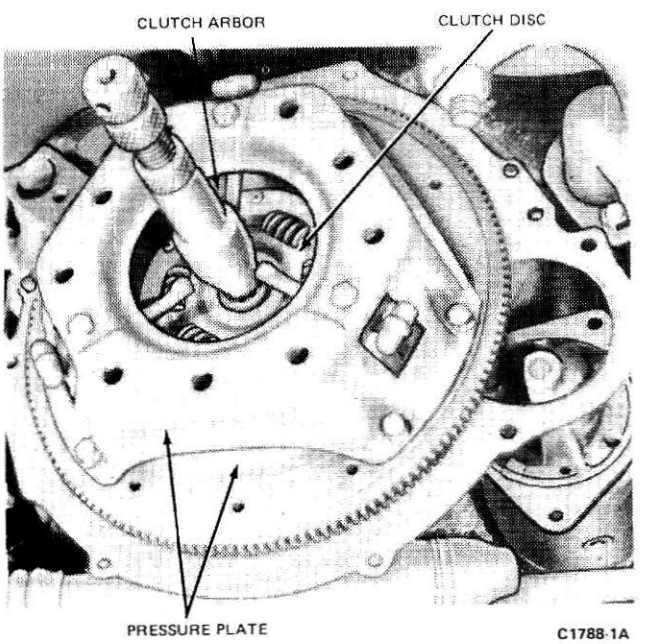


FIG. 2 Installing Clutch Disc—Typical

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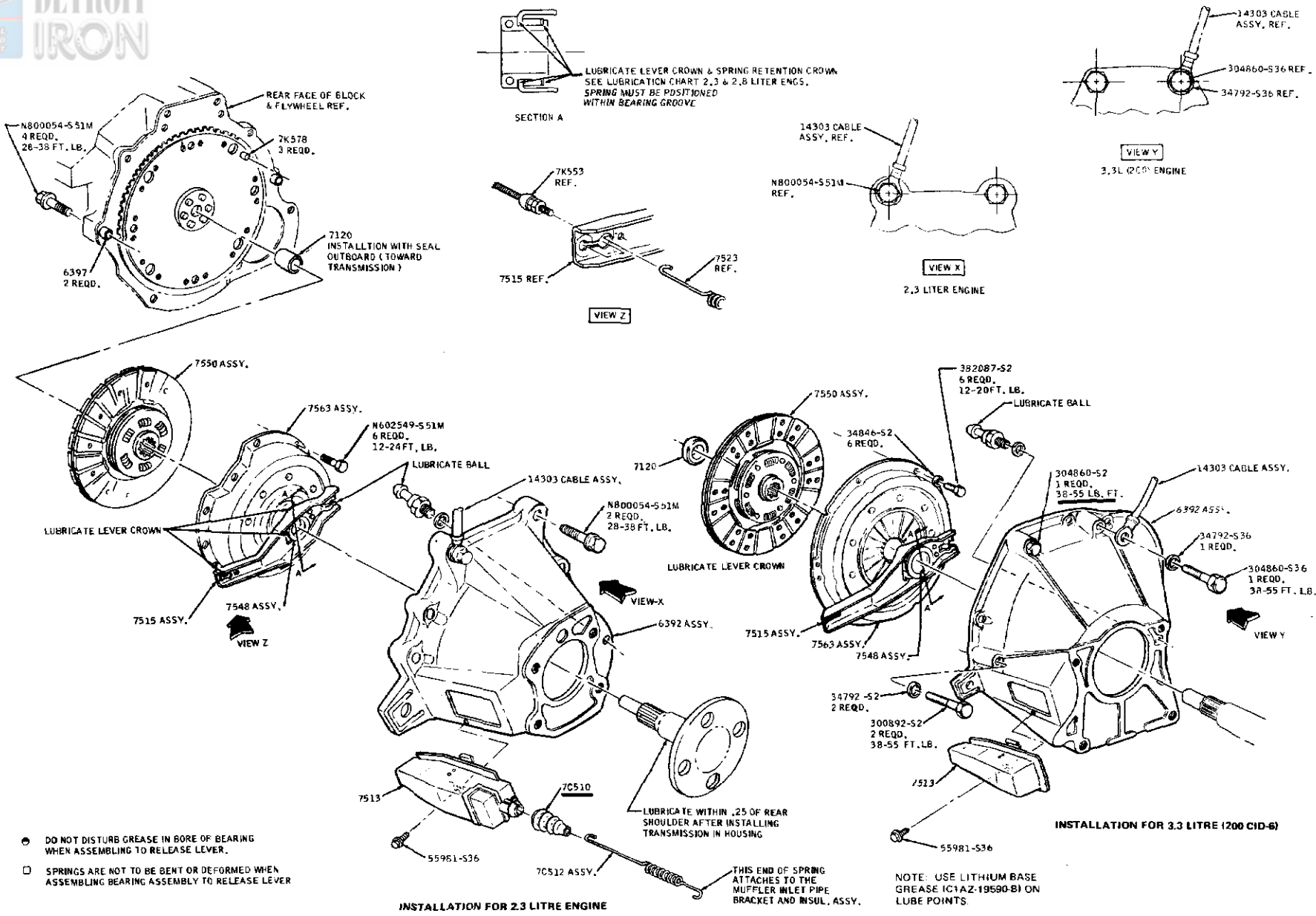
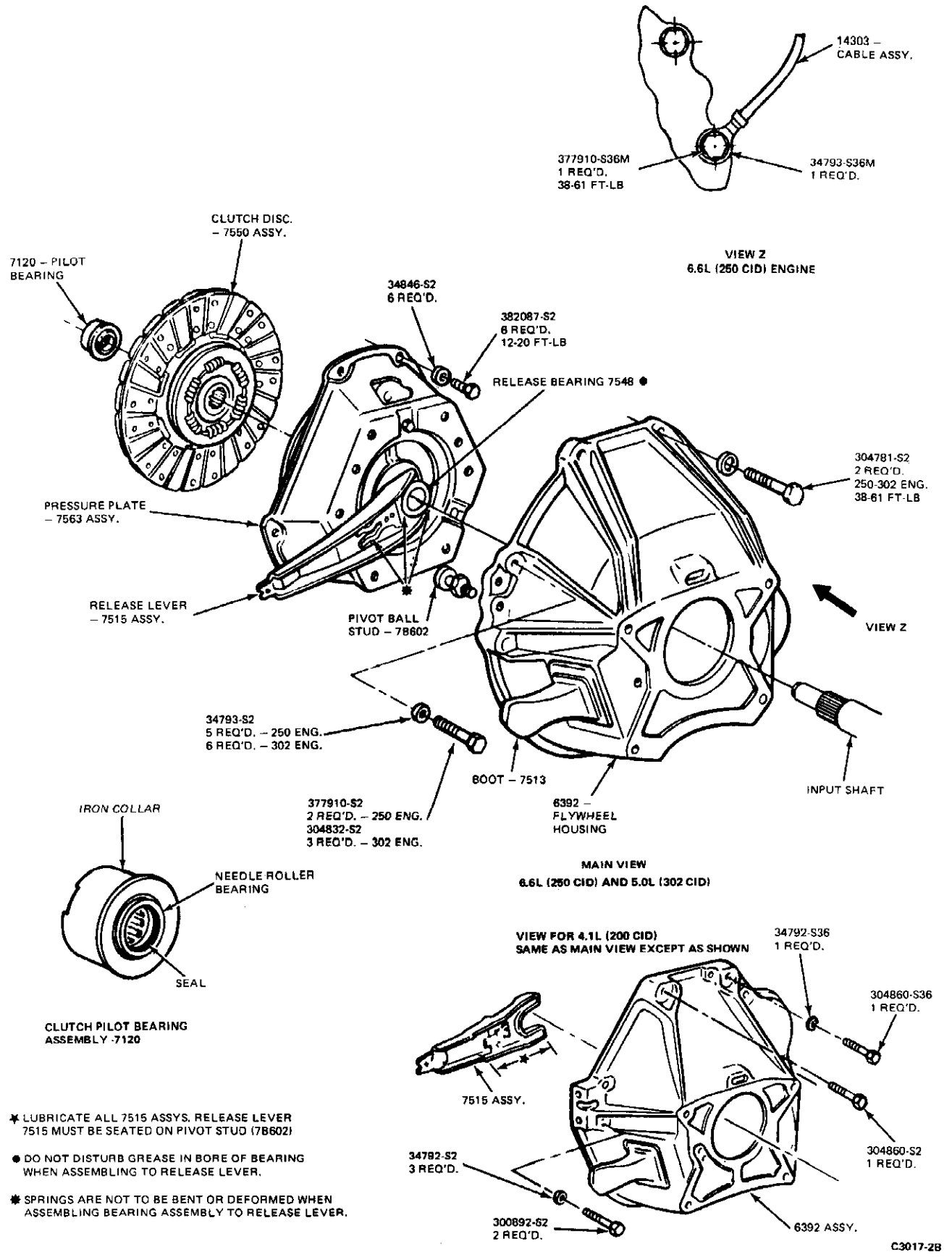


FIG. 3 Clutch Installation—Fairmont and Zephyr

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✱ LUBRICATE ALL 7515 ASSYS. RELEASE LEVER 7515 MUST BE SEATED ON PIVOT STUD (78602)

● DO NOT DISTURB GREASE IN BORE OF BEARING WHEN ASSEMBLING TO RELEASE LEVER.

✱ SPRINGS ARE NOT TO BE BENT OR DEFORMED WHEN ASSEMBLING BEARING ASSEMBLY TO RELEASE LEVER.

FIG. 4 Clutch Installation—Granada and Monarch

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DETROIT IRON

MUSTANG II 2.3 LITRE AND 5.0L (302 CID) (REFER TO FIG. 5)

Removal

1. Remove the clutch cable retaining clip and loosen the clutch cable adjusting nut to provide slack in the cable.
2. Raise the vehicle on a hoist.
3. Refer to the Transmission Part in the manual for instructions on removal of the transmission.
4. Remove the clutch lever cover and cable retainer. Disengage the clutch cable from the release lever.
5. Disconnect the clutch cable from the flywheel housing.
6. Remove the starter electrical cable and the starter motor from the flywheel housing.
7. Remove the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
8. Remove the bolts that attach the housing to the cylinder block.
9. Move the housing back just far enough to clear the pressure plate and remove.
10. Remove the clutch release lever from the housing by pulling it through the window in the housing until the retainer spring is disengaged from the pivot.
11. Loosen the six pressure plate cover attaching bolts evenly to release the spring tension without distorting the cover. If the same pressure plate and cover are to be reinstalled after the clutch is removed, mark the cover and flywheel so that the pressure plate can be reinstalled in the same position (Fig. 5).
12. Remove the pressure plate and clutch disc from the flywheel.

Installation

1. Install the clutch release lever if it was removed.
2. Position the clutch disc and pressure plate assembly on the flywheel. The three dowel pins on the flywheel must be properly aligned with the pressure plate. **Missing or damaged dowel pins must be replaced.** Start the cover attaching bolts but do not tighten them. Avoid touching the clutch disc face, dropping parts or contaminating parts with oil or grease.
3. Align the clutch disc using the proper alignment tool (See Fig. 2) inserted in the pilot bearing. Alternately tighten the cover bolts to specifications. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B or equivalent) to (1) the outside diameter of the transmission front bearing retainer, (2) the release lever fork and anti-rattle spring where they contact the release bearing hub, and (3) to the release bearing surface that contacts the pressure plate release fingers.

   Then, fill the grease groove of the release bearing hub with the same lithium base grease. Clean all excess grease from inside the bore of the bearing hub. Otherwise, excess grease will be forced onto the spline by the transmission input shaft bearing retainer, and will contaminate the clutch disc.
5. Install the clutch release bearing to the release lever.
6. Attach the release lever and release bearing to the flywheel housing.
7. Make certain that the flywheel housing and the cylinder block mounting surfaces are clean and that the dowels are in good condition. **Missing or damaged dowels must be replaced.**

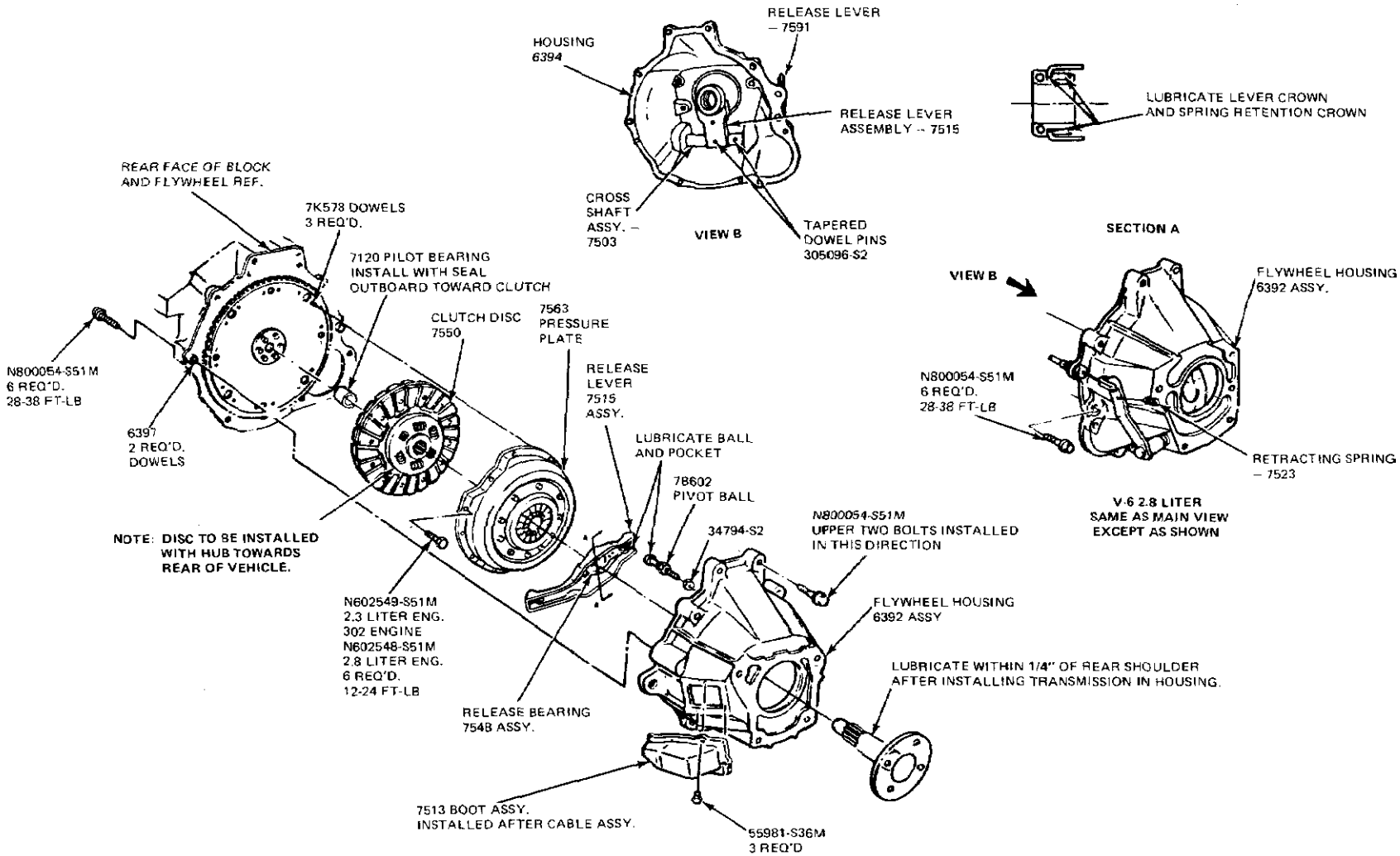
   Position the housing on the dowels in the cylinder block. Install and alternately torque the attaching bolts to specification.
8. Install the starting motor and connect the starter electrical cable.
9. Install the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
10. Connect the clutch cable to the flywheel housing.
11. Connect the cable to the release lever and reinstall the cable retainer.
12. Install the clutch lever cover.
13. Adjust the clutch pedal free travel.

MUSTANG II (2.8 LITRE) V6 ENGINE (REFER TO FIG. 5)

Removal

1. Remove the clutch cable retaining clip and loosen the clutch cable adjusting nut to provide slack in the cable.
2. Raise the vehicle on a hoist.
3. Refer to Group 16 for instructions on the removal of transmission.
4. Remove the release bearing.
5. Remove the clutch cable retaining clip and clevis pin from the clevis at the release lever connection. Disengage the clevis from the cable.
6. Disconnect the clutch cable from the flywheel housing by removing the nut that attaches the cable to the housing and pulling the cable toward the front of the vehicle until it clears the housing boss.
7. Remove the clutch retracting spring (Fig. 5)
8. Remove the starter electrical cable; then remove the starter motor from the flywheel housing.
9. Remove the four bolts holding the No. 2A crossmember and remove the crossmember.
10. Remove the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
11. Remove the bolts that attach the housing to the cylinder block. This will remove the engine decking shield which should be set to the side for reinstallation.
12. Move the housing back just far enough to clear the pressure plate and remove.
13. Remove the clutch release lever by driving the two tapered dowel pins from the cross shaft assembly and then sliding the lever and shaft assembly from the housing.
14. Loosen the six pressure plate cover attaching bolts evenly to release the spring tension and to avoid distorting the cover. If the same pressure plate and cover is to be reinstalled after the clutch is removed, mark the cover and flywheel so that the pressure plate can be reinstalled in the same position.

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2.3 LITRE AND 5.0 LITRE (302 CID) ENGINE INSTALLATION
MAIN VIEW

C2735-2F

FIG. 5 Clutch Assembly—Mustang II—2.3 Litre, 2.8 Litre and 5.0 Litre (302 CID)

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15. Remove the pressure plate and clutch disc from the flywheell.

Installation

1. If the clutch release lever was removed, install it by placing it in position and sliding the lever and shaft assembly through the housing and release lever sleeve. Insert the tapered dowel pins and seat securely by tamping with a hammer.
2. Position the clutch disc and pressure plate assembly on the flywheel. The three dowel pins on the flywheel must be properly aligned with the pressure plate. Start the cover attaching bolts but do not tighten them. Avoid touching the clutch disc face, dropping parts or contaminating parts with oil or grease.
3. Align the clutch disc using the proper alignment tool inserted in the pilot bearing. Alternately tighten the cover bolts to specification. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B or equivalent) to (1) the outside diameter of the transmission front bearing retainer, (2) the release lever fork and anti-rattle spring where they contact the release bearing hub, and (3) to the release bearing surface that contacts the pressure plate release fingers. Then, fill the grease groove of the release bearing hub with the same lithium base grease. Clean all excess grease from inside the bore of the bearing hub. Otherwise, excess grease will be forced onto the spline by the transmission input shaft bearing retainer, and will contaminate the clutch disc.
5. Install the clutch release bearing to the release lever.
6. Make certain that the flywheel housing and the cylinder block mounting surfaces are clean and that the dowels are in good condition. **Missing or damaged dowels must be replaced.** Position the housing on the dowels in the cylinder block. Install and alternately torque the attaching bolts to specification.
7. Install the four No. 2A crossmember bolts and tighten to specification.
8. Install the starting motor and connect the cable.
9. Install the transmission. Refer to Group 16.
10. Install the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
11. Connect the clutch cable to the flywheel housing and install the clevis to the cable.
12. Connect the clutch cable to the release lever with the clevis pin and retaining clip.
13. Install the clutch retracting spring.
14. Adjust the clutch pedal free travel as indicated in Part 16-03. Be sure to remove the cable to fender apron attaching bracket screw prior to adjustment.

PINTO/BOBCAT (REFER TO FIG. 6)

Removal

1. Raise the vehicle on a hoist.
2. Loosen the clutch cable adjusting and retaining nuts to provide slack in the cable.
3. Pull back the rubber dust cover and disengage the clutch cable from the release lever.
4. Disconnect the clutch cable from the flywheel housing.
5. Remove the starter electrical cable and the starter motor from the flywheel housing.
6. Remove the bolts that secure the engine rear plate to the front lower part of the flywheel housing.
7. Remove the transmission and flywheel housing. Refer to Group 16.
8. Remove the clutch release lever from the housing by pulling it through the window in the housing until the retainer spring is disengaged from the pivot.
9. Loosen the six pressure plate cover attaching bolts (Fig. 5) evenly to release the spring tension gradually and avoid distorting the cover. If the same pressure plate and cover are to be reinstalled, mark the cover and flywheel so that the pressure plate can be reinstalled in its original position. Remove the pressure plate and clutch disc from the flywheel.

Installation

1. Install the clutch release lever if it was removed.
2. Position the clutch disc and pressure plate assembly on the flywheel. The three dowel pins on the flywheel must be properly aligned with the pressure plate. **(Bent, damaged or missing dowels must be replaced.)** Start the cover attaching bolts but do not tighten them. Avoid touching the clutch disc face, dropping parts or contaminating parts with oil or grease.
3. Align the clutch disc using the proper alignment tool inserted in the pilot bearing. Alternately tighten the cover bolts to specification. Remove the alignment tool.
4. Apply a light film of lithium base grease (C1AZ-19590-B) to (1) the outside diameter of the transmission from bearing retainer, (2) the release lever fork and anti-rattle spring where they contact the release bearing hub, and (3) to the release bearing surface that contacts the pressure plate release fingers. Then, fill the grease groove of the release bearing hub with the same grease. Clean all excess grease from inside the bore of the bearing hub. Otherwise, excess grease will be forced onto the spline by the transmission input shaft bearing retainer, and will contaminate the clutch disc.
5. Install the clutch release bearing to the release lever.
6. Attach the release lever and release bearing to the flywheel housing.
7. Inspect the flywheel housing dowel holes for misalignment and wear.
8. Make certain that the flywheel housing and cylinder block mounting surfaces are clean and that the dowels are in good condition. **Missing or damaged dowels must be replaced.**
9. Install the flywheel housing and transmission. Refer to Group 16.
10. Install the bolts that secure the engine rear plate to the front lower part of the flywheel housing.

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11. Connect the clutch cable to the flywheel housing.
12. Install the starter motor and starter electrical cable.
13. Connect the clutch cable to the release lever and reinstall the rubber dust cover.
14. Adjust the clutch pedal free travel following instructions in Part 16-03.

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DETROIT IRON

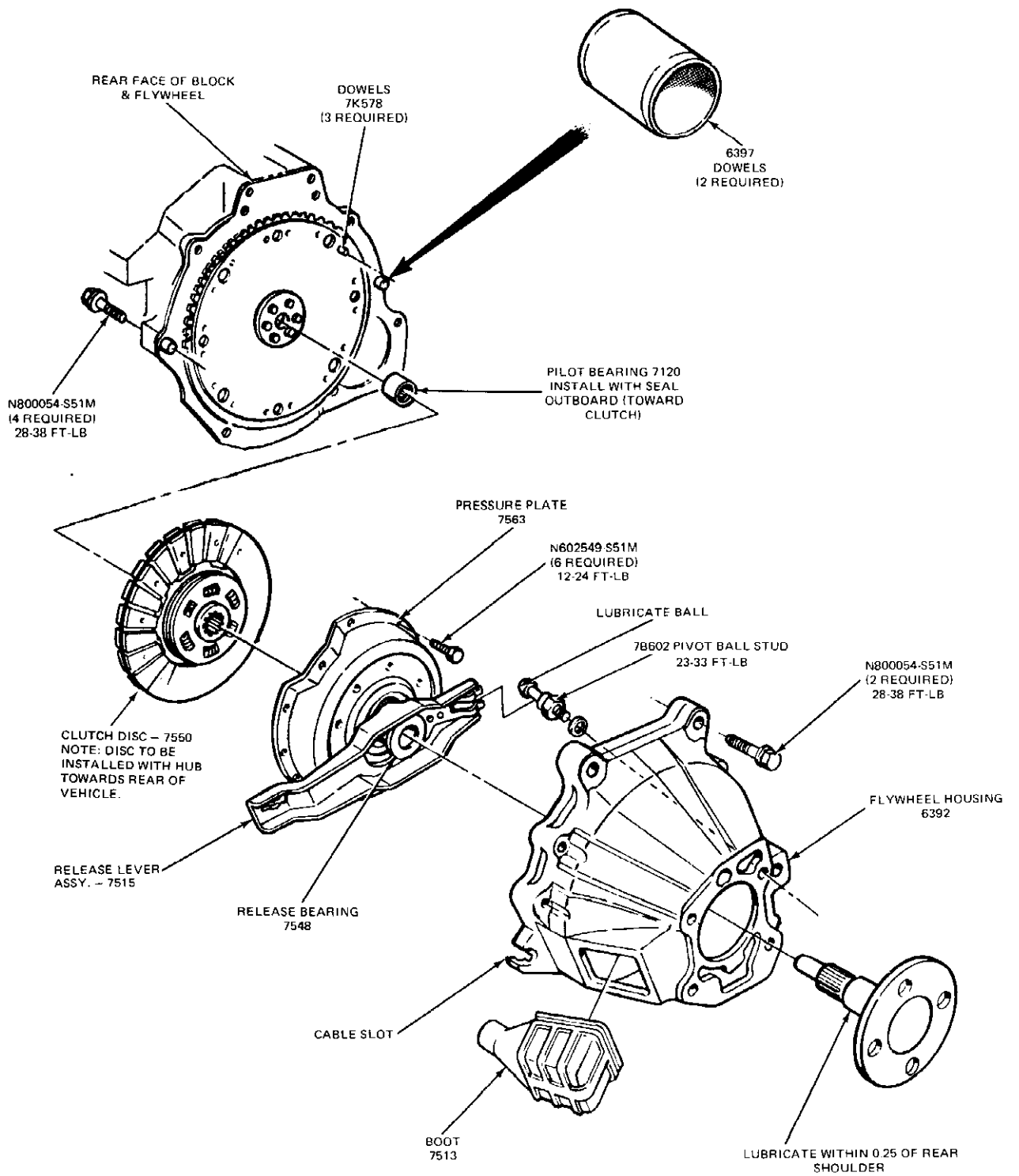


FIG. 6 Clutch Installation—Pinto and Bobcat 4-Cylinder—(2.3 Liter Engine)

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SPECIFICATIONS

CLUTCH IDENTIFICATION

Car Line	Engine	Transmission	Pressure-Plate			Disc		
			Diameter (Inches)	No. of Springs	Color Identification (Paint Daub)	Diameter (Inches)	No. of Springs	Color Identification (Paint Daub)
Pinto/Bobcat	2.3L	4-Speed	8.5	N/A	None	8.5	6	Disc – Pink Springs – 4 Plain 2 Orange
Fairmont/Zephyr	2.3L	4-Speed	8.5	N/A	Cover – Blue	8.5	6	Disc – Blue Springs – 4 Plain 2 Orange
Fairmont/Zephyr	3.3L (200 CID)	3-Speed	9	N/A	None	9	10	Disc – Brown Springs – 6 Blue
Granada/Monarch	5.0L (302 CID)	4-Speed	10	9	Cover – White Springs – Bronze w/White Stripe Pressure Plate – 2 Green	10	10	Disc – Green Springs – 5 Blue (Large) – 5 Yellow (Small)
Granada/Monarch	4.1L (250 CID)	4-Speed	10	9	Cover – White Springs – Bronze w/White Stripe Pressure Plate – 2 Green	10	10	Disc – Aluminum Springs – 6 Orange (Large) – 4 Orange (Small)
Mustang II	2.3L	4-Speed	8.5	N/A	None	8.5	6	Disc – Yellow Springs – 4 Plain – 2 Orange
Mustang II	2.8L	4-Speed	9.5	N/A	None	9.5	6	Disc – Blue Springs – 6 Orange
Mustang II	5.0L (302 CID)	4-Speed	10	N/A	None	10	12	Disc – Pink Springs – 6 Pink (Large) – 6 Orange (Small)

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DETROIT IRON

TORQUE SPECIFICATIONS – CLUTCH – GRANADA/MONARCH

Component	Torque (FT-LB)	Component	Torque (FT-LB)
Bolt – Flywheel Housing to Engine – 4.1L (250 CID), 5.0L (302 CID)	38-61	Bolt – Pressure Plate to Flywheel	12-20

CC1147-2C

TORQUE SPECIFICATIONS – PINTO/BOBCAT/MUSTANG II

Component	Torque (FT-LB)	Component	Torque (FT-LB)
Bolt – Flywheel Housing	28-38	Bolt – Pressure Plate to Flywheel	12-24

CC1148-2C

TORQUE SPECIFICATIONS – FAIRMONT/ZEPHYR

Component	Torque (FT-LB)	Component	Torque (FT-LB)
Bolt – Flywheel Housing to Engine – 2.3 Litre	28-38	Bolt – Pressure Plate to Flywheel – 2.3 Litre	12-24
Bolt – Flywheel Housing to Engine – 3.3 Litre (200 CID)	38-55	Bolt – Pressure Plate to Flywheel – 3.3 Litre (200 CID)	12-20

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Mechanical Clutch Linkage

PART 16-03

Applies To Pinto/Bobcat/Mustang II, Fairmont/Zephyr, Granada/Monarch

SUBJECT	PAGE
ADJUSTMENTS	
Clutch Free Travel	03-1
Clutch Pedal	03-1
REMOVAL AND INSTALLATION	
Clutch Cable	03-8
REMOVAL AND INSTALLATION (Cont'd.)	
Clutch Equalizer Bar or Bushing	03-8
Clutch Pedal	03-7
SPECIFICATIONS	03-10

CC3021-2B

ADJUSTMENTS

CLUTCH PEDAL

Adjust the clutch pedal free travel whenever the clutch does not disengage properly, or when new clutch parts are installed. Improper adjustment of the clutch pedal is one of the most frequent causes of clutch failure and can be a contributing factor in some transmission failures.

CLUTCH FREE TRAVEL

Pinto and Bobcat

1. Loosen the clutch cable lock nut located on the transmission side of the flywheel housing (Fig. 1).
2. Pull the cable toward the front of the car until the tabs on the nylon adjuster nut are clear of the housing boss and then rotate the nut toward the front of the vehicle approximately 1/4 inch.
3. Release the cable to neutralize the system and then pull the cable forward again until free movement of the release lever is eliminated. Rotate the adjusting nut toward the housing until contact is made between the face of the index tabs and the housing, then index the tabs so that they drop into the nearest housing groove.
4. Tighten the lock nut at the rear of the housing boss to 15 ft-lbs.

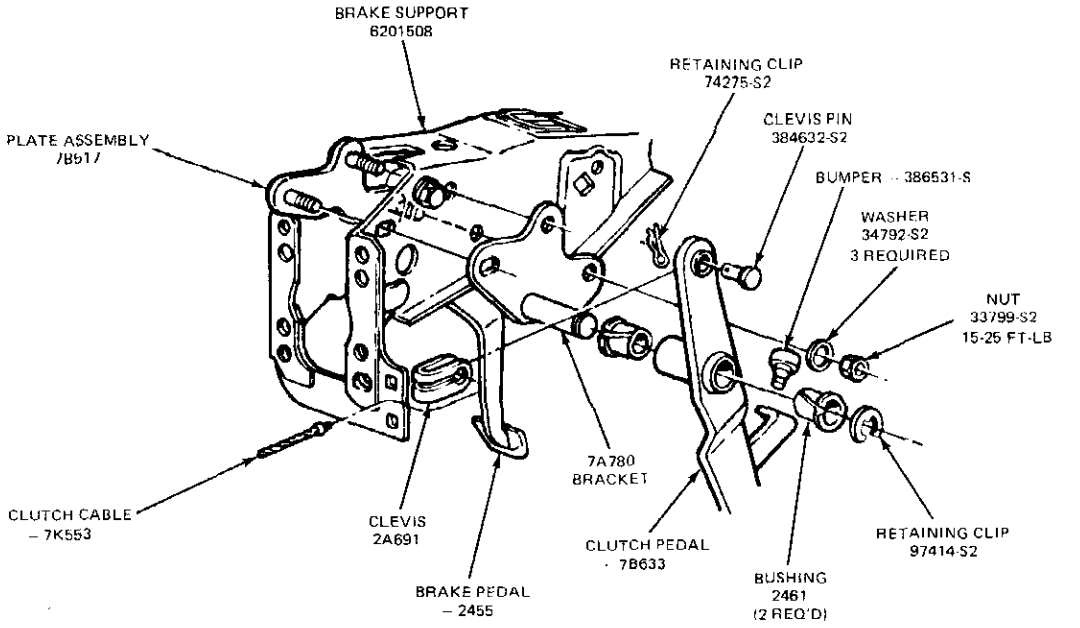
Mustang II

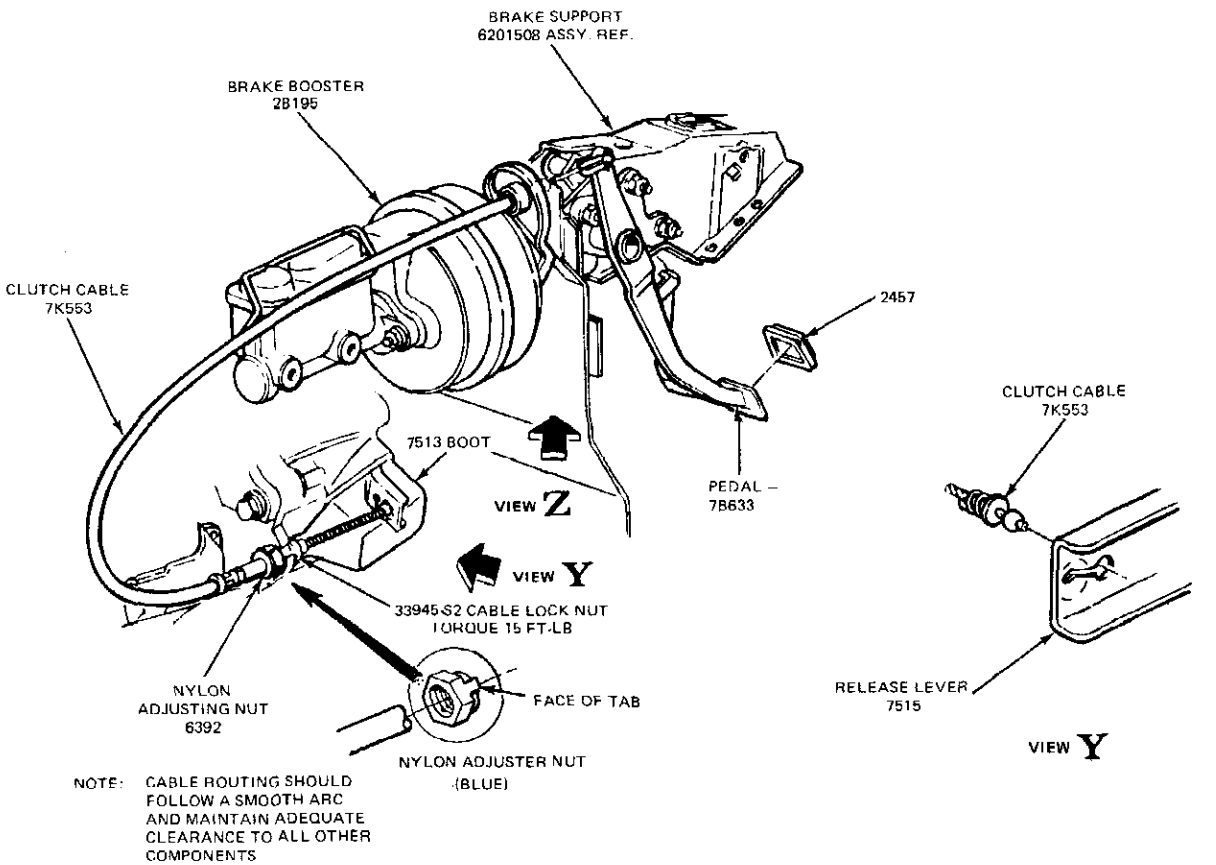
1. Remove the cable retaining clip at the dash panel. For Mustang II see Fig. 2.
2. Remove the screw holding the cable attaching bracket on the fender apron.
3. Pull the cable toward the front of the car until the adjusting nut can be rotated. Rotate the nut away from the adjustment sleeve approximately 1/4 inch.
4. Release the cable to neutralize the system, and then pull cable again until free movement of the release lever is eliminated.
5. Rotate the adjusting nut toward the adjustment sleeve until contact is made, then index into the next notch.
6. Reinstall the cable retaining clip and cable attaching bracket, and screw on the fender apron.

Granada and Monarch

1. Disconnect the clutch retainer spring from the release lever.
2. Remove the release lever rod locking pin and loosen the adjusting nut (Fig. 3).
3. Move the clutch release lever rearward until the release bearing lightly contacts the clutch pressure plate release fingers.
4. Slide the rod until it seats in the release lever pocket.
5. Insert the specified feeler gauge between the adjusting nut and the swivel sleeve. Then tighten the adjusting nut against the gauge finger.
6. Rotate the rod slightly to align the flat with the pin hole in the adjusting nut and install the locking pin. Remove the feeler gauge.
7. Install the clutch retainer spring.
8. Apply and release the clutch pedal a minimum of five times and recheck free play setting with a feeler gauge. Readjust if necessary. Free travel must be to specification.

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C2965-2C

FIG. 1 Clutch Pedal and Linkage Adjustment—Pinto/Bobcat

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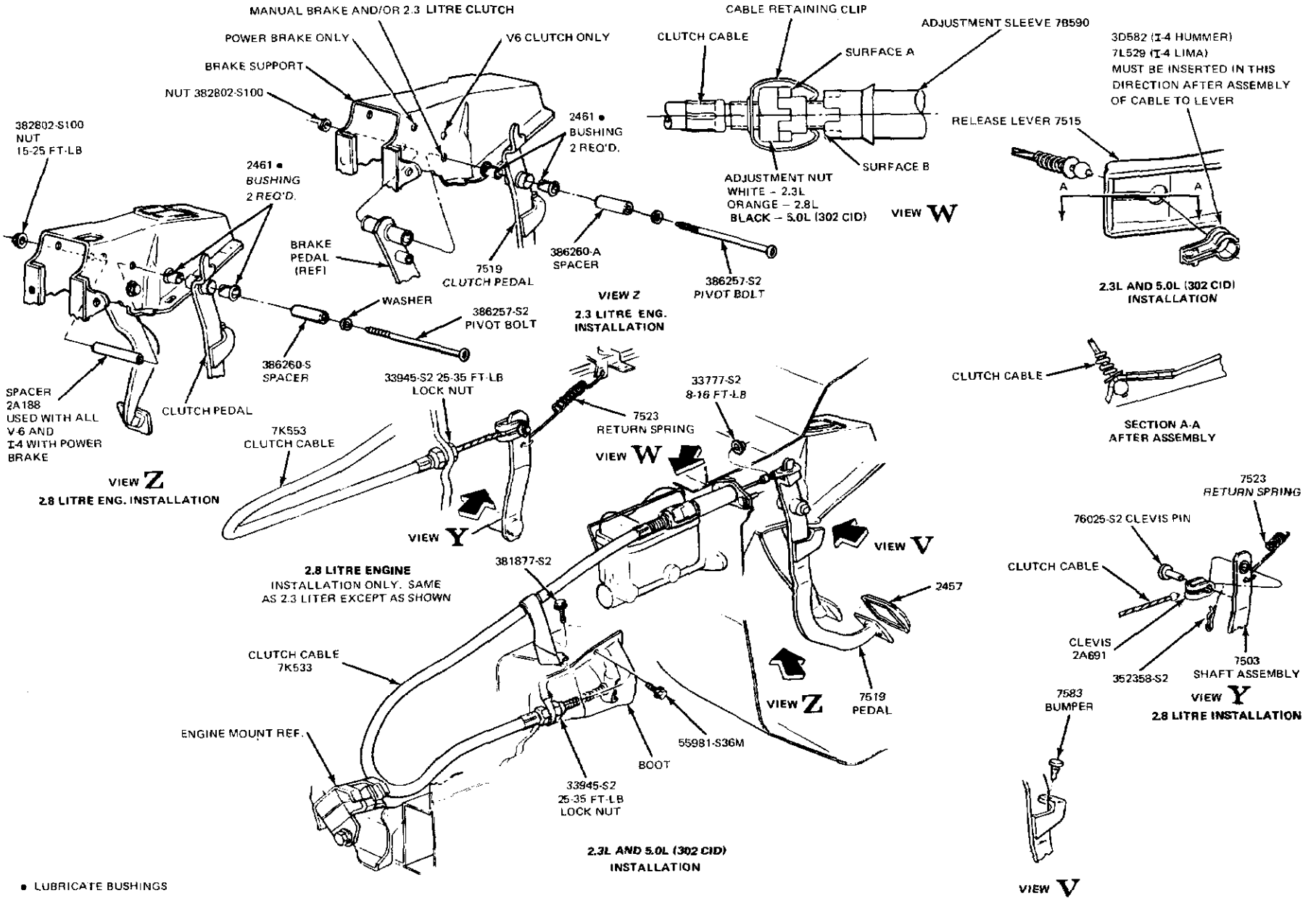
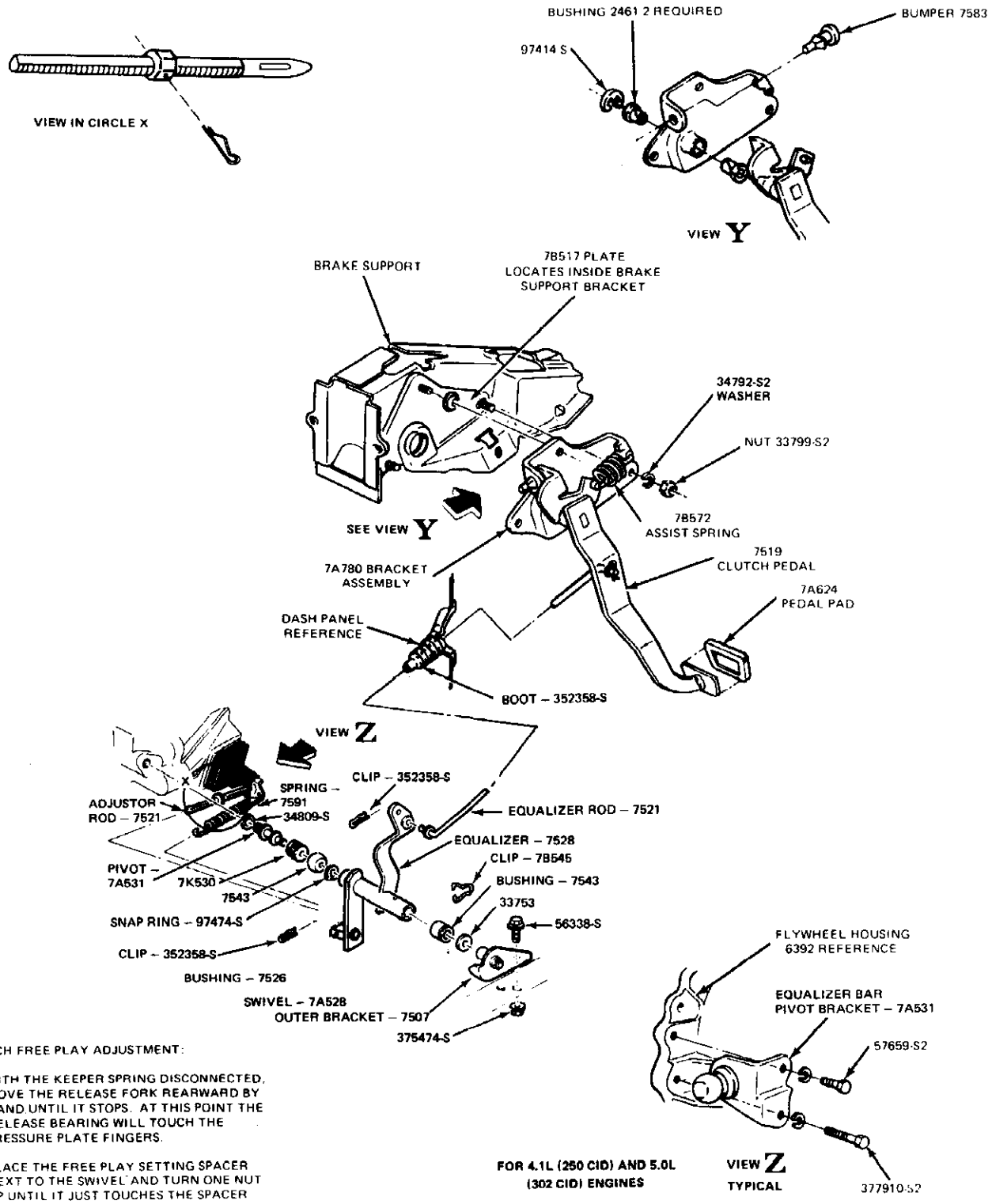


FIG. 2 Clutch Pedal and Linkage Adjustment—Mustang II

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CLUTCH FREE PLAY ADJUSTMENT:

1. WITH THE KEEPER SPRING DISCONNECTED, MOVE THE RELEASE FORK REARWARD BY HAND UNTIL IT STOPS. AT THIS POINT THE RELEASE BEARING WILL TOUCH THE PRESSURE PLATE FINGERS.
2. PLACE THE FREE PLAY SETTING SPACER NEXT TO THE SWIVEL AND TURN ONE NUT UP UNTIL IT JUST TOUCHES THE SPACER
3. RUN THE SECOND NUT UP TO THE FIRST NUT AND LOCK THEM WITHOUT TURNING THE FIRST NUT.
4. REMOVE THE SPACER
5. CONNECT THE RELEASE LEVER SPRING

C2967-2E

FIG. 3 Clutch Pedal and Linkage Adjustment—Granada and Monarch

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Fairmont/Zephyr

2.3 Litre Engine

Refer to Fig. 4

1. From under the car, remove the release lever return spring and dust shield.
2. Loosen the clutch cable locknut and adjusting nut at the release lever.
3. *Move the release lever forward until free movement* is eliminated and hold during adjustment.
4. Insert a 0.30" spacer against the release lever cable spacer. Run the adjusting nut against the 0.30" spacer finger tight.
5. Tighten the locknut against the adjusting nut, being careful not to disturb the adjustment. Torque the locknut to 5-8 ft-lbs. Remove the spacer. Cycle the clutch system several times to seat the system and *recheck the free play setting. Reset if required. The* free travel setting should result in approximately 1-1/2 inch of minimum effort clutch pedal free travel.
6. Reinstall the dust shield and return spring.

3.3L (200 CID) Engine

Refer to Fig. 4

1. Pull the clutch cable toward the front of the car until the adjusting nut can be rotated. Rotate the adjusting nut away from the rubber insulator approximately 0.30". Do not try to rotate the nylon nut until it is free of the rubber insulator. If required, to free the adjusting nut from the dash insulator, it may be necessary to remove the clutch pedal *bumper stop from the clutch pedal. Replace the* rubber bumper in the clutch pedal before continuing the free play adjustment.
2. Release the cable to neutralize the system, and then pull the cable slightly to remove the slack in the system until free movement of the release lever is eliminated.
3. Rotate the adjusting nut toward the rubber insulator until contact is made, then index the tabs *into the next notch. The free play setting should* result in approximately 1.50" of minimum effort clutch pedal free travel. Cycle the clutch system several times to seat the system and recheck the free play setting. Reset if necessary.

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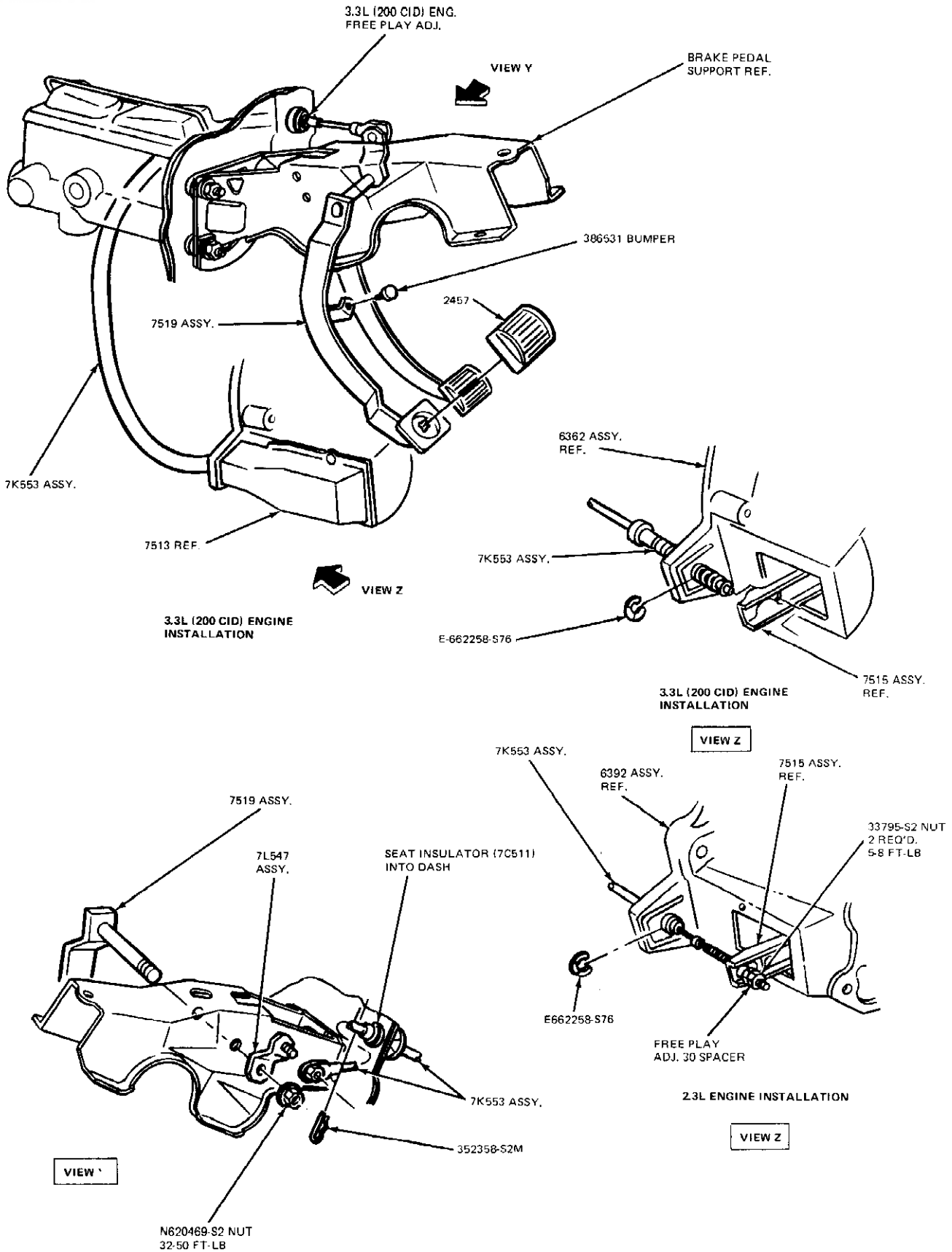


FIG. 4 Clutch Pedal and Linkage Adjustment—Fairmont/Zephyr

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REMOVAL AND INSTALLATION

CLUTCH PEDAL

Pinto/Bobcat (Refer to Fig. 1)

Removal

1. Disconnect the negative battery cable.
2. *Working from under the car, loosen* the clutch cable locking nut at the flywheel housing boss, pull the nylon adjuster nut forward to disengage the tabs from the flywheel housing and rotate the nut toward the front of the vehicle approximately one inch. **DO NOT TRY TO ROTATE THE NYLON NUT UNTIL IT IS FREE OF THE HOUSING.**
3. Lower the car and remove the hair pin clip holding the clutch cable clevis to the clutch pedal. Remove the clevis pin.
4. Remove the C-clip retainer holding the clutch pedal to the clutch pedal bracket stub shaft.
5. Move the clutch cable clevis free of the clutch pedal and slide the clutch pedal off the pedal support stub shaft.
6. Remove the clutch pedal and bushings from the vehicle.

Installation

1. Apply a light coat of SAE 10 engine oil to the bushings and assemble the clutch pedal and bushings over the stub shaft on the clutch pedal bracket assembly.
2. Install the clutch pedal C-clip retainer.
3. Position the clutch cable clevis to the clutch pedal and install the clevis pin and retaining clip.
4. From under the car, adjust the clutch pedal free travel following the procedure given in this Part.

Mustang II (Refer to Fig. 2)

Removal

1. Disconnect the negative battery cable.
2. At the dash panel, remove the clutch cable retaining clip and pull the cable toward the front of the car until the adjusting nut can be rotated. Rotate the nut away from the sleeve approximately *one inch.*
3. Remove the retaining clip and then remove the cable end fitting from the clutch pedal arm.
4. Working on the right side of the brake support bracket, remove the retaining nut from the clutch pedal pivot bolt. Slide the pivot bolt, spacer, bushing and washer out of the bracket and clutch pedal and remove the pedal and bushings.

On 2.3L and 5.0L (302 CID) engines with manual brakes, the brake pedal push rod must be disconnected, since the pivot bolt removal will also detach the brake pedal and bushings. On 2.8L engines, the clutch pedal bolt has an additional spacer between the brake support bracket flanges that will be removed during this step.

Installation

1. Apply a coating of SAE 10 engine oil to the bushings and locate the bushings in their proper place on the clutch and brake assemblies.
2. Install the clutch pedal to the pivot bolt and spacer *and install the assembly to the pedal support* bracket. Be sure that the bolt goes through the brake pedal or spacer sleeve, if required.
3. Attach the brake pedal push rod (2.3L engine).
4. Install the clutch pedal pivot bolt nut and tighten to specification.
5. Install the clutch cable end fitting to the clutch pedal arm and install the retaining clip.
6. Adjust the clutch pedal free travel.
7. Connect the battery cable.

Granada and Monarch (Refer to Fig. 3)

Removal

1. Disconnect the battery ground cable.
2. Remove the retaining clip that secures the pedal push rod to the clutch pedal. Disconnect the rod from the pedal.
3. Remove the three nuts attaching the clutch pedal and bracket assembly to the brake pedal support bracket and clutch pedal backing plate.
4. Remove the clutch pedal and bracket assembly (including spring) from the studs in the pedal backing plate.
5. Support the clutch pedal assembly in a bench vise and move the pedal through its full travel until the assist spring can be removed. Remove the assist spring.
6. Remove the retaining ring and slide the pedal and bushings out of the hub on the bracket.

Installation

1. Apply a coating of SAE 10 engine oil to the bushings and install the bushings into the hub on the bracket. *Slide the clutch pedal through the* bushings and attach the retaining ring.
2. With the clutch pedal mounting bracket held in a bench vise, position the assist spring to the pedal and bracket assembly and move the clutch pedal until it is located in its normal position against the rubber stop.
3. Position the clutch pedal and assist spring assembly over the clutch pedal backing plate studs on the brake support bracket.
4. Install the three nuts to the studs and tighten to specification.
5. Connect the pedal push rod to the clutch pedal and secure with the retaining clip.
6. Adjust the clutch pedal free travel.

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DETROIT IRON

Fairmont/Zephyr

Refer to Fig. 4

Removal

1. Disconnect the negative battery cable.
2. Loosen the clutch cable adjusting nuts; on the 2.3L, working under the car, remove the release lever return spring and dust cover, then loosen the locking nut and adjusting nut. On the 3.3L (200 CID), pull the nylon adjusting nut forward to disengage the tabs from the rubber insulator and rotate the nut toward the front of the vehicle approximately one inch. **DO NOT TRY TO ROTATE THE NYLON NUT UNTIL IT IS FREE OF THE RUBBER INSULATOR.**
3. Remove the retaining clip holding the clutch cable to the clutch pedal relay lever. Remove the clutch cable from the relay lever.
4. Remove the nut holding the relay lever to the clutch pedal shaft. Remove the relay lever and slide the pedal assembly from the pedal support bracket and remove from the vehicle.

Installation

1. Inspect the clutch pedal pivot bushings. Replace if necessary.
2. Apply a light coat of SAE 10 engine oil to the clutch pedal pivot bushings and slide the clutch pedal shaft through the pedal support bracket.
3. Assemble the clutch pedal relay lever over the corresponding 4-sided flats on the clutch pedal shaft and install the nut holding the relay lever. Torque the nut to 32-50 ft-lbs.
4. Install the clutch cable to the relay lever and attach the retaining clip.
5. Adjust the clutch pedal free travel following the procedure in this Part.

EQUALIZER BAR AND/OR BUSHING

Granada and Monarch (Refer to Fig. 3)

Removal

1. Disconnect the clutch pedal equalizer rod at the equalizer bar.
2. Raise the vehicle and disconnect the clutch release lever retaining spring. Remove the clutch adjusting rod.
3. Remove the two bolts holding the equalizer bar engine pivot bracket to the flywheel housing.
4. Separate the equalizer bar and engine pivot bracket from the equalizer bar frame pivot bracket.
5. Remove the wire clip on the equalizer bar to allow removal of the engine bracket. Remove the bushing from the bracket pivot.
6. Remove the snap ring and plastic bushing from the frame bracket.

Installation

1. Lubricate both ends of the equalizer bar tube, the frame bracket pivot and engine bracket ball pivot with lithium base grease (Ford Part No. C1AZ-19590-B) or equivalent. Install the bushing onto the ball of the engine bracket.
2. Position the equalizer bar over the bushing on the engine bracket.
3. Install the wire retaining clip to the equalizer bar. Be sure that the clip seats in the bushing groove.
4. Position the outer bushing on the frame bracket pivot and install "C" clip. Then position the equalizer bar and engine bracket assembly over the outer bushing.
5. Position the equalizer bar engine bracket on the flywheel housing and install the two attaching bolts. Torque to specification.
6. Install the clutch adjusting rod and retaining spring.
7. Lower the vehicle. Connect the clutch pedal push rod to the equalizer bar and secure with the retaining pin.
8. Adjust the clutch pedal free travel.

CLUTCH CABLE

Pinto/Bobcat (Refer to Fig. 1)

Removal

1. Disconnect the negative battery cable.
2. Working under the vehicle, loosen the cable lock nut at the flywheel housing boss. Pull the nylon adjuster nut forward toward the engine until the tabs on the nut clear the flywheel housing and the cable can be removed through the housing boss slotted hole.
3. Remove the rubber boot covering the clutch release lever and disconnect the clutch cable at the release lever.
4. Inside the car, remove the hair pin clip, clevis pin and clevis attaching the cable to the clutch pedal. Remove the clevis from the cable.
5. Depress the tangs holding the cable retainer to the dash panel and push the cable forward through the dash panel.
6. Remove the cable from the vehicle.

Installation

1. Route the cable downward through the engine compartment and insert the upper end of the cable through the dash panel until the retainer tangs are securely locked.
2. Inside the car, install the clevis onto the swaged ball at the cable end.
3. Install the clevis to the clutch pedal and secure the clevis pin and hair pin clip.
4. Under the car, insert the cable into the slotted hole in the flywheel housing, with the adjusting nut to the engine side of the boss and the lock nut on the other side.
5. Check the cable routing. The cable must follow a smooth arc between the dash panel and the flywheel housing attaching points. Any kinks, binds, or distortion must be corrected prior to final assembly at the flywheel housing.
6. Place the boot over the cable and attach the cable end to the release lever. Install the boot on the housing.
7. Adjust the clutch pedal free travel.

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Mustang II—2.3 Litre and 5.0 Litre (302 CID V-8)

(Refer to Fig. 2)

1. At the dash panel, remove the cable retaining clip and pull the cable toward the front of the car until the adjusting nut can be rotated. Rotate the nut away from the adjusting sleeve approximately one inch.
2. Remove the hairpin clip and then remove the sheet metal screw from the clamp bracket holding the cable to the fender apron.
3. Remove the cable end fitting from the top of the clutch pedal arm and push the cable through the dash.
4. Working under the vehicle, remove the sheet metal screws holding the metal release lever cover. Remove the plastic cable retaining clip and disconnect the cable from the release lever.
5. Remove the rear nut that attaches the cable to the flywheel housing and pull the cable toward the front of the vehicle until it clears the flywheel housing boss. Remove the cable from the vehicle along with the remaining lock nut and retracting spring.

Installation

1. Insert the cable in the flywheel housing boss and secure with locknut. Connect the cable to the *release lever and reinstall the plastic cable* retaining clip.
2. Install the metal release lever cover and secure with the sheet metal screws.
3. Insert the cable through the adjusting sleeve and install the cable end fitting to the clutch pedal arm. Install the hairpin clip.
4. Install the clamp bracket and sheet metal screw securing the cable to the fender apron.
5. Adjust the clutch pedal free travel.

Mustang II—2.8 Litre (Refer to Fig. 2)

Removal

1. At the dash panel, remove the cable retaining clip and pull the cable toward the front of the car until the adjusting nut can be rotated. Rotate the nut away from the adjusting sleeve approximately two inches.
2. Remove the hairpin clip and remove the sheet metal screw from the clamp bracket holding the cable to the fender apron.
3. Remove the cable end fitting from the top of the clutch pedal arm and push the cable through the dash.
4. Working under the vehicle, remove the clutch cable retracting spring.
5. Remove the retaining clip and clevis pin holding the clutch cable to the release lever shaft assembly.
6. Remove the clevis from the clutch cable.
7. Remove the nut that attaches the cable to the flywheel housing and pull the cable toward the front of the vehicle until it clears the flywheel housing boss. Remove the cable from the vehicle.

Installation

1. Insert the clutch cable in the flywheel housing boss and secure with locknut. Place the clevis over the end of the cable and attach the cable to the release lever shaft assembly with the clevis pin and retaining clip.
2. Attach the clutch cable retracting spring.
3. In the engine compartment, insert the cable through the adjusting sleeve and install the cable fitting to *the clutch pedal arm. Install the hairpin clip.*
4. Adjust the clutch cable free travel.
5. Install the clamp bracket and sheet metal screw securing the cable to the fender apron.

Fairmont/Zephyr

Removal (Refer to Fig. 4)

1. Disconnect the negative battery cable.
2. Working under the car, remove the release lever return spring (on 2.3L Engine) and dust shield.
3. On the 2.3L Engine, loosen the locking nut and adjusting nut and remove the clutch cable from the release lever.
4. On the 3.3L (200 CID) Engine, pull the nylon adjusting nut forward to disengage the tabs from the rubber insulator and loosen the nut. **DO NOT TRY TO ROTATE THE NYLON NUT UNTIL IT IS FREE OF THE RUBBER INSULATOR.** Remove the cable from the release lever.
5. Remove the cable retaining clip at the flywheel housing.
6. Remove the retaining clip on the clutch pedal relay lever. Remove the clutch cable from the relay lever and from the vehicle.

Installation

1. **Replace** the rubber insulator in the dash panel. Index the insulator tabs to the dash panel slots and seat securely.
2. Route the cable through the engine compartment. On the 2.3L Engine, securely seat the plastic cable fitting into the rubber insulator. On the 3.3L (200 CID) Engine, route the cable through the rubber insulator without seating the plastic nut.
3. *Inside the car, install the clutch cable on the relay* lever and attach the retaining clip.
4. Under the car, insert the cable into the hole in the flywheel housing and attach retaining clip to the clutch side of the flywheel housing.
5. Check the cable routing. The cable must follow a smooth arc between the dash panel and the flywheel housing attaching points. Any kinks, binds, or distortion must be corrected prior to final *adjustment.*
6. Attach the clutch cable to the release lever.
7. Adjust the clutch pedal free travel following the previously outlined procedures.
8. Attach the release lever return spring (2.3L) and dust shield.
9. Connect the negative battery cable.

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SPECIFICATIONS

CLUTCH – ADJUSTMENTS (INCHES)

Free Play Adjustment Dimension	
Granada/Monarch	0.136
Fairmont/Zephyr	0.30
Pinto/Bobcat	Built-in Adjusting Nut
Mustang II	Built-in Adjusting Nut
Clutch Pedal Free Travel (Engine Running) All Except Mustang II, Fairmont and Zephyr	7/8" – 1-1/8"
Mustang II	1-3/8" – 1-5/8"
Fairmont Zephyr	1-1/2"

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General Manual Transmission Service

PART 16-10

Applies to All Models

SUBJECT	PAGE
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Aluminum Case Repair	10-9
DIAGNOSIS	
Manual Transmission	10-2
REMOVAL AND INSTALLATION	
Sub-Assemblies	10-5
SPECIAL TOOLS	10-9

CC3018-2B

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: 08/77 GVWR: 3438
GAWR FRONT: 1755 GAWR REAR: 1691
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

8S11Y175456 F0095/R0056 PASSENGER

VEH. IDENT. NO. | TYPE

BODY	COLOR	TRIM	TRANS.	AXLE	DSO
64B	2R	AA	7	8	48

CODE	TRANSMISSION
1	Three-Speed (RAB) ③
7	Four-Speed w/O.D. (RUG) ③
7	Four-Speed (ET) ①
6	Four-Speed (RAD) ②

① F.I.G. – (Ford in Germany)
② SR4 – Borg Warner
③ TREMEC

C2134-2J

FIG. 1 Transmission Identification

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DETROIT IRON

DIAGNOSIS

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Transmission shifts hard	• Improper clutch pedal free travel	• Adjust. Assure complete clutch release. (Part 16-03).
	• Manual shift linkage binding	• Free up linkage.
	• Internal shift mechanism binding	• Remove transmission and free up shift mechanism.
	• Binding condition between input shaft and crankshaft pilot bearing	• Check alignment and repair as required. (Part 16-01).
• Noisy in forward gears	• Low lubricant level	• Fill to bottom of filler plug hole with proper lubricant.
	• Transmission to flywheel housing and to engine block bolts loose	• Tighten to specifications. (Part 16-02).
	• Misalignment of flywheel housing to engine crankshaft	• Replace housing if necessary. (Part 16-01 and 16-02).
	• Improper engagement between transmission pilot and flywheel housing	• Replace as necessary. (Part 16-01 and 16-02).
	• Worn or damaged input, output and countershaft bearings	• Remove transmission. Inspect bearings and gear teeth for wear or damage. Replace parts as required.
NOTE: Gear roll-over noise, inherent in manual transmissions, (caused by the constant mesh gears turning at engine idle speed while the clutch is engaged and the transmission is neutral); and clutch throwout bearing noise are sometimes mistaken for mainshaft bearing noise. Noise caused by a worn or damaged throwout bearing will be loudest when the clutch is held disengaged. Gear roll-over noise will disappear when the clutch is disengaged or when the transmission is engaged in gear. Clutch throwout bearing noise will disappear when the clutch is engaged. In the event that a transmission bearing is defective, the noise is more pronounced while engaged in gear under load or coast conditions than in neutral. When complaints of this nature are encountered, it will be necessary to road test the vehicle to determine if bearing noise exists. Under no circumstances should any transmission rework be attempted to eliminate gear-roll-over noise, or clutch throwout bearing noise.		
• Gears clash when shifting from one forward gear to another	• Engine idle speed too high	• Adjust engine idle speed.
	• Improper clutch pedal free travel	• Adjust. Assure complete clutch release. (Part 16-03).
	• Manual shift linkage damaged or out of adjustment	• Adjust or repair as required.
	• Binding condition between transmission input shaft and crankshaft pilot bushing	• Remove transmission and replace pilot bushing. (Part 16-01).
	• Worn or damaged shifter forks, synchronizer assembly, or gear clutch teeth	• Repair or replace as required.

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FIG. 2 Clutch and Transmission Diagnosis

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CONDITION	POSSIBLE CAUSE	RESOLUTION
• Transmission jumps out of gear	• Manual – shift linkage out of adjustment	• Adjust linkage. Align steering column to car body.
	• Floor shift – stiff shift boot	• Verify jump-out with boot removed. Replace boot if necessary.
	• Floor shift – interference between shift handle and console	• Adjust console to eliminate interference.
	• Transmission to engine mounting loose	• Tighten bolts to specification.
	• Flywheel housing to engine crankshaft out of alignment	• Replace parts as required. (Part 16-01).
	• Improper engagement between transmission pilot and flywheel housing	• Replace parts as required. (Part 16-01).
	• Input shaft pilot bearing worn	• Replace pilot bearing. (Part 16-01).
	• Worn or damaged internal components	• Check input and output shafts for excessive end play, shift forks for loose mounting on shift rails, shift rail detent system for wear or damage, synchronizer sliding sleeve and gear clutch teeth for wear or damage. Repair or replace as required.
• Transmission will not shift into one gear – all other gears okay	• Manual – shift linkage out of adjustment	• Adjust linkage. Lubricate, repair or replace as required.
	• Restricted travel of internal shifter components	• Disconnect shift rods from transmission shift levers. Try to shift the transmission levers into and out of all gear positions. If OK repair or replace linkage parts.
		• Remove transmission. Inspect shift rail and fork system, synchronizer system and gear clutch teeth for restricted travel. Repair or replace as required.
• Transmission is locked in one gear. It cannot be shifted out of that gear	• Manual shift linkage out of adjustment, binding or damaged	• Disconnect shift rods from transmission shift levers. Try to shift the transmission levers into and out of all gear positions. If OK repair or replace linkage parts.
	• Internal shifter components worn or damaged	• Remove transmission. Inspect the problem gear or gear shift rails and fork and synchronizer for wear or damage. Repair or replace as required.

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FIG. 3 Clutch and Transmission Diagnosis

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DETROIT IRON

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Transmission leaks	• Excessive amount of lubricant in transmission – wrong type	• Check level and type. Fill to bottom of filler plug hole.
	• Other component leaking	• Identify leaking fluid at engine, power steering or transmission.
	• False report	• Remove all traces of lube on exposed transmission surfaces. Check vent for free breathing. Operate transmission and inspect for new leakage. Repair as required.
	• Worn or damaged internal components	• Remove transmission. Inspect for leaks at the input shaft bearing retainer seal and gasket, shift rail expansion plug top cover gasket. Inspect case for sand holes. Repair or replace as required.
• Improper shift lever operation	• Shift lever casting pin worn or damaged	• Replace roll pin.
	• Casting around roll pin damaged	• Replace casting.
	• Shift lever return spring weak or damaged	• Pull shift lever up and assure it returns. Replace spring if necessary.
	• Shift tube or socket damaged	• Determine if shift lever angular motion is being transmitted to the shift linkage. Replace shift tube or socket.
	• Shift linkage incorrect	• Adjust shift linkage.
	• Lower column casting or lower levers on shift tube damaged	• Check operation of column shift through crossover. Repair or replace as required.
	• Column grounding	• Center column.
• Transmission will not shift into reverse (All others OK) (Four-Speed models)	• Manual – shift lever out of adjustment	• Adjust to specifications.
		• On RUG models, disconnect reverse shift rod from lever. Try to shift into reverse. If OK, repair or replace shift linkage as required.
	• Damaged back-up switch	• Remove back-up switch. Check if transmission will shift into reverse. If OK replace switch.
	• Worn or damaged internal components	• Remove transmission. Check for damaged reverse gear train, misaligned reverse relay lever, shift rail and fork system, synchronizer system and gear clutch teeth for restricted travel or damage. Repair or replace as required.

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FIG. 4 Clutch and Transmission Diagnosis

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CONDITION	POSSIBLE CAUSE	RESOLUTION
• Transmission locked in one gear (Cannot be shifted out of gear) (Four-speed models)	• Neutral sensing switch (If so equipped) for detent ball frozen in extended position • Selector arm pin broken • Bent shifter forks at pads and selector slot	• Replace switch. • On RUG models, disconnect shift rods from levers. Try to shift transmission levers into and out of all gear positions. If OK, repair or replace linkage as required. • Remove transmission. Replace pin. • Repair or replace as required.
• Transmission noisy in gear (Four-speed models)	• Lube level low or wrong type • Transmission to flywheel housing and flywheel housing to engine block bolts loose • Pilot bushing worn or damaged • Improper transmission pilot engagement into flywheel housing • Worn or damaged internal components	• Fill to bottom of filler plug hole with proper lubricant. • Tighten bolts to specifications. • Remove transmission. If noise is "howl" during start-up, check pilot bushing. Check for loose flywheel, and housing alignment. Repair or replace as required. (Part 16-01). • Replace housing or input shaft bearing retainer as required. (Part 16-01). • Disassemble transmission. Inspect input, output and countershaft bearings, gear and gear teeth for wear or damage. Repair or replace as required.

CC3019-2B[3]

FIG. 5 Clutch and Transmission Diagnosis

REMOVAL AND INSTALLATION

SUB-ASSEMBLIES

REAR SEAL

Removal

1. Remove the drive shaft.
2. Remove the seal from the extension housing with the tool shown in Fig. 6 or 10.

Installation

1. Install the new seal in the extension housing with the tool shown in Fig. 7 or 11.
2. Install the drive shaft.

REAR BUSHING AND SEAL

Removal

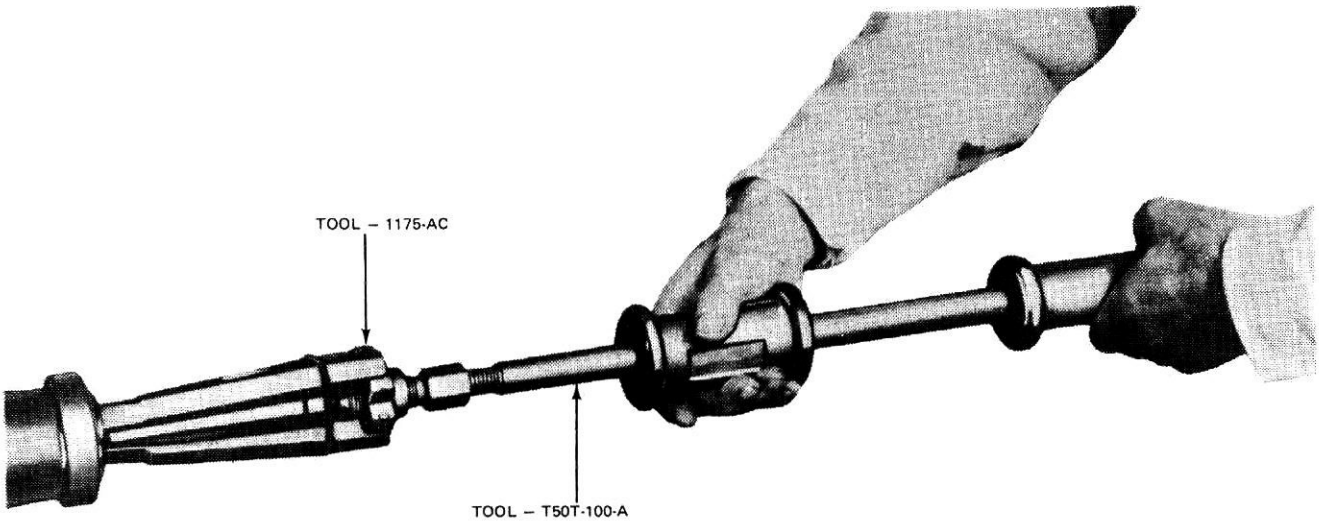
1. Remove the drive shaft from the vehicle.
2. Insert the Tool T60K-7697-A as shown in Fig. 8 into the extension housing until it grips on the front side of the bushing.
3. Turn the screw clockwise until the seal and the bushing are free of the housing.

Installation

1. Drive a new bushing into the extension housing with the proper tool as shown in Fig. 9.
2. Install a new seal in the housing as shown in Fig. 7 or 11.
3. Install the drive shaft.

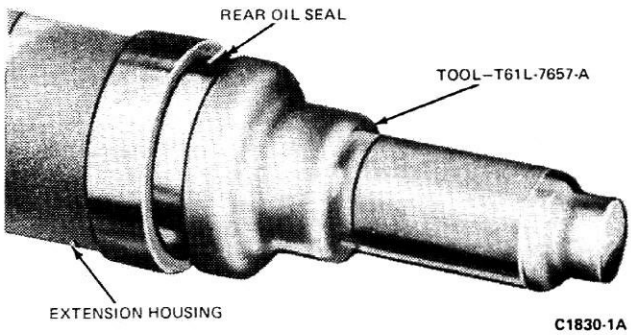
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DETROIT IRON



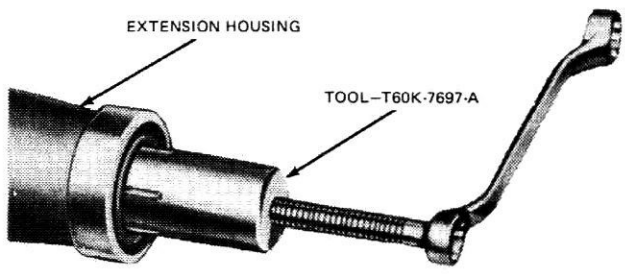
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FIG. 6 Removing Extension Housing Seal



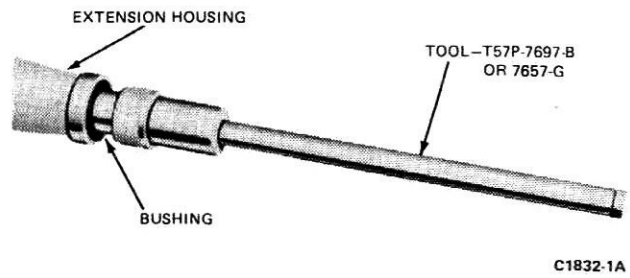
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FIG. 7 Installing Extension Housing Seal



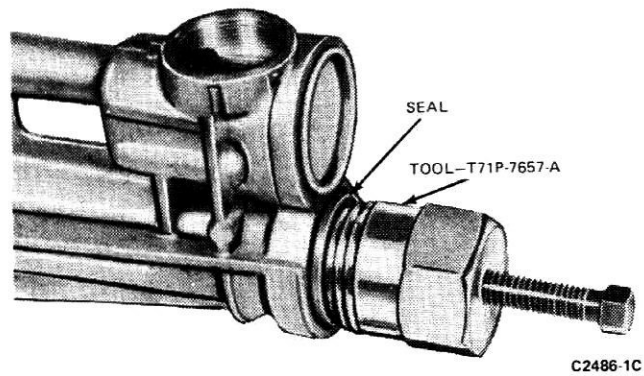
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FIG. 8 Removing Extension Housing Bushing and Seal



C1832-1A

FIG. 9 Installing Extension Housing Bushing



C2486-1C

FIG. 10 Removing Extension Housing Seal–Pinto/Bobcat/Mustang II–Fairmont/Zephyr

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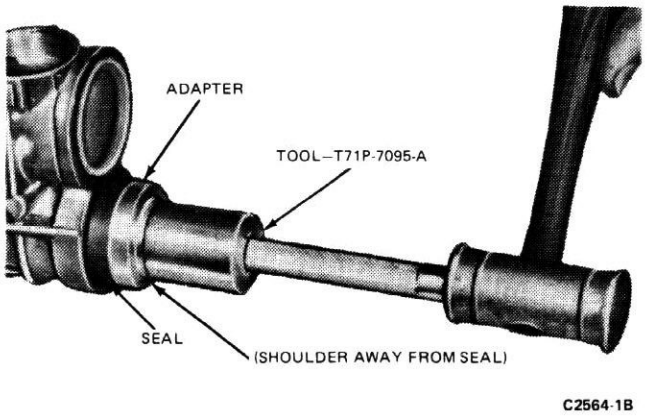


FIG. 11 Installing Extension Housing Seal—Pinto/Bobcat/Mustang II—Fairmont/Zephyr

CLEANING AND INSPECTION

TRANSMISSION

CLEANING

1. Wash all parts, except the ball bearings and seals, in a suitable cleaning solvent. Brush or scrape all foreign matter from the parts. Be careful not to damage any parts with the scraper. **Do not clean, wash or soak transmission seals in cleaning solvents. Dry all parts with compressed air.**
2. Rotate the ball bearings in a cleaning solvent until all lubricant is removed. Hold the bearing assembly to prevent it from rotating and dry it with compressed air.
3. Lubricate the bearings with approved transmission lubricant and wrap them in a clean, lint-free cloth or paper until ready for use.
4. Clean the magnet in the bottom of the case with kerosene or mineral spirits.

INSPECTION-GENERAL

1. Inspect the transmission case for cracks, worn or damaged bearing bores, damaged threads, or any other damage that could effect the operation of the transmission.
2. Inspect the front face of the case for small nicks or burrs that could cause misalignment of the transmission with the flywheel housing. Remove all small nicks or burrs with a fine stone on cast iron cases, or with a fine file on aluminum cases.
3. Replace any cover that is bent or distorted. Make sure that the vent hole in the cover is open. On RAD models, the vent hole is in the front mounting face of the extension housing.
4. Check the condition of the shift levers, forks, shift rails, and the lever and shafts.
5. Inspect the ball bearings per instructions under Ball Bearing inspection, below.
6. Replace roller bearings that are broken, worn, or rough and check their respective races.
7. Replace the countershaft (cluster) gear if the teeth are chipped, broken, or worn. Replace the countershaft if it is bent, scored, or worn.
8. Replace the reverse idler gear or sliding gear if the teeth are chipped, worn or broken. Replace the idler gear shaft if bent, worn or scored.
9. Replace the input shaft and gear if the splines are damaged or if the teeth are chipped, worn, or broken. If the roller bearing surface in the bore of the gear is worn or rough, or if the cone surface is damaged, replace the gear and the gear rollers.
10. Replace all other gears that are chipped, broken, or worn.
11. Check the synchronizer sleeves for free movement on their hubs. Make sure that the alignment marks (if present) are properly indexed.
12. Inspect the synchronizer blocking rings for widened index slots, rounded clutch teeth, and smooth internal surfaces (must have machined grooves). With the blocker ring on the cone (Fig. 12), the distance between the face of the blocker ring and the clutch teeth on the gear must not be less than 0.020 inches.

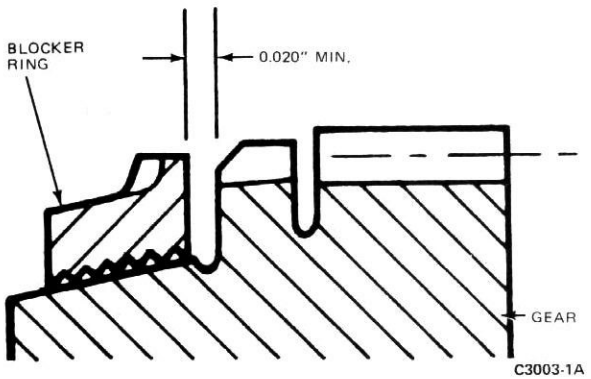


FIG. 12 Inspecting Blocker for Wear

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13. Replace the speedometer drive gear if the teeth are stripped or damaged. Make certain to install the correct size replacement gear.
14. Replace the output shaft if there is any evidence of wear or if any of the splines are damaged.
15. Inspect the bushing and the seal in the extension housing, and replace if worn or damaged. The bushing and/or seal should be replaced **after the extension housing has been installed on the transmission.**
16. Replace the seal in the input shaft bearing retainer.
17. Replace the seals on the cam and shafts.

INSPECTION—BALL BEARING

Bearing Raceways

1. Inner Ring Raceway—While holding the outer ring stationary, rotate the inner ring at least three revolutions. Examine the raceway of the inner ring from both sides for pits or spalling as shown in Fig. 13. A bearing assembly should be replaced when thus damaged. Light particle indentation is acceptable (Fig. 13).
2. Outer Ring Raceway—While holding the inner ring stationary, rotate the outer ring at least three revolutions. Examine the raceway of the outer ring from both sides as with the raceway of the inner ring. If the raceway is spalled or pitted, as in Fig. 13, replace the bearing assembly. Light particle indentation as shown in Fig. 13 is acceptable.

Bearing External Surfaces

The bearing must be replaced if damage is found in any of the following areas:

1. Radial cracks on front and rear faces of the outer or inner rings.
2. Cracks on outside diameter or outer ring (particularly around snap ring groove).
3. Deformation or cracks in ball cage (particularly around rivets).

Spin Test

1. Lubricate the bearing raceways with a slight amount of clean oil. Turn the bearing back and forth slowly until the raceways and balls are coated with oil.
2. Hold the bearing by the inner ring in a vertical position. Vertical movement between the inner and outer rings is acceptable. Spin the outer ring several times by hand (do not use an air hose). If roughness or vibration is noticeable or the outer ring stops abruptly, the bearing should be cleaned again and relubricated. Roughness in a bearing is usually caused by foreign particles in the bearing, which come from inside the transmission case. If the bearing is still rough after cleaning and relubricating three times, it must be replaced.
3. Hold the bearing by the inner ring in a horizontal position with the snap ring groove up. Spin the outer ring several times by hand (do not use an air hose). If the bearing is still rough after cleaning and relubricating three times (if not done in Step 2), it must be replaced. If the bearing passes the visual

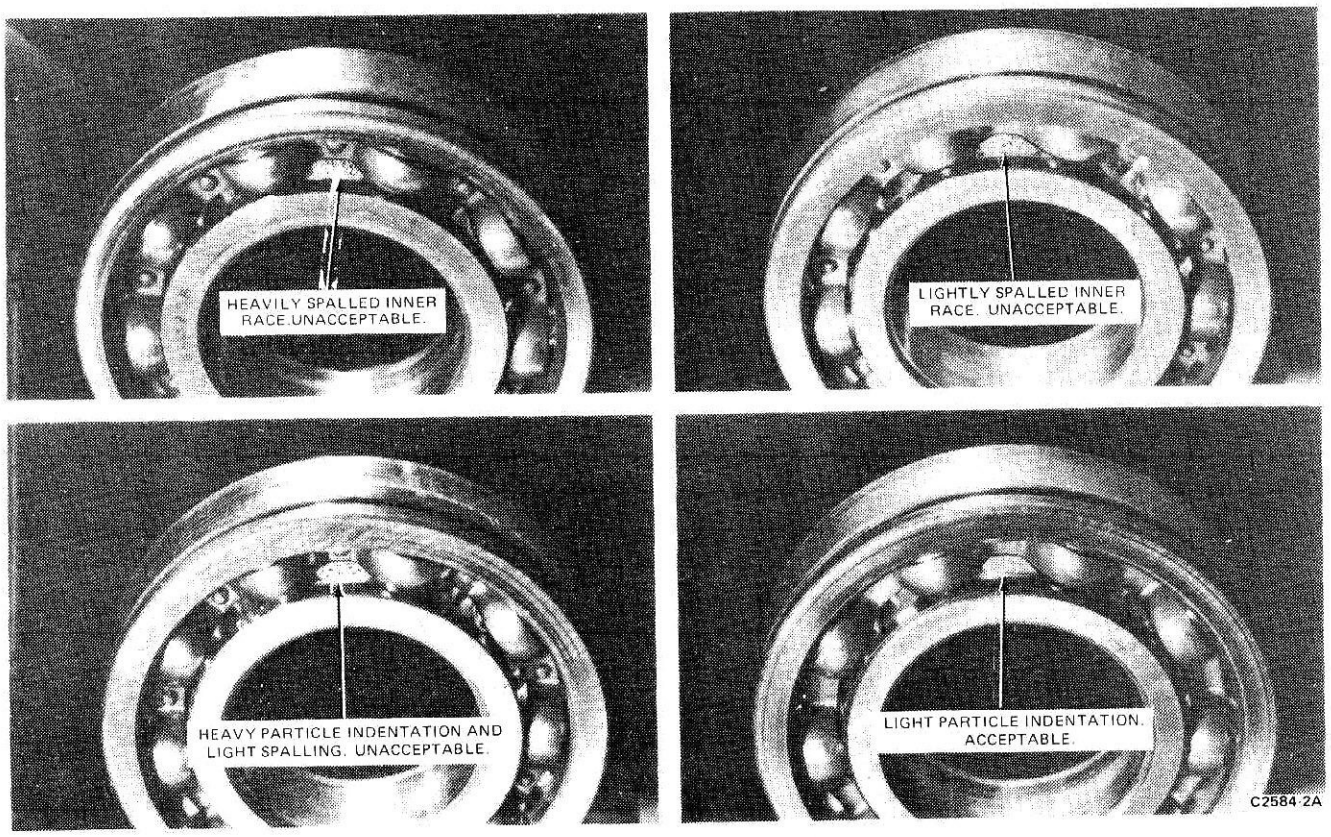


FIG. 13 Inspecting Ball Bearings

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inspection and spin tests, it should be reinstalled in the transmission.

ALUMINUM TRANSMISSION CASE REPAIR

If an aluminum transmission case thread is damaged, service kits may be purchased from local jobbers. To repair a damaged thread, the following procedures should be carefully followed.

1. Drill out the damaged threads, **using the same drill size as the thread OD.** For example, use a 5/16 inch drill for a 5/16-18 thread.
2. Select the proper special tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16-18 will not cut the same thread as a standard 5/16-18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed the original thread size (5/16-18) is restored.
3. Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is 1/2 turn below the face.
4. Working through the insert, bend the insert tang straight up and down until it breaks off at the notch.
5. Improperly installed inserts can be removed with the extractor tool. Place the extractor tool in the insert so that the blade rests against the top coil 1/4 to 1/2 turn away from the end of the coil. Tap the tool sharply with a hammer so that the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

   These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is 1/2 turn below the face.

Tool Number	Description
T59T-100A	Impact Hammer – Long
T59L-100B	Impact Hammer – Short
TOOL-1175-AC	Grease Seal Remover

Tool Number	Description
T61L-7657-A	Transmission Extension Housing Oil Seal Replacer
T57P-7697-B	Extension Housing Bushing Replacer
T57P-7657-G	Extension Housing Bushing Replacer
T50K-7697-A	Extension Housing Bushing Replacer

CC2135-2D

SPECIAL SERVICE TOOLS (PINTO/BOBCAT/MUSTANG II–FAIRMONT/ZEPHYR)

Tool Number	Description
T70P-7149	Extension Housing Bushing Remover (AA Transmission Only)
T71P-7657-A	Extension Housing Seal Remover (AA)
T70P-7095-A	Extension Housing Bushing and Seal Installer (AE)

CC1088-1F

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Ford Three-Speed Transmission

PART 16-11

Applies To Fairmont/Zephyr

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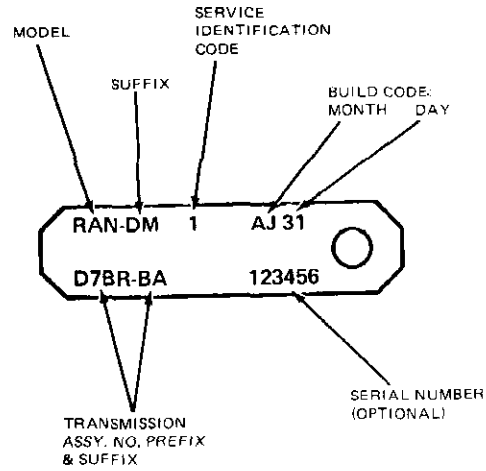
DESCRIPTION

TRANSMISSION

A transmission service identification tag is located on the front right side of the case (Fig. 1). The first line on the tag shows the transmission model and service identification code. The second line shows the transmission assembly number prefix and suffix and serial number. For further identification, a vehicle serial number is stamped on the top side of the mounting flange.

The three-speed transmission is fully synchronized with all gears except the reverse gear and sleeve being in constant mesh. All forward-speed changes are accomplished with synchronizer sleeves.

The forward-speed gears are helical-cut and in constant mesh. Gears used in the reverse gear train are spur-cut and are not synchronized.



C3002-1C

FIG. 1 Transmission Identification Tags

DIAGNOSIS

TRANSMISSION

Diagnosis of transmission conditions is covered in Part 16-10.

ADJUSTMENTS

FOR SHIFT LINKAGE ADJUSTMENT REFER TO THE INSTRUCTIONS GIVEN IN FIG. 2.

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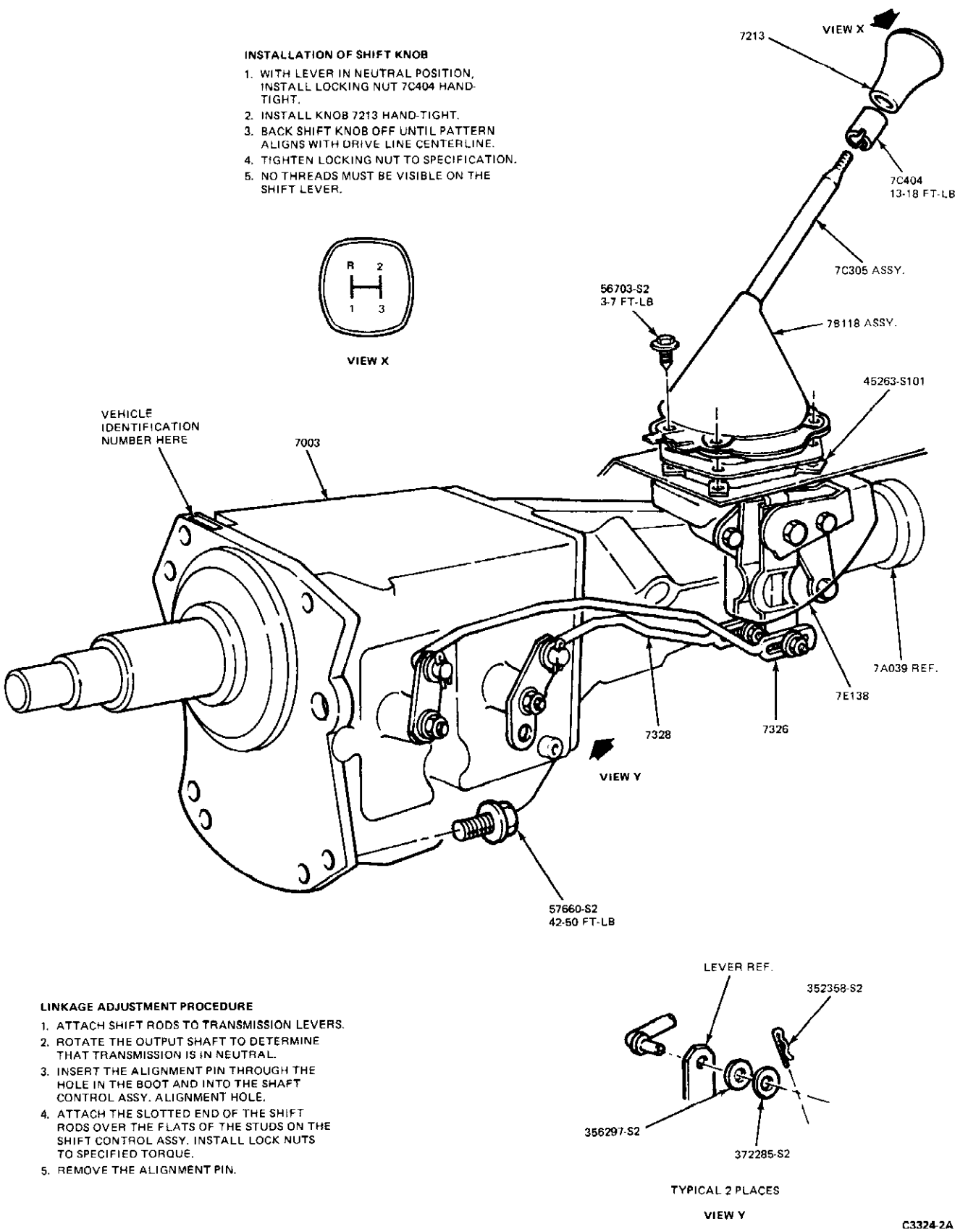


FIG. 2 Three Speed Tranmission Installation—Fairmont and Zephyr

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REMOVAL AND INSTALLATION

GEAR SHIFT LEVER AND CONTROL ASSEMBLY—FLOOR-MOUNTED

REMOVAL (Refer to Figs. 2 and 3)

1. Remove the four screws attaching the lever boot to the floor pan.
2. Remove the two bolts attaching the gear shift lever to the control assembly.
3. Remove the two locknuts that connect the shift rods to the control assembly.
4. Remove the three bolts retaining the shift control assembly to the extension housing.
5. Lower the control assembly from the vehicle and *remove the boot.*

INSTALLATION

1. Slide the control assembly into the boot and attach the entire assembly to the extension housing. Do not lose the spacer located inside the assembly.
2. *Install the two bolts attaching the gear shift lever* to the shift control assembly. Install the lever boot and torque the attaching screws to specifications.
3. Insert a 1/4 inch diameter alignment pin in the alignment holes of the control assembly.
4. Position the shift rods on the selector levers and *install the lock nuts.*
5. Remove the alignment pin.
6. Check the operation of the shift mechanism for smooth crossover and adjust as required.

TRANSMISSION

Removal

1. Raise the vehicle on a hoist.
2. Mark the drive shaft so that it may be installed in the same relative position. Disconnect the drive shaft from the rear U-joint flange.
3. Slide the front of the drive shaft out of the transmission extension housing and off the output shaft. *Insert tool T61L-7657-A into the extension* housing to prevent the lubricant from leaking out of the transmission.
4. Remove the capscrew and lockwasher that secure the speedometer cable retainer to the extension *housing. Pull the speedometer cable out of the* extension housing.
5. Remove the retaining clips, flat washers, and spring washers that secure the shift rods to the shift levers and the bolts which attach the shift control to the extension housing. Remove the shift control.
6. *Support the transmission with a transmission jack* and remove the two nuts attaching the engine rear support to the crossmember. Remove the through-bolts that attach the crossmember to the frame and remove the crossmember. Remove the two bolts that attach the rear support insulator to the *transmission extension housing* and remove the insulator.
7. Support the transmission with a transmission jack and remove the transmission from the flywheel housing.

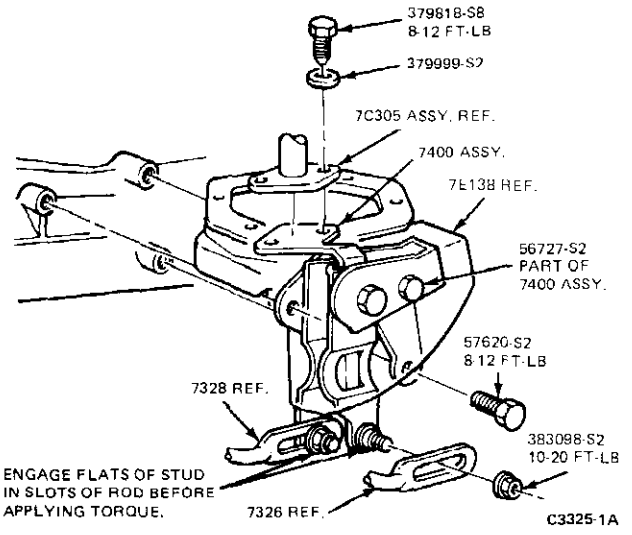


FIG. 3 Shift Control Assembly—3 Speed Tranmission

8. Move the transmission and jack rearward until the input shaft is clear of the flywheel housing.
9. Remove the transmission from the jack and mount it in a holding fixture.

Do not depress the clutch pedal while the transmission is removed.

Installation

1. Make certain that the machined surfaces of the *transmission case* and the flywheel housing are free of dirt, paint, and burrs. Be sure that the shift rail expansion plug is installed flush or below the surface of its bore.
2. Install a guide pin in each lower mounting bolt hole.
3. Mount the transmission on the transmission jack: position it under the car. Apply a thin film of polyethylene grease (Ford Part C4AZ-19584-A) or *equivalent to the* outside surface of *the input shaft* bearing retainer. Align the splines on the input shaft with the splines in the clutch disc. Move the transmission forward on the guide pins until the input shaft pilot enters the bearing or bushing in *the crankshaft. If the transmission front bearing* retainer binds up on the clutch release bearing hub, work the release bearing lever until the hub slides onto the transmission front bearing retainer. Install the two transmission-to-flywheel housing upper mounting bolts and lockwashers. Remove the two guide pins and install the lower mounting bolts and lockwashers.
4. Mount the engine rear support on the extension housing and raise the rear of the engine high enough to provide clearance for installing the crossmember. Bolt the crossmember assembly to the frame side supports. Torque the through-bolts to specifications. Install and torque the two engine rear support-to-crossmember attaching bolts.
5. Position the shift linkage control bracket to the extension housing and install and torque the

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attaching bolts. Secure each shift rod to its respective lever with the spring washer, flat washer, and retaining pin.

6. Insert the speedometer cable and driven gear in the extension housing and secure it with a capscrew and lockwasher.
7. Remove tool T61L-7657-A from the extension housing. Align the reference marks and slide the front universal joint yoke onto the output shaft and into the extension housing. Connect the rear universal joint to the axle pinion flange and torque the nuts to specifications.
8. Fill the transmission to the proper level with the approved lubricant.
9. Adjust the clutch pedal free travel and the shift linkage as required.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Disassembly

1. Mount the transmission in a holding fixture and drain the lubricant by removing the lower extension housing bolt.
2. Remove the capscrews that attach the cover to the case. Remove the cover and the gasket (Fig. 4) from the case.
3. Remove long spring that retains the detent pin in the case (Fig. 9). Remove the detent pin with a small magnet.
4. Remove the capscrews and lockwashers that attach the extension housing to the case. Remove extension and gasket from the case.
5. Remove the capscrews and lockwashers that attach the front bearing retainer to the case. Remove the front bearing retainer and gasket from the case.
6. Remove the lubricant filler plug from the right side of the case. Working through the plug opening, drive the roll pin out of the countershaft with a 1/4-inch punch (Fig. 5).
7. Tap the countershaft from the rear of the case with a dummy shaft to remove the expansion plug from the countershaft bore at the front of the case.
8. Hold the countershaft gear with a hook and with the tool shown in Fig. 6, push the countershaft out the front of the case. The countershaft (cluster) gear and thrust washers (Fig. 18) can now be lowered to the bottom of the case. Remove the countershaft from the rear of the case.
9. Remove the snap ring that secures the speedometer drive gear on the output shaft. Slide the speedometer drive gear off the shaft. Remove the speedometer drive gear lock ball from the shaft.
10. Remove the snap ring that holds the output shaft bearing on the shaft. Remove the bearing from the case and shaft as shown in Fig. 7.
11. Place both shift levers in the neutral (center) position.
12. Remove the set screw that secures the first and reverse shift fork to the shift rail. Slide the first and reverse shift rail out through the rear of the case.
13. Slide the first and reverse synchronizer forward as far as possible, and rotate the first and reverse shift fork upward. Then lift it from the case.
14. Move the second- and third-speed shift fork to the second-speed position for access to the set screw, and remove it from the fork. Rotate the shift rail 90 degrees (Fig. 8).

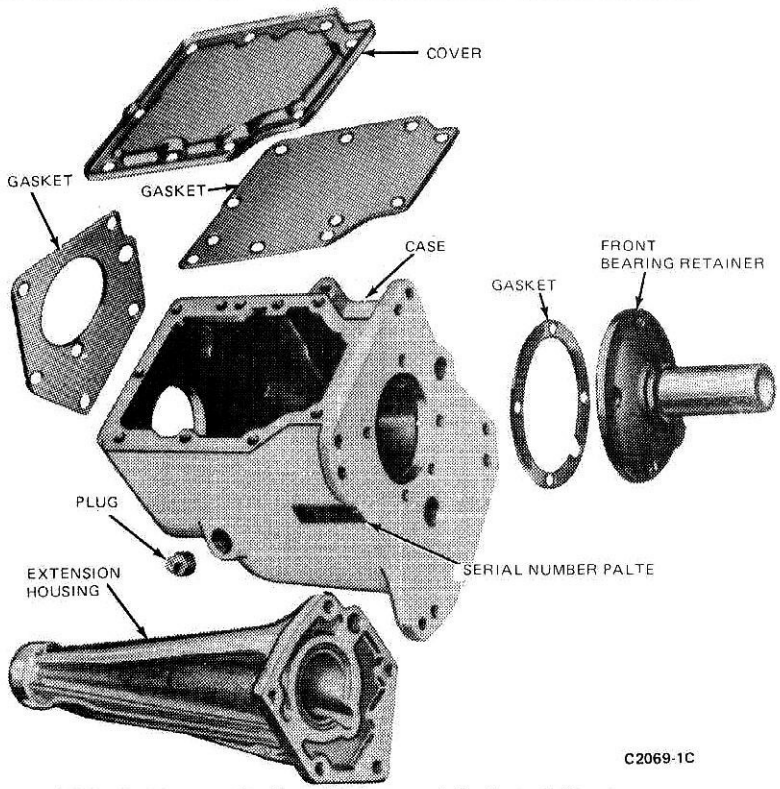


FIG. 4 Transmission Case and Related Parts—Typical

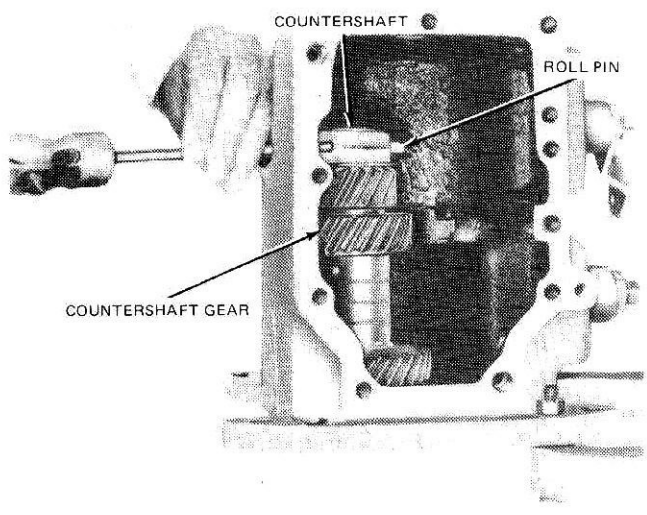


FIG. 5 Removing Countershaft Roll Pin

15. Tap on the inner end of the second- and third-speed shift rail to remove the expansion plug (Fig. 9) from the front of the case. Slide shift rail out of case.

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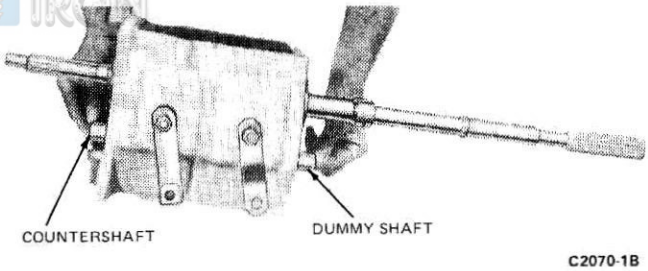


FIG. 6 Removing Countershaft

16. Pull the input gear and shaft forward to separate the input shaft and gear from the front of the case.
17. Rotate the second- and third-speed shift fork upward, and lift it from the case.
18. Carefully lift the output shaft assembly out through the top of the case.
19. Remove idler gear shaft, driving from the front of the case.
20. Lift the reverse idler gear and two thrust washers (Fig. 10) from the case. Lift the countershaft gear, thrust washer, and dummy shaft from the case. Remove detent plug and spring from the bottom of the detent hole.
21. Remove the snap ring from the front of the output shaft, and slide the synchronizer and the second-speed gear (Fig. 11) off the shaft.
22. Remove the next snap ring and tabbed thrust washer from the output shaft. Then slide the first gear and blocking ring off the shaft.
23. Remove the next snap ring from the output shaft. The first and reverse synchronizer hub is a press fit on the output shaft. To eliminate the possibility of damaging the synchronizer assembly, remove the synchronizer hub, using an arbor press as shown in Fig. 12. **Do not attempt to remove or install the hub by hammering or prying.**

Assembly

NOTE: If shift lever and seals are to be replaced, do so at this time. See Section on Sub-assemblies, Shift Lever and Seals.

1. Coat the reverse idler gear thrust surfaces in the case with a thin film of lubricant and position the two thrust washers in place. Tabs go in slots in the case.
2. Position the reverse idler gear and shaft in place. Align the gear bore and thrust washers with the case bores and install the reverse idler shaft.
3. Measure the reverse idler gear end play with a feeler gauge. End play should be within specification. If the end play is not within specification, replace the thrust washers. If the end play is within limits, leave the reverse idler gear installed.
4. Lubricate the output shaft splines and machined surfaces with transmission lubricant.
5. The first and reverse synchronizer hub is a press fit on the output shaft. To avoid damaging the synchronizer assembly, install the synchronizer hub with the teeth end of the gear facing toward the rear of the shaft, using an arbor press as shown in Fig. 12. **Do not attempt to remove or install the hub by hammering or prying.**
6. Place the blocking ring on the tapered machined surface of the first gear.
7. Slide the first gear onto the output shaft with the blocking ring toward the rear of the shaft. Rotate

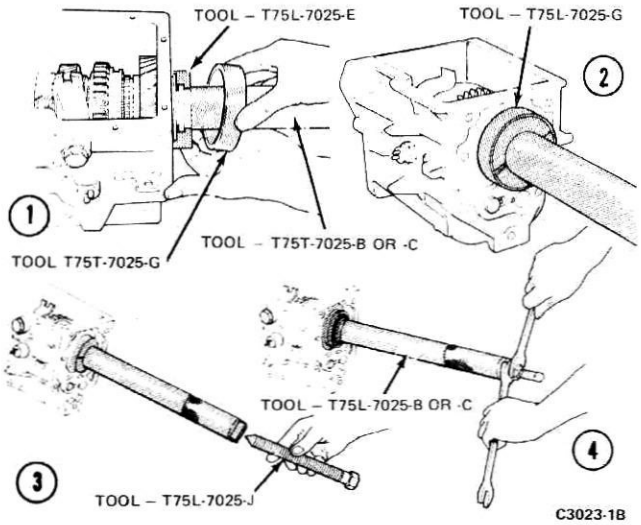


FIG. 7 Removing Input or Output Shaft Bearing

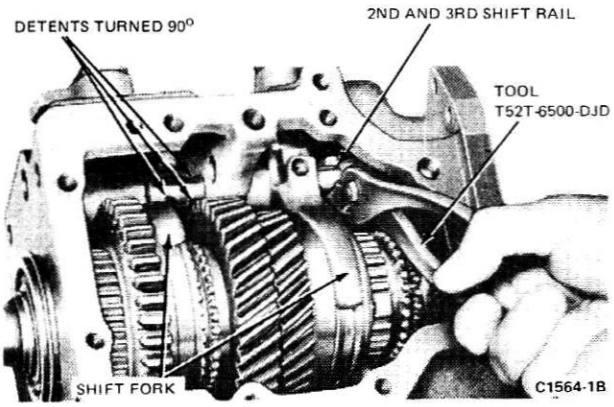


FIG. 8 Rotating Second- and Third-Speed Shift Rail

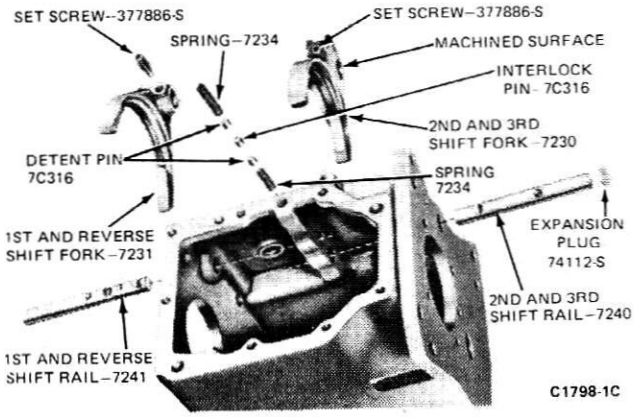


FIG. 9 Shift Rails and Forks Disassembled

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the gear as necessary to engage the three notches in the blocking ring with the synchronizer inserts. Secure the first gear with the thrust washer and snap ring.

8. Slide the blocking ring onto the tapered machined surface of the second gear. Slide the second gear with blocking ring, and the second and third gear synchronizer onto the mainshaft. The tapered machined surface of the second gear must be toward the front of the shaft. Make sure that the notches in the blocking ring engage the synchronizer inserts. Secure the synchronizer with a snap ring. Measure the end play between the synchronizer and snap ring with a feeler gauge. End play should be 0.004 installed.
9. Coat the bore of the input shaft and gear with a thin film of grease. **A thick film of grease will plug the lubricant holes and prevent lubrication to the bearings.** Install the 15 bearings (Fig. 15) in the bore.
10. Position the output shaft assembly in the case. Position the second- and third-speed shift fork on the second- and third-speed synchronizer.
11. Install input shaft through the front of the transmission with the snap ring in the bearing groove.
12. Align the second- and third-speed shift fork with the shift rail bores and slide the shift rail into place with the interlock pin in a horizontal position, (use grease to hold the pin in the rail bore). Rotate the rail 90 degrees until the three detents are facing toward the outside of the case (vertical). Place the second- and third-speed synchronizer in the second-speed position (toward rear of transmission), and secure the fork to the rail with the set screw.
13. Move the synchronizer to the neutral position.
14. Install the interlock pin in the case. If the second- and third-speed shift rail is in neutral position, the top of the interlock pin will be slightly lower than the surface of the first and reverse shift rail bore.
15. Place the first and reverse shift fork in the groove of the first and reverse synchronizer. Rotate the fork into position and install the first and reverse shift rail. Move the rail inward until the center notch (neutral) is aligned with the detent bore. Secure the fork to the shaft with the set screw.
16. Install a new shift rail expansion plug in the front of the case flush with or to 0.60 inch below the face of the case to prevent interference with the clutch housing installation.
17. Hold the input shaft and blocking ring in position. Then move the output shaft forward to seat the pilot in the roller bearings of the input gear.
18. Tap the input gear bearing into place in the case while holding the output shaft to prevent the roller bearings from dropping. Install the front bearing retainer and new gasket, making sure that the oil return slot is at the bottom of the case. Install and torque the attaching screws to specification.
19. Install the large snap ring on the rear bearing. Place the bearing on the output shaft with the snap ring end toward the rear of the shaft. Press the bearing into place with the tool shown in Fig. 13. Secure the bearing to the shaft with a snap ring.
20. Hold the speedometer drive gear lock ball in the detent and slide the speedometer drive gear into place. Secure the gear with a snap ring.
21. Place the transmission in the vertical position. Working with a screwdriver through the drain hole at the bottom of the case (if equipped), align the bore of the countershaft gear and the thrust washers with the bore of the case.
22. Working from the rear of the case, push the dummy shaft out of the countershaft gear with the countershaft. There is a countershaft-to-case clearance of 0.020 inch at the front bore and 0.010 at the rear bore. Install a new expansion plug in the countershaft bore at the front of the case. Install the plug flush with or to 0.006-0.60 inch below the

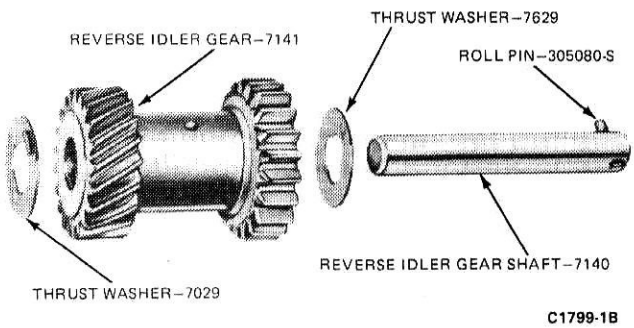


FIG. 10 Reverse Idler Shaft Disassembled

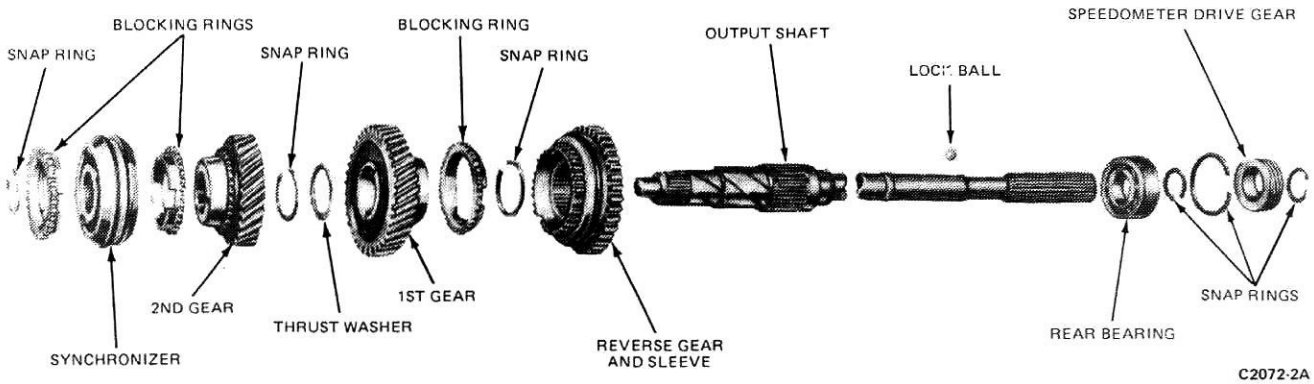


FIG. 11 Output Shaft Disassembled

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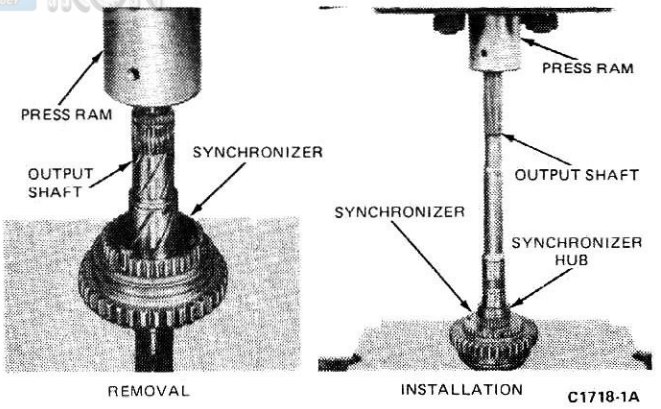


FIG. 12 Removing and Installing First and Reverse Synchronizer

face of the case to prevent interference with the clutch housing installation.

23. Coat a new extension housing gasket with sealer and position it on the case.
24. Install lockwashers on the five attaching screws. Dip the threads of the capscrews in the sealer. Secure the housing to the case and torque the capscrews to specification. Install the drain plug in the case, if so equipped. Install the filler hole plug.
25. Place the transmission in gear. Pour the specified transmission lubricant over the entire gear train while rotating the input or output shaft.
26. Install the remaining detent pin in the case. Install the long spring down against the detent pin.
27. Coat a new cover gasket (Fig. 4) with sealer. Secure the cover with capscrews. Torque the screws to specification.
28. Check the operation of the transmission in all of the gear positions.

SUB-ASSEMBLIES

Shift Levers and Seals

1. Remove the nut, lock washer, and flat washer that secure each shift lever (Fig. 14) to the shaft and lever in the transmission case. Lift the levers off the shaft. Slide each lever and shaft out of the case. Discard the O-ring from each shaft.
2. Lubricate the new O-ring seals with transmission lubricant and install them on the shafts.
3. Install the lever and shafts in the case.
4. Position a shift lever on each shaft and secure them with a flat washer, lock washer, and nut.

Input Shaft Bearing

1. Remove the bearing outer snap ring and the snap ring securing the input shaft bearing. Press the input shaft out of the bearing using the tools shown in Fig. 7.
2. Press the input shaft bearing onto the input shaft with the tools shown in Fig. 13, and install the snap ring on the shaft.

Synchronizers

1. Lightly punch or etch alignment marks on the hub and sleeve of the synchronizer before disassembly.

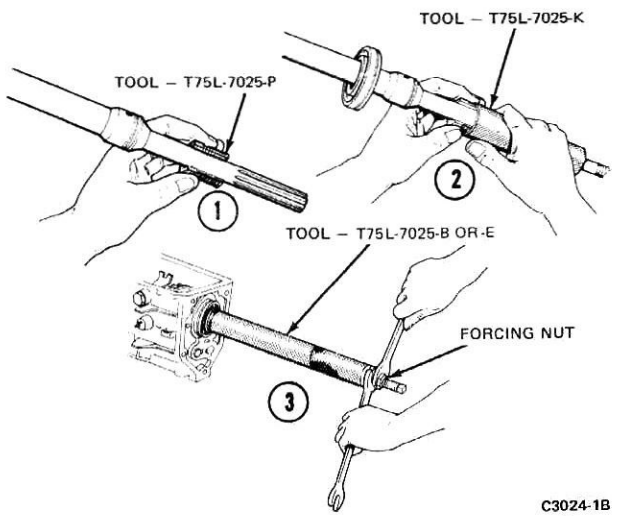


FIG. 13 Installing Input or Output Shaft Bearing

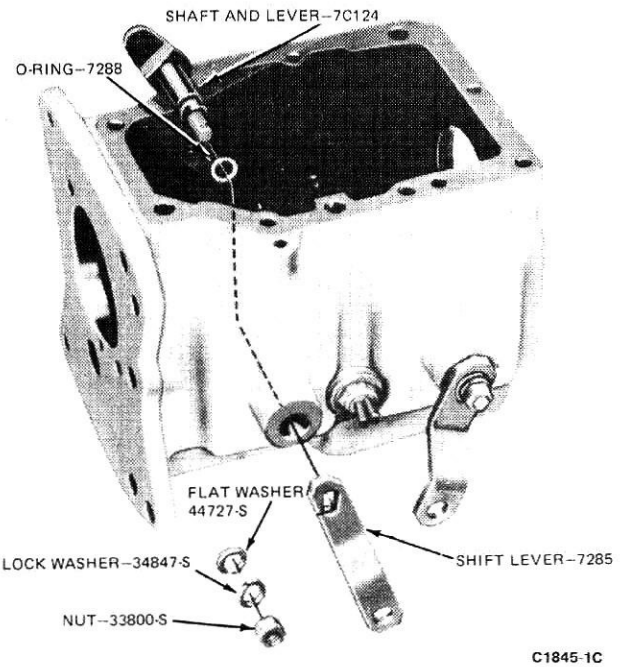


FIG. 14 Shift Lever and Shaft Disassembled

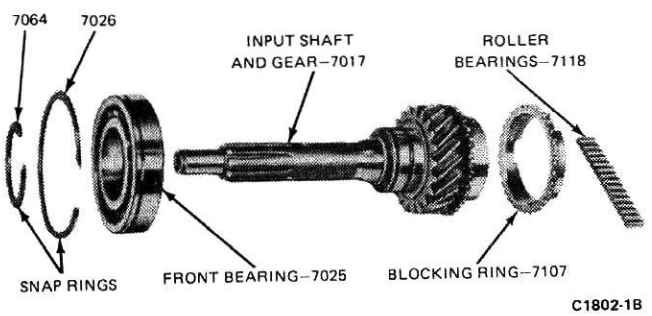


FIG. 15 Input Shaft Gear Disassembled

Push the synchronizer hub from each synchronizer sleeve.

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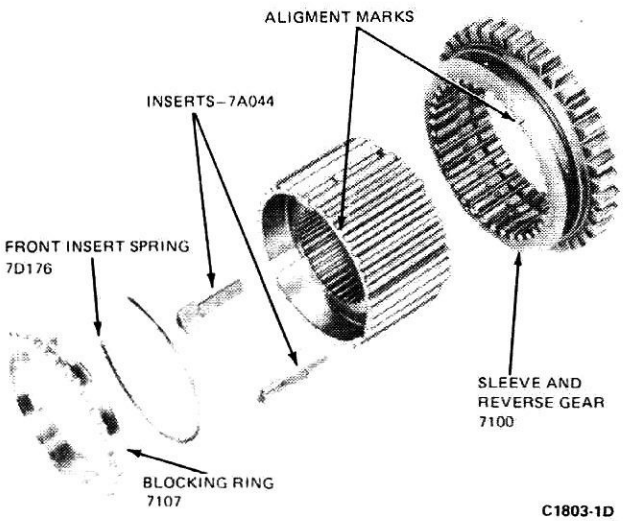


FIG. 16 First and Reverse Synchronizer Disassembled

2. Separate the inserts and insert springs from the hubs. Do not mix the parts from the second- and third-speed synchronizer with the first and reverse synchronizer (Figs. 16 and 17).

3. Install the insert spring in the hub of the first and reverse synchronizer. Make sure that the spring covers all the insert grooves. Start the hub on the sleeve, making sure that the alignment marks are properly indexed. Position the three inserts in the hub, making sure that the small end is on the inside of the hub. Slide the sleeve and reverse gear onto the hub.

4. Install one insert spring (Fig. 17) into a groove of the second- and third-speed synchronizer hub, making sure that all three insert slots are fully covered. With the alignment marks on the hub and sleeve aligned, start the hub into the sleeve. Place the three inserts on top of the retaining spring and push the assembly together. Install the remaining insert spring so that the spring ends cover the same slot as does the other spring. Do not stagger the springs. Place a synchronizer blocking ring on each end of the synchronizer sleeve.

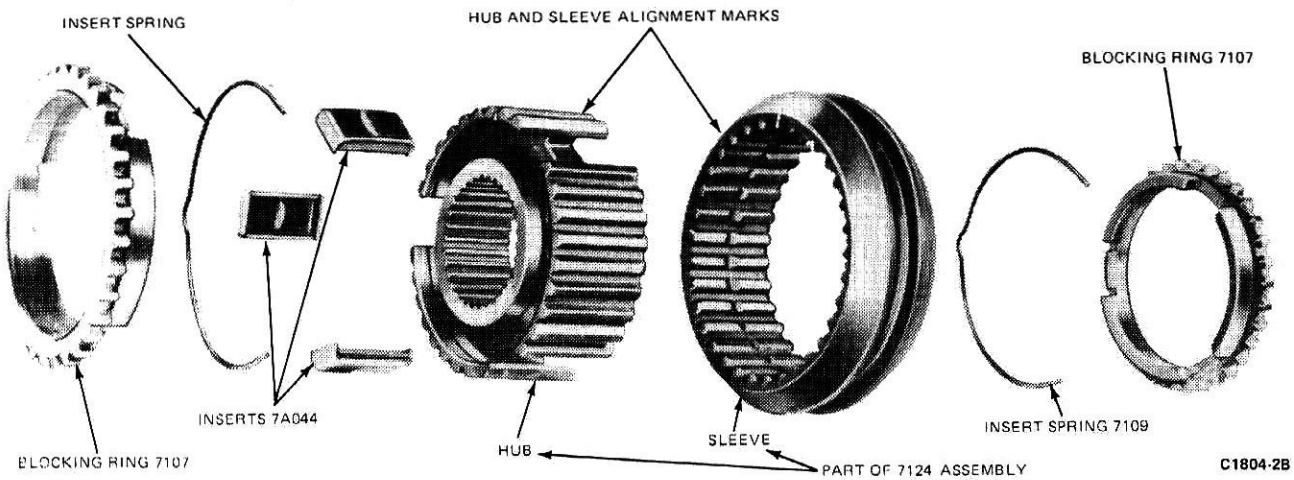


FIG. 17 Second and Third Synchronizer Disassembled

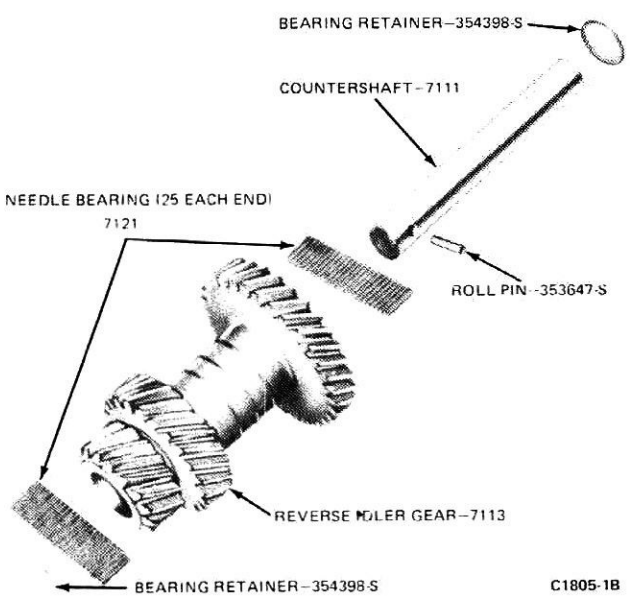


FIG. 18 Countershaft Gear Disassembled

Countershaft Gear Bearings

1. Remove the dummy shaft, fifty needle bearings, and the two bearing retainer washers from the countershaft gear (Fig. 18).
2. Coat the bore in each end of the countershaft gear with grease.
3. Hold the dummy shaft in the gear and install the twenty-five needle bearings and a retainer washer in each end of the gear.
4. Position the countershaft gear, dummy shaft, and needle bearings in the case.
5. Place the case in a vertical position. Align the gear bore and the thrust washers with the bores in the case and install the countershaft.
6. Place the case in a horizontal position and, using a feeler gauge, check the countershaft gear end play. If not within specification, replace the thrust washers.

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7. After establishing the correct end play, install the dummy shaft in the countershaft gear and allow the gear to remain at the bottom of the case until the output and input shafts have been installed.

SPECIFICATIONS

3 SPEED TRANSMISSIONS

Car Model	Engine	Transmission Model	Gear Ratio			
			1st	2nd	3rd	Reverse
Fairmont/ Zephyr	4.1L (200 CID)	RAN-DM	3.56	1.90	1.00	3.78

TRANSMISSION COMPONENT END PLAY

Component	Inches
Cluster Gear to Case	.004-.018
Reverse Idler Gear to Case	.004-.018

LUBRICANT REFILL CAPACITY (TO BOTTOM OF FILLER HOLE)

Transmission Type	Application	Lubricant Specification	Capacity (Pints)
3 Speed	All Models	ESP-M2C83-C	3.5*
*3 Pints Imperial Measure			

TORQUE SPECIFICATIONS

Component	Torque Ft-Lb 3 Speed	Component	Torque Ft-Lb 3 Speed
Input Shaft Bearing Retainer to Case Bolt	30-36	Shift Fork to Shift Rail Screw	10-18
Extension Housing to Case Bolt	42-50	Filler Plug to Case	10-20
Access Cover to Case Screw	20-25	Transmission to Flywheel Housing	37-42
Outer Gear Shift Levers to Cam and Shaft Nut	18-23		

SPECIAL TOOLS

Tool Number	Description	Tool Number	Description
T50T-100A	Impact Hammer – Long	T75L-7025-L	Shaft Adapter
T59L-100B	Impact Hammer – Short	T75L-7025-P	Collar – Shaft
Tool – 1175AB	Grease Seal Remover	T64P-7111-A	Cluster Gear Roller Retainer Shaft
T52L-7000-GAE	Extension Housing Bushing and Seal Remover	T63P-7111-A	Cluster Gear Roller Retainer Shaft
T75L-7025-B	Remover – Replacer Tube	T64P-7140-A	Reverse Idler Shaft Remover
T75L-7025-C	Remover – Replacer Tube	T61L-7657-A	Transmission Extension Housing Oil Seal Replacer
T75L-7025-E	Collet – Bearing Remover	T57P-7697-B	Extension Housing Bushing Replacer
T75L-7025-G	Sleeve – Collet	T57P-7657-G	Shift Linkage Grommet Replacer
T75L-7025-J	Screw	T67P-7341-A	Input Shaft Seal Installer
T75L-7025-K	Sleeve – Replacer		

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Model RAD Four-Speed Transmission

PART 16-28

Applies To Mustang II

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REMOVAL AND INSTALLATION	
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DESCRIPTION AND OPERATION

TRANSMISSION

The Model RAD four-speed transmission can be identified by the identification tag (Fig. 1). The tag is located under the lower left side extension to transmission case retaining bolt.

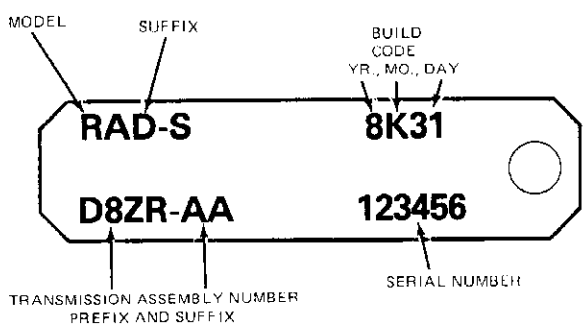


FIG. 1 Transmission Identification

The Model RAD four-speed transmission is of the fully sychronized type with all gears except the reverse gear being in constant mesh. All forward-speed changes are accomplished through forged blocker ring synchronized units.

The constant mesh gears, that is, the input shaft gear, the three other forward gears on the output shaft, and the corresponding gears on the countershaft gear, are helically cut. The reverse gear on the countershaft gear has straight-cut spur teeth which mesh, through an idler gear, with spur teeth on the outside of the first-second gear synchronizer sleeve.

Gear selection is by means of a floor shift lever (Fig. 2). The shift lever is attached directly to a single selector rail, which has the selector lever assembled to it, and is mounted in the transmission. Movement of the shift lever, and thereby the selector rail, causes the selector lever to locate in the appropriate selector fork and move it to the required position. Movement of the first-second or third-fourth selector fork causes the appropriate synchronizer sleeve to move as necessary to engage with the dog teeth on the required gear.

When reverse gear is required, movement of the reverse selector relay lever draws the reverse idle gear into mesh with both the reverse gear on the countershaft gear and on the output shaft.

Engagement of two gears at once is prevented by means of a selector interlock plate pivoted in the transmission cover. This plate engages with the selector forks that are not in use, and holds them positively in the disengaged position. The selector forks are not attached to the selector rail. The first-second and third-fourth forks, while they are mounted on the rail, are free to slide when not retained by the interlock plate.

Whenever overhauling the transmission assembly, or a part of the transmission that involves removing a snap ring, be sure to properly install the correct size of brand-new (never used) snap rings (Fig. 3).

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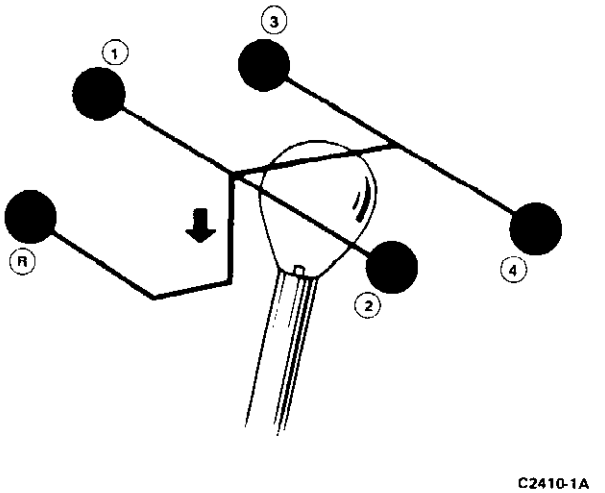


FIG. 2 Gear Shift Lever Positions

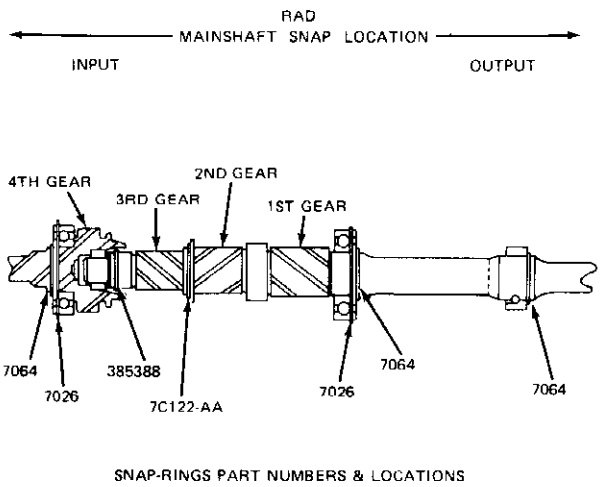


FIG. 3 RAD Mainshaft Snap Ring Locations and Parts Numbers

REMOVAL AND INSTALLATION

SHIFT LEVER

MUSTANG II

Removal

1. Place the gear shift lever in neutral position.
2. Remove the carpet and shift boot (Fig. 4).
3. Remove the three lever-attaching bolts. **Caution: Bolts are metric (M8).**

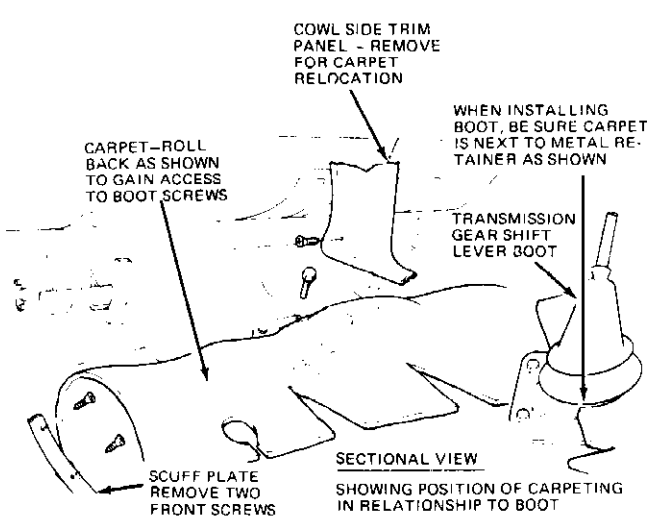


FIG. 4 Shift Lever Boot Removal —Mustang II

4. Remove shift lever from extension (Figs. 5 and 6).

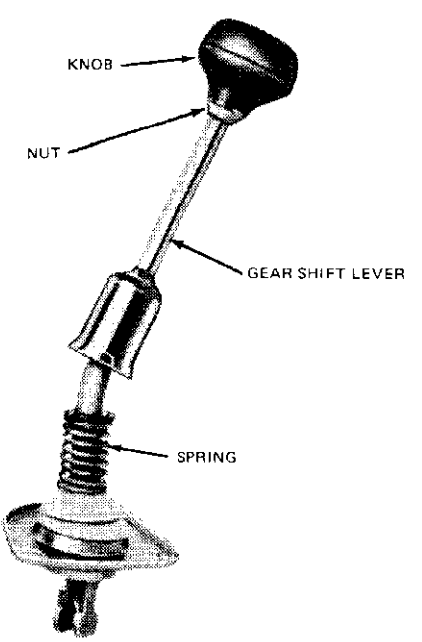


FIG. 5 Shift Lever —Mustang II

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Installation

1. Make sure the shift lever insulator is in a straight downward position on the shift rail.
2. Position the shift lever in the extension housing so that the forked ends engage in the insulator properly (Fig. 5).
3. Install the three attaching metric (M8) bolts.
4. Install the boot and attaching screws.
5. Position the carpet or floor mat and install the step plates and screws.
6. Install the two kick pads.
7. Install the locknut and shift knob.
8. Check to make sure that the transmission lever is operating properly.

TRANSMISSION

Removal

1. Remove the shift lever (Fig. 6) following directions in paragraph above.
2. Raise the vehicle on a hoist.
3. Mark the driveshaft so that it may be reinstalled in the same relative position to the rear axle companion flange. Remove the driveshaft and install Tool T71P-7095-A in the extension housing to prevent lubricant leakage.
4. Disconnect back-up lamp switch wires.
5. Remove the speedometer cable attaching screw, lift the cable from the extension housing, and plug the hole to prevent oil spillage.
6. Support the rear of the engine with a jack and remove the bolts that attach the crossmember to the body (Fig. 7).
7. Remove the two bolts that attach crossmember-to-extension housing, and remove the crossmember.
8. Lower the engine as required to permit removal of bolts that attach the transmission assembly to the flywheel housing. Slide the transmission away from the flywheel housing and from under the vehicle.

Installation

1. Install the clutch release lever and bearing.
2. Apply a film of C4AZ-19584-A lubricant to the input shaft front bearing retainer. Position the transmission assembly into the flywheel housing and install and torque attaching bolts to specification. **It may be necessary to place the transmission in gear and rotate the output shaft to align the input shaft and clutch splines.**
3. Raise the engine until the transmission is in its normal position. Secure the crossmember to the body with the attaching bolts, and torque to specification. Install the two bolts that attach crossmember to extension housing, and torque to specification.
4. Install the speedometer cable and torque the attaching screw to specification.
5. Install the driveshaft, making sure that it is connected to the pinion flange in its original position.

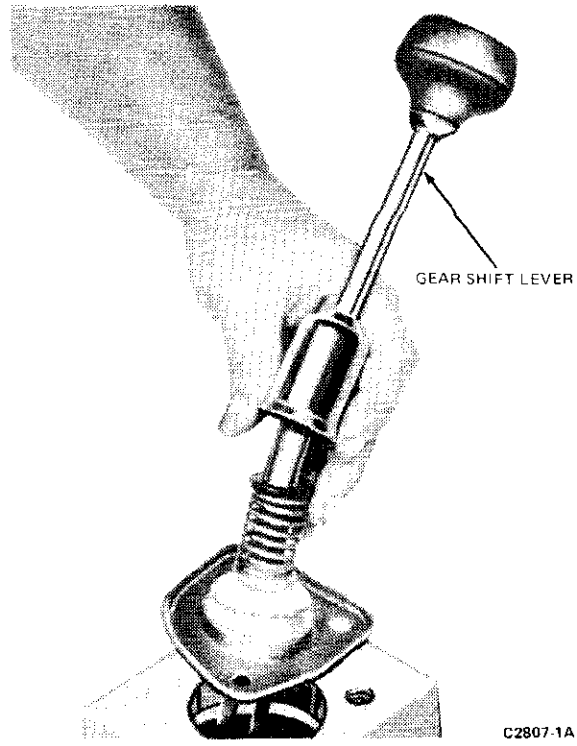


FIG. 6 Removing or Installing Shift Lever—Mustang II

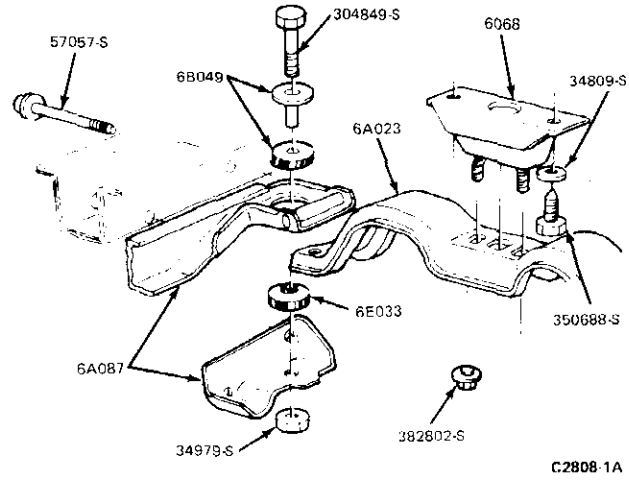


FIG. 7 Engine Rear Mount—Mustang II

6. Fill the transmission with the specified lubricant until it appears at the bottom of the filler plug hole. Install the filler plug and torque to specification.
7. Position the back-up switch wire in the clip and connect the wire to the switch.
8. Lower the vehicle to the ground.
9. Install the shift lever and carpet, following directions under Shift Lever Installation.
10. Check the transmission for proper operation.

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DISASSEMBLY AND ASSEMBLY

TRANSMISSION (REFER TO FIG. 11)

Disassembly

1. Mount the transmission in a holding fixture (Fig. 8) and drain the lubricant by removing the lower extension housing bolt.

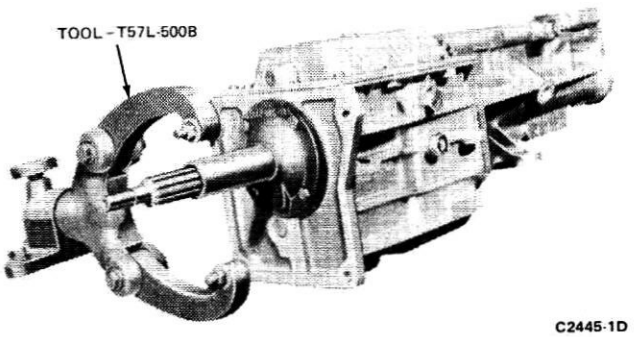


FIG. 8 Transmission Mounted in Holding Fixture

2. Drive the access plug from the rear of the extension housing. Remove the nut that secures the offset lever assembly, then remove the offset lever assembly. (See Fig. 9.)

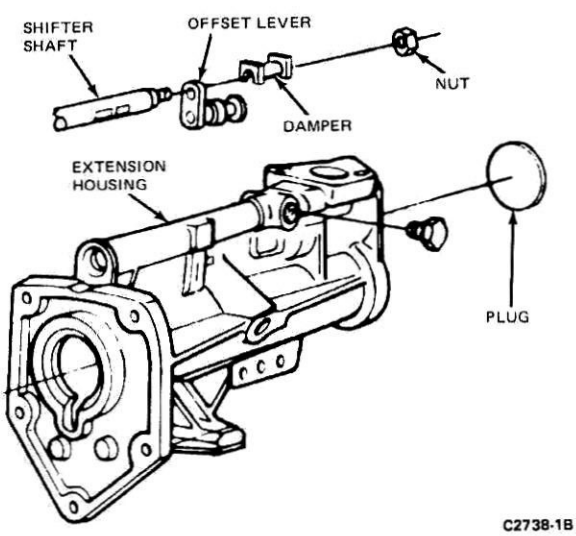


FIG. 9 Removal of Offset Lever

3. Remove the remaining metric extension housing bolts and lock washers. Remove the extension and gasket from the case.
4. Remove metric cap screws that attach cover to the transmission case. Remove the cover, shifter forks, shift rod assembly, and the cover-to-case gasket.
5. Remove metric bolts that attach the front bearing retainer to the case, then remove the front bearing retainer and gasket.
6. Remove the spring clip retaining the reverse lever assembly to pivot bolt. Remove the pivot bolt, and the reverse lever assembly.
7. Remove the snap ring securing the input bearing to the input shaft. Remove the outer snap ring from the input bearing. Locate a bearing removal tool in the outer snap ring groove and remove the bearing.
8. Remove the snap ring securing the speedometer gear to the output shaft and slide the gear off the shaft. Remove the lock ball from the shaft (Fig. 11).

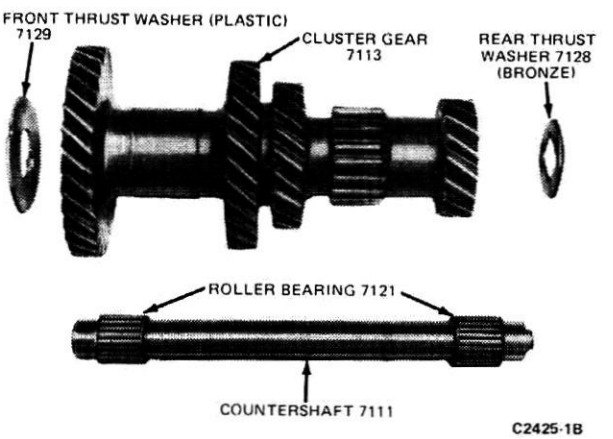


FIG. 10 Countershaft Removal

9. Remove the snap ring securing the output shaft bearing on the shaft. Remove the outer snap ring from the output shaft bearing.
10. Locate a bearing removal tool in the outer snap ring groove and pull the output shaft bearing from the case.
11. Remove the input shaft through the front bearing hole in the case. Carefully lift the output shaft and gear train through the top of the case.
12. Slide the reverse idler gear shaft out through the rear of the case and remove the reverse gear.
13. Use a dummy countershaft inserted from the front of the case to drive the countershaft out through the rear of the case. Lift out the countershaft gear, thrust washers and dummy countershaft through the top opening of the case (Fig. 10).
14. Clean and inspect all parts. DO NOT REMOVE THE BACK-UP LAMP SWITCH UNLESS DAMAGED.

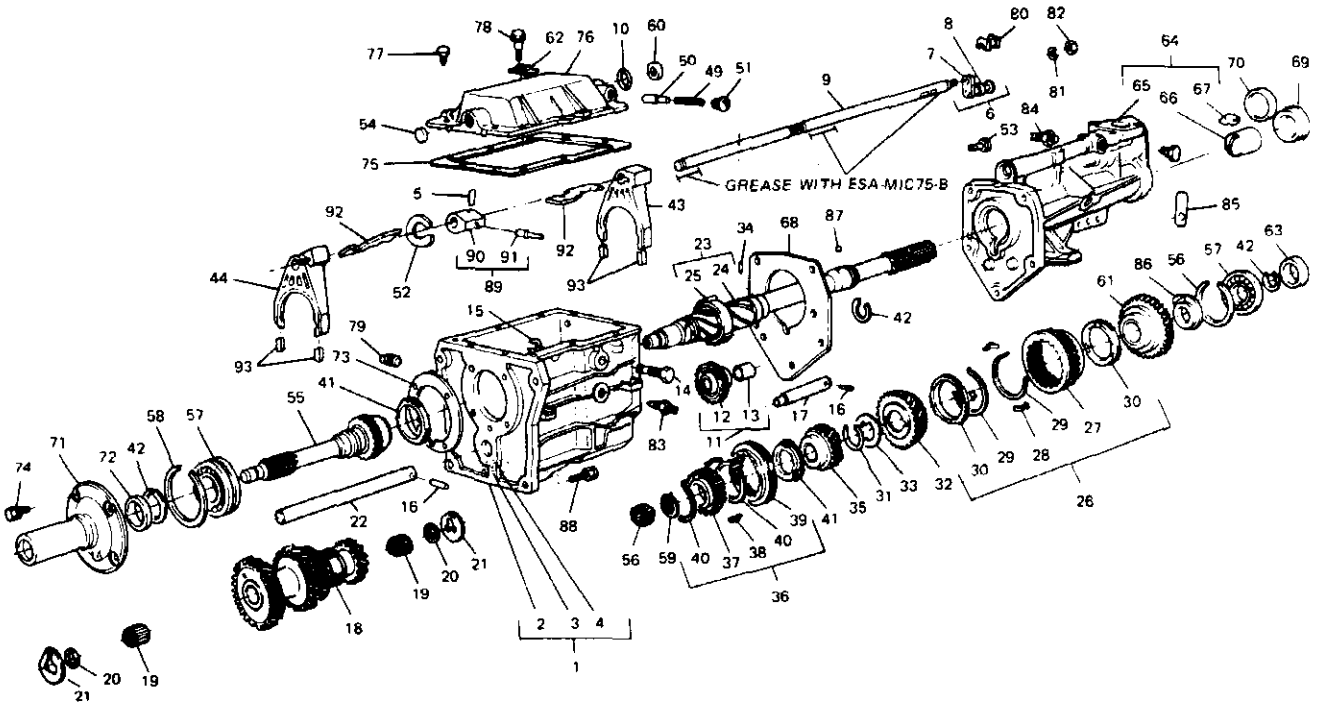
TRANSMISSION SUB-ASSEMBLIES

Cover Assembly

Disassembly

1. Remove detent screw, spring and plunger (Fig. 12).
2. Pull shifter shaft rod rearward and rotate counter-clockwise.
3. Remove spring pin that retains manual selector arm to the shifter shaft (Fig. 12).
4. Remove shifter shaft from the cover (take care not to damage seal).

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ITEM	PART NAME	REQD.
1.	CASE ASSY. – TRANS.	1
2.	CASE – TRANS.	1
3.	MAGNET - TRANS. CASE CHIP	1
4.	NUT, SPRING 9/64	1
5.	PIN-3/16 DIA. X 13/16 ROLLED SPRING	1
6.	LEVER ASSY.-TRANS. GEARSHIFT SHAFT OFFSET	1
7.	LEVER-TRANS. GEARSHIFT SHAFT OFFSET	1
8.	PIN-TRANS. GEAR SHIFT SHAFT OFFSET LEVER	1
9.	SHAFT-TRANS. SHIFTER	1
10.	SEAL-O-RING	1
11.	*GEAR & BUSH. ASSY.-TRANS. REV. IDLER SLIDING*	1
12.	GEAR-TRANS. REV. IDLER SLIDING	1
13.	BUSHING-TRANS. REV. IDLER GEAR	1
14.	PIN-TRANS. REV. GEAR SELECTOR FORK PIVOT	1
15.	RING-7/16 RETAINING	1
16.	PIN-1/4 X 1 SPRING	2
17.	SHAFT-TRANS. REVERSE IDLER GEAR	1
18.	GEAR-TRANS. COUNTERSHAFT	1
19.	ROLLER-TRANS. C'SHAFT GEAR BEARING	50
20.	WASHER-208 / .918 FLAT	2
21.	WASHER-TRANS. C'SHAFT GEAR THRUST	1
22.	COUNTERSHAFT-TRANSMISSION	1
23.	SHAFT ASSY.-TRANS. OUTPUT	1
24.	SHAFT-TRANS. OUTPUT	1
25.	HUB-TRANS. SYN. 1ST & 2ND GEAR CL.	1
26.	*SHAFT & GEAR ASSY. - TRANS. OUTPUT*	1
27.	GEAR-TRANS. REVERSE SLIDING	1
28.	INSERT-TRANS. SYNCHRO. HUB	3
29.	SPRING-TRANS. SYNCHRO RETAINING	2
30.	RING-TRANS. SYNCHRO BLOCKING	2
31.	RING-TRANS.-2ND SPEED GEAR RET. SNAP	1
32.	GEAR-TRANS. 2ND SPEED	1
33.	WASHER-TRANS. 2ND SPEED GEAR THRUST	1
34.	PIN - 1/8 x 3/8 ROLLED SPRING	1
35.	GEAR-TRANS. 3RD SPEED	1
36.	SYNCHRONIZER ASSY. - 3RD & 4TH SPEED	1
37.	HUB-TRANS. SYNC. 3RD & 4TH GEAR CLUTCH	1
38.	INSERT-TRANS. SYNC. HUB	3
39.	SLEEVE-TRANS. 3RD & 4TH GEAR CLUTCH HUB	1
40.	SPRING-TRANS. SYNCHRO. RETAINING	2
41.	*RING-TRANS. SYNCHRO. BLOCKING*	2
42.	RING-TRANS. M/D GEAR BRG. SHAFT-SNAP	3
43.	FORK-TRANS. 1ST & 2ND GEAR SHIFT	1
44.	FORK-TRANS. 3RD & 4TH GEAR SHIFT	1
45.	LEVER ASSY.-TRANS. REV. GEAR SHIFT RELAY	1
46.	RING.-TRANS. REV. GEAR SHIFT RELAY LEVER	2

ITEM	PART NAME	REQD.
47.	LEVER-TRANS. REV. GEAR SHIFT RELAY	1
48.	FORK-TRANS. REVERSE GEAR SHIFT	1
49.	SPRING-TRANS. SHIFTER INTERLOCK	1
50.	PLUNGER-TRANS. MESHLOCK	1
51.	SCREW-M12 X 10 ROUND HEAD FLAT	1
52.	PLATE-TRANS. GEAR SELECTOR INTERLOCK	1
53.	SCREW & WASHER ASSY. M10 X 30 HEX. HEAD	5
54.	PLUG - 3/4 DIA. WELSH TYPE	1
55.	SHAFT-TRANS. INPUT	1
56.	ROLLER-TRANS. M'SHAFT BEARING	15
57.	*BEARING ASSY.-TRANS. M/D GEAR BALL*	2
58.	RING-M/D GEAR BRG. RETAINING SNAP	2
59.	RING - 1.00 RETAINING	1
60.	SEAL-TRANS. SHIFT SHAFT	1
61.	GEAR-TRANS. 1ST SPEED	1
62.	CLIP-SPARK CONTROL SWITCH WIRE RET.	1
63.	GEAR-SPEEDOMETER DRIVE	1
64.	EXTENSION ASSY.-TRANS.	1
65.	EXTENSION-TRANS.	1
66.	BUSHING-TRANS. EXTENSION	1
67.	STOP-TRANS. GEAR SHIFT LEVER REVERSE	1
68.	GASKET-TRANS. EXTENSION	1
69.	SEAL ASSY.-TRANS. EXTENSION OIL	1
70.	PLUG-TRANS. EXTENSION	1
71.	RETAINER-TRANS. INPUT SHAFT GEAR BRG.	1
72.	SEAL ASSY.-TRANS. INPUT SHAFT OIL	1
73.	GASKET-TRANS. INPUT SHAFT BRG. RETAINER	1
74.	BOLT M8 X 20 HEX HEAD - LOCK	4
75.	GASKET-TRANS. CASE COVER	1
76.	COVER-TRANS. CASE	1
77.	SCREW-M6 X 20 HEX. HEAD	8
78.	BOLT-M6 X 32 HEX. WASHER HD. SHOULDER	2
79.	PLUG-1 2-14 PIPE (FILLER)	1
80.	BUSHING-TRANS. GEAR SHIFT DAMPER	1
81.	NUT-HEXAGON	1
82.	SWITCH ASSY. BACK-UP LAMP	1
83.	SWITCH ASSY. TRANS. SEAT BELT WARNING SENSOR	1
84.	TAG TRANS. SERVICE IDENTIFICATION	1
85.	WASHER-TRANS. 1ST GEAR THRUST	1
86.	BALL-.25 DIA.	1
87.	SCREW & LOCKWASHER ASSY. M12 X 40	4
88.	*ARM ASSY. TRANS. CONTROL SELECTOR*	1
89.	ARM-TRANS. CONTROL SELECTOR	1
90.	PIN-TRANS. GEARSHIFT	1
91.	PLATE-TRANS. GEARSHIFT SELECTOR ARM	2
92.	INSERT-TRANS. GEARSHIFT FORK	4

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FIG. 11 Transmission Assembly

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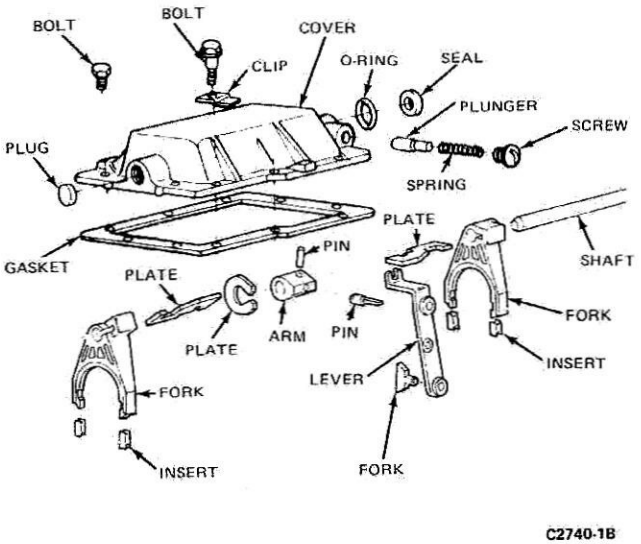


FIG. 12 Transmission Cover Assembly

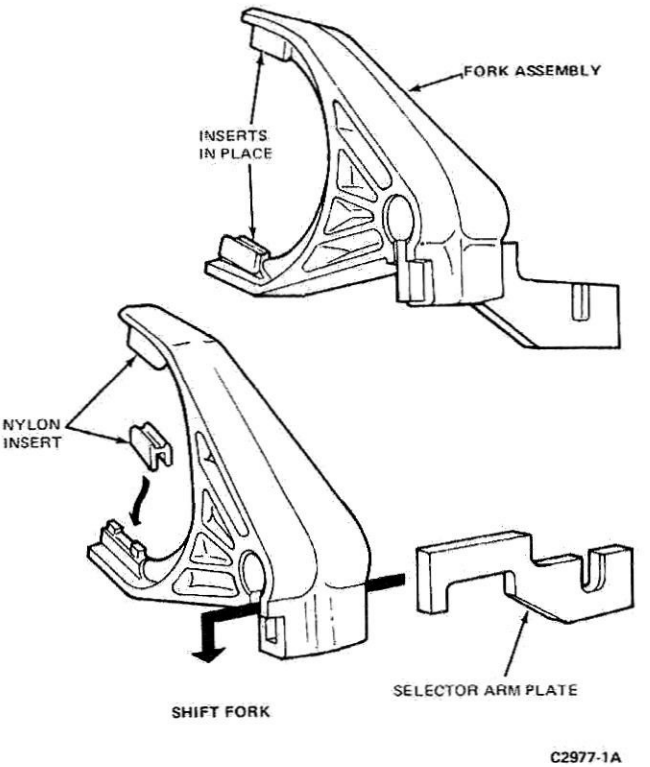


FIG. 13 Assembling Shift Forks

5. Remove manual selector arm and interlock plate.
6. Remove first- and second-speed shifter fork.
7. Remove third- and fourth-speed shifter fork.
8. Replace shifter shaft seal if damaged, replace welch plug if leaking or damaged.
9. Clean and inspect all parts.

Assembly

1. Assemble the two plastic inserts to each shift fork, making sure each insert is positioned so the two projections on the inside of each insert fit into the blind holes in each end of the shift forks (Fig. 13).
2. With inserts in place, insert the selector arm plates into the shift forks.
3. Install third- and fourth-speed shifter fork into cover.
4. Install first- and second-speed shifter fork into cover. Lubricate the shifter shaft bore with grease.
5. Install manual selector arm through the interlock plate, and position the two pieces into the cover, with wide leg of interlock plate towards the inside of transmission case.
6. Align the shifter shaft in cover, and insert the shaft through the shifter forks and manual selector. (The shifter shaft should be coated with a light coat of grease.) Make sure that the detent grooves face the plunger side of the cover.
7. Align the pin hole on the manual selector arm with the pin hole in the shifter shaft. Install the spring pin flush to surface of selector arm.
8. Install the detent plunger, spring, and plug. Torque the plug, 8 to 12 ft-lb.
9. Check the operation of the shift forks in each gear position.

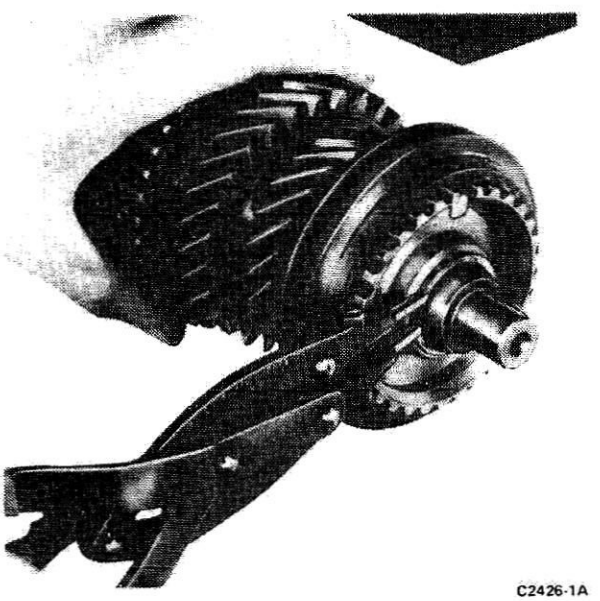


FIG. 14 Removing and Installing Third-and-Fourth Synchronizer Snap Ring

Output Shaft

Disassembly

1. Scratch or etch alignment marks on synchronizer and blocker rings. Remove the snap ring from the front of the output shaft (Fig. 14). Slide the third- and fourth-speed synchronizer assembly, blocker rings, and third-speed gear off the shaft.

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2. Remove the next snap ring and the second-speed gear thrust washer from the shaft. Slide the second-speed gear and blocker ring off the shaft. (Take care not to lose the sliding gear from first- and second-speed synchronizer assembly. The first- and second-speed synchronizer hub cannot be removed from the output shaft.)
3. From rear of output shaft, remove the first gear thrust washer (oil slinger). Remove the spring pin which retains the first-speed gear onto the shaft. The spring pin also locates and drives the thrust washer-type oil slinger.
4. Slide the first-speed gear from the output shaft, along with the first-speed blocker ring. (Take care not to lose sliding gear from first- and second-speed synchronizer assembly.)
5. Clean and inspect all parts.

Assembly

1. Place a blocker ring on the cone of the first-speed gear, and slide the gear and ring onto the output shaft. Make sure the inserts in the synchronizer engage the notches in the blocker ring.
2. Install the spring pin in the shaft to retain the first-speed gear.
3. Install a blocker ring on the cone of the second-speed gear, and slide gear and ring onto the output shaft, making sure the inserts in the synchronizer engage the notches in the blocker ring.
4. Install second-speed gear thrust washer on the shaft, along with a new snap ring.
5. Install a blocker ring on the cone of the third-speed gear, and slide the third gear and ring onto the output shaft. Install the third- and fourth-speed synchronizer. Make sure the inserts in the synchronizer engage the notches in the blocker ring (Fig. 15).
6. Install a new third- and fourth-gear synchronizer retaining snap ring (Fig. 14).
7. Position the first-speed gear thrust washer (oil slinger) on the shaft and on the spring pin retaining the first-speed gear. (Caution: Oil grooves must be positioned against gear. Do not install backwards.)

Countershaft Gear Bearing Replacement

1. Remove the dummy shaft, bearing retainer washers and the needle bearings from the countershaft gear. Clean and inspect all parts (Fig. 16).
2. Coat the bore in each end of the countershaft gear with grease.
3. Hold the dummy shaft in the gear and install the needle bearings and retainer washers in each end of the gear. (Needles should slip easily in bore.)

Input Shaft Pocket Bearing Replacement

1. Remove the roller bearings from the input shaft.
2. Clean and inspect all parts.
3. Lightly coat the bore of the input shaft with grease. (A thick film of grease will plug lubrication holes and prevent lubricant getting to the bearings.) Install the bearings (needles should slip easily in bore).

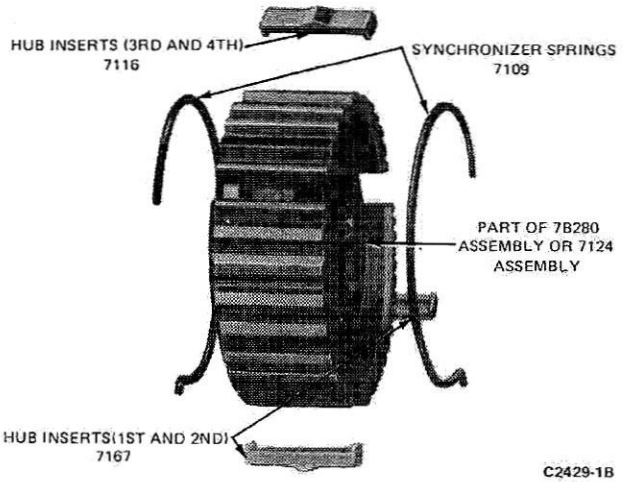


FIG. 15 Synchronizer Spring Rotation

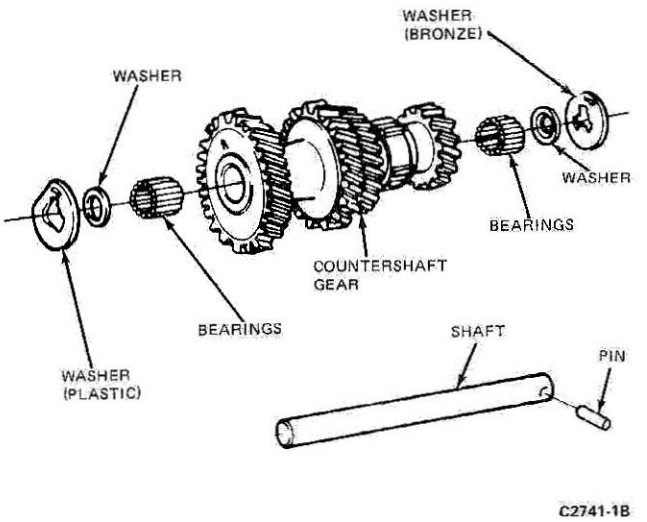


FIG. 16 Countershaft Disassembled

Synchronizer

Removal

1. Etch alignment marks on the hub and sleeve of the synchronizer before disassembly.
2. Push the synchronizer sleeve from each synchronizer hub (the first- and second-speed synchronizer hub cannot be removed from the output shaft).
3. Separate the inserts and insert springs from the hubs. Do not mix the parts of the first- and second-speed synchronizer with the third- and fourth-speed synchronizer.
4. Clean and inspect all parts.

Installation

1. Position the sleeve on the hub making sure that the alignment marks are properly indexed.
2. Place the three inserts on the hub. Install the insert springs, making sure that the bent tab is seated in

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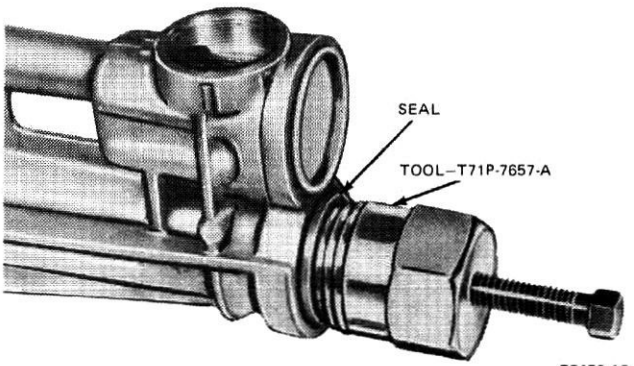


FIG. 17 Removing Extension Housing Seal

the same inserts. The springs should face in opposite directions (Fig. 15).

Rear Seal

Removal

1. Remove the driveshaft.
2. Remove the seal from the extension housing using Tool No. T71P-7657-A (Fig. 17).

Installation

1. Install the new seal in the extension housing using Tool No. T71P-7095-A (Fig. 19).
2. Install the driveshaft.

Rear Bushing and Seal

Removal

1. Remove the driveshaft from the vehicle.
2. Insert Tool No. T60K-7697-A into the extension housing until it grips on the front edge of the bushing.
3. Turn the screw clockwise until the bushing and seal are free of the housing (Fig. 18).

Installation

1. Drive a new bushing into the extension housing with Tool No. T71P-7095-A.
2. Install a new seal in the extension.
3. Inspect drive shaft yoke, and replace if worn, scored or damaged. Install the driveshaft.

TRANSMISSION

Assembly

1. Position the reverse idler gear and shaft in place.
2. Coat the countershaft thrust washers surfaces with a thin film of grease and position them on the countershaft gear and dummy shaft (plastic washer at front, bronze washer at rear). Optionally, position washers in case with tabs in case tab slots.
3. Place the transmission in the vertical position. **Do not allow the dummy shaft to fall through the front hole of the case.** Align the countershaft gear bore and thrust washers with the bore in the case. Install the countershaft from the rear of the case.

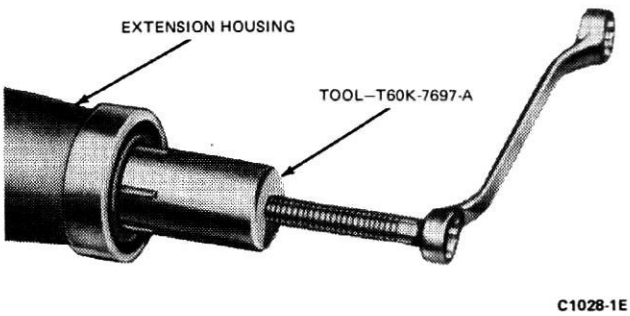


FIG. 18 Removing Extension Housing Bushing and Seal

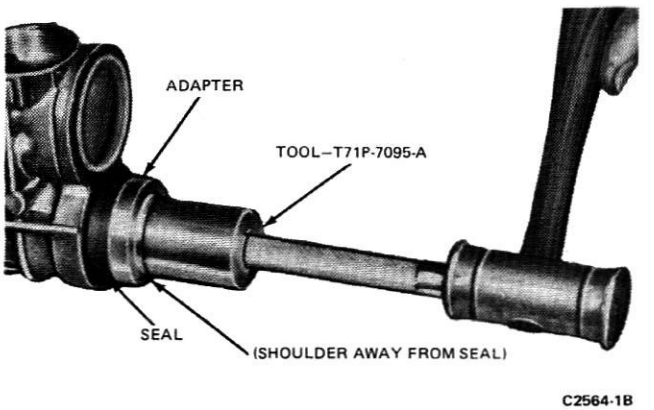


FIG. 19 Installing Typical Extension Housing Seal

4. Place the transmission in the horizontal position. Position the output shaft assembly into the case through the cover opening. Slide the dummy bearing onto the output shaft and into position to align and support the output shaft assembly.
5. Position the input shaft and fourth gear blocker ring through the front of the case, making sure that the notches in the blocker ring engage with the synchronizer insert.
6. Install a new snap ring on the input shaft bearing OD. Press the bearing into position using the input shaft bearing installation tool.
7. Install a new input shaft bearing retaining snap ring on the input shaft.
8. Install the front bearing retainer and new gasket. Apply a tape sealer or gasket sealer to the threads of the attaching bolts and torque to specifications.
9. Place the transmission in a vertical position. Remove the dummy output shaft bearing. Install a new snap ring on the output shaft bearing OD. With the snap ring positioned at the rear, install the bearing on the shaft, using the output shaft bearing installation tool.

NOTE: Make certain that the first gear thrust washer is in position on the roll pin and does not slip out of position during bearing installation. Install a new output shaft rear bearing retaining snap ring.

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10. Install the reverse idler gear lever assembly, making sure the fork is positioned in the reverse idler gear groove.
11. Use a sealer on the reverse lever pivot bolt threads, and install the bolt into the case. Align the lever on the pivot bolt and torque bolt 15 to 25 ft-lb. Install reverse lever retaining spring clip to the reverse gear pivot bolt. Tilt the transmission forward and pour a light coat of lube over the gear train.
12. Use a new cover gasket and install the cover assembly. Install the bolts and wiring clips, and tighten to specification, 7 to 12 ft-lb after extension housing is tightened. **The two shouldered locating bolts must be installed first. Position the shift rail into first- or third-gear position.**
13. Insert the speedometer drive gear lock ball into the hole. Holding the ball, slide the speedometer drive gear into place and secure with a snap ring.
14. Using a new gasket, install the extension housing to the case. Use a sealer on the attaching bolts and torque 18 to 27 ft-lb. Caution should be taken so as not to damage the extension yoke seal.
15. Install the offset lever assembly onto the shift shaft, secure offset assembly with nut, using Loctite or equivalent on sealant on shift shaft threads, and torque, 8 to 12 ft-lb. Do not overtorque.
16. Insert the gearshift lever into place and check the gear positions.
17. Install the access plug into the rear of the extension housing, using a plastic-faced or copper mallet.

SPECIFICATIONS

MODEL RAD TRANSMISSIONS

Transmission Lubricant Models RAD -W, -S, -V		
Type	Level	Capacity
ESW-M2C83-C	To Bottom of Filler Hole	3.5 Pts. – U.S. (2.6 Pts. – IMP.) (1.7 Litres)

Transmission Component End Play

Component	In Inches
Cluster Gear To Case	.004-.018

Torque Specifications – Model RAD	
Description	Ft-Lb
Input Shaft Bearing Retainer to Case Bolt	11-15
Extension Housing to Case Bolts	18-27
Access Cover to Case Screw	7-10
Filler Plug to Case	15-25
Detent Set Screw (in cover)	8-12
Reverse Pivot Bolt	15-25
Offset Assembly Nut	14-20 ①
Back-up Lamp Switch	8-12
Seat Belt Sensing Switch	8-12

① Assemble with Loctite Thread Adhesive Sealer M4G-157-A Or Equivalent

Gear Ratios – 1978

Engine	Transmission Model	1st	2nd	3rd	4th	Rev.
5.0L (302 CID) V-8	Model RAD-W	2.64	1.89	1.34	1.	2.56
2.3L	Model RAD-S	3.50	2.21	1.43	1.	3.38
2.8L	Model RAD-Y	4.07	2.57	1.66	1.	3.95

SPECIAL SERVICE TOOLS

Tool Number	Description
T70P-7113	Countershaft Dummy Shaft
T60K-7697-A	Extension Housing Bushing Remover
T71P-7095-A	Extension Housing Bushing Installer
T71P-7657-A	Extension Housing Seal Remover
T71P-7095-A	Extension Housing Seal Installer
T71P-7050-A	Input Shaft Seal Installer
T69P-4621-A	Output Shaft Bearing Remover
T71P-4621-B	Output Shaft Bearing Installer
T71P-7140-A	Reverse Idler Shaft Remover
T69P-4621-A	Speedometer Gear Remover
T71P-4621-A	Speedometer Gear Installer
T71P-7A039-A	Speedometer Gear Opening Plug Installer
T70P-7154	Snap Ring Thickness Gauge
T59L-500-A	Transmission Holding Fixture

Tool Number	Description
To Remove Input Shaft Bearing	
T75L-7025-B	Basic Input Shaft Bearing Replacer
T75L-7025-E	Split Collet (Use with T75L-7025-B)
T75L-7025-G	Collar (Use with T75L-7025-B)
T75L-7025-J	Forcing Screw (Use with T75L-7025-B)
To Install Input Shaft Bearing	
T75L-7025-B	Basic Input Shaft Bearing Replacer
T75L-7025-K	Shaft Sleeve Replacer (Use with T75L-7025-B)
T75L-7025-M, -N	Inner Shaft Collar* (Use with T75L-7025-B)
T75L-7025-Q	Dummy Bearing Insert (Use with T75L-7025-B)

*Select fit for appropriate shaft diameter.

CC2769-2E

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Model 78ET Four-Speed Transmission

PART 16-29

Applies to Pinto/Bobcat, Fairmont/Zephyr

SUBJECT	PAGE
DESCRIPTION AND OPERATION	
Transmission	29-1
DISASSEMBLY AND ASSEMBLY	
Transmission	29-7
REMOVAL AND INSTALLATION	
Shift Lever	29-3
Transmission	29-5
SPECIFICATIONS AND SPECIAL SERVICE TOOLS	29-15

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DESCRIPTION AND OPERATION

TRANSMISSION

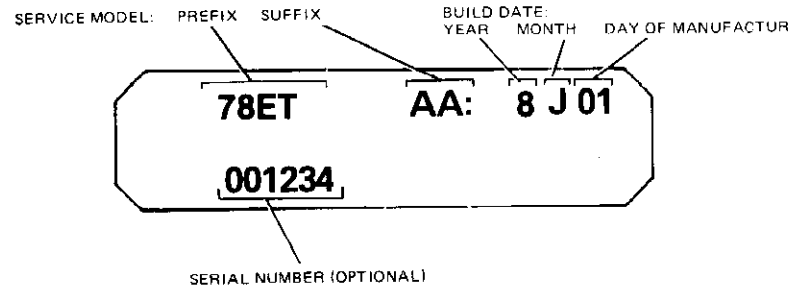
The Model 78ET four-speed transmission is manufactured in Germany. Externally, the transmission can be identified by the identification tag (Fig. 1). This tag is located under the lower left side extension to case retaining bolt.

The Model 78ET four-speed transmission (Fig. 2) is of the fully synchronized type with all gears except the reverse gear being in constant mesh. All forward-speed changes are accomplished through forged blocker ring synchronized units.

The constant mesh gears, that is, the input shaft gear, the three other forward gears on the output shaft, and the corresponding gears on the countershaft gear, are helically cut. The reverse gear on the countershaft gear has straight-cut spur teeth that mesh (through an idler gear) with spur teeth on the outside of the first-second gear synchronizer sleeve.

Gear selection is by means of a floor shift lever (Fig. 3). The shift lever is attached directly to a single selector rail, which has a selector lever assembled to it. Movement of the shift lever, and thereby the selector rail, causes the selector lever to locate in the appropriate selector fork and move it to the required position. Movement of the first-second or third-fourth selector fork causes the appropriate synchronizer sleeve to move as necessary to engage with the dog teeth on the required gear. When reverse gear is required, movement of the reverse selector relay lever draws the reverse idler gear into mesh with the reverse gear on both the countershaft gear and the output shaft.

Engagement of two gears at once is prevented by means of a selector interlock plate pivoted in the transmission case. This plate engages with the selector forks that are not in use and holds them positively in the disengaged position. The selector forks are not attached to the selector rail. The first-second and third-fourth forks, while they are mounted on the rail, are free to slide, when not retained by the interlock plate.



C2999-1C

FIG. 1 Transmission Identification Tag

Gear engagement only takes place when the selector lever locates in the appropriate fork and moves it into the required position.

Selective snap rings compensate for tolerances which must be allowed in manufacture. Excessive end play or backlash can thus be eliminated without unnecessarily close, and expensive, tolerances and fits. Whenever overhauling the gear case, or a part of the case that involves removing a snap ring, be sure to properly install the correct size in brand-new (never used) snap rings (Fig. 4).

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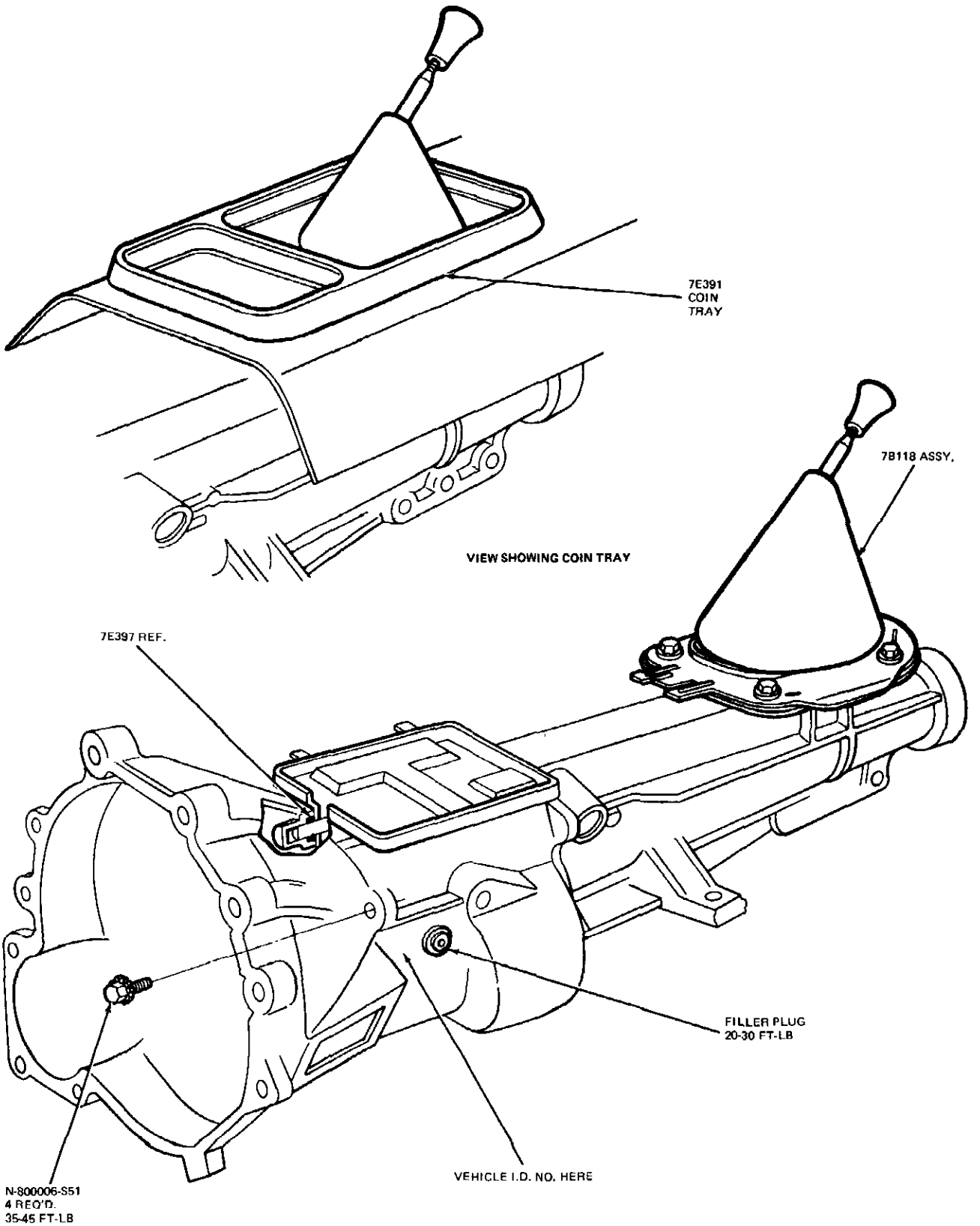
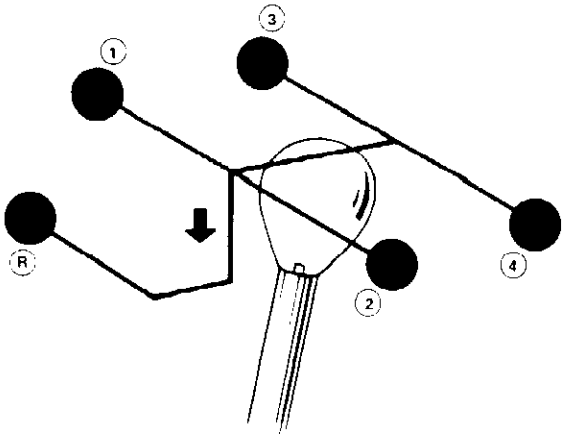


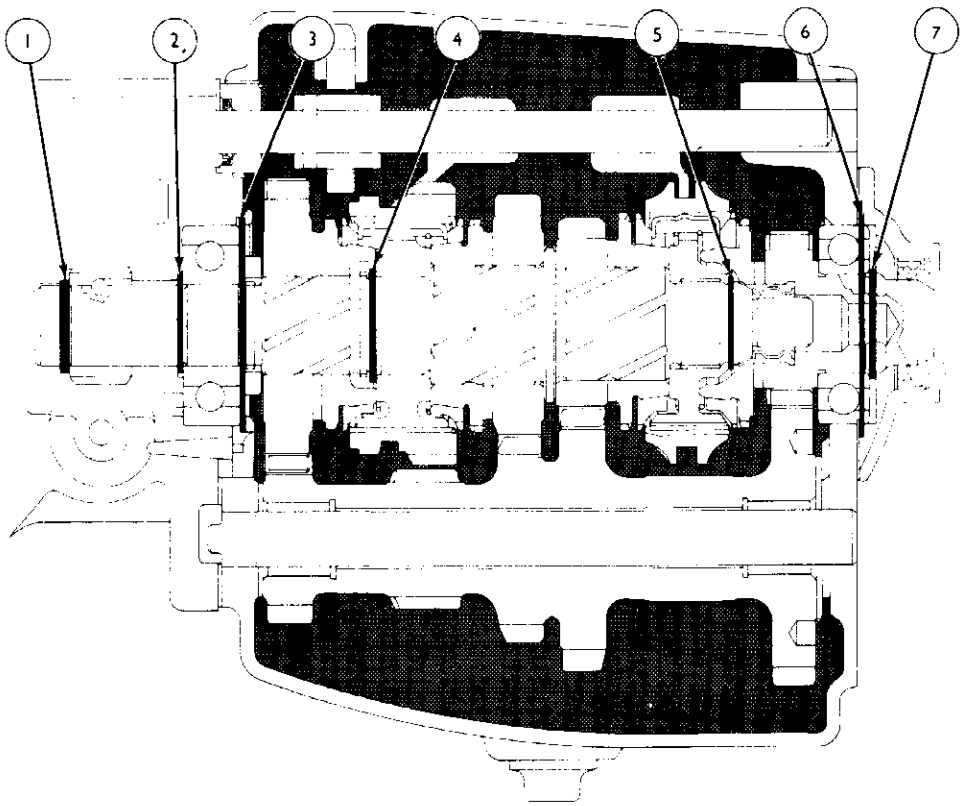
FIG. 2 Model 78ET Transmission Installation—Fairmont/Zephyr

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C2410-1A

FIG. 3 Gear Shift Lever Positions



C2206-2A

FIG. 4 Snap Ring Locations

REMOVAL AND INSTALLATION

SHIFT LEVER

PINTO/BOBCAT

Removal

1. Place the gearshift lever in the neutral position.
2. Raise the vehicle and remove the back-up lamp switch from the extension housing (Fig. 5).
3. Lower the vehicle.
4. Loosen the gearshift lever knob locknut and remove the knob and locknut.
5. Remove the two front attaching screws from each step plate.
6. Remove the attaching screws from each kick pad and remove the pads.

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7. Working from the front, fold the carpet or floor mat up against the shift lever (Fig. 6). Remove the four shift lever boot retaining ring screws. Remove the boot through the opening in the floor mat.
8. Compress the corrugated rubber spring (Fig. 7) then remove the retaining snap ring and slide the spring upward on the lever.
9. Bend the shift lever lock tabs up, then carefully thread the plastic dome nut from the extension housing (Fig. 8).
10. Lift the gear shift lever from the extension housing.

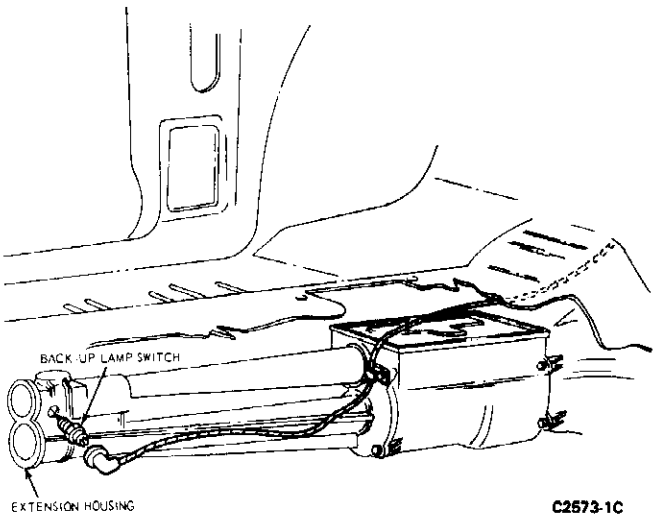


FIG. 5 Removing Back-Up Lamp Switch

Installation

1. Make sure that the shift lever insulator is in a straight downward position on the shift rail.
2. Position the shift lever in the extension housing so that the forked end engages the insulator properly.
3. Carefully thread the plastic dome nut into the extension until it seats, then bend a minimum of three tabs downward to lock it in place.
4. Compress the corrugated rubber spring, then install the retaining snap ring.
5. Install the boot and attaching screws.
6. Position the carpet or floor mat and install the step plates and screws.
7. Install the two kick pads.
8. Install the locknut and shift knob.
9. Check to make sure that the transmission lever operates in all shifts.
10. Raise the vehicle and install the back-up lamp switch.
11. Lower the vehicle.

FAIRMONT AND ZEPHYR

Removal

1. Place the gear shift lever in neutral position.
2. Remove attaching screws at rear of coin tray and lift to release from front hold-down notch on boot retainer. Lift it over the gear shift lever boot.
3. Remove the four capscrews attaching the boot to the floor pan (Fig. 9) and move the boot upward out of the way.

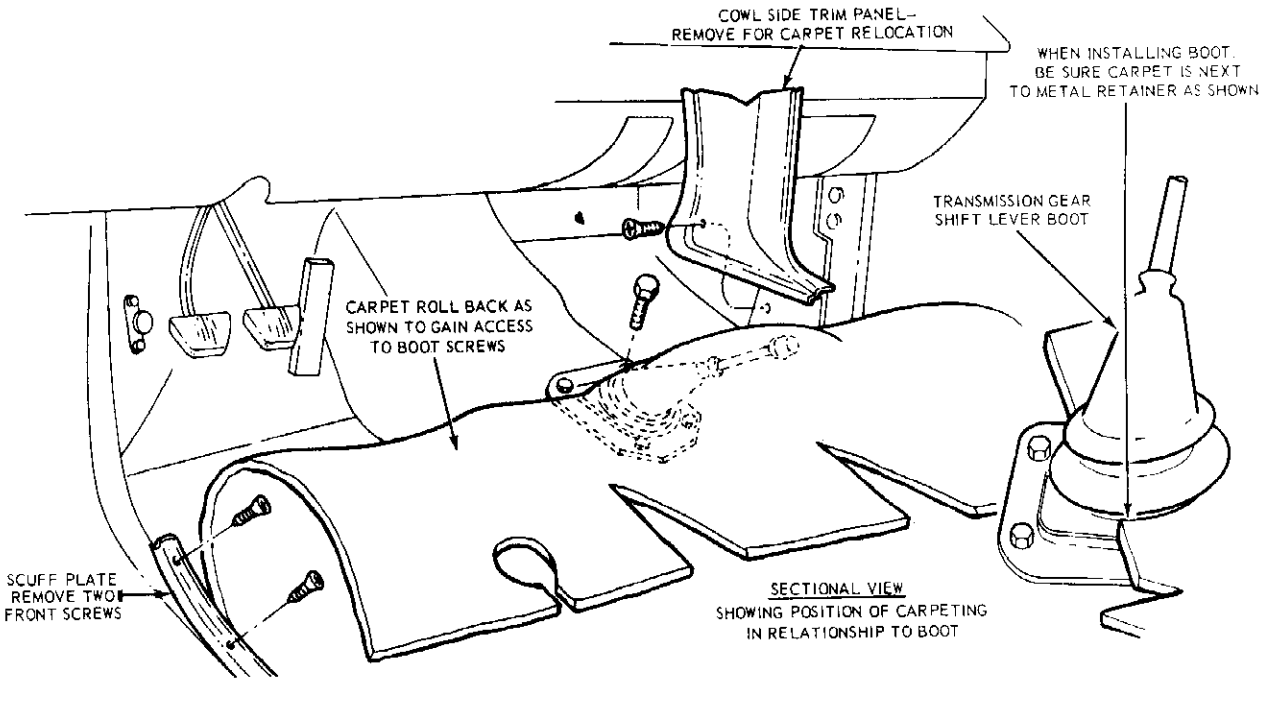


FIG. 6 Shift Lever Boot Removal

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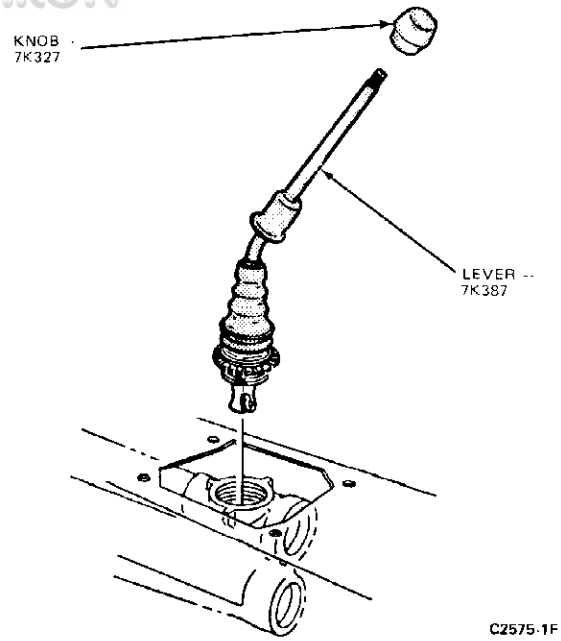


FIG. 7 Shift Lever—Pinto/Bobcat

4. Remove the three lever-attaching bolts (Fig. 9). **Caution: The attaching bolts are Metric (M8).** Remove the lever and boot assembly from the extension housing.
5. Remove the gear shift knob and lock nut and slide the boot off the lever.

Installation

1. Make sure the shift lever insulator is in a straight downward position on the shift rail.
2. Position the shift lever in the extension housing so that the forked ends engage in the insulator properly as in Fig. 7.
3. Install the three metric attaching bolts (M8) and torque to specifications (Fig. 9).
4. Slide the boot over the lever and install the attaching bolts. Torque the bolts to specifications (Fig. 9).
5. Install the gear shift knob and adjust as shown in Fig. 10.
6. Position the coin tray (Fig. 2) over the shift lever boot.
7. Secure the tray to front notch on boot retaining ring and attach at rear with screws.

TRANSMISSION

Removal

1. Remove the shift lever following directions above.
2. Working from under the hood, remove upper bolts (or stud nuts) that attach flywheel housing to engine.
3. Raise the vehicle on a hoist.
4. Mark the position of the driveshaft relative to the axle companion flange. Remove the driveshaft and install Tool T71P-7095-A in the extension housing to prevent lubricant leakage.
5. Remove the clutch release lever dust cover.

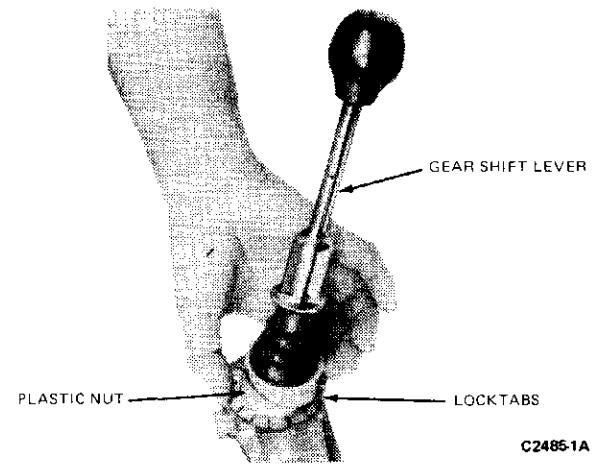


FIG. 8 Removing or Installing Shift Lever—Pinto/Bobcat

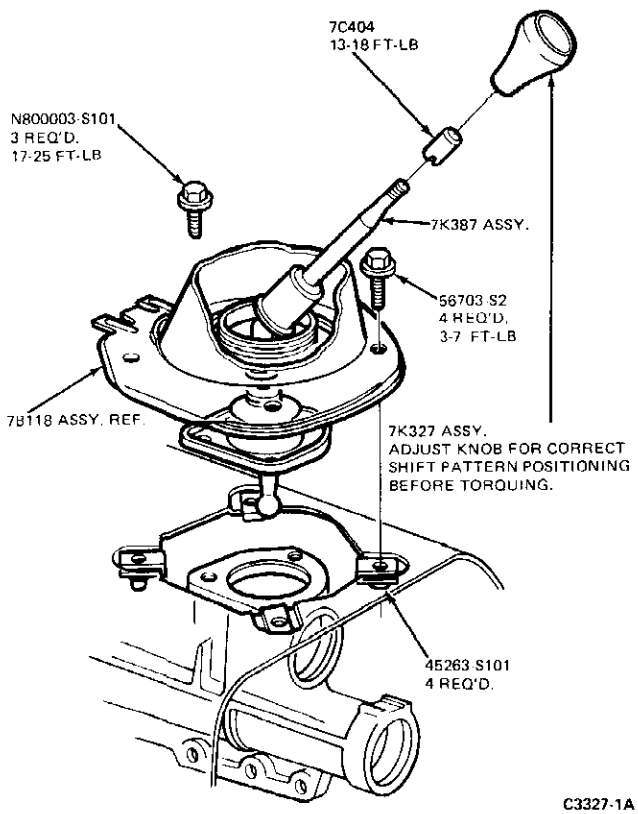


FIG. 9 - Removing and Installing Gear Shift Lever—Fairmont and Zephyr

6. Disconnect the clutch release cable from the release lever.
7. Remove the starter motor attaching bolts and place the starter to one side.
8. Remove the speedometer cable attaching screw and lift the cable from the extension housing.
9. Support the rear of the engine with a jack and remove the bolts that attach the crossmember to the body (Figs. 11 and 12).
10. Remove the bolt (or bolts) that attaches crossmember to extension housing, and remove the crossmember.

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11. Lower the engine as required to permit removal of bolts that attach the flywheel housing to the engine. Slide the transmission away from the engine and from under the vehicle.

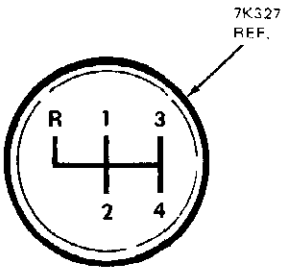
NOTE: On Fairmont/Zephyr vehicles, it may be necessary to slide the mounting bracket forward from the catalytic converter heat shield in order to move the transmission rearward far enough to remove it.

12. Remove the cover attaching bolts and drain the lubricant into a container.
13. Remove the bolts that attach flywheel housing to transmission case and remove the housing.

Installation

1. Install a new shift rod seal in the flywheel housing (if the old seal is damaged).
2. Position flywheel housing on transmission case, and install and torque the attaching bolts to specification.
3. Install the clutch release lever and bearing.
4. Make certain that machined surfaces of flywheel housing and engine are free of dirt and foreign material.
5. Apply a film of C4AZ-19584-A lubricant or equivalent to the input shaft bearing retainer. Position the flywheel housing and transmission assembly on the engine block. **It may be necessary to place the transmission in gear and rotate the output shaft to align the input shaft and clutch splines.**
6. *Slide the flywheel housing firmly and squarely onto* the locating dowels, to be sure of a positive engagement. Then, holding the flywheel housing firmly in position on the dowels, thread the attaching bolts through the hollow portion of the dowels and into the housing. Torque the bolts to specification.
7. Install and torque the center attaching bolts.
8. Lower the vehicle and install the two upper attaching bolts or stud nuts. Torque to specification. Install the shift lever (and carpet on Pinto/Bobcat) following directions under Shift Lever Installation.
9. Raise the vehicle. Raise the engine until the transmission is in its normal position. Secure the crossmember to the body with the attaching bolts, and torque to specification. Install the bolt that attaches crossmember to extension housing, and torque to specification.

   On Fairmont/Zephyr vehicles, position the catalytic converter heat shield mounting bracket to the transmission mount.
10. Remove Tool T71P-7095-A, install the speedometer cable and torque the attaching screw to specification.
11. Position the starter, install the attaching bolts, and torque to specification.
12. Apply grease to the ball end of the clutch release cable and connect it to the release lever. Install the clutch release fork dust cover.



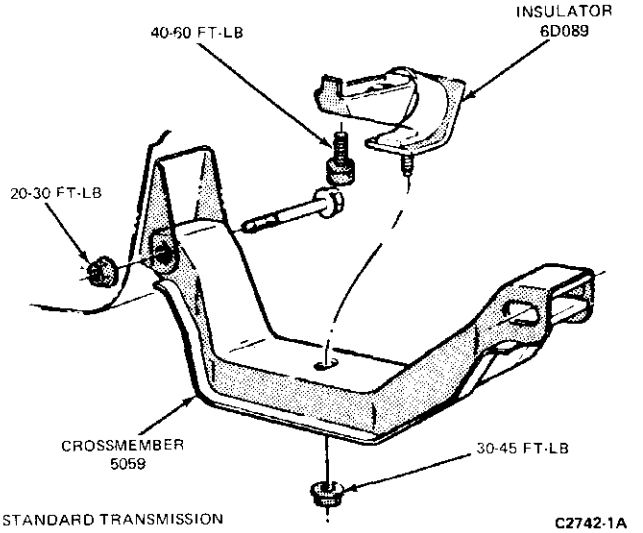
INSTALLATION OF SHIFT KNOB

WITH LEVER IN NEUTRAL POSITION, INSTALL LOCKING NUT 7C404 UNTIL HAND TIGHT. THEN INSTALL KNOB 7K327 UNTIL HAND TIGHT. BACK KNOB OFF UNTIL SHIFT PATTERN ALIGNS WITH THE ℄ OF DRIVE LINE. TIGHTEN LOCKING NUT 13-18 FT-LB. NO THREADS SHALL BE VISIBLE AFTER NUT HAS BEEN TIGHTENED. SHIFT PATTERN ALIGNMENT MUST BE WITHIN ± 15° OF ℄ OF DRIVE LINE.

STD. KNOB

C3328-1A

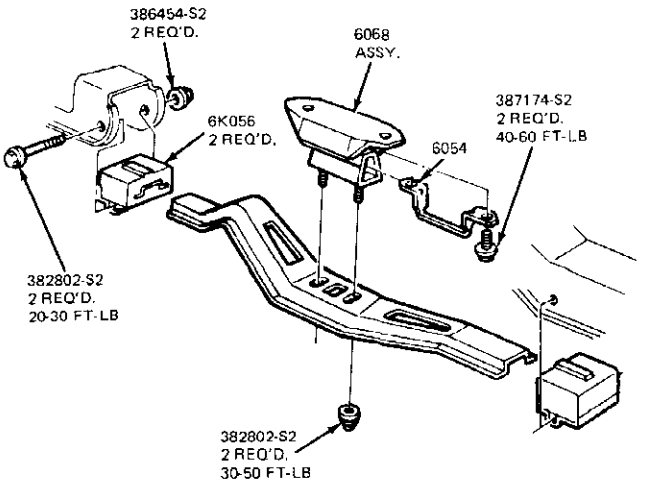
FIG. 10 - Installing Gear Shift Knob



STANDARD TRANSMISSION

C2742-1A

FIG. 11 Engine Rear Mount—Pinto/Bobcat



C3329-1A

FIG. 12 Engine Rear Mount—Fairmont/Zephyr

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13. Install the driveshaft, making sure that it is connected to the pinion flange in its original position.
14. Fill the transmission with the specified lubricant until it appears at the bottom of the filler plug hole. Install the filler plug and torque to specification.
15. Install the back-up lamp switch and connect the wire to the switch.
16. Lower the vehicle to the ground.
17. Check the transmission for proper operation.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Disassembly

1. Remove the clutch release bearing and lever. Remove the clutch housing attaching bolts and remove the housing.
2. Remove the cover attaching bolts with a 10mm wrench. Remove the cover and the gasket from the case and remove the lubricant.
3. Remove the threaded plug, spring, and the shift rail detent plunger from the front of the transmission case (Fig. 13).
4. Drive the access plug from the rear of the case (Fig. 14). Drive the interlock plate retaining pin from the case as shown in Fig. 15. Lift the interlock plate from the case.
5. Remove the roll pin (Fig. 14) from the selector lever arm.
6. Tap the front end of the shift rail to displace the plug at the rear of the extension housing.
7. Withdraw the shift rail from the extension housing and case as shown in Fig. 16.
8. Lift the selector arm and the shift forks from the case.

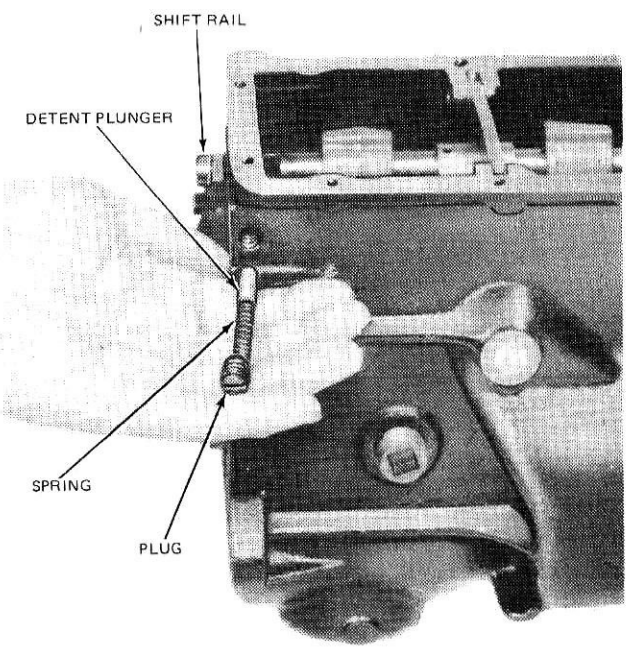


FIG. 13 Removing or Installing Shift Rail Detent Plunger

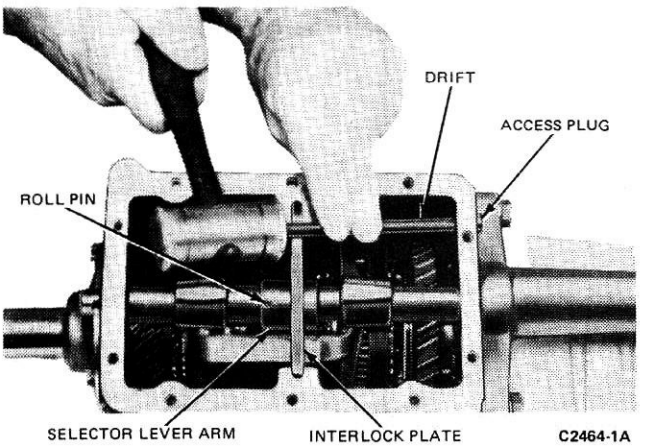


FIG. 14 Removing Interlock Plate Access Plug

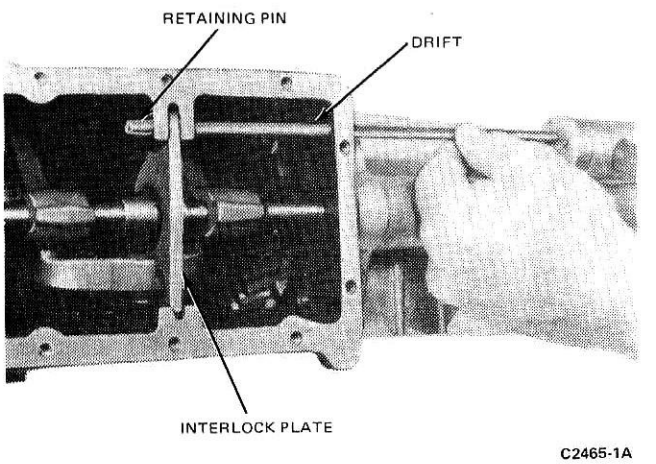


FIG. 15 Removing Interlock Plate Retaining Pin

9. Remove the four extension housing attaching bolts. Tap the extension housing with a plastic hammer to loosen it from the case so that it may be rotated.
10. Rotate the housing to align the countershaft with the cutaway in the extension housing flange. Using a brass drift, drive the countershaft rearward until it just clears the front of the case. Install the dummy shaft T71P-7111-B in the case and gear until the countershaft gear can be lowered to the bottom of the case, then remove the countershaft.
11. Lift the extension housing and mainshaft from the case as an assembly (Fig. 17).
12. Remove the four 10mm input shaft bearing retainer attaching bolts. Remove the input shaft bearing and bearing retainer from the case as an assembly.

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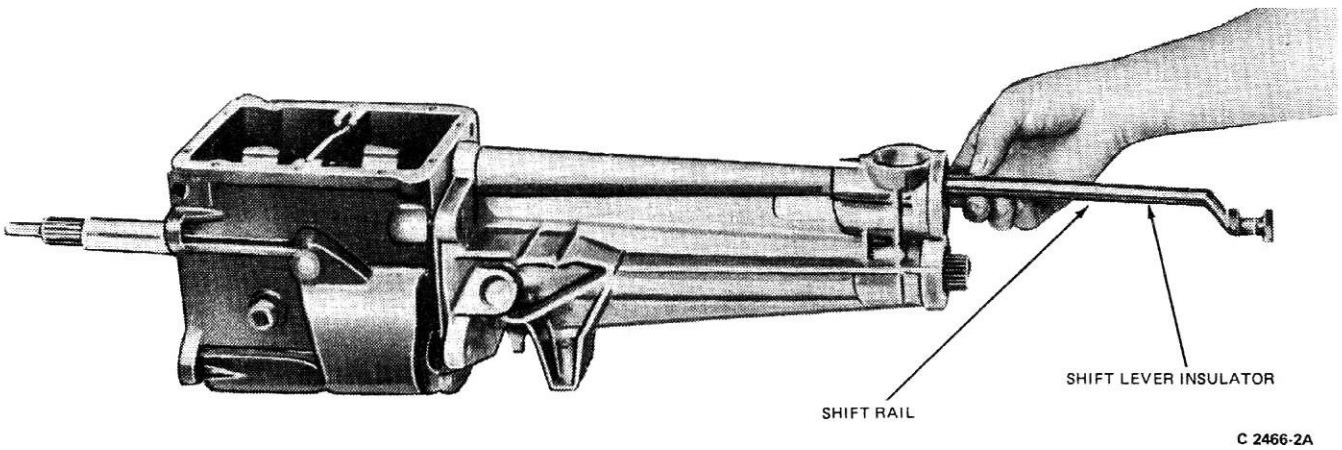


FIG. 16 Removing or Installing Shift Rail

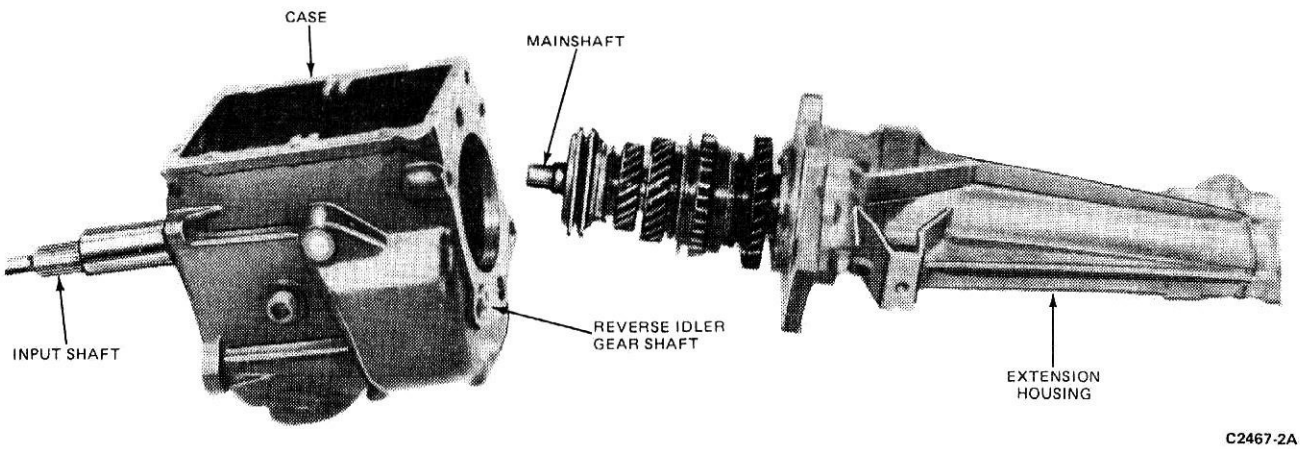


FIG. 17 Removing or Installing Extension Housing and Mainshaft

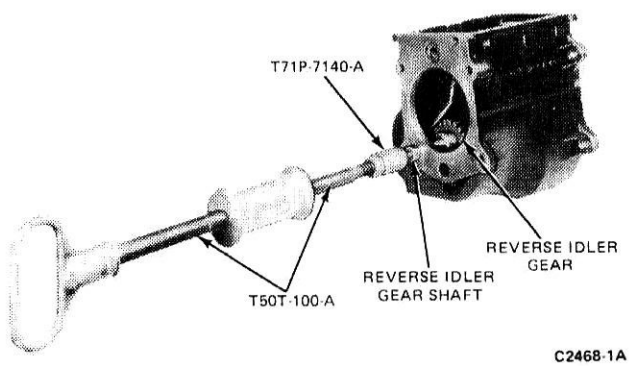


FIG. 18 Removing Reverse Idler Gear Shaft

13. Remove the reverse idler gear shaft from the rear of the case as shown in Fig. 18. Remove the reverse idler gear, and spacer.
14. Remove the countershaft gear. Remove the bearing retaining washers, (Fig. 19) bearings, and dummy shaft from the countershaft gear.
15. Remove the bearing retainer and the pilot bearing from the input shaft gear.
16. **Do not remove the ball bearing from the input shaft unless replacement is necessary.** To do so, remove the snap ring from the input shaft (Fig. 20). Press the shaft out of the ball bearing as shown in Fig. 21.
17. Pry the input shaft seal (Fig. 20) out of the bearing retainer.
18. Lift the fourth gear blocker ring (Fig. 18) from the front of the output shaft.
19. Remove the snap ring from the forward end of the output shaft and discard it.
20. Slide the third-fourth speed synchronizer assembly and third gear off the output shaft. Remove the snap ring and washer, then slide the second gear and blocker ring off the output shaft. Discard the snap ring.
21. Scratch or etch alignment marks on the hub and sleeve of the synchronizer before disassembly. Disassemble the synchronizer assembly by pulling the sleeve off the hub and removing the inserts and springs.
22. Remove the snap ring that retains the output shaft bearing in the extension housing (Fig. 22).
23. Press or tap the output shaft assembly out of the extension housing with a plastic hammer.
24. Remove the snap ring retaining the output shaft bearing to the output shaft.

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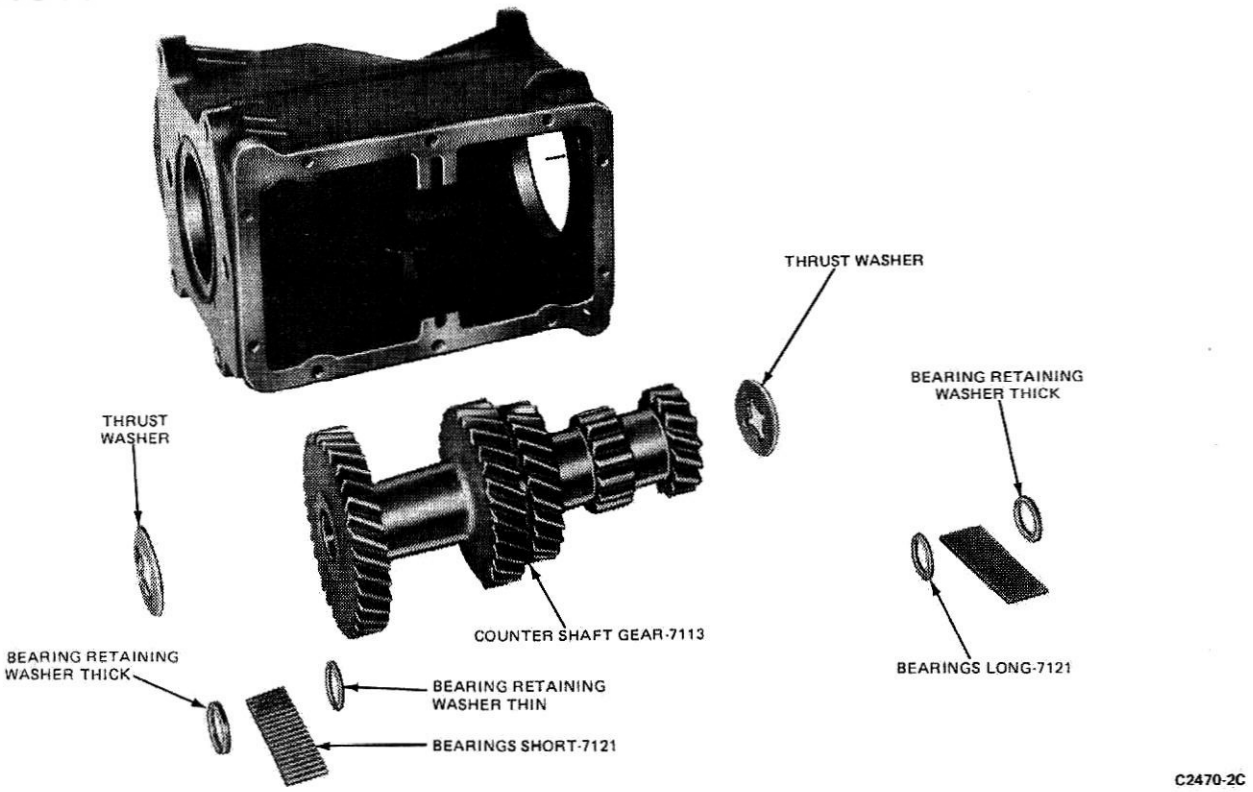


FIG. 19 Countershaft Gear Disassembled

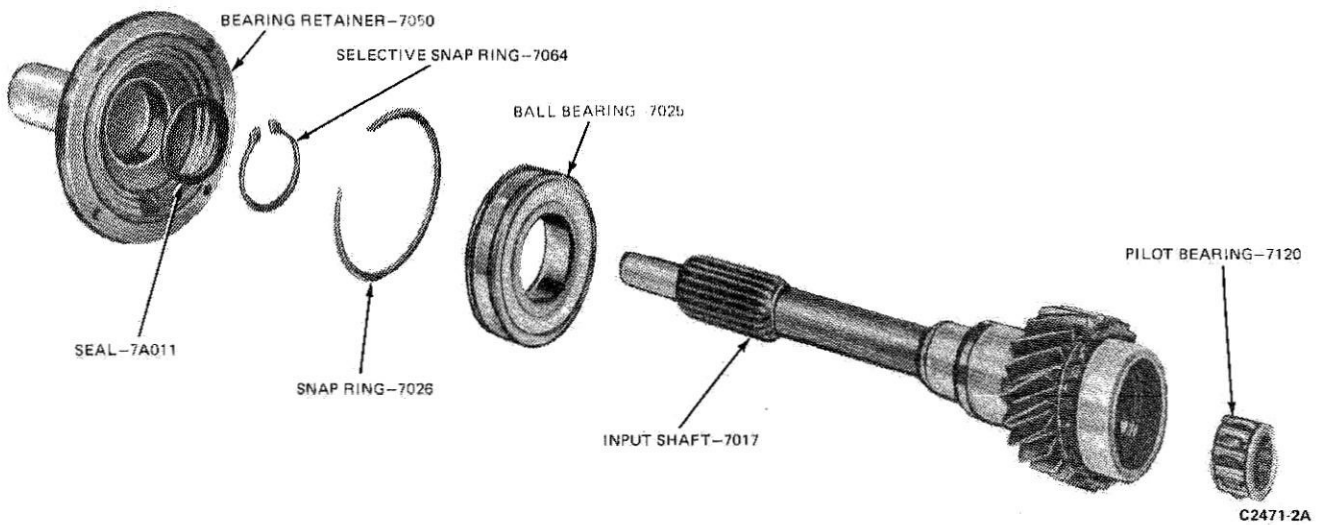


FIG. 20 Input Shaft Disassembled

25. Press the speedometer gear off the shaft.
26. Position Tool T69P-4621-A behind the first gear, then place the assembly in a press.
27. Press the first gear, spacer, and output shaft bearing off the output shaft.
28. The first- and second-speed synchronizer and hub is serviced only as an assembly, with the output shaft. Therefore no attempt should be made to separate the hub from the shaft.

    The sleeve, springs, and inserts may be removed from the hub after scratching or etching alignment marks on the hub and sleeve. The only parts that can be serviced are the springs and inserts. If the hub or sleeve is worn or damaged, the shaft and synchronizer must be replaced as an assembly.
29. Drive the shift rail bushing from the rear of the extension housing with a 9/16-inch socket and extension. **Do not remove the bushing if serviceable.**
30. Pry the shift rail seal from the rear of the transmission case.
31. Remove the remaining shift linkage from the case.

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Assembly

1. Seat the new shift rail seal in the rear of the transmission case as shown in Fig. 23.
2. If the shift rail bushing was removed from the extension housing, drive a new one into place with a 9/16-inch socket wrench and extension.
3. If the first- and second-speed synchronizer (Fig. 22) has been disassembled, slide the sleeve over the hub making sure that the shift fork groove is toward the front of the shaft. **The sleeve and hub are select fit and must be reassembled with the etch marks in the same relative location (Fig. 22).** Locate an insert in each of the three slots cut in the hub. If a new synchronizer and shaft is being used, clean all traces of preservative from the hub, sleeve, inserts and springs. Oil all parts at time of assembly. Install an insert spring inside the synchronizer sleeve beneath the inserts. The tab on the end of the spring must locate in the U-section of an insert. Fit the other spring to the opposite face of the synchronizer unit, being sure that the spring tab locates in the same insert as the spring just installed and is in the opposite rotational direction (Fig. 24).
4. Assemble a blocker ring on the first gear side of the first- and second-speed synchronizer (Fig. 22). Apply C3RZ-19C547-B lubricant or equivalent to the cone surface of the first gear, and all output shaft gear journals before installing the gear on the shaft. Slide the first gear onto the output shaft so that the cone surface engages the blocker ring.
5. Position the spacer on the shaft making certain that the larger diameter is toward the rear of the shaft.
6. Place the master spacer Tool T70P-7154 in the output shaft bearing bore of the extension housing (Fig. 25). Determine the thickness of the snap ring required to remove all end play from the master gauge. Then measure the width of the output shaft bearing outer race with a micrometer. The difference in thickness between the master gauge and the bearing outer race will determine the thickness of the selective snap ring which will finally be used to eliminate end play. If the bearing race thickness is more than that stamped on the master gauge, the snap ring thickness must be decreased by that closest to the available snap ring (Fig. 26). If the thickness is less, the snap ring thickness must be increased. (Rings should be checked with a micrometer to verify thickness.)
7. Position the selected snap ring and the bearing on the output shaft. Position Tool T71P-4621-B on the shaft, then place the assembly in a press. Press the bearing into place. Secure the bearing with the thickest snap ring that will fit the groove in the output shaft.
8. Position the second gear and blocker ring on the output shaft so that the dog teeth face rearward. Install the washer and snap ring. Position the third gear on the output shaft so that the dog teeth face forward. Apply C3RZ-19C547-B lubricant or equivalent to the cones of the gears. Assemble the blocker ring on the third gear cone, making sure that lubricant has been applied to

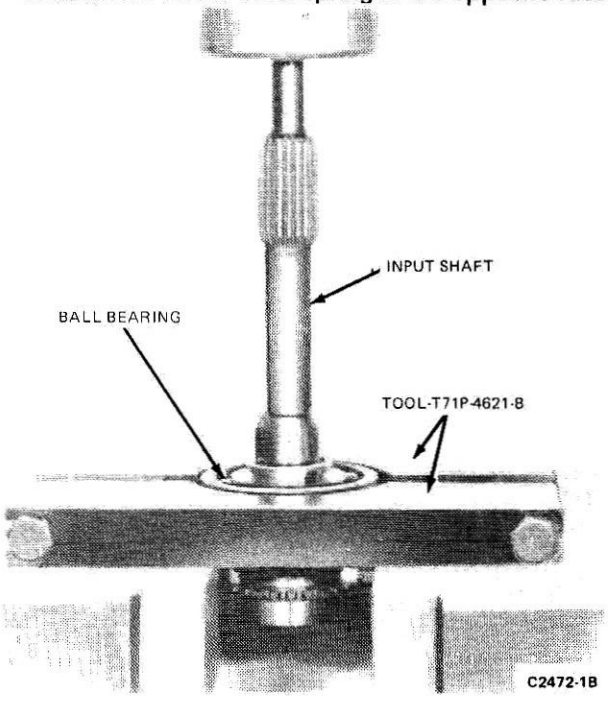


FIG. 21 Removing Input Shaft Bearing

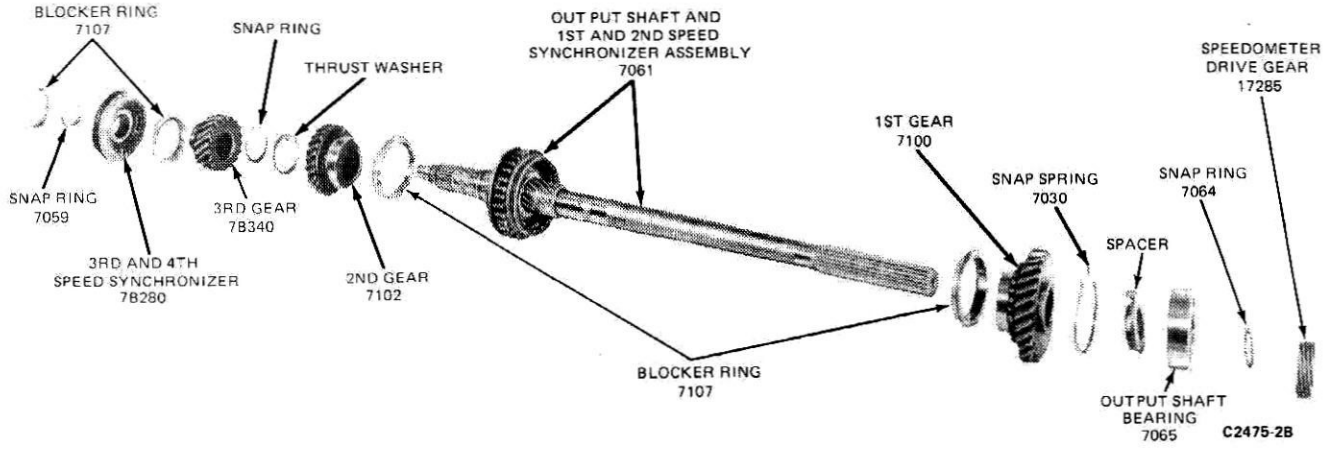


FIG. 22 Output Shaft Disassembled

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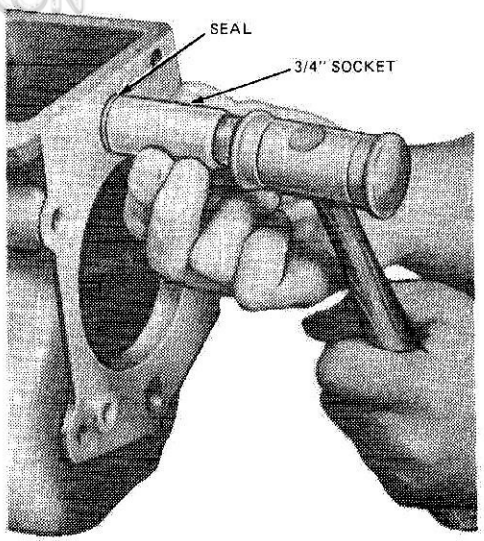


FIG. 23 Installing Shift Rail Seal

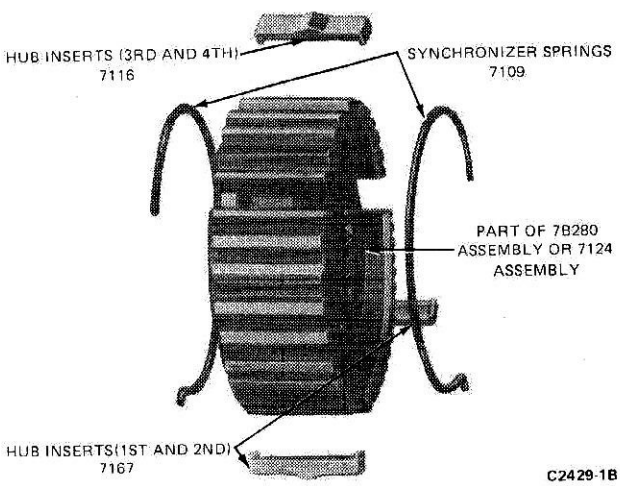


FIG. 24 Synchronizer Spring Installation

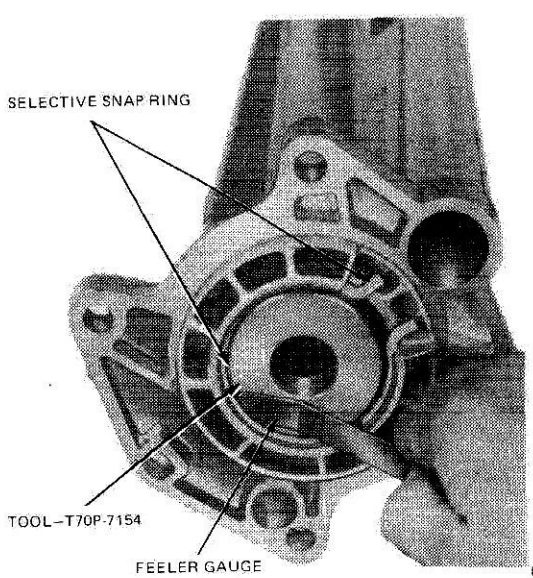


FIG. 25 Determining Snap Ring Thickness

the output shaft gear journals prior to installation of all gears.

9. Position the third-fourth synchronizer assembly on the output shaft with the hub boss (small diameter) facing forward.
10. Retain the third-fourth synchronizer assembly to the output shaft with a snap ring. Pull up on the synchronizer assembly so that the snap ring is tight in its groove.
11. Apply C3RZ-19C547-B lubricant or equivalent to the cone of the input shaft gear and place the fourth gear blocker ring on the gear cone.
12. Press the speedometer drive gear onto the shaft with Tool as shown in Fig. 27 until the dowels just contact the bearing outer race. **The dowels must contact the bearing outer race to properly locate the speedometer drive gear on the shaft.**
13. Coat the bearing bore of the extension housing with C4AZ - 19584 - A grease or equivalent. Install the output shaft in the housing. It may be necessary to tap the shaft with a plastic hammer while holding the two

Part No.	Thickness	Identification
D1FZ-7030-A	0.0679	Color Coded – Copper
D1FZ-7030-B	0.0689	Letter – W
D1FZ-7030-C	0.0699	Letter – V
D1FZ-7030-D	0.0709	Letter – U
D1FZ-7030-E	0.0719	None
D1FZ-7030-F	0.0728	Color Coded – Blue
D1FZ-7030-G	0.0738	Color Coded – Black
D1FZ-7030-H	0.0748	Color Coded – Brown

CC1004-1A

FIG. 26 Output Shaft Bearing Snap Ring Thickness

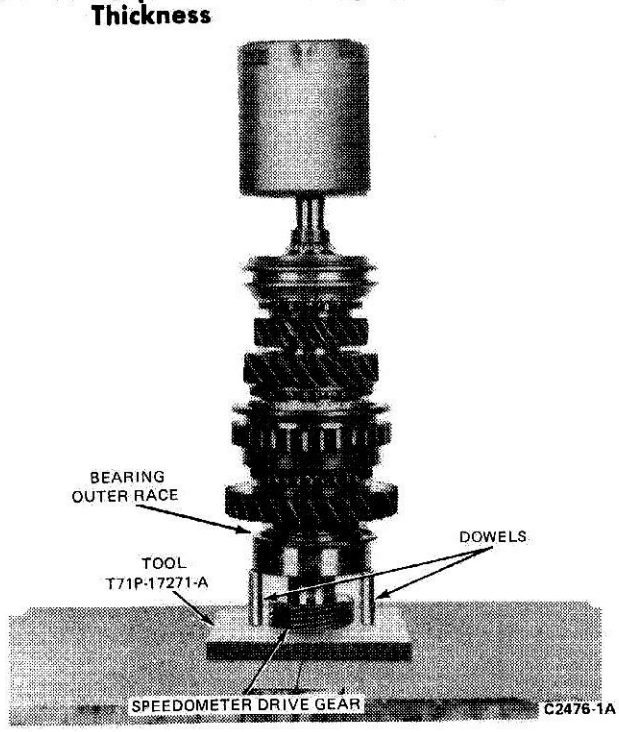


FIG. 27 Installing Speedometer Drive Gear

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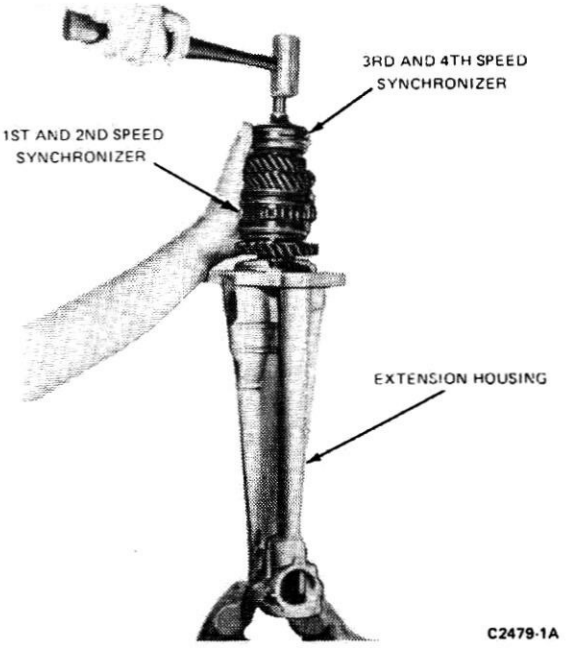


FIG. 28 Installing Output Shaft in Extension Housing

synchronizer sleeves firmly (Fig. 28) to prevent sleeve separation from the hubs. Secure it to the extension housing with the selective snap ring that was previously installed.

14. Press the bearing on the input shaft making sure that the snap ring groove is toward front end of shaft. Secure the bearing to the shaft with the thickest selective snap ring (Fig. 20).
15. Slide the dummy countershaft into the countershaft gear. Position a bearing retaining washer at each end of the dummy shaft. Coat the 42 bearings with lubricant. Load the 21 long bearings in the small end of the gear and the 21 short bearings in the large end of the gear (Fig. 29). Fit a retaining washer over each end of dummy shaft. Coat each thrust washer with grease and position one on each end of the dummy shaft. Make sure that the tabs are in the same relative position so they may engage the slots provided in the case when the gear is lowered into place. Loop a piece of rope or wire around each end of the gear (Fig. 30). Carefully install the countershaft gear and rope through the rear end of the case. Lower the gear into place being careful not to disturb the thrust washers and making sure that the tabs engage the slots in the case.
16. Apply C3RZ-19C547-B lubricant or equivalent to the reverse idler gear shaft. If the reverse selector relay lever was removed, position it on the pivot pin. Secure the lever on the pin with a spring clip. Hold the gear in the lever with the long hub toward the rear of the case (Fig. 31). Slide the reverse idler gear shaft into place, and install spacer. Seat the shaft in the case with a copper hammer.
17. Assemble the input shaft to the transmission case (covered in Step 28). If necessary, tap the outer race of the bearing with a copper hammer evenly and alternately until the outer snap ring is seated against the case. **Do not tap on the input shaft. Tapping the input shaft will result in the load passing through the bearings and may damage the races and/or bearings.**

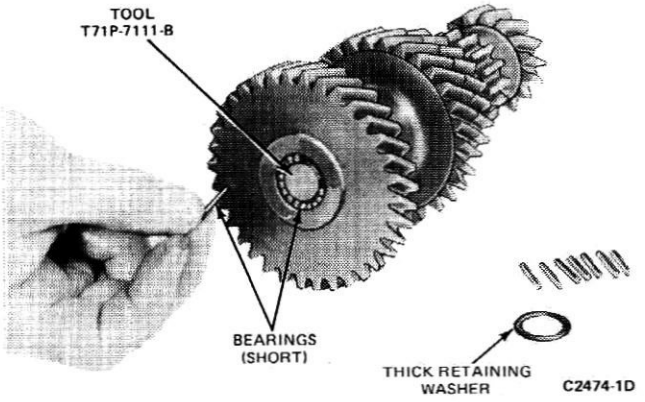


FIG. 29 Assembling Countershaft Gear

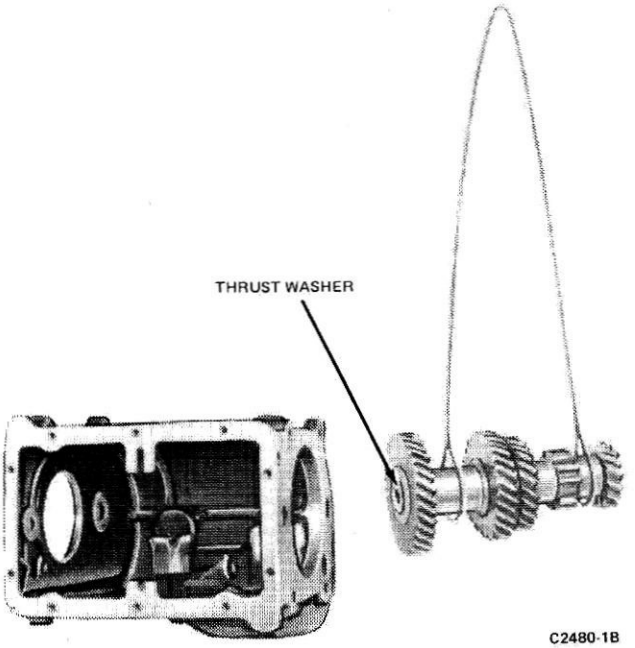


FIG. 30 Removing or Installing Countershaft Gear

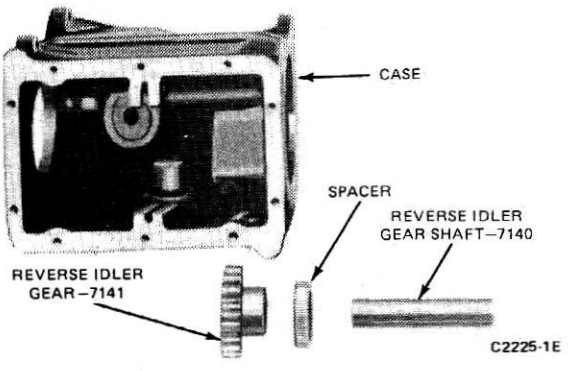


FIG. 31 Reverse Idler Gear Disassembled

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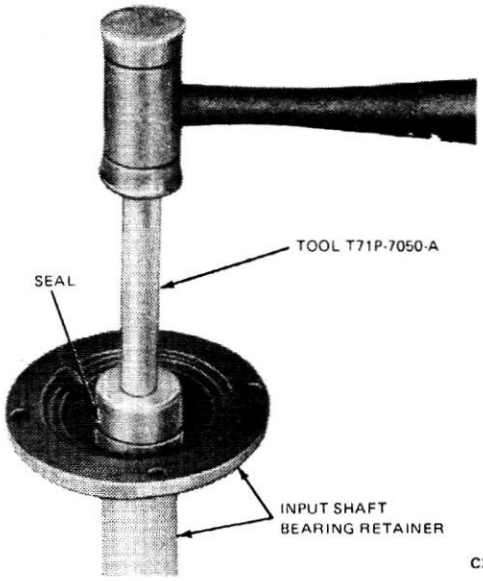


FIG. 32. Installing Bearing Retainer Seal

18. Position a new gasket on the extension housing.
19. Make certain that the input shaft pilot bearing is lubricated and installed in the shaft. Slide the extension housing and output shaft into place being careful not to disturb the third- and fourth-speed synchronizer.
20. Align the cutaway in the extension housing flange with the countershaft bore in the rear of the transmission case.
21. Lift the countershaft gear into place with the cord or wire previously installed, then slip the countershaft into position making sure that both thrust washers are in place. Make sure that the flat on the countershaft is toward the top of the case and in a horizontal position (Fig. 34), then tap it into the case with a brass hammer until the front of the shaft is flush with the case.
22. Rotate the extension housing to align the bolt holes, then install the attaching bolts loosely. Prior to tightening the extension housing bolts, make sure that the shift rail slides freely in the bore. If it binds, rotate the extension housing slightly to free the rail, then push the housing into the case. Apply sealer to the four attaching bolts. Torque the bolts to specifications making sure that the housing does not interfere with the reverse idler or countershafts.
23. Place the shift forks in the synchronizer sleeves. Position the interlock lever and install a new retaining pin. Lubricate shift rail oil seal and slide the shift rail through the extension housing, transmission case and the first- and second-speed shift fork. Position selector arm on the rail, then slide the rail through the third- and fourth-speed shift fork, then through the front of the case until the center detent is aligned with the detent plunger bore. Install a new retaining pin in the selector arm.
24. Install the detent plunger, spring, and plug with sealer as shown in Fig. 13.
25. Install a new access plug in the rear of the case (Fig. 35), if required.

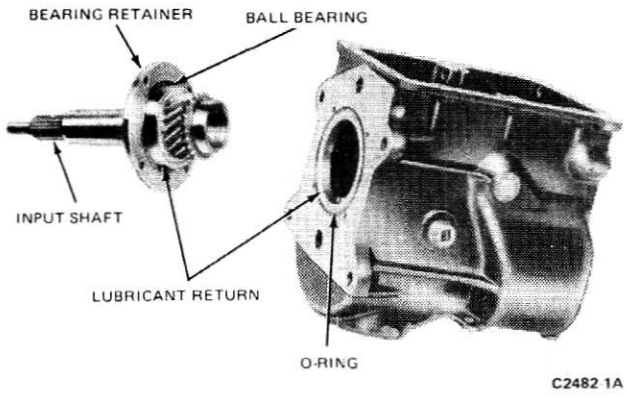


FIG. 33 Installing Input Shaft Gear

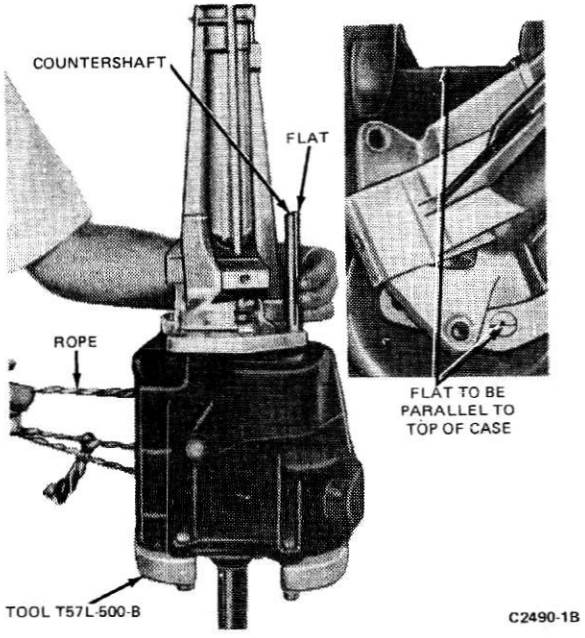


FIG. 34 Installing Countershaft

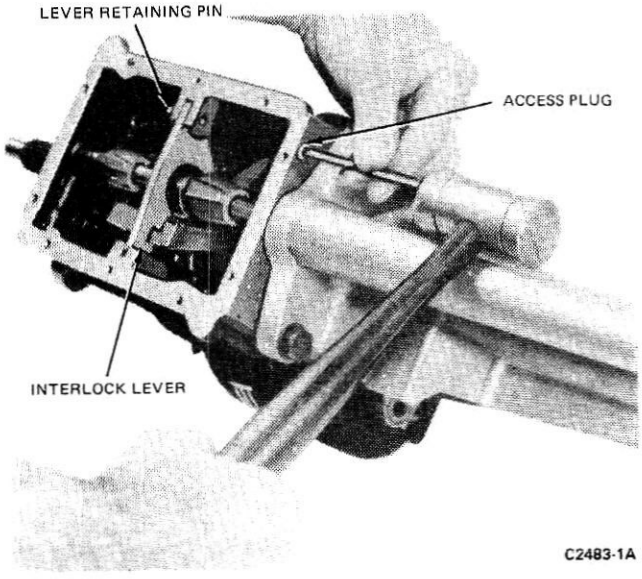


FIG. 35 Installing Interlock Lever Access Plug

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26. Position a new oil seal on Tool T71P-7050-A (Fig. 32) so that the tension spring and the lip of the sealing element face in the direction of the transmission case.

27. Drive the seal into the retainer until it bottoms.

28. Position a new O-ring in the groove in the face (Fig. 33) of the transmission case. Apply C3RZ-19C547-B lubricant or equivalent to input shaft seal journal area. Exercise care when installing the retainer to prevent damage to the seal lip. Position the input shaft bearing retainer to the transmission case. Be sure that the oil groove in the retainer is in line with the oil passage in the transmission case. Apply sealer to the four attaching bolts and washers, but do not tighten them at this time. Install the flywheel housing and torque the attaching bolts to specification. Torque the transmission front bearing retainer attaching bolts to specification.

29. Lightly coat the machined area of the front bearing retainer with C3RZ-19C547-B or equivalent grease.

30. Reinstall the clutch release arm and bearing.

31. Apply sealer to a new extension housing plug and install it with Tool No. T70P-6011-A as shown in Fig. 36.

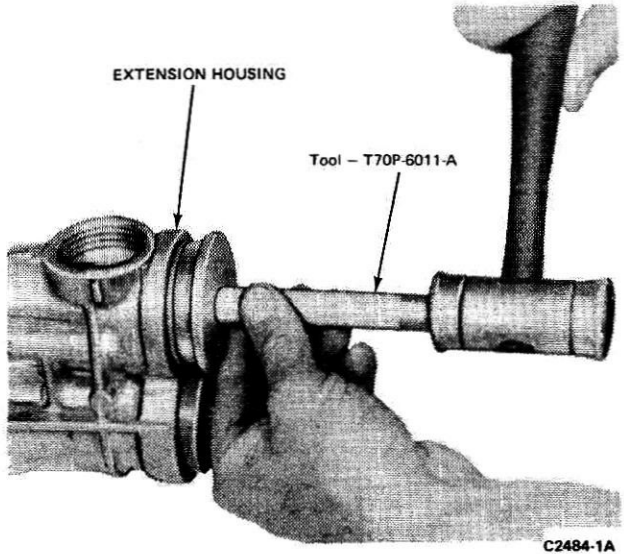


FIG. 36 Installing Extension Housing Plug

32. Place a new cover gasket on the case, with the vent toward the rear. Apply sealer to the threads of the left front cover attaching bolt, to seal the bolt hole that aligns with the detent plunger hole. Install and torque the ten attaching bolts to specification.

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SPECIFICATIONS

MODEL 78ET TRANSMISSION

Transmission Lubricant		
Type	Level	Capacity
ESW-M2C83-C	To Bottom of Filler Hole	2.8 Pts. U.S. 2.3 Pts. IMP. 1.3 Litres

Torque Specifications	
Description	Ft-Lb
Input Shaft Bearing Retainer to Case Bolt	8-10
Extension Housing to Case Bolt	33-36
Cover to Case Screw	8-10
Filler Plug to Case	24-27
Detent Plug	12-14

Transmission Component End Play

Component	In Inches
Cluster Gear To Case	.006-.018

SPECIAL SERVICE TOOLS – MODEL 78ET – TRANSMISSION (PINTO AND BOBCAT)

Tool Number	*Description*
T74P-7111-B	Countershaft Dummy Shaft
T70P-7149	Extension Housing Bushing Remover
T70P-7095	Extension Housing Bushing Installer
T71P-7657-A	Extension Housing Seal Remover
T70P-7095	Extension Housing Seal Installer
T71P-4621-A	Input Shaft Bearing Remover
T71P-4621-B	Input Shaft Bearing Installer
T71P-7050-A	Input Shaft Seal Installer
T71P-4621-A	Output Shaft Bearing Remover
T71P-4621-B	Alternate Output Shaft Bearing Remover
T71P-7025-A	Output Shaft Bearing Installer
T70P-7154	Snap Ring Thickness Guage

GEAR RATIOS – 1978

Engine	*Transmission*	*1st*	*2nd*	*3rd*	*4th*	*Rev.*
2.3 Litre Fairmont/ Zephyr ①	78ET-7003-BA	3.98:1	2.14:1	1.42:1	1:1	3.99:1
2.3 Litre Pinto/Bobcat Sedan ②	78ET-7003-AA	3.98:1	2.14:1	1.42:1	1:1	3.99:1
2.3 Litre Pinto/Bobcat S/W 2.3 Litre Pinto/Bobcat Sedan ③	78ET-7003-CA	3.65:1	1.99:1	1.37:1	1:1	3.66:1

① With 3.08 Axle ② With 2.73 Axle ③ With 3.18 Axle

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Four-Speed Overdrive Transmission

PART 16-30

Applies To Granada/Monarch

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ADJUSTMENTS	
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Floor-Mounted Shift Control	30-3
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CC3524-2A

DESCRIPTION

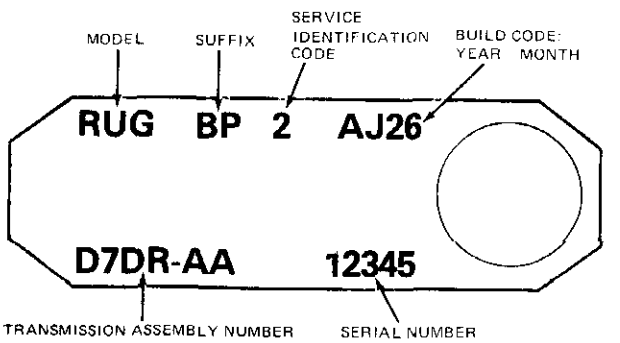
TRANSMISSION

The 4-speed overdrive transmission (Fig. 2) is of the fully synchronized type with all gears except the reverse sliding gear being in constant mesh. All forward-speed changes are accomplished with synchronizer sleeves.

All forward-speed gears in the transmission are helical-type. However, the reverse sliding gear and the external teeth of the first- and second-speed synchronizer sleeve are spur-type. The specifications section lists the transmission model numbers and vehicles in which they are used.

A transmission service identification tag is located on the right side of the case at the front (Fig. 1). The first line on the tag will show the transmission model and service identification code when required. The second line will show the transmission serial number. Additionally, a serial number is stamped on the top side of the flange on the case for further identification.

The four-speed transmission shift control unit is serviced on a limited basis only. **It is not to be disassembled. The only parts to be removed from it are the shift lever, shift lever knob, back-up light** switch retainer and back-up lamps switch (Fig. 2).



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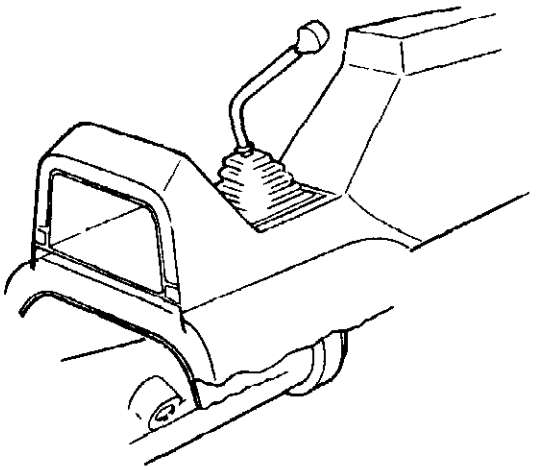
FIG. 1 Transmission Identification Tag

The shift pattern for the control unit is imprinted on the shift lever knob (Fig. 3). An automatically adjusted back-up lamps switch is installed in an indexing retainer at the lower rear portion of the shift control assembly.

ADJUSTMENTS

FOR SHIFT LINKAGE ADJUSTMENT REFER TO THE INSTRUCTIONS GIVEN IN FIG. 2

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INSTALLATION FOR MODELS WITH CONSOLE

LINKAGE ADJUSTMENT PROCEDURE

1. ATTACH SHIFT RODS TO TRANSMISSION LEVERS.
2. SHIFT THE REVERSE (MIDDLE) LEVER CLOCKWISE TO PUT THE TRANSMISSION IN REVERSE.
3. INSERT THE ALIGNMENT PIN THROUGH THE HOLE IN THE BOOT AND INTO THE SHIFT CONTROL ASSEMBLY ALIGNMENT HOLE.
4. ATTACH THE SLOTTED ENDS OF THE 1 – 2 AND 3 – OD SHIFT RODS OVER THE FLATS OF THE STUDS IN THE SHIFT CONTROL ASSEMBLY. INSTALL LOCK NUTS TO 10-20 FT-LB TORQUE.
5. SHIFT TRANSMISSION TO NEUTRAL, ATTACH REVERSE LEVER AND TORQUE TO SPECIFICATIONS.
6. REMOVE THE ALIGNMENT PIN. LUBRICATE LINKAGE WITH CHASSIS LUBE (ESA-M1C75-B).

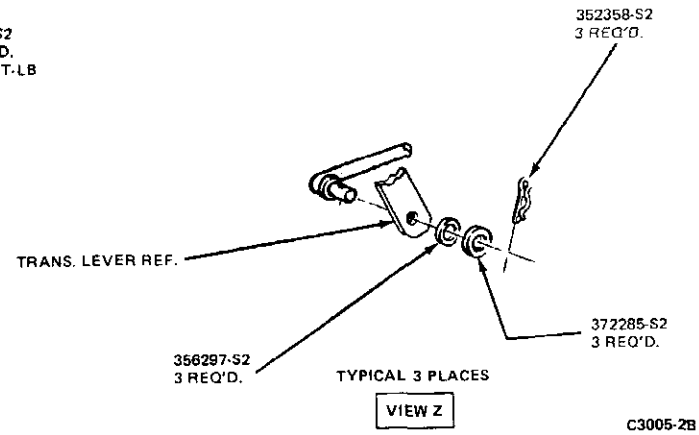


FIG. 2 Four Speed Overdrive Transmission

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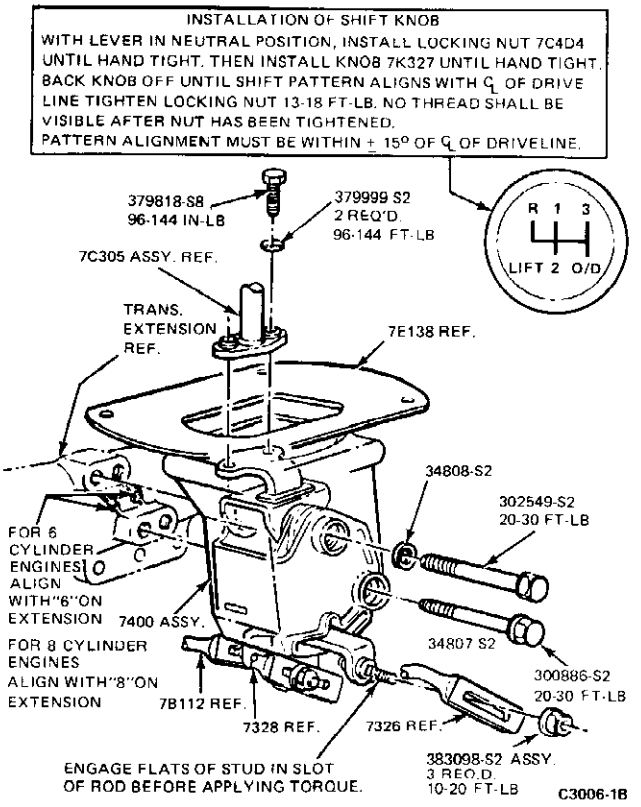


FIG. 3 Shift Control Assembly—4-Speed Overdrive

REMOVAL AND INSTALLATION

FLOOR-MOUNTED SHIFT CONTROL

Removal

1. Disconnect the battery ground terminal.
2. Remove the shift lever boot bezel as shown in (Fig. 2).
3. Remove the four screws attaching the shift lever boot to the floor and lift the boot upward out of the way (Fig. 2).
4. Remove the two bolts attaching the shift lever to the shift control and remove the lever and boot (Fig. 3).
5. From under the vehicle, remove the nuts and washers, attaching the transmission shift rods to the shift control levers.
6. Disconnect the electrical connector from the back-up lamp switch.
7. If the back-up lamp switch is functional, remove the switch from the unit by pulling the switch from the retainer. A slight rotation in both directions while pulling the switch will facilitate removal. **Do not use pliers or other such tools or damage to the switch will result.**
8. Remove the bolts and washers attaching the shift control assembly to the transmission extension housing and remove the shift control assembly (Fig. 3).

Installation

1. Install lock washer on the shift control assembly upper and lower attaching bolt and insert through holes in the shift control assembly. **The lock washer must be positioned to contact the shift assembly. Be sure to install the larger diameter bolt at the top. Also, be sure that the bolts are in the correct mounting holes as marked on the extension housing for each engine application. (Front two holes are marked 6 and rear two holes are marked 8.)**
2. Tighten attaching bolts to specification.
3. Attach shift rods to transmission levers.
4. Rotate the reverse (center) lever of the transmission clockwise so that the transmission is shifted into reverse gear.
5. Insert the alignment pin through the shift alignment hole in the control.
6. Position the two forward speed shift control rods to the corresponding transmission shift control levers. Assemble the washers and nuts and torque to specification.
7. Rotate the transmission reverse lever counterclockwise until it stops in neutral.
8. Position the reverse shift control rod to the reverse lever, assemble the washer and nut and torque to specification. Remove the alignment tool.

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9. Lubricate all connections with chassis lube, as required, and shift the transmission back to neutral.
10. Install back-up lamp switch connector on switch.
11. Lower the vehicle. Position the shift lever to the shift control and install the two attaching bolts. Torque the bolts to specification.
12. Install the 4 screws retaining the shift boot to the floor. Install the bezel to the boot.
13. Check shift assembly through all shift positions. When shift lever is shifted into reverse position it will automatically locate back-up lamp switch in proper position.
14. Connect battery ground terminal.
15. Road test the vehicle and check shifting and back-up lamp for proper functioning.

TRANSMISSION

Removal

1. Raise the vehicle on a hoist.
2. Mark the driveshaft so that it may be installed in the same relative position. Disconnect the drive shaft from the rear U-joint flange. Slide the driveshaft off the transmission output shaft and install the extension housing seal installation tool into the extension housing to prevent lubricant leakage. See Part 16-01.
3. Disconnect the speedometer cable from the extension housing.
4. Remove the retaining clips, flat washers, and spring washers that secure the shift rods to the shift levers and the bolts which attach the shift control to the extension housing.
5. Remove the shift control.
6. Support the engine with a transmission jack and remove the extension housing-to-engine rear support attaching bolts.
7. Raise the rear of the engine high enough to remove the weight from the crossmember. Remove the bolts retaining the crossmember to the frame side supports and remove the crossmember.
8. Support the transmission on a jack and remove the bolts that attach the transmission to the flywheel housing.
9. Move the transmission and jack rearward until the transmission input shaft clears the flywheel housing. If necessary, lower the engine enough to obtain clearance for transmission removal. **Do not depress the clutch pedal while the transmission is removed.**

Installation

1. Make sure that the mounting surface of the transmission and the flywheel housing are free of dirt, paint, and burrs. Install two guide pins in the flywheel housing lower mounting bolt holes. Move the transmission forward on the guide pins until the input shaft splines enter the clutch hub splines and the case is positioned against the flywheel housing.
2. Install the two upper transmission to flywheel housing mounting bolts snug, and then remove the two guide pins. Install the two lower mounting bolts. Torque all mounting bolts to specifications.
3. Raise the rear of the engine and install the crossmember. Install and torque the crossmember attaching bolts to specifications, then lower the engine.
4. With the transmission extension housing resting on the engine rear support, install the transmission extension housing attaching bolts. Torque the bolts to specifications.
5. Position the shift linkage control bracket to the extension housing and install and torque the attaching bolts.
6. Secure each shift rod to its respective lever with the spring washer, flat washer, and retaining pin.
7. Connect the speedometer cable to the extension housing.
8. Remove the extension housing installation tool and slide the forward end of the drive shaft over the transmission output shaft. Connect the driveshaft to the rear U-joint flange. Adjust the linkage following the instructions in Fig. 2.
9. Fill the transmission to the proper level with the specified lubricant.
10. Lower the car. Check the shift and crossover motion for full shift engagement and smooth crossover operation.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Disassembly

1. Mount the transmission in a holding fixture and drain the lubricant by removing the lower extension to case screw and washer.
2. Remove the cover attaching screws from the case. Lift the cover and gasket from the case.
3. Remove the long spring that retains the detent plug in the case (Fig. 5). Remove the detent plug with a small magnet.
4. Remove the extension housing attaching screws and lockwashers. Remove the housing and the gasket. Discard gasket.

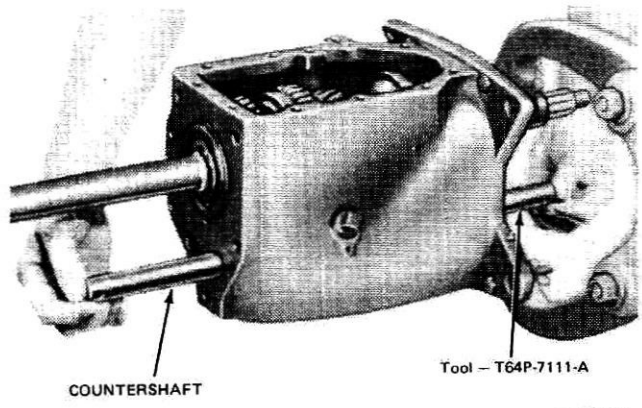


FIG. 4 Removing Counter Shaft From Case

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5. Remove the input shaft bearing retainer attaching screws. Slide the retainer off the input shaft.
6. Support the countershaft gear with a wire hook. Working from the front of the case, push the countershaft out the rear of the case with a dummy shaft (T64P-7111A) as shown in Fig. 4. Lower the countershaft to the bottom of the case with the wire hook. Remove the hook.
7. Remove the set screw from the first and second-speed shift fork (Fig. 5). Slide the first and second speed shift rail out the rear of the case.
8. Using a magnet, remove the interlock detent from between the first-second and third-overdrive shift rails.
9. Shift the transmission into overdrive position. Remove the set screw from the third and overdrive shift fork. Remove the side detent bolt, detent plug and spring. Rotate the third and overdrive speed shift rail 90 degrees clockwise and tap it out through the front of the case using a punch and hammer.

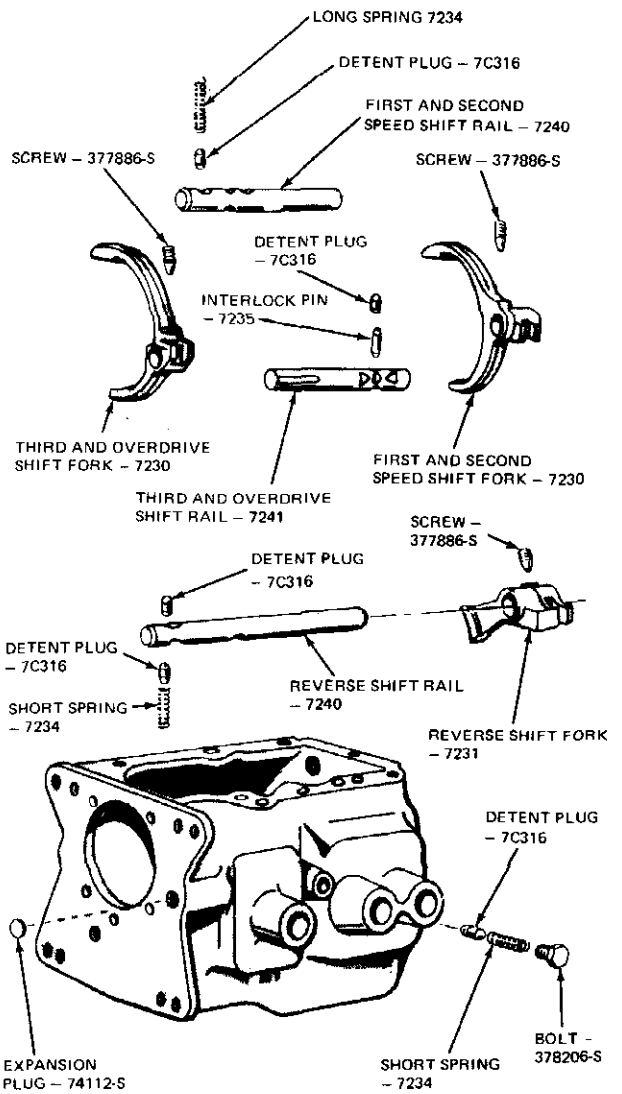


FIG. 5 Shift Rails and Forks Disassembled

10. Remove the interlock plug from the top of the case with a magnet.
11. Remove the snap ring that secures the speedometer drive gear to the output shaft. Slide the gear off the shaft, then remove the speedometer gear drive ball.
12. Remove the snap ring that secures the output shaft bearing to the shaft. Remove the snap ring from the outside diameter of the output shaft bearing.
13. Assemble the special service tools and remove the output shaft bearing from the output shaft as shown in Fig. 6.
14. Remove the snap ring that secures the input shaft bearing to the input shaft. Remove the snap ring from the outside diameter of the input shaft bearing.
15. Assemble the special service tools shown in Fig. 7 and remove the input shaft bearing from the input shaft and the transmission case.
16. Remove the input shaft and the blocking ring from the front of the case.
17. Move the output shaft to the right side of the case to provide clearance for the shift forks. Rotate the forks as shown in Fig. 8, then lift them from the case.
18. Support the thrust washer and first-speed gear to prevent them from sliding off the shaft, then lift the output shaft assembly from the case as shown in Fig. 9.
19. Remove the reverse gear shift fork set screw. Rotate the reverse shift rail 90 degrees as shown in Fig. 10. Slide the shift rail out of the rear of the case. Lift the reverse shift fork from the case.

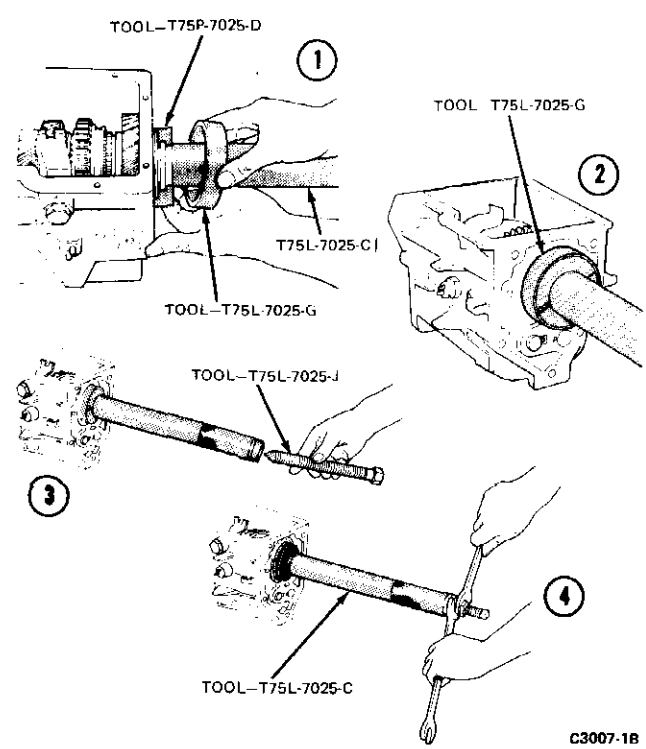


FIG. 6 Removing Output Shaft Bearing—Typical Transmission

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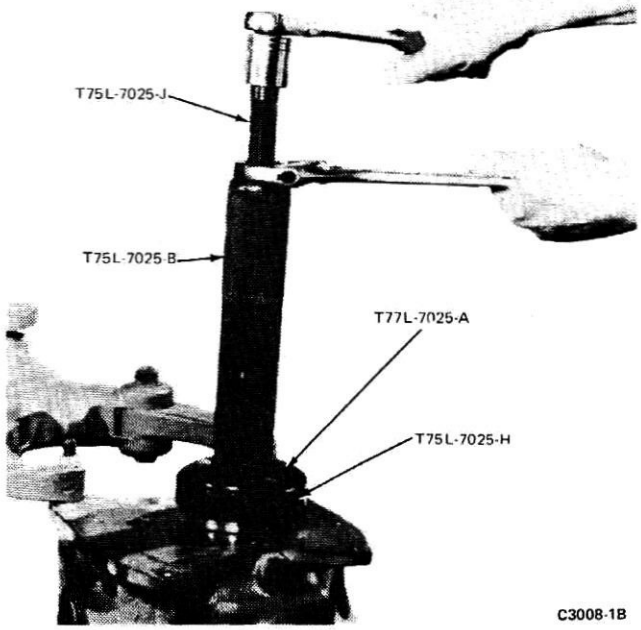


FIG. 7 Removing Input Shaft Bearing

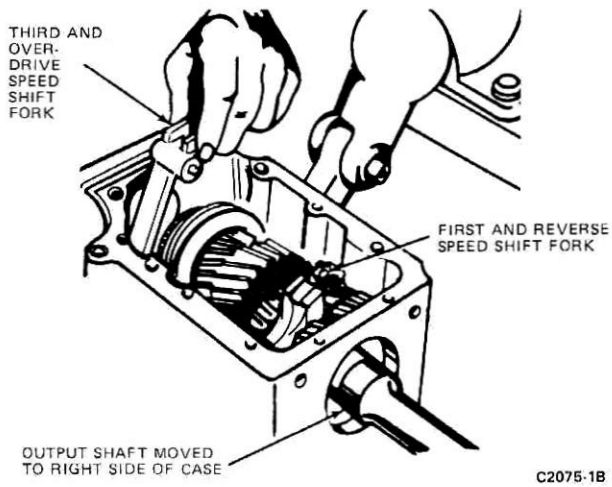


FIG. 8 Removing Shift Fork From Case

20. Remove the reverse detent plug and spring from the case with a magnet.
21. Remove the reverse idler gear shaft from the case as shown in Fig. 11.
22. Lift the countershaft gear and the thrust washers from the case. Be careful not to drop the bearings or the dummy shaft from the countershaft gear.
23. Lift the reverse idler gear and the thrust washers from the case.
24. Remove the snap ring from the front of the output shaft. Slide the third and overdrive synchronizer (Fig. 12) blocking ring and the gear off the shaft.
25. Remove the next snap ring and the second-speed gear thrust washer from the shaft. Slide the second-speed gear and the blocking ring off the shaft.
26. Remove the next snap ring.

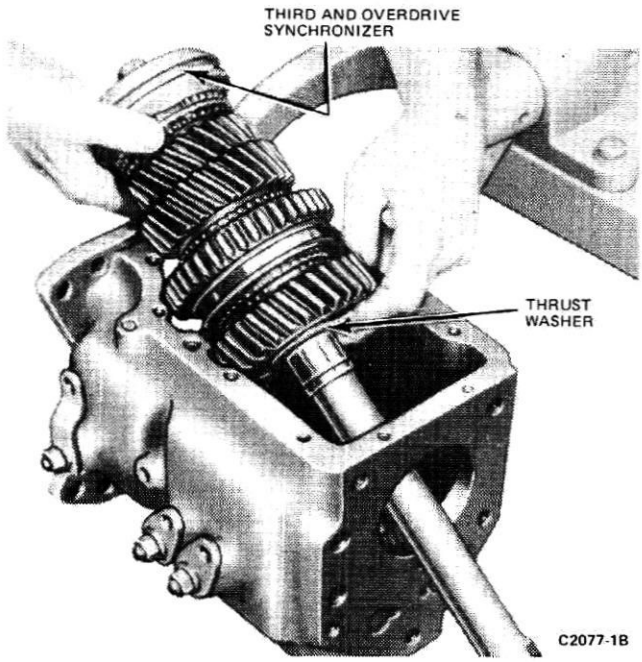


FIG. 9 Removing and Installing Output Shaft Assembly

27. Remove the thrust washer, first speed gear and blocking ring from the rear of the shaft. The first and second synchronizer hub is a slip fit on the output shaft.

Assembly

1. Coat the countershaft gear thrust surfaces in the case with a thin film of lubricant and position a thrust washer (Fig. 20) at each end of the case.
2. Position the countershaft gear, dummy shaft, and roller bearings in the case.
3. Place the case in a vertical position. Align the gear bore and the thrust washers with the bores in the case and install the countershaft.
4. Place the case in a horizontal position and check the countershaft gear end play with a feeler gauge. The end play should be within specification. If not within limits, replace the thrust washers.
5. After establishing the correct end play, install the dummy shaft in the countershaft gear and allow the gear to remain at the bottom of the case.
6. Coat the reverse idler gear thrust surfaces in the case with a thin film of lubricant and position the two thrust washers (Fig. 21) in place.
7. Position the reverse idler gear, sliding gear, dummy shaft and the roller bearings in place making sure that the shift fork groove in the sliding gear is toward the front of the case.
8. Align the gear bore and thrust washers with the case bores and install the reverse idler shaft.
9. Measure the reverse idler gear end play with a feeler gauge. End play should be within specification. If the end play is not within limits, replace the thrust washers. If the end play is within limits, leave the reverse idler gear installed.
10. Position the reverse gear shift rail detent spring and detent plug in the case. Hold the reverse shift fork

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in place on the reverse idler sliding gear and install the shift rail from the rear of the case. Secure the fork to the rail with the Allen head set screw.

11. Install the first and second-speed synchronizer (Fig. 19) into the front of the output shaft, making sure that the shift fork groove is toward the rear of the shaft. The first and reverse synchronizer hub is a slip fit on the output shaft. Install the synchronizer hub with the teeth end of the gear facing toward the rear of the shaft.
12. Position the blocking ring on the second-speed gear.
13. Slide the second-speed gear onto the front of the shaft, making sure that the inserts in the synchronizer engage the notches in the blocker ring.
14. Install the second-speed gear thrust washer and snap ring.
15. Slide the overdrive gear onto the shaft with the synchronizer coned surface toward the front.
16. Place a blocking ring on the overdrive gear.
17. Slide the third and overdrive gear synchronizer onto the shaft making sure that the inserts in the synchronizer engage the notches in the blocking ring and the thrust surface is toward the overdrive gear.
18. Install the snap ring on the front of the output shaft.
19. Position the blocking ring on the first-speed gear.
20. Slide the first-speed gear onto the rear of the output shaft making sure that the notches in the blocking ring engage the synchronizer inserts.
21. Install the heavy thrust washer on the rear of the output shaft.
22. Support the thrust washer and first-speed gear to prevent them from sliding off the shaft and carefully lower the output shaft assembly into the case as shown in Fig. 9.
23. Position the first and second-speed shift fork and the third and overdrive shift fork in place on their respective gears and rotate them into place.
24. Place a spring and a detent plug (Fig. 5) in the detent bore. Place the reverse shift rail into neutral position.
25. Coat the third and overdrive shift rail interlock pin (tapered ends) with grease and position it in the shift rail.
26. Align the third and overdrive shift fork with the shift rail bores and slide the shift rail into place making sure that the three detents are facing toward the outside of the case. Place the front synchronizer into overdrive position and install the set screw in the third and overdrive shift fork. Move the synchronizer to the neutral position. Install the third and overdrive shift rail detent plug, spring and bolt in the left side of the transmission case (Fig. 5). Place the detent plug (tapered ends) in the detent bore in the case.
27. Align the first and second-speed shift fork with the case bores and slide the shift rail into place. Secure the fork with the set screw.
28. Coat the input gear bore with a thin film of grease, then install the 15 roller bearings in the bore. **A thick film of grease could plug the lubricant holes and restrict lubrication of the bearings.**

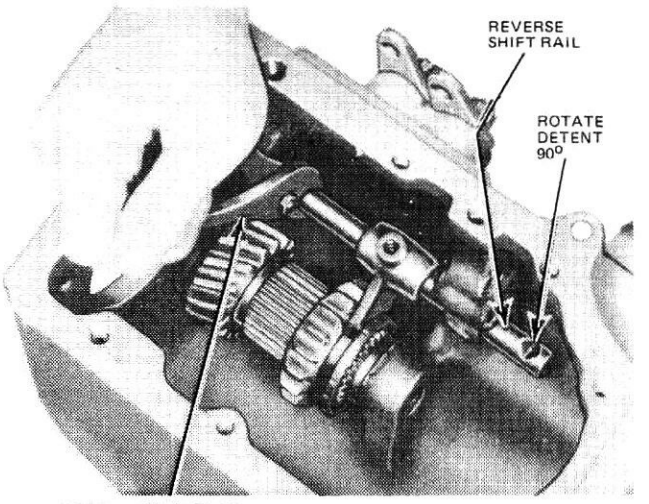


FIG. 10 Rotating Reverse Shift Rail

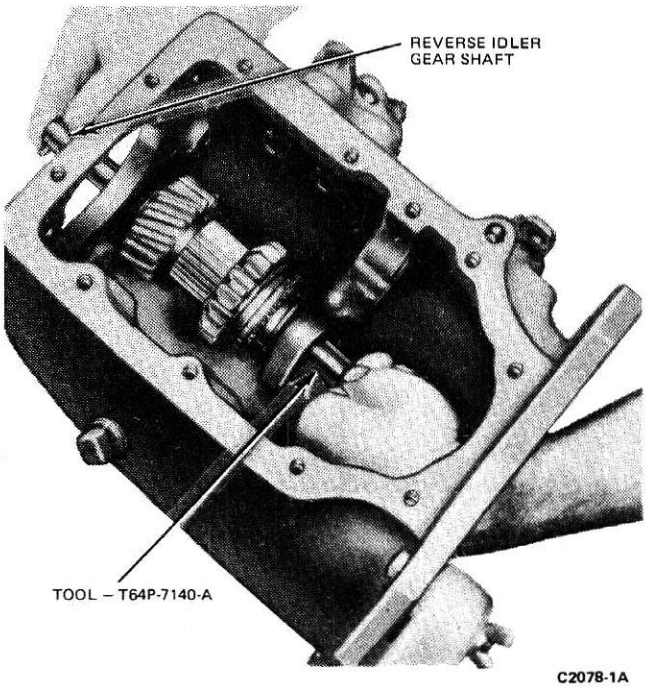


FIG. 11 Removing Reverse Idler Gear Shaft

29. Position the front blocking ring in the third and overdrive synchronizer.
30. Position the dummy bearing, Tool T77L-7025-B, on the output shaft to support and align the shaft assembly in the case (Fig. 13).
31. Place the input shaft gear into the transmission case, making sure that the output shaft pilot enters the roller bearings in the input gear pocket.
32. Position the input shaft bearing on the input shaft along with the Clamp, Tool T77L-7025-D, the Sleeve, Tool T75L-7225-K, and the bearing Replacer Tube, T77L-7025-C. Press the bearing onto the shaft and into the transmission case as shown in Fig. 14.

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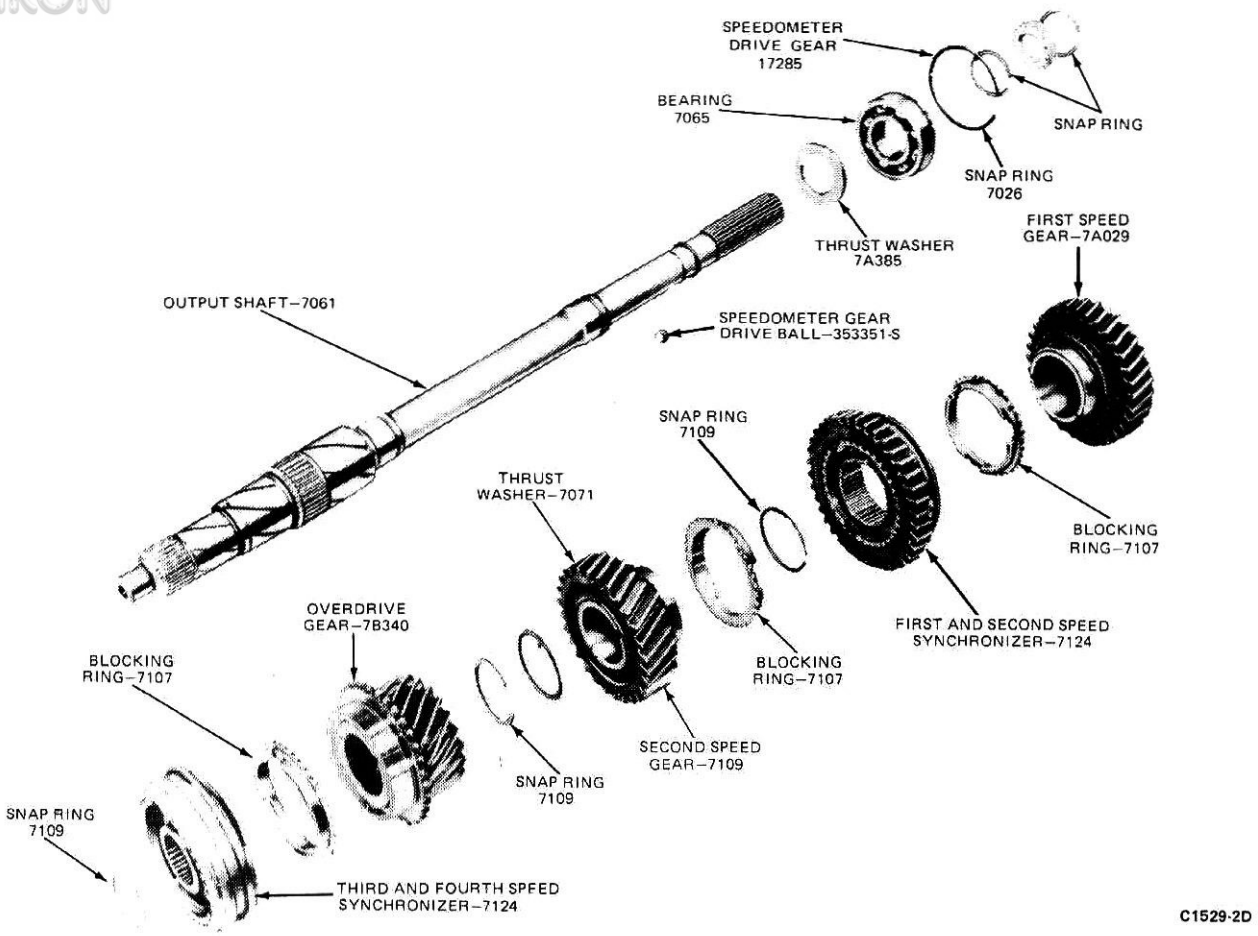


FIG. 12 Output Shaft Disassembled

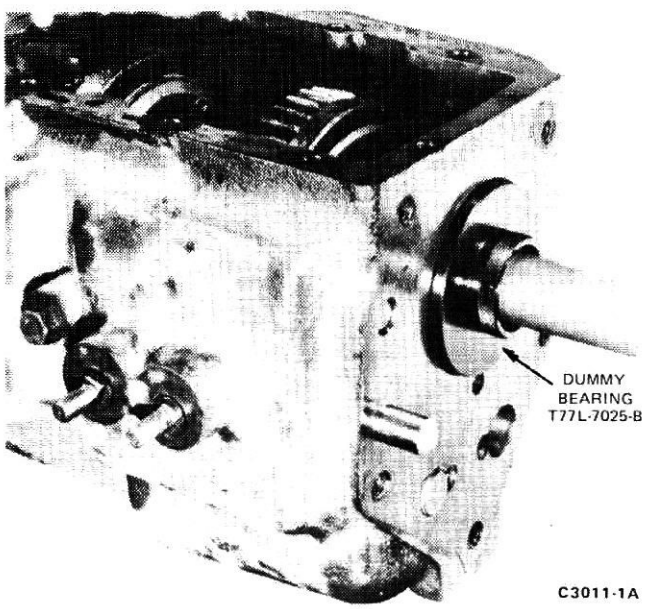


FIG. 13 Dummy Bearing Installed

33. Remove the special service tools and install the snap rings on the input shaft and the input shaft bearing.
34. Place a new gasekt on the input shaft bearing retainer. Dip the attaching bolts in sealer and install and tighten them to specifications.
35. Remove the dummy bearing from the output shaft. Assemble the special service tools to the output shaft as shown in Fig. 15. **Before pressing the bearing onto the output shaft, be sure that the output shaft bearing is aligned with the transmission case bore and that the countershaft is not interferring with the output shaft assembly.**
36. Install the output shaft bearing onto the output shaft and into the transmission case using the special service tools. Remove the special service tools and install the snap rings on the output shaft and the output shaft bearing.
37. Place the transmission in a vertical position as shown in Fig. 16. Align the countershaft gear bore and thrust washers with the bore and thrust washers with the bore in the case. Install the countershaft.
38. Use a new gasket and secure the extension housing to the case with the attaching screws. Use a sealer on the extension housing attaching screws. Torque the screws to specifications.
39. Install the filler plug in the case if it was removed.
40. Pour the specified lubricant over the entire gear train while rotating the input shaft.
41. Place each shift fork in all positions to make sure that it operates properly.

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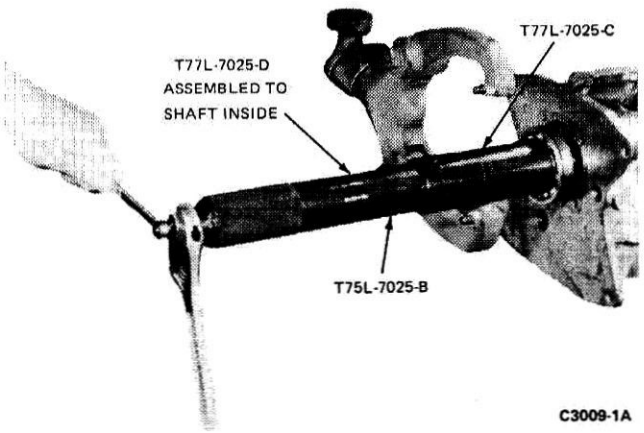


FIG. 14 Installing Input Shaft Bearing

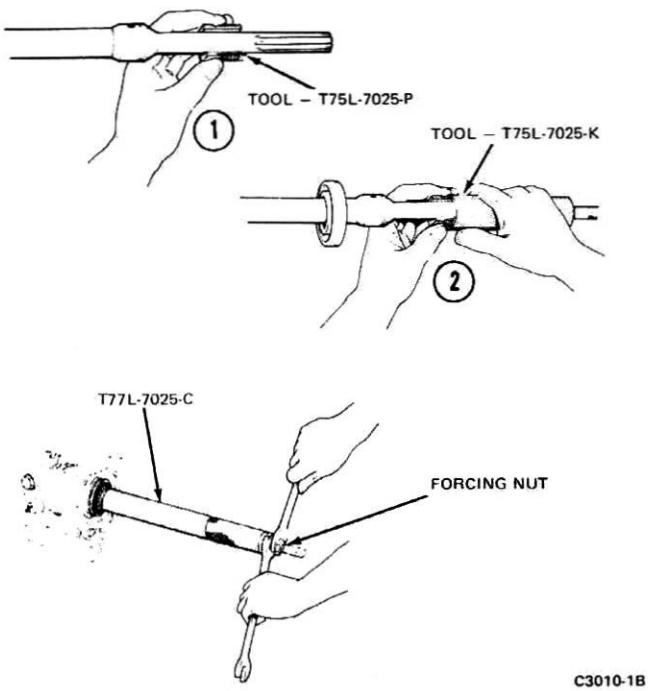


FIG. 15 Installing Output Shaft Bearing—Typical Transmission

42. Install the remaining detent plug in the case. Install the long spring (which is retained by the case) to secure the detent plug.
43. Use a new cover gasket and install the cover. Coat the cover attaching screws with sealer and install and tighten them to specifications.
44. Coat the third and overdrive shift rail plug bore with a sealer and install a new expansion plug.
45. If the extension housing bushing and seal are to be replaced, refer to Section 1.

SUB-ASSEMBLIES

CAM AND SHAFT SEALS

Removal

1. Remove the attaching nut, lockwasher and the flat washer from each shift lever and remove the three levers.

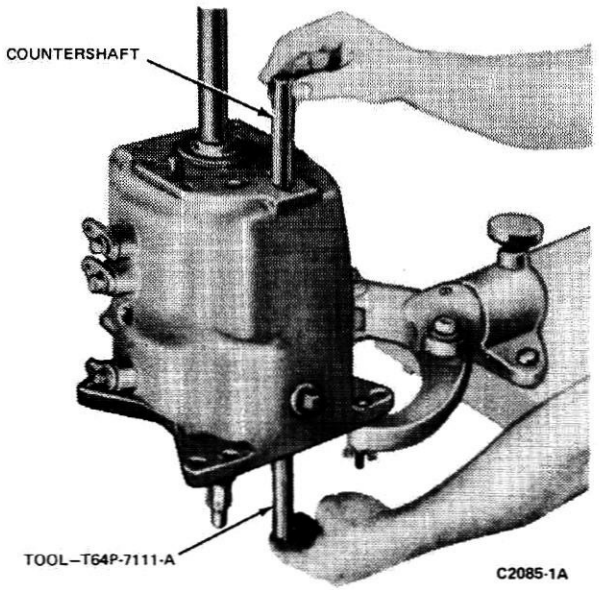


FIG. 16 Installing Countershaft

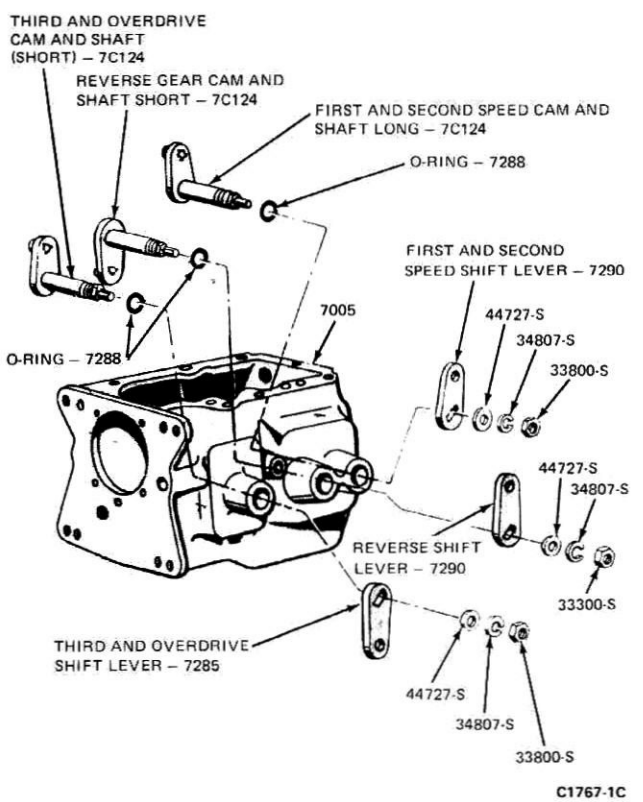


FIG. 17 Cam and Shafts and Shift Levers

2. Remove the three cam and shafts from inside the case.
3. Remove and discard the O-ring from each cam and shaft (Fig. 17).

Installation

1. Dip the new O-rings in gear lubricant and install them on the cam and shafts.
2. Slide each cam and shaft into its respective bore in the transmission case.

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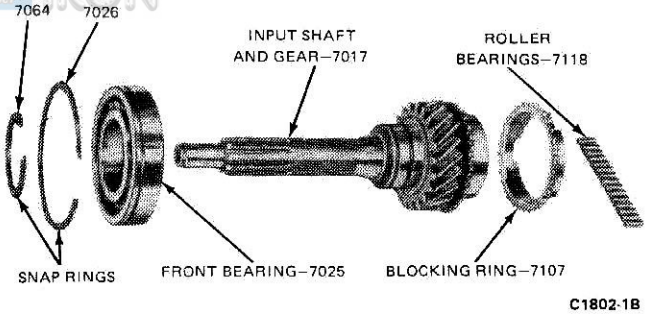


FIG. 18 Input Shaft Disassembled

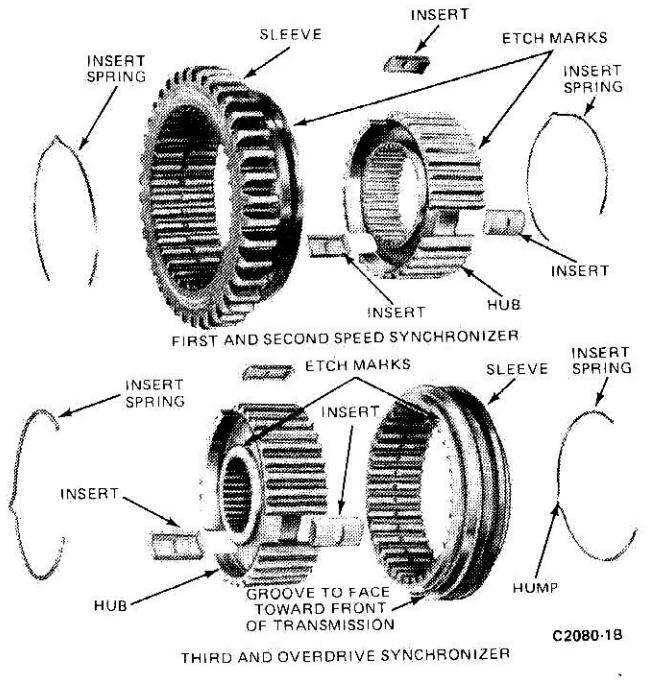


FIG. 19 Synchronizers Disassembled

3. Secure each shaft lever with a flat washer, lockwasher and nut.

SYNCHRONIZERS

Removal

1. Punch or etch alignment marks on the hub and sleeve of the synchronizer before disassembly. Push the synchronizer hub from each synchronizer sleeve (Fig. 19).

2. Separate the inserts and insert springs from the hubs. Do not mix the parts of the first and second-speed synchronizer with the third and fourth-speed synchronizer.

Installation

1. Position the hub in the sleeve, making sure that the alignment marks are properly indexed.
2. Place the three inserts into place on the hub. Install the insert springs making sure that the irregular surface (hump) is seated in one of the inserts. Do not stagger the springs.

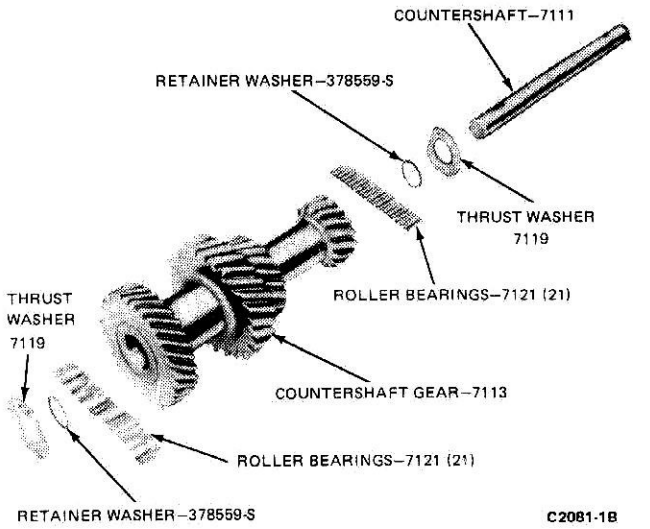


FIG. 20 Countershaft Gear Disassembled

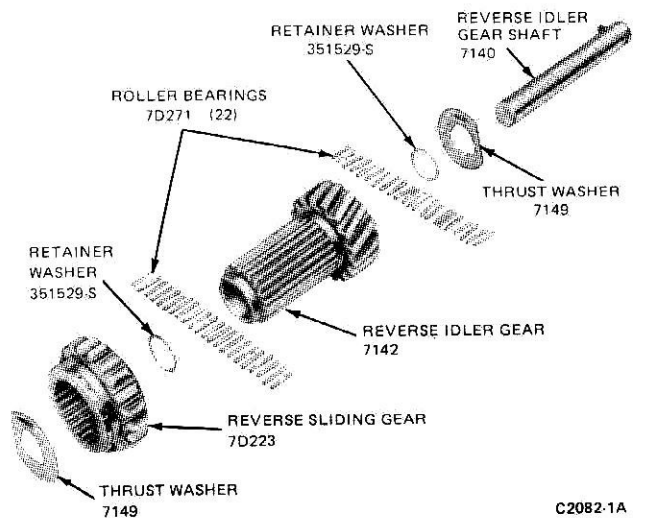


FIG. 21 Reverse Idler Gear Disassembled

COUNTERSHAFT GEAR BEARINGS

Removal

1. Remove the dummy shaft, two bearing retainer washers and the 21 roller bearings (Fig. 20) from each end of the countershaft gear.

Installation

1. Coat the bore in each end of the countershaft gear with grease.
2. Hold the dummy shaft in the gear and install the 21 roller bearings and a retainer washer in each end of the gear.

REVERSE IDLER GEAR BEARINGS

Removal

1. Slip the reverse idler sliding gear off the reverse idler gear (Fig. 21).

2. Remove the dummy shaft, two bearing retainer washers and the 44 roller bearings from the reverse idler gear.

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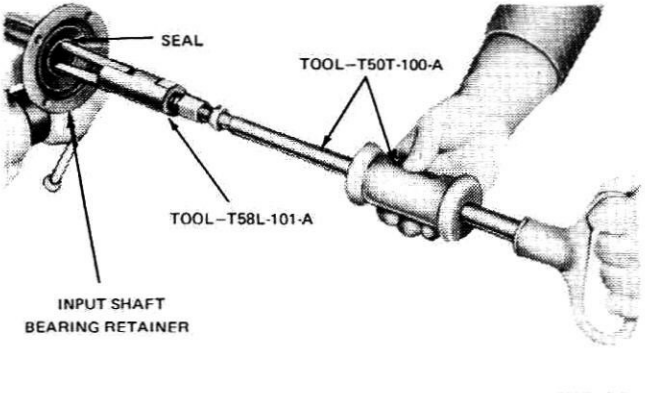


FIG. 22 Removing Input Shaft Seal

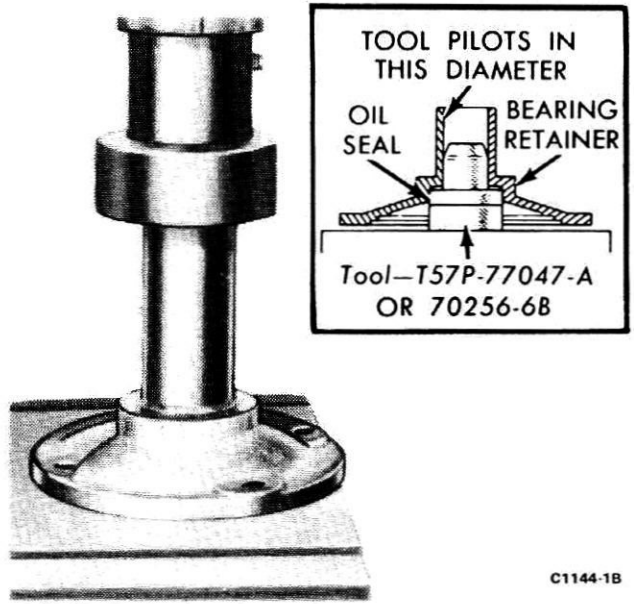


FIG. 23 Installing Input Shaft Seal

Installation

1. Coat the bore in each end of the reverse idler gear with grease.
2. Hold the dummy shaft in the gear and install the 22 roller bearings and the retainer washer in each end of the gear.
3. Install the reverse idler sliding gear on the reverse idler gear making sure that the shift fork groove is toward the front (Fig. 21).

INPUT SHAFT SEAL

Removal

1. Remove the seal from the input shaft bearing retainer as shown in Fig. 22.

Installation

1. Coat the sealing surface with lubricant.
2. Install the seal as shown in Fig. 23.

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SPECIFICATIONS

4-SPEED OVERDRIVE TRANSMISSION

Car Model	Engine	Transmission Model	Gear Ratios				
			1st	2nd	3rd	Overdrive	Reverse
Granada/Monarch 4.1L (250 CID) 5.0L (302 CID)	4.1L (250 CID) 5.0L (302 CID)	RUG-BP	3.29	1.84	1.0	0.81	3.29

LUBRICANT REFILL CAPACITY

Transmission Type	Application	Lubricant Specification	Capacity (Pints)
4-Speed O.D.	All Models	ESP-M2C83-C or ESW-M2C83-B	4.5*
*To Bottom of Filler Hole			

TRANSMISSION COMPONENT END PLAY

Component	Inches
Cluster Gear to Case	.004-.018
Reverse Idler Gear to Case	.005-.023

TORQUE SPECIFICATIONS

Application	Torque Ft-Lb 4-Speed
Input Shaft Bearing Retainer to Case Bolt	19-25
Extension Housing to Case Bolt	42-50
Access Cover to Case Screw	20-25

Application	Torque Ft-Lb 4-Speed
Outer Gear Shift Levers to Cam and Shaft Nut	18-23
Filler Plug to Case	10-20
Detent Bolt to Case	10-15

SHIFTER TORQUE LIMIT (FT-LBS)

Description	Size	Torque Ft-Lb	Description	Size	Torque Ft-Lb
Shift control upper mounting bolt	7/16-14 x 3 hex head	20-30	Transmission shift control rod to shift	5/16-18 nut and washer assembly	10-20
Shift control lever mounting bolt	3/8-16 x 2.75 UBS hex head	20-30	Control lever attaching nuts		10-20

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TOOL NUMBER	DESCRIPTION	TOOL NUMBER	DESCRIPTION
T75L-7025-B	Remover—Replacer Tube	T75L-7025-P	Collar—Shaft
T75L-7025-C	Remover Replacer Tube	T77L-7025-A	Collet—Bearing Remover
T75L-7025-D	Collet—Bearing Remover	T77L-7025-B	Dummy Bearing
T75L-7025-G	Sleeve - Collet	T77L-7025-C	Replacer Tube
T75L-7025-J	Screw	T77L-7025-D	Clamp Shaft
T75L-7025-K	Sleeve—Replacer	T64P-7111-A	Dummy Shaft

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AUTOMATIC TRANSMISSION

GROUP 17

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C3 Automatic Transmission	17-03
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JATCO Automatic Transmission	17-06
C6 Automatic Transmission	17-10
FMX Automatic Transmission	17-15
General Transmission Service	17-01
Shift Control Linkage	17-02

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DETROIT IRON

General Automatic Transmissions Service

PART 17-01

Applies To All Cars

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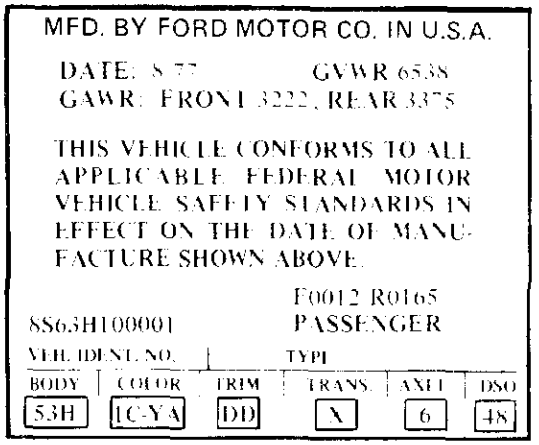
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GENERAL INFORMATION

TRANSMISSION IDENTIFICATION

All vehicles are equipped with a Vehicle Certification Label, affixed to the left (driver's) side door lock post. Refer to the stamped code in the space marked "Trans." and to Fig. 1 below for proper transmission identification.



TRANSMISSION CODE	TRANSMISSION TYPE
S	AUTOMATIC (JATCO)
U	AUTOMATIC (C6)
V	AUTOMATIC (C3)
W	AUTOMATIC (C4)
X	AUTOMATIC (FMX)
Z	AUTOMATIC (C6 POLICE)

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FIG. 1 Typical Vehicle Certification Label—Transmission Identification

DIAGNOSIS AND TESTING

GENERAL DIAGNOSIS

Troubleshooting the automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that *there is a definite procedure to follow. Don't try to* short-cut it or take it for granted that someone else has done the critical checks of adjustments.

The following procedures are recommended for checking and/or verifying that the various components are adjusted and operating properly.

AUTOMATIC TRANSMISSION TESTS

LINKAGE CHECK

Kickdown Linkage

Check for wide open carburetor and linkage travel at full throttle. The carburetor full throttle stop must be contacted by the throttle linkage and there must be a slight amount of movement left in the downshift linkage. Be sure the downshift linkage return spring is connected and the downshift lever returns to a closed position.

Manual Linkage

This is a **CRITICAL** adjustment. Be sure the "D" detent in the transmission corredponds exactly with the stop in the steering column or console. Hydraulic leakage at the manual valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted.

TRANSMISSION FLUID LEVEL CHECK

Room Temperature (Pre-Delivery) Fluid Level Checking Procedure: Refer to Part 50-17.

The automatic transmission is designed to operate with the oil level between the ADD and FULL mark on the dipstick, at an operating temperature of 150 degrees F to 170 degrees F. Fluid level should be checked under these temperatures. Obtain the operating temperature by driving 15 to 20 miles of city-type driving with the outside temperature above 50 degrees F.

Transmission at Operating Temperature (150 degrees F to 170 degrees F)

1. With transmission in P (PARK) position, engine at curb idle rpm, foot brakes applied and vehicle on level surface, move the transmission selector lever through each range. Allow time in each range to engage transmission, return to P (PARK) position, and apply parking brake. **Do not turn off the engine during the fluid level check.**
2. Clean all dirt from the transmission fluid dipstick cap, before removing the dipstick from the filler tube.
3. Pull the dipstick out of the tube, wipe it clean, and push all the way back into the tube. **Be sure it is fully seated.**
4. Pull the dipstick out of the tube again and check the fluid level. Fluid level should be between the ADD and FULL mark.

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Before adding fluid, be sure that the correct type will be used. If in doubt, check the Vehicle Certification Label affixed to the left front door lock face panel or door pillar for the Transmission Code.

The C-3 Automatic Transmission (Transmission Code V), C-4 Automatic Transmission (Code W) and the FMX Automatic Transmission (Code X) use transmission fluid meeting Ford Specification ESW-M2C33-F (Type F). Certification is evidenced by the following information appearing on the fluid container: FORD, Qualification No. 2P-XXXXXX, ESW-M2C33-F.

For C-6 Automatic Transmission (Code U) and JATCO Automatic Transmission (Code S), use fluid that meets Ford Specification ESP-M2C138-CJ. **CAUTION: Use of a fluid other than specified above could result in transmission malfunction and/or failure.**

If necessary, add enough fluid through the filler tube to raise the level to the correct position. Do not overfill the transmission, as this will result in foaming, loss of fluid through the vent, and possible transmission malfunction.

5. Install the dipstick, **making sure it is fully seated in the tube.**

TRANSMISSION FLUID CONDITION CHECK

1. Make the normal fluid check according to the above procedure.
2. Observe color and odor of the fluid. It should be red, not brown or black. Odor can sometimes indicate that there is an overheating condition or clutch disc or band failure.
3. Use an absorbent white paper (kleenex, etc.) to wipe the dipstick. Examine the stain for evidence of solids (specks of any kind) and for anti-freeze signs (gum or varnish on dipstick).

   If specks are present in the oil or there is evidence of antifreeze, the transmission oil pan must be removed for further inspection. If fluid contamination or transmission failure is confirmed by further evidence of coolant or excessive solids in the oil pan, the transmission must be disassembled and completely cleaned and repaired. This includes cleaning the torque converter and transmission cooling system. It would be a waste of time to perform any further checks before cleaning and repairing the transmission. During disassembly and assembly, all overhaul checks and adjustments of clearances and end play must be made. After repairs have been made to the transmission, all diagnosis tests and adjustments listed in the Diagnosis Guide must be completed to be sure that the problem has been corrected.

HIGH OR LOW FLUID LEVEL

A fluid level that is too high will cause the fluid to become aerated. Aerated fluid will cause low control pressure, and the aerated fluid may be forced out the vent.

A fluid level that is too low can affect the operation of the transmission. Low level may indicate fluid leaks that could cause transmission damage.

FLUID LEVEL HIGH BEFORE STARTING ENGINE—OK DURING NORMAL CHECK

FMX

1. Recheck fluid level after 6 hour soak.
2. Check for correct indicator.
3. Remove transmission.
4. Inspect components such as pump bushing that would permit converter drainback.

C3, C4 or C6

1. Check for correct operation of drainback valve in stator support.
2. Check pump bushing.
3. Replace or repair pump if required.

TRANSMISSION FLUID LEAKAGE CHECKS

Check the speedometer cable connection at the transmission. Replace the rubber seal if necessary.

Leakage at the oil pan gasket often can be stopped by tightening the attaching bolts to the proper torque. If necessary, replace the gasket.

Check the fluid filler tube connection at the transmission case or pan. If leakage is found here, install a new O-ring or tighten the fitting to the specified torque.

Check the fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid line tube nut, replace the damaged parts. When oil is found to be leaking between the case and the cooler line fitting, tighten the fitting to maximum torque specification. **Do not try to stop the oil leak by increasing the torque beyond specification. This may cause damage to the case threads.** If the leak continues, replace the cooler line fitting and torque to specifications. The same procedure should be followed for oil leaks between the radiator cooler and cooler line fittings.

COOLER LINE FITTING TORQUE SPECIFICATIONS (FT-LB)

Transmission	Radiator	Transmission	Fluid Line Nut
C3	8-12	10-15	12-18
C4	8-12	80-120 (1)	12-18
FMX	8-12	15-20	12-18
C6	8-12	10-16	12-18

(1) In Lh

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Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator is probably leaking.

The cooler can be further checked for leaks by disconnecting the lines from the cooler fittings and applying 50-75 psi air pressure to the fittings. Remove the radiator cap to relieve the pressure build up at the exterior of the oil cooler tank. If the cooler is leaking and/or will not hold pressure, the cooler must be replaced. Cooler replacement is described in Group 27—Cooling System.

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If leakage is found at either the downshift control lever shaft or the manual lever shaft, replace either or both seals.

Inspect the pipe plug on the left side of the transmission case at the front. If the plug shows leakage, torque the plug to specifications, using Motorcraft sealing compound or equivalent on the threads. If tightening does not stop the leaks, replace the plug. On the C6 transmission, inspect *the TV pressure plug on the right rear of the case.* If the plug shows leakage, torque the plug to specification.

When a converter drain plug leaks, remove the drain plug with a sixpoint wrench. Coat the threads with Motorcraft Sealing Compound, or equivalent, and install plug. Torque the drain plug to specification. Oil-soluble aniline or fluorescent dyes premixed at the rate of 1/2 teaspoon of dye powder to 1/2 pint of *transmission fluid have proved helpful in locating the* source of fluid leakage. Such dyes may be used to determine whether an engine oil or transmission fluid leak is present, or if the fluid in the oil cooler leaks into the engine coolant system. A black light must be used with the fluorescent dye solution.

FLUID LEAKAGE IN CONVERTER AREA

In diagnosing and correcting fluid leaks in the front pump and converter area, use the following *procedures to locate the exact cause of the* leakage. Leakage at the front of transmission, as evidenced by fluid around the converter housing, may have several sources. By careful observation, it is possible, in many instances, to pinpoint the source of the leak before removing the *transmission from the vehicle. The paths which the* fluid takes to reach the bottom of the converter housing are shown in Fig. 2.

1. Fluid leaking by the front pump seal lip will tend to move along the drive hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the converter housing only, near the outside diameter of the housing.
2. *Fluid leakage by the outside diameter of the seal* and front pump body will follow the same patch which the leaks by the front pump seal follow.
3. Fluid that leaks by a front pump to case bolt will be deposited on the inside of the converter housing only. Fluid will not be deposited on the back of the converter.
4. Leakage by the front pump to case gasket may cause fluid to be deposited inside the converter housing, or it may seep down between the front of the case and converter housing. Fluid on the front of the case above the pan gasket on FMX or C4 transmission is evidence that the front pump to case gasket or seal could be leaking.
5. Fluid leakage from the converter drain plugs will appear at the outside diameter of the converter on the back face of the flywheel, and in the converter housing only near the flywheel.
6. Converter to flywheel stud weld leak.

Engine oil leaks are sometimes improperly diagnosed as transmission front pump seal leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the problem.

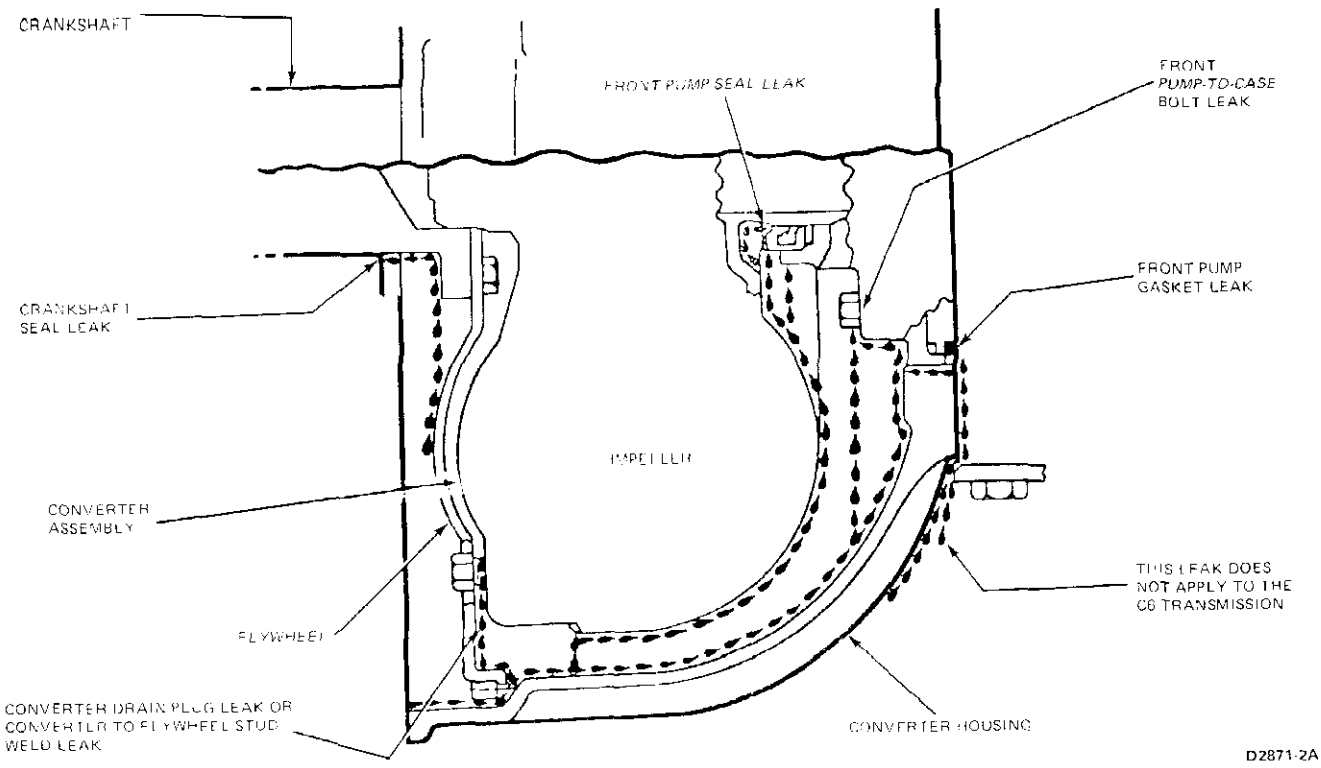


FIG. 2 Fluid Leakage in Converter Area

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a. Leakage at the rocker arm cover may allow oil to flow over the converter housing or seep down between the converter housing and cylinder block causing oil to be present in or at the bottom of the converter housing.

b. Oil gallery plug leaks will allow oil to flow down the rear face of the block to the bottom of the converter housing.

c. Leakage at the crankshaft seal will work back to the flywheel, and then into the converter housing.

7. Fluid leakage from other areas, such as the power steering system forward of the transmission, could cause fluid to be present around the converter housing due to blow back or road draft. The following procedures should be used to determine the cause of the leakage before any repairs are made.

a. Remove the transmission dipstick and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Unless a considerable amount of makeup fluid has been added or the fluid has been changed, the red color should assist in pinpointing the leak. Fluid used in the power steering system has a yellowish green dye. Since road draft may cause leaking power steering fluid to be present on the transmission, this leakage, if present, should be eliminated before checking the transmission for fluid leakage.

b. Remove the converter housing cover. Clean off any fluid from the top and bottom of the converter housing, front of the transmission case, and rear face of the engine and engine oil pan. Clean the converter area by washing with a suitable non-flammable solvent, and blow dry whith compressed air.

c. Wash out the converter housing, the front of the flywheel, and the converter drain plugs. The converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

d. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the block and top of the converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the drive and reverse ranges to increase pressure within the transmission. Observe the front of the wheel, back of the block (in as far as possible), and inside the converter housing and front of the transmission case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

CONVERTER LEAKAGE CHECK

If welds on the torque converter indicate leakage, remove the converter and make the following check.

Assemble a Rotunda 72-0004 Torque Converter Leak Detector (Fig. 3) to the converter as shown in Fig. 4. Test the converter for leaks, following the directions supplied with the Detector Kit.

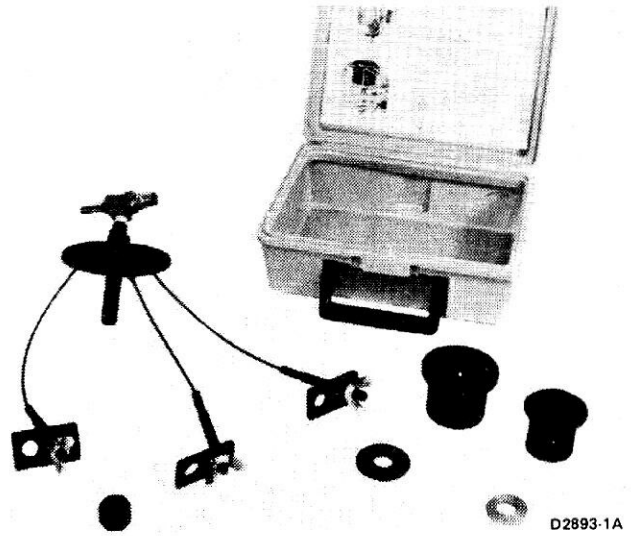


FIG. 3 Torque Converter Leak Detector

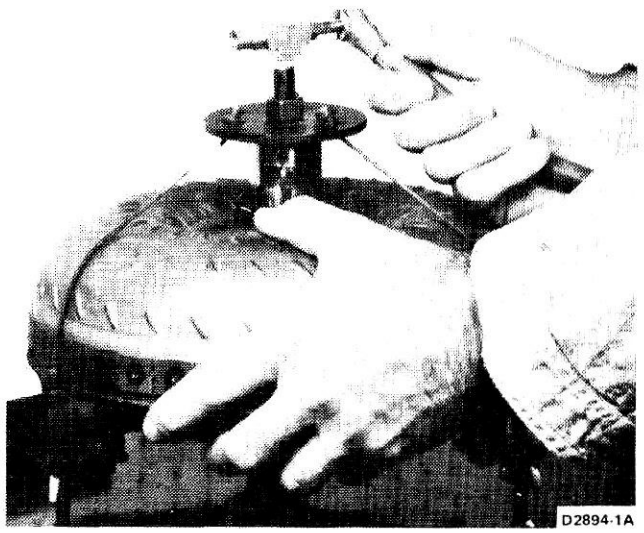


FIG. 4 Torque Converter Leak Detector Installed

ENGINE IDLE SPEED CHECK

If the idle speed is too low, the engine will run roughly. An idle speed that is too high will cause the vehicle to creep, have harsh engagements, and harsh closed-throttle downshifts.

Check and, if necessary, adjust the engine idle speed, using the procedure given in Group 24.

ANTI-STALL DASHPOT CLEARANCE CHECK

After the engine idle speed has been properly adjusted, check the antistall dashpot clearance. Follow the procedure given in Group 24 for checking and adjusting this clearance.

CONTROL PRESSURE TEST

There are two methods of performing the control pressure test. One is to perform the test using the engine vacuum. The second method is to use a remote vacuum

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source such as the one provided in the distributor tester or a hand operated vacuum pump.

ENGINE VACUUM PRESSURE

When the vacuum diaphragm unit is operating properly and the down shift linkage is adjusted properly, all the transmission shifts (automatic and kickdown) should occur within the road speed limits given in the Ford Car Performance Specification Book.

If the shifts do not occur within limits, or the transmission slips during shift point, use the following procedure to determine whether the engine, transmission, linkage, vacuum diaphragm unit or valve body is causing the condition.

1. Using the automatic transmission tester (Fig. 5) or equivalent, attach the tachometer to the engine, and the vacuum gauge to the transmission vacuum line at the manifold vacuum port (Fig. 6).
2. Attach the pressure gauge to the control pressure outlet at the transmission (Figs. 7 and 8).

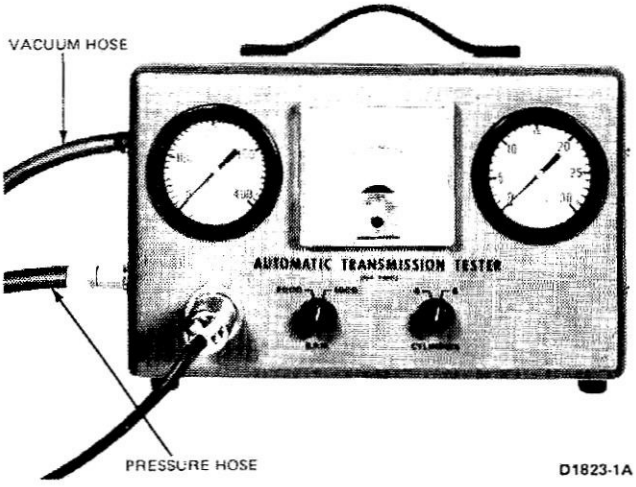


FIG. 5 Automatic Transmission Tester

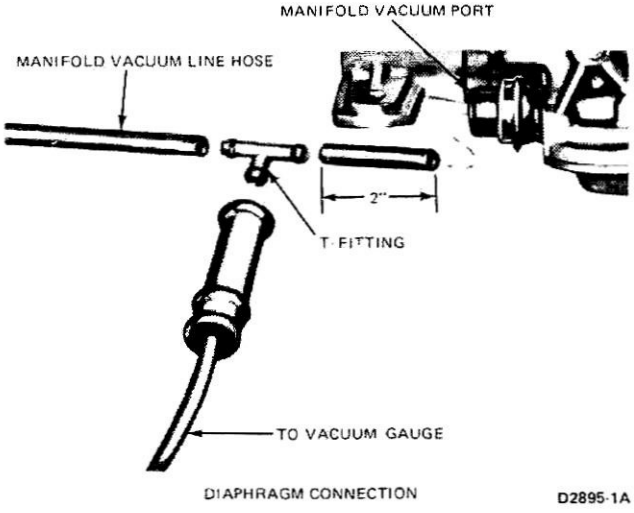


FIG. 6 Typical Vacuum Test Line Connections

3. Firmly apply the parking brake and start the engine.

   On a vehicle equipped with a vacuum brake release, apply the service brakes. The parking brake cannot be used because the brake automatically releases when the transmission selector lever is moved to a drive position.
4. Adjust the engine idle speed to the specified rpm, using the carburetor idle adjustment screw. If the

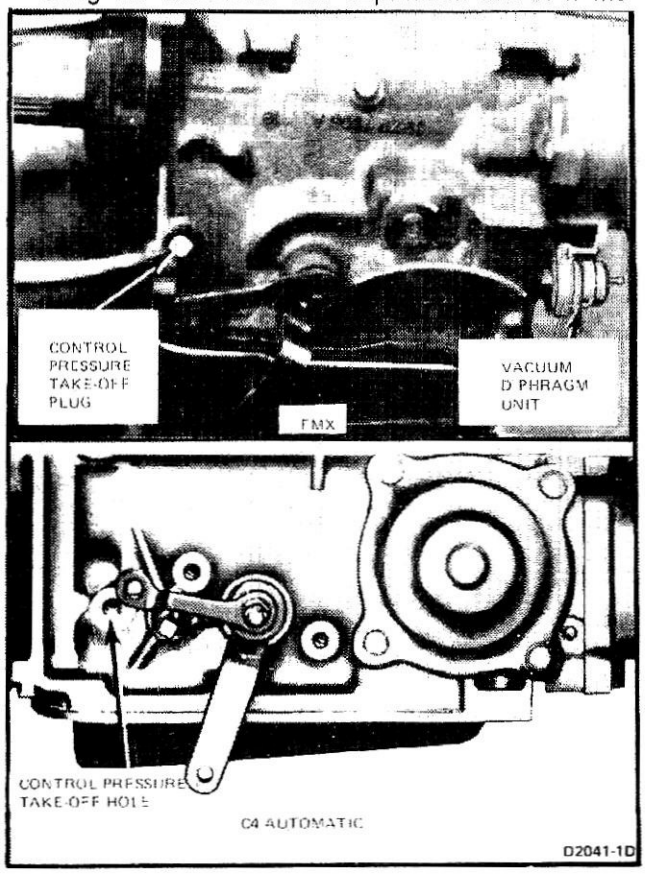


FIG. 7 Typical Vacuum Diaphragm and Control Pressure Connecting Point—C4 and FMX Transmissions

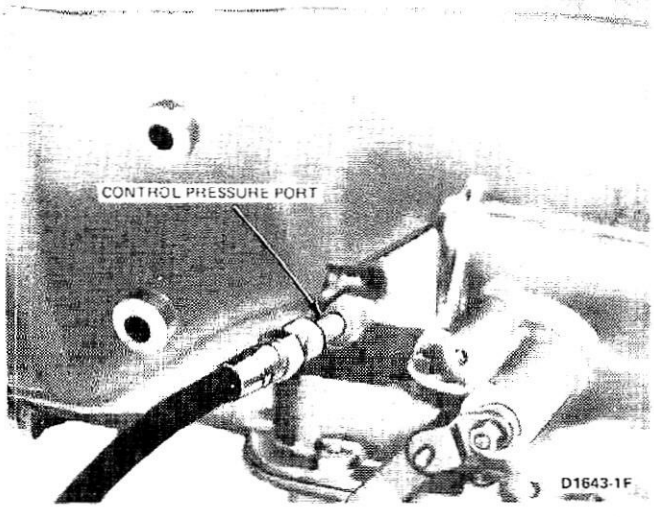


FIG. 8 Control Pressure Connecting Point— C6 Transmission

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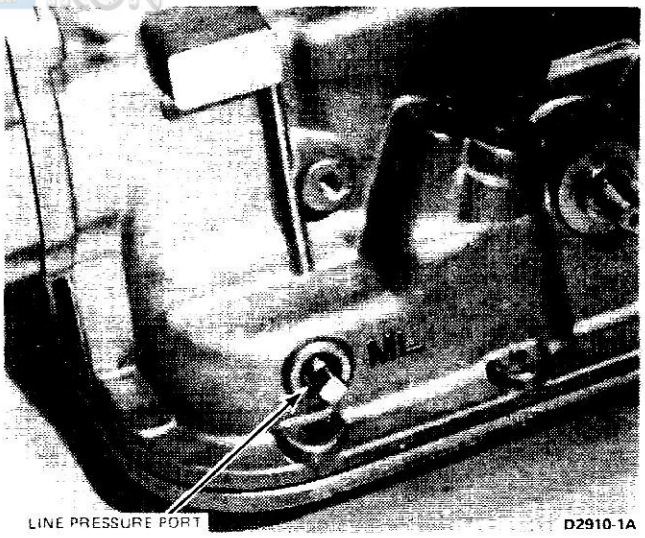


FIG. 9 Control Pressure Connecting Point—JATCO Transmission

engine idle speed cannot be brought within limits, check the throttle and downshift linkage for a binding condition. If linkage is satisfactory, check for vacuum leaks in the transmission diaphragm unit (Fig. 10) and its connecting tubes and hoses. Check all other vacuum operated units (such as the power brake) for vacuum leaks. Refer to Group 12.

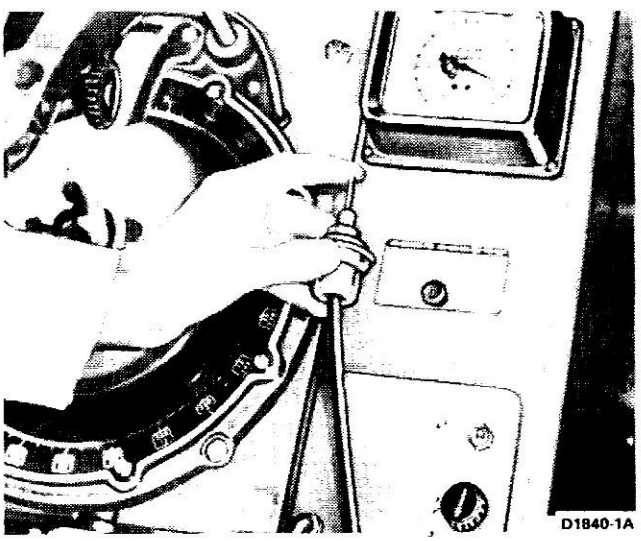


FIG. 10 Testing Transmission Vacuum Unit for Leakage

VACUUM PUMP PROCEDURE

Install the Automatic Transmission Tester. Disconnect and temporarily plug the vacuum line at vacuum diaphragm unit. Apply both the parking and service brakes. Start the engine and vacuum pump. Set the vacuum at 15 inches, read and record the control pressure in all selector positions. The two charts in Fig. 11 show what components are inoperative when the control pressure test is not within specifications. Do not proceed with the main Diagnosis Guide until you have made any repairs as required and the control pressure is within specification.

VACUUM SUPPLY TEST

The vacuum supply to the vacuum diaphragm unit and the diaphragm itself must be checked. To check the supply, disconnect the vacuum line at the diaphragm unit and connect it to a vacuum gauge. With the engine idling, the gauge must have a steady acceptable vacuum reading for the altitude at which the test is being performed. If the vacuum reading is low; check for a vacuum leak or poor engine vacuum. If the vacuum reading is okay, rapidly accelerate the engine momentarily. The vacuum reading must drop rapidly at acceleration and return immediately upon release of the accelerator. If the vacuum reading does not change or changes slowly, the transmission vacuum line is plugged, restricted or connected to a reservoir supply. Correct as required.

VACUUM DIAPHRAGM TEST—ON VEHICLE

To check the vacuum diaphragm unit, start the vacuum pump and set the regulator knob so that the vacuum gauge reads 18 inches with the end of the vacuum hose blocked off. Then connect the vacuum hose to the diaphragm unit. If the reading does not remain at 18 inches, but drops, the vacuum unit diaphragm is leaking. Replace the vacuum diaphragm unit. Also, if automatic transmission fluid is present in the vacuum side of the diaphragm or in the vacuum hose, the diaphragm is leaking and must be replaced.

VACUUM DIAPHRAGM TEST—OFF VEHICLE

To check the vacuum unit for diaphragm leakage, remove the unit from the transmission. Use a distributor tester equipped with a vacuum pump (Fig. 10). Set the regulator knob so that the vacuum gauge reads 18 inches with the end of the vacuum hose blocked off.

Connect the vacuum hose to the manifold vacuum port as shown in Fig. 9. If the gauge still reads 18 inches, the vacuum unit diaphragm **is not leaking.**

A second leakage check can be made as the hose is removed from the transmission vacuum unit. Hold a finger over the end of the control rod. When the hose is removed, the internal spring of the vacuum unit should push the control rod outward. If the vacuum diaphragm needs replacing, install a new unit that has been released for service. Vacuum diaphragm assembly identification is given in the Specifications at end of this Part.

STALL TEST (SEE FIG. 12)

Start the engine to allow it to reach its normal temperature. Apply both the parking and service brakes while making tests.

The stall test is made in D (DRIVE), 2 (SECOND), 1 (FIRST) or R (REVERSE) at full throttle to check engine performance, converter clutch operation or installation, and the holding ability of the forward clutch, reverse-high clutch and low-reverse band and the gear train one-way clutch. **While making this test, do not hold the throttle open for more than five seconds at a time.**

After test, move the selector lever to N (NEUTRAL) and run engine at 1000 rpm for about 15 seconds to

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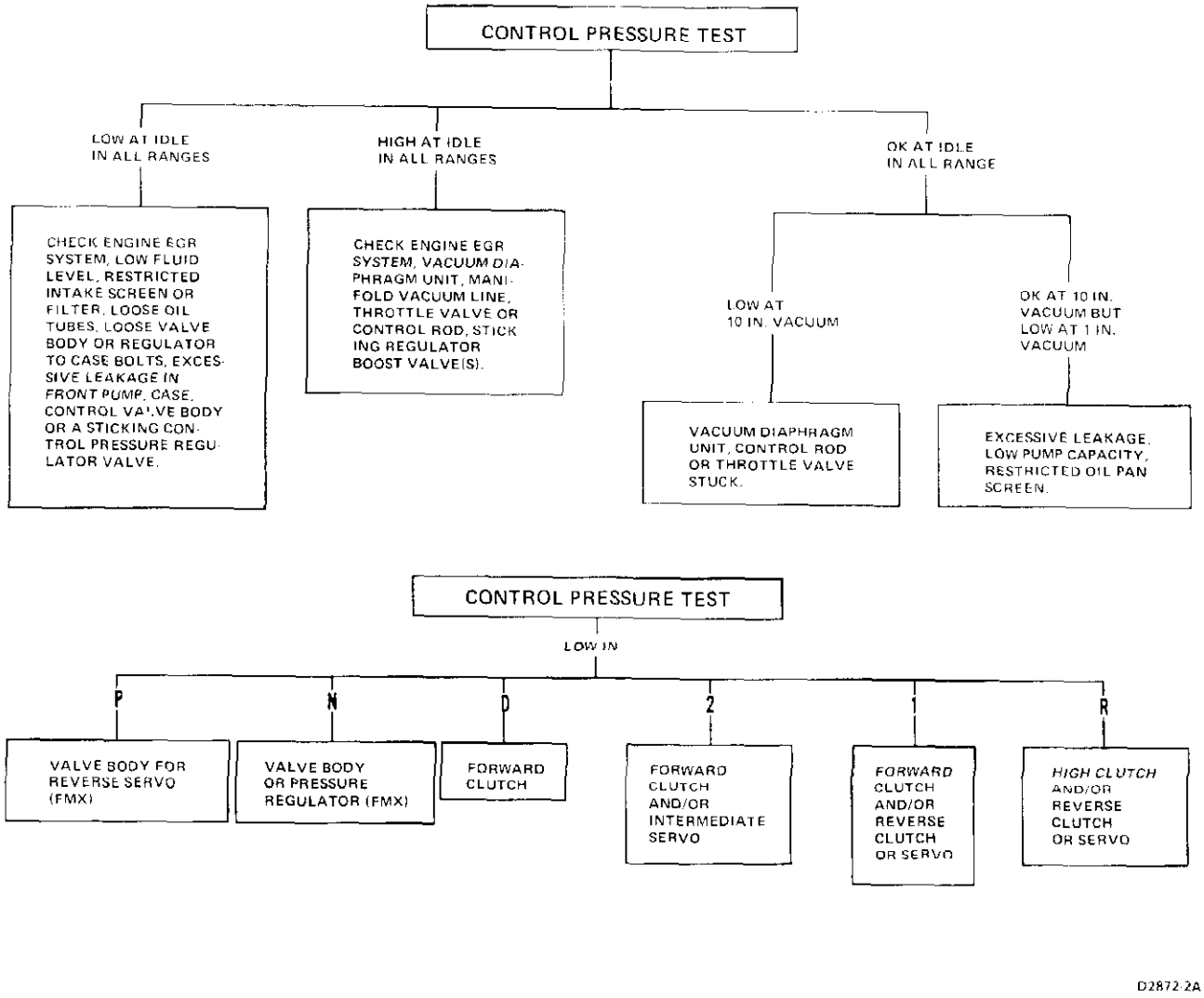


FIG. 11 Control Pressure Test Chart

cool the converter before making the next test. If the engine speed recorded by the tachometer exceeds the maximum limits given in Specifications Book, release the accelerator immediately because clutch or band slippage is indicated.

GOVERNOR CHECK

The governor can be checked at the same time as the Control Pressure Test is performed and in the same *manner.*

Raise the vehicle with an axle or frame hoist so that the rear wheels *are clear of the floor. Disconnect and* plug the vacuum line to the vacuum diaphragm unit. Connect the line from the distributor tester to the vacuum diaphragm unit. Install the Automatic Transmission Tester.

CAUTION: NEVER EXCEED 60 MPH SPEEDOMETER SPEED.

C3, C4 and C6

Place the transmission in manual 2, no load on the engine and apply 10 inches of vacuum to the vacuum diaphragm unit. Increase the speed slowly and watch the speedometer. Check the mph at which the control pressure cutbacks occur. It should occur between 10-20 mph.

NOTE: After each test move the selector to neutral, run the engine at 1000 rpm to cool the transmission.

Decrease the vacuum at the vacuum diaphragm to 0-2 inches. Repeat the check. Control pressure cutback *should occur between 30-50 mph.*

The governor is good if the cutback occurs within these specifications. If the cutback does not occur within specifications, check shift speeds to verify that it is the governor and not a stuck cutback valve, then repair or replace the governor.

FMX

With zero inches of vacuum at the vacuum diaphragm unit, place the transmission in the manual 2 and with the brakes applied, raise the engine rpm until the control pressure reaches maximum psi.

Release the brakes slowly and check the control *pressure at 10 mph, and 20 mph. While there are no* specifications, control pressure should be lower at 20 mph than at 10 mph.

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TRANSMISSION FLUID COOLER FLOW CHECK

The linkage, fluid and control pressure must be within specifications before performing this flow check.

Remove the transmission dipstick from the filler tube. Place a funnel in the transmission filler tube. Raise the vehicle, remove the cooler return line from its fitting in the case. Attach a hose to the cooler return line and fasten the free end of the hose in the funnel installed in the filler tube.

Start the engine and set idle speed at 1000 rpm with the transmission in neutral.

Observe the fluid flow at the funnel. When the flow is "solid" (air bleeding has been completed), the flow should be liberal. If there is not a liberal flow at 1000 rpm in neutral, low pump capacity, main circuit system leakage, or cooler system restriction is indicated.

To separate transmission trouble from cooler system trouble, observe the flow at the transmission case converter-out fitting.

SHIFT POINT CHECKS—(ROAD TEST)

Check the minimum throttle upshifts in D (DRIVE). The transmission should start in first gear, shift to second, and then shift to third, within the shift points given in Ford Car Performance Specifications Book.

With transmission in third gear, depress the accelerator pedal through the detent (to the floor). The transmission should shift from third to second or third to first, depending on vehicle speed.

Check the closed throttle down shift from third to first by coasting down from about 30 mph in third gear. The shift should occur within the limits given in the the Ford Car Performance Specifications Book.

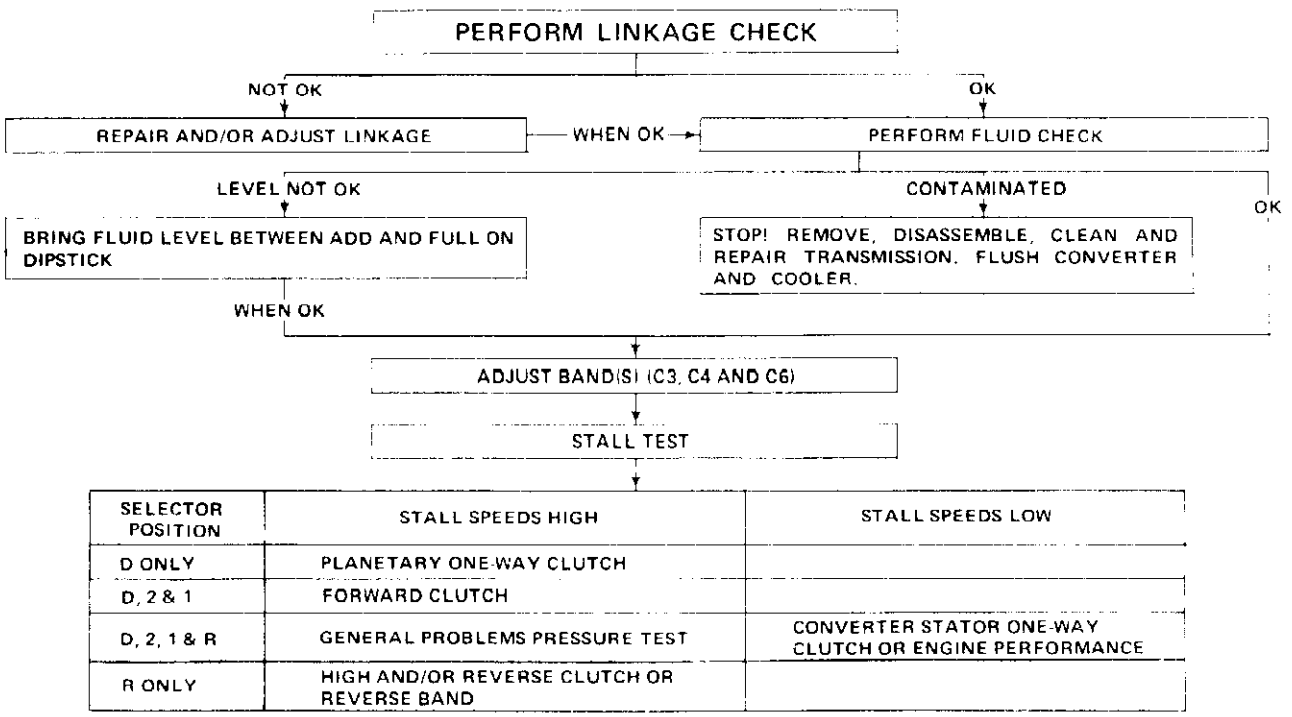
When the selector lever is at 2 (SECOND), transmission can operate only in second gear.

With the transmission in third gear and road speed over 30 mph, the transmission should shift to second gear when the selector lever is moved from D (DRIVE), to 2 (SECOND), to 1 (FIRST). The transmission will downshift from second or third to first gear when this same manual shift is made below approximately 25 mph with a C4 transmission, 30 mph with a C6 transmission or 35 mph with an FMX transmission. **This check will determine if the governor pressure and shift control valves are functioning properly. During the shift point check operation, if the transmission does not shift within specifications, or certain gear ratios cannot be obtained, refer to the Diagnosis Guide to resolve the problem.**

SHIFT TEST (IN SHOP)

A shift test can be performed in the shop to check shift valve operation, governor circuits, shift delay pressures, throttle boost and downshift valve action.

Raise the vehicle with an axle or frame hoist so that the rear wheels are clear of the floor. Disconnect and plug the vacuum line to the vacuum diaphragm unit.



SELECTOR POSITION	STALL SPEEDS HIGH	STALL SPEEDS LOW
D ONLY	PLANETARY ONE-WAY CLUTCH	
D, 2 & 1	FORWARD CLUTCH	
D, 2, 1 & R	GENERAL PROBLEMS PRESSURE TEST	CONVERTER STATOR ONE-WAY CLUTCH OR ENGINE PERFORMANCE
R ONLY	HIGH AND/OR REVERSE CLUTCH OR REVERSE BAND	

D2873-A

FIG. 12 Stall Test Diagnosis

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Connect the line from the distributor tester vacuum pump to the vacuum diaphragm unit.

CAUTION: NEVER EXCEED 60 MPH SPEEDOMETER SPEED

1. To check the shift valves and governor circuits, apply 18 inches of vacuum to the transmission vacuum diaphragm unit. Place the transmission in Drive and make a minimum throttle 1-2 and 2-3 shift test. At this point of shift you will see the speedometer needle make a momentary surge and feel the driveline bump. If the shift points are within specification, the 1-2 and 2-3 shift valves and governor are OK.

If the shift points are not within specification, perform a Governor Check to isolate the problem. NOTE: After each test, move the selector lever to neutral, run the engine at 1000 rpm to cool the transmission.

2. To check the shift delay pressures and throttle boost, decrease the vacuum at the vacuum diaphragm to 0-2 inches. Make a 1-2 shift test. If the shift point raises to specification, the throttle boost and shift delay systems are functioning.

NOTE: After each test, move the selector lever to neutral, run the engine at 1000 rpm to cool the transmission.

3. To check downshift valve action, leave the vacuum to the vacuum diaphragm at 0-2 inches. Position the downshift linkage in the wide open throttle position (through the detent) and repeat the 1-2 shift test. The speed at the shift point should be higher.

AIR PRESSURE CHECKS

A NO DRIVE condition can exist, even with the correct transmission fluid pressure, because of inoperative clutches or bands. Erratic shifts could be caused by a stuck governor valve. The inoperative units can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction.

When the selector lever is at 2, a NO DRIVE condition may be caused by an inoperative forward clutch. A NO DRIVE condition at D may be caused by an inoperative forward clutch or one-way clutch. When there is no drive in 1, the difficulty could be caused by improper functioning of the forward clutch or low-reverse band and the one-way clutch. Failure to drive in reverse range could be caused by a malfunction of the reverse-high clutch or low-reverse band or clutch.

When you have a slip problem but don't know whether it's in the valve body or in the hydraulic system beyond the valve body, the air pressure tests can be very valuable.

To make the air pressure checks, loosen the oil pan bolts and lower one edge of the oil pan to drain the transmission fluid. Remove the fluid pan and the control valve body assembly. The inoperative units can be located by introducing air pressure into the transmission case passages leading to the clutches, servos and governor (Figs. 13, 14, 15, 16 and 17).

Forward Clutch (C3, C4, C6 and JATCO) or Front Clutch (FMX)

Apply air pressure to the transmission case forward clutch or front clutch passages (Figs. 13, 14, 15, 16 and 17). A dull thud can be head when the clutch piston is applied. If no noise is heard, place the fingertips on the input shell (forward clutch cylinder—FMX) and again apply air pressure to the forward or front clutch passage. Movement of the piston can be felt as the clutch is applied.

Governor

Apply air pressure to the control pressure to governor passage, (Figs. 13, 14, 15, 16 or 17) and listen for a sharp clicking or whistling noise. The noise indicates governor valve movement.

Reverse High Clutch (C3, C4, C6 and JATCO) or Rear Clutch (FMX)

Apply air pressure to the reverse—high clutch (Figs. 13, 14, 15, 16 or 17). A dull thud indicates that the reverse—high or rear clutch piston has moved to the applied position. If no noise is heard, place the fingertips on the clutch drum and again apply air pressure to detect movement of the piston.

Intermediate Servo (C3, C4, C6 and JATCO) or Front Servo (FMX)

Hold the air nozzle in the front servo apply tube or the intermediate servo apply passages (Figs. 13, 14, 15, 16 or 17). Operation of the servo is indicated by a tightening of the front or intermediate band around the drum on C3, C4 and C6 transmission or by movement of the servo piston stem on FMX models. Continue to apply air pressure to the servo apply tube or passage, and introduce air pressure into the front release tube or the intermediate servo release pressure. The front or intermediate should release the band against the apply pressure.

Low-Reverse Servo (C3, C4) or Rear Servo (FMX)

Apply air pressure to the low-reverse or rear servo apply passage (Figs. 13, 14 or 16). On C3 and C4 transmissions, the low-reverse band should tighten around the drum if the servo is operating properly. On FMX transmissions, movement of the servo piston stem indicates correct operation.

If the servos do not operate, disassemble, clean and inspect them to locate the source of the trouble.

If air pressure applied to either of the clutch passages fails to operate a clutch or operates both clutches at once, remove and, with air pressure, check the fluid passages in the case and front pump to detect obstructions.

Low-Reverse Clutch—C6 Only

Apply air pressure to the low-reverse clutch apply passage (Fig. 15). A dull thud should be heard if the clutch is operating properly.

If the passages are clear, remove the clutch assemblies, and clean and inspect the malfunctioning clutch to locate the trouble.

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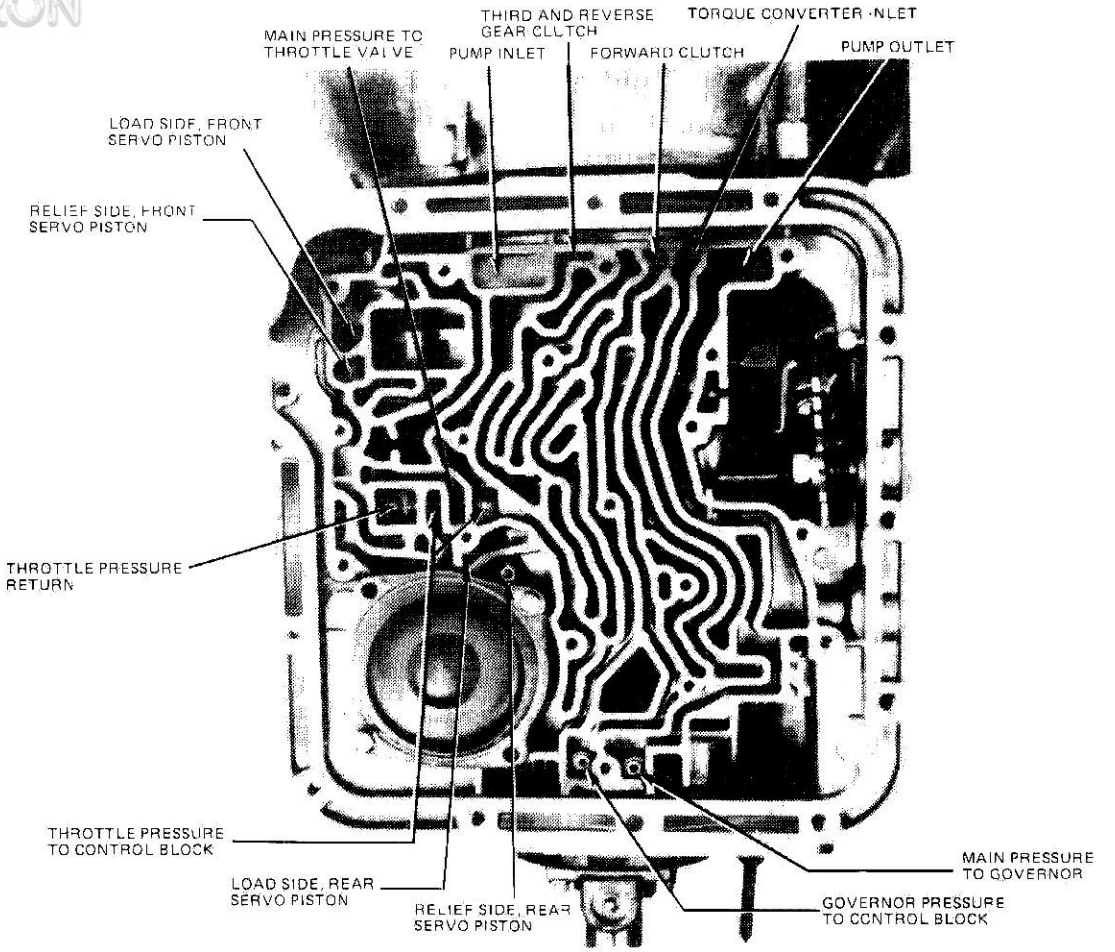


FIG. 13 Case Fluid Passage Hole Identification—C3 Automatic

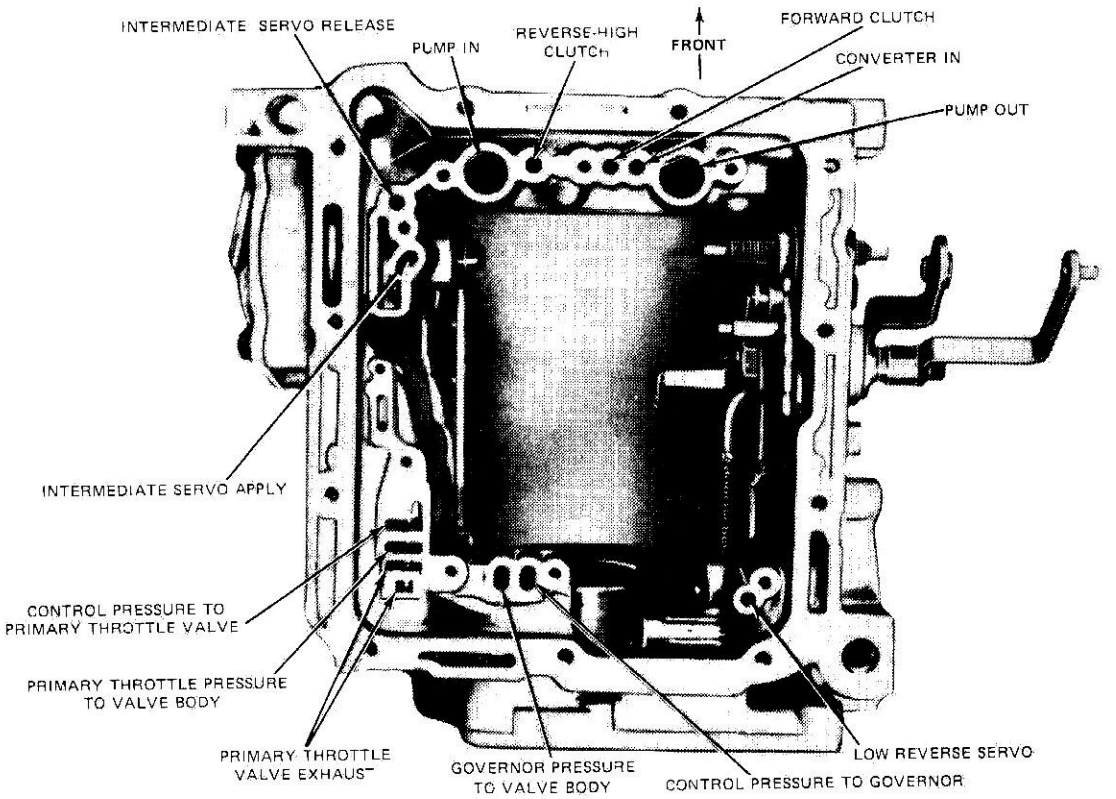


FIG. 14 Case Fluid Passage Hole Identification—C4 Automatic

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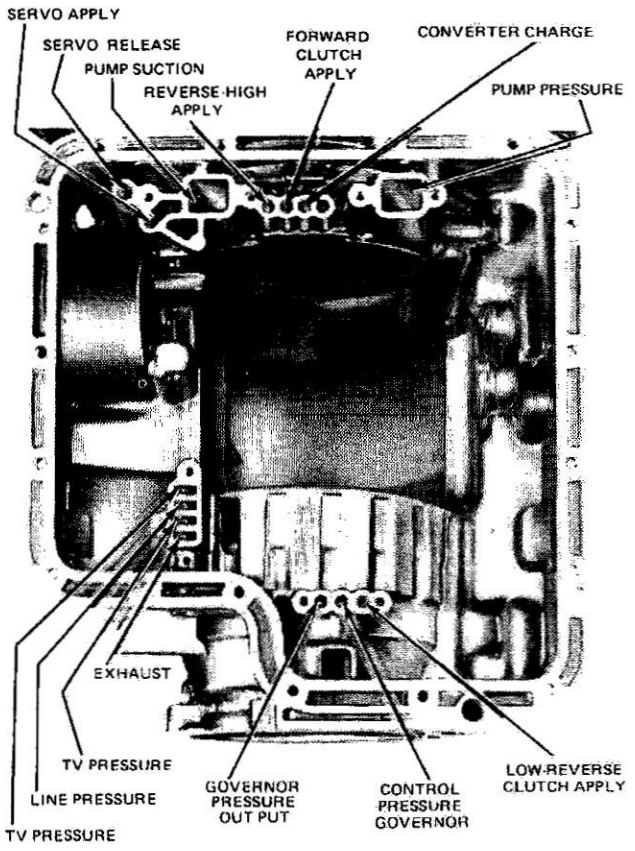


FIG. 15 Case Fluid Passage Hole Identification—C6 Automatic

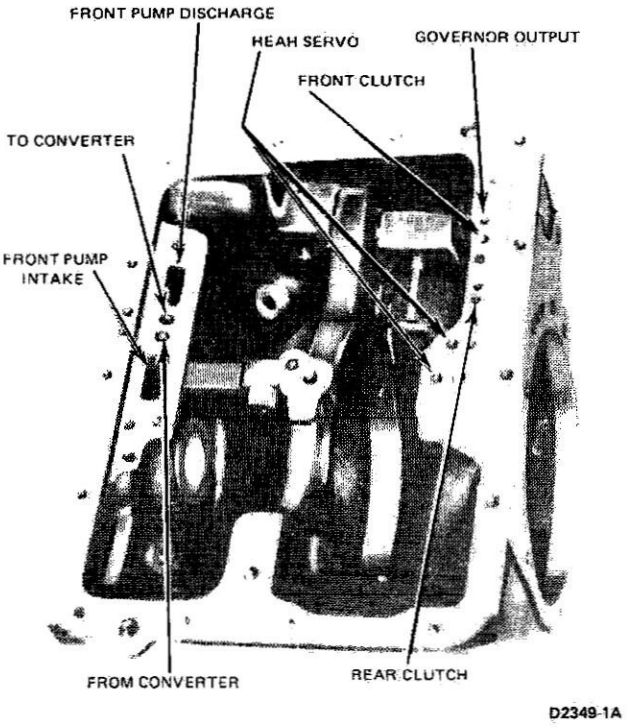


FIG. 16 Case Fluid Passage Hole Identification—FMX Automatic

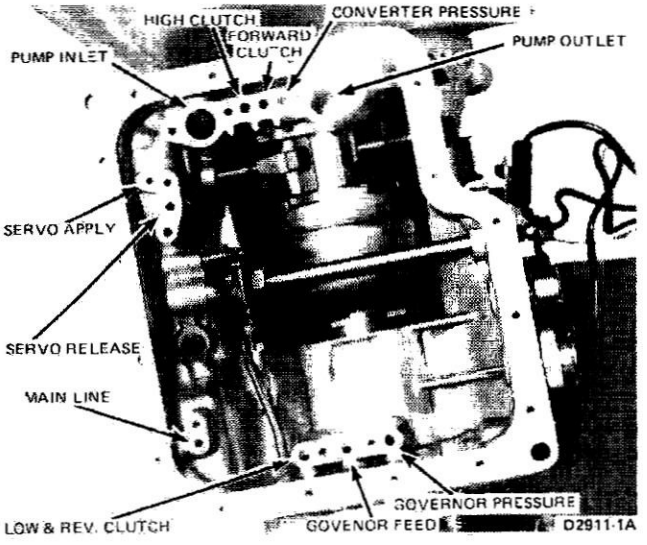


FIG. 17 Fluid Passage Hole Identification—JATCO Automatic

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DETROIT IRON

DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Slow initial engagement.	• Improper fluid level. • Damaged or improperly adjusted linkage. • Contaminated fluid. • **Improper clutch and band application, or oil control pressure.**	• Add fluid as required. • Repair or adjust linkage. • Perform fluid level check. • Perform control pressure test.
• Rough initial engagement in either forward or reverse.	• Improper fluid level. • High engine idle. • Looseness in the driveshaft, U-joints or engine mounts. • Incorrect linkage adjustment. • **Improper clutch or band application, or oil control pressure.** • Sticking or dirty valve body.	• Perform fluid level check. • Adjust idle to specifications. • Repair as required. • Repair or adjust linkage. • Perform control pressure test. • Clean, repair or replace valve body.
• No drive in any gear.	• Improper fluid level. • Damaged or improperly adjusted linkage. • **Improper clutch or band application, or oil control pressure.** • Internal leakage. • Valve body loose. • **Damaged or worn clutches.** • Sticking or dirty valve body.	• Perform fluid level check. • Repair or adjust linkage. • Perform control pressure test. • Check and repair as required. • Tighten to specification. • Perform air pressure test. • Clean, repair or replace valve body.
• No drive forward – reverse OK.	• Improper fluid level. • Damaged or improperly adjusted linkage. • **Improper clutch or band application, or oil pressure control system.** • **Damaged or worn forward clutch or governor.** • Valve body loose • Dirty or sticking valve body.	• Perform fluid level check. • Repair or adjust linkage. • Perform control pressure test. • Perform air pressure test. • Tighten to specification. • Clean, repair or replace valve body.
• No drive, slips or chatters in reverse – forward OK.	• Improper fluid level. • Damaged or improperly adjusted linkage. • Looseness in the driveshaft, U-joints or engine mounts. • **Reverse bands out of adjustment or damaged reverse clutches.** • **Improper oil pressure control.** • **Damaged or worn reverse clutch or servo.** • Valve body loose. • Dirty or sticking valve body.	• Perform fluid level check. • Repair or adjust linkage. • Repair as required. • **For C-3, C-4 or FMX – adjust reverse band. For C-6 – repair reverse clutches as required.** • Perform control pressure test. • Perform air pressure test. • Tighten to specifications. • Clean, repair or replace valve body.

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FIG. 18 Diagnosis—Automatic Transmission

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DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• No drive, slips or chatters in first gear in D. All other gears normal.	• Damaged or worn one-way clutch.	• Repair or replace one-way clutch.
• No drive, slips or chatters in second gear.	• Improper fluid level. • Damaged or improperly adjusted linkage. • Intermediate band out of adjustment. • Improper band or clutch application, or oil pressure control. • Damaged or worn servo and/or internal leaks. • Dirty or sticking valve body. • Polished, glazed intermediate band or drum.	• Perform fluid level check. • Repair or adjust linkage. • Adjust intermediate band. • Perform control pressure test. • Perform air pressure test. • Clean, repair or replace valve body. • Replace or repair as required.
• Starts in high – in D drag or lockup at 1 2 shift point or in 2 or 1.	• Improper fluid level. • Damaged or improperly adjusted linkage. • Damaged or worn governor. • Damaged or worn clutches and/or internal leaks. • Valve body loose. • Dirty, sticking valve body. • Poor mating of valve body to case mounting surfaces.	• Perform fluid level check. • Repair or adjust linkage. • Repair or replace governor, clean screen. • Perform air pressure test. • Tighten to specifications. • Clean, repair or replace valve body. • Replace valve body or case.
• Starts up in 2nd or 3rd	• Improper fluid level. • Damaged or improperly adjusted linkage. • *Improper band and/or clutch application, or oil pressure control system.* • Damaged or worn governor. • Valve body loose. • Dirty or sticking valve body. • Cross leaks between valve body and case mating surface.	• Perform fluid level check. • Repair or adjust linkage. • *Perform control pressure test.* • Perform governor check. Replace or repair governor, clean screen. • Tighten to specification. • Clean, repair or replace valve body. • Replace valve body and/or case as required.

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FIG. 19 Diagnosis–Automatic Transmission (Cont'd.)

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DETROIT IRON

DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Shift points incorrect.	• Improper fluid level. • Improper vacuum hose routing or leaks. • Improper operation of EGR system. • Linkage out of adjustment. • Improper speedometer gear installed. • Improper clutch or band application, or oil pressure control system. • Damaged or worn governor. • Dirty or sticking valve body.	• Perform fluid level check. • Correct hose routing. • Repair or replace as required. • Repair or adjust linkage. • Replace gear. • Perform shift test and control pressure test. • Repair or replace governor – clean screen. • Clean, repair or replace valve body.
• No upshift at any speed in D.	• Improper fluid level. • Vacuum leak to diaphragm unit. • Linkage out of adjustment. • Improper band or clutch application, or oil pressure control system. • Damaged or worn governor. • Dirty or sticking valve body.	• Perform fluid level check. • Repair vacuum line or hose. • Repair or adjust linkage. • Perform control pressure test. • Repair or replace governor, clean screen. • Clean, repair or replace valve body.
• Shifts 1-3 in D.	• Improper fluid level. • Intermediate band out of adjustment. • Damaged intermediate servo and/or internal leaks. • Polished, glazed band or drum. • Improper band or clutch application, or oil pressure control system. • Dirty or sticking valve body.	• Perform fluid level check. • Adjust band. • Perform air pressure test. Repair front servo and/or internal leaks. • Repair or replace band or drum. • Perform control pressure test. • Clean, repair or replace valve body.
• Engine over-speeds on 2-3 shift.	• Improper fluid level. • Linkage out of adjustment. • Improper band or clutch application, or oil pressure control system. • Damaged or worn high clutch and/or intermediate servo. • Dirty or sticking valve body.	• Perform fluid level check. • Repair or adjust linkage. • Perform control pressure test. • Perform air pressure test. Repair as required. • Clean repair or replace valve body.

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FIG. 20 Diagnosis–Automatic Transmission (Cont'd.)

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DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• Mushy 1-2 shift.	• Improper fluid level	• Perform fluid level check.
	• Incorrect engine performance.	• Tune adjust engine idle as required
	• Improper linkage adjustment.	• Repair or adjust linkage.
	• Intermediate band out of adjustment.	• Adjust intermediate band.
	• Improper band or clutch application, or oil pressure control system.	• Perform control pressure test.
	• Damaged high clutch and/or intermediate servo or band.	• Perform air pressure test. Repair as required.
	• Polished, glazed band or drum.	• Repair or replace as required.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• Rough 1-2 shift.	• Improper fluid level.	• Perform fluid level check.
	• Incorrect engine idle or performance.	• Tune, and adjust engine idle.
	• Intermediate band out of adjustment.	• Adjust intermediate band.
	• Improper band or clutch application, or oil pressure control system.	• Perform control pressure test.
	• Damaged intermediate servo.	• Air pressure check intermediate servo.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• Rough 2-3 shift.	• Improper fluid level.	• Perform fluid level check.
	• Incorrect engine performance.	• Tune and adjust engine idle.
	• Improper band or clutch application, or oil control pressure system.	• Perform control pressure test.
	• Damaged or worn intermediate servc release and high clutch piston check ball.	• Air pressure test the intermediate servo apply and release and the high clutch piston check ball. Repair as required.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• Rough 3-1 shift at closed throttle in D.	• Improper fluid level.	• Perform fluid level check.
	• Incorrect engine idle or performance.	• Tune, and adjust engine idle.
	• Improper linkage adjustment.	• Repair or adjust linkage.
	• Improper clutch or band application, or oil pressure control system.	• Perform control pressure test.
	• Improper governor operation.	• Perform governor test. Repair as required.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body (or on FMX – regulator assembly).

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FIG. 21 Diagnosis—Automatic Transmission (Cont'd.)

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DETROIT IRON

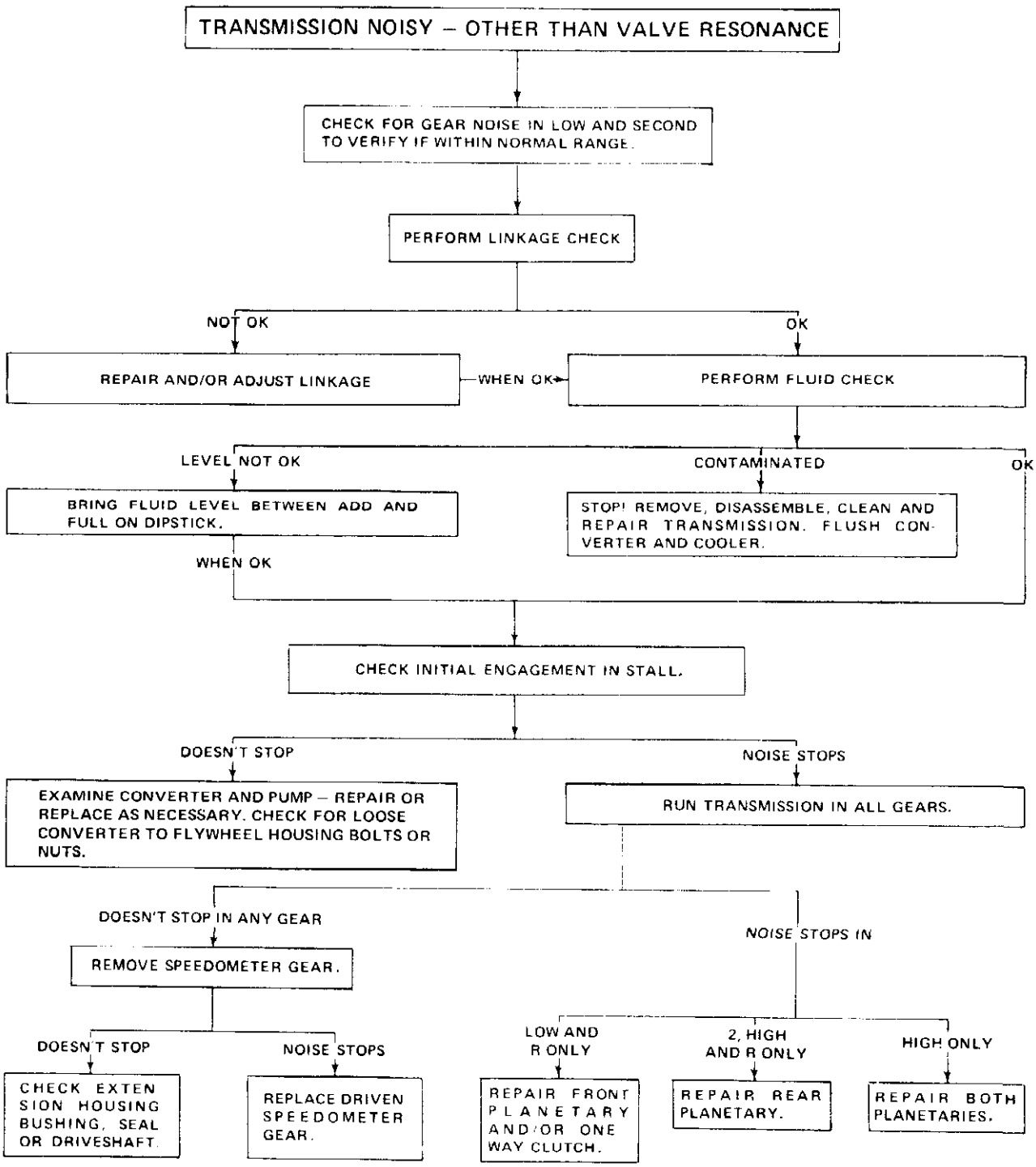
DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• No forced downshifts.	• Improper fluid level.	• Perform fluid level check.
	• Linkage out of adjustment.	• Repair or adjust linkage.
	• Improper clutch or band application, or oil pressure control system.	• Perform control pressure test.
	• Damaged internal kickdown linkage.	• Repair internal kickdown linkage.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• No 3-1 shift in D.	• Improper fluid level.	• Perform fluid level check.
	• Incorrect engine idle, or performance.	• Tune, and adjust engine idle.
	• Damaged governor.	• Perform governor check. Repair as required.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• Runaway engine on 3-2 downshift.	• Improper fluid level.	• Perform fluid level check.
	• Linkage out of adjustment.	• Repair or adjust linkage.
	• Intermediate band out of adjustment.	• Adjust intermediate band.
	• Improper band or clutch application, or oil pressure control system.	• Perform control pressure test.
	• Damaged or worn intermediate servo.	• Air pressure test check the intermediate servo. Repair servo and/or seals.
	• Polished, glazed band or drum.	• Repair or replace as required.
	• Dirty or sticking valve body.	• Clean, repair or replace valve body.
• No engine braking in manual first gear.	• Improper fluid level.	• Perform fluid level check.
	• Linkage out of adjustment.	• Repair or adjust linkage.
	• Bands or clutches out of adjustment.	• On C-3, C-4 or FMX – adjust reverse band. On C-6 – adjust low-reverse clutch.
	• Oil pressure control system.	• Perform control pressure test.
	• Damaged or worn reverse servo.	• Perform air pressure test of reverse servo. Repair reverse clutch or rear servo as required.
	• Polished, glazed band or drum.	• Repair or replace as required.

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FIG. 22 Diagnosis–Automatic Transmission (Cont'd.)

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FIG. 23 Diagnosis—Automatic Transmission (Cont'd.)

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DETROIT IRON

DIAGNOSIS – AUTOMATIC TRANSMISSION

CONDITION	POSSIBLE CAUSE	RESOLUTION
• No engine braking in manual second gear.	• Improper fluid level. • Linkage out of adjustment • Intermediate band out of adjustment. • Improper band or clutch application, or oil pressure control system. • Intermediate servo leaking. • Polished or glazed band or drum.	• Perform fluid level check. • Repair or adjust linkage. • Adjust intermediate band. • Perform control pressure test • Perform air pressure test of intermediate servo for leakage. Repair as required. • Repair or replace as required.
• Transmission noisy – valve resonance.	• Improper fluid level. • Linkage out of adjustment. • Improper band or clutch application, or oil pressure control system. • Cooler lines grounding. • Dirty sticking valve body. • Internal leakage or pump cavitation.	• Perform fluid level check. • Repair or adjust linkage. • Perform control pressure test. • Free up cooler lines. • Clean, repair or replace valve body. • Repair as required.
• Transmission overheats.	• Improper fluid level. • Incorrect engine idle, or performance. • Improper clutch or band application, or oil pressure control system • Restriction in cooler or lines. • Seized one-way clutch. • Dirty or sticking valve body.	• Perform fluid level check. • Tune, or adjust engine idle. • Perform control pressure test. • Repair restriction. • Replace one-way clutch. • Clean, repair or replace valve body.
• Transmission fluid leaks.	• Improper fluid level. • Leakage at gasket, seals, etc. • Vacuum diaphragm unit leaking.	• Perform fluid level check. • Remove all traces of lube on exposed surfaces of transmission. Check the vent for free breathing. Operate transmission at normal temperatures and inspect for leakage. Repair as required. • Replace diaphragm.

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FIG. 24 Diagnosis–Automatic Transmission (Cont'd.)

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REMOVAL AND INSTALLATION

VACUUM DIAPHRAGM

1. Disconnect the hoses from the vacuum unit.
2. On C3 transmissions remove the vacuum unit retaining bracket bolt and bracket (Fig. 25). **Do not pry or bend the bracket.** Pull the vacuum diaphragm, the actuating pin and the throttle valve from the transmission case. Remove the O-ring from the assembly.
3. Install a new O-ring. Install the throttle valve, the actuating pin and the vacuum diaphragm tube pointing rearward, in to the transmission case. Install the retaining bracket bolt and torque it to 15-23 in-lbs.
4. On C4 and C6 transmissions, remove the vacuum unit retaining bracket bolt and bracket (Fig. 24). **Do not pry or bend the bracket.** Pull the vacuum unit from the transmission case.

   On an FMX transmission, remove the vacuum unit with the tool shown in Fig. 27.
5. Remove the vacuum unit control rod from transmission case.
6. Install the vacuum unit control rod in transmission case.
7. On C4 and C6 transmissions, push the vacuum unit into the case and secure with the retaining bracket and bolt. Tighten the bolt, 28 to 40 ft-lb. on C4 transmissions and 12 to 16 ft-lb. on C6 transmissions.

   On an FMX transmission, thread the vacuum unit into the case and using a torque wrench with the tool shown in Fig. 27, tighten the unit, 15 to 23 ft-lb. torque.
8. Install the vacuum unit hose to the connector.

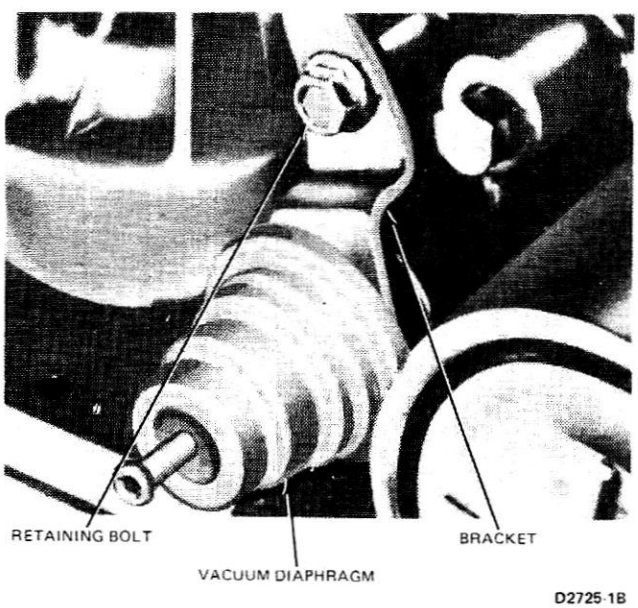


FIG. 25 Vacuum Diaphragm Installed C3 Transmission

TRANSMISSION FLUID DRAIN AND REFILL

Normal maintenance and lubrication requirements do not necessitate periodic automatic transmission fluid changes. If a major repair, such as a clutch band, bearing, etc., is required in the transmission, it will have to be removed for service. **At this time the converter, transmission cooler and cooler lines must be thoroughly flushed to remove any dirt.**

When used under continuous or severe conditions (police or taxi) the transmission and torque converter should be drained and refilled with fluid as specified in the following: C3 Automatic Transmission (Code U)*; C4 Automatic Transmission (Code W)*; and FMX Automatic Transmission (Code X)*; use fluid that meets Ford Specification ESW-M2C33-F (Type F) Certification is evidenced by the following information appearing on the fluid container: FORD, Qualification No. 25-XXXXXX, ESW-M2C33-F. C6 Automatic Transmission (Code U)* and JATCO Automatic Transmission (Code S)*. Use fluid that meets Ford Specification ESP-M2C138-CJ.

CAUTION: Use of a fluid other than specified above could result in transmission malfunction and/or failure.

*Refer to Vehicle Certification Label affixed to left front door lock face panel or door pillar for transmission code.

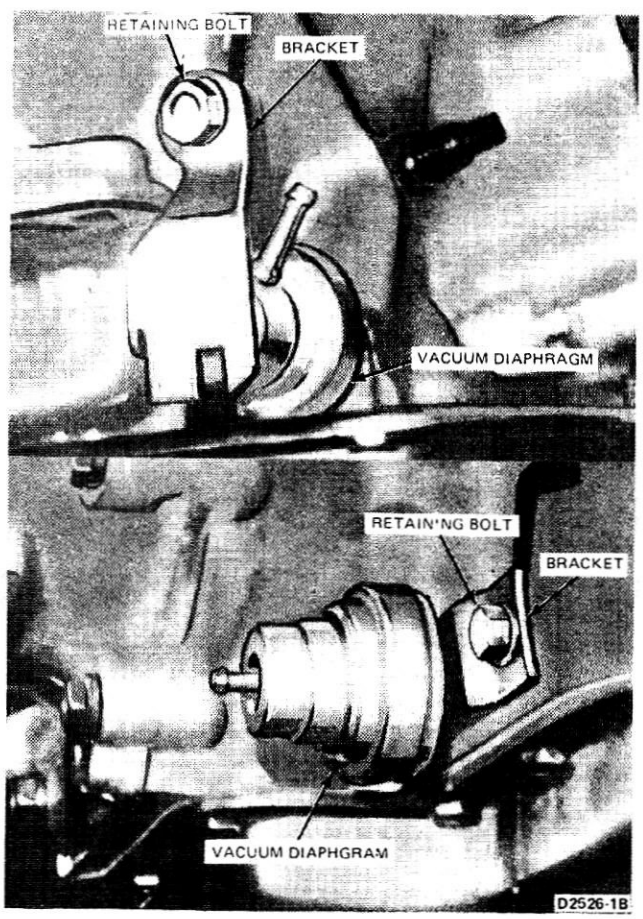


FIG. 26 Vacuum Diaphragm Installed—C4 and C6 Transmissions

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When filling a dry transmission and converter, refer to Specifications for capacity. Check the fluid level following the room temperature checking procedures described in this Part.

Procedures for partial drain and refill, due to in-vehicle repair operation, are as follows:

C3 and C4 Transmissions

1. On pan-filled models of C4 transmissions, disconnect the fluid filler tube from the transmission oil pan to drain the fluid.

   On all other models, loosen the pan attaching bolts to drain the fluid from the transmission.
2. When all fluid has drained from the transmission, remove and thoroughly clean the pan and screen. Discard the pan gasket.
3. Place a new gasket on the pan, and install the pan on the transmission.
4. On pan-filled models, connect the filler tube to the pan and tighten the fitting securely.
5. Add three quarts of fluid to the transmission through the filler tube.
6. Check the fluid level following the room temperature checking procedures described in this Part.

FMX, JATCO or C6 Transmission

1. Raise the vehicle on a hoist or jack stands.
2. Place a drain pan under the transmission.
3. Loosen the pan attaching bolts and drain the fluid from the transmission.
4. When fluid has drained to the level of the pan flange, remove the rest of the pan bolts working from the rear and both sides of the pan to allow it to drop and drain slowly.
5. When all fluid has drained from the transmission, remove and thoroughly clean the pan and the screen. Discard the pan gasket.
6. Place a new gasket on the pan, and install the pan on the transmission.
7. Add three quarts of fluid to the transmission through the filler tube.
8. Check the fluid level following the checking procedures described in this Part.

OIL COOLER TUBE

When fluid leakage is found at the oil cooler, the cooler must be replaced. Cooler replacement is described in the Cooling System Part of Group 27.

When one or more of the fluid cooler steel tubes must be replaced, each replacement tube must be fabricated from the same size steel tubing as the original line.

Using the old tube as a guide, bend the new tube as required. Add the necessary fittings, and install the tube.

After the fittings have been tightened, add fluid as needed and check for fluid leaks.

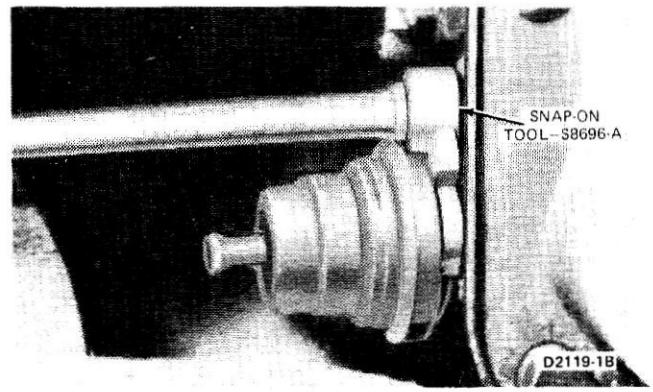


FIG. 27 Removing or Installing Vacuum Diaphragm—FMX Transmission

CLEANING AND INSPECTION

TRANSMISSION

Clean the parts with suitable solvent and use moisture-free air to dry off all parts and clean out fluid passages.

The composition clutch plates, control valve body-to-screen gasket, bands and synthetic seals should not be cleaned in a vapor degreaser or with any type of detergent solution. To clean these parts, wipe them off with a lint-free cloth. New clutch plates or bands should be soaked in the specified transmission fluid for fifteen minutes before being assembled.

CONTROL VALVE BODY

1. Clean all parts thoroughly in clean solvent, and blow dry with moisture-free compressed air. **If the valve body-to-screen gasket is removed on a C3, C4 or C6 Automatic, the gasket should not be cleaned in a degreaser, solvent or any type of detergent solution. To clean the gasket, wipe it off with a lint-free cloth.**
2. Inspect all valve and plug bores for scores. Check all fluid passages for obstructions. Inspect the check valve for free movement. Inspect all mating surfaces for burrs or distortion. Inspect all plugs and valves for burrs and scores. **Use crocus cloth to polish valves and plugs. Avoid rounding the sharp edges of the valves and plugs with the cloth.**
3. Inspect all springs for distortion. Check all valves and plugs for free movement in their respective bores. Valves and plugs, when dry, must fall from their own weight in their respective bores.
4. On a C6 transmission, inspect the separator plate screen for obstructions. The screen must be clean and free of foreign material. If contaminated,

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remove the screen from separator plate, clean in a suitable solvent, and thoroughly blow dry with compressed air.

5. Roll the manual valve on a flat surface to check for bent condition.

INTERMEDIATE SERVO (C3, C4, AND C6 TRANSMISSIONS)

1. Inspect the servo bore for cracks and the piston bore and the servo piston stem for scores. Check fluid passages for obstructions, and replace damaged seals.
2. Check the servo spring and servo band strut(s) for distortion.
3. Inspect the cover seal and gasket cover sealing surface for damage.

LOW-REVERSE SERVO (C3 and C4 TRANSMISSION)

1. Inspect the servo body for cracks and the piston bore for scores.
2. Check the fluid passages for obstructions.
3. Inspect the band and (except C3) the struts for distortion. Inspect the band ends for cracks (C4 only).
4. Inspect the servo spring for distortion.
5. Inspect the band lining for excessive wear and bonding to the metal band.
6. Replace damaged seals.

FRONT SERVO (FMX TRANSMISSION)

1. Inspect the servo bore for cracks and the piston bore and the servo piston stem for scores. Check fluid passages for obstructions. Replace damaged seals.
2. Inspect the actuating lever for free movement and wear. If necessary to replace the actuating lever or shaft, remove the retaining pin and push the shaft out of the bracket. Inspect the adjusting screw threads and lever threads for damage.
3. Check the servo spring and servo band strut(s) for distortion.

REAR SERVO (FMX TRANSMISSION)

1. Inspect the servo body for cracks and the piston bore for scores.
2. Check the fluid passages for obstructions.
3. Inspect the band and the struts for distortion. Inspect the band ends for cracks.
4. Inspect the servo spring for distortion.
5. Inspect the band lining for excessive wear and bonding to the metal band.
6. Check the servo body to case mating surface for burrs. Check the accumulator piston and the check valve for freedom of movement. Check the actuating lever socket for scores.
7. Replace damaged seals.

EXTENSION HOUSING

1. Inspect the housing for cracks. Inspect the gasket surface for burrs or warpage.
2. Inspect the bushing for scores or wear.
3. Inspect the rear seal for hardness, cracks, or wear. If the seal shows wear or deterioration, replace the seal.
4. Inspect the seal counterbore and remove all burrs and scores with crocus cloth.

GOVERNOR

1. Inspect the governor valves and bores for scores. Minor scores may be removed from the valves with crocus cloth. Replace the governor if the valves or body is deeply scored.
2. On a FMX transmission, inspect the governor screen for obstructions. The screen must be free of foreign material. If contaminated, clean thoroughly in a suitable solvent and blow dry with compressed air.
3. Check for free movement of the valves in the bores. The valves should slide freely of their own weight in the bores when dry. Inspect fluid passages in the valve body and counterweight for obstructions. **All fluid passages must be clean.**
4. Inspect the mating surfaces of the governor body and governor distributor (C3, C4 or C6 Automatic) for burrs and distortion. Mating surfaces must be smooth and flat.
5. Check the mating surface of the governor valve and the counterweight on an FMX transmission for burrs or scratches.

PRESSURE REGULATOR (FMX TRANSMISSION)

1. Inspect the regulator body and cover mating surface for burrs.
2. Check all fluid passages for obstructions.
3. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth.
4. Check free movement of the valves in their bores. The valves should fall freely into the bores when both the valve and bore are dry.
5. Inspect the valve springs and spacers for distortion.

FRONT PUMP

1. Inspect the mating surfaces of the pump body and cover for burrs.
2. Inspect the drive and driven gear bearing surface for scores, and check gear teeth for burrs.
3. Check the fluid passages for obstructions.
4. If any parts are found defective, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth.
5. On a C6 transmission, check the large seal ring groove of the pump body for damage. Check the gasket mating surface of the pump body for damage.

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REVERSE-HIGH CLUTCH (C3, C4, AND C6 TRANSMISSIONS)

1. Inspect the drum band surface, the bushing, and thrust surfaces for scores. Minor scores may be removed with crocus cloth. **Badly scored parts must be replaced.**
2. Inspect the clutch piston bore and the piston inner and outer bearing surfaces for scores. Check the air bleed ball valve in the clutch piston for free movement. Check the orifice to make sure it is not plugged.
3. Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
4. Inspect the clutch plates for wear, scoring, and fit on the clutch hub serrations. Replace all plates that are badly scored, worn, or do not fit freely in the hub serrations.
5. Inspect the clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release spring(s) for distortion.

FORWARD CLUTCH (C3, C4, AND C6 TRANSMISSIONS)

1. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if it is badly scored or damaged.
2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect the piston check ball for freedom of movement and proper seating (Fig. 28).

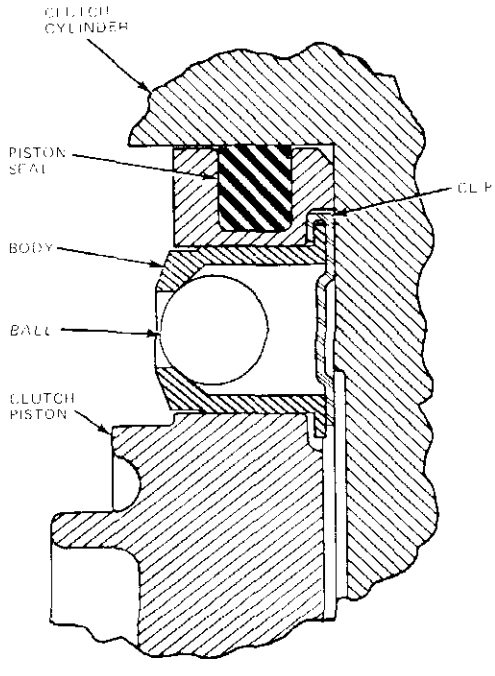


FIG. 28 Clutch Piston Check Valve

3. Check the clutch release spring (C4 only) for distortion and cracks. Replace the spring if it is distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates, and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored.
5. On C4 transmissions, check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.
7. Check the splines on the stator support for wear. Replace shaft if the splines are excessively worn. Inspect the bushing in the stator support for scores. Check the input shaft for damaged or worn splines.

LOW-REVERSE CLUTCH (C6 TRANSMISSION)

1. Inspect the clutch cylinder piston bore (in the case) and clutch plate serrations for scoring or burrs. Minor burrs may be removed with crocus cloth. Replace the case if it is badly scored or damaged.
2. Check the fluid passage in the case for obstructions. Clean out all fluid passages. Inspect the clutch piston for scoring and replace if necessary.
3. Check the piston return springs for distortion. Check the piston return spring retainer for flatness.
4. Inspect the composition clutch plates, steel clutch plates and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored.
5. Check the clutch hub splines for wear.

REAR CLUTCH (FMX TRANSMISSION)

1. Inspect the drum band surface, the bushing, and thrust surfaces for scores. Minor scores may be removed with crocus cloth. **Badly scored parts must be replaced.**
2. Inspect the clutch piston bore and the piston inner and outer bearing surfaces for scores. Check the air bleed ball valve in the clutch piston for free movement. Check the orifice to make sure it is not plugged.
3. Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
4. Inspect the clutch plates for wear, scoring, and fit on the clutch hub serrations. Replace all plates that are badly scored, worn or do not fit freely in the hub serrations.
5. Inspect the clutch pressure plate for scores on the clutch plate bearing surface. Check the clutch release spring(s) for distortion.
6. Inspect the needle bearing for worn rollers.

FRONT CLUTCH (FMX TRANSMISSION)

1. Inspect the clutch cylinder thrust surfaces, piston bore, and clutch plate serrations for scores or burrs. Minor scores or burrs may be removed with crocus cloth. Replace the clutch cylinder if it is badly scored or damaged.

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2. Check the fluid passage in the clutch cylinder for obstructions. Clean out all fluid passages. Inspect the clutch piston for scores and replace if necessary. Inspect the piston check ball for freedom of movement and proper seating (Fig. 28).
3. Check the clutch release spring for distortion and cracks. Replace the spring if it is distorted or cracked.
4. Inspect the composition clutch plates, steel clutch plates, and clutch pressure plate for worn or scored bearing surfaces. Replace all parts that are deeply scored.
5. Check the clutch plates for flatness and fit on the clutch hub serrations. Discard any plate that does not slide freely on the serrations or that is not flat.
6. Check the clutch hub thrust surfaces for scores and the clutch hub splines for wear.
7. Inspect the turbine shaft bearing surfaces for scores. If excessive clearance or scores are found, discard the unit.
8. Check the splines on the turbine shaft for wear, replace the shaft if the splines are excessively worn. Inspect the bushing in the turbine shaft for scores.

ONE-WAY CLUTCH

1. Inspect the outer and inner races for scores or damaged surface areas where the rollers contact the races. If the outer race on the C6 transmission is damaged the low-reverse clutch hub must be replaced.
2. Inspect the rollers and springs for excessive wear or damage.
3. Inspect the spring and roller case for bent or damaged spring retainers.

PRIMARY SUN GEAR SHAFT (FMX TRANSMISSION)

1. Inspect the primary sun gear for broken or worn teeth. Inspect all thrust surfaces and journals for scores. Check all fluid passages (Fig. 29) for obstructions and leakage. Inspect the seal ring grooves for burrs.
2. Inspect the sun gear shaft splines for burrs and wear.
3. Check the fit of the seal rings in the grooves of the shaft. The rings should enter the grooves freely without binding.
4. Check the fit of the seal rings in their respective bores. A clearance of 0.002 to 0.009 inch should exist between the ends of the rings.
5. Install the seal rings on the shaft, and check for free movement in the grooves.

CONVERTER AND OIL COOLER

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the converter and oil cooler. These contaminants are a major cause of recurring transmission troubles and **MUST** be removed from the system before the transmission is put back into service.

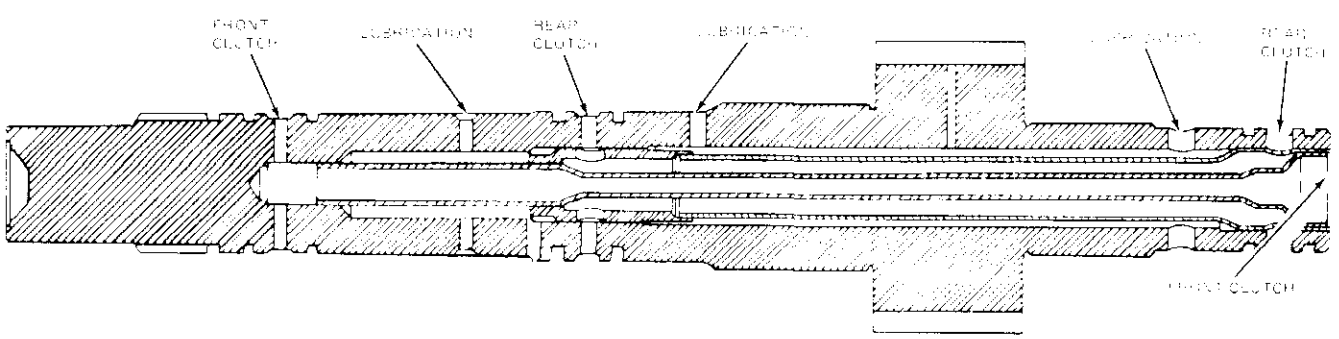
Whenever a transmission has been disassembled to replace worn or damaged parts or because the valve body sticks from foreign material, the converter and oil cooler **MUST** be cleaned by using a mechanically agitated cleaner, such as the Rotunda 14-0028 or equivalent. **Under NO circumstances should an attempt be made to clean converters or oil coolers by hand agitation with solvent.**

CONVERTER END PLAY AND ONE WAY CLUTCH CHECK

The tool shown in Fig. 30 is used to check the converter end play. The tools shown in Fig. 31 are used to check the converter one-way clutch.

END PLAY CHECK

1. Insert Tool T77L-7092-D into the converter pump drive hub until it bottoms.
2. Expand the sleeve in the turbine spline by tightening the threaded inner post (Fig. 32), until the tool is securely locked into the spline.
3. Attach a dial indicator to the tool (Figs. 32 and 33). Position the indicator button on the converter pump drive hub, and set the dial face at 0 (zero).



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FIG. 29 Primary Sun Gear—Cross Sectional View—Typical

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DETROIT IRON

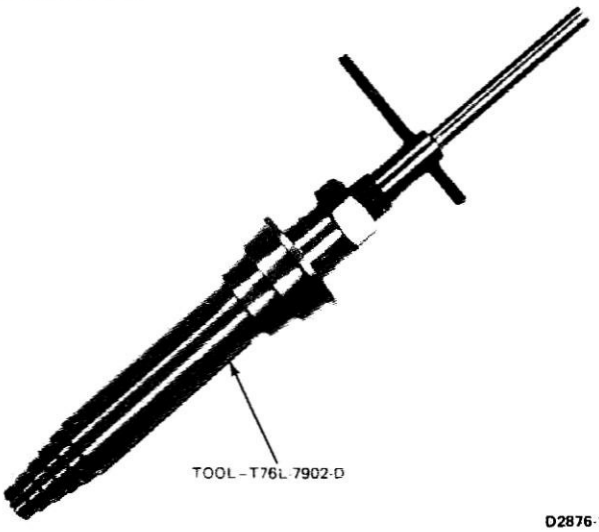


FIG. 30 Converter End Play Checking Tool

4. Lift the tool upward as far as it will go and note the indicator reading. The indicator reading is the total end play which the turbine and stator share. Replace the converter unit if the total end play exceeds the limits indicated under Specifications, at the end of each transmission part.
5. Loosen the threaded inner post to free the tool and then remove the tool from the converter.

CONVERTER ONE-WAY CLUTCH CHECK

1. Insert the one-way clutch holding tool (Fig. 34) in one of the grooves in the stator thrust washer.
2. Insert the one-way clutch torquing Tool (T77L-7902-B for C3 Automatic Transmissions and T76L-7902-C for C4, FMX, C6 Automatic transmissions) in the converter pump drive hub so as to engage the one-way clutch inner race (Fig. 34).

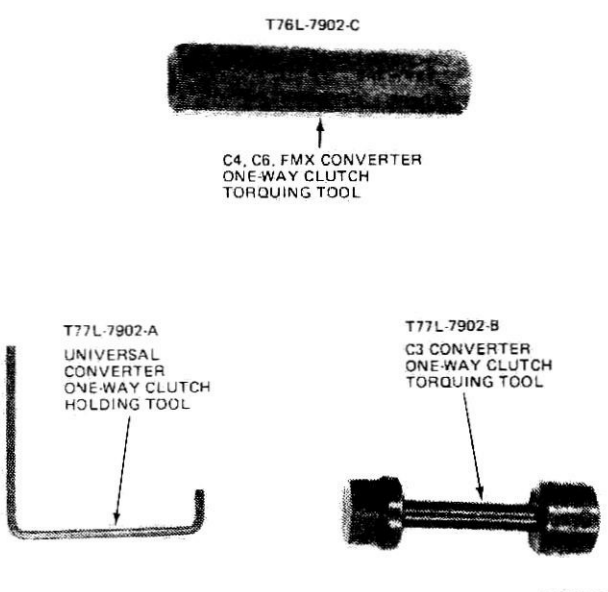


FIG. 31 Converter One Way Clutch Checking Tools

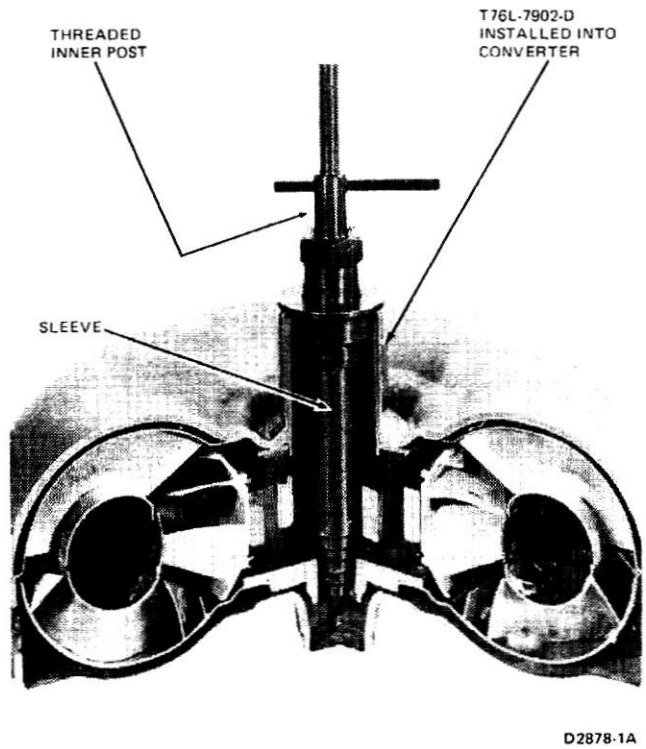


FIG. 32 End Play Checking Tool Installed

3. Attach a torque wrench to the one-way clutch torquing tool. With the one-way clutch holding tool held stationary, turn the torque wrench

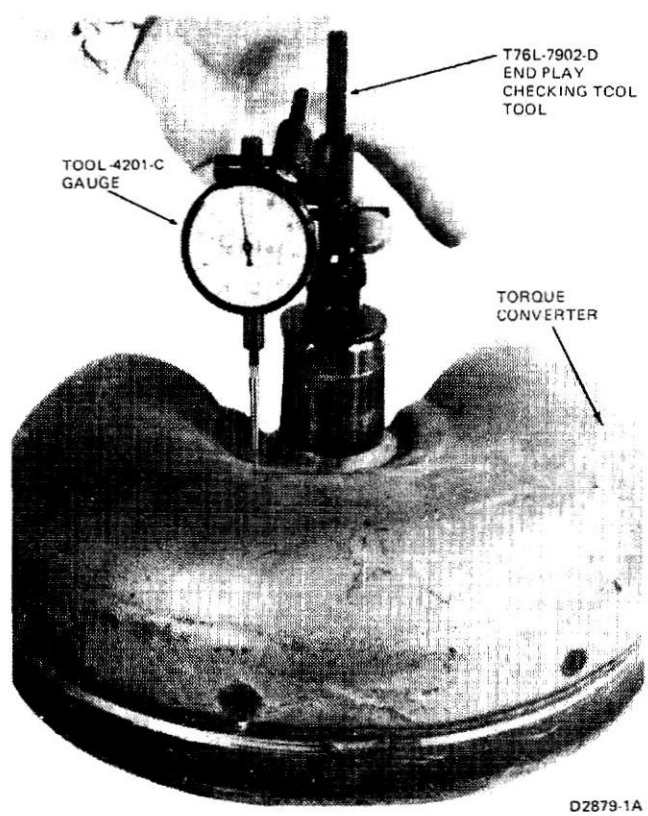


FIG. 33 Checking Stator and Turbine End Play

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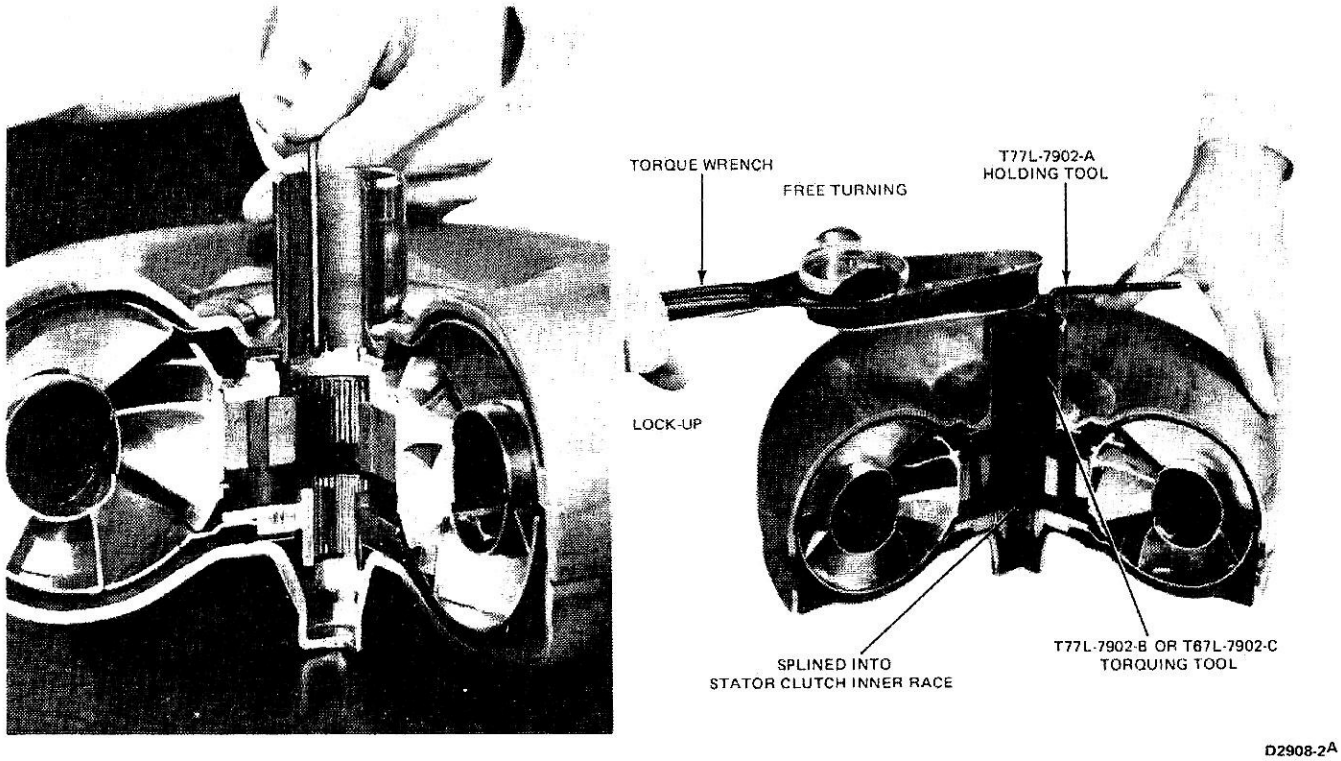


FIG. 34 Checking Stator One-Way Clutch

counterclockwise. The converter one-way clutch should lock-up and hold a 10 ft-lb force. The converter one-way clutch should rotate freely in a clockwise direction. Try the clutch for lockup and hold in at least five different locations around the converter.

4. If the clutch fails to lock up and hold a 10 ft-lb. torque, replace the converter unit.

STATOR TO IMPELLER INTERFERENCE CHECK

1. Position the front pump assembly on a bench with the spline end of the stator shaft pointing up (Fig. 35).
2. Mount a converter on the pump with the splines on the one-way clutch inner race engaging the mating splines of the stator support. The converter hub will then engage the pump drive gear.
3. Hold the pump stationary, and try to rotate the converter counterclockwise. The converter should rotate freely without any signs of interference or scraping within the converter assembly.
4. If there is an indication of scraping, the trailing edges of the stator blades may be interfering with the leading edges of the impeller blades. In such cases, replace the converter.

STATOR TO TURBINE INTERFERENCE CHECK

1. Position the converter on the bench front side down.
2. Install a front pump assembly to engage the mating splines of the stator support and stator, and pump drive gear lugs.

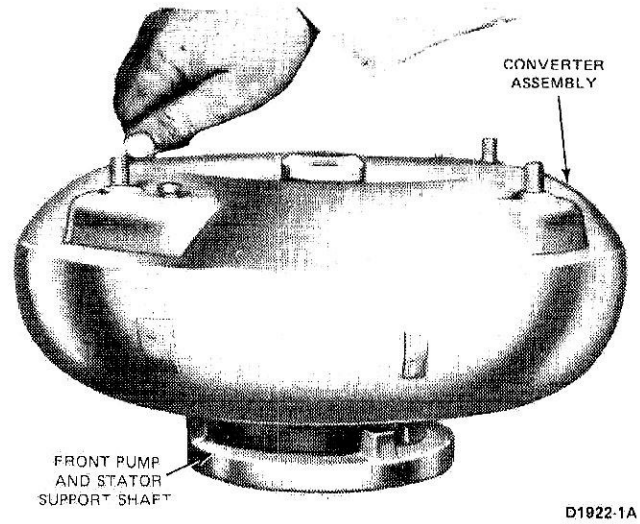


FIG. 35 Stator-To-Impeller Interference Check

3. Install the input shaft, engaging the splines with the turbine hub (Fig. 36).
4. Hold the pump stationary and attempt to rotate the turbine with the input shaft. The turbine should rotate freely in both directions without any signs of interference or scraping noise.
5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, the converter must be replaced.

The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the converter into the

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DETROIT IRON

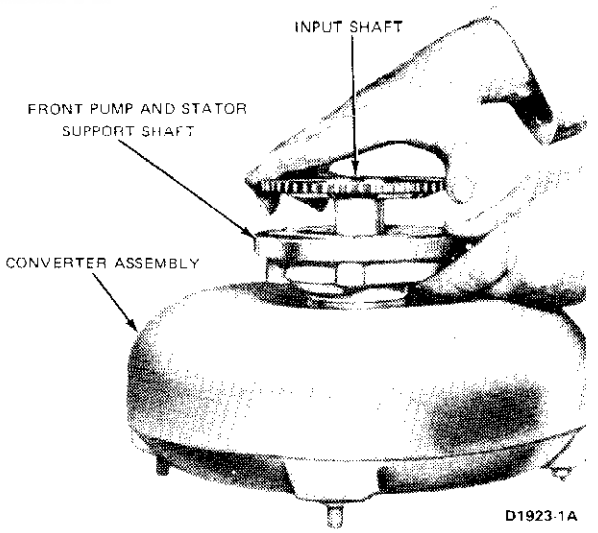


FIG. 36 Stator to Turbine Interference Check

crankshaft. Check the converter front pump drive hub for nicks or sharp edges that would damage the pump seal.

OUTPUT SHAFT (FMX TRANSMISSION)

1. Inspect the thrust surfaces and journals for scores. Inspect the internal gear for broken or worn teeth.
2. Inspect the ring grooves for burrs.
3. Inspect the keyway and drive ball pocket for wear, and inspect the splines for burrs, twist or wear.
4. Inspect the external parking gear teeth for damage and the speedometer drive gear teeth for burrs.
5. If either the output shaft or ring gear has been replaced, place the assembled unit with the gear face down on the bench, push the shaft downward, and check the clearance between the top of the snap ring and its groove (Fig. 37). If this clearance exceeds 0.002 inch, replace the snap ring with a thicker ring to reduce the clearance to less than 0.002 inch. Selective snap rings are available in several thicknesses for this purpose.

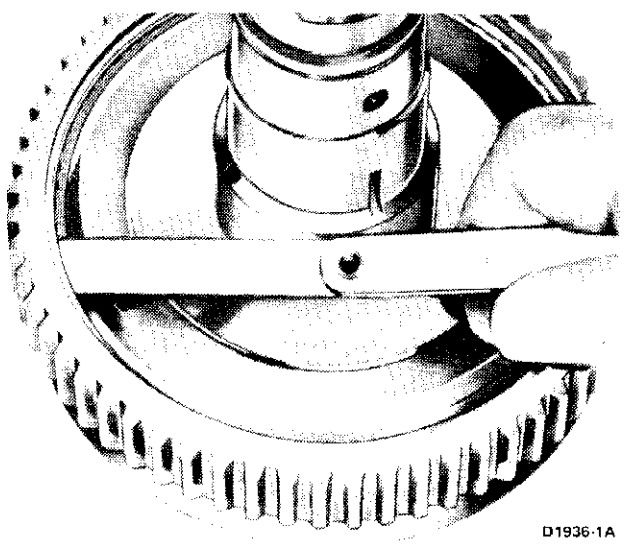


FIG. 37 Checking Output Shaft Snap Ring Clearance

PLANET CARRIER AND CENTER SUPPORT (FMX TRANSMISSION)

1. Inspect the clutch outer race, inner race, band surface, pinion gears, bearings, and thrust washer (Fig. 38) for roughness.
2. Inspect the center support bushing for roughness.

PINION CARRIERS (C3, C4 AND C6 TRANSMISSIONS)

Individual parts of the planet carriers are not serviceable.

1. The pins and shafts in the planet assemblies should be checked for loose fit and/or complete disengagement. Use a new planet assembly if either condition exists. Before installing a planet assembly, the shaft retaining pins should be checked for adequate staking. If staking does not appear adequate, the pins should be restaked before installation. When restaking, the retaining pins must not be driven into the carrier any further than 0.040 inch below the surface of the carrier.
2. Inspect the pinion gears for damaged or excessively worn teeth.
3. Check for free rotation of the pinion gears.

STATOR SUPPORT

1. Inspect the stator support splines for burrs and wear.
2. On a C3, C4 or C6 Automatic transmission, check the oil ring grooves in the stator support for nicks, burrs or damaged edges.

REAR SUPPORT (FMX TRANSMISSION)

1. Inspect the gasket mating surfaces for damage.
2. Inspect the support bushing for scores.
3. Inspect the rear support fluid passages for obstructions.
4. Check the fit of the fluid tubes in the support (FMX only).

CASE

Inspect the case for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the vent for obstructions, and check all fluid passages for obstructions and leakage (Figs. 13, 14, 15, 16 and 17).

Inspect the case bushing for scores. Check all parking linkage parts for wear or damage.

If a transmission case thread is damaged, service kits may be purchased from local jobbers. To repair a damaged thread, the following procedures should be carefully followed.

1. Drill out the damaged threads, **using the same drill size as the thread OD.** For example, use a 5/16 inch drill for a 5/16-18 thread.
2. Select the proper special tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16-18 will not cut the same thread as a standard 5/16-

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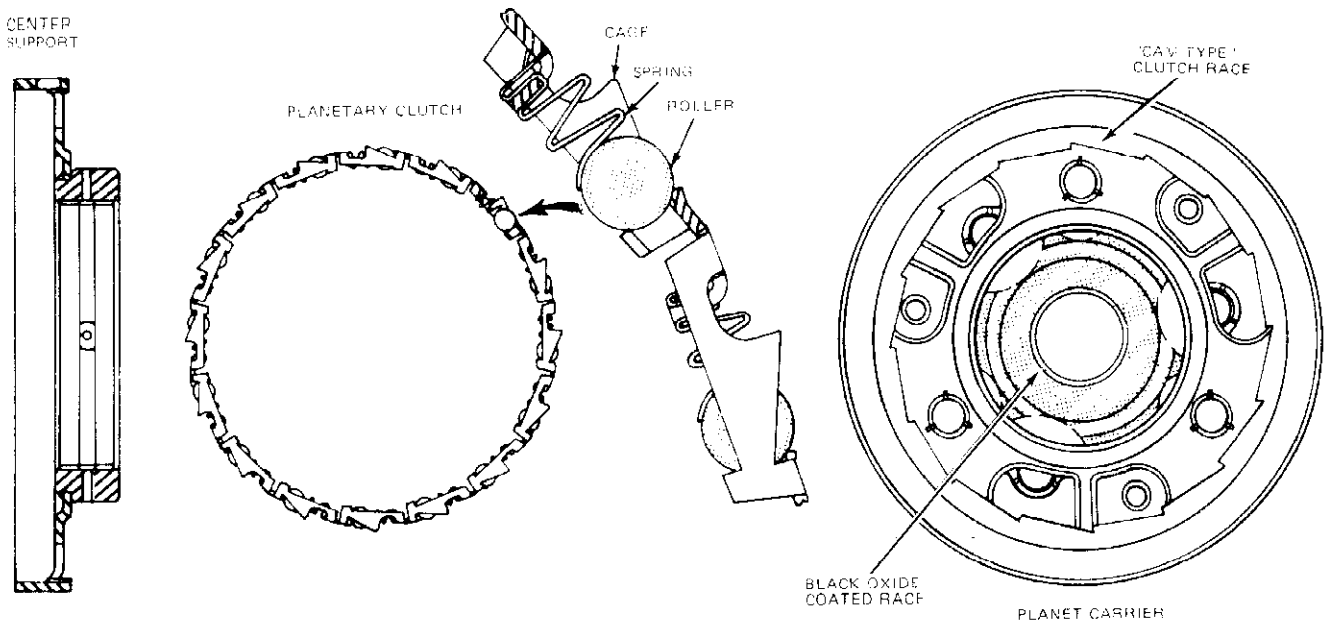


FIG. 38 Roller Type Planetary Clutch, Carrier and Center Support (FMX)

18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed the original thread size (5/16-18) is restored.

3. Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is 1/2 turn below the face.
4. Working through the insert, bend the insert tang straight up and down until it breaks off at the notch.
5. Improperly installed inserts can be removed with the extractor tool. Place the extractor tool in the insert so that the blade rests against the top coil 1/4 to 1/2 turn away from the end of the coil. Tap the tool sharply with a hammer so that the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is 1/2 turn below the face.

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DETROIT IRON

SPECIFICATIONS

SPECIAL SERVICE TOOLS

Tool No.	Description
TOOL S8696-A	Vacuum Diaphragm Wrench
LRE-60081	Torque Converter and Cooler Cleaner
TOOL-4201-C	Differential Backlash and Runout Gauge, with Universal Bracket, Dial Indicator and Bracket
TOOL-7003	Bench Test Turning Tool
T76L-7902-C	C4, C6, FMX Converter One-Way Clutch Torquing Tool
T76L-7902-D	Converter Turbine and Stator End Play Checking Tool
T77L-7902-A	Universal Converter One-Way Clutch Torquing Tool
T77L-7902-B	C3 Converter One-Way Clutch Torquing Tool
T59P-7902-C	Welded Converter Sprag Driver and Gauge - C4 and C6 Transmissions
T57L-77820-L	400 Lb. Pressure Gauge

VACUUM DIAPHRAGM ASSEMBLY SPECIFICATIONS – 1978 AUTOMATIC TRANSMISSION (EXCEPT JATCO)

Transmission Type	Transmission Models	Single or Dual Area	Diaphragm Part No.	Identification	Throttle Valve Rod
C4	(1)	SAD	D3FP-7A377-BA	1 Yellow Stripe	(2) D3AP-7A380-JA: 1.5925 1.5875 Green Daub (2) D3AP-7A380-HA: 1.6075 – 1.6025 Blue Daub (2) D3AP-7A380-KA: 1.6225 – 1.6175 Orange Daub (2) D3AP-7A380-LA: 1.6375 – 1.6325 Black Daub (2) D3AP-7A380-MA: 1.6585 – 1.6535 Pink & White Daub
	(1)	S-HAD	D7OP-7A377-AA	None	
	(1)	HAD	D7BP-7A377 AA	Rear Cover Blue	
	(1)	S-SAD	D6AP-7A377-AA	1 Green Stripe	
C6	(1)	HAD	D6AP-7A377-BA	Part No. Stamped	(2) D3AP-7A380-DA: 1.611 1.601 Yellow Daub (2) D3AP-7A380-EA: 1.644 – 1.634 Blue Daub (2) D3AP-7A380-FA: 1.660 – 1.650 Green Daub (2) D3AP-7A380-GA: 1.710 – 1.700 White Daub (2) C4AP-7A380-A: 1.677 – 1.667 No Color Code
	(1)	SAD	D7OP-7A377-BA	1 Green Stripe	
	(1)	SAD	D4TP-7A377-BA	1 Black Stripe	
	(1)	SAD	D5AP-7A377-AA	1 Purple Stripe	
C3	(1)	SAD	74DT-7A377-DA	None	74DT-7A380-AB
FMX	(1)	SAD	*C1AP-7A377-B	1 Yellow Stripe	C2AP-7A380-A
	(1)	S-SAD	D5AP-7A377-BA	1 Lt. Green Stripe	

*Production Only – For Service Use C4VP-7A377-A, Identified With (1) Lt. Blue Stripe.

(1) For Current Transmission Model and Vehicle Application, See Master Parts List.

(2) Selective

SAD – Single Area Diaphragm

S-SAD – Super Single Area Diaphragm
HAD – High Altitude Diaphragm
S-HAD – Super High Altitude Diaphragm

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Shift Control Linkage

PART 17-02

Applies To All Cars With Automatic Transmission

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Neutral Start Switch Adjustment (Console or Floor Shift Vehicles Only)	02-3
REMOVAL AND INSTALLATION	
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REMOVAL AND INSTALLATION (Cont'd.)	
Selector Lever (Console or Floor Shift Vehicles Only)	02-7
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ADJUSTMENTS

The transmission control linkage adjustments should be performed in the order in which they appear in this section of the manual.

MANUAL LINKAGE ADJUSTMENTS

Column Shift

1. Place the selector lever in the D (DRIVE) position tight against the D stop. A 10-15 lb. weight should be hung on the shift lever to be sure that the lever remains against the Drive stop during the linkage adjustment.
2. Loosen the shift rod adjusting nut at point A (Figs. 1, 3 and 4).

   On vehicles equipped with a shift cable, remove the nut at point A (Fig. 2), and remove the cable from the transmission manual lever stud.
3. Shift the transmission manual lever into the D position, second detent position from the full counterclockwise position.
4. On vehicles equipped with a shift cable, place the cable end on the transmission manual lever stud,

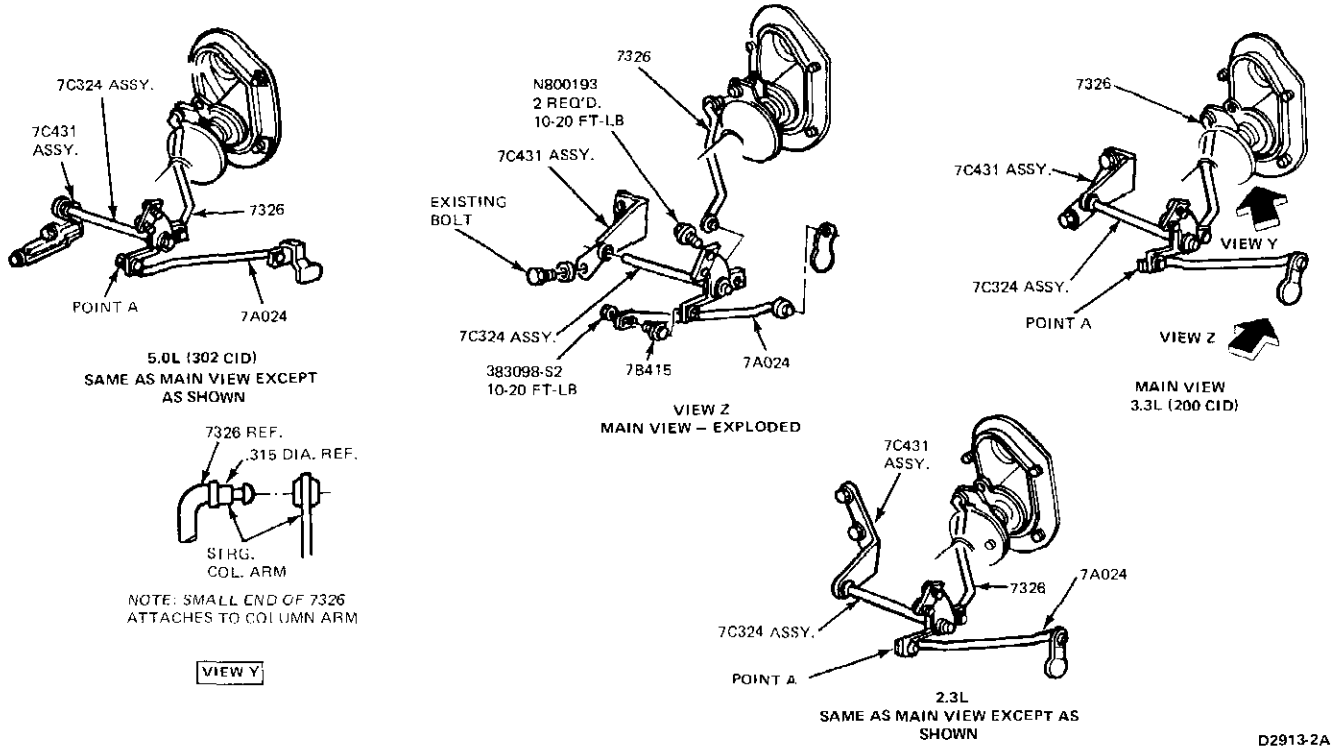


FIG. 1 Manual Linkage—Column Shift—Fairmont and Zephyr

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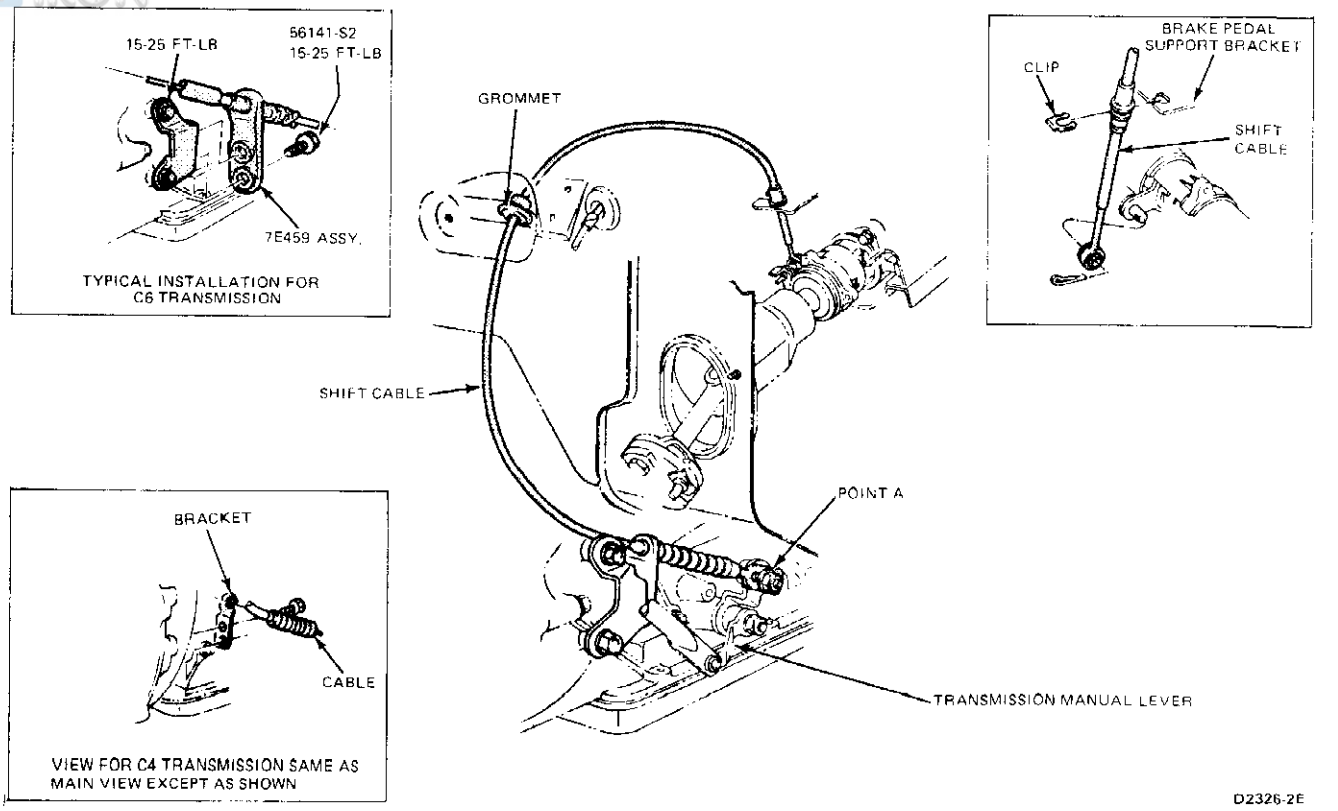


FIG. 2 Manual Linkage—Column Shift—LTD II, Cougar, Thunderbird, Continental Mark V, Granada, Monarch and Versailles

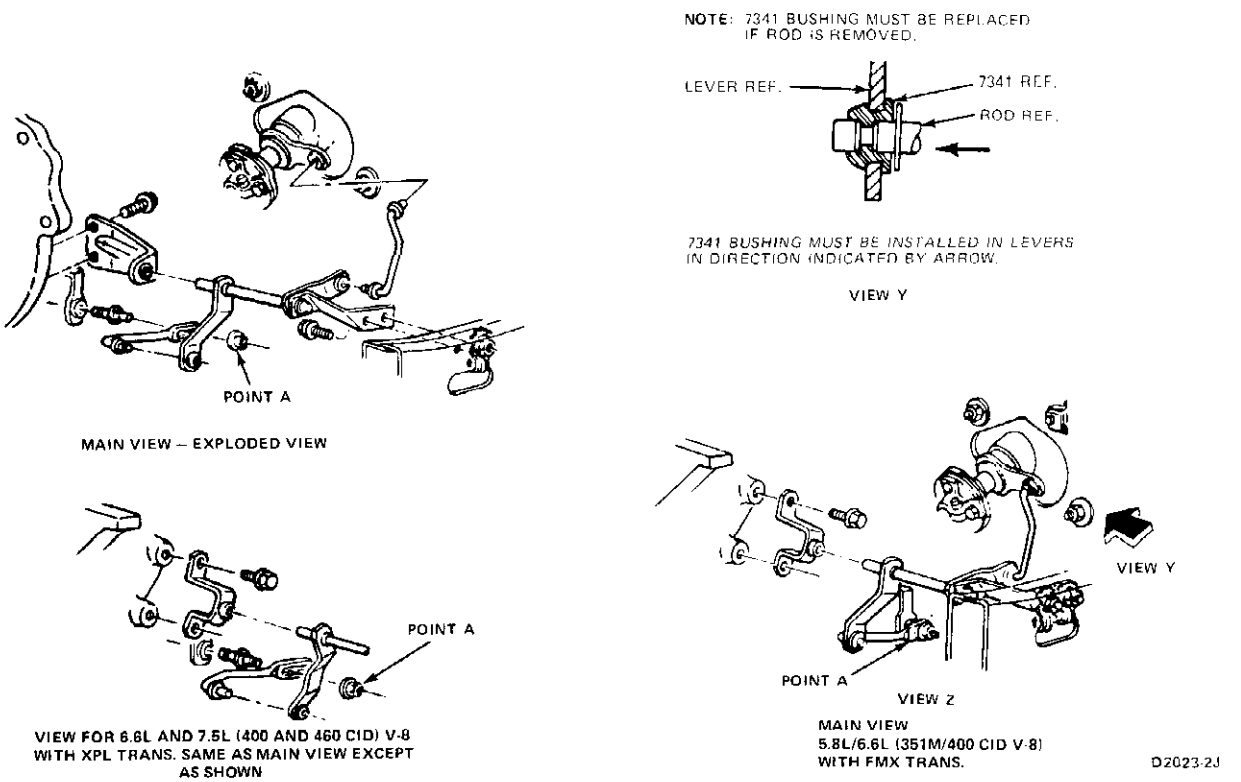


FIG. 3 Manual Linkage—Column Shift—Ford/Mercury

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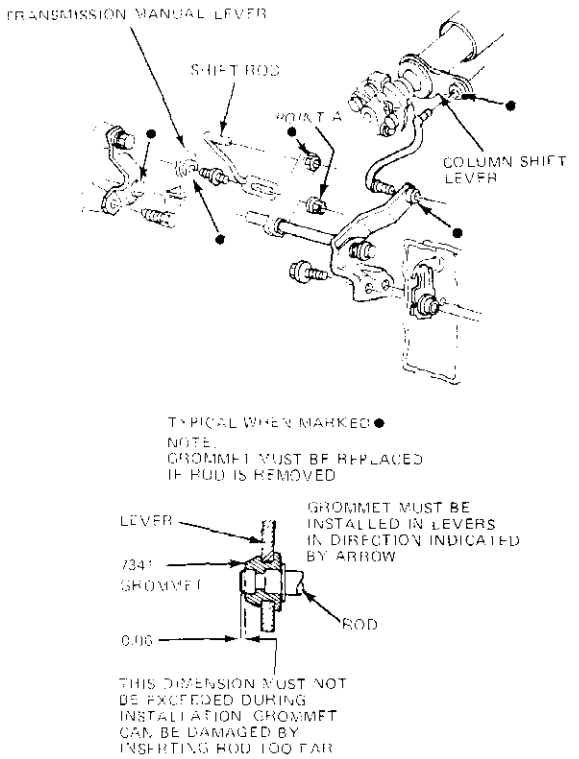


FIG. 4 Manual Linkage—Column Shift—Lincoln Continental

using care to align the flats on the stud with flats on the cable. Start the adjustment nut.

5. Make sure that the selector lever has not moved from the D stop. Torque the nut at point A, as indicated in Specifications at end of this Part.
6. Check the transmission operation for all selector lever detent positions.

Console or Floor Shift

1. Position the transmission selector lever in D (DRIVE) position against the rearward D stop. NOTE: The shift lever should be held against the rearward D stop when the linkage is adjusted.
2. Raise the vehicle and loosen the manual lever shift rod retaining nut (Figs. 5 through 7). Move the transmission manual lever to the D position, second detent position from the back of the transmission.
3. With the transmission selector lever and manual lever in the D positions, torque the attaching nut to 10 to 15 ft-lbs.
4. Check the operation of the transmission in each selector lever position.

THROTTLE AND DOWNSHIFT LINKAGE ADJUSTMENTS

Adjusting the throttle linkage is important to be certain the throttle and downshift systems are properly adjusted. The downshift system should come in when the accelerator is pressed through detent, and not before detent. Refer to Group 24 for detailed throttle and downshift linkage adjustment procedures.

NEUTRAL START SWITCH ADJUSTMENT (CONSOLE OR FLOOR SHIFT VEHICLES ONLY)

Pinto, Bobcat, Granada, Monarch, Fairmont, Zephyr and Mustang II (C4 Transmission)

1. With the manual lever properly adjusted, loosen the two switch attaching bolts (Fig. 8).

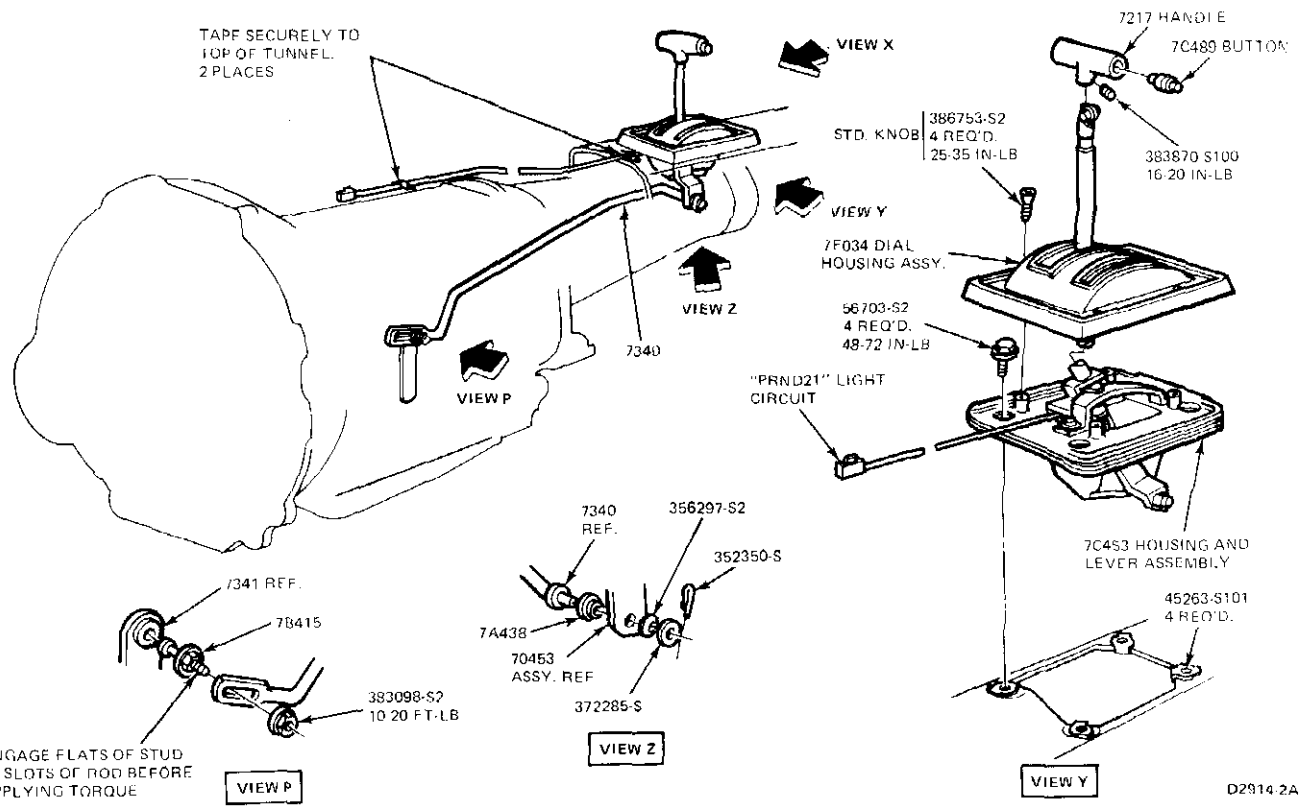


FIG. 5 Manual Linkage—Floor Shift—Fairmont and Zephyr

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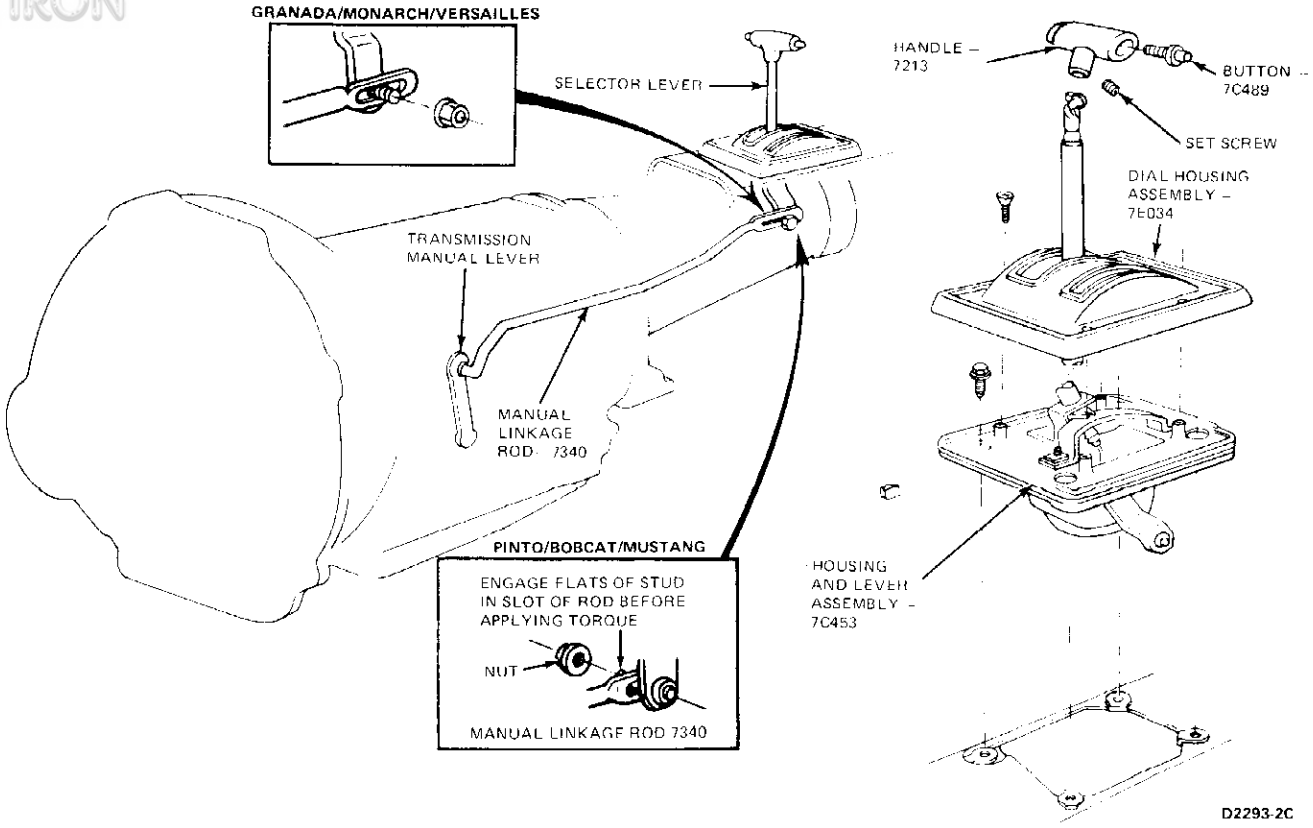


FIG. 6 Manual Linkage—Floor Shift—Pinto, Bobcat, Mustang II, Granada, Monarch and Versailles

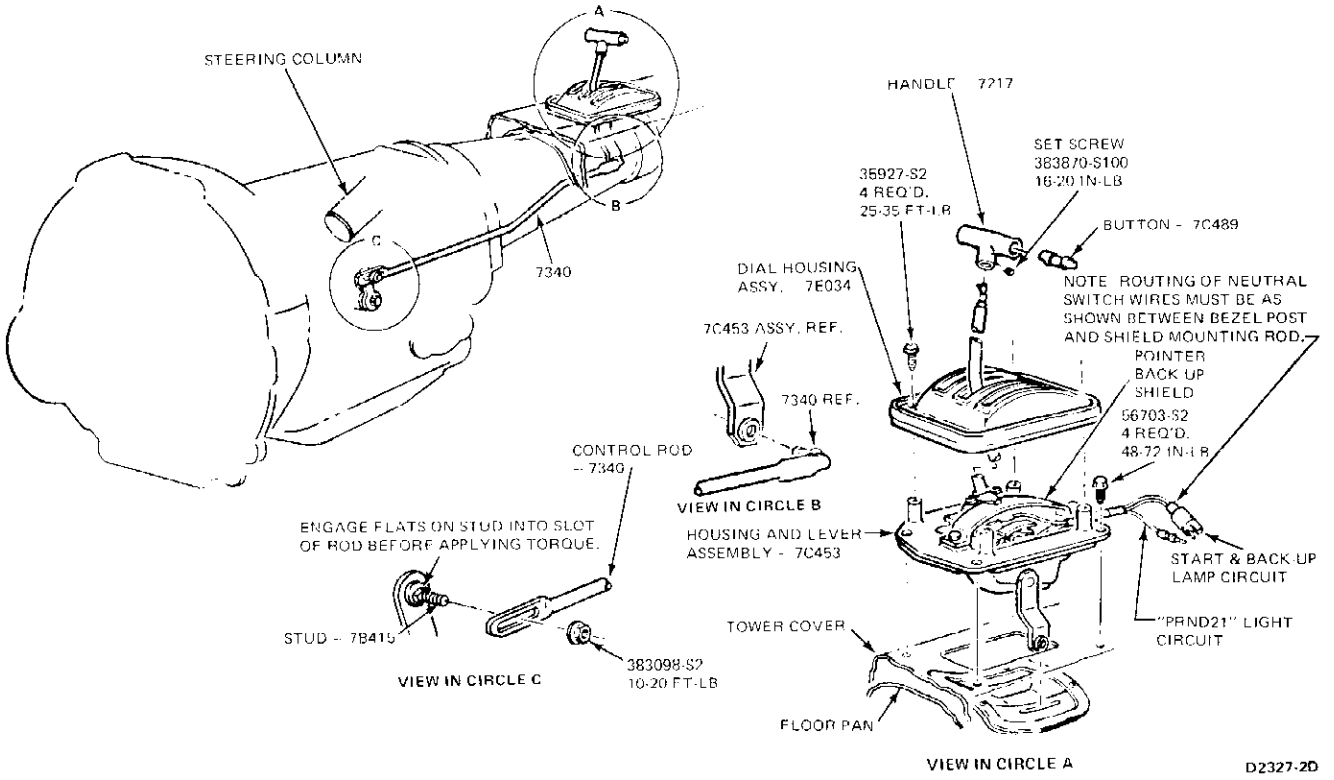


FIG. 7 Typical Manual Linkage—Console or Floor Shift—LTD II and Cougar

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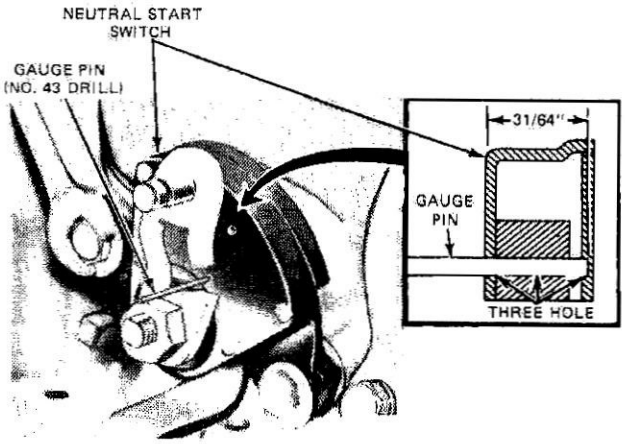


FIG. 8 Neutral Start Switch Adjustment—Pinto, Bobcat, Fairmont, Zephyr, Granada, Monarch, Mustang II, Versailles and Cougar With C4 Transmission

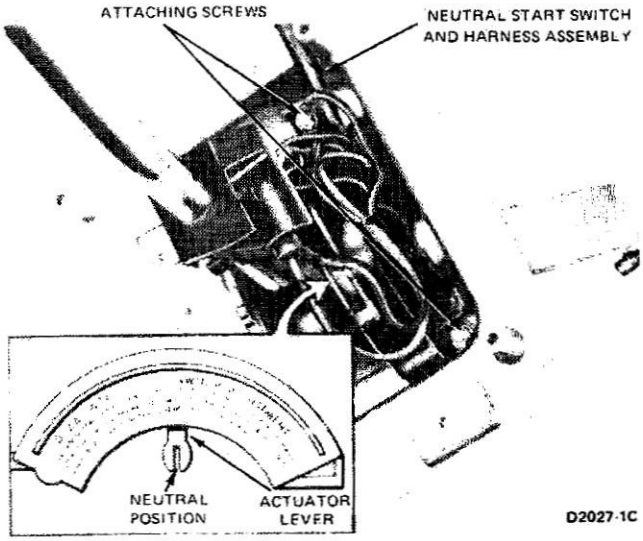


FIG. 9 Typical Neutral Start Switch Adjustment—LTD II and Cougar With C4 or C6 Transmission

2. With the transmission manual lever in neutral, rotate the switch and insert the gauge pin (No. 43 drill shank end) into the gauge pin holes of the switch. **The gauge pin has to be inserted to a full 31/64 inch into the three holes of the switch (Fig. 9).**
3. Torque the two switch attaching bolts as indicated in Specifications at end of this Part. Remove the gauge pin from the switch.
4. Check the operation of the switch. The engine should start only with the transmission selector lever in Neutral and Park.

LTD II and Cougar (C6 or C4 Transmission)

1. With the manual linkage properly adjusted and the engine turned off, place the selector lever in the N (NEUTRAL) position.
2. Remove the selector lever handle attaching screw and remove the handle (Fig. 7).
3. Remove the dial housing attaching screws and remove the housing.
4. Remove the two pointer backup shield attaching screws and remove the shield.
5. Loosen the two screws securing the neutral start switch to the selector lever housing (Fig. 9).
6. Place the selector lever in the P (PARK) position and hold it against the forward stop.
7. Move the neutral switch rearward to the end of its travel.
8. Hold the switch in the rearward position and tighten the two attaching screws.
9. With the selector lever in the P (PARK) position, check the operation of the switch. The engine should start with the selector lever in the park position. If the engine does not start, replace the switch. Refer to the Neutral Start Switch Removal and Installation procedures in this Part.
10. Install pointer back-up shield dial housing, and selector lever handle by reversing the above Steps.

REMOVAL AND INSTALLATION

SHIFT LINKAGE GROMMET

The automatic transmission linkage systems make use of an oil impregnated plastic grommet to connect the various rods and levers. **Whenever a rod is disconnected from a grommet-type connector, the old grommet must be removed and a new one installed.** Remove and install the grommet as follows:

1. Place the lower jaw of the tool between the lever and the rod (Fig. 10). Position the stop pin against the end of the rod (Fig. 10) and force the rod out of the grommet. Remove the grommet from the lever by cutting off the large shoulder with a sharp knife.
2. Adjust the stop pin to 1/2 inch and coat the outside of the grommet with lubricant. Place a new grommet on the stop pin and force it into the lever hole. Turn the grommet several times to be sure it is properly seated.
3. Squeeze the rod into the bushing until the stop washer seats against the grommet.

NEUTRAL START SWITCH (CONSOLE OR FLOOR SHIFT VEHICLES ONLY)

PINTO, BOBCAT, FAIRMONT, ZEPHYR, GRANADA, MONARCH, VERSAILLES AND MUSTANG II (C4 TRANSMISSION)

1. Remove the downshift linkage rod from the transmission downshift lever.
2. Apply penetrating oil to the downshift lever shaft and nut. Remove the transmission downshift outer lever retaining nut and lever (Fig. 8).

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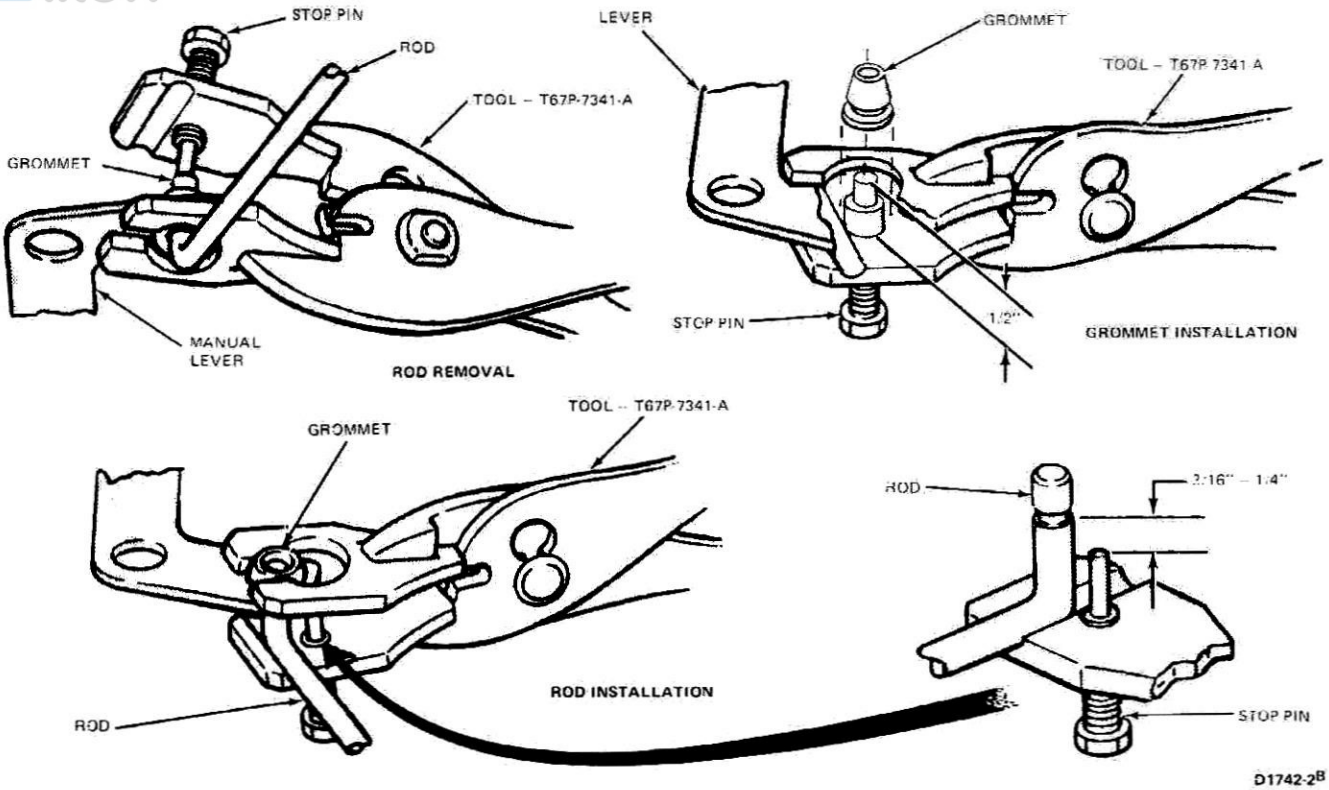


FIG. 10 Removing or Installing Shift Linkage Grommet

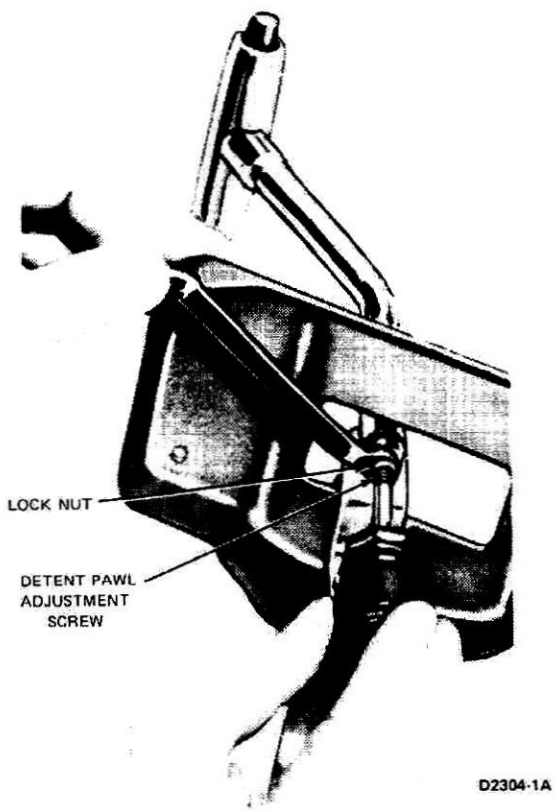


FIG. 11 Typical Selector Lever Detent Pawl Adjustment

3. Remove the two neutral start switch attaching bolts.
4. Disconnect the multiple wire connector. Remove the neutral switch from the transmission.
5. Install the neutral start switch on the transmission. Install the two attaching bolts.
6. With the transmission manual lever in neutral, rotate the switch and install gauge pin (No. 43 drill) into the gauge pin hole (Fig. 8).
7. Torque the switch attaching bolts as indicated in Specifications at end of this Part, and remove the gauge pin.
8. Install the outer downshift lever and attaching nut, and torque the nut as indicated in Specifications at end of this Part. Install the downshift linkage rod to the downshift lever.
9. Install the switch wires. Connect the wire multiple connector. Check the operation of the switch in each detent position. The engine should start only with the transmission selector lever in N (NEUTRAL) and P (PARK).

LTD II AND COUGAR

1. Place the transmission selector lever in the N (NEUTRAL) position.
2. Raise the vehicle and remove the nut that secures the shift rod to the transmission manual lever; let rod swing free on selector lever grommet (Fig. 7).
3. Lower the vehicle and remove the selector lever handle attaching screw and the handle.
4. Remove the dial housing attaching screws and the housing.
5. Disconnect the dial indicator light.

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6. Disconnect the neutral start switch and dial indicator light wires from their connectors at the dash panel. On vehicles equipped with an FMX transmission, disconnect the seat belt warning circuit connector.
7. Remove the four selector housing and lever assembly attaching bolts. Remove the selector lever and housing assembly.
8. Remove the two pointer back-up shield attaching screws and remove the shield.
9. Remove the two screws, securing the neutral start switch to the selector lever housing, and remove the switch. Push the neutral start switch harness plug inward and remove the switch and harness assembly (Fig. 9).
10. Before installing the new switch, be sure the selector lever is against the neutral detent stop and the actuator lever (Fig. 9) is properly aligned in the neutral position.
11. Position the harness and neutral switch assembly in the selector lever housing (Fig. 7). Install but do not tighten the two attaching screws.
12. Place the selector lever in the P (PARK) position and hold it against the forward stop.
13. Move the neutral switch rearward to the end of its travel.
14. Hold the switch in the rearward position and tighten the two attaching screws.
15. Install the pointer back-up shield on the housing and lever assembly.
16. Position the selector lever and housing assembly on the console and install the attaching bolts.
17. Connect the dial indicator light.
18. Connect the neutral start switch and dial indicator light wires to their respective connectors at the dash panel. On vehicles equipped with an FMX transmission, connect the seat belt warning circuit wire to its connectors.
19. Install the dial housing on the selector lever housing assembly.
20. Install the selector lever handle and place the selector lever in the D (DRIVE) position.
21. Raise the vehicle and secure the shift rod to the transmission manual lever.
22. Adjust the linkage as required. Lower the vehicle.
23. Check the operation of the switch. The engine should start only with the transmission selector lever in N (NEUTRAL) and P (PARK).

SELECTOR LEVER (CONSOLE OR FLOOR SHIFT VEHICLES ONLY)

1. Raise the vehicle and remove the nut securing the shift rod to the transmission manual lever (Figs. 5, 6 and 7). LTD II and Cougar floor shift rod must be removed from the shifter arm using Tool T67P-7341-A (Fig. 10).
2. Lower the vehicle and remove the selector lever handle attaching screw.
3. Remove the dial housing attaching screws and the housing.
4. Remove the two pointer backup shield attaching screws and remove the shield.
5. Disconnect the dial indicator light. On a LTD II and Cougar, disconnect the neutral start switch and dial indicator light wires from their connectors at the dash panel.
6. Remove the selector housing and lever assembly attaching bolts. Remove the selector lever and housing.
7. Remove the neutral start switch on a LTD II or Cougar.
8. Remove the selector lever to housing attaching nut. Remove the lever from the housing.
9. Install the selector lever in the housing and install the attaching nut. Torque the nut to 20 to 25 ft-lb.
10. Install the selector lever handle.
11. Check the clearance between the detent pawl and plate. The detent pawl, if properly adjusted, should clear the highest point on the detent plate. To adjust the pawl height, hold the adjusting screw stationary and turn the lock nut until the proper clearance is obtained (Fig. 11).
12. Remove the handle from the selector lever.
13. Connect the dial indicator light. Install the neutral start switch on a LTD II or Cougar. Connect the neutral start switch and dial indicator light wires to their respective connectors at the dash panel. Adjust the neutral switch.
14. Install the pointer back-up shield on the housing and lever assembly.
15. Install the selector housing and lever assembly as shown in Figs. 5, 6 and 7. Torque the attaching bolts 4 to 6 ft-lb.
16. Install the dial housing and tighten the attaching screws.
17. Install the selector lever handle and tighten the attaching screw.
18. Position the selector lever in the D (DRIVE) position against the D stop.
19. Raise the vehicle. Install the shift rod to the selector lever. Adjust the manual linkage.
20. Lower the vehicle and check the transmission operation in each selector lever detent position.

SHIFT CONTROL CABLE

LTD II, Cougar, Thunderbird, Granada, Monarch, Versailles and Continental Mark V Only

Removal

1. From inside the vehicle, remove the clip securing the control cable to the brake support bracket (Fig. 2).
2. Remove the cable retaining clip, at the steering column shift lever, and slide the cable and bushing from the lever.
3. Disengage the rubber grommet from the dash panel.
4. Raise the vehicle and remove the bolts securing the cable bracket assembly to the transmission housing.
5. Remove the nut at point A (Fig. 2) and remove the cable from the transmission manual lever stud. Pull the cable through the dash panel and remove it from the vehicle.

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DETROIT IRON

Installation

1. Feed the round end of the cable through the dash panel and install the rubber grommet in the dash panel opening.
2. Position the control cable to the brake pedal support bracket and secure with the retaining clip.
3. Position the bushing and cable on the steering column shift lever and secure with the retaining clip.
4. Place the selector lever in the D (DRIVE) position tight against the D stop.
5. Raise the vehicle. Position the cable and bracket assembly on the transmission housing and secure with the retaining two bolts.
6. Shift the manual lever at the transmission into the D position, second detent from the full counterclockwise position.
7. Place the cable end on the transmission manual lever stud, using care to align the flats on the stud with the flats on the cable. Start the attaching nut.
8. Make sure the selector lever has not moved from the D stop; then, tighten the nut at point A to 10-14 ft-lbs torque.
9. Lower the vehicle and check the transmission operation in each selector lever detent position.

SPECIFICATIONS

TORQUE LIMITS – SHIFT CONTROL LINKAGE

Item	Torque	Item	Torque
Selector Lever Shift Rod Retaining Nut	10-20 Ft.-Lbs.	Selector Lever-to-housing attaching Nut	20-25 Ft.-Lbs.
Selector Lever Shift Cable Retaining Nut	10-15 Ft.-Lbs.		
Steering Column Lock Rod Retaining Nut	10-20 Ft.-Lbs.	Neutral Start Switch to Case	55-75 In.-Lbs.

SPECIAL TOOLS

Ford Tool No.	Description
T67P-7341-A	Remover-Replacer Trans. Shift Linkage Insulators.

CD2306-2B

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C3 Automatic Transmission

PART 17-03

Applies to Mustang II, Pinto, Bobcat, Fairmont and Zephyr with 2.3 Litre, 2.8 Litre or 3.3 Litre (200 C.I.D. 6) Engines

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CD2883-2B

DESCRIPTION

The C-3 Automatic Transmission is a three speed unit capable of providing automatic upshifts and downshifts through three forward gear ratios. It also provides *manual selection of first and second gears.*

The transmission consists of a torque converter, planetary gear train, two multiple disc clutches, a one-way clutch and a hydraulic control system. Fig. 1 shows the various parts of the transmission. Fig. 2 shows the identification tag and its interpretation. Fig. 3 shows the *hydraulic control system.*

The only adjustment required on the C-3 transmission is on the front band.

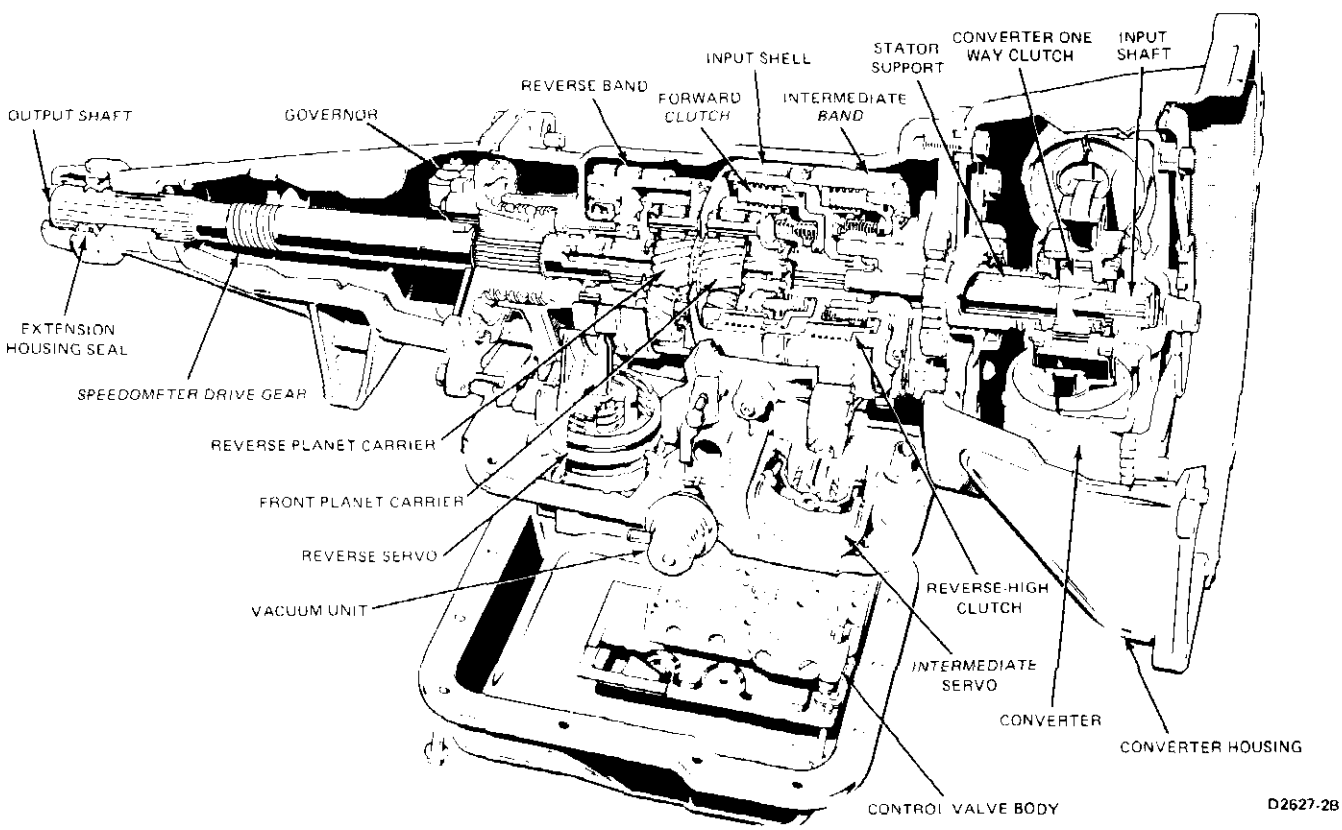


FIG. 1 C-3 Automatic Transmission

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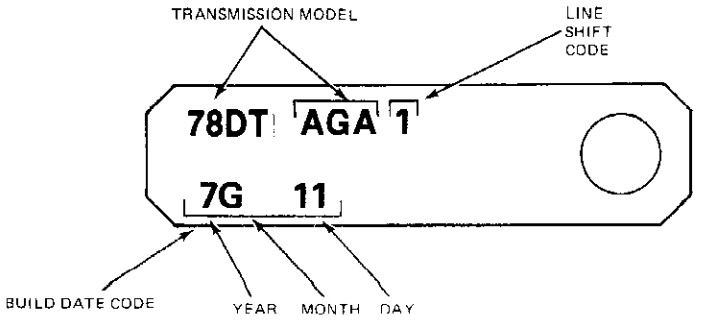


FIG. 2 Identification Tag—C-3 Transmission

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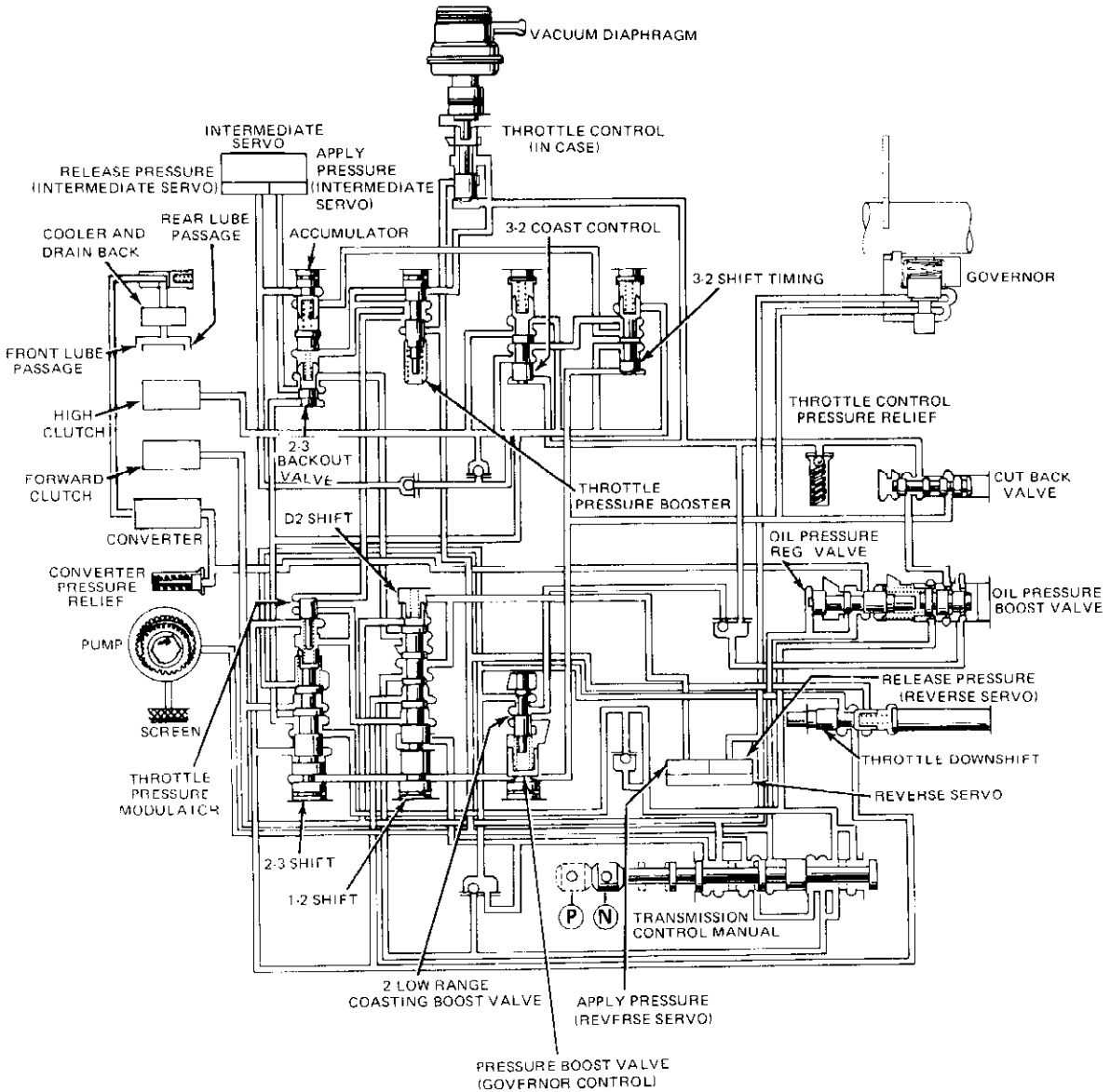


FIG. 3 Hydraulic Control System

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DETROIT IRON

ADJUSTMENTS

FRONT BAND ADJUSTMENT

1. Remove the downshift rod from the transmission downshift lever.
2. Clean all dirt from the band adjusting screw area. Remove and discard the locknut.
3. Install a new locknut on the adjusting screw. Using Tool Kit T71P-77370-A (Fig. 4), tighten the adjusting screw until the tool handle clicks. The tool is a preset torque wrench that clicks and breaks when the torque on the adjusting screw reaches 10 ft-lbs.
4. **Back off the adjusting screw exactly one and a half turns.**
5. Hold the adjusting screw from turning and torque the locknut to specification.
6. Install the downshift rod on the transmission downshift lever.

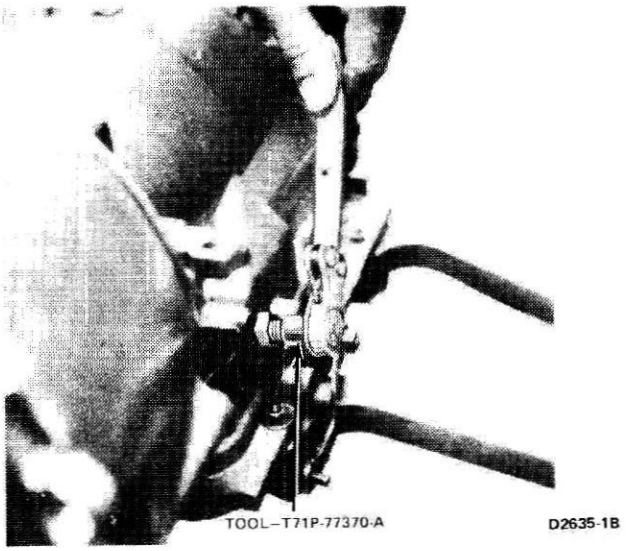


FIG. 4 Band Adjustment

REMOVAL AND INSTALLATION

TRANSMISSION

Removal

1. Raise the vehicle on a hoist.
2. Place a drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Then remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. After all the fluid has drained, install two bolts on the rear side of the pan to temporarily hold it in place.
3. Remove the converter drain plug access cover and adapter plate bolts from the lower end of the converter housing.
4. Remove the three converter- to-flywheel attaching bolts. Crank the engine to turn the converter to gain access to the bolts, using a wrench on the crankshaft pulley attaching bolt. **On belt driven overhead camshaft engines, never turn the engine backwards.**
5. Crank the engine until the converter drain plug is accessible and remove the plug. Place a drain pan under the converter to catch the fluid. After all the fluid has been drained from the converter, reinstall the plug and torque to specification.
6. Remove the drive shaft and install the extension housing seal replacer tool in the extension housing.
7. Remove the speedometer cable from the extension housing (Fig. 5).
8. Disconnect the shift rod at the transmission manual lever. Disconnect the downshift rod at the transmission downshift lever.
9. Remove the starter-to-converter housing attaching bolts and position the starter out of the way.
10. Disconnect the neutral start switch wires from the switch.
11. Remove the vacuum lines from the transmission vacuum unit.
12. Position a transmission jack under the transmission and raise it slightly.
13. Remove the engine rear support-to-crossmember nut.
14. Remove the crossmember-to-frame side support attaching bolts and remove the crossmember.
15. Remove the inlet pipe steady rest from the inlet pipe and rear engine support; then disconnect the muffler inlet pipe at the exhaust manifold and secure it.
16. Lower the jack under the transmission and allow the transmission to hang.

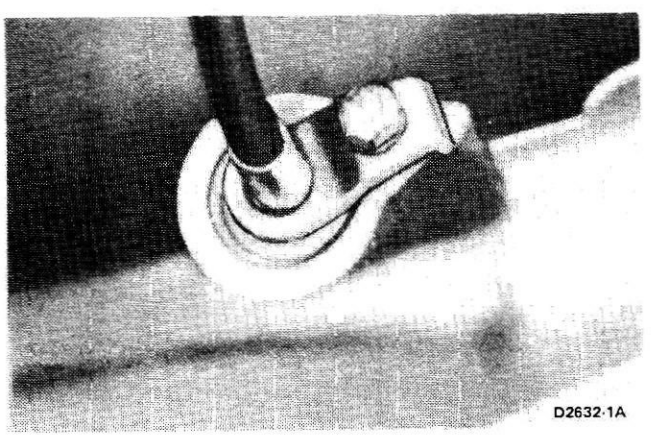


FIG. 5 Speedometer Cable and Bracket

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17. Position a jack to the front of the engine and raise the engine to gain access to the two upper converter housing-to-engine attaching bolts.
18. Disconnect the oil cooler lines at the transmission (Fig. 6). Plug all openings to keep out dirt.
19. Remove the lower converter housing-to-engine attaching bolts.
20. Remove the transmission filler tube (Fig. 6).
21. Secure the transmission to the jack with a safety chain.
22. Remove the two upper converter housing-to-engine attaching bolts. Move the transmission to the rear and down to remove it from under the vehicle.

Installation

1. Torque the converter drain plug to specification if not previously done.
2. Position the converter to the transmission making sure the converter hub is fully engaged in the pump gear (Fig. 7). **The dimension given in the illustration is for guidance only.** It does not indicate engagement.
3. With the converter properly installed, place the transmission on the jack and secure with safety chain.
4. Rotate the converter so the bolt drive lugs and drain plug are in alignment with their holes in the flywheel.

   Flywheel assemblies used with C-3 Automatic Transmissions are designed with a pilot hole to be sure of proper flywheel-to-converter alignment. Prior to installing the transmission to the engine, the flywheel must be indexed with the pilot hole, (Fig. 8) in the six o'clock position. Because the flywheel has only one converter drain plug access hole, it is necessary to rotate the converter so that the drain plug is at the 4 o'clock position with a 2.3 Litre engine and at the 8 o'clock position with a 2.8 Litre engine.
5. With the transmission mounted on a transmission jack, move the converter and transmission assembly forward into position being careful not to damage the flywheel and the converter pilot.

   During this move, to avoid damage, do not allow the transmission to get into a nosed down position as this will cause the converter to move forward and disengage from the pump gear. The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.
6. Install the two upper converter housing-to-engine attaching bolts and torque them to specification.
7. Remove the safety chain from the transmission.
8. Insert the filler tube in the stub tube and secure it to the cylinder block with the attaching bolt. Torque the bolt to specification. If the stub tube is loosened or dislodged, it should be replaced.
9. Install the oil cooler lines in the retaining clip at the cylinder block. Connect the lines to the transmission case.

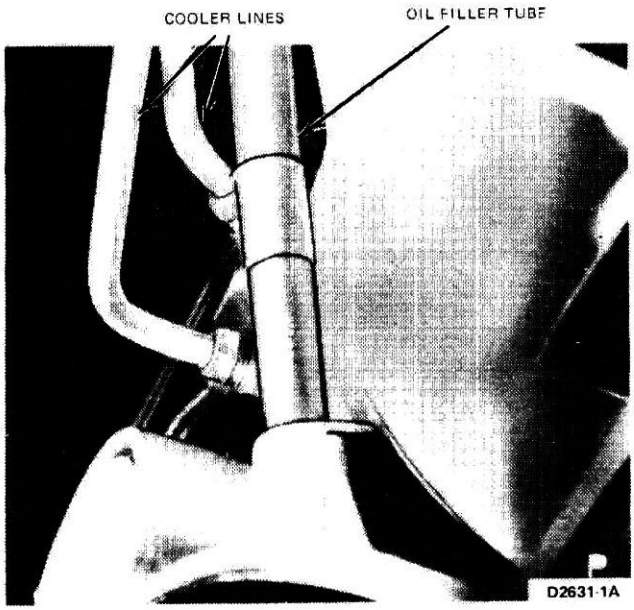


FIG. 6 Oil Cooler Lines and Oil Filler Tube

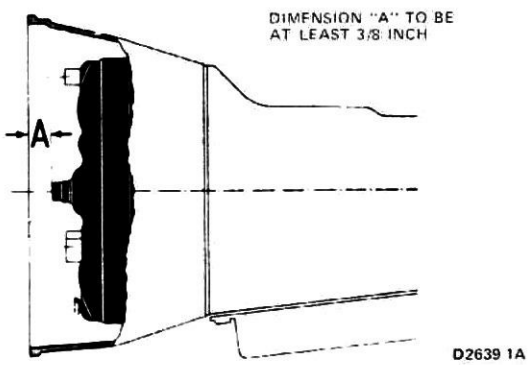


FIG. 7 Converter Hub to Housing Flange Position

10. Remove the jack supporting the front of the engine.
11. Position the muffler inlet pipe support bracket to the converter housing and install the four lower converter housing-to-engine attaching bolts. Torque the bolts to specification.
12. Raise the transmission. Position the crossmember to the frame side supports and install the attaching bolts. Torque the bolts to specification.
13. Lower the transmission and install the rear engine support- to-crossmember nut. Torque the nut to specification.
14. Remove the transmission jack.
15. Install the vacuum hose on the transmission vacuum unit. Install the vacuum line into the retaining clip.
16. Connect the neutral start switch plug to the switch.
17. Install the starter and torque the attaching bolts to specification.
18. Install the three flywheel-to-converter attaching bolts.

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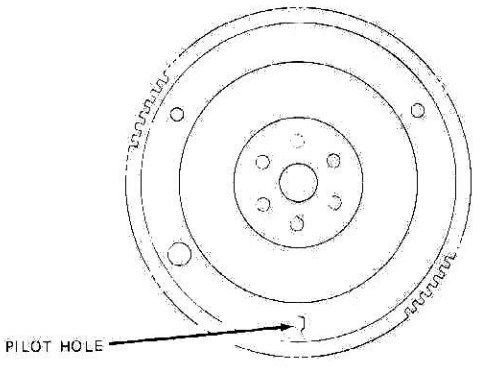


FIG. 8 Flywheel Pilot Hole

When assembling the flywheel to the converter, first install the attaching bolt through the pilot hole and torque to specification (27-37 ft-lb). Install the remaining two bolts and torque to specification. If the first bolt is not installed in the pilot hole, a misalignment of the flywheel holes and the mating converter weld nuts may occur. This misalignment will cause difficulty in installing the remaining bolts, cross-threaded bolts, or interference between flywheel and bolt threads. Any of these conditions will result in improperly torqued flywheel- to-converter attaching bolts, which may contribute to transmission or flywheel failures or damage to the front pump or housing.

19. Install the converter drain plug access cover and adaptor plate bolts. Torque the bolts to specification.
20. Connect the muffler inlet pipe to the exhaust manifold.
21. Connect the transmission shift rod to the manual lever.
22. Connect the downshift rod to the downshift lever.
23. Connect the speedometer cable to the extension housing.
24. Install the drive shaft. Torque the companion flange U-bolt attaching nuts to specification.
25. Adjust the manual and downshift linkage as required.
26. Lower the vehicle. Fill the transmission to the proper level with the specified fluid.

    Pour in five quarts of fluid; then run the engine and add fluid as required.
27. Check the transmission, converter assembly and oil cooler lines for leaks.

CONTROL VALVE BODY

Removal

Refer to Fig. 9.

1. Raise the vehicle on a hoist so the transmission fluid pan is accessible.
2. Loosen the pan attaching bolts and drain the fluid from the transmission. **If the same fluid is to be used again, filter the fluid through a 100 mesh screen. Reuse the fluid only if it is in good condition.**
3. Remove the transmission fluid pan attaching bolts, pan and gasket.
4. Remove the filter screen, gasket and, if so equipped, three spacers (early models only).
5. Remove rear servo cover and gasket.
6. Remove the bolts from the control valve body. **Note that the bolts are of different lengths and their locations are different from the bolt locations on other automatic transmissions (Fig. 10). Carefully ease the body from the case while unlocking and detaching the selector lever connecting rod.**

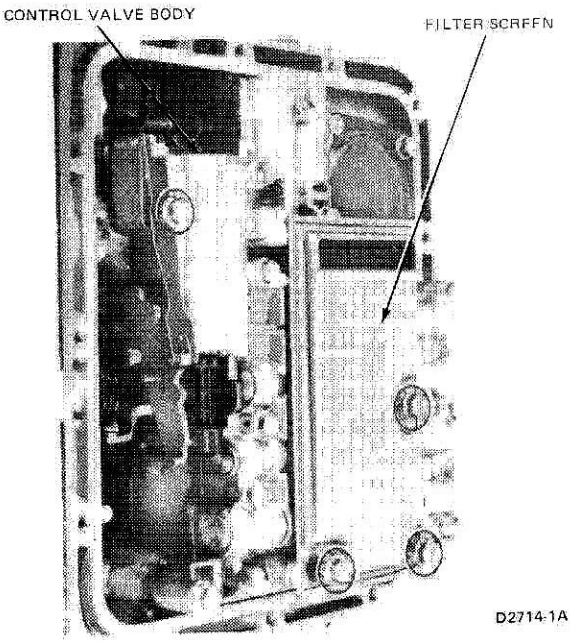


FIG. 9 Control Valve Body

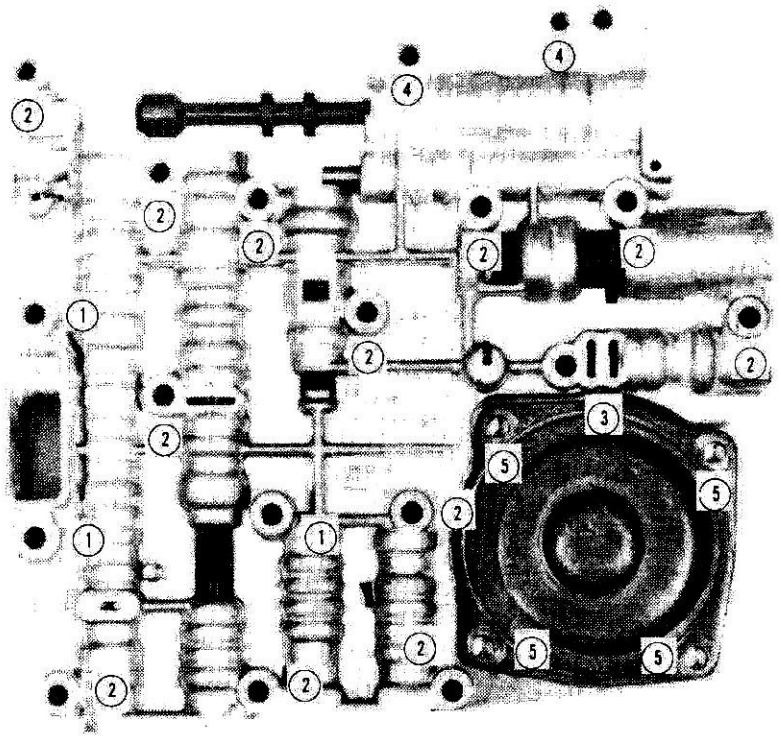
Installation

1. Clean and inspect the valve body, as described in Part 17-01, prior to installation.
2. Attach and lock the selector lever connecting rod, and ease the control valve body to the case.
3. Install the valve body retaining bolts. (Since the bolts are of different lengths be sure to install each in its correct location.) Torque the bolts to specification.
4. Install the rear servo cover and gasket.
5. Clean the filter screen with solvent. Then install the filter screen gasket.

   When installing the filter screen and gasket **do not use spacers, as was done on former models.**

   To do this would reduce control pressure and malfunction or failure would result.
6. Using a new gasket, install the fluid pan. Torque the retaining bolts to specification.
7. Lower the vehicle and fill the transmission with the proper grade and quantity of fluid.

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Position	Bolt Size Metric	Length In Inches
1	M6 x 45	1.772
2	M6 x 40	1.578
3	M6 x 35	1.378
4	M6 x 30	1.141
5	M6 x 20	.787

Position	Quantity	Torque
1	3	7-9 Ft-Lb
2	12	7-9 Ft Lb
3	1	7-9 Ft-Lb
4	2	7-9 Ft-Lb
5	4	7-10 Ft-Lb

FIG. 10 Control Valve Body Bolt Location

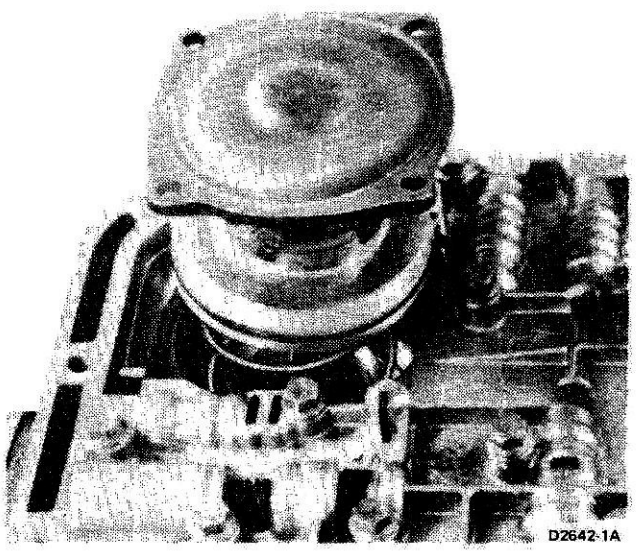


FIG. 11 Rear Servo Removal

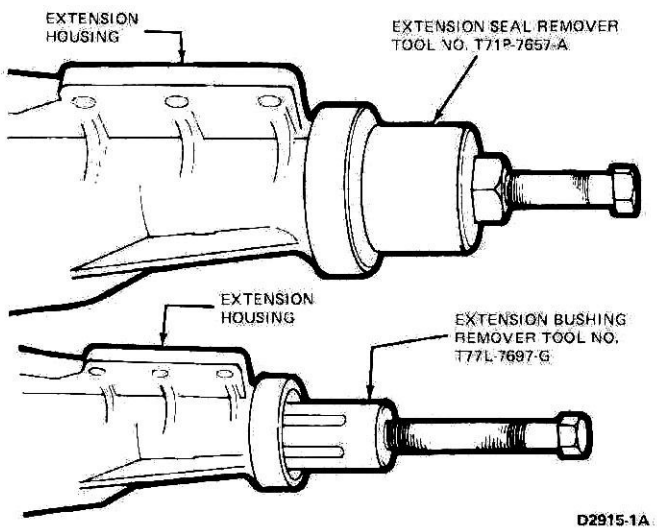


FIG. 12 Extension Housing Seal and Bushing Removal

Pour in three quarts of fluid; then run the engine and add fluid as required.

8. Operate the vehicle and check for leaks.

REAR SERVO

Removal

1. Raise the vehicle on a hoist.
2. Place a drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Remove all of the pan attaching bolts except two at the front to allow the fluid to further drain. Finally remove all of the bolts and remove the pan.
3. Remove the oil filter screen and gasket.
4. Remove the retaining screws and remove the rear servo cover and gasket. The force of the spring will raise the cover (Fig. 11).

Installation

1. Install the servo piston and spring in the servo housing.
2. Install the servo cover and the gasket.
3. Clean and replace the filter screen, gasket and three spacers (if so equipped).
4. Position the transmission fluid pan and a new gasket and install the retaining screws in two steps.

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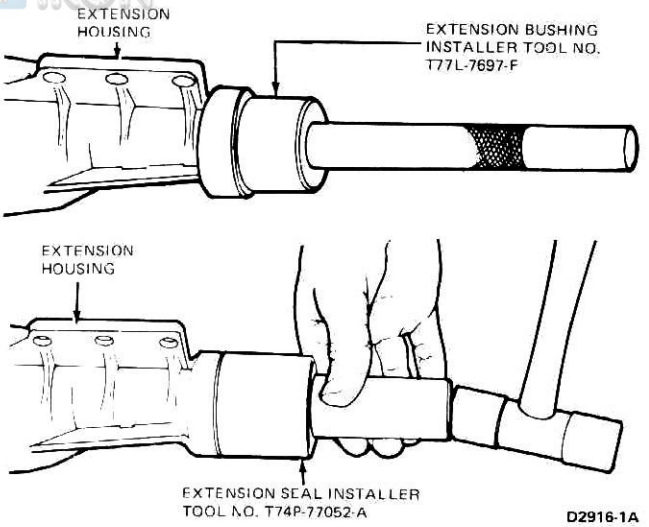


FIG. 13 Extension Housing Bushing and Seal Installation

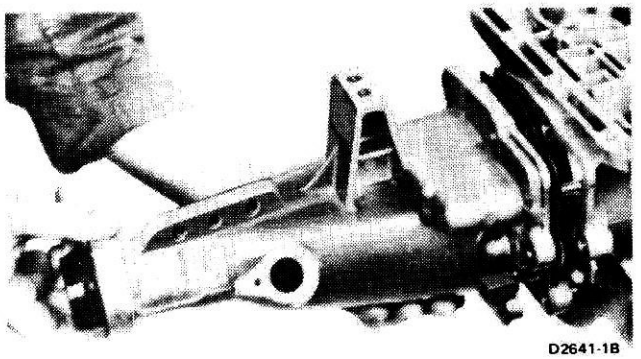


FIG. 14 Extension Housing Removal

5. Refill the transmission with the proper grade and quantity of fluid.

   Pour in three quarts of fluid; then run the engine and add fluid as required.

6. Operate the vehicle and check for leaks.

EXTENSION HOUSING REAR SEAL

Removal and Installation

1. Raise the vehicle on a hoist.
2. Remove the drive shaft. Make scribe marks on the drive shaft end yoke and the rear axle companion flange to assure proper positioning of the drive shaft during assembly.
3. Remove the oil seal (Fig. 12) using Tool T71P-7657-A.
4. Remove the extension housing bushing (Fig. 12) using Tool T77L-7697-G.
5. Install the new extension housing bushing (Fig. 13) using Tool T77L-7697-F.
6. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scoring is found, replace the yoke.
7. Inspect the counterbore of the housing for burrs. Remove any burrs with crocus cloth.
8. Install the new oil seal using Tool T74P-77052-A. Coat the inside diameter at the end of the rubber boot portion of the seal with C1AZ-19590-B or equivalent lubricant. Coat the front universal joint spline with C1AZ-19590-B lubricant or equivalent.
9. Install the drive shaft using the scribe mark as a guide to assure correct balance.
10. Lower the vehicle and check the oil level in the transmission. Add oil if necessary.

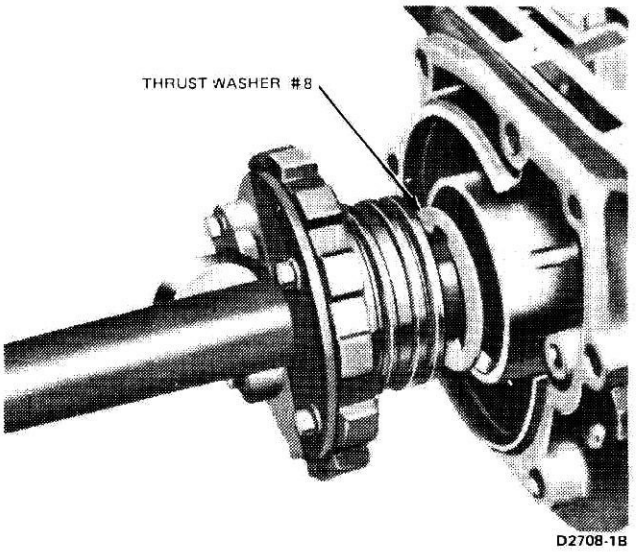


FIG. 15 Governor Removal

EXTENSION HOUSING

Removal

1. Raise the vehicle on a hoist.
2. Remove the drive shaft. Make scribe marks on the drive shaft end yoke and rear axle companion flange to assure proper positioning of the drive shaft during assembly.
3. Support the transmission with a transmission jack.
4. Remove the speedometer cable from the extension housing (Fig. 5).
5. Remove the rear support- to-crossmember attaching bolts or nuts.
6. Raise the transmission slightly and remove the rear support from the extension housing.
7. Loosen the extension housing bolts and allow the transmission fluid to drain.
8. Remove the bolts and remove the extension housing (Fig. 14).

Installation

Refer to Fig. 54.

1. Clean and inspect the exterior housing as described in Part 17-01.
2. Install a new extension housing gasket on the case.
3. Position the extension housing on the case paying special attention to correctly seating the operating rod parking notch and install the retaining bolts. Torque the bolts to specification.
4. Install the rear support and lower the transmission.
5. Install the attaching bolts. Remove the transmission jack.
6. Install the speedometer cable.
7. Install the drive shaft using the scribe mark as a guide to assure correct balance.

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8. Lower the vehicle and fill the transmission with fluid, adding as required while running the engine.
9. Check the extension housing area for fluid leakage.

GOVERNOR

Removal

Refer to Fig. 15.

1. Remove the extension housing as described in this Part.
2. Remove governor body to oil collector body attaching bolts.
3. Remove governor body, valve, spring and weight from collector body. **NOTE: Components are not retained once the governor body to oil collector body attaching bolts have been removed. It is therefore necessary to hold the governor body and components while removing or installing.**

Installation

1. Assemble governor body and components.
2. Position governor body over the oil feed holes of the oil collector body.
3. Install the governor body to oil collector body attaching bolts and torque to specification.
4. Install the extension housing as described in this Part.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts. During the repair operation, refer to Part 17-01 for Cleaning and Inspection procedures.

Ten thrust washers must be removed from between the subassemblies during the transmission disassembly. **It is important that these thrust washers be reassembled in their correct positions.** Fig. 16 shows the correct positions of the thrust washers. No. 1, located at the front pump, is the first thrust washer. The last thrust washer, No. 11 is located at the governor.

Note that No. 6, while performing a thrust function, is actually a bearing. This adds one to the thrust washer count. Because this bearing is part of the staked portion of the planet assembly, **it is not removable.**

The general instructions that apply to all transmission units must be followed during repair of the subassemblies. These instructions are given below to avoid unnecessary repetition.

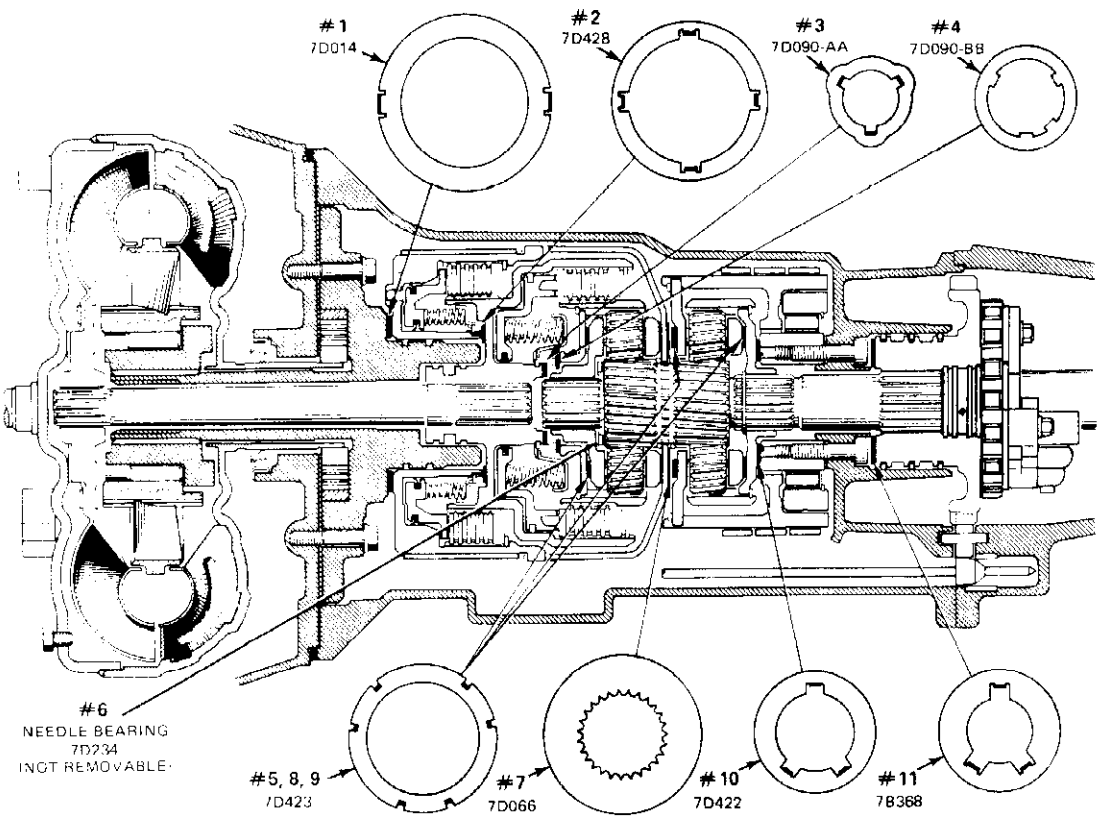


FIG. 16 Identification and Position of Thrust Washers

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Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission before assembly with clean automatic transmission fluid. **Do not use any other lubricants except on gaskets and thrust washers which may be coated with petroleum jelly to facilitate assembly. Always install new gaskets when assembling the transmission.**

Tighten all bolts and screws to specifications given at the end of this Part.

Disassembly

1. Refer to Fig. 17. Remove the torque converter.
2. Withdraw the input shaft.
3. Remove the oil pan.
4. Remove the oil filter screen, gasket and three spacers (if so equipped) (Fig. 9).
5. Remove the interlock spring.
6. Remove the rear servo cover and the gasket. (The force of the spring will raise the cover.) Take out the servo piston with the spring (Fig. 11).
7. Remove the bolts from the control valve body (Figs. 9 and 10). While easing the valve body out of the transmission, unlock and detach the selector lever connecting link. Remove the valve body and gasket.
8. Unbolt the converter housing and remove the housing and hydraulic pump as an assembly (Fig. 18). Remove the No. 1 thrust washer and the gasket.
9. Holding Tool T74P-77248-A with a spanner (Fig. 19), remove the hydraulic pump oil seal.
10. Remove the hydraulic pump from the converter housing and remove the steel plate (behind oil seal) with the O-ring.

TRANSMISSION END PLAY CHECK

Perform this check at this stage of transmission disassembly.

1. Fit the hydraulic pump with the existing No. 1 thrust washer into the case. Be sure the assembly is correctly engaged. The pump body must be **below** the level of the case gasket surface.
2. Mount the dial gauge block on the hydraulic pump with the plunger resting on the transmission housing (Fig. 20). Set the dial gauge on zero.
3. Swing the gauge around so the plunger contacts the hydraulic pump.
4. Check the reading on the dial. This reading is the amount of end play. Note for later reference.
5. Move the dial gauge block to the opposite side of the pump (180 degrees) and repeat Steps 2 through 4 above.
6. Find the average of the two end play readings. End play should be from 0.001 to 0.025. If the reading exceeds these limits, replace the No. 1 thrust washer. Refer to the specifications at the end of this Part for the sizes available.

Following the end play check, remove the hydraulic pump and thrust washer again. Mark the installed position of the hydraulic pump gears in relation to one another and remove them.

FRONT BRAKE AND FRONT SERVO ASSEMBLIES

Removal

1. Loosen the locknut, back out the adjustment screws and remove the struts (Fig. 21).
2. Remove the front brake and front assembly including thrust washer No. 8 (Fig. 22).

Transmission assembly washers Nos. 5, 8, and 9 are identical. Knowing this should prevent confusion when reviewing the remaining steps of disassembly and assembly of the transmission.

3. Press inward slightly on the front servo cover to permit removal of the snap ring.
4. Carefully force out the servo piston with compressed air (Fig. 23).

CASE AND EXTENSION HOUSING PARTS

Removal

1. Remove the transmission extension housing bolts and slide off the extension housing (Fig. 14). Remove the gasket.
2. Remove the return spring and the parking pawl.
3. Remove the large snap ring from the planet gear carrier (rear) and remove the planet gear carrier with thrust washer No. 5 from the transmission case. Remove the small snap ring from the output shaft (Fig. 24).
4. Remove the output shaft and the governor with thrust washer No. 11 (Fig. 15).
5. Remove the internal gear, the No. 10 thrust washer and the intermediate brake drum.
6. Remove the rear band assembly.
7. If necessary, due to wear or damage, remove the one-way clutch inner race (Fig. 25).
8. Remove the vacuum diaphragm as described in Part 17-01 of the Shop Manual.
9. Remove the neutral switch. **Use a thin-walled socket. An open-end wrench will crush the switch.**
10. To change the shift lever oil seal, press inward on the downshift lever. Remove the O-ring.
11. Remove the shift lever roll pin from the case.
12. Remove the shift lever nut (outside) and remove the parking pawl actuating rod.
13. Remove the selector lever from the outside and the downshift lever shaft from inside the case.
14. Remove the shift lever oil seal with a screwdriver.
15. Install a new seal (Fig. 26) using Tool T74P-77498-A.
16. Install the downshift lever shaft inside the case and the shift lever outside.
17. Install the nuts and the parking pawl actuating rod.
18. Install the roll pin, a new O-ring and the downshift lever.

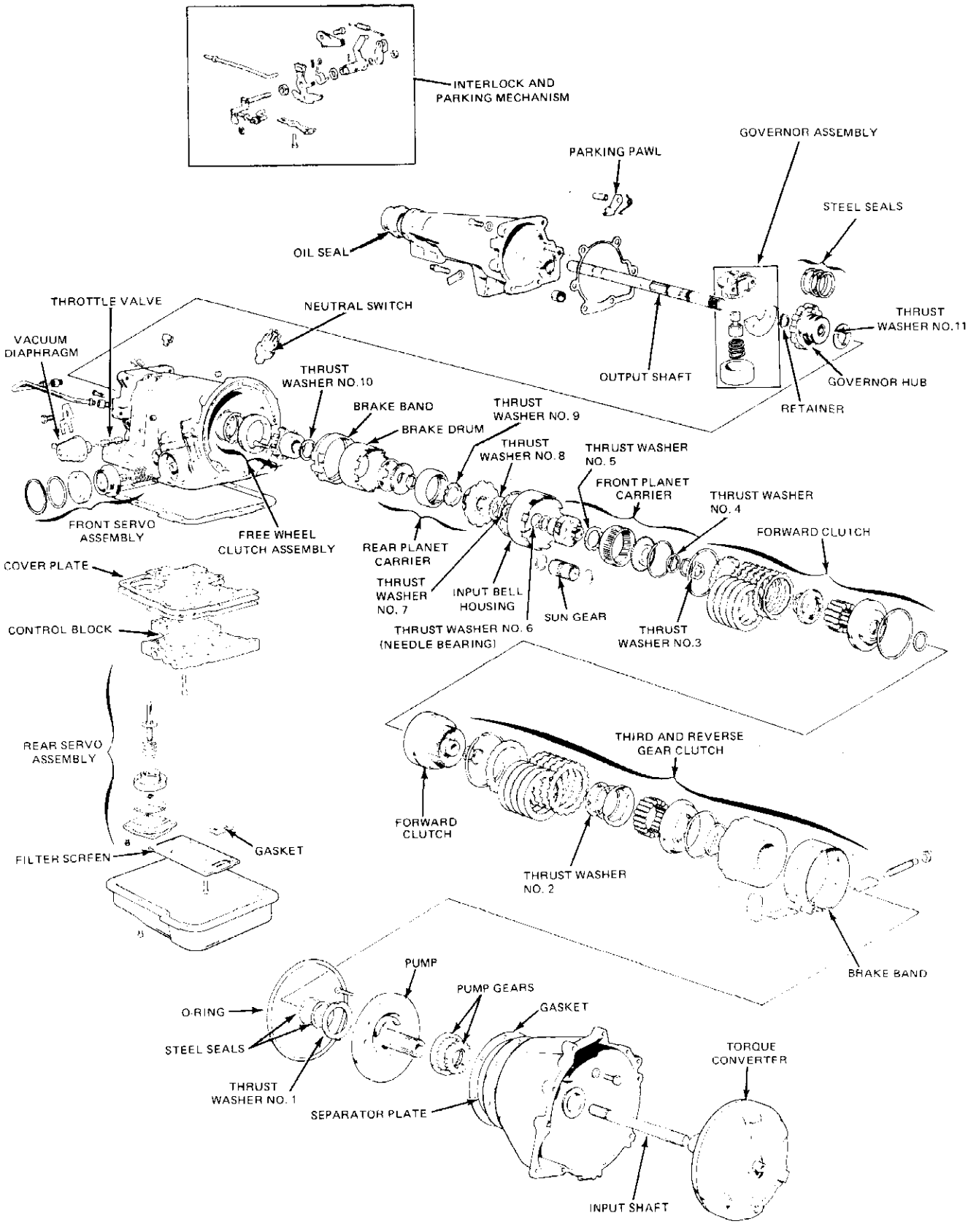
FRONT ASSEMBLY

Disassembly

Refer to Fig. 27.

1. Remove the input shell and sun gear.

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D2712 2D

FIG. 17 Exploded View of Transmission

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DETROIT IRON

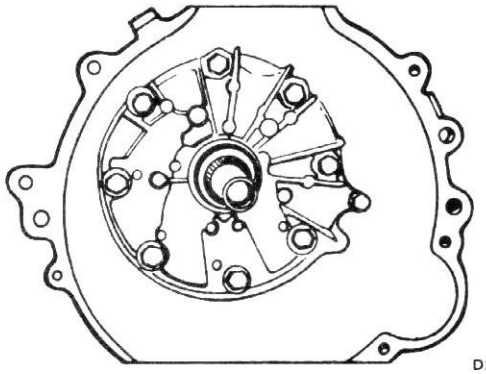


FIG. 18 Converter Housing

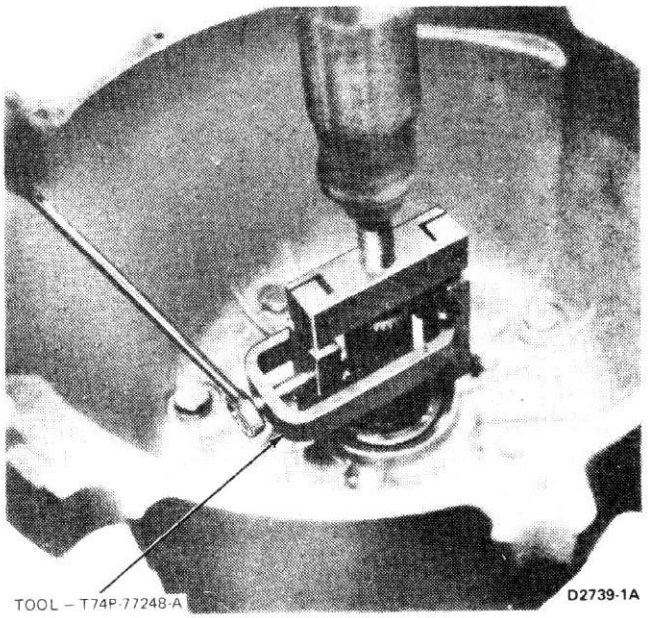


FIG. 19 Pump Oil Seal Removal

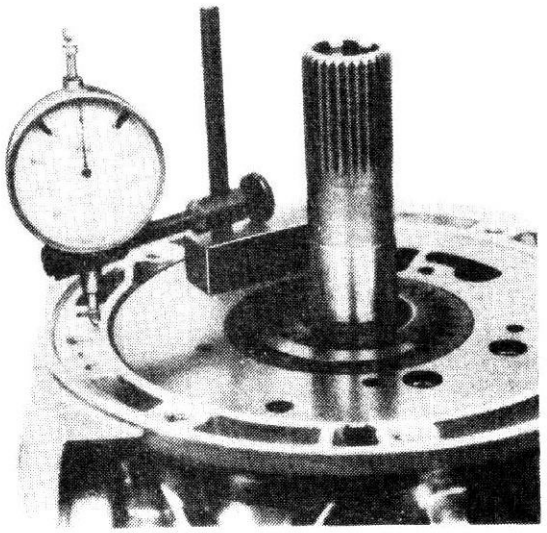


FIG. 20 End Play Check

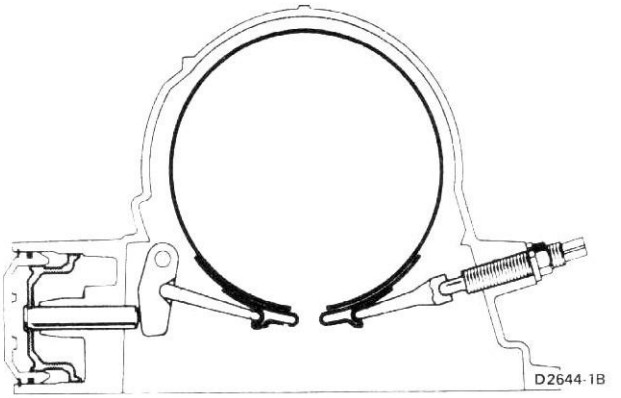


FIG. 21 Brake Band and Servo Piston

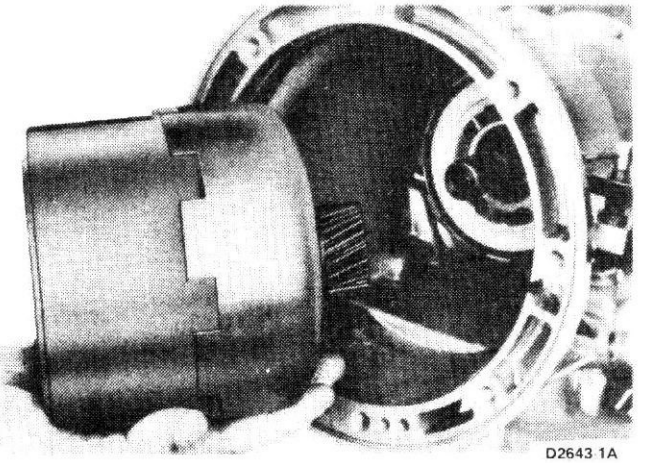


FIG. 22 Front Brake and Front Assembly Removal

2. Remove the planet gear carrier with the internal gear and thrust washer No. 5.
3. If necessary, remove the sun gear from the input shell after removing the retainer. Replace thrust washer No. 7 if it is damaged.
4. Remove the forward drive clutch and thrust washer No. 2.

REVERSE AND DIRECT DRIVE CLUTCH

Disassembly

Refer to Fig. 28.

1. Remove the pressure plate retainer ring and remove the plate pack.
2. Compress the compression springs using Tool T65L-77515-A, remove the retainer and carefully release the pressure on the springs.
3. Remove the compression springs and the compression spring retainer.
4. Turn the clutch body over and, using compressed air, carefully direct pressure into the ports as shown in Fig. 29 to force out the piston.
5. Remove the hydraulic pump and remove the O-rings from the piston and clutch body.

Assembly

1. Inspect the steel clutch plates and clutch lining plates (Fig. 30) for wear, damage or effects of

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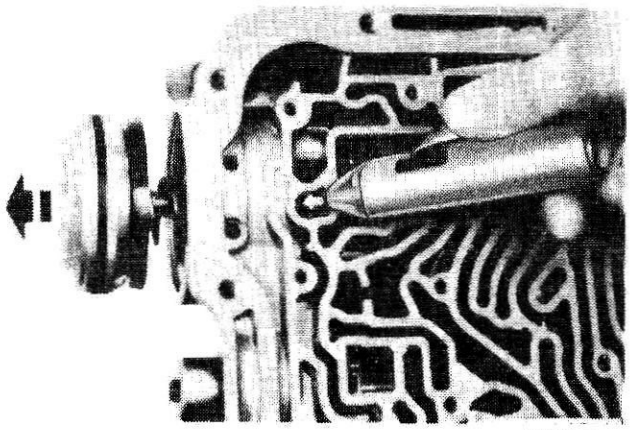


FIG. 23 Removing Servo Piston

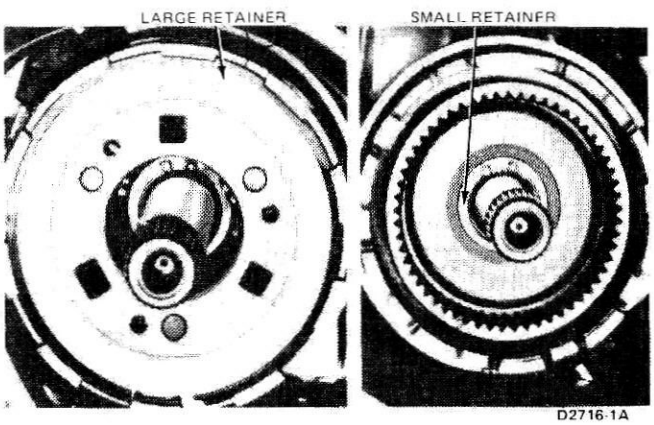


FIG. 24 Removing Planet Gear Carrier

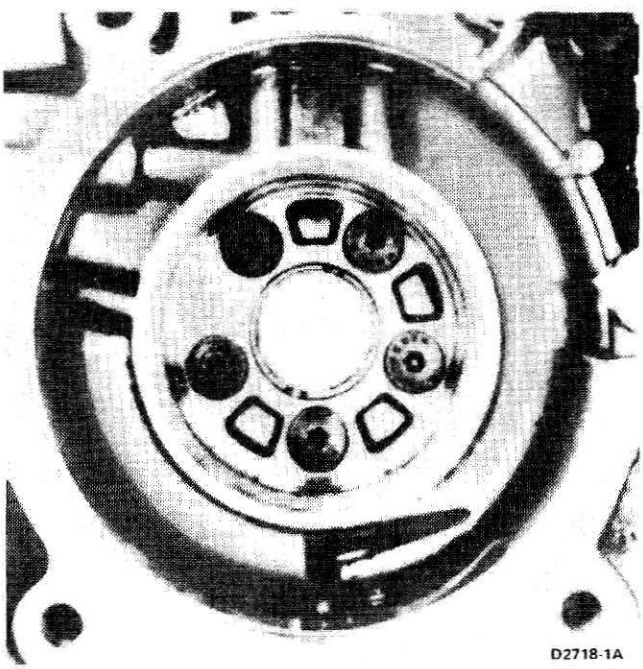


FIG. 25 One-Way Clutch

overheating. Replace the entire set if necessary. If new plates are used immerse them in transmission fluid for 30 minutes before assembly.

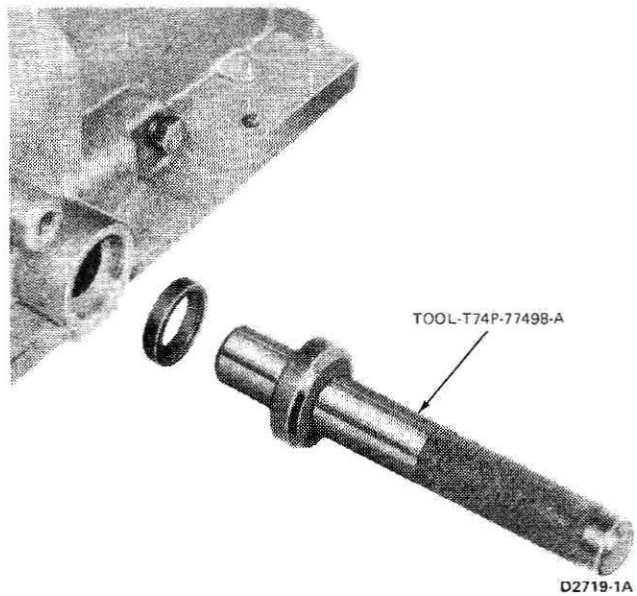


FIG. 26 Shift Lever Oil Seal Installation

2. Install new O-rings on the piston and clutch body.
3. Carefully install the clutch piston. Use Tool T74P-77404-A to protect the inner seal (Fig. 31).
4. Install the compression springs (20 required) and the spring retainer.
5. Compress the springs using Tool T65L-77515-A and install the retaining ring. Release the load on the springs and remove the tool.
6. Install the clutch plates in the correct order (Fig. 30) and secure with the retaining ring.
7. Use a feeler gage to check the clearance between the retaining ring and the pressure plate (Fig. 32). **Push downward** on the plates while making this check. The clearance should be to specifications. If the clearance is not within specification, install a different, suitable retaining ring. Refer to the specifications at the end of this Part for the clearance specification and the available retaining ring sizes.

FORWARD CLUTCH

Disassembly

Plate and piston removal procedures for the forward speed clutch assembly are similar to those for the reverse and direct drive clutch (Figs. 28 and 29).

1. Remove the retaining ring and remove the clutch plates and corrugated washer (Fig. 33).
2. Compress the springs with Tool T65L-77515-A being careful not to damage the piston.
3. Remove the retainer and carefully release the load on the springs.
4. Remove the springs and spring retainer.
5. Carefully remove the piston using air pressure.
6. Remove the hydraulic pump.
7. Remove the O-rings from the piston and clutch body.

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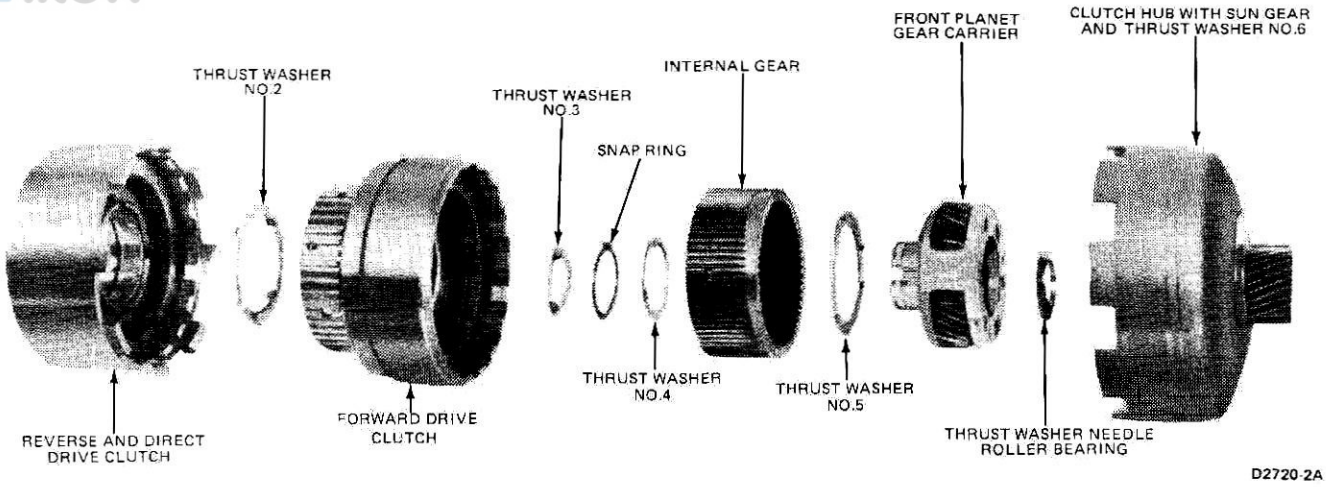


FIG. 27 Forward Part of Gear Train Disassembled

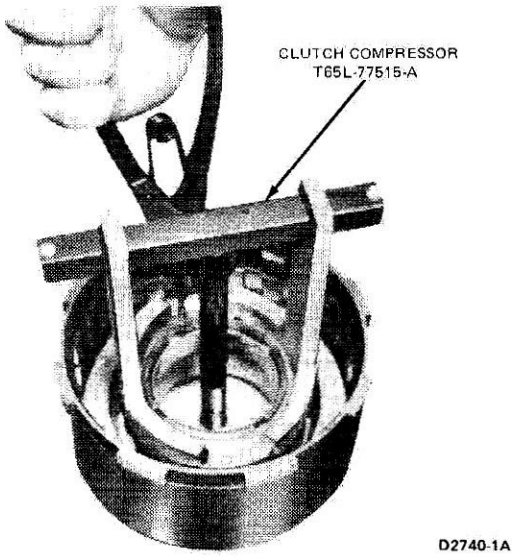


FIG. 28 Plate Pack and Spring Removal

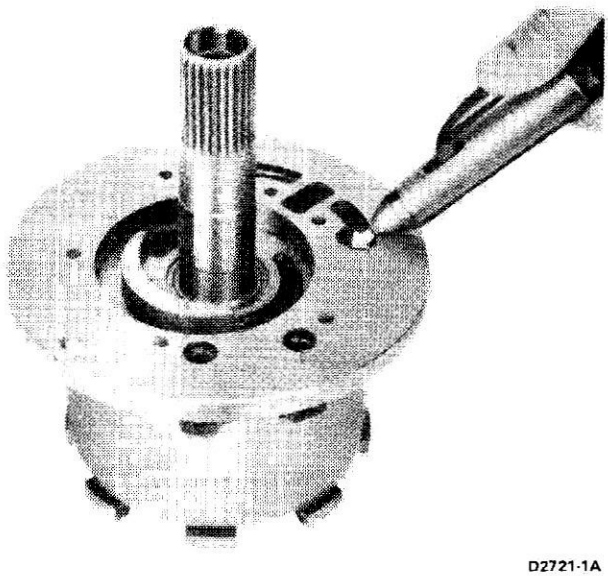


FIG. 29 Removal of Hydraulic Piston

Assembly

1. Inspect the steel clutch plates and the clutch lining plates for wear, damage or effects of overheating. If it is necessary to replace the entire set, immerse the new set of clutch plates in oil for 30 minutes before assembly.
2. Use protective tooling to prevent damage to inner and outer seals (Fig. 34). Install new O-rings on the piston, apply petroleum jelly to the rings and to the shoulder at the clutch stub, and install the piston carefully.
3. Install the compression springs and the spring retainer.
4. Use Tool T65L-77515-A to compress the springs, and install the retaining ring.
5. Install the disc spring washer and the clutch plates in the correct order (Fig. 33) and position the retaining snap ring.
6. Check the clearance between the retaining ring and the support plate following the procedure described for the Reverse and Direct Drive Clutch.
7. Install new steel seals on the clutch stub.

INTERNAL GEAR AND PLANET GEAR ASSEMBLY

Disassembly

1. Remove the snap ring, the planet gear carrier internal gear and thrust washer No. 4 (Fig. 35).
2. Separate the planet gear carrier from the internal gear and remove thrust washer No. 5.

Assembly

1. Insert the planet gear carrier with thrust washer No. 5 in the internal gear. Position thrust washer No. 5 again, and secure with a new snap ring (the internal gear must be free of the planet gear carrier).
2. **The needle roller bearing (No. 6 Washer) can only be replaced complete, with the planet gear carrier. If the thrust washer needle roller bearing is removed, the washer must be positioned with the collar pointing toward the rear (Fig. 35).**

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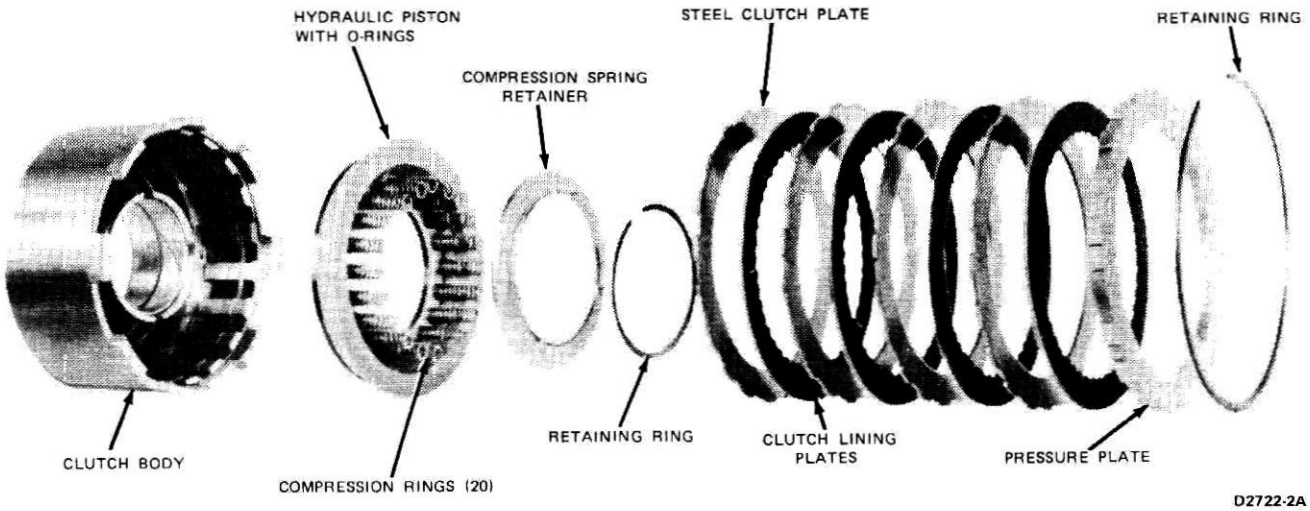


FIG. 30 Reverse and Direct Clutch Disassembled

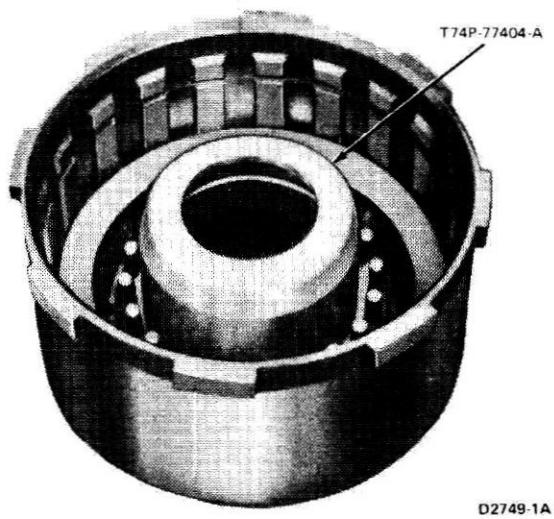


FIG. 31 Inner Seal Protector—High Clutch

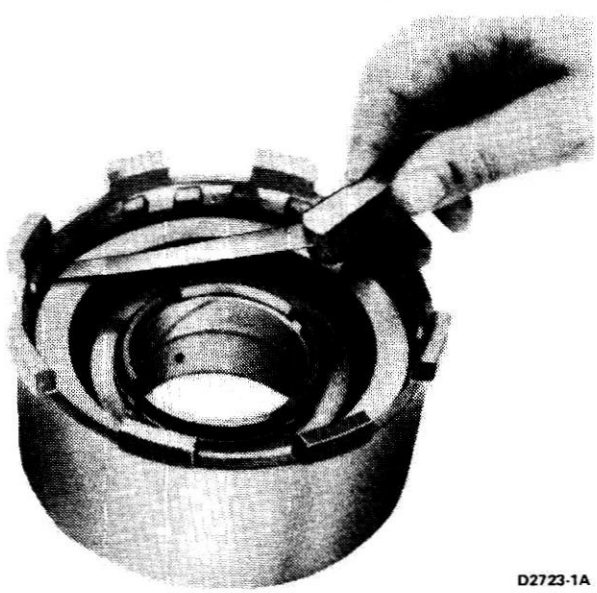


FIG. 32 Checking Clearance Between Pressure Plate and Retaining Ring

FRONT ASSEMBLY

Assembly

Refer to Fig. 27.

1. Place the reverse and direct drive clutch assembly vertically on a bench.
2. Position thrust washer No. 2 and the forward gear clutch assembly.
3. Secure thrust washer No. 3 with petroleum jelly or oil on the planet gear carrier.
4. Install the internal gears and planet gear assembly.
5. Assemble the input shell with the sun gear to the planet gear carrier, then to the body of the reverse and direct drive clutch.

ONE-WAY CLUTCH

Disassembly and Assembly

1. Remove the snap ring (Fig. 36).
2. Lift out the cage with the springs and bearing rollers as a unit.
3. Install the cage with springs.
4. Insert the bearing rollers one by one, using a suitable screwdriver and install the snap ring (Fig. 37).

GOVERNOR

Refer to Figs. 38 and 39.

1. Remove governor body to oil collector body attaching bolts (Fig. 38). **NOTE: When the governor body attaching bolts are removed, the governor components are no longer retained in position to the governor body. Care must be taken not to drop the governor body and components when the attaching bolts are removed.**
2. Remove the governor components from the governor body.
3. Remove the counterweight.
4. Clean all parts and replace any that are worn or damaged. If necessary, remove the three steel seals and carefully install new ones.

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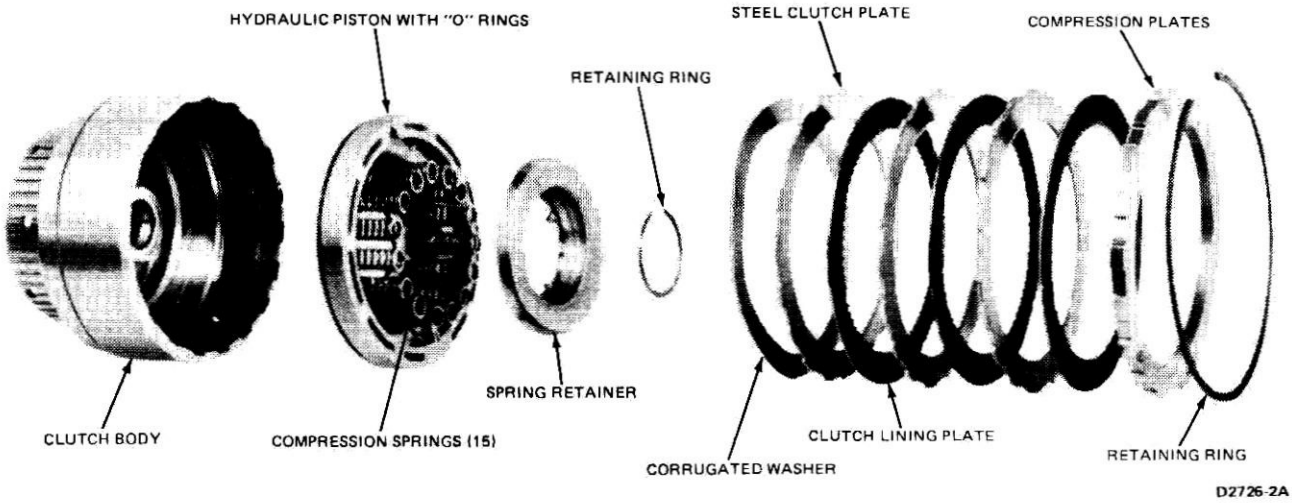


FIG. 33 Forward Drive Clutch Detail

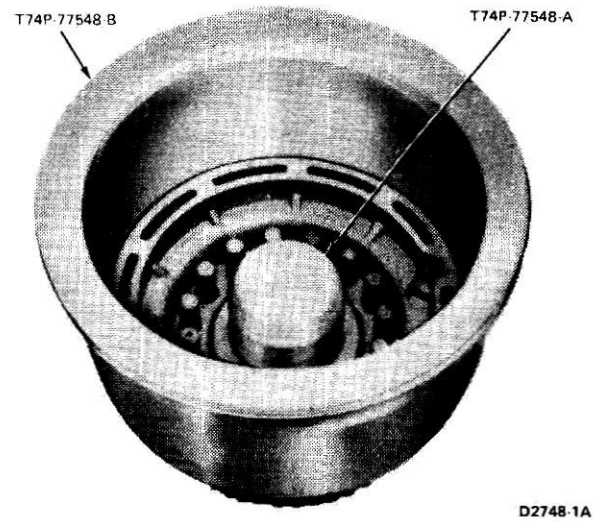


FIG. 34 Inner and Outer Seal Protector

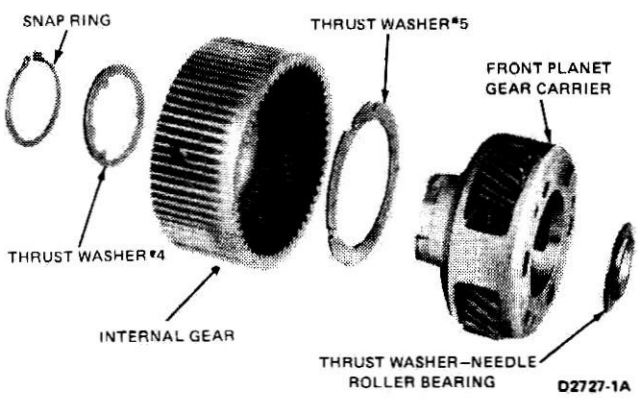


FIG. 35 Separation of Planet Gear Carrier from Internal Gear

5. Assemble the counterweight spring and primary valve in the governor body.
6. Assemble the governor body and counterweight to the oil collector body.

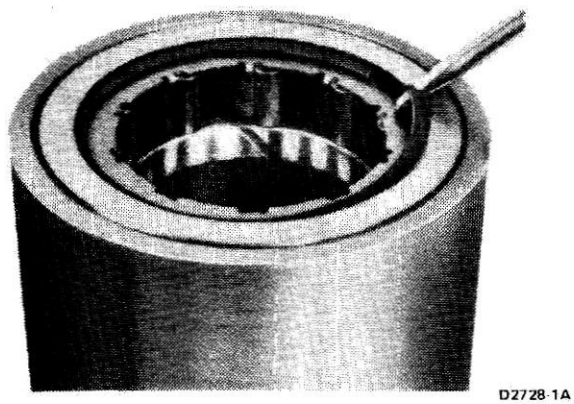


FIG. 36 Bearing and Spring Removal

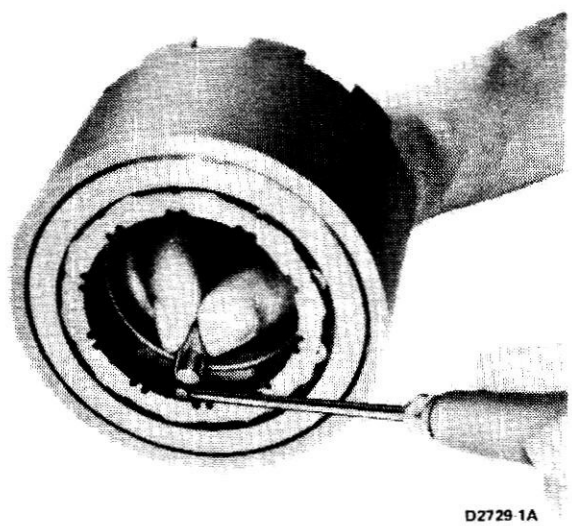


FIG. 37 Insertion of Bearing Rollers

CONTROL VALVE BODY

Refer to Figs. 40, 41, 42, and 43.

1. Remove the separator plate bolts and carefully lift off the separator plate.

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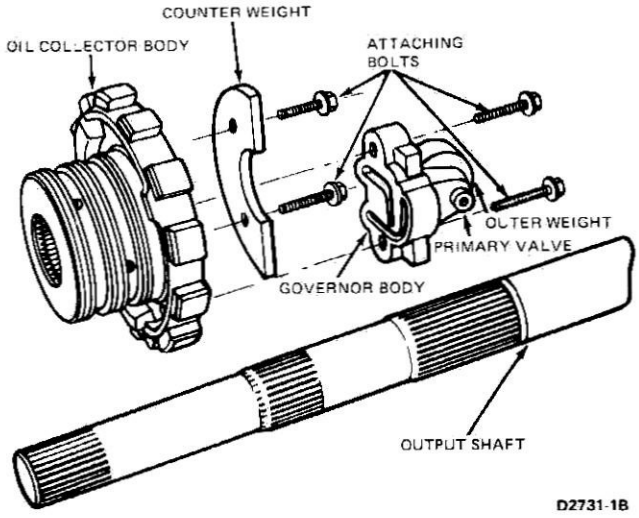


FIG. 38 Governor Components

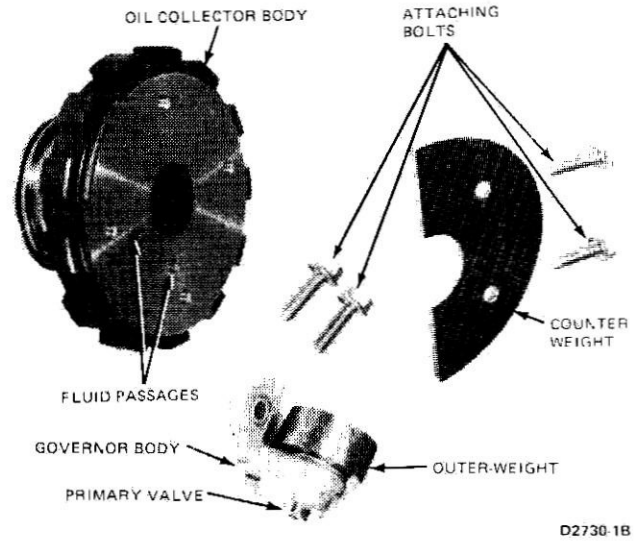


FIG. 39 Governor Housing—Disassembled

2. Remove the five ball valves and both relief valves with springs. Refer to Fig. 43 for correct replacement.
3. Remove the retaining plates; dowels, plugs and valves with springs. Do not mix the springs.
4. Carefully clean the oil channels and parts by blowing through with compressed air.
5. Inspect all parts for burring, unevenness and gum deposits. If necessary replace parts.
6. Lubricate all parts with transmission fluid, then install the valves, springs, plugs and pins (Figs. 42 and 43).
7. Using a new gasket, install the separator plate (Fig. 40). Be sure that the ID tag does not interfere with the control valve body fit to the case.

TRANSMISSION

ASSEMBLY

Review Figs. 1, 16 and 17 to make assembly of the transmission easier and prevent mistakes. Thoroughly clean all moving parts and lubricate them with the specified automatic transmission fluid before assembly.

1. Press in a new hydraulic pump oil seal using Tool T74P-77103-A and Adapter T74P-77248-B (Fig. 44).
2. Install the vacuum diaphragm as described in Part 17-01 (Fig. 13) of this Shop Manual.
3. If the one-way clutch inner race was removed (Fig. 25), install it using Tool T74P-77193-A.
4. Position thrust washer No. 11 in the case and install the output and governor assembly. **Be careful not to damage the steel oil seals.**
5. Position the rear brake band in the housing in correct relation to the guide pilots.
6. Position thrust washer No. 10 in the case and install the rear brake drum using the clutch replacing guide Tool T74P-77193-A (Fig. 45). Then remove the guide and install the internal gear. Secure with a snap ring.
7. Position thrust washer No. 9 to the back of the planet system carrier with light grease or petroleum

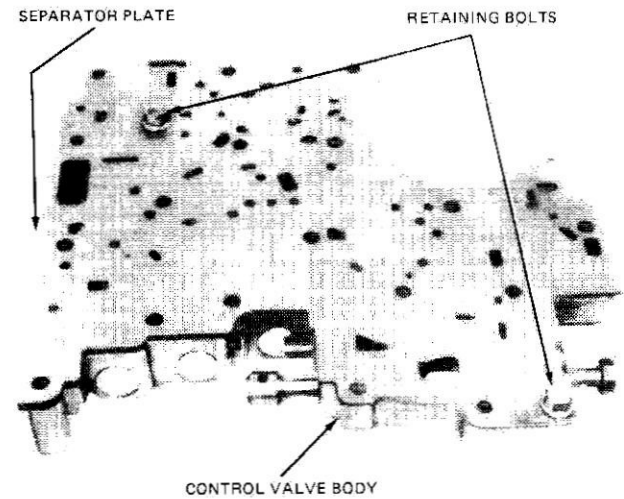


FIG. 40 Separator Plate Assembled

jelly. Install the planet system carrier (Fig. 46) and secure to the rear brake drum with the snap ring.

8. Position thrust washer No. 8 to the planet gear carrier with petroleum jelly and install the front assembly (Fig. 22).
9. Install the spiral spring on the front servo piston assembly (Fig. 47). Position the piston and cover and secure with the snap ring using Tool T74P-77028-A (Fig. 48). Replace the servo piston or O-rings at this time, if necessary.
10. Install the brake band and struts starting with the one at the servo piston lever (Fig. 21).
11. **Being careful not to damage the oil seals, turn the transmission on the assembly stand so the output shaft points downward.** Install the hydraulic pump with thrust washer No. 1 (Fig. 49).
12. Recheck the end play as described under Disassembly, and if necessary replace the thrust washer. **This step is very important.**
13. Remove the hydraulic pump. Install the inside and outside pump gears making sure that the small gear

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DETROIT IRON OFFICIAL LICENSED PRODUCT

1978 CARS

Vehicle	Engine	Trans. Model	Servo Cover	Servo Piston	Servo Spring	Servo Lever
Mustang/Pinto/ Bobcat Fairmont/Zephyr	2.3 Litre	78DT-ACA -ADA -SA	①74DT-7D027-BB	74DT-7E221-A1B, 74DT-7E221-A2B	②74DT-7D028-AB	E ③
Pinto/ Bobcat	2.8 Litre	78DT-AGA	①74DT-7D027-BB	74DT-7E221-A1B, 74DT-7E221-A2B	②74DT-7D028-AB	D ④
Fairmont/Zephyr	3.3 Litre (200 CID 6)	78DT-BCA -BAA	①74DT-7D027-BB	74DT-7E221-B1A	②74DT-7D028-AB	D ④

① Part number cast on cover.
② Orange color-coded.
③ 74DT-7D396-EB
④ 74DT-7D396-BB

CD2766-2E

FIG. 41 Intermediate Servo Piston Cover and Spring Identification

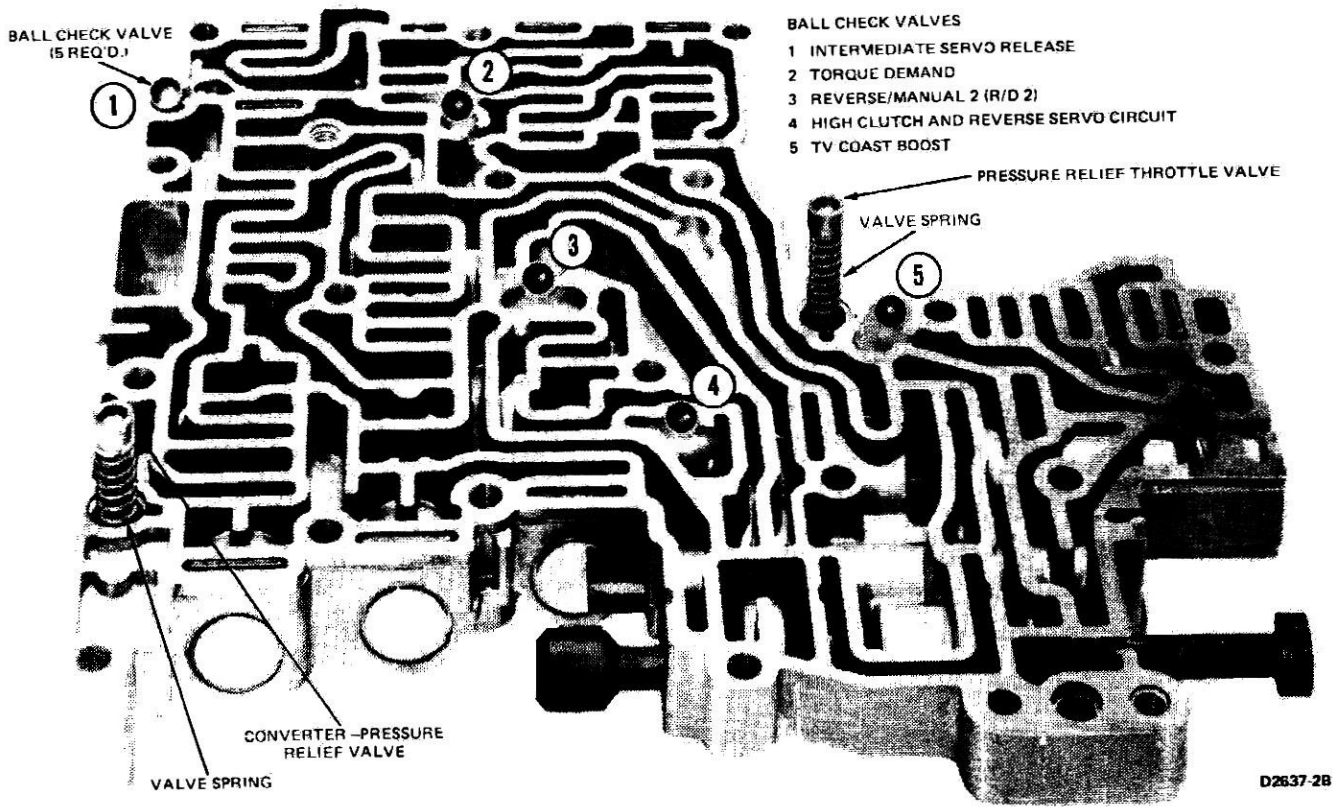


FIG. 42 Control Valve Body Assembly (Valves Installed)

has the I.D. pump drive flat recess facing upward, and that the large gear has the chamfer facing downward.

14. Position the steel plate on the hydraulic pump in the exact position required (Fig. 50); then install the complete assembly to the converter housing.
15. Tighten the bolts finger tight. Align the pump using Tool T74P-77103-A. **This tool must be used and the sleeve gauging surfaces must be in good condition. Otherwise the pump will not be aligned correctly with the converter housing; then seal leakage or bushing failure will result.** To use the tool, select the arbor with the smallest I.D. that will fit completely over the pump shaft. Assemble the common handle to the selected arbor and slide the tool down over the shaft until it bottoms against the pump. The outside diameter of the tool arbor will then automatically center the pump in the converter housing. Torque the bolts to specification and remove the tool.
16. Insert the input shaft into the pump and install the converter into the pump gears. Rotate the converter to check for free movement, then remove the converter and input shaft.
17. Position the selected thrust washer No. 1 to the pump housing with petroleum jelly. Install a new O-ring. Carefully install the converter housing with the pump, using a new gasket. **Do not damage the steel oil seals.** Install the bolts and torque to specification.
18. Adjust the brake band as described under Adjustments (Fig. 4).

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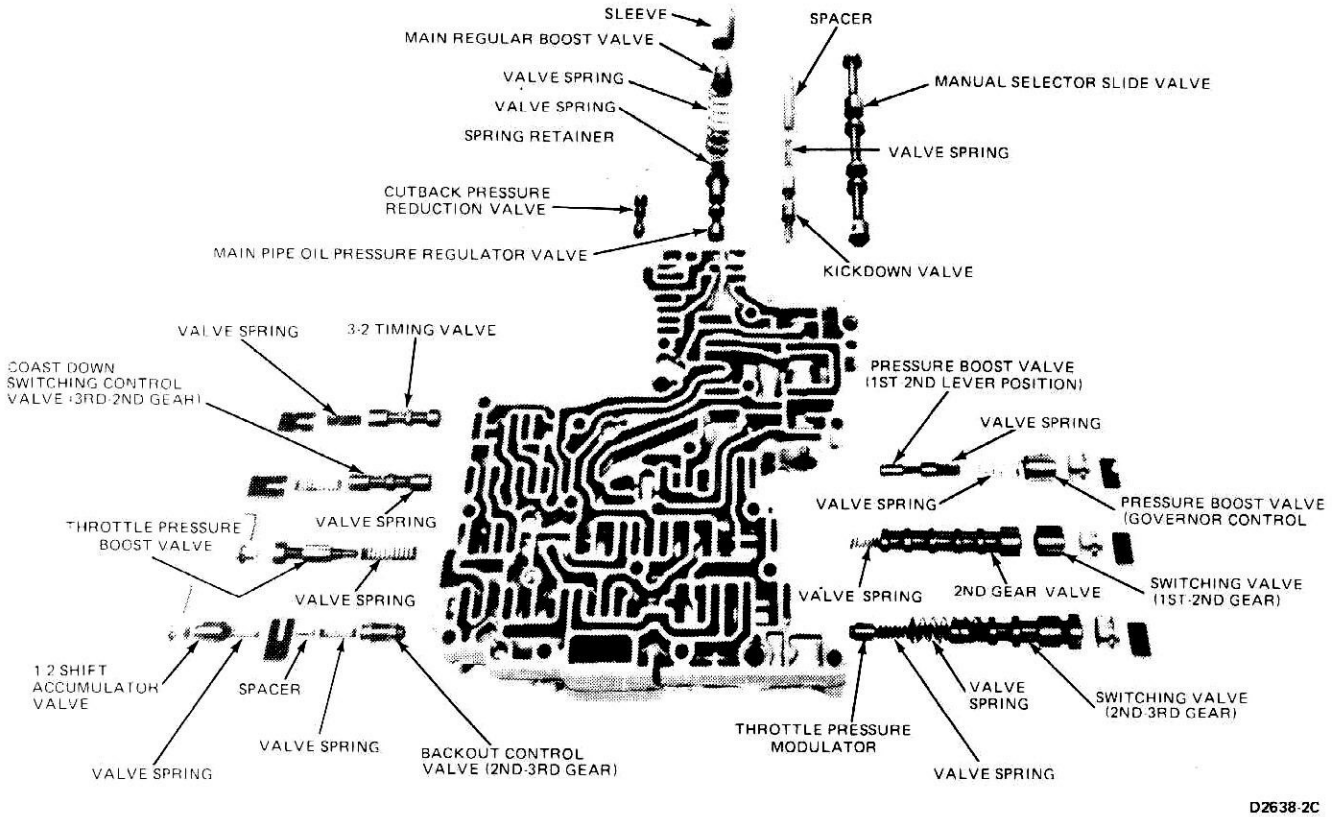


FIG. 43 Control Valve Body Assembly—Exploded View

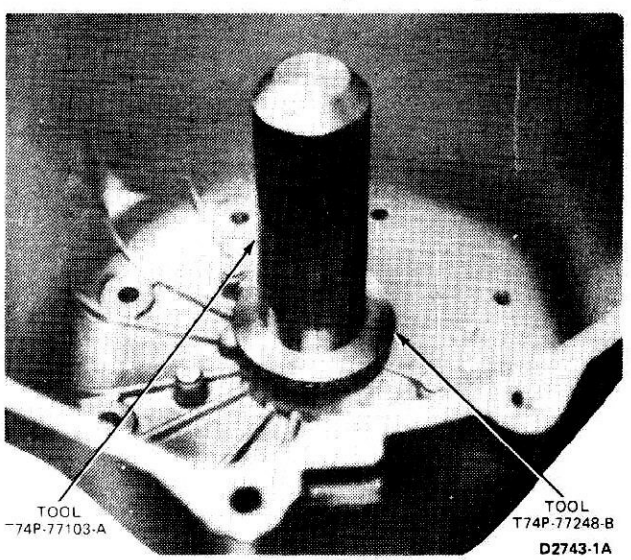


FIG. 44 Installation of Pump Oil Seal

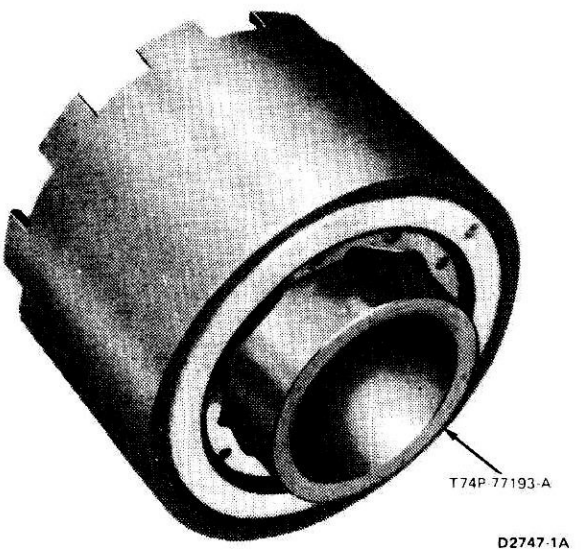


FIG. 45 Clutch Replacing Guide

19. Make the air pressure test as described in Part 17-01 of this Shop Manual.
20. Install the parking pawl and its return spring in the extension housing and preload (Fig. 53).
21. Using a new gasket, install the extension housing. Be sure to correctly seat the operating parking rod in the extension guide cup. Torque the bolts to specification (see Figs. 53 and 54).
22. Remove the extension housing oil seal and bushing (Fig. 12).
23. Install a new extension housing bushing and oil seal (Fig. 13).
24. Using a new gasket, position the control valve body, and fit and secure the connecting rod or link to the manual valve (Fig. 55). Install the retaining bolts. Because the bolts are of different lengths, make sure each bolt head bottoms on the control body. Attach the interlock spring to the control housing.
25. Before proceeding further be sure the inner downshift lever is seated between the stop and the downshift valve (Fig. 56).

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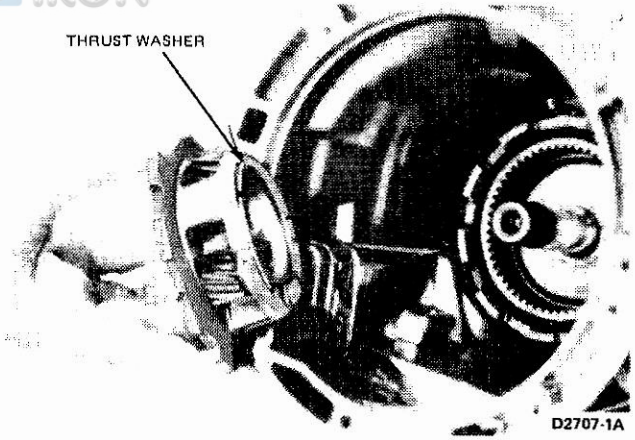


FIG. 46 Planet Carrier Installation

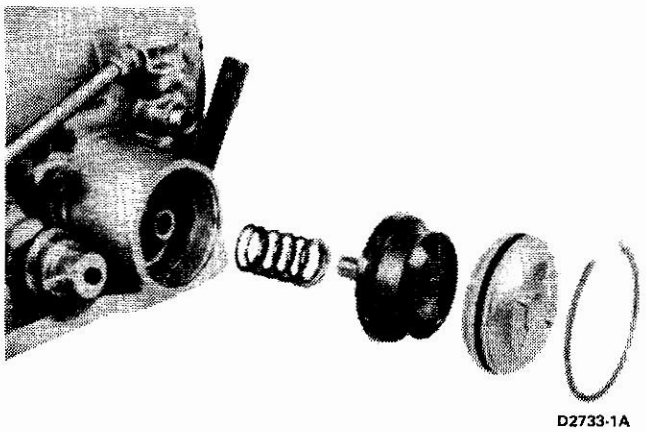


FIG. 47 Reassembly of Front Servo

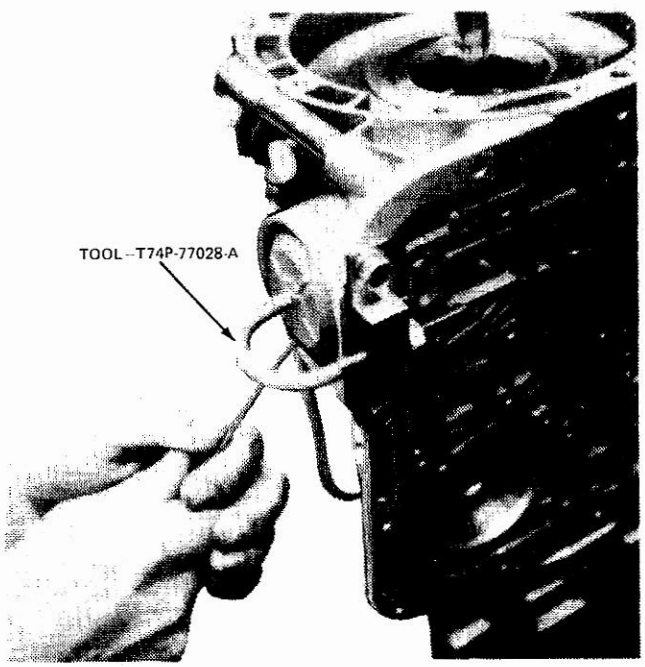


FIG. 48 Holding Front Servo Cover to Install Snap Ring

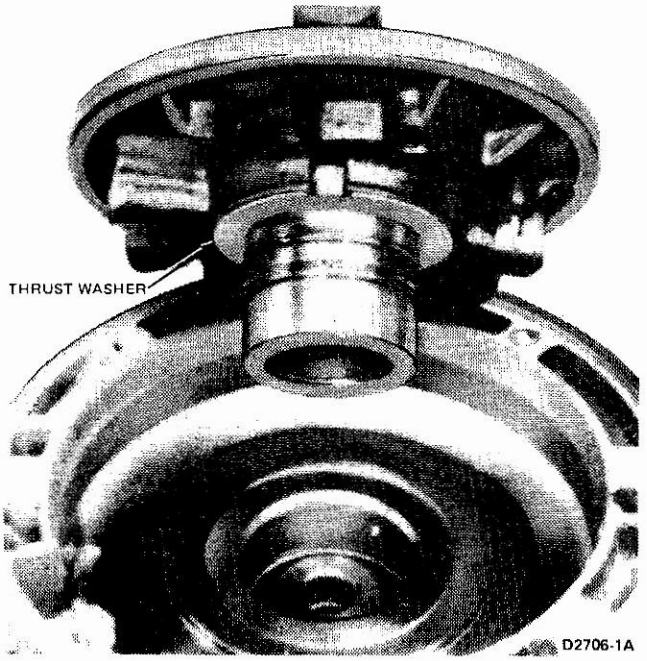


FIG. 49 Pump Installation

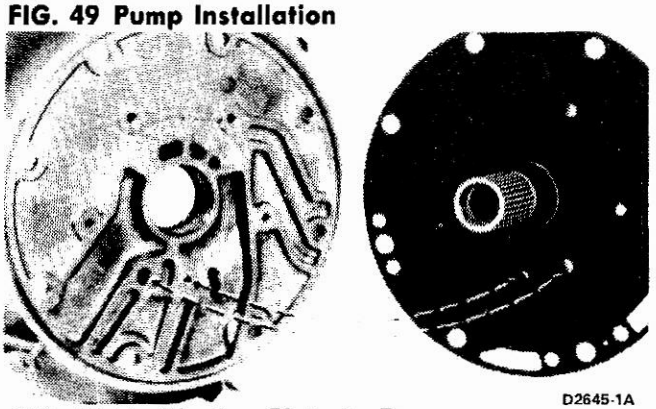


FIG. 50 Positioning Plate to Pump

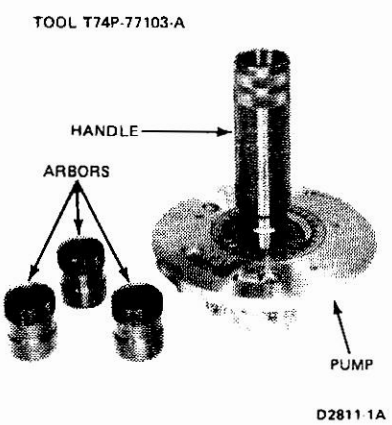


FIG. 51 Pump Alignment Tool T74P-77103-A

26. Assemble the servo piston rod, servo piston and spring. (Use available servo piston rod.)
27. Install the rear servo piston assembly and spring into the rear servo bore. Make certain the piston rod is correctly seated in the reverse band apply end.
28. Install tool T74P-77190-A with a new servo cover gasket and tighten the three attaching bolts (see

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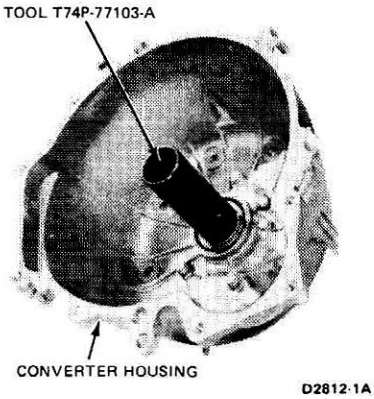


FIG. 52 Pump Alignment Tool Installed

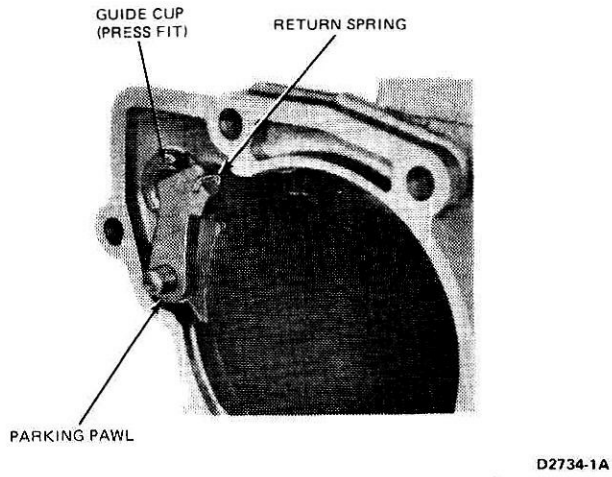


FIG. 53 Parking Pawl Installation

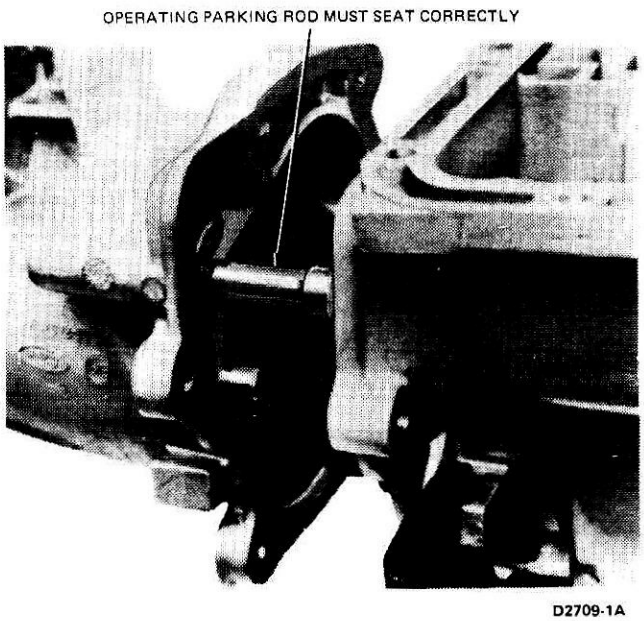


FIG. 54 Extension Housing Installation

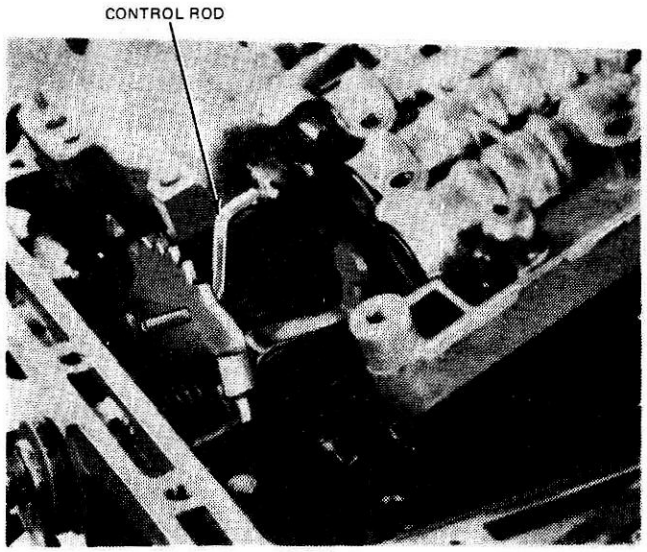


FIG. 55 Control Valve Body Installation

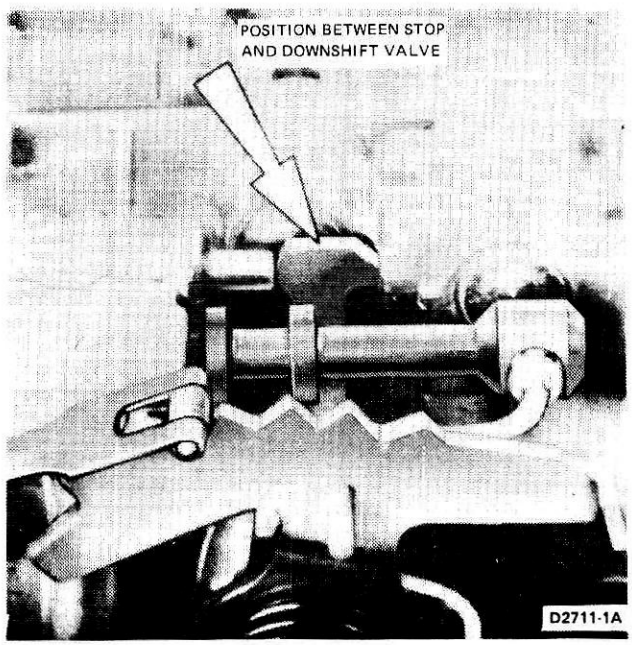


FIG. 56 Correct Seating of Inner Downshift Lever

Fig. 57). As the servo cover to case bolts are not long enough to attach adjusting tool to case, use three M6x30 main control to case attaching bolts.

29. Torque the servo tool adjusting screw to 36 in-lbs.
30. Install dial indicator on transmission case and position indicator on one of the three servo piston pads that is accessible through the cutout on the tool as shown in Fig. 57. Set dial indicator at zero.
31. Back out the servo tool adjusting screw until the servo piston bottoms out on the tool. Record the distance the servo piston travelled.
32. If piston travel is between .120 and .220 inch, it is within specification (Fig. 58). If piston travel is greater than .220 inch, use the next longer piston and rod. If piston travel is less than .120 inch, use

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DETROIT IRON

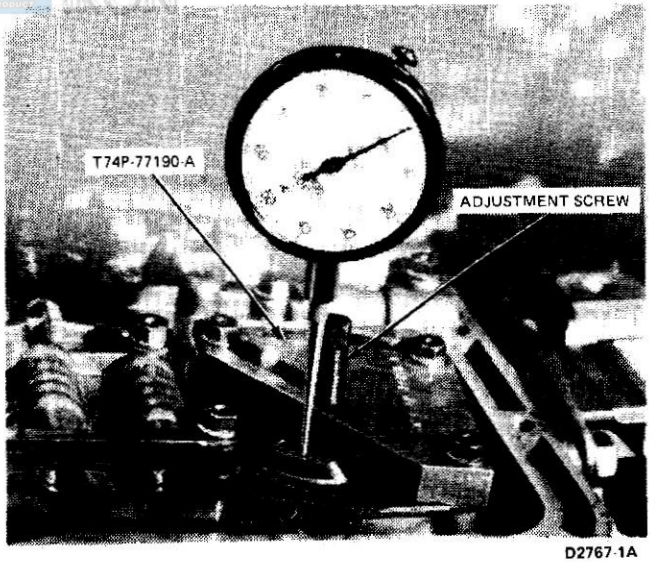
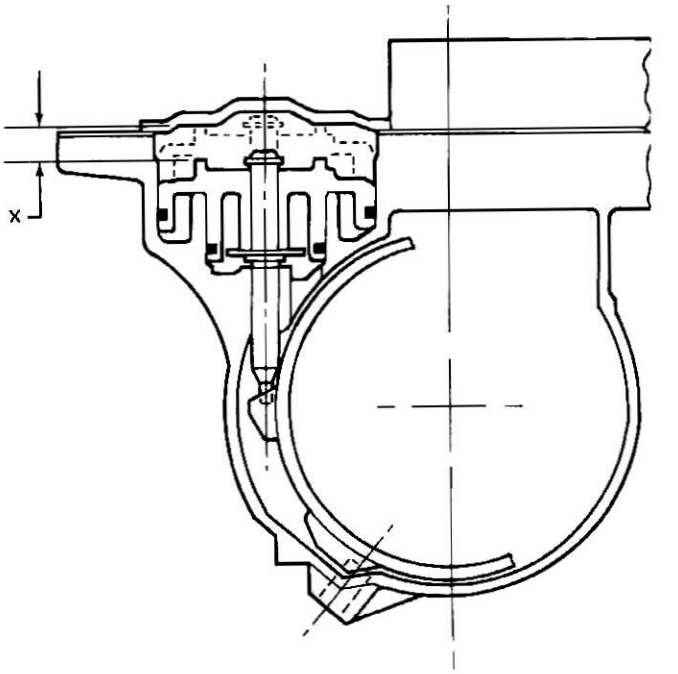


FIG. 57 Installing Piston Travel Test Tool

the next shorter piston and rod. For piston and rod selection, see Fig. 59.

33. Using the above procedure, check the piston travel with the new selected piston and rod (if required) to make sure that the piston travel is .120 to .220 inch.
34. Remove servo adjusting tool and install servo cover and gasket. Torque the 4 attaching bolts to 7 to 10 ft-lbs.
35. Install the oil pan with a new gasket. Torque the bolts to specification in two steps. Install the neutral switch.
36. Install the input shaft and the torque converter.
37. Install the transmission in the vehicle using the procedures described under Removal and Installation of Transmission in this Part.



PISTON TRAVEL X AT 36 LB-IN TORQUE
MUST BE BETWEEN .120 AND .220 IN.

D2768-1A

FIG. 58 Piston Travel

Length (Inches)	I.D.
2.112/2.085	1 groove
2.014/1.986	no groove
1.915/1.888	2 grooves

CD2769-1B

FIG. 59 Rod Sizes

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SPECIFICATIONS

SELECTIVE THRUST WASHERS (END PLAY CONTROL) C3 TRANSMISSION

		Part Numbers	Thickness	ID Number
End Play 0.007-0.032	No. 1 Thrust Washer *Front Pump Support* (Selective)	74DT-70014-EA	0.1091-0.1110	5
		74DT-70014-DA	0.0929-0.0949	4
		74DT-70014-CA	0.0768-0.0787	3
		74DT-70014-BA	0.0610-0.0630	2
		74DT-70014-AA	0.0488-0.0507	1

SELECTIVE SNAP RINGS

HIGH CLUTCH					FORWARD CLUTCH				
Part Numbers	Thickness		Diameter		Part Numbers	Thickness		Diameter	
	Inches	MM	Inches	MM		Inches	MM	Inches	MM
E 860126-S	.0539	1.37	5.161	131.1	E 860115-S	.0539	1.37	4.925	125.1
E 860127-S	.0681	1.73	5.161	131.1	E 860116-S	.0681	1.73	4.925	125.1
E 860128-S	.0819	2.08	5.161	131.1	E 860117-S	.0819	2.08	4.925	125.1
E 860129-S	.0961	2.44	5.161	131.1	E 860118-S	.0961	2.44	4.925	125.1

CLUTCH PLATES – C3 TRANSMISSION

	Forward Clutch			High Clutch		
Model	Steel	Friction	Clearance	Steel	Friction	Clearance
2.3 Litre	4	4	0.055-0.083	4	4	0.051-0.079
2.8, 3.3 Litre (200 CID 6)	5	5	0.055-0.083	5	5	0.051-0.079

CHECKS AND ADJUSTMENTS–C3 TRANSMISSION

Operation	Specification
Transmission End Play	0.007-0.032
Turbine and Stator End Play	Model 74DT-BKB New or Rebuilt – 0.023 Max.; Used – 0.050 Max.
Front (Intermediate Band) Adjustment	Remove and discard locknut. Install new locknut. Tighten adjusting screw to 10 ft-lbs torque. Back off 1-1/2 turns. Hold screw and tighten locknut.

APPROXIMATE REFILL CAPACITY C3 TRANSMISSION

All cars Equipped with C-3	U.S. Measure (Qts.)	Imperial Measure (Qts.)
Mustang II 2.3L Engine	8	6 1/2

TORQUE LIMITS–C3 TRANSMISSION

Item	Ft-Lbs
Converter Housing to Case	27-39
Extension Housing to Case	27-39
Oil Pump to Converter Housing	7-10
Flywheel to Converter Housing	27-49
Main Control to Case	7-9
Plate to Valve Body	7-9
Servo Cover to Case	7-10
Inner Race – OWC to Case	7-10
Oil Pan to Case	12-17
Governor to Collector Body	7-10

Item	Ft-Lbs
Converter Housing to Engine	28-38
Nut – Downshift Lever Outer	7-11
Nut – Manual Lever Inner	30-40
Neutral Switch to Case	12-15
Front Band Adjusting Locknut	35-45
Vacuum Diaphragm Retaining Clip to Case	15-23 (1)
Oil Cooler Line or By-pass Tube to Connector	7-10
Connector to Case	10-15
Drain Plug – Converter	20-30
Flywheel to Crankshaft	48-53
Filler Tube to Engine Clip	28-38

(1) In Lbs.

SPECIAL TOOLS – C3 TRANSMISSION

Tool Number	Description
T74P-77103-A, B, C, D, H	Oil Pump Aligning Tool Kit
T74P-77248-A	Front Oil Seal Remover
T71P-7657-A	Extension Housing Seal Remover
T74P-77052-A	Extension Housing Seal Installer
T74P-77498-A	Shift Lever Oil Seal Replacer
T74P-77902-A	Torque Converter End Play Checking Adapter
T74P-77028-A	Front Servo Cover Compressor
T74P-77248-B	Front Oil Seal Replacer Adapter
T74P-77000-A	Transmission Mounting Adapters
T74P-77247-A	Neutral Start Switch Remover and Replacer
T57L-500-B	Bench Mounting Fixture
T57P-116-2A	Converter One-Way Clutch Checking Tool
T77L-7697-F	Extension Housing Bushing Remover

Tool Number	Description
T57P-116-2A	Converter One-Way Clutch Checking Tool
T57P-116-1A	Holding Tool for Converter One-Way Clutch
T74P-77548-A	Forward Clutch Inner Seal Protector
T74P-77548-B	Forward Clutch Outer Seal Protector
T74P-77404-A	Intermediate Brake Inner Seal Protector
T74P-77193-A	Overrunning Clutch Replacing Guide
T71P-77370-A	Band Adjusting Tool Kit
T65L-77515-A	*Clutch Compressor*
T74P-77001-B	Metric Mounting Adapters (Use with T57L-500-B)
T74P-77030-A	Oil Cooler Line Wrench
T74P-77190-A	Reverse Band Servo Rod Selecting Gauge
T57P-116-1A	Holding Tool For Converter One-Way Clutch
T77L-7697-G	Extension Housing Bushing Installer

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DETROIT IRON

C4 Automatic Transmission

PART 17-05

All Cars Except Mercury, Lincoln Continental or Continental Mark V

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CD2884-2A

DESCRIPTION

The C4 automatic transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios. The transmission is also capable of providing manual selection of first and second gears.

Fig. 1 shows the location of the converter, front pump, clutches, gear train, and most of the internal parts used in the C4 automatic transmission. The identification tag (Fig. 2) is located under the lower front intermediate servo cover bolt. The tag shows the model prefix and suffix, assembly part numbers, and the built-date code. The first line on the tag shows the transmission model prefix and suffix. A number appearing after the suffix (Fig. 2) indicates that internal parts have been changed after initial production start-up. For example, a PEE-A model transmission that has been changed internally would read PEE-A1. Both transmissions are basically the same, but some service parts in the PEE-A1 transmission are slightly different than the PEE-A transmission. **Therefore, it is important that the codes on the transmission identification tag be checked when ordering parts or making inquiries about the transmission.**

The transmission consists essentially of a torque converter, planetary gear train, two multiple disc clutches, a oneway clutch and a hydraulic control system (Figs. 3 and 4).

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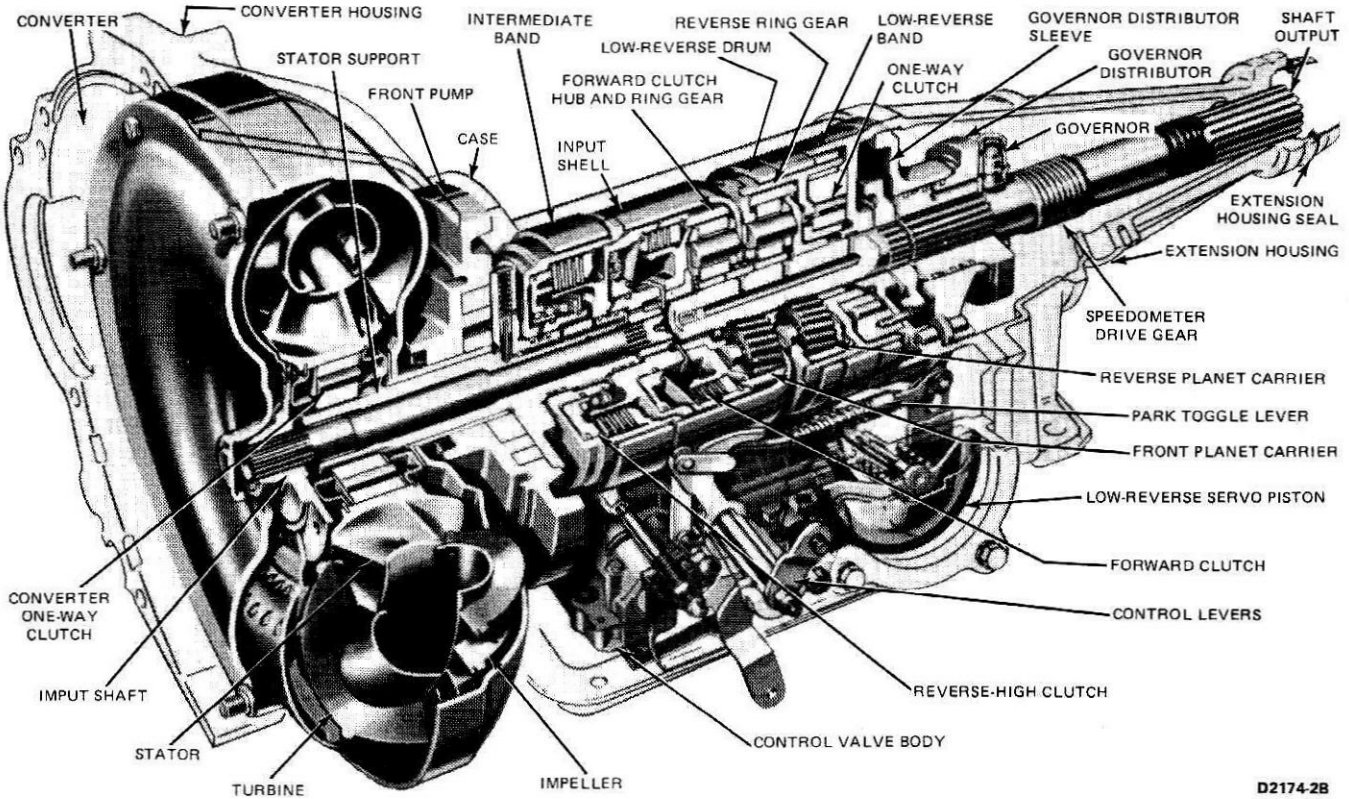


FIG. 1 C4 Automatic Transmission

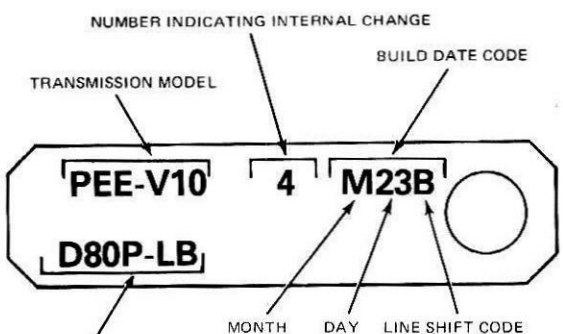
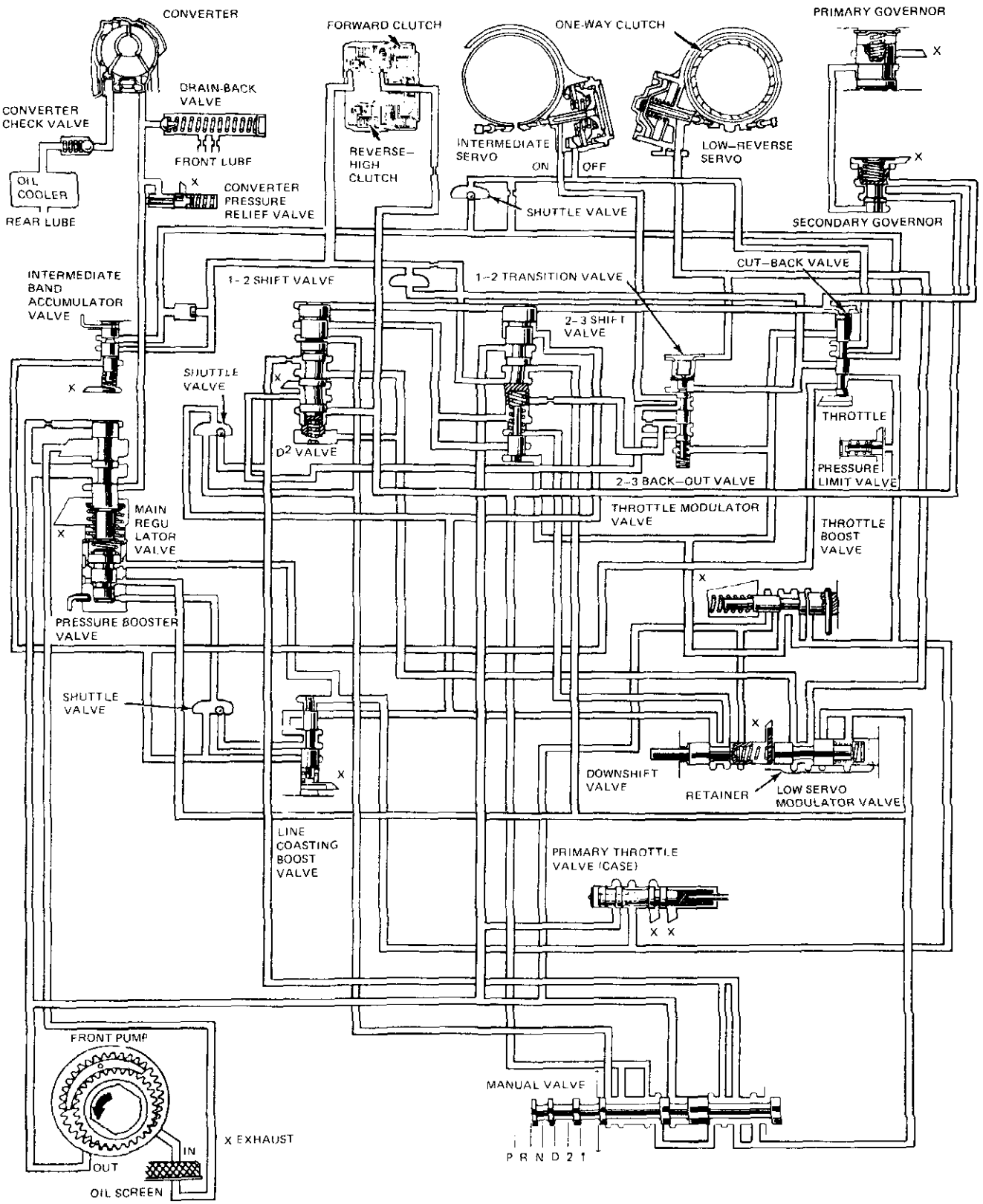


FIG. 2 Identification Tag—C-4 Transmission

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FIG. 3 Hydraulic Control System—All Except Pinto, Bobcat and Mustang II

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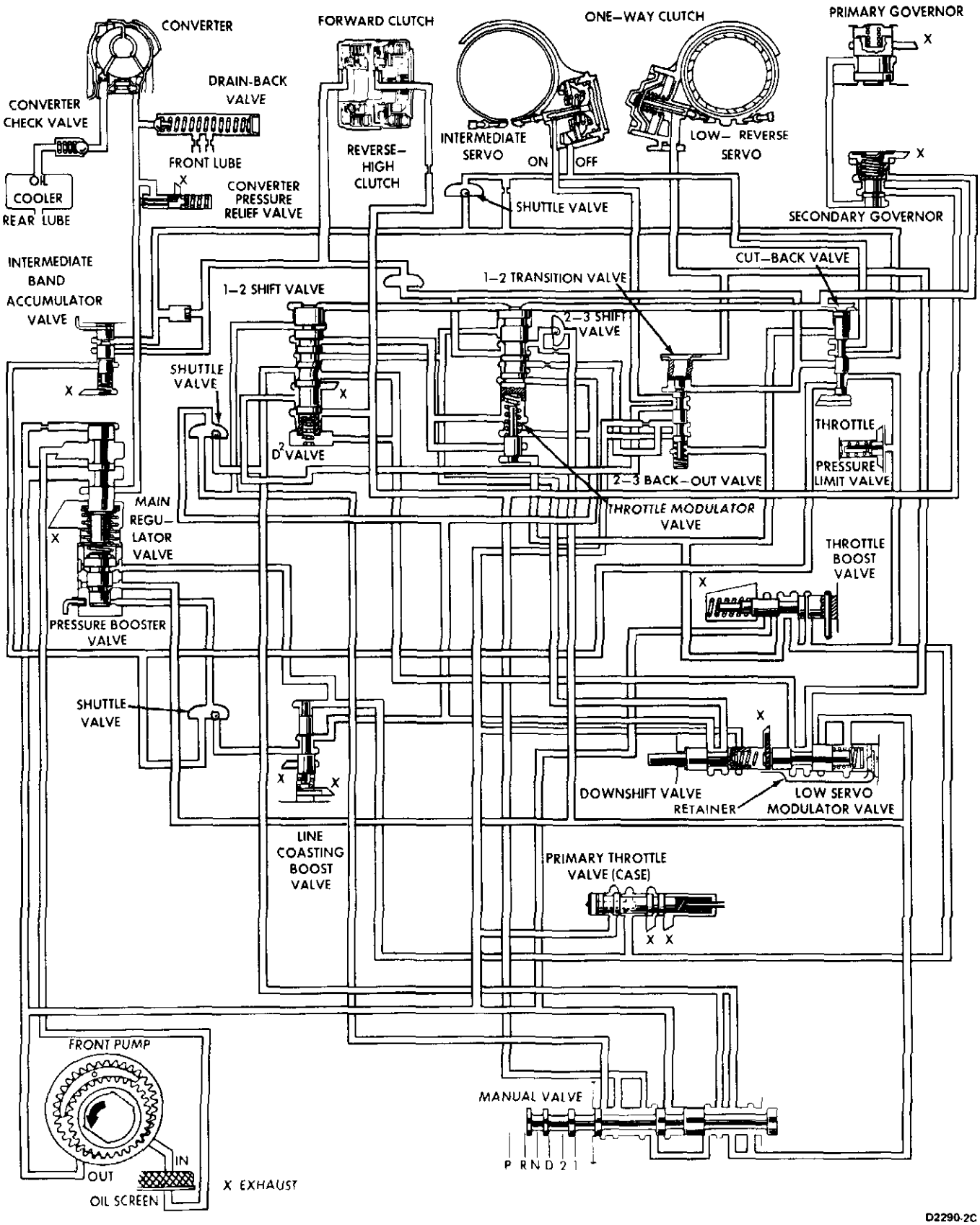


FIG. 4 Hydraulic Control System—Pinto, Bobcat and Mustang II

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ADJUSTMENTS

The only adjustments on the transmission are the intermediate and low-reverse bands.

To prevent damage to the transmission and to assure proper band adjustment, it is essential that the tools and procedures described below are used whenever the bands are adjusted.

INTERMEDIATE BAND ADJUSTMENT

1. Clean all the dirt from the band adjusting screw area. Remove and discard the locknut.
2. Install a new locknut on the adjusting screw. With the tool shown in Fig. 5, tighten the adjusting screw until the tool handle clicks. The tool is a pre-set torque wrench which clicks and breaks when the torque on the adjusting screw reaches 10 ft-lb.
3. **Back off the adjusting screw exactly 1-3/4 turns.**

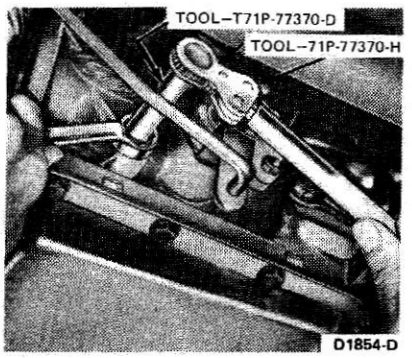


FIG. 5 Adjusting Intermediate Band

4. Hold the adjusting screw from turning and torque the locknut to specification as listed at the end of this Part.

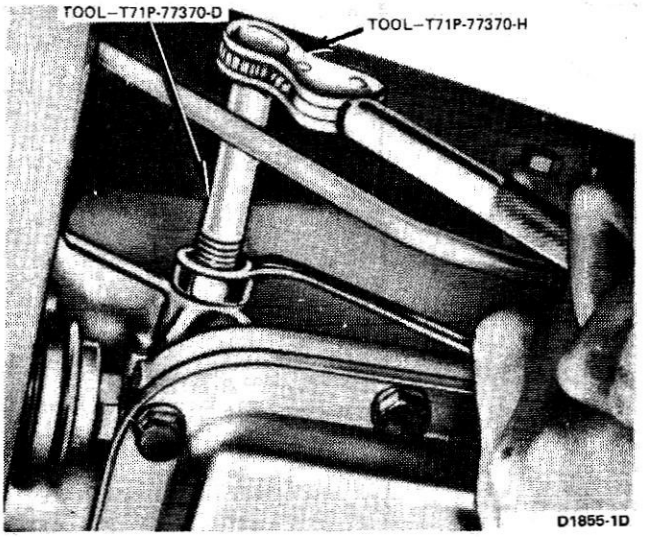


FIG. 6 Adjusting Low-Reverse Band

LOW-REVERSE BAND ADJUSTMENT

1. Clean all the dirt from the band adjusting screw area. Remove and discard the locknut. To remove the locknut on Pinto or Bobcat, use a 1-1/2-inch drive 3/4 x 1-1/2-inch long socket and socket handle.
2. Install a new locknut on the adjusting screw with the tools shown in Fig. 6. Tighten the adjusting screw until the tool handle clicks. The tool is a pre set torque wrench which clicks and breaks when the torque on the adjusting screw reaches 10 ft-lb.
3. **Back off the adjusting screw exactly 3 full turns.**
4. Hold the adjusting screw from turning and torque the locknut as indicated in Specifications at the end of this Part. On a Pinto or Bobcat, use Tool T70P-7B200-B to tighten the locknut, and to secure the adjustment, use a 3/4 x 1-1/2-inch socket with torque wrench. Torque the locknut as indicated in Specifications at the end of this Part.

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REMOVAL AND INSTALLATION

TRANSMISSION

Ford, LTD II, Fairmont, Zephyr, Versailles, Monarch, Granada, Thunderbird, and Cougar

Removal

1. Raise the vehicle on a hoist.
2. Place the drain pan under the transmission fluid pan. Remove the fluid filler tube from the pan and drain the transmission fluid on PEF models. On PEB and PEE models, loosen the pan attaching bolts and allow the fluid to drain. Start loosening the bolts at the rear of the pan and work toward the front. Finally, remove all attaching bolts except two at the front to allow the fluid to further drain. Then, install two bolts on the rear side of the pan to temporarily hold it in place.
3. Remove the converter drain plug access cover from the lower end of the converter housing.
4. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
5. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug, and remove the plug (Fig. 7). Place a drain pan under the converter to catch the fluid. With fluid drained, reinstall the plug.

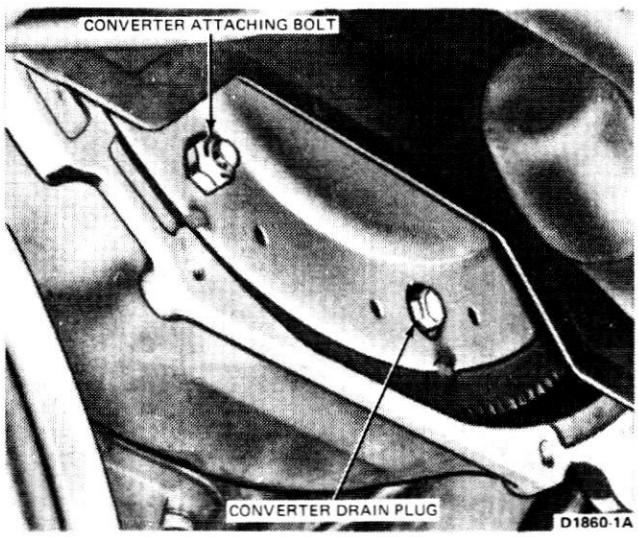


FIG. 7 Converter Drain Plug Location—Typical

6. Remove the drive shaft and install the extension housing seal replacer tool in the extension housing.
7. Remove the vacuum line hoses from the transmission vacuum unit. Disconnect the vacuum line from the retaining clip.
8. Remove the engine support-to- crossmember bolts or nuts.
9. Remove the speedometer cable from the extension housing.
10. Disconnect the oil cooler lines from the transmission case.
11. Disconnect the selector rod or cable at the transmission manual lever. Disconnect the downshift rod at the transmission downshift lever. On console and floor shift vehicles, disconnect the column lock rod at the transmission, if so equipped.
12. On a Fairmont, Zephyr, Versailles, Granada or Monarch with console shift, disconnect the neutral start switch wires from the retaining clamps and connectors.
13. Disconnect the starter cable. Remove the starter attaching bolts and remove the starter from the converter housing.
14. On case fill models, remove the bolt securing the transmission fluid filler tube to the cylinder head and remove the tube from the case.
15. On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch disconnect the muffler inlet pipe at the exhaust manifold.
16. Position the transmission jack to support the transmission, and secure the transmission to the jack with a safety chain.
17. Remove the crossmember attaching bolts and lower the crossmember.
18. Remove the five converter housing-to-engine attaching bolts. Lower the jack and remove converter and transmission assembly from under the vehicle.

Installation

1. Torque the converter drain plug to specification as listed at the end of this Part.
2. Position the converter on the transmission, making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with the safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel. To maintain initial engine/transmission balance on Versailles vehicles, align the converter to the flywheel so that the dyed converter drive stud is installed through the painted hole in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install the five converter housing-to-engine attaching bolts. Torque the bolts as indicated in Specifications at the end of this Part. Remove the safety chain from the transmission.
7. Position the crossmember and install the attaching bolts. Torque the bolts as indicated in Specifications at the end of this Part.
8. Lower the transmission and install the engine support-to-crossmember bolts or nuts. Torque the bolts or nuts as indicated in Specifications at the end of this Part.
9. On an 8 cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, connect the muffler inlet pipe to the exhaust manifold.

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10. Install the flywheel-to-converter attaching nuts. Torque the nuts as indicated in Specifications at the end of this Part.
11. Remove the transmission jack. Install the fluid filler tube in the transmission case or pan. Secure the tube to the cylinder head with the attaching bolt. Install the vacuum hoses on the transmission vacuum unit. Install the vacuum line retaining clip.
12. Connect the fluid cooling lines to the transmission case.
13. On a Fairmont, Zephyr, Versailles, Granada or Monarch with console shift, connect the neutral start switch wires to their respective connectors and secure the harness in the retaining clamps.
14. Connect the downshift rod to the downshift lever. Connect the selector rod or cable to the transmission manual lever. Connect the column lock rod on console and floor shift vehicles, if so equipped. Connect the speedometer cable to the extension housing.
15. Install the converter housing cover and torque the attaching bolts as indicated in Specifications at the end of this Part.
16. Install the starter and torque the attaching bolts as indicated in Specifications at the end of this Part. Connect the starter cable.
17. Install the drive shaft. Torque the companion flange u-bolts and/or attaching nuts to specification.
18. Lower the vehicle. Fill the transmission to the proper level with the specified fluid. Refer to Part 17-01. Adjust the manual and downshift linkage as required. Refer to Part 17-02.

Pinto, Bobcat and Mustang II

Removal

1. Raise the vehicle on a hoist.
2. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally, remove all attaching bolts, except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
3. Remove the converter drain plug access cover and adapter plate bolts from the lower end of the converter housing.
4. Remove the converter-to-flywheel attaching nuts. Using a wrench on the crankshaft pulley attaching bolt, crank the engine to turn the converter to gain access to the nuts.
5. Crank the engine until the converter drain plug is accessible, and remove the plug. **On a belt-driven overhead camshaft engine, never turn the engine backwards. This will cause the cam belt to jump teeth.** Place a drain pan under the converter to catch the fluid. With fluid drained, reinstall the plug.
6. Remove the drive shaft and install the extension housing seal replacer tool in the extension housing.
7. Remove the speedometer cable from the extension housing.
8. Disconnect the shift rod at the transmission manual lever. Disconnect the downshift rod at the transmission downshift lever.
9. Remove the starter-to-converter housing attaching bolts and position the starter out of the way.
10. Disconnect the neutral start switch wires from the retaining clamps and connectors.
11. Remove the vacuum line from the transmission vacuum unit. Disconnect the vacuum line from the retaining clip.
12. Position a transmission jack under the transmission and raise it slightly.
13. Remove the engine rear support-to-crossmember nut.
14. Remove the crossmember-to-frame side support attaching bolts and remove the crossmember.
15. Disconnect the muffler inlet pipe at the exhaust manifold and secure it in a raised position to the right side of the vehicle.
16. Lower the jack under the transmission and allow the transmission to hang.
17. Position a second jack under the front of the engine and raise the engine to gain access to the two upper converter housing-to-engine attaching nuts.
18. Disconnect the oil cooler lines at the transmission. Remove the lines from the retaining clip at the cylinder block and position them out of the way.
19. Remove the four lower converter housing-to-engine attaching bolts.
20. Remove the bolt that secures the transmission filler tube to the cylinder block and lift the tube from the case.
21. Secure the transmission to the jack with a safety chain.
22. Remove the two upper converter housing-to-engine attaching nuts. Move the transmission jack to the rear and down, and remove converter and transmission assembly from under the vehicle.

Installation

1. Torque the converter drain plug as indicated in Specifications at the end of this Part.
2. Position the converter on the transmission, making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install the two upper converter housing-to-engine attaching nuts and torque to specification.
7. Remove the safety chain from the transmission.
8. Insert the filler tube in the case and secure it to the cylinder block with the attaching bolt. Torque the bolt to specification.

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9. Install the oil cooler lines in the retaining clip at the cylinder block. Connect the lines to the transmission case.
10. Remove the jack supporting the front of the engine.
11. Position the muffler inlet pipe support bracket to the converter housing and install the four lower converter housing-to-engine attaching bolts. Torque the bolts to specification.
12. Raise the transmission. Position the crossmember to the frame side supports and install the attaching bolts. Torque the bolts to specification.
13. Lower the transmission and install the rear engine support-to- crossmember nut. Torque the nut to specification.
14. Remove the transmission jack. Install the vacuum hose on the transmission vacuum unit. Install the vacuum line retaining clip.
15. Connect the neutral start switch wires to their respective connectors and secure the harness in the retaining clamps.
16. Install the starter and torque the attaching bolts to specification.
17. Install the four flywheel-to-converter attaching nuts. Torque the nuts to specification.
18. Install the converter drain plug access cover and adapter plate bolts. Torque the bolts to specification.
19. Connect the muffler inlet pipe to the exhaust manifold.
20. Connect the transmission shift rod to the manual lever, the downshift rod to the downshift lever, and the speedometer cable to the extension housing.
21. Install the drive shaft. Torque the companion flange U-bolt attaching nuts to specification.
22. Adjust the manual and downshift linkage as required. Refer to Part 17-02.
23. Lower the vehicle. Fill the transmission to the proper level with the specified fluid. Refer to Part 17-01.
24. Check the transmission, converter assembly and oil cooler lines for leaks. Refer to Part 17-01.

CONTROL VALVE BODY

1. Raise the vehicle until transmission oil pan is accessible.
2. Drain the transmission fluid. On PEF models, disconnect the fluid filler tube from the transmission oil pan to drain the fluid. On PEB and PEE models, loosen the pan attaching bolts to drain the fluid from the transmission. **If the same fluid is to be used again, filter the fluid through a 100 mesh screen. Reuse the fluid only if it is in good condition.**
3. Remove the transmission fluid pan attaching bolts, pan and gasket.
4. Shift the transmission manual lever to the P position and remove the two bolts that attach the detent spring to the valve body and case (Fig. 8).
5. Remove the remaining valve body-to-case attaching bolts. Hold the manual valve in the valve body and remove the valve body from the case. ***Failure to hold the manual valve while removing the control assembly, could cause the manual valve to become bent or damaged.***

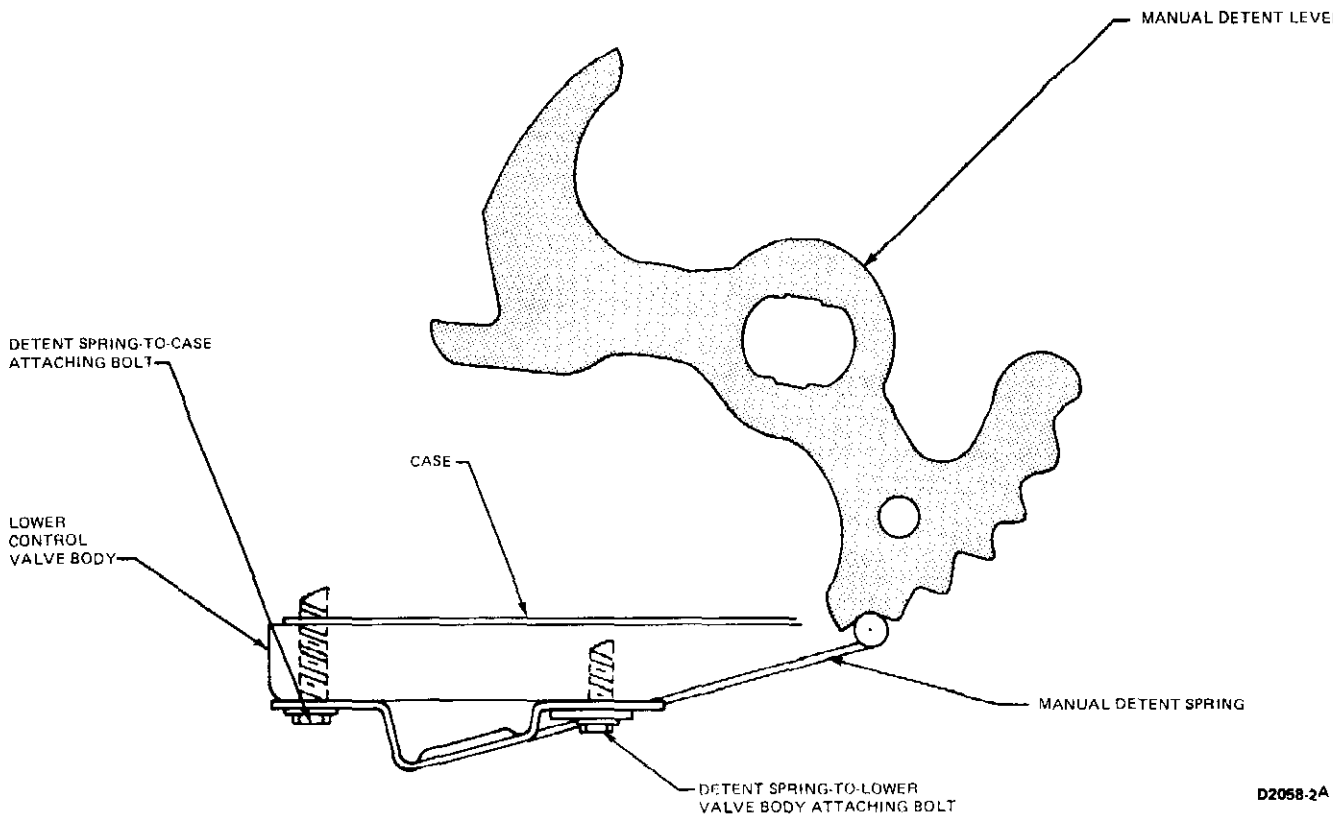


FIG. 8 Control Valve Body Detent Spring Installed

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6. Refer to the Disassembly and Assembly Section of this Part for the control valve body repair operations.
7. Thoroughly clean and remove all gasket material from the pan and pan mounting face of the case. Remove and discard the nylon shipping plug from the oil pan filler tube hole. This plug is used to retain transmission fluid within the transmission during shipment and should be discarded when the oil pan is removed.
8. Shift the manual lever at the transmission into the P detent position. Install the valve body to the case. Position the inner downshift lever between the downshift lever stop and the downshift valve. **Make sure the two lands on the end of the manual valve engage the actuating pin on the manual detent lever.** Install seven valve body-to-case bolts. Do not tighten the bolts at this time.
9. Position the detent spring to the lower valve body and install the spring-to-case bolt finger tight (Fig. 8).
10. Hold the detent spring roller in the center of the manual detent lever and install the detent spring-to-lower valve body bolt (Fig. 8). Tighten the bolt, 80 to 120 in-lb. torque.
11. Tighten all the control valve body-to-case attaching bolts, 80 to 120 in-lb. torque.
12. Place a new gasket on the pan. Install the pan and attaching bolts. Torque the bolts to Specification, as listed at the end of this Part.
13. On PEF models, connect the filler tube to the pan and tighten the fitting securely.
14. Lower the vehicle and fill the transmission with fluid. Check the transmission pan area for fluid leakage.

INTERMEDIATE SERVO

1. Raise the vehicle and remove the four servo cover-to-case attaching bolts. Remove the identification tag. To gain access to the servo on some vehicles, it will be necessary to remove the crossmember and/or cooler lines.
2. Remove the servo cover, gasket, piston, and piston return spring. Remove the piston from the cover (Fig. 53).
3. Remove the piston seals and cover gasket.
4. Install new piston seals on the piston. Lubricate the piston seals with clean transmission fluid. Install the servo piston in the cover.
5. Install the piston return spring in the case. Place a new gasket on the cover. Install the piston and cover into the transmission case.
6. Use two 5/16-18 x 1-1/4 bolts, 180 degrees apart to position the cover against the case.
7. Install the transmission identification tag. Install the two servo cover attaching bolts. Remove the two 1-1/4 inch bolts and install two attaching bolts. Torque the bolts to specification.

   On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, use a pry bar between the servo cover and floor pan to position the cover against the case. While holding the cover in position, install the identification tag and the four attaching bolts. Torque the bolts to specification.
8. Install the crossmember if it was previously removed. Torque the bolts to specification.
9. Adjust the intermediate band. Refer to Adjustments, in this Part. Lower the vehicle and check the transmission fluid level.
10. If the band cannot be adjusted properly, the intermediate band struts are not in position. Remove the pan and valve body. Install the struts, valve body, pan, and adjust the band. Refill the transmission with fluid.

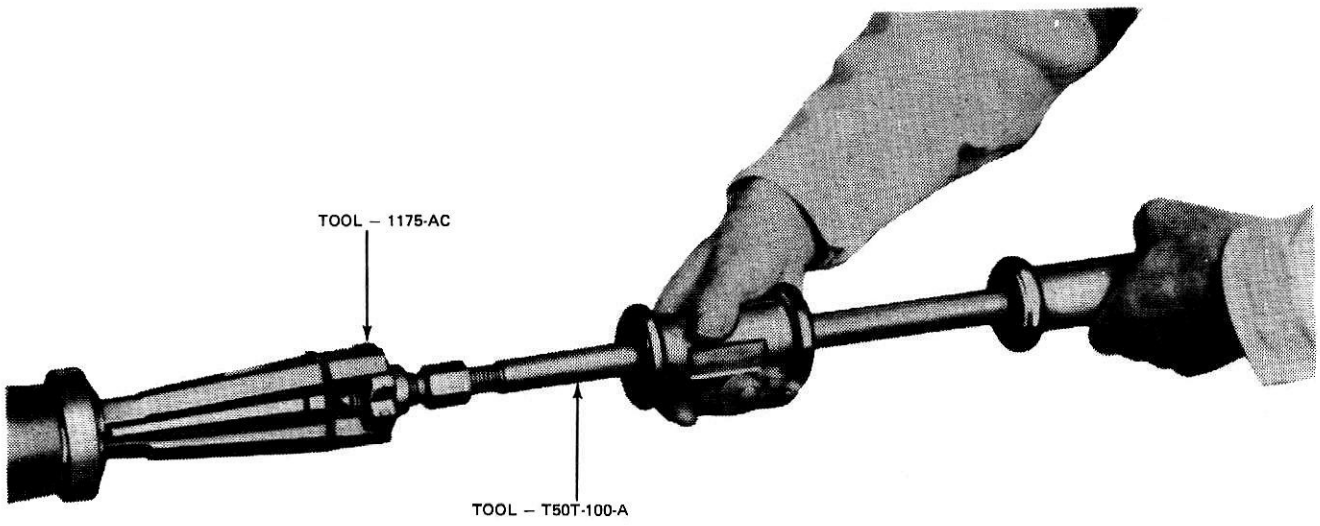
LOW-REVERSE SERVO

1. Raise the vehicle on a hoist.
2. Loosen the reverse band adjusting screw locknut. Tighten the reverse band adjusting screw to 10 ft-lb torque. (Tightening the screw will insure that the band strut will be held against the case by the band, preventing it from falling down when the reverse servo piston assembly is removed).
3. Remove the four servo cover-to-case attaching bolts. Remove the servo cover and seal from the case.
4. Remove the servo piston from the case (Fig. 55). **The piston seal cannot be replaced, without replacing the piston. The seal is bonded to the piston.**
5. To replace the piston on a Pinto, Bobcat or Mustang II, insert a small screwdriver in the hole of the piston stem (Fig. 56) and remove the piston attaching nut, piston, accumulator spring, and spacer.
6. To install the piston, position the accumulator spring and spacer (Fig. 57) on the piston stem. Make sure the crowned side of the spring is facing toward the rod. Install a new servo piston on the stem and install the attaching nut. Torque the nut to specification.
7. Install the piston into the case. Install a new seal on the cover. Install the cover by using two 5/16-18 bolts, 1-1/4 inch long, at 180 degrees apart to position the servo cover on the case. Install two cover attaching bolts. Remove the two installing bolts and install the last two attaching bolts. Torque the cover-to-case attaching bolts to specification.
8. Adjust the low-reverse band. Refer to Adjustments, in this Part. Lower the vehicle and check the transmission fluid level.
9. If the band cannot be adjusted properly, the low-reverse band struts are not in position. Remove the fluid pan and valve body. Install the struts, valve body, pan and adjust the band. Refill the transmission with fluid.

EXTENSION HOUSING BUSHING AND REAR SEAL

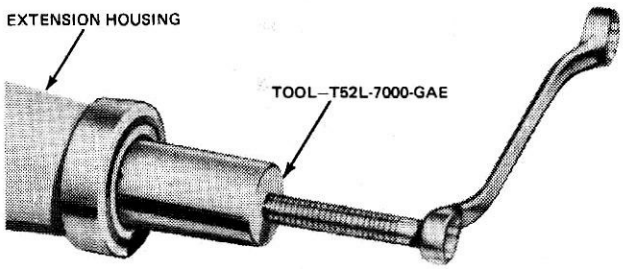
1. Raise the vehicle and disconnect the drive shaft from the transmission.
2. When only the rear seal needs replacing, carefully remove it with a tapered chisel or the tools shown in Fig. 9. Remove the bushing as shown in Fig. 10. **Use the bushing remover carefully so that the spline seal is not damaged.**
3. *When installing a new bushing use the special tool* shown in Fig. 11.

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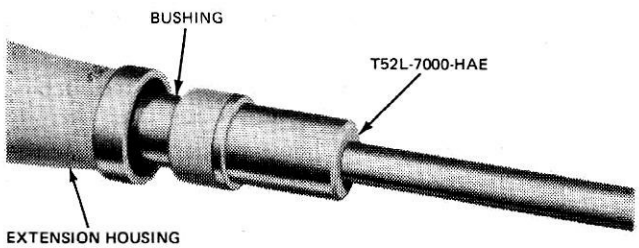
D1927-2B

FIG. 9. Removing Extension Housing Seal



D1025-1C

FIG. 10 Removing Extension Housing Bushing



D1026-1C

FIG. 11 Installing Extension Housing Bushing

4. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
5. Inspect the counterbore of the housing for burrs. Remove burrs with crocus cloth.
6. Install the seal into the housing with the tool shown in Fig. 12. The seal should be firmly seated in the bore. Coat the inside diameter at the end of the boot portion of the seal with C1AZ-19590-B lubricant.
7. Coat the front universal joint spline with C1AZ-19590-B lubricant and install the drive shaft.

EXTENSION HOUSING

1. Raise the vehicle on the hoist.
2. Remove the drive shaft. Position the transmission jack to support the transmission.
3. Remove the speedometer cable from the extension housing.
4. On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, disconnect the muffler inlet pipe at the exhaust manifolds.
5. Remove the engine rear support to crossmember attaching bolts or nuts. Raise the transmission and

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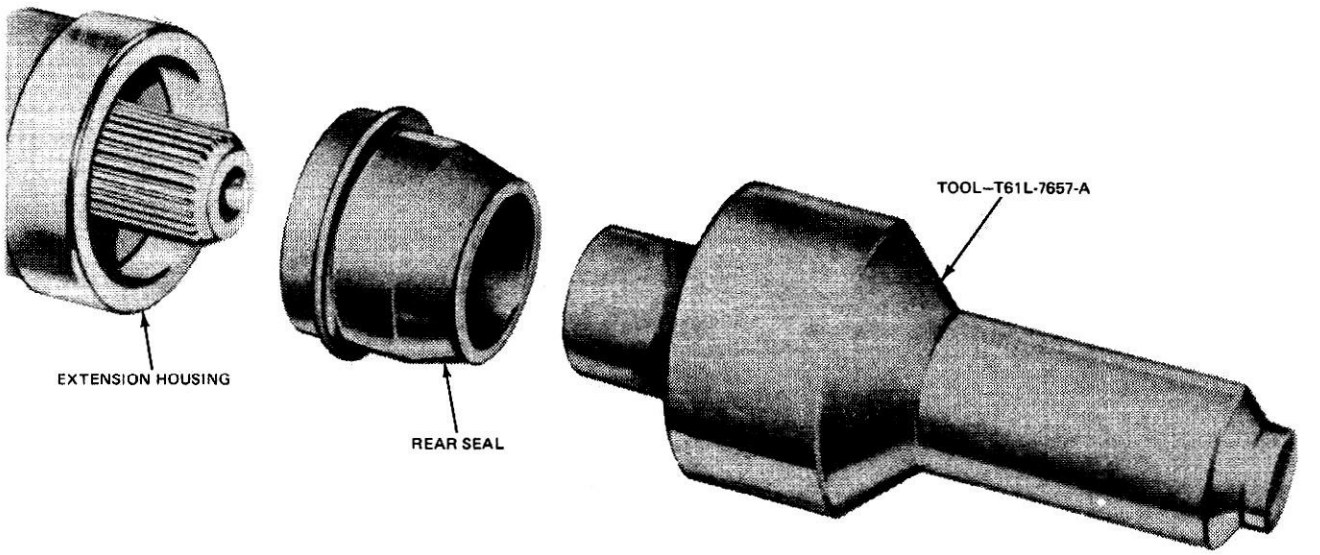


FIG. 12 Installing Extension Housing Seal

remove the rear support from the extension housing.

On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, it will be necessary to remove the crossmember in order to remove the engine rear support from the extension housing.

6. Loosen the extension housing attaching bolts to drain the transmission fluid.
7. Remove the six extension housing-to-case attaching bolts and remove the extension housing.
8. Install a new extension housing gasket on the case. Install the extension housing and six attaching bolts. Torque the bolts to specification.
9. Install the engine rear support on the extension housing.

   On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, position the crossmember on the frame side supports and install the attaching bolts. Torque the bolts to specification, as listed at the end of this Part.
10. Lower the transmission and install the engine rear support-to- crossmember attaching bolts or nuts. Torque the bolts or nuts to specification, as listed at the end of this Part. Remove the transmission jack.
11. On an 8-cylinder Fairmont, Zephyr, Versailles, Granada or Monarch, connect the muffler inlet pipe to the exhaust manifolds.
12. Install the speedometer cable in the extension housing. Install the drive shaft.
13. Lower the vehicle and fill the transmission with fluid.
14. Check the extension housing area for fluid leakage.

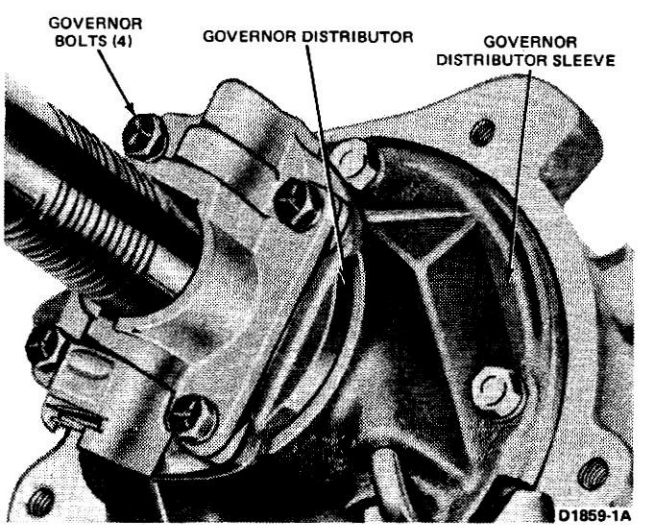


FIG. 13 Governor Installed

GOVERNOR

1. Remove the extension housing as outlined in this Part of the manual.
2. Remove the governor housing-to-governor distributor attaching bolts (Fig. 13). Remove the governor housing from the distributor.
3. Refer to the Disassembly and Assembly Section of this Part for governor repair operations.
4. Install the governor housing on the governor distributor (Fig. 13). Install the attaching bolts and torque the bolts to specification, as listed at the end of this Part.
5. Reinstall the extension housing, as outlined in this Part of the manual.

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DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts. During the repair operation, refer to Part 17-01 for cleaning and inspection procedures.

During the transmission disassembly or assembly operations, ten thrust washers located between the subassemblies must be removed and installed. **It is important that each thrust washer be installed in the correct position during the assembly operation.** To properly locate and identify the thrust washers, the various positions of the thrust washers are shown in the illustrations and are numbered 1 through 10. No. 1 is at the first thrust washer located at the front pump. The last thrust washer, No. 10 is located at the parking pawl ring gear.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmissions must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission, before assembly, with clean automatic transmission fluid. **Do not use any other lubricants, except on gaskets and thrust washers which may be coated with petroleum jelly to facilitate assembly.** Always install new gaskets when assembling the transmission.

Tighten all bolts and screws to the recommended torque as outlined in the Specifications at the end of this Part.

Disassembly

1. Remove the converter from the transmission front pump and converter housing.
2. Remove the transmission vacuum unit, and vacuum unit control rod.
3. Remove the primary throttle valve (Fig. 14) from the opening at the rear of the case.

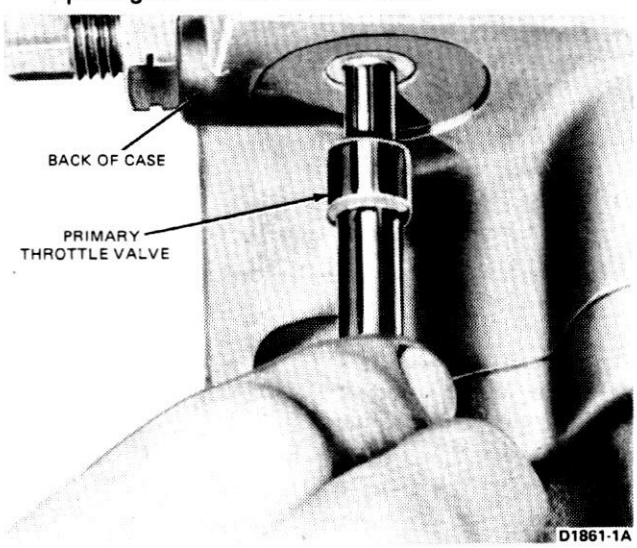


FIG. 14 Removing or Installing Primary Throttle Valve

4. Remove the two extension housing-to-case bolts shown in Fig. 15 and mount the transmission in the holding fixture.

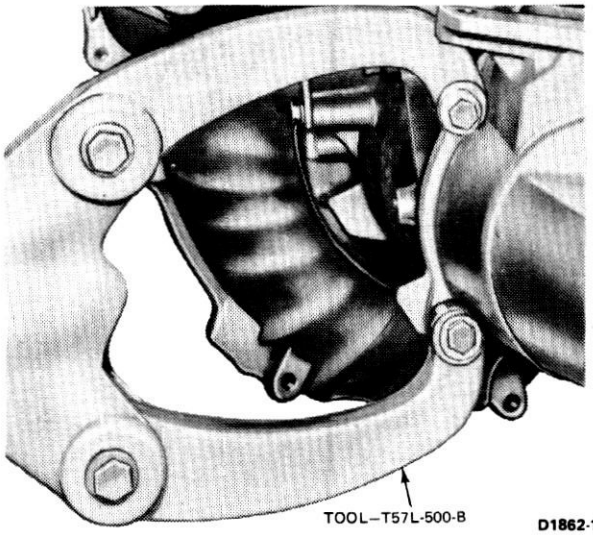


FIG. 15 Transmission Mounted in Holding Fixture

5. Remove the transmission pan attaching bolts, pan and gasket.
6. Remove the control valve body attaching bolts (Fig. 16). Remove the control valve body from the case.

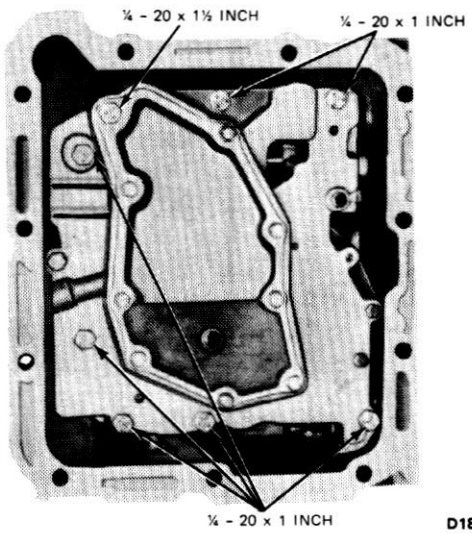


FIG. 16 Control Valve Body-To-Case Attaching Bolts—Typical

7. Loosen the intermediate band adjusting screw (Fig. 17) and remove the intermediate band struts from the case. Loosen the low-reverse band adjusting screw and remove the low-reverse band struts.

Transmission End Play Check

1. To keep the output shaft in alignment during the end play check, install the extension housing oil seal replacer tool or a front universal joint yoke in the extension housing.
2. Remove one of the converter housing-to-case attaching bolts and mount the dial indicator as shown in Fig. 18.

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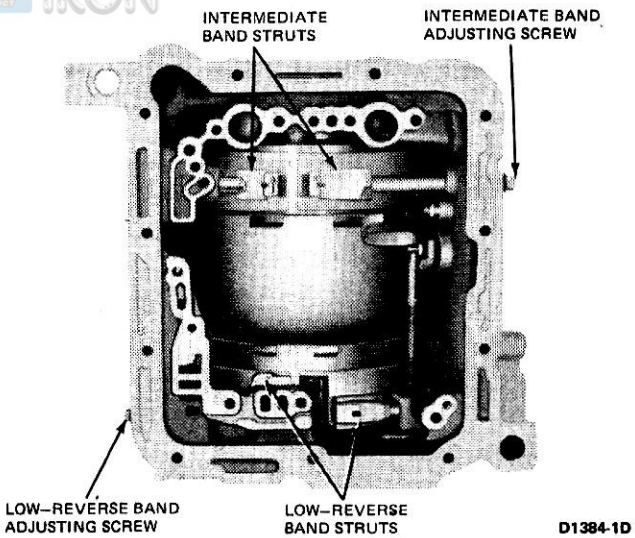


FIG. 17 Band Adjusting Screws and Struts—Typical

3. The input shaft is a loose part and has to be properly engaged with the spline of the forward clutch hub during the end play checking procedure. Move the input shaft and gear train toward the rear of the transmission case.
4. With the dial indicator contacting the end of the input shaft set the indicator at zero (Fig. 18).
5. Insert a screwdriver behind the input shell (Fig. 18). Move the input shell and the front part of the gear train forward.

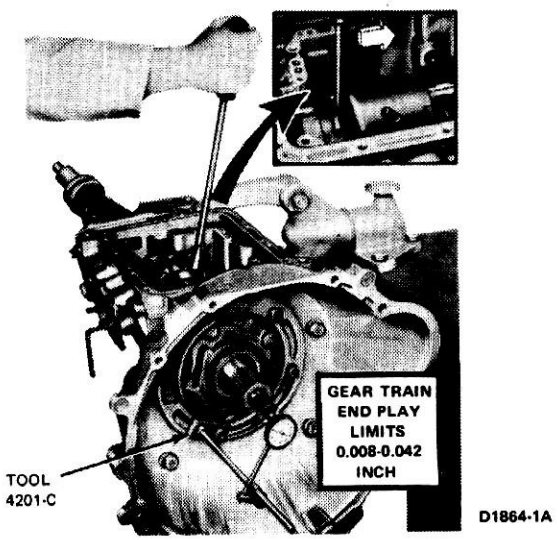


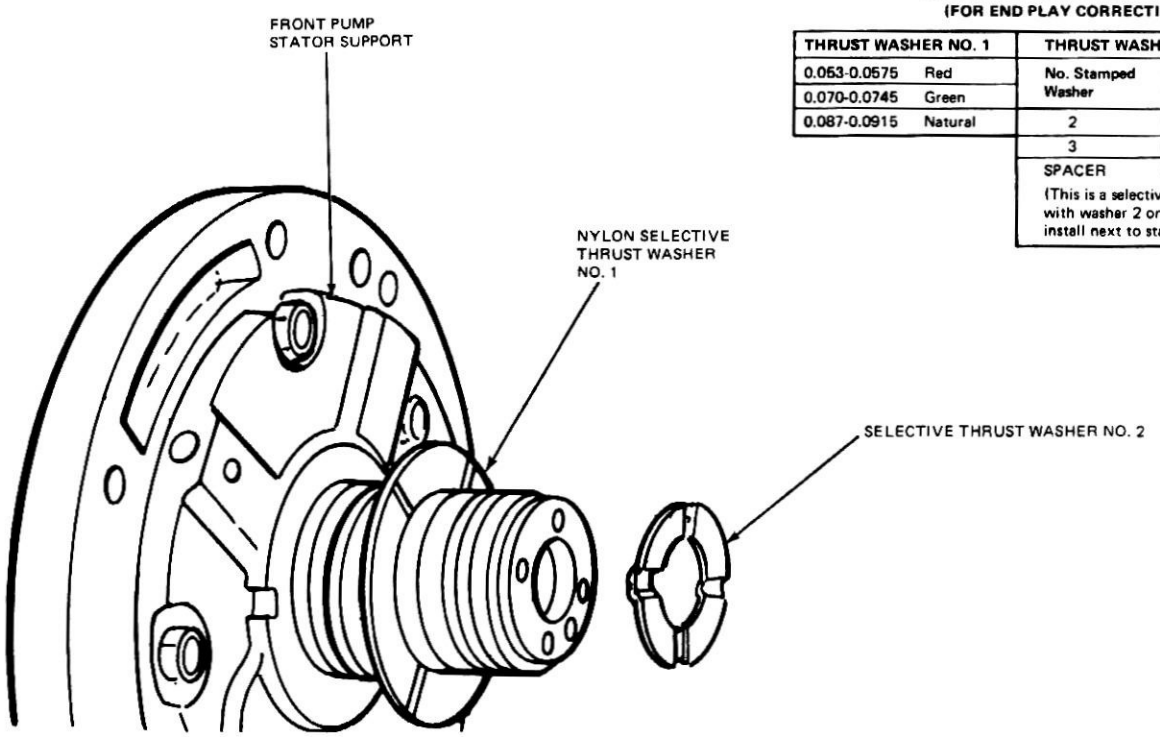
FIG. 18 Checking End Play

6. Record the dial indicator reading. The end play should be 0.008 to 0.042 inch. If the end play is not within limits, the selective thrust washers (Fig. 19) must be replaced as required. The selective thrust washers (No. 1 and 2) can be replaced individually to obtain the specified end play.
7. Remove the dial indicator and remove the input shaft from the front pump stator support (Fig. 20).

Removal of Case and Extension Housing Parts

1. Rotate the holding fixture to put the transmission in a vertical position with the converter housing up.
2. Remove the five converter housing-to-case attaching bolts (Fig. 20). Remove the converter housing from the transmission case.
3. Remove the seven front pump attaching bolts. Insert a screwdriver behind the input shell (Fig. 21) and move the input shell forward until the front pump seal is above the edge of the case. Remove the front pump and gasket from the case. If the selective thrust washer No. 1 did not come out with the front pump, remove it from the top of the reverse-high clutch.
4. Remove the intermediate and low-reverse band adjusting screws from the case. Rotate the intermediate band to align the band ends with the clearance hole in the case (Fig. 22). Remove the intermediate band from the case. **If the intermediate band is to be re-used, it must not be cleaned in a vapor degreaser or with a detergent solution. Wipe it clean with a lint-free cloth.**
5. Using a screwdriver between the input shell and rear planet carrier (Fig. 23), lift the input shell upward and remove the forward part of the gear train as an assembly (Fig. 24).
6. Place the forward part of the gear train on a bench (Fig. 25).
7. Remove the reverse-high clutch and drum from the forward clutch (Fig. 26)
8. If thrust washer No. 2 (Fig. 19) did not come out with the front pump, remove the thrust washer from the forward clutch cylinder. If a selective spacer was used, remove the spacer. Remove the forward clutch from the forward clutch hub and ring gear (Fig. 26).
9. If thrust washer No. 3 (Fig. 26) did not come out with the forward clutch, remove the thrust washer from the forward clutch hub.
10. Remove the forward clutch hub and ring gear from the front planet carrier (Fig. 26).
11. Remove thrust washer No. 4 and the front planet carrier from the input shell (Fig. 26).
12. From inside the transmission case (Fig. 24) remove thrust washer No. 6 from the top of the reverse planet carrier.
13. Remove the reverse planet carrier and thrust washer No. 7 from the reverse ring gear and hub (Fig. 27).
14. Move the output shaft forward and with the tool shown in Fig. 28, remove the reverse ring gear hub-to-output shaft snap ring.
15. Remove the reverse ring gear and hub from the output shaft. Remove thrust washer No. 8 from the low and reverse drum (Fig. 27).
16. Remove the low-reverse band from the case (Fig. 29).
17. Remove the low-reverse drum from the one-way clutch inner race (Fig. 27).
18. Rotate the one-way clutch inner race clockwise, and remove inner race from the outer race (Fig. 27).

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SELECTIVE THRUST WASHERS
(FOR END PLAY CORRECTION)

THRUST WASHER NO. 1		THRUST WASHER NO. 2	
0.053-0.0575	Red	No. Stamped Washer	Metal Thrust Washer
0.070-0.0745	Green		
0.087-0.0915	Natural	2	0.058-0.056
		3	0.075-0.073
		SPACER	0.036-0.032
		(This is a selective spacer used with washer 2 or 3. When used, install next to stator support.)	

FIG. 19 Selective Thrust Washer Locations

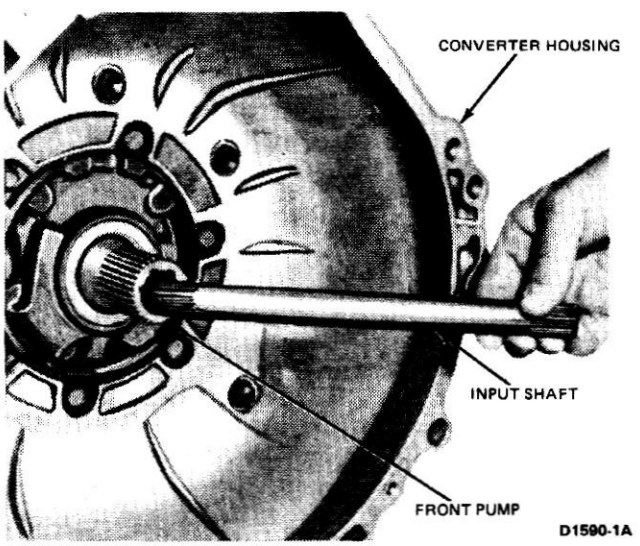


FIG. 20 Removing or Installing Input Shaft

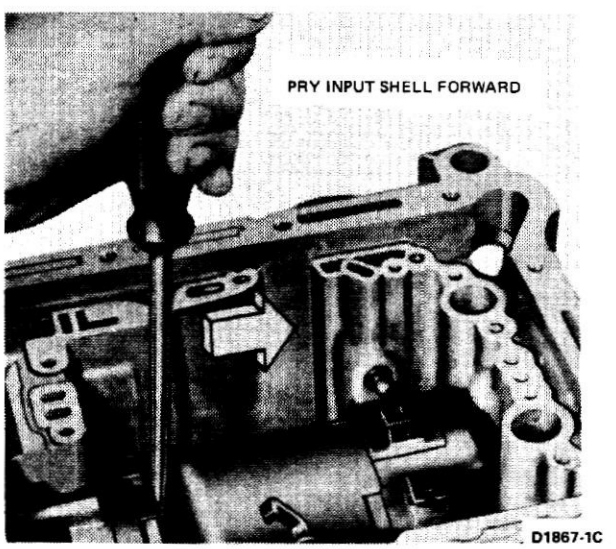


FIG. 21 Removing Front Pump

19. Remove the 12 one-way clutch rollers, springs and the spring retainer from the outer race (Fig. 27). **Do not lose or damage any of the 12 springs or rollers. The outer race of the one-way clutch cannot be removed from the case until the extension housing, output shaft and governor distributor sleeve are removed.**
20. Remove the transmission from the holding fixture. Position the transmission on the bench in a vertical position, with the extension housing up. Remove the four extension housing-to-case attaching bolts. Remove the extension housing and gasket from the case.
21. Pull outward on the output shaft and remove shaft and governor distributor assembly from the governor distributor sleeve (Fig. 30).
22. Remove the governor distributor snap ring from the output shaft (Fig. 31). Remove the governor distributor from the output shaft.
23. Remove the four distributor sleeve-to-case attaching bolts. Remove the distributor sleeve from the case. Do not bend or distort the fluid tubes as

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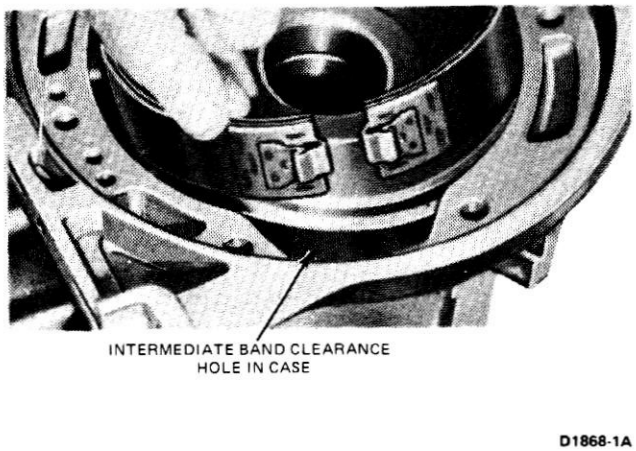


FIG. 22 Position of Intermediate Band for Removal or Installation

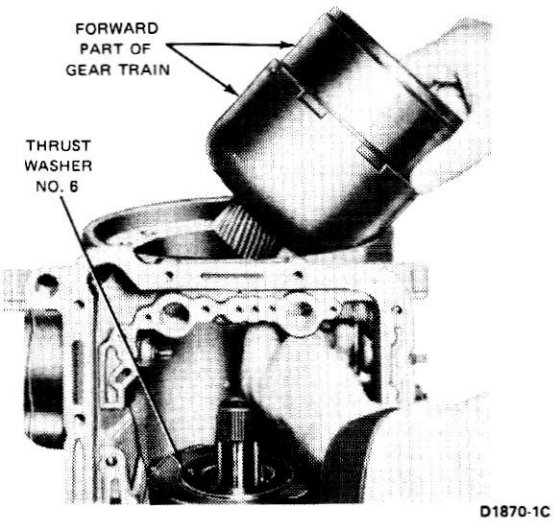


FIG. 24 Removing or Installing Forward Part of Gear Train

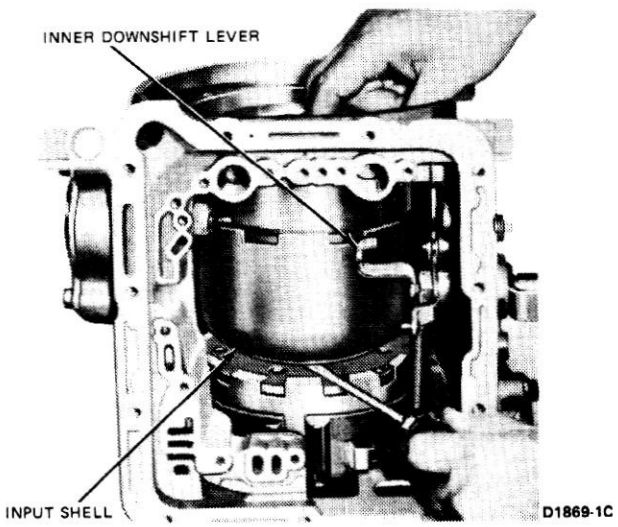


FIG. 23 Lifting Input Shell and Gear Train

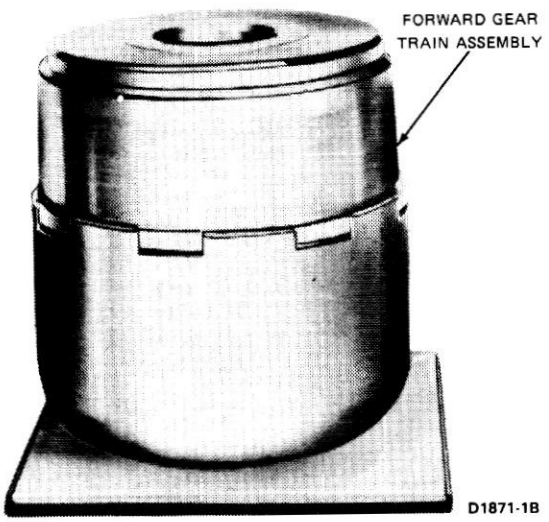


FIG. 25 Forward Part of Gear Train

the tubes are removed from the case with the distributor sleeve.

24. Remove the parking pawl return spring, pawl, and pawl retaining pin from the case (Fig. 32).
25. Remove the parking gear and thrust washer No. 10 from the case.
26. Remove the six one-way clutch outer race-to-case attaching bolts with the tool shown in Fig. 33. As the bolts are removed, hold the outer race located inside the case in position. Remove the outer race and thrust washer No. 9 from the case (Fig. 27).
27. If the transmission case bushing is worn or damaged, replace it with the tools shown in Fig. 34.

Assembly

When assembling the transmission sub-assemblies (Fig. 35), make sure that each thrust washer is installed in the correct position. Lubricate internal parts with clean transmission fluid. Petroleum jelly should be used to hold the thrust washers in their proper location. If the end play is not within specifications after the transmission is assembled, either the wrong selective thrust washers (No. 1 and 2) were used, or a thrust washer came out of position during the transmission assembly operation.

1. Install thrust washer No. 9 inside the transmission case (Fig. 36).
2. Place the one-way clutch outer race inside the case. From the back of the case install the six outer race-to-case attaching bolts. Torque the bolts with the tools shown in Fig. 37, according to Specifications at the end of this Part.
3. Place the transmission case in a vertical position with the back face of the case upward. Install the parking pawl retaining pin in the case. Install the

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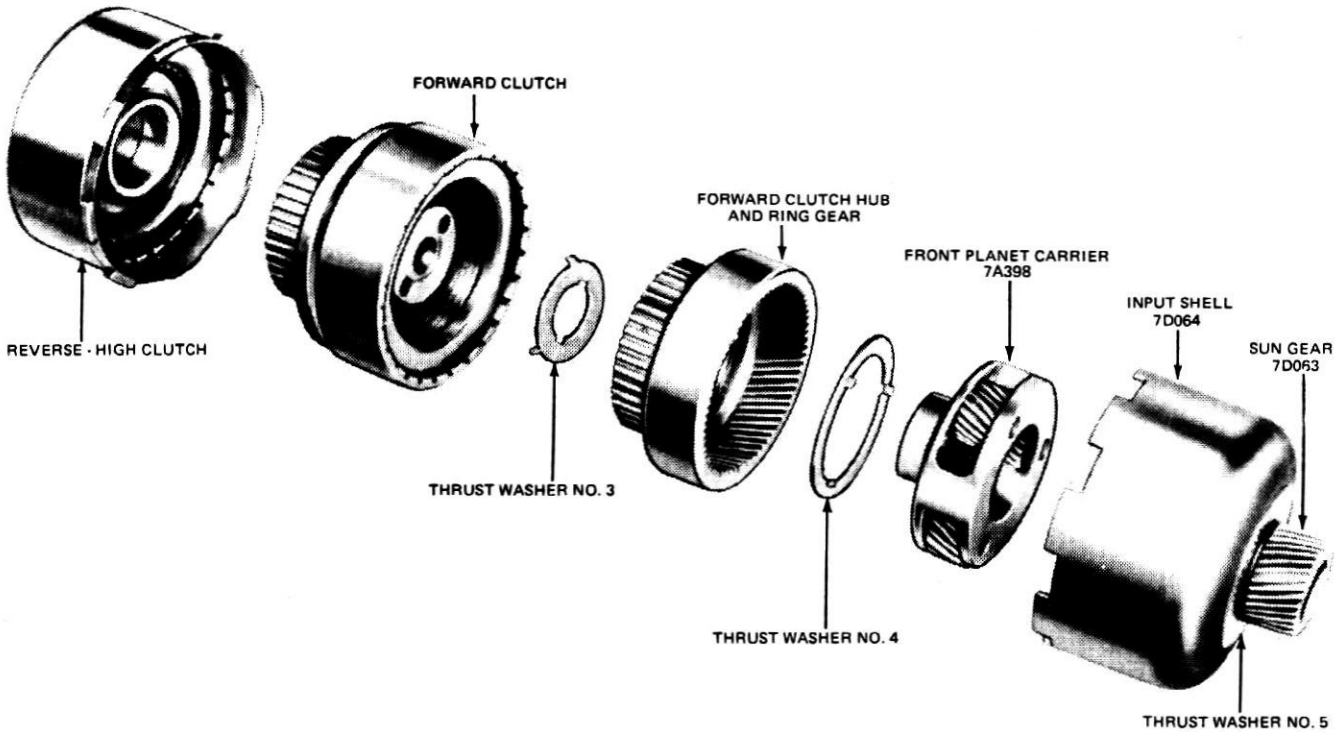


FIG. 26 Forward Part of Gear Train Disassembled

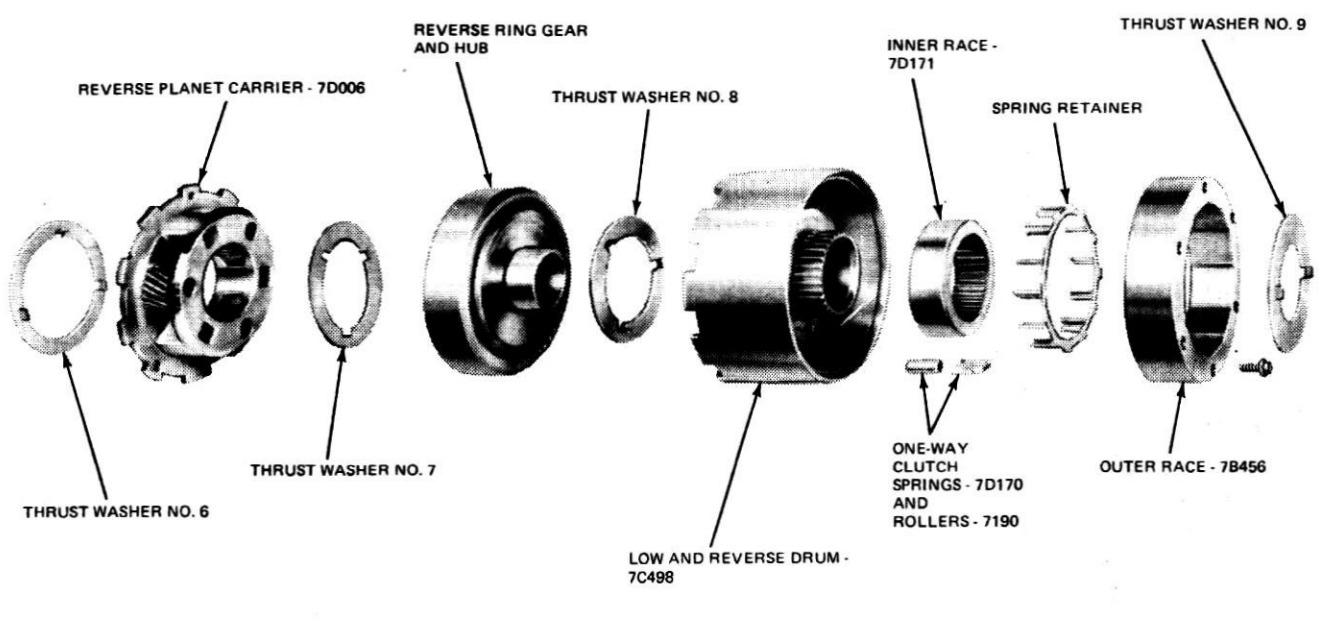


FIG. 27 Lower Part of Gear Train Disassembled

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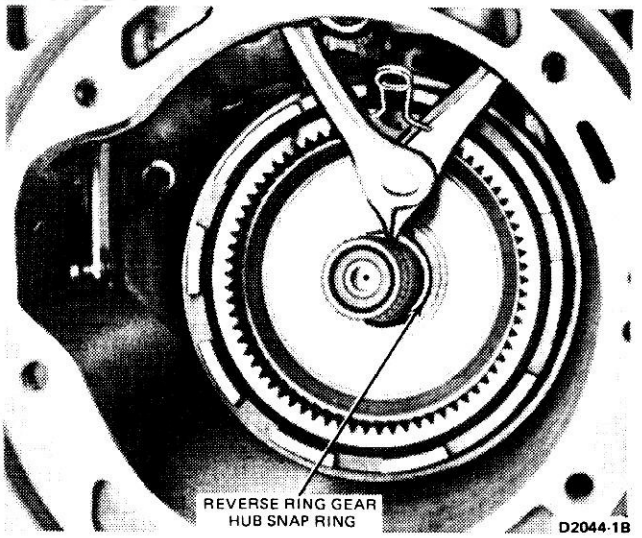


FIG. 28 Removing or Installing Reverse Ring Gear Hub Snap Ring

parking pawl on the case retaining pin, and the parking pawl return spring as shown in Fig. 38.

4. Install thrust washer No. 10 on the parking gear (Fig. 39). Place the gear and thrust washer on the back face of the case (Fig. 38).
5. Place the two distributor tubes in the governor distributor sleeve. Install the distributor sleeve on the case. As the distributor sleeve is installed, insert the tubes in the two holes in the case and insert the parking pawl retaining pin in the alignment hole in the distributor sleeve.
6. Install the four governor distributor sleeve-to-case attaching bolts and torque the bolts to specification, as listed at the end of this Part.
7. Install the governor distributor assembly on the output shaft. Install the distributor snap ring (Fig. 31).
8. Check the rings in the governor distributor, making sure the rings are fully inserted in the ring grooves

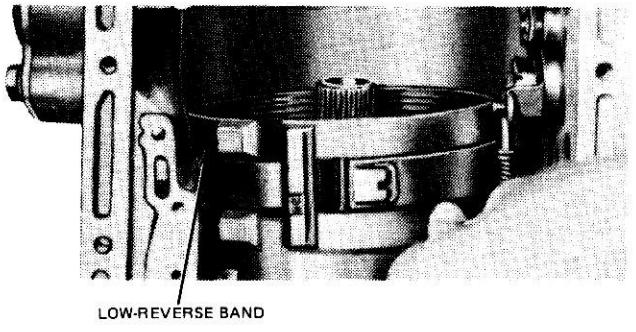


FIG. 29 Removing or Installing Low-Reverse Band

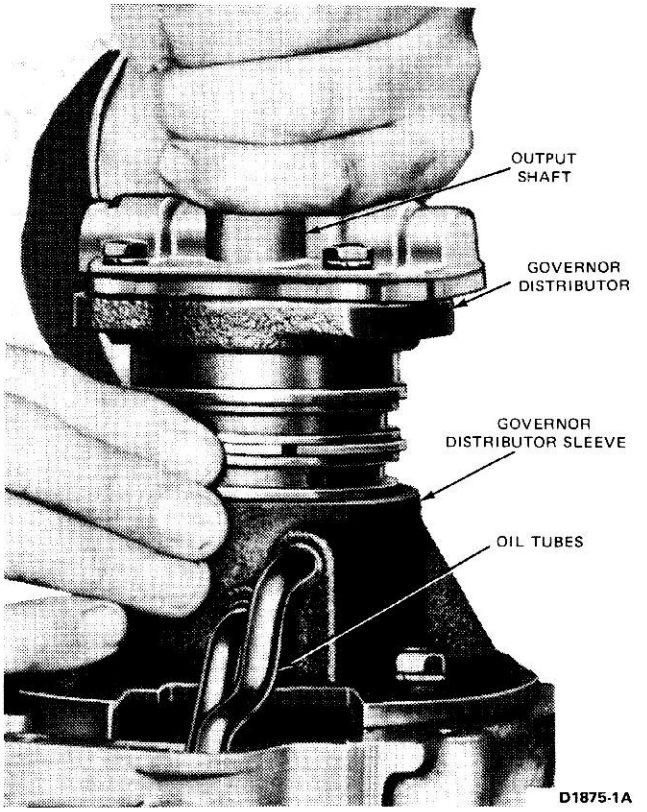


FIG. 30 Removing or Installing Output Shaft and Governor Distributor

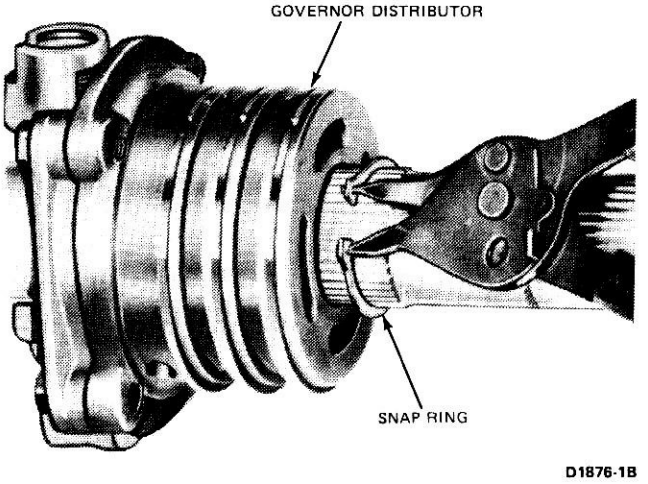


FIG. 31 Removing or Installing Governor Distributor Snap Ring

and rotate freely. Install the output shaft and governor distributor assembly in the distributor sleeve (Fig. 30).

9. Place a new extension housing gasket on the case. Install the extension housing, vacuum tube clip and the extension housing-to-case attaching bolts. Torque the bolts to specification, as listed at the end of this Part.
10. Place the transmission in the holding fixture. Rotate the holding fixture to put the transmission in a vertical position with the front pump mounting face

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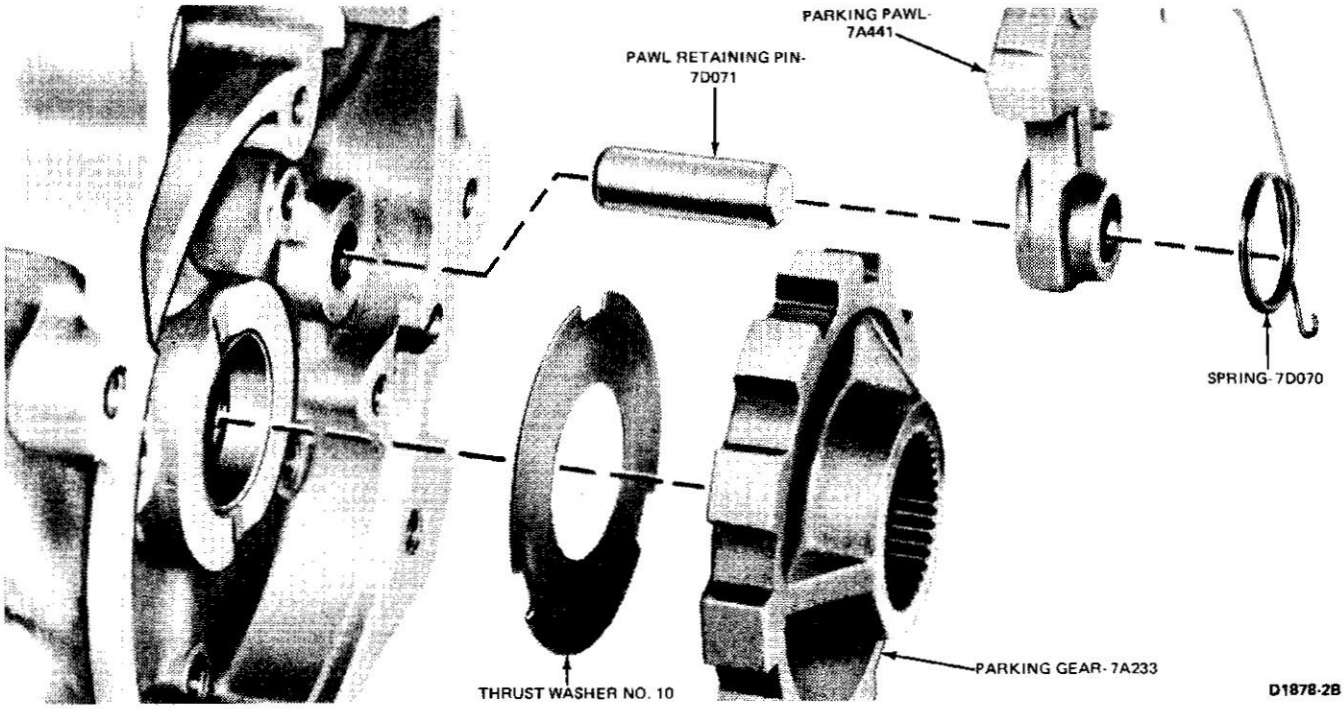


FIG. 32 Parking Pawl, Return Spring Retaining Pin and Gear

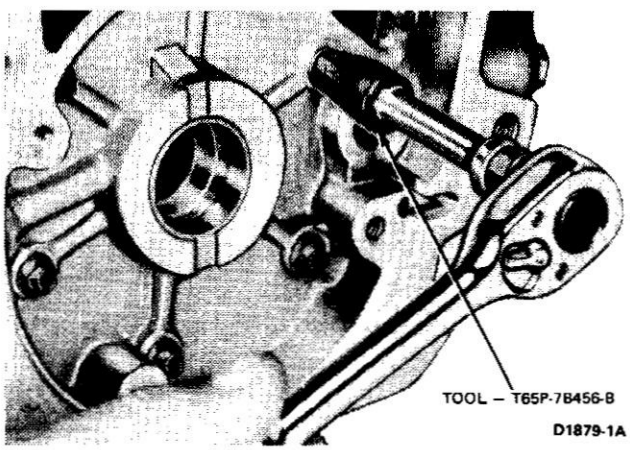


FIG. 33 Removing One-Way Clutch Outer Race Attaching Bolts

up. Make sure thrust washer No. 9 is still located at the bottom of the transmission (Fig. 36).

11. Install the one-way clutch spring retainer into the outer race (Fig. 40). Install the inner race inside of the spring retainer. **Be sure the face with the step is installed toward the rear of the case, mating with the thrust washer.**
12. Install the twelve springs between the inner and outer race as shown in Fig. 40. Install the twelve one-way clutch rollers by slightly compressing each spring and positioning the roller between the spring and the spring retainer. Rotate the inner race clockwise, after assembly, to center the rollers and springs.
13. Install the low and reverse drum (Fig. 27). The splines of the drum have to engage with the splines of the one-way clutch inner race. Check the one-way clutch operation by rotating the low and reverse drum. The drum should rotate clockwise but not rotate counterclockwise.
14. Install thrust washer No. 8 on top of the low and reverse drum (Fig. 41). Install the low-reverse band in the case, with the end of the band for the small strut toward the low-reverse servo (Fig. 29).
15. Install the reverse ring gear and hub on the output shaft. Move the output shaft forward and install the reverse ring gear hub-to-output shaft snap ring (Fig. 28).
16. Place thrust washers No. 6 and 7 on the reverse planet carrier (Fig. 42).
17. Install the planet carrier in the reverse ring gear and engage the tabs of the carrier with the slots in the low-reverse drum.
18. On the bench, install the forward clutch in the reverse-high clutch. Rotate the units to mesh the reverse-high clutch plates with the splines of the forward clutch (Fig. 43).
19. Using the recorded dial indicator readings obtained during transmission disassembly, determine which No. 2 steel-backed thrust washer is required and proceed as follows:
    a. Position the stator support vertically on the work bench and install the correct No. 2 thrust washer, or combination of washer and spacer, as required to bring the end play within limits of 0.008 to 0.042 inch.
    b. Install the reverse-high clutch and the forward clutch on the stator support.
    c. Invert the complete unit making sure that the intermediate brake drum bushing is seated on the forward clutch mating surface.
    d. Select the thickest plastic washer (No. 1) that can be inserted between the stator support and the intermediate brake drum thrust surfaces and still maintain a slight clearance. **Do not select a washer that must be forced between the stator support and intermediate brake drum.**

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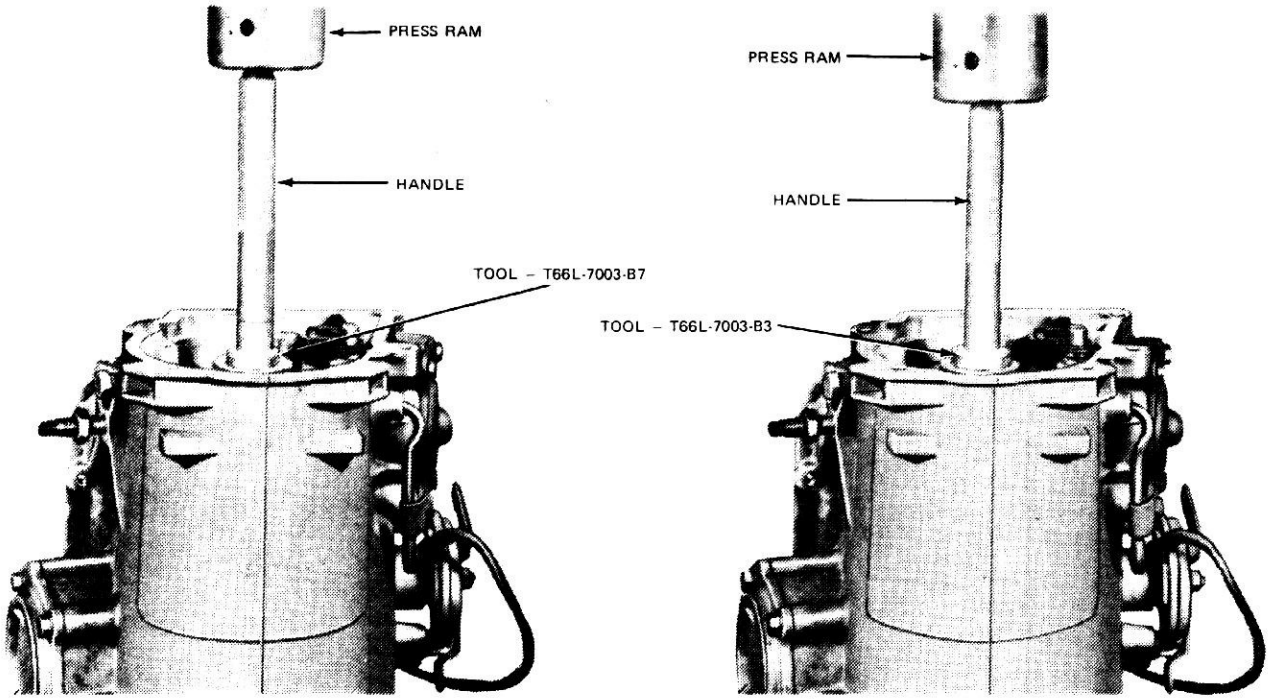


FIG. 34 Replacing Transmission Case Bushing

e. Remove the intermediate brake drum and forward clutch unit from the stator support.

f. Install the selected thrust washers (No. 1 and 2) on the front pump stator support (Fig. 19) using enough petroleum jelly to hold the thrust washers in position during the front pump installation.

20. Install thrust washer No. 3 on forward clutch (Fig. 44).

21. Install the forward clutch hub and ring gear in the forward clutch. Rotate the units to mesh the forward clutch plates with the splines on the forward clutch hub (Fig. 45).

22. Install thrust washer No. 4 on the front planet carrier (Fig. 46). Install the front planet carrier into the forward clutch hub and ring gear (Fig. 47). **Check the forward thrust bearing race inside the planet carrier for proper location against the thrust bearing. Make sure the race is centered for alignment with the sun gear on the input shell (Fig. 48).**

23. Install the input shell and sun gear on the gear train (Fig. 48). Rotate the input shell to engage the drive lugs of the reverse-high clutch. **If the drive lugs do not engage, the outer race inside the forward planet carrier is not centered to engage the end of the sun gear inside the input shell.** Center the thrust bearing race and install the input shell.

24. Hold the gear train together and install the forward part of the gear train assembly in the case (Fig. 24).

The input shell sun gear must mesh with the reverse pinion gears. The front planet carrier internal splines must mesh with the splines on the output shaft.

25. **A new band should be soaked in transmission fluid for fifteen minutes before it is installed.** Install the intermediate band through the front of the case (Fig. 22).

26. Install a new front pump gasket on the case. Line up the bolt holes in the gasket with the holes in the case.

27. Install the front pump stator support into the reverse-high clutch. Align the pump-to-case attaching bolt holes. Install the front pump-to-case attaching bolts and torque them to specification.

28. Install the input shaft (Fig. 20). **Be sure the short splined end is installed toward the rear of the transmission.** Rotate the holding fixture to place the transmission in a horizontal position. Check the transmission end play as shown in Fig. 18. If the end play is not within specification, either the wrong selective thrust washers (Fig. 19) were used, or one of the 10 thrust washers (Fig. 35) is not properly positioned.

29. Remove the dial indicator used for checking the end play and install the one front pump-to-case attaching bolt. Torque the bolt to specification.

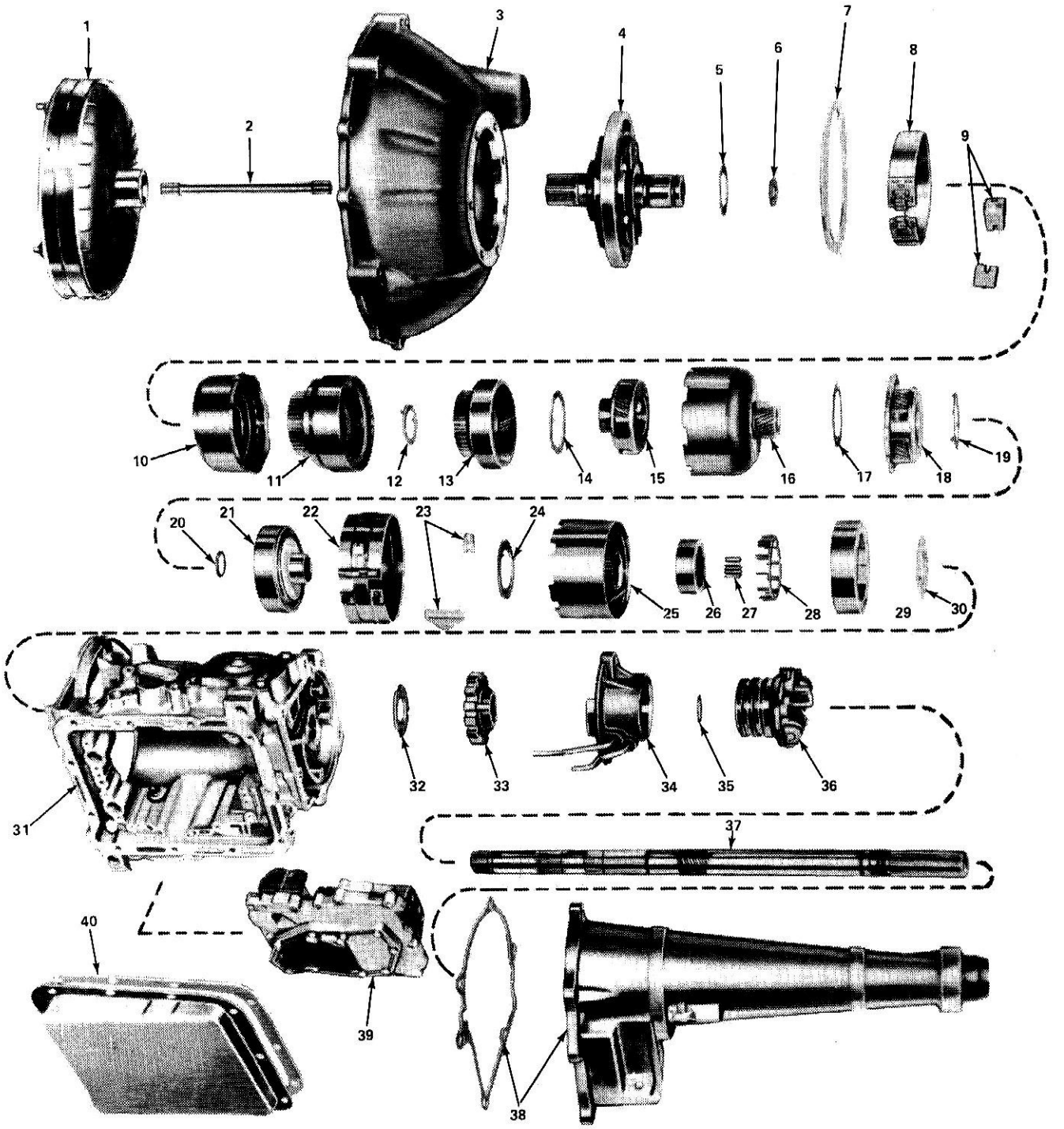
30. Place the converter housing on the transmission case. Install the five converter housing-to-case attaching bolts. Torque the bolts to specification.

31. Install the intermediate and low-reverse band adjusting screws in the case. Install the struts for each band (Fig. 17).

32. Adjust the intermediate and low-reverse band. Refer to the Adjustment Section of this Part for band adjusting procedures.

33. Install a universal joint yoke on the output shaft. Rotate the input and output shafts in both

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1. CONVERTER – 7902
2. INPUT SHAFT – 7D15
3. CONVERTER HOUSING – 7976
4. FRONT PUMP – 7A103
5. THRUST WASHER NO. 1
6. THRUST WASHER NO. 2
7. FRONT PUMP GASKET – 7A136
8. INTERMEDIATE BAND – 7D034
9. BAND STRUTS – 7D029
10. REVERSE AND HIGH CLUTCH DRUM
11. FORWARD CLUTCH AND CYLINDER
12. THRUST WASHER NO. 3
13. FORWARD CLUTCH HUB – 7B067 AND RING GEAR – 7A153
14. THRUST WASHER NO. 4
15. FRONT PLANET CARRIER – 7A398
16. INPUT SHELL – 7D064, SUN GEAR – 7D063 AND THRUST WASHER NO. 5
17. THRUST WASHER NO. 6
18. REVERSE PLANET CARRIER - 7D106
19. THRUST WASHER NO. 7
20. SNAP RING
21. REVERSE RING GEAR – 7A153 AND HUB – 7D164
22. LOW AND REVERSE BAND – 7D095
23. BAND STRUTS – 7A125
24. THRUST WASHER NO. 8
25. LOW AND REVERSE DRUM – 7C498
26. ONE-WAY CLUTCH INNER RACE – 7D171
27. ROLLER (12) – 7190 AND SPRING (12) – 7D170
28. SPRING AND ROLLER CAGE – 7D191
29. ONE-WAY CLUTCH OUTER RACE – 7B456
30. THRUST WASHER NO. 9
31. CASE – 7005
32. THRUST WASHER NO. 10
33. PARKING GEAR – 7A233
34. GOVERNOR DISTRIBUTOR SLEEVE – 7C232
35. SNAP RING
36. GOVERNOR AND DISTRIBUTOR ASSY – 7C053 (AUTOMATIC ONLY)
37. OUTPUT SHAFT – 7060
38. EXTENSION HOUSING – 7A039 AND GASKET – 7086
39. CONTROL VALVE BODY – 7A100
40. OIL PAN – 7A194 AND GASKET – 7A191

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FIG. 35 Transmission Sub-Assemblies—Typical

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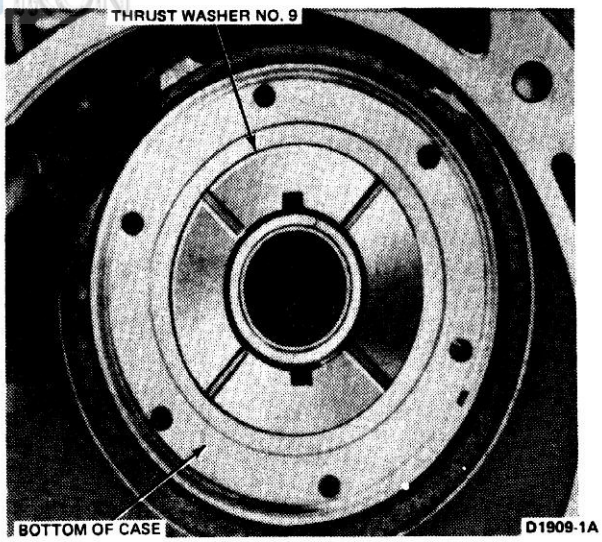


FIG. 36 Number 9 Thrust Washer Location

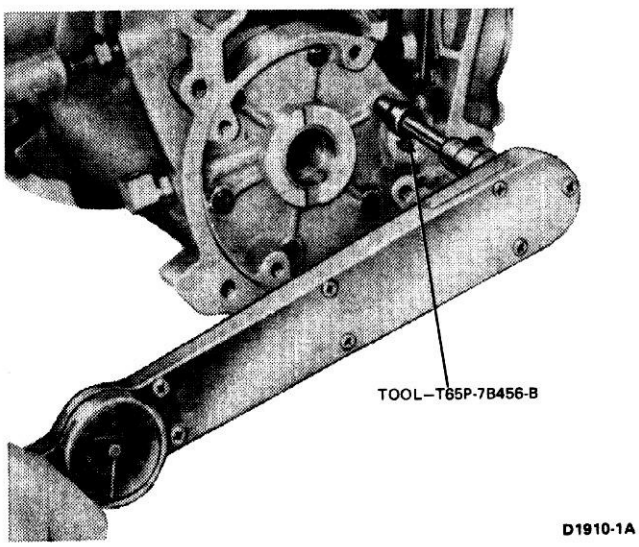


FIG. 37 Installing One-Way Clutch Outer Race Attaching Bolts

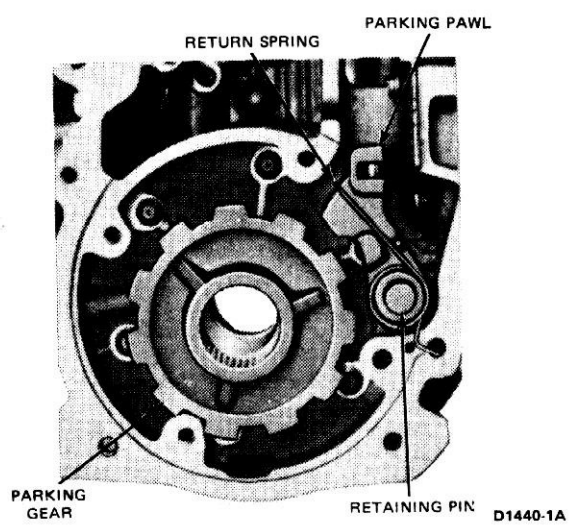


FIG. 38 Parking Pawl and Gear

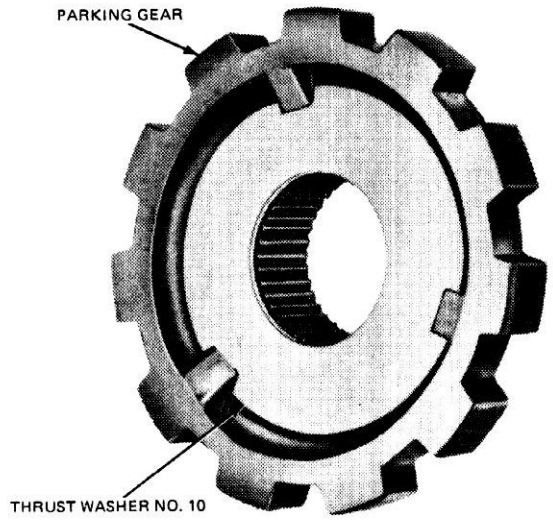


FIG. 39 Number 10 Thrust Washer Location

directions to check for free rotation of the gear train.

34. Install the control valve body (Fig. 16). Refer to the Removal and Installation Section of this Part for the control valve body installation procedures.
35. Place a new pan gasket on the case and install the pan and pan-to-case attaching bolts. Torque the attaching bolts to specification.
36. Remove the transmission from the holding fixture. Install the two extension housing-to-case attaching bolts. Torque the bolts to specification.
37. Install the primary throttle valve in the transmission case (Fig. 14).
38. Install the vacuum unit and control rod in the case.
39. Make sure the input shaft is properly installed in the front pump stator support and gear train. The short splined end of the shaft should be installed toward the rear of the transmission. Install the converter in the front pump and the converter housing.

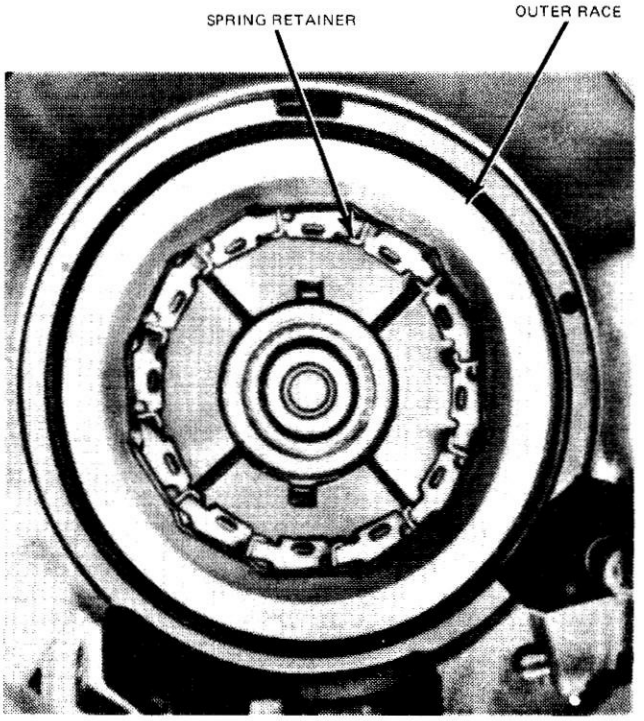
CONTROL VALVE BODY

Disassembly

When the main control is disassembled and the valve body-to-screen gasket is removed, the gasket should not be cleaned in a degreaser, solvent or any type of detergent solution. To clean the gasket, wipe it off with a lint-free cloth.

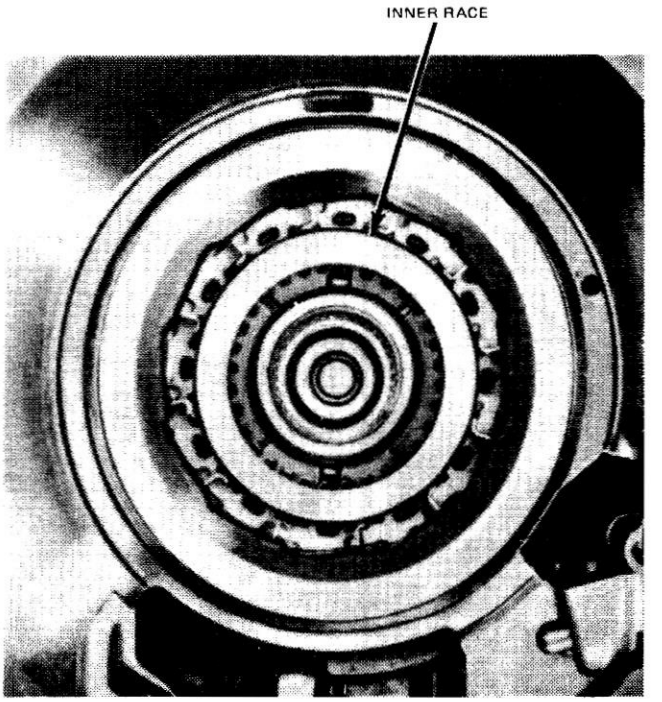
1. Remove the eight 10-24 x 1-3/8-inch screws that attach the oil screen to the body (Fig. 49) and remove the screen and gasket (Fig. 50). Be careful not to lose the throttle pressure limit valve and spring when separating the oil screen from the valve body.
2. Remove the two 1/4-20 x 1-1/2-inch attaching screws from the upper valve body and nine 10 x 24 x 7/8-inch attaching screws from the underside of the lower valve body (Fig. 49). Separate the lower valve body, gasket and separator plate (Fig. 51) from the upper valve body. **Be careful not to lose the upper valve body shuttle valve and check valve when separating the upper and lower valve bodies.**

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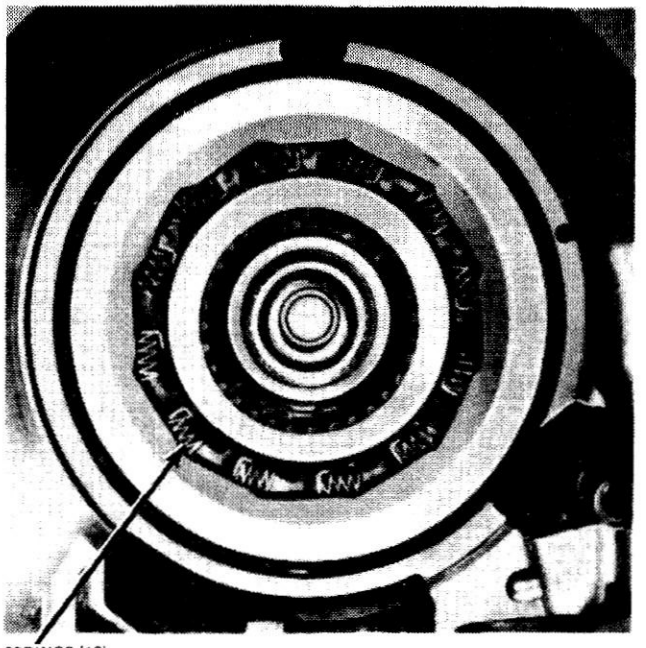
STEP - 1

INSTALL SPRING RETAINER INTO OUTER RACE



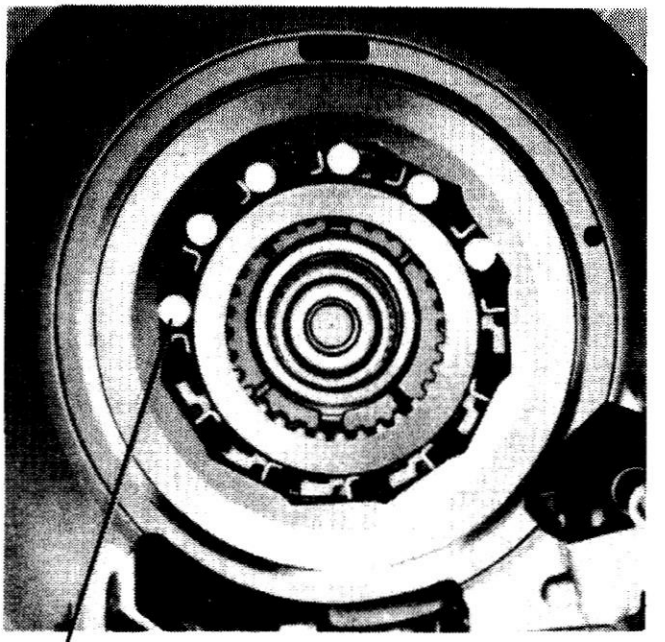
STEP - 2

INSTALL INNER RACE



STEP - 3

INSTALL 12 SPRINGS



STEP - 4

INSTALL 12 ROLLERS

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FIG. 40 Installing One-Way Clutch

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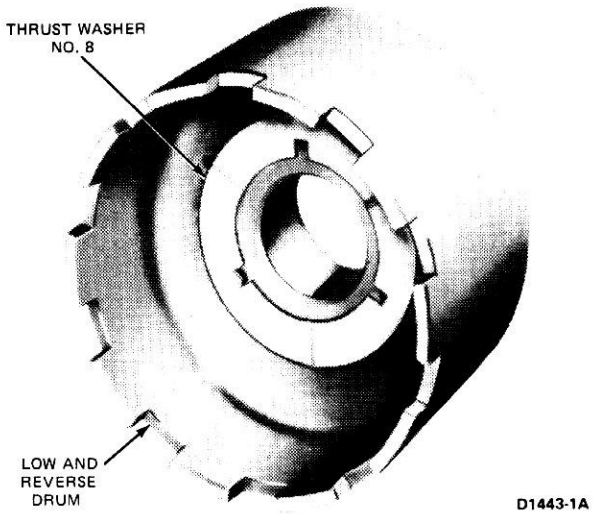


FIG. 41 Number 8 Thrust Washer Location

5. Using side cutters, carefully pry the throttle booster valve plug retaining pin from the valve body. Remove the plug, valve and spring (Fig. 52).
6. Remove the cut-back valve and transition valve cover plate from the valve body (Fig. 52).
7. Remove the cut-back valve from the body.
8. Remove the transition valve, 2-3 back-out valve and spring from the body.
9. Remove the 1-2 shift valve and 2-3 shift valve cover plate from the body.
10. Remove the 2-3 shift valve, spring and throttle modulator valve from the body (Fig. 52).
11. Remove the 1-2 shift valve, D-2 valve and spring from the body.
12. Remove the intermediate servo retaining pin and remove the intermediate accumulator retainer, valve and spring from the body.
13. Press the main oil pressure booster valve inward and remove the retaining pin. Remove the main oil pressure booster valve, sleeve, springs, retainer and the main oil pressure regulator valve (Fig. 52).

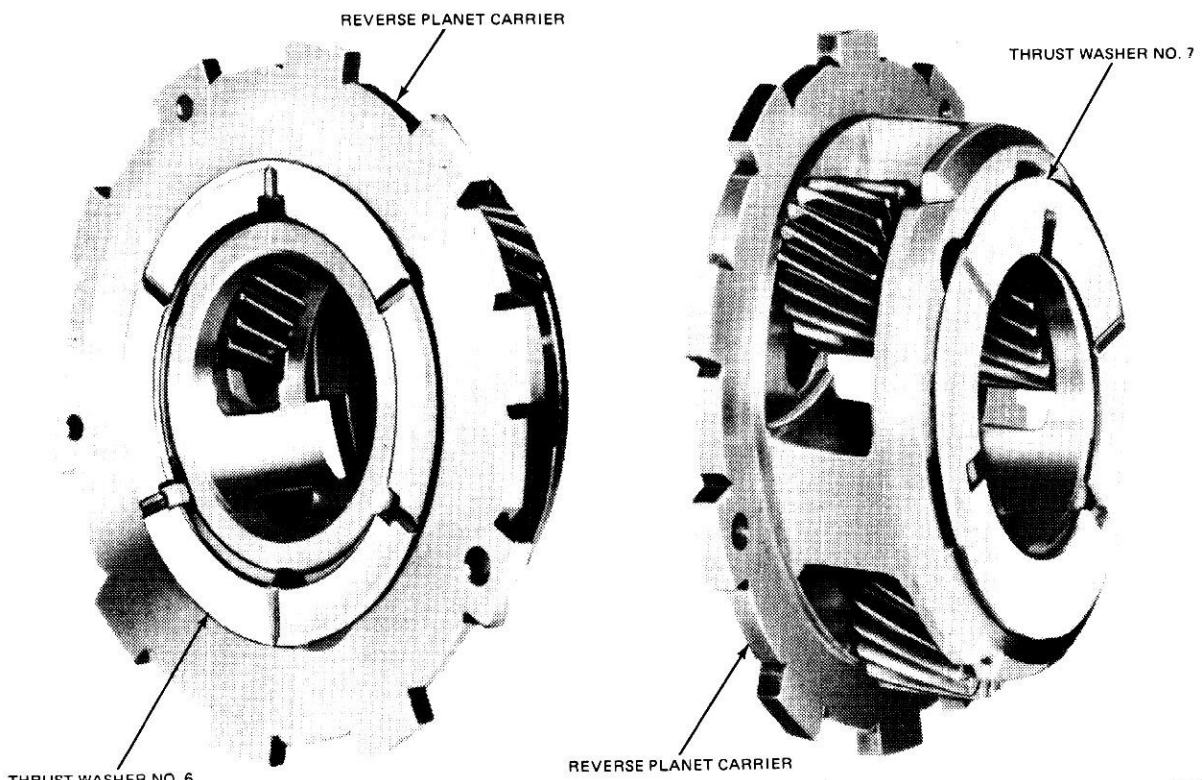


FIG. 42 Number 6 and 7 Thrust Washer Location

3. Remove the manual valve retaining ring and slide the manual valve out of the body. The retaining ring is used to hold the manual valve in its bore during shipment and should be removed and discarded before sliding the manual valve out of the control valve body.
4. Carefully pry the low servo modulator valve retainer from the body and remove the retainer plug, spring and valve from the body. While working in the low servo modulator valve bore, pry the downshift valve retainer from the body and remove the spring and downshift valve (Fig. 52).
14. Remove the line coasting boost valve retainer from the body and remove the spring and line coasting boost valve (Fig. 52).

Assembly

1. Place the shuttle valves in the upper and lower bodies as shown in Fig. 51. Position a new gasket and the separator plate on the lower body and install but do not tighten the attaching screw.
2. Place the lower body and plate assembly on the upper valve body and install the 11 attaching screws finger tight (Fig. 49). (9 of the screws are

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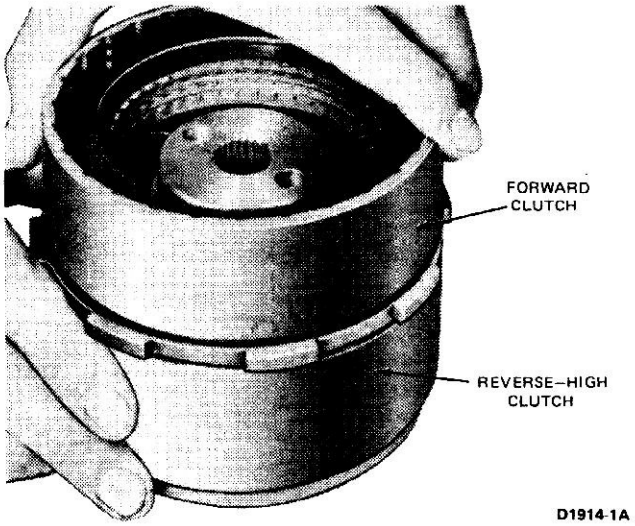


FIG. 43 Installing Clutch Units

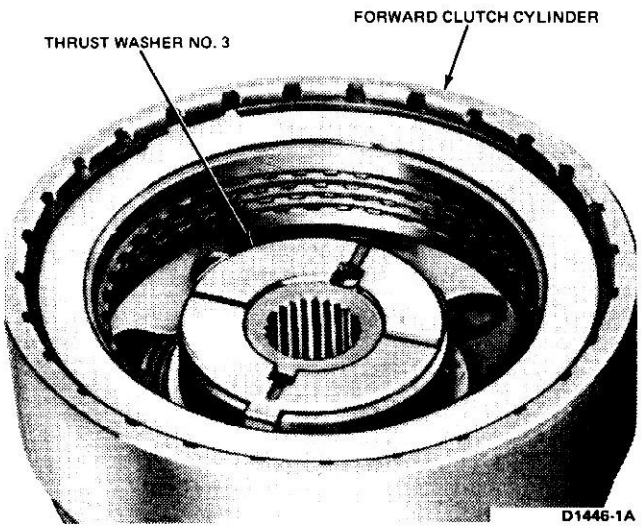


FIG. 44 Number 3 Thrust Washer Location

inserted through the lower valve body into the upper valve body, and two larger size screws are inserted from the other side through the upper valve body.)

3. Install the oil screen screws loosely, without the screen, to properly align the upper and lower valve bodies, gasket and separator plate.
4. Torque the four bolts that are covered by the screen to specification.
5. Position the throttle pressure limit valve and spring in the lower valve body (Fig. 50). Remove the oil screen attaching screws and place the gasket and oil screen in position on the lower valve body. Reinstall the screen attaching screws (Fig. 49). Torque all the valve body and screen attaching screws to specification.
6. **Insert the downshift valve (Fig. 52) into the body with the small diameter facing inward.** Install the downshift valve spring and retainer. Insert the low servo modulator valve, spring and

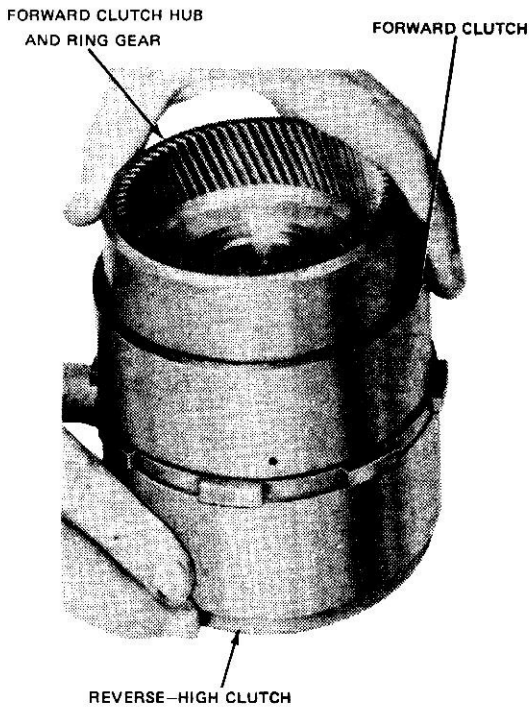


FIG. 45 Installing Forward Clutch Hub and Ring Gear

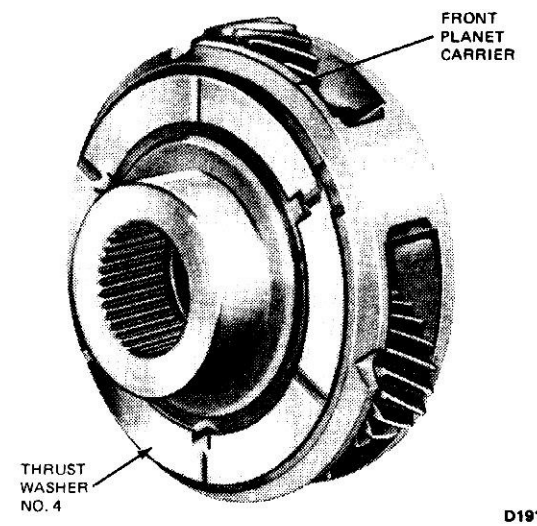


FIG. 46 Number 4 Thrust Washer Location

retainer plug in the body. Depress the plug and install the retainer.

7. Place the throttle booster valve spring, valve (small diameter end into spring) and plug into the body (Fig. 52). Depress the plug and press in the retaining pin. **Be sure the three grooves are at the top of the pin as it is installed.**
8. Place the spring, 2-3 back-out valve and the transition valve and spring in the body.
9. Place the cut-back valve in the body. Secure the cut-back and the transition valve cover plate to the

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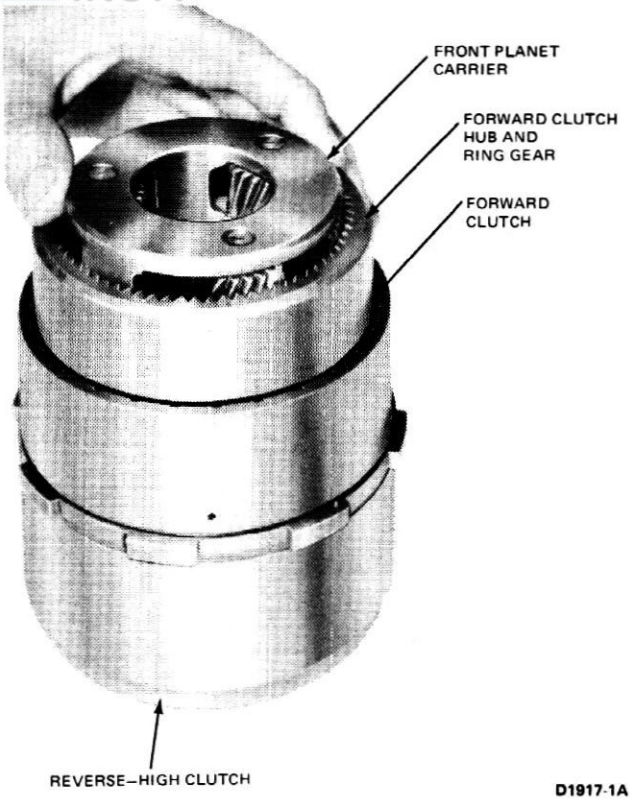


FIG. 47 Installing Front Planet Carrier

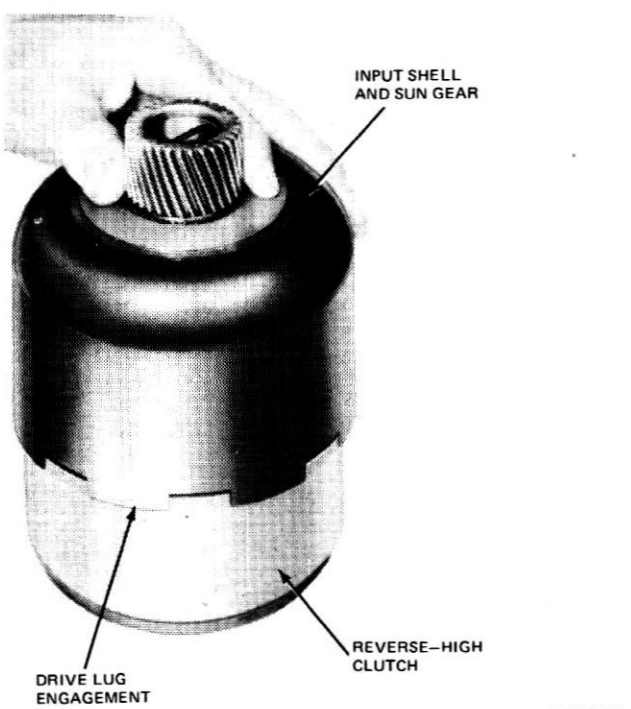


FIG. 48 Installing Input Shell and Sun Gear

body with the two attaching screws. Torque the screws to specification.

10. Place the throttle modulator valve, spring and 2-3 shift valve in the body.
11. Place the spring, D-2 valve and the 1-2 shift valve in the body.
12. Secure the 1-2 shift valve and the 2-3 shift valve cover plate to the body with the three attaching screws. Torque the screws to specification.
13. Place the spring, intermediate servo accumulator valve and retainer in the body. Depress the retainer and install the retaining pin (Fig. 52).
14. Insert the line coasting boost valve and spring in the body. Depress the spring and install the retainer.
15. Insert the main oil pressure regulator valve and spring retainer in the body (Fig. 52). Install the two springs, sleeve and the main oil pressure booster valve in the body.
16. Hold the main oil pressure booster valve in place and install the retaining pin.
17. Slide the manual valve into the valve body. **Make sure that the end with the two lands closest together is inserted first.**

INTERMEDIATE SERVO

Disassembly

1. Remove the transmission identification tag and the four servo cover-to-case attaching bolts.
2. Remove the servo cover, gasket, servo piston, and piston return spring from the case (Fig. 53).
3. Remove the intermediate servo piston from the cover.
4. Remove the seal rings from the servo piston and cover.

Assembly

1. Install a new seal on the cover and servo piston. Fig. 54 shows the correct servo piston and cover for each transmission model. Lubricate the seals with clean transmission fluid. Install the piston into the cover. Be careful not to damage the piston seal.
2. Install the piston return spring in the servo bore of the case.
3. Place a new gasket on the servo cover. **Position the servo piston and cover assembly into the case with the piston stem slot in a horizontal position to engage the strut.** Use two 5/16-18 bolts, 1-1/4 inches long, 180 degrees apart, to position the cover against the case. Install two cover attaching bolts. Remove the two 1-1/4-inch bolts and install the transmission identification tag and the other two cover attaching bolts. Torque the bolts to specification.

LOW-REVERSE SERVO

Disassembly

1. Remove the four servo cover-to-case attaching bolts.
2. Remove the servo cover, cover seal, servo piston and piston return spring from the case (Fig. 55).

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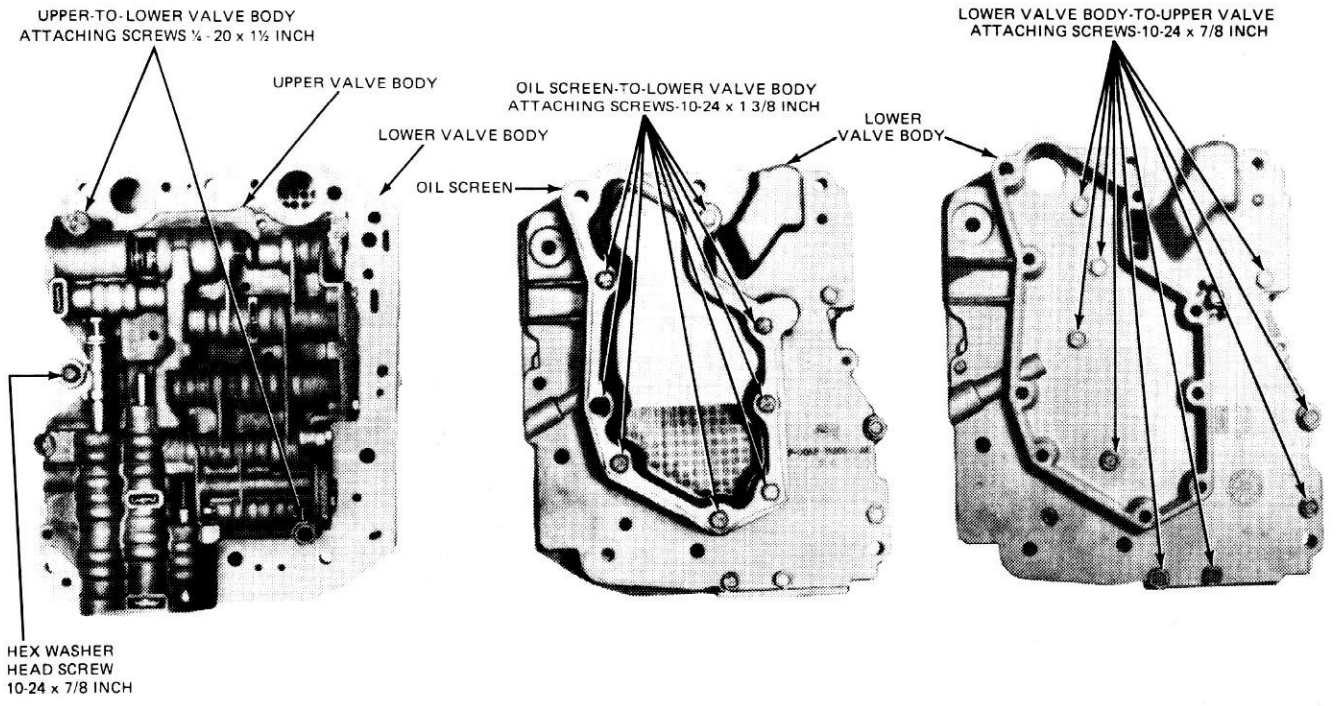


FIG. 49 Control Valve Body and Screen Attaching Screws

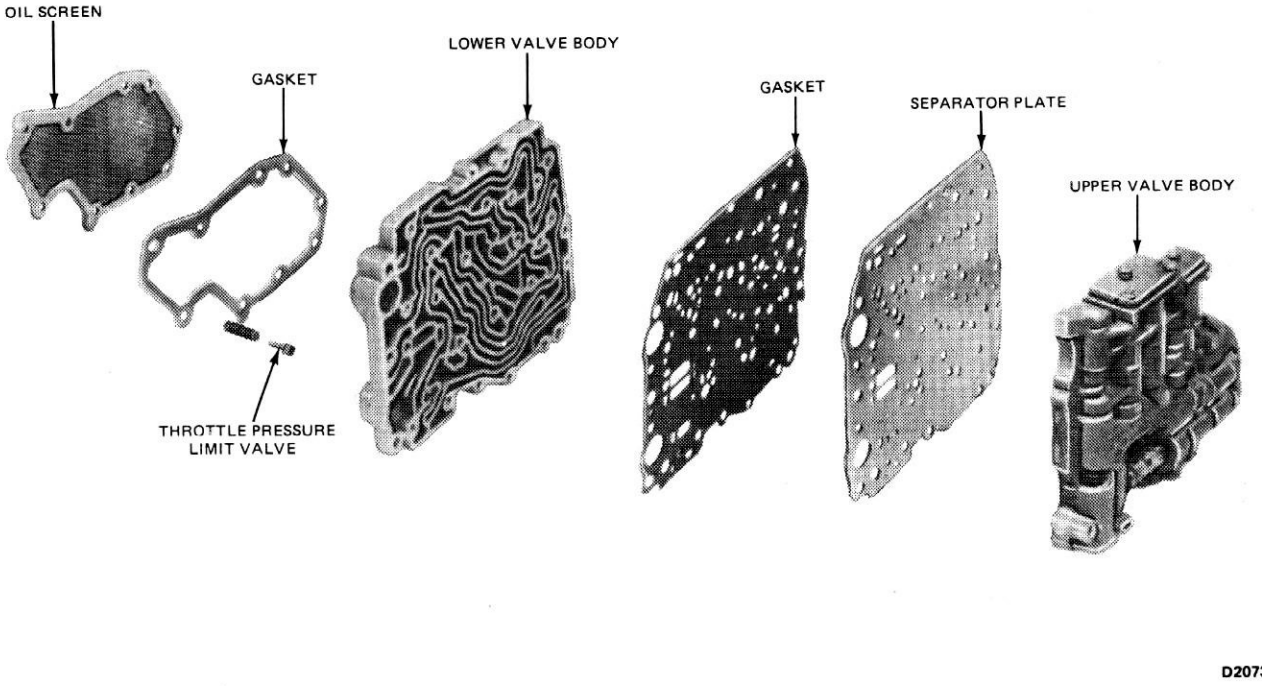


FIG. 50 Upper and Lower Valve Bodies Disassembled

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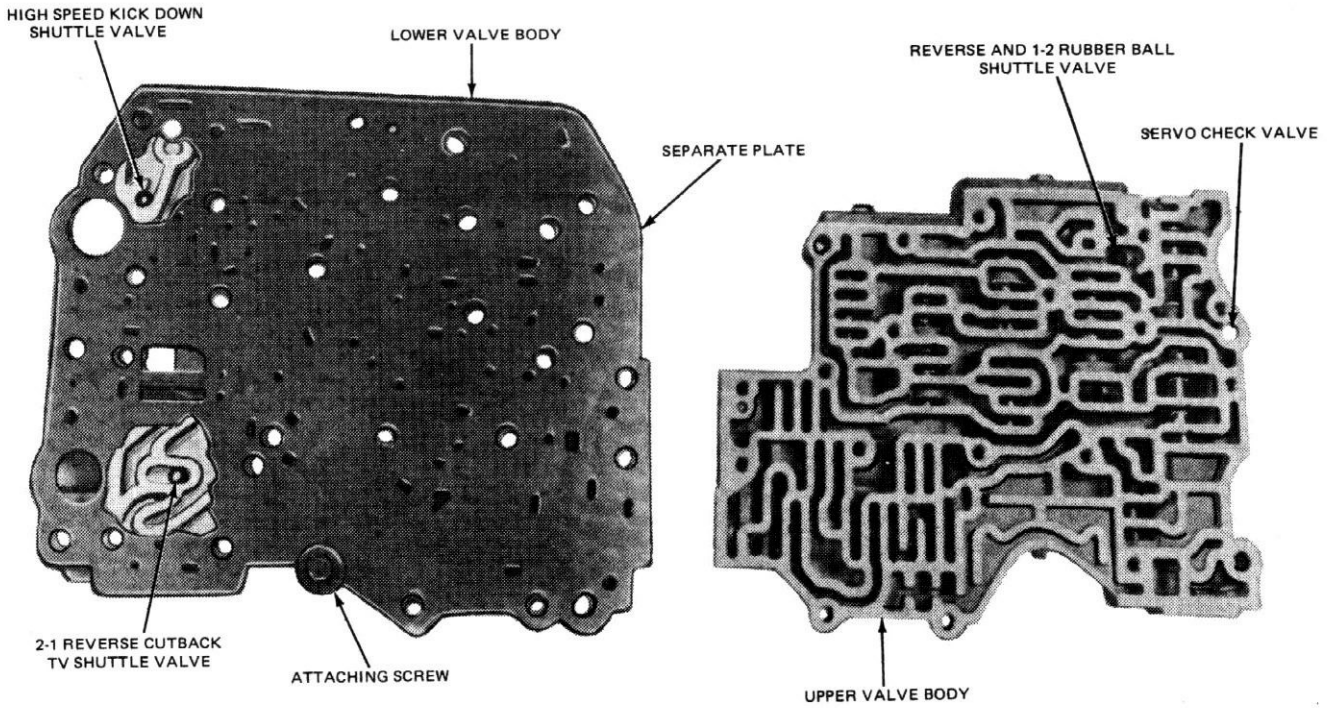


FIG. 51 Separating Upper and Lower Valve Bodies

3. The servo piston seal is bonded to the piston. If the seal has to be replaced, replace the piston assembly which includes the seal.
4. On Pinto, Bobcat and Mustang II, disassemble the servo piston from the piston stem by inserting a small screwdriver in the hole of the piston stem and removing the piston attaching nut (Fig. 56).

Assembly

1. On Pinto, Bobcat and Mustang II, position the accumulator spring and spacer (Fig. 57) on the piston stem if they were previously removed. **Make sure the crowned side of the spring is facing toward the rod.** Install a new servo piston on the stem and install the attaching nut. Torque the nut to specification as listed at the end of this Part.
2. Place the piston return spring in the servo bore of the case (Fig 55). Lubricate the piston seal with clean transmission fluid and install the servo piston into the bore of the case.
3. Place a new cover seal on the cover and install the servo cover. Install the four cover attaching bolts. Torque the cover-to-case retaining bolts to specification.

GOVERNOR

Disassembly

1. Remove the oil rings from the governor oil distributor (Fig. 58).
2. Remove the governor housing-to-distributor attaching bolts. Remove the governor from the oil distributor.
3. Remove the primary governor valve snap ring (Fig. 59). Remove the washer, spring, and primary governor valve from the housing.
4. Remove the secondary governor valve spring retaining clip, spring, and governor valve from the housing.

Assembly

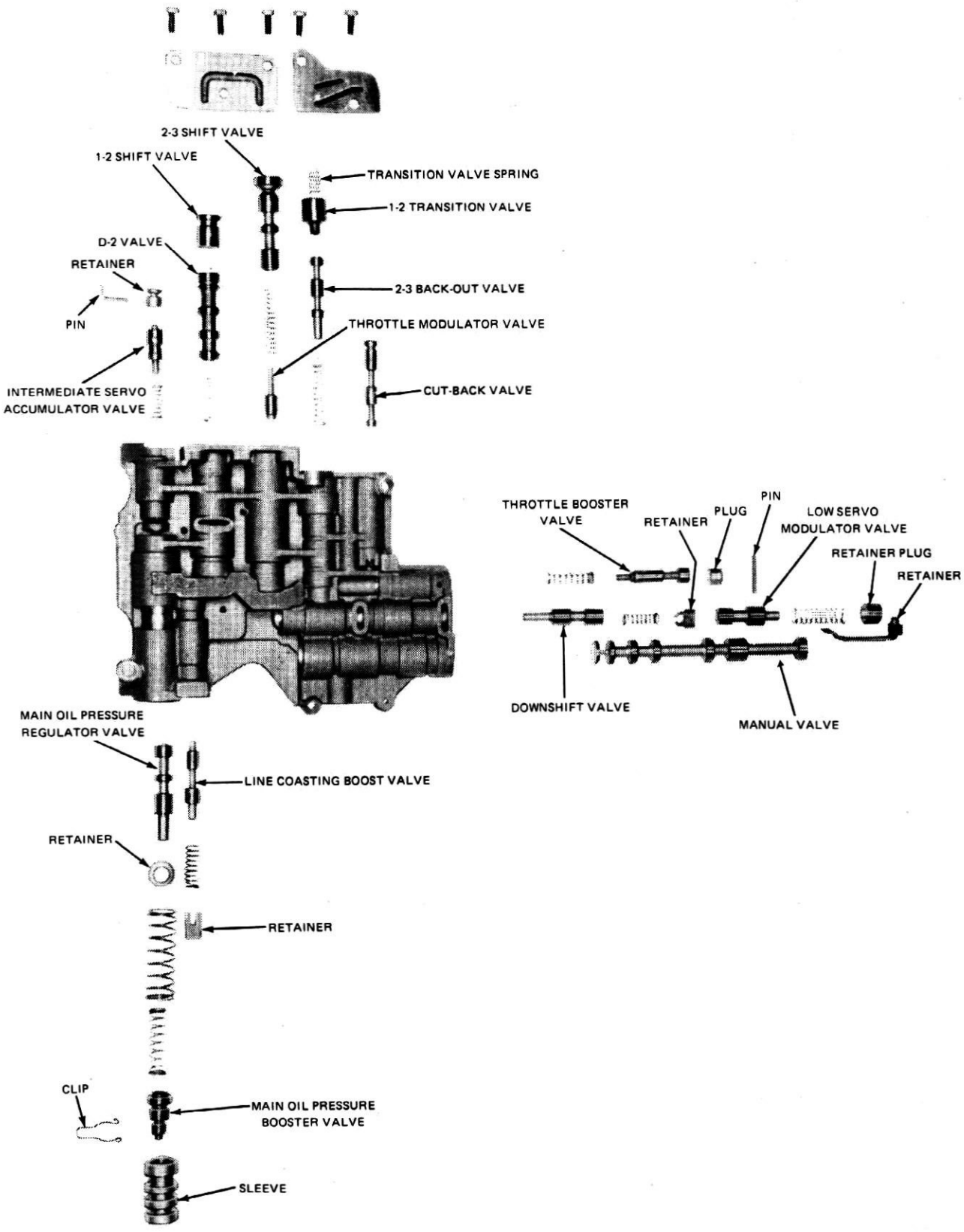
1. Install the secondary governor valve in the housing. Install the spring and retaining clip. **Make sure the clip is installed with the small concaved area facing downward, to hold the spring in the correct position.**
2. Install the primary governor valve in the housing. Install the spring washer and snap ring. **Make sure the washer is centered in the housing on top of the spring and the snap ring is fully seated in the ring groove of the housing.**
3. Install the governor assembly on the oil distributor and torque the attaching bolts to specification.
4. Install the oil rings on the distributor. Check the oil rings for free rotation in the ring grooves on the oil distributor.

DOWNSHIFT AND MANUAL LINKAGE

Disassembly

1. Apply penetrating oil to the outer lever attaching nut to prevent breaking the inner lever shaft. Remove the downshift outer lever nut and remove the downshift outer and inner levers.
2. On vehicles equipped with a case mounted neutral start switch, place a screwdriver behind the switch and carefully pry the switch off the lever.

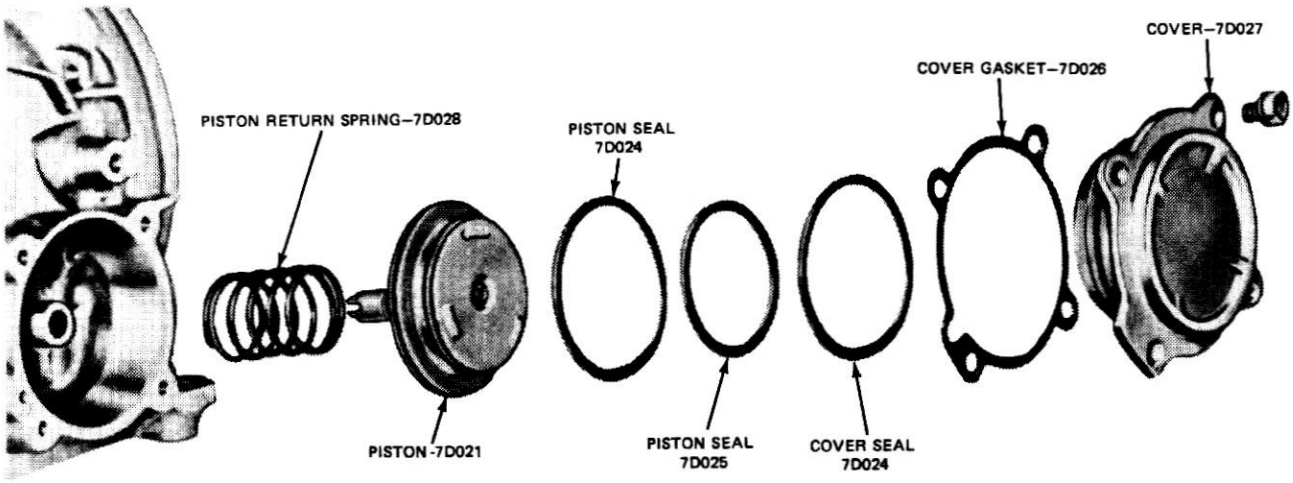
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D2075-2D

FIG. 52 Upper Valve Body Disassembled

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D1882-2C

FIG. 53 Intermediate Servo Disassembled

Vehicle	Engine	Cover Piston Ident. ①	Spring	
			Free Length	Paint Stripe
Granada/Monarch	4.1L (250 CID)	B	2.48	White
Mustang, Granada, Monarch, Versailles	5.0L (302 CID)	A	2.48	White
Ford, Granada, Monarch, LTD II, Cougar, Thunderbird	5.8L (351 CID)	R	2.48	White
Pinto, Bobcat, Mustang, Fairmont, Zephyr	3.3L (200 CID) 2.3/2.8L	Z	2.48	White

CD2122-1K

FIG. 54 Intermediate Servo Piston—Cover and Spring Identification

3. From inside the transmission case, remove the upper retaining ring from the manual lever link (Fig. 60). Remove the upper end of the lever link from the case retaining pin.
4. From the back of the transmission case, remove the lower retaining ring and flat washer from the parking pawl link (Fig. 60). Remove the pawl link from the case retaining pin.
5. From the back of the transmission case, remove the parking pawl link, toggle rod, and manual lever link as an assembly (Fig. 61).
6. Remove the rear parking pawl link upper retaining ring, flat washer and link from the toggle rod (Fig. 60).
7. Remove the manual lever link, lower retaining ring, flat washer, and link from the toggle rod.
8. Remove the inner manual lever attaching nut and lever. Remove the outer manual lever from the case.
9. To remove the manual lever seal, use the tools shown in Fig. 62. To install the new seal, use a driver that fits the ID of the seal.

Assembly

1. Install the manual and parking pawl links, flat washers and retaining rings to the toggle rods.
2. Install the outer manual lever in the case. Install the inner manual lever and attaching nut with the chamfer facing toward the lever (Fig. 60). Torque the nut to specification as listed at the end of this Part.
3. From the back of the transmission case, install the parking toggle rod and link assembly into the case (Fig. 61).
4. Install the parking pawl link on the case retaining pin. Install the flat washer and link retaining ring (Fig. 60).
5. Position the inner manual lever behind the manual lever link, with the cam on the lever contacting the lower link pin.
6. Install the upper end of the manual lever link on the case retaining pin. Install the retaining ring.
7. Operate the manual lever and check for correct linkage operation.

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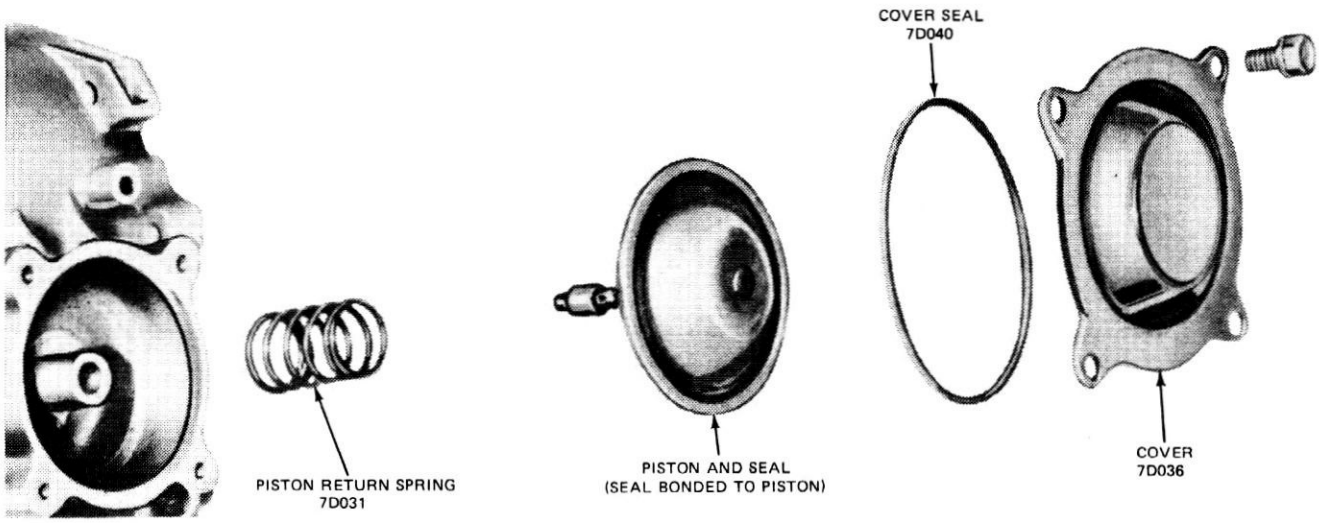


FIG. 55 Low-Reverse Servo Disassembled—All Except Pinto, Bobcat and Mustang II

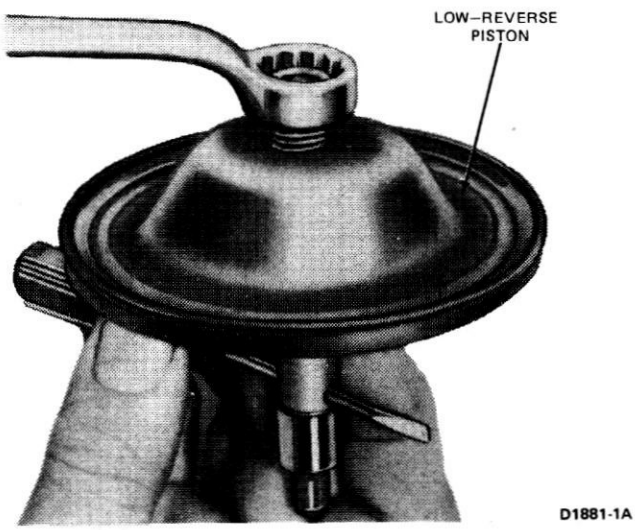


FIG. 56 Removing or Installing Low Reverse Servo Piston—Pinto, Bobcat and Mustang II

8. On vehicles equipped with a case mounted neutral start switch, reinstall the switch. Adjust the switch after the control valve body has been installed. Torque the attaching bolts to specification.
9. Install the inner and outer downshift levers. Torque the attaching nut to specification.

FRONT PUMP

Disassembly

1. Remove the four seal rings from the stator support.
2. Remove the five bolts that attach the stator support to the front pump housing. Remove the stator support from the pump housing (Fig. 63).
3. Remove the front and rear stator bushings if they are worn or damaged. Use the cape chisel (Fig. 64) and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
4. Remove the drive and driven gears from the front pump housing.
5. Press the bushing from the front pump housing with the handle and tool as shown in Fig. 65.

Assembly

1. Press a new bushing into the pump housing with the handle and tool as shown in Fig. 65. **Make sure the bushing is installed with the slot and groove positioned to the rear of the pump body and 60 degrees below the horizontal center line.**
2. Install the drive and driven gears in the pump housing. **Each gear has an identification mark on the side of the gear teeth that are chamfered. The chamfered side with the identification mark has to be positioned downward against the face of the pump housing.**

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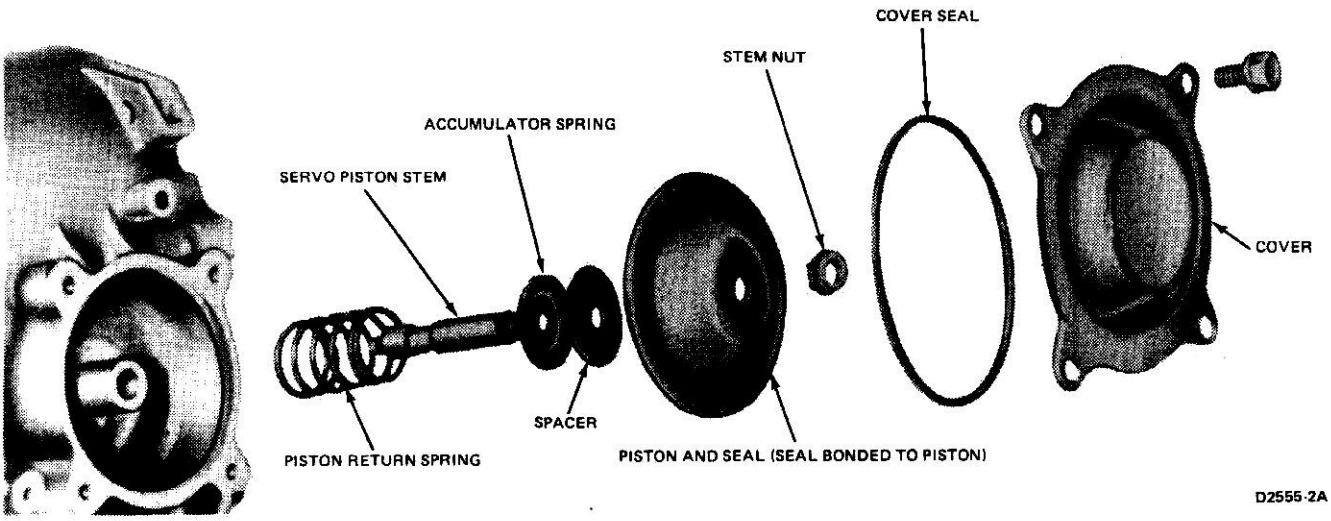


FIG. 57 Low-Reverse Servo Disassembled—Pinto, Bobcat and Mustang II

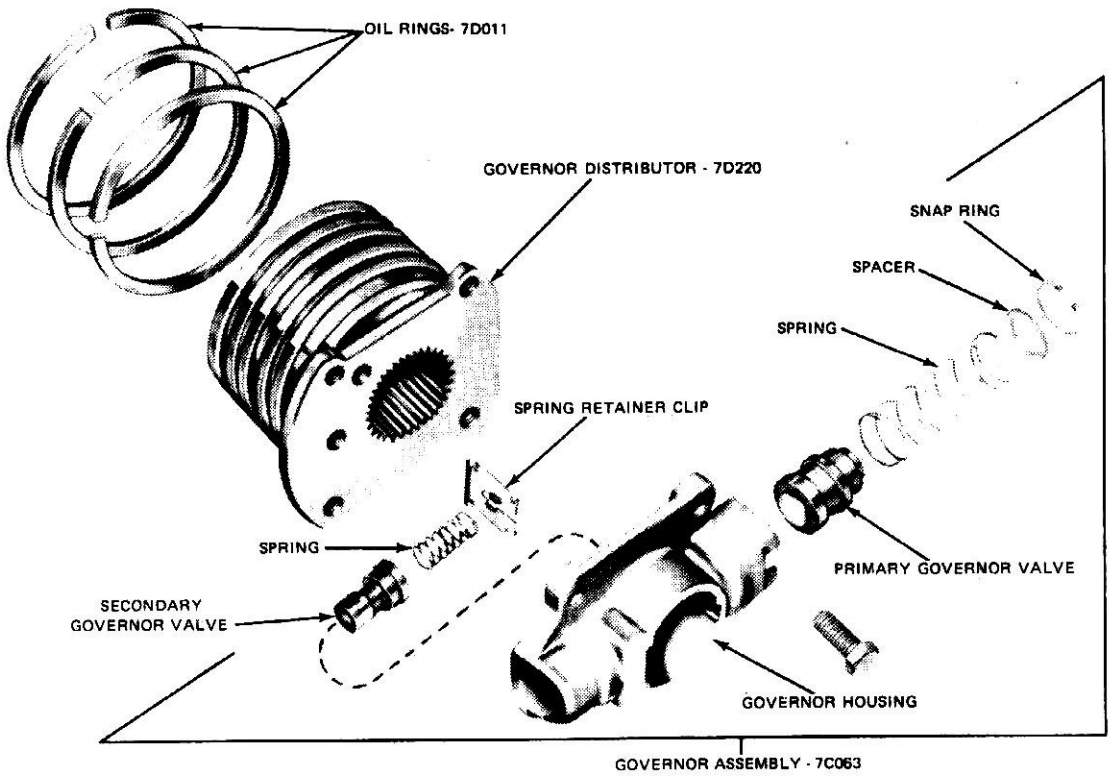


FIG. 58 Governor Disassembled

3. Press new bushings into the stator support with the tool shown in Fig. 66. Use the long end of the tool for the front bushing and the short end for the rear bushing. **When installing the rear bushing, be sure the hole in the bushing is lined up with the lube hole in the stator support.**
4. Place the stator support in the pump housing and install the five attaching bolts. Torque the bolts to specification.
5. Install the four seal rings on the stator support. **The two large oil rings are assembled first in the oil ring grooves toward the front of the stator support (Fig. 63).**
6. Check the pump for free rotation by placing the pump on the converter drive hub in its normal running position and turning the pump housing.
7. If the front pump seal must be replaced, mount the pump in the transmission case and remove the seal

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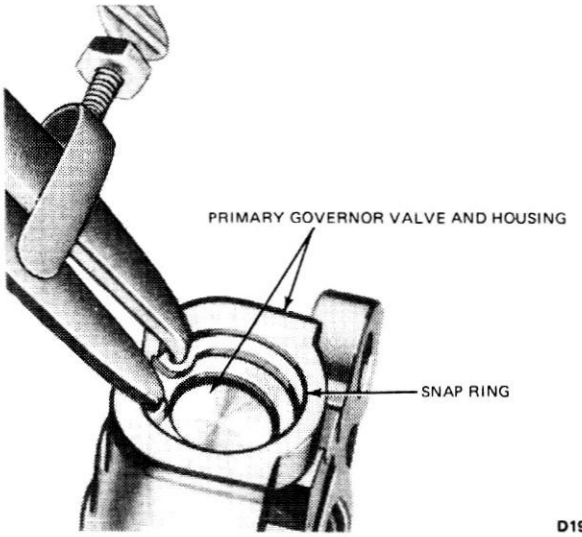


FIG. 59 Removing or Installing Governor Valve Snap Ring

with the tool shown in Fig. 67. To install the new seal, use the tool shown in Fig. 68.

REVERSE-HIGH CLUTCH

Disassembly

1. Remove the pressure plate snap ring (Fig. 70).
2. Remove the pressure plate, and the drive and driven clutch plates (Fig. 70). **If the composition clutch plates are to be reused, do not clean them in a vapor degreaser or with a detergent solution. Wipe the plates with a lint-free cloth.**
3. Place the reverse-high clutch drum in an arbor press. With the tools shown in Fig. 71, compress the piston return springs and remove the snap ring. When the arbor press ram is released, guide the spring retainer to clear the snap ring groove of the drum.
4. Remove the spring retainer and piston return spring.
5. Remove the piston by inserting air pressure in the piston hole of the clutch drum (Fig. 72).
6. Remove the piston outer seal from the piston and the piston inner seal from the clutch drum (Fig. 70).

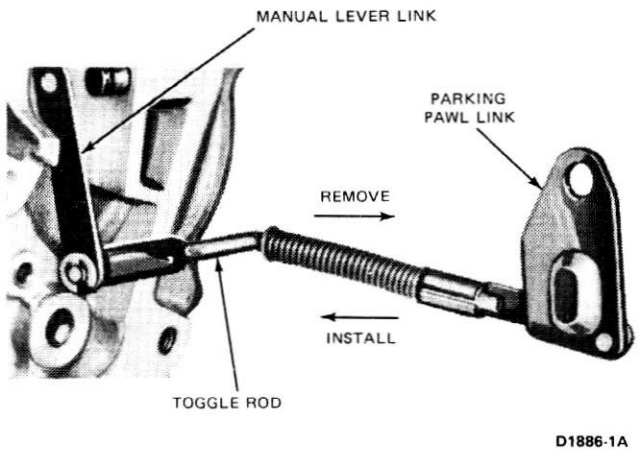


FIG. 61 Removing or Installing Parking Pawl Link

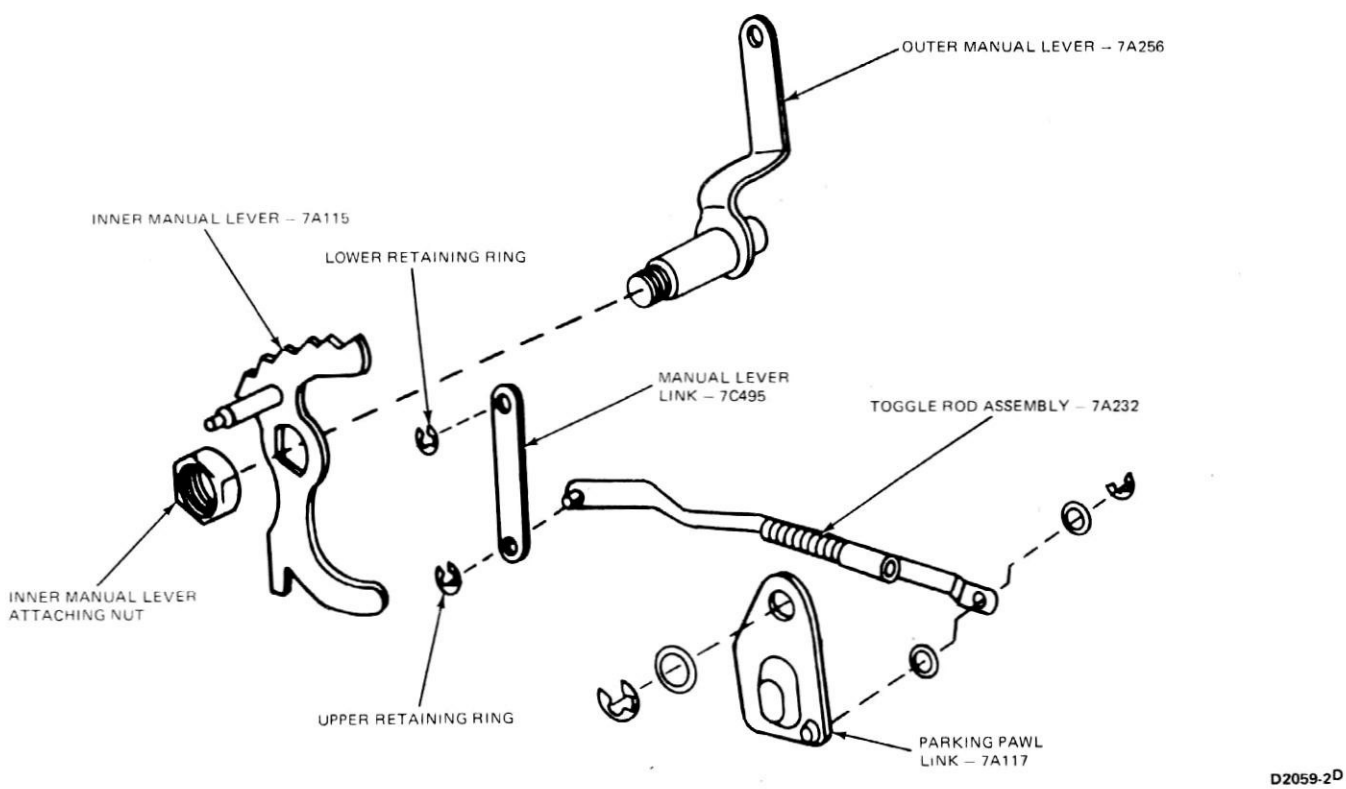


FIG. 60 Transmission Case Internal Linkage

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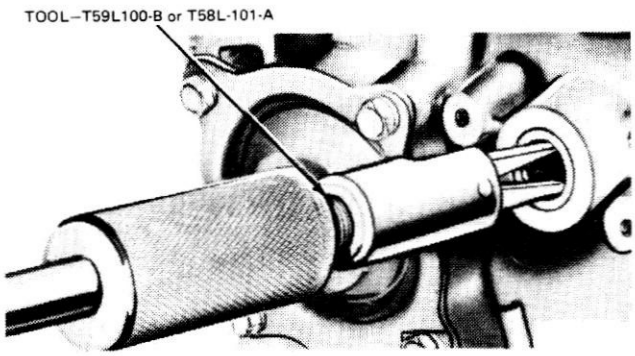


FIG. 62 Removing Manual Lever Seal

Assembly

1. Install a new inner seal in the clutch drum and a new outer seal on the clutch piston. Lubricate the seals with clean transmission fluid and install the piston into the clutch drum.
2. Place the clutch piston spring into position on the clutch piston. Place the spring retainer on top of the spring, and install assembled parts in reverse-high clutch drum. To install the snap ring, use the tools shown in Fig. 71, and place assembled clutch drum in an arbor press.

As the press ram is moved downward, make sure the spring retainer is centered to clear the snap ring groove. Install the snap ring.

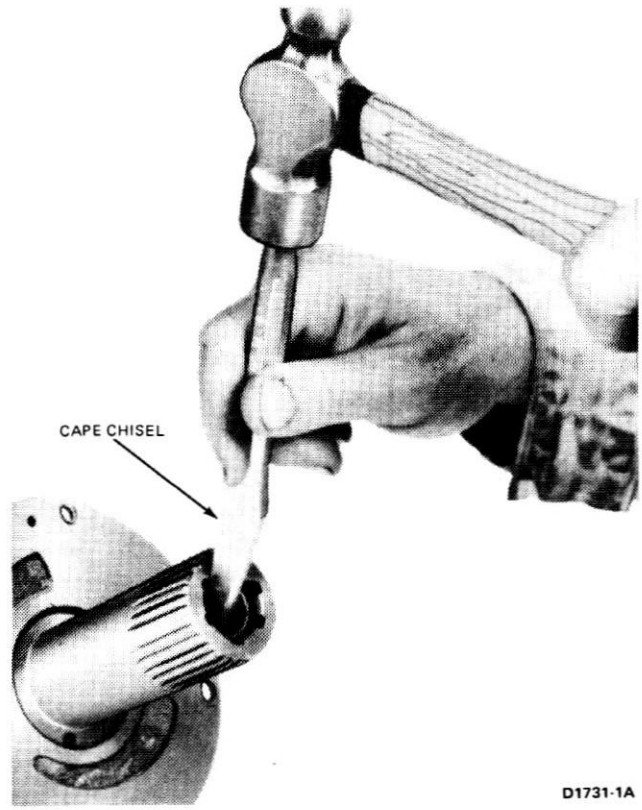


FIG. 64 Removing Stator Support Bushing

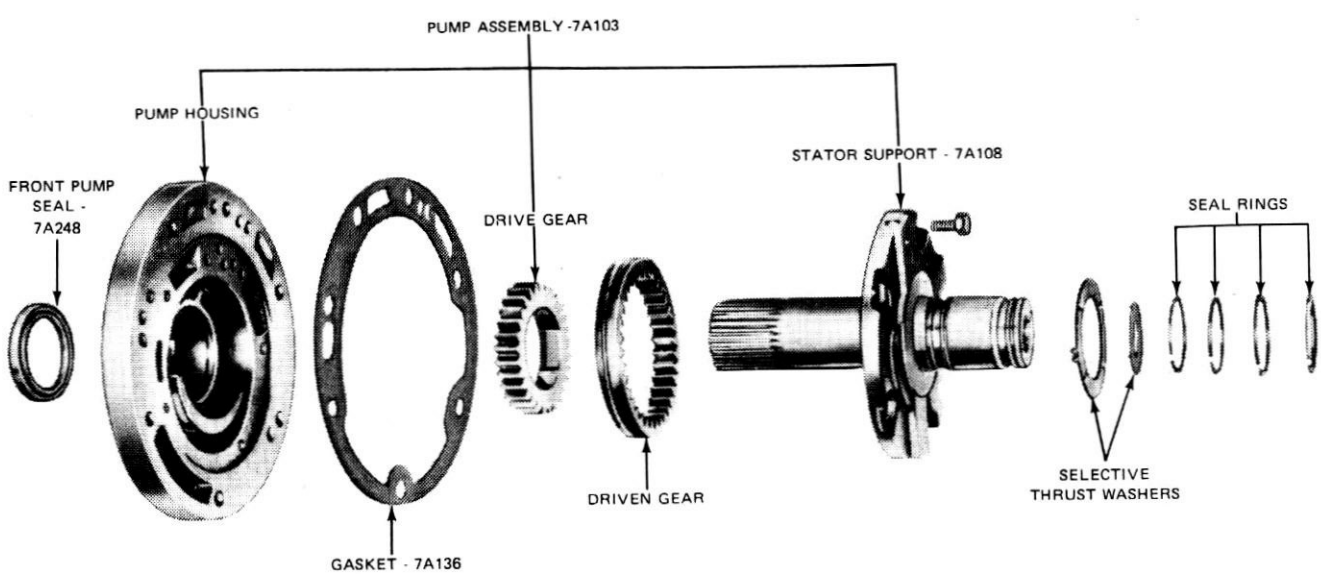


FIG. 63 Front Pump and Stator Support Disassembled

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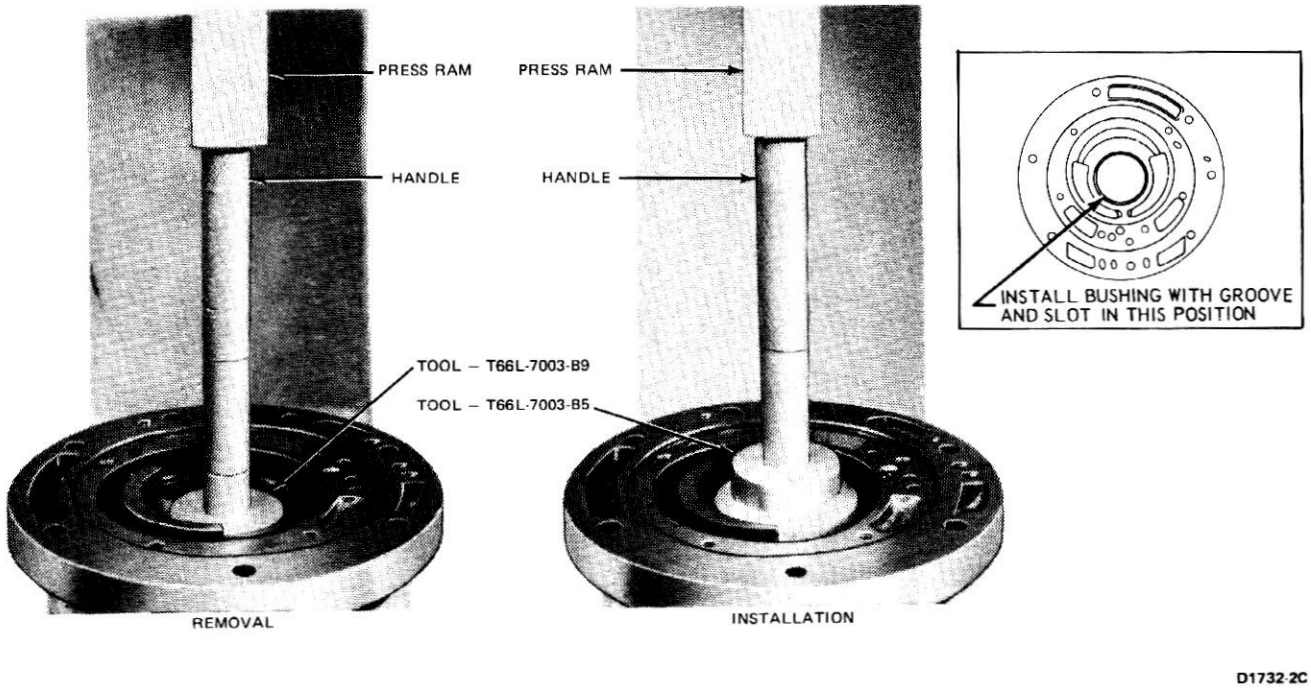


FIG. 65 Replacing Front Pump Housing Bushing

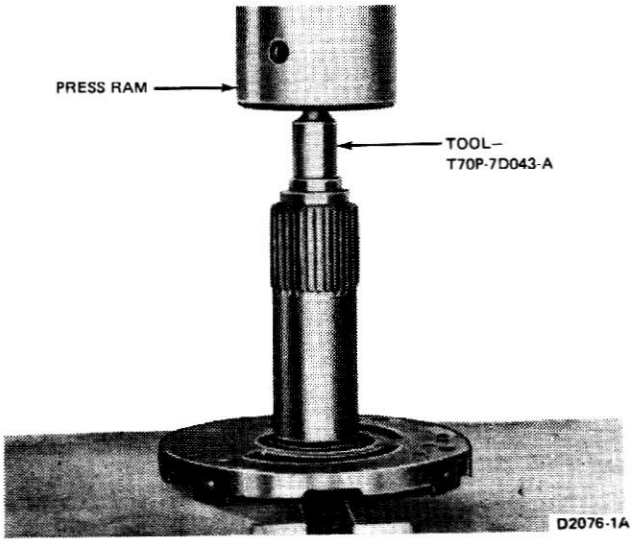


FIG. 66 Installing Stator Support Bushings

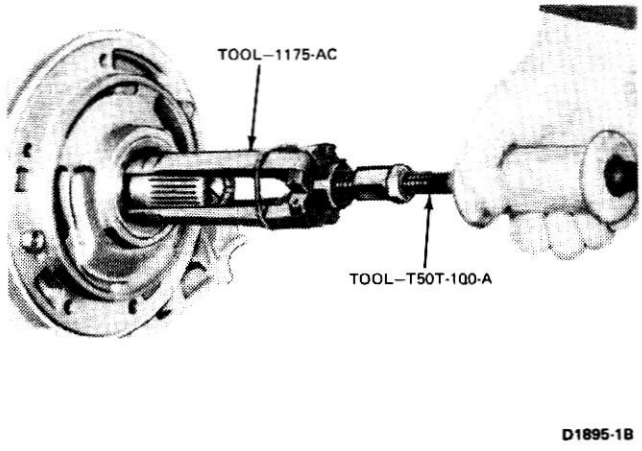


FIG. 67 Removing Front Pump Seal

3. When new composition clutch plates are used, soak the plates in transmission fluid for fifteen minutes before installing them. Install the clutch plates alternately starting with a steel plate, then a non-metallic plate (Fig. 70). The last plate installed is the pressure plate. For the correct number of clutch plates required for each transmission model, refer to specifications at end of this Part.
4. Install the pressure plate snap ring (Fig. 70). Make sure the snap ring is fully seated in the snap ring groove of the clutch hub.
5. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 73).
6. The pressure plate should be held downward as the clearance is checked. The clearance should be 0.050 to 0.071 inch. If the clearance is not within limits, selective snap rings are available in the following thicknesses: 0.050 to 0.054, 0.064 to 0.068, 0.078 to 0.082 and 0.092 to 0.096 inch. Install the correct size snap ring and recheck the clearance.

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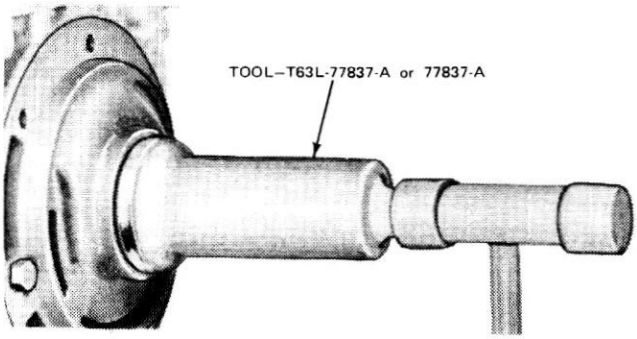


FIG. 68 Installing Front Pump Seal

FORWARD CLUTCH

Disassembly

1. Remove the clutch pressure plate snap ring (Fig. 74).
2. Remove the pressure plate, and the drive and driven clutch plates from the clutch hub (Fig. 75).
3. Remove the disc spring snap ring (Fig. 76).
4. Apply air pressure at the clutch piston pressure hole (Fig. 77) to remove the piston from the clutch hub.
5. Remove the clutch piston outer seal and the inner seal from the clutch hub (Fig. 75).

Assembly

1. Install new clutch piston seals on the clutch piston and drum. Lubricate the seals with clean transmission fluid.
2. Using a clutch piston seal protection (see Specification Section), install the clutch piston into the clutch hub. Install the disc spring and retaining snap ring (Fig. 75).
3. **Install the lower pressure plate with the flat side up and the radius side downward.**

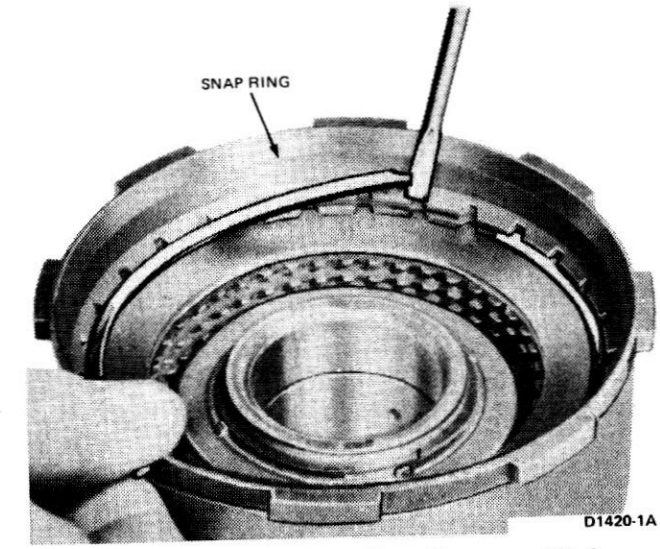


FIG. 69 Removing or Installing Reverse-High Pressure Plate Snap Ring

4. Install one non-metallic clutch plate and alternately install the drive and driven plates. Before installing new composition clutch plates, soak them in transmission fluid for fifteen minutes. The last plate installed will be the upper pressure plate. Refer to Specifications at end of this Part, for the correct number of clutch plates for the applicable model transmission.
5. Install the pressure plate snap ring (Fig. 75). Make sure the snap ring is fully seated in the ring groove of the clutch hub.
6. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 78). Downward pressure on the plate should be used when making this check. The clearance should be 0.025 to 0.050 inch.
7. If the clearance is not within limits, selective snap rings are available in the following thicknesses: 0.050 to 0.054, 0.064 to 0.068, 0.078 to 0.082 and 0.092 to 0.096 inch. Insert the correct size snap ring and recheck the clearance.

FORWARD CLUTCH HUB AND RING GEAR

Disassembly

1. Remove the forward clutch hub snap ring (Fig. 79).
2. Remove the forward clutch hub from the ring gear.
3. Press the bushing from the clutch hub as shown in Fig. 80.

Assembly

1. Install a new bushing into the clutch hub as shown in Fig. 80.
2. Install the forward clutch hub in the ring gear. Make sure the hub is bottomed in the groove of the ring gear.
3. Install the front clutch hub snap ring. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

INPUT SHELL AND SUN GEAR

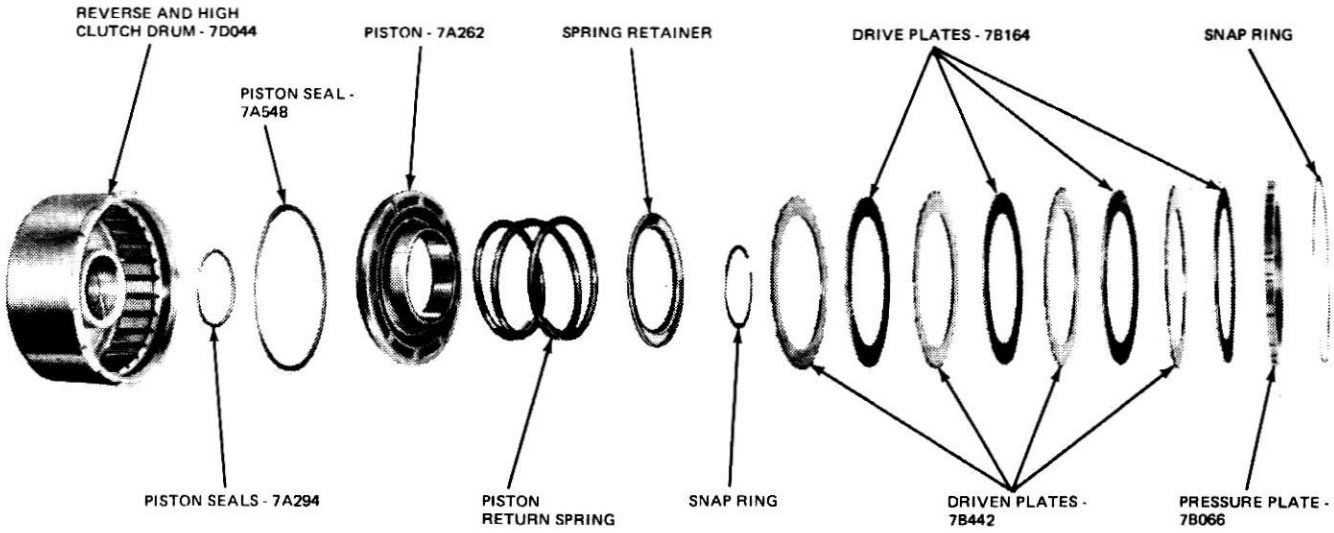
Disassembly

1. Remove the external snap ring from the sun gear (Fig. 81).
2. Remove thrust washer No. 5 from the input shell and sun gear (Fig. 82).
3. From inside the input shell, remove the sun gear. Remove the internal snap ring from the sun gear.
4. If the sun gear bushings are to be replaced, use the tool shown in Fig. 83 and press both bushings through the gear.

Assembly

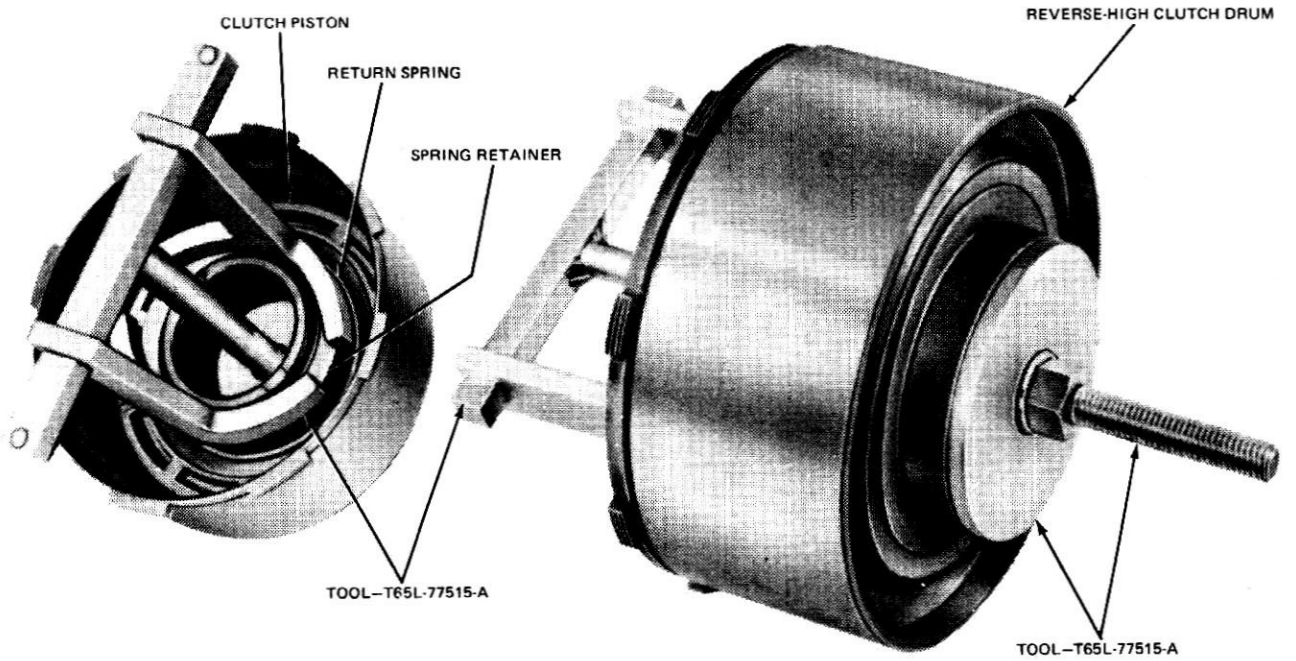
1. Press a new bushing into each end of the sun gear with the tool shown in Fig. 83.
2. Install the internal snap ring in the sun gear. Install the sun gear in the input shell.
3. Install thrust washer No. 5 on the sun gear and input shell (Fig. 82).
4. Install the external snap ring on the sun gear (Fig. 81).

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D1897-2D

FIG. 70 Reverse-High Clutch Disassembled Typical



D1591-2C

FIG. 71 Removing or Installing Reverse-High Clutch Piston Spring Snap Ring

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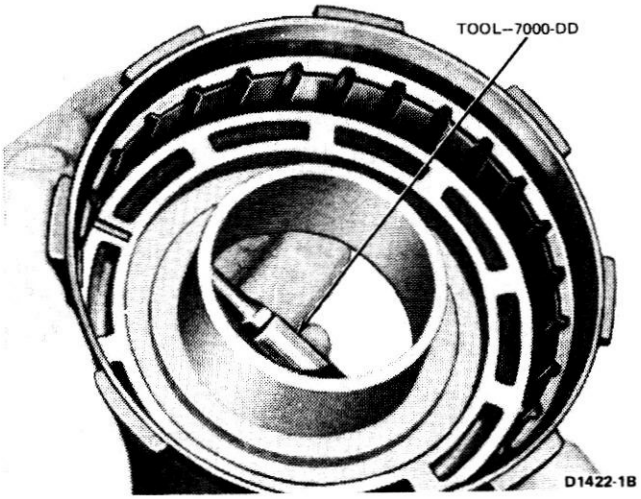


FIG. 72 Removing Reverse-High Clutch Piston

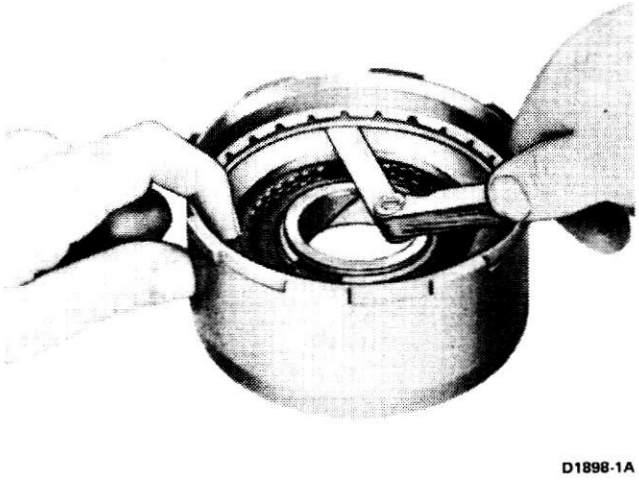


FIG. 73 Checking Reverse-High Clutch Snap Ring Clearance

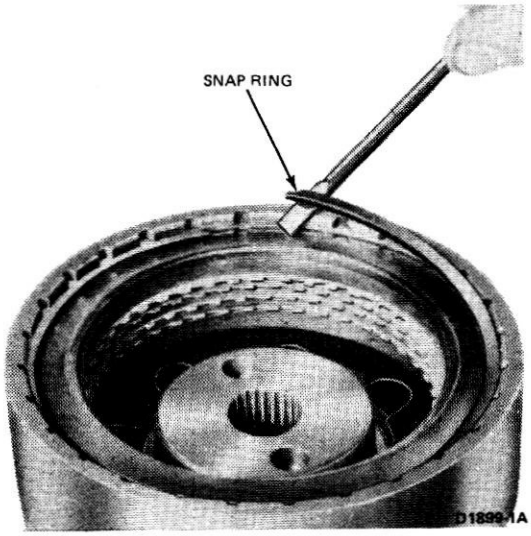


FIG. 74 Removing or Installing Forward Clutch Pressure Plate Snap Ring

REVERSE RING GEAR AND HUB

Disassembly

1. Remove the hub snap ring from the reverse ring gear.
2. Remove the hub from the reverse ring gear (Fig. 84).

Assembly

1. Install the hub in the reverse ring gear. Make sure the hub is fully seated in the groove of the ring gear.
2. Install the snap ring in the reverse ring gear. Make sure the snap ring is fully seated in the snap ring groove of the ring gear.

LOW-REVERSE BRAKE DRUM BUSHING REMOVAL AND INSTALLATION

1. Replace the low-reverse brake drum bushing if it is worn or damaged. To remove the bushing, use the cape chisel and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
2. Install a new bushing with the tool shown in Fig. 85.

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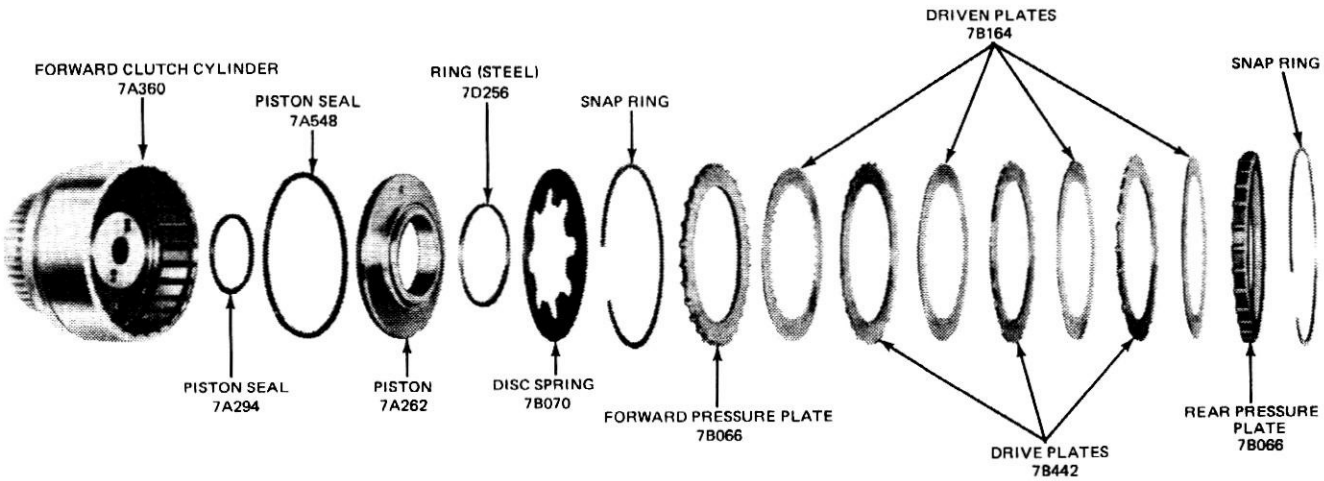


FIG. 75 Forward Clutch Disassembled Typical

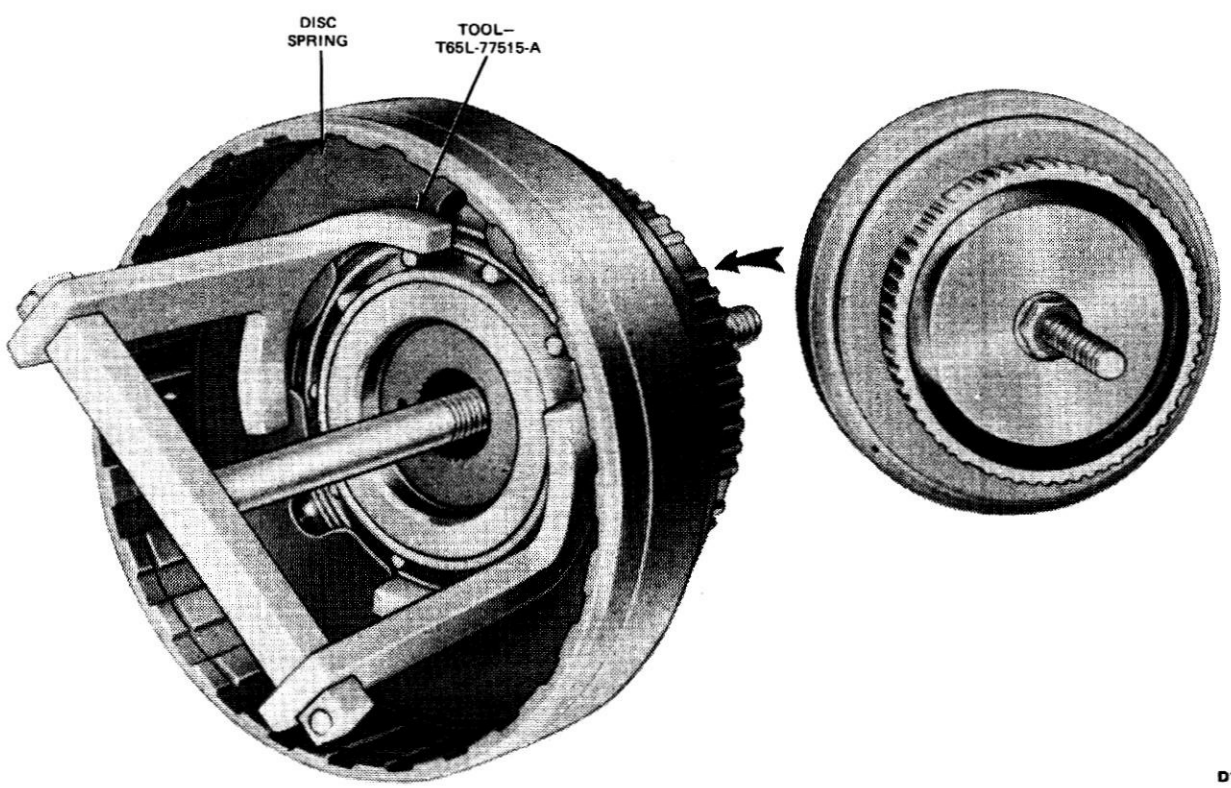


FIG. 76 Removing Disc Spring

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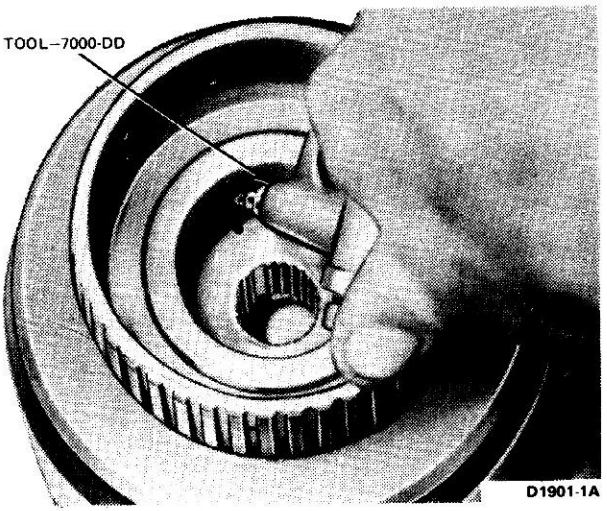


FIG. 77 Removing Forward Clutch Piston

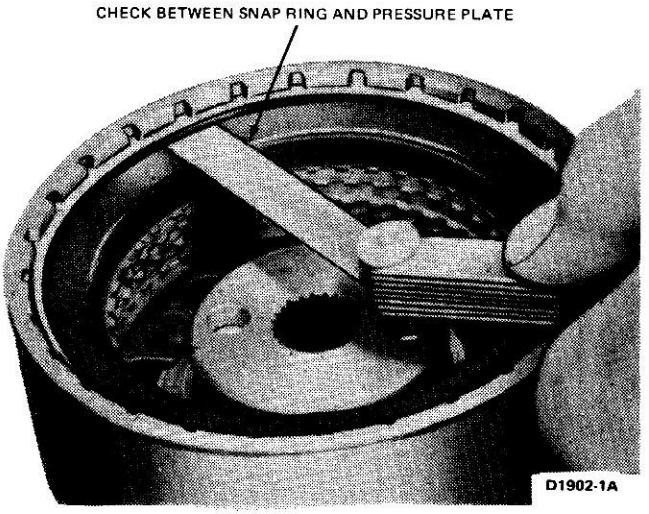


FIG. 78 Checking Forward Clutch Snap Ring Clearance

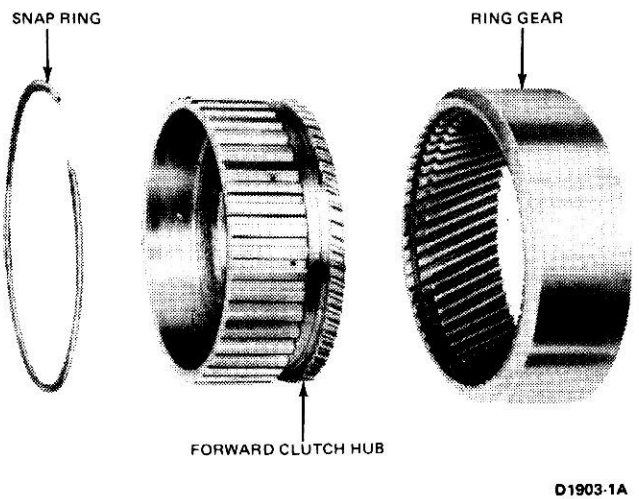


FIG. 79 Forward Clutch Hub and Ring Gear Disassembled

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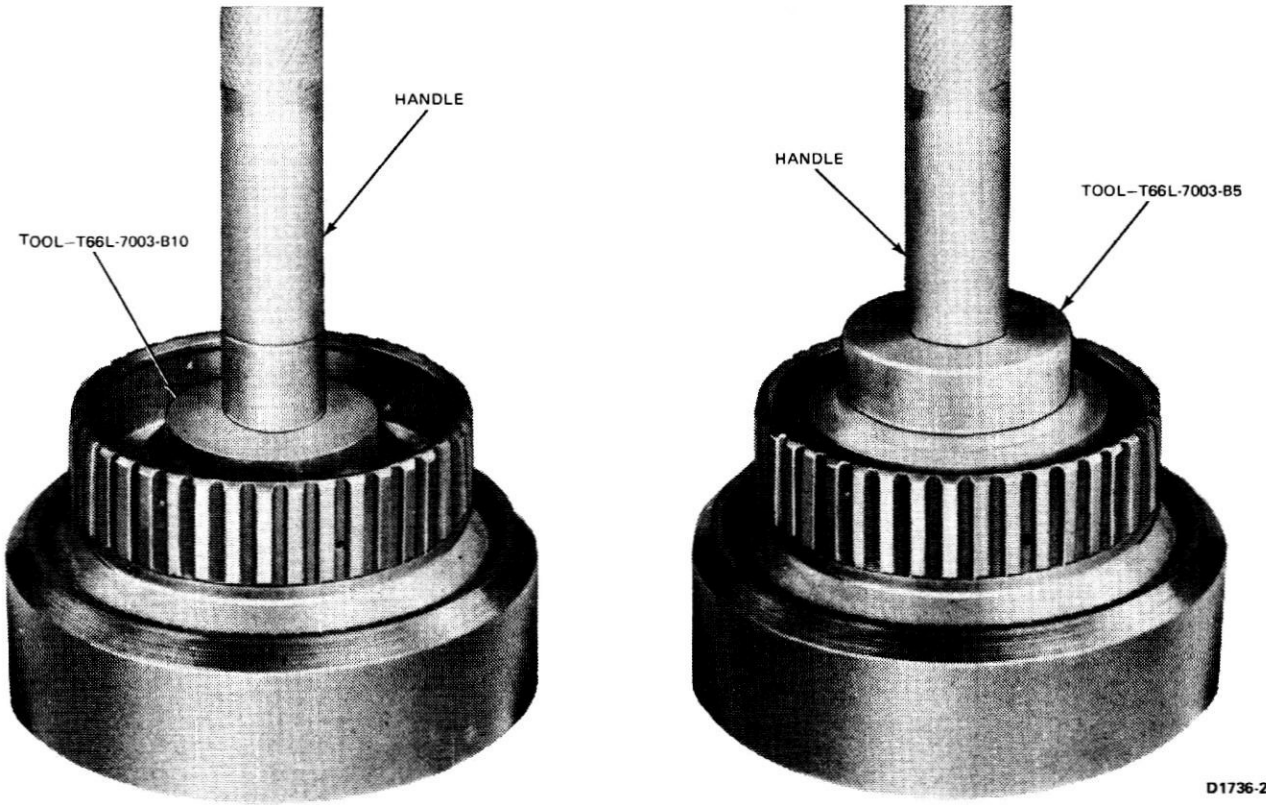


FIG. 80 Replacing Forward Clutch Hub Bushing

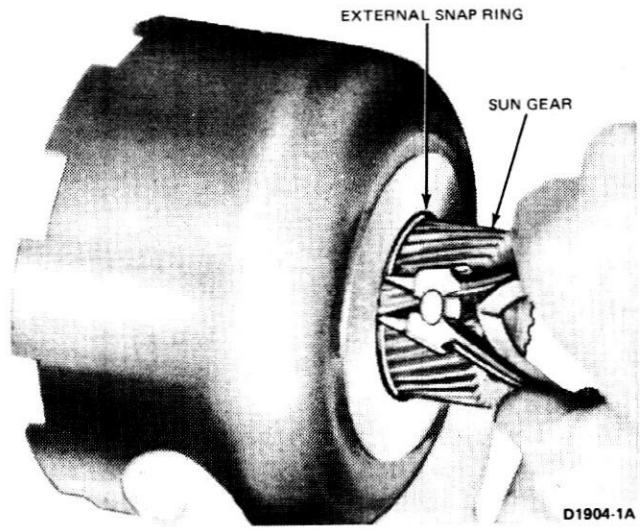


FIG. 81 Removing or Installing Sun Gear External Snap Ring

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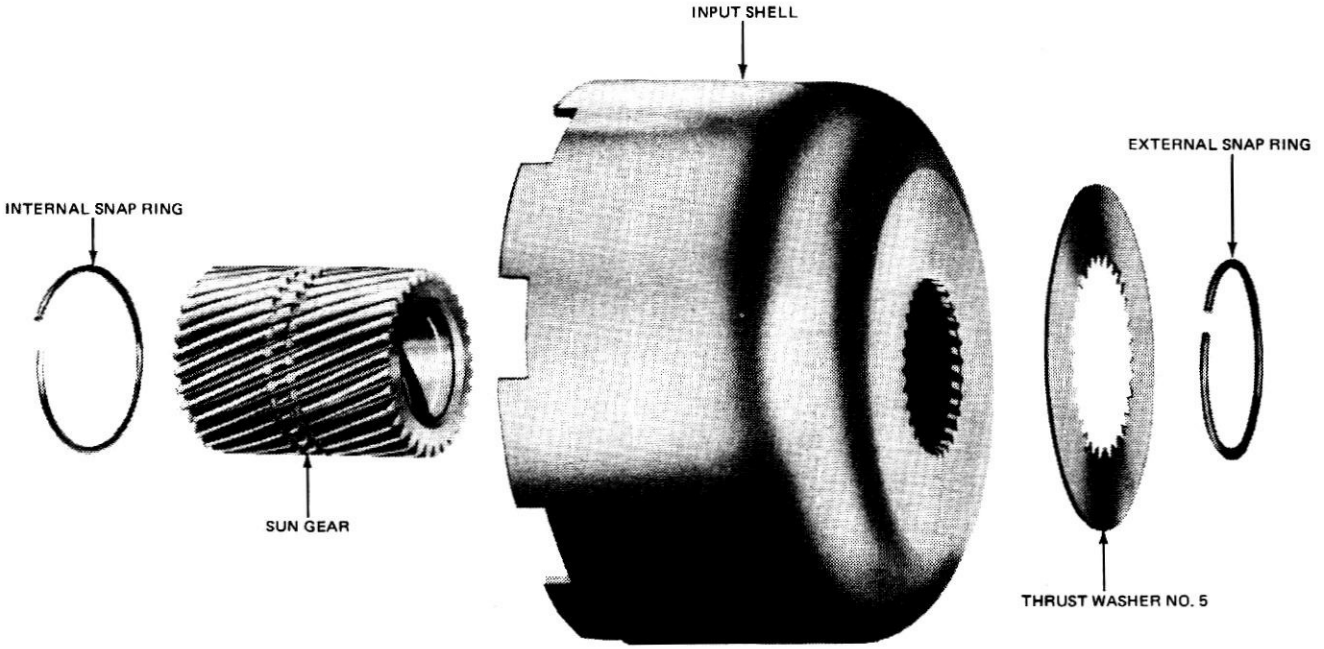


FIG. 82 Input Shell and Sun Gear Disassembled

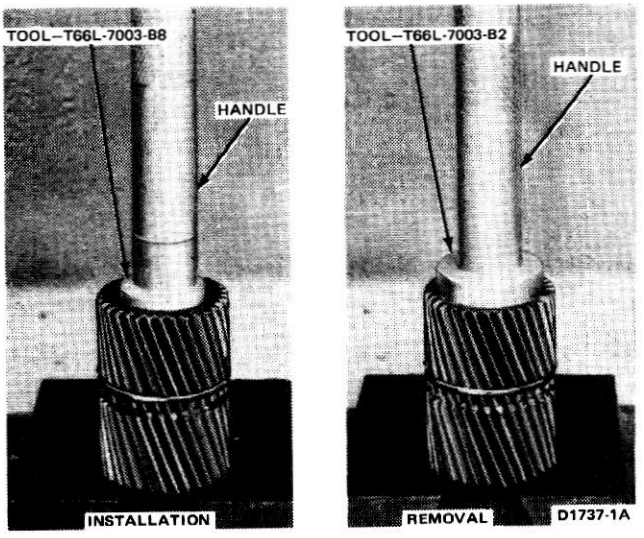


FIG. 83 Replacing Sun Gear Bushing

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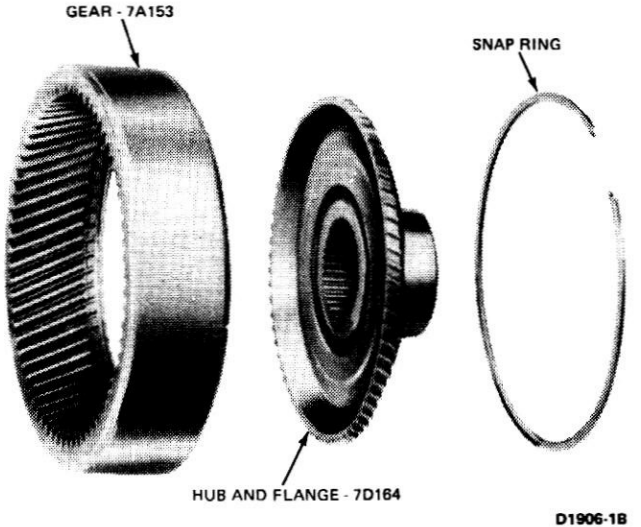


FIG. 84 Reverse Ring Gear and Hub Disassembled

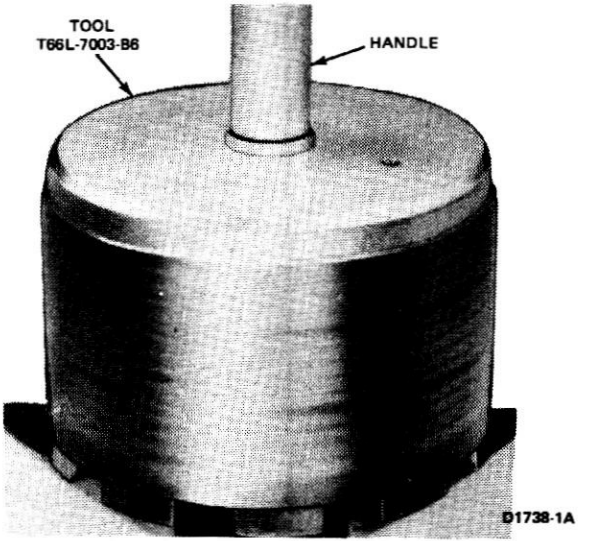


FIG. 85 Installing Low and Reverse Brake Drum Bushing

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DETROIT IRON

SPECIFICATIONS

APPROXIMATE REFILL CAPACITIES C4 TRANSMISSION

Vehicle	U.S. Measure	IMP. Measure
Fairmont/Zephyr 3.3L (200 CID) I-6	7¼ qt.	6 qt.
Granada/Monarch Fairmont/Zephyr 4.1L (250 CID) I-6	8¼ qt.	6¾ qt.
Granada/Monarch Fairmont/Zephyr LTD II/Cougar/ Thunderbird/Ford 5.0L (302 CID) V8 5.8L (351 CID) V8	10¼ qt.	8½ qt.
Mustang II/Pinto/Bobcat 2.3L I-4, 2.8L V6 – Mustang II 5.0L (302 CID) V8	7 qt.	5¾ qt.

SELECTIVE THRUST WASHERS C4 TRANSMISSION

THRUST WASHER NO. 1	
Nylon Thrust Washer W/ Tangs	Color of Washer
0.053-0.0575	Red
0.070-0.0745	Green
0.087-0.0915	Natural (White)

THRUST WASHER NO. 2	
No. Stamped on Washer	Metal Thrust Washer
2	0.056-0.058
3	0.073-0.075
Spacer	0.032-0.036 ①

① This is a selective spacer. The spacer must be installed next to the stator support to obtain correct end play.

CLUTCH PLATES–C4 TRANSMISSION

Model	Forward Clutch			Reverse Clutch		
	External Spline (Steel)	Internal Spline (Comp.)	Free Pack Clear (Inches)	External Spline (Steel)	Internal Spline (Comp.)	Free Pack Clear (Inches)
PEB	3	4	0.025-0.050	3	3	0.050-0.071
PEA, PEE, PEF	4	5		4	4	
PEJ	2	3		3	3	

CHECKS AND ADJUSTMENTS–C4 TRANSMISSION

Operation	Specification
Transmission End Play	0.008-0.042 inch (Selective Thrust Washers Available)
Turbine and Stator End Play	New or Rebuilt 0.023 max. Used 0.050 max.
Intermediate Band Adjustment	Remove and discard lock nut. Install new nut. Adjust screw to 10 ft. lbs. torque, then back off 1-3/4 turns. Hold screw and tighten lock nut to 40 ft-lb.
Low-Reverse Band Adjustment	Remove and discard lock nut. Adjust screw to 10 ft.-lbs. torque, then back off 3 turns. Install new lock nut and torque to 40 ft.-lb.
Selective Snap Ring Thickness	0.050-0.054, 0.064-0.068, 0.078-0.082, 0.092-0.096

SPECIAL TOOLS–C4 TRANSMISSION

Ford Tool No.	Description
T50T-100-A	Impact Slide Hammer
T57L-500-B	Bench Mounted Holding Fixture
Tool-1175-AC	Grease Seal Remover (Head Only)
T50T-100-A and Tool-1175-AC	Seal Remover
Tool-4201-C	Dial Indicator and Bracket
Tool-7000-DD	Air Nozzle Rubber Tip Assembly
T66L-7003-B	Automatic Transmission Bushing Kit Remover and Replacer
T70P-7D043-A	Stator Support Bushing Installer
T64P-7B456-A and T65P-7B456-B	Clutch Race to Case Bolt Socket
T58L-101-A and T59L-100B	Seal Remover (Head and Hammer)
T61L-7657-A	Transmission Extension Housing Oil Seal Replacer

Ford Tool No.	Description
T52L-7000-GAE	Transmission Extension Housing Bushing Remover
T52L-7000-HAE	Transmission Extension Housing Bushing Replacer
T71P-77370-B	Band Adjustment Socket 1/2" Long
T71P-77370-C	Band Adjustment Socket 1" Long
T71P-77370-D	Band Adjustment Socket 2" Long
T71P-77370-H	Band Adjustment Torque Wrench
T65L-77515-A	Rear Clutch Spring Compressor
T63L-77837-A	Front Pump Seal Replacer
T73P-77060-A	Wire Snap Ring Remover
T78P-77548-A	Installer – Forward Clutch Piston Lip Seal

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TORQUE LIMITS C4 TRANSMISSION

Item	In-Lbs
End Plates To Body	25-40
Separator Plate To Lower Body	40-55
Lower To Upper Body	40-60
Screen To Upper Body	40-60
Governor To Oil Collector	80-120
Pump Assembly To Case	20-35
Main Control To Case	80-120
Neutral Switch To Case	55-75
Upper Body To Lower Body	80-120
5/16" Fitting – Cooler Line To Transmission Case	80-120
Item	**Ft-Lbs**
Overrunning Clutch Race To Case	13-20
Oil Pan To Case	12-16
Stator Support To Pump	12-20
Converter Housing Cover To Converter Housing	12-16

Item	Ft-Lbs
Rear Servo Cover To Case	12-20
Intermediate Servo Cover To Case	16-22
Oil Distributor Sleeve To Case	12-20
Extension Housing To Case	28-40
Front Pump To Case	28-38
Engine To Transmission (Pinto, Mustang Only)	28-38
Transmission To Engine (Passenger Cars)	40-50
Engine Separator Plate To Converter Housing	5-9
Downshift Lever To Shaft	12-16
Flywheel To Converter	20-30
Band Adjusting Screws To Case	35-45
Manual Valve Inner Lever To Shaft	30-40
Pipe Plug – Case Front Pump Or Line Pressure	6-12
5/16" Tube Nut – Cooler Line To Transmission Case	*12-18*
Filler Tube To Oil Pan	32-42

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DETROIT IRON

JATCO Automatic Transmission

PART 17-06

Applies To Granada/Monarch

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DESCRIPTION

Fig. 1 shows the location of the converter, oil pump, clutches, gear train and most of the internal parts used in the JATCO automatic transmission.

The JATCO automatic transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios and also capable of providing manual selection of first and second gears.

The transmission consists essentially of a torque converter, planetary gear train, three multiple disc clutches, a one-way clutch, one band and a hydraulic control system (Fig. 3).

MODEL IDENTIFICATION

The JATCO automatic transmission has a service identification tag (Fig. 2) to identify assemblies for service purposes. The tag is attached to the left side of the transmission case above the manual control lever. The JATCO transmission is identified by the code letter "S" on the Vehicle Certification Label.

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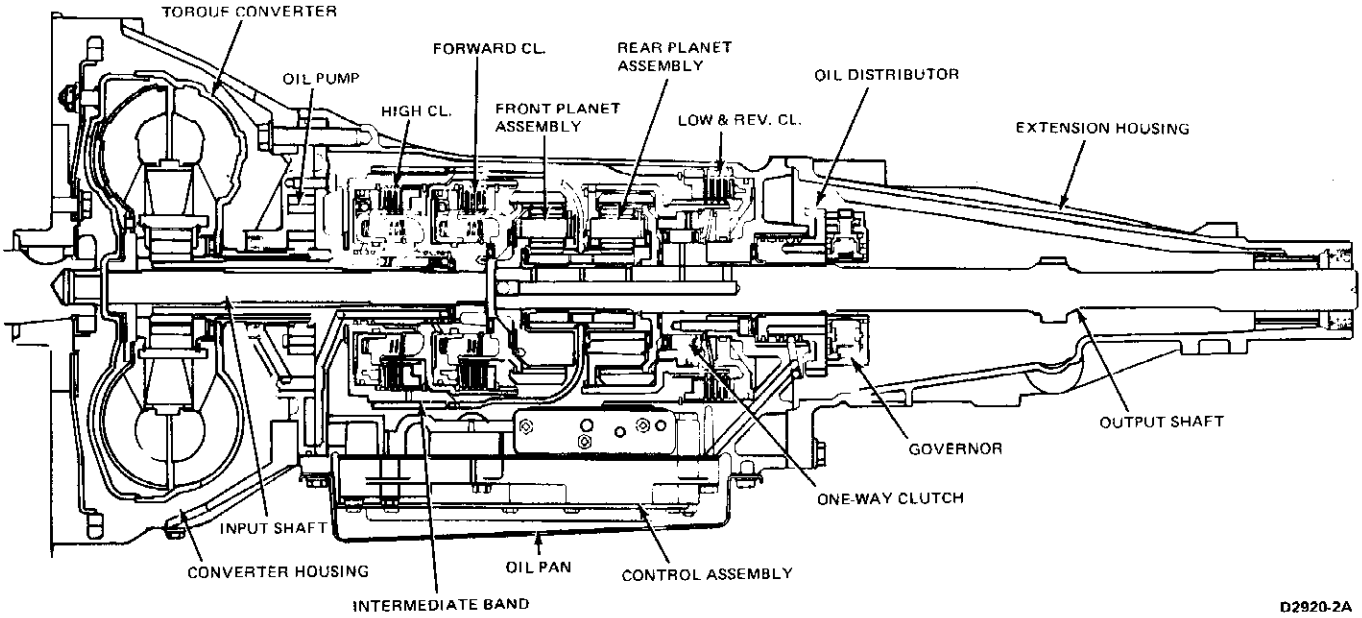


FIG. 1 Sectional View—JATCO Automatic Transmission

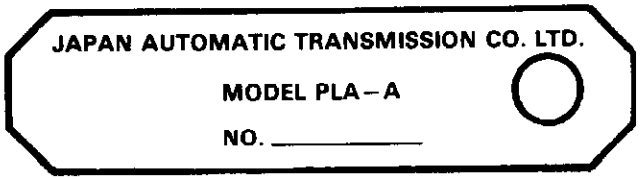
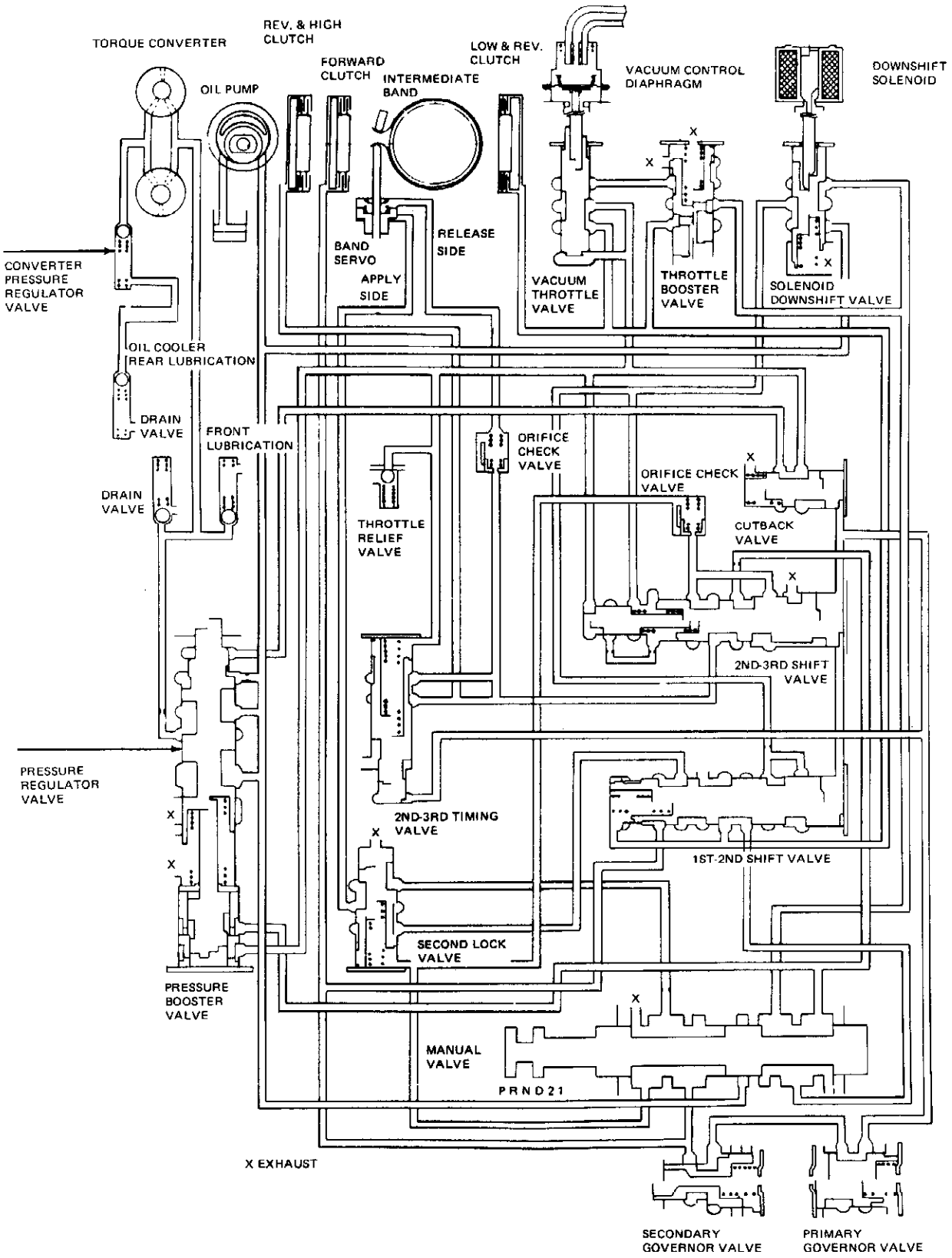


FIG. 2 Service Identification Tag—JATCO Transmission

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FIG. 3 Hydraulic Control System

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ADJUSTMENTS

INTERMEDIATE BAND

1. Raise the vehicle on hoist or jack stands.
2. Loosen the servo cover attaching bolts and remove cover.
3. Loosen the intermediate band adjusting screw lock nut and tighten the adjusting screw to 10 ft-lb torque (Fig. 4).

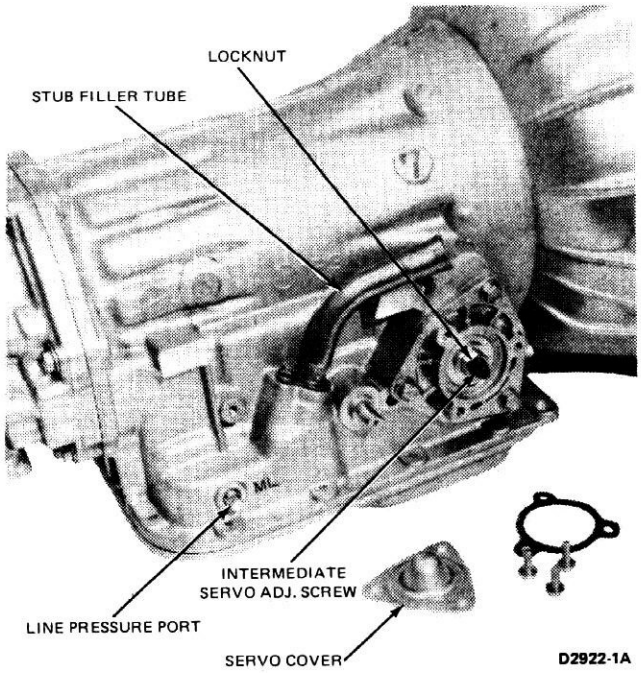


FIG. 4 Adjusting Intermediate Band

4. Back off the adjusting screw two turns. Hold the adjusting screw stationary and tighten the adjusting screw lock nut to 22-29 ft-lb torque.
5. Place a new gasket on the servo cover and install the cover on the transmission and torque bolts to specification.
6. Lower the vehicle and check the transmission fluid level.

REMOVAL AND INSTALLATION

TRANSMISSION

Removal

1. Disconnect the negative battery cable from the terminal.
2. Raise the vehicle on a hoist or jack stands.
3. Place a drain pan under the transmission. Starting at the rear of the transmission oil pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front to allow the fluid to further drain. After the fluid has drained, install two bolts on the rear side of the pan to temporarily hold it in place.
4. Disconnect the drive shaft at the rear axle.
5. Lower the drive shaft assembly and withdraw it from the transmission.
6. Disconnect the speedometer cable from the extension housing.
7. Disconnect the shift cable from the manual lever at the transmission.
8. Remove the vacuum hose from the vacuum diaphragm. Disconnect the wire connections of the downshift solenoid and remove the wire from the clip.
9. Disconnect the oil cooler lines at the transmission.
10. Remove the access cover from the lower end of the converter to the flywheel.
11. Remove the four nuts that attach the torque converter to the flywheel.
12. Remove the transmission rear support to crossmember nuts.
13. Support the transmission with a transmission jack, then remove the crossmember-to-frame attaching bolts and remove the crossmember.
14. Secure the transmission to the jack with safety chain.
15. Lower the transmission enough to remove the starter motor. Then, remove the converter housing-to-engine attaching bolts. Remove the transmission fluid filler tube.
16. With a pry bar, exert pressure between the flex plate and converter to prevent the converter from disengaging from the transmission as the assembly is moved.
17. Lower the transmission and converter as an assembly and remove it from under the vehicle.

Installation

1. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with safety chain.
2. Raise the transmission into position and install the converter housing-to-engine attaching bolts. Torque the bolts to specification.
3. Lower the transmission and install the starter motor.
4. Install the fluid filler tube and O-ring in the transmission case and secure it to the cylinder block with the attaching bolt.
5. Remove the safety chain from around the transmission.
6. Raise the transmission. Position the crossmember to the frame and install the attaching bolts.
7. Lower the transmission and install the rear support to crossmember nuts.
8. Install the four converter-to-flywheel attaching nuts and torque to specification.
9. Install the converter housing access cover.
10. Remove the transmission jack.
11. Connect the oil cooler lines to the transmission.
12. Install the wire from the downshift solenoid. Connect the vacuum hose to the vacuum diaphragm.
13. Connect the shift cable to the manual lever on the transmission.

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14. Connect the speedometer cable to the extension housing.
15. Position the drive shaft to the rear axle. Secure it with the attaching nuts.
16. Lower the vehicle and connect the battery. Pour in five quarts of fluid then run the engine and add fluid as required. Raise vehicle and check transmission for fluid leakage.

CONTROL VALVE BODY

Removal

1. Raise the vehicle so the transmission oil pan is accessible.
2. Drain the transmission fluid by loosening the pan attaching bolts and allowing the fluid to drain.
3. Remove the transmission pan attaching bolts, pan and gasket.
4. Remove the downshift solenoid, vacuum diaphragm, vacuum diaphragm rod and O-rings.
5. Remove the valve body-to-case attaching bolts. Hold the manual valve to keep it from sliding out of the valve body and remove the valve body from the case. Failure to hold the manual valve while removing the control assembly, could cause the manual valve to become bent or damaged.
6. Refer to the Disassembly and Assembly section of this Part for control valve body repair operations.

Installation

1. Thoroughly clean and remove all gasket material from the pan and pan mounting face of the case.
2. Position the valve body to the case and install the attaching bolts. Torque the bolts to specification.
3. Using a new pan gasket, secure the pan to the transmission case and torque the attaching bolts to specifications.
4. Lower the vehicle and fill the transmission to the correct level with the specified fluid.

SERVO

Removal

1. Raise the vehicle.
2. Drain the transmission fluid by loosening the pan attaching bolts and allowing the fluid to drain.
3. Remove the transmission pan attaching bolts, pan and gasket.
4. Remove control valve body from the transmission assembly.
5. Remove bolts attaching the servo cover to the retainer and remove the cover.
6. Remove the three bolts securing the servo retainer to the transmission case and remove the retainer and servo piston as an assembly. Remove the return spring from the case.
7. Through the bottom of the case remove the intermediate band, apply strut.

Installation

1. Install the piston return spring in the case.
2. Install intermediate band, apply strut in band end.
3. Install the piston and servo retainer into the transmission case and align piston rod with the band strut. While holding the retainer in place, install the three attaching bolts. Torque the bolts to specification.
4. Adjust the band as follows:

   Tighten adjusting screw to 10 ft-lb torque, then back off two turns. Hold adjusting screw stationary and tighten locknut to 22-29 ft-lb.
5. Install control valve body assembly and torque to specification.
6. Using a new pan gasket, secure the pan to the transmission case and torque the attaching bolts to specification.
7. Using a new servo cover gasket, secure servo cover to the retainer and torque attaching bolts to specification.
8. Lower the vehicle and fill the transmission to the correct level with the specified fluid.

EXTENSION HOUSING REAR SEAL

Removal

1. Raise the vehicle and disconnect the drive shaft.
2. With a sharp chisel, remove the seal from the extension housing.

Installation

1. Using a Tool (T61L-7657-A), install a new seal in the extension housing.
2. Connect the drive shaft and lower the vehicle, check fluid level and add fluid as required.

EXTENSION HOUSING

Removal

1. Raise the vehicle on a hoist or jack stands.
2. Disconnect the drive shaft at the rear axle.
3. Lower the drive shaft assembly and withdraw it from the transmission.
4. Disconnect the speedometer cable from the extension housing.
5. Remove the transmission rear support to crossmember bolts and nuts.
6. Place a jack under the transmission and raise it just enough to remove the rear support from the transmission.
7. Loosen the extension housing attaching bolts to drain the transmission fluid.
8. Remove the eight extension housing-to-case attaching bolts and remove the extension housing.

Installation

1. Clean the mounting surface on the transmission and on the extension housing. Position a new gasket on the transmission.
2. Position the extension housing to the case and install the attaching bolts. Torque the bolts to specification.
3. Lower the transmission and install the rear support to the extension crossmember install bolts and nuts. Remove the transmission jack.
4. Connect the speedometer cable to the extension housing.
5. Insert the drive shaft into the transmission extension housing.

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6. Position the drive shaft to the rear axle and secure it with the attaching nuts.
7. Lower the vehicle and fill the transmission to the proper level with the specified fluids.
8. Check the extension housing area for fluid leakage.

GOVERNOR

Removal

1. Remove the extension housing as outlined in this section.
2. Remove the four governor housing to oil distributor attaching bolts. Remove the governor housing from the distributor.
3. Refer to Disassembly and Assembly Section of this Part for governor repair operations.

Installation

1. Install the governor housing on the oil distributor. Install the attaching bolts and torque the bolts to specifications.
2. Reinstall the extension housing.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts during the repair operation.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmissions must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission before assembly with clean automatic transmission fluid. Do not use any other lubricants except on gaskets and thrust washers which may be coated with petroleum jelly to facilitate assembly. Always install new gaskets when assembling the transmission.

Tighten all bolts and screws to the recommended torque as outlined in the Specification Section.

Disassembly

1. Mount the transmission in holding fixture T57L-500-B using Metric mounting Adapters, T77J-77001-A (Fig. 5).
2. Remove the converter from the transmission front pump and converter housing.
3. Remove the converter housing attaching bolts and remove the converter housing.
4. Remove the transmission pan attaching bolts, pan and gasket.
5. Unscrew the downshift solenoid (Fig. 6) and vacuum diaphragm unit and remove the vacuum diaphragm rod from the case.
6. Remove the control valve body attaching bolts (Fig. 7). Remove the control valve body from the case.
7. Loosen the intermediate band adjusting screw lock nut and tighten the adjusting screw to prevent the reverse and high clutch drum from falling when the oil pump is removed.
8. Remove the input shaft from the front pump.
9. Remove the oil pump (Fig. 8) using Tools T73J-77103 and Slide Hammers T59L-100-B.
10. Loosen the intermediate band adjusting screw and remove the band strut.
11. Remove the band and forward part of the gear train as an assembly (Fig. 9).
12. Remove the large snap ring that secures the rear planet carrier to the connecting drum. Remove the planet carrier from the drum.
13. Remove the output shaft snap ring (Fig. 10) and remove the internal drive flange.
14. Turn the connecting drum counterclockwise as far as it will go. Then, turn the connecting drum clockwise and remove the drum and one-way clutch from the case as an assembly.
15. Remove the eight extension housing-to-case attaching bolts. Remove the extension housing and gasket from the case.
16. Slide the output shaft assembly from the transmission case.
17. Remove the governor and oil distributor from the case.
18. Remove the oil distributor needle bearing and race from inside the transmission case.
19. Remove the retaining ring from the park rod actuating lever. Then remove the lever and park pawl actuating rod.
20. Remove the manual shaft attaching nut and remove the manual plate and spacer. Remove the manual shaft from the case.
21. Remove the snap ring securing the low and reverse clutch assembly to the case. Then remove the retaining plate, steel and friction plates and dished plate from the case (Fig. 11).
22. Remove the eight one-way clutch inner race attaching bolts and washers from the rear of the case. Remove the inner race, snap ring, piston return spring and support ring from inside the case (Fig. 10).

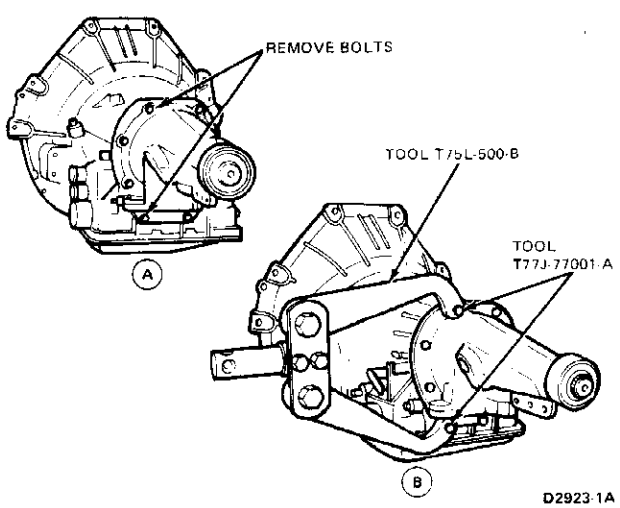


FIG. 5 Mounting Transmission in Holding Fixture

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23. Remove the low and reverse clutch piston from the case as shown in Fig. 11.

TRANSMISSION

Assembly

When assembling the transmission sub-assemblies (Fig. 13), make sure that the correct thrust washer or needle bearing is used between certain sub assemblies (Fig. 14). Lubricate surfaces with transmission fluid. Petroleum jelly should be used to hold the thrust washers and needle bearings, in their proper location. If the end play is not within specifications after the transmission is assembled, either the wrong selective thrust washers and races were used, or a thrust washer or needle bearing came out of position during the transmission assembly operation.

1. Install reverse clutch inner and outer piston seals on piston. Lubricate the low and reverse clutch piston and seals with transmission fluid and install into the transmission case.
2. Install the low and reverse clutch support ring, piston return spring, snap ring and one-way clutch inner race in the case.
3. Hold the one-way clutch inner race in position and install and torque the attaching bolts and washers to specification (Fig. 15).

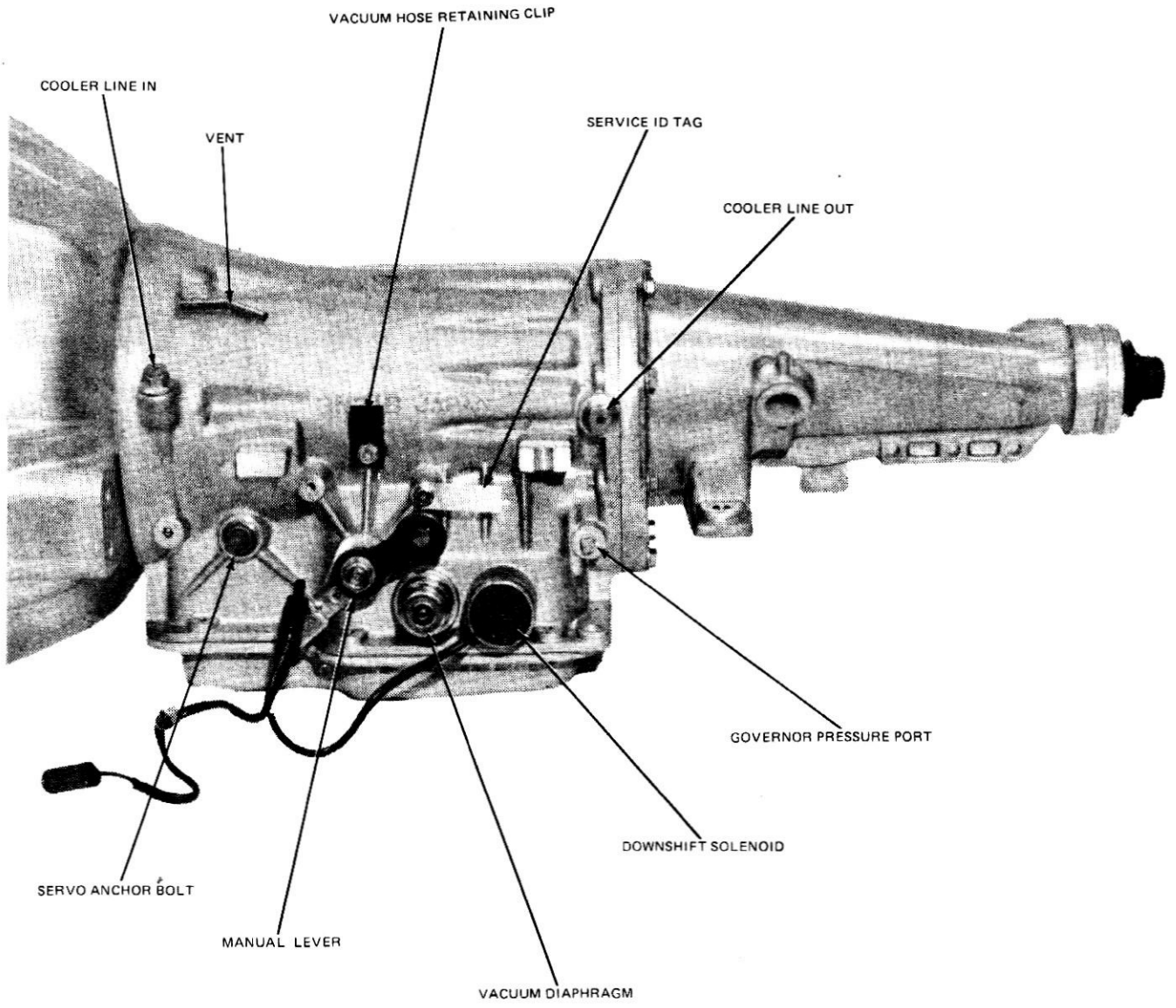


FIG. 6 L.H. Exterior View—JATCO Transmission

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4. Position the low and reverse clutch dished plate in the case. Dip the steel and friction plates in clean transmission fluid and install the plates alternately starting with a steel plate (Fig. 11).
5. After all the plates have been installed, position the retaining plate in the case. Install the pressure plate snap ring.
6. With a feeler gauge, check the clearance between the pressure plate and snap ring (Fig. 16). The clearance should be 0.032-0.041 inch. If the clearance is not within the specified range, selective pressure plates are available in the following thicknesses: 0.307, 0.315, 0.323, 0.331, 0.339 and 0.346 inch. Insert the correct pressure plate and recheck the clearance.
7. While applying pressure, rotate the connecting drum clockwise to mesh the low and reverse clutch plates with the splines of the drum.
8. Install the oil distributor needle bearing and race in the case. Then install the governor and oil distributor in the case taking care not to damage the seal rings.
9. Install the output shaft.
10. Position the needle bearings on the front and rear sides of the internal drive flange. Retain the bearings with petroleum jelly. Install the flange on the output shaft. Install the snap ring (Fig. 10).
11. Position the needle bearing race on the rear side of the rear planet carrier and the needle bearing on the front side of the carrier; retain with petroleum jelly. Insert the assembly into the internal drive flange and install the snap ring.
12. Install the manual shaft in the case. Install the manual plate, spacer and attaching nut. Torque the nut to specification.
13. Install the park actuating lever and rod into the case and secure with the retaining ring.
14. Install the servo return spring, piston and servo retainer into the case. While holding the retainer in place, install the three attaching bolts. Torque the bolts to specification.
15. Place a new gasket on the rear of the transmission case. Position the extension housing on the case and install the attaching bolts. Torque the bolts to specification.
16. Position the needle bearing on the rear end of the forward clutch hub and the bearing race on the front end of the front planet carrier. Assemble the forward clutch hub and planet carrier and install the assembly into the input shell and sun gear drum.
17. Set the input shell and sun gear assembly on a bench with the forward clutch hub facing upward (Fig. 15). Position the needle bearing on the front end of the forward clutch hub. Install the needle bearing race. Install the forward clutch assembly on the forward clutch hub by rotating the units to mesh the forward clutch plates with the splines of the forward clutch hub (Fig. 17).
18. Install the reverse and high clutch assembly on the forward clutch assembly by rotating the units to mesh the reverse and high clutch plates with the splines of the forward clutch (Fig. 18).
19. Install the reverse and high clutch, forward clutch front planet carrier and input shell and sun gear as an assembly into the transmission case (Fig. 9).
20. Insert the intermediate band into the case around the reverse and high clutch drum. Install the strut and tighten the band adjusting screw sufficiently to retain the band.
21. Place a selective thickness thrust washer and bearing race on the rear end of the oil pump cover and retain them with petroleum jelly.
22. Position the oil pump in the transmission case.
23. Place the converter housing on the case and install the six converter housing-to-case attaching bolts using Motorcraft Sealing Compound or equivalent beneath the bolt heads. Torque the bolts to specification.
24. Install the input shaft.
25. To check the oil pump cover-to-front clutch drum end play, use a feeler gauge and check the clearance between the front clutch drum and input shell and sun gear assembly. The end play should be 0.020-0.032 inch. If the end play is not within the specified range, selective thrust washers are available in the following thicknesses: 0.059, 0.067, 0.075, 0.083, 0.091, 0.098 and 0.106 inch. Insert the correct thrust washer and recheck the end play.
26. Using the tools shown in Fig. 19, check the transmission total end play.
27. With the dial indicator contacting the end of the input shaft, set the indicator at zero.
28. Insert a screwdriver behind the input shell (Fig. 17). Move the input shell and the front part of the gear train forward.
29. Record the dial indicator reading. The end play should be 0.010-0.020 inch. If the end play is not within the specified range, selective races are available in the following thicknesses: 0.047, 0.055, 0.063, 0.071, 0.079 and 0.087 inch (see Fig. 14). Insert the correct race and recheck the end play.
30. Adjust the band. Refer to the Adjustment Section of this part for the band adjustment procedures and install servo cover.
31. Install the control valve assembly (Fig. 7). Refer to *the Removal and Installation* Section of this Part for the control valve assembly installation procedures.
32. Install the vacuum diaphragm rod into the transmission case. If the valve body, transmission case or vacuum diaphragm unit was replaced, a new length vacuum throttle valve rod may be required. With the throttle valve fully depressed, measure the depth of the throttle valve bore as shown in Fig. 20. This dimension will determine which selective throttle valve rod to use. The rod length for the various depths is given below:

Depth of 1.071 inch, use the 1.140 inch rod.
Depth of 1.075-1.091 inch, use the 1.160 inch rod.
Depth of 1.095-1.110 inch, use the 1.180 inch rod.
Depth of 1.114-1.130 inch, use the 1.200 inch rod.
Depth of 1.134 inch, use the 1.220 inch rod.

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33. Install the new O-ring on the vacuum unit and install the vacuum unit in the case hand tight.
34. Install the downshift solenoid in the case hand tight (Fig. 6).
35. Using a new pan gasket, secure the pan to the transmission case and torque the attaching bolts to specifications.

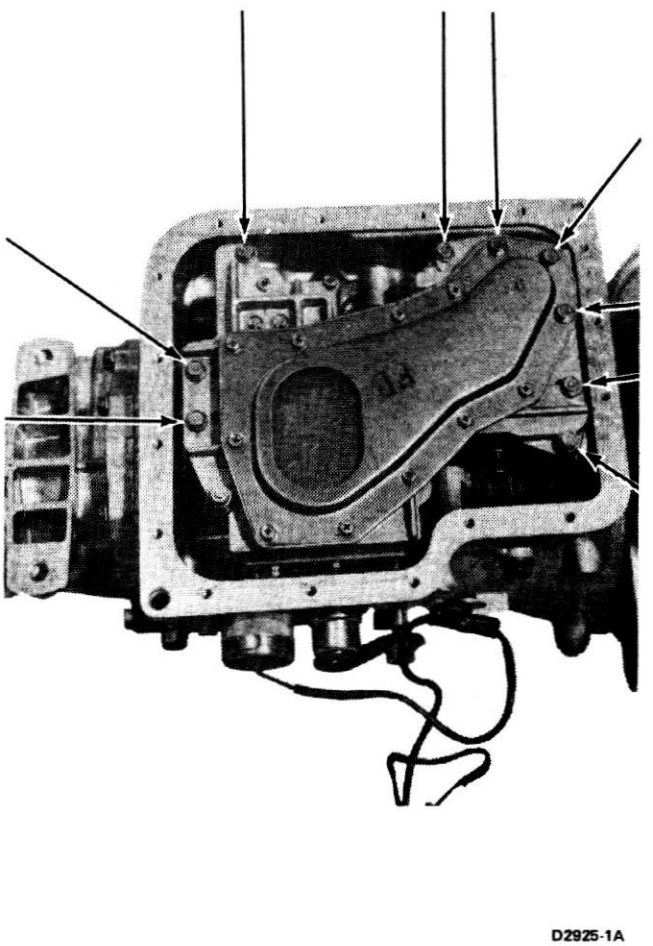
CONTROL VALVE BODY ASSEMBLY

Disassembly

1. Remove the oil screen—to control valve attaching bolts and remove the screen (Fig. 21).
2. Remove the attaching bolts from the upper and lower valve bodies. Separate the lower valve body and separator plate from the upper valve body. Be careful not to lose the lower valve body check valves and springs (Fig. 22) when separating the upper and lower valve bodies.
3. Slide the manual valve out of the valve body (Fig. 21).
4. Remove the 1-2 shift valve and 2-3 shift valve cover plate from the body.
5. Remove the 1-2 shift valve and spring from the body.
6. Remove the 2-3 shift valve, spring, and plug from the body.
7. Remove the throttle modulator valve and spring from the body.
8. Remove the downshift valve cover plate from the body.
9. Remove the downshift valve and spring from the body.
10. Remove the throttle back-up valve spring and valve from the body.
11. Remove the throttle valve from the body.
12. Remove the 2-3 timing valve spring and valve from the body.
13. Remove the pressure regulator valve cover plate from the body.
14. Remove the pressure regulator valve sleeve, plug, spring seat, spring and pressure regulator valve.
15. Remove the second lock valve and spring from the body.

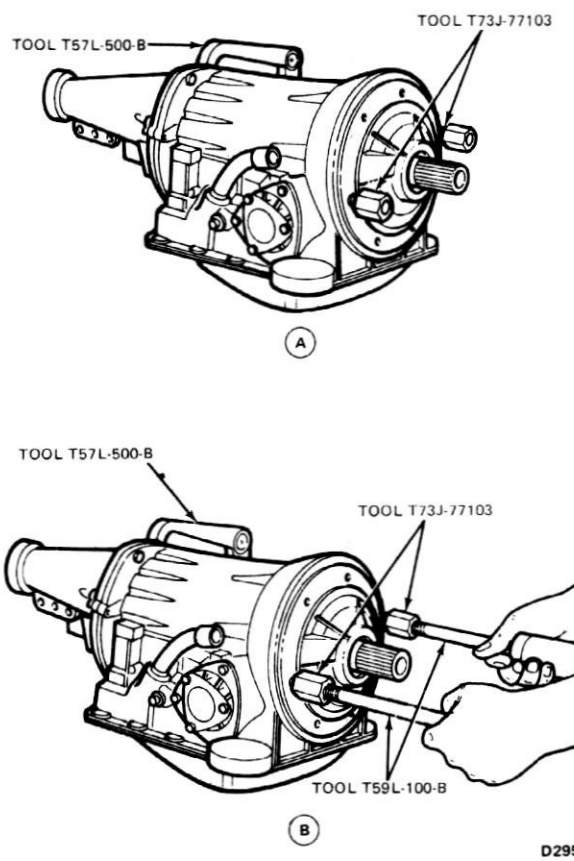
Assembly

1. Place the second lock valve and spring in the body (Fig. 21).
2. Place the pressure regulator valve, spring, spring seat, plug and sleeve in the body.
3. Secure the pressure regulator valve cover plate to the body with the three attaching bolts. Tighten the bolts to 2-3 ft-lbs torque.
4. Place the 2-3 timing valve and spring in the body.



D2925-1A

FIG. 7 Location of Valve Body Attaching Bolts



D2951-1A

FIG. 8 Removing Oil Pump

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5. Place the throttle valve in the body.
6. Place the throttle back-up valve and spring in the body.
7. Place the downshift valve spring and valve in the body.
8. Secure the downshift valve cover plate to the body with the three attaching bolts. Tighten the bolts to 2-3 ft-lbs torque.
9. Place the throttle modulator valve spring and valve in the valve body.
10. Place the 2-3 shift plug, spring and 2-3 shift valve in the body.
11. Place the 1-2 shift valve spring and valve in the valve body.
12. Secure the 1-2 shift valve and 2-3 shift valve cover plate with the three attaching bolts. Tighten the bolts to 2-3 ft-lbs torque.
13. Place the check valve and springs in the upper body (Fig. 22).
14. Position the separator plate on the lower body and place the lower body and plate assembly on the upper valve body. Install and tighten the attaching bolts to 2-3 ft-lbs torque.
15. Position the oil screen to the valve body and install the attaching bolts. Tighten the bolts to 2-3 ft-lbs torque.
16. Slide the manual valve into the valve body (Fig. 21).

SERVO

Disassembly

1. Apply air pressure to the port in the servo retainer to remove the piston (Fig. 23).
2. Remove the seals from the retainer (Fig. 24).
3. Remove the seal from the piston.

Assembly

1. Dip the new seals in transmission fluid.
2. Install new seals on the servo retainer and piston (Fig. 24).
3. Dip the piston in transmission fluid and install it in the retainer.

GOVERNOR

Disassembly

1. Remove the governor housing-to-distributor attaching bolts. Remove the governor from the oil distributor (Fig. 25).
2. Remove the secondary governor valve retainer plate and remove the secondary valve and spring from the housing.
3. Remove the primary governor valve retainer plate and remove the primary spring and valve from the housing.

Assembly

1. Install the primary governor valve and spring in the housing and install the retainer plate (Fig. 25).
2. Install the secondary governor valve spring and valve in the housing and install the retainer plate.
3. Install the governor assembly on the oil distributor and torque the attaching bolts to specification.

OIL PUMP

Disassembly

1. Remove the four seal rings from the stator support (Fig. 26).
2. Remove the large seal ring from the OD of the pump housing.
3. Remove the five bolts that attach the pump cover to the pump housing. Remove the pump cover from the housing.
4. Mark the front face of the pump inner and outer gears with prussian blue or a felt-tip marking pen to assure correct assembly. DO NOT SCRATCH THE GEARS. Remove the inner and outer gears from the pump housing (Fig. 26).

Assembly

1. Install the inner and outer gears in the pump housing. Align the mating marks made during disassembly.
2. Lubricate the gears with clean automatic transmission fluid. Install the pump housing on the oil pump aligning Tool T73J-77108 (Fig. 27). Position the pump cover and gasket to the pump housing and install the five attaching bolts. Torque the bolts to specification and remove the oil pump assembly from the aligning tool.
3. Carefully install four new seal rings on the stator support. Install a new seal ring on the OD of the pump housing (Fig. 26).
4. If the front pump seal must be replaced, use a suitable tool and remove it from the housing. Install a new seal using Tool T73J-77248 (Fig. 28).

REVERSE AND HIGH CLUTCH

Disassembly

1. Remove the clutch pressure plate snap ring (Fig. 29).
2. Remove the pressure plate, friction plates and steel plates and dished plate from the clutch hub (Fig. 29).
3. Install a T65L-77515-A spring compressor tool and remove the coil spring retainer snap ring. Remove the tool, the coil spring retainer and 10 coil springs.
4. Apply air pressure to the clutch piston pressure hole in the clutch hub (Fig. 30) and remove the piston.
5. Remove the piston outer seal from the piston and the inner seal from the clutch drum (Fig. 29).

Assembly

1. Dip new seals in transmission fluid and install one on the drum and one on the piston.
2. Lubricate the piston and install the clutch piston into the clutch hub. Position the 10 coil springs in the *piston and spring retainer on the springs. Install the* clutch spring compressor tool and compress the springs. Install the snap ring and remove the tool.
3. Dip the clutch plates in clean transmission fluid. Install the dished plate. Install the clutch plates alternately, starting with a steel plate.
4. After all clutch plates have been installed, position the pressure plate in the clutch drum. Install the pressure plate snap ring.

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5. With a feeler gauge, check the clearance between the pressure plate and snap ring (Fig. 31). The clearance should be 0.062-0.071 inch. If the clearance is not within specification, selective pressure plates are available in the following thicknesses: 0.283, 0.291, 0.299, 0.307, 0.315 and 0.323 inch. Install the correct size pressure plate and recheck the clearance.

FORWARD CLUTCH

Disassembly

1. Remove the clutch pressure plate snap ring (Fig. 31).
2. Remove the pressure plate, friction plates and steel plates and dished plate from the clutch hub (Fig. 33).
3. Install spring compressor Tool T65L-77515A and remove the coil spring retainer snap ring. Remove the tool, the coil spring retainer and 10 coil springs.
4. *Apply air pressure to the clutch piston pressure hole* in the clutch hub (Fig. 33) and remove the piston.
5. Remove the piston outer seal from the piston and the inner seal from the clutch drum (Fig. 32).

Assembly

1. Dip the new seals in transmission fluid and install one on the drum and one on the piston.
2. Lubricate the piston and install the clutch piston into the clutch hub. Position the 10 coil springs in the piston and the spring retainer on the springs. Install the clutch spring compressor tool and compress the springs. Install the snap ring and remove the tool.
3. Dip the clutch plates in clean transmission fluid, install the dished plate. Install the clutch plates alternately starting with a steel plate.
4. After all clutch plates have been installed, position the pressure plate in the clutch drum. Install the pressure plate snap ring.

INPUT SHELL AND SUN GEAR

Disassembly

1. Remove the external snap ring from the sun gear (Fig. 34).
2. Remove the thrust washer from the input shell and sun gear.
3. From inside the input shell, remove the sun gear. Remove the internal snap ring from the sun gear.

Assembly

1. Install the internal snap ring on the sun gear (Fig. 34). Install the sun gear in the input shell.
2. Install the thrust washer on the sun gear and input shell.
3. Install the external snap ring on the sun gear.

REVERSE RING GEAR AND HUB

Disassembly

1. Remove the hub retaining snap ring (Fig. 35) from the ring gear.
2. Lift the hub from the ring gear.

Assembly

1. Position the hub in the ring gear.
2. Secure the hub with the snap ring (Fig. 35). Make sure that the snap ring is fully engaged in the groove.

ONE-WAY CLUTCH

Disassembly

1. Remove the snap ring from each end of the one-way clutch and remove the clutch (Fig. 36).
2. Remove the snap ring securing the outer race to the connecting drum and remove the race.

Assembly

1. Position the outer race in the connecting drum (Fig. 36).
2. Secure the outer race with the snap ring. Make sure the snap ring is fully seated in the groove.
3. Install a snap ring in the forward snap ring groove *of the connecting drum.*
4. Install the one-way clutch on top of the snap ring. **BE SURE THE ARROW STAMPED ON THE ONE-WAY CLUTCH IS POINTED TOWARD THE FRONT OF THE TRANSMISSION.**
5. Install the remaining snap ring at the rear of one-way clutch to secure the assembly.

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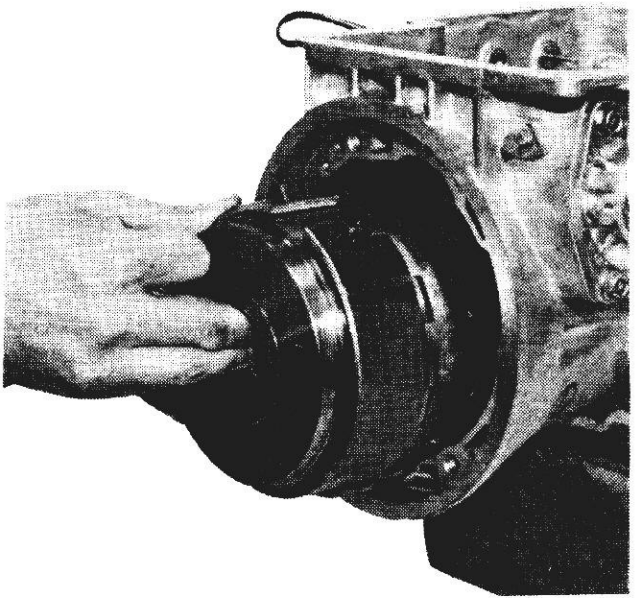


FIG. 9 Removing or Installing Forward Part of Gear Train

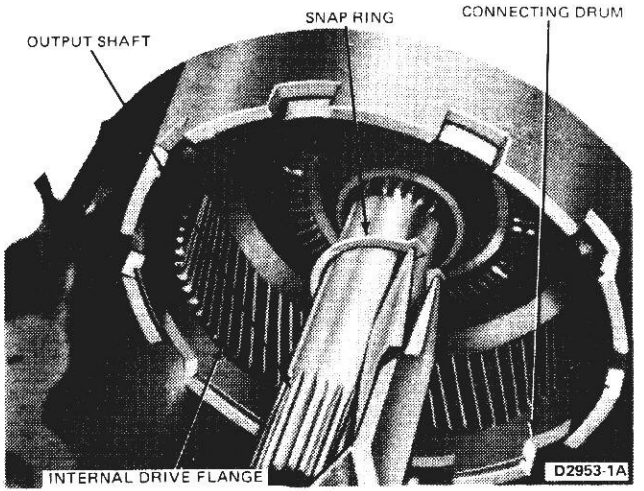


FIG. 10 Removing Internal Drive Flange

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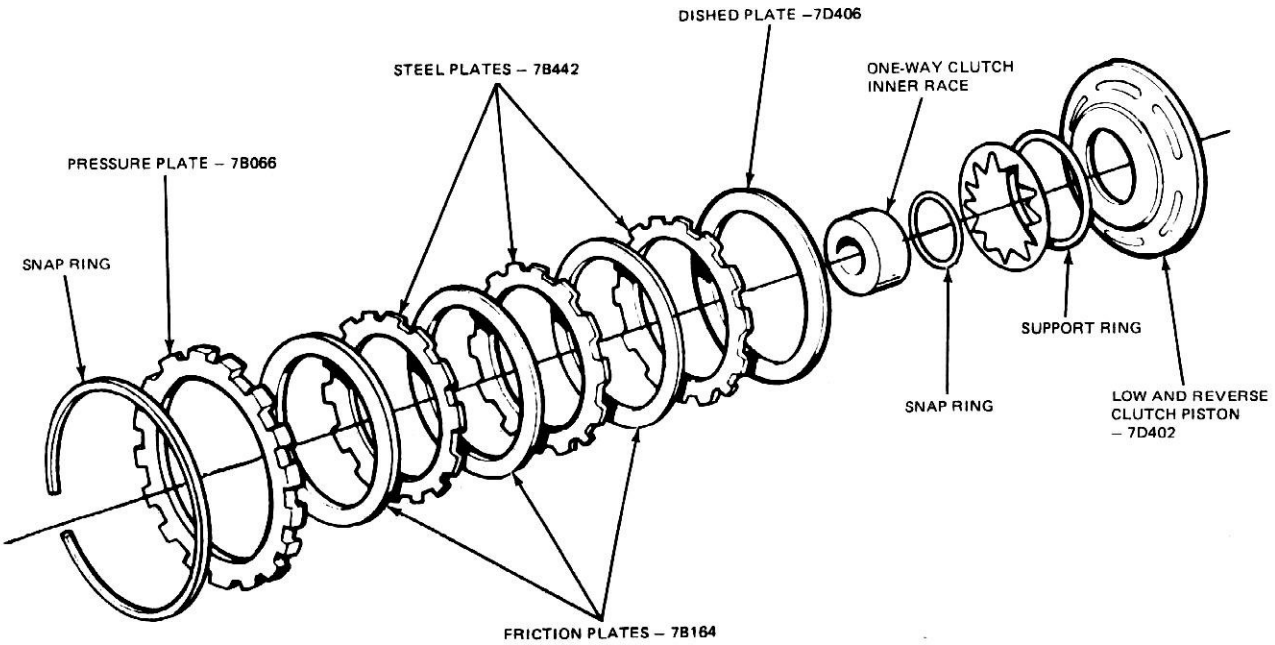


FIG. 11 Low and Reverse Clutch and One-Way Clutch Exploded View

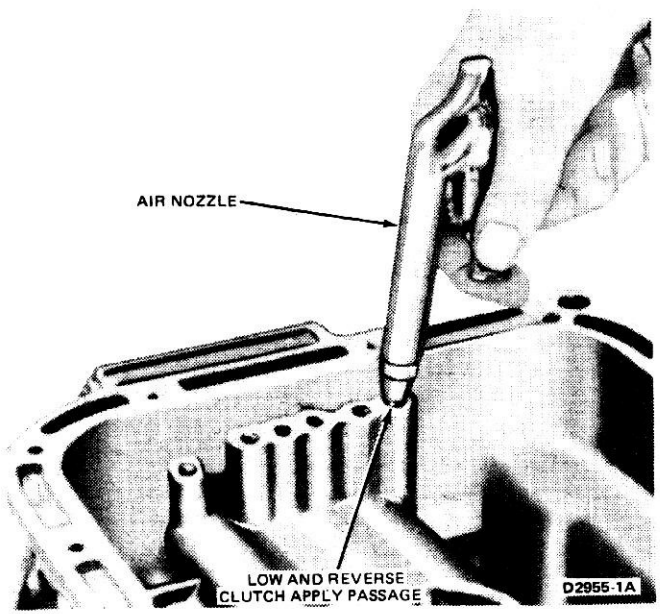


FIG. 12 Removing Low and Reverse Clutch Piston

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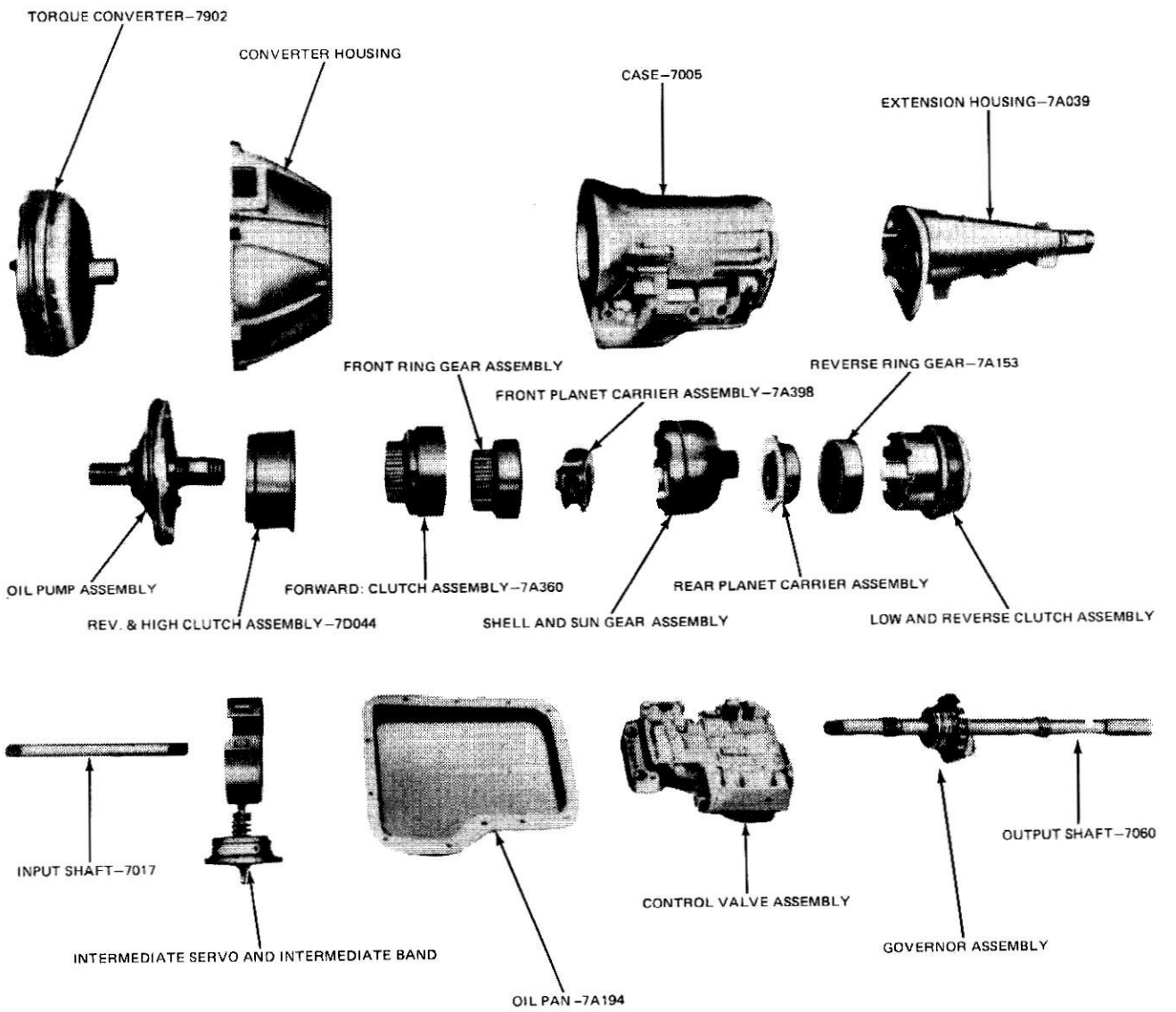


FIG. 13 Transmission—Disassembled View

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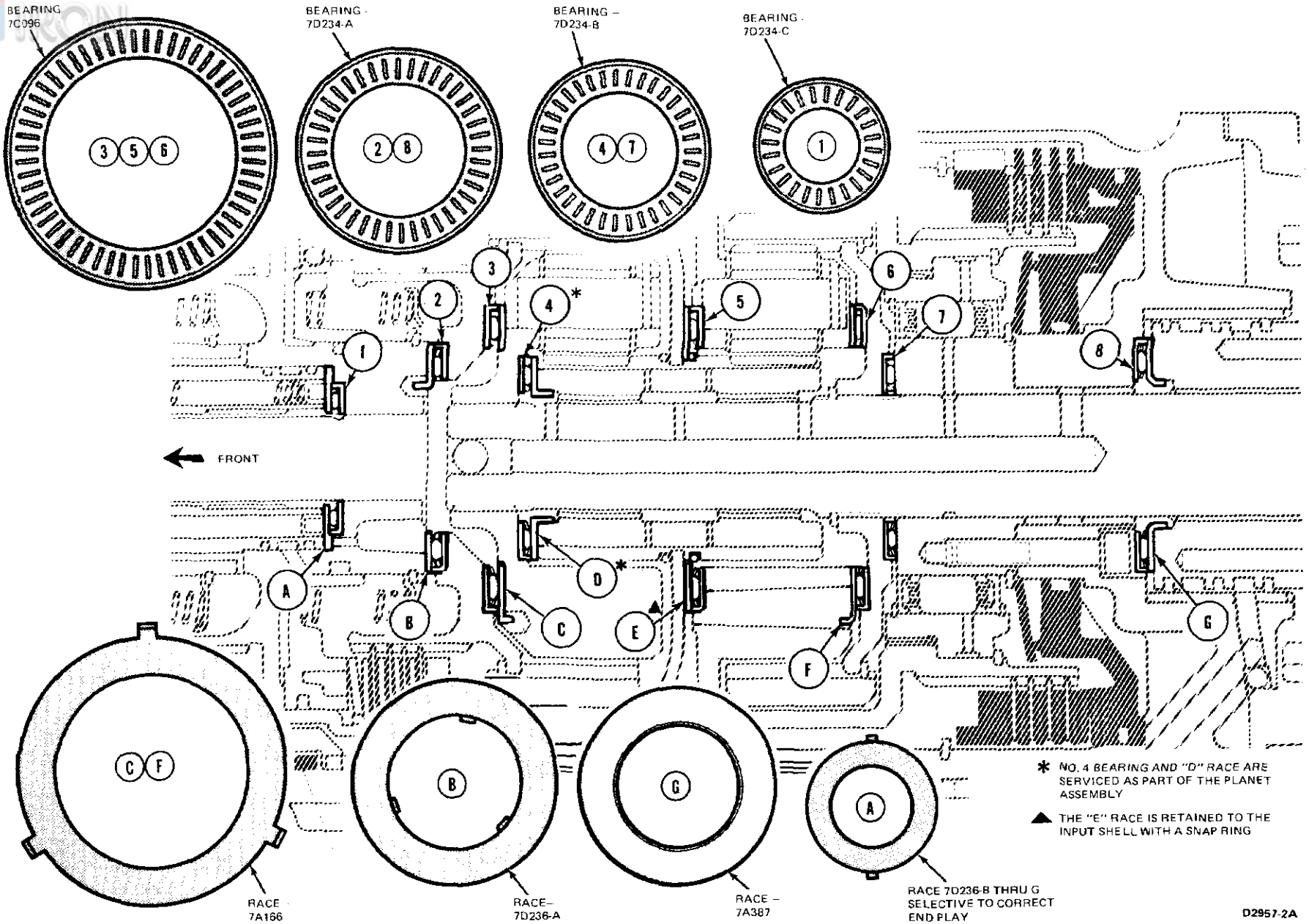
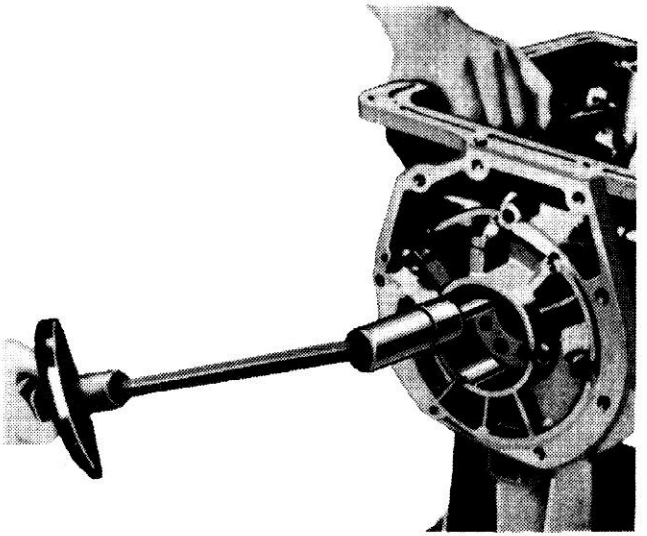


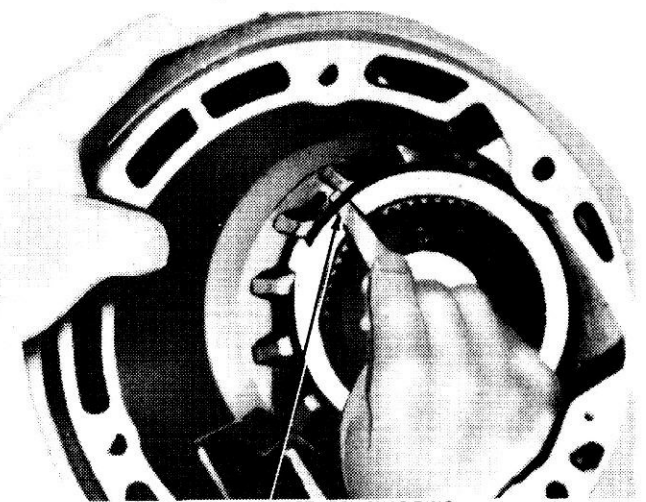
FIG. 14 Location and Identification of Thrust Bearings and Races

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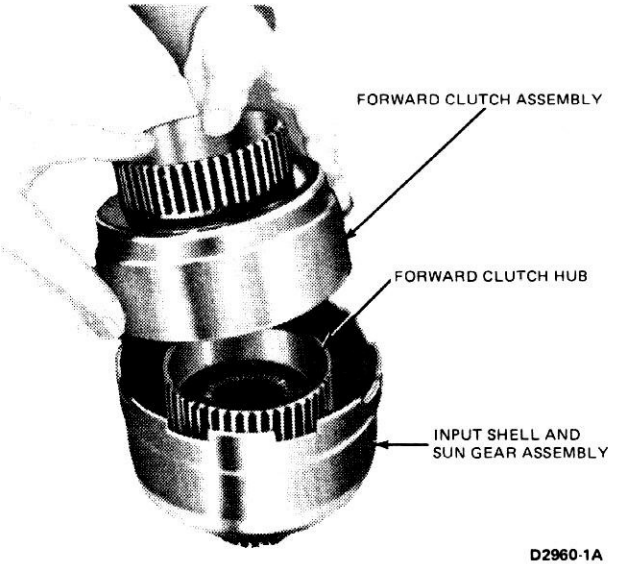
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FIG. 15 Installing One-Way Clutch Inner Race Attaching Bolts



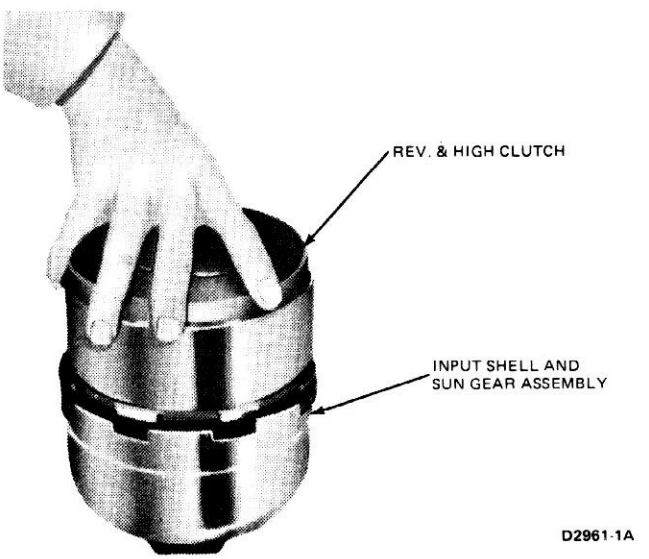
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FIG. 16 Checking Reverse Clutch Clearance



D2960-1A

FIG. 17 Installing Forward Clutch Assembly



D2961-1A

FIG. 18 Installing Reverse and High Clutch Assembly

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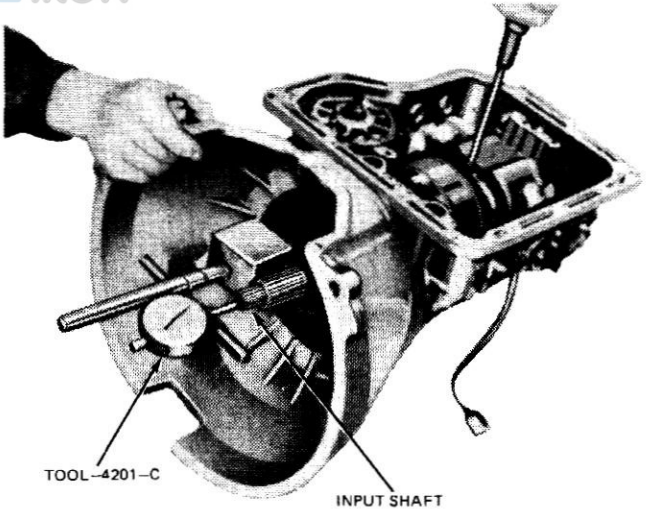


FIG. 19 Checking Total End Play

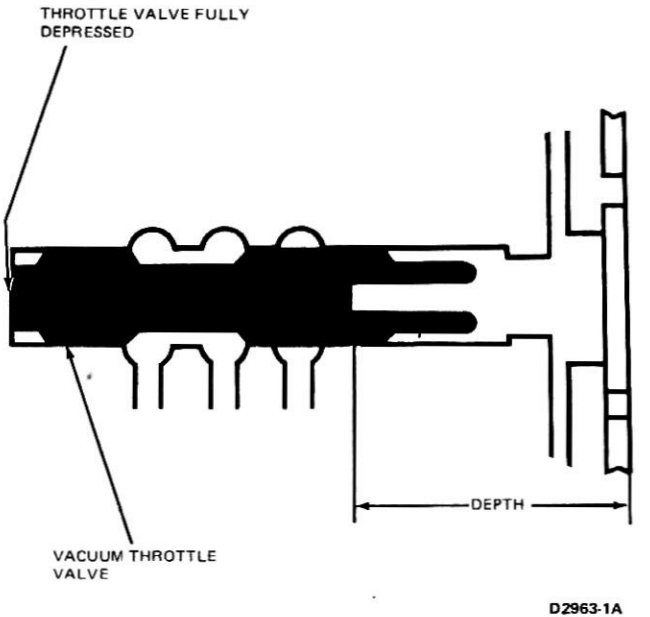


FIG. 20 Measuring Throttle Valve Rod

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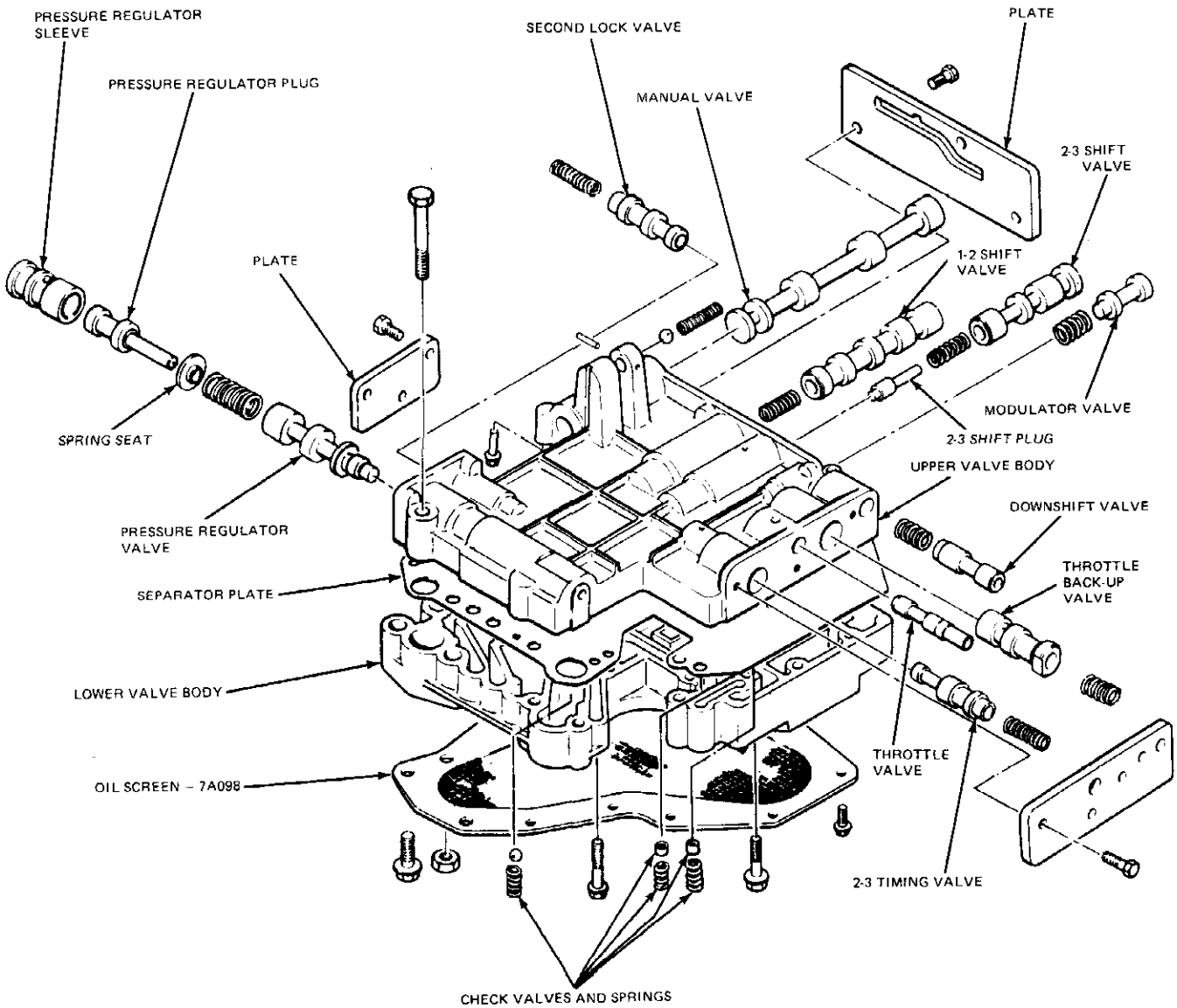


FIG. 21 Control Valve Assembly—Disassembled View

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DETROIT IRON

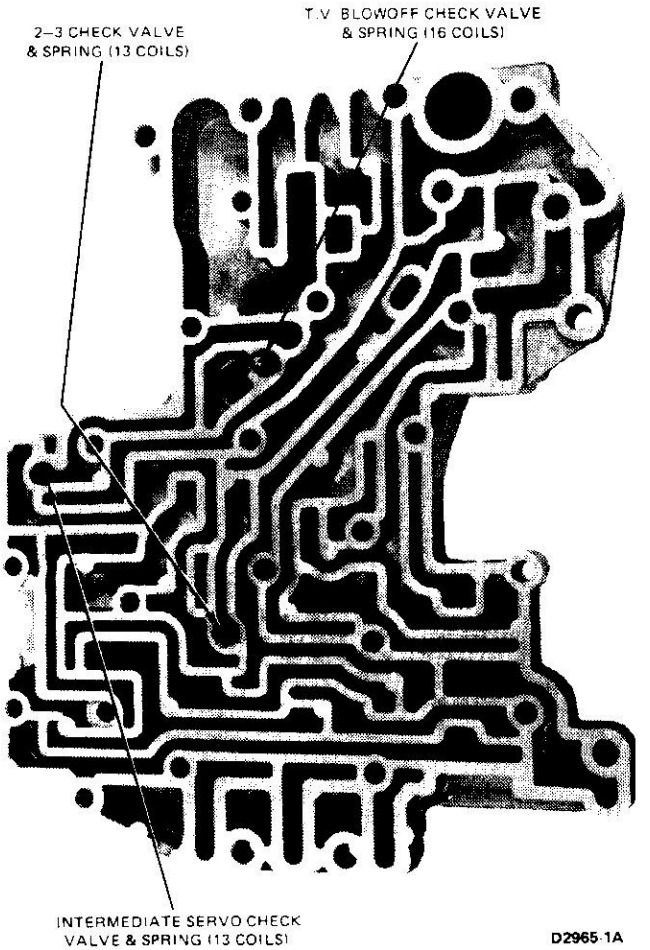


FIG. 22 Location of Check Valves and Springs—Control Valve Body

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FIG. 23 Removing Servo Piston

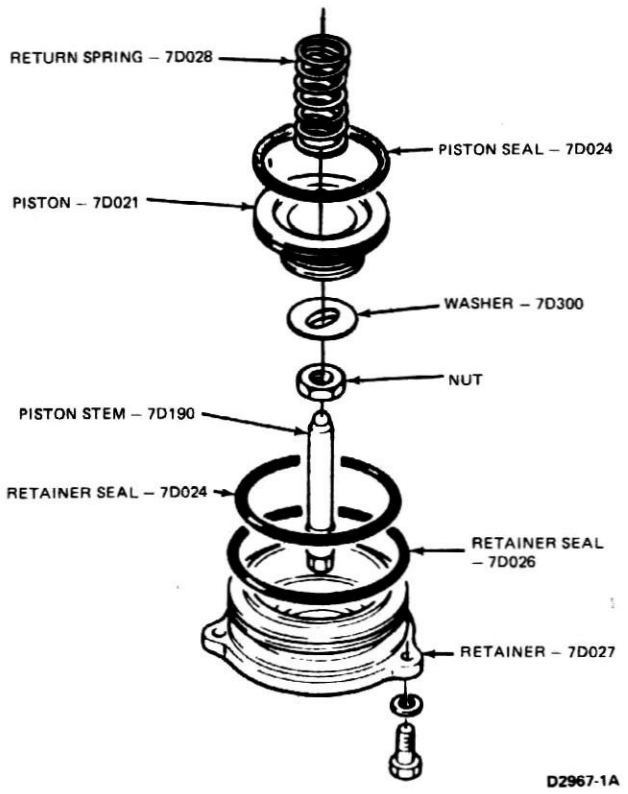


FIG. 24 Servo—Disassembled View

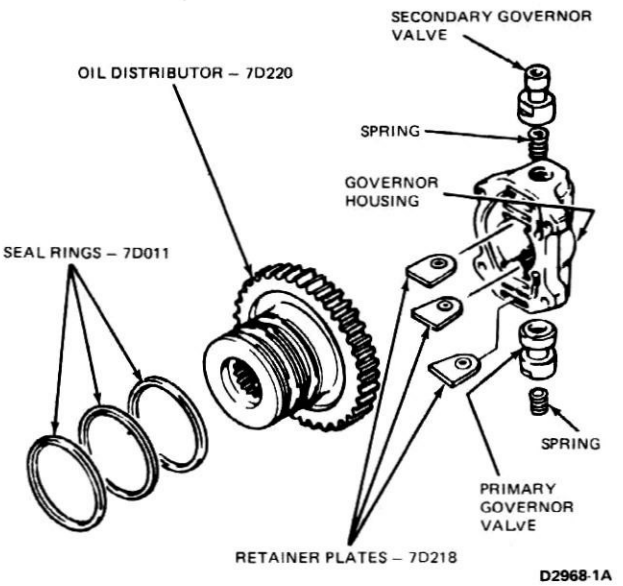


FIG. 25 Governor—Disassembled View

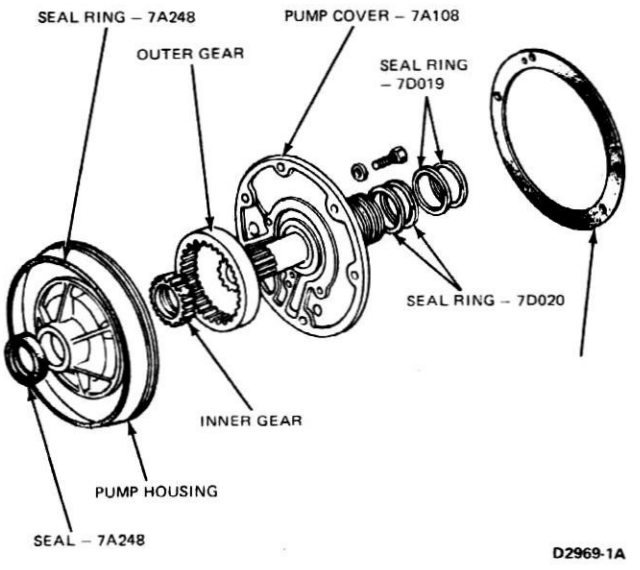


FIG. 26 Oil Pump—Disassembled View

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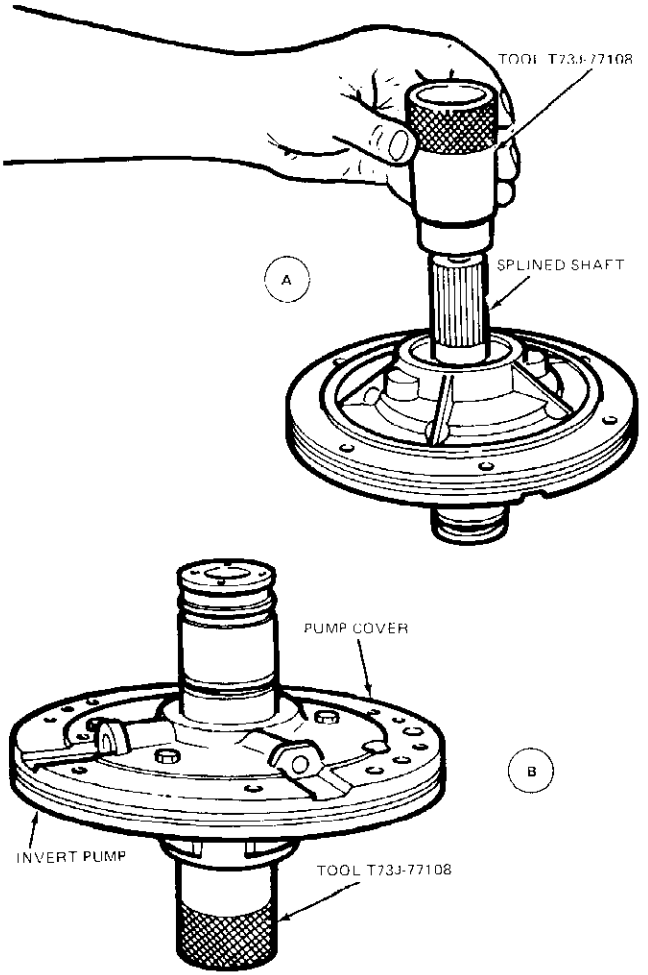


FIG. 27 Using Oil Pump Aligning Tool T73J-77108

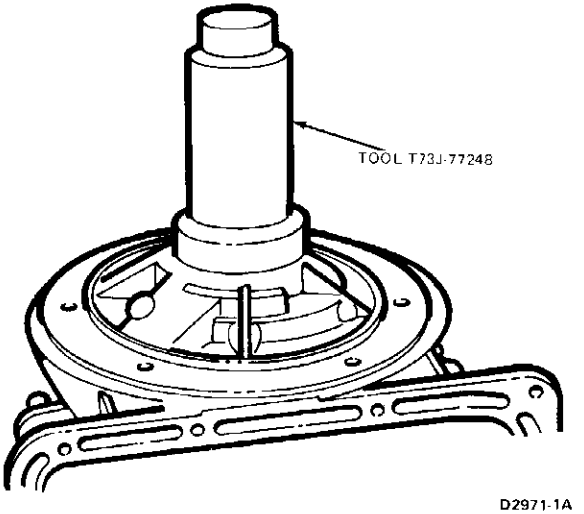


FIG. 28 Installing Seal Using Tool T73J—77248

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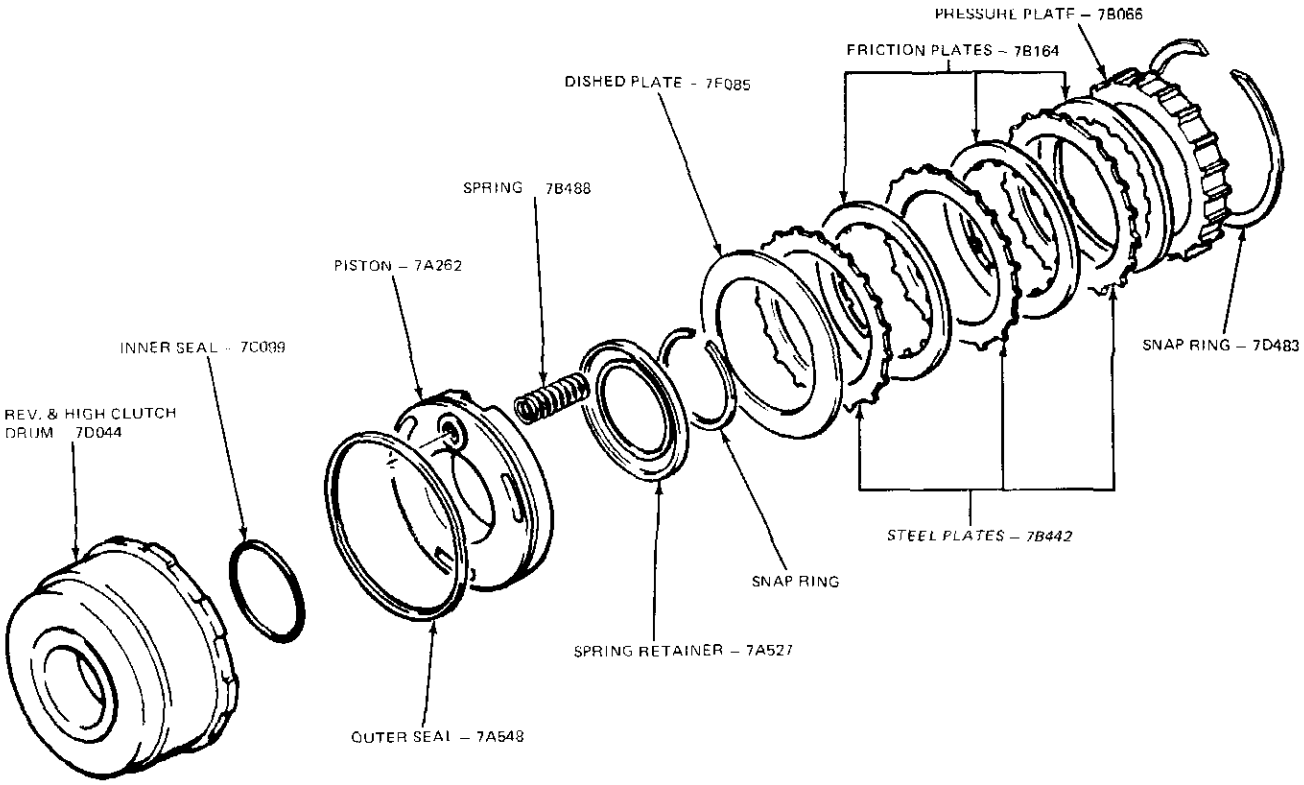


FIG. 29 Reverse and High Clutch—Disassembled View

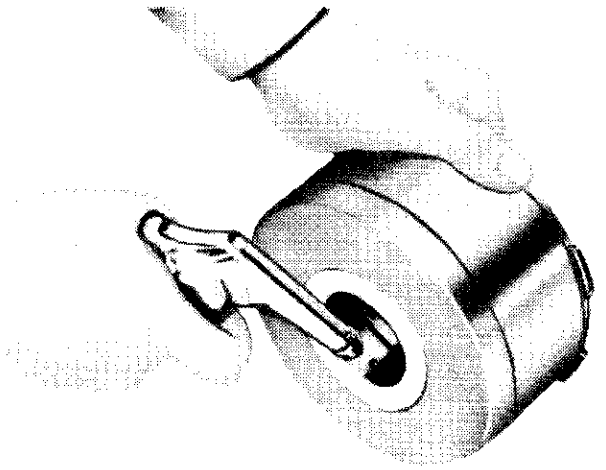


FIG. 30 Removing Reverse and High Clutch Piston



FIG. 31 Checking Clearance Between Pressure Plate and Snap Ring

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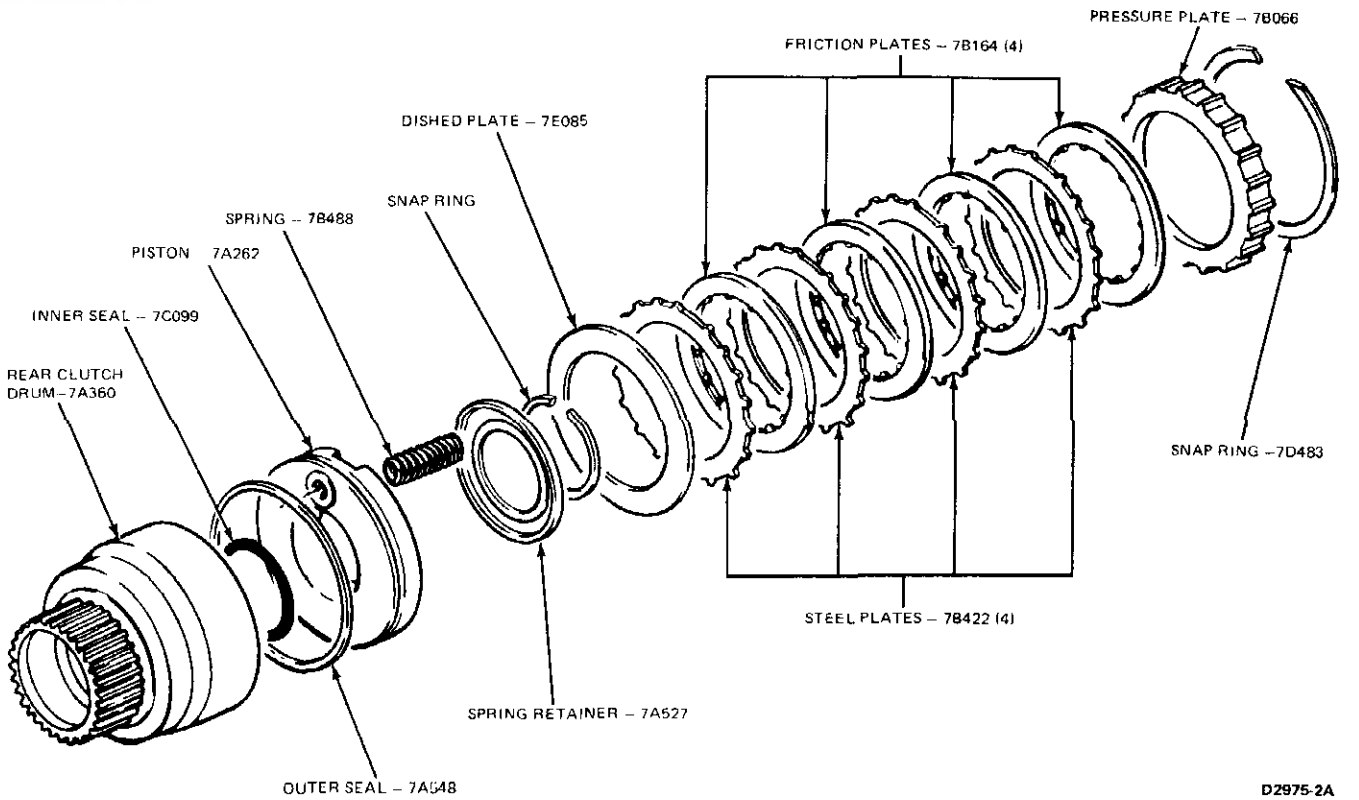


FIG. 32 Forward Clutch Assembly—Disassembled View

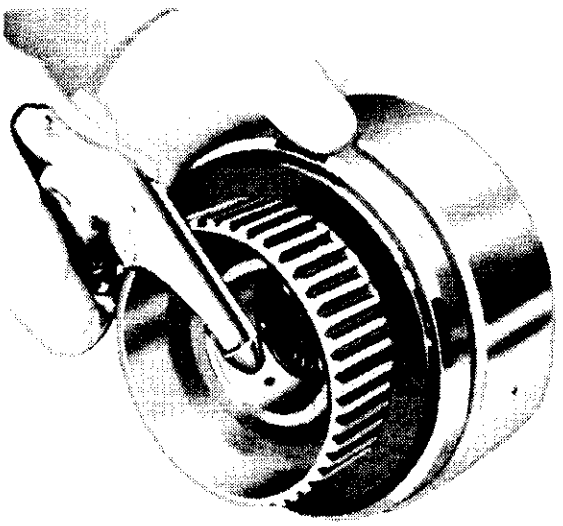


FIG. 33 Removing Forward Clutch Piston

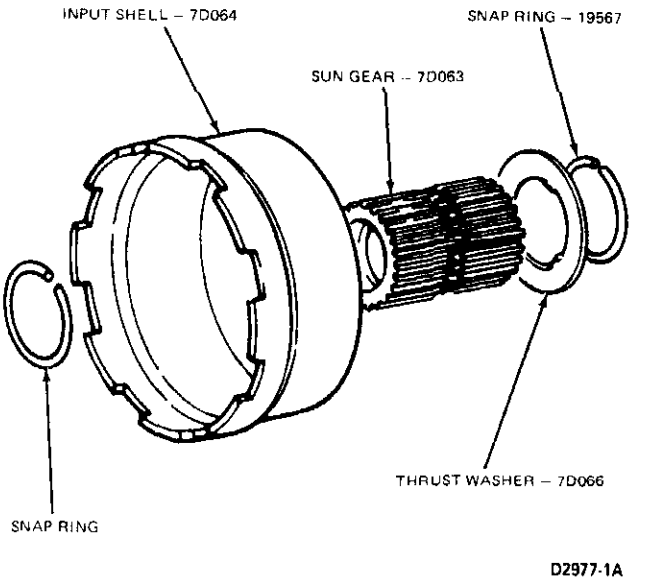


FIG. 34 Input Shell and Sun Gear—Disassembled View

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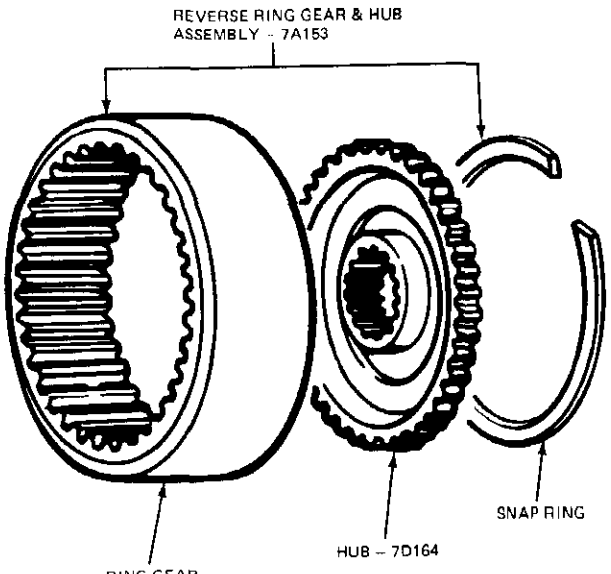


FIG. 35 Reverse Ring Gear and Hub—Disassembled View

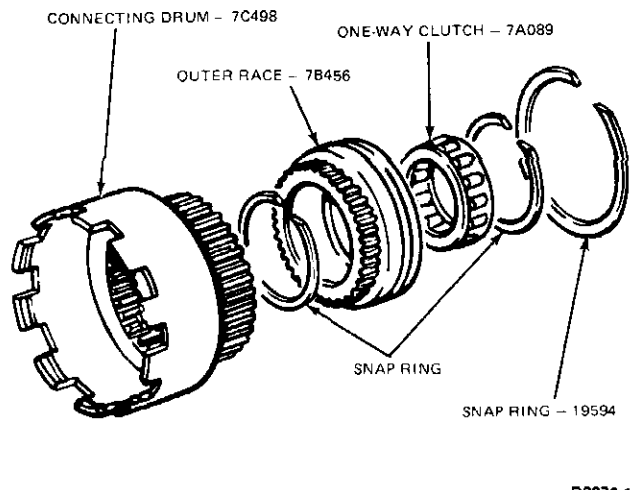


FIG. 36 One-Way Clutch—Disassembled

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DETROIT IRON

SPECIFICATIONS

MAINTENANCE SCHEDULE

The scheduled maintenance requirements for the Jatco automatic transmission are as follows:

A. Fluid Level
Check at predelivery and when performing other required maintenance service and add if necessary.

B. Intermediate Band Adjustment
There is no periodic band adjustment for normal operation.

FLUID CAPACITY

The fluid capacity for the Jatco automatic transmission is as follows:

Converter Size	U.S.	Imperial	Litres
11"	8.6 Quarts	7.2 Quarts	8.15

NOTE: DO NOT OVERFILL.

Fluid Level Indicator must be used to determine ACTUAL fluid requirements.

If it is necessary to add or replace fluid, use only fluids which have been certified by the supplier as meeting Ford Motor Company specification ESP-M2C138-CJ. This fluid is the 1978 C-6 transmission fluid.

GENERAL SPECIFICATIONS

Transmission Type	Jatco
Model	PLA-A1
Fluid Capacity	8.6 U.S. quarts, 7.2 Imperial quarts
Fluid Type	ESP-M2C138-CJ (Also used in the 1978 C-6 transmission)

Gear Ratios:

First	2.458:1
Second	1.458:1
Third	1.000:1
Reverse	2.181:1

TRANSMISSION STALL SPEEDS SPECIFICATION AND CONVERTER IDENTIFICATION

Transmission Model	I.D. Number	Stall Ratio	Stall Speed RPM
PLA-A1	FD	2.0	1750-2000

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Operation	Specifications
Total Gear Train End Play	0.010-0.020
Selective Bearing Race Thickness	0.047, 0.055, 0.063, 0.071, 0.079, 0.087
Reverse and High Clutch Pressure Plate-To-Snap Ring Clearance	0.062-0.071
Low and Reverse Clutch Pressure Plate To Snap Ring Clearance	0.032-0.041

CONTROL PRESSURE SPECIFICATION (CONTROL PSI) WITH GOVERNOR PRESSURE AT ZERO. OIL TEMPERATURE 150 DEGREES - 200 DEGREES F

SHIFT SPEEDS – ACTUAL M.P.H.

Throttle	Range	Shift	2.47:1 Axle	2.50:1 Axle
Closed	D	1-2	9-14	9-14
15" Vacuum	D	2-3	16-29	16-29
	1	2-1	30-43	30-43
To Detent	D	1-2	17-30	17-30
(Torque Demand)	D	2-3	32-45	31-44
Through Detent	D	1-2	40-53	39-52
(W.O.T.)	D	2-3	68-80	67-79

CONTROL PRESSURE SPECIFICATIONS (CONTROL PSI) WITH GOVERNOR PRESSURE AT ZERO. OIL TEMPERATURE 150 DEGREES F – 200 DEGREES F

Range	Idle 18" Vacuum	10" Vacuum	W.O.T. Through Detent
P	42-73		
R	66-97	164-194	266-296
N	42-73		
D	42-73	99-129	164-194
2	*146-189	146-189	164-194
1	42-73	99-129	164-194

*Due to increased system leakage at 200 Degrees F the lower limit for 2 range may drop to 95 PSI at idle speed.

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GOVERNOR PRESSURE (GOV. P.S.I.)

MPH	2.47:1 Axle Ratio	2.50:1 Axle Ratio
20	19-25	19-25
35	32-39	33-40
50	52-60	53-61

END PLAY SPECIFICATION

Oil Pump Cover to Front Clutch Drum	Total End Play
0.020-0.032	0.010-0.020

CLUTCH PLATE USAGE

	Forward Clutch			High Clutch		
Model	Steel	Friction	Clearance	Steel	Friction	Clearance
PLA-A	6	6	No Specification	4	4	0.062-0.071

REVERSE CLUTCH

Reverse Clutch		
Steel	Friction	Clearance
7	7	0.032-0.041

MAIN CONTROL AND GOVERNOR IDENTIFICATION

Vehicle	Engine	Transmission Model	Main Control I.D.	Governor I.D.
Granada/Monarch	250-1V (4.1L)	PLA-A1	MA	FD

INTERMEDIATE SERVO COMPONENT IDENTIFICATION

Vehicle	Engine	Trans. Model	Servo Piston I.D.	Retainer I.D.	Spring I.D.
Granada/Monarch	250-1V (4.1L)	PLA-A	F	64-36	None

DIAPHRAGM ASSEMBLY

The Jatco automatic transmission uses a SINGLE AREA vacuum diaphragm.

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FLYWHEEL ASSEMBLY

Number of Teeth & O.D.	Used with Transmission Model	Engine	Vehicle
157 Teeth, 13.3 O.D.	PLA-A1	(4.1L) 250-1V	Granada/Monarch

OIL FILLER TUBE AND INDICATOR ASSEMBLY

Full Mark to Top of Cap	Indicator Identification	Used with Transmission Model	Engine	Vehicle
19.71"	Yellow Paint on Cap	PLA-A1	(4.1L) 250-1V	Granada/Monarch

FILLER TUBE

Filler Tube Color I.D.	Used with Transmission Model	Engine	Vehicle
None	PLA-A	(4.1L) 250-1V	Granada/Monarch

SPECIAL TOOLS

Ford Tool No.	Description
T77J-77001-A	Transmission Mounting Adapters
T73J-77103	Oil Pump Remover Adaptors
T73J-77108	Oil Pump Aligning Tool
T73J-77248	Oil Pump Seal Replacer

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TORQUE SPECIFICATIONS

Item	Ft-Lbs
Flywheel to crankshaft	100-115
Flywheel to torque converter	29-36
Converter housing to engine	29-36
Converter housing to transmission case	23-24 ①
Extension housing to transmission case	15-18
Oil pan to transmission case	4-5
Servo piston rod (when adjusting intermediate band)	9-10
Servo piston rod lock nut	22-29
Servo piston retainer to transmission case	4-5
Servo cover to retainer	4-5
One-way clutch inner race to transmission case	11-13
Control valve body to transmission case	4-5
Lower valve body to upper valve body	2-3
Side plate to control valve body	2-3
Stud and nut upper to lower control valve body attaching	4-5
Oil screen to lower valve body	2-3
Governor valve body to oil distributor	4-6
Oil pump cover to oil pump housing	4-6
Manual shaft lock nut	22-29
Oil pressure test plug	7-11
Actuator for parking rod to extension housing	6-8
Down shift solenoid	Hand Tight
Vacuum diaphragm	Hand Tight
Outer manual lever to shaft nut	14-25

① Apply Motorcraft Sealer or equivalent under bolt heads.

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C6 Automatic Transmission

PART 17-10

Applies To All Cars Except Pinto/Bobcat/Mustang II, Granada/Monarch/Versailles, Fairmont/Zephyr

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DESCRIPTION

The C6 automatic transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios. The transmission is also capable of providing manual selection of first and second gears.

Fig. 1 shows the location of the converter, front pump, clutches, gear train, and most of the internal parts used in the C6 automatic transmission.

IDENTIFICATION TAG

A number appearing after the suffix (Fig. 2) indicates that internal parts have been changed after initial production start-up. For example, a PJD-E model transmission that has been changed internally would read PJD-E1. Both transmissions are basically the same, but some service parts in the PJD-E1 transmission are slightly different than the PJD-E transmission. **Therefore, it is important that the codes on the transmission identification tag be checked when ordering parts or making inquiries about the transmission.**

The hydraulic control system schematic is shown in Fig. 3.

The converter housing and the fixed splines which engage the splined OD of the low reverse clutch steel plates, are both cast integrally into the case.

Only one (intermediate) band is used in the C6 transmission. This along with the forward clutch is used to obtain intermediate gear.

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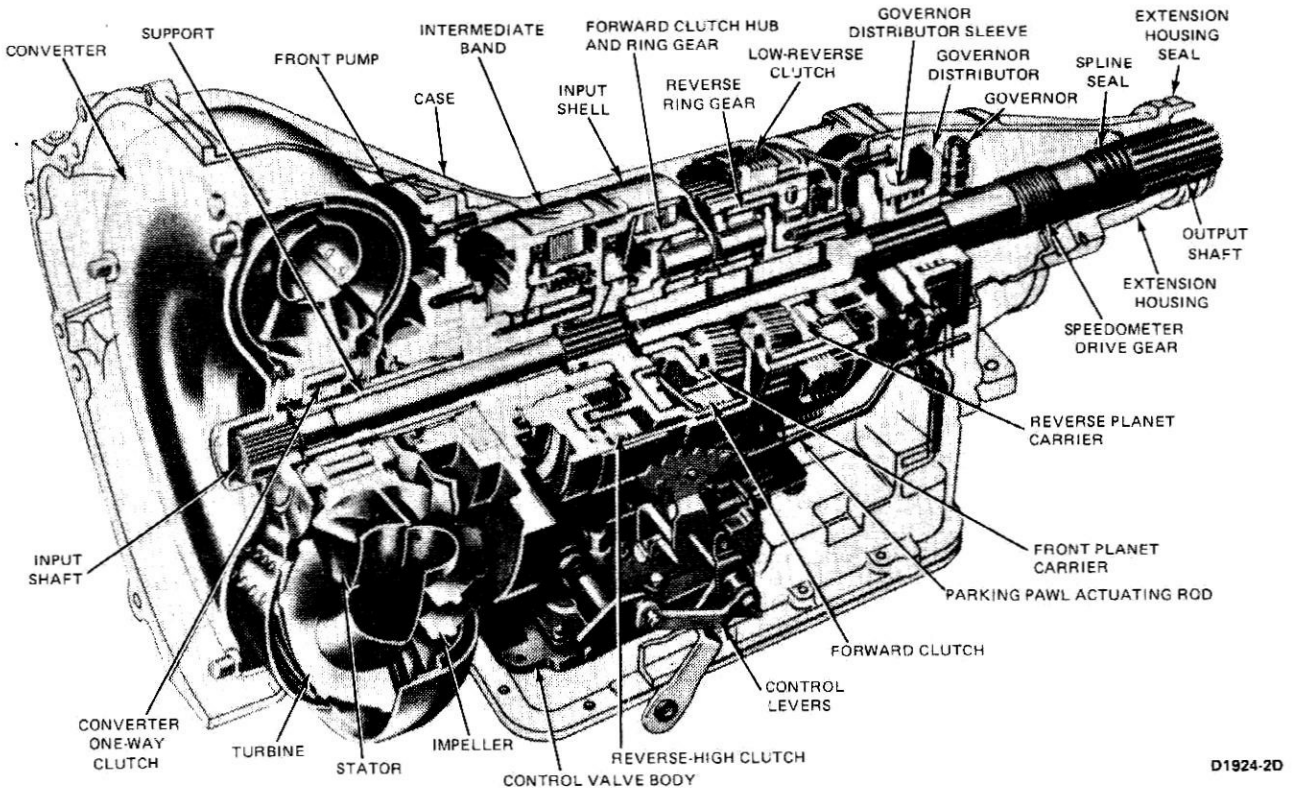


FIG. 1 C6 Automatic Transmission—Sectional View

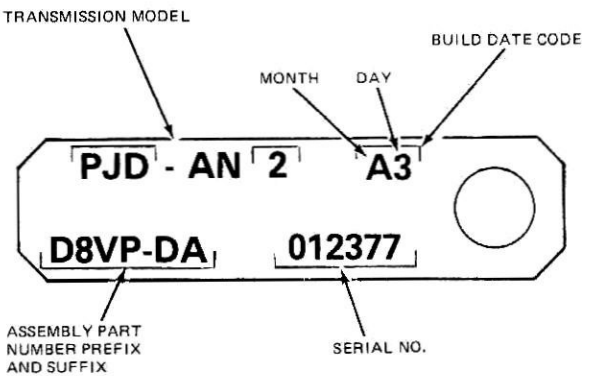


FIG. 2 Identification Tag—C-6 Transmission

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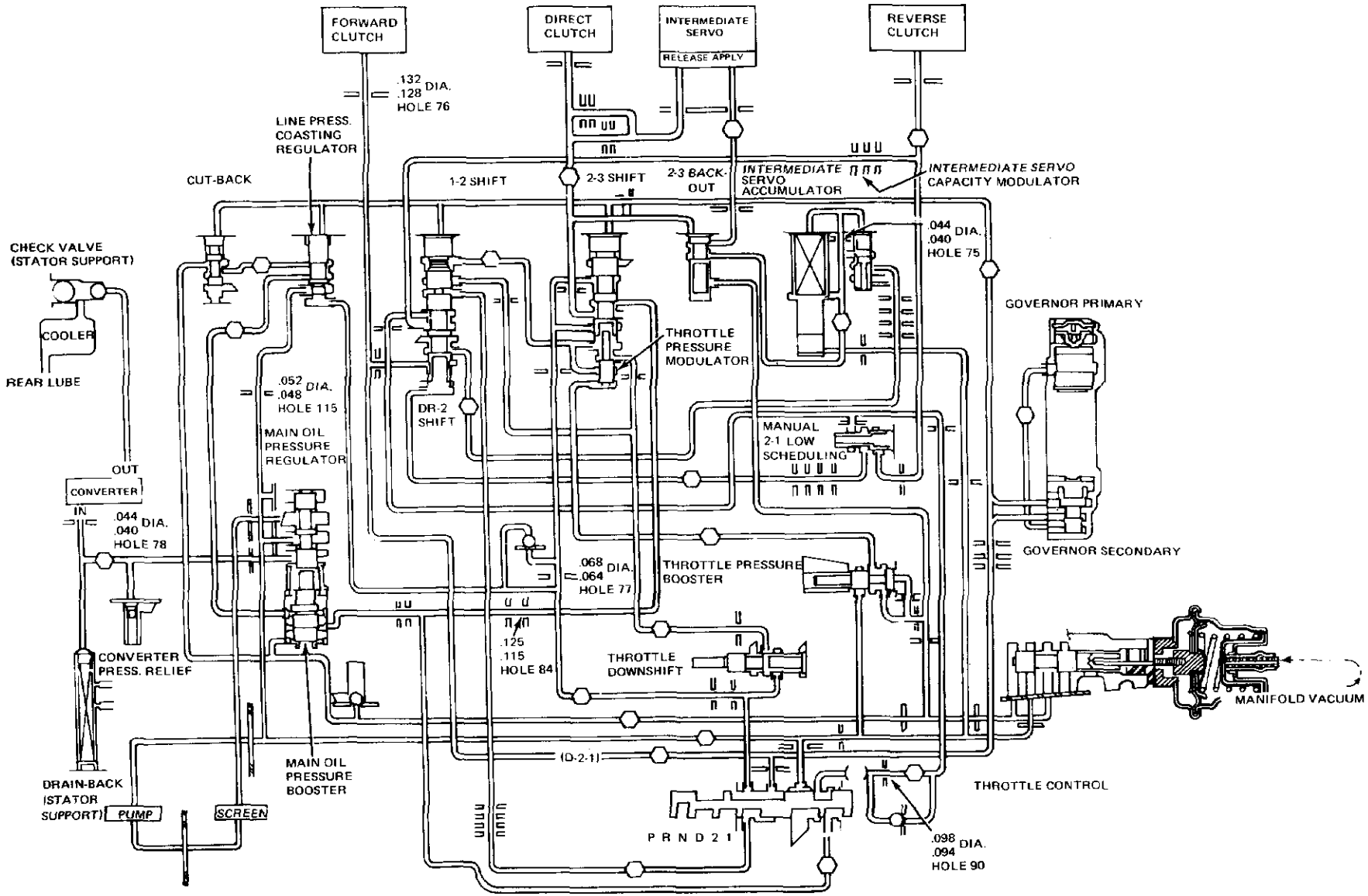


FIG. 3 Hydraulic Control System

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ADJUSTMENTS

The only adjustment on the transmission is the intermediate band.

To prevent damage to the transmission and to assure proper band adjustment, it is essential that the tools and procedures described here are used whenever the band is adjusted.

INTERMEDIATE BAND ADJUSTMENT

1. Raise the vehicle on a hoist or jack stands.
2. Clean all the dirt from the band adjusting screw area. Remove and discard the lock nut.
3. Install a new lock nut and tighten the adjusting screw.
4. Back off the adjusting screw exactly 1-1/2 turns.
5. Hold the adjusting screw from turning and torque the lock nut to specification as listed at the end of this Part.
6. Lower the vehicle.

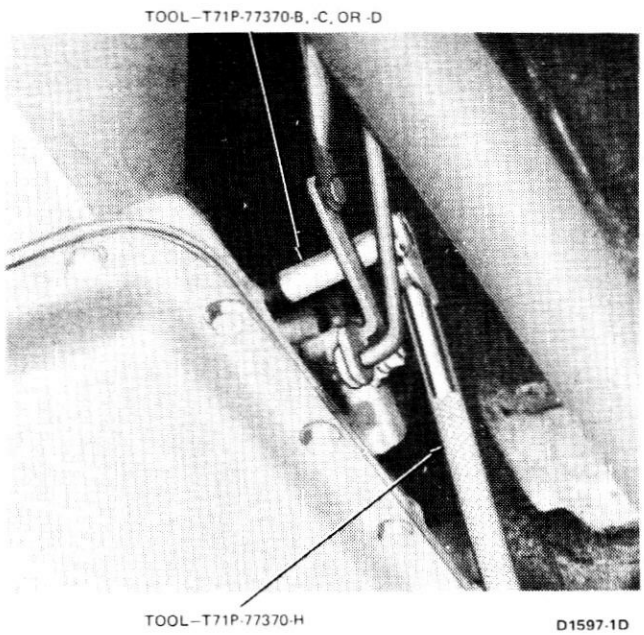


FIG. 4 Adjusting Intermediate Band

REMOVAL AND INSTALLATION

TRANSMISSION

Ford and Mercury

Removal

1. Raise the vehicle on a hoist or stands.
2. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
3. Remove the converter drain plug access cover from the lower end of the converter housing.
4. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
5. Place a drain pan under the converter to catch the fluid. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug, and remove the plug. After the fluid has been drained, reinstall the plug.
6. Disconnect the drive shaft from the rear axle and slide shaft rearward from the transmission. Install a seal installation tool in the extension housing to prevent fluid leakage.
7. Disconnect the cable from the terminal on the starter motor. Remove the three attaching bolts and remove the starter motor.
8. Remove the rear mount-to-crossmember attaching bolt and the two crossmember-to-frame attaching bolts.
9. Remove the two engine rear support-to-extension housing attaching bolts.
10. Disconnect the downshift rod from the transmission downshift lever. Disconnect the manual linkage rod from the lever at the transmission.
11. Remove the two bolts securing the bellcrank bracket to the converter housing.
12. Raise the transmission with a transmission jack to provide clearance to remove the crossmember. Remove the rear mount from the crossmember and remove the crossmember from the side supports.
13. Lower the transmission to gain access to the oil cooler lines.
14. Disconnect each oil line from the fittings on the transmission.
15. Disconnect the vacuum line from the diaphragm located at the right rear of the transmission. Remove the metal line from the retaining clip on the transmission.
16. Disconnect the speedometer cable from the extension housing.
17. Remove the bolt that secures the transmission fluid filler tube to the cylinder block. Lift the filler tube and the dipstick from the transmission.
18. Secure the transmission to the jack with the chain.
19. Remove the converter housing-to-cylinder block attaching bolts.
20. Carefully move the transmission and converter assembly away from the engine and, at the same time, lower the jack to clear the underside of the vehicle.
21. Remove the converter and mount the transmission in a holding fixture.

Installation

1. Torque the converter drain plug to specifications as listed at the end of this Part.

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2. Position the converter on the transmission, making sure the converter drive flats are fully engaged in the pump gear by rotating the converter.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with a chain.
4. Rotate the converter until the studs and drain plug are in alignment with the holes in the flywheel.
5. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install and torque the converter housing-to-engine attaching bolts to specification. Make sure that the vacuum tube retaining clips are properly positioned.
7. Remove the safety chain from around the transmission.
8. Install a new O-ring on the lower end of the transmission filler tube. Insert the tube in the transmission case and secure the tube to the engine with the attaching bolt.
9. Connect the speedometer cable to the extension housing.
10. Connect the oil cooler lines to the right side of transmission case.
11. Connect the vacuum lines to the vacuum diaphragm making sure that the metal tubes are secured in the retaining clip.
12. Position the crossmember on the side supports. Position the rear mount on the crossmember and install the attaching bolt and nut.
13. Secure the engine rear support to the extension housing and torque the bolts to specification.
14. Lower the transmission and remove the jack.
15. Secure the crossmember to the side supports with the attaching bolts and torque them to specification.
16. Position the bellcrank bracket to the converter housing and install the two attaching bolts.
17. Connect the downshift rod to the transmission downshift lever. Connect the selector rod to the manual lever at the transmission.
18. Secure the converter-to-flywheel attaching nuts and torque them to specification.
19. Install the converter housing access cover and secure it with the attaching bolts.
20. Secure the starter motor in place with the attaching bolts. Connect the cable to the terminal on the starter.
21. Connect the drive shaft to the rear axle.
22. Adjust the shift linkage as required. Refer to Part 17-02.
23. Lower the vehicle.
24. Fill the transmission to the correct level with the specified fluid. Refer to Part 17-01. Start the engine and shift the transmission to all ranges, then recheck the fluid level.

LTD II, Cougar, Thunderbird and Continental Mark V

Removal

1. Working from the engine compartment, remove the two bolts retaining the fan shroud to the radiator.
2. Disconnect the battery.
3. Raise the vehicle on a hoist or stands.
4. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
5. Remove the converter drain plug access cover and adapter plate bolts from the lower end of the converter housing.
6. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
7. Turn the converter to gain access to the converter drain plug. Then, remove the plug and place a drain pan under the converter to catch the fluid. After fluid has drained, reinstall the plug.
8. Disconnect the drive shaft from the rear axle and slide the shaft rearward from the transmission. Install a seal installation tool in the extension housing to prevent fluid leakage.
9. Disconnect the speedometer cable from the extension housing.
10. Disconnect the downshift rod from the transmission downshift lever.
11. Disconnect the shift cable from the manual lever at the transmission.
12. Remove the two bolts that secure the shift cable bracket to the converter housing and position the cable and bracket out of the way.
13. Remove the starter motor attaching bolts and position the starter out of the way.
14. Disconnect the rubber hose(s) from the vacuum diaphragm at rear of transmission. Remove the vacuum tube(s) from the retaining clip at the transmission.
15. Disconnect the muffler inlet pipe at the exhaust manifolds and allow the pipe to hang.
16. Remove the crossmember-to-frame side support bolts and nuts. Remove the nuts securing the rear engine supports to the crossmember. Position a jack under the transmission and raise it slightly. Remove the bolts securing the rear engine supports to the extension housing and remove the crossmember and rear supports from the vehicle.
17. Loosen the parking brake adjusting nut at the equalizer and remove the cable from the idler hook attached to the floor pan.
18. Lower the transmission, then disconnect the oil cooler lines from the transmission case.
19. Secure the transmission to the jack with a chain.
20. Remove the six bolts that attach the converter housing to the cylinder block.

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21. Remove the bolt that secures the transmission filler tube to the cylinder block. Lift the filler tube and dipstick from the transmission.
22. Move the transmission away from the cylinder block.
23. Lower and remove the transmission and converter assembly from under the vehicle.
24. Remove the converter and mount the transmission in a holding fixture.

Installation

1. Torque the converter drain plug to specification as listed at the end of this Part.
2. Position the converter on the transmission making sure the converter drive flats are fully engaged in the pump gear by rotating the converter.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with the safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.

NOTE: On Continental Mark V, to maintain initial engine/transmission balance, assemble the converter to the flywheel so that the orange-dyed converter drive stud is installed through the orange painted hole in the flywheel.

5. Move the converter and transmission assembly forward into position using care not to damage the flywheel and converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install a new O-ring on the lower end of the transmission filler tube. Insert the tube in the transmission case and secure the tube to the engine with the attaching bolt.
7. Install the converter housing-to-engine attaching bolts. Torque the bolts to specification. Remove the safety chain from around the transmission.
8. Connect the oil cooler lines to the transmission case.
9. Raise the transmission slightly and position the parking brake cable in the idler hook. Tighten the adjusting nut at the equalizer.
10. Place the rear engine supports on the crossmember and position the crossmember on the frame side supports.
11. Secure the engine rear supports to the extension housing with the attaching bolts. Torque the bolts to specification.
12. Remove the transmission jack from under the vehicle and install the crossmember-to-frame side support bolts and nuts. Torque the bolts and nuts to specification.
13. Install the engine rear support-to-crossmember attaching nuts, and torque to specification.
14. Connect the muffler inlet pipe to the exhaust manifolds.
15. Connect the vacuum lines to the vacuum diaphragm making sure that the metal tube is secured in the retaining clip.
16. Position the starter motor to the converter housing and secure it with the attaching bolts.
17. Install torque converter-to-flywheel attaching nuts. Torque nuts to specification.
18. Position the shift cable bracket to the converter housing and install the two attaching bolts.
19. Connect the shift cable to the manual lever at the transmission.
20. Connect the downshift rod to the lever on the transmission.
21. Connect the speedometer cable to the extension housing.
22. Remove the tool from the extension housing, and install the drive shaft.
23. Install the converter drain plug access cover and adapter plate bolts. Torque the bolts to specification.
24. Adjust the manual and downshift linkage as required. Refer to Part 17-02.
25. Lower the vehicle.
26. Working from the engine compartment, position the fan shroud to the radiator and secure with the two attaching bolts.
27. Connect the battery.
28. Fill the transmission to the proper level with the specified fluid. Refer to Part 17-01.
29. Check the transmission, converter assembly and oil cooler lines for leaks.

Lincoln Continental

Removal

1. Raise the hood and remove the transmission dipstick.
2. Raise the vehicle on a hoist. Remove the bolt that secures the transmission filler tube to the cylinder head.
3. Remove the bolts that attach the reinforcement plate at the rear of the transmission oil pan and remove the plate.
4. Remove the three bolts that attach the manual and downshift control rod splash shield to the side rail and remove the shield.
5. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
6. Remove the converter drain plug access cover from the lower end of the converter housing.
7. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
8. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug and remove the plug. Place a

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drain pan under the converter to catch the fluid. With fluid drained, reinstall the plug.

9. Remove the two front support bracket bolts at the converter housing.
10. Lift the fluid filler tube from the transmission case.
11. Remove the two idler arm bracket bolts from the frame side rail and allow the idler arm to hang free.
12. Disconnect the starter cable from the starter. Remove the starter attaching bolts and remove the starter.
13. Disconnect the oil cooler lines from the transmission.
14. Disconnect the vacuum hoses from the diaphragm.
15. Loosen the parking brake adjusting nut at the equalizer and remove the retracting spring. Disconnect the rear brake cables and remove the equalizer from the bracket.
16. Disconnect the speedometer cable from the extension housing.
17. Disconnect the drive shaft from the transmission flange and position the shaft out of the way.
18. Disconnect the downshift rod from the transmission downshift lever.
19. Remove the manual selector rod from the manual lever.
20. Remove the lower bellcrank attaching bolts and remove the bellcrank.
21. Pry the upper bellcrank out of the converter housing and allow it to hang free.
22. Remove the cooler lines from the clip at the cylinder head.
23. Remove the lower converter housing-to-cylinder block attaching bolts.
24. Remove the two nuts that attach the engine rear mounts to the crossmember.
25. Place a transmission jack under the transmission and raise it just high enough to remove the weight from the crossmember.
26. Remove the engine rear support-to-extension housing attaching bolts and remove the supports.
27. Remove the crossmember-to-frame attaching nuts and remove the crossmember.
28. Secure the transmission to the jack with safety chain. Lower the transmission and remove the upper converter housing-to-cylinder block attaching bolts.
29. Move the transmission away from the cylinder block.
30. Carefully lower the jack and remove the transmission and converter assembly from under the vehicle.
31. Remove the converter and mount the transmission in a holding fixture.

Installation

1. Torque the converter drain plug to specification as listed at the end of this Part.
2. Position the converter to the transmission making sure the converter drive flats are fully engaged in the pump gear.
3. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.

   To maintain initial engine/transmission balance, assemble the converter to the flywheel so that the orange-dyed converter drive stud is installed through the orange-painted hole in the flywheel.
4. Move the converter and transmission assembly forward into position, using care not to damage the flywheel and the converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
5. Install the converter housing-to-engine attaching bolts, and torque to specification. Remove the safety chain from around the transmission.
6. Secure the converter to the flywheel with the four attaching nuts. Torque the nuts to specification.
7. Secure the converter access cover to the converter housing with the attaching bolts.
8. Secure the two front support brackets to the converter housing with the attaching bolts.
9. Raise the transmission high enough to position the crossmember. Install the bolts, but do not tighten at this time.
10. Secure the engine rear support to the extension housing and torque the bolts to specification. At this time, install the crossmember-to-frame attaching nuts. Torque nuts to specification as listed at the end of this Part.
11. Lower the transmission and install the engine rear support-to- crossmember attaching nuts and plates. Torque the nuts to specification. Remove the transmission jack.
12. Install the upper bellcrank in the left side of the converter housing.
13. Position the lower bellcrank to the transmission and floor pan and secure it with the two attaching bolts.
14. Connect the downshift rod to transmission downshift lever.
15. Connect the manual selector rod to the manual lever.
16. Position the manual and downshift control rod splash shield to the frame side rail and secure it with the attaching bolts.
17. Connect the speedometer cable to the extension housing.
18. Connect the vacuum hoses to the vacuum diaphragm and secure with a clamp.
19. Connect the two oil cooler lines to the fittings on the right side of the case.
20. Install the cooler lines under the clip at the cylinder head.
21. Position the reinforcement plate and torque the attaching bolts to specification.
22. Install the equalizer and parking brake cables. Install the equalizer lever retracting spring.
23. Connect the drive shaft to the transmission flange.
24. Install a new seal on the filler tube and install it in the transmission case. Secure the filler tube to the cylinder head.
25. Install the starting motor and connect the cable.
26. Install the idler arm bracket-to-frame side rail.

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27. Lower the vehicle.
28. Fill the transmission to the correct level with the specified fluid. Refer to Part 17-01.
29. Adjust the manual and throttle linkage as required. Refer to Part 17-02.

CONTROL VALVE BODY

Removal

1. Raise the vehicle on a hoist or jack stands.
2. Place a drain pan under the transmission and loosen the bolts to drain the fluid from the transmission.
3. Remove the transmission pan attaching bolts from both sides and the rear to allow the fluid to drain further. Finally, remove the remainder of the attaching bolts. Remove the pan and gasket. Remove and discard the nylon shipping plug from the filler tube hole. This plug is used to retain transmission fluid within the transmission during shipment and should be discarded when the oil pan is removed.
4. Remove the valve body attaching bolts and remove the valve body from the case.

Installation

1. Position the valve body to the case making sure that the selector and downshift levers are engaged. Install and torque the attaching bolts to specification.
2. Clean the transmission pan and gasket surfaces thoroughly.
3. Using a new pan gasket, secure the pan to the transmission case. Torque the attaching bolts to specification.
4. Lower the vehicle and fill the transmission to the correct level with the specified fluid. Refer to Part 17-01.

INTERMEDIATE SERVO

All Vehicles Except Lincoln Continental

Removal

1. Raise the vehicle on a hoist or stands.
2. Remove the engine rear support-to-extension housing attaching bolts.
3. Raise the transmission high enough to remove the weight from the engine rear support.
4. Remove the bolt that secures the engine rear support to the crossmember. Remove the support.
5. Lower the transmission and remove the jack.
6. Place a drain pan under the servo. Remove the bolts that attach the servo cover to the transmission case.
7. Remove the cover, piston, spring and gasket from the case, screwing the band adjusting screw inward as the piston is removed. This places enough tension on the band to keep the struts properly engaged in the band end notches while the piston is removed.
8. Apply air pressure to the port in the servo rod to remove the piston and rod.
9. Replace the complete piston and rod assembly if the piston or piston sealing lips are damaged (Fig. 5).

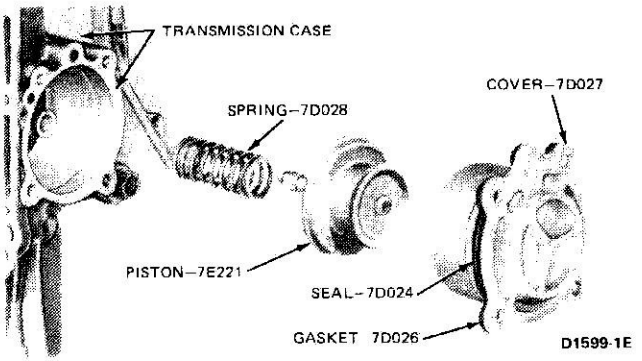


FIG. 5 Servo Disassembled—Typical

10. Remove the seal from the cover.

Installation

1. Dip the new seals in transmission fluid.
2. Install a new seal on the cover.
3. Coat a new gasket with petroleum jelly and position it on the servo cover.
4. Dip the piston in transmission fluid and install it in the cover.
5. Position the servo spring on the piston rod.
6. Insert the servo piston rod in the case. Secure the cover with the attaching bolts, taking care to back off the band adjusting screw as the cover bolts are tightened. Make sure that the service identification tag is in place.
7. Raise the transmission high enough to install the engine rear support. Secure the support to the extension housing with the attaching bolts. Lower the transmission as required to install the support-to-crossmember attaching bolt. Torque the attaching bolts to specification as listed at the end of this Part.
8. Remove the jack from the transmission.
9. Adjust the band as detailed in the Adjustment Section of this Part.
10. Lower the vehicle and replenish the fluid as required. Refer to Part 17-01.

Lincoln Continental

Removal

1. Raise the vehicle on a hoist.
2. Place a drain pan under the servo. Remove the bolts that attach the servo cover to the transmission case.
3. Remove the three bolts that attach the manual and downshift control rod splash shield to the frame side rail and remove the shield. Remove the reinforcement plate from under the transmission oil pan.
4. Loosen the band adjusting screw lock nut.
5. Remove the two nuts that attach the engine rear mounts to the crossmember.
6. Place a transmission jack under the transmission and raise it just high enough to remove the weight from the crossmember.
7. Remove the engine rear support-to-extension housing attaching bolts and remove the supports.

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8. Remove the servo cover, piston, spring and gasket from the case, turning the band adjusting screw inward as the piston is removed. This places enough tension on the band to keep the struts properly engaged in the band end notches while the piston is removed.
9. Apply air pressure to the port in the servo cover to remove the piston and rod assembly. If the piston or piston sealing lips are damaged, the complete piston and rod assembly must be replaced.
10. Remove the seal from the cover (Fig. 5).

Installation

1. Dip the new seals in transmission fluid.
2. Install a new seal on the cover.
3. Dip the piston and rod assembly in transmission fluid and install it in the cover.
4. Coat a new gasket with petroleum jelly and position it on the servo cover.
5. Position the servo spring on the piston rod.
6. Insert the servo piston rod in the case. Secure the cover with the attaching bolts taking care to back off the band adjusting screw as the cover bolts are tightened. Make sure that the transmission identification tag is installed under the lower front cover bolt.
7. Adjust the band as detailed in the Adjustment Section of this part.
8. Raise the transmission high enough to install the engine rear supports. Secure the supports to the extension housing with the attaching bolts. Lower the transmission as required to install the two support-to- crossmember nuts. Torque bolts and nuts to limits as given in the Specifications at the end of this Part.
9. Position the manual and downshift control rod splash shield to the frame side rail and secure it with the attaching bolts.
10. Remove the jack from the transmission.
11. Install the reinforcement plate and secure it with the attaching bolts.
12. Lower the vehicle and replenish the fluid as required.

EXTENSION HOUSING BUSHING AND REAR SEAL

Removal

1. Raise the vehicle and disconnect the drive shaft at the transmission.
2. On a Lincoln Continental, remove the parking brake equalizer. Position the equalizer and cables out of the way to obtain free access to the transmission extension housing.
3. When only the rear seal needs replacing, carefully remove it with a tapered chisel or the tools shown in Fig. 6. Remove the bushing as shown in Fig. 7. **Use the bushing remover carefully so that the spline seal is not damaged.**

Installation

1. When installing a new bushing use the special tool shown in Fig. 8.
2. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
3. Inspect the counterbore of the housing for burrs. Remove burrs with crocus cloth.
4. Install the seal into the housing with the tool shown in Fig. 9. The seal should be firmly seated in the bore. Coat the inside diameter of the rubber portion of the seal with C1AZ-19590-B lubricant.
5. Coat the front universal joint spline with C1AZ-19590-B lubricant and install the drive shaft.
6. On a Lincoln Continental, connect the parking brake equalizer.

EXTENSION HOUSING

Removal

1. Raise the vehicle on a hoist or stands.
2. Disconnect the parking brake cable from the equalizer. On a Lincoln Continental remove the equalizer.

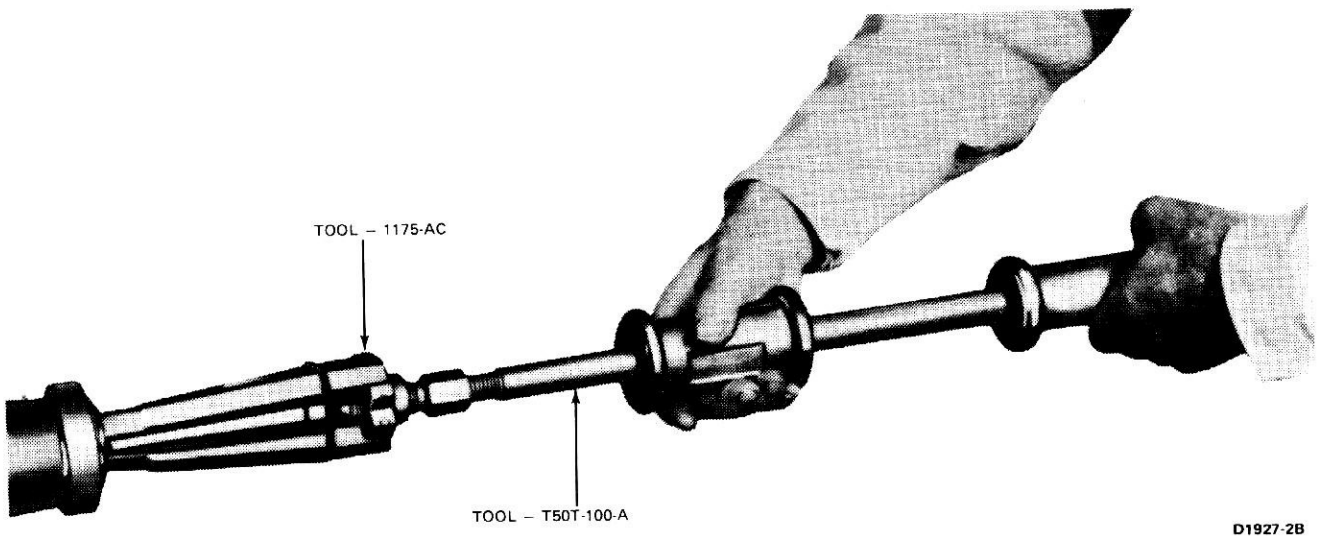


FIG. 6 Removing Extension Housing Seal

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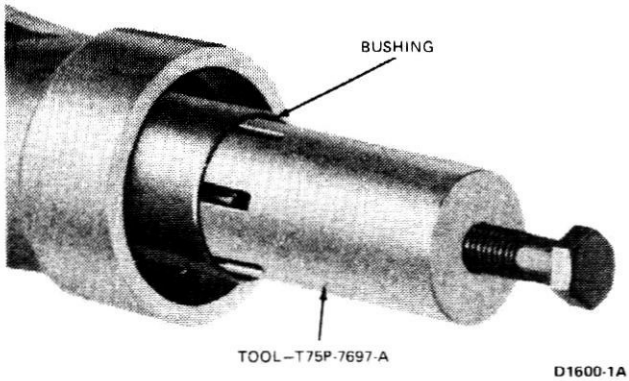


FIG. 7 Removing Extension Housing Bushing

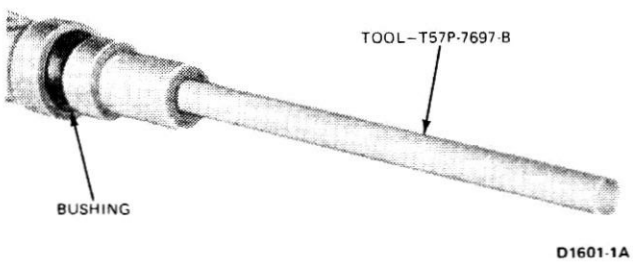


FIG. 8 Installing Extension Housing Bushing

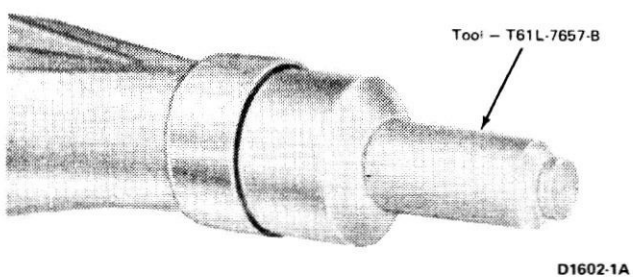


FIG. 9 Installing Extension Housing Seal

3. Disconnect the drive shaft from the rear axle flange and remove it from the transmission.
4. Disconnect the speedometer cable from the extension housing.
5. Remove the engine rear support-to-extension housing attaching bolts. On a Lincoln Continental, remove the reinforcement plate from under the transmission oil pan.
6. Place a jack under the transmission and raise it just enough to remove the weight from the engine rear support.
7. Remove the bolt that secures the engine rear support to the crossmember and remove the support.
8. Place a drain pan under the rear of the transmission case.
9. Lower the transmission and remove the extension housing attaching bolts. Slide the extension housing off the output shaft and allow the fluid to drain.

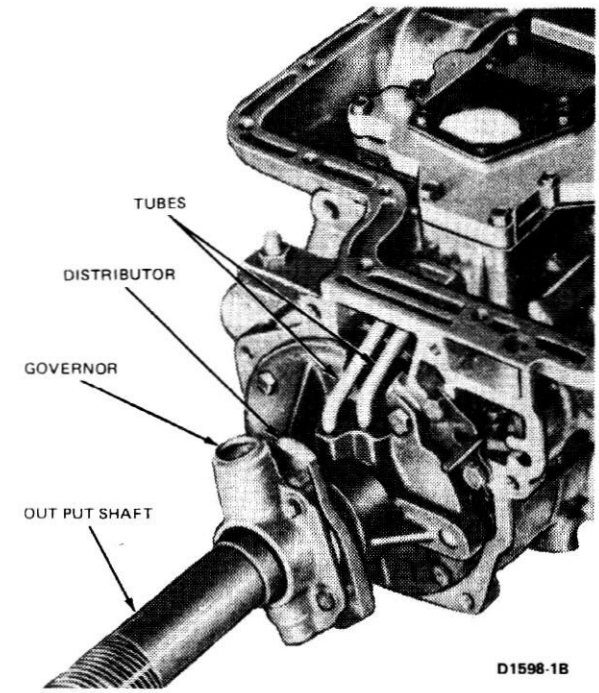


FIG. 10 Governor Installed

Installation

1. Clean the mounting surface on the transmission and on the extension housing. Position a new gasket on the transmission.
2. Hold the extension housing in place and secure it with the attaching bolts.
3. Raise the transmission high enough to position the engine rear support on the crossmember.
4. Secure the support to the crossmember with the attaching bolt and nut. Torque the bolt to specification.
5. Lower the transmission and remove the jack. Install the engine rear support-to-extension housing attaching bolts. Torque the bolts to specification.

   On a Lincoln Continental, install the reinforcement plate and secure it with the attaching bolts.
6. Secure the speedometer cable to the extension housing with the attaching bolt.
7. Connect the parking brake cable to the equalizer. On a Lincoln Continental, connect the parking brake equalizer. Adjust the parking brake as required.
8. Install the drive shaft in the transmission and connect shaft to rear axle flange.
9. Fill the transmission to the correct level with the specified fluid. Refer to Part 17-01.

GOVERNOR

Removal

1. Remove the extension housing as outlined in this section of the manual.
2. Remove the governor-to-distributor attaching bolts (Fig. 10).
3. Remove the governor from the flange.

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4. Refer to the Disassembly and Assembly Section of this Part for governor repair operations.

Installation

1. Secure the governor (Fig. 10) to the distributor flange with the attaching bolts. Torque the bolts to specification.
2. Reinstall the extension housing as outlined in this Part of the manual.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmission must be followed. Following these instructions will avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces. Lubricate all internal parts of the transmission with clean automatic transmission fluid before assembly. Do not use any other lubricants except on gaskets and thrust washers. These may be coated with petroleum jelly to facilitate assembly. Always use new gaskets and seals when assembling a transmission. Refer to Part 17-01 for cleaning and inspection procedures.

Tighten all bolts and screws to the recommended torque as outlined in the Specifications at end of this Part.

Disassembly

1. Mount the transmission in holding fixture T64L-6001-A (Fig. 11).
2. Remove the 17 fluid pan attaching bolts. Remove the pan and gasket.
3. Remove the 8 valve body attaching bolts. Lift the valve body (Fig 12) from the transmission case.
4. Attach a dial indicator to the front pump as shown in Fig. 13. Install tool T61L-7657-B in the extension housing to center the output shaft.
5. Pry the gear train to the rear of the case and at the same time, press the input shaft inward until it bottoms (Fig. 13). Set the dial indicator to read zero.
6. Pry the gear train forward (Fig. 13) and note the amount of gear train end play on the dial indicator. Record the end play to facilitate assembling the transmission. Remove the dial indicator from the pump and the tool from the extension housing.
7. Remove the vacuum diaphragm, rod and the primary throttle valve from the case. Slip the input shaft out of the front pump.
8. Remove the front pump attaching bolts. Pry the gear train forward as shown in Fig. 14 to remove the pump.
9. Loosen the band adjustment screw and remove the two struts.
10. Rotate the band 90 degrees counterclockwise to align the ends with the slot in the case (Fig. 15). Slide the band off the reverse-high clutch drum.
11. Remove the forward part of the gear train as an assembly as shown in Fig. 16.
12. Remove the bolts that attach the servo cover to the transmission case.

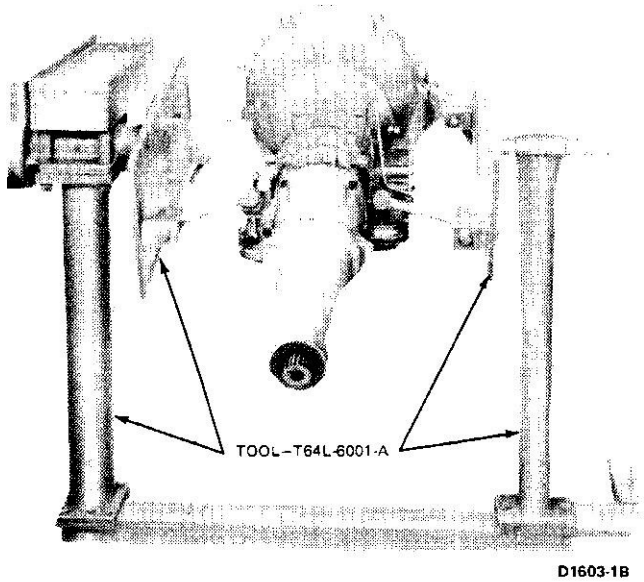


FIG. 11 Transmission Mounted in Holding Fixture

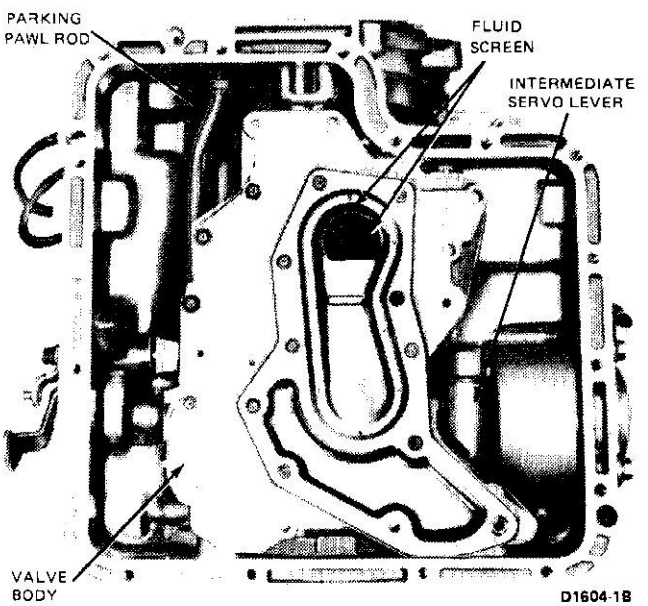


FIG. 12 Transmission With Pan Removed

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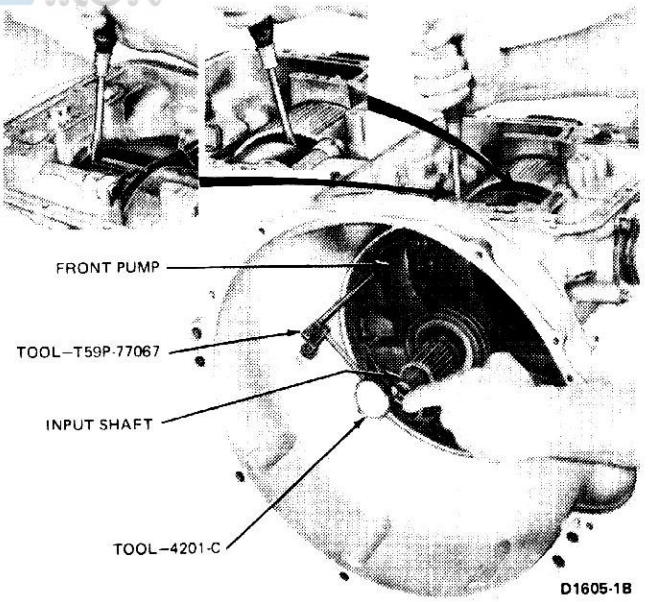


FIG. 13 Checking Gear Train End Play

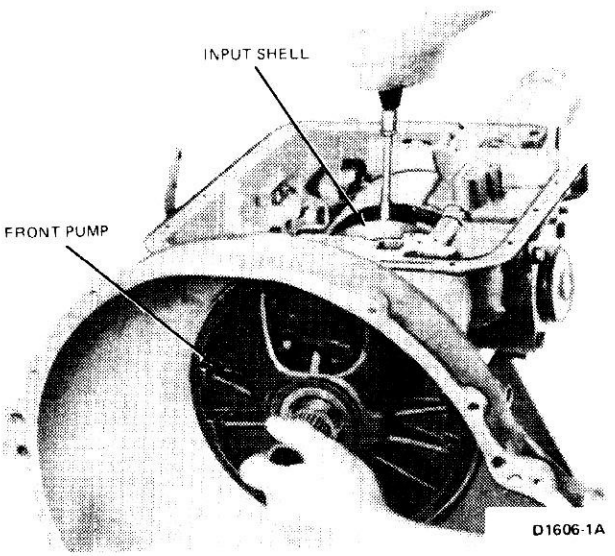


FIG. 14 Removing Front Pump

13. Remove the cover, piston, spring and gasket from the case.
14. Remove the large snap ring that secures the reverse planet carrier in the low-reverse clutch hub. Lift the planet carrier from the drum.
15. Remove the snap ring (Fig. 17) that secures the reverse ring gear and hub on the output shaft. Slide the ring gear and hub off the shaft.
16. Rotate the low-reverse clutch hub in a clockwise direction and at the same time, withdraw it from the case.
17. Remove the reverse clutch snap ring from the case, then remove the clutch discs, plates and pressure plate from the case.
18. Remove the extension housing attaching bolts and vent tube from the case. Remove the extension housing and gasket.
19. Slide the output shaft assembly from the transmission case.

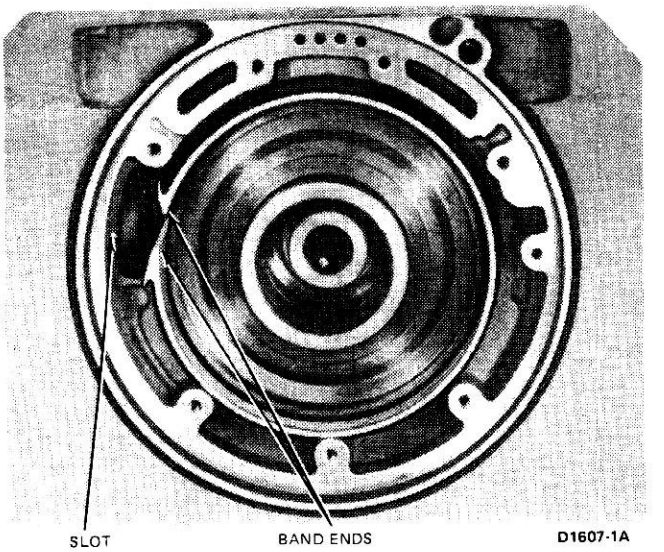


FIG. 15 Removing or Installing Band

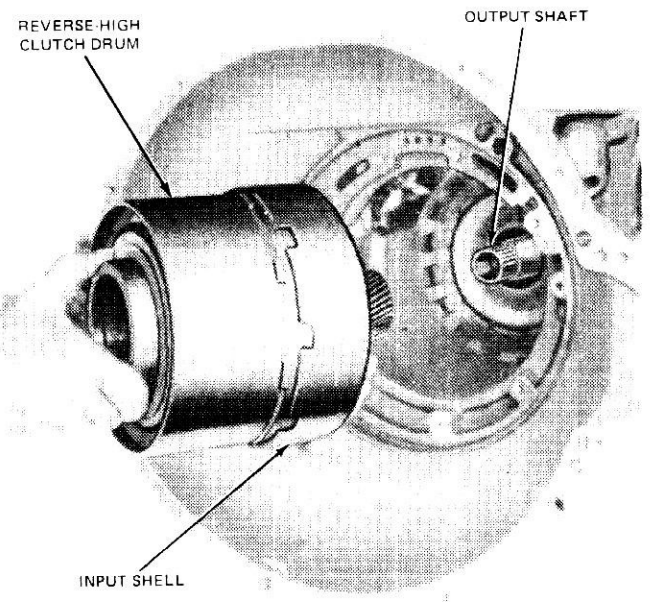


FIG. 16 Removing or Installing Forward Part of Gear Train

20. Remove the distributor sleeve attaching bolts and remove the sleeve, parking pawl gear and the thrust washer. If the thrust washer is staked in place, use a sharp chisel and cut off the metal from behind the thrust washer. Be sure to clean the rear of the case with air pressure or a suitable solvent to remove any metal particles.
21. Compress the reverse clutch piston release spring with Tool T65L-77515-A (Fig. 18). Remove the snap ring. Remove the tool and the springs and retainer assembly.
22. Remove the one-way clutch inner race attaching bolts from the rear of the case. Remove the inner race from inside of the case.
23. Remove the reverse clutch piston from the case as shown in Fig. 19.

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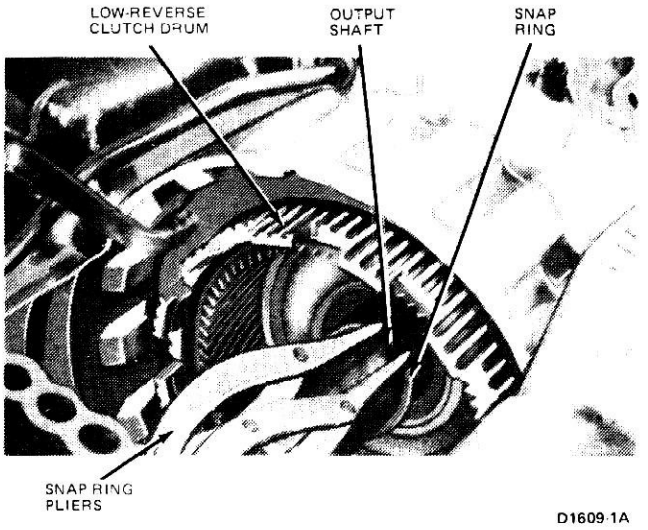


FIG. 17 Removing and Installing Reverse Ring Gear Hub Snap Ring

Assembly

1. Place the transmission case in a holding fixture.
2. Tap the piston into place in the case with a clean rubber hammer.
3. Hold the one-way clutch inner race in position and install the attaching bolts. Torque bolts to limits as given in the specification.
4. Install the low-reverse clutch return spring and retainer assembly in the clutch piston.
5. Position the retainer snap ring in place on the one-way clutch inner race.
6. Install the compressing tool shown in Fig. 18 and compress the springs just enough to install the low-reverse clutch piston retainer snap ring.
7. Install the snap ring, then remove the compressing tool.
8. Place the transmission case on the bench with the front end facing downward.
9. Position the parking gear thrust washer and the gear on the case (Fig. 28). **Do not restake the thrust washer.**
10. Position the oil distributor and tubes in place on the rear of the case. Install attaching bolts and torque to specification.
11. Install the output shaft and governor as an assembly.
12. Place a new gasket on the rear of the transmission case. Position the extension housing on the case and install the attaching bolts. Torque the attaching bolts to specification.
13. Place the transmission case in the holding fixture.
14. Coat two new gaskets with petroleum jelly and position them on the servo cover.
15. Position the servo spring on the piston rod.
16. Insert the servo piston rod in the case. Install the attaching bolts, making sure that the identification tag is in place. Torque the attaching bolts to specification.
17. Align the low-reverse clutch hub and one-way clutch with the inner race at the rear of the case. Rotate the low-reverse clutch hub clockwise while applying pressure to seat it on the inner race.
18. Install the low-reverse clutch plates, starting with the wave plate next to the piston and following with steel and friction plates alternately. Retain them with petroleum jelly. Five (5) steel and five (5) friction plates are required for all models. If new composition plates are being used, soak them in clean transmission fluid (Spec. M2C138CJ) for fifteen minutes before installation. Install the pressure plate and the snap ring. Test the operation of the low-reverse clutch by applying air pressure at the clutch pressure apply hole in the case.
19. Install the reverse planet ring gear thrust washer and the ring gear and hub assembly. Insert the snap ring in the groove in the output shaft.
20. Assemble the front and rear thrust washers onto the reverse planet assembly; retain with vaseline. Insert the assembly into the ring gear and install the snap ring.
21. Set the reverse-high clutch on the bench, with the front end facing down. Install the thrust washer on the rear end of the reverse-high clutch assembly. Retain the thrust washer with petroleum jelly and insert the splined end of forward clutch into the open end of the reverse-high clutch with splines engaging the direct clutch friction plates (Fig. 35).
22. Install the thrust washer and retain it with petroleum jelly, on the front end of the forward planet ring gear and hub. Insert the ring gear into the forward clutch.
23. Install the thrust washer on the front end of the forward planet assembly. Retain the washer with petroleum jelly and insert the assembly into the ring gear. Install the input shell and sun gear assembly.
24. Install the reverse-high clutch, forward clutch, forward planet assembly and drive input shell, and sun gear as an assembly into the transmission case.
25. Insert the intermediate band into the case around the direct clutch cylinder. Install the struts and tighten the band adjusting screw sufficiently to retain the band.
26. Place a selective thickness bronze thrust washer on the rear shoulder of the stator support and retain it with petroleum jelly. If the end play was not within specification when checked prior to disassembly, replace the washer with one of proper thickness. Refer to Specifications for selective thrust washer thicknesses. Using two 5/16-inch bolts three inches long, make two alignment studs. Cut the heads from the bolts and grind a taper on the cut end. Temporarily install the two studs opposite each other in the mounting holes of the case. Slide a new gasket onto the studs. Position pump on case, being careful not to damage the large seal on the OD of the pump housing (Removing the aligning studs). Install six of the seven mounting bolts and torque to specification as listed at the end of this Part.
27. Adjust the intermediate band as detailed under Adjustments, and install the input shaft with the long splined end inserted into the forward clutch assembly.

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28. Install tool 4201-C at the seventh pump mounting bolt (Fig. 13) and check the transmission end play. (See Specification at end of this Part.) Remove the tool. Install the seventh mounting bolt and torque to specifications.
29. Install the main control on the case, making sure that the levers engage the valves properly. Install the primary throttle valve, rod, and the vacuum diaphragm in the case.
30. Install a new pan gasket and the pan. Torque the bolts to specifications.
31. Install the converter assembly.
32. Install the transmission in the vehicle as detailed under Removal and Installation.

CONTROL VALVE BODY

Disassembly

The valve body-to-screen gasket should not be cleaned in a degreaser solvent or any type of detergent solution when disassembling the main control. To clean the gasket, wipe it off with a lint-free cloth.

1. Remove the nine screws that attach the screen to the lower valve body (Fig. 20) and remove screen and gasket (Fig. 21).
2. Remove the five upper-to-lower valve body and hold-down plate attaching screws. Remove the seven attaching screws from the underside of the lower valve body (Fig. 20).
3. Separate the bodies and remove the separator plate and gasket. Be careful not to lose the check valves and springs. Remove and clean the separator plate screen if necessary (Fig. 21).
4. Remove the manual valve plunger retaining pin from the upper valve body and remove the plunger.
5. Slide the manual valve (Fig. 22) out of the valve body.
6. Cover the downshift valve port with a finger; then, working from the underside of the body, remove the downshift valve retainer. Remove the spring and downshift valve (Fig. 22).
7. Apply hand pressure on the pressure boost valve sleeve end and remove the sleeve retaining clip from the underside of the body. Slowly release hand pressure and remove the sleeve and the pressure boost valve. Remove the two springs, the spring retainer and the main regulator valve from the bore.
8. Apply pressure on the throttle boost valve retaining plate and remove the two attaching screws. Slowly release the pressure and remove plate, throttle pressure boost valve and spring, and the manual low 2-1 scheduling valve and spring from the body (Fig. 22).
9. Apply pressure on the remaining valve retaining plate and remove the eight attaching screws.
10. Hold the valve body so that the plate is facing upward. Slowly release the pressure and remove the plate.
11. When removing the various valves from the control valve body, keep all ports covered with your fingers except the bore the valve is being removed from.

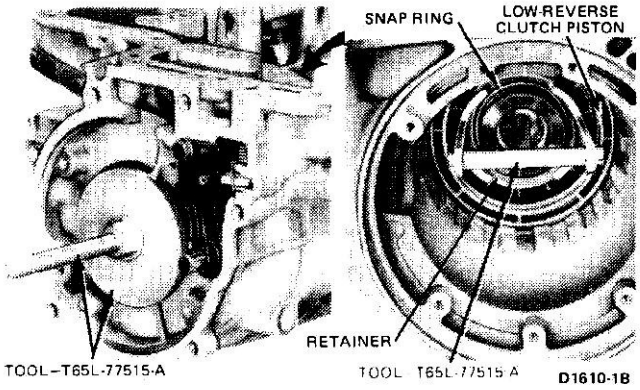


FIG. 18 Compressing Reverse Clutch Springs

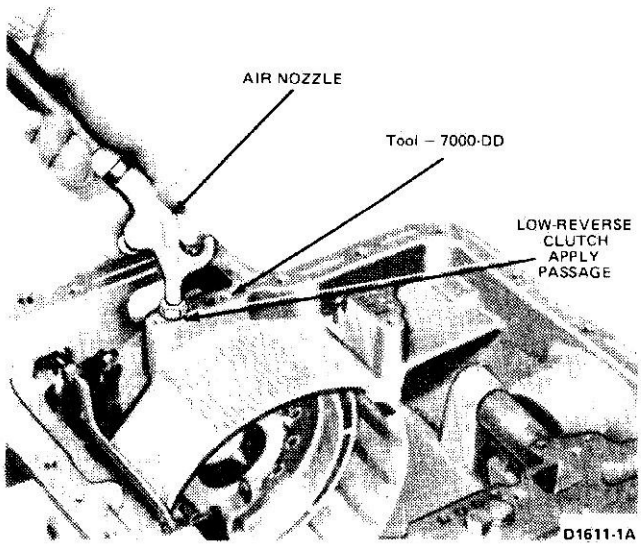


FIG. 19 Removing Low-Reverse Clutch Piston

Remove the spring and the intermediate servo modulator valve (Fig. 22) from the valve body.

12. Remove the intermediate servo accumulator valve and springs.
13. Remove the 2-3 back-out valve, spring, and 3-2 shift timing valve plug. Do not remove the 3-2 shift timing valve plug (Fig. 22) if it is found to be peened, preventing its removal. This condition will not affect transmission operation and is not cause for replacement of the main control.
14. Remove the 2-3 shift valve, spring and the throttle modulator valve.
15. Remove the 1-2 shift valve, DR-2 shift valve and the spring from the valve body.
16. Remove the coasting regulator valve (Fig. 22) from the body.
17. Remove the cutback control valve to complete the disassembly of the control valve.

Assembly

1. Place the 3-2 shift timing valve plug in the valve body if it was previously removed.
2. Place the downshift valve and spring in the valve body. Compress the spring and install the retainer from the underside of the body (Fig. 23).

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3. Place the valve body on a clean surface with the passage side facing up. Place the converter relief valve spring in its bore (Fig. 23). Coat the converter relief valve check valve with petroleum jelly and place it on top of the spring. Place the 2-3 shift check valve ball in its cavity. Place the throttle pressure relief valve spring in its bore (Fig. 23). Coat the throttle pressure relief valve check ball with petroleum jelly and place it on top of the spring.

4. Install the separator screen in the separator plate if it was previously removed. **Be sure the screen tabs are flush with the separator plate surface.** Carefully position the separator plate and new gasket on the lower valve body. Place the two hold-down plates on the separator plate and install the attaching screws finger tight.

5. Place the lower body and plate assembly on the upper valve body (Fig. 20), and install the attaching screws finger tight.

6. Install the oil screen screws loosely, without the screen, to properly align the upper and lower valve bodies, gasket and separator plate.

7. Torque the two bolts that are covered by the screen to specification as listed at the end of this Part.

8. Remove the oil screen attaching screws and place the gasket and oil screen in position on the lower valve body. Reinstall the screen attaching screws (Fig. 20).

9. Torque all the valve body and screen attaching screws to specification as listed at the end of this Part.

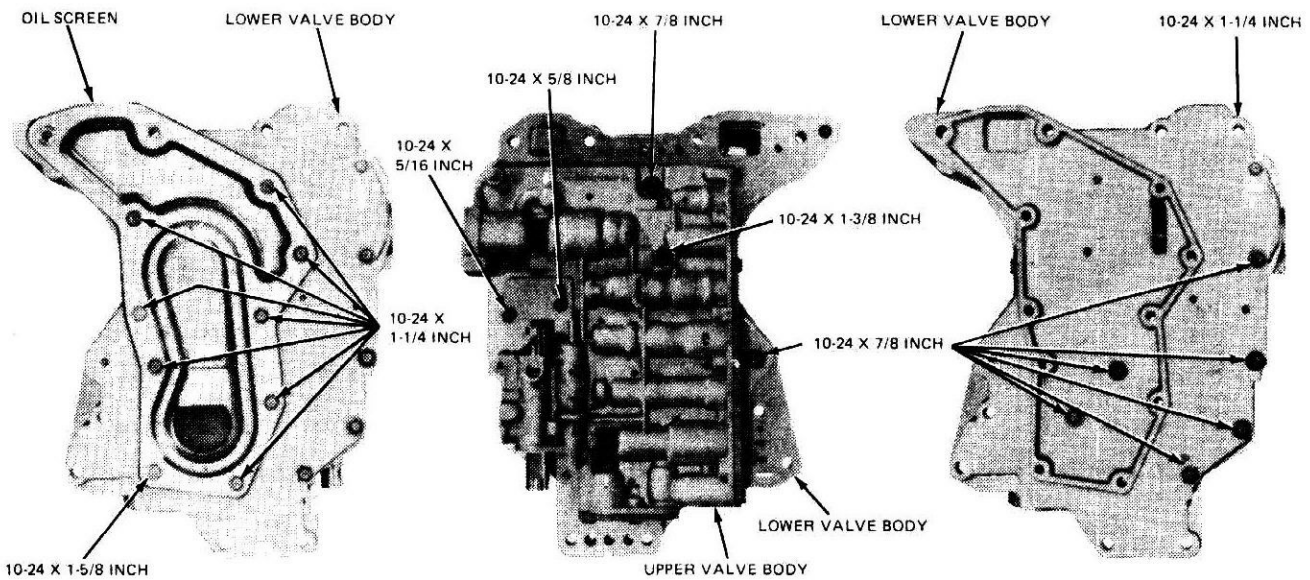


FIG. 20 Control Valve Body and Screen Attaching Screws

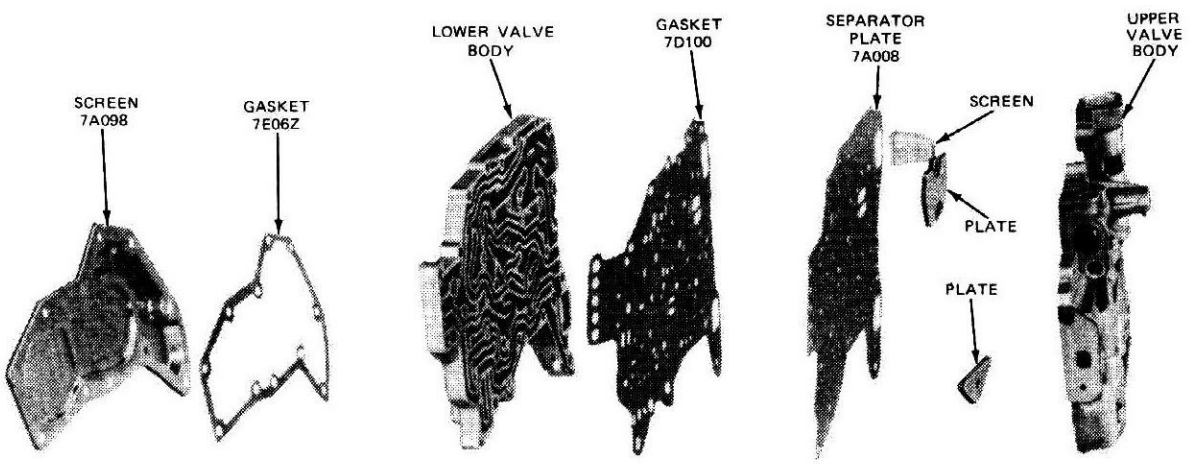


FIG. 21 Upper and Lower Valve Bodies Disassembled

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10. Place the cutback valve (Fig. 22) and coasting regulator valve in the valve body.
11. Place the spring DR-2 shift valve and the 1-2 shift valve in the body.
12. Place the throttle modulator valve and spring and the 2-3 shift valve in the valve body.
13. Place the spring and the 2-3 backout valve in the valve body.
14. Place the two springs and intermediate servo accumulator valve in the valve body.
15. Place the intermediate servo modulator valve and spring in the body.
16. Carefully place the valve retaining plate on the body and secure it with the eight attaching screws. Tighten the screws to specification.
17. Place the throttle pressure boost valve and spring in the valve body. Place the manual low 2-1 scheduling valve and spring in the valve body and install the retaining plate. Torque the attaching screws to specification.
18. Place the spring retainer on the stem of the main regulator valve so that the retainer flange is next to the valve shoulder. Place the main regulator valve, spring retainer, two springs, pressure boost valve and sleeve in the bore. Apply hand pressure on the end of the pressure boost valve sleeve and install the spring clip retainer in the groove on the underside of the body so that the clip is inserted into to end groove in the sleeve. Be sure that the pressure boost valve sleeve is free in its bore.
19. Place the manual valve in the valve body and install the plunger and the retaining pin in the body.

INTERMEDIATE SERVO

Disassembly

1. Apply air pressure to the port in the servo cover to remove the piston and rod.
2. Replace the complete piston and rod assembly if the piston or piston sealing lips are unserviceable or damaged.
3. Remove the seal from the cover.

Assembly

1. Dip the new seals in transmission fluid.
2. Install new seals on the cover. Fig. 24 shows the correct servo piston and cover for the transmission.
3. Dip the piston in transmission fluid and install it in the cover.

GOVERNOR

Disassembly

1. Remove the governor attaching bolts and remove the governor.
2. Remove the snap ring that secures the governor distributor on the output shaft (Fig. 25) and slide it off the front of the shaft.
3. Remove the seal rings from the distributor.

Assembly

1. Carefully install new seal rings on the distributor.
2. Working from the front end of the output shaft, slide the governor distributor into place on the shaft. Install the snap ring to secure it. Make sure that the snap ring is seated in the groove.
3. Position the governor on the distributor (Fig. 25) and secure with the attaching screws.

DOWNSHIFT AND MANUAL LINKAGE

Disassembly

1. Remove the nut and lock washer that secures the outer downshift lever to the transmission and remove the lever.
2. Slide the downshift lever out from the inside of the case (Fig. 26). Remove the seal from the recess in the manual lever shaft.
3. Remove the C-ring that secures the parking pawl actuating rod to the manual lever. Remove the rod from the case.
4. Remove the nut that secures the inner manual lever to the shaft. Remove the inner lever from the shaft. Slide the outer lever and shaft from the case.
5. Remove the seal from the case with Tools T59L-100-B and T58L-101-A.
6. Dip the new seal in transmission fluid and install it in the case as shown in Fig. 27.

Assembly

1. Slide the outer manual lever and shaft in the transmission case.
2. Position the inner lever on the shaft, making sure the leaf spring roller is positioned in the inner manual lever detent. Install the attaching nut. Tighten the nut to specification. Install the parking pawl actuating rod and secure it to the inner manual lever with a C-washer.
3. Install a new downshift lever seal in the recess of the outer lever shaft. Slide the downshift lever and shaft into position.
4. Place the outer downshift lever on the shaft and secure it with a lockwasher and nut.

PARKING PAWL LINKAGE

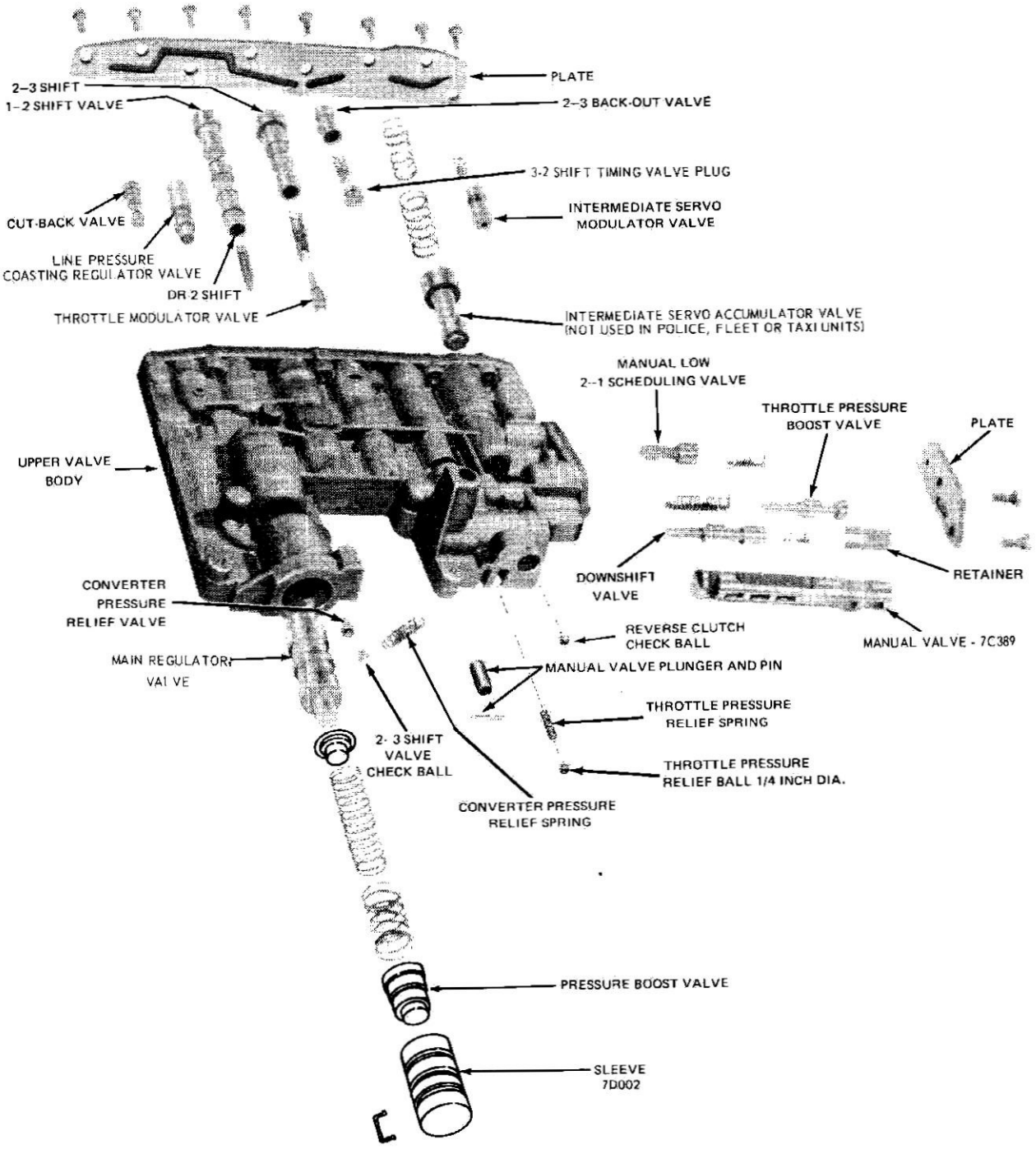
Disassembly

1. Remove the bolts that secure the parking pawl guide plate to the case (Fig. 28). Remove the plate.
2. Remove the spring, parking pawl and shaft from the case.
3. Working from the pan mounting surface, drill a 1/8-inch diameter hole through the center of the cupped plug. Pull the plug from the case with a wire hook.
4. Unhook the end of the spring from the park plate slot to relieve the tension.
5. Thread a 1/4-20 inch or 8-32 x 1-1/4 inch screw (Fig. 29) into the park plate shaft. Pull the shaft from the case with the screw.

Assembly

1. Position the spring and park plate in the case and install the shaft. Place the end of the spring into the slot of the park plate.
2. Install a new cupped plug (Fig. 28) to retain the shaft.

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D1764-2J

FIG. 22 Upper Valve Body Disassembled

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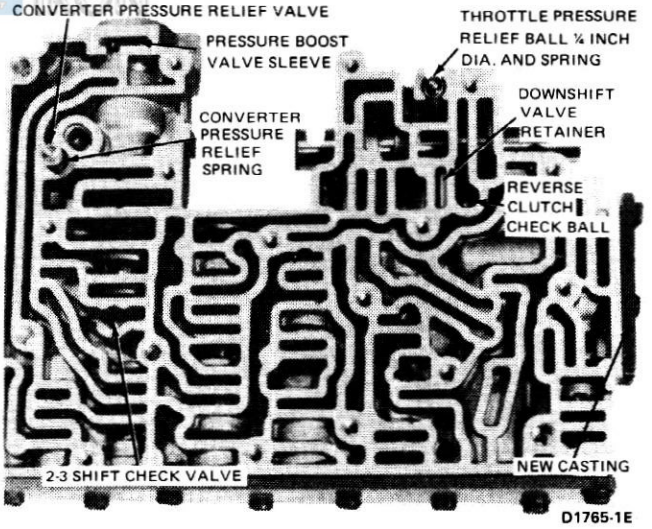
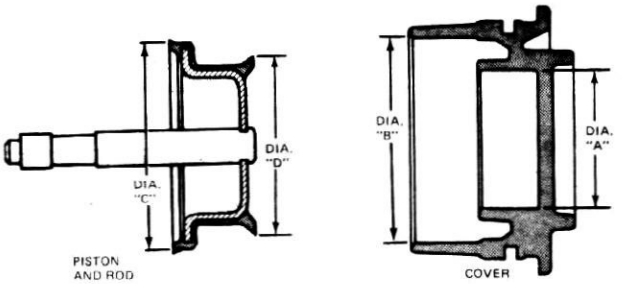


FIG. 23 Converter Pressure Relief Valve, Throttle Pressure Relief Valve, and 2-3 Shift Check Valve Locations



INTERMEDIATE SERVO PISTON AND COVER IDENTIFICATION – 1978

Transmission	Piston		Cover		
	Dia. C	Dia. D	Dia. A	Dia. B	Letter Identification
PJA-BU3	2.960 2.940	1.989 1.969	1.947 1.944	2.917 2.914	N
PJC-H16, -M3 PJD-AM3, -AN3 PJD-AP3	2.909 2.889	2.140 2.122	2.100 2.097	2.866 2.863	P
PJA-C17, -BH3 PJA-H16, -BJ3 PJA-BW3 PJA-C3, -CC	2.909 2.889	2.056 2.036	2.014 2.011	2.866 2.863	S

D2037-1M

FIG. 24 Intermediate Servo Cover and Piston Identification—1978

3. Install the parking pawl shaft in the case. Slip the parking pawl and spring into place on the shaft.
4. Position the guide plate on the case, making sure that the actuating rod is seated in the slot of the plate. Secure the plate with two bolts and lockwashers.

SERVO APPLY LEVER

Disassembly

1. Working from inside of the transmission case, carefully drive on the servo apply lever shaft to remove the cup plug. The shaft (Fig. 30) can be withdrawn from the case by hand.

Assembly

1. Hold the servo apply lever in position and install the new shaft.
2. Using the fabricated tool shown in Fig. 30, drive the cup plug into position in the case. Be sure the plug is flush with the shoulder of the counterbore. The cup plug may be coated with Loctite, Part NO. C3AZ-19554-A, or equivalent before installation.

FRONT PUMP

The front seal can be replaced after the pump has been installed on the transmission (Figs. 31 and 32).

Disassembly

1. Remove the two seal rings and the selective thrust washer (Fig. 33).
2. Remove the large square-cut seal from the O.D. of the pump housing.
3. Remove the 5 bolts that secure the stator support to the pump housing. Lift the support from the housing.
4. Remove the drive and the driven gear from the housing.
5. If the pump housing bushing is worn or damaged, replace it using the handle and tool shown in Fig. 34.

   Place the new bushing in position, making sure the half moon slot in the bushing is on top and in line with the oil lube hole near the seal bore. Press the bushing in 0.060-0.080 inches below the front face of the bushing bore. Use Tool T66L-7003-B9 and handle to seat the bushing properly. After assembly, the half moon slot must be in past the lube hole to provide proper lubrication.

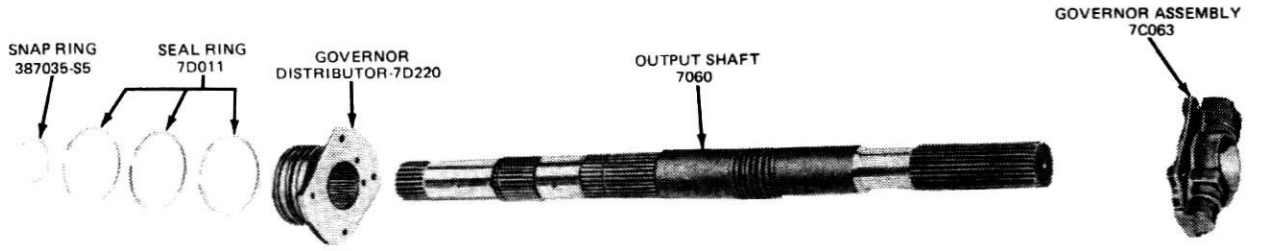


FIG. 25 Output Shaft Disassembled

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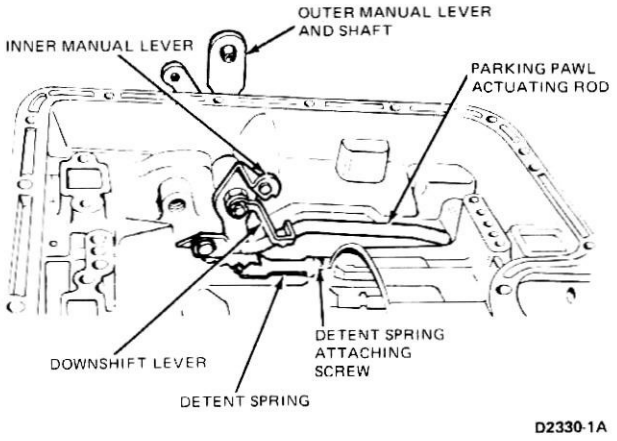


FIG. 26 Downshift and Manual Linkage

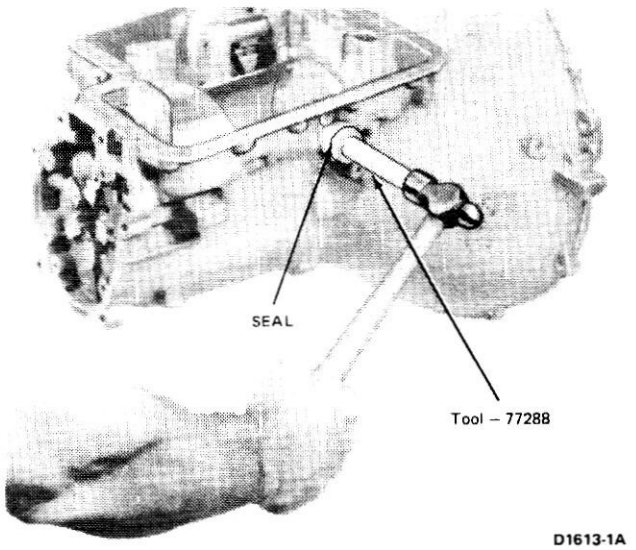


FIG. 27 Installing Manual Lever Seal

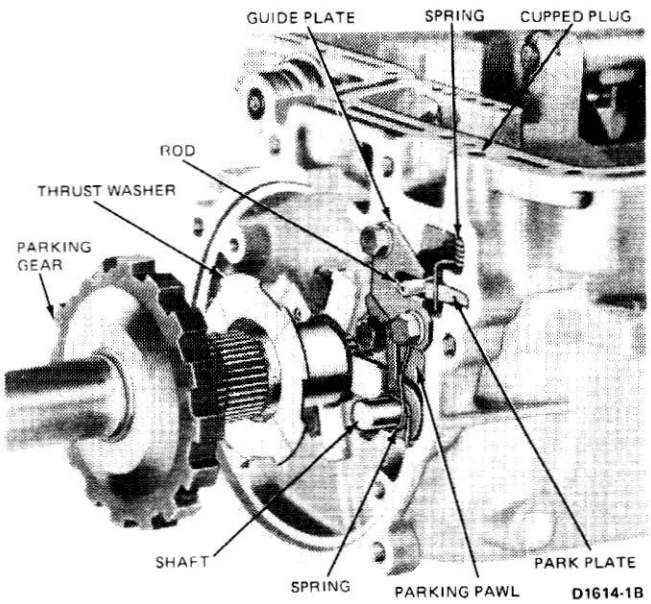


FIG. 28 Parking Pawl Mechanism

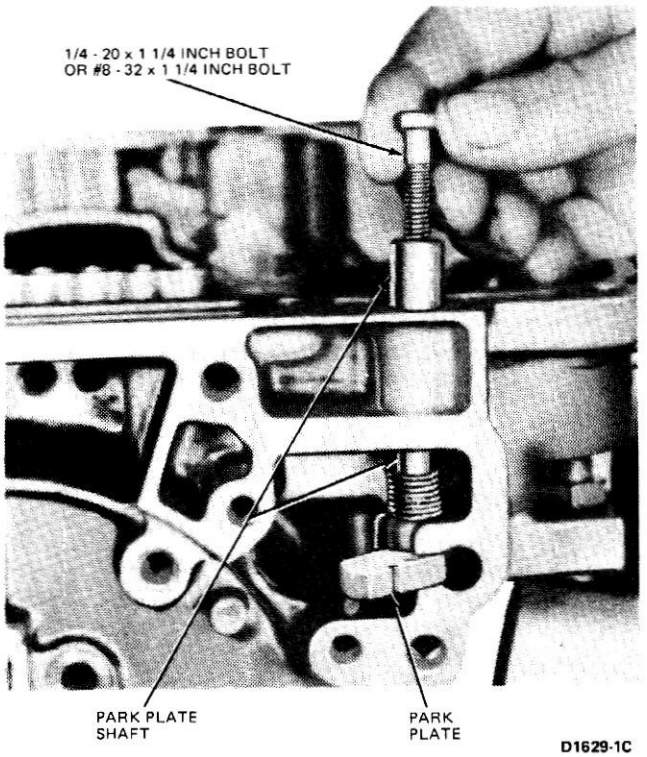


FIG. 29 Removing Park Plate

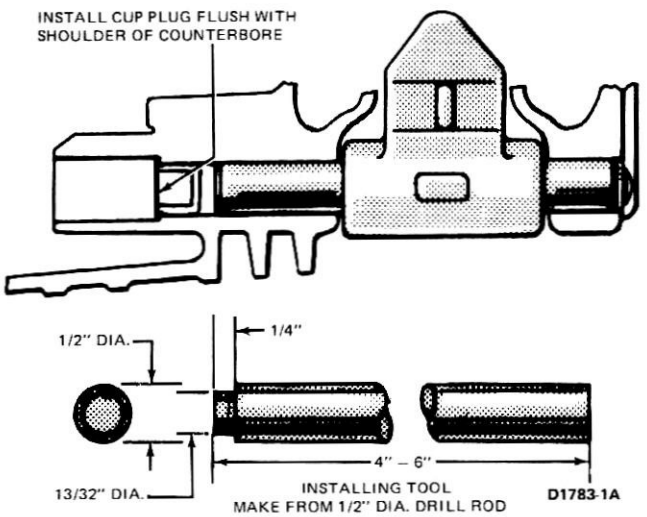


FIG. 30 Servo Apply Lever Installation

Assembly

1. Install the drive and driven gears in the pump housing. Each gear has either an identification mark or chamfered teeth on one face. **The identification mark or the chamfered surface on each gear must be installed toward the front of the pump housing.**
2. Position the stator support in the pump housing and install the five attaching bolts. Torque the bolts to specification as listed at the end of this Part.
3. Carefully install two new seal rings on the pump support. Make sure that the ends of the rings are engaged to lock them in place. Install a new square-cut seal on the O.D. of the pump housing.

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4. Install the selective thrust washer. Make sure that the correct thickness selective washer is being used to obtain the specified end play. Refer to Specifications at end of this Part.
5. Place the pump on the converter, making sure that the drive gear engages the converter hub. Rotate the pump to make sure that the gears rotate freely.

REVERSE-HIGH CLUTCH

Disassembly

1. Separate the drive train as shown in Fig. 35. Remove the pressure plate retaining snap ring as shown in Fig. 36.
2. Remove the pressure plate and the drive and driven clutch plates (Fig. 37).
3. Install Tool T65L-77515-A (Fig. 38) on the reverse-high clutch drum. Make sure that the legs clear the snap ring enough to permit expanding it for removal. Remove the snap ring and remove the tool.
4. Remove the spring retainer and the piston return springs.
5. Apply air pressure to the piston apply hole in the clutch hub (Fig. 39) and remove the piston.
6. Remove the piston outer seal from the piston and the inner seal from the clutch drum (Fig. 37).
7. Remove the front and rear bushings from the clutch drum if they are worn or damaged. To remove the front bushing, use a cape chisel and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.

   To remove the rear bushing, use the tool shown in Fig. 40, and press the bushing from the drum.

Assembly

1. If the clutch drum bushings were removed, position the drum in a press and press new bushings into the drum with the tools shown in Figs. 40 or 41.
2. Dip the new seals in transmission fluid and install one on the drum and one on the piston.
3. Install the piston in the clutch drum.
4. Position the piston return springs in the piston sockets (Fig. 42). Place the spring retainer on the springs.
5. Install Tool T65L-77515-A (Fig. 38) and compress the springs. Make certain that the spring retainer is centered while compressing the springs. Install the snap ring. Before releasing the pressure on the tool, make certain that the snap ring is positioned inside of the four snap ring guides on the spring retainer.
6. Clutch plate usage varies with each model, refer to the Specifications at end of this Part for the number of plates required. Dip the clutch plates in clean transmission fluid. Install the clutch plates alternately starting with a steel drive plate (Fig. 37). **When new composition clutch plates are used, soak the plates in automatic transmission fluid (Specification ESP-M2C138-CJ) for 15 minutes before they are assembled.**
7. After all clutch plates have been installed, position the pressure plate in the clutch drum. Install the pressure plate snap ring.
8. With a feeler gauge, check the clearance between the pressure plate and snap ring (Fig. 43).
9. The pressure plate should be held downward as the clearance is checked. Refer to Specifications at end of this Part for the proper clearance. If the clearance is not within specifications, selective thickness snap rings are available in the following thicknesses: 0.056-0.060, 0.065-0.069, 0.074-0.078, 0.083-0.087, 0.110-0.114, 0.128-0.132, and 0.092-0.096 inch. Install the correct size snap ring and recheck the clearance.

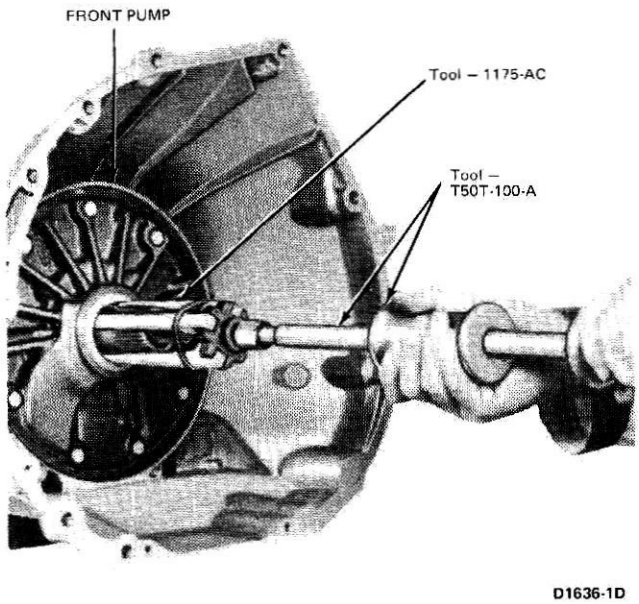


FIG. 31 Removing Pump Seal

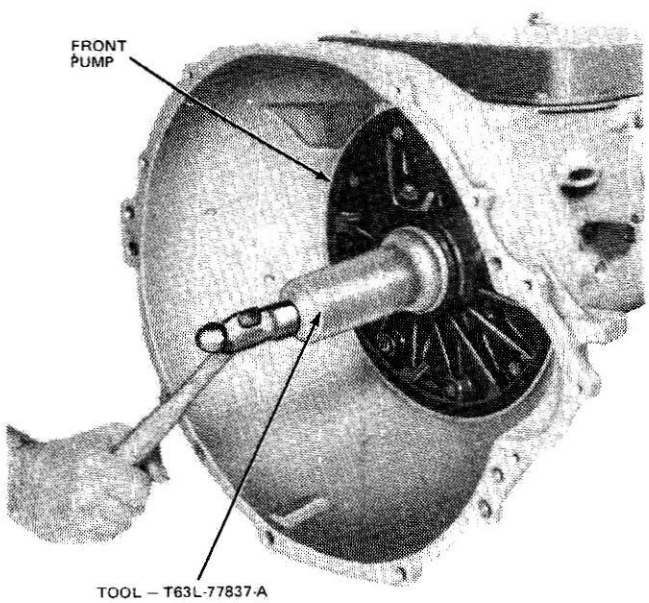


FIG. 32 Installing Front Pump Seal

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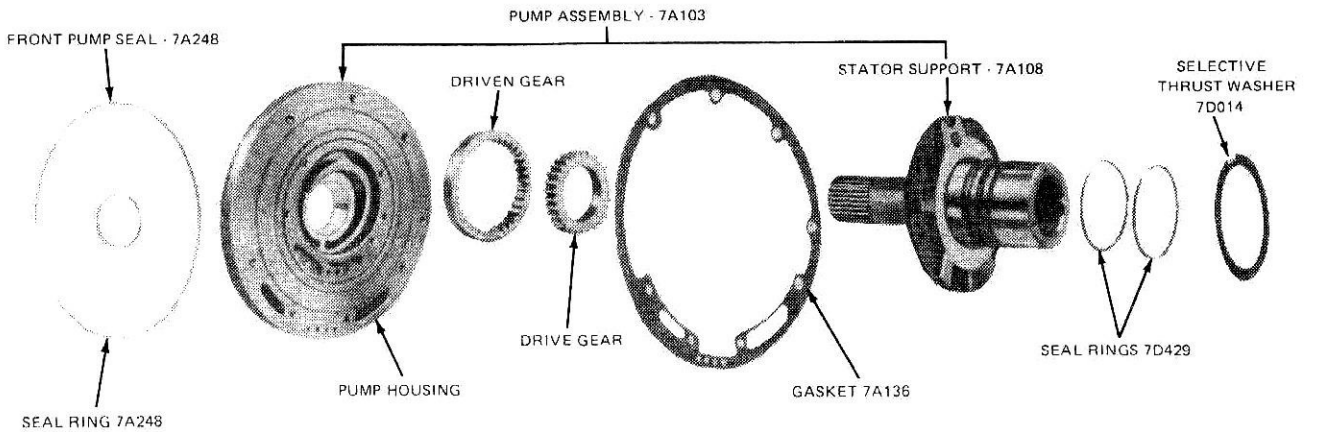


FIG. 33 Front Pump Disassembled

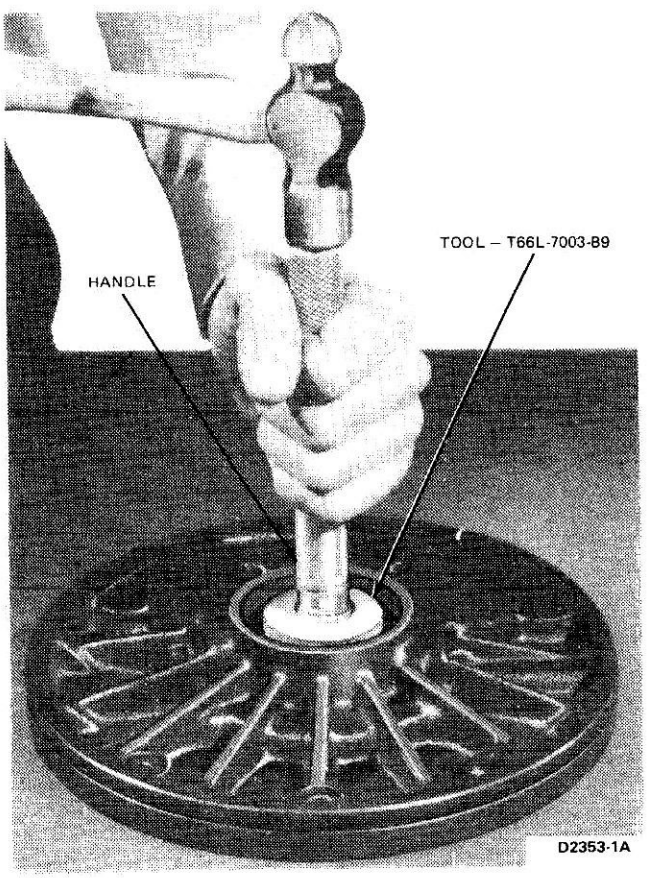


FIG. 34 Replacing Front Pump Housing Bushing

FORWARD CLUTCH

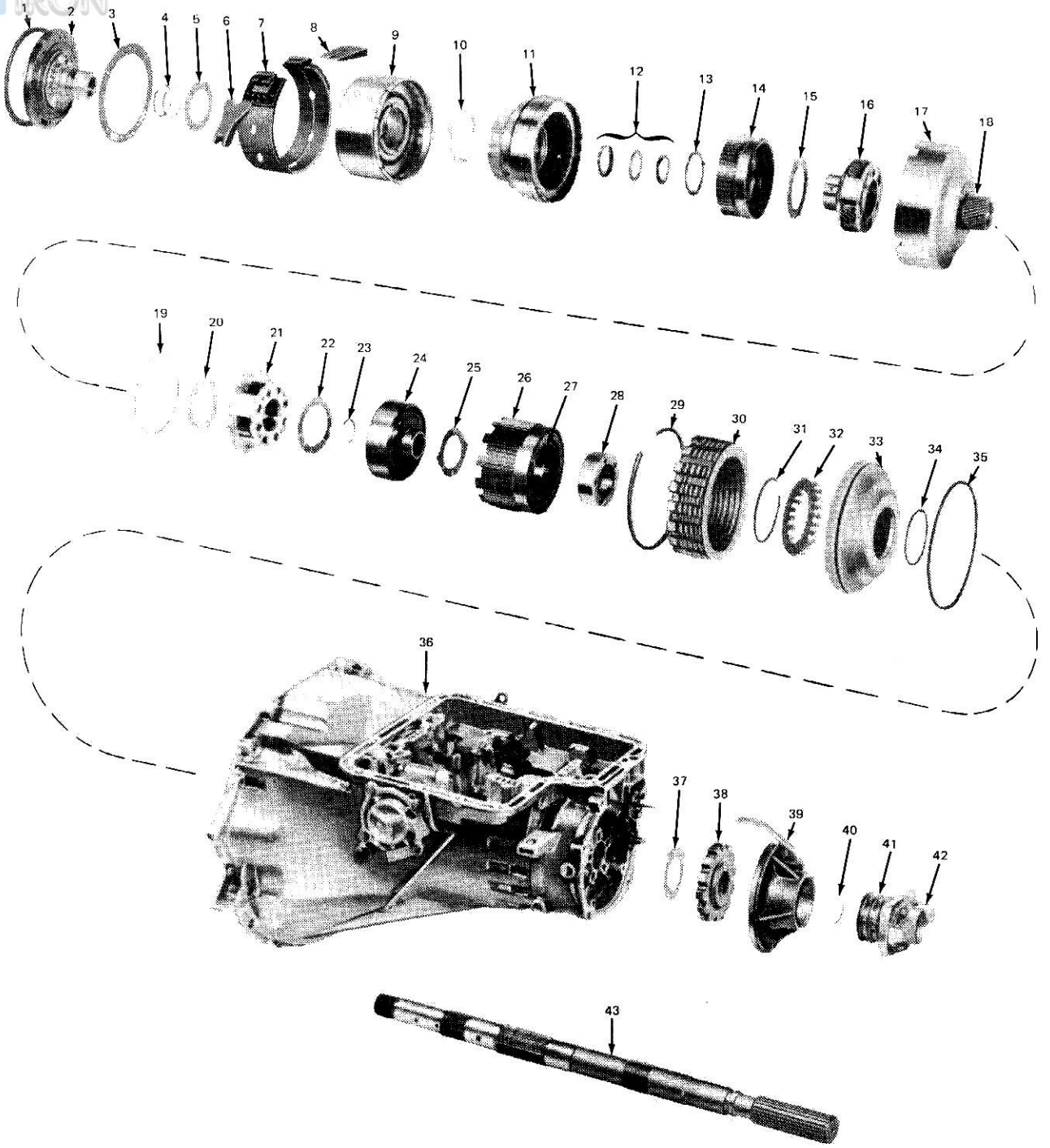
Disassembly

1. Remove the clutch pressure plate snap ring (Fig. 44).
2. Remove the rear pressure plate, the drive and driven plates and the forward pressure plate from the clutch hub (Fig. 45).
3. Remove the snap ring (Fig. 46) that secures the disc spring in the clutch cylinder. Remove the disc spring.
4. Apply air pressure to the clutch apply passage in the cylinder (Fig. 47) to remove the piston.
5. Remove the seal from the piston and the seal from the clutch hub (Fig. 45).

Assembly

1. Dip two new seals in transmission fluid. Install the smaller seal on the clutch hub and the lip seal on the clutch piston. The seal lip must face into the piston bore upon assembly.
2. Install the clutch piston and lip seal in the installation tool (T77L-77548-A) (Fig. 48).
3. Position the installation tool into the forward clutch cylinder, so that the bore of the tool is aligned with the piston bore in the cylinder. Press the piston into the cylinder until it bottoms in the bore. Remove the installation tool.
4. Make sure that the steel pressure ring is in the groove on the piston. **Position the disc spring in the cylinder with the dished face downward.** Install the spring as shown in Fig. 46. Secure the disc with the retaining snap ring.
5. Install the forward pressure plate with the flat side up and the beveled side downward. Dip the clutch plates in clean transmission fluid (Specification ESP-M2C138-CJX). Next, install the wave plate and a composition driven plate. Install the remaining plates in this sequence (Fig. 45). Refer to the Specification at end of this Part for the number of plates required. The last plate installed will be the rear pressure plate. Install the snap ring and make certain that it seats fully in the groove. When new composition clutch plates are used, soak the plates in automatic transmission fluid for 15 minutes before they are assembled.
6. With a feeler gauge, check the clearance between the snap ring and the pressure plate (Fig. 49). Downward pressure on the plate should be maintained when making this check. Refer to Specifications at end of this Part for the proper clearance.
7. If the clearance is not within specifications, selective snap rings are available in the following thicknesses: 0.056 to 0.060, 0.065 to 0.069, 0.074 to 0.078, 0.083 to 0.087 and 0.092 to 0.096, 0.110 to 0.14, 0.128 to 0.132 Inch. Insert the correct size snap ring and recheck the clearance.

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1. FRONT PUMP SEAL RING - 7A248
2. FRONT PUMP - 7A103
3. GASKET - 7A136
4. SEAL
5. NUMBER 1 THRUST WASHER (SELECTIVE)
6. STRUT INTERMEDIATE BRAKE BAND - 7D029
7. INTERMEDIATE BRAKE BAND ASSEMBLY - 7D029
8. STRUT INTERMEDIATE BRAKE BAND ANCHOR - 7D430
9. REVERSE – HIGH CLUTCH ASSEMBLY
10. NUMBER 2 THRUST WASHER
11. FORWARD CLUTCH ASSEMBLY
12. NUMBER 3 THRUST WASHER
13. NUMBER 4 THRUST WASHER
14. FORWARD CLUTCH HUB ASSEMBLY - 7D392
15. NUMBER 5 THRUST WASHER
16. FORWARD PLANET ASSEMBLY - 7A398
17. INPUT SHELL - 7D064 AND SUN GEAR ASSEMBLY - 7D063
18. NUMBER 6 THRUST WASHER
19. SNAP RING
20. NUMBER 7 THRUST WASHER
21. REVERSE PLANET ASSEMBLY - 7D006
22. NUMBER 8 THRUST WASHER
23. REVERSE RING GEAR AND HUB RETAINING RING
24. REVERSE RING GEAR - 7A153 AND HUB - 7D164
25. NUMBER 9 THRUST WASHER
26. LOW–REVERSE CLUTCH HUB - 7B067
27. ONE-WAY CLUTCH - 7A089
28. ONE-WAY CLUTCH INNER RACE - 7D171
29. SNAP RING
30. LOW–REVERSE CLUTCH
31. SNAP RING
32. LOW–REVERSE PISTON RETURN SPRING AND RETAINER - 7D406
33. LOW-REVERSE PISTON - 7D402
34. INNER SEAL
35. OUTER SEAL
36. CASE - 7005
37. NUMBER 10 THRUST WASHER
38. PARKING GEAR - 7A233
39. GOVERNOR DISTRIBUTOR SLEEVE - 7C232
40. SNAP RING
41. GOVERNOR DISTRIBUTOR - 7D220
42. GOVERNOR - 7C063
43. OUTPUT SHAFT - 7060

D1620-2D

FIG. 35 Drive Train Disassembled—Typical

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INPUT SHELL AND SUN GEAR

Disassembly

1. Remove the external snap ring from the sun gear as shown in Fig. 50.

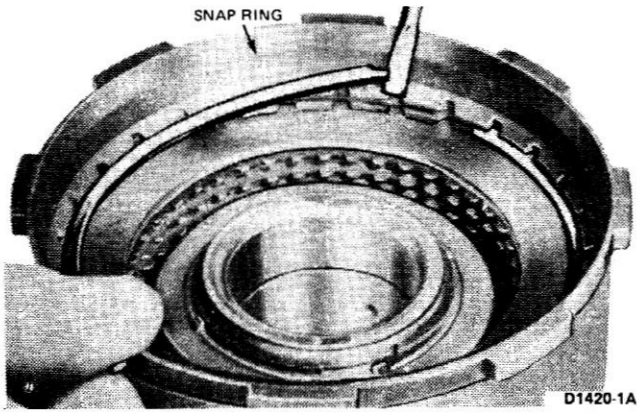


FIG. 36 Removing or Installing Reverse-High Clutch Pressure Plate Snap Ring

2. Remove the thrust washer from the input shell and sun gear (Fig. 51).
3. Working from inside the input shell remove the sun gear. Remove the internal snap ring from the gear.

Assembly

1. Install the forward snap ring on the forward end (short end) of the sun gear (Fig. 51). Working from inside the input shell, slide the sun gear and snap ring into place making sure that the longer end is at the rear (Fig. 51).
2. Place the No. 6 thrust washer on the sun gear and install the rear snap ring.

OUTPUT SHAFT HUB AND RING GEAR

Disassembly

1. Remove the hub snap ring (Fig. 52) from the ring gear.
2. Lift the hub from the ring gear.

Assembly

1. Position the hub in the ring gear.

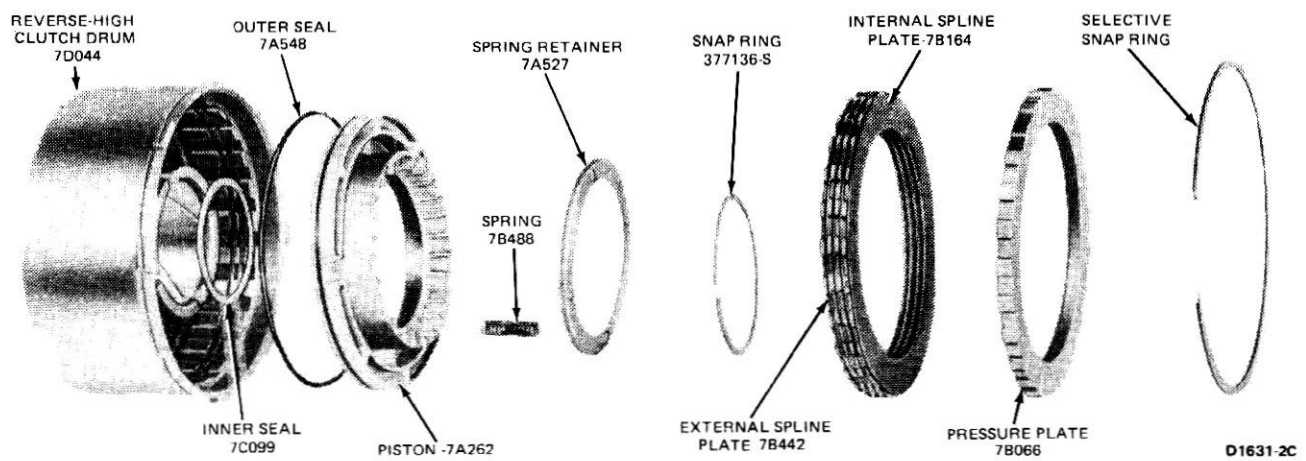


FIG. 37 Reverse-High Clutch Disassembled

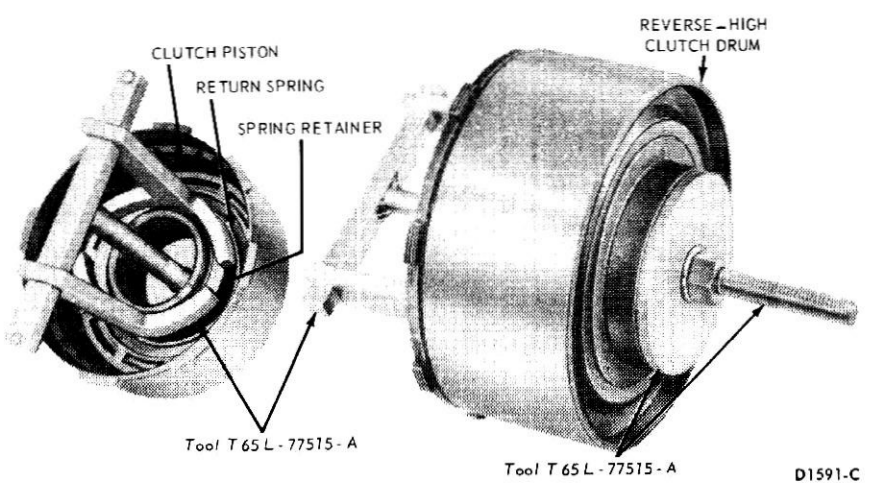


FIG. 38 Removing or Installing Reverse-High Clutch Piston Snap Ring

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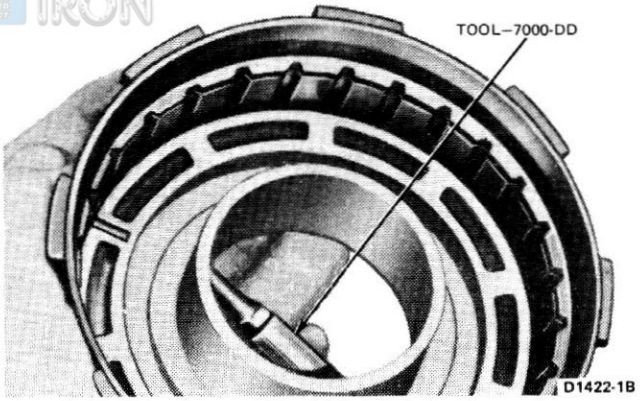


FIG. 39. Removing Reverse-High Clutch Piston

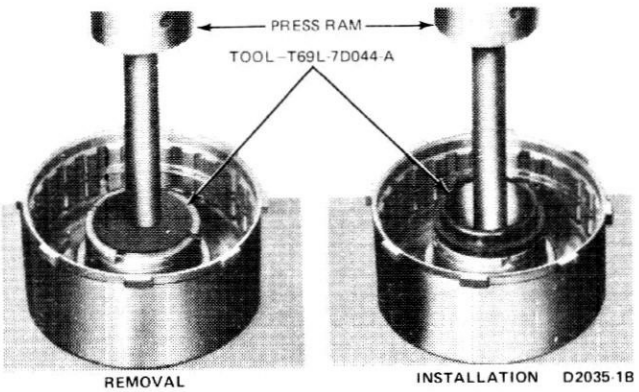


FIG. 40 Replacing Reverse-High Clutch Rear Bushing

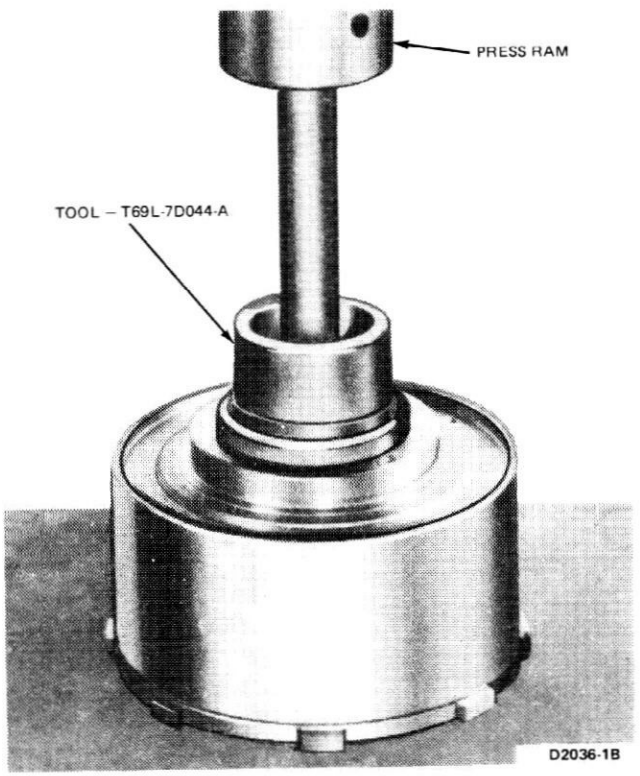


FIG. 41 Installing Reverse-High Clutch Front Bushing

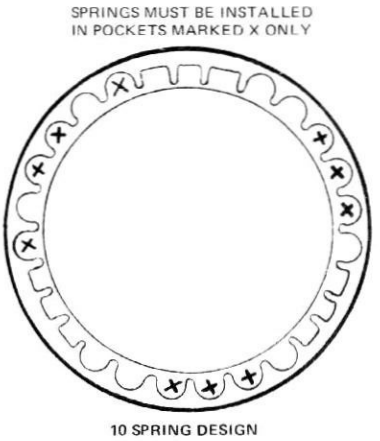


FIG. 42 Reverse-High Clutch Piston Return Spring Locations

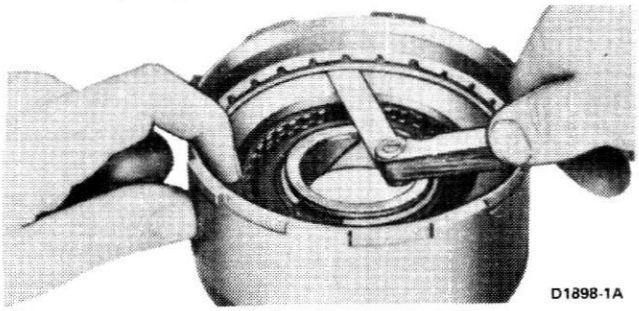


FIG. 43 Checking Reverse-High Clutch Snap Ring Clearance

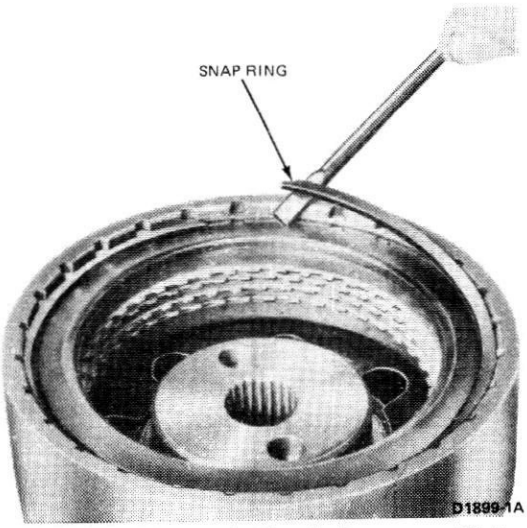


FIG. 44 Removing Forward Clutch Pressure Plate Snap Ring

2. Secure the hub with the snap ring. Make certain that the snap ring is fully engaged with the groove.

ONE-WAY CLUTCH

Disassembly

1. Remove the snap ring and bushing from the rear of the low-reverse clutch hub (Fig. 53).
2. Remove the rollers from the spring assembly and lift the spring assembly from the hub.

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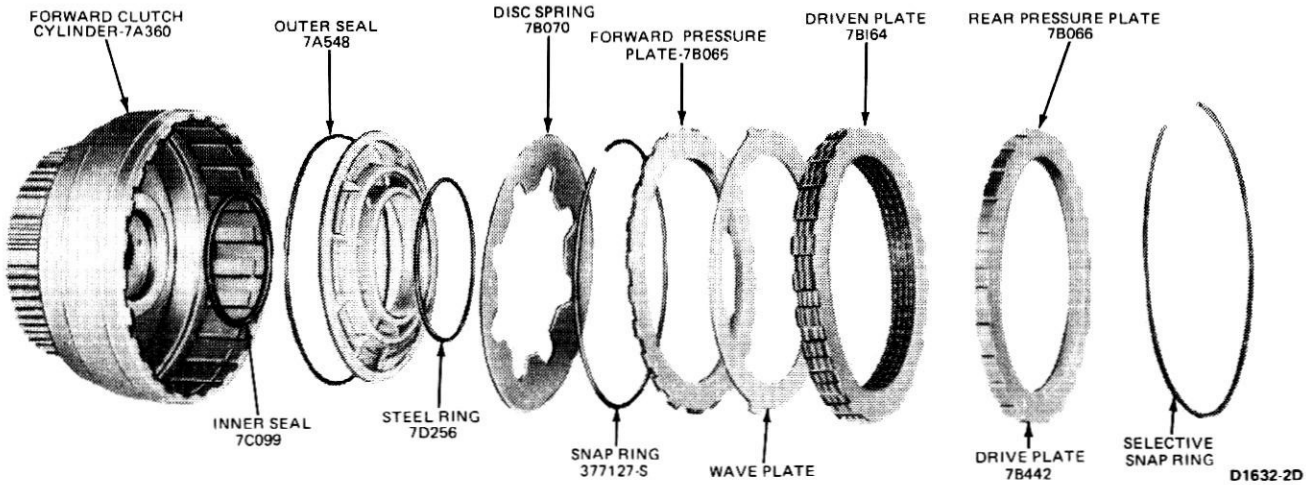


FIG. 45 Forward Clutch Disassembled

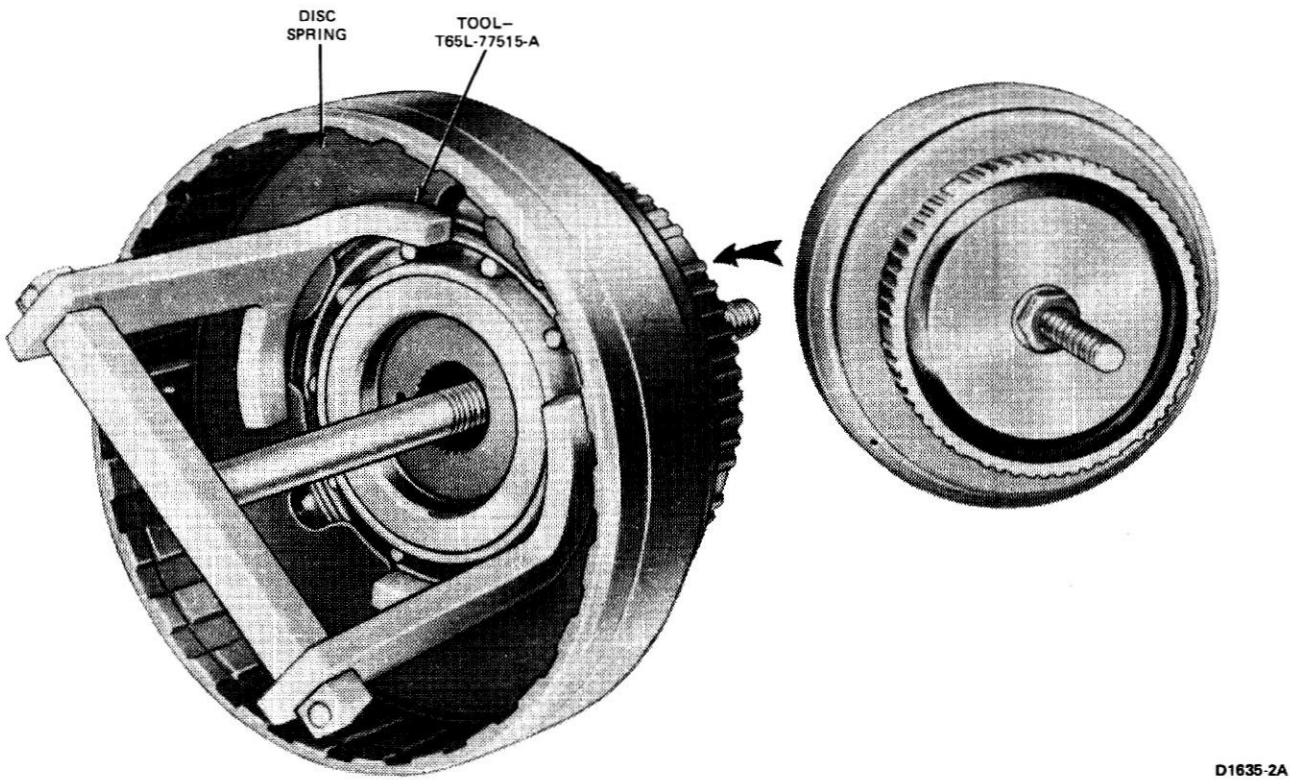


FIG. 46 Removing or Installing Disc Spring

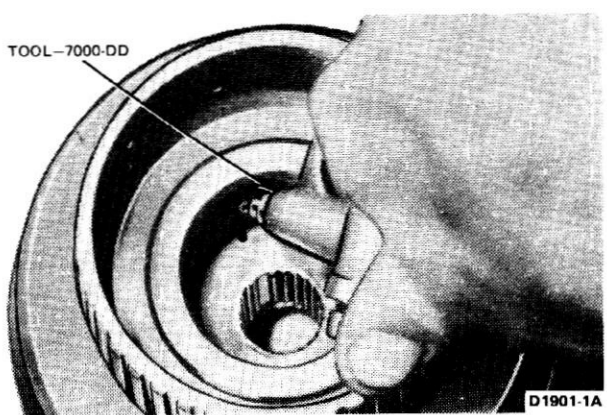


FIG. 47 Removing Forward Clutch Piston

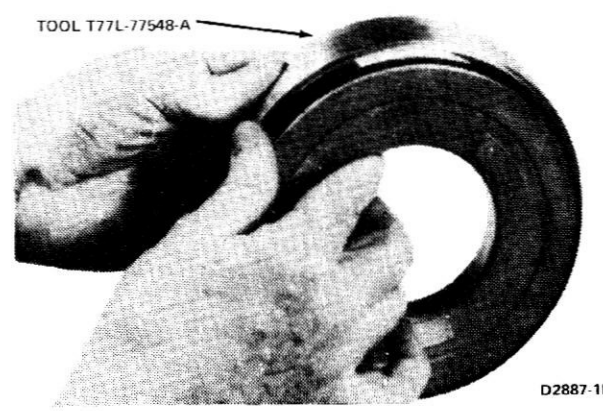


FIG. 48 Installing Forward Clutch Piston

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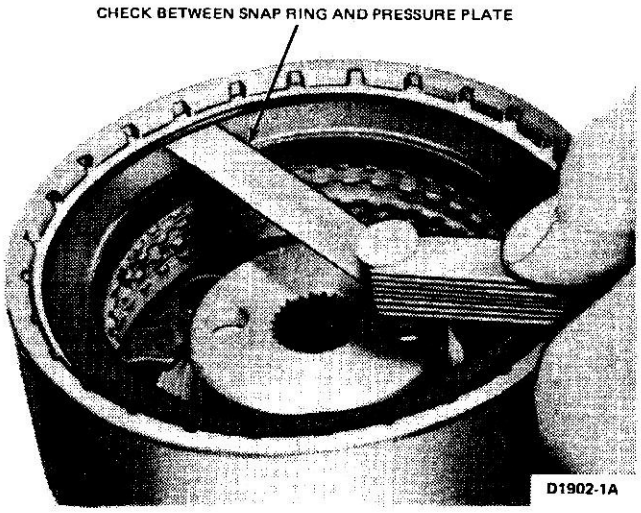


FIG. 49 Checking Forward Clutch Clearance

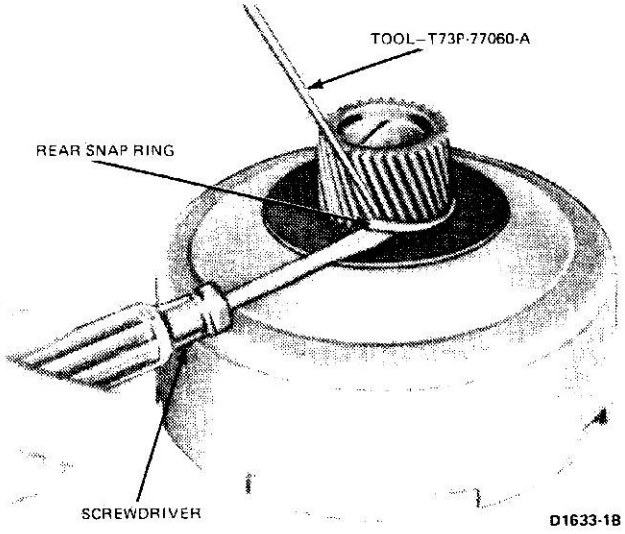


FIG. 50 Removing Sun Gear Snap Ring

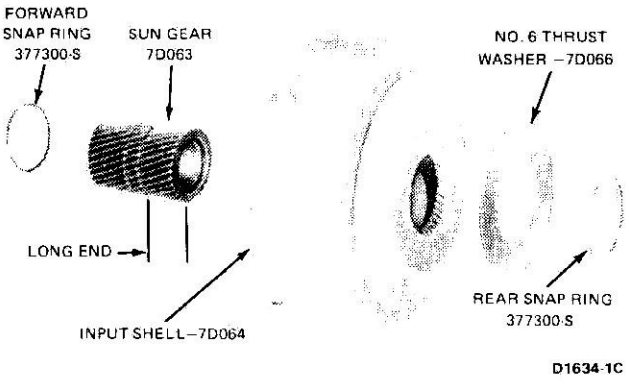


FIG. 51 Input Shell and Sun Gear Disassembled

3. Remove the remaining snap ring from the hub.

Assembly

1. Install a snap ring in the forward snap ring groove of the low-reverse clutch hub.

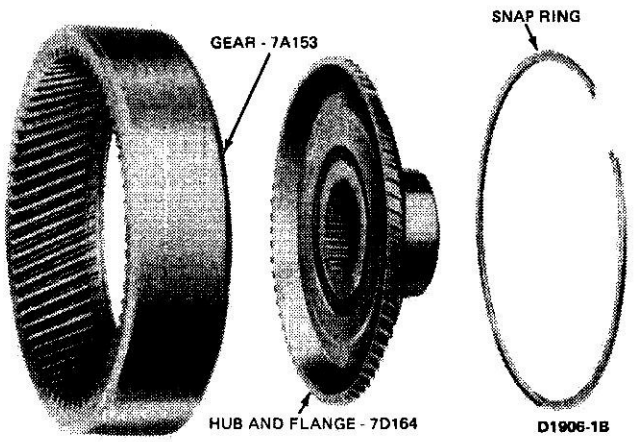


FIG. 52 Output Shaft Hub and Ring Gear

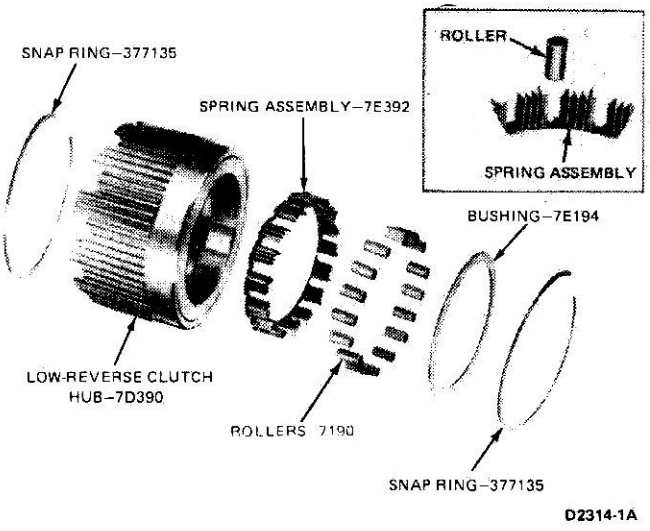


FIG. 53 One-Way Clutch Disassembled

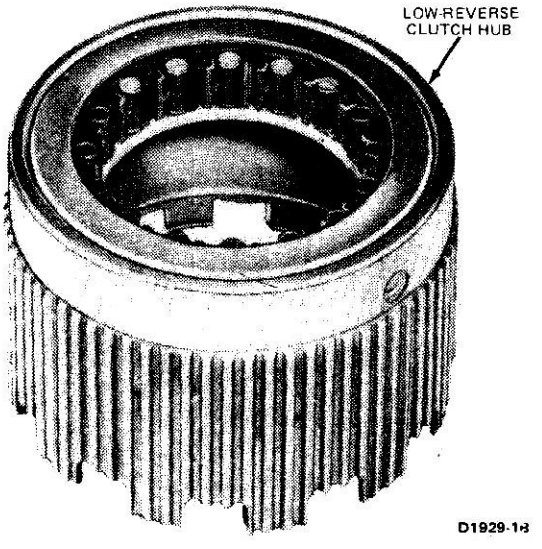


FIG. 54 One-Way Clutch Installed

2. Place the low-reverse clutch hub on the bench with the forward end down (Fig. 54).
3. Install the one-way clutch spring assembly on top of the snap ring.

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4. Install a roller into each of the spring assembly compartments (Fig. 53).
5. Install the bushing on top of the spring assembly.
6. Install the remaining snap ring at the rear of the low-reverse clutch hub to secure the assembly (Fig. 53).

LOW-REVERSE CLUTCH PISTON

Disassembly

1. Remove the inner and the outer seal from the reverse clutch piston.

Assembly

1. Dip the two new seals in clean transmission fluid.
2. Install the seals on the piston.

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DETROIT IRON

SPECIFICATIONS

APPROXIMATE REFILL CAPACITIES C6 TRANSMISSION

	U.S. Measure	Imp. Measure
All Models	12-1/4 qts.	10-1/4 qts.

SELECTIVE THRUST WASHERS C6 TRANSMISSION

Identification Color	Thrust Washer Thickness—Inch
Blue	0.056-0.060
Natural (White)	0.073-0.077
Red	0.088-0.092

CLUTCH PLATES – C6 TRANSMISSION

Transmission Model	Steel Plates	Friction Plates
Forward Clutch Plates – All	4	4
High Clutch Plates – All Except PJC-H, -N	3	3
PJC-H, -M	4	4
Reverse Clutch Plates - All	5	5

SPECIAL TOOLS – C6 TRANSMISSION

Ford Tool No.	Description	Ford Tool No.	Description
TOOL-1175-AC	Grease Seal Remover (Head Only)	T61L-7657-B	Transmission Extension Housing Oil Seal Replacer
T50T-100-A and TOOL-1175-AC	Seal Remover	T57P-7697-A	Transmission Extension Housing Bushing Remover
T59L-100-B and T58L-101-A	Slide Hammer and Puller	T57P-7697-B	Transmission Extension Housing Bushing Replacer
TOOL-4201-C	Differential Backlash and Runout Gauge, with Universal Bracket, Dial Indicator and Bracket	T59P-77067	Dial Indicator Support Fixture
		TOOL-77288	Control Shaft Seal Replacer
		T71P-77370-A	Band Adjustment Kit
TOOL-7000-DD	Air Nozzle Rubber Tip Assembly		Band Adjustment Torque Wrench
T66L-7003-B9	Front Pump Bushing Replacer	T65L-77515-A	Rear Clutch Spring Compressor
T69P-7D044	Automatic Transmission Bushing Kit Remover and Replacer	T77L-77548-A	Forward Clutch Piston Lip Seal Installer
		T63L-77837-A	Front Pump Seal Replacer
T64P-7A128-A	Manual Valve Detent Spring		

CHECKS AND ADJUSTMENTS C6 TRANSMISSION

Operation	Specification
Transmission End Play	0.008-.042 (Selective Thrust Washers Available)
Turbine and Stator End Play	New or rebuilt 0.021 max. Used 0.040 max. (1)
Intermediate Band Adjustment	Remove and discard lock nut. Adjust screw to 10 ft-lbs torque, then back off 1-1/2 turns, install new lock nut and tighten lock nut to 40 ft-lb.
Forward Clutch Pressure Plate to Snap Ring Clearance	0.021-0.046
Selective Snap Ring Thicknesses	0.056-0.060, 0.065-0.069, 0.074-0.078, 0.083-0.087, 0.092-0.096, 0.110-0.114, 0.128-0.132
Reverse High Clutch Pressure Plate to Snap Ring Clearance	0.022-0.036 0.027-0.043
Selective Snap Ring Thicknesses	0.056-0.060, 0.065-0.069, 0.074-0.078, 0.083-0.087, 0.092-0.096

(1) To check end play, exert force on checking tool to compress turbine to cover thrust washer wear plate. Set indicator at zero.

TORQUE LIMITS

C6 TRANSMISSION

Item	Ft-Lbs
Converter to Flywheel	20-30
Front Pump to Trans Case	16-30
Overrunning Clutch Face to Case	18-25
Oil Pan to Case	12-16
Stator Support to Pump	12-16
Diaphragm Ret. Clip to Case	12-16
Guide Plate to Case	12-16
Intermediate Servo Cover to Case	14-20
Distributor Sleeve to Case	12-16
Extension Assy. to Trans. Case	25-35
Oil Connector to Case	10-14
Item	**In-Lbs**
End Plates to Body	20-45
Inner Downshift Lever Stop	20-45
Reinforcement Plate to Body	20-45
Screen and Lower Body to Upper Valve Body	40-55

Item	Ft-Lbs
Pressure Gauge Tap	6-12
Band Adj. Screw Locknut to Case	35-45
Cooler Tube Connector Lock	20-35
Converter Drain Plug	14-28
Manual Valve Inner Lever to Shaft	30-40
Downshift Lever to Shaft	12-16
Filler Tube to Engine	20-25
Transmission to Engine	40-50
Engine Rear Cover to Conv. Hsg.	20-30
Oil Line Connector to Case Fitting	12-18
Item	**In-Lbs**
Control Assy to Case	95-125
Gov. Body to Collector Body	80-120
Detent Spring to Case	80-120
Converter Cover to Converter Hsg.	30-60

CD2315-2H

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FMX Automatic Transmission

PART 17-15

Applies To Ford/Mercury/LTD II/Thunderbird/Cougar

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CD2886-2A

DESCRIPTION

The FMX transmission is a three speed unit capable of providing automatic upshifts and downshifts through the three forward gear ratios. The transmission is also capable of providing manual selection of first and second gears.

Fig. 1 shows the location of the converter, front pump, clutches, bands, gear train and most of the internal parts used in the FMX Transmission.

The identification tag (Fig. 2) on the FMX transmission is attached under the lower right hand extension-to-case bolt. The tag includes the model prefix and suffix, build date code and serial number. The first line on the tag shows the transmission model prefix and suffix. A number appearing after the suffix (Fig. 2) indicates that the internal parts in the transmission have been changed after initial production startup. For example, a PHA-F model transmission that has been changed internally would read PHA-F1. Both transmissions are basically the same, but some service parts in the PHA-F1 transmission are slightly different than the PHA-F transmission. **Therefore, it is important that the codes on the transmission identification tag be checked when ordering parts or making inquiries about the transmission.**

The tag must be kept with the individual transmission it was originally installed on. If the tag was removed during disassembly, reinstall it on the same unit.

The transmission consists essentially of a torque converter, planetary gear train, two multiple disc clutches and a hydraulic control system (Fig. 3).

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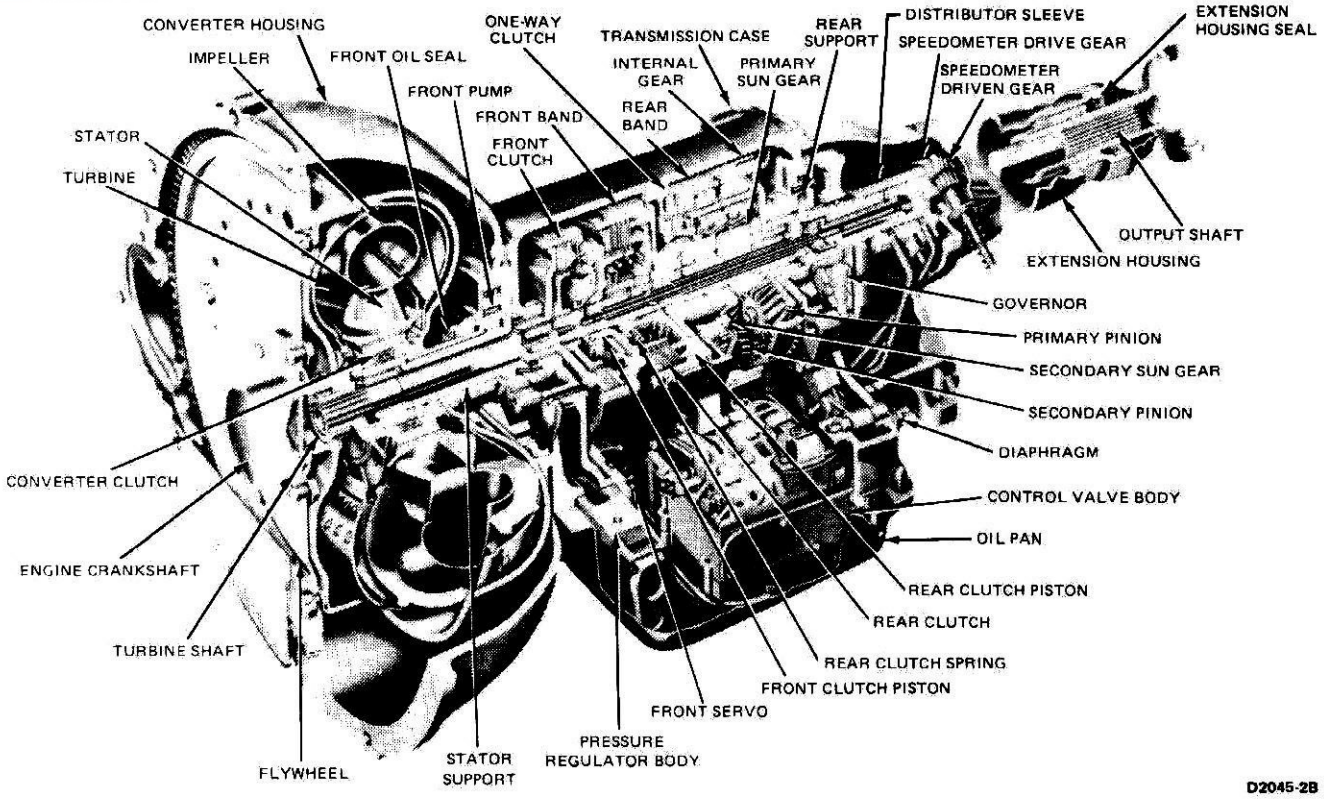


FIG. 1 FMX Transmission—Typical

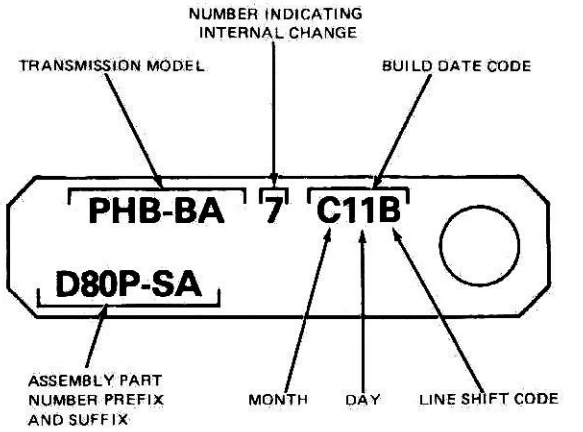


FIG. 2 Identification Tag

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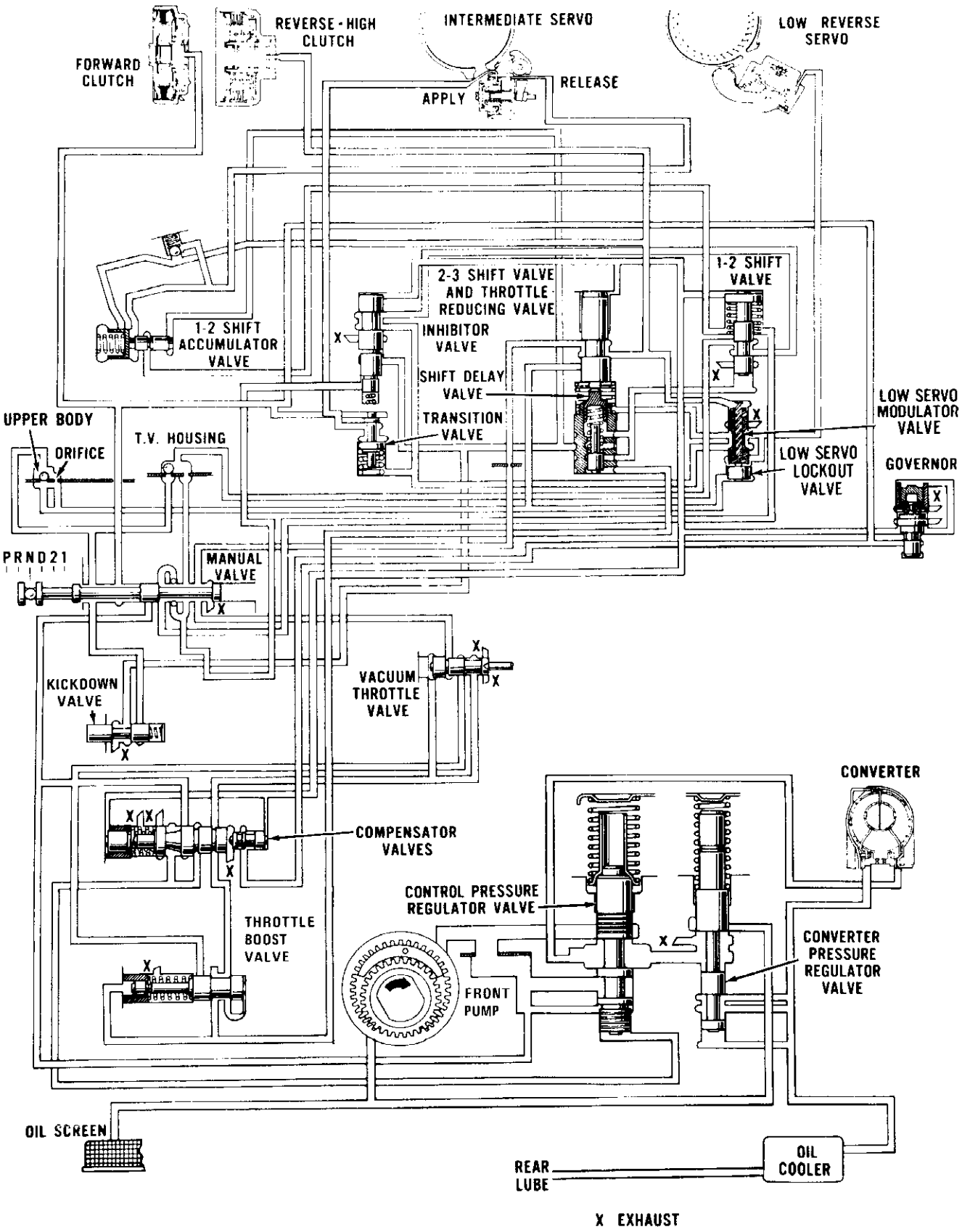


FIG. 3 Hydraulic Control System—FMX Transmission

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ADJUSTMENTS

The only adjustments on the transmission are the front and rear bands.

To prevent damage to the transmission and to assure proper band adjustment, it is essential that the tools and procedures described below are used whenever the bands are adjusted.

FRONT BAND ADJUSTMENT

(Using Tool 7225-BA)

1. Drain the fluid from the transmission by loosening the pan attaching bolts starting at the rear of the pan and working toward the front. When most of the fluid has drained from the pan, remove the remainder of the attaching bolts. **Use a clean drain can equipped with a 100-mesh screen if the fluid is to be reused.**
2. Remove the pan, then remove the fluid screen and clip from the transmission. Thoroughly clean the pan and screen. Remove all gasket material from the pan and pan mounting face of the case.
3. Loosen the front servo adjusting screw lock nut.
4. Pull back on the actuating rod, and insert the 1/4-inch spacer between the adjusting screw and servo piston stem (Fig. 4). Tighten the adjusting screw to 10 in-lb torque. Remove the spacer and tighten the adjusting screw an additional 3/4 turn. Hold the adjusting screw stationary and tighten the lock nut. Torque lock nut to specification limits as given in Specifications at end of this Part.

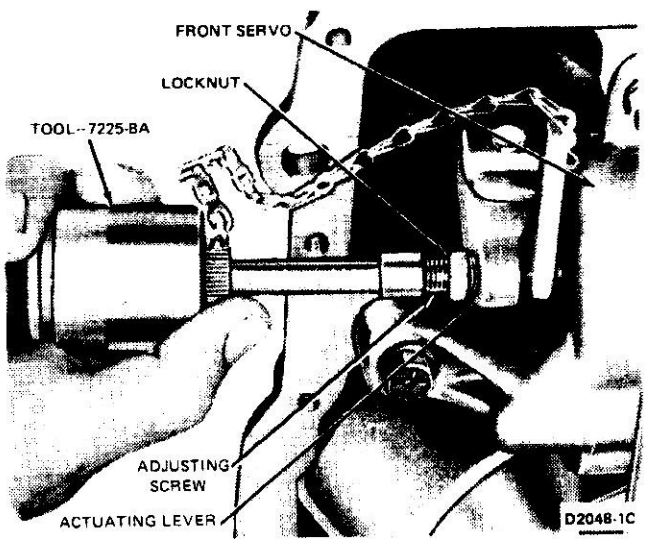


FIG. 4 Adjusting Front Band—Typical

5. Install the transmission fluid screen and clip. Install the pan using a new gasket.
6. Refill the transmission to the proper level with the specified fluid. Refer to Part 17-01.

Alternate Front Band Adjustment—(Using Tool T581-7195-A)

1. Drain the fluid from the transmission. **If the same fluid is to be used again in the transmission after the band adjustment, filter the fluid through a 100-mesh screen as it drains from the transmission. Reuse the fluid only if it is in good condition.**
2. Remove and thoroughly clean the pan and screen. Discard the pan gasket.
3. Loosen the front servo adjusting screw lock nut two full turns with a 9/16-inch wrench. Check the adjusting screw for free rotation in the actuating lever after the lock nut is loosened, and free the screw if necessary.
4. Pull the adjusting screw end of the actuating lever away from the servo body, and insert the 1/4-inch spacer (Fig. 5) between the servo piston stem and the adjusting screw.

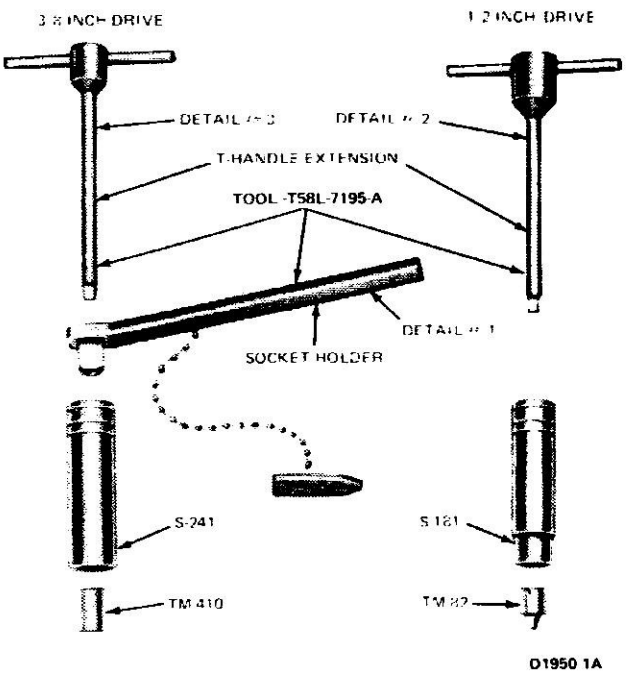


FIG. 5 Front Band Adjusting Tools

5. Install the socket handle on the 9/16 inch socket (Fig. 5).
6. Insert the T-handle extension through the socket handle and socket, and install the screwdriver socket on the T-handle extension (Fig. 5).
7. Place the tool on the adjusting screw so that the screwdriver socket engages the screw and the 9/16-inch socket engages the lock nut (Fig. 5).
8. With a torque wrench on the T-handle extension, tighten the adjusting screw to 10 in-lb torque.
9. Remove the spacer and tighten the adjusting screw an additional 3/4 turn. Hold the adjusting screw stationary, and torque the lock nut to specification as listed at the end of this Part.

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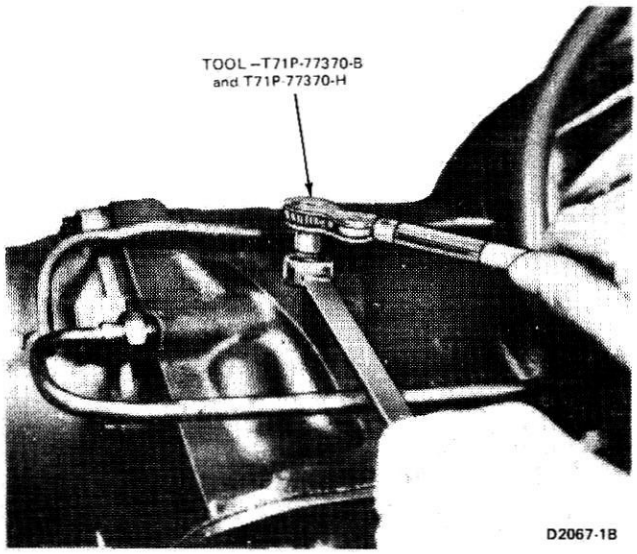


FIG. 6 Adjusting Rear Band—Except LTD II/ Thunderbird/Cougar

10. Place a new gasket on the pan, and install the screen and pan on the transmission.
11. Refill the transmission to the proper level with the specified fluid. Refer to Part 17-01.

REAR BAND ADJUSTMENT

1. Remove all dirt from the adjusting screw threads, then oil the threads.
2. Loosen the reverse band adjusting screw lock nut. Using the torque wrench shown in Fig. 6 or 7, tighten the adjusting screw until the tool handle clicks. The tool is a preset torque wrench which clicks and breaks when the torque on the adjusting screw reaches 10 ft-lb.
3. If the screw is found to be tighter than wrench capacity (10 ft-lb torque), loosen the screw and tighten until the wrench clicks and breaks.
4. Back off the adjusting screw 1-1/2 turns. Hold the adjusting screw stationary and tighten the adjusting screw lock nut to specification as listed at the end of this Part. **Severe damage may result if the adjusting screw is not backed off exactly 1-1/2 turns.**

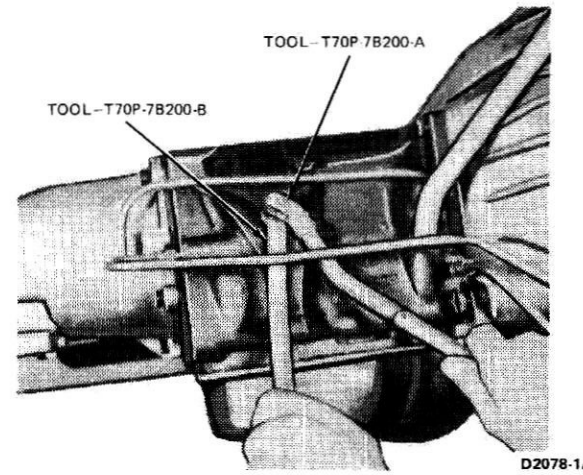


FIG. 7 Adjusting Rear Band—LTD II/ Thunderbird/Cougar

REMOVAL AND INSTALLATION

TRANSMISSION

Ford, Mercury, LTD II, Thunderbird and Cougar

Removal

1. Drive the vehicle on a hoist, **but do not raise at this time.**
2. Remove the two upper bolts and lockwashers which attach the converter housing to the engine.
3. Raise the vehicle.
4. Place the drain pan under the transmission fluid pan. Starting at the rear of the pan and working toward the front, loosen the attaching bolts and allow the fluid to drain. Finally remove all of the pan attaching bolts except two at the front, to allow the fluid to further drain. With fluid drained, install two bolts on the rear side of the pan to temporarily hold it in place.
5. Remove the converter drain plug access cover from the lower end of the converter housing.
6. Remove the converter-to-flywheel attaching nuts. Place a wrench on the crankshaft pulley attaching bolt to turn the converter to gain access to the nuts.
7. With the wrench on the crankshaft pulley attaching bolt, turn the converter to gain access to the converter drain plug, and remove the plug. Place a drain pan under the converter to catch the fluid. After the fluid has been drained, reinstall the plug.
8. Disconnect the driveshaft from the rear companion flange (marking it to assure correct assembly). Slide the shaft rearward from the transmission. Position a seal installation tool in the extension housing to prevent fluid leakage.
9. Disconnect the vacuum hoses from the vacuum diaphragm unit and the tube from the extension housing clip.
10. Install the converter housing front plate to hold the converter in place when the transmission is removed. Under no conditions should the converter be left attached to the engine when the transmission is removed. This could damage the input shaft, converter and pump.
11. Disconnect the starter cables from the starter and remove the starter.
12. Disconnect the oil cooler lines from the transmission.
13. Disconnect the downshift linkage from the transmission.
14. Disconnect the selector rod or cable from the transmission manual lever.
15. Disconnect the speedometer cable from the extension housing. Disconnect the exhaust inlet pipes at the exhaust manifolds (LTD II, Thunderbird and Cougar).

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16. Support the transmission on a transmission jack. Secure the transmission to the jack with safety chain. Remove the two engine rear support to transmission bolts. Remove the two crossmember to frame side rail attaching bolts and nuts. Raise the transmission slightly to take the weight off the crossmember. Remove the rear support to crossmember bolt and nut and remove the crossmember.
17. Lower the transmission slightly and disconnect the fluid filler tube.
18. Remove the remaining converter housing to engine attaching bolts. Move the transmission and converter assembly to the rear and down to remove it.

Installation

1. Torque the converter drain plug to specification as listed at the end of this Part.
2. If the converter has been removed from the converter housing, carefully position the converter to the transmission making sure the converter drive flats are fully engaged in the pump gear.
3. With the converter properly installed, place the transmission on the jack. Secure the transmission to the jack with safety chain.
4. Rotate the converter until the studs and drain plug are in alignment with their holes in the flywheel.
5. With the transmission mounted on a transmission jack, move the converter and transmission assembly forward into position, using care not to damage the flywheel and converter pilot. **The converter must rest squarely against the flywheel. This indicates that the converter pilot is not binding in the engine crankshaft.**
6. Install the lower converter housing-to-engine bolts. Torque bolts to specification. Remove the safety chain from the transmission.
7. Connect the fluid filler tube.
8. Install the crossmember.
9. Lower the transmission until the extension housing rests on the crossmember, and then install the rear support-to-crossmember bolts. Connect the exhaust inlet pipes at the exhaust manifolds (LTD II, Thunderbird and Cougar).
10. Install the converter attaching nuts. Install the access plates.
11. Connect the oil cooler inlet and outlet lines to the transmission case.
12. Coat the front universal joint yoke seal and spline with C1AZ-19590-B lubricant (or equivalent), and install the drive shaft. Be sure that the drive shaft markings match those of the companion flange for correct balance.
13. Connect the speedometer cable at the transmission.
14. Connect the manual selector rod or cable to the transmission manual lever.
15. Connect the downshift linkage at the transmission downshift lever.
16. Install the starter motor and connect the starter cables.
17. Connect the vacuum hoses to the vacuum diaphragm unit and the tube to its clip.
18. Lower the transmission and install the upper two converter housing-to-engine bolts. Torque bolts to specification as listed at the end of this Part.
19. Lower the vehicle and fill the transmission with transmission fluid, following the recommended procedure. Refer to Part 17-01.
20. Check the transmission, converter assembly, and fluid cooler lines for fluid leaks. Adjust the manual and downshift linkages. Refer to Part 17-02.

CONTROL VALVE BODY

Removal

1. Raise the vehicle so that the transmission fluid pan is accessible.
2. Drain the fluid from the transmission by loosening the pan attaching bolts starting at the rear of the pan and working toward the front. When most of the fluid has drained from the pan, remove the remainder of the attaching bolts. Remove the pan and gasket. Discard the gasket. **If the same fluid is to be used again in the transmission, filter the fluid through a 100-mesh screen before installing it in the transmission. Reuse the fluid only if it is in good condition.**
3. Disconnect the hoses from the vacuum diaphragm unit. Remove the diaphragm unit using Snap-On Tool S8696-A. **Do not use any tools on the diaphragm housing, such as pliers, pipe wrenches, etc. Do not allow solvents to enter the diaphragm unit. Remove the push rod.**
4. Remove the fluid filter retaining clip and the filter.

   NOTE: The dacron oil filter cannot be cleaned. If it is contaminated, it must be replaced.
5. Remove the small compensator pressure tube (Fig. 8).

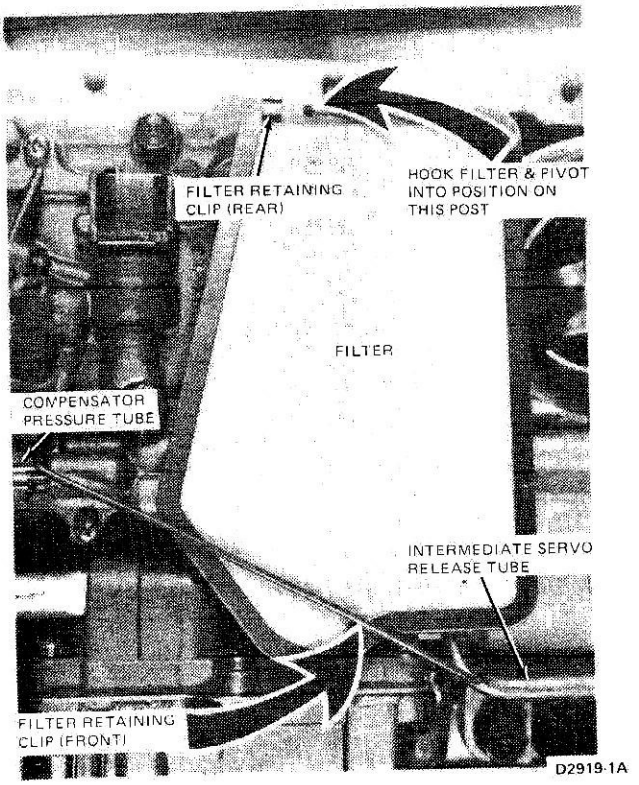


FIG. 8 Fluid Filter Transmission

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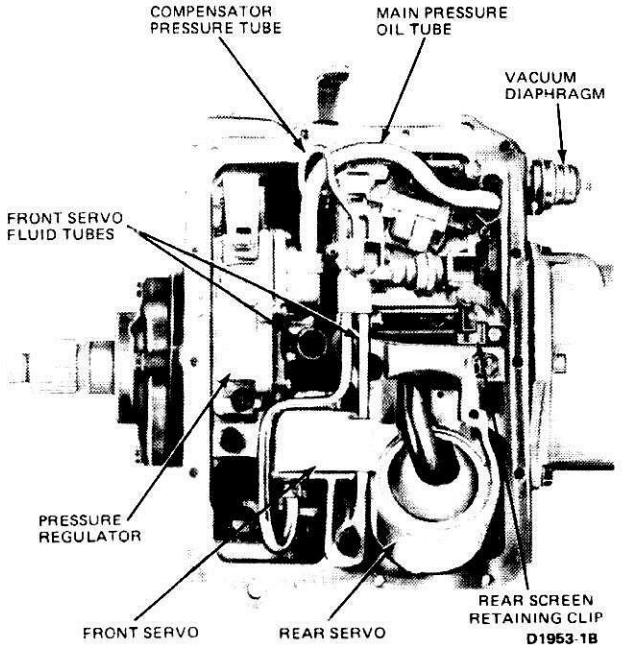


FIG. 9 Typical Hydraulic Control System

6. Remove the main pressure oil tube first, by gently prying up the end that connects to the main control valve assembly, then, remove the other end of the tube from the pressure regulator. **Be sure to remove the tube in this manner. Failure to do so, could kink or bend the tube causing excessive transmission internal leakage.**
7. Loosen the front servo attaching bolts three turns.
8. Remove the three control valve body attaching bolts, and lower the valve body while pulling it off the front servo tubes. **Be careful not to damage the valve body or the tubes.**

Installation

1. Before installing the control valve body, check for a bent manual valve by rolling it on a flat surface.
2. Install the control valve body by aligning the front servo tubes with the holes in the valve body. Shift the manual lever to the 1 detent, and place the inner downshift lever between the downshift lever stop and the downshift valve. **The manual valve must engage the actuating pin in the manual detent lever.**
3. Install but do not tighten, the control valve body attaching bolts.
4. Move the control valve body toward the center of the case until the clearance is less than 0.050 inch, between the manual valve and the actuating pin on the manual detent lever.
5. Torque the attaching bolts to specification as listed at the end of this Part. Be sure that the rear filter retaining clip is installed under the valve body bolt as shown in Fig. 8.
6. Install the main pressure oil tube. **Be sure to install the end of the tube that connects to the pressure regulator first. Then, install the other end of the tube into the main control valve assembly by tapping it gently with a soft hammer.**
7. Install the compensator pressure tube to the pressure regulator and the control valve body.
8. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the body away from the center of the case. Move the valve body only enough to relieve the binding. Torque the attaching bolts and recheck the manual valve for binding.
9. Position the push rod in the bore of the vacuum diaphragm unit. Using the diaphragm unit as a guide, insert the push rod into the threaded opening of the case. Torque the diaphragm unit to specification as listed at the end of this Part. Connect the vacuum hoses.
10. Torque the front servo attaching bolts to specification.
11. Adjust the front band as outlined in this Part.
12. Install the fluid filter by hooking the filter on the rear filter clip (Fig. 8) and pivoting it into position.
13. Install the filter retaining clip (front); attach one end to the compensator pressure tube and the other end to the intermediate servo release tube (Fig. 8).
14. Position a new pan gasket on the bottom of the transmission case, and install the pan. Torque the pan screws to specification.
15. Adjust the rear band as outlined in this Part.
16. Fill the transmission with fluid. **If the fluid that was drained from the transmission is to be used again, filter the fluid through a 100-mesh screen as it is poured back into the transmission. Re-use the fluid only if it is in good condition.**
17. If the control valve body was replaced, adjust the transmission control linkage. Refer to Part 17-02.

FRONT SERVO

Removal

1. Drain the fluid from the transmission, and remove the pan and fluid screen.
2. Remove the vacuum diaphragm unit.
3. Loosen the three control valve body attaching bolts.
4. Remove the attaching bolts from the front servo (Fig. 9), hold the strut with the fingers, and remove the servo.

Installation

1. To install the front servo, position the front band forward in the case, with the end of the band facing downward. Make sure the front servo anchor pin is in position in the case web. Align the large end of the servo strut with the servo actuating lever, and align the small end with the band end.
2. Rotate the band, strut, and servo to align the anchor end of the band with the anchor in the case. Push the servo body onto the control valve body tubes.

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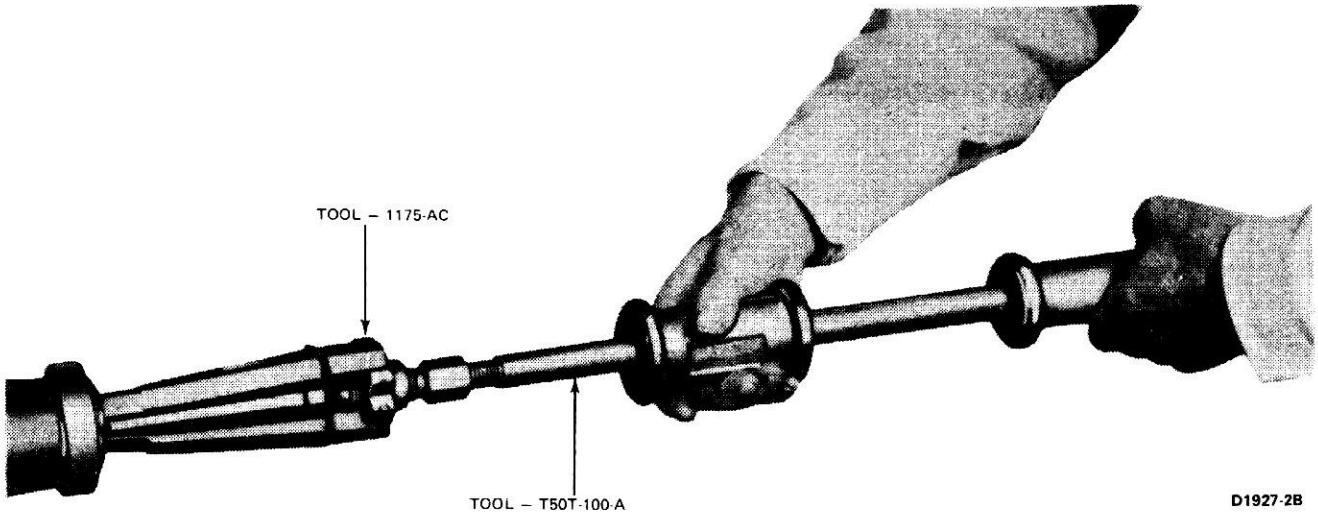


FIG. 10 Removing Extension Housing Seal

3. Install the attaching bolts and torque to specification as listed at the end of this Part.
4. Torque the control valve body attaching bolts to specification as listed at the end of this Part.
5. Check the clearance between the manual valve and manual lever actuating pin as given in Control Valve Body Installation.
6. Adjust the front band as outlined in this Part.
7. Install the vacuum diaphragm unit and rod.
8. Install the fluid filter and pan, and fill the transmission with fluid.
9. Adjust the downshift and manual linkage. Refer to Part 17-02.

REAR SERVO

Removal

1. Drain the fluid from the transmission, and remove the pan and fluid screen.
2. Remove the vacuum diaphragm unit.
3. Remove the control valve body and the two front servo tubes.
4. Remove the attaching bolts from the rear servo, hold the actuating and anchor struts with the fingers, and remove the servo.

Installation

1. To install the rear servo, position the servo anchor strut on the servo band, and rotate the band to engage the strut.
2. Hold the servo anchor strut in position with the fingers, position the actuating lever strut, and install the servo.
3. Install but do not tighten the servo attaching bolts. **The longer bolt must be installed in the inner bolt hole.**
4. Move the rear servo (with reasonable force) toward the centerline of the transmission case, against the servo attaching bolts. While holding the servo in this position, torque the attaching bolts to specification.

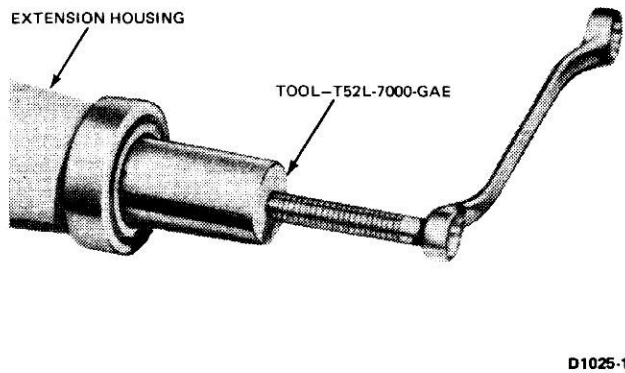


FIG. 11 Removing Extension Housing Bushing

5. Install the two front servo tubes and the control valve body.
6. Check the clearance between the manual valve and the manual lever actuating pin as given in Control Valve Body Installation.
7. Adjust the rear band as outlined in this Part.
8. Install the fluid filter and pan, and fill the transmission and fluid.

EXTENSION HOUSING BUSHING AND REAR SEAL

Removal

1. Raise the vehicle and disconnect the drive shaft.
2. Carefully remove the seal with the tools shown in Fig. 10.
3. Remove the bushing as shown in Fig. 11. **Use the bush remover carefully so that the spline seal is not damaged.**

Installation

1. When installing a new bushing, use the special tool shown in Fig. 12.

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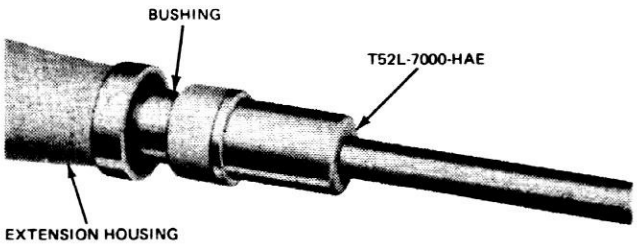


FIG. 12 Installing Extension Housing Bushing

2. Before installing a new seal, inspect the sealing surface of the universal joint yoke for scores. If scores are found, replace the yoke.
3. Inspect the counterbore of the housing for burrs. Polish off all burrs with crocus cloth.
4. Install the seal into the housing with the tool shown in Fig. 13. The seal should be firmly seated in the bore.

EXTENSION HOUSING

Removal

1. Raise the vehicle so that the transmission extension housing is accessible.
2. Drain the fluid from the transmission.
3. Disconnect the drive shaft.
4. Disconnect the speedometer cable from the extension housing.
5. Remove the two nuts that secure the engine rear support to the crossmember.
6. Position a transmission jack under the transmission and raise it just enough to remove the weight from the crossmember. Remove the crossmember to frame side rail bolts and nuts and position the crossmember out of the way.
7. Remove the two engine rear support-to-extension housing attaching bolts and remove the support.
8. Remove the extension housing attaching bolts. Slide the housing off the output shaft and remove the gasket. **When removing the extension housing, hold the output shaft and rear support from moving rearward to prevent the needle bearing and race from dropping out of location.**

Installation

1. Position a new extension housing gasket on the rear of the transmission case.
2. Slide the extension housing into place and secure it to the transmission case with the attaching bolts. Torque the bolts to specification. **With the extension housing installed, rotate the output shaft. The shaft must rotate freely by hand. If the shaft is tight or bound up, it is likely that the needle bearing and race have dropped out of location. To correct, the transmission must be partially disassembled and the bearing and race repositioned.**
3. Connect the speedometer cable to the extension housing.
4. Position the crossmember to the frame side supports, install the attaching bolts and nuts, and torque to specification.
5. Remove the transmission jack from under the vehicle. Install the rear support-to-crossmember nuts and torque to specification.
6. Install the drive shaft.
7. Fill the transmission to the correct level with the specified fluid.

GOVERNOR

Removal

1. Remove the extension housing as outlined in this Part of the manual.
2. Remove the governor to counterweight attaching screws. Lift the governor from the counterweight

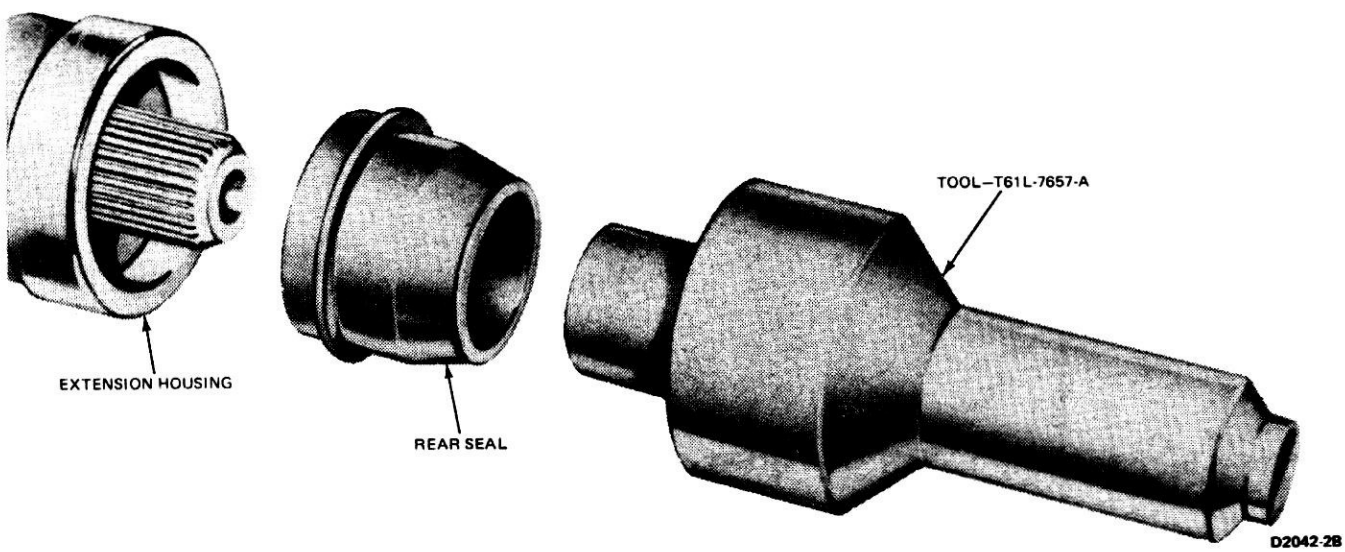


FIG. 13 Installing Extension Housing Seal

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(Fig. 14). **When removing the governor, hold the output shaft and rear support from moving rearward to prevent the needle bearing and race from dropping out of location.**

Installation

1. Lubricate the governor valve parts with clean transmission fluid. Make certain that the valve moves freely in the valve body bore.
2. Position the governor valve body on the counterweight with the cover facing toward the front of the vehicle. Install the two attaching screws, and torque to specification.
3. Reinstall the extension housing as outlined in this Part of the manual.

PRESSURE REGULATOR

Removal

1. Drain the fluid from the transmission, and remove the pan and fluid filter.
2. Remove the small compensator pressure tube from the control valve body and the pressure regulator (Fig. 9).
3. Remove the main pressure oil tube first, by gently prying up the end that connects to the main control valve assembly, then, remove the other end of the tube from the pressure regulator (Fig. 9). **Be sure to remove the tube in this manner. Failure to do so, could kink or bend the tube causing excessive transmission internal leakage.**
4. Remove the pressure regulator spring retainer, springs, and spacer. **Maintain pressure on the retainer to prevent the springs from flying out.**
5. Remove the pressure regulator attaching bolts and washers, and remove the regulator.

Installation

1. Position the replacement regulator body on the transmission case and install the two attaching bolts. Torque the bolts to specification as listed at the end of this Part.
2. Check the converter pressure and control pressure valves to be sure the valves operate freely in the bores.
3. Install the valve springs, spacer, and retainer.
4. Install the main pressure oil tube. **Be sure to install the end of the tube that connects to the pressure regulator assembly first. Then, install the other end of the tube into the main control assembly by tapping it gently with a soft hammer.**
5. Install the small compensator pressure tube.
6. Install the fluid filter and the pan, and fill the transmission to the correct level with the specified fluid. Refer to Part 17-01.

PARKING PAWL

Removal

1. Raise the vehicle and drain the fluid from the transmission.
2. Remove the drive shaft.

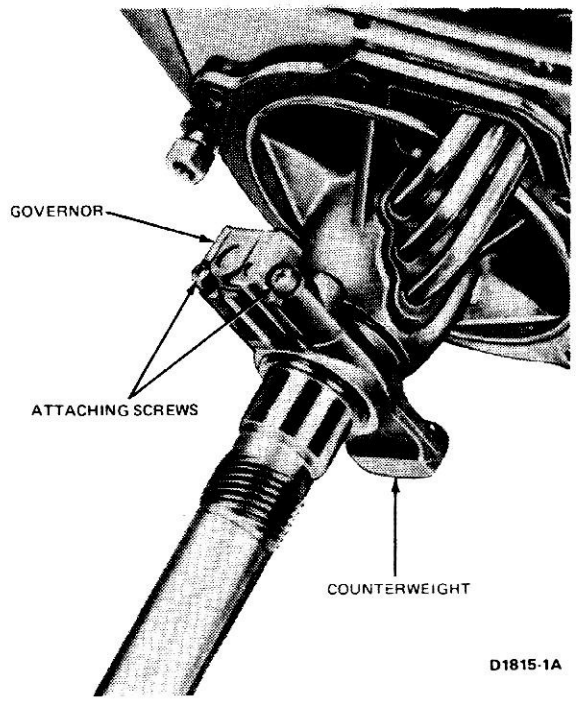


FIG. 14 Governor Installed

3. Remove the two nuts that secure the engine rear support to the crossmember.
4. Position a transmission jack under the transmission and raise it just enough to remove the weight from the crossmember. Remove the crossmember-to-frame side rail bolts and nuts and position the crossmember out of the way.
5. Remove the two engine rear support-to-extension housing attaching bolts and remove the support.
6. Disconnect the speedometer cable from the extension housing.
7. Remove the transmission pan and fluid screen.
8. Loosen the rear band adjusting screw lock nut and tighten the adjusting screw to 24 in-lb torque. **This will tighten the rear band around the planet carrier and will hold the planet carrier and clutch assemblies in position during the parking pawl repair operation.**
9. Remove the small compensator pressure tube from the pressure regulator and control valve body.
10. Remove the main pressure oil tube first, by gently prying up the end that connects to the main control valve assembly, then, remove the other end of the tube from the pressure regulator. **Be sure to remove the tube in this manner. Failure to do so, could kink or bend the tube causing excessive transmission internal leakage.**
11. Disconnect the vacuum hoses from the vacuum diaphragm and remove vacuum diaphragm and control rod.
12. Loosen the front servo attaching bolts.
13. Remove the three control valve body attaching bolts and lower the valve body while pulling it off the front servo tubes. **Be careful not to damage the valve body or the tubes.**
14. Remove the rear servo attaching bolts and remove the rear servo and struts.

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15. Remove the extension housing attaching bolts and housing.
16. Remove the output shaft and rear support assembly.
17. Remove the parking pawl pin from the case with a magnet.
18. Working from inside of the case, drive on the shoulder of the toggle lever (Fig. 32) pin with a small punch to move the retaining plug part way out of the case. Remove the plug with a pair of pliers.
19. To remove the toggle lever pin, slide the toggle lever toward the front of the case. Cock the lever to one side to apply pressure on the pin, then move the toggle to the rear of the case to move the pin outward. Repeat this procedure until the pin can be removed from the case. Lift the pawl and toggle from the case as an assembly.
20. Remove the pawl and toggle lever as an assembly.

Installation

1. Position the new parking pawl and link assembly, then install the toggle lever pin and the plug.
2. Secure the pawl to the case with the pawl pin.
3. Position a new gasket on the rear support. Hold it in place with transmission fluid or petroleum jelly.
4. Make sure that the thrust washer is in place, then position the support and output shaft in place, making sure that the pressure tubes are entered in the case.
5. Position a new gasket on the extension housing and secure the extension housing to the case with the attaching bolts.
6. Install the rear servo and strut as outlined under Rear Servo Installation.
7. Install the main control valve assembly as outlined under Control Valve Body Installation.
8. Torque the front servo attaching bolts to specification as listed at the end of this Part.
9. Install the main pressure oil tube and the small compensator pressure tube to the control valve body and pressure regulator.
10. Adjust the front and rear bands as outlined in this Part.
11. Position the vacuum control rod in the case and install the vacuum diaphragm unit. Connect the vacuum hoses.
12. Install the screen, transmission pan and a new gasket.
13. Connect the speedometer cable to the extension housing.
14. Position the crossmember to the frame side supports, and install the attaching bolts and nuts. Torque bolts to specification.
15. Remove the transmission jack from under the vehicle. Install the rear support-to-crossmember nuts. Torque nuts to specification.
16. Adjust the transmission control linkage. Refer to Part 17-02.
17. Install the drive shaft, then lower the vehicle.
18. Fill the transmission to the correct level with the specified fluid. Refer to Part 17-01.

DISASSEMBLY AND ASSEMBLY

TRANSMISSION

Before removing any of the subassemblies, thoroughly clean the outside of the transmission to prevent dirt from entering the mechanical parts.

During the repair of the subassemblies, certain general instructions which apply to all units of the transmission must be followed. These instructions are given here to avoid unnecessary repetition.

Handle all transmission parts carefully to avoid nicking or burring the bearing or mating surfaces.

Lubricate all internal parts of the transmission with transmission fluid before assembly. **Do not use any other lubricants except on gaskets and thrust washers which may be coated with petroleum jelly to facilitate assembly. Always install new gaskets when assembling parts of the transmission.**

Tighten all bolts and screws to the recommended torque as listed at the end of this Part. For detail cleaning and inspection operations refer to Part 17-01.

Disassembly

1. After the transmission has been removed from the vehicle, place the assembly in the transmission holder shown in Fig. 15.

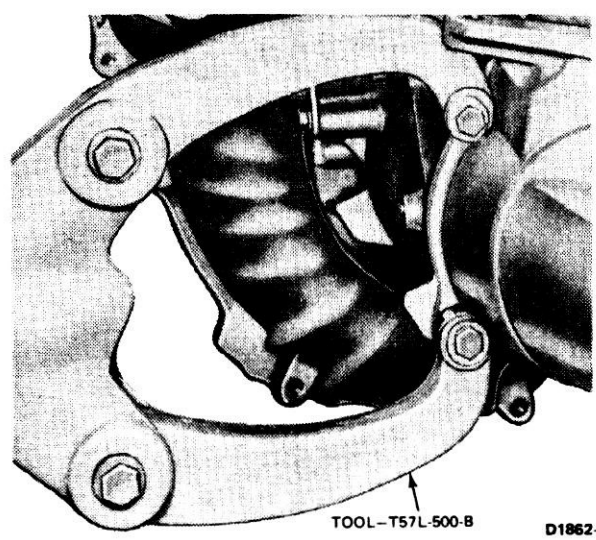


FIG. 15 Transmission Mounted in Holding Fixture—Typical

2. Remove the transmission pan, gasket, and screen retainer clip.
3. Lift the screen from the case.

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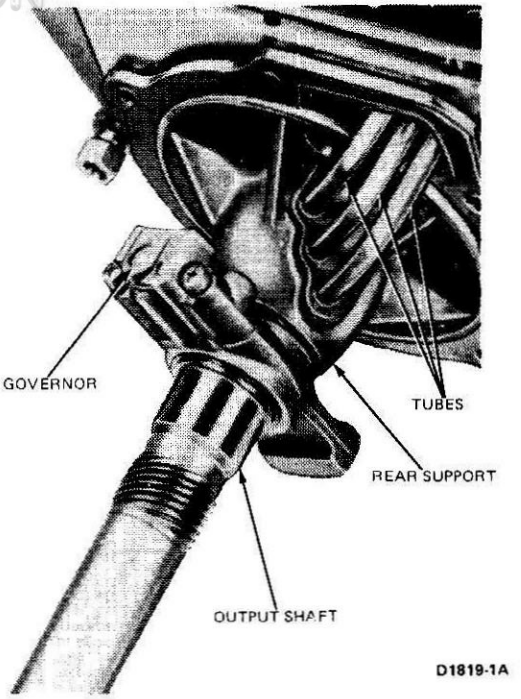


FIG. 16 Rear Support and Output Shaft Installed

4. Remove the spring seat from the pressure regulator. **Maintain constant pressure on the seal to prevent distortion of the spring seat and the sudden release of the springs.**
5. Remove the pressure regulator springs and pilots, but do not remove the valves.
6. Remove the small compensator pressure tube from the pressure regulator and the control valve body.
7. Remove the main pressure oil tube first, by gently prying up the end that connects to the main control valve assembly, then, remove the other end of the tube from the pressure regulator. **Be sure to remove the tube in this manner. Failure to do so, could kink or bend the tube causing excessive transmission internal leakage.**
8. Loosen the front and rear servo band adjusting screws five turns. Loosen the front servo attaching bolts three turns.
9. Remove the vacuum diaphragm unit and push rod.
10. Remove the control valve body attaching bolts. Align the levers to permit removal of the valve body. Then lift the valve body clear of the transmission case. Pull the body off the servo tubes and remove from the case.
11. Remove the regulator from the case. **Keep the control pressure valve and the converter pressure regulator valve in the pressure regulator to avoid damage to the valves.**
12. Remove the front servo apply and release tubes by twisting and pulling at the same time. Remove the front servo attaching bolts. Hold the front servo strut with the fingers, and lift the servo assembly from the case.
13. Remove the rear servo attaching bolts. Hold the actuating and anchor struts with the fingers, and lift the servo from the case.

Transmission End Play Check

1. Remove one of the front pump attaching bolts. Mount the dial indicator support Tool 77067 in the front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft.
2. Install the extension housing seal replacer on the output shaft to provide support for the shaft.
3. Pry the front clutch cylinder to the rear of the transmission with a large screwdriver. Set the dial indicator at zero while maintaining a slight pressure on the screwdriver.
4. Remove the screwdriver and pry the units toward the front of the transmission by inserting the screwdriver between the large internal gear and the transmission case.
5. Record the indicator reading for use during transmission assembly. End play should be 0.010 to 0.029 inch (minimum end play is preferred). If end play is not within specifications, a new selective thrust washer must be used when the transmission is assembled.
6. Remove the indicator support, and then remove the seal replacer from the output shaft.

Removal of Case and Extension Housing Parts

1. Remove the remaining front pump attaching bolts. Then remove the front pump and gasket. **If necessary, tap the screw bosses with a soft-faced hammer to loosen the pump from the case.**
2. Remove the lubrication tube from the case. Remove the five transmission to extension housing bolts. These bolts also attach the rear support to the case. Remove the extension housing.
3. Remove the output shaft assembly (Fig. 16). To facilitate output shaft removal, insert a screwdriver between the output shaft ring gear and pinion carrier and pry the output shaft rearward. **Be careful not to bend the pressure tubes between the rear support or distributor sleeve and case as the tubes are removed from the case.**
4. Remove the four seal rings from the output shaft with the fingers, to prevent breaking the rings.
5. Remove the governor snap ring from the output shaft. Using a soft-faced hammer, tap the governor assembly off the output shaft. Remove the governor drive ball (Fig. 17).
6. Remove the rear support and gasket from the output shaft. Remove the needle bearings and race from the rear support (Fig. 17).
7. Remove the selective thrust washer from the rear of the pinion carrier and remove the pinion carrier.
8. Remove the primary sun gear rear thrust bearing and races from the pinion carrier.
9. **Note the rear band position for reference in assembly.** The end of the band next to the adjusting screw has a depression (dimple) in the center of the boss. Squeeze the ends of the rear band together, tilt the band to the rear, and remove the rear band from the case.

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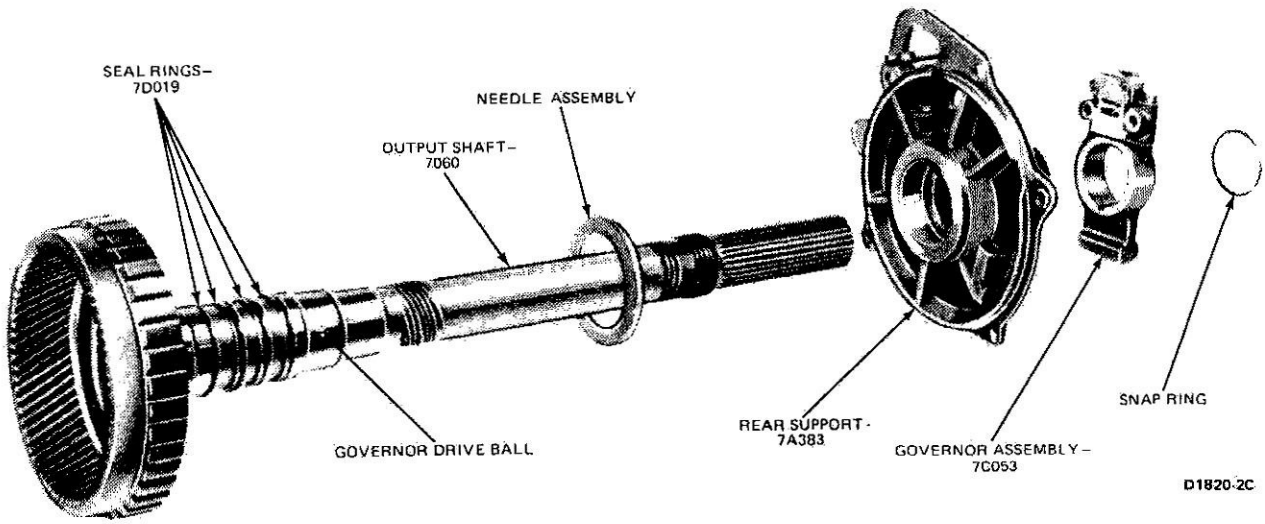


FIG. 17 Output Shaft Disassembled

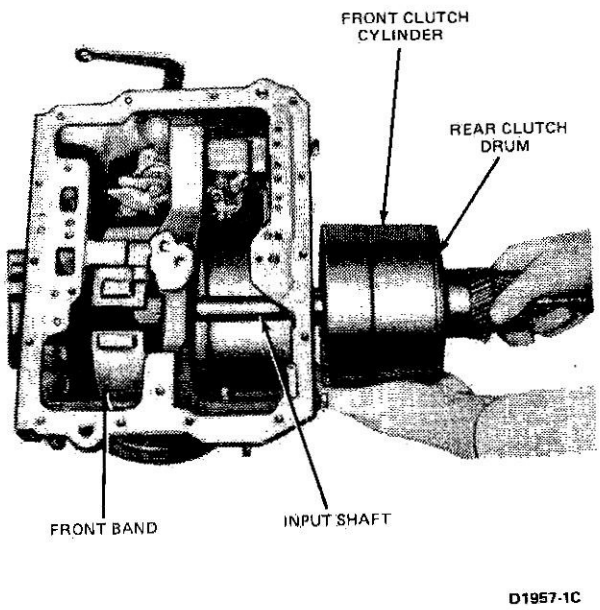


FIG. 18 Removing or Installing Input Shaft and Clutch

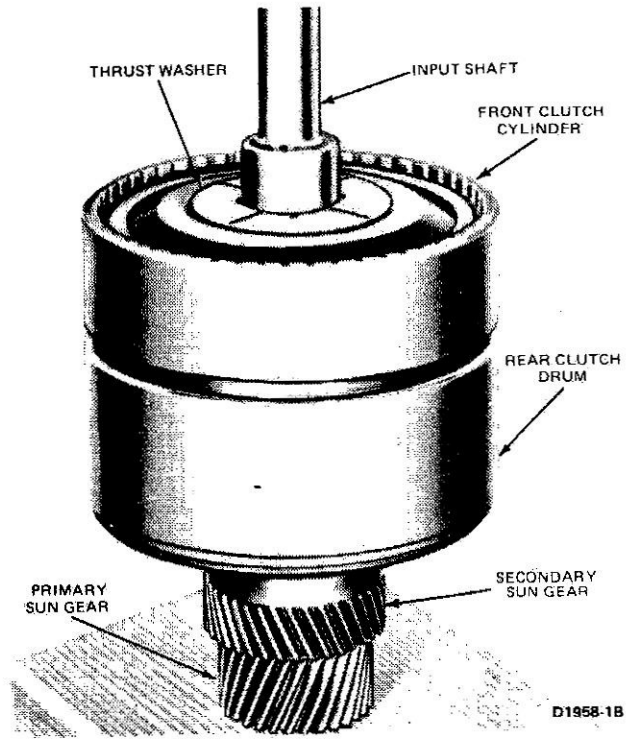


FIG. 19 Input Shaft and Clutch

10. Remove the two center support outer bolts (one each side) from the transmission case.
11. Exert enough pressure on the end of the input shaft to hold the clutch units together. Then remove the center support and the front and rear clutch assemblies as a unit (Fig. 18).
12. Remove the thrust washer from the front of the input shaft.
13. To remove the front band, position the band ends between the case webbing and tilt the bottom of the band rearward. Then, squeeze the ends of the band together and remove from the rear of the case.
14. Lift the front clutch assembly from the primary sun gear shaft.
15. Remove the bronze and the steel thrust washers from the rear clutch assembly. Wire the thrust washers together to assure correct installation.
16. Remove the front clutch seal rings from the primary sun gear shaft. Lift the rear clutch assembly from the primary sun gear shaft. Remove the rear clutch seal rings from the primary sun gear shaft. **Do not break the seal rings.** Remove the primary sun gear front thrust washer.
17. If the transmission case bushing is to be replaced, press the bushing out of the case with the tools shown in Fig. 20.
18. Install a new transmission case bushing with tool shown in Fig. 20.

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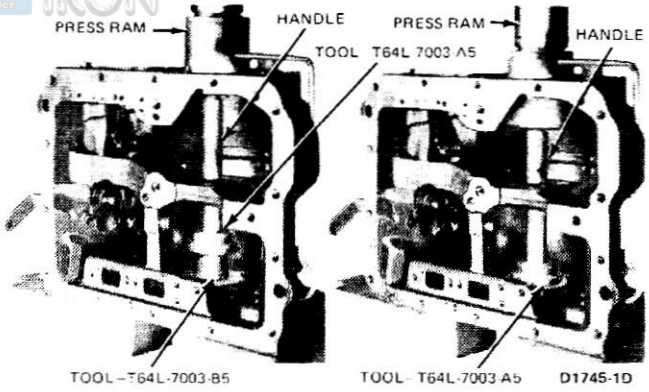


FIG. 20 Replacing Transmission Case Bushing

19. If the rear brake drum support bushing is to be replaced, press the bushing from the support as shown in Fig. 21. Press a new bushing into the brake drum support with the tool shown in Fig. 21.
20. Remove the output shaft bushing if it is worn or damaged. Use the cape chisel and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
21. Insert a new bushing into the installation tool and position the tool and bushing over the output shaft hub. Then, press the bushing on the output shaft hub as shown in Fig. 22.

Assembly

Do not use force to assemble mating parts. If the parts do not assemble freely, examine them for the cause of the difficulty. Always use new gaskets and seals during the assembly operations.

1. Install the front band in the transmission case with the anchor end aligned with the anchor in the case.
2. Make sure the thrust washer is in place on the input shaft. Lift the clutch assemblies out of the holding block. **Do not allow the clutches to separate.**
3. Install the clutch subassemblies in the transmission case while positioning the servo band on the drum. Hold the units together while installing them (Fig. 18).

Installation—Center Support

a. Install the center support and the rear band in the case.

b. Install the one-piece inner bearing and race assembly in the planet carrier, being sure that the black oxide-coated race is up (or toward the front of the transmission).

c. Lubricate the bearing surface on the center support, the rollers of the planetary clutch, and the cam race in the carrier with petroleum jelly (Fig. 23).

d. Install the planetary clutch in the carrier (Fig. 24).

e. Carefully position the planet carrier on the center support. Move the carrier forward until the clutch rollers are felt to contact the bearing surface of the center support.

f. While applying forward pressure on the planet carrier, rotate it counterclockwise, as viewed from the rear (Fig. 24). The clutch rollers will roll toward the large opening end of the cams in the race, compressing the spring slightly, and the rollers will ride up the chamfer on the planetary support and onto the inner race.

g. Push the planet carrier all the way forward.

h. Check the operation of the plantary clutch by rotating the carrier counterclockwise. It should rotate counterclockwise (viewed from the rear) with a slight drag, and should lock up when attempting to rotate in a clockwise direction.

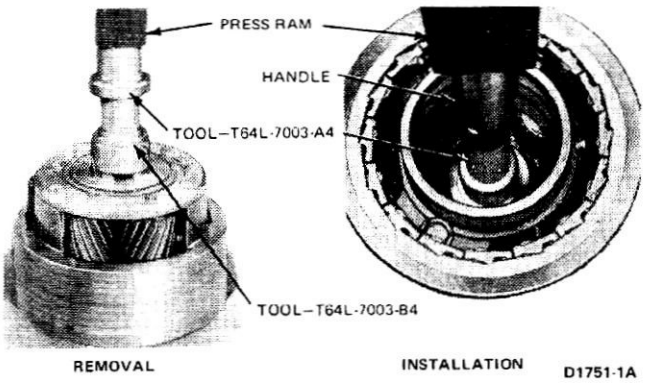


FIG. 21 Replacing Rear Brake Drum Support Bushing

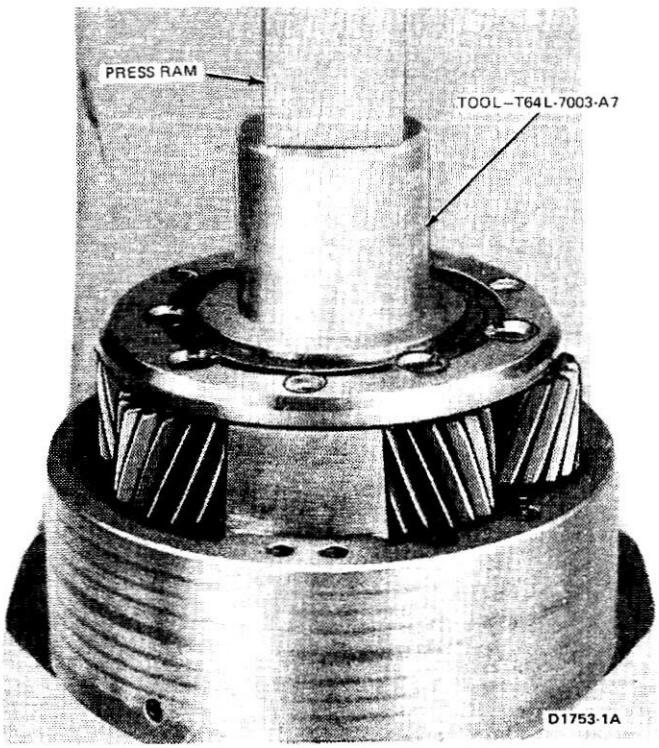


FIG. 22 Installing Output Shaft Bushing

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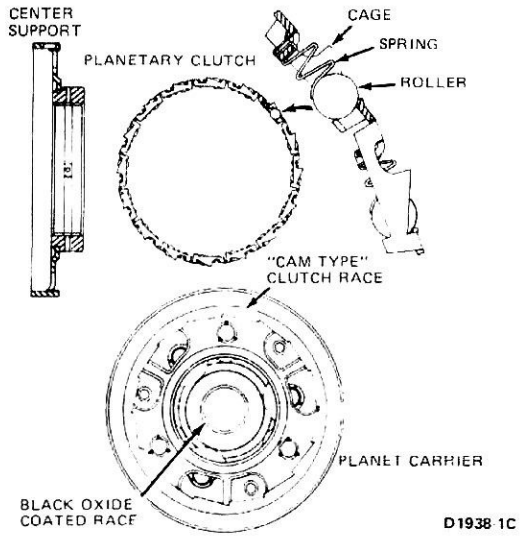


FIG. 23 Planetary Clutch, Planetary Carrier and Center Support

i. Install the selective thrust washer on the pinion carrier rear pilot. **If the end play was not within specifications when checked prior to disassembly, replace the washer with one of proper thickness.** Refer to the Specifications at end of this Part, for selective thrust washer thicknesses.

j. Install the output shaft, carefully meshing the internal gear with the pinions.

4. With the center support properly assembled, position the needle bearing and retainer on the rear support (Fig. 17).
5. Position a new rear support to case gasket on the rear support. Retain the gasket with transmission fluid.
6. Install the rear support. As the support is installed, insert the tubes into the case.
7. Position the governor drive ball in the pocket in the output shaft. Retain the ball with transmission fluid.

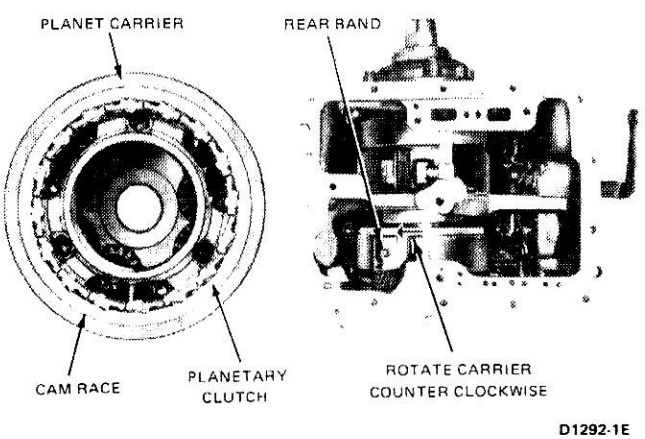


FIG. 24 Planetary Clutch Installation in Carrier

8. Install the governor assembly, aligning the groove with the ball in the output shaft.
9. Install the governor with the governor body plate toward the front of the vehicle (Fig. 16). Install the governor snap ring.
10. Insert the extension housing oil seal replacer and pilot in the housing. Position a new gasket to the extension housing and install the extension housing on the transmission case. Coat the bolt threads with B5A-19554-A sealer and install the extension housing attaching bolts, vacuum tube clip, and external tooth lockwasher. **The lockwashers must be installed with the rolled edge toward the transmission case to insure a tight seal.**
11. Torque the extension housing attaching bolts to specification. Install the lubrication tube.
12. Position a new front pump gasket in the counterbore of the transmission case.
13. Install the front pump, aligning the pump bolt holes with the holes in the case. Install three of the pump attaching bolts and torque to specification.
14. Mount the dial indicator support in a front pump bolt hole. Mount a dial indicator on the support so that the contact rests on the end of the turbine shaft.
15. Use a large screwdriver to pry the front of the clutch drum toward the rear of the transmission. Set the dial indicator at zero.
16. Remove the screwdriver and pry the units toward the front of the transmission by inserting a screwdriver between the large internal gear and the transmission case. Note the indicator reading. End play should be 0.010-0.029 inch (minimum end play is preferred). If the end play is not within specifications, a new selective thrust washer must be used.
17. Remove the indicator and the tool from the extension housing.
18. Install the one remaining front pump attaching bolt. Torque bolt to specification.
19. Position the front band forward in the case with the band ends up.
20. Position the front servo strut with the slotted end aligned with the servo actuating lever, and with the small end aligned with the band end. Rotate the band, strut, and servo into position, engaging the anchor end of the band with the anchor pin in the case.
21. Locate the servo on the case, and install the attaching bolts. **Tighten the attaching bolts only two or three threads.**
22. Install the servo release tube.
23. Position the rear servo anchor strut, and rotate the rear band to engage the strut.
24. Position the rear servo actuating lever strut with a finger, and then install the servo and attaching bolts. Move the rear servo (with reasonable force)

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toward the centerline of the transmission case, against the servo attaching bolts. While holding the servo in this position, torque the attaching bolts to specification.

25. Install the front servo apply tube.
26. Install the pressure regulator body and attaching bolts. Torque the bolts to specification.
27. Install the control and converter valve guides and springs. Install the spring retainer.
28. Install the control valve assembly, carefully aligning the servo tubes with the control valve. Align the inner downshift lever between the stop and the downshift valve. Shift the manual lever to the 1 position. **Align the manual valve with the actuating pin in the manual detent lever. Do not tighten the attaching bolts.**
29. Move the control valve body toward the center of the case, until the clearance is less than 0.050 inch between the manual valve and the actuating pin on the manual detent lever.
30. Torque the attaching bolts to specification. Be sure that the rear fluid screen retaining clip is installed under the valve body bolt as shown in Fig. 8.
31. Install the main pressure oil tube. **Be sure to install the end of the tube that connects to the pressure regulator assembly first. Then, install the other end of the tube into the main control assembly by tapping it gently with a soft hammer.**
32. Install the small control pressure compensator tube in the valve body and regulator.
33. Turn the manual valve one full turn in each manual lever detent position. If the manual valve binds against the actuating pin in any detent position, loosen the valve body attaching bolts and move the body away from the center of the case. Move the body only enough to relieve the binding. Torque the attaching bolts to specification. Check the manual valve for binding.
34. Torque the front servo attaching bolts to specification.
35. Adjust the front and rear bands as outlined in this Part.
36. Position the control rod in the bore of the vacuum diaphragm unit and install the diaphragm unit. **Make sure the control rod enters the throttle valve as the vacuum unit is installed.**
37. Torque the diaphragm unit to specification.
38. Position the fluid screen on the rear clip so that the tang enters the hole in the screen flange. Then, rotate the screen (clockwise) until the grommet is over the pump inlet port of the valve body regulator and press the screen down firmly. Install the screen retaining clip.
39. Place a new gasket on the transmission case and install the pan. Install the attaching bolts and lockwashers. Torque the bolts to specification.

If the converter and converter housing were removed from the transmission, install these components. Position the transmission assembly on the transmission jack, and refer to transmission installation procedures outlined in this Part.

CONTROL VALVE BODY

During the disassembly of the control valve assembly, avoid damage to valve parts and keep the valve parts clean. Place the valve assembly on a clean shop towel while performing the disassembly operation. **Do not separate the upper and lower valve bodies and cover until after the valves have been removed.**

Disassembly

1. Remove the manual valve (Fig. 25).
2. Remove the throttle valve body and the separator plate. **Be careful not to lose the check valve when removing the separator plate from the valve body.** Remove the throttle valve and plug.
3. Remove one screw attaching the separator plate to the lower valve body. Remove the upper body front plate. **The plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**
4. Remove the compensator sleeve and plug, and remove the compensator valve springs. Remove the compensator valve.
5. Remove the throttle boost short valve and sleeve. Remove the throttle boost valve spring and valve.
6. Remove the downshift valve and spring.
7. Remove the upper valve body rear plate.
8. Remove the compensator cut back valve.
9. Remove the lower body side plate (Fig. 25). **The plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**
10. Remove the 1-2 shift valve and spring. Remove the inhibitor valve and spring.
11. Remove the two screws attaching the separator plate to the cover. Remove the lower body end plate. **The end plate is spring-loaded. Apply pressure to the plate while removing the attaching screws.**
12. Remove the low servo lockout valve, low servo modulator valve, and spring.
13. Remove the 2-3 delay and throttle reducing valve sleeve, the throttle reducing valve, spring, and the 2-3 shift delay valve. The reducing valve sleeve is lightly staked in the valve body bore. To remove the sleeve, use a blunt instrument against the end of the 2-3 shift valve and push the sleeve from its bore. Remove the 2-3 shift valve spring, spring retainer, and valve.
14. Remove the transition valve spring and valve.
15. Remove the plate (Fig. 25) from the valve body cover.

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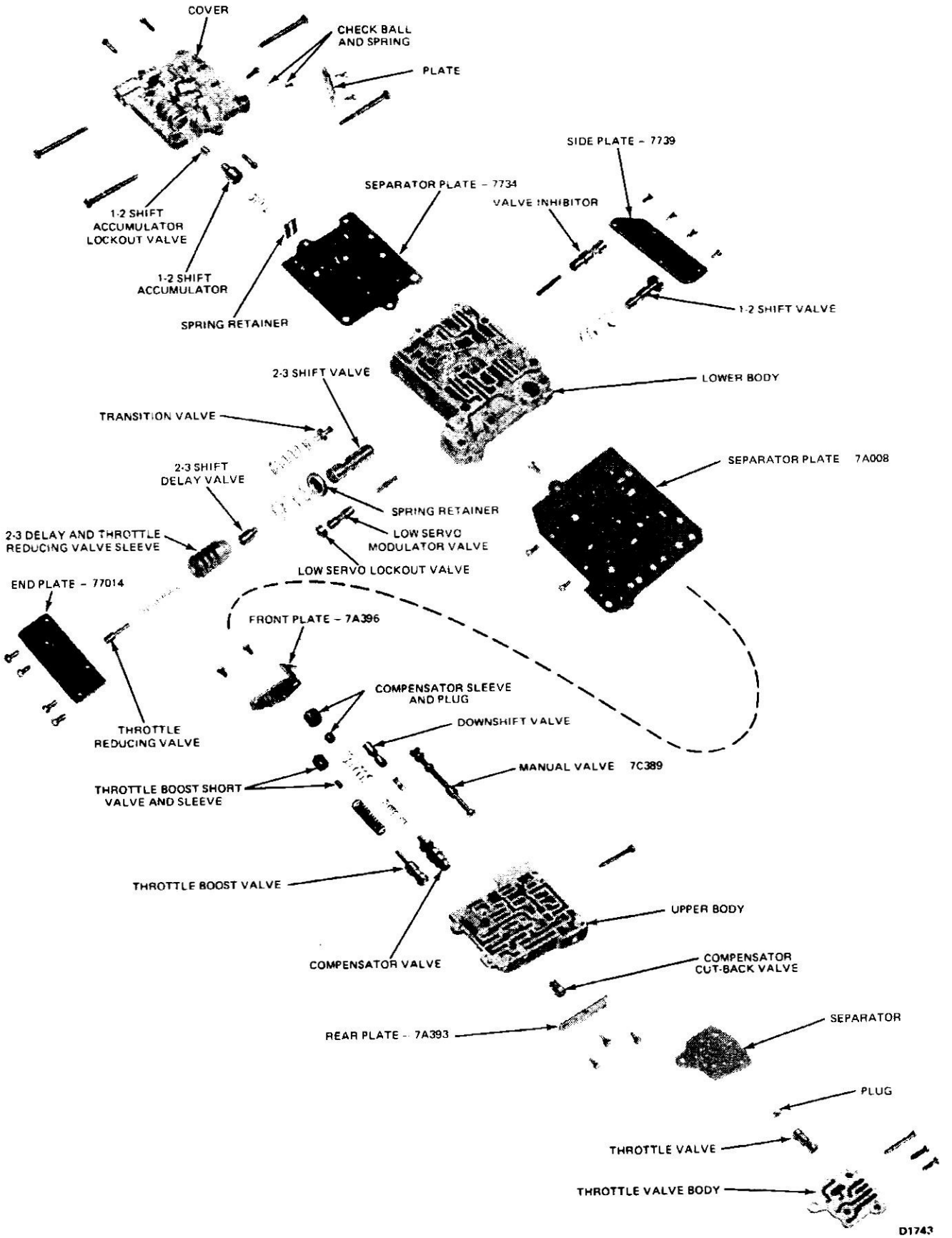


FIG. 25 Control Valve Body Disassembled

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16. Remove the check ball spring and check ball. Remove the 3-2 kickdown control valve spring and valve.
17. Remove the 1-2 shift accumulator valve spring retainer from the cover. Remove the spring, 1-2 shift accumulator valve and 1-2 shift accumulator lockout valve.
18. Remove the through bolts and screws. Then, separate the bodies. Remove the separator plates from the valve bodies and cover. Be careful not to lose the check valves.

Assembly

1. Arrange all parts in their correct positions (Fig. 25). Rotate the valves and plugs when inserting them in their bores, to avoid shearing of soft body castings.
2. Place the check valve in the upper body as shown in Fig. 26. Then, position the separator plate on the body.

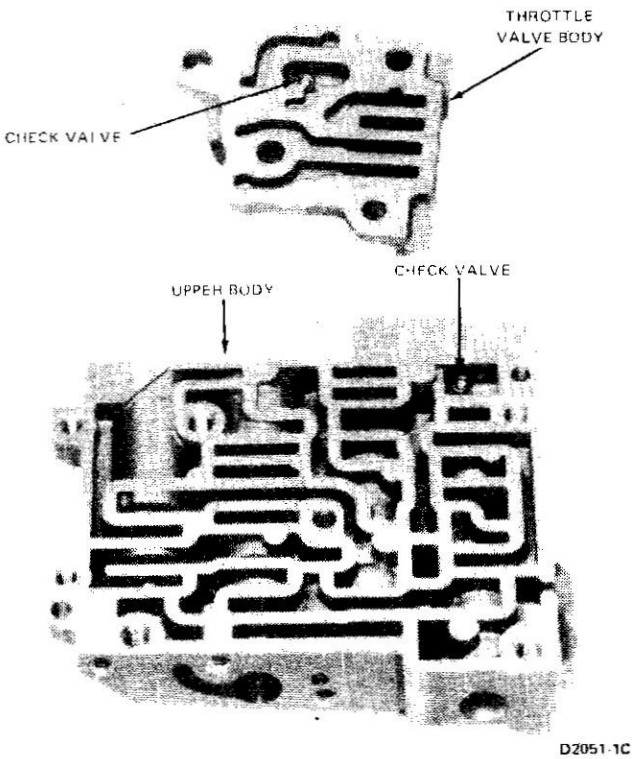


FIG. 26 Check Valve Locations

3. Position the lower body on the upper body, and start **but do not tighten the attaching screws.**
4. Position the cover and separator plate on the lower body. Start the four through bolts.
5. Align the separator with the upper and lower valve body attaching bolt holes. Install and torque the four valve body bolts to specification. **Excessive tightening of these bolts may distort the valve bodies, causing valves or plugs to stick.**
6. Install the check ball and spring in the cover. Install the plate.
7. Insert the 1-2 shift accumulator lockout valve, 1-2 shift accumulator valve, and spring in the cover. Install the valve spring retainer.
8. Install the transition valve and spring in the lower body.
9. Install the 2-3 shift valve spring retainer and spring. Install the 2-3 shift delay valve, spring, and throttle reducing valve in the sleeve. Slide the assembly into position in the lower body. Do not restake the sleeve.
10. Install the low servo lockout valve spring. Install the low servo modulator and low servo lockout valves. Install the lower body end plate.
11. Install the inhibitor valve spring and valve in the lower body.
12. Install the 1-2 shift valve spring and valve. Install the lower body side plate.
13. Install the compensator cutback valve in the upper body. Install the upper body rear plate.
14. Install the downshift valve and spring in the body.
15. Install the throttle boost valve and spring. Install the throttle boost short valve and sleeve.
16. Install the compensator valve, inner and outer compensator springs, and the compensator sleeve and plug.
17. Position the front plate. Apply pressure to the plate while installing the two attaching screws.
18. Install the throttle valve, plug, and check valve in the throttle valve body. Position the separator on the upper body and install the throttle valve body. Install the three attaching screws.
19. Install four screws attaching the cover to the lower body, two screws attaching the separator plate to the upper body, and one screw attaching the separator plate to lower body. Torque the cover and body screws to specification.
20. Install the manual valve.

FRONT SERVO

Disassembly

1. Remove the servo piston retainer snap ring (Fig. 27). The servo piston is spring-loaded. **Apply pressure to the piston when removing the snap ring.**
2. Remove the servo piston retainer, servo piston, and the return piston from the servo body. It may be necessary to tap the piston stem lightly with a soft-faced hammer to separate the piston retainer from the servo body.
3. Remove all the seal rings, and remove the spring from the servo body.
4. Inspect the servo body for cracks, and the piston bore and the servo pistons stem for scores (Fig. 27). Check fluid passages for obstructions.
5. Check the actuating lever for free movement, and inspect it for wear. To replace the actuating lever shaft, it will be necessary to press the shaft out of the bracket. The shaft is retained in the body by serrations on one end of the shaft. These serrations cause a press fit at that end. To remove the shaft, press on the end opposite the serrations. Inspect the adjusting screw threads and the threads in the lever.
6. Check the servo spring and servo band strut for distortion.

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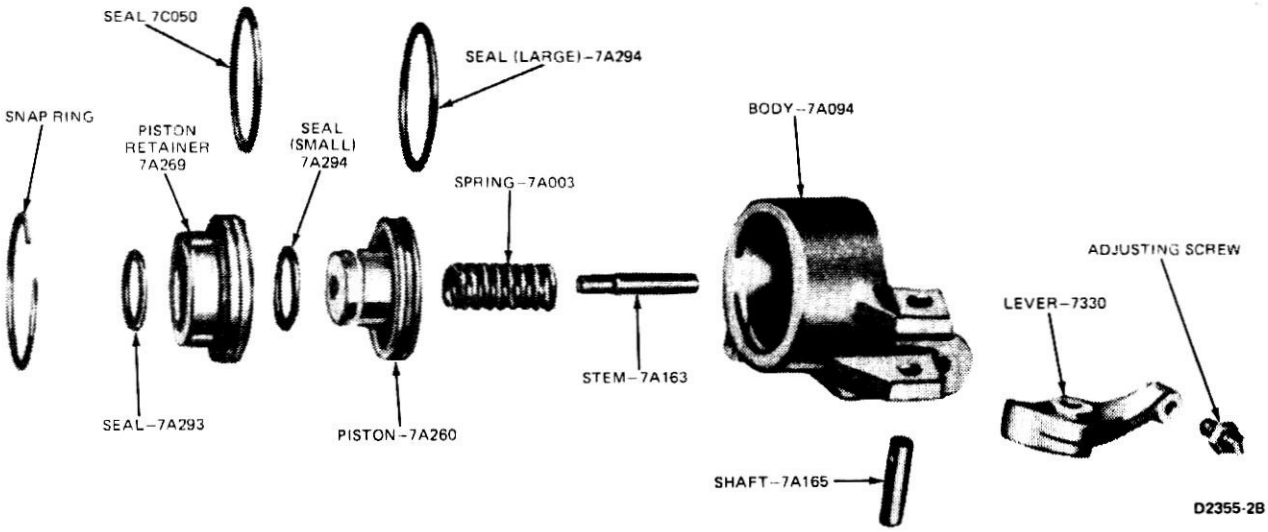


FIG. 27 Front Servo Disassembled

7. Inspect the servo band lining for excessive wear and bonding to the metal. **The band should be replaced if worn to a point where the grooves are not clearly evident.**
8. Inspect the band ends for cracks and check the band for distortion.

Assembly

1. Lubricate all parts of the front servo with transmission fluid to facilitate assembly.
2. Install the inner and outer O-rings on the piston retainer. Install a new O-ring on the return piston and on the servo piston (Fig. 27). Figure 28 shows correct piston details.
3. Position the servo piston release spring in the servo body. Install the servo piston, retainer, and return piston in the servo body as an assembly. Compress the assembly into the body, and secure it with the snap ring. **Make sure the snap ring is fully seated in the groove.**
4. Install the adjusting screw and locknut in the actuating lever if they were previously removed.

REAR SERVO

Disassembly

1. Remove the servo actuating lever shaft retaining pin with a 1/8 inch punch. Remove the shaft and actuating lever.
2. Press down on the servo spring retainer, and remove the snap ring. **Release the pressure on the retainer slowly to prevent the spring from flying out.**
3. Remove the retainer and servo spring (Fig. 29).
4. Force the piston out of the servo body with air pressure. Hold one hand over the piston to prevent damage.
5. Remove the piston seal ring.

Assembly

1. Install a new seal ring on the servo piston.
2. Install the piston in the servo body (Fig. 29). **Lubricate the parts to facilitate assembly.**

FRONT SERVO COMPONENTS IDENTIFICATION – FMX AUTOMATIC TRANSMISSION

Model Usage	Retainer	Piston	Dim. A	Dim. B	Dim. C	Dim. D
PHB	C9AP-7A269-A	C9ZP-7A260-A	1.314 1.312	2.372 2.369	1.300 1.295	2.361 2.356

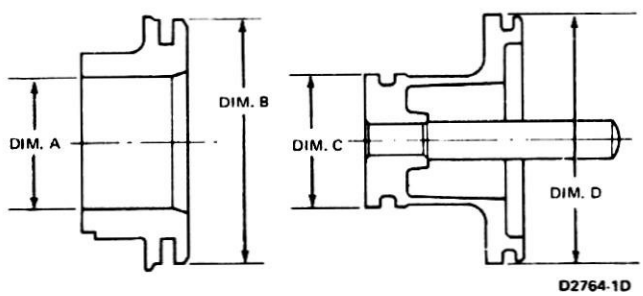


FIG. 28 Front Servo Component Identification

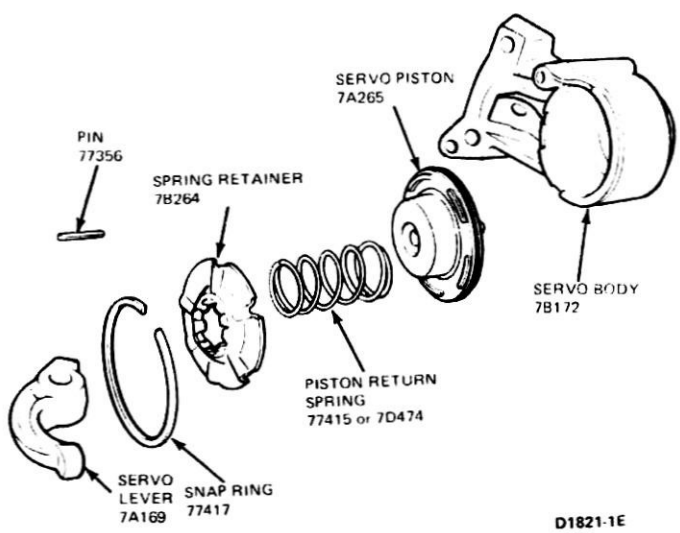


FIG. 29 Rear Servo Disassembled

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Install the servo spring with the small coiled end against the servo piston.

3. Install the spring retainer. Compress the spring with a C-clamp. Then install the snap ring. **The snap ring must be fully seated in the groove.**
4. Install the actuating lever, with the socket in the lever bearing on the piston stem. Install the actuating lever shaft, aligning the retaining pin holes, and install the pin.
5. Check the actuating lever for free movement.

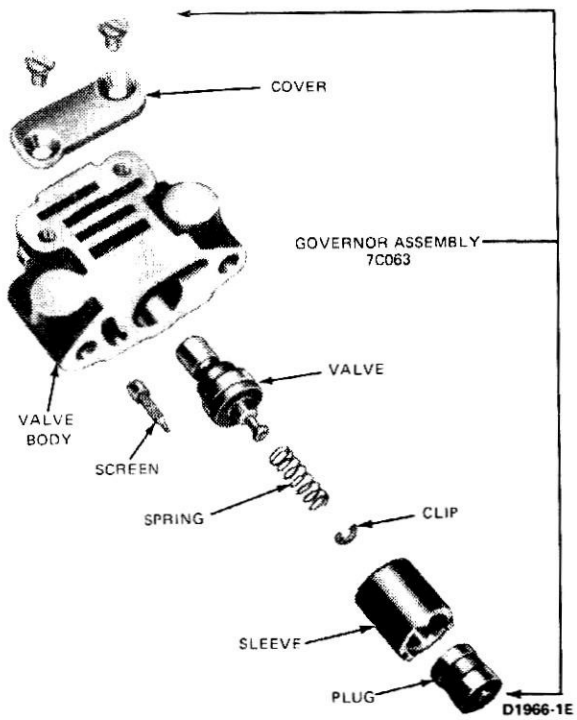


FIG. 30 Governor Disassembled

GOVERNOR

Disassembly

1. Remove the governor valve body cover.
2. Remove the valve body from the counterweight.
3. Remove the plug, sleeve, and the valve and spring from the body (Fig. 30).
4. Remove the screen from its bore in the valve body.

Assembly

1. Install the governor valve and spring assembly in the bore of the valve body. Install the sleeve and plug.
2. Install the screen (Fig. 30).
3. Install the body on the counterweight. **Make sure the fluid passages in the body and the counterweight are aligned.**
4. Position the valve body cover on the body, and install the screws.

PRESSURE REGULATOR

Disassembly

1. Remove the valves from the regulator body.
2. Remove the regulator body cover attaching screws, and remove the cover (Fig. 31).
3. Remove the separator plate.
4. Wash all parts thoroughly in clean solvent and blow dry with moisture-free compressed air.
5. Inspect the regulator body and cover mating surfaces for burrs.
6. Check all fluid passages for obstructions.

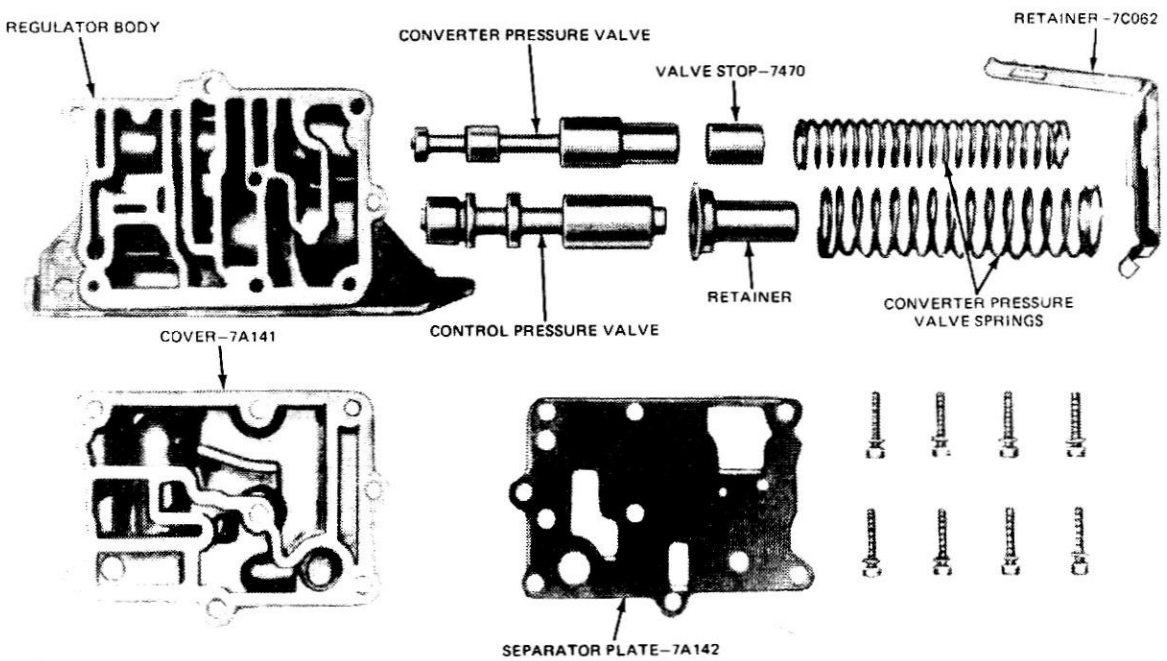


FIG. 31 Pressure Regulator Disassembled

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7. Inspect the control pressure and converter pressure valves and bores for burrs and scores. Remove all burrs carefully with crocus cloth.
8. Check the free movement of the valve in their bores. Each valve should fall freely into its bore when both the valve and bore are dry.
9. Inspect the valve springs for distortion.

Assembly

1. Position the separator plate on the regulator cover.
2. Position the regulator cover and separator plate on the regulator body, and install the attaching screws. Torque the screws to specification as listed at the end of this Part.
3. Insert the valves in the pressure regulator body (Fig. 31).

DOWNSHIFT AND MANUAL LINKAGE

Disassembly

1. Remove the inner downshift lever shaft nut (Fig. 32). Then remove the inner downshift lever.

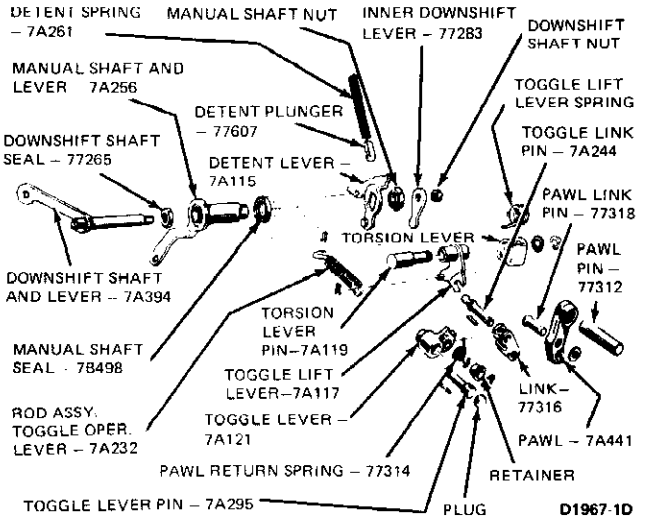


FIG. 32 Transmission Case Control Linkage

2. Remove the outer downshift lever and shaft. Remove the downshift shaft seal from the counterbore in the manual lever shaft.
3. Remove the cotter pin from the parking pawl toggle operating rod and remove the clip from the parking pawl operating lever. Remove the parking pawl operating rod.
4. Rotate the manual shift until the detent lever clears the detent plunger. Then remove the detent plunger and spring. **Do not allow the detent plunger to fly out of the case.**
5. Remove the manual lever shaft nut, and remove the detent lever. Remove the outer manual lever and shaft from the transmission case.
6. Tap the toggle lever sharply toward the rear of the case to remove the plug and pin.
7. Remove the pawl pin by working the pawl back and forth. Remove the pawl and toggle lever assembly, and then disassemble.
8. Remove the manual shaft seal and case vent tube. Remove the oil cooler return check valve from the back of the case.

Assembly

1. Coat the outer diameter of a new manual shaft seal with sealer, then install the seal in the case with a driver.
2. Install the vent tube in the transmission case.
3. Assemble the link to the pawl with the pawl link pin, washer, and pawl return spring. Assemble the toggle lever to the link with the toggle link pin. Position the pawl return spring over the toggle link pin, and secure in place with the washer and the small retainer clip (Fig. 32). Install the assembly in the transmission case by installing the pawl pin and the toggle lever pin. Press in the retaining plug tightly against the toggle lever pin. Install the torsion lever assembly. Position the spring on the torsion lever with a screwdriver. Make certain that the short side of toggle lift lever does not extend beyond the largest diameter of the ball on the toggle link pin (Fig. 32). Tap the toggle lift lever in or out as necessary to center the toggle lift lever on the ball.
4. Install the manual lever and shaft in the transmission case. Position the detent lever on the shaft, and secure with a nut. Tighten the nut to 20-30 ft-lbs torque. Rotate the manual lever to the rear of the case. Position the detent spring in the case. Hold the detent plug on the spring with a 3/16 inch socket wrench, then depress the spring until the plug is flush with the case. Carefully rotate the manual lever to the front of the case to secure the plug. **A piece of thin walled tubing may be used to depress the plug if a small socket wrench is not available.**
5. Position the ends of the parking pawl operating rod in the detent lever and toggle lift lever, and secure with the two small retaining pins.
6. Install a new seal on the downshift lever shaft, then install the lever and shaft in the case. Position the inner downshift lever on the inner end of the shaft with the mark O facing toward the center of the case. Install the lockwasher and nut, then tighten the nut to 17-20 ft-lbs torque.
7. Check the operation of the linkage. The linkage should operate freely without binding.

FRONT PUMP

Disassembly

1. Remove the stator support attaching screws and remove the stator support. **Mark the top surface of the pump driven gear with Prussian blue to assure correct assembly. Do not scratch the pump gears.**
2. Remove the drive and driven gears from the pump body.
3. Refer to Fig. 33 for a disassembled view of the front pump. Inspect the pump body housing, gear pockets and crescent for scores.
4. If the pump housing bushing is to be replaced, press the bushing from the front housing with the tools shown in Fig. 34.

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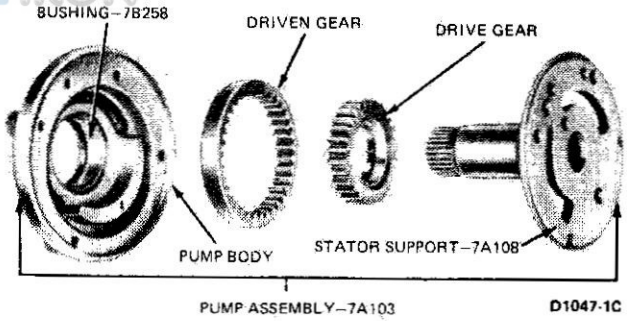


FIG. 33 Front Pump Disassembled

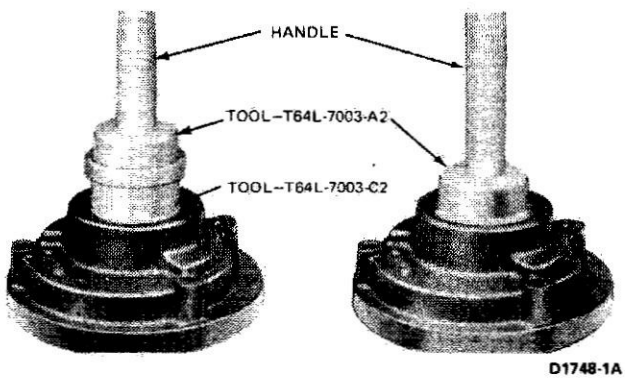


FIG. 34 Replacing Front Pump Housing Bushing

5. Press a new bushing into the pump housing with the handle and tool shown in Fig. 34.
6. If any parts other than the stator support, bushings or oil seal are found defective, replace the pump as a unit. Minor burrs and scores may be removed with crocus cloth. The stator support is serviced separately.
7. If the oil seal requires replacement, bolt the front pump to the transmission case with capscrews, and install the oil seal remover shown in Fig. 35. Then pull the front seal from the pump body.

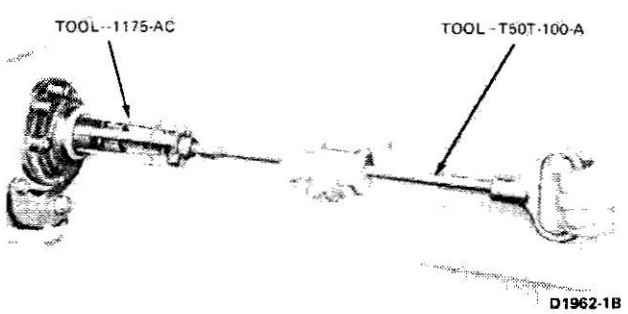


FIG. 35 Removing Front Pump Seal

8. Clean the pump body counterbore. Then inspect the bore for rough spots. Smooth up the counterbore with crocus cloth.
9. Remove the pump body from the transmission case.

Assembly

1. If the oil seal was removed, coat the outer diameter of a new seal with Motorcraft Sealing Compound, or its equivalent. Then position the seal in the pump body. Drive the seal into the pump body with the tool shown in Fig. 36, until the seal is firmly seated in the body. Tool 77837 may be reworked (Fig. 37) to install the latest type seal.

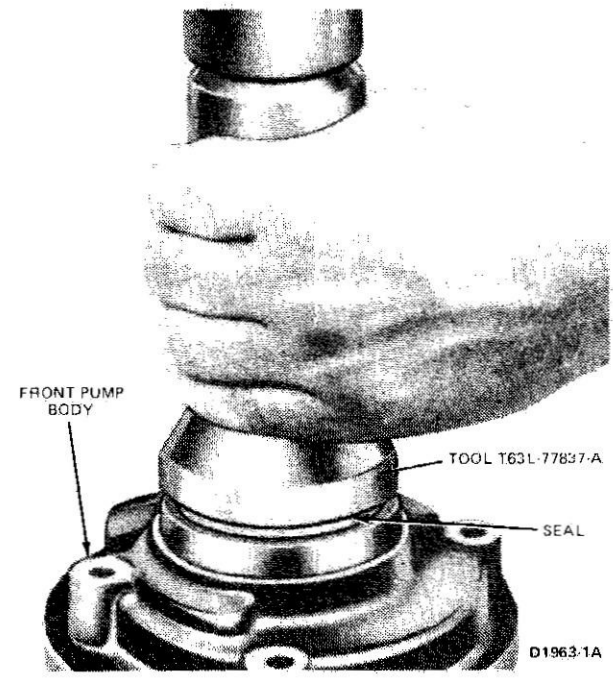


FIG. 36 Installing Front Pump Seal

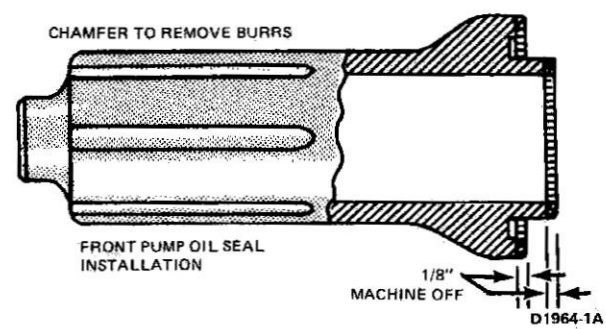


FIG. 37 Front Pump Seal Installing Tool Modification Drawing

2. **Place the pump driven gear in the pump body with the mark on the gear or tooth gear chamfer facing down. Install the drive gear in the pump body with the chamfered side of the flats facing down.**
3. Install the stator support and attaching screws. Check the pump gears for free rotation.

REAR SUPPORT BUSHING REMOVAL AND INSTALLATION

1. Remove the three pressure tubes from the support housing.
2. Remove the rear support bushing if it is worn or damaged. Use a cape chisel and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.
3. Press a new bushing into the support housing with tool shown in Fig. 38.

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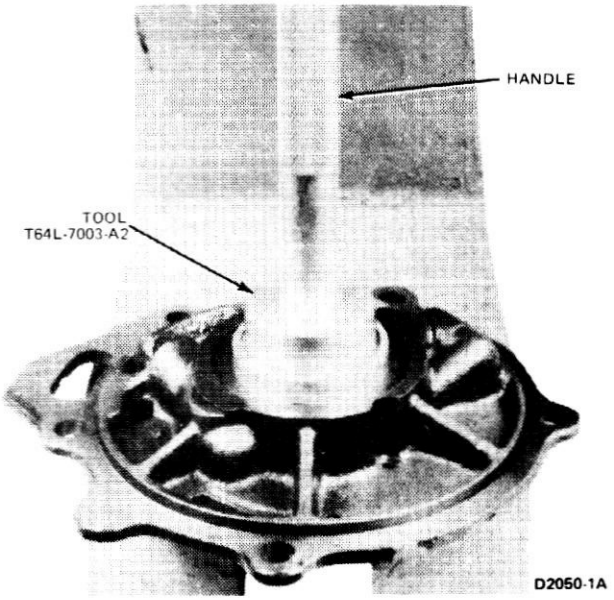


FIG. 38 Installing Rear Support Housing Bushing

4. Install the pressure tubes in the support housing.

REAR CLUTCH

Disassembly

1. Remove the clutch pressure plate snap ring, and remove the pressure plate from the drum. Remove the waved cushion spring. Remove the composition and steel plates.
2. Compress the spring with the tools shown in Fig. 39, and remove the snap ring.

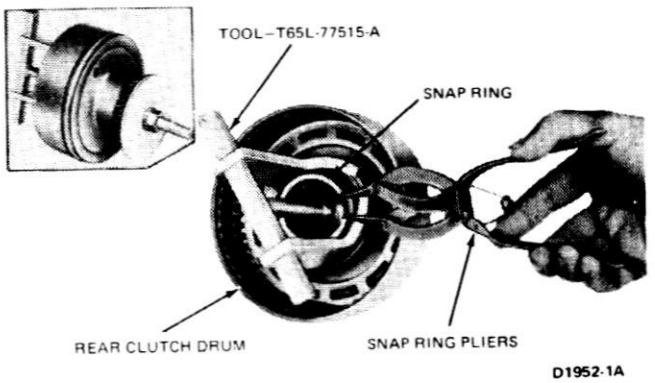


FIG. 39 Removing Rear Clutch Spring Snap Ring

3. Guide the spring retainer while releasing the pressure, to prevent the retainer from locking in the snap ring grooves.
4. Position the primary sun gear shaft in the rear clutch. Place an air hose nozzle in one of the holes in the shaft, and place one finger over the other hole. Then force the clutch piston out of the clutch drum with air pressure. **Hold one hand over the piston to prevent damage to the piston.**
5. Remove the inner and outer seal rings from the clutch piston.
6. Remove the rear clutch sun gear bushing if it is worn or damaged.

Use the cape chisel (Fig. 40) and cut along the bushing seam until the chisel breaks through the bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.

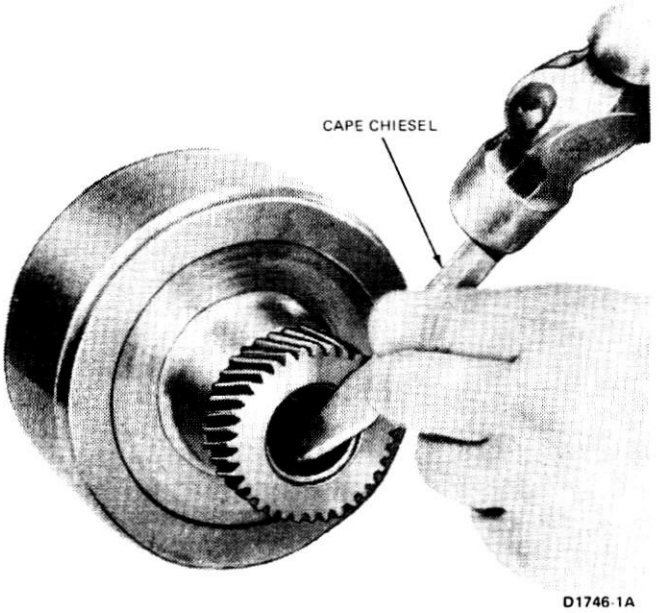


FIG. 40 Removing Rear Clutch Sun Gear Bushing

Assembly

1. If the rear clutch sun gear bushing was removed, press a new bushing into the rear clutch sun gear with the tool shown in Fig. 41.

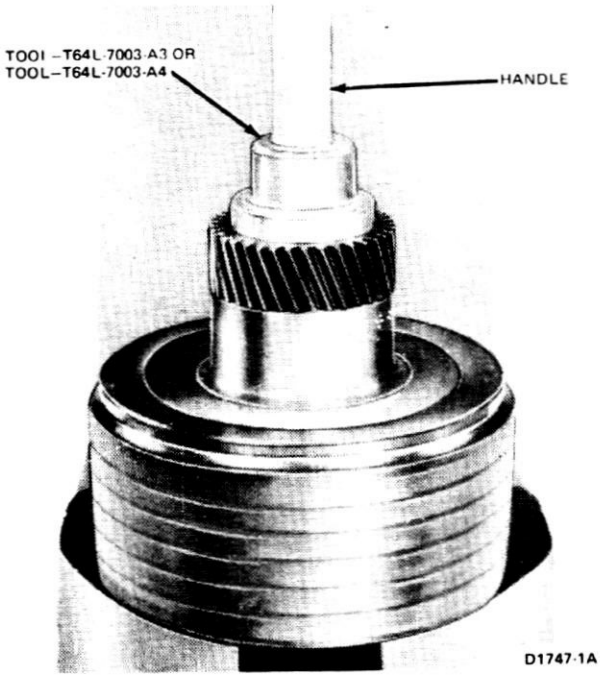


FIG. 41 Installing Rear Clutch Sun Gear Bushing

2. Install new inner and outer seal rings on the piston.
3. To install the piston in the clutch drum, lubricate the piston seals and tools (Fig. 42) with clean transmission fluid. Push the small fixture down over the cylinder hub. Insert the piston into the large

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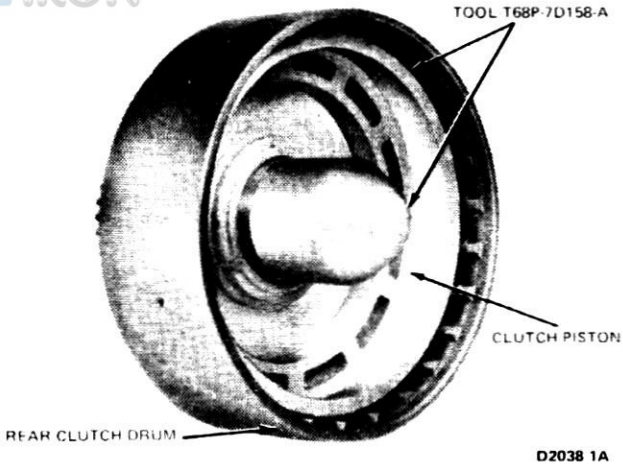


FIG. 42 Installing Rear Clutch Piston

fixture, with the seal toward the thin-walled end. Hold the piston and large fixture, and insert as a unit into the cylinder. Push down over the small fixture until the large tool stops against the shoulder in the cylinder; then push the piston down, out of the tool, until it bottoms in the cylinder. Remove the tools.

4. Install the clutch release spring, and position the retainer on the spring.
5. Install the tool on the spring retainer as shown in Fig. 39. Compress the clutch spring, and install the snap ring. **While compressing the spring, guide the retainer to avoid interference of the retainer with the snap ring groove. Make sure the snap ring is fully seated in the groove.**

   When new composition clutch plates are used, soak the plates in automatic transmission fluid for 15 minutes before they are assembled.
6. Install the external tabbed waved cushion spring. Then, install steel and friction plates alternately, starting with a steel plate.
7. Install the clutch pressure plate with the bearing surface down. Then install the clutch pressure plate snap ring. Make sure the snap ring is fully seated in the groove.
8. Check the free pack clearance between the pressure plate and the first internal plate with a feeler gauge. The clearance should be 0.030 to 0.055 inch. If the clearance is not within specifications, selective snap rings are available in the following thicknesses: 0.060 to 0.064, 0.074 to 0.078, 0.088 to 0.092 and 0.102 to 0.106 inch. Insert the correct size snap ring and recheck the clearance.
9. Install the thrust washer on the primary sun gear shaft. **Be sure the thrust washer is installed with the tabs of the washer away from the sun gear thrust face.** Lubricate all parts with automatic transmission fluid or petroleum jelly. Install the two center seal rings.
10. Install the rear clutch on the primary sun gear shaft. **Be sure all of the needles are in the hub if the unit is equipped with loose needle bearings.** Assemble two seal rings in the front grooves.

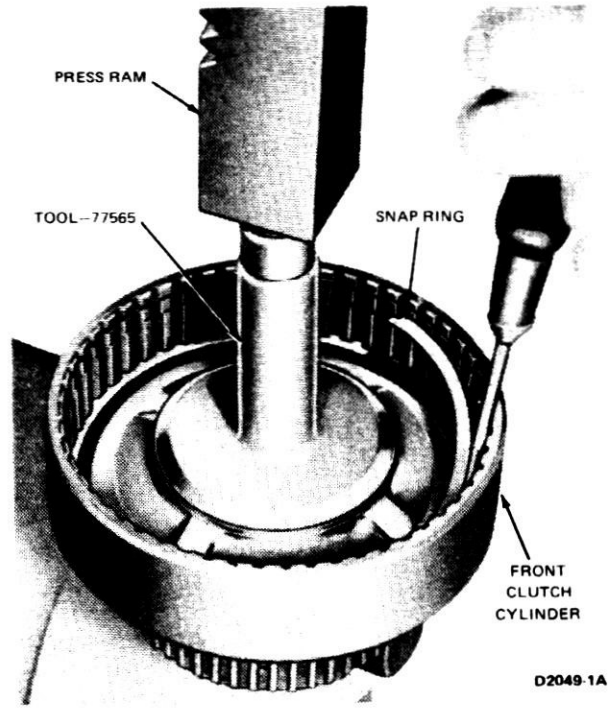


FIG. 43 Removing or Installing Front Clutch Snap Ring

11. Install the steel and the bronze thrust washers on the front of the secondary sun gear assembly. **If the steel washer is chamfered, place the chamfered side down.**

FRONT CLUTCH

Disassembly

1. Remove the clutch cover snap ring with a screwdriver, and remove the input shaft from the clutch drum.
2. Remove the thrust washer from the thrust surface of the clutch hub. Insert one finger in the clutch hub, and lift the hub straight up to remove the hub from the clutch drum.
3. Remove the composition and the steel clutch plates, and then remove the pressure plate from the clutch drum.
4. Place the front clutch spring compressor on the release spring, position the clutch drum on the bed of an arbor press, and compress the release spring with the arbor press until the release spring snap ring can be removed (Fig. 43).
5. Remove the clutch release spring from the clutch drum.
6. Install the special nozzle shown in Fig. 44 on an air hose. Place the nozzle against the clutch apply hole in the front clutch housing, and force the piston out of the housing.
7. Remove the piston inner seal from the clutch housing. Remove the piston outer seal from the groove in the piston.
8. Remove the input shaft bushing if it is worn or damaged. Use the cape chisel and cut along the bushing seam until the chisel breaks through the

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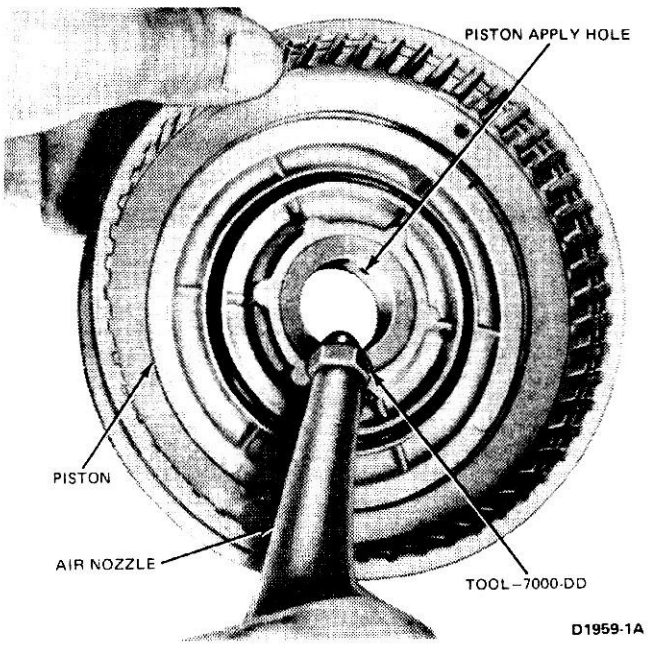


FIG. 44 Removing Front Clutch Piston

bushing wall. Pry the loose ends of the bushing up with an awl and remove the bushing.

Assembly

1. If the input shaft bushing was removed, slip a new bushing over the end of the installation tool and position the tool and bushing to the bushing hole. Then, press the bushing into the input shaft as shown in Fig. 45.
2. Lubricate all parts with transmission fluid. Install a new piston inner seal ring in the clutch cylinder. Install a new piston outer seal in the groove in the piston.
3. Install the piston in the clutch housing. **Make sure the steel bearing ring is in place on the piston.**
4. Position the release spring in the clutch cylinder with the concave side up. Place the release spring compressor on the spring, and compress the spring with an arbor press. Then install the snap ring as shown in Fig. 43. **Make sure the snap ring is fully seated in the groove.**
5. Install the front clutch housing on the primary sun gear shaft by rotating the clutch units to mesh the rear clutch plates with the serrations on the clutch hub. **Do not break the seal rings.**
6. Install the clutch hub in the clutch cylinder with the deep counterbore down (Fig. 46). Install the thrust washer on the clutch hub.
7. Install the pressure plate in the clutch cylinder with the bearing surface up (Fig. 47). Install the composition and the steel clutch plates alternately, starting with a composition plate (Fig. 48). When new composition clutch plates are used, soak the plates in automatic transmission fluid for 15 minutes before they are assembled.
8. The final friction plate to be installed is selective. Install the thickest plate that will be a minumum of 0.010 inch below input shaft shoulder in cylinder. For all other plates, use the thinnest available. Refer to the Specifications at end of this Part for available plate thicknesses.
9. Install the turbine shaft in the clutch cylinder, and then install the snap ring. **Make sure the snap ring is fully seated in the groove.**
10. Install the thrust washer on the turbine shaft.

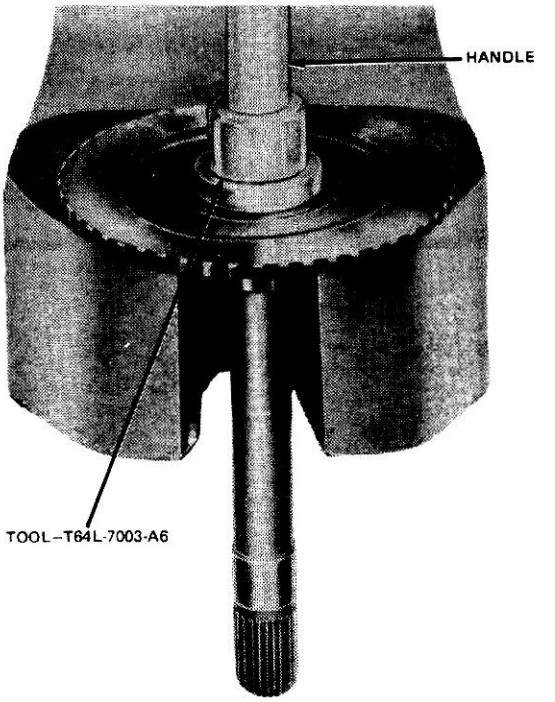


FIG. 45 Installing Input Shaft Bushing

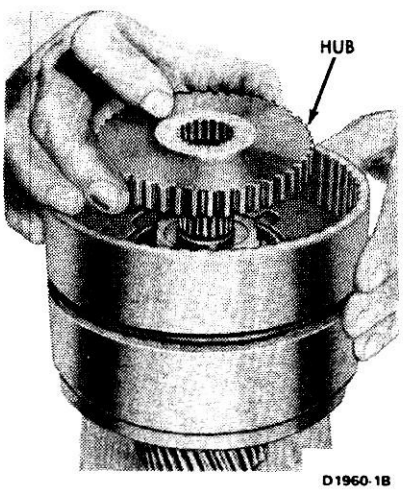


FIG. 46 Installing Clutch Hub

PRIMARY SUN GEAR SHAFT

Disassembly

1. Position the primary sun gear shaft in the clutch bench fixture.
2. Check the fit of the seal rings in their respective bores. If equipped with cast iron seal rings, a

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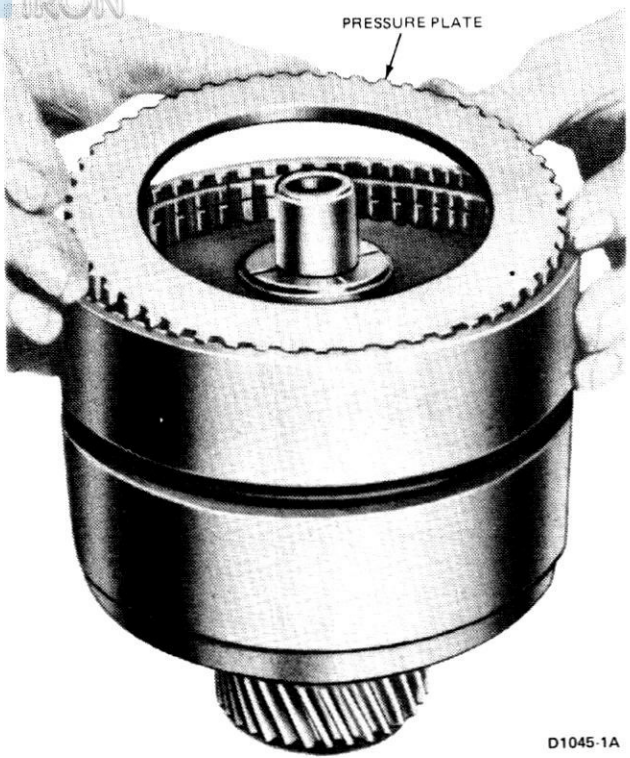


FIG. 47 Installing Pressure Plate

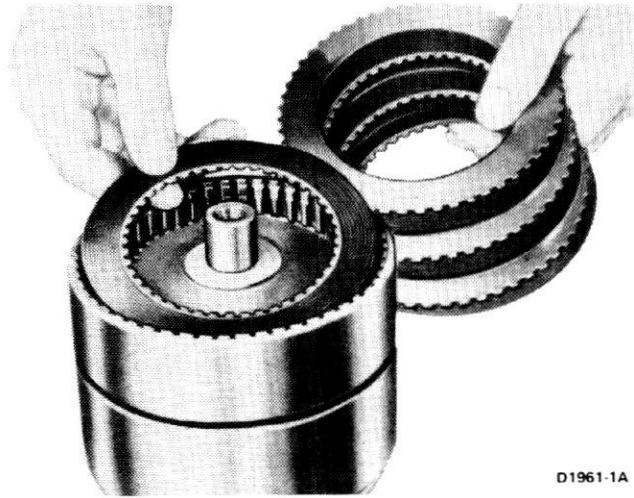


FIG. 48 Installing Clutch Plates

clearance of 0.002 to 0.009 inch should exist between the ends of the rings.

If equipped with plastic seals that are worn or damaged, cut the seals from the shaft with a sharp knife. Be careful not to score the ring grooves.

Assembly

1. Replace the plastic seals with cast iron seal rings, and check for free movement in the groove.

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SPECIFICATIONS

APPROXIMATE REFILL CAPACITIES
FMX TRANSMISSION

	U.S. Measure	Imp. Measure
All Car Lines	11	9-1/4

SELECTIVE THRUST WASHERS
FMX TRANSMISSION

Identification No.	Thrust Washer Thickness — Inch
By Thickness	0.061-0.063
	0.067-0.069
	0.074-0.076
	0.081-0.083

CLUTCH PLATES
FMX TRANSMISSION

Trans. Model	Forward Clutch				Rear Clutch		
	Steel Plates	Friction Plates	Selective Plate Thickness	Selective Plate Identification	Steel Plates	Friction Plates	Free Pack Clearance
PHB	4	5 ①	0.0565-0.0605	No Stripe	4 ②	4	0.030-0.055
			0.0705-0.0745	One Stripe			
			0.0845-0.0885	Two Stripes			

① Last plate (Friction) in forward clutch is selective. Install thickest plate in pack that will be a minimum of 0.010 inch below input shaft shoulder in cylinder. All other friction plates in pack are thinnest available.

② Plus one external tabbed waved plate installed next to piston.

CHECKS AND ADJUSTMENTS FMX TRANSMISSION

Operation	Specification
Transmission End Play Check	0.010-0.029 (Selective Thrust Washers Available)
Turbine and Stator End Play Check	New or rebuilt 0.023 max., Used 0.050 max.
Front Band Adjustment (Use 1/4 inch spacer between adjustment screw and servo piston stem)	Adjust screw to 10 in-lbs torque. Remove spacer, hold screw and then tighten screw an additional 3/4 turn. Torque locknut to 20-25 ft-lb.
Rear Band Adjustment	Loosen locknut. Adjust screw to 10 ft-lb torque, then back off exactly 1-1/2 turns. Hold screw and tighten locknut to 35-40 ft-lb.
Primary Sun Gear Shaft Ring End Gap Check	0.002-0.009
Rear Clutch Selective Snap Ring Thickness	0.060-0.064, 0.074-0.078, 0.088-0.092, 0.102-0.106

TORQUE LIMITS FMX TRANSMISSION

Item	Ft-Lb	Item	Ft-Lb	Item	Ft-Lb
Converter to Flywheel	20-30	Regulator to Case	17-22	Converter Drain Plug	15-28
Converter Hsg. to Trans. Case	40-50	Planetary Support to Trans. Case	20-30	Rear Band Adjusting Screw Locknut	35-40
Front Pump to Trans. Case	17-22	Control Valve Body to Trans. Case	8-10	Front Band Adjusting Screw Locknut	20-25
Front Servo to Trans. Case	30-35	Diaphragm Assy. to Case	15-23	Manual Valve Inner Lever to Shaft	20-30
Rear Servo to Trans. Case	40-45	Cooler Return Fitting	15-20	Downshift Lever to Shaft	17-20
Oil Pan to Case	10-13	Extension Assy. to Trans. Case	30-40	Filler Tube to Engine	20-25
Converter Cover to Converter Hsg.	12-16	Pressure Gauge Tap	7-15	Transmission to Engine	40-50

Item	In-Lb	Item	In-Lb	Item	In-Lb
Governor to Counterweight	50-60	Front Servo Release Piston	20-30	to Valve Body	20-30
Governor Valve Body Cover Screws	20-30	End Plates to Body	20-30	T.V. Body to Valve Body	20-30
Pressure Regulator Cover Screws	20-30	Stator Support to Pump	25-35	*Lower Valve Body Clearance* & Plate to Valve Body	20-30
Control Valve Body Screws (10-24)	20-30	Lower Body & Cover Plate			

SPECIAL TOOLS FMX TRANSMISSION

Ford Tool No.	Description	Ford Tool No.	Description
T50T-100-A and TOOL-1175-AB	Seal Remover	T61L-7657-B	Transmission Extension Hsg. Oil Seal Replacer
		T57P-7697-A	Transmission Extension Hsg. Bushing Remover
TOOL-7000-DD	Air Nozzle Rubber Tip Assembly	T57P-7697-B	Transmission Extension Hsg. Bushing Replacer
T64L-7003-A	Automatic Transmission Bushing Kit Remover and Replacer	TOOL-77067	Dial Indicator Support Fixture
		T65L-77515-A	Rear Clutch Spring Compressor
T68P-7D158	Seal Installer and Protector	T71P-77570-B	
T70P-7B200-A	Rear Band Torque Wrench ①	T71P-77370-H	
T70P-7B200-B	Rear Band Lock Nut Wrench ①	TOOL-77565	Front Clutch Spring Compressor
T58L-7195-A	Band Adjustment Wrench	T63L-77837-A	Front Pump Seal Replacer
TOOL-7225-BA	Front Band Adjustment Wrench		

① LTD II/Cougar/Thunderbird ② Except LTD II/Cougar/Thunderbird

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OFFICIAL LICENSED PRODUCT DETROIT IRON

NOISE, VIBRATION AND HARSHNESS DIAGNOSIS

GROUP 18

PART TITLE	PART NO.	PART TITLE	PART NO.
Noise, Vibration and Harshness Diagnosis – General Instructions	18-01		

CF2535-2A

Noise, Vibration and Harshness Diagnosis—General Instructions

PART 18-01

Applies To All Cars

SUBJECT	PAGE	SUBJECT	PAGE
TESTS		TESTS (Cont'd.)	
Checks For Vibration With Tip-In	01-3	Radial Ply Tire	01-5
Checks For Vibration Without Tip-In	01-4	Road Testing	01-1
Customer Complaint Description	01-1	Suspension Inspection	01-2
Engine Accessory Check	01-3	Tip-In Moan Noise	01-5
Engine Run-up Check	01-2	Tire Inspection	01-2

CF2536-2A

TESTS

CUSTOMER COMPLAINT DESCRIPTION

Obtaining a complete description of the condition from the customer may give important clues for diagnosing the situation. Ask the customer if any unusual characteristics accompany the complaint. Find out if the complaint existed when the vehicle was new, if it came about gradually, or if it suddenly appeared.

A gradual appearance of the complaint indicates a deterioration of a component, such as tires, U-joints, an accessory drive belt, or a wheel bearing.

A sudden appearance of the complaint could indicate a lost wheel balance weight or lost driveshaft balance weight.

NOTE: Information gained from the description of the customer's concern should never be used in place of facts gained from diagnosis, nor should it be used in an attempted short cut fix. In the long run, time will be saved by adhering to the diagnositc procedures shown in this manual.

ROAD TESTING

When practical, road testing should be performed on the same road where the noise, vibration or harshness conditions are noticed by the customer. However, if this is not practical, a similar road course may be selected with conditions as nearly the same as described by the customer. Prior to road testing, install a tachometer and

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set tire pressures to recommended specifications. Notice if the tire pressures are above recommended settings. If so, it would be a cause of a harsh ride condition. When performing a road test, the following factors must be taken into consideration to properly isolate the condition. **Remember that a thorough road test will quickly isolate the problem area.**

a. At what road speed does the complaint occur? Low speed vibration is an indication of tire runout conditions. High speed, 40 mph and up, vibration is an indication of tire imbalance.

b. At what engine rpm does the complaint occur? The tachometer reading will be used later in the engine run up test.

c. Does the vehicle have a harsh ride quality? If so, the cause is tires or suspension.

d. Transmission gear ratios will tend to eliminate certain components as contributing factors to the customer's concern. For example, if a vibration appears at 50 mph in high gear at a given tachometer rpm, but disappears in intermediate gear at 50 mph, it is probable that the vibration is being generated in the engine or its accessories. As a further check, operate the vehicle at the noted engine rpm in intermediate gear to see if the vibration still exists. If the vibration still exists, the cause is in the engine or its accessories. If the vibration disappears, the cause is probably in the drive line.

e. Drive at a constant speed within the noted range to determine if the intensity changes several times a minute, indicating two or more problems.

f. Does the symptom come and go with tip in? (accelerating and decelerating). If so, the condition is in the drive line.

g. The operating temperature of the vehicle components may have a direct bearing on a problem. Often noise and vibration problems appear after the vehicle has attained normal operating temperatures. Conversely, the symptom may only appear at engine warm up. This may be an indication of a grounded exhaust system.

TIRE INSPECTION

Inspect tires for abnormal wear such as cupping on the outer tread rows. Also check for bulges in the tread of sidewall areas which indicate a tread or body ply separation. These conditions may induce vibration in the vehicle.

a. Nylon cord tires have an inherent stiff ride quality, and will produce temporary flat spots when they have been setting for extended periods of time, such as overnight. Advise the customer of the characteristics of the nylon tires.

b. Over-inflated tires will give a hard ride quality. Set the tire pressures to the recommended setting and advise the customer to have the tire pressures checked frequently.

c. Inspect tires for the correct size and type. As an example, 8.45 x 15 4 ply tires with an 8 ply rating are intended for trailer towing. Tires of this nature produce a harsh ride when the vehicle is in an unloaded condition. Advise the customer of this situation.

d. Check for tires that are not recommended by the manufacturer. Different brands of tires often give a different ride quality to the vehicle. Advise the customer of the situation.

e. The use of a set of test tires will be helpful in determining if the tires are the cause of the customer's concern. Balance the test tires on the vehicle before road testing.

NOTE: Before removing original tires and wheels, mark them as to location (right front—left front, etc.) and position (mark the wheel stud nearest the tire valve) to facilitate reinstallation.

SUSPENSION INSPECTION

a. Check for suspension that is not lubricated properly. Refer to Group 50 for proper lubricant and lubricating procedures.

b. Check for suspension components installed with a preload on pivot points and bushings. (As an example, a leaf spring with a rear shackle bound up.)To neutralize a condition such as this, loosen the attaching nuts and jounce the vehicle to position the components in a neutral condition; then, torque the nuts to specifications.

c. Check for bent or bound-up shock absorbers. Visually inspect the shock absorber bushings to see if they are centered or the shafts are bent. If this condition exists, properly position the shock absorber or replace it if it is bent.

d. Check for heavy duty suspension components installed on the vehicle. Competition or heavy duty suspension components have hard ride characteristics. If these components are installed on a vehicle and the customer is concerned about the harsh ride, the components will have to be replaced with standard suspension parts.

ENGINE RUN UP CHECK

This procedure is useful in separating drive line and tire vibration from engine and accessory vibration. A tachometer is required to correlate engine rpm with vehicle speed. With the vehicle stationary and the transmission in park or neutral, run the engine up to the symptom rpm encountered on the road test. If the symptom appears, the vibration is probably caused by an engine accessory such as the A/C compressor or a drive belt. However, if the symptom does not appear in park or neutral, perform a stall test with the vehicle in drive range.

CAUTION: While making a stall test in drive range on automatic transmission equipped vehicles, do not hold the throttle open for more than 5 seconds at a time. Then move the selector lever to neutral and run the engine at 1,000 rpm for about 15 seconds to cool the converter.

If the symptom appears during the stall test, the disturbance is probably caused by bound-up engine mounts or exhaust system components that are grounding.

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The engine run up test is applicable to manual transmissions, with the exception of the stall test.

NOTE: Because the vehicle is stationary during engine run up checks, other noises and/or vibrations will become noticeable which were not evident under normal driving conditions. For instance, all engines have a natural vibration point which can be felt in neutral but not under normal driving conditions. For this reason, the use of a tachometer is mandatory to verify the presence of the real cause.

ENGINE ACCESSORY CHECK

a. With the engine stopped, visually inspect, adjust, torque or replace:

- all drive belts for cracking or fraying.
- the condition of all pulleys. See if they are bent, nicked or misaligned.
- the fan for bent or missing blades or the fan spacer for burrs or foreign material behind it.
- the accessory attaching bolts, such as the A/C compressor and power steering pump mounting brackets.

all the drive belts for proper tension.

b. With the engine running at idle or at the noted rpm, visually inspect:

- all drive belts for variation in belt width or belt whip.
- all pulleys for axial or radial run out.

Remove the drive belts one at a time until the vibration is eliminated. This will indicate which belt or accessory is causing the customer's concern. Replace the belts or pulleys as necessary. A stethoscope or other probing device may save you time in diagnosing an accessory problem.

c. Engine Stall Test:

Neutralize the engine mounts and the number 3 crossmember. This can be the cause of restricting the dampening effect of the engine mounts.

NOTE: To neutralize the engine mounts and the number 3 crossmember, loosen the attaching bolts, start the engine, shift to drive with the engine idling and then back to neutral. Shut off the engine and torque the bolts to specification.

Neutralize the exhaust system and hangers. A grounded or strained exhaust system can produce noise or a vibration.

NOTE: To neutralize the exhaust system, run the engine to bring the exhaust system components to their normal operating temperature. Shut the engine off and loosen the exhaust manifold pipe flanges and all hangers. Reposition all exhaust components so that they hang free and straight. Start the engine and shift to drive and then back to neutral. Shut off the engine and torque all nuts and bolts for the flanges and hangers. Be certain that no grounding condition exists and that adequate clearance exists along the entire length of the exhaust system.

CHECKS FOR VIBRATION WITH TIP IN

Drive line vibration can be dependent upon vehicle speed and tip in (acceleration and deceleration). Drive line vibrations frequently originate with excessive run out of the drive line components; namely, pinion companion flange and driveshaft run out. Run out in these components will produce vibrations because the components will be rotating on a center other than a center of balance. Imbalance of the driveshaft will also produce a vibration. Low speed vibration can be caused by improper drive line angles.

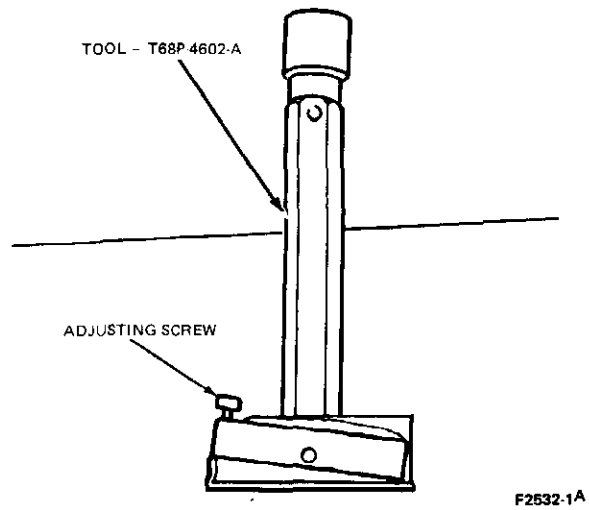


FIG. 1 Positioning Tool on V-Magnet

Driveline Angle Checking Procedure

Check for improper driveline angles.

a. Position the vee magnet (part of Tool T68-4602-A) on the drive shaft away from welds and balance weights.

b. From the left side of the vehicle, position the magnetized Tool T68P-4602-A on the vee magnet with the adjusting screw to the left (Fig. 1). Adjust the dial on the tool with the adjusting screw until the left-hand edge of the bubble is exactly on the zero line.

c. Now position the magnetized tool on a U-joint bearing cap as shown in Fig. 2 with the tool in the same relative position as it was on the vee magnet (Fig. 1).

d. Read the position of the bubble's lefthand edge on the scale to determine the drive shaft pinion angle. Compare to the degree specification in the chart at the end of Part 14-32. If adjustment is necessary, adjust to within plus or minus 30 minutes. If the vehicle is loaded, remove load to achieve "curb load" (empty car with full load of gas).

Rear Axle Companion Flange Runout Check

Refer to Part 15-01 for instructions on making this check.

Drive Line Balance Check

Refer to Part 15-60 for instructions on making this check.

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CHECKS FOR VIBRATION WITHOUT TIP IN

Vibrations that occur at steady road speeds of 40 mph or above, are usually attributed to tire and wheel imbalance. These vibrations can be felt in the steering wheel, floor pan, and in the seat. Excessive tire and wheel run out can produce an effect similar to an unbalanced tire and wheel. The tires must be warm prior to balancing or checking tire and wheel run out.

a. Check the tire and wheel balance. An apparent imbalanced tire can be caused by a lost wheel weight, a poorly balanced brake drum, excessive axle shaft run out, or by not being balanced properly. Perform an "on-the-car" balance check of all four (4) tire-wheel assemblies.

NOTE: Balance check of tire-wheel assemblies must be made by spinning the assemblies, one at a time, with the car supported by the frame members of the unit, allowing the suspension to hang in its free position per instructions of the Rotunda Balancer.

b. Check the tire and wheel run out. Irregularities in the tire, axle shaft or wheel can cause excessive runout.

Using the Rotunda Tire Runout Gauge, Part No. 19-0001 or equivalent, or a dial indicator mounted on a stand, check the "radial" runout of the tire and wheel assemblies on the car. This is done with the roller of the gauge running on the center tread of the tire and pointing to the center of the wheel for a radial runout check, and at the scrub rib for a lateral check. (Refer to Fig. 3).

If the radial runout on the center tread of the tire exceeds the service performance limit of .070 inch, measure the radial and lateral runout of the wheels. Wheel radial and lateral runouts are checked as shown in Fig. 3.

If the radial or lateral runout of the wheel exceeds .070 inch, remove the wheel and rotate it two studs on the drum and re-measure the radial and lateral runout of the wheel and tire assembly. Continue rotating the wheel until runout is within the specification or replace the wheel, if required.

If the runout of the wheel-tire assembly is reduced to the proper specification or less, the unit should exhibit acceptable performance after re-balance.

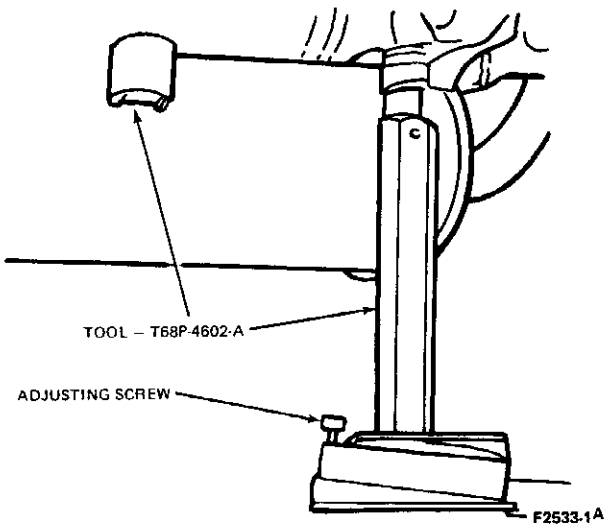


FIG. 2 Measuring Pinion Angle

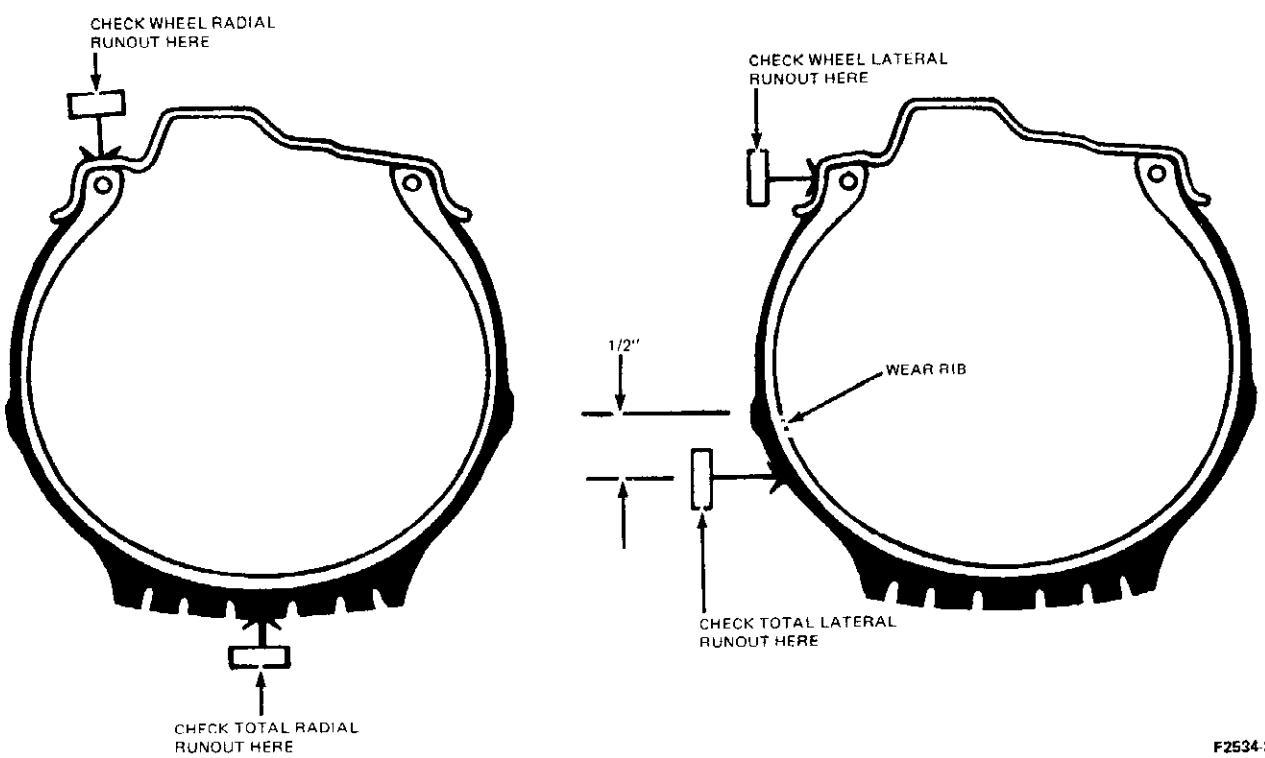


FIG. 3 Checking Wheel Lateral and Radial Runout

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If the total radial runout still exceeds the limits shown, match the highest radial point on the tire with the lowest radial point on the wheel and again measure the radial runout of the assembly on the car.

If the wheel-tire assembly is still over the limit for either radial or lateral runout and the wheel itself is within the wheel runout specification, the tire should be replaced.

c. Use test tires to evaluate original tires.

NOTE: Before removing original tires and wheels, mark them as to location (right front—left front, etc.) and position (mark the stud nearest the tire valve). Test tires must be balanced on the vehicle.

SPECIAL NOTE: (Alternate method in place of using test tires). Using ROTUNDA TIRE UNIFORMITY INDICATOR, Part No. DRE-008, when available, or an equivalent uniformity indicator, will measure loaded radial runout of the tires. This machine will give the total change in tire radius under normal vehicle load conditions.

d. Run-down rumble.

A run-down or coast-down rumble noise in neutral may still be evident after a complete tire and driveline diagnosis on vehicles with rear coil springs. This condition could be the result of spring surge and is dampened out by the installation of a spring damper kit. Each kit contains 24 rubber dampers (12 for each spring) and 4 clips to retain the dampers to the center section of the spring. In some cases, 18 or 24 dampers may be required per spring. An additional clip should be installed to separate each set of 12 dampers if 24 are used on one spring.

RADIAL PLY TIRE

Customers not already familiar with radial ply tires and their advantages, may question the under-inflated appearance, even though the pressure is to specification. The customer must be advised that this is a normal condition and is not detrimental to the tire.

Certain road and loading conditions may cause a slight whine to be induced by the road gripping characteristic of the tread. In some cases, this whine may be misinterpreted as rear axle whine. However, rear axle whine will usually vary with a change from drive, cruise or float at a given speed. Tire tread noise will remain virtually constant under the same conditions. In the event this whine condition is experienced on a customer's car, he should be advised that this is a characteristic of this radial ply tire tread design.

The use of the new Radial Tire design with increased tire life, improved handling ability and improved stopping characteristics has resulted in increased tire noise. The "sizzle" noise is caused by reaction of the tire tread to the road surface.

If after all N.V.H. diagnostic procedures have been evaluated and a noise and slight vibration can still be heard, proceed to tip-in moan noise.

TIP-IN MOAN NOISE

Tip-in moan is a term used to describe a noise that can be induced by light to medium acceleration at speeds of 40 MPH and above. A vibration felt in the floor pan may also accompany the moan noise. The noise is a by-product of a slight bending cycle condition of the engine crankshaft caused by the firing impulses of the engine. This bending cycle follows back through the transmission and sets up a vibration that affects body sheet metal and/or floor panels. A tuning fork is a good example of this. When striking an object with a tuning fork, while holding it, a noise can be heard and the vibration can be felt.

To damp or tune out this condition, on some models, a vibration damper tuned to the appropriate frequency has been attached to the bottom of the transmission extension housing. The damper usually consists of an arm and a weighted end.

For Test Purposes Only

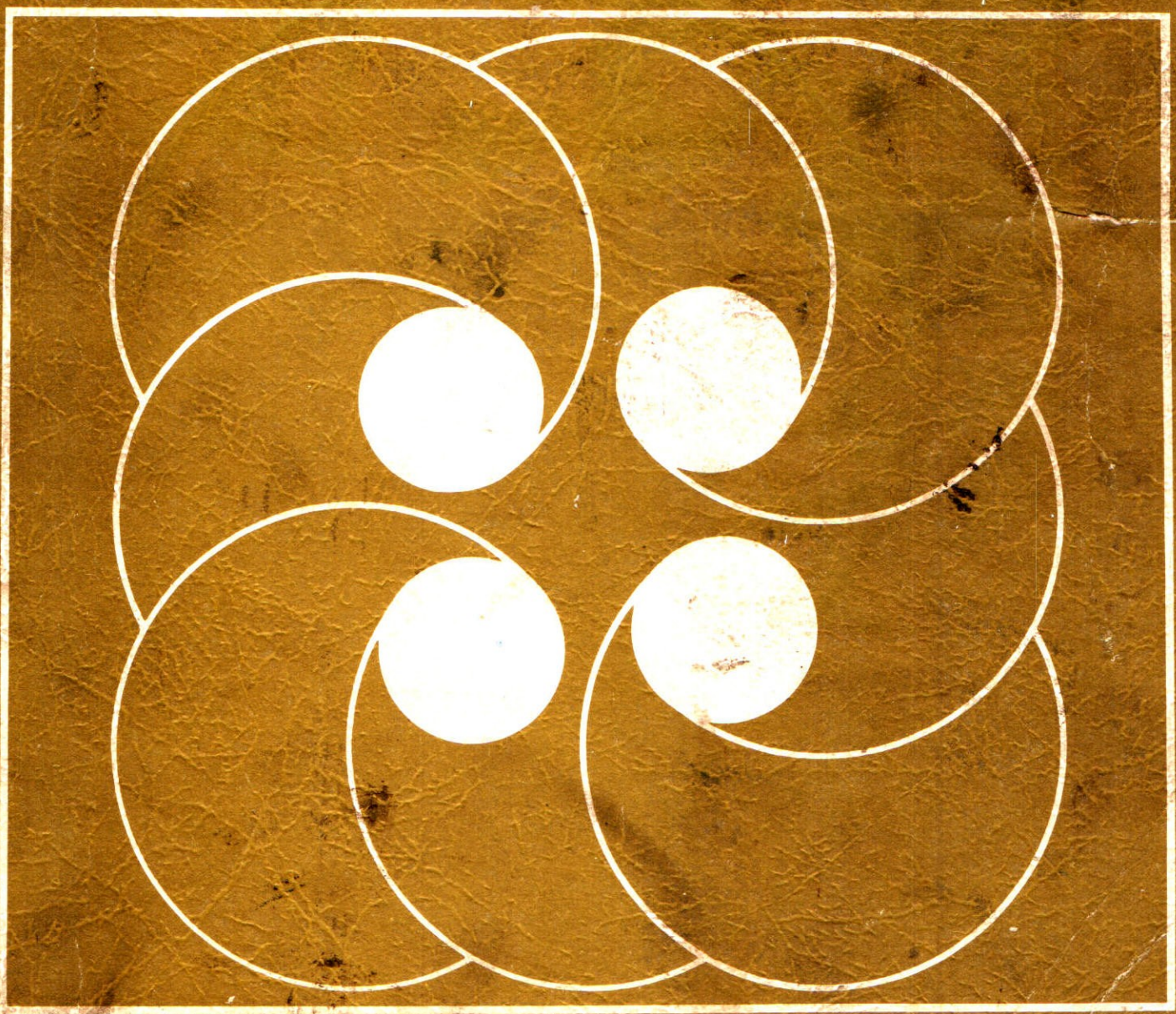
To determine if a tip-in moan condition exists which may be corrected with a vibration damper, the following procedure may be used.

1. Loosen the transmission bell housing to engine attaching bolts 1/2 to 1 turn.
2. Drive the vehicle in the problem speeds and driving modes. If the moan noise/vibration is eliminated or significantly reduced, an appropriate damper may be installed for solution of the customer's concern. If the moan condition still exists, investigate exhaust system, engine mounts and engine accessories.
3. **RETORQUE ALL LOOSENED BOLTS TO SPECIFICATION.**

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Ford
75TH ANNIVERSARY

1978 Car Shop Manual Volume 2 Engine



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DETROIT IRON

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

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DETROIT IRON

foreword...

This 1978 Car Shop Manual has been prepared to provide information covering normal service repairs and maintenance for 1978 Ford Passenger Cars manufactured in the United States and Canada. It is divided into five volumes, each covering a specific major area:

Volume 1 – Chassis
Volume 2 – Engine
Volume 3 – Electrical
Volume 4 – Body
Volume 5 – Maintenance and Lubrication.

Information in each volume is divided into Groups covering a general system. The table of contents on the cover of each volume indicates the Group title, number, and volume in which each Group is located.

For 1978, the basic part number for components covered in the Groups is also included in parenthesis after the Group number.

Example: Cooling System (General System Covered in Group) Group 27 (Group Number) (8000) (Basic Part Number for Cooling System Components)

Some components covered within a Group do not have the same basic part number. In these cases, more than one part number will appear on the Group index.

Example: Gasoline Engines (General System Covered in Group) Group 21 (6000 (Basic Part Number for Gasoline Engine Components) & 9000) (Intake and Exhaust Manifold Basic Part Number Only)

For easy reference, information in each Group has been divided into smaller units or Parts. There is one Part for each component in the system, as well as a General Service Part in some Groups to cover procedures common to several components within the Group. In general, each Part contains the Description, Operation, Diagnosis and Testing, Removal and Installation and Disassembly and Assembly procedures for the component covered in the Part. Diagnosis Charts are also included in some Parts to help you systematically locate and service conditions encountered. In most cases, specifications are included at the end of each Part.

To aid in locating specific items in this manual, the index at the front of each volume provides an alphabetical listing, with page number, for all Parts in the volume. The tab locator on the right side of this index will help you find the first page of each Group.

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On the first page of each Group there is an index listing the Part title and Part number for each component covered within the Group. The first page of each Part contains an index to locate service operations covered in that Part. This Group-Part breakdown is also indicated in the page number located at the top of each page.

Example: 11-02-21 = (Group) 11 — (Part) 02 — (Page) 21

Metric conversion tables have been included at the back of each volume to aid in converting specifications in this manual to the metric equivalent.

The descriptions and specifications in this manual were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring obligation.

Ford Parts and Service Division
Training and Publications Department

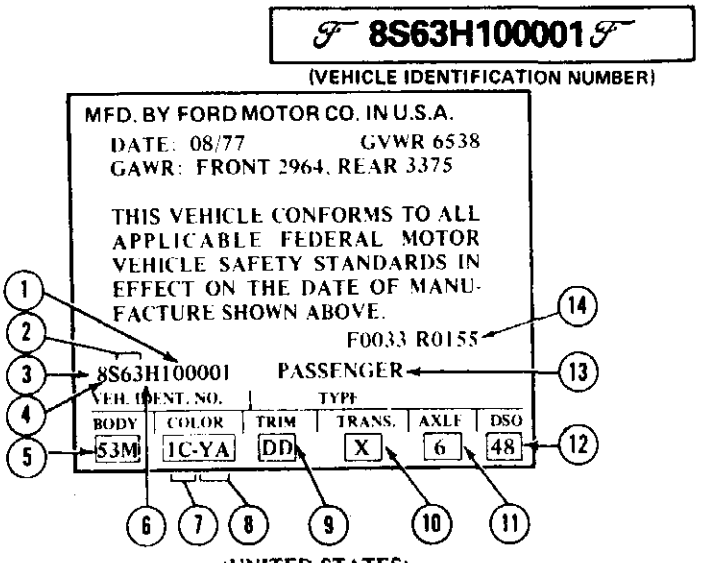
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VEHICLE IDENTIFICATION

GROUP 20

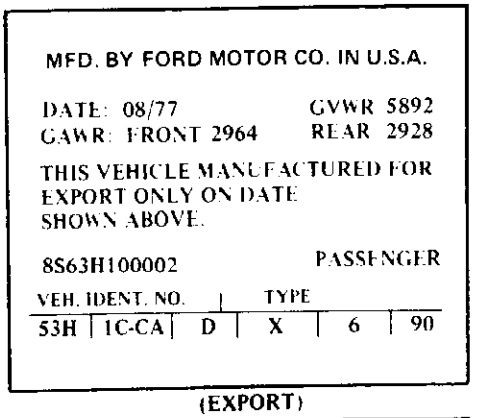
Vehicle Identification

PART 20-01

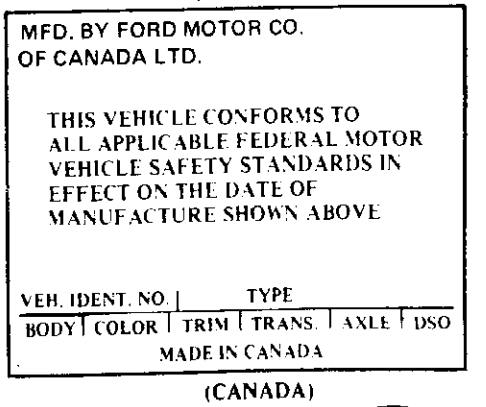


(UNITED STATES)

1. CONSECUTIVE UNIT NO.**
2. BODY SERIAL CODE
3. MODEL YEAR CODE
4. ASSEMBLY PLANT CODE
5. BODY TYPE CODE
6. ENGINE CODE
7. BODY COLOR CODE
8. VINYL ROOF TYPE/COLOR
9. TRIM CODE (First Letter = Type of Trim; Second Letter = Color)
10. TRANSMISSION CODE
11. REAR AXLE CODE
12. DISTRICT – SPECIAL EQUIPMENT
13. VEHICLE TYPE*
14. ACCESSORY RESERVE LOAD



(EXPORT)



(CANADA)

*1978 BUILD MODELS DESIGNATED 1977 MODELS WILL HAVE "PASS 1977" IN THIS SPACE.

**1978 BUILD MODELS DESIGNATED 1977 MODELS WILL HAVE ALTERED CONSECUTIVE NUMBERING AS FOLLOWS:

PINTO/MUSTANG II – 400001 THRU 499999

BOBCAT – 750001 THRU 799999

Y1410-2K

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GENERAL DESCRIPTION

OFFICIAL VEHICLE IDENTIFICATION NUMBER

The official Vehicle Identification Number (VIN) (Fig. 1) for title and registration purposes is stamped on a metal tab that is fastened to the instrument panel close to the windshield on the driver's side of the car and is visible from outside.

VEHICLE CERTIFICATION LABEL

The Vehicle Certification Label (V.C. Label) (Fig. 1) is affixed on the left front door lock face panel or door pillar. The upper half of the label contains the name of manufacturer, month and year of manufacture, Gross Vehicle Weight Rating (GVWR), Gross Axle Weight Rating (GAWR), and the certification statement.

The V.C. label also contains the Vehicle Identification Number. This number is also used for warranty identification of the vehicle. The first number indicates the model year. The letter following the model year number indicates the manufacturing assembly plant. The next two numbers designate the Body Serial Code followed by a letter expressing the Engine Code.

The last six digits of the Vehicle Identification Number indicate the Consecutive Unit Number of each unit built at each assembly plant. The Consecutive Unit Numbers begin as follows:

100,001—Ford, LTD II, Ranchero, Mustang II, Thunderbird, Granada, Fairmont and Pinto.

500,001—Mercury, Cougar, Zephyr, Monarch and Mercury Bobcat.

800,001—Lincoln Continental and Continental Mark V.

The remaining information on the V.C. Label consists of the following vehicle identification codes:

The BODY code is two numerals and a letter identifying the body style.

The COL (color) code is a number and letter indicating the exterior paint color code and vinyl roof type and color (if equipped).

The TRIM code consists of a two-letter or a letter-number combination designating the interior trim.

The AXLE code is a number or letter indicating the rear axle ratio and standard or locking type axles.

The TRNS. code is a number or letter indicating the type of transmission.

The DSO code, consisting of two numbers, designates the district in which the car was ordered and may appear in conjunction with a Domestic Special Order or Foreign Special Order number when applicable. Ford of Canada DSO codes consist of a letter and number.

The following charts provide the various codes and their respective identification:

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DETROIT IRON

IDENTIFICATION CODES

ASSEMBLY PLANT CODES

Code Letter	District
A	Atlanta
B	Oakville (Canada)
E	Mahwah
F	Dearborn
G	Chicago
H	Lorain
J	Los Angeles
K	Kansas City
P	Twin Cities
R	San Jose
S	Allen Park (Pilot)
T	Metuchen
U	Louisville
W	Wayne
X	St. Thomas
Y	Wixom
Z	St. Louis

ENGINE CODES

Codes	No. of Cyls.	Displacement Litres	CID
A	8	7.5	460-4V
C	8	7.5	460-4V (Police Interceptor)
F	8	5.0	302-2V
H	8	5.8	351-2V
L	6	4.1	250-1V
S	8	6.6	400-2V
T	6	3.3	200-1V
Y	4	2.3	139-2V (2.3L)
Z	6	2.8	169-2V (2.8L)

TRANSMISSION CODES

Codes	Type
	MANUAL
1	3 Speed
5	4 Speed Overdrive
6	4 Speed @
7	4 Speed (b)
	AUTOMATIC
V	XP (C-3)
W	XP (C-4)
X	FMX]
U	XPL (C-6)
Z	XPL (Special)

@ Borg-Warner (b) Hummer

DISTRICT CODES LINCOLN-MERCURY

Code	District
00	Special
11	Boston
15	New York
16	Philadelphia
17	Washington
21	Atlanta
22	Dallas
23	Jacksonville
26	Memphis
31	Buffalo
32	Cincinnati
33	Cleveland
34	Detroit
41	Chicago
42	St. Louis
46	Twin Cities
51	Denver
52	Los Angeles
53	Oakland
54	Seattle
84	Home Off. Reserve
90's	Export

FORD OF CANADA

Mercury Code	Region	Ford Code
A1	Central	B1
A2	Eastern	B2
A3	Atlantic	B3
A4	Midwestern	B4
A6	Western	B6
A7	Pacific	B7
12	Export	12

REAR AXLE RATIO CODES

Conventional Lock		Ratio
Y		3.08
B		2.47
1	J	2.50
8		2.73
2		2.75
3		2.79
6	@	3.00
4		3.18
7		3.40

DISTRICT CODES FORD

Code	District
00	Special
11	Boston
12	Buffalo
13	New York
14	Pittsburgh
15	Newark
16	Philadelphia
17	Washington
21	Atlanta
22	Charlotte
23	Memphis
24	Jacksonville
25	Richmond
26	New Orleans
28	Louisville
41	Chicago
42	Cleveland
43	Milwaukee
45	Lansing
46	Indianapolis
47	Cincinnati
48	Detroit
52	Dallas
53	Kansas City
54	Omaha
55	St. Louis
56	Davenport
57	Houston
58	Twin Cities
71	Los Angeles
72	San Jose
73	Salt Lake City
74	Seattle
75	Phoenix
76	Denver
83	Government
84	Home Off. Reserve
85	American Red Cross
86	Recreational Veh. Pool
87	Body Company
89	Transportation Services
90's	Export

EXTERIOR PAINT COLOR CODES

Code	Ref. #	Color
1C	1724	Black
1G	5299	Silver Met.
1N	5476	Dove Gray
1P	5523	Med. Gray Met. (Two Tone only)
1Q	5527	Med. Silver Met.
2M	3413	Dark Red
2R	5440	Brt. Red
2U	5455	Lipstick Red
3G	5094	Brt. Dk. Blue Met.
3U	5467	Lt. Blue
31	5499	Midnight Blue
34	5041	Med. Blue
46	5328	Dk. Jade Met.
47	5404	Lt. Green
4V	5233	Dk. Yellow Green Met.
5Q	5477	Dk. Brown Met.
6E	5080	Brt. Yellow
6P	5406	Cream
6U	5441	Lt. Tan
7Q	5479	Lt. Aqua Mt.
7S	5489	Dk. Emerald Met.
8G	5466	Vista Orange
8H	5470	Tan
8K	5486	Brt. Saddle Met.
8N	5496	Dk. Cordovan Met.
8P	5471	Lt. Cordovan
8Y	5494	Champagne Met.
83	5524	Chamois
84	5525	Dk. Cordovan
9D	5418	White
		(RPO) UNIQUE COLORS (NON POLISH) "D"
2Y	5492	Rose Met.
3V	5480	Brt. Blue Met.
6V	5298	Tan Met.
	5460	Med. Gold Met.
7H	5482	Brt. Aqua Met.
7L	5483	Lt. Jade Met.
7T	5490	Med. Emerald Met.
8J	5484	Med. Tan Met.
8W	5491	Chamois Met.
		(RPO) DIAMOND BRIGHT (POLISH) "W"
2S	5444	Dk. Red Met.
2G	5070	Med. Red Met.
32	5511	Med. Blue Met.
8V	5495	Med. Ember Met.
8Z	5510	Med. Nectarine Met.
1R	5512	Lt. Silver Met.
		(RPO) DIAMOND FLARE (POLISH) "G"
1J	5411	Silver Met.
1L	5472	Black Met.
2T	5462	Rose Met.
6Y	5461	Brt. Yellow Gold Met.
7B	5463	Crystal Jade Met.

CY1411-2L

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BODY SERIAL AND STYLE CODES

Vehicle	Body Serial Code	Body Style Code	Body Type	Model
PINTO	10	62B	2-Dr. Sedan	Base
	11	64B	3-Dr. Sedan	Base
	12	73B	Wagon	Base
BOBCAT	20	64H	3-Dr. Sedan	U.S.A. & Canada
	22	73H	Wagon	U.S.A. & Canada
	23	62B	2-Dr. Sedan	Canada Only
	24	64B	3-Dr. Sedan	Canada Only
	25	73B	Wagon	Canada Only
MUSTANG II	02	60F	2-Dr.	Base
	03	69F	3-Dr.	Base
	04	60H	2-Dr.	Ghia
	05	69R	3-Dr.	Mach I
GRANADA	82	54H	4-Dr. Sedan	Base
	81	66H	2-Dr. Sedan	Base
MONARCH	34	54H	4-Dr. Sedan	Base
	33	66H	2-Dr. Sedan	Base
VERSAILLES	84	54M	4-Dr. Sedan	Base
LTD II	25	65B	2-Dr. Hardtop	LTD II S
	27	53B	4-Dr. Pillar Hardtop	LTD II S
	30	65D	2-Dr. Hardtop	LTD II
	31	53D	4-Dr. Pillar Hardtop	LTD II
	43	71K	LTD II Squire	Wagon
	47	97D	500	LTD II
	48	97R	GT	Ranchero
	49	97K	Squire	
FAIRMONT	92	54B	4-Dr. Sedan	Base
	91	66B	2-Dr. Sedan	Base
	93	66R	2-Dr. Sedan	Sport Coupe
	94	74B	Wagon	
COUGAR	92	53D	4-Dr. Pillar Hardtop	Cougar
	91	65D	2-Dr. Hardtop	Cougar
	93	65L	2-Dr. Hardtop	Cougar XR-7
THUNDERBIRD	87	60H	2-Dr. Pillar Hardtop	Base
FORD	52	60D*	2-Dr. Pillar Hardtop	Custom 500
	53	53D	4-Dr. Pillar Hardtop	Custom 500
	62	60H	2-Dr. Pillar Hardtop	LTD
	63	53H	4-Dr. Pillar Hardtop	LTD
	64	53L	4-Dr. Pillar Hardtop	LTD Landau
	65	60L	2-Dr. Pillar Hardtop	LTD Landau
	72	71D	Custom 500/LTD II	Wagon
	74	71H	LTD	Wagon
MERCURY	62	53H	4-Dr. Pillar Hardtop	Marquis (FLD)
	61	65H	2-Dr. Hardtop	Canada Only
	66	53L	4-Dr. Pillar Hardtop	Grand Marquis
	65	65L	2-Dr. Hardtop	Grand Marquis
	64	53K	4-Dr. Pillar Hardtop	Marquis Brougham
	63	65K	2-Dr. Hardtop	Marquis Brougham
	74	71K	Marquis**	Wagon
CONTINENTAL MARK V	89	65D	2-Dr. Hardtop	Base
LINCOLN CONTINENTAL	81	60B	2-Dr. Pillar Hardtop	Base
	82	53B	4-Dr. Pillar Hardtop	Base
ZEPHYR	32	54D	4-Dr. Sedan	Base
	31	66D	2-Dr. Sedan	Base
	35	36R	2-Dr. Sedan	Sport Coupe
	36	74D	Wagon	

CY1615-2E

VINYL ROOF TYPE AND COLOR IDENTIFICATION

Code	Vinyl Type	Code	Vinyl Type
W	Lugano Full	Z	Valino Front Half
X	Lugano Half	T	Valino Coach
K	Lugano Front Half	B	Crosshatch Full
M	Lugano Coach	R	Crosshatch Half
D	Milano Full	S	Levant Full
E	Milano Half	E	Levant Half Rear (Mustang Dev.)
F	Milano Halo		
Q	Cayman Full	G	Odense Full
U	Cayman Half	N	Odense Half
V	Valino Full	A	Odense Front Half
Y	Valino Half		

Code	Vinyl Color	Code	Vinyl Color
A	Black	F	Cordovan
B	Blue, Medium	K	Cordovan, Light
S	Blue, Midnight		Gold, Galveston
5	Blue, Wedgewood	E	Gray, Dove
T	Brown, Dark	R	Jade, Dark
V	Camel, Lt.	M	Jade, Light
Y	Camel, Medium	4	Jade, Medium
U	Chamois	3	Jade, Wedgewood
6	Champagne, Light	D	Red/Russet
J	Champagne, Midnight	P	Silver
		W	White

When a Vinyl Roof is installed the type and color codes will be reflected after the two digit Exterior Paint Color Code.
Example: Code – 1CYA = 1C–Black Car, YA–Valino Black Half Roof.

CY1615-2E1

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DETROIT IRON

GASOLINE ENGINES

GROUP 21 (6000)

PART TITLE	PART NO.
General Gasoline Engine Service	21-01
2.3L I-4 Engine	21-05
3.3L/4.1L (200/250 CID) I-6 Engines	21-10
2.8L V-6 Engine	21-12
5.0L/5.8L (302/351W CID) V-8 Engines	21-21
5.8L/6.6L (351M/400 CID) V-8 Engines	21-22
7.5L (460 CID) Passenger Police Interceptor V-8 Engine	21-24

CA4181-2B

General Gasoline Engine Service

PART 21-01

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CA4182-2B

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GENERAL INFORMATION

All engines incorporate a closed-type crankcase ventilation system and exhaust emission control system. All engine emission control systems are covered in detail in Group 29 (Diagnosis) and Volume 5 (Maintenance).

To maintain the required exhaust emission levels, the fuel system, ignition system and engine must be kept in good operating condition and meet recommended adjustment specifications.

When performing tests, adjustments or repairs to the engine, ignition system or fuel system, it is essential to follow the procedures and specifications in Groups 21, 23, 24 and 29 of this Manual.

Before replacing damaged or worn engine components such as the crankshaft, cylinder heads, valve guides, valves, camshafts or cylinder block, be sure the part(s) are not repairable.

The following sections cover various engine tests, adjustment and repair procedures. In addition, the cleaning and inspection procedures are covered. Engine assembly and repair specifications are at the end of each specific Part.

For engine removal, disassembly, assembly, installation and adjustment procedures, refer to the pertinent Part of this Group.

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

ENGINE IDENTIFICATION

For quick engine identification, refer to the Safety Certification Decal shown in Fig. 1. The decal is mounted on the left front door lock face panel. Find the engine code (letter or number) on the decal, then refer to the engine identification chart to determine the engine type and size. An engine identification label is also attached to the engine. The symbol code on the identification tag (Fig. 2) identifies each engine for determining parts usage; for instance, engine cubic inch displacement and model year.

The change level and engine code number determine if parts are unique to specific engines. The engine plant codes designate where engines were built. It is imperative that the codes on the engine identification label be used when ordering parts or making inquiries about the engine. The pertinent codes are shown in the master parts catalog to designate unique parts.

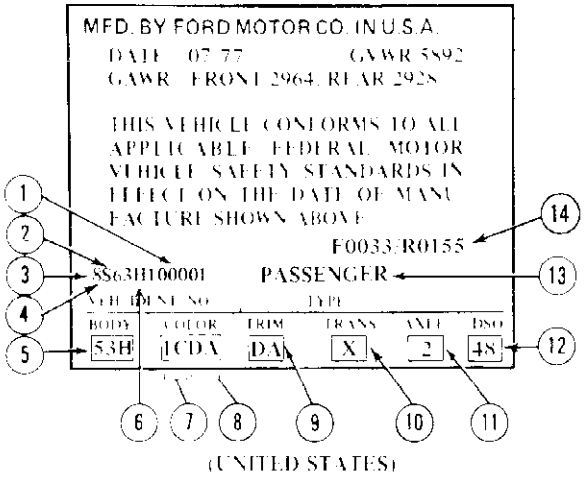
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DETROIT IRON

F 8S63H100001 F

(VEHICLE IDENTIFICATION NUMBER)

SAFETY CERTIFICATION DECAL (TYPICAL)



(UNITED STATES)

1. CONSECUTIVE UNIT NO.
2. BODY SERIAL CODE
3. MODEL YEAR CODE
4. ASSEMBLY PLANT CODE
5. BODY TYPE CODE
6. ENGINE CODE
7. BODY COLOR CODE
8. VINYL ROOF TYPE/COLOR
9. TRIM CODE (FIRST LETTER - TYPE; SECOND LETTER - COLOR)
10. TRANSMISSION CODE
11. REAR AXLE CODE
12. DISTRICT - SPECIAL EQUIPMENT
13. VEHICLE TYPE*
14. ACCESSORY RESERVE LOAD

*1978 Build Models Designated 1977 Models will have "PASS 1977" in this space.

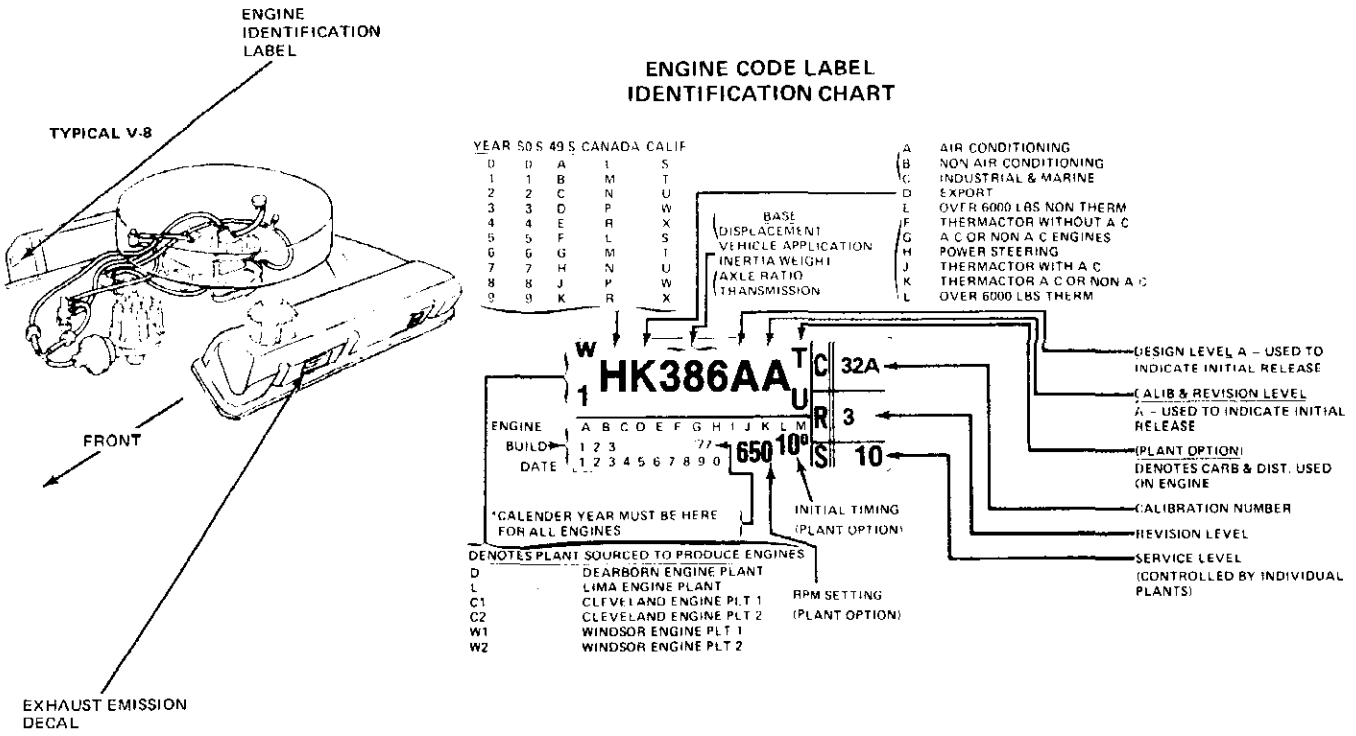
**1978 Build Models Designated 1977 Models will have altered consecutive numbering as follows.
PINTO/MUSTANG II 400001 thru 499999
BOBCAT – 750001 thru 799999

CODE			FORD			LTD II/ COUGAR/ RANCHERO		PINTO/ BOBCAT		GRANADA/ MONARCH		MUSTANG		MERCURY	FAIR- MONT/ ZEPHYR		THUNDER- BIRD		LINCOLN CONTI- NENTAL, MARK V	
	Low Comp. Export	ENGINES	Cyl.	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export	Conv.	Low Comp. Export
Y		2.3L	4					Y				Y				Y					
Z		2.8L	6					Z				Z									
T		3.3L (200 CID)	6							1						T					
L		4.1L (250 CID)	6							L	3										
F		5.0L (302 CID)	8			F				F		F				F					
H		5.8L (351-W CID)	8			H				H											
Q		5.8L (351-M CID)	8	Q		Q															
S		6.6L (400 CID)	8	S		S								S				S		S	
A		7.5L (460 CID)	8	A										A						A	
C		7.5L (460 CID) Police Interceptor	8	C										C							

A3688-2G

FIG. 1 Engine Identification

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CA1202-2B

FIG. 2 Engine Identification Label

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DIAGNOSIS AND TESTING

POSITIVE CLOSED-TYPE CRANKCASE VENTILATION SYSTEM

All emission system related components testing and diagnosis is covered in Part 29-02, Light Duty Engine Diagnosis and Testing.

COMPRESSION TEST

Compression Gauge Check

1. Be sure the oil in the crankcase is at the proper level and the battery is properly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch off; then remove all the spark plugs.
2. Set the carburetor throttle plates and choke plate in the wide open position.
3. Install a compression gauge in No. 1 cylinder.
4. Install an auxiliary starter switch in the starting circuit. With the ignition switch off, and using the auxiliary starter switch, crank the engine at least five compression strokes and record the highest reading.

   Note the approximate number of compression strokes required to obtain the highest reading.
5. Repeat the test on each cylinder as was required to obtain the highest reading on the No. 1 cylinder.

Test Conclusion

The indicated compression pressures are considered within specification if the lowest reading cylinder is within 75 percent of the highest. (See the percentage chart given in Fig. 3.)

If one, or more cylinders read low, squirt approximately one (1) tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on these cylinders.

1. If compression improves considerably, the piston rings are at fault.
2. If compression does not improve, valves are sticking or seating poorly.
3. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders.

   Engine oil and/or coolant in the cylinders could result from this problem.

   It is recommended the following quick reference chart (Fig. 3) be used when checking cylinder compression pressures. The chart has been calculated so that the lowest reading number is 75 percent of the highest reading.

Example

If, after checking the compression pressures in all cylinders, it was found that the highest reading obtained was 196 psi and the lowest pressure reading was 155 psi, the engine is within specifications and the compression is considered satisfactory.

CAMSHAFT LOBE LIFT

All Except 2.3L I-4 Engine

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the air cleaner and the valve rocker arm cover(s).
2. On the rocker shaft mounted rocker arms, remove the valve rocker arm shaft(s) assembly as detailed in the pertinent part.

Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI
134	101	174	131	214	160
136	102	176	132	216	162
138	104	178	133	218	163
140	105	180	135	220	165
142	107	182	136	222	166
144	108	184	138	224	168
146	110	186	140	226	169
148	111	188	141	228	171
150	113	190	142	230	172
152	114	192	144	232	174
154	115	194	145	234	175
156	117	196	147	236	177
158	118	198	148	238	178
160	120	200	150	240	180
162	121	202	151	242	181
164	123	204	153	244	183
166	124	206	154	246	184
168	126	208	156	248	186
170	127	210	157	250	187
172	129	212	158		

CA1005-2A

FIG. 3 Quick Reference Compression Pressure Limit Chart

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On the stud mounted rocker arms, remove the rocker arm stud nut, fulcrum seat, oil deflector and rocker arm. Use the adapter for ball-end push rods.

3. Make sure the push rod is in the valve lifter socket. Install a dial indicator in such a manner as to have the ball socket adapter of the indicator on the end of the push rod and in the same plane as the push rod movement (Fig. 4 or 5).
4. Connect an auxiliary starter switch in the starting circuit. Crank the engine with the ignition switch OFF. "Bump" the crankshaft over until the tappet is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.
5. Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position (highest indicator reading).
6. Compare the total lift recorded on the indicator with specifications.
7. To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. **If the lift on any lobe is below specified service limits, the camshaft and the tappets operating on the worn lobe(s) must be replaced, as well as any tappet that shows pitting or having contact face worn flat or concave.**
8. Remove the dial indicator and auxiliary starter switch.

   On the rocker shaft type mounted rocker arms, install the rocker arm shaft assembly(ies) as detailed in the applicable engine Part.

   Install the stud mounted or pedestal mounted rocker arms as detailed in the applicable engine Part. Adjust the valve clearance as detailed in the pertinent Part.

   After installing the rocker arms, do not rotate the crankshaft until the tappets have had sufficient time to bleed down. To do otherwise may cause serious valve damage. Manually bleeding down will reduce the waiting time.
9. Install the valve rocker arm cover(s) and the air cleaner.

2.3L I-4 Engine

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the air cleaner and the valve rocker arm cover.
2. Measure the distance between the major (A—A) and minor (B—B) diameters (Fig. 7) of each cam lobe with a Vernier caliper and record the readings. The difference in the readings on each cam diameter is the lobe lift.
3. If the readings do not meet specifications, replace the camshaft and all rocker arms.
4. Install the valve rocker arm cover and the air cleaner.

HYDRAULIC TAPPET AND HYDRAULIC LASH ADJUSTER

The hydraulic lash adjusters used in the overhead cam 2.3L I-4 engine are a zero-lash hydraulic device,

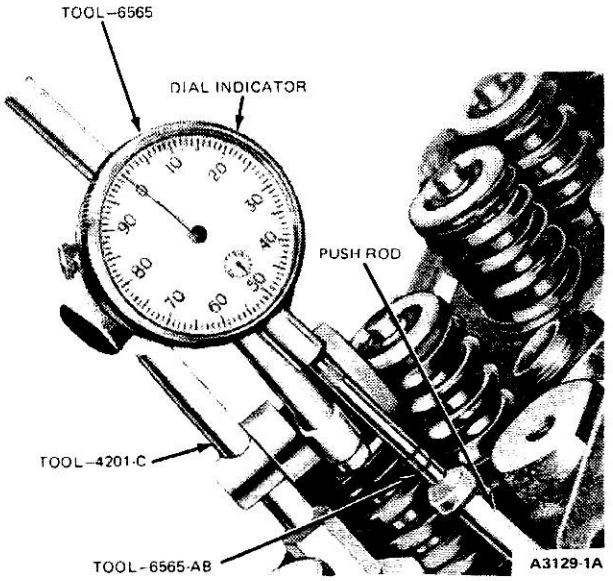


FIG. 4 Testing Camshaft Lobe Lift—Rocker Shaft Mounted Rocker Arms

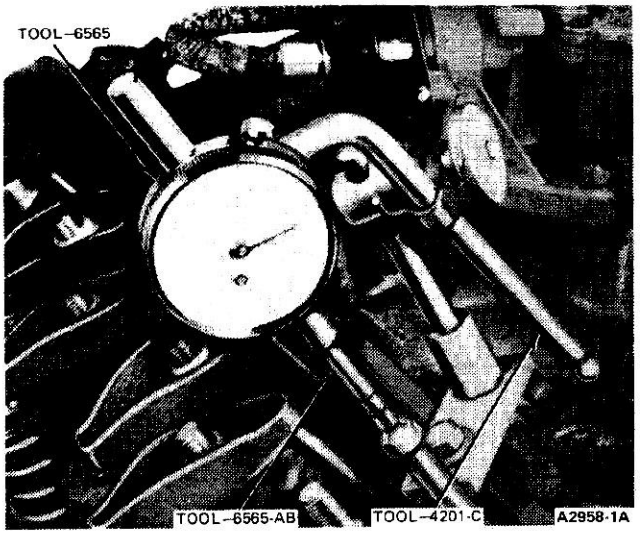


FIG. 5 Testing Camshaft Lobe Lift—Stud Mounted Rocker Arms

similar in construction and operation to the hydraulic tappets used on push-rod engines. They are cleaned, inspected and checked in the same manner. The instructions below apply equally to the lash adjuster and the tappet. Leak-down rates for the lash adjuster and hydraulic tappet are covered in the Specifications Section of the engine Part.

Hydraulic tappet noise may be caused by any of the following:

1. Excessive collapsed tappet gap.
2. Sticking tappet plunger.
3. Tappet check valve not functioning properly.
4. Air in lubrication system.
5. Leakdown rate too rapid.
6. Excessive valve guide wear.

Excessive collapsed tappet gap may be caused by loose rocker arm nuts, incorrect initial adjustment, or wear of tappet face, pushrod, rocker arm, rocker arm fulcrum or valve tip. With tappet

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collapsed (Part 21-01) check gap between valve tip and rocker arm to determine if any other valve train parts are damaged, worn, or out of adjustment.

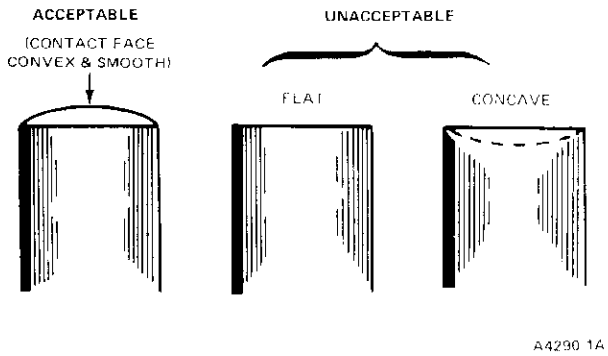


FIG. 6 Tappet Inspection (Exaggerated Contours Shown)

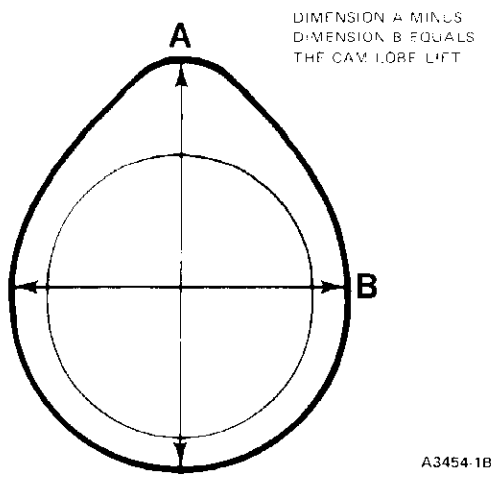


FIG. 7 Measuring Camshaft Lobe Lift

A sticking tappet plunger may be caused by dirt, chips, or varnish inside the lifter. The sticking condition can be corrected by disassembling the tappet and removing the dirt, chips or varnish that is causing the condition.

A tappet check valve that is not functional may be caused by an obstruction such as dirt or chips preventing it from closing when the cam lobe is lifting the tappet, or it may be caused by a broken check valve spring.

Air bubbles in the lubrication system will prevent the tappet from supporting the valve spring load and may be caused by too high or too low an oil level in the oil pan, or by air being drawn into the system through a hole, crack, or leaking gasket on the oil pump pickup tube.

If the leakdown time is below the specified time for used tappets, noisy operation may result. If no other cause for noisy tappets can be found, the leakdown rate should be checked and any outside the specification should be replaced.

Assembled tappets can be tested with Tool 6500-E to check the leak down rate. The leak down rate specification is the time in seconds for the plunger to move a specified distance of its travel while under a 50 lb load. Test the tappets as follows:

1. Disassemble and clean the tappet to remove all traces of engine oil. NOTE: Do not mix parts from different tappets. Parts are select-fitted and are not interchangeable.

   Tappets cannot be checked with engine oil in them. Only the testing fluid can be used.
2. Place the tappet in the tester, with the plunger facing upward. Pour hydraulic tester fluid into the cup to a level that will cover the tappet assembly. The fluid can be purchased from the manufacturer of the tester. Using kerosene or any other fluid will not provide an accurate test.
3. Place the 5/16-inch steel ball provided with the tester in the plunger cap (Fig. 8).
4. Adjust the length of the ram (Fig. 9) so that the pointer is 1/16 inch below the starting mark when the ram contacts the tappet plunger, to facilitate timing as the pointer passes the Start Timing mark.

   Use the center mark on the pointer scale as the Stop Timing point instead of the original Stop Timing mark at the top of the scale.

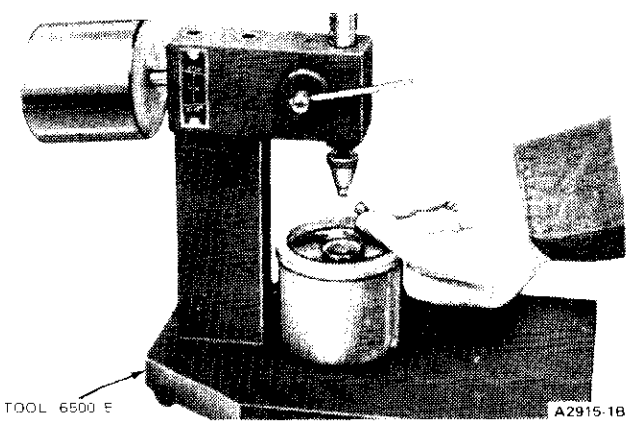


FIG. 8 Placing Steel Ball in Valve Tappet Plunger

5. Work the tappet plunger up and down until the tappet fills with fluid and all traces of air bubbles have disappeared.
6. Allow the ram and weight to force the valve lifter plunger downward. Measure the exact time it takes for the pointer to travel from the Start Timing to the Stop Timing marks of the tester.
7. A tappet that is satisfactory must have a lead-down rate (time in seconds) within the minimum and maximum limits specified.
8. If the tappet is not within specifications, replace it with a new tappet. It is not necessary to disassemble and clean new tappets before testing, because the oil contained in new tappets is test fluid.

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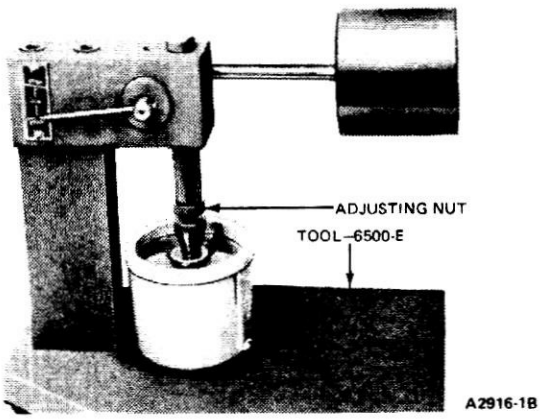


FIG. 9 Adjusting the Ram Length

9. Remove the fluid from the cup and bleed the fluid from the tappet by working the plunger up and down. This step will aid in depressing the tappet plungers when checking the valve clearance.

CAMSHAFT END PLAY

2.3L I-4 Engine

Remove the camshaft drive belt cover. Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket attaching screw or gear hub. Zero the dial indicator. Position a large screwdriver between the camshaft sprocket or gear and the cylinder head. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, replace the thrust plate at the rear of the cylinder head (Fig. 10). Remove the dial indicator and install the camshaft drive belt cover.

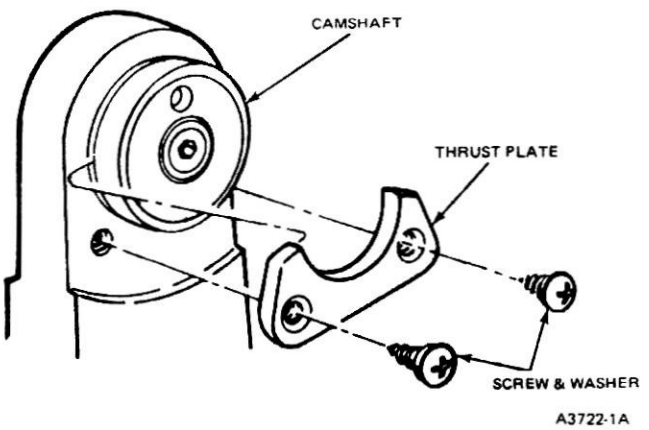


FIG. 10 Cam Shaft Thrust Plate Installation—2.3L I-4

All Except 2.3L I-4 Engine

On all V-8 engines, prying against the aluminum-nylon camshaft sprocket, **with the valve train load on the camshaft,** can break or damage the sprocket. Therefore, the rocker arm adjusting nuts must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end play, adjust the valve clearance.

Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket attaching screw (Figs. 11, 12 and 13). Zero the dial indicator. Position a large screwdriver between the camshaft sprocket or gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, replace the thrust plate.

Remove the dial indicator.

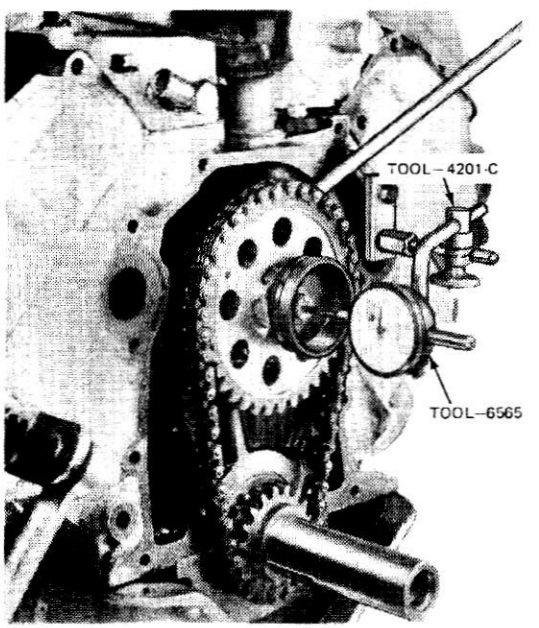


FIG. 11 Checking Camshaft End Play—Typical V-8 Engine

TIMING GEAR BACKLASH—2.8L V-6 ENGINE

Remove the valve spring load on the camshaft by backing off the adjusting screws. Install a dial indicator on the cylinder block (Fig. 14). Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator.

Hold the gear firmly against the block while making the check. Refer to the specifications for the backlash limits. If backlash exceeds specifications, replace both gears.

Readjust valve clearance according to procedure.

TIMING GEAR RUNOUT

NOTE: Valve spring load must not be on camshaft when making this check.

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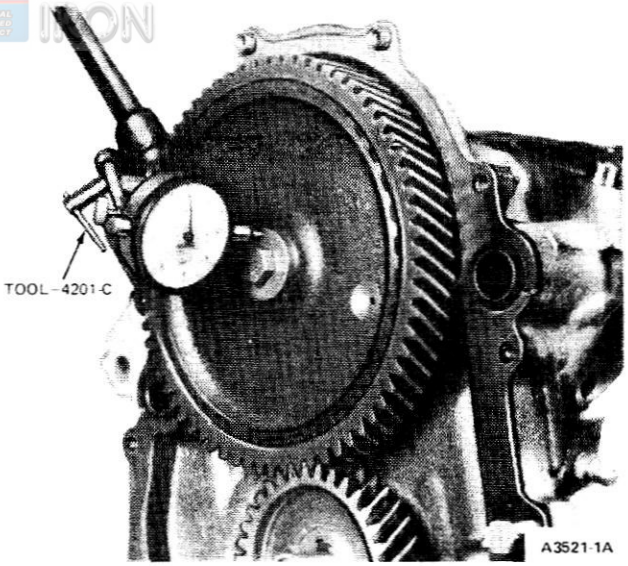


FIG. 12 Checking Camshaft End Play—2.8L V-6 Engine

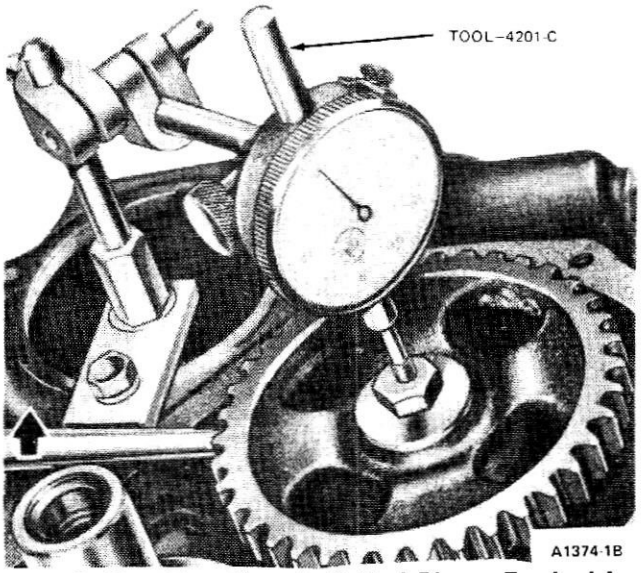


FIG. 13 Checking Camshaft End Play—Typical I-6 Engine

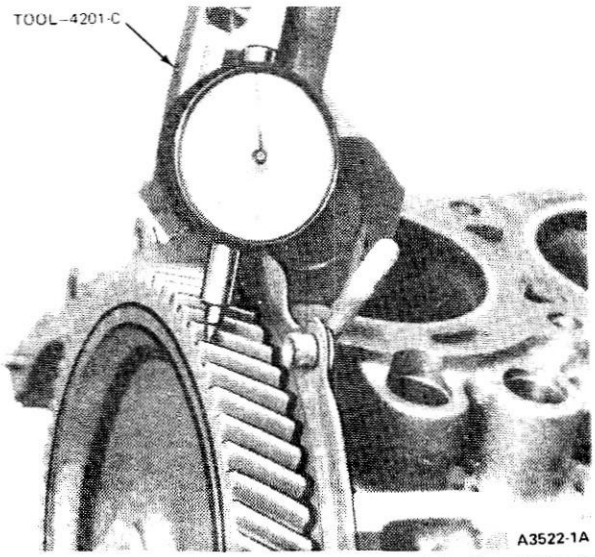


FIG. 14 Checking Timing Gear Backlash—2.8L V-6 Engine

Install a dial indicator on the cylinder block as shown in Fig. 15. Hold the camshaft gear against the camshaft thrust plate and zero the indicator.

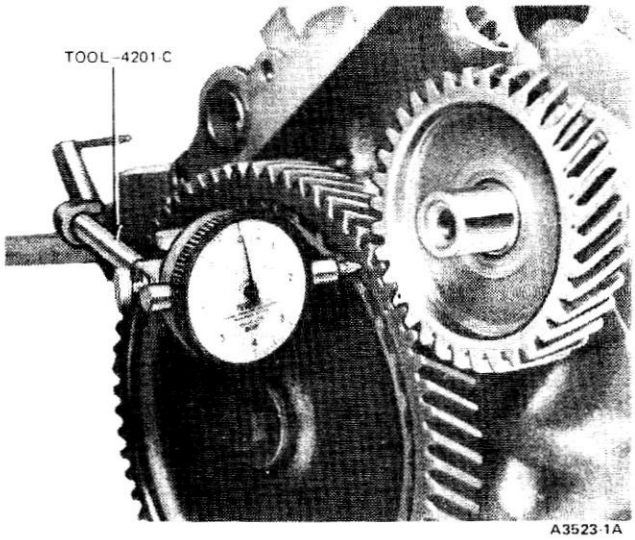


FIG. 15 Checking Timing Gear Runout—2.8L V-6 Engine

Rotate the crankshaft to turn the camshaft, while holding the camshaft gear against the thrust plate. Check the gear runout through one complete revolution of the camshaft. If the gear runout exceeds specifications, remove it and check for burrs or foreign particles on or between the camshaft and gear pilot diameter and/or mating flanges. Recheck the runout; if it still exceeds specifications, replace the gear. Recheck runout on new gear following same procedure.

TIMING CHAIN DEFLECTION

1. Rotate the crankshaft in a counterclockwise direction (as viewed from the front) to take up the slack on the left side of the chain.
2. Establish a reference point on the block and measure from this point to the chain (Fig. 16).
3. Rotate the crankshaft in the opposite direction to take up the slack on the right of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

   If the deflection exceeds specifications, replace the timing chain and sprockets.

CRANKSHAFT END PLAY

1. Force the crankshaft toward the rear of the engine.
2. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 17).
3. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.
4. If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are

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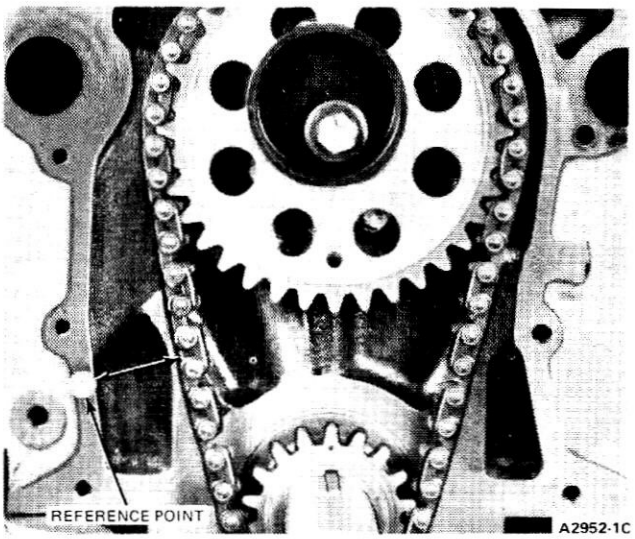


FIG. 16 Checking Timing Chain Deflection—Typical V-8

not damaged or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the procedure recommended under Main Bearing Replacement in the pertinent engine section. Recheck the end play.

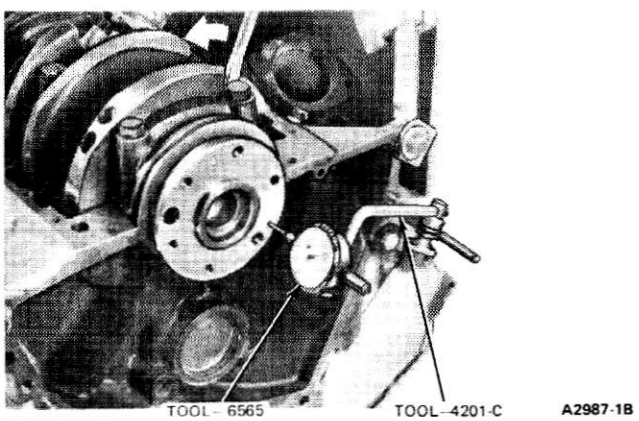


FIG. 17 Checking Crankshaft End Play

FLYWHEEL RUNOUT—AUTOMATIC TRANSMISSIONS

Remove the spark plugs.

Install a dial indicator so that the indicator point rests on the face of the ring gear adjacent to the gear teeth.

Hold the flywheel and crankshaft forward or backward as far as possible to prevent crankshaft end play from being indicated as flywheel runout.

Set the indicator dial on the zero mark. Turn the flywheel one complete revolution while observing the total indicator reading (TIR). If the TIR exceeds specifications, the flywheel and ring gear assembly must be replaced.

FLYWHEEL CLUTCH FACE RUNOUT—MANUAL-SHIFT TRANSMISSIONS

Install a dial indicator so that the indicator point bears against the flywheel face (Fig. 18). Turn the flywheel making sure to hold it in the full forward or rearward position so that crankshaft end play will not be indicated as flywheel runout.

If the clutch face runout exceeds specifications, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft-flywheel mounting face sufficiently to true up the surface if the mounting flange runout exceeds specifications. Replace it or reinstall it on the flywheel. Refer to Ring Gear Replacement in this Part for the proper procedure.

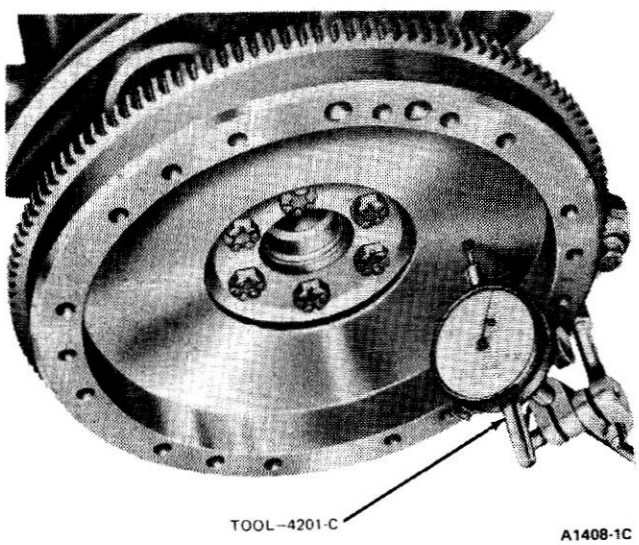


FIG. 18 Checking Flywheel Face Runout

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ADJUSTMENTS

HYDRAULIC VALVE CLEARANCE—EXCEPT 2.3L I-4 AND 2.8L V-6 ENGINES

The 2.3L I-4 engine is an overhead cam engine with hydraulic lash adjusters. Refer to Part 21-05 for adjustment procedures. The 2.8L V-6 engine has mechanical tappets. Refer to Part 21-12 for adjustment procedures.

On V-8 engines, the valve arrangement on the left bank is E-I-E-I-E-I-E-I and on the right bank is I-E-I-E-I-E-I-E. For the I-6 engine, the valve arrangement is E-I-I-E-I-E-E-I-E-I-I-E.

A shorter or longer push rod is available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the master parts list for the correct part length.

Valve stem to valve rocker arm clearance should be within specifications with the tappet completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if not compensated for, the tappet will cease to function and the valve will be held open.

To determine whether a shorter or a longer push rod is necessary, make the following check:

1. Connect an auxiliary starter switch in the starting circuit. Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC after the compression stroke.
2. With the crankshaft in the positions designated in Steps 3, 4 and 5 position the hydraulic lifter compressor tool on the rocker arm. Slowly apply pressure to bleed down the tappet until the plunger is completely bottomed (Fig. 19). Hold the tappet in this position and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge. The feeler gauge width must not exceed 3/8-inch, in order to fit between the rails on the rocker arm. If the clearance is less than specifications, install a shorter push rod. If the clearance is greater than specifications, install a longer push rod.
3. With the No. 1 piston on TDC at the end of the compression stroke (POSITION NO. 1 in Fig. 20), check the following valves:

5.0L (302 CID) and 7.5L (460 CID) V-8 Engines

No. 1 Intake No. 1 Exhaust
No. 7 Intake No. 5 Exhaust
No. 8 Intake No. 4 Exhaust

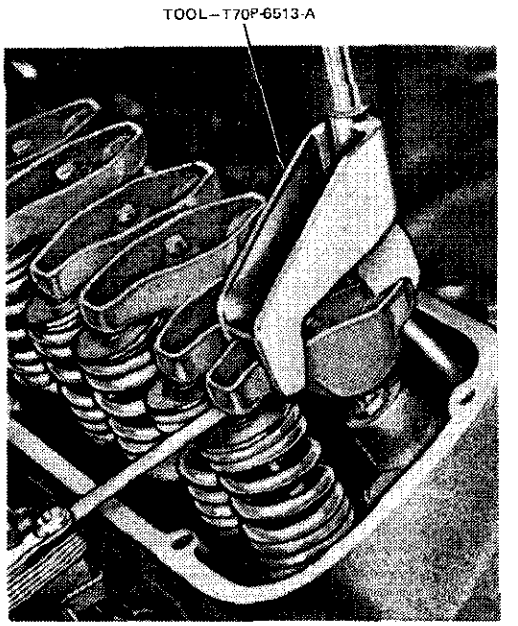
5.7L (351 CID) "M" and "W" V-8 Engines

No. 1 Intake No. 1 Exhaust
No. 4 Intake No. 3 Exhaust
No. 8 Intake No. 7 Exhaust

4. Rotate the crankshaft to POSITION NO. 2 in Fig. 20 and check the following valves:

5.0L (302 CID) and 7.5L (460 CID) V-8 Engines

No. 5 Intake No. 2 Exhaust
No. 4 Intake No. 6 Exhaust



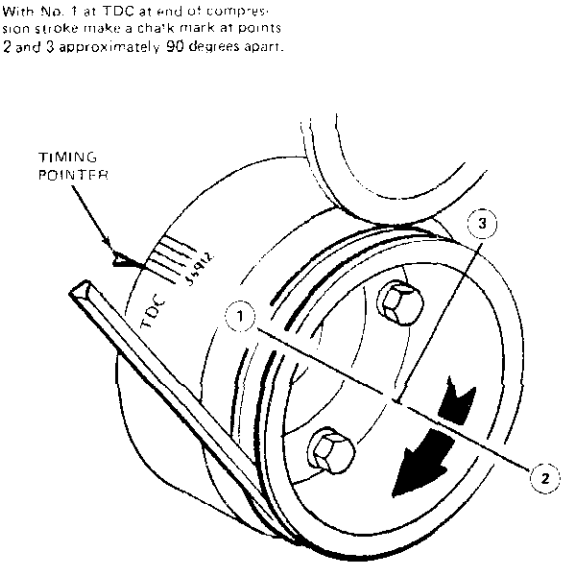
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FIG. 19 Checking Valve Clearance—Hydraulic Tappets

5.7L (351 CID) "M" and "W" V-8 Engines

No. 3 Intake No. 2 Exhaust
No. 7 Intake No. 6 Exhaust

5. Rotate the crankshaft to POSITION NO. 3 in Fig. 20 and check the following valves:



POSITION 1 — No. 1 at TDC at end of compression stroke.
POSITION 2 — Rotate the crankshaft 180 degrees (one half revolution) clockwise from POSITION 1.
POSITION 3 — Rotate the crankshaft 270 degrees (three quarter revolution) clockwise from POSITION 2.

A3234-1D

FIG. 20 Position of Crankshaft for Checking and Adjusting Valve Clearance

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5.0L (302 CID) and 7.5L (460 CID) V-8 Engines

No. 2 Intake No. 7 Exhaust
No. 3 Intake No. 3 Exhaust
No. 6 Intake No. 8 Exhaust

5.7L (351 CID) "M" and "W" V-8 Engines

No. 2 Intake No. 4 Exhaust
No. 5 Intake No. 5 Exhaust
No. 6 Intake No. 8 Exhaust

Engines With Positive Stop Rocker Arm Studs

Each stud nut should be removed and inspected for conditions shown in Fig. 21 when adjusting valve clearance.

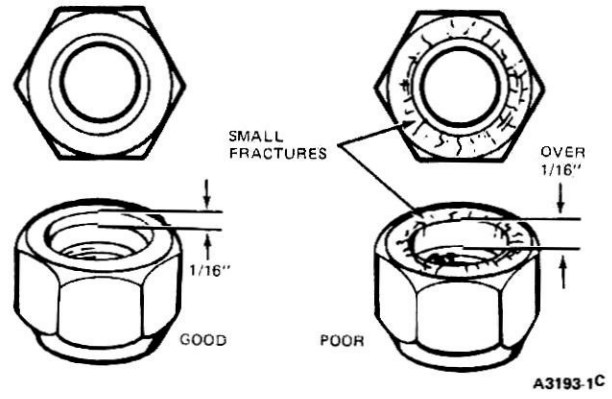


FIG. 21 Inspection of Rocker Arm Stud Nut

REMOVAL AND INSTALLATION

ROCKER ARM STUD REPLACEMENT—5.0L (302 CID) AND 5.7L (351 CID) "W" V-8 ENGINE

If it is necessary to remove a rocker arm stud, tool kit T62F-6A527-B is available which contains the following: a stud remover, a 0.006-inch oversize reamer and a 0.015-inch oversize reamer. For 0.010-inch oversize studs, use reamer T66P-6A527-B. To press in replacement studs, use stud replacer T69P-6049-D.

Rocker arm studs that are broken or have damaged threads may be replaced with standard studs. Studs in the head may be replaced with 0.006, 0.010 or 0.015-inch oversize studs which are available for service.

Standard and oversize studs can be identified by measuring the stud diameter within 1-1/8 inch from the pilot end of the stud. The stud diameters are:

Standard... 0.3714-0.3721

0.006 oversize... 0.3774-0.3781

0.010 oversize... 0.3814-0.3821

0.015 oversize... 0.3864-0.3871

When replacing a standard size rocker arm stud with a 0.010 or 0.015-inch oversize stud, always use the 0.006-inch oversize reamer before finish reaming with the 0.010 or 0.015-inch oversize reamer.

1. Position the sleeve of the rocker arm stud remover (Tool T62F-6A527-B) over the stud with the bearing end down. **When working on a 5.0L (302 CID) or 5.7L (351W CID) V-8 cylinder head, cut the threaded part of the stud off with a hack saw. This is necessary because the puller is designed for 3/8-inch studs and will not grip the 5/16-inch thread.** Thread the puller into the sleeve and over the stud until it is fully bottomed. Hold the sleeve with a wrench, then rotate the puller clockwise to remove the stud (Fig. 22).

   If the rocker arm stud was broken off flush with the stud boss, use an easy-out to remove the broken stud following the instructions of the tool manufacturer.

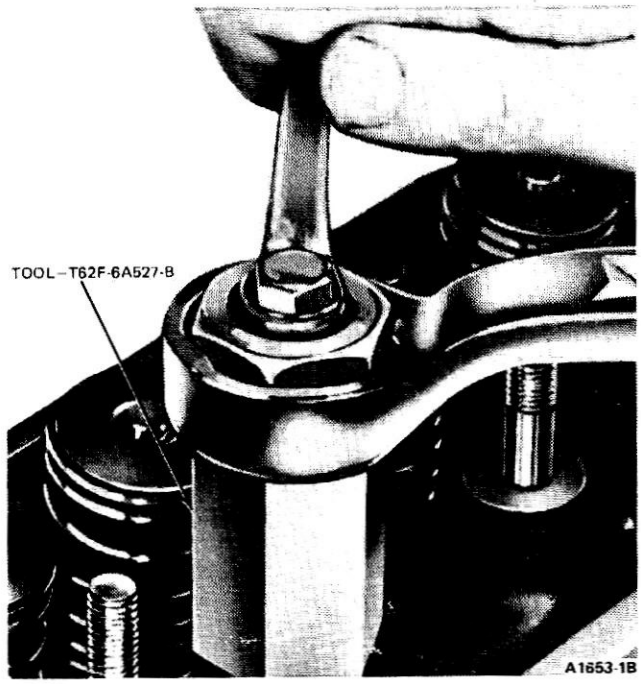


FIG. 22 Removing Rocker Arm Stud

2. If a loose rocker arm stud is being replaced, ream the stud bore using the proper reamer (or reamers in sequence) for the selected oversize stud (Fig. 23). **Make sure the metal particles do not enter the valve area.**

   Coat the end of the stud with Lubriplate or equivalent. Align the stud and installer T69P-6049-D with the stud bore, then tap the sliding driver until it bottoms (Fig. 24). When the installer contacts the stud boss, the stud is installed to its correct height.

CORE PLUGS

Removal

To remove a large core plug, drill a 1/2-inch hole in the center of the plug and remove with a universal

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impact slide hammer (T59L-100-B and T50T-100-A) or pry it out with a large drift punch. Clean and inspect the plug bore.

Prior to installing a core plug the plug bore should be inspected for any damage that would interfere with the proper sealing of the plug. If the bore is damaged it will be necessary to true the surface by boring for the next specified oversize plug.

Oversize (OS) plugs are identified by the OS stamped in the flat located on the cup side of the plug.

Coat the plug and/or bore lightly with an oil-resistant (oil galley) or water-resistant (cooling jacket) sealer and install it following the procedure for cup type or expansion type:

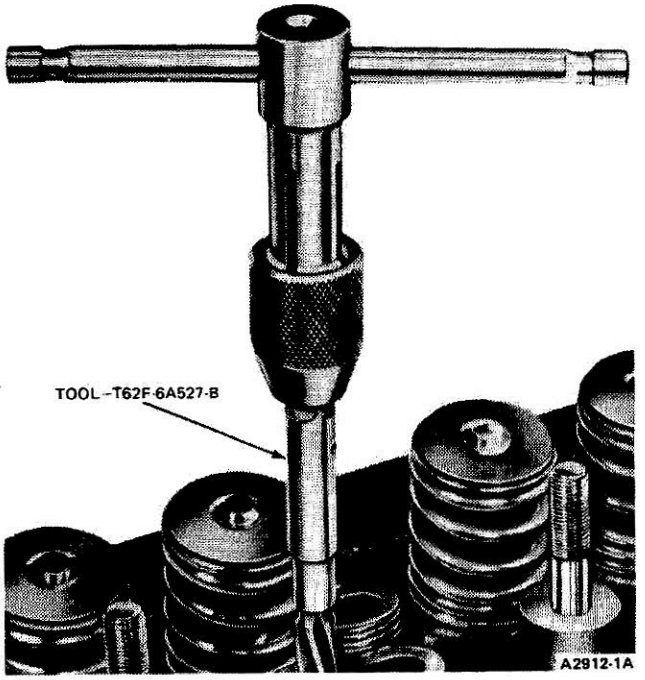


FIG. 23 Reaming Rocker Arm Stud Bore

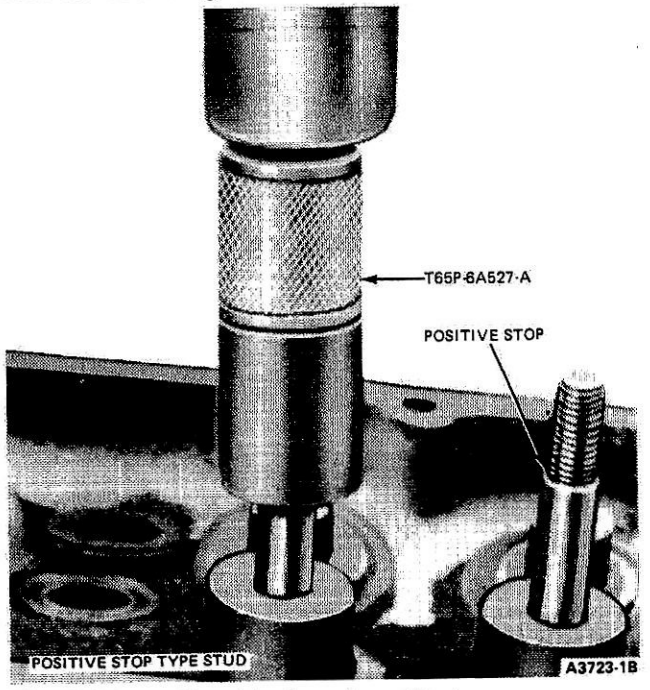


FIG. 24 Installing Rocker Arm Stud

INSTALLATION

Cup-Type

Cup-type core plugs (Fig. 25) are installed with the flanged edge outward. The maximum diameter of this plug is located at the outer edge of the flange. The flange on cup-type plugs flares outward with the largest diameter at the outer (sealing) edge.

It is imperative to install the plug in the machined bore using a properly designed tool. Under no circumstances is the plug to be driven into the bore using a tool that contacts the flange. This method will damage the sealing edge and will result in leakage and/or plug blow out. The flanged (trailing) edge must be below the chamfered edge of the bore to effectively seal the plugged bore. If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

Expansion-Type

Expansion-type core plugs (Fig. 25) are installed with the flanged edge inward. The maximum diameter of this plug is located at the base of the flange with the flange flaring inward.

It is imperative to push or drive the plug into the machined bore by using a properly designed tool. Under no circumstances is the plug to be driven using a tool that contacts the crowned portion of the plug. This method will expand the plug prior to installation and may damage the plug and/or plug bore. When installed, the trailing (maximum) diameter must be below the chamfered edge of the bore to effectively seal the plugged bore. If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

FLYWHEEL RING GEAR—MANUAL-SHIFT TRANSMISSION

Removal

To replace a damaged or worn ring gear, heat the ring gear with a blow torch on the engine side of the gear, and knock it off the flywheel. Do not hit the flywheel when removing the ring gear.

Installation

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. **Do not heat any portion of the gear to a temperature higher than 500 degrees F. If this limit is exceeded, the temper will be removed from the ring gear teeth.**

CRANKSHAFT REAR OIL SEAL—EXCEPT 2.8L V-6 ENGINE

A split-lip type crankshaft rear oil seal is provided for service. The complete seal may be replaced without removing the crankshaft (Fig. 26).

Removal

1. Remove the oil pan and the oil pump (if required), following procedures under Oil Pan and Oil Pump Removal.

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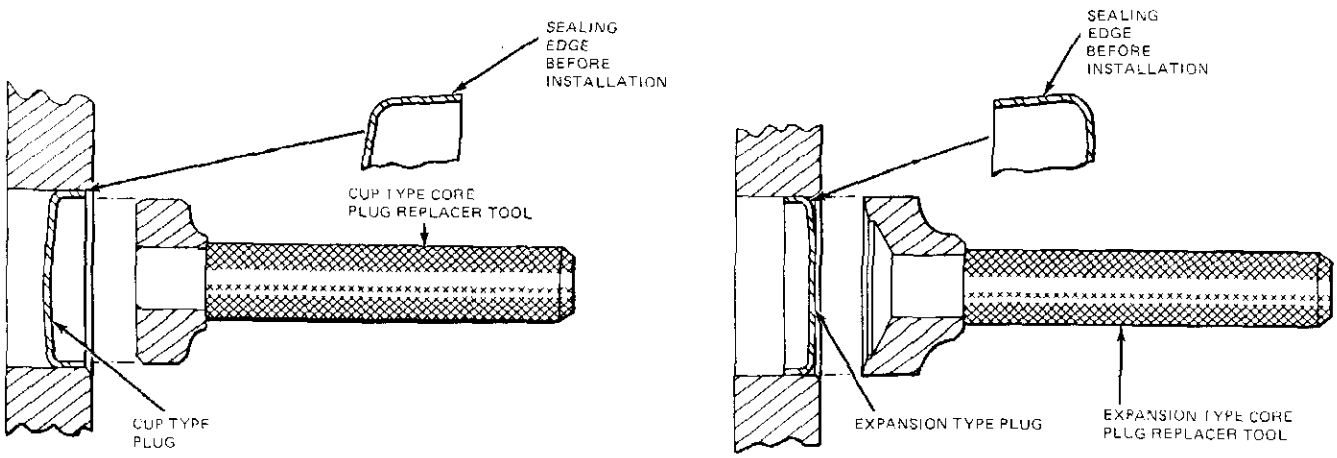


FIG. 25 Typical Core Plugs and Installation Tools

2. Loosen all the main bearing cap bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch.
3. Remove the rear main bearing cap, and remove the oil seal from the bearing cap and cylinder block. On the block half of the seal use a seal removal tool, or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Exercise caution to prevent scratching or damaging the crankshaft seal surfaces.**
4. Remove the oil seal retaining pin from the bearing cap if so equipped. **The pin must not be used with the split-lip seal.**

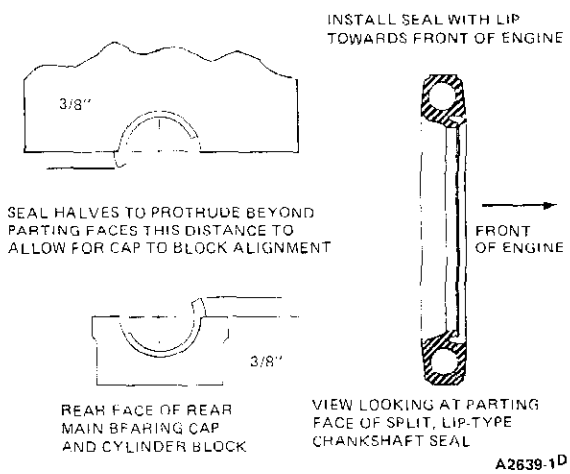


FIG. 26 Installing Crankshaft Rear Oil Seal—Except 2.3L I-4 and 2.8L V-6 Engines

Installation

1. Carefully clean the seal grooves in the cap and block with a brush and suitable solvent. Also clean the area where sealer is later to be applied (Fig. 27). Dry the area thoroughly, so no solvent touches the seal.
2. Dip the split-lip type seal halves in the clean engine oil.
3. Carefully install the upper seal (cylinder block) into its groove with undercut side of seal toward the FRONT of the engine (Fig. 26), by rotating it on the seal journal of the crankshaft until approximately 3/8 inch protrudes below the parting surface.

   Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove. Do not allow oil to get on the sealer area (Fig. 27).
4. Tighten all the bearing cap bolts and torque to specifications (except rear main bearing cap).
5. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine (Fig. 26). Allow the seal to protrude approximately 3/8-inch above the parting surface to mate with the upper seal when the cap is installed.

   On 2.3L I-4 engines, install the seals so that the locating tab faces the rear of the engine (Fig. 28).
6. Apply an even 1/16 inch bead of RTV silicone rubber sealer to the areas shown in Fig. 27, following the procedure given in the illustration.

   NOTE: Do not delay installation of bearing cap, as this sealer sets up in 15 minutes. Install the rear main bearing cap. Torque the cap bolts to specifications.
7. Install the oil pump and oil pan. Fill the crankcase with the proper amount and viscosity oil.
8. Operate the engine and check for oil leaks.

CRANKSHAFT REAR OIL SEAL—2.8L V-6 ENGINE

NOTE: Unlike other engines, the 2.8L V-6 engine does **NOT** require removal of the oil pan or the rear main bearing cap to replace the rear oil seal. Instead, the transmission must be removed.

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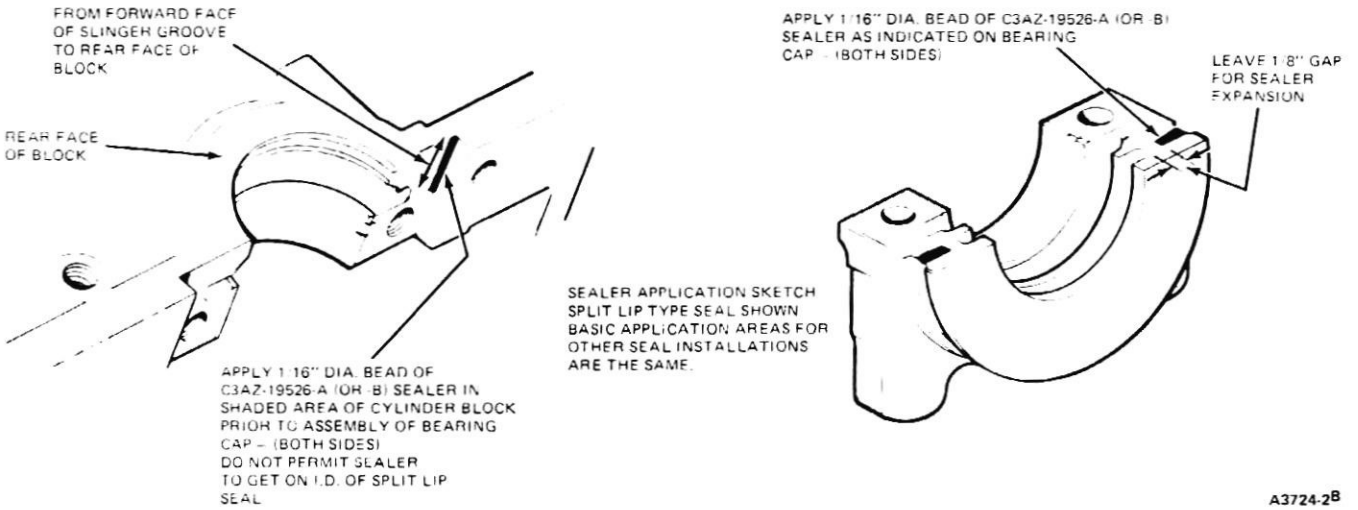


FIG. 27 Applying RTV Sealer To Main Bearing Cap and Block—Typical for I-6 and V-8 Engines

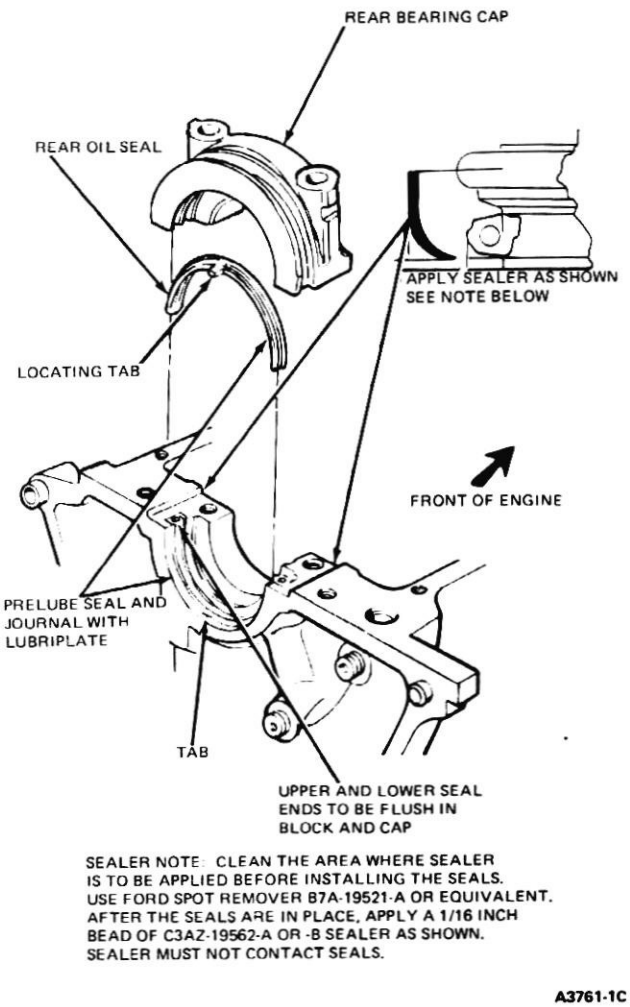


FIG. 28 Rear Oil Seal Installation—2.3L I-4 Engine

Removal

1. Remove the transmission assembly. Remove clutch pressure plate and clutch disc, if so equipped.
2. Remove the flywheel and rear plate.
3. Use an awl to punch two holes in the crankshaft rear oil seal. Punch the holes on opposite sides of the crankshaft and just above the bearing cap to cylinder block split line. Install a sheet metal screw in each hole (Fig. 29). Use two large screwdrivers or small pry bars and pry against both screws at the same time to remove the crankshaft rear oil seal. It may be necessary to place small blocks of wood against the cylinder block to provide a fulcrum point for the pry bars. **Use caution throughout this procedure to avoid scratching or otherwise damaging the crankshaft oil seal surface.**
4. Clean the oil seal recess in the cylinder block and main bearing cap. **Inspect and clean the oil seal contact surface on the crankshaft, following the procedure in this Part.**

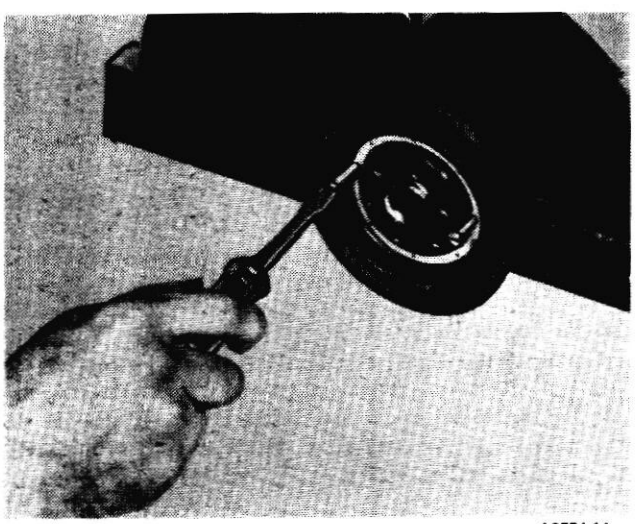


FIG. 29 Removing Crankshaft Rear Oil Seal—2.8L V-6 Engine

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Installtion

1. Coat the oil seal to cylinder block surface of the oil seal with oil. Coat the seal contact surface of the oil seal and crankshaft with Lubriplate or equivalent. Start the seal in the recess and install it with the tool as shown in Fig. 30. Drive the seal into position until it is firmly seated.
2. Install the rear plate and the flywheel. Tighten flywheel bolts to specification.
3. Install the clutch disc and clutch pressure plate, if so equipped. Align clutch disc before tightening pressure plate attaching screws.
4. Install the flywheel housing.
5. Install the transmission.

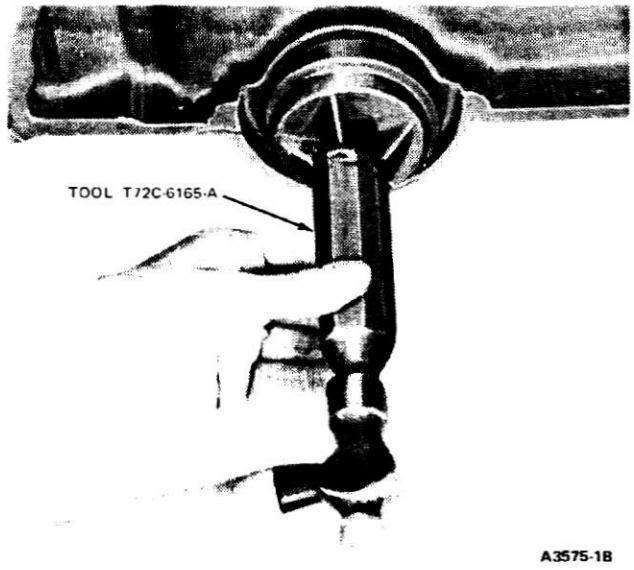


FIG. 30 Installing Crankshaft Rear Oil Seal—2.8L V-6 Engine

OVERHAUL

INTERPRETATION OF "SERVICE LIMIT" SPECIFICATIONS

"Service Limit" specifications are intended to be a guide only, to be used when overhauling or reconditioning an engine or engine component. A determination can be made whether a component is suitable for continued service or should be replaced for extended service while the engine is disassembled.

In the case of "Valve Stem To Valve Guide Clearance," the "Service Clearance" is intended as an aid in diagnosing engine noise only, and does not constitute a failure or indicate need for repair. However, when overhauling or reconditioning a cylinder head, the service clearance should be regarded as a practical working value, and used as a determinant for installing the next oversize valve to assure extended service life.

CYLINDER HEAD

Replace the head if it is cracked. **Do not plane or grind more than 0.010 inch from the original cylinder head gasket surface.** Remove all burrs or scratches with an oil stone.

Reaming Valve Guides

If it becomes necessary to ream a valve guide (Fig. 31) to install a valve with an oversize stem, a reaming kit is available which contains the following reamer and pilot combinations: a 0.003-inch OS reamer with a standard diameter pilot, a 0.015-inch OS reamer with a 0.003-inch OS pilot, and a 0.030-inch reamer with a 0.015-inch OS pilot.

When replacing a standard size valve with an oversize valve always use the reamer in sequence (smallest oversize first, and then next smallest, etc.) so as not to overload the reamers. **Always reface the valve seat after the valve guide has been reamed, and use a suitable scraper to break the sharp corner (ID) at the top of the valve guide.**

Refacing Valve Seats

Refacing of the valve seat should be closely coordinated with the refacing of the valve face so that

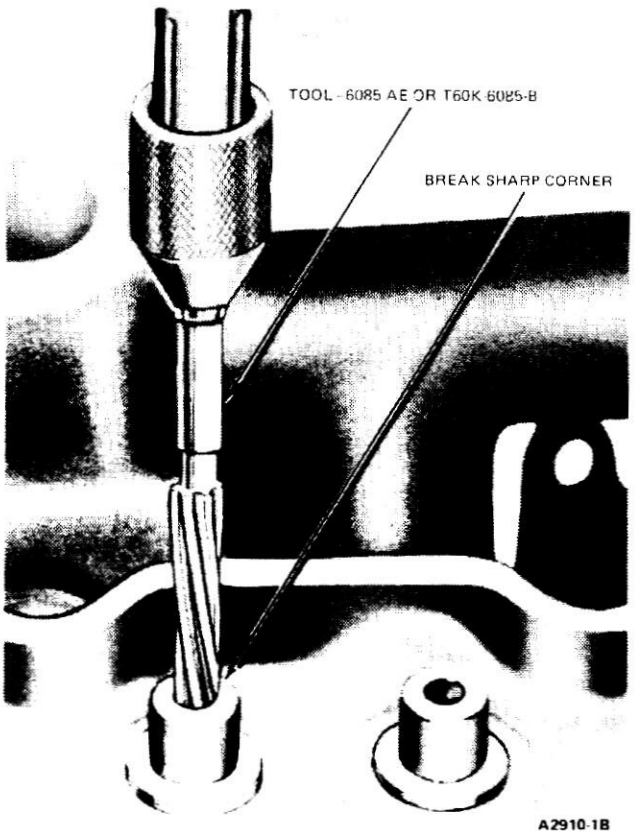


FIG. 31 Reaming Valve Guides—Typical I-6 Engine Shown

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the finished seat and valve face will be concentric and the specified interference angle will be maintained. This is important so that the valve and seat will have a compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

Grind the valve seats of all engines to a true 45 degree angle (Fig. 32). Remove only enough stock to clean up pits and grooves or to correct the valve seat runout. After the seat has been refaced, use a seat width scale or a machinist scale to measure the seat width (Fig. 33). Narrow the seat, if necessary, to bring it within specifications.

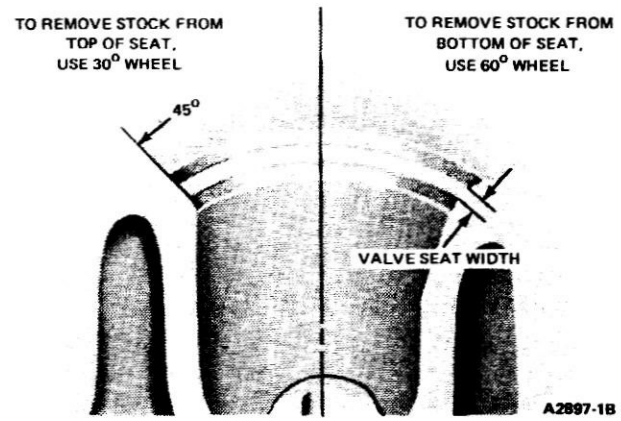


FIG. 32 Refacing Valve Seat

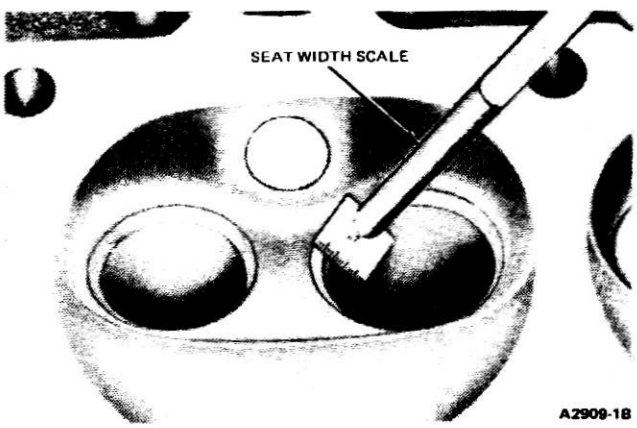


FIG. 33 Checking Valve Seat Width

If the valve seat width exceeds the maximum limit, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications.

On the valve seats of all engines, use a 60 degree angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 30 degree angle wheel to remove stock from the top of the seats (lower the seats).

The finished valve seat should contact the approximate center of the valve face. It is good practice to determine where the valve seat contacts the face. To do this, coat the seat with Prussion blue and set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

VALVES

Minor pits, grooves, etc., may be removed. Discard valves that are severely damaged, if the face runout cannot be corrected by refinishing or stem clearance exceeds specifications. **Discard any excessively worn or damaged valve train parts.**

Refacing Valves

The valve refacing operation should be closely coordinated with the valve seat refacing operations so that the finished angles of the valve face and of the valve seat will be to specifications and provide a compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

If the valve face runout is excessive and/or to remove pits and grooves, reface the valves to a true 44 degree angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the dge of the valve head is less than 1/32 inch thick after grinding (Fig. 34), replace the valve as the valve will run too hot in the engine. **The interference angle of the valve and seat should not be lapped out. Remove all grooves or score marks from the end of the valve stem, and chamfer it as necessary. Do not remove more than 0.010 inch from the end of the valve stem.**

If the valve and/or valve seat has been refaced, it will be necessary to check the clearance between the rocker arm pad and the valve stem with the valve train assembly installed in the engine.

Select Fitting Valves

If the valve stem to valve guide clearance exceeds the service clearance, ream the valve guide for the next oversize valve stem. Valves with oversize stem

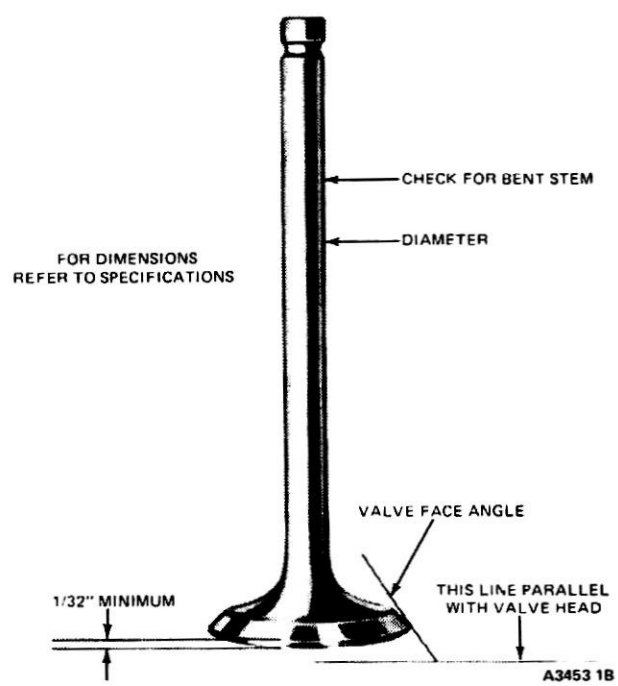


FIG. 34 Critical Valve Dimensions

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diameters of 0.003, 0.015 and 0.030 inch are available for service for all engines except 2.3L I-4 and 2.8L V-6. For these engines, oversize valve stems are available in diameters of 0.008, 0.016, and 0.032 inch oversize. **Always reface the valve seat after the valve guide has been reamed. Refer to Reaming Valve Guides.**

CAMSHAFT REPAIR

Clean and inspect camshaft as outlined under Cleaning And Inspection.

Remove light scuffs, scores or nicks from the camshaft machined surfaces with a smooth oil stone. Camshaft journals can be refinished to accommodate 0.015" undersize service bearings. If the journals will not clean up to 0.015" undersize, the camshaft must be replaced.

PISTONS, PINS AND RINGS

Fitting Pistons

Pistons are available for service in standard size and the oversizes shown in Specification section at the end of each engine Part.

The standard size pistons are color coded red or blue, or have 0.003 OS stamped on the dome. Refer to the Specifications for standard size piston dimensions.

Measure the cylinder bore and select the piston to assure the proper clearance. When the bore diameter is in the lower one third of the specified range, a red piston should be used. When the bore diameter is in the middle one third a blue piston should be used. When the bore diameter is in the upper one third the 0.003 OS piston should be used.

Measure the piston diameter to ensure that the specified clearance is obtained. It may be necessary periodically to use another piston (within the same grade size) that is either slightly larger, or smaller to achieve the specified clearance. **If none can be fitted, refinish the cylinder to provide the proper clearance for the piston. When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted. If the taper, out-of-round and piston to cylinder bore clearance conditions of the cylinder bore are within specified limits, new piston rings will give satisfactory service. If new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall glaze using only a spring-loaded cylinder none set (T73L-6011-A or equivalent) and only if there is no visible sign of cross-hatch markings on the cylinder walls. (Refer to Cylinder Block, Refinishing Cylinder Walls). Be sure to clean the cylinder bore thoroughly.**

1. Calculate the size piston to be used by taking a cylinder bore check. Follow the procedures outlined under Cleaning and Inspection.
2. Select the proper size piston to provide the desired clearance (refer to the specifications). Measure the piston diameter in line with the centerline of the piston pin and at 90 degrees to the piston pin axis.
3. Make sure the piston and cylinder block are at room temperature (70 degrees F.). **After any refinishing operation allow the cylinder bore to cool, and make sure the piston and bore are clean and dry before the piston fit is checked.**

Fitting Piston Rings

1. Select the proper ring set for the size cylinder bore.
2. Position the ring in the cylinder bore in which it is going to be used.
3. Push the ring down into the bore area where normal ring wear is not encountered.
4. Use the head of a piston to position the ring in the bore so that the ring is square with the cylinder wall. **Use caution to avoid damage to the ring or cylinder bore.**
5. Measure the gap between the ends of the ring with a feeler gauge (Fig. 35). If the ring gap is less or greater than the specified limits, try another ring set.
6. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 36). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**

Fitting Piston Pins

Install the piston pin, following the procedure under Piston Assembly in the applicable engine part.

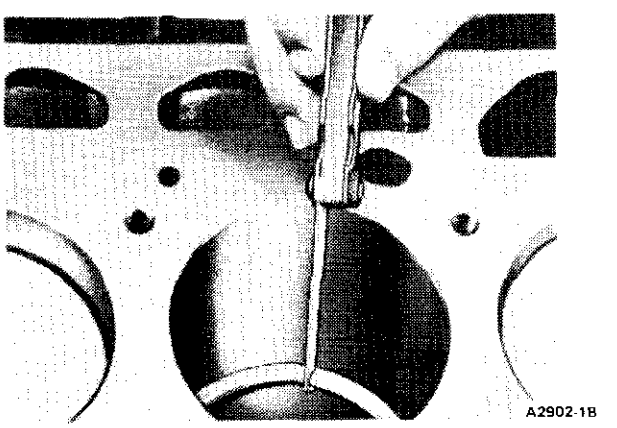


FIG. 35 Checking Piston Ring Gap

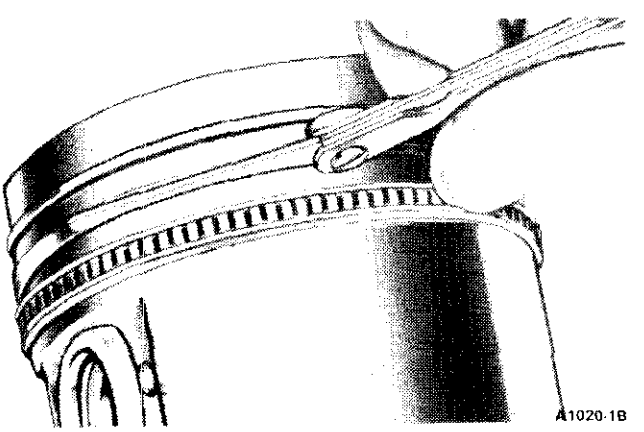


FIG. 36 Checking Piston Ring Side Clearance

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CRANKSHAFT

Dress minor scores with an oil stone. If the journals are severely marred or exceed the wear limit, they should be refinished to size for the next undersize bearing.

Refinishing Journals

Refinish the journals to give the proper clearance with the next undersize bearing. If the journal will not clean up to maximum undersize bearing available, replace the crankshaft.

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

After refinishing the journals, chamfer the oil holes; then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may also be used as a polishing agent.

All oil passages must be cleaned thoroughly after chamfering and polishing, using a suitable bristle brush and solvent.

FITTING MAIN OR CONNECTING ROD BEARINGS WITH PLASTIGAGE

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear. **When replacing standard bearings with new bearings, it is good practice to fit the bearing to minimum specified clearance.** If the desired clearance cannot be obtained with a standard bearing, try one half of a 0.001 or 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance.
2. If fitting a main bearing in the vehicle, position a jack under counterweight adjoining bearing which is being checked. Support crankshaft with jack so its weight will not compress Plastigage and provide an erroneous reading.
3. Place a piece of Plastigage on bearing surface across full width of bearing cap and about 1/4 inch off center (Fig. 37).
4. Install cap and torque bolts to specifications. Do not turn crankshaft while Plastigage is in place.
5. Remove cap. Using Plastigage scale, check width of Plastigage at widest point to get minimum clearance. Check at narrowest point to get maximum clearance. Difference between readings is taper of journals.
6. If clearance exceeds specified limits, try 0.001 or 0.002 inch undersize bearings in combination with the standard bearings. Bearing clearance must be within specified limits. If 0.002 undersize main bearings are used on more than one journal, be sure they are all installed in cylinder block side of bearing. If 0.002 inch undersize bearings do not bring clearance within desired limits, refinish crankshaft journal, then install undersize bearings.
7. After bearing has been fitted, apply light coat of engine oil to journal and bearings. Install bearing cap. Torque cap bolts to specifications.
8. Repeat procedure for remaining bearings that require replacement.

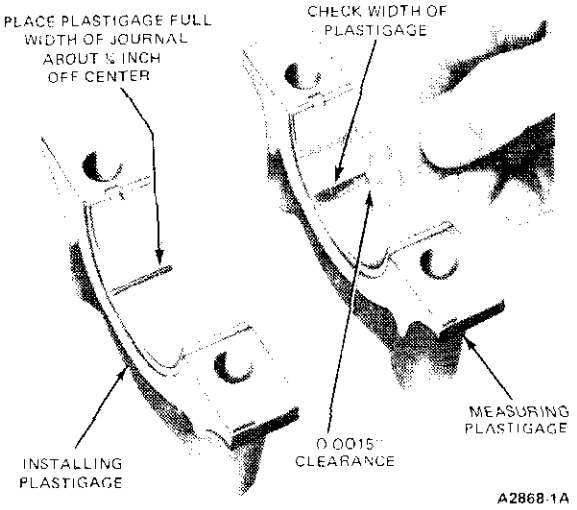


FIG. 37 Installing and Measuring Plastigage

CYLINDER BLOCK

Refinishing Cylinder Walls

Honing is recommended for refinishing cylinder walls only when no cross hatch pattern is visible on cylinder walls, or for fitting pistons to the specified clearance. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance. After honing, thoroughly clean cylinder bores with a detergent and water solution.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. **Before any cylinder is refinished, all main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the refinishing operation.** Refinish only the cylinder or cylinders that require it. All pistons are the same weight, both standard and oversize; therefore, various sizes of pistons can be used without upsetting engine balance. Refinish the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when refinished for the maximum oversize piston recommended, replace the block.

Refinish the cylinder to within approximately 0.0015 inch of the required oversize diameter. This will allow enough stock for the final step of honing so that the correct surface finish and pattern are obtained. For the proper use of the refinishing equipment follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work. Use a motor-driven, spring pressure-type hone at a speed of 300-500 rpm. Hones of grit sizes 180-220 will normally provide the desired bore surface finish of 18-38 RMS.

When honing the cylinder bores use a lubricant mixture of equal parts of kerosene and SAE No. 20

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motor oil. Operate the hone in such a way to produce a cross-hatch finish on the cylinder bore. The cross-hatch pattern should be at an angle of approximately 30 degrees to the cylinder bore. **After the final operation in either of the two refinishing methods described and prior to checking the piston fit, thoroughly clean with a detergent and water solution and oil the cylinder walls.** Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons are fitted, thoroughly clean the entire block and oil the cylinder walls.

Repairing Sand Holes or Porous Engine Castings

Porosity or sand hole(s) which will cause oil seepage or leakage can occur with modern casting processes. A complete inspection of engine and transmission should be made. If the leak is attributed to the porous condition of the cylinder block or sand hole(s), repairs can be made with metallic plastic (part No. C6AZ-19544-A or equivalent). **Do not repair cracks with this material.** Repairs with this metallic plastic must be confined to those cast iron engine component surfaces (Fig. 38) where the inner wall surface is not exposed to engine coolant pressure or oil pressure, for example:

1. Cylinder block surfaces extending along the length of the block, upward from the oil pan rail to the cylinder water jacket but not including machined areas.
2. Lower rear face of the cylinder block.
3. Intake manifold casting. **Repairs are not recommended to the intake manifold exhaust crossover section,** since temperatures can exceed the recommended temperature limit of 500 degrees F.

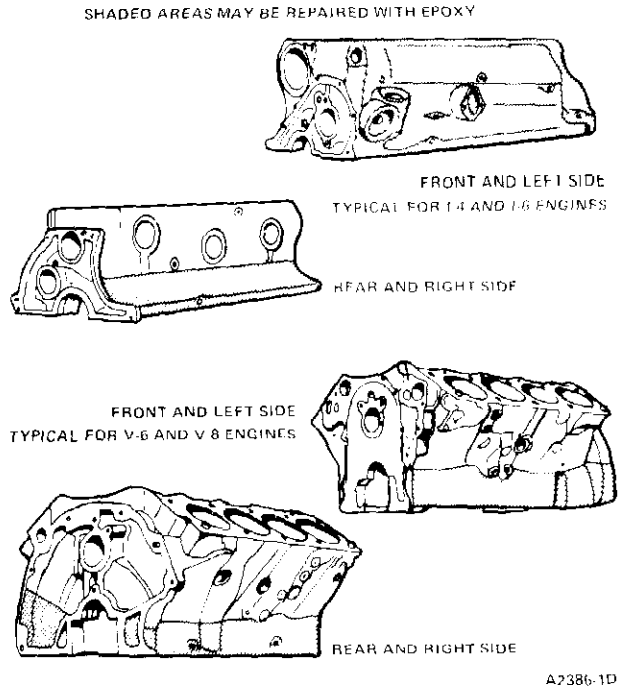


FIG. 38 Typical Cast Iron Cylinder Block Areas Repairable with Metallic Plastic

4. Cylinder front cover on engines using cast iron material.
5. Cylinder head, along the rocker arm cover gasket surface.

The following procedure should be used to *repair porous areas or sand holes in cast iron.*

1. Clean the surface to be repaired by grinding or rotary filing to a clean bright metal surface. Chamfer or undercut the hole or porosity to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole. Openings larger than 1/4 inch should not be repaired using metallic plastic. Openings in excess of 1/4 inch can be drilled, tapped and plugged using common tools. Clean the repair area thoroughly. Metallic plastic will not stick to a dirty or oily surface.
2. Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.
3. Apply the repair mixture with a suitable clean tool, (putty knife, wood spoon, etc.) forcing the epoxy into the hole or porosity.
4. Allow the repair mixture to harden. This can be accomplished by two methods, heat cure with a 250 watt lamp placed 10 inches from the repaired surface, or air dry for 10-12 hours at temperatures above 50 degrees F.
5. Sand or grind the repaired area to blend with the general contour of the surrounding surface.
6. Paint the surface to match the rest of the block.

CLEANING AND INSPECTION

The cleaning and inspection procedures are for a complete engine overhaul; therefore, for partial engine overhaul or parts replacement, follow the pertinent cleaning or inspection procedure.

INTAKE MANIFOLD

Cleaning

Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent and dry it with compressed air.

Inspection

Inspect the manifold for cracks, damaged gasket surfaces, or other defects that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. Clean the EGR exhaust passages.

Remove all filings and foreign matter that may have entered the manifold as a result of repairs. Check the baffle plate on the underside of the manifold if so equipped. The baffle should be securely fastened.

EXHAUST MANIFOLDS

Cleaning

Remove all gasket material from the manifolds.

On the right exhaust manifold of V-8 engines, make sure the automatic choke air inlet and outlet holes are completely open and the cover does not leak (if so equipped).

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Inspection

Inspect the cylinder head joining flanges of the exhaust manifold(s) for evidence of exhaust gas leaks.

Inspect the manifolds for cracks, damaged gasket surfaces, or other damage that would make them unfit for further service. Warped or cracked exhuast manifolds must be replaced.

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Cleaning

Clean all the parts thoroughly. Make sure all oil passages are open.

Make sure the oil passage in the push rod end of the rocker arm is open.

Inspection

Inspect the shaft and the rocker arm bore for nicks, scratches, scores or scuffs. Replace any damaged parts.

Inspect the pad at the valve end of the rocker arm for indications of scuffing or abnormal wear. If the pad is grooved, replace the rocker arm. **Do not attempt to true this surface by grinding. On stud-mounted rocker arms, check the rocker arm pad, side rails and fulcrum seat for excessive wear, cracks, nicks or burrs. Check the rocker arm stud and nut for stripped or broken threads. On rocker arm stud nuts, check the shoulder for damage as shown in Fig. 39. Replace all damaged nuts.**

On pedestal mounted rocker arms, check the rocker arm pad and fulcrum seat for excessive wear, cracks, nicks or burrs. Replace all damaged rocker arms.

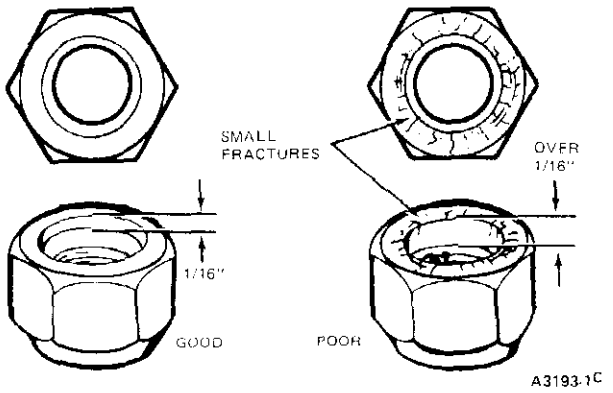


FIG. 39 Rocker Arm Stud Nut Inspection

PUSH RODS

Cleaning

Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air.

Inpsection

Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Replace damaged push rods.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator (Fig. 40).

If the push rod is bent beyond specifications, it should be replaced. **Do not attempt to straighten pushrods.**

CYLINDER HEADS

Cleaning

With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to damage the cylinder head gasket surface. After the valves are removed, clean the valve guide bores. Use cleaning solvent to remove dirt, grease and other deposits. Clean all bolt holes. Remove all deposits from the valves with a fine wire brush or buffing wheel.

Inspection

Check the cylinder head for cracks and inspect the gasket surface for burrs and nicks. Replace the head if it is cracked.

The following inspection procedures are for a cylinder head that is to be completely overhauled. For individual repair operations, use only the pertinent inspection procedure.

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head gasket surface (Fig. 41) for conformance to specifications. If necessary to refinish the cylinder head gasket surface, **do not plane or grind off more than 0.010 inch.**

Check the valve seat runout with an accurate gauge (Fig. 42). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat. Measure the valve seat width (Fig. 32). **Reface any valve seat whose width is not within specifications.**

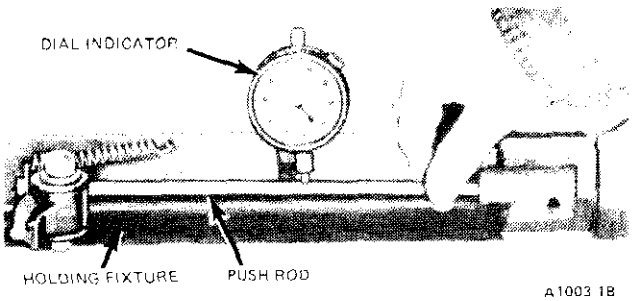


FIG. 40 Checking Push Rod Runout

The critical inspection points of the valves are illustrated in Fig. 34. Refer to the specifications for service limits.

Inspect the stem for bends and the end of the stem for grooves or scores. Check the valve head for burning, erosion, warpage and cracking. Minor pits, grooves etc., may be removed. Discard valves that are severely damaged.

Inspect the valve spring, valve spring retainers, locks and sleeves for wear or damage. Discard any damaged parts.

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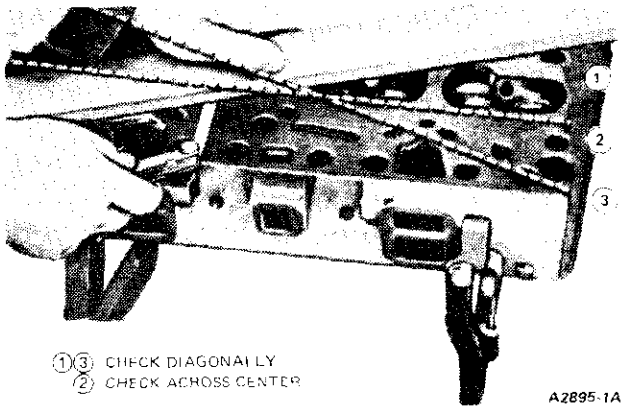


FIG. 41 Typical Cylinder Head Flatness Check

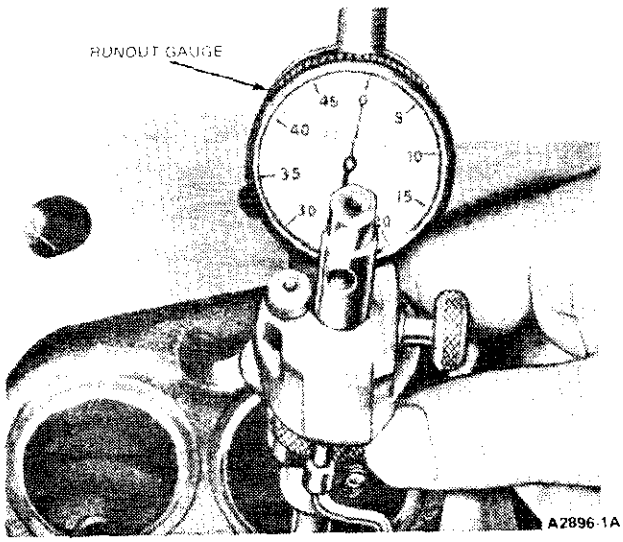


FIG. 42 Checking Valve Seat Runout

Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 43 or its equivalent. Use a flat end indicator point.

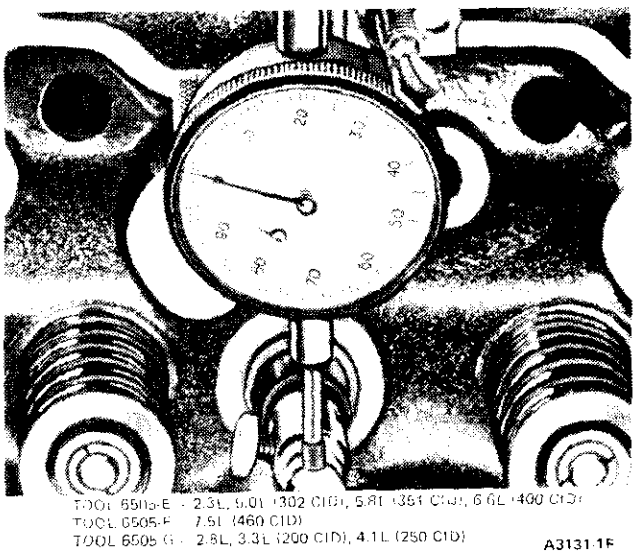


FIG. 43 Checking Valve Stem Clearance

Install the tool on the valve stem until it is fully seated, and tighten the knurled set screw firmly. Permit the valve to drop away from its seat until the tool contacts the upper surface of the valve guide.

Position the dial indicator with its flat tip against the center portion of the tool's spherical section at approximately 90 degrees to the valve stem axis. Move the tool back and forth in line with the indicator stem. Take a reading on the dial indicator without removing the tool from the valve guide upper surface. Divide the reading by two, the division factor for the tool. The resulting measurement is the valve stem clearance.

Check the springs for proper pressure (Fig. 44) at the specified spring lengths (Tool-6513-DD). Weak valve springs cause poor engine performance. Replace any spring not within specifications. Manually rotating the valve spring assemblies while installed in the engine will not determine condition of valve springs.

Check each spring for squareness, using a steel square and a flat surface (Fig. 45). Stand the spring and square on end on the flat surface. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square.

See Specifications for out-of-square limits. Follow the same procedure to check new valve springs before installation.

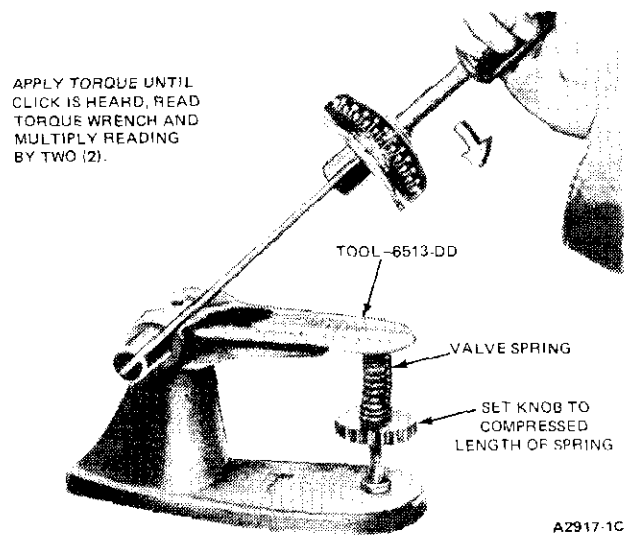


FIG. 44 Checking Valve Spring Pressure

HYDRAULIC TAPPETS AND HYDRAULIC LASH ADJUSTERS

The tappet (or lash adjuster) assemblies should be kept in proper sequence so that they can be installed in their original position. Inspect and test each tappet separately so as not to intermix the internal parts (see Fig. 46). ***If any part of the tappet assembly needs replacing, replace the entire assembly.***

Cleaning

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint-free cloth.

Inspection

Inspect the parts and discard the entire tappet assembly if any part shows pitting, scoring, galling,

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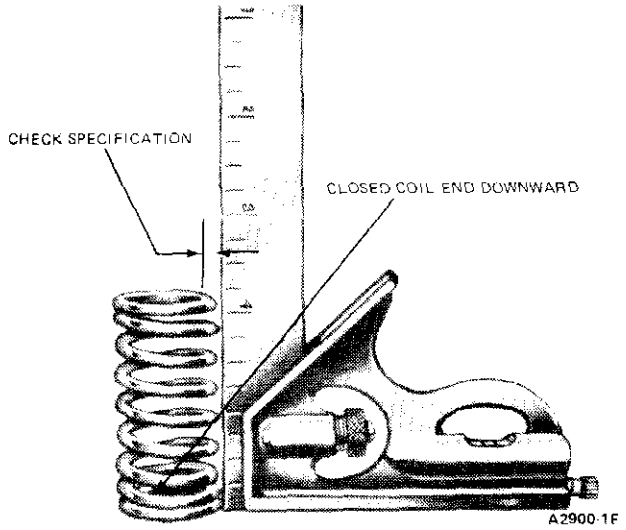


FIG. 45 Checking Valve Spring Squareness

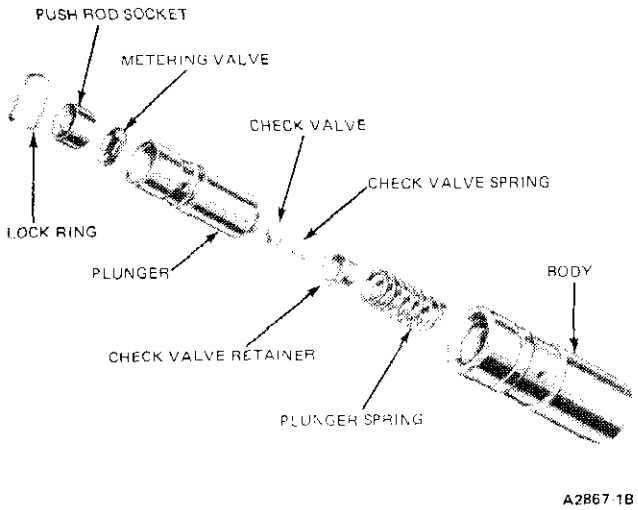


FIG. 46 Hydraulic Tappet

excessive wear or evidence of non-rotation. Replace the entire assembly if the plunger is not free in the body. The plunger should drop to the bottom of the body by its own weight when assembled dry.

Assemble the tappet assembly and check for freeness of operation by pressing down on the push rod cup. The tappets can also be checked with a hydraulic tester to test the leakdown rate. Follow the instructions of the test unit manufacturer or the procedure under Diagnosis and Testing.

TIMING CHAIN AND SPROCKETS

Cleaning

Clean all parts in solvent and dry them with compressed air.

Lubricate the timing chain with engine oil before installing it on the sprockets.

Inspection

Inspect the chain for broken links. Inspect the sprockets for cracks and worn or damaged teeth. Replace all the components of the timing chain and sprocket assembly, if any one item needs replacement.

FUEL PUMP ECCENTRIC

Cleaning

Clean the fuel pump eccentric in solvent and dry with compressed air.

Inspection

Inspect the fuel pump drive eccentric for scores, nicks and excessive wear. If the eccentric surface is scored, nicked or worn, replace it.

On two-piece designs, inspect inner and outer rings for scoring, nicks, and excessive wear. Replace any part indicating scoring or excessive wear.

CAMSHAFT

Cleaning and Inspection

Clean the camshaft in solvent and wipe it dry. Inspect the camshaft lobes for scoring and signs of abnormal wear. Lobe pitting in the general area of the lobe toe is not detrimental to the operation of the camshaft; therefore, the camshaft should not be replaced unless the lobe lift loss has exceeded specifications.

The lift of the camshaft lobes can be checked with the camshaft installed in the engine or on centers. Refer to Camshaft Lobe Lift.

Replace the camshaft if distributor drive gear has chipped or broken teeth.

OIL PAN

Cleaning

Scrape any dirt or metal particles from the inside of the pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign particles are removed from below the baffle plate.

Inspection

Check the pan for cracks, holes, damaged drain plug threads, and a loose baffle or a damaged gasket surface.

Inspect for damage (uneven surface) at the bolt holes caused by over-torquing the bolts. Straighten surfaces as required. Repair any damage, or replace the pan if repairs cannot be made satisfactorily.

OIL PUMP

Cleaning

Wash all parts in a solvent and dry them thoroughly with compressed air. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and metal particles are removed.

Inspection

Refer to Specifications for clearances and wear limits.

Check the inside of the pump housing and the outer race and rotor for damage or excessive wear.

Check the mating surface of the pump cover for wear. Minor scuff marks are normal, but if the cover

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mating surface is worn, scored or grooved, replace the pump. Inspect the rotor for nicks, burrs or score marks. Remove all high points by stoning.

Measure the outer race to housing clearance (Fig. 47).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance (rotor end play) between the straight edge and the rotor and outer race (Fig. 48). Inspect the relief valve spring to see if it is collapsed or worn. Check the relief valve spring tension. If the spring tension is not within specifications and/or the spring is worn or damaged replace the pump. Check the relief valve piston for free operation in the bore.

NOTE: Internal components are not serviced; if any component is out of specification, the complete pump must be replaced.

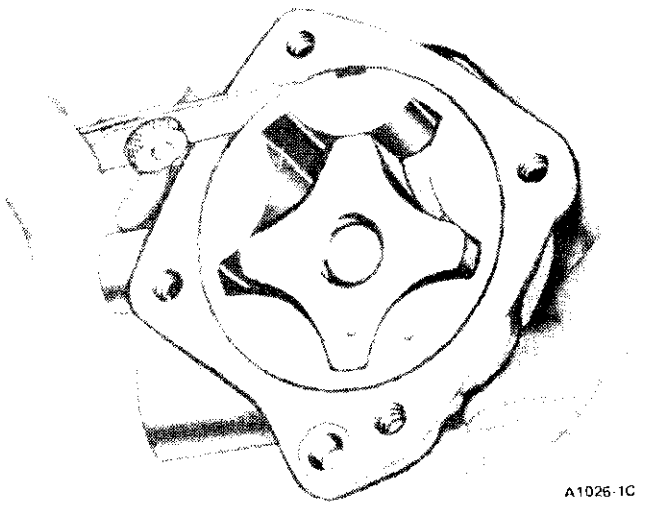


FIG. 47 Checking Outer Race to Housing Clearance

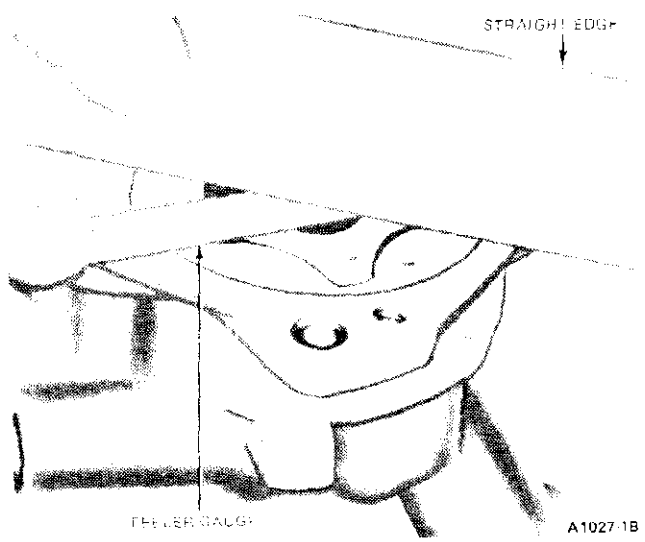


FIG. 48 Checking Rotor End Play

CONNECTING RODS

Cleaning

Remove the bearings from the rod and cap. Identify the bearings if they are to be used again. Clean the connecting rod in solvent, including the rod bore and the back of the inserts. **Do not use a caustic cleaning solution.** Blow out all passages with compressed air.

Inspection

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on either pin boss side of the piston usually indicates that a connecting rod is bent.

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, worn or damaged crankpin, or a tapered connecting rod bore.

Twisted connecting rods will not create an identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings and connecting rod assembly and may be the cause of excessive oil consumption.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits and/or if the connecting rod is fractured, it should be replaced. Check the ID of the connecting rod piston pin bore. If the pin bore in the connecting rod is larger than specifications, install a 0.001 inch oversize piston pin. First, pre-fit the oversize piston pin to the piston pin bore by reaming or honing the piston to provide 0.0002-0.0004 inch clearance (light slip fit). Then, assemble the piston, piston pin and connecting rod following the procedures for the specific engine being worked on. **It is not necessary to ream or hone the pin bore in the connecting rod. Replace damaged connecting rod nuts and bolts. Check the connecting rods for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist exceeds specifications, the connecting rod must be replaced.**

PISTONS, PINS AND RINGS

Cleaning

Remove deposits from the piston surfaces. Clean gum or varnish from the piston skirt, piston pins and rings with solvent. **Do not use a caustic cleaning solution or a wire brush to clean pistons.**

Clean the ring grooves with a ring groove cleaner (Fig. 49). Make sure the oil ring slots (or holes) are clean.

Inspection

Carefully inspect the pistons for fractures at the ring lands, skirts and pin bosses, and for scuffed, rough or scored skirts. If the lower inner portion of the ring grooves has a high step, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation or pre-ignition. A shiny surface on the thrust surface of the

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piston, offset from the centerline between the pistan pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands or fractures or damage from detonation or pre-ignition.

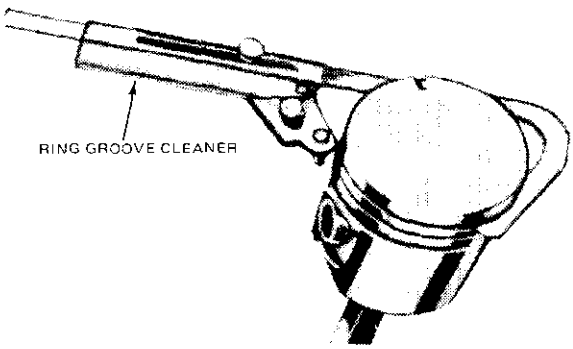


FIG. 49 Cleaning Piston Ring Grooves

Check the piston to cylinder bore clearance by measuring the piston and bore diameters. Refer to the specifications for the proper clearance. Refer to Cylinder Block Inspection for the bore measurement procedure. **Measure the OD of the piston with micrometers at the centerline of the piston pin bore and at 90 degrees to the pin bore axis.** Check the ring side clearance following the procedure under Fitting Piston Rings in this section.

Replace piston pins showing signs of fracture, etching or wear. Check the piston pin fit in the piston and rod. Refer to Piston and Connecting Rod Assembly, in the pertinent engine section.

Check the OD of the piston pin and the ID of the pin bore in the piston. Replace any piston pin or piston that is not within specifications.

Replace all rings that are scored, broken, chipped or cracked. Check the end gap and side clearance. **Rings should not be transferred from one piston to another regardless of mileage.**

MAIN AND CONNECTING ROD BEARINGS

Cleaning

Clean the bearing inserts and caps thoroughly in solvent, and dry them with compressed air. **Do not scrape gum or varnish deposits from the bearing shells.**

Inspection

Inspect each bearing carefully. Bearings that have a scored, chipped or worn surface should be replaced. Typical examples of unsatisfactory bearings and their causes are shown in Fig. 50. The copper lead bearing base may be visible through the bearing overlay. This does not mean that the bearing is worn. It is not necessary to replace the bearing if the bearing clearance is within recommended limits. Check the clearance of bearings that appear to be satisfactory with Plastigage as detailed under Main and Connecting Rod Bearings.

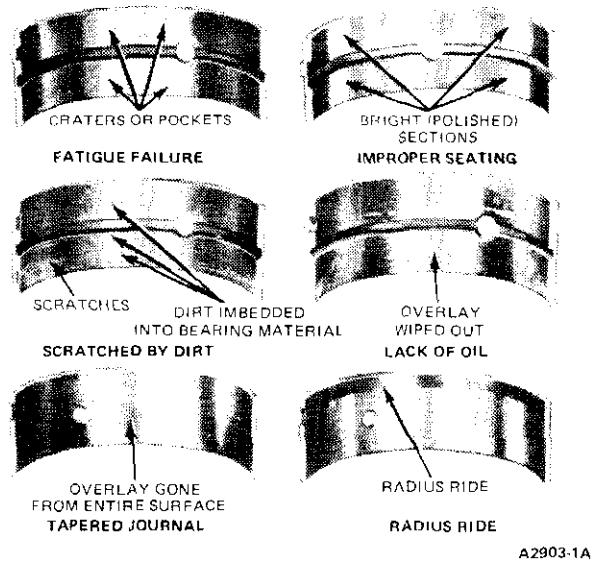


FIG. 50 Typical Bearing Failures

CRANKSHAFT

Cleaning

Handle the crankshaft with care to avoid possible fractures or damage to the finished surfaces. Clean the crankshaft with solvent, then blow out all oil passages with compressed air.

Inspection

Inspect the main and connecting rod journals for cracks, scratches, grooves or scores. Inspect the crankshaft oil seal surface for nicks, sharp edges or burrs that might damage the oil seal during installation or cause premature seal wear.

Measure the diameter of each journal in at least four places to determine an out-to-round, taper or undersize condition (Fig. 51).

Inspect the pilot bearing (roller bearing) when so equipped, for roughness, evidence of overheating or loss of lubricant. Replace it if any of these conditions are found.

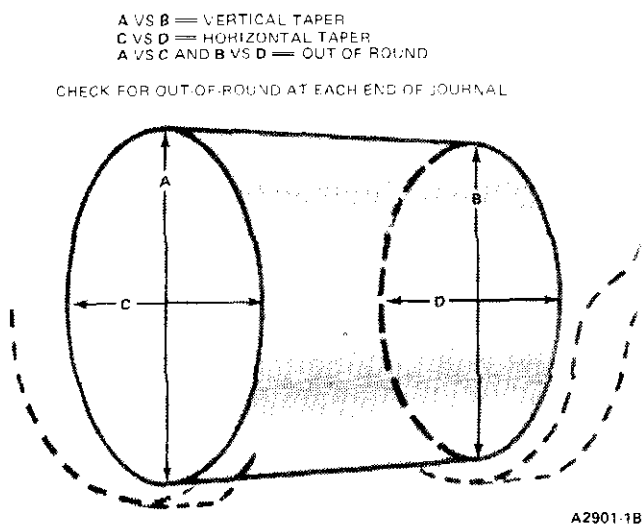


FIG. 51 Crankshaft Journal Measurement

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CRANKSHAFT VIBRATION DAMPER AND SLEEVE

Cleaning

Clean the oil seal contact surface on the crankshaft damper or sleeve with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with crocus cloth. Use crocus cloth to remove any sharp edges or burrs which might damage the oil seal during installation or cause premature seal wear. **Do not use crocus cloth to the extent that the seal surface becomes polished. A finely polished surface may produce poor sealing or cause premature seal wear.**

Inspection

Inspect the crankshaft damper seal surface for nicks, sharp edges or burrs that might damage the oil seal during installation or cause premature seal wear.

FLYWHEEL—MANUAL-SHIFT TRANSMISSION

Inspection

Inspect the flywheel for cracks, heat check, or other damage that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout, following the procedure under Diagnosis and Testing.

FLYWHEEL—AUTOMATIC TRANSMISSION

Inspection

Inspect the flywheel for cracks or other defects that would make it unfit for further service. Inspect the flywheel ring gear for worn, chipped or cracked teeth. If the teeth are damaged, replace the ring gear and flywheel assembly.

With the flywheel installed on the crankshaft, check the gear face runout.

CYLINDER BLOCK

Cleaning

After any cylinder bore repair operation, such as honing or deglazing, clean the bore(s) with soap or detergent and water. Then, thoroughly rinse the bore(s) with clean water to remove the soap or detergent, and wipe the bore(s) dry with a clean, lint-free cloth. Finally wipe the bore(s) with a clean cloth dipped in engine oil. **If these procedures are not followed, rusting of the cylinder bore(s) may occur.**

If the engine is disassembled, thoroughly clean the block with solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs that seal oil passages; then clean out all the passages. Blow out all passages, bolt holes, etc., with compressed air. Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true up threads and to remove all deposits. Thoroughly clean the grooves in the crankshaft bearings and bearing retainers.

Inspection

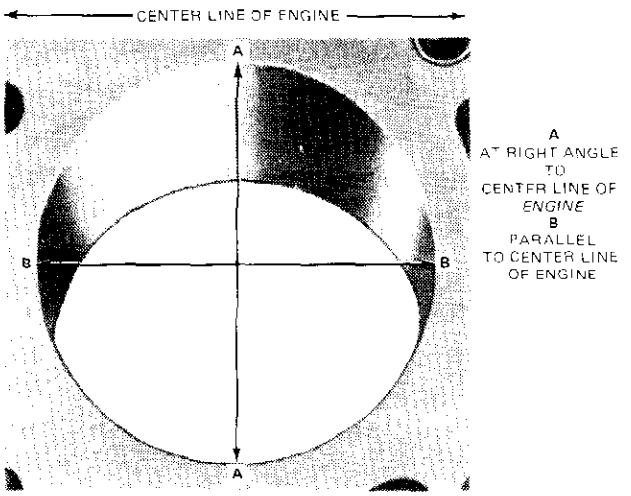
After the block has been thoroughly cleaned, check it for cracks. Tiny cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the defective area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone.

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate bore gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle and bottom with the gauge placed at right angles and parallel to the centerline of the engine (Fig. 52). **Use only the measurements obtained at 90 degrees to the engine centerline when calculating the piston to cylinder bore clearance.**

Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the service limits. If the cylinder walls have minor surface imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder walls and installing new service piston rings providing the piston clearance is within specified limits.



1. OUT-OF-ROUND - DIFFERENCE BETWEEN A AND B
2. TAPER - DIFFERENCE BETWEEN THE A MEASUREMENT AT TOP OF CYLINDER BORE AND THE A MEASUREMENT AT BOTTOM OF CYLINDER BORE

A2905-1A

FIG. 52 Cylinder Bore Out-of-Round and Taper

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SPECIAL SERVICE TOOLS

Description	Ford Tool No.	Former No.	Application Engine Size					
			2.3L	2.8L V-6	3.3L/4.1L (200/250 CID) Six	5.0L/5.8L (302/351 CID) "W" V-8	5.8L "M"/ 6.6L (351M/400 CID) V-8	7.5L (460 CID) V-8
Hydraulic Tappet Remover	T70P-14151			X	X	X	X	X
Crankshaft Front Seal Installing Tool	T70P-6B070-A						X	
Crankshaft Front Seal Removing Tool	T70P-6B070-B						X	
Impact Hammer	T50T-100-A				X	X	X	X
Puller Attachment Use with T50T-100-A or T59L-100-B	T58L-101-A				X	X	X	X
Handle Adapter	T53L-200-A				X	X	X	X
Differential Backlash and Runout Gauge, with Universal Bracket and Dial Indicator (1-1/4 inch range). Includes Indicator TOOL-6565	TOOL-4201-C		X	X	X	X	X	X
Engine Lifting Hook	T60K-6000-A				200			
Engine Lifting Hook	T65L-6000-A							X
Engine Lifting Brackets	T58P-6000-A					X	X	X
Cam Bearing Bore Plug Installing Tool	T70P-6001-A						X	
Core Plug Replacer	T54L-6015-A				200			
Cylinder Front Cover Pilot	T61P-6019-B	6059-F			200			
Front Cover Alignment Tool	T61K-6019-A				X			
Cylinder Front Cover Pilot	T68P-6019-A							X
Valve Spring Compressor, on Engine	T70P-6049-A						X	X
Valve Guide Reamer Kit	T52L-6085-AEE					X	X	X
Engine Lifting and Head Holding Brackets **	T62F-6085-A	6005-BDA				X		
Piston Pin Remover and Replacer Kit	T68P-6135-A		X	X+	X	X		X
Camshaft Bearings Remover and Replacer Adapters	T65L-6250-A	T52L-6261-CEE		X	X	X	X	
Camshaft Rear Bearing Bore Plug Replacer-Adapter--Use with T53L-200-A	T62F-6266-A					X		X
Cylinder Block Core Plug Replacer	T68P-6266-A							X
Core Plug Replacer	T52L-6266-BGD				X			
Crankshaft Damper Replacer	T64T-6306-A				X	X	X	X
Camshaft Timing Gear Replacer Screw Adapter	T65L-6306 A							
Crankshaft Damper Installer	T52L-6306-AEE				X	X	X	
Camshaft Gear Installer	T65L-6306-A							
Crankshaft Damper Remover	T58P-6316-B				200			
Cylinder Block Core Plug Replacer	T72C-6015		X	X				
Valve Guide Reamer Kit	T72C-6085		X	X				
Crankshaft Rear Oil Seal Replacer	T72C-6165		X	X				
Cam Bearing Remover and Replacer Adapter Tube	T72C-6250		X	X				
Cam Bearing Bore Plug Replacer	T72C-6266		X	X				
Cover Plate Retaining Studs	T72C-7007		X	X				
Front Cover Aligner, Seal Replacer and Timing Gear Replacer	T74P-6019-A		X	X				
Piston Pin Remover and Replacer/Adapter	T74P-6135-A		X	X				
Crankshaft Timing Gear Remover Adapter	T74P-6136-A		X	X				
Crankshaft Damper Pulley Remover and Replacer	T74P-6316-A		X	X				
Crankshaft Damper Pulley Replacer	T74P-6316-B		X	X				
Valve Spring Compressor Lever	T74P-6565-A		X	X				
Valve Spring Compressor Bar	T74P-6565-B			X				
Front Cover Seal Remover	T74P-6700-A		X	X				
Pilot Bearing Replacer Adapter*	T74P-7137-A			X				
Pilot Bearing Replacer Adapter*	T74P-7137-B		X					

*Use with TOOL T71P-7137-H or T74P-7137-H

+Use with TOOL T68P-6135-A

**When Removing Engine with Exhaust Manifolds Attached

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SPECIAL SERVICE TOOLS (Continued)

Description	Ford Tool No.	Former No.	Application Engine Size					
			2.3L	2.8L V-6	3.3L/4.1L (200/250 CID) Six	5.0L/5.8L (302/351 CID) "W" V-8	5.8L "M"/ 6.6L 351M/400 CID) V-8	7.5L (460 CID) V-8
Camshaft Damper Remover Adapter Screw	T64T-6316-A							X
Crankshaft Damper Remover	T52L-6316-FEE	6316-FF			X			
Upper Main Bearing Insert Remover and Replacer	TOOL-6331				X	X	X	
Upper Main Bearing Remover and Replacer	TOOL-6331-E							X
Hydraulic Tappet Leakdown Tester	TOOL-6500-E				X	X	X	X
Hydraulic Tappet Plunger Remover and Replacer	TOOL-6500-F				X	X	X	X
Valve Stem Deburring Tool	T70P-6505-A						X	
Valve Stem Clearance Checking Tool	TOOL-6505-E					X	X	X
Valve Stem Clearance Checking Tool	TOOL-6505-F				200			X
Valve Gauge	T64L-6507-A				X	X	X	X
Valve Spring Compressor	T65P-6513-A				200			
Valve Spring Compressor	T71P-6513-A						X	X
Air Adapter and Hose-Valve Holdup	TOOL-6513-ABA	6513-AB			X	X		X
Compressor-Tappet Bleed-Down	TOOL-6513-AC					X		X
Valve and Clutch Spring Tester	TOOL-6513-DD				X	X	X	X
Valve Spring Compressor	TOOL-6513-H				X			
Rocker Arm Stud Kit	T62F-6A527-B				X	X		
Rocker Arm Stud Installer (Supplements T62F-6A527-B)	T65P-6A527-A				X	X		
Hydraulic Tappet Bleed-Down Tool	T70P-6564-A						X	
Cup Shaped Adapter to TOOL-6565	TOOL-6565-AB				X	X	X	X
Crankcase Ventilation System Tester (Kit)	CRAZ-6B627-A				X	X	X	X
Cylinder Block Front Cover Oil Seal Replacer Adapter	T60K-6700-A	6700-C			200			
Cylinder Block Front Cover Oil Seal Replacer-Adapter Use with T53L-200-A	T58P-6700-B				250	X	X	X
Front Cover Oil Seal Replacer	T68P-6700-A							X
Crankshaft Rear Oil Seal Forming Tool	T60K-6701-A				200			
Crankshaft Rear Seal Replacer	T62F-6701-A					X		
Crankshaft Rear Seal Replacer	T65P-6701-A							
Crankshaft Rear Seal Replacer	T68P-6701-A							X
Fibre Block for 6701 Tools	T58P-6701-AC				200	X		X
Clutch Disc Pilot	T58P-7563-A					X		
Clutch Pilot Bearing Replacer	TOOL-7600-H	7600-H			X	X		
Clutch Pilot Bearing Replacer	T65L-7600-A				X			
Rocker Arm Stud Driver	T69P-6049-D					351W		
Clutch Disc Aligner	T71P-7137-H		X					
Clutch Disc Aligner	T74P-7137-H		X*					
Clutch Disc Aligner	T74P-7137-K			X				

*Mustang Only

CA1327-2E1

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2.3L I-4 Engine

PART 21-05

Pinto/Bobcat/Mustang II/Fairmont/Zephyr

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CA4183-2B

DESCRIPTION

The 2.3L I-4 overhead cam engine is of lightweight iron construction. The crankshaft is supported on five main bearings and the camshaft by four. Main, connecting rod, camshaft and auxiliary shaft bearings are all replaceable.

The camshaft is driven from the crankshaft by a cogged belt, which also operates the auxiliary shaft, and through this shaft, the oil pump, fuel pump and the distributor. Tension on the cam drive belt is maintained by a locked idler pulley bearing on the outside of the belt.

Water pump and fan are separately driven from the crankshaft by a conventional V-belt, which also drives the alternator. **CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.**

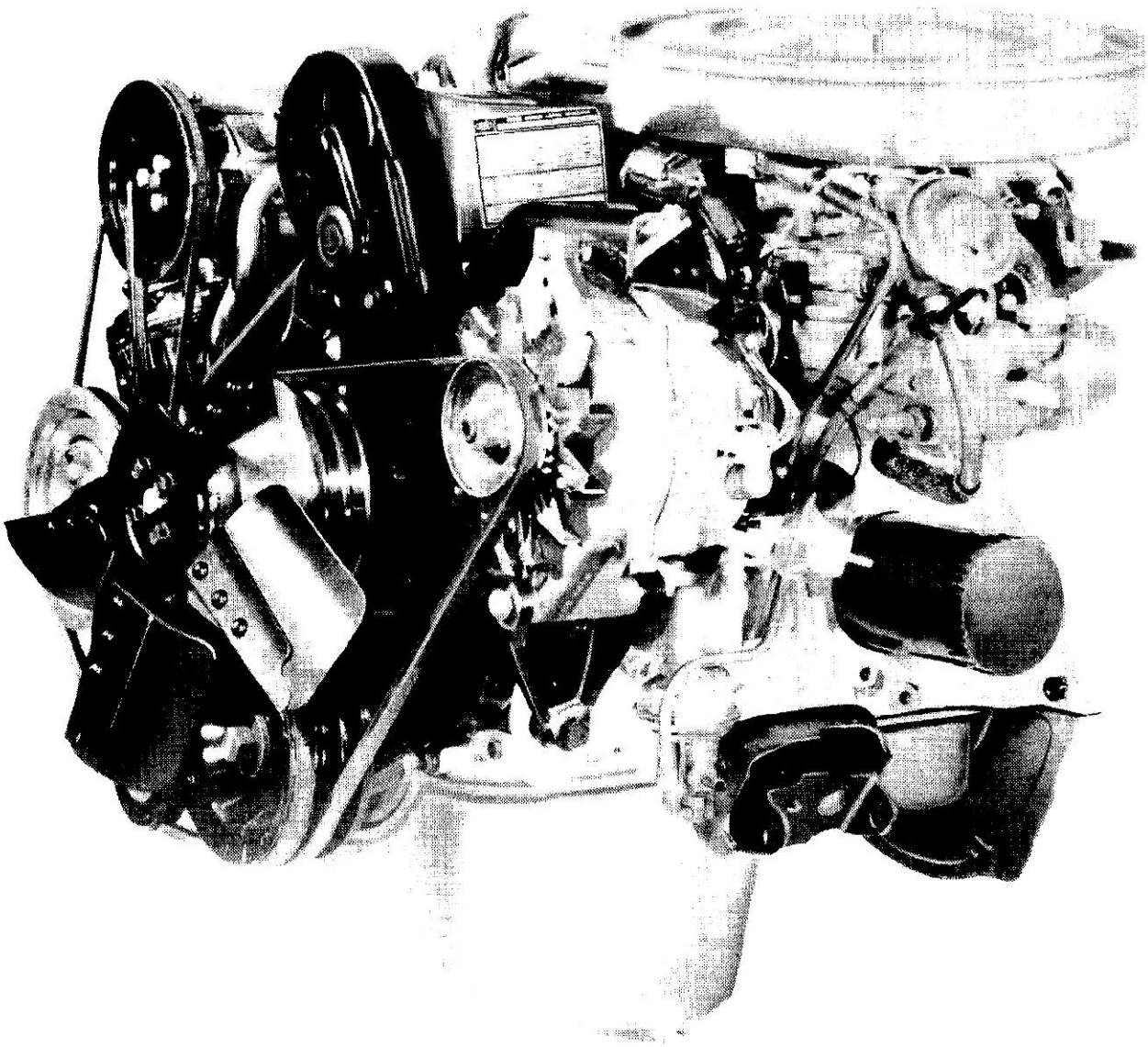
Hydraulic valve lash adjusters are used in the valve train. These units are placed at the fulcrum point of the cam followers (or rocker arms). Their action is similar to the hydraulic tappets used in push-rod engines and they are constructed and serviced in the same manner. The cylinder head has drilled oil passages to provide engine oil pressure to the lash adjusters (Fig. 2).

A set of metric wrenches is required to service the 2.3L I-4 engine.

EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices used on this engine are covered in Group 29 of this Volume, and Part 50-29 of Volume 5.

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FIG. 1 Left Front View—2.3L I-4 Engine

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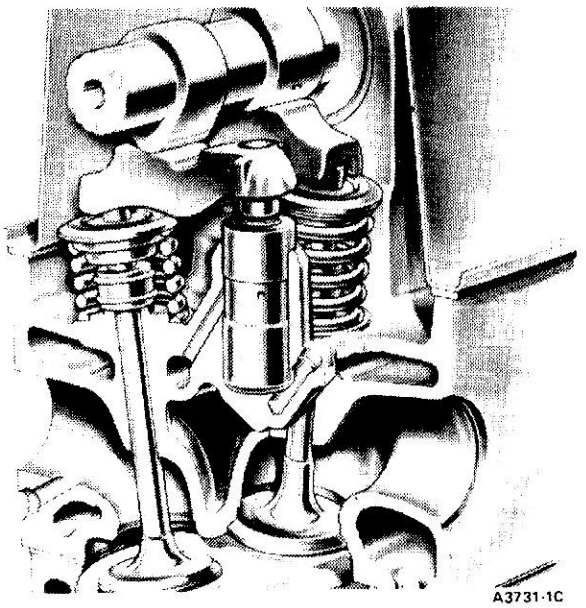


FIG. 2 Valve Train Lubrication System

CRANKCASE VENTILATION SYSTEM

This engine is equipped with a positive, closed-type crankcase ventilation system re-cycling crankcase vapors to the intake manifold.

ADJUSTMENTS

CAUTION: Do not operate engine with hood open until the fan has been first examined for possible cracks and separation.

VALVE CLEARANCE—HYDRAULIC VALVE LASH ADJUSTERS

1. Position the camshaft so that the base circle of the lobe is facing the cam follower of the valve to be checked (Fig. 3).
2. Using the tool shown in Fig. 3, slowly apply pressure to the cam follower until the lash adjuster is completely collapsed. Hold the follower in this position and insert the proper size feeler gauge between the base circle of the cam and the follower.
3. If the clearance is excessive, remove the cam follower and inspect for damage.
4. If the cam follower appears to be intact, and not excessively worn, measure the valve spring assembled height to be sure the valve is not sticking.
5. If the valve spring assembled height is correct, check the dimensions of the cam shaft following the procedure under Checking Camshaft Lobe Lift in Part 21-01.
6. If the camshaft dimensions are to specifications, remove, clean and test the lash adjuster, following the procedures given in Part 21-01.

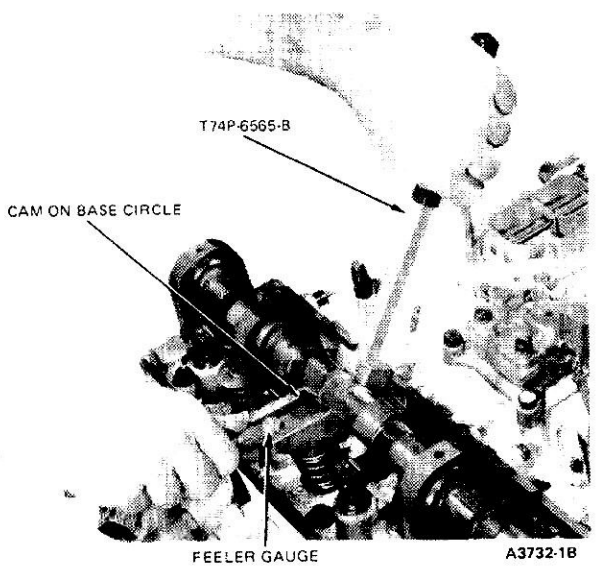


FIG. 3 Checking Hydraulic Valve Lash Adjuster

7. Re-install the lash adjuster and check the clearance. Replace damaged or worn parts as necessary.

NOTE: For any repair that requires the removal of the camshaft follower (rocker arm), each affected hydraulic lash adjuster must be collapsed after re-installation of the camshaft follower, and then released. This step must be taken prior to any rotation of the camshaft.

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CAMSHAFT TIMING

Checking Timing

An access plug is provided in the cam drive belt cover so that camshaft timing can be checked without removal of the cover or any other parts.

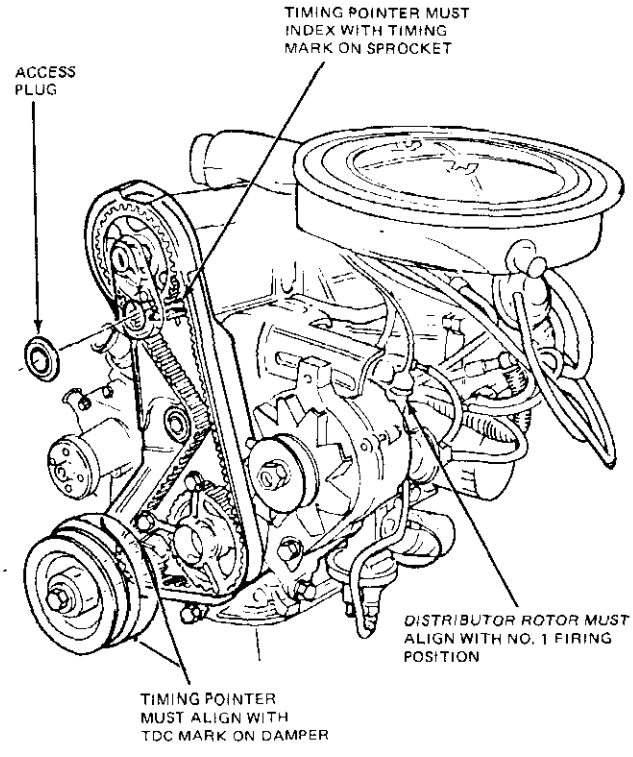


FIG. 4 Camshaft Drive Train Installation

1. Remove the access plug (Fig. 4) from the cam drive belt cover.
2. Set the crankshaft to TDC by aligning the timing pointer on the belt cover with the O mark on the crankshaft damper. **Always turn the engine in the direction of normal rotation. Backward rotation may cause the timing belt to jump time, due to the arrangement of the belt tensioner.**
3. Look through the access hole in the belt cover to be sure that the timing mark on the cam drive sprocket (Fig. 4) is lined up with the pointer on the inner belt cover.
4. Remove the distributor cap and check that the distributor rotor is facing the No. 1 position on the distributor cap.
5. Install the distributor cap.
6. *Install the belt cover access plug.*

Adjusting Timing

1. Refer to Fig. 5 and remove the timing belt outer cover.
2. If the belt timing is incorrect, loosen the belt tensioner adjustment screw (Fig. 6), position the tool shown on the tension spring rollpin and release the belt tensioner. Tighten the adjustment screw to hold the tensioner in released position.
3. Remove the crankshaft damper and belt guide (Fig. 5).
4. Remove the drive belt and inspect it for wear or damage. If the belt is damaged, replace it.
5. Position the crankshaft sprocket and the camshaft sprocket as shown in Fig. 4. Remove the distributor

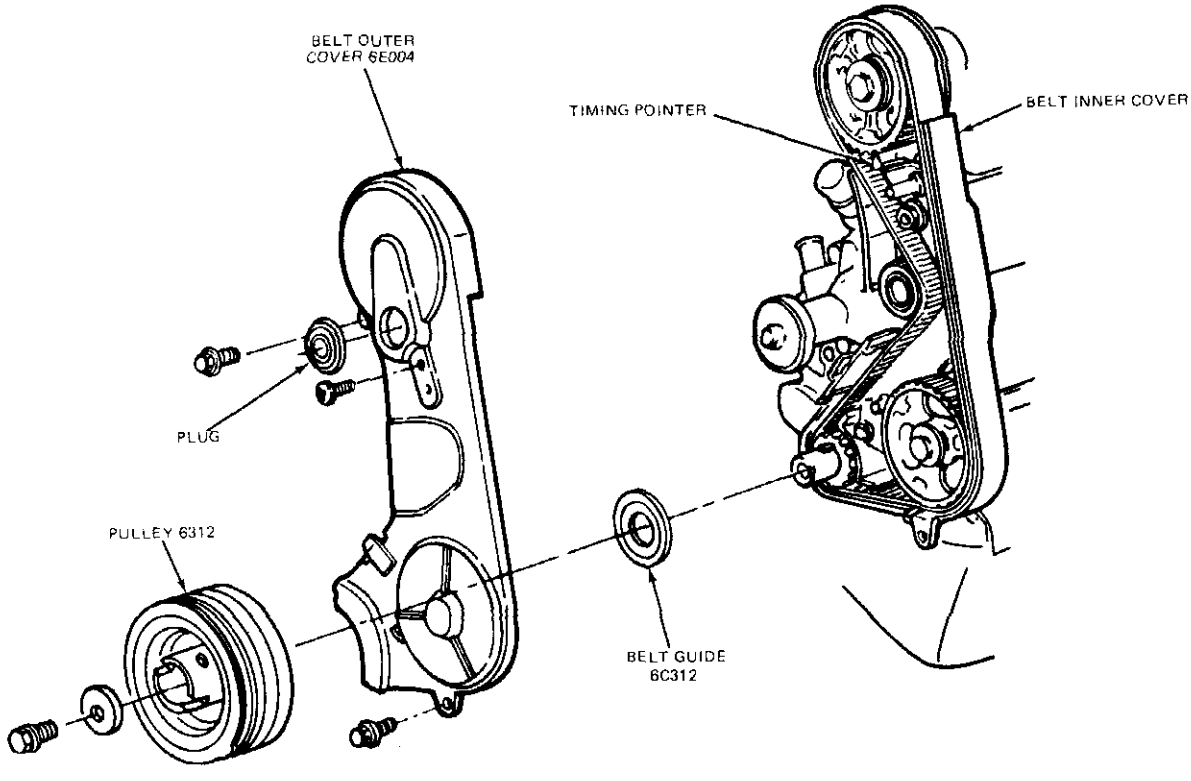


FIG. 5 Timing Belt Outer Cover, Crankshaft Belt Guide and Pulley Installation

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cap and set the distributor rotor to No. 1 firing position by turning the auxiliary shaft.

6. Install the timing belt over the crankshaft sprocket and then counterclockwise over the auxiliary and camshaft sprockets. Align the belt fore and aft on the sprockets.
7. Loosen the tensioner adjustment bolt to allow the tensioner to move against the belt. To be sure that the belt does not jump time during rotation in Step 8, remove the spark plugs.
8. Rotate the crankshaft two complete turns in normal rotation to remove the slack from the belt. Torque tensioner adjustment and pivot bolts to specifications. Re-check the alignment of the timing marks (Fig. 4).
9. Install the crankshaft damper and belt guide (Fig. 5).
10. Install the timing belt outer cover and the spark plugs.
11. Start the engine and check the ignition timing. Adjust the ignition timing to specification as required.

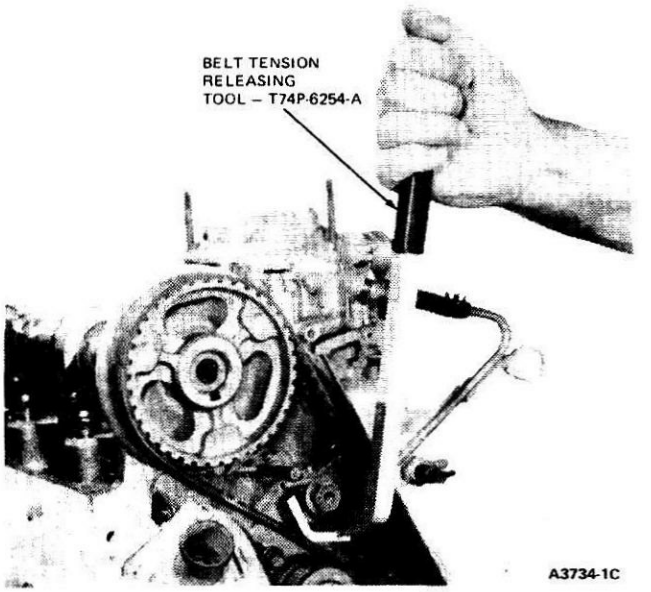


FIG. 6 Releasing Belt Tension—Typical

REMOVAL AND INSTALLATION

CAUTION: Do not operate engine with hood open until the fan has been first examined for possible cracks and separation.

When installing nuts or bolts (refer to torque specifications), oil the threads with light-weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

ENGINE

Removal

1. Raise the hood and secure it in the vertical position.
2. Drain the coolant from the radiator and the oil from the crankcase.
3. Remove the air cleaner and the exhaust manifold shroud.
4. Disconnect the ground cable from the battery.
5. Remove the radiator upper and lower hoses.
6. Remove the radiator and fan.
7. Disconnect the heater hose from the water pump and carburetor choke fitting.
8. Disconnect the alternator wires from the alternator, the starter cable from the starter, and the accelerator cable from the carburetor. On a vehicle with air conditioning, remove the compressor from the mounting bracket, and position it out of the way, leaving the refrigerant lines attached.
9. Disconnect the flexible fuel line at the fuel pump line and plug the fuel line.
10. Disconnect the coil primary wire at the coil. Disconnect the oil pressure and the water temperature sending unit wires from the sending units.
11. Remove the starter.
12. Raise the vehicle. Remove the flywheel or converter housing upper attaching bolts.
13. Disconnect the muffler inlet pipe at the exhaust manifold. Disconnect the engine right and left mount at the underbody bracket. Remove the flywheel or converter housing cover.

    On a vehicle with a manual-shift transmission, remove the flywheel housing lower attaching bolts.

    On a vehicle with automatic transmission, disconnect the converter from the flywheel. Remove the converter housing lower attaching bolts.
14. Lower the vehicle. Support the transmission and flywheel or converter housing with a jack.
15. Attach the engine lifting hooks to the existing lifting brackets. Carefully lift the engine out of the engine compartment. Install the engine on a work stand.

Installation

1. If clutch was removed, re-install per Group 16. Carefully lower the engine into the engine compartment.
2. Make sure the studs on the exhaust manifold are aligned with the holes in the muffler inlet pipe.

    On a vehicle with automatic transmission, start the converter pilot into the crankshaft.

    On a vehicle with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft in the clockwise direction slowly (transmission in gear), until the shaft splines mesh with the clutch disc splines.**
3. Install the flywheel or converter housing upper attaching bolts. Remove the engine lifting sling hooks.
4. Remove the jack from the transmission. Raise the vehicle.

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5. Install the flywheel or converter housing lower attaching bolts.

   On a vehicle with automatic transmission, attach the converter to the flywheel and torque the attaching nuts to specifications.
6. Install the flywheel or converter housing dust cover.
7. Install the engine left and right mount to the underbody bracket.
8. Remove the plug from the fuel line and connect the flexible fuel line to the fuel pump line. Install the exhaust manifold to muffler inlet pipe nuts. Torque the nuts to specifications.
9. Lower the vehicle. Connect the oil pressure and the engine temperature sending unit wires. Connect the coil wires. Connect the accelerator cable.
10. Install the starter motor. Connect the starter cable. Connect the alternator wires. Connect the heater hose to the water pump and the carburetor choke housing.
11. Install the pulley, fan, and drive belt. Adjust the drive belt tension. On a vehicle with air conditioning, install the compressor on the mounting bracket, and adjust the belt tension to specification. Install the fan and the radiator. Connect the radiator upper and lower hoses. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
12. Connect the battery ground cable.
13. Operate the engine at fast idle and check all gaskets and hose connections for leaks.
14. Install the air cleaner and connect the positive closed type crankcase ventilation hose.

ENGINE FRONT SUPPORTS

NOTE: Whenever self-locking fasteners are removed they must be replaced by new self-locking fasteners (marked * in Figs. 7, 8 and 9).

Removal

1. Remove the fan shroud attaching screws.
2. Support the engine using a wood block and jack placed under the oil pan.
3. Remove bolt attaching fuel pump shield to LH engine support bracket if so equipped.

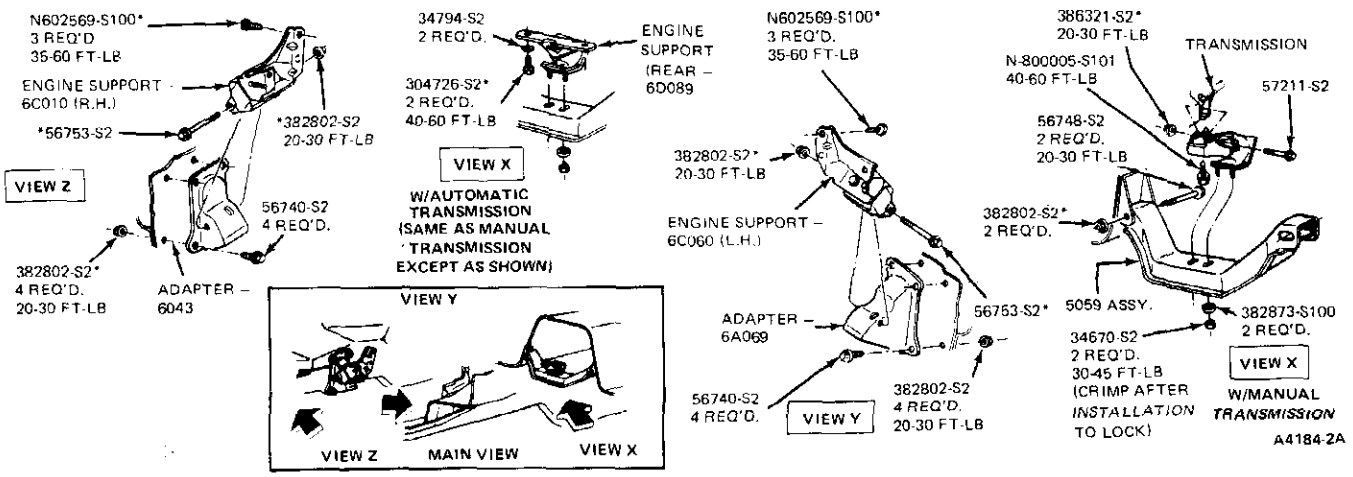


FIG. 7 Engine Supports—Pinto/Bobcat

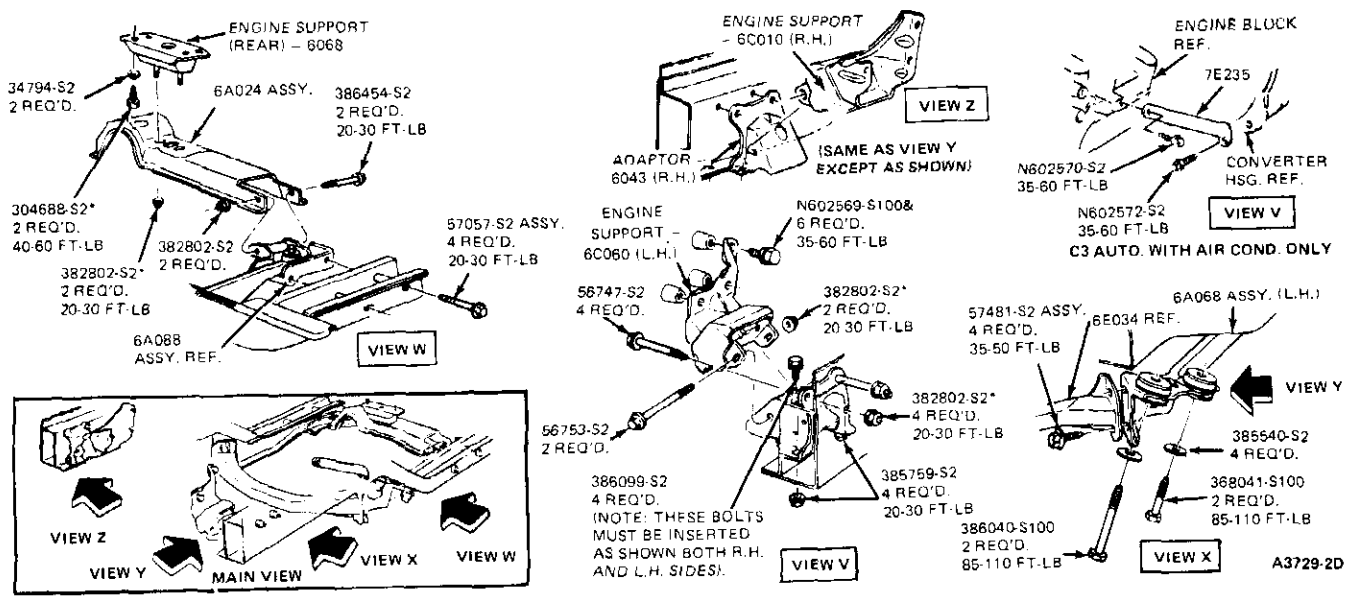


FIG. 8 Engine Supports—Mustang II

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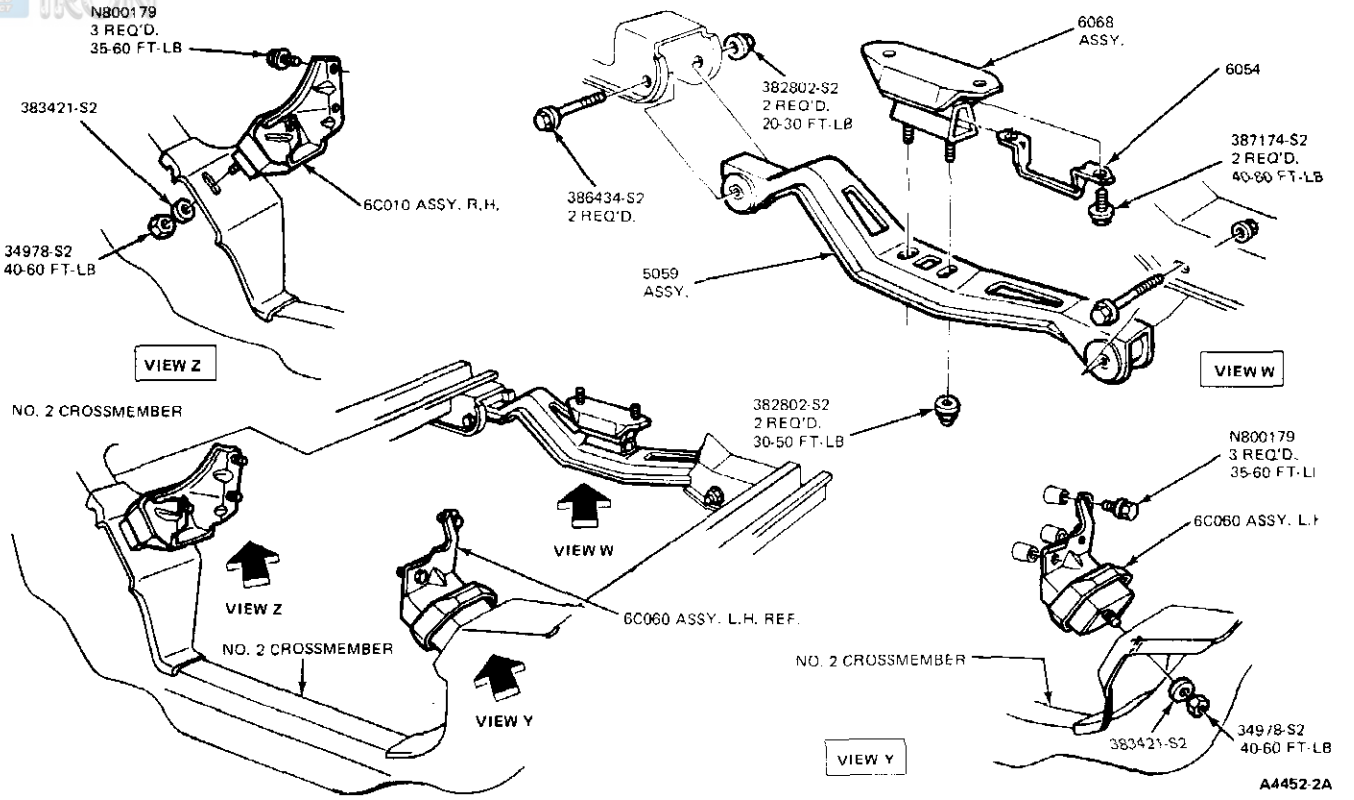


FIG. 9 Engine Support—Fairmont/Zephyr

4. **(Pinto/Bobcat/Mustang II)** Remove the through bolt and nut attaching the insulator to the support bracket. Raise the engine sufficiently to lift the insulator free of the bracket. Remove the nuts and bolts attaching the bracket to the siderail and remove the bracket.

   (Fairmont/Zephyr) Remove the nuts and washers attaching the insulators to the No. 2 crossmember pedestals. Lift the insulator sufficiently to disengage the insulator stud from the crossmember.

5. Remove the bolts attaching the insulator and bracket assembly to the engine. Remove the insulator and bracket assembly.

Installation

1. Position the insulator and bracket assembly to the engine install the attaching bolts and torque to specification.
2. **(Pinto/Bobcat/Mustang II)** Position the support bracket to the siderail and install the attaching fasteners. Torque fasteners to specification. Lower the engine until through bolt holes line up. Install through bolt and nut and torque to specification.

   (Fairmont/Zephyr) Lower engine until stud bottoms in slot. Install nut and washer and torque to specification.
3. Install bolt attaching fuel pump shield to LH bracket if so equipped and torque to specification.
4. Remove the jack and wood block from the oil pan.
5. Install fan shroud attaching screws and torque to specification.

ENGINE REAR SUPPORT

PINTO/BOBCAT/MUSTANG II/FAIRMONT/ ZEPHYR

Removal

1. Place a block of wood and a jack under the transmission.
2. Remove the two nuts attaching the insulator to the crossmember. Raise the transmission sufficiently to lift the insulator from the crossmember.
3. Remove the two bolts and nuts attaching the crossmember to the frame side rails and remove the crossmember.
4. On those vehicles so equipped, remove the fasteners attaching the exhaust hangers to the rear engine mount.
5. Remove the two bolts attaching the insulator to the transmission and remove the insulator (and retainer, if so equipped).

Installation

1. Position the insulator (and retainer, if so equipped) to the transmission. Install the two attaching bolts and torque to specification.
2. If required, install the fasteners attaching the exhaust hanger to the insulator and torque to specification.
3. Install the crossmember to the frame rails and torque the attaching nuts and bolts to specification.
4. Lower the transmission and install the insulator to crossmember attaching nuts and torque to specification.

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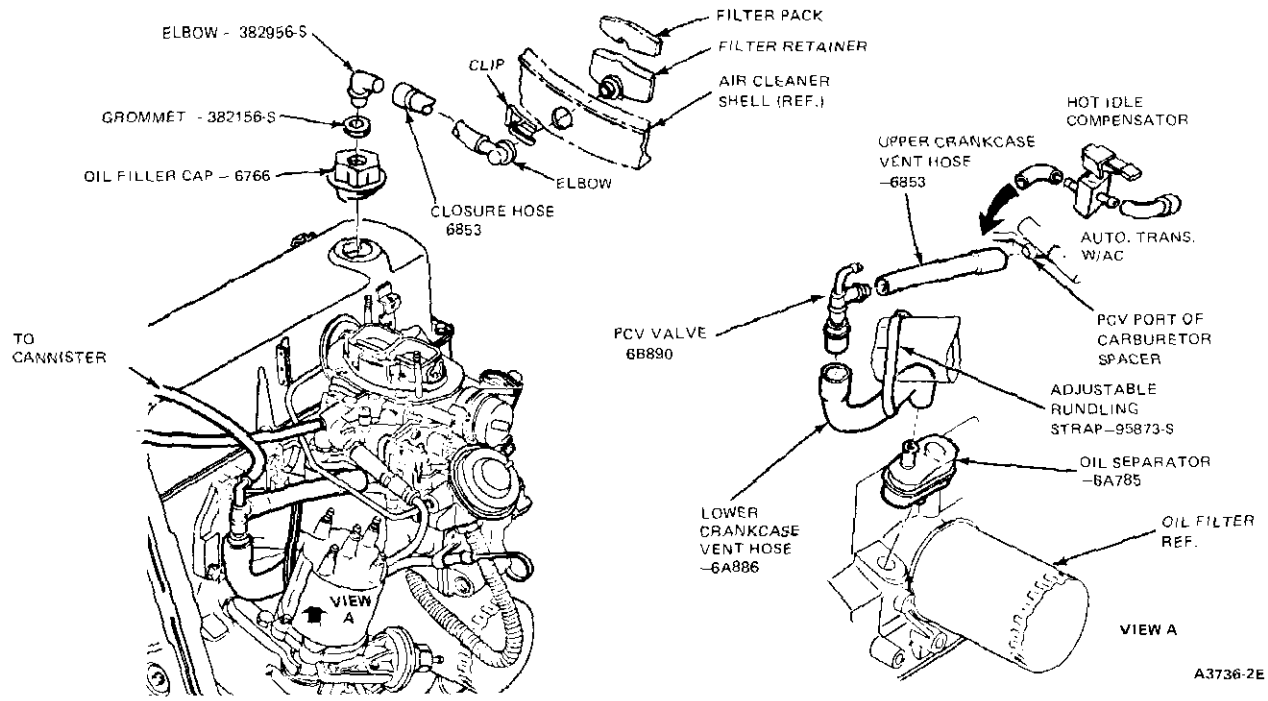


FIG. 10 Positive Crankcase Ventilation System

5. Remove the jack and wood block from under the transmission.

CRANKCASE VENTILATION SYSTEM

The positive crankcase ventilation system components are shown in Fig. 10. Disconnect and connect points are shown on the illustration.

VALVE ROCKER ARM COVER

Instructions for removal and installation of the rocker arm cover and gasket are given in Fig. 11.

VALVE ROCKER ARM (CAM FOLLOWER) AND HYDRAULIC LASH ADJUSTER

Removal

1. Remove the valve rocker arm cover and associated parts as required.
2. Rotate the camshaft so that the base circle of the cam is facing the applicable cam follower.
3. Using the tool shown in Fig. 3, collapse the lash adjuster and/or depress the valve spring if necessary and slide the cam follower over the lash adjuster and out.
4. Lift out the hydraulic lash adjuster.

Installation

1. Rotate the camshaft so that the base circle of the cam is facing the applicable cam follower.
2. Place the hydraulic lash adjuster in position in the bore.
3. Using the tool shown in Fig. 3, collapse the lash adjuster as necessary to position the cam follower over the lash adjuster and the valve stem. It may also be necessary to compress the valve spring, using the tool shown in Fig. 12.
4. Before rotating the camshaft to the next position, be sure the lash adjuster just installed is fully compressed and released.

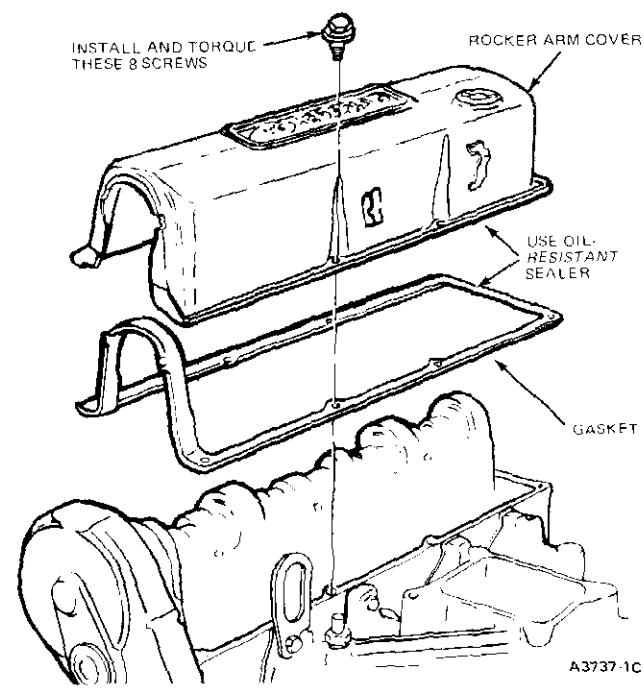


FIG. 11 Installing Valve Rocker Arm Cover—Typical

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5. Clean the gasket surfaces of the valve cover and cylinder head.
6. Coat the gasket contact surfaces of the valve cover and "UP" side of the valve cover gasket with oil resistant sealer. Allow to dry and then install gasket in valve cover, making sure locating tabs are properly positioned in slots in cover (Fig. 11).
7. Install 8 screws and torque to specification.
8. Install the air cleaner and all other hardware removed.
9. Run the engine at fast idle and check for oil leaks.

VALVE SPRING, RETAINER AND STEM SEAL

If the valve or valve seat has not been damaged; valve springs, seals and retainers may be replaced by holding the affected valve against its seat using compressed air. Use the tool shown in Fig. 12 installed in the spark plug hole. A minimum of 140 PSI line pressure is required. If air pressure does not hold the valve shut, the valve is damaged or burnt and the cylinder head must be removed and repaired (Part 21-01).

Removal

1. Remove the valve rocker arm cover and associated parts as required.
2. Remove the cam follower.
3. Using the tool shown in Fig. 12, compress the valve spring and remove the retainer locks, spring retainer, and valve spring. Remove and discard the stem seal.

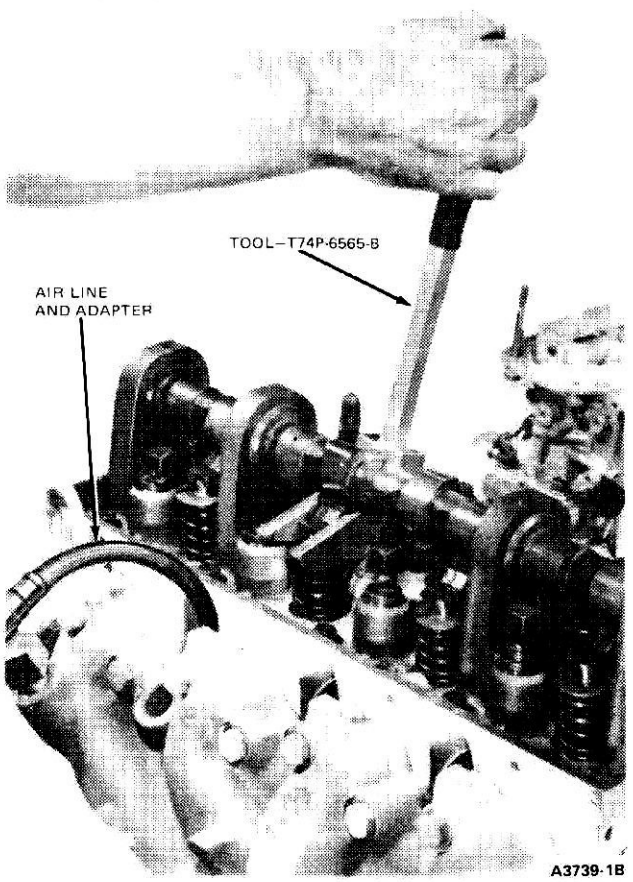


FIG. 12 Removing Valve Spring Retainer

4. If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.
5. Inspect the valve stem for damage. Rotate the valve and check the stem tip for eccentric movement. Move the valve up and down through normal travel in the valve guide and check the stem for binds. If the valve has been damaged, it will be necessary to remove the cylinder head and repair as outlined in Part 21-01.

Installation

1. Install a new valve stem seal using a plastic installation cap. Use the tool shown in Fig. 13 and the procedure given in Fig. 14. Install the valve spring, retainer and locks. Turn off the air and remove the air line and adapter.
2. Apply Lubriplate or equivalent to all contact surfaces of the cam follower and install in position. Install the spark plug. **Be sure that the affected lash adjuster has been collapsed and released before rotating the camshaft.**
3. Install the rocker arm cover following the information given in Fig. 11.

INTAKE MANIFOLD

Information necessary to properly remove and install the intake manifold is given in Figs. 16, 17 and 18).

The special tool required to remove and install the carburetor is illustrated in Fig. 15. Carburetor installation is shown in Fig. 16.

EXHAUST MANIFOLD

Information necessary to properly remove and install the exhaust manifold is given in Fig. 19.

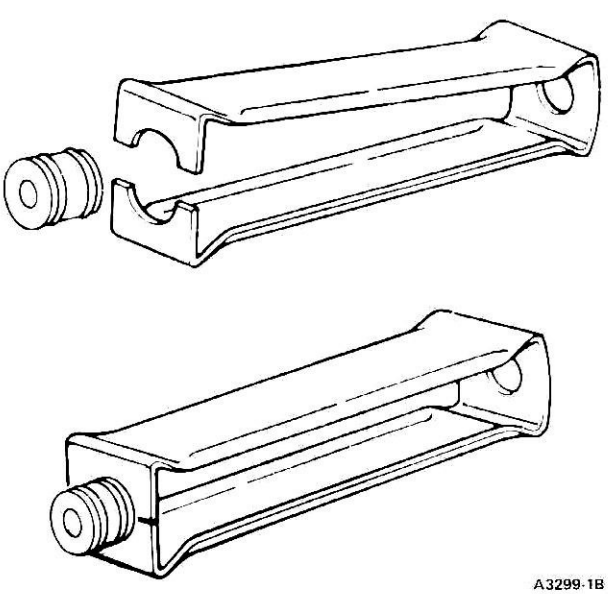
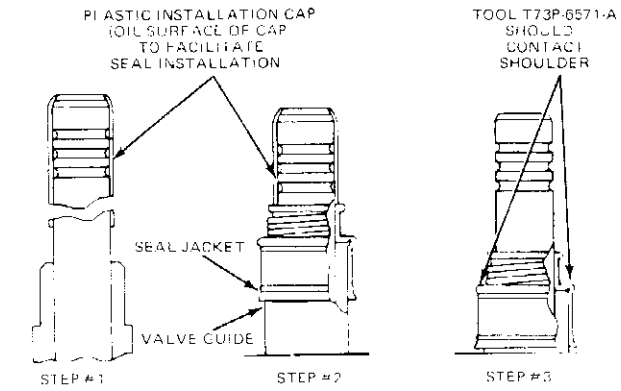


FIG. 13 Valve Stem Seal Installation Tool

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STEP #1 WITH VALVES IN HEAD, PLACE PLASTIC INSTALLATION CAP OVER END OF VALVE STEM.
STEP #2 START VALVE STEM SEAL CAREFULLY OVER CAP. PUSH SEAL DOWN UNTIL JACKET TOUCHES TOP OF GUIDE.
STEP #3 - REMOVE PLASTIC INSTALLATION CAP. USE INSTALLATION TOOL T73P-6571-A OR SCREWDRIVERS TO BOTTOM SEAL ON VALVE GUIDE.

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FIG. 14 Valve Stem Seal Installation

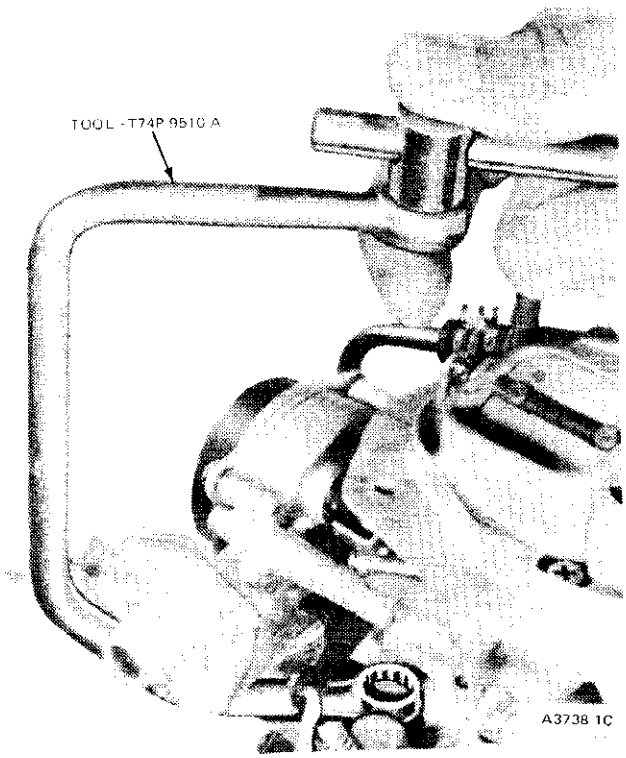


FIG. 15 Special Carburetor Wrench

CYLINDER HEAD

Information necessary to properly remove and install the cylinder head is given in Fig. 20. A disassembled view of the cylinder head is given in Fig. 42. Refer to the various other illustrations covering installation of the associated parts.

WATER PUMP

Provision for wrench clearance has been made in the timing belt inner cover, so only the outer cover must be removed in order to replace the water pump. Water pump and associated parts installation is illustrated in Fig. 21.

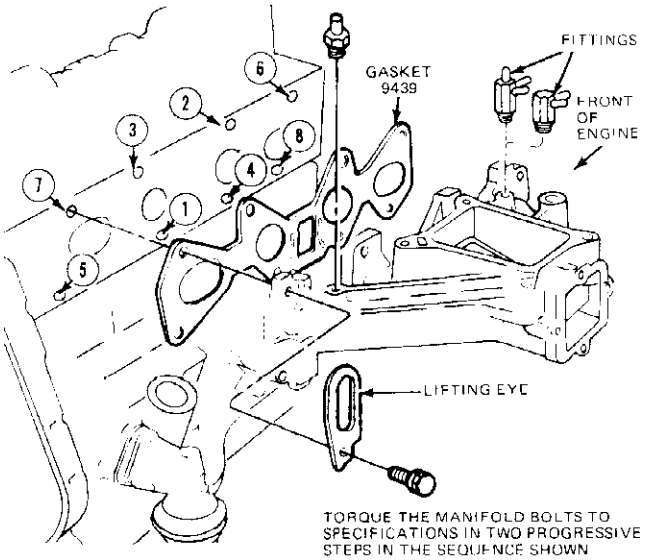


FIG. 16 Intake Manifold Installation

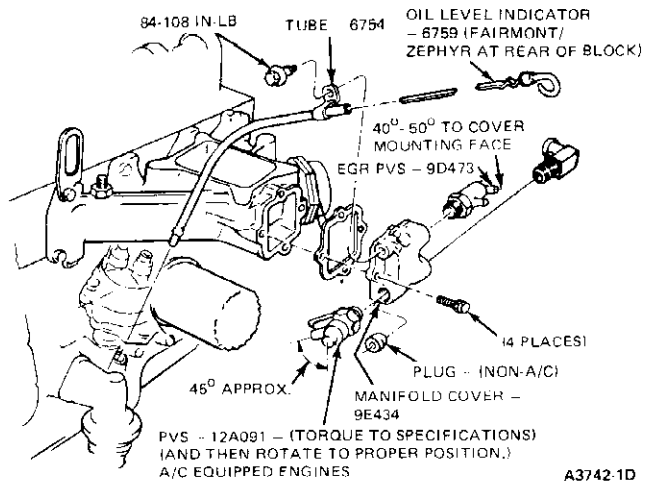


FIG. 17 Water Manifold Installation—Pinto/ Bobcat/Mustang II Shown

CYLINDER FRONT COVER, CAMSHAFT AND AUXILIARY SHAFT SEALS

The cylinder front cover, camshaft and the auxiliary shaft seals are replaced in the same manner with the same tools after the respective gear has been removed. **NOTE: Always use a new attaching bolt when replacing the camshaft sprocket or use new Teflon or equivalent sealing tape on the threads of the old bolt.**

Sprocket Removal And Installation

Fig. 22 shows the multi-purpose tool being used to pull the cam drive sprocket. This same tool is used in exactly the same manner to remove the auxiliary shaft sprocket.

Fig. 23 shows the same multi-purpose tool with the threaded puller insert removed, being used to hold the cam sprocket while the attaching bolt is installed and torqued. This is also typical of the auxiliary shaft sprocket installation.

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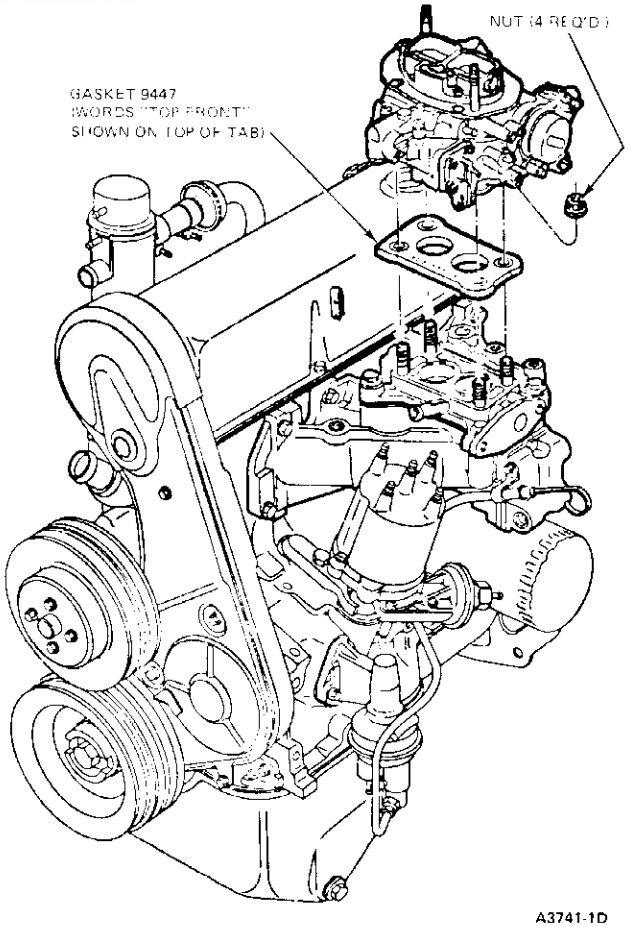


FIG. 18 Carburetor Installation

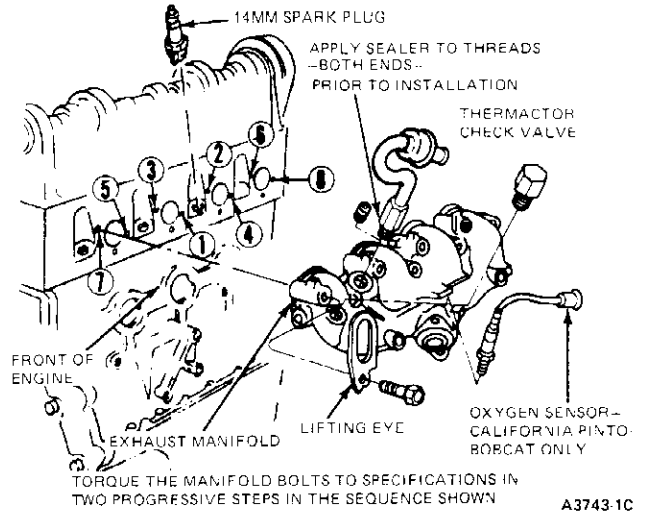


FIG. 19 Exhaust Manifold Installation

Fig. 24 shows the multi-piece tool used to pull the crankshaft drive sprocket off the crankshaft.

No special tool is required for installing the crankshaft sprocket on the crankshaft.

SEAL

Removal

One common seal removal tool is used to remove all the seals.

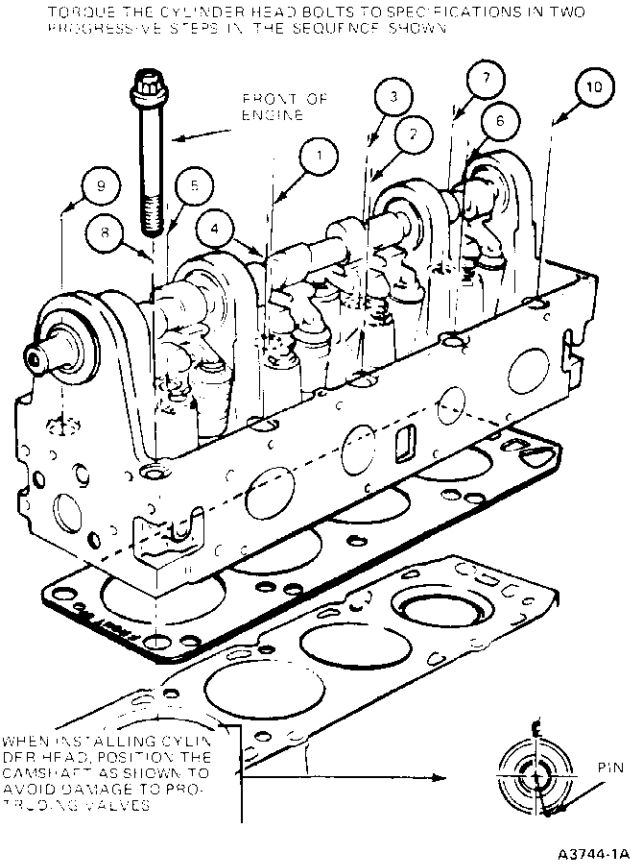


FIG. 20 Cylinder Head Installation

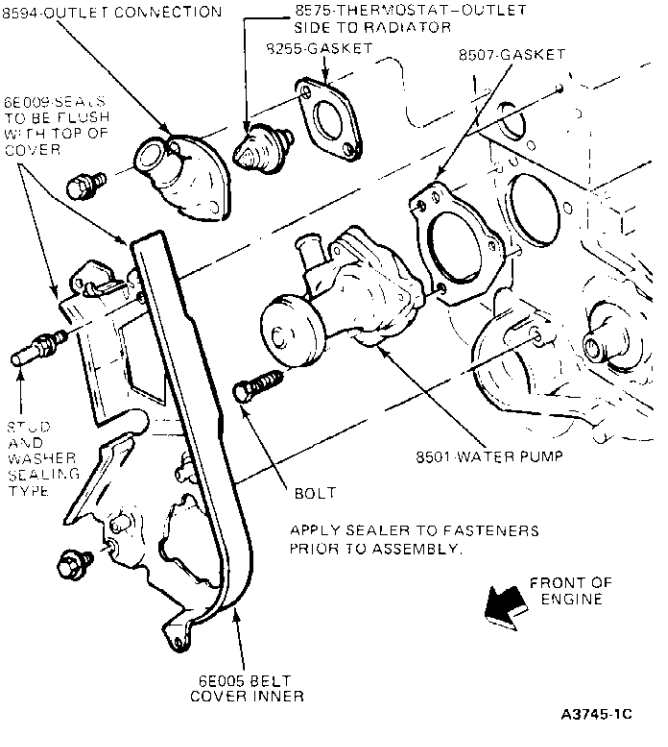


FIG. 21 Water Pump, Thermostat and Inner Timing Belt Cover Installation

Fig. 25 shows the tool being used to remove the camshaft seal. When positioning this tool, be sure that

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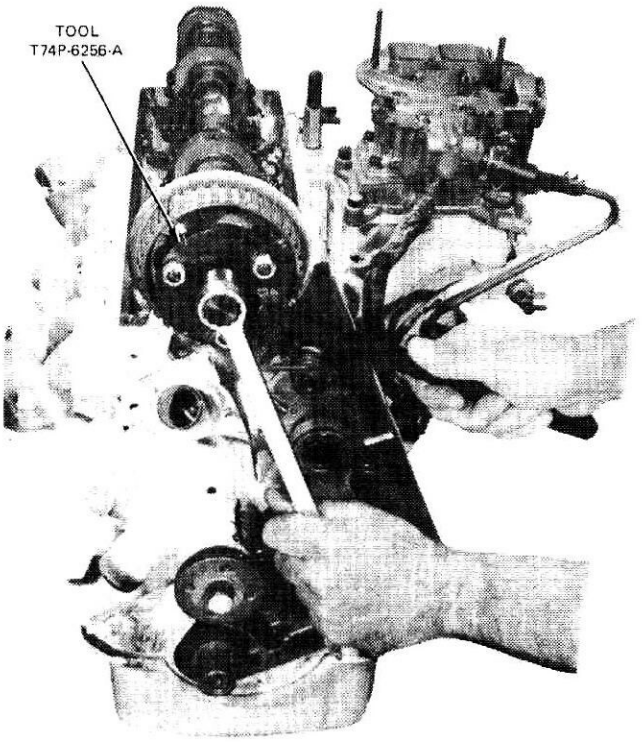


FIG. 22 Removing Cam or Auxiliary Shaft Sprocket

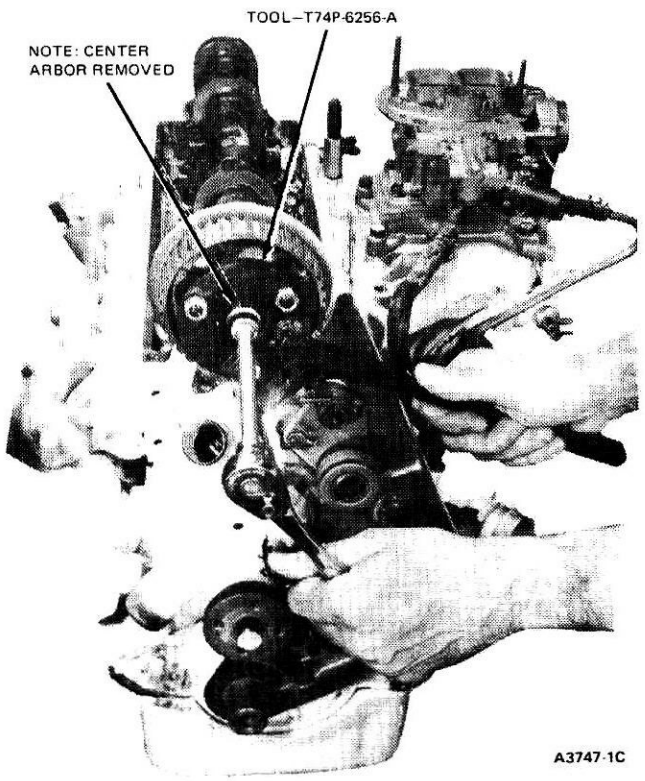


FIG. 23 Installing Cam or Auxiliary Shaft Sprocket

the jaws are gripping the thin edge of the seal very tightly before operating the jack-screw portion of the tool.



FIG. 24 Removing Crankshaft Sprocket

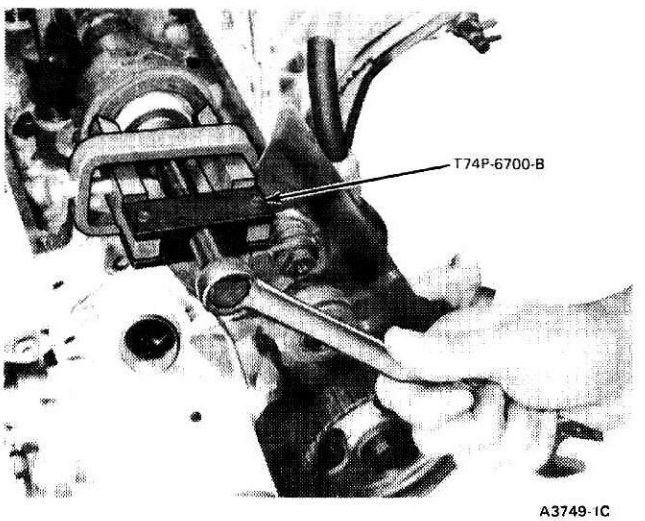


FIG. 25 Removing Cam or Auxiliary Shaft Seal

Fig. 26 shows the tool being used to remove the cylinder front cover seal.

Installation

One common tool with a stepped, threaded arbor is used to install all the seals. The tool acts as a press, using the internal threads of the various shafts as a pilot.

Fig. 27 shows the special tool being used to install the camshaft seal. This is typical of the other seal installations.

CAMSHAFT TIMING BELT

Installation information for the complete cam drive mechanism is given in Fig. 30. Associated parts are illustrated in Fig. 42 and 43.

TIMING BELT TENSIONER

Illustrated instructions are given in Fig. 30 covering installation of the timing belt tensioner. A close-up view of the tensioner assembly is shown in Fig. 33.

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AUXILIARY SHAFT AND BEARINGS

Refer to Fig. 31 for installation information on the auxiliary shaft.

If necessary, the auxiliary shaft bearings can be removed using the slide-hammer Tool T58L-101-A.

Install new bearings using a driver, Tool T57T-7003-A. Be sure to align the oil holes in the bearings with those in the block when installing.

CYLINDER FRONT COVER

The front seal has been designed so that it is not necessary to remove the cylinder front cover with the engine in the chassis.

When disassembling the engine, first remove the front seal from the cover while the cover is still on the engine, using the tool and procedure shown in Fig. 26.

When assembling the engine, install the cover on the engine without the seal and then use the special tool shown in Fig. 27 to press the seal into place. This will avoid damage to the seal.

Before finally adjusting the cover into position and torquing the attaching bolts, use the tool shown in Fig. 33 to position the cover in relation to the crankshaft. Torque the bolts to specifications with this tool in place. This will assure that the timing belt does not interfere with the front cover when operating.

Fig. 34 shows the method of overlapping the front and side pan gaskets when assembling.

Refer to Fig. 36 as a guide for further assembly information.

FLYWHEEL

Information on installation of both automatic and manual transmission flywheels is given in Fig. 35.

CLUTCH PILOT BEARING

This engine is equipped with a sealed roller bearing clutch pilot (Fig. 33).

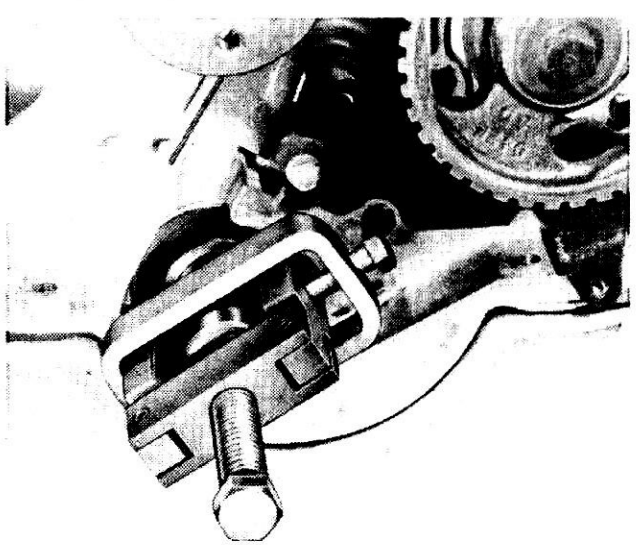


FIG. 26 Removing Cylinder Front Cover Seal

Inspection procedures are outlined under Flywheel Cleaning and Inspection in Part 21-01.

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Volume One, Group 16—Clutch.
2. Using Tools T59L-100-B and T58L-101-A, remove the pilot bearing (Fig. 28).

Installation

1. Using Tool T71P-7137-C and T71P-7137-M, install the pilot service bearing (Fig. 29).
2. Install the clutch pressure plate, disc, and the transmission following the procedure in Volume One, Group 16—Clutch.

OIL PAN

Oil pan removal and installation instructions are given in Fig. 35.

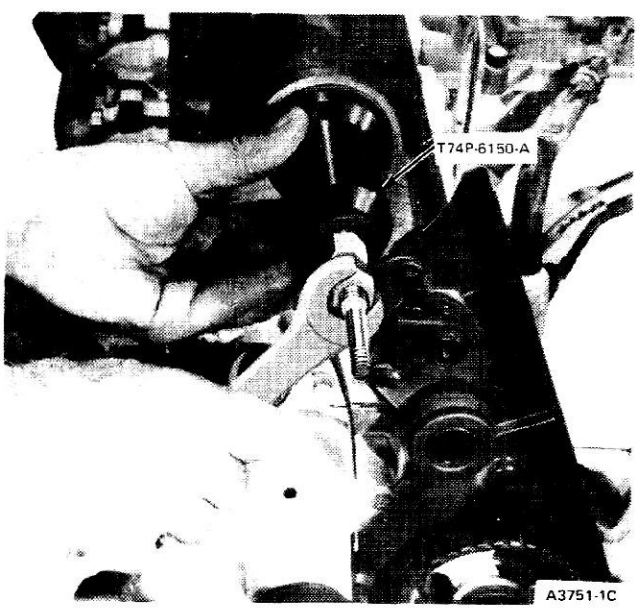


FIG. 27 Installing Camshaft Seal—Typical of Crankshaft and Auxiliary Shaft Seal Installation

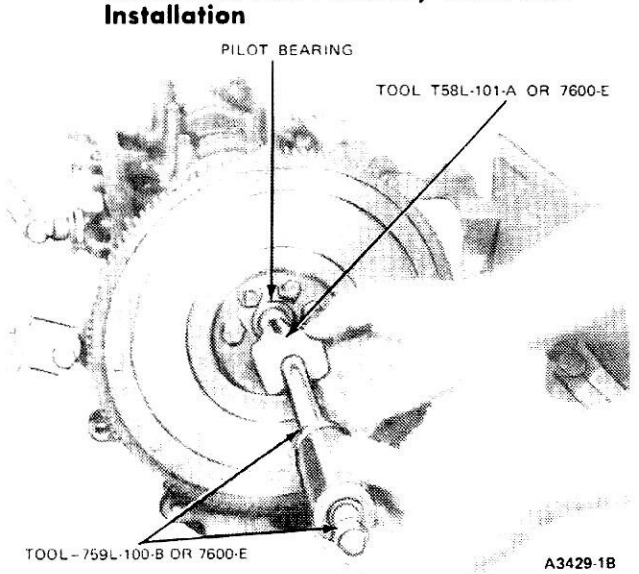


FIG. 28 Removing Pilot Bearing—Typical

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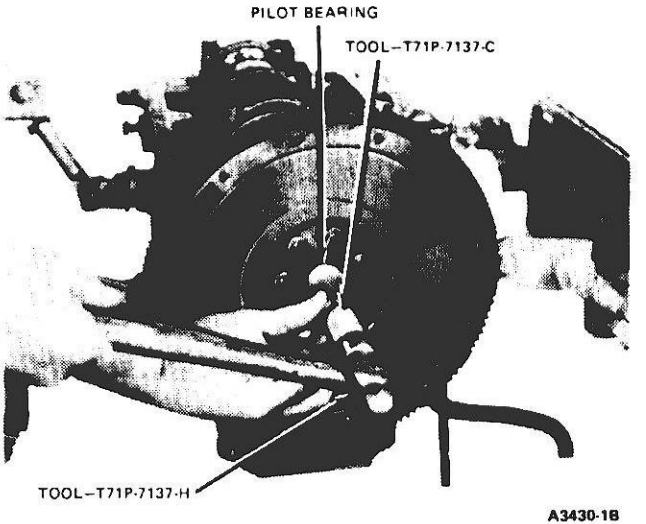
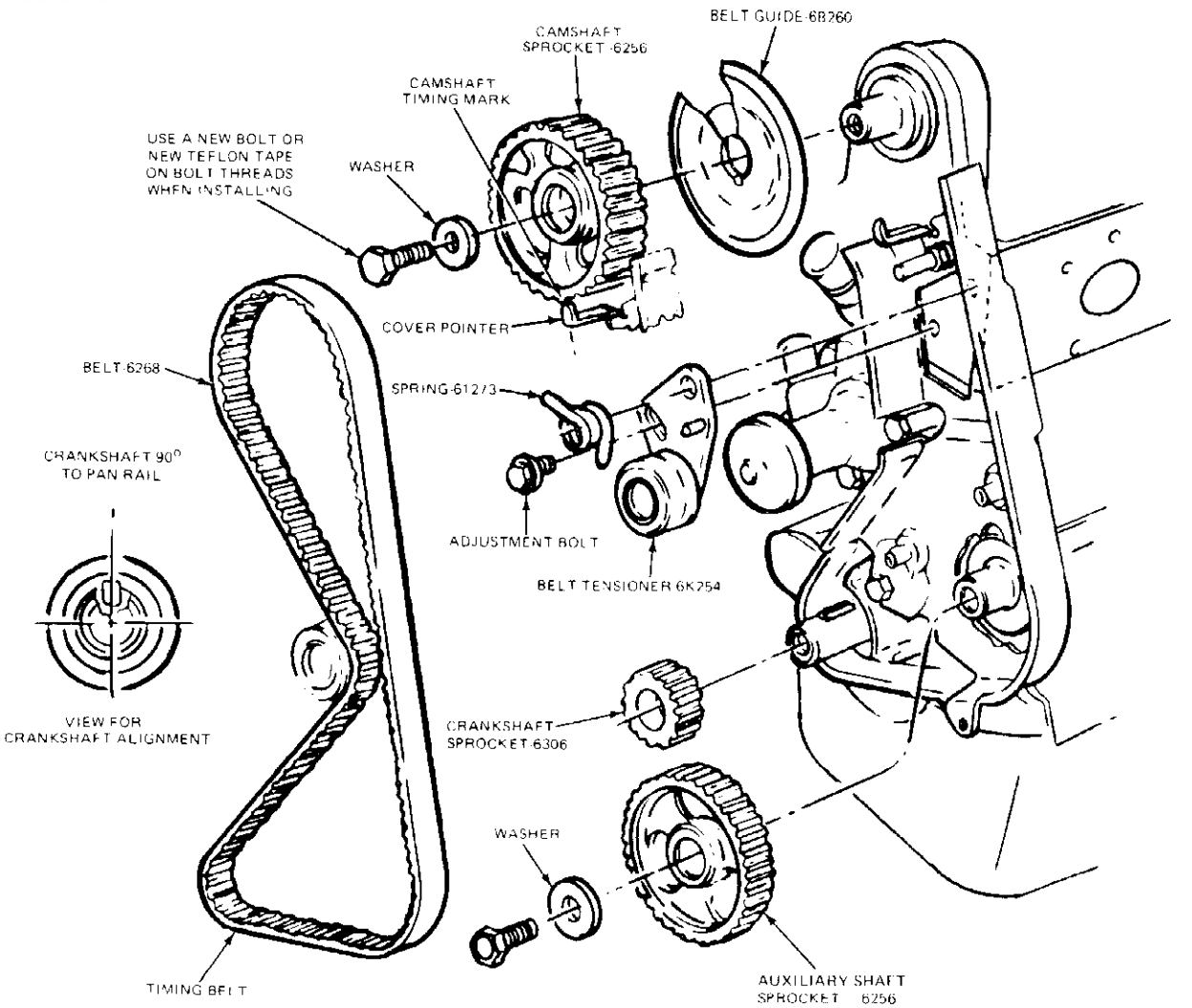
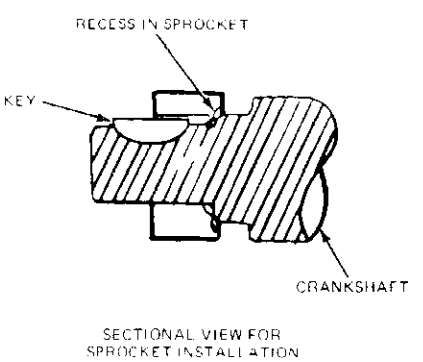


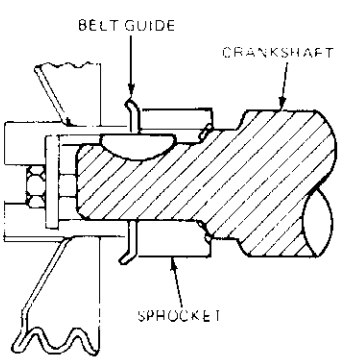
FIG. 29 Installing Clutch Pilot Bearing—Typical

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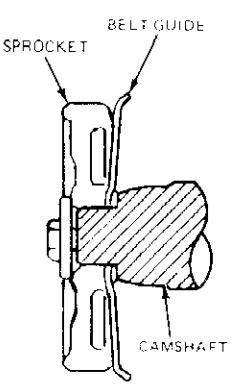




SECTIONAL VIEW FOR SPROCKET INSTALLATION



SECTIONAL VIEW FOR CRANKSHAFT BELT GUIDE INSTALLATION

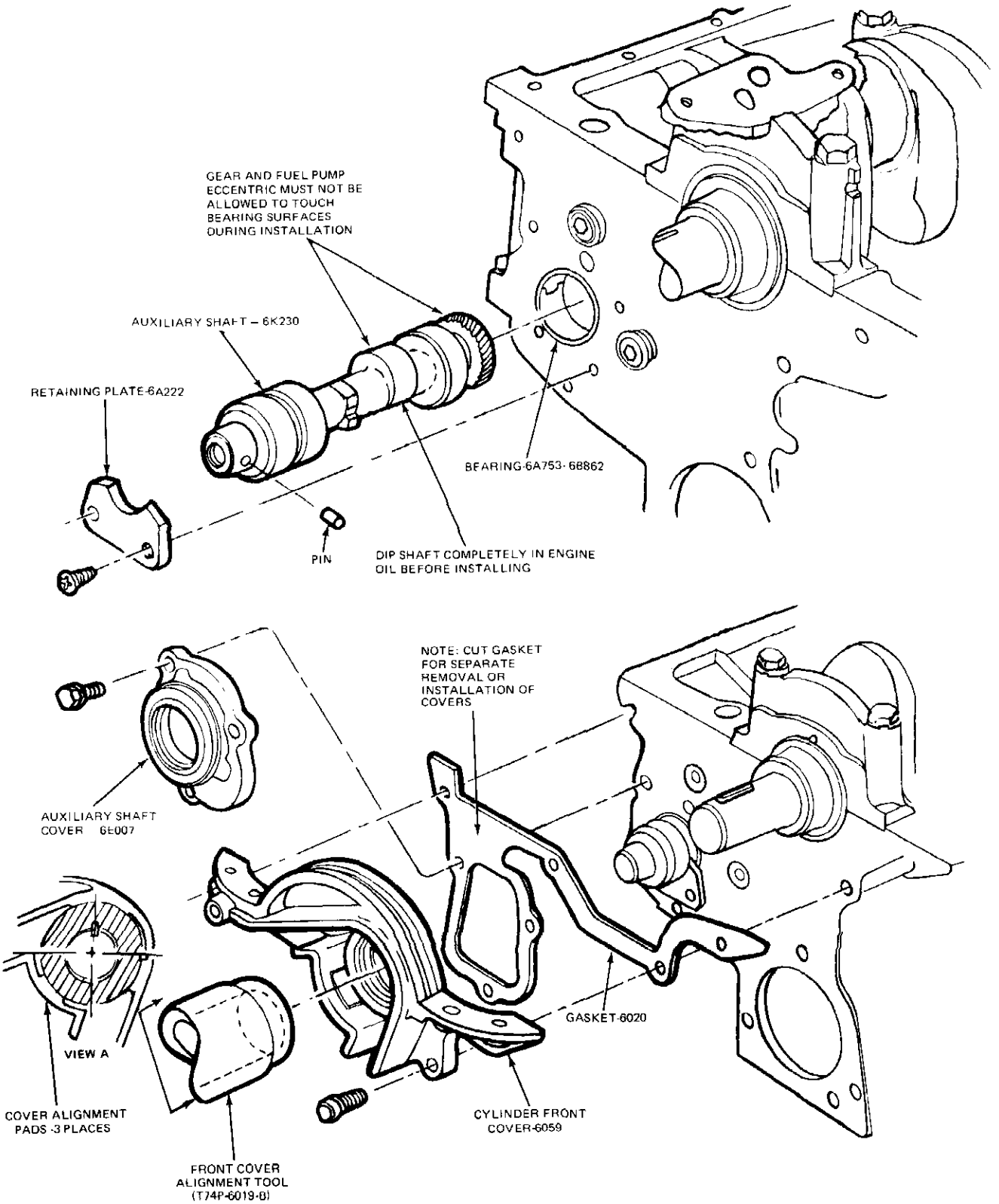


SECTIONAL VIEW FOR CAMSHAFT BELT GUIDE INSTALLATION

A3752-2B

FIG. 30 Installing Cam Drive Belt, Sprockets and Tensioner

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A3754-2B

FIG. 31 Installing Auxiliary Shaft and Bearings and Cylinder Front Cover

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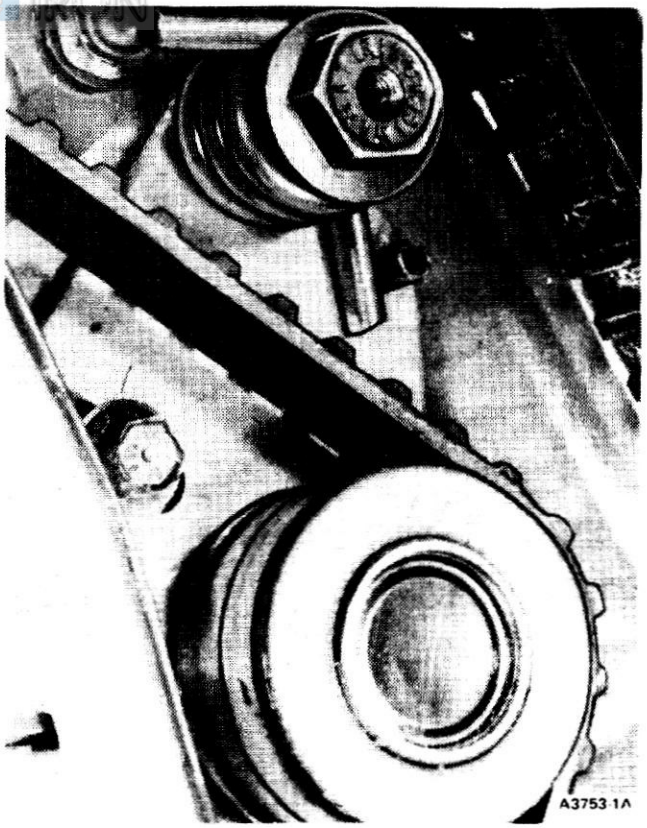


FIG. 32 Timing Belt Tensioner

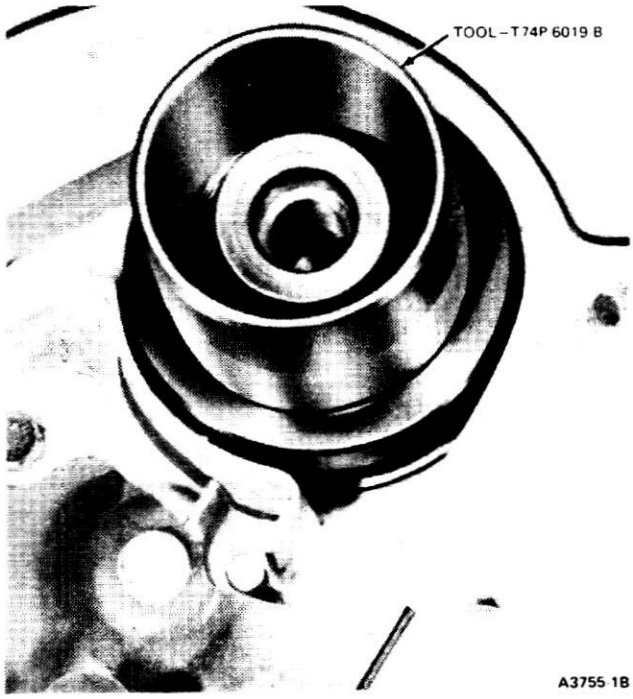


FIG. 33 Positioning Front Cover

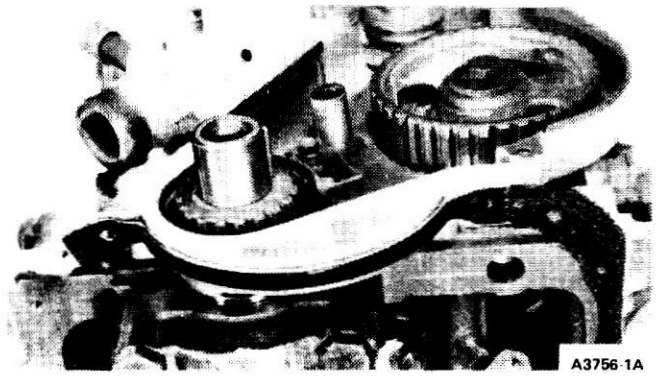


FIG. 34 Gasket Installation

OIL PUMP

Oil pump installation information is shown in Fig. 36. Prime the oil pump with engine oil when making final installation.

CRANKSHAFT REAR OIL SEAL

A split lip-type crankshaft rear oil seal is used on this engine. Installation information is given in Fig. 38.

MAIN BEARINGS

Selective-fit main bearings are used in this engine. Number three journal is the thrust bearing.

Main bearing installation information is given in Fig. 38.

Check crankshaft end play according to the procedure given in Part 21-01, under Diagnosis and Testing—Crankshaft End Play.

Fit replacement main bearings according to the procedure given in Part 21-01 under Overhaul—Fitting Main or Connecting Rod Bearings With Plastigage.

CONNECTING ROD BEARINGS

The connecting rod bearings are selective-fit. Refer to procedures under Overhaul—Fitting Main And Connecting Rods With Plastigage, Part 21-01.

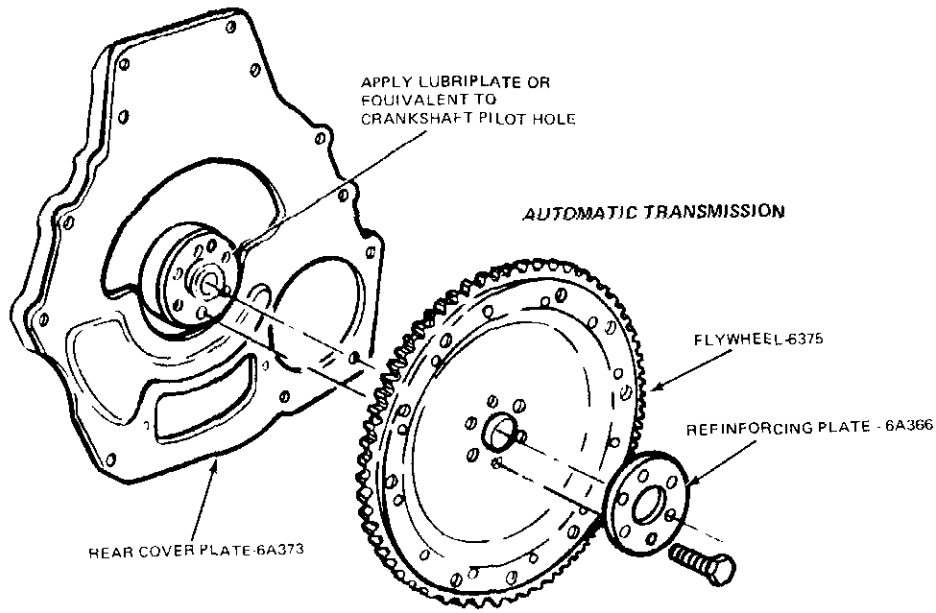
PISTONS AND CONNECTING RODS

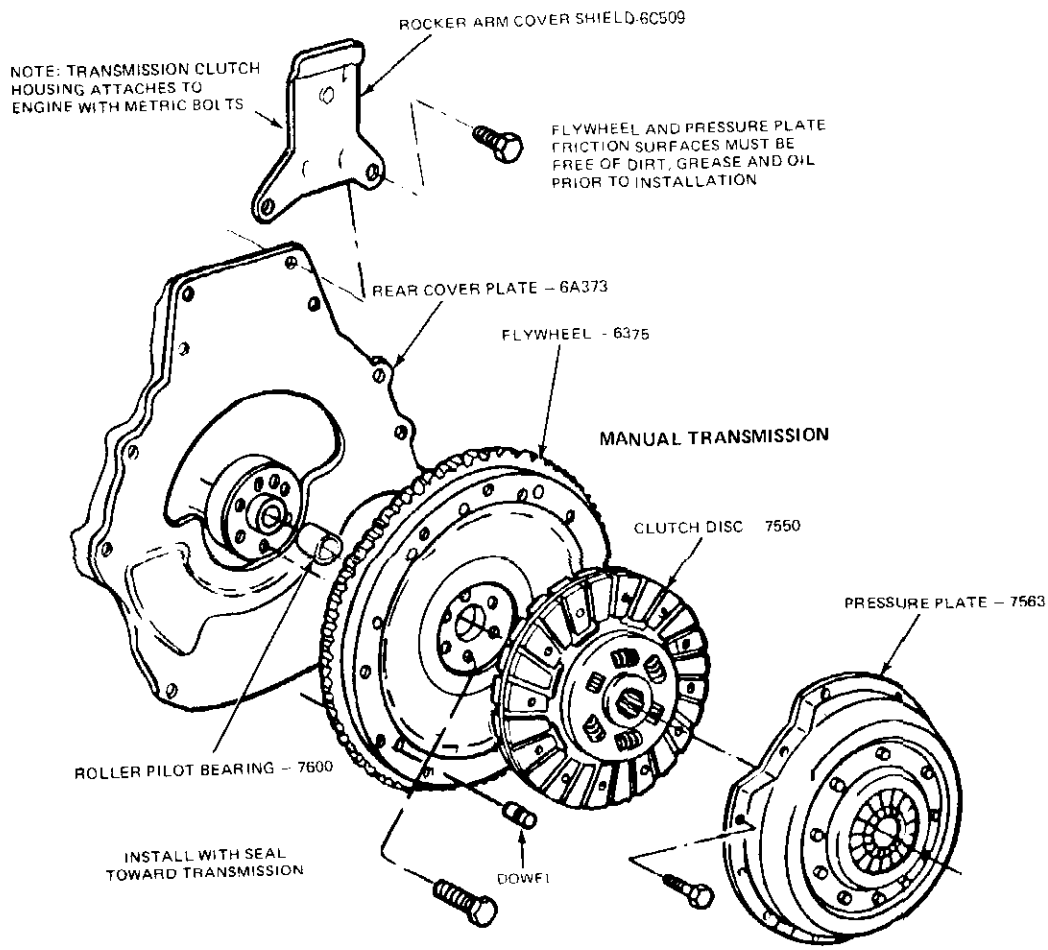
Installation information on the connecting rods and pistons is given in Fig. 40.

OIL FILTER

Installation information for the oil filter, oil pressure sender, water temperature sender and the fuel pump are shown in Fig. 41.

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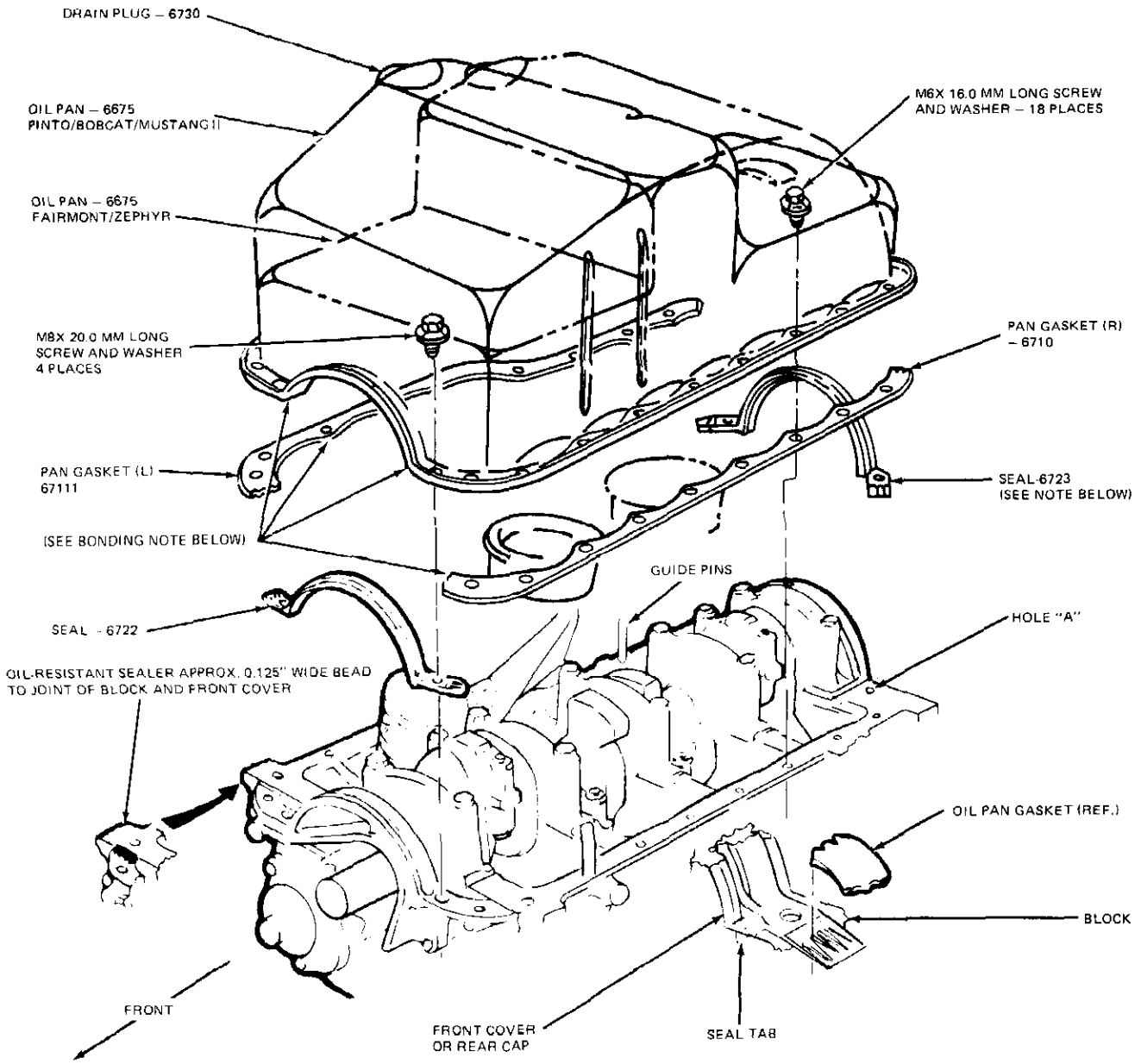




A3757 2D

FIG. 35 Flywheel Installation

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1. APPLY GASKET ADHESIVE EVENLY TO OIL PAN FLANGE AND TO PAN SIDE GASKETS. ALLOW ADHESIVE TO DRY PAST WET STAGE, THEN INSTALL GASKETS TO OIL PAN.
2. APPLY SEALER TO JOINT OF BLOCK AND FRONT COVER. INSTALL SEALS TO FRONT COVER AND REAR BEARING CAP AND PRESS SEAL TABS FIRMLY INTO BLOCK. BE SURE TO INSTALL THE REAR SEAL BEFORE THE REAR MAIN BEARING CAP SEALER HAS CURED.
3. POSITION 2 GUIDE PINS AND INSTALL THE OIL PAN. SECURE THE PAN WITH THE FOUR M8 BOLTS SHOWN ABOVE.
4. REMOVE THE GUIDE PINS AND INSTALL AND TORQUE THE EIGHTEEN M6 BOLTS, BEGINNING AT HOLE "A" AND WORKING CLOCKWISE AROUND THE PAN.

A3759-2C

FIG. 36 Oil Pan Installation

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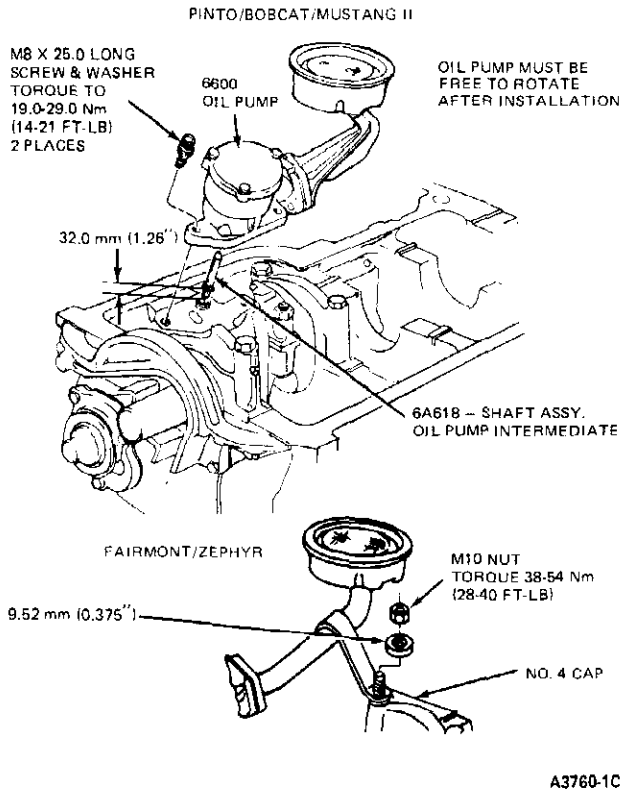
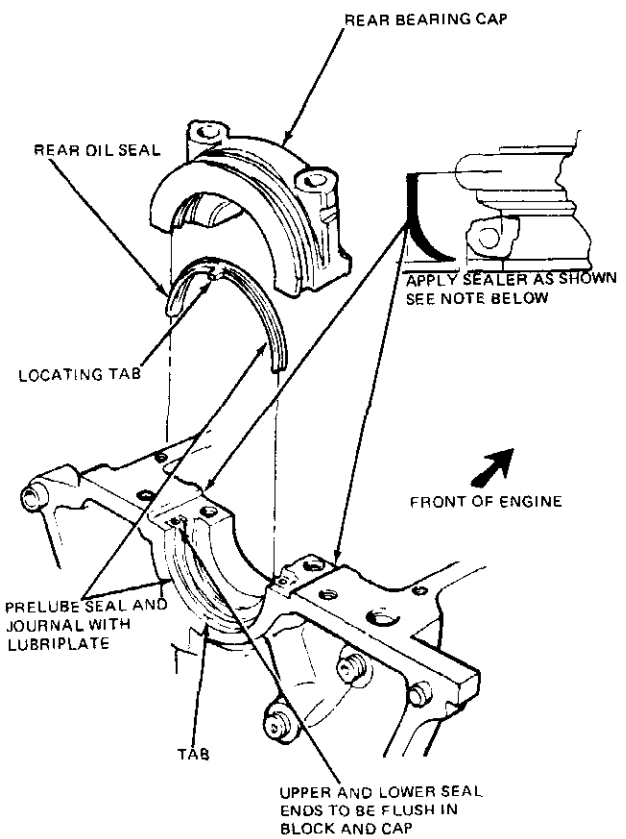


FIG. 37 Oil Pump Installation

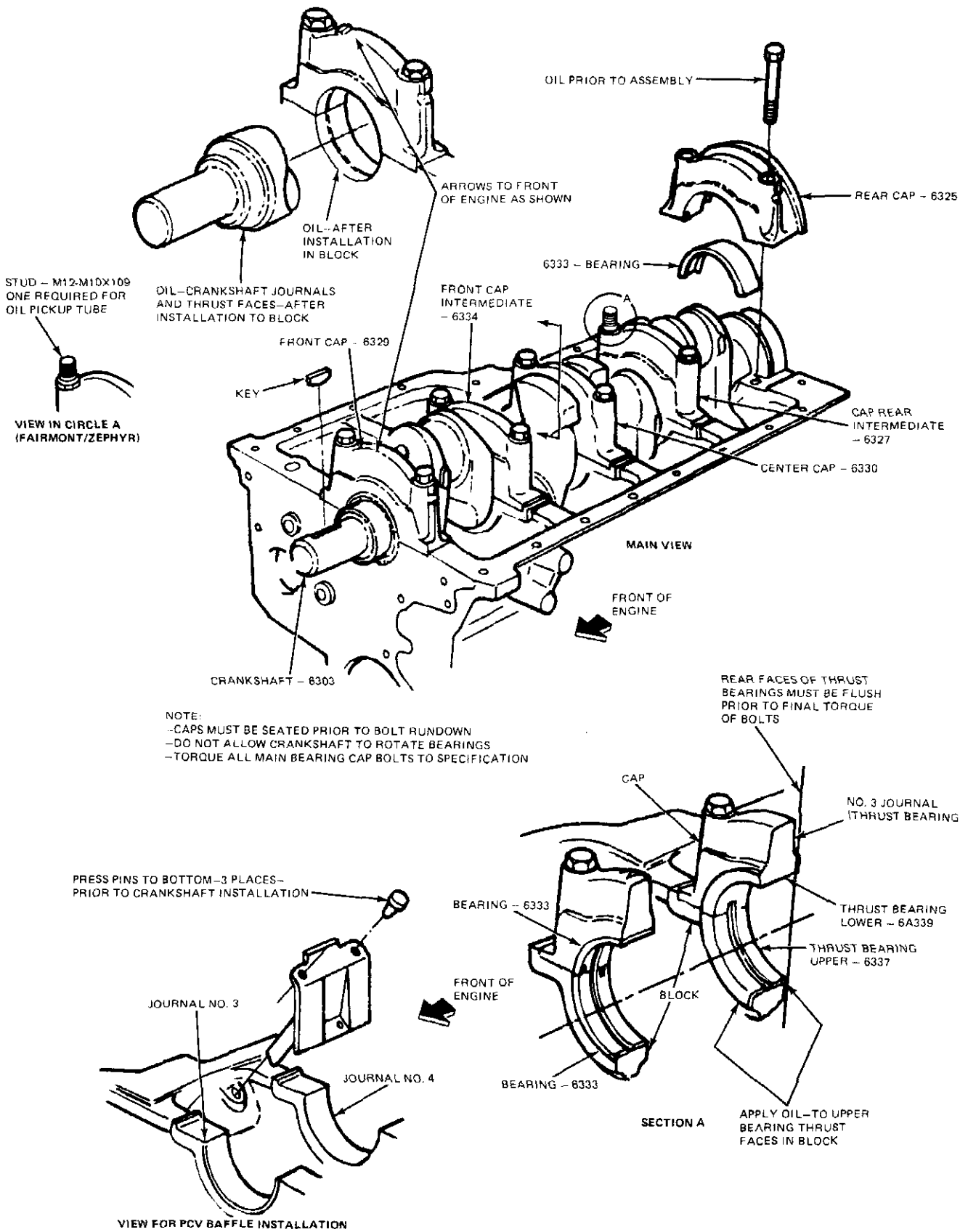


SEALER NOTE: CLEAN THE AREA WHERE SEALER IS TO BE APPLIED BEFORE INSTALLING THE SEALS. USE FORD SPOT REMOVER B7A-19521-A OR EQUIVALENT. *AFTER THE SEALS ARE IN PLACE, APPLY A 1/16 INCH* BEAD OF C3AZ-19562-A OR -B SEALER AS SHOWN. SEALER MUST NOT CONTACT SEALS.

A3761-1C

FIG. 38 Rear Oil Seal Installation

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A3762-2C

FIG. 39 Installing Crankshaft and Main Bearings

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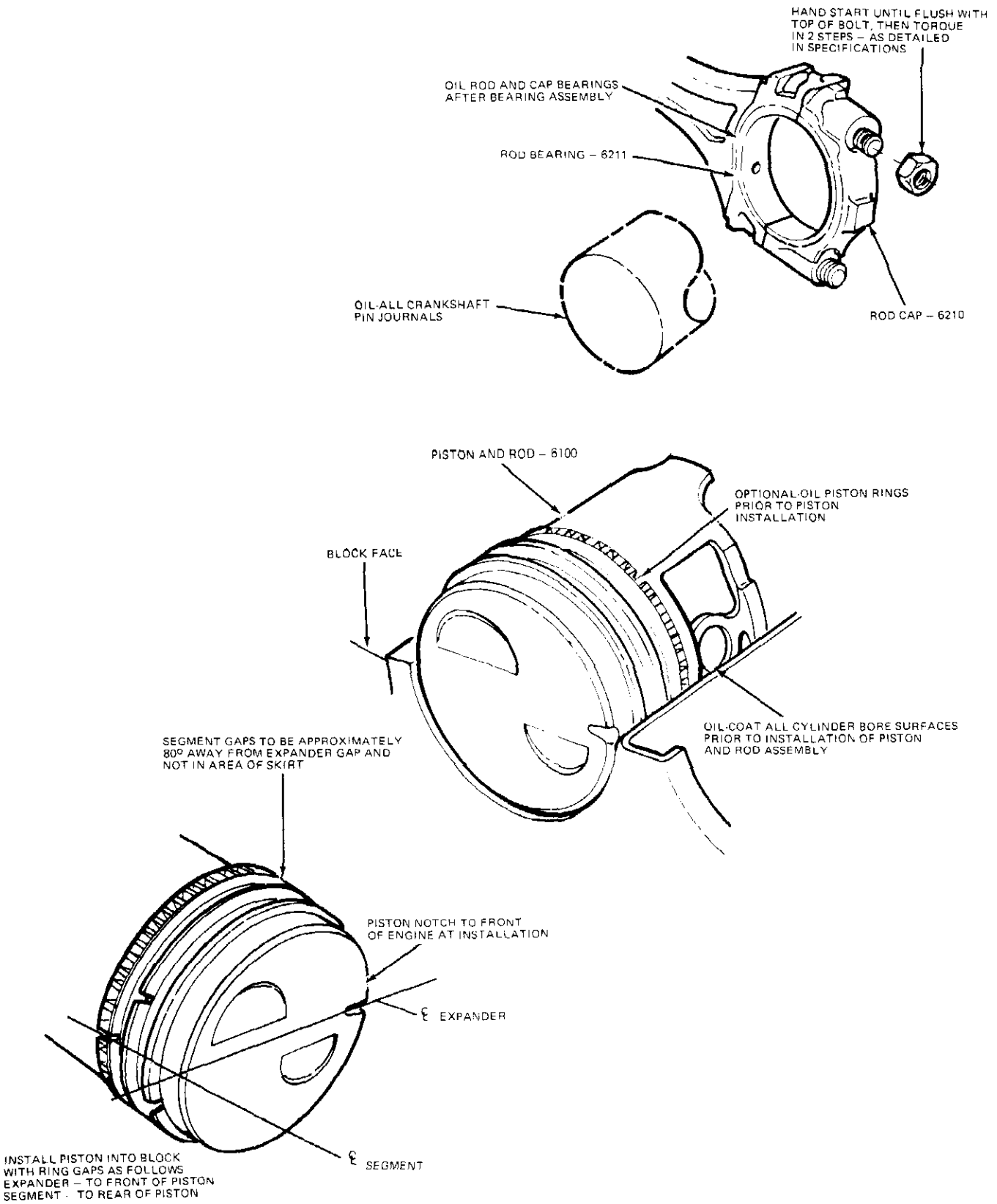


FIG. 40 Installing Pistons, Rings and Connecting Rods

A3763-2C

FIG. 40 Installing Pistons, Rings and Connecting Rods

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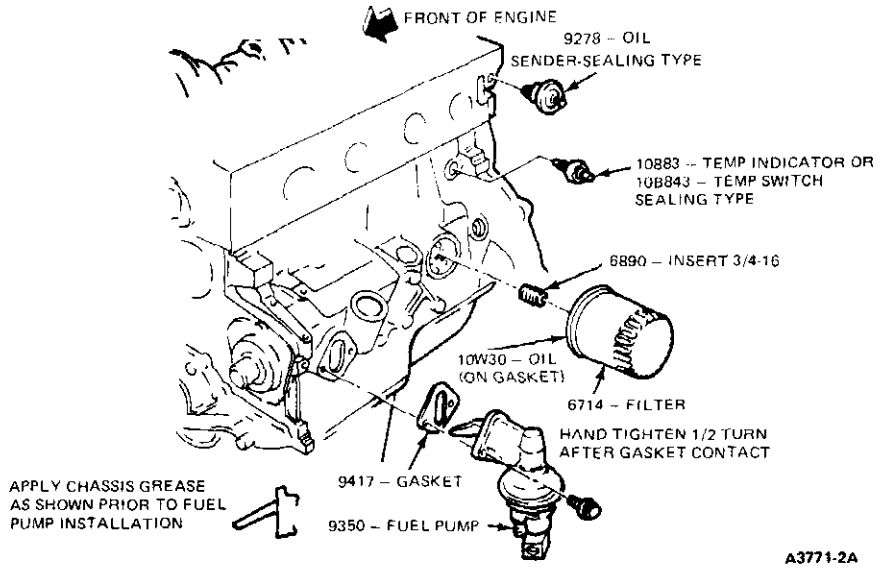


FIG. 41 Installing Oil Filter, Sending Units and Fuel Pump

DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD

Information for disassembly and assembly of the cylinder head is contained in Fig. 20, 42 and 43.

When disassembling, mark the cam followers, lash adjusters and valves so that they can be installed in the original positions.

If the cylinder head is being repaired, remove the deposits from the combustion chambers with a scraper and wire brush before removing the valves.

If necessary to replace the cam bearings, use the tool system shown in Fig. 44.

The assembled height of the valve spring can be checked as shown in Fig. 44.

If the assembled height is greater than specified, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes. This could lead to spring breakage and worn cam lobes.**

When assembling the cylinder head, apply heavy SE oil to the valve stems, cam bearings and like parts. Apply Lubriplate or equivalent to the wiping surfaces of the cam and cam followers.

OIL PUMP

Disassembly

1. Remove the oil inlet tube from the oil pump and remove the gasket.
2. Remove the cover attaching screws, then remove the cover. Remove the inner rotor and shaft assembly, then remove the outer race.
3. Drill a small hole and insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

Assembly

The oil pump assembly is shown in Fig. 46.

1. Oil all parts thoroughly.
2. Install the oil pressure relief valve plunger, spring and a new cap.
3. Install the outer race and the inner rotor and shaft assembly. **Be sure the dimple (identification mark) on the outer race is facing outward and on same side as identification mark on rotor. The race rotor and shaft and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.**

   Install the cover and torque the cover attaching screws to specifications.
4. Position a new gasket and the oil inlet tube on the oil pump and install the attaching bolts.

PISTON AND CONNECTING ROD

Disassembly

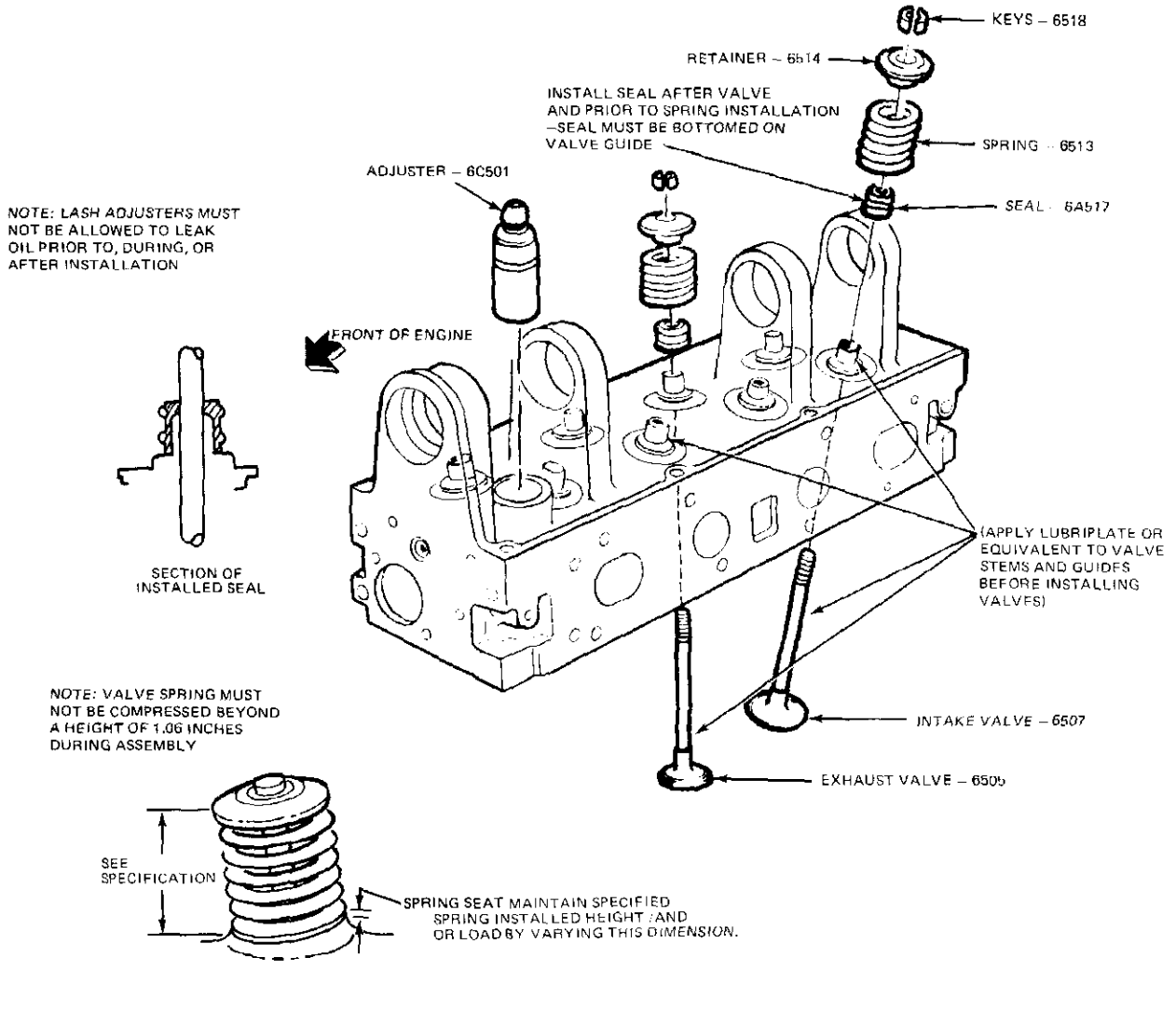
1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the piston and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Press the piston pin from the piston and connecting rod. Remove the piston rings.

Assembly

Check the fit of a new piston in the cylinder bore before assembling the piston and pin to the connecting rod.

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications.

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A3765-2D

FIG. 42 Installing Valves, Springs, Seals, Retainers and Lash Adjusters

1. Apply a light coat of engine oil, SE, to all parts. Assemble the piston to the connecting rod with the boss on the side of the connecting rod and the arrow in the piston positioned as shown in Fig. 47.
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Press the piston pin through the piston and connecting rod until the pin is centered in the piston.
3. Check the end gap and spacing (Fig. 40) of all piston rings. They must be within specifications.
4. Check the ring side clearance as outlined in Part 21-01.
5. Be sure the bearing inserts and the bearing bore in the connecting rod and cap is clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting the slots provided.

   Make certain lock slots in cap are on the same side of bore as the lock slot in rod. Avoid nicking crank pin journals during rod installation.

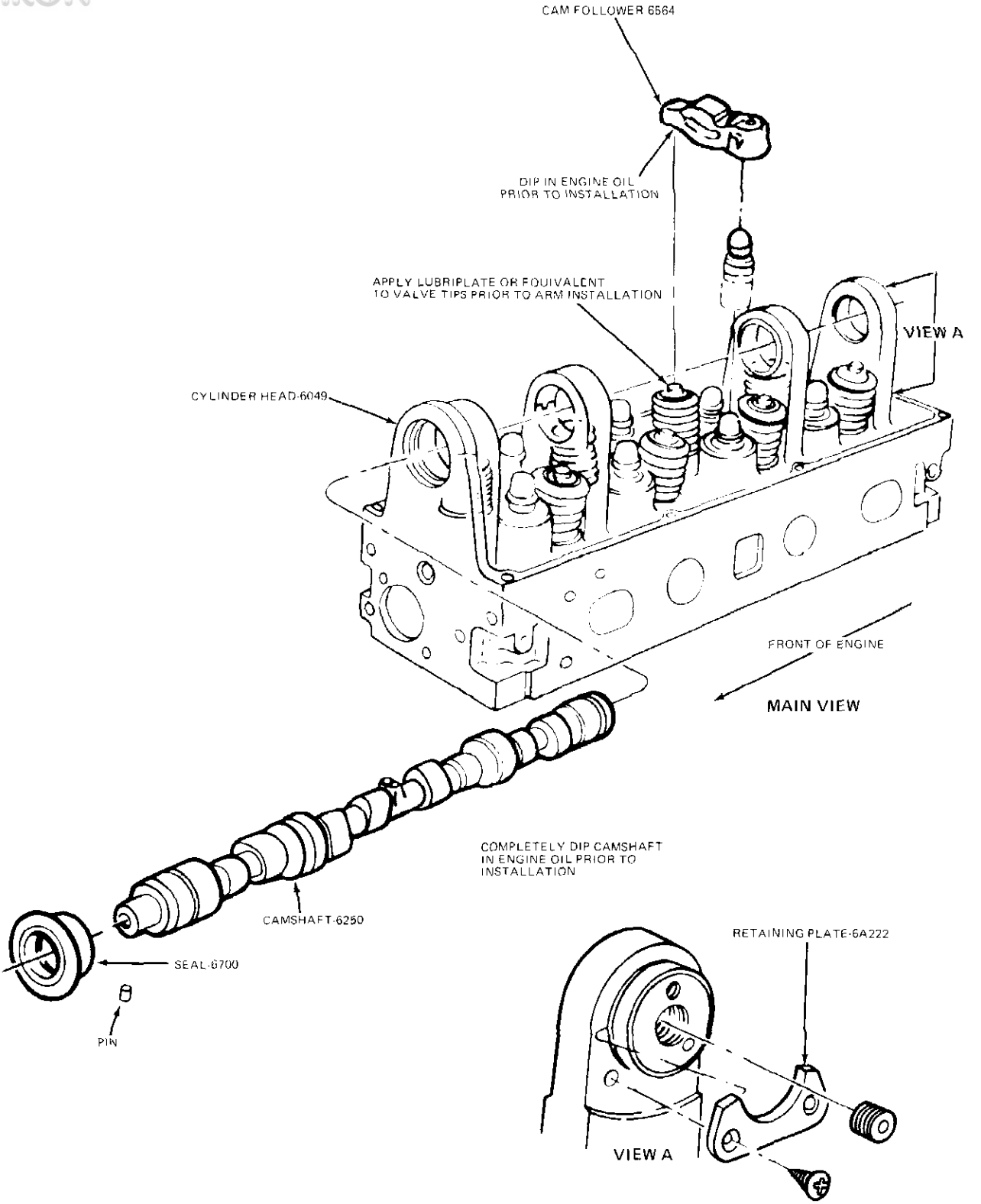
HYDRAULIC LASH ADJUSTER

Two types of hydraulic lash adjusters are used. Type I is shown in Fig. 48. Type II in Fig. 49.

Both lash adjusters are assembled with a simple crimped collar which snaps into a groove on the outside body. This collar can be removed and re-installed as necessary without damaging it.

Use the hydralic tappet leakdown tester (Part 21-01) to fill the lash adjusters with test fluid.

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A3764-2D

FIG. 43 Installing Camshaft

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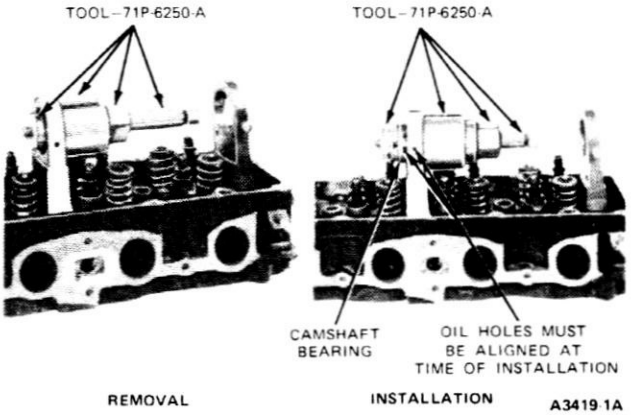


FIG. 44 Removing or Installing Camshaft Bearings—Typical

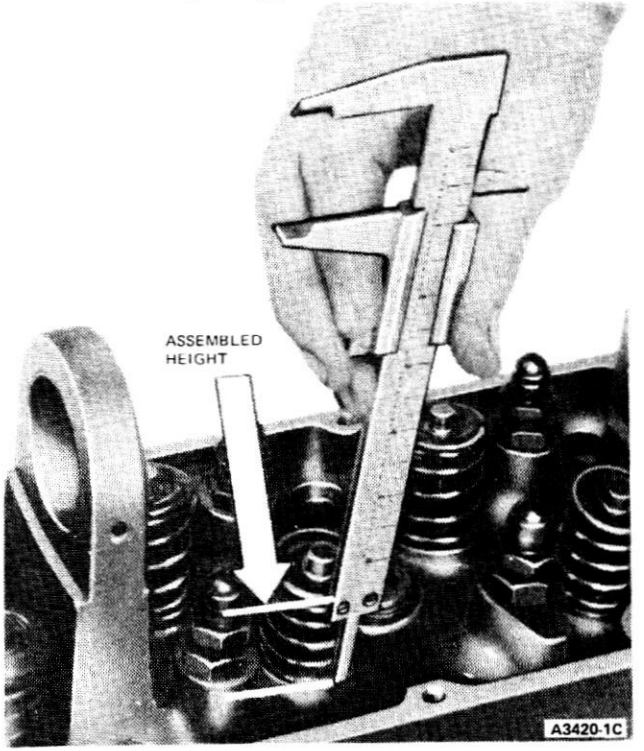


FIG. 45 Checking Valve Spring Assembled Height

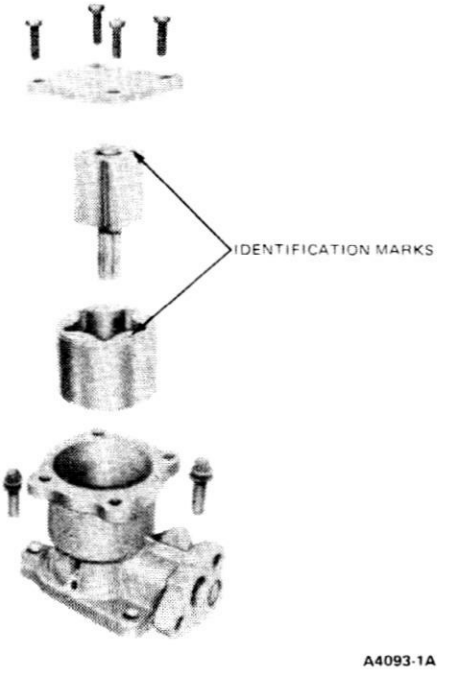


FIG. 46 Oil Pump

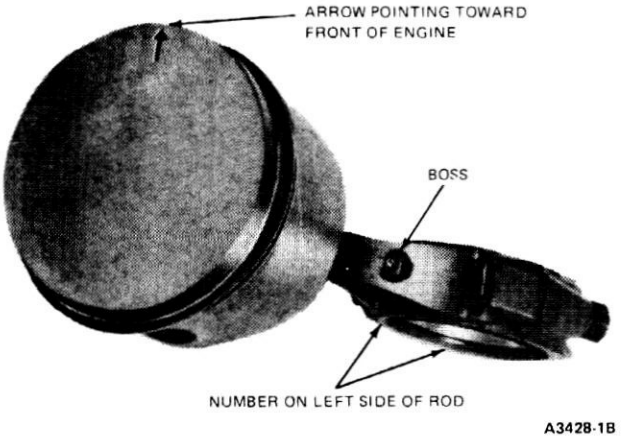


FIG. 47 Correct Piston and Rod Position

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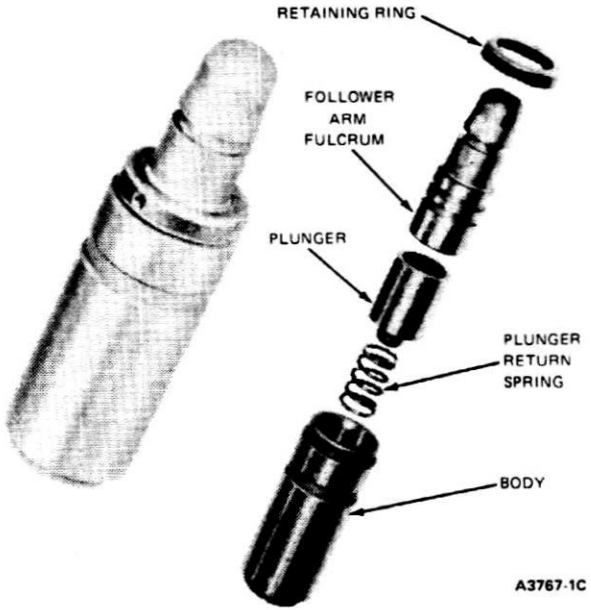


FIG. 48 Type I Lash Adjuster

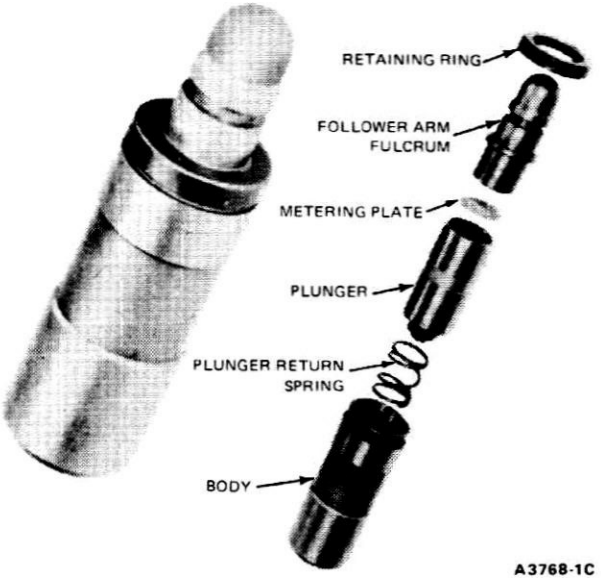


FIG. 49 Type II Lash Adjuster

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SPECIAL TOOLS

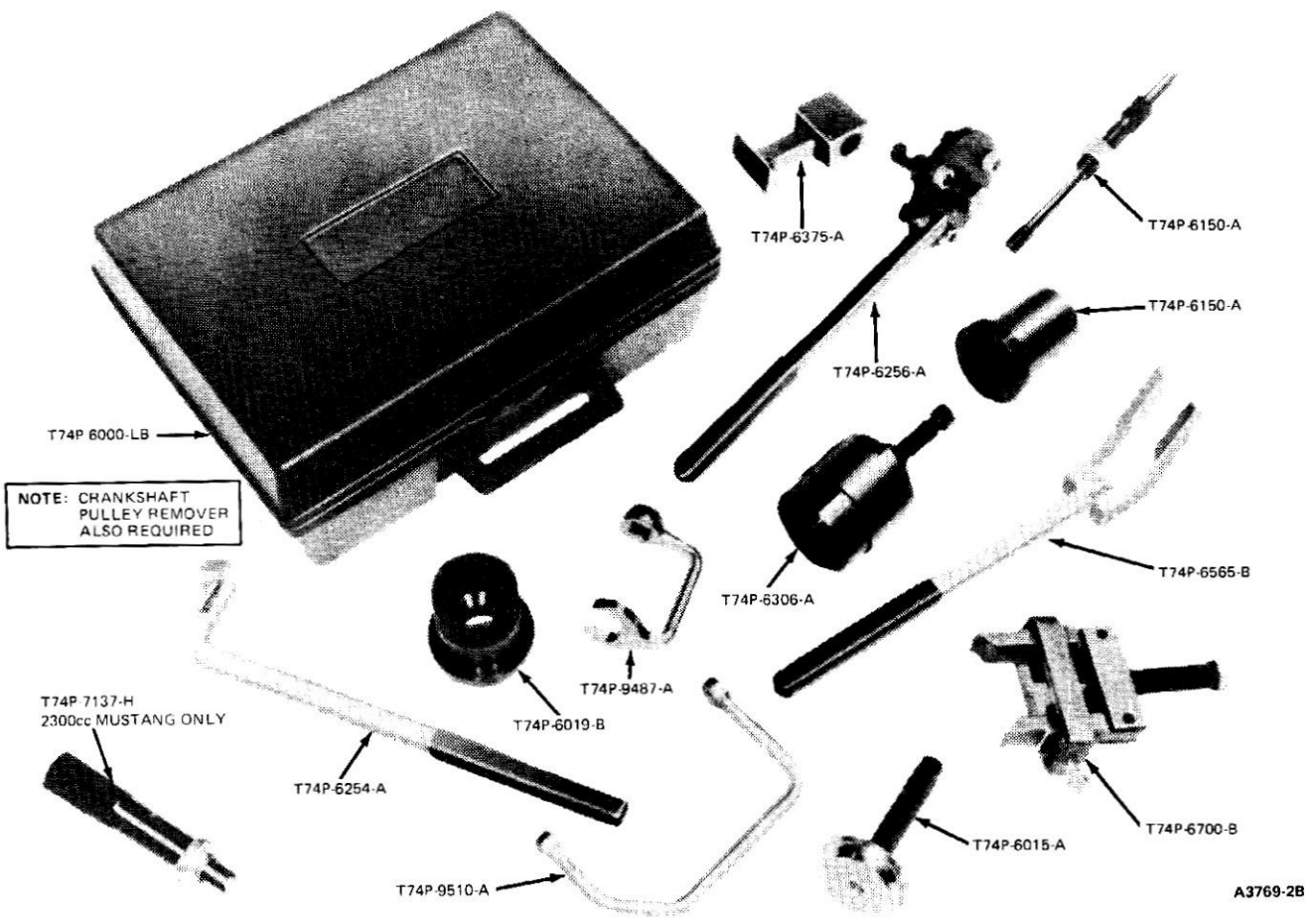


FIG. 50 Special Tool Kit 2.3L I-4 Engine

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DETROIT IRON

SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	2.3L
NUMBER OF CYLINDERS	4
BORE AND STROKE	3.78 x 3.126
FIRING ORDER	1-3-4-2
OIL PRESSURE (Hot @ 2000 RPM)	40-60
DRIVE BELT TENSION	(1)

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	59.8-62.8
VALVE GUIDE BORE DIAMETER	0.3433-0.3443
VALVE SEATS	
Width - Intake	0.060-0.080
Width - Exhaust	0.070-0.090
Angle	45°
Runout Limit (T.I.R. Max.)	0.0016
VALVE ARRANGEMENT (Front to Rear)	E-I-E-I-E-I-E-I
VALVE LASH ADJUSTER BORE DIAMETER	0.8430-0.8449
VALVE STEM-TO-GUIDE CLEARANCE	
Intake	0.0010-0.0027
Exhaust	0.0015-0.0032
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	1.73-1.74
Exhaust	1.49-1.51
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std.)	
Intake	0.3416-0.3423
Exhaust	0.3411-0.3418
0.003 Oversize	
Intake	0.3446-0.3453
Exhaust	0.3441-0.3448
0.015 Oversize	
Intake	0.3566-0.3573
Exhaust	0.3561-0.3568
0.030 Oversize	
Intake	0.3716-0.3723
Exhaust	0.3711-0.3718
VALVE SPRINGS	
Compression Pressure (Lb. @ Spec. Length)	71-79 @ 1.56 180-198 @ 1.16
Free Length (Approximate)	1.82
Assembled Height	1-17/32 - 1-19/32
Service Limit	10% Pressure Loss @ Spec. Length
Out Of Square Limit	5/64 (0.078)
ROCKER ARM/CAM FOLLOWER:	
Ratio	1.64:1
VALVE TAPPET, LIFTER OR ADJUSTER	
Diameter (Std.)	0.8422-0.8427
Clearance To Bore	0.0007-0.0027
Service Limit	0.005
Hydraulic Leakdown Rate (2)	2-8 Seconds
Collapsed Tappet Gap - Allowable	0.035-0.055 @ Cam
Desired	0.040-0.050 @ Cam

CAMSHAFT	
LOBE LIFT	
Intake	0.2437
Exhaust	0.2437
Allowable Lobe Lift Loss	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.3997
Exhaust	0.3997
END PLAY	0.001-0.007
Service Limit	0.009
JOURNAL TO BEARING CLEARANCE	0.001-0.003
Service Limit	0.006
JOURNAL DIAMETER	
#1	1.7713-1.7720
#2	1.7713-1.7720
#3	1.7713-1.7720
#4	1.7713-1.7720
Runout Limit	0.005 Max. T.I.R.
Out-Of-Round Limit	0.0005 Max. T.I.R.
FRONT BEARING LOCATION (3)	0.000-0.010

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	0.003 in any 6" 0.006 overall.

CYLINDER BLOCK (Continued)	
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	3.7795-3.7831
Surface Finish (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
MAIN BEARING BORE DIAMETER	2.5902-2.5910
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.5155-0.5170

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.3990-2.3982
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Per Inch
Journal Runout Limit	0.002 Max.
Surface Finish (RMS)	12 Max.
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	2.3990-2.3982
CONNECTING ROD JOURNAL	
Diameter	2.0464-2.0472
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Per Inch Max.
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish (RMS)	35 Front/25 Rear (Max.)
Runout Limit	0.001 Max.
FLYWHEEL CLUTCH FACE	
Runout Limit (T.I.R.)	0.005
FLYWHEEL RING GEAR LATERAL RUNOUT (T.I.R.)	
Standard Transmission	0.025
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
AUXILIARY SHAFT END PLAY	0.001-0.007
CONNECTING ROD BEARINGS	
Clearance To Crankshaft - Desired	0.0008-0.0015
- Allowable	0.0008-0.0026
Bearing Wall Thickness (Std.) (4)	0.0619-0.0624
MAIN BEARINGS	
Clearance To Crankshaft - Desired	0.0008-0.0015
- Allowable	0.0008-0.0026
Bearing Wall Thickness (Std.) (4)	0.0956-0.0951
AUXILIARY SHAFT BEARINGS	
Clearance To Shaft	0.0006-0.0026

1

Drive Belt Tension (Lbs.)			
Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(B) If less than 40 pounds, readjust to 40-60 pounds.
(C) If less than 90 pounds, readjust to 90-120 pounds.
(D) If less than 75 pounds, readjust to 90-120 pounds.

2 Time required for plunger to leak down 1/8" of travel with 50 lb. load and leakdown fluid in lash adjuster.
3 Distance in inches that front bearing is installed below front face of bearing tower.
4 0.002 Undersize = Add 0.001 to Standard Thickness.

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CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD	
Piston Pin Bore Diameter	0.9104-0.9112
Crankshaft Bearing Bore Diameter	2.1720-2.1728
Out-Of-Round Limit	0.0004
Taper Limit	0.0004
Length (Center-to-Center)	5.2031-5.2063
Alignment (Bore-to-Bore Max. Dif.)	(5)
Twist	0.024
Bend	0.012
Side Clearance (Assembled to Crank)	
Standard	0.0035-0.0105
Service Limit	0.0150
PISTON	
Diameter (6)	
Coded Red	3.7780-3.7786
Coded Blue	3.7792-3.7798
0.003 Oversize	3.7804-3.7810
Piston-To-Bore Clearance	0.0014-0.0022
Pin Bore Diameter	0.9123-0.9126
Ring Groove Width	
Compression (Top)	0.080-0.081
Compression (Bottom)	0.080-0.081
Oil	1.1880-0.1890
PISTON PIN	
Length	3.010-3.040
Diameter	
Standard	0.9119-0.9124
0.001 Oversize	0.9130-0.9133
0.002 Oversize	0.9140-0.9143
Pin-To-Piston Clearance	0.0002-0.0004
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.002-0.004
Compression (Bottom)	0.002-0.004
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.010-0.020
Compression (Bottom)	0.010-0.020
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATION SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs. @ Spec. Length)	15.2-17.2 @ 1.20
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U.S.)	4(7)

FUEL PUMP

STATIC PRESSURE (P.S.I.) (8)	5.0-7.0
MINIMUM VOLUME FLOW (9) (10)	1 Pint in 25 Seconds
ECCENTRIC TOTAL LIFT (Inches)	0.304-0.326

TORQUE SPECIFICATIONS – Special Applications

ITEM	SIZE	TORQUE (FT-LB)
AUXILIARY SHAFT GEAR BOLT	M-10*	28-40
AUXILIARY SHAFT THRUST PLATE BOLT	M-6	6-9
BELT TENSIONER (TIMING) PIVOT BOLT	M-10	28-40
BELT TENSIONER (TIMING) ADJUSTING BOLT	M-8	14-21
CAMSHAFT GEAR BOLT	M-12	80-90
CAMSHAFT THRUST PLATE BOLT	M-6	6-9
CARBURETOR-TO-SPACER STUD	M-8	7.5-15
CARBURETOR SPACER-TO-MANIFOLD BOLT	M-8	10-14
CONNECTING ROD NUT	M-9	30-36
CRANKSHAFT DAMPER BOLT	M-14	100-120
CYLINDER HEAD BOLT	M-12	80-90 (11)
DECEL VALVE NUT		10-15
DECEL VALVE TO INTAKE MANIFOLD ADAPTER		23-28
DISTRIBUTOR CLAMP BOLT	M-10	14-21
DISTRIBUTOR VACUUM TUBE TO MANIFOLD ADAPTER		5-8
EXHAUST MAN. TO CYL. HEAD BOLT, STUD OR NUT	M-10	16-23
FLYWHEEL TO CRANKSHAFT BOLT	M-10	54-64

TORQUE SPECIFICATIONS – Special Applications Continued

ITEM	SIZE	TORQUE (FT-LB)
FUEL PUMP TO CYLINDER BLOCK	M-8	14-21
INTAKE MANIFOLD TO CYL. HEAD BOLT OR NUT	M-8	14-21 (12)
MAIN BEARING CAP BOLT	M-12	80-90
OIL PRESSURE SENDING UNIT TO BLOCK		8-18
OIL PUMP PICKUP TUBE TO PUMP	M-8	14-21
OIL PUMP TO BLOCK	M-8	14-21
OIL PAN DRAIN PLUG TO PAN	M-14	15-25
OIL PAN TO BLOCK	M-6	6-8
	M-8	8-10
OIL FILTER INSERT TO BLOCK		20-25
OIL FILTER TO ENGINE		(2)
ROCKER ARM COVER TO CYLINDER HEAD	M-6	4-7
SPARK PLUG TO CYLINDER HEAD	M-14	5-10
TEMPERATURE SENDING UNIT TO BLOCK		8-18
WATER JACKET DRAIN PLUG TO BLOCK		23-28
WATER PUMP TO BLOCK: BOLT	M-8	14-21
EGR VALVE TO SPACER: BOLT	M-8	14-21
EGR TUBE TO EXHAUST MANIFOLD: CONNECTOR		9-11
EGR TUBE NUT		9-11
AUXILIARY SHAFT COVER BOLT	M-6	6-9
WATER OUTLET CONNECTION BOLT	M-8	14-21
CYLINDER FRONT COVER BOLT	M-6	6-9
INNER TIMING BELT COVER STUD	M-8	14-21
OUTER TIMING BELT COVER BOLT	M-6	6-9
ROCKER ARM COVER SHIELD BOLT	M-10	28-40
THERMACTOR CHECK VALVE TO MANIFOLD		17-20*
FUEL FILTER TO CARBURETOR		80-100 In.-Lb

TORQUE SPECIFICATIONS – General Applications

U.S. THREAD SIZES	TORQUE
1-4-20	6-9
5-16-18	12-18
5-16-24	14-20
3-8-16	22-32
3-8-24	27-38
7-16-14	40-55
7-16-20	40-60
1-2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1-8	5-8
1-4	12-18
3-8	22-33
1-2	25-35

- All values are in ft.-lb. unless otherwise noted.
- Oil threads with engine oil unless fasteners require sealers.

5 Pin bore and crank bearing bore must be parallel and in the same vertical plane within the specified total difference when measured at the ends of an 8" bar – 4" on each side of rod centerline.

6 Measured at the piston pin bore centerline – 90° to the pin.

7 Add one quart with filter change.

8 On engine, temperature normal, curb idle, neutral.

9 Pump to-tank return line pinched off, new fuel filter in line.

10 Smallest orifice = not less than 0.220" I. D.

11 Torque cylinder head bolts in sequence in two steps:
- Step 1 50-60 ft.-lb.
- Step 2 80-90 ft.-lb.

12 Torque manifold bolts in sequence in two steps
- Step 1 5-7 ft.-lb
- Step 2 14-21 ft.-lb.

* And then rotate into position.

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DETROIT IRON

3.3L/4.1L (200/250 CID) I-6 Engines

PART 21-10

Fairmont/Zephyr/Granada/Monarch

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CA4293-2B

DESCRIPTION

ENGINE

The 3.3L (200 CID) and 4.1L (250 CID) I-6 engines are in-line, overhead valve design of lightweight cast iron construction. Adjustment and repair procedures for the two engines are basically the same.

A typical I-6 engine is shown in Fig. 1.

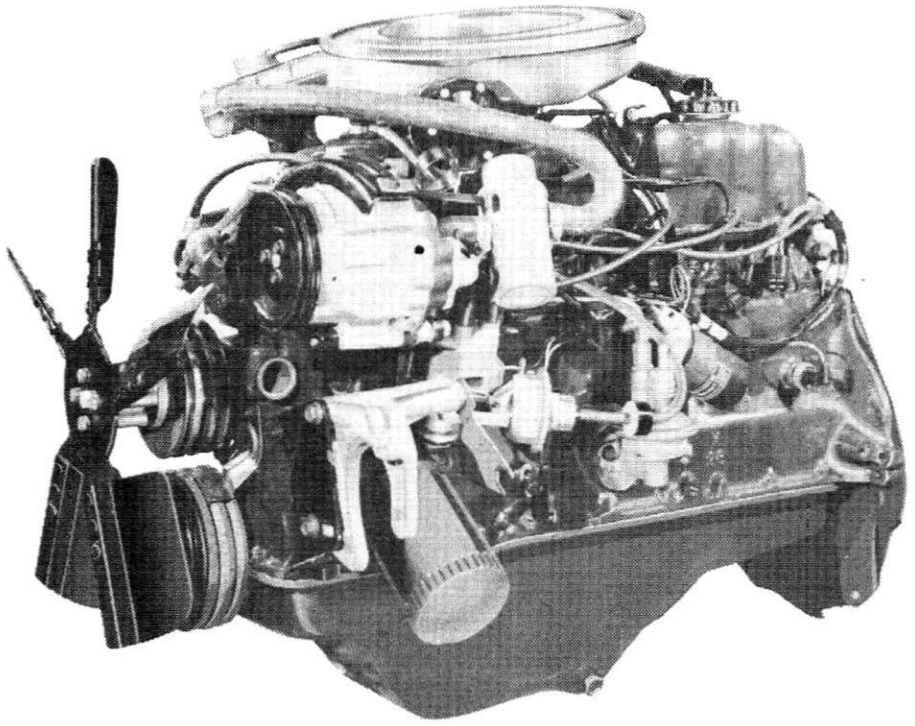
EMISSION CONTROL DEVICES

Operation, removal, installation and required maintenance of the exhaust emission control devices used on these engines are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

These engines are equipped with a positive, closed-type ventilation system re-cycling the crankcase vapors to the intake manifold.

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FIG. 1 Typical I-6 Engine

ADJUSTMENTS

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

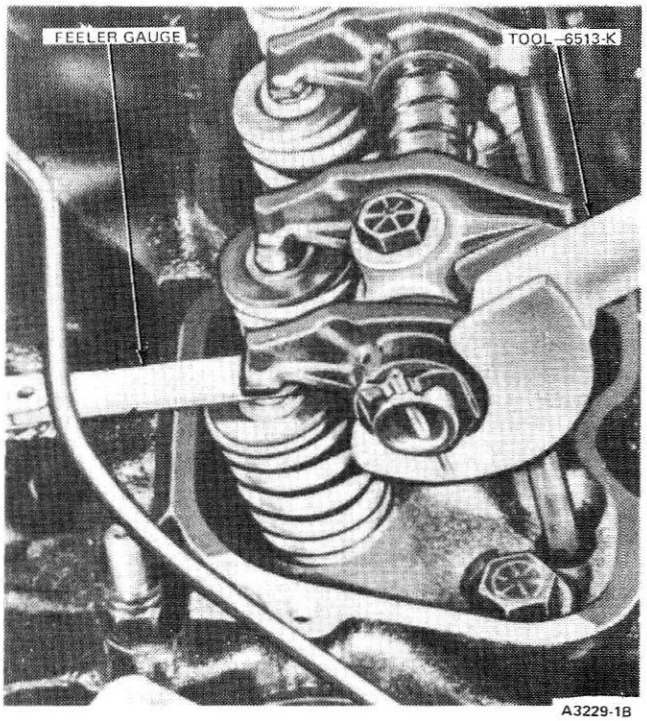
HYDRAULIC VALVE CLEARANCE

A shorter than standard push rod and a longer than standard push rod are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the master parts list or the specifications for the pertinent color code.

Valve stem to valve rocker arm clearance should be within specifications with the hydraulic tappet completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that, if not compensated for, the hydraulic tappet will cease to function and the valve will be held open.

To determine whether a shorter or a longer push rod is necessary, make the following check:

1. Connect an auxiliary starter switch in the starting circuit. **Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC after the compression stroke.**
2. With the crankshaft in the position designated in Steps 3 and 4, position the hydraulic lifter compressor tool on the rocker arm. Slowly apply pressure to bleed down the hydraulic tappet until the plunger is completely bottomed (Fig. 2). **Take care to avoid excessive pressure that might bend the push rod.** Hold the tappet in this position



A3229-1B

FIG. 2 Check Valve Clearance

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DETROIT IRON

and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge.

If the clearance is less than specified, install an under-size push rod. If the clearance is greater than specified, install an oversize push rod.

3. With the No. 1 piston on TDC after the compression stroke, use the procedure in Step 2 and check the following valves:

   No. 1 Intake
   No. 1 Exhaust
   No. 2 Intake
   No. 3 Exhaust
   No. 4 Intake
   No. 5 Exhaust

4. Now rotate the crankshaft until the No. 6 piston is on TDC after the compression stroke (1 revolution of the crankshaft). By using the procedure in Step 2, check the following valves:

   No. 2 Exhaust
   No. 3 Intake
   No. 4 Exhaust
   No. 5 Intake
   No. 6 Intake
   No. 6 Exhaust

5. When compressing the valve spring to remove the push rods, be sure the piston in the individual cylinder is below TDC to avoid contact between the valve and the piston. To replace a push rod, it will be necessary to remove the valve rocker arm shaft assembly. Upon replacement of a valve push rod, valve rocker arm shaft assembly or hydraulic valve tappet, the engine should not be cranked or rotated until the tappets have had an opportunity to leak down to their normal operating position. The leak down rate can be accelerated by using the tool shown in Fig. 2 on the valve rocker arm and applying pressure in a direction to collapse the lifter.

REMOVAL AND INSTALLATION

NOTE: Do not operate the engine with the hood open until the fan has been first examined for cracks and separation.

When installing nuts or bolts that must be torqued (refer to the Specifications at the end of this Part). Oil the threads with light-weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.** Refer to Part 21-01 for cleaning and inspection and engine test procedures.

ENGINE ASSEMBLY

Remove or disconnect Thermactor system parts that will interfere with removal or installation of the engine.

Removal

1. Remove the hood.
2. Drain the cooling system and the crankcase.
3. Disconnect the closed crankcase ventilation hose. Remove the air cleaner. Disconnect the canister purge hose from the P.C.V. valve. Disconnect the battery ground cable at the cylinder head and at the battery. Disconnect the radiator upper hose at the water outlet housing and the radiator lower hose at the water pump. On a vehicle with automatic transmission disconnect the transmission oil cooler lines from the radiator.
4. Remove the radiator. Remove the fan, spacer, belt and pulley.
5. Disconnect the heater hoses from the water pump and cylinder block. Disconnect the alternator wires from the alternator, the starter cable from the starter and the accelerator control cable from the carburetor. On a vehicle with air conditioning, remove the compressor from the mounting bracket, and position it out of the way, **leaving the refrigerant lines attached.**
6. Disconnect the fuel tank to fuel pump line at the fuel pump and plug the fuel line.
7. Disconnect the coil wires from the coil. Disconnect the oil pressure and water temperature sending unit wires from the sending units.
8. Remove the starter.

   On a vehicle with a manual-shift transmission, disconnect the clutch retracting spring. Disconnect the clutch equalizer shaft and arm bracket at the underbody rail and remove the arm bracket and equalizer shaft.
9. Raise the vehicle. Remove the flywheel or converter housing upper attaching bolts.
10. Disconnect the muffler inlet pipe at the exhaust manifold. Loosen the inlet pipe clamp and slide it off the support bracket on the engine. Disconnect the engine right and left mounts at the underbody bracket. Remove the flywheel or converter housing cover.

    On a vehicle with a manual-shift transmission, remove the flywheel housing lower attaching bolts.

    On a vehicle with automatic transmission, disconnect the converter from the flywheel. Remove the converter housing lower attaching bolts.
11. Lower the vehicle. Support the transmission and flywheel or converter housing with a jack.
12. Attach the engine lifting hook (Fig. 3). Carefully lift the engine out of the engine compartment. Place the engine on a work stand (Fig. 4).

Installation

1. If the clutch was removed, install as detailed in Group 16. Install guide pins in the flywheel or converter housing bolt holes in the rear of the engine.
2. Carefully lower the engine into the engine compartment.
3. Make sure the guide pins in the block engage the holes in the flywheel housing.

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On a vehicle with automatic transmission, start the converter pilot into the crankshaft.

On a vehicle with a manual-shift transmission, start the transmission main drive gear into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

4. Remove the engine lifting hook. Install the flywheel or converter housing upper attaching bolts.
5. Remove the jack from the transmission. Raise the vehicle.
6. Remove the guide pin and install the flywheel or converter housing lower attaching bolts.

   On a vehicle with automatic transmission, attach the converter to the flywheel and torque the attaching nuts to specifications.
7. Install the flywheel or converter housing dust cover.

   On a vehicle with a manual-shift transmission, install the clutch equalizer shaft and arm bracket. Connect the clutch retracting spring.

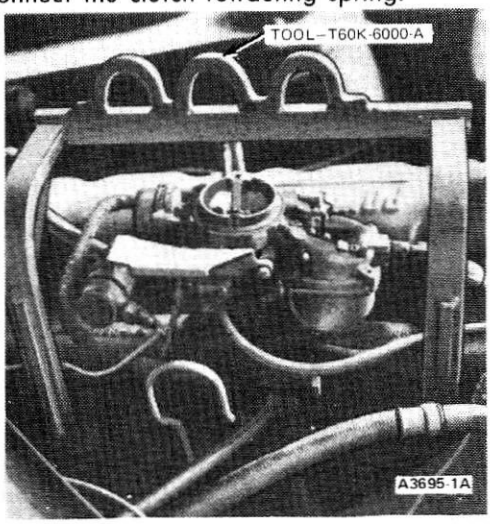


FIG. 3 Engine Lifting Hook

8. Install the engine left and right mount to the underbody bracket.
9. Remove the plug from the fuel pump line and connect the flexible fuel line to the fuel pump line. Using a new gasket, install the exhaust manifold to muffler inlet pipe with lockwashers and nuts. Torque the nuts to specifications. Position the inlet pipe clamp on the support bracket on the engine and tighten the clamp.
10. Lower the vehicle. Connect the oil pressure and the engine temperature sending unit wires. Connect the coil wires. Connect the accelerator control cable. Connect the fuel line to the fuel pump. Connect the canister purge line to the P.C.V. valve.
11. Install the starter motor. Connect the starter cable. Connect the alternator wires. Connect the heater hose at the water pump and cylinder block. Connect the battery ground cable.
12. Install the pulley, fan, and drive belt. Adjust the drive belt tension. On a vehicle with air conditioning, install the compressor on the mounting bracket, and adjust the belt tension to specifications. Install the radiator. Connect the radiator upper and lower hoses. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
13. Install and adjust the hood.
14. Operate the engine at fast idle and check all gaskets and hose connections for leaks.

    On a vehicle with automatic transmission, perform a transmission kickdown linkage adjustment (Part 24-60).
15. Install the air cleaner and connect the positive closed-type crankcase ventilation hose.

ENGINE FRONT SUPPORTS

The procedures given apply to either a right or left installation.

The engine front supports (Figs. 5 and 6) are located on each side of the cylinder block. **Whenever self-locking mounting bolts and nuts are removed, they must be replaced with new self-locking bolts and nuts.**

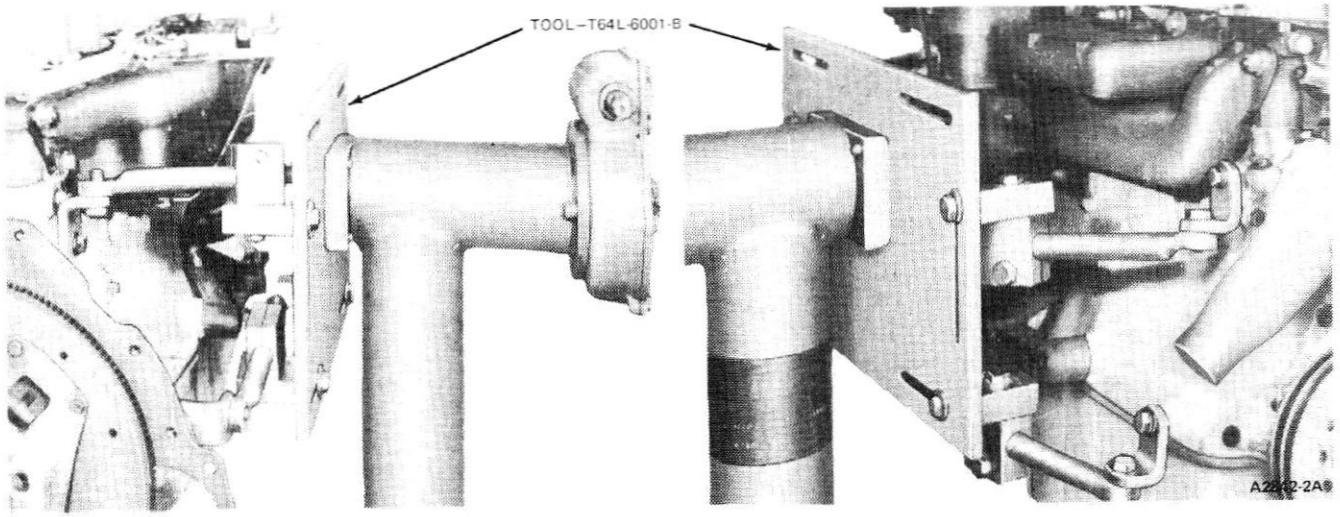


FIG. 4 Engine Mounted on Work Stand—Typical

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Removal

1. Remove the insulator to support bracket nuts and washers from both insulators.
2. Raise the engine with a jack and wood block placed under the oil pan.
3. Remove the insulator-to-engine bolts and washers and remove the insulator.

Installation

1. Position the insulator assembly on the engine and install the insulator- to-engine bolts and washers finger-tight.
2. Lower the engine carefully to make sure the insulator stud engages the hole in the support bracket.
3. Install the insulator to support bracket washer and nut on bolt engine front mounts. Tighten the insulator bolts and nuts to specification.

ENGINE REAR SUPPORT

The rear support is located at the transmission extension housing (Figs. 5 and 6). **Whenever self-locking mounting bolts and nuts are removed, they must be replaced with new self-locking bolts and nuts.**

Removal

1. On automatic transmission models, support the engine with a jack and wood block under the oil pan and remove the rear insulator to crossmember attaching nuts.
2. Remove the rear insulator to transmission extension housing bolts and lock washers.
3. On all models except those with floor shift manual transmissions, raise the transmission and remove the rear insulator.
4. On floor shift manual transmission models, support the transmission with a floor jack and remove the frame crossmember from the frame and from the rear insulator; then remove the rear insulator from the transmission. **Do not apply upward pressure on the transmission with the jack as damage to the transmission shift lever console or mounting plate will result.**

Installation

1. Position the rear insulator on the transmission extension housing.
2. On all models except those with floor shift, install the rear insulator to transmission extension housing bolts and lock-washers. Torque the bolts to specification. Lower the transmission.
3. Install the two insulator to crossmember attaching nuts and torque to specification.

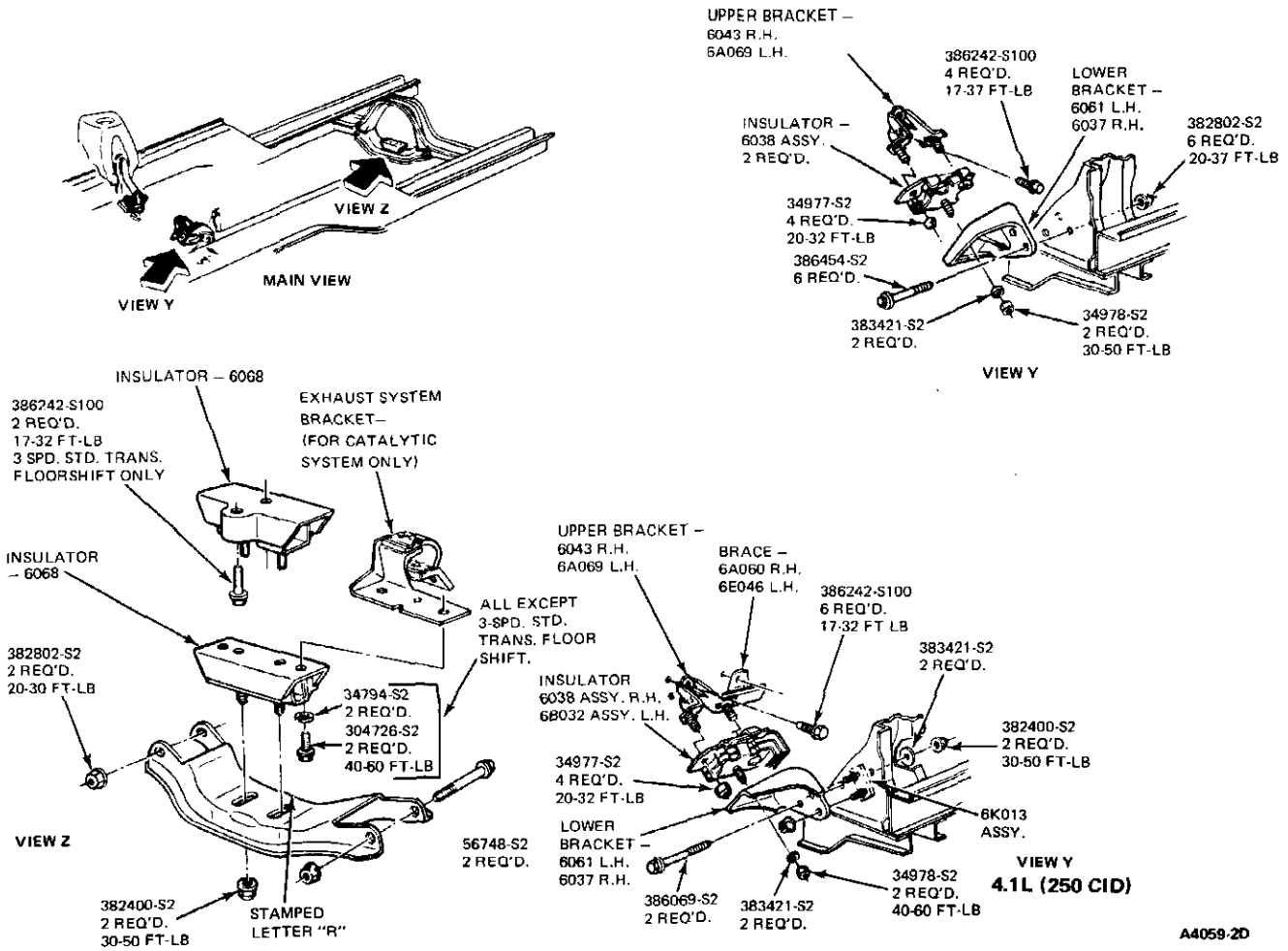


FIG. 5 Engine Supports—Granada and Monarch With 4.1L (250 CID) I-6

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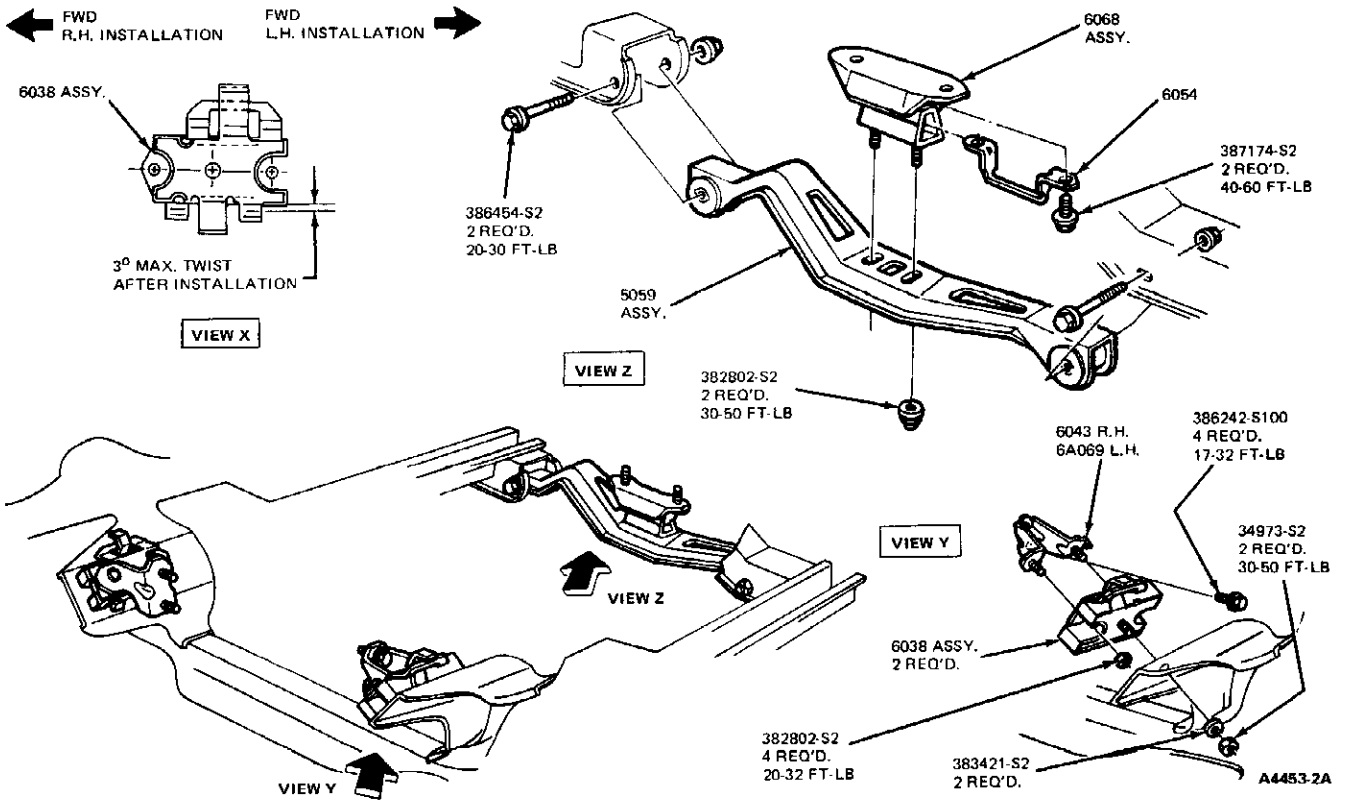


FIG. 6 Engine Supports—Fairmont and Zephyr W/3.3L (200 CID) I-6

4. On models with floor shift manual transmission, position the rear insulator to the transmission and install and torque the attaching bolts.
5. Position the removable crossmember to the frame and install the through bolts. Remove the supporting jack, install the nuts and washers attaching the support to the crossmember and torque the nuts to specification.

CRANKCASE VENTILATION SYSTEM

The closed crankcase ventilation system components are shown in Fig. 7.

Removal

1. Remove the inlet hose from the air cleaner elbow and the oil filler cap elbow. Remove the fresh air intake tube and the heat shroud tube.
2. Remove the air cleaner.
3. Grasp the PCV valve assembly near the rocker arm cover grommet and pull the regulator valve from the rocker arm cover.
4. Remove the evaporative canister purge hose from the PCV valve upper fitting and remove the vent hose from the hose fitting in the carburetor spacer and the lower fitting on the PCV valve.

Installation

1. Install the vent hose on the fitting in the carburetor spacer and on the lower fitting on the PCV valve. Connect the evaporative canister purge hose to the upper PCV valve fitting.
2. Insert the PCV valve into the rocker arm cover mounting grommet.
3. Install the air cleaner.
4. Connect the inlet hose to the air cleaner elbow and the oil filler cap elbow. Connect the fresh air intake tube and the heat shroud tube.
5. Operate the engine and check for leaks.

VALVE ROCKER ARM COVER AND ROCKER ARM

Removal

1. Remove the air cleaner assembly and the crankcase ventilation system. Remove the accelerator control cable bracket.
2. Remove the valve rocker arm cover and discard the gasket.
3. Remove the rocker arm shaft support bolts by loosening the bolts two turns at a time in sequence. Remove the rocker arm shaft assembly (Fig. 8) **Make sure the push rods are identified before removal so they can be returned to the same location when they are installed.** Remove the valve push rods.

Installation

1. Apply Lubriplate or equivalent to both ends of the push rods and to the valve stem tip.
2. Install the valve push rods. Position the valve rocker arm shaft assembly on the cylinder head.
3. Install and tighten all valve rocker arm support bolts, two turns at a time in sequence, until the

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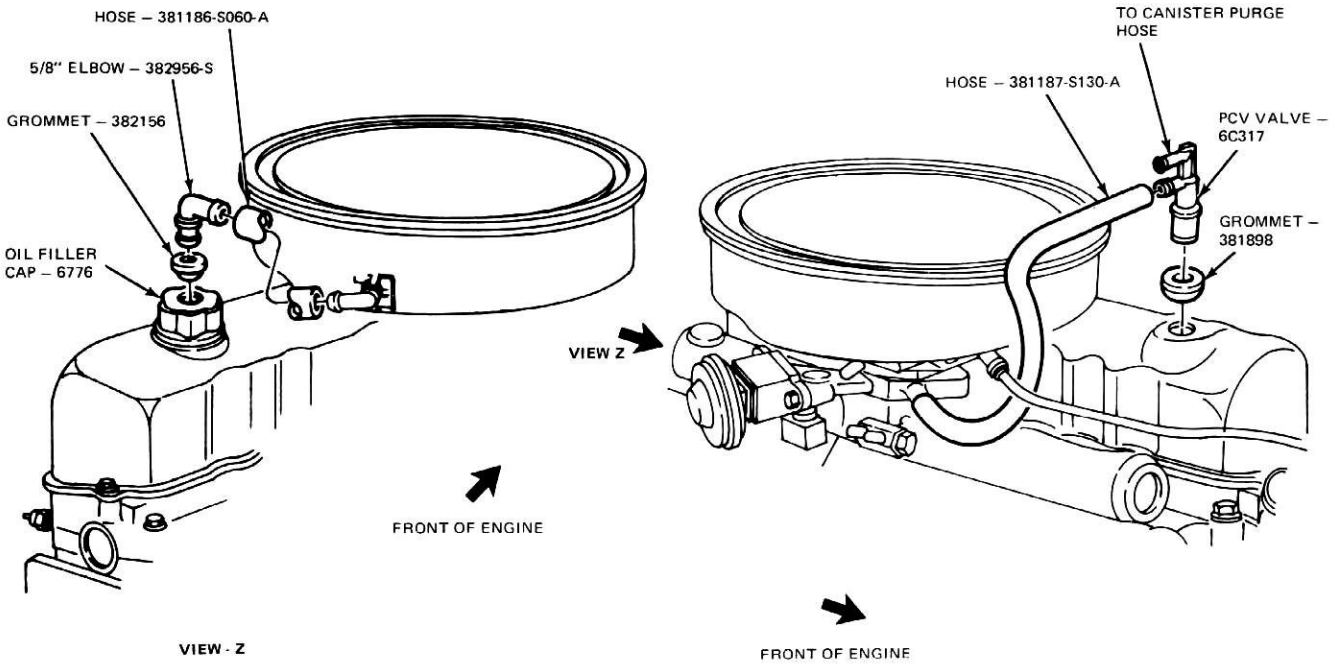


FIG. 7 Closed Crankcase Ventilation System Components

supports fully contact the cylinder head. Torque the bolts to specifications.

4. If any part which could affect the valve clearance has been changed, check the valve clearance following the procedure outlined under Hydraulic Tappet Adjustment.
5. Clean the valve rocker arm cover and cylinder head gasket surfaces. Install the gasket in the cover making sure that all of tangs of the gasket are engaged in the notches provided in the cover. Connect all vacuum lines and components using previous identification for proper connection. Tighten the cover attaching bolts in two steps. First, torque the bolts to specifications; then, retorque to the same specifications two minutes after initial tightening. Install the accelerator control cable bracket.
6. Install the crankcase ventilation system and the air cleaner assembly.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or leaking valve stem seals and retainer may be replaced without removing the cylinder head provided damage to the valve or valve seat has not occurred.

Removal

1. Remove the air cleaner assembly. Remove the PCV valve from the valve rocker arm cover. Remove the valve rocker arm cover. Remove the applicable spark plug.
2. Loosen the valve rocker arm shaft support bolts two tu MOTOR TEST ı sequence, until the valve spring

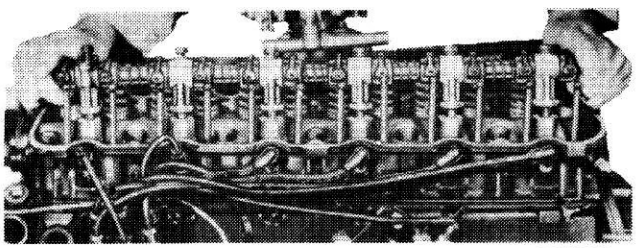


FIG. 8 Valve Rocker Arm Shaft Removal

pressure is relieved. Identify and remove both valve push rods of the cylinder to be serviced.

3. Install an air line with an adapter in the spark plug hole.
4. Tighten the attaching bolts just enough to seat the rocker arm shaft supports on the cylinder head. To move the rocker arm on either end of the shaft, it will be necessary to remove the retaining pin and spring washer and slide the rocker arm off the shaft. Push the rocker arm to one side and secure it in this position (Fig. 9).
5. Turn on the air supply. **Air pressure may turn the crankshaft until the piston reaches the bottom of the stroke.**

Using the valve spring compression tool shown in Fig. 9, compress the valve and remove the valve spring retainer locks, the sleeve, spring retainer and the valve spring. **If air pressure fails to hold the valve in the closed position during this operation, it can be presumed that the valve is not seating or is damaged. If this condition**

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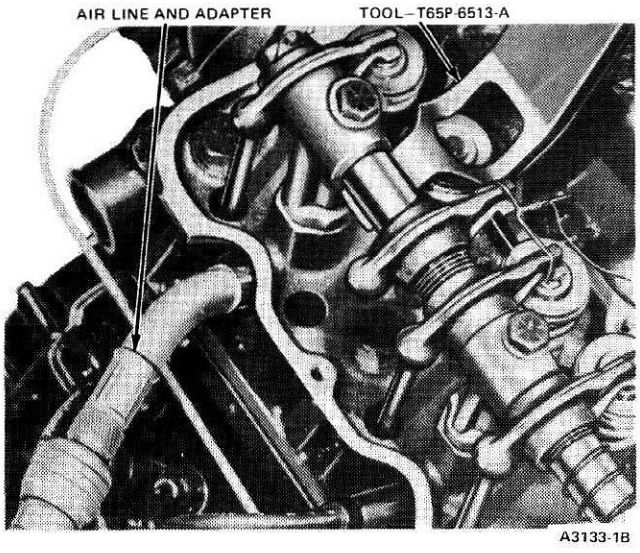


FIG. 9 Compressing Valve Spring—In Chassis

occurs, remove the cylinder head for further inspection.

6. Remove the valve stem seal (Fig. 10). If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.

Installation

1. Install a new valve stem seal. Position the spring over the valve. Install the spring retainer and sleeve. Compress the valve spring and install the valve spring retainer locks.
2. Apply Lubriplate or equivalent to both ends of the push rod, the valve and push rod ends of the rocker arm, and the valve stem tip. Remove the rocker arm shaft and install the push rod(s), making sure the lower end of the rod is positioned in the valve lifter push rod cup.
3. Remove the wire securing the valve rocker arm and slide the rocker arm into position. If an end valve rocker arm was removed, slide it into position on the shaft and install the spring washer and retainer pin. Turn off the air and remove the air line and adapter. Install the spark plug and spark plug wire.
4. Install the rocker arm shaft by following the instructions under Rocker Arm Installation.
5. Clean the valve rocker arm cover and cylinder head gasket surfaces. Install a new gasket in the cover making sure the gasket tangs are securely engaged in the notches in the cover. Position the cover on the head. Install and tighten the cover attaching bolts in two steps. First, torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.
6. Insert the PCV valve (with the vent hose and canister purge hose attached) into the valve rocker arm cover mounting grommet. Install the air cleaner assembly.

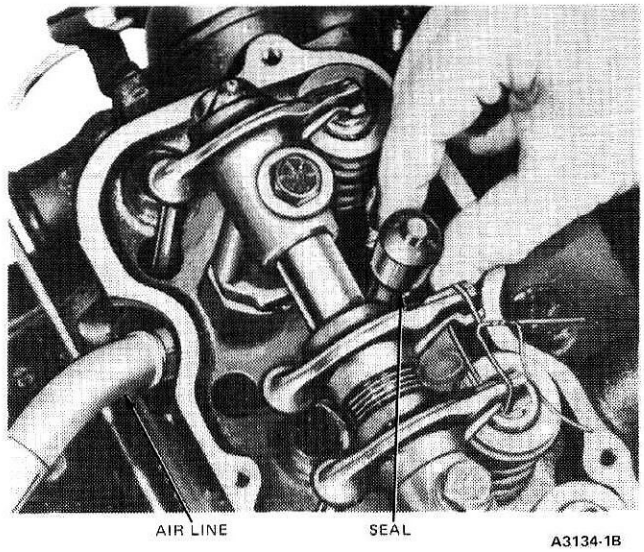


FIG. 10 Removing Valve Stem Seal

CYLINDER HEAD

Removal

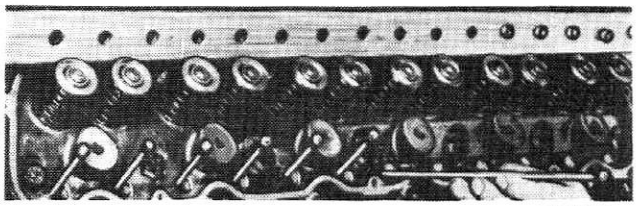
1. Drain the cooling system. Remove the air cleaner assembly. Disconnect the radiator upper hose at the engine.
2. Disconnect the muffler inlet pipe at the exhaust manifold. Pull the muffler inlet pipe down. Remove the gasket.
3. Disconnect the accelerator control cable at the carburetor.
4. Disconnect the transmission kickdown rod. Disconnect the accelerator control cable at the bracket.
5. Disconnect the fuel inlet line at the fuel filter hose. Disconnect the distributor vacuum lines. Disconnect vacuum lines and components as necessary for accessibility and identify them for proper reconnection.
6. Disconnect the carburetor fuel inlet line at the fuel pump. Remove the lines as an assembly.
7. Disconnect the spark plug wires at the spark plugs and the temperature sending unit wire at the sending unit.
8. Remove the crankcase ventilation system. Remove the accelerator control cable bracket.
9. Remove the valve rocker arm cover.
10. Remove the valve rocker arm shaft assembly. Identify and remove the valve push rods in sequence (Fig. 11).
11. Remove the remaining cylinder head bolts and remove the cylinder head. **Do not pry between the cylinder head and block as the gasket surfaces may become damaged.**

Installation

1. Clean the head and block gasket surfaces. (Refer to Part 21-01 for cleaning and inspection procedures). If the cylinder head was removed for a gasket change, check the flatness of the cylinder

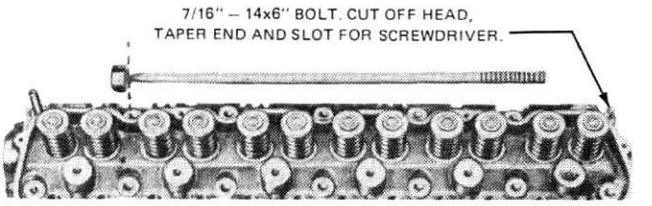
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DETROIT IRON



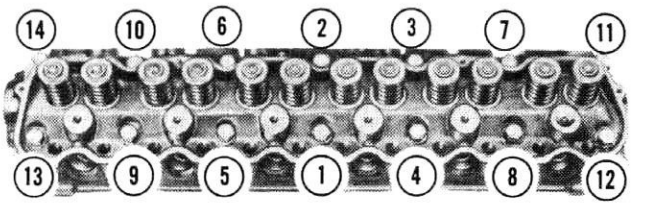
A2224-1A

FIG. 11 Valve Push Rod Removal



A2790-1A

FIG. 12 Cylinder Head Guide Studs



A1369-1B

FIG. 13 Cylinder Head Bolt Torque Sequence

head and block. Install guide studs at each end of the cylinder block (Fig. 12).

2. Position the cylinder head gasket over the guide studs on the cylinder block.
3. Install a new gasket on the flange of the muffler inlet pipe.
4. Lift the cylinder head over the guides and slide it down carefully, connect the muffler inlet pipe to the exhaust manifold.
5. Install, but do not tighten two bolts at opposite ends of the head to hold the head and gasket in position. Remove the guides and install the remaining bolts.
6. The cylinder head bolts are tightened in three progressive steps. Torque all the bolts in sequence (Fig. 13) to specifications. When cylinder head bolts have been tightened following this procedure, it is not necessary to retorque the bolts after extended operation. However, on cylinder heads with composition gaskets, the bolts may be checked and retorqued, if desired. Tighten the exhaust manifold flange attaching nuts to specification.
7. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods in the original bores, positioning the lower end of the rods into the tappet sockets. Apply Lubriplate or equivalent to the valve stem tips and to the rocker arm pads.
8. Install the valve rocker arm shaft assembly following procedures under Valve Rocker Arm Shaft Installation.

   Check the valve clearance, following the procedure outlined under Valve Clearance Adjustment.
9. Install the muffler inlet pipe lock washers and attaching nuts. Torque the nuts to specifications.
10. Connect the radiator upper hose at the coolant outlet housing.
11. Position the distributor vacuum line and the carburetor fuel inlet line on the engine. Connect the fuel line at the fuel filter using a new clamp, then connect the distributor vacuum line at the carburetor.
12. Connect the accelerator control cable bracket. Connect the transmission kickdown rod.
13. Connect the accelerator control cable retracting spring. Connect the accelerator control cable at the carburetor.
14. Connect the distributor vacuum line at the distributor. Connect the carburetor fuel inlet line at the fuel pump. Connect all vacuum components and lines using previous identification for proper connection.
15. Connect the temperature sending unit wire at the sending unit. Connect the spark plug wires.
16. Fill and bleed the cooling system.
17. Install the crankcase ventilation system.
18. Install the air cleaner assembly.
19. Start the engine and check for coolant, fuel, oil and vacuum leaks.

HYDRAULIC TAPPETS

Before replacing a hydraulic tappet for noisy operation, be sure the noise is not caused by improperly adjusted valve clearance or by worn rocker arms or push rods.

Removal

1. Remove the cylinder head and related parts following the procedure under Cylinder Head Removal.
2. Using a magnet, remove the tappets (Fig. 14). Place the tappets in a rack so they can be installed in the original positions.

   If the tappets are stuck in their bores by excessive varnish or gum, it may be necessary to use a plier-type or claw-type tool (T70L-6500-A) to remove the tappets. Rotate the tappet back and forth to loosen any gum and varnish which may have formed. **Keep the assemblies intact until they are to be cleaned.** If the tappets are to be tested or disassembled and cleaned, follow the procedures in Part 21-01. If a hydraulic tappet has been disassembled and cleaned, **be sure to fill it with test fluid before installing it in the engine.** New tappets already contain test fluid.

Installation

1. Install new (or cleaned) hydraulic tappets through the push rod openings with a magnet (Fig. 14).
2. Install the cylinder head and related parts.

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EXHAUST MANIFOLD

Removal

1. Remove the air cleaner assembly and related parts. Disconnect the muffler inlet pipe from the exhaust manifold, and remove the automatic choke hot air tube.
2. Remove or disconnect the EGR tube and all other *emission components that interfere with the* removal of the exhaust manifold.
3. Bend the exhaust manifold attaching bolt lock tabs back and remove the bolts. Remove the exhaust manifold.

Installation

1. Clean the mating surfaces of the exhaust manifold and cylinder head. Scrape the gasket material from *the mounting flange of the exhaust manifold and* muffler inlet pipe.
2. Position the exhaust manifold on the cylinder head and install the attaching bolts and tab washers. Torque the bolts and studs in sequence shown in Fig. 15. Refer to specifications.

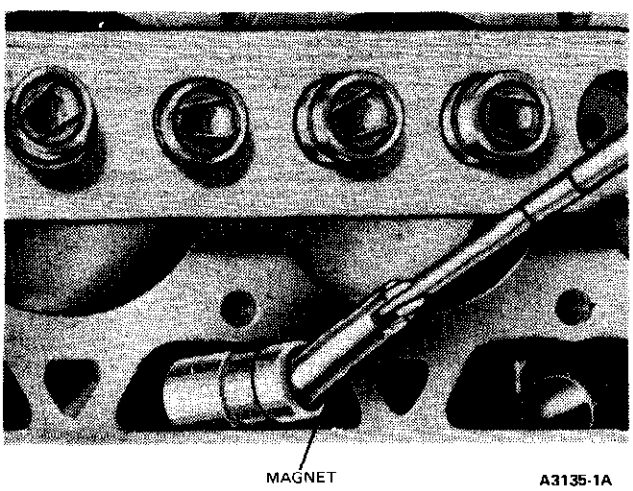


FIG. 14 Removing Hydraulic Tappets

3. Place a new gasket on the muffler inlet pipe. Position the muffler inlet pipe to the manifold. Install and torque the attaching nuts to specifications. Install the automatic choke hot air tube.
4. Install or connect the emission components previously disconnected.
5. Install the air cleaner assembly and related parts. *Start the engine and check for exhaust leaks.*

WATER PUMP

Removal

1. Drain the cooling system. Remove the Thermactor pump, power steering and air conditioner drive belts, if so equipped.
2. Disconnect the radiator lower hose at the water pump. Remove the drive belt, fan, or fan and drive *clutch, and water pump pulley.*
3. Disconnect the heater hose at the water pump.
4. Remove the water pump.

Installation

1. If a new water pump is to be installed, remove the heater hose fitting from the old pump and install it on the new pump. Clean the gasket surfaces on the water pump and cylinder block. **The 4.1L (250 CID) I-6 uses a one piece gasket for the *cylinder front cover and water pump. Trim* away the old gasket at the edge of the cylinder front cover. Use a water pump service gasket to replace it.**
2. Coat the new gasket on both sides with water-resistant sealer and position it on the cylinder block.
3. Position the water pump and install the lockwashers and attaching bolts (the alternator adjusting arm is secured by one water pump bolt). Torque the bolts to specifications.
4. Connect the radiator lower hose and the heater hose to the water pump.
5. Install the water pump pulley and fan. Torque the bolts evenly and alternately to specifications.
6. Install the Thermactor pump, power steering and air conditioner drive belts, if so equipped and adjust the tension to specifications.

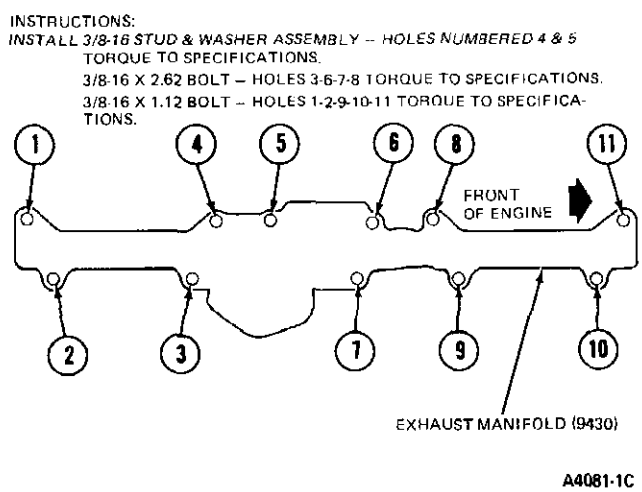


FIG. 15 Torque Sequence—Exhaust Manifold

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7. Fill and bleed the cooling system. Operate the engine until normal operating temperature is reached. Check for leaks and check the coolant level.

CYLINDER FRONT COVER AND TIMING CHAIN

Removal

1. Drain the cooling system and the crankcase. Disconnect the radiator upper hose at the coolant outlet housing and the radiator lower hose at the water pump. On a vehicle with automatic transmission, disconnect the transmission oil cooler lines from the radiator.
2. Remove the radiator. Remove the drive belt, fan and pulley. On a vehicle with air conditioning, remove the condenser attaching bolts and position the condenser forward. **Do not disconnect the refrigerant lines.** Remove the compressor drive belt. If so equipped, remove the accessory drive pulley. Using Tool T-58P-6316-B, remove the crankshaft damper.
3. On a 3.3L (200 CID) I-6 engine, remove the cylinder front cover attaching screws from the cover and from the oil pan. Pry the top of the front cover away from the block slightly and, using a thin bladed knife, cut the oil pan gasket flush with the front face of the cylinder block.
4. On a 4.1L (250 CID) I-6 engine, remove the oil pan following instructions under Oil Pan Removal. Remove the cylinder front cover.
5. Clean any gasket material from the surfaces.
6. Check timing chain deflection following the procedures given in Part 21-01. If the deflection exceeds specification, replace the timing chain and sprockets.
7. Crank the engine until the timing marks are aligned as shown in Fig. 16. Remove the camshaft sprocket attaching bolt and washer. Slide both sprockets and timing chain forward and remove them as an assembly (Fig. 17).

Installation

1. Clean and inspect all parts before installation. Oil the timing chain after installing it on the camshaft and crankshaft. Be sure the timing marks on the sprockets are positioned as shown in Fig. 16. Install the camshaft sprocket attaching bolt and washer. Torque the bolt to specifications.
2. Apply oil-resistant sealer to a new cylinder front cover gasket and position the gasket on the cylinder front cover. Apply sealer to the exposed area of the gasket. **On a 3.3L (200 CID) I-6 engine,** coat the gasket surface of the oil pan with oil resistant sealer. Cut and position the required portions of a new gasket on the oil pan. Apply sealer to the exposed areas of the gasket, including the corners where they contact the front cover gasket. **On a 4.1L (250 CID) I-6 engine, install the timing chain snubber in the front cover (Fig. 18).**
3. Install the cylinder front cover using the tool shown in Fig. 19. **On a 4.1L (250 CID) I-6 engine,** no adjustment is needed on the chain snubber (Fig. 18) as this is automatically obtained during front cover alignment. Torque the attaching bolts to specifications.
4. Lubricate the hub of the crankshaft damper with Lubriplate or equivalent to prevent damage to the seal during installation or initial engine start. Using Tool T52L-6306-AEE, install the crankshaft damper. Torque the attaching bolt to specifications.
5. On a 4.1L (250 CID) I-6 engine, install the oil pan and related parts, following the instructions under Oil Pan Installation.
6. Install the fan, pulley and drive belt. Adjust the drive belt.
7. Install the radiator. Connect the radiator upper and lower hoses. **Refill the crankcase with the**

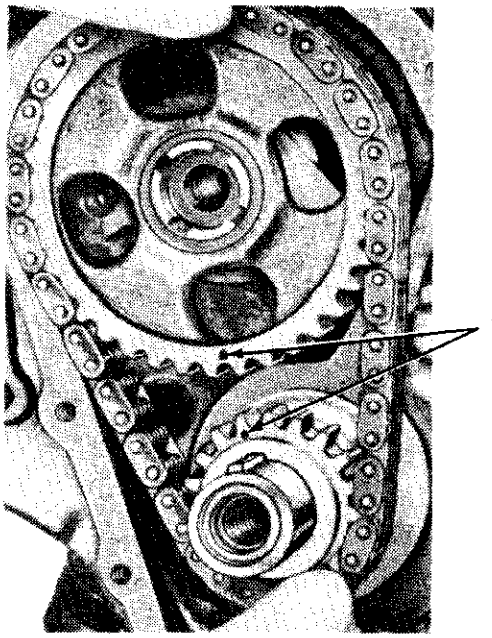


FIG. 16 Aligning Timing Marks

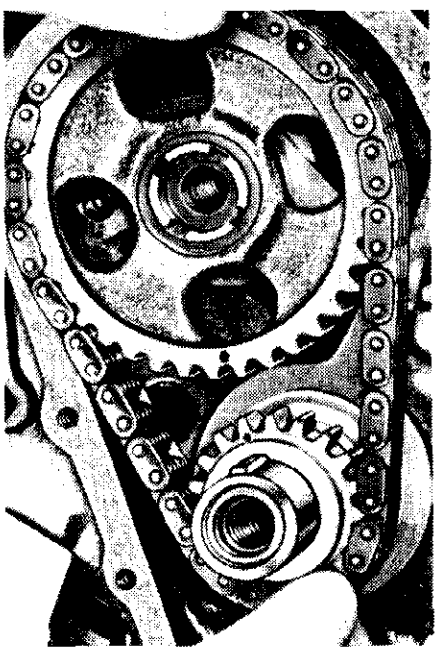


FIG. 17 Timing Chain and Sprockets Removal

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proper grade and quantity of engine oil before starting the engine.

8. Fill and bleed the cooling system.
9. Start the engine. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

FRONT OIL SEAL

Removal

1. Remove the cylinder front cover.
2. Drive out the oil seal with a pin punch. Clean the recess in the cover.

Installation

1. Coat a new seal with grease and install the seal. Drive the seal in until it is fully seated in the recess (Fig. 20). Check the seal after installation to be sure the spring is properly positioned in the seal.
2. Replace the cylinder front cover.

CAMSHAFT

The camshaft and related parts are shown in Fig. 21.

Removal

1. Drain the cooling system and the crankcase. Remove the air cleaner assembly.
2. Disconnect the radiator hoses from the coolant outlet housing and the water pump. Remove the radiator. Remove the grille. On a vehicle with air conditioning, remove the condenser attaching bolts, and position the condenser to one side. **Do not disconnect the condenser refrigerant lines.**
3. Disconnect the accelerator control cable from the carburetor and from the bracket. Disconnect the bracket from the carburetor.
4. Disconnect the fuel inlet line at the fuel filter, and the vacuum hoses and connectors that are connected to the cylinder head directly or indirectly line from the carburetor.
5. Disconnect the muffler inlet pipe from the exhaust manifold. Pull the muffler inlet pipe down. Remove the gasket.
6. Disconnect the carburetor fuel inlet line from the fuel pump.
7. Disconnect the spark plug wires from the spark plugs and the coil high tension lead at the coil.
8. Disconnect the engine temperature sending unit wire from the sending unit. Disconnect the flexible fuel line from the fuel pump line and plug the line. Remove the distributor, the fuel pump, and the oil filter.
9. Remove the crankcase vent hose, regulator valve, valve rocker arm cover and cylinder head by following steps 8 thru 11 under Cylinder Head Removal.
10. Using a magnet, remove the hydraulic tappets and keep them in order so that they can be installed in their original locations (Fig. 14). If the tappets are stuck in the bores by excessive varnish, etc., it may be necessary to use a claw-type tool to remove them.

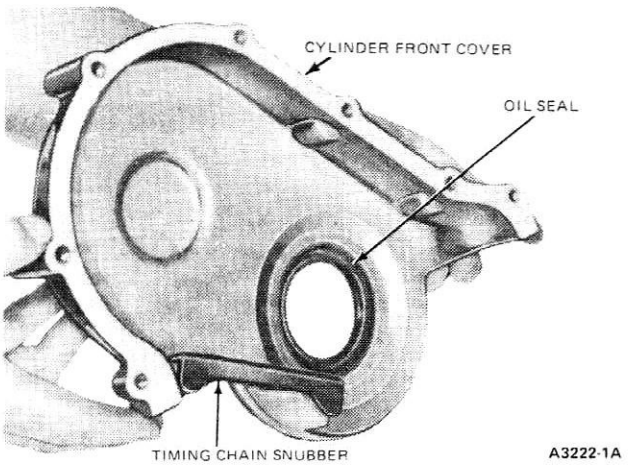


FIG. 18 Timing Chain Snubber Installation—4.1L (250 CID) I-6

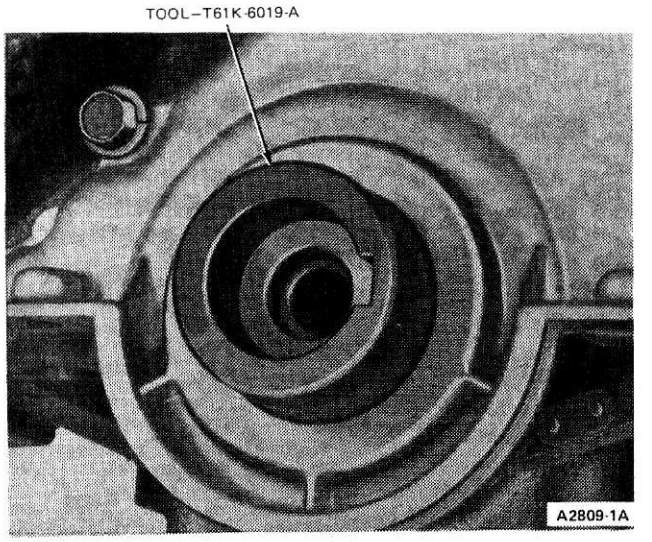


FIG. 19 Aligning Cylinder Front Cover

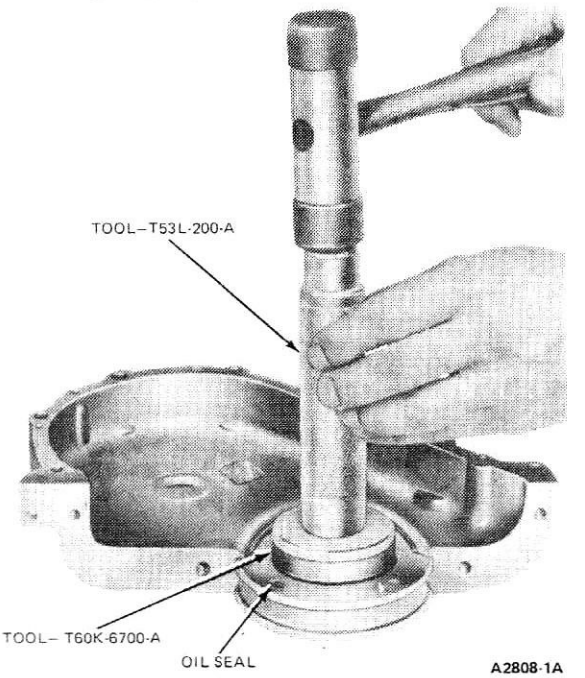


FIG. 20 Crankshaft Front Oil Seal Replacement

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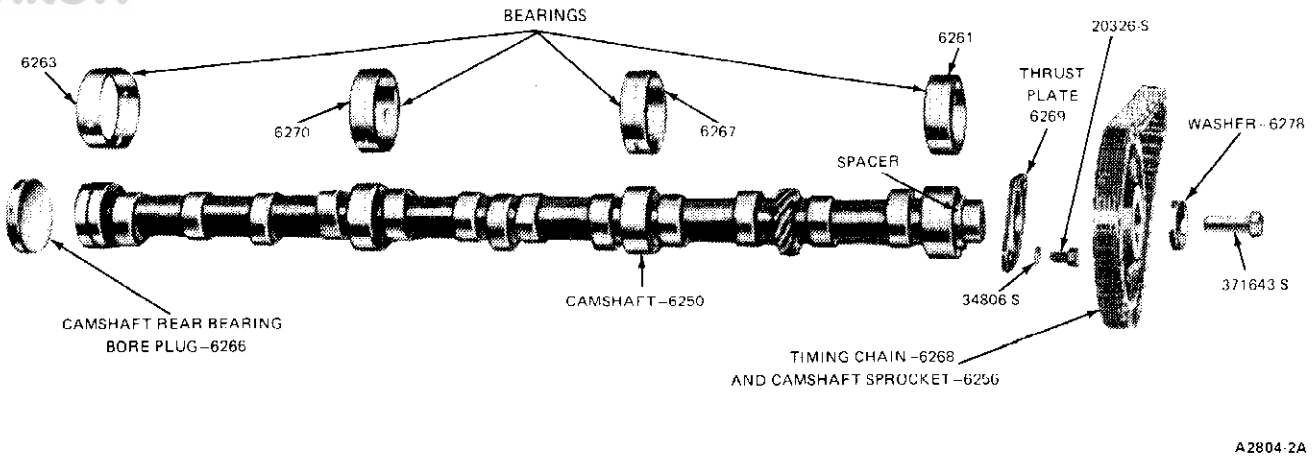


FIG. 21 Camshaft and Related Parts

11. Loosen and remove the drive belt, fan and pulley. Remove the crankshaft damper using Tool T58P-6316-B.
12. Remove the oil level dipstick. Remove the oil pan on 4.1L (250 CID) only, following instructions under Oil Pan Removal. Remove the oil pump and inlet tube assembly.
13. Remove the cylinder front cover and gasket.
14. Check camshaft end play as detailed in Part 21-01. If the end play is excessive, replace the thrust plate.
15. Remove the timing chain and sprockets as detained under Cylinder Front Cover and Timing Chain Removal.
16. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. **Use caution to avoid damaging the journals and lobes.**

Installation

1. Clean the oil passage at the rear of the cylinder block that feeds the rocker arm shaft by blowing compressed air into the opening in the block. Camshaft lobes are to be coated with Lubriplate or equivalent and the journals lubricated with heavy oil SE before installation. Carefully slide the camshaft through the bearings.
2. Install the thrust plate with the oil groove toward the rear of the engine and torque the attaching bolts to specifications. Replace the crankshaft front oil seal.
3. Install the sprockets and timing chain, cylinder front cover and crankshaft damper as detailed under Cylinder Front Cover and Timing Chain Installation.
4. Clean the oil pump inlet tube screen, oil pan, and block gasket surfaces. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the pump inlet tube. Install the oil pump and oil pan. Install the oil level dipstick.
5. Install the fan, fan pulley and drive belt. Adjust the belt tension. Install the radiator and the grille.
6. Dip the base of each hydraulic tappet body in lubriplate or equivalent, or lubricate tappets or tappet bores with heavy oil SE before installation. Install the tappets in their original bores.
7. Install the cylinder head, push rods and the valve rocker arm shaft assembly by following the procedure under Cylinder Head Installation.
8. Using a new gasket, install the fuel pump and connect the flexible fuel line. Install a new oil filter.
9. Position the No. 1 piston at TDC after the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position. Install the distributor hold-down clamp.
10. Connect the engine temperature sending unit wire. Connect the coil primary wire. Install the distributor cap. Connect the spark plug wires and the coil high tension lead.
11. Install the carburetor fuel inlet line, using a new clamp on the filter tubing. Connect the distributor vacuum line to the carburetor.
12. On a vehicle with air conditioning, position the condenser and install the attaching bolts. Install the radiator and connect the radiator upper and lower hoses and the coolant expansion bottle system reservoir.
13. Connect the accelerator retracting spring. Connect the accelerator control cable at the carburetor.
14. Fill the cooling system. (See Part 27-01.) Fill the crankcase with an approved weight and grade of engine oil.
15. Install air cleaner assembly.
16. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line to the distributor. Check for coolant, oil, fuel and vacuum leaks. Adjust the engine idle speed and the idle fuel mixture.

FLYWHEEL

Removal

1. On a manual-shift transmission, remove the transmission, clutch pressure plate and disc, following the procedures in Volume One. Group 16—Clutch. Do not drain the transmission.

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On a vehicle with an automatic transmission, remove the transmission and converter housing following the procedure in Volume One, Group 17—Automatic Transmission. Do not drain the transmission.

2. Refer to Part 21-01, Cleaning and Inspection, for flywheel face runout checking procedure. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Clean and inspect all parts before installation. Position the flywheel on the crankshaft flange. Apply oil-resistant sealer to the attaching bolts. Install and torque the bolts to sequence across from each other to specification.
2. On a manual-shift transmission, install the clutch pressure plate, disc, and the transmission following the procedures in Volume One, Group 16—Clutch.

   On a vehicle with automatic transmission, install the converter housing and transmission following the procedure in Volume One, Group 17—Automatic Transmission. It is not necessary to adjust the transmission linkage when it has been removed only for flywheel replacement.

CLUTCH PILOT BEARING

Inspection procedures are outlined under Flywheel Cleaning and Inspection in Part 21-01.

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Volume One, Group 16—Clutch.
2. Using Tools T59L-100-B and T58L-101-A, remove the pilot Bearing (Fig. 22) and adapter.

Installation

1. A new clutch pilot bushing normally does not require lubrication. However, due to long storage periods, it may lose some of the lubricant pressed into the bushing in manufacture. It is therefore recommended that the new bushing be soaked in SAE-30 non-detergent type motor oil for a minimum of one-half hour before installation. **Do not lubricate with grease of any type.**
2. Using Tool T65L-7600-A, install the pilot service bushing (Fig. 23).
3. Install the clutch pressure plate, disc, and the transmission following the procedure in Volume One, Group 16—Clutch.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. On a vehicle with a manual-shift transmission, slide the transmission to the rear and remove the clutch pressure plate and disc following the procedure in Volume One, Group 16—Clutch.

   On a vehicle with automatic transmission, remove the transmission and converter housing following the procedure in Volume One, Group 17—Automatic Transmission.
2. Remove the flywheel attaching bolts and remove the flywheel and engine rear cover plate.

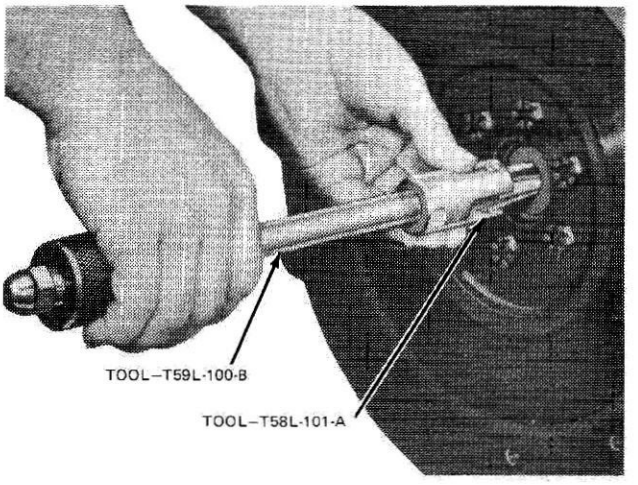


FIG. 22 Removing Clutch Pilot Bearing

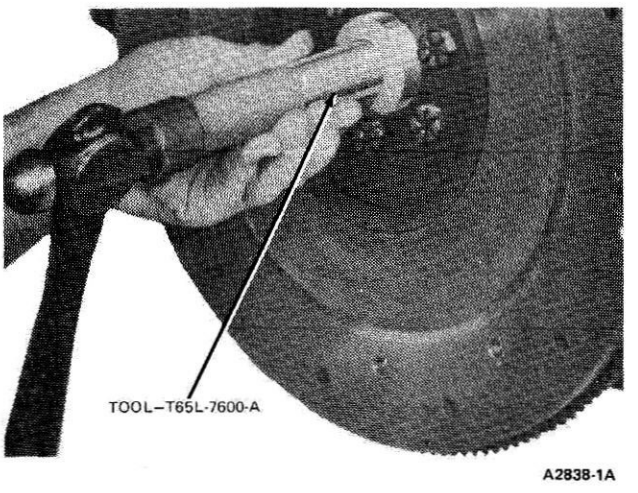


FIG. 23 Installing Clutch Pilot Service Bushing

3. Remove the plug as detailed under Core Plugs in Part 21-01.

Installation

1. Install a new plug as detailed under Core Plugs in part 21-01.
2. Install the engine rear cover plate, apply oil-resistant sealer to the flywheel bolts and install the flywheel.

   On a vehicle with a manual-shift transmission, install the clutch pressure plate, disc, and transmission following the procedure in Volume One, Group 16—Clutch.

   On a vehicle with automatic transmission install the transmission and converter housing following the procedure in Volume One, Group 17—Automatic Transmission.

OIL PAN

FAIRMONT/ZEPHYR

Removal

1. Disconnect (2) oil cooler lines at radiator (if equipped).

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2. Remove radiator top support (2) bolts.
3. Remove oil level dipstick.
4. Raise vehicle on hoist.
5. Drain crankcase.
6. Remove (4) bolts and nuts attaching sway bar to chassis and allow sway bar to hang down.
7. Remove K brace.
8. Lower front steering rack and pinion.
9. Disconnect battery lead at starter and remove (2) bolts attaching starter and remove starter.
10. Remove (2) nuts attaching engine mounts to support brackets.
11. Loosen (2) rear insulator to crossmember attaching bolts.
12. Raise engine and place 1 1/4" spacer between engine support insulator and chassis bracket.
13. Position jack under transmission and raise slightly.
14. Remove oil pan attaching bolts and lower pan to crossmember.
15. Position transmission cooler lines out of the way and remove oil pan (rotating crankshaft if required).
16. Clean oil pump pick-up tube and screen, oil pan gasket surface at cylinder block and oil pan.
17. Inspect oil pan for damage.

Installation

1. The oil pan has a two-piece gasket. Coat the block surface and the oil pan gasket surfaces with oil resistant sealer, and position gaksets to cylinder block.
2. Position the oil pan seals in the cylinder front cover and rear bearing cap (Fig. 25).
3. Insert gasket tabs under front and rear seals.
4. Position oil pan to cylinder block and install attaching bolts.
5. Position transmission cooler lines.
6. Lower jack under transmission.
7. Raise engine to remove spacers and lower engine to chassis.
8. Tighten (2) nuts attaching rear support insulator to crossmember.
9. Install (2) engine support to chassis through-bolts and nuts.
10. Position starter and install (2) attaching bolts and starter cable.
11. Reposition sway bar to chassis and install (4) bolts and nuts.
12. Reinstall front steering rack and pinion.
13. Reinstall K brace.
14. Lower vehicle partially and fill crankcase with oil.
15. Install oil level dipstick.
16. Connect oil cooler lines to radiator, install upper radiator support.
17. Lower vehicle, start engine and check for leaks.

GRANADA/MONARCH

Removal

1. Disonncect (2) oil cooler lines at radiator (if equipped).
2. Remove radiator top support (2) bolts.
3. Remove oil level dipstick.
4. Raise vehicle on hoist.
5. Drain crankcase.
6. Remove (4) bolts and nuts attaching sway bar to chassis and allow sway bar to hang down.
7. Disconnect battery lead at starter and remove (2) bolts attaching starter and remove starter.
8. Remove (2) nuts attaching engine mounts to support brackets.
9. Loosen (2) rear insulator to crossmember attaching bolts.
10. Raise engine and place 1-1/4 inch spacer between engine support insulator and chassis bracket.
11. Position jack under transmission and raise slightly.
12. Remove oil pan attaching bolts and lower pan to crossmember.
13. Position transmission cooler lines out of the way and remove oil pan (rotating crankshaft is required).
14. Clean oil pump pick-up tube and screen, oil pan gasket surface at cylinder block, and oil pan.
15. Inspect oil pan for damage.

Installation

1. The oil pan has a two-piece gasket. Coat the block surface and the oil pan gasket surfaces with oil resistant sealer, and position gaskets to cylinder block (Fig. 25).

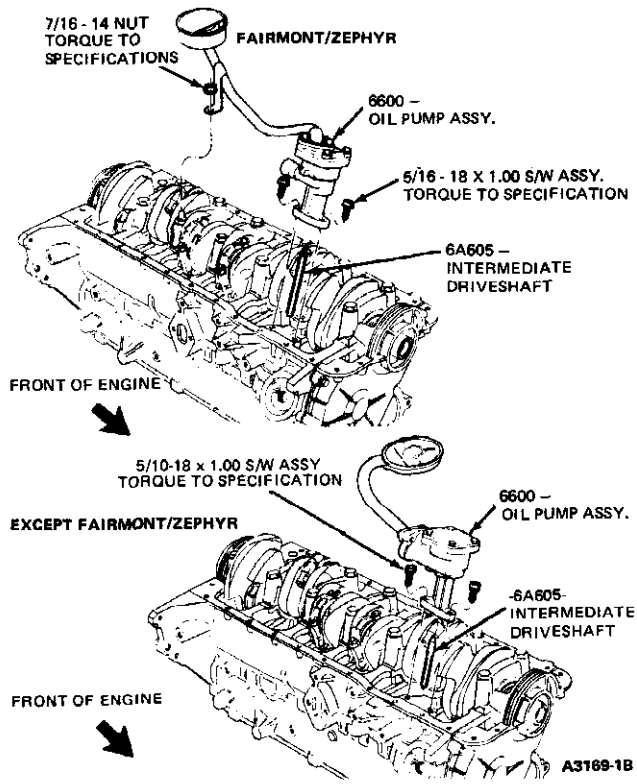


FIG. 24 3.3L (200 CID) I-6 Oil Pump Inlet Tube Installed

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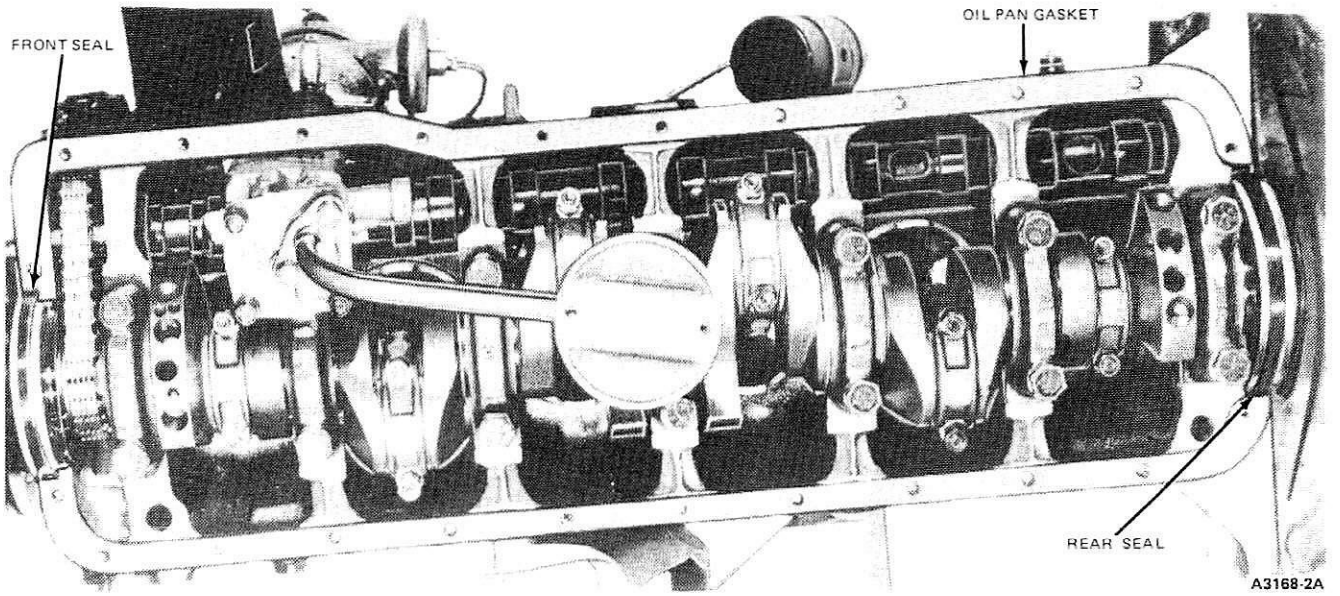


FIG. 25 —3.3L (200 CID) I-6 Oil Pan Gaskets and Seals

2. Position the oil pan seals in the cylinder front cover and rear bearing cap.
3. Insert gasket tabs under front and rear seals.
4. Position oil pan to cylinder block and install attaching bolts.
5. Position transmission cooler lines.
6. Lower jack under transmission.
7. Raise engine to remove spacers and lower engine to chassis.
8. Tighten (2) nuts attaching rear support insulator to crossmember.
9. Install (2) engine support to chassis through bolts and nuts.
10. Position starter and install (2) attaching bolts and starter cable.
11. Reposition sway bar to chassis and install (4) bolts and nuts.
12. Lower vehicle partially and fill crankcase with oil.
13. Install oil level dipstick.
14. Connect oil cooler lines to radiator, install upper radiator support.
15. Lower vehicle, start engine and check for leaks.

OIL PUMP

Removal

1. Remove the oil pan and related parts as outlined under Oil Pan Removal.
2. Remove the oil pump attaching bolts and remove the oil pump, gasket, and intermediate drive shaft.

Installation

1. Prime the oil pump by filling the inlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
2. Position the intermediate drive shaft into the distributor socket.
3. Position a new gasket on the pump housing. Insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.** Torque the oil pump attaching screws to specifications.
4. Install the oil pan and related parts as outlined under Oil Pan Installation.

CRANKSHAFT REAR OIL SEAL

A split-lip type crankshaft rear oil seal is used for replacement on all engines. **If replacement is necessary, this type of seal must be used.** The complete seal can be replaced without removing the crankshaft. Refer to Part 21-01 for removal and installation procedures.

MAIN BEARINGS

Do not file or lap bearing caps or use bearing shims to obtain the proper bearing clearance.

Main bearings are available for service in standard sizes and 0.001 and 0.002 inch undersize. Undersize bearings, which are not selective fit, are available for use on journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump inlet tube and the oil pump.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

   Remove the main bearing cap to which new bearings are to be installed.
4. Insert the upper bearing removal tool (Tool 6331) in the oil hole in the crankshaft.

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5. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.

Installation

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear. **When replacing standard bearings with new bearings, fit bearings to minimum specified clearance.** If the desired clearance cannot be obtained with a standard bearing, try one half of a 0.001 or 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance. Be certain that bearings and that the bearing bore in the block or cap are clean. Foreign material under a bearing insert can cause bearing failure.
2. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 can be inserted in the oil hole in the crankshaft. With Tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
3. Install the cap bearing.
4. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
5. If the rear main bearing is replaced, replace the oil seal in the rear main bearing cap as described under Crankshaft Rear Oil Seal in Part 21-01.
6. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings, then install the bearing cap. Torque the cap bolts to specifications. Repeat the procedure for the remaining bearings that require replacement.
7. If the thrust bearing cap (No. 5 main bearing) has been removed, install it as follows:

   Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 26). Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specification.
8. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Then install the oil pump and the inlet tube, following instructions under Oil Pan Installation.
9. Clean the gasket surfaces of the block and oil pan. Be sure to clean the seal grooves of the block and oil pan. The oil pan has a two-piece gasket. Coat the block side of the gasket with an oil resistant sealer. Position the oil pan gasket on the block, then install the oil pan and related parts following instructions under Oil Pan Installation. Install the oil level dipstick.
10. Fill the crankcase to the proper level with the recommended engine oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARINGS

Removal

1. Follow steps 1 and 2 under Main Bearing Replacement.
2. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean crankshaft journal. When replacing standard bearings with new bearings, fit the bearing to minimum specified clearance.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitted in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After bearing has been fitted, clean and apply light coat of engine oil SE to journal and bearings. Install connecting rod cap. Be sure connecting rod bolt heads are properly seated in connecting rod. Torque nuts to specifications.
7. Repeat the procedure for the remaining connecting rods that require new bearings.

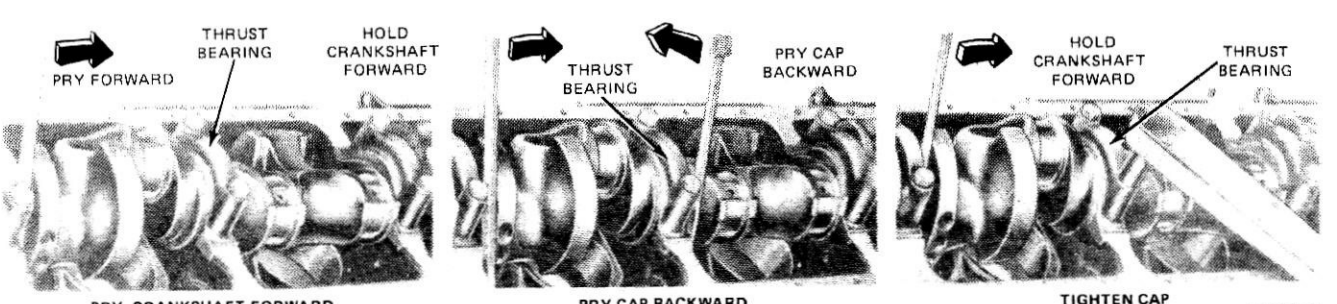


FIG. 26 Typical Thrust Bearing Alignment

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8. Install the oil pump assembly and oil pan following the procedure under Main Bearings.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase.
2. Refer to Cylinder Head Removal and remove the cylinder head and related parts.
3. Remove the oil pan and related parts. Remove the oil pump inlet tube and the oil pump.
4. Turn the crankshaft until the piston to be removed is at the bottom of the stroke, then place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
5. Make sure all the connecting rod caps are marked so that they can be installed in the original positions. Remove the connecting rod cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. Avoid damage to the crankpin or the cylinder wall when removing the piston and rod.

Installation

1. Clean the oil pump inlet tube screen, and the oil pan and block gasket surfaces.
2. Oil the piston rings, pistons and cylinder walls with light engine oil.
3. Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 6, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is transferred from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder.
4. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 27). Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 28). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the notch in the dome of the piston toward the front of the engine (Fig. 30).**
5. Check the clearance of each bearing, following the procedure under Connecting Rod Bearings.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of the stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap. Torque the nuts to specifications.
8. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal (Fig. 29).
9. Prime the oil pump by filling the inlet opening with the oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump and the oil pump inlet tube. Install the oil pan and related parts.

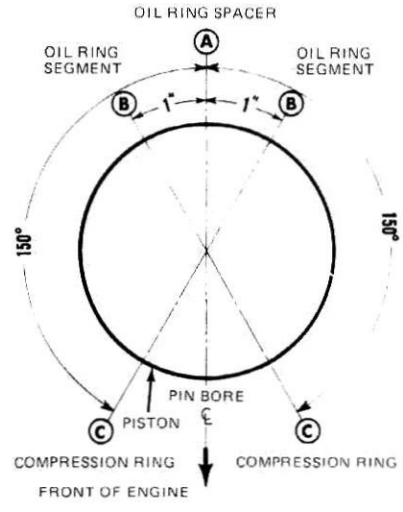


FIG. 27 Piston Ring Gap Spacing

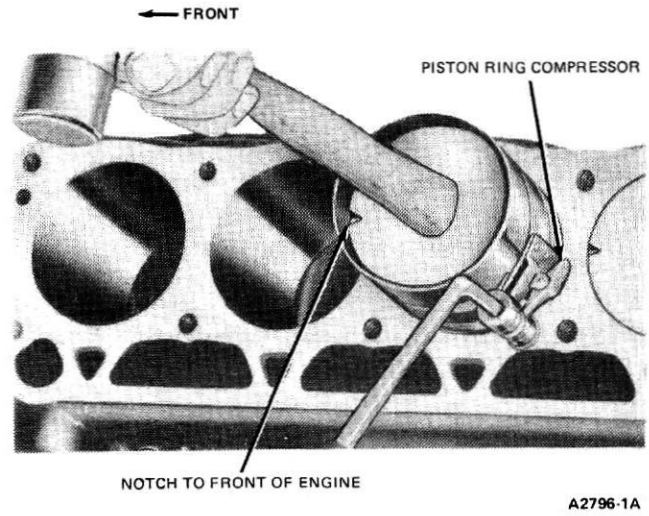


FIG. 28 Piston Installation

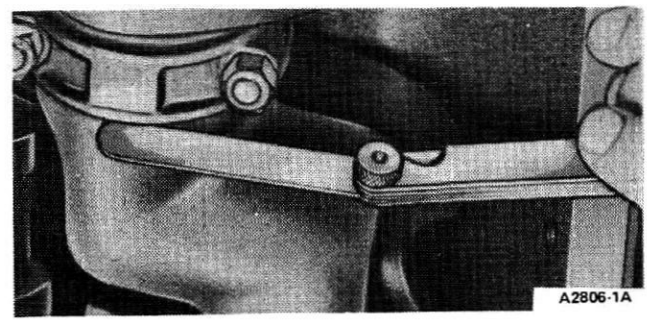


FIG. 29 Typical Connecting Rod Side Clearance

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10. Install the cylinder head by following the instructions under Cylinder Head Installation.
11. Fill the crankcase with proper grade of oil.
12. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil, coolant, fuel and vacuum leaks.
13. Check and adjust the ignition timing, engine idle speed and the fuel mixture.
14. Install the air cleaner assembly.

CRANKSHAFT

Removal

The crankshaft and related parts are shown in Fig. 31.

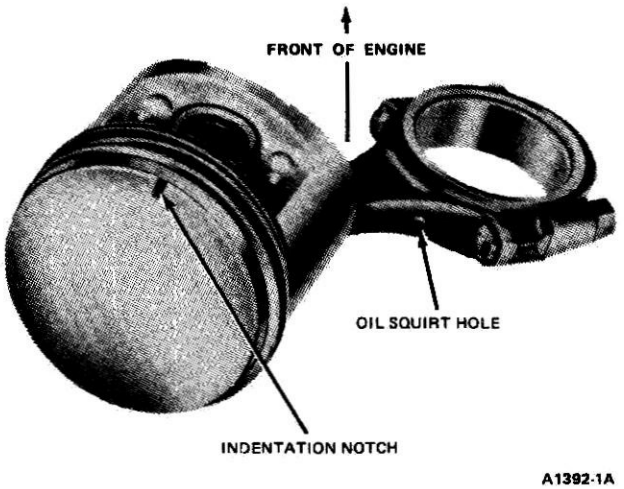


FIG. 30 Typical Piston and Connecting Rod Assembly

1. With engine removed from vehicle and placed on a work stand, remove the oil level dipstick.
2. Remove the accessory drive pulley (if so equipped). Remove the crankshaft damper attaching bolt and washer. Remove the crankshaft vibration damper using Tool T58P-6316-B.
3. Remove the cylinder front cover and air conditioning idler pulley assembly (if so equipped). Remove the cover gasket.
4. Check the timing chain deflection as detailed in Part 21-01; then remove the timing chain and sprockets as detailed under Cylinder Front Cover and Timing Chain Removal.
5. Invert the engine on the work stand. Remove the flywheel. Remove the oil pan and gasket. Remove the oil pump.
6. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations. Turn the crankshaft until the connecting rod from which the cap is being removed is down. Remove the connecting rod cap. Push the connecting rod and piston assembly up in the cylinder. Repeat for the remaining caps.
7. Remove the main bearing caps.
8. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap.

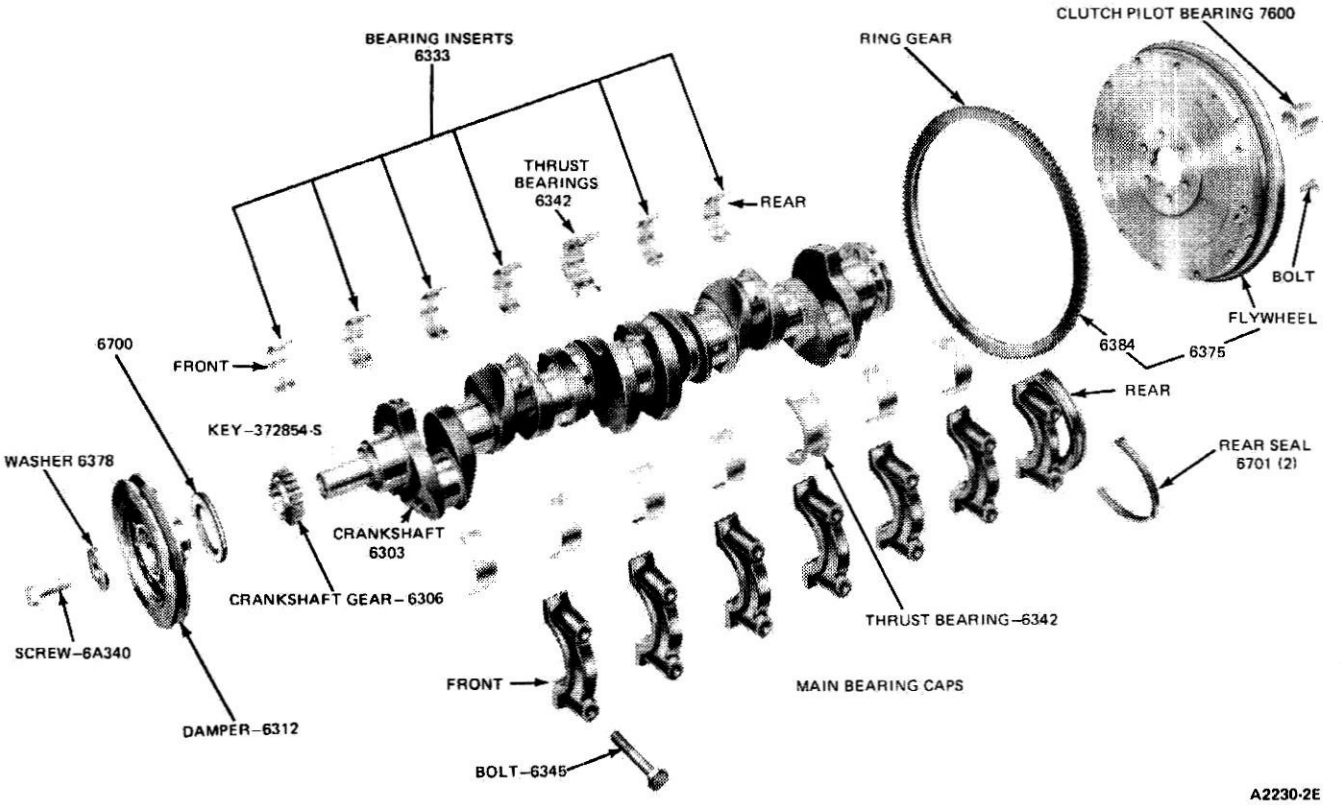


FIG. 31 Crankshaft and Related Parts

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2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. Clean the rear journal oil seal grooves. Install a new rear journal oil seal in the block and rear main bearing cap.
5. Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface. **Do not apply sealer to the area forward of the oil slinger groove.**
6. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
7. Place the upper main bearing inserts in position in the bores with the tang fitting the slot provided.
8. Install the lower main bearing inserts in the bearing caps.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**
10. Check the clearance of each main bearing. Select fit the bearings for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No. 5 bearing). **Be sure that the main bearing caps are installed in the original locations. Torque the bearing cap bolts to specifications.**
12. Align thrust bearing as described under Main Bearings.
13. Check crankshaft end plays as detailed in Part 21-01.
14. If the end play exceeds specifications, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks or dirt. If the thrust faces are not damaged or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the recommended procedure described under Main Bearings. Check the end play which should be within specifications.
15. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under Connecting Rod Bearings.
16. If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearings.
17. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
18. Install the connecting rod cap. Torque the nuts to specifications.
19. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each connecting rod crankshaft journal.
20. Turn the engine on the work stand so that the front end is up. Install the timing chain and sprockets, cylinder front cover and crankshaft pulley or damper, as detailed under Cylinder Front Cover and Timing Chain Installation.
21. Clean the oil pan, oil pump, and oil pump screen.
22. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump following steps 1, 2 and 3 under Oil Pump Installation. Install the oil pan following steps 2 thru 5 under Oil Pan Installation.
23. Position the flywheel on the crankshaft. Apply oil-resistant sealer to the flywheel attaching bolts. Install and torque the bolts to specifications.

    On a flywheel for a manual-shift transmission, locate the clutch disc and install the pressure plate.
24. Turn the engine on the work stand so that the engine is in the normal position. Install the oil level dipstick. Install the accessory drive pulley (if so equipped). Install and adjust the drive belt and accessory belts to specifications.
25. Remove the engine from the work stand and install it in the vehicle, following engine installation instructions.

CAMSHAFT BEARING

The camshaft bearings are available pre-finished to size and require no reaming for standard and 0.015 inch undersize journal diameters.

Removal

1. Remove the engine following the procedures under Engine Removal and Installation. Place the engine on a work stand and remove the flywheel and the camshaft. Remove the rear bearing bore plug.
2. Remove the camshaft bearings with the tool shown in Fig. 32.
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 32. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the

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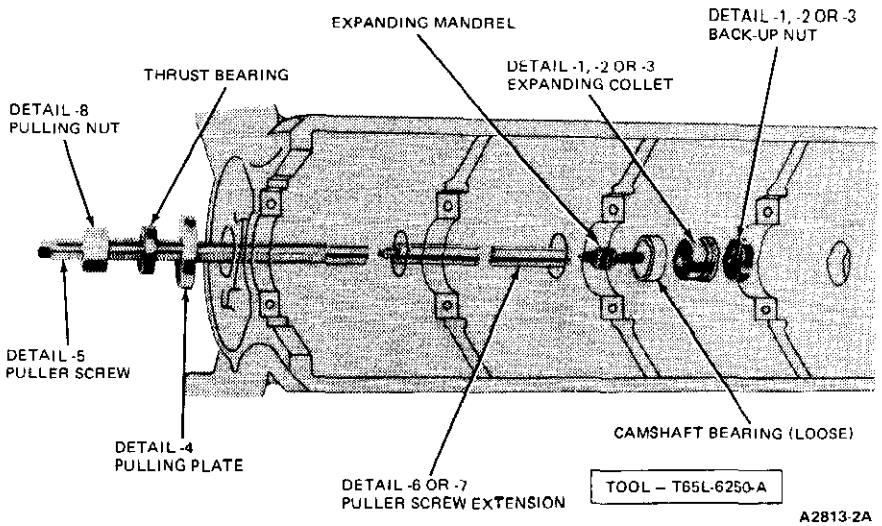


FIG. 32 Typical Camshaft Bearing Replacement

bearings with the oil holes in the cylinder block when the bearings are installed. **Be sure the front bearing is installed below the front face of the cylinder block to specifications. The rear has two oil holes and must be installed 24-3/4 inches from the face of the camshaft thrust plate surface. Check the oil passage that feeds the rocker arm shaft for obstructions by squirting oil into the opening in the cylinder *block and observing the flow through the oil* hole at the rear camshaft bearing.**

2. Install a new bearing bore plug as detailed in Part 21-01.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures. Do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

OIL FILTER

Removal

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

Installation

1. Add one quart of the proper type and grade of oil *to the crankcase. Coat the gasket on the* replacement filter with oil. Position the filter on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to the Specification at the end of this Part for torque specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer. Refer to Part 21-01, *for cleaning* and inspection procedures.**

VALVE ROCKER ARM SHAFT ASSEMBLY

Disassembly

1. Remove the pin and spring washer from each end of the valve rocker arm shaft.
2. Slide the valve rocker arms, springs, and supports off the shaft. Be sure to identify the parts.
3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end. Use a steel rod to knock out the plug on the opposite *end. Working from the open end,* knock out the remaining plug.

Assembly

1. All rocker arms and rocker arm shafts are to be lubricated with heavy oil SE before assembly.

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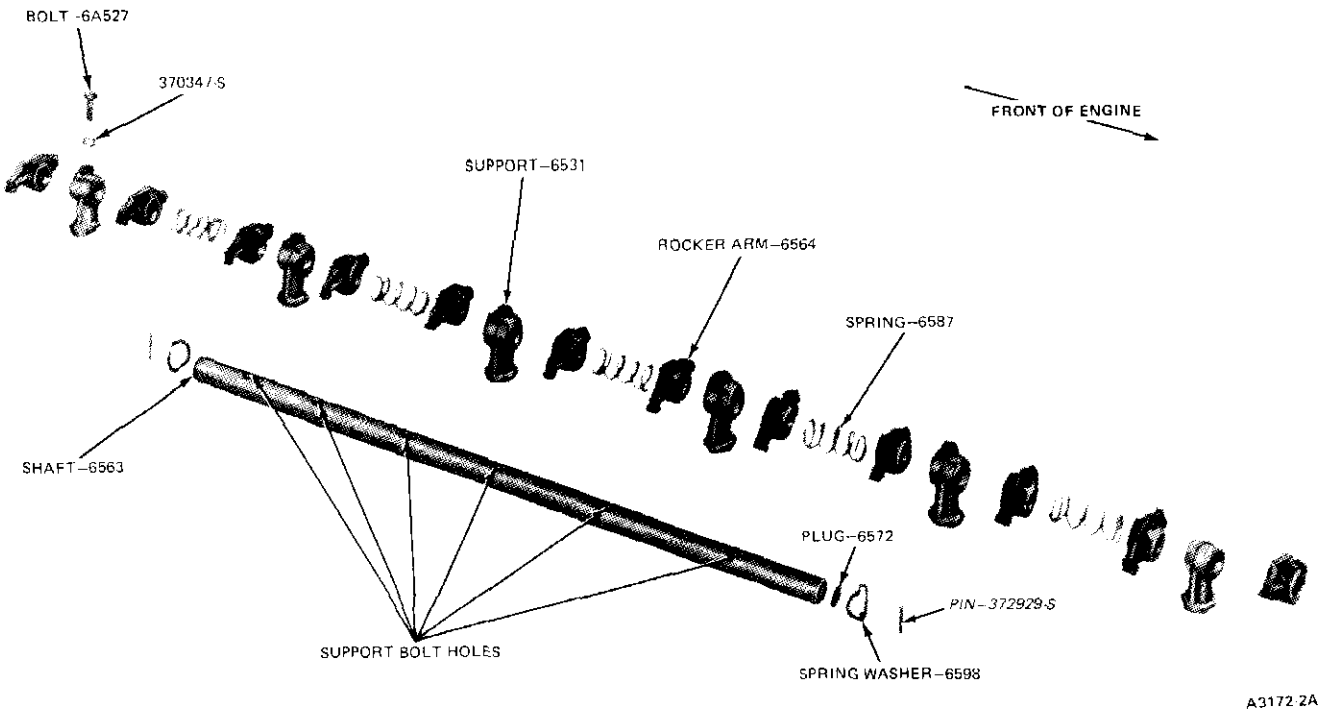


FIG. 33 Valve Rocker Arm Shaft Assembly

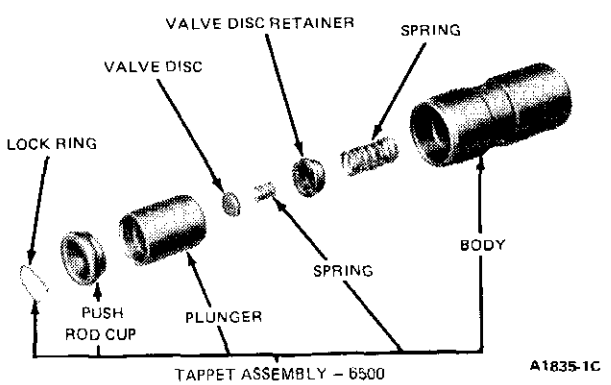


FIG. 34 Typical Tappet Assembly

2. If the plugs were removed from the ends of the shaft, use a blunt tool or large diameter pin punch and install a plug, cup side out, in each end of the shaft.
3. Install the spring washer and pin on one end of the shaft.
4. Install the valve rocker arms, supports, and springs in the order shown in Fig. 33. **Be sure the oil holes in the shaft are facing downward. Complete the assembly by installing the remaining spring washer and pin.**

HYDRAULIC TAPPETS

Disassembly

Each tappet is a matched assembly; therefore, the parts are not interchangeable. Disassemble and assemble each tappet carefully, keeping the assemblies in proper sequence so they will be installed in the original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.
2. Remove the push rod cup, plunger and spring.
3. Invert the plunger assembly and remove the check valve retainer by carefully prying up on it with a screw driver. Remove the check valve and spring. Refer to Part 21-01 for Cleaning, Inspection and Testing Procedures.

Assembly

A typical hydraulic tappet assembly is shown in Fig. 34.

1. Place the plunger in the inverted position on a clean work bench.
2. Place the check valve in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve.
3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring and then the plunger (open end up) into the tappet body.
5. Place the push rod seat in the plunger.
6. Depress the plunger and position the closed end of the lock ring in the tappet body groove. Release the plunger; then depress it again to fully seat the lock ring.

CYLINDER HEAD

Disassembly

1. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush

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before removing the valves. **Be careful not to scratch the cylinder head gasket surfaces.**

2. Compress the valve springs (Fig. 35). Remove the valve retainer locks and release the spring. If the valve locks are stuck, place a piece of steel tubing (3/4 inch OD, 1/2 inch ID and 3 inches long) over the end of the valve stem squarely against the sleeve surface. Tap the tube with a steel hammer to disengage the locks.
3. Remove the sleeve, spring retainer, stem seal, and valve. Discard the valve stem seals. Identify all valve parts. If the cylinder head is to be replaced, remove the manifold assembly.

Assembly

1. Clean, inspect and repair all parts before assembly. If the cylinder head is being replaced, install the manifold assembly. Lubricate the valve guides and valve stems with heavy engine oil SE. Apply Lubriplate or equivalent to the tips of the valve stems.
2. Install each valve (Fig. 36) in the valve guide from which it was removed or to which it was fitted. Install a new stem seal on the valve.
3. Install the valve spring assembly over the valve. Install the spring retainer and sleeve.
4. Compress the spring and install the retainer locks (Fig. 35).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 37).
6. Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of excess spacers will result in overstressing the valve springs and overloading the camshaft lobes which would lead to spring breakage and worn camshaft lobes.**

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Using an arbor press and the tool shown in Fig. 38, press the piston pin from the piston and connecting rod. Remove the piston rings.

Assembly

The piston, connecting rod and related parts are shown in Fig. 39. Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod. Refer to Part 21-01 for fitting pistons procedure.

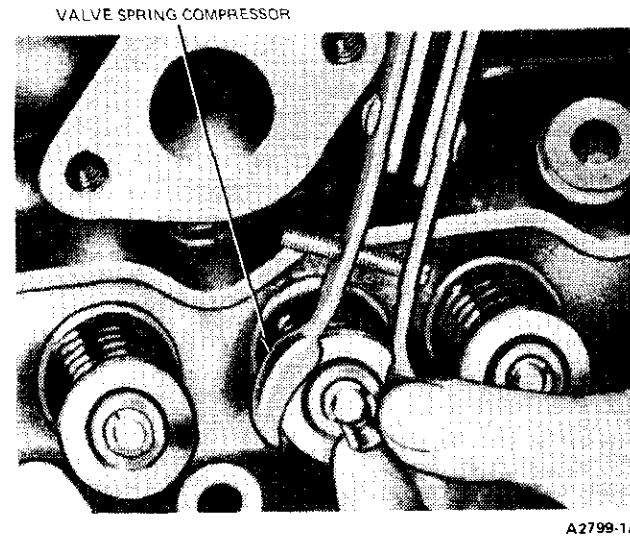


FIG. 35 Compressing Valve Spring—On Bench

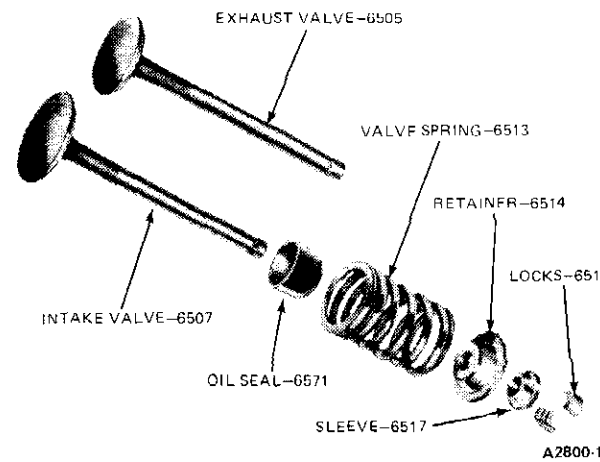


FIG. 36 Typical Valve Assembly

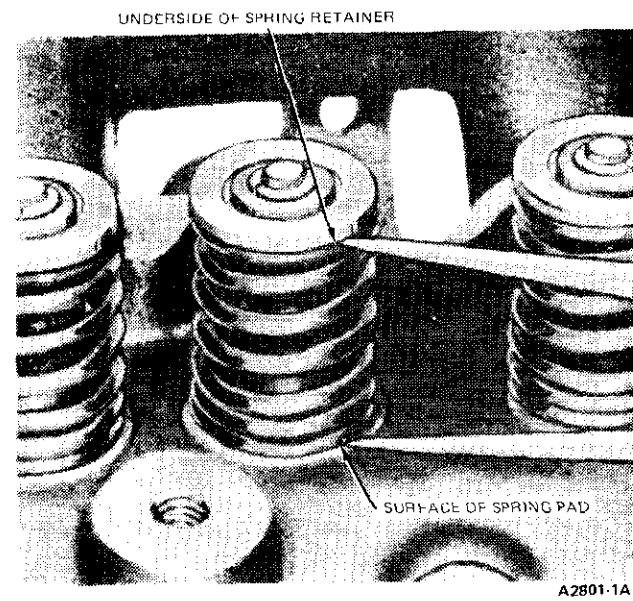


FIG. 37 Checking Valve Spring Assembled Height

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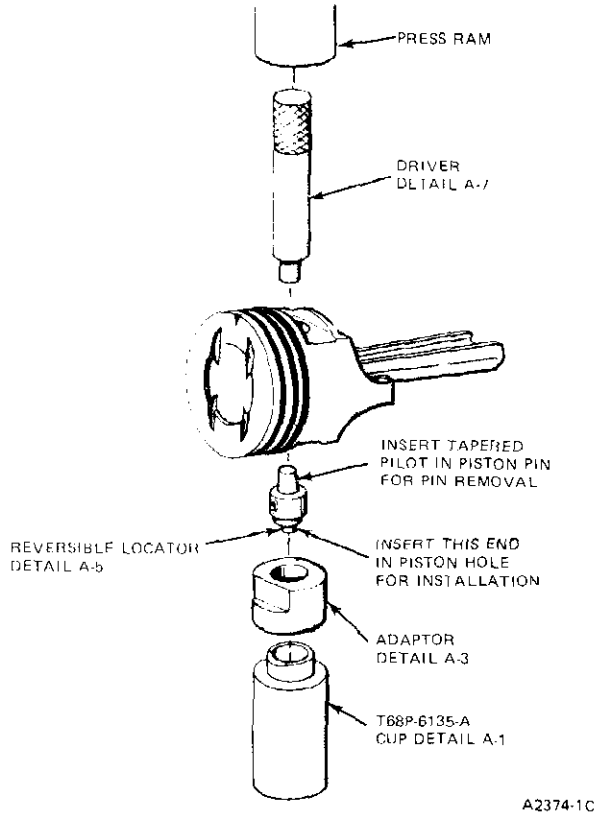


FIG. 38 Removing or Installing Piston Pin

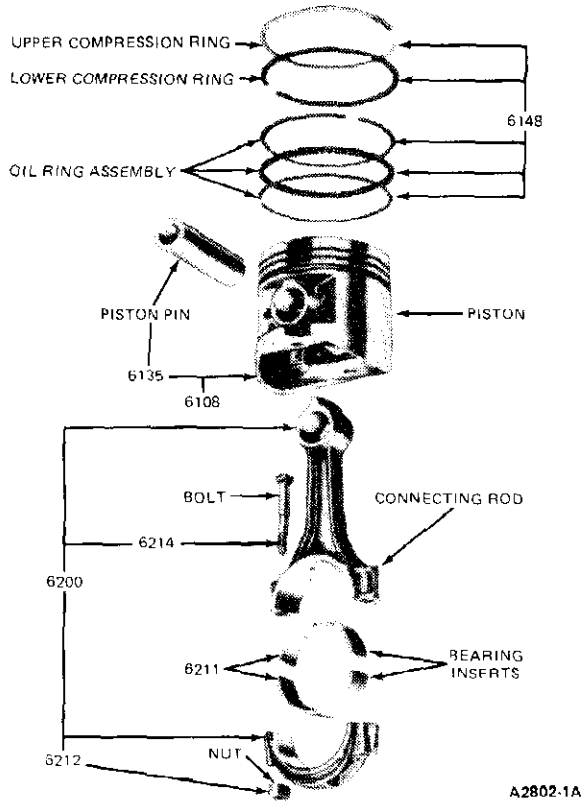


FIG. 39 Typical Piston, Connecting Rod and Related Parts

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications. Refer to specification at the end Section of this part.

1. *Apply a light coat of engine oil to all parts.* **Assemble the piston to the connecting rod with the oil squirt hole in the connecting rod and the indentation in the piston dome positioned as shown in Fig. 30.**
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press, press the piston pin through the piston and connecting rod until the pin is centered in the piston (Fig. 38).
3. Check the end gap and spacing (Fig. 27) of all piston rings. They must be within specifications.
4. Follow the manufacturer's instructions (included with the piston ring package) and install the piston rings.
5. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and the lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
6. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY

Disassembly

1. Mount the old engine on a work stand and remove all parts not furnished with the new cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
2. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder assembly on a work stand and transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Mount on a work stand and completely disassemble the old engine, following the procedures given in the Removal and Installation Section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.

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DETROIT

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in the work stand and transfer all serviceable parts removed from the old cylinder block, following the instructions given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

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SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	3.3L/4.1L (200 CID/250 CID)
NUMBER OF CYLINDERS	6
BORE AND STROKE	3.68 x 3.13 3.3L (200 CID)
	3.68 x 3.91 4.1L (250 CID)
FIRING ORDER	1-5-3-6-2-4
OIL PRESSURE (Hot @ 2000 RPM)	30-50 3.3L (200 CID)
	40-60 4.1L (250 CID)
DRIVE BELT TENSION	①
COMPRESSION PRESSURE	②

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	57.25-60.25
VALVE GUIDE BORE DIAMETER	0.3115-0.3125
VALVE SEATS	
Width – Intake	0.060-0.080
Width – Exhaust	0.070-0.090
Angle	45°
Runout Limit (T.I.R. Max)	0.002
VALVE ARRANGEMENT (Front to Rear)	E-I-I-E-I-EE-I-E-I-I-E
VALVE STEM-TO-GUIDE CLEARANCE	
Intake	0.0006-0.0025
Exhaust	0.0010-0.0027
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	1.760-1.742
Exhaust	1.381-1.399
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std.)	
Intake	*0.3100-0.3107*
Exhaust	0.3098-0.3105
(0.003 Oversize)	
Intake	0.3130-0.3137
Exhaust	0.3128-0.3135
(0.015 Oversize)	
Intake	0.3250-0.3257
Exhaust	0.3248-0.3255
(0.030 Oversize)	
Intake	*0.3400-0.3407*
Exhaust	0.3398-0.3405
VALVE SPRINGS	
Compression Pressure (Lb. @ Spec. Length)	51-57 @ 1.59
	142-158 @ 1.22
Free Length (Approximate)	1.79
Assembled Height	1-9/16–1-19/32
Service Limit	10% Pressure Loss @ Spec. Length
Out-Of-Square Limit	5/64 (0.078)
ROCKER ARM	
Shaft Diameter	0.7797-0.7807
Bore Diameter	0.7830-0.7845
Ratio	1.52:1
PUSH ROD RUNOUT (T.I.R. Max)	0.020
GASKET SURFACE FLATNESS	③
Surface Finish (RMS)	60-150
VALVE TAPPET, LIFTER OR ADJUSTER	
Diameter (Std.)	0.8740-0.8745
Clearance To Bore	0.0007-0.0027
Service Limit	0.0005
Hydraulic Leakdown Rate	5-50 Seconds④
Collapsed Tappet Gap – Allowable	0.085-0.185 3.3L (200 CID)
	0.071-0.209 4.1L (250 CID)
Collapsed Tappet Gap – Desired	0.110-0.160 3.3L (200 CID)
	0.096-0.184 4.1L (250 CID)

CAMSHAFT	
LOBE LIFT	
Intake	0.245
Exhaust	0.245
Allowable Lobe Lift Loss	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.372
Exhaust	0.372
END PLAY	0.001-0.007
Service Limit	0.009
JOURNAL-TO-BEARING CLEARANCE	*0.001-0.003*
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010

CAMSHAFT (Continued)	
JOURNAL DIAMETER	
# 1	1.8095-1.8105
# 2	1.8095-1.8105
# 3	1.8095-1.8105
# 4	1.8095-1.8105
Runout Limit	0.008
Out-Of-Round Limit	0.005 (Max. T.I.R.)
FRONT BEARING LOCATION⑤	0.030-0.050

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	③
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	3.6800-3.6848
Surface Finish (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPPET BORE DIAMETER	0.8752-0.8767
MAIN BEARING BORE DIAMETER	2.4012-2.5020 3.3L (200 CID)
	2.5902-2.5910 4.1L (250 CID)
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.5155-0.5170

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.2482-2.2490 3.3L (200 CID)
	2.3982-2.3990 4.1L (250 CID)
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Per Inch
Journal Runout Limit	*0.002 Max.*
Surface Finish (RMS)	12 Max.
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	1.275-1.277 3.3L (200 CID)
	1.199-1.201 4.1L (250 CID)
CONNECTING ROD JOURNAL	
Diameter	2.1232-2.1240
Out-Of-Round Limit	0.0006 Max.
Taper Limit	*0.0008 Per Inch*
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish (RMS)	35 Front – 25 Rear
Runout Limit	0.001 Max.
FLYWHEEL CLUTCH FACE	
Runout Limit (T.I.R.)	0.010
FLYWHEEL RING GEAR LATERAL RUNOUT (T.I.R.)	
Standard Transmission	0.030
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CONNECTING ROD BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0008-0.0026
Bearing Wall Thickness (Std.)⑥	0.0569-0.0574
MAIN BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0008-0.0024
Bearing Wall Thickness (Std.)⑥	0.0954-0.0957

① **Drive Belt Tension (Lbs.)**

Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(A)
(B) If less than 40 pounds, readjust to 40-60 pounds.
(C) If less than 90 pounds, readjust to 90-120 pounds.
(D) If less than 75 pounds, readjust to 90-120 pounds.

② To be within specifications, lowest cylinder (PSI) must be within 75% of pressure (PSI) of highest cylinder. See Part 21-01.
③ *0.003 in any 6 inches; 0.006 overall.*
④ Time required for plunger to leak down .48" with 50 lb. load and leakdown fluid in lifter.
⑤ Distance in inches that front edge of bearing is installed below front face of block.
⑥ 0.002 Undersize = Add 0.001 to Standard Thickness.

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DETROIT IRON OFFICIAL LICENSED PRODUCT

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD	
Piston Pin Bore Diameter	0.9104-0.9112
Crankshaft Bearing Bore Diameter	2.2390-2.2398
Out-Of-Round Limit	0.0004 Max.
Taper Limit	0.0004 Max.
Length (Center-to-Center)	4.7135-4.7165 3.3L (200 CID) 5.8785-5.8815 4.1L (250 CID)
Alignment (Bore-to-Bore Max. Dif.)(7)	
Twist	0.024
Bend	0.012
Side Clearance (Assembled to Crank)	
Standard	0.0035-0.0105
Service Limit	0.0140
PISTON	
Diameter(8)	
Coded Red	3.6784-3.6790
Coded Blue	3.6796-3.6802
0.003 Oversize	3.6808-3.6814
Piston-To-Bore Clearance	0.0013-0.0021
Pin Bore Diameter	0.9124-0.9127
Ring Groove Width	
Compression (Top)	0.080-0.081
Compression (Bottom)	0.080-0.081
Oil	0.188-0.189
PISTON PIN	
Length	3.010-3.040
Diameter	
Standard	0.9119-0.9124
0.001 Oversize	0.9130-0.9133
0.002 Oversize	0.9140-0.9143
Pin-To-Piston Clearance	0.0003-0.0005
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.002-0.004
Compression (Bottom)	0.002-0.004
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.008-0.016
Compression (Bottom)	0.008-0.016
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs. @ Spec. Length)	9.0-10.1 @ 1.078 3.3L (200 CID) 20.6-22.6 @ 2.49 4.1L (250 CID)
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U.S.)	4(9)

FUEL PUMP

STATIC PRESSURE (P.S.I.)(10)	5.0-7.0
MINIMUM VOLUME FLOW(10)(11)	1 Pt. in 20 Sec.
ECCENTRIC TOTAL LIFT (Inches)	0.290-0.310

TORQUE SPECIFICATIONS

CAMSHAFT SPROCKET TO CAMSHAFT	35-45
CAMSHAFT THRUST PLATE TO BLOCK	12-18
CONNECTING ROD NUTS OR BOLTS	21-26
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FUEL PUMP TO CYLINDER BLOCK OR FRONT COVER	12-18
FLYWHEEL TO CRANKSHAFT	75-85
MAIN BEARING CAP BOLTS	60-70
MANIFOLD TO CYLINDER HEAD (Exhaust)	18-24

TORQUE SPECIFICATIONS (Continued)

OIL FILTER INSERT TO CYLINDER BLOCK	10-15
OIL FILTER TO BLOCK OR ADAPTER	(13)
OIL INLET TUBE TO OIL PUMP	10-15
OIL PAN DRAIN PLUG	15-25
OIL PAN TO CYLINDER BLOCK	7-9
OIL PUMP TO CYLINDER BLOCK	10-15
PULLEY TO DAMPER (Bolt)	35-50
ROCKER ARM SUPPORT SHAFT TO CYLINDER HEAD	30-35
SPARK PLUG TO CYLINDER HEAD	10-15
VALVE ROCKER ARM COVER	3-5
ALTERNATOR BRACKET TO CYLINDER BLOCK (Bolt)	35-50
ALTERNATOR ADJUSTING ARM TO CYLINDER BLOCK	15-20 3.3L (200 CID) 35-50 4.1L (250 CID)
ALTERNATOR ADJUSTING ARM TO ALTERNATOR	24-40
THERMACTOR PUMP BRACKET TO CYLINDER BLOCK	12-18 3.3L (200 CID) 22-32 4.1L (250 CID)
THERMACTOR PUMP PIVOT BOLT	22-32 3.3L (200 CID) 30-45 4.1L (250 CID)
THERMACTOR PUMP ADJUSTING ARM TO PUMP	12-18
THERMACTOR PUMP ADJUSTING ARM TO CYLINDER BLOCK	20-28
THERMACTOR PUMP PULLEY TO SHAFT	130-118 In.-Lb.
POWER STEERING PUMP PULLEY TO DAMPER (Bolt)	35-50
FAN TO WATER PUMP HUB (Bolt)	12-18
CARBURETOR MOUNTING NUTS	12-15
CARBURETOR SPACER TO INTAKE MANIFOLD	12-15
CARBURETOR MOUNTING STUD	15 Max.
FUEL FILTER TO CARBURETOR	80-100 In.-Lb.

TORQUE SPECIFICATIONS – General Applications

U.S. THREAD SIZES	TORQUE
1/4-20	6-9
5/16-18	12-18
5/16-24	14-20
3/8-16	22-32
3/8-24	27-38
7/16-14	40-55
7/16-20	40-60
1/2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	12-18
3/8	22-33
1/2	25-35

- All values are in ft.-lb. unless otherwise noted.
- Oil threads with engine oil unless fasteners require sealers.

(7) Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of an 8" bar—4" on each side of rod centerline.
(8) Measured at the pin bore centerline at 90° to the pin.
(9) Add 1 quart with filter change.
(10) On engine, normal temperature, curb idle, in neutral.
(11) Inside diameter of smallest orifice not less than 0.220".
(12) In sequence: Step 1 = 50-55; Step 2 = 60-65; Step 3 = 70-75.
(13) 1/2 turn after gasket contacts sealing surface – with oiled gasket.

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2.8L V-6 Engine

PART 21-12

Pinto, Bobcat and Mustang II

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CA4286-2B

DESCRIPTION

ENGINE

The compact Ford 60-degree 2.8L V-6 engine (Figs. 1 and 2) is of modern lightweight cast-iron construction. It has precision-molded cast iron crankshaft, supported on four replaceable copper alloy bearings. Camshaft and connecting rod bearings are also replaceable. The connecting rods are made of forged steel.

Except for the 60-degree block inclination, it is similar to a V-8 in construction and service accessibility.

EXHAUST EMISSION CONTROL SYSTEM

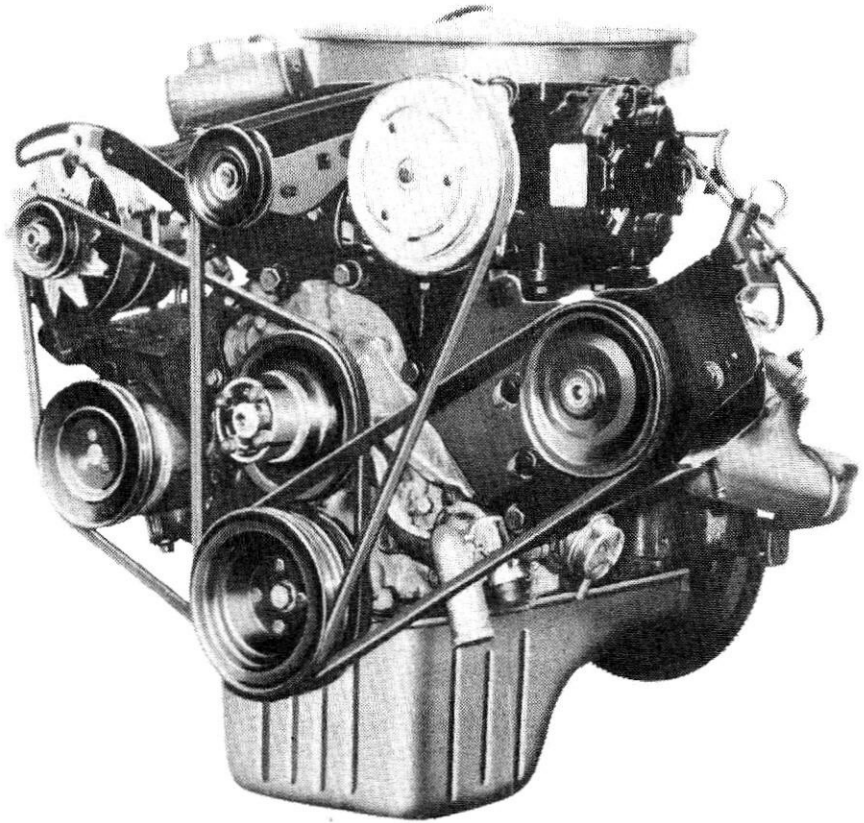
Operation and required maintenance of the exhaust emission control devices used on this engine are covered in Groups 29 and 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

The engine is equipped with a positive, closed-type crankcase ventilation system re-cycling the crankcase vapors to the intake manifold.

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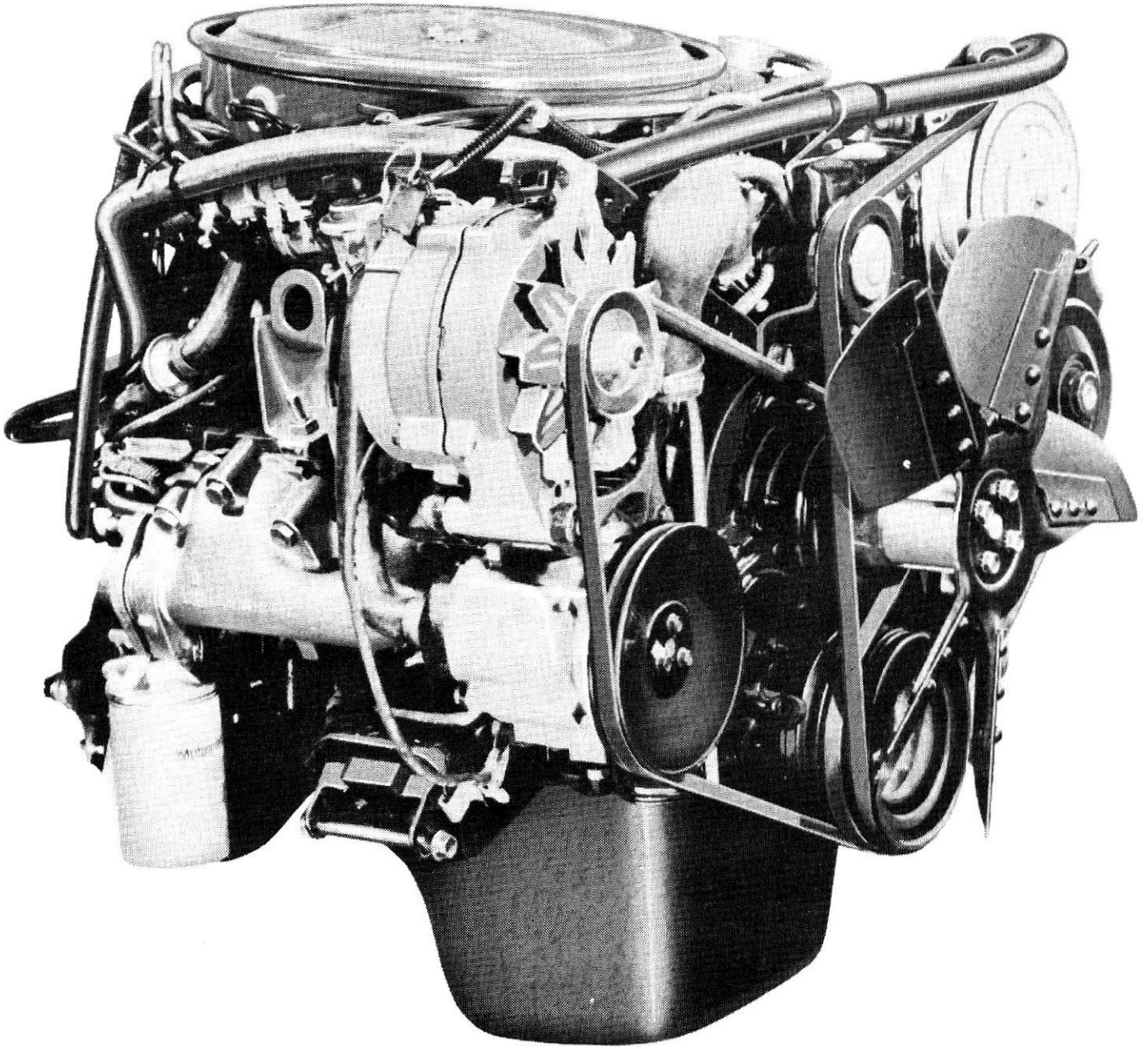
DETROIT IRON



A3717-2C

FIG. 1 2.8L V-6 Engine—With Thermactor and A/C—Left Front View

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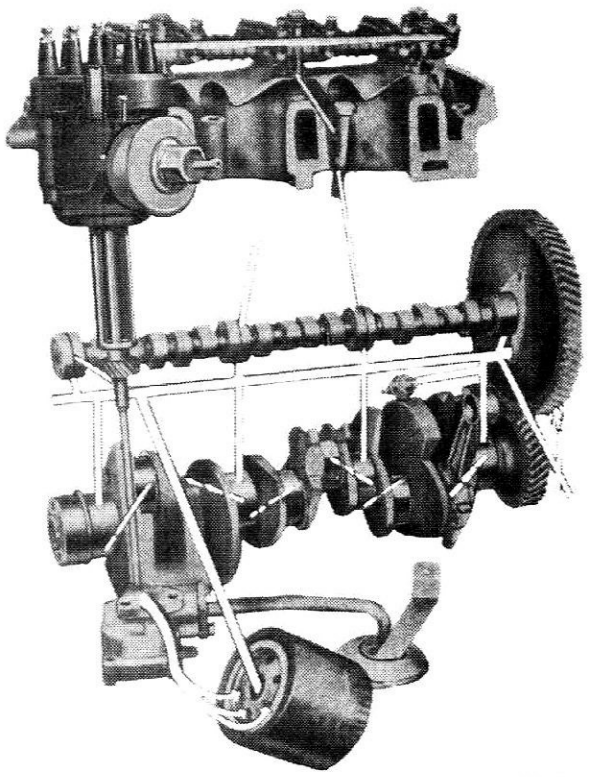


A3718-2B

FIG. 2 2.8L V-6 Engine—With Thermactor and A/C—Right Front View

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DETROIT IRON



A3541-2B

FIG. 3 V-6 Engine Full Pressure Lubrication System

ADJUSTMENTS

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

VALVE CLEARANCE

If some component of the valve train is replaced, i.e., rocker arm, push rod, camshaft, etc., it will be necessary to make a valve lash adjustment **before starting the engine.**

Cold Adjustment

1. Remove air cleaner assembly.
2. Disconnect negative battery cable from battery.
3. Disconnect hose between thermactor bypass valve and check valve at check valve.
4. Disconnect hose between thermactor air pump and bypass valve at bypass valve.
5. Disconnect thermactor bypass valve mounting bracket from engine and remove thermactor bypass valve, mounting bracket and hose to check valve.
6. Remove and discard both lifting eyes.
7. Remove alternator drive belt from alternator and rotate alternator outward toward fender.
8. Disconnect spark plug wires from spark plugs and rocker arm covers.
9. Remove electric assist choke wire from choke cap.
10. Remove wiring harnesses from attaching brackets on rocker arm covers as required and reposition to facilitate rocker arm cover removal.
11. Remove PCV valve from rocker arm cover.
12. Reposition vacuum hoses as required to facilitate rocker arm cover removal.
13. Remove rocker arm cover attaching screws.
14. Remove rocker arm covers.
15. Torque rocker arm support bolts to specification.
16. Reconnect battery cable.
17. Make sure transmission is in Neutral (manual transmission), or in Park (P) (automatic transmission), and that parking brake is applied.
18. ADJUST VALVE LASH AS FOLLOWS:
    a. Place a finger on adjusting screw of intake valve rocker arm for cylinder No. 5. The slightest motion of the rocker arm can be detected in this way.
    b. Using a remote starter button or equivalent, "bump" the engine over until the intake valve for cylinder No. 5 just begins to open. The camshaft is now in the correct position to adjust the valves on No. 1 cylinder.
    c. Adjust the No. 1 intake valve so that a 0.016" feeler has a light to moderate drag and a 0.017" feeler is very tight. (Turn adjusting screw clockwise to decrease lash and counterclockwise to increase lash). See Fig. 4. Adjusting screws are self-locking and will stay in set position.

    NOTE: Do not use step-type "go/no-go" feeler gages.

    CAUTION: When checking lash, insert feeler between rocker arm and valve tip at front (or rear) edge of valve tip and move toward opposite edge

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with a rearward (or forward) motion that is parallel to centerline of the crankshaft. **Do not insert feeler at outboard edge and move inward toward carburetor** (perpendicular to the crank centerline). This will produce an erroneous "feel" that will result in excessively tight valves.

d. Using the same method, adjust the No. 1 exhaust valve lash so that a 0.018" feeler has a light to moderate drag and a 0.019" feeler is very tight.

e. Adjust the remaining valves, in firing order (1-4-2-5-3-6) by positioning the cam according to the following chart:

To adjust both valves for cylinder #	1	4	2	5	3	6
The intake valve must be opening for cylinder #	5	3	6	1	4	2

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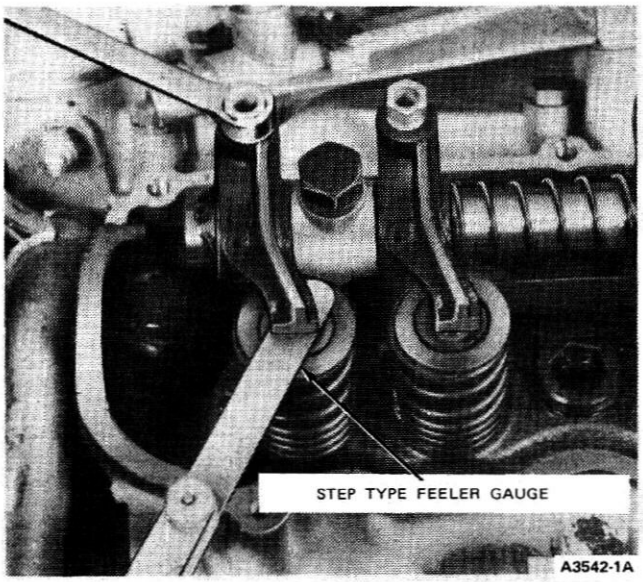


FIG. 4 Adjusting Valve Lash

19. Clean all gasket material from cylinder heads and rocker arm cover gasket surfaces.
20. Disconnect negative battery cable from battery.
21. Reinstall rocker arm covers using new gaskets and torque attaching screws to specification.
22. Reposition vacuum hoses to their original positions.
23. Reinstall PCV valve in rocker arm cover.
24. Replace wiring harnesses on rocker arm covers.
25. Reinstall electric choke assist wire to choke cap.
26. Reinstall spark plug wires on spark plugs and attach to retaining clips on rocker arm covers.
27. Reinstall alternator drive belt and tighten to specification.
28. Reinstall thermactor components.
29. Reconnect battery cable.
30. Reinstall air cleaner assembly and torque wing nut(s) to specification.
31. Start engine and check for oil and vacuum leaks.

REMOVAL AND INSTALLATION

CAUTION: Do not operate engine with hood open until fan has been first checked for possible cracks and separation.

ENGINE ASSEMBLY

Removal

Remove or disconnect Thermactor system parts that will interfere with removal or installation of the engine.

1. Disconnect the battery, drain the cooling system and remove the hood.
2. Remove the air cleaner and intake duct assembly.
3. Disconnect the radiator upper and lower hoses at the radiator.
4. Remove the fan shroud attaching bolts and position the shroud over the fan. Remove the radiator and shroud.
5. Remove the alternator and bracket. Position the alternator out of the way. Disconnect the alternator ground wire from the cylinder block.
6. Disconnect the heater hoses at the block and water pump.
7. Remove the ground wires from the cylinder block.
8. Disconnect the fuel tank to fuel pump fuel line at the fuel pump. Plug the fuel tank line.
9. Disconnect the accelerator cable or linkage at the carburetor and intake manifold.
10. Disconnect the primary wires from the ignition coil. Disconnect the brake booster line. Disconnect the wiring from the oil pressure and engine coolant temperature senders.
11. Raise the vehicle and secure with safety stands.
12. Disconnect the muffler inlet pipes at the exhaust manifolds.
13. Disconnect the starter cable and remove the starter.
14. Remove the engine front support through-bolts.
15. If equipped with automatic transmission, remove the converter inspection cover and disconnect the flywheel from the converter.

    Remove the kickdown rod.

    Remove the converter housing-to-cylinder block bolts and the adapter plate-to-converter housing bolt.

    On vehicles equipped with a manual transmission, remove the clutch linkage.
16. Lower the vehicle.
17. Attach engine lifting sling, Tool No. T53L-300-A and hoist to lifting brackets at exhaust manifolds.
18. Position a jack under the transmission.

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19. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment so that the rear cover plate is not bent or components damaged. Install the engine on a work stand.

Installation

If clutch pressure plate and disc have been removed, install by following procedures in Group 16.

1. Attach engine lifting sling (Tool No. T53L-300-A) and hoist to lifting brackets at exhaust manifolds. Remove engine from work stand.
2. Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes.

   On a vehicle with a manual-shift transmission, start the transmission main shaft into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.** On a vehicle with an automatic transmission, start the converter pilot into the crankshaft.
3. Install the clutch housing or converter housing upper bolts, making sure that the dowels in the cylinder block engage the flywheel housing. Remove the jack from under the transmission.
4. Remove the lifting sling.
5. On automatic transmission equipped vehicles, position the downshift rod on the transmission and engine.
6. Raise the vehicle and secure with safety stands.
7. On a vehicle with an automatic transmission, position the transmission linkage bracket and install the remaining converter housing bolts. Install the adapter plate-to-converter housing bolt. Install the converter-to-flywheel nuts and install the inspection cover. Connect the kickdown rod on the transmission.

   On a vehicle with a manual transmission, remove the pilot studs, then install the clutch lower housing bolts and connect the clutch linkage to the cylinder block.
8. Install the starter and connect the cable.
9. Connect the muffler inlet pipes at the exhaust manifolds.
10. Install the engine front support through bolts.
11. Lower the vehicle.
12. Install the ground wire. Connect the ignition coil primary wires, then connect the coolant temperature sending unit and oil pressure sending unit. Connect brake booster line.
13. Install the accelerator linkage. Connect the vacuum lines. Connect the fuel tank line at the fuel pump.
14. Connect the ground cable at the cylinder block. Connect the heater hoses to the water pump and cylinder block.
15. Install the alternator and bracket. Connect the alternator ground wire to the cylinder block. Install the drive belt and adjust the belt tension to specifications.
16. Position the fan shroud over the fan. Install the radiator and connect the radiator upper and lower hoses. Install the fan shroud attaching bolts.
17. Fill and bleed the cooling system. **See Part 27-01 for detailed cooling system instructions.** Fill the crankcase with the proper grade and quantity of oil. Connect the battery.
18. Operate the engine at fast idle until it reaches normal operating temperature and check all gaskets and hose connections for leaks. Adjust ignition timing and idle speed.
19. Install the air cleaner and intake duct. Install and adjust the hood.

ENGINE FRONT SUPPORTS—(FIGS. 5 AND 6)

The procedures given apply to either a right or left installation. Whenever self-locking fasteners are removed, they must be replaced with new self-locking fasteners (marked * in Fig. 5 and 6).

Removal

1. Remove the fan shroud attaching screws.
2. Support the engine using a wood block and a jack placed under the oil pan.
3. Remove the through-bolt and lock nut attaching the insulator to the insulator support bracket.
4. Remove the support bracket (between front engine mount and frame side rail) attaching bolts and nuts.
5. Raise the engine sufficiently to remove the support bracket.
6. Remove bolt attaching fuel pump shield to LH engine bracket if required.
7. Remove the engine insulator assembly to cylinder block attaching bolts and lockwashers. Remove the engine mount assembly.

Installation

1. Position the engine mount to the cylinder block. Install the bracket bolts and torque to specifications.
2. Install the bolt attaching fuel pump shield to LH bracket (if required) and torque to specification.
3. Install the support bracket to the frame side rail with attaching bolts and locknuts. Torque to specifications.
4. Lower the engine until the engine mount insulator lines up with the support bracket to allow installation of the through-bolt. Install the through bolt and locknut and torque to specifications.
5. Remove the jack and wood block from the engine oil pan.
6. Install the fan shroud attaching screws and torque to specifications.

ENGINE REAR SUPPORT—(FIGS. 5 AND 6) ALL MODELS

Removal

1. Place a block of wood and a jack under the transmission.

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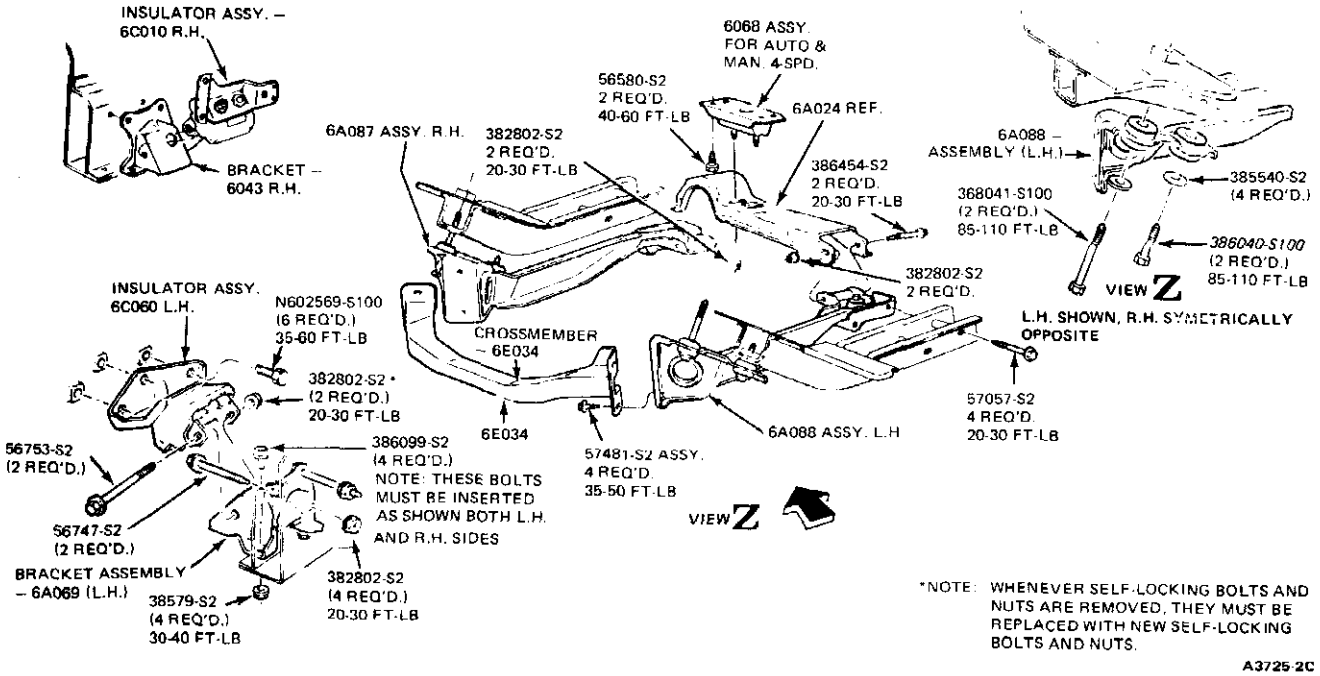


FIG. 5 Engine Supports—Mustang with 2.8L V-6 Engine

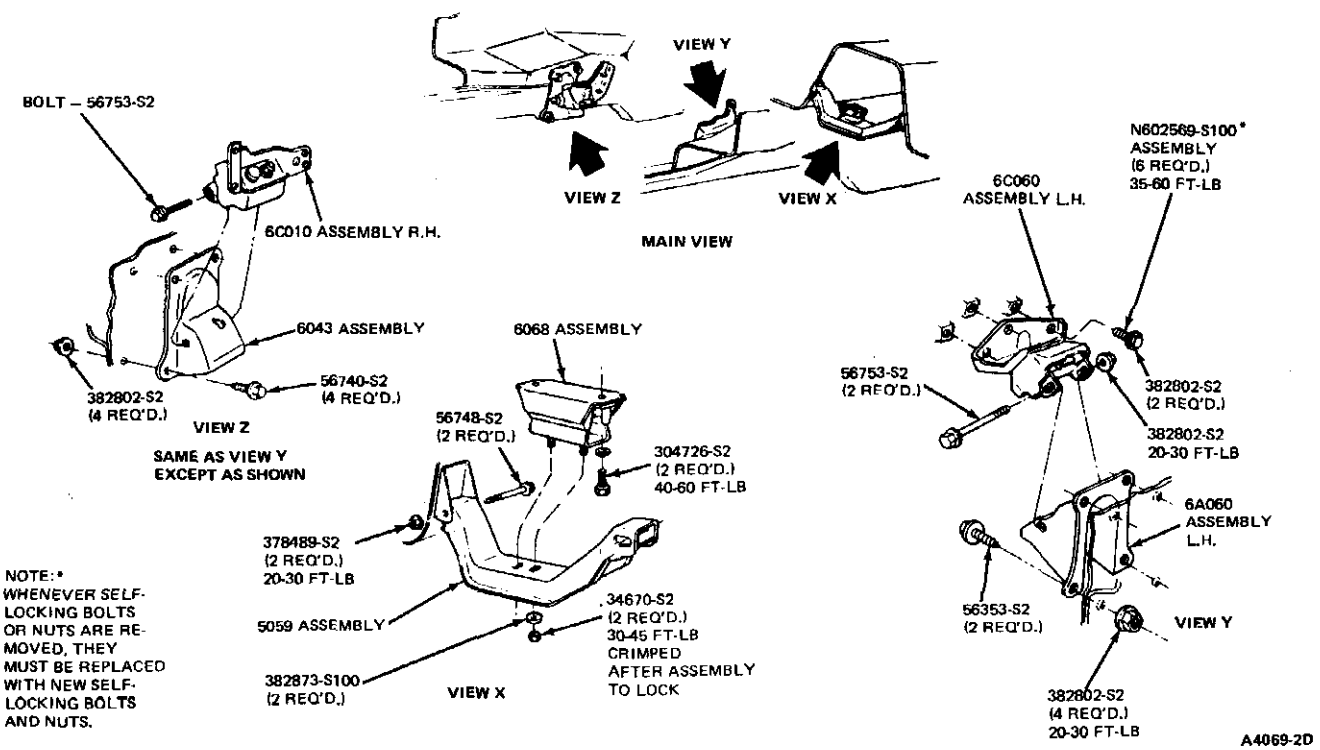


FIG. 6 Engine Supports—Pinto and Bobcat with 2.8L V-6 Engine

2. Remove the two nuts attaching the insulator to the crossmember. Raise the transmission sufficiently to lift the insulator from the crossmember.
3. Remove the two bolts and nuts attaching the crossmember to the frame side rails and remove the crossmember.
4. On vehicles so equipped, remove the fasteners attaching the exhaust hanger to the rear engine mount.
5. Remove the two bolts attaching the insulator to the transmission and remove the insulator (and retainer, if so equipped).

Installation

1. Position the insulator (and retainer, if so

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DETROIT IRON

equipped) to the transmission. Install the two attaching bolts and torque to specification.

2. If required, install the fasteners attaching the exhaust hanger to the insulator and torque to specification.
3. Install the crossmember to the frame side rails and torque the attaching nuts and bolts to specification.
4. Lower the transmission and install the insulator to crossmember attaching nuts and torque to specification.
5. Remove the jack and wood block from under the transmission.

CRANKCASE VENTILATION (PCV) VALVE

Removal

1. Remove the inlet hose from the air cleaner.
2. Remove the air cleaner.
3. Remove the crankcase vent hose and PCV valve from the rocker cover.
4. Disconnect the canister purge hose from the top port of the PCV valve.
5. Disconnect the vent hose from the remaining port of the PCV valve.

Installation

1. Install the PCV valve in the valve cover.
2. Connect the vent hose and the canister purge hose to the PCV valve.
3. Install the air cleaner.
4. Connect the inlet hose to the air cleaner.
5. Operate the engine and check for leaks.

VALVE ROCKER ARM COVER AND ROCKER ARM

Removal

Remove emission control equipment as necessary to remove cover.

1. Disconnect spark plug wires from spark plugs and rocker arm cover, using the proper plier-type tool to remove the wires from the plugs.
2. Disconnect throttle linkage to carburetor if it interferes with removal operation.
3. Remove rocker arm cover attaching screws. Tap rocker arm cover lightly with a plastic hammer to break gasket seal. Lift off rocker arm cover.
4. Remove rocker arm shaft stand attaching bolts by loosening the bolts two turns at a time, in sequence. Lift off rocker arm and shaft assembly and oil baffle (Fig. 7).

Installation

1. Loosen the valve lash adjusting screws a few turns.
2. Apply SE-type engine oil to the assembly to provide initial lubrication.
3. Install oil baffle and rocker arm shaft assembly to the cylinder head and guide adjusting screws on to push rods (Fig. 7).
4. Install and tighten rocker arm stand attaching bolts to specifications, two turns at a time, in sequence.
5. Adjust valve lash to cold specified setting.

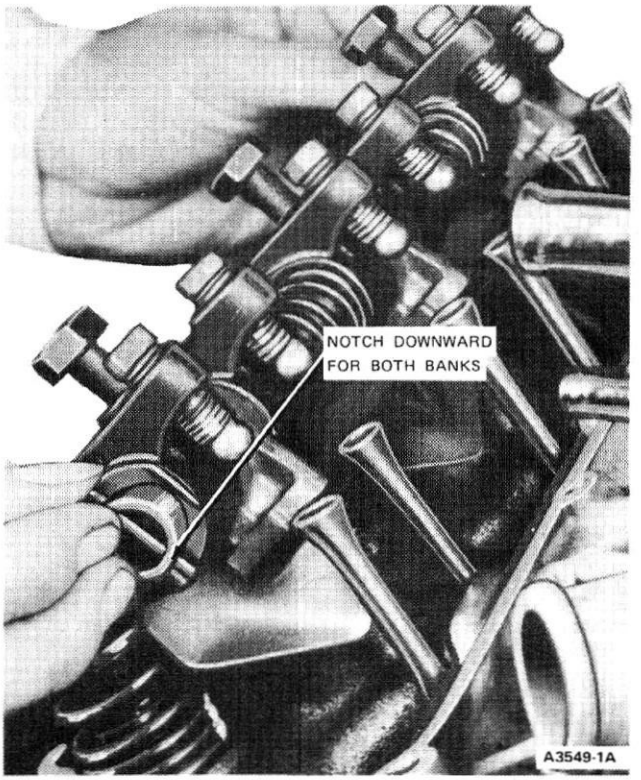


FIG. 7 Removing or Installing Rocker Arm Assembly

6. Clean the valve rocker arm cover and cylinder head gasket surfaces. Coat one side of a new gasket with an oil-resistant sealer and lay cemented side of gasket on the cover. Install the cover, making sure the gasket seats evenly around the head. Tighten the cover attaching bolts to spceifications.
7. Install parts removed to gain access to rocker arm cover.
8. Coat inside of each spark plug boot with silicone lubricant, connect spark plug wires and accelerator control cable. Connect throttle return spring.
9. Start engine and run until normal temperature is reached.
10. Run the engine at fast idle and check for oil leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or leaking valve stem seals and retainer may be replaced without removing the cylinder head provided damage to the valve or valve seat has not occurred.

Removal

1. Remove the air cleaner. Remove the valve rocker arm cover. (Procedure given under Rocker Arm Removal.) Remove the applicable spark plug wire and spark plug.
2. Remove the valve rocker arm shaft. Remove both valve push rods of the cylinder to be serviced. (Procedures given under Cylinder Head Removal.)
3. Install an air line with an adapter in the spark plug hole.
4. Turn on the air supply. **Air pressure may turn the crankshaft until the piston reaches the bottom of the stroke.** Using the valve spring compression tool shown in Fig. 8, compress the valve spring and remove the valve spring retainer locks, spring

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retainer and the valve spring. **If air pressure fails to hold the valve in the closed position during this operation, it can be presumed that the valve is not seating or is damaged. If this condition occurs, remove the cylinder head for further inspection.**

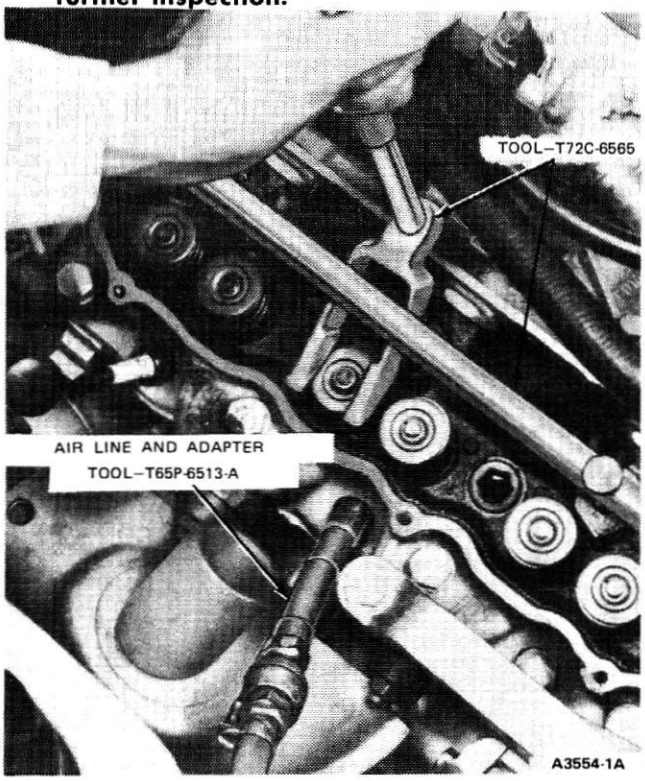


FIG. 8 Compressing Valve Spring-In Chassis—Typical

5. Remove the valve stem seal (Fig. 9). If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.

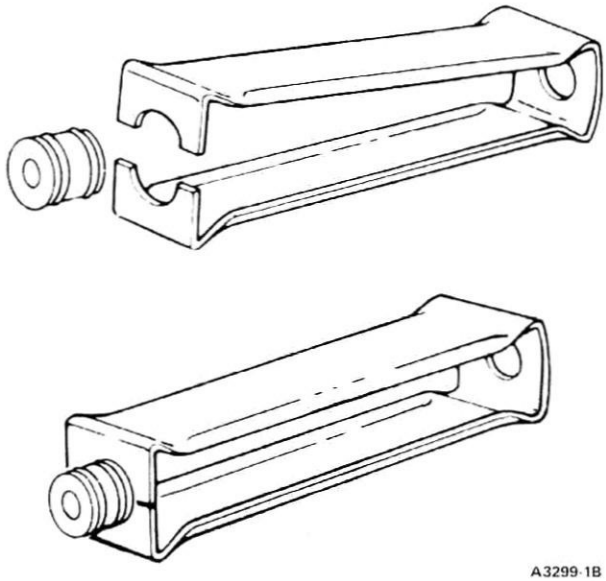


FIG. 9 Removing or Installing Valve Stem Seal

Installation

1. Install a new valve stem seal (Fig. 9). Position the spring over the valve. Install the spring retainer. Compress the valve spring and install the valve spring retainer locks.
2. Apply Lubriplate or equivalent to both ends of the push rod, the valve tips and both ends of the rocker arms. Install the push rod(s), making sure the lower end of the rod is positioned in the tappet push rod cup.
3. Turn off the air and remove the air line and adapter. Install the spark plug and spark plug wire.
4. Install the rocker arm shaft by following the instructions under Rocker Arm Installation.
5. Clean the valve cover and cylinder head gasket surfaces. Coat one side of a new gasket with an oil-resistant sealer and lay the cemented side of the gasket on the cover. Install the cover making sure the gasket seats evenly around the head. Tighten the cover attaching bolts to specification.
6. Install the air cleaner.
7. Run the engine at fast idle and check for oil leaks.

INTAKE MANIFOLD

Removal

1. Remove air cleaner. Disconnect battery negative cable.
2. Disconnect throttle cable.
3. Drain coolant. Disconnect and remove hose from water outlet to radiator and bypass hose from intake manifold to thermostat housing rear cover.
4. Remove distributor cap and spark plug wires as an assembly. Disconnect distributor wiring harness and distributor vacuum line.
5. Observe and mark the location of the distributor rotor and housing so ignition timing can be maintained at reassembly. Remove distributor hold-down screw and clamp and lift out distributor.
6. Remove fuel line and filter and rocker arm covers.
7. Remove intake manifold attaching bolts and nuts. Tap manifold lightly with a plastic mallet to break gasket seal. Lift off manifold.
8. Remove all old gasket material and sealing compound.

Installation

1. Apply sealing compound to the joining surfaces. Place the intake manifold gasket in position. Make sure that the tab on the right bank cylinder head gasket fits into the cutout of the manifold gasket.
2. Apply sealing compound to the attaching bolt bosses on the intake manifold and position the intake manifold. Tool T72C-6519 is required to torque one of the intake manifold bolts. Follow the torque sequence in Fig. 10 and torque the bolts to specifications.
3. Install distributor so that rotor and housing are in same radial position marked at removal.
4. Install distributor clamp and attaching bolt. Connect distributor wire and vacuum line.

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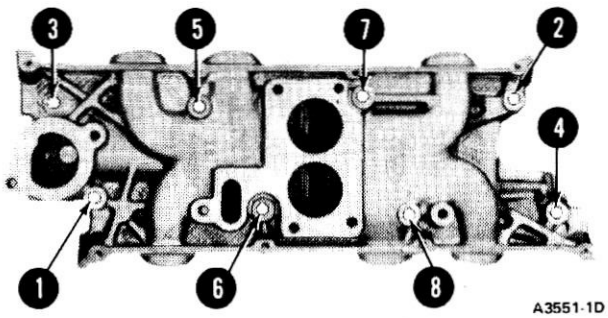


FIG. 10 Intake Manifold Torque Sequence

5. Install fuel line. Replace rocker arm cover gaskets, and reinstall rocker arm valve covers using the procedure given under Rocker Arm Cover Installation.
6. Install distributor cap, coat the inside of each spark plug wire connector with silicone grease with a small screwdriver, and install the wires. Connect distributor wiring harness.
7. Install and adjust linkage.
8. Install air cleaner and air cleaner tube at carburetor. Connect battery negative cable.
9. Connect hoses from water outlet to radiator and bypass hose from thermostat housing rear cover to intake manifold.
10. Refill the cooling system. **See Part 27-01 for detailed instructions.**
11. Recheck ignition timing and reset engine idle speed to specification.
12. Run engine at fast idle and check for coolant and oil leaks.

EXHAUST MANIFOLD

Removal

1. Remove the carburetor air cleaner.
2. Remove the attaching nuts from the exhaust manifold shroud (right side only).
3. Disconnect the attaching nuts from the muffler inlet pipe. Remove thermactor components as necessary to allow removal of exhaust manifold(s).
4. Disconnect choke heat tubes at carburetor.
5. Remove the manifold attaching nuts.
6. Lift the manifold from the cylinder head.

Installation

1. Position the manifold on the studs and install and torque the attaching bolts in sequence to specification (Fig. 11).
2. Install a new inlet pipe gasket. Install and torque the inlet pipe attaching nuts to specification.
3. Position the exhaust manifold shroud on the manifold and install and torque the attaching nuts to specification (right side). Install thermactor components that had been removed.
4. Install the carburetor air cleaner. Reinstall choke heat tube.

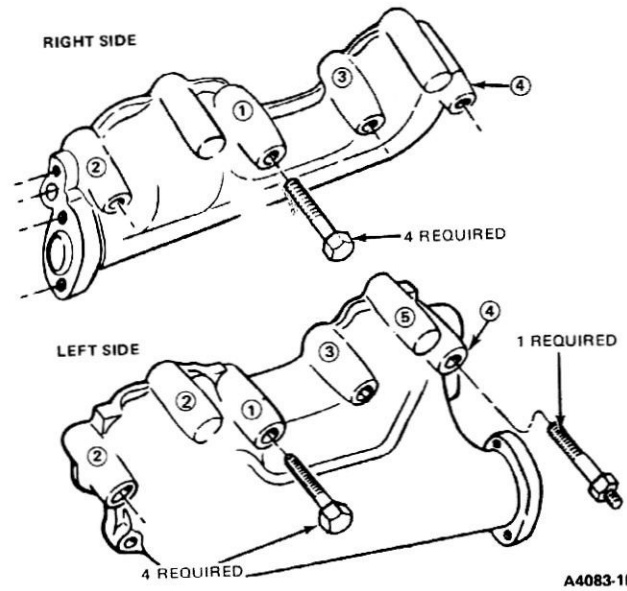


FIG. 11 Exhaust Manifold Torque Pattern—Pinto/Bobcat 2.8L Shown—Mustang II Same Pattern

CYLINDER HEAD

Removal

1. Remove air cleaner from carburetor. Disconnect negative battery cable. Disconnect linkage. Drain coolant.
2. Remove distributor cap and wires as an assembly. Disconnect distributor wiring harness. Remove distributor vacuum line, distributor, coolant outlet hose, coolant hose from thermostat housing rear cover to intake manifold, rocker arm covers, fuel line, carburetor and intake manifold.
3. Remove rocker arm shaft (by loosening two bolts at a time—in sequence) and oil baffles. Remove push rods and keep in sequence for proper assembly.
4. Remove exhaust manifold, following procedure under Exhaust Manifold—Removal.
5. Remove cylinder head attaching bolts and lift off heads. Remove head gaskets.

Installation

1. Clean cylinder head, intake manifold, valve rocker arm cover and cylinder block gasket surfaces. Place cylinder head gaskets in position on cylinder block. (Gaskets are marked with the words **front** and **top** for correct positioning.) Left and right cylinder head gaskets are different.
2. Install cylinder head assemblies on cylinder block one at a time. Guide carefully over positioning studs (Fig. 12). Tighten attaching bolts in sequence shown in Fig. 13 to specifications.
3. Install intake manifold. Be sure to use sealing compound on gasket surfaces and to position gasket correctly. Torque attaching bolts in sequence (Fig. 10).
4. Install exhaust manifold, following procedures under Exhaust Manifold—Installation

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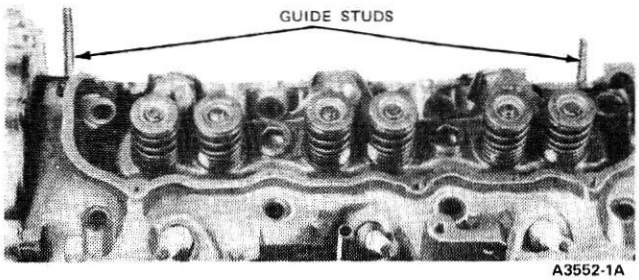


FIG. 12 Cylinder Head Guide Studs

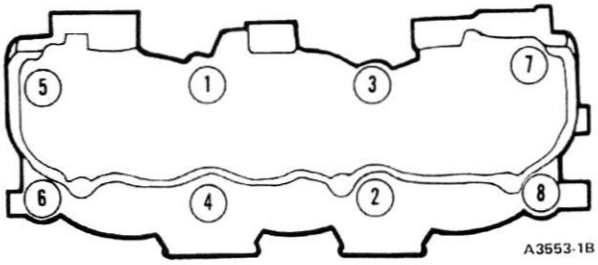


FIG. 13 Cylinder Head Bolts Torque Sequence

5. Apply Lubriplate or equivalent lubricant to both ends of the push rods. Install valve push rods, oil baffles and rocker arm and shaft assemblies.
6. Install distributor and connect wiring harness. Install distributor hold-down bolt and clamp.
7. Perform valve adjustment as described under Adjustments.
8. Install rocker arm covers with new gaskets.
9. Install carburetor and distributor cap with spark plug wires. With a small screwdriver, coat the inside of each spark plug boat with silicone lube and install them on the spark plugs. If necessary, adjust accelerator linkage.
10. Install fuel line and vacuum line.
11. Install air cleaner and air cleaner tube at carburetor. Connect battery negative cable.
12. Refill and bleed cooling system. See Part 27-01 for detailed instructions.
13. Re-check ignition timing and check idle speed.
14. Operate the engine at fast idle speed and check for coolant and oil leaks.

TAPPETS

Removal

1. Remove the cylinder head and related parts following the procedure under Cylinder Head Removal.
2. Remove the tappets with a magnet. Place them in a rack in sequence. If the tappets are stuck in bores, use plier-type Tool (T70P-14151) to remove them (Fig. 14). Rotate tappets back and forth to loosen them from gum or varnish deposits.

Installation

1. Clean the tappets. Tappets and bores are to be lubricated with heavy oil SE before installation. Install the tappets in their original bores with a magnet (Fig. 14). Check any new tappet for proper fit in bore to which it is to be installed. See specifications.

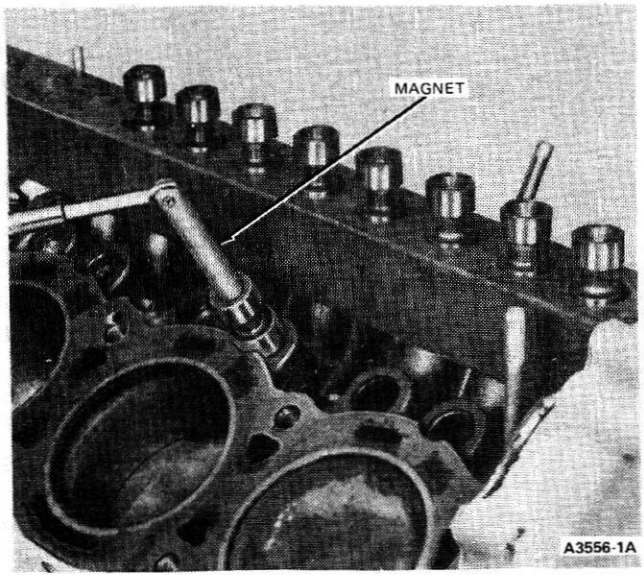


FIG. 14 Removing or Installing Tappets—Typical

2. Install the cylinder head and related parts, following the procedures given under Cylinder Head Installation.

WATER PUMP

Removal

1. Drain the coolant. Detach the radiator lower hose and the heater return hose from the water inlet housing.
2. Loosen the alternator mounting bolts and remove the belt. (With A/C, remove alternator and bracket.)
3. Remove the fan and pulley.
4. Remove the water pump assembly attaching bolts and remove water pump assembly, water inlet housing and thermostat from the front cover.

Installation

1. Remove all gasket material from the sealing surfaces on front cover and water pump assembly. Apply sealer to both sides of the new gasket and place the gasket on the water pump.
2. Position the water pump assembly to the front cover with two bolts finger tight. Remove all gasket material from the water inlet housing sealing surfaces. Appply sealer to both sides of the new gasket and place the gasket on the water inlet housing.
3. Install the thermostat and rubber gasket. Position the water inlet housing and by-pass flange to the water pump and install the attaching bolts. Torque all water pump assembly attaching bolts to specification. Note the different length bolts.
4. Install fan and pulley. (With A/C, install bracket and alternator.) Install belt and adjust tension to specification. Reconnect both hoses to water inlet housing and tighten hose clamps. Fill and vent cooling system. See Part 27-01 for detailed instructions.
5. Start the engine and check for leaks.

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CYLINDER FRONT COVER

Removal

1. Remove oil pan as described under Oil Pan—Removal.
2. Drain the coolant. Remove the radiator and any other parts to provide necessary clearance.
3. Remove A/C compressor and bracket, if equipped.
4. Remove alternator, thermactor pump and drive belt(s). Remove water pump and water lines.
5. Remove fan.
6. Remove the drive pulley from the crankshaft.

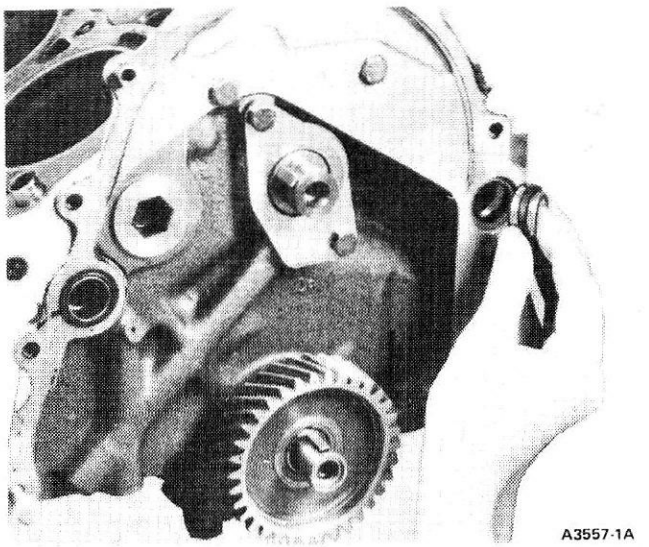


FIG. 15 Removing or Installing Guide Sleeves

7. Remove front cover retaining bolts. If necessary, tap cover lightly with a plastic hammer to break gasket seal. Remove front cover. If front cover plate gasket needs replacement, remove two screws and remove plate (Fig. 16). If necessary, remove guide sleeves from cylinder block (Fig. 15).

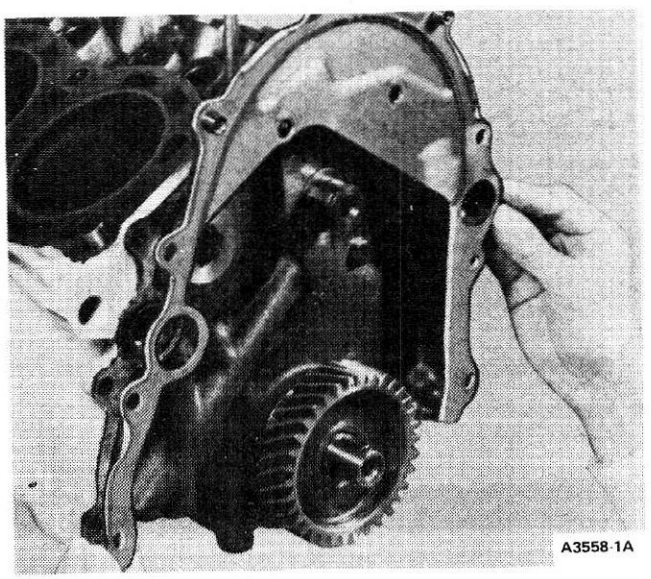


FIG. 16 Removing or Installing Front Cover Plate

Installation

1. Clean the mating surfaces of gasket material. Apply sealing compound to the gasket surfaces on the cylinder block and back side of the front cover plate. Position gasket and front cover plate on cylinder block (Fig. 16). Temporarily install four front cover screws to position gasket and cover plate in place. Install and tighten two cover plate attaching bolts (Fig. 17), then remove four screws that were temporarily installed.

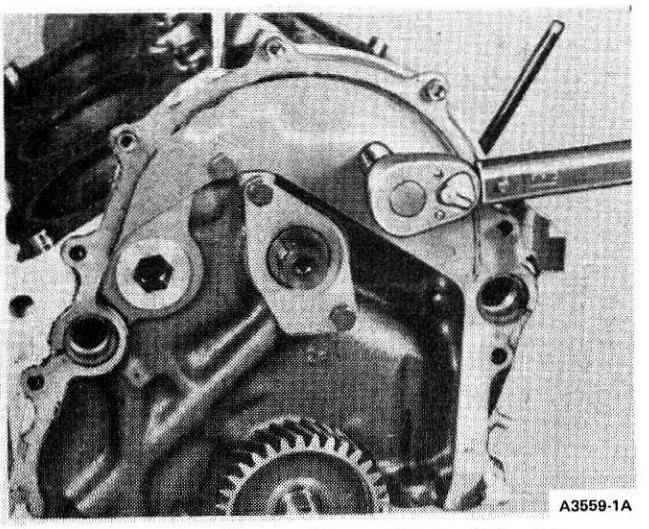


FIG. 17 Torquing Front Cover Plate Attaching Bolts

2. If removed, fit new seal rings to the guide sleeves and, with no sealer used, insert the sleeves in the cylinder block with the chamfered side of the sleeve toward the front cover (Fig. 15).
3. Apply sealing compound to front cover gasket surface. Place gasket in position on front cover.
4. Place front cover on engine and start all retaining screws two or three turns. Center cover by inserting tool in oil seal (Fig. 18).

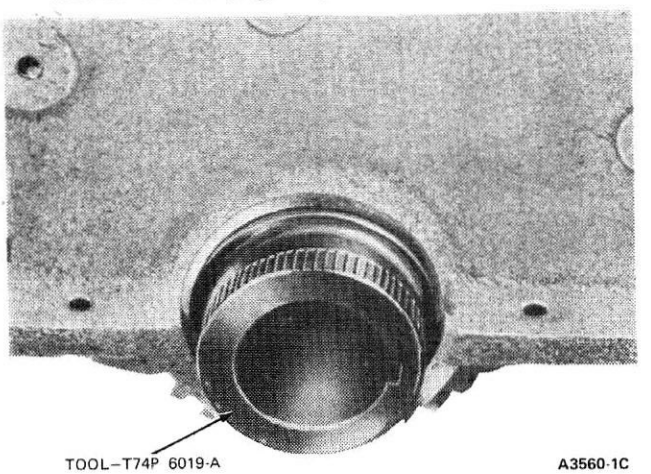


FIG. 18 Aligning Front Cover

5. Tighten front cover attaching screws to specifications.
6. Install belt drive pulley and tighten attaching bolt to specification.

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7. Install oil pan following Oil Pan Installation procedure.
8. Install water pump, water hose, A/C compressor, alternator, thermactor pump and drive belt(s). Adjust drive belt tension to specifications.
9. Fill the cooling system to the proper level with the specified coolant. See Part 27-01 for detailed instructions.
10. Operate the engine at fast idle speed and check for coolant and oil leaks.

FRONT OIL SEAL

In-Chassis

Removal

1. Drain the coolant. Remove the radiator and crankshaft pulley and water pump drive belt. It is not necessary to remove the front cover for this operation.
2. Pull the front cover oil seal out with the tools shown in Fig. 19.

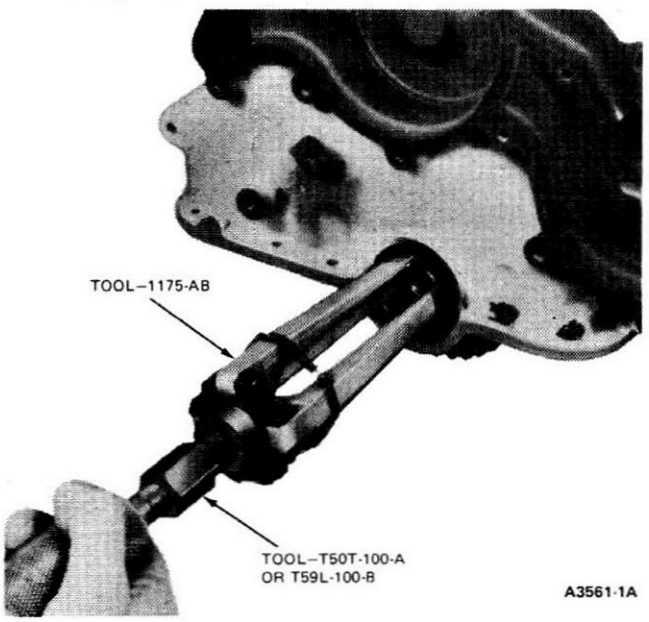


FIG. 19 Removing Front Oil Seal—In Chassis

Installation

1. Coat the new front cover oil seal with Lubriplate or equivalent. Slide tool and new oil seal onto the crankshaft. Drive the oil seal in until the tool abuts against the front cover (Fig. 20).
2. Replace crankshaft pulleys and bolt. Torque bolt to specifications, then replace radiator and drive belt. Adjust belt tension to specification using Tool T63L-8620-A.
3. Fill the cooling system to the proper level with the specified coolant. See Part 27-01 for detailed instructions.
4. Operate the engine at fast idle speed and check for coolant leaks.

Front Cover Removed

Removal

1. Support the front cover to prevent damage while driving out seal.

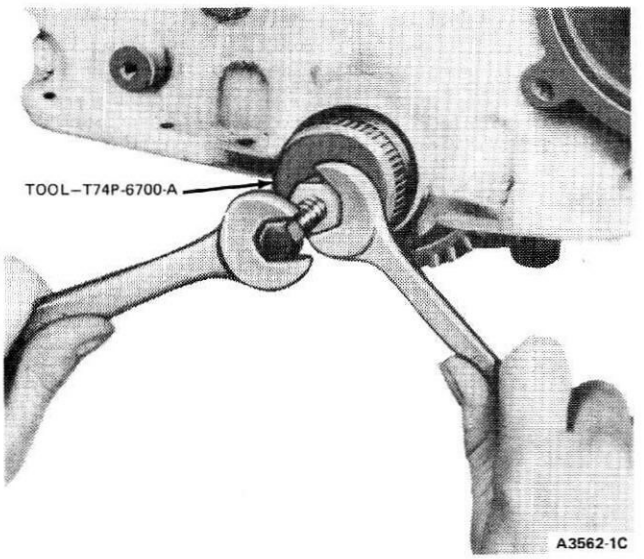


FIG. 20 Installing Front Oil Seal—In Chassis

2. Drive out seal from front cover with the tool shown in Fig. 21.

Installation

1. Support front cover to prevent damage while installing seal.
2. Coat the new front cover oil seal with Lubriplate or equivalent. Install the new seal in the front cover as shown in Fig. 22.

CAMSHAFT

The camshaft and related parts are shown in Fig. 23.

Removal

1. Drain the coolant. Remove the radiator, fan, spacer, water pump pulley and drive belt.
2. Remove distributor cap with spark plug wires as an assembly. Disconnect distributor wiring harness. Remove distributor vacuum line, distributor, alternator, thermactor pump, rocker arm covers, fuel line and filter, carburetor, and intake manifold.

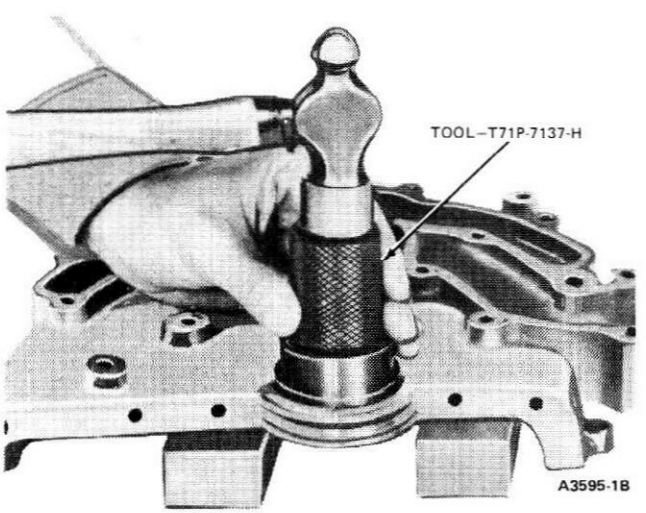


FIG. 21 Removing Front Oil Seal—Front Cover Removed

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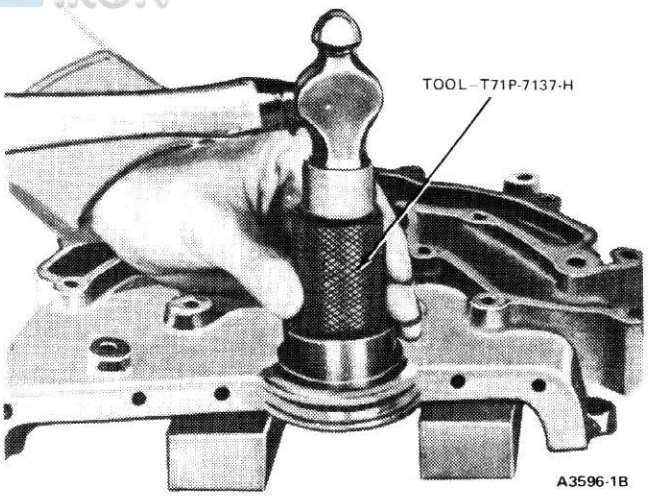


FIG. 22 Installing Front Oil Seal—Front Cover Removed

Use the proper plier-type tool to remove the spark plug wire boots.

3. Drain the crankcase. Refer to Rocker Arm Removal and remove rocker arm and shaft assemblies. Lift out push rods and place in a marked rack so they can be reinstalled in the same location.
4. Remove oil pan, as described under Oil Pan Removal.
5. Remove drive sprocket attaching bolt and slide sprocket off end of shaft.
6. Remove engine front cover and water pump as an assembly.
7. Remove camshaft gear attaching bolt and slide gear off camshaft.
8. Remove camshaft thrust plate and screws.
9. Remove the tappets, following Tappet Removal procedure.
10. Carefully pull the camshaft from the block, avoiding any damage to the camshaft bearings. Remove camshaft gear key and spacer ring.

Installation

1. Oil the camshaft journals with heavy SE engine oil and apply Lubriplate or equivalent lubricant to the cam lobes.
2. Install the camshaft in the block, carefully avoiding damage to the bearing surfaces.
3. Install the spacer ring with the chamfered side toward the camshaft. Insert camshaft key. Install thrust plate so that it covers the main oil gallery (Fig. 24). Torque attaching screws to specifications.

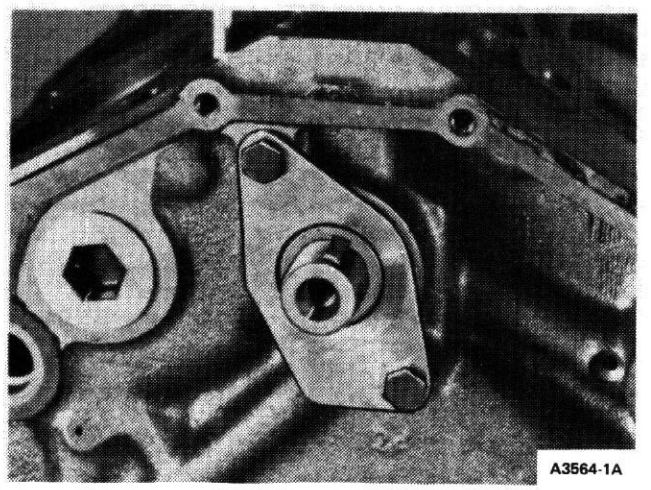


FIG. 24 Camshaft Thrust Plate Installed

4. Check the camshaft for the specified end play (see Part 21-01). The spacer ring and thrust plate are available in two thicknesses to permit adjusting the end play.
5. Turn camshaft and crankshaft as necessary to align timing marks as shown in Fig. 27 and install camshaft gear. Install attaching bolt and washer and tighten to specifications.
6. Position the tappets in their original locations, following Tappet Installation procedure.
7. Install engine front cover and water pump as an assembly.
8. Install belt drive pulley and secure with washer and attaching bolt. Tighten bolt to specifications.

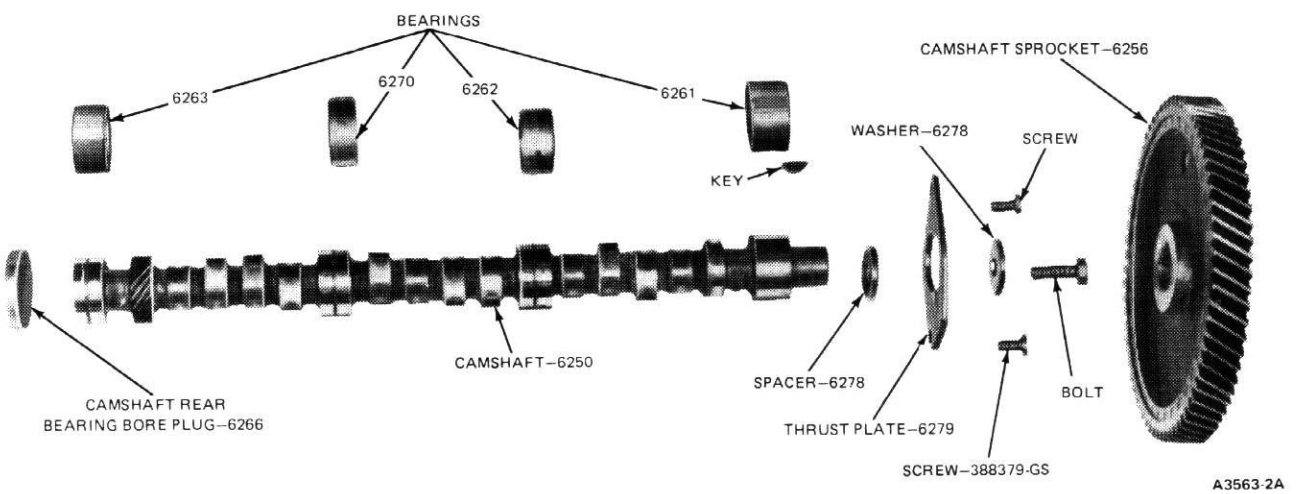


FIG. 23 Camshaft and Related Parts

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9. Install oil pan, as described under Oil Pan Installation.
10. Apply Lubriplate or equivalent to both ends of the push rods. Install valve push rods in same location as removed.
11. Install intake manifold, as described under Intake Manifold Installation.
12. Install oil baffles and rocker arm and shaft assemblies. Tighten rocker arm stand bolts to specifications. Adjust valves to specified cold setting.
13. Install water pump pulley, fan spacer, fan, and drive belt. Adjust belt tension to specifications. Install carburetor, fuel line, alternator, thermactor pump, distributor, distributor vacuum line, and distributor cap and wires. Connect distributor wiring harness. **Before installing spark plug wires, coat inside of each boot with silicone lube using a small screwdriver.** Install the radiator. Fill the cooling system to the proper level with the specified coolant. See Part 27-01 for detailed instructions. Adjust ignition timing as described in Group 29.
14. Install valve covers following Valve Cover Installation procedures.
15. Run the engine and check the idle speed.
16. Run the engine at fast idle speed and check for coolant, fuel, vacuum and oil leaks.

TIMING GEARS

Removal

1. Drain the cooling system and crankcase. Remove oil pan and radiator.
2. Remove the cylinder front cover and water pump, drive belt, and camshaft timing gear.
3. Use the gear pullers as shown in Fig. 25 and remove the crankshaft gear. Remove the key from the crankshaft.

Installation

1. Align the keyway in the gear with the key, then slide the gear onto the shaft, making sure that it seats tight against the spacer.
2. Check the camshaft end play Part 21-01). If not within specifications, replace the thrust plate.
3. Position the key in the crankshaft. Align the keyway in the crankshaft gear with the key in the crankshaft, and align the timing marks as shown in Fig. 26. Install the gear, using the tool shown in Fig. 27.
4. Install the cylinder front cover following the procedures in this section. Install the oil pan and radiator.
5. Fill the cooling system (see Part 27-01) and crankcase. Start the engine and adjust the ignition

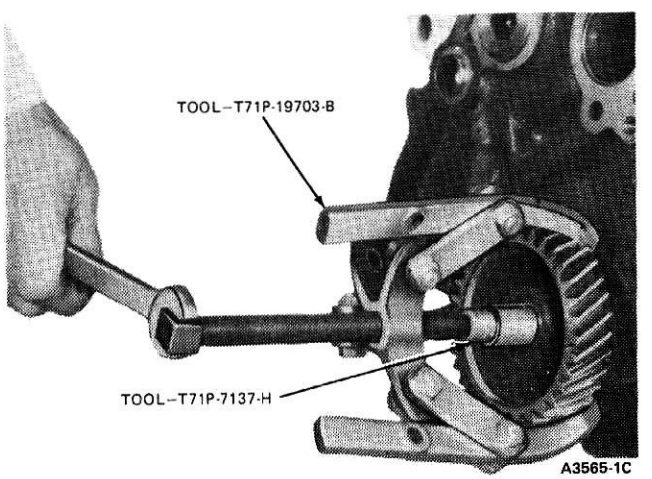


FIG. 25 Removing Crankshaft Gear

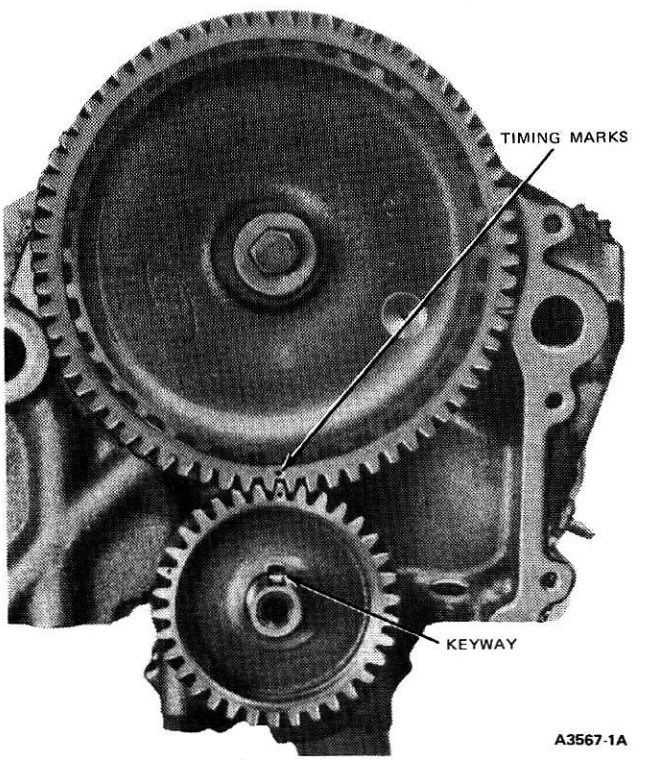


FIG. 26 Aligning Timing Marks

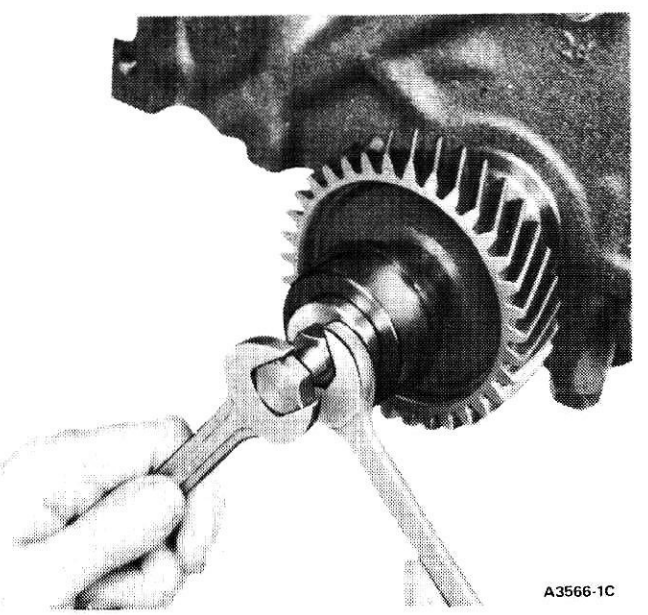


FIG. 27 Installing Crankshaft Gear

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timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks.

OIL PAN

Removal

1. Remove the oil level dipstick.
2. Remove the radiator pressure cap and drain the cooling system. Disconnect the radiator upper and lower hoses at the radiator.
3. Remove the bolts attaching the fan shroud to the radiator. Position the shroud back over the fan. Disconnect the battery ground cable at the battery.
4. Raise the vehicle. Disconnect the automatic transmission cooler lines (if so equipped) at the radiator.
5. Disconnect the steering gear (and power steering hoses, if equipped) and position the gear out of the way (see Group 13).
6. Disconnect the sway bar at the ends and rotate to allow clearance to remove pan.
7. Drain the crankcase. Remove the splash shield.
8. Disconnect the starter and remove the starter.
9. Remove the engine front support nuts.
10. Raise the engine and place wood blocks between the engine front supports and chassis brackets.
11. Remove the oil pan attaching bolts and remove the oil pan.

Installation

1. Clean the gasket surfaces of the block and oil pan.
2. Coat both pieces of the oil pan gasket block surfaces with oil resistant sealer. Position the oil pan gaskets on the cylinder block (Fig. 28).
3. Position the oil pan front seal on the cylinder cover. Make sure the tabs on the seal are over the oil pan gasket.
4. Place end seals in position, flush with the cylinder block oil pan rail. Position the oil pan rear seal on the rear main bearing cap (Fig. 28). Be sure the tabs on the seal are over the oil pan gasket.
5. Position the oil pan on the cylinder block. Install four bolts as shown in Fig. 29, to secure the front and rear of the oil pan. Install the remaining bolts and torque to specification in the sequence shown.
6. Reinstall the clutch cover (or converter housing).
7. Raise the engine and remove the wood blocks. Lower the engine and install the engine support nuts. Torque to specification.
8. Install the starter and reconnect the starter cable.

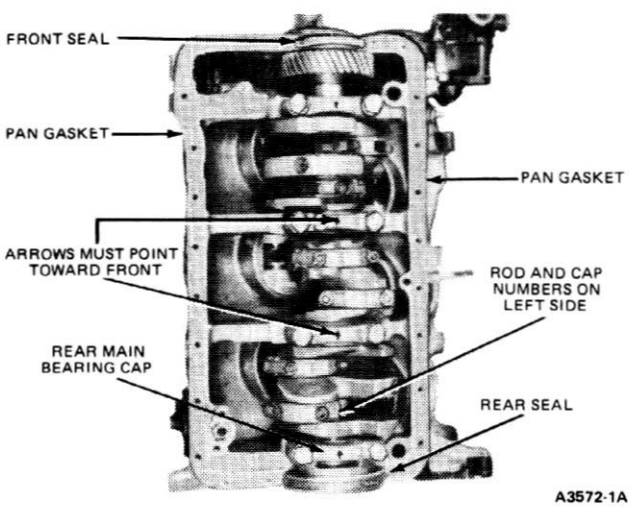


FIG. 28 Oil Pan Gaskets and Seals Installed

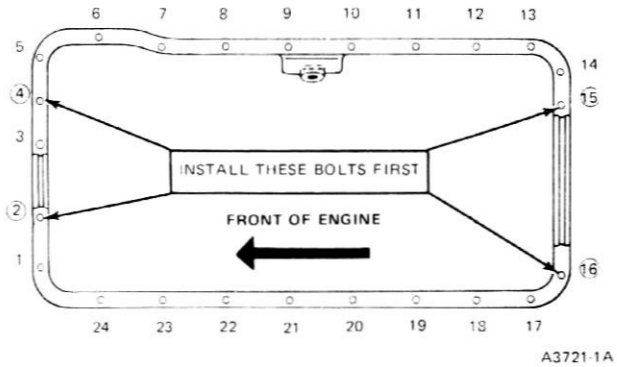


FIG. 29 Oil Pan Installation and Bolt Torque Sequence

9. Install the splash shield.
10. Reconnect the sway bar. Install the steering gear and power steering equipment disconnected following procedures in Group 13.
11. Connect the automatic transmission oil cooler lines at the radiator and reconnect the radiator lower cooling hose.
12. Lower the vehicle. Connect the radiator upper hose. Position the radiator shroud forward over the fan and install the attaching bolts. Maintain radial clearance shown in Group 27.
13. Connect the battery ground cable. Fill the cooling system following instructions in Group 27.
14. Install the oil level dipstick and fill the crankcase with the proper grade and amount of engine oil. Start the engine and check for oil or coolant leaks. Correct as necessary.

OIL PUMP

NOTE: The oil pump is only serviced as an assembly. See Part 21-01 for disassembly and cleaning instructions.

Removal

1. Remove oil pan as described under Oil Pan Removal.
2. Remove bolt that attaches oil pick-up screen to main bearing cap. Remove oil pump attaching bolts (Fig. 30). Lift off oil pump and withdraw oil pump drive shaft.

Installation

1. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
2. Insert oil pump drive shaft into block with the pointed end facing inward. The pointed end is closest to the pressed-on flange. Place oil pump in

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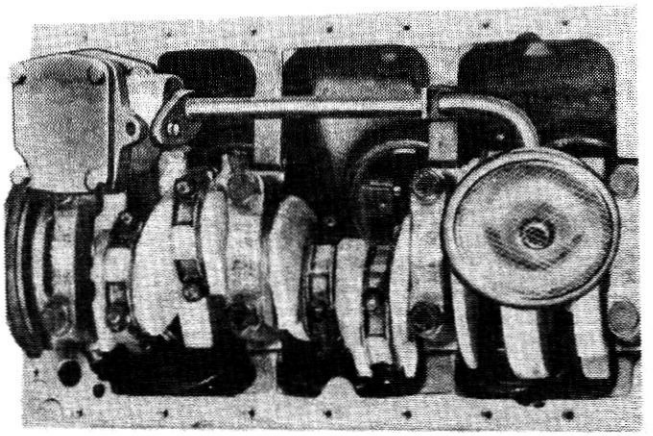

A3573-1B

FIG. 30 Oil Pump and Inlet Tube Installed

position with new gasket and install attaching screws. Tighten screws securely. Clean and install the oil pump inlet tube and screen assembly with a new gasket. Torque the bolts to specifications.

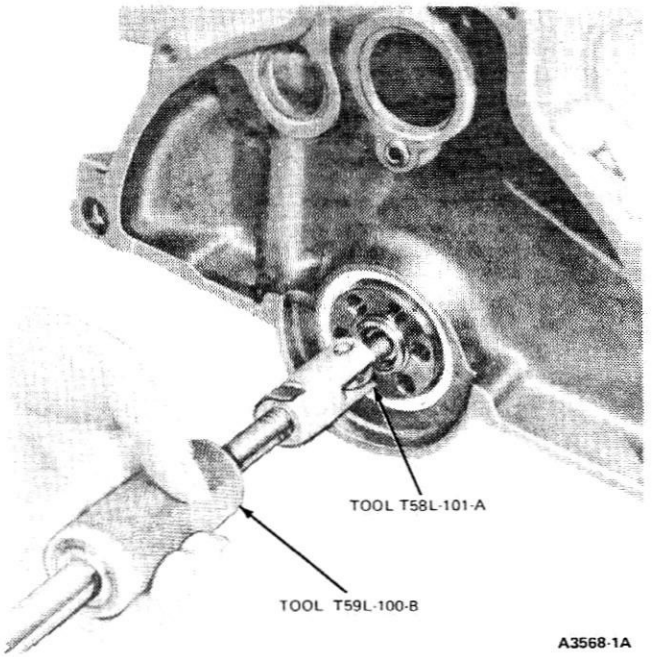
3. Install oil pan as described in this Section.
4. Operate the engine at fast idle speed and check for oil leaks.

CLUTCH PILOT BEARING

Inspection procedures are outlined in Part 21-01. NOTE: The clutch pilot bearing may be replaced with the flywheel installed or removed.

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Group 16—Clutch.
2. Using Tools T59L-100-B and T58L-101-A, remove the pilot bearing (Fig. 31).

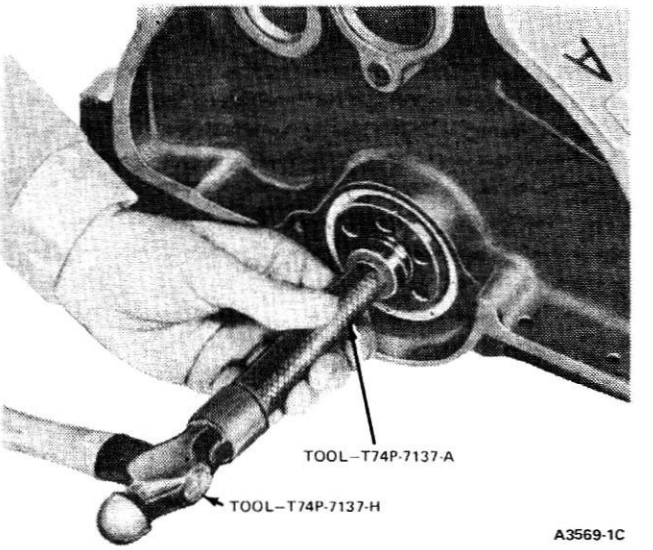


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FIG. 31 Removing Clutch Pilot Bearing

Installation

1. Using Tools T74P-7137-A and T71P-7137-H install the pilot service bearing with the seal facing the transmission (Fig. 32).



A3569-1C

FIG. 32 Installing Clutch Pilot Bearing

2. Install the clutch pressure plate and disc, and the transmission following the procedure in Group 16—Clutch.

FLYWHEEL

Removal

1. On a manual-shift transmission, remove the transmission, clutch pressure plate and disc, following the procedures in Group 16—Clutch.

   On a vehicle with an automatic transmission, remove the transmission and converter housing following the procedure in Group 17—Automatic Transmission.
2. Refer to Part 21-01 for procedure for checking flywheel face runout. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Clean and inspect all parts before installation. Position the flywheel on the crankshaft flange. Apply oil-resistant sealer to the attaching bolts. Install and torque the bolts in sequence across from each other to specifications.
2. On a manual-shift transmission, install the clutch pressure plate, disc, and the transmission following the procedures in Group 16—Clutch.

   On a vehicle with automatic transmission, install the converter housing and transmission following the procedure in Group 17—Automatic Transmission. It is not necessary to adjust the transmission, when it has been removed only for flywheel removal.

CAMSHAFT REAR BEARING CORE PLUG

Removal

1. On a vehicle with a manual-shift transmission, slide the transmission to the rear and remove the clutch

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pressure plate and disc following the procedure in Group 16—Clutch.

On a vehicle with automatic transmission, remove the transmission and converter housing following the procedure in Group 17—Automatic Transmission.

2. Remove the flywheel attaching bolts and remove the flywheel and engine rear cover plate.
3. Remove the core plug as detailed under Core Plugs in Part 21-01.

Installation

1. Install a new plug with the tool shown in Fig. 33 using the procedure given in Part 21-01.

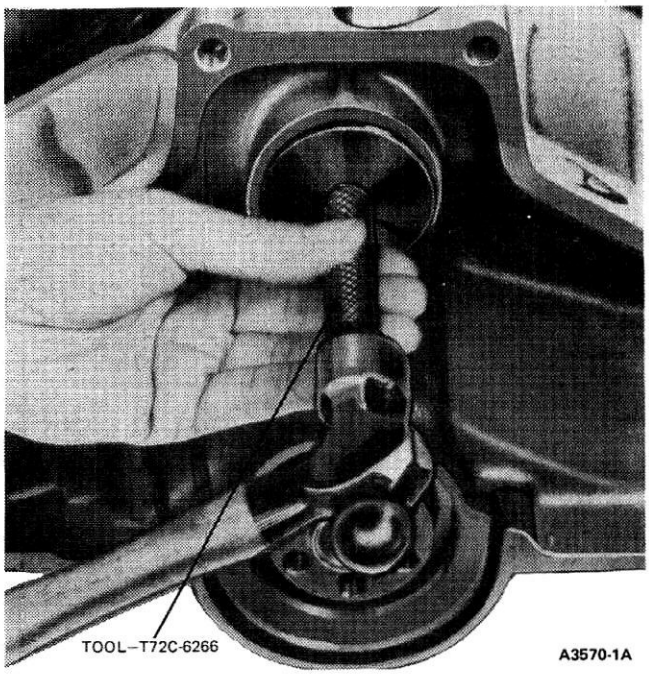


FIG. 33 Installing Camshaft Rear Bearing Core Plug

2. Install the engine rear cover plate, apply oil-resistant sealer to the flywheel bolts and install the flywheel. Torque the attaching bolts to specifications.

On a vehicle with a manual-shift transmission, install the clutch pressure plate, disc, and transmission following the procedure in Group 16—Clutch.

On a vehicle with automatic transmission, install the transmission and converter housing following the procedure in Group 17—Automatic Transmission.

CRANKSHAFT REAR OIL SEAL

Removal

1. Remove the transmission. Remove clutch pressure plate and clutch disc, if so equipped. Follow the procedures given in Group 16.
2. Remove flywheel, flywheel housing and rear plate.
3. Use an awl to punch two holes in the crankshaft rear oil seal. Punch the holes on opposite sides of the crankshaft and just above the bearing cap to cylinder block split line. Install a sheet metal screw in each hole (Fig. 34). Use two large screwdrivers or small pry bars and pry against both screws at the same time to remove the crankshaft rear oil seal. It may be necessary to place small blocks of wood against the cylinder block to provide a fulcrum point for the pry bars. **Use caution throughout this procedure to avoid scratching or otherwise damaging the crankshaft oil seal surface.**

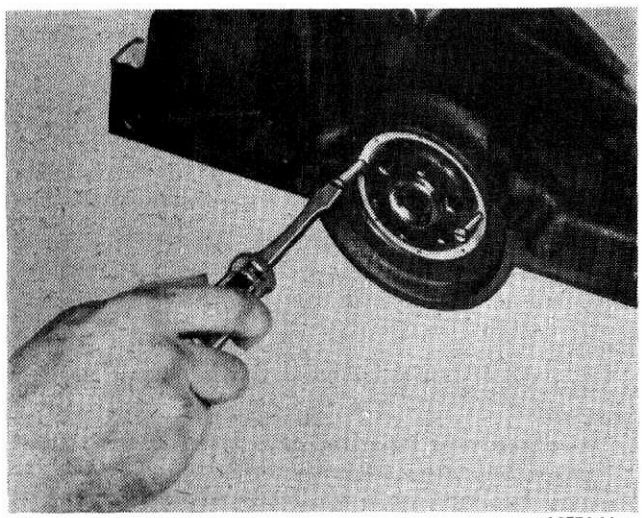


FIG. 34 Removing Crankshaft Rear Oil Seal

4. Clean the oil seal recess in the cylinder block and main bearing cap. **Inspect and clean the oil seal contact surface on the crankshaft, following the procedure in Part 21-01.**

Installation

1. Coat the oil seal to cylinder block surface of the oil seal with oil. Coat the seal contact surface of the oil seal and crankshaft with Lubriplate or equivalent. Start the seal in the recess and install it with the tool as shown in Fig. 35. Drive the seal into position until it is firmly seated.

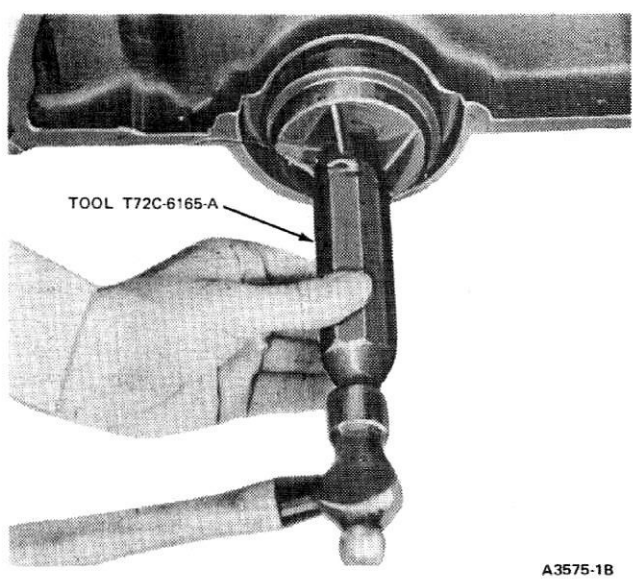


FIG. 35 Installing Crankshaft Rear Oil Seal

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2. Install rear plate, flywheel housing, and flywheel. Tighten flywheel bolts to specifications.
3. Install clutch disc and clutch pressure plate, if so equipped. Align clutch disc before tightening pressure plate attaching screws.
4. Install transmission.

MAIN BEARINGS

The main and connecting rod bearing inserts are selective fit. **Do not file or lap bearing caps or use shims to obtain the proper bearing clearance. Selective fit main bearings are available for service in standard and undersizes. Refer to the parts catalog for the available sizes. Undersize bearings which are not selective fit, are available for use on journals that have been refinished.** (See specifications.)

If the rear main bearing is to be replaced, remove the engine and place it in a work stand.

Removal

1. Drain the crankcase. Remove the oil pan and oil pump.
2. **Replace one bearing at a time, leaving the other bearings securely fastened.** Remove the main bearing cap to which new bearings are to be installed.
3. Insert the upper bearing removal Tool 6331 in the journal oil hole.
4. Rotate the crankshaft slowly in the direction of engine rotation to force the bearing insert out of the block.

Installation

1. Clean each crankshaft journal before installing the main bearing insert. Inspect the journals for nicks, burrs or bearing pick-up that would cause premature bearing wear. Make sure that the four thrust washers are in place on the No. 3 main bearing.
2. To install the upper main bearing, lubricate the bearing with heavy engine oil SE then place the end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 can be inserted in the journal oil hole. With Tool 6331 installed, rotate the crankshaft slowly in the opposite direction of engine rotation until the bearing tang is seated. Remove the bearing tool.
3. Select fit the bearing for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
4. Coat the bearing insert and journal with heavy engine oil SE and install the bearing cap. Tighten the cap bolt to specification.
5. Install the remaining bearings in the same manner. If servicing the rear main bearing, apply sealer to the cap as shown in Fig. 36. If necessary, align the thrust bearing by loosening the center main bearing cap bolts, prying the crankshaft toward the front, forcing the thrust bearing to the rear and tightening the bolts to specifications (Fig. 37).

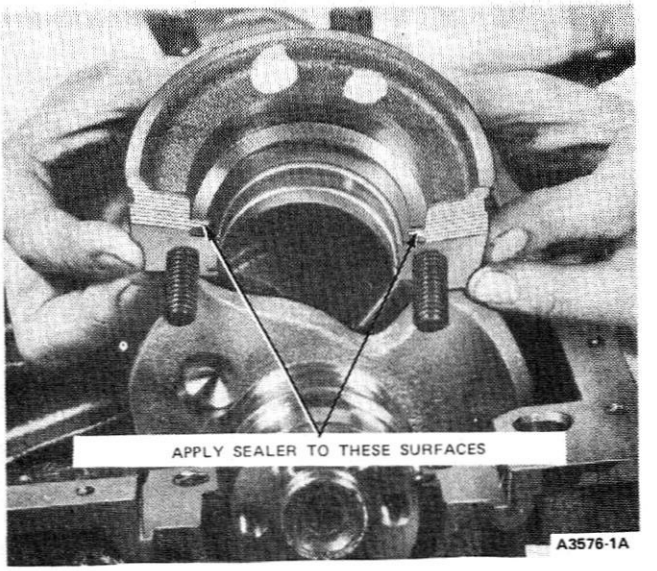


FIG. 36 Sealer Application to Rear Main Bearing Cap

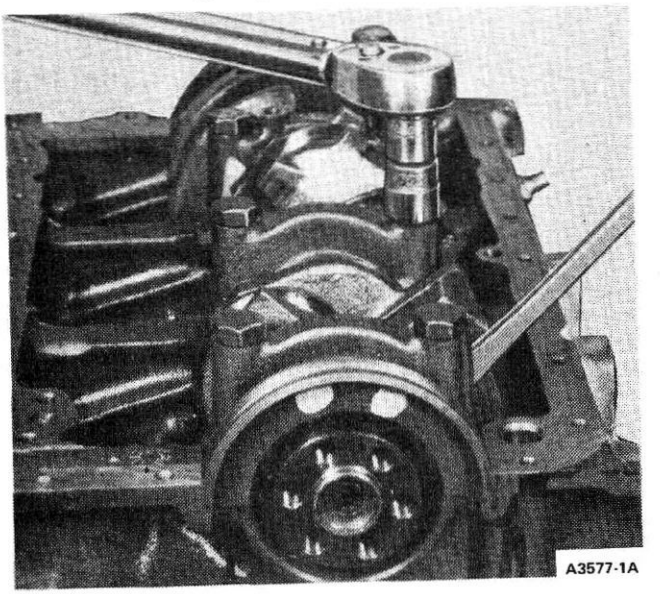


FIG. 37 Aligning Thrust Bearing

6. Clean all oil pan gasket surfaces thoroughly. Straighten the oil pan flange if deformed due to overtorquing the bolts.
7. Clean oil pump inlet tube screen. Prime pump by filling inlet opening with oil while rotating shaft until oil emerges from outlet opening. Install pump and screen and torque attaching bolts to specifications.
8. Coat the cylinder block oil pan surfaces and oil pan gasket surface with oil-resistant sealer.
9. Position the gaskets on the block. See Fig. 38 for installation of the rear main bearing cap wedge seals. Install one end seal in the rear main bearing cap and the other in the cylinder block front cover. Be sure ends engage oil pan side gaskets properly.
10. Position the oil pan and install the attaching bolts. Torque the bolts to specification.
11. Fill the crankcase to the correct level with the specified oil. Start the engine and check for leaks.

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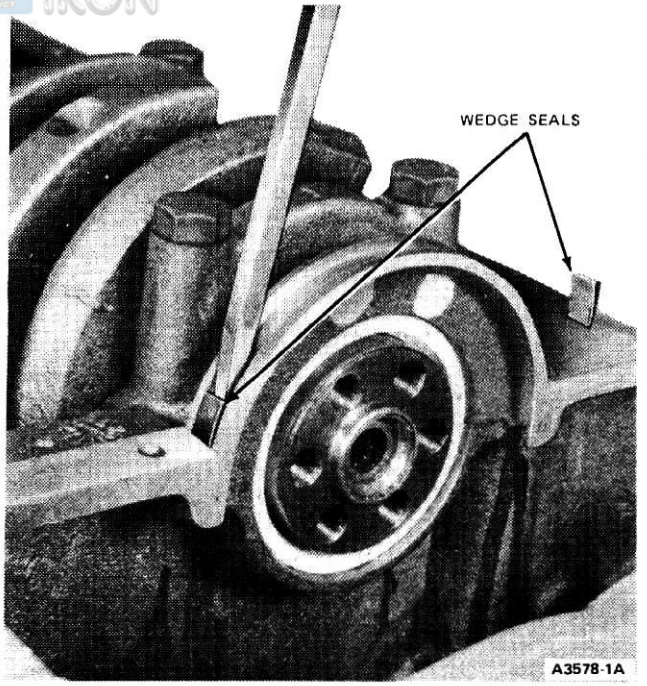


FIG. 38 Replacing Rear Main Bearing Cap Wedge Seals

CONNECTING ROD BEARINGS

The connecting rod bearings are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearing with Plastigage, Part 21-01.

Removal

1. Drain the crankcase. Remove the oil pan and related parts.
2. Remove the oil pump.
3. Rotate the crankshaft until the connecting rod in which the bearings are to be fitted, is at the bottom.
4. Remove the bearing cap from the rod, then remove the bearing inserts.

Installation

1. Make sure bearing inserts and bearing bore in connecting rod and cap are clean. Foreign material under inserts or between rod and cap will distort the bearing and cause premature failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitted in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing following procedures in Part 21-01.
6. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Tighten the nuts to specification.
7. Clean the oil pump inlet tube screen. Prime the pump by filling the inlet opening with oil while rotating the shaft until oil emerges from the outlet opening. Install the pump with a new gasket and torque the attaching bolts to specification.
8. Install the oil pan.
9. Fill the crankcase to the correct level with the specified oil. Start the engine and check for leaks.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this Part.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows:

   Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze using a spring-type honing tool. Follow the instructions of the tool manufacturer.
2. Oil the piston rings, pistons and cylinder walls with light engine oil (SE). **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted.** The connecting rod and bearing caps are numbered from 1 to 3 in the right bank and from 4 to 6 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore (Fig. 39). If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.
3. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 40).
4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 41). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation notch in the piston head toward the front of the engine (Fig. 42).**

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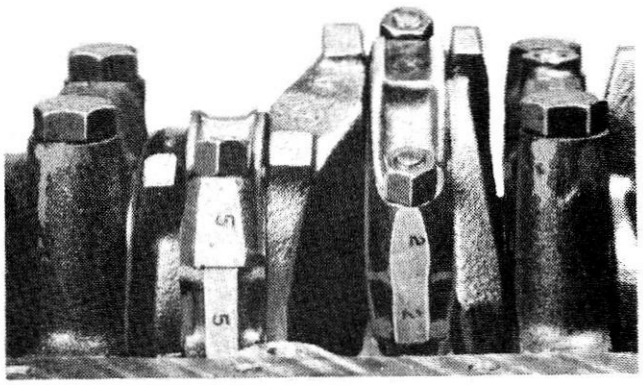


FIG. 39 Connecting Rod and Cap Numbering

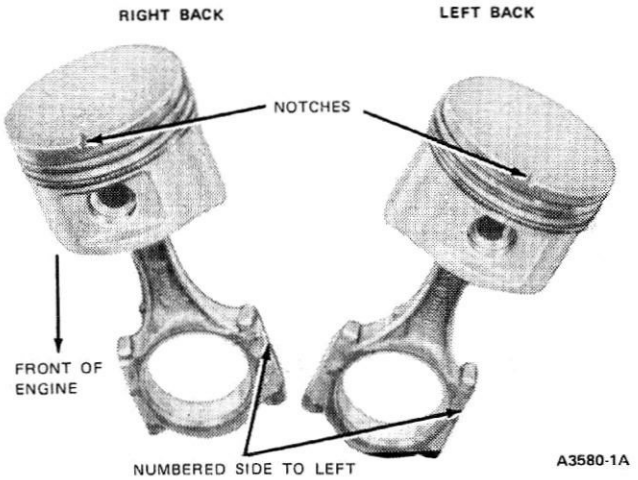


FIG. 42 Correct Piston and Rod Positions

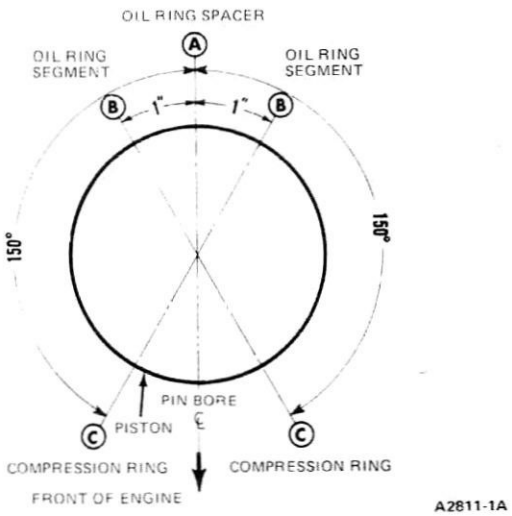


FIG. 40 Piston Ring Gap Spacing

5. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil (SE) to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap. Tighten the nuts to specifications.
9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 43).
10. Disassemble, clean, and assemble the oil pump. Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling either the inlet port or outlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump and the oil pan.

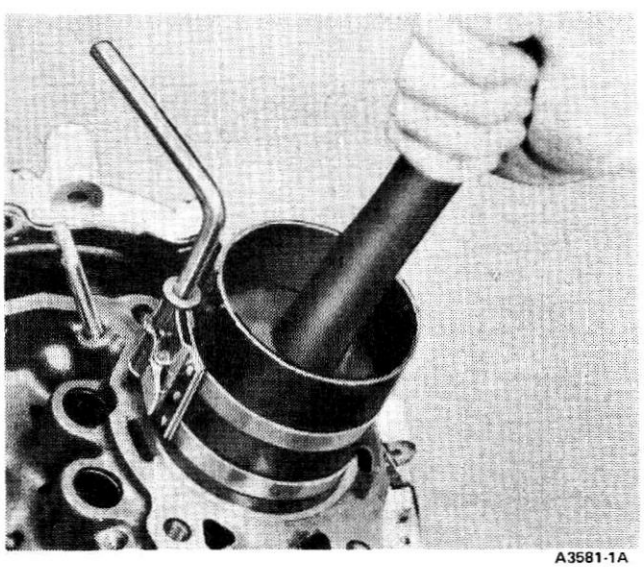


FIG. 41 Installing Piston

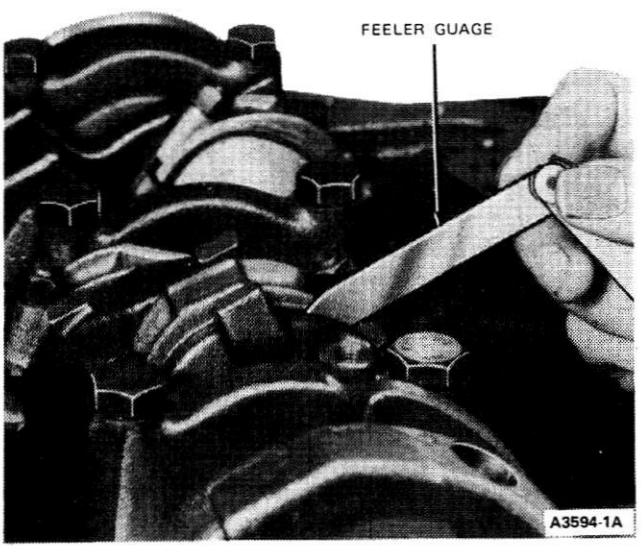


FIG. 43 Checking Connecting Rod Side Clearance

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12. Install the cylinder heads following procedures under Cylinder Head Installation.
13. Install the intake manifold following procedures under Intake Manifold Installation.
14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses at the carburetor.
16. Operate the engine at fast idle and check for oil and coolant leaks. When the engine temperature has stabilized, adjust the engine idle speed and idle fuel mixture.
17. Install the air cleaner and intake duct assembly.

CRANKSHAFT

Removal

The crankshaft and related parts are shown in Fig. 44.

1. Remove engine from the vehicle and place on a work stand.
2. Remove flywheel, flywheel housing and rear plate.
3. Remove oil pan with engine in normal upright position.
4. Remove components from front of engine and front cover.
5. Invert engine and remove oil pump and inlet tube assembly. Leave oil pump drive shaft in position.
6. Make sure all main and connecting bearing caps are marked so they can be installed in their original locations.
7. If crankshaft is being replaced, remove gear as shown in Fig. 25.
8. Remove connecting rod nuts and lift off rod cap with bearing insert. Carefully push piston and rod assemblies down in cylinders.
9. Remove main bearing bolts and lift off main bearing caps with inserts. Discard rear oil seal.
10. Carefully lift crankshaft out of cylinder block, being careful not to damage the thrust bearing surfaces. Remove bearing inserts from block and identify for position if they are to be re-used.

Installation

1. If crankshaft gear was removed, install it as shown in Fig. 26.
2. Clean the bearing bores in the block and caps and the bearing inserts on both sides. Foreign material under the inserts or on the bearing surfaces may distort the insert and cause bearing failure.
3. Assemble main bearing inserts in their correct location in bearing caps and cylinder block. Check alignment of oil holes in inserts with oil holes in block. Apply a liberal coating of SE-type engine oil to the bearing surfaces. Carefully lower crankshaft into position. Check gear timing marks for correct positioning (Fig. 27).
4. Apply a thin even coating of sealing compound to the rear sealing surface of the rear main bearing cap as shown in Fig. 36. Install main bearing caps in their correct location. The arrows on the front and center main bearing caps must point to the front of the engine.
5. Install and tighten all main bearing bolts finger tight. Then tighten all bolts, except for center thrust bearing, in steps to specifications.
6. Align the thrust bearing surfaces by forcing the crankshaft forward and the thrust bearing cap

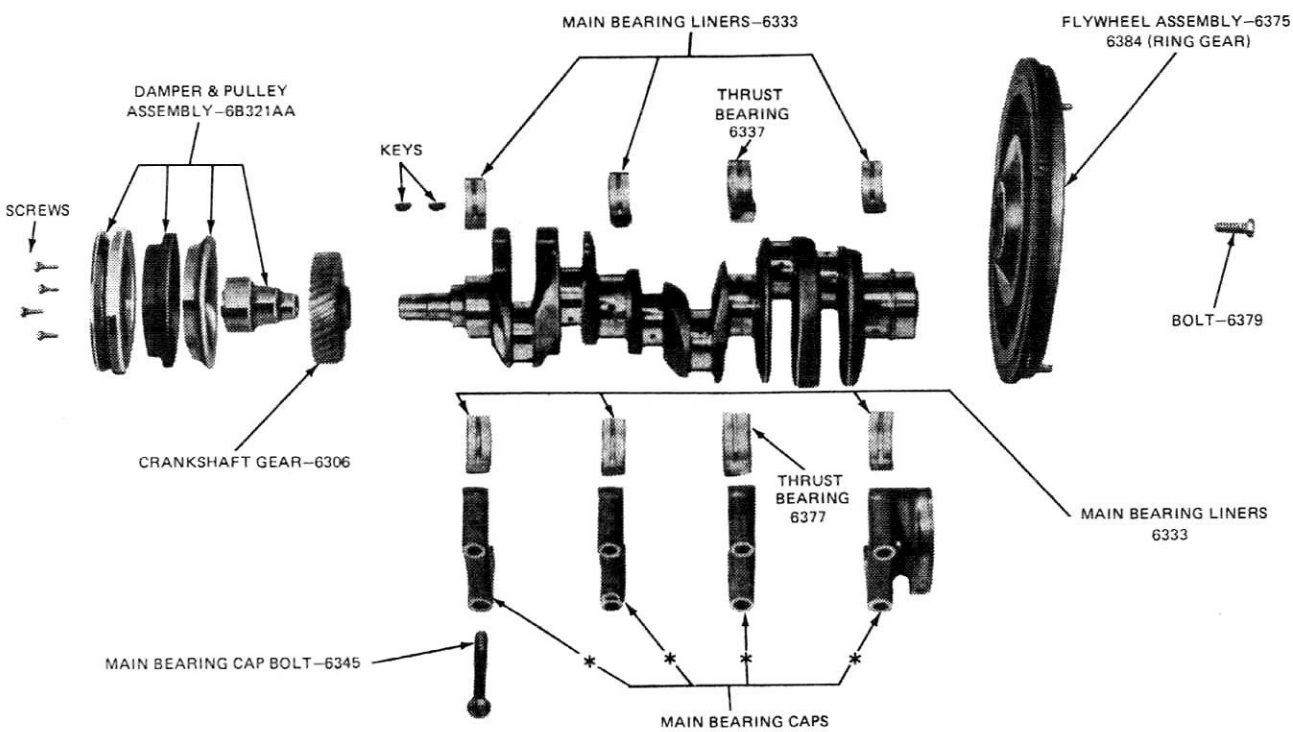


FIG. 44 Crankshaft and Related Parts

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rearward. While holding in this position, tighten the cap bolts to specifications (Fig. 37).

7. Coat the sealing lip of a new crankshaft oil seal with SE-type engine oil. Slide seal over end of crankshaft and drive into position (Fig. 35). Be sure the seal bottoms in groove.
8. Using a flat tool such as a large blunt end screwdriver, push the two wedge-shaped seals between the cylinder block and rear main bearing cap. Position the seals with the round side facing the main bearing cap (Fig. 38).
9. Pull connecting rods up one at a time and install rod caps. Be sure to apply a liberal coating of SE-type oil to the bearing surfaces. Tighten cap nuts to specifications.
10. Install oil pump and pick up tube as an assembly.
11. Install front cover.
12. Install rear cover plate, flywheel housing and flywheel. Tighten flywheel bolts to specifications.
13. Install clutch disc and clutch pressure plate, if so equipped.
14. Install oil pan as described under Oil Pan—Installation. Be sure gaskets and seals are installed as directed.
15. Install the front cover and previously removed components.
16. Install the engine in the vehicle.

CAMSHAFT BEARING

The camshaft bearings are availbale pre-finished to size and require no reaming for standard and undersize journal diameters.

Removal

1. Remove the engine from the vehicle and place in a work stand. Remove the flywheel and the camshaft. Remove the rear bearing bore plug as detailed under Core Plugs in Part 21-01.
2. Remove the camshaft bearings with the tool shown in Fig. 45.
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel.

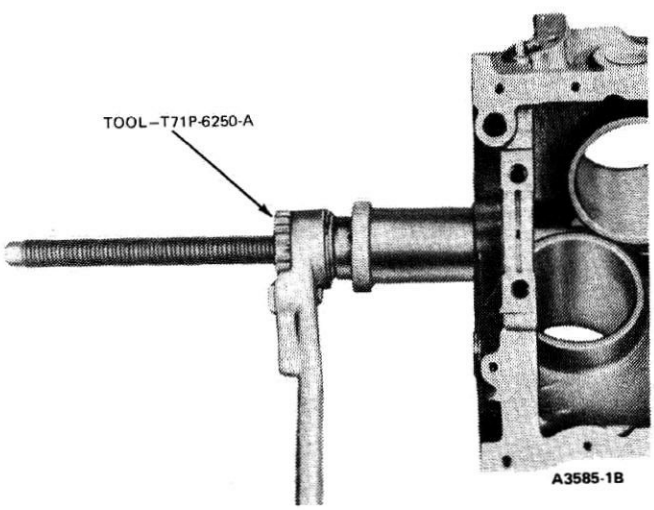


FIG. 45 Typical Camshaft Bearing Replacement

With the expanding collet collapsed, install the collet assembly in the camshaft bearing. Tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.

4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front and rear bearings, use the special adapter tube Tool T72C-6250.

Installation

1. Position the new bearings at the bearing bores, and press them in place with the tools shown in Fig. 45. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. Check oil hole alignment of Nos. 2 and 3 bearings with a welding rod of slightly smaller diameter than the oil holes. Insert the rod into the oil passage (Fig. 46). The rod will pass into the camshaft bore when the holes are properly aligned.

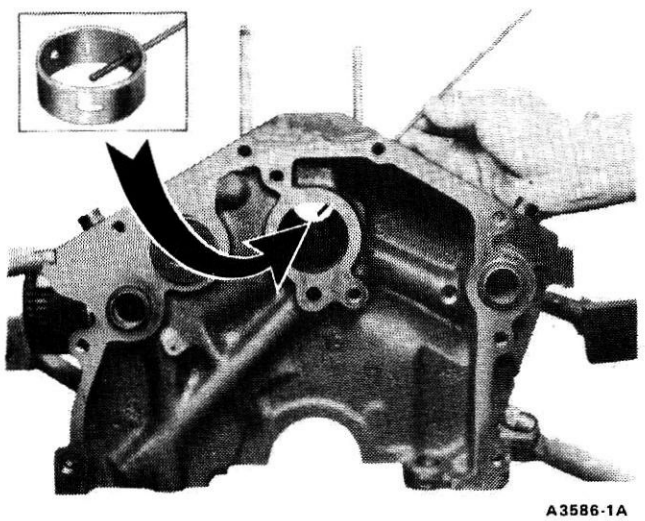


FIG. 46 Checking Oil Hole Alignment—Nos. 2 and 3 Camshaft Bearings

2. Install a new bearing bore plug. See Core Plugs in Part 21-01.
3. Install the camshaft, flywheel and related parts, following the appropriate procedures. Do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

OIL FILTER

Removal

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the filter adapter recess.

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DETROIT IRON

Installation

1. Coat the gasket on the replacement filter with oil. Position the filter on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase to the recommended level if necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to the Specification at the end of this Part for torque specifications), oil the threads with light weight (SE) engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer. Refer to Part 21-01 for cleaning and inspection procedures.**

VALVE ROCKER ARM ASSEMBLY

Refer to Fig. 47 for component parts.

Disassembly

1. Remove the spring washer and pin from each end of the valve rocker arm shaft.
2. Slide the rocker arms, springs and rocker arm shaft supports off the shaft. Be sure to mark the parts for re-assembly in the same locations.
3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce the plug on one end. Use a steel rod to knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

Assembly

1. The oil holes in the rocker arm shaft must point down when the shaft is installed. This position of the shaft can be recognized by a notch on the front face of the shaft (Fig. 7).
2. If the plugs were removed from the shaft, use a blunt tool and install a plug, cup side out, in each end of the shaft.
3. Install a spring washer and pin on one end of the shaft, coat the rocker arm shaft with heavy SE engine oil and install the parts in the same sequence they were removed.
4. Install the remaining spring washer and pin.
5. Before installation on the engine, coat the rocker arm pads with Lubriplate or equivalent.

CYLINDER HEAD

Disassembly

1. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surfaces.**
2. Compress the valve springs. Remove the valve retainer locks and release the springs.
3. Remove the spring retainer, stem seal, and valve (Fig. 48). Discard the valve stem seals. Identify all valve parts for re-assembly. Remove the manifold assembly and spark plugs.

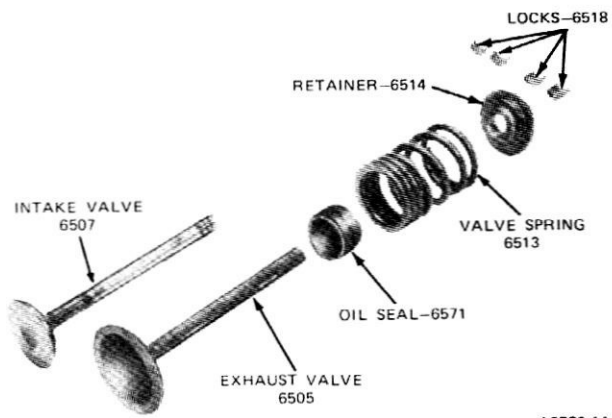


FIG. 48 Valve Assemblies

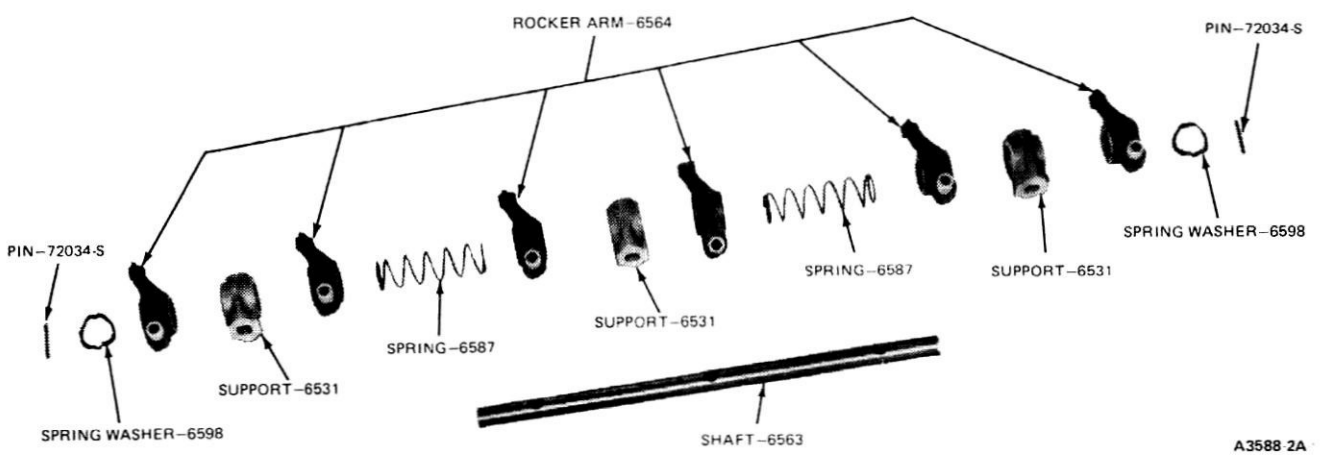


FIG. 47 Rocker Arm Shaft Assembly

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Assembly

1. Clean, inspect and repair all parts before assembly. Install the manifold assembly and spark plugs. Torque the spark plugs and manifold attaching parts to specifications. Lubricate the valve guides and valve stems with engine oil. Apply Lubriplate or equivalent to the tips of the valve stems.
2. Install each valve in the valve guide from which it was removed or to which it was fitted. Install a new stem seal on the valve.
3. Install the valve spring assembly over the valve, close coils toward the cylinder head. Install the spring retainer.
4. Compress the spring and install the retainer locks (Fig. 48).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 49).

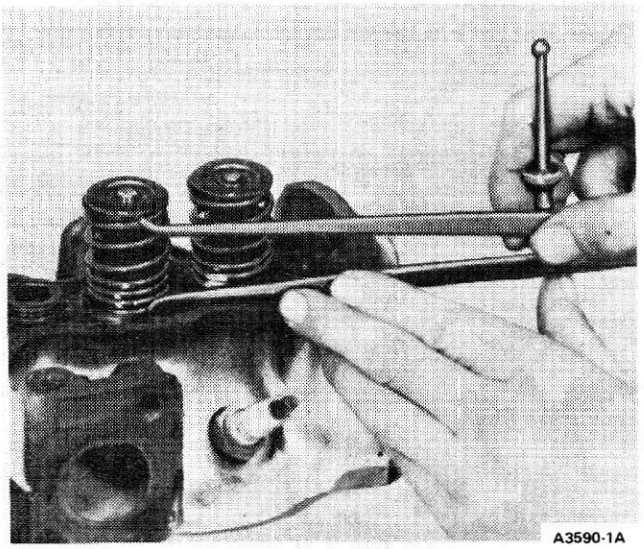


FIG. 49 Checking Valve Spring Assembled Height

6. Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of excess spacers will result in overstressing the valve springs and overloading the camshaft lobes which would lead to spring breakage and worn camshaft lobes.**

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Using an arbor press and the tool shown in Fig. 50 press the piston pin from the piston and connecting rod. Remove the piston rings.

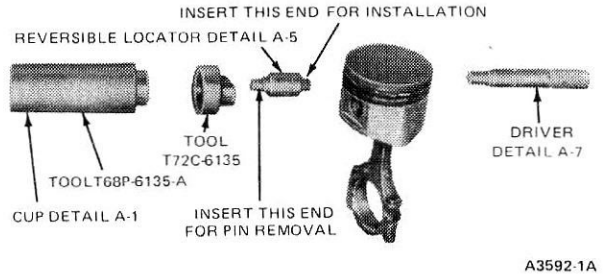


FIG. 50 Removing or Installing Piston Pin

Assembly

The piston, connecting rod and related parts are shown in Fig. 51. Clean and inspect the piston and connecting rod following procedures given in Part 21-01. Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications.

1. Apply a light coat of engine oil to all parts. **Assemble the piston and the connecting rod as shown in Fig. 42.**
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press, press the piston pin through the piston and connecting rod until the pin is centered in the piston (Fig. 50).
3. Check the end gap and spacing of all piston rings following instructions given in Part 21-01. They must be within specifications.

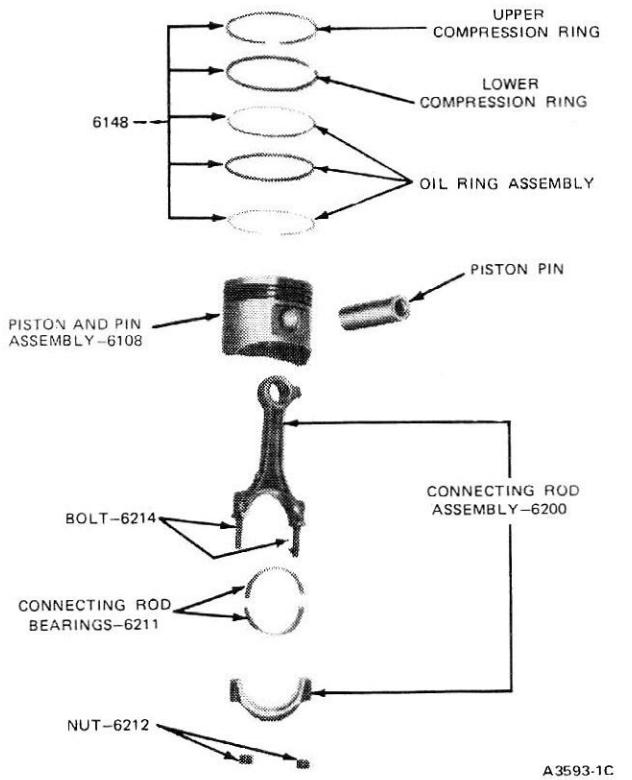


FIG. 51 Piston, Connecting Rod and Related Parts

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4. Follow the manufacturer's instructions (included with the piston ring package) and install the piston rings.
5. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and the lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
6. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY

Disassembly

1. Mount the old engine in a work stand and remove all parts not furnished with the new cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
2. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder assembly in a work stand and transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Completely disassemble the old engine, following the procedures given in the Removal and Installation Section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.

Assembly

1. Clean the cylinder block following the instructions given in Part 21-01. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand and install all serviceable parts removed from the old cylinder block, following the procedures given in the Removal and Installation Section of this Part.
3. Check all assembly clearances and correct as necessary.

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SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	2.8L (2800 cc)
NUMBER OF CYLINDERS	6
BORE AND STROKE	3.66 x 2.70
FIRING ORDER	1-4-2-5-3-6
OIL PRESSURE (Hot @ 2000 RPM)	40-60
DRIVE BELT TENSION	(1)
COMPRESSION PRESSURE	(2)

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	42.8-44.3
VALVE GUIDE BORE DIAMETER	0.3174-0.3184
VALVE SEATS	
Width – Intake	0.060-0.079
Width – Exhaust	0.060-0.079
Angle	45°
Runout Limit (T. I. R. Max.)	0.0015
VALVE ARRANGEMENT (Front to Rear)	L. H. = I-E-E-I-E-I R. H. = I-E-I-E-E-I
GASKET SURFACE FLATNESS	0.003 in 6", 0.006" overall
GASKET SURFACE FINISH (RMS)	60-150
VALVE STEM-TO-GUIDE CLEARANCE	
Intake	0.0008-0.0025
Exhaust	0.0018-0.0035
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	1.562-1.577
Exhaust	1.261-1.276
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std)	
Intake	0.3159-0.3167
Exhaust	0.3149-0.3156
(0.008 Oversize)	
Intake	0.3239-0.3245
Exhaust	0.3228-0.3235
(0.016 Oversize)	
Intake	0.3318-0.3324
Exhaust	0.3307-0.3314
(0.032 Oversize)	
Intake	0.3475-0.3481
Exhaust	0.3461-0.3468
VALVE SPRINGS	
Compression Pressure (Lb. @ Spec. Length)	60.0-68.0 @ 1.585 138.0-149.0 @ 1.222
Free Length (Approximate)	1.91
Assembled Height	1-37/64–1-39/64
Service Limit	(3)
Out-Of-Square	5/64 (0.078)
ROCKER ARM	
Shaft Diameter	0.7799-0.7811
Bore Diameter	0.7830-0.7842
Ratio	1.46:1
PUSH ROD RUNOUT (T. I. R. Max.)	0.020
VALVE TAPPET, LIFTER OR ADJUSTER	
Diameter (Std)	0.8736-0.8741
Clearance To Bore	0.0009-0.0024
Service Limit	0.005
VALVE LASH CLEARANCE (COLD)	
Intake	0.014
Exhaust	0.016

CAMSHAFT	
LOBE LIFT	
Intake	0.2555
Exhaust	0.2555
Allowable Lobe Lift Loss	0.005
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.3730
Exhaust	0.3730
END PLAY	0.0008-0.004
Service Limit	0.009
JOURNAL-TO-BEARING CLEARANCE	0.001-0.0026
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010
JOURNAL DIAMETER	
# 1	1.6497-1.6505
# 2	1.6347-1.6355
# 3	1.6197-1.6205
# 4	1.6047-1.6055
Runout	0.005 Max. T. I. R.
Out-Of-Round	0.0003 Max. T. I. R.
BEARING INSIDE DIAMETER	
# 1	1.6515-1.6523
# 2	1.6365-1.6373
# 3	1.6215-1.6223
# 4	1.6065-1.6073
FRONT BEARING LOCATION	(4) 0.040-0.060

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	(5)
Finish (RMS)	60-150
CRANKSHAFT TO REAR FACE OF BLOCK RUNOUT (T. I. R. Max.)	0.005
CYLINDER BORE	
Diameter	3.6614-3.6630
Surface Finish (RMS)	18-38
Out-Of-Round	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPER BORE DIAMETER	0.8750-0.8760
MAIN BEARING BORE DIAMETER	2.3866-2.3874
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.4534-0.4549

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.2433-2.2441
Out-Of-Round	0.0006
Taper Limit	0.0006 per inch
Journal Runout	0.002 Max.
Surface Finish (RMS)	12
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	1.039-1.041
CONNECTING ROD JOURNAL	
Diameter	2.1252-2.1260
Out-Of-Round	0.0006
Taper Limit	0.0006 per inch
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish	20 Max.
Runout (T. I. R.	0.001 Max.
FLYWHEEL CLUTCH FACE	
Runout	0.005
FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)	
Standard Transmission	0.025
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CONNECTING ROD BEARINGS	
Clearance To Crankshaft – Desired	0.0006-0.0015
– Allowable	0.0005-0.0022
Bearing Wall Thickness (Std) (6)	Red – 0.0548-0.0552 Blue – 0.0552-0.0556
MAIN BEARING	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0005-0.0019
Bearing Wall Thickness (Std) (6)	Red – 0.0707-0.0710 Blue – 0.0711-0.0714

(1)

Drive Belt Tension (Lbs.)			
Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(B) If less than 40 pounds, readjust to 40-60 pounds.
(C) If less than 90 pounds, readjust to 90-120 pounds.
(D) If less than 75 pounds, readjust to 90-120 pounds.
(2) PSI of lowest cylinder must be within 75% of highest (see part 21-01).
(3) 10% pressure loss @ specified Length.
(4) Distance in inches that front edge of bearing is installed below front face of cyl. block.
(5) 0.003 in any 6 inches – 0.006 overall.
(6) 0.002 undersize = add 0.001 to standard thickness.

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DETROIT IRON

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD	
Piston Pin Bore Diameter	0.9450-0.9452
Crankshaft Bearing Bore Diameter	2.2370-2.2378
Out-Of-Round	0.0004
Taper	0.0004
Length (Center-to-Center)	5.1386-5.1413
Alignment (Bore-to-Bore Max. Diff.) (7)	
Twist	0.006
Bend	0.002
Side Clearance (Assembled to Crank)	
Standard	0.004-0.011
Service Limit	0.014
PISTON	
Diameter (8)	
Coded Red	3.6605-3.6615
0.020 Oversize	3.6802-3.6812
Piston-To-Bore Clearance	0.0011-0.0019
Pin Bore Diameter	0.9450-0.9452
Ring Groove Width	
Compression (Top)	0.0803-0.0811
Compression (Bottom)	0.1197-0.1205
Oil	0.1579-0.1587
PISTON PIN	
Length	2.835-2.866
Diameter	
Standard	0.9446-0.9450
Pin To-Piston Clearance	0.0003-0.0006
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.0778-0.0783
Compression (Bottom)	0.1172-0.1177
Side Clearance	
Compression (Top)	0.0020-0.0033
Compression (Bottom)	0.0020-0.0033
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.015-0.023
Compression (Bottom)	0.015-0.023
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs. at Spec. Length)	13.6-14.7 @ 1.39
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U. S.)	4-1/2 (9)

TORQUE SPECIFICATIONS – SPECIAL APPLICATIONS

ITEM	SIZE	TORQUE
CAMSHAFT GEAR BOLT	M-10	30-36
CAMSHAFT THRUST PLATE BOLT	M-8	12-15
CARBURETOR TO SPACER (Stud)		3-5
CARBURETOR ADAPTER TO MANIFOLD (STUD)		3-5
CARBURETOR TO SPACER (Nut)	M-8	4-18
CONNECTING ROD NUT	M-8	21-25
CRANKSHAFT DAMPER BOLT	M-12	92-103
CRANKCASE VENT VALVE		11-14
CYLINDER HEAD BOLT	M-12	65-80 (10)
DECEL VALVE NUT		27-30
DECEL VALVE TO MANIFOLD ADAPTER		30-34
DISTRIBUTOR CLAMP BOLT	M-8	12-15
EGR TUBE FITTINGS		15-20
EGR VALVE TO SPACER BOLT	M-8	12-15
EXHAUST MANIFOLD TO EGR TUBE (CONN.)		25-35
EXHAUST MAN. TO CYLINDER HEAD (Bolt/Stud)	M-8	20-30
FLYWHEEL TO CRANKSHAFT (Bolt)	M-10	47-51
FRONT COVER TO CYLINDER BLOCK (Bolt)	M-8	12-15
FRONT PLATE TO CYLINDER BLOCK (Bolt)	M-8	12-15
FUEL PUMP TO CYLINDER BLOCK (Bolt)	M-8	12-15
INTAKE MAN. TO CYLINDER BLOCK (Bolt/Nut)	M-8	15-18 (11)
INTAKE MAN. TO CYLINDER BLOCK (Stud)	M-8	10-12
MAIN BEARING CAP BOLT	M-12	65-75

TORQUE SPECIFICATIONS – SPECIAL APPLICATIONS (Continued)

ITEM	SIZE	TORQUE
TIMING POINTER TO FRONT COVER (Bolt)	M-6	5-7
OIL PUMP PICK-UP TUBE TO PUMP (Bolt)	M-6	7-9
OIL PUMP PICK-UP TUBE TO MAIN BEARING CAP (Bolt)	M-8	12-15
OIL PUMP COVER (Bolt)	M-6	7-9
OIL PAN DRAIN PLUG	M-14	15-20
OIL PAN TO CYLINDER BLOCK (Bolt)	M-6	5-7
OIL FILTER TO CYLINDER BLOCK (INSERT)		10-15
OIL FILTER		(12)
ROCKER ARM COVER BOLT	M-6	3-5
ROCKER ARM SHAFT SUPPORT BOLT	M-10	43-49
WATER JACKET DRAIN PLUG TO BLOCK		14-18
WATER OUTLET CONNECTION BOLT	M-8	12-15
WATER PUMP TO CYLINDER BLOCK (Bolt)	M-6	7-9
WATER TEMP SENDING UNIT		7-11
SPARK PLUG TO CYLINDER HEAD		10-15
FUEL FILTER TO CARBURETOR		80-100 in-lb.
ALT MOUNTIN BRKT TO CYLINDER HEAD (Bolt)	M-8	18-25
ALT MOUNTING BRKT TO CYLINDER BLOCK (Bolt)	M-10	28-40
ALT PIVOT BOLT		45-60
ALT ADJ ARM TO FRONT COVER (Bolt)	M-12	50-71
ALT ADJUSTING ARM TO ALTERNATOR		24-40
CRANKSHAFT PULLEY TO DAMPER (Bolt)	M-8	18-25
FAN TO WATER PUMP HUB (Bolt)	M-8	14-20
THERM PUMP MTG BRACKET TO CYLINDER BLOCK (Bolt)	M-10	28-40
THERM PUMP MTG BRACKET TO CYLINDER HEAD (Bolt)	M-8	18-25
THERMACTOR PUMP ADJUSTING ARM TO PUMP (Bolt)		22-32
THERMACTOR PUMP PIVOT BOLT		30-45

TORQUE SPECIFICATIONS – General Applications

U. S. THREAD SIZES	TORQUE
1/4-20	6-9
5/16-18	12-18
5/16-24	14-20
3/8-16	22-32
3/8-24	27-38
7/16-14	40-55
7/16-20	40-60
1/2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	12-18
3/8	22-33
1/2	25-35

- All values are in ft. lb. unless otherwise noted
- NOTE: Oil threads with engine oil unless the threads require oil or water resistant sealer.

(7) Pin and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at ends of an 8" bar, 4" on each side of rod centerline.

(8) Measured at the piston pin bore centerline at 90° to the pin.

(9) Add 1/2 quart with filter change.

(10) In Sequence: Step 1 = 29-40; Step 2 = 40-51; Step 3 = 65-80;

(11) In Sequence: Step 1 = 3-6; Step 2 = 6-11; Step 3 = 11-15; Step 4 = 15-18. After engine has been operating, retorque in sequence to 15-18 (hot).

(12) 1/2 turn after gasket contacts sealing surface with oiled gasket.

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5.0L/5.8L (302/351 "W" CID) V-8 Engines

PART 21-21

Mustang II, Fairmont, Zephyr, Granada, Monarch, LTD II, Cougar, Thunderbird, Ford, Mercury and Versailles

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DESCRIPTION

ENGINE

The 5.0L (302 CID) and 5.8L (351 W CID) V-8 engines are shown in Figs. 1 and 2.

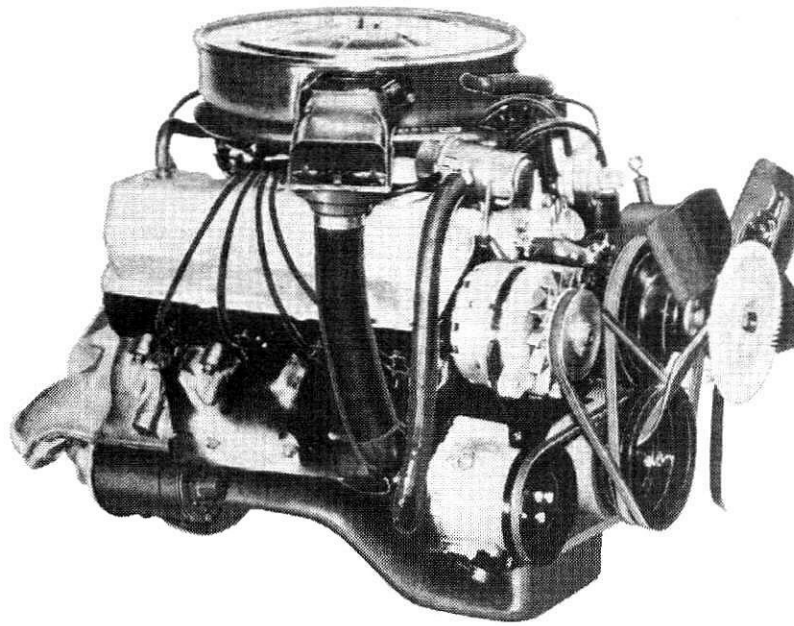
EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices used on these engines are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

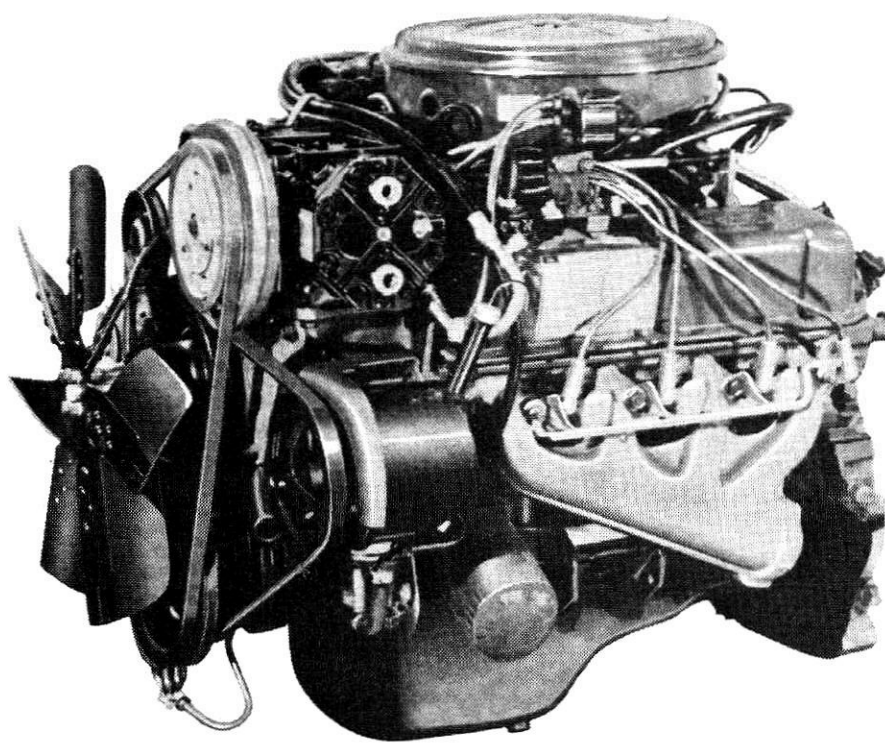
Both engines are equipped with a positive closed-type crankcase ventilation system re-cycling the crankcase vapors to the intake manifold.

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A3287-2B

FIG. 1 3/4 Right Front View—5.0L (302 CID) V-8 Engine



A2715-2E

FIG. 2 3/4 Left Front View—5.8L (351 "W" CID) V-8 Engine

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REMOVAL AND INSTALLATION

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

When installing nuts or bolts that must be torqued, oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning and Inspection and engine test procedures.

ENGINE ASSEMBLY

The Engine Removal and Installation procedures are for the engine only without the transmission attached. If the engine is equipped with the Thermactor system, remove or disconnect parts that will interfere with removal or installation of the engine.

Removal

1. Drain the cooling system and the crankcase.
2. Remove the hood. Disconnect the battery and alternator ground cables from the cylinder block.
3. Remove the air cleaner and intake duct assembly.
4. Disconnect the radiator upper hose from the coolant outlet housing and the radiator lower hose at the water pump.

   On a vehicle with an automatic transmission, disconnect the transmission oil cooler lines from the radiator.

   Remove the bolts attaching the fan shroud to the radiator, if so equipped.
5. Remove the radiator. Remove the fan, spacer, belt pulley and shroud.
6. Remove the alternator bolts and position the alternator out of the way.
7. Disconnect the oil pressure sending unit wire from the sending unit, and the flexible fuel line at the fuel tank line. Plug the fuel tank line.
8. Disconnect the accelerator cable from the carburetor.

   On a vehicle with an automatic transmission disconnect the throttle valve vacuum line from the intake manifold. Disconnect the manual shift rod and disconnect the retracting spring at the shift rod stud. Disconnect the transmission filler tube bracket from the cylinder block.

   On a vehicle with an air conditioner, isolate and remove the compressor as outlined in Group 36.

   On a vehicle with power steering, disconnect the power steering pump bracket from the cylinder head. Remove the drive belt. Position the power steering pump out of the way and in a position that will prevent the fluid from draining out.

   On a vehicle with vacuum boosted power brakes, disconnect the brake vacuum line from the intake manifold.
9. Disconnect the heater hoses from the water pump and intake manifold. Disconnect the coolant temperature sending unit wire from the sending unit.
10. Remove the flywheel or converter housing to engine upper bolts.
11. Disconnect the primary wiring connector from the ignition coil. Remove the wire harness from the left rocker arm cover and position the wires out of the way. Disconnect the ground strap from the block.
12. Raise the front of the vehicle. Disconnect the starter cable from the starter. Remove the starter.
13. Disconnect the muffler inlet pipes from the exhaust manifolds. Disconnect the engine support insulators from the brackets on the frame.

    On a vehicle with a manual-shift transmission, remove the bolts attaching the clutch equalizer bar to the frame rail and remove the equalizer from the engine block. Remove the remaining flywheel housing to engine bolts.

    On a vehicle with an automatic transmission, disconnect transmission cooler lines from retainer and remove the converter housing inspection cover. Disconnect the flywheel from the converter. Secure the converter assembly in the housing. Remove the remaining converter housing to engine bolts.
14. Lower the vehicle, and then support the transmission. Attach the engine lifting sling, Tool No. T53L-300-A or equivalent and hoist to lifting brackets on intake manifolds.
15. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment (avoid bending or damaging the rear cover plate or other components). Install the engine on a work stand.

Installation

1. Attach the engine lifting sling, Tool No. T53L-300-A or equivalent, and lifting brackets to intake manifold. Hoist the engine from the work stand.
2. Lower the engine carefully into the engine compartment. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes.

   On a vehicle with an automatic transmission, start the converter pilot into the crankshaft.

   On a vehicle with a manual-shift transmission, start the transmission main drive shaft into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**
3. Install the flywheel or converter housing upper bolts, making sure that the dowels in the cylinder block engage the flywheel housing.
4. Install the engine support insulator to bracket attaching nuts. Disconnect the engine lifting sling and remove the lifting brackets.
5. Raise the front of the vehicle. Connect both muffler inlet pipes to the exhaust manifolds. Torque the nuts to specifications.
6. Install the starter and the starter cable.

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On a vehicle with a manual-shift transmission, install the remaining flywheel housing to engine bolts. Position the clutch equalizer bar to the engine block and install the equalizer bar bracket on the frame side rail.

On a vehicle with an automatic transmission, remove the retainer holding the converter in the housing.

Attach the converter to the flywheel. Install the converter housing inspection cover. Install the remaining converter housing attaching bolts.

7. Remove the support from the transmission and lower the vehicle.
8. Connect the wiring harness to the left valve rocker arm cover and connect the coil wiring connector.
9. Connect the coolant temperature sending unit wire. Connect the heater hose to the intake manifold.
10. Connect the bellcrank to the intake manifold.

On a vehicle with an automatic transmission, connect the transmission filler tube bracket. Connect the manual shift rod and connect the retracting spring. Connect the throttle valve vacuum line.

Connect the accelerator cable.

11. Remove the plug from the fuel tank line and connect the fuel line and the oil pressure sending unit wire.
12. Install the pulley, belt, spacer and fan.
13. Position the alternator and install the alternator bolts. Connect the alternator and the battery ground cables. Adjust the belt tension to specifications.

On a vehicle with an air conditioner, install the compressor as outlined in Group 36.

On a vehicle with power steering, install the drive belt and power steering pump bracket. Install the bracket attaching bolts. Adjust the drive belt tension to specifications.

On a vehicle with vacuum boosted power brakes, connect the brake vacuum line.

14. Place the radiator shroud over the fan, if so equipped. Install the radiator. Connect the radiator upper and lower hoses. On a vehicle with an automatic transmission, connect the transmission fluid cooler lines. Install the shroud bolts if so equipped.
15. Connect the heater hose at the water pump. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of oil.
16. Adjust the transmission throttle linkage.
17. Operate the engine at fast idle and check all gaskets and hose connections for leaks.
18. Install the air cleaner and intake duct assembly.
19. Install and adjust the hood.

ENGINE FRONT SUPPORTS

The front supports are located on each side of the cylinder block (Figs. 3 thru 7). The procedures given apply to either a right or left installation. **Whenever self-locking mounting bolts and nuts are removed, they must be replaced with new self-locking bolts and nuts.** See (*) in Figs. 3-7.

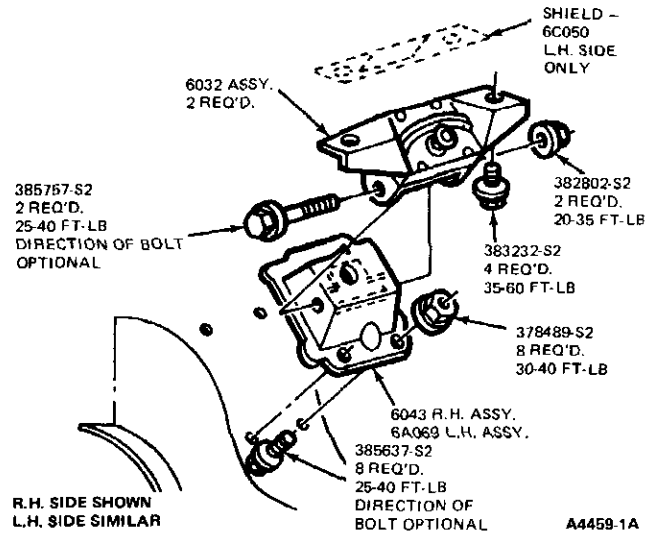


FIG. 3 Engine Front Supports—Ford and Mercury

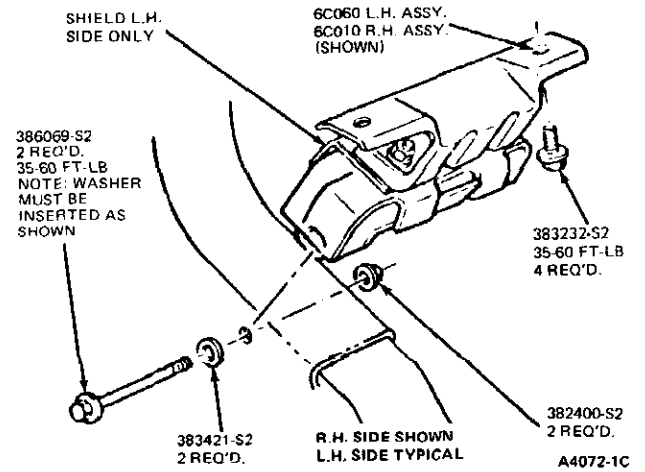


FIG. 4 Engine Front Supports—Granada, Monarch and Versailles

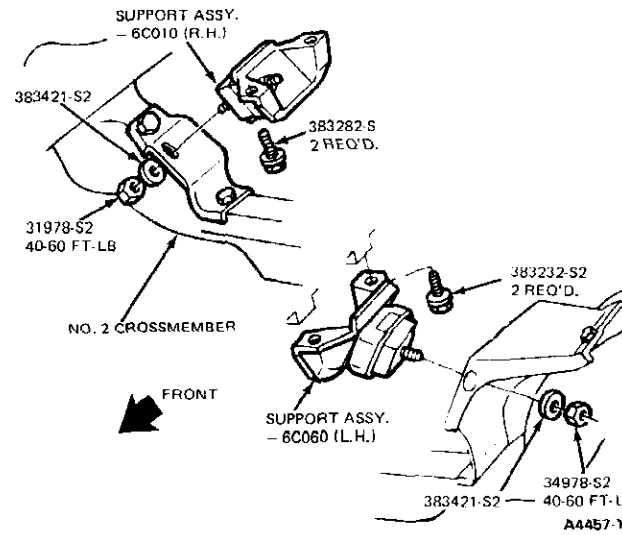


FIG. 5 Engine Front Supports—Fairmont and Zephyr

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Granada, Monarch and Versailles

Removal

1. Support the engine using a jack and wood block placed under the oil pan.
2. Remove the nut and through bolt attaching the insulator to the insulator support bracket (Fig. 4).
3. Raise the engine slightly with the jack.
4. Remove the engine insulator and bracket assembly to cylinder block attaching bolts. Remove the engine insulator assembly and the heat shield, if so equipped.

Installation

1. Position the engine insulator assembly and the heat shield, if so equipped, to the cylinder block and install the attaching lock bolts. Torque the bolts to specifications.
2. Lower the engine into position, install the engine insulator assembly to insulator support bracket through bolt and remove the jack and wood block.
3. Install the engine insulator assembly to insulator support bracket lock nut. Torque the nut to specifications.

FAIRMONT AND ZEPHYR

Wherever self-locking fasteners are removed, they must be replaced with new self-locking fasteners.

Removal

1. Remove the fan shroud attaching screws.
2. Remove the nuts attaching the insulators to the lower bracket (Fig. 5).
3. Raise the engine using a jack and wooden block placed under the oil pan.
4. Remove the bolts attaching the insulator assembly to the engine block. Remove the engine insulator assembly.

Installation

1. Position the engine insulator assembly to the engine block and install the attaching lock bolts. Torque the bolts to specification.
2. Lower the engine into position and install the lock nut. Torque the nut to specification.
3. Remove the jack and wood block.
4. Install fan shroud attaching screws and torque to specification.

LTD II, Cougar, Thunderbird, and Mustang II

Removal

1. Remove the fan shroud attaching screws.
2. From under the car support the engine using a wood block and jack placed under the oil pan.
3. Remove the nut and through bolt attaching the insulator to the frame crossmember (Figs. 6 and 7).
4. Raise engine enough to remove insulator and heat shield (if so equipped).

Installation

1. Position the insulator assembly and heat shield, if so equipped, to the engine block and torque the attaching screws to specification.

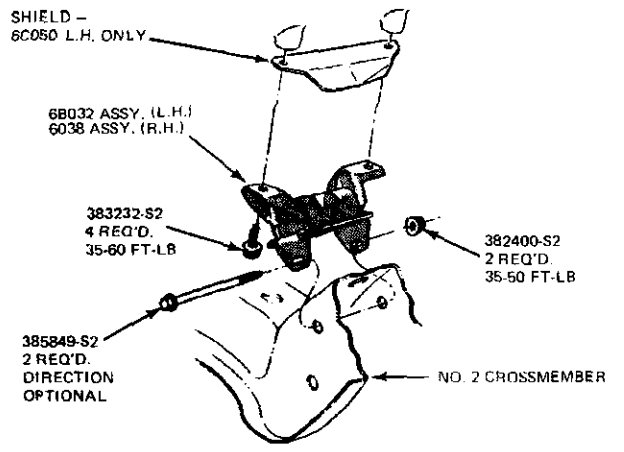


FIG. 6 Engine Front Supports—LTD II, Cougar and Thunderbird

2. Lower the engine until the through bolt can be inserted through the insulator and crossmember. Be sure the locator boss on the insulator and the locator hole in the crossmember are properly aligned.
3. Install the through bolt nut and torque to specification.
4. Remove the jack and wood block, install the fan shroud attaching screw.

ENGINE REAR SUPPORT

The rear support is located at the transmission extension housing (Figs. 7 through 11).

Whenever self-locking mounting bolts and nuts are removed, they must be replaced with new self-locking bolts and nuts. See (*) in Figs. 8 through 11.

Mustang II, LTD II, Cougar and Thunderbird

Removal

1. On LTD II, Cougar and Thunderbird models, support the engine with a jack and wood block under the oil pan and remove the support insulator to crossmember attaching nuts.
2. Remove the support insulator to transmission extension housing bolts and support insulator to crossmember nuts.
3. On all models except those with floor shift manual transmissions, raise the transmission with a floor jack. Remove the support insulator and retainer.
4. On floor shift manual transmission models, support the transmission with a floor jack and remove the frame crossmember from the frame and from the engine rear support; then remove the rear support from the transmission. **Do not apply upward pressure on the transmission with the jack as damage to the transmission shift lever console or mounting plate will result.**

Installation

1. Position the support insulator and retainer on the transmission extension housing.

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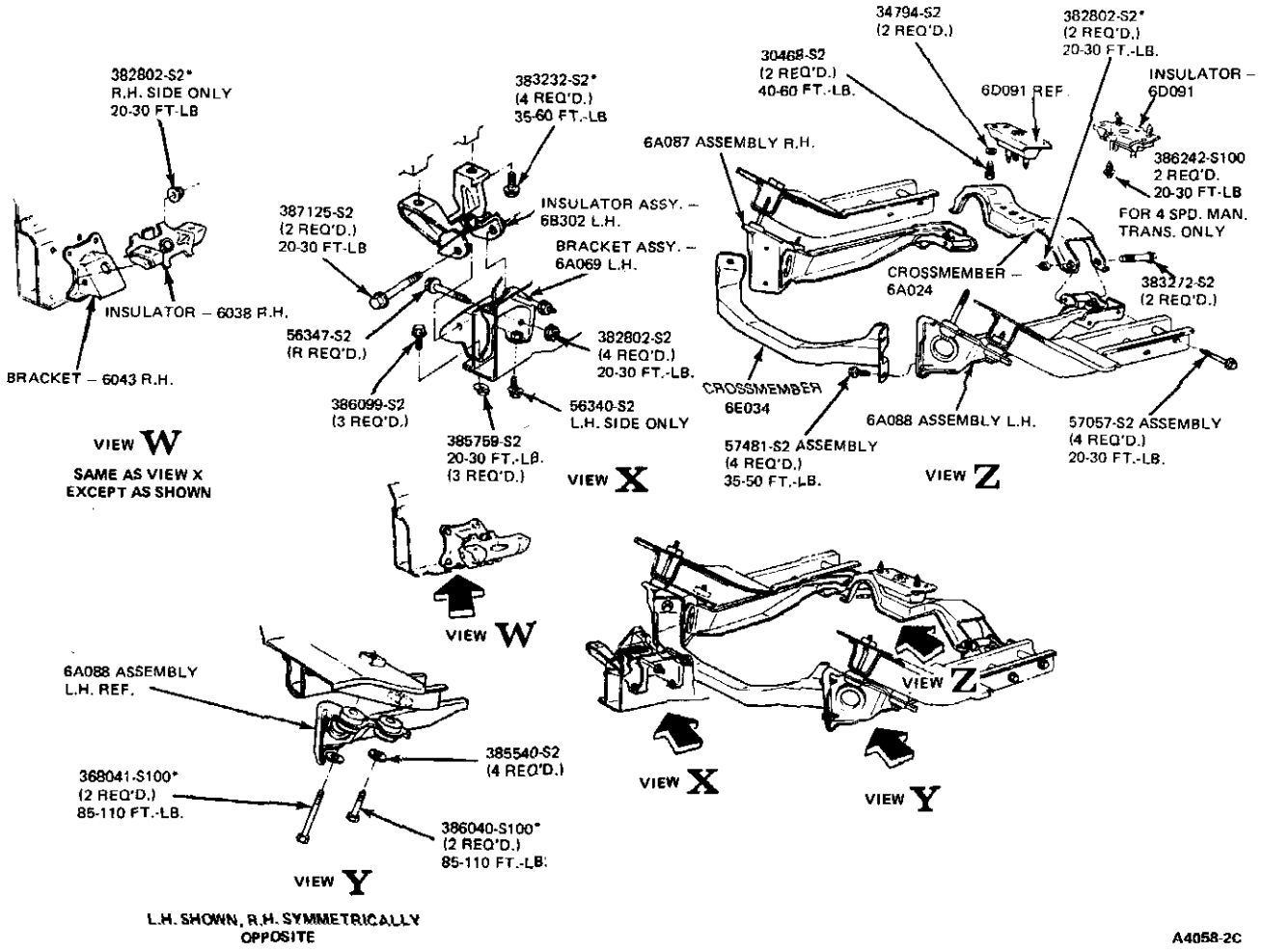


FIG. 7 Engine Rear Supports—Mustang II

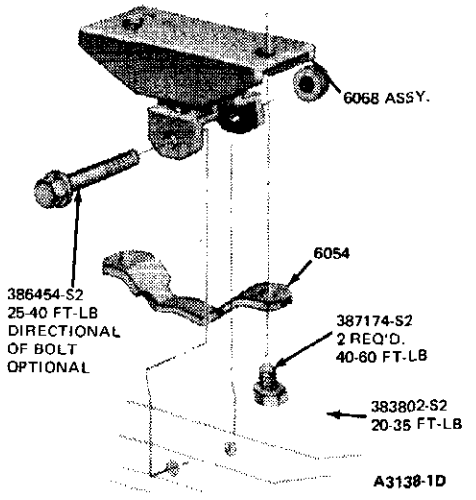


FIG. 8 Engine Rear Support—Ford and Mercury

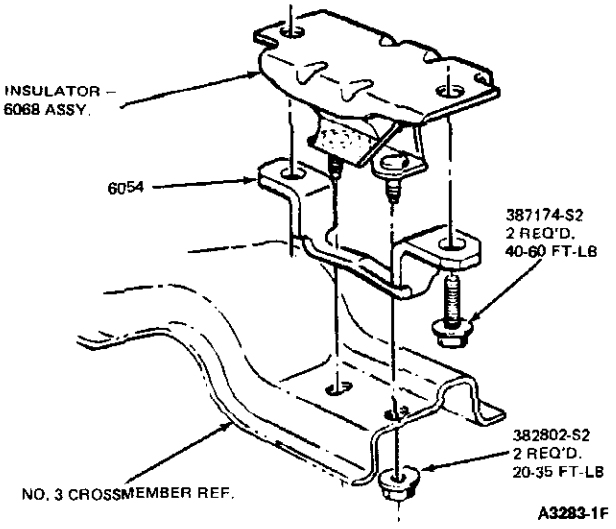


FIG. 9 Engine Rear Supports—LTD II, Cougar and Thunderbird

2. On all models except those with floor shift, install the support insulator to transmission extension housing bolts and lockwashers. Torque the bolts to specifications. Lower the transmission.

3. On models with floor shift manual transmission, position the rear support to the transmission and install and torque the attaching bolts. Position the removable crossmember to the frame and install the

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through-bolts. Remove the supporting jack, install the nuts and washers attaching the support to the crossmember and torque the nuts to specifications.

4. On LTD II, Cougar and Thunderbird models, install the support insulator to crossmember attaching nuts. Tighten the nuts to specifications.

MUSTANG II, FAIRMONT AND ZEPHYR

Removal

1. Place a block of wood and a jack under the transmission.
2. Remove the two nuts attaching the insulator to the crossmember (Fig. 11). Raise the transmission enough to allow removal of the insulator from the crossmember.
3. Remove the two bolts and nuts attaching the crossmember to the frame side rails and remove the crossmember.
4. On those vehicle so equipped, remove the fasteners attaching the exhaust hanger to the rear engine mount.
5. Remove the two bolts attaching the insulator to the transmission and remove the insulator (and retainer, if so equipped).

Installation

1. Position the insulator (and retainer, if so equipped) to the transmission. Install the two attaching bolts and torque to specification.
2. If required, install the fasteners attaching the exhaust hanger to the insulator and torque to specification.
3. Install the crossmember to the frame rails and torque the attaching nuts and bolts to specification.
4. Lower the transmission and install the insulator to crossmember attaching nuts and torque to specification.
5. Remove the jack and wood block from under the transmission.

CRANKCASE VENTILATION SYSTEM

The positive closed-type crankcase ventilation system components are shown in Fig. 9.

Removal

1. Remove the ventilation system air intake hose from the air cleaner and the right valve cover.
2. Remove the air cleaner and intake duct assembly.
3. Disconnect the crankcase vent hose from the carburetor spacer.
4. Pull the regulator valve out of the oil filler cap in the left valve cover.
5. Disconnect the vent hose from the canister purge solenoid.

Installation

1. Insert the regulator valve into the oil filler cap on the left valve cover.
2. Connect the vent hose to the regulator valve, the carburetor spacer and the canister purge solenoid.
3. Install the air cleaner and intake duct assembly.
4. Install the ventilation system air intake hose to the air cleaner and the right valve cover fitting.

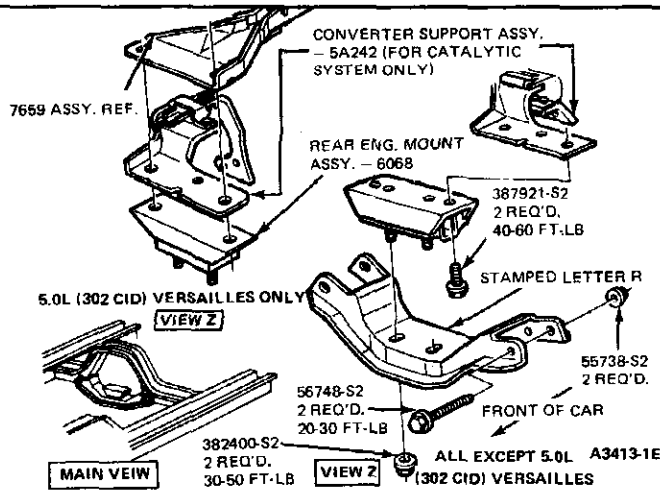


FIG. 10 Engine Rear Supports—Granada, Monarch and Versailles

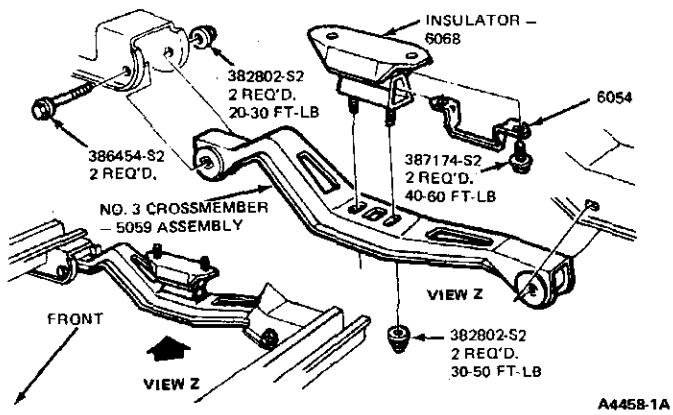


FIG. 11 Engine Rear Support—Fairmont and Zephyr

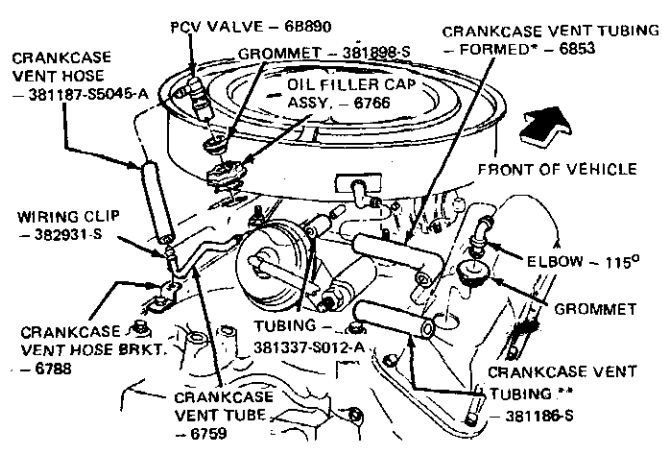


FIG. 12 Typical Crankcase Ventilation System Components

5. Start the engine and check for leaks.

EGR COOLER

Removal

1. Drain the radiator.
2. Disconnect the EGR cooler attaching bracket at the exhaust and intake manifolds, (Fig. 13).

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NOTE: If the rocker arm cover is not being removed, remove only the 1/2-inch attaching screws at the top of the bracket to disconnect the cooler assembly.

2. Cut the cooler exhaust inlet and outlet tube clamps (one at the front of the cooler and one at the EGR valve) using Tool T78P-9481-A or equivalent (follow tool manufacturer's instructions). Rotate the cooler by hand to separate the tubes after the clamps are cut.
4. Disconnect inlet and outlet coolant hoses and remove the cooler assembly.

Installation

1. Install the coolant hoses. Align the bracket and cooler assembly.
2. Position the exhaust inlet and outlet tubes—front and rear—to the cooler assembly using new gaskets and clamps.
3. Position and tighten the clamps using Tool T78P-9481-A or equivalent (follow tool manufacturer's instructions). Be sure cooler and tubes are in position before clamping.
4. Attach the cooler bracket at the exhaust and intake manifolds, or the 1/2-inch top hold-down screw (if the rocker arm cover was not removed).
5. Close the radiator drain petcock and refill the radiator according to instructions in Part 27-01. Operate engine and check for coolant or exhaust leaks.

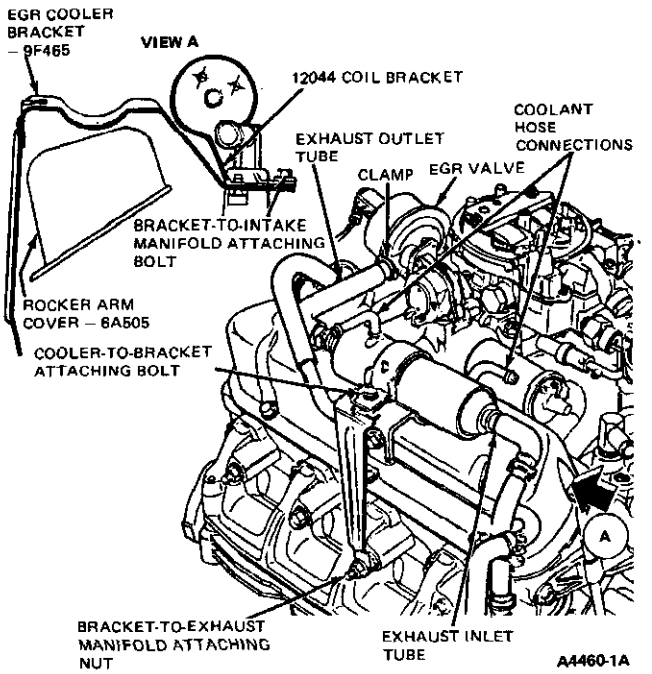


FIG. 13 EGR Cooler Installation—Versailles

VALVE ROCKER ARM COVER AND ROCKER ARM

The valve rocker arm assembly sequence is shown in Fig. 14.

Removal

1. To remove a valve rocker arm from the right cylinder head, remove the air cleaner assembly, disconnect the automatic choke heat chamber air inlet hose from the inlet tube near the right valve rocker arm cover, if so equipped.

   Remove the EGR cooler assembly, if equipped.

   Remove the automatic choke heat tube, if equipped. Remove the crankcase ventilation fresh air tube from the valve rocker arm cover. Disconnect the EGR vacuum amplifier hoses.
2. Remove the Thermactor by-pass valve and air supply hoses as necessary to provide clearance.
3. Disconnect the spark plug wires from the spark plugs using Tool No. T68P-6666-A. Do not pull on wire. Remove the wires and bracket assembly from the rocker arm cover attaching stud and position the wires out of the way.
4. On a left side rocker arm cover, remove the wire harness from the retaining clips. Remove the valve rocker arm cover attaching bolts and remove the cover.
5. Remove the valve rocker arm stud nut, fulcrum seat and rocker arm.

   If removal of the rocker arm stud is necessary, refer to the procedure under Cylinder Head Repairs in Part 21-01.

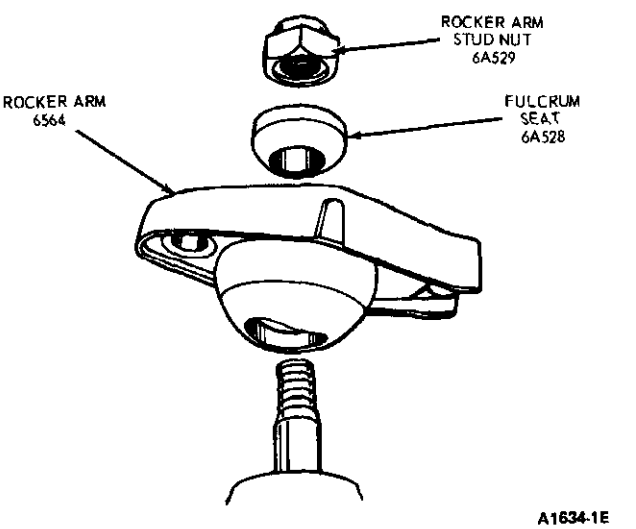


FIG. 14 Valve Rocker Arm

Installation

All rocker arms and fulcrum seats are to be lubricated with heavy engine oil SE before installation.

1. Apply Lubriplate, or equivalent, to the top of the valve stem and underside of the fulcrum seats.
2. Inspect the stud nut for damage. The chamfer on the nut should not be over 1/16-inch wide. A nut with a chamfer larger than 1/16-inch can cause the valves to be held open. (Refer to Part 21-01).
3. Rotate the crankshaft until the tappet is on the cam base circle (all the way down), and install the rocker arm, fulcrum seat and stud nut. Torque nuts to specification.
4. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Position a new service valve

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rocker cover gasket in each cover, making sure that the tabs engage the notches in the cover.

5. Position the cover(s) on the cylinder head(s). Install the bolts and wire loom clips on left hand cover. The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

   Install the crankcase ventilation hoses in the covers. Install the automatic choke heat tube and connect the automatic choke heat chamber air inlet hose at the air cleaner.

6. Install the spark plug wires and bracket assembly on the rocker arm attaching stud. Connect the spark plug wires. See Part 23-01 for special instructions. Install the air cleaner and intake duct assembly.
7. Install the Thermactor by-pass valve and air supply hoses.
8. Install EGR cooler assembly, if equipped.
9. Run engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or damaged valve stem seals and retainers may be replaced without removing the cylinder head, provided damage to the valve or valve seat has not occurred.

Removal

1. Remove the valve rocker arm cover and the applicable spark plug. Make sure the piston is at the top of its stroke with both valves closed to prevent accidental dropping of the valve into the cylinder.
2. Install an air line with an adapter in the spark plug hole and turn on the air supply. Failure of the air pressure to hold the valve(s) closed while performing the following steps as an indication of valve seat damage and necessitates removal of the cylinder head.
3. Remove the valve rocker arm stud nuts, fulcrum seats, valve rocker arms and push rods from both intake and exhaust positions, the applicable cylinder and note their positions so they can be reinstalled in their original positions. Remove the exhaust valve stem caps.
4. Install the stud nut and position the compressor tool as shown in Fig. 15. Compress the valve spring and remove the retainer locks, sleeve, spring retainer and valve spring.
5. Remove and discard the valve stem seal (Fig. 16).
6. **If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this from happening but will still allow enough travel to check the valve for binds.**

Installation

1. Remove air pressure from spark plug adaptor. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric movement during rotation. Move the valve up and down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 21-01.**
2. If the condition of the valve is satisfactory, apply heavy engine oil SE to the valve stem and hold the valve closed. Apply the air pressure within the cylinder.
3. Install a new valve stem seal (Fig. 16). Use a 5/8-inch deep wall socket and a light hammer or mallet to seat the seal on the valve stem. Place the spring in position over the valve and install the valve spring retainer and sleeve, if so equipped. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and stud nut.
4. Turn off the air pressure and remove the air line and adapter. Install the spark plug.
5. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods. Apply Lubriplate or equivalent to the tip of the valve stems. On exhaust valves, install the valve stem cap.

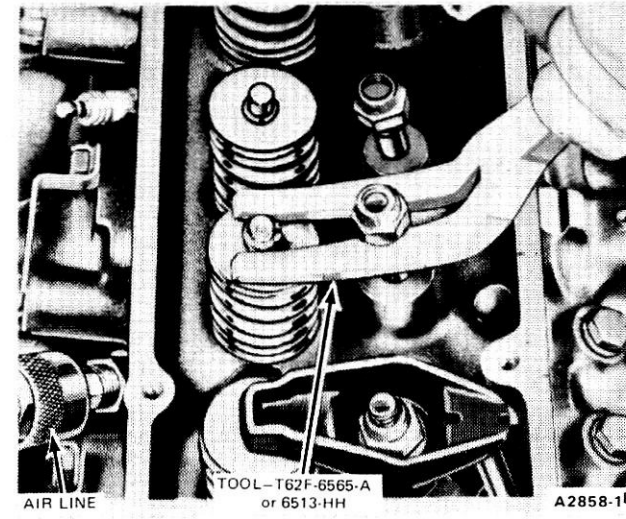


FIG. 15 Compressing Valve Spring—In Chassis

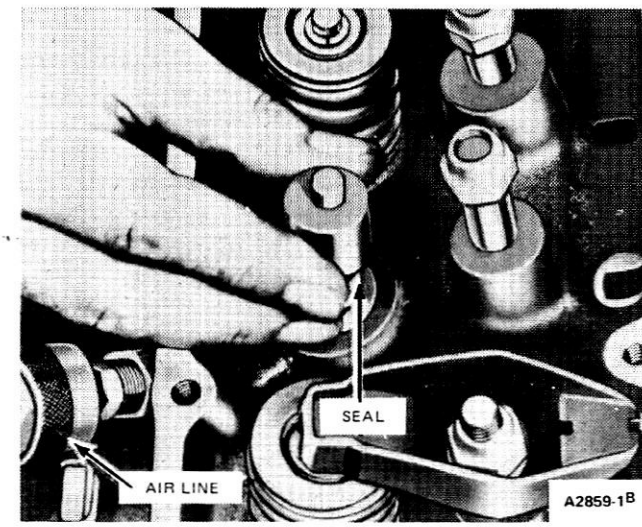


FIG. 16 Removing or Installing Valve Stem Seal

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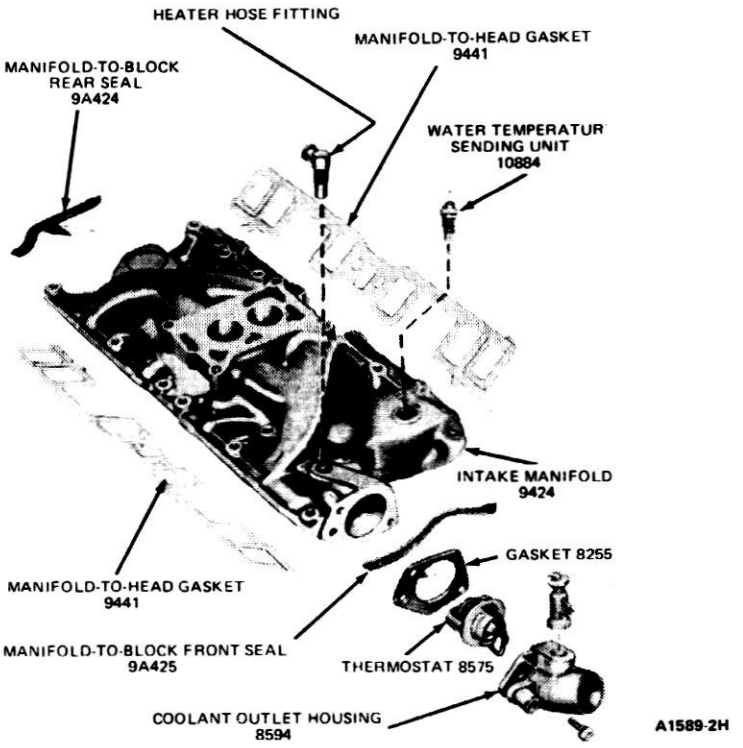


FIG. 17 Typical Intake Manifold Assembly

6. Apply Lubriplate, or equivalent, to the push rod socket, underside of the fulcrum seat and the valve pad of the rocker arm; then install the valve rocker arms, fulcrum seats and stud nuts. Torque nuts to specification.
7. Clean and install the rocker arm cover using a new service gasket.

   If the right cover was removed install the automatic choke heat tube. Install the vacuum vent valve (5.0L [302 CID]) and torque cover screws to specification.
8. Install the air cleaner and intake duct assembly. Connect the crankcase vent hose to the air cleaner.
9. Run the engine and check for leaks. Check engine idle speed and adjust as necessary.

INTAKE MANIFOLD

The intake manifold assembly is shown in Fig. 17.

Removal

1. Drain the cooling system. Remove the air cleaner, crankcase ventilation hose and intake duct assembly. Disconnect the automatic choke heat tube.
2. Disconnect the accelerator cable and speed control linkage, if equipped, from the carburetor. Remove the accelerator cable bracket.

   Disconnect vacuum lines, at the intake manifold fitting.
3. Disconnect the high tension lead and primary wiring connector from the coil.
4. Remove Thermactor by-pass valve and air supply hoses (5.0L [302 CID] only).
5. Disconnect the spark plug wires from the spark plugs using Tool No. T68P-6666-A. Do not pull on the wire. Remove the wires and bracket assembly from the rocker arm cover attaching stud. Remove the distributor cap, adapter and spark plug wire assembly.
6. Remove the carburetor fuel inlet line.
7. Disconnect the distributor vacuum hoses from the distributor. Disconnect the distributor wiring connector. Remove the distributor hold down bolt and remove the distributor.
8. Disconnect the radiator upper hose from the coolant outlet housing, and the water temperature sending unit wire at the sending unit. Disconnect the hose from the intake manifold.
9. Loosen the clamp on the water pump bypass hose at the coolant outlet housing and slide the hose off the outlet housing.
10. Disconnect the crankcase vent hose assembly at the valve rocker arm cover.
11. Remove the intake manifold and carburetor as an assembly. **It may be necessary to pry the intake manifold away from the cylinder head(s). Use caution to avoid possible damage to the gasket sealing surfaces. Remove the intake manifold gaskets and seals.**
12. If the manifold assembly is to be disassembled, identify all vacuum hoses before disconnecting them. Remove the coolant outlet housing, gasket and thermostat. Remove the ignition coil, temperature sending unit, carburetor, spacer and gaskets, and gasket. On 5.8L (351W CID) remove the choke heat stove cover and tube assembly.

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Installation

1. If the intake manifold assembly was disassembled, install the temperature sending unit (threads coated with electrical conductive sealer), ignition coil, gasket, spacer and carburetor. Install the EGR back-pressure transducer and valve using a new gasket. Position the thermostat in the coolant outlet housing. Coat the thermostat gasket with water-resistant sealer and position it on the coolant outlet housing. Install the coolant outlet housing. Connect all vacuum hoses.
2. Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block. Use a solvent such as lacquer thinner, chlorothane or tri-chlor-ethylene. Apply a 1/8 inch bead of silicone rubber sealer at the points shown in Fig. 18.

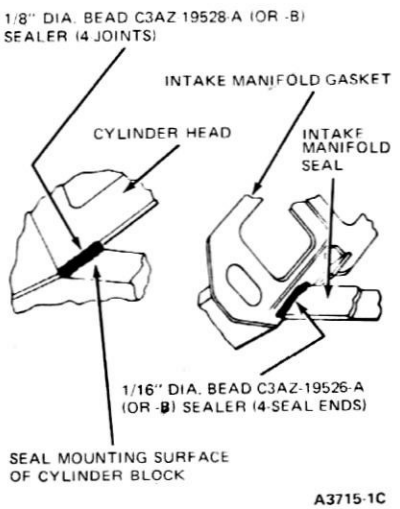


FIG. 18 Typical RTV Sealer Installation-Intake Manifold

3. Position new seals on the cylinder block and new gaskets on the cylinder heads with the gaskets interlocked with the seal tabs. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads.

   Apply a 1/16 inch bead of the above sealer to the outer end of each intake manifold seal for the full width of the seal (4 places). See Fig. 18.

   NOTE: This sealer sets up in 15 minutes, so it is important that assembly be completed promptly. Do not drip any sealer into the engine valley.
4. Using guide pins to ease installation, carefully lower the intake manifold into position on the cylinder block and cylinder heads. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**
5. Be sure the holes in the manifold gaskets and manifold are in alignment. Remove guide pins. Install the intake manifold attaching bolts and nuts. Torque the intake manifold bolts in sequence (Fig. 19) to specifications.

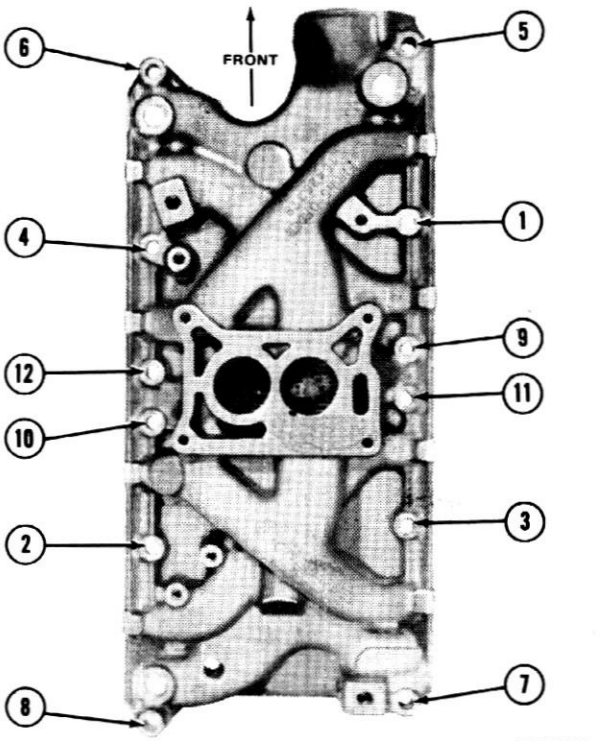


FIG. 19 Intake Manifold Bolts Torque Sequence

6. Install the water pump bypass hose on the coolant outlet housing. Slide the clamp into position and tighten the clamp.
7. Connect the radiator upper hose. Connect the heater hose at the intake manifold.
8. Install the carburetor fuel inlet line and the automatic choke heat tubes.
9. Rotate the crankshaft until the No. 1 piston is on TDC at the end of the compression stroke. Align the correct initial timing mark on the damper with the pointer. Position the distributor in the block with the rotor at the No. 1 firing position and the armature tooth centered on the stator (pick-up) coil. (See Part 23-01.) Install the hold down clamp.
10. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm cover attaching stud and connect the wires to the spark plugs. Install Thermactor by-pass valve and air supply hoses (5.0L [302 CID] only).
11. Connect the crankcase vent tube. Connect the high tension lead and coil primary wiring connector.
12. Connect the accelerator cable and accelerator cable bracket. Connect speed control, if equipped, to the carburetor.

    On a vehicle with an automatic transmission, connect the transmission vacuum line.

    On a vehicle equipped with vacuum-operated accessories, connect any vacuum lines that were disconnected from the intake manifold during removal.
13. Fill and bleed the cooling system.

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DETROIT IRON

14. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses to the distributor.
15. Operate the engine at fast idle and check all hose connections and gaskets for leaks. When engine temperatures have stabilized adjust the engine idle speed and idle fuel mixture. Retorque intake manifold bolts to specifications.
16. Install the air cleaner and intake duct assembly and crankcase vent hose.

HYDRAULIC TAPPET

Before replacing a hydraulic tappet for noisy operation, be sure the noise is not caused by improper valve to rocker arm clearance or by worn rocker arms or push rods.

Removal

1. Remove the intake manifold and related parts by following procedures under Intake Manifold Removal.
2. Remove the crankcase ventilation hoses, PCV valve and elbows from the valve rocker arm covers. Remove EGR cooler if equipped.
3. Remove the valve rocker arm covers. Loosen the valve rocker arm stud nuts and rotate the rocker arms to the side.
4. Remove the valve push rods and identify them so that they can be installed in their original positions.
5. Using a magnet, remove the tappets and place them in a rack so that they can be installed in their original bores (Fig. 20).

   If the tappets cannot be removed from their bores due to excessive varnish, etc., it may be necessary to use a plier-type tool (T52T-6500-DJD or 6500-D or equivalent) or a claw type tool to remove them. Rotate the tappet back and forth to loosen it from the gum or varnish that may have formed on the tappet.

   If necessary to disassemble a tappet, refer to Tappet Disassembly and Assembly.

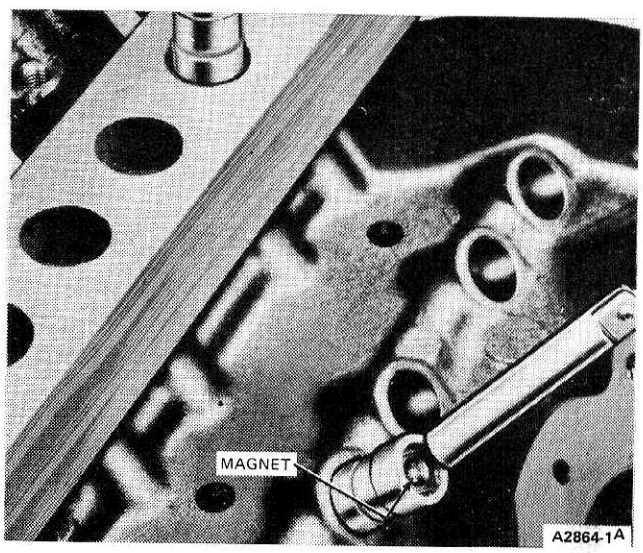


FIG. 20 Removing Tappet

Installation

Tappets and bores are to be lubricated with heavy engine oil SE before installation.

1. Clean outside of tappets and install in the bores from which they were removed. If a new tappet is being installed, check the new tappet for a free fit in the bore in which it is to be installed. Lubricate the tappet and bore with heavy engine oil SE before inserting it in the bore.
2. Install the push rods in their original position. Apply Lubriplate or equivalent to the valve stem tips and the push rod ends.
3. Lubricate the rocker arms and fulcrum seats with heavy engine oil SE. Position the rocker arms over the push rods and install stud nuts. Perform a valve clearance adjustment as outlined under Valve Clearance Adjustment—Hydraulic Tappets (Part 21-01).
4. Install the valve rocker arm covers with a new service gasket. Install EGR cooler, if equipped. Install the PCV valve or elbow in the valve rocker arm cover.
5. Install the intake manifold and related parts by following procedures under Intake Manifold Installation.
6. Run the engine and check for leaks. Check engine idle speed and adjust as necessary.

CYLINDER HEADS

If a cylinder head is to be replaced, follow the procedures under Cylinder Head Disassembly and Assembly, and transfer all valves, springs, spark plugs, etc., to the new cylinder head. Clean and inspect all parts, reface the valves (refer to Part 21-01) and check all assembly clearances before assembling the new or used parts to the new cylinder head.

Removal

1. Remove the intake manifold and carburetor as an assembly following the procedure under Intake Manifold Removal. Remove EGR cooler, if equipped.
2. Remove the rocker arm cover(s).

   If the left cylinder head is to be removed on a vehicle with an air conditioner, isolate and remove the compressor as outlined in Group 36.

   If the left cylinder head is to be removed on a vehicle with power steering, disconnect the power steering pump bracket from the left cylinder head and remove the drive belt from the pump pulley. Position the power steering pump out of the way and in a position that will prevent the oil from draining out.
3. If the right cylinder head is to be removed, remove the alternator mounting bracket bolt and spacer from the right cylinder head assembly.
4. Disconnect the exhaust manifold(s) from the muffler inlet pipe(s).
5. Loosen the rocker arm stud nuts so that the rocker arms can be rotated to the side. Remove the push rods in sequence (Fig. 21) so that they may be installed in their original positions.

   Remove the exhaust valve stem caps.

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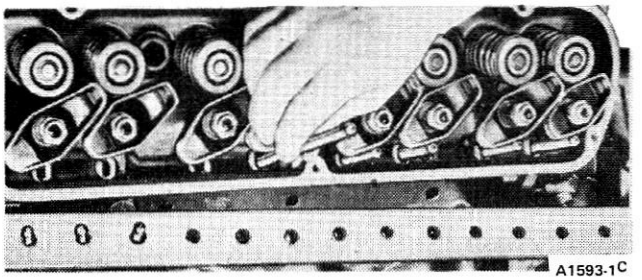


FIG. 21 Removing Valve Push Rod

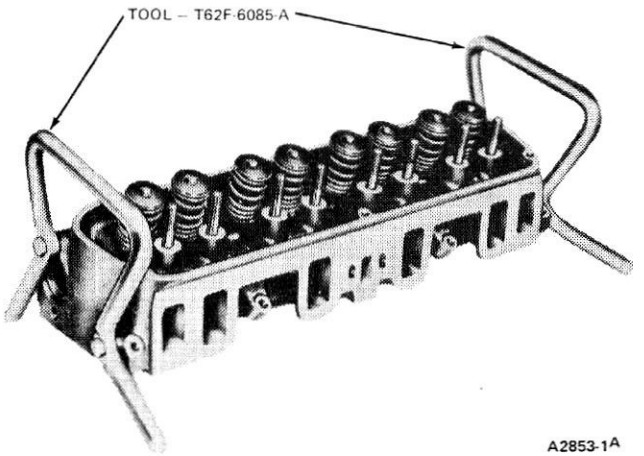


FIG. 22 Cylinder Head Holding Fixture

6. Install the cylinder head holding fixtures (Fig. 22).

   Remove the cylinder head attaching bolts and lift the cylinder head off the block. If required, remove the exhaust manifolds to gain access to the lower attaching bolts. Remove and discard the cylinder head gasket.

Installation

1. Clean the cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket surfaces. (See Part 21-01.)
2. Position the new cylinder head gasket over the cylinder dowels on the block. Position the cylinder head on the block and install the attaching bolts. Remove the holding fixtures.
3. The cylinder head bolts are tightened in three progressive steps. Torque all the bolts in sequence (Fig. 23) to specifications. When cylinder head bolts have been tightened following this procedure, it is not necessary to retorque the bolts after extended operation. However, the bolts may be checked and retorqued if desired. If removed, install the exhaust manifolds and retorque the attaching bolts to specification.
4. Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Visually check the push rods for straightness or check push rod runout with a dial indicator. If runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**

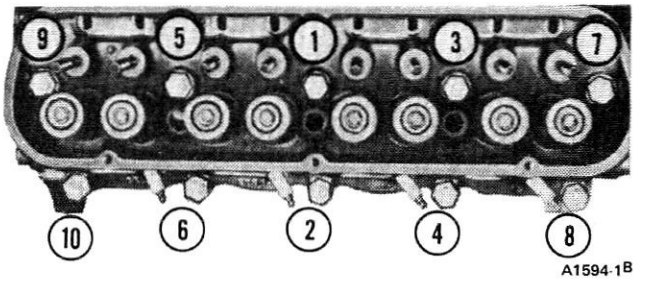


FIG. 23 Cylinder Head Bolt Torque Sequence

5. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tips. Install the exhaust valve stem caps.
6. Install the rocker arms. If all original assembly components are installed, a valve clearance adjustment is not necessary. If any valve train components are replaced, perform a valve clearance adjustment as outlined under Valve Clearance Adjustment—Hydraulic Tappets (Part 21-01).
7. Connect the exhaust manifold(s) at the muffler inlet pipe(s). Tighten the nuts to specifications.
8. If the right cylinder head was removed, install the alternator attaching bracket on the right cylinder head assembly. Install the alternator. Adjust the drive belt tension to specifications.
9. Clean the valve rocker arm cover(s). Position the valve rocker cover gasket in each cover, making sure that the tabs engage the notches in the cover. Install the valve rocker arm cover(s).

   The valve rocker cover is tightened in two steps. Tighten the bolts to specifications. Two minutes later retighten bolts to the same specifications. Install EGR cooler, if equipped.
10. If the left cylinder head was removed on a vehicle with an air conditioner, install the compressor as outlined in Group 36.

    If the left cylinder head was removed on a vehicle with power steering, install the drive belt and power steering pump bracket. Install the bracket attaching bolts. Adjust the drive belt to specifications.
11. Install the intake manifold and related parts following the procedure under Intake Manifold Installation.

EXHAUST MANIFOLDS

Removal

1. On a right exhaust manifold, remove the air cleaner and intake duct assembly. Disconnect the automatic choke heat tubes.
2. Disconnect the exhaust manifold from the muffler inlet pipe. Remove the attaching nuts and then remove the spark plug wires, spark plugs and heat shields.
3. Remove the attaching bolts and washers and remove the exhaust manifold.

Installation

1. Clean the mating surfaces of the exhaust manifold and cylinder head. Clean the mounting flange of the exhaust manifold and muffler inlet pipe.

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2. Position the exhaust manifold on the cylinder head and install the heat shields and the attaching bolts and washers. Working from the center to the ends, torque the bolts to specifications. Install the spark plugs and spark plug wires. See Part 23-01 for special installation procedure.
3. Position the muffler inlet pipe to the manifold. Install and torque the attaching nuts to specifications.
4. Install the automatic choke heat tubes. Install the air cleaner and intake duct assembly.
5. Start the engine and check for exhaust leaks.

WATER PUMP

Removal

1. Drain the cooling system. Remove the carburetor air inlet tube.

   On vehicles equipped with a fan shroud, remove the shroud attaching bolts and position the shroud over the fan.

   Remove the fan and spacer from the water pump shaft. Remove the shroud if so equipped.
2. Remove the air conditioner drive belt and idler pulley bracket if so equipped.

   Remove the alternator drive belt.

   Remove the power steering drive belt and power steering pump, if so equipped.

   Remove all accessory brackets which attach to the water pump. Remove the water pump pulley.
3. Disconnect the radiator lower hose, heater hose and water pump bypass hose at the water pump.
4. Remove the bolts that attach the pump to the cylinder front cover. Remove the pump and gasket. Discard the gasket.

Installation

1. Remove all gasket material from the mounting surfaces of the cylinder front cover and water pump.
2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover; then install the pump.
3. Install the attaching bolts and torque them to specifications.
4. Connect the radiator hose, heater hose and water pump by-pass hose at the water pump.
5. Install all the accessory brackets which attach to the water pump. Place the water pump pulley on the water pump shaft.
6. Install the power steering pump and drive belt if so equipped. Install the alternator and drive belt. Install the air conditioner idler pulley bracket and drive belt if so equipped.
7. Position the fan shroud, if so equipped, over the water pump pulley and install the spacer or fan drive clutch and fan. Install the shroud attaching bolts. Install the carburetor air inlet tube.

   Adjust the drive belts to the specified belt tension.
8. Fill and bleed the cooling system. Operate the engine until normal operating temperatures have been reached and check for leaks.

CYLINDER FRONT COVER AND TIMING CHAIN

Removal

1. Refer to Water Pump Removal. Perform all steps except removal of the pump. Leave it attached to the front cover.
2. Drain the crankcase.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the damper attaching screw and washer. Install the puller on the crankshaft vibration damper (Fig. 24) and remove the vibration damper.

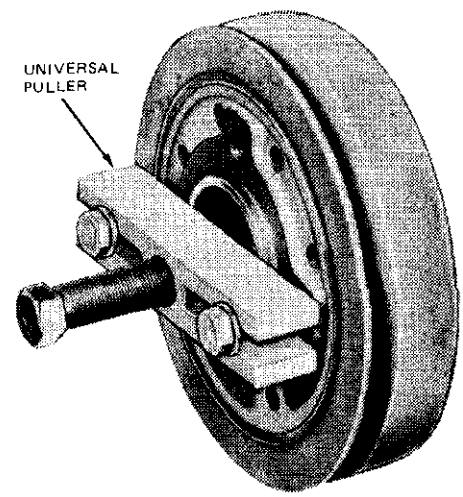


FIG. 24 Removing Crankshaft Vibration Damper

4. Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump attaching bolts and lay the pump to one side with the flexible fuel line still attached.
5. Remove the oil level dipstick.
6. Remove the oil pan to cylinder front cover attaching bolts. Use a thin blade knife to cut the oil pan gasket flush with cylinder block face prior to separating the cover from the cylinder block. Remove the cylinder front cover and water pump as an assembly.

   NOTE: Cover the front oil pan opening while the cover assembly is OFF to prevent foreign material from entering the pan.

   If a new cylinder front cover is to be installed, remove the water pump and dipstick tube from the old cylinder front cover and install them on the new cover (except Fairmont/Zephyr).
7. Discard the cylinder front cover gasket. Remove the crankshaft front oil slinger.
8. Check the timing chain deflection (refer to Part 21-01).
9. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 25.
10. Remove the camshaft sprocket cap screw, washers and fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 26).

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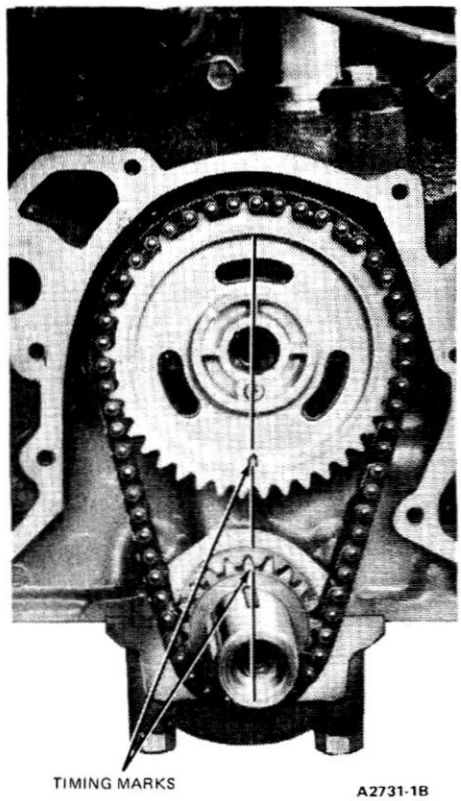


FIG. 25 Aligning Timing Marks

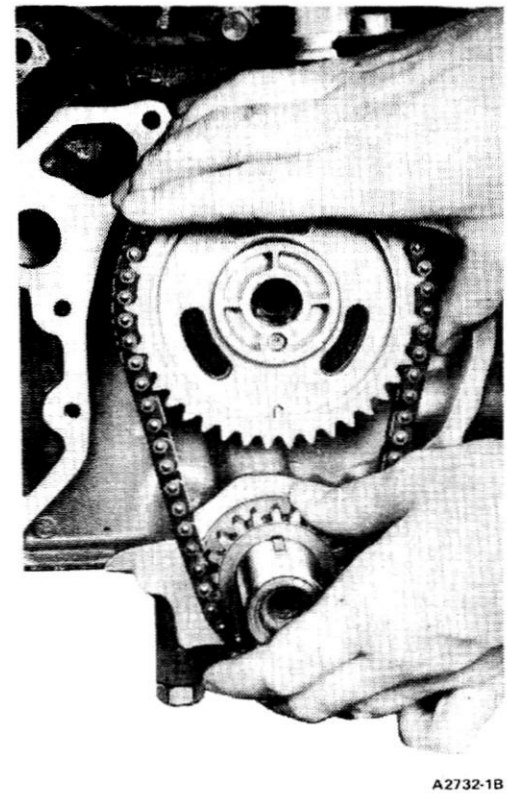


FIG. 26 Removing or Installing Timing Chain

Installation

1. Position the sprockets and timing chain on the camshaft and crankshaft simultaneously (Fig. 26). Be sure the timing marks on the sprockets are positioned as shown in Fig. 25.
2. Install the fuel pump eccentric, washers and camshaft sprocket cap screw. Torque the sprocket cap screw to specifications. On 5.8L (351 CID) engines, install the crankshaft front oil slinger (Fig. 27).
3. Clean the cylinder front cover, oil pan and the block gasket surfaces.
4. Install a new oil seal in the cylinder front cover following the procedures under Front Oil Seal Removal and Installation.
5. Lubricate the timing chain with engine oil.
6. Coat the gasket surface of the oil pan with sealer, cut and position the required sections of a new gasket on the oil pan, apply RTV sealer (Part C3AZ-19526-A or equivalent) at the corners. Install pan seal as required.

NOTE: Contact cement (Part B9AE-191508-A or equivalent) is recommended to hold the seals and gaskets in position during assembly.

Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the block.

7. Position the cylinder front cover on the cylinder block. Use care when installing the cover to avoid seal damage or possible gasket mislocation.
8. Install the cylinder front cover to seal alignment tool into proper position.

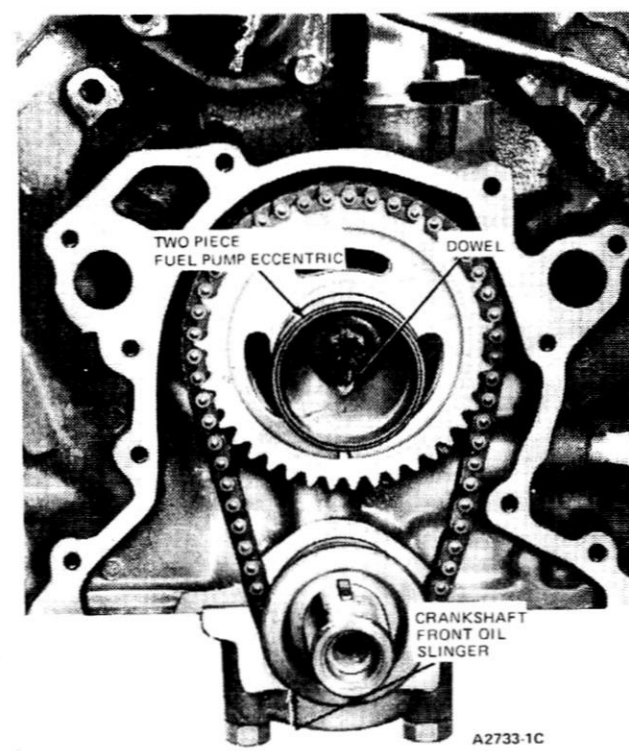


FIG. 27 Fuel Pump Eccentric and Front Oil Slinger Installed—5.8L (351 CID) Shown

9. It may be necessary to force the cover downward to slightly compress the pan gasket. This operation

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can be facilitated by using a suitable tool at the front cover attaching hole locations.

10. Coat the threads of the attaching screws with oil resistant sealer and install the screws. While pushing in on the alignment tool, tighten the oil pan to cover attaching screws to specifications (Fig. 28). Tighten the cover to block attaching screws to specifications. Remove the pilot.

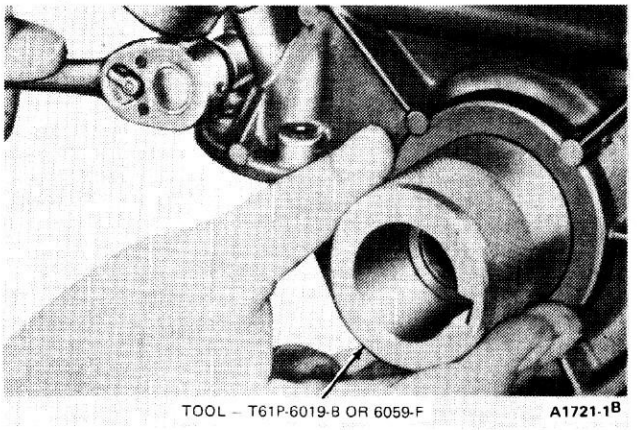


FIG. 28 Aligning Cylinder Front Cover

11. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a coating of Lubriplate or equivalent to the front of the crankshaft for damper installation.
12. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft (Fig. 29). Install the cap screw and washer. Tighten the screw to specifications. Install the crankshaft pulley.

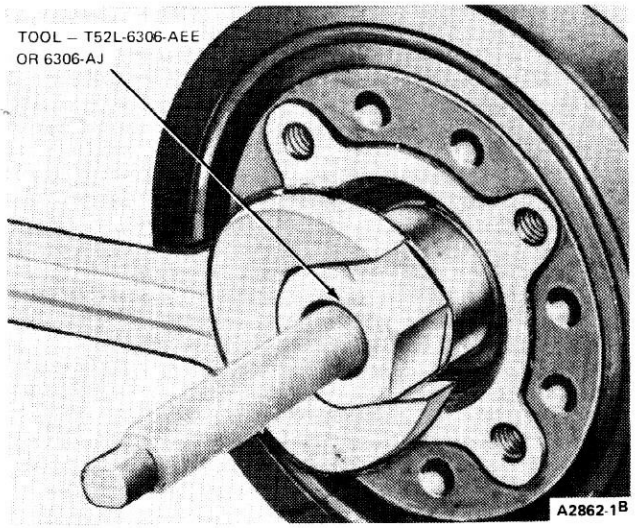


FIG. 29 Installing Crankshaft Vibration Damper

13. Install the fuel pump using a new gasket. Connect the fuel pump outlet line.
14. Install the oil level dipstick (except Fairmont/Zephyr).
15. Refer to Water Pump Installation. Perform all the required steps except installation of the pump.
16. Fill the crankcase with the proper grade and quantity of engine oil.
17. Fill and bleed the cooling system.
18. Operate the engine at fast idle and check for coolant and oil leaks. Check and adjust the ignition timing and engine idle speed.

FRONT OIL SEAL

Removal

1. Remove the cylinder front cover following the procedure under Cylinder Front Cover and Timing Chain Removal.
2. Drive out the old seal with the pin punch. Clean out the recess in the cover.

Installation

1. Coat a new seal with grease, then install the seal in the cover. Drive the seal in until it is fully seated in the recess (Fig. 30). Check the seal after installation to be sure the spring is properly positioned in the seal.

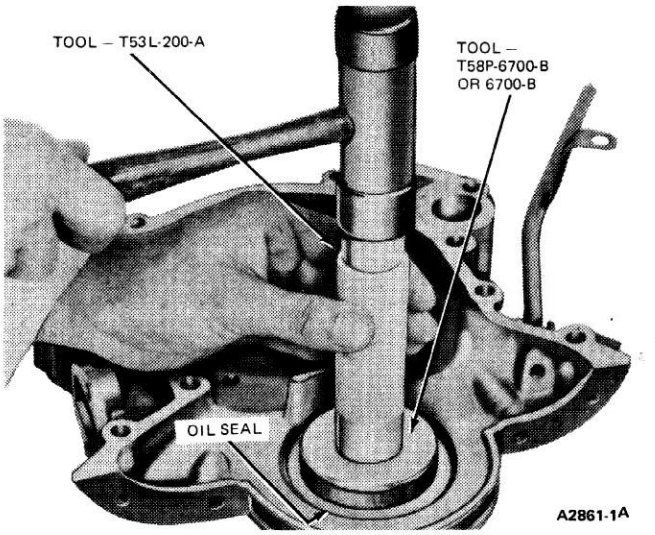


FIG. 30 Installing Crankshaft Front Oil Seal

2. Replace the cylinder front cover following the procedure under Cylinder Front Cover and Timing Chain Installation.

CAMSHAFT

The camshaft and related parts are shown in Fig. 31.

NOTE: When removing the camshaft with the Versailles 5.0L (302 CID) engine installed in the vehicle, the following components must be removed or repositioned in order to allow clearance (refer to appropriate Shop Manual Part for illustrations):

1. Remove the hood latch assembly, disconnect the A/C ambient temperature sensor wiring and remove the hood latch support bracket.
2. Remove the bolts and nuts that attach the condenser to the radiator support. Remove the fender-to-radiator support braces at each side of the engine compartment.

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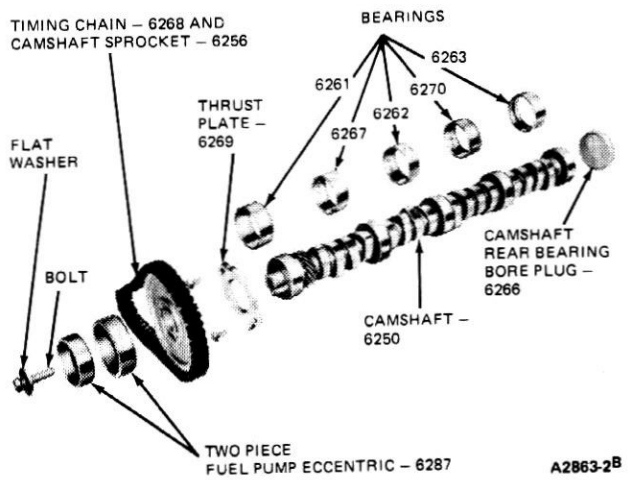


FIG. 31 Camshaft and Related Parts

3. Remove the air dam and rubber gasket that is positioned between the radiator support and the grille opening panel.
4. Carefully lift the condenser assembly upward until enough clearance is obtained to remove the camshaft (about 1/2 the height of the condenser). Proceed with camshaft removal.

After the camshaft is replaced, reverse the procedure to reinstall or reposition components.

Removal

1. Remove or reposition radiator, A/C condenser and grille components as necessary to provide clearance to remove camshaft. Remove the cylinder front cover and the timing chain following the procedure under Cylinder Front Cover and Timing Chain Removal.
2. Remove the intake manifold and related parts by following procedures under Intake Manifold Removal.
3. Remove the crankcase ventilation valve and tubes from the valve rocker arm covers. Remove EGR cooler, if equipped. Remove the valve rocker arm covers. Loosen the valve rocker arm stud nuts and rotate the rocker arms to the side.
4. Remove the valve push rods and identify them so that they can be installed in their original positions.
5. Remove the tappets following the procedure under Tappet Removal, and place them in a rack so that they can be installed in their original bores.
6. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

Installation

1. Oil the camshaft journals with heavy engine oil SE and apply Lubriplate or equivalent to the lobes. Carefully slide the camshaft through the bearings. Install the camshaft thrust plate with groove towards the cylinder block. Check camshaft end play as shown in Part 21-01. If not within specification, replace camshaft thrust plate.
2. Lubricate the tappets and bores with heavy engine oil SE. Install the tappet in the bores from which they were removed.
3. Apply Lubriplate or equivalent to each end of the push rods and install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tips. Lubricate the rocker arms and fulcrum seats with heavy engine oil SE. Position the rocker arms over the push rods.
4. Install the intake manifold and related parts by following procedures under Intake Manifold Installation.
5. Connect the coolant temperature sending unit and the engine ground strap.
6. Connect the accelerator lenkage and retracting spring.
7. Connect the heater hose at the intake manifold. Position and connect the fuel line.
8. Replace the crankshaft front oil seal following procedures under Front Oil Seal Removal and Installation. Install the timing chain, cylinder front

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cover and related parts following procedures under Cylinder Front Cover and Timing Chain Installation.

9. On vehicles equipped with air conditioning, install the air conditioning condenser.

   Position the fan shroud, if so equipped, over the fan. Install the radiator and connect the upper and lower radiator hoses.

   On a vehicle equipped with an automatic transmission, connect the transmission oil cooler lines.

   Install the fan shroud and carburetor air inlet tube attaching screws if so equipped.

10. With No. 1 piston on TDC at the end of the compression stroke, position the distributor in the block with the rotor at the No. 1 firing position and one tooth of the sintered iron rotor centered on the stator (pickup coil). See Part 23-01. Install the hold down clamp.
11. If any valve train components have been replaced, perform a Valve Clearance Adjustment as outlined under Hydraulic Tappets in Part 21-01.
12. Clean the valve rocker arm covers and the cylinder head gasket surface. Position the valve rocker cover gasket in each cover, making sure that the tabs engage the notches in the cover.
13. Position the covers on the cylinder heads. Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.
14. Clean and install the crankcase ventilation system.
15. Install the distributor cap and spacer. Position the spark plug wires in the harness brackets on the rocker arm cover attaching stud and connect the wires to the plugs. See Part 23-01 for special installation instructions. Connect the high tension lead at the coil. Connect the coil primary wiring connector.
16. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil. Connect choke heat tubes and vacuum lines except distribution line.
17. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum line at the carburetor.
18. Operate the engine at fast idle and check all hose connections and gaskets for leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture. Retorque intake manifold bolts and nuts.
19. Install the air cleaner and intake duct assembly and crankcase vent hose.

FLYWHEEL

Removal

1. On a vehicle with a manual-shift transmission, remove the transmission, clutch pressure plate and disc following the procedures in Group 16.

   On a vehicle with automatic transmission, remove the transmission and converter housing following the procedure in Group 17.

2. To check flywheel face runout or replace flywheel ring gear for manual-shift transmissions, refer to Part 21-01.
3. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts in sequence across from each other to specifications.
2. On a vehicle with a manual-shift transmission, check the flywheel runout, following the procedure in Part 21-01 and install the clutch pressure plate, disc and the transmission following the procedures in Group 16.

   On a vehicle with an automatic transmission, check the flywheel runout, following the procedure in Part 21 and install the transmission and converter housing following the procedure in Group 17.

CLUTCH PILOT BEARING

Removal

1. Remove the transmission, clutch pressure plate and disc, following the procedures in Group 16. The pilot bearing may be replaced with the flywheel installed or removed.
2. Remove the pilot bearing and adapter as shown in Fig. 33.

Installation

1. Install the service pilot bearing as shown in Fig. 33; using tool, install new bearing and adapter so the adapter is not cocked.
2. Install the clutch pressure plate, disc and the transmission, following the procedures in Group 16.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. On a vehicle with a manual transmission, remove the transmission, clutch pressure plate and disc following the procedures in Group 16.

   On a vehicle with an automatic transmission, remove the transmission and converter housing following the procedure in Group 17.

2. Remove the flywheel attaching bolts and remove the flywheel. Remove the engine rear cover plate.

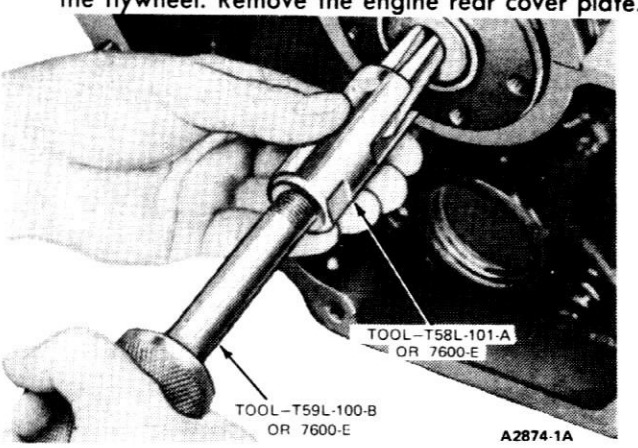


FIG. 32 Removing Clutch Pilot Bearing

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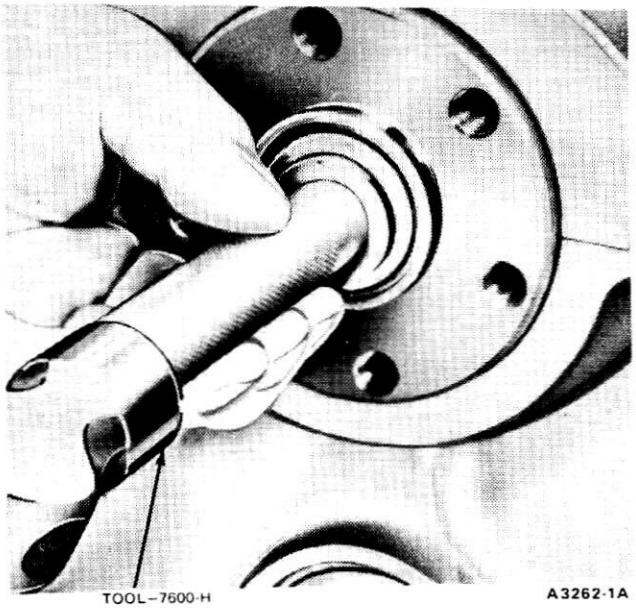


FIG. 33 Installing Clutch Pilot Bearing

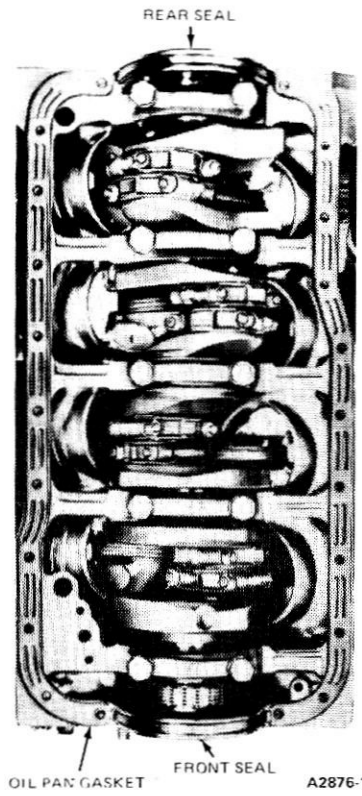


FIG. 34 Oil Pan Gaskets and Seals Installed

3. Remove the bore plug as detailed under Core Plug in Part 21-01.

Installation

1. Install the bore plug as detailed under Core Plug in Part 21-01.
2. Coat the flywheel attaching bolts with oil-resistant sealer. Position the engine rear cover plate on the cylinder block dowels. Position the flywheel on the crankshaft flange. Install and torque the attaching bolts in sequence (across from each other) to specifications.

On a vehicle with a manual transmission, install the clutch pressure plate, disc and the transmission following the procedures in Group 16.

On a vehicle with an automatic transmission, install the transmission and converter housing following the procedure in Group 17.

OIL PAN

MUSTANG II

Removal

1. Disconnect battery cable.
2. Remove 4 bolts attaching fan shroud to radiator and position shroud over fan.
3. Raise vehicle on hoist.
4. Drain crankcase.
5. Remove the 4 attaching bolts and remove the 2a crossmember.
6. Remove the attaching screw from flex joint to release steering pinion shaft. Remove 3 nuts and bolts attaching steering gear to crossmember. Remove 4 bolts attaching sway bar to chassis and move sway bar down.
7. Disconnect battery cable from starter, remove 2 starter attaching bolts and remove starter.
8. Remove oil pan attaching bolts, loosen oil pan from block and remove.

Installation

1. Clean oil pan gasket surface of cylinder block. Clean and inspect oil pan.
2. Position oil pan gasket and seals to cylinder block using contact cement (Fig. 34).
3. Position oil pan to engine and install the attaching bolts.
4. Position sway bar to chassis and install attaching bolts.
5. Position starter to clutch housing and install attaching bolts. Connect starter cable and tighten nut.
6. Position steering gear to steering shaft, install 3 attaching bolts and nuts at crossmember and torque to specification. Install flex coupling to steering gear stub shaft attaching bolt.
7. Position the 2a crossmember to the vehicle and install the 4 attaching bolts.
8. Lower the vehicle and fill the crankcase with the specified engine oil. Connect the battery cable to the battery.
9. Position the shroud to the radiator and install the 4 attaching bolts. Start the engine and check for leaks.

FAIRMONT AND ZEPHYR

Removal

1. Disconnect the battery positive cable.
2. Remove the fan shroud attaching bolts, positioning the fan shroud back over the fan.
3. Raise the vehicle on a hoist.
4. Drain the crankcase.

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5. Remove two (2) bolts attaching steering gear to main crossmember and let steering gear rest on frame away from oil pan.
6. Remove the bolts attaching the engine mounts.
7. Raise the engine and place two (2) wood blocks (2" x 4") between the engine mounts and the vehicle frame.
8. Remove rear "K" braces (4 bolts).
9. Remove the oil pan attaching bolts and lower oil pan to the frame.
10. Remove oil pump attaching bolts and the inlet tube attaching nut from the No. 3 main bearing cap stud and lower the oil pump into the oil pan.
11. Remove the oil pan, rotating the crankshaft as necessary to clear the counterweights.

Installation

1. Clean oil pan gasket surface of cylinder block. Clean and inspect oil pan.
2. Position oil pan gasket and sealer to cylinder block using contact cement (Fig. 34).
3. Position oil pump and inlet tube into oil pan. Slide oil pan into position under the engine. With the oil pump intermediate shaft in position in the oil pump, position the oil pump to the cylinder block, and the inlet tube to the stud on No. 3 main bearing cap attaching bolt. Install the attaching bolts and nut and torque to specification.
4. Position the oil pan to the engine and install the attaching bolts. Torque to specification.
5. Position the steering gear to the main crossmember. Install the two (2) attaching bolts and torque to specification.
6. Position rear "K" braces and install the the attaching bolts (4).
7. Raise engine and remove wood blocks.
8. Lower the engine and install engine mount attaching bolts. Torque to specification.
9. Lower vehicle and fill crankcase with the specified engine oil. Connect the positive battery cable.
10. Position the shroud to the radiator and install the two (2) attaching bolts. Start the engine and check for leaks.

LTD II, Cougar and Thunderbird

Removal

1. Remove the oil level dipstick. Remove the bolts attaching the fan shroud to the radiator. Position the shroud over the fan.
2. Raise the vehicle.
3. Drain the crankcase.
4. Remove the stabilizer bar from the chassis.
5. Remove the engine front support through bolts.
6. Raise the engine and place wood blocks between the engine front supports and chassis brackets.
7. If equipped with an automatic transmission, disconnect the oil cooler lines at the radiator.
8. Remove the oil pan attaching bolts and lower the oil pan onto the crossmember.
9. Remove oil pump pickup tube and screen from the oil pump. Rotate the crankshaft for clearance and remove the oil pan.

Installation

1. Clean the gasket surfaces of the block and oil pan. The oil pan has a two-piece gasket.
2. Clean the oil pump pick up tube and screen.
3. Coat the block surface and the oil pan gasket with sealer. Position the oil pan gaskets on the cylinder block (Fig. 34).
4. Position the oil pan front seal on the cylinder front cover. Be sure the tabs on the seal are over the oil pan gasket.
5. Position the oil pan rear seal on the rear main bearing cap (Fig. 34). Be sure the tabs on the seal are over the oil pan gasket.
6. Position the oil pan on the crossmember. Install a new gasket on the oil pump and install the oil pump pick up tube.
7. Position the oil pan against the block and install a bolt, finger tight, on each side of the block. Install the remaining bolts. Tighten the bolts from the center outward in each direction to specifications.
8. If equipped with an automatic transmission, connect the oil cooler lines at the radiator.
9. Raise the engine and remove the wood blocks from between the engine supports and chassis brackets. Lower the engine and install the engine support through bolts. Tighten the bolts to specifications.
10. Install the stabilizer bar to the chassis.
11. Lower the vehicle.
12. Install the fan shroud.
13. Install the oil level dipstick. Fill the crankcase with the proper grade and quantity of engine oil. Start the engine and check for oil leaks.

Granada and Monarch

Removal

1. Raise the vehicle and drain the crankcase.
2. Remove the stabilizer bar from the chassis.
3. Remove the engine front support through bolts and remove the supports. If so equipped, remove the bolt and nut retaining the power steering lines to the rear side of the lower arm.
4. Remove the idler arm bracket retaining bolts and pull the linkage down and out of the way.
5. Remove the oil pan attaching bolts and remove the pan.
6. Remove the oil pump pick-up tube and screen assembly.

Installation

1. Clean the oil pan and inspect for damage. Clean the oil pump pick-up tube and screen.
2. Clean the gasket surfaces of the block and oil pan. Position the oil pump pick-up tube and screen with gasket. Install the two bolts and torque to specifications.
3. Coat the block surface and oil pan gaskets with sealer. Position the oil pan gaskets on the cylinder block (Fig. 34).
4. Position the oil pan front seal on the cylinder front cover. Be sure the tabs on the seal are over the oil pan gasket.

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5. Position the oil pan rear seal on the rear main bearing cap (Fig. 34). Be sure the tabs on the seal are over the oil pan gasket.
6. Position the oil pan to the cylinder block. Install the attaching bolts and torque to specifications.
7. Position the idler arm bracket to the chassis and install the attaching bolts. Torque to specifications. Install the power steering line bracket to the lower control arm rear.
8. Position the engine supports to the chassis side rails and install the reattaching bolts. Torque to specifications.
9. Install the stabilizer bar.
10. Lower the vehicle. Fill the crankcase. Start the engine and check for oil leaks.

VERSAILLES

Removal

1. Disconnect the battery.
2. Remove the 2 fan shroud attaching screws and loosen shroud to prevent damage when raising engine.
3. Raise the vehicle and drain the crankcase.
4. Remove the stabilizer bar from the chassis.
5. Remove the RH & LH engine front support through bolts.
6. Loosen transmission oil cooler lines and move aside.
7. Raise engine 2" and block up with 2" x 4" blocks or equivalent under engine mounts.
8. Remove the oil pan attaching bolts and remove the pan.

   NOTE: To ease pan removal, it will be necessary to rotate the crankshaft during the removal process so the rear throw is in a *horizontal* position to clear the rear oil pan flange.
9. Remove the oil pump, pick-up tube and screen assembly.

Installation

1. Clean the gasket surfaces of the block and oil pan and inspect pan and gasket rails for damage. Correct as necessary.
2. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
3. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
4. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.**

   Torque the oil pump attaching screws to specifications.
5. Clean and install the oil pump inlet tube and screen assembly (Fig. 35).
6. Position the oil pan side gaskets on the cylinder block using contact cement (Part B9AE-19B508-A or equivalent). See Fig. 34.
7. Position the oil pan front seal on the cylinder front cover. Be sure the tabs on the seal are over the oil pan gasket.
8. Position the oil pan rear seal on the rear main bearing cap (Fig. 34). Be sure the tabs on the seal are over the oil pan gasket.
9. Position the oil pan to the cylinder block. Install the attaching bolts and torque to specifications.
10. Raise the engine and remove the 2" x 4" blocks. Lower the engine and install the engine mount through bolts. Torque to specification.
11. Install the stabilizer bar to chassis.
12. Install oil cooler lines and attaching clips.
13. Lower the vehicle. Fill the crankcase with specified quality and quantity of oil.
14. Position the fan shroud and install the attaching screws.
15. Connect the battery cable.
16. Start the engine and check for leaks.

OIL PUMP (EXCEPT FAIRMONT, ZEPHYR AND VERSAILLES)

On Fairmont, Zephyr and Versailles vehicles, Oil Pump Removal is described under Oil Pan Removal.

Removal

1. Remove the oil pan and related parts as outlined under Oil Pan Removal.
2. Remove the oil pump inlet tube and screen assembly.
3. Remove the oil pump attaching bolts and remove the oil pump and intermediate drive shaft.

Installation

1. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
2. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
3. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.**

   Torque the oil pump attaching screws to specifications.
4. Clean and install the oil pump inlet tube and screen assembly (Fig. 35).
5. Install the oil pan and related parts as outlined under Oil Pan Installation.

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CRANKSHAFT REAR OIL SEAL

A split-lip type crankshaft rear oil seal is used for replacement on all engines. **If replacement is necessary, this type of seal must be used.** The complete seal can be replaced without removing the crankshaft. Refer to Crankshaft Rear Oil Seal. Replacement in Part 21-01 for replacement procedures.

MAIN BEARING

The main bearing inserts are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts by following steps under Oil Pan Removal.
2. Remove the oil pump inlet tube assembly and the oil pump.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

   Remove the main bearing cap to which new bearings are to be installed.
4. Insert the upper bearing removal Tool (Tool 6331) in the oil hole in the crankshaft.
5. Rotate the crankshaft in the direction of the engine rotation to force the bearing out of the block.
6. Clean the crankshaft journals. Inspect the journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear.
7. If the rear main bearing is being replaced, remove and discard the rear oil seal from the bearing cap.
8. Remove the block half of the rear oil seal following the procedures given under Crankshaft Rear Oil Seal Removal in Part 21-01.
9. Repeat Steps 3 thru 8 for the remaining bearings to be replaced.

Installation

1. If the rear main bearing is being replaced clean the rear oil seal groove in the block with a brush and the recommended solvent (Part 21-01).
2. Install the block half of the rear oil seal following the procedures given under Crankshaft Rear Oil Seal Installation in Part 21-01.
3. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 can be inserted in the oil hole in the crankshaft. With Tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
4. Replace the bearing in the cap.
5. Select fit the bearing for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. If the bearing is being replaced on journal number 1, 2 or 4, apply a light coat of engine oil to the journal and bearings and install the bearing cap. Tighten the cap bolts to specifications.
7. If the rear main bearing is being replaced, clean the oil seal groove in the cap with a brush and recommended solvent (Part 21-01).

   Remove the oil seal retaining pin from the bearing cap, if so equipped. **The pin is not used with the split lip seal.**
8. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine; allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
9. **Refer to Crankshaft Rear Oil Seal Installation for instructions on use of sealer in installing the main bearing cap.** Lubricate the journal with engine oil and install the rear main bearing cap. Torque the cap bolts to specifications.
10. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

    Lubricate the journal with engine oil and install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 36). Hold the crankshaft cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications.
11. Clean the oil pump inlet tube screen. Prime by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. On all models except Versailles, install the oil pump and the inlet tube assembly. On Versailles models, install the oil pump and oil pan following instructions under Oil Pan Installation.
12. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.

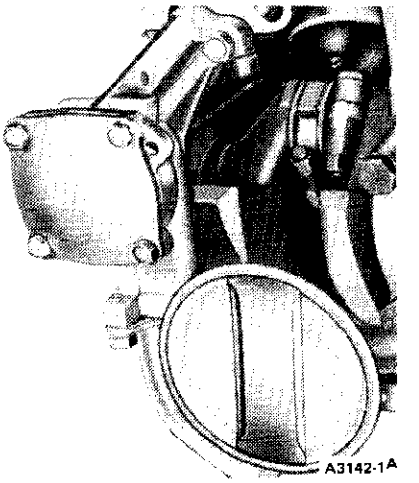


FIG. 35 Oil Pump and Inlet Tube Installed—Except Fairmont/Zephyr

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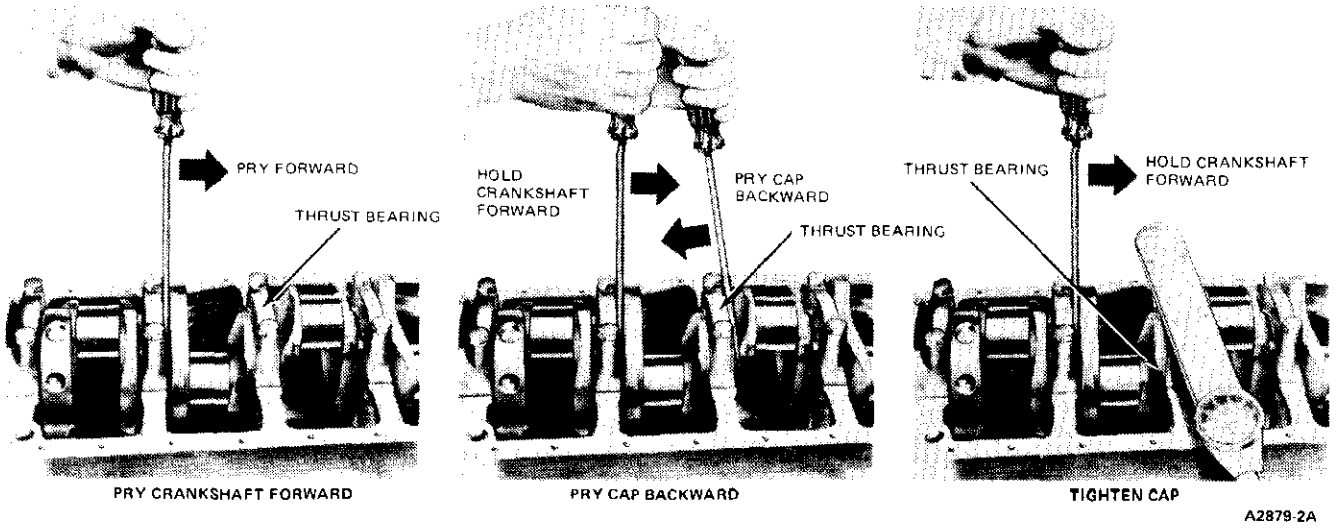


FIG. 36 Aligning Thrust Bearing

13. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARINGS

The connecting rod bearings are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts following procedures under Oil Pan Removal.
2. Remove the oil pump, inlet tube assembly and the oil pump intermediate shaft.
3. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Tighten the nuts to specifications.
7. Clean the oil pump inlet tube screen. Prime the pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. On all models except Versailles, install the oil pump and the inlet tube assembly. On Versailles models, install the oil pump, inlet tube screen and cover, intermediate shaft and oil pan following procedures under Oil Pan Installation.
8. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
9. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this Part.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows:

   Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.

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5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, and no visible cross-hatch marks remain on the cylinder wall, remove the cylinder wall glaze using a spring-type tool. Follow the instructions of the tool manufacturer. After honing, clean the cylinder walls with a detergent and water solution.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 37).

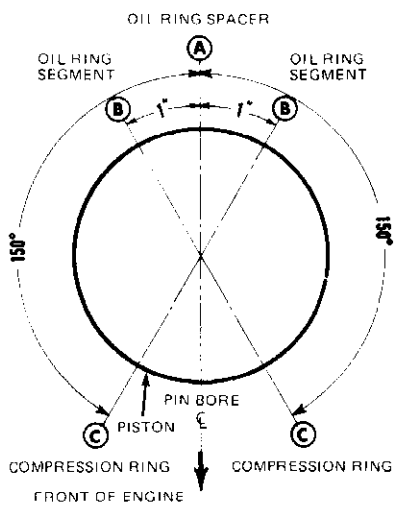


FIG. 37 Piston Ring Spacing

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 38). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the indentation notch in the piston head toward the front of the engine.**

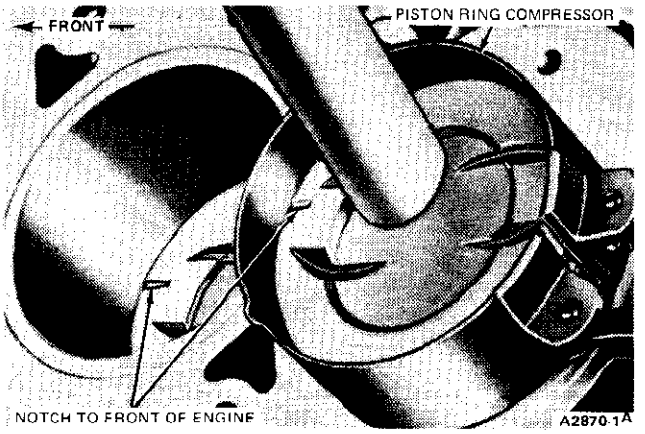


FIG. 38 Installing Piston—Typical

5. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap. Tighten the nuts to specifications.
9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 39).

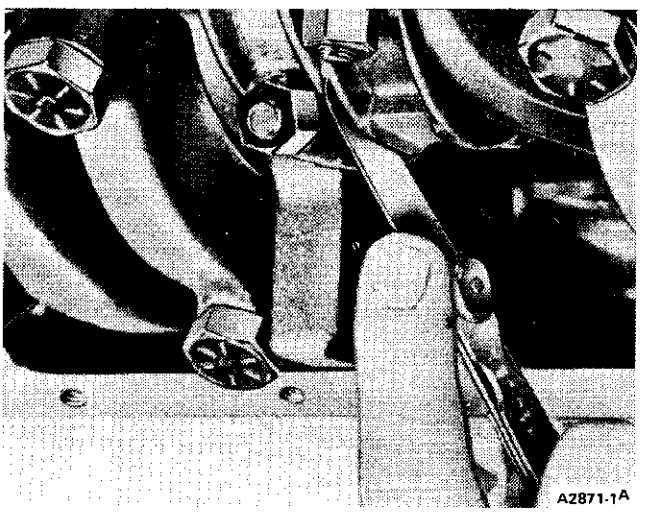


FIG. 39 Checking Connecting Rod Side Clearance

10. Disassemble, clean, and assemble the oil pump. Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling either the inlet port or outlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump, the intermediate shaft and the oil pan following instructions under Oil Pan and Oil Pump Installation.
12. Install the cylinder heads following procedures under Cylinder Head Installation.

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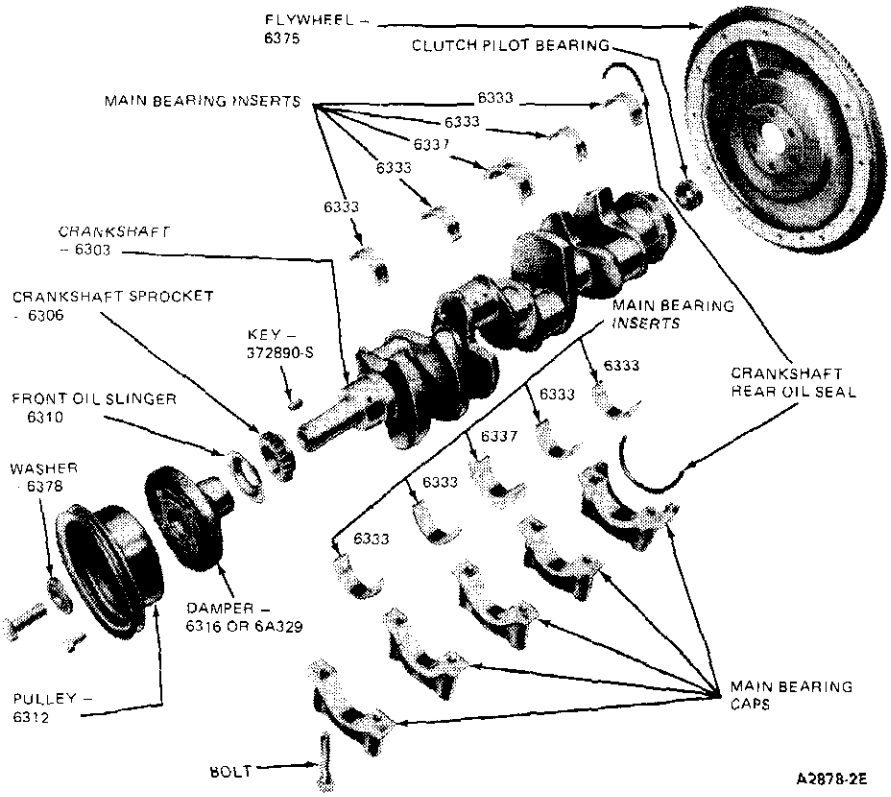


FIG. 40 Crankshaft and Related Parts

13. Install the intake manifold following procedures under *Intake Manifold Installation.*
14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses.
16. Operate the engine at fast idle and check for oil and coolant leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture.
17. Install the air cleaner, air inlet tube and crankcase vent hose.
18. Connect the automatic choke heat chamber air inlet hose.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 40.

Removal

1. With engine removed from vehicle and placed on a work stand, drain the crankcase and cylinder block. Disconnect the spark plug wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Disconnect the coil to distributor high tension lead at the coil. Remove the distributor cap and spark plug wire assembly. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Remove the fuel pump and oil filter. Slide the water pump by-pass hose clamp toward the water pump. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper (if so equipped). Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 24) and remove the damper.
4. Remove the cylinder front cover and water pump as an assembly.
5. Remove the crankshaft front oil slinger. Check the timing chain deflection, then remove the timing chain and sprockets as detailed under Cylinder Front Cover and Timing Chain Removal.
6. Invert the engine on the work stand. Remove the clutch pressure plate and disc (manual-shift transmission). Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.

   Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.
8. Remove the main bearing caps.

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9. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

   To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. If not, be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
5. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.
6. Install the lower main bearing inserts in the bearing caps.
7. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap. Remove the oil seal retainer pin from the rear main bearing seal groove, if so equipped. **The retainer pin is not used with a split lip seal.**
8. Dip the lip seal halves in clean engine oil. Carefully install the seal halves in the block and rear main bearing cap with the undercut sides of the seal toward the FRONT of the engine and approximately 3/8 inch protruding above the partial surface.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**
10. Check the clearance of each main bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings. Install the rear main bearing cap by following steps 7 thru 9 under Main Bearing Installation. Install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations. Torque the bearing cap bolts to specifications.**
12. Install the thrust bearing cap with the bolts finger-tight.
13. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 36).
14. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
15. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.
16. Force the crankshaft toward the rear of the engine.
17. Check the crankshaft end play (refer to Part 21-01).
18. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
19. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
20. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
21. Install the connecting rod cap. Torque the nuts to specifications.
22. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods and each connecting rod crankshaft journal (Fig. 39).
23. Install the timing chain and sprockets, cylinder front cover and crankshaft pulley and adapter, following Steps 1 thru 9 under Cylinder Front Cover and Timing Chain Installation.
24. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts to specifications.

    On a flywheel for a manual-shift transmission, use Tool 6392-N or equivalent to align the clutch disc. Install the pressure plate. Tighten the attaching bolts.
25. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump and oil pan by following the procedures under Oil Pan and Oil Pump Installation.
26. Install the oil filter, fuel pump and connect the fuel lines. Install the alternator, shield and mounting bracket.
27. Install the spark plugs, distributor cap and spark plug wires. Connect the spark plug wires and high tension lead. See Part 23-01 for special installation instructions.
28. Install the engine in the vehicle.

CAMSHAFT BEARINGS

Removal

1. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures in this Part. Push the pistons to the top of the cylinders.
2. Remove the camshaft rear bearing bore plug (see Part 21-01—Core Plugs). Remove the camshaft bearings (Fig. 41).
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing.

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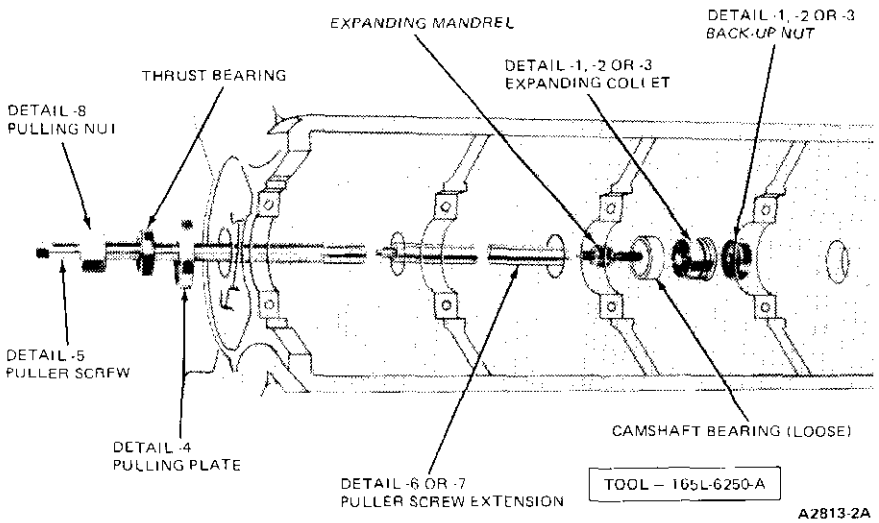


FIG. 41 Camshaft Bearing Replacement

Be sure to hold a wrench on the end of the puller screw to prevent it from turning.

5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

Camshaft bearings are available prefinished to size for standard and 0.015-inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

1. Position the new bearings at the bearing bores with the oil holes aligned with the holes in the block, and press them in place with the tool shown in Fig. 41. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage. Be sure the front bearing is installed the specified distance below the front face of the cylinder block (Fig. 42).** See Specifications.
2. *Install the bore plug as detailed under Core Plugs* in Part 21-01.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures in this Part, except do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

OIL FILTER

The oil filter assembly is shown in Fig. 43.

Removal

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting, using an oil filter wrench, and clean the adapter recess and the filter gasket sealing surface.

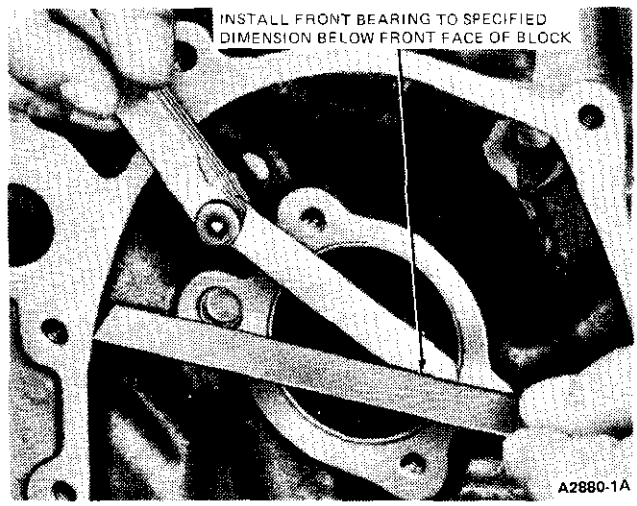


FIG. 42 Camshaft Front Bearing Measurement

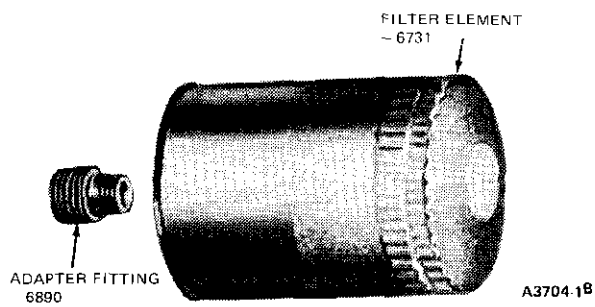


FIG. 43 Cartridge-Type Oil Filter

Installation

1. Coat the gasket on a new filter with oil. Place the new filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the sealing surface, and then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct leakage. Check the oil level and add oil as required to bring to specified level.

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DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to Specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning and Inspection procedures.

HYDRAULIC TAPPET

The internal parts of each hydraulic tappet assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned. Tappets should always be tested after assembly; refer to the cleaning, inspection and test procedures covered in Part 21-01.

Disassembly

Disassemble and assemble each tappet separately. Identify the tappet assemblies so they can be installed in their original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly, the check valve and the check valve retainer and plunger spring. Carefully remove the plunger spring, the check valve retainer and, the check valve disc from the plunger.

Assembly

Hydraulic tappet assembly is shown in Fig. 44.

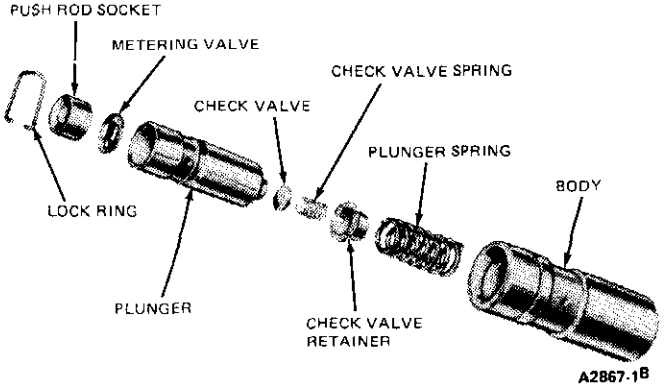


FIG. 44 Hydraulic Tappet Assembly

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).
3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring, and then the plunger (open end up) into the tappet body.
5. Position the metering valve (disc) in the plunger, and then place the push rod cup in the plunger.
6. Depress the plunger, and position the closed end of the lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use the hydraulic tappet leakdown tester (Part 21-01) to fill the tappets with test fluid.

CYLINDER HEAD

Disassembly

1. Remove the exhaust valve stem caps.
2. Remove the exhaust manifolds (if required) and the spark plugs.
3. Clean the carbon out of the cylinder head combustion chambers before removing the valves.
4. Compress the valve springs (Fig. 45). Remove the spring retainer locks and release the spring.

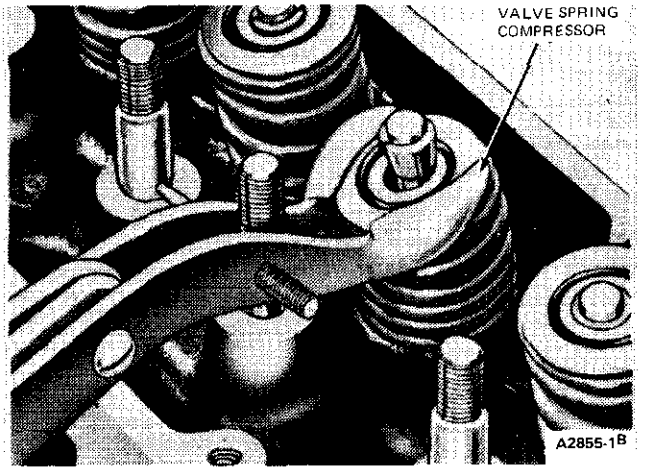


FIG. 45 Compressing Valve Spring—On Bench

5. Remove the sleeve, spring retainer, spring, stem seal and valve. Discard the valve stem seals. Identify all valve part as to which cylinder they were removed from and whether intake or exhaust.
6. Clean, inspect and repair the cylinder head as required, or prepare to transfer all usable parts to a new cylinder head.

Assembly

All valves, valve stems and valve guides are to be lubricated with heavy oil SE. The valve tips are to have Lubriplate or equivalent applied before installation.

1. Install each valve (Fig. 46) in the port from which it was removed or to which it was fitted.
2. Install the valve stem seal. Use a 5/8-inch deep wall socket and a light mallet or hammer to seat the seal on the valve stem. Install the valve spring over the valve and then install the spring retainer (and rotator, on 5.8L (351 CID) exhaust valves). Compress the spring and install the sleeve, if so equipped, and retainer locks (Fig. 46).
3. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers

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(Fig. 47). Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height.

Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs *and overloading the camshaft lobes which* could lead to spring breakage and/or worn camshaft lobes.

4. Install the exhaust manifolds (if removed) and the spark plugs.

PISTONS AND CONNECTING RODS

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Remove the piston rings. Using an Arbor Press and the tool shown in Fig. 48, press the piston pin from the piston and connecting rod.

Assembly

The piston, connecting rod and related parts are shown in Fig. 49. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications. *Refer to specification at end of this part.*

1. Apply a light coat of engine oil to all parts. **Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and the indentation notch in the piston positioned as shown in Fig. 50.**

   On replacement connecting rods, install the large chamfered side of the connecting rod bearing bore towards the crankshaft check; facing towards front of engine on right bank rods, and facing towards rear of engine on left bank rods.
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press, press the piston pin through the piston and connecting rod until the pin is centered in the piston (Fig. 48).
3. Check the end gap of all piston rings (Part 21-01). It must be within specifications. Follow the instructions contained on the piston ring package *and install the piston rings.*
4. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
5. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

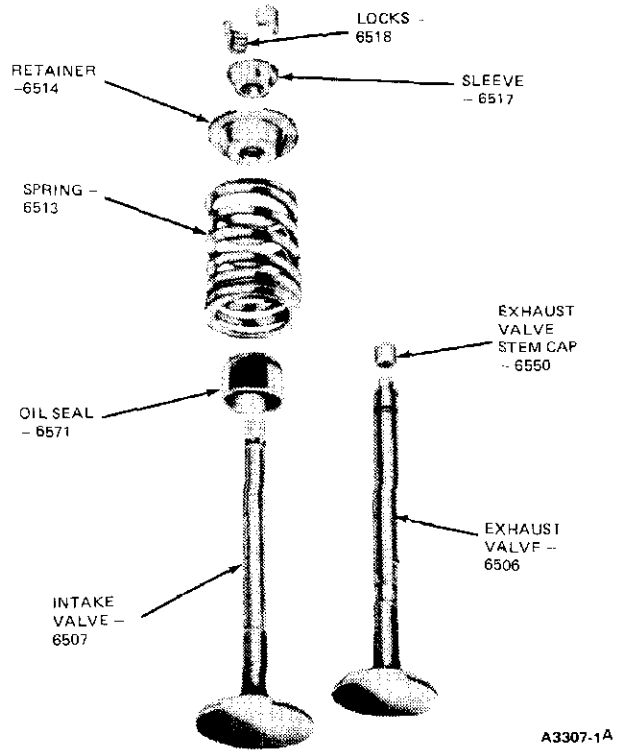


FIG. 46 Valve Assembly

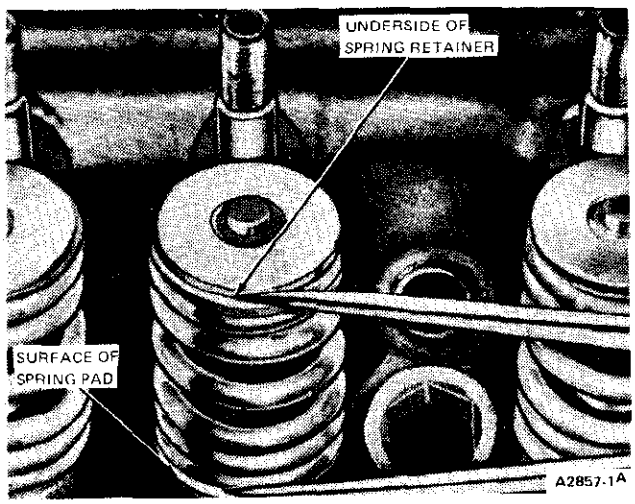


FIG. 47 Measuring Valve Spring Assembled Height

CYLINDER ASSEMBLY

Disassembly

1. *Mount the engine* in a work stand and remove all parts not furnished with the new cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
2. Remove the 4 cylinder head locating dowels and the block drain plugs.
3. *Remove the* used cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.

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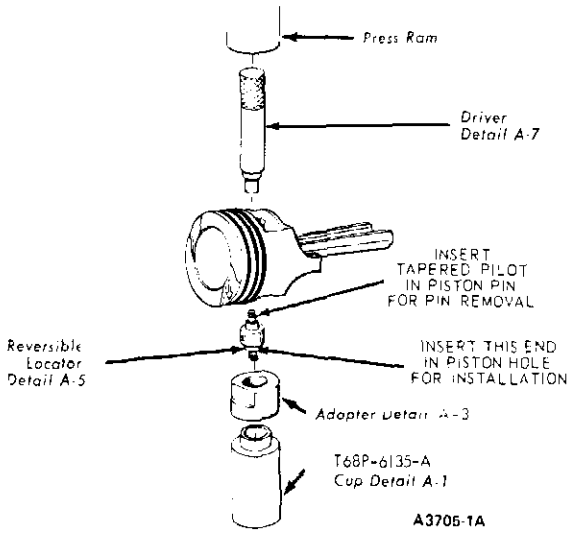


FIG. 48 Removing or Installing Piston Pin

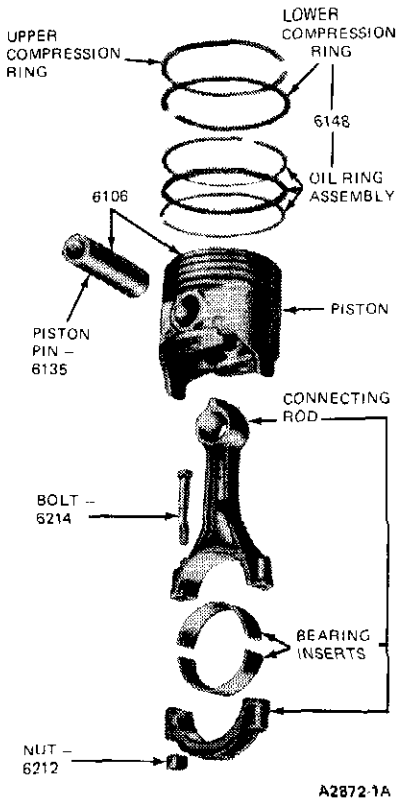


FIG. 49 Piston, Connecting Rod and Related Parts

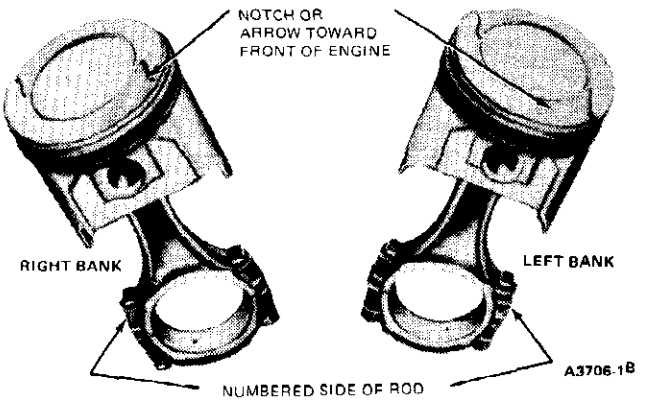


FIG. 50 Correct Piston and Rod Positions

2. Position the new cylinder assembly in a work stand and install the cylinder head locating dowels and block drain plugs.
3. Transfer all serviceable parts removed from the used cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
4. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK

Before replacing a cylinder block, determine if it is repairable. If so, make necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Completely disassemble the used engine, following the procedures given in the Removal and Installation Section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.
3. Remove the cylinder head locating dowels and the block drain plugs.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand and install the cylinder head locating dowels and the block drain plugs.
3. Transfer all serviceable parts removed from the used cylinder block, following the procedures given in the Removal and Installation Section of this Part.
4. Check all assembly clearances and correct as necessary.

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SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	*5.0L/5.8L (302 CID/351 CID)*
NUMBER OF CYLINDERS	8
BORE AND STROKE	4.00 x 3.00 5.0L (302 CID)
	4.00 x 3.50 5.8L (351 CID)
FIRING ORDER	1-5-4-2-6-3-7-8 5.0L (302 CID)
	1-3-7-2-6-5-4-8 5.8L (351 CID)
OIL PRESSURE (Hot @ 2000 RPM)	40-65
DRIVE BELT TENSION	(1)

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	67.5-70.5
VALVE GUIDE BORE DIAMETER	0.3433-0.3443
VALVE SEATS	
Width – Intake	0.060-0.080
Width – Exhaust	0.060-0.080
Angle	45°
Runout Limit (T. I. R. Max)	0.002
VALVE ARRANGEMENT (Front to Rear)	(L. H.) E-I-E-I-E-I-E-I
	(R. H.) I-E-I-E-I-E-I-E
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.0010-0.0027
Exhaust	0.0015-0.0032
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	1.770-1.794
Exhaust	1.439-1.463 5.0L (302 CID)
	1.468-1.453 5.8L (351 CID)
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std)	
Intake	0.3416-0.3423
Exhaust	0.3411-0.3418
(0.003 Oversize)	
Intake	0.3446-0.3453
Exhaust	0.3441-0.3448
(0.015 Oversize)	
Intake	0.3566-0.3575
Exhaust	0.3561-0.3568
0.030 Oversize	
Intake	0.3716-0.3723
Exhaust	0.3711-0.3718
VALVE SPRINGS	
Compression Pressure (Lb @ Spec. Length)	
Intake	76-84 @ 1.69 5.0L (302 CID)
	190-210 @ 1.31 5.0L (302 CID)
	71-79 @ 1.79 5.8L (351 CID)
	190-210 @ 1.34 5.8L (351 CID)
Exhaust	76-84 @ 1.60 5.0L (302 CID)
	190-210 @ 1.20 5.0L (302 CID)
	76-84 @ 1.60 5.8L (351 CID)
	190-210 @ 1.20 5.8L (351 CID)
Free Length (Approximate)	
Intake	1.94 5.0L (302 CID)
	2.06 5.8L (351 CID)
Exhaust	1.87 5.0L (302 CID)
	1.87 5.8L (351 CID)
Assembled Height	
Intake	1-21/32–1-23/32 5.0L (302 CID)
	1-49/64–1-13/16 5.8L (351 CID)
Exhaust	1-19/32–1-5/8 5.0L (302 CID)
	1-19/32–1-5/8 5.8L (351 CID)
Service Limit	10% Pressure Loss @ Spec. Length
Out-Of-Square Limit	5/64 (0.078) 5.0L/5.8L (302 CID/351 CID)
ROCKER ARM	
Stud Bore Diameter	0.3780-0.3795
Ratio	1.61:1
PUSH ROD RUNOUT (T. I. R. Max)	0.015
VALVE TAPPET, LIFTER OR ADJUSTER	
Diameter (Std)	0.8740-0.8745
Clearance To Bore	0.0007-0.0027
Service Limit	0.005
Hydraulic Leakdown Rate	5-50 Seconds (2)
Collapsed Tappet Gap – Allowable	0.071-0.193
Collapsed Tappet Gap – Desired	0.096-0.168

CAMSHAFT	
LOBE LIFT	
Intake	0.2373 5.0L (302 CID)
	0.2500 5.8L (351 CID)
Exhaust	0.2474 5.0L (302 CID)
	0.2600 5.8L (351 CID)
Allowable Lobe Lift Loss	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.3823 5.0L (302 CID)
	0.4186 5.8L (351 CID)
Exhaust	*0.3980 5.0L (302 CID)*
	0.4186 5.8L (351 CID)
END PLAY	0.001-0.007
Service Limit	0.009
JOURNAL-TO BEARING CLEARANCE	0.001-0.003
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010
JOURNAL DIAMETER	
# 1	2.0805-2.0815
# 2	2.0655-2.0665
# 3	2.0505-2.0515
# 4	2.0355-2.0365
# 5	2.0205-2.0215
Runout Limit	0.005 Max. T. I. R.
Out-Of-Round Limit	0.0005 Max. T. I. R
BEARING INSIDE DIAMETER	
# 1	2.0825-2.0835
# 2	2.0675-2.0685
# 3	2.0525-2.0535
# 4	2.0375-2.0385
# 5	2.0225-2.0235
FRONT BEARING LOCATION (3)	0.005-0.020

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	(4)
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	4.0004-4.0052 5.0L (302 CID)
	4.0000-4.0048 5.8L (351 CID)
Surface Finish (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPPET BORE DIAMETER	0.8752-0.8767
MAIN BEARING BORE DIAMETER	2.4412-2.4420 5.0L (302 CID)
	3.1922-3.1930 5.8L (351 CID)
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.4525-0.4541 5.0L (302 CID)
	0.5155-0.5171 5.8L (351 CID)

(1) **DRIVE BELT TENSION (Lbs.)**

Size	Newly *Installed (e)*	Used (b) Up to 10 Min.	Used (b) Over 10 Min.
1/4"	50-80	40-80 (a)	40-60 (a)
Exc. 1/4"	120-160	90-160 (c)	75-120 (d)

(a) If less than 40 lbs., readjust to 40-60 lbs.
(b) A used belt is any in operation for 10 minutes.
(c) If less than 90 lbs., readjust to 90-120 lbs.
(d) If less than 75 lbs., readjust to 90-120 lbs.
(e) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.

(2) Time required for plunger to leak down 1/16" with 50 lb. load and leakdown fluid in tappet.

(3) Distance front edge of bearing is below front face of cylinder block.

(4) 0.003 in any 8 inches – 0.006 overall.

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CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.2482-2.2490 5.0L (302 CID)
	2.9994-3.0002 5.8L (351 CID)
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Journal Runout Limit	0.002 Max.
Surface Finish (RMS)	12 Max.
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	1.137-1.139
CONNECTING ROD JOURNAL	
Diameter	2.1228-2.1236 5.0L (302 CID)
	2.3103-2.3111 5.8L (351 CID)
Out-Of-Round Limit	0.0006
Taper Limit	0.0006 per inch Max.
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish (RMS)	35 Front-25 Rear
Runout Limit	0.001 Max.
FLYWHEEL CLUTCH FACE	
Runout Limit (T. I. R.)	0.010
FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)	
Standard Transmission	0.030
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CRANKSHAFT RUNOUT TO REAR FACE OF BLOCK (T. I. R. Max.)	0.005
CONNECTING ROD BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0007-0.0024 5.0L (302 CID)
	0.0008-0.0025 5.8L (351 CID)
Bearing Wall Thickness (Std) (5)	0.0572-0.0577
MAIN BEARINGS	
Clearance To Crankshaft – Desired	No. 1 = 0.0001-0.0015 5.0L (302 CID)
	All others 0.0005-0.0015 5.0L (302 CID)
	0.0008-0.0015 5.8L (351 CID)
– Allowable	No. 1 = 0.0001-0.0020 5.0L (302 CID)
	Others 0.0005-0.0024 5.0L (302 CID)
	0.0008-0.0026 5.8L (351 CID)
Bearing Wall Thickness (Std) (5)	No. 1 = 0.0961-0.0966 5.0L (302 CID)
	All others 0.0957-0.0962 5.0L (302 CID)
	0.0957-0.0960 5.8L (351 CID)

(5) For 0.002 undersize, add 0.001 to standard thickness.

(6) Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of an 8" bar, 4" on each side of rod centerline.

(7) Measured at the piston pin bore centerline, at 90° to the pin.

CONNECTING ROD, PISTON AND RINGS	
CONNECTING ROD	
Piston Pin Bore Diameter	0.9096-0.9112
Crankshaft Bearing Bore Diameter	2.2390-2.2398 5.0L (302 CID)
	2.4265-2.9273 5.8L (351 CID)
Out-Of-Round Limit	0.004 Max.
Taper Limit	0.004 Max.
Lenth (Center-to-Center)	5.0885-5.0915 5.0L (302 CID)
	5.9545-5.9575 5.8L (351 CID)
Alignment (Bore-to-Bore Max Diff) (6)	
Twist	0.024
Bend	0.012
Side Clearance (Assembled to Crank)	
Standard	0.010-0.020
Service Limit	0.023
PISTON	
Diameter (7)	
Coded Red	3.9984-3.9990 5.0L (302 CID)
	3.9978-3.9984 5.8L (351 CID)
Coded Blue	3.9996-4.0002 5.0L (302 CID)
	3.9990-3.9996 5.8L (351 CID)
0.003 Oversize	4.0008-4.0014 5.0L (302 CID)
	4.0002-4.0008 5.8L (351 CID)
Coded Yellow	4.0020-4.0026 5.0L (302 CID)
	4.0014-4.0020 5.8L (351 CID)
Piston-To-Bore Clearance	0.0018-0.0026
Pin Bore Diameter	0.9122-0.9127 5.0L (302 CID)
	0.9124-0.9127 5.8L (351 CID)
Ring Groove Width	
Compression (Top)	0.080-0.091
Compression (Bottom)	0.080-0.091
Oil	0.188-0.189
PISTON PIN	
Length	3.010-3.040
Diameter	
Standard	0.9119-0.9124
0.001 Oversize	0.9130-0.9133
0.002 Oversize	0.9140-0.9143
Pin-To-Piston Clearance	0.0002-0.0004 5.0L (302 CID)
	0.0003-0.0005 5.8L (351 CID)
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.002-0.004
Compression (Bottom)	0.002-0.004
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.010-0.020
Compression (Bottom)	0.010-0.020
Oil Ring (Steel Rail)	0.015-0.055

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LUBRICATION SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs at Spec. Length)	*10.6-12.2 @ 1.704 5.0L (302 CID)* *18.2-20.2 @ 2.49 5.8L (351 CID)*
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U. S.)	4 (8)

FUEL PUMP

STATIC PRESSURE (P. S. I.) (9)	6.0-8.0
MINIMUM VOLUME FLOW (9) (10)	1 pt./20 sec.
ECCENTRIC TOTAL LIFT (Inches)	0.690-0.710

TORQUE SPECIFICATIONS – SPECIAL APPLICATIONS

CAMSHAFT SPROCKET TO CAMSHAFT	40-45
CAMSHAFT THRUST PLAT TO BLOCK	9-12
CONNECTING ROD NUTS OR BOLTS	19-24 5.0L (302 CID) 40-45 5.8L (351 CID)
CYLINDER FRONT COVER BOLTS	12-18
CYLINDER HEAD BOLTS	5.0L (302 (11)) 5.8L (351 (12))
DAMPER OR PULLEY TO CRANKSHAFT	70-90
DISTRIBUTOR VACUUM CONTROL VALVE	15-18
EGR VALVE TO CARBURETOR SPACER OR INT MANIFOLD	12-18
FUEL PUMP TO CYLINDER BLOCK OR FRONT COVER	19-27
FLYWHEEL TO CRANKSHAFT	75-85
MAIN BEARING CAP BOLTS	*60-70 5.0L (302 CID)* 95-105 5.8L (351 CID)
MANIFOLD TO CYLINDER HEAD (Intake)	23-25 (15)
MANIFOLD TO CYLINDER HEAD (Exhaust)	18-24
OIL FILTER INSERT TO CYLINDER BLOCK	20-30
OIL FILTER TO BLOCK OR ADAPTER	(13)
OIL INLET TUBE TO OIL PUMP	10-15
OIL PAN DRAIN PLUG	15-25
OIL PAN TO CYLINDER BLOCK	5/16 = 11-13/1/4 = 7-9
OIL PUMP TO CYLINDER BLOCK	22-32
PULLEY TO DAMPER (Bolt)	35-50
ROCKER ARM STUD NUT	17-23 (14)
ROCKER ARM STUD OR BOLT TO CYLINDER HEAD	Press Fit
SPARK PLUG TO CYLINDER HEAD	10-15
VALVE ROCKER ARM COVER	3-5
ALTERNATOR BRACKET TO CYLINDER BLOCK (Bolt)	12-18
ALTERNATOR PIVOT BOLT	45-57
ALTERNATOR ADJUSTING ARM TO CYLINDER BLOCK	15-20
THERMACTOR PUMP BRACKET TO CYLINDER BLOCK	12-18
THERMACTOR PUMP PIVOT BOLT	22-32
THERMACTOR PUMP ADJUSTING ARM TO PUMP	22-32
THERMACTOR PUMP ADJUSTING ARM TO CYLINDER BLOCK	*12-18*
THERMACTOR PUMP TO SHAFT	130-180 In.-Lb.
POWER STEERING PUMP PULLEY TO DAMPER (Bolt)	35-50
FAN TO WATER PUMP HUB (Bolt)	12-18
CARBURETOR MOUNTING NUTS	12-15
CARBURETOR MOUNTING STUD	15 Max.
FUEL FILTER TO CARBURETOR	80-100 In.-Lb.
ALTERNATOR ADJUSTING ARM TO ALTERNATOR	24-40

TORQUE SPECIFICATIONS – General Application

U. S. THREAD SIZES	TORQUE
1/4-20	6-9
5/16-18	12-18
5/16-24	14-20
3/8-16	22-32
3/8-24	27-38
7/16-14	40-55
7/16-20	*40-60*
1/2-13	55-80

PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	*12-18*
3/8	22-33
1/2	25-35

- All values are in ft-lb. unless otherwise noted
- *Oil threads with engine oil unless fasteners require sealers.*

(8) Add 1 quart with filter change.

(9) On engine, at normal operating temperature, with transmission in neutral.

(10) No restriction in test circuit smaller than 0.220".

(11) Torque in sequence: Step 1 = 55-65; Step 2 = 65-72

(12) Torque in sequence: Step 1 = 95-105; Step 2 = 105-112

(13) Advance 1/2 turn after gasket contacts sealing surface; with oiled gasket.

(14) After contact with shoulder.

(15) Retorque to specifications after engine is hot.

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DETROIT IRON

5.8L/6.6L (351 "M"/400 CID) V-8 Engines

PART 21-22

Ford, Mercury, LTD II, Cougar, Thunderbird, Lincoln Continental, Continental Mark V

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Cylinder Head	22-21
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CA4287-2B

DESCRIPTION

ENGINE

The 5.8L (351M CID) and 6.6L (400 CID) V-8 engines are basically of the same design and structure. Except for a revised crankshaft damper, the difference between the 2 engines is internal and consists of the following: the 5.8L (351M CID) V-8 engine has a shorter stroke, accomplished by using a revised crankshaft and a piston with an increased compression height (piston pin to top of piston). It also uses a revised camshaft for proper valve timing. Both engines are equipped with a thermactor air injection system for reduced engine emissions (Fig. 1).

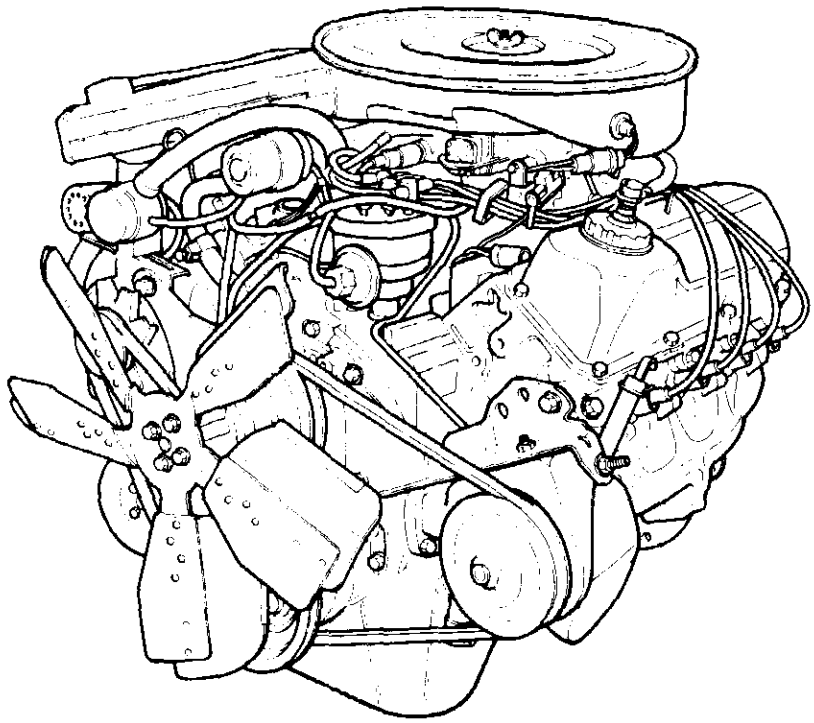
EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices used on these engines are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

The engine is equipped with a positive closed-type crankcase ventilation system re-cycling the crankcase vapors to the intake manifold.

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A4071-2C

FIG. 1 Right Front View—(Typical)

REMOVAL AND INSTALLATION

Caution: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.

When installing nuts or bolts that must be torqued (see Specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

ENGINE

Removal

Remove or disconnect Thermactor system parts that will interfere with removal or installation of the engine.

1. Disconnect the battery, drain the cooling system and remove the hood.
2. Remove the air cleaner and air intake tube assembly.
3. Disconnect the radiator upper hose at the engine and the lower hose at the radiator. Disconnect the transmission oil cooler lines at the radiator.
4. Remove the fan shroud attaching bolts and position the shroud over the fan. Remove the radiator and shroud.
5. Remove the fan and spacer.
6. On vehicles equipped with air conditioning, loosen the idler pulley and remove the drive belt.
7. Loosen the alternator and remove the drive belt.
8. Loosen and remove the power steering pump drive belt.
9. Remove the water pump pulley.
10. Remove the power steering pump brackets and position the pump out of the way in an upright position to prevent fluid loss.
11. On vehicles equipped with air conditioning, isolate and remove the compressor as outlined in Group 36.
12. Remove the alternator and bracket. Position the alternator out of the way. Disconnect the alternator ground wire from the cylinder block.
13. Disconnect the heater hoses at the block and water pump.
14. Remove the ground wires from the cylinder block and right cylinder head.
15. Disconnect the fuel line at the fuel pump. Plug the fuel tank line. Disconnect the vacuum lines at the rear of the intake manifold. Disconnect vacuum control valve hoses and wires on engines so equipped.
16. Disconnect the accelerator cable or linkage at the carburetor and intake manifold. Disconnect transmission downshift linkage, if so equipped.
17. Disconnect the engine wire harness at the ignition coil, water temperature sending unit and oil pressure sending unit. Remove the wire harness from the hold down clips.
18. Raise the vehicle and secure with safety stands.
19. Disconnect the exhaust system at the exhaust manifolds and remove the exhaust heat control valve (if so equipped) or the exhaust manifold-to-pipe spacer.
20. Disconnect the starter cable and remove the starter.

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21. Remove the engine front support through bolts and the starter cable clamp at the engine right front support.
22. Remove the converter inspection cover and disconnect the flexplate from the converter. Remove the downshift rod.

    Remove the four converter lower housing-to-engine block bolts and the adapter plate-to-converter housing bolt.
23. Lower the vehicle.
24. Remove the two converter housing upper bolts.
25. Attach engine lifting sling (Tool No. T53L-300-A or equivalent), and hoist, to lifting brackets at exhaust manifolds.
26. Position a jack under the transmission.
27. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment so that the rear cover plate is not bent or components damaged. Install the engine on a work stand.

Installation

1. Attach an engine lifting sling, Tool No. T53L-300-A or equivalent, and hoist to lifting brackets at exhaust manifolds. Remove engine from work stand.
2. Lower the engine carefully into the engine compartment.

    Start the converter pilot into the crankshaft.
3. Install the converter housing upper bolts, making sure that the dowels in the cylinder block engage the flywheel housing. Remove the jack from under the transmission.
4. Remove the lifting sling.
5. Position the downshift rod on the transmission and engine.
6. Raise the vehicle and secure with safety stands.
7. Position the transmission linkage bracket and install the remaining converter housing bolts. Install the adapter plate-to-converter housing bolts. Install the converter-to-flywheel nuts and install the inspection cover. Connect the downshift rod to the transmission.
8. Install the starter and connect the cable.
9. Install the exhaust heat control valve (if so equipped) or manifold-to-pipe spacer and connect the exhaust system to the exhaust manifolds.
10. Install the engine front support through bolts and install the starter cable clamp at the engine right front support.
11. Lower the vehicle.
12. Connect the ground wire at the right cylinder head. Install the engine wire harness and connect it to the ignition coil, then install the water temperature sending unit and oil pressure sending unit.
13. Install the accelerator linkage and connect the downshift rod.
14. Connect the vacuum lines at the rear of the intake manifold. Connect the fuel tank line at the fuel pump.
15. Connect the battery ground wire to the right front of cylinder block. Connect the heater hoses to the water pump and cylinder block.
16. Install the alternator and bracket. Connect the alternator ground wire to the cylinder block.
17. On a vehicle with air conditioning, install the air conditioning compressor and brackets as outlined in Group 36.
18. Install the power steering pump and brackets. Install all parts of the Thermactor system that were disconnected and/or removed.
19. Install the water pump pulley, fan and spacer. Install the drive belts on their respective pulleys and adjust the belt tension to specification.
20. Position the fan shroud over the fan. Install the radiator and connect the radiator upper and lower hoses. Install the fan shroud attaching bolts.
21. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of oil. Adjust the transmission downshift linkage. Connect the battery.
22. Operate the engine at fast idle until it reaches normal operating temperature and check all gaskets and hose connections for leaks. Adjust ignition timing and idle speed.
23. Install the air cleaner and air inlet tube. Install and adjust the hood.

ENGINE FRONT SUPPORTS

Whenever self-locking mounting bolts and nuts are removed, they must be replaced with new self-locking fasteners. (Marked * in Figs. 2, 3 and 4).

The front supports are located on each side of the cylinder block (Figs. 2, 3 and 4). The procedures given apply to either a right or left installation.

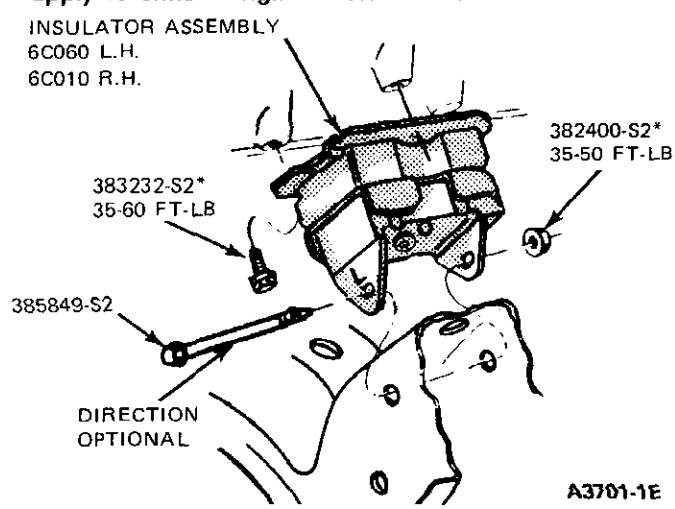


FIG. 2 Engine Front Supports—LTD II, Cougar, Thunderbird and Continental Mark V

Removal

1. Remove the fan shroud attaching bolts. On Ford, Mercury and Lincoln Continental, remove the transmission oil cooler inlet and outlet lines from the retaining bracket on the block.
2. Remove the through bolt and lock nut attaching the insulator to the insulator support bracket (No. 2 crossmember on LTD II, Cougar, Thunderbird and Continental Mark V). On Ford, Mercury, remove the

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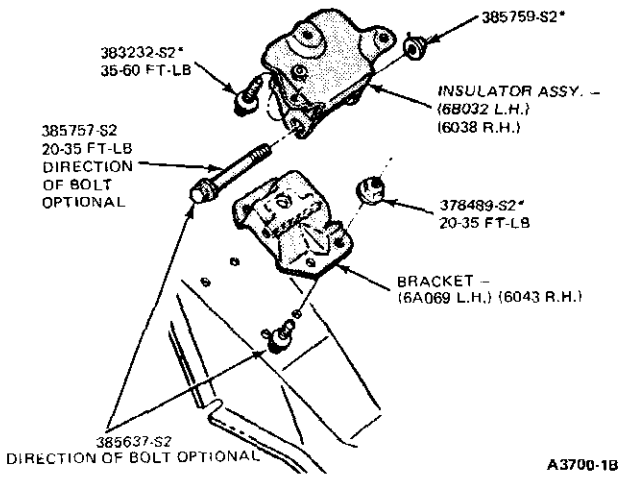


FIG. 3 Engine Front Support—Ford and Mercury

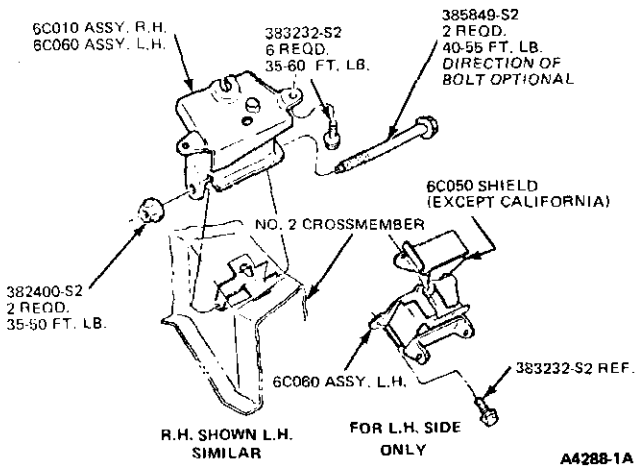


FIG. 4 Engine Front Support—Lincoln Continental

nut and through bolt on the opposite mount to prevent distortion of the insulator.

3. Raise the engine slightly with a jack and a wood block placed under the oil pan.
4. Remove the engine insulator assembly to cylinder block attaching bolts. Remove the engine insulator assembly and heat shield, if so equipped.

Installation

1. Position the engine insulator assembly and heat shield, if so equipped, to the cylinder block and install the attaching bolts. Tighten the bolts to specification.
2. Lower the engine into position, install the engine insulator assembly to the support bracket (No. 2 crossmember on LTD II, Cougar, Thunderbird and Continental Mark V). Install the through bolt and remove the jack and wood block.
3. Install the engine insulator assembly. Tighten the nut to specification. On Ford and Mercury, install the transmission oil cooler lines in the retaining bracket on the cylinder block.
4. Install the fan shroud attaching bolts.

ENGINE REAR SUPPORT

The rear support is located at the transmission extension housing (Figs. 5, 6 and 7). **Whenever self-locking mounting bolts and nuts are removed, they *must be replaced with new self-locking bolts and* nuts.** (Marked * in Figs. 5, 6 and 7).

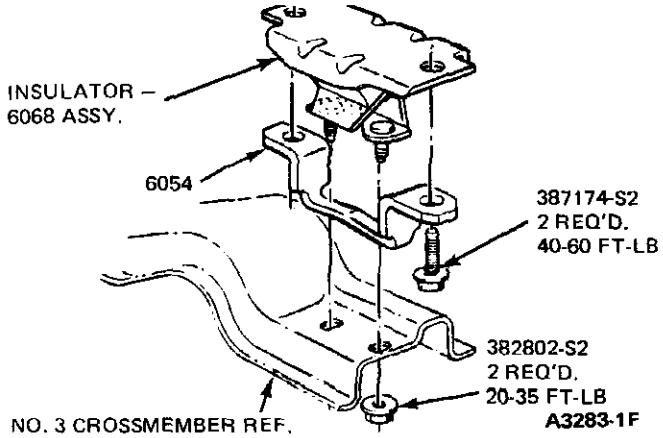


FIG. 5 Engine Rear Support—LTD II, Cougar and *Thunderbird*

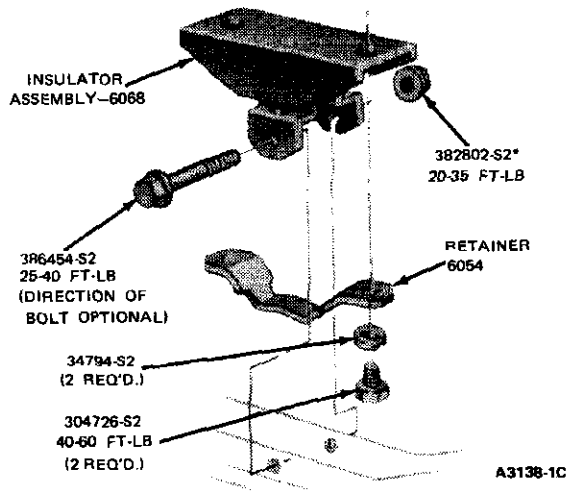


FIG. 6 Engine Rear Support—Ford and Mercury

Removal

1. Support the transmission with a floor jack to remove weight from the supporting crossmember.
2. Remove the nuts attaching the insulator assembly to the crossmember.
3. On LTD II, Cougar and Thunderbird, remove or loosen the bolts attaching the supporting crossmember for repositioning or removal as necessary to remove the insulator assembly.
4. Remove the bolts and washers that attach the engine rear insulator to the transmission.
5. *Remove the insulator assembly.*

Installation

1. Position the engine rear insulator assembly in place beneath the transmission. Install the attaching bolts and washers and torque to specification.

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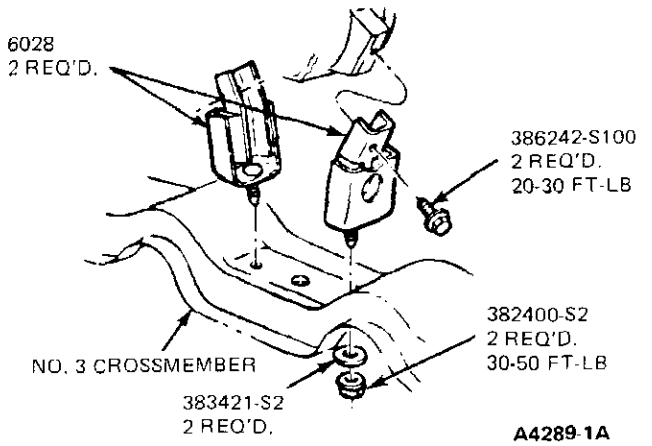


FIG. 7 Engine Rear Support—Lincoln Continental and Continental Mark V

2. On LTD II, Cougar and Thunderbird, position the supporting crossmember. Install/tighten the bolts to proper torque specification.
3. Install the nuts attaching the insulator assembly to the crossmember.
4. Remove the floor jack.

CRANKCASE VENTILATION SYSTEM

The crankcase ventilation system components are shown in Fig. 8.

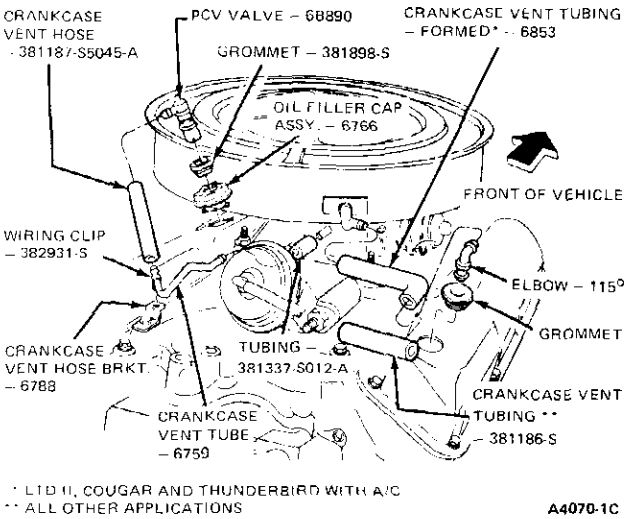


FIG. 8 Typical Crankcase Ventilation System Components

Removal

1. Remove the ventilation system air intake hose from the air cleaner.
2. Remove the crankcase vent hose from the PCV valve located in oil fill cap.
3. Remove the air cleaner and intake duct assembly.
4. Disconnect the crankcase vent hose from the carburetor.
5. Pull the PCV valve out of the oil fill cap.
6. Remove the crankcase ventilation filter from the air cleaner body.

Installation

1. Install the crankcase ventilation filter in the air cleaner body.
2. Insert the PCV valve into the oil fill cap mounting grommet.
3. Connect the vent hose to the carburetor.
4. Install the air cleaner and intake duct assembly.
5. Install the ventilation system air intake hose to the air cleaner and the PCV valve.
6. Start the engine and check for leaks.

VALVE ROCKER ARM COVER AND ROCKER ARM

The valve rocker arm is shown in Fig. 9.

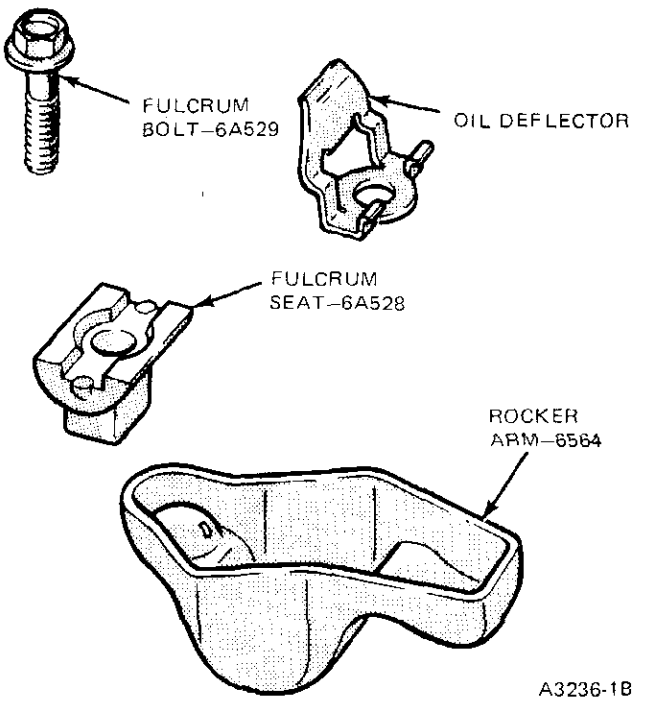


FIG. 9 Rocker Arm and Related Parts

Removal

1. Remove the air cleaner and air inlet tube assembly. Remove appropriate crankcase ventilation hose(s) at the valve rocker arm cover(s).
2. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the molded cap only with the proper tool. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.
3. Remove the valve rocker arm cover(s).
4. Remove the valve rocker arm bolt, oil deflector, fulcrum seat and rocker arm.

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Installation

All rocker arms and fulcrum seats are to be lubricated with heavy engine oil SE before installation.

1. Apply Lubriplate or equivalent to the top of the valve stem. Lubricate the rocker arm and fulcrum seat with heavy engine oil SE.
2. Position the No. 1 piston on TDC at the end of the compression stroke, POSITION 1 in Fig. 10, and install the rocker arm, fulcrum seat, oil deflector, and fulcrum bolts on the following valves:

   No. 1 Intake No. 1 Exhaust

   No. 4 Intake No. 3 Exhaust

   No. 8 Intake No. 7 Exhaust

   Position the crankshaft in POSITION 2 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and fulcrum bolts on the following valves:

   No. 3 Intake No. 2 Exhaust

   No. 7 Intake No. 6 Exhaust

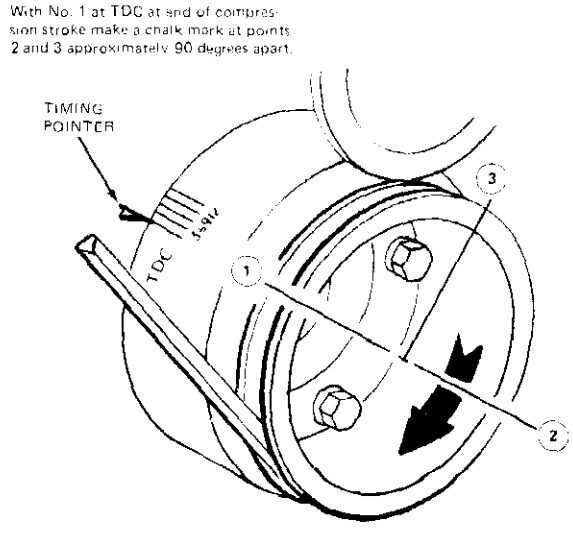


FIG. 10 Position of Crankshaft for Installing Rocker Arms

Position the crankshaft in POSITION 3 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and fulcrum bolts on the following valves:

No. 2 Intake No. 4 Exhaust

No. 5 Intake No. 5 Exhaust

No. 6 Intake No. 8 Exhaust

Be sure that the fulcrum seat base is seated in its slot on the cylinder head before tightening the fulcrum bolts. Tighten the fulcrum bolt to specification. Check the valve clearance following the procedures under Valve Clearance Adjustment in Part 21-01.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s) in place in the cover(s).
4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Tighten the bolts to specification. Two minutes later, tighten the bolts to the same specification.

   Reconnect the crankcase ventilation hose(s).

   Install the air cleaner and intake duct assembly.
5. Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires. See Part 23-01 for special installation instructions.
6. Start the engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or damaged valve stem seals and retainers may be replaced without removing the cylinder head, provided damage to the valve or valve seat has not occurred.

Removal

1. Remove the required rocker arm(s) following the instructions given in Rocker Arm Removal.
2. Install an air line with an adapter in the spark plug hole and turn on the air supply.
3. Install the compressor tool as shown in Fig. 11. Compress the valve spring and remove the retainer locks, spring retainer and valve spring.
4. Remove and discard the valve stem seal (Fig. 11).

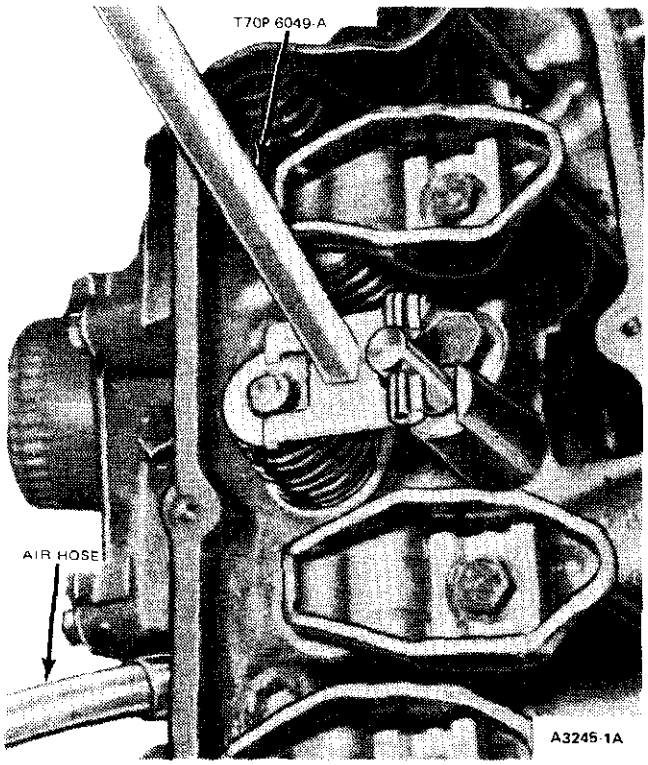


FIG. 11 Compressing Valve Spring in Chassis

5. If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.

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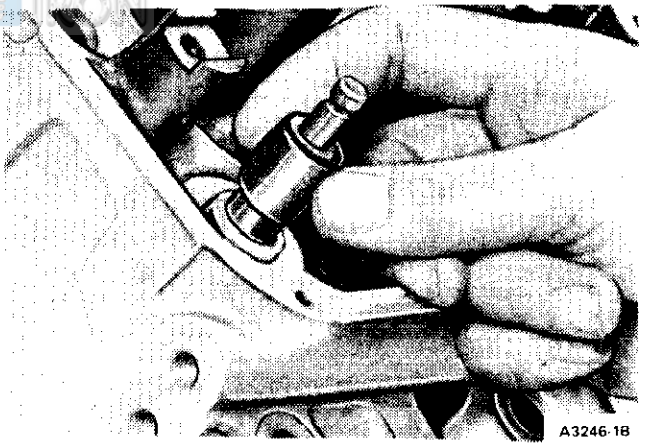


FIG. 12 Removing or Installing Valve Stem Seal

Installation

1. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric movement during rotation. Move the valve up and down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 21-01.**
2. If the condition of the valve proves satisfactory, hold the valve in the closed position and apply the air pressure within the cylinder.
3. Lubricate the valve stem with heavy engine oil SE.
4. Install a new valve stem seal (Fig. 11). Place the spring in position over the valve and install the valve spring retainer. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and stud nut. Turn off the air and remove the air line adapter.
5. Lubricate and install the push rod. Apply Lubriplate or equivalent to the tip of the valve stem.
6. Install the required rocker arm(s) following the instructions given in Rocker Arm Installation.
7. Check the rocker arm to valve stem clearance and install the related parts as outlined in Valve Rocker Arm Cover and Rocker Arm Installation.

INTAKE MANIFOLD

A typical intake manifold assembly is shown in Fig. 13.

Removal

1. Remove the air cleaner and intake duct. On Ford and Mercury vehicles, with Frigidaire A/C compressor, isolate and remove the compressor, following procedure in Group 36.
2. Disconnect the high tension lead and wires from the coil. Disconnect the engine wiring harness and position it out of the way.
3. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the molded cap only. (Use Tool T75P-6666-A.) Remove the wires from the harness brackets on the valve rocker arm covers. Remove the distributor cap and spark plug wire assembly. Remove the Thermactor bypass valve and hose from the check valve.

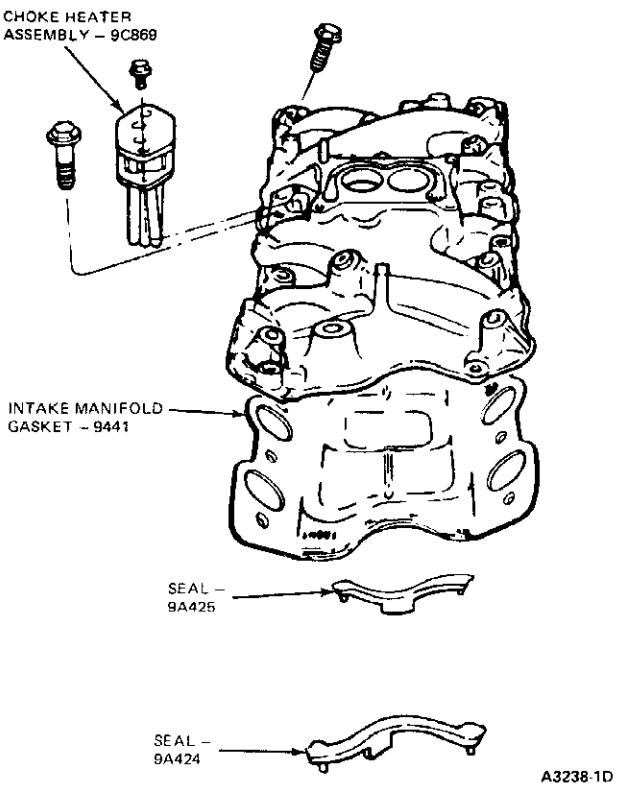


FIG. 13 Intake Manifold Assembly

4. Remove the carburetor fuel inlet line.
5. Remove the heater hoses from the retainers and position the hoses out of the way.
6. Remove the ignition coil, vacuum solenoid valve, and bracket.
7. Disconnect the crankcase emission hose at the left rocker arm cover.
8. Disconnect the vacuum lines from the intake manifold.
9. Disconnect the distributor vacuum hoses from the distributor. Disconnect the distributor wiring harness. Remove the distributor hold down bolt and clamp and remove the distributor. Block the distributor hole with a rag to prevent entry of foreign material into the crankcase.
10. Disconnect the accelerator linkage and position out of the way.
11. Remove the carburetor.
12. Remove the manifold attaching bolts. Remove the manifold. Remove and discard the intake manifold gasket and seals.
13. If the manifold assembly is to be disassembled, disconnect vacuum hoses.

Installation

1. Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block. Use a solvent such as lacquer thinner, chlorothane or tri-chlor-ethylene. Apply a 1/8 inch bead of silicone rubber sealer at the points shown in Fig. 14. **Caution: Do not apply sealer to waffle section of end seals as the sealer will rupture the seal material.**

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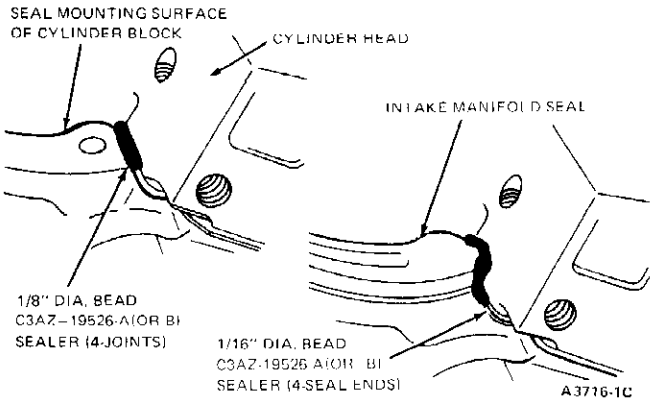


FIG. 14 Typical RTV Sealer Installation—Intake Manifold

2. Position new seals on the cylinder block and press the seal locating extensions into the holes in the mating surface.
3. Apply a 1/16 inch bead of the above sealer to the outer end of each intake manifold seal for the full width of the seal (4 places). See Fig. 14. **Caution: Do not apply sealer to waffle section of end seals as the sealer will rupture the seal material.** NOTE: This sealer sets up in 15 minutes, so it is important that assembly be completed promptly. Do not drip any sealer into the engine valley. **Position the intake manifold gasket onto the block and cylinder heads with the alignment notches under the dowels on the cylinder heads. Be sure the holes in the gasket are aligned with the holes in the cylinder head.**
4. Carefully lower the intake manifold into position on the cylinder block and cylinder heads.
5. Be sure the holes in the manifold gaskets and manifold are in alignment. Install the intake manifold attaching bolts. Tighten the intake manifold bolts in three steps (Fig. 15).

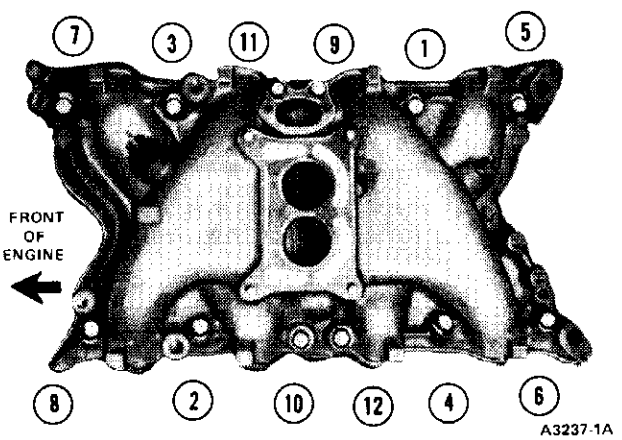


FIG. 15 Intake Manifold Torque Sequence

Tighten all bolts in sequence to specification.

After completing the remaining assembly steps, operate the engine until it reaches normal operating temperature then re-tighten the manifold bolts in sequence to specification.

6. Install the carburetor and gasket.
7. Rotate the crankshaft damper until the No. 1 piston is on TDC at the end of the compression stroke. Position the distributor in the block with the rotor at the No. 1 firing position. Install the hold down clamp and connect the distributor wiring harness.
8. Install the accelerator linkage.
9. Install the vacuum solenoid valve and the ignition coil.
10. Connect the vacuum lines at the manifold. Install the Thermactor by-pass air supply hose.
11. Position the engine wiring harness under the hold down clips on the left rocker arm cover and connect the wires at the ignition coil, water temperature sending unit and throttle solenoid (if equipped).
12. Connect the crankcase emission hose at the left hand rocker arm cover.
13. Install the heater hoses in the retainers.
14. Connect the fuel pump to carburetor fuel line at the carburetor.
15. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the spark plugs. See Part 23-01 for special installation instructions. On Ford and Mercury vehicles equipped with Frigidaire A/C compressor, install compressor following procedure in Group 36.
16. Start the engine and check for leaks. Adjust the ignition timing and connect the distributor vacuum lines.
17. When engine temperature has stabilized, adjust idle mixture and speed. Retorque the intake manifold to specification.
18. Install the air cleaner and re-check idle speed.

HYDRAULIC TAPPETS

Before replacing a tappet for noisy operation, be sure the noise is not caused by improperly adjusted valve clearance (collapsed tappet clearance) or by worn rocker arms or push rods.

The following procedure applies to the removal of one or all tappets. **NOTE: Since not all pushrod holes are large enough to permit the removal of the associated lifter, it may be necessary to remove the adjacent rocker arm and pushrod and use that pushrod hole for access.**

Removal

1. Remove the valve rocker arm covers.
2. Remove the valve necessary rocker arm(s) push rod(s) and identify them so that they can be installed in their original positions.
3. Using tool T70P-14151, remove the tappet(s) and place them in a rack so that they can be installed in their original bores (Fig. 16). If removing tappet through adjacent pushrod hole, use a small light to aid in transferring tappet into position for lifting out with T70P-14151 Tool.
4. Instructions for disassembling and assembling the tappets are given in Hydraulic Tappet—Disassembly and Assembly.

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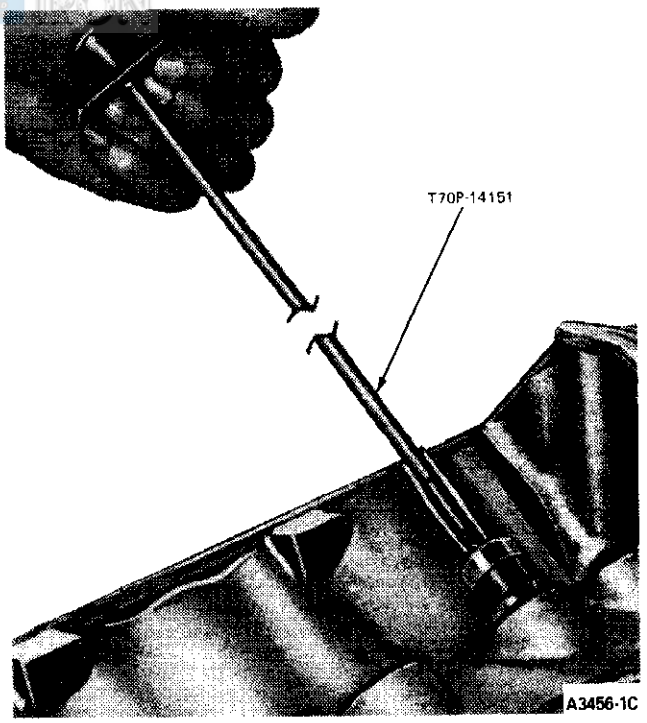


FIG. 16 Removing Hydraulic Tappets

Installation

Tappets and bores are to be lubricated with heavy engine oil SE before installation.

1. Clean the external surfaces of the tappets and install in the bores from which they were removed. If a tappet is being installed, check the new tappet(s) for a free fit in the bore in which it is to be installed. Lubricate the tappet(s) and bore(s) with heavy engine oil SE before inserting it in the bore.
2. Install the push rods in their original position. Apply Lubriplate or equivalent to the valve stem tips.
3. Install the rocker arm(s) following the instructions given in Rocker Arm Installation.
4. Check the rocker arm to valve stem tip clearance (collapsed tappet clearance), and install the related parts as outlined in Valve Rocker Arm Cover and Rocker Arm Installation.

EXHAUST MANIFOLD

Removal

1. If a right exhaust manifold is being removed, remove the air cleaner, intake duct and heat stove. If a left-hand exhaust manifold is being removed, first remove the oil filter.
2. On vehicles equipped with a column selector and automatic transmission, disconnect the selector lever cross shaft for clearance.
3. Disconnect the muffler inlet pipe or catalytic converter inlet pipe at the exhaust manifold. Remove the spark plug heat shields.
4. Remove the exhaust manifold attaching bolts and remove the manifold.

Installation

1. Clean the mating surfaces of the exhaust manifold and cylinder head. Clean the mounting flange of the exhaust manifold and muffler inlet pipe or catalytic converter inlet pipe.
2. Apply graphite grease to the mating surface of the exhaust manifold.
3. Position the exhaust manifold on the head and install the attaching bolts. Working from the center to the ends, tighten the bolts to specification. Install the spark plug heat shields.
4. Install the spacer between the inlet pipe and the exhaust manifold.
5. Connect the muffler inlet pipe or catalytic converter inlet pipe at the exhaust manifold. Tighten the attaching nuts to specification.
6. If a left exhaust manifold is being installed, install the oil filter.

   On a vehicle with an automatic transmission and column selector, connect the selector cross shaft at the chassis and cylinder block.
7. If a right exhaust manifold is being replaced, install the air cleaner heat stove. Install the air cleaner and intake duct.
8. Start the engine and check for exhaust or oil leaks.

CYLINDER HEADS

If a cylinder head is to be replaced, follow the procedures under Cylinder Head Disassembly and Assembly, and transfer all valves, springs, spark plugs, etc., to the new cylinder head. Clean and inspect all parts, reface the valves (refer to Part 21-01) and check all clearances before assembling the new or used parts to the new cylinder head.

Removal

1. Remove the intake manifold and carburetor as an assembly following the procedure under Intake Manifold Removal.
2. Remove the rocker arm cover(s).

   If the left cylinder head is to be removed on a vehicle with an air conditioner, isolate and remove the compressor as outlined in Group 36.

   If the left cylinder head is to be removed, disconnect the power steering pump bracket from the left cylinder head and remove the drive belt from the pump pulley. Position the power steering pump out of the way and in a position that will prevent the oil from draining out.
3. If the right cylinder head is to be removed, remove the alternator mounting bracket through bolt and air cleaner inlet duct from the right cylinder head assembly. Remove the ground wire at the rear of the cylinder head.
4. Disconnect the exhaust manifold(s) from the muffler inlet pipe(s) or catalytic converter inlet pipe(s).
5. Remove the rocker arm bolts, oil deflectors, rocker arms, and push rods in sequence (Fig. 17) so that they may be installed in their original positions.
6. Remove the cylinder head attaching bolts and lift the cylinder head off the block. Remove and discard the cylinder head gasket.

Installation

1. Clean the cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket surfaces (see Part 21-01).

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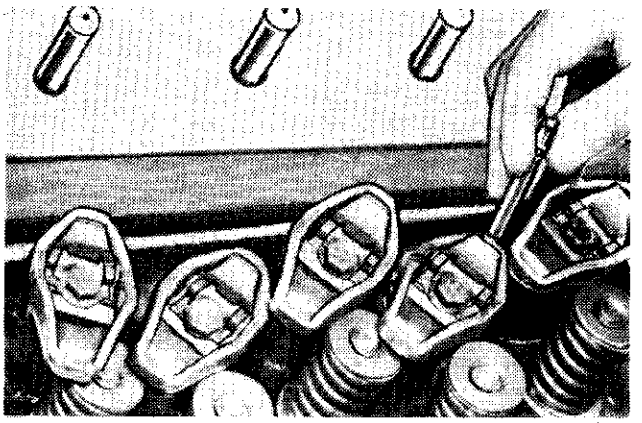
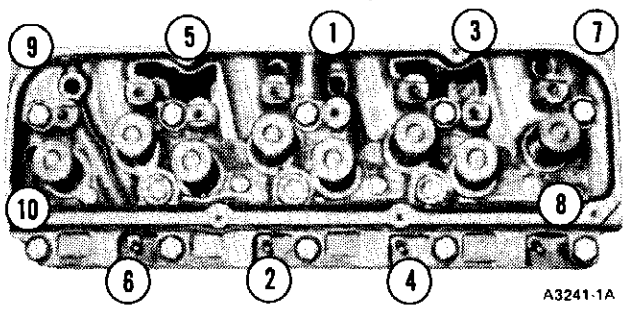

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FIG. 17 Removing Valve Push Rod

2. Position the new cylinder head gasket over the cylinder dowels on the block. Position the cylinder head on the block and install the attaching bolts.
3. The cylinder head bolts are tightened in three progressive steps. Tighten all the bolts in sequence (Fig. 18) to 75 ft-lbs, then to specification. When cylinder head bolts have been tightened following this procedure, it is not necessary to retorque the bolts after extended operation. However, the bolts may be checked and retorqued if desired.



A3241-1A

FIG. 18 Cylinder Head Bolt Torque Sequence

4. Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Visually check the push rods for straightness or check push rod runout with a dial indicator. If runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**
5. Lubricate and install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tips.
6. Lubricate and install the rocker arms following procedures under Valve Rocker Arm Installation.
7. Connect the exhaust manifold(s) at the muffler inlet pipe(s) or catalytic converter inlet pipe(s). Tighten the nuts to specification.
8. If the right cylinder head was removed, install the alternator mounting bracket through bolt and air cleaner inlet duct on the right cylinder head assembly. Connect the ground wire at the rear of the cylinder head. Adjust the drive belt tension to specification.
9. Apply sealer to the rocker cover and cover gasket to hold gasket in place. Position gasket on cover aligning the holes in cover and gasket. Install the valve rocker arm cover(s).

   If the left cylinder head was removed on a vehicle with an air conditioner, install the compressor as outlined in Group 36.

   If the left cylinder head was removed, install the drive belt and power steering pump bracket. Install the bracket attaching bolts. Adjust the drive belt to specification.
10. Install the intake manifold and related parts following the procedure under Intake Manifold Installation.

WATER PUMP

Removal

1. Drain the cooling system and disconnect the battery.
2. Remove the air inlet tube and fan shroud attaching bolts and position the shroud rearward.
3. Remove the fan and spacer from the water pump shaft.
4. Remove the air conditioner compressor drive belt lower idler pulley and compressor mount to water pump bracket, if so equipped.
5. Loosen the alternator and remove the drive belt.
6. Loosen the power steering pump and remove the drive belt.
7. Remove the water pump pulley.
8. Remove the alternator bracket from water pump and position it out of the way.
9. Remove the power steering pump bracket from the water pump and position it out of the way.
10. Remove the heater hose from the water pump.
11. Disconnect the radiator lower hose at the water pump.
12. Remove the water pump attaching bolts and remove the water pump.

Installation

1. Remove all gasket material from the mounting surfaces of the cylinder front cover and water pump. On Ford and Mercury vehicles with Frigidaire A/C compressors, remove all gasket material from the water pump spacer.
2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover (on spacer for Ford and Mercury vehicles with A/C compressor); then install the pump. Coat the threads of the attaching screws with oil-resistant sealer and install the screws. Tighten the attaching screws to specification.
3. Install the air conditioner compressor to water pump bracket and lower idler pulley, if so equipped.
4. Position the alternator bracket and power steering pump bracket on the water pump and install the bracket bolts.
5. Position the water pump pulley on the water pump shaft and install the drive belts.
6. Place the fan shroud over the pulley and install the fan and spacer.
7. Install the fan shroud and air inlet tube attaching bolts.
8. Adjust the drive belts to specification.

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9. Connect the radiator lower hose at the water pump.
10. Connect the heater hose at the water pump.
11. Connect the battery cable. Fill and bleed the cooling system. Operate the engine until normal operating temperature has been reached and check for leaks.

CYLINDER FRONT COVER PLATE AND TIMING CHAIN

Removal

1. Refer to Water Pump Removal. Perform Steps 1 thru 9, but leave the water pump attached to the front cover plate.
2. Remove the heater hose and lower radiator hose from the water pump.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the vibration damper attaching screw. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the vibration damper.

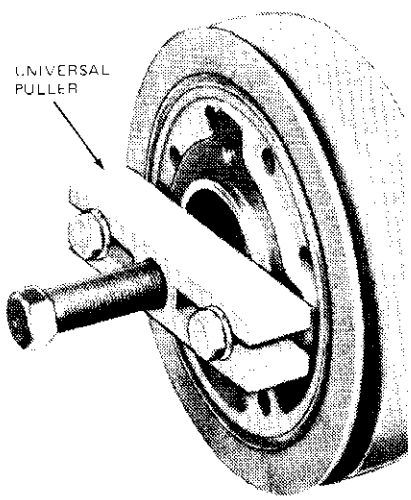


FIG. 19 Removing Crankshaft Vibration Damper

4. Remove the timing pointer.
5. Remove the bolts attaching the front cover plate and water pump to the cylinder block. Remove the front cover plate and water pump assembly.
6. Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump attaching bolt and nut and lay the pump to one side with the flexible fuel line still attached.
7. Discard the cylinder front cover plate gasket and oil pan seal.
8. Check the timing chain deflection (refer to Part 21-01).
9. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 20.
10. Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 21).

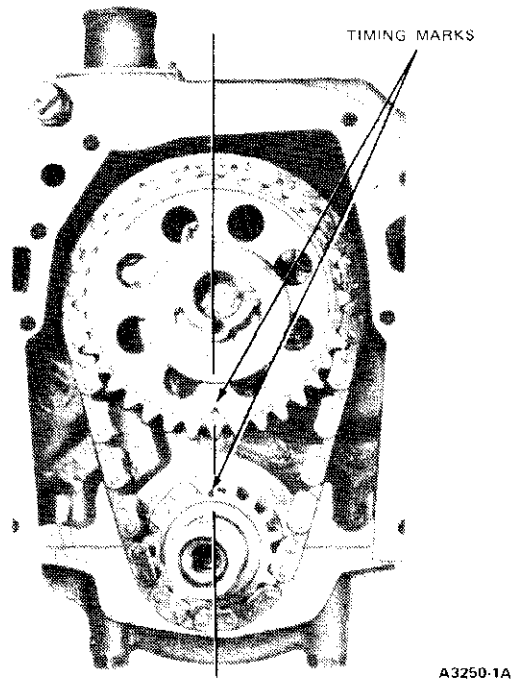


FIG. 20 Aligning Timing Marks

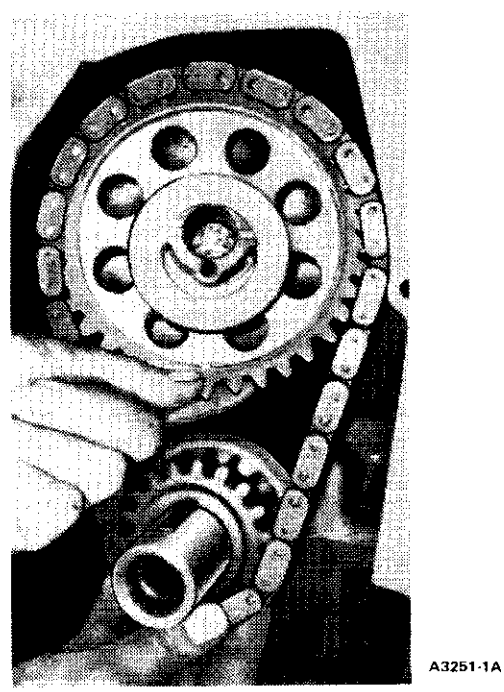


FIG. 21 Removing or Installing Timing Chain

Installation

1. Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 22). Be sure the timing marks on the sprockets are positioned as shown in Fig. 20.

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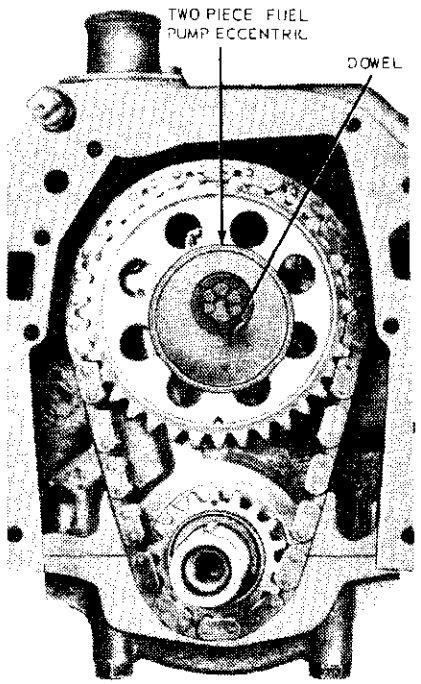


FIG. 22 Fuel Pump Eccentric Installed

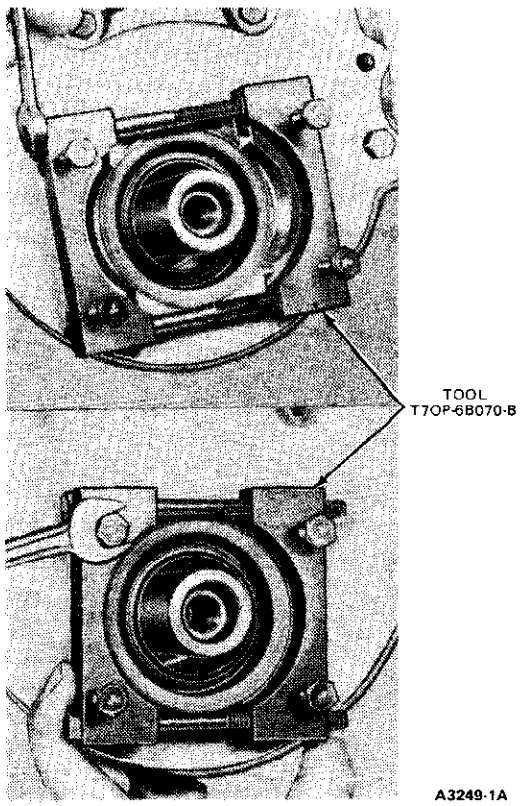


FIG. 23 Removing Crankshaft Front Seal

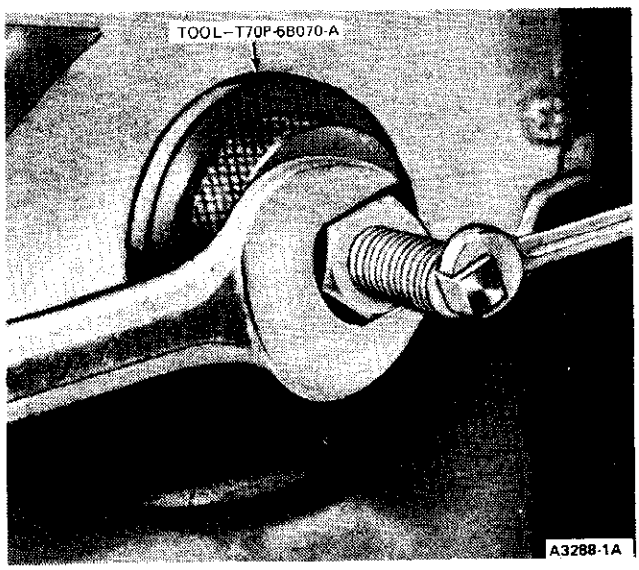


FIG. 24 Installing Front Crankshaft Seal

2. Install the two-piece fuel pump eccentric, washers and camshaft sprocket cap screw (Fig. 22). Torque the sprocket cap screw to specification. **Be sure the outer eccentric sleeve rotates freely.**
3. Coat a new fuel pump gasket with oil-resistant sealer and position the fuel pump and gasket on the cylinder block with pump arm resting on the eccentric outer sleeve. Install the pump attaching bolt and nut and tighten to specification. Connect the fuel pump outlet line.
4. Remove the front crankshaft seal from the cylinder front cover plate with the tool shown in Fig. 23. Clean the cylinder front cover plate and the engine block gasket surfaces.
5. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the cylinder block alignment dowels.
6. Position the cylinder front cover plate and water pump assembly on the cylinder block alignment dowels.
7. Coat the threads of the attaching bolts with oil-resistant sealer and install the timing pointer and attaching bolts. Torque the bolts to specification.
8. Install the front crankshaft seal into the cylinder front cover plate with the tool shown in Fig. 24.
9. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
10. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft using Tool T52L-6306-AEE (or 6306-AJ) (Fig. 25). Install the cap screw and washer. Tighten the cap screw to specification. Install the crankshaft pulley.
11. Connect the heater hose and the radiator lower hose at the water pump.
12. Refer to Water Pump Installation and complete Steps 3 thru 11 to install the necessary parts, fill and bleed the cooling system, etc.
13. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation.

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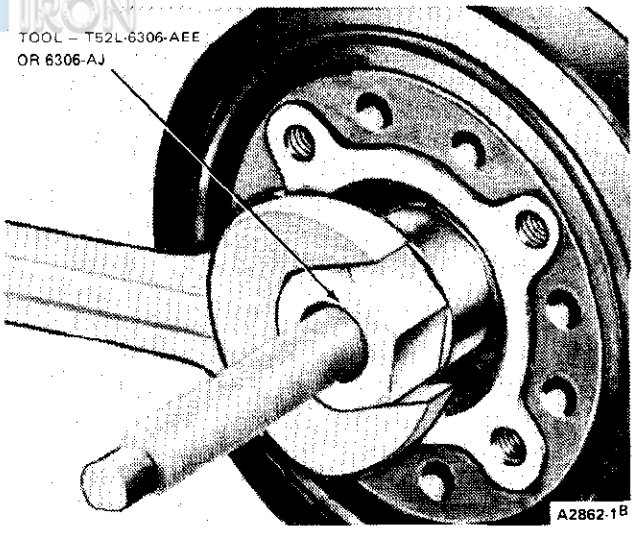


FIG. 25 Installing Crankshaft Vibration Damper

14. Lower the vehicle.
15. Fill the crankcase with the proper grade and quantity of engine oil. Fill and bleed the cooling system.
16. Connect the battery. Operate the engine until normal operating temperature has been reached and check for leaks.

FRONT OIL SEAL

Removal

1. Remove the bolts attaching the fan shroud to the radiator.
2. Remove the fan and spacer bolts from the water pump shaft. Remove the fan, spacer and shroud.
3. Loosen the alternator, power steering, Thermactor and air conditioner drive belts, if so equipped. Remove the drive belts.
4. Remove the crankshaft pulley from the vibration damper. Remove the damper attaching screw and washer. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the vibration damper.
5. Place the front seal removing tool onto the front cover plate over the front seal as shown in Fig. 23. Tighten the two through bolts to force the seal puller under the seal flange.
6. Alternately tighten the four puller bolts a half turn at a time as shown in Fig. 23 to pull the oil seal from the front cover.

Installation

1. Coat a new front cover plate oil seal with Lubriplate or equivalent and place it onto the front oil seal alignment and installation sleeve as shown in Fig. 24. Place the sleeve and seal onto the end of the crankshaft and push it toward the engine until the seal starts into the front cover.
2. Place the installation screw, washer and nut onto the end of the crankshaft. Thread the screw into the crankshaft. Tighten the nut against the washer and installation sleeve to force the seal into the front cover plate. Remove the installation tool from the crankshaft.
3. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
4. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft (Fig. 25). Install the cap screw and washer. Torque the screw to specification. Install the crankshaft pulley.
5. Install the alternator, power steering pump, Thermactor and air conditioner belts, if so equipped.
6. Position the fan shroud over the water pump pulley. Install the fan and spacer. Install the fan shroud attaching screws.
7. Adjust the drive belts to specification.

CAMSHAFT

The camshaft and related parts are shown in Fig. 26.

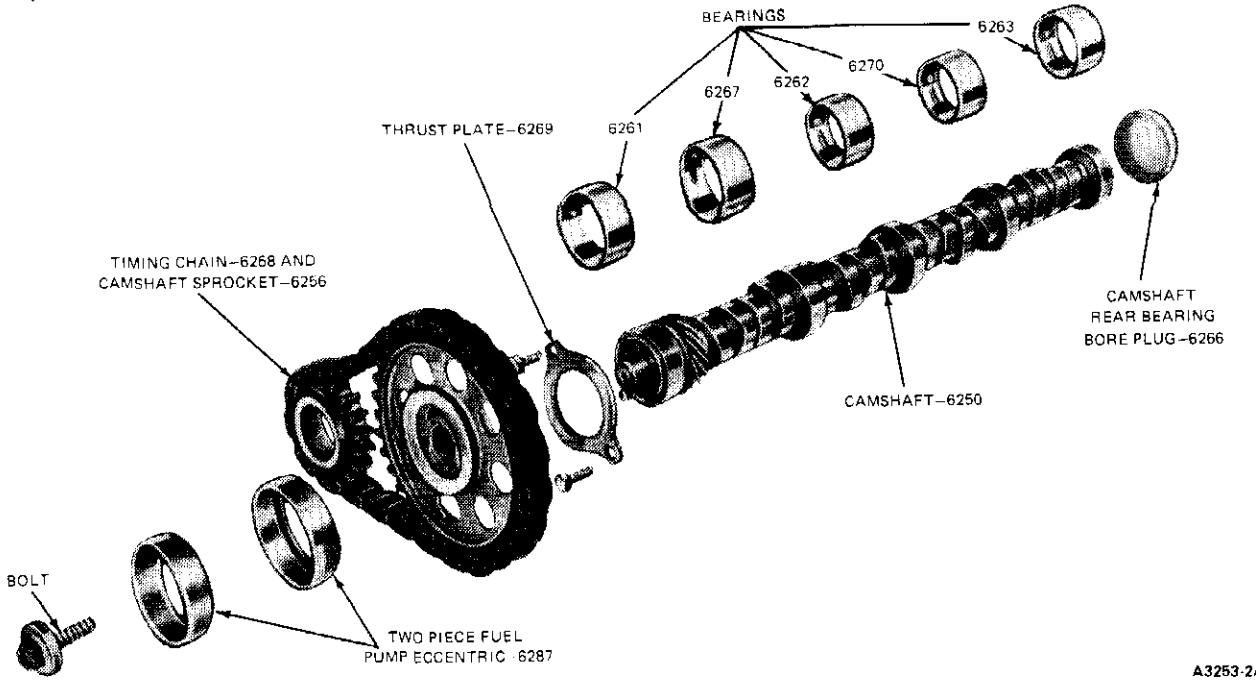


FIG. 26 Camshaft and Related Parts

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Removal

1. Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator. Disconnect the oil cooler lines at the radiator. If equipped with air conditioning, remove the condenser.
2. Remove the cylinder front cover plate, fuel pump and the timing chain following the procedure under the Cylinder Front Cover Plate and Timing Chain Removal.
3. Remove the intake manifold following the procedure under Intake Manifold Removal.
4. Remove the valve rocker arm covers. Loosen the valve rocker arm fulcrum bolts and rotate the rocker arms to the side.
5. Remove the valve push rods and identify them so that they can be installed in their original positions.
6. Using the tool shown in Fig. 16, remove the tappets and place them in a rack so that they can be installed in their original bores.

   Rotate the tappet back and forth to loosen it from the gum or varnish that may have formed.
7. Be sure the Number 1 piston is in the TDC position and the distributor motor points at number one. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

Installation

1. **Oil the camshaft journals and apply Lubriplate or equivalent to the lobes.** Carefully slide the camshaft through the bearings. Install the camshaft thrust plate onto the cylinder block. Install the timing sprockets and timing chain. Check camshaft end play as shown in Part 21-01.
2. Install the tappets in the bores from which they were removed.
3. Install fuel pump, cylinder front cover plate and related parts following steps 1 thru 13 under Cylinder Front Cover Plate and Timing Chain Installation.
4. Adjust the drive belts to specification.
5. Install the push rods in their original positions.
6. Install the rocker arms following the procedure given in Rocker Arm Installation.
7. Install the rocker arm covers following the procedure given in Rocker Arm Cover Installation.
8. Install the intake manifold, distributor and related parts by following procedures under Intake Manifold Installation.
9. Connect the accelerator cable and retracting spring. Connect the transmission downshift rod if so equipped. Install the vacuum lines that were disconnected from the intake manifold during removal.
10. Clean and install the crankcase ventilation system.
11. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the plugs. Connect the high tension lead at the coil.
12. If equipped with air conditioning, install the condensor.
13. Place the radiator shroud over the fan. Install the radiator and connect the hoses. Connect the transmission oil cooler lines at the radiator. On vehicles so equipped, install the radiator shroud attaching bolts.
14. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation.

    Lower the vehicle. Install the fan shroud attaching bolts.
15. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
16. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum lines.
17. Operate the engine at fast idle and check all hose connections and gaskets for leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture.
18. Install the air cleaner and intake duct assembly.

FLYWHEEL

Removal

1. Remove the transmission and converter housing following the procedure in Group 17.
2. To check ring gear for lateral run-out, refer to Part 21-01.
3. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and torque the bolts in sequence (across from each other) to specification.
2. Check the flywheel lateral runout, following the procedure in Part 21-01, and install the transmission and converter housing following the procedure in Group 17.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission and converter housing following the procedure in Group 17.
2. Remove the flywheel attaching bolts and remove the flywheel. Remove the engine rear cover plate.
3. Remove the bore plug as detailed in Part 21-01 under Core Plugs.

Installation

1. Using Tool T70P-6011-A, install the bore plug as outlined in Part 21-01.
2. Coat the flywheel attaching bolts with oil-resistant sealer. Position the engine rear cover plate on the cylinder block dowels. Position the flywheel on the crankshaft flange. Install and torque the attaching bolts in sequence (across from each other) to specification.

   Install the transmission and converter housing following the procedure in Group 17.

OIL PAN

Removal

1. Disconnect the battery cable. Remove the oil level dipstick.

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2. Remove the fan shroud attaching bolts and position the fan shroud and air inlet tube over the fan.
3. Raise the vehicle.
4. Drain the crankcase.
5. Remove the sway bar attaching bolts from the chassis and lower the sway bar for clearance (except Ford and Mercury).
6. Remove the engine front support through bolts.
7. Raise the engine and place wood blocks between the engine supports and chassis brackets.
8. Remove the oil pan attaching bolts.
9. Position the transmission fluid cooler lines out of the way.
10. Lower the oil pan. Loosen the oil pump and inlet tube and let the assembly drop into the pan. Position the rear crankshaft throw horizontally to permit oil pan removal.
11. Remove the oil pan.

Installation

1. Clean the gasket surfaces of the block and oil pan. The oil pan has a two-piece gasket.
2. Clean the oil pump pick-up tube and screen.
3. Coat the block surface and the oil pan gasket with contact cement (B9AE-19B508-A or equivalent). Position the oil pan gaskets on the cylinder block (Fig. 27).

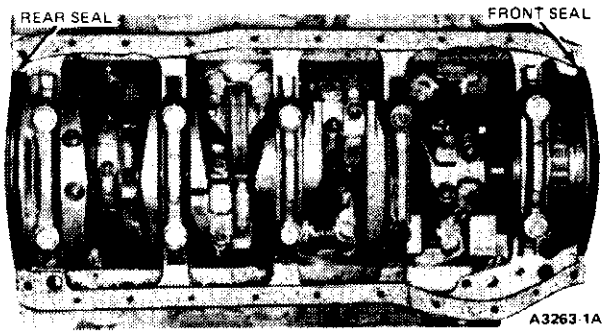


FIG. 27 Oil Pan Gasket and Seals Installed—Typical

4. Position the oil pan front seal on the cylinder front cover plate. Be sure the tabs on the seal are over the oil pan gasket.
5. Position the oil pan rear seal on the rear main bearing cap (Fig. 27). Be sure the tabs on the seal are over the oil pan gasket.
6. Place the oil pump and intake tube in position in the oil pan and position the oil pan under the engine. Install the oil pump and intake tube and torque the attaching bolts to specification. Position the oil pan against the block and install a bolt, finger tight, on each side of the block. Install the remaining bolts. Tighten the bolts from the center outward in each direction to specification.
7. Raise the engine and remove the wood blocks from between the engine supports and chassis brackets. Lower the engine and install the engine support through bolts. Tighten the bolts to specification.
8. Install the sway bar to chassis attaching bolts (except Ford and Mercury).
9. Install the starter and connect the starter cable.
10. Lower the vehicle.
11. Install the fan shroud and air inlet tube attaching bolts.
12. Install the oil level dipstick. Fill the crankcase with the proper grade and quantity of engine oil. Start the engine and operate at idle speed until it reaches normal operating temperature. Check for oil leaks.

OIL PUMP

Removal

1. Remove the oil pan and related parts as outlined under Oil Pan Removal.
2. Remove the oil pump attaching bolts and remove the oil pump with pick up tube and screen, gasket and intermediate drive shaft.

Installation

1. Clean and install the oil pump inlet tube and screen assembly (Fig. 28).

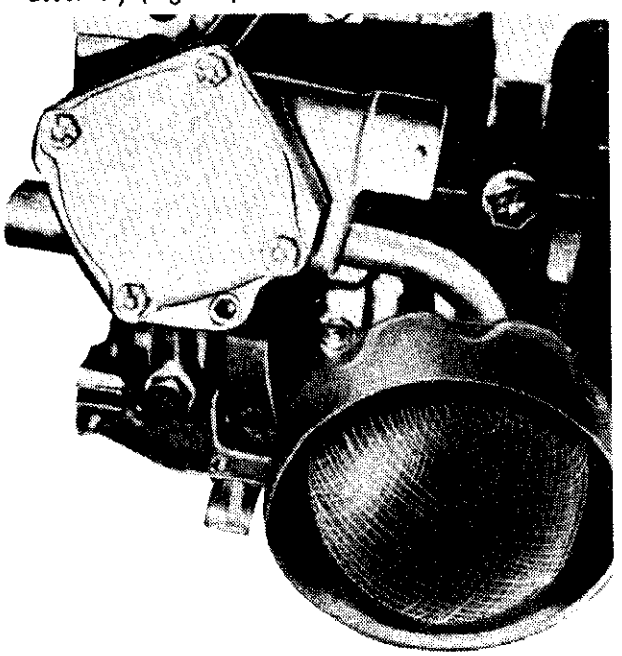


FIG. 28 Oil Pump and Inlet Tube Installed

2. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
3. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
4. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly.

   Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.

   Tighten the oil pump attaching screws to specification. Be sure the oil pick up screen is parallel with the oil pan mounting surface.
5. Install the oil pan and related parts as outlined under Oil Pan Installation.

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CRANKSHAFT REAR OIL SEAL

A split-up type crankshaft rear oil seal is used for replacement on all engines. If replacement is necessary, this type of seal must be used. The complete seal can be replaced without removing the crankshaft. Refer to Part 21-01 for removal and installation procedures.

MAIN BEARING INSERTS

Main bearing inserts are selective fits. Do not file or lap bearing caps or use bearing shims to obtain proper clearance.

Selective fit bearings are available for service in standard size, 0.001 and 0.002 inch undersize. Undersize bearings (0.010, 0.020, 0.030 and 0.040 inch) which are not selective fit, are available for use on crankshaft journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

   Remove the main bearing cap to which new bearing inserts are to be installed.
4. Insert the upper bearing removal tool (Tool 6331) in the oil hole in the crankshaft.
5. Rotate the crankshaft in the direction of the engine rotation to force the bearing insert out of the block.
6. If the rear main bearing is being replaced, remove and discard the rear oil seal from the bearing cap.

   Loosen all main bearing bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch. Remove the block half of the rear oil seal. Use a seal removal tool or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Be careful not to burr the crankshaft seal rubbing surface.**

Installation

1. If the rear main bearing is being replaced, clean the rear oil seal groove in the block with a brush and solvent.

   Carefully install the upper seal (split lip type) into its groove with the undercut side of the seal toward the FRONT of the engine by rotating it on the seal journal of the crankshaft until approximately 3/8 inch protrudes below the parting surface. **Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove. Tighten the bolts on main bearings 1, 2, 3 and 4, thereby raising the crankshaft to its original position. Torque the bolts to specification.**
2. Clean the crankshaft journals. Inspect the journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear.
3. To install the upper main bearing insert, place the plain end of the bearing insert over the shaft on the locking tang side of the block and partially install the bearing insert so that Tool 6331 can be inserted in the oil hole in the crankshaft. With Tool 6331 positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing insert seats itself. Remove the tool.
4. Replace the cap bearing.
5. Select fit the bearing for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. If the bearing insert is being replaced on journal number 1, 2 or 4, apply a light coat of engine oil to the journal and bearing inserts and install the bearing cap. Tighten the cap bolts to specification.
7. If the rear main bearing is being replaced, clean the oil seal groove with a brush and solvent.
8. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
9. Refer to Part 21-01 for special instructions in applying sealer to the rear main bearing cap. Lubricate the journal with engine oil and install the rear main bearing cap. Tighten the cap bolts to specification.
10. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

    Lubricate the journal with engine oil and install the thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. (See Fig. 34.) Hold the crankshaft cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Torque the cap bolts to specification.
11. Clean the oil pump inlet tube screen. Prime the pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
12. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
13. Fill the crankcase with proper grade of oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARING INSERTS

The connecting rod bearings are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase oil. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

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OFFICIAL LICENSED PRODUCT DETROIT IRON

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Torque to specification.
7. Clean the oil pump inlet tube screen. Prime by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
8. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover plate. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
9. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this section.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows:

   Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**
3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze using a spring type cylinder hone only if there is no visible sign of cross hatch markings on cylinder walls. Follow the instructions of the tool manufacturer. After deglazing or honing cylinder walls, clean bore with a detergent and water solution.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure the ring gaps are properly spaced around the circumference of the piston (Fig. 29).

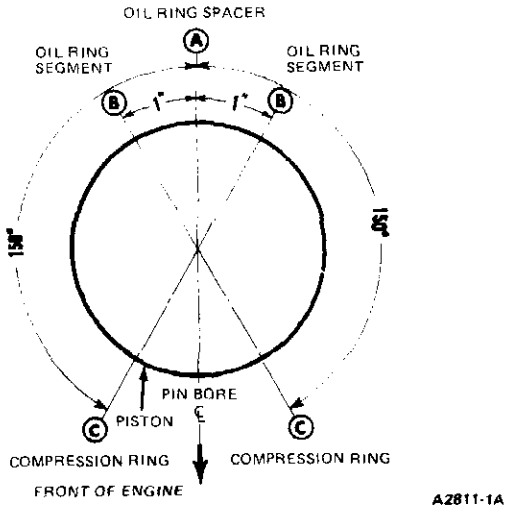


FIG. 29 Piston Ring Spacing

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 30). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the arrow on the piston head toward the front of the engine (Fig. 31).**
5. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap and bearing. Torque the nuts to specification.

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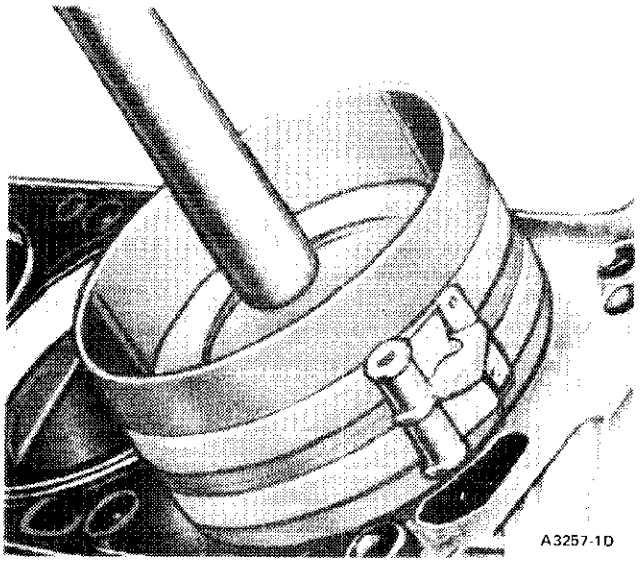


FIG. 30 Installing Piston

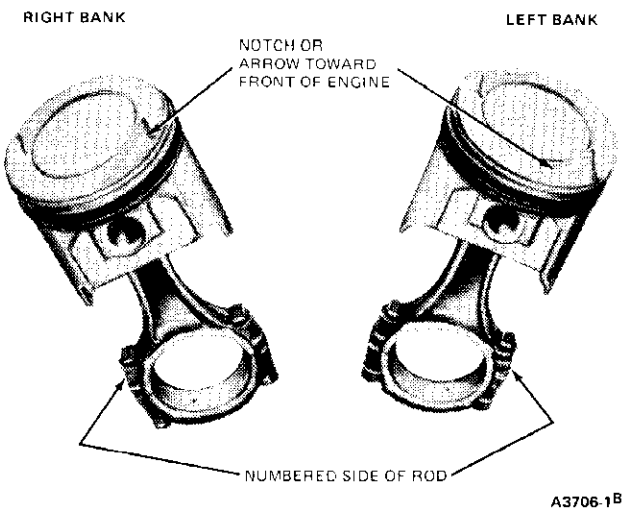


FIG. 31 Correct Piston and Rod Positions

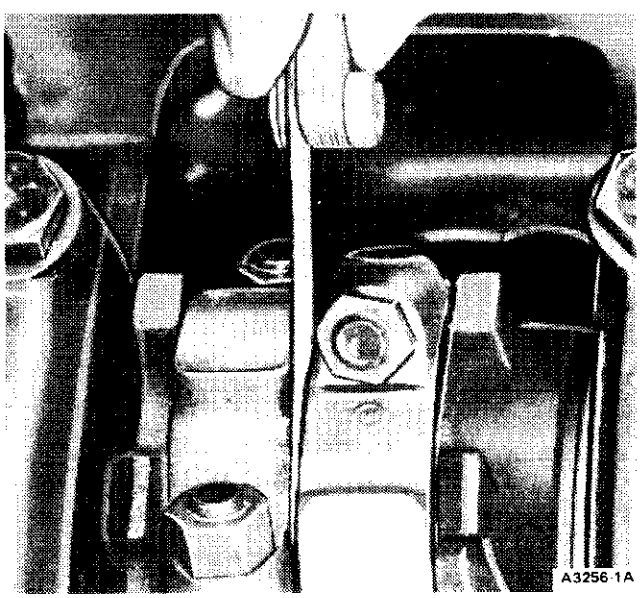


FIG. 32 Checking Connecting Rod Side Clearance

9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Fig. 32).
10. Disassemble, clean and assemble the oil pump (see Part 21-01). Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling either the inlet port or outlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump and the oil pan.
12. Install the cylinder heads following procedures under Cylinder Head Installation.
13. Install the intake manifold following procedures under Intake Manifold Installation.
14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses at the distributor.
16. Operate the engine at fast idle until it reaches normal operating temperature and check for oil and coolant leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture.
17. Install the air cleaner and inlet tube assembly.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 33.

Removal

1. With engine removed from vehicle and placed on a work stand, disconnect the spark plug wires at the spark plugs and remove the wires from the ignition harness brackets on the valve rocker arm covers. Disconnect the coil-to-distributor cap and spark plug wires. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Disconnect the fuel pump outlet line at the pump. Remove the fuel pump from the cylinder block. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 19) and remove the damper.
4. Remove the timing pointer. Remove the water pump and cylinder front cover plate as an assembly. Discard the gasket.
5. Check the timing chain deflection (Refer to Part 21-01). Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward and remove them as an assembly (Fig. 21).
6. Invert the engine on the work stand. Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.

Turn the crankshaft until the connecting rod from which the cap is being removed is down, and

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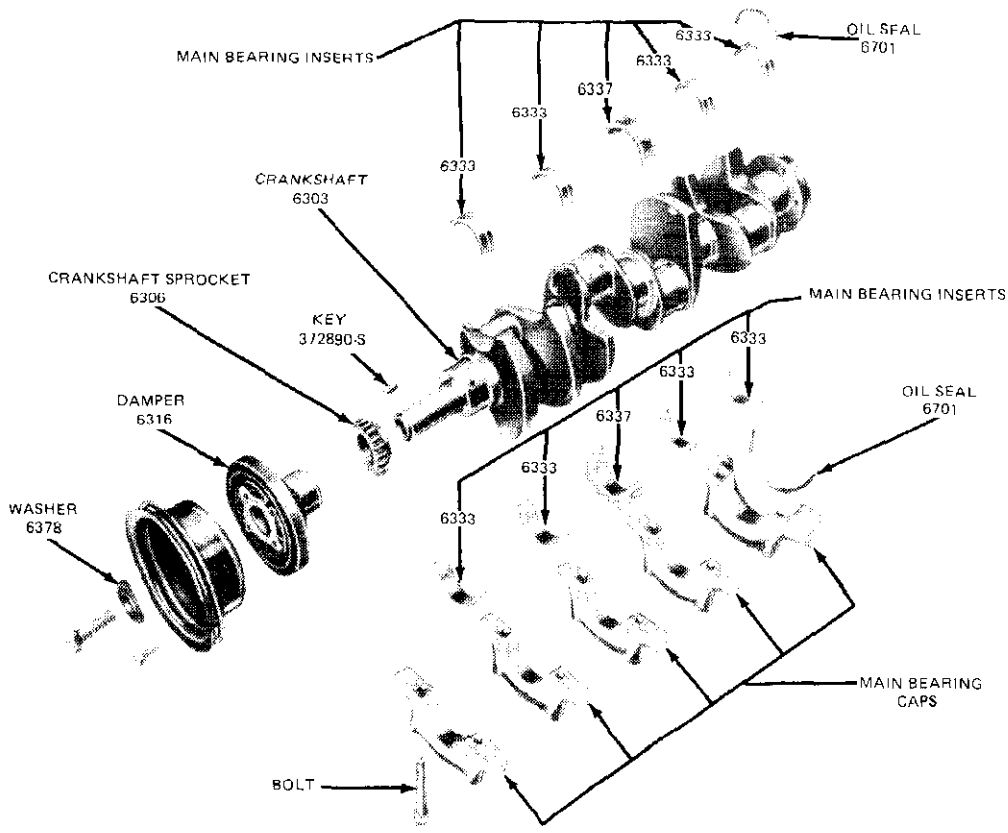


FIG. 33 Crankshaft and Related Parts

remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.

8. Remove the main bearing caps.
9. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. ***Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.*** To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. *Remove the rear journal oil seal from the block and* rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. *Clean the rear journal oil seal groove and the* mating surfaces of the block and rear main bearing cap.
4. Remove the connecting rod bearing inserts from the connecting rods and caps.
5. *If the crankshaft main bearing journals have been* refinished to a definite undersize, install the correct undersize bearings. If not, it will be necessary to select-fit new gearing inserts using the Plastigage Method. (See Part 21-01). Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
6. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.
7. Install the lower main bearing inserts in the bearing caps.
8. Dip the lip seal halves in clean engine oil. Install the lip seals in the bearing cap and block with the undercut side of the seal toward the FRONT of the engine.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surface.**
10. If main bearings were not refinished to a standard undersize, check the clearance of each main bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply sealer to the rear main bearing cap, following the instructions given in Part 21-01 for use of silicone rubber sealer in this area.
12. Apply heavy engine oil SE to the journals and bearings.
13. Install the rear main bearing cap with the rear surface flush or slightly ahead of the rear of the cylinder block. Install all bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.**

    Torque the bearing cap bolts to specification.
14. Install the thrust bearing cap with the bolts finger tight.
15. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 34).
16. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
17. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specification.
18. Force the crankshaft toward the rear of the engine.

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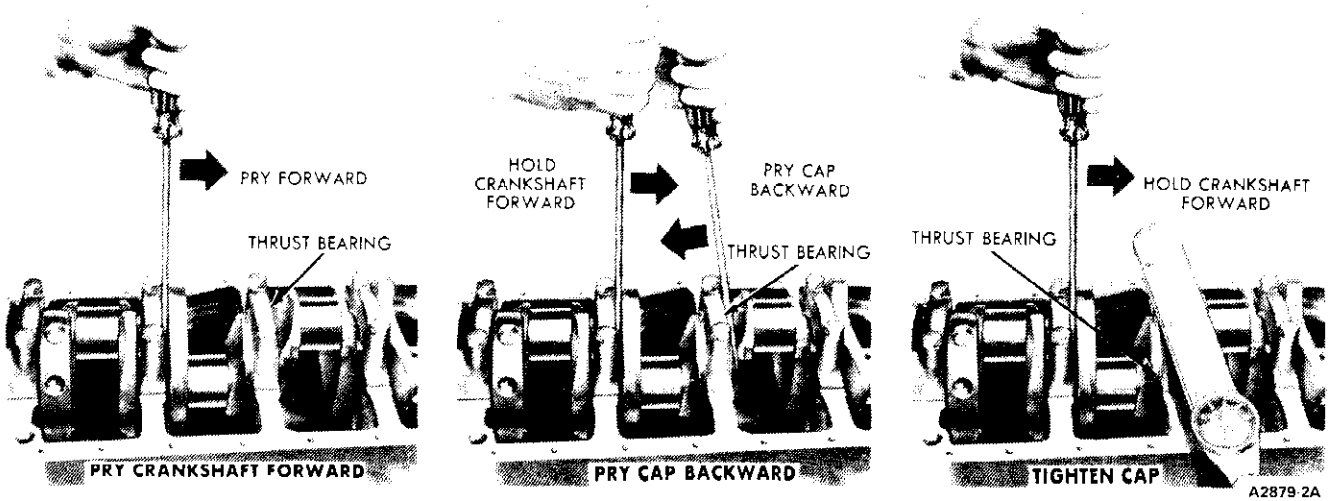


FIG. 34 Aligning Thrust Bearing

19. Check the crankshaft end play (Refer to Part 21-01).
20. Install the timing chain and sprockets, cylinder front cover plate and fuel pump, following steps 1 thru 8 under Cylinder Front Cover Plate and Timing Chain Installation.
21. Install the engine rear cover plate onto the alignment dowels at the rear of the cylinder block.
22. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and tighten the bolts to specification.
23. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
24. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
25. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
26. Install the connecting rod cap. Torque the nuts to specification.
27. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 32).
28. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump and oil pan by following the procedures under Oil Pan and Oil Pump Installation.
29. Install the front oil seal, vibration damper and crankshaft pulley, following Steps 10 thru 12 under Cylinder Front Cover Plate and Timing Chain Installation.
30. Install the spark plugs, distributor cap and spark plug wires. Refer to Part 23-01 for special installation instructions. Connect the spark plug wires and high tension lead.
31. Install the engine in the vehicle.

CAMSHAFT BEARING

Camshaft bearings are available prefinished to size for standard and 0.015 inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

Removal

1. Remove the engine from the vehicle. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures in this part. Push the pistons to the top of the cylinders.
2. Remove the camshaft rear bearing bore plug. (See Core Plugs in Part 21-01.) Remove the camshaft bearings (Fig. 35).

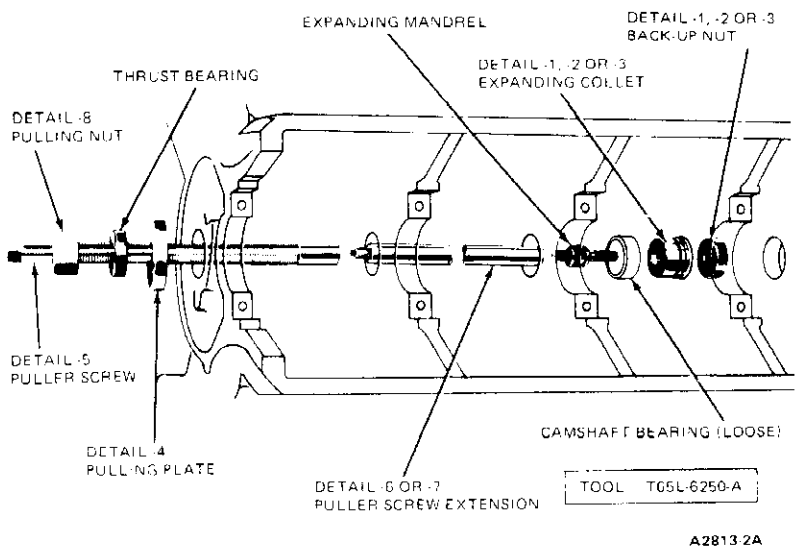


FIG. 35 Camshaft Bearing Replacement

3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the

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collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.

4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. *Wrap a cloth around the threads of the* puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores with the oil holes aligned, and press them in place with the tool shown in Fig. 35. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage. Be sure the front bearing is installed the specified distance below the front face of the cylinder block (Fig. 36).**
2. Install the core plug as detailed in Part 21-01.
3. *Install the camshaft, crankshaft, flywheel and* related parts, following the appropriate procedures in this section except do not check connecting and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

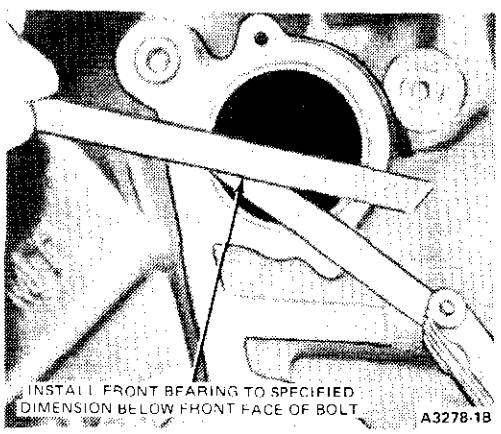


FIG. 36 Camshaft Front Bearing Measurement

OIL FILTER

The oil filter assembly is shown in Fig. 38.

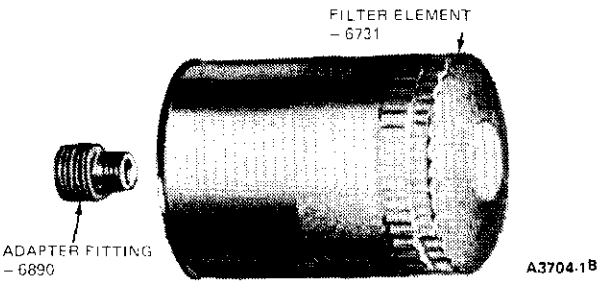


FIG. 37 Oil Filter Installation

Removal

Place a drip pan under the filter. Unscrew the filter from the adapter fitting using a filter wrench and clean *the adapter recess.*

Installation

1. Coat the gasket on a new filter with oil. Place the new filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the sealing surface, and then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct leakage. Check the oil level and fill the crankcase if necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to torque specification), oil the threads with light *weight engine oil.* ***Do not oil threads that require*** **oil-resistant or water-resistant sealer.** Refer to Part 21-01, for cleaning and inspection procedures.

CYLINDER HEAD

Disassembly

1. Remove the exhaust manifolds, the spark plugs and spark plug wire shields.
2. Clean the carbon out of the cylinder head combustion chambers before removing the valves.
3. Compress the valve springs (Fig. 38). Remove the spring retainer locks and release the spring.
4. Remove the spring retainer, spring and stem seal. Discard the valve stem seals. **Remove any burrs from the valve stem with tool T70P-6505-A as shown in Fig. 39 to prevent damage to the valve guide bore. Remove the valve. Identify *all valve parts.***

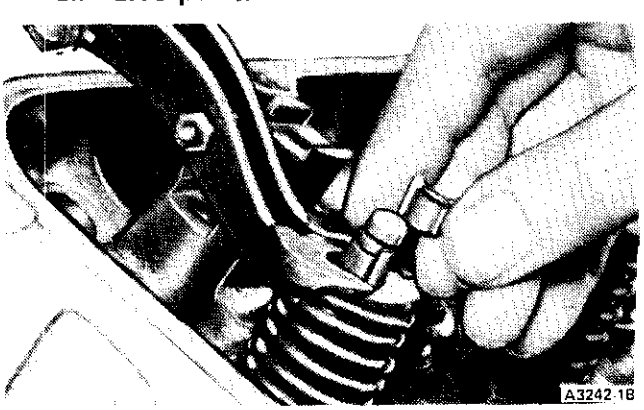


FIG. 38 Compressing Valve Spring

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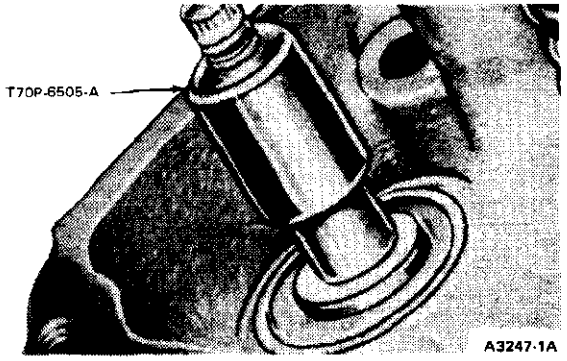


FIG. 39 Removing Valve Stem Burrs

5. Clean, inspect and repair the cylinder head as required, or transfer all usable parts to a new cylinder head.

Assembly

All valves, valve stems and valve guides are to be lubricated with heavy engine oil SE. The valve tips are to have Lubriplate or equivalent applied. The lubricant is to be applied before installation.

1. Clean the spring retainer lock grooves on the valves to remove any loose material left by the valve stem deburring tool.
2. Lubricate the valve guide and valve stem with heavy engine oil SE.
3. Install each valve (Fig. 40) in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve. Use a 5/8-inch deep wall socket and a light hammer or mallet to seat the seal on the valve system.

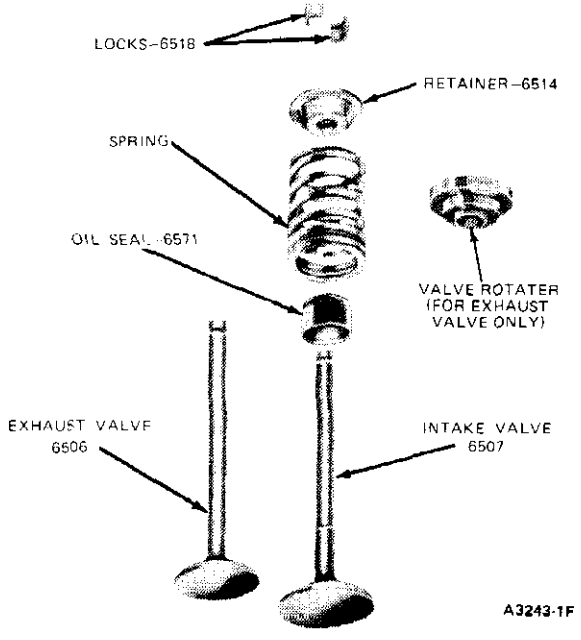


FIG. 40 Valve and Related Parts

4. Install the valve spring over the valve, and then install the spring retainer. Compress the spring and install the retainer locks (Fig. 40).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 41). Check the dividers against a scale. If the assembled height is greater than specification, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height. **Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and over-loading the camshaft lobes which could lead to spring breakage and/or worn camshaft lobes.**

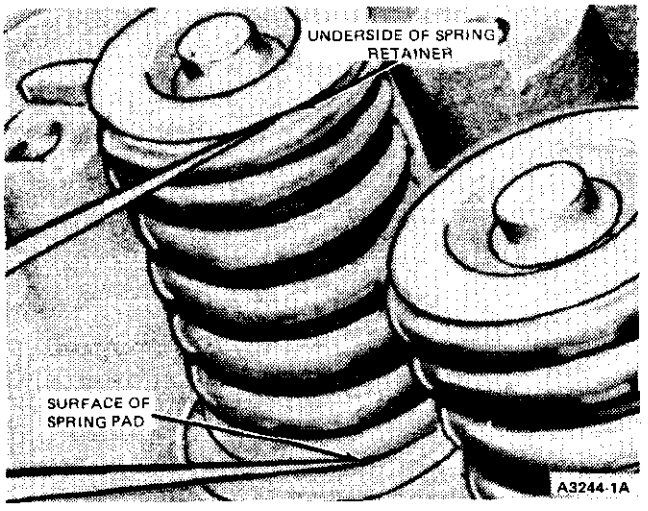


FIG. 41 Valve Spring Assembled Height

6. Install the exhaust manifolds and the spark plugs.

HYDRAULIC TAPPET

The internal parts of each hydraulic tappet assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.

Tappets should always be tested after assembly; refer to the procedures covered in Part 21-01 for cleaning, inspection and testing.

Disassembly

Disassemble and assemble each tappet separately. Identify the tappet assemblies so they can be installed in their original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly, the check valve and the check valve retainer and plunger spring. Carefully remove the plunger spring, the check valve retainer and, the check valve disc from the plunger.

Assembly

Hydraulic tappet assembly is shown in Fig. 42.

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).

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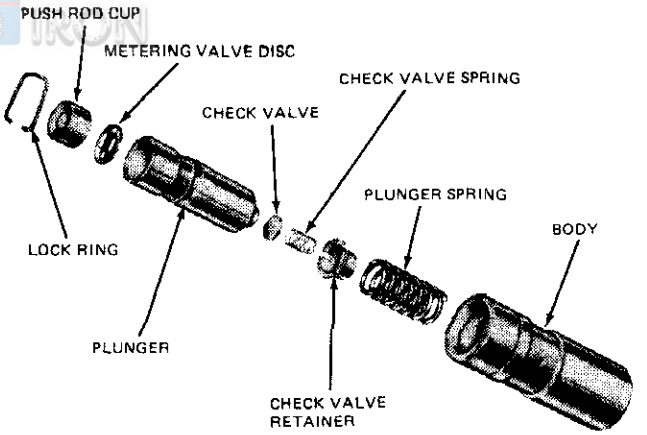


FIG. 42 Hydraulic Tappet Assembly

3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring, and then the plunger (open end up) into the tappet body.
5. Position the metering valve (disc) in the plunger, and then place the push rod cup in the plunger.
6. Depress the plunger, and position the closed end of the lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use the hydraulic tappet leakdown tester (Part 21-01) to fill the tappets with test fluid.

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Remove the piston rings. Using an arbor press and the tool shown in Fig. 43, press the piston pin from the piston and connecting rod.

Assembly

The piston connecting rod and related parts are shown in Fig. 44. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specification.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and the arrow on the piston positioned as shown in Fig. 31. On replacement connecting rods, install the large-chamfered side of the connecting rod bearing bore towards the crankshaft cheek; facing towards front of engine on right bank rods, and facing towards rear of engine on left bank rods.
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press and the tool shown in Fig. 45, press the piston pin through the piston and connecting rod until the pin is centered in the piston.

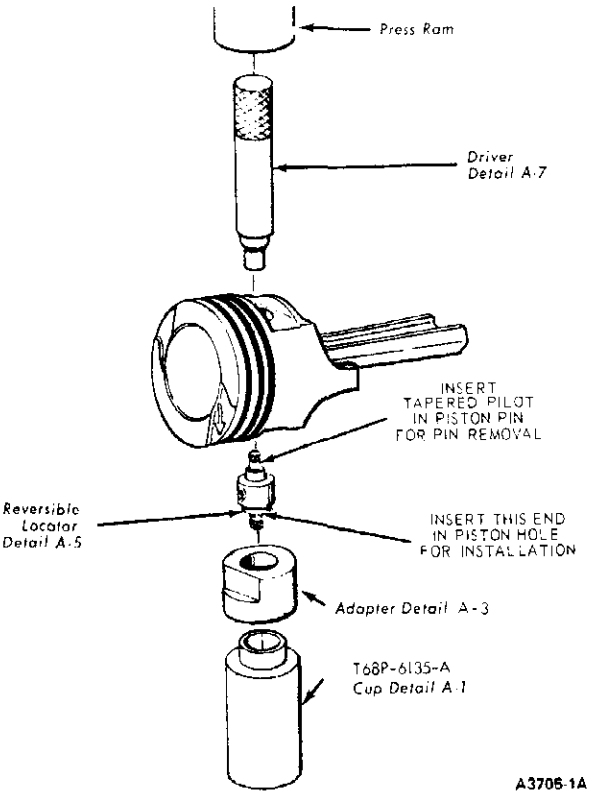


FIG. 43 Removing or Installing Piston Pin

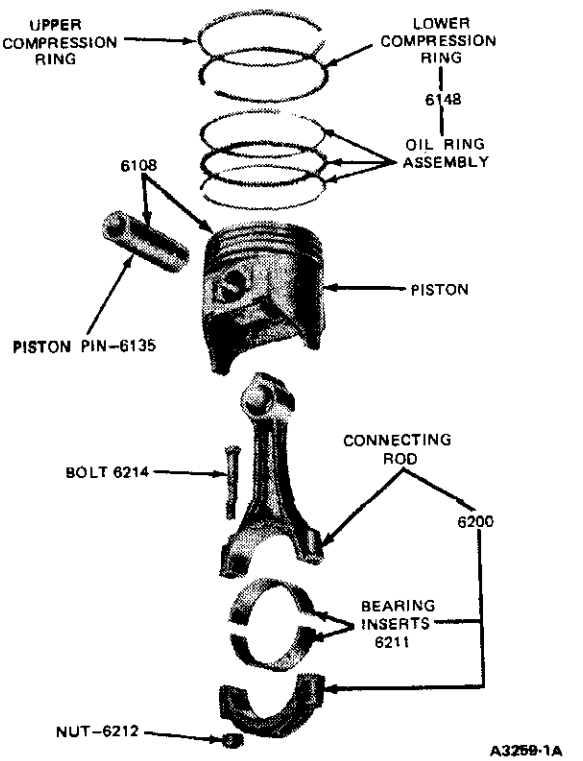


FIG. 44 Piston, Connecting Rod and Related Parts

3. Check the end gap of all piston rings (Part 21-01). It must be within specification. Follow the instructions contained on the piston ring package and install the piston rings.

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4. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
5. Be sure the bearing inserts, the bearing bore and the mating surfaces on the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY (6009)

Disassembly

1. Remove the intake manifold, cylinder heads, front cover (with water pump attached), thermostat and housing, oil pressure and temperature sending units, fuel pump, flywheel, oil pan, oil pump and associated attaching parts from the old engine, using the procedures given in the Removal and Installation section of this Part.
2. Remove the dipstick tube, oil filter adapter and fuel pump retaining stud from the old block. Remove fasteners and components not received with the replacement cylinder block.

Assembly

1. Clean the gasket and seal surfaces of all parts and assemblies.
2. Position the replacement cylinder assembly in a work stand. Install the cylinder block drain plugs, cylinder head locating dowels, front and rear cover plate locating dowels, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Transfer all serviceable parts removed from the old cylinder assembly, following the installation procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK (6010)

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Disassemble the engine completely, following the various procedures given in the Removal and Installation section of this Part. Remember to remove any ridge or carbon deposit from the upper end of the cylinder bores before removing pistons.
2. Remove the temperature and oil pressure sending units from the old block, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Remove the old cylinder block from the work stand.

Assembly

1. Install the replacement cylinder block on the work stand. Install the temperature and oil pressure sending units, dipstick tube, oil filter adapter and fuel pump retaining stud. Remove fasteners and components not received with the replacement cylinder block.
2. Clean all the gasket and seal surfaces of all parts and assemblies before installing on the replacement cylinder block.
3. Transfer all serviceable parts removed from the old cylinder block to the replacement unit, using the procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances and correct as necessary.

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DETROIT IRON

SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	5.8L/6.6L (351M/400 CID)
NUMBER OF CYLINDERS	8
BORE AND STROKE	4.00 x 3.50 5.8L (351 CID) 4.00 x 4.00 6.6L (400 CID)
FIRING ORDER	1-3-7-2-6-5-4-8
OIL PRESSURE (Hot @ 2000 RPM)	50-75
DRIVE BELT TENSION	(1)

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	76.9-79.9
VALVE GUIDE BORE DIAMETER	0.3433-0.3443
VALVE SEATS	
Width - Intake	0.060-0.080
Width - Exhaust	*0.060-0.080*
Angle	45°
Runout Limit (T. I. R. Max.)	0.002
VALVE ARRANGEMENT (Front to Rear)	(LH) E-I-E-I-E-I-E-I (RH) I-E-I-E-I-E-I-E
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.0010-0.0027
Exhaust	0.0015-0.0032
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	2.032-2.050
Exhaust	5.8L (351M CID) 1.6635-1.6455 6.6L (400 CID) 1.6495-1.6595
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER(Std)	
Intake	0.3416-0.3423
Exhaust	0.3411-0.3418
(0.003 Oversize)	
Intake	0.3446-0.3453
Exhaust	0.3441-0.3448
(0.015 Oversize)	
Intake	0.3566-0.3575
Exhaust	0.3561-0.3568
(0.030 Oversize)	
Intake	0.3716-0.3723
Exhaust	0.3711-0.3718
VALVE SPRINGS (INTAKE)	
Compression Pressure (Lb. @ Spec. Length)	76-84 @ 1.82 215-237 @ 1.39
Free Length (Approximate)	2.06
Assembled Height	1-13/16-1-27/32
Service Limit	(2)
Out-Of-Square Limit	5/64 (0.078)
VALVE SPRINGS (EXHAUST)	
Compression Pressure (Lb. @ Specified Length)	79-87 @ 1.68 215-237 @ 1.39
Free Length (Approximate)	1.93
Assembled Height	1-13/16-1-27/32
Service Limit	(2)
Out-Of-Square Limit	5/64 (0.078)
ROCKER ARM	
Ratio	1.64:1
PUSH ROD RUNOUT (T. I. R. Max.)	0.015
VALVE TAPPET	
Diameter (Std)	0.8740-0.8745
Clearance To Bore	0.0007-0.0027
Service Limit	0.005
Hydraulic Leakdown Rate	5-50 Seconds (3)
Collapsed Tappet Gap - Allowable	0.100-0.200
- Desired	0.125-0.175

CAMSHAFT	
LOBE LIFT	
Intake	0.235 5.8L (351 CID) 0.2474 6.6L (400 CID)
Exhaust	0.285 5.8L (351 CID) 0.2500 6.6L (400 CID)
Allowable Lobe Lift Loss	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	0.4065 5.8L (351 CID) 0.4280 6.6L (400 CID)
Exhaust	0.4065 5.8L (351 CID) 0.4325 6.6L (400 CID)
END PLAY	0.001-0.006
Service Limit	0.009
JOURNAL-TO-BEARING CLEARANCE	0.001-0.003
Service Limit	0.006
CAMSHAFT GEAR BACKLASH	0.006-0.010
JOURNAL DIAMETER	
# 1	2.1238-2.1248
# 2	2.0655-2.0665
# 3	2.0505-2.0515
# 4	2.0355-2.0365
# 5	2.0205-2.0215
Runout Limit	0.005
Out-Of-Round Limit	0.0005
CAMSHAFT BEARING INSIDE DIAMETER	
# 1	2.1258-2.1268
# 2	2.0675-2.0685
# 3	2.0525-2.0535
# 4	2.0375-2.0385
# 5	2.0225-2.0235
FRONT BEARING LOCATION (4)	0.005-0.020

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	(5)
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	4.0000-4.0048
Surface Finish (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPPET BORE DIAMETER	0.8752-0.8767
MAIN BEARING BORE DIAMETER	3.1922-3.1930
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.5160-0.5175

(1)

Drive Belt Tension (Lbs.)			
Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(B) If less than 40 pounds, readjust to 40-60 pounds.
(C) If less than 90 pounds, readjust to 90-120 pounds.
(D) If less than 75 pounds, readjust to 90-120 pounds.

(2) 10% pressure loss at specified length.
(3) Time required to leak down 1/16" with 50 lb. load and lifter filled with leakdown fluid.
(4) Distance Front edge of bearing is installed below front face of block.
(5) 0.003 in any 6 inches - 0.006 overall.

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CRANKSHAFT AND FLYWHEEL

MAIN BEARING JOURNAL DIAMETER	2.9994-3.0002
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Journal Runout Limit	0.002 Max.
Surface Finish (RMS)	12 Max.
Runout Service Limit	0.005
THRUST BEARING JOURNAL	
Length	1.137-1.139
CONNECTING ROD JOURNAL	
Diameter	2.3103-2.3111
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish	25 Front/20 Rear
Runout Limit	0.001 Max.
FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)	
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CONNECTING ROD BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0008-0.0025
Bearing Wall Thickness (Std) ⑥	0.0622-0.0625
MAIN BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0008-0.0026
Bearing Wall Thickness (Std.) ⑥	0.0955-0.0960

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD	
Piston Pin Bore Diameter	0.9726-0.9742
Crankshaft Bearing Bore Diameter	2.4361-2.4369
Out-Of-Round Limit	0.0004 Max.
Taper Limit	0.0004 Max.
Length (Center-to-Center)	6.5785-6.5815
Alignment (Bore-to-Bore Max. Diff.) ⑦	
Twist	0.024
Bend	0.024
Side Clearance (Assembled to Crank)	
Standard	0.010-0.020
Service Limit	0.023
PISTON	
Diameter ⑧	
Coded Red	3.9982-3.9988
Coded Blue	3.9994-4.0000
0.003 Oversize	4.0006-4.0012
Coded Yellow	4.0018-4.0024 6.6L (400 CID) Only
Piston-to-Bore Clearance	0.0014-0.0022
Pin Bore Diameter	0.9754-0.9757

CONNECTING ROD, PISTON AND RINGS (Continued)

Ring Groove Width	
Compression (Top)	0.080-0.081
Compression (Bottom)	0.080-0.081
Oil	0.188-0.189
PISTON PIN	
Length	3.150-3.170
Diameter	
Standard	0.9749-0.9754
0.001 Oversize	0.9763-0.9760
0.002 Oversize	0.9770-0.9773
Pin-To-Piston Clearance	0.0003-0.0005
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.002-0.004
Compression (Bottom)	0.002-0.004
Oil Ring	Snug Fit
Service Limit	0.006
Ring Gap	
Compression (Top)	0.010-0.020
Compression (Bottom)	0.010-0.020
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs. at Spec. Length)	20.6-22.6 @ 2.49
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearance	0.015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-To-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U. S.)	4 ⑨

FUEL PUMP

STATIC PRESSURE (P.S.I.) ⑩	6.0-8.0
MINIMUM VOLUME FLOW ⑩ ⑪ ⑫	1 Pint in 20 Seconds
ECCENTRIC TOTAL LIFT (Inches)	0.602-0.622

⑤ For 0.002 Undersize, add .001 to Standard Thickness.
⑦ Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of an 8" bar – 4" on each side of rod centerline.
⑧ Measured at the piston pin bore centerline @ 90° to the pin.
⑨ Add 1 quart with filter change
⑩ On engine, normal temperature, curb idle, transmission in neutral.
⑪ No orifice in test circuit smaller than 0.220" I. D.
⑫ With new filter; pump to tank return line pinched off.

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TORQUE SPECIFICATIONS

CAMSHAFT SPROCKET TO CAMSHAFT	30-45
CAMSHAFT THRUST PLATE TO BLOCK	9-12
CONNECTING ROD NUTS OR BOLTS	40-45
CYLINDER FRONT COVER BOLTS	12-18
CYLINDER HEAD BOLTS	(13)
DAMPER OR PULLEY TO CRANKSHAFT	70-80
DISTRIBUTOR VACUUM CONTROL VALVE	10-15
EGR TO CARBURETOR SPACER OR INT MANIFOLD	12-18
FUEL PUMP TO CYLINDER BLOCK OR FRONT COVER	Nut = 14-20 Bolt = 10-15
FLYWHEEL TO CRANKSHAFT	75-85
MAIN BEARING CAP BOLTS	95-105
MANIFOLD TO CYLINDER HEAD (Intake)	3/8 = 22-32 5/16=19-25
MANIFOLD TO CYLINDERHEAD (Exhaust)	18-24
OIL FILTER INSERT TO CYLINDER BLOCK	20-30
OIL FILTER TO BLOCK OR ADAPTER	(14)
OIL PAN DRAIN PLUG	15-25
OIL PAN TO CYLINDER BLOCK	5/16 = 11-13 1/4 = 7-9
PULLEY TO DAMPER (Bolt)	35-50
ROCKER ARM STUD OR BOLT TO CYLINDER HEAD	18-25
SPARK PLUG TO CYLINDER HEAD	10-15
VALVE ROCKER ARM COVER	3-5
ALTERNATOR BRACKET TO CYLINDER BLOCK (Bolt)	15-20
ALTERNATOR PIVOT BOLT	45-57
ALTERNATOR ADJUSTING ARM TO CYLINDER BLOCK	15-20
ALTERNATOR ADJUSTING ARM TO ALTERNATOR	240
THERMACTOR PUMP BRACKET TO CYLINDER BLOCK	15-20
THERMACTOR PUMP PIVOT BOLT	35-45
THERMACTOR PUMP ADJUSTING ARM TO PUMP	22-32
THERMACTOR PUMP ADJUSTING ARM TO CYLINDER BLOCK	15-20
THERMACTOR PUMP PULLEY TO SHAFT	130-180 In.-Lb.
POWER STEERING PUMP PULLEY TO DAMPER (Bolt)	35-50
FAN TO WATER PUMP HUB (Bolt)	12-18

TORQUE SPECIFICATIONS (Continued)

CARBURETOR MOUNTING NUTS	12-15
CARBURETOR MOUNTING STUD	4-7

TORQUE SPECIFICATIONS General Applications

U. S. THREAD SIZES	TORQUE
1-4-20	6-9
5-16-18	12-15
5-16-24	17-20
3-8-16	22-32
3-8-24	27-35
7-16-14	40-55
7-16-20	40-60
1-2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1-8	5-8
1-4	12-18
3-8	22-33
1-2	25-35

● All values are in ft. lb. unless otherwise noted
● Oil threads with engine oil unless fasteners require sealers.

⑬ Torque in sequence: Step 1 75, Step 2 95-105.
Ⓜ 1/2 turn after contacting sealing surface with oiled gasket

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7.5L (460 CID) Passenger and Police Interceptor V-8 Engines

PART 21-24

Ford, Mercury, Lincoln Continental and Continental Mark V

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CN4036-2B

DESCRIPTION

ENGINE

The 7.5L (460 CID) V-8 engine (Fig. 1) is a lightweight cast iron design. The Police Interceptor version is basically the same engine except for durability items such as the crankcase oil cooler and performance items such as revised camshaft specifications. All operations in this Part apply to both engines unless otherwise specified.

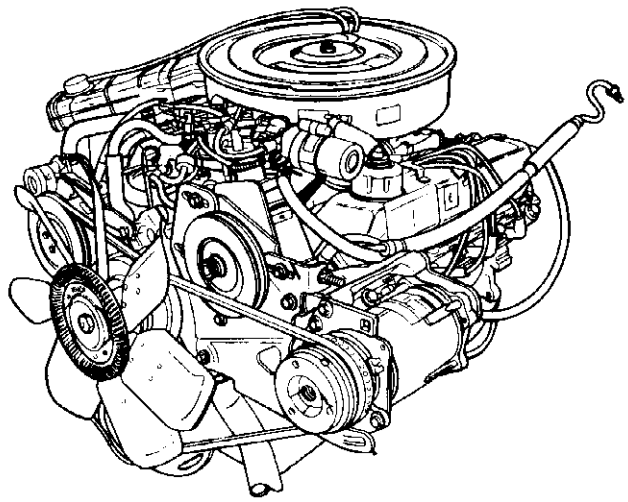
EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices used on this engine are covered in Group 29 and Group 50 of this Manual.

CRANKCASE VENTILATION SYSTEM

The 7.5L (460 CID) V-8 engines have a positive closed-type crankcase ventilation system recycling the crankcase vapors to the intake manifold.

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A2976-1D

FIG. 1 3/4 Left Front View—7.5L (460 CID) V-8 Engine

REMOVAL AND INSTALLATION

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

When installing nuts or bolts that must be torqued (refer to torque specifications), oil the threads with lightweight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning, Inspection and Test procedures.

ENGINE

The engine removal and installation procedures are for the engine, without the transmission attached. Remove or disconnect Thermactor parts that will interfere with removal or installation of the engine.

Removal

1. Raise the hood and mask the edges of the hood, fenders and cowl to protect the paint. Place fender covers on fenders.
2. Remove the hood.
3. Drain the cooling system at the radiator and the cylinder block.
4. Disconnect the ground cable from the battery. Remove the air cleaner and intake duct assembly. Cover the carburetor air horn with a clean cloth.
5. Disconnect the radiator upper and lower hoses at the engine. Disconnect the transmission oil cooler lines at the radiator. On Police Interceptor models, disconnect engine oil cooler water hoses at oil cooler.

   CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging hose from twisting.
6. Remove the fan shroud attaching bolts.
7. Remove the cooling fan-to-water pump hub attaching bolts. Remove the cooling fan and the shroud.
8. Remove the radiator upper support and the radiator.
9. If equipped with air conditioning, purge the system of freon. Remove the clamp bolt at the air conditioner muffler support if so equipped and position the refrigerant lines out of the way.

   Loosen the compressor adjustment and remove the drive belt. Remove the compressor support bracket-to-water pump bolt. Remove the compressor-to-mounting bracket bolts. Remove the power steering pump and position it to one side. Disconnect the compressor clutch wire and remove the compressor. Remove the compressor mounting bracket and idler pulley.
10. Disconnect the fuel inlet line at the fuel pump. Plug or cap the line to prevent fuel loss. Disconnect the fuel return line.
11. Loosen the alternator adjusting arm and mounting bolts. Remove the drive belts and water pump pulley. Remove the alternator and mounting brackets and position out of way, leaving the wires connected.
12. Disconnect the ground cable at the right front corner of cylinder block. Disconnect the heater hoses. Remove the transmission fluid filler tube attaching bolt from the right valve rocker arm

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cover, and position the transmission filler tube out of the way.

13. Disconnect all vacuum lines at the rear of intake manifold.
14. Disconnect the speed control at carburetor if so equipped. Disconnect the accelerator cable and secure out of way.
15. Disconnect the engine wiring harness at the multi-connector on dash.
16. Raise the vehicle on a hoist. Disconnect the inlet pipes at exhaust manifolds. On Police Interceptor models, disconnect engine oil cooler hoses from oil filter adaptor and plug hoses.

    CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging the hoses from twisting.
17. Disconnect the starter cable from starter solenoid or starter. Remove starter attaching bolts and remove starter by moving starter assembly forward, rotating it to turn solenoid outward, then removing it toward rear of vehicle.
18. Remove access cover from converter housing. Remove the flywheel to converter attaching nuts, rotating the flywheel as necessary. Remove the converter-to-engine lower rear cover plate attaching bolts.
19. Remove the nuts attaching the front support insulators to the underbody crossmember.
20. Hold the transmission in position with a support tool.
21. Lower the vehicle on hoist. Remove converter housing to cylinder block upper attaching bolts (left side). Disconnect the coil wiring harness, and remove the coil and bracket assembly from the intake manifold.
22. Attach an engine lifting sling, Tool No. T53L-300-A, hoist and lifting brackets to intake manifolds. Carefully remove engine from the vehicle. Install the engine on a work stand and remove the lifting sling.

Installation

1. Attach engine lifting sling, Tool No. T53L-300-A, hoist and lifting brackets to intake manifolds. Remove engine from work stand.
2. Carefully lower engine into vehicle. With engine supported by lifting sling, align converter-to-flywheel mounting studs with flywheel. Position the engine support insulator heat shields, then lower the engine, guiding the front support insulator studs into holes in underbody crossmember.
3. Install the converter housing-to-cylinder block upper attaching bolts and torque to specification. Remove the transmission support. Position the hoist out of the way and remove lifting sling.
4. Raise the vehicle on a hoist and install the front support insulator stud nuts. Torque them to specification. Install the converter housing-to-engine rear cover plate lower attaching bolts and torque them to specification.
5. Install the nuts on converter-to-flywheel mounting studs and torque nuts to specification. Install converter access plate.
6. Install the starter and connect starter cable.
7. With gaskets in place on inlet pipes, guide pipe ends into exhaust manifold flanges. Install nuts on flange studs and torque to specifications. On Police Interceptor models, connect engine oil cooler hoses to oil filter adaptor. Make sure and observe color codes on adaptor and hoses (Fig. 2).

    CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging the hoses from twisting.
8. Lower the vehicle and connect accelerator cable. Connect engine wiring harness at multi-connector at dash.
9. Connect all vacuum lines at rear of intake manifold. Connect speed control chain, if so equipped, to carburetor linkage.
10. Connect heater hoses. On Police Interceptor models, connect coolant hoses to engine oil cooler on left fender apron. Torque clamps to specifications.

    CAUTION: Use 2 wrenches when disconnecting hoses to avoid damaging hose from twisting. Set transmission filler tube in position and tighten bolt at right valve rocker arm cover to secure tube.
11. Connect ground wire to right front corner of cylinder block. Install alternator and mounting brackets.
12. If equipped with air conditioning, install the compressor upper mounting bracket to left cylinder head. Position the air conditioner muffler bracket and power steering reservoir or pump on studs in left cylinder head. Install compressor to upper mounting bracket and attach compressor support bracket to water pump. Connect compressor clutch wire bullet connector.
13. Connect the fuel inlet line and fuel return line to the fuel pump. Install the coil to intake manifold and connect wires.
14. If equipped with air conditioning, connect the service valves to compressor and install air conditioner muffler.
15. Set radiator in position and install the radiator upper support. Install the radiator upper and lower hoses. Connect the oil cooler lines to radiator.
16. Fit the water pump pulley in position. Install all drive belts.
17. Place fan assembly inside radiator shroud and position the shroud. Install fan assembly to water pump hub and torque bolts to specification. Install the shroud attaching bolts.
18. Fill the crankcase, cooling system and power steering reservoir to the correct level with specified lubricants. Adjust the tension of drive belts to specification.
19. Connect the distributor and vacuum lines. Install the air cleaner and intake duct, crankcase ventilation system air supply hose and oil filler cap.
20. Connect the battery. Start the engine and check for leaks.
21. When engine temperature stabilizes, adjust the ignition timing, engine idle speed and mixture, and transmission linkage, as required.

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22. If equipped with air conditioning, recharge the system.
23. Install the hood. Remove the masking tape and fender covers.

CRANKCASE OIL COOLER (POLICE INTERCEPTOR)

Removal

1. Drain the cooling system.
2. Disconnect the water coolant lines from the oil cooler (Fig. 2).
3. Disconnect the oil cooler inlet and outlet hoses.
4. Remove the one nut and one capscrew that attaches the front support to the front strap.
5. Remove the two nuts that attach the oil cooler to the rear strap.
6. Remove the two screws that attach the front support bracket to the oil cooler and remove the bracket.

Installation

1. Install the front support bracket on the oil cooler with the top end as shown in Fig. 2 to fit the contour of the fender apron.
2. Position the oil cooler on the fender apron and install the three attaching nuts and one bolt.
3. Connect the oil inlet hose to the rear of the cooler and torque it to specification. Connect the oil outlet hose to the front of the cooler and torque it to specifications. Use two wrenches when tightening. Be careful not to bend the hoses in a tight radius. The teflon liner in the hose could be crimped or twisted causing an oil leak or obstruction if bent too sharply.
4. Connect the water inlet hose to the upper fitting on the oil cooler and the outlet hose to the lower fitting. Tighten the hose clamps.
5. Fill the cooling system with the specified coolant.
6. Check the oil level and fill to the proper level with the specified oil.
7. Start the engine and bleed the cooling system. Check for oil and coolant leaks.

OIL FILTER ADAPTER

Removal

1. Remove the oil filter.
2. Disconnect the oil cooler inlet and outlet hoses from the oil filter adapter (Fig. 2).
3. Remove the oil filter adapter attaching bolt and gasket. Remove the adapter and mounting gasket from the cylinder block.

Installation

1. Clean all old gasket material from the cylinder block.
2. Position a new mounting gasket with the rib in the horizontal position and the rib of the adapter in the vertical position (Fig. 2).
3. Install a new gasket and the adapter attaching bolt. Tighten the attaching bolt to specification.
4. Connect the oil cooler inlet hose and the outlet hose to the adapter making sure that the paint mark on each hose is matched with that on the adapter and that they are in alignment.

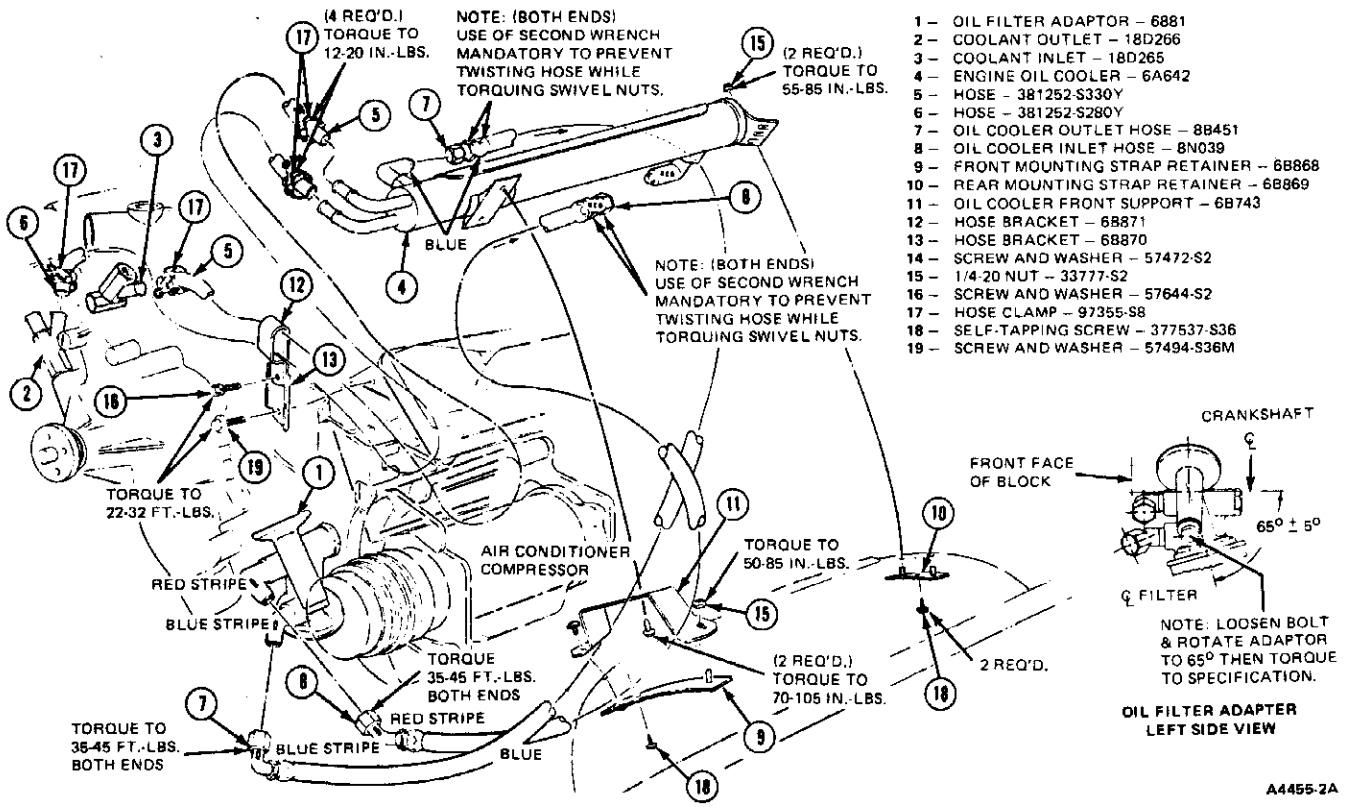


FIG. 2 Engine Oil Cooler Installation—Ford/Mercury Police Interceptor—A/C Shown

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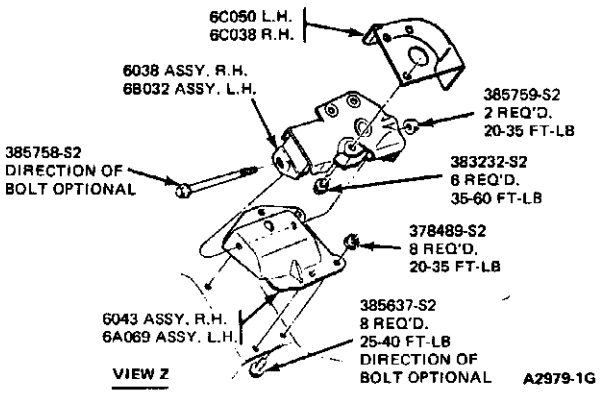


FIG. 3 Engine Front Support—Ford and Mercury

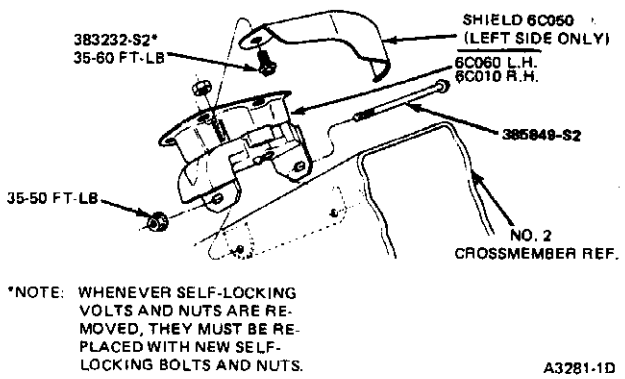


FIG. 4 Engine Front Support-Lincoln Continental

5. Install a new oil filter element.
6. Fill the crankcase to the correct level with the specified oil.
7. Start the engine and check for oil leaks.
8. Recheck oil level after running and add oil as necessary to obtain correct level.

ENGINE FRONT SUPPORTS

Front supports (Figs. 3 through 5) are located on each side of the cylinder block. Following procedures apply to either support.

When self-locking fasteners (marked * in following Figs.) are removed, they must be replaced with new self-locking fasteners.

FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Remove the fan shroud attaching bolts, leaving the fan shroud loose in the vehicle.
2. Remove the through bolt and nut attaching the insulator to the insulator support bracket and/or the No. 2 crossmember. Remove the through bolts on both mounts at the same time.
3. Using a jack and wood block placed under the oil pan, raise the engine approximately 1 to 1-1/2 inches, allowing the insulator locator stud, if present, to disengage from the locator hole in the bracket crossmember.
4. Remove the bolts attaching the insulator assembly to the engine block. Remove the insulator assembly and heat shield, if so equipped.

Installation

1. Position the insulator assembly and heat shield, if so equipped, on the engine block. Install the attaching bolts and torque to specification.
2. Lower the engine into place and align the through bolt holes on the insulator assembly with those on the support bracket or crossmember. Install the through bolt. Remove jack and wood block. Torque through bolt and nut to specification.
3. Install the fan shroud retaining bolts and torque to specification.

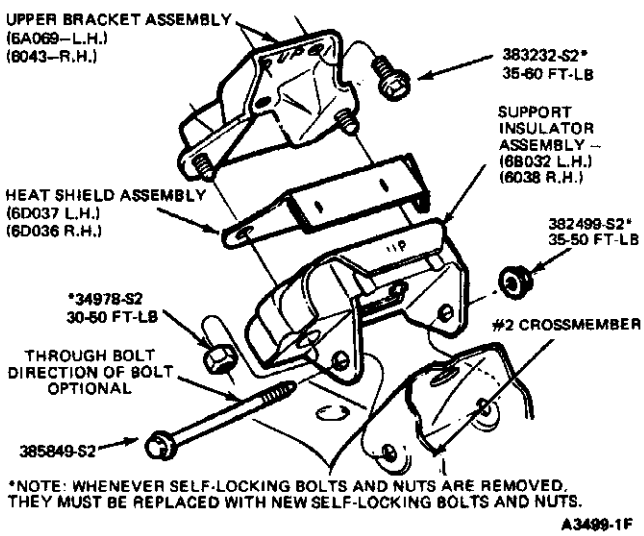


FIG. 5 Engine Front Support-Continental Mark V

ENGINE REAR SUPPORT

Engine rear supports (Figs. 6 and 7) are located between the transmission extension housing and the vehicle crossmember.

Whenever self-locking fasteners (marked * in following Figs.) are removed, they must be replaced with new self-locking fasteners.

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FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Remove the nuts (and through bolt where applicable) attaching the insulator to the No. 3 crossmember.
2. Raise the transmission with a jack to obtain clearance.
3. Remove the bolts and washers that attach the rear insulator assembly to the transmission.
4. Remove the insulator assembly.

Installation

1. Position the rear insulator assembly on the transmission. Install the attaching bolts and washers and torque to specification.
2. Lower transmission into position.
3. Install the nuts (and through bolts where applicable) attaching the insulator assembly to the crossmember. Torque to specification.
4. Remove the jack supporting the transmission.

CRANKCASE VENTILATION SYSTEM (FIG. 8)

Removal

1. Remove ventilation system air intake hose from air cleaner. Remove the hose, elbow and grommet from the left rocker arm cover.
2. Remove air cleaner and intake duct assembly.
3. Disconnect the inlet vent hose and tube from the carburetor.

   Unlock and remove the oil filler cap.
4. Pull PCV valve out of mounting grommet in right valve rocker arm cover and remove inlet vent hose and PCV valve as an assembly. Disassemble as necessary.

Installation

1. Install the oil filler cap. Insert the regulator (PCV) valve into the right rocker arm cover grommet.
2. Reassemble vent tubes and hoses to canister purge tee and hose. Position the inlet vent hose and tube and connect to carburetor and PCV valve.
3. Install air cleaner and intake duct assembly.
4. Install ventilation system air intake hose, elbow and grommet to air cleaner and oil filler cap.

VALVE ROCKER ARM COVER AND ROCKER ARM

The valve rocker arm and attaching parts are shown in Fig. 9.

Removal

1. Remove the air cleaner and intake duct assembly.

   If a right cylinder head rocker arm is to be removed, remove the crankcase ventilation regulator valve from the valve rocker arm cover.
2. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the moulded cap only with Tool T74P-6666-A. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.

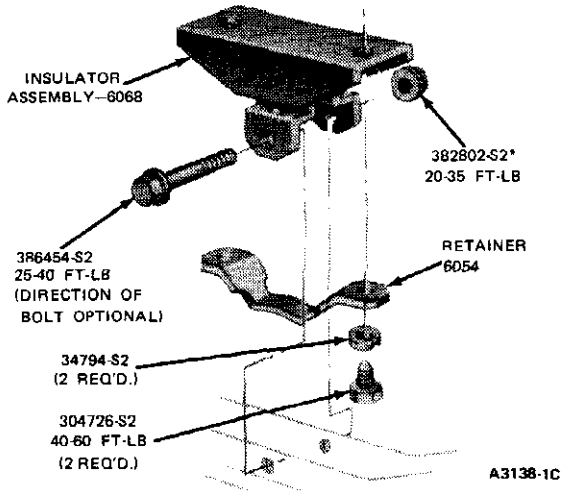


FIG. 6 Engine Rear Support—Ford and Mercury

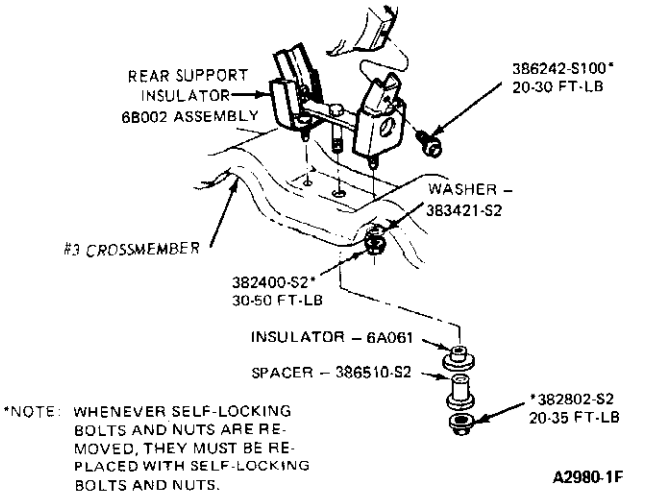


FIG. 7 Engine Rear Support—Continental Mark V

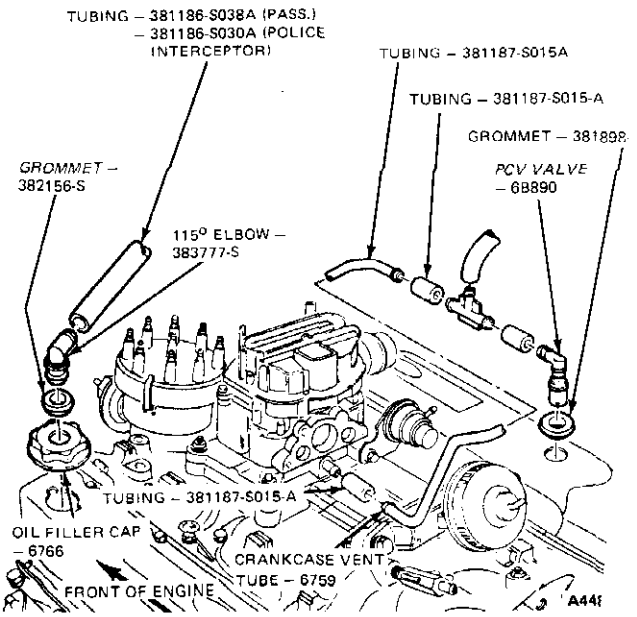


FIG. 8 PCV System

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3. Remove the valve rocker arm cover(s).
4. Remove the valve rocker arm bolt, oil deflector, fulcrum seat and rocker arm.

Installation

1. Apply Lubriplate or equivalent to the top of the valve stems, the rocker arm and fulcrum seats.
2. Position the No. 1 piston on TDC at the end of the compression stroke in position 1 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

   No. 1 Intake No. 1 Exhaust

   No. 7 Intake No. 5 Exhaust

   No. 8 Intake No. 4 Exhaust

   Position the crankshaft in position 2 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

   No. 4 Intake No. 2 Exhaust

   No. 5 Intake No. 6 Exhaust

   Position the crankshaft in position 3 in Fig. 10 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

   No. 2 Intake No. 3 Exhaust

   No. 3 Intake No. 7 Exhaust

   No. 6 Intake No. 8 Exhaust

   Be sure that the fulcrum seat base is inserted in its slot on the cylinder head before tightening the fulcrum bolts. Tighten the fulcrum bolt to specification. Check the valve clearance following the procedures in Part 21-01 under Valve Clearance Adjustment.
3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Position the new gasket in the cover, making sure that the gasket tangs are secured in the notches in the cover.
4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Tighten the bolts to specification. Two minutes later, tighten the bolts to the same specification.

   If the right cover was removed, install the PCV valve.

   Install the air cleaner and intake duct assembly and connect the PCV system.
5. Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires. See Part 23-01 for special installation instructions.
6. Start the engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or damaged or worn valve stem seals or retainers may be replaced without removing the cylinder head if valve or valve seat is not damaged.

Removal

1. If damaged or worn spring, retainer, or seal is on right side of engine, remove air cleaner and intake duct assembly. Remove crankcase ventilation system PCV valve and attachments from right valve rocker arm cover. Remove spark plug wires.

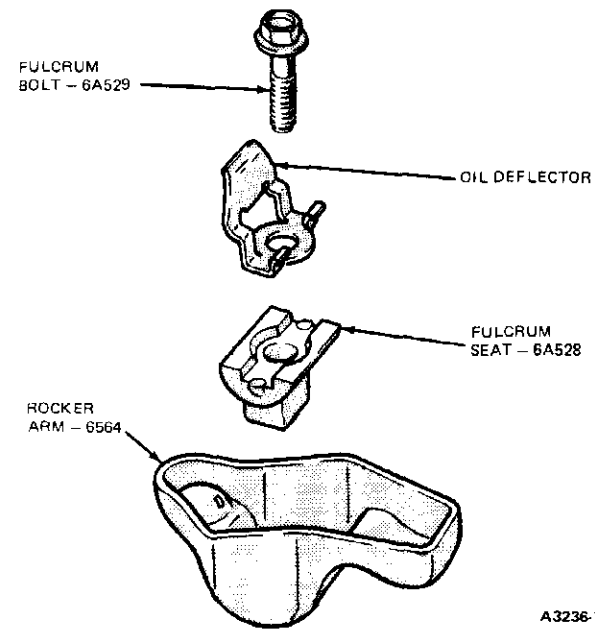
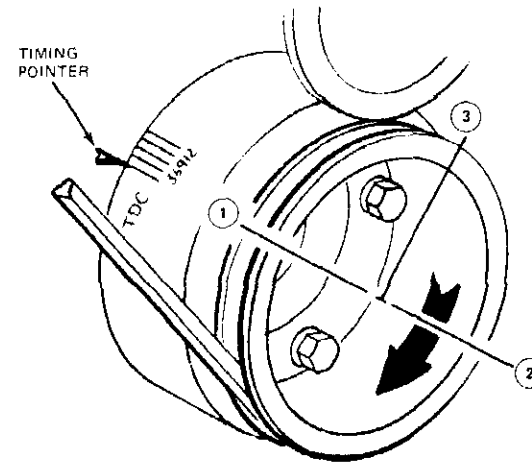


FIG. 9 Rocker Arm and Attaching Parts

With No. 1 at TDC at end of compression stroke make a chalk mark at points 2 and 3 approximately 90 degrees apart.



POSITION 1 – No. 1 at TDC at end of compression stroke.
POSITION 2 – Rotate the crankshaft 180 degrees (one half revolution) clockwise from POSITION 1.
POSITION 3 – Rotate the crankshaft 270 degrees (three quarter revolution clockwise from POSITION 2.

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FIG. 10 Position of Crankshaft for Installing Valve Rocker Arms

If spring, retainer, or seal to be removed is on left side of engine, remove oil filler cap and ventilation hose from left valve rocker arm cover and position out of way.

2. Remove valve rocker arm cover(s) and applicable spark plug(s).

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3. Remove valve rocker arm bolts, oil deflectors, fulcrum seats, rocker arms, and pugh rods from affected cylinder(s).
4. Install air line with adapter in spark plug hole. Turn on air supply to hold valves closed.
5. Install Tool T70P-6049-A (Fig. 11) and compress valve spring. Remove retainer locks, spring retainer, and spring. Remove and discard valve stem seal (Fig. 12). **If air pressure fails to hold valve in closed position, valve damage affecting sealing is indicated. Remove and inspect cylinder head assembly.**
6. Wrap rubber band, tape or string around end of valve stem to prevent valve from dropping into cylinder when air pressure in cylinder is shut off if piston is at bottom of cylinder. Shut off air pressure.
7. Inspect valve stem for damage. Rotate valve, checking tip for eccentric movement. Move valve up and down through normal travel in valve guide and check for binding. **If valve is damaged, cylinder head must be removed for repairs.**

Installation

1. If valve proves satisfactory, hold valve closed and turn on air pressure in cylinder.
2. Lubricate the valve stems with heavy engine oil SE. Install new valve stem seal (Fig. 12). Use a 5/8" deep socket and a light hammer or mallet to drive seal onto valve stem. Set spring and retainer over valve stem. Compress valve spring (Fig. 11) and install retainer locks. Release spring and remove tool and stud nut.
3. Shut off air pressure and remove air line and adapter. Install spark plug.
4. Apply Lubriplate (or equivalent) to tip of valve stem and each end of push rod. Install push rod. **Be sure lower end of push rod is seated in tappet.**
5. Lubricate fulcrum seats and sockets with Lubriplate or equivalent.
6. Lubricate the push rod socket, fulcrum seat and the valve pad of the rocker arm with heavy engine oil SE.
7. Install the rocker arms using the procedure and sequence given under Rocker Arm Installation.
8. Clean gasket material from rocker arm cover and cylinder head and install the rocker arm cover, using a new gasket.

   If the right cover was removed, install the crankcase ventilation regulator (PCV) valve.
9. Install the spark plug and connect the spark plug wires. See Part 23-01 for special installation instructions.
10. Install the air cleaner and intake duct assembly.

INTAKE MANIFOLD

Removal

1. Drain cooling system. Remove air cleaner and intake duct assembly.
2. Disconnect radiator upper hose at engine.
3. Disconnect heater hoses at intake manifold and water pump, and position out of way. Loosen water pump by-pass hose clamp at intake manifold.

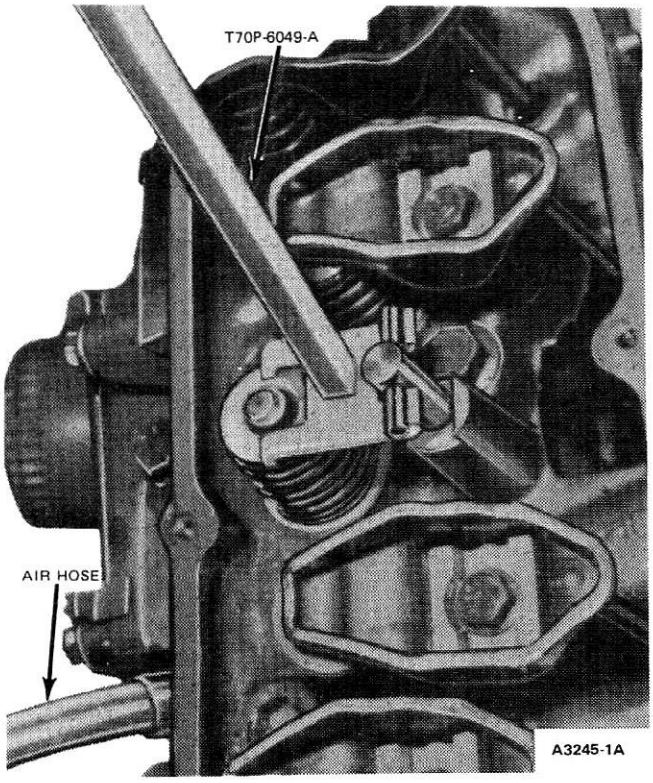


FIG. 11 Compressing Valve Spring—In Chassis

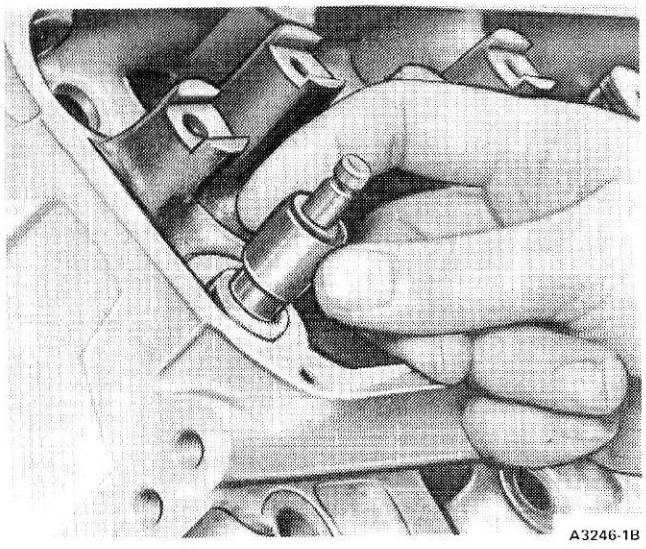


FIG. 12 Removing or Installing Valve Stem Seal

4. Disconnect positive crankcase ventilation valve and hose at right valve rocker arm cover. Disconnect all vacuum lines at rear of intake manifold and tag for proper installation.
5. Disconnect wires at spark plugs by twisting and pulling moulded caps with Tool T74P-6666-A (see Part 23-01). Remove wires from brackets on valve rocker arm covers. Disconnect coil high tension lead at coil and remove distributor cap and wires as an assembly.
6. Disconnect all distributor vacuum lines at carburetor and vacuum control valve and tag for proper installation. Disconnect distributor wiring

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connector. Remove distributor and vacuum lines as an assembly.

7. Disconnect accelerator linkage at carburetor. Remove speed control linkage bracket, if so equipped, from intake manifold and disconnect it from the carburetor. Remove bolts holding accelerator cable bracket and position cable out of way.
8. Disconnect fuel line at carburetor.
9. Disconnect wiring harness at coil connector, engine temperature sending unit, oil pressure sending unit, and other connections as necessary. Disengage wiring harness from three clips at left valve rocker arm cover bolts, and position wiring harness out of way.
10. Remove coil and bracket assembly. Remove the Thermactor air supply tubes and check valve from the rear of the cylinder heads.
11. Remove attaching bolts and nuts and remove intake manifold and carburetor as an assembly (Fig. 13). **If necessary to pry manifold away from cylinder heads, do not damage gasket sealing surfaces.**
12. Remove and discard intake manifold gaskets and seals. (See Fig. 15.)
13. If manifold is to be further disassembled (Fig. 16), remove coolant outlet housing, gasket, and thermostat. Remove automatic choke heat tubes, vacuum hoses, carburetor, spacer, EGR valve and gaskets. Remove the thermostatic choke heater tube. Remove engine temperature sending unit. Discard all gaskets.

Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent and dry it with compressed air.

Inspect the manifold for cracks, damaged gasket surfaces, or other damage that would make it unfit for service. Replace all studs that are stripped or otherwise damaged. Remove all filings and foreign matter that may have entered the manifold as a result of repairs.

Installation

1. If intake manifold assembly was disassembled, install coolant outlet housing, new gasket, and thermostat. Install carburetor, EGR valve spacer, new gaskets, automatic choke heat tubes and thermostatic choke heater tube. Coat threads with electrical conductive sealer and install water temperature sending unit.
2. Clean mating surfaces of intake manifold, cylinder heads, and cylinder block. Use a solvent such as lacquer thinner, chlorothane, trichlor-ethylene or similar degreasing agent.
3. Apply a 1/8 inch diameter bead of silicone rubber sealer in and along the joint, the full width of the cylinder block seal mounting surface (4 corners) as shown in Fig. 14.
4. Install the cylinder head to manifold gaskets and valley baffle assembly (Fig. 15), and the front and rear intake manifold to cylinder block seals. Apply a 1/16 inch bead of sealer at the outer end of each intake manifold seal for the full width of the seal (Fig. 14).

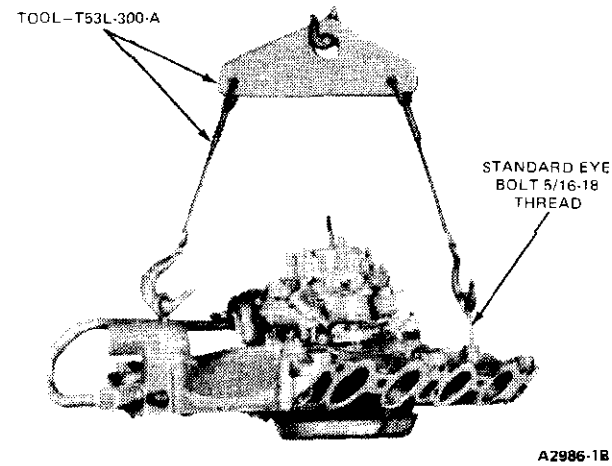


FIG. 13 Removing or Installing Intake Manifold

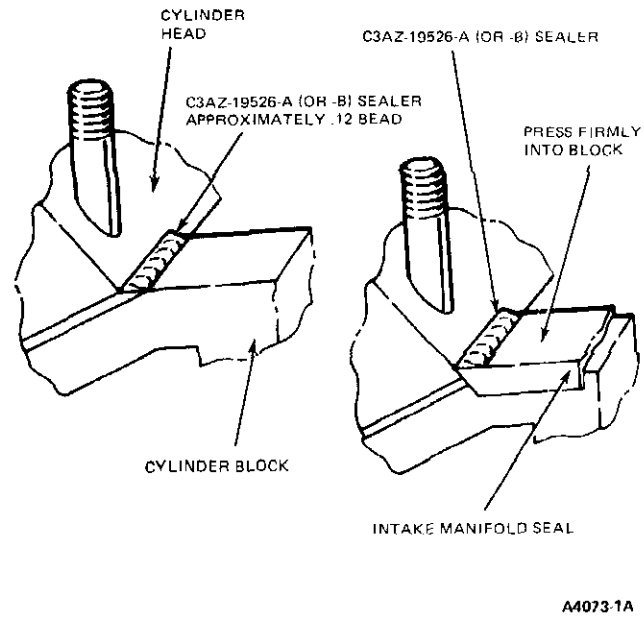


FIG. 14 Sealing Intake Manifold with RTV Sealer

NOTE: This sealer sets up within 15 minutes after application, so assembly should proceed promptly.

5. Carefully lower intake manifold into position over four (4) studs in ends of cylinder heads. **When intake manifold is in place, run finger around seal area to be sure seals are in place. If seals have shifted, remove manifold and reposition seals.**
6. Install attaching bolts and nuts snugly to manifold. Torque bolts and nuts in sequence (Fig. 17) to specification to compress gaskets and seals. Then repeat sequence, torquing bolts and nuts to same specification.
7. Install water pump by-pass hose to intake manifold fitting.
8. Connect radiator upper hose to coolant outlet housing.

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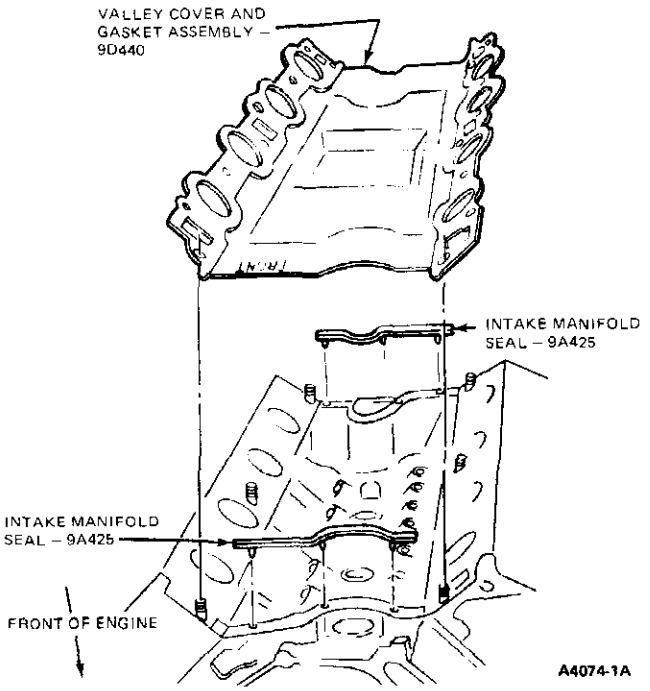


FIG. 15 Installing Intake Manifold Gaskets and End Seals

9. Rotate crankshaft damper until No. 1 piston is at TDC at end of compression stroke. Align the correct timing mark on the damper with the pointer. Position distributor in block with rotor at No. 1 firing position and with the armature tooth centered on the stator coil (see Part 23-01). Install hold-down clamp.
10. Connect heater hose at intake manifold and water pump.
11. Connect positive crankcase ventilation (PCV) valve and hose assembly to right valve rocker arm cover and carburetor.
12. Connect fuel line to carburetor.
13. Install coil and bracket assembly to intake manifold.
14. Fit wiring harness into two (2) clips on left valve rocker arm cover and connect to all terminals.
15. Position accelerator cable bracket on manifold. Attach speed control linkage bracket to intake manifold, if so equipped. Install attaching bolts and connect linkage to carburetor.
16. Connect the vacuum lines to their respective ports on the intake manifold. Install Thermactor air supply tubes and check valve to rear of cylinder heads.
17. Secure distributor cap to distributor. Connect spark plug wires to spark plugs and fit wires into brackets on valve rocker arm covers. Connect coil high tension lead to coil and attach connector to coil terminals.
18. Fill the cooling system.
19. Start engine. Check and adjust ignition timing. Connect distributor vacuum lines to their respective parts.
20. Operate engine at fast idle and check for coolant leaks. Recheck coolant level and refill as necessary.

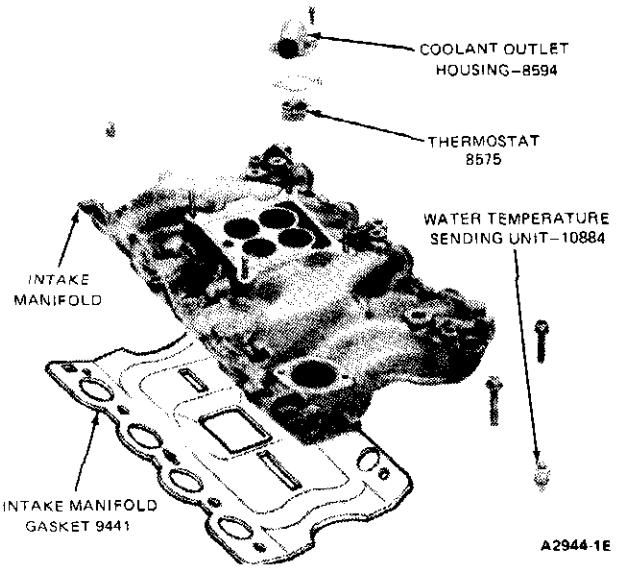


FIG. 16 Intake Manifold Disassembled

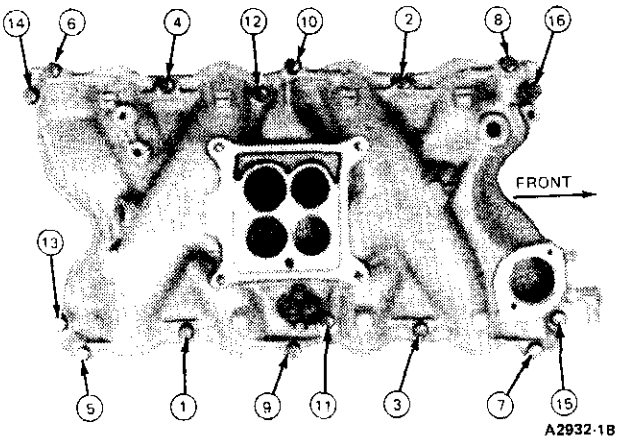


FIG. 17 Intake Manifold Torque Sequence

21. Allow engine to reach normal operating temperature, then retorque the manifold attaching nuts and bolts to specification.
22. Check and adjust carburetor (Group 24 and Group 29) as required. Install air cleaner and intake duct assembly.

HYDRAULIC TAPPETS

The following procedure is applicable for removing one or all of the tappets. Before replacing a hydraulic tappet for noisy operation, be sure the noise is not caused by improper valve clearance or by worn rocker arms and/or push rods.

Removal

1. Remove intake manifold and carburetor as an assembly, following instructions under Intake Manifold.
2. Remove the valve rocker arm covers. Loosen the rocker arm bolts and turn rocker arms to one side.
3. Remove the push rods in sequence.
4. Remove the tappets with a magnet. Place them in a rack in sequence. If the tappets are stuck in bores,

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use plier-type Tool (T70P-14151) to remove them. Rotate tappets back and forth to loosen them from gum or varnish deposits.

Refer to Part 21-01 for cleaning, inspection and testing prodedure. If necessary to disassemble tappets, refer to Tappet Disassembly and Assembly in this Part.

Installation

1. Clean the outside of tappets. Tappets and bores are to be lubricated with heavy oil SE before installation. Install the tappets in their original bores. Check any new tappet for free fit in bore to which it is to be installed.
2. Install push rods in original positions. Apply Lubriplate or equivalent to valve stem tips and push rod ends.
3. Position the rocker arms over the push rods and tighten the bolts following the procedure under Valve Rocker Arm Installation. Adjust valve clearance.
4. Clean gasket material from rocker arms and cylinder head and install valve rocker arm covers.
5. Install intake manifold and carburetor, following the instructions under Intake Manifold.

CYLINDER HEADS

Removal

1. Remove intake manifold and carburetor as an assembly, following procedure under Intake Manifold Removal.
2. Disconnect muffler inlet pipe at exhaust manifold.
3. Loosen air conditioning compressor drive belt, if so equipped.
4. Loosen alternator attaching bolts and remove bolt attaching alternator and air pump bracket to right cylinder head.
5. If equipped with air conditioning purge the system of freon. Remove nuts attaching compressor support bracket to water pump. Remove bolts attaching compressor to upper mounting bracket and remove compressor. Remove compressor upper mounting bracket from cylinder head.

   If not equipped with air conditioning, remove bolts attaching power steering reservoir bracket to left cylinder head. Position reservoir and bracket out of way.
6. Remove valve rocker arm covers. Remove rocker arm bolts, rocker arms, oil deflectors, fulcrums and push rods in sequence (Fig. 18) so they can be installed in their original positions.
7. Remove cylinder head attaching bolts. Lift cylinder heads and exhaust manifolds as assemblies from cylinder block with a hoist. **If necessary to loosen cylinder head gasket seal, pry at forward corners of cylinder heads against casting bosses provided on cylinder block. Do not damage machined surfaces of head or block. Discard cylinder head gasket.**
8. If disassembly or machining of cylinder head is required, remove exhaust manifold.

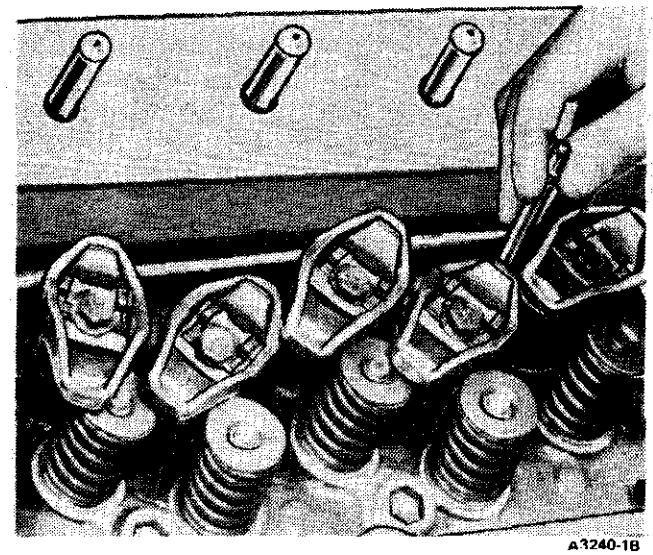


FIG. 18 Removing Valve Push Rod

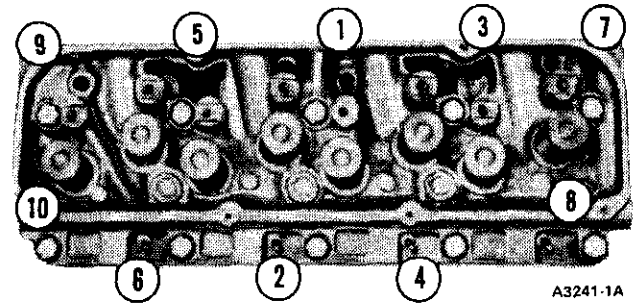


FIG. 19 Cylinder Head Bolt Torque Sequence

Installation

1. Clean cylinder head, intake manifold, valve rocker arm cover, and cylinder block gasket surfaces. If cylinder head was removed for cylinder head gasket replacement, check flatness of cylinder head and block gasket surfaces. If exhaust manifold was removed, coat cylinder head and manifold port areas with film of graphite grease and install manifold to cylinder head.
2. Place two (2) long cylinder head attaching bolts in two rear lower bolt holes of left cylinder head. Place a long cylinder head attaching bolt in rear lower bolt hole of right cylinder head. Use rubber bands to retain bolts in position until cylinder heads are installed.
3. Position new cylinder head gaskets on block over dowels. Do not apply sealer to head gasket surfaces. Place cylinder heads on block, guiding exhaust manifold studs into inlet pipe connections. Install remaining attaching bolts (longer bolts in lower row of bolt holes). Tighten all cylinder head attaching bolts in sequence (Fig. 19) to specification. When this procedure is used, it is not necessary to retorque bolts after extended operation.
4. Clean and inspect push rods, one at a time. Inspect visually or use a dial indicator to read runout. If bent, do not attempt to straighten, but replace.

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Clean the oil passage in the push rods with a suitable solvent, and blow out with compressed air.

5. Install push rods in original positions. Apply Lubriplate or equivalent to valve stem tips and push rod ends.
6. Lubricate and install the rocker arms following the procedure under Valve Rocker Arm installation. **Be sure lower ends of push rods remain seated in tappets.**
7. Torque catalyst inlet pipe or muffler inlet pipe stud nuts to specification.
8. Install intake manifold and carburetor assembly, following procedure under Intake Manifold Installation.
9. If valve train components were changed, perform valve clearance adjustment, as detailed under Valve Clearance adjustment (Part 21-01).
10. If equipped with air conditioning, install compressor upper mounting bracket to left cylinder head. Attach compressor to upper mounting bracket. Attach power steering reservoir and compressor mounting bracket to left cylinder head and water pump. Connect hoses to compressor.

    If not equipped with air conditioning, attach power steering reservoir bracket to left cylinder head.
11. Apply oil-resistant sealer to one side of new valve rocker arm cover gaskets. Lay cemented side of gaskets in place in covers. Install covers.
12. Install bolt attaching alternator and air pump bracket to right cylinder head. Adjust alternator and air pump drive belt tension to specification and tighten attaching bolts.
13. If equipped with air conditioning, adjust compressor drive belt tension to specification and tighten attaching bolts.
14. Fill radiator and power steering reservoir, as necessary.
15. Start engine and check for leaks.
16. Check and adjust carburetor idle speed and mixture (Group 24 and Group 29) as required.
17. If equipped with air conditioning, evacuate and charge system with refrigerant (Group 36).

EXHAUST MANIFOLDS

Removal

1. If removing right exhaust manifold, remove air cleaner and intake duct assembly.
2. Disconnect exhaust manifold(s) at catalyst or muffler inlet pipe(s).
3. Remove attaching bolts and washers, and remove exhaust manifold(s) and spark plug wire heat shields.

   Inspect the cylinder head joining flanges of the exhaust manifold(s) for evidence of exhaust gas leaks.

   Inspect the manifold(s) for cracks, damaged gasket surfaces, or other damage or wear that would make them unfit for service.

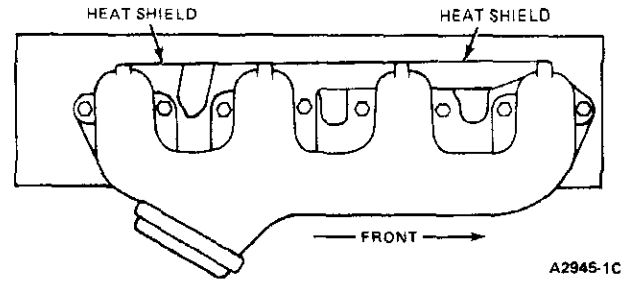


FIG. 20 Right Exhaust Manifold Installation

Installation

1. Clean mating surfaces of exhaust manifold(s) and cylinder head(s). Clean mounting flange of manifold(s) catalyst and inlet pipe(s). Apply light film of graphite grease to exhaust manifold(s).
2. Position spark plug wire heat shields and exhaust manifold(s) on cylinder head(s). Install attaching bolts and washers, starting at fourth bolt hole from front of each manifold. Position lifting bracket under bolts at third exhaust port from front of engine. On right exhaust manifold, install shoulder stud(s) for air intake heat shield at first and sixth bolt holes from front of manifold (Fig. 20). Torque bolts to specification, working from center of manifold to both ends.
3. Place new gasket(s) on resonator or muffler inlet pipe(s). Position inlet pipe(s) to manifold(s). Install attaching nuts and torque to specification.
4. Install air cleaner and intake duct assembly, if removed.
5. Start engine and check for exhaust leaks.

WATER PUMP

Removal

1. Drain cooling system and remove the fan shroud attaching bolts.
2. Remove bolts attaching fan assembly to water pump and remove shroud and fan.
3. Loosen the power steering pump attaching bolts.
4. If vehicle is equipped with air conditioning, loosen compressor attaching bolts. Remove the compressor and power steering pump drive belts.
5. Loosen the alternator pivot bolt. Remove the two attaching bolts and spacer. Remove the belt, then rotate the bracket out of the way. Remove the Thermactor air pump pulley and air pump pivot bolt. Remove the air pump adjusting bracket at the pump. Remove the upper bracket attaching bolt and swing bracket out of way.
6. Remove the three air conditioning compressor attaching bolts and secure the compressor to the left fender brace.
7. Remove the power steering pump attaching bolts and position the pump to one side.
8. Remove the air conditioner bracket attaching bolts and remove the bracket.
9. Disconnect the radiator lower hose and the heater hose from the water pump. On Police Interceptor models, disconnect coolant hose to oil cooler.

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10. Loosen the by-pass hose clamp at the pump.
11. Remove remaining water pump attaching bolts and remove water pump from cylinder front cover. Remove cover plate from water pump. Discard gaskets.

Installation

1. Remove any gasket material from water pump, cylinder front cover and pump cover.
2. Position new gaskets coated on both sides with water-resistant sealer.
3. Position water pump on cylinder front cover and install only those bolts not used to attach compressor bracket (if installed) and alternator bracket to water pump. Torque bolts to specification. Install the Thermactor parts removed or loosened in Step 5 of Removal.
4. Connect radiator lower hose, heater return hose, and by-pass hose to water pump. On Police Interceptor models, connect coolant hoses for engine oil cooler. Torque clamps to specification.
5. Position the air conditioner compressor bracket and install and torque the attaching bolts, stud and nuts.
6. Secure the compressor to the bracket.
7. Position the power steering pump bracket and install the three attaching bolts and the nut.
8. Rotate the alternator bracket into position and install the two attaching bolts and spacer. Adjust the belt tension and torque the attaching bolts to specification.
9. Place the water pump pulley on the pump. Position the power steering and compressor drive belts on their respective pulleys.
10. Lower the fan and radiator shroud into position. Install the fan attaching bolts and the shroud attaching bolts. Torque the bolts to specification.
11. Adjust the power steering, alternator and compressor and air pump belt tension. Torque the compressor attaching bolts to specification.
12. Fill the cooling system.
13. Start the engine and check for leaks.

CYLINDER FRONT COVER AND TIMING CHAIN

Removal

Cylinder front cover oil seal replacement is recommended whenever the cover has been removed.

1. Drain cooling system and crankcase.
2. Remove screws attaching radiator shroud to radiator. Remove bolts attaching fan to water pump hub. Remove fan and radiator shroud.
3. Disconnect radiator upper and lower hoses at engine. Disconnect oil cooler lines at radiator.
4. Remove radiator upper support and remove radiator.
5. Loosen alternator and air pump attaching bolts to relieve tension on drive belt. If equipped with air conditioning, loosen compressor idler pulley. Remove drive belts and water pump pulley.

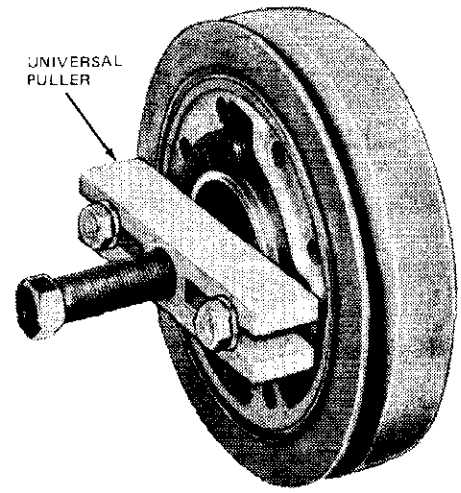


FIG. 21 Removing Crankshaft Vibration Damper

6. Remove bolts attaching compressor support, water pump and compressor, and remove compressor support (if so equipped).
7. Remove the crankshaft pulley from the vibration damper.
8. Remove bolt and washer attaching crankshaft damper. Remove crankshaft damper with a puller (Fig. 21). Remove Woodruff key from crankshaft.
9. Loosen by-pass hose at water pump. Disconnect heater return tube at water pump. On Police Interceptor models, disconnect coolant hoses for engine oil cooler.
10. Disconnect and plug fuel inlet line at fuel pump. Disconnect fuel line to carburetor at fuel pump. Remove fuel pump.
11. Remove bolts attaching cylinder front cover to cylinder block. Using a thin blade knife, cut the oil pan seal flush with cylinder block face prior to separating the cover from the cylinder block. Remove cylinder front cover and water pump as an assembly. Discard cylinder front cover gasket and oil pan seal.
12. If new cylinder front cover is to be installed, remove water pump and install it and a new gasket on the new front cover.
13. Check timing chain deflection as shown in Part 21-01.

    If the deflection exceeds specification, replace the timing chain and sprockets.
14. If the timing chain and sprocket are to be removed, crank the engine until timing marks on sprockets are as shown in Fig. 22.
15. Remove camshaft sprocket cap screw, washer, and two piece fuel pump eccentric. Slide timing chain and sprockets forward, and remove as an assembly (Fig. 23).

    Refer to Part 21-01 for cleaning and inspection procedures.

Installation

1. Assemble the timing chain and sprockets so sprocket timing marks point directly toward each

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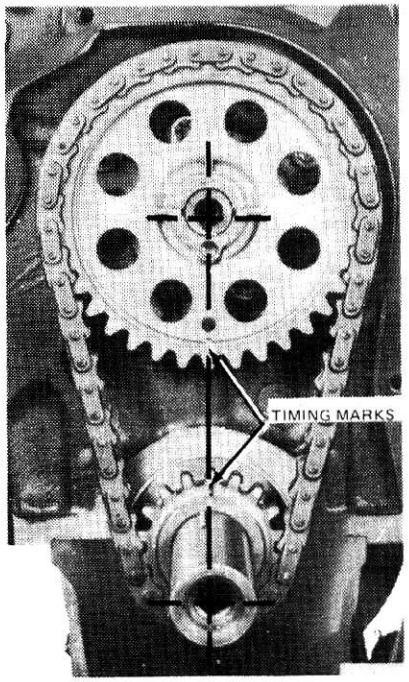


FIG. 22 Aligning Timing Marks

other as shown in Fig. 22. Install the chain and sprockets as an assembly to crankshaft and camshaft. Verify proper alignment of timing marks after installation.

2. Install the fuel pump eccentric, camshaft sprocket cap screw and washer. Torque cap screw to specification. Lubricate timing chain with engine oil.
3. Coat the gasket surface of the oil pan with sealer. Cut and position the required sections of a new seal on the oil pan. Apply sealer at the corners.
4. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the block.
5. Position the cylinder front cover and water pump on the cylinder block. Use care when installing the cover to avoid seal damage or possible mislocation.
6. Install the cylinder front cover to seal alignment tool into proper position. It may be necessary to force the cover downward to slightly compress the pan seal. This operation can be made easier by using a suitable tool at the attaching bolt hole locations.
7. Coat the threads of the attaching bolts with oil-resistant sealer and install the screws.
8. While pushing in on the alignment tool (Fig. 24), torque the oil pan to cover attaching bolts to specification. Torque the cover to cylinder block attaching screws. Remove alignment tool.
9. Apply Lubriplate or equivalent to front of crankshaft for damper installation.
10. Position crankshaft damper Woodruff key and install crankshaft damper (Fig. 25). Install damper attaching screw and washer.
11. Install the crankshaft pulley.
12. Coat new fuel pump gasket with oil-resistant sealer and place on fuel pump. Install fuel pump. Connect fuel lines to fuel pump.
13. Install compressor support bracket to compressor and water pump, if so equipped.

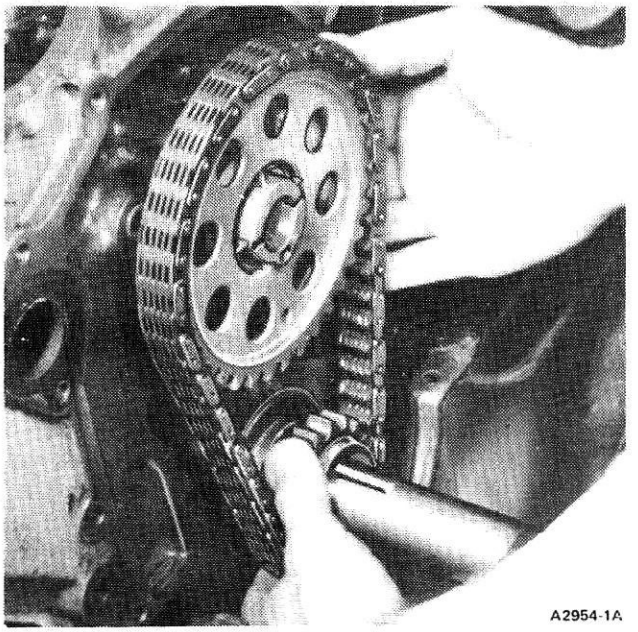


FIG. 23 Removing or Installing Timing Chain

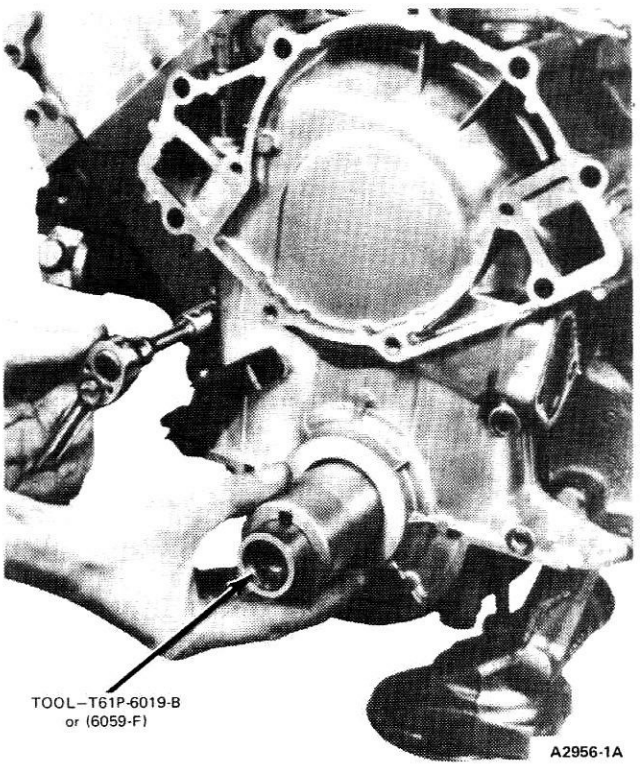


FIG. 24 Aligning Cylinder Front Cover

14. Install water pump pulley and all drive belts.
15. Position radiator to lower support, position upper support to radiator, and install attaching bolts. Connect radiator upper and lower hoses at engine. On Police Interceptor models, connect engine oil cooler coolant lines at water pump and tighten hose clamps to specification. Connect oil cooler lines.
16. Place fan assembly inside radiator shroud and set in position in vehicle. Position the fan on the water pump and install and torque the attaching bolts. Install screws attaching shroud to radiator.

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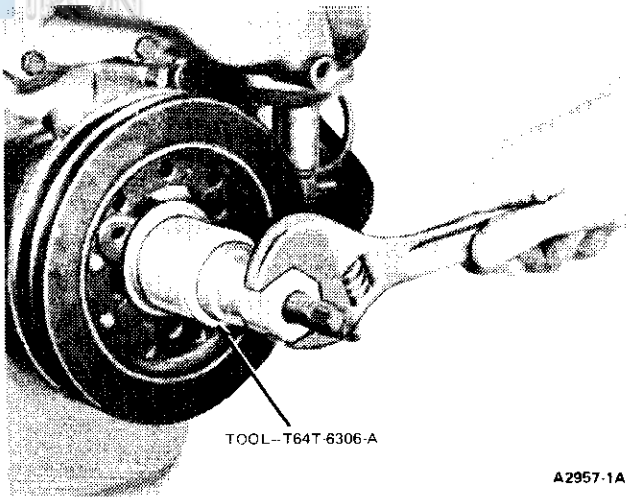


FIG. 25 Installing Crankshaft Vibration Damper

17. Adjust belt tensions to specification. Tighten alternator and air pump attaching bolts and compressor idler pulley, if so equipped, to specification.
18. Fill and bleed the cooling system. Fill the crankcase to the correct level with the recommended oil.
19. Run engine at fast idle and check for coolant and oil leaks. Adjust ignition timing.

FRONT OIL SEAL

Removal

Replacement of the front oil seal is recommended whenever the cylinder front cover is removed.

1. Drive out the old seal with a pin punch. Clean the seal recess in the cylinder front cover.

Installation

1. Coat a new seal with grease. Install the seal with Tool T68P-6700-A (Fig. 26). **After installation, be sure seal spring remains in proper position.**

CAMSHAFT

The camshaft and related parts are shown in Fig. 27.

Removal

1. Remove timing chain and sprockets, following procedure under Cylinder Front Cover and Timing Chain. Check timing chain deflection before removal (Part 21-01).
2. Remove the intake manifold and carburetor as an assembly, following the instructions under Intake Manifold.
3. Remove valve rocker arm covers. Back off all rocker arm bolts, turn rocker arms sideways, and remove the push rods in sequence (Fig. 18).
4. Remove the tappets with a magnet and place them in a rack in sequence. If the tappets are stuck in bores, use Tool (T70P-14151) to remove them. Rotate the tappets back and forth to loosen them from gum or varnish deposits.
5. Remove the bolts attaching the air conditioning condenser to the chassis, if so equipped, and carefully move the condenser to rest on the left fender apron. Secure it in this position.
6. Remove the grille.
7. Remove the camshaft thrust plate attaching bolts, and carefully remove the camshaft from the front of engine. **Do not damage the camshaft bearings.**

Refer to Part 21-01 for cleaning and inspection procedures.

Refer to Part 21-01 for repair procedure.

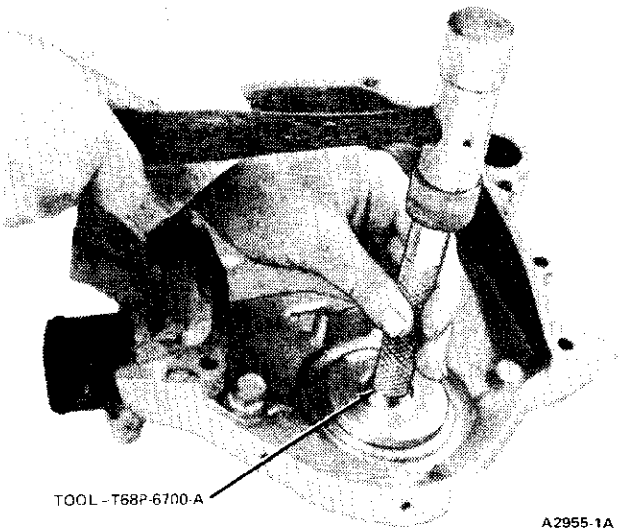


FIG. 26 Installing Front Oil Seal

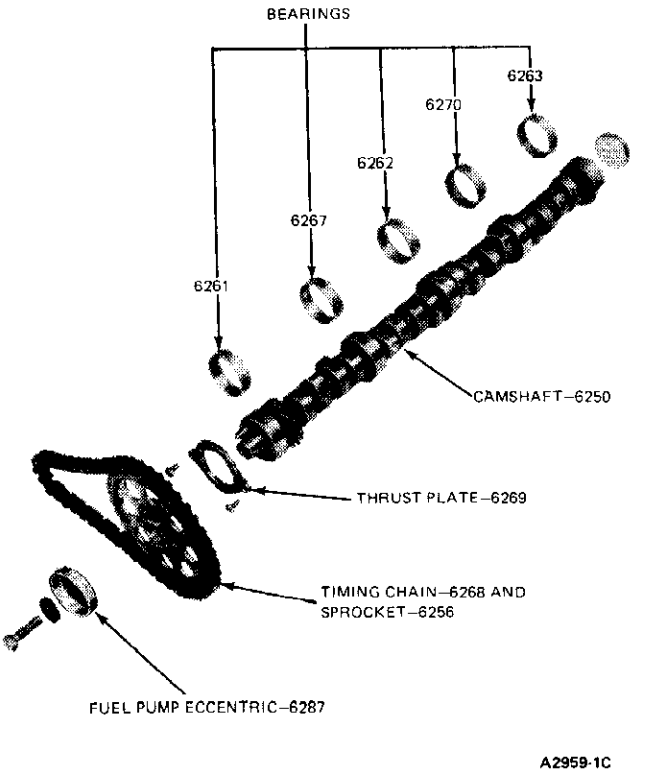


FIG. 27 Camshaft and Related Parts

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Installation

1. Oil the camshaft journals and apply Lubriplate or equivalent to the cam lobes. Carefully slide camshaft into position.
2. Install camshaft thrust plate. Check camshaft end play, following procedure in Part 21-01. If end play is excessive, replace the camshaft thrust plate.
3. Install timing chain, sprockets, and cylinder front cover as detailed under Cylinder Front Cover and Timing Chain. Install the vibration damper.
4. Position the radiator in the vehicle and install the radiator upper support to secure radiator. Connect the radiator fan shroud, fresh air duct assembly hose and transmission oil cooler lines.
5. Install the grille center support and air conditioning condenser, if so equipped.
6. Lubricate the tappets and tappet bores with heavy oil SE before installing them. Lubricate the push rod ends with Lubriplate or equivalent. Install the tappets and push rods in their original position.
7. Install intake manifold and carburetor, following the procedure under Intake Manifold.
8. Rotate the crankshaft damper until No. 1 piston is at TDC at the end of compression stroke. Position the distributor in the block with the rotor at No. 1 firing position and the stator tooth centered on the magnetic pickup (see Part 23-01). Install the hold down clamp. Connect the distributor wiring harness.
9. Apply Lubriplate or equivalent to valve stem tips. Position rocker arms over push rods and tighten bolts following the procedure under Valve Rocker Arm Installation. Check tappet clearance, as shown in Part 21-01.
10. Clean the valve rocker arm covers and cylinder head gasket surfaces. Apply oil-resistant sealer to one side of the new cover gaskets. Lay the cemented side of gaskets in place in the covers.
11. Position the covers on the cylinder heads and make sure that gaskets seat evenly. Install cover attaching bolts and torque to specification. Two minutes later, torque bolts to same specification.
12. Connect the radiator upper hose. Connect heater hose at intake manifold and at water pump.
13. Connect the fuel line to carburetor.
14. Install the coil and bracket assembly to intake manifold.
15. Install the accelerator linkage. Install the speed control linkage, if so equipped.
16. Engage engine wiring harness in clips on left cylinder head and connect all wire terminals. Connect engine vacuum lines to their original outlets on the fitting at rear of the intake manifold. Connect positive crankcase ventilation (PCV) valve and hose to right valve rocker arm cover.
17. Install the distributor cap and connect the coil and spark plug wires. See Part 23-01 for special installation instructions.
18. Place the water pump pulley and drive belts in position. Place the fan assembly in the radiator shroud and set in position. Position the fan assembly to water pump hub and install and torque the attaching screws to specification. Install screws attaching shroud to the radiator.
19. Adjust the tension of drive belts to specifications and tighten attaching screws.
20. Fill and bleed the cooling system and power steering reservoir. Run engine at fast idle and check for leaks.
21. Adjust the ignition timing and connect distributor and all other vacuum lines.
22. Check and adjust the carburetor idle speed and mixture as required after engine temperature has stabilized. Adjust transmission linkage, if necessary. Install the air cleaner and intake duct.

FLYWHEEL

Removal

1. Remove the transmission from vehicle. Remove the mounting bolts and remove flywheel from the crankshaft.

   Refer to Part 21-01, for inspection.

Installation

1. Install flywheel on crankshaft. Install the mounting bolts and torque to specifications.
2. Check flywheel runout and ring gear runout following procedure in Part 21-01.
3. Install transmission assembly in vehicle.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission from the vehicle as detailed in Group 17.
2. Remove flywheel and engine rear cover plate, following procedure under Flywheel Removal.
3. Replace the plug as detailed under Core Plugs in Part 21-01.

Installation

1. Install the engine rear cover plate and flywheel, following procedure under Flywheel Installation.
2. Install the transmission as detailed in Group 17.

OIL PAN

Lincoln Continental and Continental Mark V

Removal

1. Disconnect the battery ground cable. Disconnect the two transmission oil cooler lines from the radiator and move aside.
2. Remove the fresh air intake duct, radiator shroud attaching bolts and position the shroud over the fan.
3. Raise the vehicle on a hoist.
4. Drain the crankcase. Remove "X" brace below oil pan (Continental Mark V).
5. Remove end attachments of front stabilizer bar and rotate ends of bar down to raise center of bar.
6. Support the engine with a jack, then remove long engine support through-bolts.
7. Raise the engine high enough to position a wood block 3 inches high between each engine support

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DETROIT IRON

bracket and frame. Lower the engine to allow the blocks to support the engine.

8. Remove the oil pan attaching bolts and lower the pan to the No. 2 crossmember. Position rear crankshaft throw horizontally to ease pan removal.
9. Remove the pan.

Refer to Part 21-01 for cleaning and inspection procedures. Check the gasket surface for damage caused by over-torqued bolts. Straighten the surface as required to restore original flatness.

Installation

1. Clean the gasket surfaces of the block and oil pan. Coat the block gasket surface with Ford contact cement or equivalent. Position the oil pan gaskets on the cylinder block.
2. Position the oil pan front seal on the cylinder front cover. Be sure that the tabs on the seal are over the oil pan gasket.
3. Position the oil pan rear seal on the rear main bearing cap. Be sure that the tabs on the seals are over the oil pan gasket.
4. Hold the oil pan in place against the block and install a bolt, fingertight, on each side of the pan. Install the remaining bolts. Torque the bolts from the center outward in each direction to specification.
5. Raise the engine and remove the two wood support blocks.
6. Install the engine support.
7. Lower the engine into place and install and torque the engine support through-bolts to specification.
8. Rotate front stabilizer bar into position and attach ends to lower control arms.
9. Lower the vehicle to the floor.
10. Position the radiator shroud and install the attaching bolts. Install the carburetor fresh air inlet duct.
11. Connect the transmission oil cooler lines to the radiator.
12. Fill the crankcase to the proper level with the recommended oil.
13. Connect the battery ground cable. Start the engine and check for leaks and correct as required.

Ford and Mercury

Removal

1. Disconnect the battery ground cable. Disconnect the fresh air inlet tube, remove the radiator shroud from the radiator, and position it over the fan.
2. Raise the vehicle on a hoist and drain the crankcase.
3. Remove the sway bar attaching bolts. Remove the two bolts and bushings that attach the sway bar to the lower arms. Move the sway bar forward on the struts.
4. Remove the through bolt from each engine support. Place floor jack under the front edge of the oil pan, with block of wood between jack and oil pan. Raise the engine just enough to insert 2x4 inch blocks of wood between the insulators and brackets. Remove the floor jack.
5. Remove the oil pan attaching bolts and lower the pan. Rotate the crankshaft to provide clearance between the pan and crank throw or counterweight.
6. Remove the oil pan.
7. Refer to Part 21-01 for cleaning and inspection procedures. Check the gasket surface for damage caused by over-torqued bolts. Straighten the surface as required to restore original flatness.

Installation

1. Clean the gasket surfaces of the block and oil pan. Coat the block gasket surface and the oil pan gasket surface with Ford contact cement or equivalent. Position the oil pan gaskets on the cylinder block.
2. Position the oil pan front seal on the cylinder front cover. **Be sure that the tabs on the seal are over the pan gasket.**
3. Position the oil pan rear seal on the rear main bearing cap. **Be sure that the tabs on the seal are over the oil pan gasket.**
4. Hold the oil pan in place against the block and install a bolt, fingertight, on each side of the oil pan. Install the remaining bolts. Torque the bolts from the center outward in each direction to specification.
5. Move the stabilizer bar into position and install the attaching bolts. Rotate the stabilizer bar into position and attach the ends to the lower control arms.
6. Clean the oil filter seal surface and install a new oil filter.
7. Raise the engine slightly with a floor jack and wood block against the forward edge of the oil pan. Remove the wood spacers from under the front support insulators. Lower the engine as required to install the insulator through bolts. Remove the jack, then torque the nuts to specification.
8. Lower the vehicle on a hoist and attach shroud and fresh air tube. Connect the battery ground cable.
9. Fill the crankcase to the proper level with the recommended oil. Start the engine and check for leaks.

OIL PUMP

Removal

1. Remove the oil pan, following the procedure under Oil Pan Removal.
2. Remove the oil pump mounting bolts, and remove the pump from the cylinder block.

Installation

1. Prime the oil pump by filling the inlet port with engine oil. Rotate the pump shaft to distribute oil within the pump body.
2. Install the distributor intermediate shaft in the oil pump rotor.
3. Insert the intermediate shaft into the distributor shaft hex bore. Make certain that the intermediate shaft is properly seated. Do not force the pump into position if it will not seat readily. The intermediate shaft hex may be misaligned with distributor shaft.

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To align, rotate the intermediate shaft until it can be seated. Secure the oil pump to cylinder block and torque the screws to specifications.

4. Install the oil pan and related parts, following procedure under Oil Pan Installation.

CRANKSHAFT REAR OIL SEAL

A split-lip type crankshaft rear oil seal is used for replacement on all engines. If replacement is necessary, this type of seal must be used. The complete seal can be replaced without removing the crankshaft. Refer to Part 21-01 for removal and installation procedures.

MAIN BEARING

Main and connecting rod bearing inserts are selective fits.

Selective fit bearings are available for service in standard size. 0.001 and 0.002 inch undersize. Undersize bearings, (0.010, 0.020, 0.030 and 0.040 inch) which are not selective fit, are available for use on crankshaft journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts, following the procedure under Oil Pan Removal.
2. Remove the oil pump.
3. Replace one bearing at a time, leaving other bearings securely fastened. Remove the main bearing cap to which new bearings are to be installed.
4. Insert the upper bearing removal tool (Tool 6331) in oil hole in crankshaft (Fig. 28).
5. Rotate the crankshaft in the direction of engine rotation to force bearing out of block.
6. Clean the crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear.

Installation

1. To install upper main bearing, place plain end of bearing over shaft on locking tang side of block and partially install bearing so Tool 6331 can be inserted in oil hole in crankshaft (Fig. 29). With Tool 6331 in oil hole, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
2. Fit the main bearings as detailed in Part 21-01 under Fitting Bearings with Plastigage.
3. After the bearing has been fitted, apply light coat of engine oil to journal and bearings. Install the bearing cap. Torque the cap bolts to specification.
4. Repeat the procedure for remaining bearings that require replacement.
5. If the rear main bearing is to be replaced, remove the rear main bearing cap. Remove and discard the rear oil seal.
6. Clean rear journal oil seal groove and mating surfaces of block and rear main bearing cap.
7. Install the new seal.

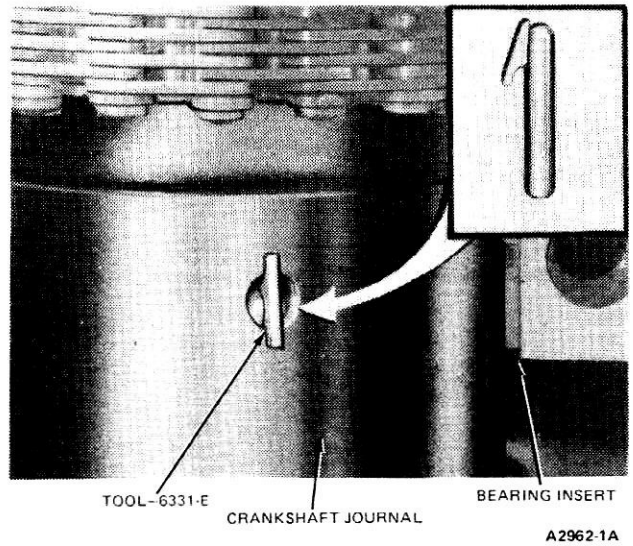


FIG. 28 Removing or Installing Upper Main Bearing Insert

8. Refer to Part 21-01 for procedure used in sealing the rear main bearing cap. After sealing, install the rear main bearing cap and torque cap bolts to specification.
9. If thrust bearing cap (No. 3 main bearing) has been removed, install as follows:

   Install the thrust bearing cap with bolts finger-tight. Pry the crankshaft forward against the thrust surface of upper half of bearing (Fig. 29). Hold the crankshaft forward and pry thrust bearing cap to rear. This aligns thrust surfaces of both halves of bearing. Retain forward pressure on crankshaft. Torque cap bolts to specification.
10. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump following procedure under Oil Pump Installation.
11. Install the oil pan, following procedure under Oil Pan Installation.
12. Fill the crankcase to the proper level with the recommended oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARING

Removal

1. Follow steps 1 and 2 under Main Bearing Removal.
2. Turn the crankshaft until connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from rod and cap.
3. Be sure the bearing inserts and bearing bore in connecting rod and cap are clean. Foreign material under inserts will distort bearing and cause a failure.
4. Clean the crankshaft journal. When replacing standard bearings with new bearings, it is good practice to fit the bearing to minimum specified clearance.

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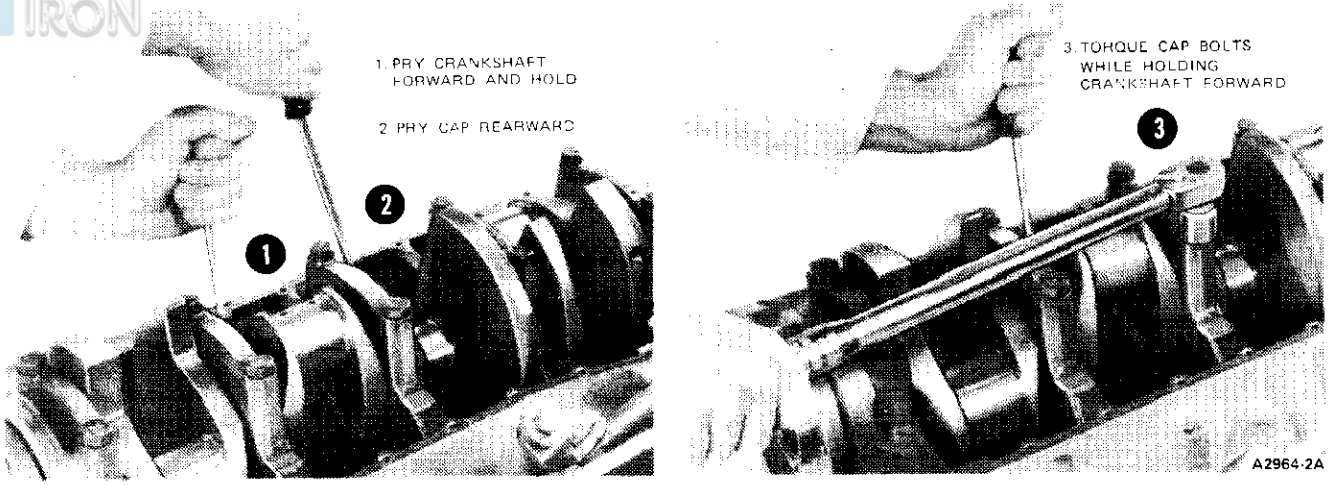


FIG. 29 Aligning Thrust Bearing

Installation

1. Fit connecting rod bearings as detailed in Part 21-01 under Fitting Bearings with Plastigage.
2. Install the bearing inserts in the connecting rod and cap with tangs in the slots provided.
3. Pull the connecting rod assembly down firmly on the crankshaft journal.
4. Apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Be sure the connecting rod bolt heads are properly seated in the connecting rod. Torque the nuts to specification.
5. Repeat the procedure for the remaining connecting rods that require new bearings.
6. To complete installation, follow instructions under Main Bearing Installation.

Refer to Part 21-01 for cleaning and inspection procedures.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following procedures in this section.
2. Remove any ridge and/or deposits from upper end of cylinder bores as follows:

   Turn the crankshaft until the piston to be removed is at bottom of its travel. Place a cloth on top of the piston to collect cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore. Remove the cylinder ridge with a ridge cutter. Follow instructions furnished by tool manufacturer. **Never cut into ring travel area in excess of 1/32 inch when removing ridges.** Repeat the procedure at the remaining cylinders.
3. Make sure that all connecting rod caps are marked so they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out through the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze. Follow instructions as detailed in Part 21-01.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install pistons in the same cylinders from which they were removed or to which they were fitted. Connecting rod and bearing caps are numbered from 1 to 4 in the right bank, and 5 to 8 in the left bank, beginning at the front of engine. Numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure that ring gaps are properly spaced around circumference or piston (Fig. 30).
4. Install piston ring compressor on piston and push in with hammer handle until it is slightly below top of cylinder (Fig. 31). Be sure to guide connecting rods while tapping them into position to avoid damaging crankshaft journals. **Install piston with indentation notch in piston head toward front of engine.**
5. Check clearance of each bearing, following procedure under Fitting Connecting Rod Bearings, Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the connecting rod bearings seat on the crankshaft journal.

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8. Install the connecting rod cap. Be sure connecting rod bolt heads are properly seated in the connecting rod. Torque the nuts to specifications.
9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal.
10. Disassemble, clean and assemble the oil pump. Clean the oil pump inlet tube screen, and oil pan and the block gasket surfaces.
11. Prime the oil pump by filling the inlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump. Install the oil pan, following the procedure under Oil Pan Installation.
12. Install the cylinder heads, following instructions under Cylinder Head Installation.
13. Install the intake manifold, following instructions under Intake Manifold Installation.
14. Fill and bleed the cooling system. Fill the crankcase to the correct level with the specified engine oil.
15. Start the engine and adjust the ignition timing. Connect the distributor vacuum line.
16. Operate the engine at fast idle and check for oil and coolant leaks. With the engine temperatures stabilized, adjust the engine curb idle speed and mixture.
17. Install the air cleaner and intake duct assembly.

CRANKSHAFT

To perform the following operation, it is necessary to remove the engine and install it on a work stand.

Crankshaft and related parts are shown in Fig. 32.

Removal

1. Disconnect the wires from the spark plugs. Remove the spark plugs to allow easy rotation of crankshaft. Drain the oil and coolant from the engine.
2. Remove the fuel pump and the oil filter. Slide water pump by-pass hose clamp toward the water pump.
3. Remove the crankshaft pulley from the vibration damper.
4. Remove the cap screw and washer from the end of the crankshaft. Install a puller on the crankshaft vibration damper (Fig. 19) and remove damper. Remove Woodruff key.
5. Remove the cylinder front cover and water pump as an assembly. Check the timing chain deflection. Remove the timing chain and sprockets as detailed in Cylinder Front Cover and Timing Chain Removal.
6. Invert the engine on a work stand. Remove the flywheel and the engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. Make sure that all bearing caps (main and connecting rod) are marked so they can be installed in their original locations.

   Turn the crankshaft until the connecting rod from which cap is being removed is down, then remove the bearing cap. Push the connecting rod and piston assembly up out of the cylinder. Repeat this procedure until all connecting rod bearing caps are removed.
8. Remove the main bearing caps.
9. Carefully lift the crankshaft out of the block so thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to finished surfaces.**

   Refer to Part 21-01 for cleaning and inspection procedures. Clean the crankshaft damper.

   To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

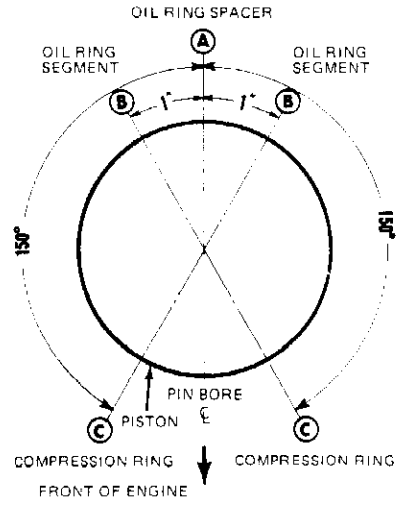


FIG. 30 Piston Ring Spacing

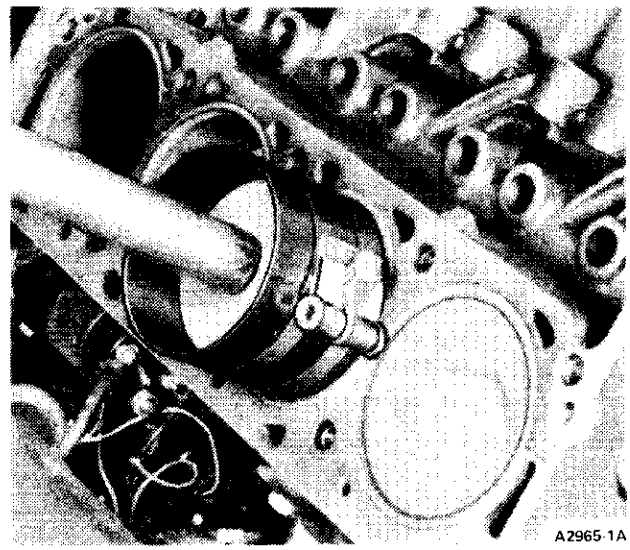


FIG. 31 Installing Piston Assembly

Installation

1. Remove the rear journal oil seal from block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.

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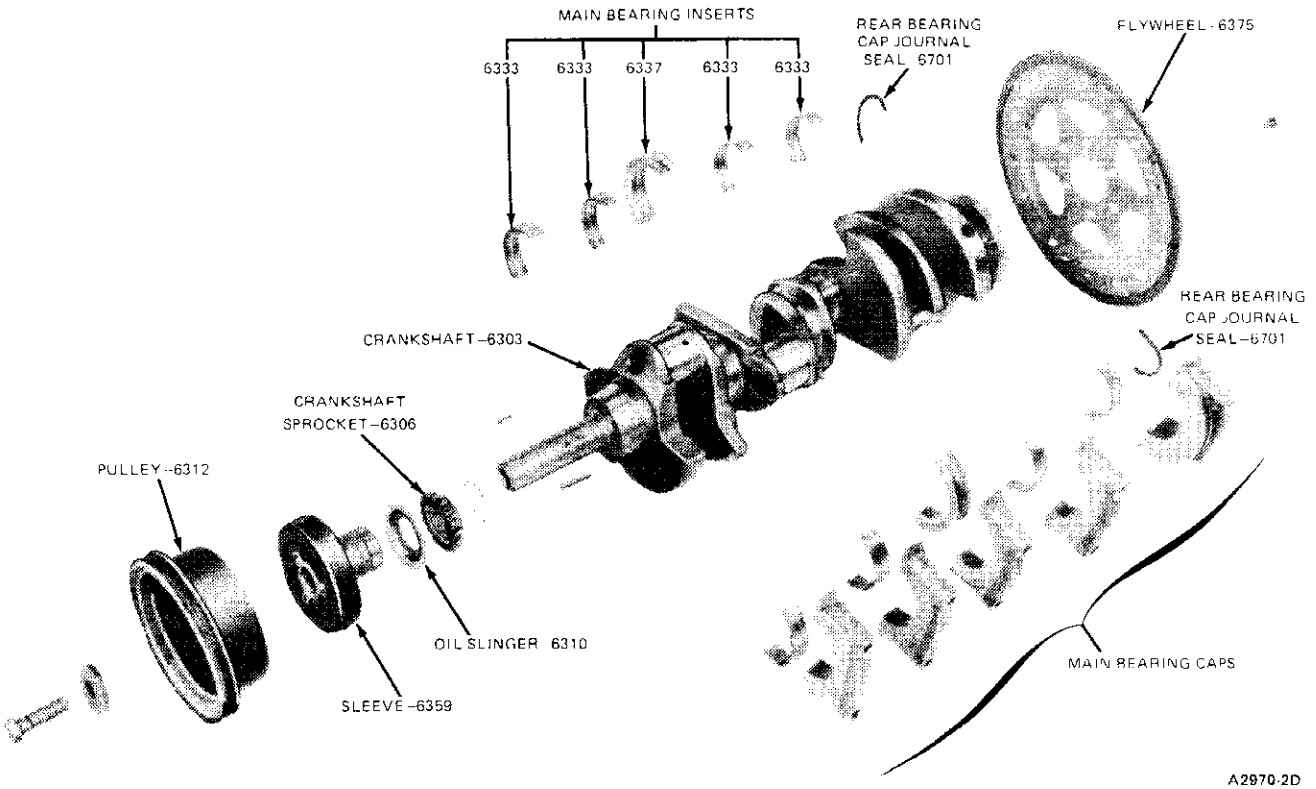


FIG. 32 Crankshaft and Related Parts

4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearing. Be sure that bearing inserts and bearing bores are clean. Foreign material under inserts will distort the bearing and cause failure.
5. Place the upper main bearing inserts in the bores with tang in slot.
6. Install lower main bearing inserts in bearing caps.
7. Clean the rear journal oil seal groove and mating surfaces of the block and rear main bearing cap.
8. Install a new rear main bearing oil seal in the block and cap as detailed in Part 21-01.
9. Carefully lower the crankshaft into place. **Be careful not to damage bearing surfaces.**
10. Check the clearance of each main bearing as detailed in Part 21-01.
11. After bearings have been fitted, apply light coat of engine oil to journals and bearings. Install a new seal in the rear main bearing cap and install the rear main bearing cap. Install all bearing caps except thrust bearing cap (No. 3 bearing). **Be sure that main bearing caps are installed in original locations.** Torque the bearing cap bolts to specification.
12. Install the thrust bearing cap with bolts fingertight.
13. Pry the crankshaft forward against thrust surface of upper half of bearing (Fig. 29).
14. Hold crankshaft forward and pry thrust bearing cap to rear. This aligns thrust surfaces of both halves of bearing.
15. Retain forward pressure on the crankshaft. Tighten cap bolts to specifications.
16. Force the crankshaft toward the rear of engine.
17. Check the crankshaft end play (refer to Part 21-01).
18. Install new bearing inserts in the connecting rods and caps. Check clearnace of each bearing, following procedure detailed in Part 21-01, Fitting Bearings with Plastigage.
19. After the connecting rod bearings have been fitted, apply light coat of engine oil to journals and bearings.
20. Turn the crankshaft throw to bottom of its stroke. Push the piston all the way down until rod bearing seats on the crankshaft journal.
21. Install the connecting rod cap. Be sure that connecting rod bolt heads are properly seated in connecting rod. Torque nuts to specifications.
22. After piston and connecting rod assemblies have been installed, check side clearance between connecting rods on each connecting rod crankshaft journal.
23. Install timing chain and sprockets, cylinder front cover, and crankshaft damper as detailed in Cylinder Front Cover and Timing Chain Installation.
24. Install the engine rear cover plate. Coat flywheel attaching bolt threads with oil-resistant sealer. Position flywheel on crankshaft flange. Install and torque the bolts to specifications.
25. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling inlet port with engine oil and rotating pump shaft to distribute oil within housing. Install oil pump and oil pan by following procedures under Oil Pan and Oil Pump Installation.

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26. Install the oil filter and fuel pump, and connect the fuel lines.
27. Install the spark plugs and connect the spark plug wires.
28. Install the engine in vehicle.

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and undersize journal diameters.

Removal

1. Remove the camshaft, flywheel, and crankshaft, following the appropriate procedures in this part. Push pistons to top of cylinders.
2. Remove the camshaft rear bearing bore plug as detailed under "Core Plugs" in Part 21-01. Remove camshaft bearings using special tool shown in Fig. 33.

Installation

1. Select the proper size expanding collet and back-up nut and assemble on expanding mandrel. With the expanding collet collapsed, install the collet in the camshaft bearing, and tighten back-up nut on expanding mandrel until collet fits camshaft bearing.
2. Assemble the puller screw and extension (if necessary) as shown in Fig. 33 and install on expanding mandrel. Wrap a cloth around threads of the puller screw to protect the front bearing or journal. Tighten pulling nut against the thrust bearing and pulling plate to remove camshaft bearing. Hold a wrench on the end of puller screw to prevent it from turning.
3. Repeat the procedure for each bearing. To remove the front bearing, install puller screw from rear of cylinder block.
4. Position new bearings at bearing bores, and press in place with the tool shown in Fig. 33. Be sure to center the pulling plate and puller screw to avoid bearing damage. **Failure to use correct expanding collet can cause severe bearing damage.** Align oil holes in bearings with oil holes in cylinder block before pressing them into block. Be sure front bearing is installed specified distance below front face of cylinder block (Fig. 34).
5. Install the bearing bore plug as detailed under "Core Plugs" in Part 21-01.
6. Install the camshaft, crankshaft, flywheel and related parts, following appropriate procedures in this part, except do not check connecting rod and main bearing clearances.

OIL FILTER

Removal

The oil filter assembly is shown in Fig. 35.

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting with a suitable filter wrench and clean the adapter recess. Clean the oil filter gasket surface.

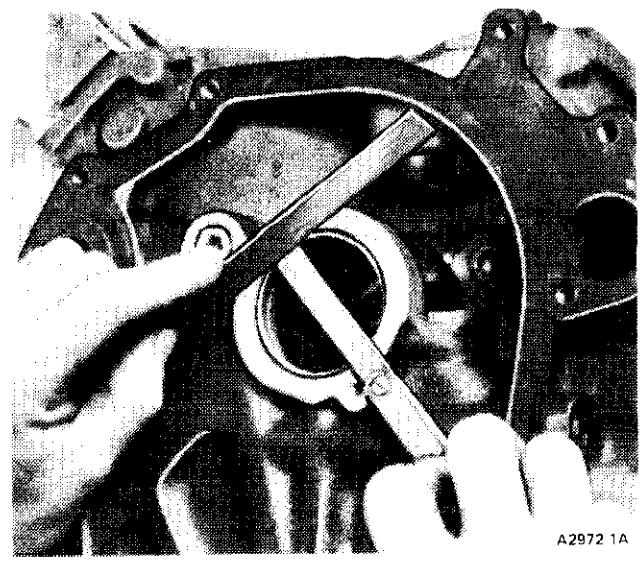


FIG. 34 Measuring Depth of Camshaft Front Bearing

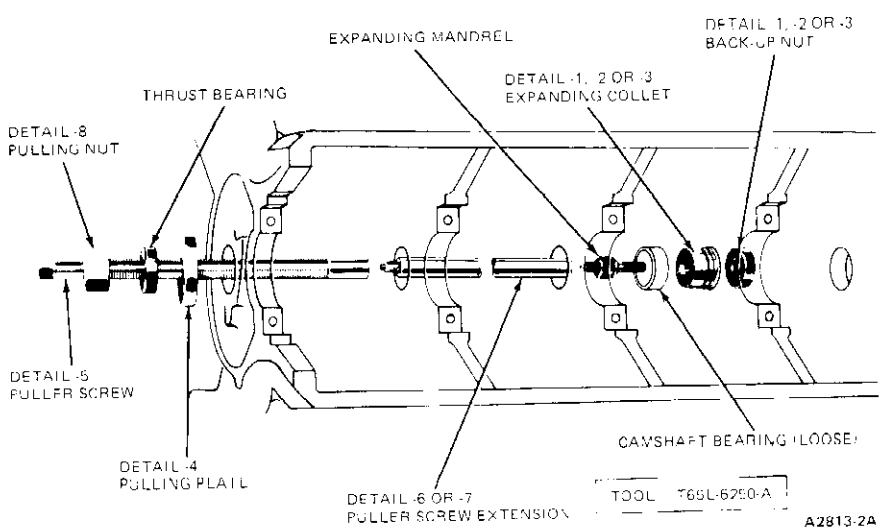


FIG. 33 Replacing Camshaft Bearing

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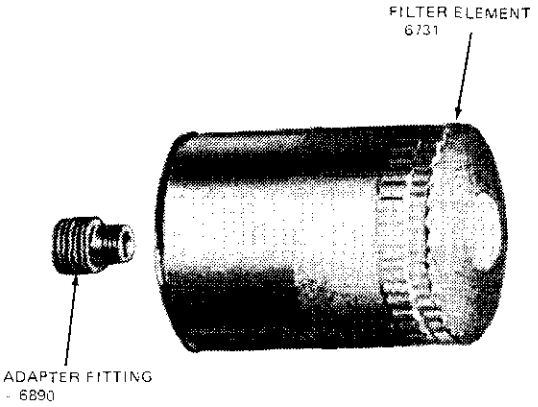


FIG. 35 Oil Filter

Installation

1. Coat the gasket on a new filter with oil. Place a new filter on the adapter fitting. Hand tighten the filter until the gasket contacts the sealing surface then tighten 1/2 turn more.
2. Operate the engine at fast idle and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase to the correct level.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued, refer to Specifications. Oil the threads with light engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

HYDRAULIC TAPPETS

Each tappet is a matched assembly. If parts of one are intermixed with those of another, improper valve operation may result. Disassemble and assemble each tappet separately. Tappets should be tested after assembly as described in Part 21-01. Keep the tappet assemblies in proper sequence so they can be installed in their original bores.

Disassembly

A typical hydraulic tappet assembly is shown in Fig. 36.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly and the plunger spring. Carefully remove the plunger spring, check valve retainer spring, check valve retainer and check valve disc from the plunger.

   Refer to Part 21-01 for cleaning and inspection procedures.

Assembly

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).
3. Position the check valve retainer over the check valve and spring then push the retainer down into place on the plunger.

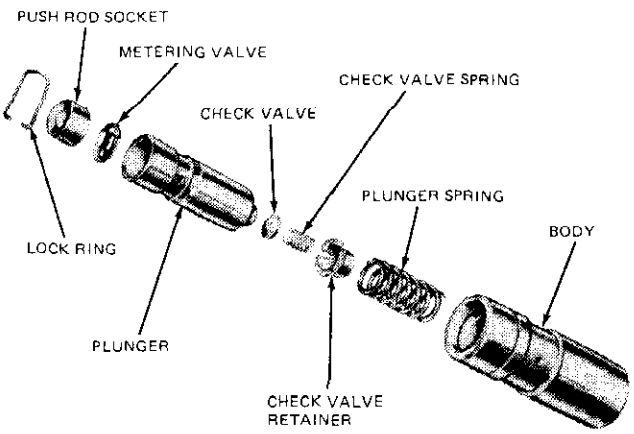


FIG. 36 Typical Hydraulic Tappet

4. Place the plunger spring and the plunger (open end *up) into tappet body.*
5. Position the metering valve (disc) in the plunger, and place push rod seat in the plunger.
6. Depress the plunger and position the closed end of lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use a hydraulic tappet leak-down tester to fill the *tappet with test fluid.*

CYLINDER HEAD

Disassembly

1. Remove rocker arm bolts, oil deflectors, fulcrum seats and rocker arms. Remove exhaust manifolds and spark plugs.

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2. Clean carbon from combustion chambers before removing valves.
3. Compress valve springs (Fig. 37). Remove spring retainer locks and release springs. Remove retainers, springs, stem seals, and valves. Discard stem seals.

   Clean and inspect cylinder head(s) and related components, using pertinent procedures in Part 21-01.

   Refer to Part 21-01 for repair procedures for cylinder heads and valves.

Assembly

Lubricate all valves, valve stems and valve guides with heavy oil SE. The valve tips are to have Lubriplate or equivalent applied. The lubricant is to be applied before installation.

1. Install each valve in port from which it was removed or to which it was fitted. Install new stem seal on each valve.
2. Set valve spring and retainer over valve stem. Compress spring (Fig. 37) and install retainer locks.
3. With dividers, measure assembled height of valve spring from surface of spring pad on cylinder head to underside of spring retainer (Fig. 38). Check dividers with accurate scale. If assembled height exceeds specification, install spacer(s) below spring to reduce height to recommended dimension. **Reducing assembled height below specification can cause spring breakage and rapid wear of cam lobe.**
4. Coat the fulcrum seats and sockets with Lubriplate or equivalent. Make certain that the rocker arm bolts are in serviceable condition before installing them. Install rocker arms, fulcrum seats, oil deflectors and bolts as detailed under Valve Rocker Arm Installation.
5. Install exhaust manifolds and spark plugs. Refer to Part 21-01 for cleaning and inspection procedures.

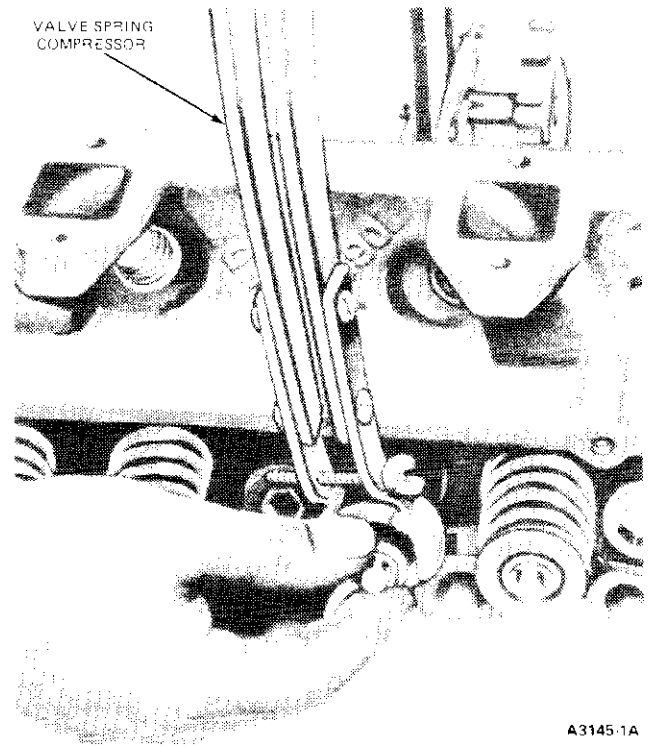


FIG. 37 Compressing Valve Spring—On Bench

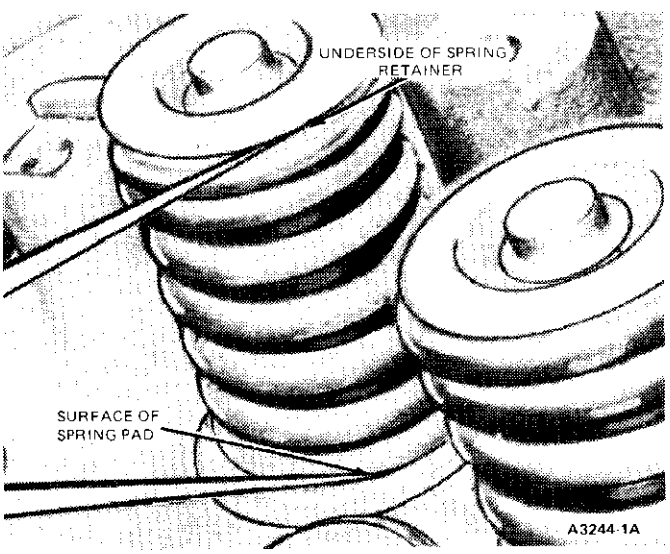


FIG. 38 Measuring Valve Spring Assembled Height

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons to assure assembly with same rod and installation in the same cylinders from which they were removed.
3. Using an arbor press and tool shown in Fig. 39, press the piston pin from the piston and connecting rod. Remove the piston rings.

   Refer to Part 21-01 for cleaning and inspection procedures.

   Refer to Part 21-01 for repair procedures.

Assembly

Check the fit of a new piston in the cylinder bore before assembling piston and piston pin to connecting rod. Piston pin bore of connecting rod and diameter of piston pin must be within specification.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and indentation notch in piston positioned as shown in Fig. 40.
2. Start the piston pin in the piston and the connecting rod. Using an arbor press, press the piston pin through the piston and connecting rod until the end of pin is 1/16-inch to 1/8-inch below chamfer of the pin bore in the piston.
3. Check the end gap of all piston rings. End gap must be within specification. Follow the instructions contained on piston ring package and install the piston rings.
4. Check the ring side clearance of compression rings with a feeler gauge inserted between the ring and

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DETROIT IRON

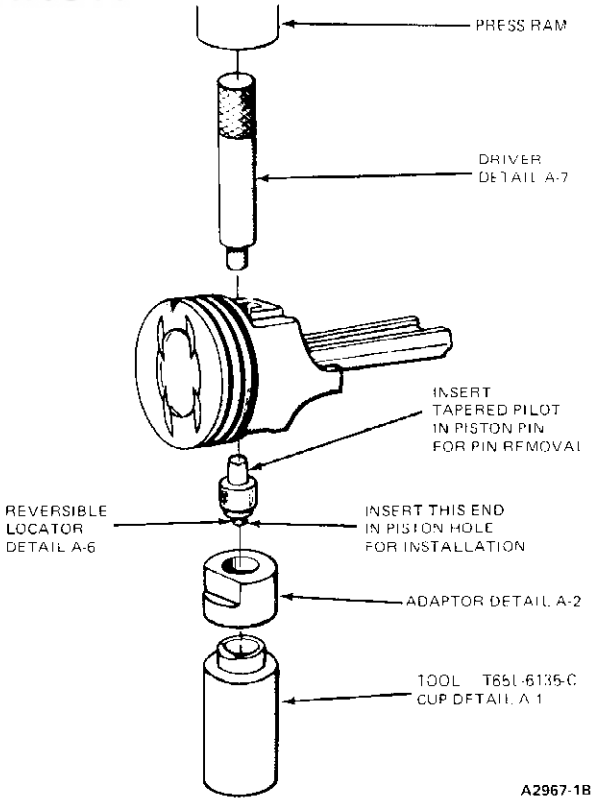


FIG. 39 Removing or Installing Piston Pin—Typical

the lower land. Feeler gauge should slide freely around the ring circumference without binding. Any wear will form a step at the inner portion of the lower land. **If the lower lands have high steps, replace the piston.**

5. Be sure the bearing inserts and bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause failure. Install bearing inserts in connecting rod and cap with tangs fitting in slots provided.

CYLINDER ASSEMBLY

Disassembly

1. Mount the old engine in a work stand and remove all the parts not furnished with the new cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
2. Remove the 4 cylinder head locating dowels and the block drain plugs.
3. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.

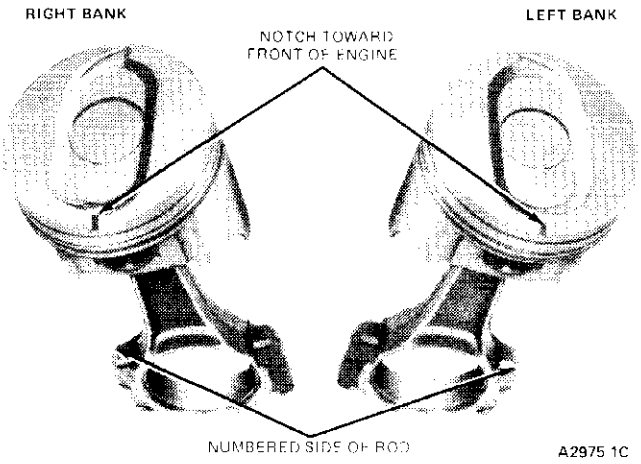


FIG. 40 Correct Piston and Rod Positions

2. Position the new cylinder assembly in a work stand and install the cylinder head locating dowels and block drain plugs.
3. Transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in the Removal and Installation Section of this Part.
4. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Mount the old engine in a work stand and completely disassemble it, following the procedures given in the Removal and Installation Section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.
3. Remove the cylinder head locating dowels and the block drain plugs.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand and install the cylinder head locating dowels and the block drain plugs.
3. Transfer all serviceable parts removed from the old cylinder block, following the procedures given in the Removal and Installation Section of this Part.
4. Check all assembly clearances and correct as necessary.

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SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	7.5L (460 CID)
NUMBER OF CYLINDERS/TYPE	V8-OHV
BORE AND STROKE	4.36 x 3.85
FIRING ORDER	1-5-4-2-6-3-7-8
OIL PRESSURE (Hot @ 2000 RPM)	40-65
DRIVE BELT TENSION	(1)
COMPRESSION PRESSURE	(2)

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	94.7-97.7
VALVE GUIDE BORE DIAMETER	0.3433-0.3443
VALVE SEATS	
Width – Intake	0.060-0.080
Width – Exhaust	0.060-0.080
Angle	45°
Runout Limit (T. I. R. Max.)	0.002
VALVE ARRANGEMENT (Front to Rear)	(RH) E-I-E-I-E-I-E-I (LH) I-E-I-E-I-E-I-E
VALVE STEM-TO-GUIDE CLEARANCE	
Intake	0.0010-0.0027
Exhaust	0.0010-0.0027
Service Clearance	0.0055
VALVE HEAD DIAMETER	
Intake	2.075-2.090
Exhaust	1.645-1.661
VALVE FACE RUNOUT LIMIT	0.002 Max.
VALVE FACE ANGLE	44°
VALVE STEM DIAMETER (Std)	
Intake	0.3416-0.3423
Exhaust	0.3416-0.3423
(0.003 Oversize)	
Intake	0.3446-0.3453
Exhaust	0.3446-0.3453
(0.015 Oversize)	
Intake	0.3566-0.3573
Exhaust	0.3566-0.3573
(0,030 Oversize)	
Intake	0.3716-0.3723
Exhaust	0.3716-0.3723
VALVE SPRINGS	
Compression Pressure (Lb. @ Spec. Length)	76-84 @ 1.81 218-240 @ 1.33
Free Length (Approximate)	2.07
Assembled Height	1-51/64–1-53/64
Service Limit	(3)
Out-Of-Square Limit	5/64 (0.078)
ROCKER ARM	
Ratio	1.73:1
PUSH ROD RUNOUT (T. I. R. Max.)	0.015
VALVE TAPPET OR ADJUSTER	
Diameter (Std)	0.8740-0.8745
Clearance To Bore	0.0007-0.0027
Service Limit	0.005
Hydraulic Leakdown Rate	5-50 Seconds (4)
Collapsed Tappet Gap – Allowable	0.075-0.175
– Desired	0.100-0.150

(1)

Size	Newly Installed (A)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (B)	40-60 (B)
Exc. 1/4"	120-160	90-160 (C)	75-120 (D)

(A) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(B) If less than 40 pounds, readjust to 40-60 pounds.
(C) If less than 90 pounds, readjust to 90-120 pounds.
(D) If less than 75 pounds, readjust to 90-120 pounds.

(2) PSI If lowest cylinder must be 75% of highest.
(3) 10% Pressure loss @ specified length.
(4) To leak down 1/16", with 50 lb. load and tappet filled with leakdown fluid.
(5) Distance front edge of bearing is below front face of block.
(6) 0.003 in any 6 inches; 0.006 overall.
(7) For 0.002 Undersize, add 0.001 to standard.

CAMSHAFT	Police Interceptor	Pass.
LOBE LIFT		
Intake	0.278	0.253
Exhaust	0.290	0.278
Allowable Lobe Lift Loss	0.005 Max.	0.005 Max.
THEORETICAL VALVE LIFT @ ZERO LASH		
Intake	0.481	0.437
Exhaust	0.502	0.481
END PLAY	0.001-0.006	
Service Limit	0.009	
JOURNAL-TO-BEARING CLEARANCE	0.001-0.003	
Service Limit	0.006	
JOURNAL DIAMETER		
# 1	2.1238-2.1248	
# 2	2.1238-2.1248	
# 3	2.1238-2.1248	
# 4	2.1238-2.1248	
# 5	2.1238-2.1248	
Runout Limit (T. I. R. Max.)	0.005	
Out-Of-Round Limit (T. I. R. Max.)	0.0005	
BEARING INSIDE DIAMETER (ALL)	2.1258-2.1268	
FRONT BEARING LOCATION (5)	0.040-0.060	

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	(6)
HEAD GASKET SURFACE FINISH (RMS)	60-150
CYLINDER BORE	
Diameter	4.3600-4.3636
Surface (RMS)	18-38
Out-Of-Round Limit	0.0015
Out-Of-Round Service Limit	0.005
Taper Service Limit	0.010
TAPPET BORE DIAMETER	0.8752-0.8767
MAIN BEARING BORE DIAMETER	3.1922-3.1930
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	0.5160-0.5175

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL DIAMETER	2.9994-3.0002
Out-Of-Round Limit	0.0006 Max.
Taper Limit	0.0006 per inch
Journal Runout Limit	0.002 Max.
Runout Wear Limit	0.005
Surface Finish (RMS)	12 Max.
THRUST BEARING JOURNAL	
Length	2.1124-1.126
CONNECTING ROD JOURNAL	
Diameter	2.4992-2.5000
Runout Service Limit	0.0006 Max.
Taper Limit	0.0006 Max.
Surface Finish (RMS)	12 Max.
MAIN BEARING THRUST FACE	
Surface Finish (RMS)	25 Front/23 Rear
Runout Limit	0.001 Max.
FLYWHEEL RING GEAR LATERAL RUNOUT (T. I. R.)	
Automatic Transmission	0.060
CRANKSHAFT FREE END PLAY	0.004-0.008
Service Limit	0.012
CONNECTING ROD BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	0.0008-0.0026
Bearing Wall Thickness (Std) (7)	0.0756-0.0761
MAIN BEARINGS	
Clearance To Crankshaft – Desired	0.0008-0.0015
– Allowable	No. 1 = 0.0004-0.0021 All others = 0.0008-0.0026
Bearing Wall Thickness (Std) (7)	No. 1 (Upper) = 0.0960-0.0965 All others = 0.0935-0.0960

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DETROIT IRON OFFICIAL LICENSED PRODUCT

CONNECTING ROD, PISTON AND RINGS

CONNECTING ROD	
Piston Pin Bore Diameter	1.0386-1.0393
Crankshaft Bearing Bore Diameter	2.6530-2.6522
Out-Of-Round Limit	0.0004 Max.
Taper Limit	0.0004 Max.
Length (Center-to-Center)	6.6035-6.6065
Alignment (Bore-to-Bore Max. Diff.) (8)	
Twist	0.024
Bend	0.012
Side Clearance (Assembled to Crank)	
Standard	0.010-0.020
Service Limit	0.023
PISTON	
Diameter (9)	
Coded Red	4.3585-4.3591
Coded Blue	4.3597-4.3603
0.003 Oversize	4.3609-4.3615
Piston-To-Bore Clearance	0.0014-0.0022
Pin Bore Diameter	1.0402-1.0405
Ring Groove Width	
Compression (Top)	0.0805-0.0815
Compression (Bottom)	0.0805-0.0815
Oil	0.188-0.189
PISTON PIN	
Length	3.290-3.320
Diameter	
Standard	1.0398-1.0403
0.001 Oversize	1.0410-1.0413
Pin-To-Piston Clearance	0.0002-0.0004
Pin-To-Rod Clearance	Interference Fit
PISTON RINGS	
Ring Width	
Compression (Top)	0.077-0.078
Compression (Bottom)	0.077-0.078
Side Clearance	
Compression (Top)	0.0025-0.0045
Compression (Bottom)	0.0025-0.0045
Service Limit	0.006
Oil Ring	Snug Fit
Ring Gap	
Compression (Top)	0.010-0.020
Compression (Bottom)	0.010-0.020
Oil Ring (Steel Rail)	0.015-0.055

LUBRICATING SYSTEM

OIL PUMP	
Relief Valve Spring Tension (Lbs. at Spec. Length)	20.6-22.6 @ 2.49
Drive Shaft-To-Housing Bearing Clearance	0.0015-0.0030
Relief Valve-To-Bore Clearnace	0.0015-0.0030
Rotor Assembly End Clearance (Assembled)	0.004 Max.
Outer Race-Ro-Housing Clearance	0.001-0.013
OIL CAPACITY (Quarts U. S.)	4 (10)

FUEL PUMP

STATIC PRESSURE (P. S. I.) (11)	5.7-7.7
MINIMUM VOLUME FLOW (11) (12)	1 pt./20 sec
ECCENTRIC TOTAL LIFT (Inches)	0.890-0.910

(8) Pin and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at ends of an 8" bar, 4" on each side of rod centerline.
(9) Measured at piston pin bore centerline; at 90° to the pin.
(10) Add 1 quart when changing filter.
(11) With new filter in line and pump-to-tank return line pinched off.
(12) No orifice in test circuit smaller than 0.220" I. D.
(13) Torque in sequence: Step 1 = 70-80; Step 2 = 100-110; Step 3 = 130-140.
(14) Retorque to specification after engine is hot.
(15) 1/2 turn after oiled gasket contacts sealing surface.

TORQUE SPECIFICATIONS – SPECIAL APPLICATION

CAMSHAFT SPROCKET TO CAMSHAFT	40-45
CAMSHAFT THRUST PLATE TO BLOCK	9-12
CONNECTING ROD NUTS OR BOLTS	40-45
CYLINDER FRONT COVER BOLTS	12-18
CYLINDER HEAD BOLTS	(13)
DAMPER OR PULLEY TO CRANKSHAFT	70-90
DISTRIBUTOR VACUUM CONTROL VALVE	15-18
EGR VALVE TO CARBURETOR SPACER OR INT MANIFOLD	12-18
FUEL PUMP TO CYLINDER BLOCK OR FRONT COVER	19-27
FLYWHEEL TO CRANKSHAFT	75-85
MAIN BEARING CAP BOLTS	95-105
MANIFOLD TO CYLINDER HEAD (Intake)	22-32 (14)
MANIFOLD TO CYLINDER HEAD (Exhaust)	28-33
OIL FILTER INSERT TO CYLINDER BLOCK	20-30
OIL FILTER TO BLOCK OR ADAPTER	(15)
OIL INLET TUBE TO OIL PUMP	Press Fit
OIL PAN DRAIN PLUG	15-25
OIL PAN TO CYLINDER BLOCK	5/16 = 9-11/1/4 = 7-9
OIL PUMP TO CYLINDER BLOCK	22-32
PULLEY TO DAMPER (Bolt)	35-50
ROCKER ARM STUD OR BOLT TO CYLINDER HEAD	18-25
SPARK PLUG TO CYLINDER HEAD	10-15
VALVE ROCKER ARM COVER	5-6
ALTERNATOR BRACKET TO CYLINDER BLOCK (Bolt)	35-50
ALTERNATOR PIVOT BOLT	45-57
ALTERNATOR ADJUSTING ARM TO CYLINDER BLOCK	35-50
ALTERNATOR ADJUSTING ARM TO ALTERNATOR	24-40
THERMACTOR PUMP BRACKET TO CYLINDER BLOCK	35-50
THERMACTOR PUMP PIVOT BOLT	25-35
THERMACTOR PUMP ADJUSTING ARM TO PUMP	22-32
THERMACTOR PUMP ADJUSTING ARM TO CYLINDER BLOCK	29-37
THERMACTOR PUMP PULLEY TO SHAFT	130-180 In.-Lb
POWER STEERING PUMP PULLEY TO DAMPER (Bolt)	35-50
FAN TO WATER PUMP HUB (Bolt)	12-18
OIL COOLER/FILTER ADAPTER TO CYLINDER BLOCK	40-50
OIL COOLER LINES TO OIL FILTER ADAPTER AND COOLER (POLICE INTERCEPTOR)	35-45
COOLANT HOSE TO OIL COOLER AND ENGINE FITTINGS (CLAMP)	12-20 In.-Lb.
CARBURETOR MOUNTING NUTS	12-15
CARBURETOR MOUNTING STUD	15 Max.
FUEL FILTER TO CARBURETOR	29-31

TORQUE SPECIFICATIONS – General Applications

U. S. THREAD SIZES	TORQUE
1/4-20	6-9
5/16-18	12-18
5/16-18	14-20
3/8-16	22-32
3/8-24	27-38
7/16-14	40-55
7/16-20	40-60
1/2-13	55-80

METRIC THREAD SIZES	TORQUE
M-6	6-9
M-8	14-21
M-10	28-40
M-12	50-71
M-14	80-114

PIPE THREAD SIZES	TORQUE
1/8	5-8
1/4	12-18
3/8	22-33
1/2	25-35

o All values are in ft.-lb. unless otherwise noted.
o Oil threads with engine oil unless fasteners require sealers.

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IGNITION SYSTEM

GROUP 23 (12000)

CB3518-2A

General Ignition Service

PART 23-01

All Models Except Versailles with EEC System

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Distributor	01-3
Dual Mode Timing Ignition Module	01-2
Vacuum Advance	01-3
ADJUSTMENTS	01-5
TESTING	
Ignition Timing	01-5
REMOVAL AND INSTALLATION	
Connecting To Coil Connector For Tachometer – All Engines	01-11
Distributor, Rotor and Cap	01-10
Distributor – V-8 Engines	01-7
Magnetic Pickup Assembly	01-7
Vacuum Advance Unit	01-7

SUBJECT	PAGE
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CB3519-2B

GENERAL INFORMATION

All California passenger cars (except the Versailles) equipped with a 5.0L (302 CID) V-8 are equipped with the high energy "Dura Spark I" ignition system.

All other California, 49 States and Canadian vehicles are equipped with the "Dura Spark II" ignition system.

Dura Spark I features special vehicle primary wiring, a unique coil and electronic control module, a distributor cap and adapter, high energy secondary wiring and special wide-gap spark plugs. In operation, it senses current flow through the coil, adjusting "dwell" for maximum spark intensity. Thus, coil "on" time is adjusted for best efficiency related to engine rpm. If the module senses that the ignition switch is ON and the distributor is not turning, it will automatically turn the coil current OFF after about one second. To reestablish the module cycle, turn the key to START or to OFF and then to ON again.

Dura Spark II is basically a solid state ignition system with two major differences: the ballast resistor value has been changed from 1.35 to 1.10 ohms to boost coil current and energy output, and the system now uses the new Dura Spark I rotor, distributor cap and adapter, ignition secondary wires and wide-gap spark plugs to take advantage of the higher energy produced.

Both systems (except Versailles with the EEC System) use the same distributor (Fig. 1) and both control

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modules have the same exterior appearance (Fig. 2). **See Part 29-06 for operation and servicing of the EEC system components not covered in this Part.**

Dual Mode Timing Ignition Module

On some applications, a special Dura Spark II ignition module is used, with altitude compensation and economy features (Fig. 2). This special module, plus the altitude sensor or economy distributor modulator, allows the base engine timing to be modified to suit either altitude or engine load conditions. All other elements and performance characteristics of this module are identical to both modes of operation of other Dura Spark II systems. All Dura Spark II modules equipped with altitude feature have three connectors instead of the normal two.

Altitude Compensation

An aneroid switch (Fig. 2) provides an automatic retard signal to the module at different altitudes, giving appropriate advanced timing at higher altitudes and retard mode for spark knock control at lower altitudes.

Economy Calibrations

A vacuum switch (Fig. 2) sensing intake manifold vacuum provides an automatic retard signal to the distributor under heavy engine load, while allowing spark advance under light to moderate engine loads.

It is important to note that the Dura Spark II amplifier module and coil are "on" when the ignition switch is "on". Because of this, the ignition system will generate a spark when the key is turned "off". This feature may be used as a diagnostic tool, to verify continuity of

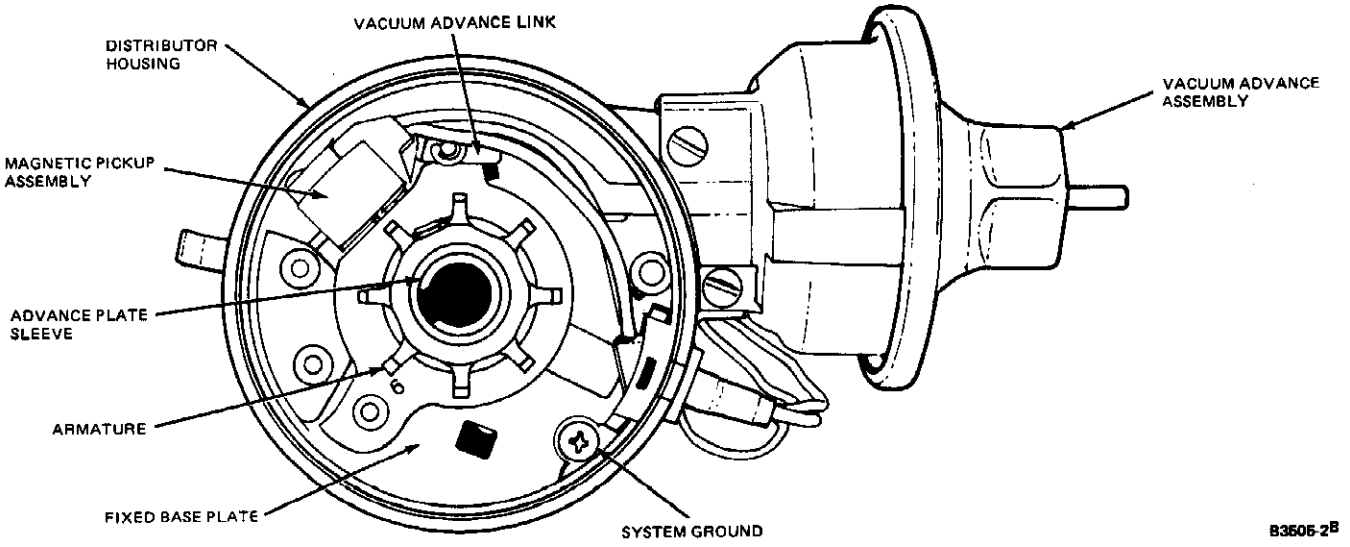


FIG. 1 Distributor—V-8 Shown—Others Similar

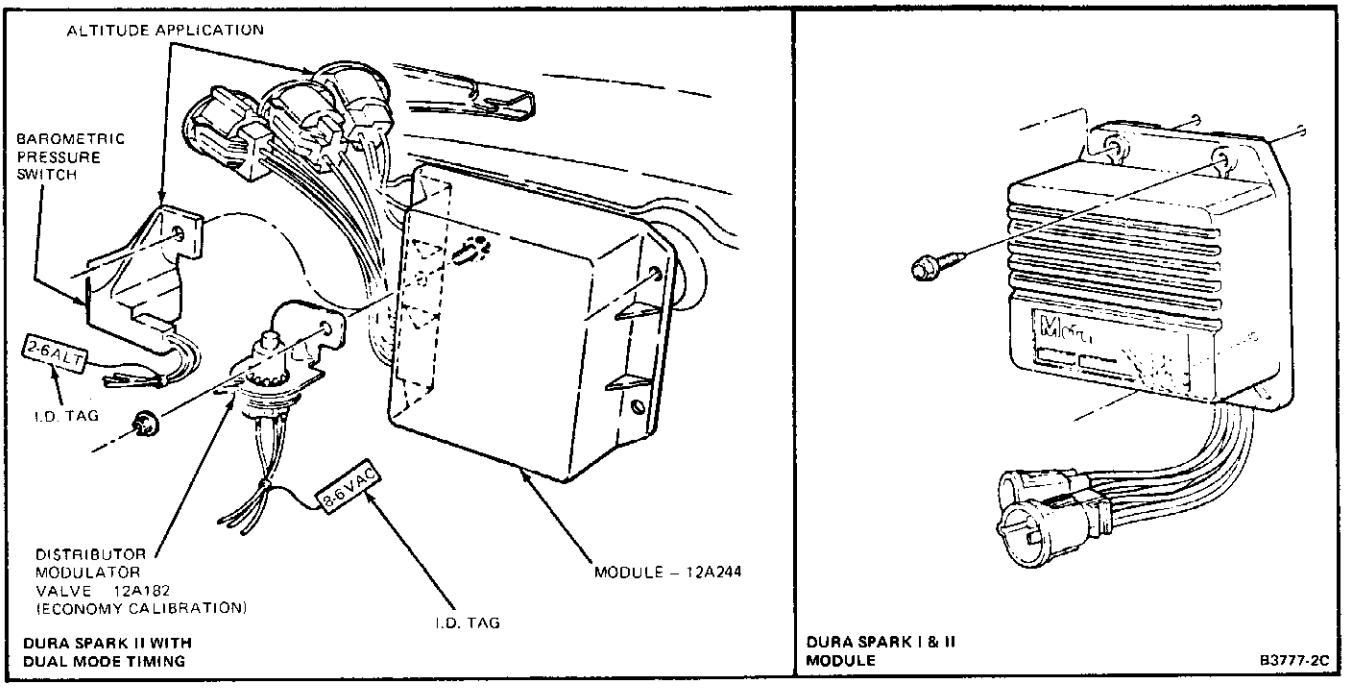


FIG. 2 Typical Dura Spark Modules

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circuit, coil and ignition switch. Certain other service actions such as removing the distributor cap with the ignition switch "on" may also cause the system to fire. **For this reason, the ignition switch should remain "off" during any underhood operations unless the intent is to start the vehicle engine, or to perform a specific test that requires the ignition switch to be "on". This procedure will prevent the possibility of inadvertent engine rotation caused by triggering of the ignition system during servicing.**

Dura Spark I systems automatically shut down when the system senses no distributor rotation within one second.

DISTRIBUTOR

The armature turns with the distributor shaft, causing fluctuations in the magnetic field generated by the pickup coil assembly. These fluctuations cause the amplifier to turn the ignition coil current off and on, generating high tension spark needed to fire the spark plugs. The distributor is equipped with a new high energy cap and adapter (Fig. 3).

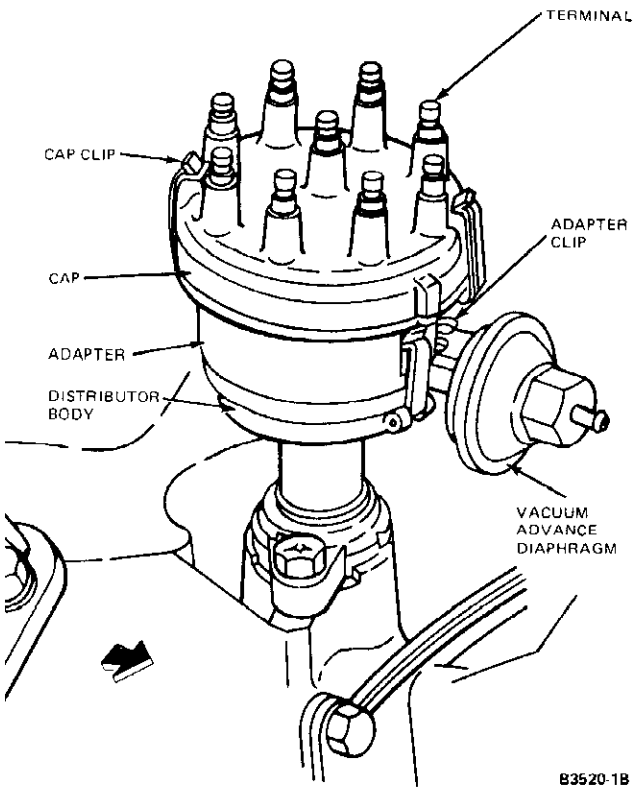


FIG. 3 Typical Dura-Spark Distributor

All distributors except Versailles with EEC System are equipped with both vacuum and centrifugal spark advance control units. The vacuum advance unit governs ignition timing according to engine load, while the centrifugal advance unit governs ignition timing according to engine speed (rpm). A dual diaphragm vacuum advance unit is used on some engines to provide additional ignition timing retard during engine closed throttle operation. This occurs both at curb idle and during engine coast-down with closed throttle. Retarding the timing during these periods helps control engine emissions.

The distributor on four or six cylinder engines rotates in a clockwise direction. To advance timing; rotate the distributor counterclockwise. The distributor on V-8 engines rotates counterclockwise. To advance timing, rotate the distributor clockwise.

CENTRIFUGAL ADVANCE

The distributor advance units operate independently, with vacuum advance operating the base plate assembly and centrifugal advance operating the position of the armature in relation to the distributor shaft. The centrifugal advance assembly, located below the base plate, has centrifugal weights that move inward or outward with changes in engine speed.

As engine speed increases, the weights move the sleeve and plate assembly ahead of the distributor shaft, thus advancing the position of the armature. The rate of advance is controlled by calibrated springs.

VACUUM ADVANCE

The dual diaphragm unit consists of two diaphragms that operate from two independent sources of vacuum (Fig. 4). The outer (primary) diaphragm operates from carburetor venturi vacuum to provide timing advance during normal off-idle driving conditions. This diaphragm is connected to the distributor magnetic pickup coil assembly by the vacuum advance link.

The inner (secondary) diaphragm operates from intake manifold vacuum and acts to retard ignition timing. This retard diaphragm is connected to the outer diaphragm by means of a sliding linkage. Since intake manifold vacuum is stronger than carburetor venturi vacuum during closed throttle operation, the secondary diaphragm will retard the spark during these periods. In all other phases, the larger primary diaphragm operates from venturi vacuum and pulls the base plate against distributor rotation, advancing the spark timing.

On some A/C applications, a fast-idle compensator applies intake manifold vacuum to the primary side of the diaphragm during hot engine conditions, acting to increase engine idle speed as an aid to cooling.

Return springs in both the advance and retard portions center the diaphragms when vacuum drops.

Vacuum modulators installed in the vacuum supply lines from the carburetor and intake manifold will vary the operation of the advance and retard diaphragms. These modulators are covered in Group 29 and Group 50.

CIRCUIT OPERATION

The Dura Spark System consists of a primary (low voltage) and a secondary (high voltage) circuit (Fig. 5).

The primary circuit consists of the:

1. Battery.
2. Ignition Switch.
3. Primary Circuit Resistance Wire (in Dura Spark II).
4. Primary Windings of the Ignition Coil.
5. Magnetic pickup coil assembly.
6. Ignition Module.

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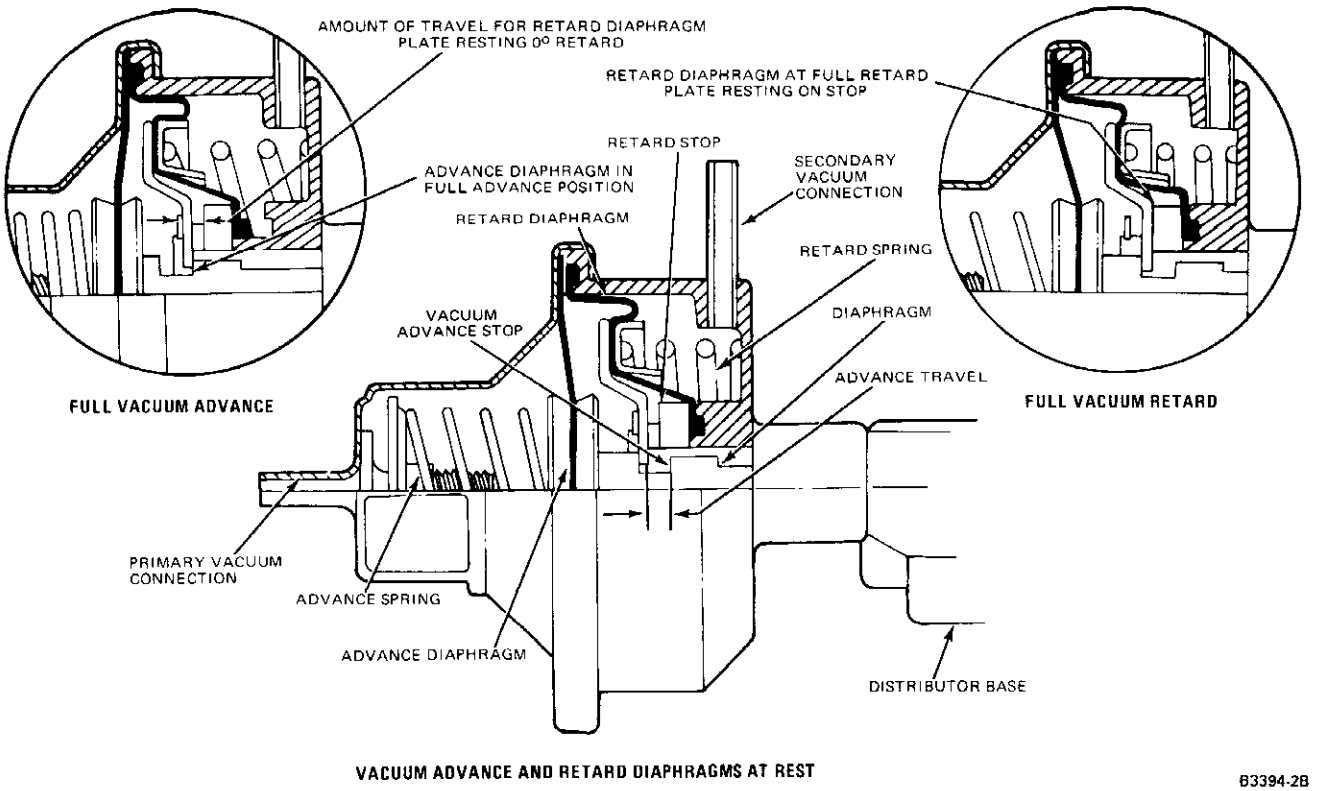


FIG. 4 Dual Diaphragm Vacuum Advance Mechanism

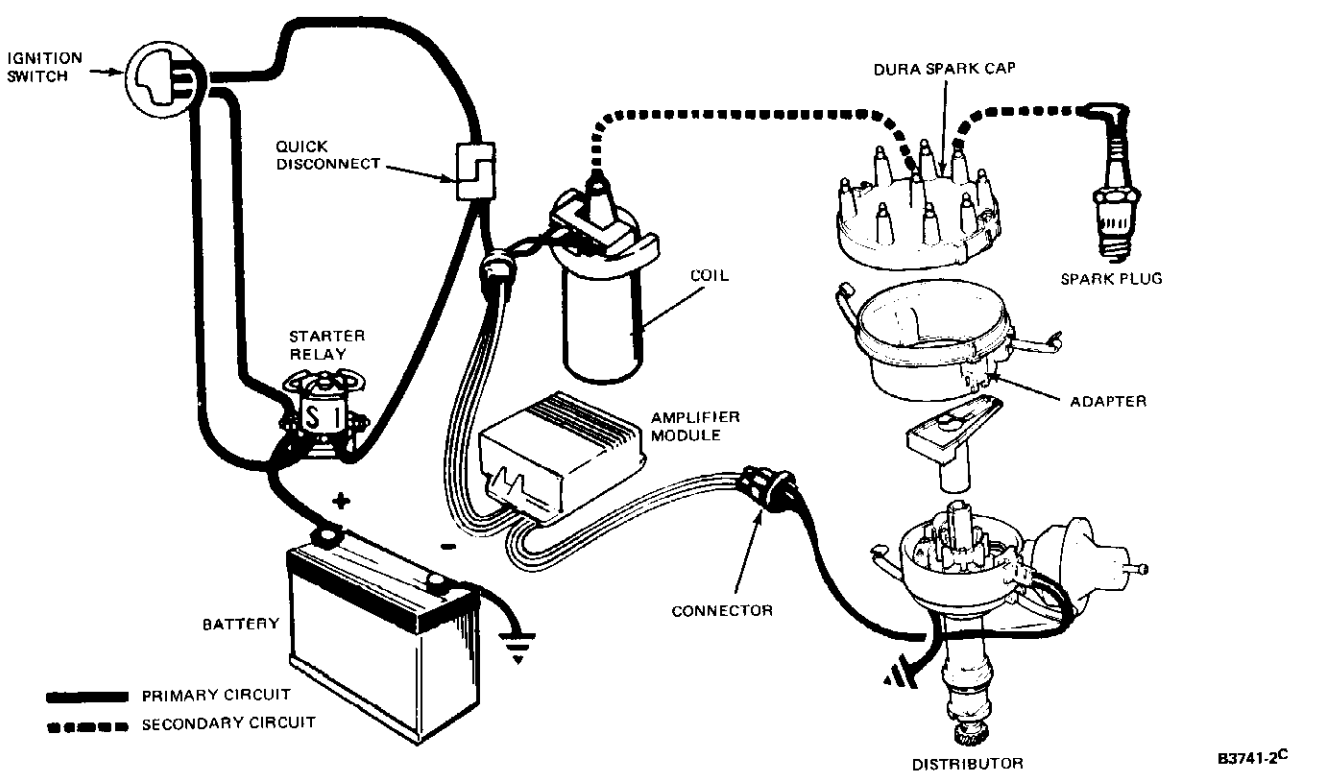


FIG. 5 Typical Dura Spark System

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The secondary circuit consists of the:

1. Secondary windings of the ignition coil.
2. Distributor rotor.
3. Distributor cap.
4. High tension (spark plug) wires.
5. Spark plugs.

With the ignition switch "on", the primary circuit is on and the ignition coil is energized. When the armature "spokes" approach the magnetic pickup coil assembly, they induce a voltage which tells the amplifier to turn the coil primary current off. A timing circuit in the amplifier module will turn the current on again after the coil field has collapsed. When the current is "on", it flows from the battery through the ignition switch, the primary windings of the ignition coil, and through the amplifier module circuits to ground. When the current is off, the magnetic field built up in the ignition coil is allowed to collapse, inducing a high voltage into the secondary windings of the coil. High voltage is produced each time the field is thus built up and collapsed.

The high voltage flows through the coil high tension lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap. This process is repeated for every power stroke of the engine.

Ignition system troubles are caused by a failure in the primary and/or the secondary circuit; incorrect ignition timing; or incorrect distributor advance. Circuit failures may be caused by shorts, corroded or dirty terminals, loose connections, damaged wire insulation, cracked distributor cap or rotor, damaged pick-up coil assembly or ignition module, or fouled spark plugs.

If an engine starting or operating trouble is attributed to the ignition system, start the engine if possible and verify the complaint. On engines that will not start, be sure there is gasoline in the fuel tank and that fuel is reaching the carburetor. Then locate the ignition system problem by an oscilloscope test, spark intensity test, or by means of the ohmmeter test procedure.

ADJUSTMENTS

No adjustments are to be made to the ignition system except initial engine timing and spark plug gap (Part 50-29).

TESTING

For testing and system diagnosis, refer to Part 29-02.

IGNITION TIMING

All engines are equipped with conventional ignition timing marks and pointers. Engines sold in California are also equipped with the new "monolithic" timing features. The conventional system employs degree numbers on the crankshaft vibration damper, a timing pointer near the damper, and an index mark on both the distributor rotor and distributor body.

The "monolithic" system employs a timing receptacle designed to accept an electronic probe (Fig. 6) that is connected to digital read-out equipment. Thus, the timing is determined electronically. The receptacle is located at the front of all engines except the 2.3L I-4 which has a boss for monolithic timing in the left rear of the cylinder block.

To check and adjust timing, follow the procedures outlined in Groups 50 and 29.

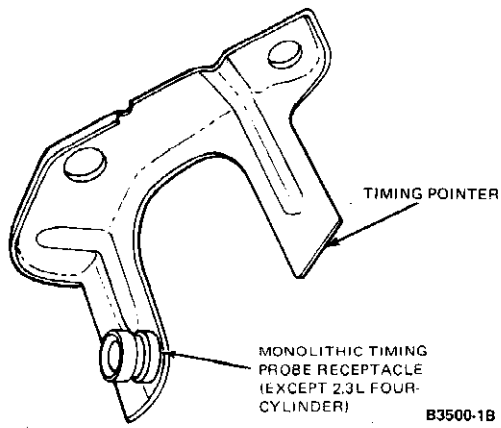


FIG. 6 Typical Timing Pointer and Probe Receptacle

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DETROIT IRON

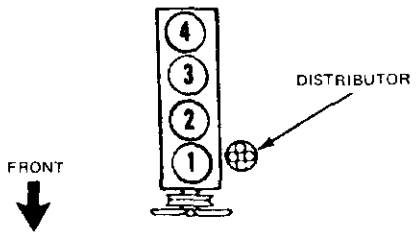
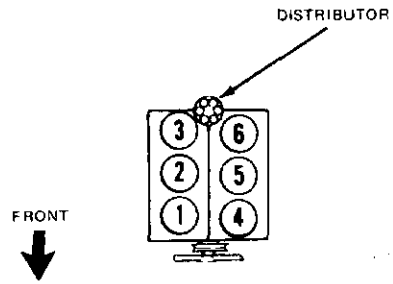
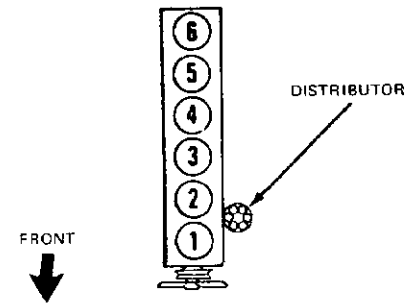
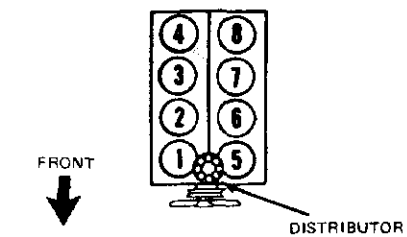
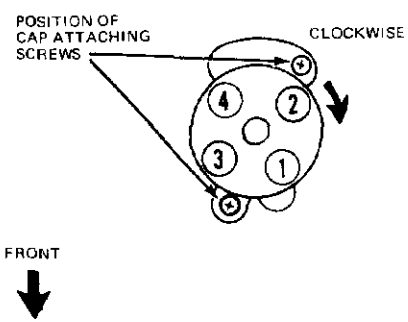
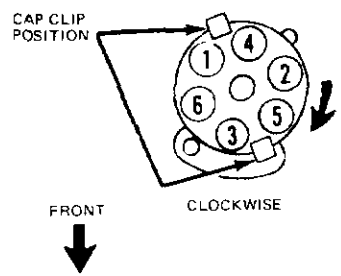
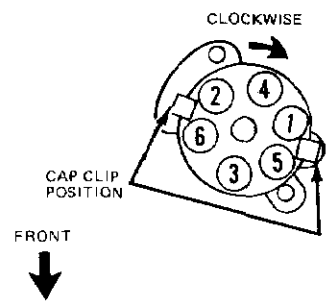
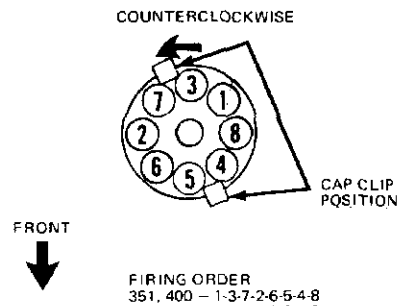
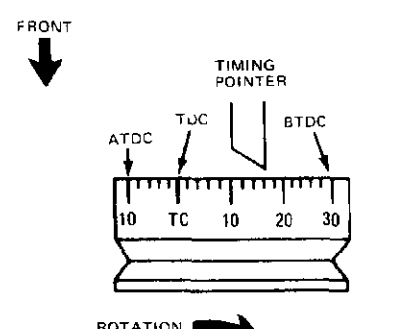
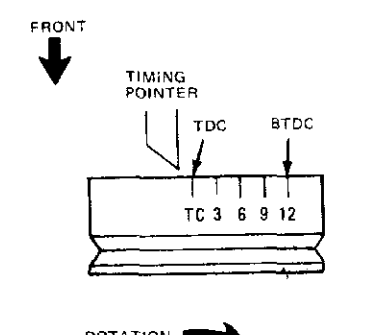
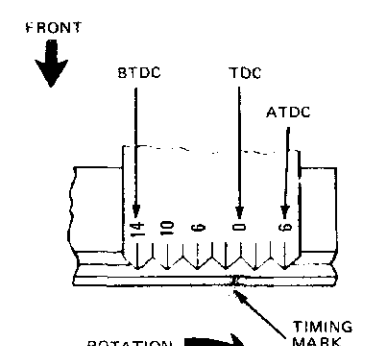
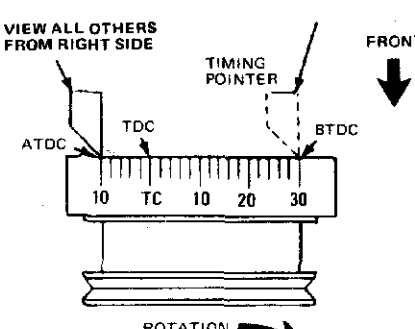
2.3L4-CYLINDER	2.8L V-6	3.3L/4.1L (200/250 C.I.D.) I-6	5.0L/5.8L/6.6L/7.5L (302/351/400/460 C.I.D.) V-8
CYLINDER NUMBERING AND DISTRIBUTOR LOCATION 	CYLINDER NUMBERING AND DISTRIBUTOR LOCATION 	CYLINDER NUMBERING AND DISTRIBUTOR LOCATION 	CYLINDER NUMBERING AND DISTRIBUTOR LOCATION 
FIRING ORDER AND POSITION  FIRING ORDER –1-3-4-2	FIRING ORDER AND ROTATION  FIRING ORDER – 1-4-2-5-3-6	FIRING ORDER AND ROTATION  FIRING ORDER – 1-5-3-6-2-4	FIRING ORDER AND ROTATION  FIRING ORDER 351, 400 – 1-3-7-2-6-5-4-8 302, 460 – 1-5-4-2-6-3-7-8
 CRANKSHAFT TIMING MARKS	 CRANKSHAFT TIMING MARKS	 CRANKSHAFT TIMING MARKS	VIEW 5.8L 351M/400 C.I.D. W/FRIGIDAIRE A/C *FROM LEFT SIDE OF ENGINE*  CRANKSHAFT TIMING MARKS

FIG. 7 Engine Timing and Cylinder Firing Order

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REMOVAL AND INSTALLATION

DISTRIBUTOR—V-8 ENGINES

Removal

1. Remove the air cleaner. Disconnect the distributor wiring connector from the vehicle wiring harness.
2. Disconnect the vacuum advance lines at the distributor. Remove the distributor cap and place it and wires to one side.
3. Scribe a mark on the distributor body and the cylinder block indicating the position of the rotor in the distributor and the distributor in the block. These marks will be used as guides when installing the distributor.
4. Remove the distributor hold-down bolt and clamp. Lift the distributor out of the block. Do not rotate the engine while the distributor is out of the block, or it will be necessary to time the engine.

Installation

1. If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine as follows: Rotate the crankshaft until No. 1 piston is on TDC after the compression stroke. Align the correct initial timing mark on the timing pointer with the timing pointer on the crankshaft damper. Position the distributor in the block with one of the armature segments as shown in Fig. 8, and the rotor at number one firing position.

   Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, after the distributor drive gear is partially engaged, in order to engage the oil pump intermediate shaft. Install, but do not tighten, the retaining clamp and bolt. Rotate the distributor to advance the timing to a point where the armature tooth is aligned properly. Tighten the clamp.

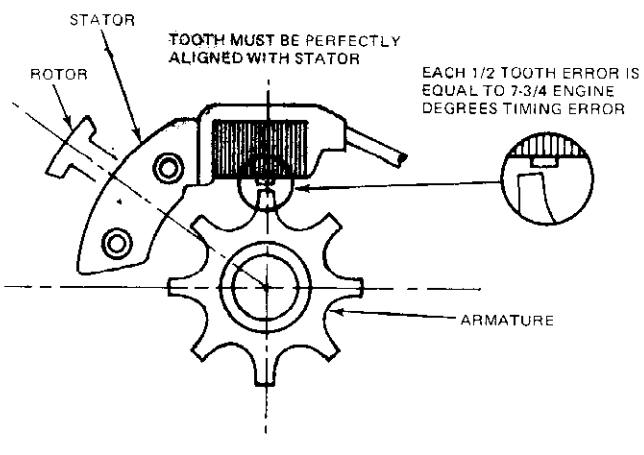


FIG. 8 Static Timing Position—8-Cylinder Engine Distributor

2. If the crankshaft has not been moved position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body and the marks on the distributor body and cylinder block in alignment.
3. Install the distributor cap and wires.
4. Connect the distributor wiring connector to the vehicle harness.
5. Check the ignition timing with a timing light and adjust to specifications. NOTE: Due to the higher coil charging currents inherent in the new Dura Spark system, it may be necessary to use a timing light specifically designed for this type system. Existing inductive pickup type lights might also work satisfactorily if an insulated standoff such as a piece of split vacuum hose is first put around the plug wire. Connect the vacuum line(s), and check the advance with the timing light when the engine is accelerated.
6. Install the air cleaner.

MAGNETIC PICKUP COIL ASSEMBLY

Removal

1. Remove the distributor cap, rotor and adapter, and disconnect the distributor harness plug (Fig. 9).
2. Using a small gear puller or two screwdrivers, lift or pry the armature from the advance plate sleeve. Remove the roll pin.
3. Remove the large wire retaining clip from the base plate annular groove.
4. Remove the snap ring that secures the vacuum advance link to the pickup assembly.
5. Remove the magnetic pickup assembly ground screw and lift the assembly from the distributor.
6. Lift the vacuum advance arm off the post on the pickup assembly and move it out against the distributor housing.

Installation

1. Place the new pickup assembly in position over the fixed base plate and slide the wiring in position through the slot in the side of the distributor housing.
2. Install the fine wire snap ring securing the pickup assembly to the fixed base plate.
3. Position the vacuum advance arm over the post on the pickup assembly and install the snap ring.
4. Install the grounding screw through the tab on the wiring harness and into the fixed base plate.
5. Install the armature on the advance plate sleeve, making sure the roll pin is engaged in the matching slots.
6. Install the distributor adapter, rotor and cap.
7. Connect the distributor wiring plug to the vehicle harness.

VACUUM ADVANCE UNIT—DUAL DIAPHRAGM

Refer to Fig. 9 for proper relationship of internal parts.

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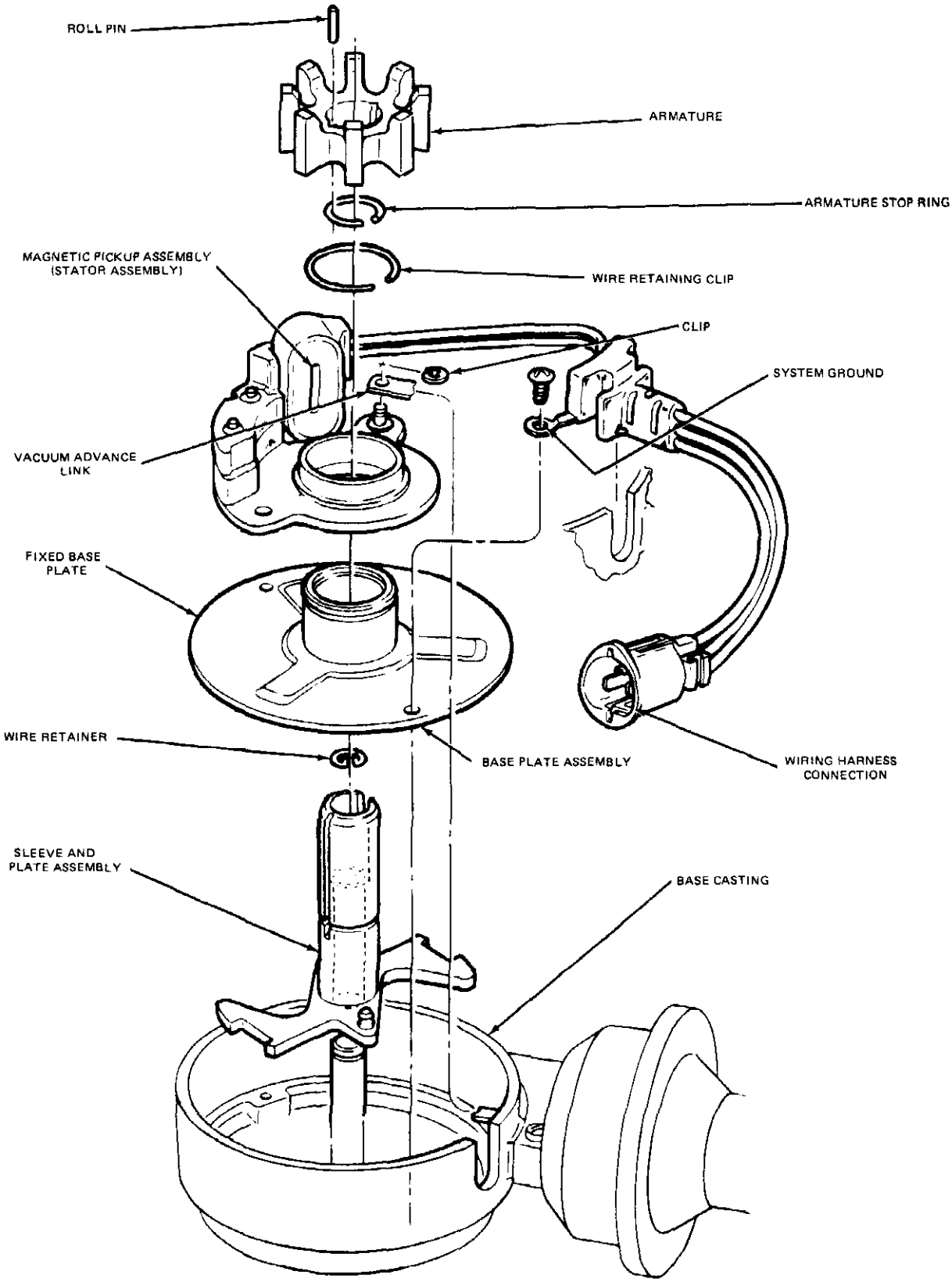


FIG. 9 Typical Dura Spark Distributor—Disassembled

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Removal

1. Remove the cap, rotor and adapter.
2. Disconnect the vacuum lines.
3. Remove the spring clip that secures the diaphragm link to the movable advance plate.
4. Remove the diaphragm unit attaching screws and carefully remove the unit by tilting downward to disengage the link from the post on the movable advance plate.

Installation

1. Position the diaphragm unit on the distributor and hook the diaphragm link in position.
2. Install the spring clip that secures the diaphragm link to the movable advance plate. Install the diaphragm unit attaching screws.
3. Connect the vacuum lines.
4. Install the rotor, adapter and distributor cap.

FIXED BASE PLATE

Removal

1. Remove the distributor cap, adapter and rotor.
2. Remove the vacuum advance diaphragm unit.
3. Remove the magnetic pickup assembly.
4. Remove the remaining attaching screw from the fixed base plate and lift it out of the distributor.

NOTE: Do not remove sleeve and plate assembly, weights or weight springs.

Installation

1. Position fixed base plate in distributor and install first attaching screw.
2. Install pick-up assembly and wiring.
3. Install vacuum advance unit.
4. Install the distributor adapter, rotor and cap.

DISTRIBUTOR—I-4, V-6 AND I-6 ENGINE

Removal

1. Remove the air cleaner assembly on V-6 engines. On 4-cylinder and 6-cylinder in-line engines, remove one thermactor pump mounting bolt, and the drive belt; then, swing the pump to one side to allow access to the distributor. It may also be necessary to disconnect the Thermactor air filter and lines.
2. Using a remote starter switch or rotating the engine by hand, position the proper timing mark on the engine crankshaft damper with the timing pointer.
3. Remove the distributor cap and check to see that the rotor and armature are lined up with the index mark on the top of the magnetic pickup (Fig. 10), and the marks on the side of the distributor body.
4. Disconnect the vacuum hose(s) from the distributor. Disconnect the ignition lead from the wiring harness.
5. Remove the distributor hold-down bolt and remove the distributor from the block. The hex shaft that drives the oil pump may stick in the distributor shaft and be withdrawn from the pump.

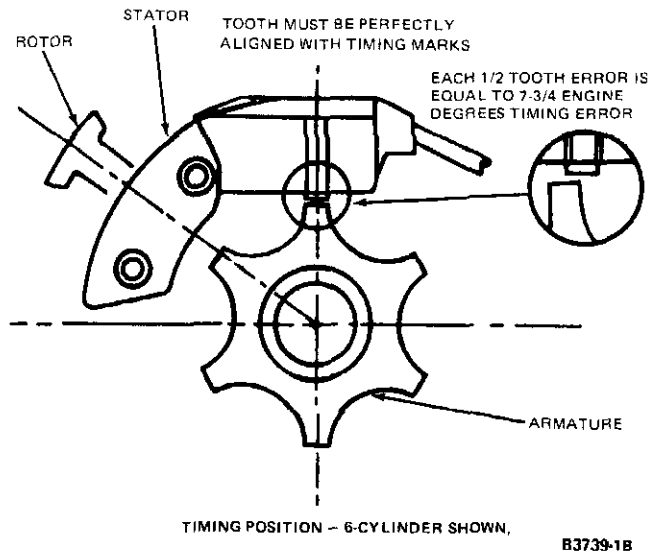


FIG. 10 Static Timing Position—6-Cylinder Shown—4-Cylinder Similar

Installation

1. Make sure the engine is still aligned with the proper timing marks. Align the distributor rotor with the marks on the distributor and the armature with the marks on the top of the magnetic pickup (Fig. 10). If the oil pump drive shaft was withdrawn with the distributor, coat one end with heavy grease, insert that end into the hex hole in the distributor shaft and position the distributor into the cylinder block. Make sure the oil pump drive shaft is fully seated in the pump, and that the distributor rotor and body are in the proper position.
2. Install the distributor hold-down bolt and bracket.
3. Install the vacuum hose(s) and connect the ignition wire to the wiring harness.
4. Install the rotor, adapter and distributor cap.
5. Install the thermactor belt on four and in-line 6-cylinder engines, and adjust belt tension to specification. Connect all Thermactor hoses and the filter.
6. Check engine timing as covered in Part 29-02 or 50-29 under Ignition Timing.

MAGNETIC PICKUP COIL ASSEMBLY

Removal

1. Remove the distributor cap, adapter and rotor and disconnect the distributor harness plug.
2. Using a small gear puller or two screwdrivers, lift or pry the armature from the advance plate sleeve. Remove the roll pin.
3. Remove the snap ring, washer and wave washer that secure the pickup coil assembly to the lower plate.
4. Remove the magnetic pickup assembly ground screw and lift the assembly from the distributor.

Installation

1. Place the pickup assembly in position over the fixed base plate and insert the pickup assembly post into the vacuum advance arm.

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2. Slide the wiring grommet into the slot at the edge of the lower plate and install the ground screw. Install the washers and snap ring to secure the pickup coil assembly to the lower plate.
3. Install the armature on the advance plate sleeve, making sure the roll pin is engaged in the matching slots.
4. Install the distributor rotor, adapter and cap and connect the distributor wiring plug to the vehicle harness.

VACUUM ADVANCE UNIT

Removal

1. Remove the distributor cap, rotor and adapter.
2. Disconnect the vacuum line(s).
3. Remove the diaphragm unit attaching screws and carefully remove the unit by tilting downward to disengage the link from the advance plate.

Installation

1. Hook the diaphragm link in position and position the diaphragm unit on the distributor.
2. Install the diaphragm unit attaching screws.
3. Connect the vacuum line(s).
4. Install the adapter, rotor and distributor cap.

SPARK PLUG WIRES

SECONDARY (HIGH TENSION) WIRES

The secondary wires include the wires connecting the distributor cap to the spark plugs and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

These wires are the radio resistance-type which filter out the high frequency electrical impulses that are the source of ignition noise interference.

Check ignition wire resistance through the distributor cap. To check the secondary wire resistance, turn the ignition switch "off" and then remove the distributor cap. It is important that the ignition system be "off" to prevent inadvertant engine rotation due to firing of the ignition system.

Do not, under any circumstance, puncture an ignition cable when checking resistance. Do not use a commercial probing device, but measure resistance only from the ends of the wire or the wire terminals inside the distributor cap.

If the resistance of a wire exceeds 5,000 ohms per inch, it should be completely removed from the distributor cap and the resistance measured directly from the wire ends. If the resistance still exceeds 5,000 ohms per inch, the wire should be replaced.

When removing wires from spark plugs, use Tool T74P-6666-A or equivalent. (Fig. 11.) Grasp and twist the molded cap back and forth on the plug insulator to free cap. Use the special tool to pull the cap from the plug. Do not pull on the wire directly, or it may become separated from the connector inside the cap.

Whenever a high tension wire is removed for any reason from a spark plug, coil or distributor terminal housing, silicone grease must be applied to the boot before it is reconnected. Using a small clean tool, coat the entire interior surface of the boot with Ford silicone grease D7AZ-19A331-A or equivalent.

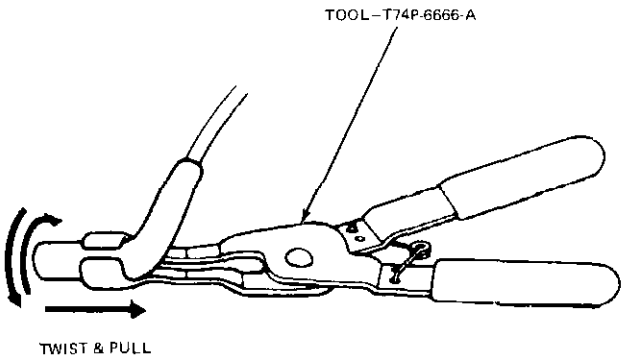


FIG. 11 Removing Wires from Spark Plugs

Installation

1. Insert each wire on the proper terminal of the distributor cap. Be sure the wires are forced all the way down over their terminals. The No. 1 terminal is identified on the cap. Install the wires starting with No. 1. Each spark plug wire is numbered. Cylinders are numbered 1-2-3-4-5-6 on all I-6 engines and from front to rear; right bank 1-2-3-4, left bank 5-6-7-8 on all V-8 engines. V-6 engines are numbered from front to rear; right bank 1-2-3, left bank 4-5-6. I-6 engines are numbered from front to rear, 1-2-3-4.
2. Remove the wire retaining brackets from the old spark plug wire set and install them on the new set in the same relative position. Install the wires in the brackets on the valve rocket arm covers (V-8 and V-6).
3. Connect the wires to the proper spark plugs. Install the coil high tension lead. Be sure the No. 7 spark plug wire is positioned in the bracket.

   Notice that the wires are positioned in this bracket in a special order from front to rear (7-5-6-8). This applies to all V-8 engines except the 5.8L (351 CID) and 6.6L (400 CID) engine. The wires for the 5.8L (351 CID) and 6.6L (400 CID) should be positioned in the bracket from front to rear (5-7-8-6). Arranging the wires in this manner will prevent cylinder cross-fire.

DISTRIBUTOR ROTOR AND CAP

When installing a new distributor cap or rotor, coat the brass rotor electrode surfaces on all sides outboard of the plastic, including the outer edge, with D7AZ-19A331-A silicone grease (or equivalent Dow Corning No. 111 or General Electric G-627 compounds) to approximately 1/16" thickness. Do not reapply or attempt to remove any silicone coating from the distributor cap electrodes. As this compound ages, it has

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the appearance of being a contaminant of the cap and rotor electrodes. This condition is normal and causes no performance loss.

REPLACING SPARK PLUGS

Removal

1. Remove the wire from each spark plug by grasping the molded boot with Tool T74P-6666-A (Fig. 11). Twist the boot until it loosens and then pull it off the spark plug. Do not pull on the wire, as the connection may become damaged.
2. Any wire damaged must be replaced. Each original spark plug wire is numbered for the cylinder to which it is designed. If wires are not numbered, each wire should be numbered as to the plug from which it was removed.
3. Clean the area around each spark plug port with compressed air.
4. Using the proper size spark plug socket remove the spark plugs.

Installation

1. Check the gap on each new spark plug and set to specification, if necessary (Fig. 12).

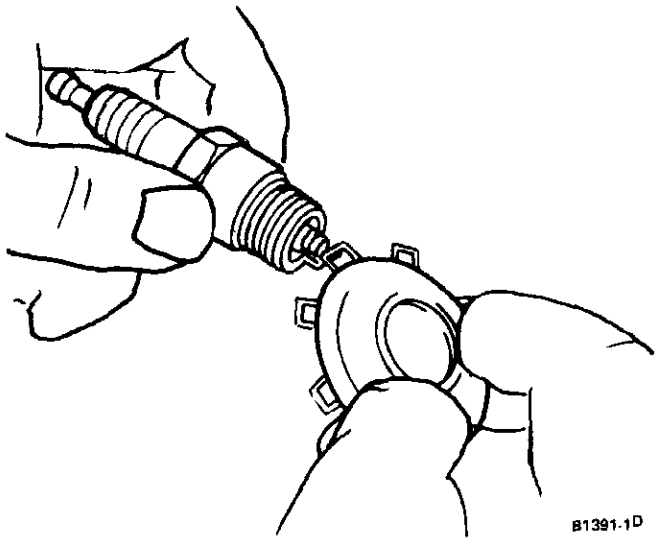


FIG. 12 Checking and Setting Spark Plug Gap

2. Install each spark plug and torque to specification.
3. Coat the inside of each spark plug boot with silicone grease D7AZ-19A331-A or equivalent, using a small screwdriver blade. Connect each spark plug wire to the plug from which it was removed. Be sure each wire is fully depressed on each plug and molded boot is firmly in place.

CONNECTING TO COIL CONNECTOR FOR TACHOMETER TEST—ALL VEHICLES

The ignition coil connector allows a tachometer test lead with an alligator-type clip to be connected to the DEC (Distributor Electronic Control) terminal without removing the connector (Fig. 13).

When engine rpm must be checked, install the tachometer alligator clip into the "TACH TEST" cavity as shown. If the coil connector must be removed, grasp the wires and pull in the direction of the wires until it disconnects from the terminals.

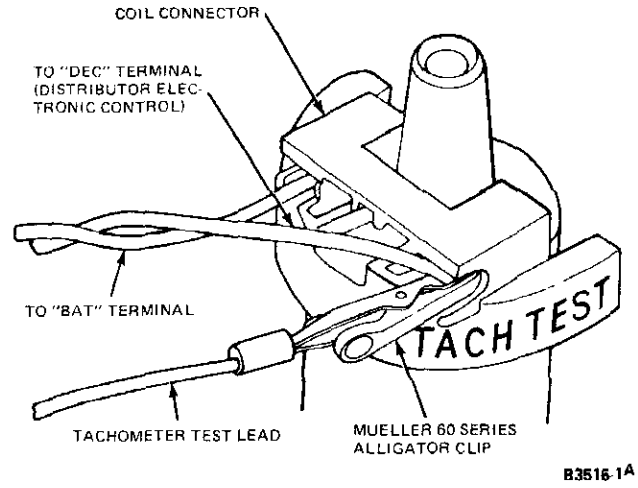


FIG. 13 Attaching Tachometer Lead to Coil Connector

SPARK PLUG BOOT REPLACEMENT—ALL ENGINES

When it is necessary to replace only the boot on a particular spark plug wire, proceed as follows:

1. Cut off the old boot. Apply silicone lubricant D7AZ-19A331-A or equivalent to that area of the old wire that will contact the new boot.
2. Position the new boot onto Tool T75L-6666-A as shown in Fig. 14.

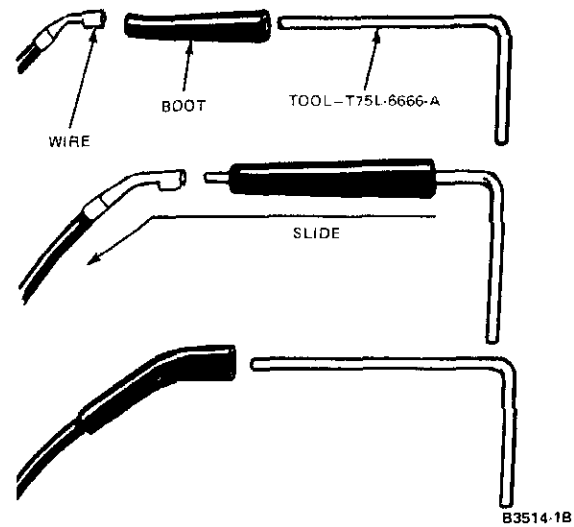


FIG. 14 Installing Spark Plug Wire Boot on Wire

3. Position the tool onto the wire terminal and slide the boot onto the wire. Remove the tool from the end of the wire terminal.

CLEANING AND INSPECTION

SPARK PLUGS

Examine the firing ends of the spark plugs, noting the type of deposits and the degree of electrode erosion. Refer to Fig. 15 for the various types of spark plug fouling and their causes.

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GAP BRIDGED



IDENTIFIED BY DEPOSIT BUILD-UP CLOSING GAP BETWEEN ELECTRODES. CAUSED BY OIL OR CARBON FOULING. REPLACE PLUG, OR, IF DEPOSITS ARE NOT EXCESSIVE, THE PLUG CAN BE CLEANED.

OIL FOULED



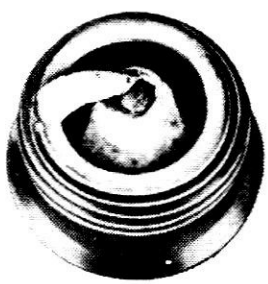
IDENTIFIED BY WET BLACK DEPOSITS ON THE INSULATOR SHELL BORE ELECTRODES CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBER THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. REPLACE THE PLUG. IF ENGINE IS NOT REPAIRED, USE A HOTTER PLUG.

CARBON FOULED



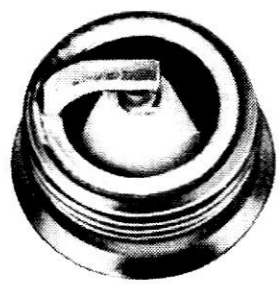
IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES. CAUSED BY TOO COLD A PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.

WORN



IDENTIFIED BY SEVERELY ERODED OR WORN ELECTRODES. CAUSED BY NORMAL WEAR. SHOULD BE REPLACED

NORMAL



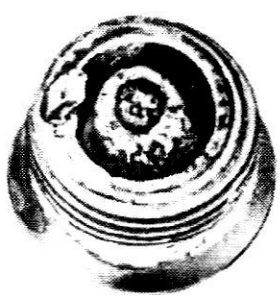
IDENTIFIED BY LIGHT TAN OR GRAY DEPOSITS ON THE FIRING TIP.

LEAD FOULED



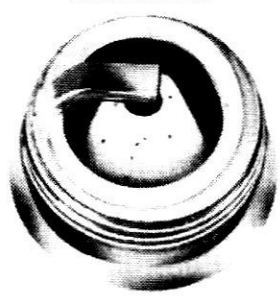
IDENTIFIED BY DARK GRAY, BLACK, YELLOW OR TAN DEPOSITS OR A FUSED GLAZED COATING ON THE INSULATOR TIP. CAUSED BY HIGHLY LEADED GASOLINE. REPLACE THE PLUG.

PRE-IGNITION



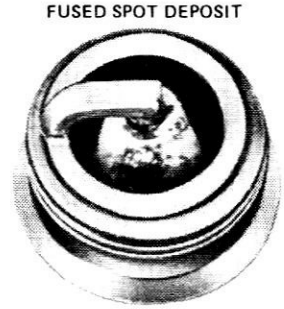
IDENTIFIED BY MELTED ELECTRODES AND POSSIBLY BLISTERED INSULATOR. METALLIC DEPOSITS ON INSULATOR INDICATE ENGINE DAMAGE. CAUSED BY WRONG TYPE OF FUEL, INCORRECT IGNITION TIMING OR ADVANCE, TOO HOT A PLUG, BURNT VALVES OR ENGINE OVERHEATING. REPLACE THE PLUG.

OVERHEATING



IDENTIFIED BY A WHITE OR LIGHT GRAY INSULATOR WITH SMALL BLACK OR GRAY BROWN SPOTS AND WITH BLUISH-BURNT APPEARANCE OF ELECTRODES, CAUSED BY ENGINE OVERHEATING. WRONG TYPE OF FUEL, LOOSE SPARK PLUGS, TOO HOT A PLUG, LOW FUEL PUMP PRESSURE OR INCORRECT IGNITION TIMING. REPLACE THE PLUG.

FUSED SPOT DEPOSIT



IDENTIFIED BY MELTED OR SPOTTY DEPOSITS RESEMBLING BUBBLES OR BLISTERS. CAUSED BY SUDDEN ACCELERATION. CAN BE CLEANED IF NOT EXCESSIVE. OTHERWISE REPLACE PLUG.

B3235-2B

FIG. 15 Spark Plug Inspection

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Clean the plugs on a sand blast cleaner, following the manufacturer's instruction. **Do not prolong the use of the abrasive blast as it will erode the insulator and electrodes.**

Examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of failure. Replace as required.

DISTRIBUTOR

Inspect distributor components to see that all snap rings are in place, and that the magnetic pickup assembly moves freely on the fixed base plate. Blow assembly clean with compressed air. Make sure no filings or metal chips adhere to pickup magnet face.

DISTRIBUTOR CAP

Wipe the distributor cap with a clean, damp cloth. Dry the cap with compressed air. Inspect the cap for cracks, burned contacts, broken carbon button, carbon tracks or dirt or corrosion in the sockets. Replace the cap if it is damaged.*

ROTOR

Wipe the rotor with a clean, damp cloth. Dry the rotor with compressed air. Inspect the rotor for breaks, cracks, carbon tracks or burns. Replace the rotor if it is corroded or damaged.*

***NOTE: When it is necessary to clean a distributor cap or rotor for inspection, or when a new cap or rotor is being installed, silicone grease must be applied as outlined under distributor Rotor and Cap Installation.**

SECONDARY WIRING

Without removing from the engine, inspect the secondary wires for visable damage such as cuts, pinches, cracks or torn boots. Do not remove wires from distributor cap. Replace wires that are damaged. If spark plug boot is damaged, replace it (refer to Spark Plug Boot Replacement—All Engines, in this Part).

COIL

Wipe the coil with a damp cloth and check for any cracks or other defects.

IGNITION RESISTOR WIRE

(Vehicles equipped with Dura Spark II)

The special ignition resistance wire must be of a specified length and diameter to reduce the operating voltage of the ignition system. Due to its special resistance, under no circumstances should it be replaced by any other wire other than the correct service resistor wire. When a new resistor wire is installed, the old one should be isolated from the system.

Note: Although the Lincoln Continental system is shown, all other systems are similar in operation and repair. The only difference will be in the disconnect points in the 14401 wiring harness. See the latest service information for other vehicles not contained in this manual.

Lincoln Continental

The procedure which follows should be used when making a replacement of a damaged ignition resistor wire (part of 14401 wiring harness). The resistor wire is fed from a circuit weld in the harness approximately 3" from the connector to the ignition switch on the steering column, and is routed to the connector on the back of the fuse panel which connects with the 14398 engine compartment wiring harness on the left side of the dash panel.

1. Disconnect the battery cable.
2. In the engine compartment, disconnect the 14398 wiring connector from the 14401 wiring and fuse panel (on the left side of the dash panel). See Fig. 16.
3. To facilitate easier access to the fuse panel and the ignition switch connection, remove the lower trim panel and disconnect the steering column from the instrument panel.
4. Inside the car, detach the 14401 wiring connector that mates with the 14398 wiring connector from the back of the fuse panel.
5. Drop or pull the connector detached from the fuse panel below the instrument panel to facilitate the removal of the damaged resistor wire from the connector.
6. Locate the No. 16A red-light green stripe wire in the connector and retract the terminal retaining tab with a small screwdriver or a large paper clip. Now pull the female terminal from the connector (Fig. 17).
7. Cut the damaged resistor wire as close to the harness as possible and insulate the exposed ends with C1AZ-19627-A electrical tape or equivalent.
8. Now locate the ignition switch connector and about 3 inches from the connector unwrap the tape covering and expose the circuits welded into the harness.
9. Cut the damaged No. 16A (red-light green stripe) wire from the 14401 harness at the weld. Approximately 1 1/2" from the connector, cut the 16 gage red-light green wire, strip about 3/8" of insulation from each cut end and install a C5AZ-14294-B bullet connector to each end. Re-connect the circuit by plugging both bullet connectors into a B6A-14487-A double connector (Fig. 18).
10. Install one end of a new -12250-resistor wire into the remaining opening in the double connector. Re-wrap the exposed welded circuits previously exposed in the 14401 harness using appropriate plastic tape.
11. Route the new resistance wire to the connector behind the fuse panel and tape it to the harness.

    CAUTION: Do not fold, loop or overlap the resistor wire onto itself under the harness covering.
12. Cut a 4" piece of No. 16 gage wire (B6A-14296-C) from bulk stock, strip 3/8" of insulation from each end. Install a D2OB-14474-CB female terminal on one end and a C5AZ-14294-B bullet terminal on the other end (Fig. 18).
13. Install the female terminal into the vacated cavity of the fuse panel connector, where the damaged 16A circuit was removed (Fig. 17). Push the terminal firmly into place until the locking tab snaps into place.

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14. Connect the free end of the new resistor wire to the free end of the jumper, using a B7A-14487-A single connector (Fig. 18).
15. Reassemble the connector to the back of the fuse panel and connect it with the 14389 wiring harness at the dash panel.
16. *Reconnect the battery cable to the battery.*
17. Start the vehicle and see if the engine will continue running when the lock cylinder is released to the *RUN position. If not, check for proper voltage at* the ignition coil IGN terminal. Voltage should be about 6.4 volts, or resistance to ground should read from 1.05-1.15 ohms at 75°F. The new resistor allows for a slightly higher current to the coil.

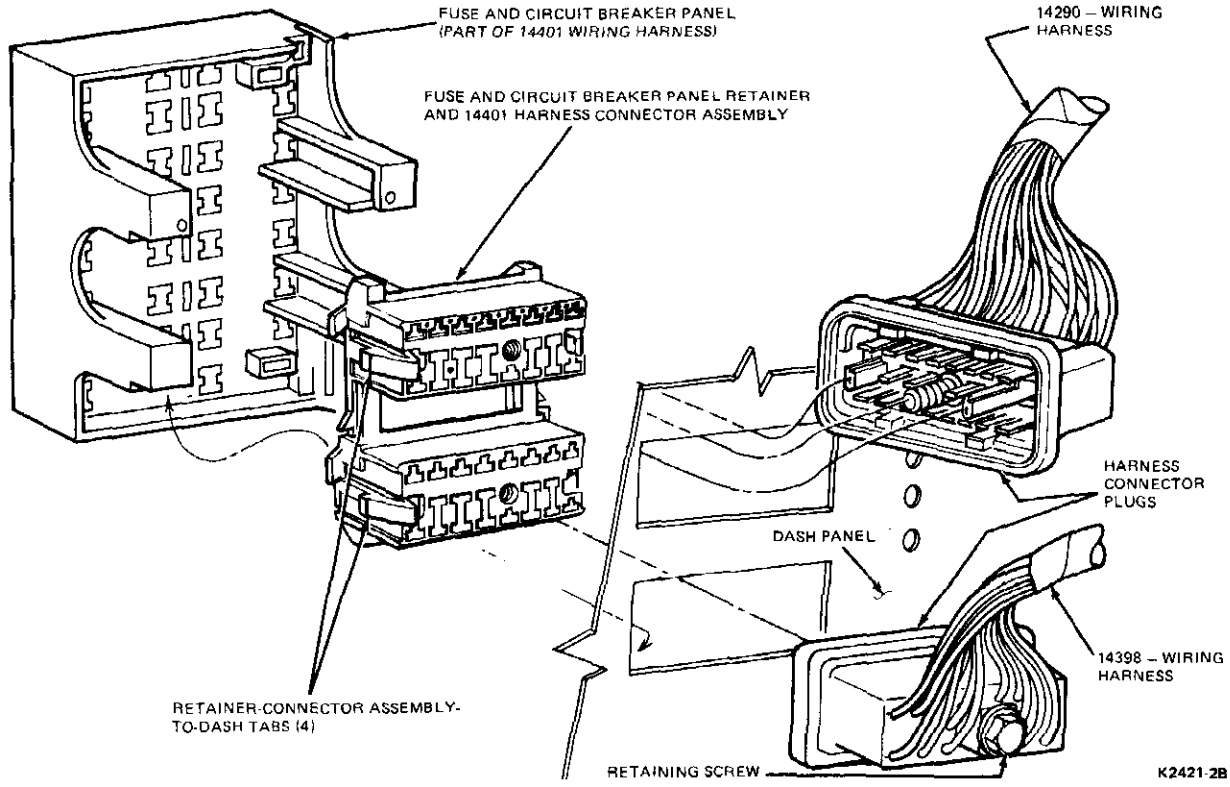
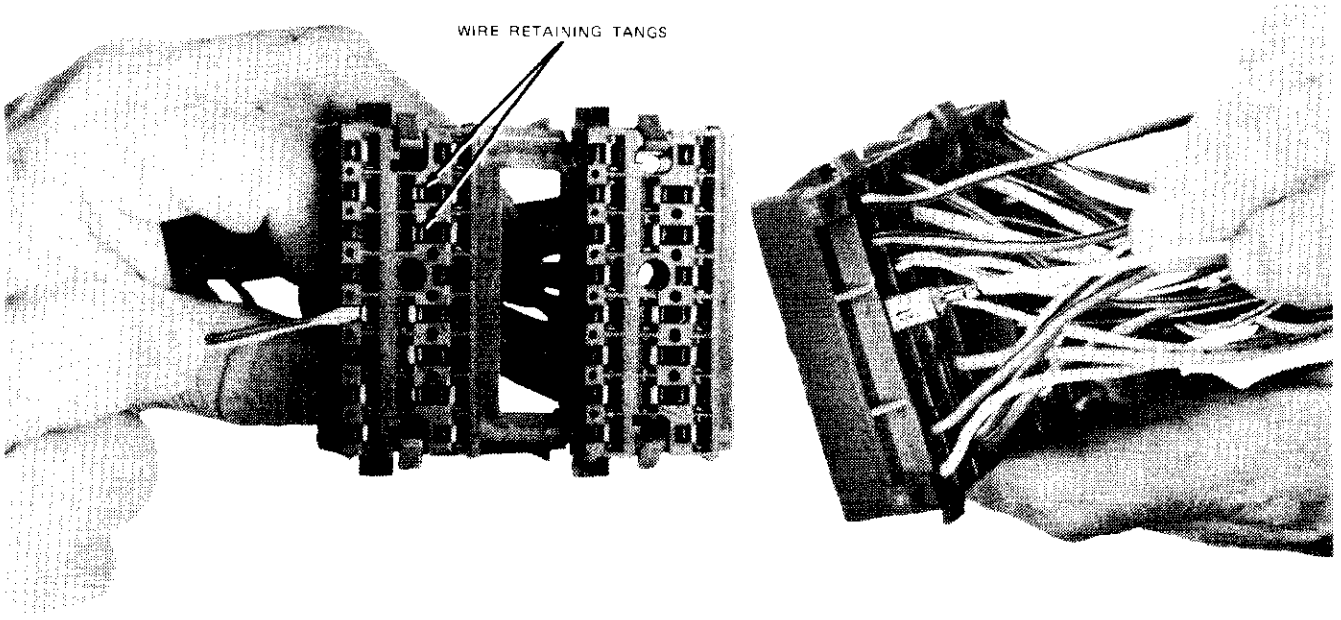


FIG. 16 Disconnecting 14398 Wiring From Fuse Block—Typical

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UNLOCKING WIRE FROM RETAINER-CONNECTOR ASSEMBLY

INSTALLING WIRE TERMINAL TO RETAINER-CONNECTOR ASSEMBLY

K2591-2A

FIG. 17 Removing Female Terminal From Fuse Block Connector

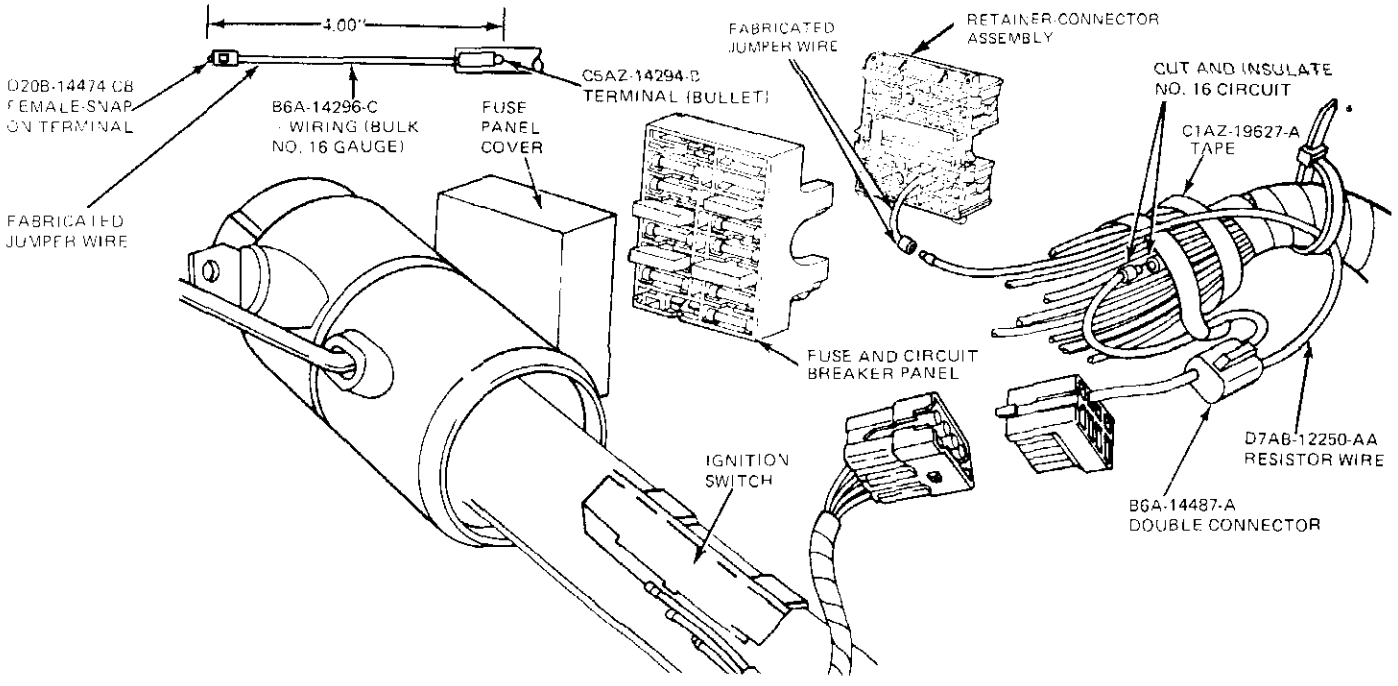


FIG. 18 New Resistor Wire Installation—Lincoln Continental Shown, Others Similar

B3743-2A

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SPECIFICATIONS

DISTRIBUTOR GENERAL INFORMATION

Engine	Distributor *Shaft End* Play ①	Gear *Location* ②	Engine	Distributor Shaft End Play ①	Gear Location ②
2.3L	0.022-0.033	2.220-2.230	5.8L (351 CID)	0.024-0.035	4.031-4.038
2.8L	0.022-0.033	2.655-2.660	6.6L (400 CID)	0.024-0.035	4.031-4.038
3.3L (200 CID)	0.022-0.033	2.510-2.515	7.5L (460 CID)	0.024-0.035	4.031-4.038
4.1L (250 CID)	0.022-0.033	2.510-2.515	7.5L (460 CID)	0.024-0.035	4.031-4.038
5.0L (302 CID)	0.024-0.035	4.031-4.038	Police Interceptor		

① Measured with distributor removed. ② Distance from bottom of mounting flange to bottom of gear.

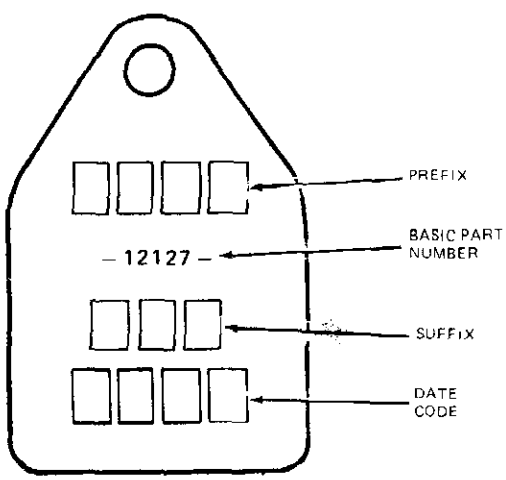
IGNITION SYSTEM GENERAL INFORMATION

Application	*Coil Primary* Resistance (Ohms)	*Coil Secondary* Resistance (Ohms)	*Primary Circuit* Ballast Resistor (Ohms)	*Rotor Air Gap* Voltage Drop (Kv Max)
Dura Spark I	.71-.77	7350-8250	Not Required	8.0
Dura Spark II	1.13-1.23	7700-9300	1.05-1.15	8.0

CB3742-2D

DISTRIBUTOR IDENTIFICATION

The distributor identification number is stamped on the metal tag attached to the distributor vacuum advance diaphragm assembly attaching screw (Fig. 19). The basic part number for distributors is 12127. To procure replacement parts, refer to the part number prefix and suffix stamped on the distributor tag, identifying the particular distributor. If the Master Parts Catalog lists a change date relating to the part needed, it may also be necessary to refer to the date code stamped on the distributor tag.



B3401-1B

FIG. 19 Distributor Identification Tag

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SPECIAL TOOLS

Tool Description	Tool No.
Spark Plug Boot Replacing Tool	T77L-6666-A
Engine Analyzer	36-0036 or 02-0305

Tool Description	Tool No.
Spark Plug Wire Removing Tool	T74P-6666-A

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FUEL SYSTEM

GROUP 24 (9500)

PART TITLE	PART NO.
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CV2260-2B

General Fuel System Service

PART 24-01

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CV2261-2B

DESCRIPTION

FUEL SYSTEM

Ford Motor Company vehicles manufactured for domestic sale are equipped with a variety of emission control systems. Modification or adjustment of these systems so as to render them inoperative constitutes a violation of federal law.

This Part of the shop manual will cover those test and adjustment procedures related directly to carburetors. Other emission systems related to the fuel system, but not directly to the carburetor, will be covered in Group 29 or in Volume 5, Part 50-29.

Carburetor Identification

A carburetor identification tag is attached to each carburetor, usually under one of the fuel bowl cover attaching screws. The basic part number for carburetors is 9510. To procure replacement parts, it is necessary to supply the proper prefix and suffix. In some instances, the design change code (Fig. 1) must also be supplied. Always refer to the master parts list for parts usage and interchangeability before replacing a carburetor or any of its component parts.

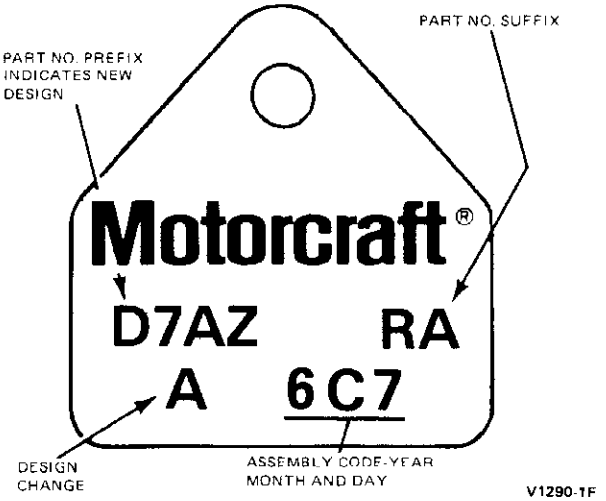


FIG. 1 Typical Carburetor Identification Tag

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TESTING AND ADJUSTMENT

All adjustments affect engine emissions and should be performed by competent personnel using specified equipment. Refer to Part 50-29 of Volume 5 before performing critical fuel system adjustments.

Refer to each carburetor section for specific adjustment points for individual carburetors. Refer to Groups 29 and 50 for test and adjustment procedures for decel valves, EGR valves, PVS switches and all other emission control systems equipment.

CLEANING AND INSPECTION

AIR CLEANER

Refer to Volume 5 for the recommended air cleaner assembly maintenance mileage interval. **Cleaning the air cleaner or crankcase ventilation filter elements is not recommended.** They should be replaced at the specified mileage intervals. Clean the air cleaner body and the cover with a solvent or compressed air. Wipe the air cleaner body and cover dry if a solvent is used. Inspect the air cleaner body and cover for distortion or damage at the gasket mating surfaces. Replace the cover or body if they are damaged beyond repair. Hold the filter in front of a light and carefully inspect it for any splits or cracks. If the filter is split or cracked, replace it.

CARBURETOR

Dirt, gum, water or carbon contamination in the carburetor or the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. Efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection of those parts not included in the carburetor overhaul repair kit are covered here. All gaskets and parts included in the repair kit should be installed when the carburetor is assembled and the old gaskets and parts should be discarded.

Wash all the carburetor parts (except the accelerating pump diaphragm, the enrichment valve, the choke pulldown diaphragm, and the anti-stall dashpot assembly) in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, lacquer thinner or denatured alcohol may be used.

Rinse the parts in kerosene to remove all traces of the cleaning solvent, then dry them with compressed air. Wipe all parts that can not be immersed in solvent with a clean, soft, dry cloth. Be sure all dirt, gum, carbon, and other foreign matter are removed from all parts.

Force compressed air through all passages of the carburetor. **Do not use a wire brush to clean any parts, or a drill or wire to clean out any openings or passages in the carburetor.** A drill or wire may enlarge the hole or passage, changing the calibration of the carburetor.

Check the choke shaft for grooves, wear and excessive looseness or binding. Inspect the choke plate for nicked edges and for ease of operation, and free it if necessary. Make sure all carbon and foreign material has been removed from the automatic choke housing and the piston. Check the operation of the choke piston in the choke housing to make certain it has free movement.

Check the throttle shafts in the bores for excessive looseness or binding and check the throttle plates for burrs which prevent proper closure. Inspect the main body, throttle body, air horn, nozzle bars and booster venturi assemblies, choke housing and thermostatic spring housing, enrichment valve cover and accelerating pump cover for cracks.

Check metallic float(s) for leaks by holding them under water that has been heated to just below the boiling point. Bubbles will appear if there is a leak. Shake the float to check for the entry of fuel or water. If a float leaks, replace it. Replace the float if the arm needle contact surface is grooved. If the floats are serviceable, polish the needle contact surface of the arm with crocus cloth or steel wool. Replace the float shafts if they are worn. Replace all screws and nuts that have stripped threads. Replace all distorted or broken springs.

Inspect all gasket mating surfaces for nicks and burrs. Repair or replace any parts that have a damaged gasket surface.

FUEL PUMP

Clean the exterior of the fuel pump with a cloth. Inspect the fuel pump for cracks or damage. Inspect the mounting flange for distortion. Inspect the rocker arm and pin for wear, cracks or damage. Replace the pump if any of these conditions are noted.

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DETROIT IRON

Model YFA 1-V Carburetor

PART 24-06

I-6 Engines Except Fairmont/Zephyr w/Automatic Transmission

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DESCRIPTION

CARBURETOR ASSEMBLY

The Carter Model YFA 1-V carburetor is made up of three main assemblies: the air horn, the main body and throttle body (Figs. 1, 2 and 3).

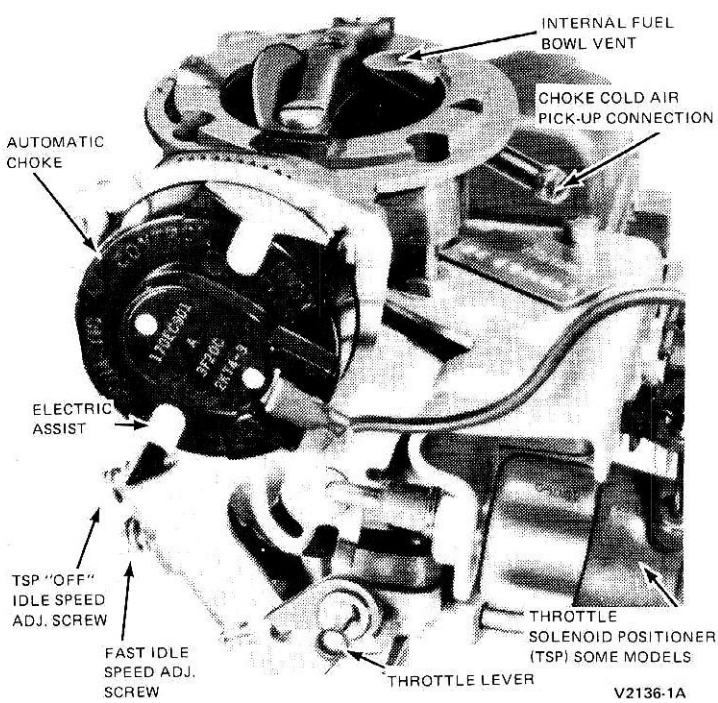


FIG. 1 Model YFA 1-V Carburetor—Rear View

The air horn, which serves as the main body cover, contains the choke plate, an internal vent for the fuel bowl, automatic choke thermostatic control and electric assist choke (if equipped), fuel inlet fitting, inlet needle and seat and the float and lever assembly. The throttle positioner is attached to the air horn by means of a bracket. The Model YFA carburetor has a choke hot air inlet adapter, an external mechanical bowl vent for improved control of evaporative emissions, and an integral hot idle compensator (HIC) (some models). An externally-mounted choke pulldown diaphragm is used on all models.

The main body contains the integral hot idle compensator (some models), accelerator pump assembly, metering rod, main metering jet, low-speed jet, accelerator pump check ball, weight, temperature compensator valve, and the main discharge nozzle.

The throttle body contains the throttle plate, throttle shaft and lever and idle mixture adjusting screw with a plastic limiter cap.

The Model YFA Carburetors used on some I-6 engines may be equipped with solenoid throttle positioners (Fig. 1). The solenoid reduces "dieseling" or after-running by allowing the throttle plate to close further than the normal curb idle position when the ignition is turned off. Some models use a second solenoid when equipped with A/C.

The engine speed is regulated and controlled by the amount of fuel and air delivered to the cylinders for all

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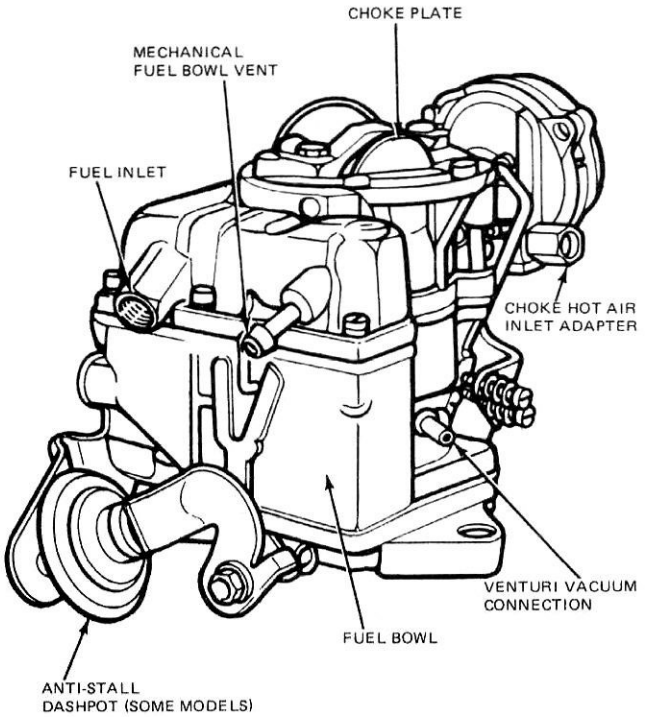


FIG. 2 Model YFA 1-V Carburetor—Left Front View

engine operating conditions. Operation is based on the principle of pressure differences.

Air is drawn into the carburetor air horn by manifold vacuum. As the air passes through the carburetor on the way to enter the cylinders, low pressure is created at the fuel discharge outlets of the carburetor. The fuel bowl is vented to the carburetor air horn. The higher air pressure exerted on the fuel in the bowl forces the fuel to travel up through the fuel discharge channels and out into the air stream passing through the carburetor. The fuel and air is mixed at this point and distributed into the engine cylinders for combustion.

To more closely match accelerator pump fuel discharge with engine requirements over a wide range

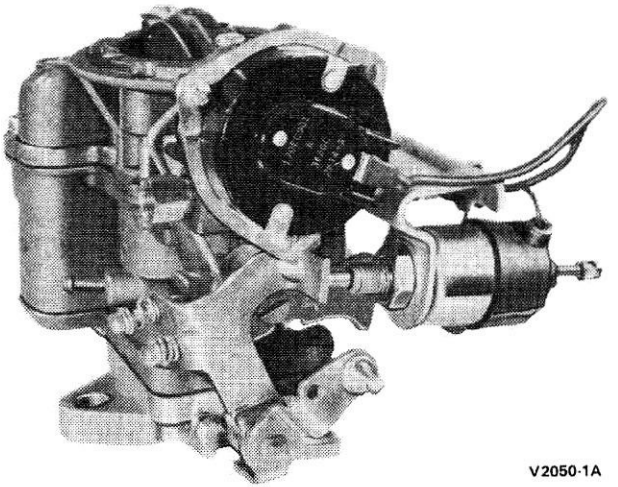


FIG. 3 YFA 1-V Carburetor Equipped with Solenoid—Rear View

of engine temperature conditions, a temperature controlled pump bleed is incorporated (Fig. 4).

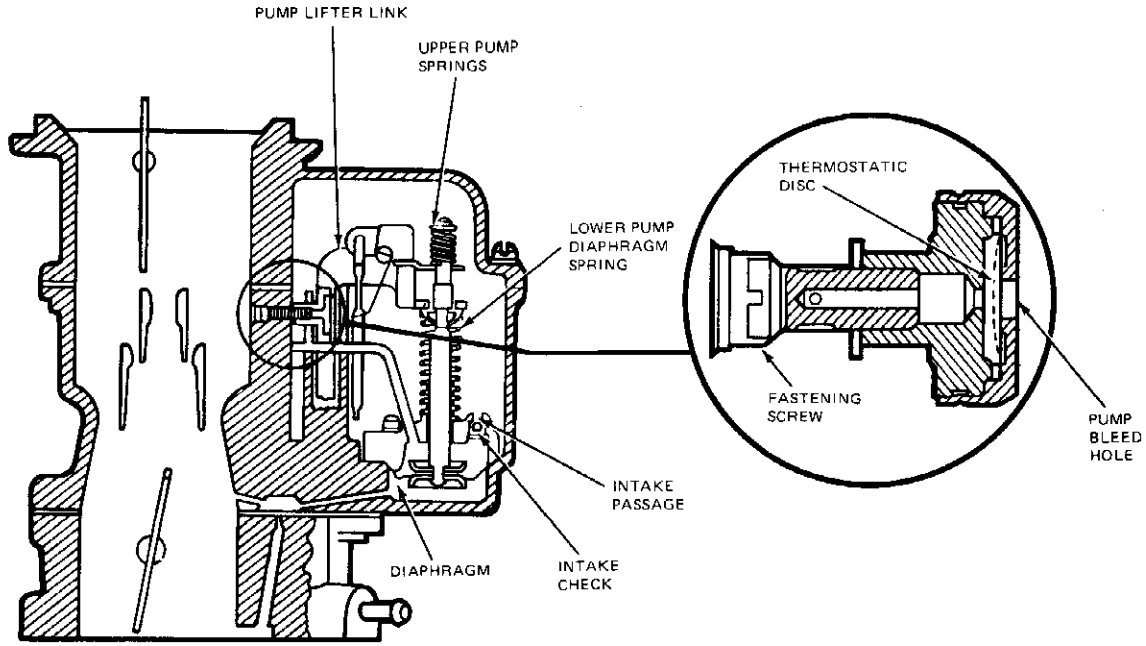
A thermostatic disc is designed to open and close within a specified temperature range. As the disc warms to a temperature of 71°F and above, it uncovers a calibrated pump bleed hole, permitting a portion of the fuel to be returned to the fuel bowl during the pump stroke. As the carburetor temperature drops to 49°F and below, the disc covers the pump bleed and the maximum pump volume is once again delivered to the engine.

An externally mounted choke pulldown diaphragm and counterweighted choke lever (Fig. 5) is used to more closely control optimum fuel/air ratio throughout the choke cycle.

The counterweight provides extra closing force when the choke is closed, providing a richer cranking mixture to aid in cold starts. When the engine starts, and the choke begins to open, the weighted portion of the choke shaft lever travels "overcenter" with respect to the choke shaft and begins to apply additional opening effort to the assist during choke warmup.

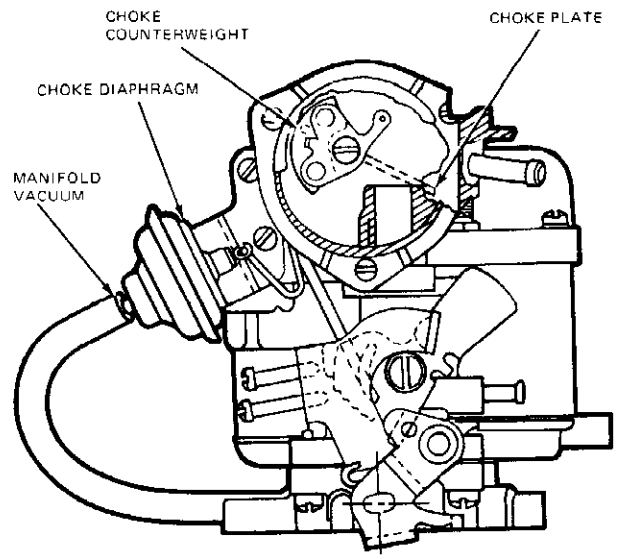
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DETROIT IRON



V2320-2A

FIG. 4 Temperature Compensated Accelerator Pump System



V2321-1A

FIG. 5 Choke Pulldown System

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ADJUSTMENTS

Most carburetor adjustments are factory set, and based on guidelines determined for reduced engine emission. In order to adjust:

Automatic Choke

Idle Speeds

Fuel Mixture

you must refer to Engine Emission Control System Part 29-01 of this Volume or Part 50-29 of Volume 5. Specifications can be found on the engine emission decal and in the Ford Car Performance Specification book.

Adjustment points for the YFA 1-V Carburetor are shown in Figs. 1, 2, 3 and 4.

FAST IDLE SPEED ADJUSTMENT

Make certain the curb idle speed and mixture are adjusted to specification before attempting to set the fast idle speed.

1. With the engine operating temperature normalized (hot), EGR vacuum disconnected and a jumper line (if required) to the distributor, air cleaner removed and the tachometer attached, manually rotate the fast idle cam until the fast idle adjusting screw rests on the kickdown step of the cam as shown in Fig. 7.
2. Adjust fast idle speed to specification. Turning the fast idle speed adjustment screw clockwise increases the fast idle speed.

AUTOMATIC THERMOSTATIC SPRING HOUSING

The automatic choke has an adjustment to control its reaction to engine temperature. By loosening the retaining screws that attach the thermostatic spring housing to the choke housing, the spring housing can be turned to alter the adjustment. Refer to the engine emissions decal for the proper setting.

1. Remove the air cleaner assembly from the carburetor.
2. Loosen the thermostatic spring housing retaining screws. Set the spring housing to the specified index mark and tighten the retaining screws.
3. If other carburetor adjustments are not required, install the air cleaner assembly on the carburetor.

DECHOKE ADJUSTMENT

1. Remove the air cleaner assembly.
2. Hold the throttle plate fully open and close the choke plate as far as possible without forcing it. Use a drill of the proper diameter to check the clearance between the lower edge of the choke plate and air horn (Fig. 8).
3. If the clearance is not within specification, adjust by bending the arm on the choke trip lever of the throttle lever. Bending the arm downward will decrease the clearance, and bending it upward will increase the clearance. Always recheck the clearance after making any adjustment.

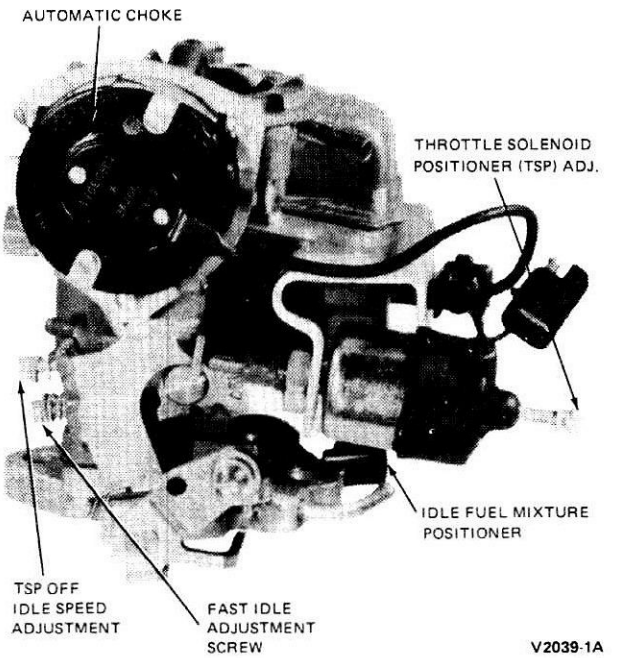


FIG. 6 Carburetor Adjustments—Model YFA 1-V

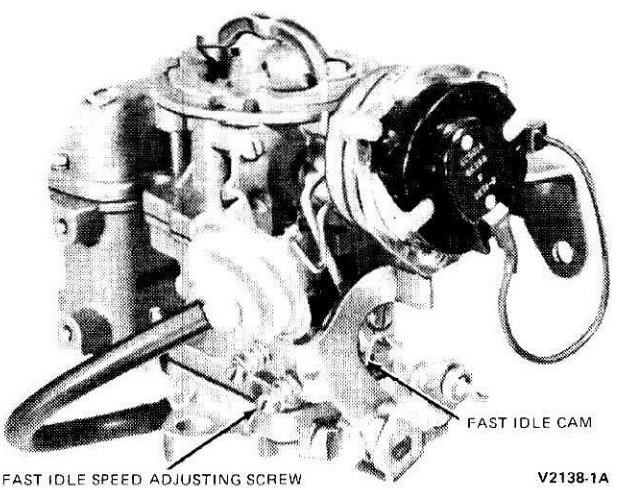


FIG. 7 Fast Idle Adjusting Screw

CHOKE PLATE PULLDOWN

1. Remove the air cleaner assembly.
2. Set the throttle on the highest step of the fast idle cam.
3. Cool the choke housing until the bi-metal closes the choke plate lightly in the air horn.
4. Record the index position of the choke bi-metal cap for later use in resetting the cap.
5. Loosen the retaining screws and rotate the bimetal cap 90 degrees in the closing (rich) direction. Retighten the retaining screws.
6. Activate the choke pulldown motor by applying vacuum to the external vacuum tube.
7. Manually insure that the pulldown motor is fully retracted by pushing down on the choke lever and releasing again.

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NOTE: Do not push the linkage or the shaft of the motor itself, as this will actuate the modulator spring.

- If the motor does not fully retract with vacuum, test the pulldown motor diaphragm for leakage.
- If the vacuum pulldown motor diaphragm is leaking and the motor will not retract fully with vacuum, replace the motor.

Warning: Insure that the choke plate linkage is not interferred with or erroneous measurement may result.

8. Use a drill of the proper diameter to check the clearance between the choke plate lower edge and the air horn wall (Fig. 9).
9. To adjust choke plate pulldown clearance, bend the choke pulldown linkage as required to obtain proper clearance.
10. Reset bi-metal cap to proper index.
11. Replace air cleaner assembly.

FAST IDLE CAM SETTING

1. Position the fast idle screw on the kickdown step of the fast idle cam against the shoulder of the high step (Fig. 7).
2. Adjust by bending the choke plate connecting rod to obtain the specified clearance between lower edge of the choke plate and the carburetor bore.

METERING ROD ADJUSTMENT

1. Remove the carburetor air horn and gasket from the carburetor.
2. Back out the idle speed adjusting screw until the throttle plate is closed tight in the throttle bore.
3. Press down on the end of the pump diaphragm shaft until the assembly bottoms.
4. To adjust the metering rod, hold the diaphragm assembly as in Step 3, then, turn the rod adjustment screw counterclockwise (Fig. 10) until the metering rod just bottoms in the body casting.
5. Turn the metering rod adjustment screw in (clockwise) **one additional turn** for the final adjustment.
6. Install the carburetor air horn with a new gasket on the carburetor.

FLOAT LEVEL ADJUSTMENT

The dry float fuel level adjustment is a final float or fuel level adjustment.

1. Remove the carburetor air horn and gasket from the carburetor. Refer to Air Horn to Main Body Gasket Replacement for the proper procedure.
2. Fabricate a float level gauge (Fig. 11) to the specified float level dimension.
3. Invert the air horn assembly, and check the clearance from the float indentation on the top of the float to the bottom of the air horn with the float level gauge (gasket removed) (Fig. 11). Hold the air horn at eye level when gauging the float level. The float arm (lever) should be resting on the needle pin. **Do not load the needle when adjusting the float.** Bend the float arm as necessary to adjust the float level (clearance). **Do not bend the tab at the end of the float arm.** It prevents the fuel inlet needle from becoming disengaged.
4. Install the carburetor air horn and a new gasket on the carburetor. Refer to Carburetor Air Horn to

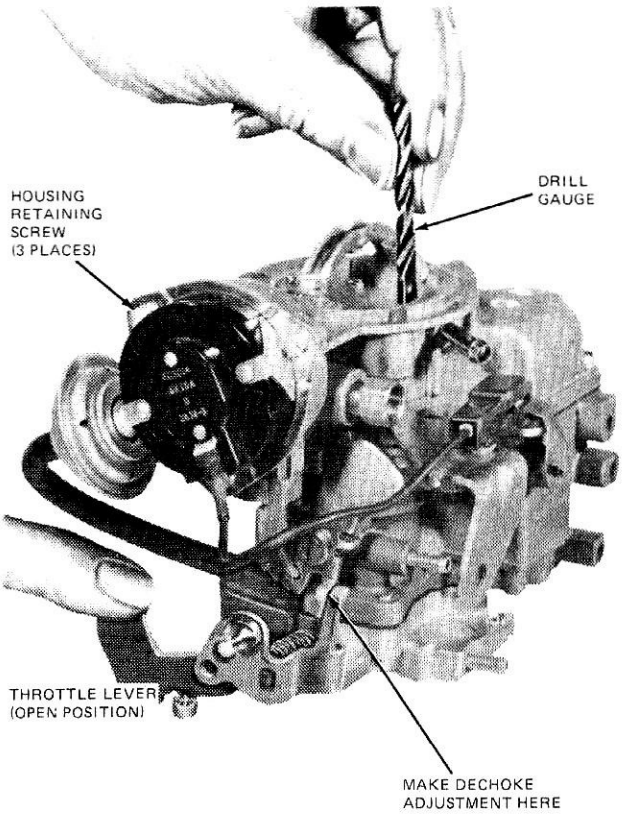


FIG. 8 Choke Plate Clearance Adjustment

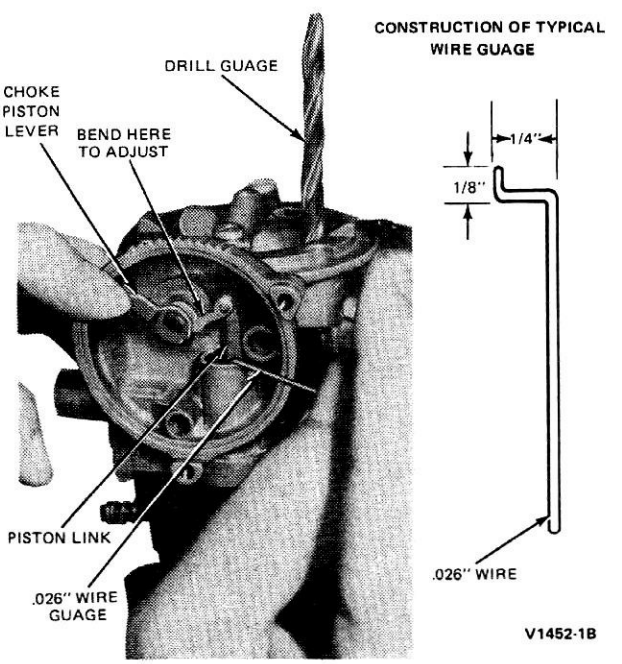


FIG. 9 Pull down Clearance Adjustment—Model YFA 1-V

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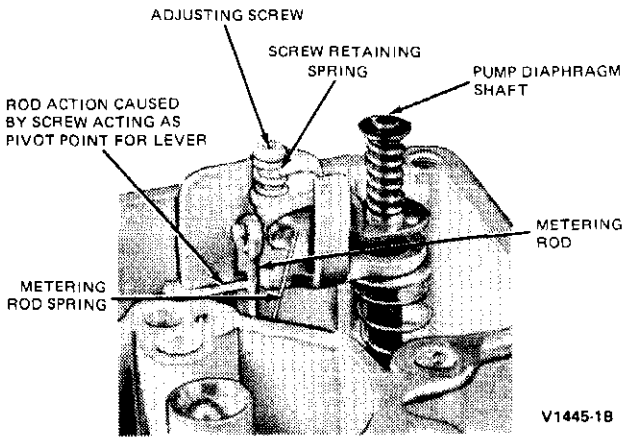


FIG. 10 Metering Rod Adjustment

Main Body Gasket Replacement for the proper procedure.

FLOAT DROP ADJUSTMENT

1. Remove the carburetor air horn and gasket from the carburetor. Refer to Air Horn to Main Body Gasket Replacement for the proper procedure.
2. Fabricate a float drop gauge to the specified dimension.
3. Hold the air horn upright and let the float hang free. Measure the maximum clearance from the top of the float to the bottom of the air horn gasket a(gasket removed) with the float drop gauge. Hold the air horn at eye level when gauging the dimension.
4. To adjust, bend the tab (Fig. 11) at the end of the float arm to obtain the specified setting.
5. Install the carburetor air horn and a new gasket on the carburetor as described in this Part.

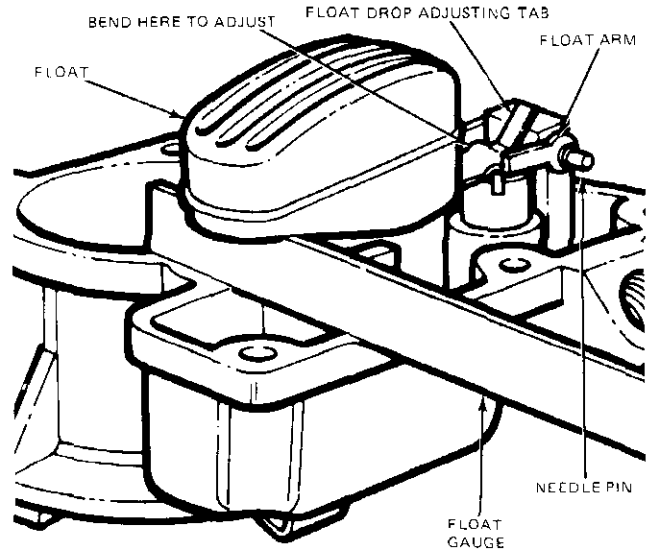


FIG. 11 Fuel Level Float Adjustment

REMOVAL AND INSTALLATION

AIR HORN TO MAIN BODY GASKET

Removal

1. Remove the air cleaner.
2. Disconnect the choke heat tube at the carburetor air horn. Disconnect the fuel inlet line at the carburetor. Disconnect the choke clean air hose at the carburetor. Disconnect the external vent hose.
3. Disconnect the solenoid wire at the connector. Disconnect the electric choke wire at the connector.
4. Remove the clip retaining the link joining the choke shaft lever to the fast idle cam and remove the link.
5. Remove the air horn assembly attaching screws, solenoid throttle positioner and air horn gasket. Discard the gasket.

Installation

1. Install a new air horn to main body gasket. **Make sure all holes in the new gasket have been properly punched and that no foreign material has adhered to the gasket.** Install the air horn assembly, making sure the bowl vent rod engages the forked vent actuating lever. Install the solenoid throttle positioner and air horn attaching screws. Position the link joining the fast idle cam to the choke shaft lever and retain in place with a wire clip.
2. Connect the fuel inlet line, choke heat tube and choke clean air hose and external vent hose (if equipped) to the carburetor air horn.
3. Connect the solenoid wire and electric choke wire (if equipped).
4. Install the air cleaner. Start the engine, check for fuel leaks and run it until normal operating temperature is reached. Install the air cleaner. Adjust the idle fuel mixture and idle speed.

FLOAT OR NEEDLE VALVE

Removal

1. Remove the carburetor air horn and gasket. Follow instructions under Air Horn to Main Body Gasket Replacement.
2. Hold the air horn assembly bottom side up, and remove the float pin and float and lever assembly. Turn the air horn assembly over and catch the needle pin, spring and needle.
3. Remove the needle seat, inlet screen and gasket.

Installation

1. Replace the float if the needle pin contact surface is grooved. If the float is serviceable, polish the needle pin contact surface with crocus cloth or steel wool. Replace the float pin if it is worn.
2. Install the needle seat, gasket and inlet screen in the air horn. With the air horn inverted, install the

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needle, pin spring, needle pin, float and lever assembly and float pin (Fig. 15).

3. Adjust the float level to specifications.
4. Install the carburetor air horn and gasket.

CARBURETOR ASSEMBLY

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl may then be examined for contamination as the carburetor is disassembled.

1. Remove the air cleaner.
2. Remove the throttle cable or rod from the throttle lever. Disconnect the EGR vacuum line, distributor vacuum line, fuel line and choke heat tube at the carburetor.
3. Disconnect the solenoid wire at the connector (if equipped). Disconnect the electric choke wire at the connector (if equipped).
4. Disconnect the choke clean air hose and the external vent hose from the air horn.
5. Remove the carburetor retaining nuts; then remove the carburetor. Remove the carburetor mounting gasket, spacer (if equipped) and lower gasket, from the intake manifold.

Installation

1. Clean the gasket mounting surfaces of the spacer and carburetor. Place the spacer between two new gaskets and position the spacer and gaskets on the intake manifold. Position the carburetor on the spacer and gasket and secure it with the attaching nuts.

   To prevent leakage, distortion or damage to the carburetor body flange, snug the nuts; then, alternately tighten each nut to the specified torque.
2. Connect the fuel line, throttle cable, choke heat tube, distributor vacuum line and EGR vacuum line.
3. Connect the choke clean air hose and external vent hose to the air horn. Connect the solenoid wire and electric choke wire (if equipped).
4. Install the air cleaner.
5. Adjust the engine idle speed, the idle fuel mixture and anti-stall dashpot (if so equipped).

MAIN METERING JET, LOW-SPEED JET, METERING ROD AND ACCELERATOR PUMP

Removal

1. Remove the carburetor from the engine as described in this Part.
2. Remove the carburetor air horn and gasket by following the instructions under Air Horn to Main Body Gasket Replacement.
3. Turn the main body casting upside down and catch the accelerating pump check ball and weight and the hot idle compensator (if equipped).

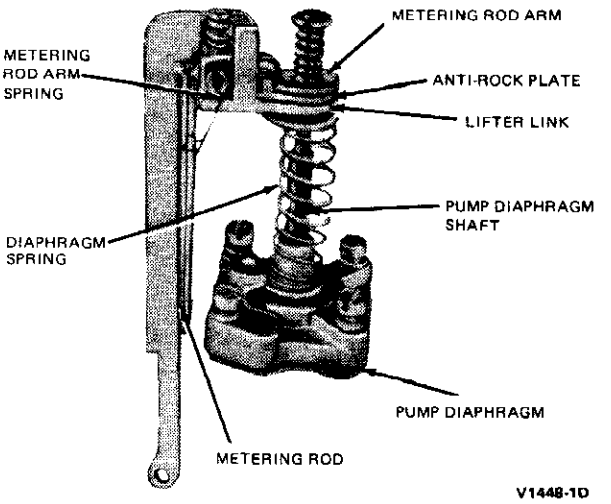


FIG. 12 Accelerating Pump and Lifter Link Assembly

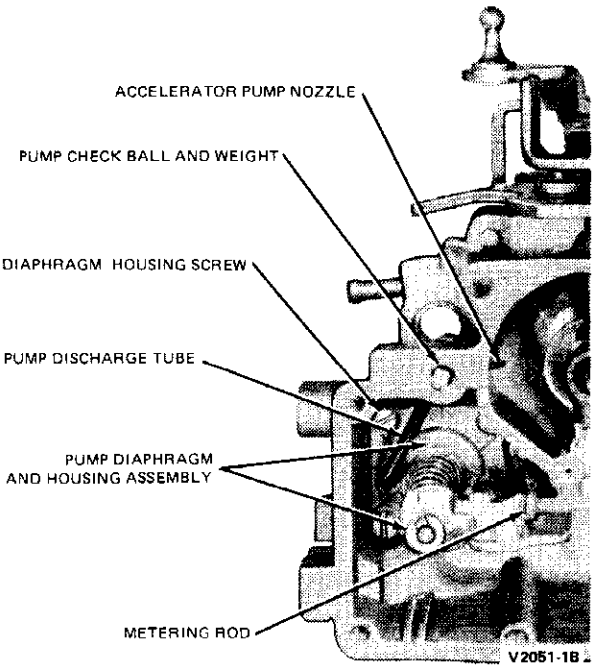


FIG. 13 Pump Diaphragm and Housing Installation

4. Remove the mechanical bowl vent operating lever screw, lever, wave washer, actuating lever, spacer and E-clip from the throttle shaft.
5. Loosen the throttle shaft arm screw, and remove the arm and the pump connector link.
6. Remove the accelerator pump diaphragm housing screws. Remove the accelerator pump discharge tube. Lift out the pump diaphragm assembly, the pump lifter link, seal, and the metering rod as a unit (Figs. 12 and 13).
7. Disengage the metering rod arm spring from the metering rod, and remove the metering rod from the metering rod arm assembly. **Note the location of any washers shimming either spring for proper reassembly.** Compress the upper pump spring, and remove the spring retainer. Remove the

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pump spring, the metering rod arm assembly, the anti-rock plate and the pump lifter link from the pump diaphragm shaft. Compress the pump diaphragm spring. Remove the pump diaphragm spring retainer, spring and pump diaphragm assembly from the pump diaphragm housing assembly (Fig. 12).

8. With the proper size jet tool or screwdriver, remove the low speed jet and the main metering jet (Fig. 15).

Installation

1. With the proper size jet tool (or screwdriver) install the low speed jet and the main metering jet (Fig. 15).
2. Install the pump diaphragm in the pump diaphragm housing. Position the pump diaphragm spring on the diaphragm shaft and housing assembly. **Install the spring shim washers (if equipped) in the proper locations.** Install the spring retainer. Install the pump lifter link, the anti-rock plate, metering rod arm and spring assembly and the upper pump spring on the diaphragm shaft. Depress the spring and install the upper pump spring retainer.
3. Install the metering rod on the metering rod arm and place the looped end of the metering rod arm spring on the metering rod as shown in Fig. 10. Align the pump diaphragm with the diaphragm housing; make sure holes are aligned. Install the housing attaching screws to keep the diaphragm and housing aligned. Install the accelerator pump discharge tube.
4. Install the throttle shaft arm and link to the end of the throttle shaft.
5. Adjust metering rod as described in this Part.
6. Install the E-clip, spacer, bowl vent actuating lever, wave washer and vent operating lever. Tighten the retaining screw. Replace the hot idle compensator valve and the accelerator pump check ball and weight.
7. Install the carburetor air horn and gasket as described under Air Horn to Main Body Gasket Replacement.
8. Install the carburetor on the engine as described in this Part.

DISASSEMBLY AND ASSEMBLY

Refer to Part 24-01 for Cleaning and Inspection procedures.

CARBURETOR ASSEMBLY

Disassembly

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor; however, certain components of the carburetor may be serviced without a disassembly of the entire unit.

1. Remove carburetor as outlined under Removal and Installation.
2. Remove the two retaining screws, disconnect the choke pulldown link and remove the pulldown motor assembly. Disengage the link from the choke shaft lever.
3. Remove the choke retaining screws and housing retainers, the thermostatic spring housing assembly, spring housing gasket, spring housing baffle plate and fast idle link.
4. Remove the air horn assembly attaching screws, solenoid bracket assembly(s), air horn assembly, and air horn gasket (Fig. 15).
5. Hold the air horn assembly bottom side up and remove the float pin and float and lever assembly. Turn the air horn assembly over and catch the needle pin, spring and needle.
6. Remove the needle seat and gasket.
7. Remove the air cleaner bracket. Remove the choke plate attaching screws. File the staked ends, if necessary, and use new screws upon reassembly. Remove the choke plate from the air horn assembly; remove the choke link lever and attaching screw. Remove the assembly from the air horn.
8. Turn main body casting upside down and catch the accelerating pump check ball and weight and hot idle compensator (if equipped).
9. Remove the mechanical bowl vent operating lever screw, lever, wave washer, actuating lever, spacer and E-clip from the throttle shaft.
10. Loosen the throttle shaft arm screw, and remove the arm and pump connector link.
11. Remove the fast idle cam and shoulder screw.
12. Remove the accelerating pump diaphragm housing screws. Lift out the pump diaphragm assembly, the pump lifter link, seal and the metering rod as a unit.
13. Disengage the metering rod arm spring from the metering rod, and remove the metering rod from the metering rod arm assembly. **Note the location of any washers shimming either spring for proper reassembly.** Compress the upper pump spring, and remove the spring retainer. Remove the upper spring, the metering rod arm assembly and the pump lifter link from the pump diaphragm shaft. Compress the pump diaphragm spring, and remove the pump diaphragm spring retainer, spring, and pump diaphragm assembly from the pump diaphragm housing assembly.
14. With the proper size jet tool or screwdriver, remove the main metering rod jet and the low speed jet (Figs. 13 and 14).
15. With a sharp punch or an awl, remove the temperature compensated accelerator pump bleed

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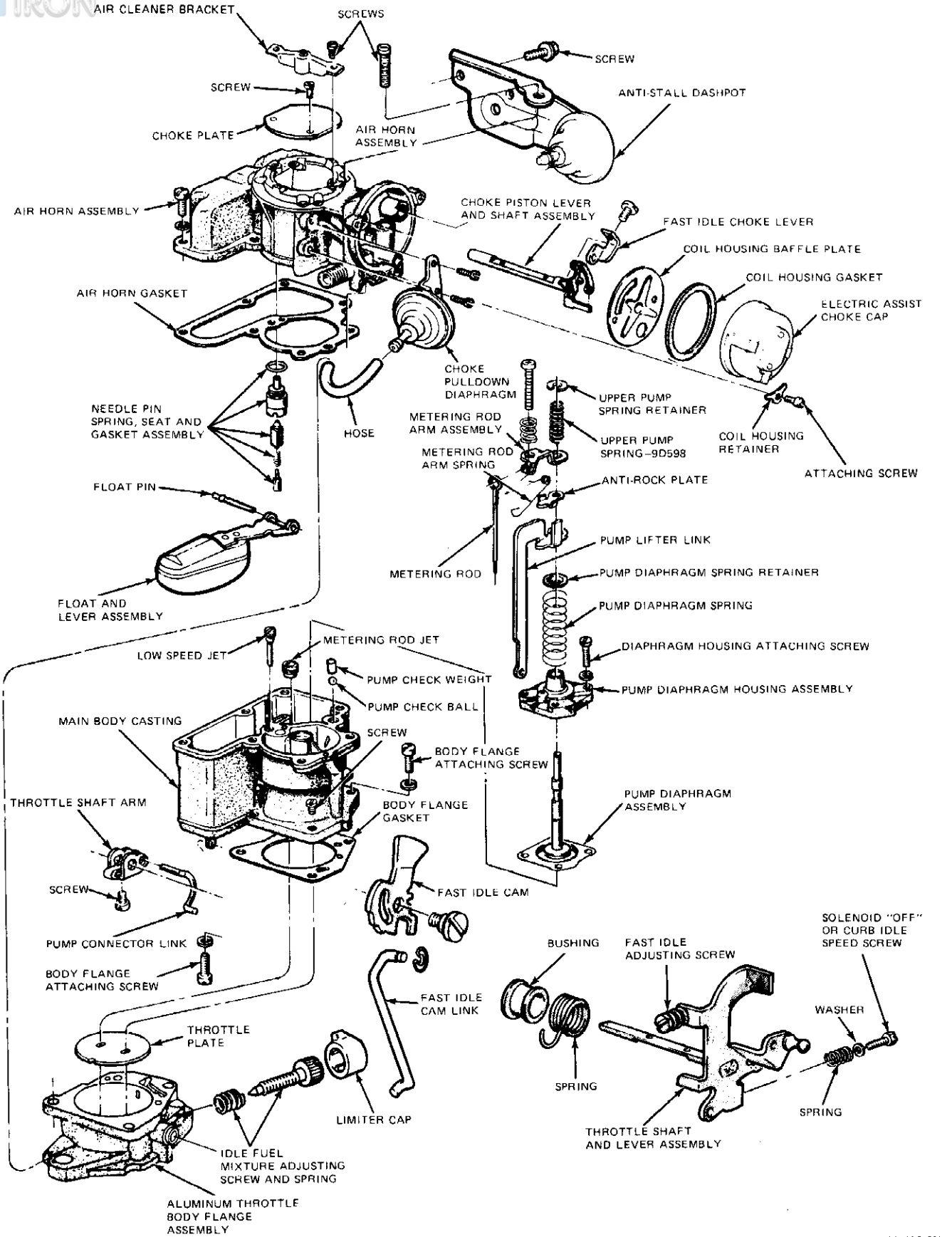


FIG. 14 Model YFA 1-V Carburetor Assembly

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valve plug from the (outside) main body casting. Loosen the bleed valve screw and remove the valve.

16. Remove the retaining screws and separate the throttle body flange assembly from the main body casting. Remove the body flange gasket.
17. Remove the throttle plate retaining screws. File the staked ends, if necessary, and use new screws upon assembly. Slide the throttle shaft and lever assembly out of the throttle body flange assembly. **Note the location of the ends of the torsion spring on the throttle shaft for proper reassembly. When removing the idle mixture limiter cap be sure to note the position of the tab. After removing the limiter cap count the number of turns to lightly seat the needle. This information will be used in reassembly.**

Assembly

1. Install the throttle shaft and lever assembly with torsion throttle return spring and bushing (Figs. 14 and 15) in the throttle body flange. Position the throttle plate on the throttle shaft with the notch in the plate aligned with the slotted idle port (Fig. 15) in the throttle body flange. Install the throttle plate attaching screws snug, but not tight. Move the shaft back and forth and rotate it to be sure the throttle plate does not bind in the flange bore. It is necessary that the throttle plate should close tight in the bore therefore the idle speed screw should be backed out sufficiently to insure it does not contact the throttle stop. Reposition the plate, if necessary. Tighten the screws and stake (or peen) the screws in place.

   Install the idle mixture screw the same number of turns out from lightly seated. Install the limiter cap in the same position as removed.

NOTE: Final idle fuel mixture adjustments must be made according to procedures outlined in Part 50-29 of this Manual.

2. Place a new body flange gasket and the main body casting on the throttle body flange. Install the attaching screws and tighten them evenly.
3. With the proper size jet tool (or screwdriver) install the low speed jet and the main metering rod jet (Figs. 13 and 14).
4. Install the pump diaphragm in the pump diaphragm housing (Fig. 13). Position the pump diaphragm spring on the diaphragm shaft and housing assembly. Install the spring shim washers in the proper locations. Install the spring retainer. Install the pump lifter link, metering rod arm and spring assembly, and upper pump spring on the diaphragm shaft. Depress the spring and install the upper pump spring retainer.
5. Install the metering rod on the metering rod arm and place the looped end of the metering rod arm spring on the metering rod as shown in Fig. 12. Align the pump diaphragm with the diaphragm housing; make sure the holes are aligned. Install the housing attaching screws to keep the diaphragm and housing aligned.
6. Align the pump housing, pump lifter link, metering rod and baffle plate with the main body casting.

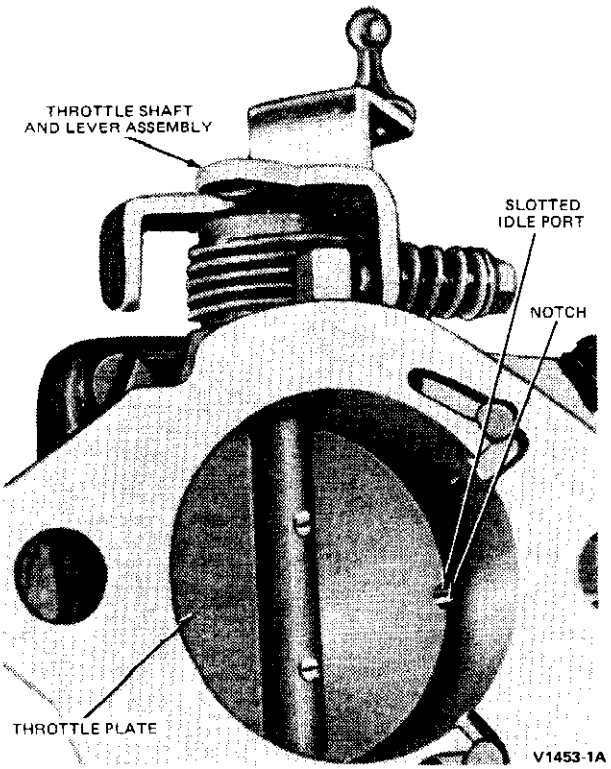


FIG. 15 Throttle Plate and Shaft Arm Installation

Be sure the vacuum passage in the diaphragm housing is aligned with the vacuum passage in the main body. Install the assembly in the main body casting being careful to engage the pump lifter link with the main body, and to insert the metering rod in the main metering rod jet. Install the pump housing attaching screws snug, but not tight. Push down on the diaphragm shaft to compress the diaphragm, and tighten the attaching screws. Adjust the metering rod, following the procedure under Metering Rod Adjustment.

7. Position pump bleed valve and washer, and install valve retaining screw. Install a new welch plug by seating it securely with a 1/4" flat drift punch.
8. Install the fast idle cam and shoulder screw. Install the throttle shaft arm and pump connector link on the throttle shaft and pump lifter link (Fig. 15). Tighten the lock screw.
9. Install the E-clip, spacer, bowl vent actuating lever, wave washer, and vent operating lever. Tighten the retaining screw. Replace the hot idle compensator valve and accelerator pump check ball and weight.
10. Install the choke shaft assembly through the choke housing, the pulldown link lever, and into the air horn. Tighten the lever retaining screw.
11. Position the choke plate on the choke shaft and install the screws snug. Check the choke plate movement to be sure it isn't binding. Tighten the screws and peen or stake them to prevent loosening. Install the choke link lever and tighten the attaching screw.
12. Install the needle seat and gasket in the air horn. With the air horn inverted, install the needle, pin spring, needle pin, float and lever assembly, and float pin. Adjust the float level to specifications.

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13. Align the bowl vent flapper valve with the vent rod. Make sure the spring is properly installed on the vent rod shaft. Install the spring retainer.
14. Position a new air horn gasket, the air horn assembly, and the solenoid bracket on the main body. Install and tighten the attaching screws.

NOTE: When installing the air horn assembly onto the main body, make sure the mechanical fuel bowl vent is engaged with the forked actuating lever.

15. Install the thermostatic coil housing, gasket and baffle plate, identification mark facing outward, with the gasket between the baffle and coil housing. Be sure the thermostatic spring engages the choke lever tang and is not stopped by a retaining tab on the baffle plate (if equipped). Install the retainers and housing screws. Set the coil housing index to specifications and tighten the screws.
16. Install the air cleaner bracket. Install the fast idle link.
17. Engage the choke pulldown link with the choke shaft lever and the pulldown diaphragm rod. Position the diaphragm bracket on the air horn and install the two attaching screws. Connect the pulldown vacuum hose from the throttle body vacuum connector to the diaphragm housing.

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Holley Model 1946 1-V Carburetor

PART 24-08

Fairmont and Zephyr

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DESCRIPTION

The Holley model 1946 1-V carburetor (Figs. 1-3) is used on Fairmont and Zephyr 3.3L (200 CID) I-6 engines with automatic transmission. It uses seven basic systems to provide an appropriate air/fuel mixture for fuel economy, driveability and emissions under a wide range of conditions. The systems are: (1) fuel inlet system, (2) idle system, (3) main metering system, (4) power enrichment system, (5) accelerator pump system, (6) external fuel bowl vent system, and (7) automatic choke system. The operation of each system will be detailed under the specific system heading.

Three main assemblies make up the model 1946 carburetor: the air horn, main body, and throttle body (Fig. 1). The AIR HORN assembly contains the fuel bowl vent, the enrichment valve piston and the accelerator pump piston, cup, spring and operating lever, as well as the choke plate, shaft, lever, housing and choke cap. In addition, the idle air bleed and the high speed bleed restrictors are contained in the air horn assembly.

The MAIN BODY assembly contains the fuel inlet system including the needle and seat assembly, the float, the float hinge pin, and retainer. The centrally-

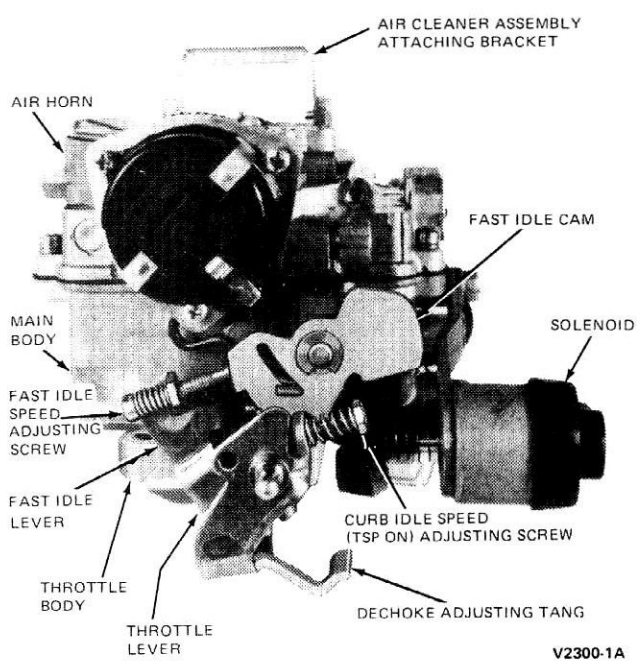


FIG. 1 Holley Model 1946 Carburetor—Side View

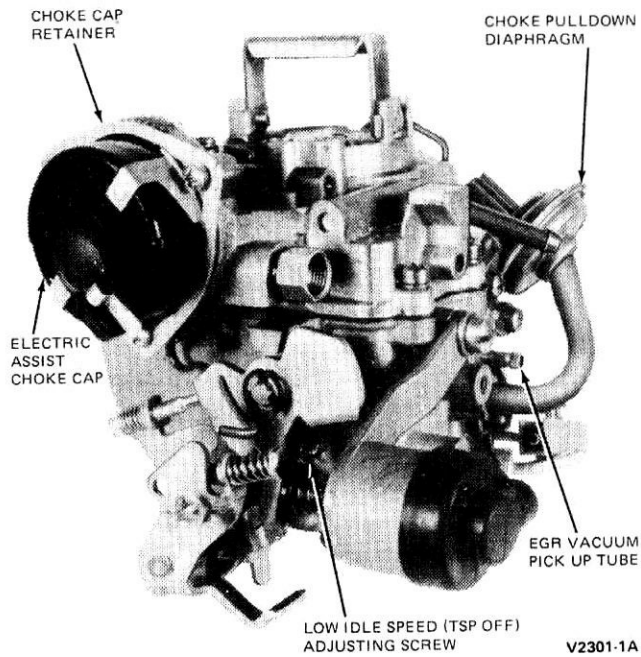


FIG. 2 Holley Model 1946 Carburetor—3/4 Rear View

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located venturi contains two venturi vacuum boosters and the main discharge passage. The accelerator pump well, passages, check ball and weight, main metering jet, enrichment valve, idle tube and hot idle compensator (HIC) valve are all contained in the main body assembly. Venturi vacuum pickup tube (green), manifold vacuum, and EGR port vacuum pickup tubes (silver) are incorporated in the main body (Figs. 2 and 3), while the spark vacuum port pickup tube (gold) is located near the mounting flange in the throttle body assembly.

The THROTTLE BODY regulates air flow through the carburetor and provides a suitable mounting flange for attachment of the carburetor to the intake manifold. The throttle plate, shaft lever and return spring assemblies regulate air flow. Also found in the throttle body are the spark vacuum port, EGR vacuum port, idle transfer slot, curb idle discharge port, and the idle mixture adjusting screw (Fig. 11).

Other features of the Model 1946 include a throttle solenoid (TSP) to help prevent "dieseling" by permitting a lower (solenoid OFF) idle speed when the ignition switch is turned off. Altitude compensation for vehicles sold in high altitude areas is achieved through carburetor calibration.

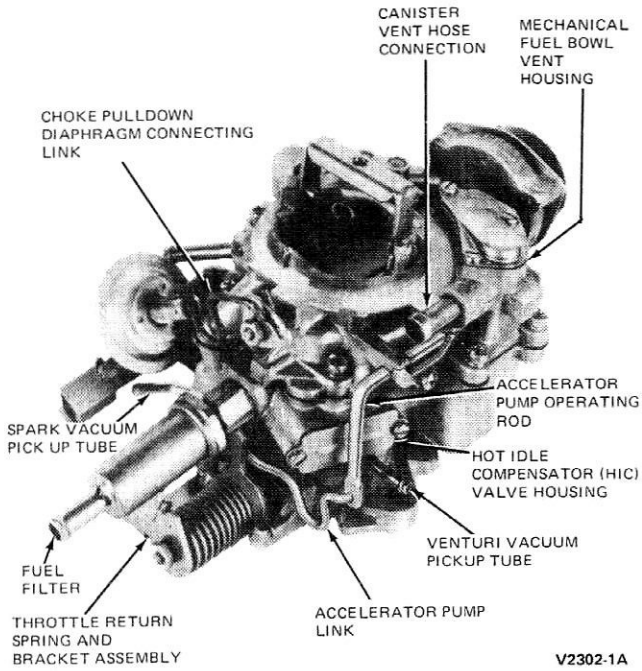


FIG. 3 Holley Model 1946 Carburetor—Elevated View

OPERATION

FUEL INLET SYSTEM

The fuel inlet system (Fig. 4) maintains the fuel level in the carburetor bowl so the basic fuel metering systems can deliver the proper mixture to the engine. As the fuel level in the bowl drops, the float also drops, permitting additional fuel to enter the bowl through the fuel inlet fitting located in the main body. Only enough fuel is admitted to replace the amount used.

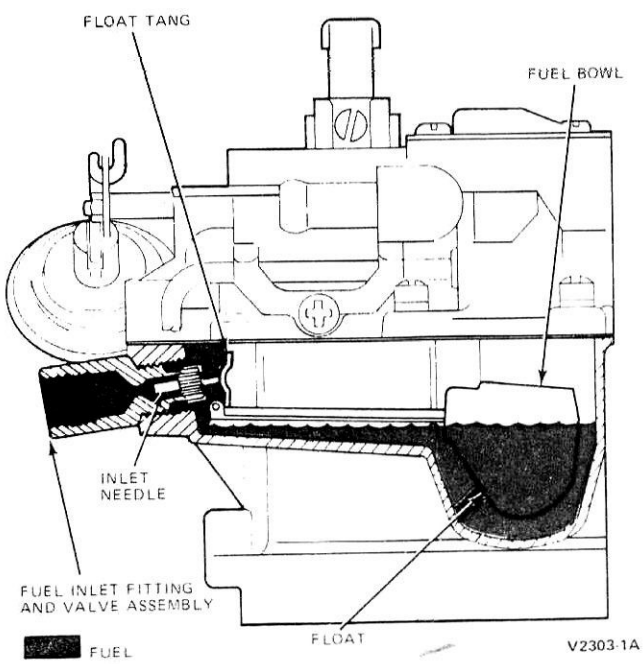


FIG. 4 Fuel Inlet System

A dual-pontoon float made of non-porous material monitors and maintains the proper fuel level in the fuel bowl. The Viton-tipped inlet needle seats directly in the fuel inlet fitting, and is permanently retained by a cap assembled to the fitting. The fuel inlet fitting and inlet needle are serviced as an assembly. Fuel flows past the needle and seat and enters the bowl through four holes in the valve seat body. Because the valve seat body extends only a short distance into the fuel bowl, the discharging fuel is shrouded by the main body casting and the inlet does not require a separate fuel baffle.

IDLE SYSTEM

During idle and low speed operation (Fig. 5), air flow through the carburetor is not sufficient to cause fuel to be discharged through the main discharge passage. For this reason, a separate idle system is part of the construction of the model 1946 1-V. The idle system is capable of fine adjustment, and can supply the engine with an appropriate air/fuel mixture at idle and can supplement the main metering system during critical off-idle (part throttle) operation.

Fuel entering the idle system flows from the fuel bowl through the main metering jet into the main well. An angular idle well connects with the main well, and an idle tube is pressed into this well. Fuel flows up through the idle tube where it is mixed with air entering through the idle air bleeds located in the air horn. With the throttle plate at curb idle, the fuel and air mixture flows down the idle channel where additional air is introduced through the portion of the transfer slot which is above the throttle plate. The air/fuel mixture is then discharged below the throttle plate at the curb idle discharge port. Idle fuel mixture is regulated by the adjustment of the idle mixture screw. Maximum fuel flow at idle is limited by the size of the restriction in the idle tube.

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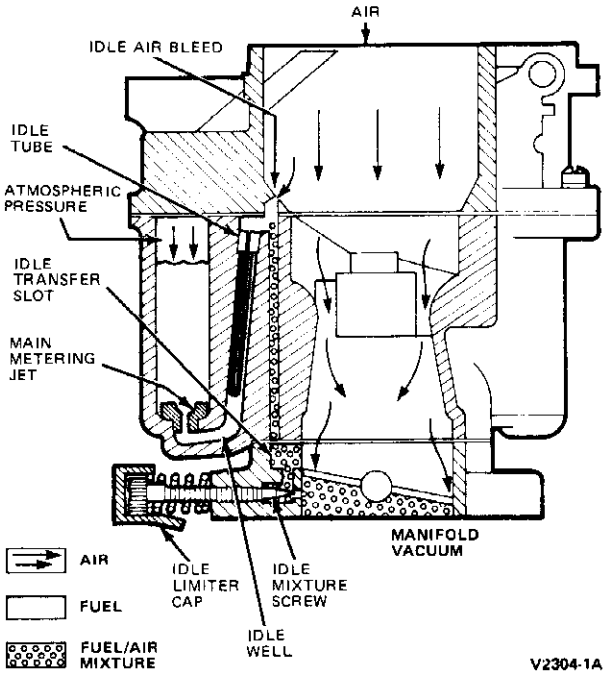


FIG. 5 Idle System

During low speed operation, as the throttle plate opens, it begins to expose the idle transfer slot to manifold vacuum. As the throttle is opened further, and engine speed increases, the air flow through the carburetor also increases. The increased air flow creates a low pressure in the venturi, and the main metering system begins to discharge fuel.

In conjunction with the idle system, an internal hot idle compensator (HIC) is used to improve idle quality. The HIC is temperature sensitive and opens during hot engine condition to admit additional air, which helps reduce idle fuel richness (Fig. 6).

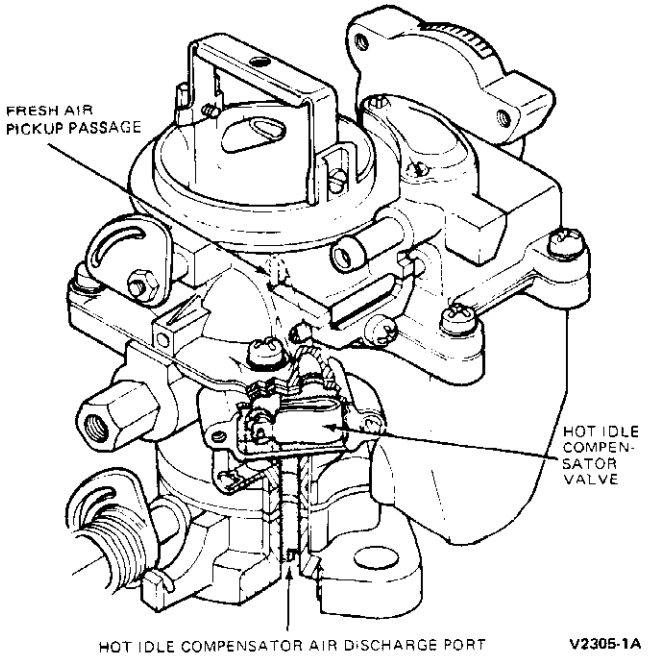


FIG. 6 Hot Idle Compensator (HIC) System

MAIN METERING SYSTEM

As engine speed increases, air flow through the carburetor increases, causing lower pressure in the venturi (Fig. 7). Near atmospheric pressure, present in the fuel bowl above the fuel, causes the fuel to flow to the lower pressure created at the venturi. This venturi action is increased by the use of dual venturi boosters. This stronger venturi effect in turn provides more precise response to changes in air flow through the carburetor.

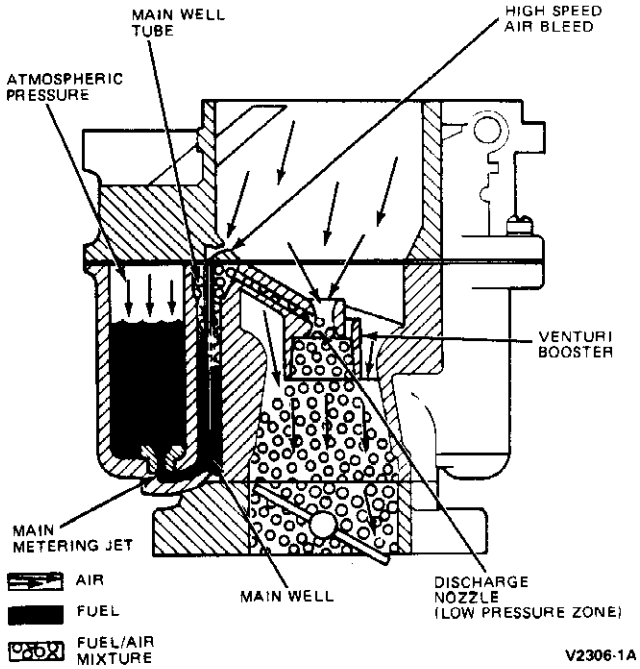


FIG. 7 Main Metering System

Fuel flows from the fuel bowl through the main jet into the main well. A small amount of air is admitted by the high speed bleed. This air is carried down the main well tube to a series of small holes where it escapes and mixes with fuel in the main well. The resultant mixture of fuel and air—being lighter than solid fuel—responds faster to changes in pressure in the venturin and is more readily vaporized when discharged into the air stream.

The main metering system is calibrated to deliver a lean mixture for improved part-throttle economy and exhaust emissions. When additional power is required, a vacuum-operated power system enriches the air/fuel mixture.

POWER ENRICHMENT SYSTEM

A vacuum-operated enrichment system is used to provide the fuel mixture enrichment necessary for wide open throttle (WOT) operation. The enrichment system consists of an enrichment valve assembly containing a needle, installed in the floor of the fuel bowl near the center of the main body, and a vacuum piston installed in the air horn (Fig. 8).

A vacuum passage leads from the top of the piston bore to the carburetor mounting flange. When the manifold vacuum is high, the vacuum piston is raised to the top of its cylinder and the spring above the piston

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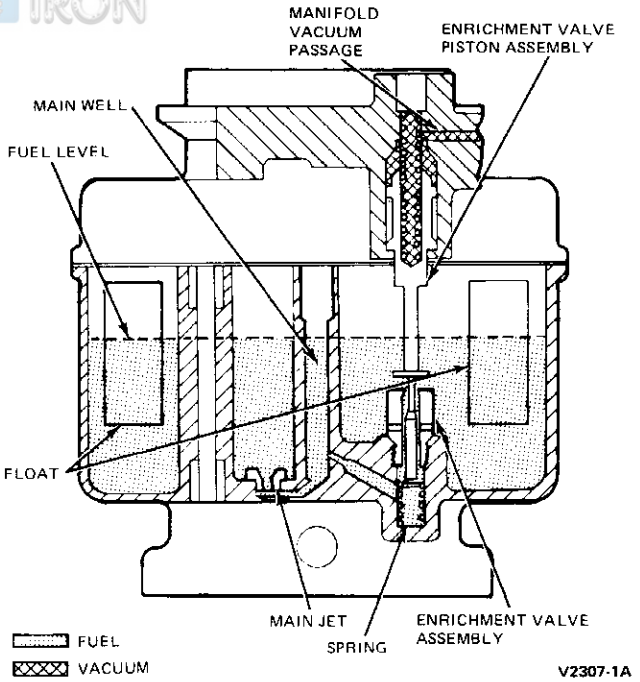


FIG. 8 Power Enrichment System

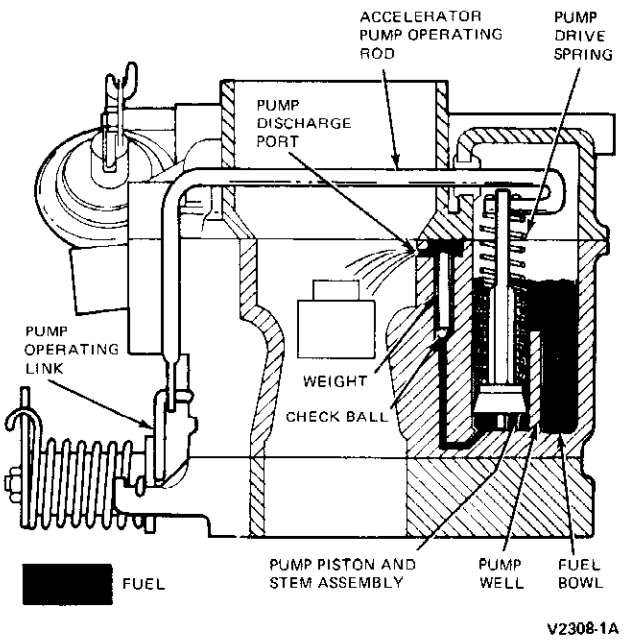


FIG. 9 Accelerator Pump System

is compressed. When manifold vacuum drops to a predetermined level, the spring overcomes the vacuum and pushes the piston down, permitting fuel to pass by the needle, through the calibrated enrichment valve channel restriction and into the main well. This fuel supplements the fuel being discharged through the main metering system jet.

ACCELERATOR PUMP SYSTEM

When the throttle plate is opened suddenly, the air flow through the carburetor increases almost immediately, but there is a brief lag before the fuel begins to flow enough to provide the desired air/fuel ratio. The accelerator pump system (Fig. 9) operates as the throttle is opened, supplying the fuel necessary to maintain the correct mixture until the main metering system can "catch up" to the air flow.

The fuel level is above the normal raised position of the pump piston, causing fuel to enter the pump cylinder through the pump cup stem clearance hole when the pump is lifted to a refill position (throttle released). As the throttle is again opened, the pump link—operated through a system of levers and a drive spring—pushes the pump piston down, seating the pump cup against the face of the stem. Fuel is forced through a passage, around a check ball and weight, and through the pump discharge jet which is drilled in the main body.

When the pump is not in operation, vapors or bubbles forming in the pump cylinder can escape through the stem clearance hole of the floating piston cup and past the pump stem into the fuel bowl.

EXTERNAL FUEL BOWL VENT SYSTEM

The Holley model 1946 1-V carburetor has a mechanical external fuel bowl vent operated by linkage from the throttle lever (Fig. 10). The system permits fuel bowl vapors to flow to the carbon canister when the engine is OFF. At any position except idle, the valve closes and the bowl vents through the internal vent tube to the carburetor air horn and into the engine intake.

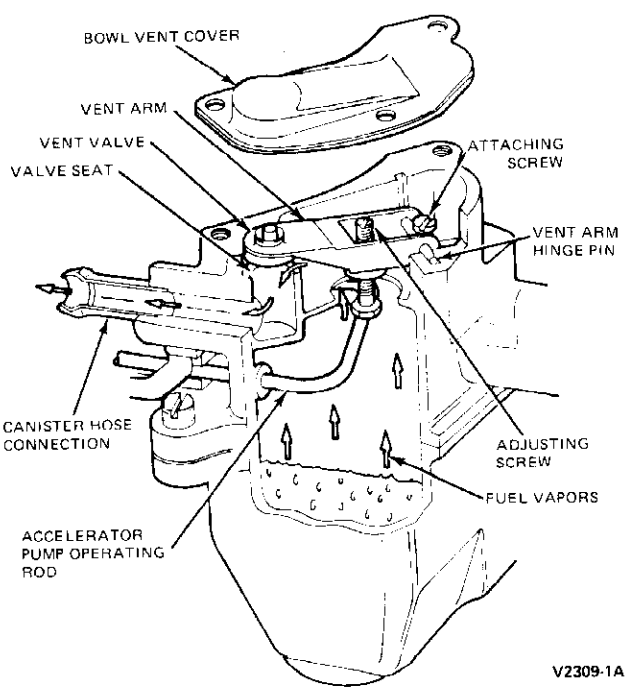


FIG. 10 Fuel Bowl Vent System

Unlike other carburetors used on Ford passenger vehicles, the fuel bowl vent can be serviced without removing the carburetor from the vehicle. The vent valve and arm are located on the top of the carburetor air horn, under a special vent valve cover.

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AUTOMATIC CHOKE SYSTEM

The automatic choke system (Fig. 11) provides the richer air/fuel mixture required for starting and operating a cold engine.

A bimetal spring inside the choke housing, which is part of the air horn assembly, begins to exert closing pressure on the choke valve at temperatures below approximately 75°F. As the temperature drops, closing pressure on the choke plate increases. As the engine warms up, manifold heat transmitted by hot air to the choke housing relaxes the pressure from the bimetal spring.

When the engine starts, two auxiliary systems also act to open the choke plate against the pressure of the bimetal spring. First, manifold vacuum is applied to a modulated choke diaphragm assembly through an externally-routed manifold vacuum hose. A link connected to the diaphragm pulls the choke open a sufficient amount to let the engine run without flooding out. The amount of choke opening depends on the temperature of the bimetal spring, since the closing force of the bimetal is opposed by a "modulating" spring within the pulldown motor. This type of system is thus called a 'modulated choke pulldown' system.

In addition to choke pulldown, choke opening is assisted by air rushing into the carburetor and acting against the choke plate, which is offset on the shaft.

To aid in the warm-up of the bimetal spring, the choke housing is equipped with a thermostatically-controlled Positive Temperature Coefficient (PTC) heater which is activated above about 60°F when the engine is running. Below this temperature, the heater is not activated and the desired pulldown is achieved through the vacuum pulldown motor acting against the bimetal spring.

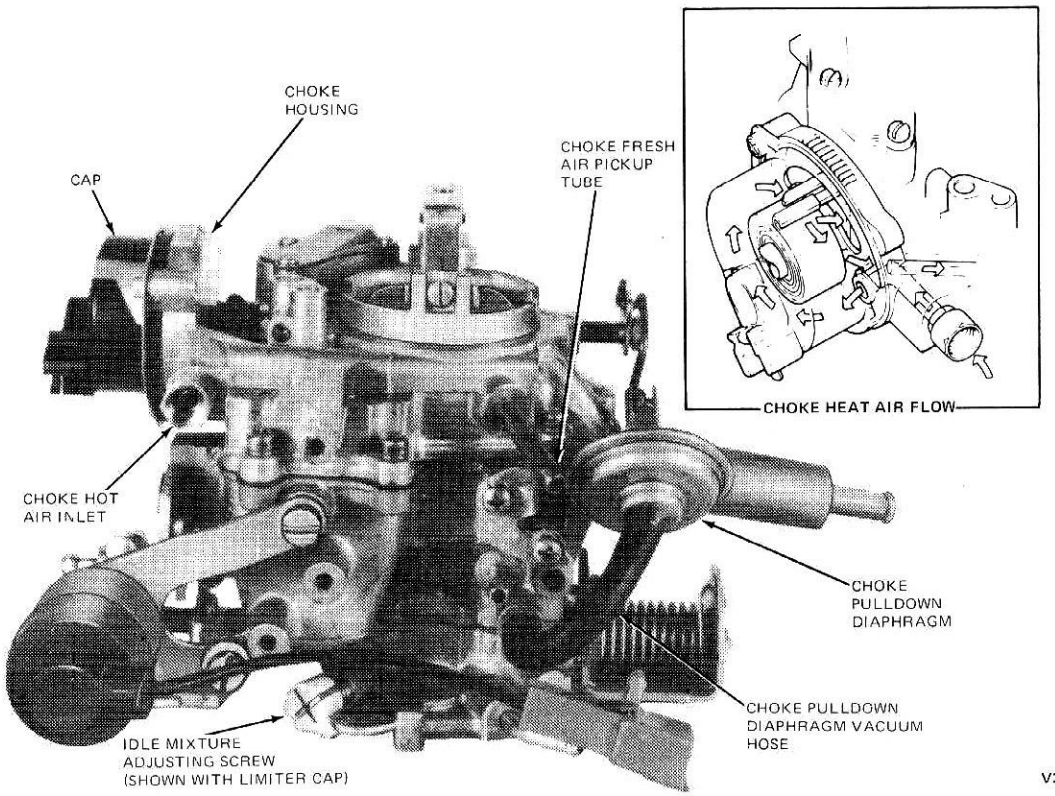


FIG. 11 Automatic Choke System

ADJUSTMENTS

Most carburetor adjustments are factory set to meet engine emission, performance and economy requirements. If it becomes necessary to check or adjust:

- Automatic Choke
- Idle Speeds
- Idle Fuel Mixture
- Idle CO

refer to Engine Emission Control Systems, Part 29-02 or Part 50-29 of this Manual. Choke cover setting and idle speed specifications are provided on the Engine Emission Decal on each vehicle.

CURB IDLE SPEED (TSP ON)

Curb idle speed is achieved through the use of a Throttle Stop Positioner (TSP) mounted to the carburetor body and an adjusting screw on the throttle lever. Use the curb idle adjusting screw (Fig. 1), which contacts the plunger of the TSP, to adjust curb idle speed. The curb idle adjusting screw has a 5/16 inch hex head on the

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TSP end and a screwdriver slot on the other end, to provide for adjustment with the air cleaner assembly in position. When adjusting from the TSP end, turn the screw counterclockwise to increase idle speed. When using the screwdriver slot end, turn the screw clockwise to increase idle speed.

LOW IDLE SPEED (TSP OFF)

The low idle speed is always adjusted with the TSP off. The adjusting screw is located in the main body boss just below the fast idle cam and contacting the fast idle lever tab (Fig. 2). Turn the screw clockwise to increase the low idle speed.

FAST IDLE SPEED

A fast idle speed is provided to help prevent stalls after cold engine starts. Fig. 12 shows the proper position of the fast idle cam and the contact point of the adjusting screw for fast idle speed adjustment and fast idle cam position adjustment. Turn the adjusting screw clockwise to increase fast idle speed.

IDLE FUEL MIXTURE

The idle fuel mixture adjustment screw is located in the throttle body (Fig. 11) near the mounting stud, and is equipped with a plastic limiter cap. The limiter cap must not be removed unless the Idle Mixture Adjustment procedure in Part 29-02 of this manual is followed and a new cap installed. Turning the screw counterclockwise enriches the idle fuel mixture.

FAST IDLE CAM POSITION

Fast idle cam position adjustment is necessary to make sure the fast idle screw contacts the various steps of the fast idle cam at the proper time during engine warm-up (Fig. 12). This adjustment can be made with the carburetor on the engine (with the engine off) or with the carburetor removed from the engine.

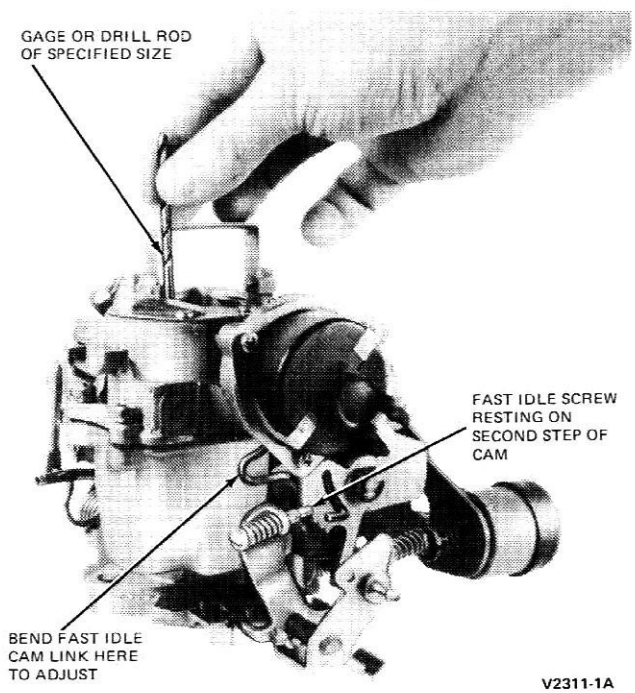


FIG. 12 Fast Idle Cam Position Adjustment

1. With the fast idle speed adjusting screw contacting the second highest step of the fast idle cam (kickdown step), move the choke plate toward the closed position with light pressure on the choke lever or choke plate.
2. Check the fast idle cam setting using the specified size gage or drill bit between the upper edge of the choke plate and the wall of the air horn (Fig. 12).
3. Bend the fast idle cam link to achieve the specified setting. NOTE: To fabricate a convenient bending tool, file a slot in the blade of a flat screwdriver just wide enough to slip over the 1/8-inch fast idle cam link. The tool can also be used in other applications where bending a similar rod for adjustment is required.

ACCELERATOR PUMP STROKE

The accelerator pump stroke is pre-set at the factory and should not be adjusted in an effort to improve driveability.

NOTE: Take care when disassembling the carburetor so that the accelerator pump operating link is not bent, and make sure it is returned to the proper slot in the throttle return spring arm.

The inner pump rod slot is identified as number one, while the outer slot is number two (Fig. 13). If the pump link is damaged or bent, check the length as shown in Fig. 13 and readjust by bending the loop provided to achieve the dimension specified in the Car Performance Specifications Book.

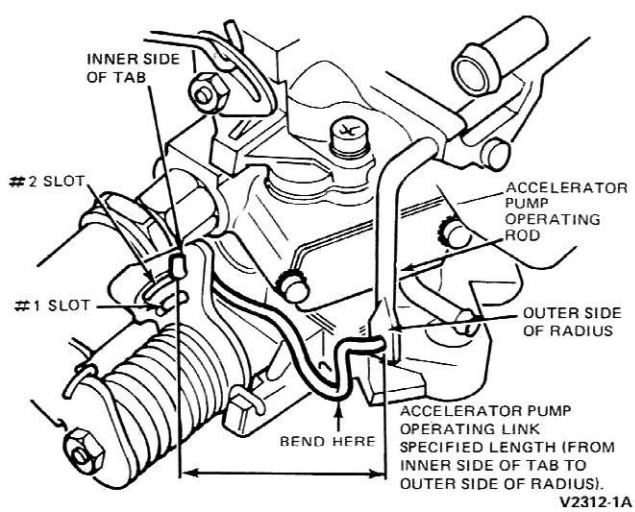


FIG. 13 Accelerator Pump Operating Link

DECHOKE

The dechoke feature provides a means of partially opening the choke plate during cold engine starts, even though the choke bimetal spring is holding it closed. By depressing the accelerator pedal fully, engines that may have become 'flooded' or that have stalled due to excessive choke action can be cleared. To adjust the dechoke clearance, proceed as follows:

1. With the engine off, hold the throttle in the wide open position (Fig. 14).

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2. Insert the specified size gage or drill bit between the upper edge of the choke plate and the inner wall of the air horn.
3. With light pressure against the choke shaft lever, a slight drag should be felt as the gage or drill bit is withdrawn.
4. To adjust, bend the unloader tab of the throttle lever until the correct opening is obtained. The tab can be bent with a pair of pliers or other suitable bending tool. Bending the tab upward will increase the dechoke clearance.

CHOKE PULLDOWN

Adjust choke pulldown by bending the choke pulldown diaphragm connecting link (Fig. 15). Use a gage or drill bit of the specified diameter to check the clearance between the top of the choke plate and the air horn. FOLLOW THE PROCEDURE IN PART 29-02 OF THIS MANUAL.

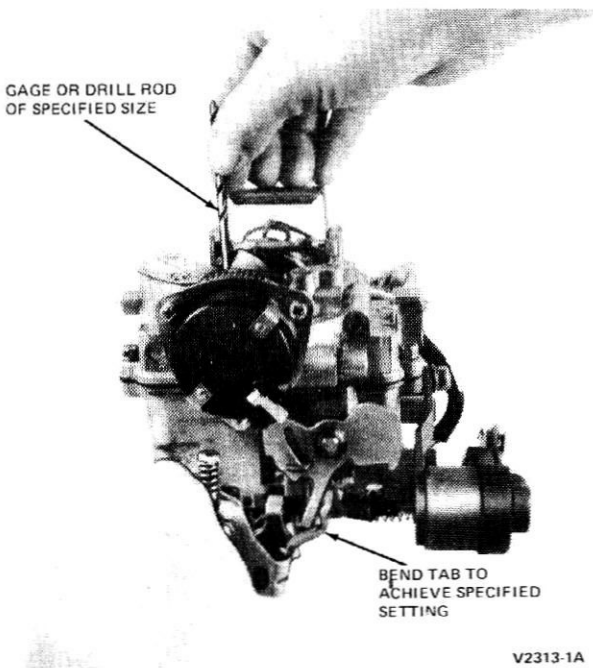


FIG. 14 Dechoke Adjustment

EXTERNAL FUEL BOWL VENT

Adjust the external fuel bowl vent (Fig. 16) with the carburetor installed on the engine and the ignition OFF, after having first adjusted the low idle speed (TSP OFF).

1. Remove the air cleaner assembly.
2. Disconnect the canister vent hose from the bowl vent tube on the air horn.
3. Attach a hand operated vacuum pump (Rotunda 000-0000 or equivalent) to the bowl vent tube, using a 3/8-inch adaptor.
4. Remove the three (3) bowl vent cover screws located on the top of the air horn.
5. Remove the bowl vent cover gasket and spring.
6. Turn the vent adjusting screw (located on the nylon vent arm) clockwise until no more than 1/8-inch of the adjustment screw threads is visible above the vent arm (Fig. 16).
7. While operating the hand vacuum pump, gradually turn the adjusting screw counterclockwise 1/8 turn at a time until vacuum is indicated on the gauge, showing that the valve is closed. Release the vacuum and turn the adjusting screw 1/2 turn clockwise. Disconnect the hand vacuum pump and adaptor from the vent hose.
8. Reconnect the canister vent hose and install the air cleaner assembly.

FLOAT LEVEL

1. With the air horn removed, place a finger over the hinge pin retainer and invert the main body. Catch

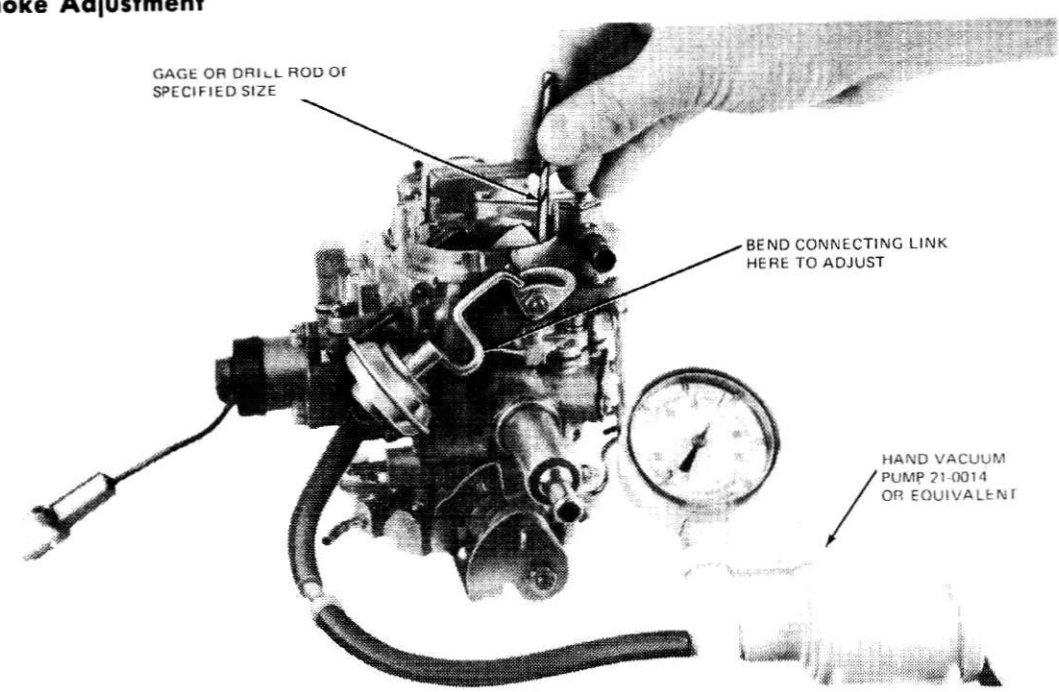


FIG. 15 Choke Pulldown Adjustment

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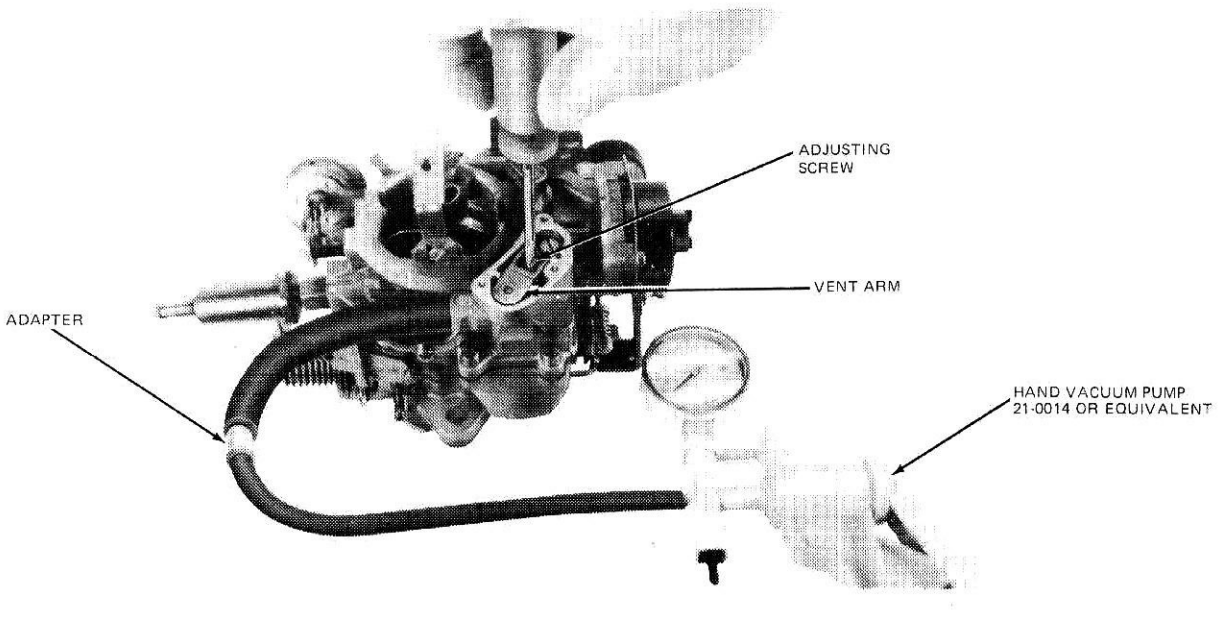


FIG. 16 External Fuel Bowl Vent Adjustment

the accelerator pump check ball and weight as they drop from the pump channel.

2. Using a straight edge (Fig. 17), check the position of the floats. The straight edge should just touch the lowest point on the floats when held as shown. If necessary, bend the float tang to obtain this position.
3. When the position is correct, turn the main body right side up and check float **alignment.** The float should move freely throughout its range without touching the fuel bowl walls. If the float pontoons are misaligned, straighten by bending the float arms. Recheck the float level adjustment.

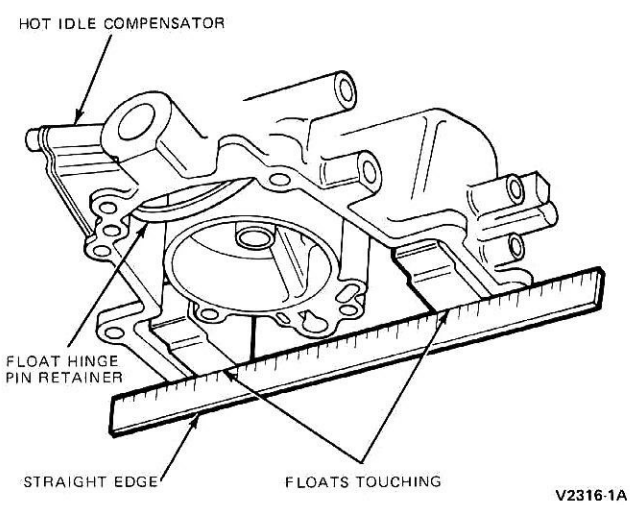


FIG. 17 Checking Float Adjustment

REMOVAL AND INSTALLATION

CARBURETOR

Removal

1. Remove the air cleaner assembly.
2. Disconnect the throttle cable from the throttle lever. Disconnect the distributor vacuum line, EGR vacuum line, venturi vacuum line, fuel line and choke heat tube from the carburetor.
3. Disconnect the TSP electrical connection at the connector. Disconnect the choke PTC heater at the connector.
4. Disconnect the choke clean air hose at the air horn.
5. Remove the two (2) carburetor attaching nuts and remove the carburetor from the intake manifold. Remove the carburetor mounting gasket, spacer (if equipped) and lower gasket from the intake manifold.

Installation

1. Clean the gasket mounting surfaces of the spacer (if equipped), the intake manifold and the carburetor. Place the spacer between two new gaskets on the intake manifold. Position the carburetor on the spacer and gasket and install the attaching nuts. To prevent leakage, distortion or damage to the carburetor body flange, snug the nuts and then alternately tighten each nut to specification.

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2. Connect the fuel line, throttle cable, choke heat tube, distributor vacuum line, EGR vacuum line and the venturi vacuum line.
3. Connect the choke clean air hose to the air horn. Connect the TSP electrical connection and the choke heater wire.
4. Install the air cleaner assembly.
5. Adjust the curb idle speed (TSP ON), slow idle speed (TSP OFF) and fast idle speed as necessary, following procedures in Parts 29-02 and 50-29 of this Manual.

DISASSEMBLY AND ASSEMBLY

GENERAL

To make overhaul easier, and to help prevent damage to carburetor throttle plates, use the EGR spacer (if equipped) as a holding fixture. If a spacer is not available, use a carburetor stand with appropriate mounting bolt holes.

The following procedure is for completely disassembling and reassembling the carburetor. For a carburetor overhaul, follow all the steps. To service only some of the components, follow only the applicable steps. To identify components, see Fig. 18: Disassembled View.

DISASSEMBLY

AIR HORN

1. Remove the choke cover attaching screws, retainer, gasket and bimetal cover.

   CAUTION: Do not immerse the cover assembly in cleaner. Clean by wiping dirt from the cover and gently blowing out the inside with compressed air. If the assembly is corroded or damaged, it should be replaced.

2. Remove the two (2) pulldown diaphragm bracket screws, disconnect the vacuum hose from the main body and remove the pulldown diaphragm and linkage assembly.

   CAUTION: Do not immerse the pulldown diaphragm assembly in cleaner, as serious damage to the diaphragm could result.

3. Remove the three (3) fuel bowl vent cover attaching screws from the top of the air horn. Remove the cover, spring and gasket from the air horn. **Note the position of the spring when removing.** Remove the bowl vent attaching screw and remove the bowl vent assembly from its seat.

   CAUTION: Do not immerse the bowl vent assembly in cleaner, as serious damage could result.

4. Remove the fast idle cam retainer and fast idle cam. Remove choke control lever retaining screw.
5. Remove the throttle return spring bracket attaching nut and lock washer. Disengage the return spring from the throttle body and carefully remove the spring and bracket, **noting in which slot the accelerator pump link is located for proper reassembly.**
6. Remove the accelerator pump link.
7. Remove the seven (7) screws holding the air horn assembly to the main body and remove the air horn.

   CAUTION: Do not pry the air horn from the upper body, but tap it gently from side to side with a plastic hammer or screwdriver handle until it is loose.

   Place the air horn upside down on a clean working surface.

8. Remove the air horn gasket. If any material remains on either the air horn or main body gasket surface, remove it with a suitable cleaner.

   NOTE: Do not use a metal scraper to remove gasket residue, as it may damage the gasket surface. Use either a nylon scraper or other suitable hard plastic material.

9. Remove the accelerator pump operating rod attaching screw and retainer clamp.
10. Remove the accelerator pump spring retaining plate and attaching screw.
11. Rotate the pump operating rod and disconnect the pump drive spring and accelerator pump assembly.

    CAUTION: Do not immerse the pump plunger and cup assembly in cleaner as damage to the cup may result.

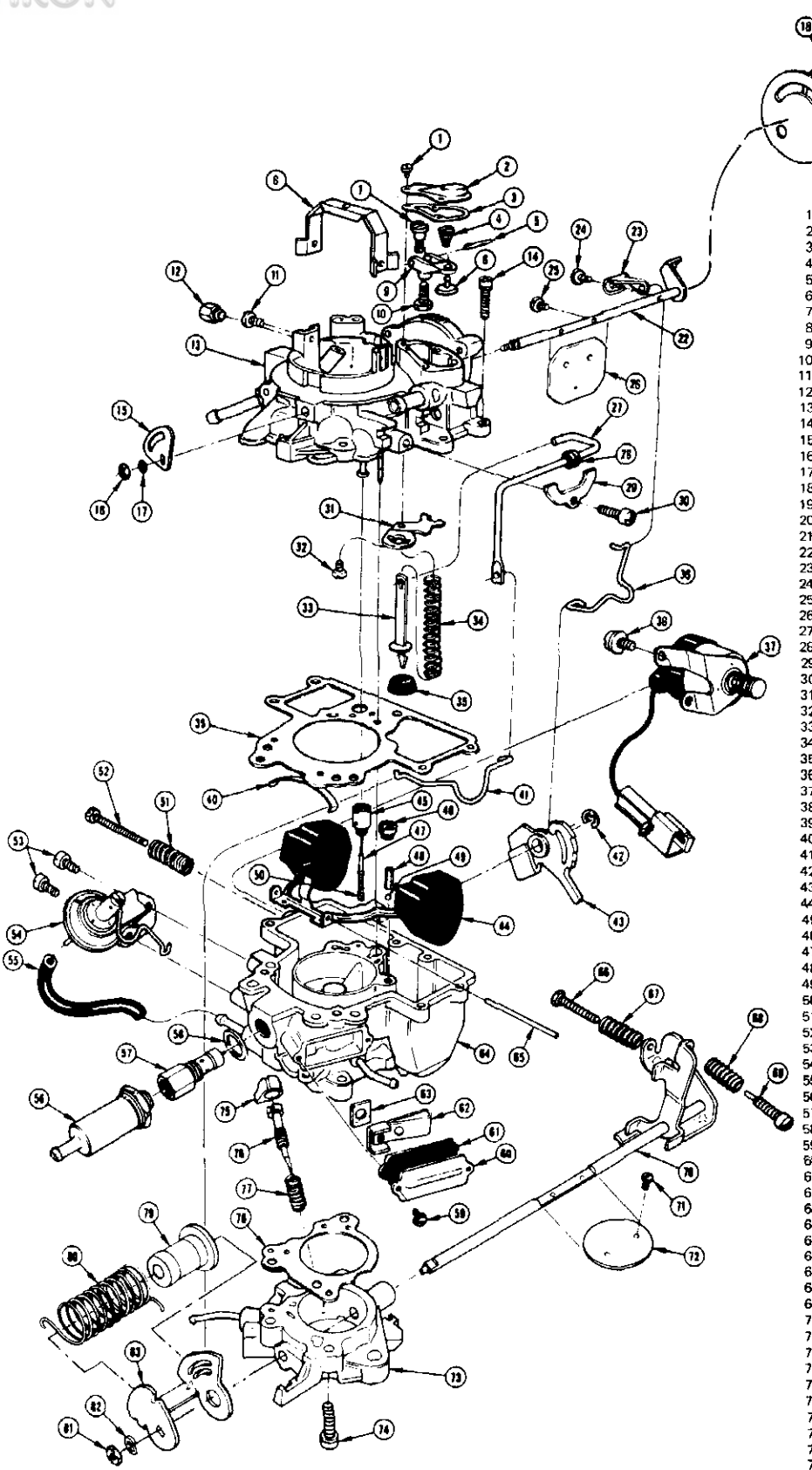
12. Rotate the pump operating rod and remove the rod and grommet from the bowl cover.
13. **The main well tube cannot be removed but must be cleaned carefully from both inside and outside the cover with compressed air.**
14. Remove choke thermostat housing retainer screws (3), retainer, housing and gasket.

NOTE: It is not recommended that the choke plate and shaft be removed during normal disassembly unless they are damaged and are to be replaced. Use caution during handling of components so they will not be damaged. Always rest the air horn upside down so that the gasket surface, pump assembly, main well tube and enrichment valve piston will not be damaged.

Main Body

1. Turn the carburetor main body (Fig. 18) upside down and catch the accelerator pump discharge weight and ball as they fall from the channel. Retain the weight and ball for reassembly.
2. Remove the fuel inlet valve and fitting assembly and the gasket,
3. Remove the float shaft retainer, float shaft and float.
4. Remove the main metering jet with a suitable jet wrench. If a jet wrench is not available, a 3/8-inch wide screwdriver may be used. Use caution to avoid damage to the jet.
5. Remove the enrichment valve assembly using a 3/8-inch wide screwdriver which has been modified by

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1. SCREW
2. BOWL VENT COVER
3. VENT COVER GASKET
4. VENT VALVE SPRING
5. VENT VALVE HINGE PIN
6. VENT VALVE
7. VENT VALVE HINGE ATTACHING SCREW
8. AIR CLEANER BRACKET
9. VENT VALVE ARM
10. VENT VALVE ADJUSTING SCREW
11. AIR CLEANER BRACKET SCREW
12. CHOKE HEAT TUBE ADAPTER
13. AIR HORN
14. SCREW
15. CHOKE PULLDOWN LEVER
16. CHOKE SHAFT NUT
17. LOCKWASHER
18. CHOKE BIMETAL SPRING COVER
19. SCREW
20. CHOKE COVER RETAINER
21. CHOKE HOUSING GASKET
22. CHOKE SHAFT AND LEVER ASSEMBLY
23. CHOKE CONTROL LEVER
24. SCREW
25. SCREW
26. CHOKE PLATE
27. ACCELERATOR PUMP OPERATING ROD
28. ACCELERATOR PUMP ROD GROMMET
29. ROD RETAINING CLAMP
30. SCREW
31. ACCELERATOR PUMP SPRING RETAINING SPRING
32. SCREW
33. ACCELERATOR PUMP PISTON STEM
34. ACCELERATOR PUMP SPRING
35. ACCELERATOR PUMP PISTON CUP
36. FAST IDLE CAM LINK
37. ANTI-DIESEL SOLENOID
38. SCREW
39. AIR HORN GASKET
40. FLOAT HINGE RETAINER
41. ACCELERATOR PUMP OPERATING LINK
42. RETAINING CLIP
43. FAST IDLE CAM
44. FLOAT ASSEMBLY
45. POWER VALVE BODY
46. MAIN METERING JET
47. POWER VALVE PIN
48. ACCELERATOR PUMP WEIGHT
49. ACCELERATOR PUMP CHECK BALL
50. POWER VALVE SPRING
51. SPRING
52. LOW IDLE (SOLENOID OFF) ADJUSTING SCREW
53. SPEED SCREW
54. CHOKE PULLDOWN DIAPHRAGM ASSEMBLY
55. CHOKE DIAPHRAGM VACUUM HOSE
56. FUEL FILTER
57. FUEL INLET NEEDLE & SEAT ASSEMBLY
58. GASKET
59. SCREW
60. HOT IDLE COMPENSATOR COVER
61. COVER GASKET
62. HOT IDLE COMPENSATOR
63. GASKET
64. MAIN BODY ASSEMBLY
65. FLOAT HINGE PIN
66. CURB IDLE ADJUSTING SCREW
67. SPRING
68. SPRING
69. FAST IDLE ADJUSTING SCREW
70. THROTTLE SHAFT & LEVER ASSEMBLY
71. SCREW
72. THROTTLE PLATE
73. THROTTLE BODY ASSEMBLY
74. THROTTLE BODY SCREW
75. LIMITER CAP
76. IDLE FUEL MIXTURE ADJUSTING SCREW
77. SPRING
78. THROTTLE BODY GASKET
79. THROTTLE RETURN SPRING BUSHING
80. THROTTLE RETURN SPRING
81. NUT
82. LOCK WASHER
83. THROTTLE RETURN SPRING BRACKET

VZ317-2A

FIG. 18 Holley Model 1946 1-V Carburetor—Disassembled

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cutting a 1/16-inch wide by 3/8-inch deep slot in the blade. The slot will provide clearance for the enrichment valve stem.

6. Remove the two hot idle compensator cover attaching screws, the cover, the HIC valve and gaskets from the main body.
7. Remove the three main body to throttle body attaching screws and gently tap and separate the throttle body from the main body.
8. Remove the low idle speed (TSP OFF) adjusting screw and spring.
9. Remove solenoid.

THROTTLE BODY

1. Turn the idle limiter cap on the idle mixture adjustment screw clockwise to its leanest position and remove the cap.

   CAUTION: When removing idle fuel mixture limiter cap, take care not to bend screw.

2. **Note position of idle mixture adjusting screw when cap is removed.** Turn mixture screw clockwise until it lightly seats, recording the number of turns required. **The needle must be returned to this same position when the carburetor is reassembled in order to maintain proper calibration.**

   CAUTION: Do not tighten the needle against its seat as damage to the needle and/or seat may result. If the needle is bent or grooved where it seats, it must be replaced.

3. Remove the curb idle speed (TSP ON) adjusting screw and spring, and the fast idle speed adjusting screw and spring.
4. Inspect the throttel plate and shaft for nicks, burrs or wear.

   NOTE: **Do not remove the throttle plate or shaft from the throttle body.** If wear or damage is evident, the complete throttle body assembly must be replaced.

ASSEMBLY

THROTTLE BODY

1. Reassemble the fast idle speed adjusting screw (round head) and the curb idle speed adjusting screw (hex head) and springs to the throttle shaft and lever assembly.
2. Place the idle mixture adjusting needle through the spring and install in the throttle body. Lightly seat the needle **(do not tighten against seat),** then back the needle out counterclockwise the number of turns recorded during disassembly, stopping with the screw slot in the same position noted at time of removal of the limiter cap. **Final idle mixture needle adjustment must be made after the carburetor is installed on the engine, following instructions in Part 50-29 of this Manual.** Following adjustment, a new service limiter cap must be installed on the idle mixture needle.

MAIN BODY

1. Install the low idle speed (TSP OFF) adjusting screw and spring.
2. Position the throttle body and gasket on the inverted main body and install the three (3) throttle body attaching screws. Tighten securely.
3. Position the hot idle compensator valve gasket and the valve in the main body. (The valve is held in position on its seat by the cover.) Place the cover and gasket over the compensator and install the two (2) cover screws.
4. Snap the small diameter end of the enrichment valve spring over the shoulder on the large end of the pin and insert the pin into the valve body from the threaded end. Install the valve body, pin and spring in the main body. Tighten with the specially modified screwdriver described under Disassembly.
5. Install the main metering jet using a jet wrench or suitable screwdriver.
6. Install the float hinge pin in the float arm and lower the float and hinge into position in the main body. *Install the hinge retainer.*
7. Install the fuel inlet valve assembly and gasket and check the dry float setting.
8. Install the accelerator pump check ball and weight.

AIR HORN

1. Install the pump operating rod and grommet in the air horn.
2. Push the accelerator pump cup over the retaining tab on the end of the pump piston rod. Assemble the pump spring and pump spring retainer plate to the piston rod by compressing the spring enough to let the plate slip over the piston rod. The larger diameter end of the pump spring should contact the retainer plate and seat over the shoulder.
3. While holding the assembly together, connect the pump operating rod through the slotted hole in the piston rod and rotate the rod so that the plate can be positioned and the screw inserted. Tighten the *plate attaching screw.*
4. Install the pump operating clamp and attaching screw.
5. Position the air horn gasket over the alignment pin and carefully lower the air horn into place on the main body.

   CAUTION: DO NOT FORCE. Guide the accelerator pump cup into the pump well and the main well tube into the main well. Align the air horn *and lower it into place. Make sure the enrichment* valve piston stem contacts the enrichment valve pin squarely.

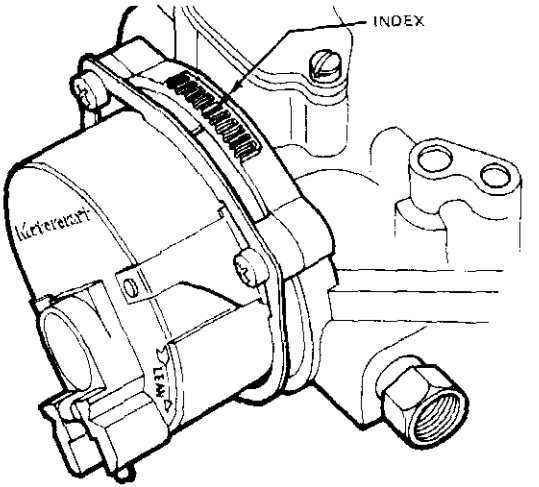
6. Install the seven (7) air horn attaching screws.
7. Hook the accelerator pump link into the pump operating rod and into the correct slot in the throttle return spring bracket, noted during disassembly.
8. With the pump link engaged in the proper slot, slide the throttle return spring bracket assembly over the *throttle shaft and align it with* the shoulders on the end of the shaft.

   NOTE: Depressing the pump operating rod against its spring pressure will provide sufficient clearance to permit assembly.

9. Install the attaching nut and lock washer and engage the throttle return spring over the throttel body stop.

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10. Place the fast idle cam link in position so that the link engages the fast idle cam slot. Install the cam and retainer. Install the choke control lever and screw.
11. Position the bowl vent assembly and hinge pin in the housing and install the hinge pin attaching screw. Place the small diameter of the bowl vent spring over the shoulder of the vent arm. Position the cover and gasket and install the three (3) cover attaching screws.
12. Connect the choke pulldown diaphragm linkage and install the two (2) diaphragm bracket attaching screws. Reinstall the vacuum hose from the manifold vacuum tube to the diaphragm assembly.
13. Position the choke bimetal cap gasket in the choke housing. Install the choke cap, making certain that the bimetal spring tab is engaged in the slotted choke shaft lever. Install the choke cap retainer and the three (3) attaching screws. Set the choke cap to the specified setting (Fig. 19) and tighten the screws.



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FIG. 19 Choke Cap Adjustment

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Model 5200 2-V Carburetor

PART 24-10

2.3L I-4 Engine

SUBJECT	PAGE
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General	10-1
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ADJUSTMENTS	
Choke Plate Vacuum Pulldown	10-3
Dry Float Setting	10-4
ADJUSTMENTS (Cont'd.)	
Fast Idle Cam Clearance	10-3
Secondary Throttle Stop Screw	10-4
DISASSEMBLY AND ASSEMBLY	
Disassembly	10-5
Assembly	10-7

CV2262-2B

DESCRIPTION

GENERAL

The Motorcraft Model 52000 2-V carburetor is a two stage, two venturi carburetor. The primary venturi is smaller than the secondary venturi. The secondary system is operated by mechanical linkage.

The primary stage includes a curb idle system, accelerator pump system, idle transfer system, main metering system and power enrichment system.

The secondary side includes a secondary idle system, transfer system, main metering system and power system. Both the primary and secondary systems draw fuel from a common fuel bowl.

The Model 5200 2-V is equipped with an automatic choke featuring an electric heater assist. This provides for choke pull-off in a short time after engine start. Testing and adjustment information for the choke is contained in Part 29-01 of this volume.

The choke housing and electric choke components are shown in Fig. 1. An overcenter spring is provided to assist in closing the choke plate for initial starting of a cold engine in high ambient temperatures. After initial choke pull-down occurs, the overcenter spring has little or no effect on choke operation.

Four throttle positioners (TSP) are used, (Fig. 2); a dashpot, a solenoid, a combination solenoid/dashpot, and a solenoid kicker. The solenoids operate when ignition switch is on.

The vacuum kickers are actuated when air conditioning units are turned on, by vacuum switched through a vacuum solenoid valve. This provides higher idle speed when the air conditioner compressor is operating.

The carburetor is provided with a drilled passage to connect the EGR valve.

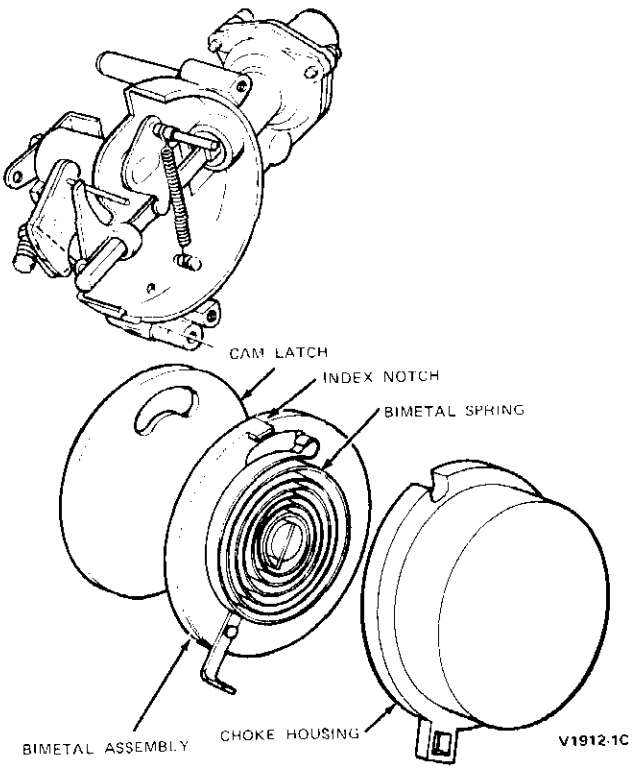


FIG. 1 Fast Idle Cam Latch

FUEL BOWL VENT

All Model 5200 carburetors are equipped with a vacuum-operated, solenoid-assisted fuel bowl vent (Fig. 4), called a "switching bowl vent".

With engine off, a spring holds the external vent open, closing the internal vent passage (Fig. 5). In this position, vapors from the fuel bowl are allowed to pass to the evaporative emission canister. When the engine is started, manifold vacuum acting on the diaphragm overcomes the spring pressure and pulls the external vent to its seated position, thus uncovering the internal vent passage. A holding solenoid, wired to the ignition circuit, makes sure the vent doesn't inadvertantly open under low vacuum conditions. Thus, the vent will only close again when the ignition is switched OFF.

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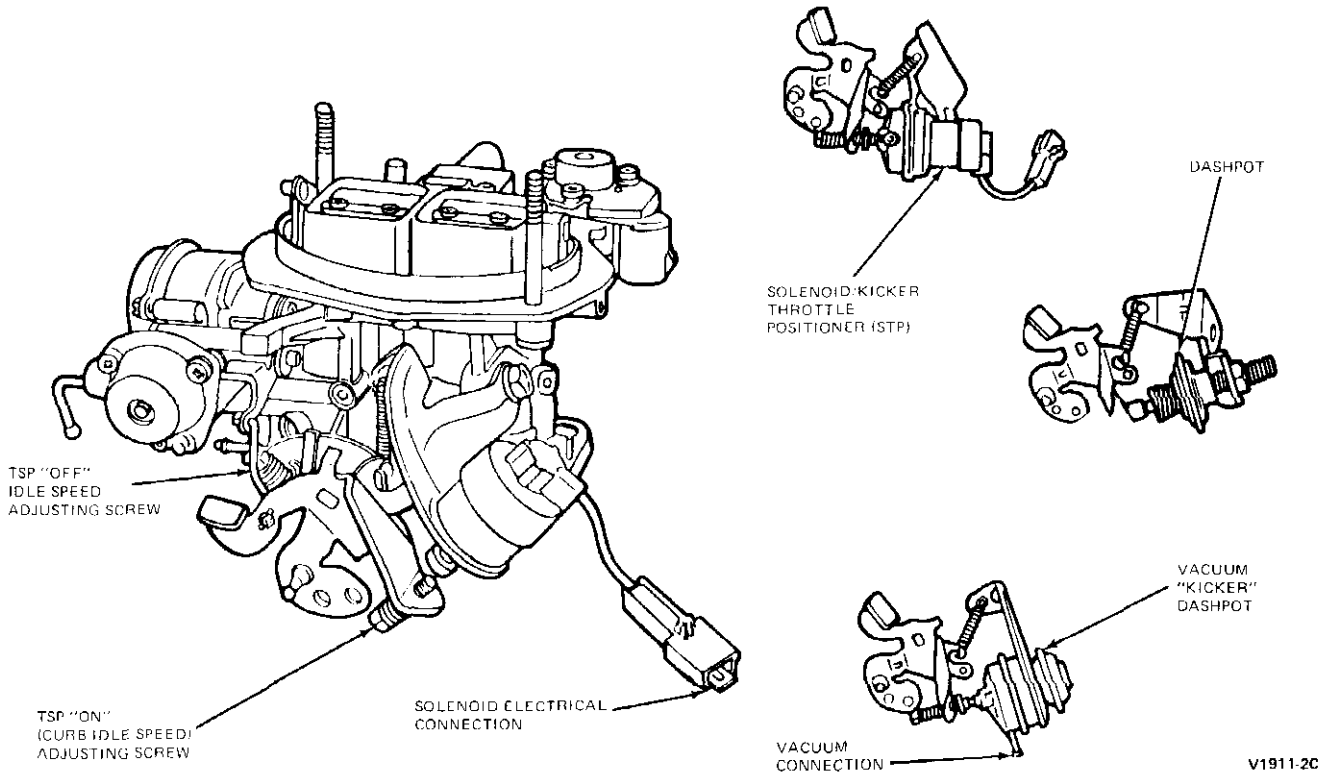


FIG. 2 Model 5200 2-V Carburetor With Solenoid Throttle Positioner—Alternate Throttle Positioners Shown

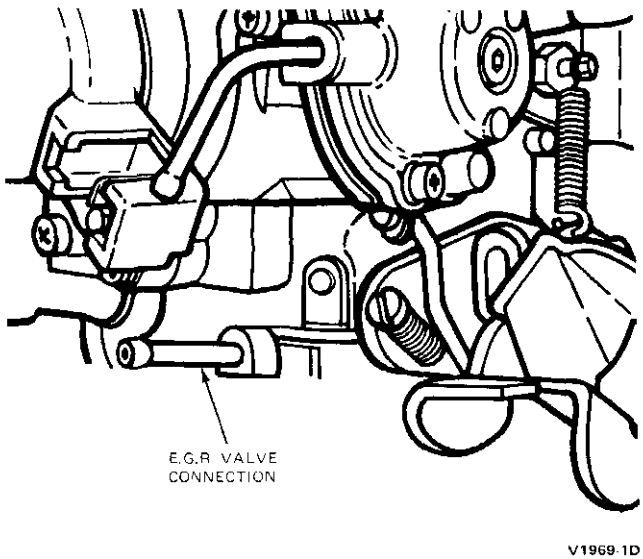


FIG. 3 EGR Valve Connection

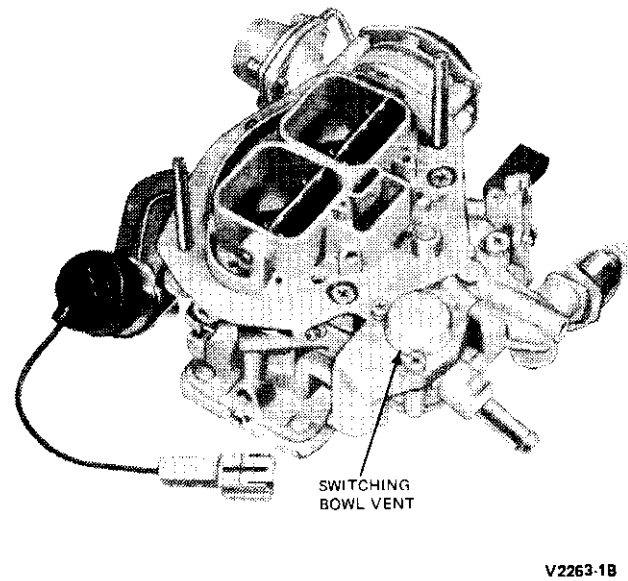


FIG. 4 Model 5200 Carburetor with Switching Bowl Vent

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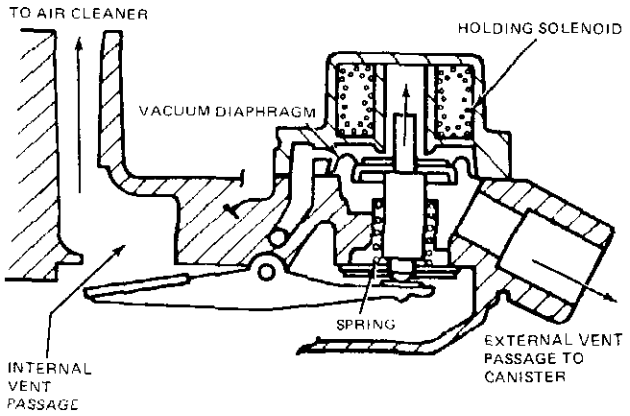


FIG. 5 Switching Bowl Vent

ADJUSTMENTS

Most carburetor adjustments are factory set, and based on guidelines determined for reduced engine emission. In order to adjust:

Automatic Choke and Electric Assist
Idle Speeds
Fuel Mixture
Idle CO

you must refer to Engine Emission Control Systems Part 29-02 of this Volume or Part 50-29 of Volume 5.

Adjustment points for the Motorcraft 5200 2-V carburetor are shown in Figs. 2, 6 and 7.

FAST IDLE CAM CLEARANCE

1. Insert a specified inch drill between the lower edge of the choke plate and the air horn wall.
2. With the fast idle screw held on the bottom step of the fast idle cam, against the top step, measure the clearance between the tang of the choke lever and the arm on the fast idle cam (Fig. 8). The tang and arm should be in light contact. Bend choke lever tang up or down as required.

CHOKE PLATE VACUUM PULLDOWN

1. Remove the three hex head screws and the ring retaining the choke thermostatic spring cover.
2. Remove choke electric assist assembly. Remove latch plate assembly. **CAUTION: Choke plate must be closed in air horn when reinstalling the electric assist with latch.**
3. Set the fast idle cam on the second step.
4. Using a screwdriver, push the diaphragm stem back against its stop (Fig. 9). Place a specified gage rod or drill between the lower edge of the choke plate and the air horn wall.

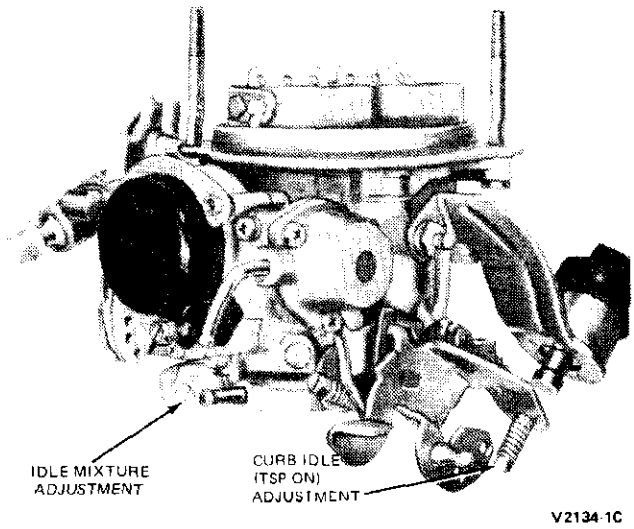


FIG. 6 Curb Idle Speed and Mixture Adjustment

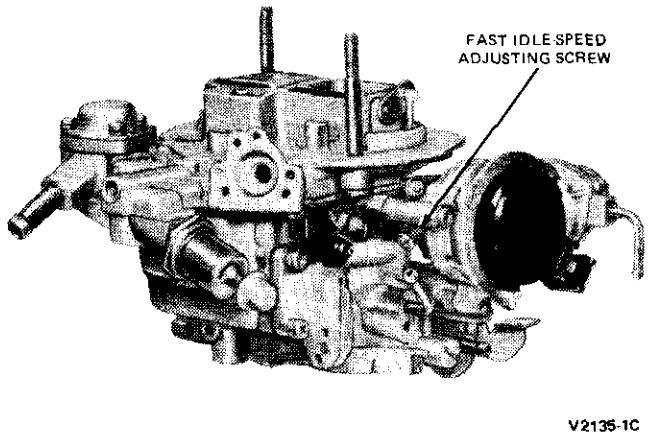


FIG. 7 Fast Idle Speed Adjustment

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5. Remove the slack from the choke linkage by attaching a rubber band to the choke operating lever as shown in Fig. 10.
6. To adjust the choke plate-to-air horn clearance, turn the vacuum diaphragm adjusting screw in or out as required (Fig. 10).

DRY FLOAT SETTING

With the bowl cover held in an inverted position and the float tang resting lightly on the spring loaded fuel inlet needle, measure the clearance between the edge of the float and the bowl cover (Fig. 11). To adjust the clearance, bend the float tang up or down as required (Fig. 12). **Do not scratch or damage the tang.**

Adjust both floats equally.

SECONDARY THROTTLE STOP SCREW

1. Back off the secondary throttle stop screw until the secondary throttle plate seats in its bore.
2. Turn the screw in until it touches the tab on the secondary throttle lever.
3. Turn the screw in an additional 1/4 turn for a 2.3L I-4 engine (Fig. 13).

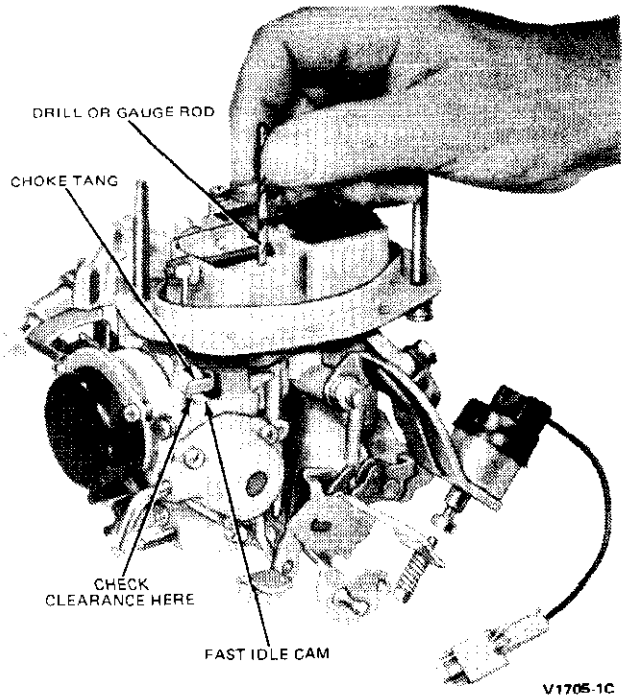


FIG. 8 Fast Idle Cam Clearance

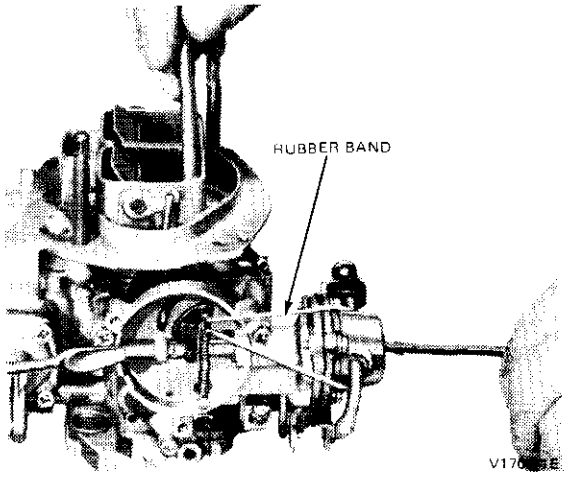


FIG. 9 Measuring Choke Plate Pulldown

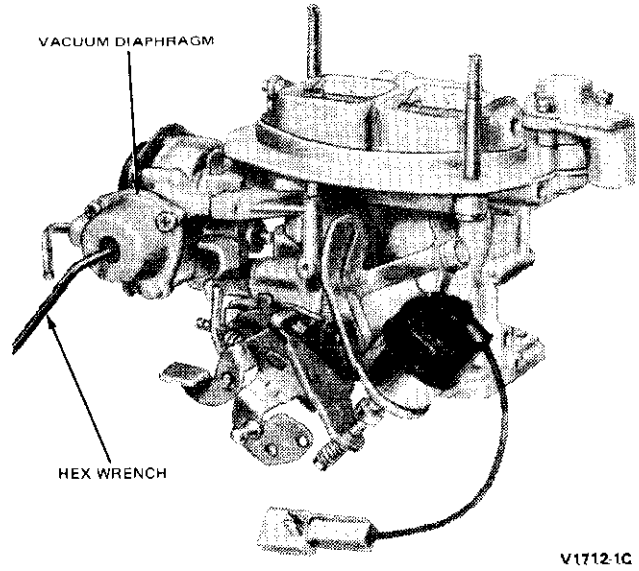


FIG. 10 Adjusting Choke Plate Pulldown

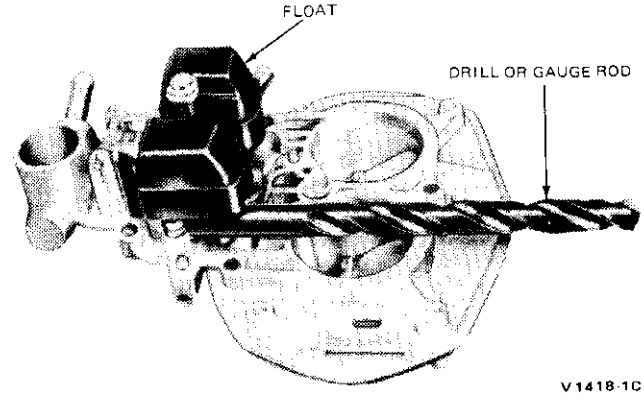


FIG. 11 Dry Float Setting

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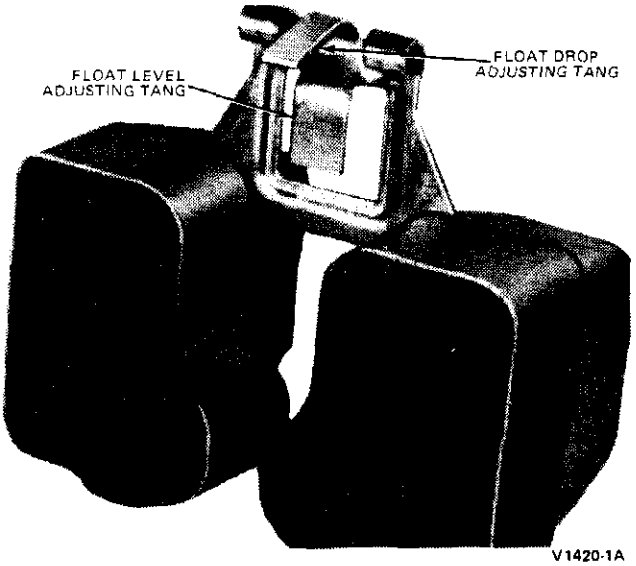


FIG. 12 Float Adjustment

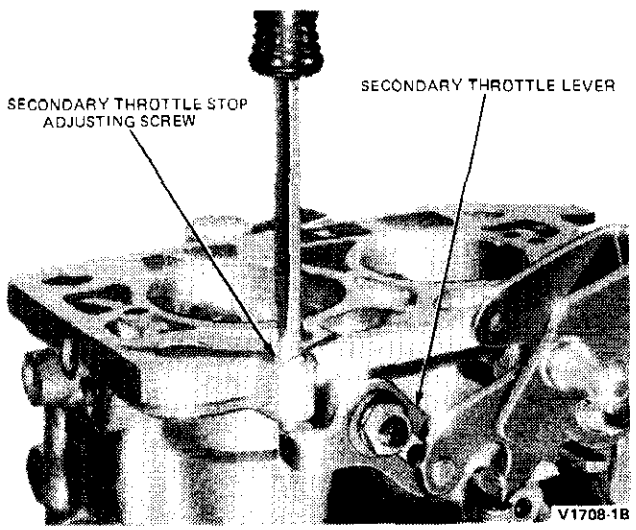


FIG. 13 Secondary Throttle Stop Adjustment

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

Refer to Fig. 14 for the disassembled view of the carburetor.

BOWL COVER

1. Remove the bowl cover screws and lockwashers.
2. Remove the retainer clips from the choke rod and carefully remove the bowl cover (Fig. 15). Remove the choke rod seal.
3. Remove the float hinge pin, float and inlet needle.
4. Remove the inlet needle seat and gasket.
5. Remove the three enrichment valve vacuum diaphragm screws, washers and diaphragm.
6. Remove (3) vent cover/solenoid attaching screws and remove cover.
7. Carefully pry vent arm pivot pin toward fuel inlet seat and remove pin and vent arm.
8. Remove E-clip from vent diaphragm stem and remove diaphragm assembly, vent spring, vent valve retainer and vent valve.

AUTOMATIC CHOKE

1. Remove the choke thermostatic spring housing retaining ring attaching screws. Remove the ring, housing and electric heater assembly.
2. Remove the choke housing assembly screws. Note that the long screw goes in the long leg of the assembly. Slip the housing away from the main body and disengage the fast idle rod. Remove the O-ring from the vacuum passage (Fig. 16).
3. Remove the choke shaft nut and lockwasher, choke lever and fast idle cam.
4. Remove the fast idle lever attaching screw, fast idle lever and spacer. Remove the screw and spring from the lever.

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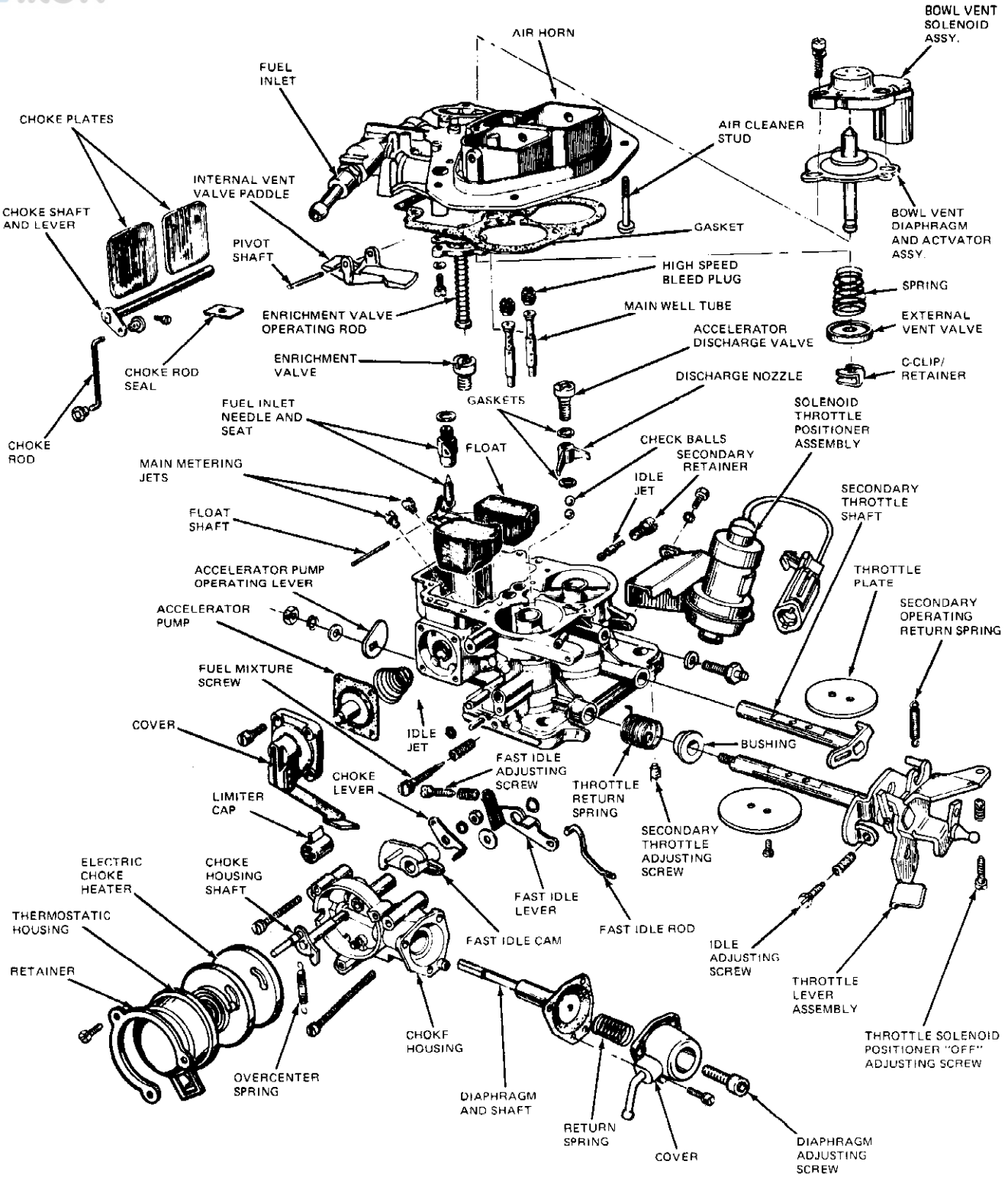


FIG. 14 Model 5200 Carburetor Disassembled

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5. Remove the choke diaphragm cover screws and cover, return spring, diaphragm and rod assembly.

ACCELERATOR PUMP

1. Remove the four pump cover screws and pump cover assembly. Remove the pump diaphragm assembly and pump return spring.
2. Remove the pump discharge screw assembly and pump discharge nozzle and two gaskets. Remove the two pump discharge check balls (Fig. 14).

MAIN BODY

1. Remove the primary high speed bleed and main well tube (Fig. 17).
2. Remove the secondary high speed bleed and main well tube. **Note the size of the air bleed plugs and main well tubes so they may be installed in the correct position.**
3. Remove the primary and secondary main metering jets. **Note the different size jets so they may be installed in the correct position (Fig. 18).**
4. Remove the power valve and gasket. Remove the primary and secondary idle jet retainers and idle jets located on the sides of the carburetor body (Fig. 18).
5. Turn the idle limiter cap in to the stop. Remove the idle limiter cap. Count the turns required to lightly seat the idle adjustment needle. Count to the nearest 1/16 turn. Remove the idle needle and spring.
6. Remove the secondary operating lever return spring.
7. Remove the primary throttle lever nut and lock tab. Remove the primary lever and flat washer. Remove the secondary operating lever assembly and lever bushing.
8. Remove the idle adjusting lever spring and shaft washer. **Note how the primary throttle return spring is hooked over the idle adjusting lever and the carburetor body.**
9. Remove the idle speed screw and spring from the idle adjusting lever.
10. Remove the secondary throttle lever nut, lockwasher, flat washer and secondary throttle lever. Remove the secondary idle adjusting screw.

ASSEMBLY

MAIN BODY

1. Install the secondary idle adjusting screw, secondary throttle lever, flat washer, lockwasher and nut.
2. Install the idle speed screw and spring in the idle adjusting lever.

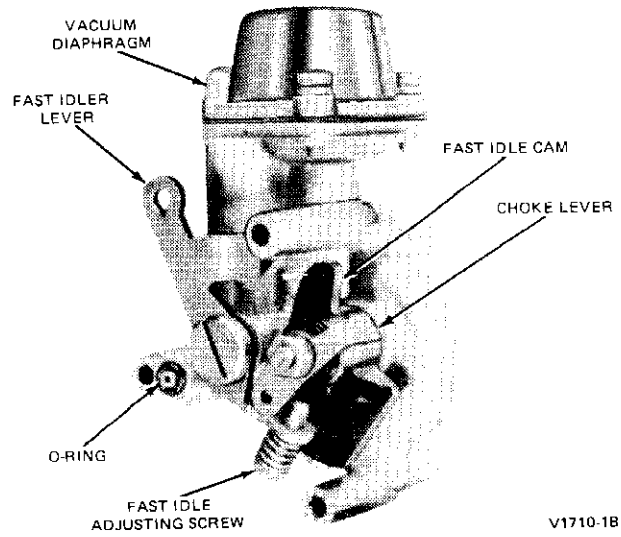


FIG. 16 Removing Automatic Choke

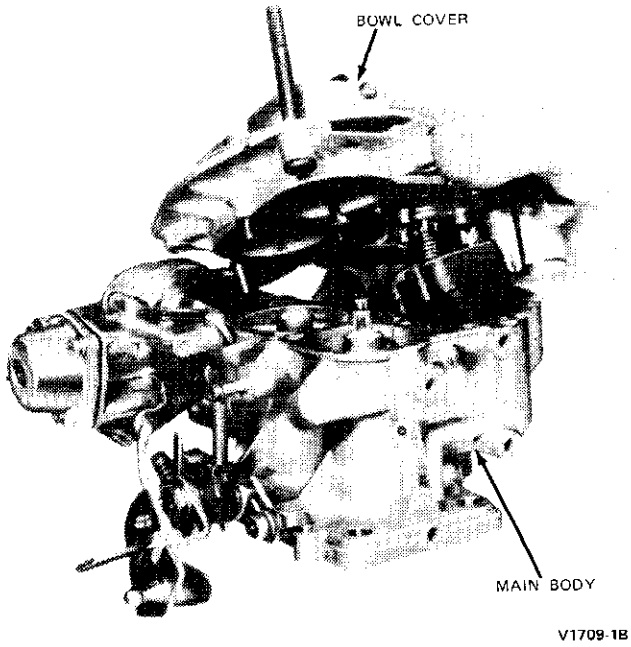


FIG. 15 Removing Bowl Cover

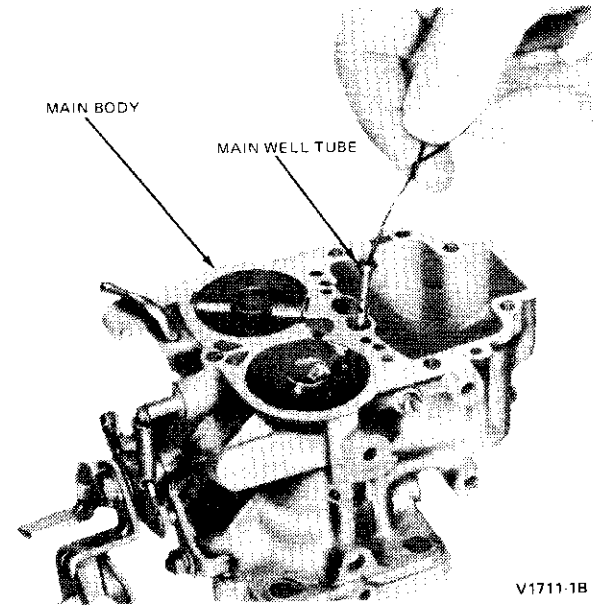


FIG. 17 Removing Main Well Tubes

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3. Install the washer, primary throttle return spring and idle adjusting lever and lever bushing. Install the secondary operating lever assembly (Fig. 14).
4. Install the flat washer and primary throttle lever. Install the lockwasher and nut. Attach the secondary operating lever return spring.
5. Install the idle mixture adjusting needle and spring. Turn it in until it lightly bottoms. Back out the screw the exact number of turns recorded at disassembly. Install a new limiter cap on the idle mixture needle with the stop tab on the cap against the lean side of the stop on the carburetor body.
6. Install the idle jet and retainer assembly on the secondary side of the carburetor body. Check carefully for the correct secondary size (Fig. 18).
7. Install the power valve gasket and power valve.
8. Install the primary and secondary main jets. Be sure the correct sizes are installed.
9. Install the primary and secondary main well tubes and high speed bleeds. Be sure the correct sizes are installed.

ACCELERATOR PUMP ASSEMBLY

1. Install the pump discharge check balls (2) screw. Install the pump discharge nozzle with a gasket on top and bottom. Install the pump discharge screw.
2. Install the pump return spring and pump disphragm assembly. Start the four pump cover screws. Hold the pump operating lever partially open to align the diaphragm gasket. Tighten the four cover screws evenly.

AUTOMATIC CHOKE

1. Install the diaphragm adjusting screw. Initially adjust the screw so that the threads are flush with the inside of the cover.
2. Install the choke diaphragm and rod assembly. Install the diaphragm return spring and cover. Install the cover screws and lock-washers.
3. Install the fast idle adjusting screw and spring to the fast idle arm. Install the flat spacer, fast idle arm and attaching screw.
4. Install the choke shaft into the housing and position the fast idle cam on the housing post.
5. Install the choke lever, lockwasher and nut.
6. Install the O-ring on the vacuum passage. Install the fast idle rod with the end with one tab in the fast idle adjusting lever and the end with two tabs in the primary throttle lever.
7. Position the choke housing against the main carburetor body and install the long attaching screw in the long leg of the housing. Install the other screws.
8. Adjust choke plate pulldown, referring to ADJUSTMENT Section.
9. Install the latch plate and electric choke heater, thermostatic housing, retaining ring and attaching screws. Be sure choke plate is in full closed position before installing the choke electric assist heater element. Index the housing and tighten the screws.

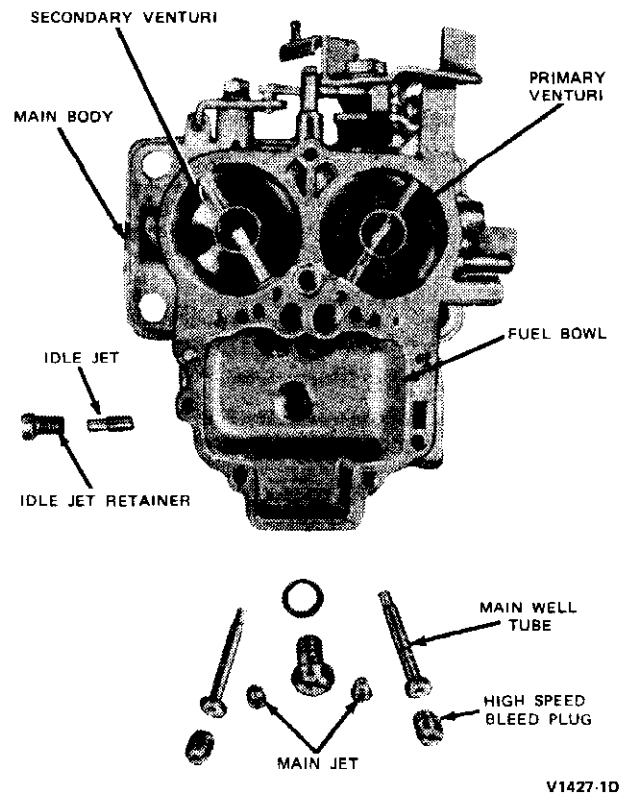


FIG. 18 Main Metering Jets and Idle Jets

BOWL COVER

1. Install bowl vent diaphragm, vent valve, spring, retainer and E-clip.
2. Position vent arm and install vent arm pivot pin.
3. Install vent valve cover/solenoid with (3) screws and tighten securely.
4. Install the inlet needle seat and gasket.
5. Install the power valve vacuum diaphragm. Depress the spring and install the screws and washers finger tight. Hold the stem so that the diaphragm is horizontal and tighten the screws evenly.
6. Install the float needle clip on the float tab and position the float and needle. Install the float shaft.
7. Hold the bowl cover in an inverted position and adjust the dry float setting (Fig. 11).
8. Hold the cover in its normal position and adjust the float drop (Fig. 12).
9. Install the choke rod seal and seal plug. Install the choke rod through the seal and hook it into the choke lever. Install the retaining clip.
10. Install the bowl cover gasket.
11. Install the choke link into the choke lever. Install the retaining clip.
12. Install the five bowl screws and torque them evenly.
13. Install the throttle positioner.

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Holley/Weber Model 6500 Feedback Carburetor

PART 24-12

Pinto and Bobcat with 2.3L I-4 (California Only)

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	12-1	ADJUSTMENTS	12-3

CA4501-2A

DESCRIPTION

GENERAL

Pinto and Bobcat vehicles manufactured for sale in California and equipped with the 2.3L I-4 engine are also equipped with a Feedback Electronic Engine Control system. This system requires more precise fuel metering than is possible with a conventional carburetor, and is therefore equipped with the new Holley/Weber Model 6500 Feedback carburetor (Fig. 1).

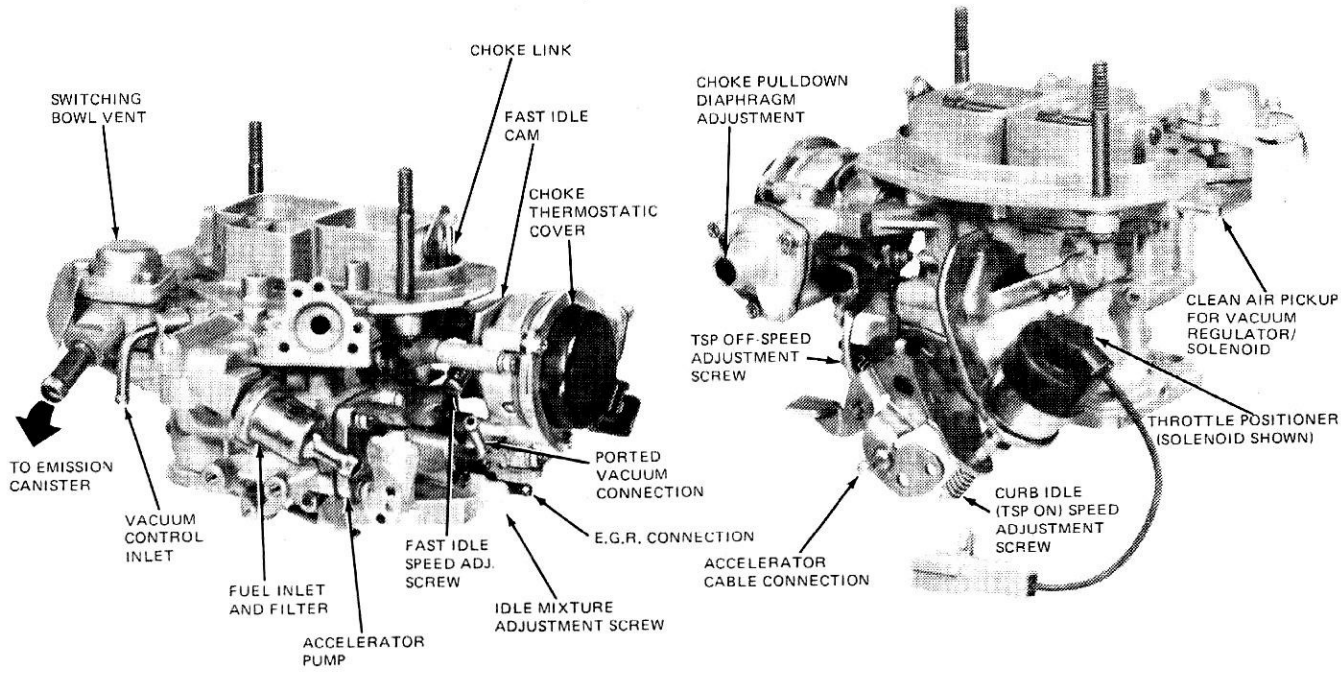


FIG. 1 Holley/Weber Model 6500 Feedback Carburetor

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DETROIT IRON

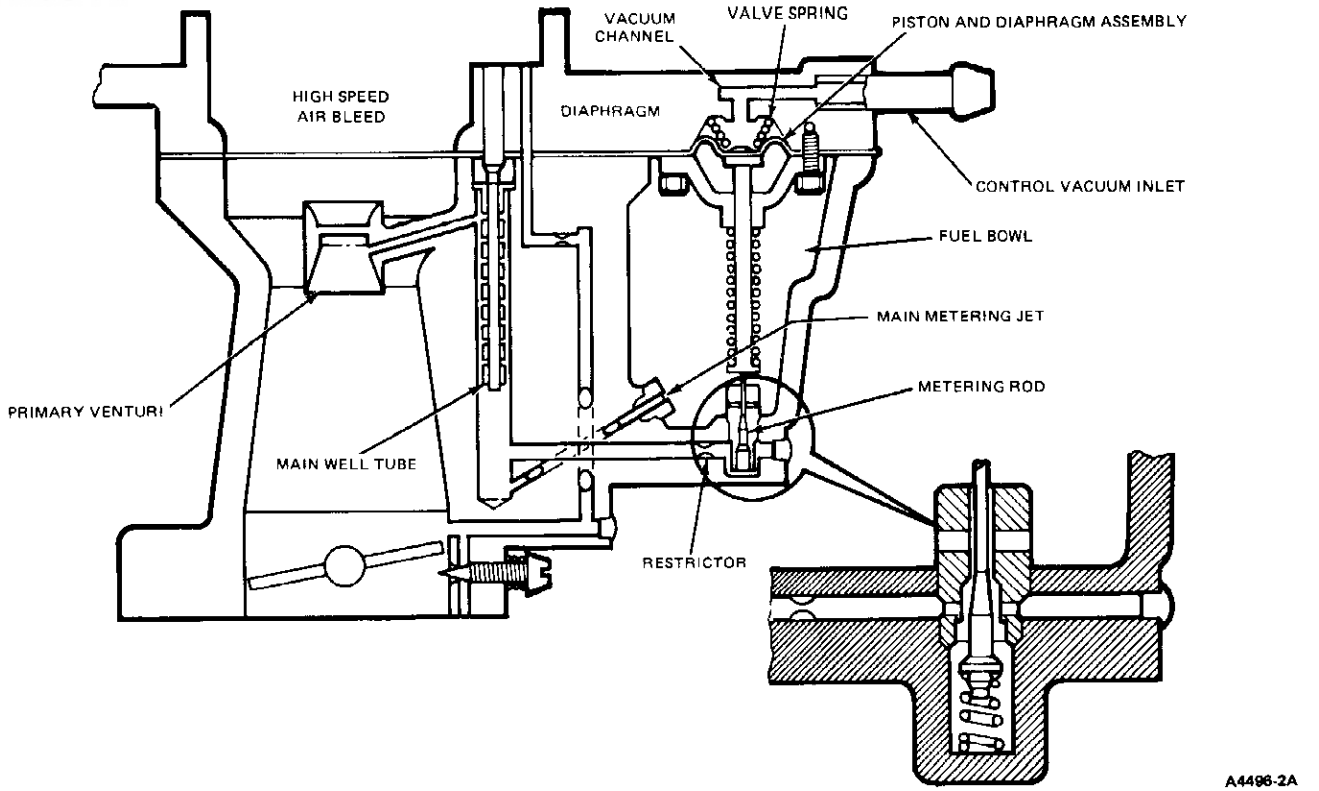


FIG. 2 Fuel Metering

The Holley/Weber Model 6500 Feedback carburetor is basically a Model 5200 carburetor (see Part 24-10) with an externally-variable auxiliary fuel metering system in place of the enrichment valve used on the Model 5200. The auxiliary system consists of a metering valve assembly, a metering valve operating piston and a diaphragm (Fig. 2).

The feedback metering valve supplements fuel entering the main well through the conventional main metering jet and chennel. The amount of fuel entering the main well through the metering valve depends on the position of the tapered metering rod in its orifice. The position of the metering rod depends on the metering rod operating piston assembly.

Control vacuum from the vacuum regulator solenoid is channeled to the cavity above the metering rod diaphragm (Fig. 2). With no vacuum present, the valve spring causes the valve to move to its lowest (richest) position, where maximum fuel can pass through the orifice. As vacuum is applied to the diaphragm, spring pressure is overcome and the metering rod rises, reducing the orifice area and permitting less fuel to pass. The metering valve is calibrated so that the maximum vacuum signal supplied by the vacuum regulator/solenoid (5 inches Hg) raises the rod to its highest (leanest) position.

For feedback system description and function, refer to Part 29-08.

The Holley/Weber Model 6500 Feedback carburetor differs from the Model 5200 in another major component; the Model 6500 features an internal choke pulldown vacuum passage similar to the 1977 Model 5200, rather than the external vacuum connection introduced on the 1978 Model 5200 (See Part 24-10). Adjustment on this feature is included under ADJUSTMENTS. For all other service procedures, refer to the information in Part 24-10, 29-02, 29-08 and 50-29.

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ADJUSTMENTS

All adjustments for the Model 6500 Feedback carburetor are the same as those included in Part 24-10 for the Model 5200 carburetor, except Choke Plate Vacuum Pulldown. The Model 5200 is equipped with a new external connection for vacuum, while the Model 6500 carburetor is equipped with internal passages and requires different adjustment procedures.

CHOKE PLATE VACUUM PULLDOWN

1. Remove the three hex head screws and the ring retaining the choke thermostatic spring cover.
2. Remove the choke cap, bi-metal heater assembly and the plastic shield.
3. Set the fast idle speed adjusting screw on the top step of the fast idle cam.
4. Using a screwdriver, push the diaphragm stem back against its stop (Fig. 3). Place a specified gage rod or drill between the lower edge of the choke plate and the air horn wall.

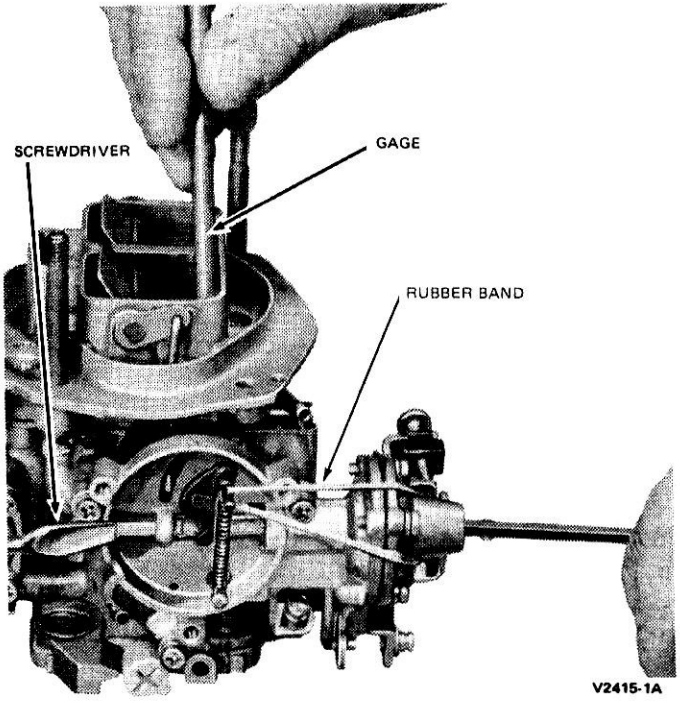


FIG. 3 Measuring Choke Plate Pulldown

5. Remove the slack from the choke linkage by attaching a rubber band to the choke operating lever as shown in Figure 3.
6. To adjust the choke plate-to-air horn clearance, turn the vacuum diaphragm adjusting screw in or out as required (Fig. 4).

For all other adjustments, see Part 24-10, 29-02, 29-08, 50-29.

For specifications for the Model 6500 Carburetor, refer to the Ford Car Performance Specifications Book.

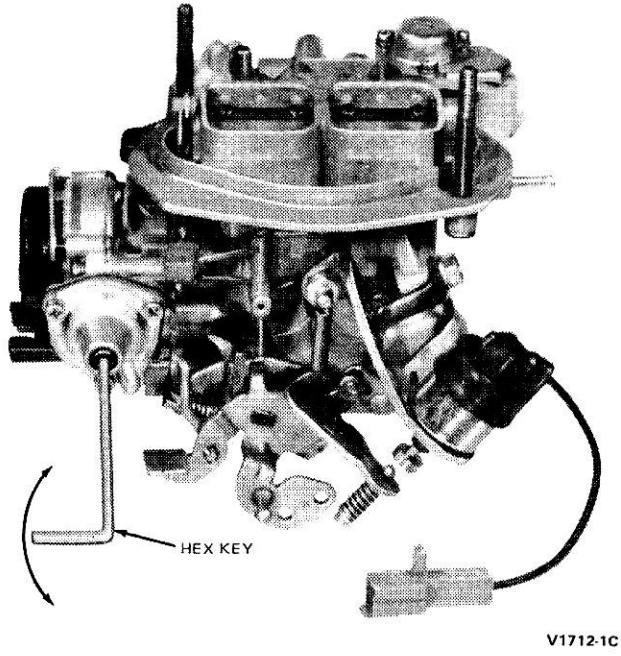


FIG. 4 Adjusting Choke Plate Pulldown

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DETROIT IRON

Model 2150 2-V Carburetor

PART 24-25

2.8L, 5.0L (302 CID) Except California, 5.8L/6.6L (351W, 351M CID, 400 CID)

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CV1275-2B

DESCRIPTION

GENERAL

The Motorcraft Model 2150 2-V carburetor (Figs. 1, 2 and 3) has two main assemblies; the air horn and the main body.

Some carburetors are equipped with altitude compensation, designed to provide improved high altitude emission control and driveability (Figs. 1 and 2).

To provide improved high altitude cold engine starts, those carburetors equipped with altitude compensation are also equipped with a choke in the bypass air intake, linked to the main choke plate.

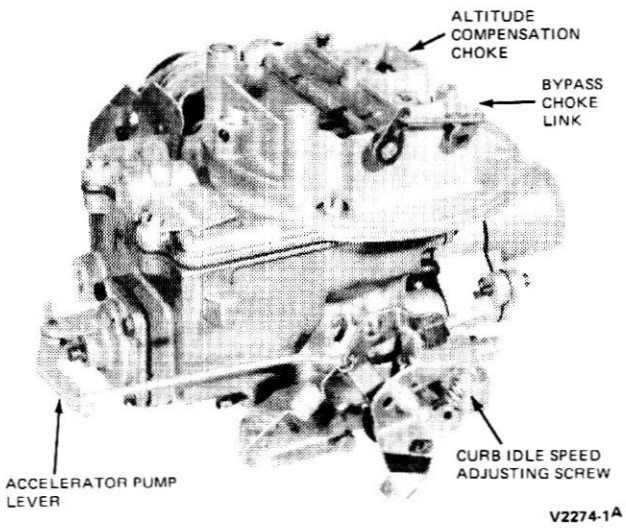


FIG. 1 Model 2150 2-V Carburetor—Left Front 3/4 View (With Altitude Compensation)

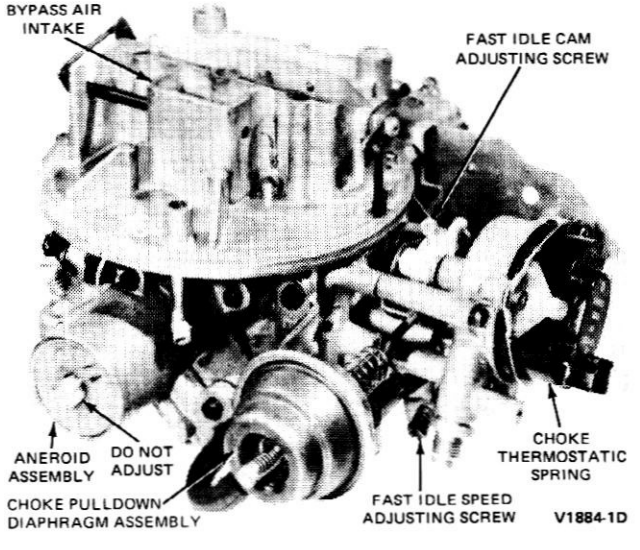


FIG. 2 Model 2150 Carburetor—Right Rear 3/4 View (With Altitude Compensation)

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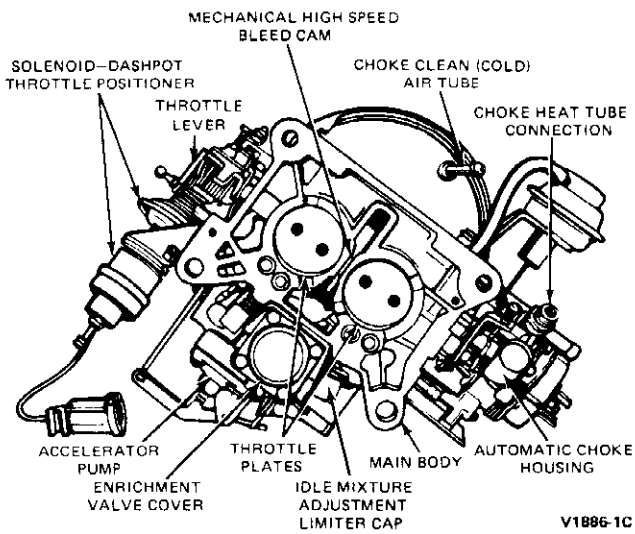


FIG. 3 Model 2150 2-V Carburetor—Bottom View (w/o Altitude Compensation)

The air horn assembly, which serves as the main body cover, contains the choke plate and the fuel bowl vent valve.

It also contains the pullover enrichment system, which provides additional fuel flow at high air flow through the air horn (Fig. 1).

Fuel is drawn through metered orifices from the fuel bowl into the air flow stream through bleeds in the air horn.

The throttle plate, the accelerator pump assembly, the enrichment valve assembly, the fuel bowl and the mechanical high speed bleed cam are in the main body. The automatic choke housing and choke pulldown diaphragm are attached to the main body.

Each bore contains a main and booster venturi, main fuel discharge, accelerator pump discharge, idle fuel discharge and throttle plate.

The booster venturi contains high speed bleed orifices, along with a mechanical variable high speed bleed control system. This system consists of a mechanical lift rod that actuates reverse-tapered "ballbat" metering rods in the high speed bleed orifices. This allows control of fuel/air mixture to the booster venturis for more precise high speed operation and improved low-speed response.

The Model 2150 2-V also uses the electric assist automatic choke system. This system consists of a choke cap, thermostatic spring, bimetallic temperature sensing disc (switch), and a ceramic heater powered from the stator tap of the alternator (Fig. 4).

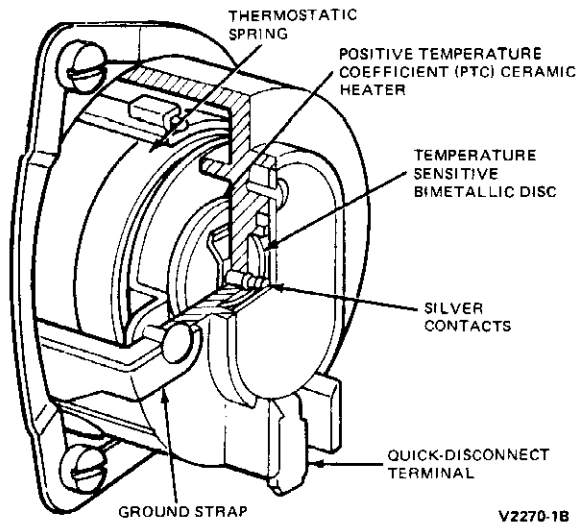


FIG. 4 Electric Assist Choke—Typical

Voltage is supplied to the temperature sensing switch when the engine is running. The system is grounded through a strip connected to the carburetor body. At temperatures above approximately 80°-110°F., the temperature sensing switch closes, and current is supplied to the heater, causing the thermostatic spring to pull the choke plate open at an increased rate.

Testing and adjustment of electric assist choke is covered in Part 29-02 of this Manual.

FUEL INLET SYSTEM

The amount of fuel entering the fuel bowl (Fig. 5) is regulated by the distance the fuel inlet needle is raised off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a pre-set level, the float lowers the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used. A retaining clip is attached to the fuel inlet needle assembly. The clip hooks over the tab on the end of the lever of the float assembly. This clip assures reaction of the fuel inlet needle to any downward movement of the float. Downward movement of the float (or float drop) is controlled by adjustment of the tab end of the float lever. A wire-type retainer prevents movement of float shaft within the guides on each side of the fuel bowl. The retainer fits into a groove on the outside of the fuel inlet needle seat. The ends of the retainer are hooked over grooves on opposite ends of the float shaft. The fuel bowl is internally vented to the air cleaner and externally vented to the carbon canister.

IDLE SYSTEM

The difference in pressure between the fuel bowl and the curb idle discharge ports forces fuel through the idle system. Fuel flows from, the fuel bowl through the main jets and into the main wells as shown in Fig. 6. From the main wells the fuel flows up the idle tubes through short diagonal passages in the booster venturi assembly into the idle down channels in the main body.

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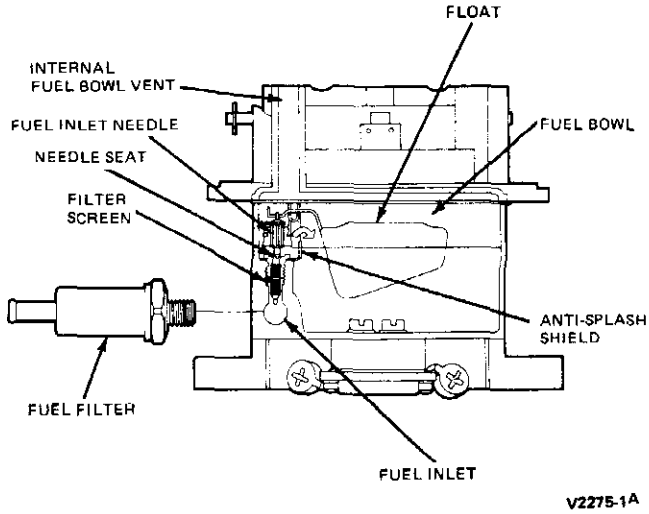


FIG. 5 Fuel Inlet System

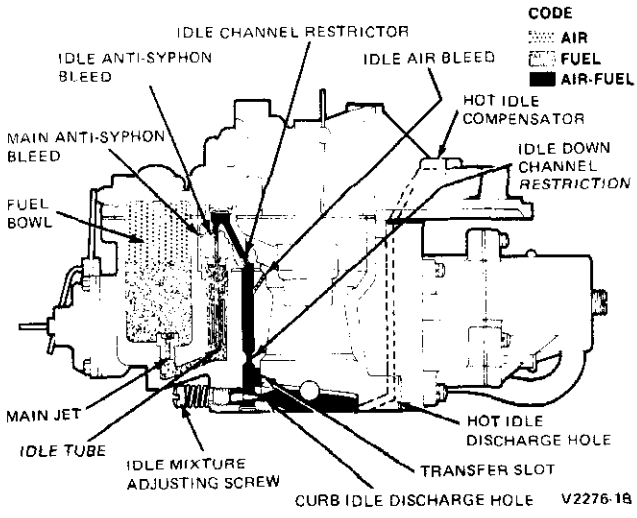


FIG. 6 Idle System

Calibrated restrictions at the lower end of the idle tubes meter the flow of fuel. Air first enters the idle system through idle anti-syphon bleeds at the upper end of the idle tubes. These air bleeds also act to prevent syphoning when the engine is stopped. Additional air enters the system through the idle air bleeds located in the main body adjacent to the booster venturi. The fuel air mixture continues through the idle down channels past the idle down channel restrictors. At curb idle additional air from the idle transfer slots mixes with the fuel just before it enters the engine through the curb idle discharge ports below the throttle plate. The amount of this mixture that enters the engine is controlled by the *tapered idle mixture* adjusting screws which protrude into the curb idle discharge ports and vary the effective metering area of the ports.

During off-idle when the throttle plates are moved slightly past the idle transfer slots the slots begin discharging fuel as they are exposed to manifold vacuum. These transfer slots allow a smooth transition from the idle to the main fuel metering system. As the *throttle plates are opened still wider, and the engine* speed increases, the air flow through the carburetor also increases. This creates a vacuum in the booster venturi strong enough to bring the main fuel system into operation. Fuel flow from the idle system tapers off as the main fuel system begins discharging fuel.

On some model carburetors, a Hot Idle Compensator (HIC) is mounted in the air horn (Fig. 6). A bi-metal strip opens a valve to admit air below the throttle plates, to *improve hot engine idle.*

ACCELERATOR PUMP SYSTEM

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the flowing fuel, which is heavier than air, can gain the required flow speed to maintain the desired balance of air and fuel.

During this interval, the accelerator system, shown in Fig. 7, supplies fuel until the other systems can once again provide the proper mixture. When the throttle is closed, the diaphragm return spring forces the diaphragm toward the cover, drawing fuel into the chamber through the inlet. The inlet has an Elastomer valve which uncovers the inlet hole to admit fuel from the fuel bowl. The valve covers the inlet hole when the accelerator pump is operated to prevent the fuel from returning to the bowl. A discharge weight and ball check prevents air from entering from the discharge nozzle when fuel is drawn into the diaphragm chamber. When the throttle is opened, the diaphragm rod is moved inward, forcing fuel from the chamber into the discharge passage. Fuel, under pressure, forces the pump discharge weight and ball off their seat, and fuel passes through the accelerator pump discharge screw and is sprayed into each main venturi through discharge ports. An air bleed in the wall of the accelerator pump fuel chamber prevents vapor entrapment and pressure build-up in the diaphragm chamber. When the pump is activated this bleed hole also allows a calibrated amount of fuel to return to the fuel bowl. The pump bleed size is a factor in determining total pump discharge capacity.

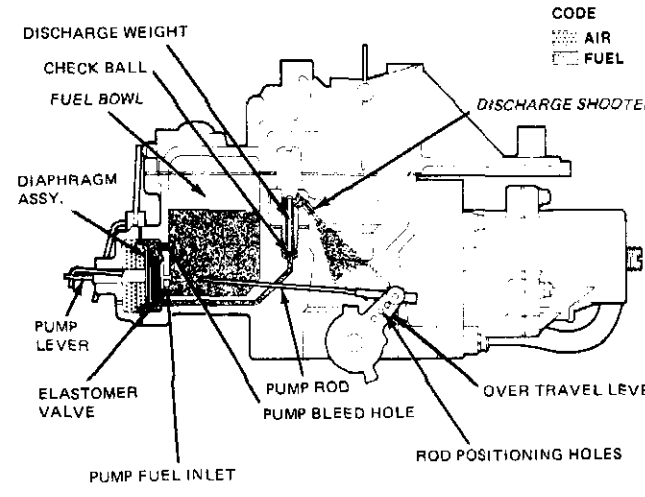


FIG. 7 Accelerator Pump System

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HIGH SPEED BLEED SYSTEM

The mechanical high-speed bleed system provides close control over fuel mixture by providing a direct link between air-fuel ratio and throttle plate position. When the throttle plate is closed, the cam does not contact lift rod. When the throttle starts to open the cam engages the lift rod which raises the metering rods in the high-speed bleed orifices. Raising the metering rods decreases air flow through the high-speed bleed orifices. This causes a richer mixture. The lift rod is factory adjusted and may not be field adjusted.

MAIN SYSTEM

As engine speed or load increases, the air passing through the booster venturi creates an increase in vacuum. This vacuum or difference in pressure between the main discharge ports in the booster venturi and the fuel bowl causes fuel to flow. Fuel travels up the main well tubes and is mixed with air from the anti-syphon and high speed bleeds which enters the fuel stream through holes in the main well tubes. The high speed bleeds meter a decreasing amount of air as the throttle plate opening and air flow through the carburetor increases maintaining the required air fuel ratio. The anti-syphon bleeds also act as vents to prevent syphoning when the engine is shut down. The mixture of fuel and air is desireable because it is lighter than raw fuel and responds to faster changes in venturi vacuum. It also atomizes more readily than raw fuel. The air fuel mixture is discharged through the main discharge nozzles in the booster venturi where it is mixed with the air flowing through the carburetor. The throttle plates control the amount of the air fuel mixture admitted to the intake manifold regulating the speed and power output of the engine.

HIGH SPEED PULLOVER SYSTEM

The high speed pullover system (Fig. 10) consists of an air bleed located in a raised boss in the front of the air horn, a connecting discharge nozzle for each venturi, and a tube with a calibrated orifice at the lower end. The tube extends from the air horn into the fuel bowl. At high speeds the air flow through the carburetor creates a vacuum at the discharge nozzles causing fuel to be pulled up the tube. The fuel is mixed with air from the air bleed and discharged into the air stream as it enters the carburetor to provide additional fuel for high speed operation.

ENRICHMENT SYSTEM

During periods of increased road loads or high speed operation, the air-fuel ratio must be increased for added power. The added fuel required during this period is supplied by the enrichment system shown in Fig. 11. The enrichment system is controlled by the intake manifold vacuum. Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and enrichment valve chamber, to the enrichment valve diaphragm. The manifold vacuum, acting on the enrichment valve at idle speed or normal road load conditions, is great enough to hold the enrichment valve diaphragm down, overcoming the tension of the spring on the valve stem, and holding the valve closed. When high power

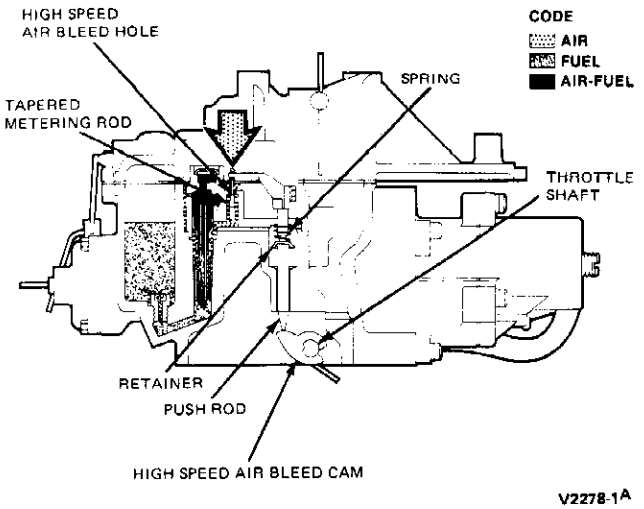


FIG. 8 High Speed Bleed System

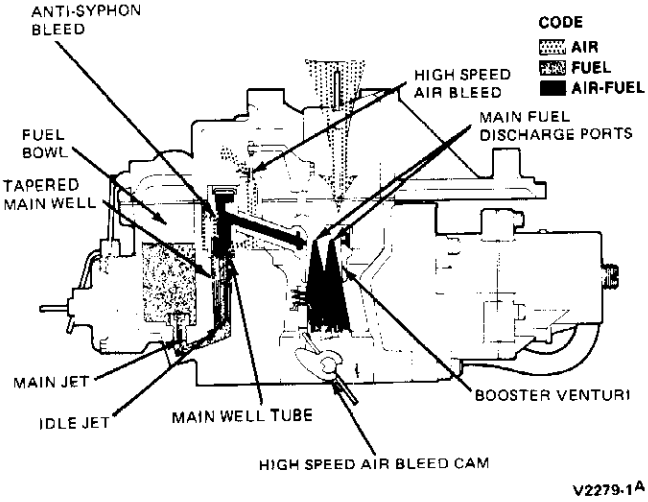


FIG. 9 Main Fuel System

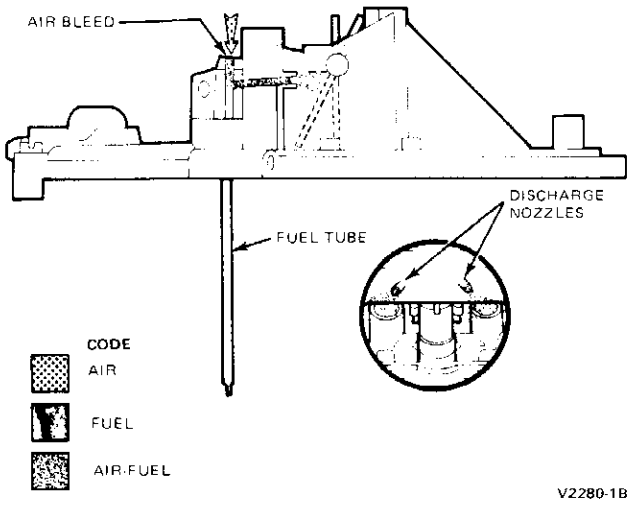


FIG. 10 High Speed Pullover System

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operation places a greater load on the engine, and manifold vacuum drops below a predetermined value, the spring opens the enrichment valve. Fuel from the fuel bowl flows through the enrichment valve and into passages leading to the main fuel well. Here the additional fuel is added to the fuel from the main fuel system, enriching the mixture. As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the enrichment valve.

ALTITUDE COMPENSATOR

The model 2150-2V carburetor altitude compensator device, as shown in Fig. 12, provides automatic main system compensation. The main system compensation discharges venturi bypass air into the throttle bores above the throttle plates, leaning out the mixture as required by altitude conditions. Air flow is controlled by a valve activated by an aneroid attached to the rear of the carburetor main body.

To provide improved high-altitude cold engine starts, the bypass intake is equipped with a choke plate linked to the choke system.

NOTE: The altitude compensator is factory set and should not be adjusted.

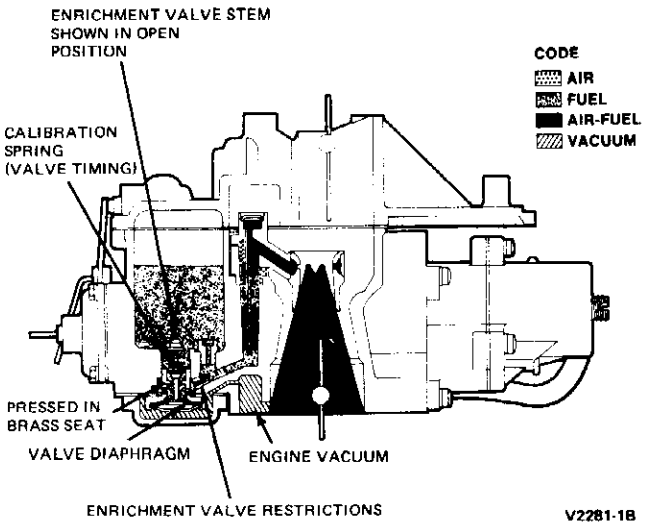


FIG. 11 Enrichment System

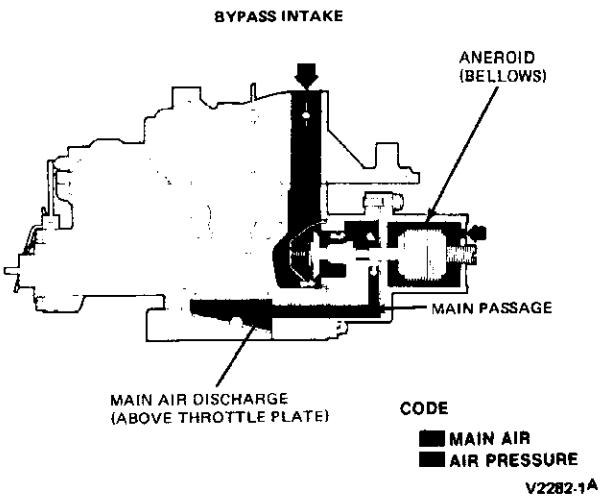


FIG. 12 Altitude Compensator

DIAGNOSIS AND TESTING

Refer to the Engine Diagnosis in Part 29-02 of this Volume for all diagnosis and testing.

ADJUSTMENTS

Most carburetor adjustements are set at assembly, based on guidelines established for reduced engine emission and acceptable driveability.

For adjustment procedures for:

Automatic Choke

Idle Speeds

Idle Fuel Mixture

Idle CO

you must refer to Group 29 or 50. Adjustment points for these items are shown in Figs. 13 through 16.

ACCELERATOR PUMP STROKE ADJUSTMENT

The accelerator pump stroke has been factory set for a particular engine application and should not be readjusted.

If the stroke has been changed from the specified hole, reset to specification by following these procedures (Fig. 16):

1. To release the rod from the retaining clip, lift upward on the portion of the clip that snaps over the shaft and then disengage the rod.
2. Position the clip over the specified hole in the overtravel lever and insert the operating rod through the clip and the overtravel lever. Snap the end of the clip over the rod to secure.

CHOKE PLATE PULLDOWN AND FAST IDLE CAM CLEARANCE

See Part 29-02 for this adjustment.

NOTE: To adjust fast idle cam clearance or other choke functions, refer to Part 50-29 or 29-02 of this Manual.

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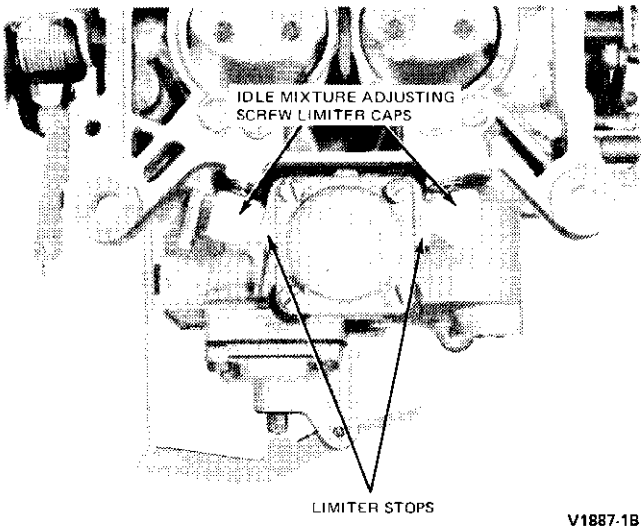


FIG. 13 Idle Fuel Mixture Adjusting Screw Limiters and Stops

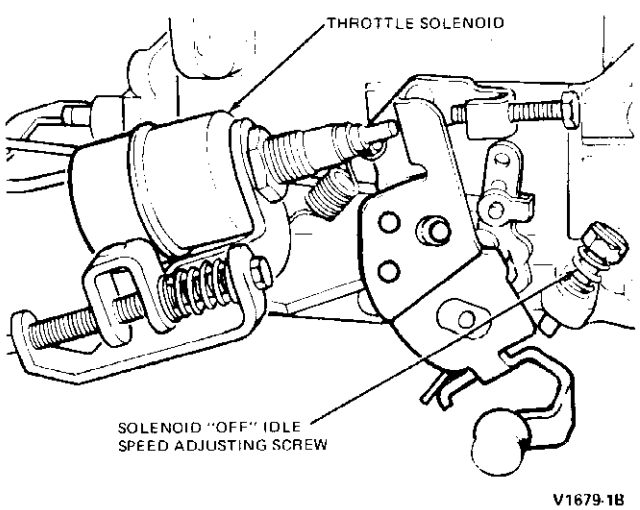


FIG. 14 Curb Idle Speed Adjustment

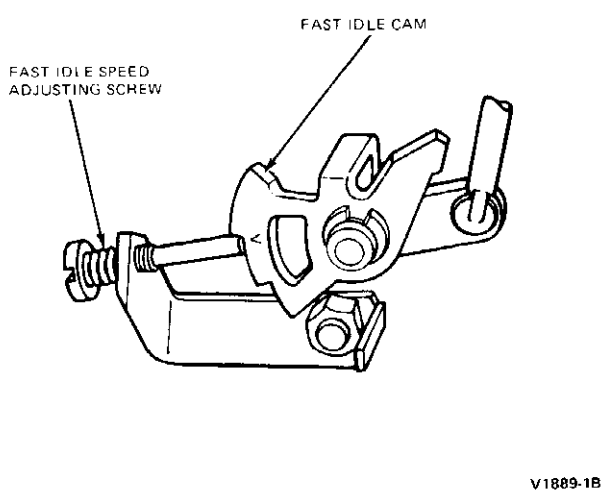


FIG. 15 Fast Idle Speed Adjustment

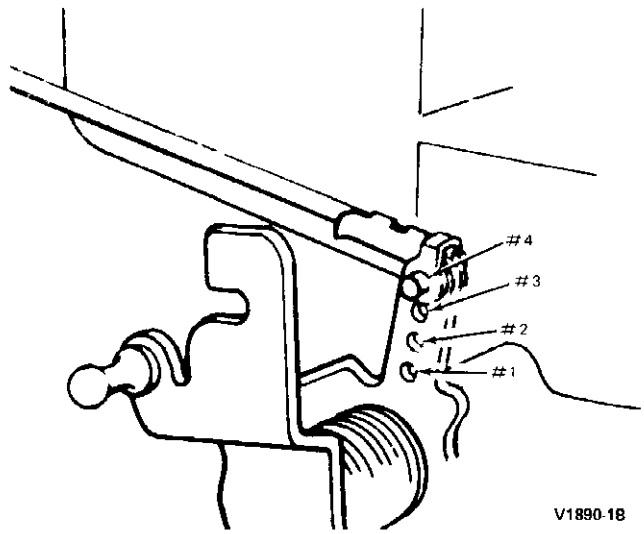


FIG. 16 Accelerator Pump Stroke Adjustment

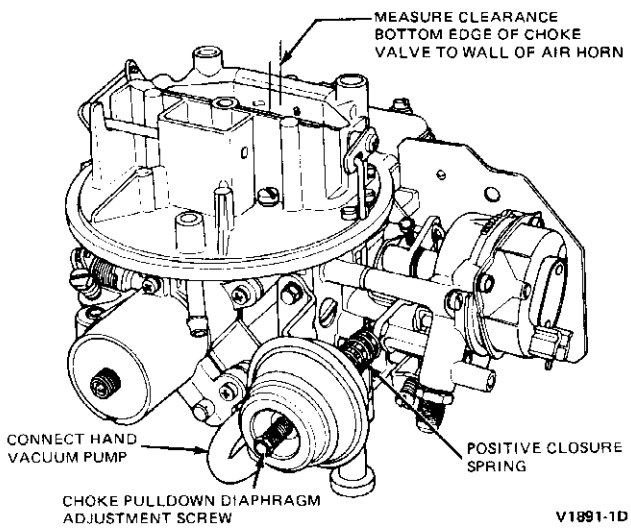


FIG. 17 Adjusting Choke Plate Pulldown

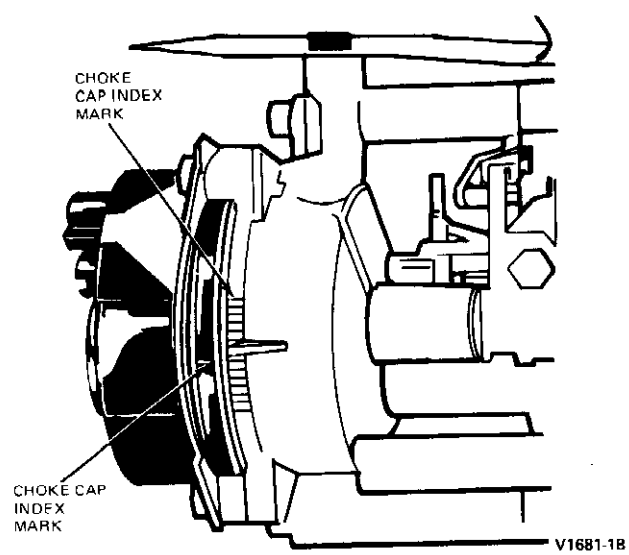


FIG. 18 Automatic Choke Thermostatic Spring Housing Adjustment

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FUEL LEVEL (FLOAT) ADJUSTMENT—DRY

The dry float adjustment is a preliminary fuel level adjustment only. The final adjustment (Fuel Level Float Adjustment—Wet) must be made after the carburetor is mounted on the engine.

With the air horn removed, the float raised and the fuel inlet needle seated, check the distance between the top surface of the main body (gasket removed) and the top surface of the float for conformance to specification. Depress the float tab to seat the fuel inlet needle. **CAUTION: Excessive pressure can cause damage to the Viton tip on the needle.** Take the measurement near the center of the float at a point 1/8 inch from the free end of the float.

If the cardboard float gauge is used, place the gauge in the corner of the enlarged end section of the fuel bowl (Fig. 19). The gauge should touch the float near the end, but not on the end radius.

If necessary, bend the tab on the float to bring the setting within the specified limits. This should provide the proper preliminary fuel level setting.

FUEL LEVEL (FLOAT) ADJUSTMENT—WET

1. Operate the engine to normalize engine temperatures, and place the vehicle on a flat surface as near level as possible. Stop the engine.
2. Remove the carburetor air cleaner assembly if not previously removed.
3. Remove the air horn attaching screws and the carburetor identification tag. Temporarily leave the air horn and gasket in position on the carburetor main body and start the engine. Let the engine idle for a few minutes, then remove the air horn and gasket to provide access to the float assembly.
4. While the engine is idling, use a standard depth scale to measure the vertical distance from the top machined surface of the carburetor main body to the level of the fuel in the fuel bowl (Fig. 20).

   The measurement must be made at least 1/4 inch away from any vertical surface to assure an accurate reading, because the surface of the fuel is concave (higher at the edges than in the center). Care must be exercised to measure the fuel level at the point of contact with the gauge. Refer to the specifications for the correct fuel level (wet) setting.
5. If any adjustment is required, **stop the engine to minimize the hazard of fire due to fuel spray when the float setting is disturbed.** To adjust the fuel level, bend the float tab (contacting the fuel inlet valve) upward in relation to the original position to raise the fuel level, and downward to lower it.

   Each time an adjustment is made to the float tab to alter the fuel level, the air horn must be re-installed, and the engine started and permitted to idle for a few minutes to stabilize the fuel level. Remove the air horn and gasket and check the fuel level after each adjustment until the specified level is obtained.
6. Install a new air horn gasket, the air horn assembly, carburetor identification tag and the attaching screws. Be sure the plastic dust seal on the choke operating rod is positioned correctly and does not cause the rod to bind. Tighten the screws.
7. Check the idle fuel mixture, idle speed adjustments and the carburetor throttle positioner adjustment (if so equipped). Adjust the carburetor as required.
8. Install the air cleaner.

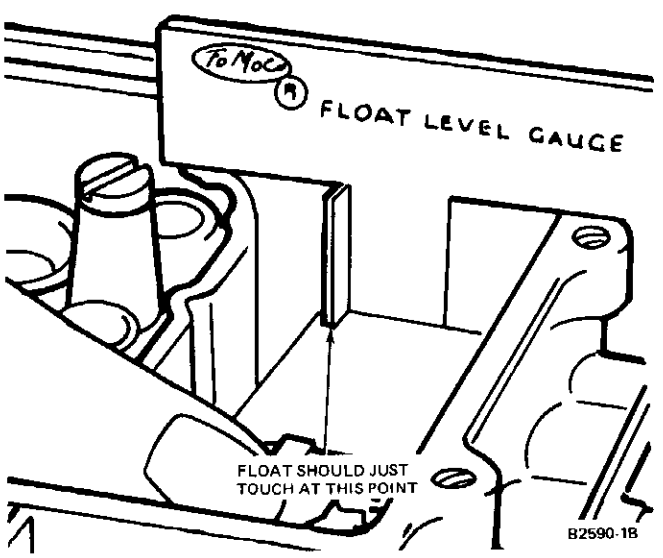


FIG. 19 Fuel Level (Float) Adjustment—Dry

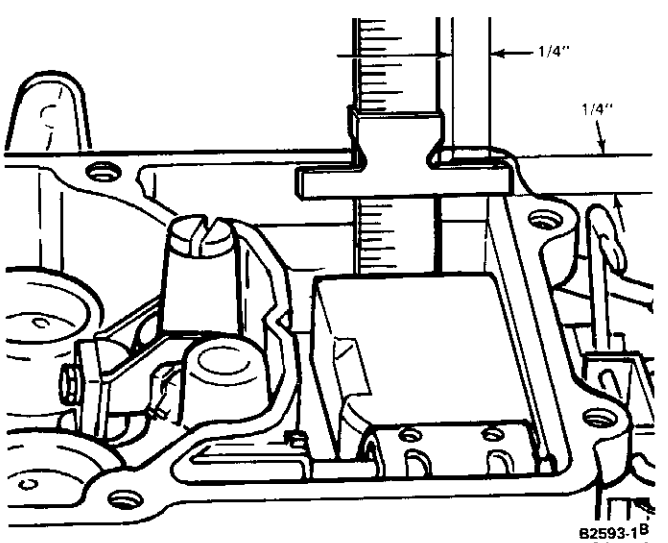


FIG. 20 Fuel Level (Float) Adjustment—Wet

REMOVAL AND INSTALLATION

CARBURETOR ASSEMBLY

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl may then be examined for contamination as the carburetor is disassembled.

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1. Remove the air cleaner.
2. Remove the throttle cable from the throttle lever. Disconnect all vacuum lines, emission hoses, the fuel line, electrical connection and the choke heat tube at the carburetor.
3. Remove the carburetor retaining nuts; then remove the carburetor. Remove the carburetor mounting gasket, spacer (if equipped) and lower gasket from the intake manifold.

Installation

1. Clean the gasket mounting surfaces of the spacer and carburetor. Place the spacer between two new gaskets and position the spacer and gaskets on the intake manifold. Position the carburetor on the spacer and gasket. Position and connect the choke heat tube. Take care to avoid damage to the tube nut.
2. Install the spark and EGR vacuum lines (if so equipped) before bolting carburetor in place. Secure the carburetor with the attaching nuts. To prevent leakage, distortion or damage to the carburetor body flange, snug the nuts; then, alternately tighten each nut in a criss-cross pattern to the specified torque.
3. Connect the fuel line, throttle cable, and all emission lines and vacuum lines removed. Observe color coded vacuum line connections on carburetor.
4. Adjust the engine idle speeds and fuel mixture if necessary and make sure the accelerator pump rod is set in the specified hole.

AIR HORN TO MAIN BODY GASKET

Removal

1. Remove the air cleaner.
2. Disconnect the automatic choke clean air tube at the carburetor.
3. Remove the automatic choke plate operating rod to choke lever retainer.
4. Remove the air horn attaching screws and lock washers, and the carburetor identification tag. Remove the air horn gasket.

Installation

1. Install a new air horn to main body gasket. **Make sure all holes in the new gasket have been properly punched and that no foreign material has adhered to the gasket.**
2. Position the air horn on the main body and gasket so that the choke plate operating rod fits into the opening in the choke housing lever. Install the choke plate rod retainer. Be sure the plastic dust shield on the choke operating rod is properly positioned and does not cause the rod to bind.
3. Install the air horn attaching screws and lock washers and the identification tag.
4. Connect the automatic choke clean air tube to the carburetor.
5. Install the carburetor air cleaner assembly.

FLOAT, NEEDLE VALVE AND SEAT, INLET SCREEN OR MAIN JETS

Removal

1. Remove the carburetor air horn following the procedure under Air Horn to Main Body Gasket Replacement.
2. With the use of a screwdriver, pry the float shaft retainer form the fuel inlet seat. Remove the float, float shaft retainer and fuel inlet needle assembly.
3. If required, remove the fuel inlet needle seat, filter screen, baffle and main jets with a jet wrench. Be sure the correct (specified) jets are installed.

Installation

1. If required, install the fuel inlet filter in the inlet valve seat bore. Install the valve seat, baffle and gasket. Install the fuel inlet needle valve.
2. Slide the float shaft into the float lever. Position the float shaft retainer on the float shaft.
3. Insert the float assembly into the fuel bowl and hook the float lever tab under the fuel inlet needle clip. Insert the float shaft into the guides at the sides of the fuel bowl.
4. With the use of the screwdriver, position the float shaft retainer on the groove of the fuel inlet needle seat.
5. Refer to Float Adjustment—Dry, and perform a dry float fuel level adjustment on the float.
6. Install the carburetor air horn and gasket and related parts. Refer to Air Horn to Main Body Gasket Replacement.
7. Refer to Fuel Level Float Adjustment—Wet, and perform the wet fuel level adjustment procedures.

ACCELERATOR PUMP DIAPHRAGM AND/ OR ELASTOMER VALVE

Removal

1. Remove the carburetor air horn to main body gasket following the procedure under Air Horn to Main Body Gasket Replacement.
2. Remove the accelerator pump operating rod retainer. To release the rod from the retaining clip, lift upward on the portion of the clip that snaps over the shaft and then disengage the rod. Remove the rod. Remove the accelerator pump cover, diaphragm assembly and spring.
3. If inspection proves it necessary to remove the Elastomer valve, remove the float, grasp the elastomer valve firmly and pull it out. **If the Elastomer valve tip broke off during removal, be sure to remove the tip from the fuel bowl. An Elastomer valve must be replaced whenever it is removed from the main body. See Fig. 19 and 22.**

Installation

1. If the Elastomer valve was removed, lightly lubricate the tip of a new valve and insert the tip into the accelerator pump cavity. Using needle-nosed pliers, reach into the fuel bowl and grasp the valve tip. Pull the valve in until it seats, and cut off the tip forward of the retainer shoulder. Remove the tip from the bowl. Install the float.

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2. Position the new accelerator pump diaphragm assembly to the cover and place the cover and diaphragm assembly in position on the return spring and main body. **The large end of the spring must face the Elastomer valve.** Install the cover screws fingertight. Push the accelerator pump cover against the main body and tighten the cover screws.
3. Position the accelerator pump operating rod in the hole in the pump operating arm.
4. Adjust the accelerator pump stroke to specification by installing the accelerator pump rod in the proper hole in the overtravel lever. Position the rod retainer over the proper hole and insert the end of the rod through the hole in the retainer. Snap the end of the retainer over the rod.
5. Install the carburetor air horn and gasket. Refer to the Air Horn to Main Body Gasket Replacement.

CHOKE PULLDOWN DIAPHRAGM ASSEMBLY

Removal

1. Remove the air cleaner.
2. Remove the two (2) attaching screws from the bracket, disconnect the vacuum supply tube and remove the pulldown diaphragm.
3. Remove the attaching screws holding the diaphragm assembly on the main body. Rotate the diaphragm assembly to disengage the rod (Fig. 21).

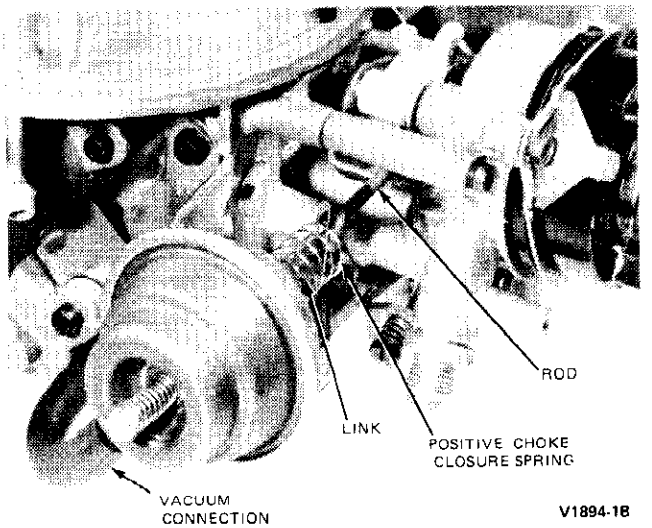


FIG. 21 Choke Pulldown Diaphragm Assembly

Installation

1. Engage rod in the diaphragm assembly link. Rotate the assembly to align the mounting bracket with the main body casting. Install the two (2) attaching screws.
2. Connect the vacuum supply tube to the correct vacuum base tube connection.
3. Perform the automatic choke pulldown and fast idle cam adjustments as described in Part 50-29 of this Manual.
4. Install the air cleaner assembly.

MAJOR REPAIR OPERATIONS

DISASSEMBLY

To facilitate working on the carburetor, and to prevent damage to the throttle plates, install carburetor legs on the base. If legs are unavailable, install four (4) bolts (about 2-1/4 inches long of the correct diameter) and eight (8) nuts on the carburetor base.

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor. However certain components of the carburetor may be serviced without a complete disassembly of the entire unit. For a complete carburetor overhaul, follow all of the steps. To partially overhaul a carburetor or to install a new gasket kit, follow only the applicable steps.

AIR HORN

1. Remove the air cleaner anchor screw.
2. Remove the automatic choke control rod retainer.
3. Remove the air horn attaching screws, lock washers and the carburetor identification tag. Remove the air horn and air horn gasket.
4. Remove the choke control rod by loosening the screw that secures the choke shaft lever to the choke shaft. Remove the rod from the air horn. Slide the plastic dust seal out of the air horn.
5. If it is necessary to remove the choke plate, remove the staking marks on the choke plate attaching screws and remove the screws. Remove the choke plate by sliding it out of the shaft from the top of the air horn. Remove any burrs around screw holes prior to removing chokeshaft. If equipped with altitude compensation, rotate the main choke shaft and disconnect the connecting link. Slide the choke shaft out of the air horn.
6. Remove the staking marks on the bypass air choke plate attaching screws (if used) and remove the screws. Slide the choke shaft from the air horn.

CHOKE PULLDOWN DIAPHRAGM ASSEMBLY

Follow procedures given under Removal and Installation.

AUTOMATIC CHOKE

1. Remove the fast idle cam retainer.
2. Remove the thermostatic choke spring housing retaining screws and remove the clamp, housing and gasket.
3. Remove the choke housing assembly retaining screws. If the air horn was not previously removed, remove the choke control rod retainer. Remove the

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choke housing assembly, gasket and the fast idle cam and rod from the fast idle cam lever.

4. Remove the choke lever retaining screw and washer. Disconnect the choke control rod from the choke lever. Remove the choke lever and fast idle cam lever from the choke housing.

MAIN BODY

1. With the use of a screwdriver, pry the float shaft retainer from the fuel inlet seat (Figs. 22 and 23). Remove the float, float shaft retainer and fuel inlet needle assembly. Remove the retainer and float shaft from the float lever.
2. Remove the fuel inlet needle, seat, filter screen, and the main jets with a jet wrench.
3. Remove the booster venturi screw (accelerator pump discharge), booster venturi and metering rod assembly and gasket. Invert the main body and let the accelerating pump discharge weight and ball fall into the hand.
4. Remove the accelerator pump operating rod from the overtravel lever and the retainer. To release the operating rod from the overtravel lever retainer, press upward on that part of the retainer that snaps over the rod. Disengage the rod from the retainer and from the overtravel lever. Remove the rod and retainer.
5. Remove the accelerator pump cover attaching screws. Remove the accelerator pump cover, diaphragm assembly and spring (Fig. 24).
6. If it is necessary to remove the Elastomer valve, grasp it firmly and pull it out. If the Elastomer valve tip was broken off during removal, be sure to remove the tip from the fuel bowl. An Elastomer valve must be replaced whenever it has been removed from the carburetor.
7. Invert the main body and remove the enrichment valve cover and the gasket. Remove the enrichment valve with a box wrench or socket wrench (Fig. 25). Remove the enrichment valve gasket. Discard the gasket.

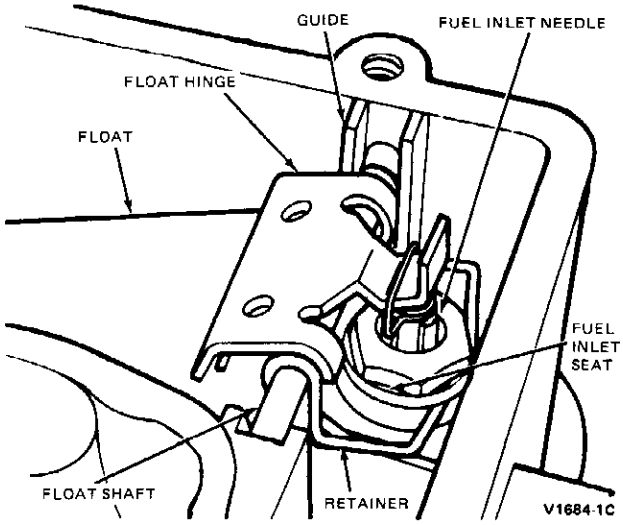


FIG. 22 Float Assembly

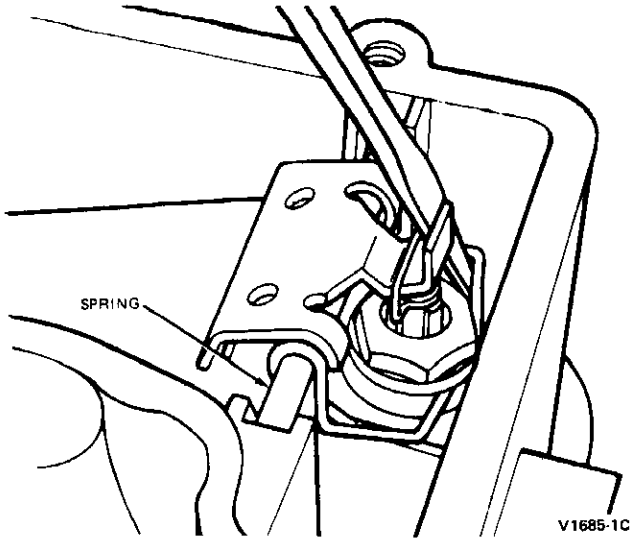


FIG. 23 Removing or Installing Float Shaft Retainer

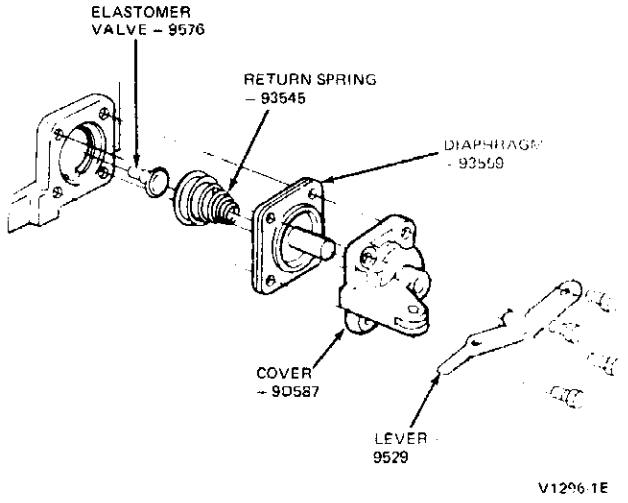


FIG. 24 Accelerator Pump Assembly

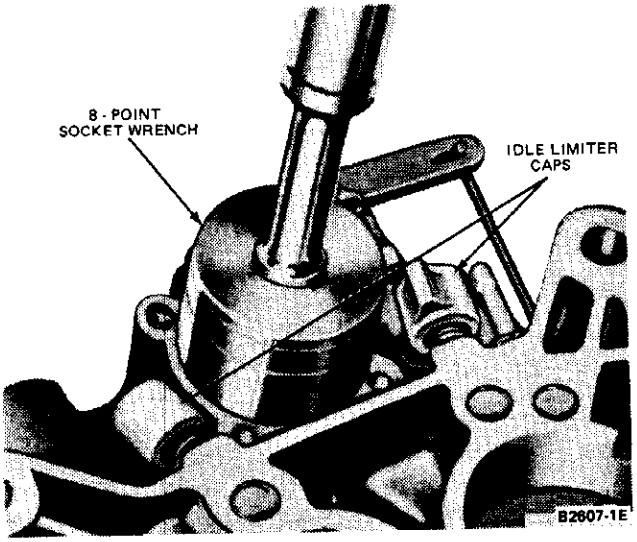


FIG. 25 Removing or Installing Enrichment Valve

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8. Remove the idle fuel mixture adjusting screws (needles) and the springs. Remove the limiters from the adjusting screws.
9. If necessary, remove the nut and washer securing the fast idle adjusting lever asssembly to the throttle shaft, and remove the lever assembly. If necessary, remove the idle screw and the spring from the fast idle adjusting lever.
10. Remove the four (4) screws that attach the aneroid assembly to the main body (if altitude compensated) and remove the assembly.
11. If it is necessary to remove the throttle plates, lightly scribe the throttle plates along the throttle shaft, and mark each plate and its corresponding bore with a number or letter for proper installation (Fig. 26). Remove the throttle plate attaching screws. Carefully remove any burrs caused by the screw removal to prevent scoring the throttle shaft bores as the throttle shaft is withdrawn.

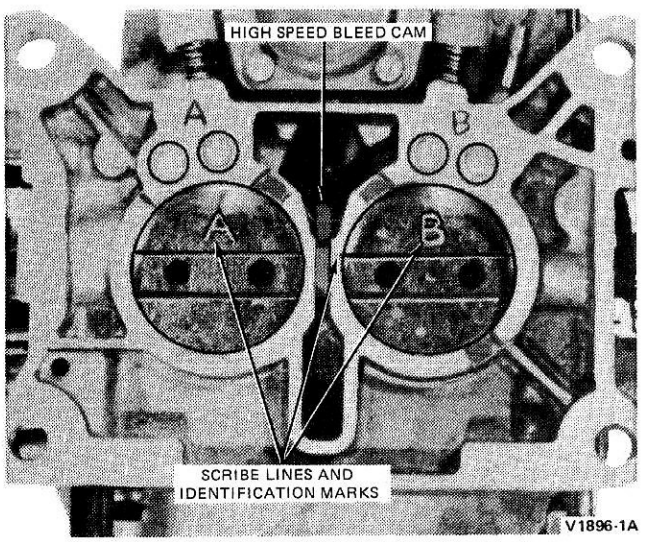


FIG. 26 Scribing Throttle Plates

12. Slide the throttle shaft out of the main body, making sure you catch the mechanical high speed bleed actuator located on the throttle shaft between the throttle plates.

Clean and inspect the carburetor component parts according to procedures outlined in Part 29-02 of this Manual.

ASSEMBLY

Make sure all holes in new gaskets have been properly punched, and that no foreign material has adhered to the gaskets. Make sure the accelerator pump diaphragm is not torn or cut. The Model 2150 2-V carburetor is shown disassembled in Fig. 27.

MAIN BODY

1. Slide the throttle shaft assembly into the main body until it begins to enter the high speed bleed cam slot in the body.
2. Holding the cam by the edge of the point, hold it in the slot and rotate the throttle shaft until it will pass through the cam. Rotate the shaft clockwise until the throttle lever clears the boss for the TSP "Off" idle speed screw. Continue inserting the shaft into proper position, rotating as necessary to properly position cam.
3. Refer to the lines scribed on the throttle plates and install the throttle plates in their proper location with the screws snug, but not tight. Always use new screws when installing throttle plates.
4. Close the throttle plates. Invert the main body, and hold it up to the light. Little or no light should show between the throttle plates and the throttle bores. Tap the plates lightly with a screwdriver handle to seat them. Hold the throttle plates closed and tighten and stake the attaching screws. Stake hardened screws by crimping exposed threads with diagonal cutters.
5. If necessary, install the fast idle screw spring and the screw on the fast idle adjusting lever.
6. Position the aneroid assembly to the main body (if altitude compensated) and attach with four (4) screws.
7. Place the fast idle adjusting lever assembly on the throttle shaft and install the retaining washer and nut (Fig. 27).
8. If the Elastomer valve was removed, lightly lubricate the tip of a new Elastomer valve and insert the tip into the accelerator pump cavity center hole. Using a pair of needle-nosed pliers, reach into the fuel bowl and grasp the valve tip. Pull the valve in until it seats in the pump cavity wall and cut off the tip forward of the retaining shoulder. Remove the tip from the bowl.
9. Install the accelerator pump diaphragm return spring on the boss in the chamber (Fig. 18). Insert the diaphragm assembly in the cover and place the cover and diaphragm assembly into position on the main body. Install the cover screws.
10. Insert the accelerator pump operating rod into the hole in the accelerator pump actuating lever. Position the accelerator pump operating rod retainer over the specified hole in the over-travel lever. Insert the operating rod through the retainer and the hole in the overtravel lever and snap the retainer down over the rod.
11. Invert the main body. Install the enrichment valve and new gasket with a wrench (Fig. 25). Tighten the valve securely.
12. Install the idle mixture adjusting screws (needles) and springs (Fig. 27). Turn the needles in gently with the fingers until they just touch the seat, then back them off 1-1/2 turns for a preliminary idle fuel mixture adjustment. **Do not install the idle mixture limiters at this time. Install the enrichment valve cover and new gasket. The cover must be installed with the limiter stops on the cover in position to provide a positive stop for the tabs on the idle mixture adjusting screws limiters.**
13. Install the main jets and the fuel inlet seat, filter screen, baffle and new gasket. **Be sure the correct jets are installed.**
14. Install the fuel inlet needle assembly in the fuel inlet seat.
15. Slide the float shaft into the float lever (Fig. 22). Position the float shaft retainer on the float shaft.

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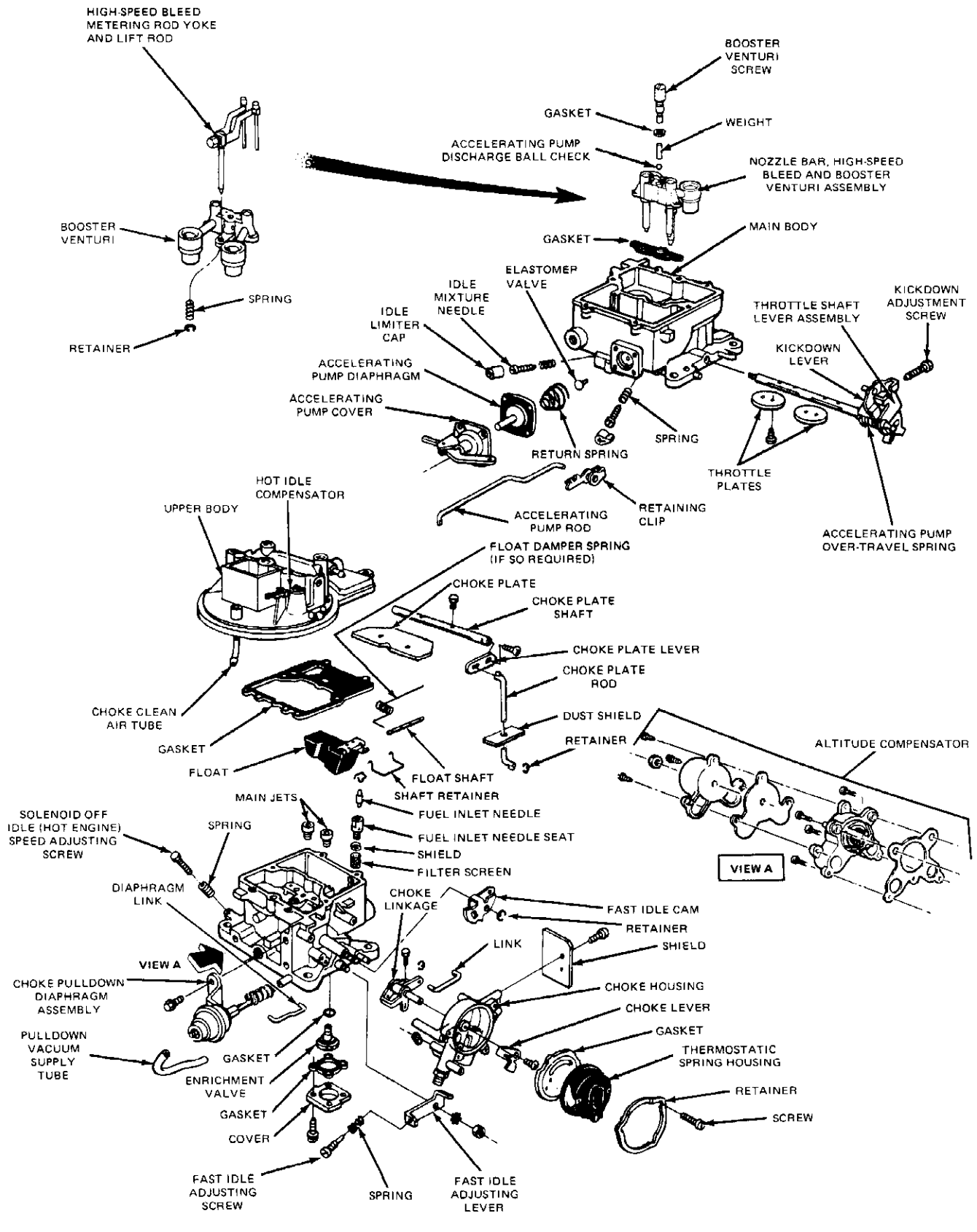


FIG. 27 Model 2150 2-V Carburetor—Disassembled View

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16. Insert the float assembly into the fuel bowl and hook the float lever tab under the fuel inlet needle assembly. Insert the float shaft into its guides at the sides of the fuel bowl.
17. With a screwdriver, position the float shaft retainer in the groove on the fuel inlet needle seat (Fig. 23). Check the float setting. **Be sure the float does not interfere with the elastomer valve.**
18. Drop the accelerator pump discharge ball and weight (if removed during disassembly) into the passage in the main body.
19. Position the new booster assembly gasket and the booster venturi assembly in the main body. Install the accelerator pump discharge screw. Tighten the screw.

AUTOMATIC CHOKE

1. Position the fast idle cam lever on the thermostatic choke shaft and lever assembly. **The bottom of the fast idle cam lever adjusting screw must rest against the tang on the choke lever.** Insert the choke lever into the rear of the choke housing. Position the choke lever so that the hole in the lever is to the left side of the choke housing.
2. Install the fast idle cam rod on the fast idle cam lever. Place the fast idle cam on the fast idle cam rod and install the retainer. Place the choke housing vacuum pick-up port to main body gasket on the choke housing flange.
3. Position the choke housing on the main body and at the same time, install the fast idle cam on the hub on the main body. Position the gasket, and install the choke housing attaching screws. Install the fast idle cam retainer. Install the thermostatic spring housing.

CHOKE PULLDOWN DIAPHRAGM ASSEMBLY

Refer to procedure under Removal and Installation.

AIR HORN

Refer to Fig. 27 for the correct location of the parts.

1. If removed, position the bypass air choke plate shaft through the air horn, then install the bypass choke plate. Before tightening the mounting screws, check for proper fit and shaft rotation.
2. If the main choke plate shaft was removed, position the shaft in the air horn. Rotate the main choke plate shaft and connect the bypass choke link. Install the choke plate rod on the end of the main choke shaft.
3. If the choke plate was removed, insert the choke plate into the choke plate shaft. Install the choke plate screws snug, but not tight. Check for proper plate fit, binding in the air horn and free rotation of the shaft by moving the plate from the closed position to the open position. If necessary, remove the choke plate and grind or file the plate edge where it is binding or scraping the air horn wall. If the choke plate and shaft moves freely, tighten the choke plate screws while holding the choke in the fully closed position. Stake the choke plate screws by crimping the exposed threads with a diagonal cutter.
4. Position the fuel bowl gasket and the choke rod plastic seal on the main body. Position the air horn on the main body and gasket so that the choke plate rod fits through the seal and the opening in the main body.
5. Insert the end of the choke plate rod into the automatic choke lever. Install the air horn attaching screws and the carburetor identification tag. Tighten the attaching screws. Install the choke plate rod retainer. Install the air cleaner anchor screw. Tighten the air cleaner anchor screw to the specified torque.

Perform all automatic choke adjustments and other carburetor functions as required to meet specifications. See Group 29 for adjustments not covered in this Part.

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Model 4350 4-V Carburetor

PART 24-26

7.5L (460 C.I.D.) V-8

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ADJUSTMENTS	
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DESCRIPTION

GENERAL

The Motorcraft Model 4350 4-V carburetor (Figs. 1, 2 and 3) has three main assemblies; the upper body, the main body and the throttle body.

The upper body, which serves as the main body cover, contains the choke plate, booster venturi assembly, the secondary air valve, accelerating pump plunger, mechanical fuel bowl vent valve and fuel inlet and float system.

The main body contains the fuel bowl and primary fuel metering system vacuum piston and rods.

The throttle body contains both primary and secondary throttle plates. Primary throttle operation is from the accelerator linkage. Secondary throttle operation is accomplished by mechanical linkage from the primary throttle lever. A lockout tang coupled to the automatic choke linkage prevents operation until the choke is fully off. The secondary throttle shaft is split and loosely coupled in the center to allow tighter secondary throttle plate seating in the bores (Fig. 4).

Primary fuel metering is accomplished by tapered metering rods that are raised or lowered according to engine vacuum, limited by mechanical system that is

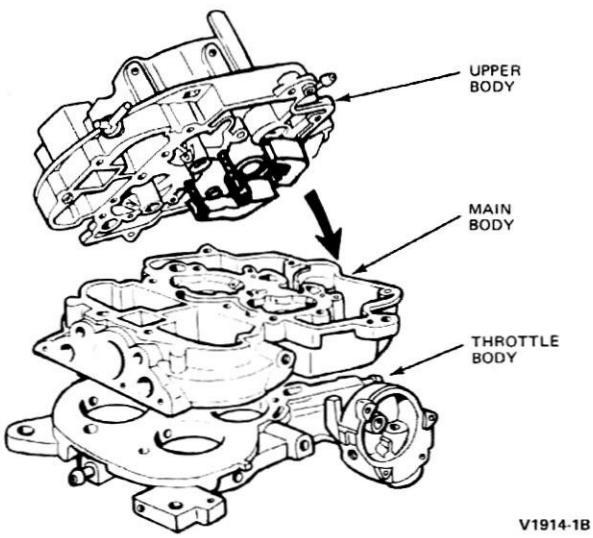


FIG. 1 Model 4350 4-V Carburetor—Main Assemblies

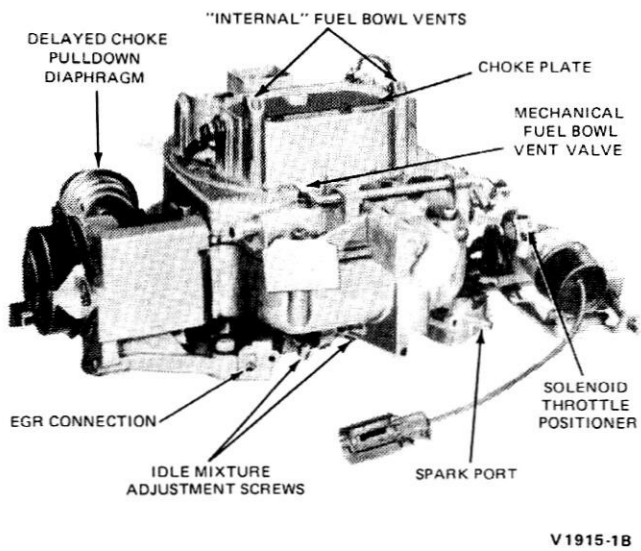


FIG. 2 Model 4350 4-V Carburetor—Front View

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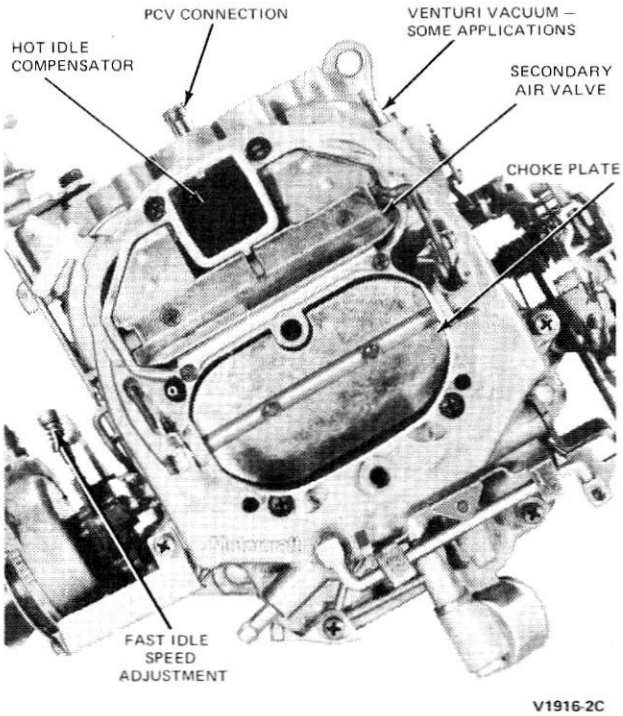


FIG. 3 Model 4350 4-V Carburetor—Top View Without Altitude Compensation

positioned according to throttle plate opening (Figs. 5 and 30). A lever on the acceleration pump operating shaft moves upward as the throttle is opened.

Under high engine vacuum conditions, the vacuum piston pulls the metering rods down into the main jets, causing a lean mixture to be delivered. Under acceleration, when engine vacuum is lowered, an internal spring causes the piston to rise. This puts the narrower part of the metering rod in the jet, causing a larger fuel opening and enriching the fuel mixture.

Fuel inlet to the fuel bowl is controlled by a twin pontoon type float (or two floats on police models) hinged to the upper body of the carburetor. The acceleration pump is piston type. The linkage and operating rod are part of the upper body, and the piston is suspended into the pump well in the fuel bowl.

The automatic choke system consists of a standard bimetallic thermostatic choke mechanism. Also, an electric assist is used when underhood temperatures are above 60°F. This system operates to assure full choke opening within a predetermined time of engine start.

The electric assist choke system consists of a choke cap, thermostatic spring, bimetallic temperature sensing disc (switch), and ceramic Positive Temperature Coefficient (PTC) heater (Fig. 6).

The choke is powered from the stator tap of the alternator, providing voltage to the system as long as the engine is running. The system is grounded through a ground strap connected to the carburetor body.

At temperatures below approximately 60°F., the switch is open and no current is supplied to the ceramic

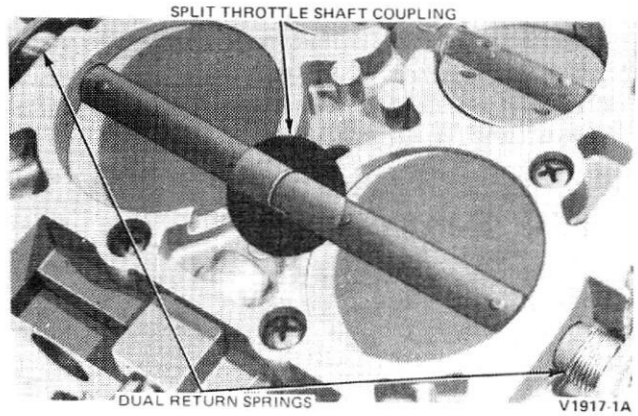


FIG. 4 Split Secondary Throttle Shaft

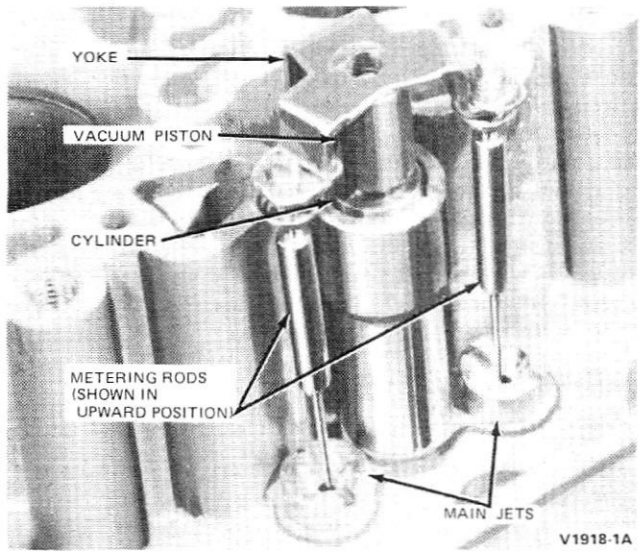


FIG. 5 Metering Rod Primary Metering System

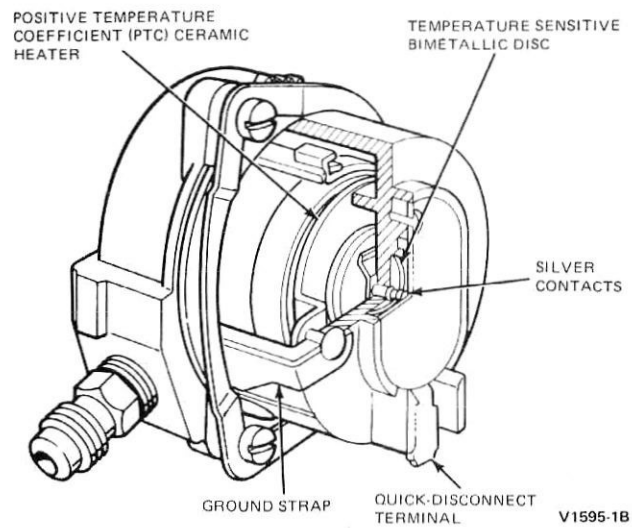


FIG. 6 Electric Assist Choke—Model 4350 4-V Carburetor

heater located within the thermostatic spring. Normal thermostatic choking action then occurs.

At temperatures above approximately 60°F., the temperature sensing switch closes and current is

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supplied to the PTC ceramic heater. As the heater warms, it causes the thermostatic spring to pull the choke plate open within 70 seconds.

For test and adjustment information, refer to this Part and to Part 50-29.

DELAYED CHOKE PULLDOWN AND FAST IDLE TOP STEP PULLOFF

The Motorcraft 4350 4-V carburetor is equipped with a unique, vacuum-operated delayed choke pulldown diaphragm. This system operates in addition to the usual choke pulldown system in the choke housing.

The remotely-mounted delayed choke pulldown diaphragm assembly is connected to the automatic choke linkage by an override linkage (Fig. 7).

When the engine is first started, the piston inside the choke housing pulls the choke plate slightly open (initial choke pulldown). This is accomplished with engine vacuum through internal passages in the carburetor. At the same time, vacuum bleeds to the delayed choke pulldown diaphragm. When the delayed pulldown diaphragm is fully retracted (about 6-18 seconds after engine start) it opens the choke to the delayed pulldown setting. At the same time, linkage pulls the fast idle screw from the top step of the fast idle cam to the kickdown step.

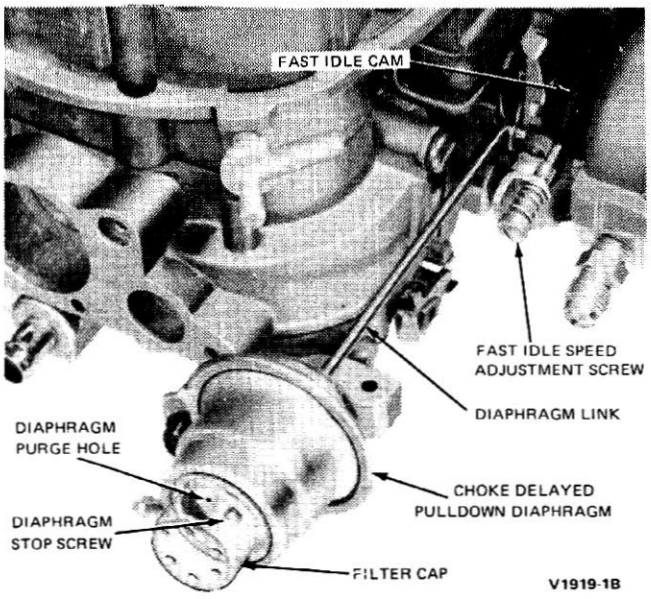


FIG. 7 Delayed Choke Pulldown and Fast Idle Top Step Pulloff Diaphragm

HIGH ALTITUDE COMPENSATION

Some Carburetors Built for High Altitude Operation

Some Motorcraft Model 4350 4-V carburetors are equipped with altitude compensation, designed to provide improved high-altitude emission control and driveability (Fig. 8).

Intake air entering the by-pass intake is metered into the air flow below the primary, thus making for a leaner mixture needed at higher altitudes. Air flow is controlled by a valve activated by an aneroid attached to the rear of the carburetor main body housing.

To provide improved high-altitude cold engine starts, the bypass intake is equipped with a choke plate linked to the main choke system.

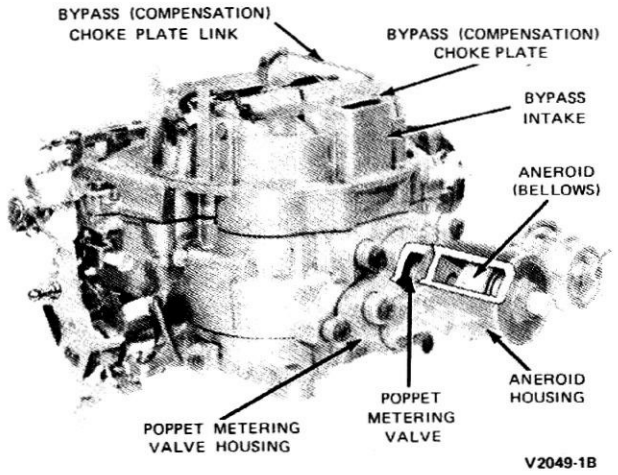


FIG. 8 Motorcraft Model 4350 4-V Carburetor With Altitude Compensation (Cutaway View)

ADJUSTMENT

Most carburetor adjustments are set at assembly, based on guidelines established for reduced engine emission and acceptable driveability.

Adjustments not covered in this Part will be found in Part 29-02 or Part 50-29. Adjustment points for all carburetor adjustments are shown in Figs. 8 thru 22.

ACCELERATOR PUMP ADJUSTMENT

The accelerator pump has only two adjustments, a piston-to-shaft pin position which is set at the factory to deliver the proper amount of fuel for the engine on which it is installed, and a capacity adjustment which should only be made if the operating arm is replaced.

This setting should not be changed from the specified adjustment (Fig. 12).

The control rod that operates the accelerator pump also operates the limiter that controls the height of the main metering rod piston (Fig. 13).

Do not turn the vacuum piston limiter lever adjusting nut in order to adjust the stroke of the accelerator pump. This adjustment is set at the factory and changing it could affect drivability of the vehicle.

Remove the upper body assembly and invert it (see Removal and Installation).

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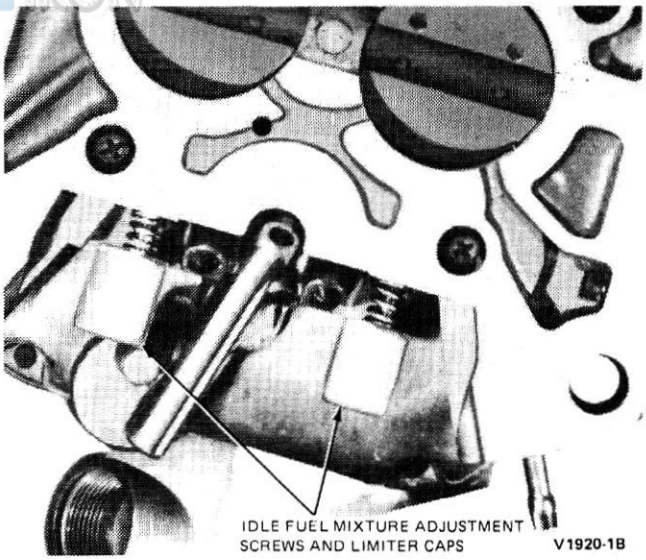


FIG. 9 Idle Fuel Mixture Adjusting Screws, Limiters and Stops

Disconnect the accelerator pump from the operating arm by holding downward on the spring and sliding the arm out of the pump shaft slot.

1. Disassemble the spring and nylon keeper that retains the adjustment pin (Fig. 12). If the pin is not in the specified hole, remove it, reposition the shaft to the correct hole in the piston assembly and reinstall the pin.
2. Slide the nylon retainer over the pin and position the spring on the shaft. Compress the spring on the shaft and install the pump on the pump arm.

If the nylon pump arm is damaged during disassembly or assembly, follow this procedure to replace and adjust the arm. The throttle plates, shafts and lever must be installed to specification to properly adjust the replacement pump arm.

1. Remove the screw retaining the mechanical fuel bowl vent rod bracket and remove the bracket and rod.
2. Remove the two expansion plugs (one aluminum, one brass) from the air horn over the accelerator pump arm. This will give access to the arm adjusting screw and gauge pin hole. These access plugs can be removed by penetrating with a sharp drift and prying out.
3. Remove the upper body assembly from the main body.
4. Remove the vacuum piston limiter lever and nylon accelerator pump arm from the accelerator pump lever and shaft assembly (Fig. 38). Also remove the accelerator pump adjusting screw (5/64 in. allen wrench) from the old nylon pump arm.
5. Install the accelerator pump adjusting screw in the new nylon pump arm. Position the screw so that one full thread of the point end of the screw is exposed below the pump arm.
6. Install the nylon accelerator pump lever and shaft assembly using an "E" clip (Fig. 38).
7. Install upper body to main body and install accelerator pump rod into the proper hole in the throttle pump lever.

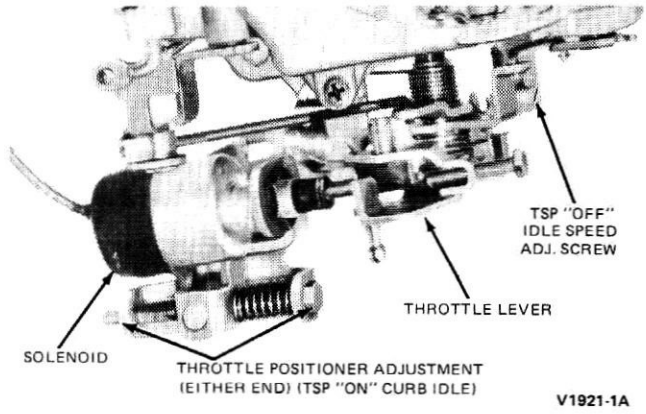


FIG. 10 Idle Speed Adjustment Points—Vehicles With Solenoid Throttle Positioner

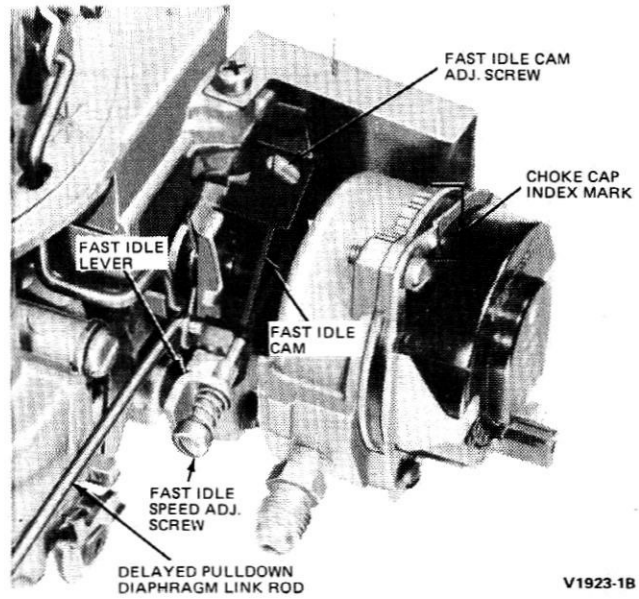


FIG. 11 Automatic Choke Adjustments

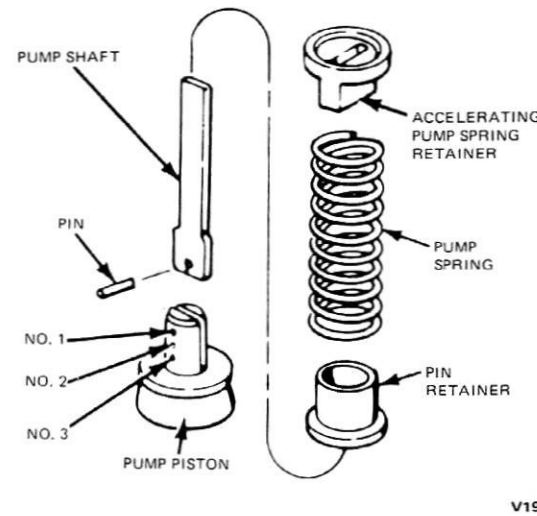


FIG. 12 Setting Accelerator Pump Stroke

8. Position the accelerator pump gage pin thru the accelerator pump gage access hole so that it will rest on top of the accelerator pump stem (Fig. 39).

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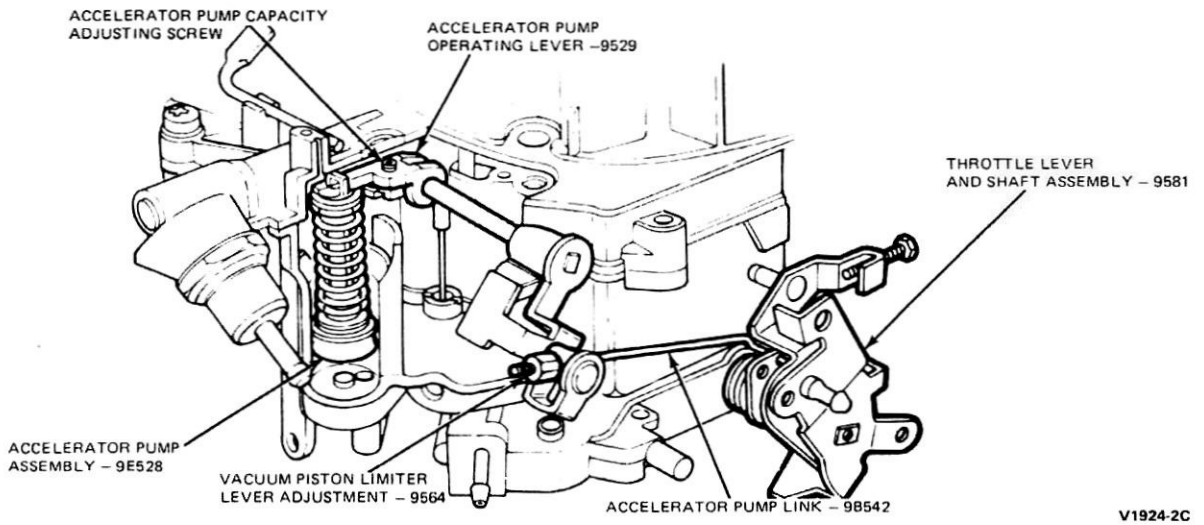


FIG. 13 Throttle-To-Accelerator Pump Linkage

9. With the throttle lever at the idle position, measure the distance from the top of the gage pin to the upper body casting surface using a depth scale and note the measurement.
10. Rotate throttle lever to wide open throttle position (W.O.T) and again measure the distance from top of the gage pin to the upper body casting surface. The difference between the two measurements at idle and W.O.T. should be 5/16 inch (.312). If the difference is not 5/16 in., turn the accelerator pump adjustment screw clockwise to increase and counterclockwise to decrease the reading. Recheck reading using the same procedure.
11. Install new access hole plugs.
12. Install the mechanical bowl vent rod, bracket and retaining screw.

NOTE: Do not attempt to adjust the accelerator pump with the nylon nut on the vacuum piston limiter lever.

MECHANICAL FUEL BOWL VENT VALVE

The vent valve is designed to be open to the carbon canister when the engine is off and closed when the engine is operating. Adjust the valve with the carburetor installed on the vehicle.

1. With the engine at **CURB IDLE** speed, and the solenoid throttle positioner (if equipped) in the retracted (de-energized) position, adjust the vent valve so that the adjustment screw just touches the drive tab on the accelerator pump lever (Fig. 14), then turn the adjusting screw one (1) turn clockwise.
2. Turn the engine off and observe that the vent operating linkage pushes down on the vent valve stem.

AUTOMATIC CHOKE FUNCTIONS

Initial Choke Pulldown

When the engine is first started, the choke plate is pulled to an initial pulldown position by a small piston in the choke housing, operated by engine vacuum. To adjust initial choke plate pulldown, follow this procedure:

1. Remove the choke thermostatic spring housing assembly.
2. Open throttle about half-throttle and position the fast idle adjusting screw on the high step of the fast idle cam.
3. Bend a 0.036 inch diameter wire gauge at a 90 degree angle approximately 1/8 inch from its end. Insert the bent end of the gauge between the choke piston slot and the upper edge of the right-hand slot in the choke housing (Fig. 15).
4. Rotate the choke thermostat lever counterclockwise until the gauge is snug in the piston slot. Hold the gauge in position with light force on the lever and move the top of the choke rod away from the carburetor while moving the bottom of the rod toward carburetor to remove end play from linkage.
5. Using a drill gauge or equivalent, check initial choke pulldown clearance by placing the gauge

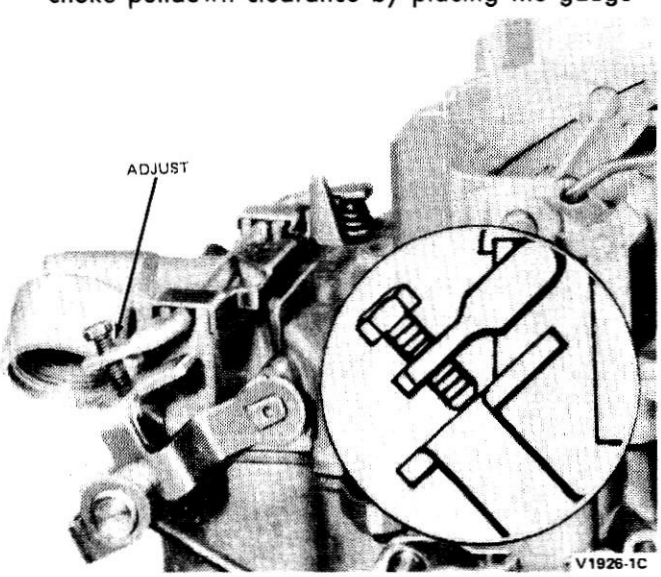


FIG. 14 Adjusting Mechanical Fuel Bowl Vent Valve

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DETROIT IRON

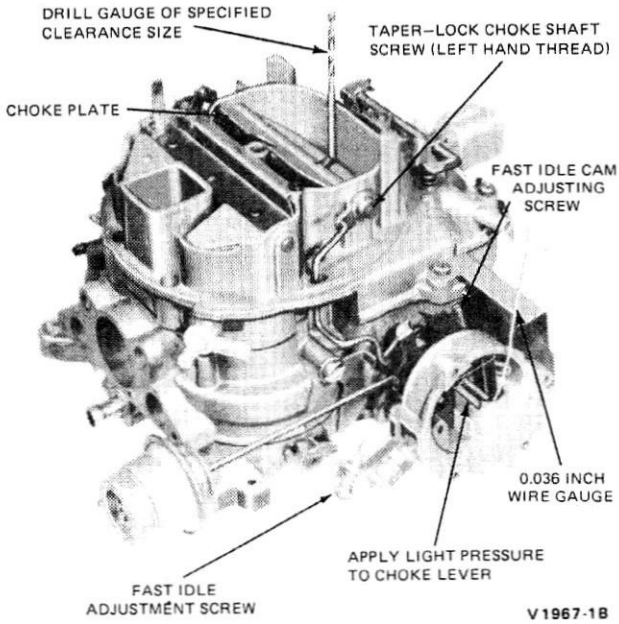


FIG. 15 Checking and Adjusting Initial Choke Plate Pulldown

against the inner wall of the choke air horn on the downstream side at approximately the longitudinal centerline of the carburetor and check clearance from wall to edge of choke plate.

6. If the measured clearance is not within specification, adjust clearance by turning the hex head lock screw on the choke plate shaft in a clockwise direction three (3) full turns. **(Note: Lock screw is left-hand threaded).** Pry choke lever from shaft to loosen taper lock. Choke lever should rotate freely on choke shaft.
7. Hold the drill gauge with diameter equal to specified pulldown clearance between the lower edge of the choke plate and air horn wall, maintaining light closing force on choke plate.
8. With choke piston snug against the 0.036 inch wire gauge, the top of the choke rod held away from the carburetor while moving the bottom of the rod toward the carburetor to remove end play from linkage, and the choke plate held against the drill gauge, tighten the hex head screw on the choke shaft.
9. Using the .036 inch gauge in the vacuum slot, above the top of the piston, hold the piston in the full down position. Now rotate the thermostatic spring lever back and forth to check for binding.
10. Reinstall the gasket and choke thermostatic spring housing assembly.

Delayed Choke Pulldown

The Model 4350 4-V carburetor is equipped with a vacuum-diaphragm operated delayed choke pulldown that opens the choke to a wider setting approximately 6-18 seconds after engine startup. To check and adjust, follow this procedure:

1. With throttle set on fast idle cam, note position of index marks on cap of choke bimetallic cap. Loosen retaining screws and rotate cap 90 degrees in the closing (rich) direction.
2. Disconnect the vacuum supply hose from the port on the delayed choke pulldown diaphragm assembly. Place a piece of tape over the purge hole after removing the filter cap and connect a vacuum source of at least 14-18 in. Hg to the port (Fig. 16).
3. Measure hard gage pulldown dimension at lower edge of choke plate, in center of air horn, using gauge of specified diameter (see Group 29). Adjust by turning stop screw on delayed choke pulldown diaphragm.
4. After pulldown is properly set, remove external vacuum source, reconnect tube to carburetor port and reset choke thermostatic cap to specified index setting. When using a hand vacuum pump, cover purge hole (Fig. 7).

Fast Idle Top Step Pulloff

As the delayed choke pulldown diaphragm operates, additional linkage pulls the fast idle lever and screw from the top step of the fast idle cam to the second step, reducing cold engine idle speed (Fig 17).

To check the operation of the fast idle top step pulloff linkage, operate the delayed pulldown diaphragm manually or by connecting an external vacuum source of 14-18 in. Hg to the vacuum port. Place hand over holes in filter cap. Position the fast idle speed screw on the top step of the fast idle cam with the choke plate closed. (Rotate choke thermostatic cap if necessary to close choke plate.) Observe the fast idle speed adjusting screw drops to second (kickdown) step of cam as delayed choke pulldown diaphragm is operated.

Fast Idle Cam Clearance

1. Loosen the attaching screws and rotate the spring housing to align the center index mark on the choke housing with the index mark on the spring housing.

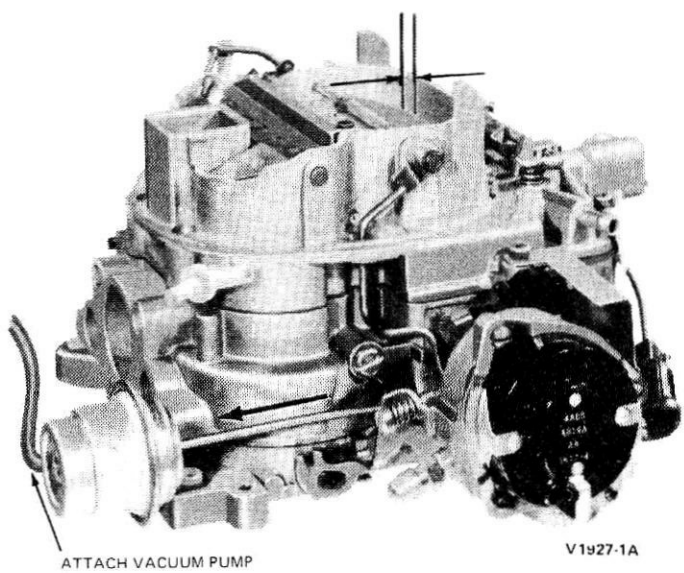


FIG. 16 Choke Plate Delayed Pulldown Adjustment

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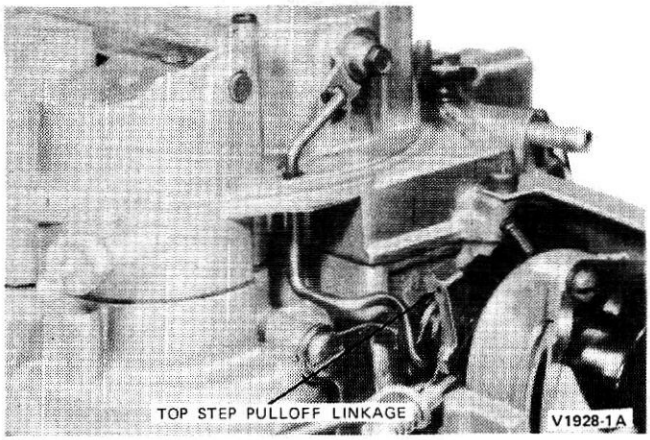


FIG. 17 Fast Idle Top Step Pulloff Linkage

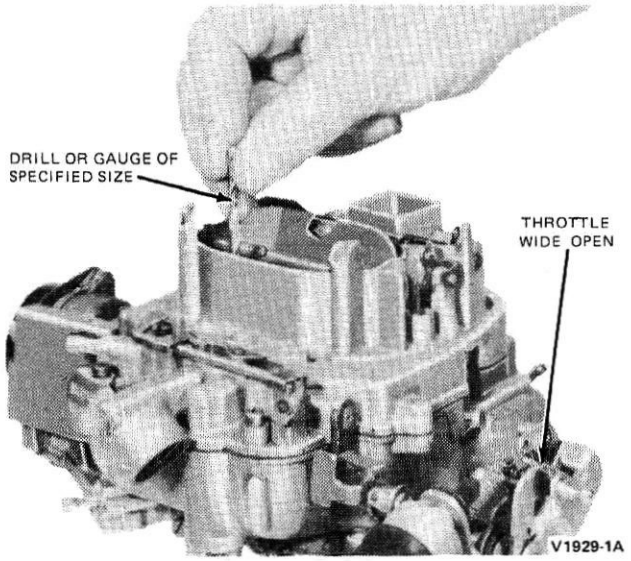


FIG. 18 Checking Dechoke Clearance

Rotate the spring housing an additional 90 degrees counterclockwise and tighten the attaching screws.

2. Position the fast idle speed, adjusting screw end on the kickdown (center) step of the fast idle cam. Close the choke plate as far as it will go. Check the clearance between the lower edge of the choke plate and the air horn wall. Turn the fast idle cam adjusting screw inward to increase the clearance or outward to decrease the clearance. Make sure the fast idle speed adjusting screw stays at the kickdown step of the fast idle cam during the adjustment.
3. Loosen the attaching screws, set the thermostatic choke housing to the specified index mark and tighten the attaching screws.
4. If the choke plate clearance and fast idle cam linkage adjustment was performed with the carburetor on the engine, adjust the engine idle speed and fuel mixture.

Dechoke Clearance

1. Open the throttle plate to the wide open position and hold.
2. Rotate the choke plate toward the closed position until the pawl on the fast idle speed lever contacts the fast idle cam.
3. Check the clearance between the lower edge of the choke plate and the air horn wall (Fig. 18).
4. Adjust the clearance to specification by bending the pawl on the fast idle speed lever forward to increase or backward to decrease the clearance.

FUEL INLET SYSTEM ADJUSTMENTS

Checking Fuel Level With Bubble Type Fuel Level Gauge (Before Carburetor Disassembly)

1. Make sure vehicle is level.
2. Remove the air cleaner assembly.
3. Start the engine and allow to run briefly, until the fuel level is stabilized.
4. Insert the Fuel Level Gauge T72L-9550-B into the carburetor fuel bowl vent on the throttle lever side as shown in Fig. 19. Rest the gauge pad on the other vent.
5. Using the fuel primer, syphon fuel into the sight tube and allow the fuel to reach a level.
6. Note where the fuel level falls on the gauge. If the fuel level is within the specified band, adjustment is not required. If the fuel level is not correct, adjust as follows.

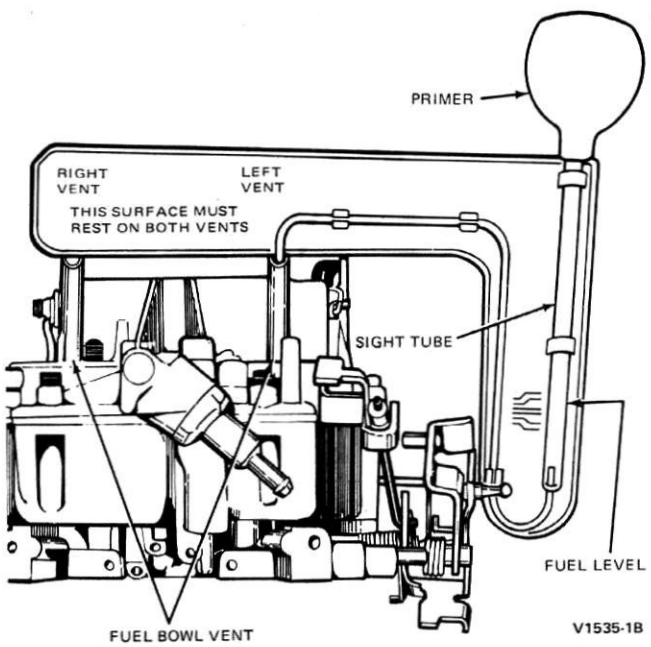


FIG. 19 Checking Fuel Level

Float Setting (With Fabricated Gauge and Bending Tools)

To simplify parallel setting of the dual pontoons, first refer to Fig. 19 for the construction of an adjustable float gauge and a float tab bending tool.

NOTE: When adjusting float(s), always use the float tab bending tool. If a tool such as needle

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nose pliers is used, the tab could be scratched or otherwise marred, resulting in a sticking float.

Refer to MAJOR REPAIR OPERATIONS for disassembly of the Model 4350 4V carburetor. Pay particular attention to instructions for scribing reference lines on the accelerator pump operating arm shaft and the carburetor air horn casting. This relationship must be maintained when disassembling and assembling the carburetor.

1. Adjust gauge to the specified height.
2. Insert gauge into the air horn outboard holes (Fig. 21).

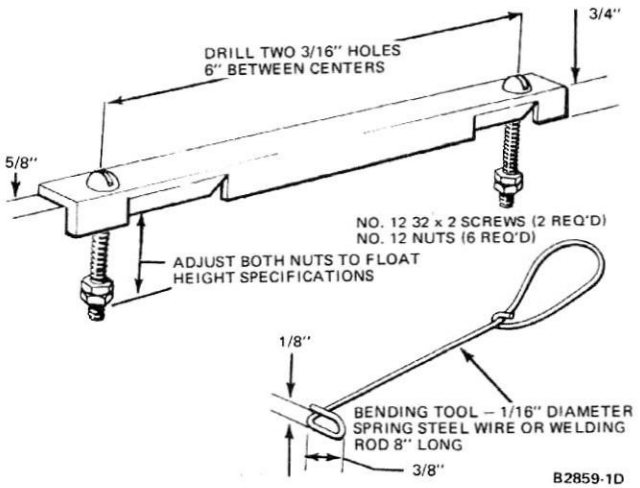


FIG. 20 Float Gauge and Bending Tool Details

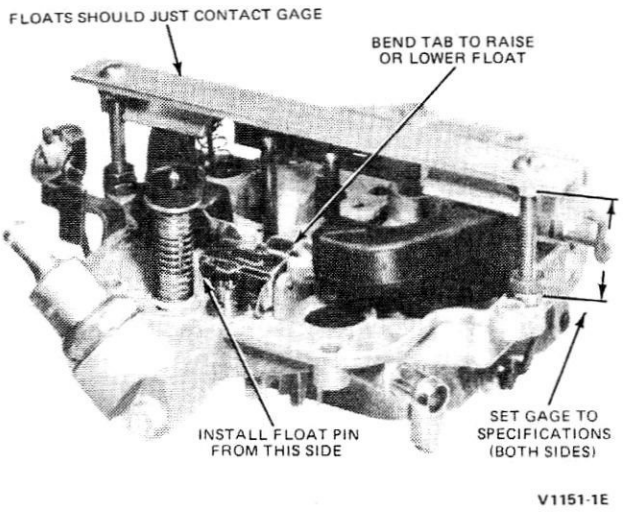


FIG. 21 Float Setting—Fabricated Gauge (Passenger Carburetor Shown—Police Interceptor Carburetor Similar)

3. Check the clearance and alignment of the pontoons to the gage. Both pontoons should just touch the gauge for the proper setting. Align the pontoons if necessary on passenger models by slightly twisting the pontoons.

   If it is necessary to adjust the float clearance, bend the primary needle tab downward to raise the float and upward to lower the float. On police models, it is necessary to set each float independently.

To bend the tabs with the float bending tool, the procedure is as follows:

To Raise the Float, insert the open end of the bending tool to the RIGHT side of the float lever tab and between the needle and float hinge. Raise the float lever off the needle and bend the tab downward. **To Lower the Float,** insert the open end of the bending tool to the LEFT side of the float lever tab, between the needle and float hinge. Support the float lever and bend the tab upward.

Float Setting (With Gauge Supplied in Rebuilding Kit)

1. With the air horn removed from the carburetor and inverted, check the clearance of the pontoon floats to the gauge (Fig. 22).

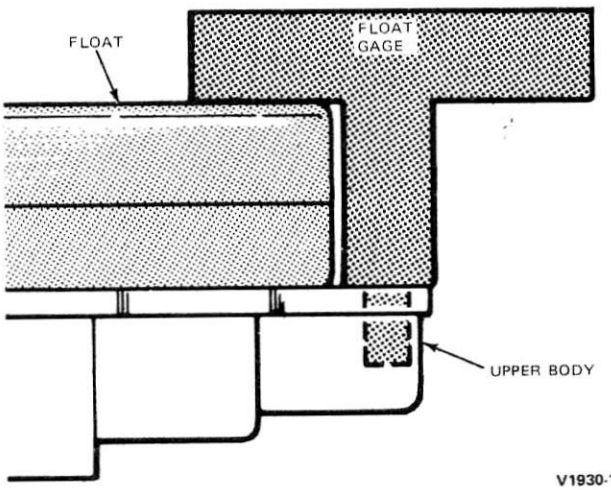


FIG. 22 Float Setting—Rebuilding Kit Gauge

2. If necessary, adjust the alignment and height of the floats as outlined under adjustments for fabricated gauge and tool.

Auxiliary (Supplemental) Fuel Inlet Valve Setting

With the float gauge installed to maintain the specified setting, invert the upper body. Check the auxiliary valve clearance (Fig. 23). If it is necessary to adjust the auxiliary valve and float tab to the specified clearance, use the bending tool shown in Fig. 20.

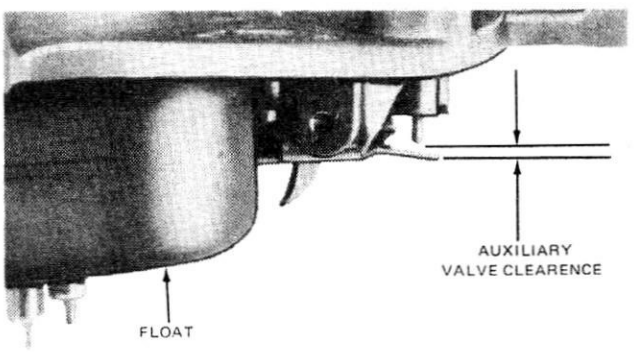


FIG. 23 Auxiliary (Supplemental) Valve Setting

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Fuel Inlet Needle Drop Limiter Adjustment

All model 4350 4V carburetors except Police Interceptor models are equipped with a new fuel inlet needle drop limiter. The limiter (Fig. 24) controls fuel inlet during stops and turns to help prevent engine stalling and must be installed and ajusted correctly. Improper adjustment can result in engine stalling or fuel starvation. Adjust the limiter as follows:

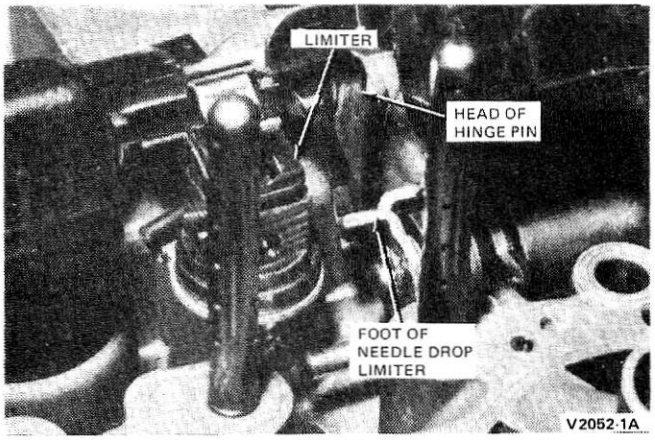


FIG. 24 Fuel Inlet Needle Drop Limiter

1. After adjusting float level, remove the float hinge pin, float(s) and inlet needle.
2. Re-install the fuel inlet needle drop limiter and the hinge pin, with the foot of the limiter behind the tang on the vacuum piston limiter lever (Fig. 25).

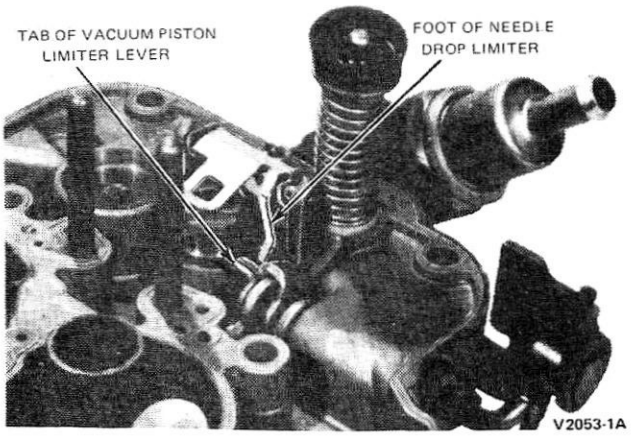


FIG. 25 Limiter Installed For Adjusting

3. Rotate the vacuum piston limiter lever and shaft assembly until the new scribe marks made during disassembly line up (Fig. 26). Hold in place with heavy duty tape.
4. Invert the upper body and check the clearance between the needle drop limiter tab and the fuel inlet seat with a feeler gauge (Fig. 27). If not .005 inch, first loosen the holding tape and rotate the vacuum piston limiter lever away from the needle drop limiter and then adjust for proper clearance by carefully bending the long "foot" on the needle drop limiter. Re-index the vacuum piston limiter lever and recheck the clearance.
5. When clearance is to specification, remove hinge pin and needle drop limiter. Re-install inlet needle, float(s) and inlet needle drop limiter. Make sure foot of needle drop limiter is behind tab of vacuum piston limiter lever.

VACUUM PISTON AND METERING RODS ADJUSTMENT

There are no "driveability" adjustments to be made to the main fuel metering system. The metering rod setting is unique to each carburetor and is set during manufacture with "flow box" test equipment to a critical air/fuel ratio at a given part throttle opening. This setting cannot be determined in service

HIGH ALTITUDE COMPENSATION SYSTEM

No adjustment of the high altitude system is permitted. To clean the poppet-type metering valve (See Maintenance Schedule for interval) remove the three screws that attach the aneroid bellows housing to the valve and remove the housing. Spray Ford Carburetor Choke Cleaner C9AZ-19A501-B or equivalent directly on the poppet valve and stem/guide area. Check to see that valve moves freely by depressing and releasing. Repeat if valve is sticking. Reinstall housing and tighten screws.

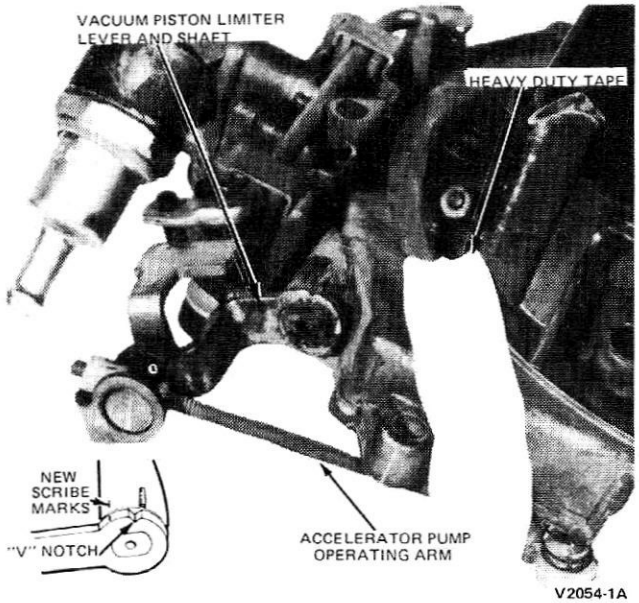


FIG. 26 Aligning Disassembly Scribe Marks

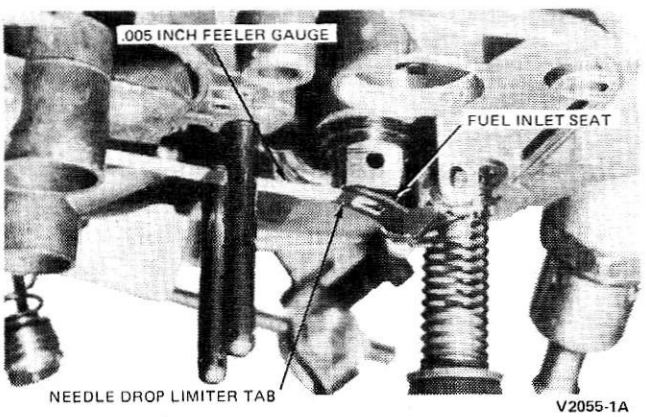


FIG. 27 Checking Needle Drop Limiter Clearance

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REMOVAL AND INSTALLATION

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances caused by foreign matter in the carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl can then be examined for contamination as the carburetor is disassembled.

1. Remove the air cleaner assembly.
2. Disconnect the throttle cable from the throttle lever. Disconnect and remove transmission kickdown linkage. Disconnect all fuel, vacuum and heat lines from the carburetor.
3. Disconnect the choke clean (cold) air pick-up connecting tube from the carburetor air horn.
4. Remove the carburetor attaching nuts and the carburetor.
5. Remove the carburetor spacer, if equipped, the carburetor and spacer gasket from the intake manifold.

Installation

1. Clean the gasket surfaces of the spacer and carburetor. Place the spacer between two new gaskets and position the spacer and gaskets on the intake manifold.
2. Position the carburetor on the spacer and gaskets and connect the choke heat tube. **BE VERY CAREFUL NOT TO CROSSTHREAD THE TUBE NUT.** Position and snug the attaching nuts and washers. Alternately torque the carburetor attaching nuts to specification, working in a criss-cross pattern.
3. Connect the throttle cable and all lines.
4. Adjust engine idle speeds, fuel mixture and throttle positioner, if equipped. Refer to Part 29-02 or 50-2 for procedures.

MAJOR REPAIR OPERATIONS

DISASSEMBLY

The mechanical portion of the fuel metering system maintains a direct relationship between the fuel flow through the main jets (metering rod and vacuum piston rod height) and throttle plate position.

This relationship is established during manufacturing and should not be changed.

To maintain the relationship during carburetor disassembly and assembly, follow this procedure:

1. Before disassembly, scribe a line on both the pump operating lever and the carburetor air horn casting, with the throttle set at fast idle position (with the fast idle screw on the top step of the fast idle cam). See Fig. 28.

   DO NOT USE THE LINES ALREADY SCRIBED ON THE LEVER AND HOUSING. THEY ARE FOR MANUFACTURING REFERENCE ONLY.

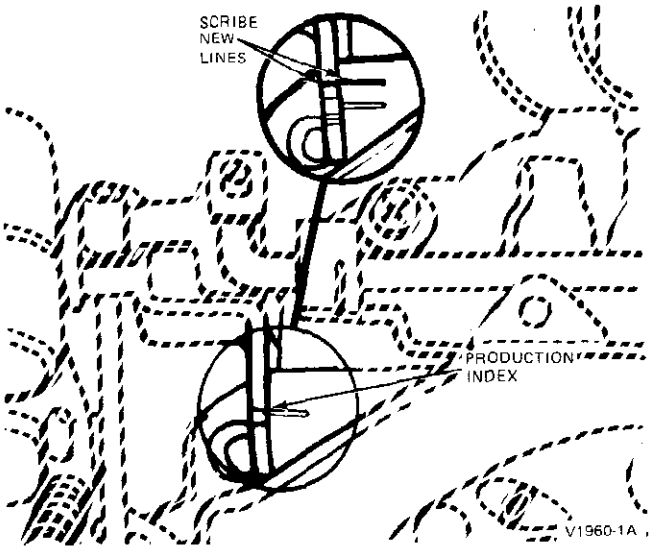


FIG. 28 Scribing New Index Line Before Removal of Air Horn Assembly

2. Now the throttle link to the vacuum piston limiter lever can be removed by unscrewing the nylon adjusting nut.

   To facilitate working on the carburetor, and to prevent damage to the throttle plates, install carburetor legs on the base. If legs are unavailable, install four 5/16 x 2-1/2 inch bolts and 8 nuts; install nuts on the bolts, above and below the carburetor base.

   Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly. Refer to Part 24-01 for cleaning and inspection.

   The following is a step-by-step sequence of operations for completely overhauling the carburetor. **However, certain components of the carburetor may be serviced without a complete disassembly of the entire unit.**

Air Horn

1. Remove the fuel inlet line from the fuel filter.
2. Remove the choke clean air pick up connecting tube from the air horn.
3. Remove the choke control rod retainer from the automatic choke lever. Separate the rod from the lever.
4. Remove the air cleaner assembly anchor screw and remove the air horn to fuel bowl attaching screws.
5. Remove accelerator pump drive rod at the throttle lever.
6. Lift the air horn off the main body.
7. Invert the air horn, pull the float pivot pin and remove the float(s) and float drop limiter.
8. Using the proper tool, remove the main and auxiliary (supplemental) fuel inlet valve seats and gaskets.
9. Remove the secondary air valve lever pivot pin and the rod from the damper piston assembly and air

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valve plate, then remove the air valve damper piston rod and spring.

10. If it is necessary to remove the secondary air valve plates or shaft proceed as follows: **Do not perform this operation with carburetor on engine, as parts may fall through to intake manifold.** Remove the C-clip from the secondary air valve plate link from the damper lever. Remove the link from the damper lever. Then remove the air valve plate retaining screws. Slide the shaft out of the body. **Note that there are spacers used at either end of the shaft.** Lift the air valve plate and attached metering rods out of the carburetor (Fig. 29).

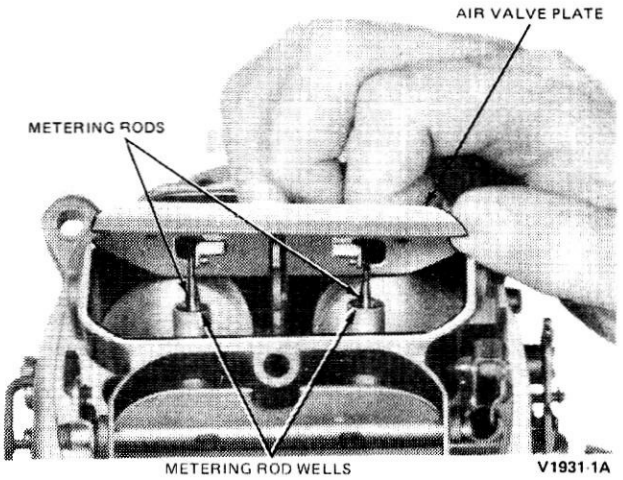


FIG. 29 Removing Air Valve Plate

11. If necessary to remove choke plate, first remove the staking marks on the choke plate attaching screws and remove the screws. If the tips of the screws are flared excessively, file the flared portion to prevent damage to the threads in the shaft. If equipped with altitude compensation, disconnect the compensation choke plate control link. Remove the choke plate, then slide the shaft and lever out of the air horn. The choke lever is attached to the shaft with a left hand thread screw.
12. Disengage the operating arm from the accelerator pump piston. Remove the clip from accelerator pump operating shaft and remove both the vacuum limiter lever and accelerator pump arm. Slide the shaft out of the air horn casting.
13. Remove the hex-head screw that attaches the mechanical fuel bowl vent valve operating rod retainer. Remove the retainer and operating rod (see Fig. 30).
14. Remove the C-clip that retains the spring on the shaft. Remove the spring and plunger assembly.

Main Body

1. Turn the main body upside down and catch the accelerator pump discharge needle and ball, (Fig. 31).
2. **Turn the body right side up again and depress the metering rod hanger and check the gap between the bottom edge of the metering rod hanger and the top of the vacuum cylinder (Fig. 32). Record the dimension for reference during assembly.** With a pair of needle-nosed pliers, remove the vacuum piston stop (nylon) from the channel in the main body casting.
3. Remove the main metering vacuum piston and fuel metering rods as an assembly. **DO NOT DISTURB SETTING OF PISTON ADJUSTMENT SCREW OR METERING ROD ADJUSTMENT SCREWS.**
4. With the appropriate screwdriver, unscrew the vacuum piston cylinder and remove the cylinder, the return spring and guide pin (Fig. 32).

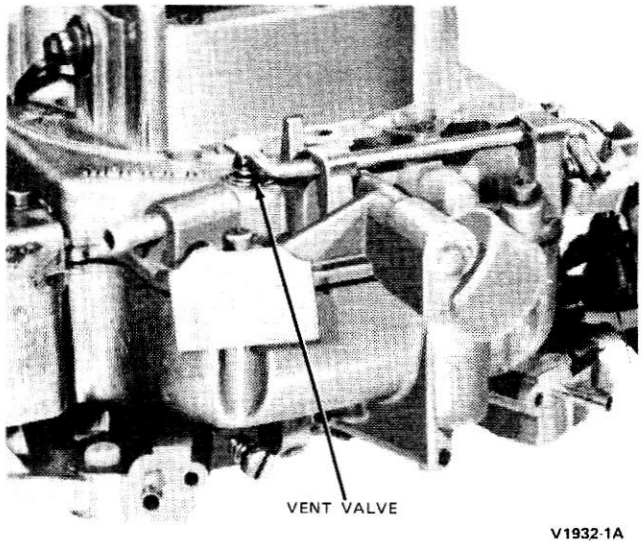


FIG. 30 Mechanical Fuel Bowl Vent Valve—Removal and Installation

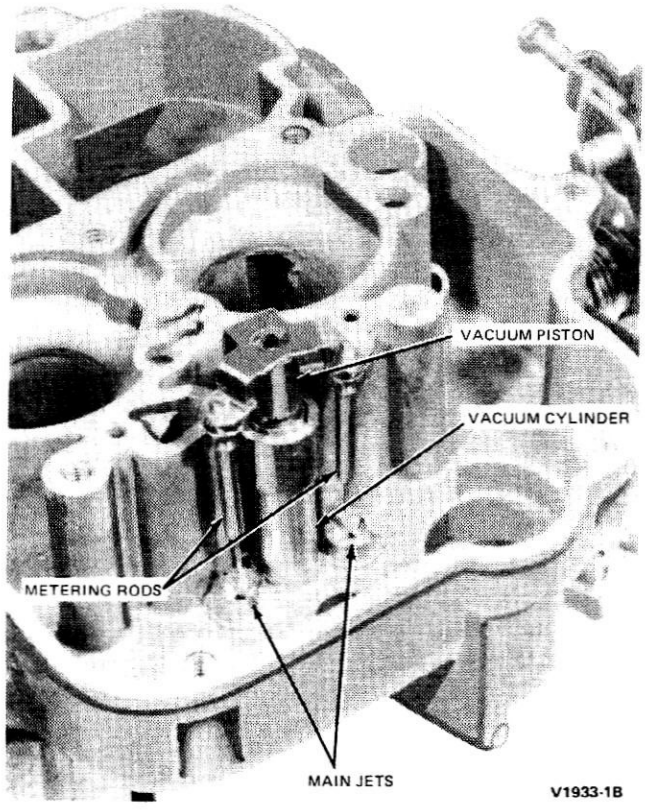


FIG. 31 Main Body Components—Air Horn Removed

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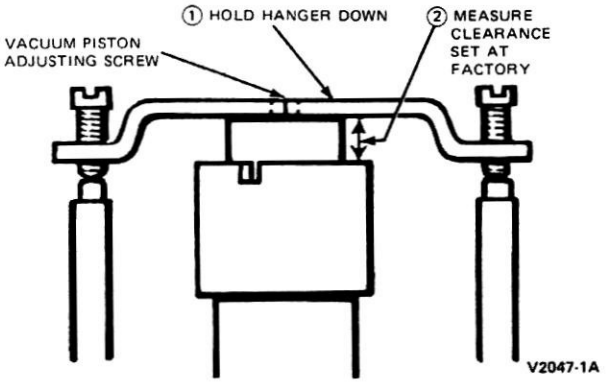


FIG. 32 Measuring Vacuum Piston Setting Before Disassembly

5. Remove the main metering jets from the fuel bowl with a jet tool.
6. Remove the four (4) altitude compensation aneroid assembly attaching screws and remove the assembly from the carburetor body.
7. If equipped with altitude compensation, you will now be able to remove the two (2) hot idle compensator attaching screws through the aneroid poppet valve hole and remove the compensator. If not equipped with altitude compensation, you must remove the cup plug that is inserted in this hole before removing the hot idle compensator mounting screws and compensator.

Throttle Body

Do not remove the idle mixture limiter caps or the mixture screws from the throttle body.

1. Remove the throttle body to main body screws from the bottom of the throttle body (Fig. 33) and separate the two castings.

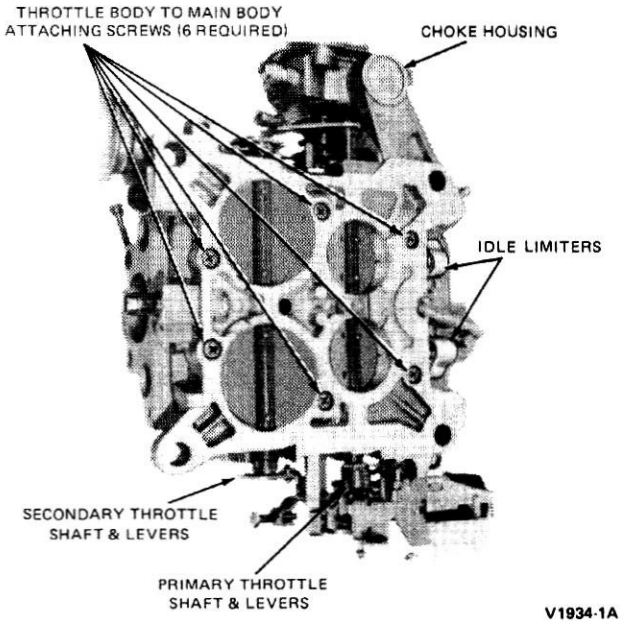


FIG. 33 Throttle Body Bottom View

2. Remove the choke housing cover screws, cover, gasket and thermostatic spring.
3. Remove the choke piston lever retaining screw, then remove the piston assembly.
4. Remove the retainers from the secondary throttle lever to primary throttle connecting link, then remove the link.
5. If it is necessary to remove the throttle plates or shafts from the throttle body, remove the staking marks on the throttle plate attaching screws. Remove the screws and the plates. **Discard the screws.**
6. The secondary throttle shaft is of two-piece design, and is removed in halves. Pull each half out of the throttle shaft bores after the plates are removed.
7. Remove the screw from the primary throttle shaft, remove the fast idle lever and adjusting screw. Slide the shaft assembly out of the primary throttle shaft bore.
8. Slide the primary return spring off the throttle shaft assembly.
9. If it is necessary to remove the fast idle cam or bushing, carefully press the bushing out of the choke housing and bushing column. **The column may bend out of alignment or break without proper support to the column during bushing removal or installation. Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Gasket surfaces must be clean and flat and free of nicks or burrs.** The carburetor assembly is shown in Fig. 34.

ASSEMBLY

Throttle Body

1. If the throttle plates and shafts have been removed, slide the primary throttle return spring on the primary throttle shaft (one-piece shaft) and slide the shaft into the primary shaft bores (mixture needles side of body).
2. Position the primary throttle plates (smaller diameter) in the primary bores with ground flat edges of the plate facing toward the idle mixture needles. Install the plate attaching screws snug but not tight.
3. Rotate the throttle shaft to the closed position and tap the plate lightly with the end of a screw driver handle or similar tool, so that the plates are properly and fully seated in the throttle bores (when viewed with a light behind the plates, little or no light should be observed). Tighten the throttle plate screws.
4. Install the secondary throttle lock out lever.
5. Install the fast idle speed lever and adjusting screw.
6. Engage the throttle plate return spring tang in the recess provided in the throttle body casting. Make sure spring operates in a closing direction.
7. Install return springs on each half of the secondary throttle plate shaft, with the hook positioned over the lever and the straight tang on the inboard end of the shaft. Insert the shafts into their bores until the tang on the return spring engages the appropriate boss. Rotate the halves of the shaft in opposite directions until the center key indexes.
8. Position the secondary throttle plates in the bores with the embossed letter "A" on the plates facing

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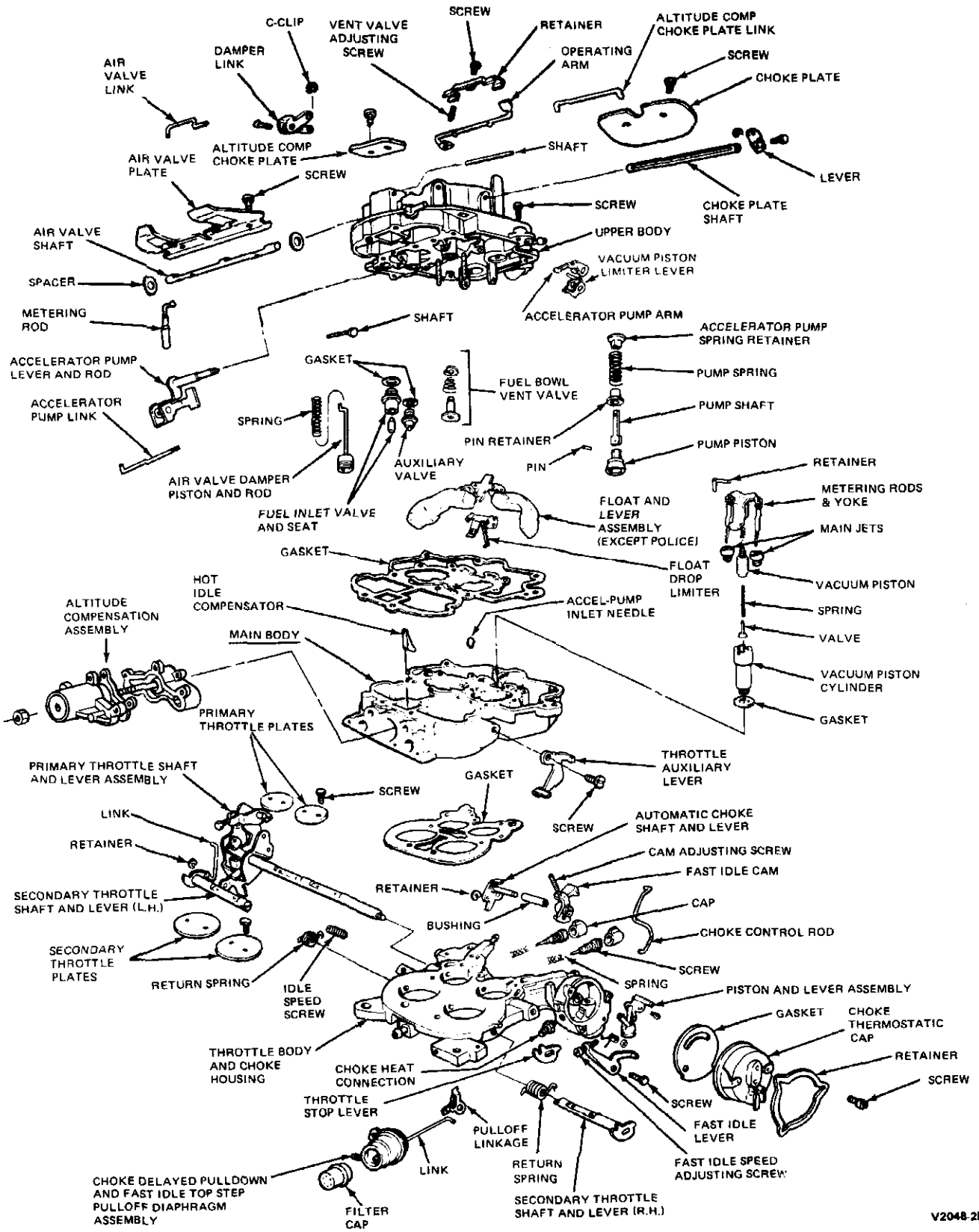


FIG. 34 Model 4350 4-V Carburetor With Altitude Compensation—Disassembled View

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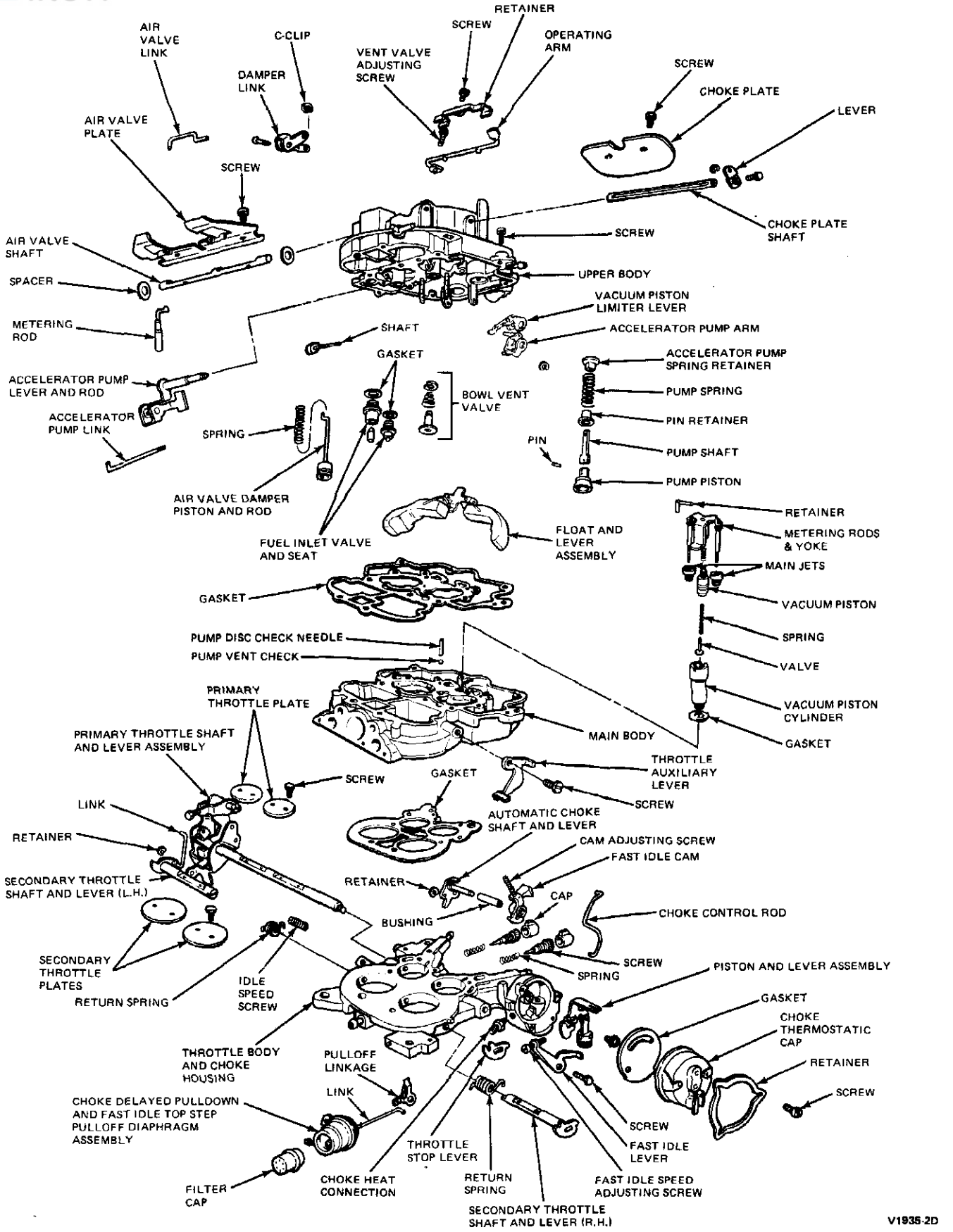


FIG. 35 Model 4350 4-V Carburetor Without Altitude Compensation (Police Model)—Disassembled View

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upward and toward the rear of the carburetor. Install the new attaching screws snugly but not tight. Position and check as with the primary throttle plates. Make sure return springs operate in a closed direction.

9. If the fast idle cam and bushing were removed, insert the automatic choke shaft bushing through the choke housing. Position the fast idle cam between the choke housing and bushing column. *Slide the bushing through the fast idle cam. Press* the bushing in the choke housing and into the column. Clean the bushing with a 1/4-inch reamer.
10. Insert the automatic choke shaft and lever in the bushing.
11. Position the automatic choke piston in the choke cylinder and the lever on the automatic chokeshaft. Install the attaching screw and lock washer.
12. Position the hot idle compensator into the bypass air intake and secure with two mounting screws through the altitude compensation poppet valve opening.
13. Insert the secondary throttle to primary throttle connecting rod into the throttle levers and install retainers.

Main Body To Throttle Body

1. Position the main body on a working surface with the fuel bowl down. If equipped with altitude compensation, position gasket and aneroid assembly to main carburetor body and attach with four (4) screws. If not equipped with altitude compensation, seal the poppet valve hole in the casting with a 1-1/8 inch cup plug and an appropriate driver tool.
2. Position the main body to throttle body gasket on the main body.
3. Position the throttle body on the main body and install the attaching screws.
4. Invert the main body and the throttle body so the fuel bowl is upward.
5. With the appropriate jet wrench or screwdriver, install main jets in the fuel bowl.
6. Install the vacuum piston cylinder and gasket assembly into the main body. Place the spring over the guide pin so that it sits in the retaining groove and position the pin and spring in the bottom of the vacuum piston cylinder. Slide the vacuum piston over the spring.
7. Carefully position the metering piston and metering rods into the cylinder and main metering jets. Push the piston and metering rods to the full downward position and install the nylon piston stop in the channel in the main body casting.
8. If the metering rod adjustment has been disturbed, manually depress the metering rod hanger. Using a small screwdriver no wider than 3/32 inch, carefully turn the vacuum piston adjusting screw (Fig. 37) and the metering rod adjusting screws counterclockwise until the metering rod hanger is fully seated against the vacuum cylinder top face.

   NOTE: If you do not have a suitable 3/32 inch wide screwdriver, make one by flattening a heavy paper clip and then filing to the correct dimensions (Fig. 36).

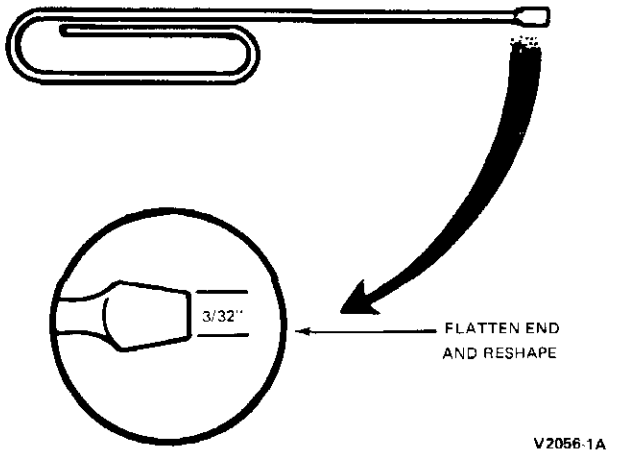


FIG. 36 Fabricating Special 3/32 inch Wide Screwdriver

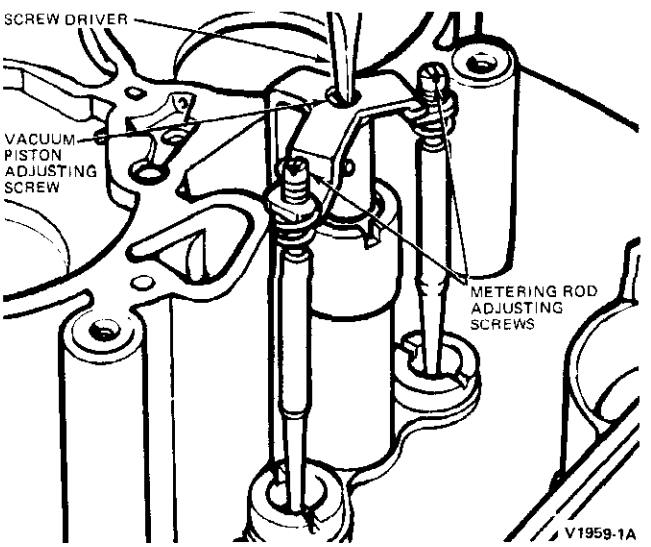


FIG. 37 Preliminary Vacuum Piston Adjustment

9. Holding the metering rod hanger lightly in the full downward position, turn each metering rod adjusting screw clockwise until the metering rod hanger just starts to rise. (The metering rods are now set in the proper relationship with the vacuum piston.)
10. Now turn the vacuum piston adjusting screw clockwise until the clearance between the bottom of the metering rod hanger and the top edge of the vacuum piston cylinder (recorded during disassembly) is achieved (Fig. 37).
11. Install the choke-to-throttle lockout lever.
12. Place the accelerator pump discharge check ball and weight in position in the body.

Air Horn

1. Install the accelerator pump operating shaft into the bore in the upper body casting. Assemble the vacuum piston limiter lever and accelerator pump operating arm to the end of the shaft and secure with a clip (Fig. 38).

   NOTE: If a new accelerator pump operating arm is being installed, refer to Adjustments for proper sequence of operations.

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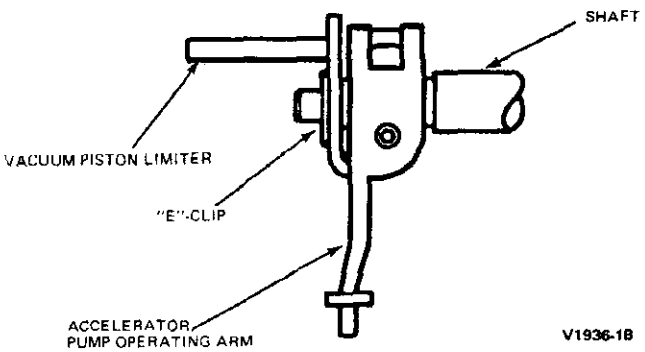


FIG. 38 Assembling Components to Vacuum Piston Limiter Lever Shaft

2. Install the accelerator pump on the arm. Install the vent valve plunger, spring and clip.
3. If the choke plate and shaft were removed, slide the choke shaft through the holes in the air horn. Install the choke shaft lever on the end of the shaft on the automatic choke side. If equipped with altitude compensation, position compensation choke plate link to compensation choke plate and main choke plate. **The lever and shaft are tapered and the attaching screw has a left hand thread. Insert the choke plate into the slot in the choke shaft and install the plate attaching screws snug but not tight.**
4. Close the choke plate and gently tap the plate with the end of a screwdriver or a similar tool to properly position the plate in the air horn.

   Tighten and stake the plate attaching screws.
5. If the air valve plate and shaft were removed, slide the shaft through the holes on the secondary side of the air horn and with the slotted end of the shaft in the air valve spring chamber.
6. Install the secondary metering rods in the keyed slots on the air valve plate. **Do not attempt to remove or install the secondary air valve plate and metering rods with the carburetor installed on the engine, as the shaft spacer(s), metering rods and attaching screws can fall into the intake manifold.** Lower the air valve plate into position while guiding the metering rods into the air valve wells. Then slide the air valve shaft and spacer(s) into position and install the air valve plate to the shaft.
7. Close the air valve plate and lightly tap the plate with end of a screwdriver or similar tool to properly position it in the air horn.

   Tighten and stake the plate attaching screws. Be sure the plate and shaft turns freely after assembly.
8. Install fuel inlet needle seat and gasket, using proper tool. Insert fuel inlet needle into the fuel inlet needle seat.
9. Install the supplementary fuel inlet valve and gasket.
10. Position float and lever assembly between hinge post and over fuel inlet valves.
11. Insert the float hinge pin through the post and float lever. **The pin must be inserted from the accelerator pump plunger side for self-retention.**
12. Position return spring over air valve damper rod. Insert assembly through upper body and insert cranked end of damper rod into inner arm hole in damper link.
13. Position damper link (bell crank) over post on upper body and install split pin shaft.
14. Insert cranked end of air valve link through tang on air valve plate and position other end throughout board end through remaining hole in damper link (bell crank). Install C-clip over end of air valve link.
15. Insert the accelerating pump bleed disc into the pump bleed cavity.
16. Set the float level.
17. Position the mechanical vent valve operating lever in the cast slots and install the retainer and screw.

Upper Body To Main Body

1. Position the main body to upper body gasket on the main body.
2. Carefully position the upper body assembly over the main body. Guide the accelerator pump plunger and the secondary throttle dashpot piston into their chambers as the upper body is gently lowered into position.
3. Install the other upper body attaching screws.
4. Position the throttle levers so that the fast idle screw is positioned on the high step of the fast idle cam. Insert the key end of the accelerator pump link into the keyed hole in the primary throttle lever.
5. Insert the threaded end of the accelerator pump link through the hole in the accelerator pump lever and install the nut (nylon) so that the index marks made during disassembly line up. The nut is self-locking.
6. Insert the choke control rod end into the automatic choke lever. With long nose pliers, install the retaining clip.
7. Install the choke cover gasket so that round hole lines up with the air inlet hole in the casting.
8. Install the choke thermostatic spring housing and retainer. Set the cap to the 90 degree rich position.
9. Check the fast idle cam clearance.
10. Reset the choke cap to specifications.
11. Remove the carburetor legs or bolts from the throttle body.

Note: Adjust mechanical fuel bowl vent valve after carburetor is reinstalled on vehicle. (See ADJUSTMENT.)

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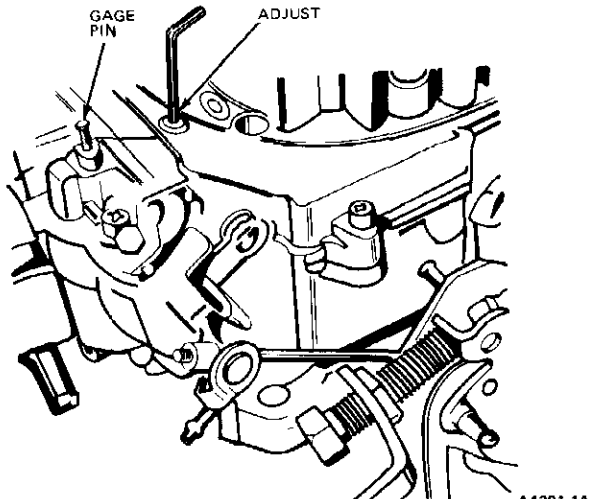


FIG. 39 Adjusting Accelerator Pump Nylon Arm

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DETROIT IRON

Motorcraft Model 2700 VV Carburetor

PART 24-27

Pinto, Bobcat, Mustang II, Granada, Monarch and Versailles

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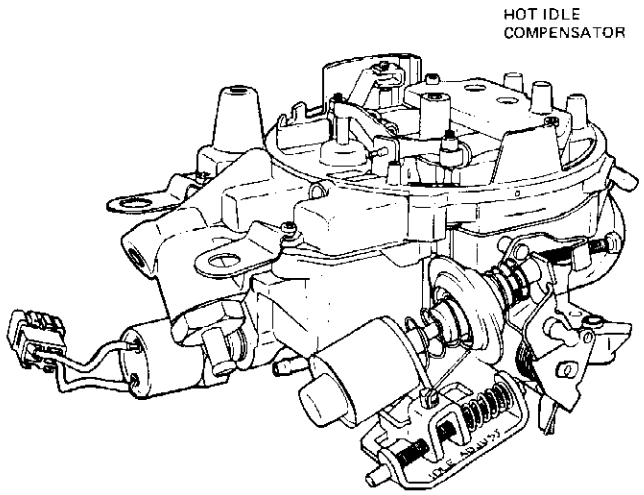
CV2059-2B

GENERAL INFORMATION

The Motorcraft Model 2700 VV (variable venturi) carburetor is able to vary the area of its venturi according to engine speed and load, making it different from all other Motorcraft carburetors, which have fixed area venturi. The 2700 VV uses a dual-element venturi valve that moves in and out of the air flowing into the two throats of the carburetor (Figs. 1 and 2).

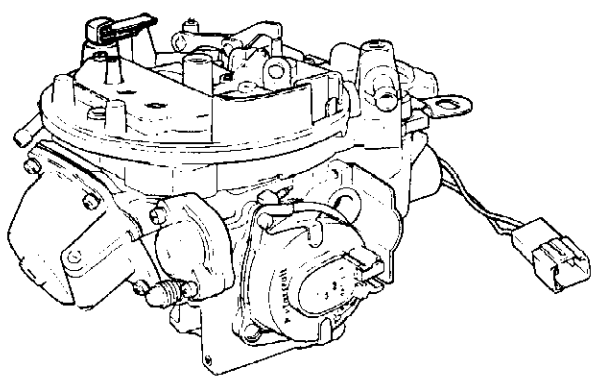
The venturi valve is controlled by engine vacuum and throttle position, and is connected to two main metering rods which control fuel flow. In operation, air speed through the carburetor is fairly constant, making for more even air/fuel mixtures throughout the engine operating range. In a fixed venturi carburetor, air flow speed varies according to throttle opening and engine speed. In order to work with the changing flow speed, supplementary systems such as an independent idle system, enrich-valve system and choke plate are needed. In the Motorcraft 2700 VV carburetor, none of these supplementary systems are needed.

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V2060-1B

FIG. 1 Motorcraft Model 2700 VV Carburetor—3/4 Front View



V2061-1B

FIG. 2 Motorcraft Model 2700 VV Carburetor—3/4 Rear View

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OPERATION

FUEL INLET SYSTEM

The fuel inlet system has a single suspended float. All applications use an integral filter at the fuel inlet. The float and lever assembly controls fuel inlet through a single inlet valve and seat assembly (Fig. 3).

The needle valve riding on the float lever reacts to changes in fuel level, admitting enough fuel to replace that used.

MAIN METERING SYSTEM

The pressure drop caused by airflow past the fuel discharge nozzles causes solid fuel to flow from the fuel bowl, up the main well tubes, through the main metering jets and into the venturi (Fig. 4).

The fuel flow rate is controlled by tapered metering rods inserted into the main metering jets and linked to the venturi valve. Small torsion springs are used to position the metering rods against the top of the main metering jet orifices for more precise fuel flow control. A change in throttle plate opening or engine load causes a change in venturi valve and metering rod position, providing fuel flow in proportion to air flow.

CONTROL VACUUM

During normal warm-engine operation, the position of the venturi valve is controlled by two forces: a spring that acts to close the valve, and control vacuum that acts to open the valve. Both these forces are present in the control vacuum diaphragm assembly (Fig. 5).

Control vacuum is the vacuum below the venturi valve and above the throttle plates, and is routed to the control vacuum diaphragm through the upper body, main body and the diaphragm housing. The diaphragm is connected to the venturi valve.

When the engine is running, an increase in throttle plate opening will normally increase the control vacuum. When the vacuum signal increases, the control vacuum diaphragm pulls in against the spring and opens the venturi valve and the main metering jets. Since the venturi valve is not linked directly to the throttle shaft, the control vacuum and spring can select the precise fuel/air ratio for all speed and load conditions except wide open throttle (WOT).

VENTURI VALVE LIMITER

At wide open throttle, under some load conditions, the control vacuum will not be strong enough to override the venturi valve diaphragm spring pressure and open the valve fully. In this case, the valve is opened by the venturi valve limiter lever on the throttle shaft (Fig. 6).

CRANKING ENRICHMENT SYSTEM

The cranking enrichment system provides fuel for cold engine starting (below 75°F.) when the ignition key is in the START position. It consists of a normally closed solenoid valve mounted at the front of the carburetor. Fuel inlet to this valve is controlled by a bimetallic valve that is closed above 75° fuel bowl temperature (Fig. 7).

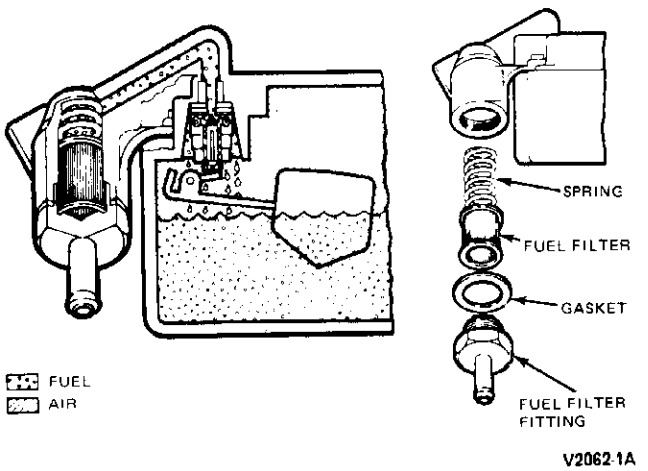


FIG. 3 Fuel Inlet System

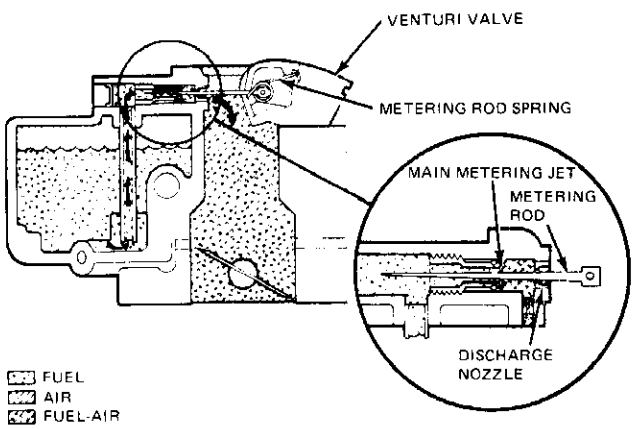


FIG. 4 Main Metering System

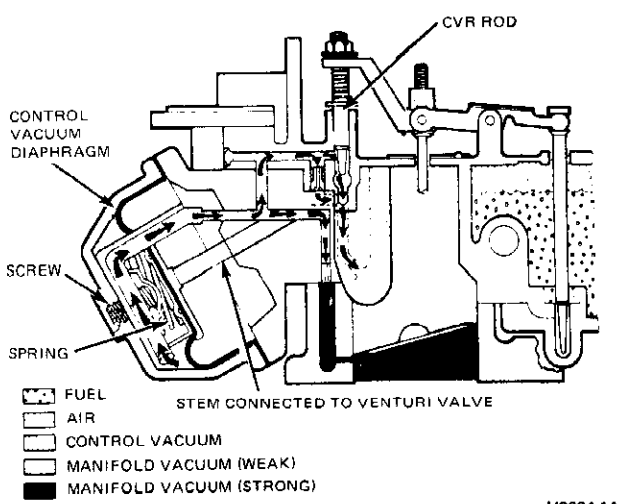


FIG. 5 Control Vacuum Circuit

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The volume of fuel flowing in the system is controlled by the position of the solenoid valve and the position of the bimetallic valve. Some carburetors also have a small bypass restrictor located in the bottom of the fuel bowl which allows fuel to flow even if the bimetallic valve is closed, to aid in hot engine starting.

When the ignition switch is in the START position, the cranking enrichment solenoid is energized, allowing fuel to flow in the cranking enrichment system if the fuel bowl temperature is below 75° and the cranking fuel control valve is open. Fuel flows from the fuel bowl through the cranking fuel control valve (bimetal), through the cranking enrichment solenoid valve, to the discharge points below the venturi valve. When the engine starts, and the key is released to the RUN position, the cranking enrichment solenoid is de-energized and closes. Fuel for cold driveaway is controlled by the main metering system and the cold enrichment system.

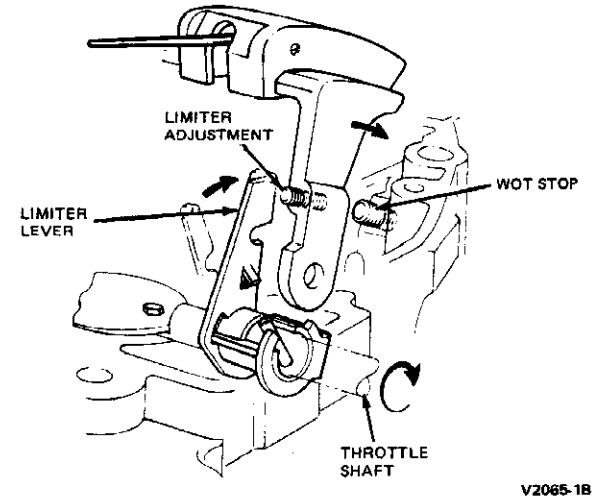


FIG. 6 Venturi Valve Limiter

COLD ENRICHMENT SYSTEM

The cold enrichment system utilizes a conventional exhaust heated bimetal coil type choke system to regulate the flow of fuel and the positioning of both the venturi valve and the fast idle cam for cold engine operation.

Fuel flow is metered by a metering rod suspended from the upper body through a jet located in the bottom of the fuel bowl (Fig. 8). The metering rod height is regulated by the choke bimetal and the fuel is channeled through the same passage as the cranking enrichment fuel.

After a cold start (below 95°F) the control vacuum regulator (CVR) restricts part of the normal control vacuum to the venturi valve operating diaphragm. This restriction allows manifold vacuum to override the control vacuum and determine the position of the venturi valve. Manifold vacuum applied to the diaphragm causes the venturi opening to be slightly larger than normal (hot engine) to prevent engine loading at idle due to an overrich fuel mixture.

Under acceleration, the venturi valve assumes the normal position providing a richer mixture for good cold driveaway.

FAST IDLE CAM

A conventional fast idle cam controls engine speed during the cold enrichment cycle. A unique feature of the fast idle cam mechanism is a vacuum operated high cam speed positioner (HCSP). Under cold start conditions, a lever is inserted between the fast idle cam and fast idle lever to provide increased throttle plate opening for starting (Fig. 9). When the engine starts, manifold vacuum is applied to the (HCSP) diaphragm and the lever is retracted, after the first throttle movement, and remains retracted as long as the engine is running. This lowers the fast idle speed for all cold drive modes.

CONTROL VACUUM REGULATOR

When the engine warms up and the choke bimetal unwraps, the CVR rises, opens the restricted port in the

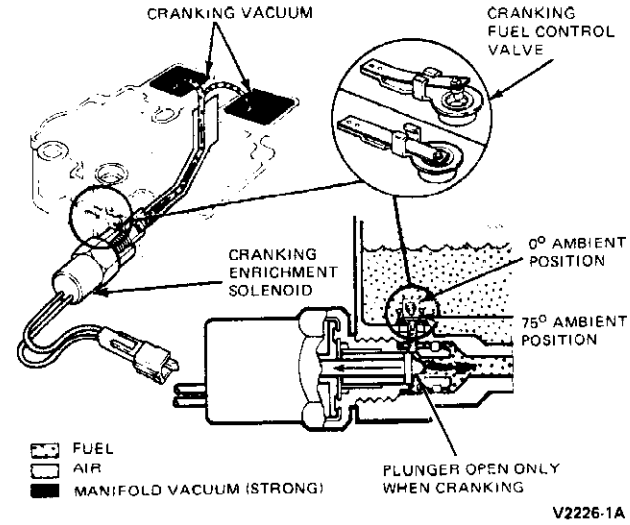


FIG. 7 Cranking Enrichment System

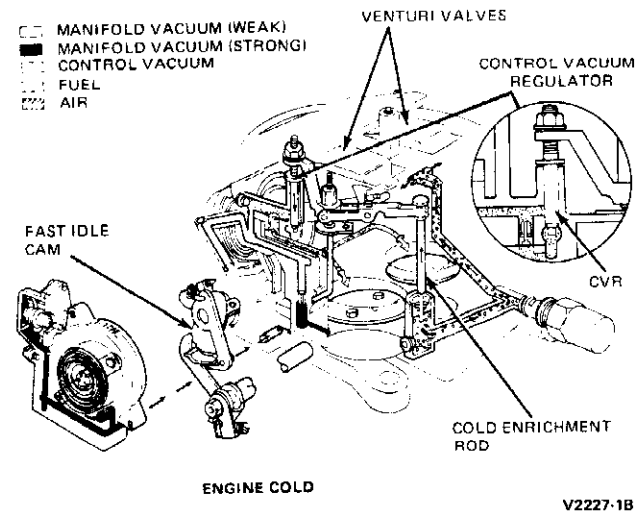


FIG. 8 Cold Enrichment System

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control vacuum circuit and allows the control of the venturi valve to return to normal as described under main metering system (Fig. 10). As the CVR rises the cold enrichment rod is lowered until it is seated in its jet shutting off the cold enrichment fuel.

IDLE TRIM SYSTEM

This carburetor does not have a conventional idle system since the idle fuel is controlled through the main metering jets. However a system is provided to trim the fuel flow at idle (Fig. 11). The idle trim fuel is pulled, by manifold vacuum, from the main metering chamber, flows through an independent channel and is discharged through a timed port below the trailing edge of each throttle plate. The flow of this fuel is controlled by tapered screws which bypass air into the trim channels.

There is an idle fuel trim channel for each bore. **Idle trim is determined during manufacture and is not adjusted in service.**

ACCELERATOR PUMP SYSTEM

The accelerator pump system is a positive displacement, piston type. It consists of a piston assembly that is activated by an overtraveling spring system mounted on the throttle shaft (Fig. 12).

The pump cavity, located in the bottom of the fuel bowl, fills from the top and the floating cup acts as an inlet check valve.

As the throttle is opened, and the pump piston is driven downward, pressure developed in the cavity seals the cup against the piston causing the fuel to flow. An anti-syphon check ball and weight, located in the up channel are unseated and fuel is delivered through the pump discharge nozzles in the venturis. When the fuel supply in the pump channel is exhausted, the check ball and weight return to the seated position to prevent syphoning during high speed operation. When the throttle returns to the idle position, the return spring forces the piston upward and allows the pump cavity to refill.

A bypass system built into the main body allows some of the fuel to be diverted through a calibrated restrictor back into the fuel bowl. The size of this restrictor (some carburetors may not have one) is determined by the amount of fuel required for a particular engine.

Another unique feature of this carburetor is the positive seal internal vent. A rubber coated disc type valve is mounted on the accelerator pump piston and opens or closes the internal vent in response to throttle position. The internal vent is closed at the idle position with the engine off.

EXTERNAL VENT SYSTEM

The external vent system is used to relieve fuel bowl pressure caused by fuel vapor formed in the fuel bowl during hot engine conditions (Fig. 13).

When fuel vapor pressure builds up in the fuel bowl, the external vent check valve is lifted from its seat, allowing the fuel vapor to be vented to a carbon canister that is part of the vehicle's evaporative emission system. Disposing of these fuel vapors in this manner helps prevent hot engine starting problems that could arise if the vapor remained trapped in the carburetor.

HOT IDLE COMPENSATOR

A hot idle compensator is incorporated into the venturi valve cover plate to improve hot engine idle

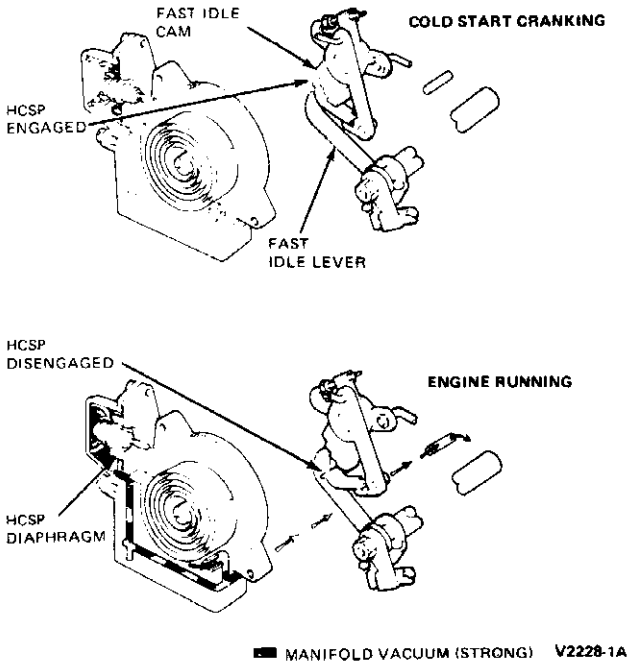


FIG. 9 Fast Idle Cam and HCSP Operation

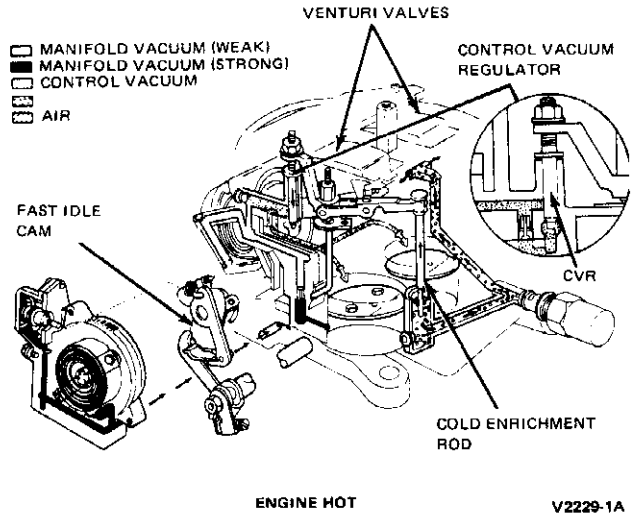


FIG. 10 Control Vacuum Regulator (CVR)

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capability (Fig. 14). The normally closed bimetal valve opens at a predetermined temperature, allowing additional air to flow through a drilled passage and be discharged below the throttle plates.

AUTOMATIC ALTITUDE COMPENSATION

Some carburetors will be equipped with altitude compensation to provide improved emission control and driveability at high altitude (Fig. 15). This is accomplished by installing a self-contained bellows and Pintle valve unit. The bellows senses barometric pressure and opens the pintle valve according to this pressure. Opening the valve allows control vacuum to lower the pressure in the fuel bowl area, causing the fuel mixture to be leaner. NOTE: The compensator assembly shown in Fig. 15 is rotated out of position for clarity. It is actually located just forward of the choke housing on the main body parallel with the throttle shaft.

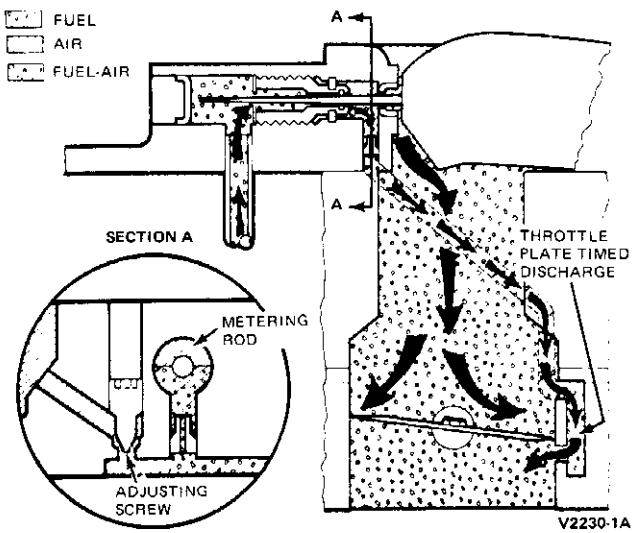


FIG. 11 Idle Trim System

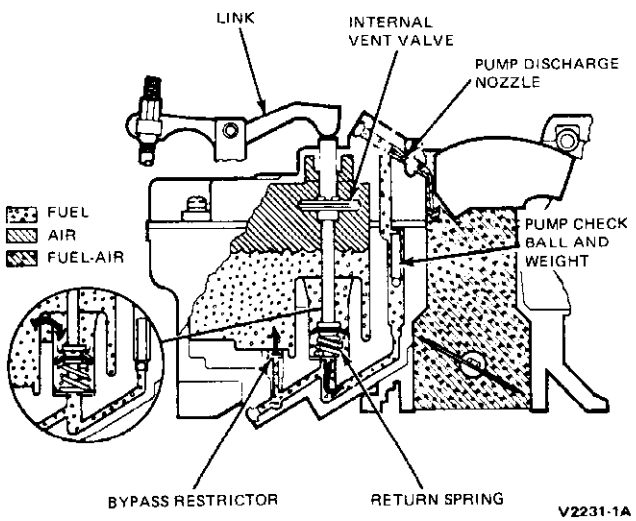


FIG. 12 Accelerator Pump System

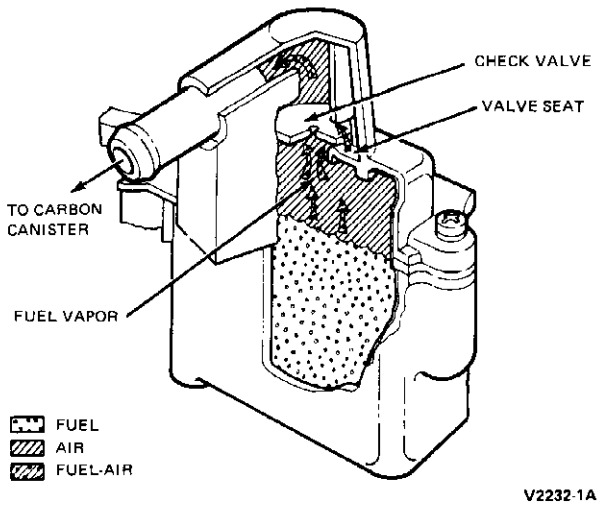


FIG. 13 External Vent System

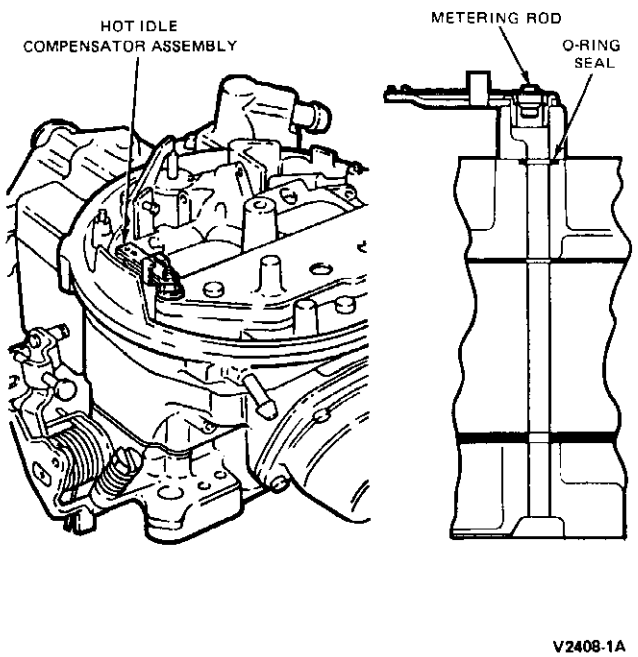


FIG. 14 Hot Idle Compensator

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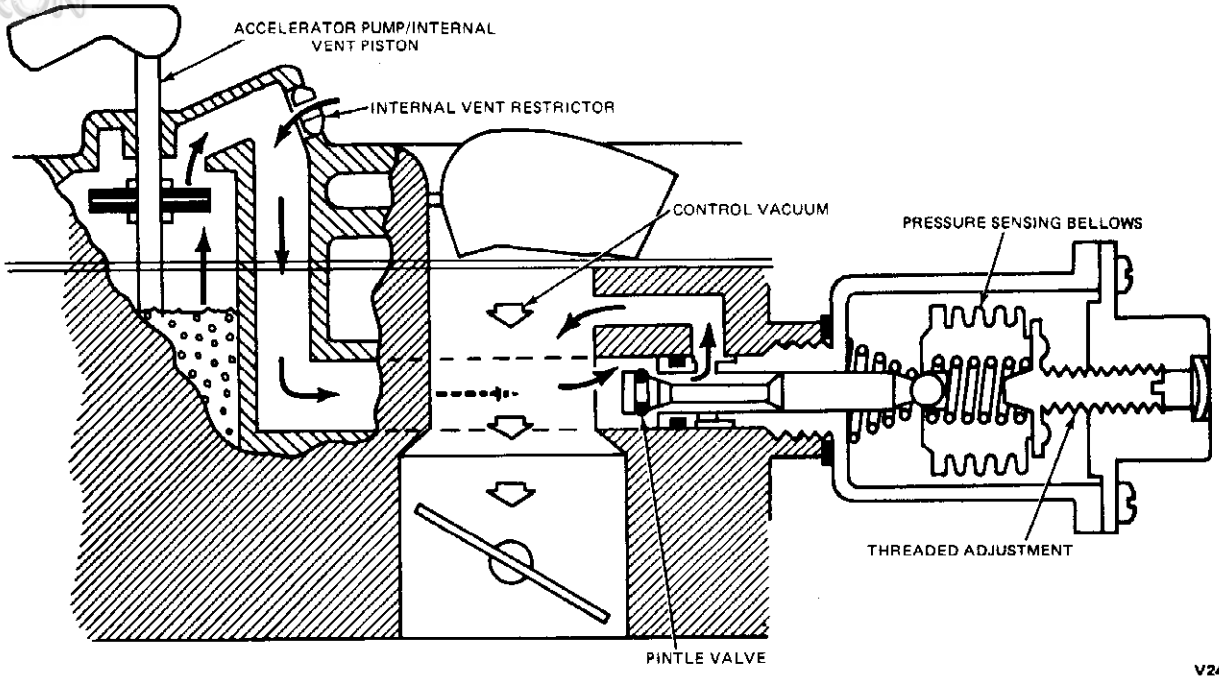


FIG. 15 Automatic Altitude Compensation

ADJUSTMENTS

Before making any adjustments with the engine running, set the vehicle parking brake and/or block the wheels. If the vehicle has a vacuum parking brake release, disconnect the line to the parking brake control and plug the line.

Conduct all engine running tests with the engine at normal operating temperature (radiator upper hose hot to touch).

CURB IDLE SPEED

Curb idle speed is adjusted in conventional manner, depending on the throttle positioner used (Fig. 14). Refer to the engine emission control decal for curb idle speed specification. Refer to Part 29-02 for curb idle speed adjustment procedure.

COLD ENRIGHMENT METERING ROD

1. Remove the choke cap.
2. Install the stator cap (Tool T77L-9848-A) as a weight to seat the cold enrichment rod (Fig. 17).
3. Install a dial indicator (Tool 4201-C) or equivalent with the tip on the top surface of the enrichment rod and adjust the dial to zero. Raise the weight slightly and release to make sure the zero repeats.
4. Remove the stator cap and reinstall it at the index position, the dial indicator should read to specification. If the rod height is not to specification turn the adjusting nut clockwise to increase or counterclockwise to decrease height.
5. If not adjusting the Control Vacuum Regulator (CVR), reinstall the choke cap at the specified setting.

INTERNAL VENT

1. Set the curb idle speed to specification.
2. Place a .010'' feeler gauge between the accelerator pump stem and the pump operating link. (Fig. 18).
3. Turn the nylon adjusting nut until there is just a slight drag when the gauge is removed.

NOTE: This adjustment must be checked and/or set whenever the curb idle speed is adjusted.

FAST IDLE SPEED

1. With the engine idling at normal operating temperature, place the fast idle lever on the specified step of the fast idle cam (Fig. 19).

NOTE: (EGR disconnected and vacuum line plugged.)

2. Make sure the high cam speed positioner lever is disengeged.
3. Turn the fast idle adjusting screw clockwise to increase speed and counterclockwise to decrease speed.

FAST IDLE CAM

1. Remove the choke cap.
2. Place the fast idle lever in the corner of the specified step of the fast idle cam (counting the highest step as the first) with the high cam speed positioner retracted (Fig. 20).
3. Hold the throttle lightly closed with a rubber band to maintain cam position.

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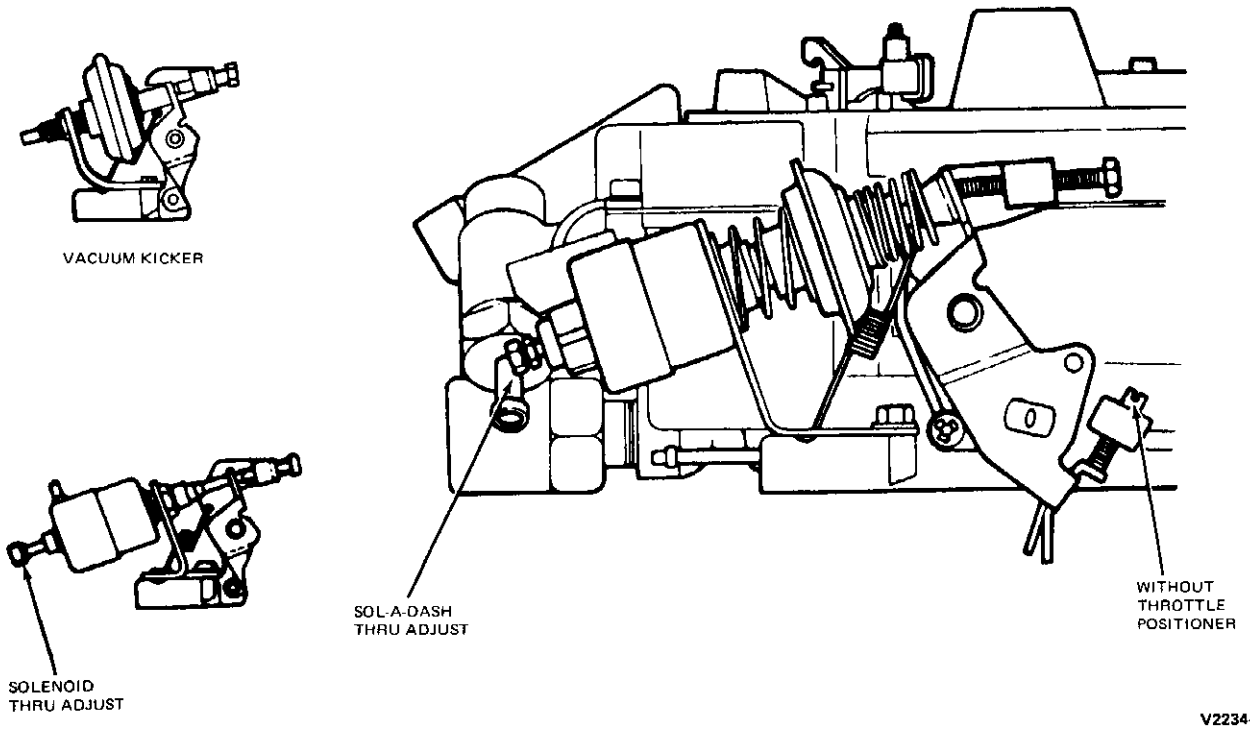


FIG. 16 Throttle Positioners

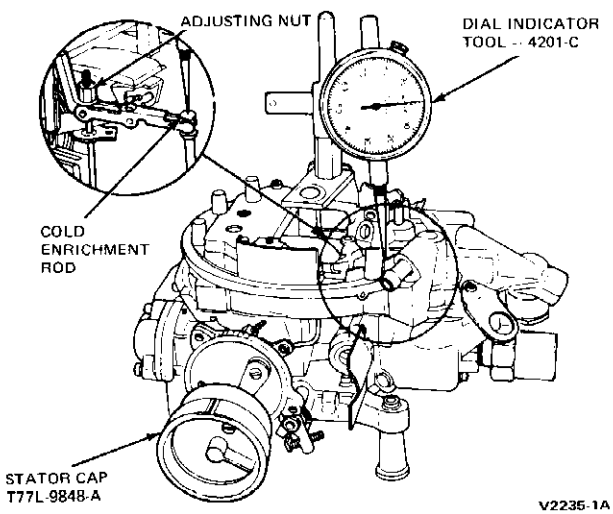


FIG. 17 Cold Enrichment Metering Rod Adjustment

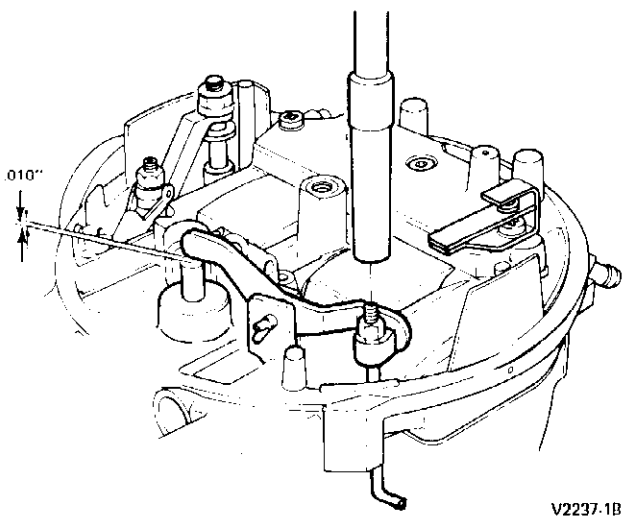


FIG. 18 Internal Vent Adjustment

NOTE: This step is not required if the adjustment is done on the vehicle.

4. Install the stator cap (T77L-9848-A) and rotate clockwise until lever contacts the adjusting screw.
5. Turn the fast idle cam adjusting screw until the index mark on the stator cap lines up with the specified notch on the choke casting.
6. Remove the stator cap and reinstall the choke cap to specified setting.

FUEL LEVEL

1. Remove the upper body assembly. Remove the upper body gasket and install a new gasket before making the adjustment.
2. Fabricate a gauge to the specified dimension (Fig. 21).
3. With the upper body inverted, place the fuel level gauge on the cast surface of the upper body (NOT ON THE GASKET) and measure the vertical distance from the cast surface of the upper body and the bottom of the float.

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4. To adjust, bend the float operating lever away from the fuel inlet needle to decrease the setting and toward the needle to increase the setting.
5. Check and/or adjust the float drop.

NOTE: The float pontoon must be parallel with the gasket.

FLOAT DROP

1. Fabricate a gauge to the specified dimension.
2. With the upper body assembly held in the upright position, place the gauge against the cast surface of the upper body (NOT ON THE GASKET) and measure the vertical distance between the cast surface of the upper body and the bottom of the float (Fig. 22).
3. To adjust, bend the stop tab on the float lever away from the hinge pin to increase the setting and toward the hinge pin to decrease the setting.
4. Reinstall the upper body assembly.

VENTURI VALVE LIMITER

1. Remove the carburetor.
2. Remove the venturi valve cover and roller bearings.
3. Remove the expansion plug located at the rear of the main body on the throttle side of the carburetor (CENTER PUNCH TILL LOOSE).
4. Using an allen wrench, remove the venturi valve wide open throttle stop screw (Fig. 23).
5. Block the throttle plates wide open.
6. Apply light closing pressure on the venturi valve and check the gap between the valve and the air horn wall (if not to specification it must be adjusted).
7. Manually move the venturi valve to the wide open position and insert an allen wrench into the hole from which the stop screw was removed. Turn the limiter adjusting screw clockwise to increase the gap and counterclockwise to decrease.
8. Remove the allen wrench and apply light closing pressure to the valve. Recheck the gap.
9. Reinstall the venturi valve wide open stop screw and turn clockwise until it contacts the valve.
10. Push the venturi valve to the wide open position and check the gap between the valve and the air horn wall.
11. Turn the stop screw until the gap is to specification.
12. Install a new expansion plug in the access hole.
13. Reinstall the venturi valve cover and roller bearings.
14. Reinstall the carburetor.

CONTROL VACUUM REGULATOR (CVR) ADJUSTMENT

NOTE: The cold enrichment metering rod adjustment must be checked and/or set before making this adjustment.

1. After adjusting the cold enrichment metering rod, leave the dial indicator in place but remove the stator cap (Tool T77L-9848-A).

NOTE: Do not reset the "O" reading on the indicator after removing the stator cap.

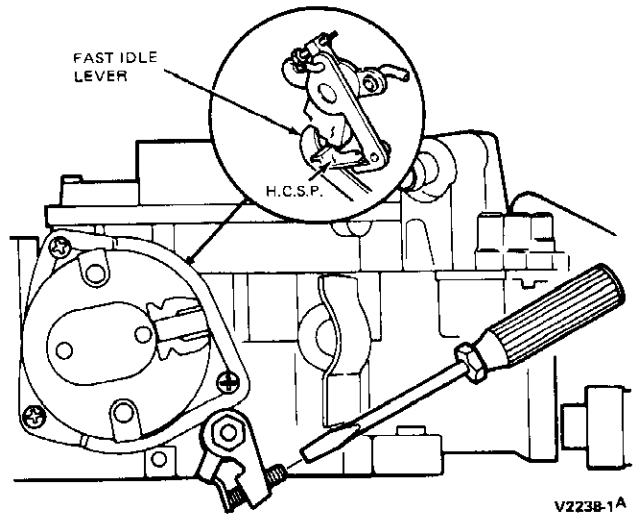


FIG. 19 Fast Idle Speed Adjustment

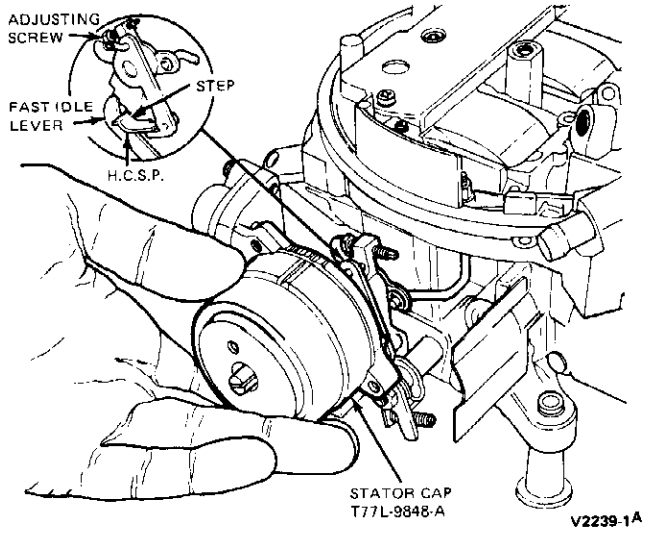


FIG. 20 Setting Fast Idle Cam

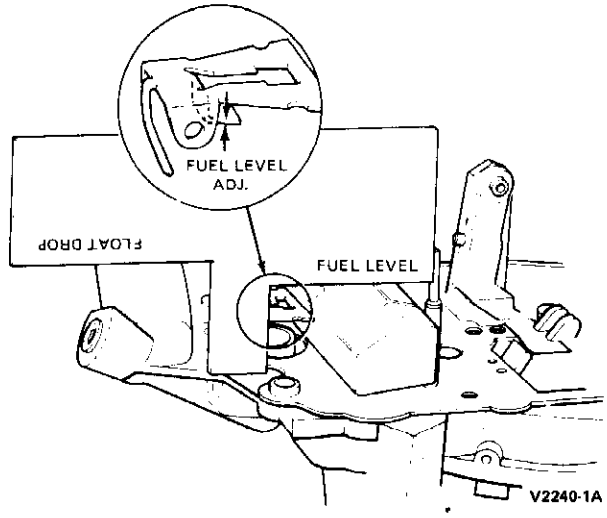


FIG. 21 Fuel Level Adjustment

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2. Press down on the CVR rod until it bottoms on its seat (Fig. 24). Read the downtravel on the dial indicator. If it is not within specification adjust as follows:
3. Place a 3/8" box end wrench over the CVR adjusting nut to prevent turning.
4. Using a 3/32" Allen wrench turn the CVR rod counterclockwise to increase the travel and clockwise to decrease.

HIGH CAM SPEED POSITIONER (H.C.S.P.)

1. Place the high cam speed positioner (H.C.S.P.) in the corner of the specified cam step (counting the highest step as the first). See Fig. 25.
2. Place the fast idle lever in the corner of the H.C.S.P.
3. Hold throttle closed firmly to maintain Steps 1 and 2.
4. Remove diaphragm cover and adjust diaphragm assembly clockwise until lightly bottomed on casting, then rotate counterclockwise 1/2 to 1-1/2 turn, until the vacuum port and diaphragm hole line up.
5. Install the diaphragm cover.

NOTE: For adjustments not shown in this part, refer to Part 29-02.

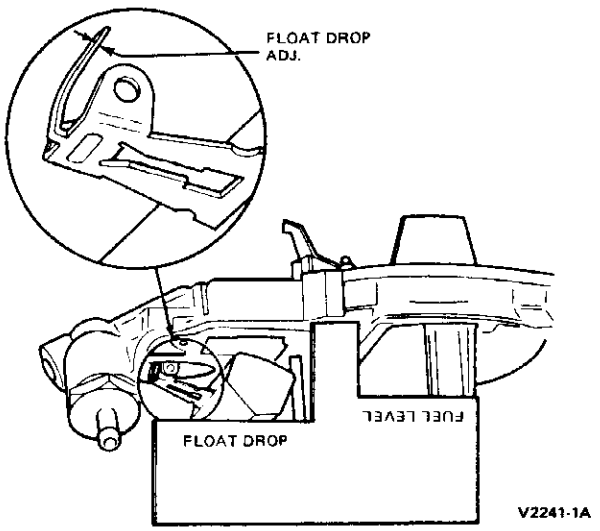


FIG. 22 Float Drop Adjustment

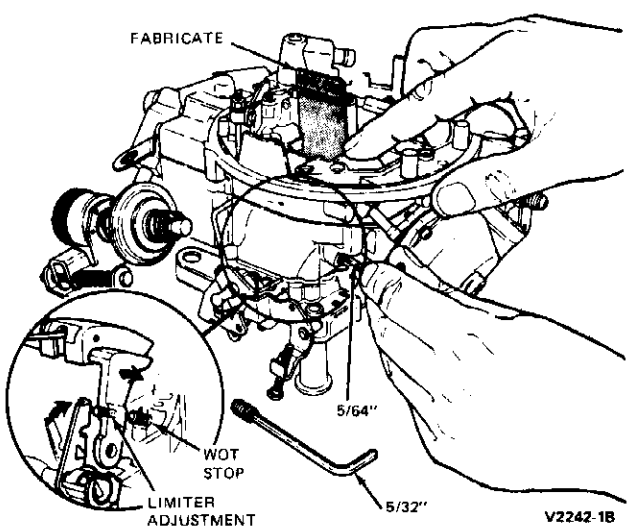


FIG. 23 Venturi Valve Limiter Adjustment

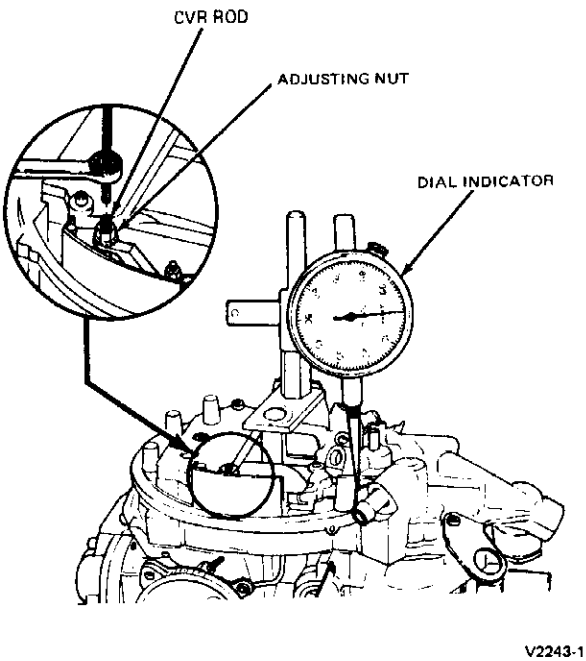


FIG. 24 Control Vacuum Regulator (CVR) Adjustment

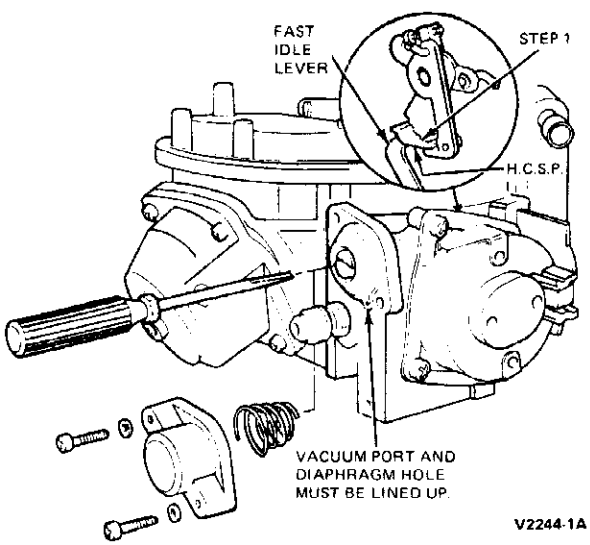


FIG. 25 High Cam Speed Positioner (H.C.S.P.) Adjustment

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DETROIT IRON

DISASSEMBLY AND ASSEMBLY

To facilitate working on the carburetor and prevent damage to the throttle plates, the carburetor should be placed on a carburetor stand. If a proper stand is not available use four (4) bolts 5/16 x 2-1/2 inch as legs. Install nuts on the bolts above and below the throttle body.

The following is a step-by-step sequence of operations for completely overhauling the carburetor. However, most components may be serviced without a complete disassembly of the unit. To replace individual components of the carburetor follow only the applicable steps.

NOTE: Use a sepatate container for the component parts of each sub-assembly to insure proper assembly. See Figs. 26, 27 and 28 for a disassembled view of the major sub-assemblies. Numbers in parenthesis refer to the parts indicated on the disassembled views.

DISASSEMBLY

Upper Body (Fig. 26)

1. Remove the fuel inlet fitting, fuel filter, gasket and spring. (1, 2, 3, 4)
2. Remove the E rings on the accelerator pump rod and the choke control rod and disengage the rods. (5, 6, 7)
3. Remove the air cleaner stud. (Not Shown)
4. Remove the seven screws retaining the upper body assembly, remove the upper body and place it inverted on a clean work surface. (8, 8A). Note position of 2 long screws for re-assembly.
5. Remove the float hinge pin and the float assembly. (10,11)
6. Remove the float bowl gasket. (12)
7. Remove the fuel inlet valve, seat and gasket. (13, 14, 15)
8. Remove the accelerator pump rod and the dust seal. (6, 16)
9. Remove the accelerator pump link retaining pin and the link. (17, 18)
10. Remove the accelerator pump swivel and adjusting nut (19, 20)
11. Remove the choke control rod. Remove the dust seal by lifting the retainer carefully and sliding the seal out. (7, 16)
12. Remove the E ring on the choke hinge pin and slide the pin out of the casting. (5, 21)
13. Remove the cold enrichment rod adjusting nut, lever, adjusting swivel, control vacuum regulator, and adjusting nut as an assembly (Fig. 27); disassemble as required. (20, 22, 23, 24, 25)
14. Slide the cold enrichment rod out of the upper body casting and nylon seal. (26)
15. Remove the venturi valve cover plate screws, the plate and the roller bearings. (27, 28, 29)
16. Remove the venturi air bypass screw. (30)
17. Using special Tool T77P-9928-A, press the tapered plugs out of the venturi valve pivot pins. (31) See Fig. 28.
18. Push the venturi pivot pins out and slide the venturi valve to the rear until it is free of the casting. (32, 33)
19. Remove the venturi valve pivot pin bushings. (34)
20. Remove the metering rod pivot pins (on the outboard sides of the venturi valve), the metering rods and the springs. (35, 36, 37)

    NOTE: Identify the rods, "throttle" or "choke" side, for proper assembly.

    CAUTION: Always block the venturi valve wide open when working on the jets.
21. Using the jet plug removal Tool (T77L-9533-B) remove the cup plugs recessed in the upper body casting. (38)

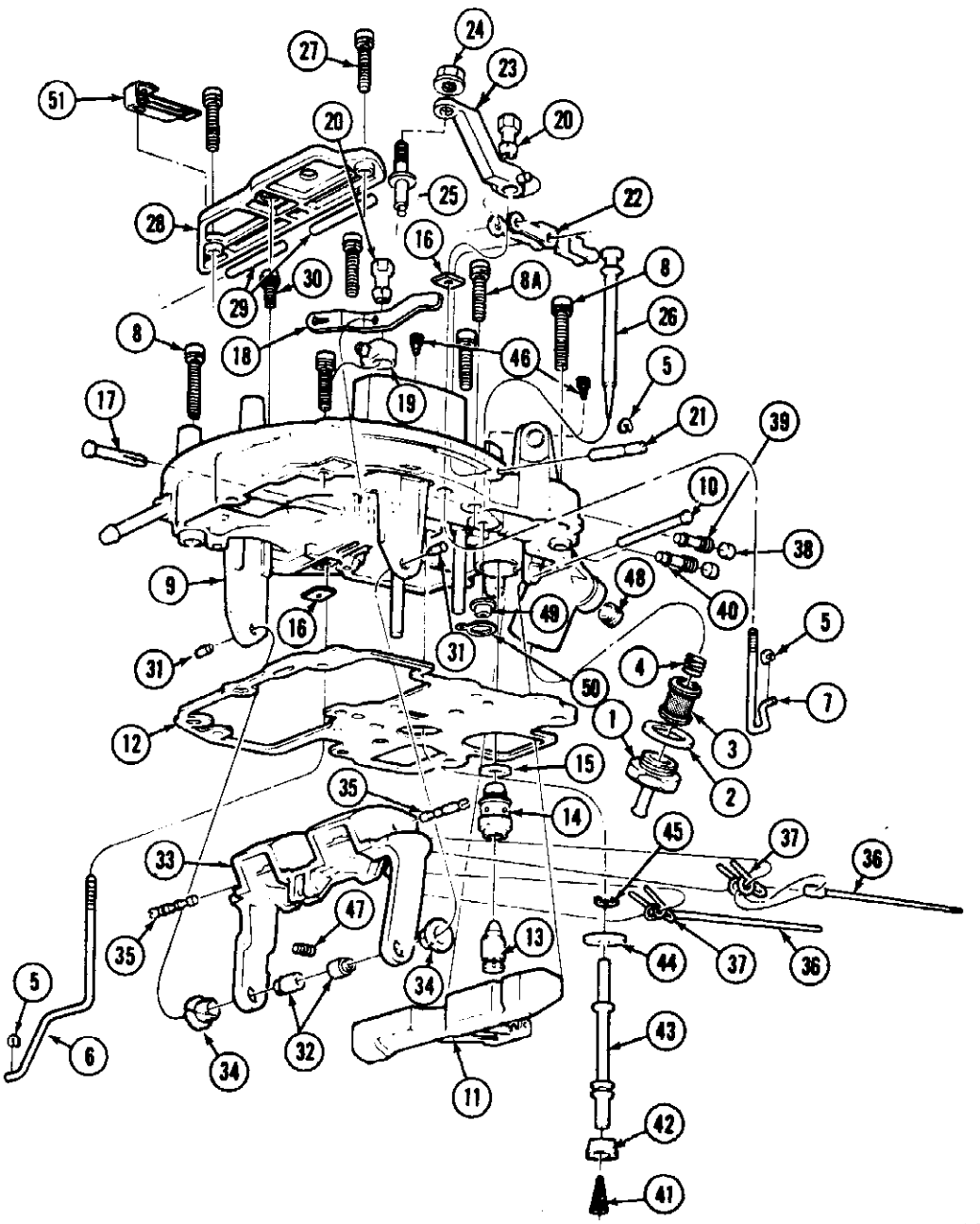
    NOTE: The main metering jet setting is an important factor in the overall carburetor calibration. For this reason the following steps must be carefully followed:
22. Using the special jet wrench (T77L-9533-A) turn each main metering jet clockwise counting the number of turns, until they bottom in the casting. Record the number of turns to the nearest 1/4 turn.
23. Turn the jet assembly counterclockwise to remove. Remove "O" rings and identify the jets, "throttle" or "choke" side, for proper assembly. (39, 40)
24. Remove the accelerator pump plunger assemble and disassemble as required. (41, 42, 43, 44, 45)
25. Remove the idle trim screws. (46)
26. Remove the venturi valve limiter adjusting screw from the throttle side of the venturi valve. (47)
27. Remove the 1/8" pipe plug in the fuel inlet boss if required for cleaning (48)

Main Body (Fig. 31)

1. Remove the cranking enrichment solenoid and remove the "O" ring seal. (1, 2)
2. Remove the venturi valve diaphragm cover retaining screws, cover, spring guide and spring. (3, 4, 5, 6) (Tap lightly to loosen the cover, do not pry)
3. Carefully loosen the diaphragm and slide it out of the main body. (7)
4. Remove the venturi valve diaphragm adjusting screw. (9)
5. Remove the venturi valve wide open stop screw (Note: center punch the access hole cover plug until loose). (10, 11)
6. Remove the cranking fuel control assembly from the bottom of the fuel bowl. (12)

   CAUTION: This part should not be removed unless there is evidence of physical damage. If control is damaged, bend the bi-metal enough to expose the discharge port and use the jet plug removal Tool (T77L-9533-B) to extract the control assembly (Fig. 32).
7. Place the carburetor inverted on a clean surface (hold your hand in position to catch the accelerator pump check ball and weight while turning the carburetor over). (13, 14)

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1. FUEL INLET FITTING.	18. ACCELERATOR PUMP LINK.	35. METERING ROD PIVOT PIN.
2. FUEL INLET FITTING GASKET.	19. ACCELERATOR PUMP SWIVEL.	36. METERING ROD.
3. FUEL FILTER.	20. NUT - NYLON.	37. METERING ROD SPRING.
4. FUEL FILTER SPRING.	21. CHOKE HINGE PIN.	38. CUP PLUG.
5. 1/8 RETAINING E-RING.	22. COLD ENRICHMENT ROD LEVER.	39. MAIN METERING JET ASSEMBLY.
6. ACCELERATOR PUMP ROD.	23. COLD ENRICHMENT ROD SWIVEL.	40. "O" RING.
7. CHOKE CONTROL ROD.	24. CONTROL VACUUM REGULATOR ADJUSTING NUT.	41. ACCELERATOR PUMP RETURN SPRING.
8. SCREW (2), 8-32 X .88	25. CONTROL VACUUM REGULATOR.	42. ACCELERATOR PUMP CUP.
8A. SCREW (5) 8-32 X .75	26. COLD ENRICHMENT ROD.	43. ACCELERATOR PUMP PLUNGER.
9. UPPER BODY	27. SCREW (2) 8-32 X .75	44. INTERNAL VENT VALVE.
10 FLOAT HINGE PIN.	28. VENTURI VALVE COVER PLATE.	45. 3/16 RETAINING E-RING.
11. FLOAT ASSEMBLY.	29. ROLLER BEARING.	46. IDLE TRIM SCREW.
12. FLOAT BOWL GASKET.	30. VENTURI AIR BYPASS SCREW.	47. VENTURI VALVE LIMITER ADJUSTING SCREW.
13. FUEL INLET VALVE.	31. VENTURI VALVE PIVOT PLUG.	48. PIPE PLUG.
14. FUEL INLET SEAT.	32. VENTURI VALVE PIVOT PIN.	49. COLD ENRICHMENT ROD SEAL
15. FUEL INLET SEAT GASKET.	33. VENTURI VALVE.	50. SEAL RETAINER
16. DUST SEAL.	34. VENTURI VALVE PIVOT PIN BUSHING.	51. HOT IDLE COMPENSATOR
17. PIN .12 X .69		

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FIG. 26 Upper Body

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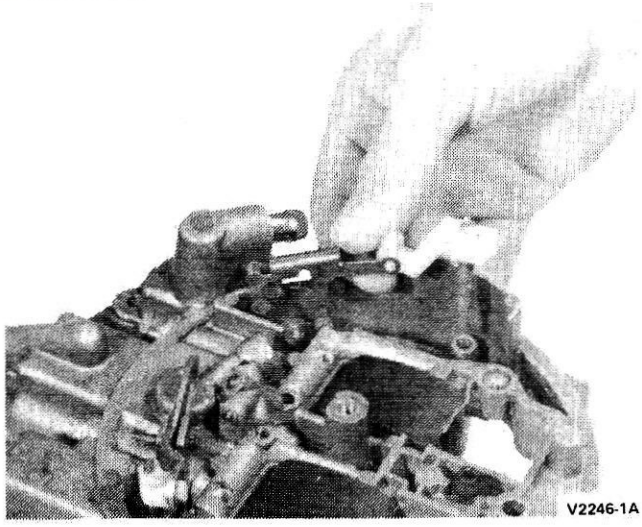


FIG. 27 Removing Cold Enrichment Rod Assembly and CVR Assembly

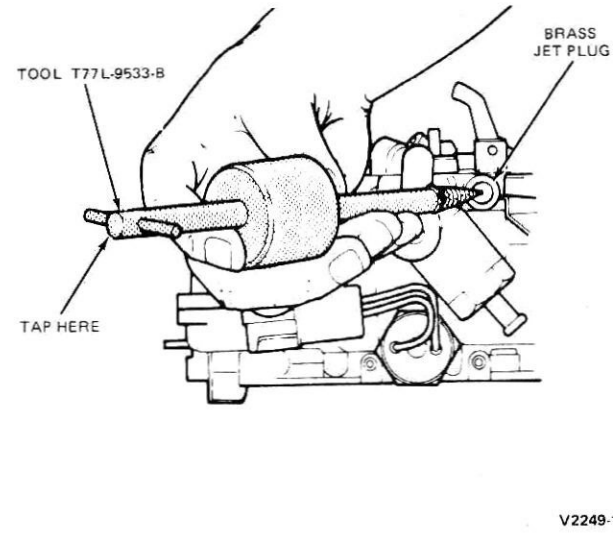


FIG. 29 Removing Cup Plugs

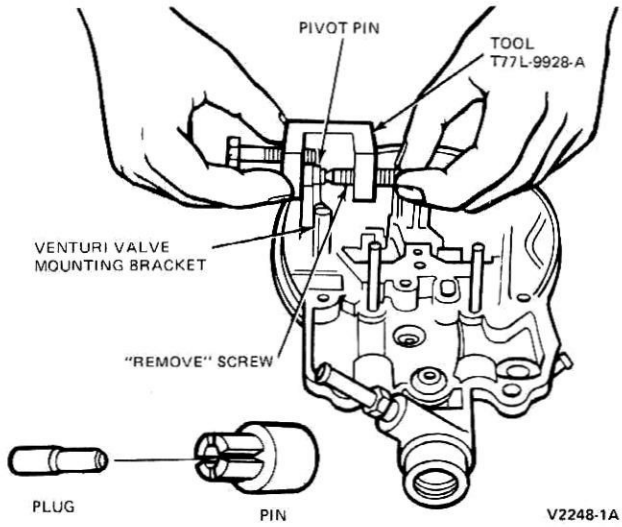


FIG. 28 Pressing Out Tapered Pins

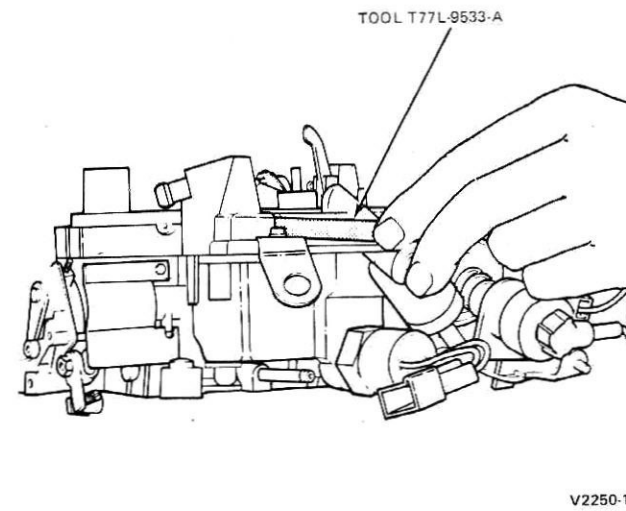


FIG. 30 Removing Main Jets

8. Remove the five screws retaining the throttle body and remove the throttle body and gasket. (15)
9. Remove the choke heat shield screw and the shield. (16, 17)

Throttle Body (Fig. 33)

1. Remove the throttle return control device sol-a - dash, solenoid, dashpot and bracket (Disengage the kickdown return spring). (1, 2, 3, 4, 5, 37, 38)
2. Remove the choke thermostatic housing screws, retainer ring, housing, and gasket. (6, 7, 8, 9)
3. Remove the choke thermostatic lever screw and lever. (10, 11)
4. Slide the choke shaft and lever assembly out of the casting and remove the fast idle cam. (12, 13, 35, 36)
5. Remove the high cam speed positioner assembly. (14)
6. Remove the high cam speed positioner cover screws, cover and return spring. (15, 16, 17)
7. Remove the high cam speed positioner diaphragm and rod (disassemble if necessary). (18, 19)
8. The choke housing bushing is pressed into the casting and staked in place. Should replacement be required, it will have to be carefully pressed out. While pressing the casting must be supported to prevent damage. (20)

CAUTION: Before pressing, file or grind off the staked areas.

9. Remove the choke heat tube fitting. (21)
10. Remove the (T.S.P. Off) idle speed adjusting screw. (22)
11. Remove the throttle shaft retaining nut, the fast idle adjusting lever, the fast idle lever and the fast idle adjusting screw. (23, 24, 25, 26)

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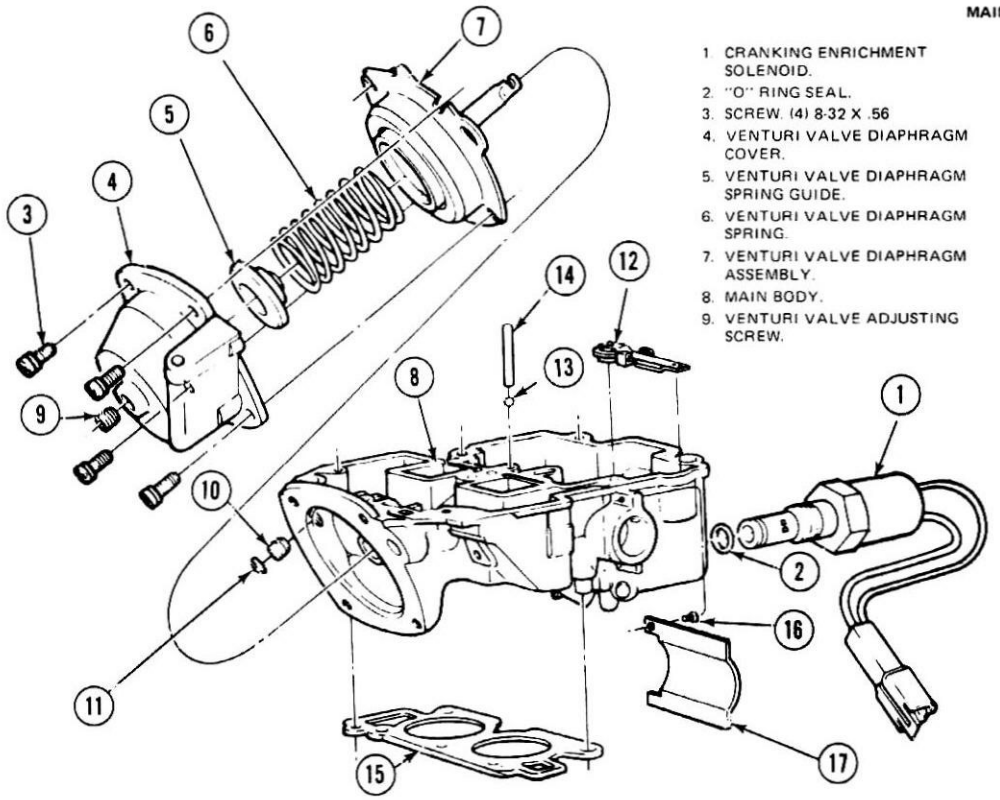


FIG. 31 Main Body

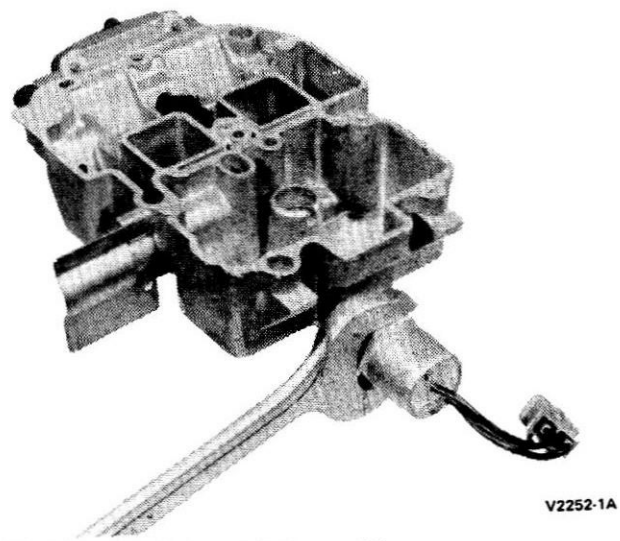


FIG. 32 Removing Cranking Enrichment Solenoid Assembly

12. If necessary to remove the throttle plates lightly scribe a line along the shaft and mark the plates T or C for throttle or choke side to insure proper assembly.

    CAUTION: The throttle plate screws are staked at assembly, the staked ends should be filed before removal. The old screws should be discarded.

    Remove the throttle plate screws and the plates. (27, 28)

13. In order to remove the throttle shaft assembly it is necessary to drive the limiter lever stop pin down until it is flush with the shaft. (29)

14. Slide the throttle shaft assembly out of the casting and remove the transmission kickdown adjusting screw if necessary. (29, 30)

15. Remove the venturi valve limiter lever and bushing, disassemble if necessary. (32,33)

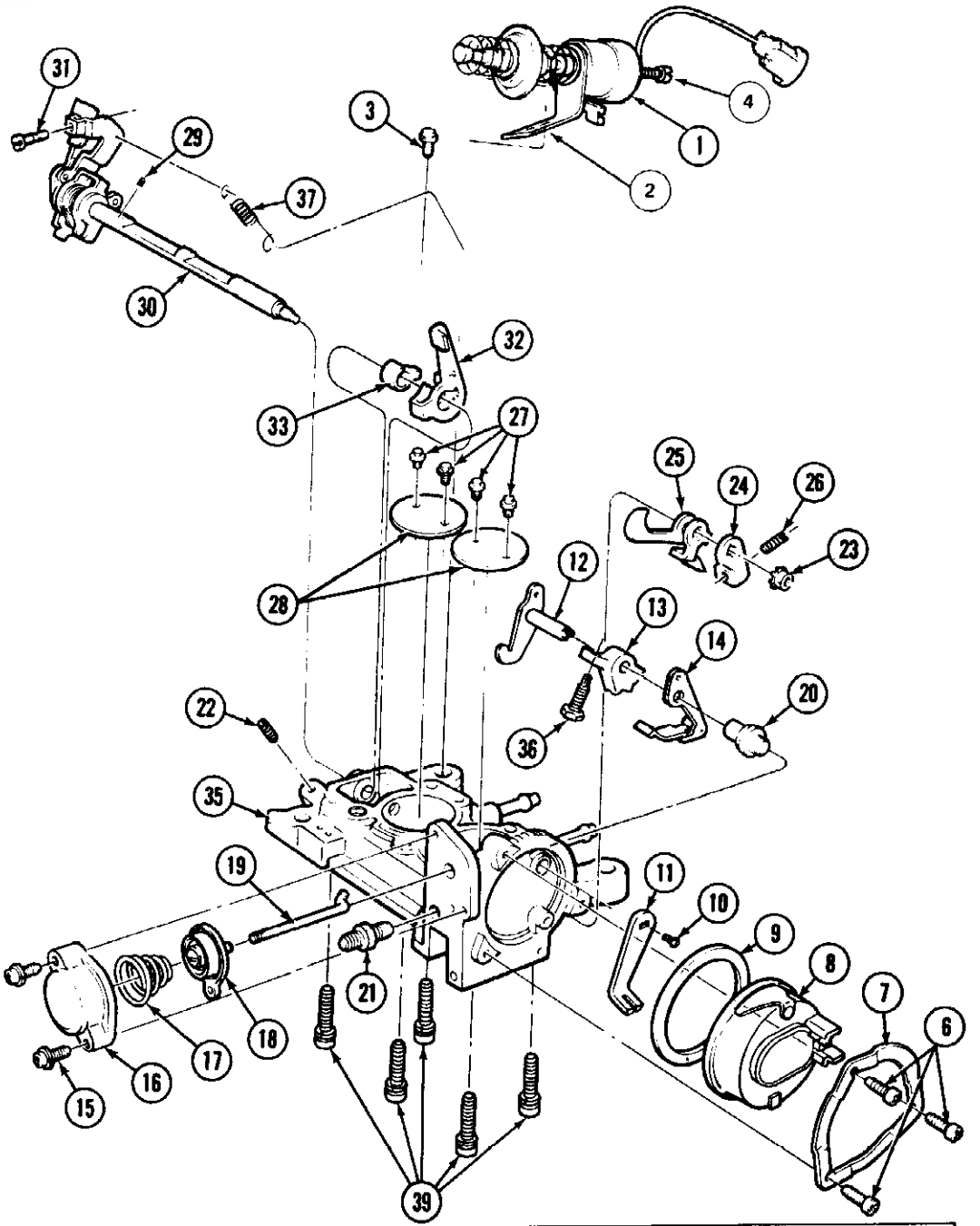
ASSEMBLY

Throttle Body (Fig. 33)

NOTE: Before installing, carefully support the throttle shaft assembly and drive the venturi valve limiter stop pin out of the shaft. (Discard the Pin.)

1. Place the venturi valve limiter assembly in the throttle body and slide the throttle shaft into place. (30, 31, 32, 33)

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1. THROTTLE RETURN CONTROL DEVICE.	21. CHOKE HEAT TUBE FITTING.
2. THROTTLE RETURN CONTROL DEVICE BRACKET.	22. CURB IDLE ADJUSTING SCREW (TSP OFF).
3. MOUNTING SCREW. 10-32 X .50	23. RETAINING NUT. 10-32
4. ADJUSTING SCREW (TSP ON)	24. FAST IDLE ADJUSTING LEVER.
5. (NOT APPLICABLE 1978)	25. FAST IDLE LEVER.
6. SCREW (3). 8-32 X .50	26. FAST IDLE ADJUSTING SCREW.
7. CHOKE THERMOSTATIC HOUSING RETAINER.	27. THROTTLE PLATE SCREWS (4).
8. CHOKE THERMOSTATIC HOUSING.	28. THROTTLE PLATES.
9. CHOKE THERMOSTATIC HOUSING GASKET.	29. VENTURI VALVE LIMITER STOP PIN.
10. SCREW. 6-32 X .50	30. THROTTLE SHAFT ASSEMBLY.
11. CHOKE THERMOSTATIC LEVER.	31. TRANSMISSION KICKDOWN ADJUSTING SCREW.
12. CHOKE LEVER AND SHAFT ASSEMBLY.	32. VENTURI VALVE LIMITER LEVER.
13. FAST IDLE CAM.	33. VENTURI VALVE LIMITER BUSHING.
14. HIGH CAM SPEED POSITIONER ASSEMBLY.	34. (NOT APPLICABLE 1978)
15. SCREW (2). 8-32 X .75	35. THROTTLE BODY.
16. HIGH CAM SPEED POSITIONER DIAPHRAGM COVER.	36. FAST IDLE CAM ADJUSTING SCREW.
17. HIGH CAM SPEED POSITIONER DIAPHRAGM SPRING.	37. TRANSMISSION KICKDOWN LEVER RETURN SPRING.
18. HIGH CAM SPEED POSITIONER DIAPHRAGM ASSEMBLY.	38. (NOT APPLICABLE 1978)
19. HIGH CAM SPEED POSITIONER ROD.	39. SCREW (5) 8-32 X .75
20. CHOKE HOUSING BUSHING.	

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FIG. 33 Throttle Body

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2. Place the throttle plates in the proper position (NOTE: The scribed marks) and turn the new screws in until they are snug but not tight. With the throttle closed, tap the plates lightly to insure proper centering and tighten the screws. Stake the screws carefully. (27, 28)
3. Drive the new venturi valve limiter stop pin into the shaft. Leave approximately 1/8 inch exposed. (29)
4. Install the fast idle lever, the fast idle adjusting lever, the throttle shaft retaining nut, and the fast idle adjusting screw. (23, 24, 25, 26)
5. Install the T.S.P. Off idle speed adjusting screw. (22)
6. If the bushing was removed, it must be carefully pressed into the housing and staked in place. The casting must be carefully supported while pressing and staking.
7. Install the cam speed positioner assembly and the fast idle cam (13, 14, 36).
8. Slide the high cam speed positioner diaphragm and rod into position and engage the rod. (18, 19)
9. Slide the choke shaft and lever assembly into the casting and install the choke thermostatic lever and screw. (10, 11, 12)

   NOTE: Refer to the adjustment section and adjust the high cam speed positioner diaphragm before installing the cover.
10. Install the high cam speed positioner diaphragm spring, cover and screws. (15, 16, 17)
11. Install the choke thermostatic gasket, housing, retainer and attaching screws. (6, 7, 8, 9)
12. Install the throttle return control device and bracket. (1, 2, 3, 4, 5)
13. Install the choke heat tube fitting. (21)

Main Body (Fig. 31)

1. Position the throttle body gasket on the main body and assemble the main body to the throttle body. (15)
2. Drop the accelerator pump check ball and weight into the pump discharge channel. (13, 14)
3. If the cranking fuel control has been removed install a new assembly. Place the control assembly on its cavity and tap lightly using a brass drift and small hammer alternating from side to side until it is firmly seated. (12)
4. Do not install the venturi valve wide open stop screw and plug at this time. They should be installed after complete assembly. (10, 11) (Refer to the venturi valve limiter adjustment.)
5. Slide the venturi valve diaphragm into the main body. (7)
6. Install the venturi valve diaphragm spring, spring guide, cover and retaining screws. (3, 4, 5, 6)
7. Install the venturi valve diaphragm adjusting screw. (9) The final adjustment of the screw is made on the vehicle.
8. Place the cranking enrichment solenoid "O" ring seal on the solenoid and install the assembly. (1, 2)

   NOTE: "O" rings should be lubricated with a mild solution of soapy water before installation.

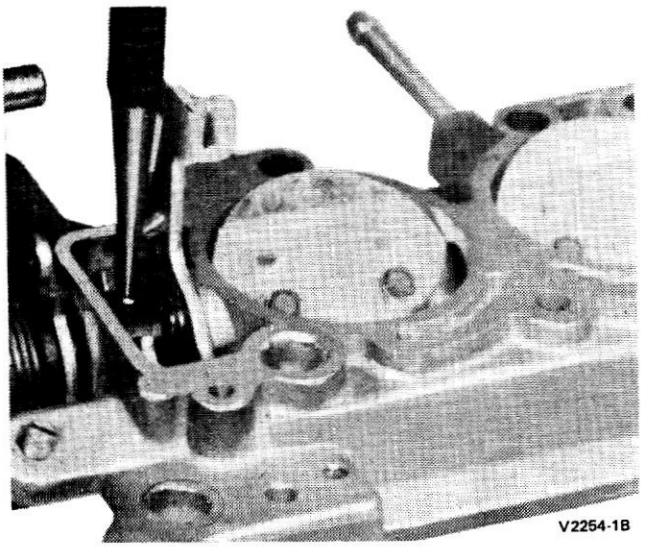


FIG. 34 Positioning Stop Pin For Throttle Shaft Removal

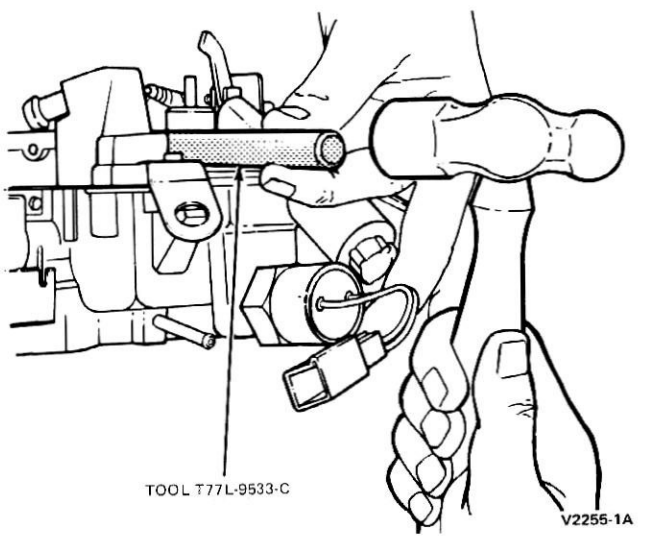


FIG. 35 Installing Main Jet Plugs

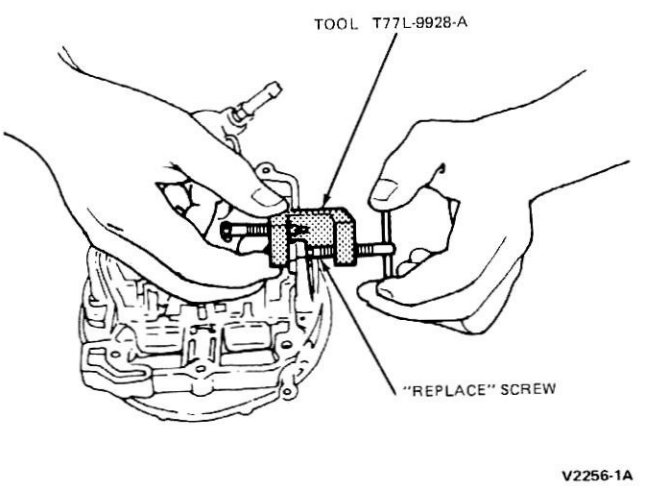


FIG. 36 Installing Tapered Plugs

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9. Install the choke heat shield and attaching screw. (16, 17)

Upper Body (Fig. 26)

1. Install the 1/8 inch pipe plug in the fuel inlet boss. (48)
2. Install the venturi valve limiter screw in the venturi valve. (47)
3. Install the idle trim screws. (46)
4. Install the "O" ring seals on the main metering jets. (40)

   NOTE: "O" ring seals should be lubricated with a mild solution of soapy water before installation.
5. Using the special jet wrench (T77L-9533-A) turn each main metering jet clockwise until it is seated in the casting. Then turn each jet counterclockwise the number of turns recorded during disassembly. (39)
6. Using the special jet plug driver (T77L-9533-C) install the jet plugs. Tap lightly until the tool bottoms on the face of the casting. (38) See Fig. 35.
7. Install metering rods, the metering rod springs and the metering rod pivot pins on the venturi valve. (35, 36, 37)
8. Install the venturi valve, carefully guide the metering rods into the main metering jets. (33) Press down on the metering rods. If the springs are properly assembled they will spring back.
9. Install the venturi valve pivot pin bushings and the pivot pins. (32, 34)
10. Carefully press the tapered plugs into the venturi valve pivot pins with Special Tool T77P-9928-A (Fig. 36).
11. Install the venturi air bypass screw. Turn clockwise four turns to provide clearance for installing the cover plate. (30)
12. Install the venturi valve cover plate roller bearings, the plate and attaching screws. (27, 28, 29)
13. Insert the accelerator pump swivel and adjusting nut into the pump link.. (19, 20)
14. Install the accelerator pump link and the retaining pin. (17, 18)
15. Install the accelerator pump operating rod and the dust seal. (6, 16)
16. Install the fuel inlet valve seat gasket, the seat and the valve. (13, 14, 15)
17. Install the float bowl gasket. (12)
18. Install the float assembly and the float hinge pin. (10, 11)
19. Assemble the accelerator pump return spring, cup, plunger, internal vent valve and retainer. Place the pump piston assembly in position in the hole in the upper body. (41, 42, 43, 44, 45)
20. Assemble the upper body to the main body. Hold the pump piston assembly with your finger and guide it into the pump cavity in the main body. (8, 8A)

    CAUTION. Make sure that the venturi valve diaphragm stem engages the venturi valve.
21. Install the fuel filter spring, the filter, the inlet fitting gasket and the inlet fitting. (1, 2, 3, 4)
22. Install the air cleaner stud. (Not Shown)
23. Install the choke control rod dust seal and tap gently to straighten the retainer. (16)
24. Slide the cold enrichment rod into the upper body. (26)
25. Assemble the cold enrichment rod adjusting nut, lever, adjusting swivel, the control vacuum regulator and adjusting nut. Install the assembly. (20, 22, 23, 24, 25)
26. Install the choke hinge pin and the "E" ring. (5, 21)
27. Install the choke control rod. For final adjustment, see cold enrichment rod and control vacuum regulator adjustment. (7)
28. Engage the accelerator pump operating rod and the choke control rod and install the "E" ring retainers. (5, 6, 7)
29. Install the wide open stop screw (omitted when assembling the main body) and follow the venturi valve limiter adjusting procedure. (Main Body 10, 11)

SPECIFICATIONS

Refer to Ford Car Performance Specifications book on all carburetor specifications not contained in this Part.

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SPECIAL TOOLS

Description	Number
Pivot Pin Remover and Installer	T77L-9928-A
Choke Adjustment Tool (Stator Cap)	T77L-9848-A
Vacuum Test Tool	T77L-9510-A
Jet Plug Remover	T77L-9533-B
Jet Plug Installer	T77L-9533-C
Metering Jet Adjustment Tool	T77L-9533-A

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DETROIT IRON

Fuel Pump—Mechanical

PART 24-30

All Models

SUBJECT	PAGE
DESCRIPTION	30-1
TESTING	
Capacity (Volume) Test	30-2
Pressure Test	30-2
REMOVAL AND INSTALLATION	30-2
SPECIFICATIONS	30-3

CA4244-2A

DESCRIPTION

A single action fuel pump (mechanically operated) is standard equipment for all vehicle models.

The fuel pump on the I-6 engine is mounted on the lower left center of the engine cylinder block.

On all V-8 engines, the fuel pump is mounted on the left-side of the cylinder front cover. On the I-4 and V-6 engines the fuel pump is mounted on the left-front of the engine. The pump is actuated by an eccentric on the auxiliary shaft on 2.3L I-4 engines, and on the camshaft on 2.8L V-6 engines.

A separate fuel filter is used on all engines. The filter is of one piece construction and does not contain a cleanable filter element.

All passenger car engines are equipped with a disposable-type fuel pump (Fig. 1).

These pumps have no serviceable parts, and must be replaced if out of specification.

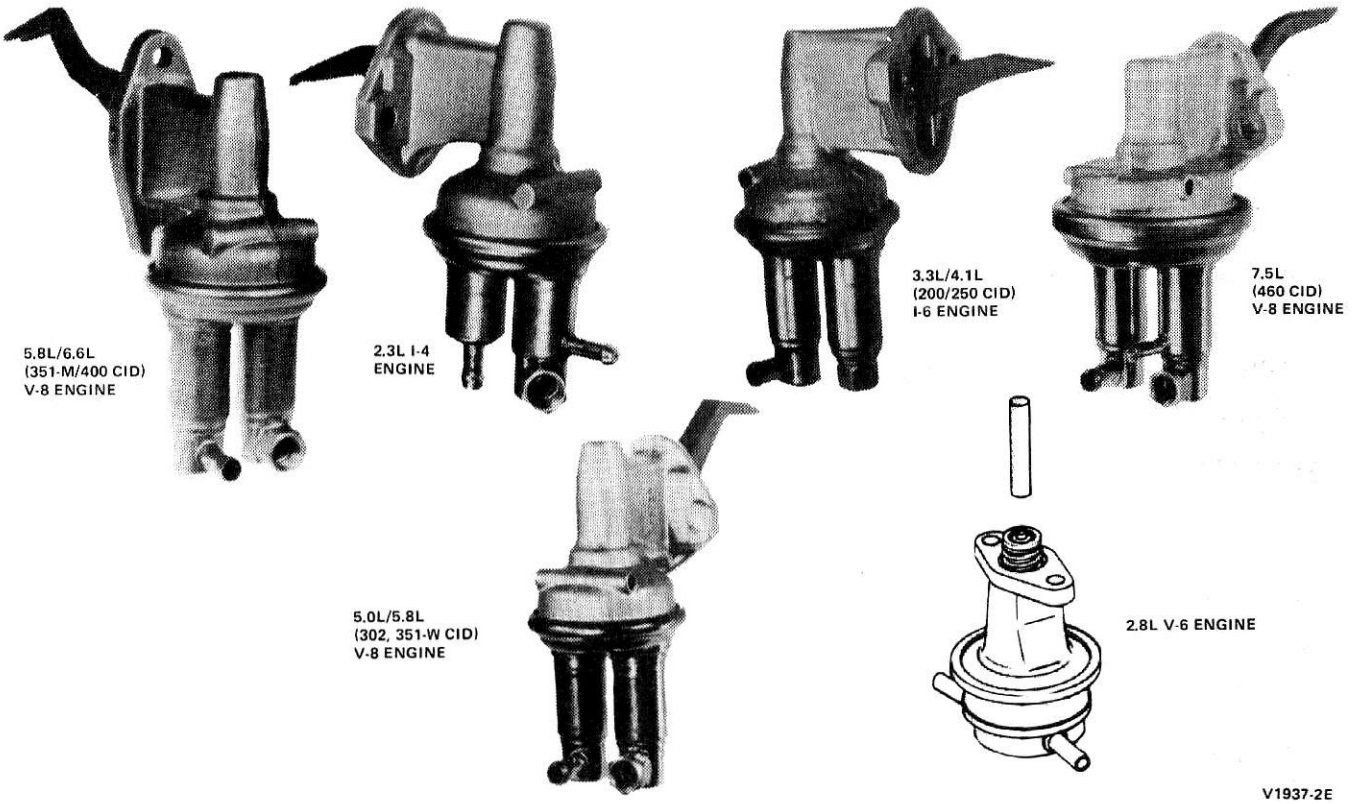


FIG. 1 Typical Mechanical Fuel Pumps

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TESTING

Incorrect fuel pump pressure and low volume (capacity of flow rate) are the two most likely fuel pump troubles that will affect engine performance. Low pressure will cause a lean mixture and fuel starvation at high speeds. Excessive pressure will cause high fuel consumption and carburetor flooding. Low volume will cause fuel starvation at high speeds.

To determine that the fuel pump is in safisfactory operating condition, tests for both fuel pump pressure and fuel pump capacity (volume) should be performed.

The tests are performed with the fuel pump installed on the engine and the engine at normal operating temperature and at idle speed. **Before the tests, make sure the replaceable fuel filter has been changed within the recommended maintenance mileage interval.** When in doubt, install a new filter.

PRESSURE TEST

Refer to Fuel System Specifications at the end of this Part and note the fuel pump pressure and capacity (volume) specifications.

1. Remove the air cleaner assembly. Disconnect the fuel inlet line or the fuel filter at the carburetor. **Use care to prevent combustion from fuel spillage.**
2. Connect a pressure gauge, a restrictor and a flexible hose (Fig. 2) between the fuel filter and the carburetor.
3. Position the flexible hose and the restrictor so the fuel can be discharged into a suitable, graduated container (Fig. 2).
4. Before taking a pressure reading, operate the engine at the specified idle rpm and vent the system into the container by opening the hose restrictor momentarily.
5. Close the hose restrictor, allow the pressure to stabilize, and note the reading.

If the pump pressure is not within specifications, and the fuel lines and filter are in satisfactory condition, the pump should be replaced.

If the pump pressure is within specifications, perform the test for fuel capacity (volume).

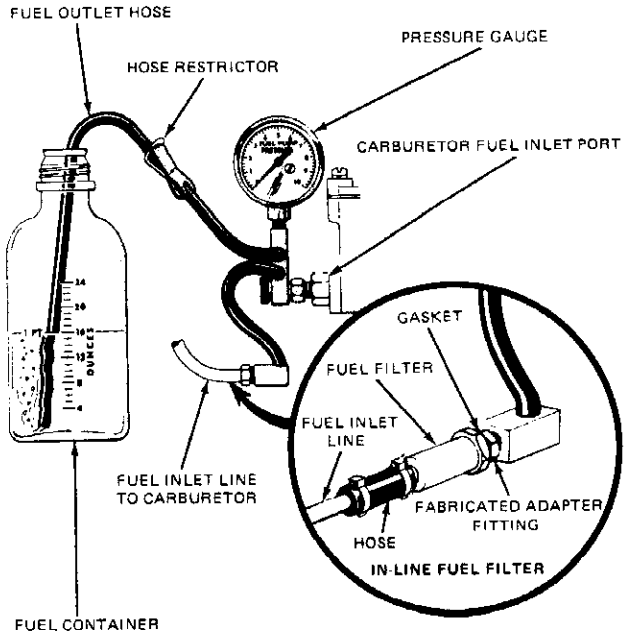


FIG. 2 Typical Fuel Pump Pressure and Capacity Test Equipment

CAPACITY (VOLUME) TEST

With the fuel pump pressure within specifications, test the capacity (volume) as follows:

1. Operate the engine at the specified idle rpm.
2. Open the hose restrictor and allow the fuel to discharge into the graduated container (Fig. 2) for the specified time; then, close the restrictor. **At least one pint of fuel should have been discharged within the specified time limit. If the pump volume is below specifications, repeat the test using an auxiliary fuel supply and a new fuel filter. If the pump volume meets specifications while using the auxiliary fuel supply, check for a restriction in the fuel supply from the tank and for improper tank ventilation.**

REMOVAL AND INSTALLATION

NOTE: Before removing or installing fuel pump, rotate engine so that low point of fuel pump cam lobe is against pump arm. This position can be determined by rotating the engine with the pump held loosely in position until tension is removed from arm.

Removal

1. Disconnect the inlet line and the outlet line at the fuel pump.
2. Remove the fuel pump attaching bolts and remove the pump and the gasket. Discard the gasket.

Installation

1. Remove all the gasket material from the mounting pad and pump. Apply oil-resistant sealer to both sides of a new gasket. Position the new gasket on the pump flange and hold the pump in position against the mounting pad. **Make sure the rocker arm or rod is riding on the camshaft or intermediate shaft eccentric.**
2. Press the pump tight against the pad, install the attaching bolts and alternately torque them to specifications.

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3. Connect the fuel inlet line or hose (use a new clamp on the hose) and the outlet line. If a hose is used at the fuel pump connection, crimp the retaining clamp securely.
4. Operate the engine and check for fuel leaks.

SPECIFICATIONS

FUEL PUMP—MECHANICAL

FUEL PUMP – MECHANICAL

Engine		Static Pressure	Min. Volume Flow	Eccentric Total Lift
Litre	C.I.D.	(PSI) ①	① ③	(Inches)
2.3		5.0 – 7.0 ②	1 Pt. in 25 Sec.	.304 – .326
2.8		3.0 – 6.0	1 Pt. in 25 Sec.	.193 – .213
3.3	200	5.0 – 7.0	1 Pt. in 30 Sec.	.290 – .310
4.1	250	5.0 – 7.0	1 Pt. in 20 Sec.	.290 – .310
5.0	302	6.0 – 8.0	1 Pt. in 20 Sec.	.690 – .710
5.8	351W	6.0 – 8.0	1 Pt. in 20 Sec.	.690 – .710
5.8	351M	6.0 – 8.0	1 Pt. in 20 Sec.	.602 – .622
6.6	400	6.0 – 8.0	1 Pt. in 20 Sec.	.602 – .622
7.5	460 ④	5.7 – 7.7	1 Pt. in 20 Sec.	.890 – .910

① On engine, with temperatures normalized and at normal curb idle speed, transmission in neutral.

② With the pump-to-tank fuel return line pinched off, and a new fuel filter installed in fuel line.

③ Inside diameter of smallest passage in test flow circuit must not be smaller than 0.220".

④ 7.5L (460 CID) Police Interceptor has in-tank electric fuel pump (see Part 24-31).

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Fuel Pump - Electric

PART 24-31

Vehicles w/7.5L (460 CID) Police Interceptor V-8

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	31-1	DIAGNOSIS	31-3
REMOVAL AND INSTALLATION			
Fuel Pump	31-3		

CA4489-2A

DESCRIPTION

An in-tank electric fuel pump (Fig. 1) is used on all 7.5L (460 CID) Police Interceptor V-8 equipped vehicles. The circuit provides an interlock system that (1) provides power to the fuel pump during starting through a contact of the starter relay, (2) provides reduced operating voltage during normal operation, and (3) provides full battery voltage during wide open throttle (WOT) operation. In addition, should engine oil pressure be lost during operation, the fuel pump is automatically disconnected from the electrical circuit (Fig. 2).

With the ignition switch OFF, current is fed to the ignition switch only. Vacuum switch "F", relay "A" and oil pressure switch "B" are all closed. When the ignition switch is turned to the START position, current flows through fuse "C", diode "G", through the windings of the fuel pump to the tank ground (Fig. 1). The diode is required to prevent current supplied to the pump during normal operation from activating the starter relay.

When the starter switch is returned to the RUN position, current is supplied through the ignition module connector to fuse "D", through resistor "E", through the contacts of relay "A", through the windings of the fuel pump to the tank ground. If the engine is not running when the switch is turned to the RUN position, current will flow through the windings of the "A" relay and through the closed contacts of the oil pressure switch "B" to ground, opening the operating path of the fuel pump at the contacts of the "A" relay.

At wide open throttle (WOT), the vacuum operated switch "F" (Fig. 3) closes its internal contacts, allowing fuel pump operating current to bypass the voltage-dropping resistor "E".

An additional diode ("H") is required to prevent current flowing in the ENGINE warning lamp circuit from operating the relay "A" and cutting off the operating path of the fuel pump in the event of engine overheating.

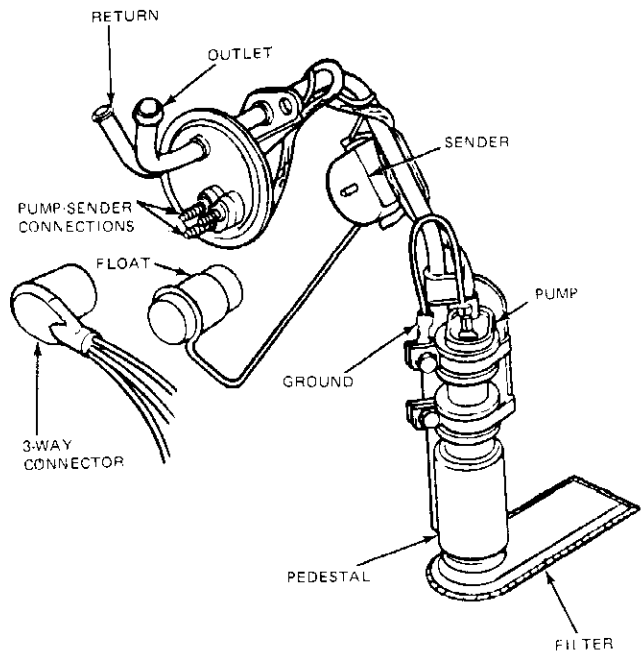


FIG. 1 Electric Fuel Pump

A rollover valve located in the position normally occupied by the mechanical fuel pump controls fuel flow and has a 0.070" orifice for controlling fuel return to the fuel tank through a second line.

Some models are equipped with an oil pressure gauge instead of or in addition to the ENGINE warning lamp. In this case, a "Y" fitting is installed in the cylinder block, with one branch used for the oil pressure gauge sender and the other branch for the oil pressure switch.

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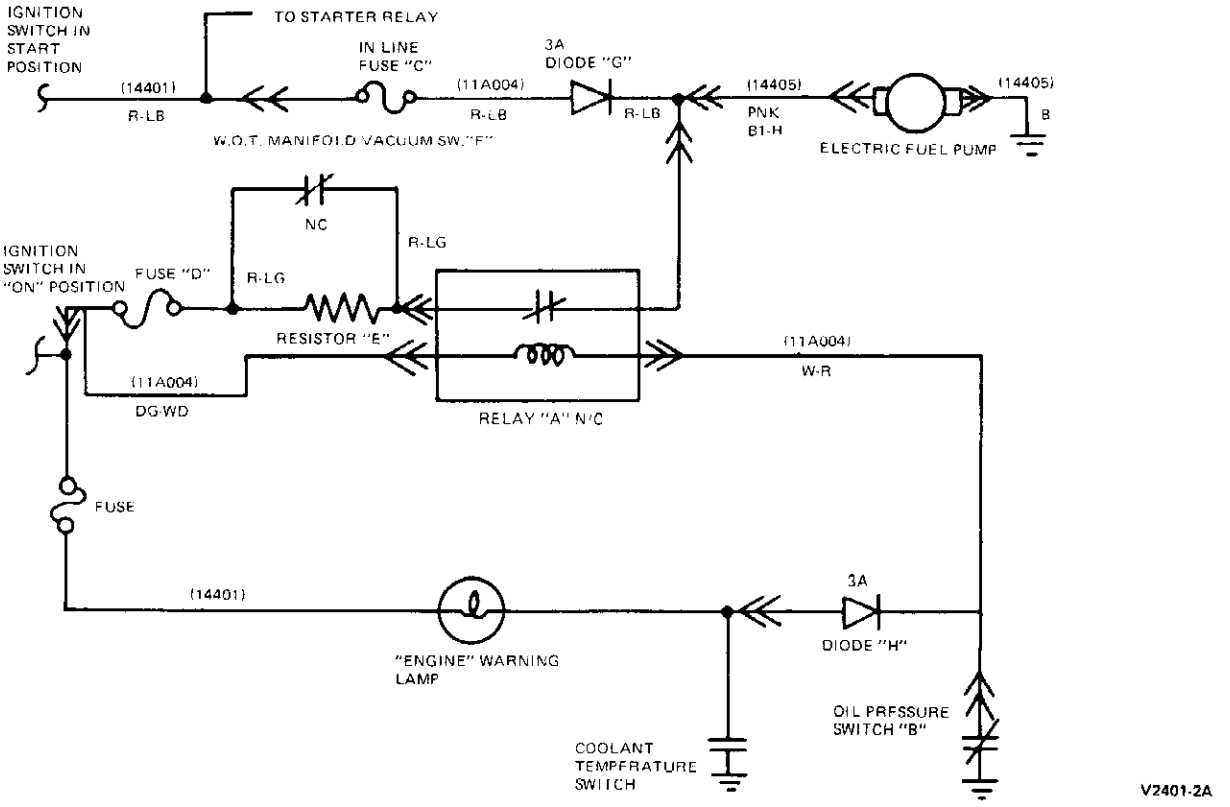


FIG. 2 Electric Fuel Pump Wiring Diagram

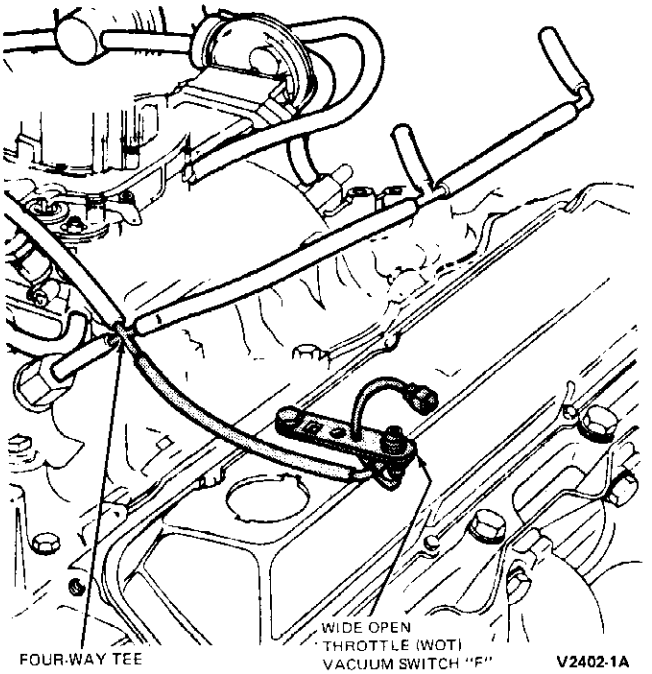


FIG. 3 Wide Open Throttle (WOT) Switch "F" Location

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REMOVAL AND INSTALLATION

FUEL PUMP

Removal

1. Open the hood and install fender covers. Disconnect the positive battery cable.
2. Raise the vehicle on hoist.
3. Disconnect the fuel outlet and return line at the fuel pump.
4. Remove fuel from the tank as necessary to make sure fuel level is below fuel pump level.
5. Remove any dirt that has accumulated around the fuel pump attaching flange, so that it won't enter the tank during removal or installation.
6. Turn the fuel pump locking ring counterclockwise with tool T74P-9275-A and remove the locking ring, mounting gasket and fuel pump.

Installation

1. Clean the fuel pump mounting flange at the fuel tank. Position a new gasket on the mounting flange, making sure it is properly seated. NOTE: Put a light coating of heavy grease on the gasket to hold it in place during assembly.
2. Insert the float into the fuel tank and twist and feed the free end of the filter into the fuel tank hole. NOTE: Locating the float rod in the slot in the fuel tank will allow additional clearance for insertion of the pump assembly through the hole (Fig. 4).
3. Secure the fuel pump and sender unit with the locking ring by rotating the locking ring against the stop with tool T74P-9275-A (Fig. 5).
4. Connect the fuel tank lines to the electric fuel pump sender unit with hose clamps. Install the electrical wiring connector to the pump/sender unit (Fig. 5).
5. Lower the vehicle.
6. Connect the positive cable to the battery. Replace fuel in tank, if drained. Install fuel filler cap.
7. Start the vehicle and check electric fuel pump operation. Check for fuel leaks.

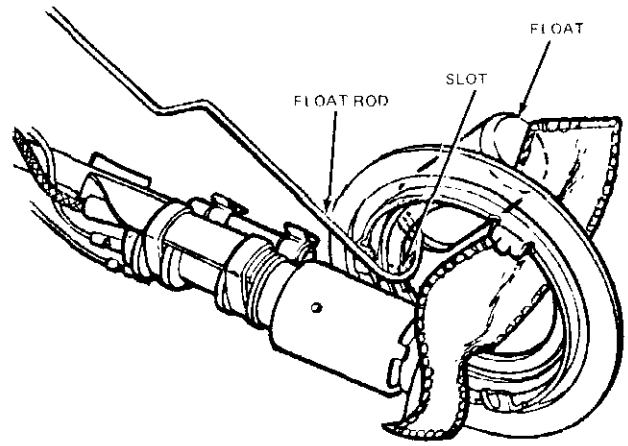


FIG. 4 Positioning Float Rod

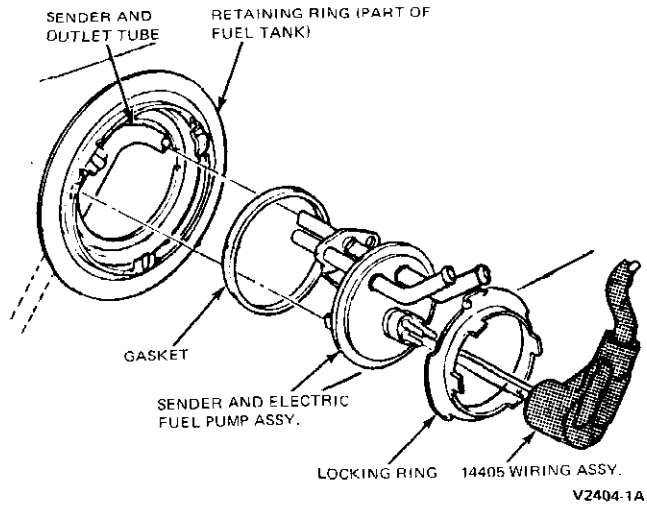


FIG. 5 Securing Fuel Pump Assembly

DIAGNOSIS

Following are tests to be performed in diagnosing complaints of inoperative electric fuel pump:

1. Check fuel tank for adequate fuel supply.
2. Check fuel pump operation by removing fuel line at carburetor fuel filter and installing a fuel pressure gauge with a range of 0-15 PSI between the line and the carburetor. Turn ignition switch to START position momentarily.
3. If no fuel pressure is present in this test, check for blown in-line fuse in 11A004 wiring harness in engine compartment (Fig. 6).
4. Disconnect lead to oil pressure switch "B" at relay "A" (W-R). Turn ignition switch to RUN position and watch for fuel pressure. If no fuel pressure is present, check for 12V at relay "A" connector (red/light green wire). If no current, trace circuit back to source (Fig. 7).
5. If current in Step 4, replace relay.
6. If relay OK, check wire connector to taillight wiring harness near dimmer switch (Fig. 8).

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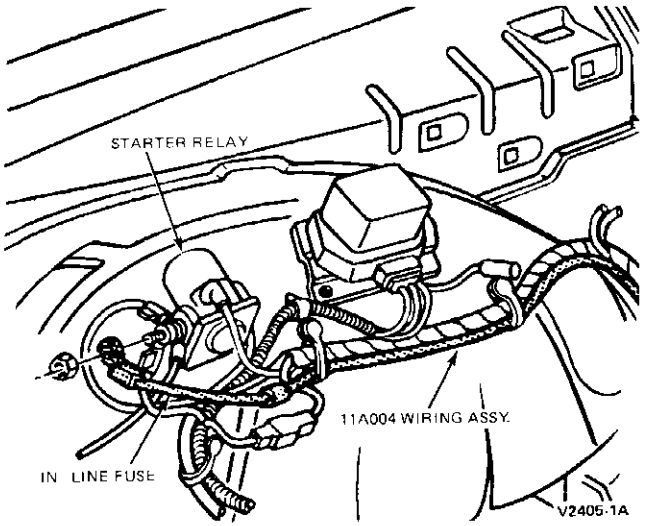


FIG. 6 In-line Fuse

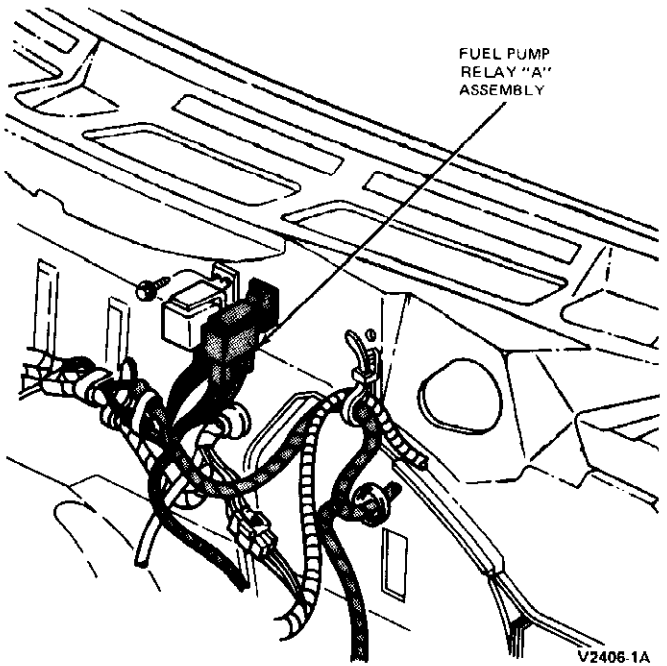


FIG. 7 Relay "A" Location

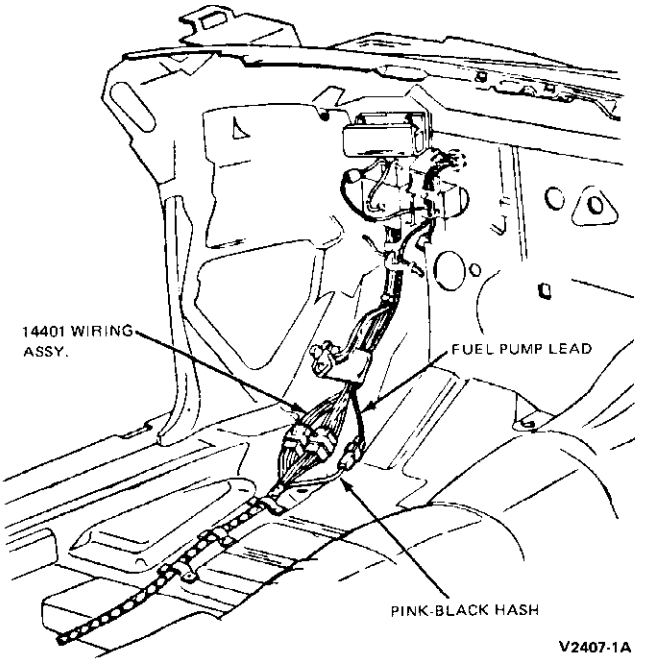


FIG. 8 Connection To Taillight Harness

7. Check power lead (pink with black hash) at fuel pump 3-way connector; check black wire for ground at fuel pump connector.
8. If 12V is present on pink/black hash wire and black wire is grounded, replace the fuel pump/sender assembly and retest (see Removal and Installation).
9. If engine starts, but runs for only a short time (1 minute or less), check engine for proper oil pressure. Check operation of oil pressure sender. An inoperate oil pump or switch will activate relay "A", stopping current flow to the fuel pump.
10. When complaint is resolved, remove test pressure gauge from fuel line and reconnect line to fuel filter.

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Air Cleaner and Duct Systems

PART 24-41

All Models

SUBJECT	PAGE
DESCRIPTION	41-1
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Auxiliary Air Inlet Valve –	
7.5L (460 CID) Police Interceptor V-8	41-2
REMOVAL AND INSTALLATION	
Duct and Valve Assembly –	
Vacuum Operated	41-4
REMOVAL AND INSTALLATION (Cont'd.)	
Replacing Crankcase Ventilation	
Replacing Air Filter Element	41-3
SPECIFICATIONS	41-4

DESCRIPTION

All passenger car engines are equipped with dry type air cleaners with replaceable air filter elements and replaceable crankcase ventilation system filter element. The air cleaner assembly is attached to the top of the carburetor and employs various sensors, switches and vacuum motors to control intake air temperature. In addition, sensors for other engine control systems are *mounted either in or on the air cleaner assembly* (Fig. 1).

The air cleaner assembly intake duct is attached to a cold air intake and to a heat shroud around the exhaust manifold. Air flow through these two sources is controlled by a "door" in the duct operated by a

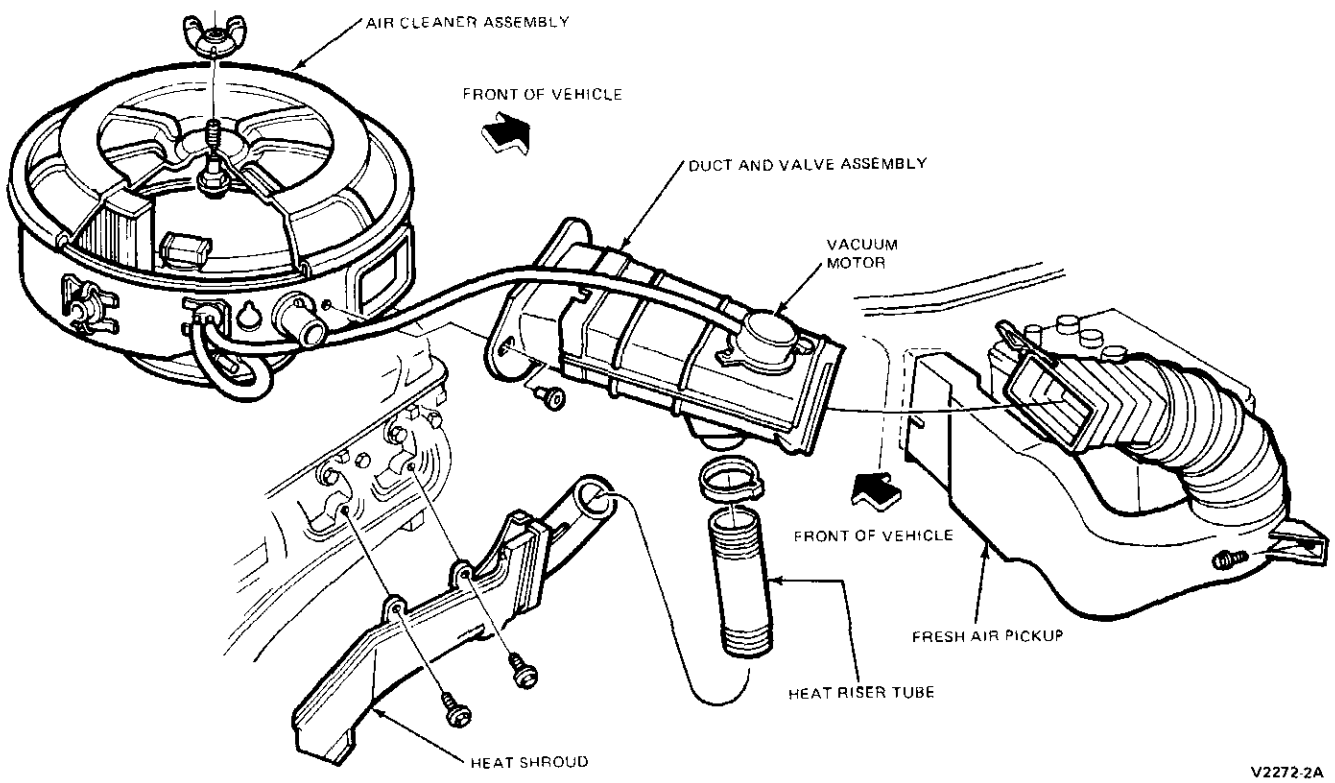


FIG. 1 Typical Air Cleaner and Duct System—V-8 Shown

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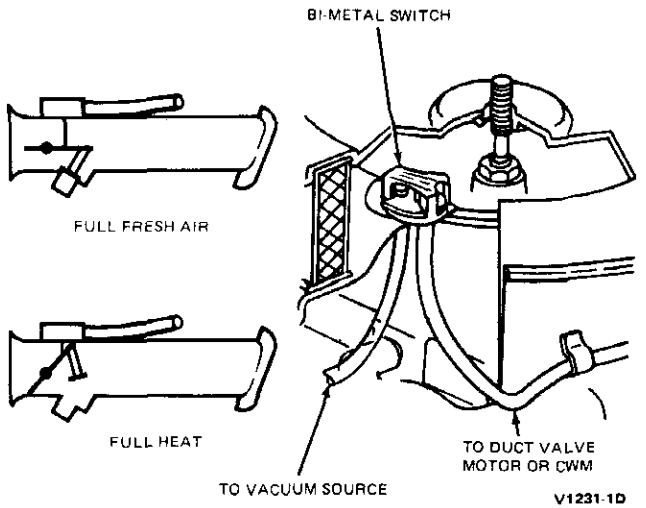


FIG. 2 Vacuum-Operated Duct and Valve Assembly

vacuum motor (Fig. 2). Operation of the motor is controlled by delay valves, temperature sensors and other vacuum control systems that vary with each application and engine calibration.

The positive crankcase ventilation (PCV) system takes air in through a filter pack mounted in the outside skin of the air cleaner assembly and connected to the engine valve cover either through an elbow and grommet or through the PCV valve and oil filler cap.

Police interceptor models feature an "auxiliary inlet valve" that allows increased air flow into the air cleaner assembly under wide open throttle conditions. Engine vacuum holds the auxiliary valve in the closed position during normal operation. Under heavy load or acceleration, vacuum drops and spring pressure opens the valve, admitting the required additional air.

Lincoln Continental and Continental Mark V engines have a cylindrical "resonator" attached to one side of the air cleaner assembly to help reduce air cleaner resonance under certain throttle and load conditions. There are no service or adjustment procedures required for the resonator.

TESTING

AUXILIARY AIR INLET VALVE—7.5L (460 CID) P.I. V-8

In addition to checking the duct and valve assembly, the vacuum motor that is attached to the air cleaner should be checked for functional operation.

1. Start the engine, observe the vacuum motor plate. It should be fully closed (Fig. 3).
2. Disconnect the vacuum hose at the vacuum motor. The plate should be in the full-open position.
3. If the positions as described are not obtained, check for interference and alignment of plate and motor rod and vacuum for the hose at the vacuum motor (minimum of 10 inches Hg).

   If vacuum is not available, check the hose and connection for leaks.
4. If the vacuum motor plate still remains in one position, remove the vacuum motor from the air cleaner, connect it to another vacuum source to confirm that vacuum motor is not operating. If the motor rod does not move when vacuum is applied, the motor should be replaced.
5. Reassemble the motor to the air cleaner and repeat Steps 1 and 2.

FOR OTHER AIR CLEANER AND DUCT SYSTEM-RELATED TESTS AND ADJUSTMENTS, SEE PART 29-02, PROCEDURE SSD-9.

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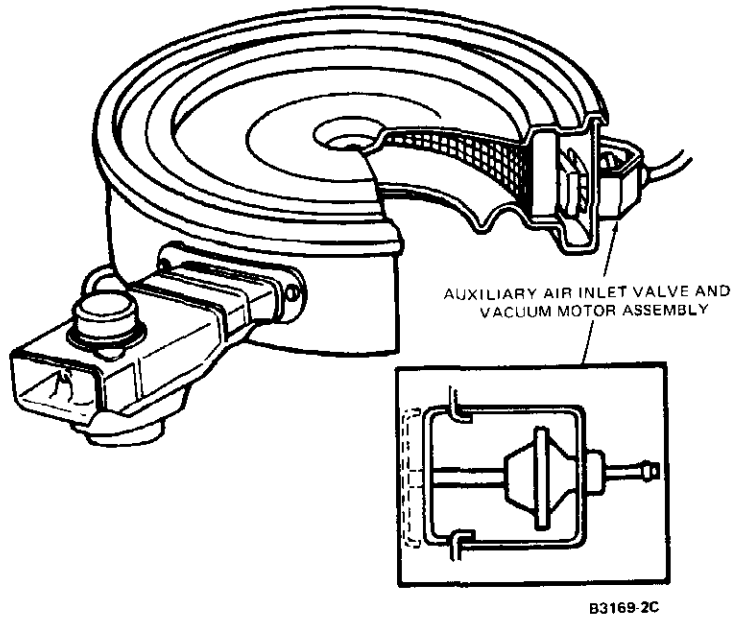


FIG. 3 Air Cleaner With Auxiliary Air Inlet Valve and Vacuum Motor

REMOVAL AND INSTALLATION

REPLACING AIR FILTER ELEMENT

Refer to Part 50-29 "Emissions Systems Maintenance Schedule" for frequency of filter inspection and/or replacement.

Removal

1. Disconnect the crankcase ventilation hose at the air cleaner body. Disconnect the cold air intake tube at the flexible duct (except 2.3L). On 2.3L engines, disconnect the vacuum hose from the vacuum motor and leave the vacuum motor and duct attached to the cold air intake tube.
2. *Disconnect the temperature vacuum switch* (TVS) vacuum supply hose at the TVS. On 2.8L V-6 engines, also disconnect the vacuum vent valve vacuum harness at the air cleaner body.
3. Disconnect the vacuum harness from the Cold Weather Modulator (CWM) on 4.1L (250 CID) I-6 engines so equipped. On 7.5L (460 CID) P.I. V-8 engines, disconnect the vacuum hose from the auxiliary air inlet valve vacuum motor.
4. Remove the wing nut(s) or screw(s) and grommet(s) (if equipped) and lift the air cleaner assembly off the carburetor. On all models except 2.3L I-4, disengage the duct assembly from the exhaust manifold heat shroud.
5. On Fairmont/Zephyr models equipped with the 3.3L (200 CID) I-6 and Pulse Air exhaust air injection system, disconnect the hose from the Pulse Air filter to the bottom of the air cleaner body. Remove the air cleaner assembly cover and the filter element.

Inspection

Visually inspect the element and the air cleaner cover and body for signs of dust or dirt leaking through holes in the filter media or past the end seals. Place a light on the inside (clean side) of the filter and look through the filter at the light. Any hole in the element, even the smallest, is cause for replacement.

Also check the element for charred (burned) or brittle spots that could fail under engine operating vibration *and cause a hole. Discoloration only, caused by* backfire, is not a cause for replacement.

Installation

1. Wipe all inside surfaces of the air cleaner body and cover. Install the air filter element. Check the condition of the air cleaner assembly to carburetor gasket and replace as necessary.
2. Connect the vacuum hoses that were removed during removal of the air cleaner assembly and position and assembly to the exhaust manifold heat shroud (except 2.3L I-4) and to the carburetor. Install the wing nut(s) or screw(s) and grommet(s) and torque to specification.

   NOTE: On 2.3L I-4 engines, it is necessary to recheck the torque on the first wing nut after the second one has been tightened to specification.

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3. On 7.5L (460 CID) P.I. V-8, connect the auxiliary air inlet valve vacuum motor hose. On 4.1L (250 CID) I-6 engines so equipped, connect the Cold Weather Modulator (CWM) vacuum hose.
4. On 2.8L V-6 engines, connect the vacuum vent valve at the air cleaner assembly. Connect the TVS on those models so equipped.
5. On 2.3L I-4 engines, connect the vacuum hose from the duct vacuum motor. Connect the cold air intake tube to the air cleaner assembly at the flexible duct. Connect the crankcase ventilation hose to the air cleaner body.

REPLACING CRANKCASE VENTILATION FILTER IN AIR CLEANER

The crankcase ventilation system air filter is shown in Fig. 4.

Removal

1. Disconnect the air cleaner closure hose at the air cleaner by unsnapping the elbow from the retainer clip (except 2.3L) or sliding off the hose from the PCV filter adaptor (2.3L).
2. Remove the air cleaner body cover.
3. Remove the crankcase ventilation filter retainer clip and remove the filter retainer from the air cleaner body.
4. Remove the filter pack from the retainer, clean out the retainer and install a new filter pack.

Installation

1. Position crankcase ventilation filter assembly in air cleaner body and install retainer clip.
2. Connect closure hose at filter retainer clip.
3. Install air cleaner cover and secure with wing nut(s) or screw(s), and torque to specification.

NOTE: On 2.3L I-4 air cleaners, it is necessary to recheck the torque on the first wing nut tightened after tightening the second.

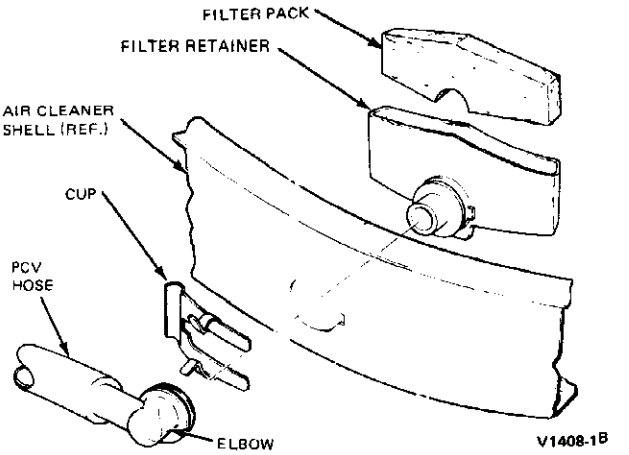


FIG. 4 Crankcase Ventilation System Filter

DUCT AND VALVE ASSEMBLY—VACUUM OPERATED

Removal

1. Disconnect the vacuum hose at the vacuum motor.
2. Remove either the hex cap screws or the pop rivets that secure the air intake duct and valve assembly to the air cleaner. The cap screws should be removed in the normal manner; the pop rivets can only be removed by grinding the rivet heads off and punching the **rivet** out.
3. Remove the duct and valve assembly from the engine.

Installation

1. Position the duct and valve assembly to the air cleaner and heat stove tube. Reinstall the previously removed cap screws, or when required, install new pop rivets.
2. Connect the vacuum line at the vacuum motor.

SPECIFICATIONS

TORQUE SPECIFICATIONS – AIR CLEANER WING NUTS OR BOLTS

Fastener Composition	Torque (In-Lb)
Steel	15-25
Plastic	25-35

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Fuel Tanks and Lines

PART 24-50

All Models

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DESCRIPTION AND OPERATION

FUEL TANKS AND FILLERS

All vehicles, except Canadian vehicles using leaded fuel, are equipped with a restricted fuel filler neck that allows only a non-leaded fuel nozzle to be inserted (Fig. 1).

The restrictor consists of a narrow opening in the filler covered by a spring steel trap door. The smaller non-leaded fuel nozzle will fit through the narrow opening and push the trap door aside, allowing normal filling. If the nozzle for leaded fuel is inserted, however, it does not fit through the narrow opening. The trap door being closed causes a fuel backup, and automatic nozzle shutoff.

The restricted fuel filler is serviced as an assembly, and cannot be repaired.

DOUBLE LOCKING FUEL CAP

A double set of locking tangs or tabs are used on the pressure/vacuum fuel cap on all vehicles except Granada with exposed styled fuel cap. These caps use a single set of tabs. These tangs require a two stage removal/installation procedure and provide for escape of any residual pressure in the system during cap removal. This system is also used with the optional locking-type fuel cap. Whenever a fuel cap is replaced, it should be replaced with the proper pressure relief double locking cap to prevent possible system malfunction (Fig. 1).

FUEL VAPOR EMISSION CONTROL SYSTEM

As a part of the fuel system, all passenger cars are equipped with fuel evaporative emission control systems to meet federal requirements in effect at the time of production.

The evaporative emission control systems have been revised for 1978 to reflect the latest requirements of the new S.H.E.D. (Sealed Housing Evaporative Determination) specifications. The new test consists of placing a vehicle in a sealed housing and periodically sampling the air in the housing to measure the amount of vapors escaping from the fuel tank, carburetor or air cleaner.

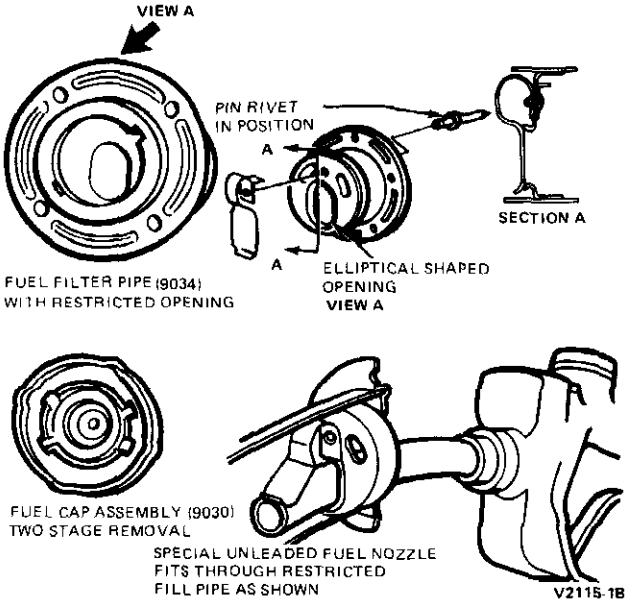


FIG. 1 Restricted Fuel Tank Filler Opening and Double Locking Fuel Cap

The 1978 systems consist of:

- Sealed Fuel Tank
- Pressure/vacuum Relief Fuel Cap
- Fuel Tank Vapor Valve
- Carbon Canister
- Purge Control Valve
- Solenoid Vent Valve and Purge Regulator Valve (Some Vehicles)
- Thermactor Idle Vacuum Valve (TIV)

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Not all of these components are used on any one system, since usage depends on the calibration of the complete vehicle.

System control and operation are accomplished through six separate basic functions in the system which are:

a. Fill Control Vent System
b. Tank Vapor Vent and Storage System
c. Carburetor Cowl Vent and Storage System
d. Pressure and Vacuum Relief System (fuel cap)
e. Fuel Vapor Return System
f. Fuel Vapor Purge System

FILL CONTROL/VENT SYSTEM

Fill limiting is accomplished through fill neck configuration and/or internal vent lines within the fill neck and tank. The vent system is designed to permit an approximate 10-12 percent tank volume air space when the tank is filled to capacity. This air space provides for thermal expansion of fuel as well as being an aid to the in-tank vapor vent system.

VAPOR VENT SYSTEM

In-Tank Venting

This system provides a vapor space above the gasoline surface in the fuel tank. This area is sufficient to permit adequate breathing space for the tank vapor valve assembly under all static and most dynamic conditions. Horizontally mounted tanks accomplish this by a raised mounting section for the vapor valve assembly that is centrally located on the upper surface of the tank. Vertically mounted tanks use a centrally mounted vapor valve assembly on the uppermost surface of the fuel tank.

Tank Vapor Valve (Orifice) Assembly

All fuel tank vapor valves make use of a small orifice that tends to allow only vapor and not fuel to pass into the line running forward to the vapor storage canister. This assembly mounts directly to the fuel tank using a rubber grommet. (Fig. 2)

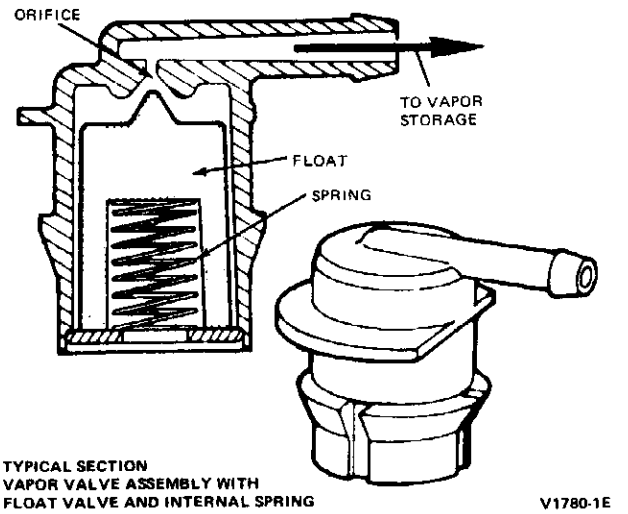


FIG. 2 Fuel Tank Vapor Valve

Fuel vapors trapped in the sealed fuel tank are vented through the orificed vapor valve assembly in the top of the tank. The vapors leave the valve assembly through a single vapor line and continue to the carbon canister in the engine compartment for storage, until such time as they are purged to the engine.

In vehicles equipped with fuel/vapor return lines, vapor generated in the fuel supply line is continuously vented back to the fuel tank. This action prevents engine surging from unwanted fuel enrichment and assists in hydrocarbon emission control.

CARBON CANISTER

Fuel vapor emitted through the fuel vapor valve and carburetor bowl vent is stored in a carbon-filled canister. Some models are equipped with two canisters, depending on fuel tank capacity and engine calibration (Fig. 3).

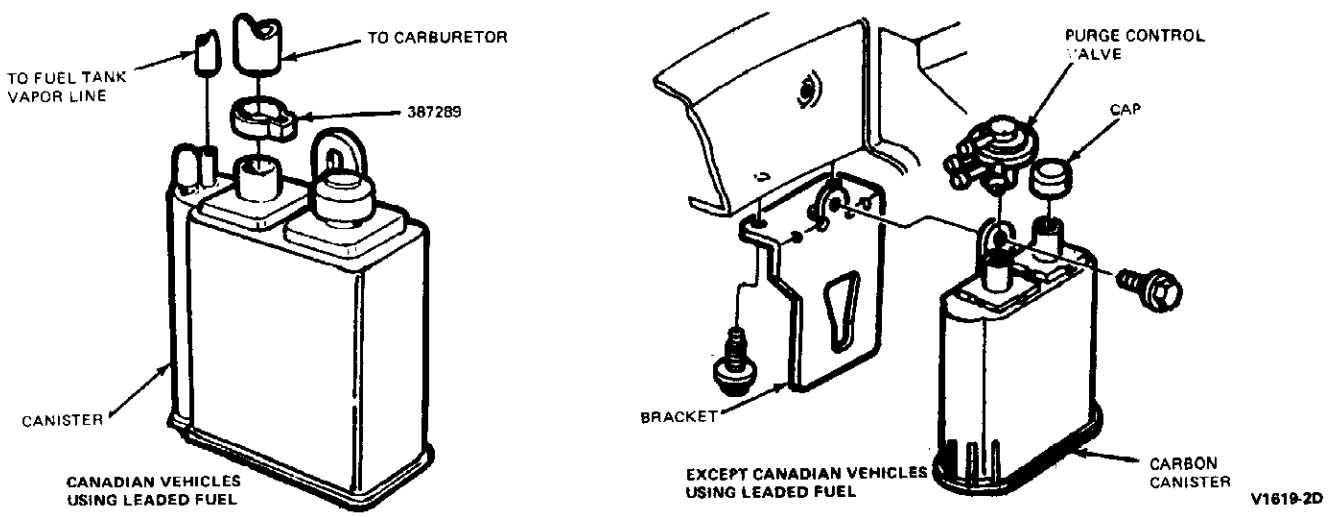
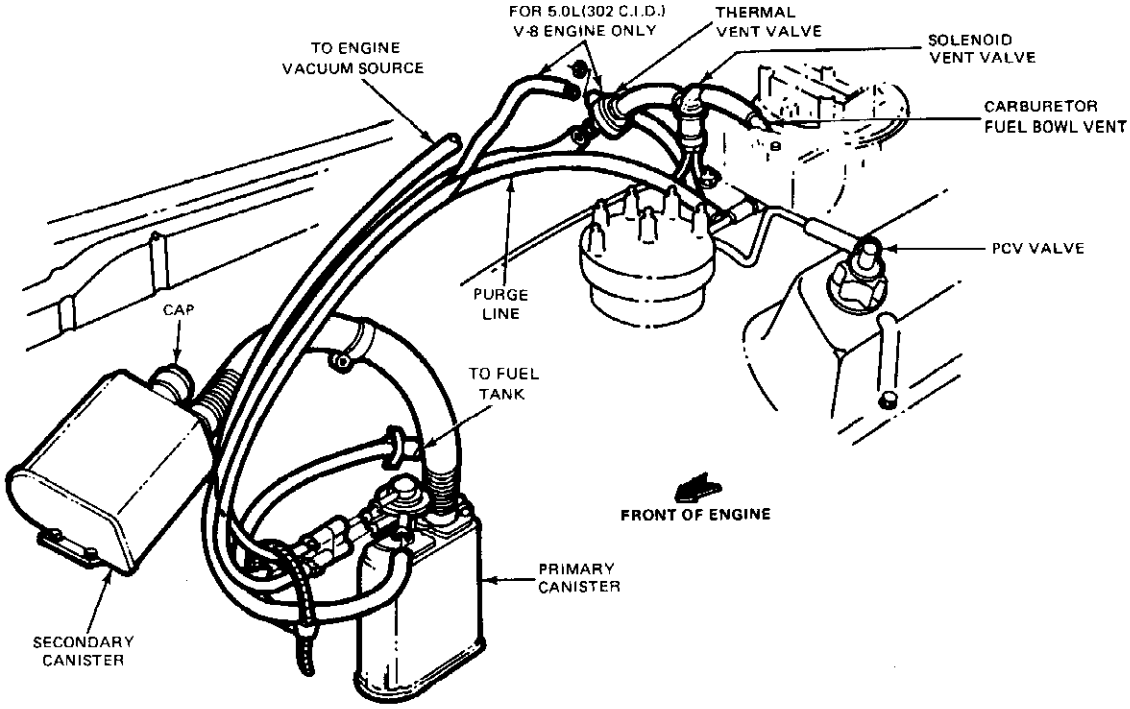
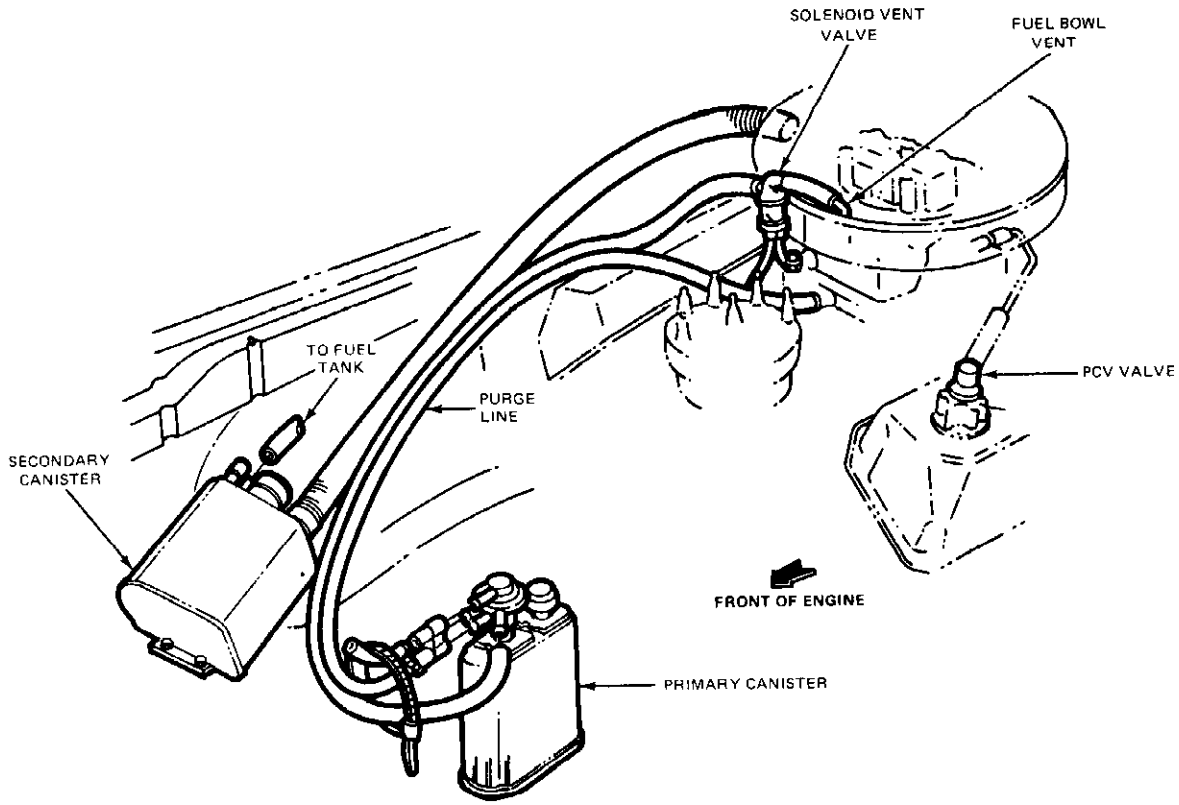


FIG. 3 Typical Canisters

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5.8L/6.6L(351 M/400 C.I.D.) V-8 (EXCEPT ALTITUDE) – NON UNITIZED VEHICLES
(EXCEPT LINCOLN CONTINENTAL AND CONTINENTAL MARK V)



5.0L/5.8L(302/351 C.I.D.), 5.8L/6.6L(351 M/400 C.I.D.) ALTITUDE,
7.5L(460 C.I.D.) – NON UNITIZED VEHICLES
(EXCEPT LINCOLN CONTINENTAL AND CONTINENTAL MARK V)

V2293-2A

FIG. 4 Typical Dual Canister Carburetor Venting Systems

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CARBURETOR VENTING

Fuel vapors which might otherwise collect in the carburetor bowl and pass directly into the atmosphere are vented to the carbon canister when the engine is stopped. Flow of these vapors is controlled by the fuel bowl vent valve, the purge control valve, or the fuel bowl thermal vent valve, depending on the particular carburetor and engine calibration used. When the engine is started, and depending on the operating mode when purging the system is most efficient, the vapors will be drawn into the engine for burning.

Typical storage and return systems for fuel vapors are shown in Fig. 4.

PURGE CONTROL VALVE

The Purge Control Valve is mounted directly to the carbon canister and controls the flow of fuel vapors into and out of the canister (Fig. 5).

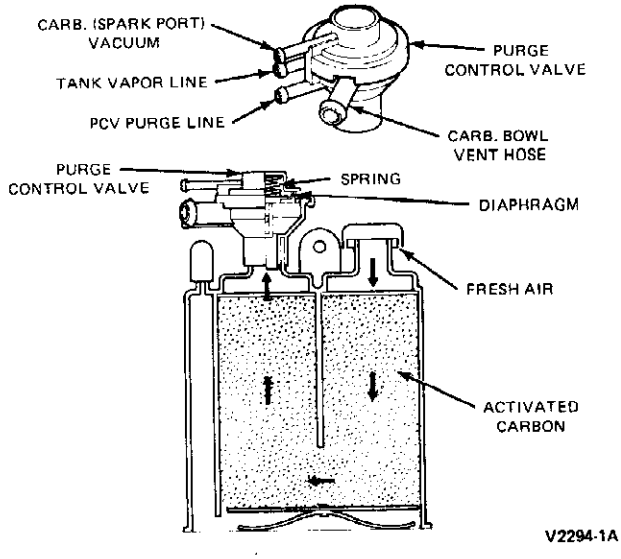


FIG. 5 Purge Control Valve

When the engine is stopped, vapors from the fuel tank and the carburetor fuel bowl flow through the purge valve imto the canister. On systems using spark port or EGR port vacuum to actuate the purge control valve, the signal is strong enough during normal cruise to open the valve, and vapors are drawn from the canister to the engine vacuum connection. At the same time, vapors from the fuel tank are re-routed directly to the purge line and into the engine. On some systems where purging doesn't affect idle quality, the purge control valve is connected to engine manifold vacuum and opens any time there is enough manifold vacuum.

FUEL BOWL SOLENOID VENT VALVE

The Fuel Bowl Solenoid Vent Valve is a normally open valve located in the fuel bowl vent line, and is normally used with Motorcraft Model 2150 2V and Model 4350 4V carburetors, which don't have a built-in fuel bowl vent valve. The solenoid vent valve closes off the fuel bowl vent line when the engine is running, and returns to the normally open condition when the ignition switch is turned off. (Fig. 6).

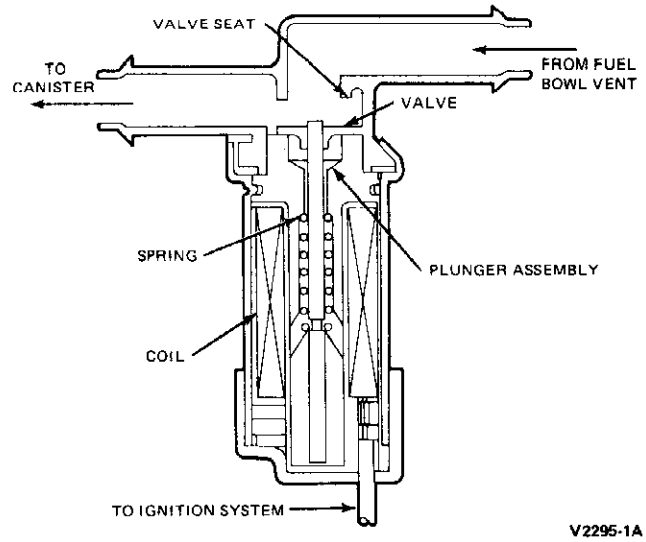


FIG. 6 Fuel Bowl Solenoid Vent Valve

DIAGNOSIS NOTE: If lean fuel mixture is suspected as the cause of a customer complaint, inspect either the solenoid vent valve or the fuel bowl vent valve for proper closing during engine operation. If the valve opens, allowing purge vacuum to affect fuel bowl balanced air pressure, the carburetor will give a leaner air/fuel mixture.

FUEL BOWL THERMAL VENT VALVE

The Thermal Vent Valve (Fig. 7) is inserted in the carburetor-to-canister vent line and is closed when the engine compartment is cold. This prevents fuel tank vapors generated when the fuel tank heats up before the engine compartment does from being vented through the carburetor fuel bowl.

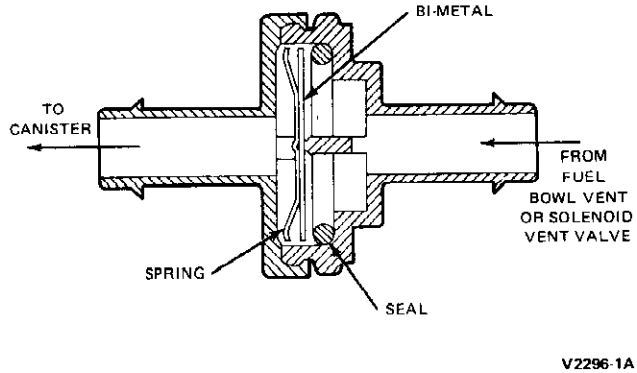


FIG. 7 Fuel Bowl Thermal Vent Valve

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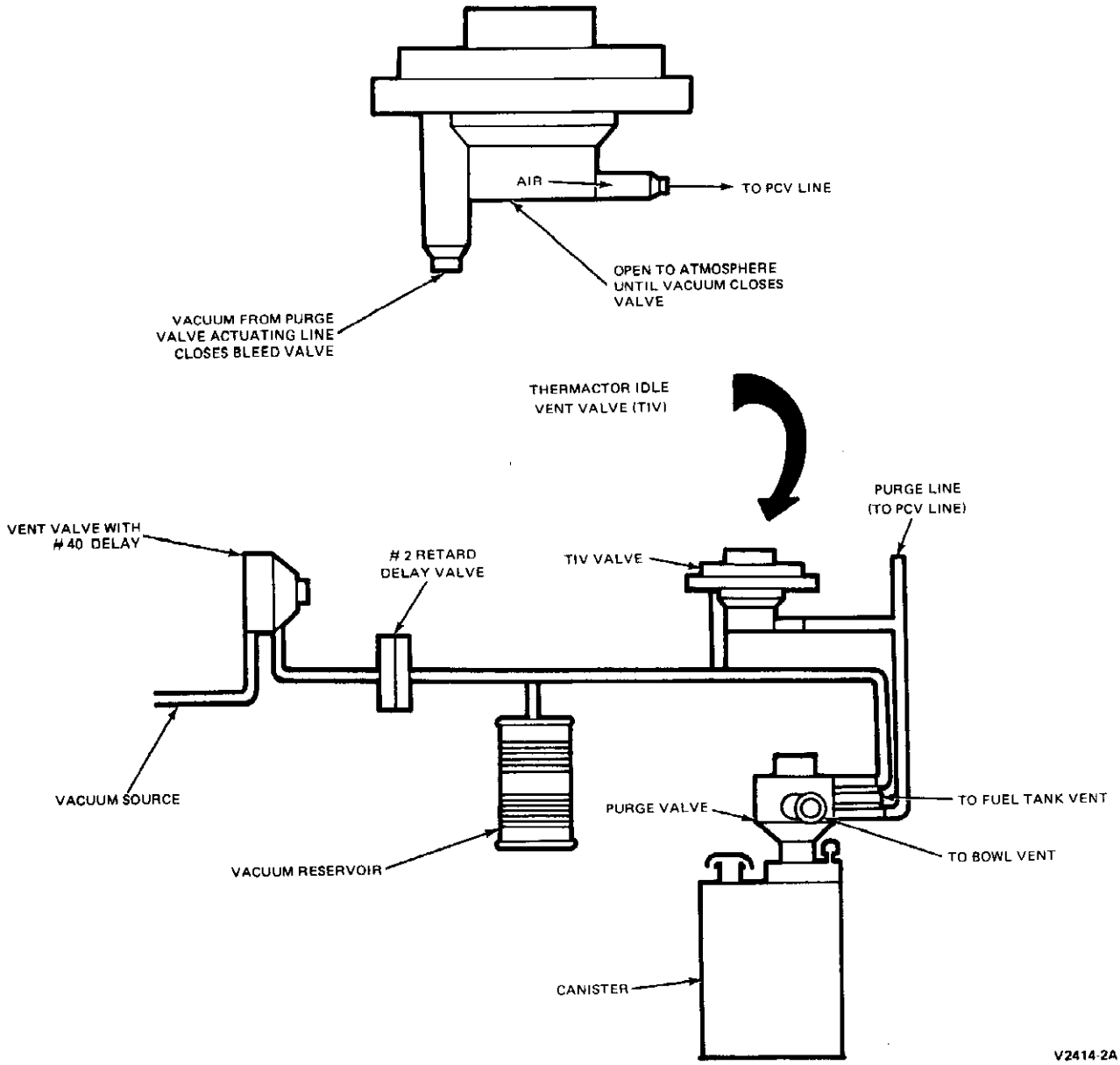


FIG. 8 Thermactor Idle Vacuum Valve (TIV)

This effect can occur, for instance, when sunlight strikes a vehicle which has been sitting out all night, and begins to warm the fuel tank. With the thermal vent valve closed, the vapors cannot enter the carburetor fuel bowl vent (now open) but must be routed to the carbon canister. As the engine compartment warms up, during normal engine operation, the Thermal Vent Valve opens. When the engine is again turned off, the fuel bowl vent valve (or solenoid vent valve) opens, allowing vapors to flow through the thermal vent valve (now open) and into the carbon canister. As the thermal vent valve cools, it again closes and the cycle begins again.

THERMACTOR IDLE VACUUM VALVE (TIV)

A thermactor Idle Vacuum Valve (TIV) is used with some evaporative emission systems to improve idle quality at hot start (Fig. 8).

When the engine is at normal operating temperature, the purge system is activated and purge air is drawn from the canister through the PCV tube and into the induction system via the carburetor spacer. The purge air flow into the carburetor spacer is taken into consideration when the idle air/fuel mixture is calibrated and set. However, under warm start conditions the purge valve is closed and the choke is off (no fast idle).

An overly rich mixture condition then exists, resulting in poor idle quality. The closed purge valve — choke off — no fast idle condition only exists for a few moments after a warm start, however, because actuation of the purge valve is delayed by the vacuum delay valve and by the time required to evacuate the vacuum reservoir.

To overcome this poor idle condition, the TIV bleeds air into the PCV tube, leaning the idle fuel mixture until the purge valve opens. The same vacuum that opens the purge valve closes the TIV valve.

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AIR CLEANER ASSEMBLY

Auxiliary Fuel Bowl Vent Tube

On some models, an Auxiliary Fuel Bowl Vent Tube is connected to the fuel bowl vent tube to vent the fuel bowl when the internal fuel bowl vent or the solenoid vent valve are closed and the thermal vent valve is also closed. An air filter is installed on the air cleaner end of the tube to make sure contaminants don't enter the carburetor fuel bowl.

Vapor Dam

A Vapor Dam is installed in the air cleaner assembly at the fresh air tube opening (Fig. 8) to trap most of the vapors emitted by the carburetor while the engine is stopped. These heavy vapors lie in the bottom of the air cleaner tray and are purged when the engine starts.

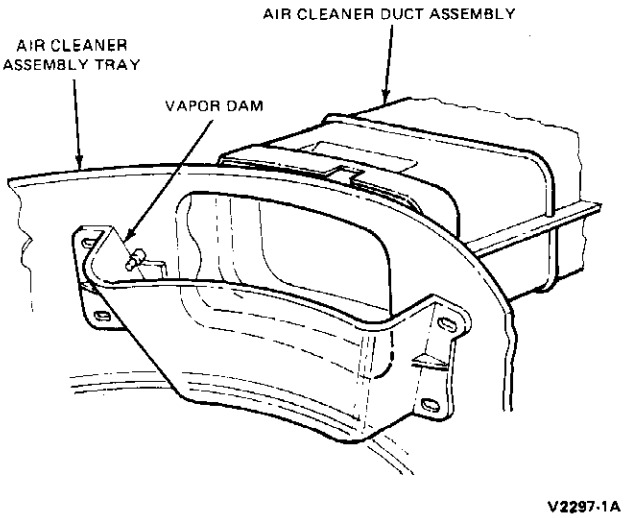


FIG. 9 Air Cleaner Assembly Vapor Dam

PURGE REGULATOR VALVE

The Purge Regulator Valve (Fig. 10) is installed in the purge tube between the purge control valve and the vacuum source, and regulates the amount of air being drawn into the intake manifold through the carbon canister. The valve contains a plunger and spring which function in the same manner as a PCV valve. High engine vacuum draws the plunger upward against the calibrated spring, closing the orifice and controlling air flow. When the vacuum drops, the plunger is lowered and air flow restriction is reduced. The valve must be mounted in an upright or nearly upright position for proper function.

2-PORT OR 4-PORT PVS (PORTED VACUUM SWITCH)

The PVS used in the Evaporative System can be either a 2-port or a 4-port type. The 2-port type is the same as the EGR PVS, while the 4-port type is new and consists of two 2-port vacuum valves built into one body. The 4-port type performs the same function as two 2-port PVS valves. The PVS used in the evaporative emission control system turns the Purge Valve vacuum on as the engine warms up, and allows the Purge Valve to close when the engine is turned off and vacuum is lost.

PRESSURE AND VACUUM RELIEF SYSTEM

Sealed Fill Cap

The fill cap is a sealed cap with a built in pressure-vacuum relief valve. Fuel system vacuum relief is provided after negative 0 to ¼ psi and pressure relief from ¾ to 1.8 PSI. Under normal operating conditions, the fill cap operates as a check valve, allowing air to enter the tank as gasoline is used, while preventing vapors from escaping the tank through the cap.

FUEL VAPOR RETURN SYSTEM

A fuel vapor return system has been added to 2.3L I-4 and 7.5L (460 CID) P.I. V-8 engines to reduce the amount of fuel vapor entering the carburetor (Figs. 10 and 11).

The system consists of a vapor return line from the fuel pump to the fuel return outlet of the fuel sender.

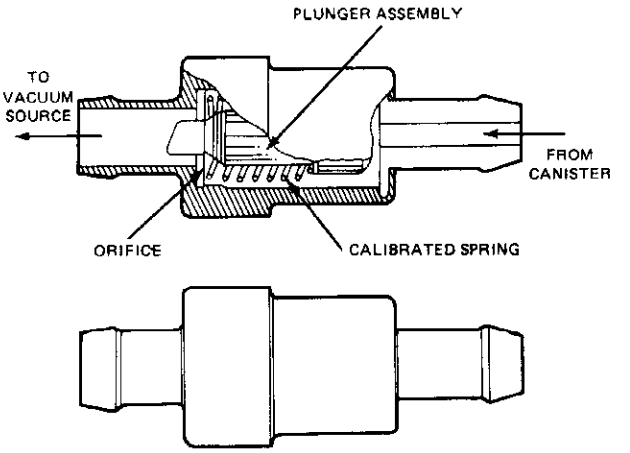


FIG. 10 Purge Regulator Valve

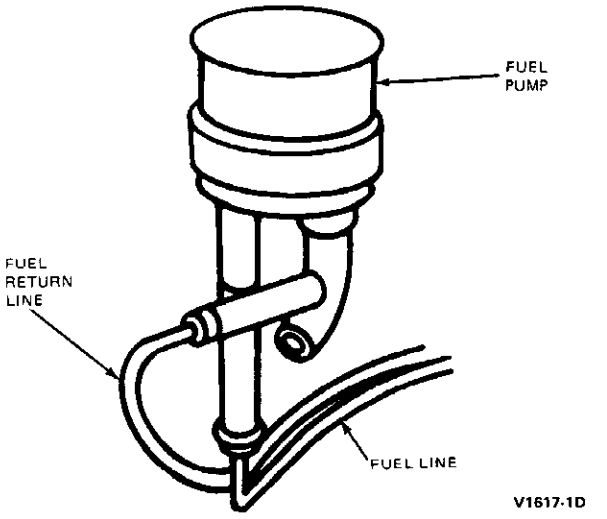


FIG. 11 Fuel Pump Vapor Separator

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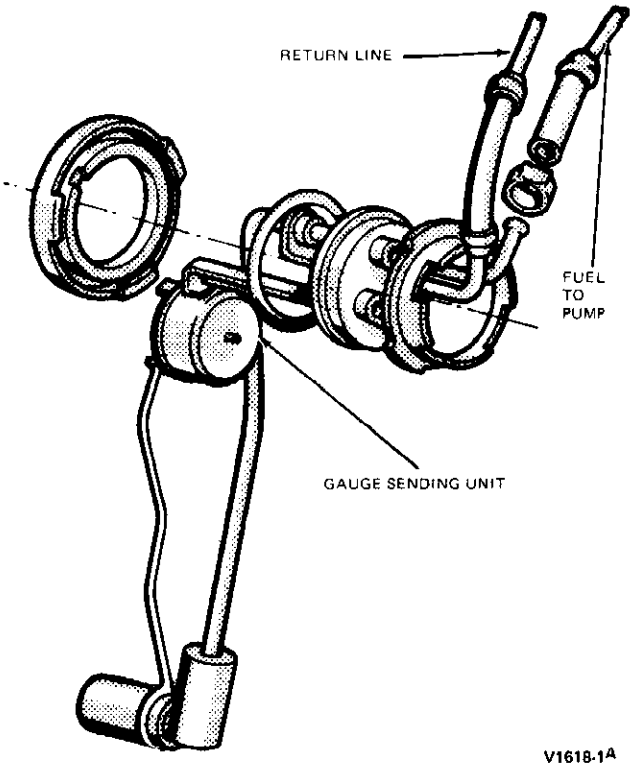


FIG. 12 Fuel Return Line Connections At Sender Unit

AUXILIARY FUEL TANK

On all Mustang II equipped with the 5.0L (302 CID) V-8 engine, a separate auxiliary fuel tank is required (see Fig. 20).

Component parts required with Mustang II auxiliary fuel tanks include an upper filler pipe with rubber seal, lower filler pipe with hose connection between the auxiliary tank and main tank, a vapor separator, fill vent tube connector (in main and auxiliary tanks and connected by vent pipe and section of hose) and a restraining strap and hose clamps to complete the system between the fill opening and the main tank. The fuel/vapor separator is connected to the carbon canister. The fill vent tube connector is attached to another connector in the main tank. A unique retaining strap is also used on Mustang auxiliary tanks. When the bolt is torqued to 25-35 ft-lbs, the strap is properly positioned and becomes "bottomed out" on the outer wheel housing (Fig. 20).

DIAGNOSIS

Physical damage, leaks, and missing items are the major answers to diagnosis of emission system complaints. Fill cap damage or contamination that renders the pressure-vacuum valve inoperative may result in deformation of the tank. Care should always be exercised to be sure that a proper fill cap (in working order) is used.

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REMOVAL AND INSTALLATION

MAIN FUEL TANKS

All component parts of the standard fuel system are serviced by a simple nut, bolt, or screw part removal and installation. Refer to individual systems drawings for specific part references.

AUXILIARY FUEL TANK

NOTE: Removal and installation procedures described here may also be required when removing and installing main fuel tanks associated with these auxiliary tanks. Connecting hoses and tubes will require following some of the steps, if only for removal and installation of common parts.

Mustang II vehicles will require care during auxiliary tank removal to ensure that the fuel level in the main tank is below the auxiliary fill pipe connection before it is disconnected. The main tank should be drained below the fill pipe by disconnecting the fuel sending unit hose at the point where it connects to the fuel line leading to the fuel pump.

MUSTANG II (SEE FIG. 20)

Removal

1. Siphon or pump out the auxiliary fuel tank.
2. Remove the four screws holding the filler tube to the body sheet metal at the fill opening. Remove the filler tube.
3. Inside the left rear wheelhousing, remove the three bolts holding the inner splash panel that covers the auxiliary fuel tank. Remove the panel.
4. Disconnect the hose between the main tank fuel sending unit and the fuel line at the fuel line. Drain a sufficient quantity of fuel to drop the main tank level below the auxiliary tank fill pipe connection.
5. Loosen the two clamps that hold the rubber hose located on the filler tube between the auxiliary and main tank.
6. Carefully slide the rubber hose off the auxiliary tank and downward on the metal pipe attached to the main fuel tank. It may be necessary to put a drain can under the rubber hose during this operation to catch any gasoline that might be left in the auxiliary tank.
7. Remove the screw holding the auxiliary fuel tank retaining strap and remove the strap.
8. Lower the tank until the clamp holding the boot to the fill tube neck of the auxiliary tank can be loosened and the rubber boot removed.
9. Continue to lower the tank until the vapor separator and fill vent tube connector can be disengaged from the top of the tank.
10. Remove the auxiliary tank from the vehicle.

Installation

1. Install the vapor separator and fill vent tube connector, then the fill tube neck rubber boot using clamp 380153-S8. Be sure to correctly align the locating notch in the boot with the locating rib on the tank filler neck. Tighten the boot clamp and position the tank in the fender well.
2. Raise the tank sufficiently to install the rubber boot to the lip of the filler tube opening in the quarter panel.
3. Attach the tank retaining strap and loosely install the strap attaching screw.
4. Slide the rubber hose connecting the main and auxiliary tanks into position over the auxiliary tank outlet neck. Tighten the hose clamps and the tank retaining strap screw. Atttach the hose from the fuel sending unit (on the main tank) to the fuel line using a new hose clamp.
5. Install the fuel filler tube into the auxiliary tank and attach the tube flange to the body sheet metal with the four attaching screws.

The removal/installation procedure will also be used in conjunction with removal/installation of the main fuel tank either in part or in its entirety to enable draining of the main tank for servicing.

MAJOR REPAIR OPERATIONS

MAIN FUEL TANKS

Fuel emission type fuel tanks do not require special repair procedures and may be steam-cleaned and/or repaired using standard procedures. After steaming, allow to thoroughly air dry. The orificed vapor separator assembly should be replaced, if found to be damaged or inoperative.

AUXILIARY FUEL TANKS

Maintenance and repair consists of replacement of damaged parts and cleaning. Repairs to the auxiliary tank are not possible inasmuch as the material used for construction is high density polyethylene. Tanks that are damaged should be replaced. Cleaning of a tank is accomplished using a detergent solution to thoroughly flush the tank and clean water rinsing until all detergent is removed. The tank must be completely dry prior to re-installing in the system.

AUXILIARY FUEL TANKS MUST NOT BE STEAM CLEANED OR EXPOSED TO EXTREME HEAT OF ANY KIND.

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FUEL LINES

REPAIR

With the exception of the pump-to-carburetor fuel supply tubes (Fig. 13) the various fuel lines are not serviced as assemblies. They must be cut, squared and formed out of rolls of fuel system service tubing and hose material available at dealerships.

A damaged section of tubing longer than 12 inches can be cut out of the existing line and replaced by a comparable metal service tubing section, spliced into the line by means of connecting hoses and retaining clamps. A damaged section of tubing shorter than 12 inches can be cut out of the line and replaced by a length of service hose and two retaining clamps.

All replacement hoses must be cut to a length that will assure proper clamp retention beyond the flared ends of the connecting tubing.

Removal

1. Drain the fuel from the tank.
2. Disconnect the line at the fuel gauge sender unit and the fuel pump. Remove the lines from the holding clips along the underbody. Remove all damaged hose sections and tube sections.

Installation

1. Cut a new section of tubing to approximately the same length as the section to be replaced. Allow extra length for flaring the ends of the tubing. Square the ends of the cut tubing with a file.
2. Ream the inside edges of the cut tubing with the reamer blade on the tube cutter. Be sure metal chips are removed from inside the tube(s). Double flare the ends of the cut tubing, as required.
3. Bend the tube section to conform to the contour of the original tube. Cut an ample length of hose to form a coupling between the flared ends of the fuel lines. Connect the hose couplings to the tubing and install the retaining clamps.
4. Position the lines in the underbody clips and tighten the clips. Connect the line to the fuel gauge sender unit and the fuel pump. Fill the tank and check for leaks.

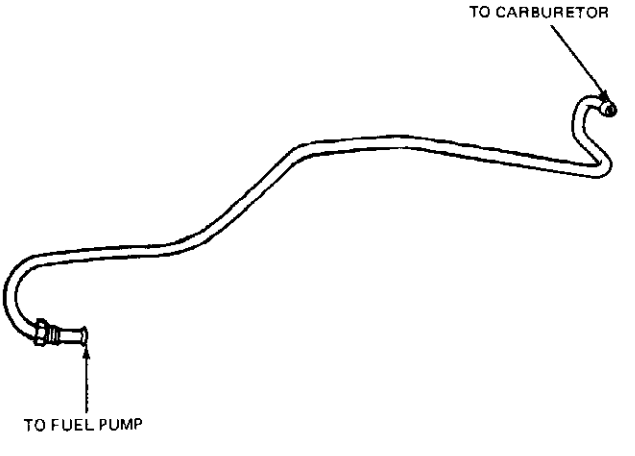
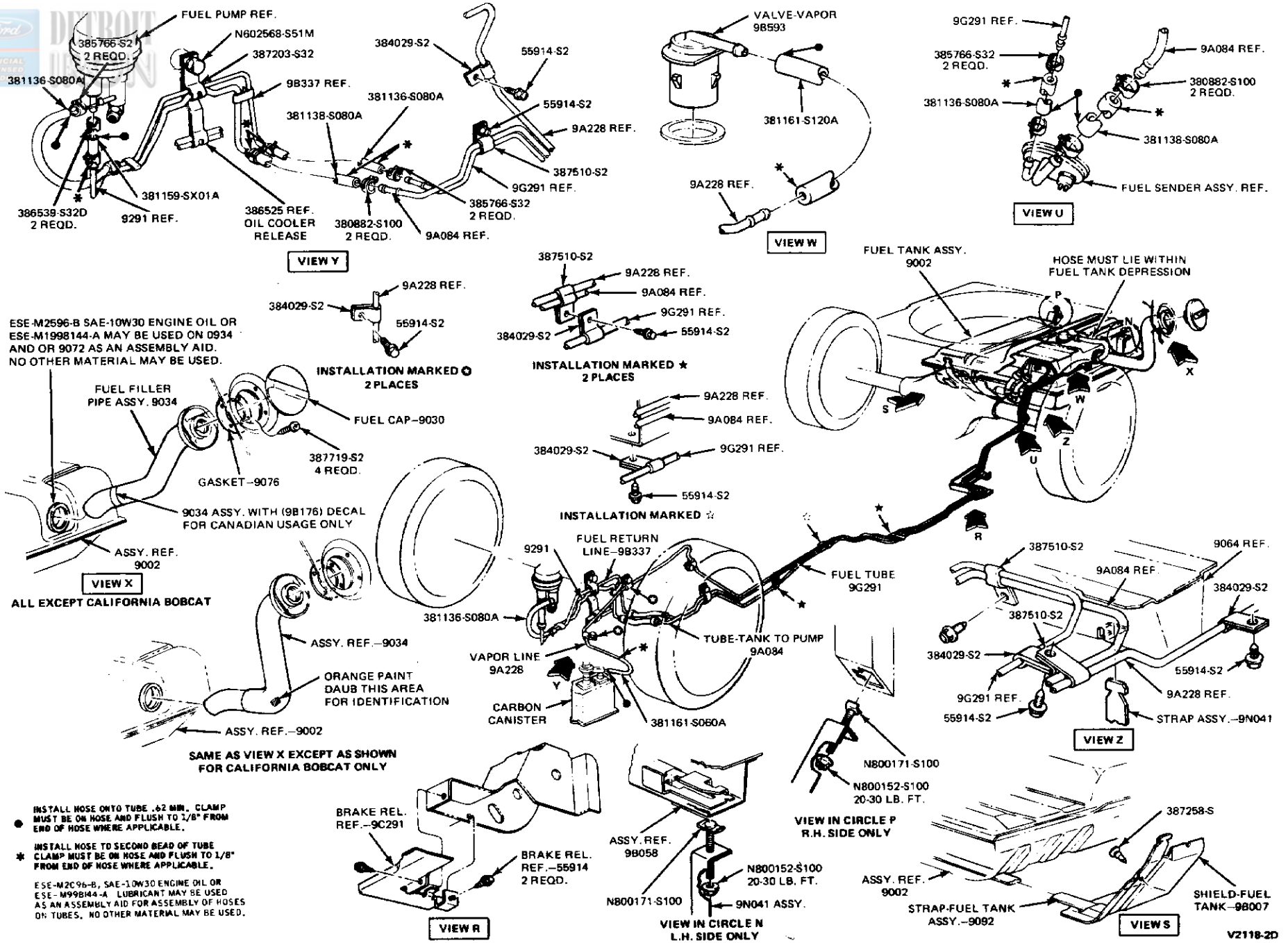


FIG. 13 Fuel Supply Tube Assembly

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● INSTALL HOSE ONTO TUBE .62 MIN. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

✱ INSTALL HOSE TO SECOND BEAD OF TUBE CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE-10W30 ENGINE OIL OR ESE-M99B144-A LUBRICANT MAY BE USED AS AN ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

FIG. 14 Fuel and Vapor Emission Control Systems — Pinto and Bobcat Sedan W/2.3L I-4

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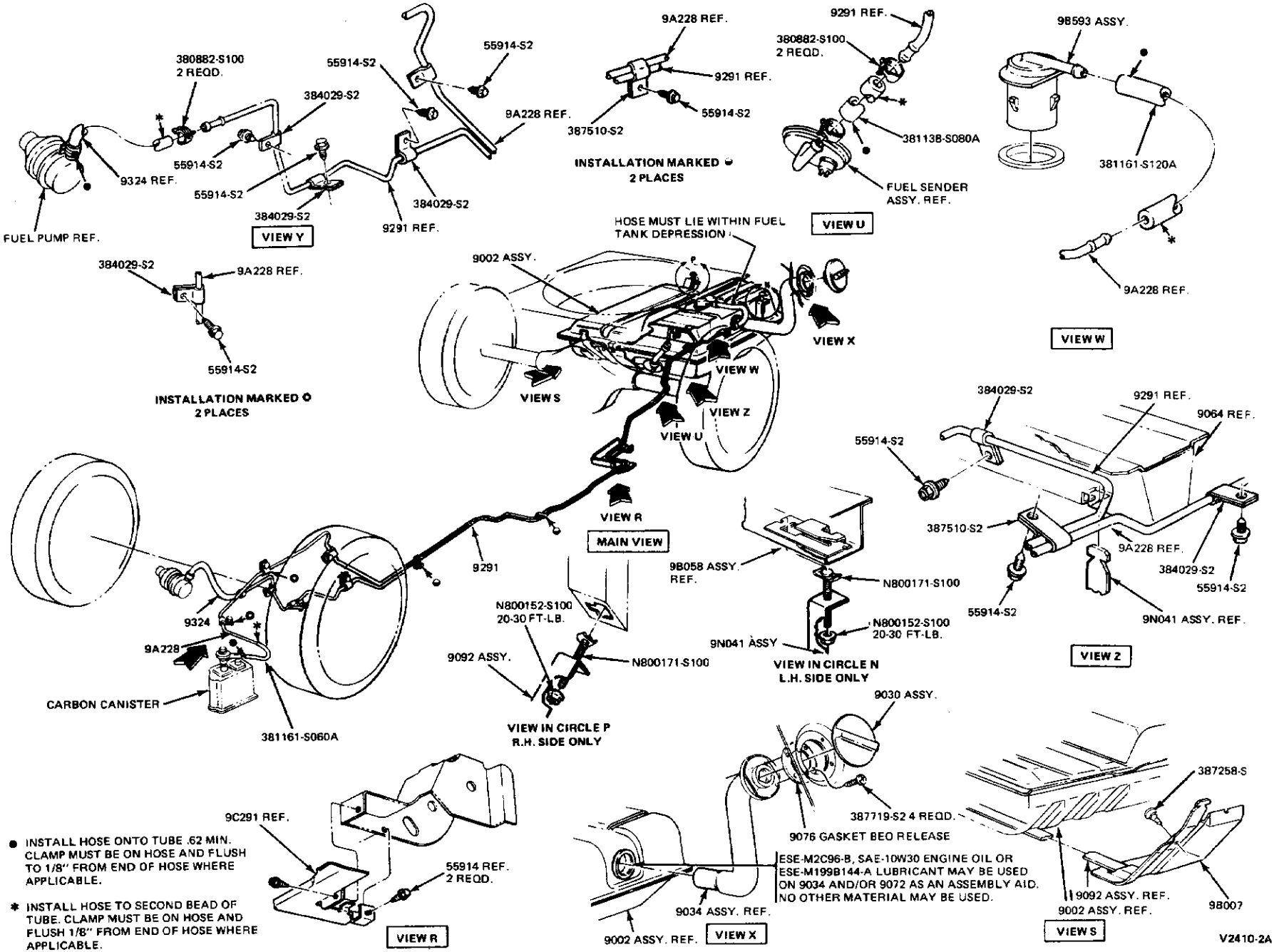


FIG. 15 Fuel and Vapor Emission Control Systems — Pinto and Bobcat Sedan w/2.8L V-6

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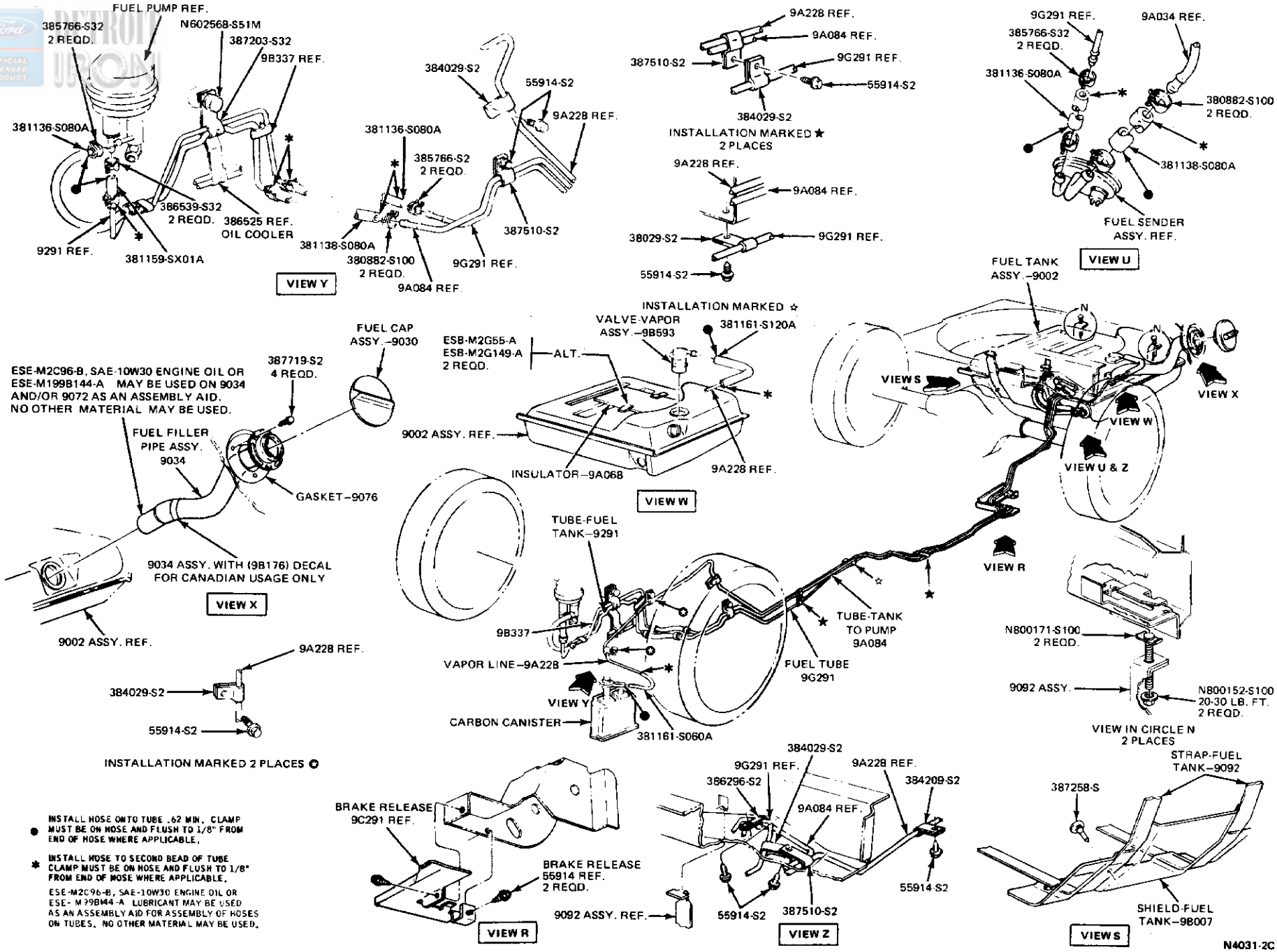
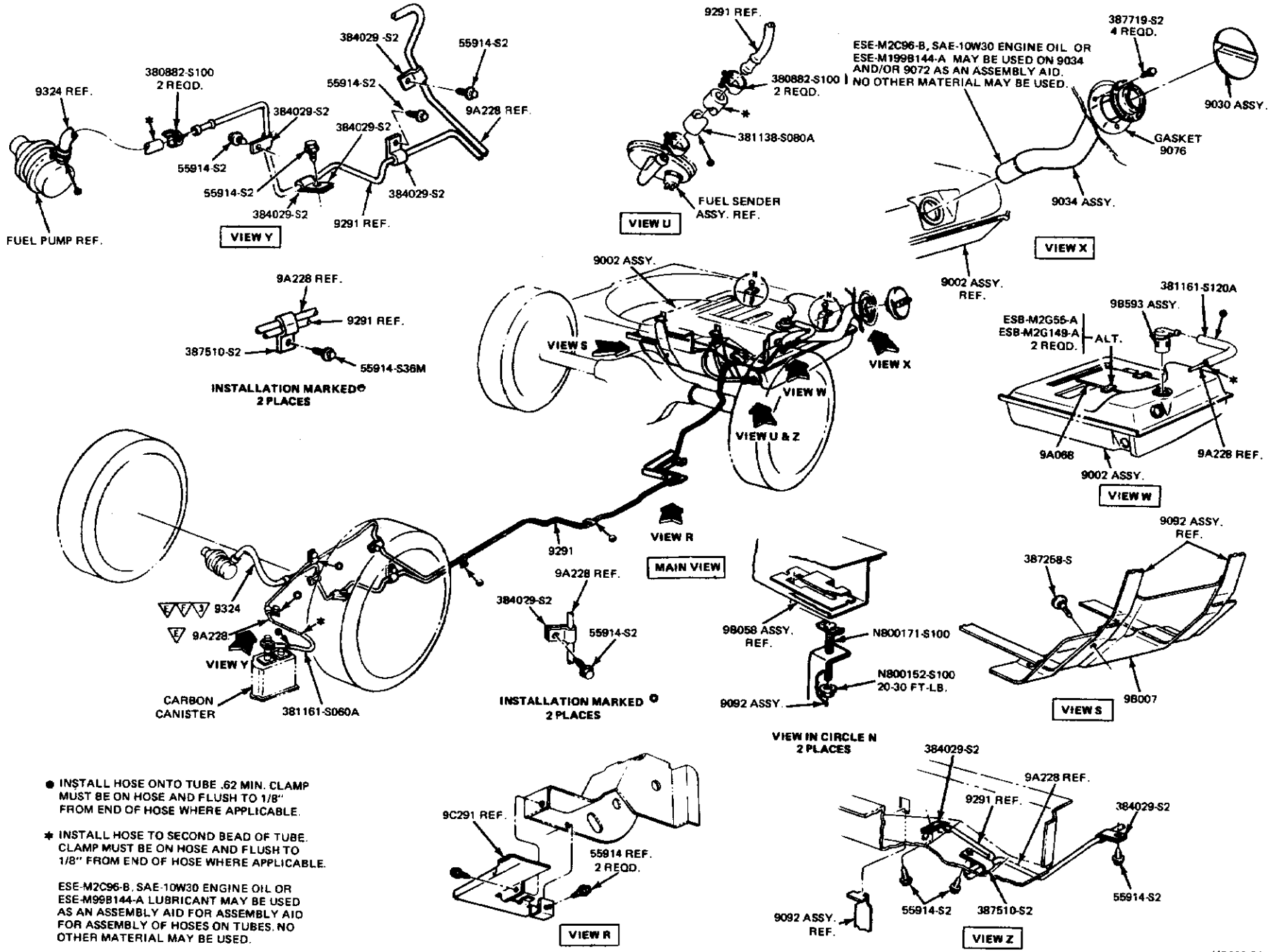


FIG. 16 Fuel and Vapor Emission Control System — Pinto and Bobcat Wagon w/2.3L I-4

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● INSTALL HOSE ONTO TUBE .62 MIN. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

✱ INSTALL HOSE TO SECOND BEAD OF TUBE. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE-10W30 ENGINE OIL OR ESE-M99B144-A LUBRICANT MAY BE USED AS AN ASSEMBLY AID FOR ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

FIG. 17 Fuel and Vapor Emission Control Systems — Pinto and Bobcat Wagon w/2.8L I-4

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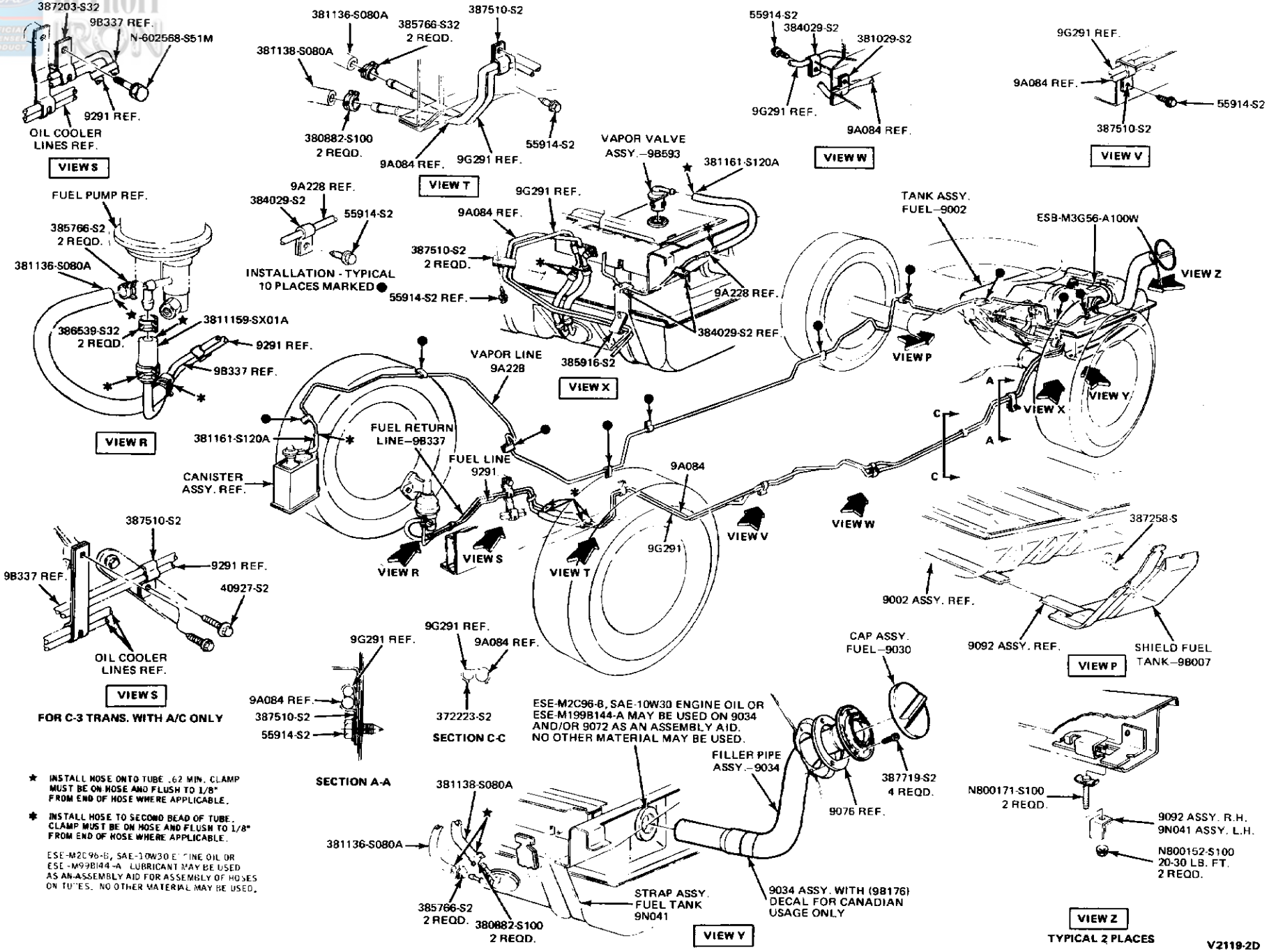


FIG. 18 Fuel and Vapor Emission Control Systems — Mustang II w/2.3L I-4

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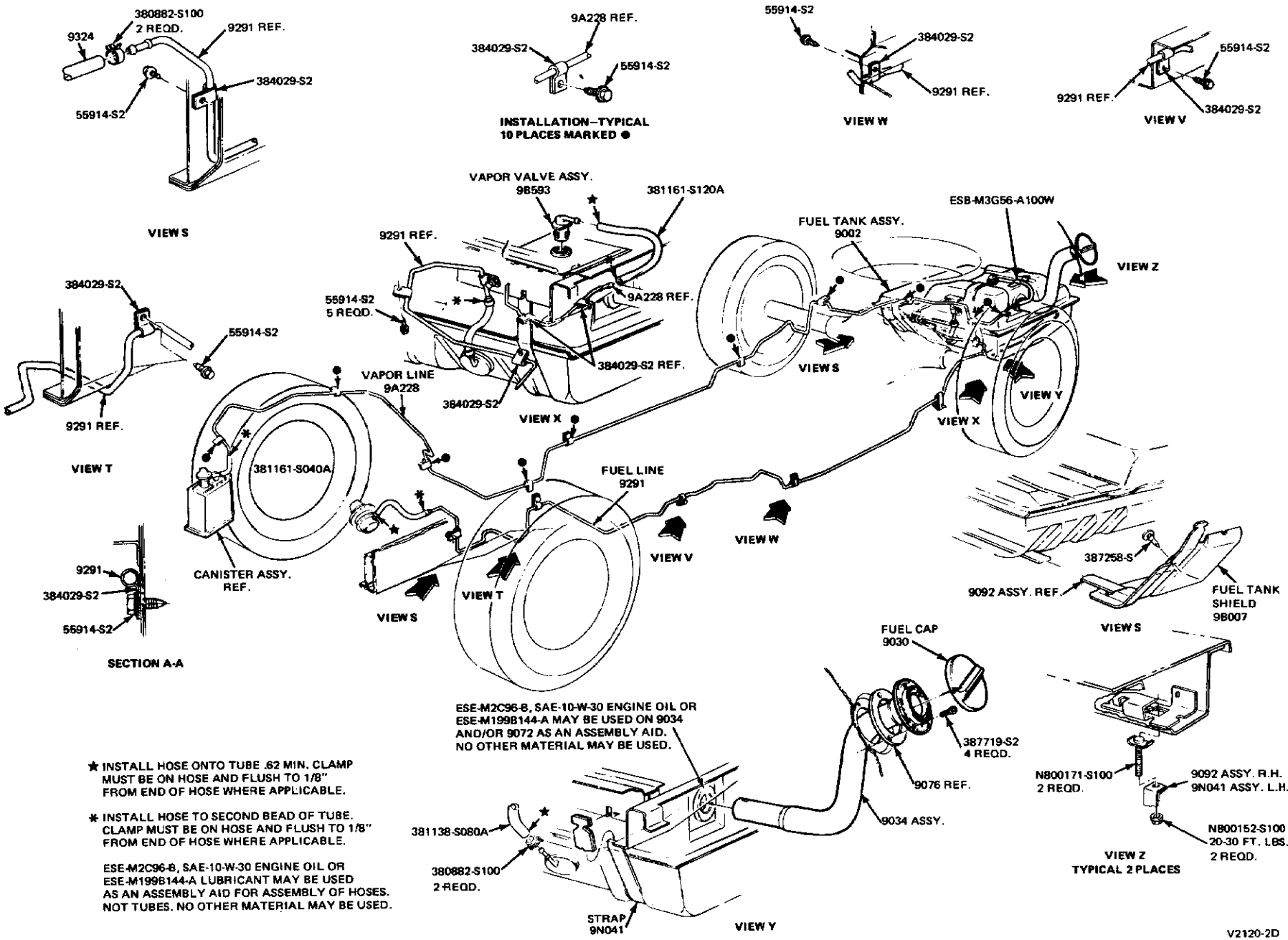
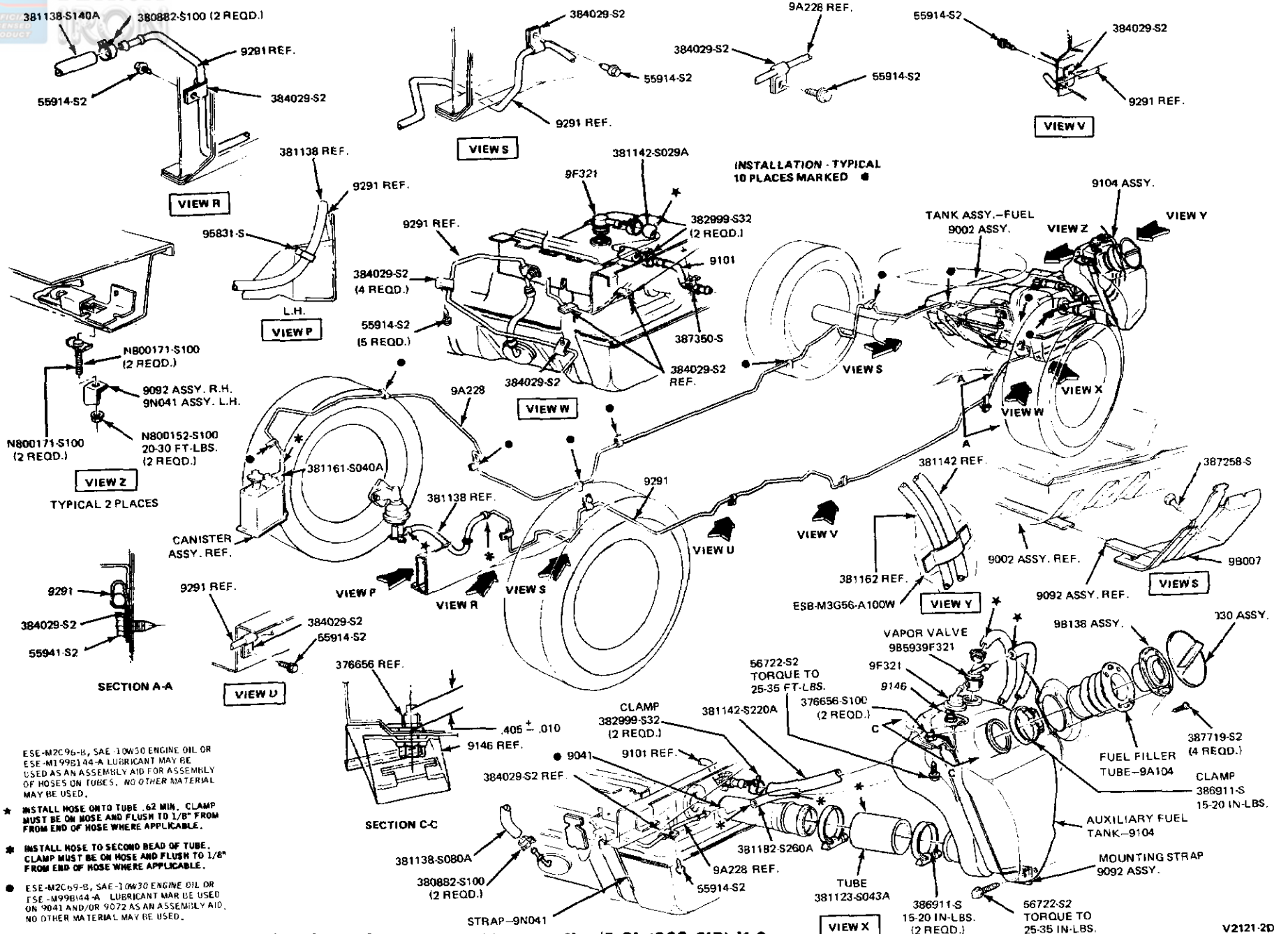


FIG. 19 Fuel and Vapor Emission Control Systems — Mustang II w/2.8L V-6

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ESE-M2C96-B, SAE 10W30 ENGINE OIL OR ESE-M1998144-A LUBRICANT MAY BE USED AS AN ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

★ INSTALL HOSE ONTO TUBE .62 MIN. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM FROM END OF HOSE WHERE APPLICABLE.

✱ INSTALL HOSE TO SECOND BEAD OF TUBE. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

● ESE-M2C69-B, SAE 10W30 ENGINE OIL OR ESE-M99B144-A LUBRICANT MAR BE USED ON 9041 AND/OR 9072 AS AN ASSEMBLY AID. NO OTHER MATERIAL MAY BE USED.

FIG. 20 Fuel and Vapor Emission Control Systems — Mustang II w/5.0L (302 CID) V-8

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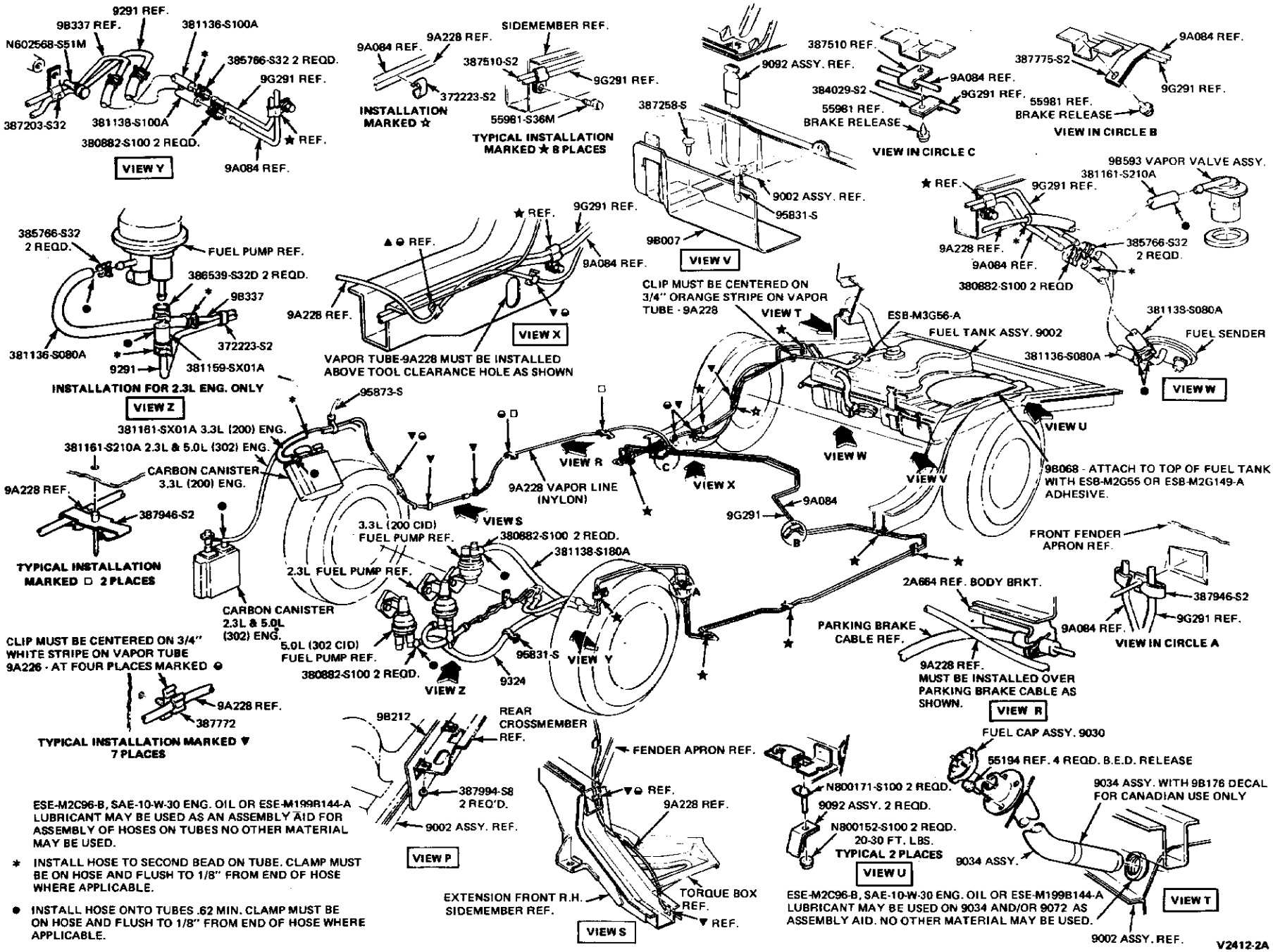
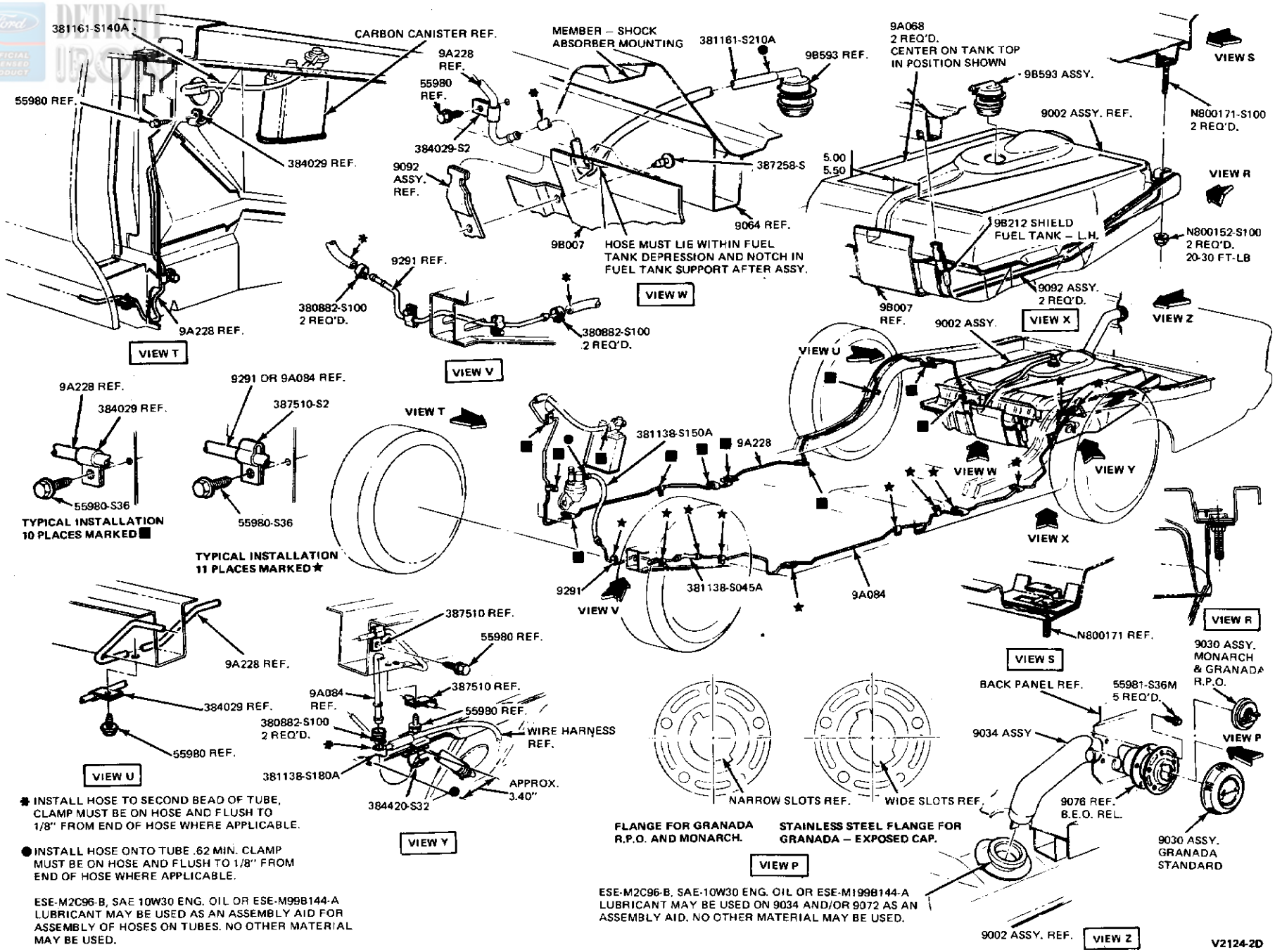


FIG. 21 Fuel and Vapor Emission Control Systems — Fairmont and Zephyr

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★ INSTALL HOSE TO SECOND BEAD OF TUBE, CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

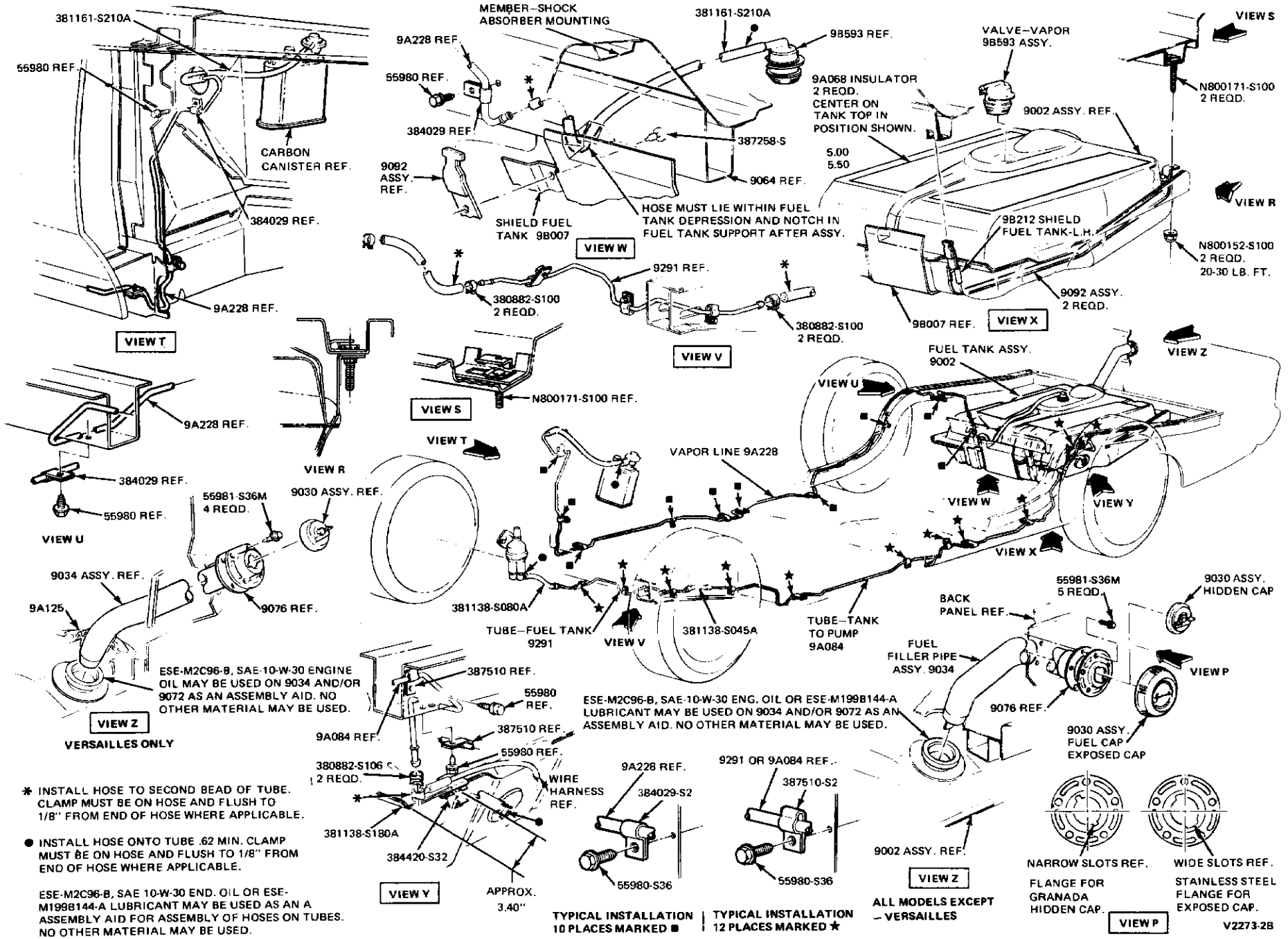
● INSTALL HOSE ONTO TUBE .62 MIN. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE 10W30 ENG. OIL OR ESE-M99B144-A LUBRICANT MAY BE USED AS AN ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

ESE-M2C96-B, SAE-10W30 ENG. OIL OR ESE-M1998144-A LUBRICANT MAY BE USED ON 9034 AND/OR 9072 AS AN ASSEMBLY AID. NO OTHER MATERIAL MAY BE USED.

FIG. 22 Fuel and Vapor Emission Control System — Granada and Monarch w/4.1L (250 CID) I-6

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* INSTALL HOSE TO SECOND BEAD OF TUBE. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

● INSTALL HOSE ONTO TUBE .62 MIN. CLAMP MUST BE ON HOSE AND FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE 10-W-30 END. OIL OR ESE-M1998144-A LUBRICANT MAY BE USED AS AN A ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

FIG. 23 Fuel and Vapor Emission Control System — Granada, Monarch and Versailles w/5.0L (302 CID) V-8

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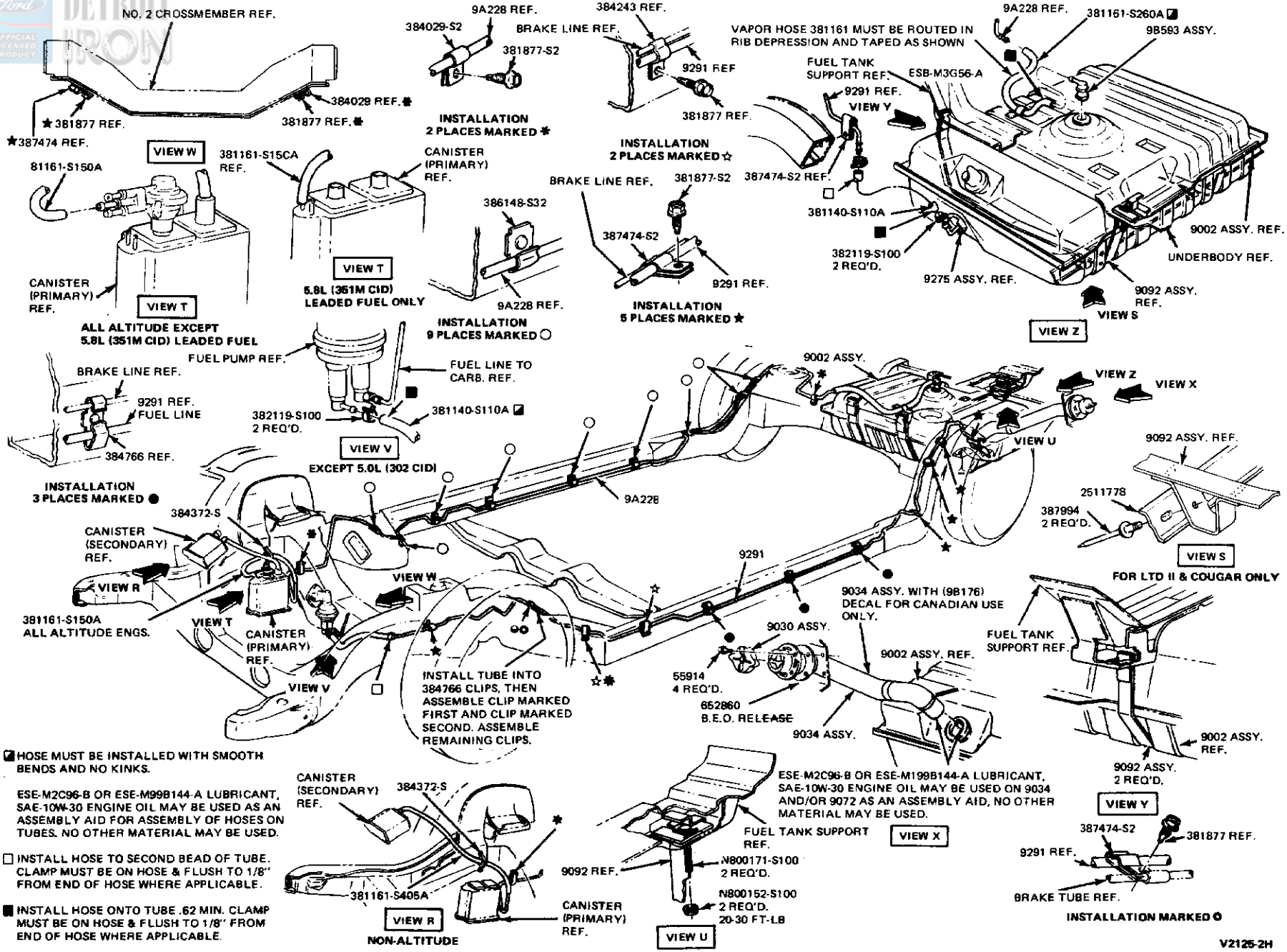


FIG. 24 Fuel and Vapor Emission Control System — LTD II, Cougar and Thunderbird

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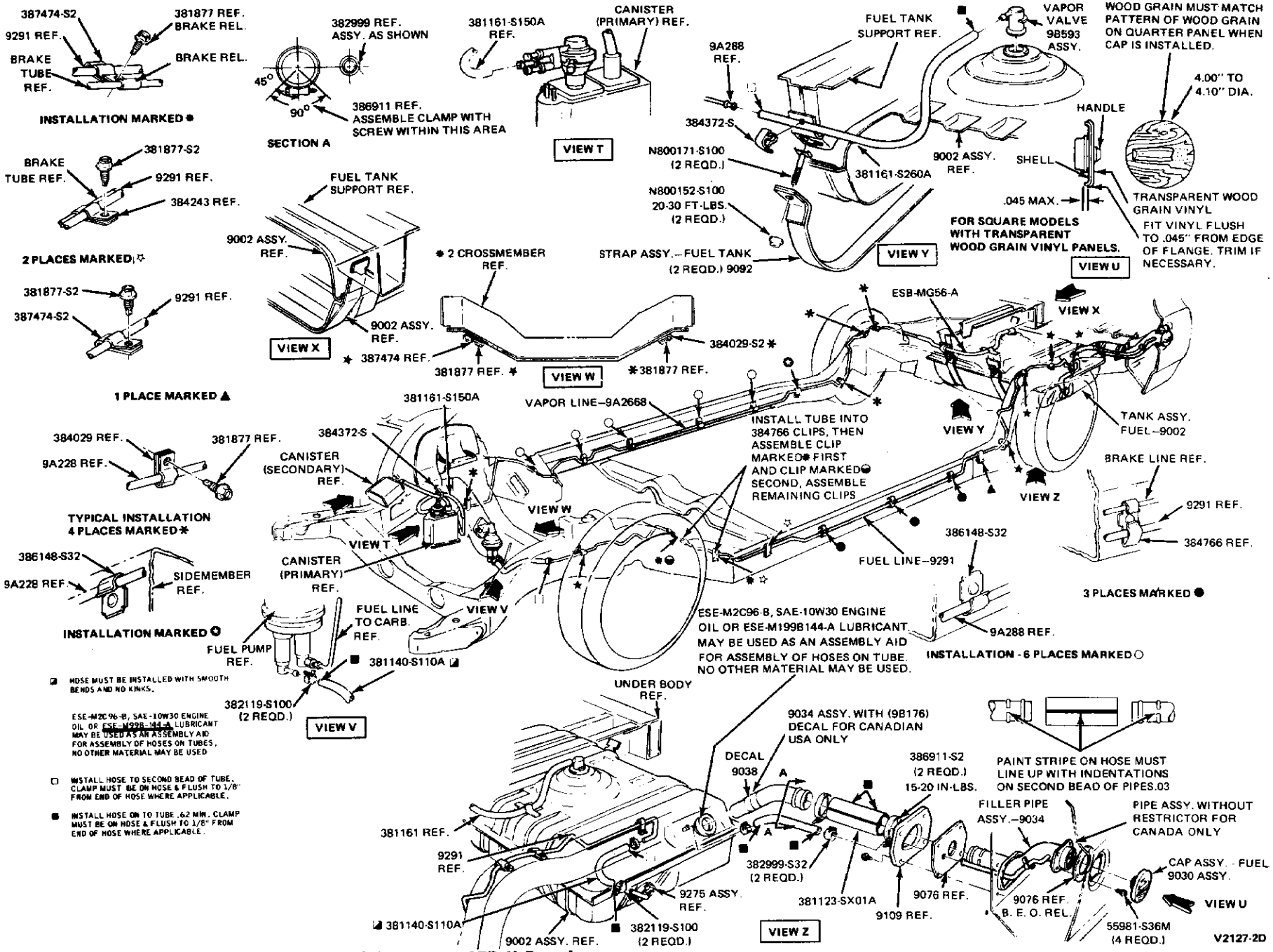


FIG. 25 Fuel and Vapor Emission Control System — LTD II Ranchero

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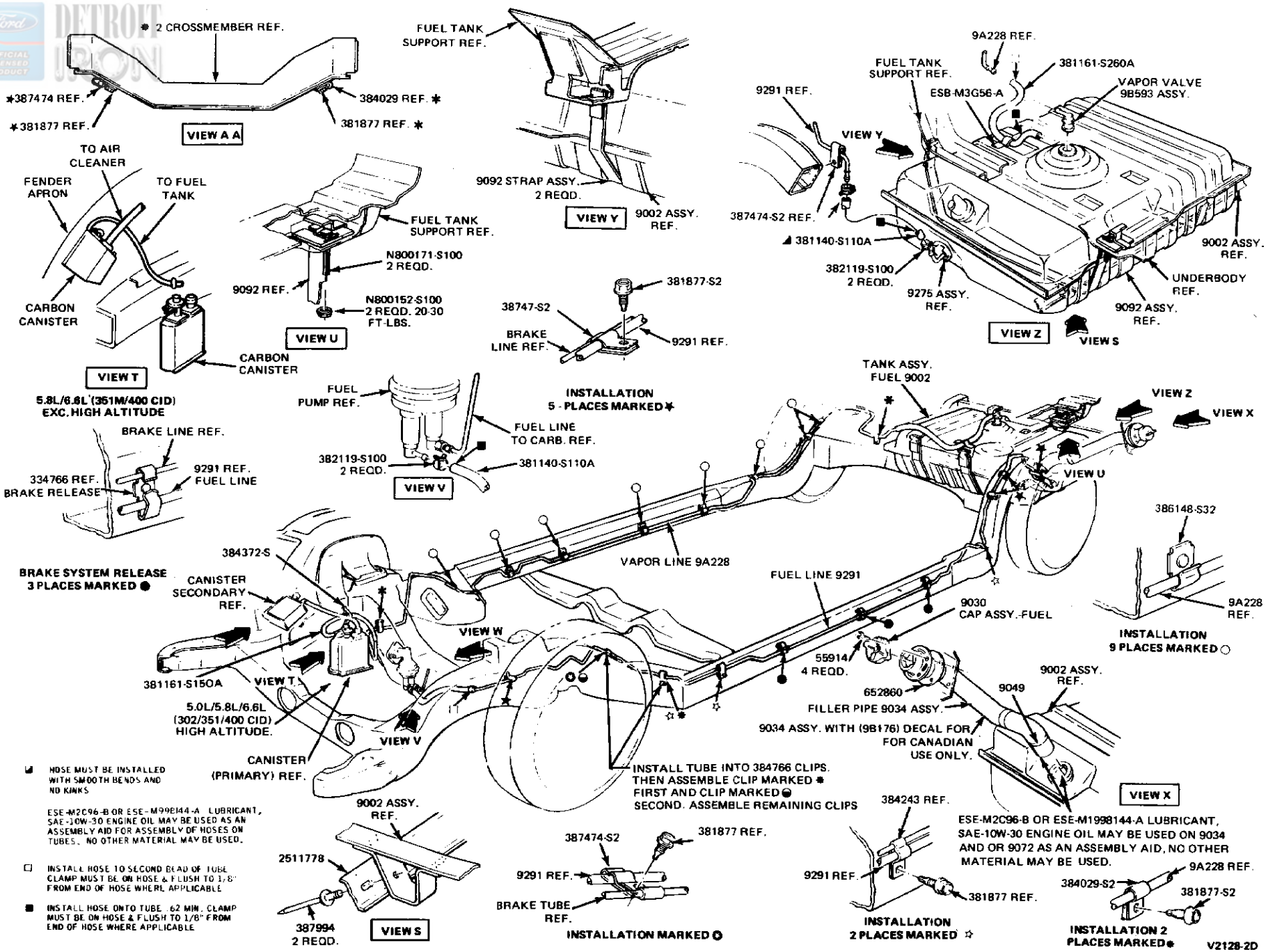
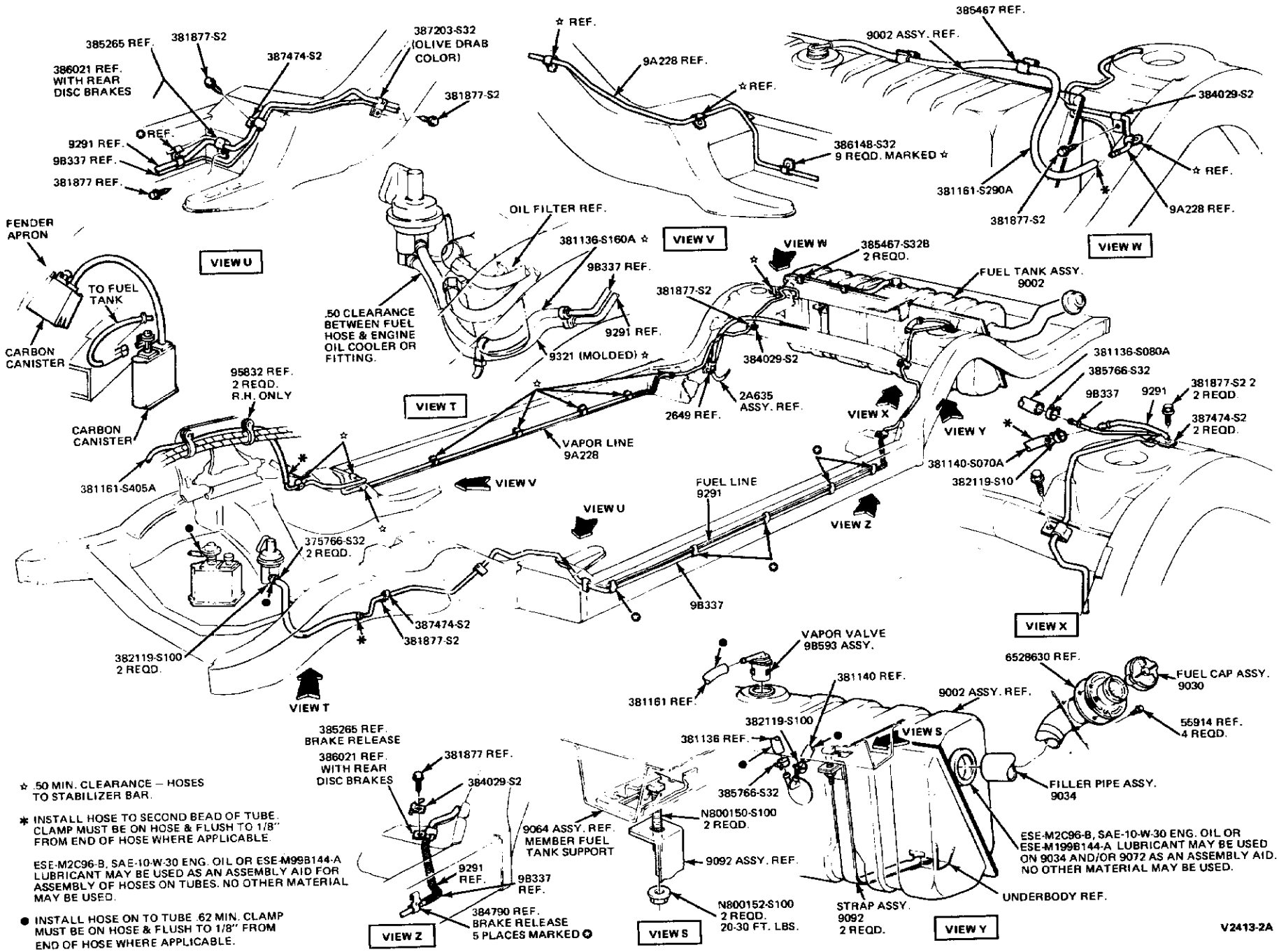


FIG. 26 Fuel and Vapor Emission Control System — Ford and Mercury Sedan (Except Police Interceptor 7.5L (460 CID) V-8

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☆ .50 MIN. CLEARANCE — HOSES TO STABILIZER BAR.

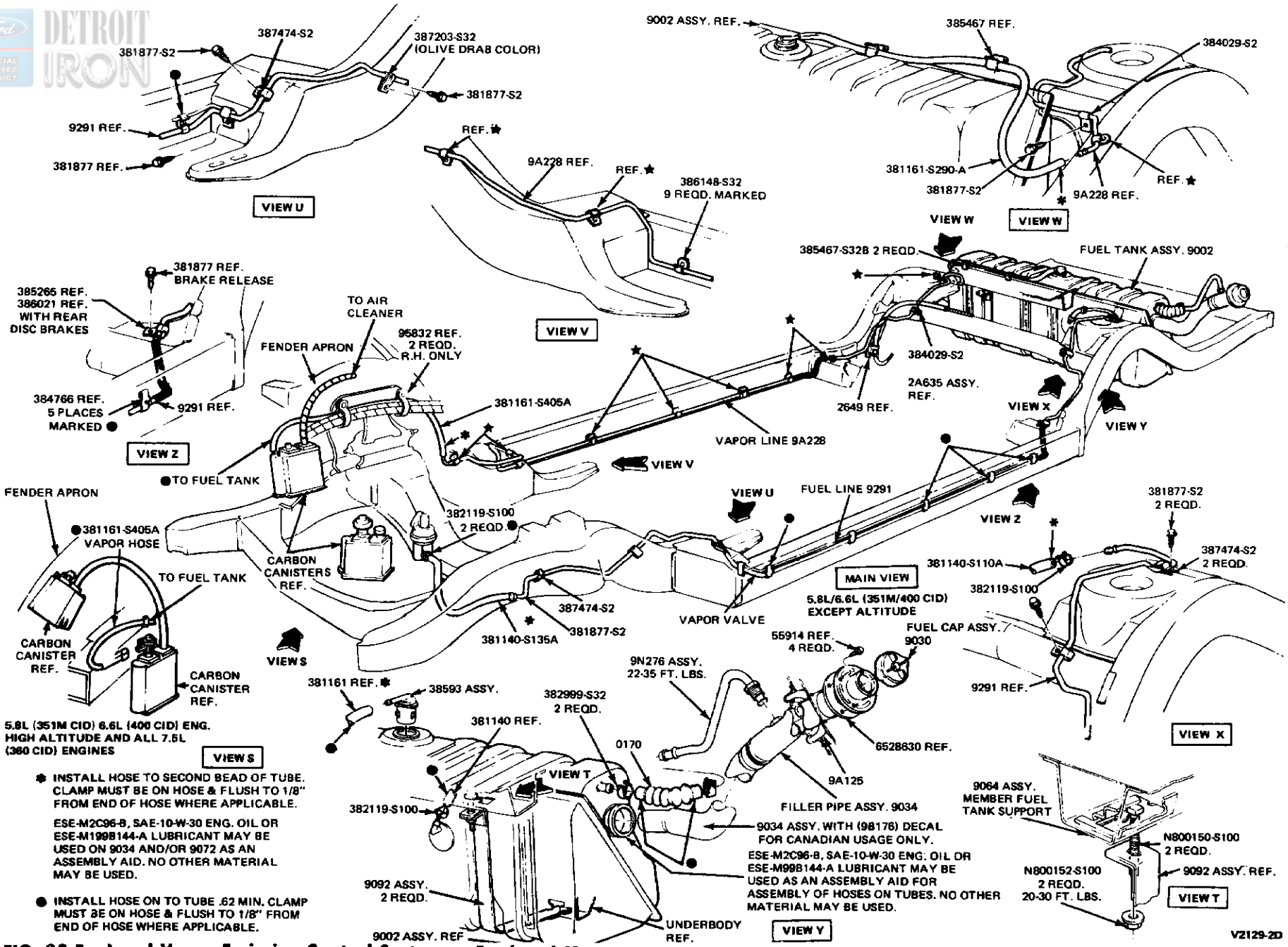
✱ INSTALL HOSE TO SECOND BEAD OF TUBE. CLAMP MUST BE ON HOSE & FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE-10-W-30 ENG. OIL OR ESE-M99B144-A LUBRICANT MAY BE USED AS AN ASSEMBLY AID FOR ASSEMBLY OF HOSES ON TUBES. NO OTHER MATERIAL MAY BE USED.

● INSTALL HOSE ON TO TUBE .62 MIN. CLAMP MUST BE ON HOSE & FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

FIG. 27 Fuel and Vapor Emission Control System — Ford and Mercury Sedan w/7.5L (460 CID) Police Interceptor V-8

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✱ INSTALL HOSE TO SECOND BEAD OF TUBE. CLAMP MUST BE ON HOSE & FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

ESE-M2C96-B, SAE-10-W-30 ENG. OIL OR ESE-M199B144-A LUBRICANT MAY BE USED ON 9034 AND/OR 9072 AS AN ASSEMBLY AID. NO OTHER MATERIAL MAY BE USED.

● INSTALL HOSE ON TO TUBE .62 MIN. CLAMP MUST BE ON HOSE & FLUSH TO 1/8" FROM END OF HOSE WHERE APPLICABLE.

FIG. 28 Fuel and Vapor Emission Control System — Ford and Mercury Wagon

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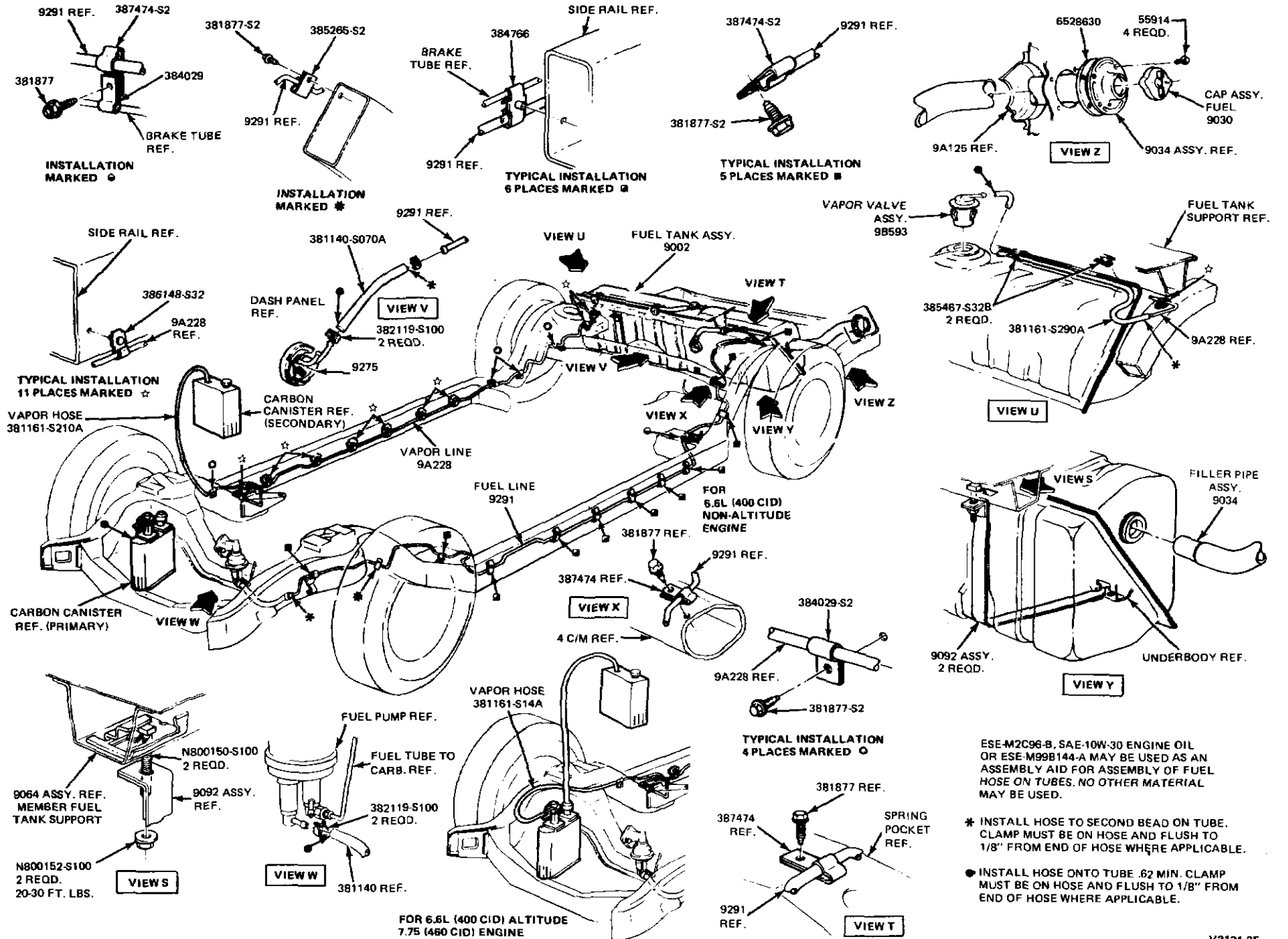


FIG. 29 Fuel and Vapor Emission Control System — Lincoln Continental

24-50-25

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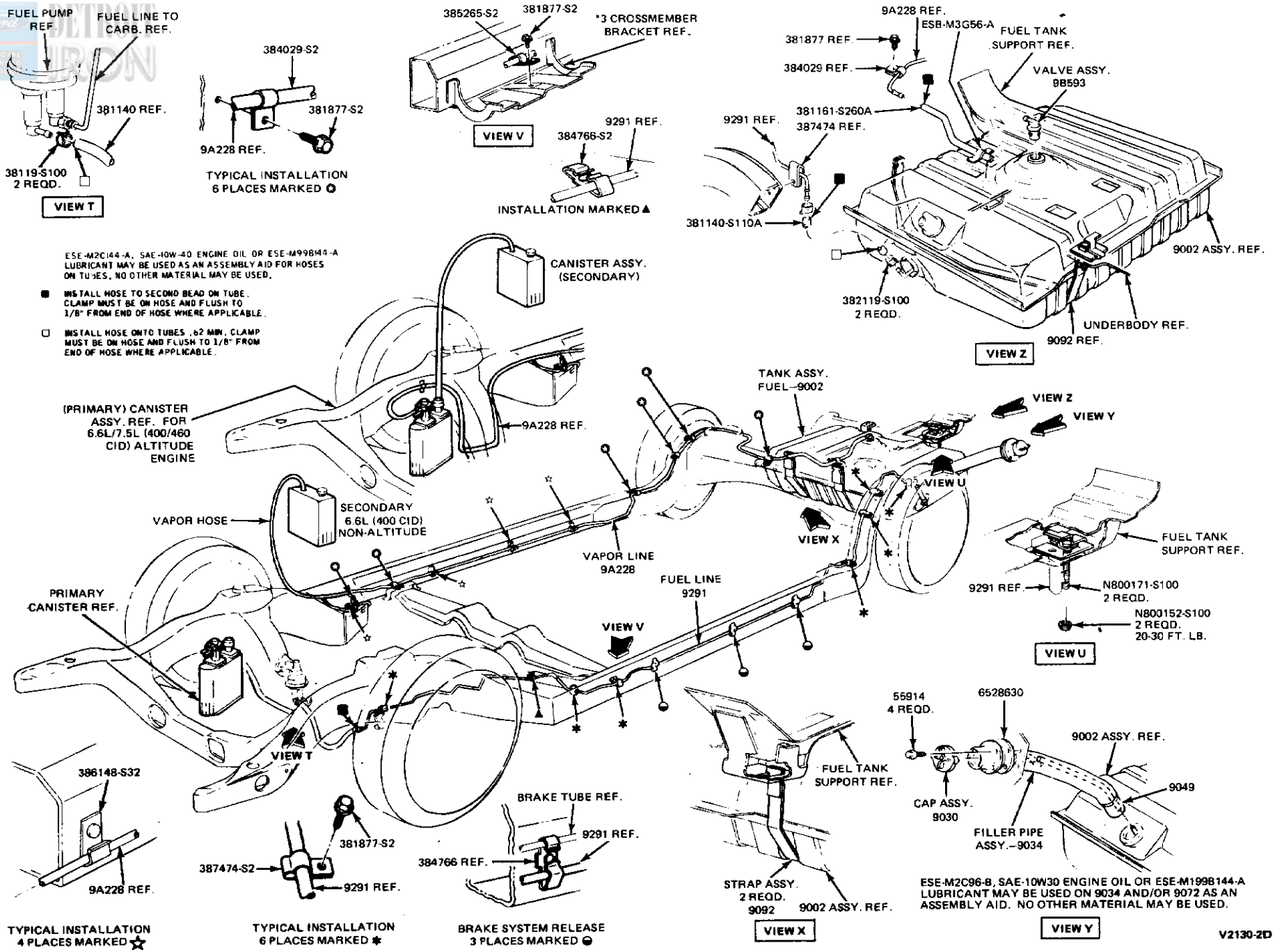


FIG. 30 Fuel and Vapor Emission Control System — Continental Mark V

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SPECIFICATONS

Car Line	Model/Usage	Approximate *Fuel Tank Capacity* (In U.S. Gallons) Usable	Car Line	Model/Usage	Approximate *Fuel Tank Capacity* (In U.S. Gallons) Usable
Bobcat	2.3L Calif. Sedan	11.7	LTD II/Cougar	All sedans	21.0
Pinto/Bobcat	All sedans except 2.3L Calif. Bobcat	13.0	Ranchero	All	26.0
			Thunderbird	All	21.0
Pinto/Bobcat	All station wagons	14.0	Mark V	All	25.0
Mustang II	Except 5.0L (302 CID) V-8	13.0	Ford/Mercury	All sedans	24.2
Mustang II	5.0L (302 CID) V-8 with Auxiliary fuel tank	16.5	Ford/Mercury	All station wagons	21.0
			Lincoln	All	24.2
Fairmont/Zephyr	All	16.0	Versailles	All	18.2
Granada/Monarch	All	18.0			

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Fuel Filter

PART 24-51

DESCRIPTION

The fuel filters used on all engines except those using the Motorcraft model 2700 VV carburetor are of one-piece construction and cannot be cleaned. The model 2700 VV uses a replaceable element type filter in the fuel inlet of the carburetor. Inside the one-piece filter is a magnet to trap metallic particles which might be present in the fuel. **Replace the filter at the specified service interval or if it becomes clogged or restricted.**

NOTE: When replacing fuel filters, make sure you have the correct one specified for the engine and carburetor being serviced.

REMOVAL AND INSTALLATION

FUEL FILTER

ALL MODELS EXCEPT 2700 VV CARBURETOR, All ENGINES

Removal

1. Remove the air cleaner.
2. Loosen (screw-type) or remove (spring-type) the clamp securing the inlet hose to the fuel filter line. If filter is located in line, loosen or remove outlet hose clamp.
3. Unscrew the fuel filter from the carburetor on those models that are so equipped. Disconnect the fuel filter hose from the metal line and discard the clamp, filter and hose.

Installation

1. Install new clamps on a new inlet hose and connect the hose to the filter and line. Thread the filter into the carburetor inlet port if so equipped. Tighten the filter.
2. Position the fuel line hose clamps and tighten the clamps securely (Fig. 1).
3. Start the engine and check for fuel leaks.

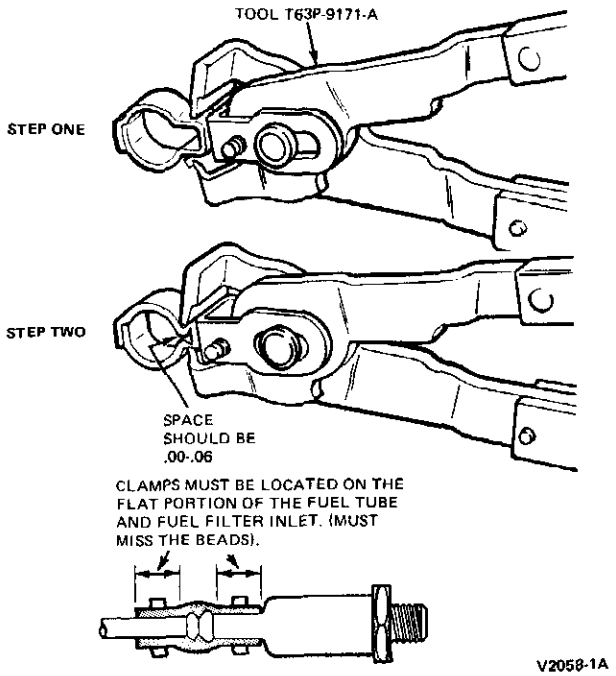


FIG. 1 Installing Crimp—Type Clamps

ENGINES EQUIPPED WITH 2700 VV CARBURETOR

Removal

1. Remove the air cleaner.
2. Loosen (screw-type) or remove (spring-type) the clamp securing the fuel line to the fuel-inlet fitting. Remove the line.
3. Unscrew the fuel-inlet fitting and remove the fuel filter, gasket and spring (Fig. 2).

Installation

1. Install the fuel filter spring, filter, inlet fitting gasket and the gasket into the carburetor.
2. Position the fuel line and clamp onto the fuel inlet fitting and tighten the clamp securely.
3. Start the engine and check for leaks.
4. Replace the air cleaner.

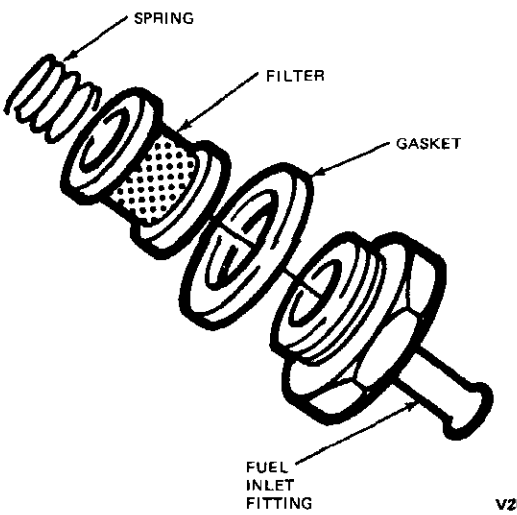


FIG. 2 Model 2700 VV Carburetor—Fuel Filter—Typical

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DETROIT IRON

Throttle Linkage

PART 24-60

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		ADJUSTMENTS (Cont'd.)	
Accelerator Cable	60-1	Accelerator Pedal Assembly	60-1
Accelerator Cable Mounting Bracket	60-1	Downshift Linkage	60-1

CN4043-2A

ADJUSTMENTS

DOWNSHIFT LINKAGE—AUTOMATIC TRANSMISSION

All Models

Adjustment instructions are given on the illustrations, Figs. 1 through 10.

ACCELERATOR CABLE

ALL MODELS

Removal

1. Refer to the applicable illustration.
2. Using a suitable tool, push the accelerator cable nylon bushing out of the accelerator pedal arm. Remove the retaining clip attached to the cable at the dash panel inside the vehicle.
3. Disconnect the accelerator cable at the carburetor throttle lever. Be sure to pull on the connector and not the cable.
4. Disconnect the cable-attaching screw from the engine bracket.
5. Remove the screws attaching the cable to the dash panel.
6. Remove the cable from the dash panel.

Installation

1. Position the cable end through the dash panel and install the attaching screws.
2. Install the cable to the engine mounting bracket with one screw.
3. Connect the cable to the carburetor throttle lever. Install the cable sound absorber attaching clip.
4. Press the snap-in nylon bushing on the accelerator cable into the accelerator pedal arm.

ACCELERATOR CABLE MOUNTING BRACKET

ALL MODELS

Removal

1. Remove the accelerator cable mounting screw. Remove the cable from the bracket.
2. Remove the bolts securing the accelerator cable mounting bracket to the engine. On Pinto/Bobcat and Mustang II 2.3L engines, disconnect automatic transmission kickdown rod (if equipped).

Installation

1. Install the accelerator cable mounting bracket on the engine and torque the attaching bolts to specification. Reinstall the cable and attaching screw. On Pinto/Bobcat and Mustang II 2.3L engines, reconnect automatic transmission kickdown rod (if equipped).

ACCELERATOR PEDAL ASSEMBLY

ALL MODELS

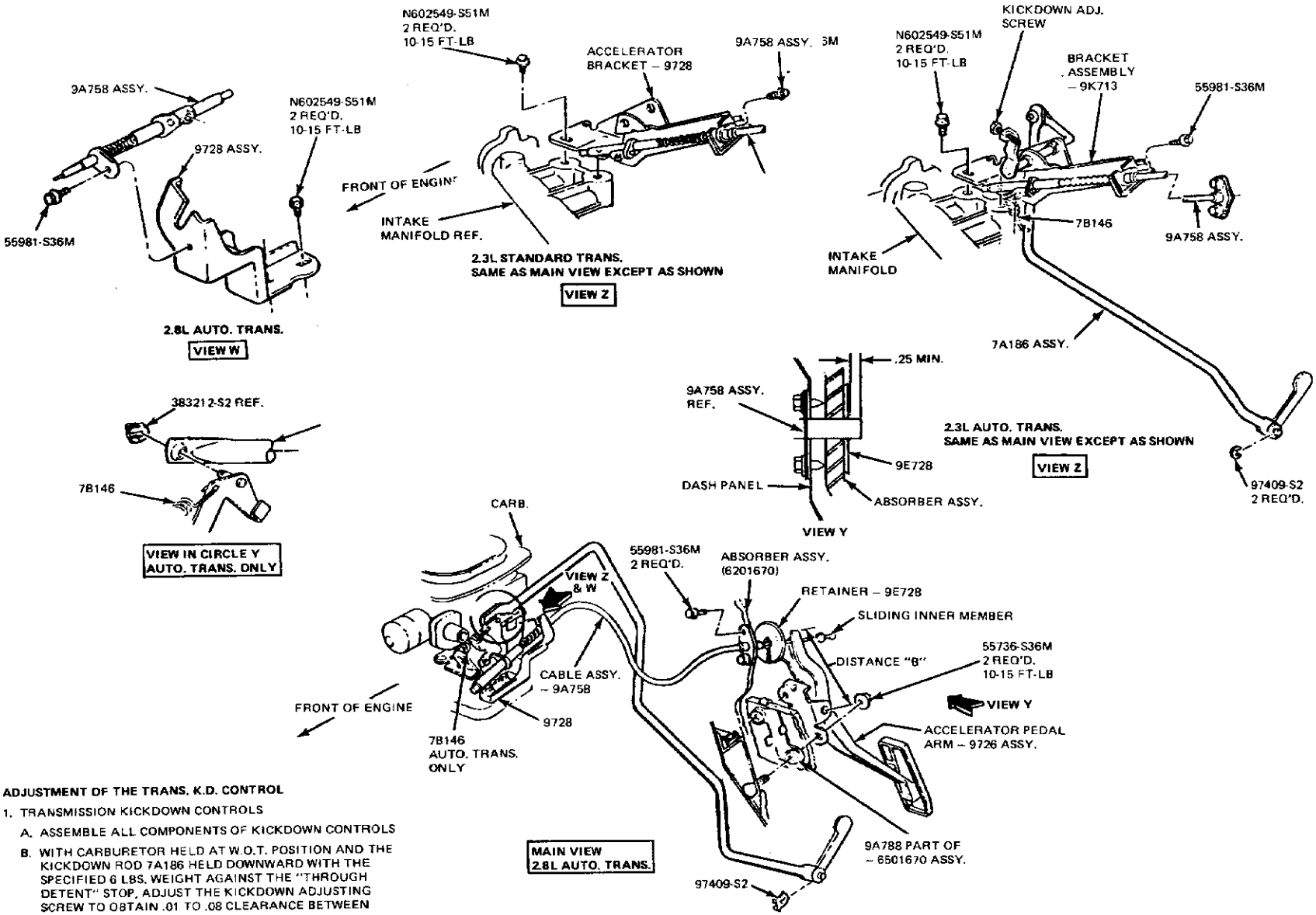
Removal

1. Using a suitable tool, push the accelerator cable nylon bushing out of the accelerator pedal arm.
2. Remove the two nuts attaching the accelerator pedal assembly to the floor.
3. If replacing the assembly and if the vehicle is equipped with a pedal pad cover, uncrimp the pedal pad cover and remove from the pedal.

Installation

1. Install the pedal pad cover, if so equipped, and carefully crimp the retaining tabs.
2. Position the pedal assembly on the two mounting studs and install the two attaching nuts. Check to be sure that carpeting and/or sound deadener is properly assembled. Torque to specifications.
3. Install the snap-in nylon bushing of the accelerator cable into the accelerator pedal arm.

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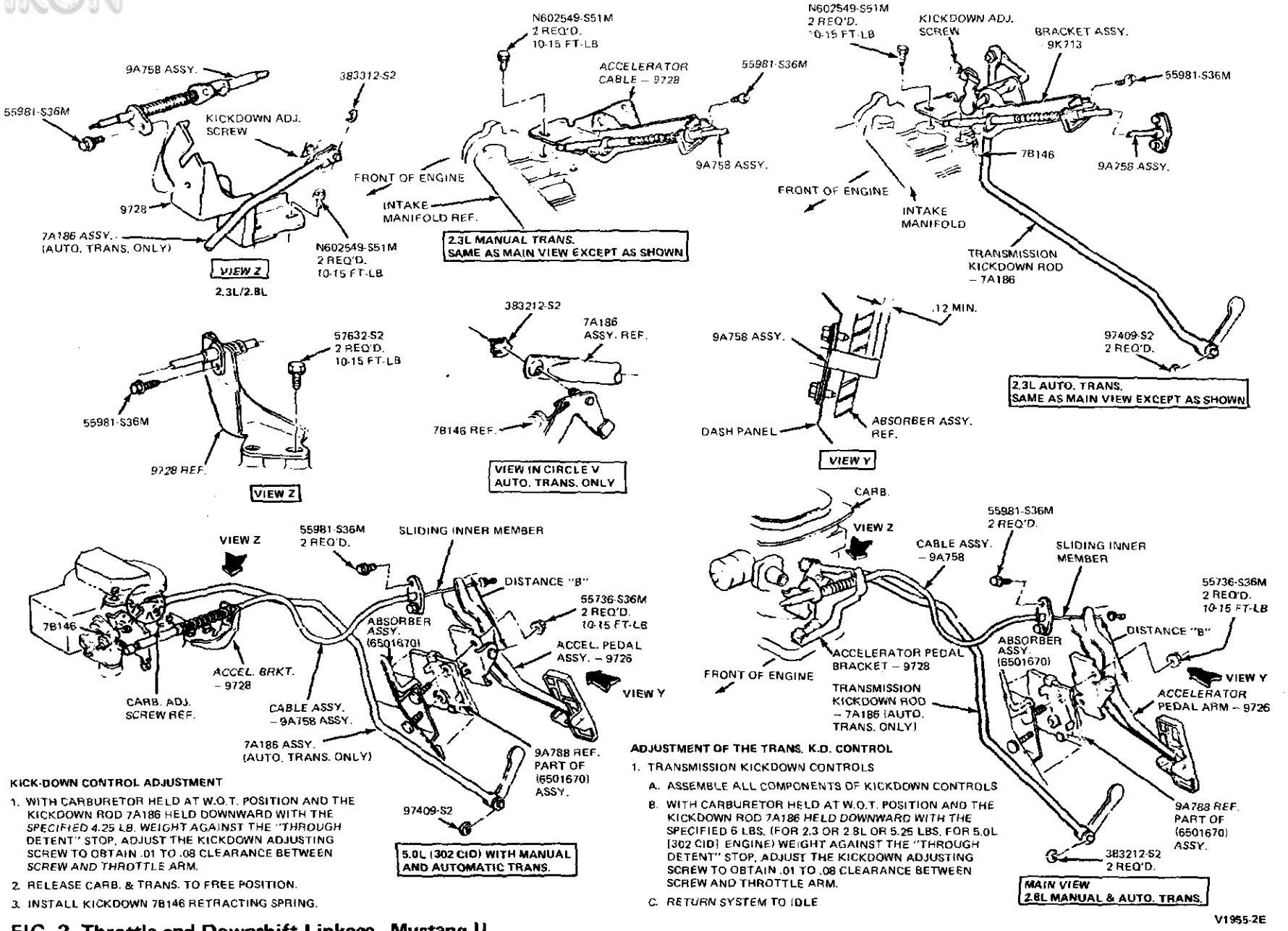
ADJUSTMENT OF THE TRANS. K.D. CONTROL

1. TRANSMISSION KICKDOWN CONTROLS
   - A. ASSEMBLE ALL COMPONENTS OF KICKDOWN CONTROLS
   - B. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD WITH THE SPECIFIED 6 LBS. WEIGHT AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
   - C. RETURN SYSTEM TO IDLE.

V1954-2E

FIG. 1 Throttle and Downshift Linkage—Pinto and Bobcat with 2.3L and 2.8L Engines

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KICK-DOWN CONTROL ADJUSTMENT

1. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD WITH THE *SPECIFIED 4.25 LB. WEIGHT AGAINST THE "THROUGH* DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN *SCREW AND THROTTLE ARM.*
2. RELEASE CARB. & TRANS. TO FREE POSITION.
3. INSTALL KICKDOWN 7B146 RETRACTING SPRING.

ADJUSTMENT OF THE TRANS. K.D. CONTROL

1. TRANSMISSION KICKDOWN CONTROLS
   - A. ASSEMBLE ALL COMPONENTS OF KICKDOWN CONTROLS
   - B. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD *7A186 HELD DOWNWARD WITH THE* SPECIFIED 6 LBS. (FOR 2.3 OR 2.8L OR 5.25 LBS. FOR 5.0L [302 CID] ENGINE) WEIGHT AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
   - C. *RETURN SYSTEM TO IDLE*

V1955-2E

FIG. 2 Throttle and Downshift Linkage—Mustang II

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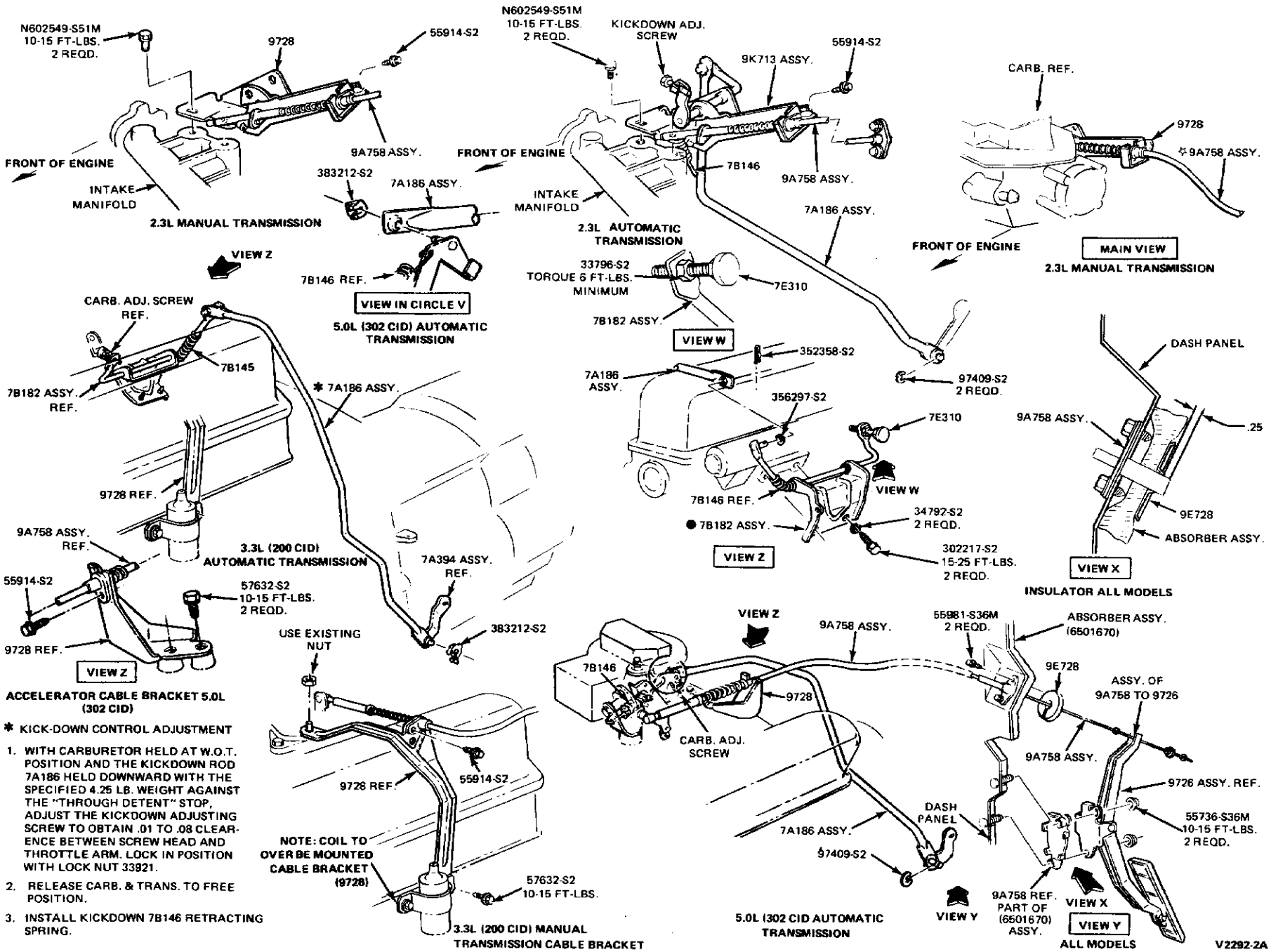
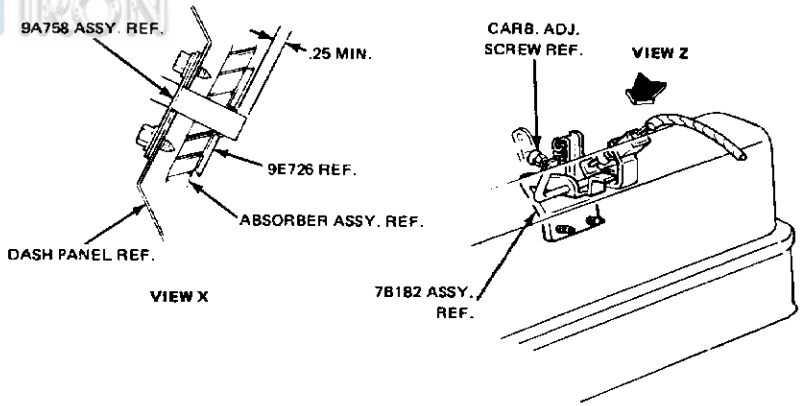
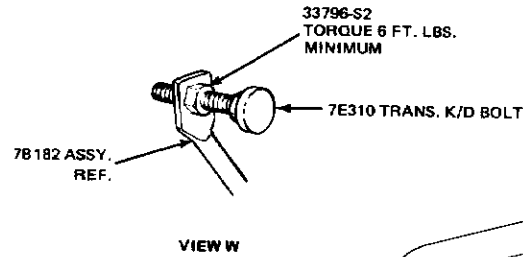
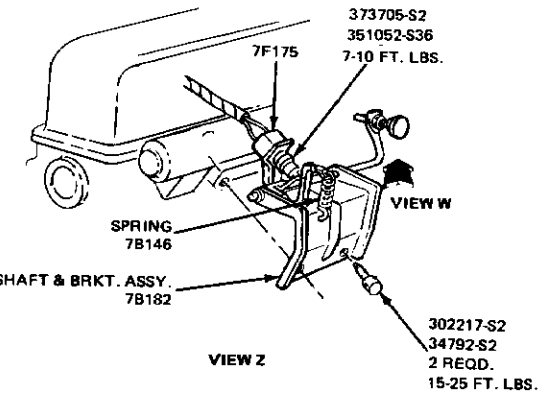


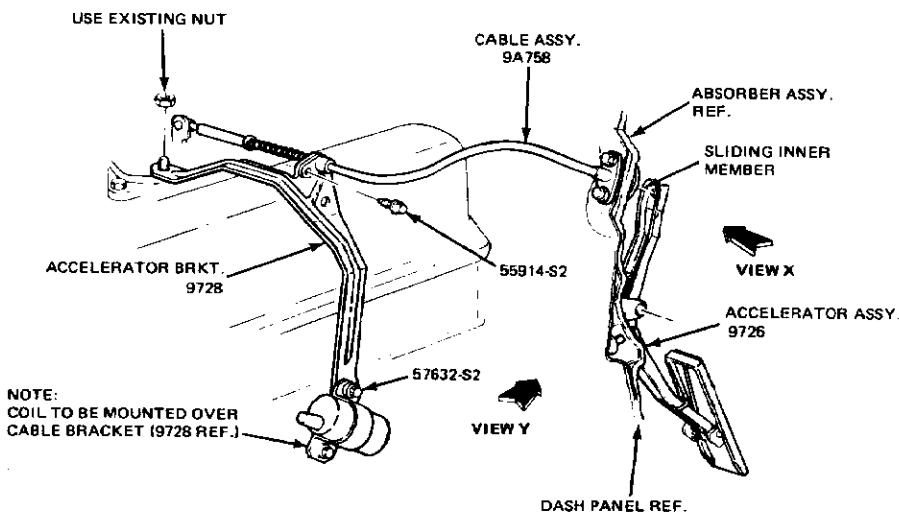
FIG. 3 Throttle and Downshift Linkage—Fairmont and Zephyr

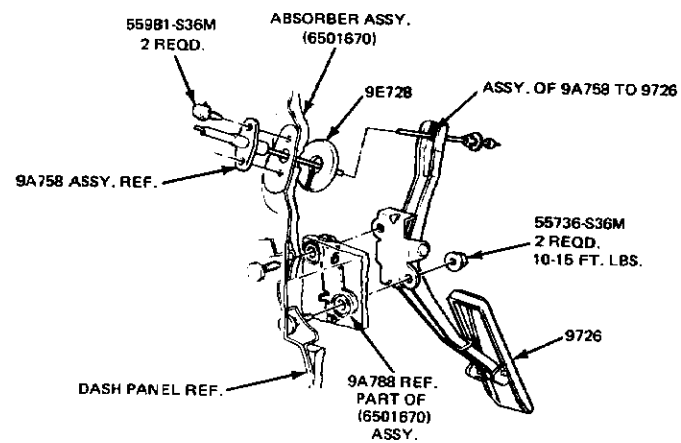
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KICK-DOWN CONTROL ADJUSTMENT

1. WITH CARBURETOR HELD AT W.O.T. POSITION AND SWITCH 7F175 AF FULL DETENT ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN BOLT HEAD AND THROTTLE ARM. LOCK IN POSITION WITH LOCK NUT 33796.
2. RELEASE CARB. & TRANS. TO FREE POSITION.
3. INSTALL KICKDOWN 7B146 RETRACTING SPRING.

SHAFT ASSY. 9726 MUST BE INSTALLED ON DASH PANEL PLATE PRIOR TO ATTACHING CABLE ASSY. 9A758 TO 9726.

V2323-2A

FIG. 4 Throttle and Downshift Linkage—Monarch and Granada W/4.1L (250 CID) I-6 and JATCO Transmission

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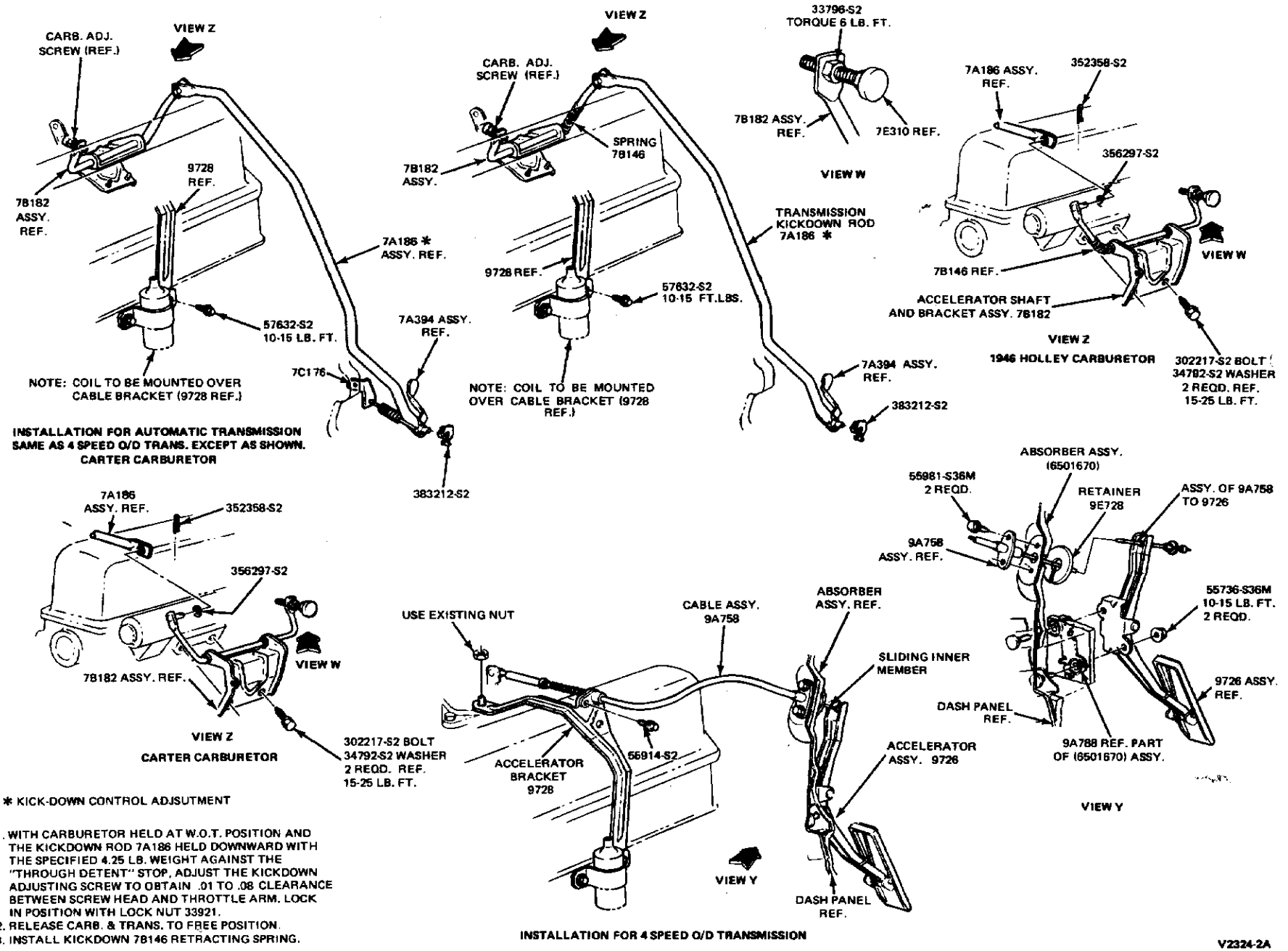
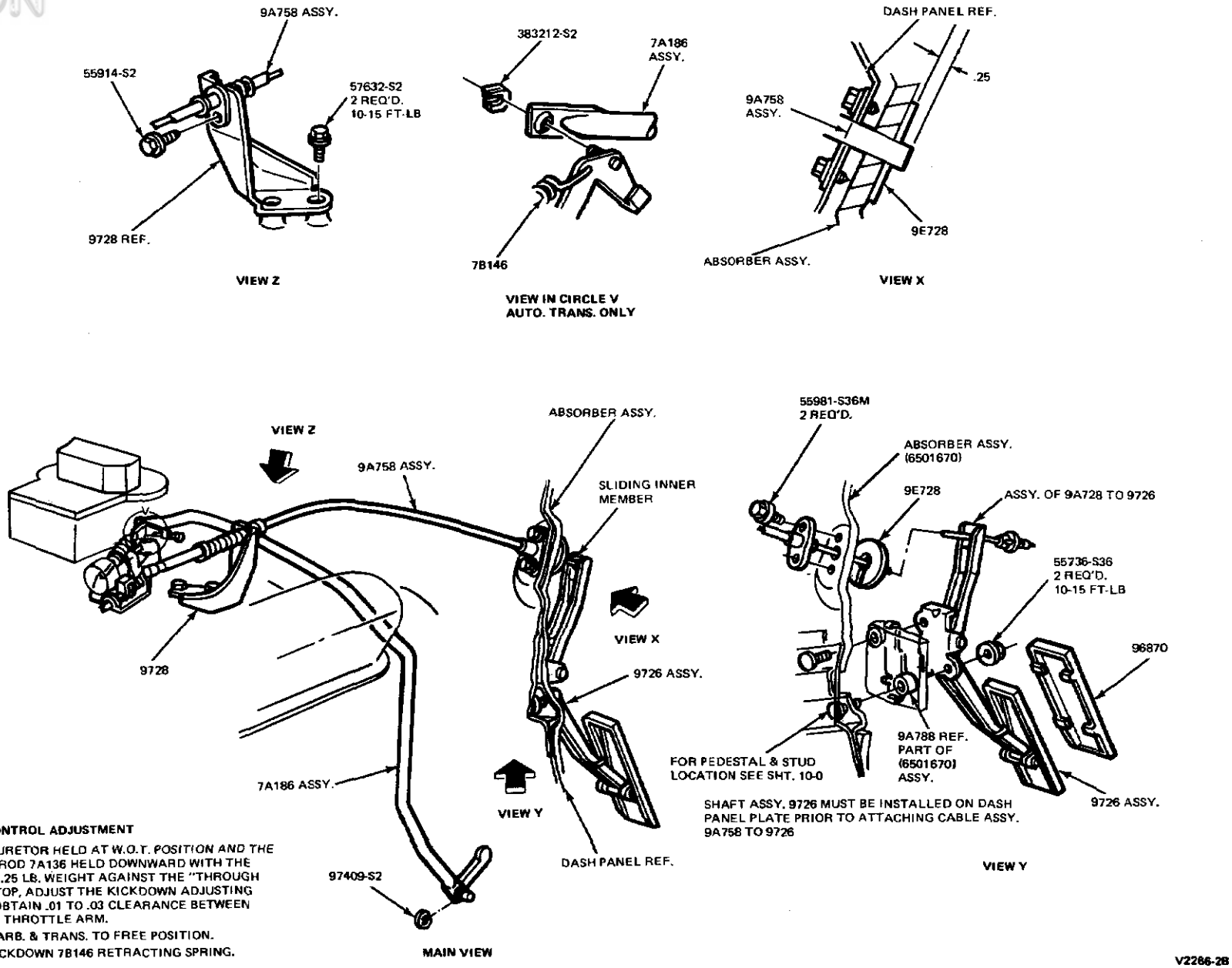


FIG. 5 Throttle and Downshift Linkage—Monarch and Granada W/4.1L (250 CID) I-6 and Holley or Carter Carburetor

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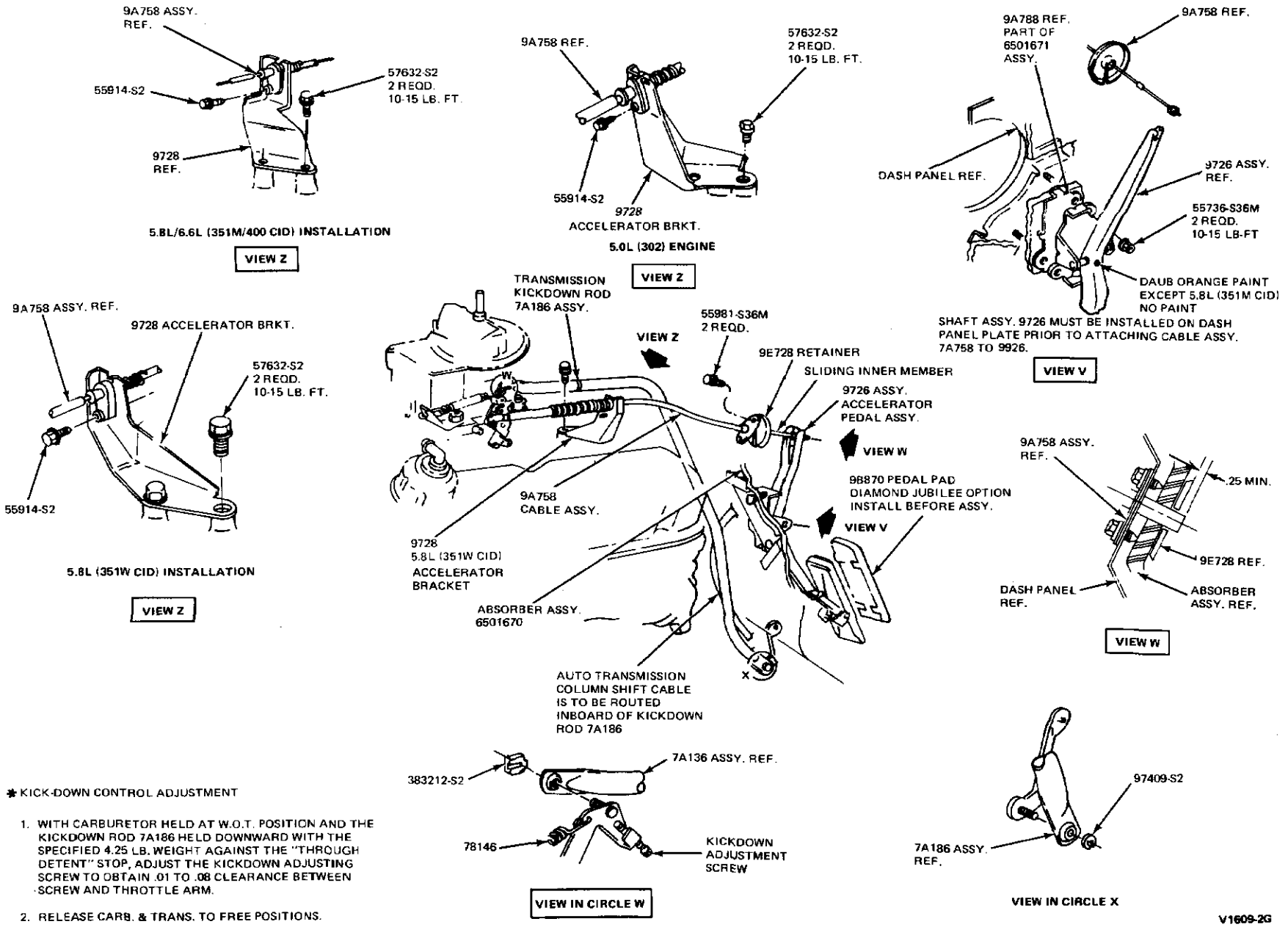
KICK-DOWN CONTROL ADJUSTMENT

1. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A136 HELD DOWNWARD WITH THE SPECIFIED 4.25 LB. WEIGHT AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .03 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
2. RELEASE CARB. & TRANS. TO FREE POSITION.
3. INSTALL KICKDOWN 7B146 RETRACTING SPRING.

V2286-2B

FIG. 6 Throttle and Downshift Linkage—Versailles

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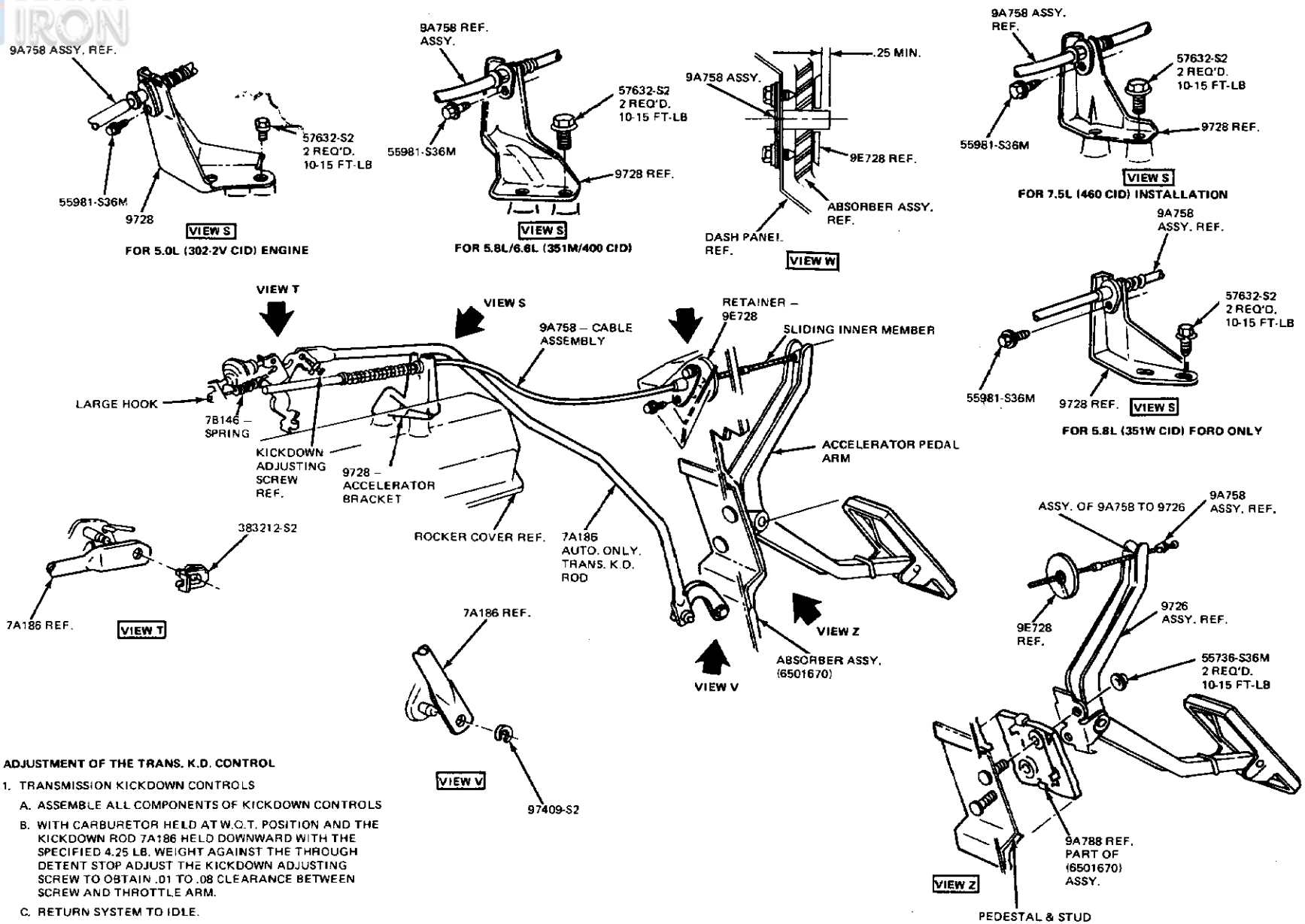


✱ KICK-DOWN CONTROL ADJUSTMENT

1. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD WITH THE SPECIFIED 4.25 LB. WEIGHT AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
2. RELEASE CARB. & TRANS. TO FREE POSITIONS.

FIG. 7 Throttle and Downshift Linkage—LTD II, LTD II Ranchero, Thunderbird and Cougar

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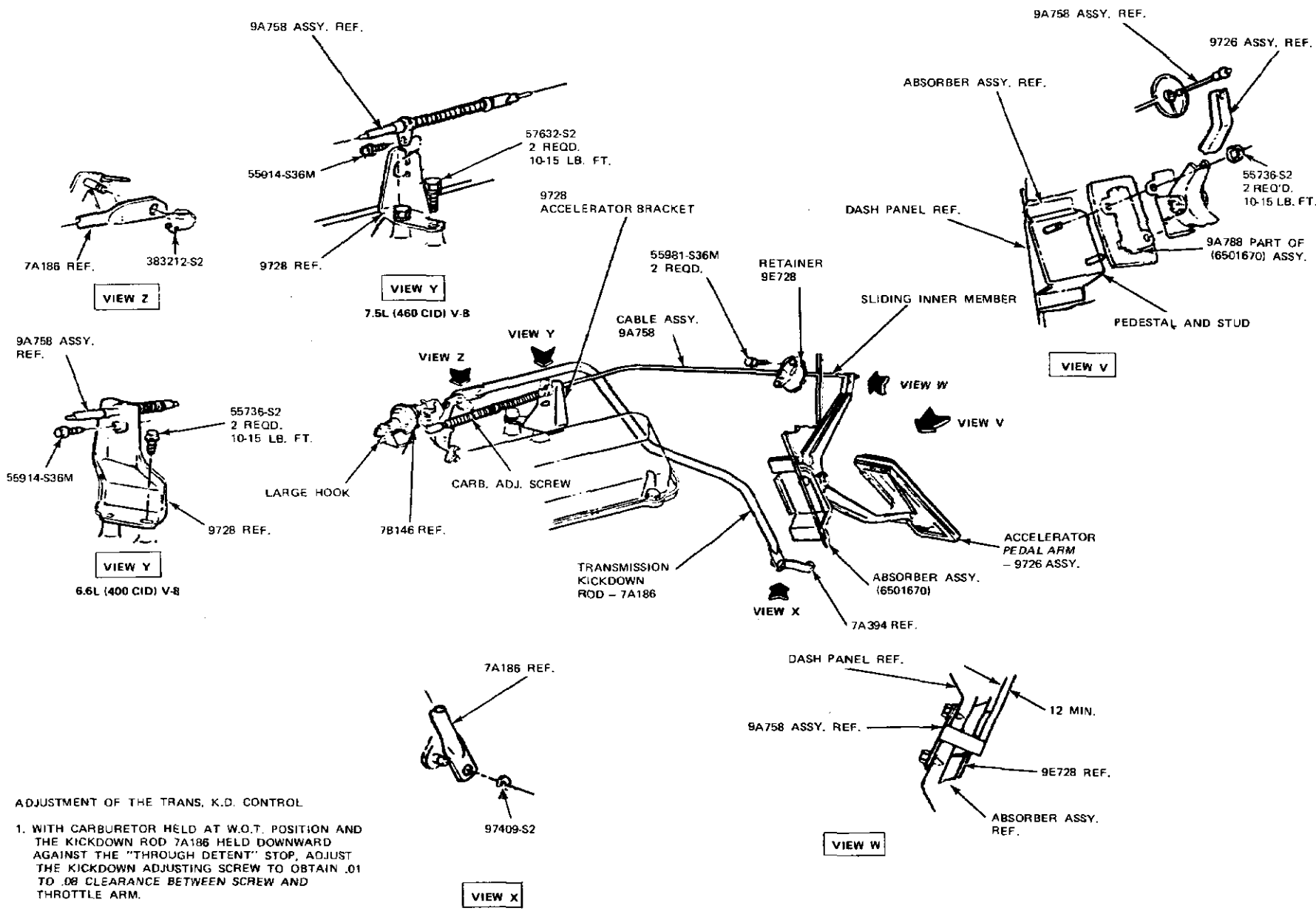
ADJUSTMENT OF THE TRANS. K.D. CONTROL

1. TRANSMISSION KICKDOWN CONTROLS
   - A. ASSEMBLE ALL COMPONENTS OF KICKDOWN CONTROLS
   - B. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD WITH THE SPECIFIED 4.25 LB. WEIGHT AGAINST THE THROUGH DETENT STOP ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
   - C. RETURN SYSTEM TO IDLE.

FIG. 8 Throttle and Downshift Linkage—Ford and Mercury

V1610-2G

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ADJUSTMENT OF THE TRANS. K.D. CONTROL

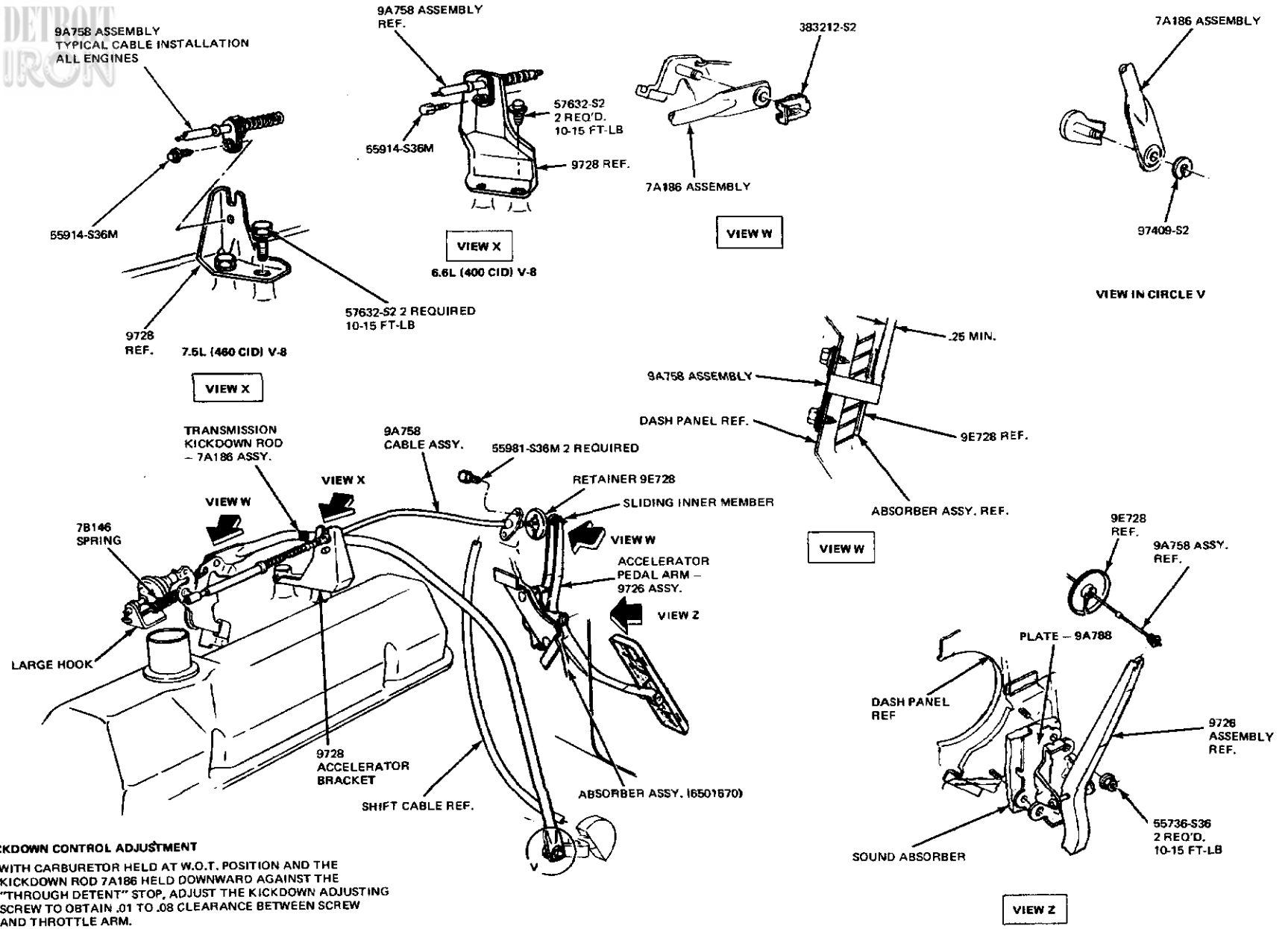
1. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.

2. RETURN SYSTEM TO IDLE.

V1723-2F

FIG. 9 Throttle and Downshift Linkage—Lincoln Continental

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KICKDOWN CONTROL ADJUSTMENT

1. WITH CARBURETOR HELD AT W.O.T. POSITION AND THE KICKDOWN ROD 7A186 HELD DOWNWARD AGAINST THE "THROUGH DETENT" STOP, ADJUST THE KICKDOWN ADJUSTING SCREW TO OBTAIN .01 TO .08 CLEARANCE BETWEEN SCREW AND THROTTLE ARM.
2. RETURN SYSTEM TO IDLE.

FIG. 10 Throttle and Downshift Linkage—Continental Mark V

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EXHAUST SYSTEM

GROUP 26 (5000)

PART TITLE	PART NO.
I-4 Engine	
Single Exhaust System	26-02
General Exhaust System	26-01
Six Cylinder Engine Single Exhaust System	26-10
V-8 Dual Exhaust System	26-22
V-8 Single Exhaust System	26-20
V-6 Exhaust Systems	26-03

CN4033 -2B

General Exhaust System

PART 26-01

CN4034-2B

GENERAL INFORMATION

This Part covers the general exhaust system, adjustments and repair procedures.

Always refer to the master parts catalog for parts usage and interchageability before replacing a component part of the exhaust system.

The exhaust system must be free of leaks, binding, grounding and excessive vibrations.

These conditions are usually caused by loose, broken or misaligned clamps, shields, brackets or pipes. If any of these conditions exist, check the exhaust system components and alignment. Adjust or replace as necessary to maintain the specified clearances (refer to the illustrations in each Part).

Brackets, clamps and insulators should be replaced if they are damaged or badly corroded. Do not attempt to repair these parts.

Inspect the inlet pipe(s), outlet pipe(s), catalytic converters, resonator(s) and muffler(s) for cracked joints, broken welds and corrosion damage that would result in a leaking exhaust system. Inspect the clamps, *brackets and insulators for cracks and stripped or badly* corroded bolt threads. When pipe clamp(s) are loosened and/or removed to replace a pipe, muffler or resonator, replace the clamp(s) if there is reasonable doubt that its service life is limited.

DESCRIPTION AND APPLICATION

Fig. 1 lists the various exhaust system applications.

SINGLE EXHAUST SYSTEMS

The factory-installed single exhaust system consists of a catalytic converter, inlet pipe assembly, muffler and supporting hangers. A resonator and/or two catalytic converters are required on some systems (see Fig. 1).

INLET PIPE EXTENSION AND MUFFLER ASSEMBLY

Some exhaust systems include a catalytic converter. Refer to the individual Parts for appropriate replacement procedures.

DUAL EXHAUST SYSTEMS

Dual exhaust systems used with the V-8 engine consist of two one-piece catalytic converter and inlet pipe extension assemblies connecting the exhaust manifolds to the muffler inlet "H" pipe which is connected to the muffler.

The dual exhaust system may or may not be equipped with a resonator. Refer to Part 16-22 for replacement procedures.

EXHAUST SHIELD REPAIR AND/OR REPLACEMENT—ALL VEHICLES SO EQUIPPED

Exhaust shields, consisting of formed metal sheets, attach to the exhaust system or the catalytic converter connections using various methods.

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Car Line	Model: Sedan	Model: Sta. Wagon	Model: Ranchero	System	Number of Converters: 0	Number of Converters: 1	Number of Converters: 2	Engines: 2.3L	Engines: 2.8L	Engines: 3.3L (200 CID)	Engines: 4.1L (250 CID)	Engines: 5.0L (302 CID)	Engines: 5.8L (351 CID)	Engines: 5.0L (302 CID)	Engines: 5.8L (351W CID)	Engines: 5.8L (351M CID)	Engines: 6.6L (400 CID)	Engines: 7.5L (460 CID)	Engines: 7.5L (460 CID) P.I.	Engines: 6.6L (400 CID)	Engines: 7.5L (460 CID)	Released For: 49S	Released For: Can.	Released For: Cal.
Pinto/ Bobcat	X	X		Single		X		X	X													X	X	
	X	X		Single		X		X	X															X
	X	X		Single	X			X															X	
Mustang II	X			Single		X		X	X			X										X	X	X
	X			Single		X		X															X	
Fairmont/ Zephyr	X	X		Single		X		X		X		X										X	X	
	X	X		Single		X		X		X		X												X
	X	X		Single	X			X															X	
Granada/ Monarch	X			Single		X				X	X	X										X	X	
	X			Single		X					X	X												X
	X			Single	X							X											X	
Versailles	X			Single		X							X									X	X	
	X			Single		X						X												X
LTD II	X		X	Single			X	X	X													X	X	
	X		X	Single			X			X	X											X	X	X
	X		X	Single			X			X	X													X
				Single			X				X													X
	X		X	Single	X					X	X												X	
Cougar	X			Single			X	X	X													X	X	
	X			Single			X			X	X											X	X	X
	X			Single			X			X	X													X
	X			Single	X					X	X												X	
							X				X													X
Thunder-bird	X			Single			X	X	X													X	X	
	X			Single			X															X	X	X
	X			Single	X																		X	
Ford/ Mercury	X			Single			X		X	X												X	X	
	X	X		Single			X				X											X	X	X
	X	X		Single			X					X										X	X	
	X			Dual			X						X									X	X	
	X			Single	X					X													X	
Lincoln	X			Single			X	X														X	X	X
	X			Single			X		X													X	X	
Mark V	X			Single			X		X													X	X	
	X			Dual			X		X													X	X	
	X			Single			X	X														X	X	X

CU1497-2F

FIG. 1 Exhaust System Applications

Exhaust shields are not subject to repair other than replacing missing or damaged attaching parts such as clamps or screws, and removing debris that may collect in the shield area. If an exhaust shield is damaged or shows evidence of deterioration it should be replaced rather than repaired.

Removal/Installation procedures are, in most cases, a matter of removing the shield attachments and shield; installation is the reverse process using new parts. The illustrations in each Part indicate the types and proper positioning of exhaust shields and clamps.

REPAIR

CATALYTIC CONVERTER FASTENER

Catalytic converters need not be replaced just because they have broken studs, stripped threads or loose nuts. The following procedure is recommended for repairing these fasteners:

Converters with Threaded Flanges

Remove damaged studs and install new studs or a bolt of suitable length. If the flange thread has minor damage, retap the hole with a 3/8"-16 tap. If the flange thread cannot be repaired, resize the hole with a 13/32" drill and use a 3/8" diameter bolt of suitable length and a locking nut. See the following chart for replacement studs and appropriate lengths.

Converter	Flange	Stud Thread and Length
4" Round	Outlet	3/8 – 16 X 2.83"
	Inlet	3/8 – 16 X 1.50"
5" Round	Outlet	3/8 – 16 X 1.50"
4" x 7" Oval	Outlet	3/8 – 16 X 3.25"
	Inlet	3/8 – 16 x 2.00"

Note: Use 45358-S7 Nut for all applications.

CN4040-1A

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Converters with Loose Clinch or Weld Nuts in the Flange

1. Remove the loose nut.
2. Dress the flange surface upon which the bolt and washer will rest.
3. Fasten the joint with a suitable 3/8" bolt, lock nut and flat washer between the bolt head and the dressed flange surface.

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I-4 Single Exhaust System

PART 26-02

Pinto, Bobcat, Mustang II, Fairmont and Zephyr

SUBJECT	PAGE
DESCRIPTION	02-1
REMOVAL AND INSTALLATION	
Catalytic Converter	02-5
Inlet Pipe – (Front) With Catalytic Converter	02-1
REMOVAL AND INSTALLATION (Cont'd.)	
Non-Catalytic System	02-1
Muffler Assembly	02-5

CN4055-2B

DESCRIPTION

All four-cylinder I-4 engines use a single-pipe type exhaust system. The production exhaust system shown in the illustrations in this Part differs from the service replacement system in the number of basic pieces used.

Factory installed exhaust systems have two pieces for a non-converter system and three pieces for a converter system. The non-converter System has an inlet pipe which connects to the engine exhaust manifold, and a muffler inlet pipe, muffler and tailpipe, all welded together. On catalytic converter system, the converter assembly is a bolt on unit connected between the inlet pipe and the muffler. Flat flange connections are used between the inlet pipe and the converter, while ball joint connections are used between the converter and the muffler.

The exhaust system is usually serviced in three pieces for a non-converter system and four pieces for a converter system. The rear section of the muffler inlet pipe (intermediate muffler inlet) is furnished separate from the muffler. For exact service replacement parts information, refer to the master parts catalog.

REMOVAL AND INSTALLATION

Typical factory installed exhaust systems for the 2.3L I-4 engines are shown in Figs. 1 thru 3.

NON-CATALYTIC SYSTEM

Removal

1. Raise the vehicle.
2. Remove the screws that attach the front hanger insulator to the inlet pipe bracket.
3. Support the muffler assembly with a soft wire and remove the inlet pipe to muffler assembly slip joint clamp.
4. Remove the attaching nuts securing the inlet pipe to the exhaust manifold and remove the inlet pipe.
5. Replace any damaged parts.

Installation

1. Clean the exhaust manifold outlet seat.
2. Insert the inlet pipe in the muffler pipe and install but do not tighten the clamp.
3. Position the inlet pipe to the manifold flange and loosely install the attaching nuts.
4. Loosely attach the front hanger insulator to the inlet pipe bracket.
5. Align the exhaust system to conform to clearance specifications. Starting at the rear of the system, torque all nuts, screws or bolts.
6. Check the system for leaks and lower the vehicle.

INLET PIPE—(FRONT) WITH CATALYTIC CONVERTER

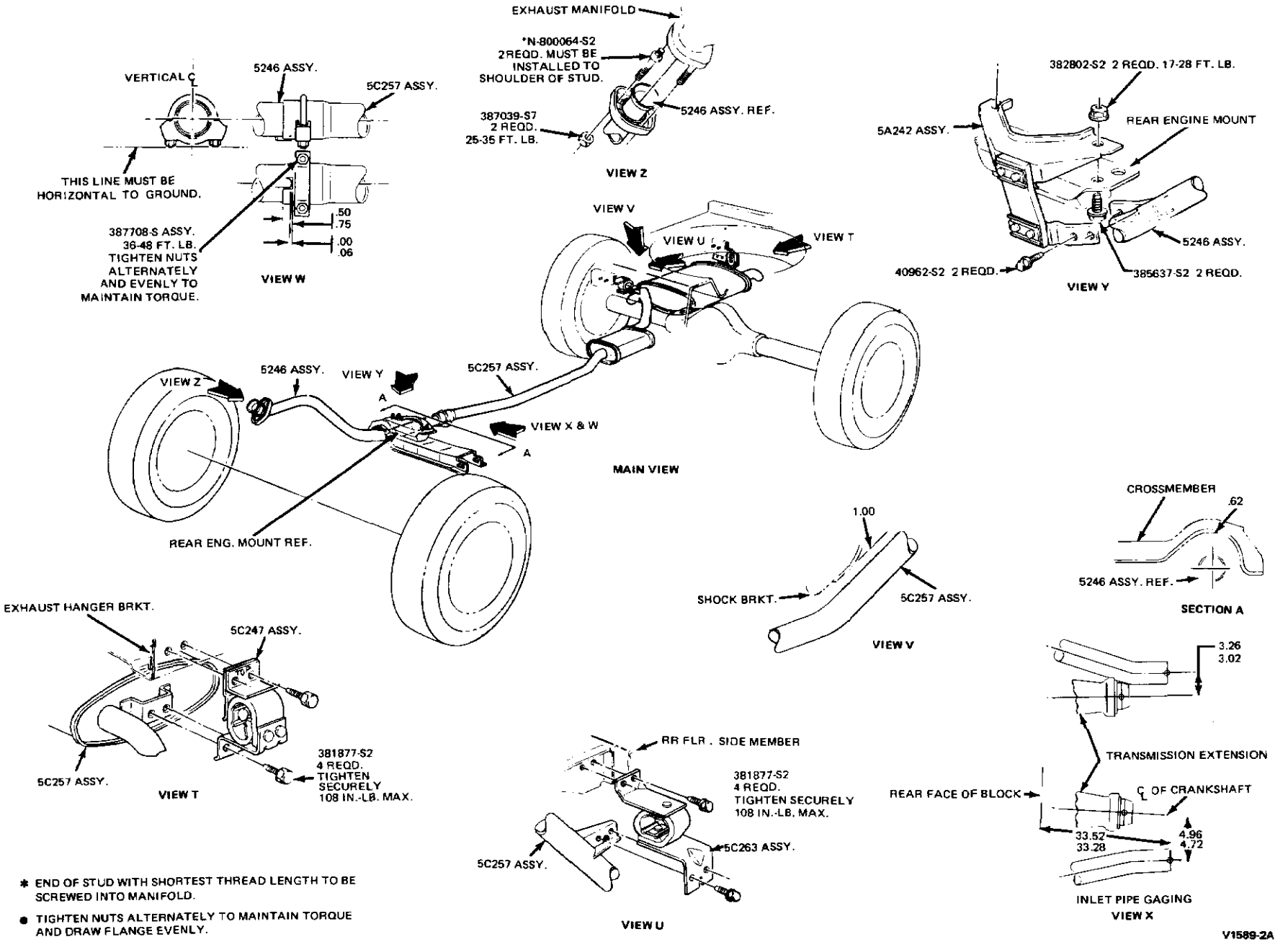
Removal

1. Raise the vehicle.
2. Support the muffler assembly with a soft wire.
3. Remove the bolts that attach the converter inlet flange to the inlet pipe.
4. Remove the screws that attach the front hanger to the inlet pipe.
5. Remove the nuts attaching the inlet pipe flange to the exhaust manifold and remove the inlet pipe.
6. Replace any damaged parts.

Installation

1. Clean the exhaust manifold and catalytic converter flange seats.
2. Position the inlet pipe to the manifold and install but do not tighten the attaching nuts.
3. Install the front hanger to inlet pipe. Do not tighten the attaching screws.
4. Using a new gasket, position the inlet pipe to the catalytic converter. Align the upper (and lower if so equipped) heat shield, to the converter inlet flange and loosely start the attaching bolts.
5. Remove the wire support for the muffler assembly.

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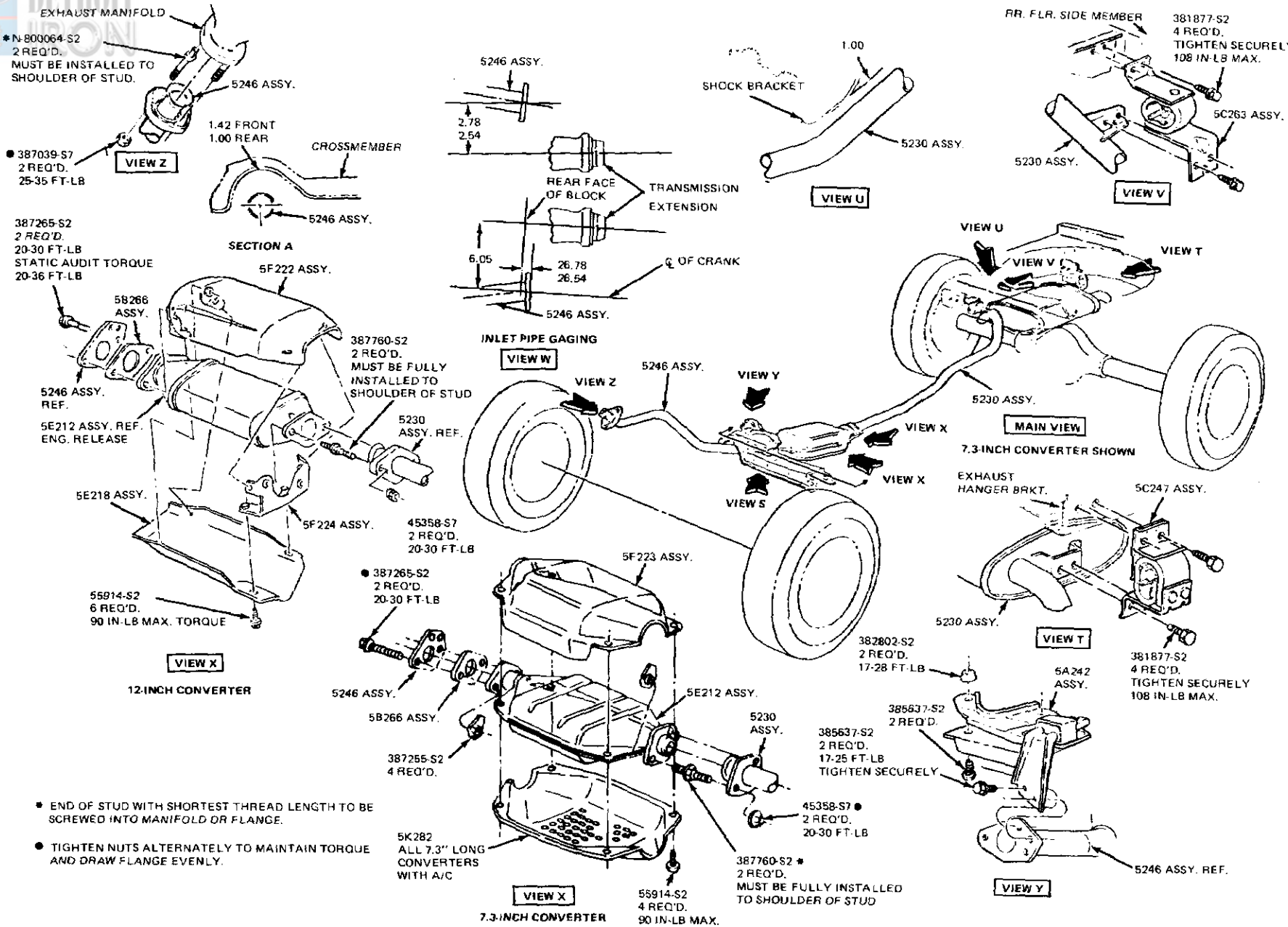


* END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 1 Exhaust System—Mustang II without Converter

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● END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD OR FLANGE.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 2 Exhaust System—Mustang II with Converter

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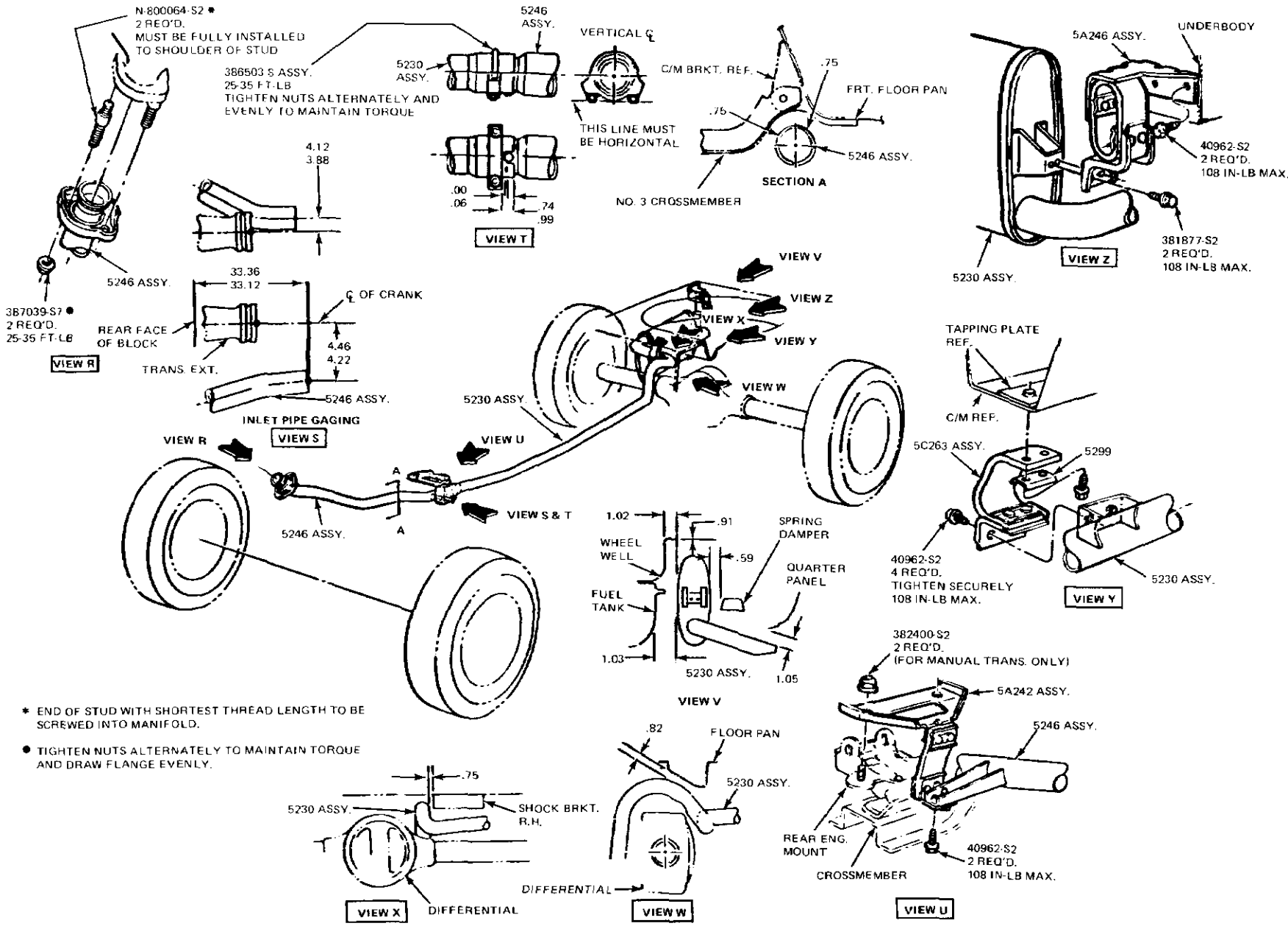


FIG. 3 Exhaust System—Pinto/Bobcat Station Wagon Without Converter

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6. Align the exhaust system to proper clearance specifications and starting at the front, tighten all nuts, screws, and bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

MUFFLER ASSEMBLY

Removal

1. Raise the vehicle by means of the frame lift points to allow the axle full downward travel. This will provide the clearance necessary to remove and replace the muffler and pipe.
2. Non-catalytic converter vehicles—loosen and remove the inlet pipe clamp.
3. Catalytic converter equipped vehicles—remove the rear converter to muffler pipe flange connection attaching nuts.
4. Remove the attaching screws from the rear hanger assembly to muffler support.
5. Slide the muffler assembly rearward to disconnect it from the catalytic converter.
6. Remove the attaching screws from the intermediate support on the muffler inlet pipe and remove the muffler assembly.
7. Replace any damaged parts.

Installation

1. Position the muffler assembly over the rear axle and loosely attach the intermediate support bracket.
2. Non-catalytic converter vehicles—assemble the muffler assembly to the inlet pipe from the manifold and loosely attach the retaining clamp.
3. Catalytic converter vehicles—position the muffler inlet pipe flange to the converter flange. Install but do not tighten the attaching nuts.
4. Position the muffler rear support bracket and loosely install the attaching screws.
5. Align the exhaust system to conform to the proper clearance specifications and, starting from the muffler inlet pipe connection, torque all nuts and screws to specifications.
6. Check the system for leaks and lower the vehicle.

CATALYTIC CONVERTER

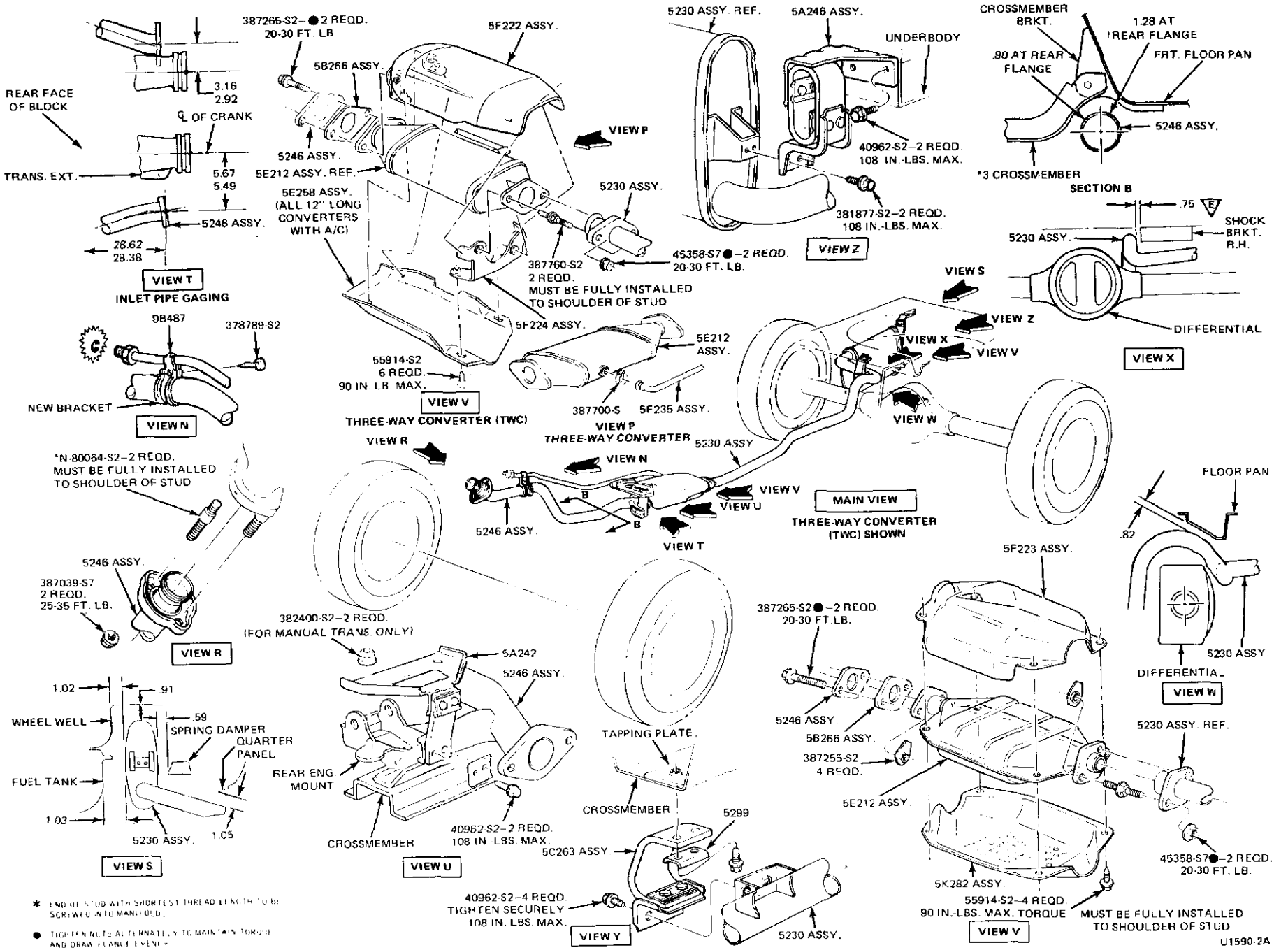
Removal

1. Raise the vehicle.
2. Remove the upper and lower heat shields, if so equipped, attached to the converter.
3. Remove the front and rear catalytic converter flange fasteners.
4. Separate the catalytic converter inlet and outlet flange connections.
5. Remove the converter.

Installation

1. Align the heat shield brackets to the inner flanges on the converter and position the catalytic converter to the inlet pipe using a new gasket. Loosely install the attaching bolts.
2. Install the muffler inlet flange to the converter outlet flange. Loosely install the attaching nuts.
3. Attach the heat shields to the converter.
4. Align the exhaust system to specification and starting at the front of the system, tighten all nuts and bolts to specification.
5. Check the system for leaks and lower the vehicle.

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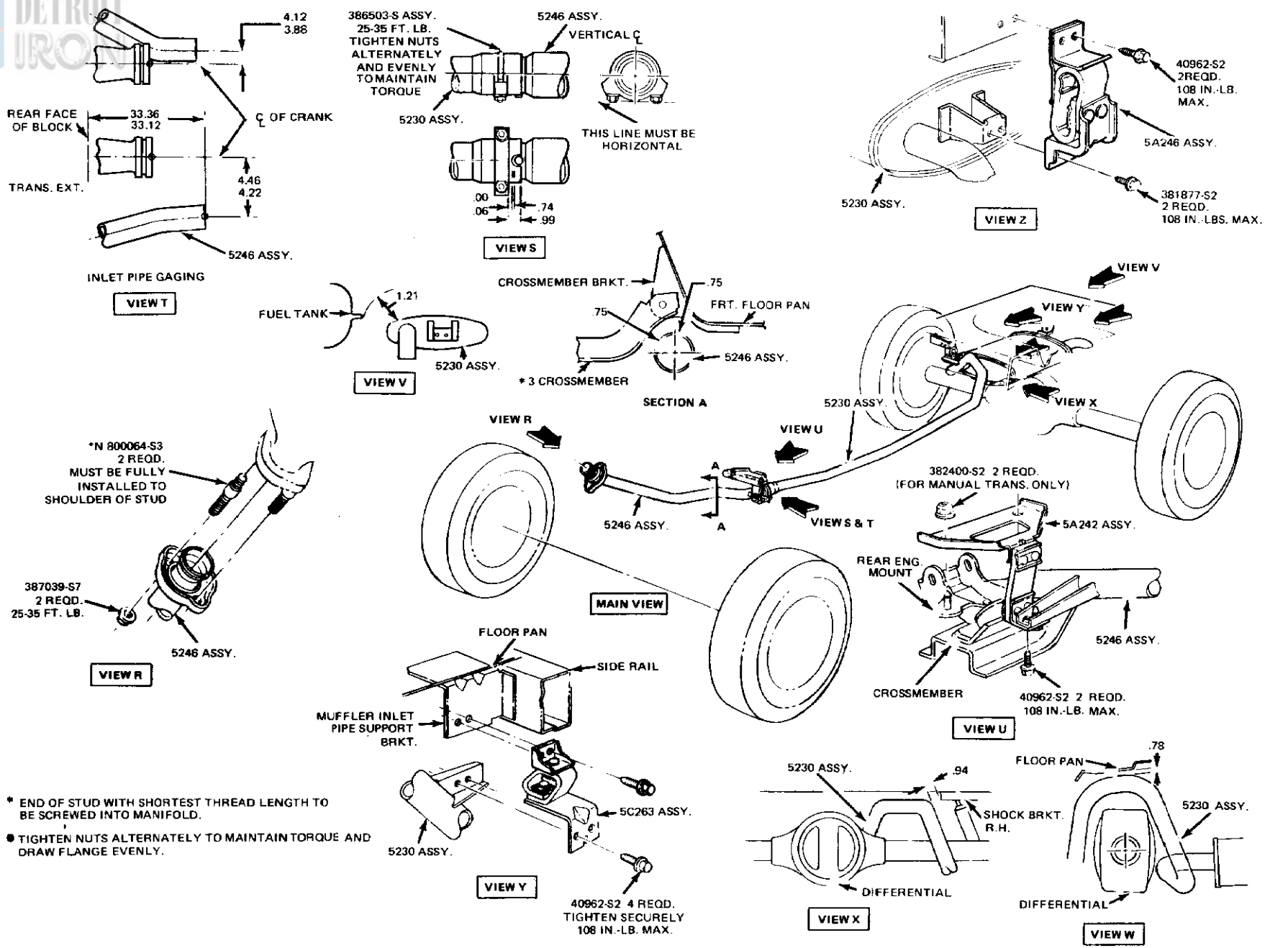


* END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 4 Exhaust System—Pinto/Bobcat Station Wagon with Converter

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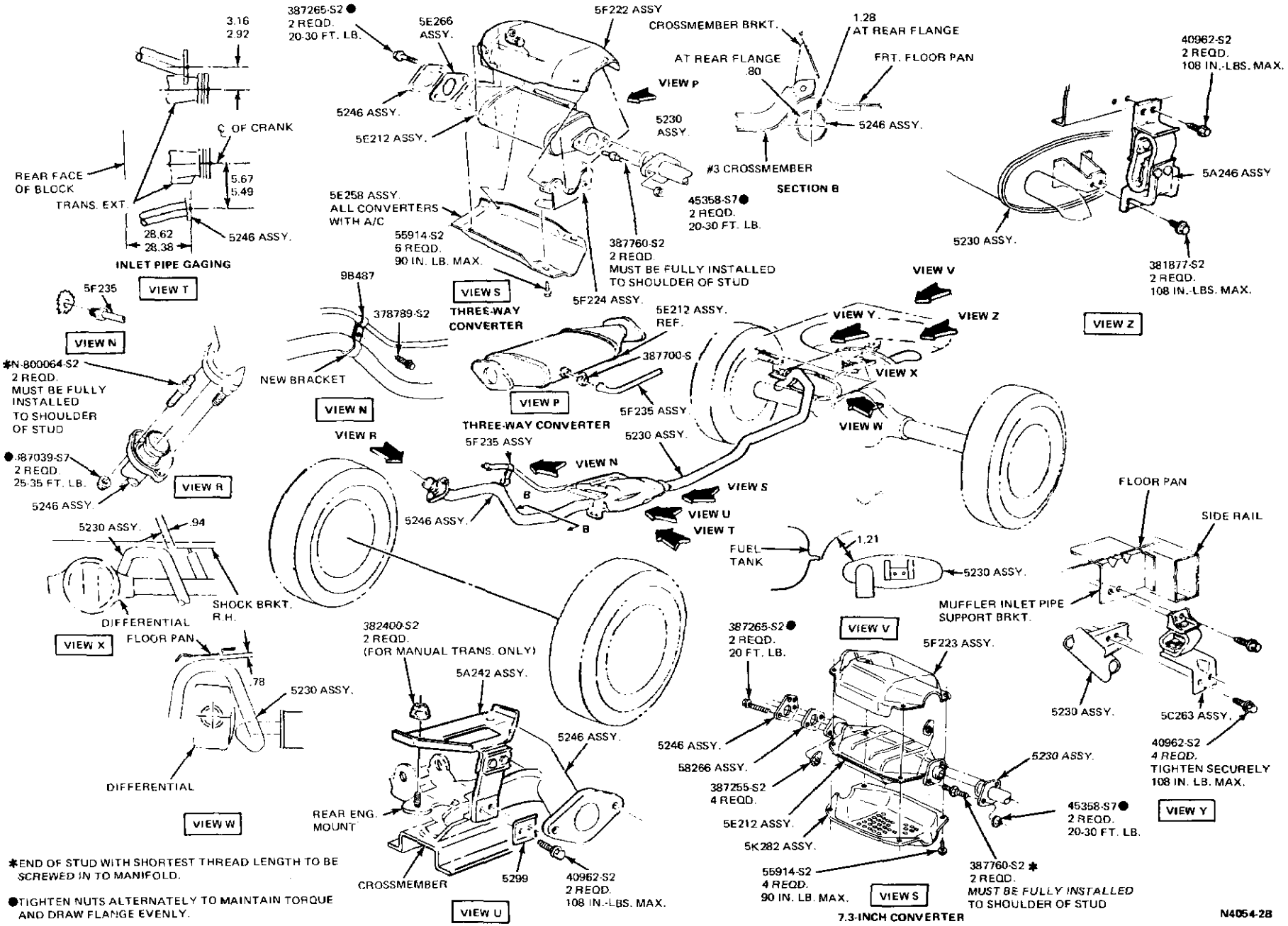
* END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

U1593-2A

FIG. 5 Exhaust System—Pinto/Bobcat Sedan without Converter

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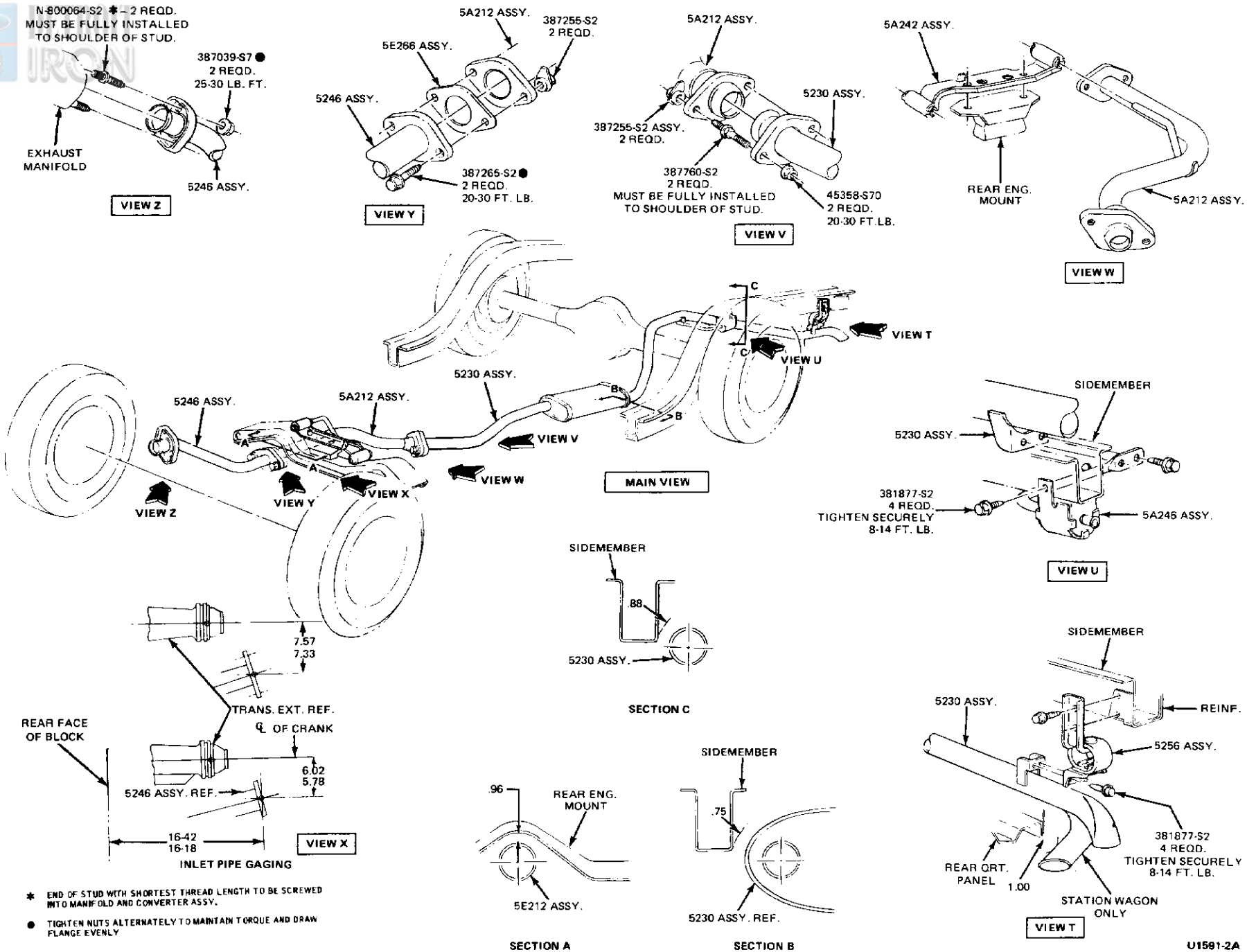


✱END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED IN TO MANIFOLD.

●TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 6 Exhaust System—Pinto/Bobcat Sedan with Converter

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✱ END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY

FIG. 7 Exhaust System–Fairmont/Zephyr without Converter

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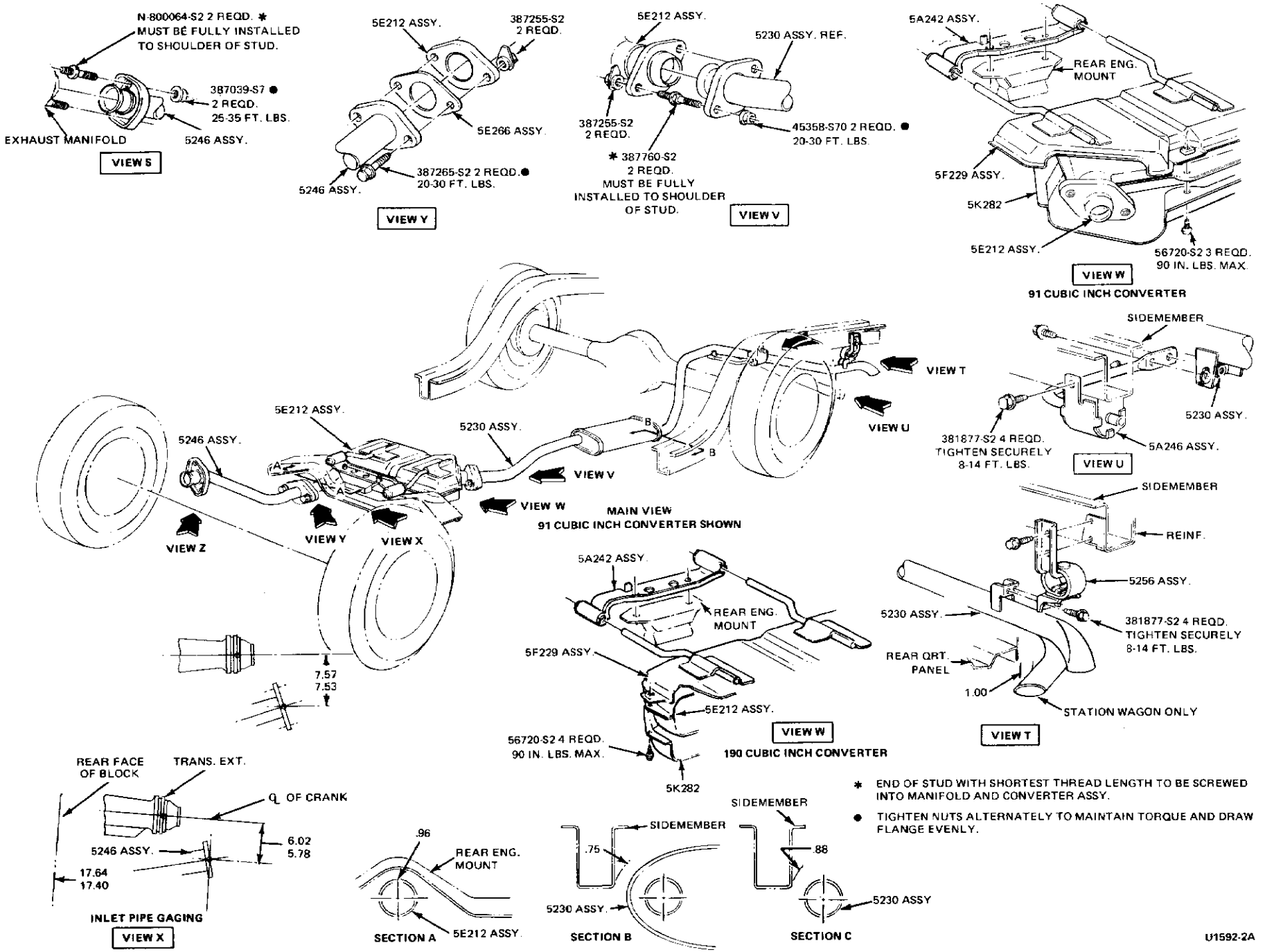


FIG. 8 Exhaust System—Fairmont/Zephyr with Converter

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DETROIT IRON OFFICIAL LICENSED PRODUCT

V-6 Single Exhaust System

PART 26-03

Pinto, Bobcat and Mustang II

SUBJECT	PAGE
DESCRIPTION	03-1
REMOVAL AND INSTALLATION	
Catalytic Converter	03-1
REMOVAL AND INSTALLATION (Cont'd.)	
Inlet Pipe	03-1
Muffler and Resonator	03-1

CN4059-2B

DESCRIPTION

All 2.8L V-6 engines are equipped with a single exhaust system. The factory installed system shown in the illustrations in this Part consists of the welded "Y"-pipe, one catalytic converter and either a muffler assembly or muffler and resonator assembly (used only on the Mustang II). The exhaust system is usually serviced in separate pieces consisting of an inlet pipe, catalytic converter, resonator and inlet pipe assembly (if so equipped) and a muffler and tailpipe assembly. For exact service replacement parts information, refer to the master parts catalog.

REMOVAL AND INSTALLATION

INLET PIPE—(FRONT)

Removal

1. Raise the vehicle.
2. Support the muffler assembly with a soft wire.
3. Remove the screws that attach the front hanger insulator to the inlet pipe bracket.
4. Remove the bolts that attach the converter inlet flange to the inlet pipe.
5. Remove the nuts attaching the inlet pipe flange to the exhaust manifold and remove the inlet pipe.
6. Replace any damaged parts.

Installation

1. Clean the exhaust manifold and catalytic converter flange seats.
2. Position the inlet pipe to the manifold and install but do not tighten the attaching nuts.
3. Install the front hanger bracket insulator to inlet pipe bracket. Do not tighten the attaching screws.
4. Using a new gasket, position the inlet pipe to the catalytic converter. Align the upper and lower heat shield to the converter inlet flange and loosely start the attaching bolts.
5. Remove the wire support for the muffler assembly.
6. Align the exhaust system to proper clearance specifications and starting at the front, tighten all nuts, screws, and bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

MUFFLER AND RESONATOR

Removal

1. Raise the vehicle by means of the frame lift points to allow the axle full downward travel. This will provide the clearance necessary to remove and replace the muffler and pipe.
2. Catalytic converter equipped vehicles—remove the rear converter to muffler or resonator pipe flange connection attaching nuts.
3. Remove the attaching screws from the rear hanger assembly to muffler support.
4. Slide the muffler assembly rearward to disconnect it from the catalytic converter.
5. Remove the attaching screws from the intermediate support on the muffler inlet pipe and remove the muffler assembly.
6. Replace any damaged parts.

Installation

1. Position the muffler assembly over the rear axle and loosely attach the intermediate support bracket.
2. Catalytic converter vehicles—position the muffler inlet pipe flange to the converter flange. Install but do not tighten the attaching nuts.
3. Position the muffler rear support bracket and loosely install the attaching screws.
4. Align the exhaust system to conform to the proper clearance specifications and, starting from the muffler inlet pipe connection, torque all nuts and screws to specifications.
5. Check the system for leaks and lower the vehicle.

CATALYTIC CONVERTER

Removal

1. Raise the vehicle.
2. Remove the upper and lower heat shields, if so equipped, attached to the converter.
3. Remove the front and rear catalytic converter flange fasteners.

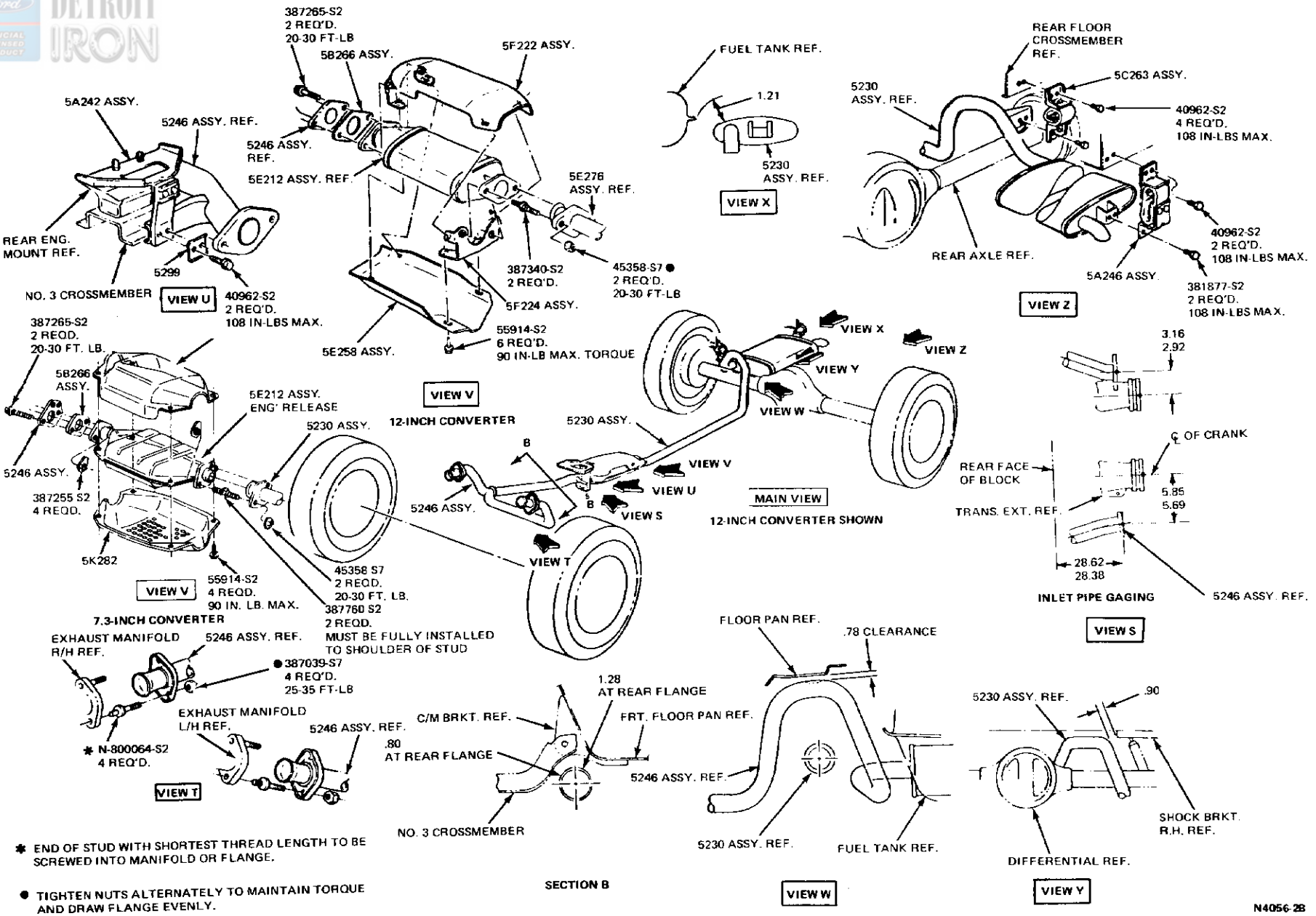
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4. Separate the catalytic converter inlet and outlet flange connections.
5. Remove the converter.
6. Replace any damaged parts.

Installation

1. Align the heat shield brackets to the inner flanges on the converter and position the catalytic converter to the inlet pipe using a new gasket. Loosely install the attaching bolts.
2. Install the muffler inlet flange to the converter outlet flange. Loosely install the attaching nuts.
3. Attach the heat shields to the converter.
4. Align the exhaust system to specification and starting at the front of the system, tighten all nuts and bolts to specification.
5. Check the system for leaks and lower the vehicle.

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✱ END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD OR FLANGE.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 1 Exhaust System—Pinto/Bobcat, Sedan—2.8L Engine

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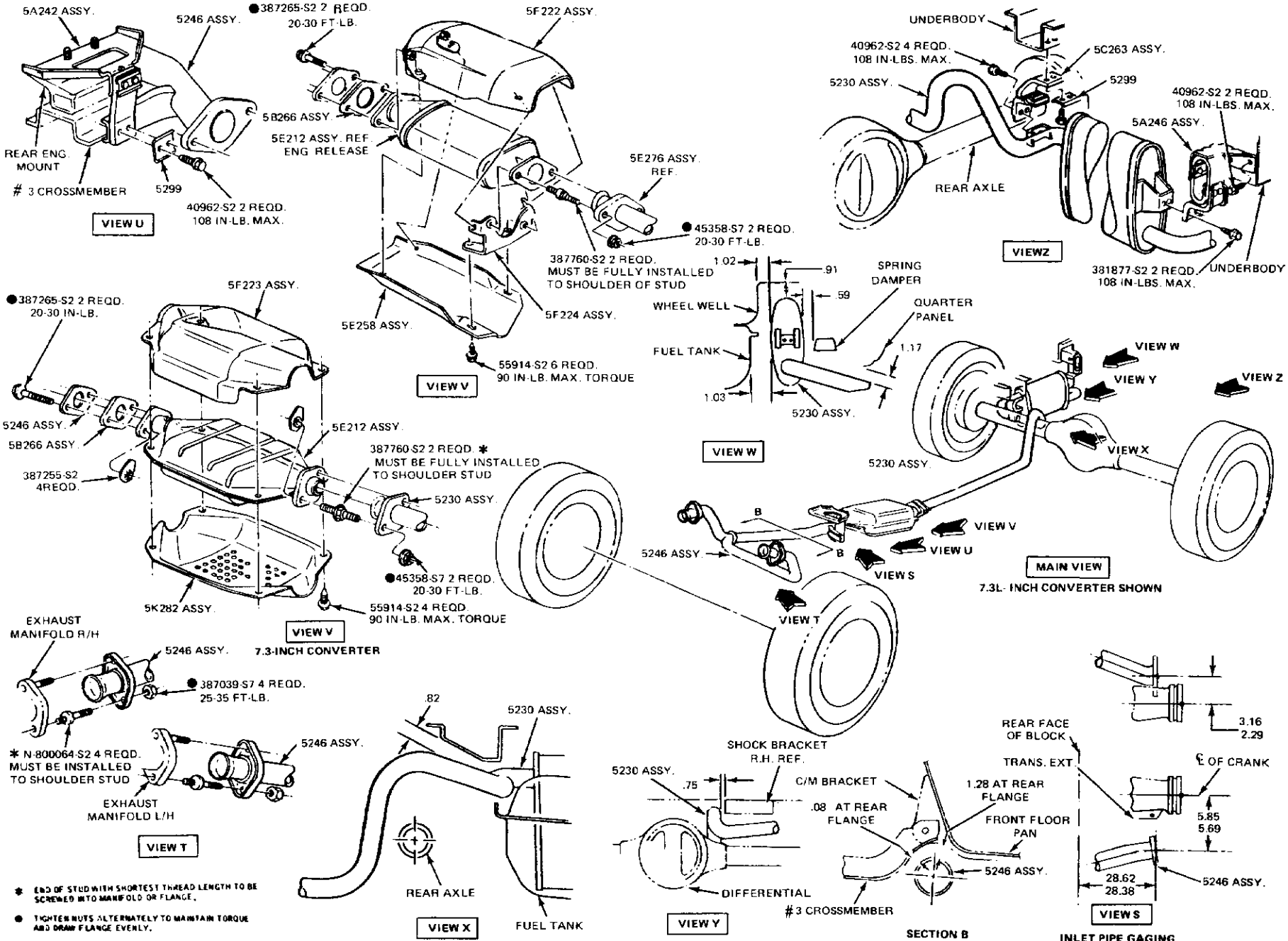


FIG. 2 Exhaust System—Pinto/Bobcat Station Wagon—with Converter

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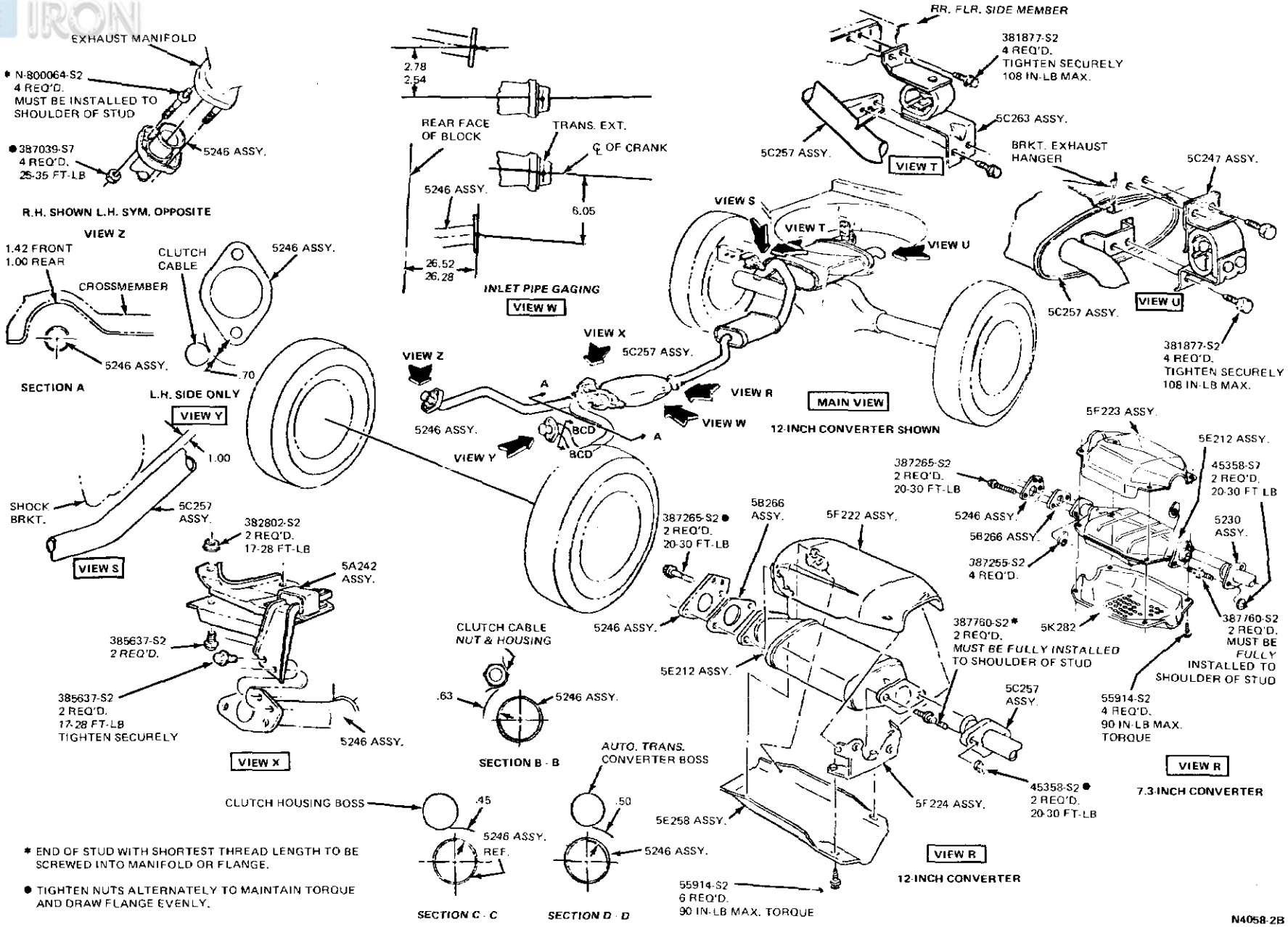


FIG. 3 Exhaust System—Mustang II—2.8L Engine

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6-Cylinder Engine Single Exhaust System

PART 26-10

Granada, Monarch, Fairmont and Zephyr

SUBJECT	PAGE
DESCRIPTION	10-1
REMOVAL AND INSTALLATION	
Resonator Inlet Pipes	10-1
REMOVAL AND INSTALLATION (Cont'd.)	
Muffler and Resonator	10-2
Catalytic Converter	10-2

CN4035-2B

DESCRIPTION

All 3.3L (200 CID) and 4.1L (250 CID) I-6 engines have basically the same type single muffler exhaust system. (See illustrations in this Part.) These systems have a resonator inlet pipe, resonator, resonator outlet pipe and a muffler. On some systems, a catalytic converter is used between the resonator inlet pipe and the resonator.

Service replacement parts for these exhaust systems usually consist of more pieces than do the factory-installed systems shown in the illustrations. Refer to the master parts catalog for information on the available service assemblies.

REMOVAL AND INSTALLATION

RESONATOR INLET PIPE (FRONT) WITHOUT CATALYTIC CONVERTER

Removal

1. Raise the vehicle.
2. Support the resonator/muffler assembly with soft wire.
3. Remove the bolts that attach the inlet pipe to the resonator/muffler flange.
4. Remove the bolts that attach the front hanger bracket to the inlet pipe (Granada and Monarch). Remove the bolts that attach the inlet pipe extension to the inlet pipe and slide the extension pipe rearward out of the front hanger (Fairmont/Zephyr).
5. Remove the inlet pipe to exhaust manifold attaching nuts and remove the inlet pipe from the vehicle.

Installation

1. Clean the exhaust manifold outlet seat.
2. Position the inlet pipe to the exhaust manifold and loosely install the attaching nuts. Be sure the gasket is properly seated in the exhaust manifold.
3. Install the bolts that attach the front hanger bracket to the inlet pipe and tighten (Granada and Monarch). Slide the extension pipe mounting rod into the front hanger, align the inlet pipe to the extension pipe, install bolts and tighten (Fairmont and Zephyr).
4. Align the resonator/muffler assembly to flange on the inlet pipe or inlet extension pipe and loosely assemble bolts.
5. Align the exhaust system to conform to clearance specifications shown.
6. Starting from the exhaust manifold, tighten all screws, nuts or bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

RESONATOR INLET PIPES (FRONT) WITH CATALYTIC CONVERTER

Removal

1. Raise the vehicle.
2. Support the resonator/muffler assembly with a soft wire.
3. Remove the bolts that attach the converter inlet flange to the inlet pipe.
4. Remove the bolts that attach the front hanger bracket to the inlet pipe bracket (Granada and Monarch).

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5. Remove the nuts attaching the inlet pipe flange to the exhaust manifold and remove the inlet pipe.
6. Replace any damaged parts.

Installation

1. Clean the exhaust manifold and catalytic converter flange seats.
2. Position the inlet pipe to the exhaust manifold and loosely install the attaching nuts. Be sure the gasket is properly seated in the exhaust manifold.
3. Install the front hanger bracket to inlet pipe bracket. Do not tighten the attaching bolts (Granada and Monarch).
4. Using a new gasket, position the inlet pipe to the catalytic converter. Align the upper and lower heat shield, (if so equipped) to the converter inlet flange and loosely start the attaching bolts.
5. Remove the wire support from the resonator/muffler assembly.
6. Align the exhaust system to conform to clearance specifications and starting at the front, tighten all nuts, screws, and bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

MUFFLER AND RESONATOR ASSY

Removal

1. Raise the vehicle by means of the frame lift points to allow the axle full downward travel. This will provide the clearance necessary to remove and replace the resonator and muffler assembly.
2. Non-catalytic converter vehicles—loosen and remove bolts that attach muffler/resonator to inlet pipe flange.
3. Catalytic converter equipped vehicles—remove the rear converter to resonator pipe flange connection attaching nuts.
4. Remove the attaching screws from the rear hanger assembly to muffler support (on vehicles so equipped).
5. Slide the resonator and muffler assembly rearward until the resonator pipe is separated from the inlet pipe or catalytic converter.
6. Remove the attaching screws from the intermediate support bracket to resonator and remove the resonator and muffler assembly.
7. Replace any damaged parts.

Installation

1. Position the resonator and muffler assembly over the rear axle and loosely attach the intermediate support bracket.
2. Non-catalytic converter vehicles—assemble the resonator assembly to the inlet pipe and loosely attach resonator/muffler.
3. Catalytic converter vehicles—position the resonator inlet pipe flange to the converter flange. Install but do not tighten the attaching nuts.
4. Position the muffler rear support bracket and loosely install the attaching screws.
5. Align the exhaust system to conform to the proper clearance specifications and, starting from the resonator inlet pipe connection, torque all nuts and screws to specifications.
6. Check the system for leaks and lower the vehicle.

CATALYTIC CONVERTER

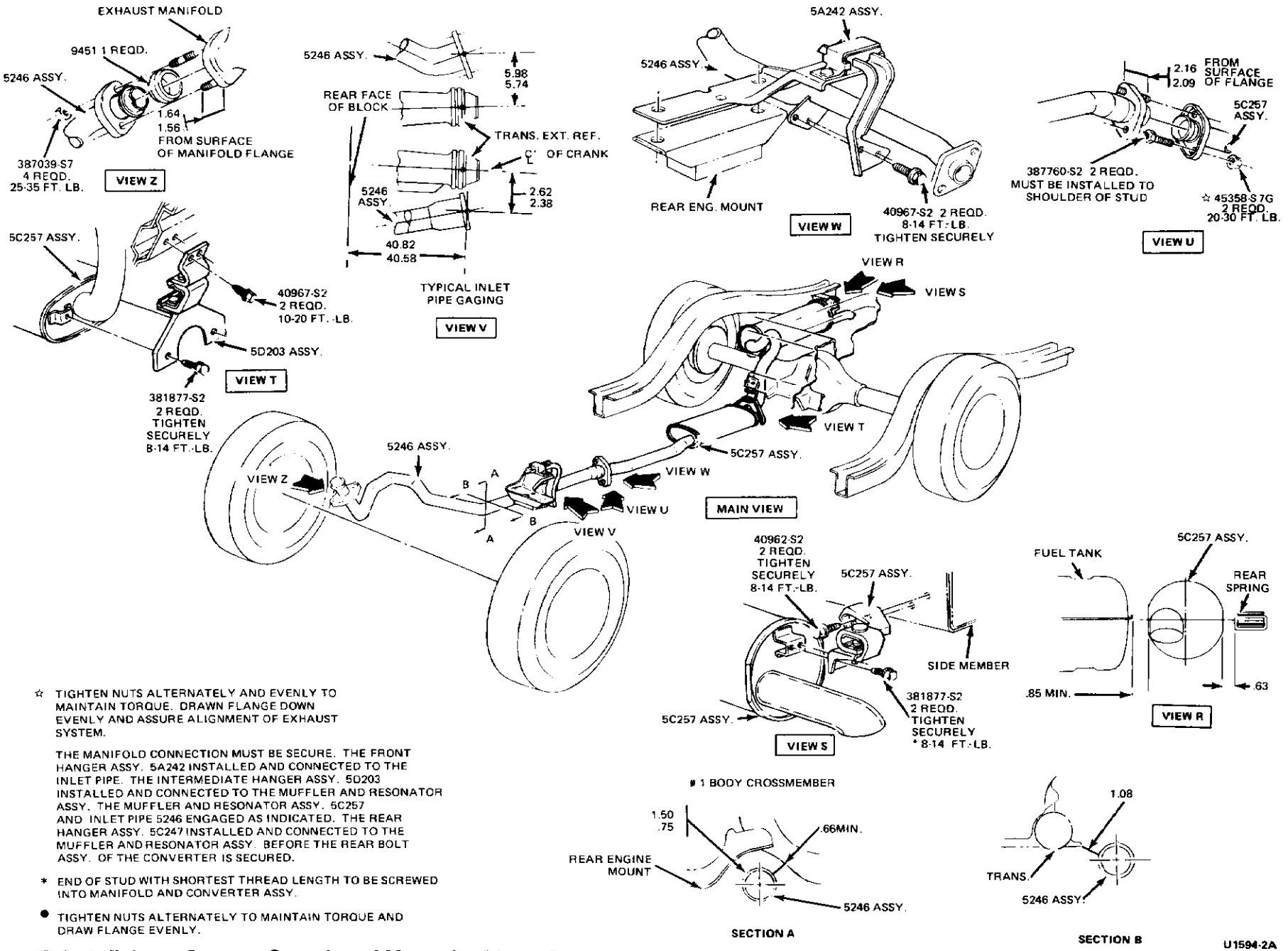
Removal

1. Raise the vehicle.
2. Loosen the intermediate and rear exhaust system hanger bracket attaching bolts.
3. Remove the upper and lower heat shields, if so equipped, attached to the converter (Granada and Monarch).
4. Remove the front and rear catalytic converter flange fasteners.
5. Slide the resonator/muffler assembly rearward and separate the catalytic converter inlet and outlet flange connections.
6. Remove the converter.
7. Remove upper heat shield/hanger assembly and grass shield from catalytic converter (Fairmont and Zephyr).

Installation

1. (Granada and Monarch) Align the heat shield brackets to the inner flanges on the converter and position the catalytic converter to the inlet pipe using a new gasket. Loosely install the attaching bolts. (Fairmont and Zephyr) Install heat shield/hanger assembly and grass shield to catalytic converter and slide assembly into front hanger. Position new gasket between catalytic converter and inlet pipe and install attaching bolts to the specified torque.
2. Install the resonator inlet flange to the converter outlet flange. Loosely install the attaching nuts.
3. Attach the heat shields to the converter (Granada and Monarch).
4. Align the exhaust system to specification and starting at the front of the system, tighten all nuts and bolts to specification.
5. Check the system for leaks and lower the vehicle.

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☆ TIGHTEN NUTS ALTERNATELY AND EVENLY TO MAINTAIN TORQUE. DRAWN FLANGE DOWN EVENLY AND ASSURE ALIGNMENT OF EXHAUST SYSTEM.

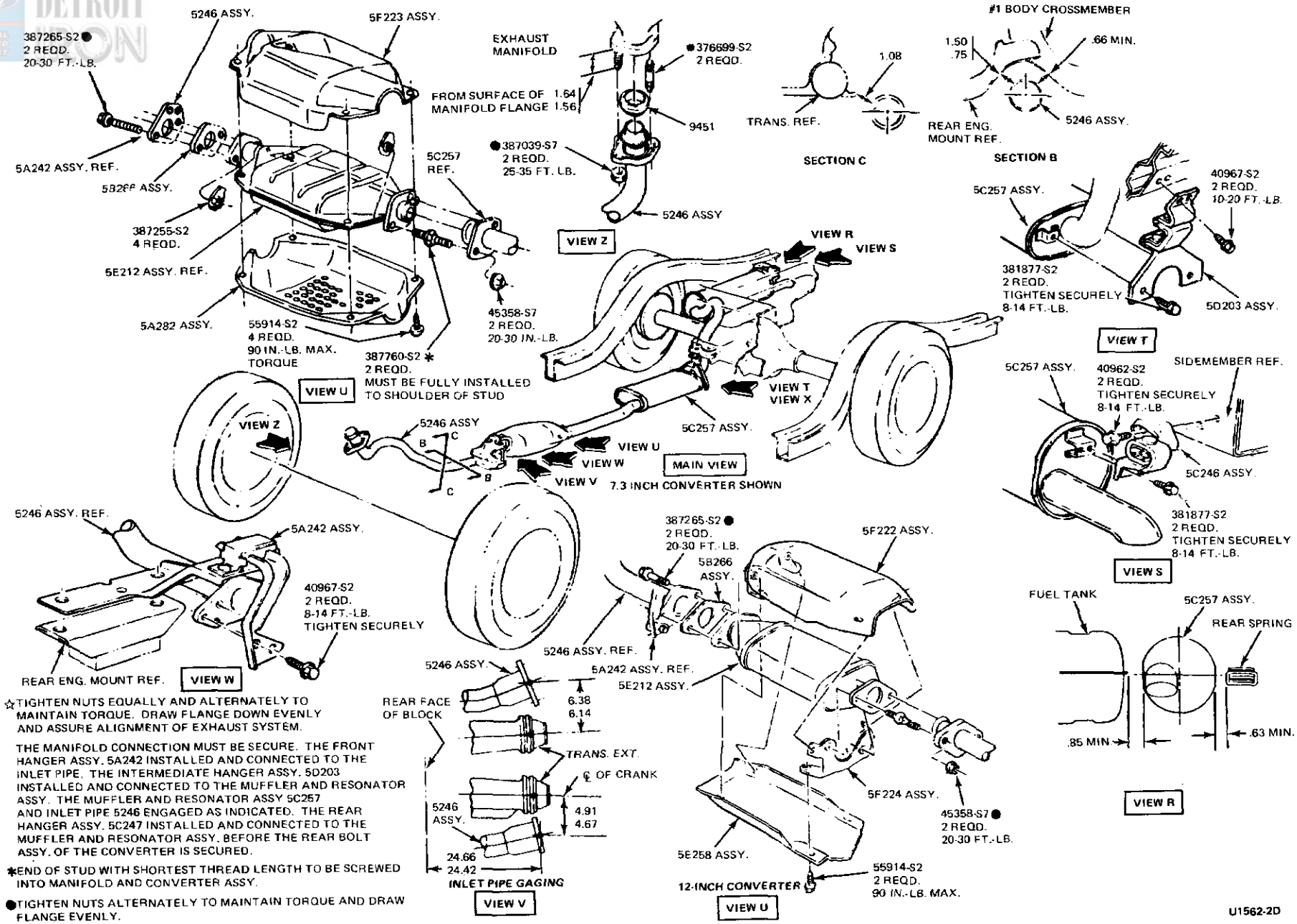
THE MANIFOLD CONNECTION MUST BE SECURE. THE FRONT HANGER ASSY. 5A242 INSTALLED AND CONNECTED TO THE INLET PIPE. THE INTERMEDIATE HANGER ASSY. 5D203 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. THE MUFFLER AND RESONATOR ASSY. 5C257 AND INLET PIPE 5246 ENGAGED AS INDICATED. THE REAR HANGER ASSY. 5C247 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. BEFORE THE REAR BOLT ASSY. OF THE CONVERTER IS SECURED.

* END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 1 Exhaust System—Granada and Monarch without Converter

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☆TIGHTEN NUTS EQUALLY AND ALTERNATELY TO MAINTAIN TORQUE. DRAW FLANGE DOWN EVENLY AND ASSURE ALIGNMENT OF EXHAUST SYSTEM.

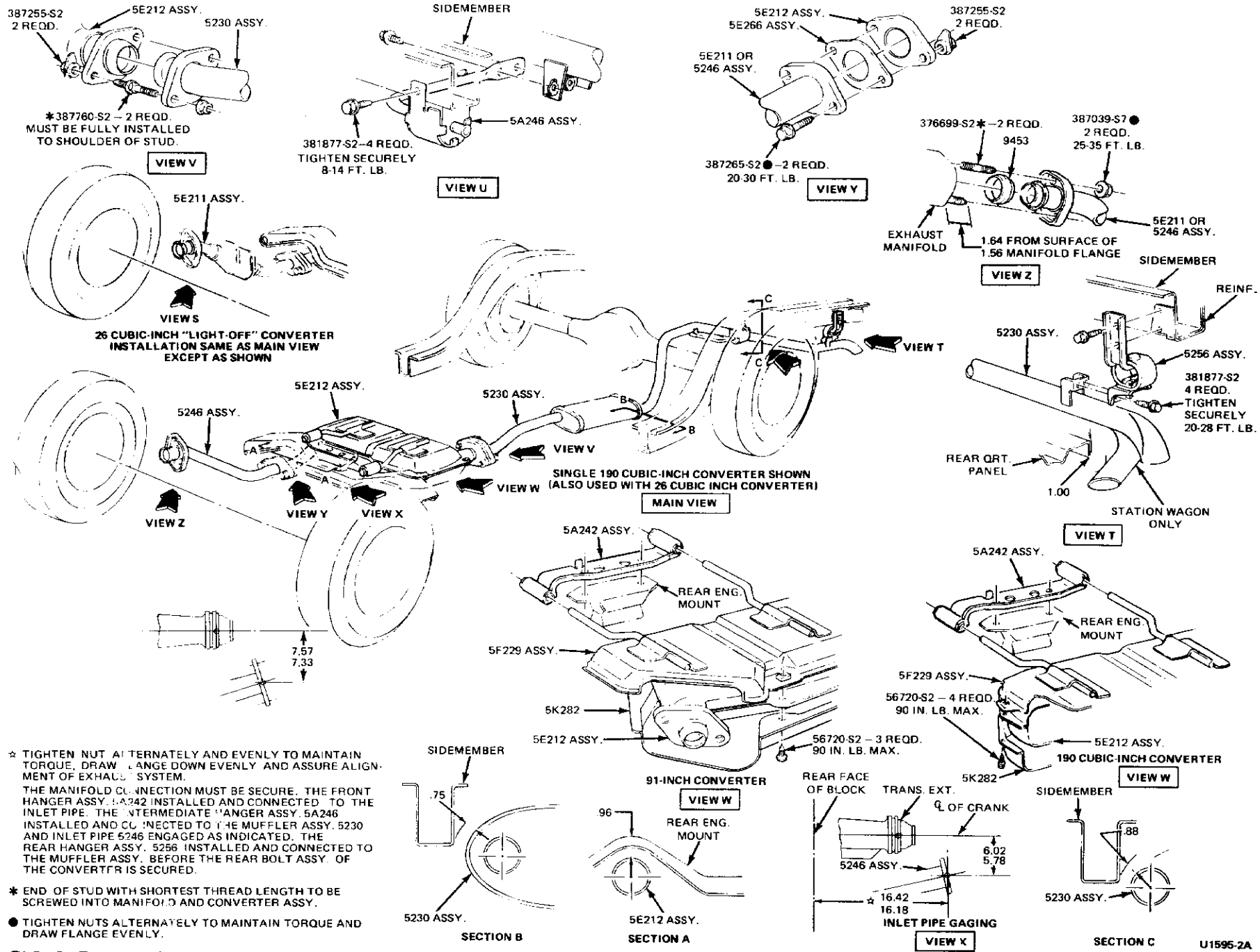
THE MANIFOLD CONNECTION MUST BE SECURE. THE FRONT HANGER ASSY. 5A242 INSTALLED AND CONNECTED TO THE INLET PIPE. THE INTERMEDIATE HANGER ASSY. 5D203 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. THE MUFFLER AND RESONATOR ASSY 5C257 AND INLET PIPE 5246 ENGAGED AS INDICATED. THE REAR HANGER ASSY. 5C247 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. BEFORE THE REAR BOLT ASSY. OF THE CONVERTER IS SECURED.

*END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

●TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 2 Exhaust System—Granada and Monarch with Converter

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☆ TIGHTEN NUT ALTERNATELY AND EVENLY TO MAINTAIN TORQUE, DRAW FLANGE DOWN EVENLY AND ASSURE ALIGNMENT OF EXHAUST SYSTEM.
THE MANIFOLD CONNECTION MUST BE SECURE. THE FRONT HANGER ASSY. 5A242 INSTALLED AND CONNECTED TO THE INLET PIPE. THE INTERMEDIATE HANGER ASSY. 5A246 INSTALLED AND CONNECTED TO THE MUFFLER ASSY. 5230 AND INLET PIPE 5246 ENGAGED AS INDICATED. THE REAR HANGER ASSY. 5256 INSTALLED AND CONNECTED TO THE MUFFLER ASSY. BEFORE THE REAR BOLT ASSY. OF THE CONVERTER IS SECURED.

✱ END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

● TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 3 Exhaust System—Fairmont and Zephyr with Converter(s)

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V-8 Single Exhaust System

PART 26-20

Except Pinto/Bobcat

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	20-1	REMOVAL AND INSTALLATION	20-1

CN4044-2B

DESCRIPTION

The basic single exhaust system used with V-8 engines consists of a muffler and a resonator and/or diffuser. This basic system is subject to the addition of one or two catalytic converters as indicated in the exhaust systems application chart, Section 26-01.

The factory-installed exhaust systems shown in the illustrations in this Part differ from the service replacement systems in the number of pieces used. When making a service replacement, refer to the master parts catalog for the current assemblies.

Detailed illustrations of the various V-8 Single Exhaust Systems are found in Figs. 1 through 10.

REMOVAL AND INSTALLATION

The removal and installation procedures given apply to all vehicle models unless otherwise noted. Refer to the appropriate system illustration when servicing exhaust system.

RESONATOR "Y" PIPE (FRONT) WITHOUT CATALYTIC CONVERTER—GRANADA, MONARCH AND VERSAILLES

Removal

1. Raise the vehicle.
2. Remove the bolts which attach the muffler/resonator to the inlet pipe.
3. Loosen the attaching screws at the muffler rear hanger support.
4. Slide the resonator/muffler assembly rearward to disengage the "Y" pipe.
5. Remove the attaching nuts securing the resonator inlet "Y" pipe to the exhaust manifolds and front hanger and remove the "Y" pipe from the vehicle.

Installation

1. Clean the exhaust manifold outlet seat.
2. Position the "Y" pipe to the exhaust manifold and loosely install the attaching nuts. Be sure the gasket is properly seated in the exhaust manifold.
3. Secure the "Y" pipe to the front hanger and tighten to specified torque. Install muffler/resonator to inlet pipe and install but do not tighten bolts.
4. Align the exhaust system to conform to clearance specifications shown in (Fig. 2).
5. Starting from the exhaust manifold, tighten all screws, nuts or bolts to specifications.
6. Check the exhaust system for leaks and lower the vehicle.

RESONATOR INLET PIPE (FRONT) WITH CATALYTIC CONVERTER

Removal

1. Raise the vehicle.
2. Support the resonator/muffler assembly with a soft wire (Granada, Monarch and Versailles).
3. Remove the bolts that attach the converter inlet flange to the "Y" pipe.
4. Remove the bolts that attach the front hanger bracket to the inlet pipe bracket. (Granada, Monarch and Versailles).
5. Remove the nuts attaching the "Y" pipe flange to the exhaust manifold and remove the inlet pipe.
6. Replace any damaged parts.

Installation

1. Clean the exhaust manifold and catalytic converter flange seats.
2. Position the inlet "Y" pipe to the exhaust manifold and loosely install the attaching nuts. Be sure the gasket is properly seated in the exhaust manifold.
3. Install the front hanger bracket to inlet pipe bracket. Do not tighten the attachment bolts. (Granada, Monarch and Versailles).
4. Using a new gasket, position the inlet pipe to the catalytic converter. Align the upper and lower heat

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shield (if so equipped) to the converter inlet flange and loosely start the attaching bolts.

5. Remove the wire support from the resonator/muffler assembly. (Granada, Monarch and Versailles).
6. Align the exhaust system to conform to clearance specifications shown in Fig. 2 and starting at the front, tighten all nuts, screws, and bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

RESONATOR INLET PIPE—MUSTANG II

Removal

1. Raise the vehicle.
2. Support the resonator/muffler assembly with a soft wire. (See Fig. 1.)
3. Remove the bolts that attach the converter inlet flange to the inlet pipe.
4. Remove the bolts that attach the front hanger bracket to the inlet pipe bracket.
5. Remove the nuts attaching the inlet pipe flange to the exhaust manifold and remove the inlet pipe.
6. Replace any damaged parts.

Installation

1. Clean the exhaust manifold and catalytic converter flange seats.
2. Position the inlet pipe to the exhaust manifold and loosely install the attaching nuts. Be sure the gasket is properly seated in the exhaust manifold.
3. Install the front hanger bracket to inlet pipe bracket. Do not tighten the attachment bolts.
4. Using a new gasket, position the inlet pipe to the catalytic converter. Align the upper and lower heat shield (if so equipped) to the converter inlet flange and loosely start the attaching bolts.
5. Remove the wire support from the resonator/muffler assembly.
6. Align the exhaust system to conform to clearance specifications shown in Fig. 1 and starting at the front, tighten all nuts, screws, and bolts to specification.
7. Check the exhaust system for leaks and lower the vehicle.

MUFFLER INLET "Y" PIPE SINGLE EXHAUST—LTD II, COUGAR, THUNDERBIRD, FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Raise the vehicle.
2. Units equipped with exhaust shields

   Remove the screws and clamps that secure the shields to the right hand and left hand catalytic converter assemblies and remove shields.
3. Support the muffler in car position with a soft wire.
4. Remove the "U" bolt clamp at the muffler inlet connection and discard.
5. Units without catalytic converters

   Remove and discard the nuts attaching the inlet "Y" pipe to the right hand and left hand manifolds.

   Disengage the inlet "Y" pipe from the manifolds.
6. Units with catalytic converters

   Remove and discard the bolts attaching the inlet "Y" pipe flat flanges to the converter flat flanges.
7. Units with shields

   Remove the brackets used to attach the flat flanges and shields.
8. Units without shields

   Remove and discard the flag nut assemblies.

   Disengage the inlet "Y" pipe from the catalytic converter and discard gaskets (both sides).
9. Separate the inlet "Y" pipe from the muffler slip joint connection. If it is necessary to obtain clearance to separate the inlet pipe joints, remove the rear hanger to outlet pipe attachments.

Installation

1. Units without catalytic converters

   Clean manifold spherical gasket faces.
2. Units with catalytic converters

   Clean converter flat flange faces.

   Loosen manifold nuts, right hand and left hand, enough to allow converter movement without binding.
3. Slide a new "U" bolt clamp over the outlet end of the inlet "Y" pipe.
4. Insert the inlet pipe into the muffler slip joint and loosely secure the "U" bolt clamp. The inlet pipe tab must fully engage the muffler alignment slot.
5. Units without catalytic converters

   Position the inlet pipe to the manifolds and loosely install new attaching nuts.
6. Units with catalytic converters

   Install new gaskets between the inlet "Y" pipe flat flange and the right hand and left hand catalytic converters and position the converter to the "Y" pipe.

   Install new bolts at each of the right hand and left hand catalytic converter/inlet pipe flat flange joints.
7. On units without shields

   Install a new flag nut to each bolt and alternately torque the bolts to specification.
8. On units with shields

   Install a bracket assembly (shield and flange attaching) to the forward side of the left hand and right hand catalytic converter flat flange. Engage the bolts and alternately torque to specification.
9. Align the system to specification, see Figs. 4 through 10.
10. With the system held to alignment specification:

    Assure that the inlet pipe tab is fully engaged into the muffler alignment slot and alternately torque the "U" bolt nuts to specification.

    Alternately torque the right hand and left hand manifold nuts to specification.

    Tighten the rear hanger to outlet pipe attachments to specification, if required.

NOTE: Alternate torque of joint fasteners is required to provide uniform clamping in order

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to prevent joint distortion, a major cause of leaks and system misalignment.

11. Remove alignment restraints and soft wire muffler supports.
12. Check the exhaust system for leaks and proper alignment.
13. On applicable models, install catalytic converter exhaust shields, left hand and right hand, to specification.
14. Lower the vehicle.

MUFFLER AND RESONATOR—GRANADA, MONARCH, FAIRMONT, ZEPHYR AND VERSAILLES

Removal

1. Raise the vehicle on a hoist that permits the axle to lower to the full extent of its travel. This will provide the clearance necessary to replace the muffler and resonator.
2. Without catalytic converter—remove the inlet flange attaching bolts at the connection with resonator pipe.
3. With catalytic converter—remove the rear converter flange attaching nuts.
4. Remove the attaching screws from the rear hanger assembly to muffler support (if so equipped).
5. Slide the resonator and muffler assembly rearward to disconnect it from the inlet pipe or the catalytic converter flange.
6. Remove the attaching screws from the intermediate support to resonator assembly and remove resonator, connecting pipe and muffler.
7. Replace damaged parts.

Installation

1. Position the muffler to the rear hanger bracket and loosely install the screws (if so equipped).
2. Position the resonator and muffler assembly to the inlet "Y" pipe or converter flange connection. The converter seat must be cleaned prior to attaching the resonator pipe. Loosely install flange attaching nuts.
3. Position the resonator in the intermediate hanger bracket and loosely install the attaching screws.
4. Align the exhaust system to conform to the clearance specifications.
5. Starting from the inlet "Y" pipe outlet end, torque all nuts and bolts to specifications.
6. Check the system for leaks.
7. Lower the vehicle.

MUFFLER AND RESONATOR ASSEMBLY—MUSTANG II

Removal

1. Raise the vehicle by means of the frame lift points to allow the axle full downward travel. This will provide the clearance necessary to remove and replace the muffler, resonator and pipe.
2. Remove the rear converter to resonator pipe flange and U-bolt connection attaching nuts (Fig. 1).
3. Remove the attaching screws from the rear hanger assembly to muffler support.
4. Slide the muffler and resonator assembly rearward to disconnect it from the catalytic converter pipe.
5. Remove the attaching screws from the intermediate support on the muffler inlet pipe and remove the resonator/muffler assembly.
6. Replace any damaged parts.

Installation

1. Clean the catalytic converter flange seat.
2. Position the resonator and muffler assembly over the rear axle and loosely attach the intermediate support bracket.
3. Position the muffler rear support bracket and loosely install the attaching screws.
4. Position the resonator pipe and flange to the converter flange and slip joint. Install but do not tighten the attaching nuts.
5. Align the exhaust system to conform to the proper clearance specifications and, starting from the resonator pipe connection, torque all nuts and screws to specifications.
6. Check the system for leaks and lower the vehicle.

MUFFLER ASSEMBLY—LTD II, THUNDERBIRD, COUGAR, FORD, MERCURY, LINCOLN CONTINENTAL AND CONTINENTAL MARK V

Removal

1. Raise the vehicle on a hoist that permits the rear axle to lower to the full extent of its travel. This will provide the clearance necessary to remove the muffler assembly.
2. Support the muffler inlet pipe with a soft wire and remove the "U" bolt clamp at the inlet pipe to muffler inlet connection.
3. Remove the rear support bracket to muffler assembly attachment screws.
4. Remove the screws securing the intermediate support bracket to the muffler.
5. Separate the muffler to inlet pipe connection and remove the muffler assembly.

Installation

1. Slide a new "U" bolt clamp over the outlet end of the inlet pipe.
2. Position the muffler assembly on the inlet pipe and loosely install the clamp. Be sure that the tab is fully inserted into the locating slot and muffler.
3. Position the muffler to the intermediate support bracket. Install the attaching screws to specification.
4. Attach the screws holding the rear support bracket and tighten to specification.
5. Align the exhaust system to conform to the clearance specifications.

NOTE: If specified alignment specifications cannot be obtained, the right hand and left hand manifold attachments should be loosened. After specifications are obtained, tighten the manifold

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attaching nuts to specification while holding clearances.

6. Position and alternately torque the "U" bolt clamp nuts at the inlet pipe to muffler connection to specification. Be sure the tab and slot are properly engaged.
7. Remove the temporary wire supports, check the system for leaks, and lower the vehicle.

CATALYTIC CONVERTER—MUSTANG II/ GRANADA/MONARCH/FAIRMONT/ ZEPHYR

Removal

1. Raise the vehicle.
2. Remove the upper and lower heat shields, if so equipped, attached to the converter.
3. Remove the front and rear catalytic converter flange fasteners.
4. Separate the catalytic converter inlet and outlet flange connections.
5. Remove the converter.
6. Remove the heat shield/hanger assembly and grass shield from the catalytic converter (Fairmont and Zephyr).
7. Replace any damaged parts.

Installation

1. Secure heat shield/hanger assembly and grass shield to catalytic converter (Fairmont and Zephyr).
2. Align the heat shield brackets to the inner flanges on the converter (if so equipped) and position the catalytic converter to the inlet pipe using a new gasket. Loosely install the attaching bolts.
3. Install the muffler inlet flange to the converter outlet flange. Loosely install the attaching nuts.
4. Attach the heat shields to the converter.
5. Align the exhaust system to specification and starting at the front of the system, tighten all nuts and bolts to specification.
6. Check the system for leaks and lower the vehicle.

CATALYTIC CONVERTER—LTD II, THUNDERBIRD, COUGAR, FORD, MERCURY, CONTINENTAL MARK V AND LINCOLN CONTINENTAL

Removal

1. Raise the vehicle.
2. Remove the exhaust shield(s), if so equipped, from the catalytic converter(s). (See Figs. 4-10.)
3. Support the exhaust inlet pipe in its relative position by securing the pipe to the No. 3 frame crossmember with soft wire.
4. Remove and discard bolts attaching the converter and inlet "Y" pipe flat flanges (both sides).

   Units with shields, remove the brackets that attach the shields and flat flanges (both sides).

   Units without shields, remove and discard flag nut assemblies (both sides).
5. Remove the converter flange attaching nuts holding the converters to the exhaust manifold (both sides).
6. Slide the inlet pipe rearward until the catalytic converter(s) can be removed. It may be necessary to disconnect the rear hanger-to-outlet pipe attachment to obtain sufficient clearance to separate the converter at manifold connection(s).
7. Discard gasket(s) and damaged parts.

Installation

1. Clean the inlet "Y" pipe flange face.
2. Position the catalytic converter(s) to the exhaust manifold. Loosely install the attaching nuts.
3. Install new gaskets between the inlet "Y" pipe/ converter flat flanges. Position the inlet pipe flange to the converter outlet flange connections and insert new attaching bolts. On units without shields, loosely install flag nuts to the bolts, and on units with shields, position attaching brackets forward of the converter flat flange and loosely engage the bolts.
4. Alternately tighten the converter to inlet pipe flange connection(s) to specification.
5. Align the system to proper clearance specifications.
6. Alternately tighten the manifold nuts to specification.
7. Check the system for leaks.

   NOTE: Alternate torque of joint fastener is required to provide uniform clamping in order to prevent joint distortion, a major cause of system leaks and misalignment.
8. Install the exhaust shield(s) to the catalytic converter(s) to specification. See Figs. 4-10.
9. Lower the vehicle.

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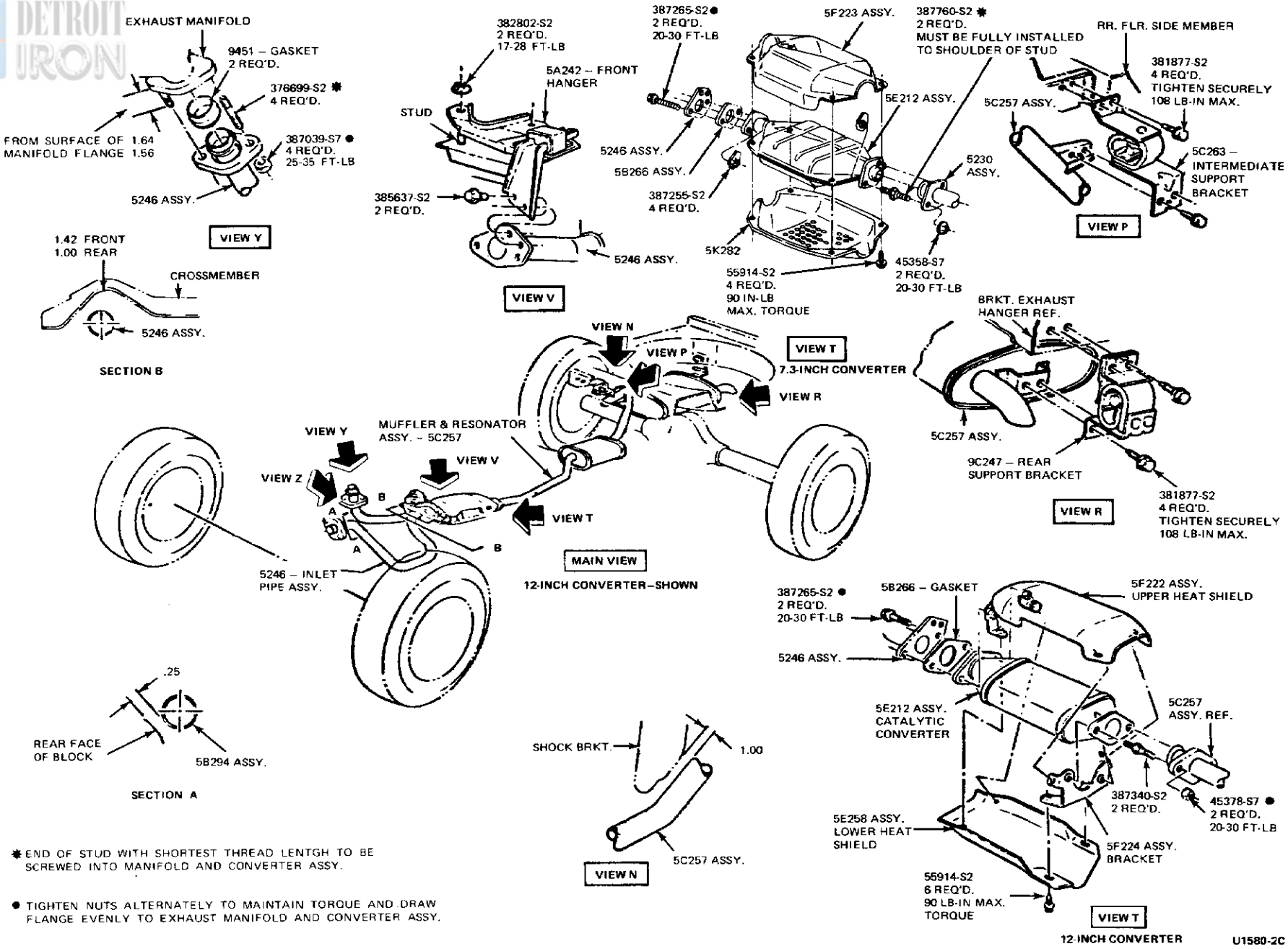
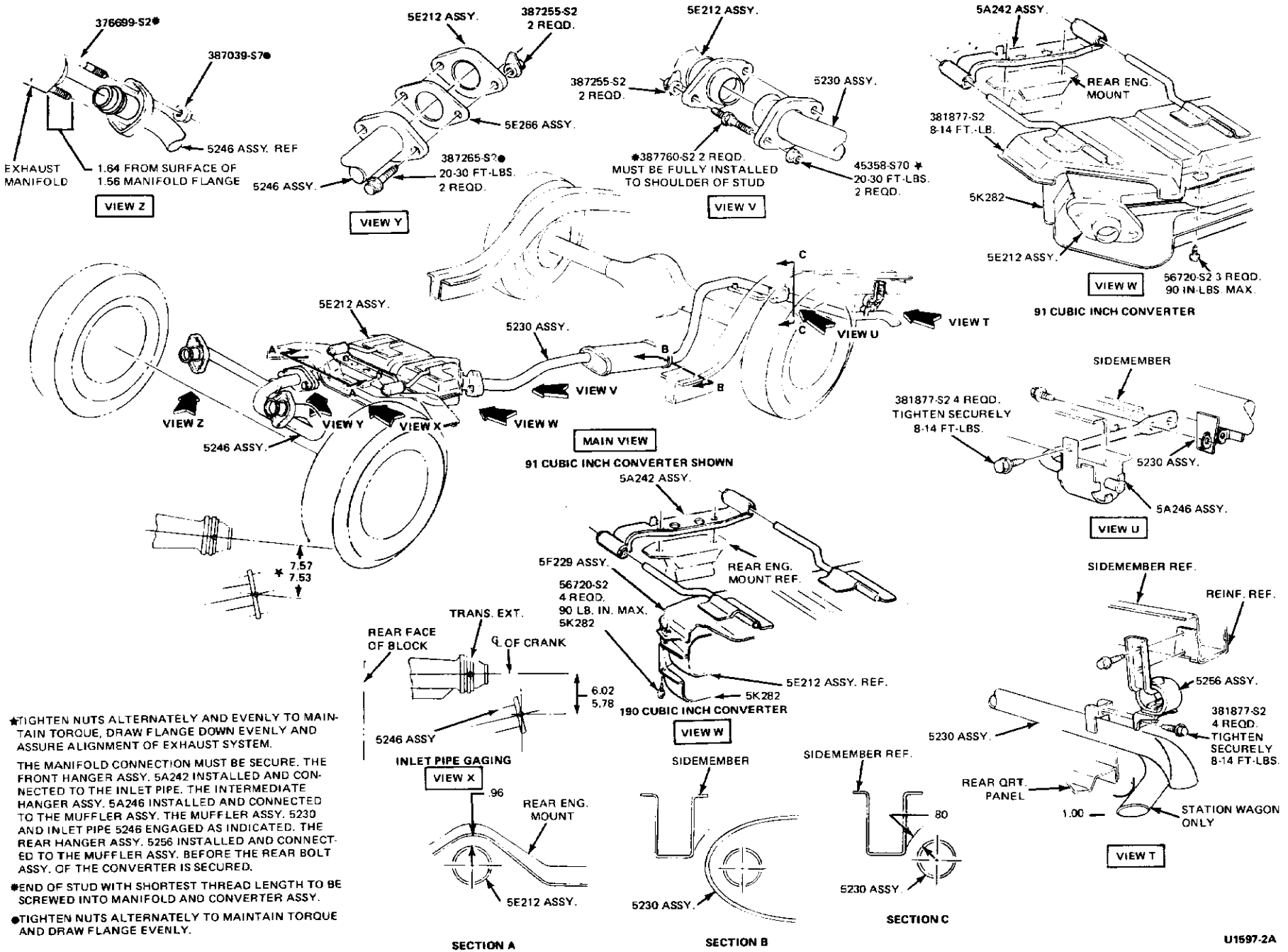


FIG. 1 Exhaust System—Mustang II with 5.0L (302 CID) V-8 (No Catalytic Converter)

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★TIGHTEN NUTS ALTERNATELY AND EVENLY TO MAINTAIN TORQUE, DRAW FLANGE DOWN EVENLY AND ASSURE ALIGNMENT OF EXHAUST SYSTEM.

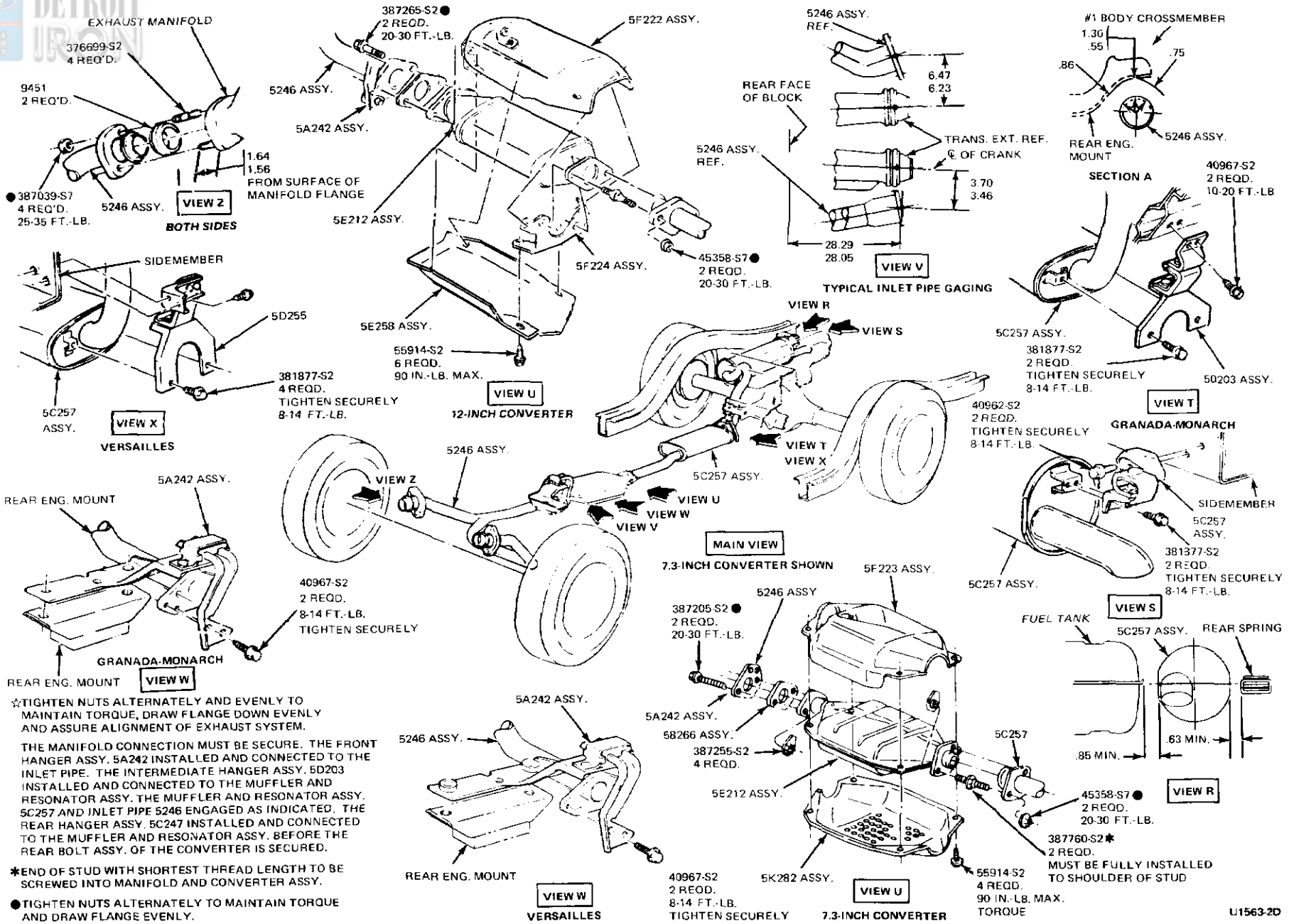
THE MANIFOLD CONNECTION MUST BE SECURE. THE FRONT HANGER ASSY. 5A242 INSTALLED AND CONNECTED TO THE INLET PIPE. THE INTERMEDIATE HANGER ASSY. 5A246 INSTALLED AND CONNECTED TO THE MUFFLER ASSY. THE MUFFLER ASSY. 5230 AND INLET PIPE 5246 ENGAGED AS INDICATED. THE REAR HANGER ASSY. 5256 INSTALLED AND CONNECTED TO THE MUFFLER ASSY. BEFORE THE REAR BOLT ASSY. OF THE CONVERTER IS SECURED.

✱END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

●TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 2 Exhaust System—Fairmont and Zephyr with Converter

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☆TIGHTEN NUTS ALTERNATELY AND EVENLY TO MAINTAIN TORQUE, DRAW FLANGE DOWN EVENLY AND ASSURE ALIGNMENT OF EXHAUST SYSTEM.

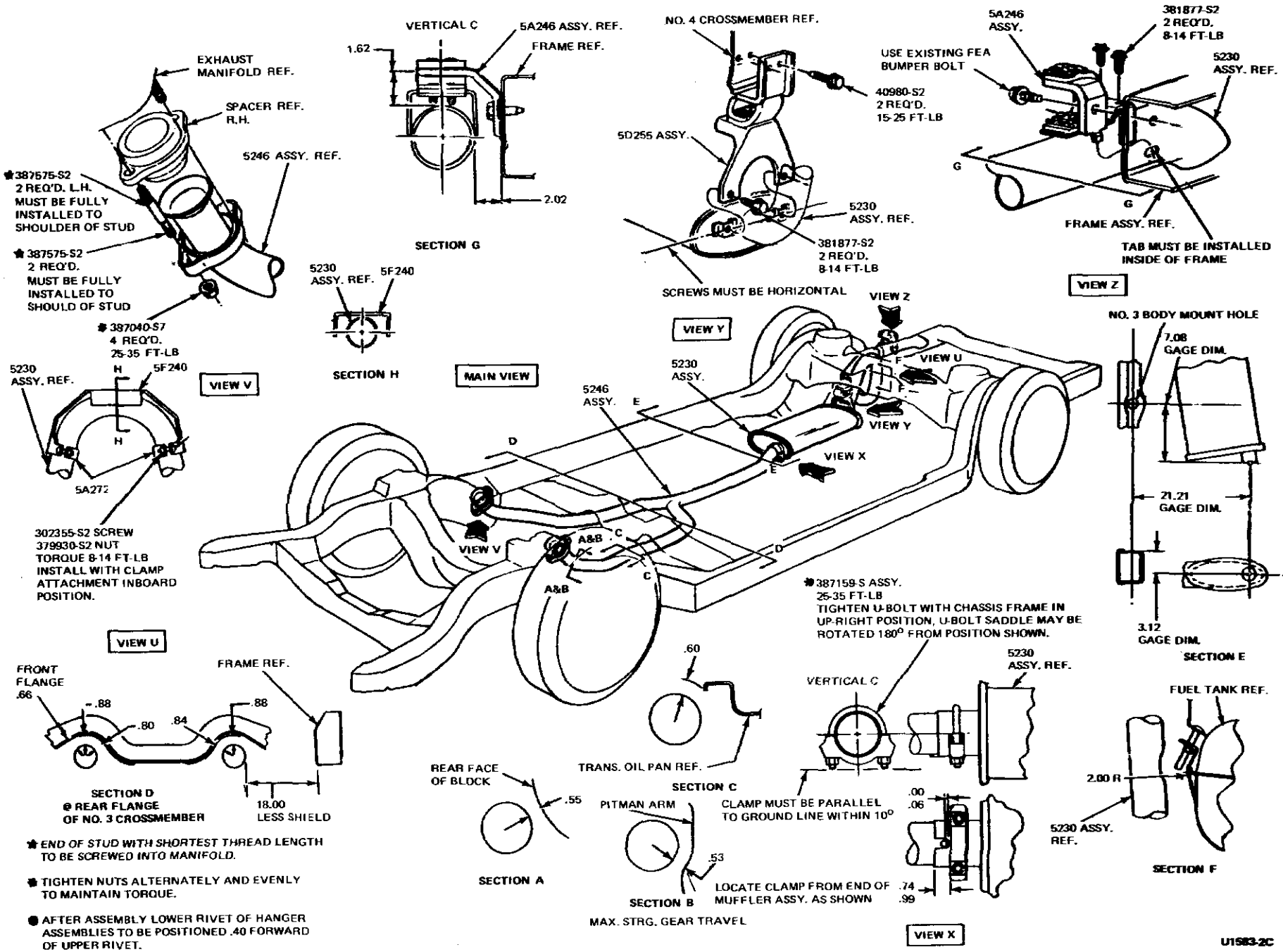
THE MANIFOLD CONNECTION MUST BE SECURE. THE FRONT HANGER ASSY. 5A242 INSTALLED AND CONNECTED TO THE INLET PIPE. THE INTERMEDIATE HANGER ASSY. 5D203 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. THE MUFFLER AND RESONATOR ASSY. 5C257 AND INLET PIPE 5246 ENGAGED AS INDICATED. THE REAR HANGER ASSY. 5C247 INSTALLED AND CONNECTED TO THE MUFFLER AND RESONATOR ASSY. BEFORE THE REAR BOLT ASSY. OF THE CONVERTER IS SECURED.

✱END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD AND CONVERTER ASSY.

●TIGHTEN NUTS ALTERNATELY TO MAINTAIN TORQUE AND DRAW FLANGE EVENLY.

FIG. 3 Exhaust System—Granada, Monarch and Versailles with Converter

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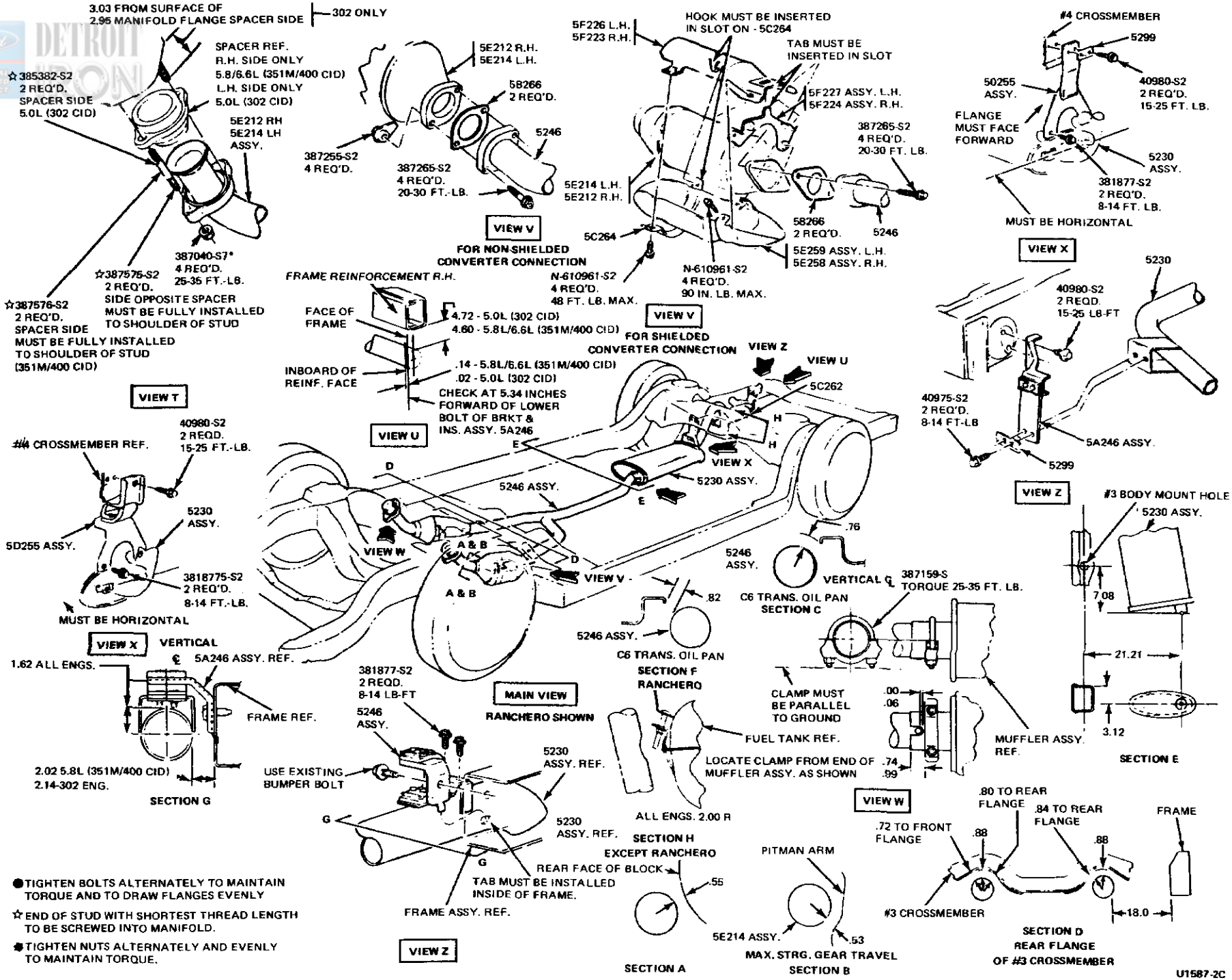
* *END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.*

* TIGHTEN NUTS ALTERNATELY AND EVENLY TO MAINTAIN TORQUE.

● AFTER ASSEMBLY LOWER RIVET OF HANGER ASSEMBLIES TO BE POSITIONED .40 FORWARD OF UPPER RIVET.

FIG. 4 Exhaust System—LTD II/Thunderbird/Cougar/Ranchero without Converter

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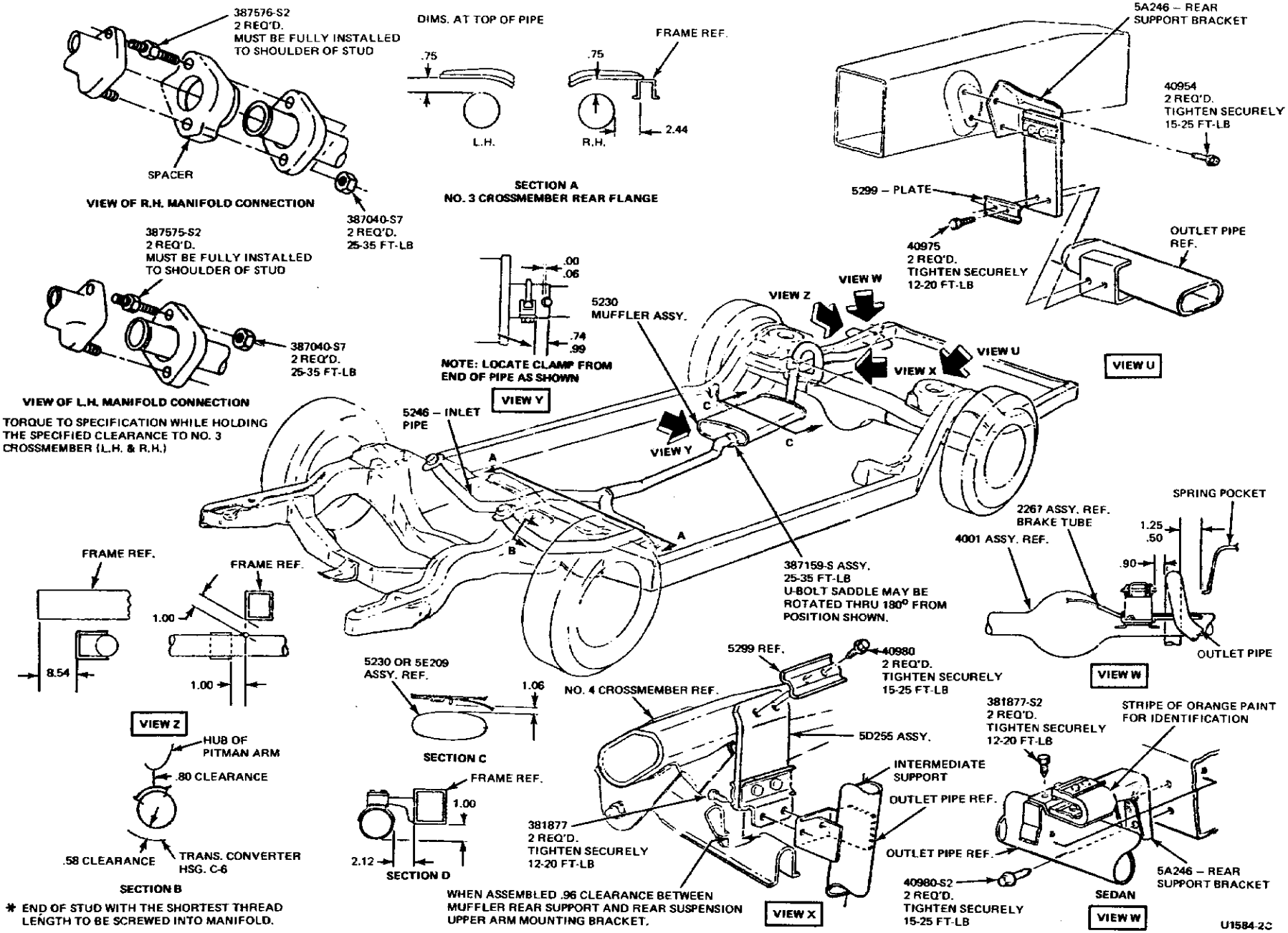
● TIGHTEN BOLTS ALTERNATELY TO MAINTAIN TORQUE AND TO DRAW FLANGES EVENLY

☆ END OF STUD WITH SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.

* TIGHTEN NUTS ALTERNATELY AND EVENLY TO MAINTAIN TORQUE.

FIG. 5 Exhaust System—LTD II/Thunderbird/Cougar/Ranchero with Converters

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* END OF STUD WITH THE SHORTEST THREAD LENGTH TO BE SCREWED INTO MANIFOLD.

FIG. 6 Exhaust System—Ford/Mercury Sedan and Station Wagon—with no Catalytic Converters

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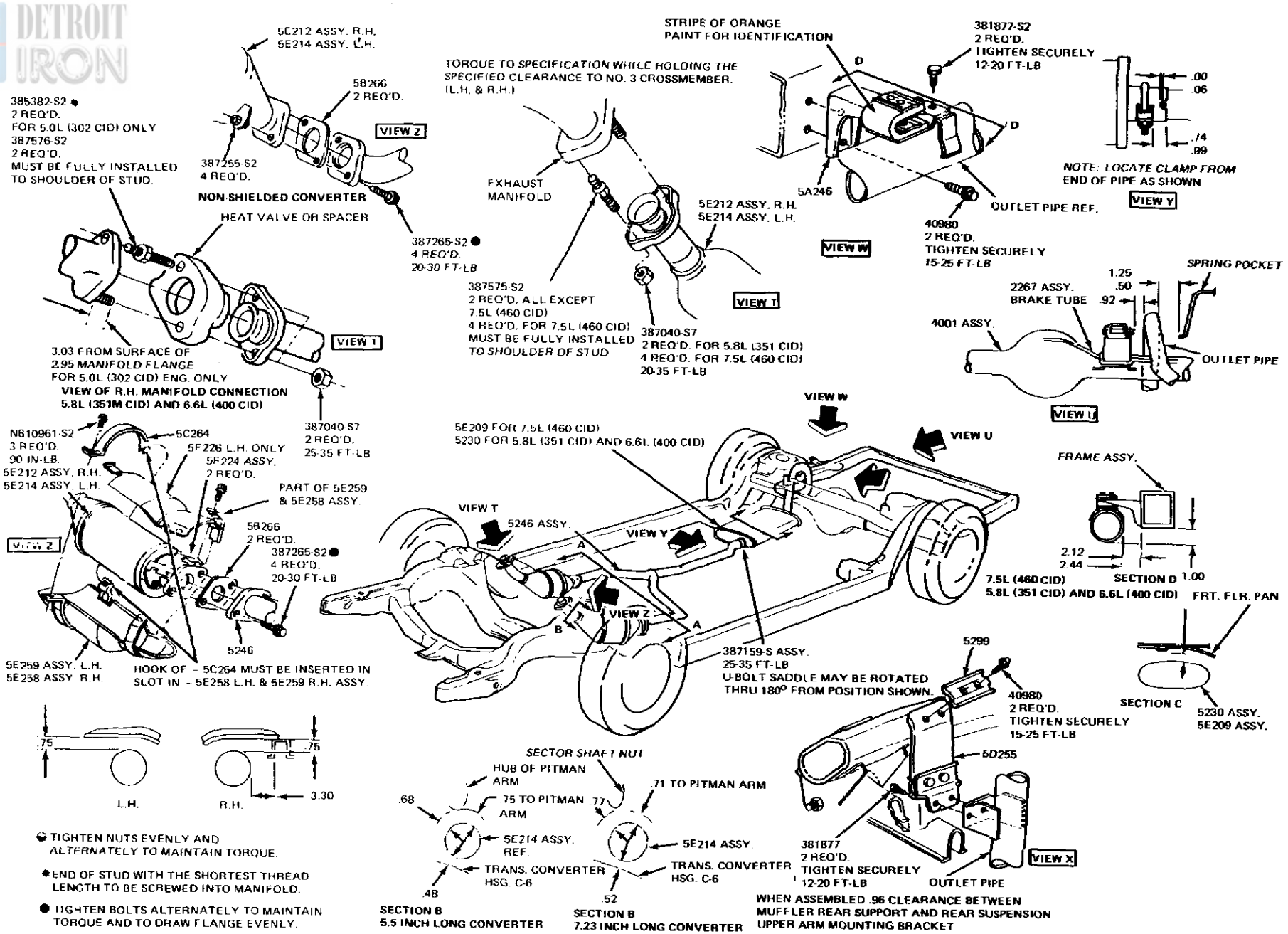


FIG. 7 Exhaust System—Ford/Mercury Sedan with Two Converters

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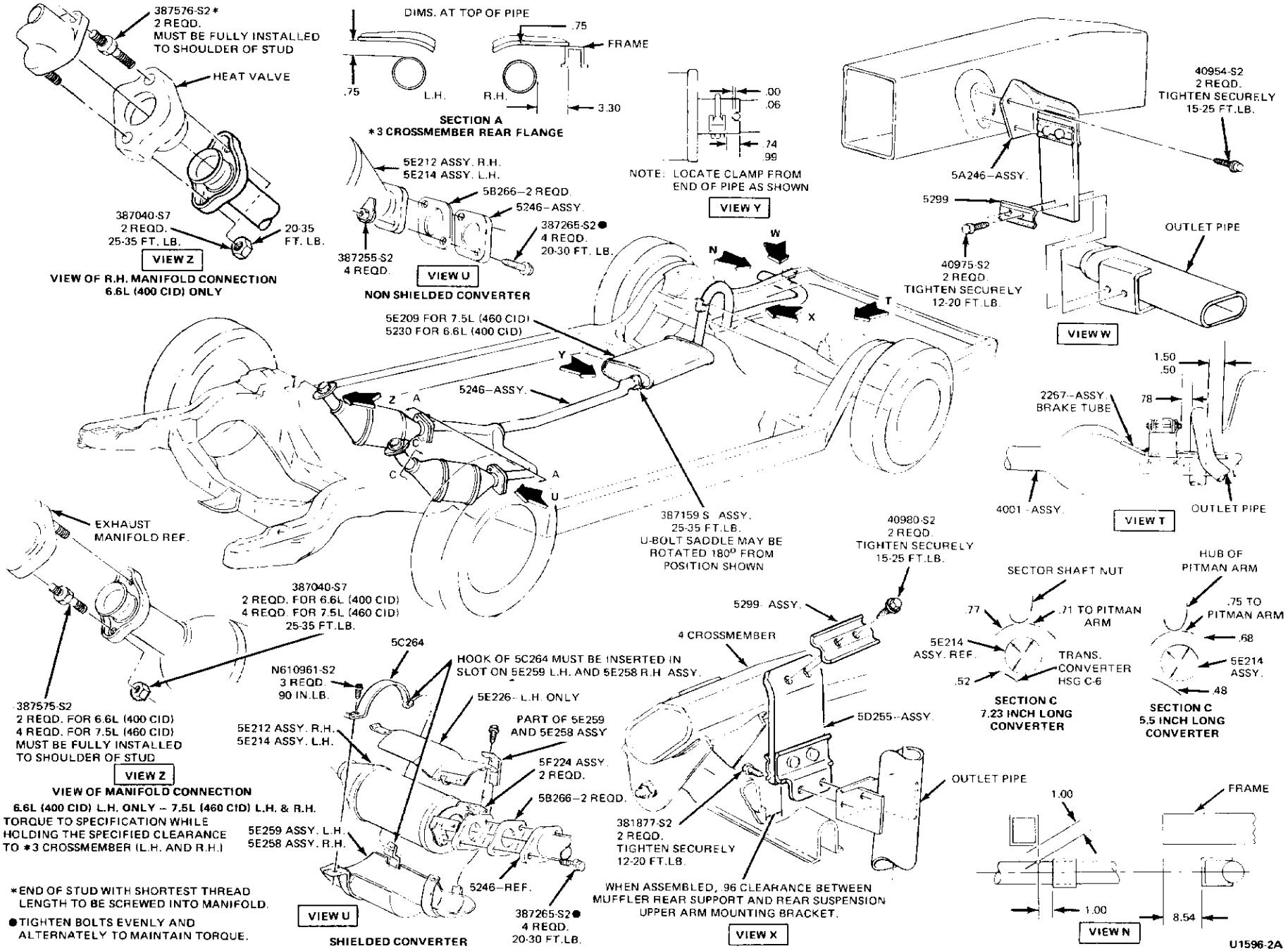


FIG. 8 Exhaust System—Ford/Mercury Wagon with Two Converters

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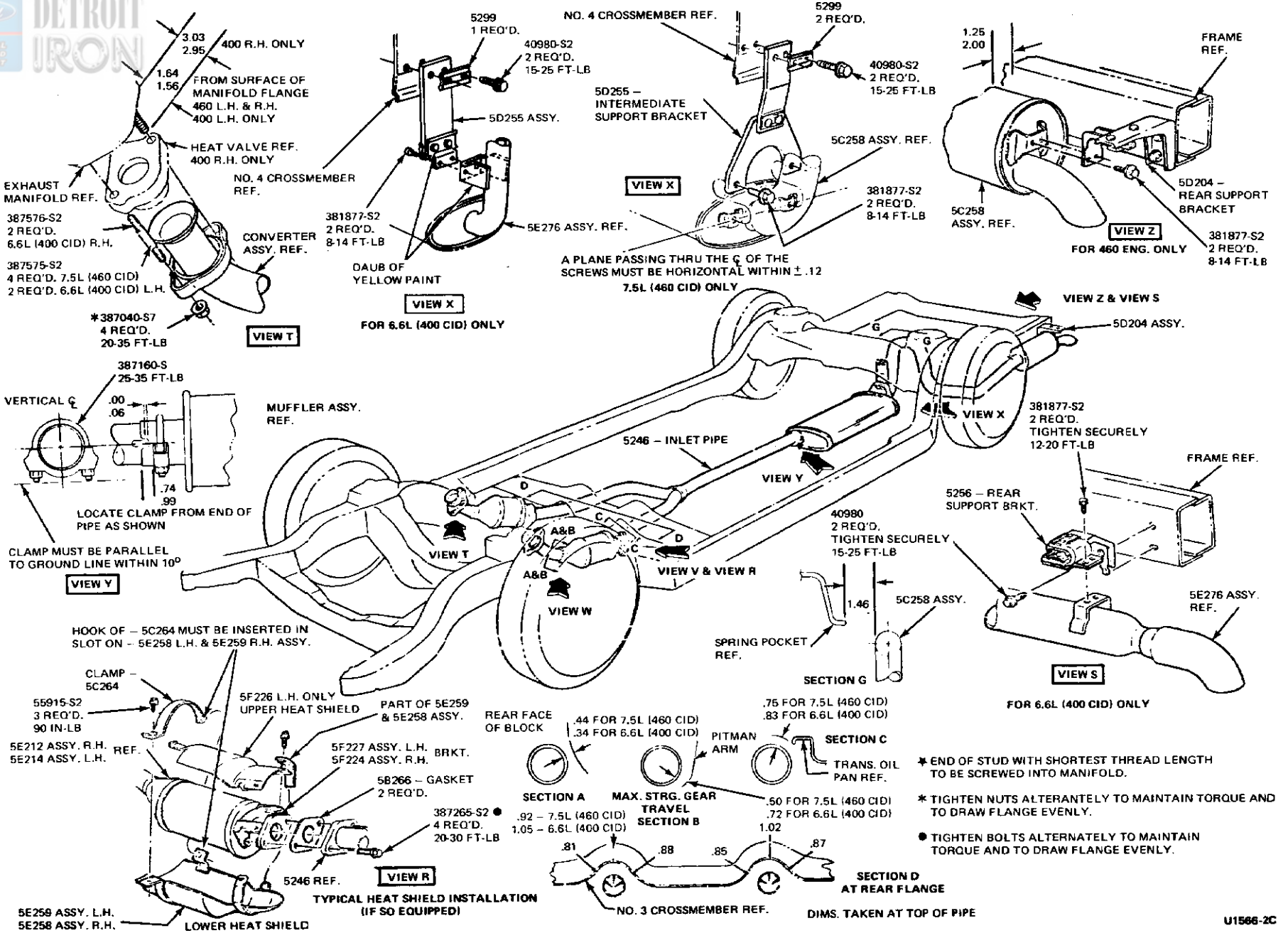


FIG. 9 Exhaust System—Continental Mark V

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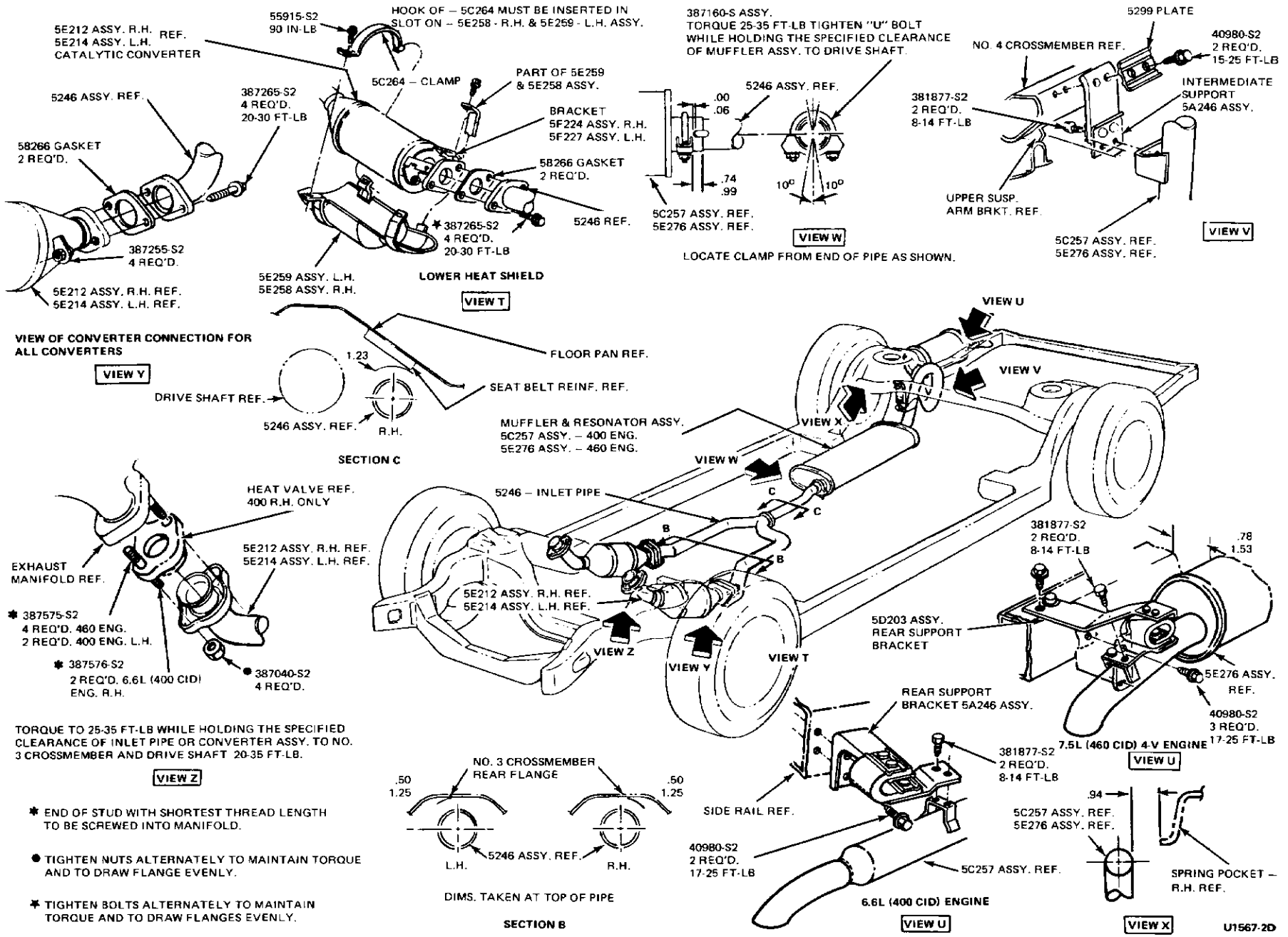


FIG. 10 Exhaust System—Lincoln Continental

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V-8 Dual Exhaust Systems

PART 26-22

Ford and Mercury Police Interceptor and Continental Mark V w/7.5L (460 CID) V-8

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Muffler and Resonator Assembly – Mark V	22-2

CN4032-2B

DESCRIPTION

DUAL EXHAUST SYSTEM WITHOUT RESONATOR

The dual-pipe exhaust systems without resonators are of all the same basic design. The H-shaped inlet pipe assembly is of one-piece construction. Muffler and outlet pipe on the factory installation is a welded assembly.

Normal service parts procedure is to furnish the H-pipe as a single, welded assembly, while the muffler and outlet pipe are serviced separately and assembled with clamps. Refer to the master parts catalog for current service parts systems.

DUAL EXHAUST SYSTEM WITH RESONATOR

As factory-installed, this system consists of a welded H-pipe assembly connected to two welded muffler-resonator assemblies (Fig. 2).

For service replacement, the H-pipe is furnished as a single welded assembly, but the muffler/resonator, and outlet pipe are available separately. Refer to the master parts catalog for current service parts.

Two catalytic converters are connected to most dual exhaust systems. These converters are located between the exhaust manifold and the inlet "H" pipe.

REMOVAL AND INSTALLATION

The replacement procedures given apply to all vehicle models and to right and left assemblies of dual exhaust systems unless otherwise noted.

INLET "H" PIPE—FORD, MERCURY AND CONTINENTAL MARK V

Removal

1. Raise the vehicle.
2. Remove the "U" bolt clamps at the muffler inlet connections.
3. Support the mufflers in their proper position using soft wire.
4. Remove the nuts attaching the inlet pipe to converter flat flange connections. Do not remove the inlet pipe to right hand or left hand manifold connection nuts.
5. Slide the inlet pipe rearward until the catalytic converter can be disconnected from the "H" inlet pipe.
6. Disconnect the inlet pipe from the catalytic converter connection. It may be necessary to disconnect the rear hanger to outlet pipe attachment in order to obtain sufficient clearance to separate the converter connection.

Installation

1. Clean converter flat flanges. Loosen manifold nuts (right hand and left hand) enough to allow converter movement without binding.
2. Slide the "U" bolt clamp(s) over the muffler end(s) of the "H" inlet pipe.
3. Position the inlet pipe to the muffler slip joint connection(s) and loosely install the "U" bolt clamp(s). Be sure the tab(s) on the inlet pipe is properly located in the muffler slot(s).
4. Install a new gasket or exhaust restrictor plate to the right hand and left hand converter flat flange to "H" pipe connections.
5. Position the inlet pipe to the converter flat flange connections and loosely install the attaching nuts.
6. Tighten the left hand and then the right hand flat flange connection attaching nuts to specification.

NOTE: If a catalytic converter(s) is being replaced along with the inlet pipe, the

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converter(s) should be installed to the manifold(s) loosely, then the inlet pipe to converter(s) flat flange connection attaching nuts must be installed and tightened to specification BEFORE the manifold to converter attaching nuts to insure proper alignment.

7. Tighten the "U" bolt clamp(s) at the muffler slip joint(s) to specification. Be sure the tab and slot are properly engaged.
8. Tighten the rear hanger to muffler outlet pipe attachment to specification, if required.
9. Check the exhaust system for leaks and alignment and install the exhaust shields to inlet pipe(s) as required.
10. Lower the vehicle.

CATALYTIC CONVERTER—FORD, MERCURY AND CONTINENTAL MARK V

Removal

1. Raise the vehicle.
2. Remove the exhaust shield(s), if so equipped, from the catalytic converter(s).
3. Support the exhaust inlet pipe in its relative position by securing the pipe to the No. 3 frame crossmember with soft wire.
4. Remove and discard bolts attaching the converter and inlet "Y" pipe flat flanges (both sides).

   Units with shields, remove the brackets that attach the shields and flat flanges (both sides).

   Units without shields, remove and discard flag nut assemblies (both sides).
5. Remove the converter flange attaching nuts holding the converters to the exhaust manifold and inlet pipe (both sides).
6. Slide the inlet pipe rearward until the catalytic converter(s) can be removed. It may be necessary to disconnect the rear hanger-to-outlet pipe attachment to obtain sufficient clearance to separate the converter at manifold connection(s).
7. Discard gasket(s) or exhaust restrictor plate(s) and damaged parts.

Installation

1. Clean the inlet "Y" pipe flange face.
2. Position the catalytic converter(s) to the exhaust manifold. Loosely install the attaching nuts.
3. Install new gaskets or exhaust restrictor plate(s) between the inlet "Y" pipe/converter flat flanges. Position the inlet pipe flange to the converter outlet flange connections and insert new attaching bolts. On units without shields, loosely install flag nuts to the bolts, and on units with shields, position attaching brackets forward of the converter flat flange and loosely engage the bolts.
4. Alternately tighten the converter to inlet pipe flange connection(s) to specification.
5. Align the system to proper clearance specifications.
6. Alternately tighten the manifold nuts to specification.
7. Check the system for leaks.

NOTE: Alternate torque of joint fastener is required to provide uniform clamping in order to prevent joint distortion, a major cause of system leaks and misalignment.

8. Install the exhaust shield(s) to the catalytic converter(s) to specification.
9. Lower the vehicle.

MUFFLER—FORD AND MERCURY

Removal

1. Raise the vehicle on a hoist that permits the rear axle to lower to the full extent of its travel. This will provide the clearance necessary to remove the muffler assembly.
2. Support the muffler inlet pipe with a soft wire and remove the "U" bolt clamp at the inlet pipe to muffler inlet connection(s).
3. Remove the rear support bracket screws.
4. Remove the screw securing the intermediate support bracket to the muffler(s).
5. Separate the muffler to inlet pipe connection(s) and remove the muffler assembly.
6. Replace "U" bolt clamps and any other worn or damaged parts.

Installation

1. Slide the "U" bolt clamp(s) over the outlet end(s) of the inlet pipe.
2. Position the muffler assembly on the inlet pipe and loosely install the clamp(s). Be sure that the tab is fully inserted into the locating slot.
3. Position the muffler to the intermediate support bracket. Loosely install the attaching screws.
4. Attach the screws holding the rear support bracket and tighten to specification.
5. Align the exhaust system to conform to the clearance specifications. **NOTE: If specified alignment specifications cannot be obtained, the right hand and left hand manifold attachments should be loosened. After specifications are obtained, tighten the manifold attaching nuts to specification while holding clearances.**
6. Tighten intermediate support bracket screws to specification.
7. Position and secure the "U" bolt(s) at the inlet pipe to muffler connection(s) to specification. Be sure the tab and slot are properly engaged.
8. Remove the temporary wire support, check the system for leaks, and lower the vehicle.

MUFFLER AND RESONATOR ASSEMBLY—CONTINENTAL MARK V

Removal (Refer to Fig. 2) For Service System Replacement

1. Raise the vehicle on a hoist that permits the axle to lower to the full extent of its travel. This will provide the clearance necessary to remove the muffler and outlet pipe.
2. Support the inlet pipe with a soft wire.
3. Cut the muffler outlet pipe(s) at the kick-up area just above the muffler(s).

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4. Remove the screws which attach the resonator(s) to the rear hanger(s). Remove the resonator(s) and pipe(s).
5. Remove the screws securing the muffler(s) to the intermediate support bracket(s).
6. Remove the clamp(s) securing the inlet pipe(s) to the muffler(s).
7. Separate the muffler(s) from the inlet pipe(s) and remove the muffler(s).
8. Replace any damaged or badly rusted parts and the "U" bolt clamps.

Installation

1. Position the muffler(s) and outlet pipe(s) to the intermediate support bracket(s) and loosely install the attaching screws.
2. Slide the muffler(s) onto the inlet pipe(s) and properly position the clamp(s). Be sure to maintain the specified clearances for the clamp and locating tab and be sure that the tab is fully inserted into the locating slot.
3. Install a clamp on each resonator inlet and slide each resonator onto the muffler outlet. Loosely install the "U" bolt clamp(s) snug, but not tight.
4. Attach the resonator(s) to the rear hanger bracket(s), install and tighten the attaching screws to specification.
5. Align the exhaust system to conform to the clearance specifications.

   NOTE: If the alignment clearances cannot be obtained, loosen the right hand and left hand manifold attachments until the necessary clearance can be obtained. Tighten the manifold bolts to specification.
6. Tighten intermediate support bracket screws to specification.
7. Tighten the "U" bolt clamps at the inlet pipe(s) to muffler connection(s) and at the muffler outlet(s) to resonator inlet connection(s) to specification.
8. Remove the temporary support wire, check the exhaust system for leaks and lower the vehicle.

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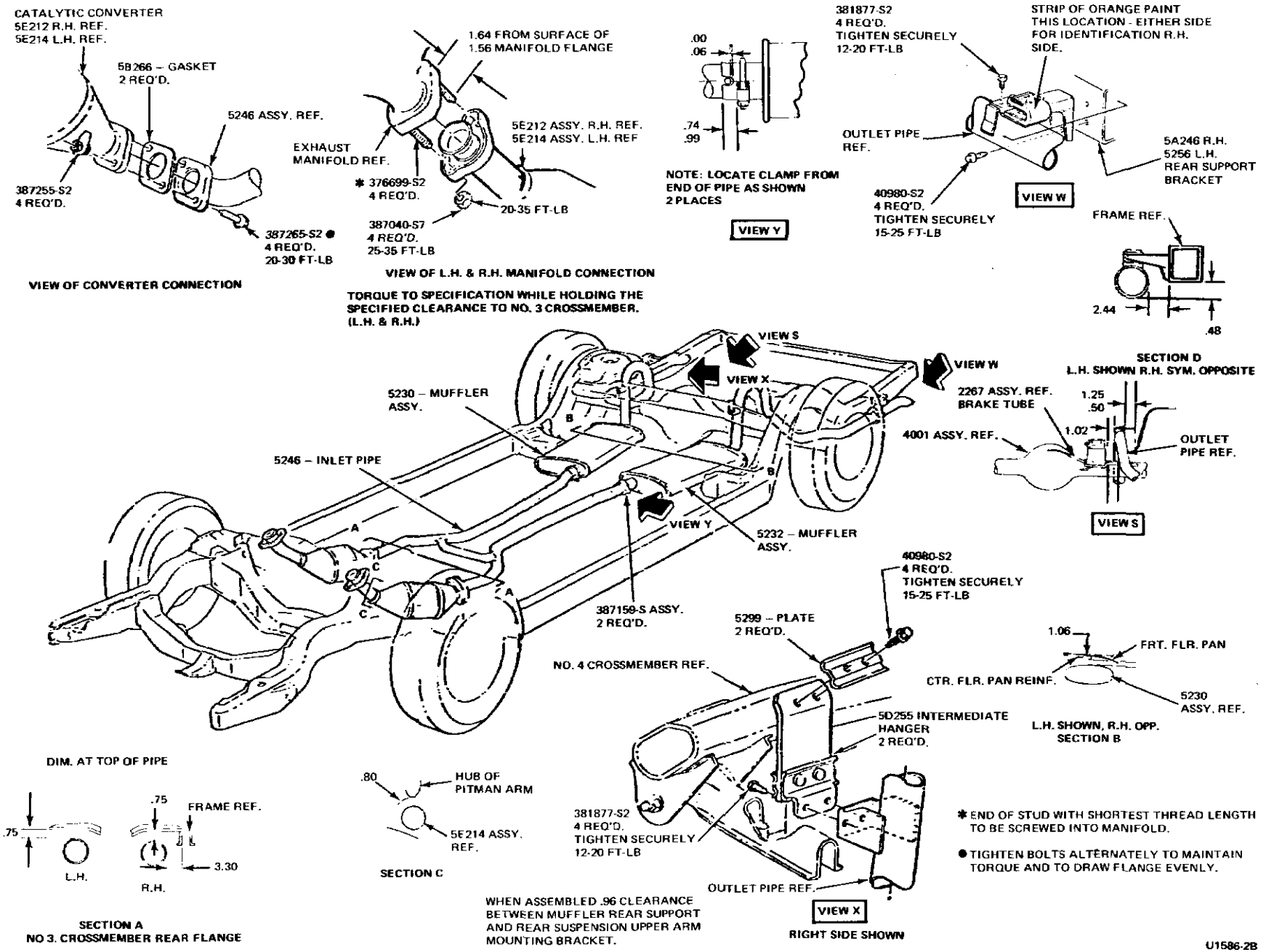


FIG. 1 Exhaust System—Ford/Mercury Sedan with 7.5L (460 CID) Police Interceptor V-8

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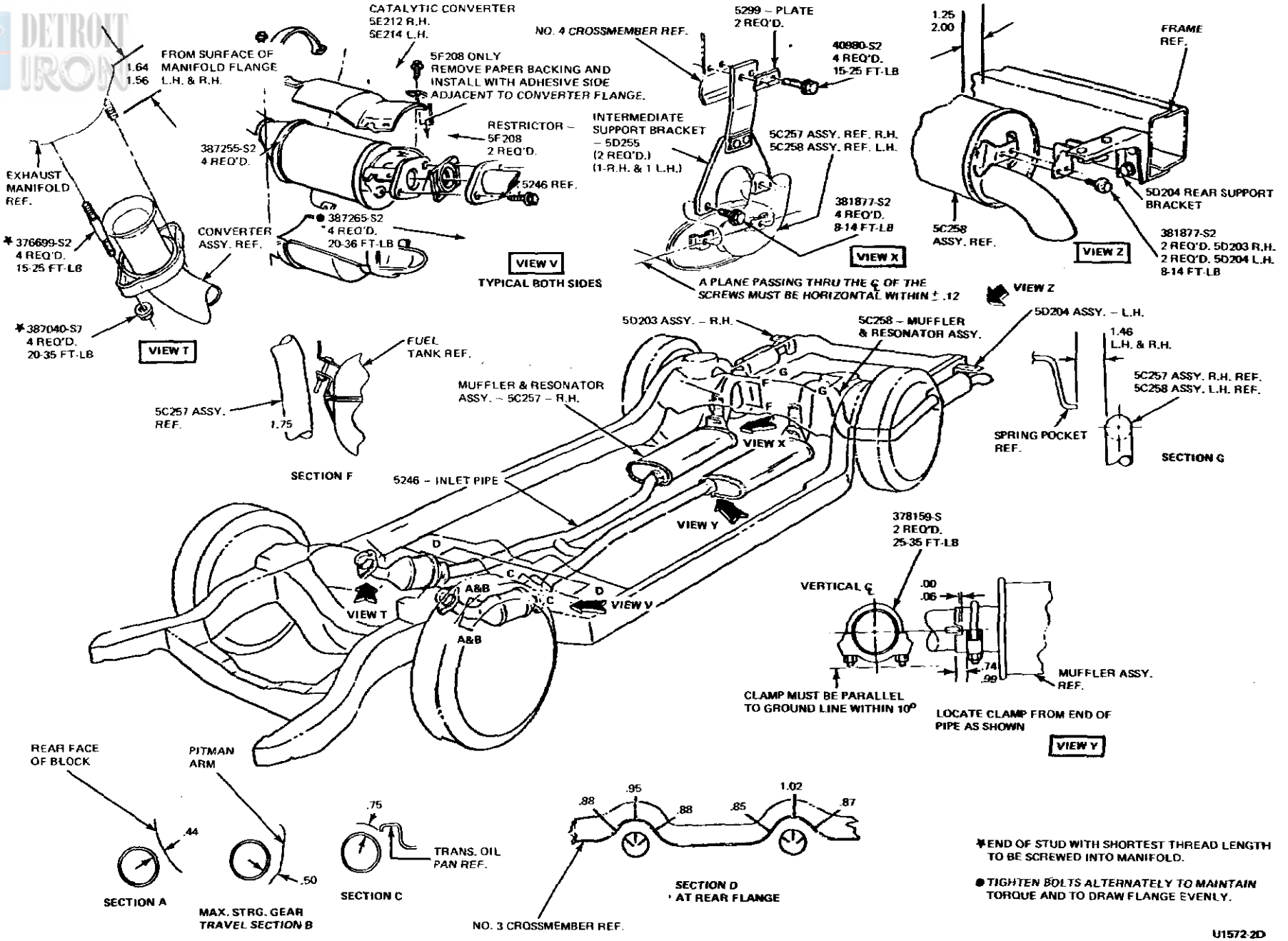


FIG. 2 Exhaust System—Continental Mark V with 7.5L (460 CID) V-8

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COOLING SYSTEM

GROUP 27 (8000)

PART TITLE	PART NO.
Fan Drive Clutch	27-05
Flex-Blade Fan	27-06
General Cooling System Service	27-01
Radiators	27-03

CN4038-2A

General Cooling System Service

PART 27-01

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CN4039-2A

GENERAL INFORMATION

This part covers general cooling system diagnosis service. For cooling system component removal, disassembly, assembly, installation and repair procedures and specifications, refer to the pertinent Part of this Group.

CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.

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DIAGNOSIS

Refer to the following Diagnosis Chart for cooling system complaints, their possible cause and recommended resolution. Refer to the pertinent Part for testing and repair.

The most frequent cooling system complaints concern leakage and overheating. Either of these problems will soon render the vehicle inoperable.

Most vehicles use an Ethylene glycol base anti-freeze solution to which the manufacturers have added a dye color. The dye color makes the anti-freeze solution an excellent leak detector. If this type of solution is not being used in the cooling system, a vegetable dye may be added to aid in locating external leakage.

Complaint	Possible Cause	Resolution
• Loss of coolant.	• Pressure cap and gasket. • Leakage. • External Leakage. • Internal Leakage.	• Inspect, wash gasket and test. Replace only if cap will not hold pressure test specification. • Pressure test system. • Inspect hose, hose connection, radiator, edges of cooling system gaskets, core plugs and drain plugs, transmission oil cooler lines, water pump, heater system components. Repair or replace as required. • Disassemble engine as necessary – check for: cracked intake manifold, blown head gaskets, warped head or block gaskets surfaces, cracked cylinder head or engine block.
• Engine overheats.	• Low coolant level. • Loose fan belt. • Pressure cap. • Radiator or A/C condenser obstruction. • Closed thermostat. • Fan drive clutch. • Ignition. • Temp gauge or cold light. • Engine	• Fill as required. Check for coolant loss. • Adjust. • Test. Replace if necessary. • Remove bugs, leaves, etc. • Test, replace if necessary. • Test, replace if necessary. • Check timing and advance. Adjust as required. • Check electrical circuits and repair as required. Refer to Volume 3. • Check water pump, block for blockage.
• Engine fails to reach normal operating temperature.	• Open thermostat. • Temperature gauge or cold light.	• Test, replace if necessary. • Check electrical circuits and repair as required. Refer to electrical section.

CQ1403-2B

TESTING

GENERAL TEST PROCEDURES

Visual Inspection

A. Check for leakage at:

1. All hoses and hose connections.
2. Radiator seams, radiator core, and radiator drain petcock.
3. All block core plugs and drain plugs.
4. Edges of all cooling system gaskets.
5. Transmission oil cooler.
6. Vehicle heating system components.
7. Water pump.

B. Examine oil dipstick for evidence of coolant contaminated with engine oil.

C. Check radiator for evidences of oil in coolant (leakage at transmission oil cooler).

COOLING SYSTEM PRESSURE TEST

1. Shut the engine off.

WARNING—Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, press down on the cap (still with a cloth), turn and remove it.

2. Adjust the radiator coolant (Fill or drain) to one inch below the filler neck opening before testing. Wet the rubber sealing surface of the cap before installing the cap tightly on the radiator.

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3. Disconnect the electrical connector from the coolant temperature sending unit and remove the temperature sending unit from the engine.

   With the radiator cap installed and the cooling system pressure relieved, only a small amount of coolant will be lost when the sending unit is removed.

4. Install the adapter fitting from the pressure tester 21-0012 (or equivalent) (male thread on one end, and a hose connector on the other end to accommodate the tester hose) tightly into the intake manifold or cylinder head in place of the sending unit. (See Fig. 1).

5. Remove the radiator overflow hose from the retainer clips. If vehicle is equipped with an expansion bottle system, use a separate hose. Make sure the hose is firmly installed on the radiator overflow nipple and is in good condition. Insert the free end of the overflow hose into a container of water.

6. Attach the pressure pump and gauge (Fig. 1) to the adapter fitting and pressurize the cooling system to the cap LOWER LIMIT as shown in the test chart.

   No bubbles should appear in the water container when the system is pressurized to the LOWER LIMIT. If the system is satisfactory at the lower limit, gradually increase the system pressure until a slight stream of bubbles appears in the water container. This is the upper limit of the pressure cap.

   Replace any radiator cap that exceeds the specified UPPER LIMIT pressure without discharging bubbles.

7. If the radiator cap does not hold pressure, remove and wash the cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the radiator filler neck.

   Inspect the cam lock flanges on both sides of the filler neck for maximum cap engagement.

8. Pressurize the cooling system as outlined in Step 6 (using a radiator cap that operates within the specified upper and lower pressure limits) and observe the gauge reading for approximately two minutes. See Specifications. Pressure should not drop during this time.

   RESULTS: If the pressure drops, check for leaks at the engine to heater core hoses, engine to radiator hoses, bypass hose, water valve hose (if applicable), thermostat housing gasket, radiator and heater core, etc. Also refer to engine system checks if a leak cannot be located in the cooling system. Any leaks which are found must be corrected and the system rechecked.

   If the system holds pressure proceed to Step 9.

9. Release the system pressure by loosening the radiator cap and remove the adapter. Reinstall the temperature sending unit, check coolant level and replenish (if necessary) with the correct coolant solution.

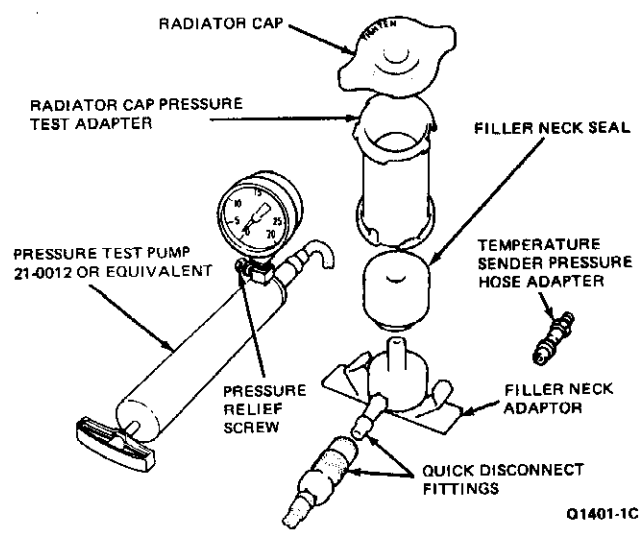


FIG. 1 Pressure Test Pump and Attachments

RADIATOR CAP PRESSURE TEST

Refer to Fig. 1

1. Remove the radiator cap from the radiator filler neck.

2. Use water to clean the cap in the area of the rubber seal and the vacuum relief valve. Refer to Cleaning and Inspection for procedure. Immerse the radiator cap in water and install on the shallow filler neck of the 21-0012 Radiator Cap Pressure Test Adapter or equivalent adapter.

   NOTE: The adapter is designed to accept both deep and shallow neck radiator caps.

3. Immerse the filler neck seal in water and install in the filler neck adapter.

   NOTE: The filler neck seal is reversible so that it may be used on either a deep or shallow radiator filler neck. It will also fit either end of the radiator cap pressure test adapter.

4. Install the filler neck adapter with filler neck seal on the deep filler neck end to the radiator cap pressure test adapter.

5. Connect the female quick disconnect fitting of the pressure test pump to the male quick disconnect fitting of the filler neck adapter.

6. SLOWLY depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

   NOTE: If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

7. Release the pressure by turning the pressure relief screw counterclockwise. Then tighten the pressure relief screw and repeat Step 6 (at least twice) to be sure the pressure test reading is repeatable within the acceptable gauge reading limits of the radiator cap and is not erratic. Refer to Specifications.

8. If the pressure test gauge readings are not within the acceptable gauge reading limits, replace the radiator cap. If the pressure test gauge readings are within the acceptable gauge reading limits, perform the Cooling System Pressure Test.

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DETROIT IRON OFFICIAL LICENSED PRODUCT

THERMOSTAT TEST-THERMOSTAT REMOVED

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open at least 0.230" after one minute at 212°F.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to the lighted background. Leakage of light all around the thermostat valve (thermostat at room temperature) indicates that the thermostat is unacceptable and should be replaced. It is possible, on some thermostats, that a **slight** leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

FAN DRIVE CLUTCH TEST

Spin the fan blade. A light resistance should be felt. If there is no resistance or very high resistance, the minimum and maximum fan speeds must be checked as follows:

Minimum Slip Fan Drive Requirement Test

1. Using a suitable marker, mark the water pump pulley hub, one of the fan blade attaching bolts and the crankshaft pulley.
2. Connect a tachometer to the engine.
3. Install a throttle adjusting tool.
4. Connect a Sun Strobe Light or equivalent. This can be a SLT-1 or SLT-2 Strobotach or a STA-1 Strobe Trigger adapter for the Sun Distributor Test Stand.

CAUTION: Do not operate the engine until the fan has been first examined for possible cracks and separation.

5. Start the engine and run it at approximately 1500 rpm until engine temperature has normalized.
6. Adjust the engine to the specified engine testing speed (Part 27-05).
7. Operate the Strobe Light at 2000 rpm and aim it at the water pump pulley. Adjust the engine speed until the light flashes and the water pump pulley mark are synchronized.
8. Aim the timing light at the fan blade attaching bolts. Adjust the Strobe Light until it is synchronized with the fan blades (fan blade appears to stand still).
9. The fan speed must not be greater than the specified minimum fan test speed at 2000 water pump rpm.
10. Turn the engine off.
11. If the fan speed was greater than the specified minimum fan test speed, check for proper parts usage.

    If the correct parts are used, replace the fan drive clutch.

    If the part(s) are not the correct ones, replace the part(s) and perform the test again.
12. If the Maximum Slip Fan Drive Requirement Test is going to be performed, do not remove the tachometer, Strobe Light or throttle adjusting tool.
13. If a Maximum Slip Fan Drive Requirement Test is not going to be performed, remove the tachometer, Strobe Light and Throttle adjusting tool.

Maximum Slip Fan Drive Requirement Test

1. If the Minimum Slip Fan Drive Requirement Test was not performed, follow steps 1 thru 5 under Minimum Slip Fan Drive Requirement Test.
2. Block off areas on each side of the core in the engine compartment and the front of the grille. This will raise the temperature of the air striking the clutch control unit and should cause the fan to operate at maximum speed.
3. Place the air conditioning selector to the maximum position and the blower switch to the high position.
4. Adjust the Strobe Light to 2000 rpm.

   CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and separation.
5. Start the engine and adjust it until the water pump pulley is synchronized with the Strobe Light. This will be near the engine testing speed given in the specifications.
6. Turn off the air conditioning blower switch.
7. Synchronize the timing light with the marked fan to clutch attaching bolts.
8. The fan speed must meet or exceed the specified maximum slip fan test speed at 2000 water pump rpm.
9. If the fan speed was less than the specified maximum slip fan test speed, check for proper parts usage.

   If the correct parts are used, replace the fan drive clutch.

   If the part(s) are not the correct ones, replace the part(s) and perform the test again.

ADJUSTMENTS

DRIVE BELTS

The fan drive belt(s) should be properly adjusted at all times. Loose drive belt(s) cause improper alternator, fan and water pump operation. A belt that is too tight places a severe strain on the water pump and the alternator bearings.

Properly tensioned drive belts minimize the noise and also prolong service life of the belt. Therefore, it is recommended that a belt tension gauge be used to check and adjust the belt tension. **Any belt that has operated for a minimum of 10 minutes is**

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considered a used belt, and, when adjusted, it must be adjusted to the reset tension shown in the specification.

Belt Tension

1. Install the belt tension tool on the drive belt (Fig. 2) and check the tension following the instructions of the tool manufacturer.
2. If adjustment is necessary, loosen the alternator mounting and adjusting arm bolts. Move the alternator toward or away from the engine until the correct tension is obtained. Remove the gauge. Tighten the alternator adjusting arm and mounting bolts. Install the tension gauge and check the belt tension.
3. Follow similar procedures for adjusting Thermactor air pump, air conditioner compressor and power steering pump drive belts.

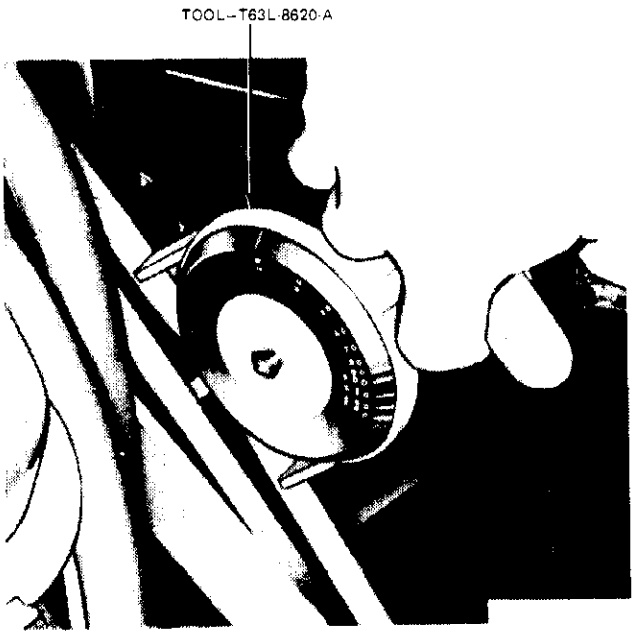


FIG. 2 Checking Drive Belt Tension

REMOVAL AND INSTALLATION

FOUR AND SIX-CYLINDER ENGINE COOLING FAN

Removal

Remove the screws and washers assemblies attaching the fan to the water pump hub. Remove the fan.

Installation

Position the fan and spacer on the water pump hub. Loosen fan belt, if necessary. Install the lock washer and screws and torque the capscrews to specifications. Adjust the fan belt tension to specifications.

V-8 ENGINE COOLING FAN

On a car with an air conditioner or extra-cooling radiator, a fan drive clutch may be used (see Specifications). Cars without air conditioning or equipped with Flex-Blade Fan utilize a pulley-to-fan spacer.

Removal

1. Remove the radiator upper support and fan guard or shroud. Remove the screw and washer assemblies attaching the fan and spacer (or drive clutch) to the water pump hub. Remove the fan and spacer (or drive clutch).
2. If equipped with a fan drive clutch, remove the attaching screw and washer assemblies and separate the fan from the drive coupling.

Installation

1. Position the replacement fan on the drive clutch and install the washer and screw assemblies. Torque the capscrews evenly and alternately to specifications.
2. Position the fan and spacer (or drive clutch) on the water pump hub and install the washer and screw assemblies. Loosen the belt, if necessary. Torque the capscrews evenly and alternately to specifications. Adjust the fan belt tension to specifications. Then, check the fan drive clutch flange-to-water pump hub for proper mating. Install the radiator upper support and fan guard or shroud.

FAN DRIVE BELT

Removal

If equipped with power steering and/or air conditioning and Thermactor exhaust emission control system it will be necessary to loosen and remove the drive belts before the fan drive belt can be removed.

1. On a car with power steering (except Lincoln Continental), loosen the power steering pump at the mounting bracket and remove the drive belt.

   On a car with an air conditioner, remove the compressor drive belt.
2. Loosen the alternator mounting and adjusting arm bolts. Move the alternator toward the engine. Remove the belt(s) from the alternator and crankshaft pulleys, and lift them over the fan.

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Installation

1. Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley and alternator pulley grooves. Adjust the belt tension to specifications.
2. On a car with an air conditioner, install and adjust the compressor drive belt to specifications.
3. On a car with power steering (except Lincoln Continental), install the power steering pump drive belt and tighten the pump at the mounting bracket. Adjust the drive belt tension to specifications.

RADIATOR HOSE

Removal

Radiator hoses should be replaced as directed in the pertinent car Maintenance Schedule or whenever they become cracked, rotted or have a tendency to collapse.

Drain the radiator; then loosen the clamps at each end of the hose to be removed. Slide the hose off the radiator connection and the engine water outlet connection (upper hose) or the water pump connection (lower hose).

Installation

Position the clamps at least 1/8 inch from each end of the hose. Coat the connection areas with an approved water-resistant sealer and slide the hose on the connections. **Make sure the clamps are beyond the bead and placed in the center of the clamping surface of the connections. Tighten the clamps. Fill the radiator with the recommended permanent antifreeze and water mixture. Operate the engine for several minutes, then check the hoses and connections for leaks.**

THERMOSTAT (REFER TO FIGS. 3, 4 AND 5.)

On V-6 engines, the thermostat is located on the bottom of the water pump housing (Fig. 5). The thermostat housing connects to the radiator lower hose, rather than the upper, as is customary on all other engines.

Removal

1. Drain the cooling system so that the coolant level is below the thermostat.
2. Disconnect the heater return hose at the thermostat housing located on the left front lower side of engine.
3. Remove the coolant outlet housing retaining bolts. Pull the elbow away from the cylinder head or manifold (water pump on V-6) sufficiently to provide access to the thermostat. Remove the thermostat and gasket. On V-6, remove gasket, O-ring and thermostat

Installation

Check the thermostat before installing it, following the procedure under **Thermostat Test in this Part.**

1. Clean the coolant outlet housing and cylinder head, manifold or water pump gasket surfaces. Coat a new gasket with water resistant sealer. Position the gasket on the cylinder head opening. **The gasket must be positioned on the cylinder head or the intake manifold, before the thermostat is installed,** except on 5.8L (351M CID), 6.6L (400 CID) and 7.5L (460 CID) engines, where the thermostat is installed in the block (351M and 400) or intake manifold (460) first, and then the gasket is installed. On 2.8L V-6 engines, install the gasket on the coolant elbow, install the thermostat into the recess in the water pump, and position the O-ring in the water pump over the thermostat.

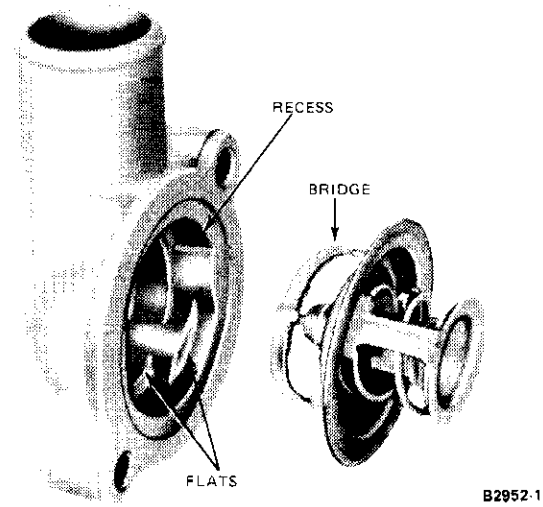


FIG. 3 Installing Thermostat—Typical I-6 Engine and V-8 Engine

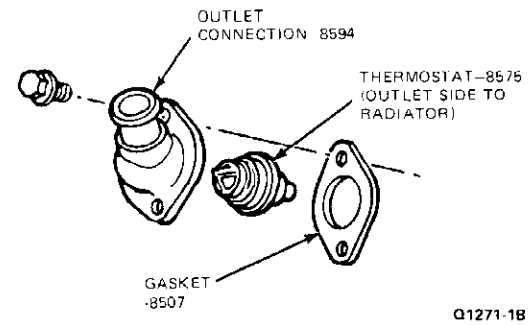


FIG. 4 I-4 Engine Thermostat and Housing—Disassembled View

To prevent incorrect installation of the thermostat, the water outlet casting on all engines except 5.8L/6.6L (351M/400 CID), 7.5L (460 CID) and 2.8L V-6 models contains a locking recess into which the thermostat is turned and locked. Install the thermostat with the bridge section (Figs. 3 and 4) in the outlet casting. Turn the thermostat clockwise to lock it in position on the flats cast into the outlet elbow.

2. Position the coolant outlet elbow against the cylinder head, intake manifold or water pump. Install and torque the retaining bolts to specifications.

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3. Connect heater hose to thermostat housing.
4. Fill the cooling system with the recommended Permanent Antifreeze and water mixture. If equipped with a crossflow radiator, follow the special instructions in Part 27-03 regarding checking coolant level. Check for leaks and proper coolant level after the engine has reached normal operating temperatures.

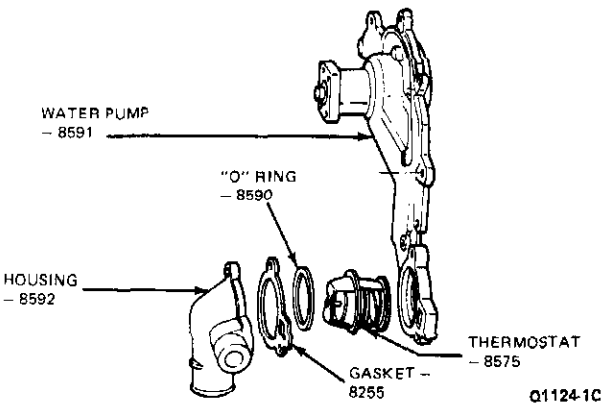


FIG. 5 V-6 Thermostat and Housing

CLEANING AND INSPECTION

CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use Rotunda Cooling System Cleanser. Removal of such material restores cooling efficiency and avoids overheating. **Always remove the thermostat prior to pressure flushing. A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow. In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method. Various types of flushing equipment are available.**

RADIATOR PRESSURE CAP

1. Inspect the areas under the vacuum valve and rubber seal for rust or dirt particles (Fig. 6).
2. Use warm tap water, raise the vacuum valve and rubber seal and thoroughly flush away loose rust or dirt particles trapped under the vacuum valve, rubber seal and on the seal surface.
3. Inspect and remove any imbedded rust or dirt particles on the sealing surfaces of the rubber seal.
4. Inspect the radiator filler neck opening for rust or dirt particles on the sealing surface at the bottom of the filler neck opening. Use a clean cloth and wipe the sealing surface to remove any rust or dirt particles.

NOTE: If paint is observed on the filler neck sealing surface, remove it using paint thinner.

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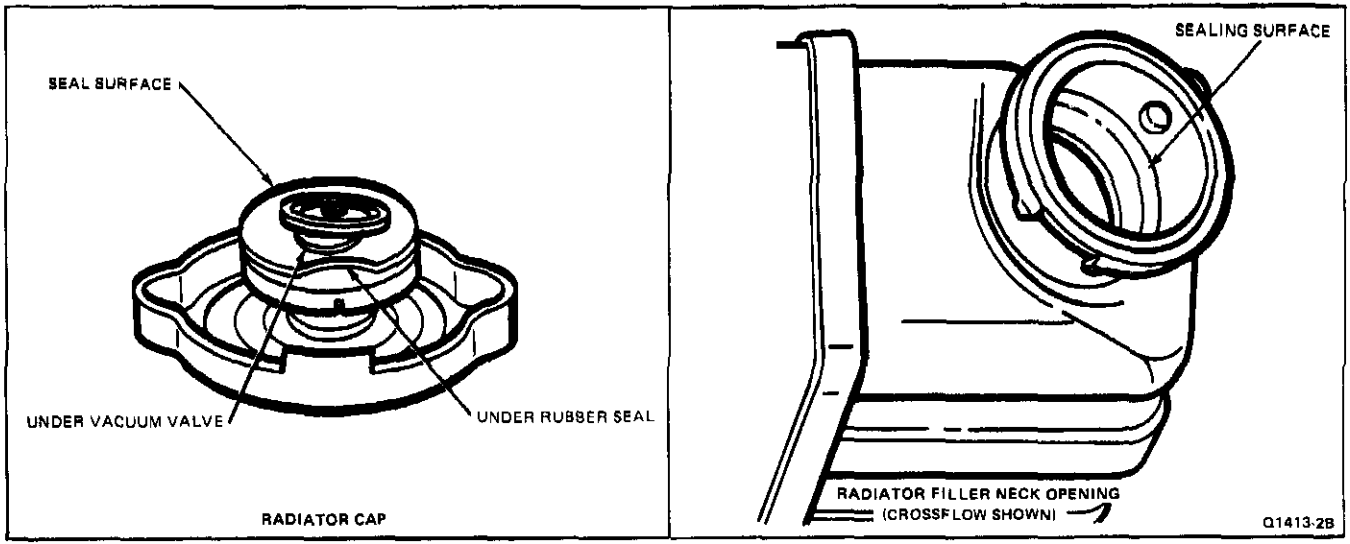


FIG. 6 Cleaning and Inspecting Radiator Cap and Filler Neck Opening

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SPECIFICATIONS

COOLING SYSTEM CAPACITIES

VEHICLE	ENGINE	OPTIONS	CAPACITY (QTS.) U.S.	IMP.
Pinto/Bobcat	2.3L	S/C	8.6	7.1
	2.3L	A/C	9.0	7.5
	2.8L	S/C	8.5	7.0
	2.8L	A/C	9.1	7.6
Mustang II	2.3L	S/C	8.8	7.1
	2.3L	A/C	9.1	7.6
	2.8L (M/T)	S/C	8.4	7.0
	2.8L (A/T)	S/C	8.6	7.1
	2.8L (M/T)	A/C	8.6	7.1
	2.8L (A/T)	A/C	9.1	7.6
	5.0L (302 CID)	S/C & A/C	14.6	12.1
Fairmont/Zephyr	2.3L	S/C	8.6	7.1
	2.3L	A/C	10.3	8.6
	3.3L (200 CID)	S/C, A/C	9.0	7.5
	5.0L (302 CID)	S/C	13.9	11.5
	5.0L (302 CID)	A/C	14.0	11.6
Granada/Monarch	4.1L (250 CID)	S/C, X/C	10.5	8.7
	4.1L (250 CID)	A/C	10.6	8.8
	5.0L (302 CID)	S/C	14.2	11.8
	5.0L (302 CID)	A/C	14.3	11.9
Versailles	5.0L (302 CID)	S/C	14.2	11.8
	5.0L (302 CID)	A/C	14.3	11.9
LTD II/Cougar/Ranchero	5.0L (302 CID)	S/C	14.3	11.9
	5.0L (302 CID)	A/C	14.6	12.1
	5.0L (302 CID)	Police Interceptor & Taxi	15.9	13.2
LTD II/Cougar/Thunderbird	5.8L (351W CID)	S/C	15.4	12.8
	5.8L (351W CID)	A/C	15.7	13.0
	5.8L (351M CID)	S/C, A/C, T.T.	16.5	13.7
	5.8L (351M CID)	Police Interceptor & Taxi	17.0	14.1
	6.6L (400 CID)	S/C, A/C	16.5	13.7
	6.6L (400 CID)	T.T., Police Interceptor	17.0	14.1
Ford/Mercury	5.0L (302 CID)	S/C, A/C	15.2	12.6
	5.0L (302 CID)	Police Interceptor	17.1	14.2
	5.8L (351W CID)	S/C, A/C	16.3	13.5
	5.8L (351W CID)	Police Interceptor	18.2	15.1
	5.8L (351M CID)	S/C, A/C	17.0	14.2
	6.6L (400 CID)	S/C, A/C	17.0	14.2
	6.6L (400 CID)	Police Interceptor & T.T.	17.46	14.5
	7.5L (460 CID)	S/C, A/C	18.6	15.4
	7.5L (460 CID)	T.T. & Police Interceptor	19.7	16.3
Continental Mark V	6.6L (400 CID)	S/C, A/C	16.9	14.06
	7.5L (460 CID)	S/C, A/C	18.6	15.4
	7.5L (460 CID)	T.T.	18.8	15.6
Lincoln Continental	6.6L (400 CID)	A/C	16.9	14.06
	7.5L (460 CID)	A/C	18.7	15.5
	7.5L (460 CID)	T.T.	19.0	15.8

To convert to imperial measure, multiply U.S. quarts shown by .83.

7.5L (460 CID) Police Interceptor includes engine oil cooler.

Capacities shown include heater.

Service refill recommendations are 50/50 mix of water and Ford Long Life Coolant ESE-M97B18-C.

Expansion reservoirs do not use coolant in bottle except during extreme operation.

All figures shown are actual but may vary ± 15% due to system variations.

S/C – no air conditioning (standard cooling).
A/C – air conditioning.

CQ1153-2E

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DETROIT IRON

TORQUE VALUES (ALL CARS)

NOTE: All specifications are given in ft-lbs unless otherwise noted.

Fan shroud assembly to radiator where applicable	24-48 in-lbs
Fan to pulley hub (All engines)	12-18
Radiator hose clamps	20-30 in-lbs
Transmission oil cooler tubes to radiator - all engines	9-12

SPECIAL SERVICE TOOLS (ALL CARS)

Description	Ford Tool No.
Belt Tension Gauge	T63L-8620-A

DRIVE BELT TENSIONS (lbs.)

Size	Newly Installed (1)	Used	
		Up to 10 Min.	Over 10 Min.
1/4"	50-80	40-80 (2)	40-60 (2)
Except 1/4"	120-160	90-160 (3)	75-120 (4)

(1) Read tension immediately after belt is installed, before it stretches or seats in pulley grooves.
(2) If less than 40 pounds, readjust to 40-60 pounds.
(3) If less than 90 pounds, readjust to 90-120 pounds.
(4) If less than 75 pounds, readjust to 90-120 pounds.

THERMOSTATS

Starts to Open °F	188°-195°
Fully Open	212°-215°

CQ1090-2G

RADIATOR PRESSURE CAP

Vehicle Application	Specified Cap Pressure (PSI)	Lower Limit (PSI) (Must Retain)	Upper Limit (PSI) (Must Relieve
Mustang II/Pinto/ Bobcat, Fairmont/Zephyr w/ Std. Cooling	13	11	17
Ford/Mercury, LTD II/Cougar, Thunderbird/ Continental/Mark V, Lincoln Continental, Granada/ Monarch/Versailles Fairmont/Zephyr Exc. Std. Cooling	16	13	19

CQ1402-1C

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Radiators

PART 27-03

SUBJECT	PAGE
DESCRIPTION	
Constant – Full Cooling System	03-1
Crossflow Radiators	03-1
Diagnosis	03-2
Downflow Radiators	03-1
DESCRIPTION (Cont'd.)	
Filling Cooling System	03-1
REMOVAL AND INSTALLATION	
Automatic Transmission Oil Cooler	03-3
Radiator	03-3

CN4049-2A

DESCRIPTION

Standard and extra-cooling radiators are installed in production, but service replacement radiators are usually of the extra cooling type.

WARNING—Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury.

To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, press down on the cap (still with a cloth), turn and remove it.

DOWN FLOW RADIATORS

These radiators are the tube and slit-fin-core type with the tubes arranged for vertical flow of the coolant. The radiator bottom header tank on automatic transmission cars contains a heat exchanger for cooling the transmission oil. Down flow radiators may also be equipped with a constant-full coolant return system.

CROSSFLOW RADIATORS

These radiators are of the tube and slit-fin-core type with the tubes arranged horizontally for crossflow of the coolant. Two header tanks, one on each side of the radiator, provide uniform distribution of the coolant to the cross-flow tubes. The header tank, or chamber, on the left side of the radiator contains a heat exchanger for cooling the transmission fluid. All crossflow radiators are equipped with a constant-full coolant return system.

FILLING COOLING SYSTEM—WITHOUT CONSTANT-FULL COOLANT RETURN

On initial fill or refilling the cooling system, the following procedures must be followed to prevent air entrapment and inadequate coolant levels.

1. Check all hose clamps for proper tightness. Be sure radiator drain cock is closed.
2. Position heater temperature selector in the maximum heat position.
3. Fill cooling system to 1-1/2 inches below the fill cap seat (Fig. 1).

   CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.

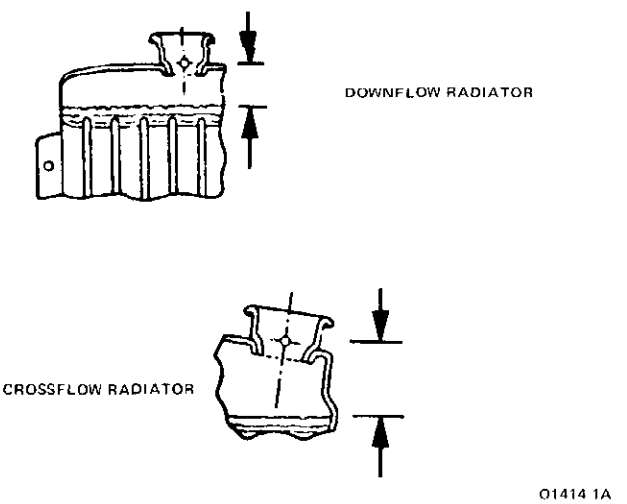


FIG. 1 Fill Level—Crossflow and Downflow Radiator

4. Leave radiator cap off and run engine until thermostat opens (hot coolant flows through radiator upper hose).
5. Stop engine and add coolant to 1-1/2 inches below fill cap seat (crossflow) or 1/4 inch below fill cap seat (downflow). Install radiator cap.

CONSTANT-FULL COOLING SYSTEM

This system is based around a 13 psi pressure cap (vehicles with downflow radiators), or a 16 psi pressure

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cap (vehicle with crossflow radiators) and a plastic reservoir and hose. When the coolant in the radiator expands to the overflow point, it passes through the pressure cap and into the plastic reservoir (Fig. 2). When the coolant in the radiator cools down and therefore contracts, it pulls coolant from the reservoir through a vacuum relief valve in the pressure cap, back into the radiator.

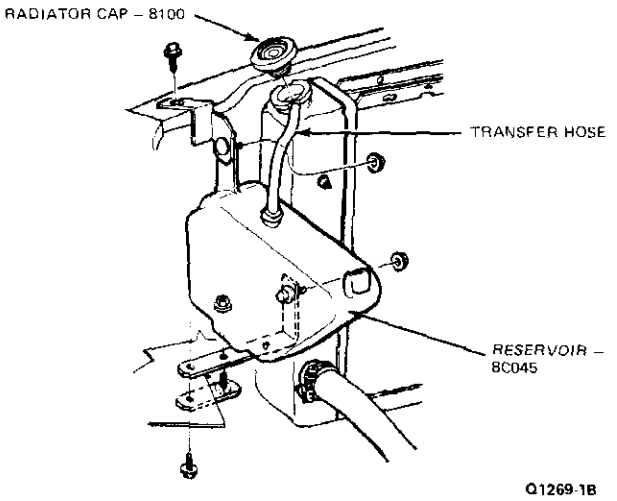


FIG. 2 Constant-Full Cooling System—Typical Ford/Mercury

The advantages of the system are the extra coolant carried in the expansion tank and the fact that any air bubbles trapped in the cooling system are vented in the plastic reservoir, rather than causing excessive aeration of the coolant.

Special Filling Instructions-Crossflow Radiators

Coolant level cannot be accurately checked while the engine is running, due to the construction of this radiator.

Filling Constant-Full Cooling System

1. Check all hose clamps for proper tightness. Be sure radiator drain cock is closed.
2. Place heater temperature selector in maximum heat position.
3. Fill radiator to 3/4" to 1-1/2 inches below the radiator cap seal (downflow radiators) or 2-1/2 to 4 inches below the radiator cap seal (crossflow radiators). See Fig. 1.

   CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.
4. Run engine until thermostat opens (coolant flowing through radiator upper hose becomes hot).
5. Stop engine and add coolant to radiator as necessary to adjust level to 3/4" below the radiator cap seal (downflow radiators) or 1-1/2 inches below the radiator cap seal (crossflow radiators).

DIAGNOSIS

In the event no coolant is observed in the reservoir, or when a coolant level change does not occur, check the system as follows:

1. With the engine cold, remove the radiator pressure cap, and inspect the filler neck sealing gasket for foreign material between the gasket and cap diaphragm. Rinse cap in clean water.

   The radiator pressure cap used on this system is unique; replace only with the proper cap.
2. Remove the radiator overflow-to-reservoir hose at the radiator filler neck connection and at the bottle.
3. Inspect the reservoir hose for obstruction, cracks or cuts. Replace if necessary.
4. Inspect filler neck nipple to neck flared soldered joint for possible separation. Repair if necessary.
5. Reinstall the hose with a 3/8 to 5/8 inch clearance to bottom of plastic reservoir.
6. Pressure test the system.
7. Replenish the coolant in the radiator as required.
8. Reinstall the radiator pressure cap.

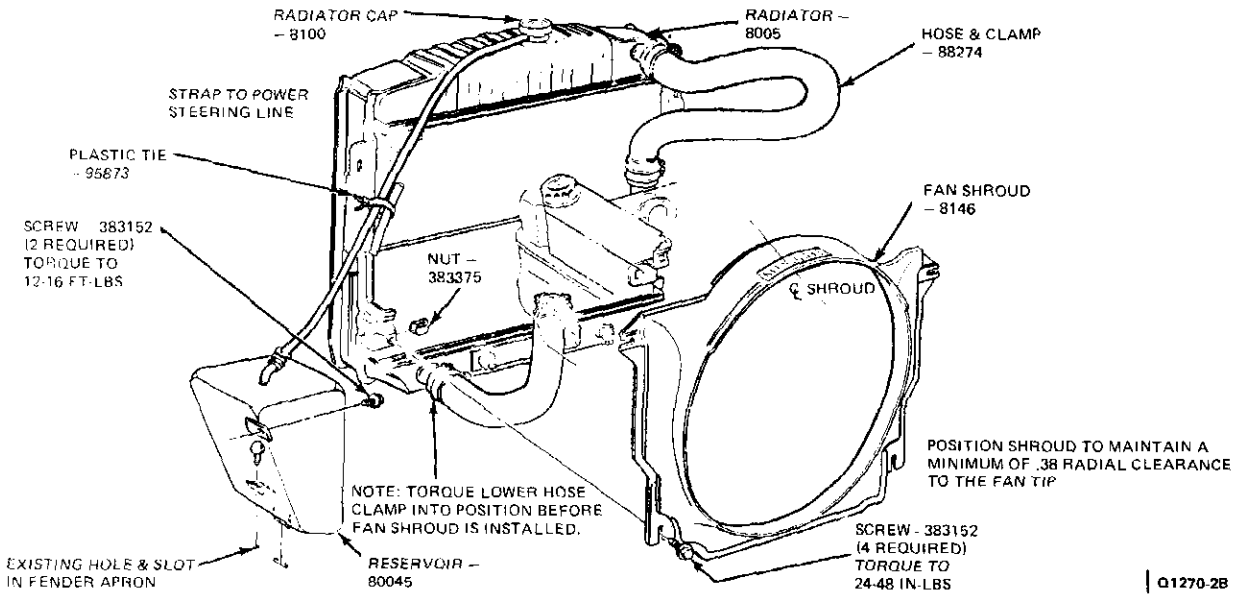


FIG. 3 Constant Full Cooling System—Mustang II W/Optional 5.0L (302 CID) V-8 Engine

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REMOVAL AND INSTALLATION

RADIATOR

Removal

1. Drain the cooling system. Disconnect the radiator upper and lower hoses from the radiator.

   On a vehicle with an automatic transmission, disconnect the automatic transmission fluid cooler inlet and outlet lines from the radiator.

2. Crossflow radiators
   a. If equipped with fan shroud, remove two upper shroud attaching bolts at radiator support. Lift fan shroud sufficiently to disengage lower retaining clips and lay shroud back over fan.
   b. Remove radiator upper support attaching bolts and remove support(s). Lift the radiator from vehicle.
3. Downflow radiators
   a. If equipped with fan shroud, remove four attaching bolts, two at each side of radiator. Lay shroud back over fan.
   b. Remove radiator attaching bolts, two at each side of radiator. Lift radiator from vehicle.

Installation

1. If a new radiator is to be installed, remove the drain cock from the old radiator and install it on the new radiator.
2. If a new radiator is to be installed on vehicles equipped with automatic transmission, transfer the oil cooler line connectors to the new radiator, using oil resistant sealer.
3. Position the radiator assembly into the vehicle.
   a. On downflow radiators, install the four attaching bolts, two on each side of the radiator.
   b. On crossflow radiator, install upper supports and secure with bolts.
4. On vehicles with automatic transmissions, connect the oil cooler lines.
5. Place fan shroud into clips on lower radiator support of crossflow radiator. Secure to upper support with two bolts. Position shroud to downflow radiator and secure with two bolts each side of radiator. Position shroud to maintain a minimum of 0.38 inch minimum radial clearance to fan blade tips.
6. Connect the radiator upper and lower hoses. Close the drain cock. Fill the cooling system.

   CAUTION: Do not operate the engine with the hood open until the fan has been first examined for cracks and separation.
7. Operate the engine and check for leaks at the hose connections and the automatic transmission fluid cooler lines. Check the automatic transmission and radiator fluid level.

AUTOMATIC TRANSMISSION OIL COOLER AND RADIATOR DRAINCOCK

Replacement of the automatic transmission oil cooler or radiator draincock in the radiator lower or side tank, as given below, is usually performed by radiator specialty shops on a sub-let basis. However, the operation can be performed in a dealer service department, providing proper equipment is available.

Downflow radiators use a threaded design draincock and boss, while crossflow radiators use a draincock soldered directly to the radiator side tank.

Only manufactured or natural gas torches should be used to perform radiator repairs. Do not *use acetylene.*

No attempt should be made to repair a fractured radiator tank. Should a fractured tank be encountered, it must be replaced. Tank repairs usually result in repeat failures, due to the flexible nature of the tank.

Removal

1. Drain the cooling system.
2. Remove the radiator from the vehicle, following the *procedure outlined previously.*
3. Thoroughly clean the radiator assembly internally and externally by submerging in a tank filled with a caustic solution. Then, using clean water, flush until the caustic solution is removed from all internal and external surfaces. **NOTE: Caution should be exercised during the disassembly and assembly solder operation of radiator components. Avoid excess heat concentration which could result in burning through the radiator sheet metal or loosening an adjoining soldered area.**

   On downflow radiators, apply heat to separate support tabs from lower tanks.
4. Remove the radiator tank containing the damaged or leaking oil cooler. (Tank removal is not necessary for repair of draincock).
5. Melt the puddled solder from the oil cooler inlet and outlet fittings. Remove the retaining rings from the fittings in the oil cooler.
6. Remove the oil cooler or draincock.
7. Clean the soldered surface areas and inspect and tin as necessary to assure proper solder bonding.

Installation

1. **Draincock** : Position the replacement draincock in the tank opening and solder using the procedures for oil cooler.

   ***Oil Cooler** : Install the replacement oil cooler* assembly into the tank openings and secure cooler with new retaining rings. For threaded design, torque retainer to 20-50 in-lb; for bead design, push ring past fitting bead. Retaining ring tangs should point away from tank (Fig. 4).
2. Puddle-solder the oil cooler fittings completely to the tank.
3. Seat the tank assembly in the header well and solder securely, completely filling the well. Use 40-60 solder with either zinc chloride 30 (BAUME) or 5-B NALCO flux.
4. Resolder the supports in position on downflow radiator.
5. Flush off all excess acid, internally and externally.
6. Pressure-test the radiator assembly to 14-16 psi for leaks.

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7. *Paint as required.*
8. Install the radiator and fan shroud to the vehicle. Install the connectors in the oil cooler inlet and outlet fittings and connect the transmission oil cooler lines.
9. *Connect the hoses to the radiator inlet and outlet* connections.
10. Flush the cooling system and refill with the recommended mixture of all season coolant.

NOTE: If one-piece draincock is not available, a threaded boss (-8120-) and draincock (-8115-) must be used. Solder the boss into the tank following the procedure for one-piece draincocks, then wrap the draincock threads with sealer tape and install the *draincock in the boss. Tighten the draincock* to 12-15 ft-lb.

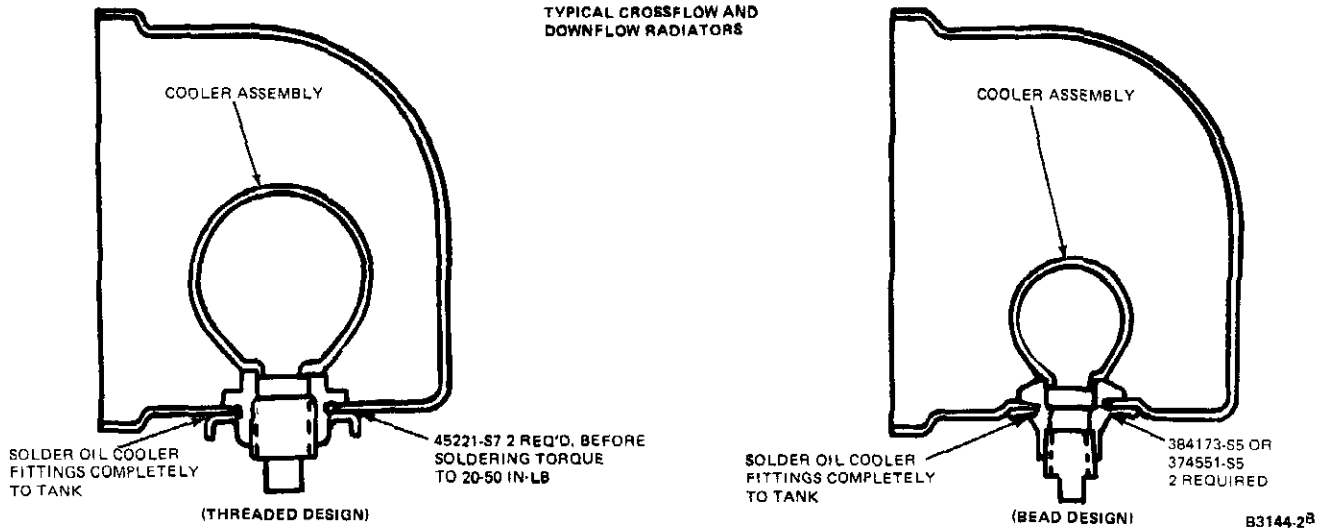


FIG. 4 Typical Radiator Oil Cooler Installation

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Fan Drive Clutch

PART 27-05

Granada/Monarch/Ford/Mercury/Lincoln Continental/Continental Mark V/Versailles

SUBJECT	PAGE
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Fan Drive Clutch	05-1
REMOVAL AND INSTALLATION	
Fan Drive Clutch	05-2
SPECIFICATIONS	05-3

CA4250-2B

DESCRIPTION AND OPERATION

FAN DRIVE CLUTCH

The fan clutch (Figs. 1, 2 and 3) permits use of a powerful fan without paying the penalty of power loss or noise. It is basically a temperature-controlled fluid coupling that regulates fan speed according to the temperature of the air coming through the radiator core and flowing around the bi-metal control valve located on the forward face of the clutch.

Pulley ratios and slip-speeds are given in the Specification Section of this Part.

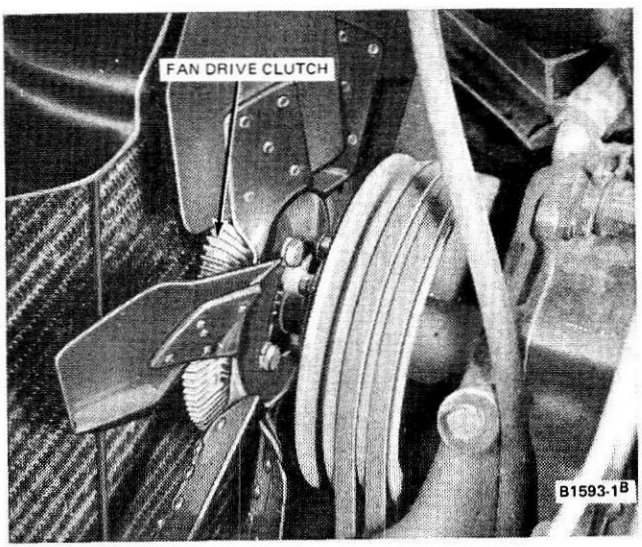


FIG. 1 Typical Fan Drive Clutch Installation

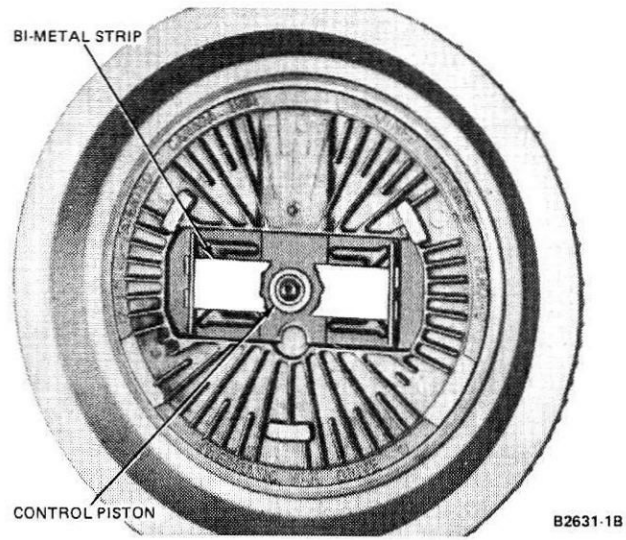


FIG. 2 Fan Drive Clutch With Flat Bi-Metal Spring

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DETROIT IRON

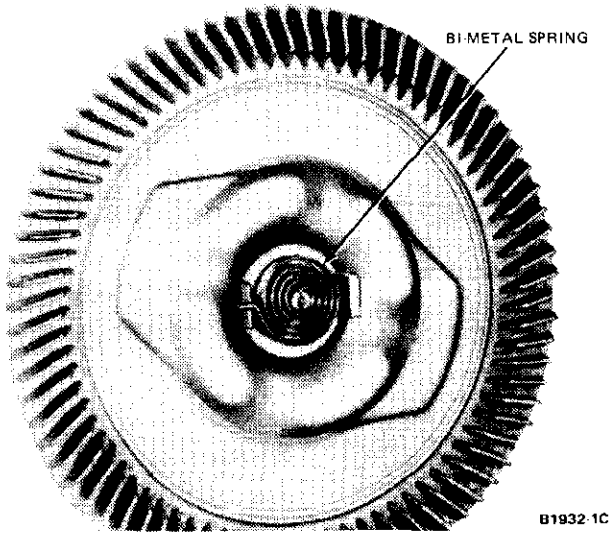


FIG. 3 Fan Drive Clutch With Coil Bi-Metal Spring

REMOVAL AND INSTALLATION

FAN DRIVE CLUTCH

Removal

1. Remove the radiator upper support and/or fan guard or shroud.
2. Loosen the fan belt. Remove the bolt and washer assemblies attaching the fan drive clutch to water pump hub (Fig. 1). Remove the fan drive clutch and *fan as an assembly*.
3. Remove the attaching bolt and washer assemblies and separate the fan from the drive clutch.

Installation

1. Position the fan on the drive clutch. Install the bolt and washer assemblies and torque to specifications.
2. Position the fan drive clutch and fan assembly and belt to the water pump hub (Fig. 4). Install and torque the attaching bolt and washer assemblies evenly and alternately to specifications. Then, check the fan drive clutch flange-to-water pump hub for proper mating. Adjust the fan belt tension to specifications.
3. Install radiator upper support and/or fan guard or shroud.

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks and separation.

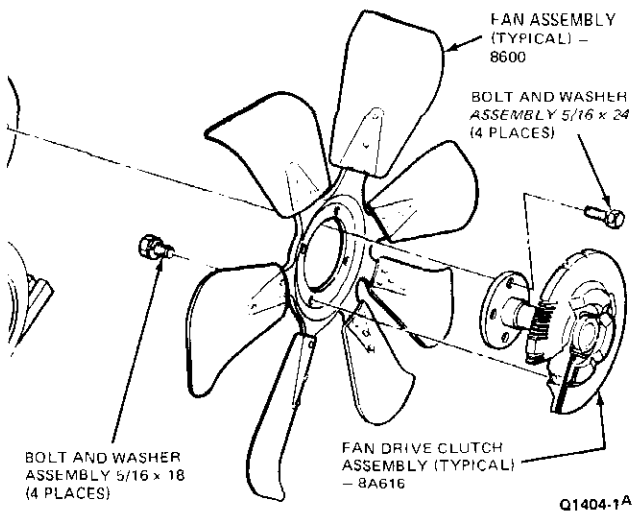


FIG. 4 Fan Drive Clutch and Fan

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SPECIFICATIONS

TORQUE VALUES (ALL CARS) – FT-LB

NOTE: All specifications are given in ft.-lbs. unless otherwise noted.			
Fan to Fan Clutch – All Engines	12-18	Fan Clutch to Water Pump – All Engines	12-18

FAN DRIVE CLUTCH SPECIFICATIONS

Vehicle	Engine	Cooling Option	Water Pump Pulley Ratio	Engine RPM Required to Run Water Pump 2000 RPM	Fan Test Speed @ 2000 Water Pump RPM	
					Minimum RPM	Minimum RPM
Mark V, Ford, Mercury, Lincoln Continental	7.5L (460 CID)	A/C and/or Trailer Tow Police (All)	1.25:1	1600	1400	500
Granada, Monarch, Versailles	5.0L/5.8L (302/351W CID)	A/C	1.13:1	1770	1600	500

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DETROIT IRON

Flex-Blade Fan

PART 27-06

CN4037-2A

DESCRIPTION

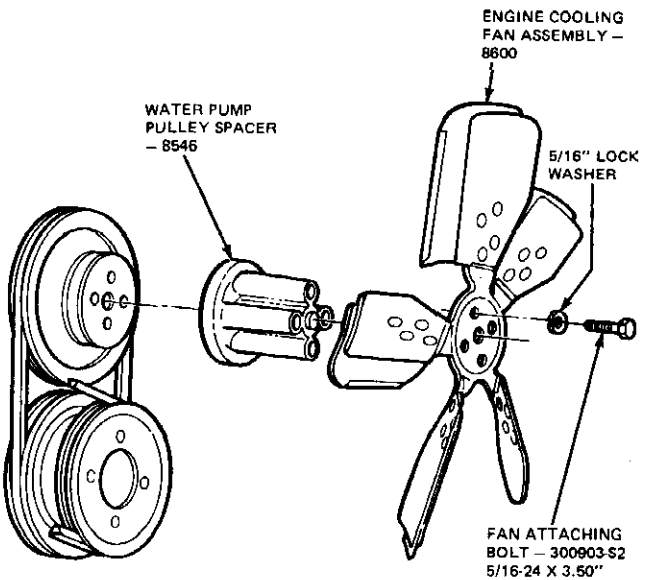
DESCRIPTION

The flex blade fan (Fig. 1) consists of a spider stamping of either 5-blade or 7-blade configuration, to which are riveted the flexible blade assemblies. Other than the riveted flexible blades, the fan is conventional in appearance and is removed and replaced in the same manner as a standard fan (Part 27-01).

OPERATION

Because the blades flex as engine rpm increases, the flex-blade fan tends to use less power and to generate less noise than does a conventional rigid cooling fan of fixed pitch. This fan adjusts itself to the engine speed without the use of complicated drive mechanisms. No test or adjustment is therefore required, beyond keeping the fan drive belt adjusted to the proper (standard) tension.

CAUTION: Do not operate engine with hood open until fan has been first examined for possible cracks or separation.



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FIG. 1 Flex-Blade Fan

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DETROIT IRON

STARTING SYSTEM

GROUP 28 (11000)

PART TITLE	PART NO.	PART TITLE	PART NO.
Positive Engagement Starter	28-02	Starting System General Service	28-01

CA4248-2B

Starting System General Service

PART 28-01

GENERAL INFORMATION

The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start. Heavy cables, connectors, and switches are used in the starting system because of the large current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. A discharged or damaged battery, loose or corroded connections or partially broken cables will result in slower than normal cranking speeds, and may even prevent the starter from cranking the engine.

In cases of starting system trouble, the owner may have discharged the battery before calling for assistance. A road service procedure is presented in Part 28-02 to aid the service technician in such cases of starting trouble. Be sure to follow diagnosis procedures in order to locate the cause of the starting difficulty. The road service is not a part of the diagnosis procedures.

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DETROIT IRON

Positive Engagement Starter

PART 28-02

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DISASSEMBLY AND ASSEMBLY	
Positive Engagement Starter	02-5
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CN4050-2B

DESCRIPTION AND OPERATION

POSITIVE ENGAGEMENT STARTER

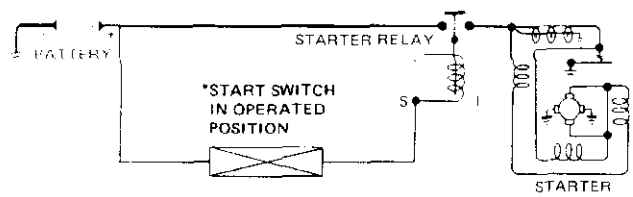
The starting system includes the starter motor with an integral positive-engagement drive, the battery, a remote control starter switch (part of the ignition switch), the neutral-start switch (automatic transmission with floor shift only), the starter relay, and heavy circuit wiring.

Turning of the ignition key to the START position actuates the starter relay, through the starter control circuit. The starter relay then connects the battery to the starter.

Vehicles equipped with a console or floor mounted shift lever have a neutral-start switch in the starter control circuit, which prevents operation of the starter if the selector lever is not in the N (neutral) or P (park) position.

Vehicles equipped with a column shift do not use a neutral-start switch. The ignition switch mechanism in the steering column is designed so that the ignition switch can be turned to the start position only when the selector lever is in NEUTRAL or PARK.

When the starter is not in use, one of the field coils is connected directly to ground through a set of contacts



J1083-1J

FIG. 1 Starting Circuit

(Fig. 1). When the starter is first connected to the battery, a large current flows through the grounded field coil, actuating a movable pole shoe. The pole shoe is attached to the starter drive plunger lever and thus the drive is forced into engagement with the flywheel ring gear.

When the movable pole shoe is fully seated, it opens the field coil grounding contacts and the starter is then in normal operation. A holding coil is used to maintain the movable pole shoe in the fully seated position during the time that the starter is turning the engine.

TESTING

ROAD SERVICE

On road service calls, connect a 12-volt booster battery to the system for cases of a starter that will not crank the engine or a starter that cranks the engine very slowly.

USE OF BATTERY JUMPER CABLES

The following instructions contain precautions that should be observed to avoid possible injury to yourself or damage to the vehicle. Be certain that transmission is in park or neutral.

CAUTION—Use only a 12-volt jumper system. You can damage a 12-volt starting motor and ignition system beyond repair by connecting it to a 24-volt power supply (two 12-volt batteries in series, or a 24-volt motor-generator set).

WARNING—Keep batteries out of reach of children. They contain SULFURIC ACID. Avoid

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contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin, eyes, or clothing, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF 15 MINUTES. If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg or vegetable oil. CALL A PHYSICIAN IMMEDIATELY.

Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near the battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

Use particular care when connecting a booster battery to prevent sparks. Before jump starting, turn the heater A/C blower "ON" and leave it on after the engine starts until after the jumper cables are removed. Turn all the lights "OFF" before jump starting and leave them off after the engine starts until after the jumper cables are removed. To jump start: (1) connect ends of one cable to positive (+) terminals of each battery, (2) connect one end of other cable to negative (-) terminal of "good" battery, (3) connect other end of cable to engine block on vehicle being started (NOT TO NEGATIVE (-) TERMINAL OF BATTERY). To prevent damage to other electrical components on vehicle being started, make certain that engine is at idle speed before disconnecting jumper cables. When disconnecting cables, remove cable from engine block before disconnecting cable from battery positive terminal.

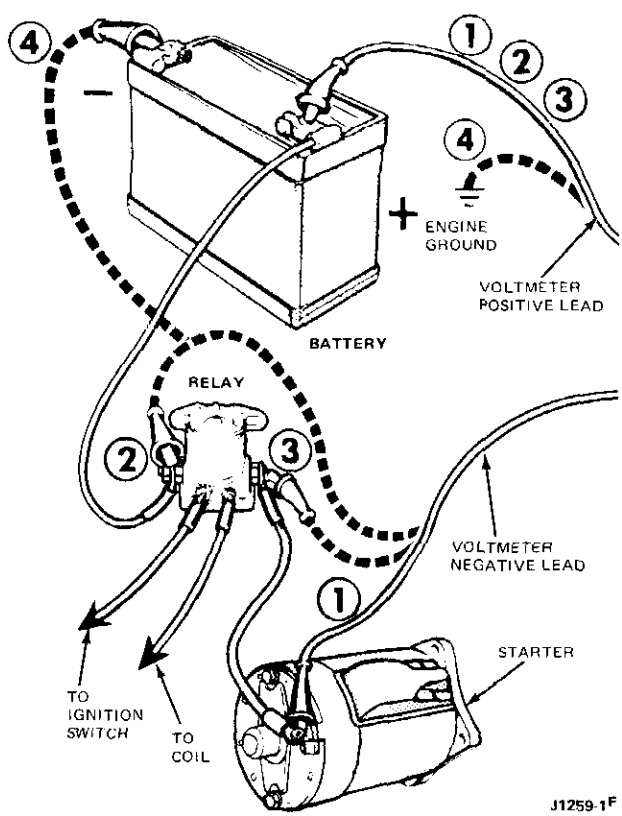


FIG. 2 Starter Cranking Circuit Test

If the starter does not turn the engine over, even with the booster battery attached, refer to the following tests.

ON-VEHICLE TESTING

Disconnect vacuum line to thermactor by-pass valve before performing any cranking tests. After tests, run engine 3 minutes before connecting vacuum line.

STARTER DRIVE TEST

1. With the transmission in park or neutral only, pull the push-on connector from the starter relay terminal "S".
2. Connect a remote control starter switch to the starter relay "S" and "BATTERY" terminals.
3. Turn the ignition switch key to the ON position and depress the remote control starter switch. As soon as the engine begins to run, turn ignition key to "OFF" position while holding the remote control switch in the START position. The **dead engine should now be cranked by the starter.**
4. Observe if the starter is cranking the dead engine and if it continues to crank the engine until the remote control switch is released. If the starter is heard to be rotating but does not crank the **dead engine, the drive assembly is slipping.**
5. Repeat the test at least three times in succession to detect intermittent operation.

STARTER CRANKING CIRCUIT TEST

Excessive resistance in the starter circuit can be determined from the results of this test. Make the test connections as shown in Fig. 2. Crank the engine with the ignition OFF. This is accomplished by disconnecting the push-on connector(s) at the starter relay and by connecting a remote-control starter switch from the battery terminal of the starter relay to the "S" terminal of the relay.

The voltage drop in the circuit will be indicated by the voltmeter (0 to 2 volt range). Maximum allowable voltage drop should be:

1. 0.5 volt with the voltmeter negative lead connected to the starter terminal and the positive lead connected to the battery positive terminal (Fig. 2, connection 1).
2. 0.1 volt with the voltmeter negative lead connected to the starter relay (starter side) and the positive lead connected to the positive terminal of the battery (Fig. 2, connection 2).
3. 0.3 volt with the voltmeter negative lead connected to the starter relay (battery side) and the positive lead connected to the positive terminal of the battery (Fig. 2, connection 3).
4. 0.3 volt with the voltmeter negative lead connected to the negative terminal of the battery and the positive lead connected to the engine ground (Fig. 2, connection 4).

STARTER LOAD TEST

Connect the test equipped as shown in Fig. 3. Be sure that no current is flowing through the ammeter and heavy-duty carbon pile rheostat portion of the circuit (rheostat at maximum counterclockwise position).

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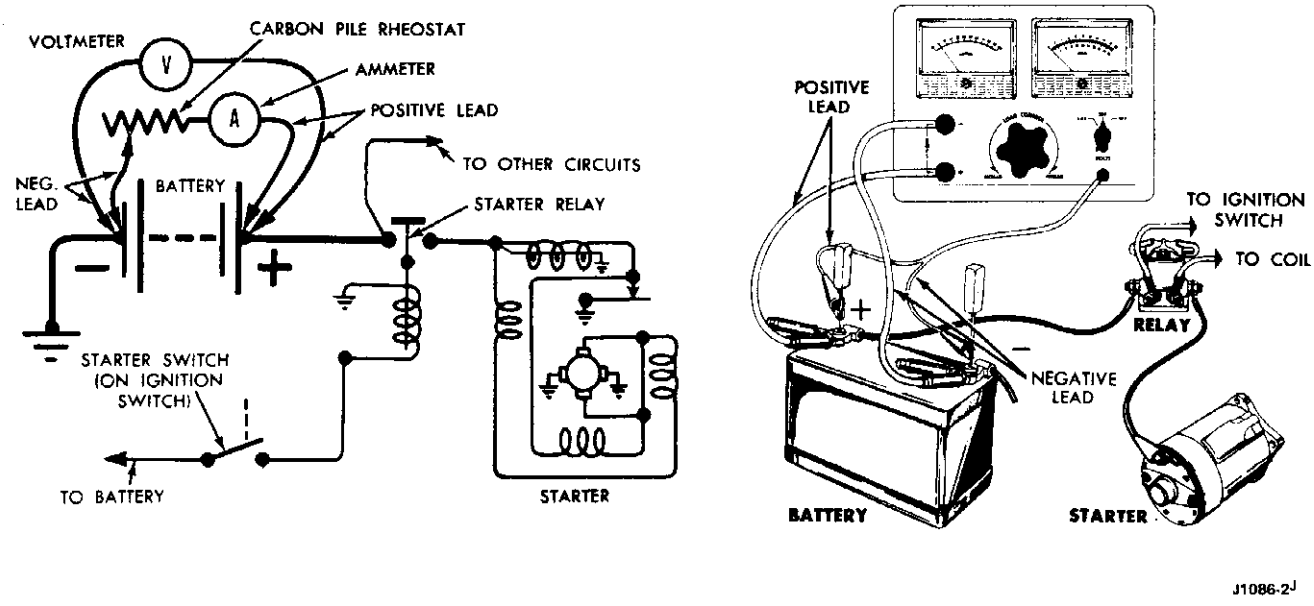


FIG. 3 Starter Load Test

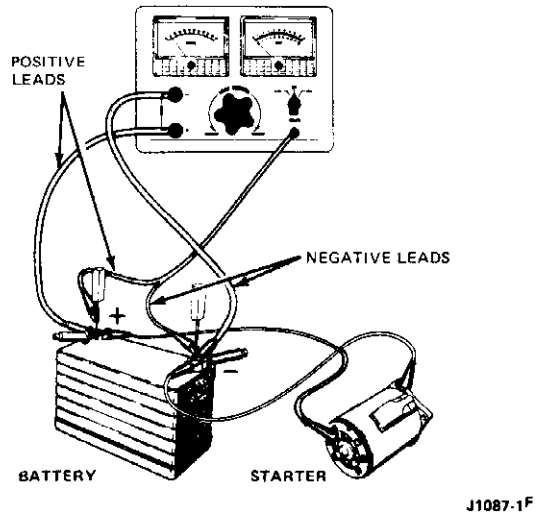


FIG. 4 Starter No-Load Test on Test Bench

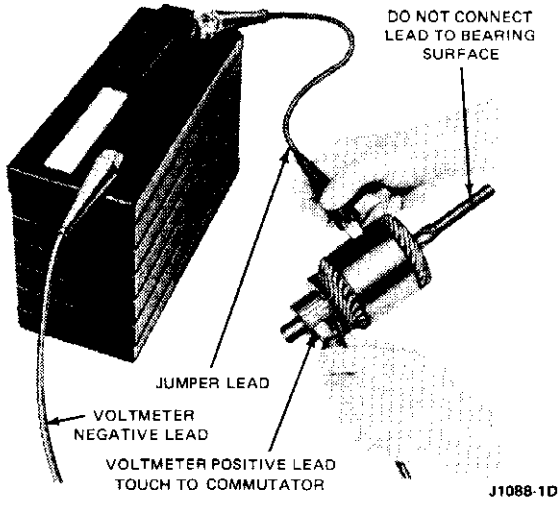


FIG. 5 Armature Grounded Circuit Test

Crank the engine with the ignition OFF, and determine the exact reading on the voltmeter. This test is accomplished by disconnecting the push-on connector "S" at starter relay and by connecting a remote-control starter switch from the positive battery terminal to the "S" terminal of the starter relay.

Stop cranking the engine, and reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load.

BENCH TESTS

Starter No-Load Test

The starter no-load test will uncover such faults as open or shorted windings, rubbing armature, and bent armature shaft. The starter can be tested, at no-load, on the test bench only.

Make the test connections as shown in Fig. 4, with cables connected to the starter large enough to carry high current—the same as in the vehicle. The starter will run at no-load. Be sure that no current is flowing through the ammeter (rheostat at maximum counterclockwise position). Determine the exact reading on the voltmeter.

Disconnect the starter from the battery, and reduce the resistance of the rheostat until the voltmeter indicates the same reading as that obtained while the starter was running. The ammeter will indicate the starter no-load current draw.

If current exceeds specifications, check for rubbing armature, bent shaft, binding bearings, or shorts in armature, fields or brush assembly.

ARMATURE OPEN CIRCUIT TEST

An open circuit armature may sometimes be detected by examining the commutator for evidence of burning.

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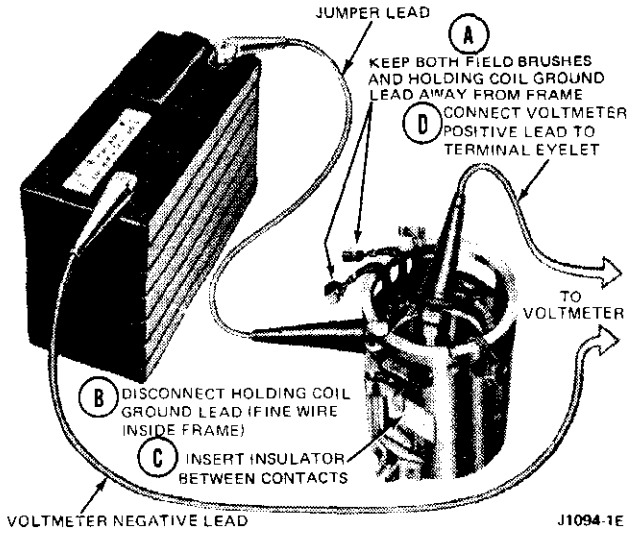


FIG. 6 Field Grounded Circuit Test

A spot burned on the commutator is caused by an arc formed every time the commutator segment, connected to the open circuit winding, passes under a brush.

ARMATURE AND FIELD GROUNDED CIRCUIT TEST

This test will determine if the winding insulation has failed, permitting a conductor to touch the frame or ARMATURE core.

To determine if the armature windings are grounded, make the connections as shown in Fig. 5. If the voltmeter INDICATES any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections and following the instructions shown in Fig. 6. If the voltmeter indicates any voltage, the field windings are grounded.

REMOVAL AND INSTALLATION

GRANADA, MONARCH AND VERSAILLES WITH 5.0L (302 CID) V-8 ENGINE

Removal

1. Disconnect negative battery cable.
2. Raise the vehicle on a hoist.
3. Disconnect starter cable at the starter terminal.
4. Remove the thru bolt and nut attaching the motor mount insulator to mounting bracket.
5. Remove the two bolts attaching the insulator to block and remove the insulator from vehicle.
6. Position jack under engine and raise it.
7. Remove starter attaching bolts and remove starter.

Installation

1. Position starter to flywheel housing and install the two attaching bolts.
2. Connect starter cable to starter.
3. Position insulator to vehicle and start the two attaching bolts to cylinder block.
4. Lower engine and install thru bolt and nut attaching motor mount insulator to mounting bracket. Torque all bolts to specifications and remove jack.
5. Lower vehicle and connect negative battery cable.

FAIRMONT AND ZEPHYR WITH 2.3L I-4 AND GRANADA AND MONARCH WITH 4.1L (250 CID) I-6 ENGINE

Removal

1. Disconnect negative battery cable.
2. Disconnect starter cable from motor.
3. Raise the vehicle on hoist.
4. Remove starter attaching bolts and remove starter assembly.

Installation

1. Position starter motor to engine and install attaching bolts. Torque to specification.
2. Lower vehicle to the floor.
3. Connect starter cable to motor. Torque to specification.
4. Connect negative battery cable.

FAIRMONT AND ZEPHYR WITH 3.3L (200 CID) I-6 ENGINE

Removal

1. Disconnect negative battery cable.
2. Remove the top starter bolt.
3. Remove two nuts and remove exhaust heat shield.
4. Disconnect starter cable from motor.
5. *Raise the vehicle on hoist.*
6. Remove wishbone brace.
7. Remove the last two starter mounting bolts.
8. Remove the starter assembly.

Installation

1. Position starter motor to engine and hold firmly in place against mounting surface, then install (2) attaching bolts.
2. Install wishbone brace.
3. Lower vehicle to the floor.
4. Install starter cable to motor.
5. Install exhaust shield and two retaining nuts.
6. Install the top starter mounting bolt.
7. Connect battery ground cable.

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FARIMONT AND ZEPHYR WITH 5.0L (302 CID) V-8 ENGINE

Starter Removal

1. Disconnect negative battery cable.
2. Raise the vehicle on hoist.
3. Remove wishbone brace.
4. Remove starter attaching bolts and remove starter assembly.
5. Disconnect starter cable from motor.

Installation

1. Connect starter cable to motor. Torque to specification.
2. Position starter motor to engine and install (2) attaching bolts.

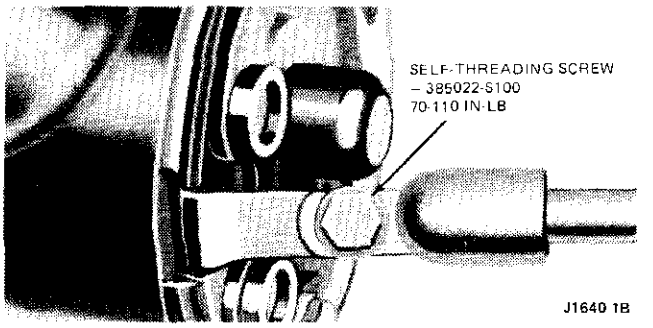


FIG. 7 Starter Cable Attachment To Starter Terminal

3. Install wishbone brace.
4. Lower vehicle to the floor.
5. Connect negative battery cable.

DISASSEMBLY AND ASSEMBLY

POSITIVE ENGAGEMENT STARTER

Use the following procedure when it becomes necessary to completely overhaul the starter. Figs. 8 and 9 illustrate a disassembled starter.

Disassembly

1. Remove the cover screw, cover, through bolts, starter drive end housing, and the starter drive plunger lever return spring.
2. Remove the pivot pin retaining the starter gear plunger lever and remove the lever and the armature.
3. Remove the stop ring retainer from the armature shaft. Remove the stop ring from the groove in the armature shaft and discard it. Remove the starter drive gear assembly.
4. Remove the brush end plate and insulator assembly.
5. Remove brushes from plastic brush holder and lift out brush holder. Note location of brush holder with respect to end terminal.
6. Remove the two screws retaining the ground brushes to frame.
7. Bend up the edges of the sleeve which is inserted in the rectanguear hole in the frame and remove sleeve and retainer. Detach field coil ground wire from copper tab riveted to frame.
8. Remove the three coil retaining screws, using Tool 10044-A and an arbor press (Fig. 10). The arbor press prevents the wrench from slipping out the screw. Cut the field coil connection at the switch post lead and remove pole shoes and coils from frame.
9. Cut the positive brush leads from the field coils, as close to the field connection point as possible.

Cleaning and Inspection

1. Use a brush or air to clean the field coils, armature assembly, brush holder, brushes, drive assembly and drive end housing. Wash all other parts in solvent and dry the parts.
2. Inspect the armature windings for broken or burned insulation and unsoldered or open connections.
3. Check the armature for open circuits and grounds.
4. Check the commutator for run out (Fig. 11). Inspect the armature shaft and the two bearings for scoring and excessive wear. If the commutator is rough, or more than 0.005 inch out-of-round, turn it down to specification.
5. Check the plastic brush holder for cracks or broken mounting pads. Replace the brushes if worn to 1/4 inch in length.
6. Inspect the field coils for burned or broken insulation and continuity.
7. Check the field brush connections. A brush kit and contact kit are available. All other assemblies are to be replaced rather than repaired.
8. Examine the wear pattern on the starter drive teeth. The pinion teeth must penetrate to a depth greater than 1/2 the ring gear tooth depth (Fig. 12), to eliminate premature ring gear and starter drive failure.
9. Replace starter drives and ring gears that have milled, pitted or broken teeth or show evidence of inadequate engagement (Fig. 12).

ASSEMBLY

1. Position the coils and pole pieces, then install the retaining screws (Fig. 10); as the pole shoe screws are tightened, strike the frame several sharp blows with a soft faced hammer to seat and align the pole shoes, then stake the screws.
2. Install the plunger coil sleeve and retainer and bend the tabs to retain the coils to the frame.
3. Position grommet on end terminal and align into the notch in the frame.
4. Solder field coil to starter terminal post strap. Use 300 watt iron and rosin core solder.
5. Check for continuity and grounds in assembled coils.

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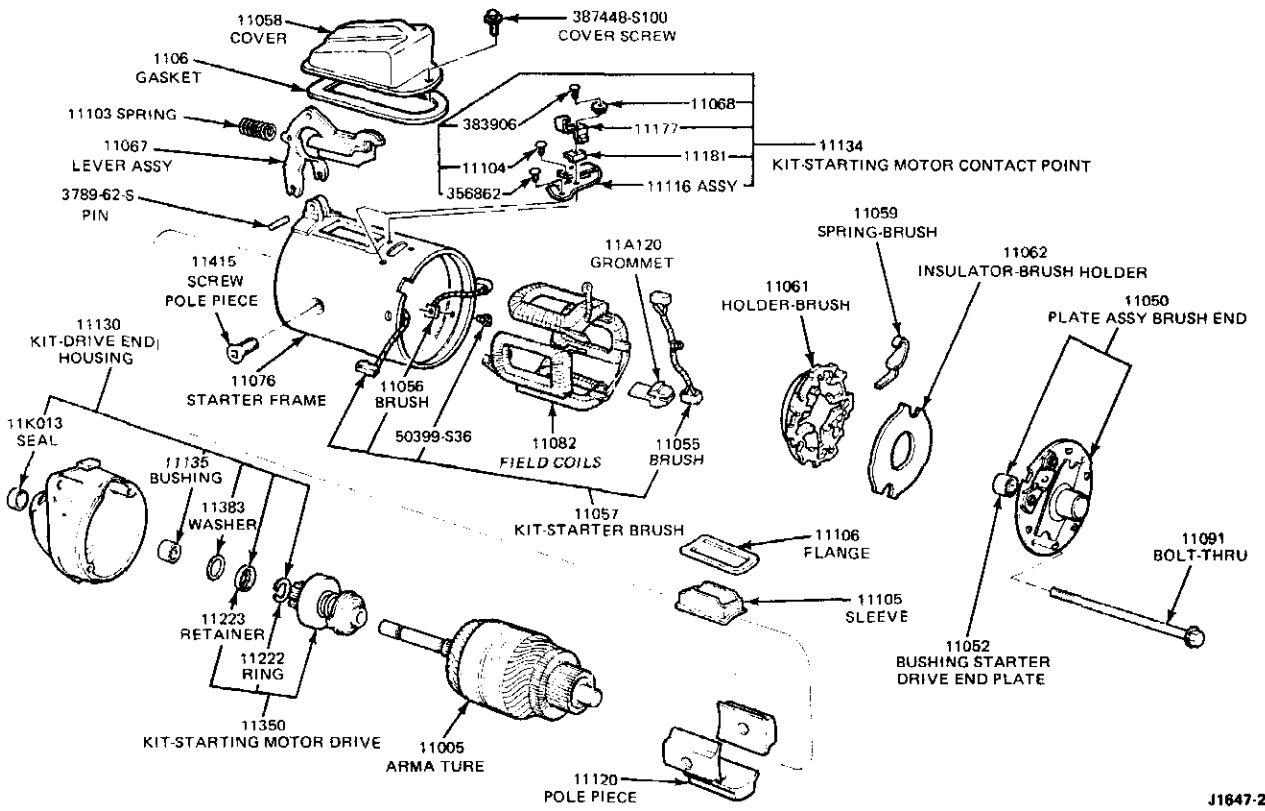


FIG. 8 Positive Engagement Starter Disassembled—(4.0 Inch)

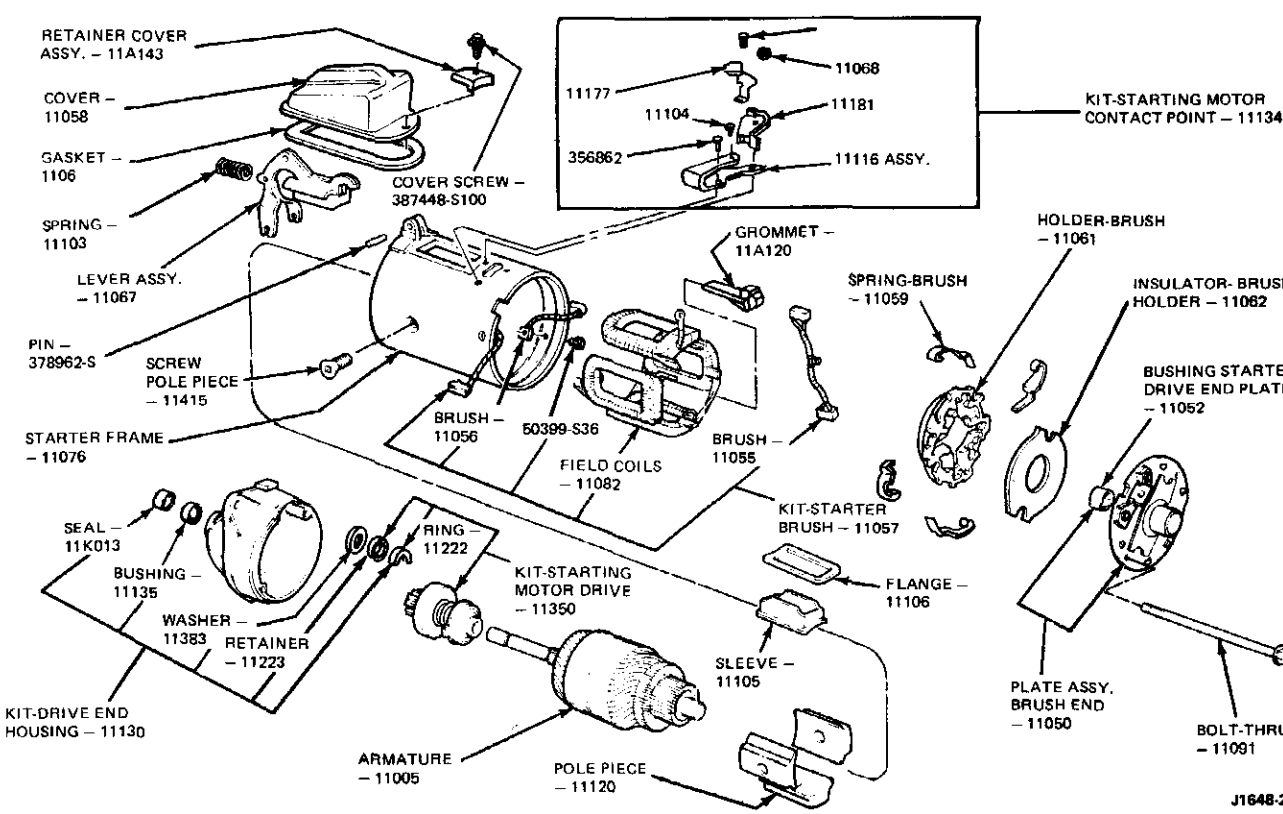


FIG. 9 Positive Engagement Starter Disassembled—(4.5 Inch)

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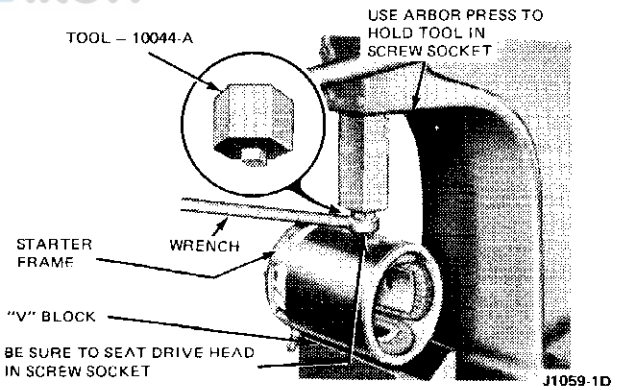


FIG. 10 Pole Shoe Screw Removal

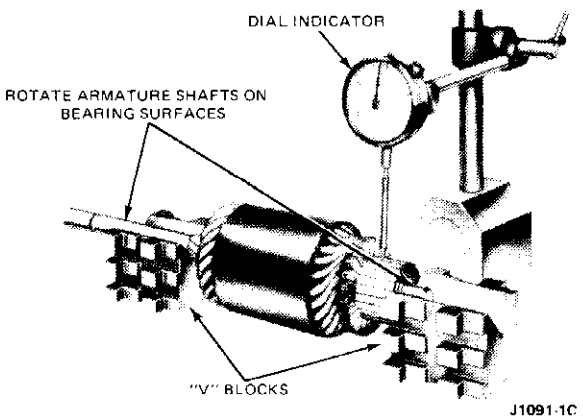


FIG. 11 Commutator Runout Check

6. Position the ground brushes to the starter frame and install the retaining screws.
7. Apply a thin coating of Lubriplate 777 or equivalent on the armature shaft splines. Install starter motor drive gear assembly to the armature shaft and install a new stop ring. Install a new stop-ring retainer.
8. Install the armature in the starter frame.
9. Position the starter drive gear plunger lever to the frame and starter drive assembly, and install the pivot pin. Apply grease into end housing bearing bore (approximately 1/4 full). Position drive end housing to frame.
10. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots in the brush holder to prevent potential grounding.
11. Install the brush end plate. Be certain end plate insulator is positioned properly on end plate.
12. Install the two thru bolts to the starter frame and torque to 55-75 in-lbs.
13. Install starter drive plunger lever cover and tighten retaining screw.
14. Check the starter no-load current draw per specifications.

STARTER DRIVE REPLACEMENT

1. Remove the plunger lever cover (Figs. 8 and 9).
2. Loosen the through bolts enough to allow removal of the drive end housing and the starter drive plunger lever return spring.

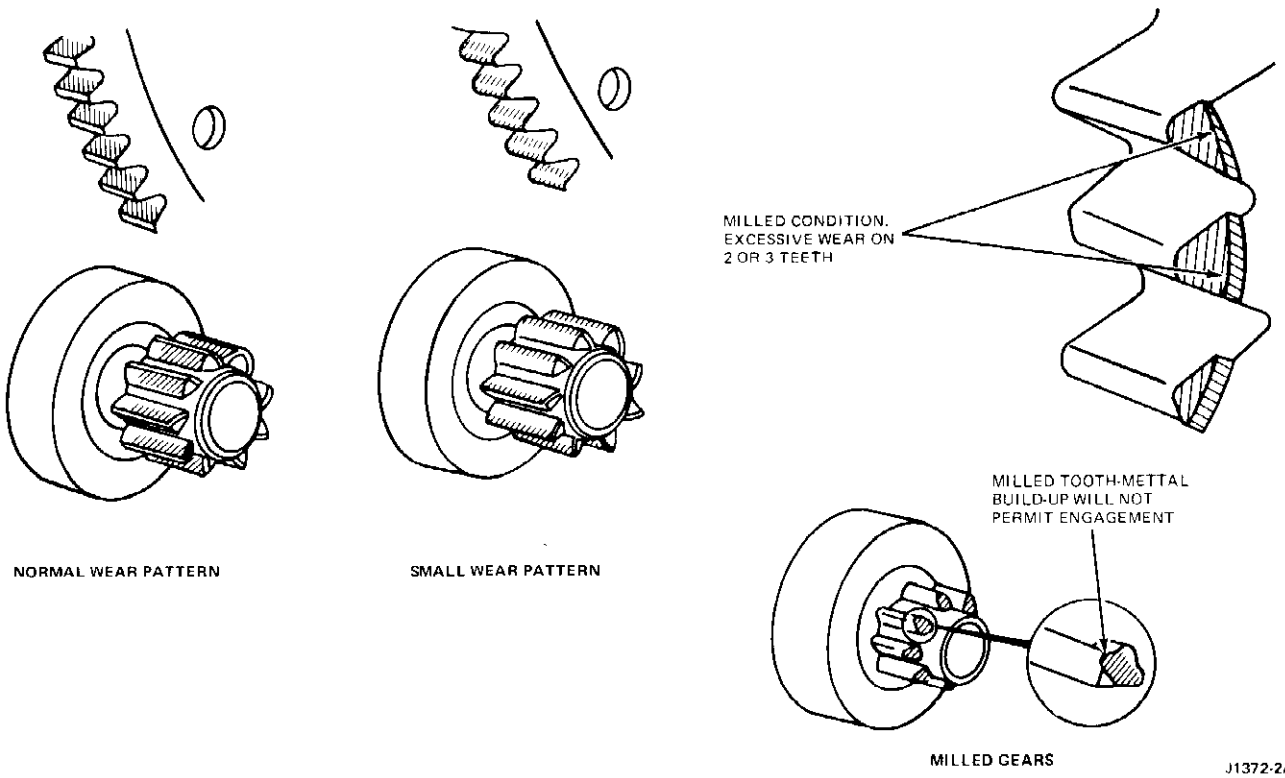


FIG. 12 Starter Pinion and Ring Gear Wear Patterns

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3. Remove the pivot pin retaining the starter drive plunger lever and remove the lever.
4. Remove the drive gear stop ring retainer and stop ring from the groove in the armature shaft and remove the drive gear assembly.
5. Apply a thin coating of Lubriplate 777 or equivalent on the armature shaft splines. Install the new drive gear assembly on the armature shaft and install a new stop ring.
6. Position the starter gear plunger lever on the starter frame and install the pivot pin. **Be sure that the plunger lever properly engages the starter drive assembly.**
7. Install a new stop-ring retainer. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the starter drive plunger lever return spring and drive end housing to the starter frame, and then tighten the through bolts to specifications (55 to 75 in-lbs).
8. Position the starter drive plunger lever cover on the starter. Tighten the retaining screw.

ARMATURE REPLACEMENT

1. Remove plunger lever cover retainer screw and remove cover.
2. Remove the through bolts, the drive end housing, and the drive plunger lever return spring, brush end plate.
3. Remove the pivot pin retaining the starter gear plunger lever, and remove the lever. Remove brushes and lift out brush holder.
4. Remove the armature. If the starter drive gear assembly is being reused, remove the stop ring retainer and stop ring from the end of the armature shaft, and remove the drive.
5. Place the drive gear assembly on the new armature with a new stop ring.
6. Install the armature in the starter frame.

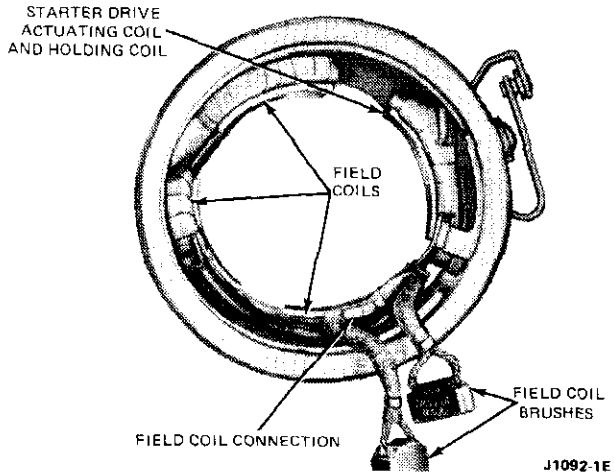


FIG. 13 Field Coil Assembly

7. Position the drive gear plunger lever to the frame and drive gear assembly and install the pivot pin.
8. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the drive plunger lever return spring, the drive end housing to the starter frame. Be sure that the stop ring retainer is seated properly in the drive housing.
9. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots to prevent grounding.
10. Install the brush end plate (be certain end plate insulator is positioned properly on end plate).
11. Install the two thru bolts to the starter frame and torque to 55-75 in-lbs.
12. Install plunger lever cover and tighten retaining screw.
13. Check the starter no-load current draw.

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SPECIFICATIONS

POSITIVE ENGAGEMENT STARTER

Positive Engagement Starter Motor						Starter Brushes					
Dia. (Inches)	Current Draw Under Normal Load (Amps)	Normal Engine Cranking Speed (rpm)	Min. Stall Torque @ 5 Volts (Ft-Lbs)	Max. Load (Amps)	No. Load (Amps)	Mfg. Length (Inches)	Wear Limit (Inches)	Spring Tension (Ounces)	Through Bolt Torque (In-Lbs)	Mounting Bolt Torque (In-Lbs)	Cable Attaching Screw (In-Lbs)
4	150–200	180–250	9.0	460	70	0.50	0.25	40	55–75	15–20	70–110
4-1/2	150–180	150–290	15.5	670	80	0.50	0.25	80	55–75	15–20	70–110

Maximum Commutator runout is 0.005 inch. Maximum starting circuit voltage drop (battery positive terminal to starter terminal) at normal engine temperature is 0.5 volt.

SPECIAL TOOLS

Ford Tool No.	Former No.	Description
TOOL 10044-A	10044-A	Generator Pole Screw Wrench

CJ1430-2D

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ENGINE EMISSION CONTROL SYSTEMS

GROUP 29 (9000)

PART TITLE	PART NO.
2.3L Feedback Carburetor Electronic Engine Control System	29-08
EEC System	29-06
EGR System	29-07
Engine Diagnosis and Service	29-02
General Service	29-01
Thermactor System	29-03

CA4253-2B

Emission Systems General Service

PART 29-01

All Models

SUBJECT	PAGE
GENERAL INFORMATION	
Air Cleaner Mounted Switches	01-4
Emission Related Fuel System Components	01-1
Emission Related Miscellaneous Components	01-4
GENERAL INFORMATION (Cont'd.)	
Emission Related Spark Control Components	01-2
Identification	01-1

CA4254-2A

GENERAL INFORMATION

The Engine Emission Control Systems section of this Manual is designed to cover those adjustments and *service operations required to meet factory* specifications for passenger cars. General information for emission reduction systems and miscellaneous emission related parts will be covered in Part 29-01, while descriptions of the various components will be carried in the individual Parts. Engine Diagnosis and Service are covered in Part 29-02.

IDENTIFICATION

Each passenger car is equipped with a decal containing emission control data that applies specifically to that vehicle and engine. This data is critical to the servicing of the emission systems (Fig. 1).

When performing services listed in Part 29-02, refer to this decal located either on the engine or, in the case of Pinto and Bobcat, on the inside front of the engine compartment hood.

EMISSION-RELATED FUEL SYSTEM COMPONENTS

ELECTRIC ASSISTED CHOKE

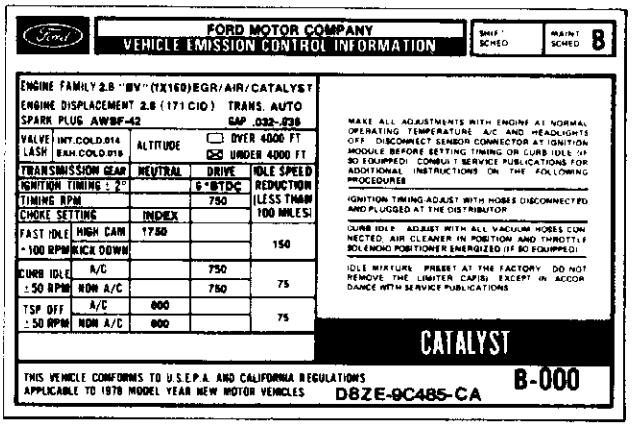
Some passenger cars use an electrically-assisted choke thermostatic spring heater as an aid to fast choke release and better emission characteristics during engine warm-up (Fig. 2). The heaters are temperature sensitive and operate from current supplied from the center tap of the alternator when the engine is running (Fig. 4).

The temperature sensitive electric choke assist system consists of a choke cap, thermostatic spring, a bi-metal temperature sensing disc (switch), and a ceramic positive temperature coefficient (PTC) heater. The current to operate the system is supplied from the center tap of the alternator to the temperature sensing switch.

The system is grounded through a ground strap connected to the carburetor body. At temperatures

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FIG. 1 Typical Emission Control Decal

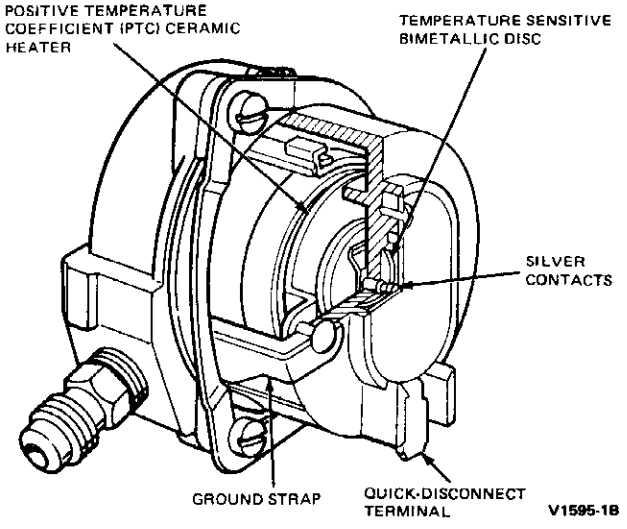


FIG. 2 Temperature Sensitive Type Electric Assisted Choke

below approximately 60 degrees F, the switch is open and no current is supplied to the ceramic heater located within the thermostatic spring. Normal thermostatic spring choking action then occurs. At temperatures above approximately 60 degrees F, the temperature sensing switch closes and current is supplied to the

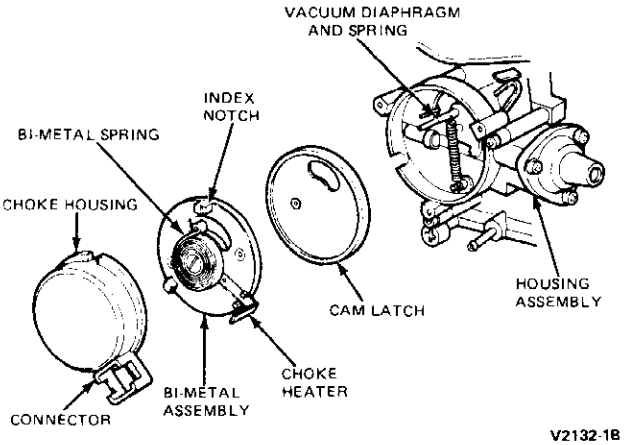


FIG. 3 Constant Operating Type Electric Assisted Choke

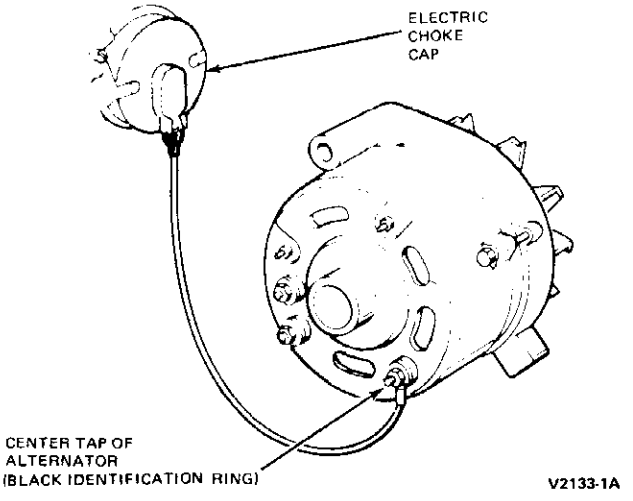


FIG. 4 Typical Electric Assisted Choke Wiring—Temperature Sensitive Type Shown

ceramic heater. As the heater warms, it causes the thermostatic spring to pull the choke plates open within 1 to 1-1/2 minutes.

The electric choke system used on the Model 5200 and 6500 carburetors is installed between the choke thermostatic spring and the choke casting and heats whenever the engine is running.

EMMISION RELATED SPARK CONTROL COMPONENTS

PORTED VACUUM SWITCHES (PVS)

These switches are used in several places in emission control and other engine systems. They consist of two-

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three- or four-port coolant temperature operated vacuum switching devices. A typical three-port PVS is used in the cooling system to increase engine idle rpm when the engine overheats (Fig. 5).

When cold, the 3-port PVS provides a path through the top and center ports. When hot, only the center and bottom ports are connected. In the case of the cooling PVS, this provides carburetor spark port vacuum to the distributor vacuum advance under normal (cool) conditions and switches to engine manifold vacuum for increased idle speed when the engine is abnormally hot. As soon as the engine cools off, carburetor spark port vacuum is once again selected and the idle speed decreases as the spark is retarded again.

DISTRIBUTOR VACUUM VENT VALVE

Some engines require a distributor vacuum vent valve. The primary functions of the valve are to prevent fuel migration to the distributor and to act as a delay valve.

The distributor vacuum vent valve (Fig. 6) helps control exhaust emissions by delaying vacuum spark advance during light acceleration and by "dumping" vacuum to eliminate vacuum advance during heavy acceleration, deceleration and idle. The valve also eliminates fuel migration to the distributor diaphragm.

When spark port vacuum is applied to the vent valve diaphragm (Fig. 7), the dump valve closes, the check valve opens and the distributor diaphragm begins to evacuate through the sintered metal restrictor. At the same time, any fuel in the spark port line is evacuated. The sintered metal restrictor located in the vent valve diaphragm acts as a spark delay valve slowing spark advance.

When spark port vacuum decreases, the check valve closes and the dump valve opens the distributor vacuum line to atmosphere. Venting the distributor vacuum line to atmosphere prevents fuel migration to the distributor diaphragm and returns the distributor to zero vacuum advance.

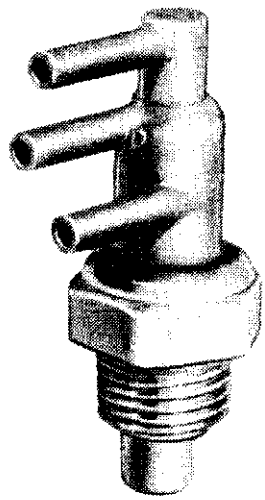
COLD START SPARK ADVANCE (CSSA)

On some engines, a Cold Start Spark Advance System (CSSA) is added to the distributor spark control system (Fig. 8).

This system momentarily traps spark port vacuum on the distributor spark advance diaphragm when the engine coolant temperature is below 125° F. The vacuum path is from the carburetor vacuum tap, through the Distributor Retard Control Valve (DRCV), through the CSSA PVS through the cooling PVS and to the distributor.

At and above the CSSA PVS temperature, the CSSA PVS is operated. Vacuum then reaches the distributor as follows: from the carburetor spark port, through the SDV, through the CSSA PVS, through the cooling PVS and to the distributor.

Above 235° F., the cooling PVS operates, directing intake manifold vacuum to the distributor. In an over-temperature situation at idle, this will increase engine rpm by providing increased vacuum. When the engine temperature decreases, spark will once more be controlled from the spark port of the carburetor.



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FIG. 5 Cooling PVS—Typical

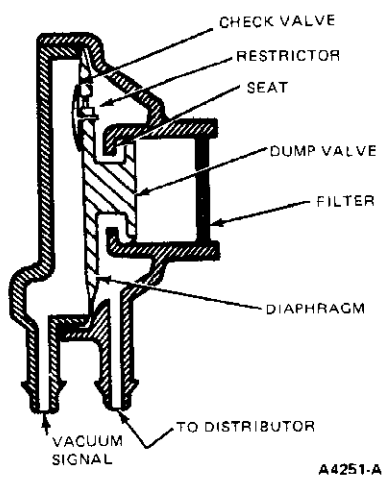


FIG. 6 Distributor Vacuum Vent Valve

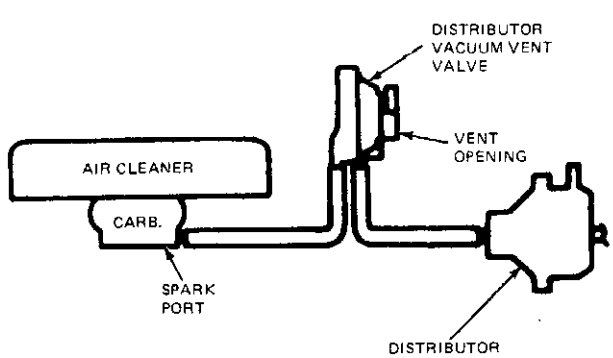


FIG. 7 Typical Vent Valve Installation

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COLD START SPARK HOLD (CSSH)

The Cold Start Spark Hold system provides momentary spark advance hold during acceleration when the engine is cold, and is used to provide improved cold engine acceleration.

When the engine coolant is less than 53°C (128°F), the CSSH PVS is closed and the distributor vacuum signal travels through the restrictor (Fig. 9).

At cold start, high vacuum acts on the distributor diaphragm, giving maximum spark advance. During cold acceleration, the high vacuum already in the distributor diaphragm is slowly bled down through the restrictor, providing a modified vacuum advance during the initial stage of acceleration.

SPARK DELAY VALVES (SDV)

Spark delay valves are installed on many engines to permit closer control of vacuum operated emission related equipment. All SDV's have an internal sintered orifice to slow air flow in one direction, a check valve to allow free air flow in the opposite direction, and a filter. They can be installed on previous model year vehicles (Figs. 10 and 11).

EMISSION RELATED MISCELLANEOUS COMPONENTS

PCV VALVE AND CRANKCASE VENT CAP

All engines are equipped with a closed crankcase emission control system that features a filler cap ventilated to the crankcase and a vacuum-operated Positive Crankcase Ventilation (PCV) valve (Fig. 12).

When the engine is running, vapors that may escape past piston rings are pulled back into the intake manifold, causing fresh air to flow into the crankcase through the filler cap. Periodic maintenance is required to keep system operating properly.

AIR CLEANER MOUNTED SWITCHES

Cold Weather Modulator (Fig. 13)

The Cold Weather Modulator is a vacuum modulator located in the air cleaner on some modulator located in the air cleaner on some models. During engine operation in cold ambient temperatures, it prevents the air cleaner duct door from opening to non-heated intake air. When available air from the "fresh air" intake is above 55° F., the cold weather modulator does not operate.

Normally, the duct air door will be closed to outside air any time vacuum from the bimetal sensor is applied. This occurs when the outside temperature is low enough to require heated air for carburetor intake. When the vacuum is cut off, the door will open. This occurs when

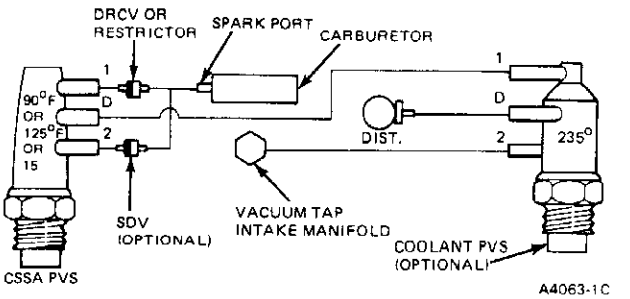


FIG. 8 Cold Start Spark Advance (CSSA) System—Typical

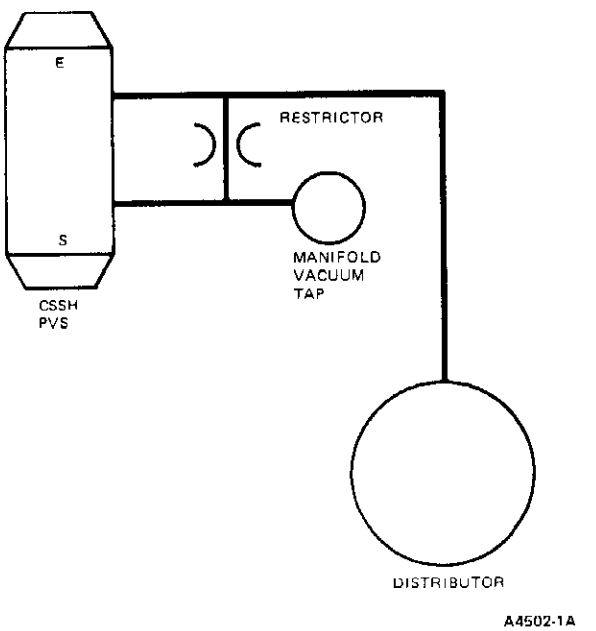


FIG. 9 Cold Start Spark Hold (CSSH) System

temperature rises high enough to operate the bi-metal sensor. It also happens during acceleration in cold conditions. When this situation is encountered, the Cold Weather Modulator, inserted in the vacuum line between the bi-metal sensor and the vacuum duct motor, will close the vacuum to the motor and hold the duct door open.

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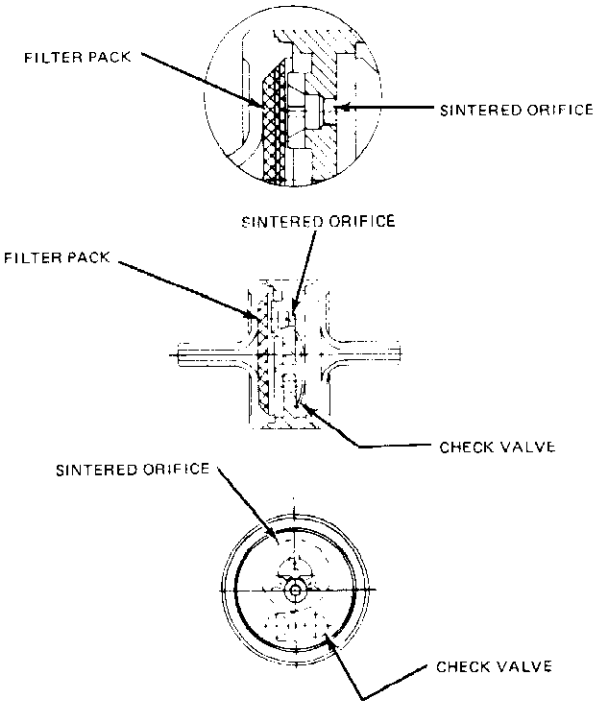


FIG. 10 Spark Delay Valve (SDV)

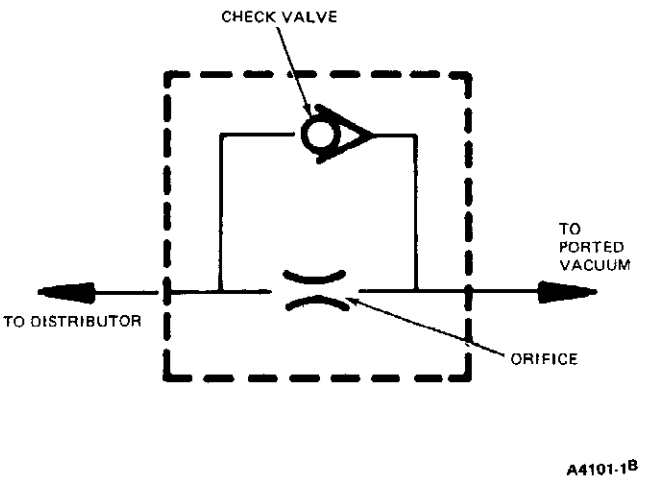


FIG. 11 Spark Delay Valve (SDV) Schematics

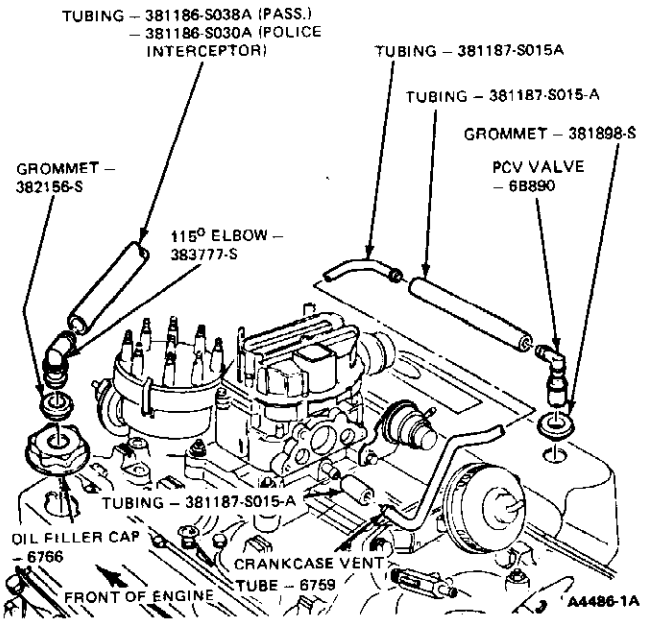


FIG. 12 Typical PCV System

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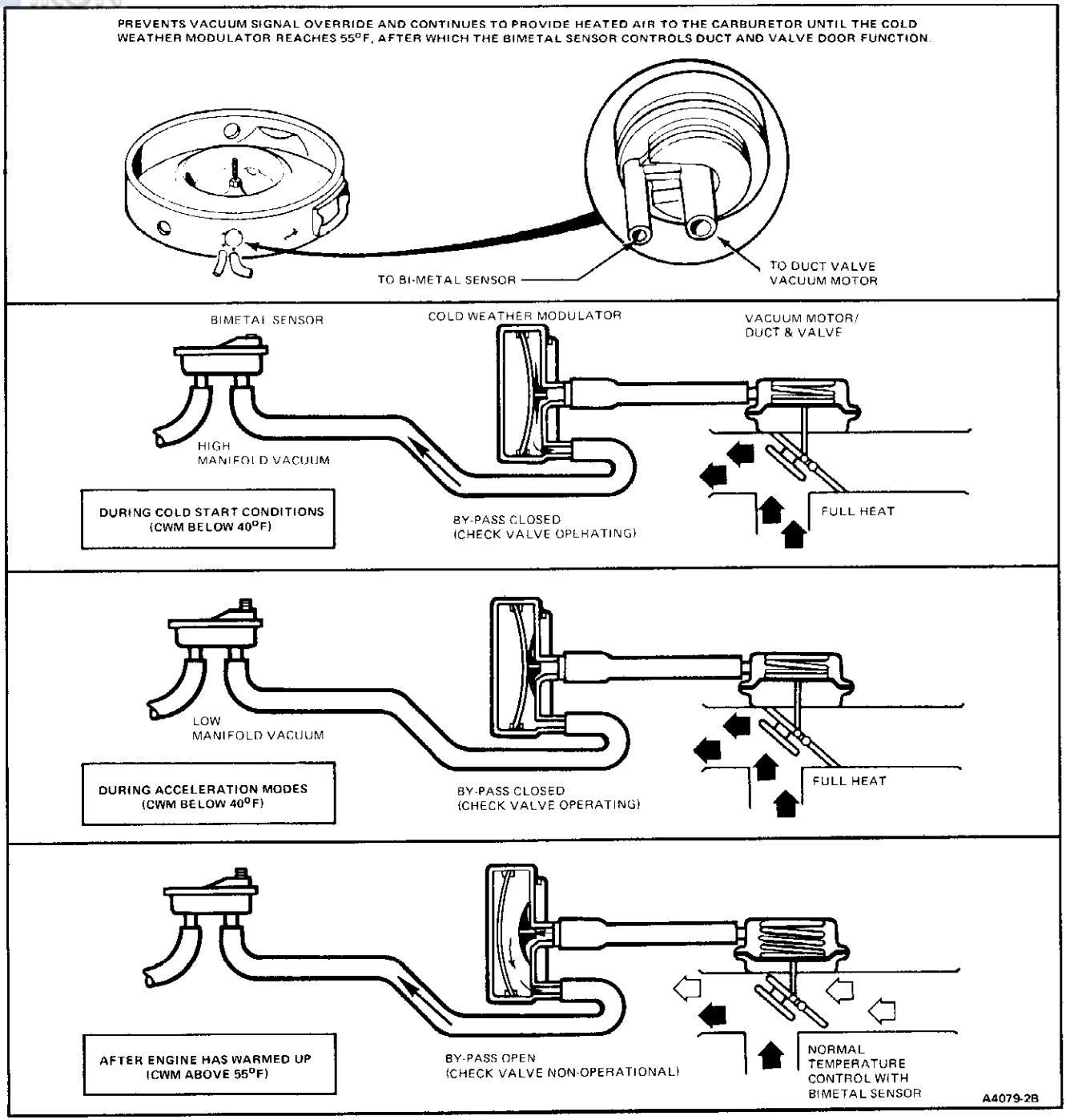


FIG. 13 Cold Weather Modulator Operation

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Engine Diagnosis and Service

PART 29-02

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Diagnosis Chart Index	02-2
DIAGNOSIS PROCEDURES	
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CA4263-2A

GENERAL INFORMATION

The following information comprises the Engine Diagnosis and Service procedures related to emission system related components. The diagnosis and related service routines provided here are the only authorized service procedures for Ford Cars. Refer to Volume 5 of this Manual for Maintenance Procedures.

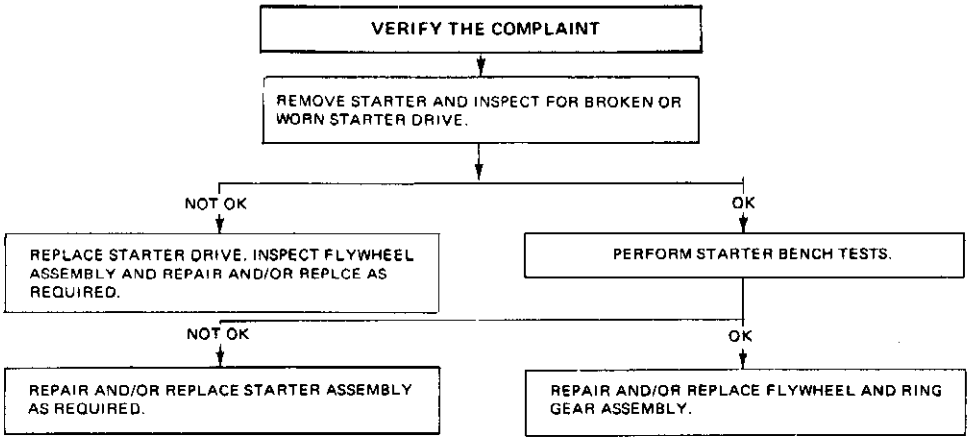
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DIAGNOSIS CHARTS

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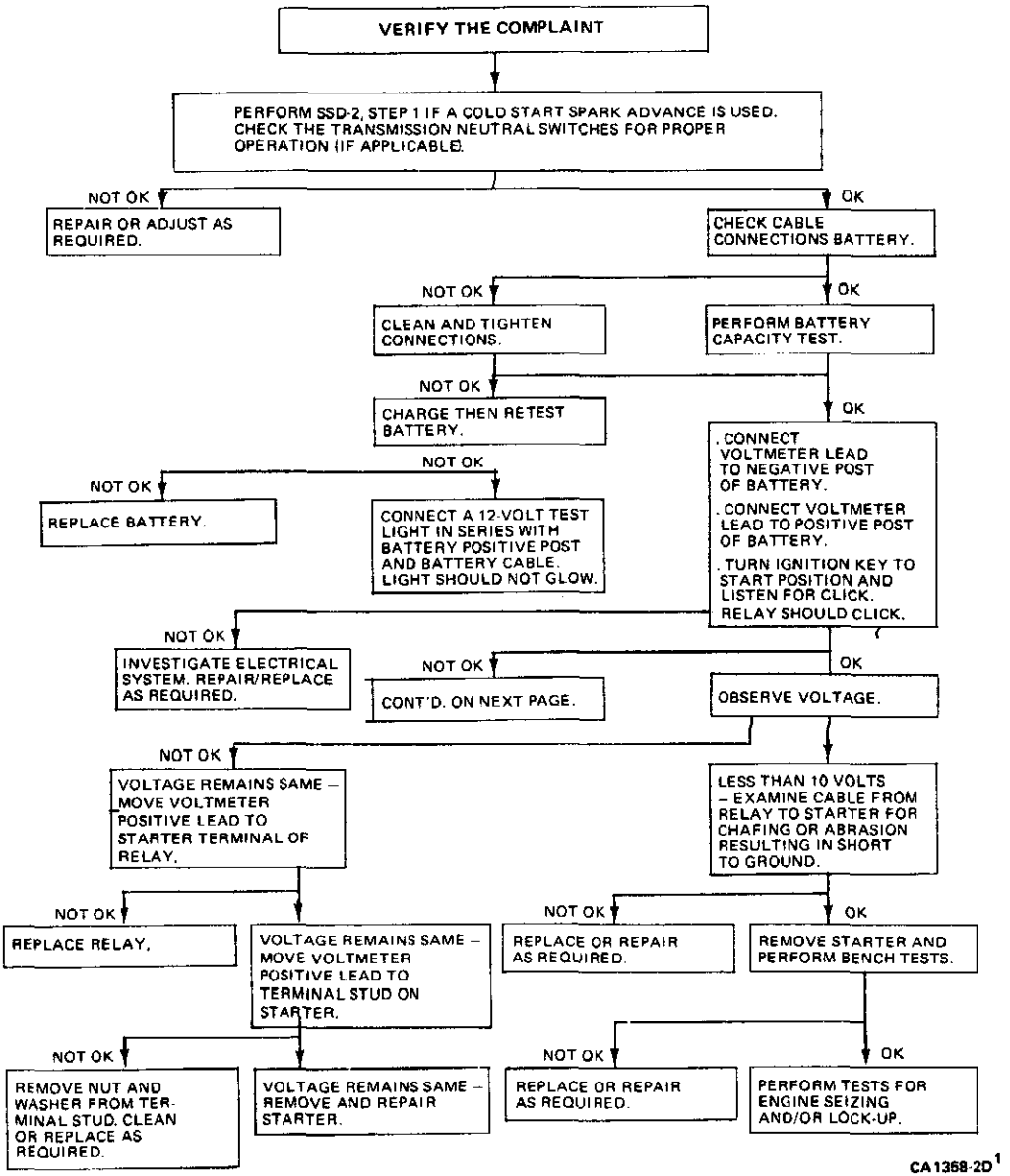
ROUTINE NO. 101
ENGINE WILL NOT CRANK – STARTER SPINS



CA1357-2B

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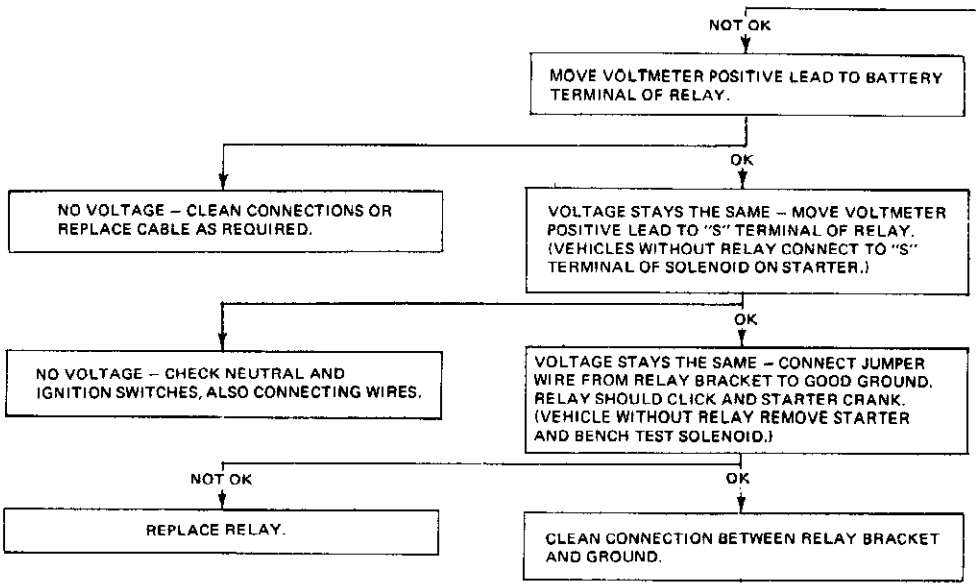
ROUTINE NO. 102
ENGINE WILL NOT CRANK



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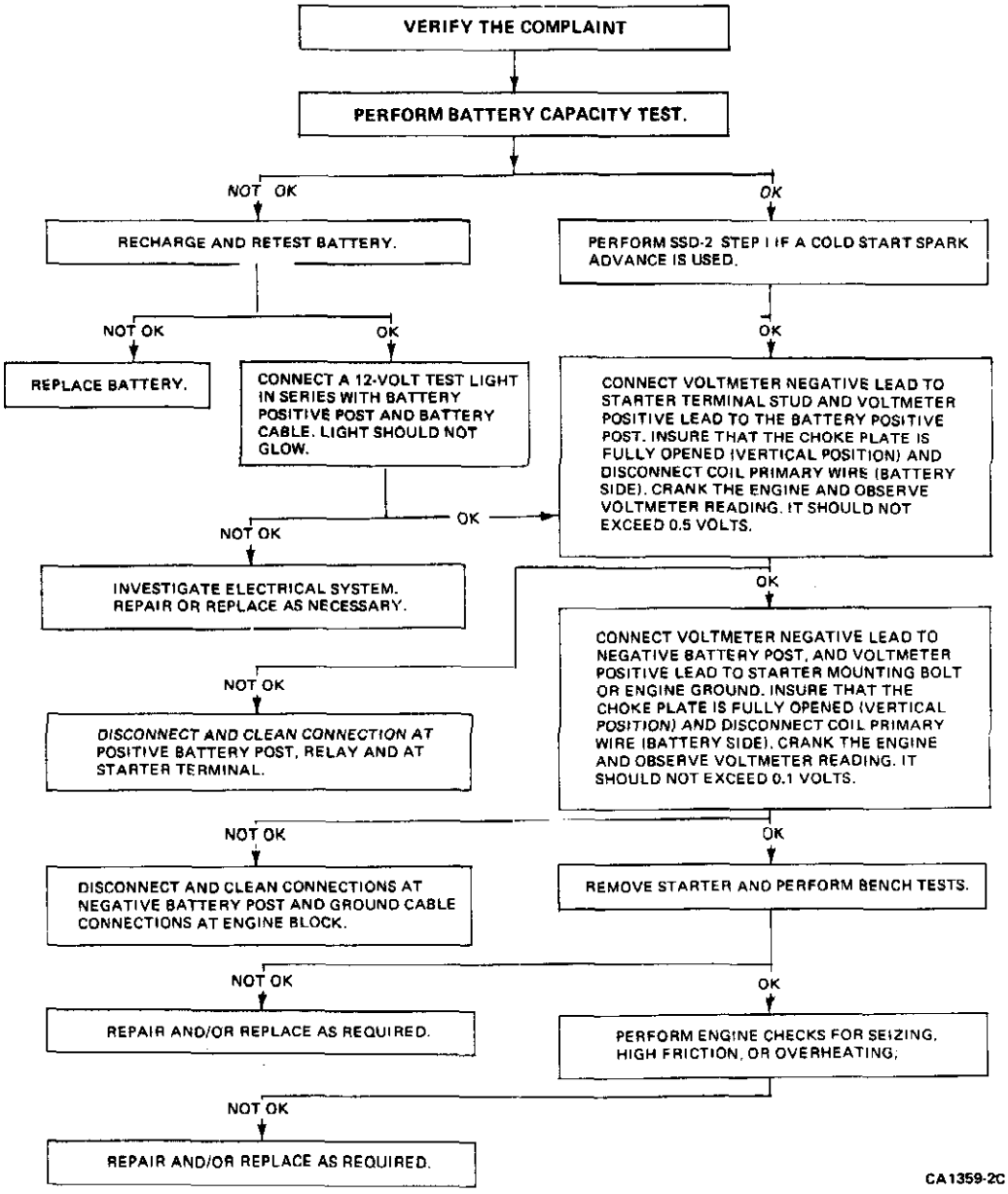
ROUTINE NO. 102
ENGINE WILL NOT CRANK – CONTINUED



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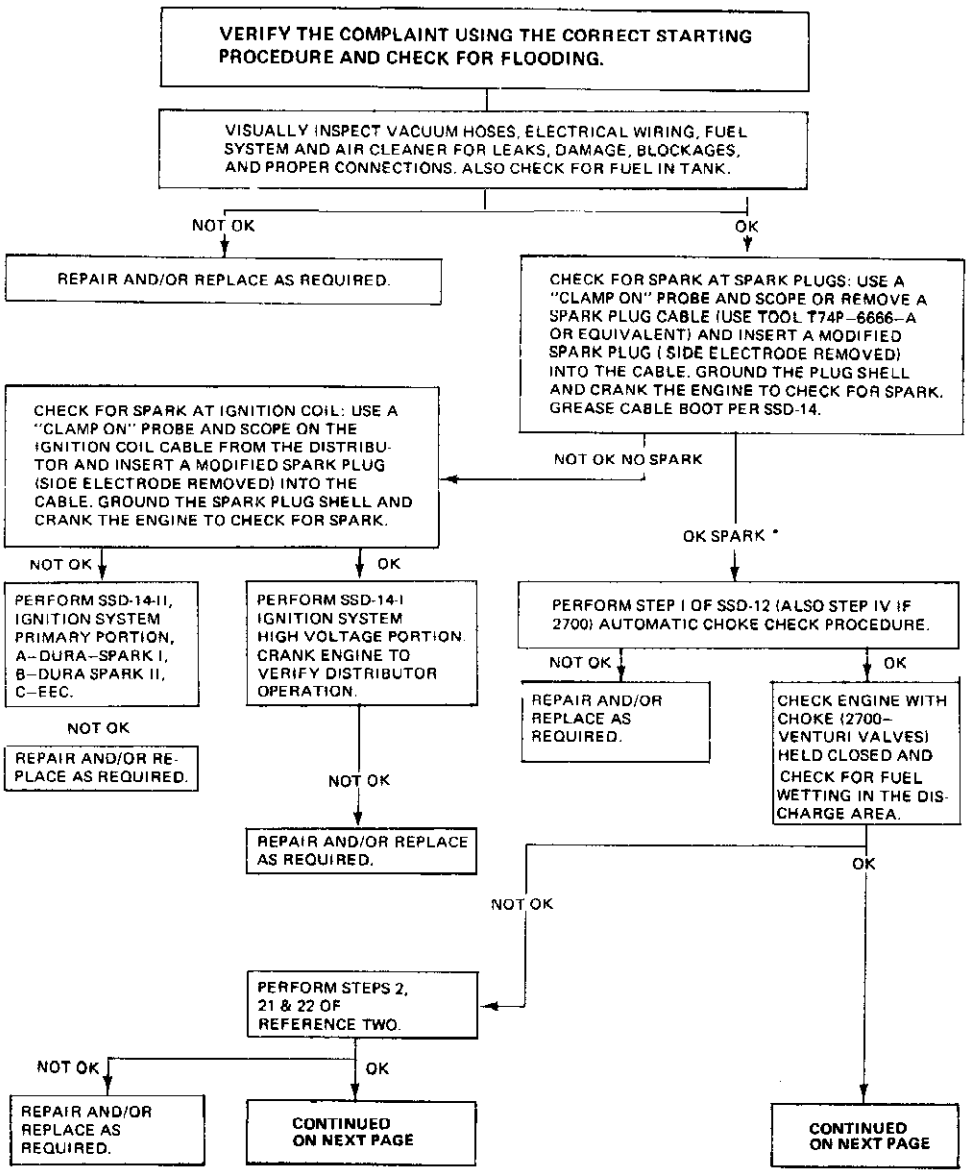
ROUTINE NO. 103
ENGINE CRANKS SLOWLY



CA1359-2C

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ROUTINE NO. 104
ENGINE CRANKS NORMALLY – WILL NOT START

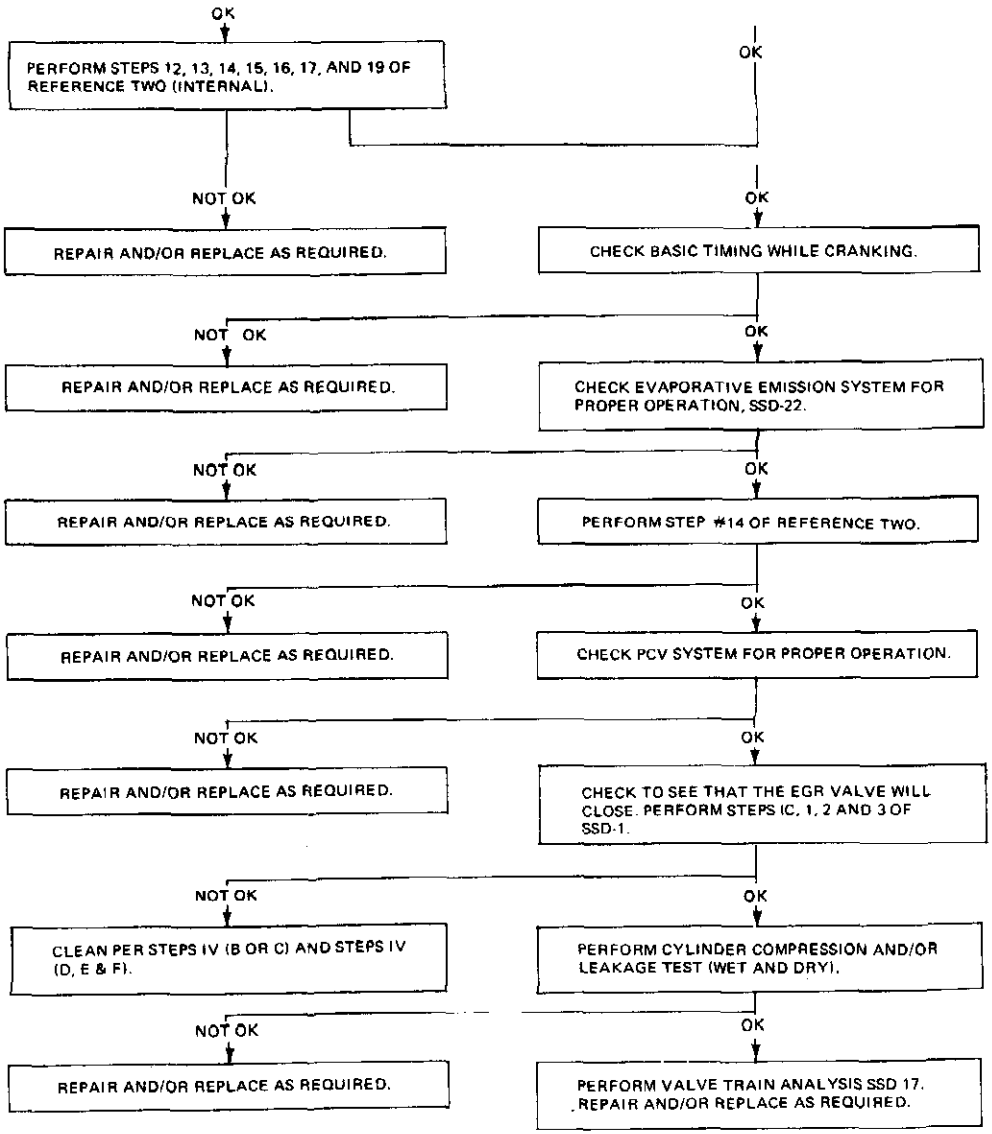


IF ENGINE ATTEMPTS TO START DURING CRANK, BUT DIES WHEN IGNITION SWITCH IS RETURNED TO THE "ON" POSITION, PERFORM SSD-14-II A FOR DURA SPARK I, B–DURA SPARK II, E–EEC.

CA1360-2C[1]

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ROUTINE NO. 104
ENGINE CRANKS NORMALLY – WILL NOT START – CONTINUED

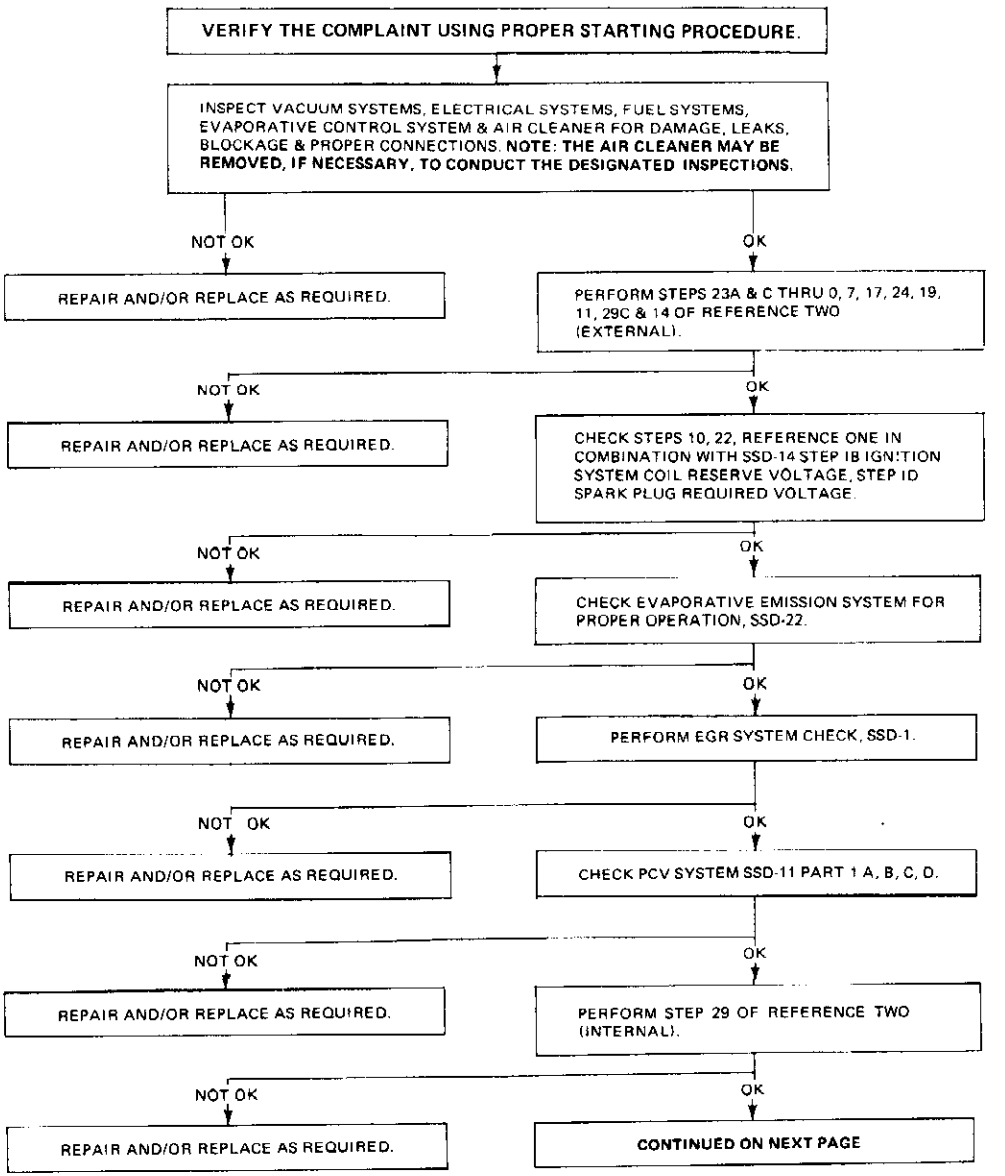


CA1360-2D[2]

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ROUTINE NO. 105

ENGINE CRANKS NORMALLY – STARTS HARD WHEN COLD

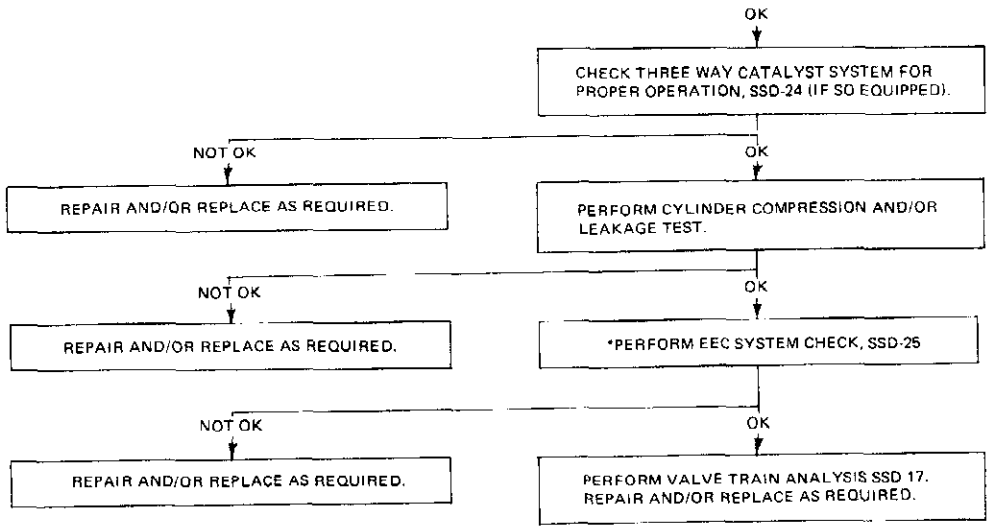


CA1361-2D

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ROUTINE NO. 105

ENGINE CRANKS NORMALLY – STARTS HARD WHEN COLD – CONTINUED

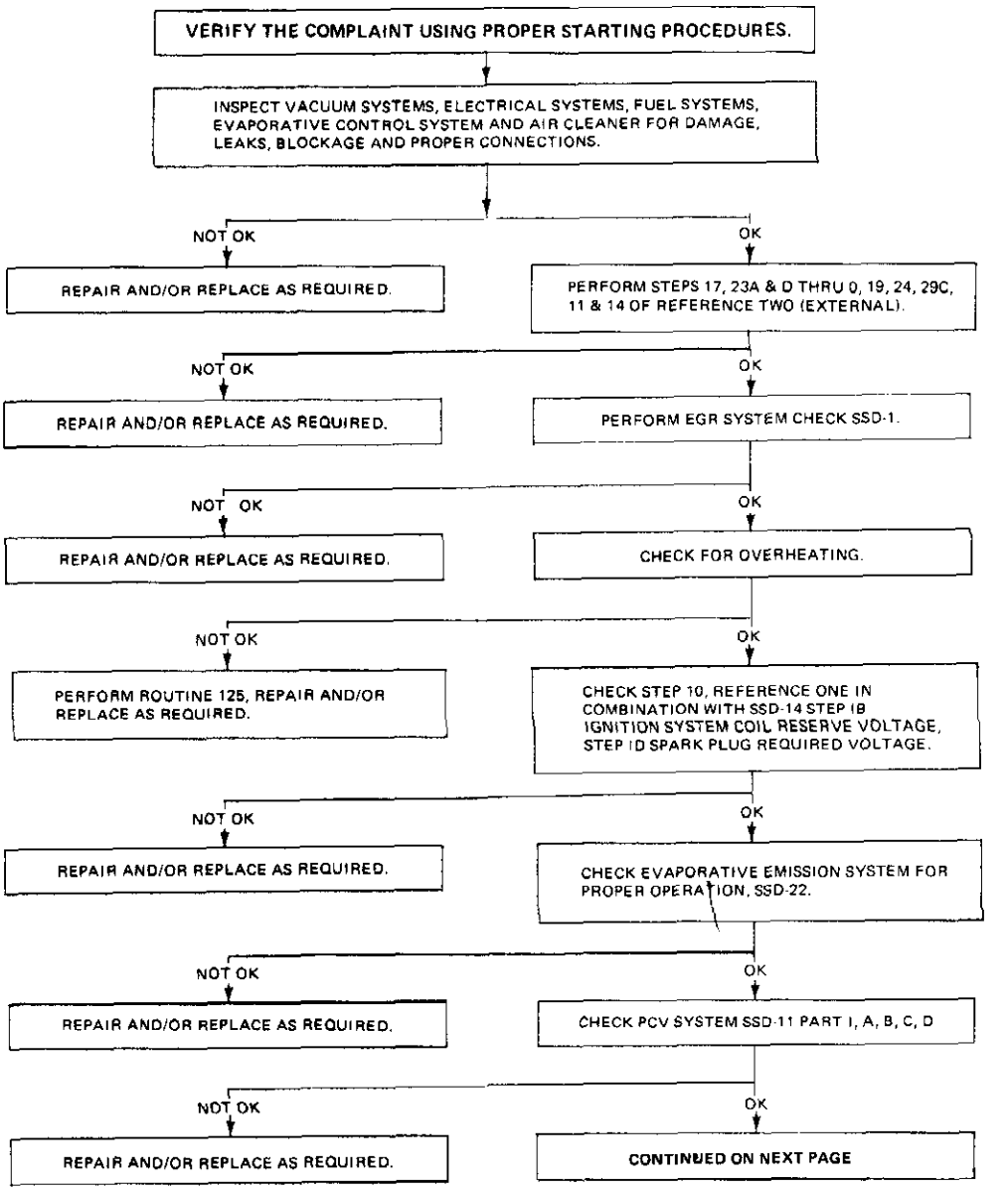


*IF EQUIPPED WITH AN EEC SYSTEM.

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ROUTINE NO. 106
ENGINE CRANKS NORMALLY –STARTS HARD WHEN HOT

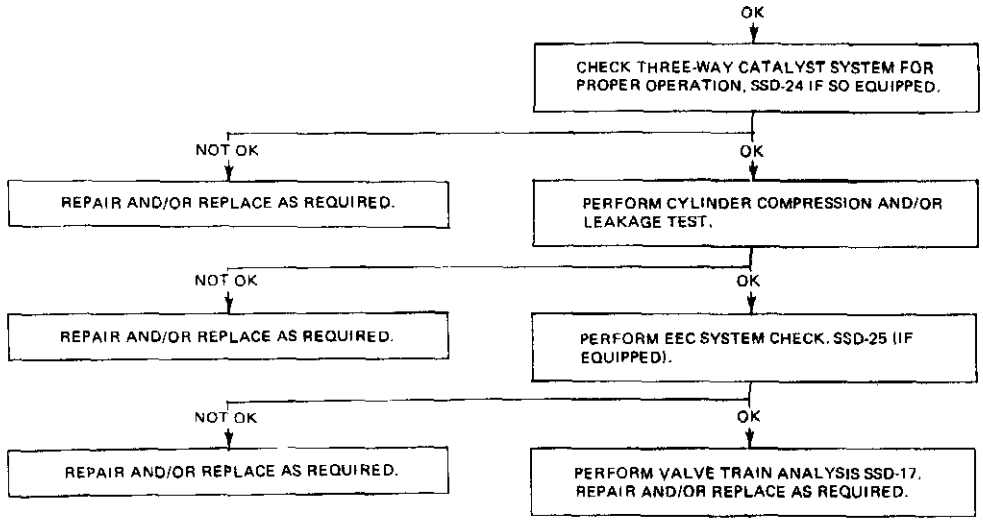


CA1362-2C[1]

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ROUTINE NO. 106

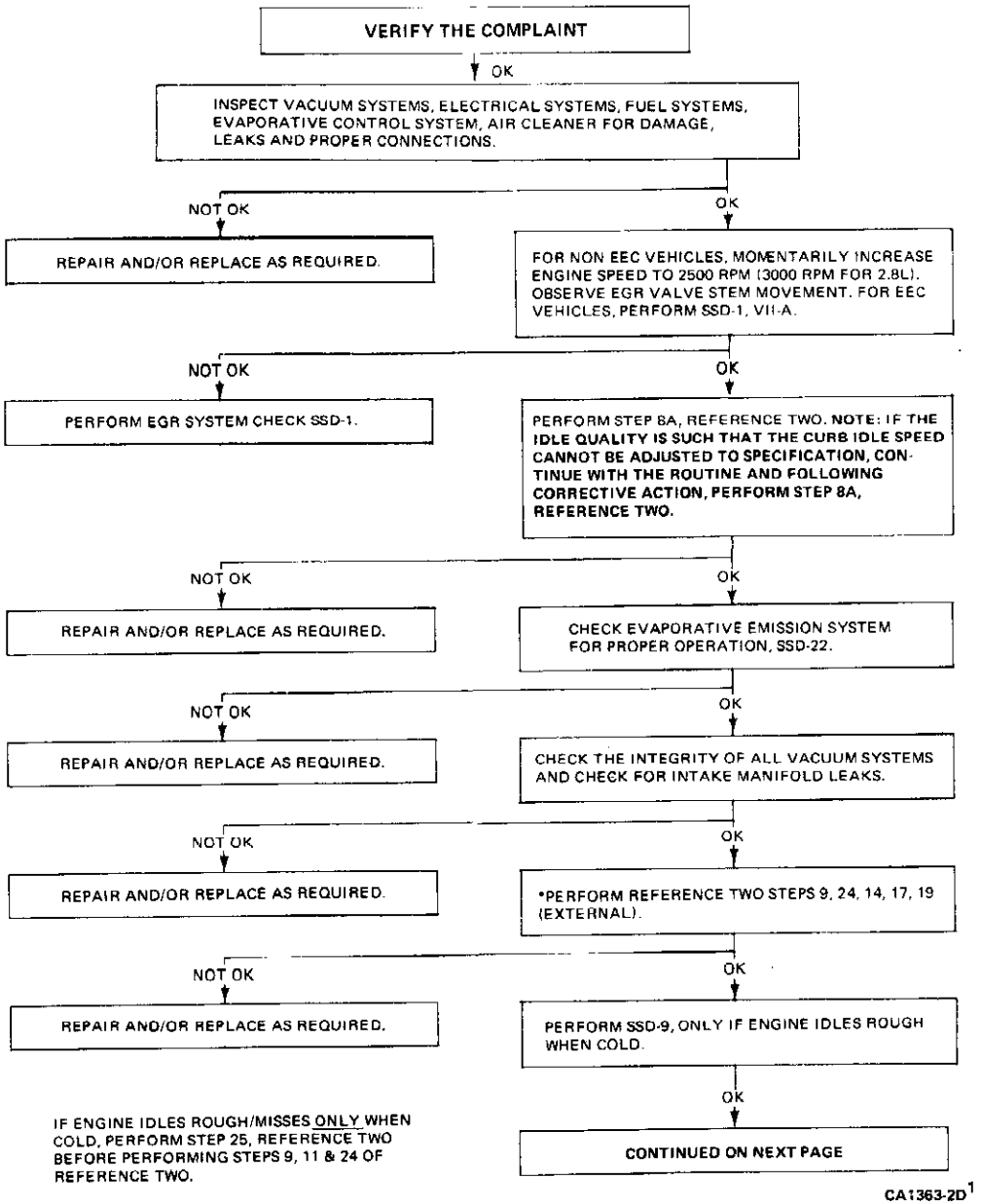
ENGINE CRANKS NORMALLY – STARTS HARD WHEN HOT – CONTINUED



CA1362-2C[2]

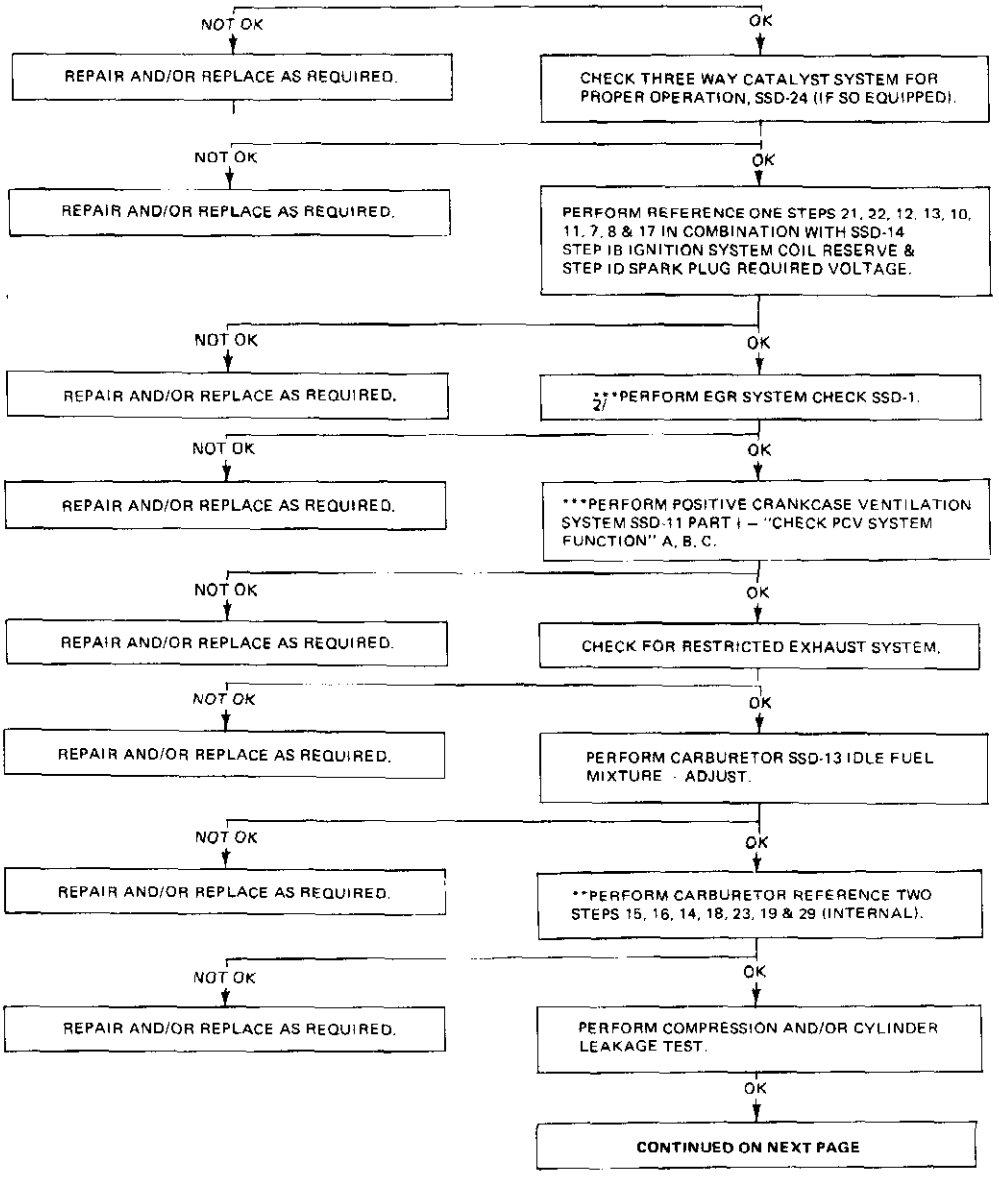
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ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES (WARM OR COLD ENGINE)



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ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES – CONTINUED (WARM OR COLD ENGINE)

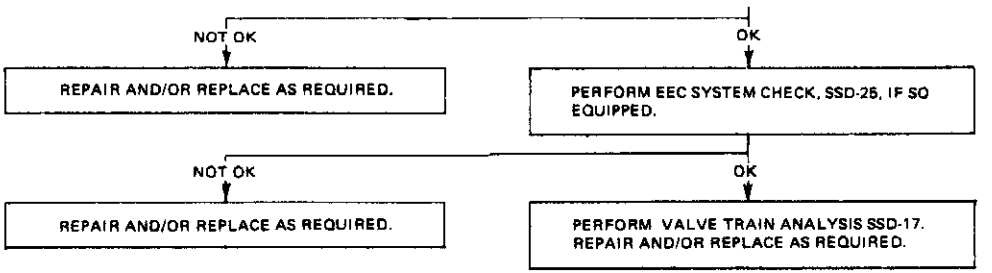


CA1363-2D2

**PERFORM STEP 23, REFERENCE TWO, OF THIS STEP ONLY IF IT WAS NOT PERFORMED EARLIER IN THE ROUTINE
***IF ENGINE IDLES ROUGH ONLY WHEN COLD, PERFORM THIS STEP AFTER PERFORMING CARBURETOR REFERENCE TWO STEPS 15, 16, 18, 23, 19 & 29.
2/ OMIT THIS STEP (SSD-) IF IT HAD BEEN PERFORMED EARLIER IN THIS ROUTINE.

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ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES – CONTINUED (WARM OR COLD ENGINE)

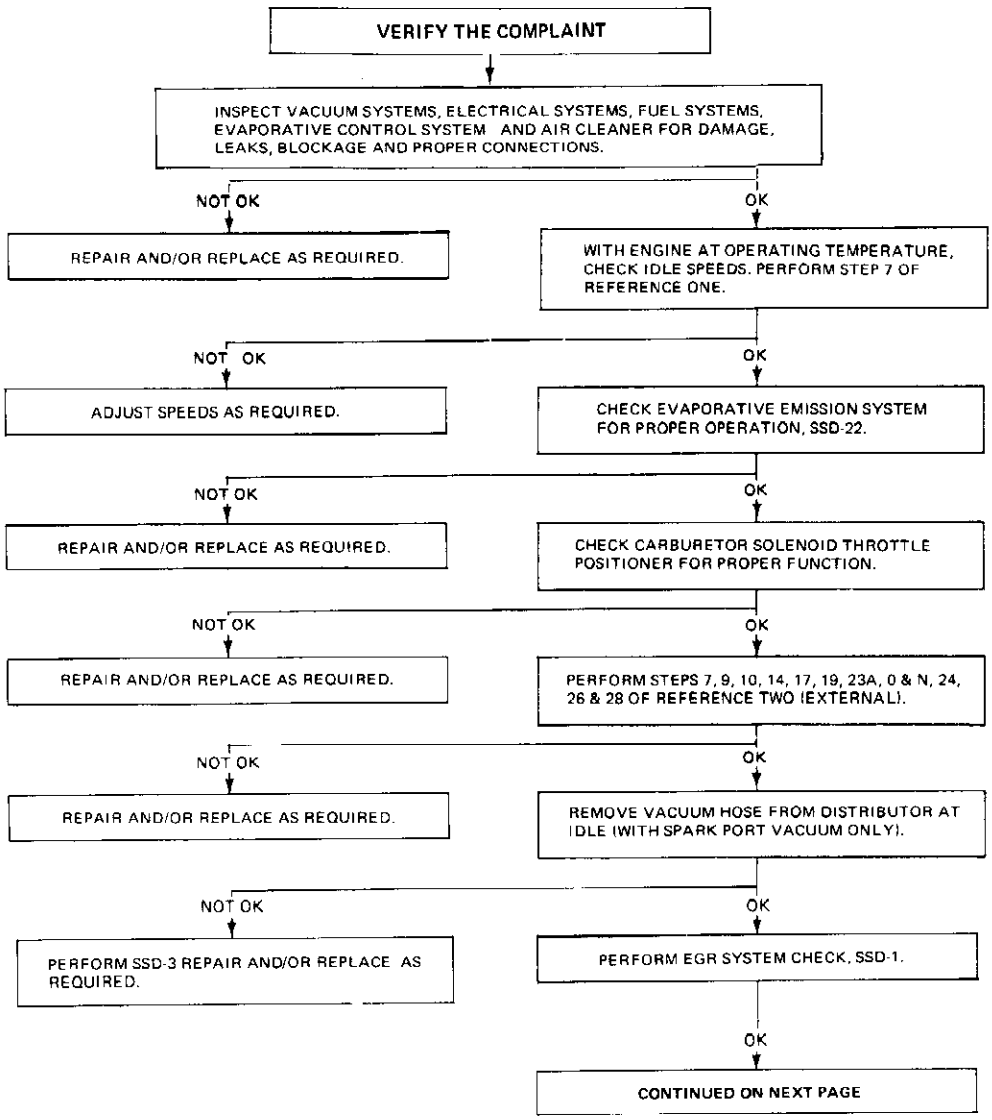


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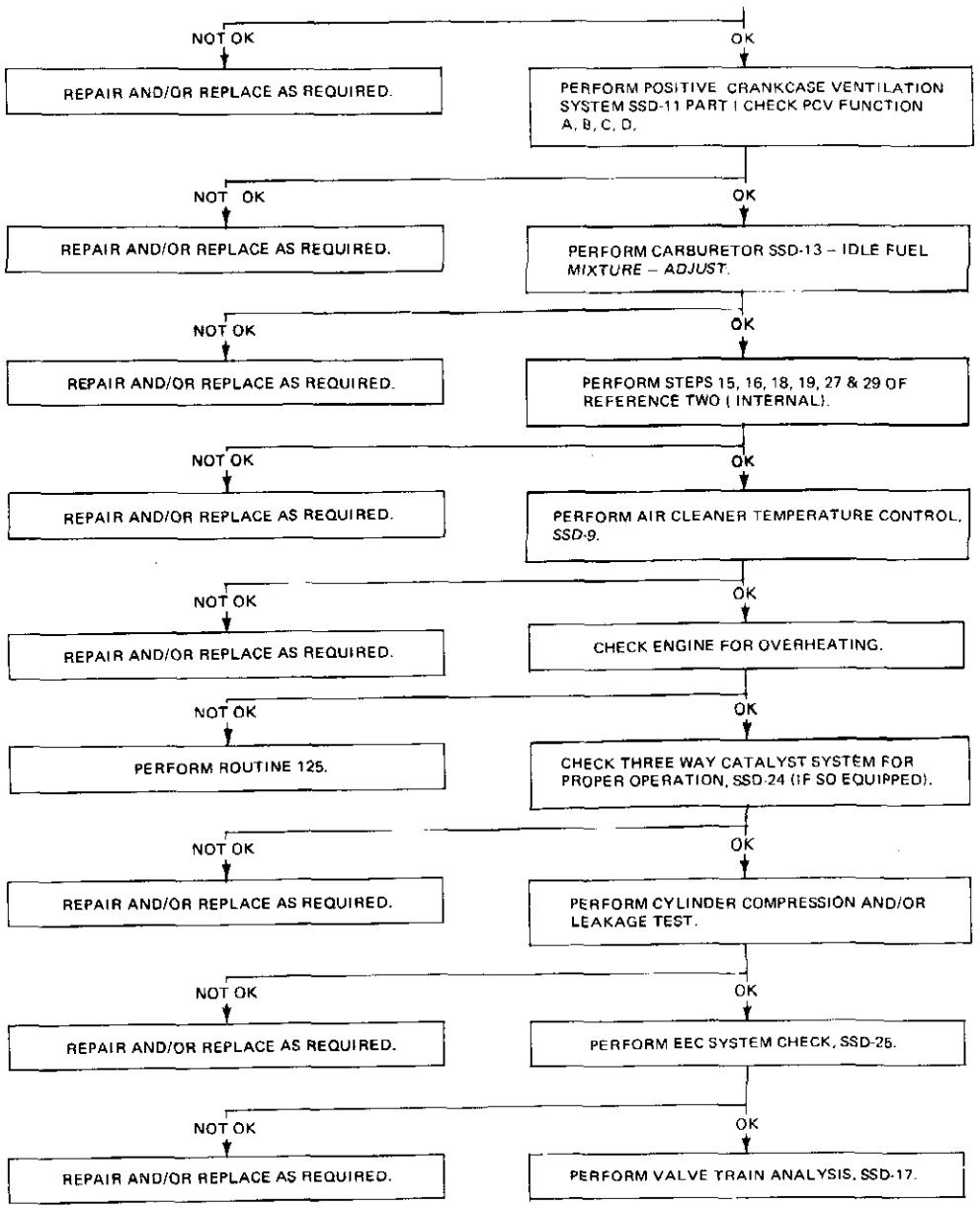
ROUTINE NO. 108
ENGINE IDLE SPEED VARIES



CA1364-2D[1]

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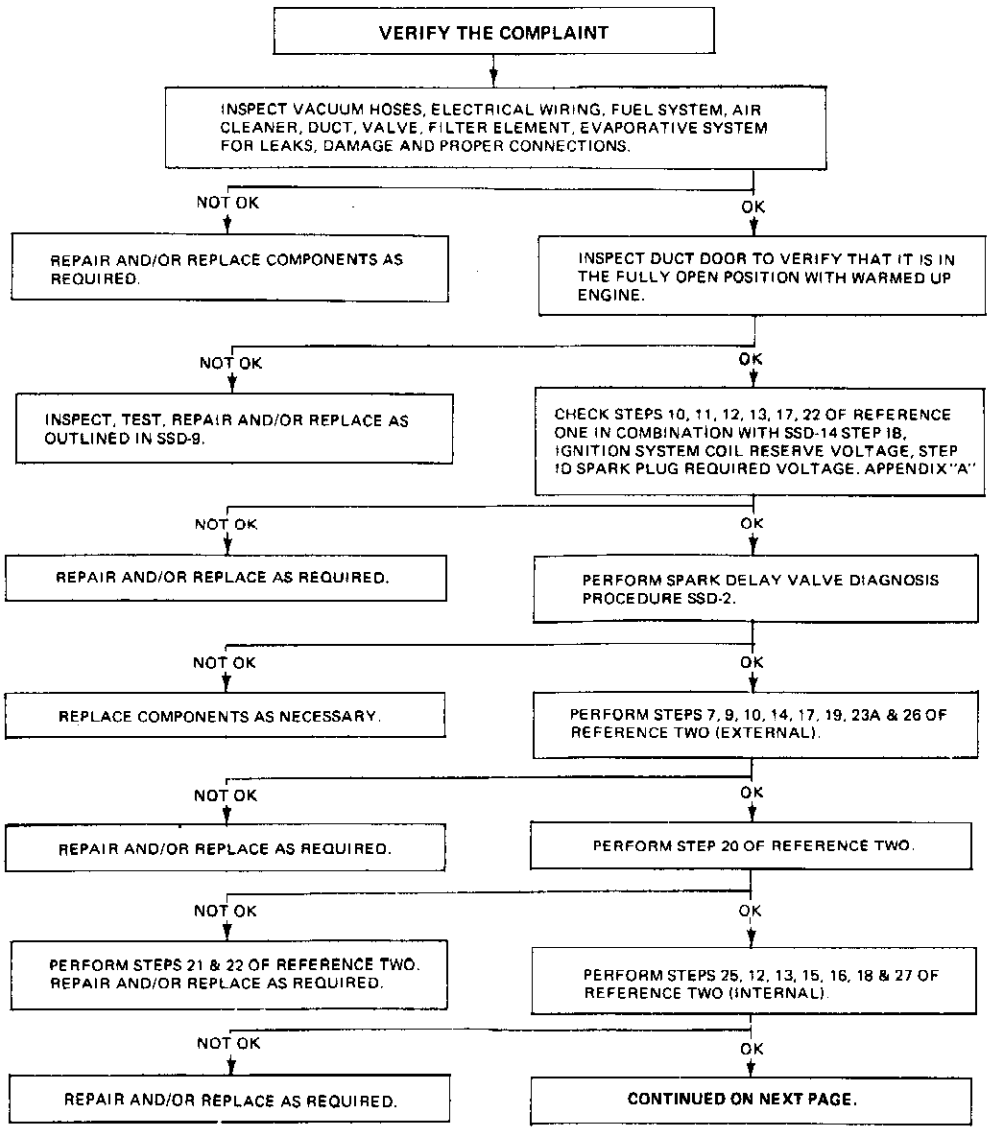
ROUTINE NO. 108
ENGINE IDLE SPEED VARIES – CONTINUED



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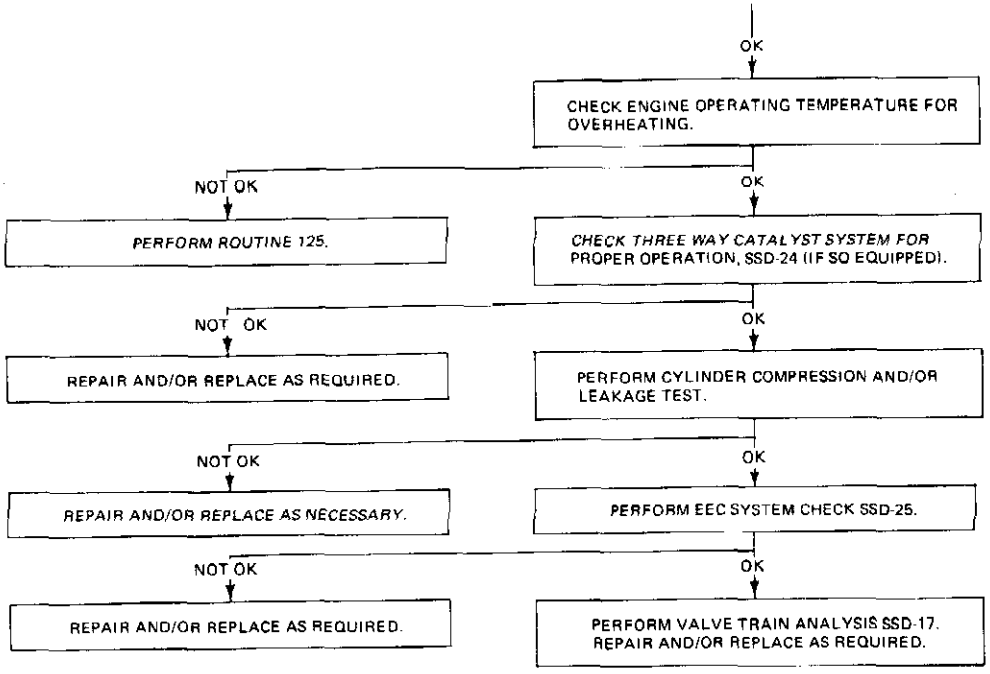
ROUTINE NO. 109
ENGINE MISSES AT HIGH SPEED



CA1365-2D[1]

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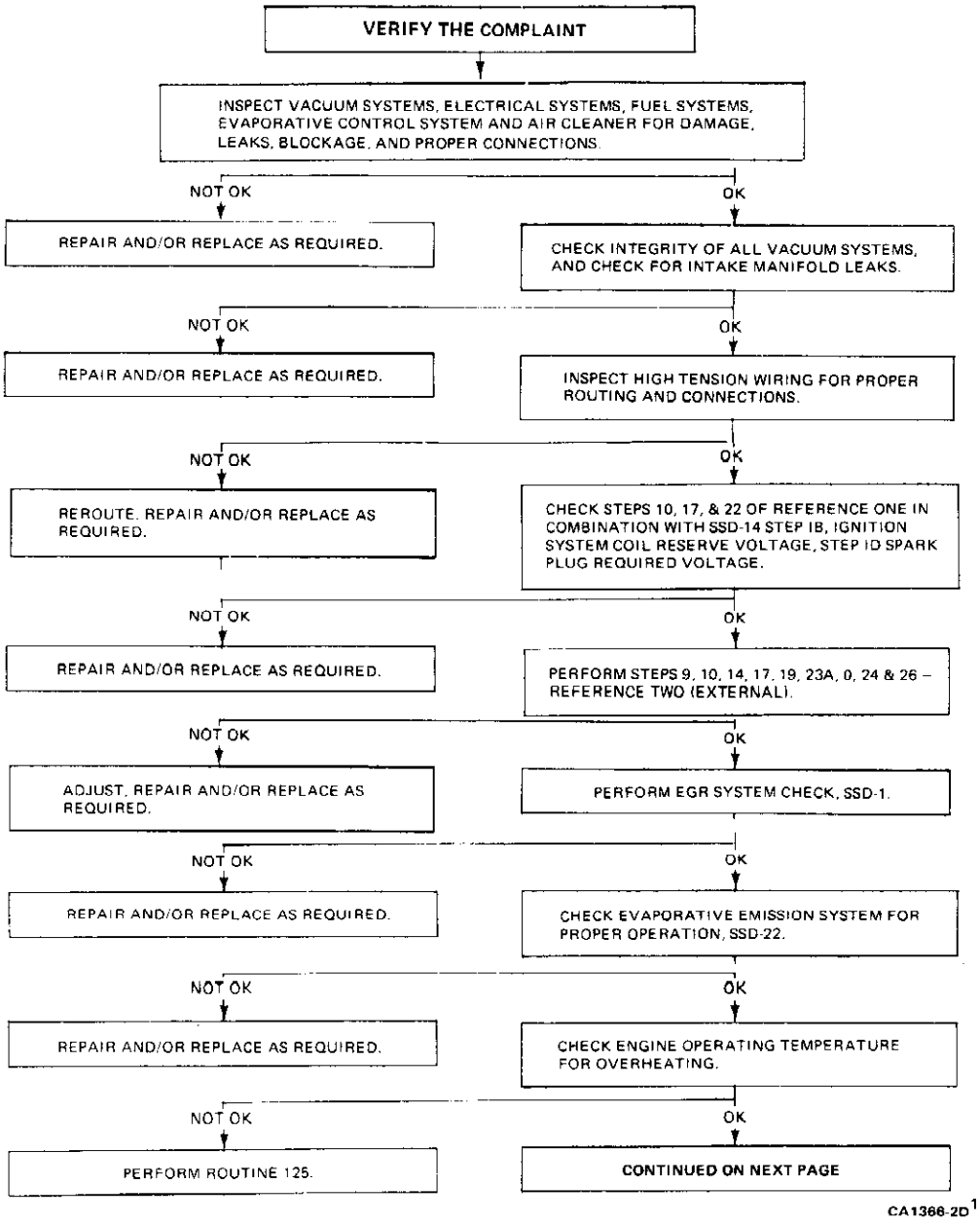
ROUTINE NO. 109
ENGINE MISSES AT HIGH SPEED – CONTINUED



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ROUTINE NO. 110
ENGINE MISSES AT LOW SPEEDS

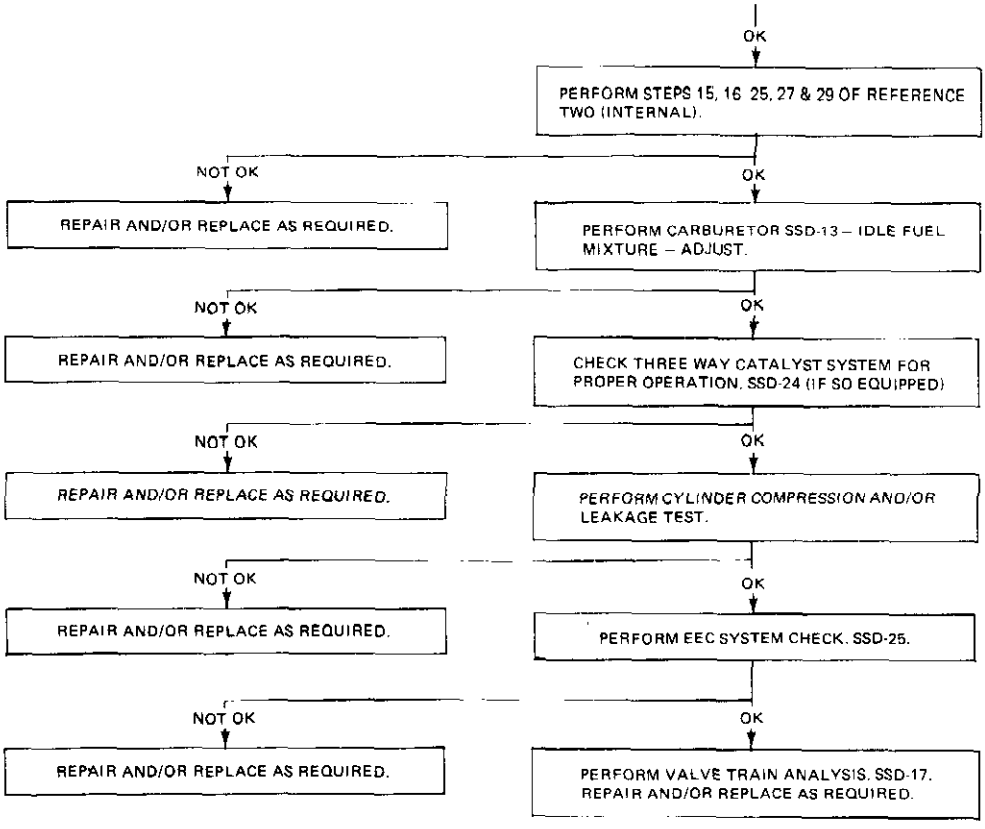


CA1366-2D[1]

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ROUTINE NO. 110

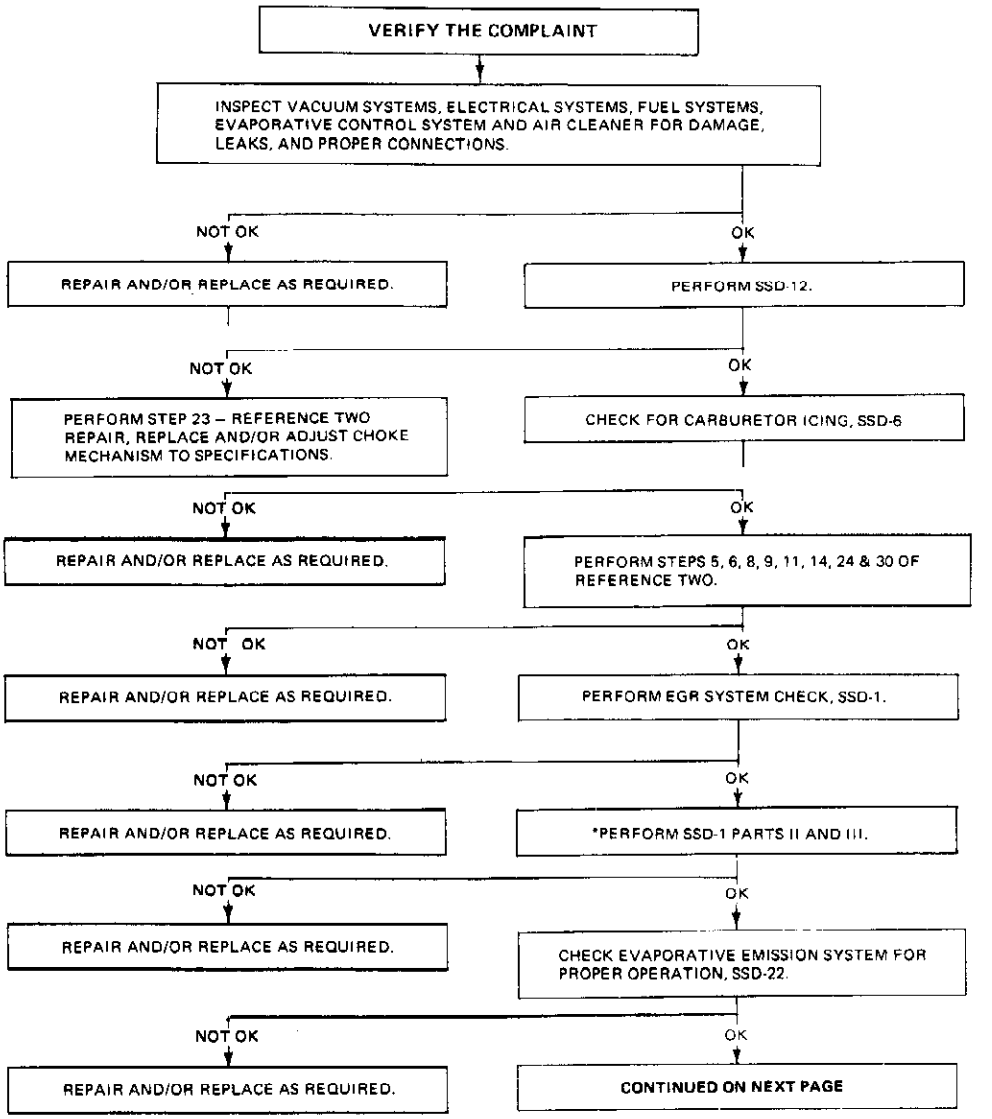
ENGINE MISSES AT LOW SPEEDS – CONTINUED



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ROUTINE NO. 111
ENGINE STALLS AT IDLE – ENGINE COLD

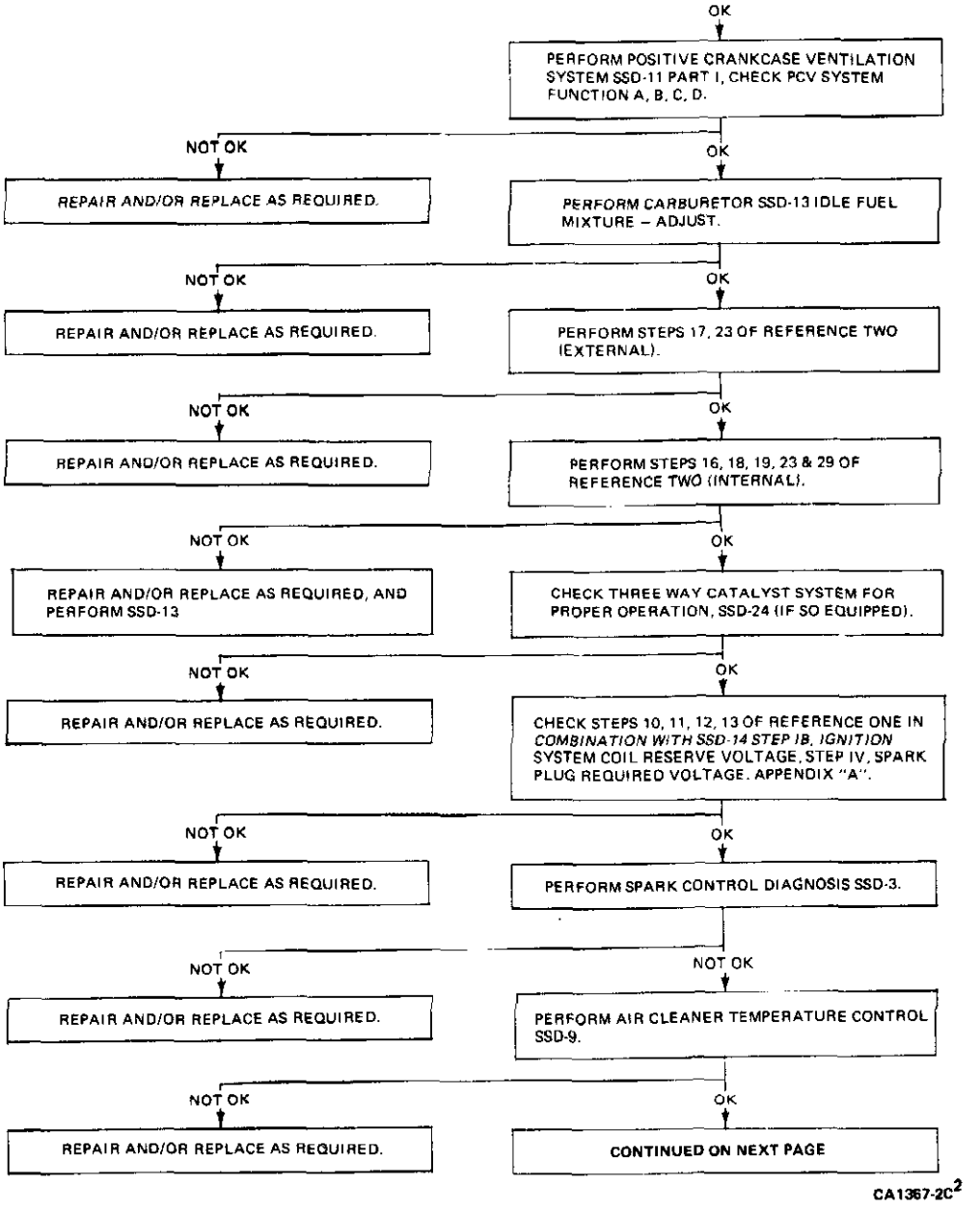


*NOT REQUIRED FOR VEHICLES EQUIPPED WITH EEC.

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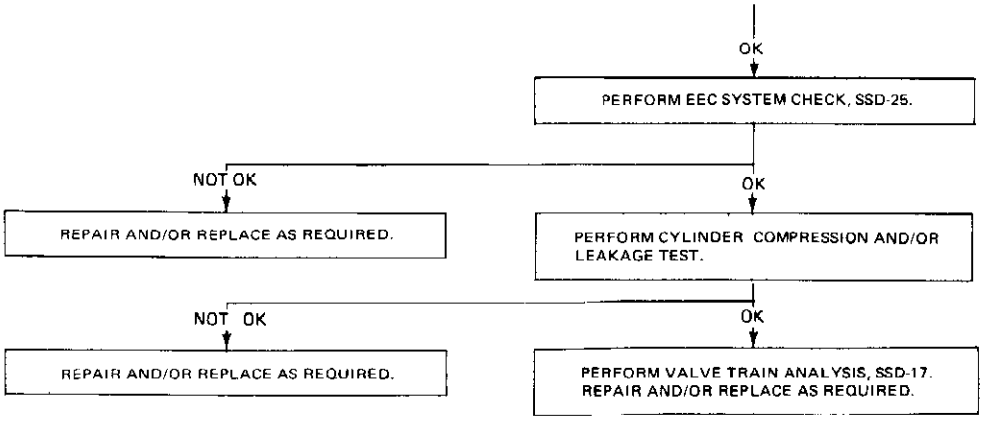
ROUTINE NO. 111
ENGINE STALLS AT IDLE – ENGINE COLD – CONTINUED



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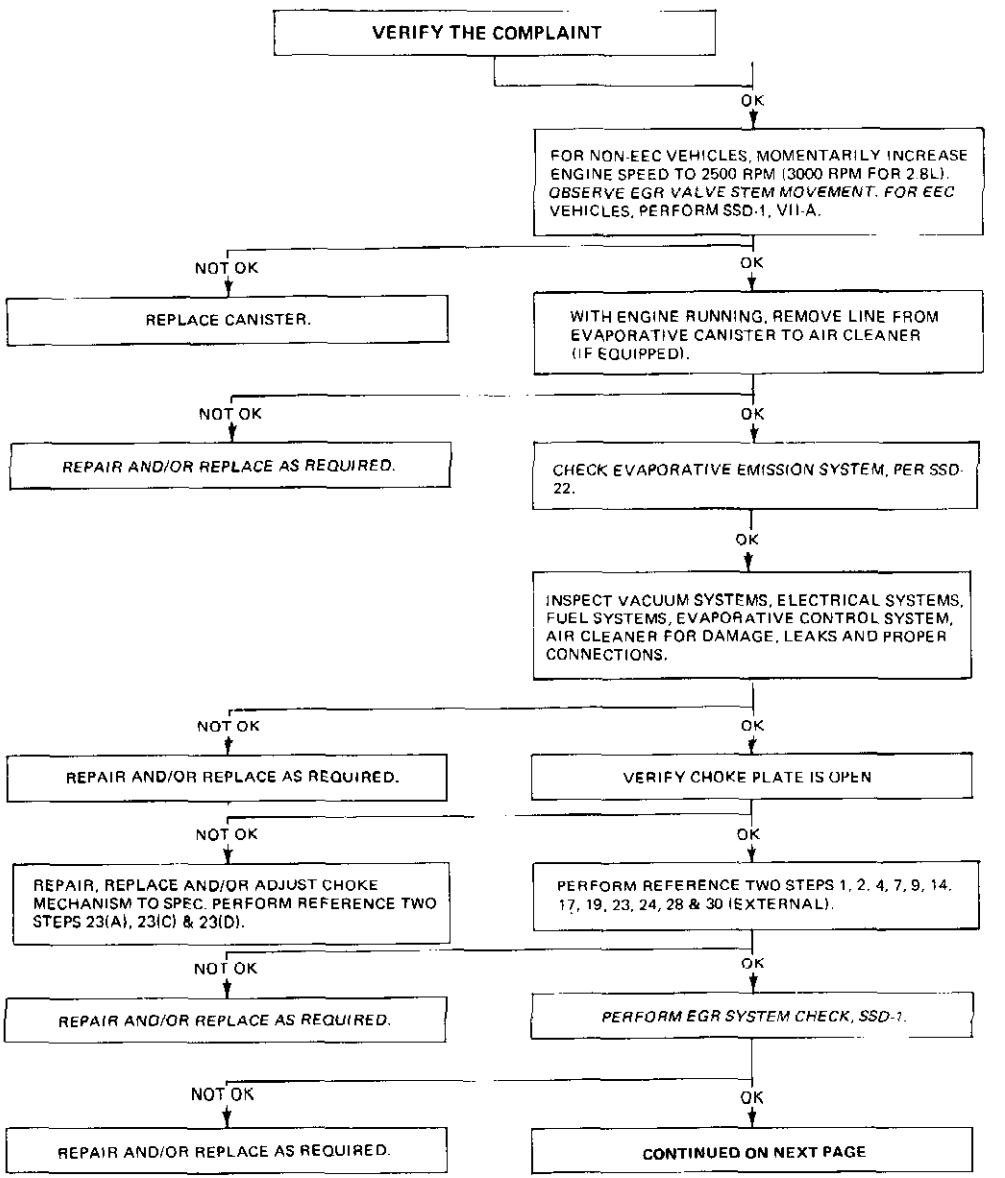
ROUTINE NO. 111
ENGINE STALLS AT IDLE – ENGINE COLD – CONTINUED



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ROUTINE NO. 112
ENGINE STALLS AT IDLE - ENGINE HOT

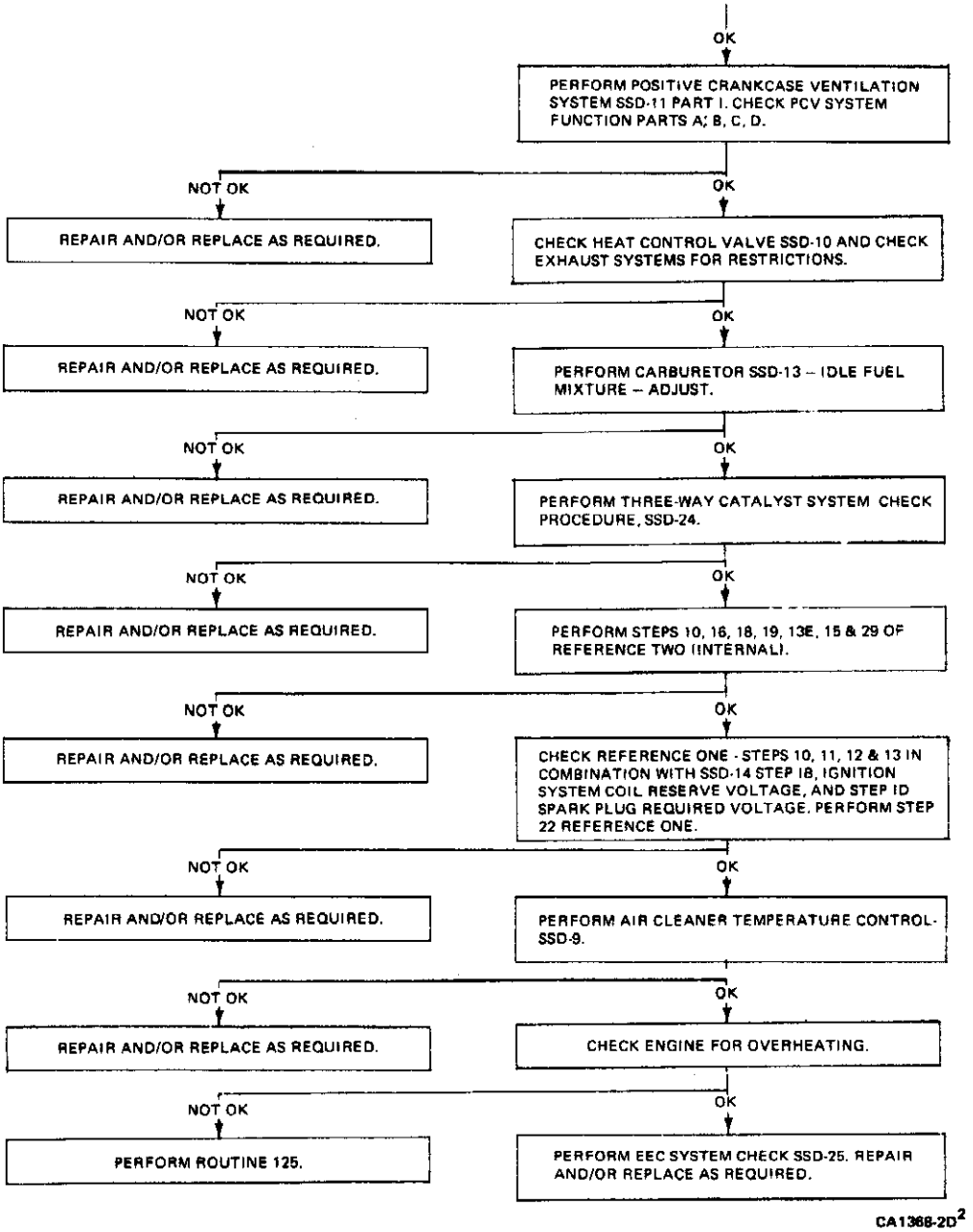


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ROUTINE NO. 112

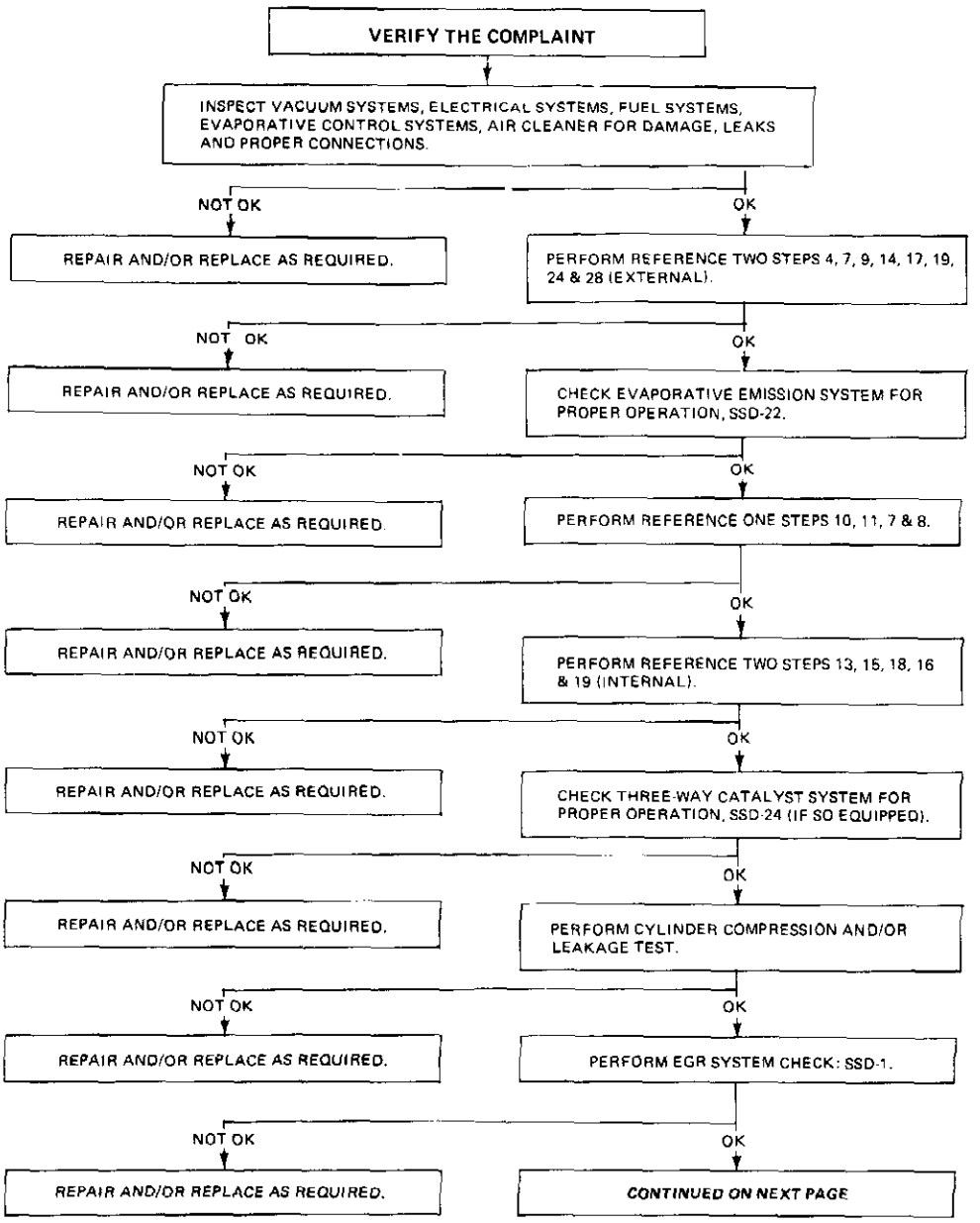
ENGINE STALLS AT IDLE – ENGINE HOT – CONTINUED



CA1368-2D[2]

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ROUTINE NO. 113
ENGINE STALLS DURING DECELERATION OR ON QUICK STOP



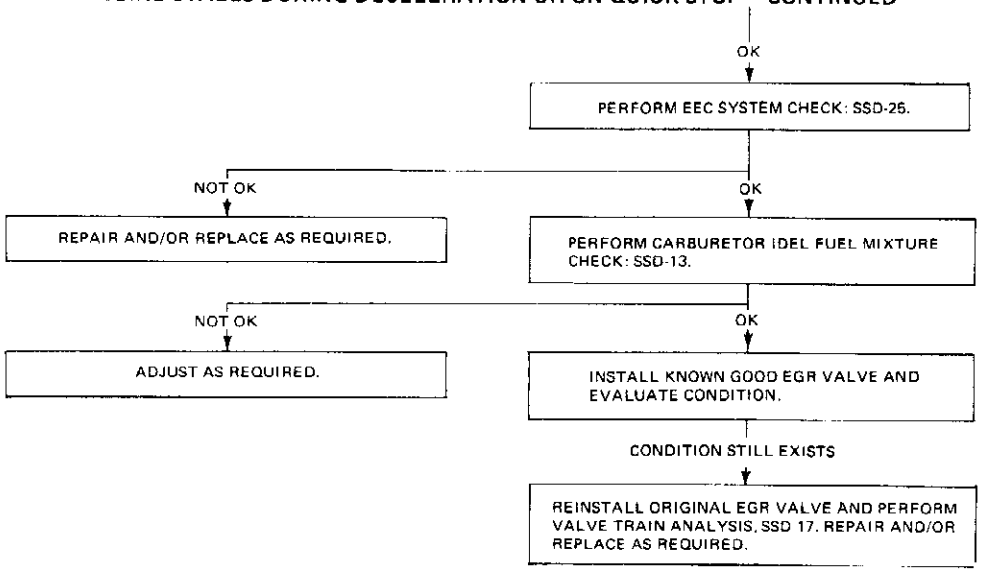
CA1369-2D

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ROUTINE NO. 113

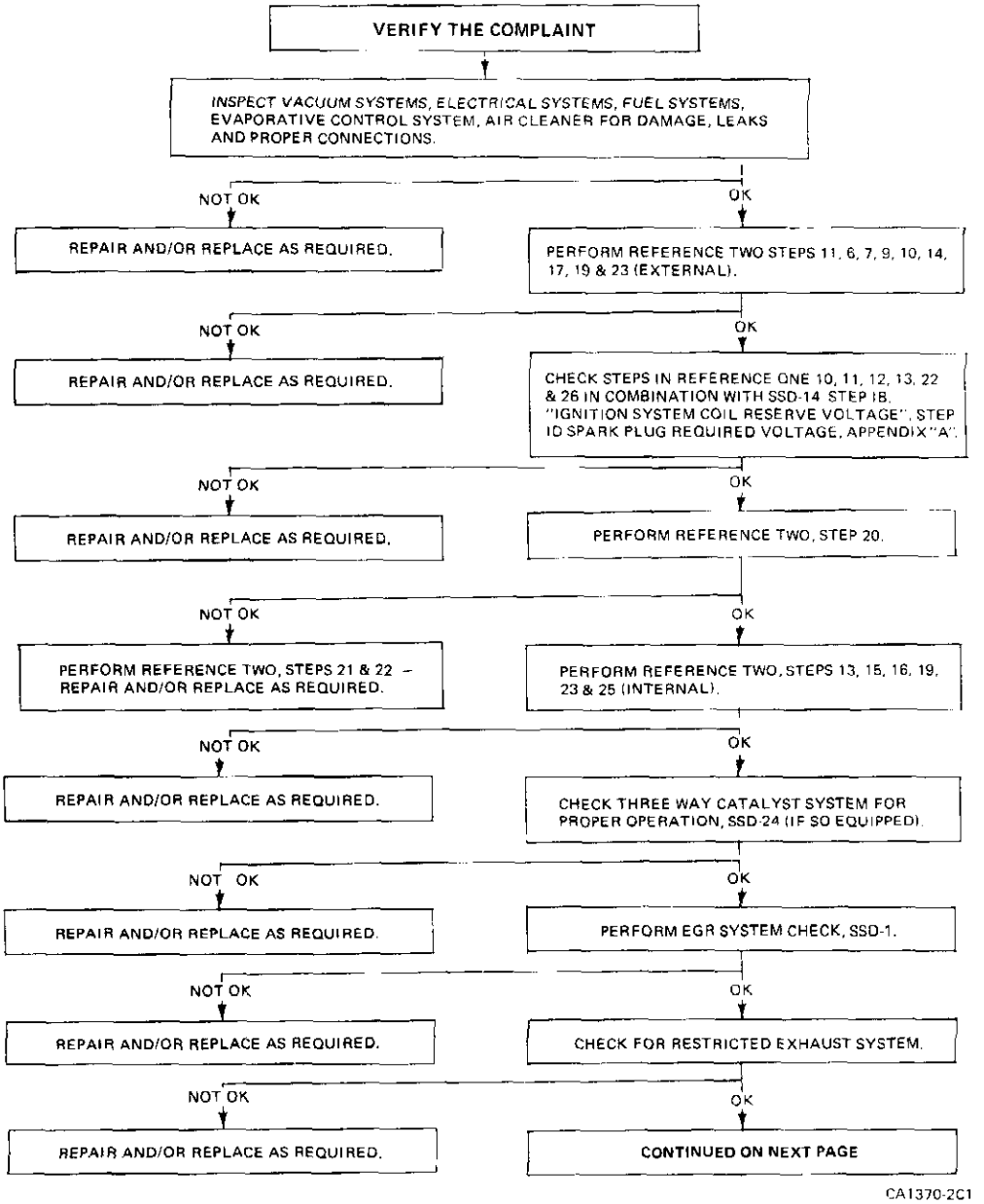
ENGINE STALLS DURING DECELERATION OR ON QUICK STOP – CONTINUED



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ROUTINE NO. 114
ENGINE HESITATES/STALLS DURING ACCELERATION

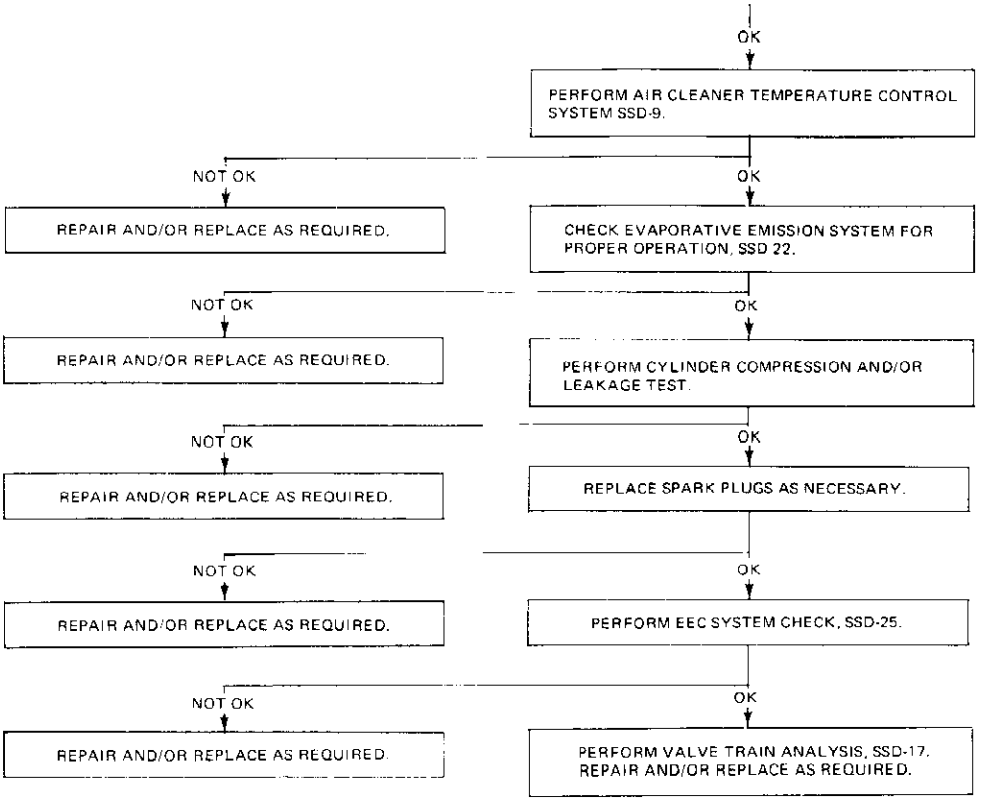


CA1370-2C1

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ROUTINE NO. 114

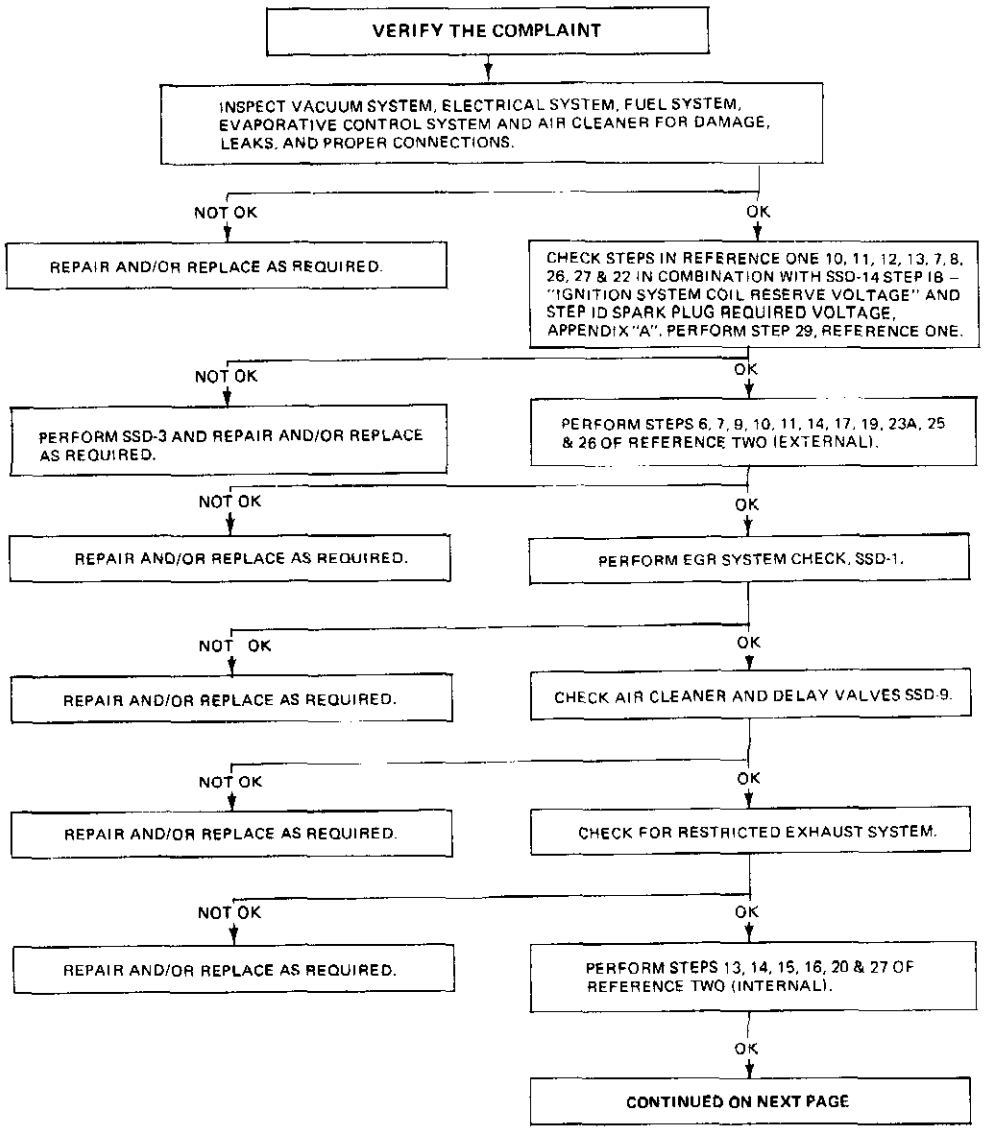
ENGINE HESITATES/STALLS DURING ACCELERATION – CONTINUED



CA1370-2C[2]

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ROUTINE NO. 115
ENGINE HAS POOR ACCELERATION



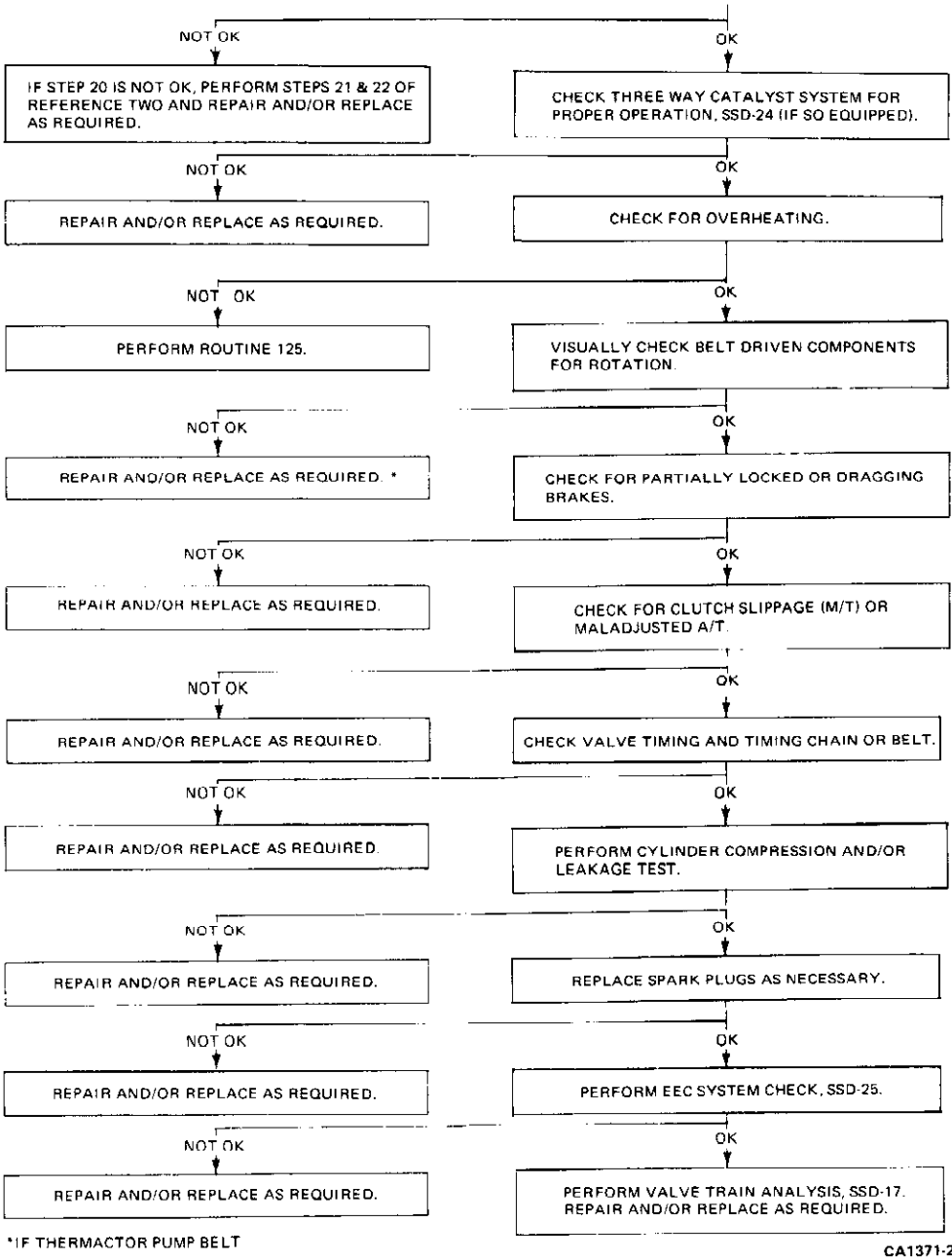
CA1371-2D[1]

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DETROIT IRON

ROUTINE NO. 115

ENGINE HAS POOR ACCELERATION – CONTINUED

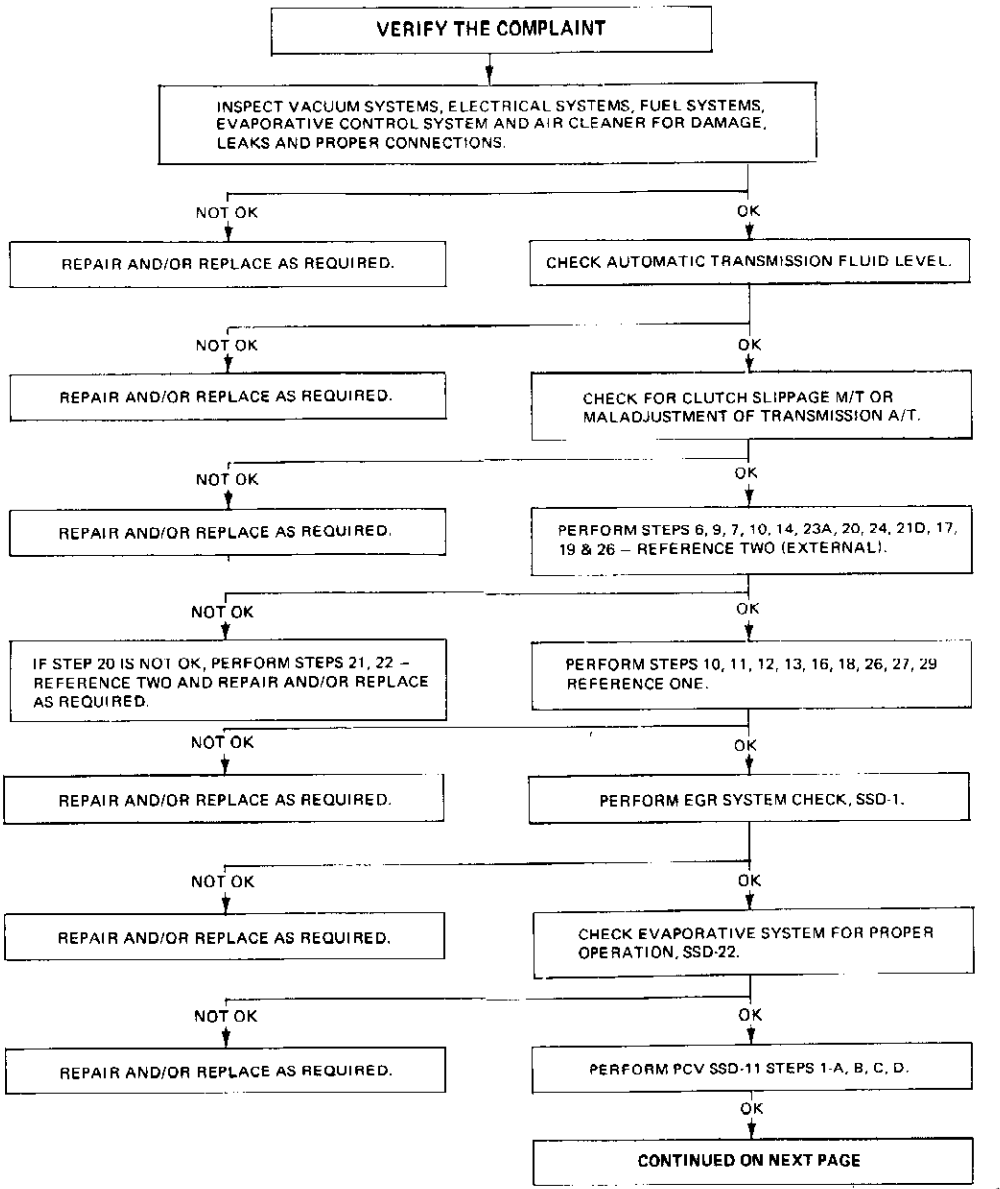


*IF THERMACTOR PUMP BELT

CA1371-2C[2]

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ROUTINE NO. 116
ENGINE HAS LESS THAN NORMAL POWER

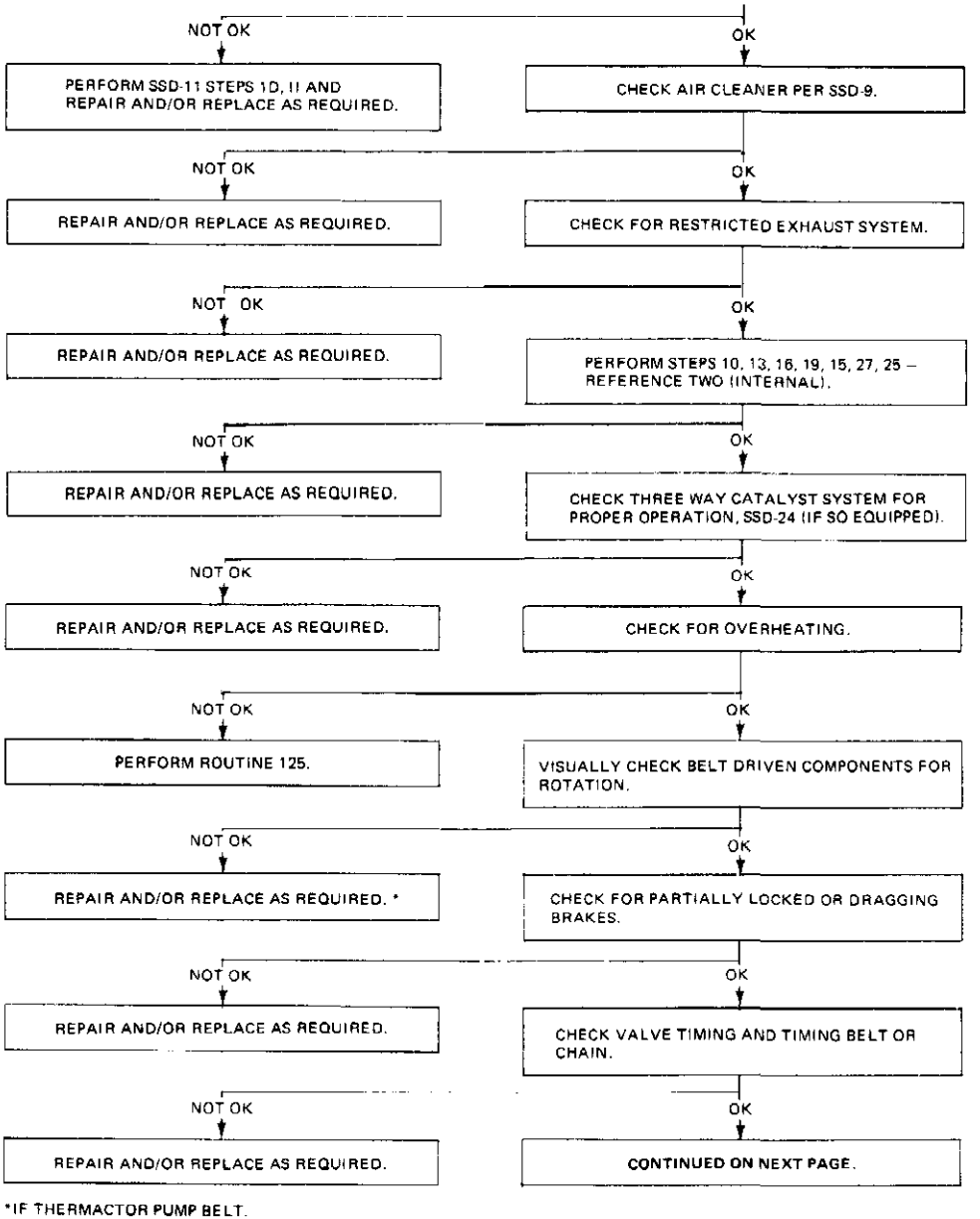


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ROUTINE NO. 116

ENGINE HAS LESS THAN NORMAL POWER – CONTINUED

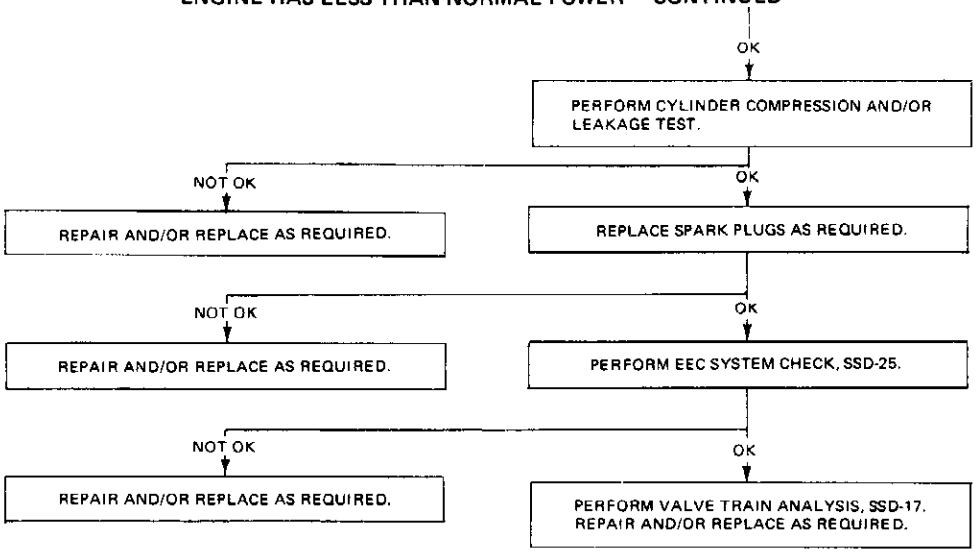


*IF THERMACTOR PUMP BELT.

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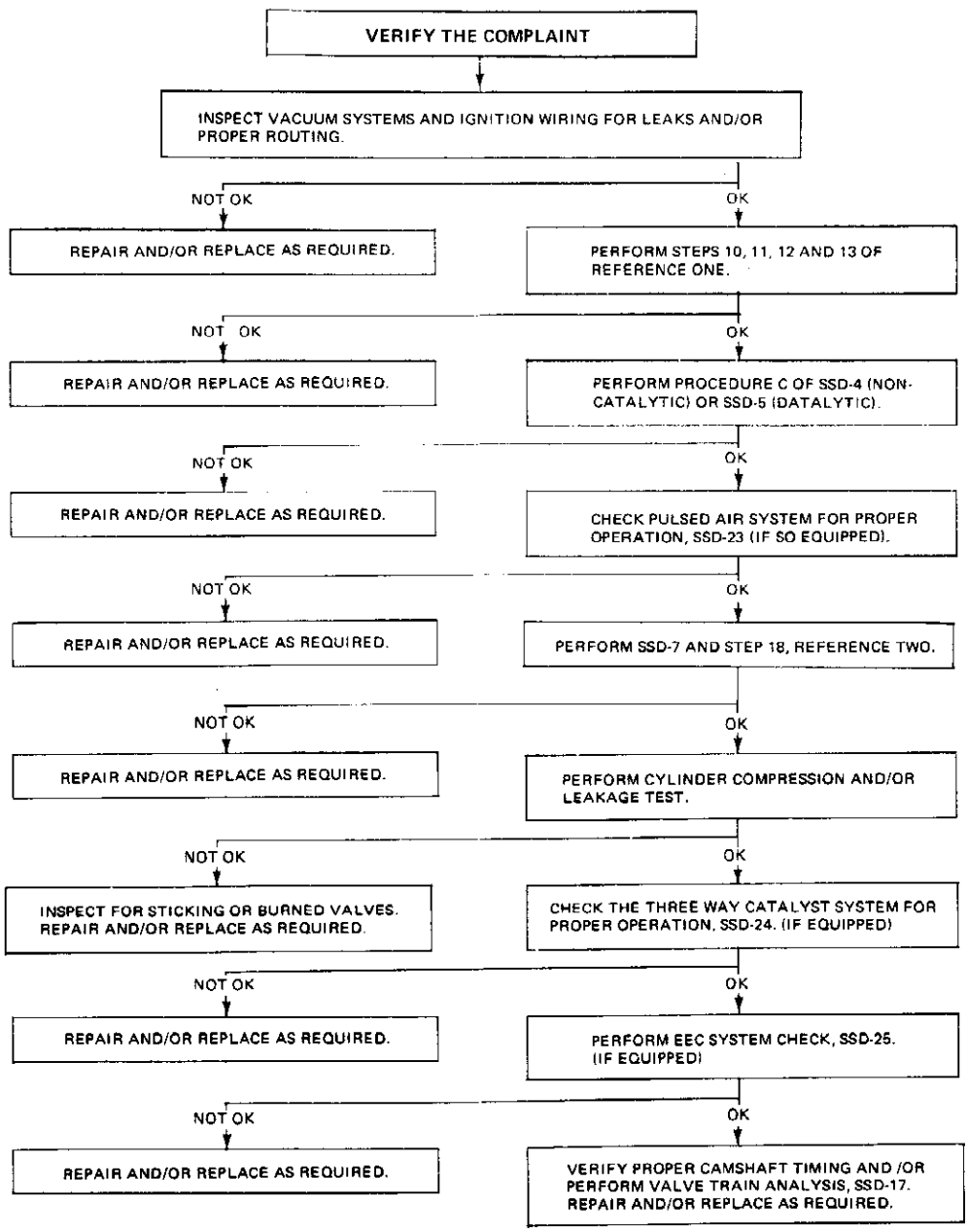
ROUTINE NO. 116
ENGINE HAS LESS THAN NORMAL POWER – CONTINUED



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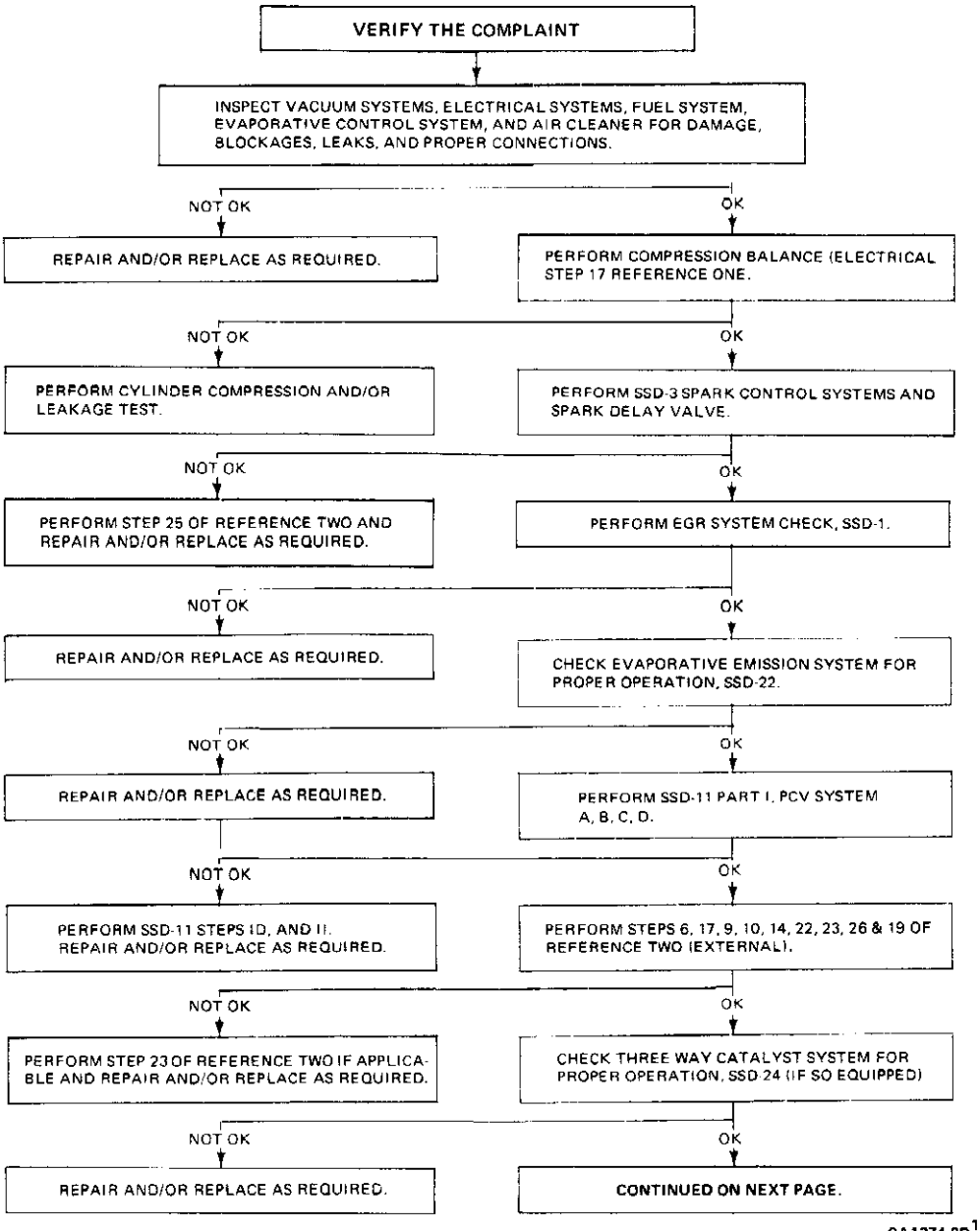
ROUTINE NO. 117
EXHAUST SYSTEM BACKFIRE



CA1373-2C

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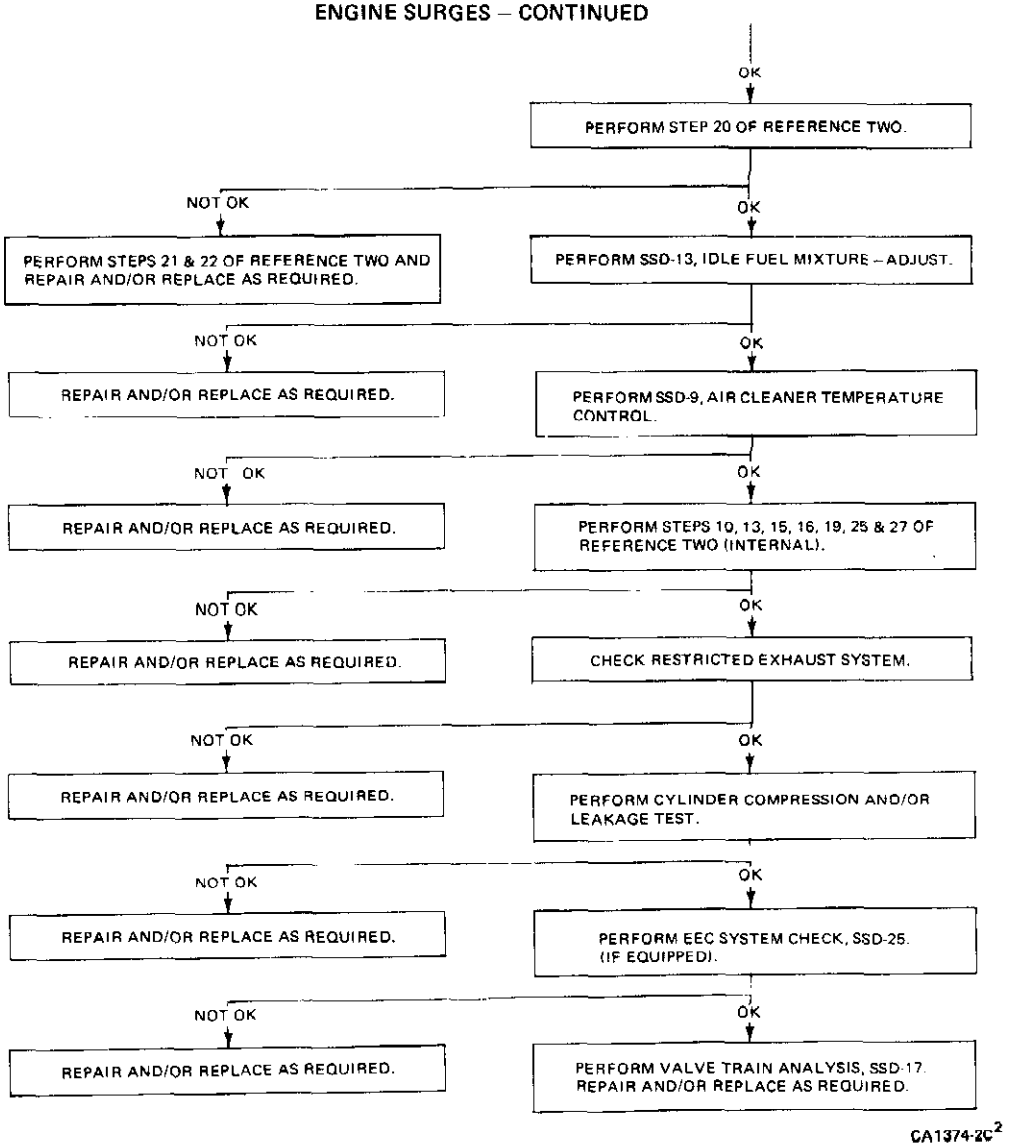
ROUTINE NO. 118
ENGINE SURGES



CA1374-2D[1]

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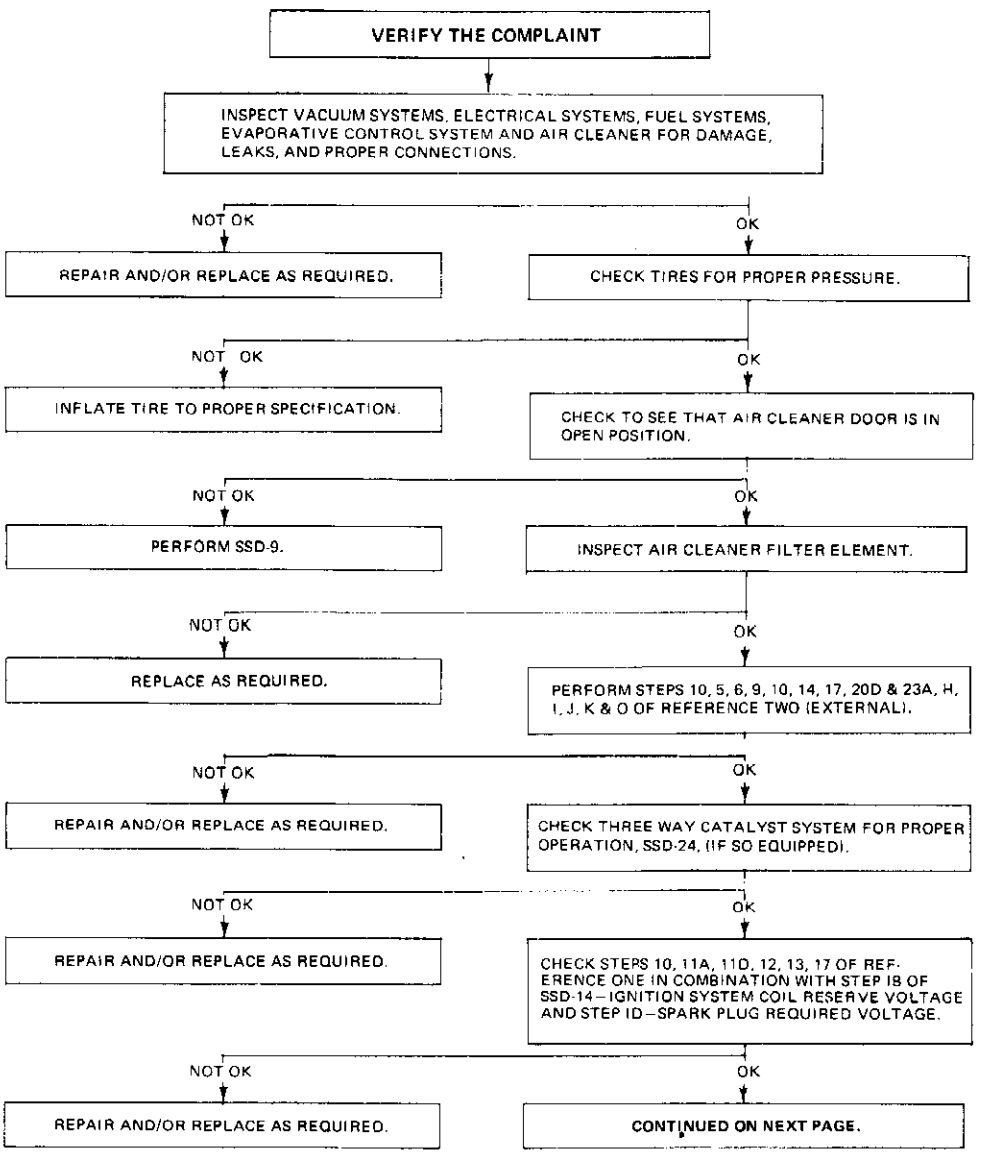
ROUTINE NO. 118
ENGINE SURGES – CONTINUED



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ROUTINE NO. 119
EXCESSIVE FUEL CONSUMPTION

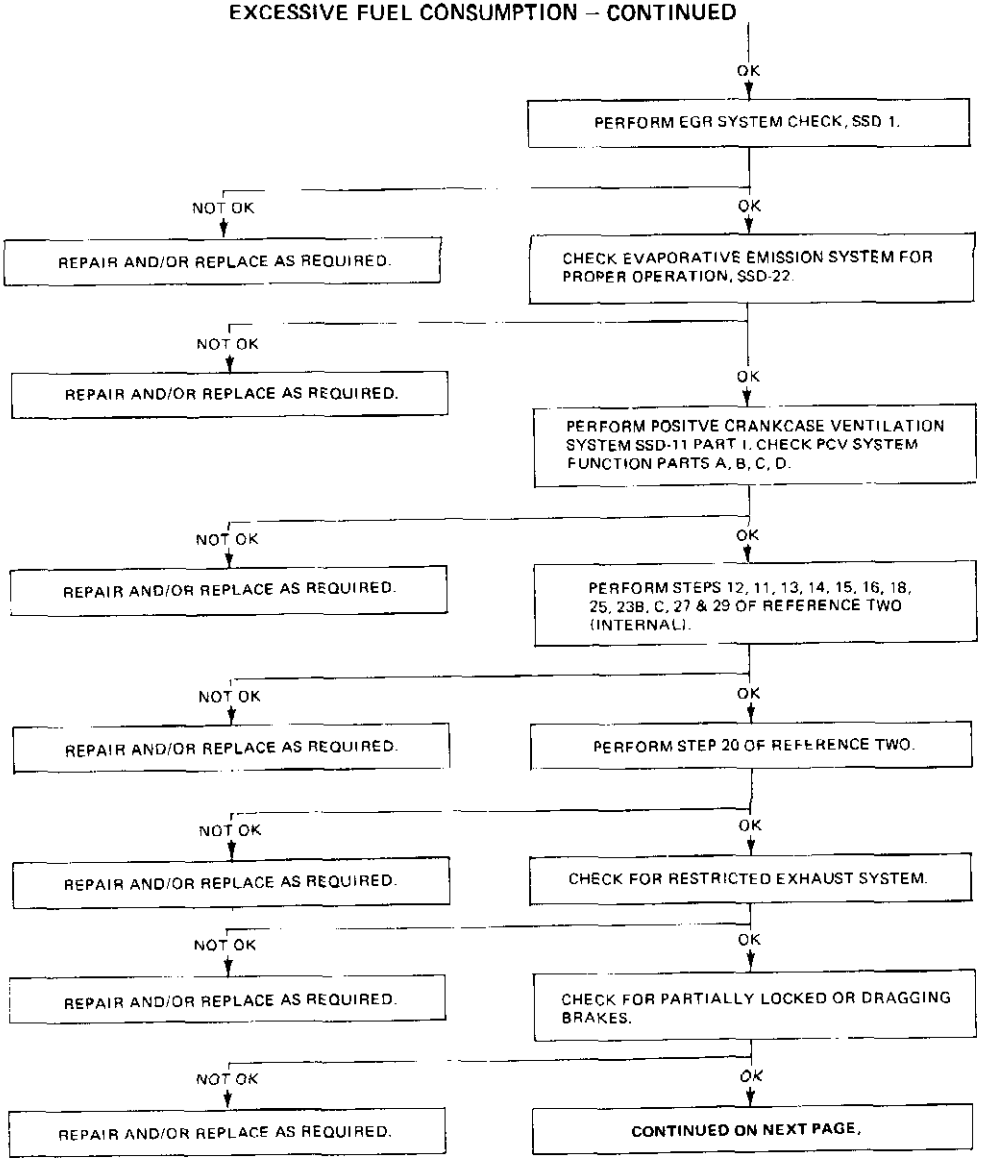


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DETROIT IRON

ROUTINE NO. 119
EXCESSIVE FUEL CONSUMPTION – CONTINUED

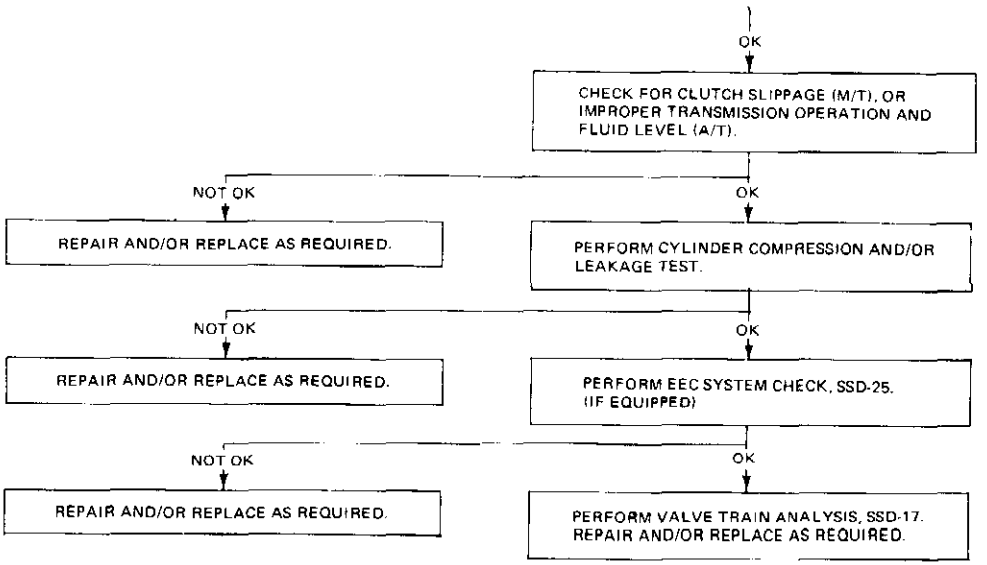


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ROUTINE NO. 119

EXCESSIVE FUEL CONSUMPTION – CONTINUED



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DETROIT IRON

ROUTINE NO. 120

EXCESSIVE OIL CONSUMPTION

VERIFY THE COMPLAINT

THE MOST COMMON CAUSE OF OIL LOSS IS LEAKAGE. TO VERIFY AN EXCESSIVE OIL CONSUMPTION COMPLAINT, IT IS NECESSARY THAT A THOROUGH INSPECTION BE MADE TO INSURE THAT LEAKAGE DOES NOT EXIST. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO RESOLVE AN EXCESSIVE OIL CONSUMPTION COMPLAINT:

A. STEAM CLEAN THE ENGINE (IF NECESSARY) TO REMOVE ACCUMULATED DIRT AND/OR OIL.

B. DRAIN ENGINE OIL AND CHANGE THE OIL FILTER.

C. FILL THE CRANKCASE WITH THE SPECIFIED AMOUNT OF THE RECOMMENDED GRADE OF OIL. (CHECK TO BE SURE THE CORRECT DIPSTICK HAS BEEN INSTALLED).

D. PERFORM POSITIVE CRANKCASE VENTILATION SYSTEM SSD-11 PART I A, B, C, D.

E. WITH THE VEHICLE ON A LEVEL SURFACE, PLACE A CLEAN PAPER UNDER THE ENGINE (TO AID IN DETECTING LEAKAGE) AND OPERATE THE ENGINE FOR APPROXIMATELY 20 MINUTES AT 1200 RPM WITH THE TRANSMISSION IN NEUTRAL.

F. SHUT OFF THE ENGINE AND CHECK FOR LEAKAGE AT:

1. VALVE ROCKER ARM COVER GASKETS.
2. OIL PAN GASKET.
3. CYLINDER BLOCK FRONT COVER GASKET
4. CYLINDER BLOCK TO FUEL PUMP GASKET AND FUEL PUMP AIR VENT.
5. INTAKE MANIFOLD SEALS.
6. CRANKSHAFT SEALS.
7. DISTRIBUTOR HOUSING O-RING.
8. OIL FILTER.
9. OIL PRESSURE SENDING UNIT.

G. WHEN ALL CAUSES OF LEAKAGE (IF ANY) HAVE BEEN REPAIRED, CHECK THE OIL LEVEL AND USE A FILE OR CENTER PUNCH TO MARK THE DIPSTICK AT THE INDICATED LEVEL.

H. RECORD THE ODOMETER READING. HAVE THE CUSTOMER OPERATE THE ENGINE FOR THE APPROXIMATE NUMBER OF MILES INDICATED BY THE COMPLAINT AND THEN RETURN IT FOR EXAMINATION.

I. WHEN CUSTOMER RETURNS THE VEHICLE, VERIFY THE ODOMETER READING, CHECK THE OIL LEVEL, AND RE-INSPECT THE ENGINE FOR SIGNS OF OIL LEAKAGE.

J. ADD A MEASURED AMOUNT OF OIL AS NECESSARY TO BRING THE OIL LEVEL TO THE PREVIOUSLY INSCRIBED MARK ON THE DIPSTICK.

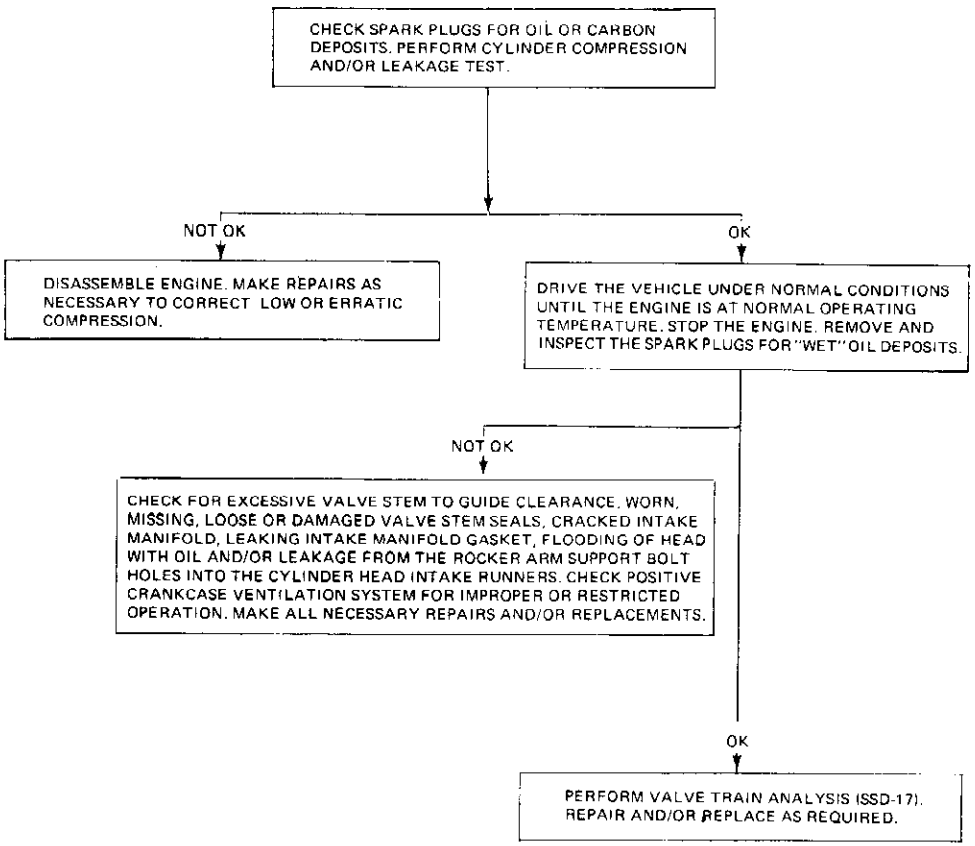
K. IF OIL CONSUMPTION IS NOT WITHIN SPECIFIED LIMITS, PROCEED WITH OIL CONSUMPTION DIAGNOSIS AS OUTLINED ON THE NEXT PAGE.

CONTINUED ON NEXT PAGE

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ROUTINE NO. 120
EXCESSIVE OIL CONSUMPTION – CONTINUED

NOTE: A NEW ENGINE MAY REQUIRE UP TO 6,000 MILES OF OPERATION IN ORDER TO PROPERLY SEAT (BREAK IN) THE PISTON RINGS. FOR THIS REASON, THE ENGINE SHOULD NOT BE CONDEMNED AS LONG AS OIL ECONOMY IS IMPROVING WITH MILEAGE ACCUMULATION. IF OIL ECONOMY CEASES TO IMPROVE WITH MILEAGE ACCUMULATION, CORRECTIVE ACTION SHOULD BE TAKEN.

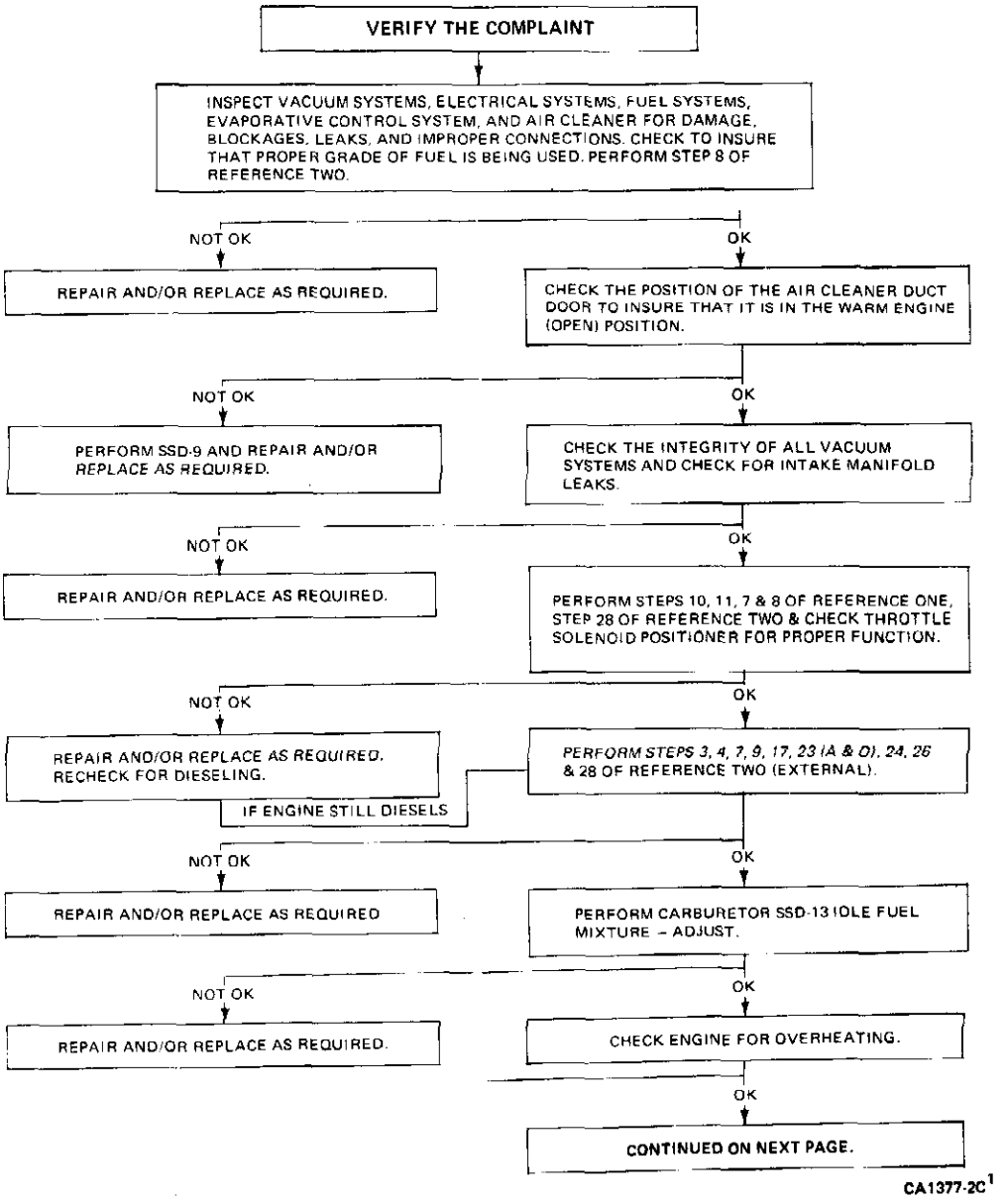


CA1376-2B[2]

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ROUTINE NO. 121

ENGINE DIESELS – CONTINUES TO RUN AFTER SHUT OFF

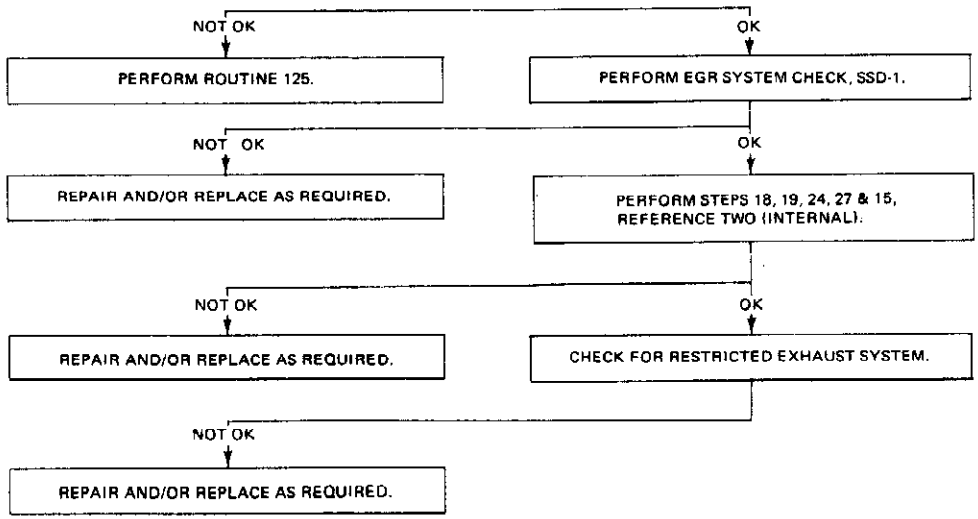


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ROUTINE NO. 121

ENGINE DIESELS – CONTINUES TO RUN AFTER SHUT OFF – CONTINUED



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DETROIT IRON

ROUTINE NO. 122

ENGINE NOISE

NOISY ENGINE OPERATION COVERS A WIDE RANGE OF COMPLAINTS; THEREFORE, TO MAKE THE MOST EFFICIENT USE OF DIAGNOSTIC AIDS TO RESOLVE THE COMPLAINT, AN ACCURATE VERIFICATION OF THE SYMPTOMS MUST BE MADE WHEN THE SYMPTOM IS IDENTIFIED AS TO THE TYPE AND GENERAL LOCATION OF THE NOISE, PROCEED TO THE APPLICABLE STEP OUTLINED BELOW. IT WILL BE SEEN THAT MANY OF THE STEPS ARE BASED ON SIMILAR SYMPTOMS AND, INDEED MAY BE A MATTER OF INDIVIDUAL INTERPRETATION. THEREFORE, IF THE MOST LIKELY STEP FAILS TO RESOLVE THE COMPLAINT, PROCEED TO THE NEXT LIKELY STEP, AND SO ON UNTIL THE COMPLAINT IS RESOLVED.

A. THERMACTOR SYSTEM NOISE: (VEHICLES SO EQUIPPED)

THE THERMACTOR SYSTEM IS NOT COMPLETELY NOISELESS. UNDER NORMAL CONDITIONS, NOISE RISES IN PITCH AS ENGINE SPEED INCREASES. TO DETERMINE IF EXCESSIVE NOISE IS THE FAULT OF THE AIR INJECTION SYSTEM, DISCONNECT THE DRIVE BELT AND OPERATE THE ENGINE. IF THE NOISE DISAPPEARS, REFER TO SSD-4 OR SSD-5.

B. PULSE AIR SYSTEM NOISE: (VEHICLES SO EQUIPPED)

1. IF NOISE IS ISOLATED TO THE AIR CLEANER, CHECK THE FILTER PACK(S) FOR CORRECT INSTALLATION. REINSTALL PROPERLY. IF STILL NOISY, REFER TO PULSE AIR SYSTEM TEST, SSD-23.

2. IF THE FILTER PACK(S) WAS DAMAGED, OR DIRTY, REPLACE AND CHECK THE PULSE AIR SYSTEM ACCORDING TO SSD-23.

C. LIGHT CLICKING VARIES WITH ENGINE SPEED

CHECK ACCESSORY COMPONENTS AS SOURCE OF NOISE BY LOOSENING AND/OR REMOVING DRIVE BELTS ONE AT A TIME UNTIL NOISE STOPS. ALSO INVESTIGATE FUEL PUMP AND/OR FUEL PUMP DRIVE AS THE POSSIBLE CAUSE. IF NOISE CONTINUES, IT COULD BE CAUSED BY IMPROPERLY ADJUSTED, FAILED, DAMAGED OR WORN VALVE TRAIN COMPONENTS. INSERT FEELER GAUGE BETWEEN ROCKER ARM AND VALVE STEM TIP AND/OR EXERT PRESSURE ON ROCKER ARM. IF NOISE IS ELIMINATED ADJUST VALVE TIP CLEARANCE TO SPECIFICATION (WHERE APPLICABLE). IF CONDITION PERSISTS, INSPECT FOR WORN, STUCK OR DAMAGED VALVE TRAIN COMPONENTS BY PERFORMING SSD-17. IF NO FAILURE IS DETECTED, CHECK FOR THE EFFECT OF EXCESSIVE VALVE STEM TO VALVE GUIDE CLEARANCE BY EXERTING SIDE PRESSURE ON VALVE STEM. IF DIAGNOSIS INDICATES THAT THE CLEARANCE RESULTS IN OBJECTIONABLE NOISE, AND THE SPECIFIED SERVICE CLEARANCE (MEASURED WITH A SERVICE TOOL) HAS BEEN EXCEEDED, THE GUIDE BORES SHOULD BE REAMED TO ACCEPT OVERSIZE VALVES AND/OR GUIDE BUSHINGS.

D. SHARP RAPPING – VARIES WITH ENGINE SPEED

USUALLY CAUSED BY MALFUNCTIONING HYDRAULIC TAPPET AND MAY BE LOCATED WITH THE AID OF A STETHOSCOPE. IF THE COMPLAINT ISN'T RESOLVED, PERFORM STEP C.

E. HISSING

INSPECT VACUUM SYSTEMS FOR LEAKAGE DUE TO LOOSE OR BROKEN CONNECTIONS AND/OR DAMAGED OR WORN PARTS. INSPECT MANIFOLDS FOR LEAKS. PERFORM CYLINDER COMPRESSION AND/OR LEAKAGE TESTS TO IDENTIFY AND ISOLATE CYLINDER HEAD GASKET LEAKS. INSPECT FOR CARBURETOR GASKET LEAKS.

NOTE: IF NOISE IS ISOLATED TO THE EGR SYSTEM, PERFORM SSD-1. IF NOISE IS ISOLATED TO THE EVAPORATIVE EMISSION SYSTEM, PERFORM SSD-22.

F. SHARP SNAPPING NOISE DURING ACCELERATION

PERFORM STEPS 21, 22 AND 23 OF REFERENCE ONE FOR HIGH TENSION CIRCUIT LEAKAGE.

G. SQUEAKS AND/OR SQUEALS

LOOSEN DRIVE BELTS ONE AT A TIME TO DETERMINE IF ACCESSORY COMPONENT OR WATER PUMP IS CAUSING NOISE.

H. HEAVY SQUEAL DURING ACCELERATION

CHECK FOR ACCESSORY DRIVE BELT SLIPPAGE AND ADJUST TENSION OR REPLACE AS REQUIRED.

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ROUTINE NO. 122
ENGINE NOISE – CONTINUED

I. RINGING, GRINDING OR COMBINATION OF BOTH

CHECK FOR LOOSE, BENT OR IMPROPER PULLEYS, CHECK FOR FRONT END BRACKET INTERFERENCE BETWEEN ROTATING PARTS AND SURROUNDING COMPONENTS CAUSED BY MISALIGNMENT OF ENGINE, ENGINE COMPONENTS, OR SURROUNDING COMPONENTS. CHECK FOR WORN OR DAMAGED WATER PUMP OR ACCESSORY COMPONENTS BY LOOSENING DRIVE BELTS ONE AT A TIME UNTIL NOISE STOPS.

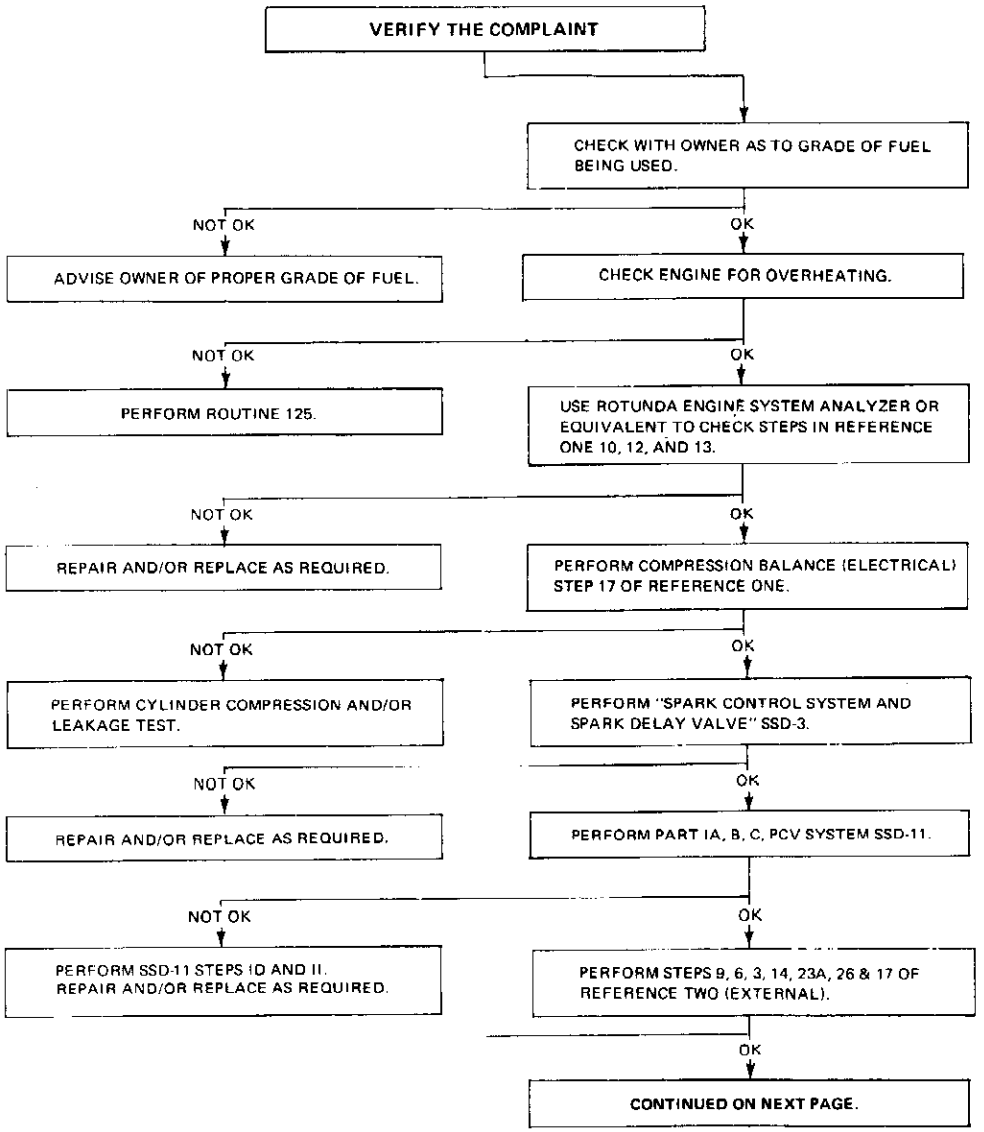
J. BUZZING OR WHISTLING DURING ENGINE OPERATION

PERFORM RADIATOR CAP FUNCTIONAL CHECK AND VERIFY PROPER CAP SEALING. IF ENGINE OVERHEATING IS INDICATED, PERFORM ROUTINE 125. CHECK FOR INTERFERENCE WITH THE FAN OR ENGINE ACCESSORY DRIVE COMPONENTS BY FOREIGN MATERIAL OR LOOSE, OR BROKEN SURROUNDING PARTS. CHECK FOR LOOSE CARBURETOR MOUNTING. CHECK FOR VACUUM LEAKS, CHECK POWER STEERING. CHECK SSD-1 EGR SYSTEM, PART V (BACK-PRESSURE EGR).

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DETROIT IRON

ROUTINE NO. 122A
SPARK KNOCK OR PINGING

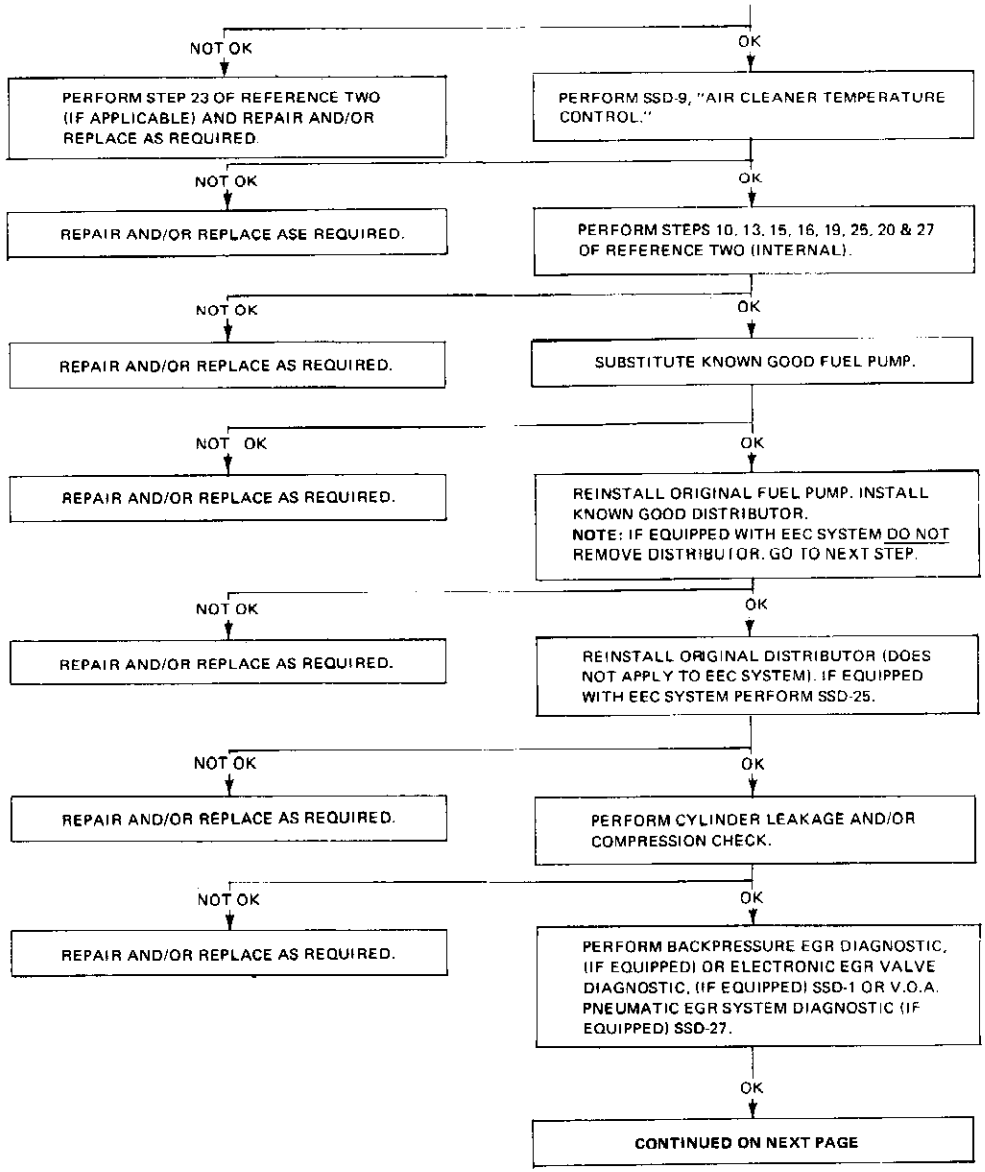


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ROUTINE NO. 122A

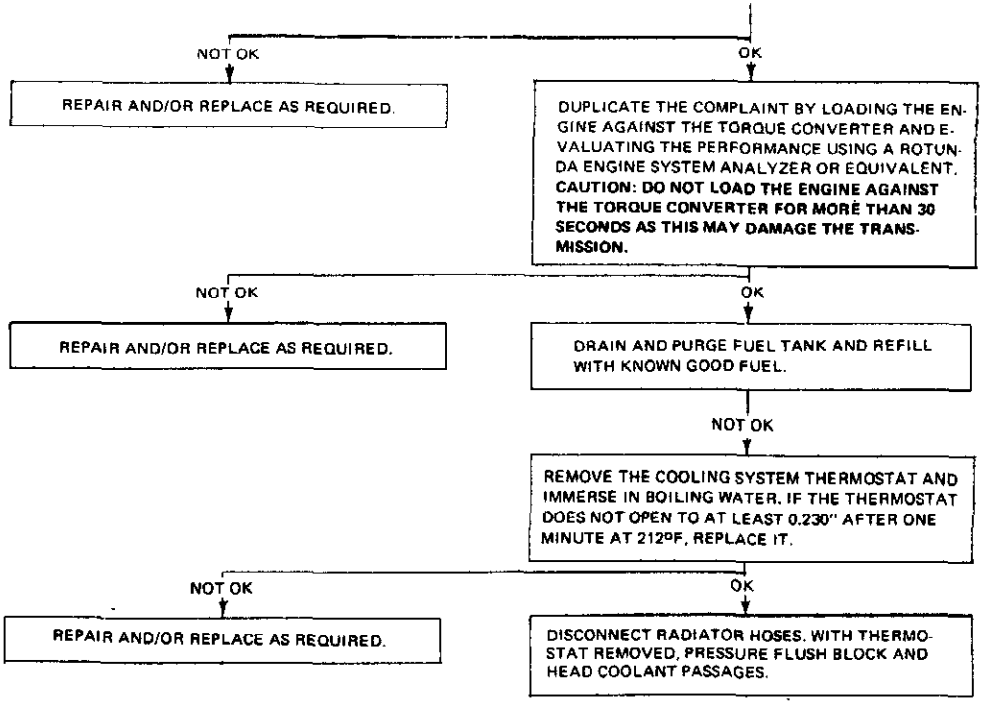
SPARK KNOCK OR PINGING – CONTINUED



CA1378-2D[3]

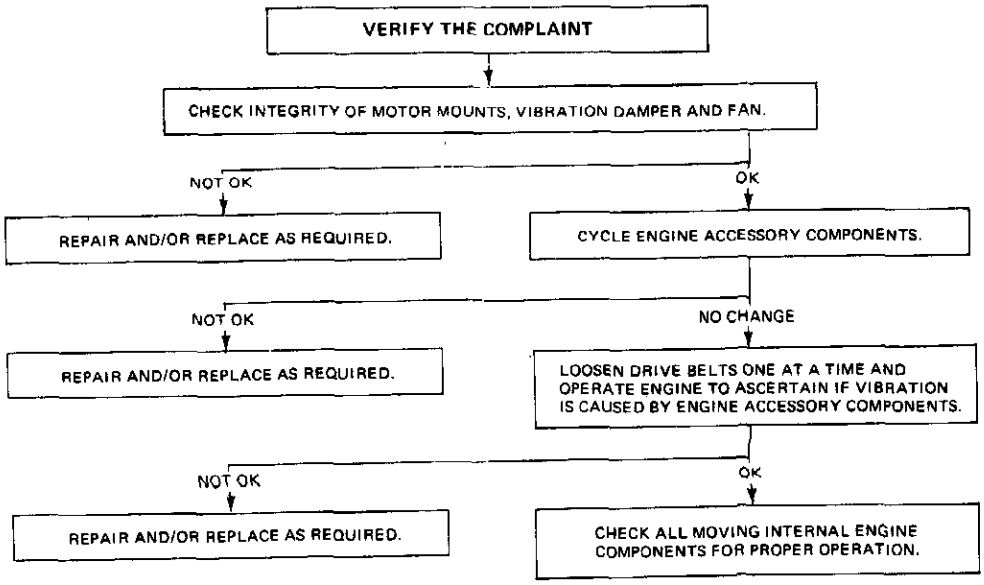
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ROUTINE NO. 122A
SPARK KNOCK OR PINGING – CONTINUED



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ROUTINE NO. 123
ENGINE VIBRATION

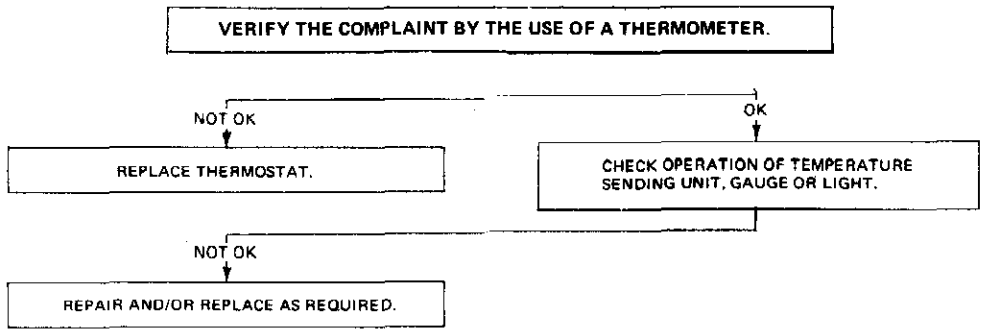


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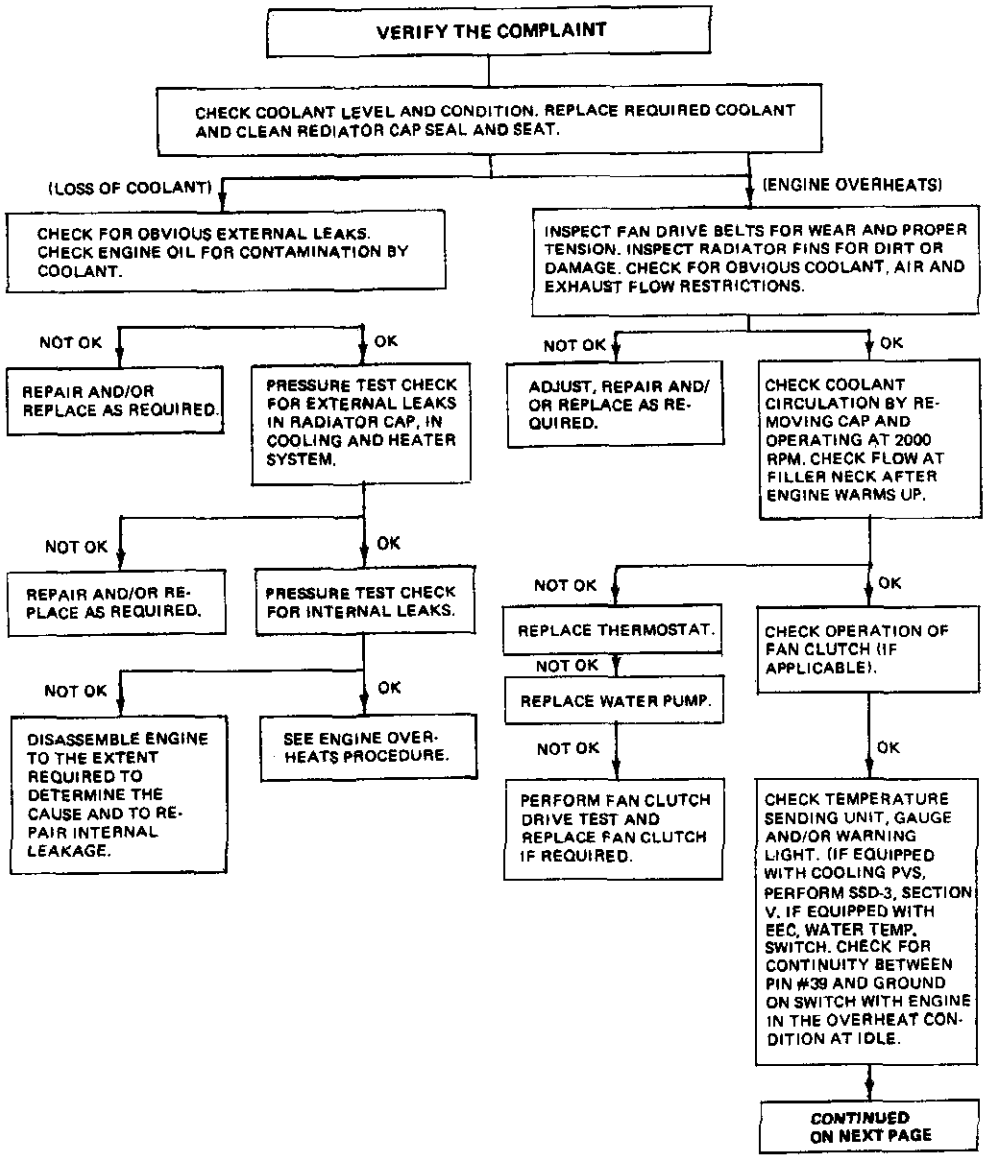
ROUTINE NO. 124
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE



CA1380-28

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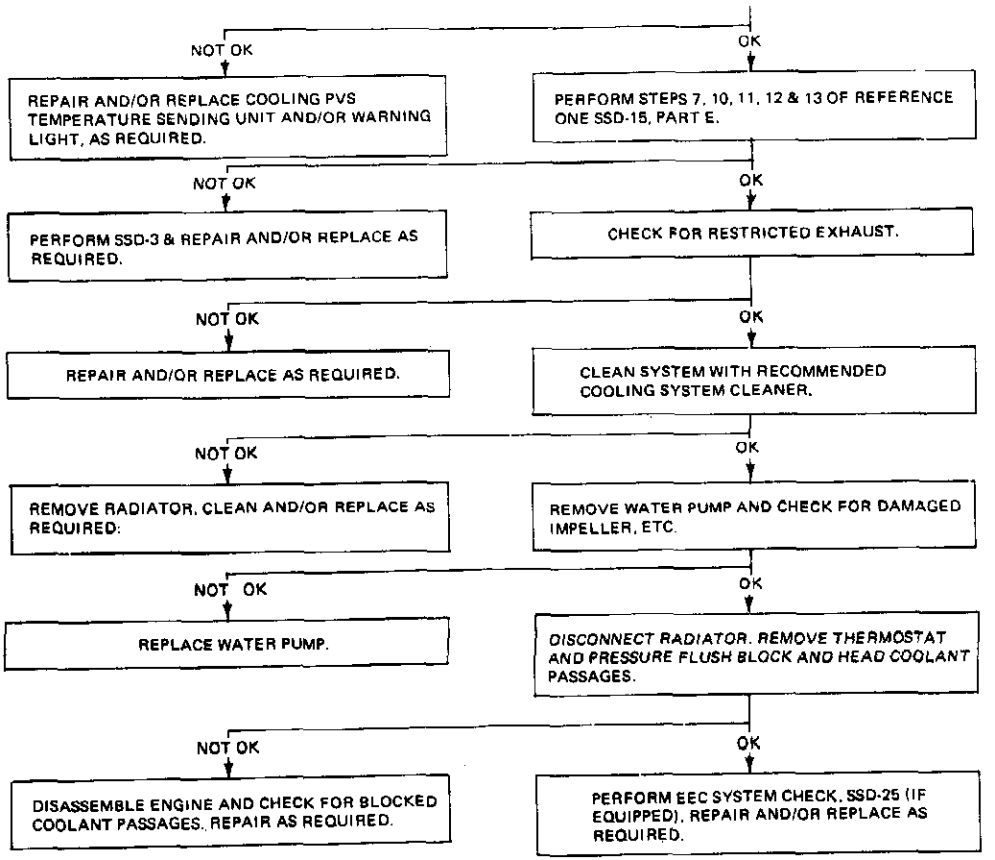
ROUTINE NO. 125
LOSS OF COOLANT OR ENGINE OVERHEATING



CA1381-2C1

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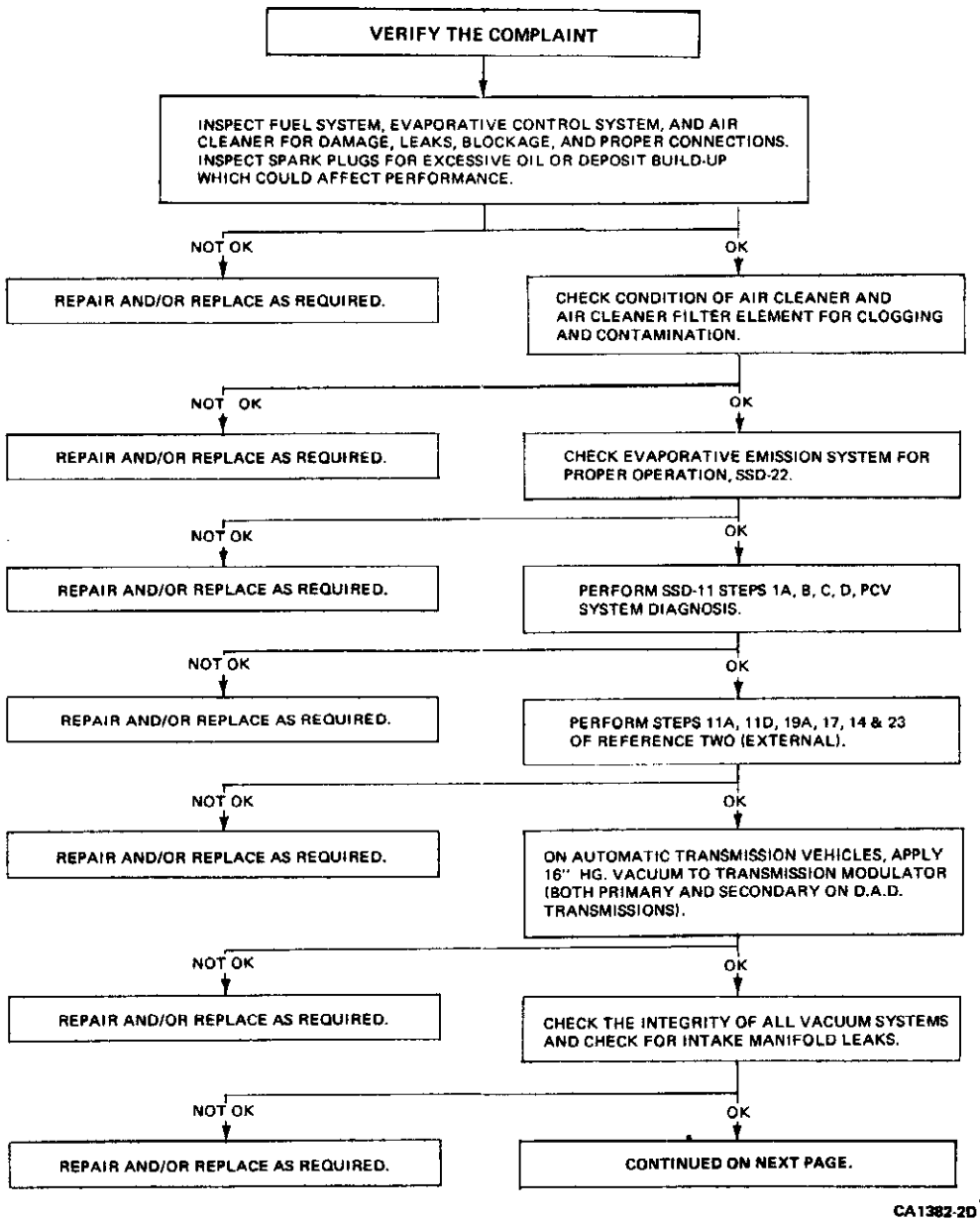
ROUTINE NO. 125
LOSS OF COOLANT OR ENGINE OVERHEATING – CONTINUED



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ROUTINE NO. 126
SMOKE FROM VEHICLE EXHAUST SYSTEM

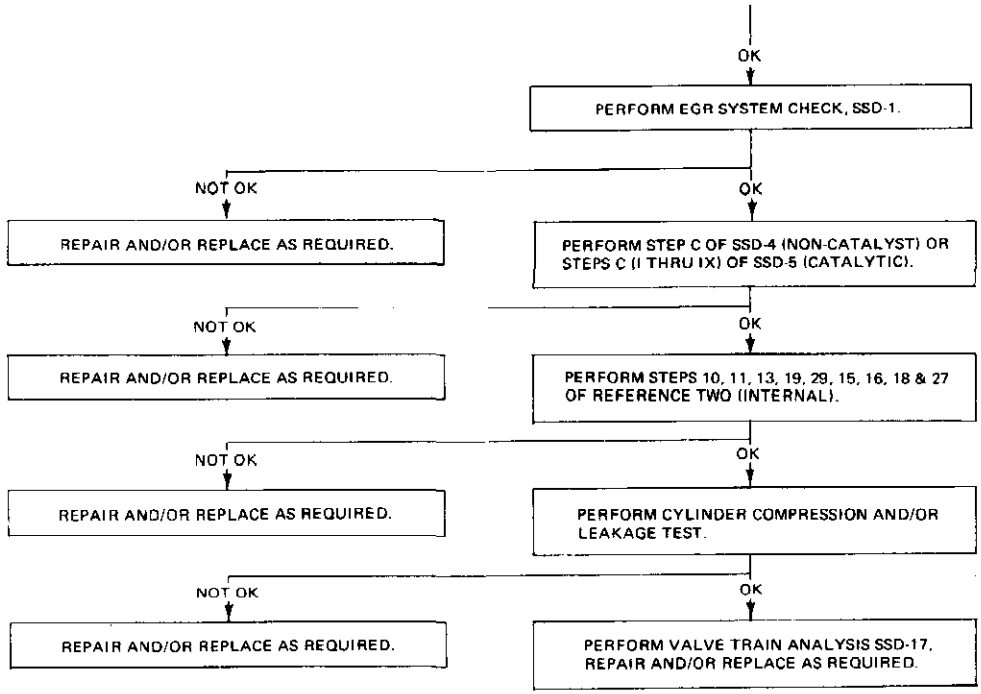


CA1382-2D[1]

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ROUTINE NO. 126

SMOKE FROM VEHICLE EXHAUST SYSTEM – CONTINUED



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ELECTRICAL SYSTEMS DIAGNOSIS
REFERENCE ONE

1. Check battery using Rotunda tester or equivalent.
2. Check starter draw.
3. Check battery voltage during cranking.
4. Check cranking speed.
5. Check basic timing while cranking.
6. Check spark plug firing voltage while cranking.
7. Check low idle speed with and without TSP (SSD-26). NOTE: When idle speed is adjusted, also perform Fuel Bowl Vent Procedure SSD-16 (Except Model 4350).
8. Check fast idle speed.
9. Check engine idle manifold vacuum.
10. Check basic timing – per SSD-15. (Except for EEC equipped vehicles)
11. Check retard timing – per SSD-15. (Except for EEC equipped vehicles)
12. Check mechanical advance – per SSD-15. (Except for EEC equipped vehicles)
13. Check total advance at 2500 RPM – per SSD-15. (Except for EEC equipped vehicles)
14. Check ignition coil primary voltage at 1000 RPM (measured at "Bat" terminal).
15. Check battery voltage – 1000 RPM.
16. Check spark plug firing voltage per SSD-14 (loaded or on quick acceleration).
*17. Check compression balance 1-8 cylinders (electrical – no EGR).
*18. Check ignition system coil reserve voltage – 1000 RPM, per SSD-14.
*19. Check distributor rotor high voltage gap drop, per SSD-14.
20. Check coil and spark plug wire resistance, per SSD-14.
21. Inspect coil and spark plug wires and connections.
22. Inspect condition of cap and rotor.
23. Check ignition coil condition and operation, per SSD-14.
24. Check primary wiring in ignition system, per SSD-14.
25. Check charging rate to battery with engine operating at approximately 1000 RPM.
26. Check spark delay valve for correct operation (SSD-2).
27. Use auxiliary vacuum source to check integrity of vacuum advance and retard diaphragm. (Except for EEC equipped vehicles)
28. Check distributor dwell at normal engine idle and at 2500 RPM.
29. Check function of vacuum switch.

* On catalyst equipped vehicles, do not perform Steps 17, 18 and 19 until vehicle passes Step 16.

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REFERENCE TWO

CARBURETOR AND FUEL SYSTEM DIAGNOSIS

TO DETERMINE THE CAUSE OF A FUEL SYSTEM COMPLAINT, USE THE APPROPRIATE COMBINATION OF THE FOLLOWING DIAGNOSIS STEPS AS OUTLINED IN THE PROBLEM DIAGNOSTIC PROCEDURES. ALL DISCREPANCIES SHOULD BE REPAIRED, ADJUSTED, CLEANED AND/OR REPLACED AS REQUIRED. IDLE MIXTURE SHOULD BE VERIFIED AND/OR ADJUSTED AFTER CARBURETOR INTERNAL REPAIRS.

1. **CHECK FUEL SUPPLY IN FUEL TANK**
   - A. CHECK FOR FUEL AVAILABILITY
   - B. CHECK FOR FUEL CONTAMINATION
   - C. CHECK FOR FUEL LEAKS IN TANK AND FUEL LINES
   - D. CHECK FOR DAMAGED PARTS IN TANK AND FUEL LINES

2. **CHECK FUEL DELIVERY TO CARBURETOR**
   - A. CHECK FOR FUEL DELIVERY TO FILTER PRIOR TO REMOVING FILTER FROM CARBURETOR.
   - B. CHECK FOR FUEL DELIVERY THROUGH FILTER(S) TO CARBURETOR (ON MODEL 1946 CARBURETORS, CARE MUST BE TAKEN TO KEEP INLET FITTING IN PLACE).
   - C. CHECK FOR FUEL PUMP LEAKS.
   - D. CHECK FOR DAMAGE, LEAKS, BLOCKAGES AND/OR PROPER CONNECTIONS.
   - E. CHECK FOR CONTAMINATION.
   - F. CHECK FOR DAMAGED PARTS.

3. **CHECK CARBURETOR VACUUM HOSES, FUEL LINES, AND PCV LINE (INCLUDING FEEDBACK VACUUM CONNECTIONS FOR THE MODEL 6500 CARBURETOR)**
   - A. CHECK FOR LEAKS
   - B. CHECK FOR DAMAGED PARTS
   - C. CHECK FOR PROPER ASSEMBLY
   - D. CHECK FOR CONTAMINATION

4. **CHECK ELECTRICAL CONNECTIONS**
   - A. CHECK FOR PROPER ASSEMBLY
   - B. CHECK FOR SHORTED CIRCUIT
   - C. CHECK FOR DAMAGED PARTS

5. **CHECK CHOKE HEAT SUPPLY SYSTEM**
   - A. CHECK FOR AIR LEAKS
   - B. CHECK FOR DAMAGED PARTS
   - C. CHECK FOR PROPER ASSEMBLY
   - D. CHECK FOR MISSING PARTS (EXTERNAL ONLY)

6. **CHECK AIR CLEANER**
   - A. CHECK FILTER ELEMENT(S) FOR CONTAMINATION
   - B. CHECK HEAT CONTROL VALVE FOR FUNCTION (SSD-9)
   - C. CHECK FOR DAMAGED PARTS
   - D. CHECK FOR PROPER ASSEMBLY

7. **CHECK THROTTLE LINKAGE AND THROTTLE PLATES**
   - A. CHECK FOR BINDING
   - B. CHECK FOR FULL TRAVEL
   - C. CHECK FOR PROPER ASSEMBLY
   - D. CHECK FOR CONTAMINATION
   - E. CHECK FOR DAMAGED PARTS

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8. **CHECK ENGINE SPEED ADJUSTMENTS**

NOTE: ALL ENGINE SPEED ADJUSTMENTS AND CHECKS SHOULD BE PERFORMED AFTER ENGINE HAS BEEN PROPERLY WARMED AND AFTER VACUUM, IGNITION, FUEL, AND/OR MECHANICAL COMPLAINTS HAVE BEEN PROPERLY RESOLVED – THEN FINAL ADJUSTMENTS SHOULD BE MADE ACCORDING TO SPECIFICATION.

A. CHECK CURB IDLE SPEED. ADJUST AS NECESSARY PER SSD-26.
B. CHECK LOW IDLE SPEED WITHOUT TSP. **NOTE:** WHEN IDLE SPEED IS ADJUSTED, ALSO PERFORM FUEL BOWL VENT PROCEDURE SSD-16 (EXCEPT MODEL 4350).
C. CHECK FAST IDLE SPEED. ADJUST AS NECESSARY PER SSD-26.

9. **CHECK SECONDARY THROTTLE LINKAGE AND CHOKE LOCKOUT LINKAGE**

A. CHECK FOR LINKAGE BINDING
B. CHECK FOR DAMAGED PARTS
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR CONTAMINATION

10. **CHECK AIR VALVE PLATE, METERING NEEDLES AND/OR JETS (MODEL 4350 ONLY)**

A. CHECK FOR BINDING
B. CHECK FOR DAMAGED PARTS
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR CONTAMINATION

11. **CHECK ACCELERATOR PUMP SYSTEM**

A. CHECK FOR FUEL DISCHARGE
B. CHECK FOR BINDING
C. CHECK FOR PROPER ADJUSTMENT (SSD-26, PAGE 3, STEP 8, FOR THE MODEL 2700)
D. CHECK FOR FUEL LEAK
E. CHECK FOR CONTAMINATION
F. CHECK FOR PROPER ASSEMBLY
G. CHECK FOR DAMAGED PARTS

12. **CHECK FOR FUEL IN FUEL BOWL**

A. USE FUEL GAUGE TO CHECK FOR FUEL IN BOWL (WHEN GAUGE IS AVAILABLE) (EXCEPT MODEL 2700)
B. CHECK FOR CONTAMINATION AND IF REQUIRED CLEAN CARBURETOR PER SSD-18
C. DISASSEMBLE AND CHECK ITEM #13, AS REQUIRED

13. **CHECK FUEL INLET SYSTEM COMPONENTS**

A. CHECK FOR CONTAMINATION AND, IF REQUIRED CLEAN CARBURETOR PER SSD-18.
B. CHECK FOR BINDING
C. CHECK FOR DAMAGE
D. CHECK FOR PROPER ASSEMBLY
E. CHECK FOR CORRECT FUEL LEVEL
F. CHECK FOR FLOAT ALIGNMENT
G. CHECK FLOAT FOR LEAKS
H. CHECK NEEDLE DROP LIMITER CLEARANCE (MODEL 4350 ONLY) PER SSD-18

14. **CHECK FUEL BOWL VENTS PER SSD-16**

A. CHECK FOR RESTRICTION IN CARBURETOR OR VENT LINE
B. CHECK FOR PROPER ADJUSTMENT
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR BINDING
E. CHECK FOR SEALING (INTERNAL VENT MODEL 2700 @ IDLE) (ALSO MODELS 1946, 2150, YFA AND 4350)

15. **CHECK FUEL METERING SYSTEM (IDLE AND MAIN)**

A. CHECK FOR CONTAMINATION
B. CHECK FOR FUEL LEAKS
C. CHECK FOR AIR LEAKS
D. CHECK FOR RESTRICTIONS
E. CHECK FOR PROPER ASSEMBLY
F. CHECK FOR DAMAGED PARTS
G. CHECK FOR PROPER IDLE FUEL MIXTURE (SSD-13)

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16. CHECK FUEL ENRICHMENT SYSTEM

A. CHECK FOR AIR LEAK
B. CHECK FOR FUEL LEAK
C. CHECK FOR RESTRICTIONS
D. CHECK FOR DAMAGED PARTS
E. CHECK FOR PROPER ASSEMBLY
F. CHECK FOR CONTAMINATION
G. CHECK FOR PROPER ALIGNMENT OF VENTURI VALVE LIMITER (MODEL 2700) – REMOVE UPPER BODY.
H. CHECK FOR PROPER ADJUSTMENT OF VENTURI VALVE LIMITER (MODEL 2700) – SEE PART 24 - 27 OF THIS MANUAL.

17. CHECK ALTITUDE COMPENSATOR

A. CHECK FOR BINDING
B. CHECK FOR AIR LEAK
C. CHECK FOR FUEL LEAK (MODELS 2150 AND 5200 ONLY)
D. CHECK FOR CONTAMINATION
E. CHECK FOR DAMAGED PARTS
F. CHECK FOR PROPER ASSEMBLY
G. CHECK FOR PROPER ADJUSTMENT (MODELS 4350 & 1946 CLOSED AT SEA LEVEL)

18. CHECK VENTURI VALVE SYSTEM (MODEL 2700)

A. CHECK FOR BINDING
B. CHECK FOR CONTAMINATION (SSD-18, APPENDIX "C")
C. CHECK FOR IMPROPER ASSEMBLY
D. CHECK FOR LEAKS (VACUUM) (SSD-19)
E. CHECK FOR DAMAGED PARTS
F. CHECK FOR VENTURI VALVE LIMITS AND ADJUST AS NECESSARY (SEE PART 24-27 OF THIS MANUAL).

19. CHECK FUEL PUMP FUEL DELIVERY

A. CHECK PRESSURE AND VOLUME WITH ORIGINAL FILTER
B. CHECK PRESSURE AND VOLUME WITH NEW FILTER
C. CHECK FOR CONTAMINATION
D. CHECK FOR FUEL LEAK

20. CHECK FUEL TANK

A. CHECK FOR LEAKS
B. CHECK FOR SOURCES WHERE DIRT OR WATER MAY ENTER
C. CHECK TANK FILTER AND PICK-UP FOR FUNCTION
D. CHECK GAS TANK CAP FOR PROPER FUNCTION

21. CHECK FUEL LINES FROM TANK TO PUMP

A. CHECK FOR CONTAMINATION
B. CHECK FOR KINKS OR DAMAGED PARTS
C. CHECK FOR LEAKS
D. CHECK FUEL RETURN LINE IF EQUIPPED

22. CHECK CHOKE SYSTEM (SSD-12)

A. CHECK PER SSD-12 LINKAGE SYSTEM
B. CHECK PER SSD-12 HEAT SYSTEM
C. CHECK PER SSD-12 ELECTRICAL SYSTEM (STEPS III AND IV FOR MODEL 2700)
D. CHECK FOR PULLDOWN (EXCEPT MODEL 2700)
E. CHECK FOR DECHOKE (VISUAL)
F. CHECK FOR CLEARANCE (EXCEPT MODEL 2700) ONLY IF A PROBLEM IS FOUND IN STEP D ABOVE
G. CHECK CHOKE PLATE ALIGNMENT
H. CHECK CHOKE CAP INDEX SETTING
I. CHECK FOR PROPER ASSEMBLY
J. CHECK FOR DAMAGED PARTS
K. CHECK FOR CONTAMINATION

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L. CHECK CHOKE METERING ROD INDEX (MODEL 2700 ONLY-PER CHOKE SET PROCEDURE, STEPS 1 - 5)
M. CHECK FAST IDLE CAM SETTING (MODEL 2700 ONLY-PER CAM SET PROCEDURE, STEPS 1 - 5)
N. CHECK HIGH CAM FINGER SETTING (MODEL 2700 ONLY-PER HIGH CAM FINGER SETTING PROCEDURE)
O. CHECK FOR CHOKE METERING ROD SEATING (MODEL 2700 ONLY-FULLY DEPRESS CHOKE METERING ROD AND CHECK FOR STICKING OR BINDING)

23. CHECK HOT IDLE COMPENSATOR

A. CHECK FOR DAMAGED PARTS
B. CHECK FOR AIR LEAK
C. CHECK PROPER TEMPERATURE CALIBRATION (EXCEPT MODEL 4350)
D. CHECK FOR CONTAMINATION
E. CHECK FOR PROPER ASSEMBLY
F. CHECK FOR RESTRICTION
G. CHECK TO MAKE SURE THE BI-METAL STRIP IS COOL AND THAT THE COMPENSATOR PLUG IS SEATED BEFORE ATTEMPTING TO MAKE CARBURETOR IDLE ADJUSTMENT (MODEL 4350 ONLY)

24. CHECK SPARK PORT, EGR PORT AND/OR ELA VENTURI PORT

A. CHECK FOR RESTRICTION
B. CHECK FOR CONTAMINATION
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR DAMAGED PARTS
E. CHECK FOR AIR LEAKAGE

25. CHECK EXTERNAL GASKETS AND GASKET SURFACES

A. CHECK FOR AIR LEAKS
B. CHECK FOR FUEL LEAKS
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR DAMAGED PARTS
E. CHECK FOR PROPER TYPE OF GASKET

26. CHECK INTERNAL GASKETS AND GASKET SURFACES

A. CHECK FOR AIR LEAKS
B. CHECK FOR FUEL LEAKS
C. CHECK FOR PROPER ASSEMBLY
D. CHECK FOR DAMAGED PARTS
E. CHECK FOR CONTAMINATION
F. CHECK FOR PROPER TYPE OF GASKET

27. CHECK DASHPOT AND BRACKET, SOLENOID OR SOLI-DASH

A. CHECK FOR PROPER ADJUSTMENT
B. CHECK FOR PROPER ASSEMBLY
C. CHECK FOR DAMAGED PARTS
D. CHECK FOR CONTAMINATION

28. CHECK CRANKING SYSTEM (MODEL 2700)

A. CHECK FOR FUEL LEAKS (SSD-19)
B. CHECK FOR DAMAGED PARTS
C. CHECK FOR ELECTRICAL CIRCUIT (SSD-12, PART IV, STEPS 3 AND 4)

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DIAGNOSIS PROCEDURES (SSD's)

NOTE: For specifications not contained in the following procedures, refer to Shop Manual Parts for the individual components or systems being diagnosed or serviced, or refer to the appropriate Service or Performance Specifications Book for the vehicle being serviced. In addition, always consult the latest bulletins and other service information for changes in procedures and/or latest specifications.

EMISSION CONTROL SYSTEM DIAGNOSIS AND SERVICE PROCEDURES

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SSD-1—EGR SYSTEM DIAGNOSIS

NOTE: The EGR delay valve diagnosis is described in SSD-2. For vehicles equipped with V.O.A. Pneumatic EGR-4.1L (250 CID) and 5.0L (302 CID) California engines—perform SSD-27.

I. Check of EGR Valve When on the Engine. (Remote Type EGR Valve)

NOTE: If the engine is equipped with an Integral Type Backpressure EGR Valve perform Step VI. If the engine is equipped with an Electronic-EGR Valve perform Step VII.

A. Start the engine and warm it up until engine coolant temperature is above the calibrated temperature of the EGR PVS valve as indicated below according to the color code of the PVS valve:

Color Code	Temperature (°F)
Pink Top or Natural Top	Above 90°
Black Top	Above 100°
Plain Silver or Blue Top	Above 133°
Yellow Top or Gray Top	Above 155°

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B. Check all vacuum hoses in the system to be sure they are open and not broken, split or cracked and fit snugly onto the connectors. Remove the EGR vacuum supply hose from the EGR valve, plug and hook a vacuum hose from the EGR valve to an external, gauged, variable vacuum source with increments of one in. Hg., 0.10 in. Hg. graduations and a minimum capacity of 10 in. Hg.

C. Gradually apply vacuum to the EGR valve and simultaneously observe the movement of the EGR valve stem.

1. With the engine at idle, the stem should visually be observed to start to move within ±1.0 Hg of the diaphragm signal vacuum as noted for the low flow point noted on the EGR valve flow chart per the "start to open" specifications (to observe movement, mark stem).

2. If valve does not meet "start to open" specification, replace.

3. With the engine off, apply 8 in. Hg vacuum to the EGR valve and trap. Vacuum should remain within 1 in. Hg for a minimum of 30 seconds. Replace the EGR valve if out of specification.

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4. With the engine at idle, apply vacuum to the EGR valve of at least 8 in. Hg. The valve should move to the full extent of its travel and engine should roughen, RPM should decrease and/or stop completely. If idle quality doesn't change there is no EGR flow and if the specifications of Step 3 have been met something is plugging the EGR system. Perform cleaning procedure to determine problem.
5. With the hose routings properly connected, restart the engine and stabilize temperatures. If the engine idle quality is not acceptable, the EGR valve may not be sealing properly. If this condition is encountered, install a new EGR valve and a new gasket. Adjust engine idle to specified curb idle. Recheck the idle condition of the engine. If there is no improvement in the idle quality, the problem is elsewhere. The original EGR valve should be re-installed and further engine diagnosis should be performed to determine the offending component. If there is improvement in idle quality, retain the new EGR valve on the engine.

II. To Check the Carburetor EGR Port, Perform the Following Steps:

A. Attach a vacuum gauge directly to the EGR port on the carburetor using a suitable hose.
B. With the engine running, open the carburetor throttle quickly and momentarily to at least the 1/2 wide open position. (Note: avoid overspeeding).
C. Observe the vacuum gauge for a quick rise and fall as the throttle is opened and closed. (Absolute vacuum value is not a criteria). If a vacuum is evident, the EGR port is open and OK. If no vacuum is evident, the EGR port in the carburetor is plugged or restricted and should be cleaned.

III. EGR TVS-PVS Functional Check

Verify that the EGR valve, external vacuum passages, and/or solenoid valve (if equipped) are functional.

A. Perform TVS functional check, SSD-9, Steps 13-a, b and c. (If so equipped.)
B. **PVS with Two Connectors**
   1. Disconnect both vacuum hoses at the PVS valve. Connect vacuum gauge to either connector on the PVS. Connect manifold vacuum or auxiliary vacuum source of at least 10 in. Hg to other connector.
   2. Start engine and warm it up until engine coolant temperature is above the calibration temperature of the EGR PVS as previously indicated.
      a. If no reading is noted on vacuum gauge—PVS has failed and should be replaced.
      b. If vacuum is noted—PVS is OK.
C. **PVS with Three Connectors**
   1. Disconnect EGR vacuum hose at carburetor and connect manifold vacuum or auxiliary vacuum source to hose.
   2. Disconnect EGR vacuum hose at EGR valve and connect a vacuum gauge to the hose.
   3. Start engine and warm it up until engine coolant temperature is above the calibration temperature of the EGR PVS as previously indicated.
      a. If no reading is noted on vacuum gauge—PVS has failed and should be replaced.
      b. If vacuum is noted—PVS is OK.
D. **PVS with Four Connectors**
   1. Disconnect vacuum hoses at the PVS valve. Connect a vacuum gauge to either of the two ports marked "D" and "M". Connect a vacuum supply to the other.
   2. Start engine and warm it up until engine coolant temperature is above the calibration temperature of the EGR PVS as previously indicated.
      a. If there is no vacuum reading—that portion of the PVS is OK.
      b. If vacuum is noted—the PVS should be replaced.
   3. Connect the gauge to either one of the bottom two port marked "E" and "S" and the vacuum supply to the other.
      a. If vacuum is noted—the PVS is OK.
      b. If there is no vacuum reading—the PVS should be replaced.
E. Do not go to Step IV if, at this point, the EGR system is functioning properly.

IV. Poppet and Internal Tapered Stem EGR Valve

NOTE: Sequence of maintenance can be varied to suit individual engine characteristics. Coordinate with Part V, Step F where applicable.

Procedure for cleaning and conditions for replacing EGR valve:

A. **EGR Valve Removal**
   1. Remove the EGR valve for cleaning.
      CAUTION: Do not strike or pry on the valve diaphragm housing or supports, as this may damage the valve operating mechanism and/or change the valve calibration.
   2. Check orifice hole in the EGR valve body for deposits. A small hand drill may be used to clean the hole if plugged. **Extreme care** must be taken to avoid enlarging the hole, or damaging the surface.
B. **If the valve is "Not Approved" to be taken apart for cleaning:**
   1. Prior to cleaning, if the orifice plate is less than a .450 in dia. hole, it must be removed. Caution must be used in removing the orifice to prevent deforming—use a hook type tool for removal.
   2. To clean the valve seat and poppet, first apply 15 in Hg vacuum to retract the diaphragm.
   3. **Preferred cleaning method**
      a. Where facilities for blast cleaning metal parts are available, the following procedure should be followed.
      b. Apply masking tape to diaphragm for protection.

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c. Direct the blaster stream against the valve poppet until the poppet appears free of deposits. Remove debris with shop air.
CAUTION: Do not direct blaster stream against the valve diaphragm.

d. Clean orifice plate and counterbore in valve body. Reinstall orifice by using a small amount of contact cement to retain plate in place while assembling the valve to the carburetor spacer.
CAUTION: Apply cement only to outer edges of orifice plate to avoid restriction to orifice.

4. **Alternate cleaning method**

a. The passages and cavities of the valve body can be cleaned by scraping or utilizing a short length of speedometer cable driven by a drill motor. Insert cable up into valve cavity and with slight force move cable back and forth while drill motor is in motion.

b. To clean the valve seat and poppet, insert cable between poppet and seat. Turn on drill motor and allow cable to move around the valve seat area in a circular motion. Care should be used to avoid removal of metal and damaging valve seat or poppet.

c. Remove all debris with shop air.

d. Clean orifice plate and counterbore in valve body. Reinstall orifice by using a small amount of contact cement to retain plate in place while assembling the valve to the carburetor spacer.
CAUTION: Apply cement only to outer edges of orifice plate to avoid restriction to orifice.

C. **If the valve is approved to be taken apart for cleaning:**

1. Separate the diaphragm section from the main mounting body.
2. Clean the valve plate, stem, and the mounting plate using a small power driven rotary type wire brush taking care not to damage the parts.
3. Remove deposits between stem and valve disc by using a steel blade or steel shim (0.28 thick) in a sawing motion around the stem shoulder at both sides of the disc. The poppet must be free to wobble and move axially before re-assembly.
4. Clean the cavity and passages in the main body section with a small power driven rotary type wire brush taking care not to damage the valve seat.
5. Remove all loosened debris using shop air.
6. Re-assemble the diaphragm section on the main body using a new gasket between them. Torque the attaching screws 23-33 in-lbs.
7. Clean orifice plate and the counterbore in valve body. Re-install orifice by using a small amount of contact cement to retain plate in place while assembling the valve to carburetor spacer.
CAUTION: Apply cement only to outer edges of orifice plate to avoid restriction to orifice.

D. **EGR Supply tube and spacers**

1. Remove the carburetor and carburetor spacer except on engines where the valve is not mounted on the spacer.
2. Clean supply tube with a small power driven rotary type wire brush or blast cleaning equipment.
3. Clean the exhaust gas passages/cavities in the spacer using a suitable wire brush and/or scraper. The machined holes in the spacer can be cleaned by using a suitable round wire brush. Hard encrusted material should be probed loose first, then brushed out.

E. **Exhaust Gas Channels**

1. Clean the exhaust gas channel, where applicable, in the intake manifold using a suitable carbon scraper. Clean the exhaust gas entry port in the intake manifold by hand passing a suitable drill bit thru the holes to auger out the deposits. Do not use a wire brush.
CAUTION: The manifold riser bore(s) should be suitably plugged during the above action to prevent any of the residue from entering the induction system.
2. The 3.3L (200 CID) and 4.1L (250 CID) valve is mounted on the side of the cylinder head below the carburetor pad. After removal of the EGR valve, inspect the passages with a small light. If deposits are present in the exhaust passage (left hand side) remove with a wire brush or a suitable drill bit. The re-entry passage (right hand side) may be cleaned with a suitable drill bit hand operated. Remove all foreign particles prior to reassembly.
CAUTION: Do not allow pieces to get into right hand side. An electric drill should not be used to remove deposits.

F. **EGR floor entry intake manifold maintenance**

1. Remove carburetor and EGR valve.
2. Use scraper, dull drill, or other suitable means to clean EGR passages both at the EGR valve and below carburetor in the floor.
CAUTION: The manifold riser bore(s) should be suitably plugged during the above action to prevent any of the residue entering the induction system. Remove all foreign particles prior to reassembly.
3. Do not use wire bursh.

G. **Check of EGR valve function when off the engine**

1. After cleaning valve hook a vacuum hose from EGR valve to an externally gauged variable vacuum source with minimum 10 in. Hg capacity. Start at low vacuum (less than 2 in. Hg) and vary vacuum steadily up to 10 in. The valve stem must move smoothly without apparent sticking, binding, or chattering action. The valve should not be noisy or exhibit excessive vibration due to the above operation. If erratic motion or vibration as described above is detected—replace valve. Valve stem may cease to move above 7 in. Hg of applied vacuum—this is not cause for replacement.

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Remove vacuum and using a felt tip pencil, mark stem position closest to the valve main body. Re-install valve and related components on engine using new gaskets.

V. Backpressure EGR Diagnostic Procedure (Remote EGR Valve and Transducer)

A. Remove air cleaner assembly from carburetor to observe the EGR valve. Place air cleaner assembly in such a position so that vacuum hoses are **not** disconnected from the air cleaner TVS switch.

B.1. **EGR Backpressure System Integrity**
Check EGR system vacuum hose routing for proper connection—refer to vacuum hose routings in emission calibrations—correct as required.

B.2. **Check Integrity of Backpressure Transducer to Sensor Tube Joint**
The brazed joint between the EGR transducer and the steel exhaust pressure sensing tube should be rigid. If this brazed joint has separated (as indicated by relative movement of the pressure sensing tube within the flared opening on the transducer body), replace the EGR backpressure transducer.

C. **Backpressure Transducer Leak Check** (NOTE: Transducer and sensor tube must not be hot for this step. If transducer assembly is hot to the touch, use shop air or freon to cool.)

C.1. Disconnect vacuum source to EGR backpressure transducer diaphragm and plug with golf tee or other suitable plug.

C.2. Start the engine—immediately place the throttle on high cam (1500-2000 rpm). Using leak check or leak detector fluid, coat the sensor tube joint at the transducer.

C.3. Check for evidence of exhaust gas leakage (bubbles from detector fluid) at the sensor tube joint. If bubbles are evident, replace the EGR backpressure transducer.

C.4. If Step 3 was satisfactory, firmly grasp the transducer and attempt to wiggle the transducer in several directions (do not use excessive force, to avoid bending the tube or bracket). Add more leak check or detector fluid if necessary. If bubbles appear at the sensor tube-to-transducer joint or along the sensor tube, replace the EGR backpressure transducer.

D. **EGR System Function Check**

D.1. Reconnect the vacuum source to the EGR backpressure transducer diaphragm.

D.2. Warm up engine to normal operating temperature.

D.3. **With Transmission in Neutral**

a. While slowly opening and closing the throttle, the EGR valve stem must move upward, appear to oscillate, and move downward to the closed position when the engine returns to idle.
CAUTION: Do not exceed 1/2 throttle or 2500 rpm.
If engine performance seems rough, proceed to check EGR system with engine under load.
If the valve stem moves or operates properly and the engine shows very little roughness and variation in speed during this test sequence—the EGR system is functioning properly. Discontinue diagnostic procedure.

b. If the EGR valve does not appear to operate properly; i.e., valve appears to move near full stroke (approx. 0.4 in.), does not have noticeable oscillation and the engine does not have exceptional roughness, proceed to check EGR system with engine under load.

c. When a vehicle has a severe drive problem which appears at throttle tip in/driveaway (i.e. severe stumble or surge during driveaway or tip in) the EGR system must always be checked under load in sequence with Steps D-3a and D-3b.

D.4. **With Transmission in Drive**
NOTE: Throttle positions for the following tests must be equal to or greater than those used in D-3a to assure similar EGR valve motion and also exposure of the carburetor EGR vacuum supply port.

a. Properly brake vehicle. Apply throttle slightly and hold constant.
CAUTION: Do not exceed 1250 rpm.
If the engine begins to roll and surge excessively—replace the EGR backpressure transducer.

b. Vehicles equipped with manual transmission must be tested in third gear with rear wheels free of the ground and engine load created by applying the foot brake. Apply throttle slightly and foot brake simultaneously to create engine load—do not stall engine with brake load.
CAUTION: Do not exceed 2000 rpm.
If engine begins to roll and surge excessively—replace the EGR backpressure transducer.

E.1. If the EGR valve stem does not move and/or oscillate properly (as described in Step D), disconnect the transducer vacuum supply hose at the TVS or PVS nipple and connect a vacuum gauge to the TVS or PVS nipple. Slowly open and close throttle (as in Step D) and observe vacuum signal in gauge:

a. If vacuum signal is less than 4.0 in. Hg., check EGR PVS (SSD-1, Part III) or air cleaner TVS switch (SSD-5, Part C). Also check EGR port on carburetor per SSD-1, Part II.

b. If vacuum signal is 4.0 in. Hg. or greater, the problem is associated with the backpressure transducer or the EGR valve. Check EGR valve system and backpressure transducer as follows:

F.1. Check EGR valve on engine per SSD-1, Parts B and C, Steps 1 thru 4.

a. If EGR valve functions as described above, remove EGR valve and transducer and inspect passages in EGR spacer, EGR valve and transducer for deposits or loose particles.

b. If EGR valve, spacer and transducer cavities are free of deposits or loose particles, replace transducer with new part and verify backpressure functioning according to Step D. If EGR valve functions properly, leave new part on. Otherwise, replace with original part.

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F.2. If the EGR valve, spacer and transducer have deposits, clean EGR valve and spacer per SSD-1, Part IV. Also clean backpressure pick-up in control chambers with small wire brush or scraper.
CAUTION: Do not use liquid solvents or compressed air on transducer.

F.3. If any repairs were made in Step F, verify backpressure functioning according to Step D. If the EGR valve does not move and/or oscillate, *replace backpressure transducer.*

VI. Backpressure EGR Transducer Procedure (Integral Type Backpressure EGR Valve)

A. Remove air cleaner assembly from carburetor, if required, to observe EGR valve. Place air cleaner assembly in such a position so that vacuum hoses are not disconnected from the air cleaner TVS switch.

B. Inspect EGR system vacuum routing for proper connections—refer to emissions calibrations publications. Check vacuum supply to valve per SSD-1, Part II and III.

C. Inspect integral EGR valve assembly for loose or broken support brackets, loose or broken diaphragm vacuum nipple, and exhaust blowouts at base to upper cover gasket or base to carburetor spacer gasket. (Replace valve or spacer gasket as necessary.)

D. ***EGR system function check***

D.1. Warm up engine to normal operating temperature.

D.2. a. With the engine in neutral, slowly open and close the throttle. Observe the EGR valve stem or underside of the diaphragm to which the valve stem is attached. The stem and diaphragm must move upward, appear to oscillate, and move downward to closed *position when the engine* returns to idle.

b. If unable to detect if valve strokes and oscillates Step D.2.(a), open throttle to 2000 to 2500 rpm and hold at a steady speed. Then remove and pinch off vacuum hose. With vacuum hose disconnected, engine speed should increase significantly (at least 50 rpm increase).
CAUTION: Do not exceed 1/2 throttle or 2500 rpm in Step D.2.

c. If valve operates properly in Step D.2.(a), *i.e.* valve moves and oscillates, or in Step D.2.(b) (idle speed increases), the EGR system is functioning properly. Discontinue diagnostic procedure.

d. If engine does not appear to operate properly in Steps D.2.(a) or D.2.(b) (has exceptional roughness or stalls), make the following check. At normal idle speed, remove the *vacuum hose to the* EGR valve and cap this hose. Connect another hose between the EGR valve and a manifold vacuum source.
If the idle speed drops significantly or the engine begins to run exceptionally rough or stalls with the hose from the manifold vacuum supply to the valve, replace the EGR valve.

e. On engines with an external exhaust gas supply tube, improper EGR valve seating can be determined by evaluation without EGR gas flow:

(1) Remove the EGR gas supply tube. Apply appropriate plugs at both exhaust and intake fittings. Plugs at the EGR intake fitting must be air tight.

(2) Remove the vacuum line from the EGR valve nipple and apply an appropriate cap on the EGR vacuum hose.

(3) Warm the engine to normal operating temperature and evaluate the idle. The engine should idle smoothly and normally.

(a) If the engine idle has not improved, check for leakage at the EGR spacer or gaskets. Repair and/or replace as required. Remove the carbureter, EGR spacer and related gaskets and inspect the spacer and gaskets for cracks and/or porosity. Repair and/or replace as required. Reassemble the components removed and check the engine idle quality. If the engine now idles smoothly and normally, discontinue the diagnostic procedure. If not, go to the next step in the Routine.

(b) If the idle has improved, remove the carbureter, EGR spacer and related gaskets and inspect the spacer and gaskets for *cracks and/or porosity.*

1. If OK, reinstall the components removed (leaving the EGR tube disconnected) and go to Step (c).

2. If not OK, repair and/or replace parts as required. Reassemble the components removed (including the EGR supply tube) and check the engine idle quality. If the engine now idles smoothly and normally, *discontinue the diagnostic procedure.* If not, go to Step (c).

(c) Install a slave EGR valve (EGR tube connected) and evaluate its operation by removing the vacuum hose to the slave EGR valve and capping this hose and connecting another hose between the EGR valve and a manifold vacuum source. If the idle speed drops significantly or the engine begins to run exceptionally rough or stalls with the hose from the manifold vacuum supply to the valve, replace the slave EGR valve with another and repeat. If the slave valve is OK, disconnect the manifold vacuum hose, reinstall the EGR vacuum signal hose and reevaluate the engine idle quality. If the idle does not improve with the slave EGR valve, reinstall the original valve and go to the next step in the Diagnostic Routine. If the *engine now* idles smoothly and normally, discontinue the Diagnostic Procedure.

VII. Electronic EGR Valve Diagnostic Procedure

A. **EGR Valve Position Check**

1. Verify that the ignition key is "OFF" and then disconnect the electrical harness from the EGR valve position sensor.

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2. Using an ohmmeter, measure the following resistances on the EGR valve connector (see Fig. 35).
   a. Pin A to pin C should be 3000 to 5000 ohms.
   b. Pin B to pin C should be 400 to 825 ohms.
3. If both resistance readings are OK, proceed to Step VII-B.
4. If either resistance reading is out of tolerance, replace the EGR valve and repeat test VII-A.

B. **Cold Engine EGR Valve Check**

1. Verify that the intake manifold temperature is less than 90° F (should feel cool to the touch).
2. Disconnect the EGR pressure line at the EGR valve and connect a pressure gage to the line.
3. Connect a tachometer to the engine.
4. Block the vehicle front wheels and apply the parking brake.
5. Remove the vacuum supply hose from the top of thermactor air bypass valve and connect a hose from a hand operated vacuum pump (21-0014 or equivalent); apply 8-10" HG vacuum to the bypass valve. Start the engine, place the transmission selector in neutral or park and bring the engine speed to 1000 RPM and hold for 5 seconds; note the reading on the pressure gage.
6. If the pressure is less than 0.5 psig, proceed to Step VII-C.
7. If the pressure is greater than 0.5 psig, proceed to SSD-25.

C. **Warm Engine EGR Valve Check**

1. Warm the engine to normal operating temperature with the transmission in neutral or park and the parking brake set.
2. Connect an appropriate diameter hose to the EGR valve pressure fitting and tee-in an 0-15 psi pressure gage to the other end of the hose. Attach, via an appropriate hose, a hand operated pressure pump to the remaining nipple on the tee fitting (use Tool 21-0012 or equivalent with the hose connected to the **pressure** output side, i.e., upper fitting). With the engine idling in neutral, apply 1.5-2.0 psi to the EGR valve (note, **do not exceed 3.0 psi pressure).** If the engine stalls, proceed to Step 5. If the engine does **not** stall, proceed to Step 3.
3. Remove the EGR valve. Using the same pressure hose routing as in Step 2, slowly apply pressure to the EGR valve and observe the movement of the EGR valve pintle (NOTE— **do not exceed 3.0 psi pressure).** The valve pintle should be fully retracted (approx. 0.4 in of travel) at 2.5 psi. Remove pressure line from valve and observe pintle movement; the pintle should return to the fully extended position. If the valve pintle does not retract fully and/or does not return to the fully extended position, replace the EGR valve and repeat this procedure. If the valve operates as described, proceed to Step 4.
4. With the EGR valve removed, start the engine and let idle in neutral or park. Exhaust gasses should be observed coming from the open end of the EGR cooler outlet tube. If gasses are not observed, inspect EGR passages per SSD-1, Step E 3. If gasses are observed, inspect EGR spacer per SSD-1, Step D. After completion of this procedure, reinstall EGR valve and repeat Step 2.
5. Remove thermactor air pressure line from the EGR pressure solenoid and install 0-15 psi pressure gage in end of line. Remove the thermactor air hose from the **outlet** of the thermactor air bypass valve and install a thermactor pump pressure gage (Tool T75L-9486-A or equivalent) to the outlet using a short length of appropriate diameter hose. Remove the vacuum control supply hose from the top of the air bypass valve and connect a hose from a hand operated vacuum pump (Tool 21-0014 or equivalent) and apply 8-10 in Hg **vacuum** to the bypass valve. Start engine and increase speed to 1000 rpm in neutral or park. Observe pressure at both gages; pressure must be 2.25 psi minimum. If the pressure at both gages is less than 2.25 psi, the thermactor air pump or air bypass valve are malfunctioning; proceed to SSD-5 (upon completion of SSD-5, repeat this procedure). If the thermactor air pump pressure meets specification, but the EGR air pressure does not, reinstall the EGR pressure gage ahead of the pressure line air filter and repeat procedure. If EGR pressure now meets specification, repair or replace air filter, and repeat original procedure. When both pressures meet specifications, proceed to Step 6.
6. Make sure that the air cleaner is properly installed on the engine; check all vacuum hoses and fittings for the thermactor air bypass valve vacuum control system. Repair or replace hoses and/or fittings if required. Reconnect the vacuum control system hose to the top of the air bypass valve. Start the engine and warm to normal operating temperature in neutral or park. With the front wheels blocked and the parking brake on, increase engine speed to 1300 rpm with the transmission in drive. Observe the pressure at both test gages; the pressure at both gages should be 2.25 psi minimum. If both pressures meet specification, proceed to Step 7. If pressures do not meet specification, check the thermactor air bypass valve vacuum control system by proceeding to SSD-5, Steps C(v), C(vi), C(vii), C(xi), C(xii), C(xiii), and C(xiv). Repeat this procedure upon completion of these steps.
7. If the vehicle is still not OK after completion of Steps 1-6, proceed to SSD-25.

VIII. EGR Vacuum Load Control Valve Diagnositc Procedure

A. Remove air cleaner assembly from carburetor to observe the EGR valve. Place air cleaner assembly in such a position so that vacuum hoses are not disconnected from the air cleaner TVS switch.
B. Check EGR system vacuum hose routing for

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proper connection—refer to emissions calibrations publications.

C. Warm up engine to normal operating temperature and connect tachometer.

D. While slowly opening and closing the throttle, the EGR valve stem must move upward and/or oscillate and move downward to the closed position when the throttle is released to the idle position.

CAUTION: *Do not exceed 1/2 throttle or 3000* rpm when opening or closing throttle.

If the EGR valve stem moves and/or oscillates properly, the EGR system is functioning satisfactorily. Discontinue diagnostic procedure.

E. If the EGR valve stem does not move and/or *oscillate properly (as described in Step D)*, disconnect the vacuum supply hose between the EGR vacuum load control valve and the TVS, at the vacuum load control valve, and connect a vacuum gage to the hose. Raise engine speed to 1200-1500 rpm in neutral and observe vacuum *signal:*

1. If vacuum signal is less than 4.0 in. Hg, proceed as follows:
   a. Perform EGR PVS procedure SSD-1, Part III.
   b. Perform air cleaner TVS switch procedure SSD-9, Part II.
   c. *Perform either EGR port on carburetor* procedure SSD-1, Part II, or spark port on carburetor, Reference Two, Part 25, depending on the vacuum source to the load control valve.
2. If vacuum signal is 4.0 in. Hg or greater, remove the gage, reinstall the vacuum hose on the EGR vacuum load control valve and proceed as follows:

F. Remove the vacuum hose between the EGR vacuum load control valve and the EGR backpressure transducer at the vacuum load control valve and connect a vacuum gage to the vacuum load control valve port.

1. Remove the hose from the venturi port on the carburetor to the vacuum load control valve at the valve.
2. Raise the engine idle speed to 1200-1500 rpm in neutral and observe vacuum signal.
   a. If vacuum signal is less than 4.0 in. Hg, replace the EGR vacuum load control valve.
   b. If vacuum signal is 4.0 inches of Hg or greater, apply one of the following vacuum levels, from an external source, to the venturi port of the load control valve, and observe the first gage signal:

Decal Color of EGR Vacuum Load Control Valve	Vacuum Level (inches of Hg) Applied to Venturi Port
Blue	3.0
Red	4.5

CA4264-1A

If the gage signal does not drop to less than 2.0 in. Hg, replace the load control valve. If the gage signal drops to less than 2.0 in. of Hg and does not return to greater than 4.0 in. of Hg when the external source vacuum is removed from the venturi port, replace the load control valve.

SSD-2—SPARK DELAY VALVE

To determine if a delay valve is operating correctly, use the following procedure:

EQUIPMENT REQUIRED

A. Vacuum gauge—USG Model 12121-1, 2" dia., 0-30" *Hg vacuum gauge or equivalent with* 0.2" OD vacuum hose nipple adaptor and 24" of 5/32" ID distributor vacuum hose or equivalent.

B. Stop watch or wrist watch with a sweep second hand.

C. External vacuum source capable of maintaining a constant vacuum (10" Hg minimum).

PROCEDURE

I. Mono Delay Valve

1.(a) Set external vacuum source to 10" Hg.
(b) Connect black side of delay valve to vacuum source.
(c) Connect the 24" section of vacuum hose to gauge and to colored side of delay valve.
(d) Apply vacuum and observe time in seconds for gauge to read from 0" to 8" Hg with a constant 10" Hg vacuum source.

2. The minimum and maximum time for the valve to reach 8" Hg should be as follows:

Color	I.D. No.	Time in Seconds	
		Minimum	Maximum
Black and Gray	*1*	*0.6*	*1.6*
Black and Brown	2	1.0	3.0
Black and White	5	2.7	9.3
Black and Yellow	10	4.5	13.2
Black and Blue	15	6.8	18.8
Black and Green	20	8.0	26.0
Black and Orange	30	11.6	38.0
Black and Red	40	14.0	47.2

CV1382-1B

When checking the delay valve, care must be *exercised to prevent oil or dirt from getting into* the valve as this will impair the functioning.

3. Replace the delay valve if the above test showed it to be out of specification. Otherwise, re-install delay valve to its original position.

II. Retard Delay Valve

1.(a) *Set external vacuum source to 10" Hg.*
(b) Connect colored side of delay valve to vacuum source.
(c) Connect the 24" section of vacuum hose to a gauge and to the white side of delay valve.

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(d) Apply vacuum and observe time in seconds for the gauge to read from 0" to 8" while applying a constant 10" Hg vacuum.

2. The minimum and maximum time for the valve to reach 8" Hg should be as follows:

Color Code	I.D. No.	Time in Seconds	
		Minimum	Maximum
White/Pink	5	2.7	9.3
White/Brown	2	1.0	3.0
White/Green	20	8.0	26.0
White/Yellow	10	4.5	13.2

CA1384-1C

When checking the delay valve, care must be exercised to prevent oil or dirt from getting into the valve as this will impair the functioning.

3. Replace the delay valve if the above test showed it to be out of specification. Otherwise, re-install delay valve to its original position.

III. Air Cleaner Delay Valve

Procedure:

1.a) Set external vacuum source to 10" Hg.

b) Connect colored side of delay valve to vacuum source. Note: 0.20" OD to 0.27" OD adaptor may be required to connect colored side of valve to vacuum source.

c) Connect the 24" section of vacuum hose to gauge and to white side of delay valve.

d) Apply vacuum and observe time in seconds for gauge to read from 0" to 8" Hg with a constant 10" Hg vacuum source.

2. The minimum and maximum time for the valve to reach 8" Hg should be as follows:

Color Code	I.D. No.	Time in Seconds	
		Minimum	Maximum
White/Red	40	14.0	47.2
White/Blue	20	8.0	26.0

CA1434-1B

When checking the delay valve, care must be exercised to prevent oil or dirt from getting into the valve as this will impair its function.

3. Replace the delay valve if the above test showed it to be out of specification. Otherwise, re-install delay valve in its original position.

V. Distributor Vacuum Vent Valve

Procedure:

1.a) Set an external vacuum source to 10 inches Hg.

b) Connect the "VAC" side (side with code number) of the vacuum vent valve to vacuum source.

c) Connect a 24 inch section of vacuum hose to a gage and to the other side of the vacuum vent valve.

d) Apply vacuum and observe time in seconds for the gage to read from 0 inches Hg to 8 inches Hg while applying a constant 10 inches Hg vacuum.

2. The minimum and maximum time for the valve to reach 8 inches of Hg vacuum should be as follows:

Code No.	Time in Seconds	
	Minimum	Maximum
20	16	36.8
40	28	67.6

CA4265-1A

When checking the vacuum vent valve, care must be exercised to prevent oil or dirt from getting into the valve, as this will impair its function.

3. Replace the vacuum vent valve if the above test showed it to be out of specification. Otherwise, re-install valve to its original position.

SSD-3—SPARK CONTROL SYSTEMS AND SPARK DELAY VALVE

NOTE: Does not apply to vehicles equipped with Electronic Engine Control.

I. NON-THERMAL CONTROL SYSTEM

(1) Remove air cleaner. Remove SDV if so equipped and check per the delay valve procedure (SSD-2). Install a connector in place of the SDV in order to carry out system checks.

(2) Install "T" fitting and vacuum gauge at distributor.

(3) With engine at normal operating temperature and with transmission in neutral, momentarily open throttle (1/2 open).

(4) Observe the vacuum gauge for a quick rise and fall as the throttle is opened and closed. If a vacuum is evident the system is OK. If no vacuum is evident check the vacuum lines, evaporative canister purge valve "T" (if applicable) and port in carburetor for plugging. Correct if necessary.

(5) For vehicles with a Cooling PVS check vacuum reading at distributor at normal idle and engine operating temperature. If vacuum reading is 2 in. Hg or less the PVS is OK. If vacuum reading is greater than 2 in. Hg remove the top vacuum line (the line that goes to the carburetor) at PVS. If vacuum reading is still greater than 2 in. Hg, PVS is leaking and should be replaced.

(6) Remove the vacuum gauge, "T" fitting, connector (where used), re-install SDV (where used), and re-connect all vacuum lines.

(7) Re-install air cleaner and torque wing nut to specifications.

II. COLD LOCK-OUT SPARK SYSTEM

(1) Remove air cleaner. Remove SDV if so equipped and check per delay valve procedure (SSD-2).

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Install a connector in place of SDV for system checks.

(2) Install "T" fitting and vacuum gauge in primary side of distributor.

(3) With engine at normal operating temperature and transmission in neutral, momentarily open throttle (1/2 open).

(4) Observe the vacuum gauge for a quick rise and fall as the throttle is opened and closed. If a vacuum is evident, the system is OK. If no vacuum is evident check the vacuum lines, evaporative canister purge valve, "T" (if applicable), cold lock-out PVS, and the carburetor port for plugging. Correct if necessary.

(5) Remove vacuum gauge, "T" fitting, connector (if used) and install SDV (if used) and reconnect all vacuum lines.

(6) Re-install air cleaner and torque wing nut to specification.

III. COLD START SPARK ADVANCE SYSTEM

NOTE: Perform Steps 1 thru 5 only if engine complaint is spark knock or pinging.

CAUTION: Do not leave transmission in drive during Steps 2 and 4 for longer than 15 seconds.

1. Connect a tachometer to the engine and start the engine.
2. With brake pedal depressed and transmission in drive (see Caution), accelerate engine and record rpm at which spark knock or pinging occurs.
3. To allow transmission to cool, put engine in neutral and accelerate to 1500 rpm three times for 15-30 seconds each time.
4. Remove vacuum advance line from distributor and plug. Restart engine and repeat Step 2 (see Caution above) to recorded rpm.
5. If spark knock or pinging reoccurred with vacuum advance line disconnected, stop engine and proceed to next step. If spark knock or pinging did not reoccur, the system has a CSSA PVS and/or retard delay valve or check valve (if so equipped) that is not operating properly. Repair and/or replace as required.
6. Remove air cleaner. Remove SDV if so equipped and check per delay valve procedure (SSD-2). Install connector in place of SDV. Remove vacuum check valve or retard delay valve (if so equipped) and check per vacuum check valve or retard delay valve procedure. Install connector in place of check valve or retard delay valve.
7. Install "T" fitting and vacuum gauge at distributor primary.
8. Remove vacuum line from bottom port of Cold Start PVS and cap.
9. With engine at normal operating temperature and at idle the vacuum reading should be zero. If vacuum is not zero, the Cold Start PVS should be replaced.
10. Remove cap and reconnect the removed line to the bottom port of the Cold-Start PVS.
11. Remove vacuum line from top port of Cold-Start PVS and plug.
12. For vehicles with a Cooling PVS check vacuum reading at distributor at normal idle. If vacuum reading is 2 in. Hg or less the Cooling PVS is OK. If vacuum reading is greater than 2 in. Hg remove the top vacuum line (the line that goes to the carburetor) at Cooling PVS and plug. If vacuum reading is still greater than 2 in. Hg Cooling PVS is leaking and should be replaced.
13. With engine running and transmission in neutral momentarily open the throttle (1/2 open).
14. Observe vacuum gauge for a quick rise and fall as the throttle is opened and closed. If vacuum is evident the spark advance system is OK. If no vacuum is evident, check the vacuum lines, evaporative canister purge valve, "T" (if applicable), ports in the cooling and cold-start PVS's and port in the carburetor for plugging. Correct if necessary.
15. Remove "T" fitting, vacuum gauge, plug and connectors. Install SDV and check valve or retard delay valve (if used) and reconnect all vacuum lines.
16. Re-install air cleaner and torque wing nut to specifications.

IV. DISTRIBUTOR VACUUM ALTITUDE COMPENSATOR VALVE

1. Attach a vacuum source to the large nipple end.
2. Attach a vacuum gauge to the small nipple end.

If the drive complaint occurs at high altitudes:

a. Supply 10 in. Hg vacuum at 4000 ft altitude or higher.

b. The output reading should be 10 in. Hg. If not, replace the valve.

If the drive complaint occurs at low altitudes:

a. Supply 10 in. Hg vacuum at 1500 ft. altitude or lower.

b. The output reading should be less than 10 in Hg but greator than 6 in. Hg. If not, replace the valve.

IV. DELAY VALVE BYPASS SYSTEM (PVS OPERATED)

1. Remove air cleaner.
2. Remove SDV and check per Delay Valve Procedure SSD-2. Install a connector in place of SDV. Remove vacuum line at distributor and install a T-fitting and vacuum gauge.
3. With engine idling at normal operating temperature and with transmission in neutral, momentarily open throttle (1/3 open).
4. Observe the vacuum gauge for a quick rise and fall as the throttle is opened and closed. If a vacuum is evident, the system is OK. If no vacuum is evident, check the vacuum lines, evaporative canister purge valve, "T" (if applicable) and port in the carburetor for plugging. Correct if necessary.
5. Shut engine off.
6. Remove vacuum gauge, "T" fitting, and connector. Reinstall SDV and reconnect vacuum hoses.
7. Remove vacuum check valve and check per Vacuum Check Valve Check Procedure.

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8. Reinstall check valve in hose to distributor.
9. Install connector and vacuum gauge in vacuum hose from PVS to check valve.
10. With engine running at normal operating temperature and transmission in neutral, momentarily open throttle (1/2 open).
11. Observe the vacuum gauge for evidence of vacuum. If vacuum reading is two inches Hg or less, PVS is OK. If vacuum reading is greater than two inches Hg the PVS should be replaced.
12. Remove vacuum gauge, connector and plugs (where used), reinstall check valve and reconnect all vacuum hoses.
13. Reinstall air cleaner and torque to specifications.

V. "COOLING PVS OPERATION CHECK"

1. Check all vacuum hose routings and connections. If incorrect or loose, reroute hoses correctly. Replace any broken, split or cracked hose and secure loose connections. Recheck complaint.
2. Disconnect vacuum line leading from distributor at port "D" (center port) of the PVS valve. Connect suitable vacuum gauge and vacuum hose to port "D" of PVS valve in line with the port. Leave other vacuum lines connected to the valve.
3. Remove backing from Tempilabel or equivalent, exposing adhesive surface and press firmly onto thermostat housing or intake manifold surface is close proximity to the cooling PVS valve where it can easily be seen. Use Tempilabel new series temperature monitor part or equivalent rated at 235°F.Mounting surface should be cleaned of all dirt, oil and foreign matter using a suitable solvent and wiping dry with a clean dry cloth.
4. Restrict the incoming air to the radiator by placing a piece of cardboard in front of the radiator.
5. Idle vehicle to heat up the cooling system. Monitor the vacuum gauge attached to the PVS cooling valve for an increase in vacuum before the silver colored Tempilabel or equivalent turns black (color change indicates 235°F temperature has been reached). If the vacuum fails to increase before indicator changes color, replace PVS valve if vacuum gauge shows a definite increase in vacuum before the color change, PVS valve is considered good.
6. A Tempilabel or equivalent of 240°F may be used if the 235°F label is not readily available.

VI VACUUM CHECK VALVE OPERATION

1. For checking function:
   (a) Set vacuum source at 5 in. Hg.
   (b) Apply vacuum to the check side of the check valve and trap. After 30 seconds the vacuum should not be less than 4 in. Hg. If it is, replace the valve.
2. For flowing function:
   (a) Set vacuum source at 5 in. Hg.
   (b) Connect gauge to check side (same side source was connected to in (1)).
   (c) Apply vacuum to opposite side used in (1). Reading on gauge should be same as source. If it is not, replace the valve.

SSD-4—THERMACTOR NON-CATALYTIC CONVERTER EMISSION SYSTEM CHECK

The thermactor non-catalyst system consists of the following major components:

- Belt-driven air pump supply pump
- Air Bypass Valve
- Check Valve(s)
- Internal or external air manifold(s)
- Air supply tubes
- Crossover tube to connect RH and LH air manifolds (internal system only)

PROCEDURE:

A. Air Pump Supply Test

1. Remove air cleaner.
2. Inspect all hoses and hose connections in the system for any abnormal conditions and correct and/or repair and/or replace as necessary.
3. Check the air pump belt tension and adjust to specification. (See Procedure "B" of this Diagnostic Procedure.)
4. With the transmission in neutral or park and the parking brake on, warm the engine to normal operating temperature.
5. Stop the engine and disconnect the air supply hose(s) from the air pump to the air bypass valve at the air bypass valve.
6. Insert the Thermactor pump pressure gauge (Tool T75L-9486-A or equivalent) in the end of the hose disconnected from the bypass valve. Clamp the hose securely to the air supply tester to prevent it from blowing out.
   CAUTION: Position the air pump supply tester so that the air blast emitted will be harmlessly dissipated.
7. Connect a tachometer to the engine and start the engine.

8a. Slowly increase engine speed to 1000 rpm and observe the pressure produced at the test gage. The air pump pressure must be 2.25 (2 1/4) psi minimum.

8b. If special Tool is not available, increase engine speed to 1500 rpm, place hand over the open hose. Air flow should be heard and felt.

9. If air flow does not comply with minimum requirements listed in Step 8, install a new air pump and repeat Step 8.
10. Turn off the engine. Remove all test equipment and reconnect the air supply hose to the air bypass valve and tighten the hose clamp. Torque the air cleaner nut to specification if the cleaner was removed.

B. Thermactor Air Pump Drive Belt Adjustment

1. Install the belt tension gauge (Tool T75L-8620-A or equivalent) on the drive belt and check the tension following the instructions of the tool

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manufacturer. Compare the belt tension to the specified belt tension and adjust as necessary.

2. If adjustment is necessary, loosen the air pump mounting and adjusting arm bolts. Move the air pump toward or away from the engine until the correct tension is obtained. Use air pump belt tensioning tool (Tool T75L-9480-A or equivalent) to hold belt tension while tightening the mounting bolts. Remove the gauge. Tighten the air pump adjusting arm and mounting bolts. Install the tension gauge and check the belt tension.
   CAUTION: *Do not use a pry bar.*
3. Check all air pump pulleys and mounting bolts and torque to specification.

   CAUTION: Any belt that has operated for a minimum of ten minutes is considered a used belt; and when adjusted, it must be adjusted to the tension shown in the specifications for used belts.

C. Air Bypass Valve Functional Tests (Timed Bypass Valve Fig. 2)

Determine if the air bypass valve is functioning properly by performing the following operation:

1. If necessary, warm the engine to normal operating temperature with the transmission in neutral or park and the parking brake on.
2. Stop the engine and remove the air bypass valve-to-air manifold check valve hose at the bypass valve. For a tee system, remove both hoses connecting the bypass valve to the check valves. Remove any restricting device in the sense vacuum hose. Install a tachometer on the engine.
3. With the transmission in neutral or park and the parking brake on, start the engine. Accelerate the engine to 1500 rpm. Verify that air is flowing from the air bypass valve hose connection(s) by placing hand over valve connection. Air flow should be felt and heard.
4. With transmission in neutral or park and parking brake on, accelerate to 1500 rpm. With hand held over the bypass valve connection momentarily (approximately 5 to 8 seconds) pinch off the vacuum hose to the bypass valve to duplicate the air bypass cycle. Release the pinched vacuum hose. Air flow thru the bypass valve should be felt and heard to diminish or stop for a short period of time, then resume as before (normal air flow). The length of time required to resume normal flow cannot be specified since the time interval is dependent on engine vacuum and length of time the vacuum line is pinched off. Air will be discharged thru the exhaust port in the side of the valve silencer cover. If this complete cycle does not occur, the valve must be replaced.
5. Perform the following test ONLY if the air pump supply tester is available:

   Install the Thermactor pump pressure gauge (Tool T75L-9486-A or equivalent) to the air bypass valve outlet using a short length of appropriate diameter hose. If the air bypass valve has two outlets, plug the one without the tester. Increase engine speed to 1000 rpm. Observe the pressure produced at the test gauge. The air pressure must be 2.25 (2 1/4) psi minimum. If the air pressure is not within specification, replace the valve.
6. Turn off the engine, remove all test equipment and connect the air supply hose(s) to the air bypass valve(s), and tighten all clamps.

Determine if the air bypass valve **controls** are functioning properly by performing the following operations:

D.(1). Check Valve Test

1. With the engine stopped, inspect the hose(s) from the check valve to the bypass valve for any leaks due to cracks, splits, holes, etc. Replace if required.
2. Inspect the hose clamp(s) at the check valve for being properly positioned and tightened. Correct, position, tighten or replace as required.
3. Disconnect the Thermactor hose(s) from check valve to the bypass valve at the bypass valve end.
4. Connect the Thermactor check valve tester (Tool T75L-9487-A or equivalent), to the open end of the check valve hose. Position the hose clamp and tighten to specification.
5. Squeeze the rubber bulb, on the tester, to force as much air from the bulb as possible. Quickly release the bulb and start timing. The bulb should remain collapsed (not return to its original free shape) for at least 15 seconds.
6. If the test bulb does not return to its original free shape for 15 seconds, the check valve and hose are good. Remove the check valve tester from the end of the hose and reinstall the hose on the bypass valve. Position and tighten the hose clamp to specification.
7. If the test bulb returns to its original free shape in 15 seconds or less, both hose and check valve are questionable.
8. Remove the test bulb from the end of the hose. Remove the hose from the check valve. Install a 6 to 18 inch length of appropriate diameter hose to the check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5 above.
9. If the test bulb does not return to its original free shape for 15 seconds it indicates the check valve is good and the original bypass valve to check valve hose must be replaced. Remove the test hose from the check valve and test bulb. Install a new hose of the proper part number, to the check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5 to be sure the new hose does not leak. After test remove the hose clamp and test bulb. Install the hose on the bypass valve nipple. Position and tighten the hose clamp to specification.
10. If the test bulb returns to its original free shape (Step 8) in 15 seconds or less, the check valve must be replaced.
11. Test the new check valve for leaks before installing on the engine. Connect a 6 to 18 inch length of appropriate diameter hose to the new

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check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5 above.

12. Remove the hose from the check valve. Install the new check valve on the engine and torque to specification. Visually inspect the original hose for any surface condition that would cause a problem in the near future. Replace with a new hose if required. Install the hose on the check valve and bypass valve nipples. Route the hose as required. Position and tighten to specification a hose clamp at each end of the hose.

E. Thermactor System Noise Test

NOTE: The thermactor system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the air injection system, disconnect the drive belt and operate the engine. If the noise disappears, refer to the Thermactor Noise Diagnosis Chart (Fig. 1):

CONDITION	POSSIBLE CAUSE	RESOLUTION
1. Excessive Belt Noise	a. Loose belt	• Tighten to specification using tool T75L-9480-A or equivalent to hold belt tension and Belt Tension Gage T63L-8620-A or equivalent. CAUTION: Do not use a pry bar to move the air pump.
	b. Seized pump	• Replace pump.
	c. Loose pulley	• Replace pulley and/or pump if damaged. Torque bolts to specification (130-180 in-lbs.)
	d. Loose or broken mounting brackets or bolts	• Replace parts as required and torque bolts to specification.
2. Excessive Pump Noise (Chirps, Squeaks & Ticks)	a. Insufficient break-in or worn or damaged pump	• Check the thermactor system for wear or damage and make any necessary corrections. If less than 500 miles in service, allow for a 500 mile break-in period. Replace the pump if the noise continues after a 500 mile break-in period.
3. Excessive Mechanical Clicking Noise	a. Over torqued mounting bolt	• Torque to 25 ft-lbs.
	b. Excessive flash on the air pump adjusting arm boss.	• Remove flash from the boss.
	c. Distorted adjusting arm	• Replace adjusting arm.
	d. Adjusting arm bolt too long (bottom of the bolt boss is pushed in)	• Replace pump using a proper length bolt.
4. Excessive Thermactor System Noise (Putt-Putt, Whirling or Hissing)	a. Leak in hose	• Locate source of leak using soap solution and replace hoses as necessary.
	b. Loose, pinched or kinked hose	• Reassemble, straighten or replace hose and clamps as required.
	c. Hose touching other engine parts	• Adjust hose to prevent contact with other engine parts.
	d. By-pass valve inoperative	• Test by-pass valve and replace as necessary.
	e. Check valve inoperative	• Test check valve and replace as necessary.
	f. Pump mounting fasteners loose	• Torque fasteners to specification.
	g. Restricted or bent pump outlet fitting	• Inspect fitting and remove any flash blocking the air passage way. Replace bent fittings.
	h. Pump worn or damaged	• Replace pump.

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FIG. 1 Thermactor Noise Diagnosis

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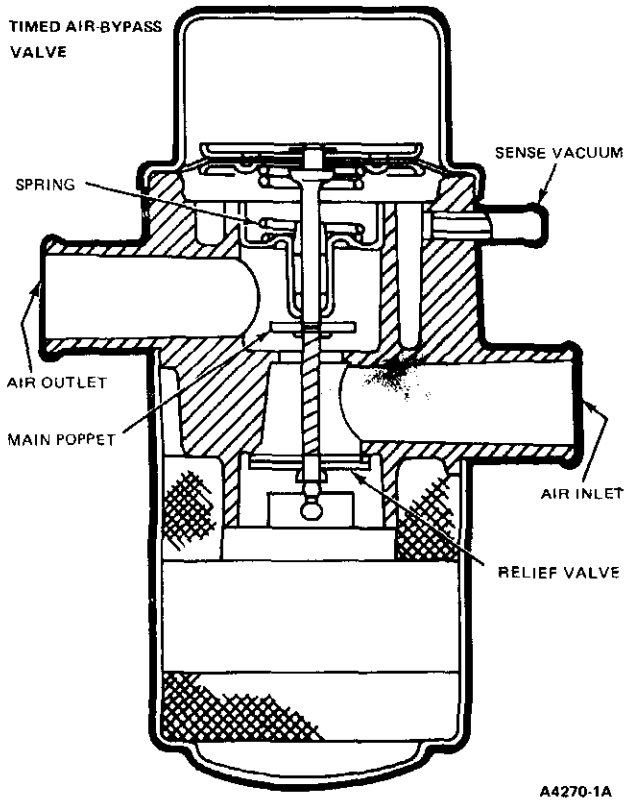


FIG. 2 Timed Air Bypass Valve

SSD-5—THERMACTOR CATALYTIC CONVERTER EMISSION SYSTEM CHECK

The thermactor catalytic converter system consists of the following major components:

- Belt-drive air pump supply pump
- Air bypass valve
- Air control valve
- Check valve(s)
- Enternal or external air manifold(s)
- Air supply tubes
- Crossover tube to connect RH to LH air manifolds (internal system only)
- Differential vacuum valve (Decel)
- Air Cleaner Temperature sensor
- Electric PVS (ported vacuum switch) high temperature coolant lock out
- Solenoid vacuum valve
- EGR vacuum load control valve (for EGR and thermactor)
- Vacuum delay valve (idle air dump)
- Thermactor idle vacuum valve
- Thermactor vacuum vent valve

PROCEDURE:

A. Air Pump Supply Test

1. Remove air cleaner.
2. Inspect all hoses and hose connections in the system for any abnormal conditions and correct and/or repair and/or replace as necessary.
3. Check the air pump belt tension and adjust to specifications. (See Procedure "B" of this Diagnostic Procedure.)
4. With the transmission in neutral or park and the parking brake on, warm the engine to normal operating temperature.
5. Stop the engine and disconnect the air supply hose(s) from the air pump to the air bypass valve at the air bypass valve.
6. Insert the thermactor pump pressure gauge (Tool T75L-9486-A or equivalent) in the end of the hose disconnected from the bypass valve. Clamp the hose securely to the thermactor pump pressure gauge to prevent it from blowing out.

   CAUTION: Position the thermactor pump pressure gauge so that the air blast emitted will be harmlessly dissipated.
7. Connect a tachometer to the engine and start the engine.

8a. Slowly increase engine speed to 1000 rpm and observe the pressure produced at the pressure gauge. The air pressure must be 2.25 (2-1/4) psi minimum.

8b. If the special test gauge is not available, increase the engine speed to 1500 rpm, place hand over the open hose. Air flow should be heard and felt.

9. If air flow does not comply with minimum requirements listed in Step 8, install a new air pump and repeat Step 8.
10. Turn off the engine. Remove all test equipment and reconnect the air supply hose(s) to the air bypass valve and tighten the hose clamp(s). Torque the air cleaner wing nut to specifications if the air cleaner was removed.

B. Thermactor Air Pump Drive Belt Adjustment

1. Install the belt tension gauge (Tool T75L-8620-A or equivalent) on the drive belt and check the tension following the instructions of the tool manufacturer. Compare the belt tension to the specified belt tension and adjust as necessary.
2. If adjustment is necessary, loosen the air pump mounting and adjusting arm bolts, move the air pump toward or away from the engine until the correct tension is obtained. Use air pump belt tensioning tool (Tool T75L-9480-A or equivalent) to hold belt tension while tightening the mounting bolts. Install the tension gauge and check the belt tension.

   CAUTION: Do not use a pry bar.
3. Check all air pump pulleys and mounting bolts and torque to specification.

   CAUTION: Any belt that has operated for a minimum of 10 minutes is considered a used belt; and when adjusted, it must be adjusted to the tension shown in the specifications for used belts.

C(I). Air Bypass Valve Functional Tests (Normally Closed Bypass Valve Figs. 3 and 5.)

Determine if the air bypass valve is functioning properly by performing the following operations:

1. If necessary, warm the engine to normal operating temperature with the transmission in neutral or park and the parking brake on.

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2. Stop the engine and remove the air bypass valve to air manifold check valve hoses at the bypass valve. For a tee system, remove both hoses connecting the bypass valve to the check valves. Install a tachometer on the engine.
3. With the transmission in neutral or park and the parking brake on, start the engine. Accelerate the engine to 1500 rpm. Verify that air is flowing from the air bypass valve hose connection(s) by placing hand over valve connection. Air flow should be heard and felt.
4. Remove the vacuum hose from the bypass valve and plug off the vacuum hose. With the engine at 1500 rpm and hand held over the bypass valve connection, there should be virtually no air flow felt or heard. Air flow will be discharged thru the exhaust ports in the end of the valve silencer cover. If air flow is felt or heard thru the bypass valve connection, the valve should be replaced.
5. Stop the engine. Remove the plug from the vacuum hose.
6. Reinstall the vacuum hose on the bypass valve sense vacuum nipple.
7. If available, install the thermactor pump pressure gauge (Tool T75L-9486-A or equivalent) to the air bypass valve outlet using a short length of appropriate diameter hose. If the air bypass valve has two outlet(s), plug the one without the tester. If the air bypass valve has a small pressure outlet, as pictured in Fig. 5, install a pressure gauge on this port. Start the engine and increase engine speed to 1000 rpm. Observe the pressure produced at the test gauge(s). The air pressure must be 2.25 (2-1/4) psi minimum. If the air pressure is not within specification, replace the valve.
8. Turn off the engine, remove all test equipment and connect the air supply hoses(s) to the air bypass valve and tighten all hose clamp(s).

Determine if the air bypass valve controls are functioning properly by performing the following operation(s).

C(II). Differential Vacuum Valve (Decel) Functional Check

1. If necessary, warm the engine to normal operating temperature with the transmission in neutral or park and parking brake on.
2. Stop the engine and remove the air bypass valve to air manifold check valve hose at the bypass valve. For a tee system, remove both hoses. Install a tachometer on the engine.
3. Start the engine. With hand held over the bypass valve outlet connections accelerate to approximately 2500 rpm. Release the throttle for a normal return to engine idle rpm. During the deceleration period, the air flow in the valve outlet should be felt and/or heard to momentarily diminish or stop and then resume as before (normal air flow). Air flow will be discharged thru the exhaust ports in the end of the bypass valve silencer cover. The air flow interruption during deceleration cannot be specified due to variations in the rate of deceleration and manifold vacuum.
4. If the bypass valve meets test requirements, but does not function as described in Step 3, check to be sure the decel valve is receiving a vacuum signal. If the decel valve is receiving a signal then the decel valve is to be replaced.
5. Turn off the engine. Remove all test equipment and reconnect all related components of the thermactor system.

C(III). Electric PVS (Ported Vacuum Switch) High Temperature Coolant Lock Out Vacuum Check

1. Disconnect vacuum line (air bypass valve to PVS valve) at the air bypass valve and connect to a vacuum gauge.
2. With transmission in park or neutral and the parking brake on, start engine and let idle.
3. With engine temperature stabilized, check for a vacuum signal.
   If no vacuum signal is noted, PVS should be replaced.
   If idle vacuum is indicated, the PVS valve is OK.

C(IV). Thermactor System: Solenoid Vacuum Valve

A. **Normally Closed Valve, Type I**

NOTE: A normally closed Type I, solenoid vacuum valve is used in conjunction with a Type I air cleaner temperature switch (see Procedure SSD-9: Air Cleaner Temperature Control and Delay Valve, Step No. 8).

1a. Determine that engine air cleaner ambient temperature is above 65°F.

1b. Engine **must** be at normal operating temperature.

2. While the engine is at idle condition, disconnect vacuum hose to thermactor air bypass valve. Thermactor air should dump to atmosphere thru the exhaust ports in the end of the valve silencer cover. Re-connect vacuum hose.
   If thermactor air dumps to atmosphere, the solenoid hose connections are correct.

   NOTE: Vacuum supply always goes to the bottom vacuum fitting on the solenoid vacuum valve.

   Disconnect vacuum supply hose at the solenoid valve. Place finger over end of open vacuum hose. Your finger should be attracted to the hose opening by the vacuum supplied by the engine manifold. If vacuum supply is not observed, check and/or replace vacuum sources as required. Re-connect vacuum hose.
3. Disconnect wiring to solenoid vacuum valve.
   a. Determine which wire has battery voltage when the ignition switch is in the RUN position.
   b. Connect wire which has battery voltage to solenoid vacuum valve.

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4a. While the engine is at idle condition, ground the other exposed terminal on the solenoid vacuum valve to chassis ground. Thermactor air should not dump to atmosphere.

4b. Connect wire removed in Step 3a to solenoid vacuum valve. Thermactor air should not be dumped to atmosphere.

5. Replace solenoid vacuum valve if statement 4a is not a true statement.

Re-install related system components.

B. **Normally Opened Valve, Type 2**

NOTE: A normally open, Type 2, solenoid vacuum valve is used in conjunction with a Type 2 air cleaner temperature switch (see Diagnostic Procedure SSD-9, Air Cleaner temperature Control and Delay valve, Step No. 9).

1a. Determine that engine air cleaner ambient temperature is above 65°F.

1b. Engine **must** be at normal operating temperature.

2a. While the engine is at idle condition, disconnect vacuum hose to thermactor air bypass valve. Thermactor air should dump to atmosphere thru the exhaust ports in the end of the valve silencer cover.

2b. If thermactor air dumps to atmosphere, the solenoid hose connections are correct. Re-connect vacuum hose.

NOTE: Vacuum supply always goes to black input nozzle on solenoid valve.

3. Disconnect wiring to solenoid vacuum valve.
   a. Determine which wire has battery voltage when the ignition switch is in the RUN position.
   b. Connect wire which has battery voltage to solenoid vacuum valve.

4a. While the engine is at idle condition, ground the other exposed terminal on the solenoid vacuum valve to chassis ground. Thermactor air should be dumped to atmosphere.

4b. Connect wire removed in Step 3a solenoid vacuum valve. Thermactor air should not be dumped to atmosphere.

5. Replace solenoid vacuum valve if statement 4b is not a true statement.

Re-install related system components.

C(V). Vacuum Reservoir Check (Required on some catalyst converter control systems)

a) Disconnect vacuum hose on reservoir which connects to electric solenoid valve vacuum nipple.

b) Connect 10-30" vacuum gauge with suitable length of 3/16 vacuum hose to reservoir.

c) Remove manifold vacuum hose from reservoir and connect external vacuum source to this nipple. Charge reservoir to 14 in. Hg vacuum from external source and trap. Vacuum or gauge Step (b) should not drop more than 1 in. in one minute. Replace reservoir if out of specification.

d) Remove all test equipment, reinstall vacuum lines to the reservoir and torque all clamps and air cleaner to specification.

C(VI). Vacuum Delay Valve Check (only required on vehicles equipped with a delay valve in the *bypass valve vacuum line)*

Delay Valve Functional Test

Equipment Required:

a) Vacuum gauge—USG Model 12121-1, 2" dia. 0-30" Hg vacuum gauge or equivalent with .20" OD vacuum hose nipple adaptor and 24" of 5/32" ID Distributor Vacuum Hose or equivalent.

b) Stop watch or wrist watch with a sweep second hand.

c) External vacuum source capable of maintaining a constant vacuum (10"Hg minimum).

NOTE: The vacuum gauge must have a small internal volume and be free from external leakage.

Procedure:

1. a) Set external vacuum source to 10" Hg.
   b) Connect colored side of delay valve to vacuum source.

   NOTE: .20" OD to .27" OD adaptor may be required to connect colored side of valve to vacuum source.
   c) Connect the 24" section of vacuum hose to gauge and to white side of delay valve.
   d) Apply vacuum and observe time in seconds for gauge to read from 0" to 8" Hg with a constant 10" Hg vacuum source.

2. The minimum and maximum time for the valve to reach 8" Hg should be as follows:

Color Code	I.D. No.	Time in Seconds	
		Minimum	Maximum
White/Red	40	14.0	47.2
White/Blue	20	8.0	26.0

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When checking the delay valve, care must be exercised to prevent oil or dirt from getting into the valve as this will impair its function.

DIAGNOSIS GUIDE:

Replace delay valve if any of the above tests show the valve is out of specification.

C(VII). Temperature Vacuum System (TVS) Valve (Only on applicable models)

See Procedure SSD-9, Step 13: Air Cleaner *Temperature Control and Delay Valve.*

C(VIII). Thermactor Idle Vacuum Valve Diagnostic Procedure

Preparation

NOTE: Insure that bypass valve is OK per SSD-5, Step C.

A. Remove the thermactor idle vacuum (TIV) valve from the connector on the air bypass valve.

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B. Install a vacuum hose on the small nipple on the TIV valve and connect it to one leg of a 3-way "tee".
C. Connect the second leg of the "tee" to a vacuum gage and connect the third leg of the "tee" to the connector on the bypass valve.
D. Connect a vacuum gage to the intake manifold.
E. Warm up the engine to normal operating temperature.

Procedure

1. With engine at idle in neutral, disconnect the hose at the large diameter port of the TIV, and from another vacuum source, apply 3-1/2-4 in. Hg to the large port.
   Vacuum level on the gage at the bypass valve should increase to within 3 in. Hg or less of intake manifold vacuum.
2. If the vacuum does not increase to within 3 in. Hg or less, the TIV should be replaced.
3. If, when the 3-1/2-4 in. Hg vacuum source is removed from the TIV, the gage reading does not drop to 1.0 in. Hg or less, the TIV should be replaced.
4. At the conclusion of the above procedure, remove all test equipment and reconnect all vacuum hoses, connectors and the TIV valve.

C(IX). Air Bypass Valve Functional Tests (Timed Bypass Valve with Vacuum Vent Fig. 4)

Determine if the air bypass valve is functioning properly by performing the following operations:

1. If necessary, warm the engine to normal operating temperature with the transmission in neutral or park and the parking brake on.
2. Stop the engine and remove the air bypass valve to check valve hose at the bypass valve. For a tee system, remove both hoses connecting the bypass valve to the check valves. Cap the bypass valve vacuum vent nipple. Remove, or short circuit, any restricting or delaying device in the sense vacuum hose. Install a tachometer on the engine.
3. With the transmission in neutral or park and the parking brake on, start the engine. Accelerate the engine to 1500 rpm. Verify that air is flowing from the air bypass valve hose outlet connection(s) by placing hand over the valve connection. Air flow should be felt and heard. If no air flow is detectable, the valve must be replaced.
4. With the transmission in neutral or park, and the parking brake on, accelerate to 1500 rpm. With hand held over the bypass valve outlet, momentarily (approximately 5 to 8 seconds) pinch off the sense vacuum hose to the bypass valve to simulate the air bypass cycle. Release the pinched hose. Air flow through the bypass valve should be felt and heard to diminish or stop for a short period of time, then resume as before (normal air flow). The length of time required to resume normal air flow cannot be specified since the time interval is dependent on engine vacuum, and the length of time the vacuum line is pinched off. Air will be discharged through the exhaust ports in the valve silencer cover. If this cycle does not occur, the valve must be replaced.
5. Stop the engine and remove the cap from the vacuum vent nipple, and leave nipple open.
6. With the transmission in neutral or park and the parking brake on, start the engine. Accelerate the engine to 1500 rpm. Virtually no air flow should be detectable from the air bypass valve outlet(s). Air will be discharged from exhaust ports in the silencer housing. If air flow can be felt and heard at the bypass valve outlet(s) the valve must be replaced.
7. Stop engine. Correctly connect hoses to the sense vacuum nipple and the vacuum vent nipple.
8. Perform the following test ONLY if the air pump supply tester is available:
   Install the thermactor pump pressure gauge (Tool T75L-9486-A or equivalent) to the air bypass valve outlet using a short length of appropriate diameter hose. If the air bypass valve has two outlets, plug the one without the tester. Increase engine speed to 1000 rpm. Observe the pressure produced at the test gauge. The air pressure must be 2.25 (2-1/4) psi minimum. If the air pressure is not within specifications, replace the valve.
9. Turn off the engine, remove all test equipment and connect the air supply hoses(s) to the air bypass valve(s), and tighten all clamps.

C(X). EGR Vacuum Load Control Valve Test

1. With the engine warmed up, tachometer connected, and engine off, remove the air cleaner assembly from the carburetor, placing the air cleaner assembly in such a position so that the vacuum hoses ar not disconnected from the cold weather modulator valve(s) on the air cleaner.
2. Disconnect the vacuum supply hose, between the EGR vacuum load control valve and the vacuum reservoir, at the EGR vacuum load control valve and connect a vacuum gage to the EGR vacuum load control valve. Disconnect the vacuum supply hose between the venturi port of the carburetor and the EGR vacuum load control valve at the vacuum load control valve.
3. Start the engine and raise the speed to 1200-1500 rpm in neutral and observe the vacuum signal on the gage:
   a. If the vacuum signal is less than 4.0 in. Hg, replace the EGR vacuum load control valve.
   b. If the vacuum signal is 4.0 in. Hg or greater, apply one of the following vacuum levels from an external source to the venturi port of the load control valve and observe the first gage signal:

Decal Color of EGR Vacuum Load Control Valve	Vacuum Level (inches of Hg) Applied to Venturi Port
Blue	3.0
Red	4.5

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If the first gage signal does not drop to less than 2.0 in. Hg, replace the load control valve. If the gage signal drops to less than 2.0 in. Hg and does not return to greater than 4.0 in. Hg when the external source vacuum is removed from the venturi port, replace the vacuum load control valve.

C(XI). Thermactor Vacuum Vent Valve Functional Test

1. If necessary, remove the air cleaner assembly.
2. Disconnect the vacuum tubing or connector block from the valve (note the orientation for reinstallation).

   NOTE: It may be necessary to remove the valve from the bracket or air cleaner tray to gain access to the vacuum ports on the valve.

3. Connect the black (or cover) vacuum port to a manifold vacuum source.
4. Connect an external vacuum source to the white (or body) vacuum port.
5. Start the engine. With the engine at idle, in neutral, apply 10 in. Hg vacuum to the white port and trap. If 10 in. cannot be obtained, replace the valve.
6. Remove the manifold vacuum source line from the black port. The trapped vacuum should drop to zero. Replace the valve if the trapped vacuum does not drop to zero.
7. Remove all test equipment, reconnect all vacuum hoses and connectors and reinstall the valve and air cleaner assembly (if removed in Step 1).

C(XII) Thermactor PVS with Two Connectors Functional Check

1. Disconnect both vacuum hoses at the PVS valve. Connect vacuum gauge to bottom connector on the PVS. Connect auxiliary vacuum source of at least 10 in Hg to the top connector. With engine cold, no vacuum should be observed on the other side. If vacuum is observed, replace PVS.
2. Start engine and warm it up until engine coolant thermostat is open. (NOTE: hot air through the radiator.) Using same set-up as in Step 1, apply at least 10 in Hg to the top connector.
   a. If no reading is noted on vacuum gauge, PVS should be replaced.
   b. If vacuum is noted, PVS is OK.

C(XIII) Vacuum Check Valve Operation

1. For checking function:
   a. Set vacuum source at 5 in Hg.
   b. Apply vacuum to the check side of the check valve (white) and trap. After 30 seconds, the vacuum should not be less than 4 in Hg. If vacuum is less than 4 in Hg, replace valve.
2. For flowing function:
   a. Set vacuum source at 5 in Hg.
   b. Connect gauge to check side (white)—same side source was connected to in Step 1).
   c. Apply vacuum to opposite side (black); reading on gauge should be the same as source. If it is not, replace the valve.

C(XIV) Vacuum Reservoir Check

1. Disconnect vacuum hoses from both ends of the vacuum reservoir.
2. Plug one end with vacuum cap.
3. Connect Tool 21-0014 with a small hose to open end of the reservoir and apply vacuum of 10 in Hg. Vacuum should hold for 10 seconds.

   If vacuum is less than 10 in Hg after 10 seconds, replace vacuum reservoir.

D(I). Check Valve Test

1. With the engine stopped, inspect the hose(s) from the check valve to the bypass valve for any leaks due to cracks, splits, holes, etc. Replace if required.
2. Inspect the hose clamp(s) at the check valve for being properly positioned and tightened. Correct, position, tighten or replace as required.
3. Disconnect the thermactor hose(s) from check valve to the bypass valve at the bypass valve end.
4. Connect the thermactor check valve tester (Tool T75L-9487-A or equivalent) to the open end of the check valve hose. Position the hose clamp and tighten to specification.
5. Squeeze the rubber bulb, on the tester, to force as much air from the bulb as possible. Quickly release the bulb and start timing. The bulb should remain collapsed (not return to its original free shape) for at least 15 seconds.
6. If the test bulb does not return to its original free shape for 15 seconds, the check valve and hose are good. Remove the check valve tester from the end of the hose and reinstall the hose on the bypass valve. Position and tighten the hose clamp to specification.
7. If the test bulb returns to its original free shape in 15 seconds or less, both hose and check valve are questionable.
8. Remove the test bulb from the end of the hose. Remove the hose from the check valve. Install a 6 to 18 inch length of appropriate diameter hose to the check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5 above.
9. If the test bulb does not return to its original free shape for 15 seconds, it indicates the check valve is good and the original bypass valve to check valve hose should be replaced. Remove the test hose from the check valve and test bulb. Install a new hose of the proper part number, to the check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5 to be sure the new hose does not leak. After test, remove the hose clamp and test bulb. Install the hose on the bypass valve nipple. Position and tighten the hose clamp to specification.
10. If the test bulb returns to its original free shape (Step 8) in 15 seconds or less, the check valve is to be replaced.
11. Test the new check valve for leaks before installing on the engine. Connect a 6 to 18 inch length of appropriate diameter hose to the new

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check valve and test bulb. Position and tighten to specification a hose clamp at each end of the hose. Repeat Step 5.

12. Remove the hose from the check valve. Install the new check valve on the engine and torque to specification. Visually inspect the original hose for any surface condition that would cause a problem in the near future. Replace with a new hose if required. Install the hose on the check valve and bypass valve nipples. Route the hose as required. Position and tighten to specification a hose clamp at each end of the hose.

E. Step Not Required for 1978

F. Thermactor System Noise Test

NOTE: The thermactor system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the air injection system, disconnect the drive belt and operate the engine. If the noise disappears, proceed with the diagnosis, shown in Fig. 1.

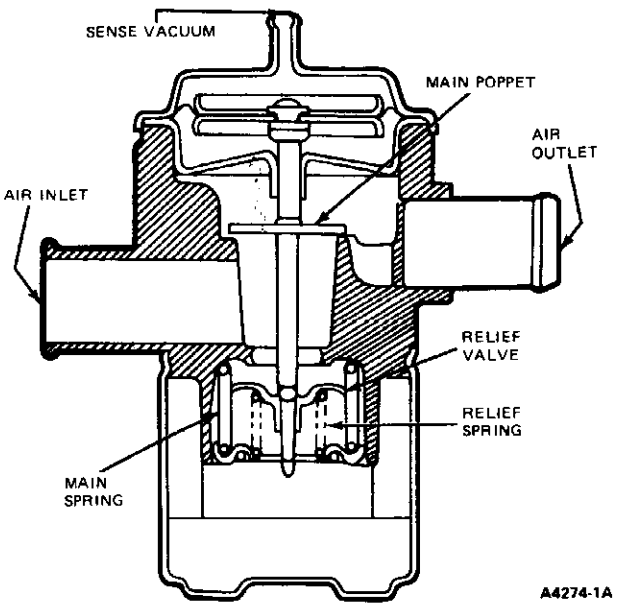


FIG. 3 Normally Closed Air Bypass Valve

SSD-6—CARBURETOR ICING

Generally, carburetor icing can occur if the outside temperature is 30° to 50°F and the relative humidity is 75 percent or greater. The symptons of carburetor icing are engine roughness or stalling on high cam or closed throttle modes, generally within the first five miles of a cold start and driveaway.

I. Review driver's complaint to see if the above conditions and symptoms existed at the time of the complaint.

II. If carburetor icing is suspected, perform SSD-9, air cleaner temperature control and delay valve, and SSD-10, exhaust heat control valve.

SSD-9—AIR CLEANER TEMPERATURE CONTROL

VACUUM OPERATED SYSTEMS CHECK

NOTE: On vehicles equipped with an air cleaner retard delay valve, check the valve according to SSD-2.

On vehicles equipped with a cold weather modulator, by-pass the modulator by connecting the two vacuum lines from the modulator.

CAUTION: This check must be performed in ambients of not less than 60°F.

Do not immerse any part of the vacuum-operated duct and valve assembly in water.

1. Apply parking brake and block wheels.

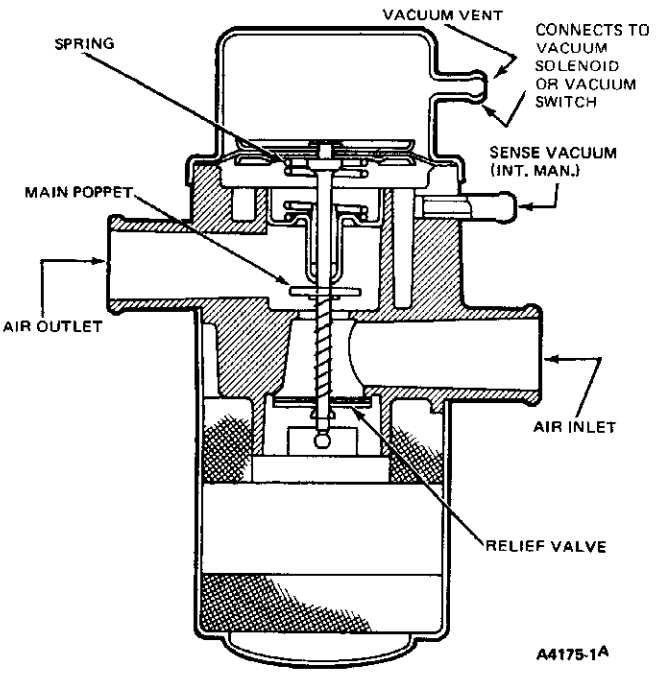


FIG. 4 Timed Air Bypass Valve with Vacuum Vent

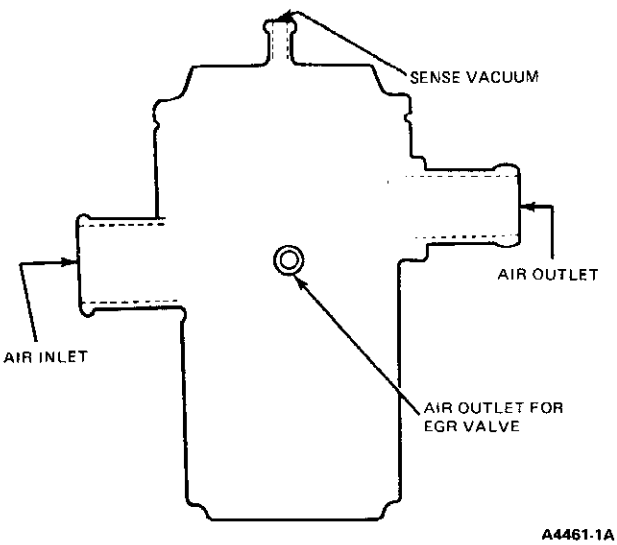


FIG. 5 Normally Closed Air—Bypass Valve with EGR Tap

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2. Remove the air cleaner cover and element. Inspect heat riser tube and zip tube for proper installation and/or damage. Repair or replace as required.
3. Remove items necessary to see the duct door.
4. Remove the vacuum line at the duct and valve. Look to confirm that the duct door is in the open (fresh air side) position. If the duct door is in the closed position, check for binding and sticking. Repair and/or replace as required.
5. Place a magnetic base temperature indicator (Kent-Moore J22973 or equivalent) as near as possible to the temperature sensor on the air inlet side.

   NOTE: Do not allow the temperature indicator magnet to touch the temperature sensor.

   If the air cleaner is aluminum, loop a piece of electrical or masking tape (adhesive side out) and press it against the temperature indicator magnet. Press the tape and the indicator against the air cleaner, as near as possible to the temperature sensor on the inlet side.
6. Start the engine. If the duct door is closed, proceed to Step 7. If the duct door is not closed, turn off the engine. Cool the temperature sensor by spraying with liquid from a small can of R-12 refrigerant and a 23-0009 can adapter or equivalent for 20 seconds after liquid contacts sensor.

   CAUTION: Do not cool the temperature sensor while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in well-ventilated area.

   Restart the engine. If the duct door is closed, proceed to Step 7. If duct door is open during idle, check related vacuum system per Appendix "A".
7. Reinstall the air cleaner cover without installing the wing nut(s).
8. With the engine running, observe the duct door. When the duct door starts to open, remove the air cleaner cover and note the temperature reading of the temperature indicator. It should be within the following specifications:

   For sensors color coded with a brown stripe: temperature should not exceed 90°F.

   For sensors color coded with a black or pink stripe: temperature should not exceed 100°F.

   For sensors color coded with a blue or yellow stripe: temperature should not exceed 115°F.

   (a) If the temperatures are greater than those specified here, replace the sensor.

   (b) If the air temperature is greater than 120°F and the door is less than 5/8 inch open, recheck Step 4. If the door is not binding or sticking, replace the sensor.

   If the duct door does not start to open within 5 minutes, remove the air cleaner cover and note the temperature. If temperature is less than those specified, the temperature is insufficient to operate the duct door. Reinstall the air cleaner cover without installing the wing nut(s) and run engine until the specified temperature is reached. If the duct door has not started to open by then, replace the sensor.
9. Turn off the engine. Remove all test instruments and check to insure that no extraneous dirt or sand is on the air cleaner tray or cover on the inside of the air cleaner element. If dirt is apparent, the assembly should be cleaned per the maintenance procedure. Reinstall the system components and torque the wing nut to specification.
10. Cold Weather Modulator (only on applicable models).
    a. Cool the cold weather modulator to 40°F or less. The modulator can be cooled by spraying with liquid R-12 refrigerant and a 23-0009 can adapter or equivalent. Allow sufficient time for the modulator temperature to stabilize and the modulator valve to close.

       CAUTION: Do not cool the cold weather modulator while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in a well-ventilated area.
    b. A 24-inch length of 1/4 inch ID vacuum hose should be used between the cold weather modulator and the vacuum gage. Using an external vacuum source, apply a minimum of 16 inches of vacuum to the vacuum motor side of the modulator and trap the vacuum. The modulator must hold at least 5 inches Hg vacuum for 30 seconds, otherwise replace the modulator.
    c. **With blue CWM D5DF-9E862-AA**

       Warm the modulator to 70°F or above. The modulator should not hold vacuum at or above this temperature. If the modulator does not function as indicated, it must be replaced.
    d. **With green CWM D7ZE-9E862-AA**

       Warm the modulator to 80°F or above. The modulator should not hold vacuum at or above this temperature. If the modulator does not function as indicated, it must be replaced.
11. Cold Temperature Actuated Vacuum System (only on applicable models) Temperature Switch Functional Test (Type 1)
    a. Disconnect the connector from the wiring harness.
    b. Connect the leads from an ohmmeter or self-powered test light to the temperature switch connector terminals.
    c. Cool the switch to a temperature below 40°F. The switch can be cooled by spraying liquid from a small can of R-12 refrigerant with a 23-0009 can adapter or equivalent.

       CAUTION: Do not spray the switch with liquid R-12 refrigerant while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

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When the switch is cooled below 40°F, the internal switch contacts should be open. The ohmmeter should read maximum resistance and the test light **should not** light.

If the switch does not open below 40°F, the switch should be replaced.

d. Increase the switch temperature until the temperature is above 70°F. The switch temperature can be increased by placing the palm of the hand on the metal surface of the switch or by starting the engine and allowing the exhaust manifold heat to increase the intake air temperature. When the switch temperature is above 70°F, the switch contacts should be closed. The ohmmeter should read zero resistance or the test light **should** light.

If the switch does not close, or if the ohmmeter indicates a resistance of 1 ohm or more, the switch should be replaced.

e. If it is necessary to replace the switch, check the operation of the new switch before connecting the wiring harness connector.

12. Cold Temperature Actuated Vacuum System (only on applicable models) Temperature Switch Functional Test (Type 2)

a. Disconnect the connector from the wiring harness.

b. *Connect the leads from an ohmmeter or self-*powered test light to the temperature switch connector terminals.

c. Cool the switch to a temperature below 40°F. The switch can be cooled by spraying liquid from a small can of R-12 refrigerant with a 23-0009 can adapter or equivalent.

CAUTION: Do not spray the switch with liquid R-12 refrigerant while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

When the switch is cooled below 40°F, the internal switch contacts should be closed. The ohmmeter should read zero resistance; the test light **should** light.

If the switch is cooled below 40°F, or if the ohmmeter indicates a resistance value of 1 ohm or more, the switch should be replaced.

d. Increase the switch temperature until the temperature is above 70°F. The switch temperature can be increased by placing the palm of the hand on the metal surface of the switch or by starting the engine and allowing the exhaust manifold heat to increase the intake air temperature. When the switch temperature is above 70°F, the switch contacts should be open. The ohmmeter should indicate maximum resistance and the test light **should not** light.

If the switch contacts do not open, the switch should be replaced.

e. If it is necessary to replace the switch, check the operation of the new switch before connecting the wiring harness connector.

13. Temperature Vacuum System Valve (only on applicable models)

a. TVS Valve—normally opened type (white)

1. Cool the TVS valve to 40°F or less. The valve can be cooled by spraying with liquid R-12 refrigerant and a 23-0009 can adapter or equivalent. Allow sufficient time for the valve temperature to stabilize and the TVS valve to close.

CAUTION: Do not cool the TVS valve while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

2. A 24-inch length of 1/4 inch ID vacuum hose should be used between the TVS valve and a vacuum gauge. Using an external vacuum source apply a minimum of 16 inches Hg vacuum to the 1/4 inch OD port of the TVS valve and trap. The TVS must hold at least 5 inches Hg vacuum for 30 seconds, otherwise replace the TVS valve.

3. Warm the valve to 80°F or above. The valve should not hold vacuum at or above this temperature. If the valve does not function as indicated, it must be replaced.

b. *TVS Valve—normally closed type (red)*

1. Heat the valve to 80°F or above. Attach a 24 inch length of vacuum hose (1/4 ID) between the 1/4 inch port of the TVS valve and a vacuum source and gauge. Apply and trap 16 inches Hg vacuum minimum in the valve system. The TVS valve must hold 5 inches Hg vacuum for 30 seconds; otherwise, replace the TVS valve.

2. Cool the TVS valve to 40°F or less. The valve can be cooled by spraying with liquid R-12 refrigerant and a 23-0009 can adapter or equivalent. Allow sufficient time for the valve temperature to stabilize and the TVS valve to open. The valve should not hold vacuum at or below this temperature.

CAUTION: Do not cool the cold weather modulator while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas may be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

If the valve does not function as indicated, replace it.

APPENDIX "A"

All Engines

A. Check air cleaner vacuum system integrity. Repair or replace as required.

B. Check the duct door for sticking or binding by depressing with fingers and allowing the internal vacuum motor spring to return the door to the normal position. Correct any sticking or binding before proceeding with test.

C. Disconnect the vacuum hose from the vacuum motor connector tube.

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D. Using an external vacuum source, apply a minimum of 16" Hg vacuum and trap. The vacuum motor should remain closed for 60 seconds. If not, replace the duct and valve assembly.

SSD-11—PCV SYSTEM

ALL VEHICLES—ALL ENGINES

I. Check PCV System Function:

A-1. **With the Engine Idling.**

1. Remove fresh air inlet of PCV system from rocker arm cover (located on side/end of engine opposite PCV valve).
2. Hold approved Ford PCV valve tester or equivalent over the opening in the valve cover, making sure there is a positive seal between the tester and cover.
3. Start the engine and allow it to operate at the idle speed.
4. If the ball settles in the good (green) area, the system is functioning properly. If the ball settles in the repair (red) area, disconnect the evaporative canister purge hose from the PCV line (if so equipped) TEE and cap. Recheck with tester. If the ball still settles in the repair (red) area, servicing of the system is needed. If the ball settles in the good (green) area, refer to SSD-22 to check the evaporative purge system.

NOTE: If a special PCV Tester is not applicable, use Alternate A-2.

A-2. **With Vehicle at Normal Operating Temperature:**

1. Remove the PCV valve from its mounting, leaving the valve hose attached. If the valve is functioning properly and not plugged, a hissing air noise will be heard as the air passes through the valve, and a strong vacuum should be felt when a finger is placed over the valve inlet. While finger is over the valve inlet, check for vacuum leaks in the hose line and at all connections.
2. Re-install the PCV valve, then remove the crankcase air inlet hose at the air cleaner connection. Loosely hold a small piece of stiff paper (such as a 3 x 5 memo card or parts tag card) over the opening at the end of the inlet hose. The paper should be sucked against the hose opening with a noticeable force **after** sufficient time has lapsed for the crankcase pressure to lower (usually about a minute or more).

B. **For 2.3L Engines Only**

Remove PCV valve from engine. Install a known good slave PCV valve. If idle quality improves, the original valve was not functioning normally.

C. **With the Engine Stopped**

Remove the PCV valve from its mounting and shake it. A metallic clicking noise should be heard, indicating the valve is free.

D. If the PCV system meets the requirements of tests A-1 or A-2, B (if applicable) and C, the system is functioning satisfactory and no further service is required. If it fails any of the tests, replace the PCV valve and clean the PCV system per Step II.

II. Clean PCV System:

1. Remove the PCV System components, filler cap, PCV valve, hoses, tubes, fittings, etc. from the engine.
2. Clean the rubber ventilation hose(s) by passing a suitable cleaning brush through them.
3. Thoroughly wash the rubber hoses in a low volatility petroleum base solvent and dry with compressed air.
4. Thoroughly wash the crankcase breather cap (if so equipped) in a low volatility petroleum base solvent and shake dry.
5. Thoroughly clean tubes, fittings, connections to assure unobstructed flow of emission gases.
6. Install a new PCV valve and re-install previously removed hoses, tubes, fittings, etc. to their proper location.
7. Replace any system component that shows signs of damage, wear or deterioration as required, particularly rubber hoses that no longer fit snugly onto fitting.
8. Replace any hose or tube that cannot be cleaned satisfactorily.

SSD-12—AUTOMATIC CHOKE CHECK PROCEDURE MODEL 2150 2V CARBURETOR

2.8L, 5.0L, 5.8L and 6.1L (302, 351 and 400 CID) ENGINES

I. Freedom of Linkage and System Integrity Check

With the engine off, perform the following operations:

1. Remove air cleaner, verify that the hold-down wingnut has not been over torqued thus causing the air cleaner housing to interfere with the choke plate operation. Also confirm that vacuum hoses, solenoid, and electric choke wires are properly connected and intact. Correct as required.
2. Check the following for freedom of operation: throttle system, choke plate, all linkages, fast idle cam, altitude compensator air bypass plate, if so equipped. Correct as required.

II. Choke Heat System Leakage and Flow and Flow Meter (Except 5.8L/6.1L [351M/400 CID])

1. Connect choke flow meter (Tool T75L-9850-A or equivalent) to choke cold air supply tube.
2. Warm engine to normal operating temperature and, at curb idle, observe flowmeter reading.
3. If flowmeter reading is within specification, remove and proceed to Section III.
4. If the flowmeter reading is not within specification, clean, repair or replace as required to meet flow specifications.

III. Electric Choke Function and Choke Plate Pulldown Check

1. Disconnect the stator lead at choke cap terminal and connect a test light in series with ground.
2. The light should glow at all times while engine is running.
3. If light does not glow, either the alternator or choke wire is defective and should be repaired as necessary.

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4. If necessary, restart the engine and warm to normal operating temperature.
5. Place test light in series with choke terminal and stator lead. If light does not glow, replace choke cap assembly. If light glows, turn-off engine. Remove light.
6. Manually open throttle and set on fast idle cam. Remove (see Caution in Step 10) the hot air supply tube at the choke housing and install a choke tester (14-0206 or equivalent). Cool choke housing per choke tester manufacturer's instruction until bimetal closes choke plate lightly in air horn.

   NOTE: Do not use choke tester manufacturer's time specification.
7. With throttle set on the highest step of the fast idle cam:

   • Record the index position of the choke bimetal cap for later use in resetting the cap.

   • Loosen retaining screws and rotate bimetal cap 90 degrees in the closing (rich) direction, and retighten screws.

   • Activate pulldown motor by applying vacuum to external vacuum tube.

   • Manually insure that the pulldown motor is fully retracted.

   • If motor does not fully retract with vacuum, test pulldown motor diaphragm for leakage.

   • If pulldown motor diaphragm is leaking and motor will not retract fully with vacuum, perform vertical hard gage measurement while manually forcing the motor to the fully retracted position.

   NOTE: Insure that choke plate linkage is not interferred with or erroneous measurement may result.

   • Measure vertical hard gage clearance between choke plate and center of carburetor air horn wall nearest the fuel bowl.

   • Pulldown setting should be within specifications.

   • If choke plate opening requirement is met, proceed to Step 7.

   • If choke pulldown motor is leaking or will not fully retract with vacuum, replace the motor.

   • Adjust choke plate vertical hard gage setting to value measured in previous steps by turning adjustment screws.

   • Apply Loctite 290 or equivalent to adjusting screw threads at base of the motor after adjustment. Allow 15 minutes set-up time for Loctite or equivalent to solidify.

   • Every time that the pulldown adjustment is made, perform the following fast idle cam setting procedure:

   —Open and close the throttle slightly and watch where the fast idle screw contacts the fast idle cam. (The fast idle screw should be set to the approximate high cam speed when making the cam setting.)

   —The fast idle screw should strike the second highest step at the "V" on the fast idle cam. The adjustment is made with the cam adjusting screw.

   —After making the cam adjustment, allow the choke plate to close. Check the choke plate to be sure it closes tightly in the air horn.
8. This completes the pulldown check. Next, install new choke cap gasket and reset the choke bimetal cap to previously recorded recommended index position and as specified in the vehicle specifications, and install new choke cap clamp. Reset retaining screws. Check and/or reset (according to specified procedure) fast idle speed to specifications if necessary. Recool choke housing per III-5, if required.
9. Reconnect terminal and alternator stator lead.
10. Disconnect the choke tester (14-0206 or equivalent) from the carburetor.
11. Install plug or cap in choke housing heat inlet port at carburetor.

    CAUTION: On 2.8L engine, move fast idle cam to kickdown step to avoid excessive rpm.

Start the engine without touching throttle and observe the following:

a. If diaphragm retracts.
b. Record the time from engine start up until the choke plate rotates to a vertical position.

If diaphragm fails to retract refer to Appendix A.

Complete rotation of the choke plate to vertical should occur within specification. If time exceeds specifications, repeat Electric Choke Function. If time still exceeds specifications replace choke cap and repeat Electric Choke Function.

If choke plate to vertical time is still not within specifications, check alternator and lead wire per shop manual. Repair and/or replace as required.

12. Remove the plug from the choke heat inlet. Reinstall the hot air supply tube (see Caution below).

    CAUTION: Exercise extreme care in removing, reinstalling and checking for leaks in the choke hot air supply tube, as its retaining nut could be easily cross-threaded.
13. Check choke heat system.
    a. Connect flow meter to choke cold air supply tube.
    b. Warm engine to normal operating temperature and, at curb idle, observe flowmeter reading.
    c. If flowmeter reading is within specification, remove meter.

       If flowmeter reading is not within specifications, clean, repair, or replace as required to meet flow specifications.

IV. Altitude Compensator Assembly—Internal

1. Remove the aneroid housing (the outermost housing) and gasket by removing the three machine screws.
2. This exposes the poppet valve assembly. Check the poppet valve for freedom of operation. Confirm that the poppet valve is free and returns to the seated position.
3. If poppet valve is sticky or binds, spray choke cleaner (C9AZ-19A501-B or equivalent) on the poppet valve and guide area to remove any deposits. Make sure that valve is completely free by depressing the valve.

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4. If further cleaning is required, remove altitude compensator assembly from the carburetor (removing four machine screws) and clean with lead-free fuel, or equivalent. If unable to free-up the valve, replace the altitude compensator assembly.
5. If required, reinstall the aneroid housing and gasket onto the valve housing (three machine screws).
6. Re-install systems components, torque air cleaner wing nut to specifications.

YFA 1V Carburetor 4.1L (250 CID) Engine

HOLLEY "1946" IV CARBURETORS 3.3L (200 CID) ENGINE

I. Freedom of Linkage and System Integrity Check

With the engine off, perform the following operations:

1. Remove air cleaner. Verify that vacuum hoses, solenoid and electric choke wires are properly connected and intact. Correct as required.
2. Check the following for freedom of operation: throttle system, choke plate and shaft, all linkages, fast idle cam, etc. Correct as required.

II. Choke System Leakage and Flow

1. Disconnect the choke clean air hose (rubber) from the carburetor air horn and attach choke flow meter (Tool T75L-9850-A or equivalent) to the hose. Disconnect and plug EGR vacuum hose at EGR valve and distributor vacuum advance hose.
2. Warm the engine to normal operating temperature. Place transmission in neutral. Bring engine up to 900-1000 rpm and observe choke flow meter reading.
3. If flow meter reading is within specification, remove flow meter. Reconnect the clean air hose to the carburetor, EGR hose to EGR valve, and distributor advance hose to distributor primary. Proceed to Section III.
4. If the flow meter reading is not within specification, refer to Appendix "A".

III. Choke Funtional Tests

1. Disconnect the stator lead at the connector leading from the choke cap and connect a test light in series with the stator lead and ground.
2. The test light should glow with the engine running.
3. If light does not glow, repair or replace either the alternator or choke wire.
4. Restart engine and warm to normal operating temperature. Place test light in series with choke terminal and alternator stator lead. If light does not glow, replace choke cap assembly. (Engine **and** choke cap must be warmed to normal operating temperature whenever choke cap is replaced.) If light glows, turn off engine. Reconnect choke terminal and alternator stator lead.
5. Remove (see Caution in Step 10) the hot air supply tube at the carburetor choke housing. Attach choke tester (14-0206 or equivalent). Manually set fast idle cam on high step. Cool choke housing until choke plate **just** closes.
6. Check for choke resistance by securing an ohmmeter across the choke cap terminal and choke ground strap.
7. This value should be within specification. If range is exceeded, replace choke cap and repeat III beginning with Step 4.
8. Recool choke housing until choke plate **just** closes. (If choke plate is closed, this step should not be performed.)
9. Remove choke tester (14-0206 or equivalent).
10. Install plug or cap in the choke housing heat inlet part at the carburetor (Model 1946 only).
11. With the heat tube removed and the choke plate closed (fast idle screw is positioned on the high step of the cam), disconnect the electric choke harness and connect a jumper wire from the positive terminal of the battery to the terminal on the choke cap. Observe that the choke plate opens to a vertical position with electrical assistance only. Record the choke come-off time. If the choke does not open with electrical assistance only, replace the choke cap and repeat III beginning with Step 4 (Model 1946 only).
12. With heat tube removed and choke plate closed (fast idle screw is positioned on high step of cam), start engine without touching throttle and see that choke opens to a vertical position with electrical assist only. Record choke come-off time. If choke does not open with electrical assist only, replace choke cap and repeat III beginning with Step 4 (except Model 1946).
    CAUTION: Exercise extreme care in removing, reinstalling and checking for leaks in the choke hot air supply tube as its retaining nut and/or choke housing can easily be cross-threaded.
13. Stop engine. Remove instruments and reinstall related system components. Torque carburetor wing nut (on air cleaner) to specification.

IV. Choke Plate Pulldown

A. Model YFA IV Carburetor

1. Remove the air cleaner assembly, then remove the choke thermostatic spring housing and gasket from the carburetor.
2. Bend a 0.026 in. diameter wire gauge at a 90 degree angle approximately 1/8-inch from one end. Insert the bent end of the gauge between the choke piston slot and the right hand slot in the choke housing. Rotate the choke piston lever counterclockwise until the gauge is snug in the piston slot. (See Fig. 6).

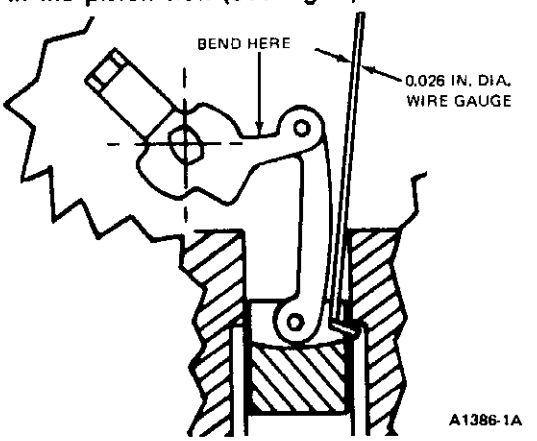


FIG. 6 Choke Plate Pulldown Adjustment

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3. Exert a light pressure on the choke piston lever to hold the gauge in place, then use a drill with a diameter equal to the specified pulldown clearance between the lower edge of the choke plate and the carburetor bore to check clearance.
4. To adjust the choke plate pulldown clearance, bend the choke piston lever as required to obtain the specified setting. When bending the lever, be careful not to distort the piston link.
5. Install the choke thermostatic spring housing and gasket. Set the housing to specifications.

B. Model 1946 IV Carburetor

1. Remove the air cleaner assembly.
2. Set the throttle on the highest step of the fast idle cam.
3. Cool the choke housing until the bi-metal closes the choke plate lightly in the air horn.
4. Record the index position of the choke bi-metal cap for later use in resetting the cap.
5. Loosen the retaining screws and rotate the bi-metal cap 90 degrees in the closing (rich) direction and retighten the screws.
6. Activate the pulldown motor by applying vacuum to the external vacuum tube.
7. Manually insure that the pulldown motor is fully retracted by pushing on the small metal plate in the bottom of the linkage slot on the pulldown shaft.
   NOTE: Do **not** push the linkage or the shaft itself as this will actuate the modulator spring.
   - If the motor does not fully retract with vacuum, test the pulldown motor diaphragm for leakage.
   - If the pulldown motor diaphragm is leaking and the motor will not retract fully with vacuum, perform the choke plate pulldown clearance test while manually forcing the motor to the fully retracted position.

   Warning: Insure that the choke plate linkage is not interferred with or erroneous measurement may result.
8. Use a drill of the proper diameter to check the clearance between the choke plate and the air horn.
9. The pulldown setting should be within specification.
10. If the choke pulldown motor is leaking or will not fully retract with vacuum, replace it.
11. To adjust the choke plate pulldown clearance, bend the choke pulldown linkage as required to obtain the specified setting.

V. Dechoke

1. Remove the air cleaner.
2. Hold the throttle plate fully open and close the choke plate as far as possible without forcing it. Use a drill of the proper diameter to check the clearance between the choke plate and air horn.
3. If the clearance is not within specification, adjust by bending the arm on the choke trip lever. Bending the arm downward will decrease the clearance, and bending it upward will increase the clearance. Always recheck the clearance after making any adjustment.
4. If the choke plate clearance and fast idle cam linkage adjustment was performed with the carburetor on the engine, adjust the engine idle speed. Adjust the dashpot (if so equipped).

VI. Fast Idle Cam Index Setting

1. Position the fast idle screw on the kickdown step of the fast idle cam against the shoulder of the high step.
2. Adjust by bending the choke plate connecting rod to obtain the specified clearance between lower edge of the choke plate and the carburetor bore.

Model 5200 2S/2V Carburetors and Model 6500 Feedback Carburetors

2.3L Engines (All Electric Choke Applications)

Section I—Freedom of Linkage and System Integrity Check

1. Apply parking brake and block wheels.
2. Connect tachometer.
3. Bring engine to normal operating temperature.
4. Turn off the engine.
5. Remove air cleaner assembly and plug vacuum line(s) to air cleaner assembly.
6. Verify that vacuum hoses, solenoid and electric choke wires are properly connected and intact, check that all carburetor hold down nuts are torqued to specification. Correct as required.
7. Check all carburetor linkages for freedom of operation. Repair or replace and adjust as required.

Section II—Bimetal and Linkage Functional Check

1. Inspect if bimetal index is set to specification. Correct as required.
2. With throttle held at 1/4 open position, rotate and hold choke plates to the closed plate position. Release choke plates; they should rotate smoothly to the fully open position. If choke plates do not rotate smoothly, clean and/or repair, then bring engine to normal operating temperature and recheck.
   Caution No. 1: If bimetal assist spring is to be removed during repair, extreme care must be taken so as not to deform the spring during removal and/or reinstallation.
   Caution No. 2: If fast idle cam latch assembly is removed during repair, the choke plates must be in the closed plate position prior to reinstalling the fast idle cam latch assembly to the choke housing. This will prevent damage to the delicate latch bimetal.
3. Cool the choke bimetal with a choke tester (14-0206 or equivalent) by blowing the cool air directly onto the choke bimetal housing cover. Cool housing for seven (7) minutes, then open throttle linkage to 1/4 open position and slowly release throttle. If the choke plates do not lightly seat themselves in the air horn bores, continue cooling for an additional minute, then open and close the throttle as mentioned above. If plates still do not close, repeat Section I, Step No. 6 and Section II, Steps No. 2 and 3.
4. Manually open choke plates to vertical position and open and close throttle to allow the cam to drop to the kickdown position. Release choke

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plates (choke plates will not close completely) and observe that the fast idle adjusting screw is seated on the kickdown step of the fast idle cam. If this condition is met, proceed quickly to Section III. If this condition **is not** met, repair or replace fast idle cam latch assembly, following Caution No. 2 as outlined in Section II, Step No. 2. Then recool bimetal (if necessary) according to Section II, Steps No. 3 and 4 and proceed quickly to Section III.

Section III—Electric Choke Functional Test

1. Without touching throttle, start the engine, position throttle and hold approximately 2500 RPM. Check the time for the choke plates to rotate to the vertical position and the time for the fast idle cam to drop from the kickdown position to the curb idle position.
   a) If time to rotate is **within** specification, let engine run until the fast idle cam drops to the curb idle position or a maximum of an additional 2 minutes.
      If cam does not drop within specification, check fast idle cam latch assembly installation as outlined in Section II, Step No. 2, Caution No. 2. If installation is satisfactory, replace fast idle cam latch assembly and check if cam drops.
      If cam drops within specification, no further tests are required. Turn off the engine; remove all test equipment and reinstall system components. Torque wing nuts to specification.
   b) If time to rotate is **not within** specification, proceed to Step No. 2.
2. Disconnect the stator lead at the choke cap terminal or at the lead connector and connect it to one lead of a test light. Connect the second test light lead to ground.
3. With engine running, observe **one** of the following conditions:
   a) If the light does not glow, either the alternator is not functioning or the automatic choke wire from the stator has an open circuit and should be repaired as necessary. Then, repeat Section II, Steps No. 3 and 4 and Section III.
   b) If the light glows, replace the choke bimetal assembly. Proceed to Step No. 4.
4. Turn off the engine, remove all test equipment and reinstall systems components. Torque air cleaner wing nuts to specification.

Model 4350-4V Carburetor—7.5L (460 CID) Engines

I. Freedom of Linkage and System Integrity Check

With the engine off, perform the following operations:

1. Remove air cleaner, verify that the vacuum hoses, solenoid and electric choke wires are properly connected and intact. Correct as required.
2. Check the following for freedom of operation: Throttle system (primary and secondary), air valve, choke plate, all linkages, fast idle cam, etc. Correct as required.

II. Choke Heat System Leakage and Flow Meter

1. Disconnect the choke clean air hose from the carburetor air horn and attach a flow meter to the hose.
2. Warm engine to normal operating temperature and observe flow meter reading.
3. If flow meter reading is within specification, remove the flow meter, reconnect the clean air hose to the carburetor and proceed to Section III.
4. If the flow meter reading is not within specification, refer to Appendix A.

III. Choke Functional Checks

1. Disconnect the stator lead at choke cap terminal and connect a test light in series with ground.
2. The light should glow at all times while engine is running.
3. If light does not glow, either the alternator or choke wire should be replaced as necessary.
4. Place test light in series with choke terminal and stator lead. If light does not glow, replace choke cap assembly. If light glows, turn off engine.
5. Remove (see caution in Step 9) the hot air supply tube at the choke housing and install a choke tester (14-0206 or equivalent). Cool choke housing per choke tester manufacturer's instruction until bimetal closes choke plate lightly in air horn.
6. Check for choke resistance by adequately securing an ohmmeter across the choke cap terminal and choke ground strap.
7. This value should be within specifications. If out of specifications, replace choke cap assembly. Remove Ohmmeter.
8. Apply external vacuum 16" (Hg)+ 2" to pulldown control diaphragm. Measure (at lower edge) choke plate opening. Pulldown setting should be within specifications for minimum choke plate opening. If choke plate minimum opening is met, continue with Diagnosis. Reset pulldown if found to be out of specification.
9. Remove choke tester from adaptor.
10. Start the engine without touching throttle and observe the following:
    —*If diaphragm retracts.*
    —On applicable models, the fast idle cam should rotate and throttle should move to kickdown step of cam in specified time.
    —That the choke plate rotates to the specified position within the specified time.
    NOTE: The choke plate time to rotate to the specified position is measured from engine start-up until the choke linkage moves the secondary throttle lockout nut **just** clear of the secondary throttle shaft lever.
    If any of these conditions are **not** met, refer to the appropriate section of Appendix A.
11. Re-install hot air supply tube.
    CAUTION: Use extreme care in re-installing the hot air supply tube as its retaining nut could easily be cross-threaded.
12. Stop the engine. Remove instruments and reinstall related system components. Torque the air cleaner wing nuts to specification.

IV. Choke Plate Pulldown Check

1. Remove the choke thermostatic spring housing assembly.

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2. Open throttle about half-throttle and position the fast idle adjusting screw on the high step of the fast idle cam.
3. Bend a 0.036" diameter wire gauge at a 90 degree angle approximately 1/8" from its end. Insert the bent end of the gauge between the choke piston slot and the upper edge of the right-hand slot in the choke housing.
4. Inspect vacuum piston linkage for binding between pin and slotted link, by rotating thermo-spring lever.
5. Rotate the choke thermostat lever counterclockwise until the gauge is snug in the piston slot. Hold the gauge in position with light force on the lever and move the top of the choke rod away from the carburetor while moving the bottom of rod toward carburetor to remove end play from linkage.
6. Using a drill gauge or equivalent, check initial choke pulldown clearance by placing the gauge against the inner wall of the choke air horn on the downstream side at approximately the longitudinal centerline of the carburetor and check clearance from wall to edge of choke plate.
7. If the measured clearance is not within specifications, adjust clearance by turning the hex-head lock screw on the choke shaft in a clockwise direction three (3) full turns. (NOTE: Lock screw is left hand threaded.) Pry choke lever from choke shaft to break taper lock. Choke lever should rotate freely on the choke shaft.
8. Hold the drill gauge with diameter equal to specified pulldown clearance between the lower edge of the choke plate and air horn wall, maintaining light closing force on choke plate.
9. With choke piston snug against the 0.036 inch wire gauge, the top of the choke rod held away from the carburetor while moving the bottom of the rod toward the carburetor to remove end play from linkage and the choke plate held against the drill gauge, tighten the hex-head screw on the choke shaft.
10. Reinstall the choke thermostatic spring housing assembly.
11. Check altitude compensator assembly (if so equipped) as follows:
    a. Remove the aneroid housing (outer most housing) and gasket by removing the three machine screws.
    b. This exposes the poppet valve assembly. Check the poppet valve for freedom of operation. If poppet valve is free, proceed to (10d).
    c. If poppet valve is sticky or binds, spray choke cleaner (C9AZ-19A501-B or equivalent) on the poppet valve and guide area to remove any deposits. Make sure that valve is completely free by depressing the valve. If unable to free-up the valve, replace the altitude compensator assembly.
    d. Re-install the aneroid housing and gasket onto the valve housing (three machine screws).
12. Re-install system components. Torque carburetor wing nut (on air cleaner) to specification.

SSD-12 AUTOMATIC CHOKE CHECK
PROCEDURE

Model 2700 Carburetor

I. Freedom of Linkage and System Integrity Check With the Engine Off, Perform the Following Operations:

1. Remove the air cleaner. Confirm that vacuum hoses, solenoid and electric wires are intact and properly connected. Correct as required.
2. Check the following for freedom of operation: Throttle system linkage, all choke linkages (fast idle cam, levers, etc.). The throttle should be held open slightly for this check. Correct as required and/or clean according to the choke linkage cleaning procedure.

II. Choke Heat System Leakage and Flow with Flow Meter

1. Connect flow meter T75L-9850-A or equivalent to choke cold air supply tube. (Use a 9/32" ID (Minimum) adaptor between the choke tester and the cold air supply tube.)
2. Warm engine to normal operating temperature and at curb idle, observe flow meter reading.
3. If flow meter reading is within specification, remove and proceed to Section III.
4. If flow meter reading is not within specification, clean, repair or replace as required to meet flow specifications.

III. Electric Choke Function and Kickdown Check

1. Bring engine to normal operating temperature and turn off. Disconnect the stator lead at the choke cap terminal. Connect a test light in series with the stator lead and ground.
2. The light should glow at all times while engine is running.
3. If light does not glow, check alternator and choke wire and repair as necessary.
4. Place test light in series with choke terminal and stator lead. If light does not glow, replace choke cap assembly. If light glows, turn off engine.
   NOTE: If choke cap is replaced, repeat Step 4 to check system and heat bi-metal disc to close contact on electric choke cap.
5. Remove (see caution in Step 13) the hot air supply tube at the choke housing and install a choke tester (14-0206 or equivalent).
6. Open to 1/2 throttle to set the fast idle lever on the specified Step of the fast idle cam (Fig. 7).
7. Cool choke housing per choke tester manufacturer's instructions until the cam lever just touches the cam adjusting screw (Fig. 7). **Do not follow choke tester manufacturer's time specifications.**
8. H.C.S.P. diaphragm check.
   a. Open the throttle and manually move H.C.S.P. to its retracted position.
   b. Close throttle with H.C.S.P. retracted.
   c. Open and close throttle to observe if H.C.S.P. automatically positions itself between fast idle cam and fast idle lever.
   d. Repeat Steps a, b, and c three times to assure proper operation.

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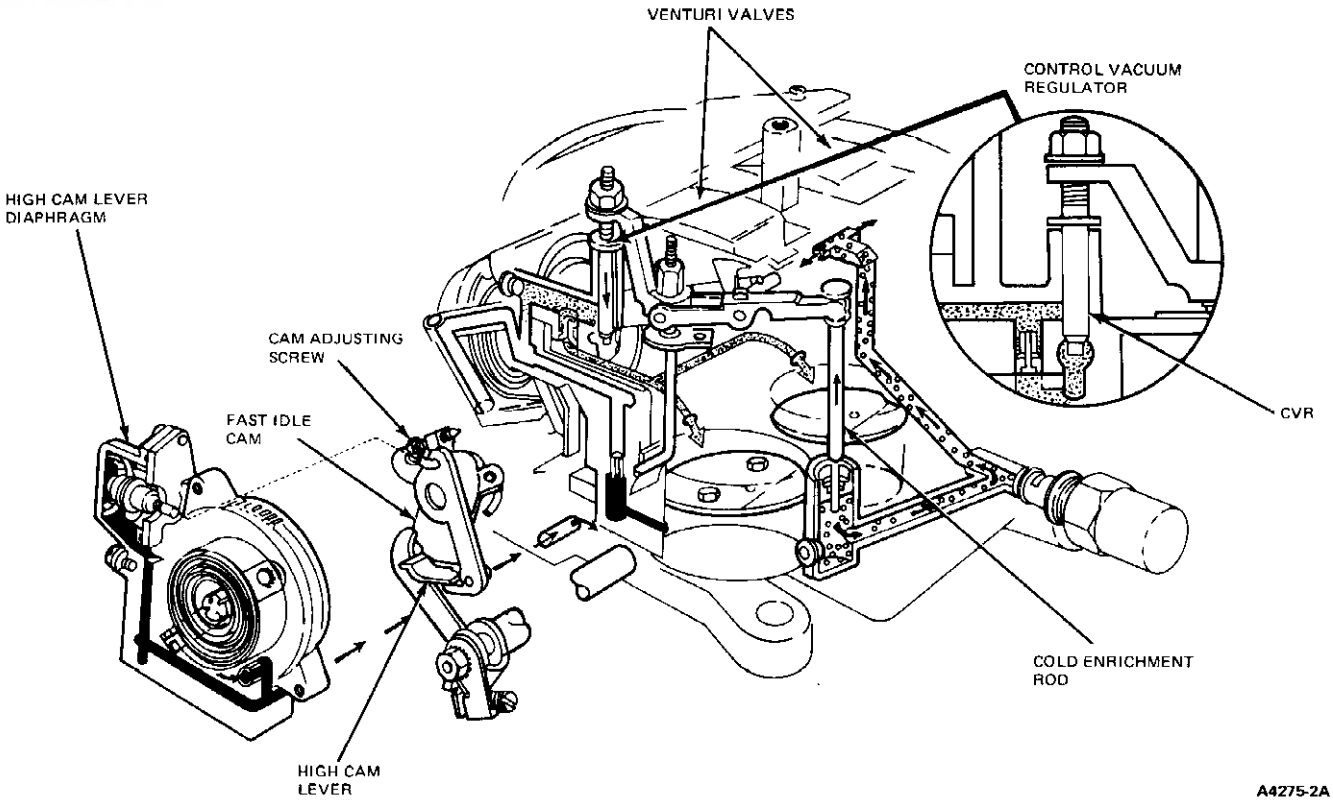


FIG. 7 Model 2700 VV Carburetor

e. If H.C.S.P. function is OK, proceed with Step 9. If not OK, refer to Appendix "A" for corrective action.

9. Remove choke tester. Start engine without touching throttle. Open throttle—the H.C.S.P. should retract. If the H.C.S.P. fails to retract, refer to Appendix "A" for corrective action. Shut engine off.
10. Install choke tester 14-0206 or equivalent.
11. Open to 1/2 throttle to set the fast idle lever on the specified Step of the fast idle cam.
12. Cool choke housing per instructions until the cam lever just touches the cam adjusting screw. **Do not follow choke tester manufacturer's time specification.**
13. Remove choke tester from adaptor and reconnect alternator stator lead to choke terminal.
    CAUTION: Exercise extreme care in removing, re-installing and checking for leaks in the choke hot air supply tube, as its retaining nut could be easily cross-threaded.
14. Start the engine without touching the throttle. Record the time in seconds required for the choke metering rod to move downward to the seated position. Recorded time should be within specification.
15. *If time exceeds specification, repeat Steps 10-14.*
16. If time still exceeds specification, proceed to Appendix "A".
17. Choke heat system check:
    a. Connect a flow meter to the choke cold air supply tube.
    b. Warm engine to normal operating temperature—and, at curb idle, observe flow meter reading.
    c. If flow meter reading is within specification, remove meter.
    d. If flow meter reading is not within specification, clean, repair, and/or replace as required to meet flow meter specification.
18. Remove instruments and re-install related system components.

IV. Cold Cranking Enrichment Circuit Check

1. Check the electrical connections of the carburetor cranking solenoid circuit for proper installation. Repair and/or replace as necessary.
2. **Check the water temperature switch for proper operation.** Disconnect the wiring harness at the water temperature switch. Measure the resistance between the cold terminal (marked "C" or "R") of the water temperature switch and engine ground. The resistance should be less than one ohm on a cold engine and a warm engine should indicate infinite resistance or an open circuit. If the engine is warm, above 125 degrees, remove the water temperature switch and cool to less than 125 degrees and recheck resistance. If both hot and cold resistance are not *met, replace the water temperature switch.* (*Do* not reinstall temperature switch at this time.)
3. **Check the cranking circuit harness.** Connect the harness to the temperature switch (switch must remain below 125 degrees). Disconnect the wiring harness at the cranking solenoid and place

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a test light across the terminals on the harness connector (female receptacle). While cranking the engine the test light should glow. If light does not glow, repair and/or replace cranking electrical circuit. Then repeat Step 3. If light glows, install water temperature switch and proceed.

4. **Check for cranking solenoid activation when battery voltage is applied.** Run two jumper wires to solenoid, one from positive terminal of the battery, the other from engine ground. There should be a distinct click (or audible sound). Repeat three times. If a click is not heard, replace the cranking solenoid according to Appendix B. If click is heard, proceed.
5. Reconnect the harness to the temperature switch making sure the rubber boot is not rolled under, and reconnect the cranking solenoid to the wiring harness.

MODEL 2700 CARBURETOR CAM SET PROCEDURE

Special Tool: 120 degrees Index Stator Choke Cap T77L-9848-A

1. Remove choke cap.
2. Hold throttle lightly closed with a rubber band to maintain cam position.
3. Place the fast idle lever in the corner of the steps (see specification for proper step setting) of the fast idle cam with the H.C.S.P. assembly in its retracted position (Fig. 7).
4. Install 120 degrees stator cap.
5. Turn the cam adjusting screw until the index mark on the stator cap lines up with the proper mark on the choke casting (see specification). Make sure the fast idle lever is still in the corner of the step.
6. Remove the stator cap and reinstall the choke cap, making sure that the tang is engaged in the choke bimetal lever.

MODEL 2700 CARBURETOR CHOKE SET PROCEDURE

Special Tools Needed:

1) Dial indicator Tool-4201-C or equivalent.
2) Choke weight and 120 degrees index stator choke cap T77L-9848-A or equivalent.

Procedure:

1) Remove choke cap.
2) Install choke weight on the choke bi-metal lever.
3) Remove air cleaner stud and install dial indicator with the tip on the top surface of the choke metering rod. With the choke weight in place, adjust dial indicator to read zero. Make sure the zero repeats. This is critical.
4) Remove choke weight.
5) Install 120 degrees index stator choke cap at index. Verify that dial indicator reading conforms to vehicle specification. If not proceed to Step 6.
6) Turn the choke rod indexing nut (clockwise to increase or counterclockwise to decrease the height) to achieve specification (Fig. 7).
7) Repeat Steps 2 thru 6 to establish repeatability. Adjust if necessary.
8) Remove the stator cap and dial indicator.
9) Re-install the choke cap at index assuring that the bimetal tang is properly inserted in the cam bimetal lever. Re-install air cleaner stud.

APPENDIX A (EXCEPT MODEL 2700 CARBURETOR)

Diaphragm Fails to Retract

1. Check for binding of linkage—repair or replace as required.
2. Check for cracked vacuum hose (on carburetors with external vacuum supply, check vacuum supply to diaphragm).
3. Check for plugged vacuum channel (2V carburetor). Remove vacuum hose at diaphragm. Connect a vacuum source to the hose and trap. If a vacuum reading is maintained, the system is plugged. Clean, repair and/or replace as required.
4. Check for vacuum leak at gasket surfaces or ruptured diaphragm.
5. Check for loose attachment. Correct, repair or replace as required.

Fast Idle Cam Does Not Rotate or Does Not Meet Minimum Time Specification

- Check adjustment and reset as required to insure that fast idle screw rests on fast idle cam kickdown step when diaphragm is fully retracted.
- Check for leaks in diaphragm assembly if time is excessive.
- Replace diaphragm assembly if restriction cannot be cleared.

Choke Plate Does Not Open to Specified Position in Specified Time

- Check for binding linkage.
- Remove thermo assembly and inspect the vacuum piston linkage for binding between the pin and the slotted link.
- If plate does not rotate to specified position in prescribed time, replace choke thermo assembly.

Choke Heat System Flow Not Within Specification

1. Check for leaks; tighten connections in the hot air circuit.
2. Disconnect the hot air tube from the choke housing.
3. Connect choke flow meter to hot air connection on the choke housing.
4. If choke flow meter reading is within specification, check air supply system. Clean, repair or replace as necessary.
5. If choke flow meter reading is not within specification, clean, repair or replace as necessary.

Choke Pulldown Adjustment

1. Make certain that choke plate is lightly closed in carburetor air horn. (If engine is warm use choke

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DETROIT IRON

tester, 14-0206 or equivalent, to cool choke until choke plate lightly closes in the air horn.)

2. Note index position of bimetal cap and wrap choke cap 90 degrees in the rich direction (CCW) from that position and secure.
3. Activate pulldown motor manually or with external vacuum if the pulldown motor has an external vacuum tube.
4. Set specified MEAN choke plate opening between choke plate and the center of the carburetor air horn nearest to the fuel bowl by turning the adjusting screw at the back of the pulldown motor.
5. After the adjustment is made, apply Locitite 290 or equivalent to the threads of the adjusting screw where it enters the pulldown motor.
6. Return choke cap to its original position.

APPENDIX "A" FOR VEHICLES EQUIPPED WITH 2700-VV CARBURETOR

I. H.C.S.P. Diaphragm Fails to Retract (Fig. 7)

A. Check for binding, misaligned linkages, broken parts, contamination and/or loose parts. Repair and/or replace.

B. If repair or replacement was made, check H.C.S.P. diaphragm to see if it retracts, by repeating Section III, SSD-12 (Steps 5-8). If diaphragm retracts, return to Diagnostic Procedure, Step 9. Otherwise, perform Steps 1-4 of C.

C. If repair or replacement was not made, proceed as follows:

1. Remove carburetor.
2. Remove H.C.S.P. diaphragm cover and check the sealing surface for a cracked, bent, distorted or chipped surface or for contamination. Replace or repair as required.
3. Using hand vacuum pump 21-0014 or equivalent, apply a vacuum to the vacuum passage in the H.C.S.P. diaphragm flange. If a vacuum reading is maintained, the system is plugged. If plugged, clean as required.
4. Remove the H.C.S.P. diaphragm from its base, being careful not to tear or distort it. Inspect it for pinholes, cracks, or decomposed diaphragm material:

a. If the H.C.S.P. diaphragm is satisfactory, reinstall the diaphragm cover taking care to align all vacuum passages. Check linkage and diaphragm for freedom of movement. Install carburetor on vehicle making all necessary connections, and return to Step 9.

b. If the H.C.S.P. diaphragm needs replacement, proceed as follows:

1) Unscrew diaphragm assembly.
2) While holding the throttle lightly in the closed throttle position, rotate the fast idle cam so the fast idle lever and the high cam choke lever rest on a cam step. The fast idle lever should now be resting at the bend in the H.C.S.P. as shown in Fig. 7.
3) Still holding the throttle in the closed position, gently screw diaphragm assembly onto shaft until it bottoms. Then to align the vacuum passage and hole in the diaphragm, rotate the diaphragm counterclockwise until aligned.

NOTE: The H.C.S.P. diaphragm can only be adjusted in increments of one full turn. The vacuum passage in the diaphragm must be aligned with the vacuum passage on the flange.

4) Install diaphragm spring and cover assuring that the vacuum passages are aligned and that the mechanism works freely.
5) Using a hand vacuum pump 21-0014 or equivalent, blocking vacuum passage which enters choke housing from the underside of throttle body, apply a vacuum to the choke hot air inlet making sure that the fast idle lever is free to allow cam and choke lever movement. The H.C.S.P. diaphragm should retract.
6) If the H.C.S.P. diaphragm fails to retract, remove the choke cap and apply a vacuum using the hand vacuum pump 21-0014 or equivalent to the heat restrictor vacuum passage next to the choke bimetal. Again the vacuum passage in the underside of throttle body near the choke housing must be plugged, clean as required. If the H.C.S.P. diaphragm retracts, reinstall choke cap, inspecting gasket and cap to insure their good condition and install carburetor on vehicle. If the diaphragm still fails to retract check for leaks in choke housing at the lead seals and at H.C.S.P. diaphragm seating surface. Repair or replace as necessary.
7) Install carburetor on vehicle making necessary connections and check to make sure the repaired mechanism is functional on running vehicle.

II. If the Choke Metering Rod Mechanism Fails to Move Downward Within the Specified Time.

A. Disconnect the stator lead at choke cap terminal. Connect a test light in series with stator lead and ground.

B. The light should glow at all times while engine is running.

C. If light does not glow, either alternator or choke wire should be repaired as necessary.

D. Place test light in series with choke terminal and stator lead. If light does not glow, replace choke cap assembly. If light glows, turn off engine.

E. Check for damaged, missing, and/or misaligned parts. Check for dirt, grease or any foreign material on moving parts. Repair or replace and clean as required. If any linkage is repaired or replaced check choke set and cam set. If necessary, reset per Choke Set and Cam Set Procedure.

F. If any corrective action is taken in Steps A thru E, re-install Stator lead and then perform electric choke function check, Section III, Steps 10 thru 14. If choke metering rod moves downward within the specified time, return to Diagnostic Procedure Step 17; otherwise, proceed to Step G.

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G. Remove carburetor from vehicle.
1. Remove the retaining ("E") ring which holds the choke operating rod to the cam lever and remove the linkage from the cam lever (Fig. 7).
2. Open the throttle slightly and check cam lever for freedom of movement. The choke cap spring should provide the only resistance and the cam lever should spring back to the original position.
3. If movement is OK, proceed with Step 4. If the *cam movement is still not free, remove the* throttle body from the carburetor. Remove the choke cap and disassemble the choke shaft, the cam lever, and the fast idle cam. Check the surfaces of all parts for grease, foreign material, bends, cracks, or distortion. Clean and replace parts as necessary. If a new fast idle cam is installed, refer to the Model 2700 carburetor cam set procedure. Install throttle body on carburetor and toruqe to specifications.
4. Check remaining parts of choke system for freedom of movement by manually moving choke operating rod up and down. The movement should be free.
   If movement is OK, proceed with Step "e". If the movement is not free, remove the retaining ("E") ring and pin from the choke metering rod lever (Fig. 7).
   Carefully lift the choke metering rod, the choke CVR rod, and the choke metering rod lever up and out of the air horn as far as the choke operating rod will allow. Inspect the parts for foreign material, bends, distortion or breakage, clean and replace as necessary. If the choke CVR needs replacing, replace and set per Control Vacuum Regulator (CVR) adjustment procedure.
5. Make sure the choke operating rod is connected to the cam lever with the retaining ("E") ring.
6. Install carburetor on vehicle making sure all parts operate freely. Connect all vacuum hose(s) and electrical wires.

APPENDIX "B FOR VEHICLES EQUIPPED WITH MODEL 2700 CARBURETORS

I. Replacement of Electric Cranking Solenoid

A. Remove carburetor from vehicle.
B. Remove electric solenoid from main body of carburetor.
C. Coat the "O" ring seal of the new solenoid with a mild solution of soap and water. This is important as a damaged "O" ring may result in a fuel leak.
D. Install the cranking solenoid to the carburetor being careful not to damage the "O" ring. *Torque to specification (See Part 24-27).*
E. Install carburetor on the vehicle making all the necessary connections.

MODEL 2700 CARBURETOR HIGH CAM FINGER SETTING PROCEDURE

Open to 3/4 throttle and depress choke operating rod to full travel, then close throttle. The fast idle lever should be resting at the bend in the H.C.S.P. as shown in Fig. 7. If not, repair and/or replace as required.

MODEL 2700 CARBURETOR CHOKE LINKAGE CLEANING PROCEDURE

1) Remove choke cap.
2) Using automatic choke cleaner (C9AZ-19A501-B) or equivalent, spray inside of choke cap on and near the bi-metal until dirty deposits and dirt buildup is washed away.
3) **Using the Wand Provided with the Cleaner,** spray all areas of the choke thermostat shaft inside and out of choke housing. Also, spray the entire choke linkage external to the carburetor. Use abundant amount of spray and move the choke thermostat lever, the fast idle lever, and the fast idle cam moderately while spraying.
4) Blow the choke parts previously cleaned with compressed air until visibly dry. Again, move the moveable parts moderately while blowing dry.
5) Repeat Steps 3 and 4.
6) Install choke cap gasket, choke cap (making sure that it is properly indexed) and choke cap retainer ring. Torque screws to specification.

MODEL 2700 CARBURETOR CONTROL VACUUM REGULATOR (CVR) ADJUSTMENT PROCEDURE

NOTE: The cold enrichment metering rod adjustment *must be checked and/or set before making* this adjustment.

1. Loosen the screws on the choke cap and rotate it 180 degrees clockwise (rich direction) from index and cycle the throttle to set the cam.
2. Press lightly on the CVR rod (Fig. 8), if there is any downward travel, the rod is not seated and must be adjusted. If there is no downward travel, turn the adjusting screw counterclockwise until there is some travel and proceed with the adjustment.
3. Turn the CVR rod clockwise until the adjusting nut just beings to rise (see Fig. 8).

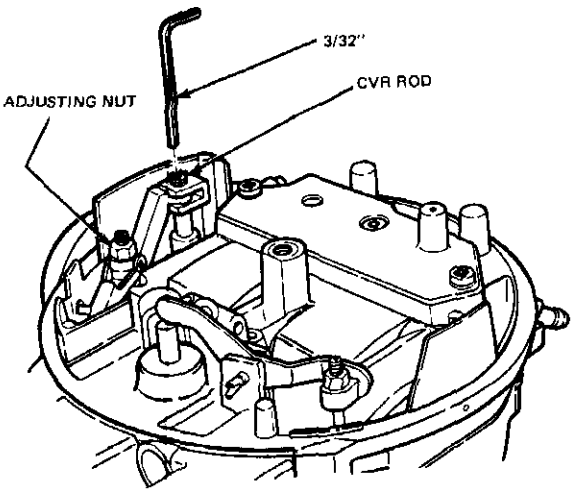


FIG. 8 Adjusting CVR (Control Vacuum Regulator)

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4. Again, press lightly on the CVR rod—if any springback can be seen, the rod is not fully seated. Turn the adjusting screw clockwise by 1/4 turn increments until no springback can be seen.
5. Reset the choke cap to the specified setting.

SSD-13 IDLE FUEL MIXTURE

A. Propane Enrichment Method

NOTE: Leave all vacuum signal hoses attached to the air cleaner assembly when relocating the assembly to perform carburetor adjustments. **The air cleaner assembly must be installed, however, when measuring engine speeds.**

—Some engines may experience normal oscillations in idle speeds which could cause variations in engine speed measurement. If this condition is encountered, use the **average** engine speed.

1. Apply the parking brake and block the wheels. Then, start the engine, bring to normal operating temperature, and turn off.
2. Connect a tachometer.
   NOTE: If the engine has a "Dura-Spark I" ignition system (blue coil tower), use tachometer 02-0362 or equivalent.
3. If so equipped, disconnect the fuel evaporative purge valve signal vacuum hose as follows:
   Trace the purge valve vacuum hose from the purge valve (located on the canister) to the first point where the vacuum hose can be detached from the underhood hose routing, (vacuum tee connection, PVS, etc.). Disconnect the vacuum hose at **that** point, cap the open port and plug the vacuum hose.
   CAUTION: To prevent possible damage to the purge valve, **do not** disconnect the vacuum hose **at the purge valve.**
4. If so equipped, disconnect the evaporative emission purge hose at the air cleaner and plug the nipple.
5. Disconnect the crankcase ventilation closure hose from the air cleaner and plug the nipple.
6. Disconnect the flexible fresh air tube from the air cleaner duct or adaptor. Using a propane enrichment tool (T75L-9600-A or equivalent), insert the tool hose approximatley 3/4 of the way into the duct or fresh air tube. If necessary, secure the hose with tape.
7. Verify that the idle mixture limiter(s) is set to maximum rich position (counterclockwise against the stop); correct if required.
8. For vehicles equipped with Thermactor systems, revise the dump valve vacuum lines as follows:
   a. For dump valves with one or two vacuum lines at the side, disconnect and plug the line(s).
   b. For dump valve with one vacuum line at the top, check line to see if it is connected to intake manifold vacuum. If not, remove and plug the line at the dump valve and connect a slave line from the dump valve vacuum fitting to an intake manifold vacuum fitting.
9. Check engine curb idle rpm (or A/C - off rpm) according to procedure SSD-26; if necessary, reset to specification.

   NOTE: Even if the vehicle has less than 100 miles of operation, set the speed to the "normal" engine specification and not the green engine spec.
10. With the engine idling, place the transmission selector in the position specified for the idle fuel mixture check (see the note below). Gradually open the propane tool valve and watch for engine speed gain, if any, on the tachometer. When the engine speed reaches a maximum and then begins to drop off, note the amount of speed gain.
    NOTE: -On vehicles equipped with automatic transmission, the transmission selector position in which curb idle speed is set **may differ** from the position in which the idle fuel mixture check is performed. Be sure the correct transmission selector position is employed in both cases.
    - With the transmission in neutral, run the engine at approximately 2500 rpm for 15 seconds before each mixture check.
    - If the engine speed will not drop off, check the bottle gas supply. If necessary, repeat Step 10 with a new bottle gas supply.
11. Compare measured speed gain to specified speed gain:
    NOTE: If it is determined that idle fuel mixture adjustment will be necessary, adjust the mixture according to the **reset** rpm specification.
    • Certain engines have unique "green" engine idle fuel mixture specifications. If the vehicle has less than 100 miles of operation, be sure to use these specifications.
    a. If the measured speed gain is within specification, except as noted below, proceed to Step 12.
       NOTE: If the measured speed gain is "0" rpm (no rpm rise) and the minimum speed gain specification is "0" rpm, proceed to Step 11d.
    b. If the measured speed gain is **higher** than the speed gain specification:
       - Turn the mixture screw(s)/limiter(s)* **counterclockwise** (rich) in equal amounts and simultaneously repeat Steps 8-9 until the measured speed rise meets the **reset** rpm specification. After final adjustment, proceed to Step 12.
    c. If the measured speed gain is **lower** than the speed gain specification:
       - Turn the mixture screw(s)/limiter(s)* **clockwise** (lean) in equal amounts and simultaneously repeat Steps 9-10 until the measured speed rise meets the **reset** rpm specification. After final adjustment, proceed to Step 12.
    d. If there is no rpm rise and the **minimum** speed gain specification is "0" rpm, perform the following speed drop test:
       NOTE: Speed drop test information is specified with the artificial enrichment requirements on the engine emission decal whenever the minimum speed gain specification is "0" rpm.
       * If the mixture limiter(s) must be removed for further adjustment, use Tool T-75L-9500-A to simplify removal and prevent damage.

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(1) *While watching the tachometer, adjust the* mixture screw(s)/limiter(s) clockwise (lean) by the number of turns specified for the speed drop test. Note the drop in engine speed.

- If the measured speed drop is **equal to** or drops off by **more than** (including stall) the speed drop specification, return the mixture limiter(s) to the maximum rich position, or the mixture screw(s) to the position before adjustment. Proceed to Step 12.
- If the measured speed drop is **less than** the specified **minimum** speed drop specification, leave the mixture limiter(s) in the adjusted position and repeat Steps 9-11.

12. Turn engine off. Install new service limiter(s) against the maximum rich stop if the mixture limiter(s) were removed. If the mixture limiter(s) was **not** removed but the mixture limiter(s) is **not** against the maximum rich stop, remove the limiter(s) and install new service limiter(s) against the stop.

    NOTE: Re-check engine rpm and idle fuel mixture if the mixture screw is disturbed during limiter installation.

    Pre-soaking the limiter cap in hot water will soften the material and reduce the installation effort.
13. If the vehicle has less than 100 miles of operation, reset the curb idle speed to the "green" engine specification.
14. Remove test equipment and secure air cleaner wing nut(s) to specification.

B. *Optimum Idle Method* (California Only—To be used only when propane enrichment equipment is not available)

NOTE: - Leave all vacuum signal hoses attached to the air cleaner assembly when relocating the assembly to perform carburetor adjustments. **The air cleaner assembly must be installed, however, when measuring engine speeds.**

- Some engines may experience normal rpm oscillations at idle speed which could cause variations in engine speed measurement. If this condition is encountered, use the **average** engine speed.

1. Apply the parking brake and block the wheels. Then, start the engine, bring to normal operating temperature, and turn off.
2. Connect a tachometer.

   NOTE: If the engine has a "*Dura-Spark I*" ignition system (blue coil tower), use tachometer 02-0362 or equivalent.
3. If so equipped, disconnect the fuel evaporative purge valve signal vacuum hose as follows:
   a. Trace the purge valve vacuum hose from the purge valve (located on the canister) to the first point where the vacuum hose can be detached from the underhood hose routing, (vacuum tee connection, PVS, etc.). Disconnect the vacuum hose at **that** point, cap the open port and plug the vacuum hose.

      CAUTION: To prevent possible damage to the purge valve, **do not** disconnect the vacuum hose **at the purge valve.**
4. *If so equipped, disconnect the evaporative* emission purge hose at the air cleaner and plug the nipple.
5. Disconnect the crankcase ventilation closure hose from the air cleaner and plug the nipple.
6. For vehicles equipped with Thermactor systems, revise the dump valve vacuum lines as follows:
   a. For dump valves with one or two vacuum lines at the side, disconnect and plug the line(s).
   b. For dump valve with one vacuum line at the top, check line to see if it is connected to intake manifold vacuum. If not, remove and plug the line at the dump valve and connect a slave line from the dump valve vacuum fitting to an intake manifold vacuum fitting.
7. Remove the idle mixture limiter(s) with Tool T75L-9500-A or equivalent.
8. Check curb idle rpm (or A/C-OFF rpm) in accordance with procedure D-2; if necessary, reset to specification.

   NOTE: Even if the vehicle has less than 100 miles of operation, set the speed to the "normal" engine specification and not the "green" engine specification.
9. With the engine idling, place the transmission selector in the position specified for the propane enrichment check (see engine emission decal). Adjust the engine rpm to the "alternate idle speed change" rpm. (See engine emission decal.) Note the **new** idle speed rpm on the tachometer.

   NOTE: - If the "alternate idle speed change" rpm is specified as "0", the above idle speed *adjustment is not necessary.*

   On vehicles equipped with automatic transmission, the transmission position in which curb idle rpm is set **may differ** from the position in which the idle fuel mixture check is performed. Be sure the correct transmission position is employed in both cases.
10. Adjust the idle mixture screw(s) (rich or lean) and idle speed to achieve best idle at the new idle speed rpm.
11. If the "alternate idle speed change" rpm is "0", proceed to Step 13; otherwise, proceed to Step 12.
12. Turn the idle mixture screw(s) clockwise (lean) in equal amounts until the engine speed drops by the specified "alternate idle speed change" rpm.
13. *Turn the engine off. Install new service limiter(s)* at the maximum rich stop.

    NOTE: If the mixture screw setting is disturbed during limiter installation, repeat Steps 8-12.

    Pre-soaking the limiter cap in hot water will soften the material and reduce the installation effort.
14. Reconnect hoses removed in Steps 3, 4, 5 and 6.
15. If the vehicle has less than 100 miles of operation, reset the curb idle speed to the "green" engine specification.
16. Remove test equipment and secure the air cleaner wing nut(s) to specification.

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DETROIT IRON OFFICIAL LICENSED PRODUCT

C. Propane Enrichment Method for All Vehicles Equipped with Model 2700 Carburetors

CAUTION: Block the wheels **before** starting the engine.

NOTE: Remove and reinstall air cleaner when necessary to perform adjustments.

1. Connect a tachometer and bring the engine to normal operating temperature.
   NOTE: If the engine has a "Dura Spark I" ignition system (blue coil tower), use a tachometer rated for this type of system.
2. Disconnect the evaporative emission purge hose from air cleaner or remove the evaporative canister purge line from the PCV line "Tee" and cap. Disconnect the crankcase ventilation closure hose from the air cleaner assembly and plug the air cleaner hole.
3. Check engine curb idle speed; if necessary, reset to specification.
   NOTE: Even if the vehicle has less than 100 miles of operation, set the speed to the "normal" engine specification and not the "green" engine specification.
   • With transmission in neutral, run engine at approximately 2500 rpm for 15 seconds before each speed check. The idle speed must be set to specification with air cleaner assembly installed.
4. Where specified, install (using a "Tee" fitting) a calibrated air leak tool or equivalent into the PCV line.
5. For vehicles equipped with Thermactor systems, reivse the dump valve vacuum line(s) as follows:
   a. For dump valves with one or two vacuum lines at the side, disconnect and plug the line(s).
   b. For dump valves with one vacuum line at the top, check line to see if it is connected to intake manifold vacuum. If not, remove and plug the line at the dump valve and connect a slave line from the dump valve vacuum fitting to an intake manifold vacuum fitting.
6. Plug gas Tool T75L-9600-A or equivalent into the air cleaner evaporative purge nipple or dust and valve of air cleaner. With the engine idling, slowly open the gas bottle valve until the engine speed reaches a maximum and then begins to drop—note the maximum amount of speed increase. If speed will not drop, check bottle gas supply. If necessary, repeat this operation with a new bottle gas supply.
   a. If speed increase is within specification, proceed to Step 7.
   b. If speed increase is higher than specification:
      —Enrich the mixture **without propane** by turning the mixture screws clockwise in equal amounts until the rpm increases as necessary (i.e., if the increase was "0" rpm and the desired reset increase is 20 rpm, the mixture screws should be leaned to attain a 20 rpm decrease).
      —Repeat Steps 3 and 6.
      NOTE: Do not turn the mixture screws more than 4 turns from a lightly seated position.
7. Remove Rotunda tool or equivalent from air cleaner purge nipple or duct and valve of air cleaner and reinstall all system components removed in Step 2. Also, move "TEE" from the PCV line that was installed in Step 4.
8. Set curb idle speed to specification. If curb idle speed was adjusted in Step 3 or 8, then check the internal fuel bowl vent clearance and adjust as necessary, to specification.
   NOTE: If the vehicle has less than 100 miles of operation, set the curb idle speed to the "green" engine specification.
9. Turn off the engine. Disconnect tachometer and make sure that wing nut(s) in the air cleaner is torqued to specification.

SSD-14—IGNITION SYSTEM

To properly diagnose the ignition system the following steps must be taken:

• The E.E.C. Ignition System can be identified by the lack of any distributor diaphragm advance mechanism.

• The spark plug wire sequence for E.E.C. equipped engines can be found on the top of the distributor cap.

• NOTE: Because of the unique two-level rotor, the firing order is not the spark plug wire sequence.

CAUTION: Due to the critical nature of E.E.C. rotor registry, the E.E.C. rotor should be removed for replacement reasons **only.**

• For complete E.E.C. ignition system diagnostic procedures—also refer to SSD-25.

• If for any reason any two-piece distributor cap (cap and adaptor) must be removed, the top portion of the cap must be removed first, followed by the rotor and then the bottom portion of the cap (adaptor).

CAUTION: On catalytic converter equipped engines, no spark plug wire should be removed for more than 30 seconds for the coil reserve and rotor-to-cap voltage drop tests combined. Engine rpm should be increased to measurement speed before spark plug wire removal to keep the test time to a minimum.

• If for any reason any high tension wire is disconnected, the interior of the terminal boot must be greased with silicone grease D7AE-19A331-AA or equivalent before reconnection. This should be performed by applying a thin layer of the silicone grease (using a clean small screwdriver) to the boot interior from the terminal to the end of the boot.

• All distributor brass rotor tips have a coating of silicone grease to reduce RFI (radio frequency interference) noise emissions. Do not attempt to remove this silicone coating from the rotor tip or distributor cap electrodes onto which some of the grease may have transferred. As this compound ages it has the appearance of being a contaminant. This condition is normal and causes no functional or performance problem.

• Unless otherwise specified, all high voltage measurements are to be made with only a "clamp on" type high voltage probe connected to the coil to distributor high tension wire.

I. HIGH VOLTAGE PORTION (ALL ENGINE FAMILIES)

A. Visually inspect all wires, connections and related system components for any abnormal conditions. Repair and/or replace as required.

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B. Measure the Ignition System Coil Reserve Voltage. Specification: **28 Kv minimum.**

To make this measurement, connect a diagnostic console 36-0036 or equivalent, capable of displaying high voltage and engine rpm readings to the vehicle. Its "clamp on" voltage pickup must be connected to the coil-to-distributor high tension wire. With the engine running at 1000 rpm, observe engine operation and read scope pattern for any abnormal conditions. Note abnormal condition and proceed. With engine running at 1000 rpm, (see Caution in Note 2 and below), remove one spark plug wire from its plug, not allowing the wire to arc to ground and read the highest open circuit voltage indicated on the scope.

CAUTION: For this test, do not remove the following spark plug wires while engine is running: (Except for vehicles equipped with an E.E.C. system)

No. 1 or No. 8 wire on V-8 engines
No. 3 or No. 5 wire on I-6 engines
No. 1 or No. 4 wire on V-6 engines
No. 1 or No. 3 wire on I-4 engines

If this reading fails, the problem may be in the system module (breakerless distributor), the ignition coil, the primary wiring circuits or in the coil to the distributor high voltage wire. Regardless of the reading, continue with the tests.

a. Check coil-to-distributor high voltage wire. Specification: 5K Ohms per inch max. Replace if required.

b. Check primary (low voltage) portion. Repair and/or replace as required.

(1) Step IIA (Dura Spark II)
(2) Step IIB (Dura Spark I)

C. Measure the Distributor Rotor-to-Cap Voltage Drop

Specification: **8 Kv. Max.**

To make this measurement connect a diagnostic console 36-0036 or equivalent high voltage probe to the coil to distributor high voltage wire. Remove one spark plug wire from its spark plug and ground the wire to the engine block with an appropriate ground wire connected to the spark plug terminal. Run the engine at idle and do not allow a spark gap to occur between ground and the spark plug wire.

If this test fails, the problem is in the distributor rotor or the distributor cap, or both. First, replace the rotor according to Appendix "B", if the vehicle is equipped with an EEC system and rerun the test. If the test again fails, replace the distributor cap.

Important for grease requirements:

A. When replacing the rotor, the brass electrode tip (non-EEC systems) or the two wide blade brass rotor tips (EEC systems) must be coated approximately 1/16 inch thick on all sides (outboard of the plastic) with D7AZ-19A331-AA silicone grease or equivalent (Dow 111 or G.E. G-627 compound).

B. For EEC systems **only,** when replacing the distributor cap, the brass "cross" surfaces shown in Fig. 9 must be coated with D7AZ-19A331-AA silicone grease or equivalent (Dow 111 or G.E. G-627 compound).

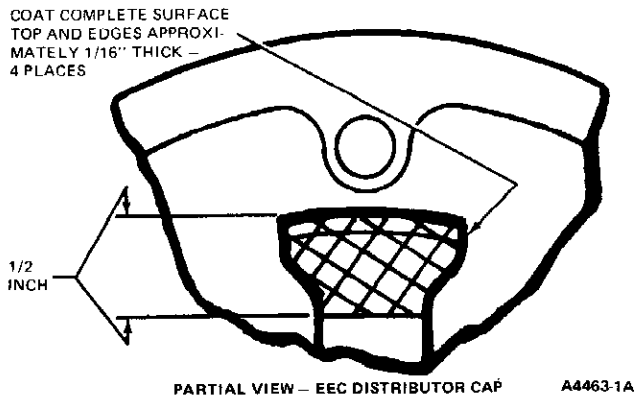


FIG. 9 Partial View—EEC Distributor Cap

D. Measure Spark Plug Required Voltage

Specification: **8-20 Kv.**

To make this measurement connect a diagnostic console 36-0036 or equivalent high voltage probe to the coil to distributor high voltage wire. Momentarily bring engine to approximately 2000 rpm, and read the highest spark plug high voltage requirement for each cylinder.

1. If the required voltage fails low, remove the probe from the coil wire and connect it to each spark plug wire to determine which spark plug is low.

   NOTE: When measuring required voltage on individual plug wires, the minimum specification is reduced to **6 Kv.**

   Remove the spark plug from any cylinder having a required voltage less than approximately **6 Kv.** and/or significantly lower voltage than other cylinders during acceleration and inspect for closed gap, bridged gap fouled insulator nose, or cracked ceramic. Repair or replace as required.

2. If required voltage is more than approximately **20 Kv.** and/or significantly (50 percent) higher than other cylinders, use the same procedure as shown above (1) to locate the problem cylinder. Check both the spark plug and the high voltage spark plug wire. Remove spark plug and inspect for excessively worn or burnt electrodes, or high resistance between terminal and center electrodes or high resistance between terminal and center electrode. Repair or replace as required.

E. Spark Plug Wires

Specification: **5K Ohms Per Inch Max.**

To properly inspect the spark plug wire harness, first remove all wires from the spark plugs by twisting the spark plug boot carefully to loosen its seal on the plug insulator. Remove the wire by pulling on the plug boot. Disconnect the wire separators from the valve covers, and remove the distributor cap from the distributor—leaving the

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plug wires connected to the cap. Do not remove the spark plug wires from the cap except for replacement. Using an ohmmeter, check the resistance of each wire by connecting one meter lead to the spark plug terminal (use adaptor if available) and the other lead to the distributor cap insert. Replace any wires that are not within specification. Visually inspect the spark plug boots for possible damage due to heat or handling. Replace as required.

II. PRIMARY (LOW VOLTAGE) PORTION

A.Dura Spark I (Limited California Application Only)—See Fig. 10

*SUGGESTIONS FOR INTERMITTENT OPERATION (DURA SPARK I AND DURA SPARK II APPLICATIONS)

If ignition system becomes operative in the course of performing these procedures and you have not made a repair, it is likely an intermittent connection or an intermittent ignition component has become functional. The following suggestions are offered:

Perform First: With the engine running, attempt to recreate the problem by wiggling the wires at the coil, module, distributor and other harness connectors. Start first with the connections you might have already disturbed. Also check the ground connection in the distributor. Disconnecting and reconnecting connectors may also be helpful.

CAUTION: DO NOT CLEAN GREASE FROM CONNECTORS as it is required to prevent terminal corrosion.

Perform Second: Intermittent Component Testing.

Pick-Up Coil: With the engine off, heat the stator pick-up coil by placing a 250 watt heat lamp approximately 1" to 2" from its top surface. Apply heat for 5 to 10 minutes while monitoring pick-up coil continuity between the parallel blades of the disconnected distributor connector. The resistance should be 400-1000 ohms. Tapping with a screwdriver handle may also be helpful.

Ignition Module: With engine running, heat module by placing a 250 watt heat lamp approximately 1" to 2" from the top surfaces of the module. Tapping may also be helpful.

CAUTION: THE MODULE TEMPERATURE SHOULD NOT EXCEED 212 DEGREES F (BOILING). AFTER THE FIRST 10 MINUTES OF HEATING, CHECK THE TEMPERATURE BY APPLYING A FEW DROPS OF WATER TO THE MODULE HOUSING. REPEAT THE CHECK EVERY TWO MINUTES UNTIL THE WATER DROPLETS BOIL. AVOID TAPPING THE MODULE TO THE EXTENT THAT THE HOUSING IS DISTORTED.

If this procedure results in ignition malfunction, substitute (do not install) a known good module. If the malfunction is corrected by the substitution, VALIDATE THAT THE ORIGINAL MODULE IS MALFUNCTIONING BY RECONNECTING IT TO THE VEHICLE. A functional check of the original and known good module can quickly be accomplished by using the "RUN MODE TEST".

*SUGGESTIONS FOR INTERMITTENT OPERATION (EEC—DURA SPARK II APPLICATIONS ONLY)

If ignition system becomes operative in the course of performing these procedures and you have not made a repair, it is likely an intermittent connection or an intermittent ignition component has become functional. The following suggestions are offered:

Perform First: With the engine running, attempt to recreate the problem by wiggling the wires at the coil, module and other harness connectors. Start first with the connections you might have already disturbed. Disconnecting and reconnecting connectors may also be helpful.

CAUTION: DO NOT CLEAN GREASE FROM CONNECTORS as it is required to prevent terminal corrosion.

Perform Second: Intermittent Component Testing.

Ignition Module: With engine running, heat module by placing a 250 watt heat lamp approximately 1" to 2" from the top surface of the module. Tapping may also be helpful.

CAUTION: THE MODULE TEMPERATURE SHOULD NOT EXCEED 212 DEGREES F (BOILING). AFTER THE FIRST 10 MINUTES OF HEATING, CHECK THE TEMPERATURE BY APPLYING A FEW DROPS OF WATER TO THE MODULE HOUSING. REPEAT THE CHECK EVERY TWO MINUTES UNTIL THE WATER DROPLETS BOIL. AVOID TAPPING THE MODULE TO THE EXTENT THAT THE HOUSING IS DISTORTED.

If the procedure results in ignition malfunction, substitute (do not install) a known good module. If the malfunction is corrected by the substitution, VALIDATE THAT THE ORIGINAL MODULE IS MALFUNCTIONING BY RECONNECTING IT TO THE VEHICLE. A functional check of the original and known good module can quickly be accomplished by using the "RUN MODE TEST".

APPENDIX "A"

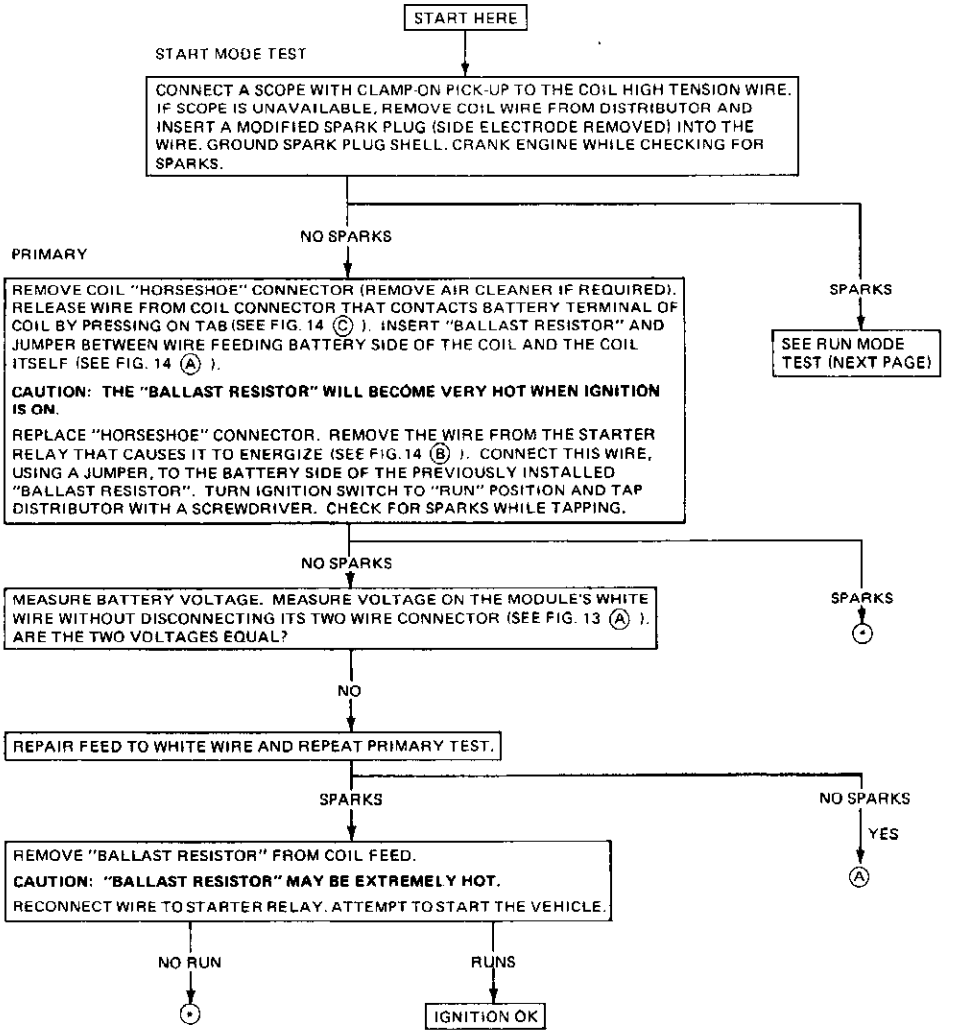
(All Ignition Systems, Except the EEC System)

NOTE: See SSD-25 for complete diagnostic procedures for the EEC System.

An engine that idles smoothly but becomes rough when accelerated (1000-2000 rpm) can have crossed orange and purple primary ignition wires in the engine harness between the distributor and the module. When this condition exists, the initial timing marks can be properly aligned but the distributor will be as much as 22 degrees from its normal position.

1. With the ignition key off, rotate the engine to initial timing mark firing point.
2. Remove the distributor cap.
   a. If one of the "spokes" of the armature is opposite the pole of the stator (Magnetic pick-up coil), the ignition primary circuit is OK. See Fig. 22.

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⊙ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST).
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION

IMPORTANT

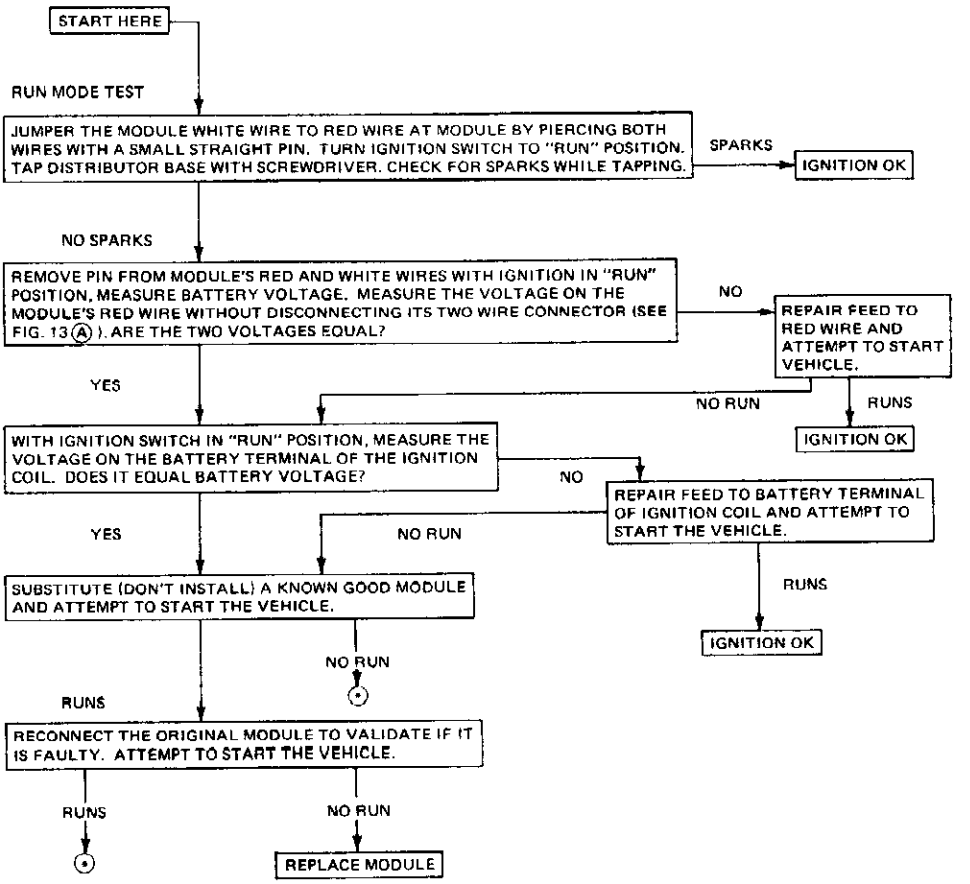
. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

Ⓐ – CONTINUE WITH DIAGNOSIS IN FIG. 12.

CA4464-2A

FIG. 10 Low-Voltage Diagnosis—Dura-Spark I (California)

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⊙ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST).
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION.

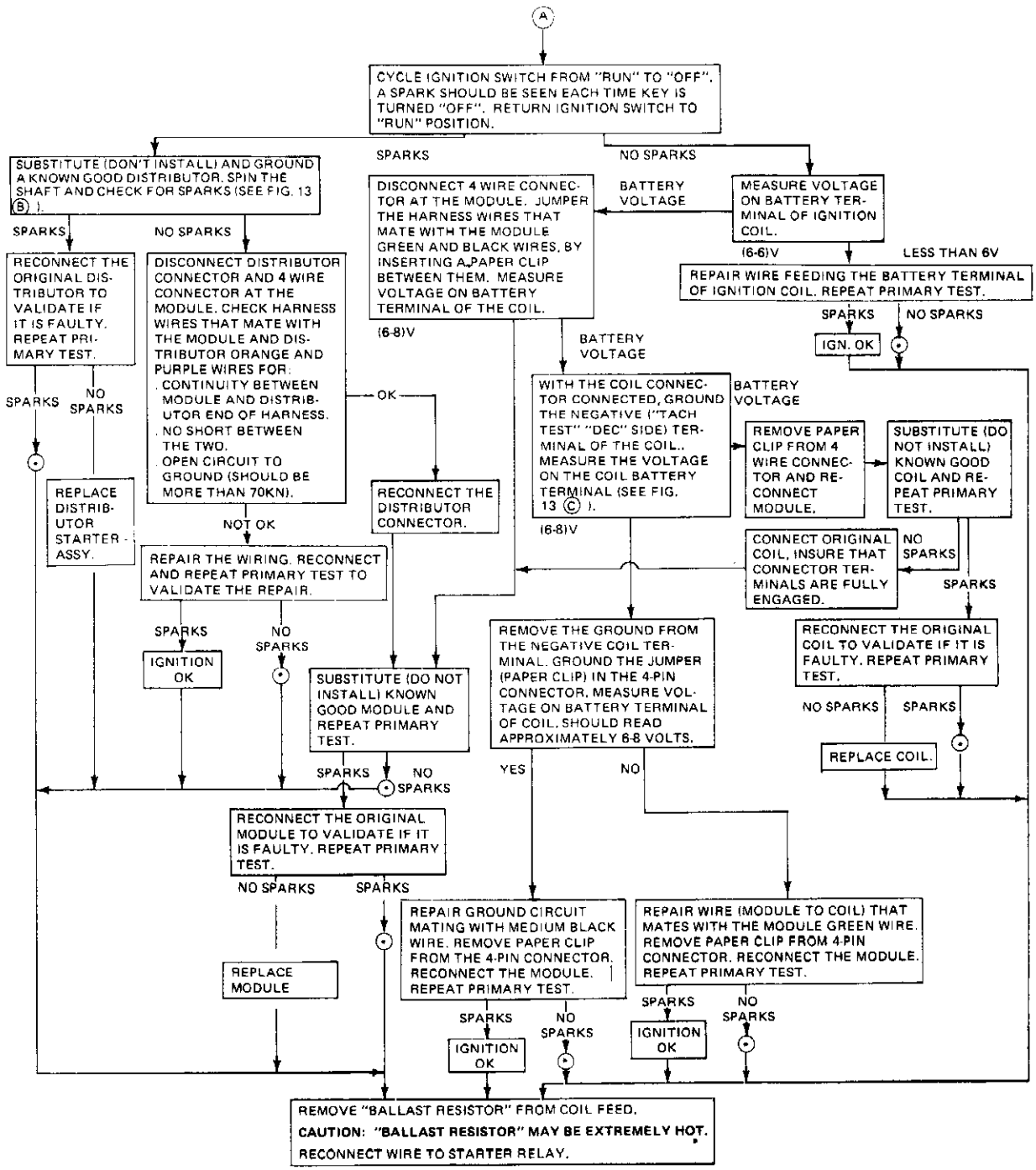
IMPORTANT

. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4464-2A[1]

FIG. 11 Low-Voltage Diagnosis—Dura Spark I (California)—Cont'd

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Ⓐ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST)
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION.

IMPORTANT

. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4464-2A2

FIG. 12 Low-Voltage Diagnosis—Dura Spark I (California)—Cont'd

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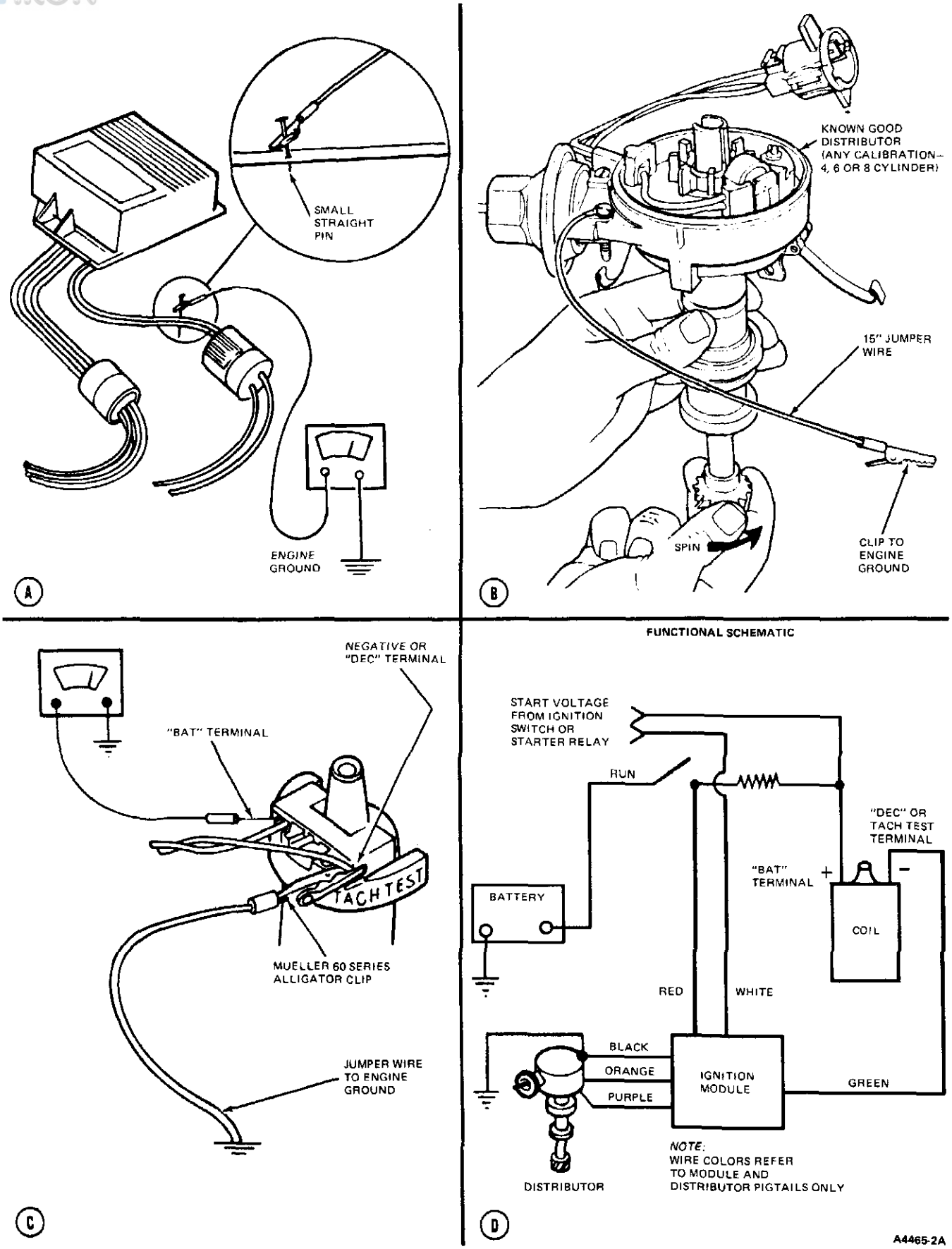


FIG. 13 Dura Spark I Test Connections

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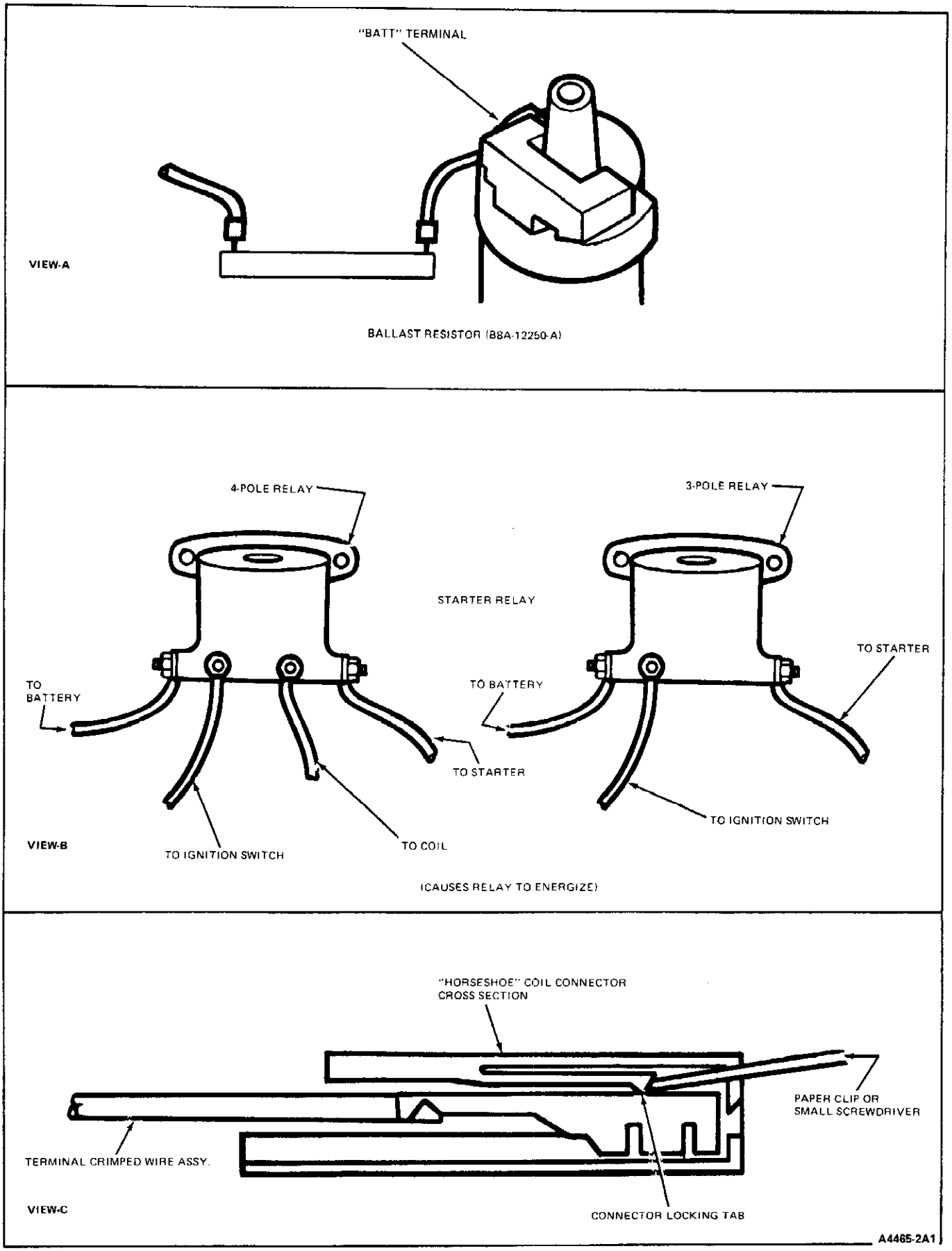
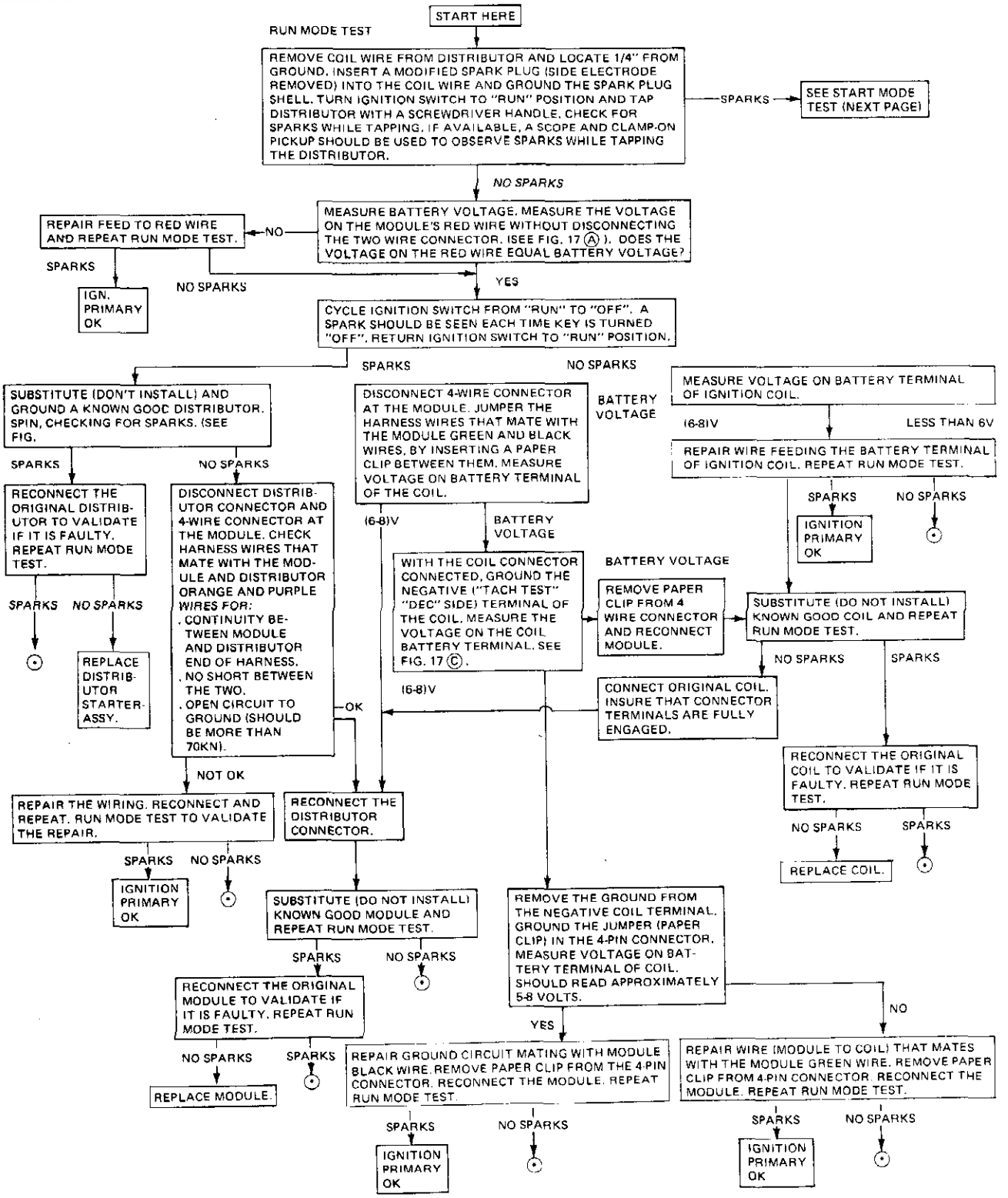


FIG. 14 Dura Spark I Test Connections (Cont'd)

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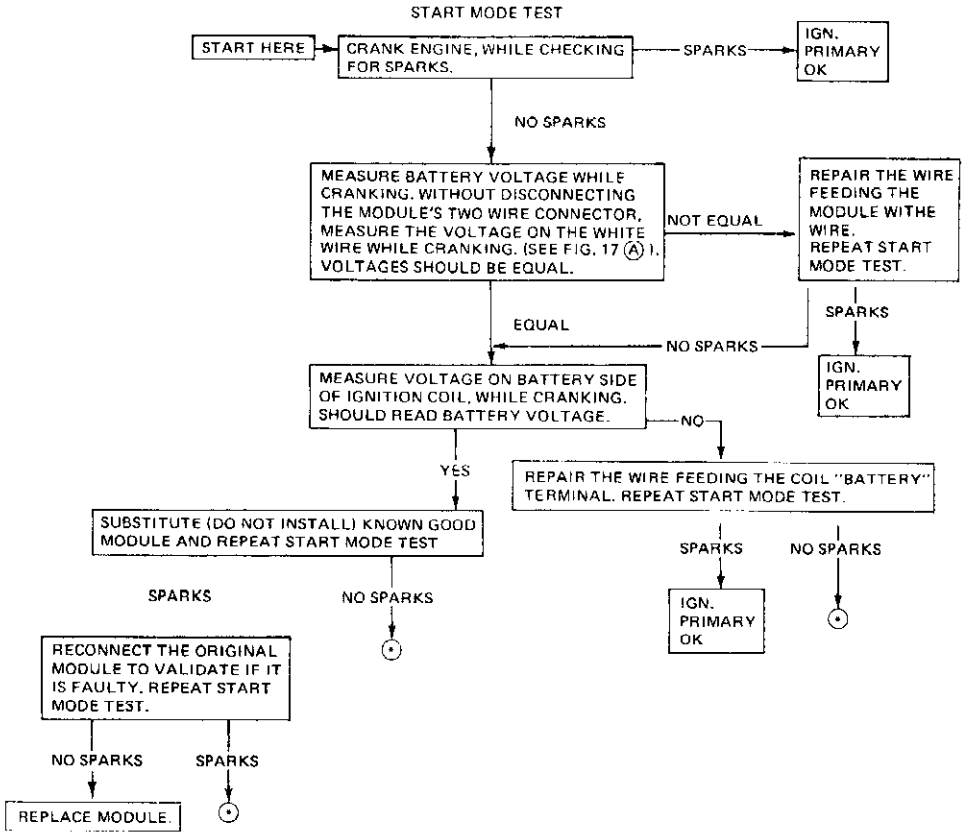
Ⓒ SUGGESTIONS
. REPEAT PROCEDURE (RETURN TO RUN MODE TEST).
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION.

IMPORTANT
WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4466-2A

FIG. 15 Low Voltage Diagnosis—Dura Spark II

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⊙ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST).
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION.

IMPORTANT

. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4466-2A[1]

FIG. 16 Low Voltage Diagnosis—Dura Spark II (Cont'd)

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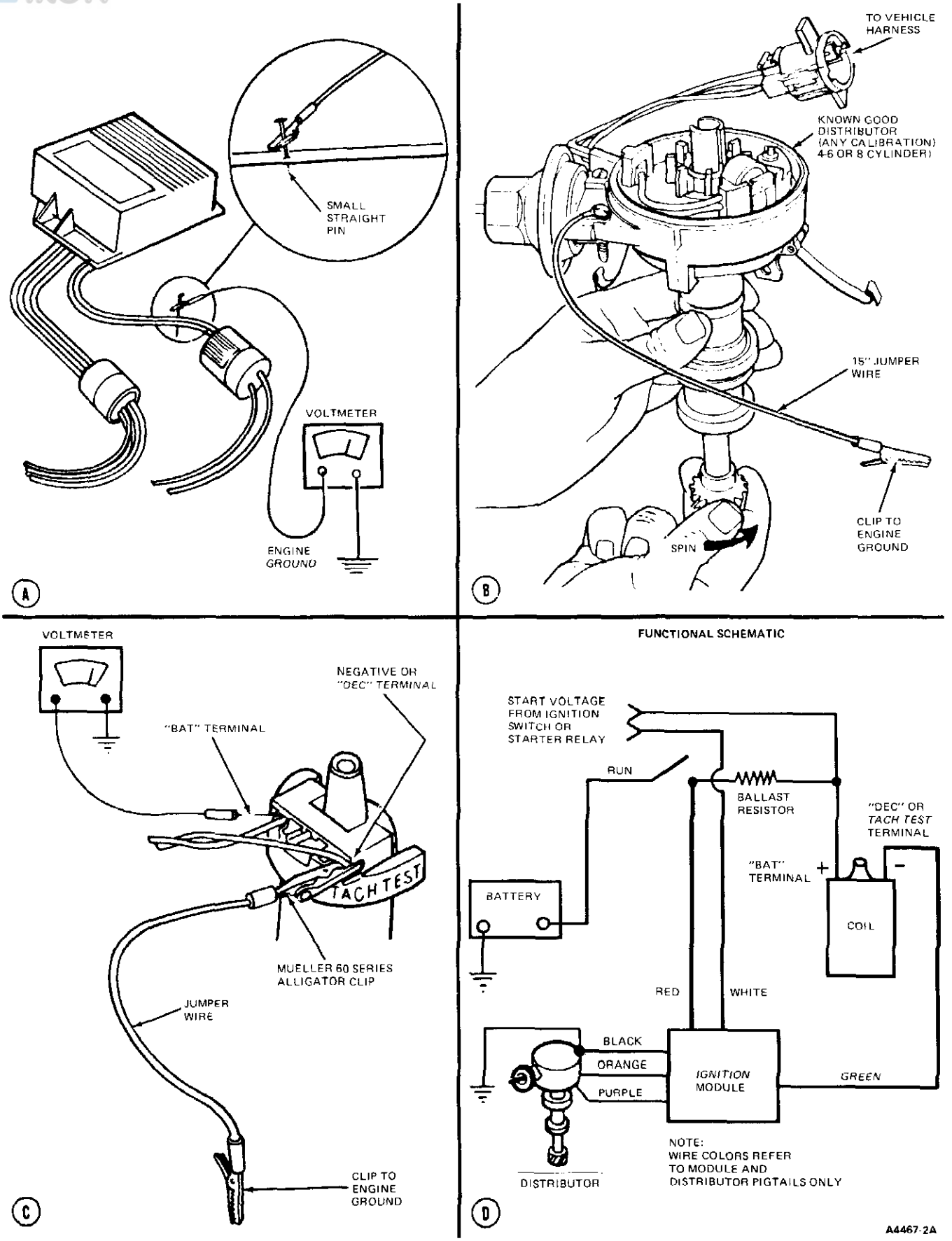
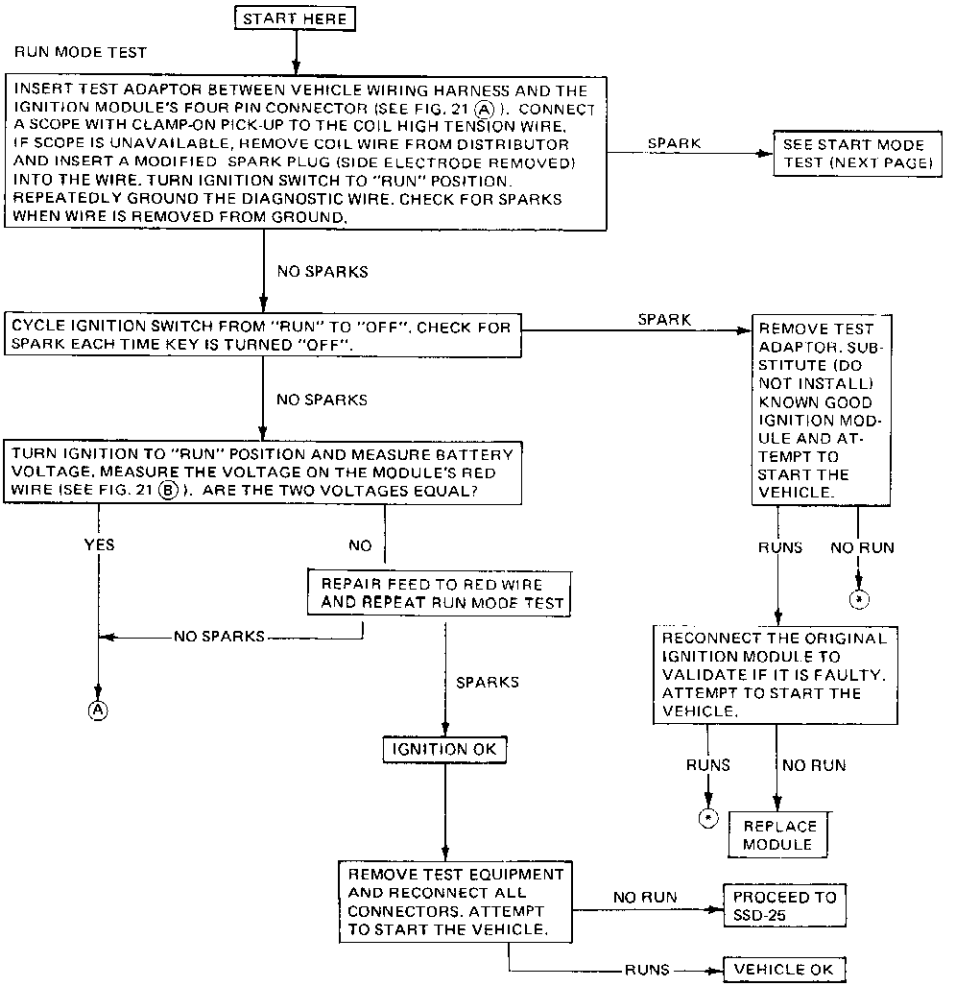


FIG. 17 Dura Spark II Test Connections

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⊙ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST)
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION.

IMPORTANT

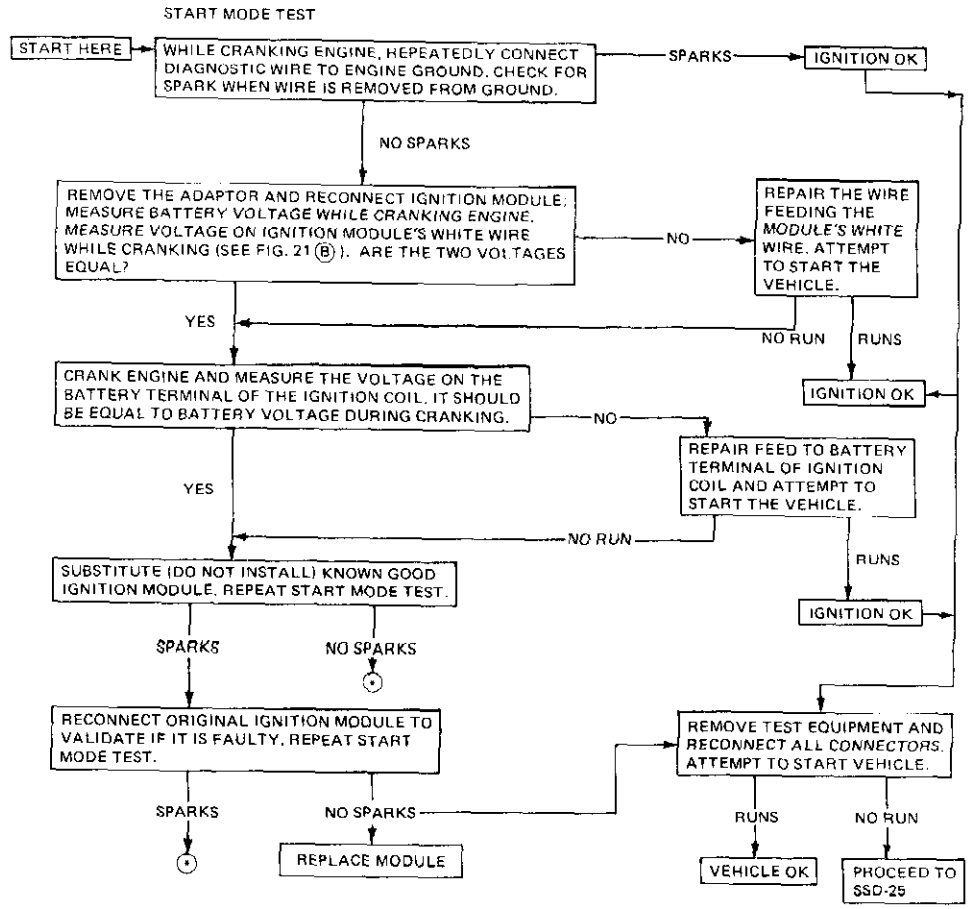
. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

Ⓐ CONTINUE WITH PROCEDURE IN FIGURE 20.

CA4468-2A

FIG. 18 Low Voltage (Primary) Diagnosis—EEC Dura Spark II

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⊙ SUGGESTIONS

- REPEAT PROCEDURE (RETURN TO RUN MODE TEST)
- SEE SUGGESTIONS FOR INTERMITTENT OPERATION

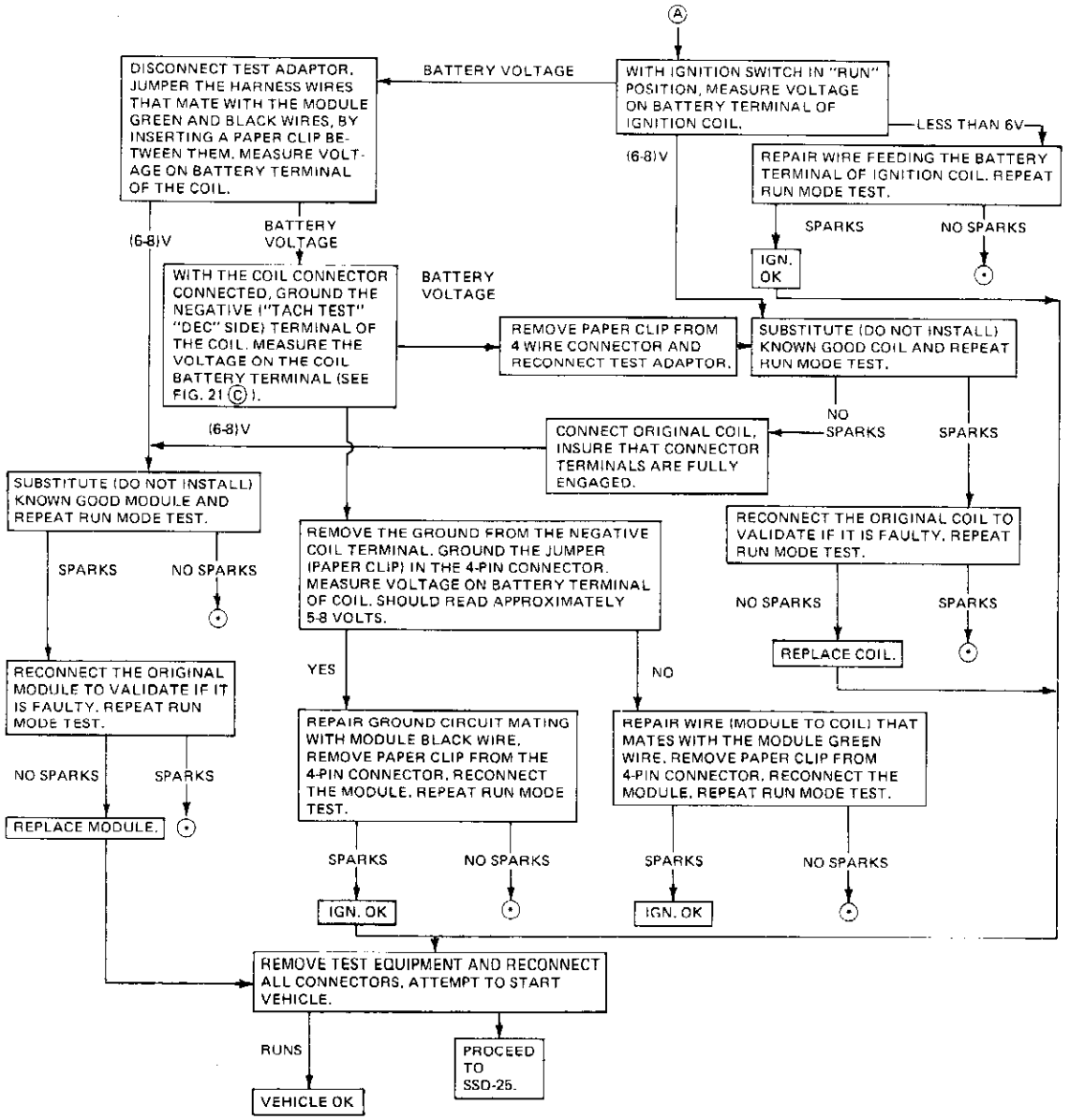
IMPORTANT:

WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4468-2A1

FIG. 19 Low Voltage (Primary) Diagnosis—EEC Dura Spark II (Cont'd)

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⊙ SUGGESTIONS

. REPEAT PROCEDURE (RETURN TO RUN MODE TEST)
. SEE SUGGESTIONS FOR INTERMITTENT OPERATION

IMPORTANT

. WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

CA4468-2A2

FIG. 20 Low Voltage (Primary) Diagnosis—EEC Dura Spark II (Cont'd)

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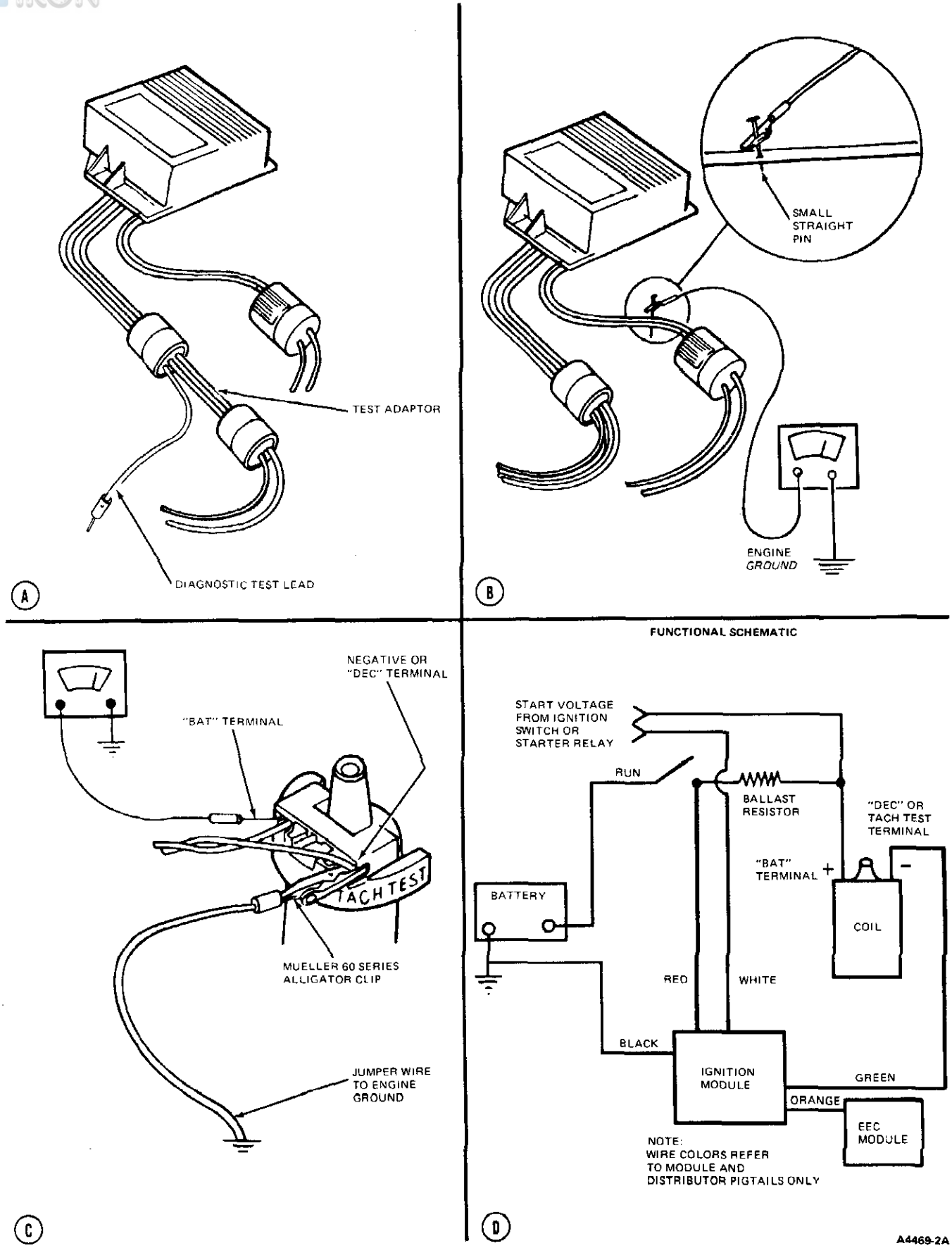


FIG. 21 EEC System Test Connections

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b. If the stator pole is between two "spokes", the primary wires are probably crossed see Fig. 22. If the position is incorrect, proceed to Step 3.

3. Visually check the color continuity of both the orange and purple wires through the distributor to engine harness connector (A) and through the module to engine harness connector (B) before separating the connectors. (Fig. 21)
4. Disconnect the two connectors and check continuity of both the orange and the purple wires through the engine harness.
   a. If color and electrical continuity in 3 and 4 are good, the problem is not in the orange and purple wire harness. Substitue the distributor stator assembly and/or the ignition module with known good components to check for crossed wires in these components.
   b. If not, cut open the engine harness, cut, cross, splice, solder and tape wires corresponding to the orange and purple wires of the distributor and retape the harness.
5. Return the distributor to the normal position and/or reset initial timing per SSD-15 Step A, if required, and verify effectiveness of repair.

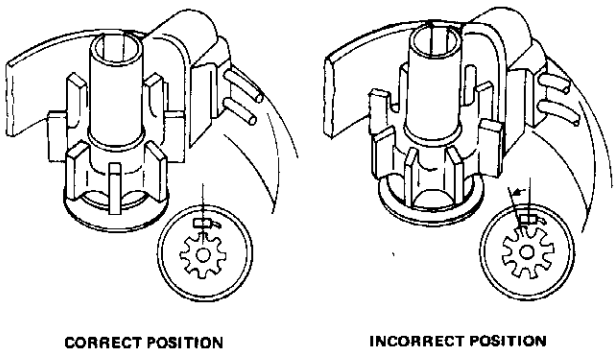


FIG. 22 Checking Initial Timing Firing Point

APPENIDIX "B"

E.E.C. System Rotor and Distributor Replacement Procedure

Rotor Replacement and Alignment Procedure (Refer To Fig. 23)

1. Remove the distributor cap by loosening the two spring clips holding the cap to the distributor adapter.
2. Rotate the crankshaft sufficiently to align the upper blade (blade with slot) with the locating slot in the distributor adapter so that the rotor alignment tool (T78P-12200-A or equivalent) will drop into place. At the same time the zero mark on the damper (No. 1 Cyl. TDC) should align with the pointer on the front cover. If the damper does not align with the pointer by this procedure or if the rotor or adapter is damaged and alignment is not possible, then position the crankshaft at the No. 1 cylinder TDC position by aligning the zero mark on the damper with the pointer on the front cover.
3. Remove the rotor alignment tool (if used in previous step) and remove the two screws securing the rotor to the distributor shaft. Remove the rotor.
   Caution: Do not rotate the crankshaft once the rotor has been removed.
4. Place the new rotor on the distributor shaft with the slot in the upper blade pointing to the locating notch in the distributor adapter. Install, but do not tighten, both rotor mounting screws.
5. Position the rotor alignment tool (T78P-12200-A or equivalent) in the adapter so that the tang on the underside of the tool simultaneously engages the locating notch in the distributor adapter and the slot in the rotor.
6. Tighten both rotor mounting screws to 15-20 in-lbs.

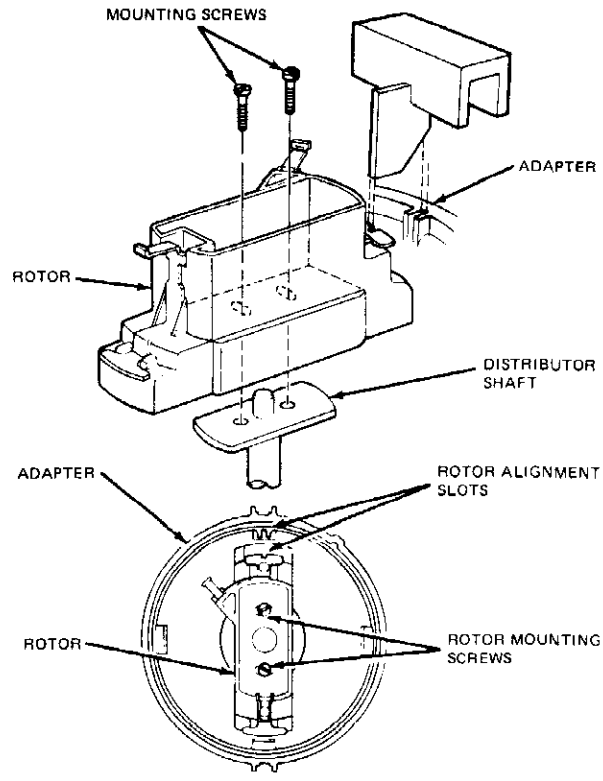


FIG. 23 Rotor Alignment—EEC System

7. Remove the rotor alignment tool and reinstall the distributor cap (top portion). Seat both cap to adapter spring clips.

Distributor Removal and Replacement Procedure

1. Remove the top portion of the distributor cap by unfastening the two spring clips holding the distributor cap to the adapter.
2. Rotate the crankshaft sufficiently to align the upper blade (blade with slot) with the locating slot in the distributor adapter so that the rotor alignment tool (T78P-12200-A or equivalent) will drop into place. At the same time the zero mark on the damper (No. 1 Cyl. TDC) should align with the pointer on the front cover. If the damper does not align with the pointer by this procedure or if

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the rotor or adapter is damaged and alignment is not possible, then position the crankshaft at the No. 1 cylinder TDC position by aligning the zero mark on the damper with the pointer on the front cover.

From this point on do not rotate the crankshaft.

3. Loosen and remove the distributor clamp and retaining bolt.
4. Remove the distributor assembly from the engine block, noting the position of the rotor blade with respect to the distributor base when the cam and distributor gears are felt to disengage.
5. *Position the replacement distributor in the block so that when fully seated the following conditions are met simultaneously:*

   (It will be helpful at this point to position the rotor with respect to the base at the same location as noted in Step 4.).

   a) Align the slot on the distributor base hold down flange with the corresponding clamp bolt hole in the block.

   b) Approximately align the slot in the upper blade of the rotor with the slot in the adaptor. If alignment is not possible within rotor *adjustment range, raise the distributor out of* the block sufficiently to disengage the cam gear and rotate the distributor shaft slightly to allow the next tooth to engage. Repeat this procedure until both conditions a and b are met.
6. Install the distributor to block clamp and bolt. Torque the bolt to 15-18 ft-lbs.
7. Position the rotor alignment tool in the adapter so that the tang on the underside of the tool simultaneously engages the locating notch in the distributor adapter and the slot in the rotor.
8. Tighten both rotor mounting screws to 15-20 in-lbs.
9. Remove the rotor alignment tool and reinstall the distributor cap (top portion). Seat both cap to adapter spring clips.

SSD-15—IGNITION TIMING

Application: All Engines Except Those Equipped with an EEC System

If for any reason any "Dura Spark" two-piece distributor cap (cap and adaptor) must be removed, the top portion of the cap must be removed first, followed by the rotor and then the bottom portion of the cap.

If for any reason any "Dura Spark" high tension wire is disconnected, the interior of the terminal boot must be greased with silicone grease D7AE-19A331-AA or equivalent before reconnection. This should be performed by applying a thin layer of the silicone grease (using a clean small screwdriver) to the boot interior from the terminal to the end of the boot.

After adjusting the initial timing, the idle speeds should be checked and, if necessary, readjusted.

A. BASIC TIMING

Applicability: All Engines

1. Clean the surface of the front damper and place a white mark on the proper degree line on the damper and pointer according to specification.
2. Disconnect the vacuum line(s) at the distributor and plug.
3. *For vehicles equipped with dual mode timing* ignition module (-12A244-) using either the ignition barometric pressure switch assembly or distributor modulator valve switch, disconnect the *3 pin switch assembly connector from the dual* mode timing ignition module (Fig. 24).
4. Connect timing light 27-0001 or equivalent to the No. 1 spark plug wire.

   CAUTION: For the "Dura Spark I" ignition system, only clamp-on type timing devices, which have an inductive pickup, may be used.
5. *Connect a tach-dwell meter* 02-0362 or equivalent. Start the engine and warm up. Set timing idle speed to specification.

   CAUTION: For the "Dura Spark I" ignition system *be sure to use a tachometer rated for this* type of ignition system.
6. Check engine initial timing. If within ± 2 degrees of the specification, do not reset.

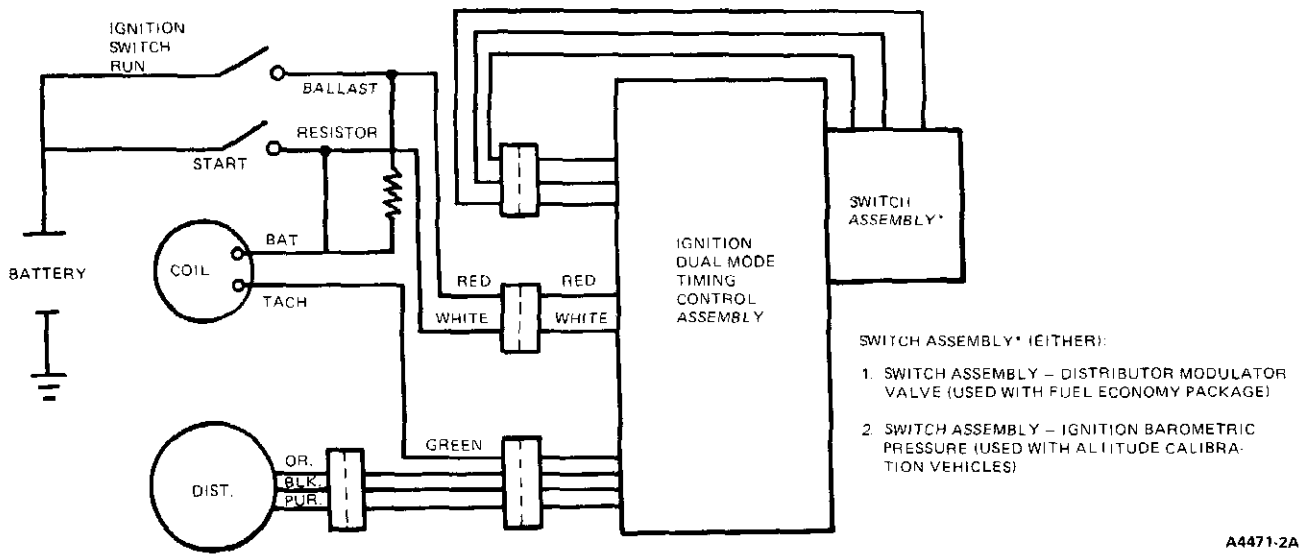


FIG. 24 Dual Mode Timing Ignition Module

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7. If more than ±2 degrees, loosen the distributor hold-down bolt and adjust initial timing to specification by rotating the distributor against rotor rotation to advance the timing, or with rotor rotation to retard the timing. When the white mark (Step 1) is directly in line with the pointer, ignition timing is correct. Tighten hold-down bolt to specification. Recheck timing after hold-down bolt has been tightened.
8. For vehicles equipped with a dual mode timing ignition module, reconnect the 3 pin switch assembly connector to the module and check its function as follows:
   a) Vacuum Switch Applications:
      • Disconnect vacuum line to the switch and using an external vacuum source, apply vacuum to the switch and compare basic timing to the requirements below:

Applied Vacuum	Basic Timing
Greater than 10 in Hg	Per Specification
Less than 6 in Hg or 0	Per Specification less 3-6°

   b) Barometric Pressure Switch Applications:
      • Compare basic timing to the requirements below:

Elevation	Basic Timing
Below 2400 ft	Per Specification less 3-6°
2400 ft to 4300 ft	Per Specification or Per Specification less 3-6°
Over 4300 ft	Per Specification

If the requirements are not met, see Fig. 25.

B. Centrifugal Advance

1. Check centrifugal advance by accelerating engine (in neutral) to 2500 rpm. If ignition timing advance is noted during acceleration, the centrifugal advance mechanism is functional. If not, remove distributor and replace.

C. Total Advance

1. Install a vacuum gauge in the vacuum line from the carburetor source to the vacuum advance diaphragm (outer diaphragm on dual diaphragm distributors). Increase engine speed to 2500 rpm to verify available vacuum. If no vacuum is available within 60 seconds, vacuum system is at fault, perform SSD-3. If a vacuum is available, perform Step C-2.
2. Install distributor vacuum line (without spark delay valves) to outer diaphragm (on dual diaphragm distributor). Accelerate engine to 2500 rpm. Total advance should now be greater than in Part "B" if advance mechanism is functional. If not, replace vacuum advance components as required.

D. Vacuum Retard (Dual Diaphragm Distributor)

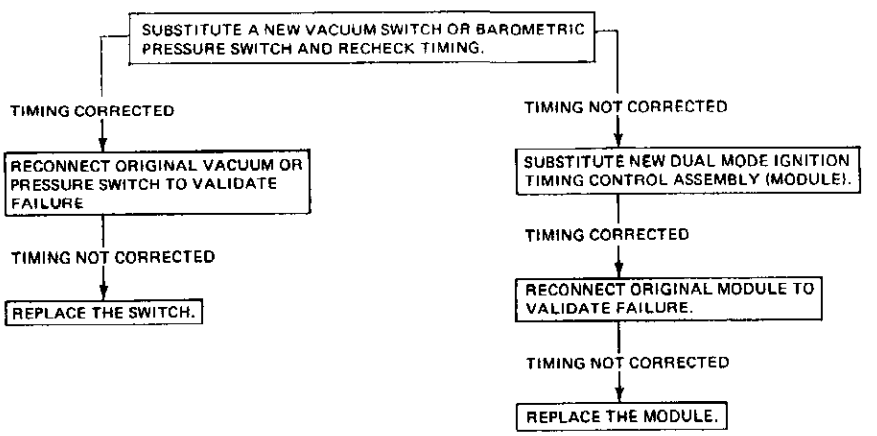
1. Install vacuum gauge in vacuum line from the intake manifold source to the vacuum retard diaphragm (inner diaphragm on dual diaphragm distributors). With the engine at idle verify available vacuum. If vacuum is not available, vacuum system is at fault. Correct as required. If vacuum is available, perform Step D-2.
2. Remove the vacuum gauge and reinstall the vacuum line to the retard diaphragm (inner *diaphragm on dual diaphragm distributors*). Ignition timing should indicate retard. If no retard is indicated, replace vacuum retard components as required.

SSD-16—FUEL BOWL VENT CLEARANCE

I. Model 2150 Carburetors

A. Mechanical Bowl Vent (if so equipped)

1. Inspect the valve and linkage for damage, leaks and/or improper connections.
2. Check for plugged bowl vent tube by connecting a vacuum source to the bowl vent tube. If a vacuum is maintained the tube is plugged. Clean and repair and/or replace as required.
3. If necessary, bring engine to normal operating temperature.
4. Check TSP-off speed (for 2.8L engine which does not have a solenoid, check curb idle speed) to specifications. Adjust as required.



CA4472-2A

FIG. 25 Vacuum Switch Diagnosis

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5. With TSP de-energized (2.8L engine at curb idle) and vent valve plunger depressed, measure the clearance between the vent valve plunger and the actuating lever.
6. Clearance should be within specification. Bend actuating lever as required to obtain the specified clearance.

B. **Solenoid Switch Vent** (If so equipped)

1. Remove air cleaner assembly.
2. Place hand on switch vent assembly and turn the ignition switch on and then off.
3. If solenoid activates/deactivates (an audible click should be heard and felt with the hand), reinstall air cleaner assembly.
4. If solenoid does not activate/deactivate, disconnect electrical lead.
5. Connect volt meter and insure that voltage is being applied to the solenoid. Repair as required.
6. If solenoid is receiving applied voltage, check for binding/plugged vent valve. Clean and/or repair as required.
7. If solenoid valve is not bound or plugged, replace the solenoid/valve assembly.

II. **Model 4350 Carburetor**

1. Disconnect external fuel bowl vent hose from the carburetor. Connect an external vacuum source to the vent hose. Turn the ignition key to the "ON" position. Apply 10 in Hg vacuum and observe the bleed-down rate. If unable to obtain a vacuum, or if the 10 in Hg vacuum bleeds down in less than 3 seconds, the solenoid vent valve has failed opened. Replace the valve.
2. Turn the ignition key to the "OFF" position. Try to apply vacuum to the vent hose. If able to obtain a vacuum, the solenoid vent valve has failed closed. Replace the valve.
3. Reconnect vent hose to the carburetor.

   Note: Be sure that the carburetor bowl vent line has a continuous downward slope to the evaporative canister.

Internal Fuel Bowl Vent Clearance Set and External Vent Check

2700 Carburetor Internal Vent Setting

1. Inspect the valve and linkage for damage.
2. Disconnect the bowl vent line at the carburetor. Check for plugged vent line by connecting a 21-0014 hand vacuum pump or equivalent to the vent line. If a vacuum is maintained the line is plugged. Clean, repair and/or replace as required. With the line already disconnected at the carburetor, disconnect the line at the carbon canister. Check for any liquid in the line by blowing shop air through it. Clean, repair and/or replace as required.

   NOTE: If the bowl vent line has liquid in it, the canister must also be checked for liquid.
3. If necessary, bring engine to normal operating temperature.
4. Check idle speed (with TSP energized or at curb idle for carburetors w/o TSP) to specifications. Adjust as required.
5. With TSP energized (at curb idle for carburetors w/o TSP) measure clearance between accelerator pump rod and accelerator pump lever (Fig. 26).
6. Clearance should be within specifications. If incorrect, turn accelerator pump adjusting nut to obtain specification (Fig. 26).

   NOTE: Apply a slight downward pressure on the top of the nylon vent adjusting nut to take up linkage clearances when making this adjustment.

Model 1946 Carburetor

1. Apply parking brake and block the wheels.
2. Check curb idle speed and fast idle speed to specification. Adjust as required.
3. Turn the engine off.
4. Remove the air cleaner assembly. Remove the canister vent hose from the bowl vent located on the air horn. Check the condition of the canister vent hose. Clean, repair and/or replace as required.
5. Attach a vacuum hand pump (tool 21-0014 or equivalent), with a 3/8 inch adaptor hose to the bowl vent on the carburetor.

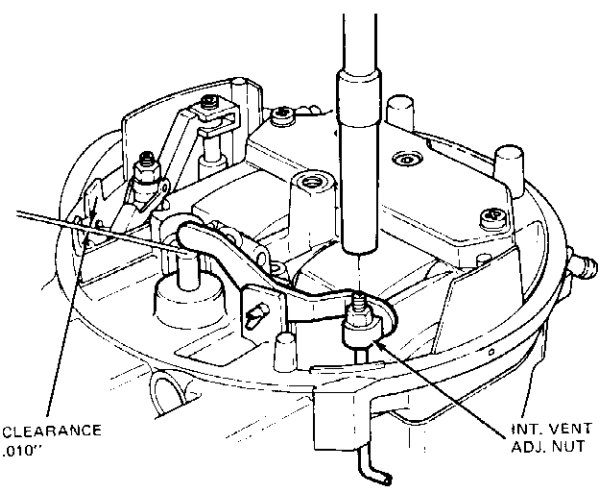


FIG. 26 Internal Vent System—Model 2700 Carburetor

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6. With the ignition switch in the off position, set the choke plate in the open position. Make sure that the fast idle cam mechanism is set at the engine curb idle position. Gently operate the vacuum hand pump and observe one of the following:
   a. If the hand pump does not produce a vacuum, proceed to Step 7.
   b. If a vacuum of 5-10 in Hg is present, perform Steps 8-12.
7. With the ignition off, set the throttle to the maximum "High Cam" position. Gently operate the vacuum hand pump and observe one of the following:
   a. If the hand pump produces a 5-10 in Hg vacuum, the bowl vent is properly adjusted. Proceed to Step 13.
   b. If a vacuum is not present, perform Steps 8-12.
8. With the ignition off, remove the three (3) bowl vent cover screws located on the top of the air horn.
9. Remove the bowl vent cover, gasket and spring. (CAUTION: The spring is located under the bowl vent cover.)
10. Set the throttle on the lower idle speed screw (solenoid off position). While pumping the hand vacuum pump, turn the adjustment screw (located in the middle of the nylon arm) counterclockwise 1/8 of a turn at a time, until a vacuum is produced by the pump. Release the vacuum and turn the adjustment screw 1/2 turn clockwise.
11. Reinstall the spring, gasket, vent cover and retaining screws.
12. Repeat Steps 6 and 7.
13. Remove all test equipment and verify that all hoses are reinstalled to their original location. Reinstall the air cleaner assembly.

Model YFA Carburetors

1. Check curb idle rpm to specification (with solenoid activated if applicable). Adjust as required.
2. Stop engine and turn ignition key to "on" position so that the solenoid is activated but the engine is not running (where applicable). Secure the choke plate in the wide open position.
3. Open the throttle so that the throttle vent lever does not touch the fuel bowl vent rod.
4. Close throttle and measure the travel of the fuel bowl vent rod at point "A" from open throttle position (Step 3 above) to idle position (Step 2 above). Travel of the fuel bowl vent rod at point "A" should be 0.060 ± 0.010.
5. If out of specification, bend throttle vent lever at point indicated in Fig. 27 to obtain the required travel.

CARBURETOR FUEL BOWL VENT FUNCTION—FUNCTIONAL CHECK

—MODEL 5200 CARBURETOR AND—MODEL 6500 CARBURETOR (FEEDBACK)—2.3L ENGINE

1. Apply parking brake and block wheels.
2. Remove the air cleaner assembly and plug any vacuum hoses that required disconnection.

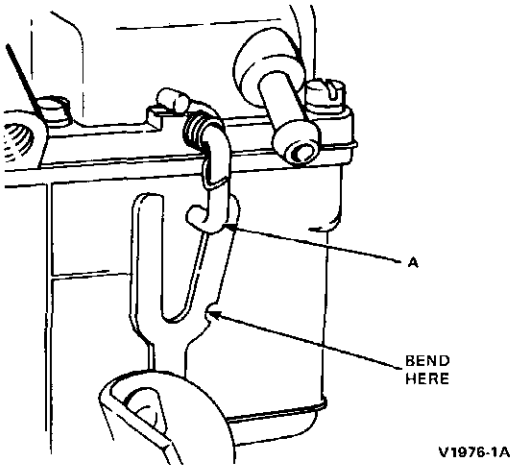


FIG. 27 Adjusting Fuel Bowl Vent Valve—Model YFA Carburetor

3. Remove the bowl vent-to-canister hose from the canister. Check bowl vent solenoid for external damage and electrical connections. Repair or replace as required.
4. Attach tool T75L-9487-A or equivalent to the canister end of the vent hose.
5. With the ignition switch in the **off position** and the choke plates held in the open position, force air into the fuel bowl vent system by squeezing the rubber bulb of T75L-9487-A tool or equivalent. Observe one of the following:
   A. If fuel is displaced through the metering system of the carburetor, proceed to Step No. 6.
   B. If no fuel is displaced through the metering system of the carburetor, start the engine, run it for two (2) minutes and turn it off. Then, repeat Step No. 5. If fuel is still not displaced through the metering system of the carburetor, proceed to Appendix "B", Step No. 4.
6. With the engine running at idle, force air into the fuel bowl vent system by squeezing the rubber bulb of T75L-9487-A tool or equivalent. Observe one of the following:
   A. If the rubber bulb resists rapid squeezing (pressure builds up), the bowl vent is functioning properly. Proceed to Step No. 7.
   B. If the rubber bulb does not resist rapid squeezing (pressure does not build up), proceed to Appendix "B", Steps No. 1, 2 and 3, as required.
7. Remove all test equipment (reassemble carburetor, install on engine—if removed and taken apart) and reinstall the air cleaner assembly.

CARBURETOR FUEL BOWL VENT FUNCTION

MODEL 5200 CARBURETOR AND MODEL 6500 CARBURETOR (FEEDBACK)—2.3L ENGINE

APPENDIX "B"

NOTE: The carburetor must be removed from the engine in order to remove and reinstall the bowl vent solenoid.

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1. Disconnect the electrical lead to the bowl vent solenoid and connect it to one lead of a test light. Connect the second test light lead to ground.
2. With the ignition switch in the **on position,** observe one of the following:
   a. If the test light glows, proceed to Step 3.
   b. If the test light does not glow, either the vehicle's battery is dead or the electrical lead to the bowl vent solenoid has an open circuit and should be repaired/replaced as required. Then, repeat Step No. 5 of the functional check.
3. Remove the test light and reconnect the electrical lead to the bowl vent solenoid. Proceed to Step 4.
4. Remove airhorn.
   a. Check for proper position of vent valve parts. The normal position of the parts should be as follows:
      The plastic paddle should be flush against the apature plate with a slight spring force supplied by the valve actuator. Push gently (5 oz. max.) on the valve actuator. The exterior vent should close and internal vent open (movement of .090 inch min.) if OK go to 4b. If no movement occurs, or excessive force is required to obtain movement, disassemble and check for:
      1. Binding in any part—free as required.
      2. Missing spring—install new spring.
      3. Foreign objects in assembly—remove objects.
      4. Plugged drillings in airhorn—open drillings.
      5. Diaphragm improperly installed—reassemble correctly.
   b. Place hand vacuum pump (21-0014 or equivalent) nozzle into switch vent channel.
      Pump to 5" Hg vacuum and observe. Switch vent parts should shift to interior vent.
      Continue to pump to 19" Hg vacuum—measure leak-down time to leak to 10" Hg—should be more than 10 seconds.
      Apply 12 VDC between switch vent solenoid connector and airhorn casting.
      Gently push valve actuator to the energized position. Valve should be held by solenoid.
      Turn off 12 VDC—valve will then shift to normal position.
      If none of these conditions is met, replace the bowl vent solenoid and go to Step 7 of the functional check.

SSD-17—VALVE TRAIN INSPECTION

I. Removal of Rocker Cover

A. Remove air cleaner.
B. Disconnect and remove any hoses, wires, spark plug leads and components that would interfer with the removal of the rocker arm cover.
C. Remove the rocker arm cover bolts. **
D. Remove the rocker arm cover.

II. Static Valve Train Analysis

Check for damaged and/or severely worn parts, for correct assembly and assured use of correct parts, by proceeding as follows, with the static engine analysis.

A. Rocker Arm Assemblies—individually mounted.
   1. Check for loose mounting stud and nut or bolt.
   2. Check for plugged oil feed in rocker arm.
B. Rocker Arm Shaft Assemblies
   1. Check for loose mounting bolt(s).
   2. Check for plugged oil feeds.
C. Push Rods
   1. Check for bent push rods.
D. Valve Spring Assembly—with or without damper spring
   1. Check for broken or damaged parts.
E. Retainer and Keys—both 2-piece and 1-piece retainers
   1. Check for proper seating of keys on valve stem and in retainer.
F. Positive Rotator and Keys
   1. Check for proper seating of keys on valve stem and in positive rotator.
G. Valves and Cylinder Head
   1. Check cylinder head gasket for proper installation. (For 2.8L engine, make sure there are three fingers visible on front of left head and three fingers visible on rear of right head.)
   2. Check for plugged oil drain back holes.
   3. Check for worn or damaged valve tips.
   4. Check for missing or damaged valve stem oil seals or guide-mounted oil seals.
   5. Check valve lash—mechanical tappet applications.
   6. Check collapsed tappet gap—hydraulic tappet applications.
   7. Check installed spring height.
H. Overhead Cam Follower Arm and Lash Adjuster Assemblies
   1. Check for broken or severely worn parts.
I. Camshaft—Overhead Camshaft Applications
   1. Check for plugged oil feed.
   2. Check for correct cam lift.

The preceding static checks are to be made on the engine prior to the following dynamic procedure.

III. Dynamic Valve Train Analysis

CAUTION: DO NOT USE THIS PROCEDURE FOR OVERHEAD CAMSHAFT ENGINES.

Start the engine and while running at idle check for proper operation of all parts. Check the following items under firing engine operating conditions:

A. Rocker Arm Assemblies—individually mounted
   1. Check for plugged oil feed in rocker arm.
B. Rocker Arm Shaft Assemblies
   1. Check for plugged oil feeds.
   2. Check for proper overhead valve train lubrication.
      If a condition of insufficient oiling is suspected, accelerate engine to 1200 ±100 rpm with transmission in neutral and engine at normal operating temperature. Oil should spurt from rocker arm oil holes such that valve tips and rocker arms are well oiled and/or, with rocker arm cover off, oil splash may overshoot rocker

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arm. If oiling is insufficient for this condition to occur, check oil passages for blockage.

C. Push Rods
1. Check for bent push rods.
2. Check for proper rotation of push rods.

D. Positive Rotator and Keys
1. Check for proper operation of positive rotator.

E. Valves and Cylinder Head
1. Check for plugged oil drain back holes.
2. Check for missing or damaged valve stem oil seals or guide mounted oil seals.

IV. Reinstallation of Rocker Cover

A. Remove old gasket from cover.

B. Scrape both the rocker arm cover rail on the cylinder head and the gasket flange on the cover to remove all traces of the old gasket if necessary.

C. Install a new gasket and replace the cover on the engine.

D. Reinstall the rocker arm cover bolts** and tighten in accordance with applicable sequence and torque specification.

**To avoid interference with the distributor or the 2.8L V-6, it is suggested that a 1/2-inch drive and 10mm universal socket be used to remove or reinstall the rear rocker arm cover bolt.

E. Reconnect all hoses, wires, spark plug leads and components that were removed in Part I.

SSD-18—CARBURETOR CLEANING PROCEDURE

Model 5200 Carburetors

This procedure is to be used if contamination must be removed from the carburetor.

After cleaning the carburetor, flush the fuel system and change the fuel filter.

For carburetor disassembly and assembly refer to the service manual.

1. Remove the carburetor from the vehicle.
2. Remove the following: (Note which items were removed from Primary and which from Secondary)
   a. Remove the air horn
   b. Remove high speed bleeds
   c. Remove well tubes
   d. Remove main metering jets
   e. Remove idle jets
   f. Remove limiter cap and idle adjustment screw (Note number of turns off seat)
3. Clean the fuel bowl and all of the items removed in Step 2.
4. Using compressed air, blow out the following main body channels in the listed order:
   a. Primary idle channel from adjustment screw opening.
   b. Primary and secondary idle channels from idle jet opening.
   c. Fuel bowl and primary and secondary main metering jet channels.
   d. Primary and secondary main well channels.
5. Using compressed air, dry off the items removed in Steps 2 b, c, d, e, and f above.
6. Install new fuel filter.
7. Adjust dry float setting. (See Part 24-10.)
8. Reassemble the carburetor using a new air horn gasket.
9. Check and reset as necessary:
   a. Choke pulldown
   b. Cam set
10. Reinstall carburetor on vehicle.
11. Check all idle speeds and idle fuel mixture to specification. Adjust as required.

2150 Carburetor

This procedure is to be used if contamination must be removed from the carburetor.

After cleaning the carburetor, flush the fuel system and change the fuel filter.

For carburetor disassembly and assembly refer to Part 24-10.

1. Disassemble and clean carburetor in the following sequence:
   a. Remove air horn.
   b. Note position on idle limiter caps.
   c. Clean fuel bowl. Remove and clean float, inlet needle and seat, inlet filter screen.
2. If further cleaning is required, remove carburetor from vehicle and:
   a. Clean fuel bowl. Remove and clean booster hold-down screw, booster assembly, pump weight, pump check ball.
   b. Remove and clean accelerator pump cover, pump spring, power valve cover, power valve, main metering jets.
3. Using compressed air, dry all parts, blow out all channels in booster assembly (if applicable), main body and air horn.
4. Reassemble carburetor in reverse order of Steps 1 and/or 2. Use new gaskets for the following as required:
   Power valve
   Power valve cover
   Booster assembly
   Accelerator pump diaphragm
   Install new fuel filter.
5. If required, reinstall assembled carburetor to specifications on vehicle using new gaskets.
6. Check fuel level to specifications and adjust as required.
7. Reinstall air horn to specifications with new gasket.
8. Check all idle speeds and idle fuel mixture to specifications. Adjust as required.

Model 4350 Carburetors

This procedure is to be used if contamination must be removed from the carburetor.

After cleaning the carburetor, flush the fuel system and change the fuel filter.

For carburetor disassembly and assembly refer to Part 24-10.

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1. Clean carburetor in the following sequence:
   a. Set choke on high cam position and scribe a line on the air horn corresponding to the bottom of the "V" notch on the accelerator pump lever.
   b. Remove external connections, air horn hold down screws, and air cleaner stud. Lift air horn assembly vertically from carburetor and place on a flat surface.
   c. Clean fuel bowl.
   d. Clean air horn assembly.
   e. Remove needle drop limiter and float assembly. Clean as required.
   f. Remove primary and supplementary inlet needle and seat assemblies. Remove fuel inlet filter and gasket.
2. If further cleaning is required, remove external connections, remove carburetor from vehicle and:
   a. Separate main body and throttle body assemblies.
   b. Remove and clean accelerator pump weight and pump check ball.
   c. Clean carburetor bodies.
3. Replace fuel inlet assemblies, inlet filter and gasket with new components.
4. Set dry float level to specification and check supplementary inlet valve.
5. Align scribe line on air horn with "V" notch and check clearance (see chart) between needle drop limiter and primary inlet seat. Adjust as required by bending the foot on the limiter.

Applicable Description	Limiter to Seat Clearance (Inches)
7.5L (460 CID) Altitude Compensator Equipped	0.065
7.5L (460 CID) 49 States	0.035
6.6L (400 CID) 49 States and California	0.035

CA4473-1A

6. Reassemble carburetor on vehicle using new retainers at choke rod and pump rod.
7. Manually check operation of air valve and choke linkage to ascertain freedom of movement. Repair and/or replace as required.
8. Make all external connections to carburetor on vehicle.
9. Check all idle speeds and idle fuel mixture to specifications. Adjust as required.

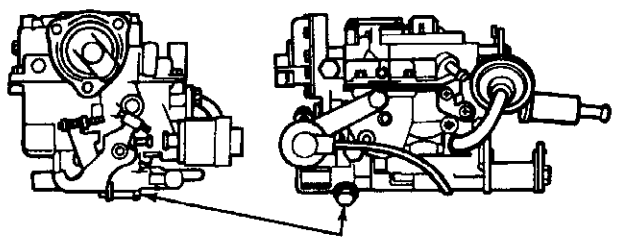
Holley Model 1946 Carburetors

• This procedure is to be used if contamination is to be removed from the carburetor.

• After cleaning the carburetor, flush the fuel system and change the fuel filter.

• For carburetor disassembly and assembly refer to Part 24-08.

1. Remove carburetor from engine and:
   a. Remove air horn.
   b. Clean fuel bowl. Remove and clean float, inlet needle and seat, inlet filter screen, and blow out inlet channels with compressed air.
   c. Remove and clean idle jet and pump discharge weight and ball.
   d. Remove and clean vacuum power valve, main metering jet and pump diaphragm assembly. (See Fig. 28).
   e. Using compressed air, dry all parts, blow out all channels, parts, and fuel bowl.
   f. Reassemble carburetor in reverse order (Steps B, C and D).
   g. Adjust dry float setting to specification and reassemble air horn with new gasket.
2. Reinstall carburetor on vehicle with new gasket.
3. Install new fuel filter.
4. Check all idle speeds and idle fuel mixture. Adjust as required and install new limiter at maximum rich position.



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FIG. 28 Disassembly Note—Holley Model 1946 Carburetor

Carter Model YFA Carburetors

This procedure is to be used if contamination is to be removed from the carburetor.

After cleaning the carburetor, flush the fuel system and change the fuel filter.

For carburetor disassembly and assembly refer to Part 24-06.

1. Remove carburetor from engine and:
   a. Remove air horn.
   b. Clean fuel bowl. Remove and clean float, inlet needle and seat, inlet filter screen, and blow out inlet channels with compressed air.
   c. Remove and clean idle jet and pump discharge weight and ball.
   d. Remove and clean step-up spring, metering rod, main metering jet and pump diaphragm assembly (Fig. 29).
   e. Using compressed air, dry all parts, blow out all channels, parts, and fuel bowl.
   f. Reassemble carburetor in reverse order (Steps B, C and D).
   g. Adjust dry float setting to specification and reassemble air horn with new gasket.

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2. Reinstall carburetor on vehicle with new gasket.
3. Install new fuel filter.
4. Check all idle speeds and idle fuel mixture. Adjust as required and install new limiter at maximum rich position.

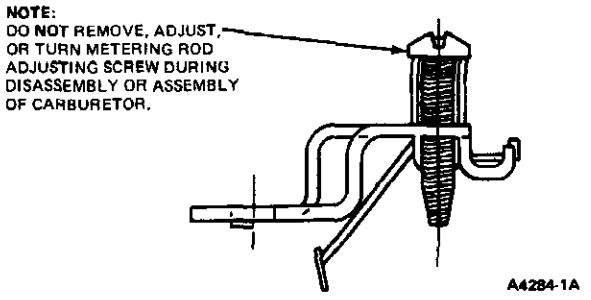


FIG. 29 Disassembly Note—Carter Model YFA Carburetor

Model 2700 Carburetors

This procedure is to be used if contamination is to be removed from the carburetor.

After cleaning the carburetor flush the fuel system and change the fuel filter.

For carburetor disassembly and assembly, refer to Part 24-27 of this Manual.

1. Clean carburetor in the following sequence:
   a. Use compressed air to dry all parts.
2. Remove the carburetor from the vehicle.
   a. Remove air horn assembly.
   b. Clean fuel bowl
   c. Remove and clean float assembly
   d. Remove fuel filter (Appendix "B"), fuel inlet needle and seat
   e. Remove and clean accelerator pump weight, pump check ball, and pump channels.
   f. Remove the cranking solenoid and clean passage. See Appendix "A", for solenoid check procedure.
   g. Blow out main well passages in air horn with 30 psi air pressure.
3. Replace fuel inlet needle and seat using new components.
4. Replace fuel filter according to Appendix "B".
5. Install cranking solenoid with a new lubricated "O" ring to the specified torque.
6. Set the dry float level to specification.
7. Assemble carburetor using a new air horn gasket and new retainers at the choke and pump rods.
8. Manually check operation of venturi valve and choke linkage for freedom of movement. Repair and/or replace as required.
9. Install carburetor on vehicle making all necessary external connections. NOTE: Choke heat tube nut connector may easily be cross threaded (use care).
10. Check choke heat system, according to SSD-12, Section III, Step 17.
11. Check idle speed and idle fuel mixture to comply with specification. Adjust as required.

Appendix "A" (Model 2700 Carburetor)

If electric cranking solenoid fails to click or a new solenoid check (Carburetor removed from vehicle).

1. Remove electric solenoid from the main body of the carburetor.
2. Apply a lead from the positive terminal of the vehicle battery to the cranking solenoid connector. Touch the solenoid body or case to a clean metal surface on the vehicle to provide a good ground. Observe if the cranking solenoid pintle retracts. If it does retract, proceed with Step 3. if not:
   A. Check the battery for required voltage and its connectors for continuity.
   B. Ensure that the solenoid body or case has a good ground.
   C. If battery and ground are OK, replace the cranking solenoid and make voltage check on the new one.
3. Apply 5" Hg vacuum with a hand vacuum pump (21-0014 or equivalent) to outlet of cranking solenoid and observe for zero leak. Repeat three times operating solenoid between each check. If OK, proceed with Step 4. If not OK, replace solenoid and repeat checks starting with Step 2.
4. Install solenoid in main body of carburetor. Use a new "O" ring (lubricated with a mild soap and water solution) on the nose of the solenoid and torque to specification.
5. Remove Air Horn Assembly
   A. Plug choke jet
   B. Apply 5" Hg vacuum to cranking channel discharge hole. If no leak at the solenoid, unplug choke jet and proceed with Step 6. If leaking at the solenoid, check for choke jet blockage. If still leaking, remove solenoid and check "O" ring for proper seating. Repeat Step 4.
   C. If "O" ring is cut, go back to Step 4. If "O" ring looks OK, then start from Step 3 and proceed.
6. Install air horn on body making all necessary connections.

Appendix "B"—Fuel Filter Replacement (Model 2700 Carburetor)

Removal

1. Remove the air cleaner.
2. Loosen (screw type) or remove (spring type) the clamp securing the fuel line to the fuel inlet fitting. Remove the line.
3. Unscrew the fuel inlet fitting and remove the fuel filter, gasket and spring.

Installation

1. Install the fuel filter spring, filter, inlet fitting gasket and the fitting into the carburetor.
2. Position the fuel line and clamp onto the fuel inlet fitting and tighten the clamp securely.
3. Start the engine and check for fuel leaks.
4. Replace the air cleaner on the carburetor.

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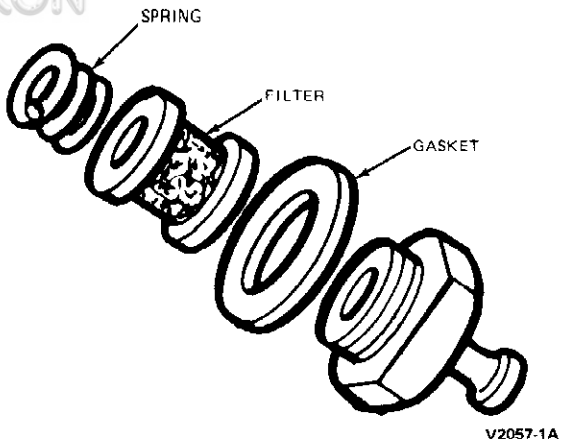


FIG. 30 Model 2700 Carburetor Fuel Filter

Appendix "C"—Venturi Valve Degumming Procedure (Model 2700 Carburetor)

1. Apply the parking brake and block the wheels.
2. Bring the engine to normal operating temperature and turn off.
3. Remove the air cleaner assembly, venturi valve cover and the two valve bearings. See Part 24-27 *for exploded view.*
4. Using automatic choke cleaner (C9AZ-19A501-B or equivalent), spray the venturi valve and valve diaphragm shaft until the surfaces are wet (not more than 2 seconds total). Manually cycle the valve and let stand (soak) for one minute.
5. Reinstall the bearings, cover, and air cleaner assembly.
6. Start the engine and let it run at high cam speed for three minutes.
7. Check for freedom of movement by cycling the throttle with the engine running. The valve should now respond rapidly to throttle position changes.

Model 6500 (Feedback) Carburetor

• This procedure is to be used if contamination must be removed from the carburetor.

• After cleaning the carburetor, flush the fuel system and change the fuel filter.

• For carburetor disassembly and assembly, refer to Part 24-14.

1. Remove the carburetor from the vehicle.
2. Remove the following: (note which items were removed from the primary and which from the secondary)
   a. Remove the air horn
   b. Remove high speed bleeds
   c. Remove well tubes
   d. Remove main metering jets
   e. Remove idle jets
   f. Remove limiter cap and idle adjustment screw. (Note turns off seat)
   g. Remove main system diaphragm assembly (only if diaphragm is ruptured or leaking).
   h. Remove the main system feedback metering needle housing from the mainbody.
3. Clean the fuel bowl and all the items removed in Step 2.
4. Using compressed air, blow out the following main body channels in the listed order:
   a. Primary idle channel from the adjustment screw opening.
   b. Primary and secondary air bleed metering channels from the idle jet opening.
   c. The fuel bowl; the primary, the secondary, and the main system feedback fuel metering channels.
   d. Primary and secondary main well channels.
5. Using compressed air, dry off the items removed in Steps 2b through h above.
6. Install a new fuel filter.
7. Adjust dry float setting according to Part 24-14.
8. Reassemble the carburetor using a new air horn gasket.
9. Check and reset as necessary:
   a. Choke pull down
   b. Cam set.
10. Reinstall the carburetor on the engine.
11. Check all idle speeds and idle fuel mixture to specification. *Adjust as required.*

SSD-19—LEAK CHECKS - CARBURETOR SYSTEMS

I. Venturi Valve System (Model 2700 Carburetors)

1. Check for vacuum leaks.
2. Remove carburetor from the engine.
3. Remove the upper (carburetor) body from the carburetor (See Part 24-27).
4. Open throttle plate fully.
5. Cover both ports located at the rear of the choke side throttle bore with finger.
6. Depress diaphragm shaft fully.
7. Cover the rectangular hole on the top.
8. Release the diaphragm shaft.
9. Shaft should not move. If it does, repair and/or replace as required.
10. Reassemble the carburetor following procedures in Part 24-27.

II. Cranking System (Model 2700 Carburetors)

1. Check for fuel leaks.
2. Remove the carburetor from the engine.
3. Remove upper (carburetor) body from the carburetor (See Part 24-27).
4. Apply 8 inches of vacuum to the cold enrichment jet.
5. Seal off cold enrichment discharge channel with finger.
6. The 8 inches of vacuum should be maintained for a minimum of 30 seconds. If it is not, repair and/or replace as required.
7. Reassemble the carburetor following procedures in Part 24-27.

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SSD-22 EVAPORATIVE EMISSION CONTROL SYSTEM

VAPOR PURGE CONTROL VALVE

I. Engine Will Not Start or Run

A. *Remove the purge line from the* PCV line "Tee" and cap. Attempt to start the engine.

B. If the engine now runs, procced to the next step; if not, continue with the diagnostic routine pertaining to the complaint.

C. With the engine running at idle, disconnect the vacuum signal hose from the purge valve, remove the valve from the evaporative canister and reconnect the purge line to the PCV line "Tee". If a **strong** hissing sound is heard from the purge valve, replace it. (Note: A **slight** hissing sound may be heard due to the small valve orifice.)

D. Connect a vacuum gage to the vacuum signal hose to the purge valve. Bring the engine to normal operating temperature. With the transmission selector in neutral, run the engine at approximately 2000 rpm for 10-20 seconds. The vacuum gage reading should be at least 5" Hg minimum. If not, check the carburetor signal port for any blockage per Reference Two, Step 25, the ported signal PVS per SSD-1, the PCV per SSD-11, or the SDV and/or RDV per SSD-2. Repair and/or replace as required.

E. With the purge valve still removed from the evaporative canister, connect a vacuum source to the purge valve and apply 5" Hg vacuum. With the engine idling, listen for a **strong** hissing. If a **strong** hissing is not heard, replace the valve.

F. Disconnect the vacuum source from the purge valve and reconnect the vacuum signal hose. With the engine at idle, there should not be any **strong** hissing. If there is, check the SDV and/or RDV per SSD-2 and the ported signal per *Reference Two, Step 25.* Repair and/or replace as required.

G. Reconnect all parts and hoses as originally equipped.

NOTE: Be sure that the carburetor bowl vent line has a continuous downward slope to the evaporative canister.

II. Engine Will Start and Run

A. Start the engine and with it running at idle, disconnect the vacuum signal hose from the purge valve and remove the valve from the evaporative canister. If a **strong** hissing sound is heard from the purge valve, replace it. (Note: A **slight** hissing sound may be heard due to the small valve orifice.)

B. Connect a vacuum gage to the vacuum signal hose to the purge valve. Bring the engine to normal operating temperature. With the transmission selector in neutral, run the engine at approximately 2000 rpm for 10-20 seconds. The vacuum gage reading should be at least 5" Hg minimum. If not check the carburetor signal port for any blockage per Reference Two, Step 25, the ported signal PVS per SSD-1, the PCV per SSD-11, or the SDV and/or RDV per SSD-2. Repair and/or replace as required.

C. With the purge valve still removed from the evaporative canister, connect a vacuum source to the purge valve and apply 5" Hg vacuum. With the engine idling, listen for a **strong** hissing. If a **strong** hissing is not heard, replace the valve.

D. Disconnect the vacuum source from the purge valve and reconnect the vacuum signal hose. With the engine at idle, there should not be any **strong** hissing. If there is, check the SDV and/or RDV per SSD-2 and the ported signal per Reference Two, Step 25. Repair and/or replace as required.

E. Reconnect all parts and hoses as originally equipped.

Note: Be sure that the carburetor bowl vent line has a continuous downward slope to the evaporative canister.

SSD-23 THERMACTOR II (PULSED AIR) SYSTEM

1. With the engine off, inspect the hose(s) from the pulse air valve(s) to the air cleaner for any cracks, splits, holes, etc. Replace if required.
2. Inspect the hose clamp(s) at the pulse air valve(s) for being properly positioned and tightened. Correct, reposition, tighten or replace as required.
3. If the hose from the valve to the air cleaner is damaged, due to overtemperature and/or firing, the pulse air valve should be replaced.
4. Disconnect the thermactor hose(s) from the pulse air valve(s) to the air cleaner at the valve(s).
5. Connect the thermactor check valve tester (Tool T751-9487-A or equivalent) to the open end of the pulse air valve. Position the hose clamp and tighten to specification.
6. Squeeze the test bulb on the tester. The bulb *should collapse completely.* If bulb does not collapse, the pulse air valve should be replaced.
7. Remove all test equipment and connect the air hose(s) to the valve(s) and tighten clamp.

SSD-24 2.3L FEEDBACK CARBURETOR ELECTRONIC ENGINE CONTROL SYSTEM DIAGNOSTIC PROCEDURE

I. PURPOSE

A. *Determine if the feedback* carburetor electronic engine control system is operating properly.

B. Locate the cause if the system is not operating properly.

C. This procedure is intended for vehicles with the throttle angle vacuum switch.

II. TEST EQUIPMENT REQUIRED

A. Essential Special Service Tools Special tester.

1. *Meter: Digital volt/ohm meter T78L-50-DVOM*
2. Tester: T-78L-50-FBC-1

Vacuum gage requirements:
SNAP-ON MT-14F or equivalent

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DETROIT IRON

Range, 0-25 ±/- 5 inches Hg
Resolution, 0.5 inch Hg
Accuracy, ±/- 3 percent of full scale, maximum

C. Vacuum tester: model 21-0014 or equivalent.
D. Tachometer
Requirements: Range, 0-3000 RPM
Accuracy, ± 40 RPM
Resolution, 20 RPM
E. Speed control tool: SNAP-ON GA-437 or equivalent.

III. PRE-CHECKS

A **Visual Inspection**

Note: The system will not function properly if air or vacuum leaks exist, or if there are bad electrical connections. Therefore, the following checks should be made prior to testing the feedback system.

B. Inspect all vacuum lines per Fig. 34 for:
1) Proper connections to fittings.
2) Broken, cracked, or pinched vacuum lines.
C. Inspect the electrical harness (Fig. 34) for:
1) Loose or detached connectors.
2) Broken or detached wires.
3) Terminals not completely seated in the connector.
4) Partially broken or frayed wires at connectors.
5) Shorting between wires.
6) Excessive corrosion.
D. Inspect the system's major components, Fig. 34, for evidence of physical damage.
E. While the engine is running, check the exhaust manifold and around the exhaust gas oxygen sensor for leaks.
F. Repair or replace items as required and proceed to Step IV.

IV. TEST EQUIPMENT HOOK-UP

A. Turn ignition key "OFF."
B. Disconnect the harness connectors from the Electronic Control Unit (ECU).
C. Connect the test equipment to vehicle per Fig. 33. The hose length between the vacuum gauge and the test setup is critical. Hose length must be 3 ft minimum, 4 ft maximum and 5/32" ID. Remove air cleaner as required to install test equipment and perform tests.
D. Set DVOM to Battery Test. Verify battery exceeds minimum voltage requirements stated on TESTER.

CAUTION: When using the DVOM with the selector switch in the "TESTER" position, the test leads must be removed from the DVOM test jacks for proper operation.

V. PROCEDURE - SYSTEM CHECK

Note: Air cleaner cover or assembly may be removed and replaced during these subroutines.

A. This procedure assumes that the other diagnostic procedures (SSD'S) have been run in accordance with the appropriate routines.

B. **Vehicle Will Not Start or Run**

1. Verify that the IGNITION key is "OFF."
2. Remove the primary connector from the ignition coil and disconnect the four pin circular connector at the IGNITION MODULE.
3. Set DVOM Selector Switch to TESTER position. Set the TESTER Test Selector Switch to position 4.
(a) If the reading is greater than 10.0 (10000 ohms) recheck diagnostic routine 104.
(b) If the reading is less than 10.0 (10000 ohms), disconnect the square four pin in-line connector between the TESTER and the ECU.
I) If the reading is still less than 10.0 (10000 ohms), locate and repair the short in the electrical harness.
II) If the reading is greater than 10.0 (10000 ohms), replace the ECU.
(c) Reconnect all connectors. Verify vehicle will start and run properly.

- If it will start and run, proceed to section Vc. of this routine.
- If it will not start and run, return to Routine 104 of the Diagnostic Procedures.

C. **Vehicle Conditioning**

1. Block both front wheels.
2. Put PARKING BRAKE "on.".
3. Start the engine and let it run in neutral or park until the thermostat is open and the upper radiator hose is hot and pressurized.
4. Turn all electrical loads OFF.

D. **Data Collection**

NOTE: Complete all data gathering per Test sequences I, II, and III prior to performing any diagnostic subroutines except as noted on the Data Chart. Air cleaner cover or assembly may be removed and replaced as required while performing the Test sequences.

1. Test Sequence I
Refer to "2.3L Feedback Carburetor Diagnostic Data Chart."
(a) Install speed control tool. Using tool, set engine speed within the 2200-2800 rpm range.
(b) Starting with the Test Selector Switch in position 1 and DVOM switch to TESTER position, record the required data on the chart.
2. Test Sequence II.
This test sequence requires that a function be timed. Therefore, read the procedure first and then perform it.
(a) At the VACUUM GAGE TEE (Fig. 33) fitting remove the control vacuum line that goes to the carburetor. At the same time, cover the tee opening with a finger and measure the time it takes the VACUUM GAGE and the VACUUM REGULATOR LIGHT to go to a steady indication.

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(b) Record the time on the data chart.

3. Test Sequence III.
   (a) Set engine rpm in the 2200-2800 range.
   b) Reconnect the control vacuum line to the VACUUM GAGE TEE.
   (c) Disconnect the vacuum line from the Cold Temperature Switch (PINK HOSE).
   (d) Apply 4.5-5.5 in. Hg vacuum to the Cold Temperature Switch and record the required data on the data chart.
   (e) While covering the carburetor idle air bleed hole, reduce the vacuum to zero (0) and record the required data on the data chart.
   (f) Uncover the idle air bleed hole and record the required data on the data chart.
   (g) Return engine to curb idle condition and verify reading is less then 0.3 (volts).
4. Turn the engine OFF, reconnect the vacuum lines to their normal fittings and reconnect all electrical connections. Proceed to Step V-E.

E. **Data Analysis**

1. Review the test data in "Diagnostic Data Chart." If all data is within limits the system is operating properly or the complaint is no longer present. Refer to V-E.4. If no additional testing is required, disconnect tester from harness and reconnect harness to ECU.
2. If one or more of the test points are out of limits, perform the subroutine indicated at the bottom of the appropriate column. The subroutines should be used in sequence from left to right.
3. Whenever a part is repaired or replaced, a retest is required. The retest should be:
   (a) Repeat Steps V-D.1. through V-D.4.
4. **IMPORTANT**

   If the initial system check or a subroutine is completed and the cause of the complaint is not found and resolved, proceed as follows:
   (a) Verify that the initial problem still exists.
   • If it does, repeat the initial system check and/or the appropriate subroutine of this procedure.
   • If it does not, operate the vehicle on the road, or on a chassis dynamometer, or expose to the appropriate environment to try and induce the problem. Then repeat initial system check and/or the appropriate subroutine of this procedure.
   • Once the malfunction has been corrected, reconnect all vacuum and electrical connections per Fig. 34.
   (b) If the problem still has not been corrected go to the next step in the Diagnostic Routine, or repeat the Routine from the beginning, or *perform the appropriate checks per reference* One or Two of the Engine Diagnostic Procedures.

VI. PROCEDURE—COMPONENT CHECK (Subroutines)

Note: Air cleaner cover or assembly may be removed and replaced as required during these subroutines.

A. Battery Voltage Not Within Limits

Start and run engine at idle to normal operating temperature (upper radiator hose hot and pressurized) and set the Test Selector SWITCH to position 1.

1. If the reading is less than 11.5 volts, check for one or more of the following conditions:
   (a) Discharged battery. Charge or replace as required and retest.**
   (b) Damaged ignition switch. Replace and retest.
   (c) Wire between ECU and ignition switch Circuit No. 687 open or shorted, repair wire and retest.**
   (d) Open ground wire between ECU and engine block. Connect test lead from TESTER continuity lead test jack to engine block. Set the Test Selector Switch in position 6. If reading is greater than 3.0 (ohms), *repair the wire and retest.*** (Circuit 57)
   (e) Faulty voltage regulator (see Group 31).
2. If the reading is over 18.0 (volts), check battery electrolyte level, and fill, if required. Also, replace the voltage regulator if required and retest.**

B. **Cold Temperature Switch or Throttle Angle Vacuum Switch Not Within Limits**

Start engine, let it idle in neutral and verify that the engine is at normal operating temperature (upper radiator hose hot and pressurized).

1. Remove the vacuum line (PINK HOSE) from the Cold Temperature Switch and feel for vacuum.
   (a) If no vacuum is present, proceed with Step VI-B.2.
   (b) If vacuum is present, replace the Feedback Carburetor PVS (Feedback PVS, Fig. 33) and retest.**
2. Run the engine at 1500 rpm.
   (a) Remove the vacuum hose from the Throttle Angle Vacuum Switch and feel for vacuum.
   (b) If there is vacuum present, proceed to Step VI-B.3.
   (c) If no vacuum is present, check for blocked vacuum hose or carburetor vacuum spark port. Repair or replace as required and retest.**
3. Turn the ignition KEY to "OFF" position.
   (a) Disconnect the flat three pin connector between the Cold Temperature Switch/ Throttle Angle Vacuum Switch Assembly and the harness.
   (b) Set the Test Selector Switch to position 7.
   (c) If the reading is greater than 1.0(1000 ohms), proceed to Step VI-B-4.
   (d) If the reading is less than 1.0(1000 ohms), proceed to VI-B.3.e.
   (e) Disconnect the square four pin Tester-to-ECU connector.

****Whenever a component has been repaired or replaced and a retest is required, conduct or repeat V-D.1. thru V-D.4.**

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(f) Set the Test Selector Switch to position 8.

(g) If the reading is greater than 4.0 (ohms), replace the ECU and retest.**

(h) If the reading is less than 4.0 (ohms) repair or replace the harness Circuit No. 75 and retest.**

4. Turn the ignition KEY to "ON" position/engine "OFF".

(a) Set the Test Selector Switch to position 2.

(b) If the reading is 10.5-18.0 (volts), proceed to Step VI-B.5.

(c) If the reading is less than 10.5 (volts), replace the Electronic Control Unit and retest.**

5. Turn the ignition KEY to "OFF" position.

(a) Reconnect the Cold Temperature Switch/ Throttle Angle Vacuum Switch Assembly to harness.

(b) Set the Test Selector Switch to position 7.

(c) If the reading is less than 0.5(500 ohms), proceed to Step VI-B.7.

(d) If the reading is greater than 0.5(500 ohms), proceed to Step VI-B.6.

6. Apply 5.0 inches of vacuum to the Cold Temperature Switch.

(a) If the reading is 0.5 (500 ohm) or greater, replace harness Circuit No. 75 and retest.**

(b) If the reading is less than 0.5(500 ohms), replace the Cold Temperature Switch/ Throttle Angle Vacuum Switch Assembly and retest.**

7. Remove the vacuum line (yellow hose) from the Throttle Angle Vacuum Switch and apply 5.0 inches of vacuum to the switch.

(a) Set the Test Selector Switch to position 8.

(b) If the reading is greater than 4.0 (ohms), proceed to Step VI-B.8.

(c) If the reading is less than 4.0 (ohms), replace the Cold Temperature Switch/Throttle Angle Vacuum Switch Assembly and retest.**

8. Disconnect and plug the vacuum hose from the Cold Temperature Switch.

(a) Set the Test Selector Switch to position 2.

(b) Run engine in the 2200-2800 rpm range.

(c) Apply zero and 5.0 inches of vacuum to Cold Temperature Switch.

(d) If the reading is 11.5-18.0 (volts) at zero inches of vacuum and less than 11.5 (volts) at 5.0 inches of vacuum, proceed to VI.B.9.

(e) If the reading is less than 11.5 (volts) at zero inches of vacuum and/or 11.5-18.0 (volts) at 5.0 inches of vacuum, replace the Cold Temperature Switch/Throttle Angle Vacuum Switch Assembly and retest.**

9. Reconnect all vacuum and electrical connections per Figure 34.

(a) Turn the Test Selector SWITCH to position 2.

(b) Turn the engine "OFF", and the ignition key to "RUN".

(c) Apply 5.0 inches of vacuum to Throttle Angle Vacuum Switch.

(d) If the reading is less than 10.5 (volts), replace the ECU and retest** (Step V-D.1.) and test sequence III (Step V-D.3).

(e) If the reading is 10.5-18.0 (volts), repeat test sequence I (Step V-D.1) and test sequence III (Step V-D.3.)

(f) If data chart is within limits, the system is operating properly or the problem is no longer present. Refer to V-E.4.

C. **Exhaust Gas Oxygen (EGO) Sensor Not Within Limits**

Use the following table to determine which diagnostic subroutine to use.

****Whenever a component has been repaired or replaced and a retest is required, conduct or repeat V-D.1. thru V-D.4.**

EGO Sensor Indicator	Solenoid Vacuum Regulator Light	Feedback Vacuum Control (in. Hg.)	Engine RPM Range	Subroutine Step
Rich	ON	4.5 – 5.5	2200 – 2800	VI – C.1.
Rich	ON	0 – 0.5	2200 – 2800	VI – C.2.
Rich	OFF	0 – 0.5	2200 – 2800	VI – C.3.
Lean	ON	4.5 – 5.5	2200 – 2800	VI – C.4.
Lean	OFF	4.5 – 5.5	2200 – 2800	VI – C.5.
Lean	OFF	0 – 0.5	2200 – 2800	VI – C.6.
Lean "blinking", rich "off"	BLINKING	N/A	2200 – 2800	VI – C.7.
Rich "blinking", lean "off"	BLINKING	N/A	2200 – 2800	VI – C.8.

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FIG. 31 Diagnostic Subroutine Chart

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1. **EGO Sensor Rich, Control Vacuum High, Vacuum Solenoid Light "on"**
   (a) Check for proper operation of the CHOKE per SSD-12 and retest. If the complaint is still present proceed to the next step.
   (b) Check for proper operation of the CARBURETOR per SSD-31 and retest.**
2. **EGO Sensor Rich, Control Vacuum Low, Vacuum Solenoid Lights "On"**
   With the engine rpm at 2200-2800, remove the control vacuum line from carburetor.
   (a) Check the vacuum at the **input** to the VACUUM SOLENOID REGULATOR. The vacuum should be greater than 10.0 inches Hg. If it is not, check for a vacuum leak or blockage in the feedback vacuum system (see Fig. 34) and repair or replace and retest.**
   (b) If the vacuum is greater than 10 inches reconnect the hose to the *REGULATOR input* and check the vacuum at the REGULATOR **output port.** If it is less than 4.5 inches, replace the VACUUM SOLENOID REGULATOR and retest.**
   (c) If the vacuum is greater than 4.5 inches, check the hose between the VACUUM REGULATOR and the CARBURETOR for leaks or blockage. Replace and retest.**
   (d) If the hose is O.K. check the CARBURETOR for vacuum leakage per SSD-31 and then retest.**
3. **EGO Sensor Rich, Control Vacuum Low, Vacuum Solenoid Light "Off"**
   (a) Disconnect the square 4 pin connector at the module—tester harness interface and set the Test Selector Switch to position 11.
   • *If the reading* is less than 10.5 (volts) proceed to step (b).
   • If the reading is greater than 10.5 (volts) replace the ECU and retest.**
   (b) Turn IGNITION switch to "OFF" and set the Test Selector Switch to position 5. Disconnect the two pin connector to the Vacuum Solenoid Regulator. Attach the Tester continuity lead probe to circuit 687A *in the harness connector which* mates to the Vacuum Solenoid Regulator (See Fig. 33 for pin location).
   • If the reading is greater than 3 (ohms), repair or replace 687A circuit and retest.**
   • If the reading is less than 3 (ohms) proceed to Step c.
   (c) Set the Test Selector Switch to position 12. Attach TESTER continuity lead probe to circuit 77 located in the harness connector which mates to the Vacuum Solenoid Regulator (see Fig. 33 for pin location). If the reading is less than 3 (ohms), proceed to Step (d). If the reading is greater than 3 (ohms), repair or replace circuit 77 and retest.**
   (d) Use the DVOM to measure the resistance of the Vacuum Solenoid Regulator coil. With the Selector switch in the 200 (ohm) position, this reading should be between 30-55 (ohms). If reading is not within this range, replace Vacuum Solenoid Regulator and retest.** If the reading is within limits, the system is operating properly or the specific problem is no longer present. *Refer to V-E.4.*
4. **EGO Sensor Lean, Control Vacuum High, Vacuum Solenoid Light "On"**
   Replace the ECU and retest.**
5. **EGO Sensor Lean, Control Vacuum High, Vacuum Solenoid Light "Off"**
   (a) Verify that the IGNITION KEY is "OFF".
   (b) Check the VACUUM SOLENOID REGULATOR valve. Apply 12-14" Hg of vacuum to Vacuum Solenoid Regulator input port. If the vacuum gage reading at the output port is 2.0" Hg or more replace the Vacuum Regulator and retest.**
   (c) Disconnect the harness from the VACUUM SOLENOID REGULATOR to check circuit 77 for an open circuit. Set the Test Selector switch to position 12 *and attach TESTER continuity lead Probe* to circuit 77 in the harness connector which mates to the solenoid (see FIG. 33 for pin location). Measure the resistance. If the reading is less than 3 (ohms), proceed to Step (d). However, if the reading is greater than 3 (ohms), repair or replace circuit 77 and retest.**
   (d) Use the DVOM with the selector switch in the *2000 (ohms) position to check for a short to* ground at the VACUUM SOLENOID REGULATOR connector. The resistance from both pins on the connector to ground should be greater than 300 (ohms). If the reading is less than 300 (ohms), replace the VACUUM REGULATOR and retest.**
6. **EGO Sensor Lean, Control Vacuum Low, *Vacuum Solenoid Light "Off"***
   (a) Verify that the IGNITION KEY is "Off".
   (b) Disconnect the EGO sensor from the harness. Set the Test Selector Switch to position 13 and take a reading between the TESTER/CONTINUITY LEAD JACK on the TESTER and the EGO connector on the harness.
   (c) If the reading is greater than 3 (ohms), repair *or replace the wire (circuit 74) and retest.***
   (d) If the reading is less than 3 (ohms), proceed.
   (e) Connect the DVOM between the EGO sensor lead and the engine block. Disconnect and

****Whenever a component has been repaired or replaced and a retest is required, conduct or repeat V-D.1. thru V-D.4.**

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move aside the air output hose from the AIR BYPASS VALVE. Start engine and let it idle until it has reached normal operating temperature (upper radiator hose hot and pressurized). Then operate engine for a minimum of 3 minutes between 2200 and 2800 rpm. Reduce engine speed to curb idle and immediately perform Step (f) and obtain reading per Step (g).

(f) Place a finger over the carburetor IDLE AIR BLEED HOLE (see SSD-31 for location of the hole). After reading meter, reconnect hose to Air Bypass Valve.

(g) If the meter reading is less than 0.55 (volts), replace the EGO sensor, and retest.**

(h) If the voltage is 0.55 (volts) or greater, proceed.

(i) Remove your finger from the IDLE AIR BLEED HOLE and reconnect the EGO sensor to the harness. Increase the engine speed to approximately 2200-2800 rpm.

(j) If the EGO indicator is lean, check the CARBURETOR, per SSD-31 and retest. If the indicator varies between Lean and Rich, refer to SSD-5.

7. EGO SENSOR BLINKING "LEAN" ONLY, VACUUM SOLENOID LIGHT BLINKING.

(a) Start engine and let it idle until it has reached normal operating temperature (upper radiator hose hot and pressurized). Set DVOM to TESTER, and Test Selector Switch to position 22.

(b) Operate engine for a minimum of three minutes in the range of 2200-2800 rpm. Reduce engine speed to curb idle and immediately perform Steps (c) and (d).

(c) Place a finger over the carburetor IDLE AIR BLEED HOLE (see SSD-19 for location of the hole).

(d) If the meter reading is less than 0.55 (volts), remove and replace EGO SENSOR. If reading is 0.55 (volts) or greater, system is O.K. Check TESTER per TESTER MANUAL to verify it is functioning properly.

8. EGO SENSOR BLINKING "RICH" ONLY, VACUUM SOLENOID LIGHT BLINKING.

(a) Start engine and let it idle until it has reached normal operating temperature (upper radiator hose hot and pressurized). Set DVOM to TESTER, and Test Selector Switch to position 22.

(b) Operator engine for a minimum of three minutes in the range of 2200-2800 rpm.

(c) With the engine still at 2200-2800 rpm, remove the vacuum hose to the Evaporative Control Canister at the fitting located in the vacuum line between the PCV valve and the carburetor. Observe the meter reading.

(d) If the meter reading is greater than 0.25 (volts), remove and replace the EGO SENSOR. If the reading is 0.25 (volts) or less, indicating the lean mixture, the system is O.K. Check the TESTER per TESTER MANUAL to verify it is functioning properly.

(e) Reconnect vacuum hose to fitting.

D. **Vacuum Solenoid Light Not Within Limits**

1. If the Vacuum Solenoid light in the Test Sequence II, (Fig. 32), changed from "Blinking" to "On" in more than the specified time, proceed to Step VI-D.2.

   If the Vacuum Solenoid light malfunctioned in any other manner, proceed to Step VI-D.3.

2. Set the Test Selector Switch to Position 4.

   • If reading is less than .5 (500 Ohms), replace ECU and retest**.

   • If reading is .5 (500 Ohms) or greater, repair open in circuit 11 and retest**.

3. If the other functions (EGO Sensor, Cold Temperature Switch and Throttle Angle Vacuum Switch) are OK, check the tester for a malfunction in the Vacuum Solenoid light circuit. (Refer to TESTER manual for instructions). If the tester is OK, proceed to the next step:

4. Turn the ignition switch to RUN position with engine OFF.

(a) Set the Test Point Selector Switch to position 11. If the meter reading is:

• 7.0-14.0 (volts average), replace the ECU and retest**.

• 4.5-7.0 (volts average) recheck the Tester for a malfunction in the Vacuum Solenoid Light circuit or retest V-D.1. through V-D.4. with a tester that is known to be operating properly.

• 0.5-4.5 (volts average), replace the ECU and retest**.

• 0.0-0.5 (volts average), continue testing.

(b) Set the Test Selector Switch to position 1.

• If the reading is less than 10.5 (volts), repair or replace circuit 687 and retest**.

• If the reading is 10.5 (volts) or greater, continue.

(c) Turn the ignition switch OFF and:

(1) Set the Test Selector Switch to position 5.

(2) Disconnect the two pin connector to the Vacuum Solenoid Regulator.

(3) Attach the tester Probe to Circuit 687A, located in the harness connector which mates to the Vacuum Solenoid Regulator (See Fig. 33 for pin locations).

• If the reading is less than 3 (ohms), proceed to Step VI-D.4. (d).

****When a component has been replaced or repaired and a retest is required, conduct or repeat V-D.1. through V-D.4.**

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Test Selector Switch						
Test Sequence	Vehicle Condition	No. 1 Vehicle Battery Voltage	No. 2 Cold Temperature Switch and Throttle Angle Switch	EGO Sensor Indicator	Vacuum Regulator Light	Feedback Vacuum Control
I Step V-D.1.	1. Front wheels blocked 2. Parking brake "ON" 3. Engine "Hot" in neutral 4. RPM = 2200 – 2800	Limits 11.5 – 18.0	Limits 11.5 – 18.0	Limits Alternating between Lean and Rich	Limits "Blinking"	Limits See Performance Specifications Book
II Step V-D.2.	1. Remove the carburetor feedback vacuum control line from TEE and immediately cover the TEE opening. 2. RPM = 2200 – 2800				Limits From "Blinking" to "ON" in ** sec. or less	Limits See Performance Specifications Book
III Step V-D.3.	1. Replace carburetor feedback vacuum control line. RPM = 2200 – 2800 2. Apply 5" vacuum to Cold Temperature Switch		Limits Condition 2: 0.3 (V) Max.		Limits Condition 2: Blinking	Limits See Performance Specifications Book
	3. While covering Carburetor idle air bleed hole, remove vacuum from Cold Temperature Switch.		Condition 3: 11.5 (V) Min.		Condition 3: "ON"	
	4. Uncover idle air bleed hole.		Condition 4: 11.5 (V) Min.		Condition 4: Blinking	
	5. Return to curb idle		Condition 5: 0.3 (V) Max.			
		If out of limits, Stop Sequence & Proceed to V.I.A.	If out of limits* See VI-B.	If out of limits* See VI-C.	If out of limits* See VI-D.	If out of limits* See VI-E.

* Complete all data gathering per test sequence I, II, and III prior to performing any diagnostic subroutines, except as noted.
** See Performance Specifications Book.

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FIG. 32 Feedback Carburetor Diagnostic Data Chart

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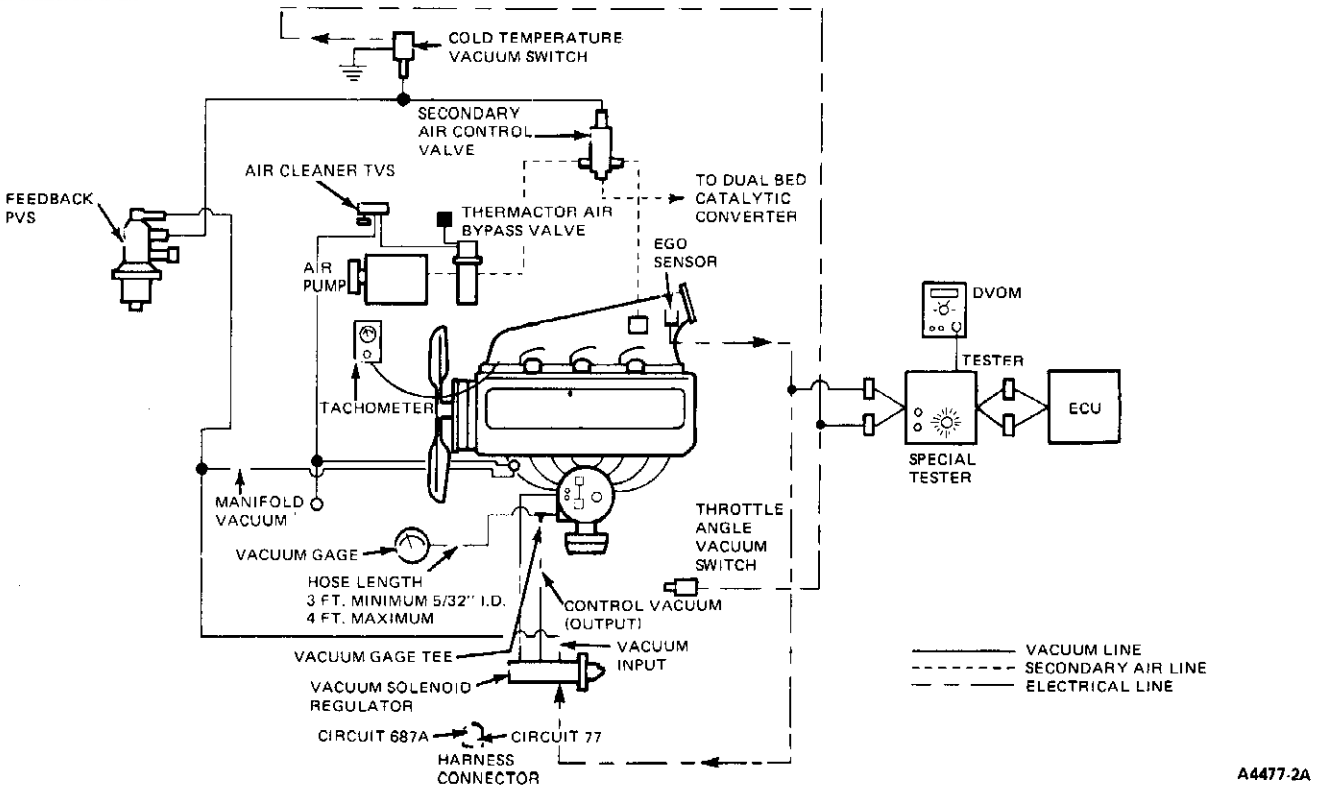


FIG. 33 Test Connections—2.3L I-4 Electronic Engine Control System

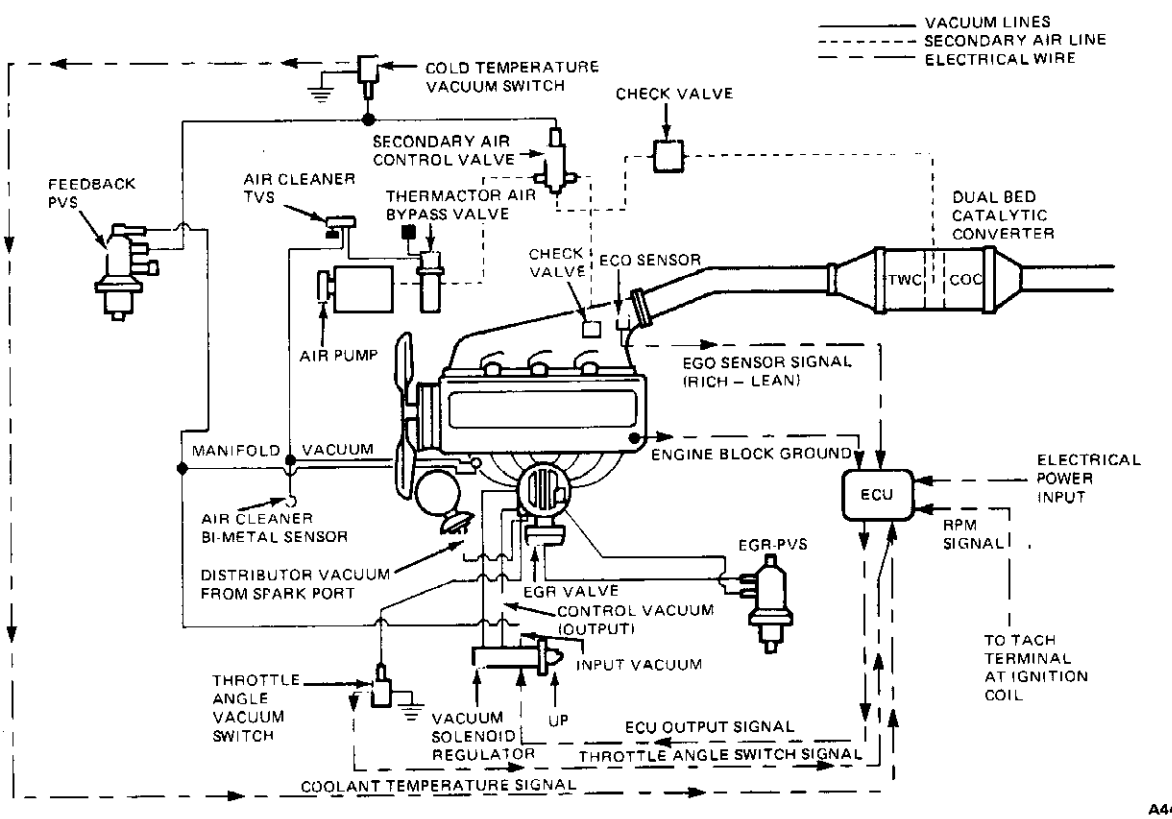


FIG. 34 Typical System Connections—2.3L Electronic Engine Control System

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- If the reading is 3 (ohms) or greater, replace or repair Circuit 687A and retest**.

(d) Set the Test Selector Switch to position 12. Attach TESTER continuity lead probe to circuit 77, located in the harness connector which mates to the Vacuum Solenoid Regulator (see Fig. 33 for Pin locations). If the reading is less than 3 (ohms), proceed to Step (3). If the reading is 3 (ohms) or greater, repair or replace circuit 77 and retest**.

(e) Use the DVOM to measure the resistance of the Vacuum Solenoid Regulator Coil. With the DVOM Selector Switch in the 200 Ohm position, the reading should be between 30 and 55 ohms. If the reading is not within this range, replace the Vacuum Solenoid Regulator and retest**.

(f) **If the reading is within the appropriate range, the system is operating properly or the condition which caused the complaint is no** longer present. Reconnect connector to the vacuum regulator solenoid. Go to section V-E.4.

E. **Feedback Vacuum Control Not Within Limits**

1. **Disconnect the manifold vacuum input line from the** VACUUM SOLENOID REGULATOR, **connect the vacuum gage to that line. Start the engine, let idle in neutral, and measure the vacuum.**

   NOTE: Verify that the throttle is off the fast idle cam.

   a. **If the vacuum is less than 12 inches Hg., check for leakage in the vacuum system or blocked vacuum hose. Repair and retest.**
   b. **If the vacuum is greater than 12 inches Hg., proceed to the next step.**

2. **Reconnect the manifold vacuum line to the** VACUUM SOLENOID REGULATOR. **Disconnect the vacuum control line from the CARBURETOR and connect the vacuum gage to it.**

   a. If the vacuum is less than 1.75 or greater than 3.25 inches Hg. average, replace the VACUUM SOLENOID REGULATOR and retest.**
   b. **If the vacuum is between 1.75 and 3.25 inches Hg. average, check the carburetor per SSD-31 and retest.****

SSD-25 5.0L (302 CID) ELECTRONIC ENGINE CONTROL (EEC-I) SYSTEM DIAGNOSTIC PROCEDURE

ELECTRONIC ENGINE CONTROL (EEC) SYSTEM

I. Purpose

A. Determine if the EEC system is operating properly.
B. Locate the cause if it is not operating properly.

II. Test Equipment Required

A. Essential Special Service Tools.
   1. Meter: Digital volt/ohm meter (DVOM) T78L-50-DVOM
   2. Tester: Model T78L-50-EEC-1 Including test fixtures:
      a. Sensors(3) blue, yellow, brown
      b. Ignition module(1) black
B. *Tachometer Range: 0 to 3000 RPM Accuracy: ± 40 RPM Resolution: 20 RPM.
C. *Vacuum/Pressure Gage requirements Range, 0-25+5, −0 inches Hg. 0-15+/−5 psi
   Resolution, 1/2 inches Hg maximum 0.25 psi maximum
   Accuracy, 3% Full scale, minimum
D. Ohmmeter: DVOM, T78L-50-DVOM Voltmeter: DVOM, T78L-50-DVOM
E. *Timing light 27-0002 or equivalent or magnetic pick up timing and advance meter.
F. Speed control tool, Snap-On, GA-437 or equivalent.

*Alternate for items B, C, E and F, engine analyzer, 36-0037 or equivalent.

III. Pre-Checks

A. Visual Inspection

1. Remove air cleaner assembly and inspect all vacuum and pressure hoses for:
   a. Proper connection to fittings
   b. Broken, cracked or pinched conditions
2. Inspect the EEC Sub-system harness for:
   a. Proper connection to the EGR solenoids, red wire to both, yellow wire to pressure and green wire to vent.
   b. Loose or detached connectors.
   c. Broken or detached wires.
   d. Terminals not completely seated in the connector.
   e. Partially broken or frayed wires at connectors.
   f. Shorting between wires.
   g. Excessive corrosion.
3. Inspect the sensors for evidence of physical damage.
4. Repair items as required, replace air cleaner assembly and proceed to Step IV.

IV. Test Equipment Hookup

A. Turn ingnition KEY "off."
B. Disconnect the harness from the Electronic Contol Assembly (ECA).
C. Connect the test equipment to vehicle per Figure 35.
D. Set the DVOM switch to "BATTERY TEST" and verify the reading is greater than the value stated on face plate. If the voltage is low consult the tester manual. Set the DVOM switch to position "TESTER."

   CAUTION: When using DVOM with selector switch in "TESTER" position, test leads **MUST BE removed from DVOM "TEST LEADS" jacks** for proper operation.

E. When necessary to remove air cleaner to perform a test or check-out, remove as required.
F. If engine starts, proceed to step VI, if engine will not start, proceed to step V.

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V. Engine Will Not Start

A. Depress and hold the "NO START" switch on TESTER. Set ignition key to "start" position while attempting to start engine.
   1. If vehicle starts, release the "NO START" button and proceed to Step V-B.
   2. If vehicle fails to start, release the "NO START" button and proceed to Step V-C.

B. Set the TESTER "TEST SELECTOR SWITCH" (TSS) to position "9" and ignition key to "run" position (verify engine is not running).
   1. If the reading is 10.5 (volts) or more, replace the ECA and verify the engine starts normally. Check the EEC system by performing steps VI-A thru VI-D.
   2. If the reading is less than 10.5 (volts), check for:
      - A discharged battery
      - Open wire from the battery to the ECA power relay coil (Circuit 175).
      - Open wire from the ignition switch to the ECA power relay coil (Circuit 20).
      - Open wire from the ECA to the ECA power relay coil (Circuit 361).
      - Inoperative ECA power relay.

      Repair or replace the damaged or worn component as required and retest. (1)

C. Turn the IGNITION KEY off. Set the TSS switch to position 10.
   1. Disconnect Crankshaft Position (CP) connector and install the blue continuity test fixture to the wiring harness. Measure the resistance.
      - If the reading is between 100 and 250 (ohms) proceed to step 2.
      - If the reading is less than 100 or greater than 250 (ohms), check circuits 349 and 350 for an open or short. Repair the harness as required and retest (1).
   2. Remove the test fixture and reconnect the CP connector.
      - If the reading is less than 100 or greater than 550 (ohms) replace the CP sensor and retest (1).
      - If the reading is between 100 and 550 (ohms) proceed to step V-D.

D. Set the TSS switch to position 11 and connect the black four pin CONTINUITY TEST FIXTURE to the four-blade, wiring harness connector at the ignition module.
   1. If reading is between 7-13 (ohms), disconnect test fixture, reconnect harness, and proceed to SSD-14.
   2. If the reading is less than 7 (ohms), check for short in circuits 57 and 144. If reading is greater than 13 (ohms), check for open in circuits 57 and 144. Repair harness as required and retest(1).

      CAUTION: Remove test fixture and reconnect harness.

VI. Engine Runs

This procedure assumes that the other diagnostic procedures (SSD's) have been run in accordance with the appropriate routines.

A. Vehicle Conditioning

1. Block both front wheels.
2. Put the parking brake **on** and set transmission selector to "PARK".
3. Turn off all vehicle electrical loads (radio, air conditioner, heater and lights, etc.).
4. Crank Signal Check
   a. Disconnect the harness wire from terminal "S" of the Starter Relay.
   b. Set the tester "TEST SELECTOR SWITCH" (TSS) to position.
      - Verify that reading is greater than 5 (volts) with ignition key to "Start" position.
      - If not, proceed to step VI-D-11
      - If 5 (volts) or greater, reconnect wire to terminal "S" of Starter Relay and proceed to step C.
   c. Start the engine. Let the engine run until the thermostat is open and the upper radiator hose is hot and pressurized. Check that throttle is off fast idle and on curb idle.
5. Turn the engine **off**, then turn the IGNITION KEY to the **run** position, engine "off."

B. Data Collection

1. Set the TESTER "TEST SELECTOR SWITCH" (TSS) to position 1 and the DVOM selector switch to "TESTER". Turn Ignition Key to "RUN" position (engine "off").
2. Using the TSS switch on the special tester, gather the data for test sequence I and record it on the Diagnostic Data Chart (Fig. 36). Be sure the throttle is completely off fast idle.
   - If Vref is out of limits, proceed immediately to step VI-D.1. If Vref is within limits, complete gathering and recording data for Test Sequence I. Then, proceed to the following steps for Test Sequence II.

   NOTE: Complete all data gathering per Test Sequences I and II prior to performing any diagnostic subroutine, except as noted on the Data Chart.

3. Prior to starting Test Sequence II, turn ignition key "off." Disconnect Manifold Absolute Pressure (MAP) and Inlet Air Temperature (IAT) Sensors from wiring harness.
   - Install CONTINUITY TEST FIXTURES as follows:

     CAUTION: Check for correct pin orientation prior to mating.

     a. MAP Sensor: Install YELLOW fixture to the harness MAP Sensor connector.

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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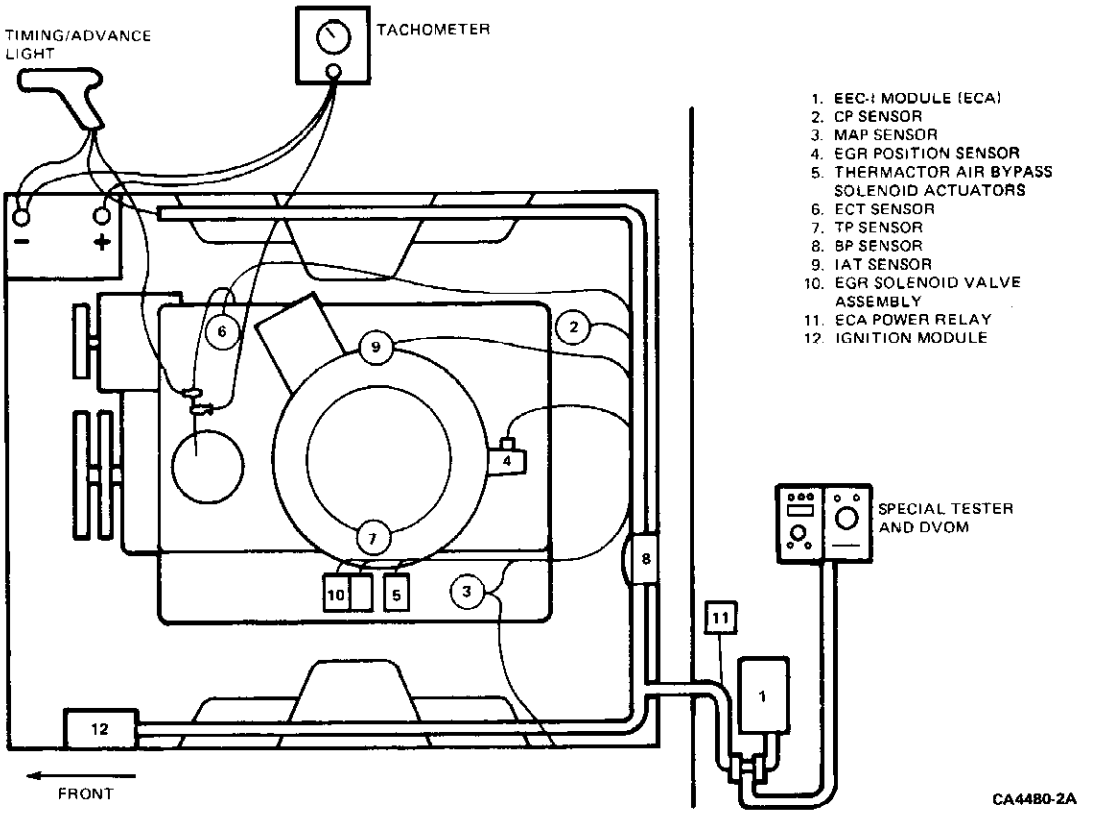


FIG. 35 Test Equipment Hook-Up and Component Location

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Vehicle Condition	Test Selector Switch Position 1 Vref	2 MAP	3 TP	4 BP	5 BCT	6 IAT	7 TAB	8 EVP	Spark Advance (degrees)
TEST SEQUENCE I (See Step VI.B.) 1. Parking brakes "on" 2. Engine, "off" & "hot", key "run" 3. All accessories "off" 4. Crank signal checked per VI.A.4.	*Limits* 8.5 – 9.5V ** Reading ___ V	*Limits* table A Reading ___ V	*Limits* 1.65 2.14V Reading ___ V	*Limits* table A Reading ___ V	Limits 1.9 – 3.7V Reading ___ V	Limits 4.1 – 6.3V Reading ___ V	Limits Greater Than 10.5V Reading ___ V	Limits 1.09 – 1.61V Reading ___ V	
TEST SEQUENCE II (See Step VI.B.) 1. Parking brakes "on" 2. Install test fixtures: MAP (yellow), IAT (brown) 3. Engine "hot" and "running" in "park" at "curb idle". All accessories "off". (4.) Observe MAP and IAT data. (5.) Raise RPM to 1600 – 1800. Start timing TAB when throttle returns to curb idle. (6.) Set engine to 1600 ± 50 RPM. Observe EVP and Spark Advance.		Limits (4) 3.5 – 5.5V ** Reading ___ V				Limits (4) 5.2 – 7.2V ** Reading ___ V	Limits (5) Less than 1.6V changing to greater than 10.5V within 60 ± 5 sec. yes no	Refer (6) to engine emission label Reading ___ V	Refer (6) to engine emission label Reading ___ V
DATA ANALYSIS: (See Step VI.C.)	If out of limits** Step VI.D.1.	If out of limits* Step VI.D.2.	If out of limits* Step VI.D.3.	If out of limits* Step VI.D.4.	If out of limits* Step VI.D.5.	If out of limits* Step VI.D.6.	If out of limits* Step VI.D.7.	If out of limits* Step VI.D.8.	If out of limits* Step VI.D.10.

TABLE A

Service Location Elevation (feet)	MAP and BP Limits
0 – 1000	6.7 – 7.8V
1000 – 2000	6.5 – 7.4V
2000 – 3000	6.2 – 7.3V
3000 – 4000	6.0 – 7.0V
4000 – 5000	5.8 – 6.8V
5000 – 6000	5.5 – 6.6V
6000 – 7000	5.3 – 6.4V

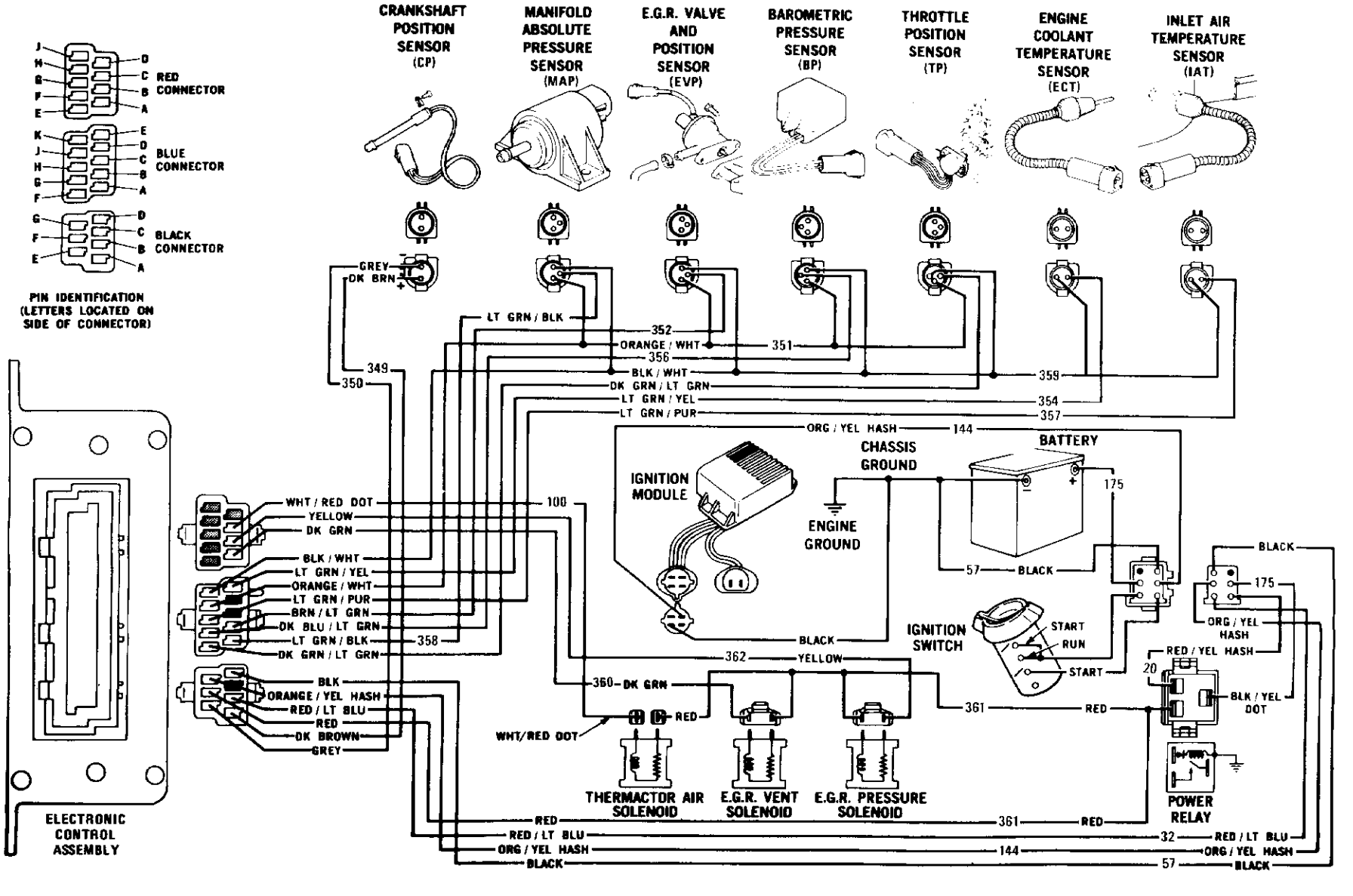
* *Complete all data gathering per Test Sequence* I and II prior to performing any Diagnostic Subroutine except as noted with "***".

** If reading is out of limits, perform indicated diagnostic Step prior to continuing Test Sequence.

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FIG. 36 5.0L (302 CID) Diagnostic Data Chart

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FIG. 37 EEC Subsystems Wiring Diagrams

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b. IAT Sensor: Install BROWN fixture to the harness IAT Sensor connector.

4. Operate engine at "curb idle", in "park" until the thermostat is open and the upper radiator hose is hot and pressurized. Gather data for Test Sequence II per the following steps and record it on the Diagnostic Data Chart.
5. With engine at curb idle, obtain data for TSS switch positions 2 and 6 in Test Sequence II.
   - If either reading is out of limits, perform appropriate diagnostics steps listed in Data Chart before continuing.
6. Set TSS switch to position 7 and be prepared to make the indicated timed measurement.
   - Raise engine speed briefly to 1600-1800 RPM.
   - Begin timing, per Test Sequence II of Data Chart, when throttle is released for return to curb idle.
7. Install SNAP-ON #GA-437 speed control tool or equipment. Using tool, set engine speed to 1600 ± 50 RPM.
   - Obtain EVP and Spark Advance data per Diagnostics Data Chart.
8. Remove speed control tool and turn ignition key to "OFF".
9. Remove MAP and IAT continuity test fixtures (brown and yellow) and reconnect MAP and IAT Sensors to harness. Proceed to analyze data per paragraph C.

C. Data Analysis

1. Review the test data. If all data is within limits the system is operating properly, or the cause of the complaint is no longer present. Refer to Step VI-C3.
2. If one or more of the test points are out of limits, perform the subroutine indicated at the bottom of the appropriate column. The subroutines should be used in sequence from left to right.

IMPORTANT

3. If the initial system check or a subroutine is completed and the cause of the complaint is not found and resolved, proceed as follows: Turn engine off, remove all test equipment and reconnect all vacuum, air, and electrical connections.
   a. Verify that the initial complaint still exists.
      - If it does, repeat the initial system check and/or the appropriate subroutine of this procedure.
      - If it does not, operate the vehicle on the road or on a chassis dynamometer or expose to the appropriate environment to try to induce the condition. Then repeat initial system check and/or the appropriate subroutine of this procedure.
   b. If the complaint still has not been resolved, perform one of the following steps as required.
      (1.) Go to the next step in the Diagnostic Routine.
      (2.) Repeat the routine from the beginning.
      (3.) Perform the appropriate checks per Reference One or Two of the Engine Diagnostic Procedures.

D. Component Diagnosis (Sub-routines) — See Fig. 37 for circuit.

1. Reference Voltage (Vref) Not Within Limits

a. Turn the TSS switch to position 9, ignition key to RUN position and DVOM switch to TESTER.
   - If the battery voltage is less than 10.5 (volts), check for:
     - A discharged battery
     - Open wire from the battery to the ECA power relay coil (circuit 175).
     - Open wire from ignition switch to the ECA power relay coil (circuit 20).
     - Open wire from the ECA to the ECA power relay coil (circuit 361).
     - Inoperative ECA power relay.
   - Repair or replace the item as required and retest.(1)
   - If the battery voltage is greater than 10.5 (volts), proceed to Step VI-D-1b.

b. Disconnect the Engine Coolant Temperature (ECT) sensor at its connector and set the TSS switch to position 1.
   - If the reference voltage is between 8.5 and 9.5 volts, replace ECT sensor and retest.(1)
   - If the reference voltage does not come within limits, proceed to the next step.

c. Disconnect the Inlet Air Temperature Sensor (IAT) at its connector.
   - If the reference voltage is between 8.5 and 9.5 volts, replace IAT Sensor and retest.(1)
   - If the reference voltage does not come within limits, proceed to the next step.

d. Disconnect the EGR Valve Position (EVP) Sensor at its connector.
   - If the reference voltage is between 8.5 and 9.5 volts, replace the EGR Valve assembly and retest.(1)
   - If the reference voltage does not come within limits, proceed to the next step.

e. Disconnect the Throttle Position (TP) Sensor at its connector.
   - If the reference voltage is between 8.5 and 9.5 volts, replace TP Sensor and retest.(1)

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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- If the reference voltage does not come within limits, proceed to the next step.

f. Disconnect the Manifold Absolute Pressure (MAP) Sensor at its connector.
- If the reference voltage is between 8.5 and 9.5 volts, replace MAP Sensor and retest.(1)
- If the reference voltage does not come within limits, proceed to the next step.

g. Disconnect the Barometric Pressure (BP) Sensor at its connector.
- If the reference voltage is between 8.5 and 9.5 volts, replace EP Sensor and retest.(1)
- If the reference voltage does not come within limits, proceed to the next step.

h. Disconnect the blue (10 pin) harness connector from the TESTER.
- If the reference voltage is within 8.5 - 9.5 volts check circuits 351 (A, B, C and D), 354 and 357 for a short or check circuits 359 (A thru F) for an open. Repair the circuit and retest.(1)
- If the reference voltage does not come within limits, replace the ECA and retest.(1)

i. Reconnect all sensors to the harness and the harness to the TESTER. Complete gathering and recording data per Test Sequences I and II of Diagnostics Data Chart.

2. Manifold Absolute Pressure (MAP) Sensor — Not Within Limits

Note: If MAP reading is **not** within limits during Test Sequence I, proceed to step VI.D.2.a. If **not** within limits during Test Sequence II, proceed to step VI.D.2.e.

a. On the DIAGNOSTIC DATA CHART, compare the MAP and BP sensor readings of TEST SEQUENCE I.
- If the MAP reading is within 0.75 volts of the BP reading, both sensors are OK. **DO NOT CHANGE THEM** — the out of tolerance condition is the result of variations in local air pressure.
- If the MAP reading differs from the BP reading by 0.75 volts or more, proceed to step VI.D.2.b.

b. Verify that the ignition switch is "off" and disconnect MAP sensor. Connect the yellow CONTINUITY TEST FIXTURE to the wiring harness. Set the TSS switch to position "13", and DVOM switch to TESTER.
- If the reading is between 100 and 250 (ohms), proceed to next step.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair short or open in circuit 358 and/or 359 of wiring harness and retest.(1)

c. Set the TSS switch to position "12".
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair short or open in circuit 351 and/or 359 of wiring harness and retest.(1)
- If the reading is between 100 and 250 (ohms), inspect the sensor connector. If bad, repair. If good, replace MAP sensor and retest.
- If the voltage is still out of limits, replace ECA and retest.(1)

d. Turn TESTER FUNCTION switch to "off" and disconnect the test equipment.

CAUTION: Remove CONTINUITY TEST FIXTURE.

e. If MAP reading is not within limits during TEST SEQUENCE II,
- Turn ignition key "OFF".
- Remove YELLOW CONTINUITY TEST FIXTURE from MAP connector of harness.
- Using DVOM on 2000 ohm range, check resistance between adjacent pins of YELLOW test fixture.
- If resistance is less than 170 (ohms) or greater than 230 ohms, repair or replace test fixture (refer to TESTER INSTRUCTION MANUAL) and repeat TEST SEQUENCE II.
- If resistance is within 170 to 230 (ohms), carefully align pins of YELLOW test fixture with MAP connector of harness and reconnect. Repeat TEST SEQUENCE II.

3. Throttle Position (TP) Sensor Not Within Limits

a. Verify that the ignition switch is **off**. Set the TSS switch to position 12, and the DVOM switch to "TESTER". Disconnect the TAP connector and connect the yellow CONTINUITY TEST FIXTURE to the TP sensor harness connector.
- If the reading is between 100 and 250 (ohms), proceed to the next step.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair the short or open in circuit 351 and/or 359 and retest.(1)

b. Set the TSS switch to position 14.
- If the reading is between 100 and 250 (ohms), proceed to next step.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair the short or open in circuit 355 and/or 359 and retest.(1)

c. Connect DVOM between circuit 351 and circuit 359 of the TP Sensor connector. Set DVOM switch to 200 x 1000 ohms range.
- If the reading is less than 3(x1000 ohms) or more than 5(x1000 ohms), replace the sensor and retest.(1)

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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- If the reading is between 3(x1000) and 5(x1000 ohms), proceed to the next step.

d. Connect DVOM between circuit 355 and circuit 359 of the connector. Set DVOM switch to 2000 ohms range. Verify the throttle is in the closed position (i.e., off high cam).
- If the reading is less than 580 (ohms), or greater than 1100 (ohms), readjust by loosening the bolt and turning the TP sensor until the reading is within limits and retest.(1) If not able to set to this range replace the TP sensor and retest.

  NOTE: *Torque mounting screws to 8-10* in.-lbs.
- If the reading is between 580 and 1100 (ohms) reconnect the sensor to the harness. Set the TSS switch to position "3", key to "run" position and DVOM to "TESTER". Adjust the sensor by loosening the bolt and turning the TP sensor until the VOLTMETER reads 1.82 + 0.11 (volts). Retest. (1)

  NOTE: *Torque mounting screws to 8-10* in.-lbs.
- If the sensor cannot be adjusted to obtain the proper voltage replace the ECA and retest.(1)

e. Turn DVOM switch to **off** and disconnect the test equipment.

CAUTION: Remove CONTINUITY TEST FIXTURE.

4. Barometric Pressure (BP) Sensor — Not Within Limits

a. On the DIAGNOSTIC DATA CHART, review the BP and MAP readings of TEST SEQUENCE I.
- If the BP reading is within 0.75 volts of the MAP reading, both sensors are OK. DO **NOT** CHANGE THEM — the out of tolerance condition is the result of variations in local air pressure.
- If the BP reading differs from the MAP reading by 0.75 volts or more, proceed to step VI.D.4.b.

b. Verify that the ignition switch is **off** and disconnect BP sensor. Connect the yellow CONTINUITY TEST FIXTURE to wiring harness. Set the TSS switch to position 12 and DVOM to TESTER.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair short or open in circuit 351 and/or 359 of wiring harness and retest.(1)
- If the reading is between 100 and 250 (ohms), proceed to next step.

c. Set the TSS switch to position 15.
- If reading is less than 100 (ohms) or more than 250 (ohms), repair short or open in circuit 356 and/or 359 of wiring harness and retest.(1)
- If the reading is between 100 and 250 (ohms), inspect the sensor leads and connector. If damaged, repair. If ok, replace BP sensor and retest.(1)
- If the voltage is still out of limits, replace the ECA and retest.(1)

d. Turn DVOM switch to **off** and disconnect test equipment.

CAUTION: Remove CONTINUITY TEST FIXTURE.

5. Engine Coolant Temperature (ECT) Sensor Not Within Limits

a. Verify that the ignition switch is **off**. Set the TPS switch to position 10, DVOM to TESTER. Disconnect the ECT connector and connect the blue CONTINUITY TEST FIXTURE to the wiring harness ECT connector.
- If the reading is between 100 and 250 (ohms), proceed to the next step.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair the short or open in circuit 354 or 359 and retest.(1)

b. Connect the DVOM between the two pins of the ECT sensor connector. Set DVOM switch to 200x1000 ohms scale.
- If reading is greater than 6(x1000 ohms), verify engine coolant temperature, per diagnostics routine no. 124. If coolant temperature is below 160 degrees F (107 degrees C) follow routine no. 124 and retest (1). If coolant temperature is above 160 degrees F (107 degrees C) replace the sensor and retest.(1)
- If reading is less than 1.5(x1000 ohms) verify engine coolant temperature per diagnostic routine no. 125. If coolant temperature is above 220 degrees F (140 degrees C) follow routine no. 125 and retest (1). If coolant temperature is below 220 degrees F (140 degrees C), replace the sensor and retest.(1)
- If reading is between 1.5(x1000) and 6.0(x1000 ohms), replace ECA and retest.(1)

c. Turn TESTER FUNCTION switch to **off** and disconnect test equipment.

CAUTION: Remove CONTINUITY FIXTURE.

6. Inlet Air Temperature (IAT) Not Within Limits

NOTE: If IAT reading is **not** within limits during TEST SEQUENCE I, proceed to step VI.D.6.a. If **not** within limits during TEST SEQUENCE II, proceed to step VI.D.6.d.

a. Verify the ignition switch is **off**. Set the TSS switch to position 17. Disconnect the IAT connector and connect the blue CONTINUITY TEST FIXTURE to the wiring harness.

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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- If the reading is between 100 and 250 (ohms), proceed to the next step.
- If the reading is less than 100 (ohms), or more than 250 (ohms), repair the short or open in circuit 357 and/or 359 and retest.(1)

b. Connect the DVOM between circuit 357 and circuit 359 of the IAT sensor connector. Set DVOM switch to 200 (x 1000 ohms) scale.
- If the reading is less than 6.5(x1000 ohms) are greater than 45(x1000 ohms), check air cleaner temperature control per SSD-9, if the temperature control is OK replace the IAT sensor and retest.(1)
- If the reading is between 6.5(x1000) and 45(x1000 ohms) replace the ECA and retest.(1)

c. Turn TESTER FUNCTION switch to **off** and disconnect test equipment.

d. If IAT reading is **not** within limits during TEST SEQUENCE II,
- Turn Ignition Key "OFF".
- Remove BROWN CONTINUITY TEST FIXTURE from IAT connector of harness.
- Using DVOM on 200 (x 1000 ohm) range, check resistance between pins of BROWN TEST FIXTURE.
- If resistance is less than 23.3(x1000 ohms) or greater than 25.3(x1000 ohms), repair or replace test fixture (refer to TESTER INSTRUCTION MANUAL) and repeat TEST SEQUENCE II.
- If resistance is within 23.3(x1000) to 25.3(x1000 ohms), carefully align pins of BROWN TEST FIXTURE with IAT connector of harness and reconnect. Repeat TEST SEQUENCE II.

7. Thermactor Air Bypass (TAB) Solenoid Not Within Limits

a. Turn the TSS switch to position 7, DVOM to the TESTER position and the ignition key to the RUN position.
- If reading is greater than 10.5 (volts) proceed to VI.D.7.b.
- If reading is less than 10.5 (volts) check circuit 361. With a DVOM measure the voltage between circuit 361 and the engine block. If reading is less than 10.5 (volts) repair open in circuit 361 and retest. (1)
- If circuit 361 reading is greater than 10.5 (volts) repair open in circuit 100 and retest.

b. Install a vacuum gage between Thermactor Air Bypass (TAB) solenoid and air bypass valve. Operate engine at 1600 (+/50) R.P.M. until vacuum stabilizes. Return to idle and observe vacuum (15" to 20" Hg.) drop to less than 1" Hg. within 60 (+/-5) seconds after release of throttle for return to curb idle. If not, check thermactor air bypass valve per SSD-5. (1)

c. If complaint still isn't resolved replace ECA (1).

8. EGR Valve Position (EVP) Sensor Not Within Limits

a. Turn engine **OFF** and disconnect the EVP sensor. Connect the yellow CONTINUITY TEST FIXTURE to the wiring harness. Set the TSS switch to position 12, DVOM switch to TESTER.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair the short or open in circuit 352 and/or 359 of the harness and retest. (1)
- If the reading is between 100 and 250 (ohms) proceed to the next step.

b. Set the TSS switch to position 18.
- If the reading is less than 100 (ohms) or more than 250 (ohms), repair the short or open in circuit 352 and/or 359 of the harness and retest. (1)
- If the reading is between 100 and 250 (ohms), proceed to the next step.

c. Connect the DVOM between circuit 351 and circuit 359 of the EGR valve connector. Set DVOM switch to 200 (x 1000 ohms) scale.
- If the reading is between 2.8 (x1000) and 5.3 (x1000 ohms), proceed to the next step.
- If the reading is below 2.8 (x1000 ohms) or above 5.3 (x1000 ohms) replace the EGR valve assembly and retest. (1)

d. Connect an OHMMETER between circuit 352 and circuit 359 of the EGR valve connector.
- If the reading is between 350 and 940 (ohms), proceed to the next step.
- If the reading is less than 350 (ohms) or greater than 940 ohms replace the EGR valve assembly and retest. (1)
- Reconnect EVP connector to wiring harness.

e. Disconnect the EGR air hose from the AIR BYPASS VALVE (small hose on side of valve) and connect the PRESSURE GAGE to the fitting. Leave EGR hose disconnected during this step. Run the engine at about 1600 RPM in **park.**
- If the pressure is greater than 1.5 PSI proceed to VI-D-8.
- If the pressure is less than 1.5 PSI check the AIR BYPASS VALVE per SSD-5 Step C 1.

f. Connect a known good test hose between the small port at the side of AIR BYPASS VALVE and the EGR valve assembly. Run the engine at about 1600 RPM with transmission selector in **park** with the TSS switch in position 8.
- If the voltage is 6.4 (volts) or less, replace the EGR valve and sensor

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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assembly and retest. (1)
- If the voltage is greater than 6.4 (volts), reinstall the original hoses and proceed to step VI-D9a. Reconnect all pressure and vacuum hoses to their proper connection.

9. EGR Solenoid Valve Check

a. Turn the key to run (engine "off"). Set the TSS to position 19. Depress and hold the "EGR PRESSURE" test button on TESTER while reading DVOM.
- If the reading is less than 1.0 (volt), repair the open circuit (check circuits 361 and 362) in the harness or replace the solenoid valve assembly as required and retest. (1)
- If the reading is greater than 5.0 (volts), replace the solenoid valve assembly as required and retest. (1)
- If the reading is between 1 and 5 (volts), proceed to the next step.

b. Set the TSS to position 20 and depress and hold the "EGR VENT" button on TESTER.
- If the reading is less than 1.0 (volt), repair the open circuit (check circuits 360 and 361) in the harness or replace the solenoid valve assembly as required and retest. (1)
- If the reading is greater than 5.0 (volts), replace the solenoid valve assembly as required and retest. (1)
- If the reading is between 1.0 and 5.0 (volts), proceed to the next step.

c. Disconnect the pressure hose from the output side of the EGR pressure solenoid (lower fitting) and connect a pressure gage to the solenoid. Leave pressure hose disconnected. Run the engine at about 1100 +/-100 RPM with the transmission selector in **neutral** or **park.**
- If the pressure is greater than 0.5 psi after 5 seconds, replace the solenoid valve assembly and retest. (1)
- If the pressure is less than 0.5 psi, proceed to the next step.

d. Reconnect the pressure hose to the output side of EGR pressure solenoid. Disconnect the EGR valve pressure hose at the hose tee and connect the pressure gage to the tee. Leave EGR valve hose disconnected. Run the engine at about 1100 $\pm$ 100 RPM with the transmission selector in **neutral** or **park.** Depress and hold the EGR PRESSURE and EGR VENT test buttons, on the TESTER, until the pressure stabilizes. Then release the EGR PRESSURE button.
- If the maximum pressure is less than 0.5 psi or decreases more than 0.5 psi in 5 seconds, replace the EGR solenoid assembly or hoses and fittings and retest. (1)
- If the maximum pressure is greater than 0.5 psi and decreases less than 0.5 psi in 5 seconds, proceed to the next step.

e. With the engine at 1100 $\pm$ 100 RPM and EGR valve hose still disconnected, press and hold the EGR PRESSURE and VENT buttons until the pressure stabilizes. Release EGR PRESSURE button, then release the EGR VENT button. The pressure should drop IMMEDIATELY.
- If the pressure remains within 0.5 psi of the maximum reading for 5 seconds replace the EGR solenoid assembly and retest.
- If the pressure drops immediately, to less than half of the maximum reading, replace the EGR valve assembly and retest. (1)
- If after retest, the EVP data is still out of limits, proceed to the next step.

f. Replace the ECA and retest (1).

10. Spark Advance (in degrees) Not Within Limits

With the engine fully warmed-up, run the engine at idle, in park.Then depress and hold the "No Start" switch and check the Spark Advance.
- If the Spark Advance is within 8 to 12° BTDC, in the "Depress" mode, replace the ECA and retest. (1)

11. Crank Signal — Not Within Limits

a. Using DVOM, test battery voltage (10.5 volts, minimum).
- Recharge, repair, or replace as required and retest. (1)

b. Disconnect harness wire from the "S" terminal on the Starter Relay and set TESTER TSS to position "22".

c. With Ignition Key in "Start" position, verify reading is 5.0 (volts) or greater.
- If reading is less than 5.0 (volts), check for an open or short in harness circuits 32 and 57. Repair as required and retest. (1)

CAUTION: Reconnect harness wire to "S" terminal on Starter Relay.

(1) Whenever a component has been repaired or replaced and a retest is required, conduct or repeat VI-A thru VI-B.

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SSD-26 ENGINE IDLE SPEEDS

A. Pre-Adjustment Instructions (All Engine Speeds)

NOTE - Leave all vacuum signal hoses attached to the air cleaner assembly when relocating the assembly to perform carburetor adjustments. **The Air cleaner assembly must be installed, however, when measuring engine speeds.**

- Some engines may experience normal oscillations in idle speeds which could cause variations in engine speed measurement. If this condition is encountered, use the **average** engine speed.

- When performing engine rpm adjustments on vehicles equipped with the hydro-boost brake system, make certain the service brake pedal is not depressed - since engine rpm is affected by pedal pressure.

1. Apply the parking brake and block the wheels.

   NOTE: If vehicle is equipped with automatic parking brake release, disconnect the vacuum line at the parking brake and plug the vacuum line.

2. Turn off all accessories. Start the engine, bring to normal operating temperature, and turn engine off.

3. On 2.3L engine applications equipped with thermactor systems, revise the dump valve vacuum hoses as follows:

   a. For dump valves with one or two vacuum hoses at the **side**, disconnect and plug the hose(s).

   b. For dump valves with one vacuum hose at the **top** only connected to the spark port in the carburetor, remove the hose at the dump valve and plug it. Connect a slave hose from the dump valve vacuum fitting to an intake manifold vacuum fitting.

4. Disconnect the fuel evaporative purge valve signal vacuum hose as follows: Trace the purge valve vacuum hose from the purge valve (located on the canister) to the first point where the vacuum hose can be detached from the underhood hose routing, (vacuum tee connection, etc). Disconnect the vacuum hose at **that** point, cap the open port, and plug the vacuum hose.
   CAUTION: To prevent damage to the purge valve, do not disconnect the vacuum hose at the purge valve.

5. Check throttle and chock linkages for freedom of movement. Correct as required.

6. Connect a tachometer.

   NOTE: If the engine has the "Dura Spark I" ignition system (blue coil tower), use tachometer 02-0362 or equivalent.

B. Fast Idle RPM

1. Revise the distributor vacuum advance hose as follows:
   a. On all engines **except** 2.8L/5.0L (302 CID) engines with Model 2700 carburetor, remove the spark delay valve, if so equipped, and route the distributor vacuum advance hose directly to the advance side of the distributor.
   b. On 2.8L/5.0L (302 CID) engines with Model 2700 carburetor, remove and plug the distributor vacuum advance hose.
2. Trace the EGR signal vacuum hose from the EGR valve to the carburetor:
   a. If an EGR/PVS valve or cold weather modulator is located in the vacuum hose routing, disconnect the EGR vacuum hose at the EGR valve and plug the hose.
   b. If not equipped with an EGR/PVS valve or cold weather modulator, **do not detach** the EGR vacuum hose.
3. On 2.3L engines with Model 6500 Feedback carburetor:
   a. Remove vacuum hose from cold start vacuum switch.
   b. Apply vacuum signal to cold start vacuum switch (5" Hg minimum). Use manifold vacuum or external source.
4. With the engine running at normal operating temperature, the choke plate fully opened, and the transmission in Neutral (M/T) or Park (A/T), place the fast idle lever on the specified step of the fast idle cam. Allow engine speed to stabilize and measure the fast idle rpm. Adjust if not within ± 100 rpm of specification.
   NOTE: For engines with less than 100 miles of operation, the measured rpm should be the fast idle specification less the idle speed reduction (250 rpm on 4-Cyl. engines, 150 rpm on 6 and 8 Cyl. engines). If not, adjust to this rpm.
5. Run engine at approximately 2500 rpm for 15 seconds and recheck fast idle rpm.
6. On 5.0L (302 CID) engine with Model 2700 carburetor, check the auxiliary fast idle rpm as follows:
   a. Turn the engine off. Disconnect the vacuum hose from the vacuum-operated throttle modulator and plug the hose.
   b. Connect a slave vacuum hose from an engine manifold vacuum source to the throttle modulator.
   c. Start the engine and depress the throttle until vacuum modulator plunger extends fully. Then, release the throttle.
   d. Check the auxiliary fast idle rpm. If adjustment is necessary, loosen the locknut securing the modulator. Turn the modulator until the specified auxiliary fast idle rpm is obtained; then, tighten the locknut.
      NOTE: For engines with less than 100 miles of operation, the measured rpm should be the auxiliary fast idle rpm less the idle speed reduction of 150 rpm. If not, adjust to this rpm.
   e. Remove the slave vacuum hose and reconnect the system vacuum hose.

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7. Repeat Steps 4 thru 6 until the required fast idle rpm can be repeated.
8. Turn the engine off. Reconnect the vacuum line(s)/spark delay valve (if so equipped) removed in Steps 1 thru 3.

C. Curb Idle Speed (Also Includes "A/C-Off", "A/C-On", and "TSP OFF" Speeds, If so Specified

1. Before each speed check (includes re-check), run the engine at approximately 2500 rpm for 15 seconds in **neutral** or **park.** Allow engine to return to curb idle.
2. With the air conditioning selector in the OFF position (unless otherwise specified), the engine at normal operating temperature, the choke plate fully opened, and the transmission selector in the specified gear (see engine emission decal), measure each required engine speed as defined and specified on the engine emission decal. If not within ± 50 rpm of specification, adjust the respective engine speed as follows:

NOTE: —The method of adjusting each engine speed depends upon the speed-controlling device(s) employed. Therefore, examine the carburetor, determine the device(s) used, if they are functional, and then perform the adjustment procedure.

—Repeat Steps 1 and 2 until each engine speed is repeatable.

—On carburetors equipped with a dashpot, the dashpot clearance must be adjusted each time the curb idle speed is adjusted.

—For engines with less than 100 miles of operation, the measured rpm should be the required engine speed as defined less the idle speed reduction. If not, adjust to this rpm. The idle speed reduction values follow:

No. of Cylinders	Curb Idle	TSP-OFF Idle
4	50 RPM	50 RPM
6	75 RPM	75 RPM
8	50 RPM	75 RPM

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2.3L Engine with Models 5200 and 6500 Carburetors

a. **No Solenoid Device**

(1) Curb Idle rpm
Turn the throttle stop adjusting screw until the specified curb idle rpm is obtained. (Insure adjusting screw is against stop).

(2) Dashpot Clearance (if equipped)
With the engine off, collapse the dashpot plunger and check the clearance between the plunger and throttle lever pad. Adjust if not in specified limits.

b. **Anti-Diesel TSP or Anti-Diesel TSP with Vacuum-Operated Throttle Modulator (A/C Only)**

(1) Curb Idle rpm
Turn the TSP-ON idle adjusting screw until the specified curb idle rpm is obtained.

(2) TSP-OFF rpm
With the engine running, collapse the TSP plunger by forcing the throttle lever pad aginst the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

c. **Solenoid-Dashpot**

(1) Curb Idle rpm
Adjust the curb idle rpm by turning the TSP-ON adjusting screw until the specified curb idle rpm is obtained.

(2) Dashpot Clearance
Dashpot clearance adjustment is not required. Clearance is controlled by the TSP.

(3) TSP-OFF rpm
With the engine running, collapse the solenoid-dashpot plunger by forcing the throttle lever pad against the TSP plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

d. **Vacuum-Operated Throttle Modulator (A/C Only)**

(1) Curb Idle rpm
Loosen the locknut securing the vacuum-operated throttle modulator and rotate the modulator until there is clearance between the modulator stem and the throttle lever pad. Adjust curb idle rpm by turning the throttle stop adjusting screw until the specified curb idle rpm is obtained.

Adjust the vacuum-operated throttle modulator by turning the modulator (locknut loosened) until the modulator stem contacts the throttle lever pad. Then, tighten the locknut.

e. **Vacuum-Operated Throttle Modulator with Dashpot (A/C Only)**

(1) Curb Idle rpm
Adjust the curb idle rpm by turning the throttle stop adjusting screw until the specified curb idle rpm is obtained.

NOTE: If the curb idle rpm cannot be adjusted low enough, loosen the TSP-ON adjusting screw on the throttle lever pad until sufficient clearance is present.

(2) Dashpot Clearance
Collapse the throttle modulator plunger and check the clearance between the stem pad and the TSP-ON adjusting screw on the throttle lever pad. If adjustment is necessary, turn the TSP-ON adjusting screw until the specified clearance is obtained between the screw and the modulator pad.

3.3L (200 CID) Engine with Model 1946 Carburetor

a. **No Solenoid Device**

(1) Curb Idle rpm
Turn the throttle stop screw until the specified curb idle rpm is obtained.

(2) Dashpot Clearance (if equipped)
With the engine off, collapse the dashpot

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plunger and check the clearance between the plunger and throttle lever pad. Adjust if not in specified limits.

b. **Anti-Diesel TSP**

(1) Curb Idle RPM

Turn the TSP-ON adjusting screw until the specified curb idle rpm is obtained.

(2) TSP-OFF RPM

With the engine running, collapse the TSP plunger by forcing the throttle lever pad against the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

3.3L/4.1L (200/250 CID) Engines with Model YFA Carburetor

a. **No Solenoid Device**

(1) Curb Idle RPM

Turn the throttle stop adjusting screw until the specified curb idle rpm is obtained.

(2) Dashpot Clearance (if equipped)

With the engine off, collapse the dashpot plunger and check the clearance between the plunger and throttle lever pad. Adjust if not to specified limits.

b. **Anti-Diesel TSP**

(1) Curb Idle RPM

Turn the throttle stop adjusting screw until the specified curb idle rpm is obtained.

(2) TSP-OFF RPM

With the engine running, collapse the TSP plunger by forcing the throttle lever pad against the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

c. **Anti-Diesel TSP and A/C TSP**

(1) A/C-On RPM

—Move the climate control selector on the instrument panel to "A/C-On" to energize the **front** TSP.

—Open the throttle to allow the TSP plunger to extend fully. Then, release the throttle.

—Disconnect the A/C compressor clutch wire at the compressor.

—Check A/C-On rpm. If adjustment is required, loosen the locknut securing the **front** TSP and turn the TSP until the specified A/C-On rpm is obtained. Then tighten the locknut.

—After completion, move the climate control selector to the "off" position. Reconnect the A/C compressor clutch wire.

(2) **A/C-Off RPM**

Adjust the TSP—located at the back of the carburetor—by turning the hex head on the rear of the solenoid until the specified A/C-Off rpm is obtained.

(3) **TSP-OFF RPM**

With the engine running, collapse the back TSP plunger by forcing the throttle lever pad against the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

2.8L/5.0L/5.8L/6.6L (302/351W/351M/400 CID) Engines with Model 2150 Carburetor

2.8L/5.0L (302 CID) Engines with Model 2700 Carburetor

NOTE: On engines equipped with the Model 2700 carburetor, the accelerator pump lever lash must be checked and adjusted (if necessary) each time the A/C-Off rpm or curb idle rpm is adjusted. Perform the following procedure:

—Apply a slight pressure downward on the top of the nylon nut located on the accelerator pump to take up the linkage clearances.

—Check the accelerator pump lever lash, between the top of the accelerator pump stem and the accelerator pump lever. Compare to specified clearance.

—If necessary, adjust the accelerator pump lash using the nylon nut on the accelerator pump rod to obtain the specified clearance.

a. **No Solenoid Device**

(1) Curb Idle RPM

Turn the throttle stop adjusting screw until the specified curb idle rpm is obtained.

(2) Dashpot Clearance (if equipped)

With the engine off, collapse the dashpot plunger and check the clearance between the plunger and the throttle lever pad. Adjust if not to specification.

b. **Anti-Diesel TSP (Non-A/C Only)**

(1) Curb Idle RPM

V-8 Engines: Adjust the solenoid positioner by rotating the long screw (part of the TSP mounting bracket) until the specified curb idle rpm is obtained.

2.8L Engines: Adjust the solenoid positioner by turning the hex head, located on the rear of the solenoid, until the specified curb idle RPM is obtained.

(2) TSP-OFF RPM

With the engine running, collapse the TSP plunger by forcing the throttle lever pad against the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

c. **A/C TSP (A/C Only)**

(1) **A/C-On Speed**

—Move the climate control selector on the instrument panel to "A/C-On".

—Open the throttle to allow the TSP plunger to extend fully. Then, release the throttle.

—Disconnect the A/C compressor clutch wire at the compressor.

—Check A/C-On rpm and, if necessary, adjust as follows:

— **V-8 Engines:** Turn the long screw (part of the TSP mounting bracket) until the specified A/C-On rpm is obtained.

— **2.8L Engines:** Adjust the solenoid positioner by turning the hex head, located on the rear of the solenoid, until the specified A/C-On rpm is obtained.

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—After completion, move the climate control selector to the "OFF" position. Reconnect the A/C compressor clutch wire.

(2) **A/C-Off RPM**

Turn the throttle stop adjusting screw until the specified A/C-OFF rpm is obtained.

7.5L (460 CID) Engine with Model 4350 *Carburetor*

a. **Non-A/C (Except Police Interceptor)**

(1) **Curb Idle RPM**

Turn the throttle stop adjusting screw until the specified curb idle RPM is obtained.

b. **A/C TSP (Except Police Interceptor)**

(1) **A/C-ON Speed**

—Move the climate control selector on the instrument panel to "A/C-ON".

—Open the throttle to allow the TSP plunger to extend fully. Then, release the throttle.

—Disconnect the A/C compressor clutch wire at the compressor.

—Check A/C-ON RPM and, if necessary, adjust as follows:

—Turn the long screw (part of the TSP mounting bracket) until the specified A/C-ON RPM is obtained.

—After completion, move the climate control selector to the "OFF" position. Reconnect the A/C compressor clutch wire.

(2) **A/C-OFF RPM**

Turn the throttle stop adjusting screw until the specified A/C-OFF RPM is obtained.

c. **Anti-Diesel TSP: Police Interceptor A/C and Non-A/C Only**

(1) Curb Idle RPM

Adjust the solenoid positioner by rotating the long screw (part of the TSP mounting bracket) until the specified curb idle rpm is obtained.

(2) TSP-OFF RPM

With the engine running, collapse the TSP plunger by forcing the throttle lever pad against the plunger. Turn the throttle stop adjusting screw until the specified TSP-OFF rpm is obtained.

D. Post-Adjustment Instructions (All Engine Speeds)

1. On 2.3L engines equipped with Thermactor systems, correct the dump valve vacuum hose routing (see Step 4 in Pre-Adjustment Instructions).
2. Reconnect the fuel evaporative purge valve signal vacuum hose (see Step 5 in Pre-Adjustment Instructions).
3. Stop engine. Remove all test equipment, reconnect automatic parking brake release (if disconnected), and torque the air cleaner wing nut(s) to specification.

SSD-27 V.O.A. PNEUMATIC EGR SYSTEM

I. Pneumatic EGR Valve Diagnostic Procedure

A. To determine if the EGR valve is flowing exhaust gas, perform the following procedure:

1. If necessary, warm the engine to normal operating temperature with the transmission in **neutral** or **park** and parking brake on.
2. Remove the air cleaner assembly.
3. Start the engine and let it idle with the transmission in neutral or park and the parking brake on.
4. Remove the actuator pressure line (lower line) connected to the EGR valve and connect an external source of 10±1 in Hg (5.0±0.5 psi) pressure. Do not exceed 20" Hg (10 psi) pressure. See Fig. 38 for details.
5. Remove the signal pressure line (upper line) connected to the EGR valve and connect an external source of 3±0.5 in Hg (1.5±0.3 psi) pressure. (Do not exceed 20 in Hg pressure.) The engine should idle rough and/or stall, *indicating that the EGR system is flowing.*
6. If the engine does not stall or idle rough, remove the EGR valve and inspect the passages in the EGR valve, EGR spacer, EGR cooler and tubes for deposits or loose particles. If no deposits are present, replace the valve. If deposits are present, clean the passages per SSD 1, Part IV.
7. To check the air pressure supply for the pneumatic EGR valve, remove the air supply line to the actuator nipple (as in *Step 4*). Install a pressure gauge in the line that was removed. Also install a thermactor pump pressure gauge (Tool T76L-9486-A or equivalent) to the air bypass valve outlet using a short length of appropriate diameter hose. If the air bypass valve has two outlet(s), plug the one without the tester. Start the engine and increase engine speed to 1000 rpm. Observe the pressure produced at the test gauges. The air pressure must be 2.25 psi minimum. If not, check all hoses to be sure they are open and not broken, split or cracked, and fit tightly onto the connectors. Repair and/or replace as required. If the hoses are OK, check the filter for plugging by installing the test gauge at the filter and repeating the test. Repair and/or replace as required. If the filter is OK, check the bypass valve per SSD 5, Section C(I).

NOTE: Be sure that the vacuum system for the bypass valve is intact and that the valve is not in the bypass mode while performing the above step.

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8. Remove all test equipment, reconnect pressure line and install air cleaner. Torque wing nut to specification.

B. If the engine idle quality is not acceptable, the EGR valve may not be sealing properly. To determine if the EGR valve is sealing properly, perform the following procedure:

1. Check to make sure the vacuum/pressure hose routings are correct.
2. If ncessary, start the engine and warm it to normal operating temperature with the transmission in neutral or park and the parking brake on.
3. Observe the idle quality.
4. Stop the engine and remove the air cleaner assembly.
5. Install a known good new EGR valve and gasket and adjust the engine idle to the specified curb idle.
6. Recheck the idle quality. If there is improvement in idle quality, retain the new EGR valve. If there is no improvement in the idle quality, the problem is elsewhere. Reinstall the original EGR valve and perform further engine diagnosis.
7. After resolving the complaint, remove all test equipment, reconnect pressure lines and install air cleaner assembly. Torque wing nut to specification.

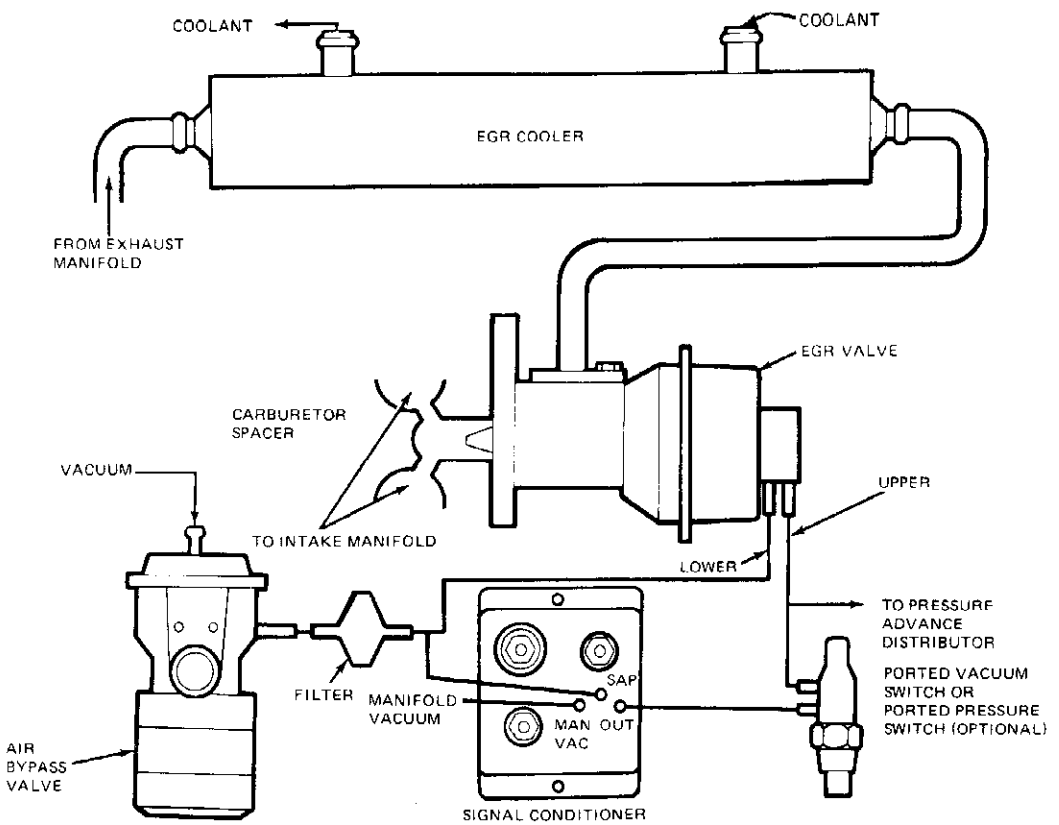
II. Signal Conditioner Diagnostic Procedure

A. If necessary, start the engine and warm it to normal operating temperature with the transmission in **neutral** or **park** and the parking brake on.

B. Remove the air cleaner assembly.

C. Remove the output line from the signal conditioner and install a 0-10 in Hg pressure gauge on the output port of the signal conditioner and note the change in the idle quality.

D. If the complaint was rough idle and the idle



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FIG. 38 V.O.A. Pneumatic EGR System

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quality improved when the output line was removed, replace the signal conditioner.

E. Remove the manifodl vacuum line to signal conditioner. The output pressure of the signal conditioner should be less than 1.0 in Hg (0.5 psi).

F. Increase the engine speed to approximately 2000 rpm, the output should remain at Zero. If not, replace the signal conditioner.

G. Connect an external vacuum source to the manifold vacuum port of the signal conditioner.

H. With the engine speed at approximately 2000 rpm, apply 6.0 in Hg vacuum to the manifold vacuum port, observe the output and note the reading. Increase the vacuum signal to 17 in Hg. As the vacuum signal increases the output pressure should remain greater than 1.0 in Hg (0.5 psi). If this does not occur, replace the signal conditioner.

NOTE: Be sure that the vacuum system for the bypass valve is intact and that the valve is not in the bypass mode while performing the above step.

I. If the signal conditioner has been changed, verify that the original complaint has been resolved. Otherwise, perform further engine diagnosis.

J. When complaint has been resolved, remove all test equipment and reinstall all vacuum and pressure lines.

K. Install the air cleaner assembly and torque the wing nut to specification.

III. P.P.S. (Ported Pressure Switch) and P.V.S. (Ported Vacuum Switch) Diagnostic Procedure (if equipped)

A. Check all pressure hoses in the system to make sure that they are open, not split or cracked, and fit tightly onto the connector.

B. Verify that the signal conditioner and EGR valve are functioning properly.

C. Disconnect the pressure hose from the upper connector of the pressure switch and connect a pressure gauge. (An auxiliary pressure of 6 in Hg (3.0 psi) may be used on the lower connector instead of system pressure.)

D. If necessary, start the engine and warm it to normal operating temperature with the transmission in neutral or park and the parking brake applied.

1. If no reading is noted on the pressure gauge, the P.P.S. must be repalced.
2. If a pressure is noted, the P.P.S. is functioning properly.

NOTE: Be sure that the vacuum system for the bypass valve is intact and that the valve is not in the bypass mode while performing the above step.

E. When complaint has been resolved, remove all test equipment and reinstall the pressure line.

F. Install the air cleaner assembly and torque the wing nut to specification.

SSD-31 CARBURETOR FEEDBACK SYSTEM

I. Carburetor Feedback Diaphragm Assembly

A. Not Used in 1978

B. **Holley Model 6500 Feedback Carburetor**

1. With the engine off, disconnect the vacuum hose between the vacuum regulator solenoid valve and the carburetor at the valve. Using an external vacuum source, apply 10 inches Hg vacuum to the hose and note the leakage rate.
2. If the vacuum falls from 10" to 7" Hg within 15 seconds, disconnect the hose and apply vacuum directly to the carburetor. If the leakage rate exceeds the specification, proceed to the next step, otherwise replace the vacuum hose, recheck the vacuum leak rate and proceed to Step 7.
3. Seal the feedback main system diaphragm adjustment screws (with lead plugs on) with your fingers and check the leak rate (see Fig. 42). If the vacuum leak rate now falls within the specified limits, pry open the lead plug on the feedback main system adjustment screw, determine by trial and error the leaking screw, apply Locktite No. 290 or equivalent to the housing threads at the leaking screw, let dry and recheck the leak rate. If the leak rate now falls within the specified limits, install a new lead plug and go to Step 7. Otherwise go to the next step.
4. Disassemble the airhorn and remove the float assembly. Check for the proper torque on the feedback main system diaphragm assembly cover screw (min. 1 in-lb—see Fig. 41). If under the specified limit, tighten the screw to 4-5 in-lb torque and recheck the leak rate. If the leak rate now falls within the specified limits, go to Step 6. Otherwise, go to the next step.
5. Disassemble the main system diaphragm assembly cover screws, examine the sealing surfaces for burrs, nicks, or other types of contamination and repair or clean as required. If the sealing surfaces are suspected as the cause of the complaint, reinstall the original diaphragm assembly (tighten the cover screws to 4-5 in-lb) and check the leak rate. If the leak rate falls within the specified limits, go to Step 6. If the complaint still persists, replace the carburetor with a new carburetor assembly.
6. While applying 5 in Hg vacuum to the feedback diaphragm vacuum source, observe the main diaphragm assembly stem for movement (approximate total stroke must be 0.09 in as the vacuum is applied from 0-5 in Hg). Repair/replace as required. Check the feedback main system metering needle located at the bottom of the fuel bowl for free movement (approximate total stroke from the free to the fully depressed position must be 0.20" (see Fig. 40). Repair/replace as required. Reassemble the float assembly and install the airhorn on the carburetor. If new diaphragm assemblies have been installed, reset the idle F/A mixture using procedure SSD 13.

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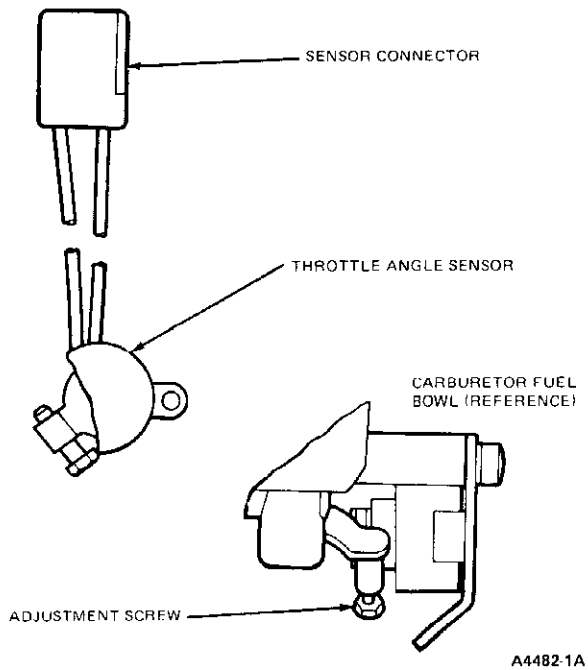


FIG. 39 Throttle Position (TP) Sensor

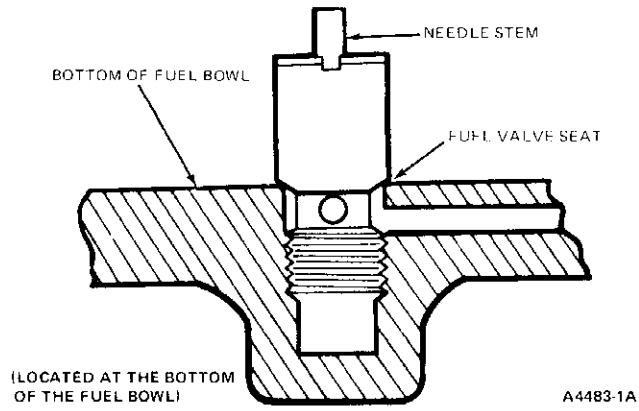


FIG. 40 Feedback Main Metering Needle

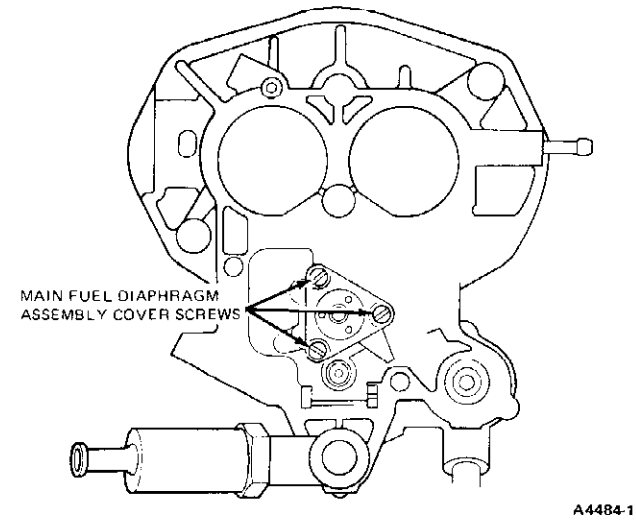


FIG. 41 Airhorn Bottom View—Model 6500 Carburetor

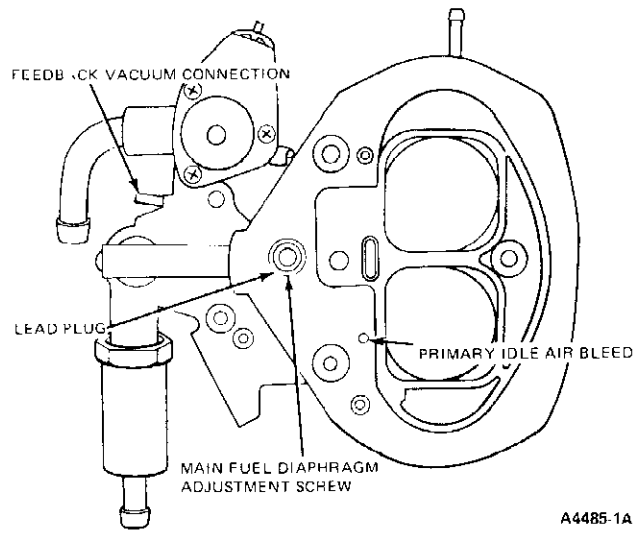


FIG. 42 Airhorn Assembly Top View—Model 6500 Carburetor

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Thermactor System

PART 29-03

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GENERAL INFORMATION

The Thermactor Exhaust Control System (Fig. 1) reduces carbon monoxide and hydrocarbon content of combustion by-product gases, by injecting fresh air into the hot exhaust gas stream as it leaves the combustion chamber. A pump supplies air under pressure to the exhaust port near the exhaust valve, by either an "external" air manifold, or through "internal" drilled-passages in the cylinder head or exhaust manifold. The oxygen in the fresh air, plus the heat of the exhaust gases, causes further oxidation (burning), which converts the exhaust gases into carbon dioxide and water.

Thermactor air may also be injected into the catalytic convertor on systems equipped with the Three Way Catalyst (TWC). See Part 29-08.

The major components (Fig. 1 and 2) of a typical Thermactor system include:

a. Air supply pump—belt driven from crankshaft pulley or from alternator
b. Air bypass valve
c. Vacuum differential valve (VDV) with some systems
d. Air supply system—external or internal
e. Cylinder heads with air passages to exhaust ports
f. Air supply check valves
g. Vacuum reservoir—some models
h. Air supply pump muffler—Mustang II, with 302 CID V-8
j. Vacuum Vent Valve (with 2700 Carburetor)

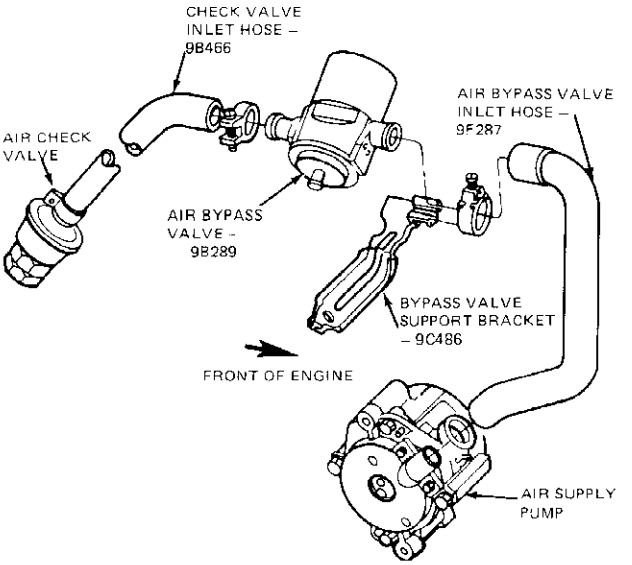
AIR SUPPLY PUMP

The belt driven air pump (Fig. 3) takes air in through an impeller-type centrifugal air filter fan, thus eliminating the need for a separate air filter. Dust and dirt particles cannot enter the pump because these heavier-than-air contaminants are thrown from the air intake by centrifugal force.

The air supply pump does not have a pressure relief valve, this function being controlled by the air bypass valve (Fig. 3).

AIR BYPASS VALVES

Several different types of bypass valves are used (Figs. 4-7). Some are "in line" (connected to the



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FIG. 1 Typical Thermactor System Components

Thermactor air pump with a hose) and some are mounted on the air pump. Both types can be either "timed" or not "timed". Any type bypass valve may be used in a catalyst or non catalyst equipped system.

The timed bypass valve operates as follows: During normal operation, vacuum is equalized on both sides of the diaphragm (Fig. 4). The diaphragm return spring holds the valve closed, allowing thermactor pump air to flow to the exhaust ports.

During deceleration, the sudden rise of intake manifold vacuum under the diaphragm overcomes return spring pressure and pulls the valve downward. Thermactor air is then diverted to the atmosphere momentarily, because vacuum is quickly equalized

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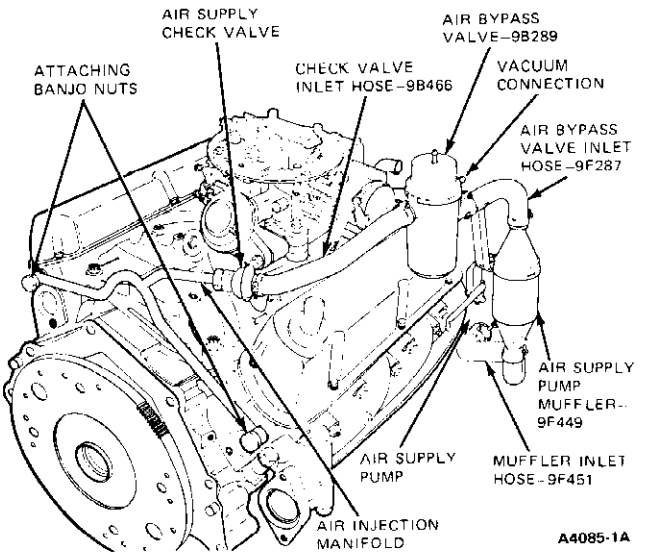


FIG. 2 Mustang II 302 CID V-8 Thermactor System

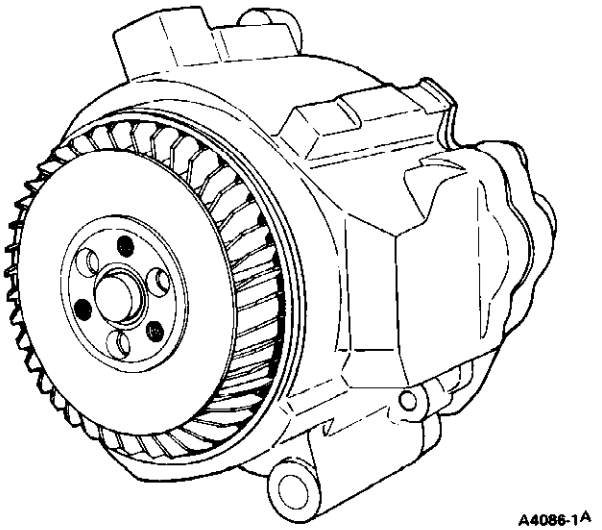


FIG. 3 Thermactor Air Supply Pump—Typical

again on both sides of the diaphragm through a small orifice in the diaphragm.

The normally-closed, timed bypass valve used with catalytic systems operates as follows: During normal operation, engine intake manifold vacuum applied through the VDV holds the normally-closed valve upward, allowing thermactor air to flow to the cylinder head(s) and blocking the vent port (Fig. 5). When engine intake manifold rises or drops sharply (such as during acceleration or deceleration, or system blockage or failure), the VDV operates and momentarily cuts off the vacuum to the bypass valve. The spring pulls the stem down, seating the valve to cut off pump air to the exhaust manifold, and opening the dump valve at the lower end of the bypass valve to momentarily divert the pump air to the atmosphere. In the case of excess pump volume or a downstream restriction, the excess pressure will unseat the valve in the lower portion of the bypass valve and allow a partial flow of pump air to the atmosphere. At the same time, the valve in the upper

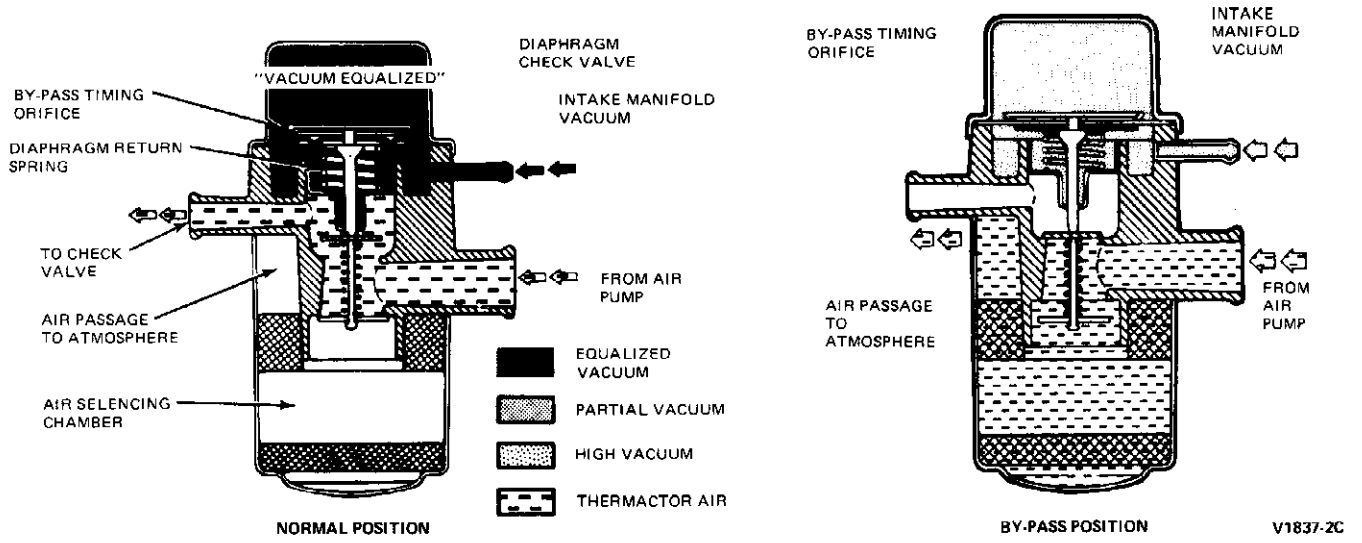


FIG. 4 Timed Bypass Valve

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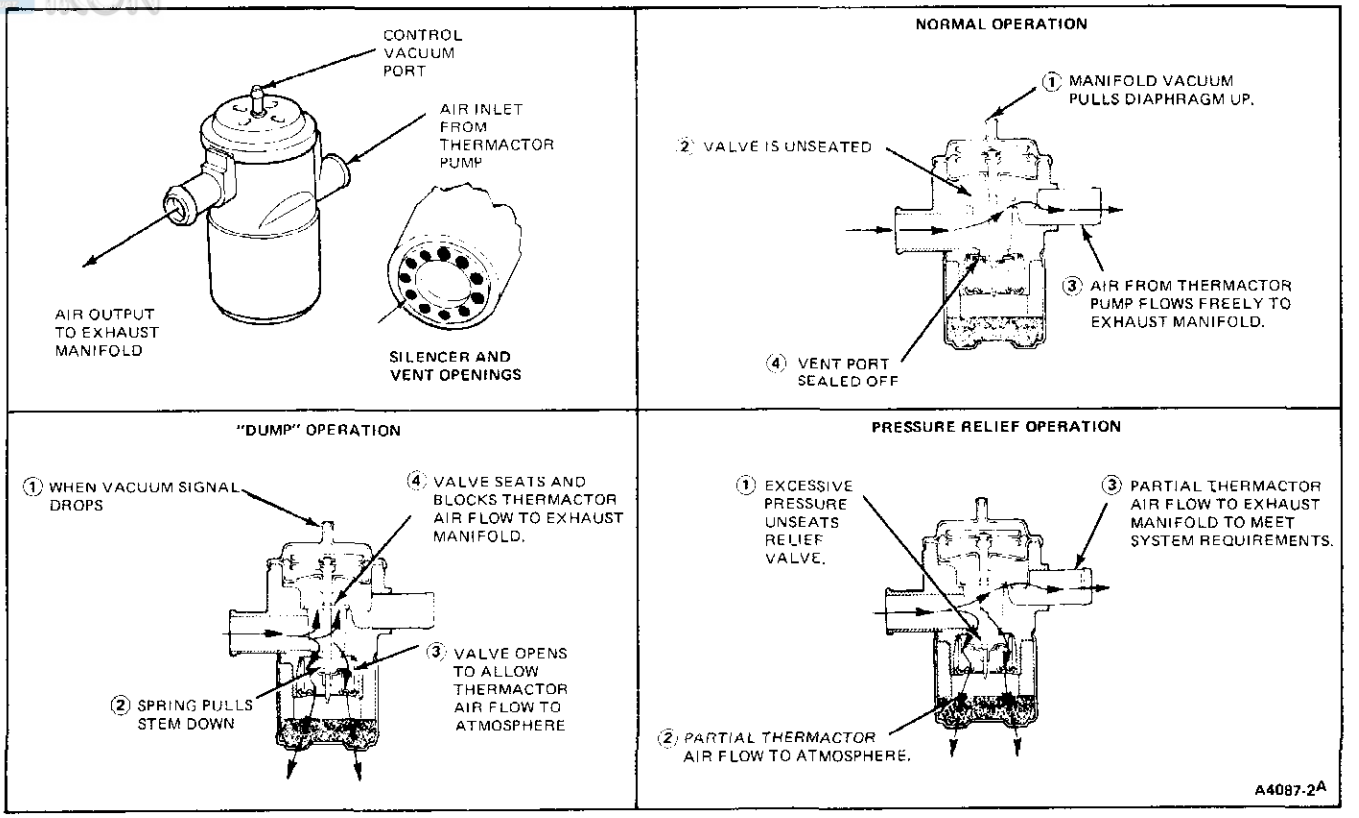


FIG. 5 Bypass Valve—Normally Closed

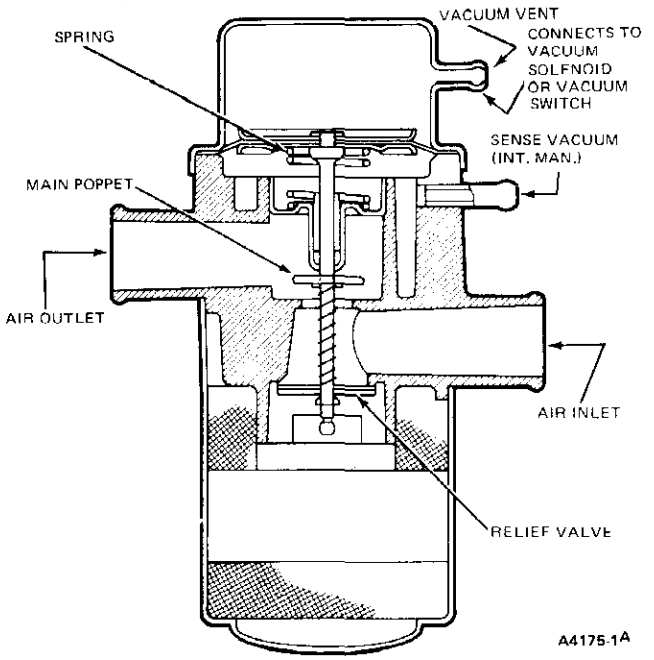


FIG. 6 Timed Air By-Pass Valve With Integral Vacuum Differential Function

part of the bypass is still unseated, allowing a partial flow of pump air to the exhaust manifold to meet system requirements.

A timed air by-pass valve is used with some thermactor systems (Fig. 6).

This by-pass valve contains an integral vacuum differential function and a vacuum vent. A separate VDV is not required with this valve. When the vent is blocked, the valve functions as a timed by-pass valve just as was used in past years with a VDV. When the vent is open to atmospheric pressure, however, and a vacuum of 4" Hg or more is applied to the source port, the valve goes immediately to the "dump" mode. Thermactor air pump mounted bypass valves are shown in Fig. 7. Operation for these valves is the same as similar types of in-line valves.

VACUUM DIFFERENTIAL VALVE (VDV)—CATALYST SYSTEMS

The vacuum differential valve (VDV) controls the operation of the bypass valve that doesn't have an integral differential valve (Fig. 8).

The VDV is inserted in the vacuum control line to the bypass valve and serves to cut off the vacuum and de-energize the bypass valve. The differential valve consists of a diaphragm connected to a dump valve that controls the vacuum to the bypass valve. During normal operation, vacuum is equalized on both sides of the diaphragm and the spring holds the dump valve closed. When sudden higher than normal vacuum is encountered, such as under deceleration conditions, vacuum is higher on the dump valve side of the diaphragm and the diaphragm operates the dump valve. As the dump valve operates, the vacuum signal to the bypass valve is diverted through the built-in filter system to atmosphere. When the vacuum bleeding through the bypass timing orifice in the VDV has equalized on both sides of the diaphragm, the diaphragm return spring once again closes the dump valve and applies vacuum to the bypass valve, which again directs pump air to the exhaust ports.

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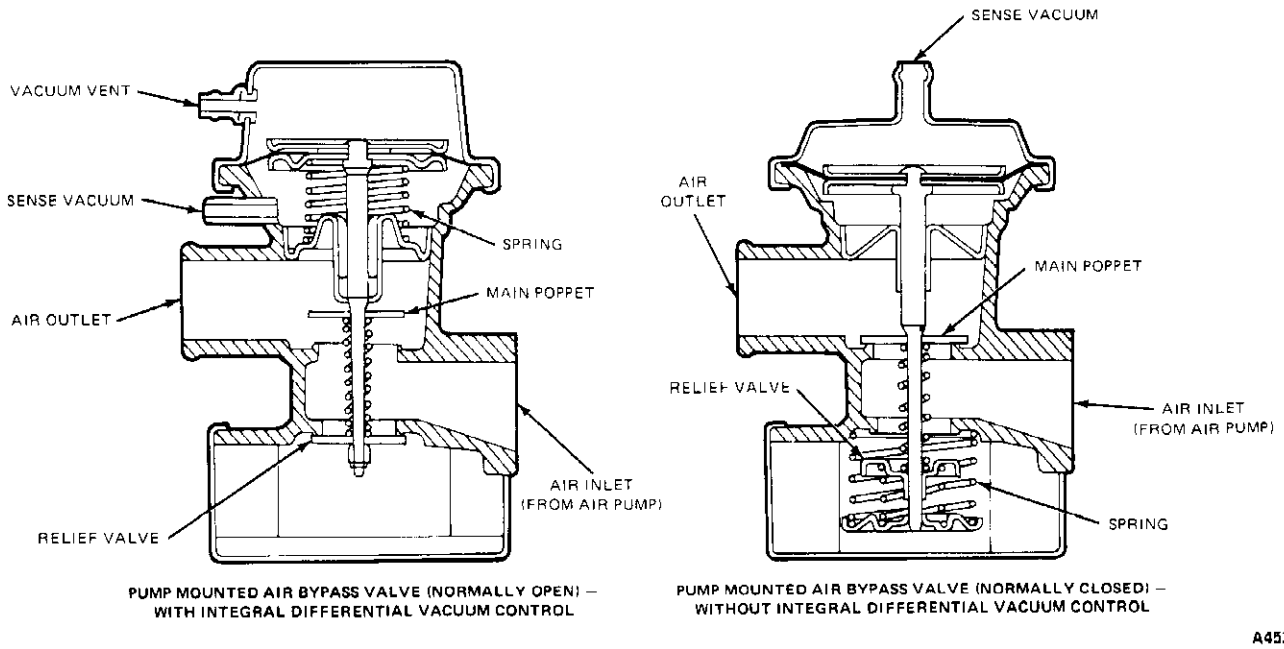


FIG. 7 Air Pump Mounted Bypass Valves

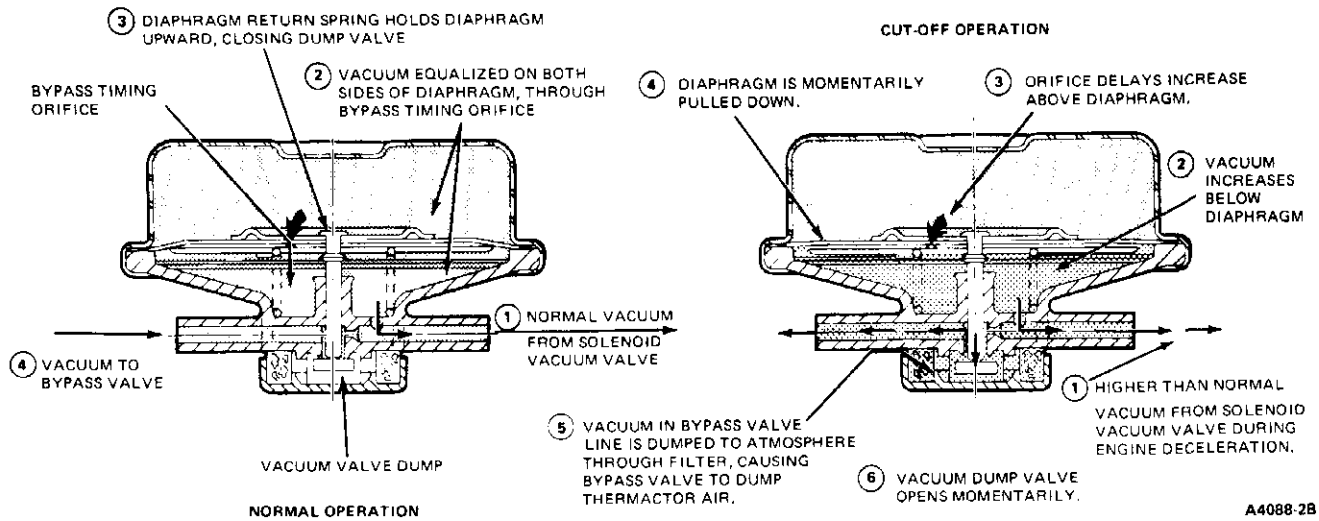


FIG. 8 Vacuum Differential Valve (VDV)—Catalyst Systems Only

DIFFERENTIAL VALVE DELAY VALVE (DVDV)

This delay valve is used to delay air bypass during periods of low engine manifold vacuum. The DVDV is installed in series with the VDV (Fig. 9).

This installation of a delay valve in the sense vacuum line delays operation of the vacuum differential valve during sudden drops in manifold vacuum such as during hard acceleration. During sudden deceleration, however, the sudden rise in intake manifold vacuum opens the check in the delay valve, passing the signal along instantly.

VACUUM VENT VALVE

Some engines which use the 2700 variable venturi carburetor require vacuum vent valves (Fig. 10).

The thermactor vacuum vent valve provides the makeup air for the thermactor retard delay valve and air bypass valve during idle modes to deactivate the thermactor system after a controlled period of time.

Application of vacuum from the carburetor to both ports of the thermactor vacuum vent causes the diaphragm to initially move left (Fig. 10) and the dump valve to seat. With the dump valve seated, the vacuum is applied to the rest of the system.

The removal of vacuum during idle modes results in the diaphragm moving right (Fig. 10). The dump valve leaves the seat, opening the vent and allowing air to enter the system to reduce the vacuum previously applied to the retard delay valve.

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EXHAUST CHECK VALVE (FIG. 12)

The exhaust gas check valve allows thermactor air to enter the exhaust port drillings, but prevents the reverse flow of exhaust gases in the event of improper operation of system components. The valve is located between the bypass valve and the exhaust port drillings, either mounted on the external air manifold or directly on the engine.

THERMACTOR II SYSTEM (Pulsed Air Type)

The 3.3L (200 CID) I-6 used in Fairmont and Zephyr with automatic transmission (49 States) is equipped with a new exhaust air injection system called "Thermactor II". (California, altitude, and manual transmission applications use Thermactor I system). The new system differs from the Thermactor system used on other applications in that it has no air pump. In operation, the system uses the natural pulses present in the exhaust system to "pull" air into the exhaust manifold.

An air inlet valve (Fig. 13) and a flame arrestor are connected to the exhaust manifold and air cleaner with hoses. The air inlet valve looks like a conventional Thermactor check valve, but they are not interchangeable.

When the pressure in the exhaust manifold is **more** than the pressure in the air cleaner (Fig. 14), the reed valve closes. When the pressure in the exhaust manifold is **less** than the pressure in the air cleaner, the reed valve opens and air is drawn into the exhaust manifold. The incoming oxygen reduces the hydrocarbon and carbon monoxide content of the exhaust gases by continuing the combustion of unburned gases in the same manner as the conventional air pump type Thermactor system.

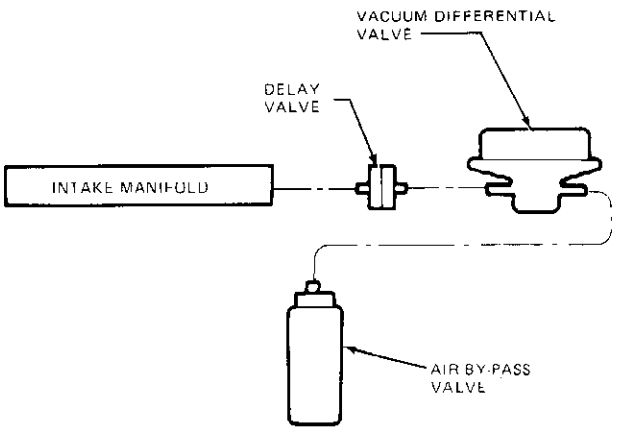


Fig. 9 Differential Valve Delay Valve

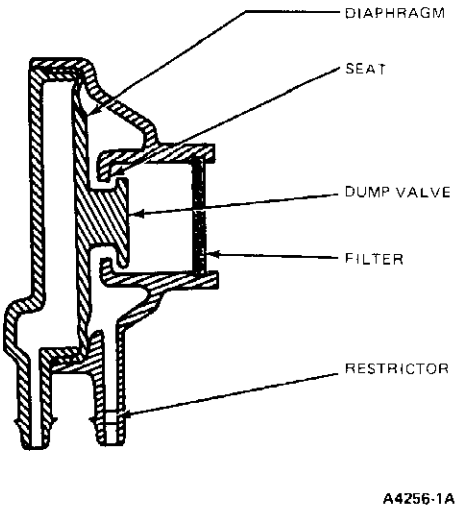


FIG. 10 Thermactor Vacuum Vent Valve

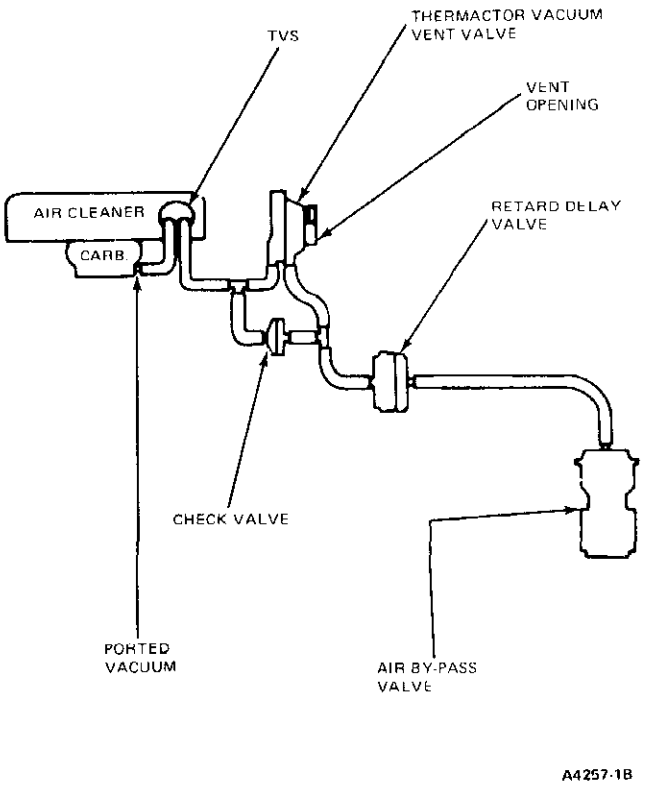


FIG. 11 Typical Vent Valve Installation

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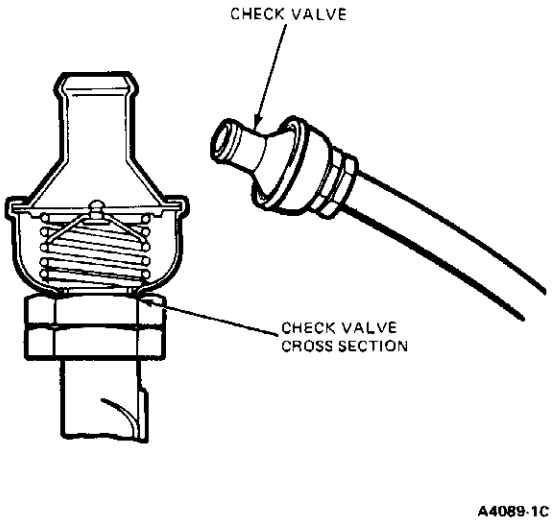


FIG. 12 Exhaust Check Valve

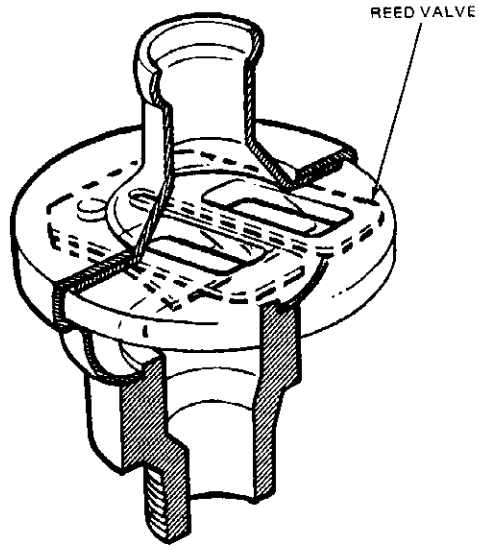
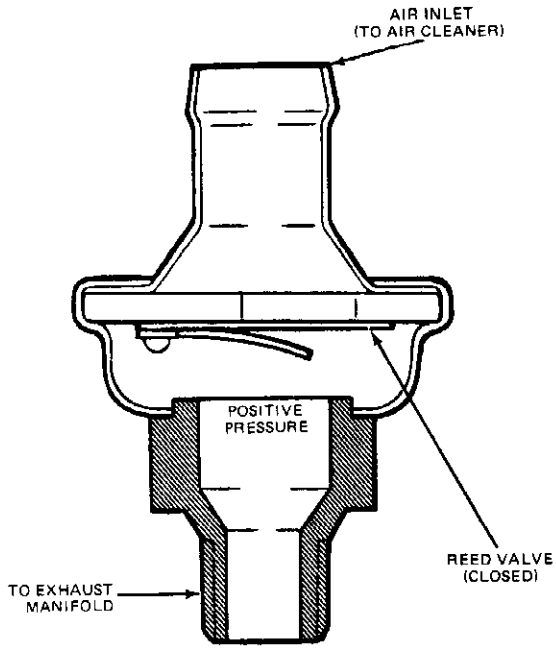


FIG. 13 Thermactor II Air Inlet Valve



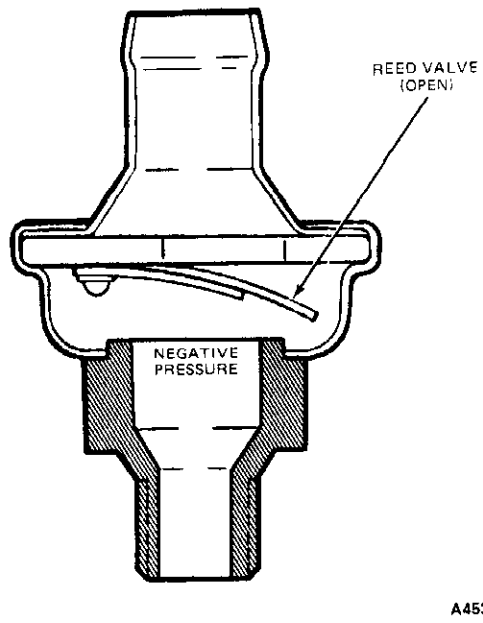


FIG. 14 Air Inlet Valve Operation

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Electronic Engine Control (EEC) System

PART 29-06

Lincoln Versailles W/5.0L (302 CID) Only

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CA4531-2A

DESCRIPTION

GENERAL

The Lincoln Versailles for 50 states and Canada is equipped with an integrated electronic engine control system designed to more precisely control ignition timing, EGR flow rate and Thermactor System air flow. The new system is called the Electronic Engine Control (EEC) System, and consists of an Electronic Control Assembly (ECA) and seven sensors, a Dura-Spark II ignition module and coil, a unique distributor assembly and an air pressure operated EGR System (Fig. 1).

To monitor ambient conditions and the function of the vehicle and engine, two pressure sensors, two temperature sensors and three position sensors are required. The sensors monitor:

- Manifold Absolute Pressure
- Barometric Pressure
- Engine Coolant Temperature
- Inlet Air Temperature
- Crankshaft Position
- Throttle Position
- EGR Valve Position

The sensors monitor these various engine and ambient conditions and send electrical signals to the ECA for processing. The ECA computes the correct ignition timing, EGR flow rate and Thermactor air flow for the best performance and emission control and sends command to the ignition module, the EGR Control Solenoids and the Thermactor Air Control Solenoid.

If for some reason the ECA should not function properly, it goes into what is called the Limted Operation Strategy (LOS) Mode. In the LOS mode, spark advance is held constant at 10 degrees BTDC; EGR and Thermactor systems are deactivated. This allows operation of the vehicle, although with reduced performance, until repairs can be made.

EEC SYSTEM COMPONENTS

Electronic Control Assembly (ECA)

The Electronic Control Assembly (ECA) is the "brain" of the EEC System, and is a solid-state, micro-computer consisting of a Processor Assembly and a Calibration Assembly (Fig. 2). This assembly is located in the passenger compartment under the instrument panel, just to the right of the steering column.

PROCESSOR ASSEMBLY

The processor assembly is housed in an aluminum case and contains circuits designed to:

- Continuously sample the seven sensor input signals.
- Convert the sampled signal to a form usable by the computer section in calculations
- Perform ignition timing, thermactor and EGR flow calculations
- Send electrical output control signals to the ignition module and control solenoids to adjust timing, EGR flow rate and Thermactor air flow.

The processor assembly also provides a continuous reference voltage (about 9 volts) to the sensors.

CALIBRATION ASSEMBLY

The Calibration Assembly (Fig. 2) is attached to the top of the Processor Assembly with two screws, and

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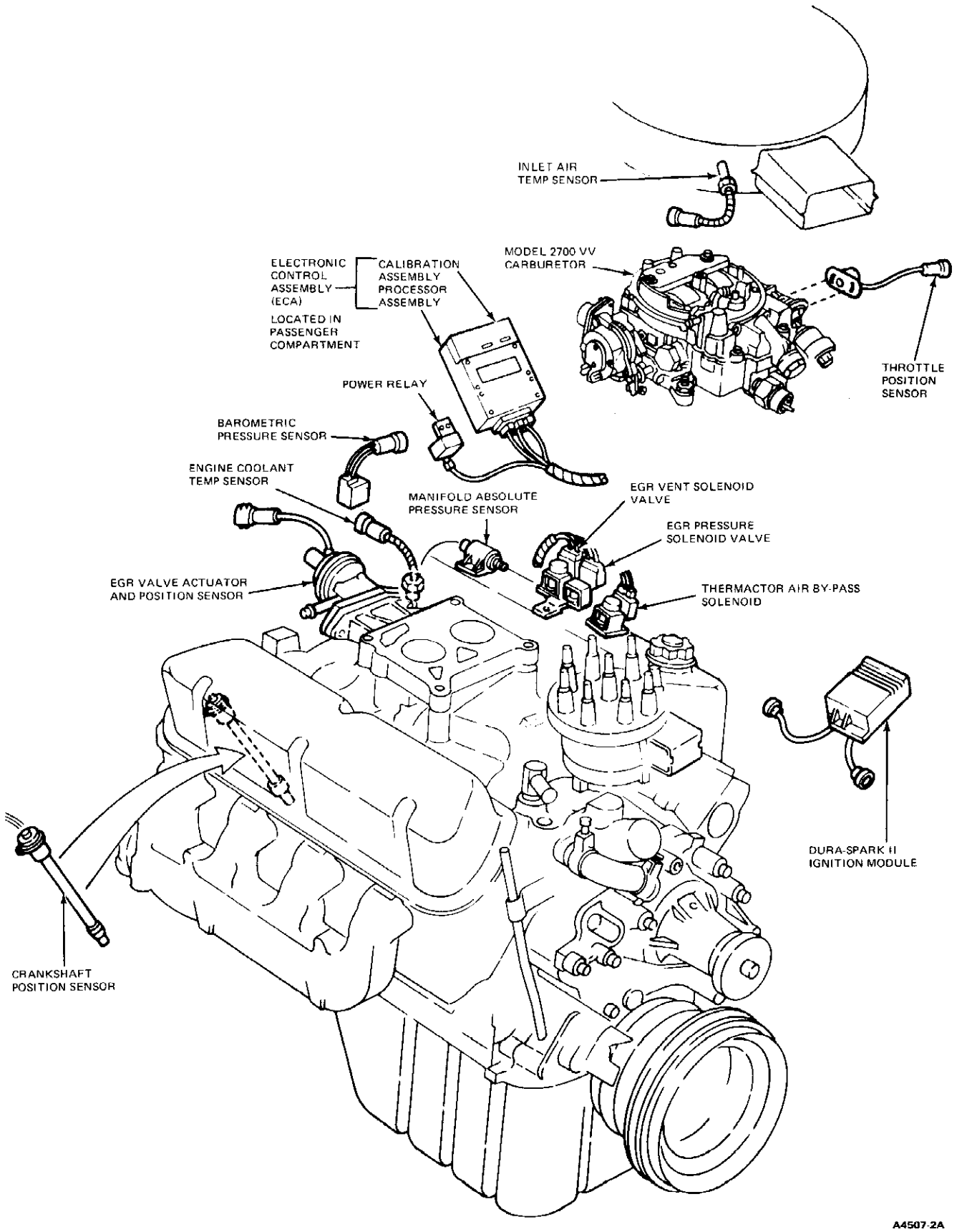


FIG. 1 Typical EEC System

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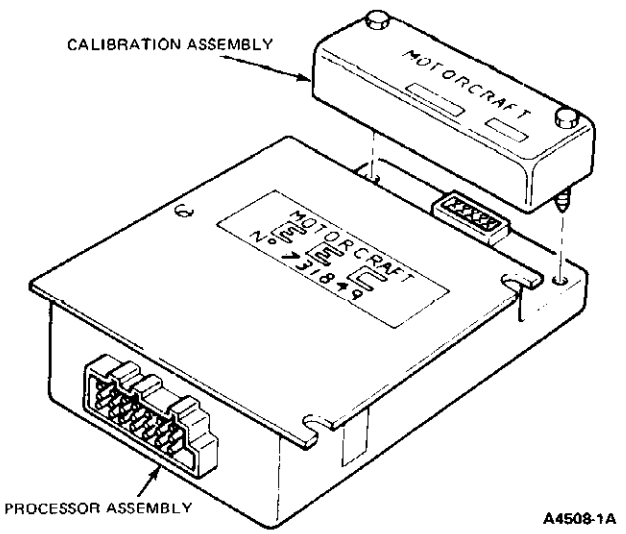


FIG. 2 Electronic Control Assembly (ECA)

contains the "memory" and programming for the processor assembly. It is capable of:

- Providing calibration information for that particular vehicle, for use by the processor assembly.
- Storing calculations for the processor assembly.
- Recalling information from its memory when asked.

Power Relay

A power relay attached to the lower right hand side of the ECA mounting bracket (Fig. 3) supplies battery voltage to the EEC system. It also protects the ECA from damage possible due to reversed voltage polarity.

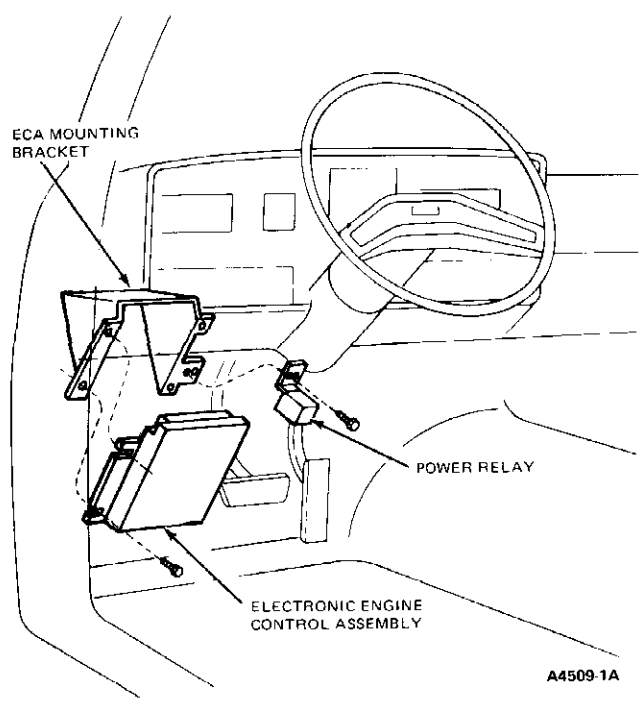


FIG. 3 Power Relay and ECA Attachment

EEC Crankshaft

To provide the EEC system with an accurate "reference timing" (indication when pistons reach top dead center (TDC) the rear of the crankshaft is fitted with a four-lobe "pulse ring" (Fig. 4).

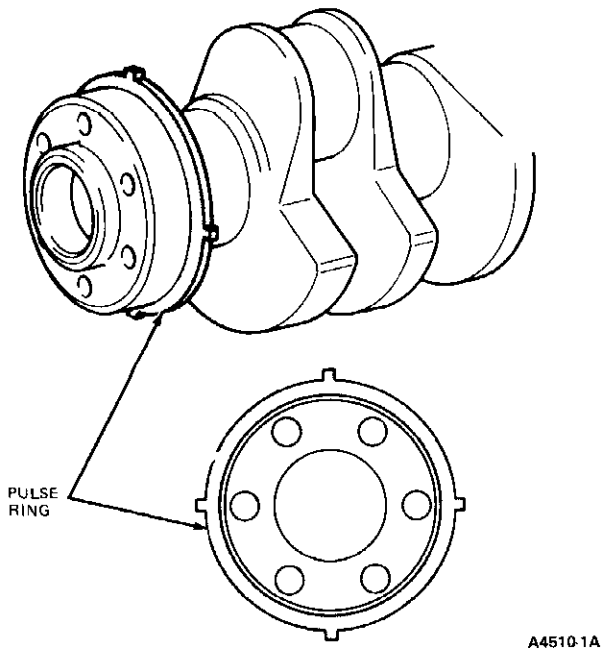


FIG. 4 Crankshaft Pulse Ring

The pulse ring is a thin (1/4") powdered metal ring carefully positioned on the crankshaft during manufacturing. It has four equally-spaced lobes which represent when pistons are at TDC. (The ring is actually positioned 10 degrees **before** top dead center (BTDC) to establish the engine reference timing at 10 degrees BTDC). Since four cylinders fire during each crankshaft revolution, only four lobes are needed.

Crankshaft Position Sensor

As the crankshaft rotates, the lobes on the pulse ring pass by the tip of the Crankshaft Position (CP) sensor (Fig. 5).

In operation, the crankshaft position sensor works somewhat like the breakerless distributor pickup coil; that is, the pulse ring interrupts the magnetic field generated by the tip of the sensor. When the field is interrupted, an output signal is generated and sent to the Electronic Control Assembly (ECA). As the crankshaft turns, the ECA interprets the electrical impulses to determine the exact position of the crankshaft at any given time. From the frequency of the pulses, the ECA can determine the engine rpm. By knowing these two factors, the ECA will determine the appropriate ignition timing advance required for best engine operation.

The crankshaft position sensor is held in place by a retaining clip and screw. An "O" ring near the top of the sensor seals the lower opening in the rear of the engine block. Once the sensor is locked in place, no field adjustment is necessary.

A broken sensor or open wiring will prevent the ECA from receiving a position signal, and the ECA will not

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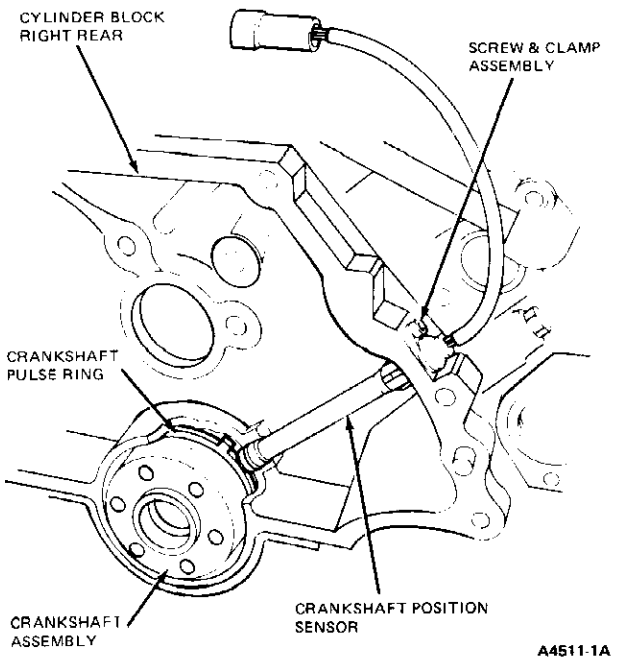


FIG. 5 Crankshaft Position (CP) Sensor

send a firing signal to the ignition module, thus disabling the ignition system and preventing the engine from starting.

Throttle Position (TP) Sensor

The Throttle Positioner (TP) Sensor is a potentiometer (rheostat) switch that responds to changes in throttle angle (Fig. 6).

With a reference voltage applied, the TP sensor output is interpreted as one of the following modes:

- Closed Throttle (idle or deceleration)
- Part Throttle (cruise)
- Wide Open Throttle (maximum acceleration)

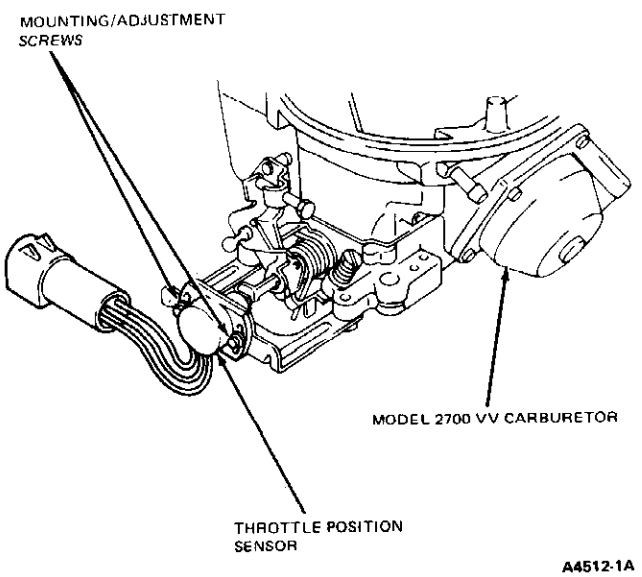


FIG. 6 Throttle Position (TP) Sensor

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

The EGR system used with Versailles consists of three major components (Fig. 7):

1. EGR valve/sensor assembly
2. EGR Control Solenoids (2)
3. EGR Cooler Assembly

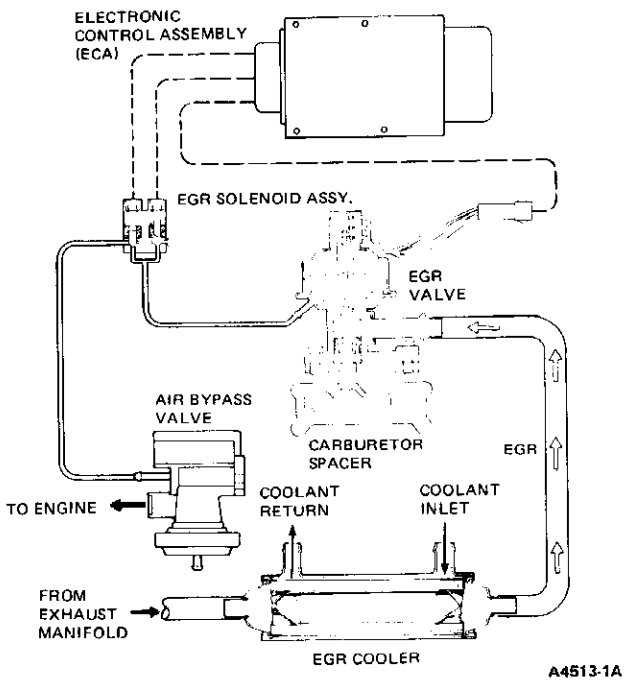


FIG. 7 Typical EGR System Used With EEC System

The EGR gas flow is controlled by the ECA, which utilizes air pressure from the Thermactor system bypass valve to operate the EGR valve. When the valve is open, exhaust gas from the exhaust manifold is allowed to flow into the intake manifold, becoming part of the combustion cycle and reducing NOx emissions.

EGR Valve and Sensor Assembly

The EGR valve used with the EEC system resembles the valve used with non-EEC system applications, but is air pressure operated rather than vacuum operated (Fig. 8).

The EGR valve attaches to a spacer (Fig. 9) that mounts under the carburetor on the intake manifold. The valve controls the flow of gases through a tapered pintle valve and seat. A position sensor built into the valve provides an electrical signal to the ECA that indicates EGR valve position.

Unlike non-EEC system EGR valves, the EEC system EGR valve is completely sealed, and no pintle valve movement can be seen when the valve is installed on the spacer. The valve and position sensor are serviced as a unit.

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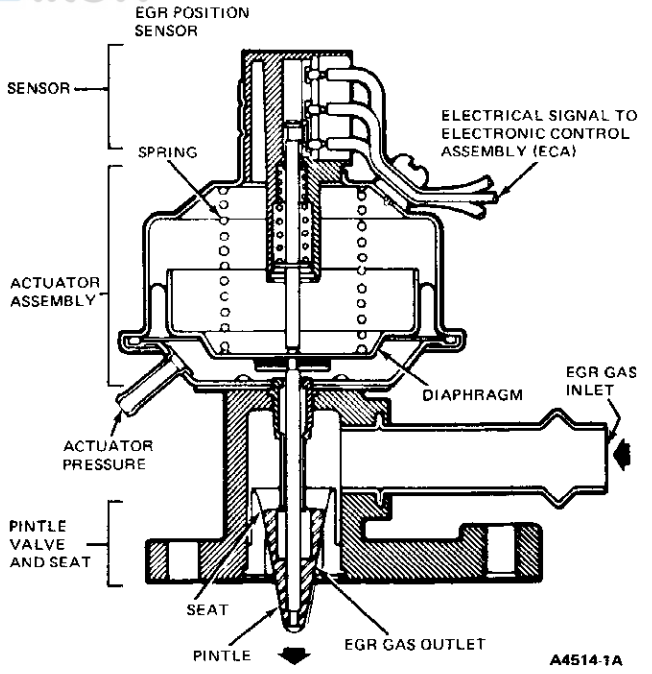


FIG. 8 EGR Valve Used With EEC System

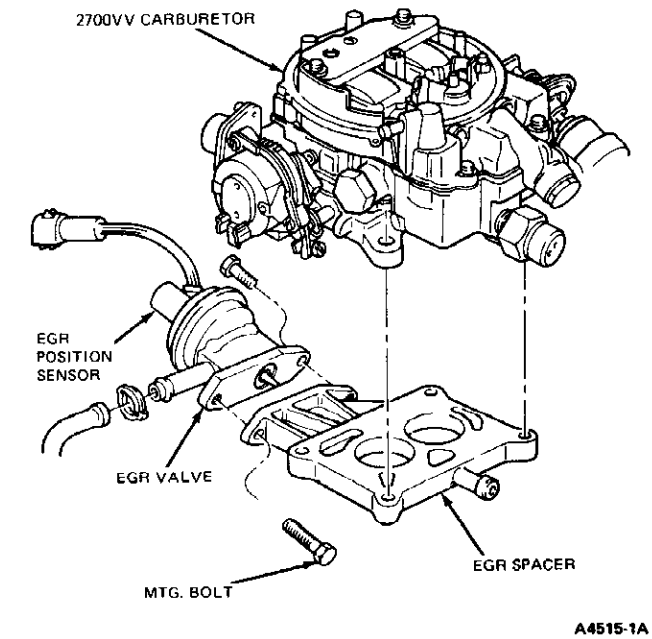


FIG. 9 EGR Valve And Spacer

EGR Cooler Assembly

In order to provide improved flow characteristics, better engine operation and EGR valve durability, an external EGR gas cooler is used to reduce EGR gas temperature (Fig. 10). The cooler assembly is mounted over the right valve cover and uses engine coolant to reduce the temperature of exhaust gases routed from the exhaust manifold to the EGR valve.

Dual EGR Control Solenoids

EGR valve movement is controlled by two solenoid valves mounted on a bracket above the left hand valve cover (Fig. 11).

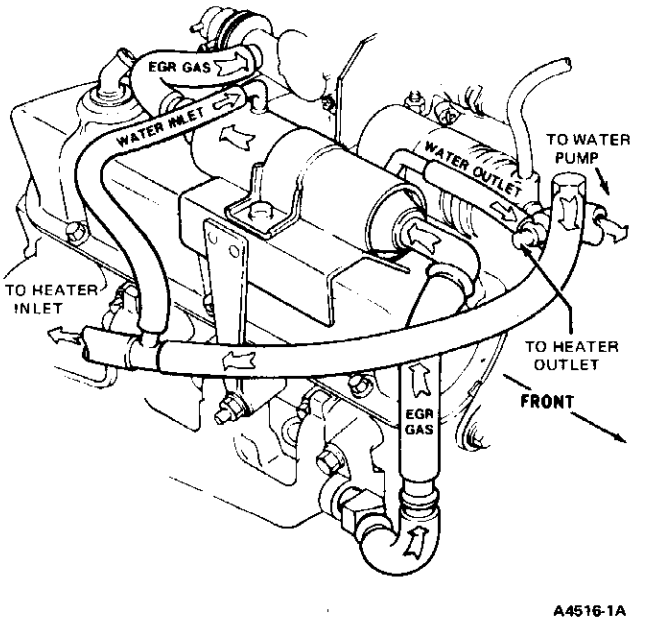


FIG. 10 EGR Gas Cooler

To properly control the air pressure used to operate the EGR valve, and to allow for application, hold and release of the air pressure, requires two types of solenoid valve:

1. A "vent" valve, which is normally open—that is, the outlet port is normally connected to the inlet port (Fig. 12) when the solenoid is **not** operated.
2. A "pressure" valve, which is normally closed—that is, the outlet port is normally blocked when the solenoid is **not** operated (Fig. 12).

EGR SYSTEM OPERATION

The EGR Valve is operated by air pressure supplied from the thermactor bypass valve. The pressure and vent solenoid valves work together under the direction of the ECA to:

- INCREASE EGR FLOW by applying air pressure to the EGR valve
- MAINTAIN EGR FLOW by trapping air pressure in the system
- DECREASE EGR FLOW by venting system pressure to atmosphere

With data received from the various sensors, the ECA determines the correct amount of EGR flow required, checks the position of the EGR valve pintle, and decides if a change in position is required. In response to these calculations, the ECA puts the EGR system into one of the modes shown in Fig. 13. The ECA samples and calculates these changes about 10 times each second, for improved economy and driveability under all conditions.

Fig. 14 is an overall view of the EGR system, showing the relationship of the thermactor bypass valve and control solenoid as it applies to the EGR system.

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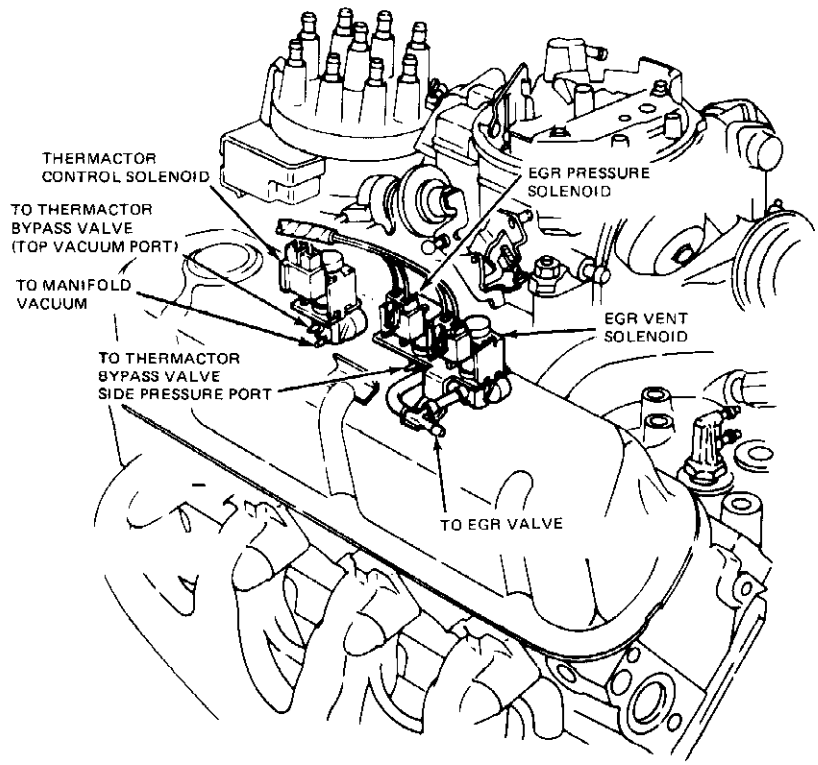


FIG. 11 Dual EGR Control Solenoids

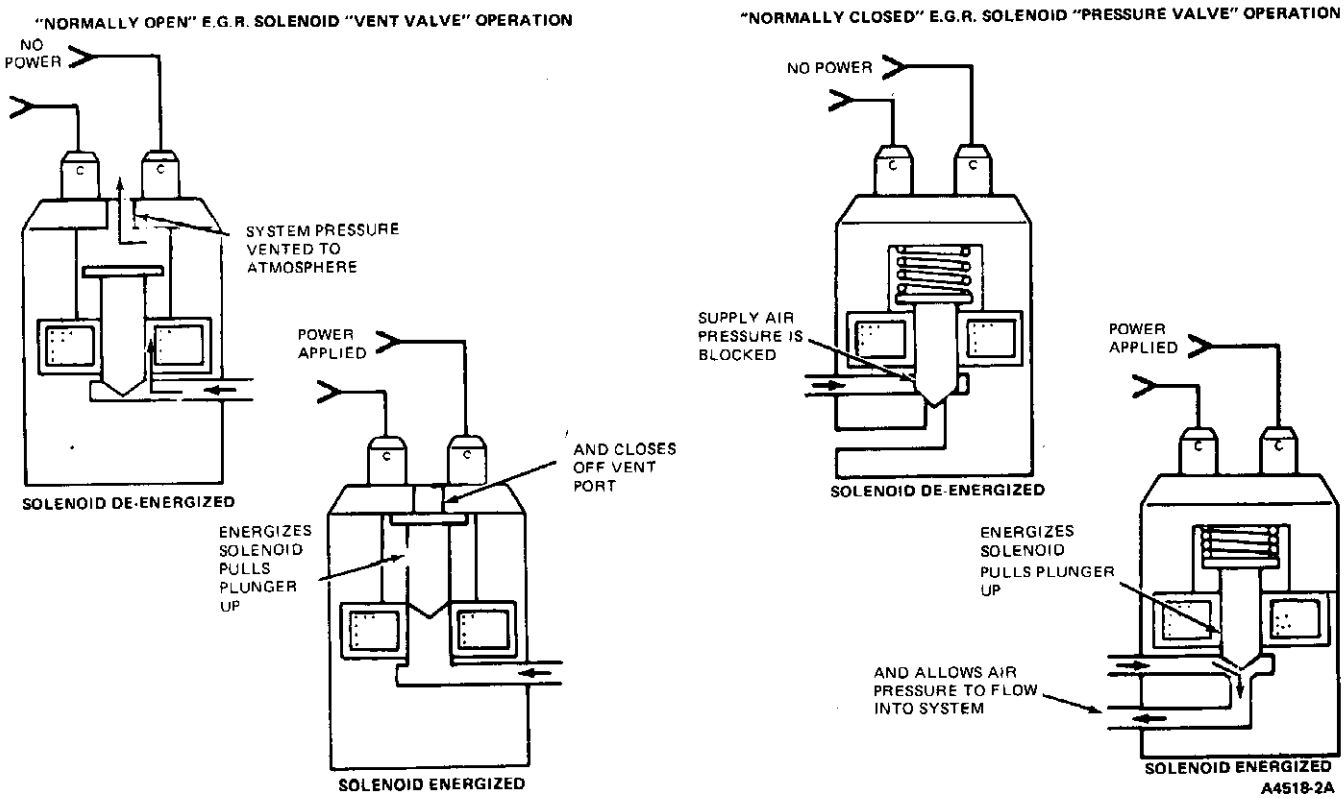


FIG. 12 Vent and Pressure Solenoid

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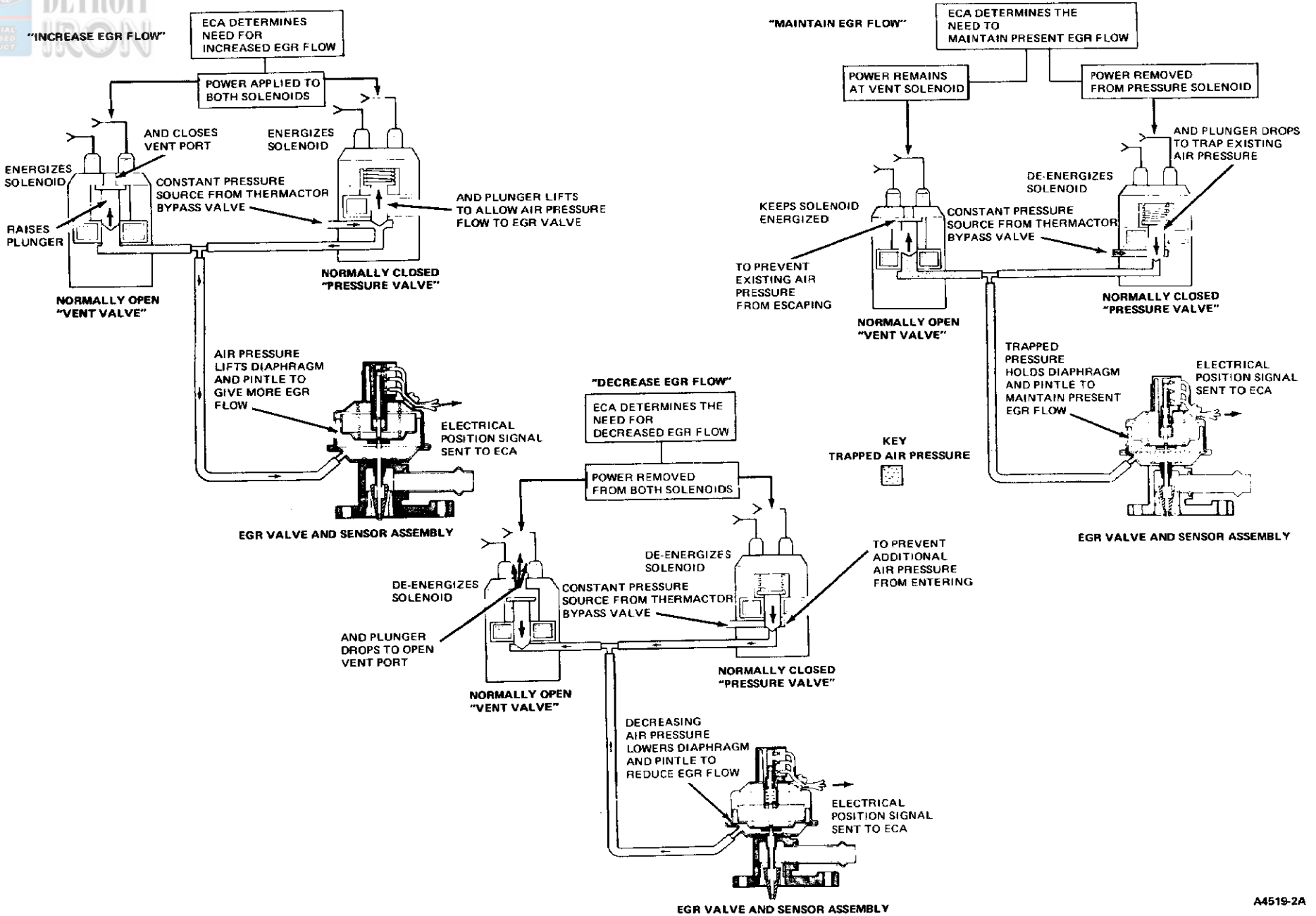


FIG. 13 EGR System Operation

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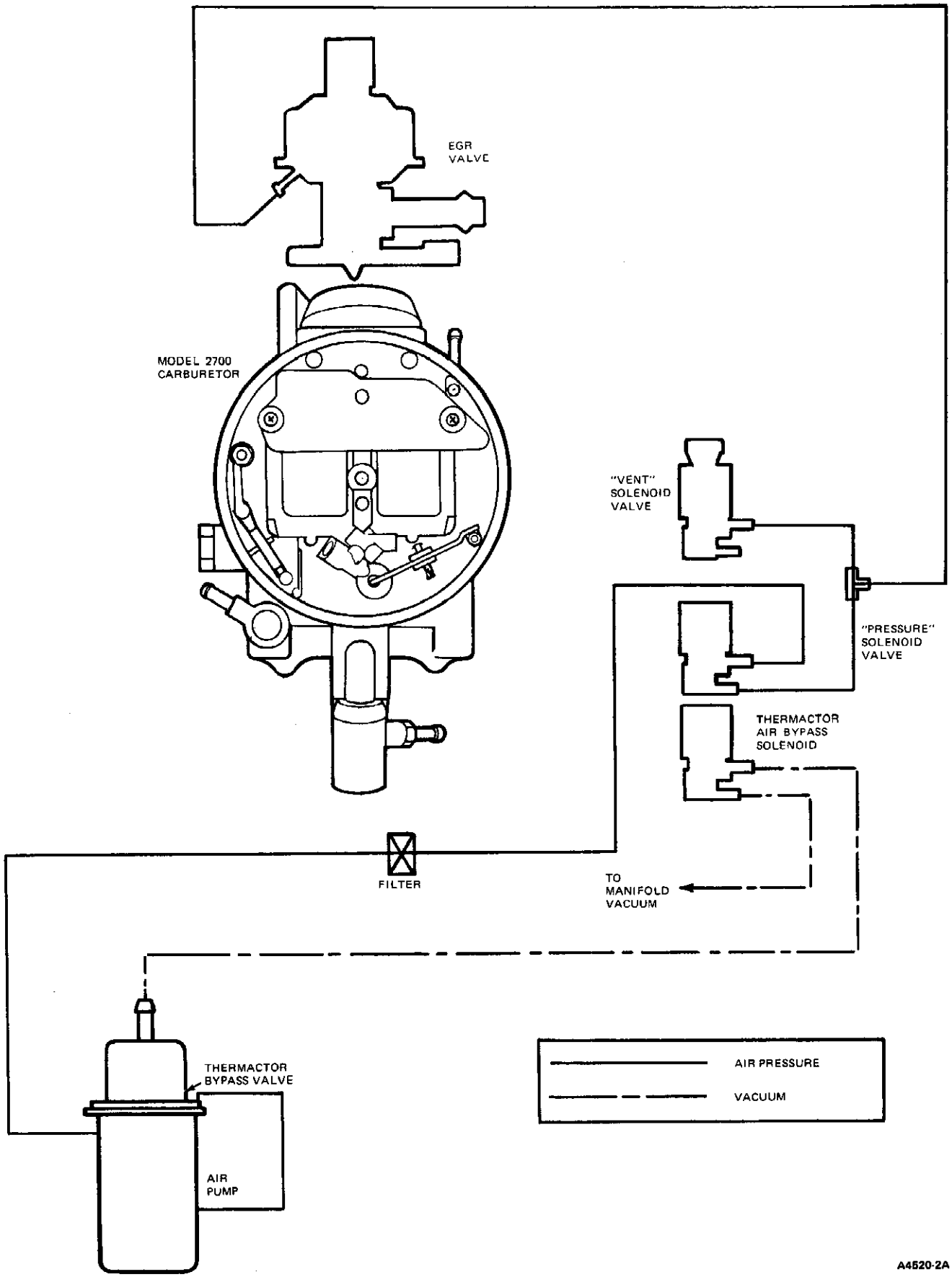


FIG. 14 EGR System Vacuum/Pressure Line Schematic

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MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The Manifold Absolute Pressure (MAP) sensor (Fig. 15) monitors the changes in intake manifold pressure which result from changes in engine load, speed and atmospheric pressure. (Manifold Absolute Pressure is defined as barometric pressure minus manifold vacuum). The MAP sensor contains a pressure-sensing element and electronic circuits that convert pressure sensed by the unit into an electric signal for the ECA. This signal is used by the ECA to determine part throttle spark advance and EGR flow rate.

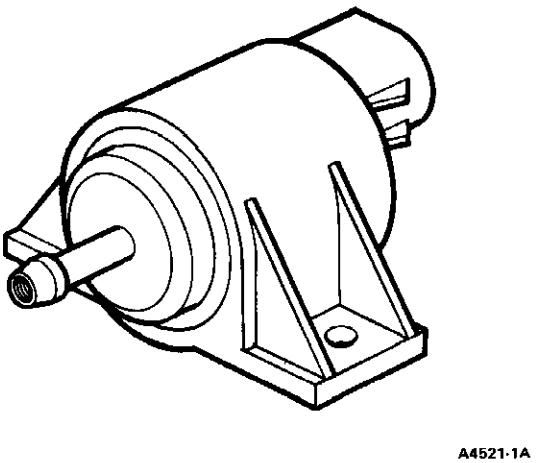


FIG. 15 Manifold Absolute Pressure (MAP) Sensor

BAROMETRIC PRESSURE (BP) SENSOR

The BP sensor is mounted on the engine compartment side of the dash panel (Fig. 16) and senses barometric pressure. The pressure is then converted into an electrical signal and fed to the ECA for computations. From this input, the ECA is able to determine EGR flow requirements depending on the altitude at which the vehicle is being driven.

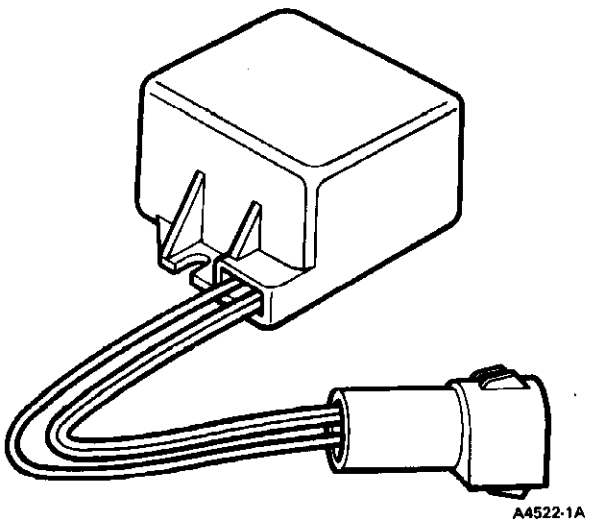


FIG. 16 Barometric Pressure (BP) Sensor

COOLANT TEMPERATURE SENSOR (ECT)

The engine coolant temperature sensor (Fig. 17) is installed in the rear of the intake manifold and converts engine coolant temperature into an electrical signal for the ECA to process. The sensor consists of a brass housing which contains a thermistor (variable resistor in which the resistance decreases as the temperature rises) that measures engine temperature. When the reference voltage is applied to the sensor, the resistance can be measured by the resulting voltage drop, telling the ECA the coolant temperature.

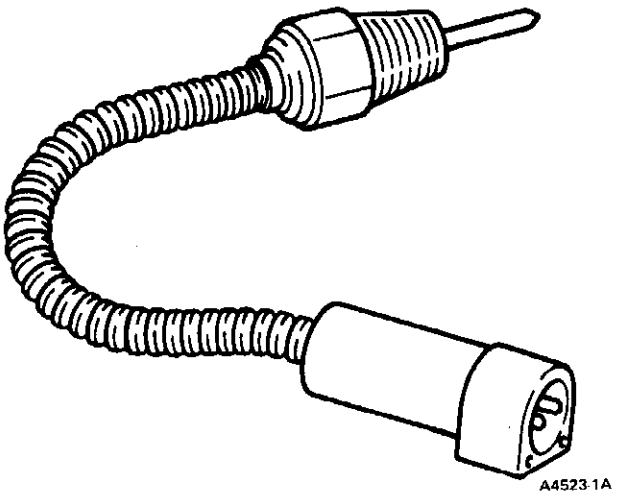


FIG. 17 Coolant Temperature Sensor (ECT)

The coolant temperature sensor takes the place of the cooling PVS and EGR PVS used in the conventional system. When the engine coolant temperature reaches a predetermined value stored in the system's memory, the ECA will cut off all EGR flow. In addition, if the engine coolant overheats from prolonged idle, the ECA will advance the engine initial ignition timing for increased engine idle speed and improved cooling system efficiency.

INLET AIR TEMPERATURE (IAT) SENSOR

The inlet air temperature sensor is similar in construction and function to the coolant temperature sensor, except for the addition of a protective shield near the tip (Fig. 18).

The sensor is mounted in the air cleaner body near the duct and valve assembly and is sensitive to changes in inlet air temperature. As inlet air temperature rises, the resistance of the sensing thermistor decreases, allowing the ECA to keep constant check on the temperature. With this information, the ECA can determine the proper spark advance and Thermactor system air flow. At high inlet air temperatures (above 32°C (90°F)) the ECA will modify ignition timing advance as necessary to prevent spark "knock".

THERMACTOR AIR BYPASS SOLENOID

The thermactor control solenoid is a normally closed valve that functions the same as the EGR pressure solenoid valve (Fig. 12). The upper port is connected to

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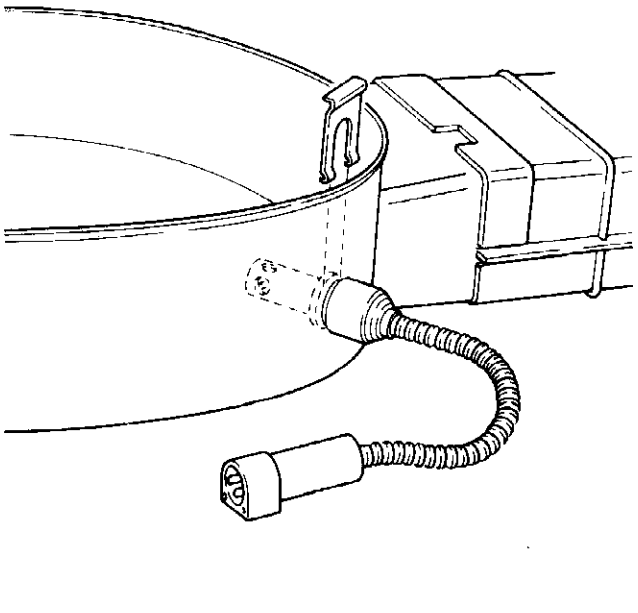


FIG. 18 Inlet Air Temperature (IAT) Sensor

the Thermactor bypass valve top (actuator) port and the lower port is connected to manifold vacuum. When the ECA energizes the Thermactor air bypass solenoid, manifold vacuum is applied to the bypass valve and Thermactor air is injected into the cylinder head exhaust ports. When the ECA de-energizes the Thermactor air bypass solenoid, the valve closes and the bypass valve "dumps" Thermactor air to the atmosphere. The ECA uses information from the inlet air temperature sensor and the throttle position sensor to determine when to inject air and when to dump air to the atmosphere.

IGNITION SYSTEM

The ignition system used with the EEC system uses a Dura Spark II ignition module and ignition coil (see Part 23-01) to generate the required high voltage spark. Routing the secondary voltage to the appropriate spark plugs is accomplished with an all-new distributor designed exclusively for the new EEC system.

Distributor

The EEC distributor does not have conventional mechanical or vacuum advance mechanisms as do other Ford distributors. Instead, all ignition timing is controlled by the Electronic Control Assembly (ECA), which is capable of firing the spark plug at any point from top dead center (TDC) to 60 degrees before top dead center (BTDC). This increased spark advance capability requires greater separation of adjacent distributor cap electrodes to prevent cross-fire.

BI-LEVEL ROTOR AND DISTRIBUTOR CAP

The distributor rotor and cap electrodes have been designed to handle the additional advance capability, by using a two-level design (Fig. 19).

Both the rotor and cap have upper and lower electrode levels. As the rotor turns, one of the high-voltage electrode pickup arms (Fig. 20) aligns with one

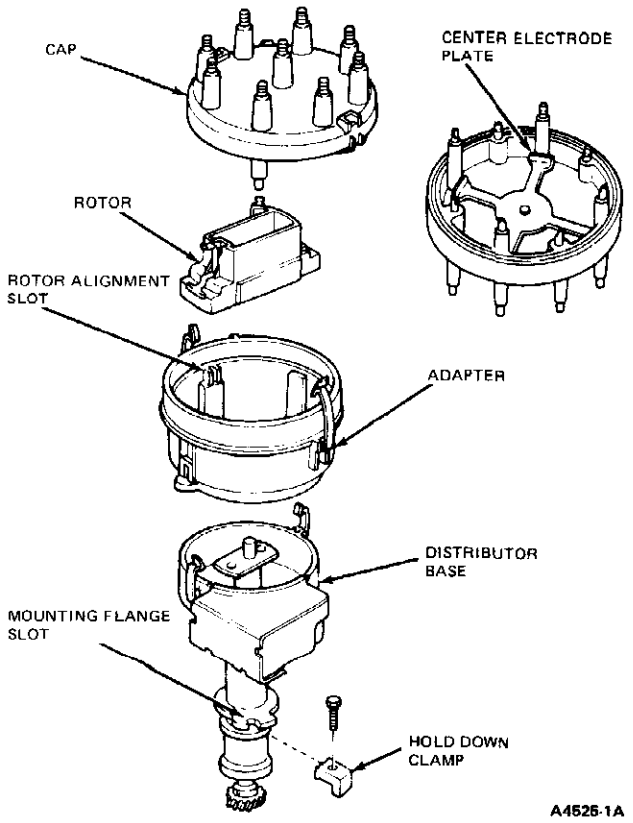


FIG. 19 EEC Distributor, Cap and Rotor

spoke of the distributor cap center electrode plate, allowing high voltage to pass from the plate, through the rotor to a terminal on the distributor cap and out to the spark plug.

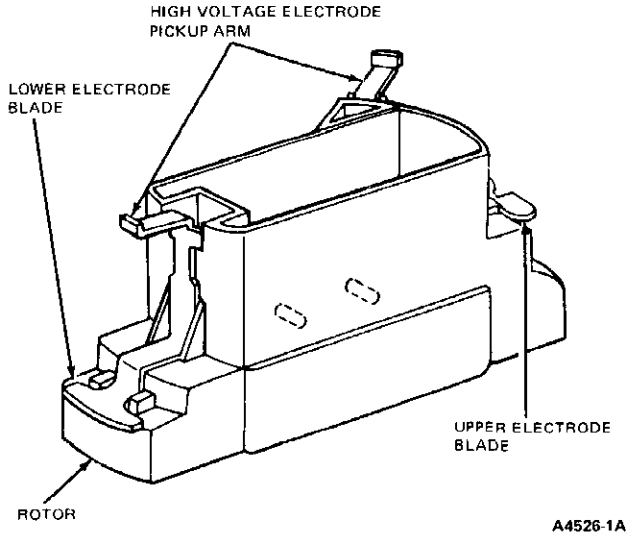


FIG. 20 Distributor Rotor

The numbers molded into the top of the cap are spark plug wire identification numbers (Fig. 21). Due to the unique construction of the distributor cap and rotor, however, the wires are not arranged in the cap in firing order. The inner ring of numbers (Fig. 21) is for the Versailles 5.0L (302 CID) V-8. The outer ring of numbers is for future use in 5.8L/6.6L (351/400 CID) V-8

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applications. The actual firing order for the 5.0L (302 CID) V-8 is 1-5-4-2-6-3-7-8, as noted on the intake manifold.

NOTE: Do not attempt to remove any silicone coating from the rotor lower electrode blades or from the distributor cap electrodes, including the center plate electrodes. As this silicone compound ages, it has the appearance of being a contaminant of the cap and electrodes. This condition is normal and causes no performance loss.

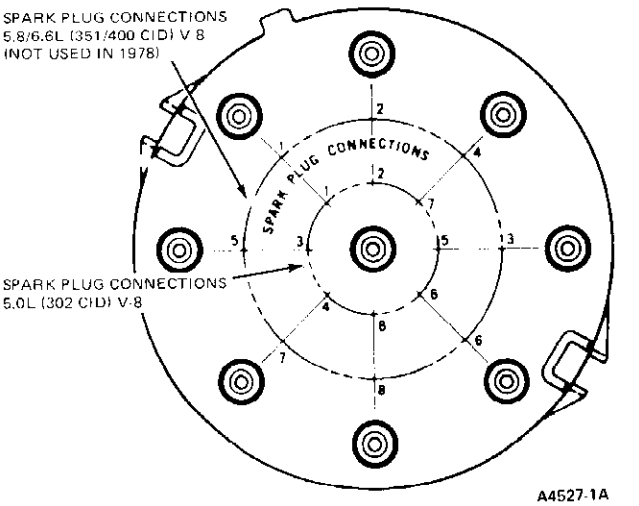


FIG. 21 Spark Plug Wire Connections

REMOVAL AND INSTALLATION

ELECTRONIC CONTROL ASSEMBLY (ECA)

The Electronic Control Assembly (ECA) is mounted behind the instrument panel on the driver's side near the brake pedal support. The ECA is attached to its mounting bracket with three screws. If the ECA requires replacement, loosen only the two left hand screws and remove the one right hand screw. There are slots which allow the unit to slide out and away from the left hand mounting screws. The bottom side of the ECA has 3 wiring harness connectors which are easily removed for diagnostic work and test equipment connection. The harness connector bodies are polarized (keyed) to prevent improper connection. Each connector body is color coded (Black=7-pin, Blue=10-pin, Red=9-pin) and each has pin identification letters on the side of the connector. Also, corresponding colored dots are located on the bottom side of the ECA to aid in reconnection of the three wiring harness connectors. Refer to the wiring diagram (Fig. 24) for further information.

DISTRIBUTOR ROTOR

In order to obtain maximum timing advance without crossfire to adjacent distributor cap electrodes, it is important that proper distributor rotor alignment be established, using the special rotor alignment tool designed for this purpose. Since there is no mechanical advance mechanism or adjustments under the rotor, there is no need to remove the rotor except to replace it.

Removal

1. Remove the distributor cap by loosening the two spring clips holding the cap to the distributor adaptor (Fig. 19).
2. Rotate the crankshaft sufficiently to align the distributor rotor upper blade (with slot) with the locating slot in the distributor adaptor (Fig. 22), so the distributor rotor alignment Tool T78P-12200-A will drop into place. **If the rotor or adapter is damaged and alignment is not possible, position the crankshaft with number 1 piston at compression TDC by aligning the zero mark on the damper with the timing pointer on the front cover.**
3. Remove the rotor alignment tool and remove the two screws attaching the rotor to the distributor shaft. Remove the rotor.

CAUTION: DO NOT ROTATE THE CRANKSHAFT AFTER THE ROTOR HAS BEEN REMOVED.

Installation

NOTE: When replacing the rotor, coat the lower electrode blades approximately 1/16" thick on all sides (outboard of the plastic) with D7AZ-19A331-AA silicon grease or equivalent (Dow 111 or G.E. G-627 compound).

1. Place the new rotor on the distributor shaft with the slot in the upper blade pointing to the locating notch in the distributor adapter. Install, but do not tighten both rotor attaching screws.
2. Position the rotor alignment Tool T78P-12200-A in the distributor adapter so that the tang on the underside of the tool engages the locating notch in the distributor adapter and the slot in the rotor at the same time.
3. Tighten both rotor attaching screws to 15-20 in-lb.
4. Remove the rotor alignment tool and reinstall the distributor cap. Seat both cap-to-adapter spring clips.

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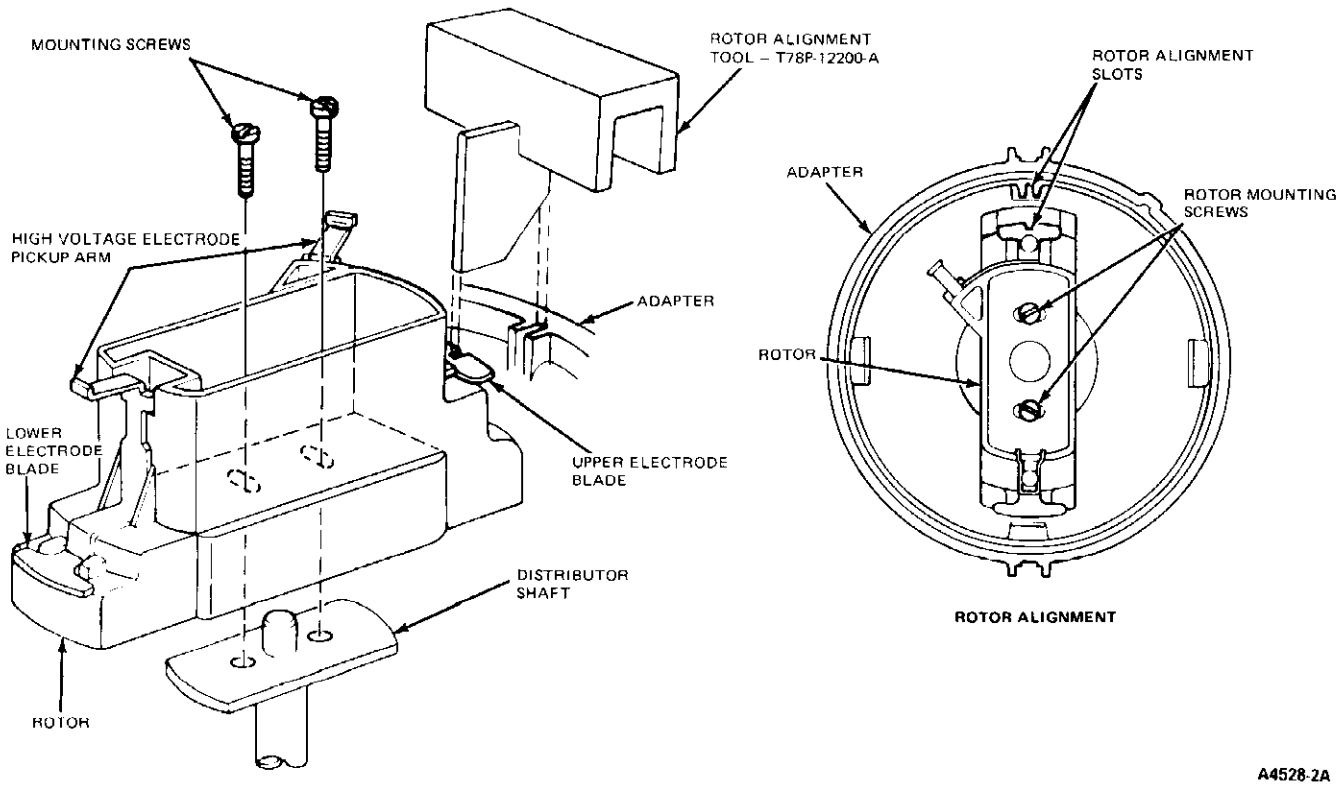


FIG. 22 Rotor Alignment

DISTRIBUTOR

The EEC distributor is locked in place during engine assembly and no rotational adjustment is possible. A slot in the distributor base mounting flange fits around the distributor clamp hold-down bolt, preventing movement (Fig. 19). Adjustment is not required, since all timing is controlled by the ECA.

Removal

1. Remove the distributor cap and insert the rotor alignment Tool T78P-12200-A by following Steps 1 and 2 under Rotor Removal.
2. With the rotor alignment tool inserted, loosen the distributor hold-down bolt and clamp. Remove alignment tool.
3. Slowly remove the distributor assembly from the engine block, noting the position of the rotor blade with respect to the distributor base when the cam and distributor drive gear are felt to disengage.

   CAUTION: DO NOT ROTATE THE CRANKSHAFT AFTER THE DISTRIBUTOR HAS BEEN REMOVED FROM THE ENGINE.

Installation

1. Position the distributor in the block so that when fully seated the following conditions are met:
   a. The slot on the distributor base hold-down flange is aligned with the clamp bolt hole in the block, and
   b. the slot in the upper blade of the rotor is apporximately aligned with the slot in the adapter.

   If alignment is not possible when the distributor is fully seated, raise the distributor out of the block enough to disengage the cam gear and rotate the distributor shaft slightly to allow the next tooth on the distributor drive gear to engage the cam gear. Repeat this procedure until conditions outlined in (a) and (b) are satisfied.
2. Install the distributor-to-block clamp and bolt and torque to specifications.
3. Align the rotor and install the distributor cap following procedures outlined under Rotor Installation (Steps 1-4).

   NOTE: When installing a new distributor cap, coat the brass center electrode plate tip surfaces shown in Fig. 23 **with D7AZ-19A331-AA silicon grease or equivalent (Dow 111 or G.E. G-627 compound).**

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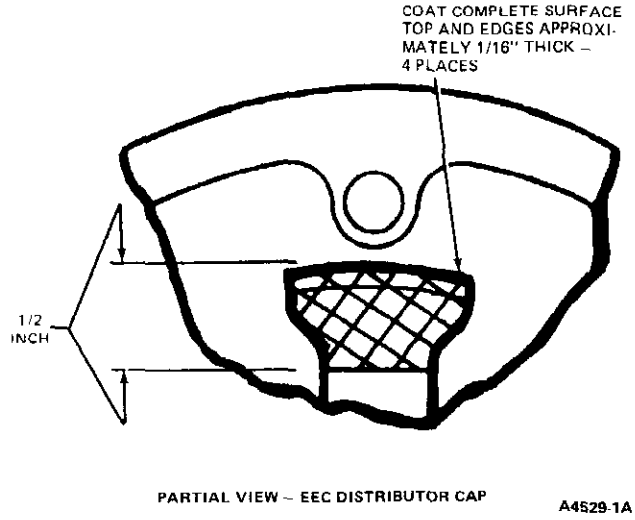


FIG. 23 Coating New Distributor Cap

DIAGNOSIS

Due to the complexity of the EEC system, two special diagnosis aids are required:

1. **EEC Diagnostic Tester T78L-50-EEC-1** —Plugs in between ECA and vehicle wiring harness to monitor EEC signals. Refer to Part 29-02 and the Tester Operator's Manual for required diagnostic procedures and test specifications. Diagnostic limits for spark advance and EGR valve position sensor are located on the vehicle emission control information decal located on the engine valve cover. These specifications will vary for various calibrations.
2. **Digital Volt/Ohmmeter (DVOM) T78L-50-DVOM-1** —Accurate, high input impedance unit developed for gathering EEC system data. Digital readout minimizes errors, giving technician necessary accuracy for EEC diagnosis. Can also be used for other electrical system diagnosis in addition to EEC system.

An advance timing light such as Rotunda 27-0002 (or equivalent), compatible with the Dura Spark II ignition system, a pressure/vacuum gauge and a tachometer are also required for diagnosis of the EEC system. Refer to Part 29-01 and 50-29 for diagnosis and service of the applicable EEC system components. Refer *to Fig. 24 for the EEC system wiring diagram.*

NOTE: The EEC Diagnostic Tester (T78L-50-EEC-1) and Digital Volt/Ohmmeter (DVOM) (T78L-50-DVOM) are available from: Owatonna Tool Company, Owatonna, Minnesota, Attention Ford Order Desk.

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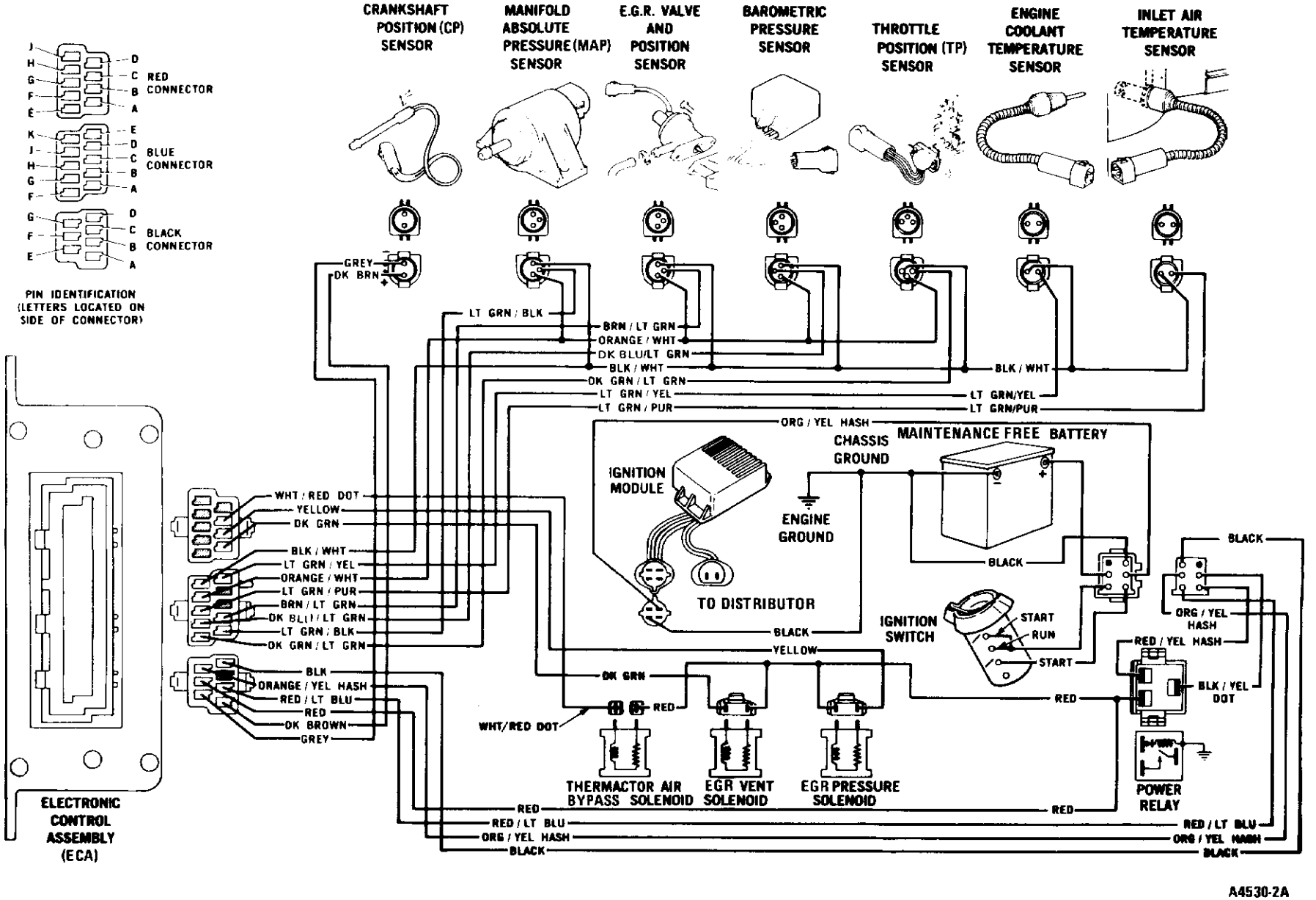


FIG. 24 EEC System Wiring Diagram

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Exhaust Gas Recirculation (EGR) System

PART 29-07

All Models Except Versailles W/ EEC System

SUBJECT	PAGE
GENERAL INFORMATION	
EGR Backpressure Transducer	07-1
EGR/CSC System	07-4
EGR System WOT (Wide Open Throttle) Load Control Valve	07-4
EGR Valve	07-1
Integral Transducer Backpressure EGR Valve	07-1
GENERAL INFORMATION (Cont.'d)	
Poppet Type	07-1
Tapered Stem Type – Internal	07-1
Spacer Entry EGR System	07-1
Venturi Vacuum Amplifier (VVA)	07-1

CA4258-2B

GENERAL INFORMATION

The Exhaust Gas Recirculation System (EGR) is designed to re-introduce small amounts of exhaust gas into the combustion cycle, thus reducing the generation of nitrous oxides (NOX). The amount of exhaust gas re-introduced and the timing of the cycle are controlled by various factors such as engine vacuum, exhaust system backpressure and temperature. Typical systems are shown in Figs. 1 and 2.

EGR VALVE

The EGR valve (Figs. 3, 4 and 5) is a vacuum-operated unit that attaches to a spacer that fits under the carburetor. When the valve is open, exhaust gas is permitted to enter the intake manifold passages. When the valve is closed, internal or external sealing takes place, preventing the flow of exhaust gases into the intake passages.

Ford EGR valves are operated by a vacuum motor. There are four different types of valves to provide various degrees of flow rate as follows:

POPPET TYPE

The poppet valve (Fig. 3) is a rapid opening valve—the poppet disc is retracted from the seat providing the intial flow curve shape. The flow is limited by the valve seat diameter in valves above approximately 10 CFM. Below approximately 10 CFM the flow is limited by various orifice plates inserted in the mounting pad.

TAPERED STEM TYPE—INTERNAL

The tapered stem valve (Fig. 3) utilizes a pintle protruding through the valve seat to provide greater slope ratios of the flow curve than that obtained with a simple poppet. The flow rate is controlled by the relationship of the pintle OD to the seat ID.

INTEGRAL TRANSDUCER BACK PRESSURE EGR VALVE

The integral transducer EGR valve (Fig. 4) combines the exhaust backpressure transducer within the diaphragm housing of a typical EGR valve. This device modulates EGR flow by venting the EGR valve vacuum available to open the valve dependent upon exhaust backpressure. The exahust backpressure is sensed in the cavity between the orifice and the poppet/tapered stem. The EGR flow is dependent upon source vacuum, exhaust pressure, control setting and the orifice.

EGR BACKPRESSURE TRANSDUCER

Some EGR systems employ a Backpressure Transducer connected to an adapter between the EGR valve and the intake manifold. The transducer modulates EGR flow by varying the EGR valve vacuum signal according to exhaust backpressure. The exhaust pressure is sensed in the pressure cavity of the transducer spacer (Fig. 5).

SPACER ENTRY EGR SYSTEM

On this type of system, exhaust gases are routed to the EGR valve, which is attached to a spacer mounted between the carburetor and the intake manifold (Fig. 6).

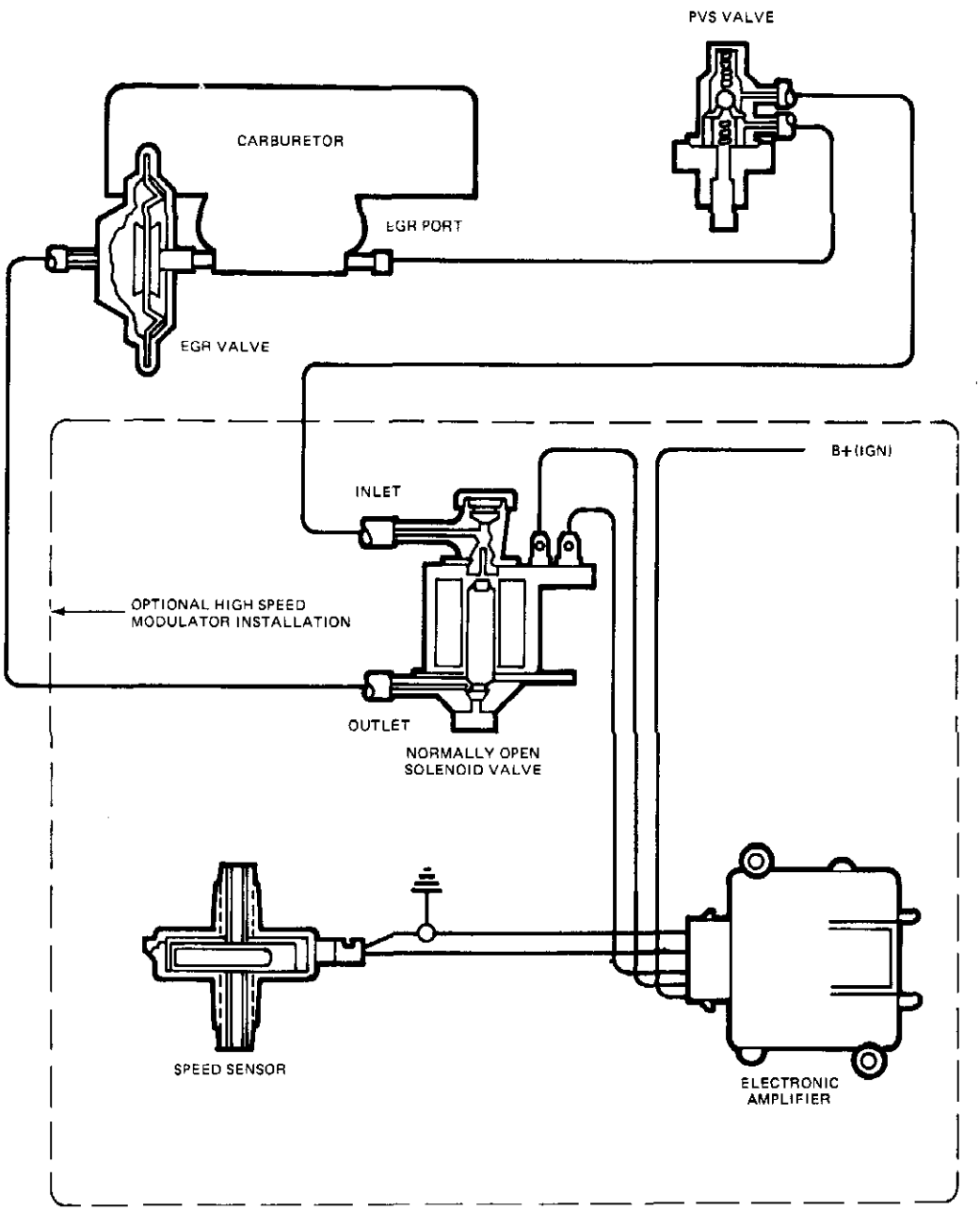
VENTURI VACUUM AMPLIFIER (VVA)

The EGR Venturi Vacuum Amplifier (Fig. 7) uses a relatively weak venturi vacuum signal in the throat of the carburetor to shape a strong intake manifold vacuum signal to operate the EGR valve. This makes it possible to achieve an accurate, repeatable and almost exact proportion between venturi air flow and EGR flow. Thus, it assists in controlling oxides of nitrogen emissions with minimal sacrifice in vehicle driveability.

The amplifier connects to a vacuum reservoir and contains a check valve to maintain adequate vacuum supply regardless of variations in engine manifold vacuum (Fig. 8).

A relief valve is also used to "dump" or cancel the output EGR signal whenever the venturi vacuum signal

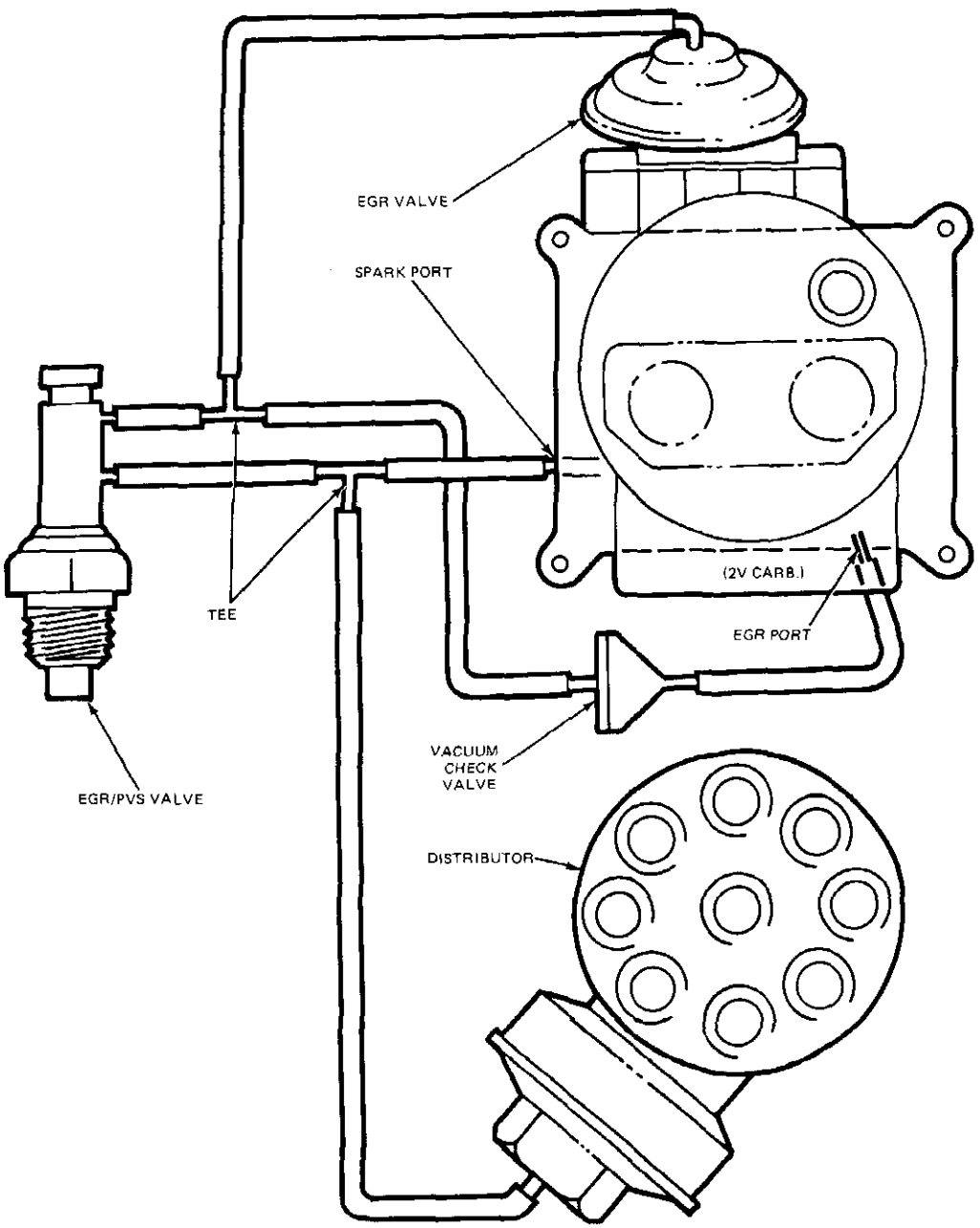
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A4503-2A

FIG. 1 Typical EGR System Installation

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FIG. 2 Typical Modified Combined Vacuum (Modified COVAC) Installation

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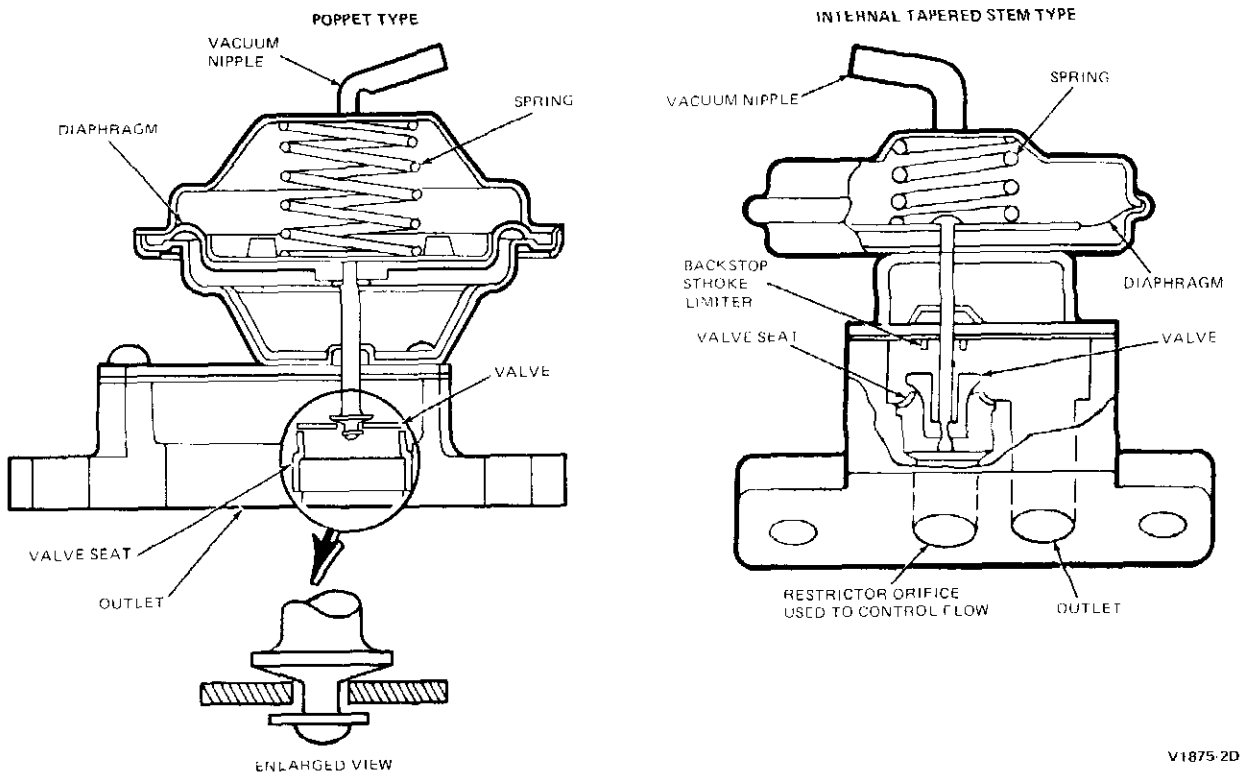


FIG. 3 Typical EGR Valves

is equal to, or greater than, the intake manifold vacuum. This allows the EGR valve to close at or near wide-open throttle acceleration, when maximum power is required from the engine.

EGR/CSC SYSTEM

This vacuum installation (Fig. 9) operates to control the spark advance and EGR flow as follows:

At cold start (coolant temperatures below EGR PVS opening temperature) the EGR PVS connects carburetor EGR port vacuum to the distributor through the check valve and by-passing the spark delay valve. As the engine temperature increases and coolant temperature reaches EGR PVS opening temperature, the EGR PVS switches EGR port vacuum from the distributor to the EGR valve. At coolant temperatures above EGR PVS opening temperature the EGR vacuum port on the carburetor controls the EGR valve and the spark vacuum port controls spark advance through the cooling PVS and the spark delay valve.

EGR SYSTEM WOT (WIDE OPEN THROTTLE) LOAD CONTROL VALVE

Some EGR systems feature a load control valve that closes the EGR valve when the engine requires maximum power at or near wide open throttle (Fig. 10).

The WOT valve is installed in the vacuum line between the ported vacuum connection on the carburetor and the EGR valve. A vacuum line from the carburetor venturi vacuum tap is connected to the top port on the WOT valve and provides control for the valve. When the venturi vacuum signal is at a predetermined level near wide open throttle, it is strong enough to overcome the calibration spring pressure and unseat the diaphragm valve, diverting EGR source vacuum to the atmosphere and causing the EGR valve to close. Normal EGR flow is resumed when there is a reduction in engine load from the wide open throttle condition.

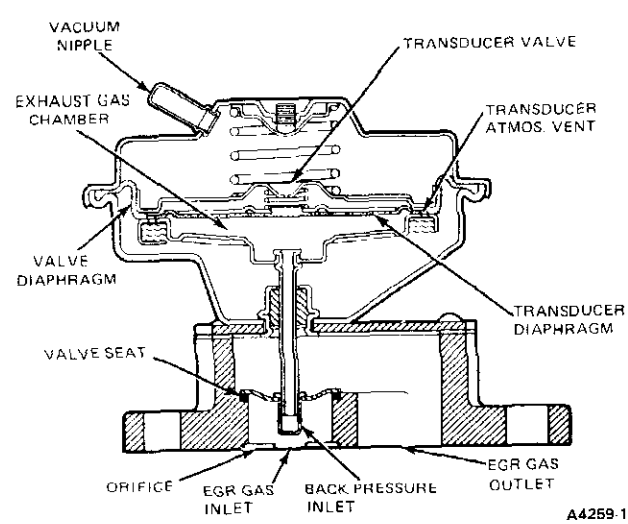


FIG. 4 Typical Integral Backpressure Transducer/EGR Valve

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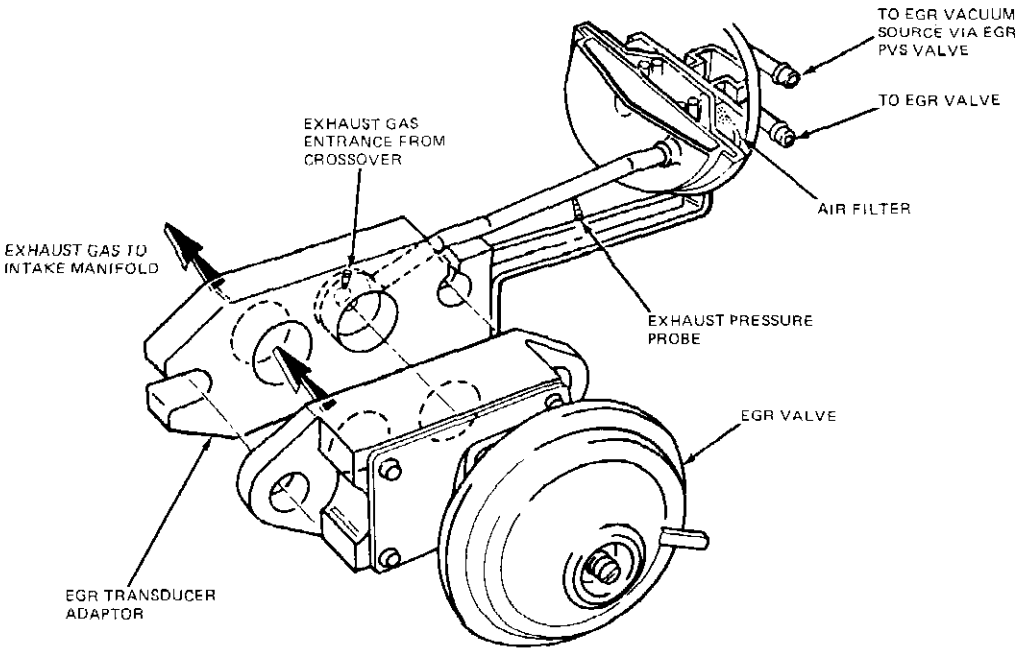


FIG. 5 EGR Valve Exhaust Backpressure Transducer

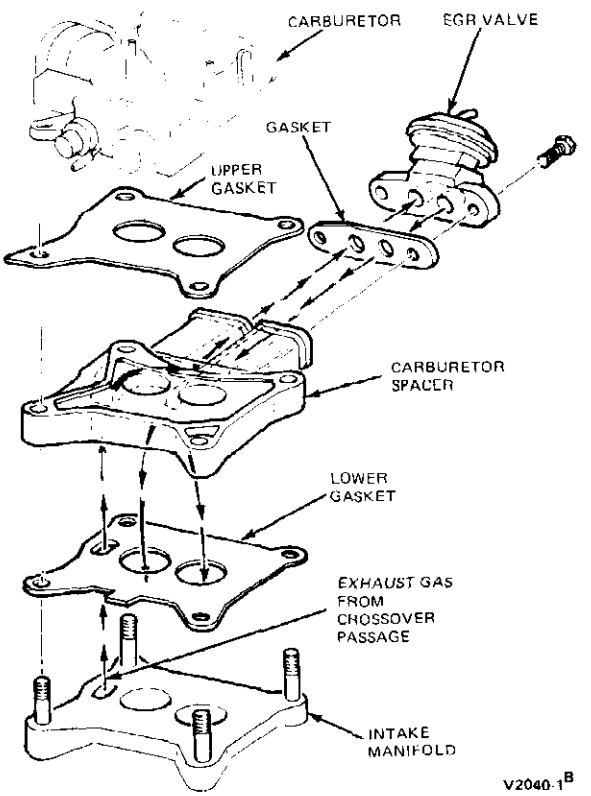


FIG. 6 Spacer Entry EGR System—Typical

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AMPLIFIER CODED FOR PORT CONNECTIONS:

O – OUTPUT TO EGR VALVE
R – FROM RESERVOIR
S – VACUUM SOURCE (SPARK OR EGR PORT)
V – VENTURI VACUUM
A – ATMOSPHERE (VENT)

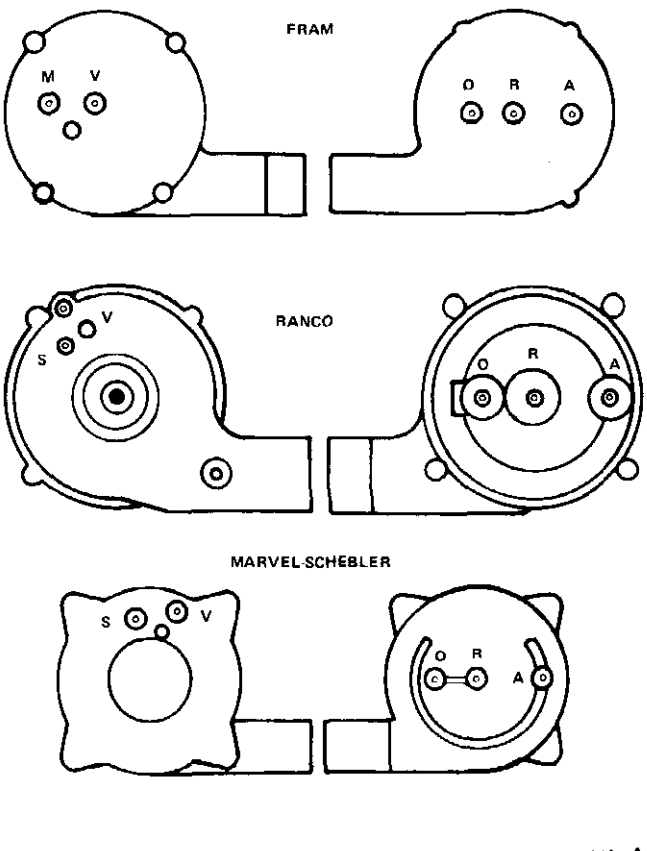


FIG. 7 Venturi Vacuum Amplifier—Dual Connector Type

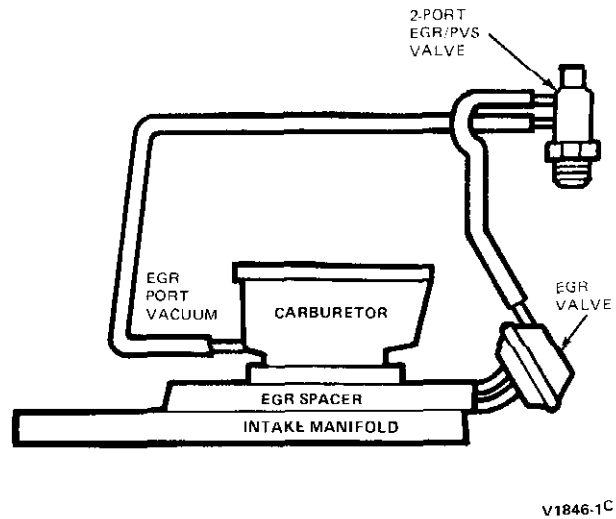


FIG. 8 Typical EGR System With Venturi Vacuum Amplifier

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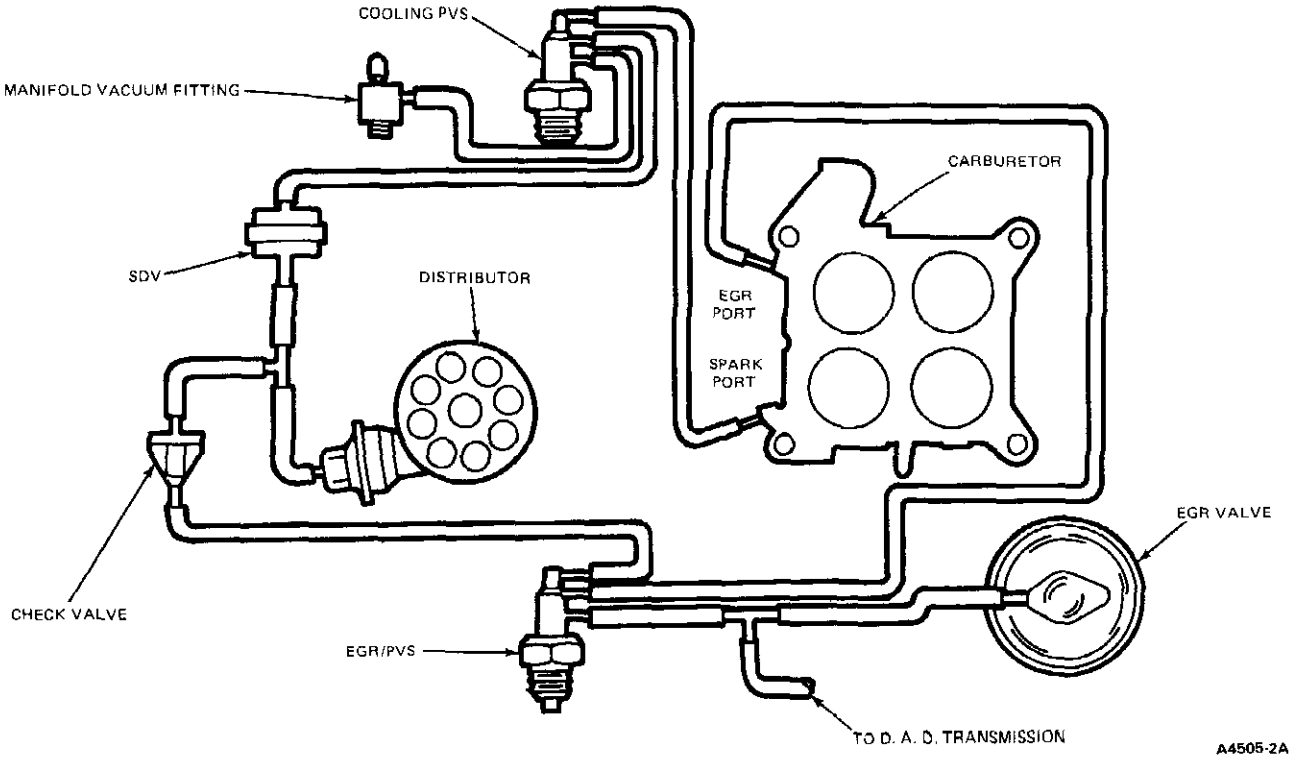


FIG. 9 Exhaust Gas Recirculation and Coolant Spark Control (EGR/CSC) System

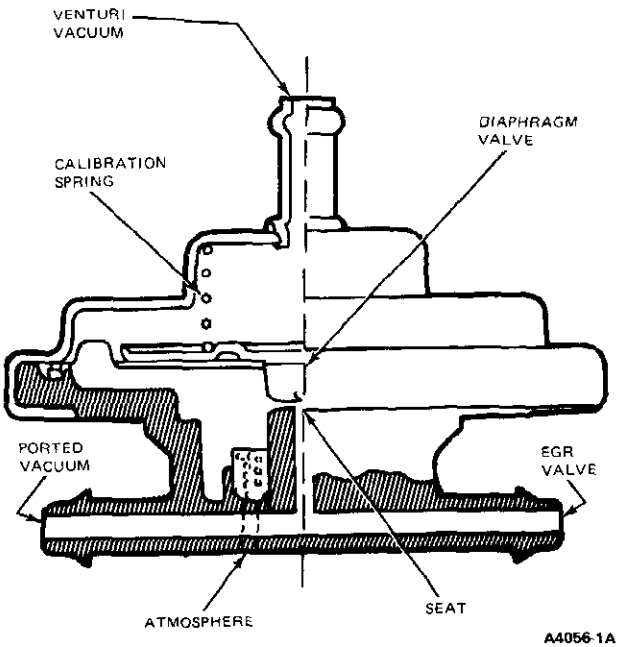


FIG. 10 EGR Load Control (WOT) Valve

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2.3L Feedback Carburetor Electronic Engine Control System

PART 29-08

Pinto and Bobcat with 2.3L I-4 (California Only)

SUBJECT	PAGE
DESCRIPTION	
Cold Temperature Vacuum Switch	08-8
Electronic Control Unit	08-7
Electronically Controlled Feedback Carburetion	08-3
Exhaust Gas Oxygen (EGO) Sensor	08-6
General	08-1
DESCRIPTION (Cont'd.)	
Model 6500 Feedback Carburetor	08-3
Throttle Angle Vacuum Switch	08-8
Vacuum Solenoid/Regulator	08-6
Vacuum Switches	08-7
DIAGNOSIS	08-8

CA4490-2A

DESCRIPTION

General

Pinto and Bobcat vehicles manufactured for sale in California and equipped with the 2.3L I-4 engine are also equipped with a Feedback electronic engine control system. This system consists of three subsystems:

1. Dual Catalytic Converter
2. Thermactor Air Control
3. Electronic Feedback Caburetion

These three subsystems work together to provide improved fuel economy, engine performance and lower exhaust emissions. A detailed explanation of each subsystem is provided here.

Generally, the engine control system works as follows: The Electronic Control Unit (ECU) monitors the composition of the exhaust gases via the Exhaust Gas Oxygen (EGO) and commands modification of carburetor main metering mixture for best exhaust emissions.

Dual Catalytic Converter

The Dual Catalytic Converter consists of two catalytic converters in one shell, with a mixing chamber between the two (Fig. 1).

The cutaway view shows the two separate catalytic converters, each composed of a ceramic "honeycomb" coated with catalytic material. The front converter is coated with a rhodium/platinum catalyst designed to control oxides of nitrogen (NOx), unburned hydrocarbons (HC) and carbon monoxide (CO), and this is therefore called a "Three-Way Catalyst" (TWC). The rear converter is coated with platinum catalyst and is called a "Conventional Oxidation Catalyst" (COC) converter. The platinum catalyst is also sometimes called a "Two Way Catalyst" because it only acts on two of the major pollutants: HC and CO.

The TWC converter operates on the exhaust gases as they arrive from the engine. As the gases flow from the TWC to the COC converter, they mix with air from the Thermactor pump injected into the mixing chamber or "mid bed". This air is required for proper oxidation of HC and CO in the COC converter.

Thermactor Air Control

The efficiency of the dual catalytic converter is heavily dependent upon temperature and the chemical composition of the exhaust gases. To help satisfy these requirements, an air supply system called Thermactor Air Control is provided (Fig. 2). The Thermactor system used with ECU-A is similar in design and operation to the conventional Thermactor system, with the addition of a second air control valve (besides the air bypass valve), and a second exhaust check valve. The Thermactor system used with the 2.3L engine consists of:

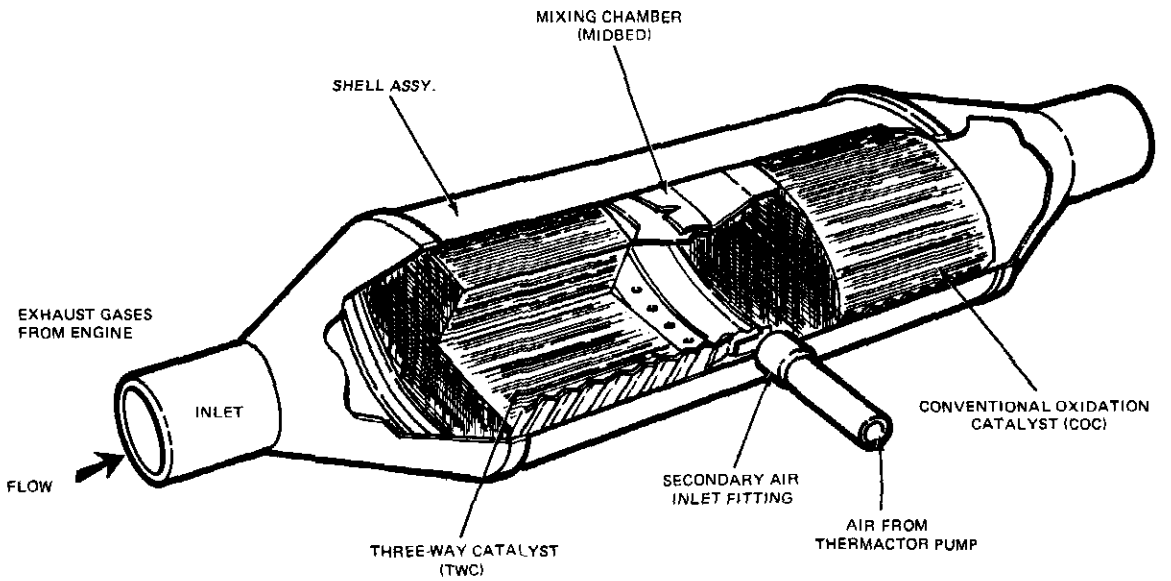
- Thermactor Air Pump
- Air Bypass Valve
- Air Control Valve
- Ported Vacuum Switch (PVS)
- Temperature Vacuum Switch (TVS)
- Two Exhaust Check Valves

With the air bypass valve in normal (non-dump) position, Thermactor air passes to the air control valve. If the Thermactor PVS is operated (coolant temperature above 52°C (125°F), vacuum is cut off from the actuator port on the air control valve and Thermactor air is routed to the dual catalytic converter midbed to assist in operation of the converter (Fig. 2).

During engine warm-up, when the coolant temperature is below 52°C (125°F), the PVS applies vacuum to the actuator port on the air control valve, causing it to operate. Thermactor air is then diverted through the operated air control valve to the engine exhaust manifold, to aid in the removal of excessive amounts of HC and CO produced during warmup (Fig. 3).

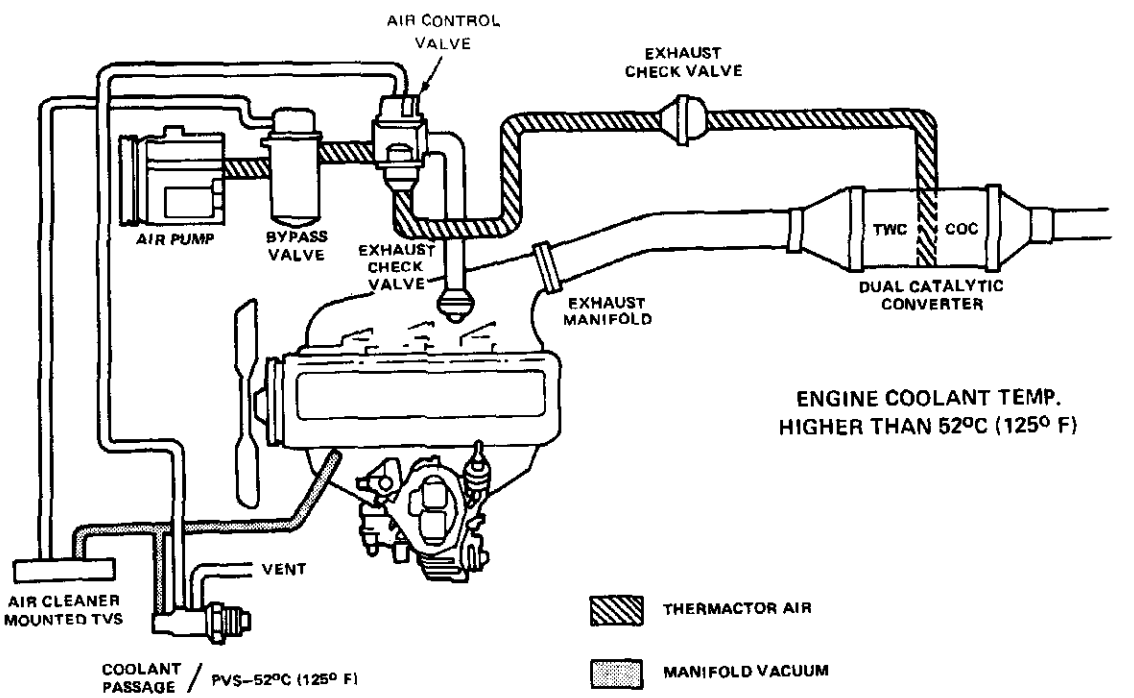
The Thermactor system includes a catalyst protection feature that applies vacuum to the actuator port on the

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A4491-2A

FIG. 1 Dual Catalytic Converter



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FIG. 2 Thermactor System—Coolant Temperature Above 52 degrees C (125 degrees F)

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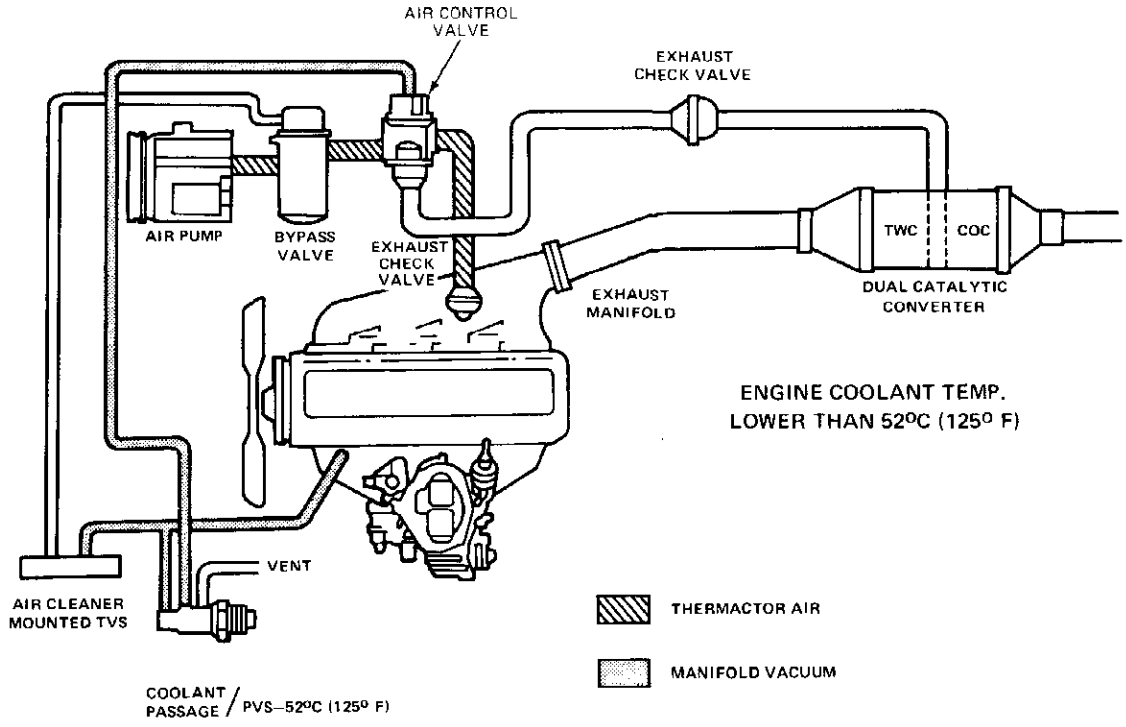


FIG. 3 Thermactor System—Coolant Temperature Below 52 degrees C (125 degrees F)

air bypass valve if the air cleaner mounted TVS is operated by inlet air cooler than 9°C (49°F). This causes the bypass valve to immediately dump thermactor air to the atmosphere rather than to the catalytic converter or exhaust manifold.

Electronically Controlled Feedback Carburetion

The use of a three-way catalyst requires more precise fuel metering for efficient operation than is possible with a conventional carburetor. To provide this metering, the new Model 6500 caburetor is used. This carburetor features external air/fuel ratio control and is an integral part of the feedback system. The electronic engine control system consists of:

- Model 6500 Feedback Carburetor
- Exhaust Gas Oxygen (EGO) Sensor
- Electronic Control Unit (ECU)
- Vacuum Solenoid/Regulator
- Throttle Angle Vacuum Switch
- Cold Temperature Vacuum Switch

In operation, the electronically controlled system has two "modes" of operation that are determined by conditions monitored by the various sensors:

Closed Loop Control - where each component in the system is sensitive to the other components. This means that the carburetor is being controlled by the Vacuum Regulator/Solenoid, which is being controlled by the ECU in relation to a signal from the EGO in the exhaust manifold, which is being influenced by the mixture from the carburetor, and so on. When all the components are thus functioning together, the system is said to be under closed loop control.

Open Loop Control - where the air/fuel mixture is set to a predetermined, nonvarying setting by the ECU, and is not influenced by EGO sensor signals. In this case, such as when coolant temperature is below normal operating range and the catalytic converter is not up to efficient operating temperature, or when the throttle is closed (idle or deceleration), the fuel mixture is under the control of the ECU.

Model 6500 Feedback Carburetor

The Model 6500 Feedback carburetor is basically a Model 5200 carburetor with an externally-variable auxiliary fuel metering system in place of the enrichment valve used on the Model 5200 (Fig. 5). The auxiliary system is operated by vacuum from the vacuum regulator/solenoid under control of the ECU. The Model 6500 also has a switching bowl vent that allows venting of fuel bowl vapors to the vapor canister and fresh air pickup for the vacuum regulator/Solenoid.

In the Model 6500, the fuel enrichment valve found in the model 5200 is replaced by a metering valve assembly and a metering valve, operating piston and diaphragm assembly (Fig. 6).

The feedback metering valve supplements fuel entering the main well through the conventional main metering jet and channel. The amount of fuel entering the main well through the metering valve depends on the position of the tapered metering rod in its orifice. The position of the metering rod depends on the metering rod operating piston assembly.

Control vacuum from the vacuum regulator solenoid is channeled to the cavity above the metering rod diaphragm (Fig. 6). With no vacuum present, the valve

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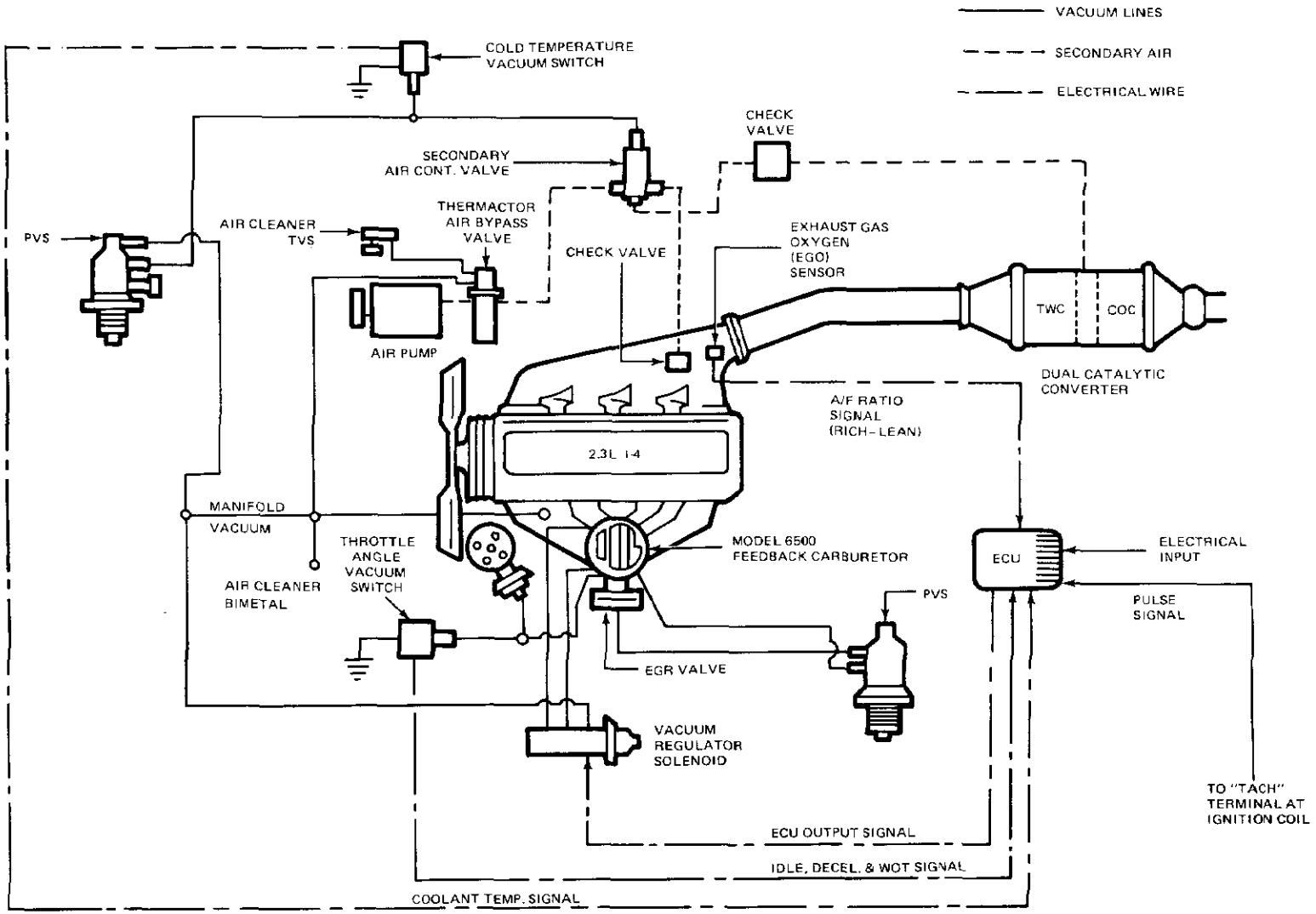


FIG. 4 2.3L Feedback Caburetor Electronic Engine Control System Schematic

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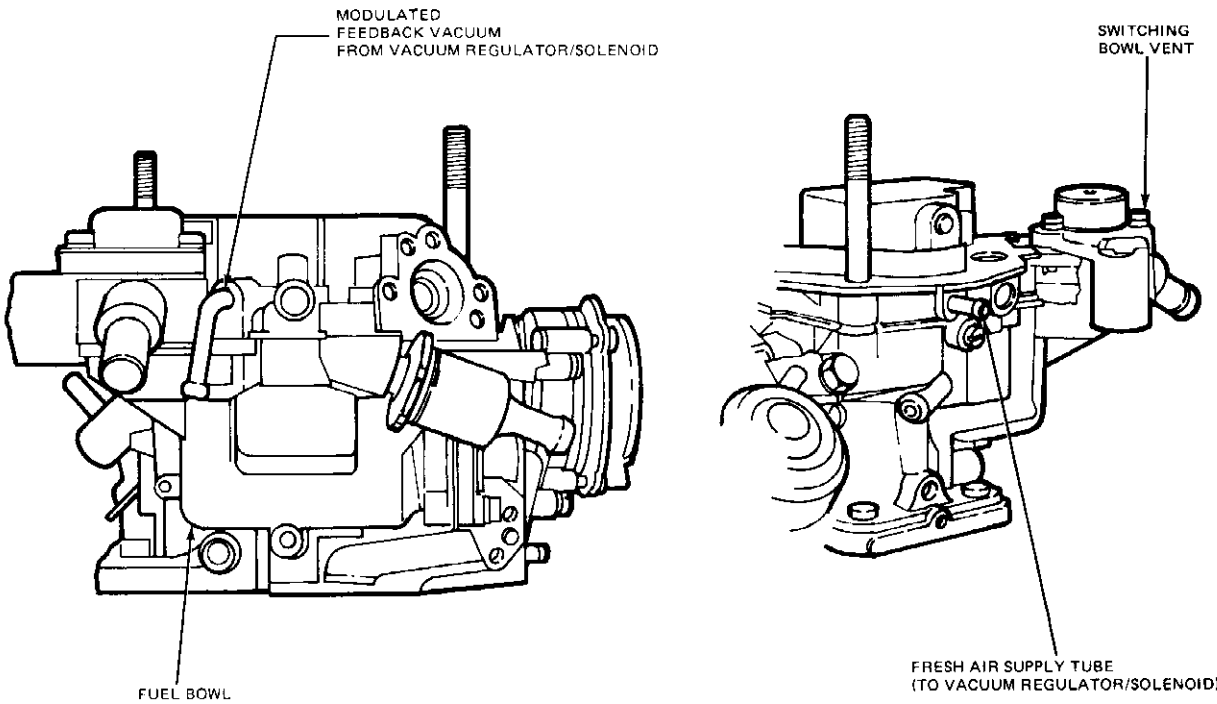


FIG. 5 Model 6500 Carburetor—External

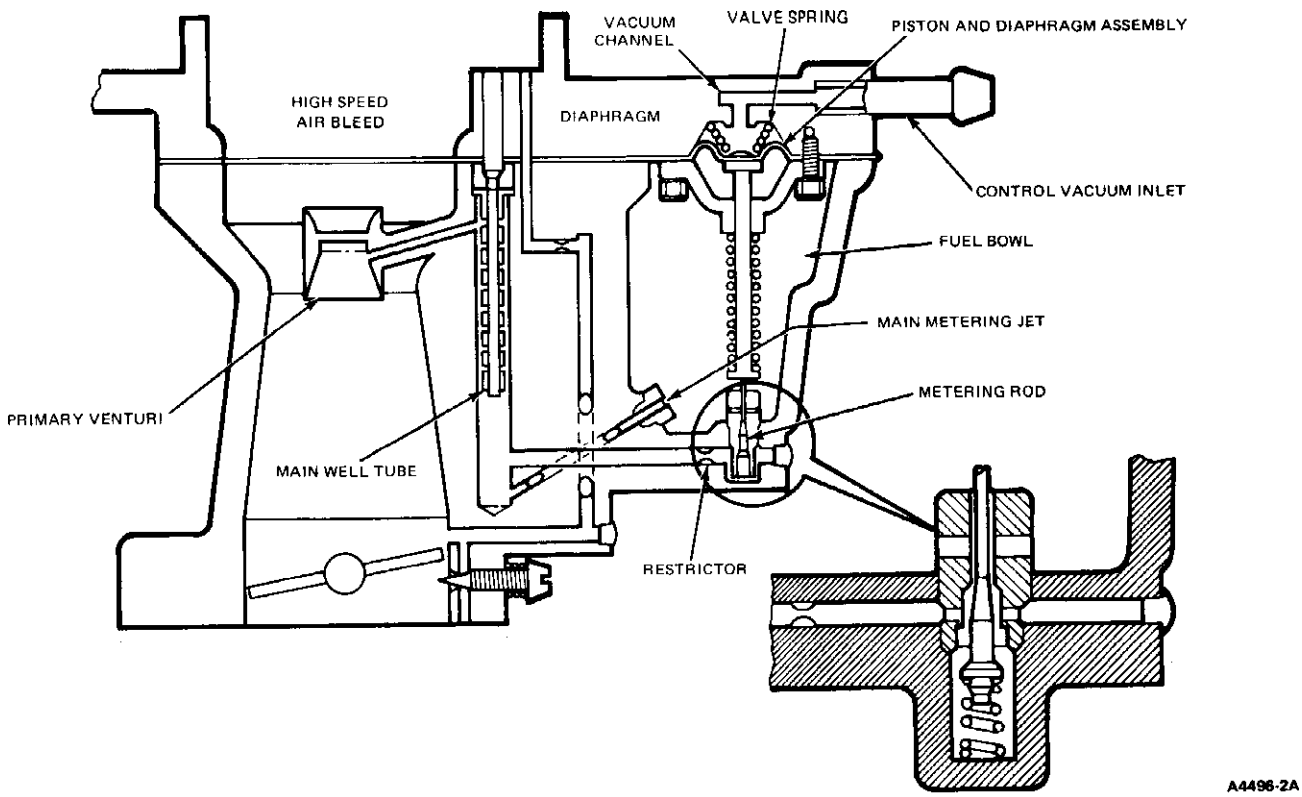


FIG. 6 Fuel Metering

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spring causes the valve to move to its lowest (richest) position, where maximum fuel can pass through the orifice. As vacuum is applied to the diaphragm, spring pressure is overcome and the metering rod rises, reducing the orifice area and permitting less fuel to pass. The metering valve is calibrated so that the maximum vacuum signal supplied by the vacuum regulator/solenoid (5 inches Hg) raises the rod to its highest (leanest) position.

In the open loop mode, a constant vacuum of 2-1/2" Hg is applied to the feedback valve diaphragm, holding the metering rod at its mid-position. In closed loop operation, the vacuum signal varies from 0 to 5" Hg, producing a richer or leaner mixture in response to commands from the ECU.

During wide open throttle (WOT) acceleration, manifold vacuum drops, resulting in little or no output vacuum signal. The feedback metering valve moves to its lowest (richest) position, providing a richer air/fuel mixture in conjuction with the main metering system and thus the correct mixture for good engine performance.

The Model 6500 Feedback Carburetor differs from the Model 5200 in one other major feature: it has an internal choke pulldown diaphragm vacuum supply rather than the new external vacuum connection used on the Model 5200. Adjustment of choke pulldown is thus similar to that used on the 1977 Model 5200 carburetor.

Vacuum Solenoid/Regulator

The component that supplies the vacuum signal to the carburetor feedback valve is the vacuum solenoid/regulator (Fig. 7).

The vacuum solenoid and regulator are enclosed in a single housing, with two input ports, one output port and an electrical connection for the solenoid. In operation, the solenoid turns the assembly on and off, while the vacuum regulator controls the amount of vacuum applied to the lower chamber at a constant 5" Hg. The vent input port is open to the atmosphere, so the upper chamber is always at atmospheric pressure.

The solenoid is shown in Fig. 7 in the de-energized position, with the armature held in the lower seat by the armature return spring. In this position, the vacuum in the lower chamber is cut off from the output port and atmospheric pressure from the vent port is connected to the output through the passage shown near the top of the armature.

When current is applied to the solenoid coil, the armature moves upward until it rests on its upper seat (Fig. 7). This blocks the atmospheric pressure passage and opens the vacuum passage to the output port. The output vacuum will now reach a constant 5" Hg. When current is removed from the coil, the armature moves downward until it seats against its lower seat. This opens the atmospheric pressure passage and closes the vacuum passage, causing the output vacuum to drop to zero.

In operation, the armatures actually cycles up and down at a rate of 10 times each second, according to the signal received from the ECU. The output vacuum is an average value, related to the length of time the armature spends in each position. (If the solenoid is energized half the time, the average reading would be 1/2 of 5" Hg, or 2-1/2" Hg.)

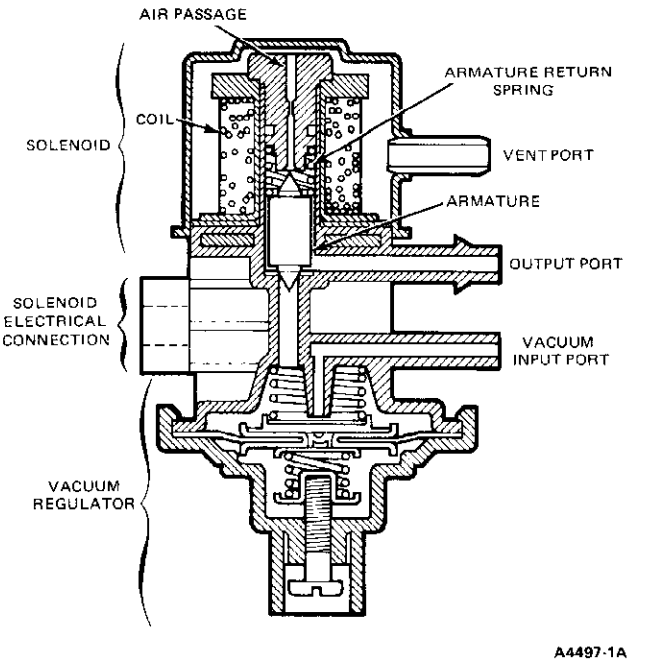


FIG. 7 Vacuum Solenoid/Regulator

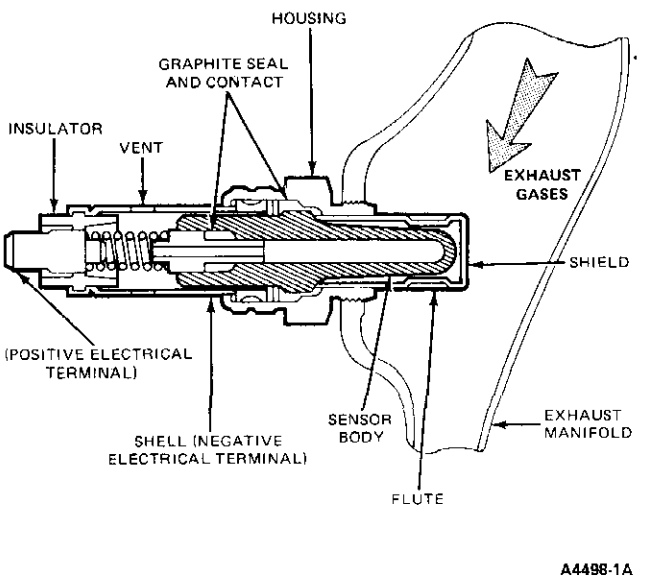


FIG. 8 Exhaust Gas Oxygen (EGO) Sensor

Exhaust Gas Oxygen (EGO) Sensor

The Exhaust Gas Oxygen (EGO) sensor is threaded into the exhaust manifold, and provides information to the ECU regarding the oxygen content of the exhaust gas (Fig. 8).

The outer surface of the sensor is composed of a threaded steel housing and shell, and the sensor body is protected by a shield pressed into the housing where it projects into the exahust manifold (Fig. 8). Exhaust gases contact the sensor body by entering through

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flutes in the sensor shield. A vent is provided in the shell to allow atmospheric air to enter the inner portion of the sensor body. The sensor connects to the vehicle wiring harness with a connector that contacts the inner (positive) terminal. The shell is the (negative) terminal of the sensor, and provides the signal return path via the engine block.

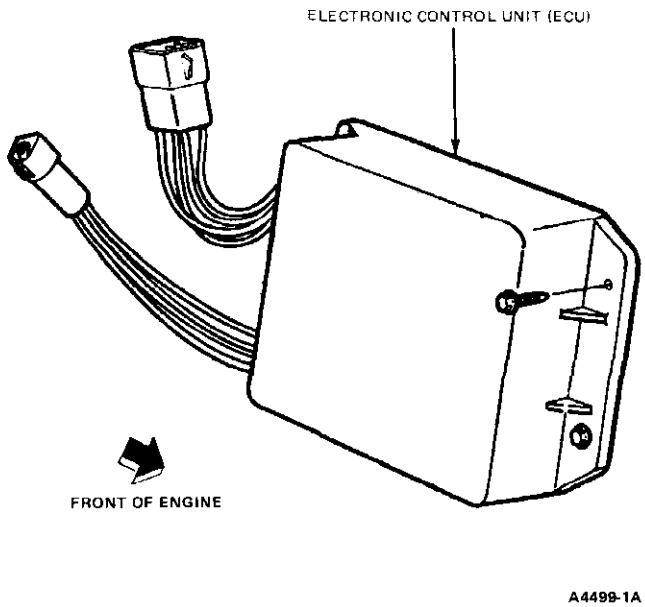


FIG. 9 Electronic Control Unit (ECU)

The EGO sensor monitors the air/fuel ratio and generates an output of 0.6 to 1.0 volts when surrounded by a rich exhaust gas mixture (absence of oxygen) and less than 0.2 volts when surrounded by a lean mixture (presence of oxygen). This constantly changing voltage signal is sent to the ECU for analysis.

Electronic Control Unit

The Electronic Control Unit (ECU) used in this system is similar to the ignition module in appearance and size, but has noticeably different connectors to prevent wrong connections (Fig. 9).

The ECU is the "brain" of the system, and is the central component of the control "loop". The ECU continuously monitors the signals from the exhaust gas oxygen sensor, throttle angle vacuum switch and cold temperature vacuum switch, analyzes them, and sends out commands to the vacuum solenoid/regulator, which in turn supplies the vacuum signal to adjust the fuel metering rod in the carburetor to obtain the proper air/fuel ratio required for optimum operation of the catalytic converter. The ECU also contains circuitry *that—based on engine rpm—varies the time required* for the carburetor to adjust from rich to lean or lean to rich. The engine rpm signal is taken from the TACH terminal of the ignition coil connector (See Part 23-01).

Vacuum Switches

The throttle angle and cold temperature vacuum switches share a mounting bracket on the left fender apron (Fig. 10). Depending on engine load (throttle angle vacuum switch) or coolant temperature (cold temperature vacuum switch), these switches signal the

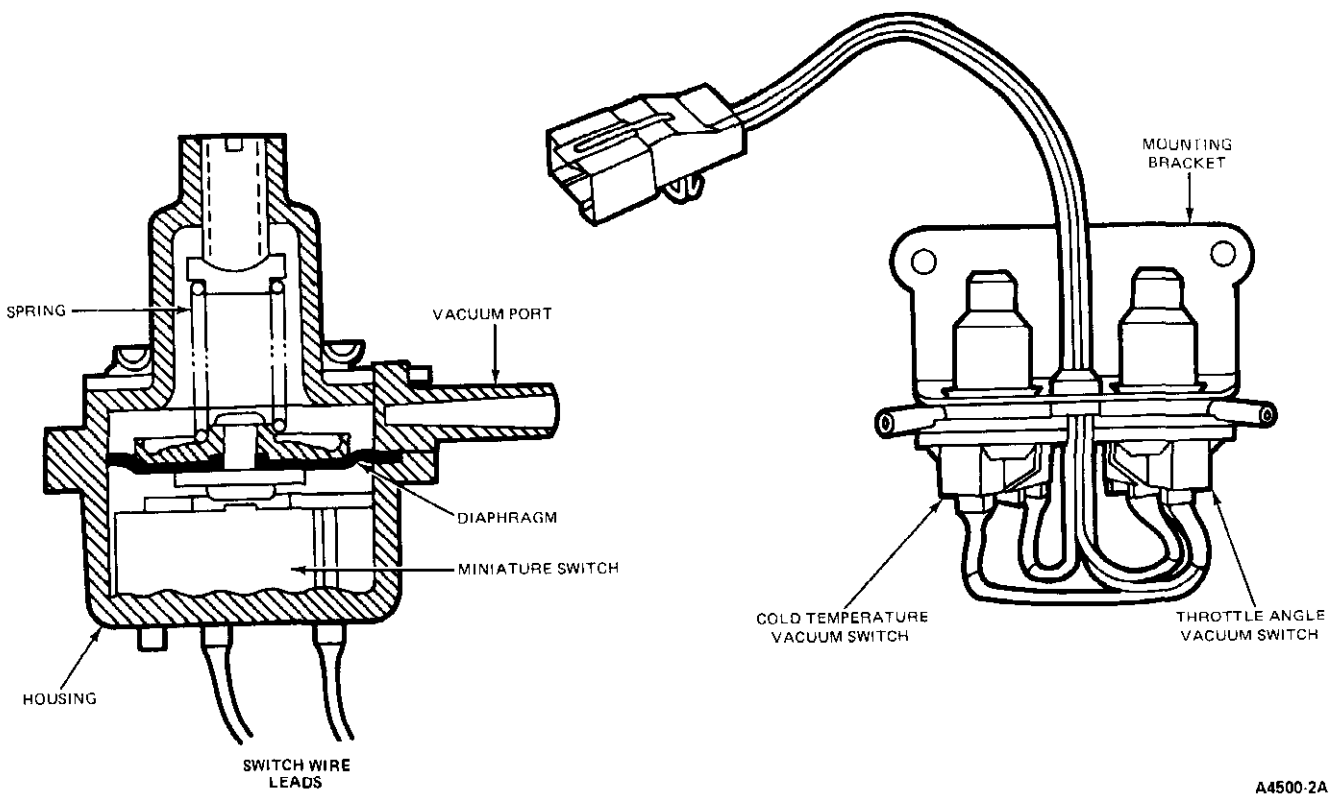


FIG. 10 Vacuum Switches

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ECU when to change from "open loop" to "closed loop" operation.

Throttle Angle Vacuum Switch

The throttle angle vacuum switch is a vacuum actuated electrical switch with noramlly closed contacts (Fig. 10). This vacuum switch is connected to vacuum at the carburetor spark port. When a vacuum of 3" Hg or more is applied to the vacuum port, the electrical contacts open.

During closed throttle operation (idle and deceleration), no spark port vacuum is available and the switch contacts are closed, sending a signal to the ECU to operate in "open loop" mode. In this mode, the ECU ignores the EGO sensor signal and commands the feedback fuel metering rod to mid-position. During part throttle operation (acceleration or cruise), spark port vacuum causes the switch contacts to open, signalling the ECU to operate in "closed loop" mode. In this mode, there is full feedback control, and the ECU adjusts the air/fuel ratio in response to EGO sensor signals.

Cold Temperature Vacuum Switch

The cold temperature vacuum switch is a normally open contact vacuum switch, mounted on the same bracket with the throttle angle vacuum switch (Fig. 10). The vacuum switch is connected to the 3-way PVS, which supplies vacuum to the switch when engine coolant is below 52°C (125°F), operating the switch and closing the contacts. This signals the ECU to operate in the "open loop" mode. As the temperature rises above 52°C(125°F), the coolant PVS switches, cutting off vacuum from the cold temperature vacuum switch and signalling the ECU to go into the "closed loop" mode.

DIAGNOSIS

Complete diagnosis and testing of the ECU-A system is contained in Part 29-02 of this Manual. Because of the sophisticated nature of the ECU-A system, two special diagnostic aids are required for diagnosis:

1. **Feedback Control Tester T78L-50-FBC** - Connects into the electronic control unit (ECU) and the system harness, which provides access to the ECU input and output signals. The tester also contains plugs for continuity test and Digital Volt/Ohmmeter connection.
2. **Digital Volt/Ohmmeter (DVOM) T78L-50-DVOM** - Plugs into the Feedback Control Tester and provides technician with precision data necessary to diagnose ECU-A system. Unit may also be used for other electrical system diagnosis.

In addition to these two special testers, a tachometer, vacuum gauge, throttle rpm tool and hand vacuum pump/tester are required for proper diagnosis.

NOTE: The Feedback Control Tester (T78L-50-FBC) and Digital Volt/Ohmmeter (DVOM) (T78L-50-DVOM) are available from Owatonna Tool Company; Owatonna, Minnesota; Attention Ford Order Desk.

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