GMC
TRUCK

1990
LIGHT TRUCK
UNIT REPAIR MANUAL

FOREWORD

This manual includes procedures involved in disassembly and assembly of components listed in the "Table of Contents."

This manual should be kept in a handy place for ready reference. If properly used, it will meet the needs of technicians and vehicle owners.

CAUTION:

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same location whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.

GMC TRUCK OPERATION
TRUCK & BUS GROUP
General Motors Corporation
Pontiac, Michigan

CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed.

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various *Cautions* and *Notices* that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

1990

UNIT REPAIR MANUAL

COVERING LIGHT DUTY TRUCKS

The Table of Contents on this page indicates the sections covered in this manual. At the beginning of each individual section is a Table of Contents which gives the page number on which each major subject begins.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations, and specifications contained in this Manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

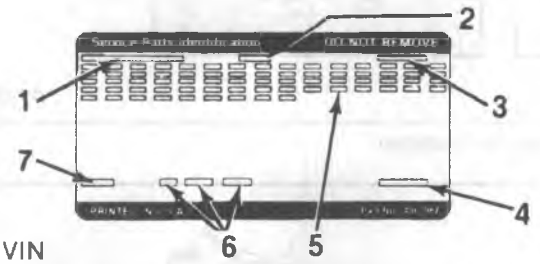
X-9037

TABLE OF CONTENTS

SECTION 0A

GENERAL INFORMATION

CONTENTS



1. VIN
2. Wheel Base
3. Model Number
4. Order Number
5. RPO/SEO Codes
6. Exterior Color WA Numbers
7. Paint System

F5402

Figure 1—Service Parts Identification Label

1. Typical VIN

F7557

Figure 2—VIN Location

SERVICE PARTS IDENTIFICATION LABEL

The Truck Service Parts Identification Label is provided on all models (figure 1). It is located on the inside of the glove box door (or on an inner body panel for Forward Control models). The Label lists the VIN (Vehicle Identification Number), wheelbase, paint information and all Production options or Special Equipment on the vehicle when it was shipped from the factory. ALWAYS REFER TO THIS INFORMATION WHEN ORDERING PARTS.

VEHICLE IDENTIFICATION NUMBER

The VIN is the legal identifier of the vehicle. On all models except Forward Control, it is located on a plate which is attached to the left top of the instrument panel and can be seen through the windshield from the outside of the vehicle (figure 2). On Forward Control models, the plate is on the dash and toe panel. To find out the manufacturer, model and chassis type, engine type, GVW range, model year, plant code, and sequential number, refer to figure 3.

CERTIFICATION LABEL

The Certification Label shows the GVWR, and the front and rear GAWRs, and the Payload Rating for your vehicle (figure 4).

Gross Vehicle Weight (GVW) is the weight of the orginally equipped vehicle and all items added to it after it has left the factory. This would include bodies, winches, booms, etc.; the driver and all occupants; and the load the vehicle is carrying. The GVW must not exceed the GVWR. Also, the front and rear gross axle weights must not exceed the front and rear GAWRs.

The Payload Rating shown on the label is the maximum allowable cargo load (including the weight of the

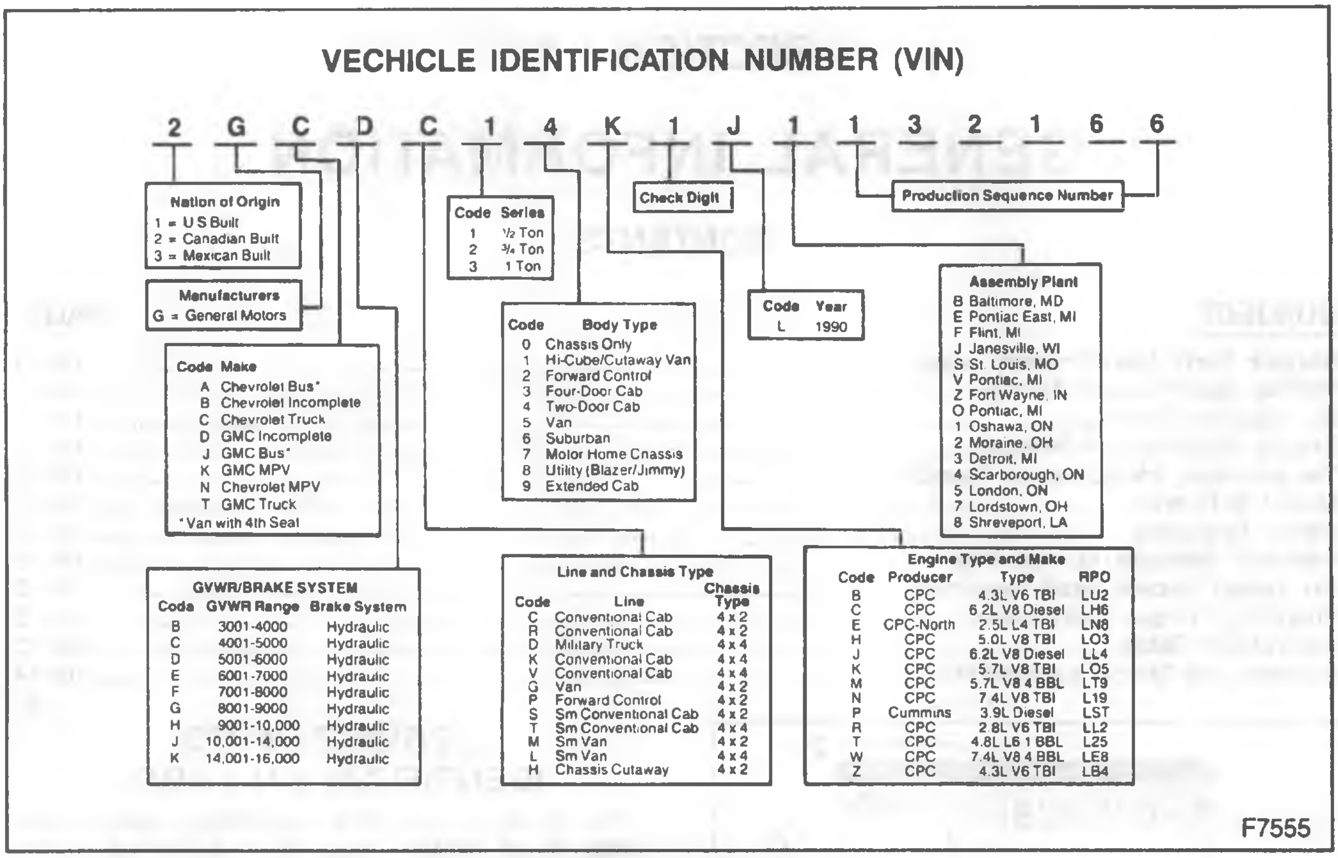


Figure 3—Vehicle Identification Number

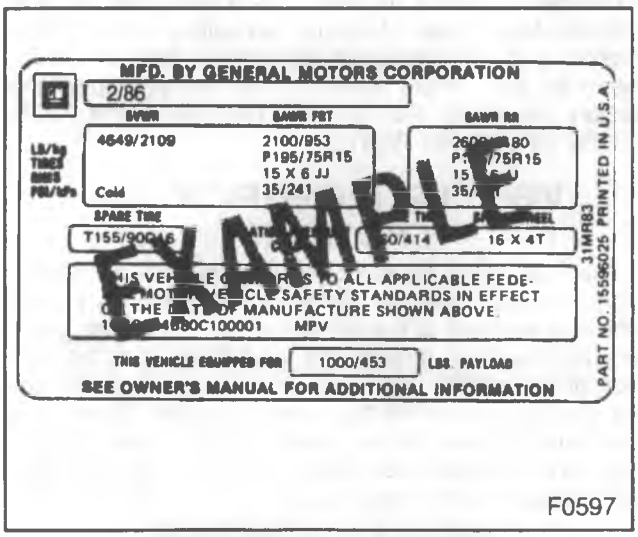


Figure 4—Certification Label

driver and all occupants) that the vehicle can carry based on all factory installed equipment on the vehicle. The Payload Rating is reduced if any accessories or other equipment is added to the vehicle after final date of manufacture. The weight of these items should be determined and deducted from the Payload Rating.

The vehicle may also have a GCWR (Gross Combination Weight Rating). The GCW (Gross Combination Weight) is the total weight of the loaded tow vehicle (including passengers) and a loaded trailer.

The tires on the vehicle must be the proper size and properly inflated for the load which you are carrying.

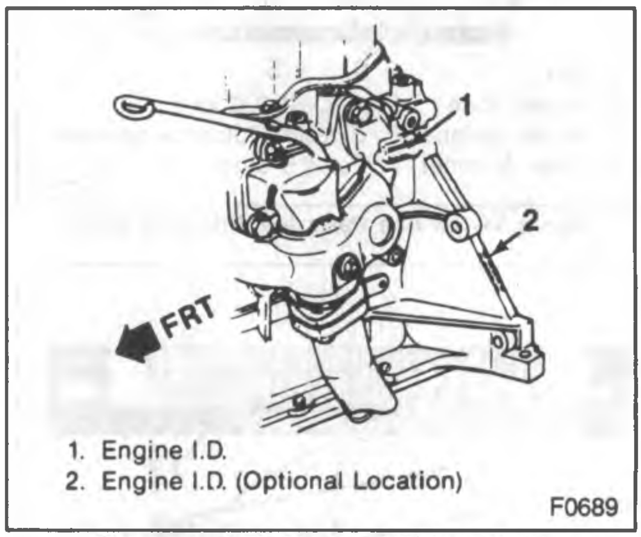


Figure 5—2.5L Engine I.D. Locations

The vehicle Certification Label shows the originally equipped tire size and recommended inflation pressures.

ENGINE IDENTIFICATION NUMBER

Refer to figures 5, 6, 7, 8 and 9 to determine the location of the engine I.D. number.

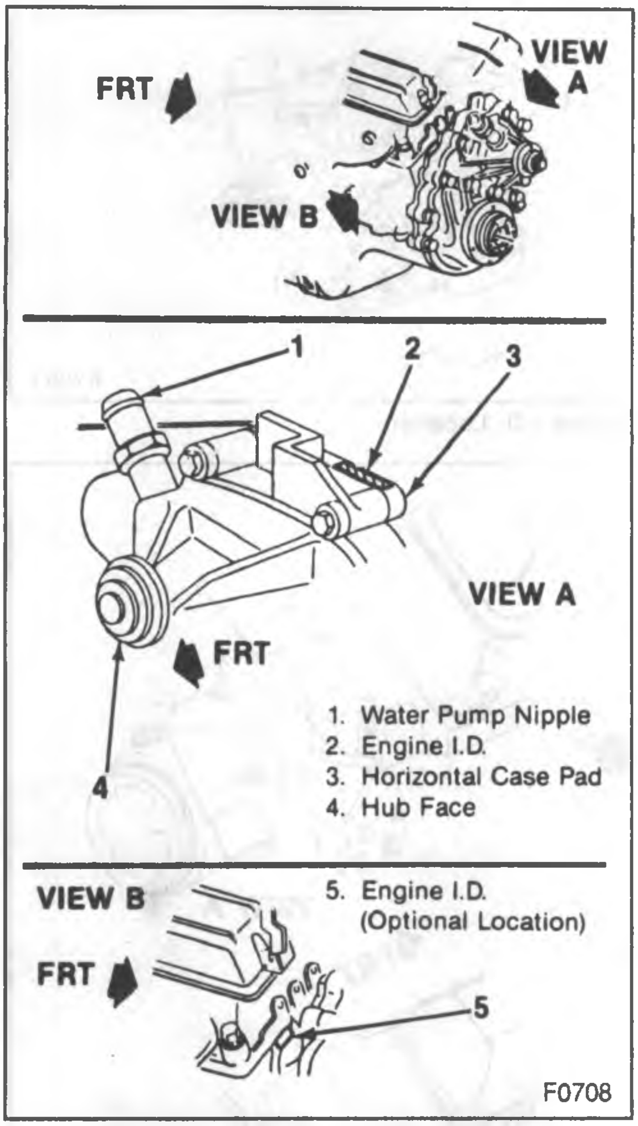


Figure 6—2.8L Engine I.D. Location

TRANSMISSION IDENTIFICATION NUMBER

Refer to figures 10 through 13 for determining transmission identification numbers and code meanings.

MODEL REFERENCE

Refer to figures 14 through 19 for determining vehicle model. C, R, and S models are two wheel drive. K, V,and T models are four wheel drive.

METRIC FASTENERS

The vehicle models are primarily dimensioned in the metric system. Many fasteners are metric and are very close in dimension to well-known customary fasteners in the inch system. It is most important that replacement fasteners be of the correct nominal diameter, thread pitch and strength.

Original equipment metric fasteners (except "beauty" bolts, such as exposed bumper bolts, and cross recess head screws) are identified by a number marking indicating the strength of the material in the fastener as outlined later. Metric cross recess screws are identified by a Posidriv or Type 1A shown in figure 20. Either a Phillips head or Type 1A cross recess screwdriver can be used in Posidriv recess screw heads, but Type 1A cross recess screwdrivers will perform better.

NOTICE: Most metric fasteners have a blue color coating. However, this should not be used as positive identification as some fasteners are not color coated.

General Motors Engineering Standards, along with other North American Industries, have adopted a portion of the standard metric fastener sizes defined by ISO (International Standards Organization). This was done to reduce the number of fastener sizes used and yet retain the best strength qualities in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.X1 screw which has nearly the same diameter and has 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

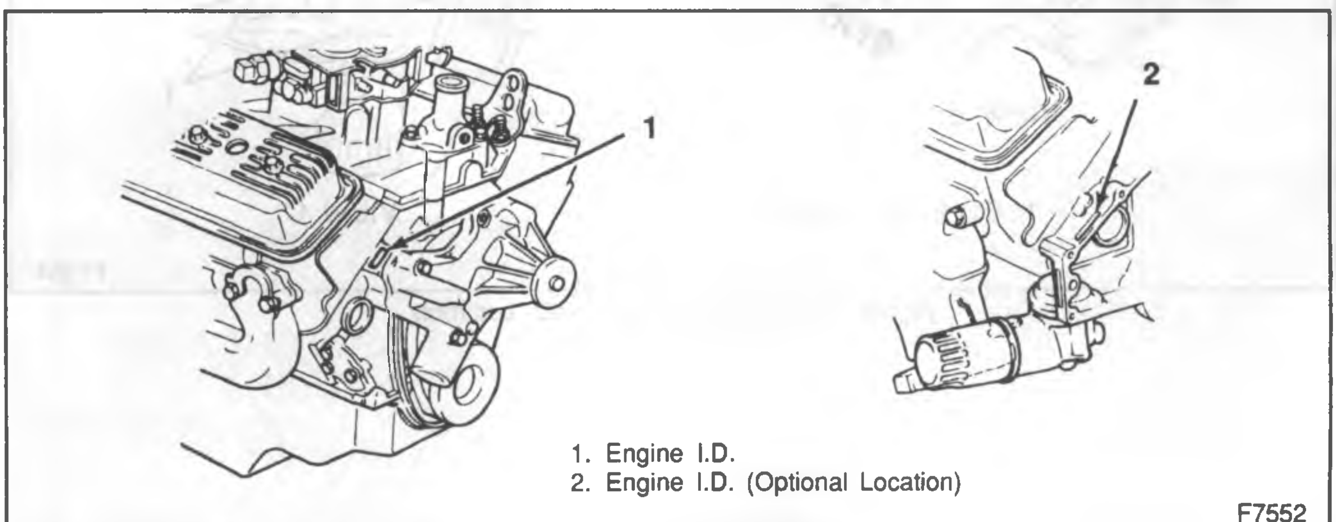


Figure 7—4.3L Engine I.D. Location

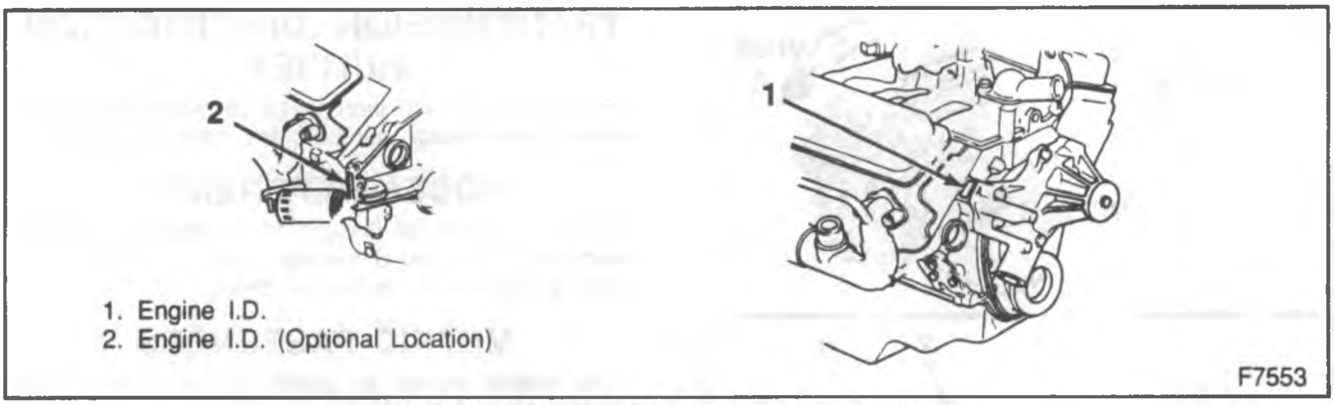


Figure 8—5.0L, 5.7L, 7.4L Engine I.D. Location

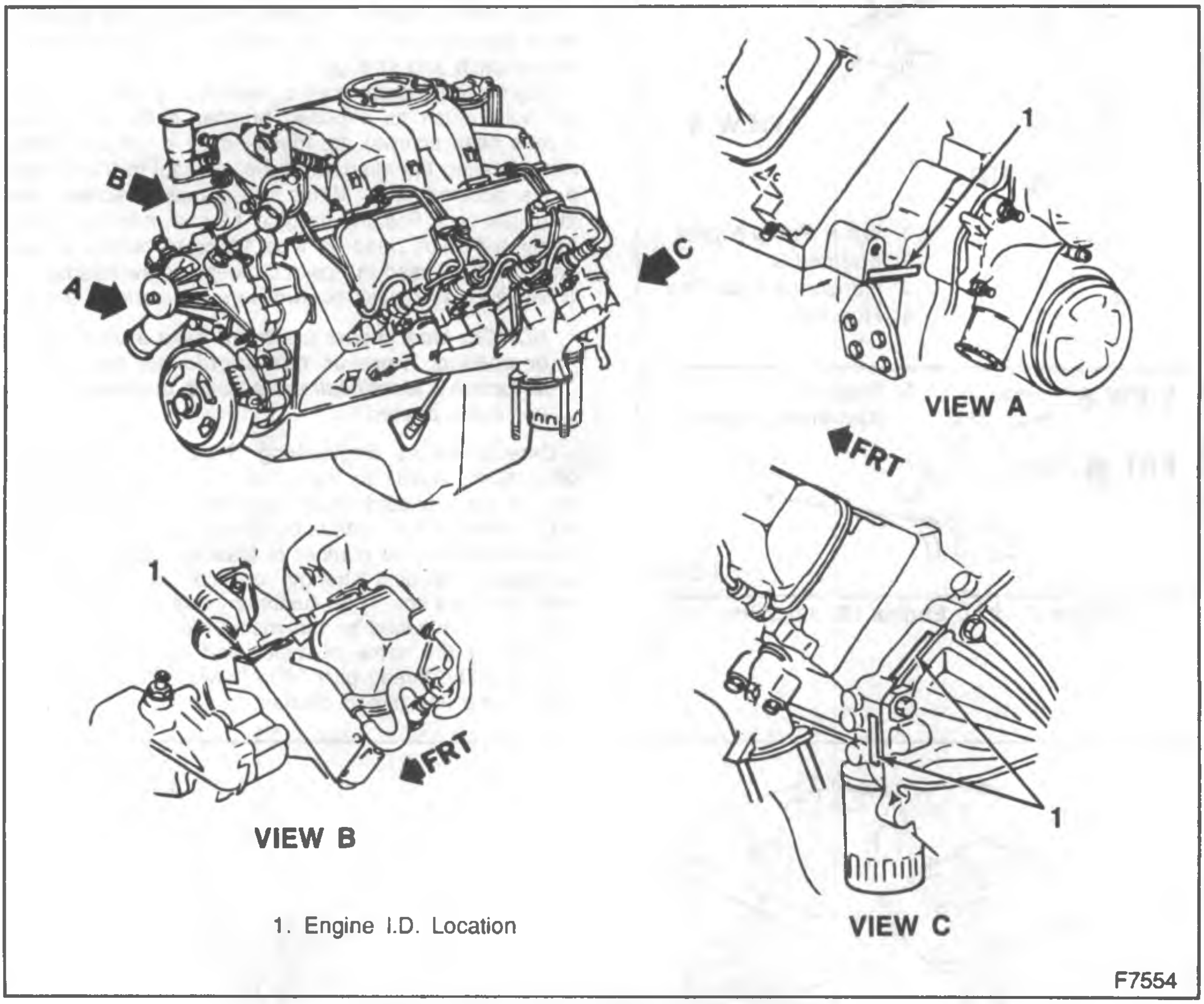
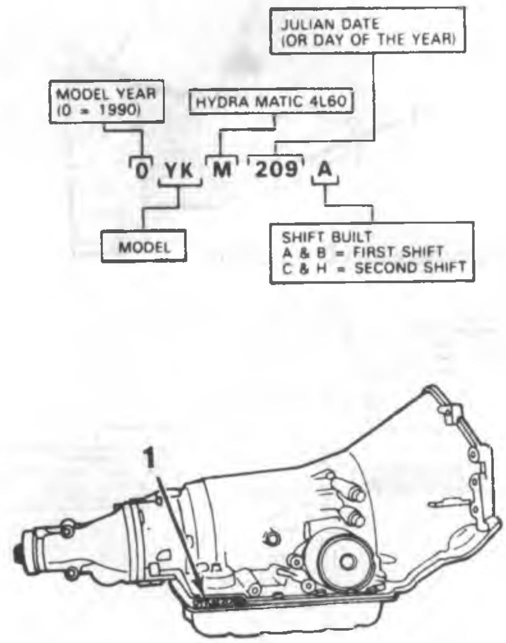


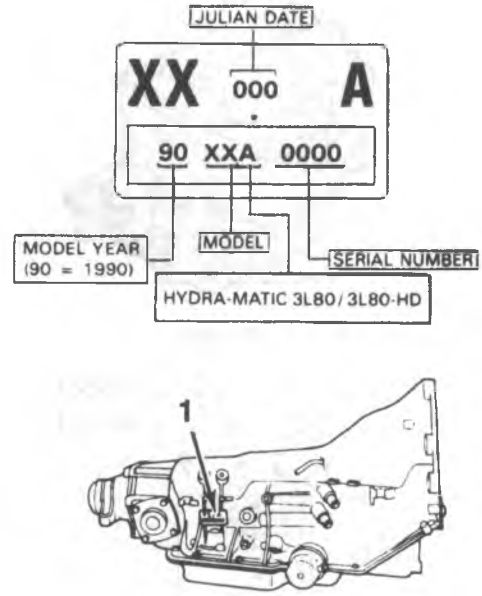
Figure 9—6.2L Diesel Engine I.D. Location



1. Transmission I.D. Location

F7572

Figure 10—Hydra-matic THM-700R4 (4L60) Transmission I.D. Location



1. Transmission I.D. Location

F7573

Figure 11—Hydra-matic THM-180C (3L80/3I80-HD) Transmission I.D. Location

Metric and customary thread notation differ slightly. The difference is shown in figure 21.

FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength properly classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with radial line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed radial lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. Figure 20 shows the different strength markings.

When replacing metric fasteners, be careful to use bolts and nuts of the same strength or greater than the original fasteners (the same number marking or higher). It is likewise important to select replacement fasteners of the correct size. Correct replacement bolts metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States, and may be of a lower strength, may not have the numbered head marking system, and may be of a different thread pitch. The metric fasteners used on GM products are designed to new, international standards that may not yet be manufactured by some non-domestic bolt and nut suppliers. In general, except for special applications, the common sizes and pitches are:

M6 x 1
M8 x 1.25
M10 x 1.5
M12 x 1.75

SIX LOBED SOCKET HEAD FASTENERS

Six lobed socket head (Torx) fasteners are used in some applications on vehicles covered in this manual (figure 22). The door striker bolt is of this design.

Tools designed for these fasteners are available commercially. However, in some cases, if the correct tool is not available, a hex socket head wrench may be used.

PREVAILING TORQUE FASTENERS

A prevailing torque nut is designed to develop an interference between the nut and bolt threads. This is most often accomplished by distortion of the top of an all-metal nut by using a nylon patch on the threads in the middle of the hex flat. A nylon insert may also be used as a method of interference between nut and bolt threads (figure 23).

A prevailing torque bolt is designed to develop an interference between bolt and nut threads, or the

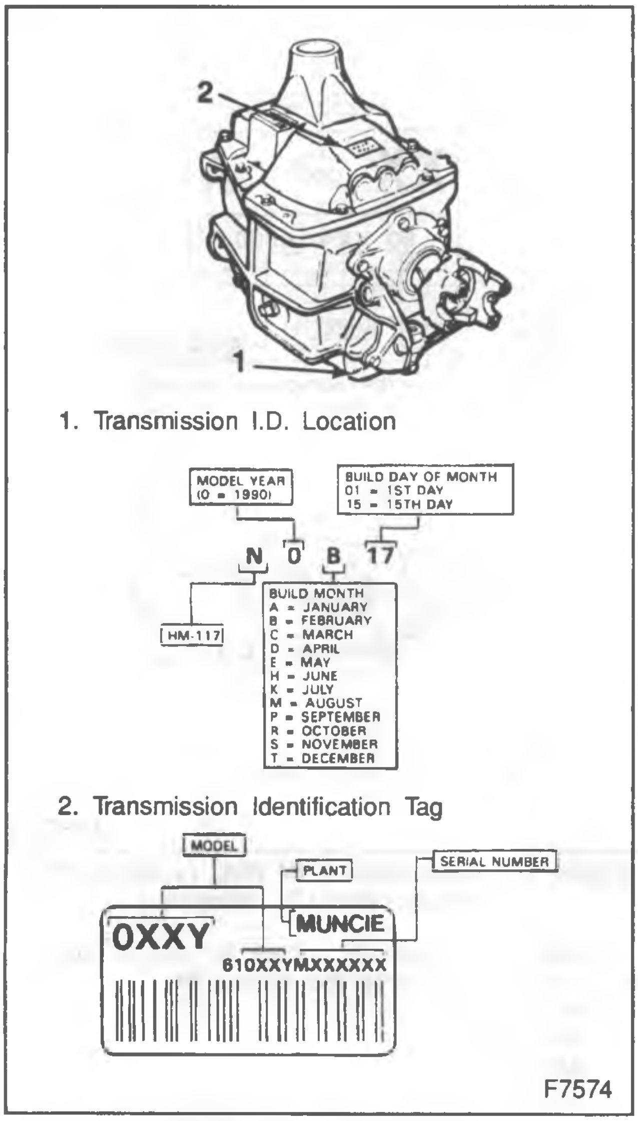


Figure 12—Hydra-matic HM-117 Transmission I.D. Location

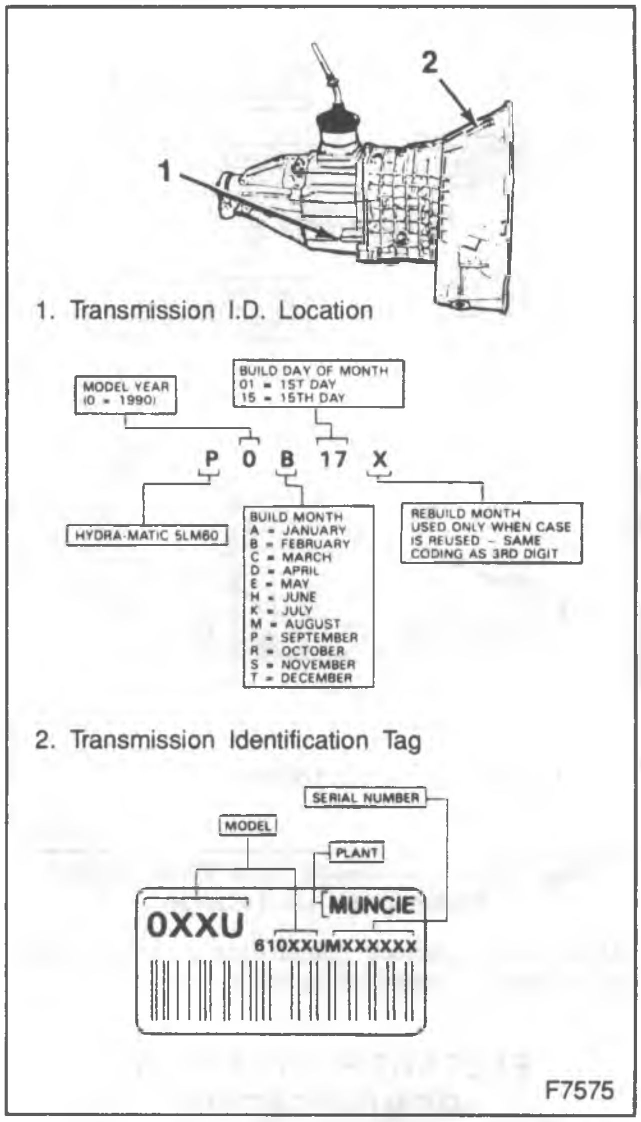


Figure 13—Hydra-matic HM-290 (5LM60) Transmission I.D. Location

threads of a tapped hole. This is accomplished by distorting some of the threads or by using a nylon patch or adhesive (figure 23).

RECOMMENDATIONS FOR REUSE:

1. Clean, unrusted prevailing torque nuts and bolts may be reused as follows:
   a. Clean dirt and other foreign material off the nut or bolt.
   b. Inspect the nut or bolt to insure there are no cracks, elongation, or other signs of abuse of overtightening. (If there is any doubt, replace with a new prevailing torque fastener or equal or greater strength.)
   c. Assemble the parts and hand start the nut or bolt.
   d. Observe that, before fastener seats, it develops torque per the chart in figure 23 (if there is any doubt, replace with a new prevailing torque fastener of equal or greater strength).
   e. Tighten the fastener to the torque specified in the appropriate section of this manual.
2. Bolts and nuts which are rusty or damaged should be replaced with new parts of equal or greater strength.

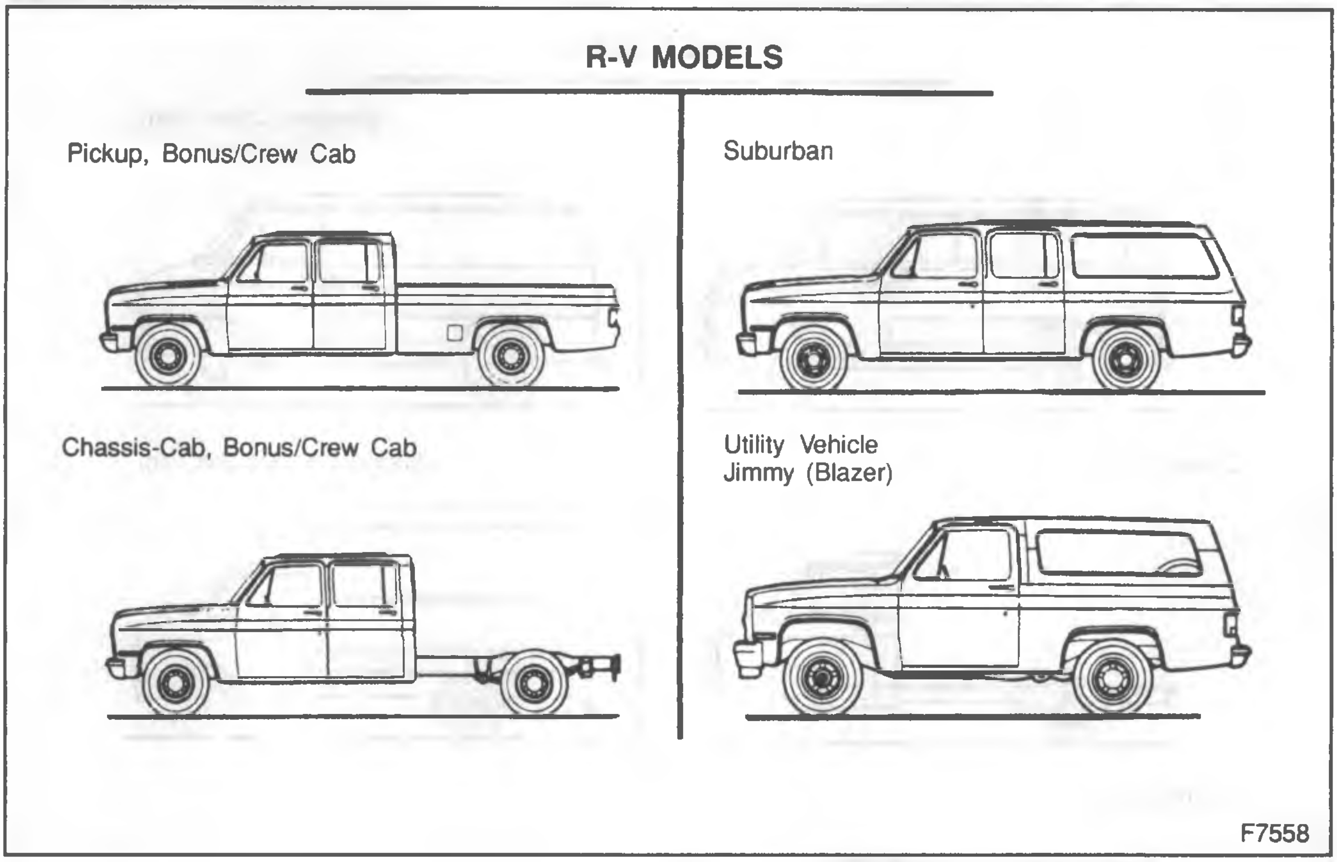


Figure 14—RV Models

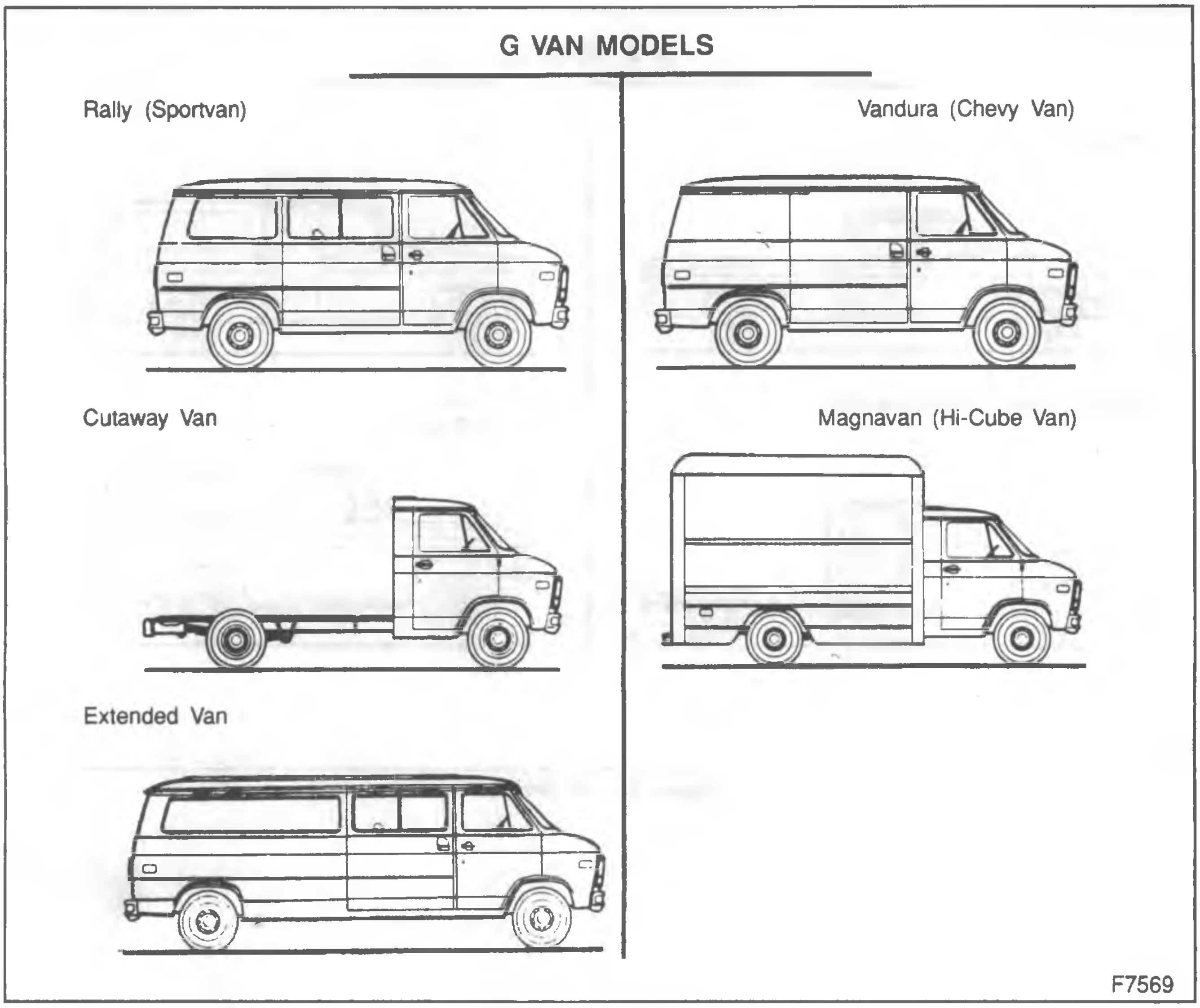


Figure 15—G Models

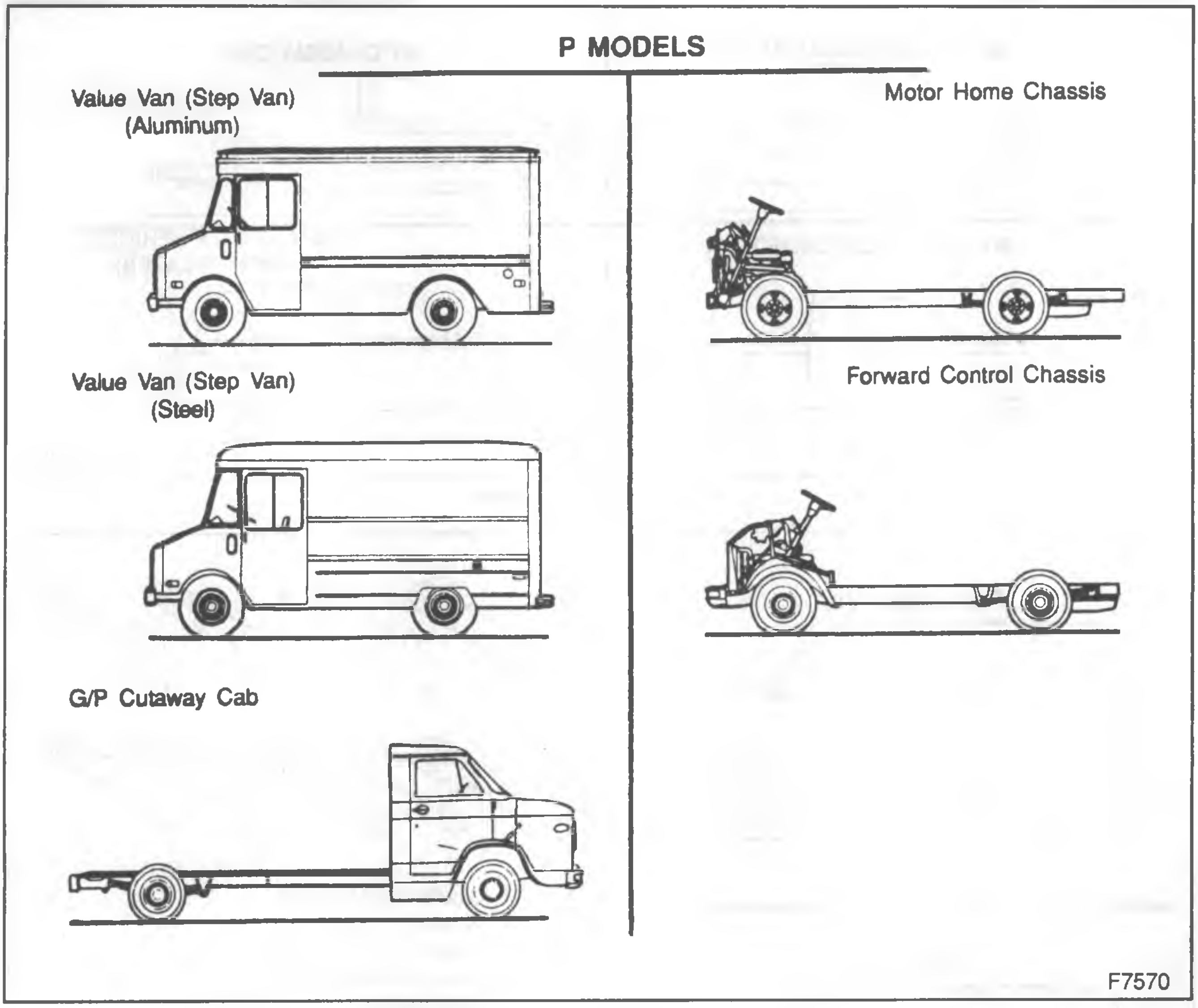


Figure 16—P Models

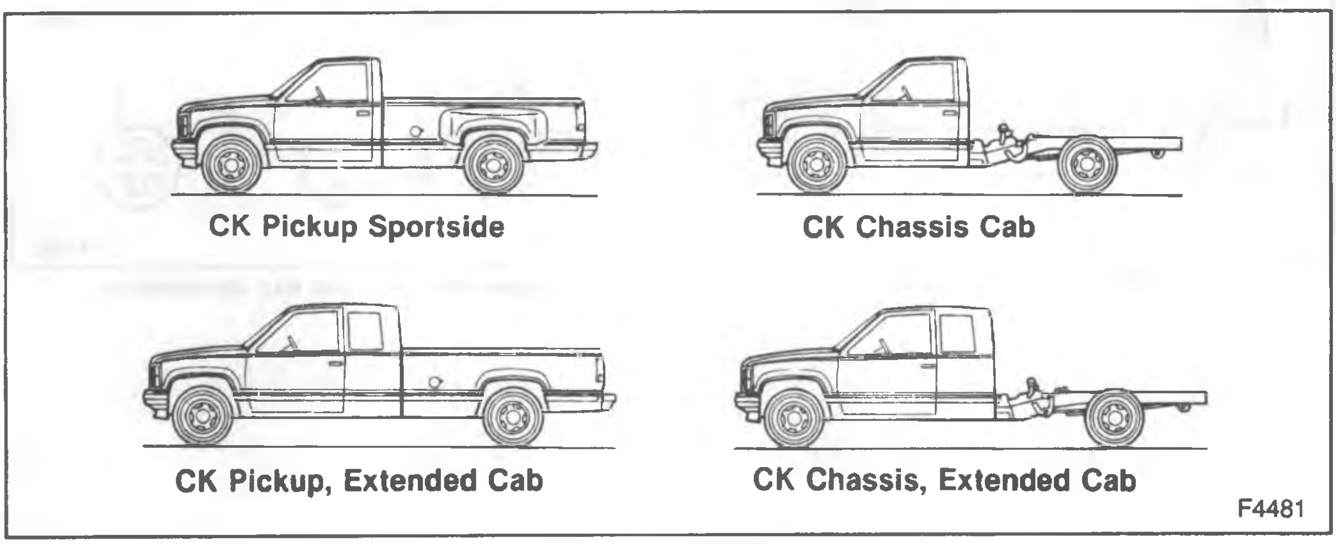


Figure 17—CK Models

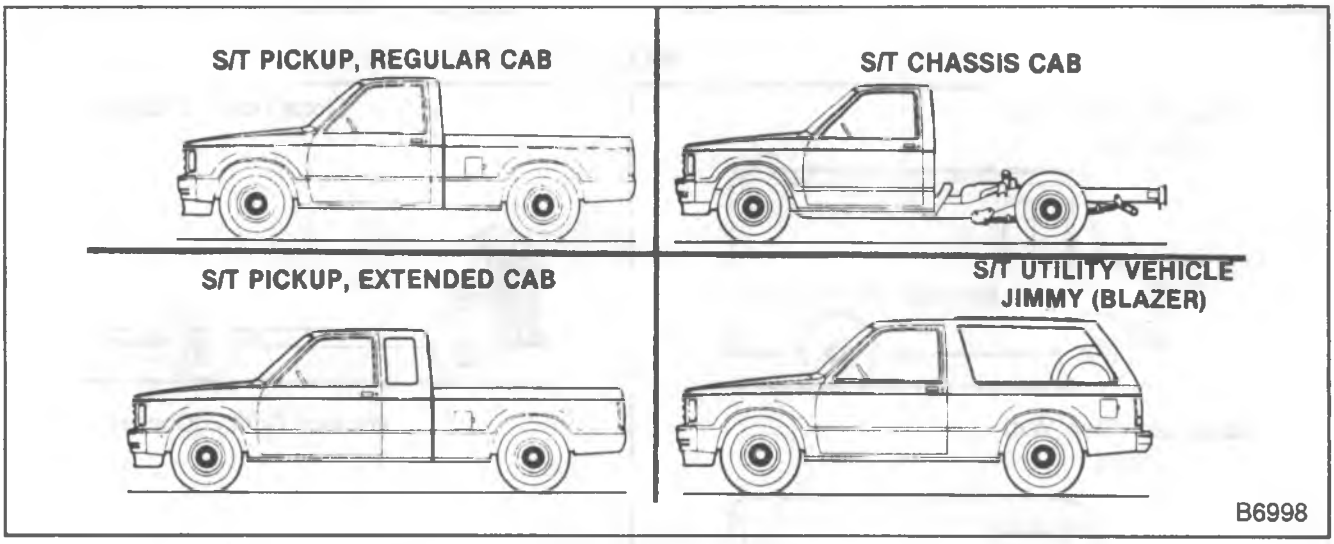


Figure 18—ST Models

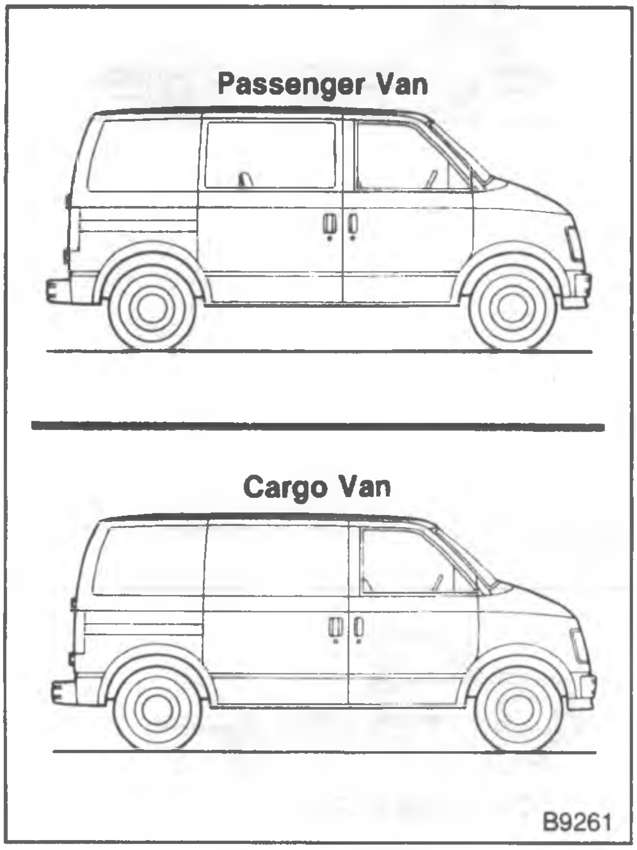


Figure 19—M Models

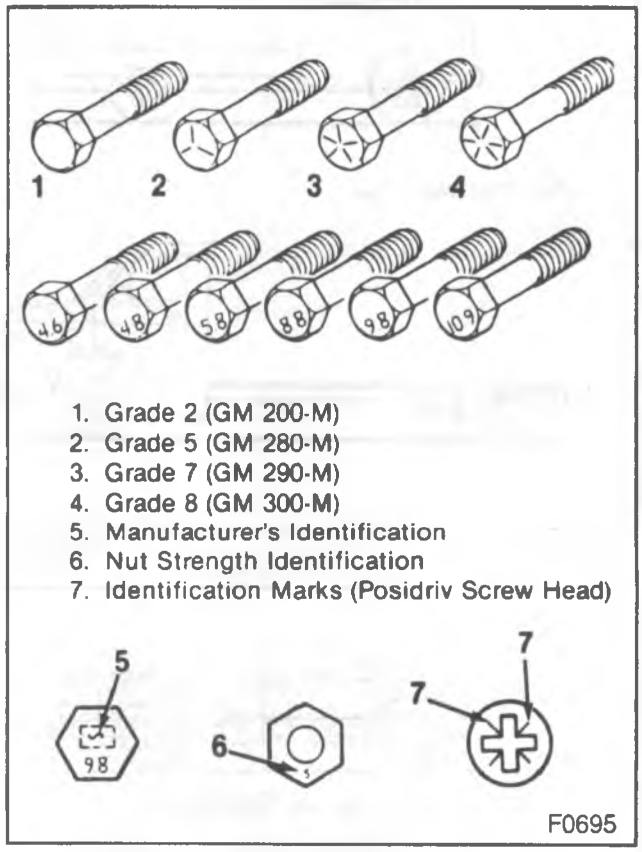
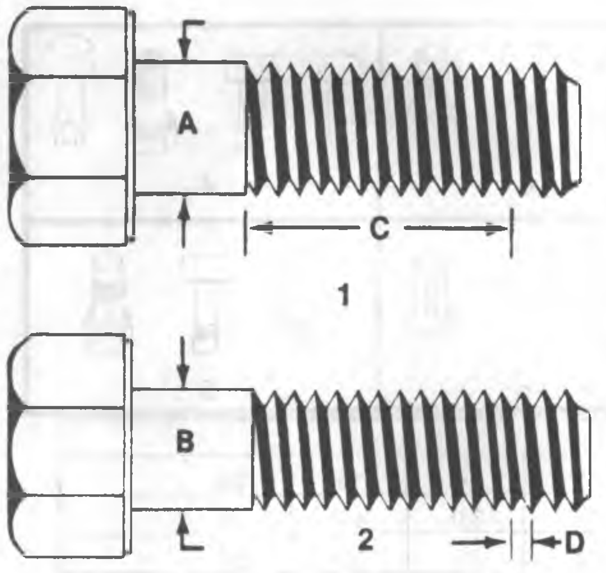


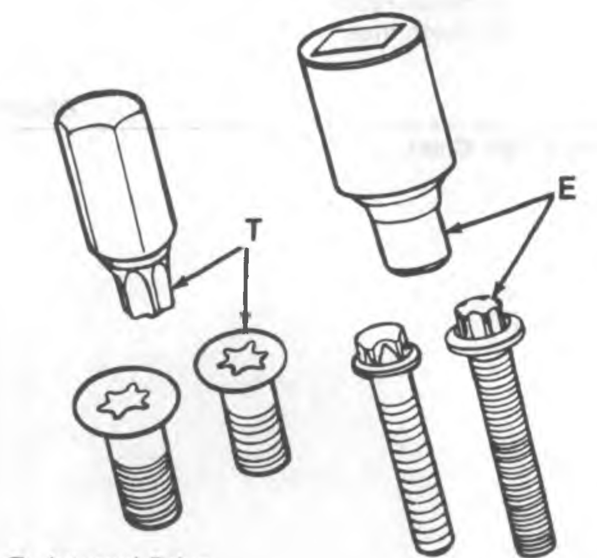
Figure 20—Bolt and Nut Identification



1. Customary Bolt—1/4-20
2. Metric Bolt—M6.0x1
A. 1/4-inch
B. 6 mm
C. 20 Threads Per Inch
D. 1 Thread Per Millimeter (25.4 Threads Per Inch)

F0705

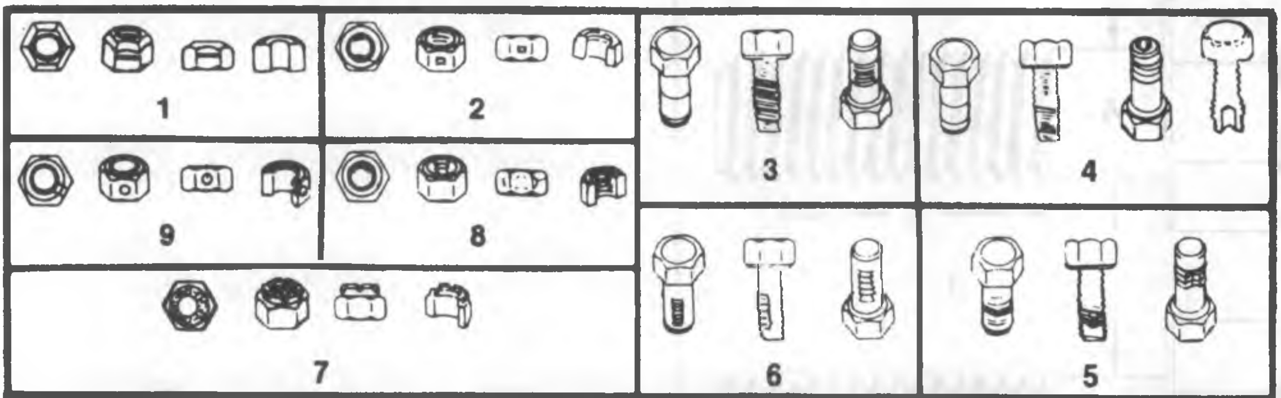
Figure 21—Thread Notation



T - Internal Drive
E - External Drive

B2221

Figure 22—Six Lobed Socket Head Fasteners



A									
		6 & 6.3	8	10	12	14	16	20	
4, 5	N·m	0.4	0.8	1.4	2.2	3.0	4.2	7.0	
	In. Lbs.	4.0	7.0	12	18	25	35	57	
1, 2, 3, 6, 7, 8, 9	N·m	0.4	0.6	1.2	1.6	2.4	3.4	5.6	
	In. Lbs.	4.0	5.0	10	14	20	28	46	
B									
		.250	.312	.375	.437	.500	.562	.625	.750
4, 5	N·m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	In. Lbs.	4.0	5.0	12	15	20	27	35	51
1, 2, 3, 6, 8, 9	N·m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	In. Lbs.	4.0	5.0	9.0	12	15	22	28	43

A. Metric Sizes
B. Inch Sizes

1. Top Lock Type
2. Center Lock
3. Dry Adhesive Coating
4. Out Of Round Thread
5. Deformed Thread Profile
6. Nylon Strip Or Patch
7. Nylon Washer Insert
8. Nylon Patch
9. Nylon Insert

B2406

Figure 23—Torque Nuts and Bolt Chart

CONVERSION TABLE

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimeters (mm)
Foot	0.304 8	meters (m)
Yard	0.914 4	meters
Mile	1.609	kilometers (km)
AREA		
Inch^2	645.2	millimeters^2 (mm^2)
	6.45	centimeters^2 (cm^2)
Foot^2	0.092 9	meters^2 (m^2)
Yard^2	0.836 1	meters^2
VOLUME		
Inch^3	16.387	mm^3
	16.387	cm^3
	0.016 4	liters (l)
Quart 0.946 4	liters	
Gallon	3.785 4	liters
Yard^3	0.764 6	meters^3 (m^3)
MASS		
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(† °F-32) ÷ 1.8	degree Celsius (C)

Multiply	by	to get equivalent number of:
ACCELERATION		
Foot/sec^2	0.304 8	meter/sec^2 (m/s^2)
Inch/sec^2	0.025 4	meter/sec^2
TORQUE		
Pound-inch	0.112 98	newton-meters (N·m)
Pound-foot	1.355 8	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of water	0.249 1	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000 or 3.6 x 10^6	joules (J $^{\$}$ one W)
LIGHT		
Foot candle	1.076 4	lumens/meter^2 (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425 1	kilometers/liter (km/l)
Gal/mile	2.352 7	liter/kilometer (l/km)
VELOCITY		
Miles/hour	1.609 3	kilometers/hr. (km/h)

B5497

Figure 24—Conversion Table

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric mm	Fractions	Decimal In.	Metric mm
1/64	0.015625	0.39688	33/64	0.515625	13.09687
1/32	0.03125	0.79375	17/32	0.53125	13.49375
3/64	0.046875	1.19062	35/64	0.546875	13.89062
1/16	0.0625	1.58750	9/16	0.5625	14.28750
5/64	0.078125	1.98437	37/64	0.578125	14.68437
3/32	0.09375	2.38125	19/32	0.59375	15.08125
7/64	0.109375	2.77812	39/64	0.609375	15.47812
1/8	0.125	3.1750	5/8	0.625	15.87500
9/64	0.140625	3.57187	41/64	0.640625	16.27187
5/32	0.15625	3.96875	21/32	0.65625	16.66875
11/64	0.171875	4.36562	43/64	0.671875	17.06562
3/16	0.1875	4.76250	11/16	0.6875	17.46250
13/64	0.203125	5.15937	45/64	0.703125	17.85937
7/32	0.21875	5.55625	23/32	0.71875	18.25625
15/64	0.234375	5.95312	47/64	0.734375	18.65312
1/4	0.250	6.3500	3/4	0.750	19.05000
17/64	0.265625	6.74687	49/64	0.765625	19.44687
9/32	0.28125	7.14375	25/32	0.78125	19.84375
19/64	0.296875	7.54062	51/64	0.796875	20.24062
5/16	0.3125	7.93750	13/16	0.8125	20.63750
21/64	0.328125	8.33437	53/64	0.828125	21.03437
11/32	0.34375	8.73125	27/32	0.84375	21.43125
23/64	0.359375	9.12812	55/64	0.859375	21.82812
3/8	0.375	9.52500	7/8	0.875	22.22500
25/64	0.390625	9.92187	57/64	0.890625	22.62187
13/32	0.40625	10.31875	29/32	0.90625	23.01875
27/64	0.421875	10.71562	59/64	0.921875	23.41562
7/16	0.4375	11.11250	15/16	0.9375	23.81250
29/64	0.453125	11.50937	61/64	0.953125	24.20937
15/32	0.46875	11.90625	31/32	0.96875	24.60625
31/64	0.484375	12.30312	63/64	0.984375	25.00312
1/2	0.500	12.7000	1	1.00	25.40000

B7676

Figure 25—Decimal and Metric Equivalents

SECTION 1

AIR CONDITIONING

CONTENTS

SECTION 1B1

A-6 AIR CONDITIONING COMPRESSOR

CONTENTS

DESCRIPTION

When servicing the Harrison A-6 compressor, prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly.

Keep tools and work area clean. Clean the compressor exterior before disassembly. Clean parts with trichloroethane, naptha or Stoddard solvent, kerosene or equivalent. Dry with air.

Use a non-lint producing type cloth to clean each part.

Although certain service operations can be performed without removing the compressor from the vehicle, the operations described here are based on bench repair with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components (figure 1).

For compressor removal and installation, refer to the proper truck service manual.

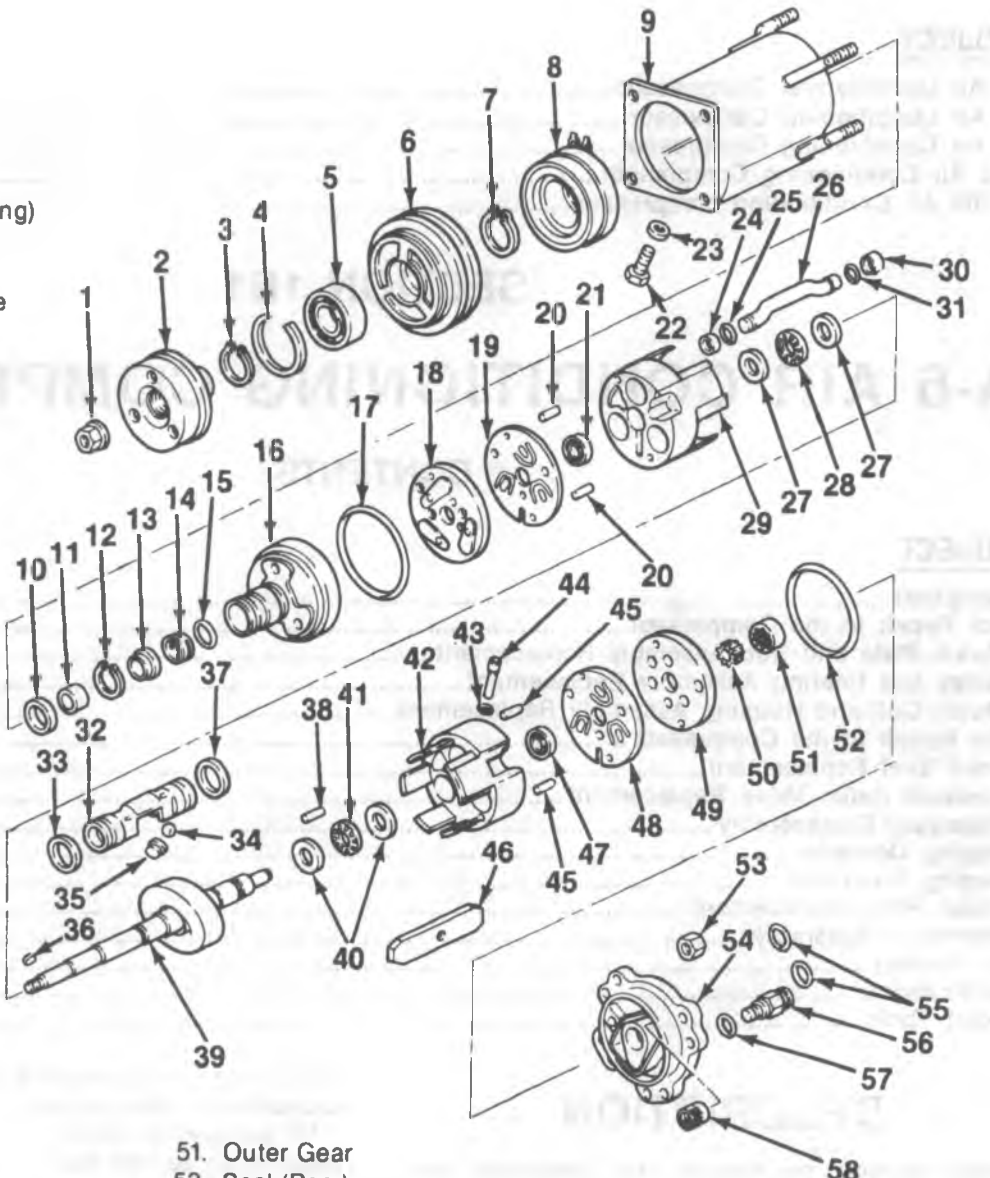
Do not kink or place excessive tension on lines or hoses.

After removing the compressor from the vehicle, drain and measure the refrigerant oil. Add new 525 viscosity refrigerant oil after repair. Refer to "Specifications."

IDENTIFICATION

An identification label attached to the compressor provides the name of the manufacturer, model number and build code. If the label is removed or becomes dislodged during service operation, reattach it using an adhesive sealant such as Loctite 312 or equivalent.

1. Nut
2. Clutch
3. Ring
4. Pulley Bearing Ring
5. Bearing
6. Pulley
7. Clutch Coil Ring
8. Coil
9. Shell
10. Sleeve Seal
11. Flat Seal
12. Ring
13. Seat Seal
14. Shaft Seal
15. Shaft Seal (O-ring)
16. Front Head
17. Seal (Front)
18. Discharge Valve Plate (Front)
19. Reed Suction Valve (Front)
20. Pin
21. Bearing
22. Drain Screw
23. Gasket
24. Sleeve
25. Seal
26. Tube
27. Race
28. Bearing
29. Cylinder (Front)
30. Sleeve
31. Seal
32. Piston
33. Ring (Piston)
34. Ball
35. Seal (Ball)
36. Key
37. Ring (Piston)
38. Pin
39. Shaft
40. Race
41. Bearing
42. Cylinder (Rear)
43. Seal
44. Tube
45. Pin
46. Plate
47. Bearing
48. Discharge Valve Plate (Rear)
49. Reed Suction Valve (Rear)
50. Inner Gear
51. Outer Gear
52. Seal (Rear)
53. Nut
54. Rear Head
55. Seal
56. Pressure Relief Valve
57. Seal
58. Screen



F1538

Figure 1—Compressor Component View

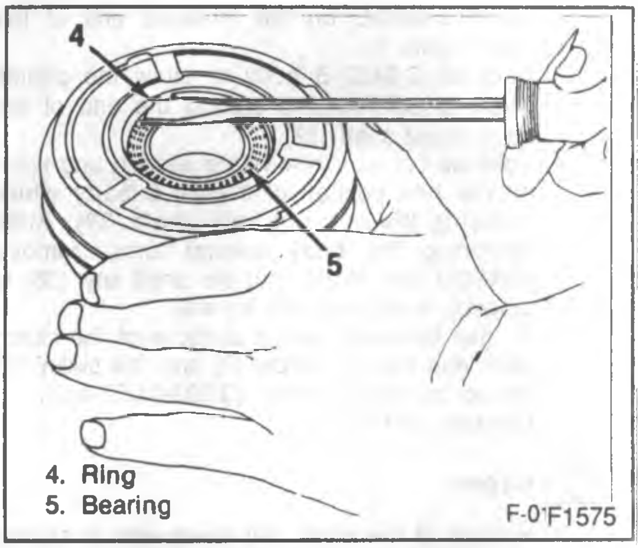


Figure 2—Removing the Shaft Nut

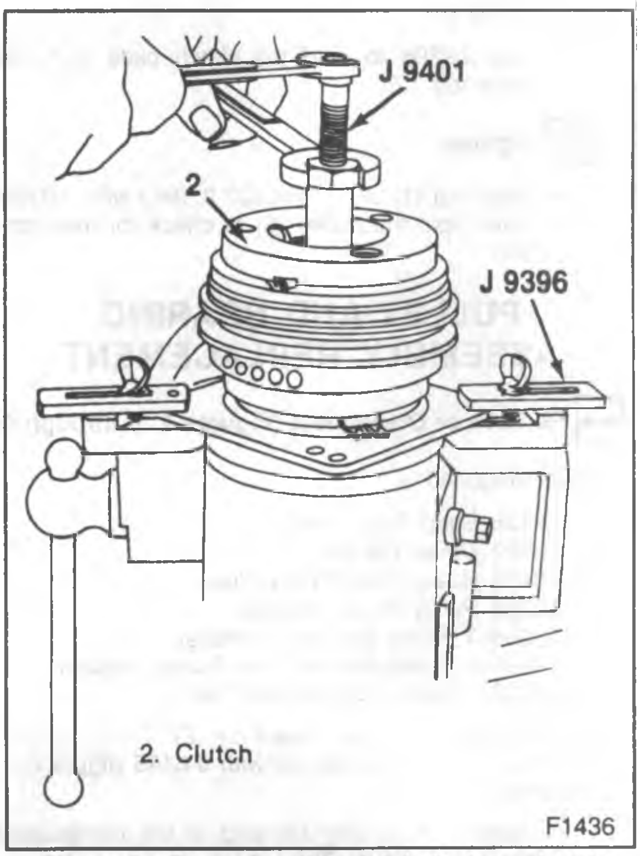


Figure 3—Removing the clutch Plate and Hub Assembly

MINOR REPAIR TO THE COMPRESSOR

Operations to the clutch plate and hub, pulley and bearing, and coil and housing are covered as "Minor" because they may be performed without purging the system.

Servicing the shaft seal and pressure relief valve are covered in "Major Repair Procedures" because the system must be purged of Refrigerant-12.

Illustrations used in describing these operations show the compressor removed from the vehicle to illustrate the various operations.

When servicing the compressor, remove the components that preliminary diagnosis indicates need servicing. Refer to figure 1 for part name and location.

Keep the work area, tools and parts clean. Use Piston Tray J 9402 (refer to "Special Tools") for parts removed and for replacement parts.

When a compressor is removed from the vehicle for servicing, drain and measure the amount of oil remaining in the compressor. After servicing, add new 525 viscosity refrigerant oil to the compressor.

CLUTCH PLATE AND HUB ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 1, 2 and 3)

Tools Required:
- J 9396 Compressor Holding Fixture
- J 9399 Compressor Shaft Nut Socket
- J 9401-A Hub Drive Plate Remover
- J 25030 Clutch Hub Holding Tool

- Clamp J 9396 in a vise.
- Compressor to J 9396. Secure with thumb screws (figure 2).

1. Shaft nut (1) with J 9399.
   - Hold the clutch plate and hub assembly (2) with J 25030 (figure 2).
2. Clutch plate and hub assembly (2).
   - Thread J 9401-A into the clutch plate and hub (2) (figure 3).
   - Hold the body of J 9401 with a winch and tighten the center screw into the remover body.
3. Shaft key (36).
   - Retain the shaft key (36) if usable.

Inspect (Figures 1, 4 and 5)

- All parts and replace as necessary.

Install or Connect (Figures 1, 4 and 5)

Tools Required:
- J 9399 Compressor Shaft Nut Socket
- J 9480-B Hub and Drive Plate Assembly Installer
- J 25030 Clutch Hub Holding Tool

1. Shaft key (36).
   - Allow the shaft key (36) to extend 4.5 mm (3/16-inch) out of the bottom of the hub keyway (figure 4).
   - The shaft key (36) is curved to give an interference fit in the groove.

Important

- Do not drive or pound on the clutch hub or the shaft (39). Internal damage to the compressor may result.

2. Clutch plate and hub assembly (2) (figure 4).
   - Install the clutch plate and hub assembly (2) over the compressor shaft lining up the key slot on the hub with the keyway slot in the shaft.

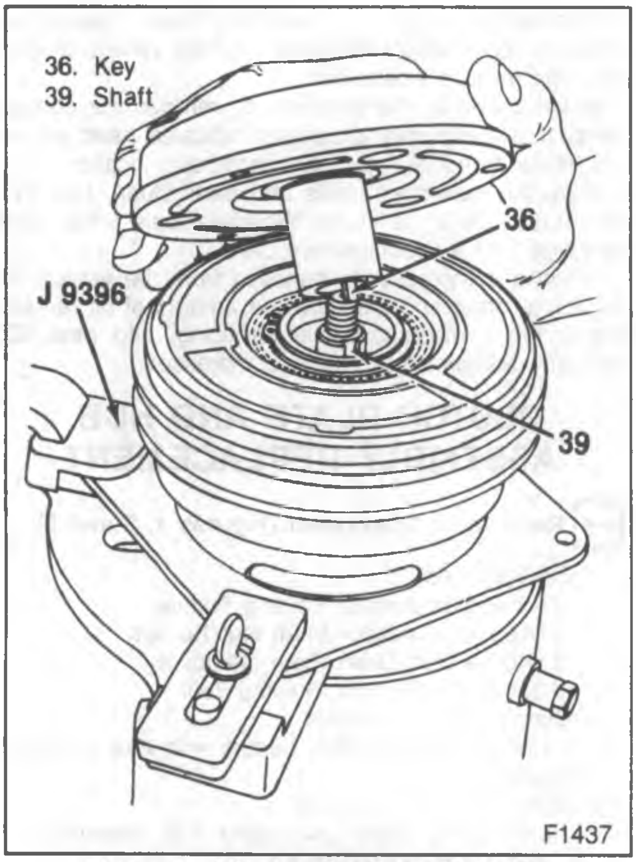


Figure 4—Aligning the Drive Plate Key

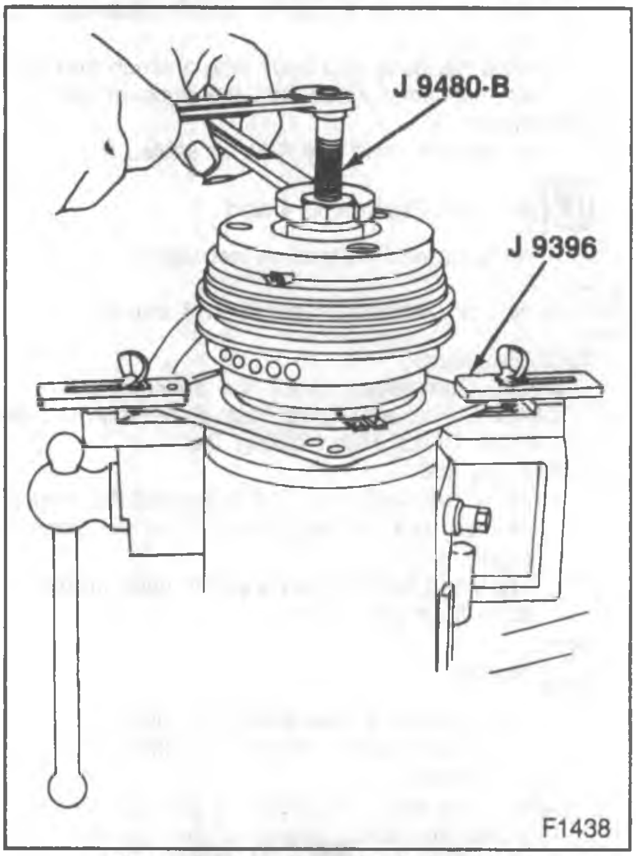


Figure 5—Installing the Drive Plate

- Install J 9480-B on the threaded end of the shaft (figure 5).
- Back off J 9480-B body to allow the center screw to be threaded against the end of the compressor shaft (39).
- Hold the center screw with a wrench and tighten the hex portion of J 9480-B body while pressing the hub onto the shaft (39). After tightening the body several turns, remove J 9480-B and check that the shaft key (36) is properly in place in the keyway.
- Air gap between contact surfaces of the clutch plate and hub assembly (2) and the pulley (6) should be 0.56-1.34 mm (0.022-0.057-inch).
- Remove J 9480-B.

Inspect

- Position of the shaft (39) (even with or slightly above the clutch hub).

3. Shaft nut (1).

- Use J 9396 to hold the clutch plate and hub assembly (2).

Tighten

- Shaft nut (1) to 27 N·m (20 ft. lbs.) with J 9399.
- Hand spin the pulley (6) to check for free rotation.

PULLEY AND BEARING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 1, 6 through 9)

Tools Required:

J 6435 Snap Ring Pliers
J 8092 Driver Handle
J 8433 Heavy Duty Pulley Puller
J 9395 Pulley Puller Adapter
J 9398-A Pulley Bearing Remover
J 9481-A Pulley Bearing and Pulley Installer
J 24092 Pulley Hub Adapter Set

1. Clutch plate and hub assembly (2).
2. Pulley bearing retainer (2) with J 6435 (figure 6).
3. Pulley (6).

- Install J 9395 over the end of the compressor shaft (38) (figure 7).

Important

- Use J 9395 puller pilot to prevent internal damage to the compressor when removing the pulley. Do not use the pulley directly against the end of the shaft.

- Place J 8433 over J 9395 for the regular V-groove pulley.
- Place J 24092 over J 9395 for the multi-groove pulley.

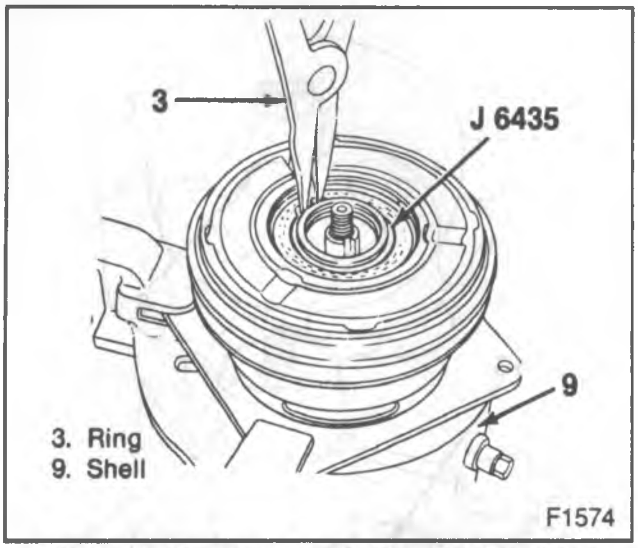


Figure 6—Removing the Pulley Retainer Ring

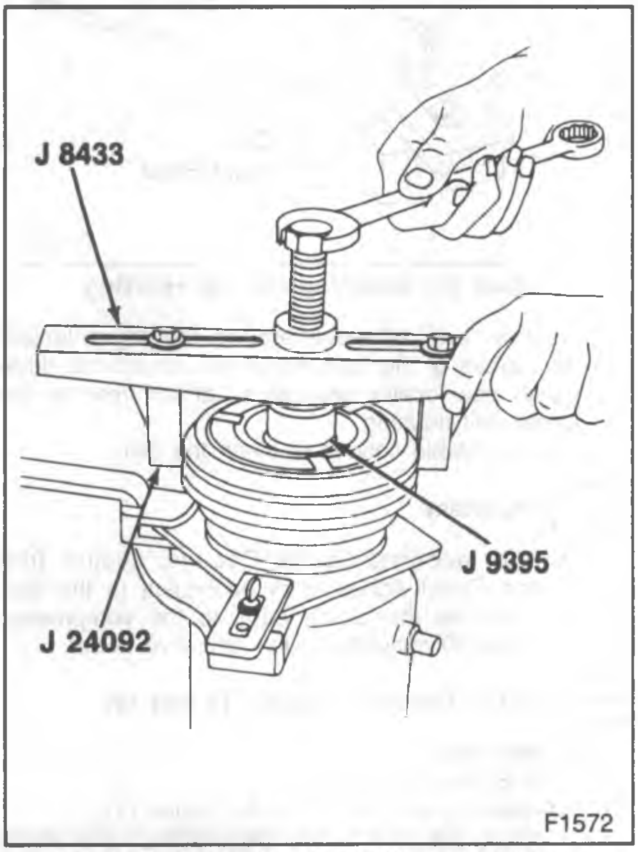


Figure 7—Removing the Pulley and Bearing

- Turn the screw on J 8433 to remove the pulley (6).

Important

- When using J 24092, the puller arms must extend around to the rear side of the pulley. Do not attempt to pull the pulley off by engaging the puller arms in a multi-groove pulley.

4. Bearing (5) from the pulley (6) (figure 8).
   - Remove the retaining ring (3).
   - Pulley (6) to J 21352 (figure 9).

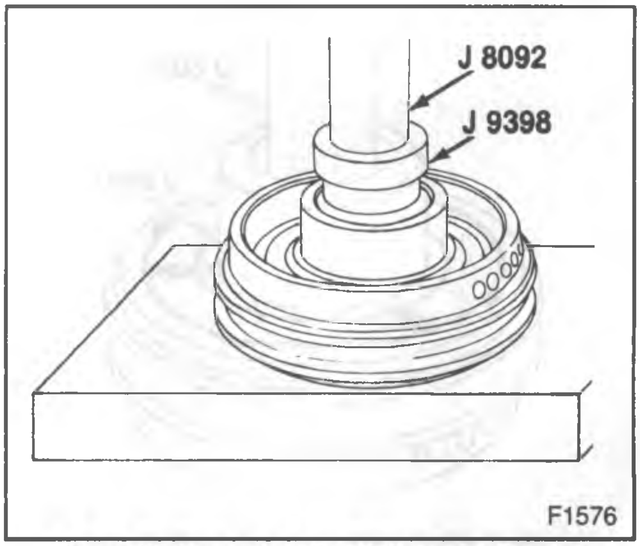


Figure 8—Removing the Pulley and Bearing Retainer Ring

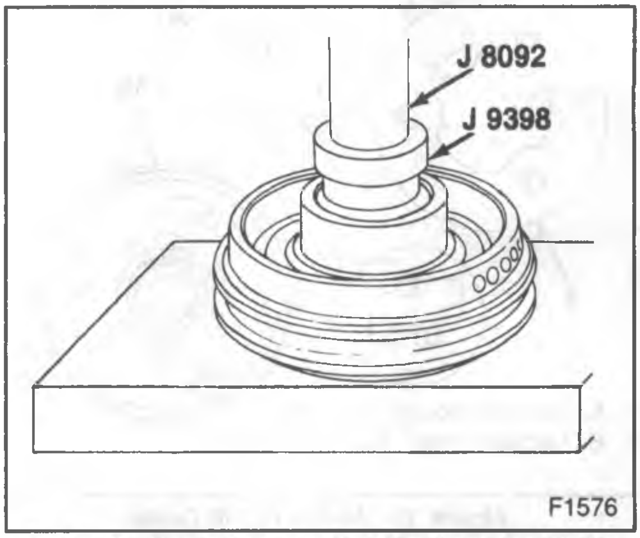


Figure 9—Removing the Bearing from the Pulley

- Drive the bearing (5) from the pulley (6) with J 9398 and J 8092.

Install or Connect (Figures 1 and 10)

Tools Required:

J 6435 Snap Ring Pliers
J 8092 Driver Handle
J 9481-A Pulley Bearing and Pulley Installer

1. Bearing (5) to the pulley (6) with J 8092 and J 9481-A (figure 10).
2. Retainer ring (4) to the pulley (6).
3. Pulley (6) and bearing (5) to shaft (38) with J 8092 and J 9481-A.
4. Retainer ring (4) to pulley (6) and bearing (5).
5. Pulley retainer ring (3) with J 0435.
6. Clutch plate and hub assembly(2).
   - Refer to "Clutch Rotor and Hub Assembly Replacement."

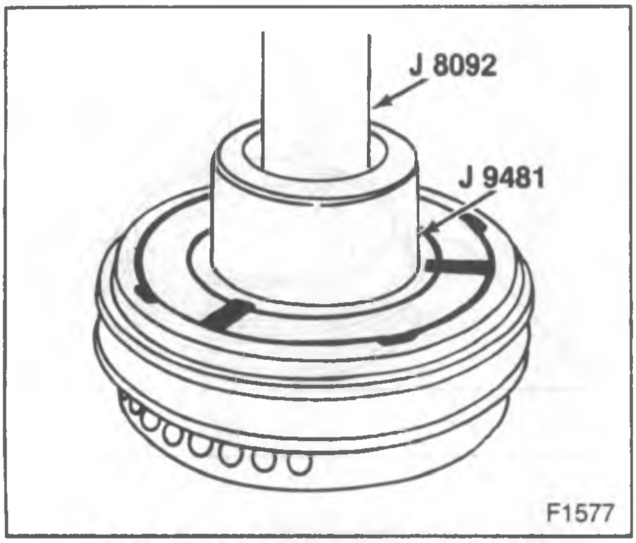


Figure 10—Installing the Pulley Bearing

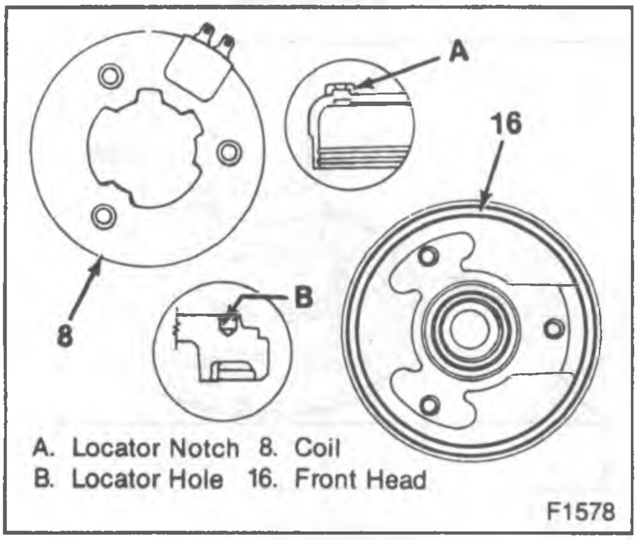


Figure 11—Adhesive Fill Guide

CLUTCH COIL AND HOUSING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 1)

Tool Required:
J 6435 Snap Ring Pliers

1. Clutch plate and hub assembly (2).
2. Pulley (6).
- Mark or scribe the location of the clutch coil (8) to terminal on the compressor front head (16).
3. Clutch coil assembly (8).
   - Coil housing retaining ring (7) with J 6435.
   - Using a large screwdriver or small pry bar, pry the clutch coil away from the front head. If necessary, hand impact a blow to the screwdriver handle or pry bar to break the adhesive bond of the clutch coil to the front head.

Clean

- Adhesive from the coil by scraping with a putty knife.

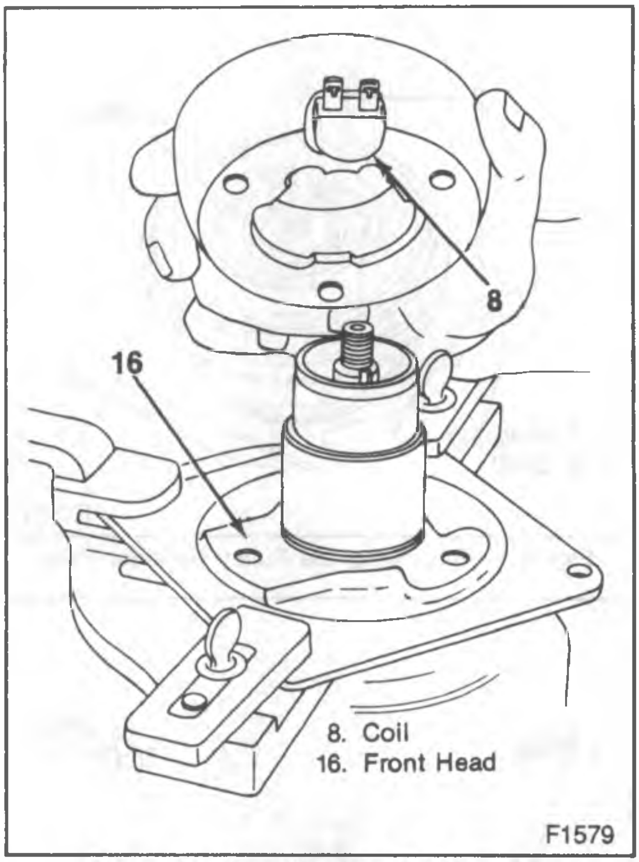


Figure 12—Installing the Coil Housing

- Remove any adhesive around the three locator hole areas of the front head and around the three clutch coil locator protrusions at the rear of the clutch coil housing.
- Use a suitable solvent to clean the coil.

Important

- After applying Loctite Depend, Loctite Trim and Detail Adhesive or equivalent to the coil, install all the clutch parts to the compressor. Allow 30 minutes for the adhesive to set.

Install or Connect (Figures 11 and 12)

Tool Required:
J 6435 Snap Ring Pliers

1. Adhesive to the clutch coil (8) (figure 11).
   - Place the clutch coil "face down" and apply the adhesive in a circular bead around the three coil locator protrusions.
2. Clutch coil (8) to the front head (16) (figure 12).
   - Align the coil and housing assembly on the compressor front head (16) so that the electrical terminals line up the marks scribed on the compressor.
   - Align the coil locator projections on the coil housing with the holes in the front head (16).
3. Coil and housing retainer ring (7) with J 6435.

Clean

- Remove any excess adhesive.

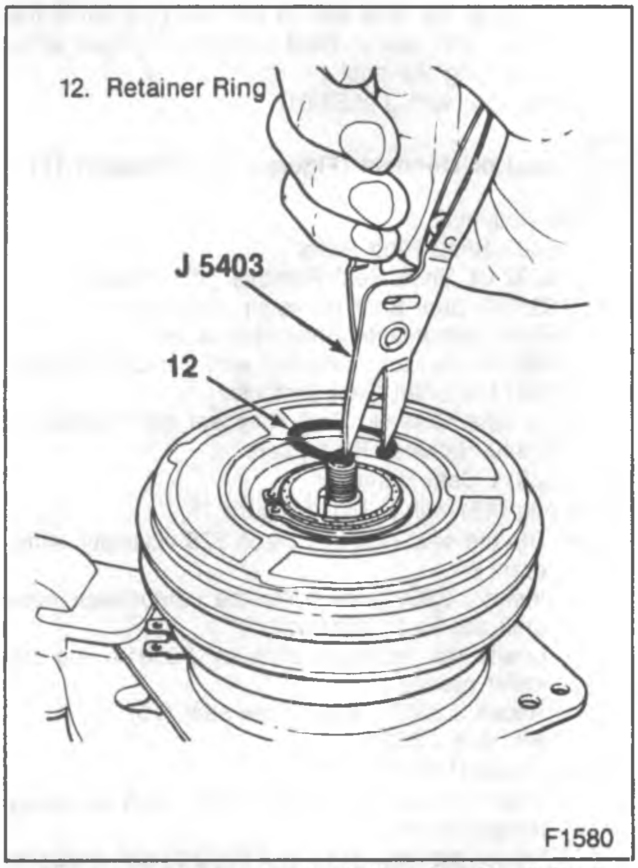


Figure 13—Removing/Installing the Shaft Seal Retaining Ring

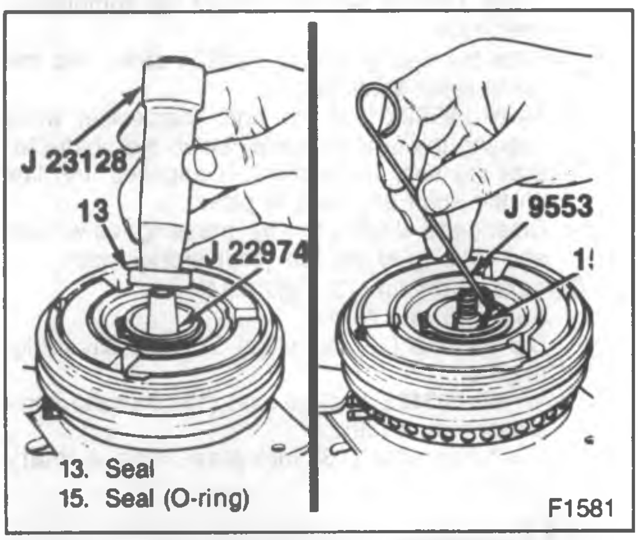


Figure 14—Removing/Installing the Shaft Seal Seat and Seal

4. Pulley and bearing assembly (5 and 6).
5. Clutch plate and hub assembly (2).

MAJOR REPAIR TO THE COMPRESSOR

Service repair procedures to the compressor shaft seal and pressure relief valve or disassembly of the internal compressor mechanism are considered "Major" since the refrigeration system must be purged of refrigerant before proceeding.

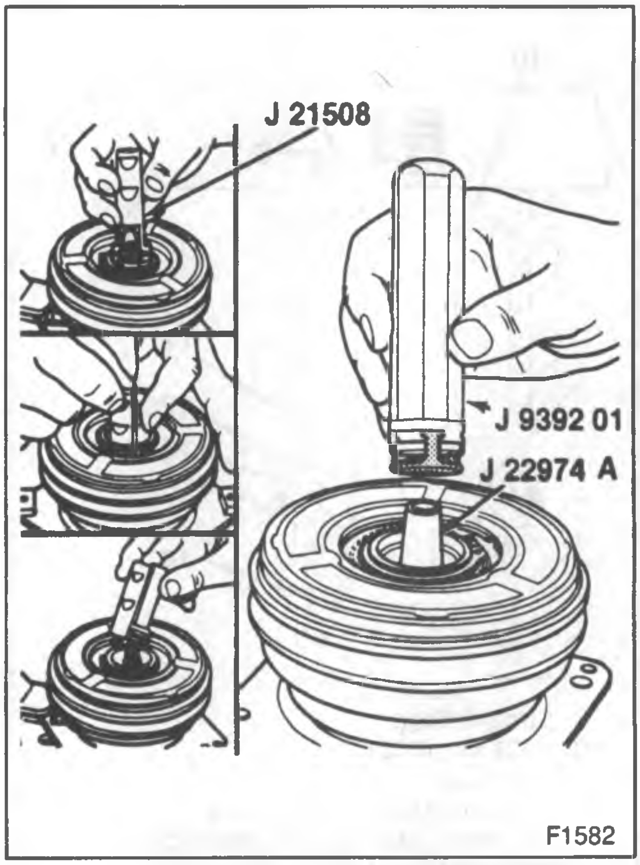


Figure 15—Removing/Installing the Shaft Seal and Seal

If servicing or replacing the internal cylinder and shaft assembly chain, measure and replace the oil with new 525 viscosity refrigerant oil.

Disassemble the compressor in a clean work area. Use clean tools. Disassembly procedures require proper service tools. Using inadequate equipment may damage the compressor.

Replacement parts are packaged and can be used without cleaning.

Piston shoe discs and shaft thrust races are "numbered." To determine size and dimension, refer to the chart in this section.

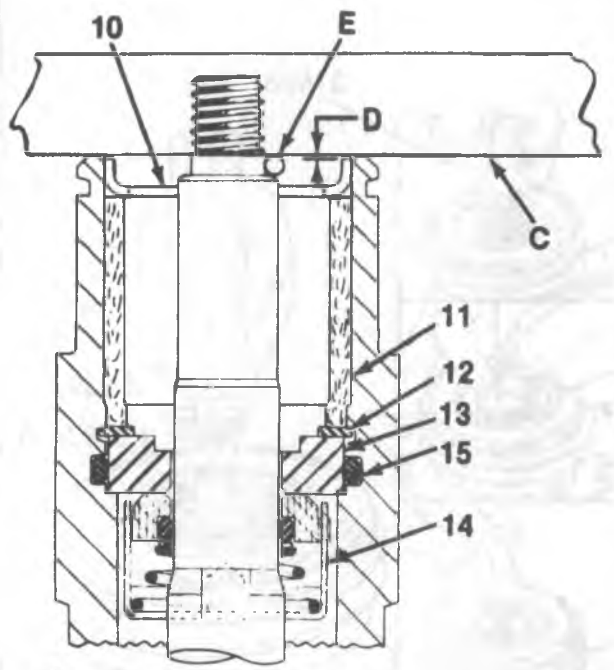
SHAFT SEAL REPLACEMENT

↔ Remove or Disconnect (Figures 1, 13, 14 and 15)

Tools Required:

- J 5403 Snap Ring Pliers
- J 9392-01 Shaft Seal Remover and Installer
- J 9553 Seal Remover
- J 22974-A Compressor Shaft Oil Seal Protector
- J 23128-A Compressor Shaft Seal Seat Remover and Installer

1. Clutch plate and hub assembly(2).



C. Straight Edge
D. 0.793 mm (0.0313")
E. Wire Gage
0.66 mm (0.026") Should "GO"
1.91 mm (0.075") Should "Not Go"
or Should "Just Go"
10. Retainer
11. Sleeve
12. Retainer
13. Seat
14. Seal
15. Seal (O-ring)

F1583

Figure 16—Shaft and Seal Position and correct Position Gaging Guide

Clean

- The inside of the compressor around the shaft (38). Prevent dust and dirt from entering the compressor.

2. Sleeve retainer (10).
3. Absorbent felt sleeve (11).
4. Shaft seat retaining ring (12) with J 5403 (figure 13).
5. Shaft seat (13) (figure 14).
   - Engage J 23128 into the recessed portion of the seat by turning J 23128 to the right (clockwise).
   - Lift the seat (13) from the compressor with a rotary motion.
6. Shaft seal (14) (figure 15).
   - Place J 22974-A over the end of the shaft (38) to prevent cutting the O-ring (13).
   - Insert J 9392-01 over the compressor shaft (39).
   - Engage the tabs on the seal (14) by twisting the J9392-01 to the right.
   - Engage the tabs and lift the seal (14) out of the shaft (39) cavity. Hold J 22974 in place while removing the seal.
7. O-ring (15) with J 9553-01.

Install or Connect (Figures 1, 13 through 16)

Tools Required:
J 5403 Snap Ring Pliers
J 9392-01 Shaft Seal Remover and Installer
J 9393-A Seal Seat Remover and Installer
J 9366 Compressor Shaft Nut Socket
J 9625-A Pressure Test Set with Schrader Valves
J 22974-A Shaft Seal Protector
J 23128-A Ceramic Seal Remover and Installer
J 24340 Retainer Ring Pliers
J 33011 Seal Remover

1. O-ring (15) with J 33011 (figure 15).
   - Dip the seal (15) into clean 525 viscosity refrigerant oil.
   - Insert J 33011 down into the compressor neck until the tool "bottoms."
   - Lower the movable slide of J 33011 into the lower groove.
   - Rotate J 33011 to seat the seal (15).
   - Remove J 33011.
2. Seal seat (14) (figure 15).
   - Coat the seal (14) with clean 525 viscosity refrigerant oil.
   - Mount the seal (14) to J 9392-01 by engaging the tabs of the seal with the tangs of J 9392-01.
   - Place J 22974 over the end of the compressor shaft (39).
   - Slide the seal (14) and J 22974 down onto the compressor shaft (38).
   - Twist J 9392-01 to the right (clockwise) while pushing the seal assembly down the shaft (38) until the seal assembly (14) engages the flats on the shaft and seat in place.
   - Disengage J 9392-01 by pressing downward and twisting to the left (counterclockwise).
3. Ceramic seal seat (13) (figure 14).
   - Seal (13) to J 23128.
   - Dip the seal (13) into clean 525 viscosity refrigerant oil.
   - Install J 23128 and the seal (13) over the compressor shaft (39).
   - Push the seal (13) into place with a rotary motion.

Important

- Do not dislodge the seal (O-ring) (15).

4. Seal shaft retainer ring (12) with J 5403 (figure 13).
   - Place the flat side against the seal seat.
   - Use the sleeve of J 23128-A to press the ring into its groove.
5. J 9625 to the rear head of the compressor:
   - Gage charging lines or pressurize the suction side (low pressure side) of the compressor with refrigerant to equalize the pressure to the drum pressure.

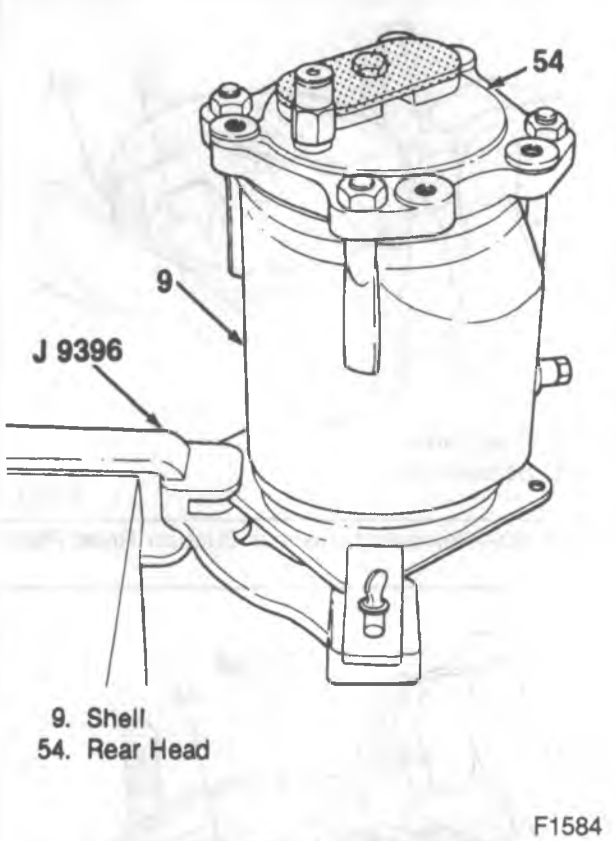


Figure 17—Compressor to J 9396

6. New absorbent sleeve (11).
   - Roll the material into a cylinder, overlapping the ends.
   - Slip the sleeve into the compressor front head with the overlap toward the top of the compressor.
   - With a scrwdriver spread the sleeve ends of the sleeve butt at the top vertical centerline.
7. Sleeve retainer (10) with J 9393.
   - Place the flange face against the front end of the sleeve.
   - Press and tap with a mallet to set the retainer and sleeve into place. Place the retainer 0.7937 mm (0.03125-inch) from the face of the compressor neck (figure 16).
8. Clutch plate and hub assembly (2).
   - Refer to "Clutch Plate and Hub Assembly Replacement."

Important

- Using improper procedures, pounding or collisions can damage the shaft seal and the axial plate. If the axial plate is out of position, the carbon face of the shaft seal may not contact the seal seat.
- To check the position of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft with a wire gage. The clearance should be 0.66-1.9 mm (0.026-0.075-inch) (figure 16).
  - If the shaft has been pushed back in the axial plate (measurement greater than 1.9 mm (0.075-inch), disassemble the compressor and replace the shaft and axial plate assembly, thrust races and thrust bearings.
  - If there is too much or not enough air gap between the drive and driven plates, check for shaft dislocation. It will not be possible to service the compressor if the carbon seat is not seating against the seal seat.

9. Shaft nut (1) with J 9399.

- Place the compressor in a horizontal position with the oil sump down.
- Rotate the compressor shaft by hand.
- Leak test with J 23400
- Replace shaft nut (1) with a new one.

PRESSURE RELIEF VALVE REPLACEMENT

The pressure relief valve is located at the rear of the compressor.

Remove or Disconnect (Figure 1)

1. Valve (56).
2. Seal (57).

Clean

- The valve cavity to remove any dust or dirt before installing a new seal.

Remove or Disconnect (Figure 1)

1. Seal (57) to the compressor.
   - Dip the seal (57) in 525 viscosity refrigerant oil.
2. Valve (56) to the compressor.

Tighten

- Valve (56) to 19 N·m (14 ft. lbs.).

COMPRESSOR DISASSEMBLY

Remove or Disconnect (Figures 1, 17 through 26)

Tools Required:
- J 9396 Compressor Holding Fixture
- J 9397 Compressing Fixture
- J 9402 Piston Assembly Tray
- J 21352-A Compressor Support Block

- J 9396 to a vise.
- Compressor to J 9396. Secure with thumb screws (figure 17).

1. Nuts (42) from the threaded studs.
2. Rear head (43) (figure 18).
   - Tap around the edge to remove the rear head (43).
3. Suction screen (47).
4. Gears (50 and 51).
   - Mark the face of the gears before removing.

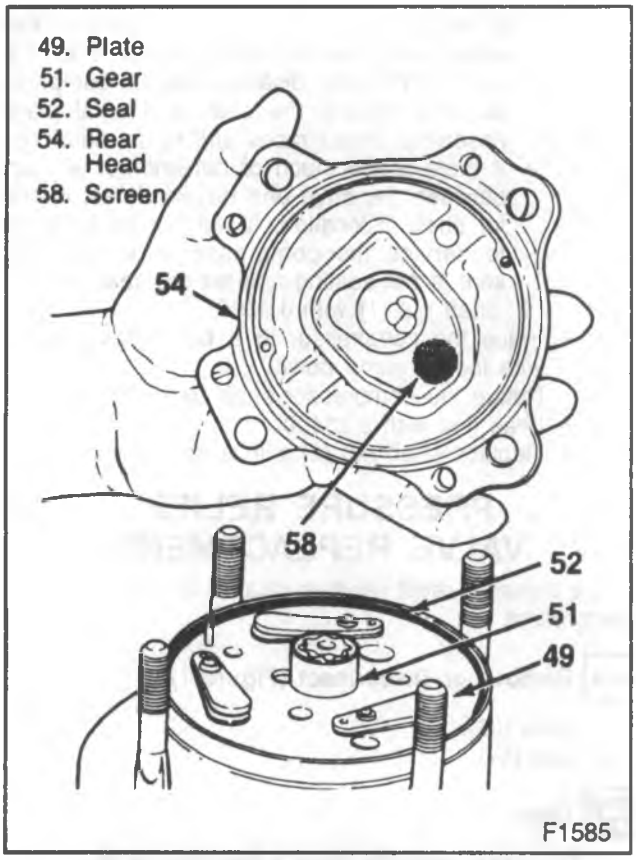


Figure 18—Removing the Rear Head

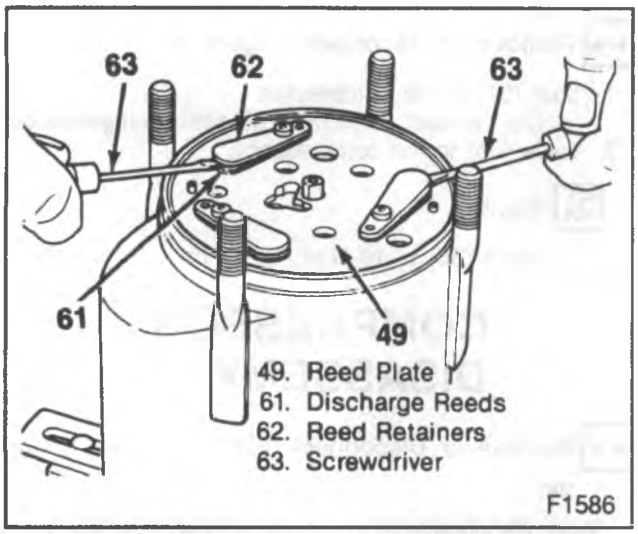


Figure 19—Removing the Rear Discharge Valve Plate and Seal

5. Seal (52).
6. Rear discharge valve plate assembly (49) (figure 19).
   - Use two small screwdrivers under the reed retainers to remove the assembly.
   - Do not position the screwdrivers between the reeds and the reed seats.
7. Rear suction reed plate (48) (figure 20).
   - Do not pry up on the horse-shoe shaped reed valves.
8. Oil pick-up tube (37) with J 5139 (figure 21).

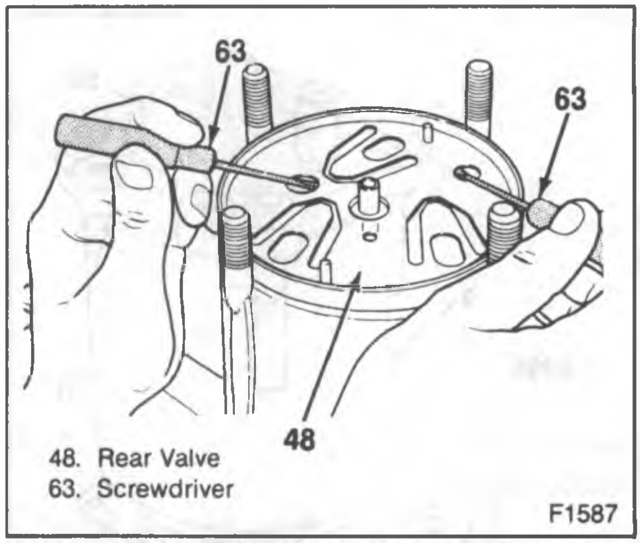


Figure 20—Removing the rear Suction Reed Plate

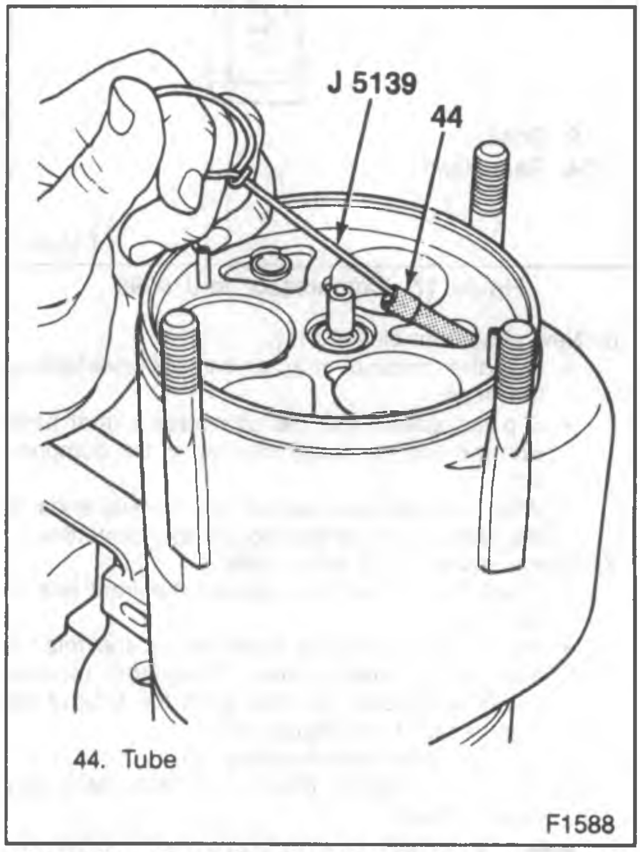


Figure 21—Removing the Rear Suction Reed Plate

9. Seal (36).
10. Compressor to J 21352.
    - Loosen the compressor from J 9396.
    - Place J 21352 over the oil pump end of the shaft.
    - Holding the support block in position with one hand, lift the compressor from the holding fixture with the other hand.
    - Invert the compressor and place the shaft end up on the bench with the internal assembly support block resting on the bench.

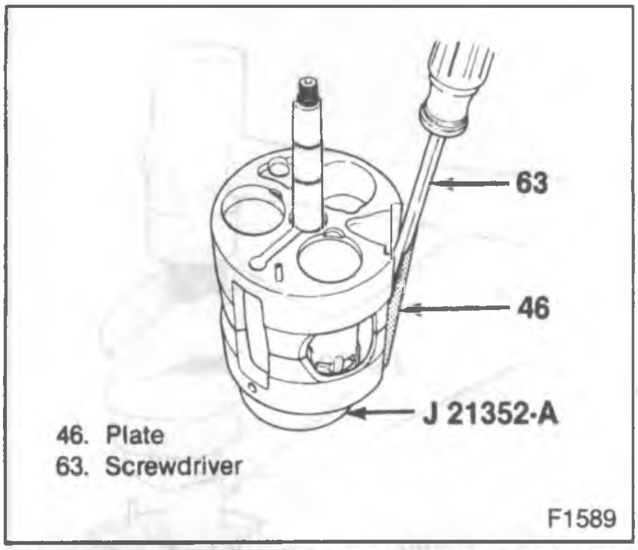


Figure 22—Removing the Rear Suction Reed Plate

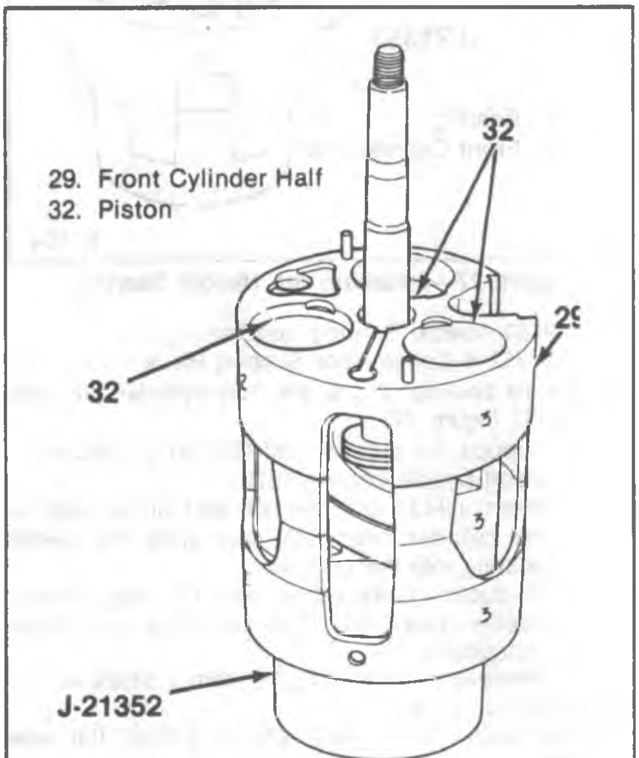


Figure 23—Numbering the Pistons and Cylinders

Important

- To prevent damaging the shaft, do not tap on the end of the compressor shaft to remove the internal mechanism. If the mechanism will not slide out of the compressor shell, tap on the front head with a plastic hammer.

11. Front head assembly (16) from the shell (9).
    - Rest the compressor shell (9) on its side and push the fronthead assembly (16) through the shell (9).

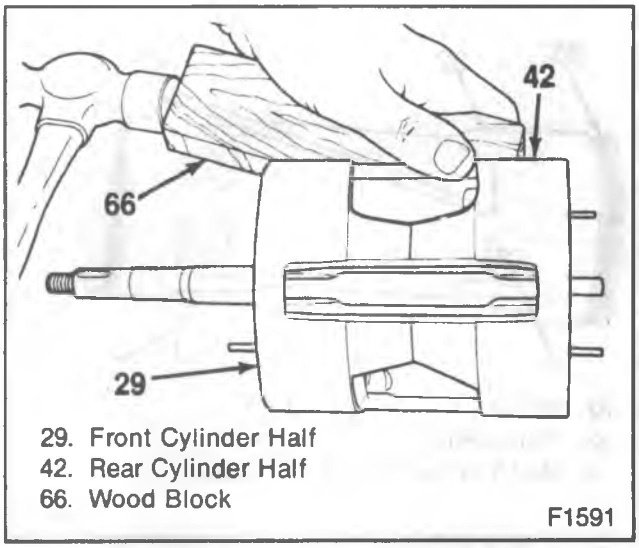


Figure 24—Separating the Cylinder Halves

12. Front seal (17).
    - Tap on the outside of the front head (16) with a plastic hammer to overcome the friction of the seal (17) between the fronthead (16) and the shell (9).
13. Front discharge valve plate (18).
14. Front suction reed plate (19).
15. Suction cross-over plate (46) (figure 22).
    - Pry with a screwdriver between the casting (29) and the cover.
16. Cylinder halves (29 and 42).
    - Number the piston and the piston bores with the same numbers so the pistons can be installed in their bores (figure 23).
    - Separate the cylinders (29 and 42) with a block of wood and a mallet (figure 24).
    - Do not let the discharge cross-over tube (26) touch the axial plate (39).
    - Do not strike the shaft at either end to separate the upper and lower cylinder halves because the shaft (39) can be damaged.
17. Rear half (42) of the compressor from the pistons (30).
18. Front cylinder half (29) with the piston (38), shaft and axial plate (38) to J 9397.
19. Pistons (30), balls (31) and seats (33) in the order in which the pistons are marked.
    - Place parts in J 9402.
    - Place the pistons (32) in J 9402 with the notch in the casting web at the front end of the piston into the dimpled groove of the J 9402 (figure 25).
20. Rear thrust races (40) and thrust bearing (41) from the shaft (39) (figure 26).
21. Shaft (39) from the front cylinder half (29).
    - If necessary, bend the discharge cross-over tube (26) to remove the shaft (39).
22. Front thrust races (27) and thrust bearing (28).
23. Discharge crossover tube (26) from the cylinder half (29) with locking jaw pliers.
    — This is necessary on original factory equipment because the tube ends are swedged into the cylinder halves.

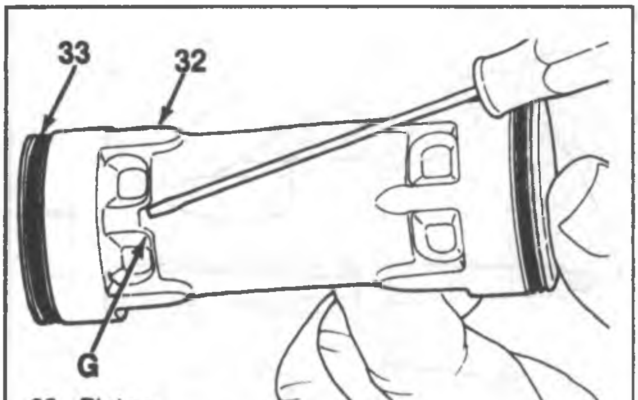


Figure 25—Identifying the Notch at the Front of the Piston

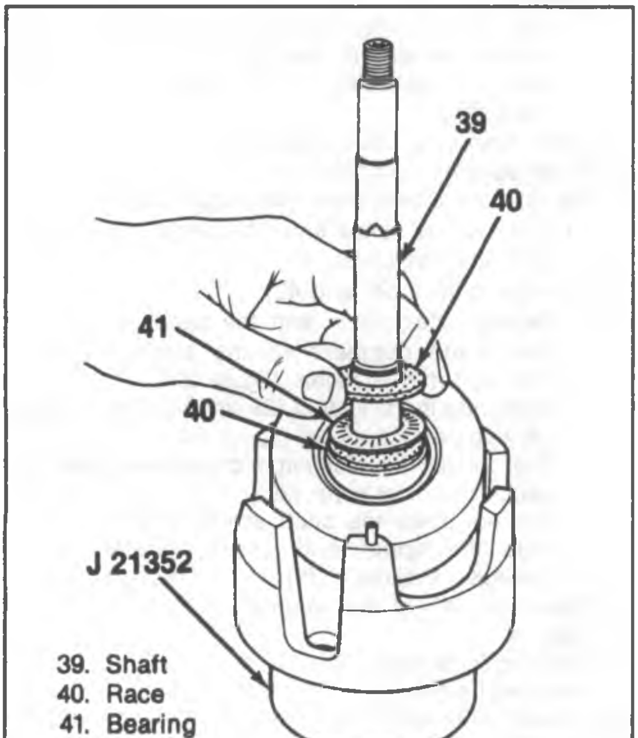


Figure 26—Removing the Front Thrust Races and Bearing

— If previously serviced, the discharge cross-over tubes (26) will have a seal and bushing at the end of the tube. Remove these tubes by hand.

GAGING OPERATION

Install or Connect (Figures 27 through 31)

Tools Required:
J 9396 Compressor Holding Fixture
J 9397 Compressing Fixture

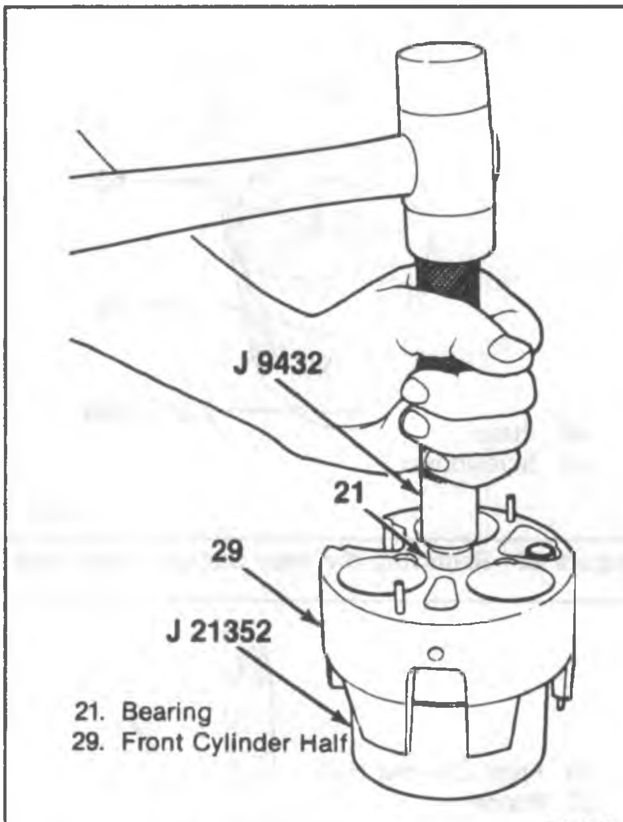
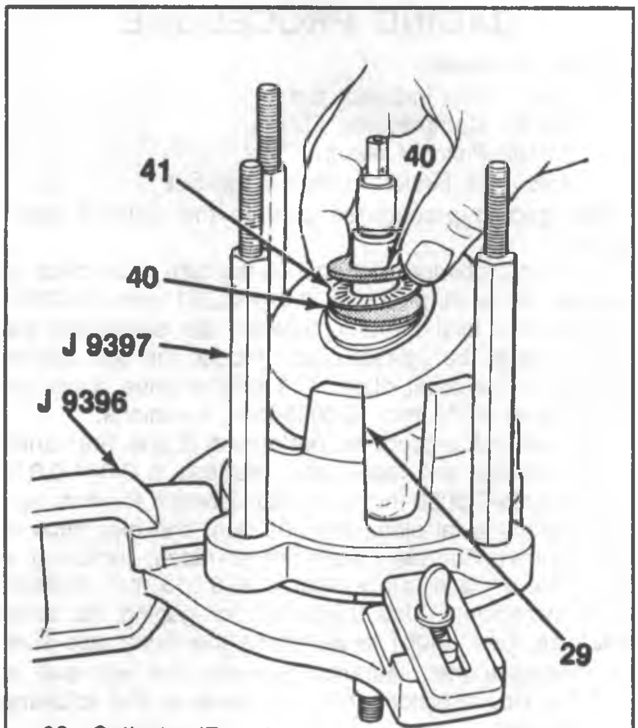


Figure 27—Installing the Needle Bearing

J 9432 Needle Bearing Installer
J 21352-A Compressor Support Block

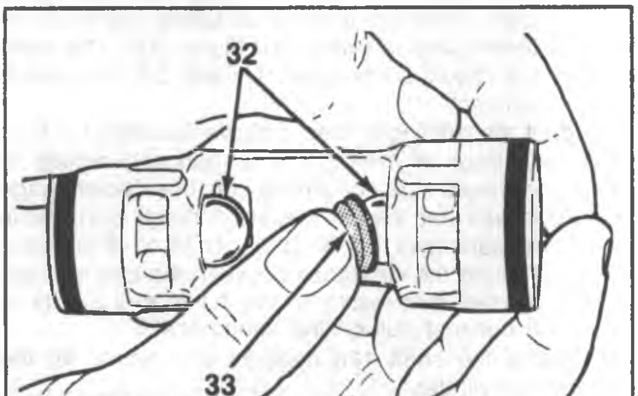
1. Needle bearing (21) to the front cylinder (29) with J 9432 (figure 27).
   - Support the cylinder half (29) on J 21352-A.
   - Insert needle bearing (21).
   - Insert J 9432 into the hub end (inner side) of the cylinder head (29) and drive the needle bearing into the cylinder.
   - Production compressors use 1/2- and 5/8-inch needle bearings. The bearings are interchangeable.
   - Remove cylinder half (29) from J 21352-A.
2. J 9397 on J 9396.
3. The front cylinder half (29) in J 9397 flat side down.
   - The front cylinder half (29) has a long slot extending out from the shaft hole. The "legs" of the front cylinder half (29) will point upward.
4. "Zero" thrust race (27), thrust bearing (28) and "zero" thrust race (27) to the front end of the shaft (39) (figure 28).
   - Lubricate the races (27) and the bearing (28) with petroleum jelly.
5. Threaded end of the shaft (39) through the needle bearing (21) in the front cylinder half (29) and allow the thrust race (27) and bearing (28) to rest on the hub of the cylinder.
6. Insert a thrust race on the rear end of the shaft (39) so that it rests on the hub of the axial plate.
   - Lubricate the races and bearing with petroleum jelly.



29. Cylinder (Front)
40. Race
41. Bearing

F1595

Figure 28—Installing the Rear Thrust Races and Bearing

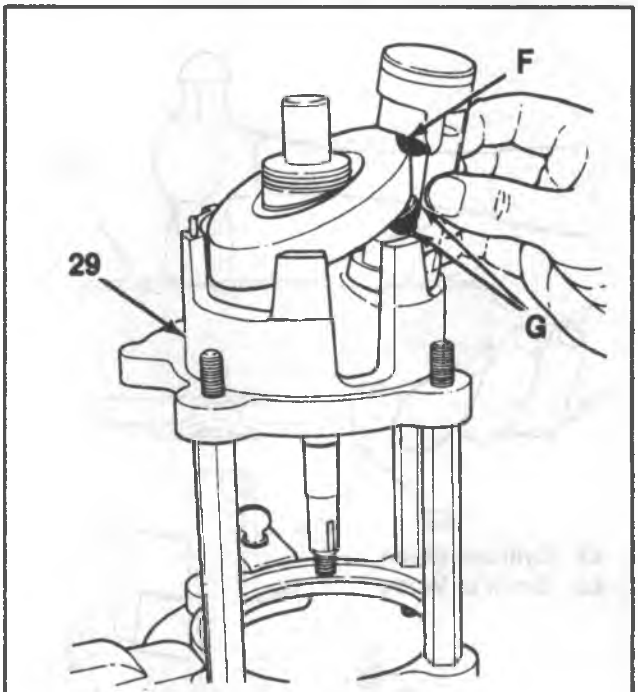


32. Balls
33. Shoe Disc

F5003

Figure 29—Installing the Front Shoe Disc

7. Place the balls (34) into the sockets of number one piston (figure 29).
   - Lubricate the ball sockets with 525 viscosity refrigerant oil.
8. Place the shoe discs (35) over the ball (34) in the front end of the piston.
   - Lubricate the cavity of the shoe disc with 525 refrigerant oil.
   - The front end of the piston (32) has an identifying notch in the casting web.



F. Piston drive ball at the rear.
G. Piston drive ball and a "zero" shoe disc at the front.
29. Front cylinder half.

F1597

Figure 30—Installing the Piston during the Gaging Operation

Important

- Do not install the shoe discs (35) on the rear of the piston (32).

9. Rotate the shaft and axial plate (39) until the high point of the axial plate is over the No. 1 piston cylinder bore.
10. Lift the axial shaft assembly (39) up a little out of front cylinder half (29).
    - Hold the front thrust races and bearing ("zero" race, race bearing, "zero" race) against the axial plate hub.
11. Position the No. 1 piston (32) over the No. 1 cylinder bore (notched end of the piston being on the bottom and the piston straddling the axial plate) and lower the shaft to allow No. 1 piston to drop into its bore (figure 30).
12. Repeat step 11 for pistons Nos. 2 and 3.
13. Install the rear cylinder half (42) on the pistons, aligning the cylinder with the discharge cross-over tube hole in the front cylinder.
    - Tap the piston into place using a plastic mallet or piece of clean wood and a hammer (figure 31).
14. Position the discharge cross-over tube opening between a pair of compressing fixture bolts to permit access for the feeler gage.
15. Install the top plate to J 9397.

Tighten

- Nuts to 20 N·m (15 ft. lbs.).

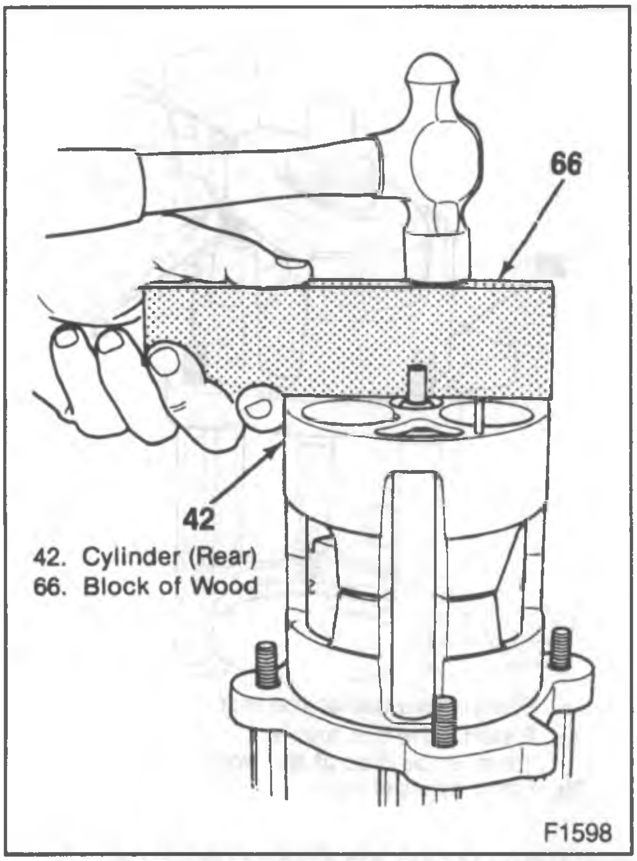


Figure 31—Assembling the Cylinder Halves

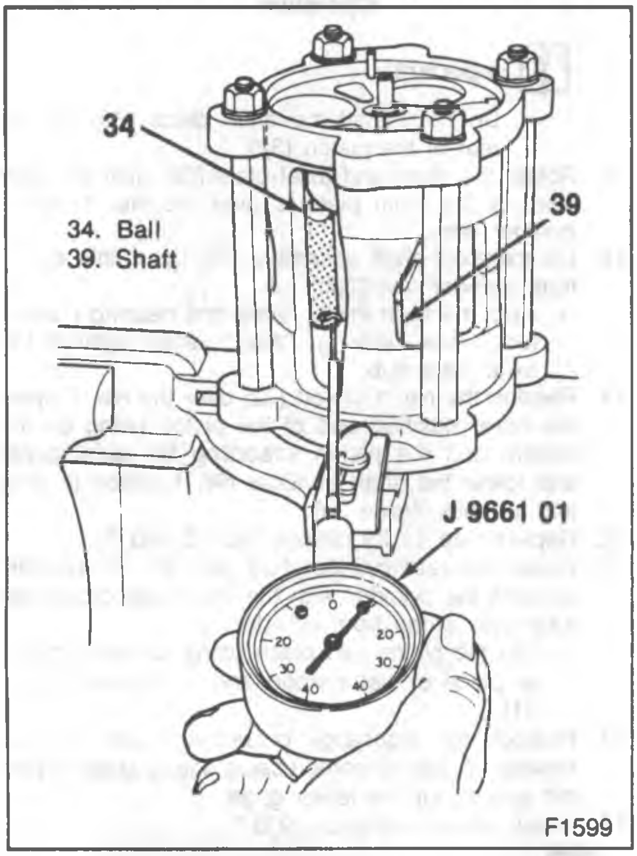


Figure 32—Gaging the Rear Piston Ball

GAGING PROCEDURE

Tools Required:

J 8001 Dial Indicator Set
J 9397 Compressing Fixture
J 9402 Piston Assembly Tray
J 9661-01 Feeler Tension Gage Set

Two gaging procedures provide the running tolerances.

The first procedure determines the size shoe discs to provide at each piston a 0.041-0.061 mm (0.0016-0.0024-inch) total preload between the seats and the axial plate at the tightest place through the 360 degree rotation of the axial plate. The bronze shoe discs are available in 0.013 mm (0.0005-inch) variations.

The second procedure, performed at the rear shaft thrust bearing and race pack, provides a 0.064-0.077 mm (0.0025-0.0030-inch) preload between the hub surfaces of the axial plate, and the front and rear hubs of the cylinder. Fourteen steel thrust races, including a basic "zero" race, are available in 0.013 mm (0.0005-inch) increments. Use J 9661-01 for gaging the shoe disc size. Use J 8001 to determine the thrust race size.

1. Measure the clearance between the rear ball of the No. 1 piston and axial plate in the following manner:
   a. Select a combination of oiled feeler gage leaves to fit snugly between the ball and axial plate.
   b. Attach J 9661-01 to the feeler gage. A distributor point checking scale may be used.
   c. Pull on the spring scale to slide the feeler gage stock out from between the ball and axial plate. Note the reading on spring scale as the feeler gage is sliding out (figure 32). The reading should be between 1.1 and 2.2 N (4 and 8 ounces).
   d. If the reading in step c above is under 1.1 N (4 ounces) or over 2.2 N (8 ounces), reduce or increase the thickness of the feeler gage leaves and repeat steps a through c to obtain a reading of 1.1 N to 2.2 N (4 to 8 ounces). Record the clearance between the ball and axial plate that results in the 1.1 N to 2.2 N (4 to 8 ounces) pull on the spring scale.
2. Rotate the shaft 120 degrees and repeat for the No. 2 cylinder.
   - If the shaft is hard to rotate, install the shaft nut onto the shaft and turn the shaft with a wrench.
3. Rotate the shaft another 120 degrees and repeat for cylinder No. 3.
4. Select a numbered shoe disc corresponding to the minimum feeler gage reading recorded in the three checks:
   - Place the shoe discs in J 9402 compartment with the discs corresponding to piston No. 1 and the rear ball pocket position.
   - Shoe discs are available in 0.013 mm (0.0005-inch) variations. Eleven sizes are available for field servicing. Shoe discs are marked with the shoe size which corresponds to the last three digits of the part number (figure 33).

	Position 1	Position 2	Position 3	Select and Use Shoe No.
Piston No. 1	.019"	.0195"	.019"	19
Piston No. 2	.020"	.020"	.020"	20
Piston No. 3	.021"	.021"	.022"	21

T2500

SHOE DISC

Part No. Ending In	Identification Stamp	Min. Feeler Gage Reading
000	0	.0000
175	17½	.0175
180	18	.0180
185	18½	.0185
190	19	.0190
195	19½	.0195
200	20	.0200
205	20½	.0205
210	21	.0210
215	21½	.0215
220	22	.0220

THRUST BEARING RACE

Part No. Ending In	Identification Stamp	Dial Indicator Reading
000	0	.0000
050	5	.0050
055	5½	.0055
060	6	.0060
065	6½	.0065
070	7	.0070
075	7½	.0075
080	8	.0080
085	8½	.0085
090	9	.0090
095	9½	.0095
100	10	.0100
105	10½	.0105
110	11	.0110
115	11½	.0115
120	12	.0120

F1398

Figure 33—Service Shoes and Thrust Washers

- After selecting the shoe size, the matched combination of the shoe disc to the rear ball spherical cavity in the piston must be kept in the proper relationship during disassembly after performing the gaging operation and the final assembly of the internal mechanism.

5. Repeat the gaging procedure for pistons Nos. 2 and 3.
6. Mount a dial indicator on the edge of J 9397 with J 8001.
7. Position the dial indicator on the rear of the shaft (39) and adjust to zero (figure 34).
   - From the bottom, apply full hand force at the end of the shaft a few times before reading the clearance. This will squeeze the oil out from between the mating parts. Now push upward and record the measurement. Dial indicator increments are 0.03 mm (0.001-inch); estimate the reading to the nearest 0.013 (0.0005-inch).
   - An alternate method is to use J 9661-01 in selecting a suitable feeler gage leaf until the result is a 1.1 N to 2.2 N (4 to 8 ounces) pull

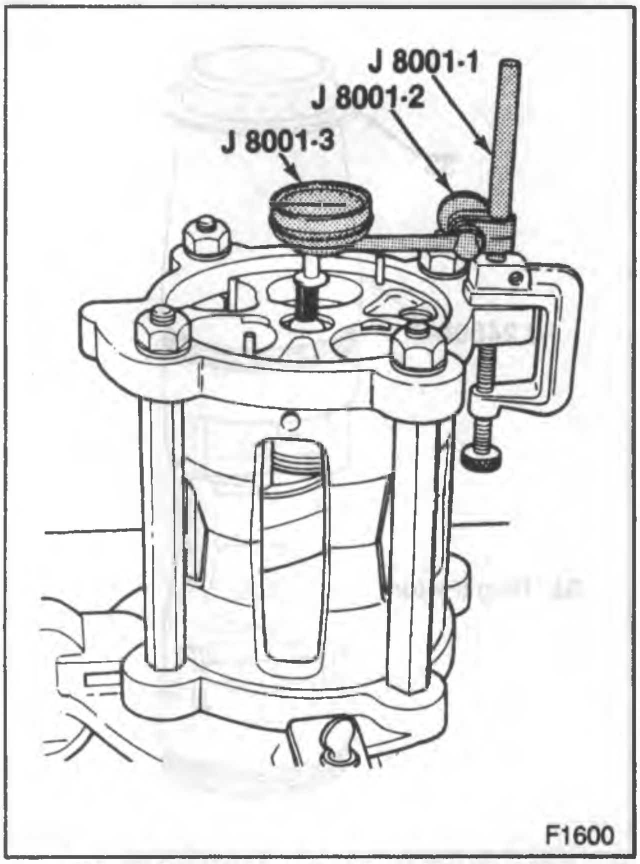


Figure 34—Gaging the Rear Thrust Plate

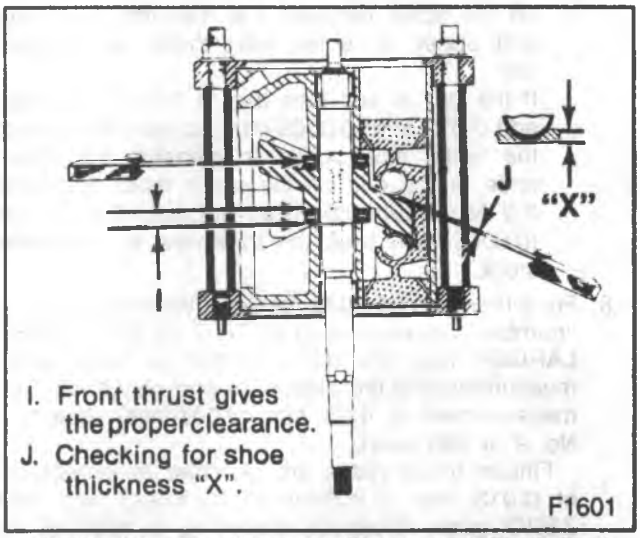


Figure 35—Checking the Piston and Shaft End Play

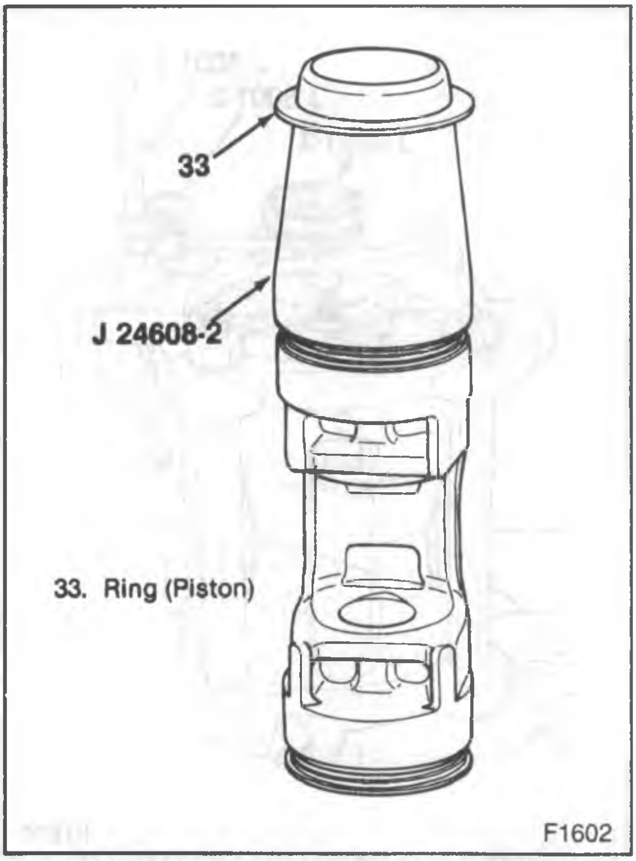


Figure 36—Piston Ring Position and Installer Guide

on the scale between the rear thrust bearing and upper (or outer rear) thrust race (figure 35).

If the pull is just less than 1.1 N (4 ounces), add 0.013 mm (0.0005-inch) to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 2.2 N (8 ounces), then subtract 0.013 mm (0.0005-inch) from the thickness of the feeler stock.

8. For either method used, select a thrust race with a "number" corresponding to TWO (2) FULL SIZES LARGER than the dial indicator or feeler gage measurement of the amount of end play shown. (If measurement is 0.18 mm (0.007-inch), select a No. 9 or 090 race).

   Fifteen thrust races are provided in increments of 0.013 mm (0.0005-inch) thickness and one ZERO gage thickness providing a total of 16 sizes. The thrust race "number" corresponds to the last three digits of the part number. Refer to figure 33.
9. Remove the nuts from the top plate of the J 9397.
10. Remove the top plate.
11. Separate the cylinder halves while the unit is in the fixture.
    - If necessary, use a wood block and a mallet.
12. Remove the rear cylinder half; remove one piston at a time from the axial plate and front cylinder half.
    - Do not lose the relationship of the front ball and shoe disc and rear ball.
    - Transfer each of the piston, ball and shoe disc sets to J 9402.
13. Remove the rear outer "zero" thrust race (it will be on top) from the shaft and install the thrust race just selected in Steps 6 and 7 that is in J 9402.
    - The "zero" thrust race may be put aside for reuse in additional gaging or rebuilding operations.

PISTON RING REPLACEMENT

Remove or Disconnect (Figures 1, 36 through 39)

Tool Required:
J 24608 Teflon Piston Ring Installer

- Piston rings (33) and (37).
  - Slice through the ring with a knife while holding the blade flat with the piston surface.
  - Do not damage the aluminum piston (32) or piston groove.

Clean

- The piston and piston ring grooves with a recommended cleaning solvent (trichloroethane, naptha, Stoddard solvent, kerosene, or equivalent) and blow the piston dry with dry air.

Install or Connect (Figures 1, 36 through 39)

1. Piston (32) to J 24608-2 (figure 36).
   - Set the piston on a clean, flat surface.
2. Piston ring (33) to J 24608-2.
   - Place the dished or dull side down and the glossy side up.
3. Piston ring (33) to piston (32) (figure 37).
   - Push J 24608-5 (installer) down over J 24608-2 (guide).
   - If the piston ring is off-positive in the groove, reposition by moving with a fingernail or a blunt-edge tool.
   - J 24608-5 (installer) will keep the J 24608-2 (guide) inside when the piston ring is installed on the piston (32).
   - Remove the guide from the installer and do not store the guide in the installer because the seal will be stretched and weakened during storage. This can cause the seal not to hold the ring installer segments tight enough to the J 24608-2 (guide) when installing the piston ring (33) to the piston (32).
4. Piston (32) to J 24608-6 (figure 38).
   - Lubricate the piston ring (33) area with 525 viscosity refrigerant oil.
   - Rotate the piston (32) and ring (33) into J 24608-6 at a slight angle until the piston is inserted against the center stop of J 23608-6.

NOTICE: Do not push the piston and ring assembly into J 24608-6 without positioning and rotating because the needle bearings of the ring sizer may damage the end of the piston.

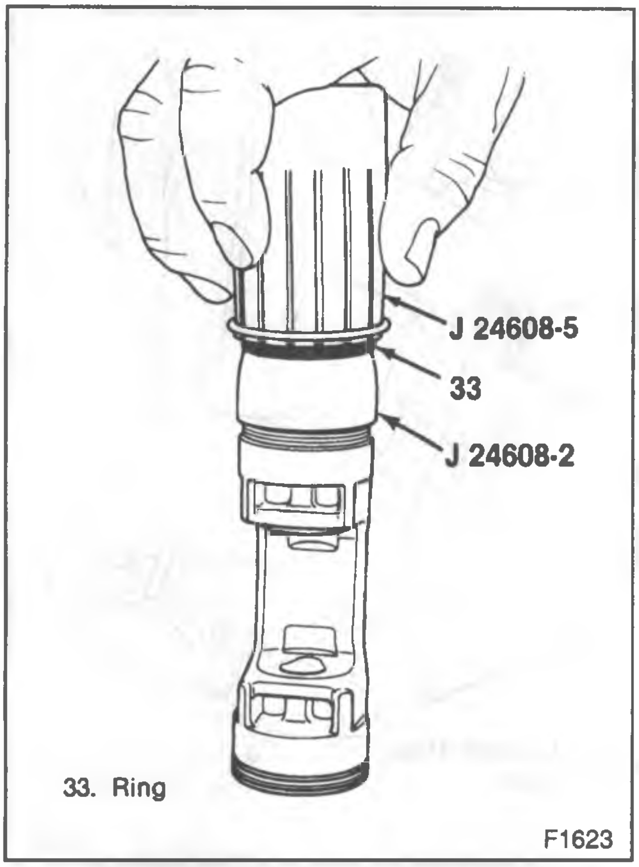


Figure 37—Installing the Piston Ring

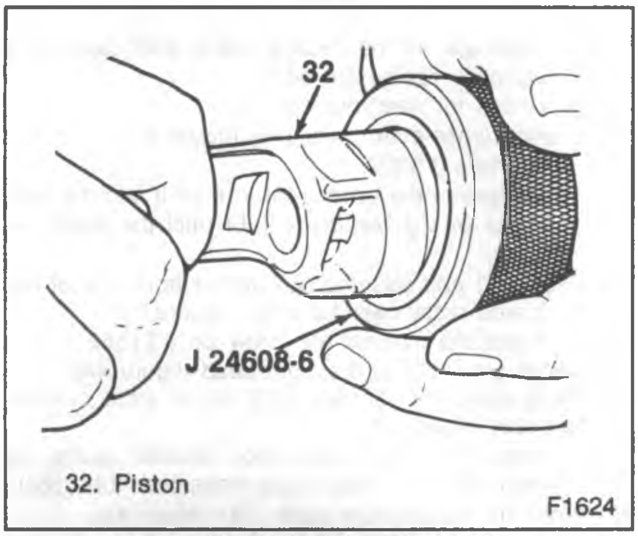


Figure 38—Sizing the Piston Ring

- Rotate the piston and ring assembly in J 24608-6 several turns until the assembly rotates relatively free in the ring sizer.

5. Piston (32) to J 24608-1 (figure 39).
   - The piston (32) should pass through the ring gage with a two to eight pound force.
6. Repeat for the opposite end of the piston (32).
7. Lubricate both ends of the piston (32) with 525 viscosity refrigerant oil before installing the piston into the cylinder bore.

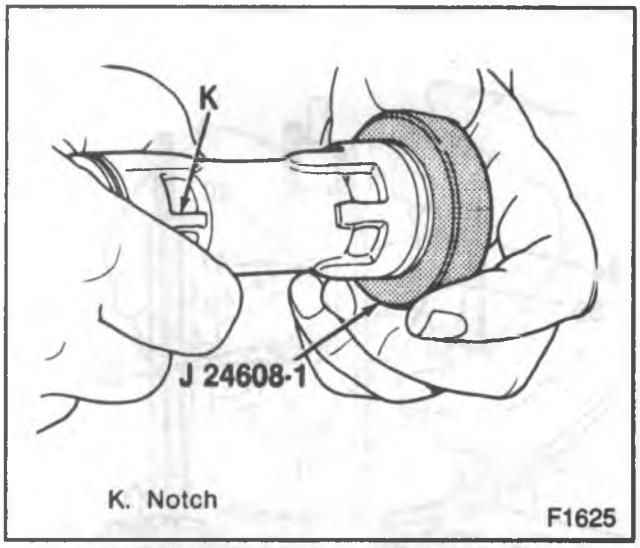


Figure 39—Gaging the Piston Ring Size

COMPRESSOR ASSEMBLY

Assemble the cylinder assembly after performing the "Gaging Procedure," choosing the correct shoe discs and thrust races and installing any piston rings. Install new seals supplied in the service kit.

Remove or Disconnect (Figures 1, 40 through 51)

- Support the front half of the cylinder (29) on J 9397.

1. Shaft and axial plate (38).
   - Place the shaft, threaded-end down, with the front bearing race pack (race and bearing) into the cylinder if this was not done at the end of the "Gaging Procedure."
2. Balls (32) and shoe discs (33) to the pistons (30).
   - Apply a coat of petroleum jelly to the "numbered" shoe discs.
3. Piston assembly (30) into the front cylinder half (29) (figure 40).
   - Rotate the axial plate (39) to place the high point above cylinder bore No. 1.
   - Hold the front thrust bearing pack against the axial plate hub.
   - Repeat for pistons Nos. 2 and 3.
4. Discharge the cross-over tube (26) (figure 41).
   - Face the flattened portion of the tube to the inside of the compressor to allow for axial plate clearance.
5. Rear cylinder half (42) over the shaft (39).
   - Rotate the shaft (39) to position the pistons in a stair-step arrangement.
   - Start the pistons into the cylinder bores.
6. Discharge cross-over tubes (26) into the rear half of the cylinder (29).
7. Rear cylinder half (42) over the locating dowel pins (45).
   - After aligning, tap the rear half of the cylinder with a mallet and wood block.
   - If necessary, clamp the cylinder in J 9397 to draw the halves together.

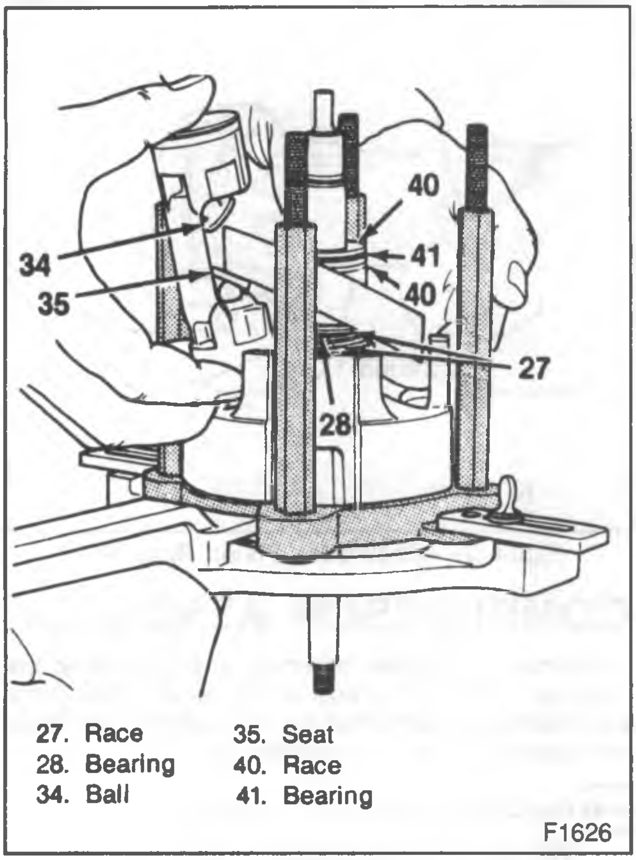


Figure 40—Installing No. 1 Piston

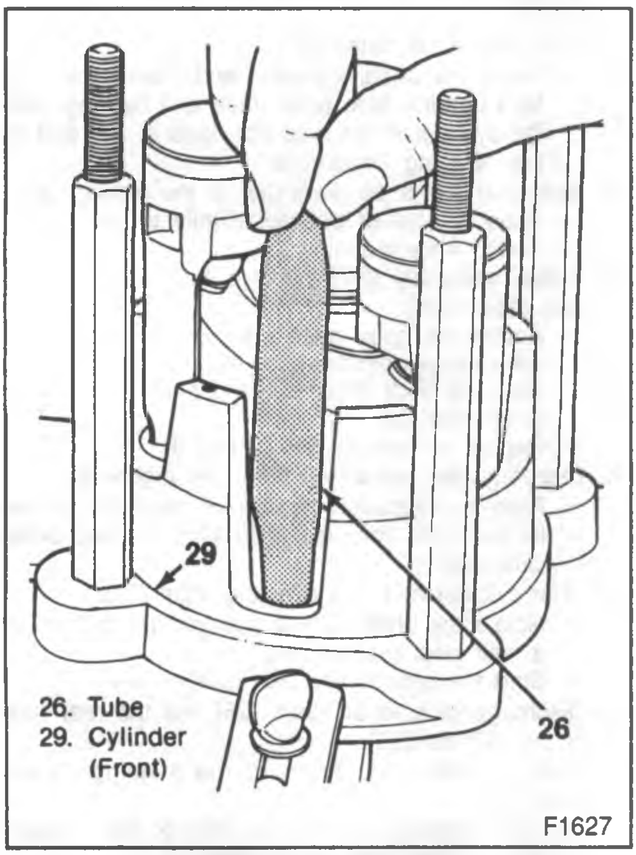


Figure 41—Installing the Discharge Crossover Tube

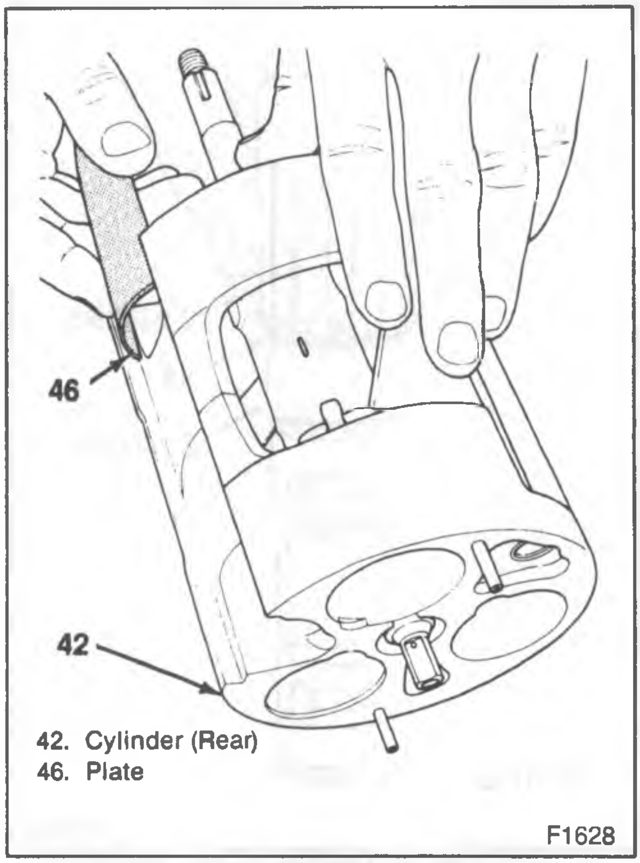


Figure 42—Installing the Suction Crossover Tube Plate

- Lubricate all the moving parts with clean 525 viscosity refrigerant oil.
- Check for free rotation.

8. Suction cross-over cover (46) (figure 42).
   - Remove J 9397.
   - Compress the cover (46) to start it into the slot.
   - Press or top the cover (46) until the ends are flush.
9. Seal 925) and bushing (24) to the front end of the discharge cross-over tube (26) (figure 43).
   - Place the internal assembly on J 21352.
10. Dowel pins (20) to the front head (figure 44).
11. Front suction reed plate (19) to the front cylinder half (29) (figure 44).
    - Align the dowel pins (20), suction ports, oil return slot and discharge cross-over tube (26).
12. Front discharge valve plate (18) (figure 45).
    - Align the holes with the dowel pins (20) and the openings in the front suction reed plate (18). The front discharge plate (18) has a large hole in the center.
13. Front head (16) (figure 46).
    - Coat the sealing surfaces on the webs of the compressor front head casting with clean 525 viscosity refrigerant oil.
    - Determine the position of the front head (16) in relation to the dowel pins (20).
    - Mark the position of the dowel pins (20) on the sides of the front head (16) and on the sides of the internal assembly with a grease pencil.
    - Lower the front head (16).

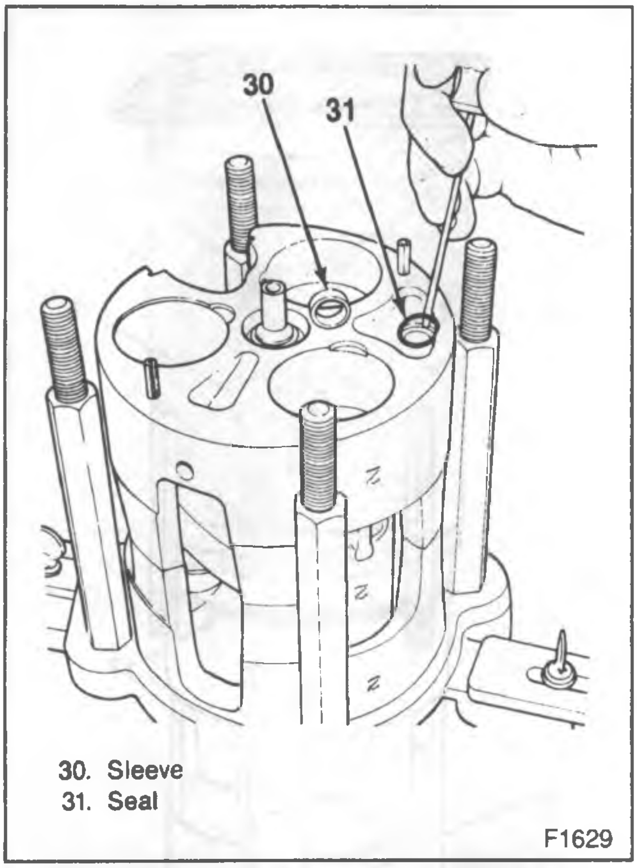


Figure 43—Installing the Discharge Crossover Tube

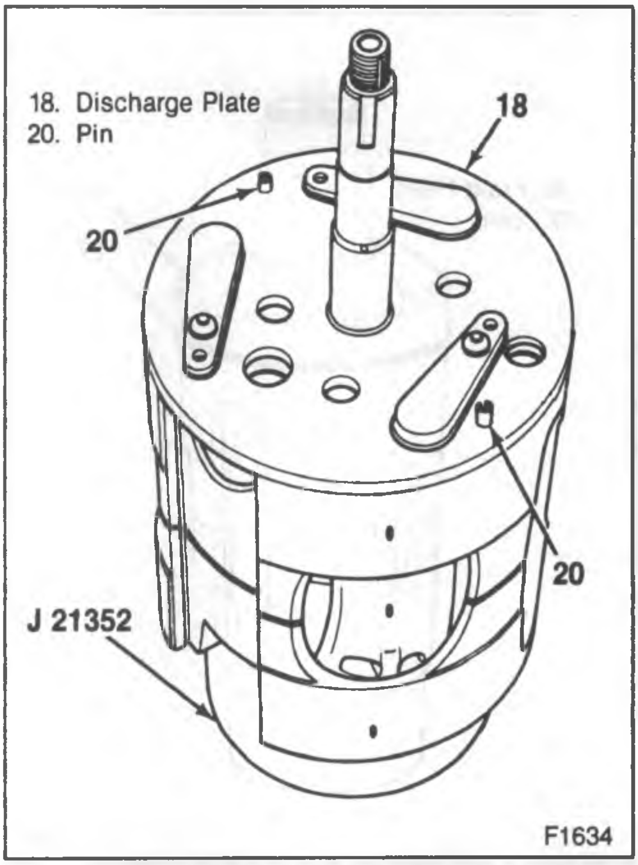


Figure 45—Installing the Front Discharge Valve Plate

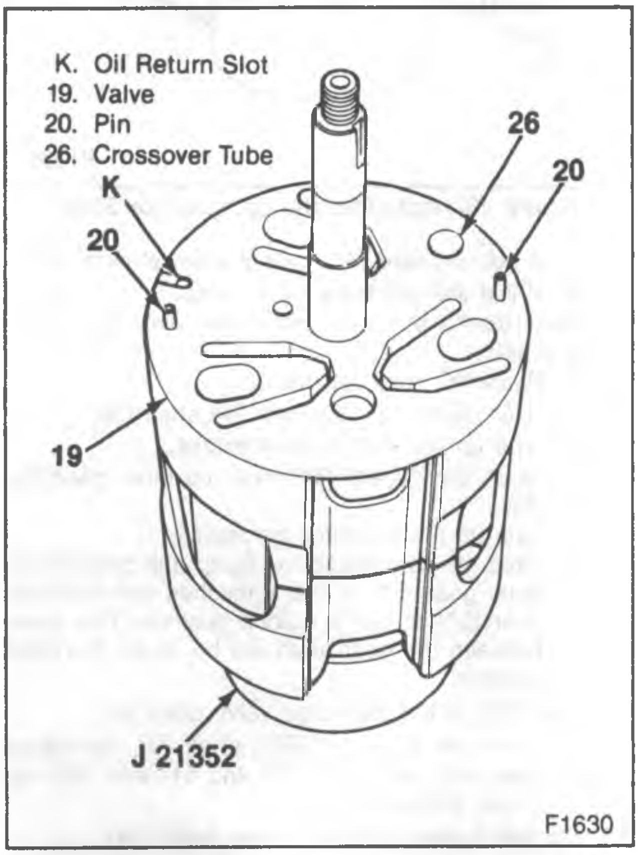


Figure 44—Installing the Front Suction Reed Plate

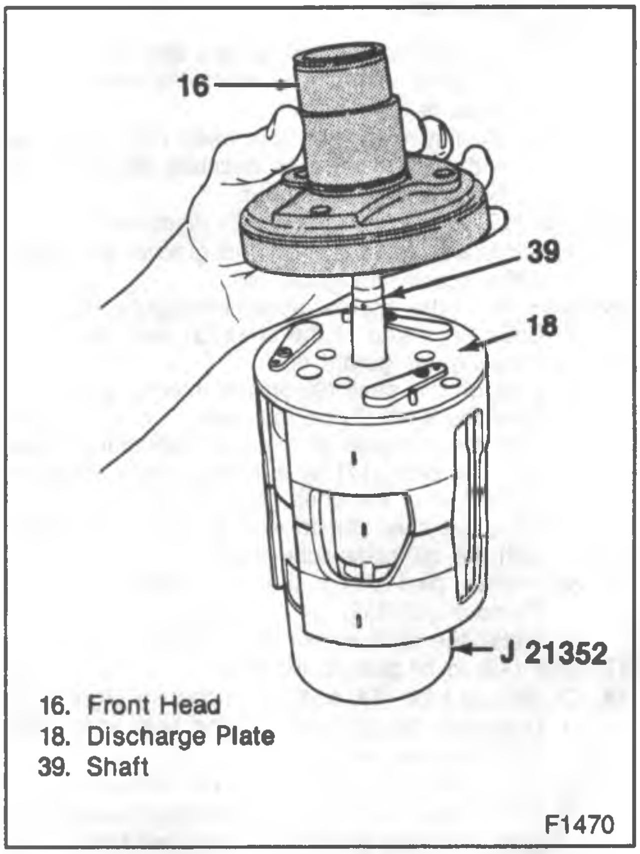


Figure 46—Installing the Front Head

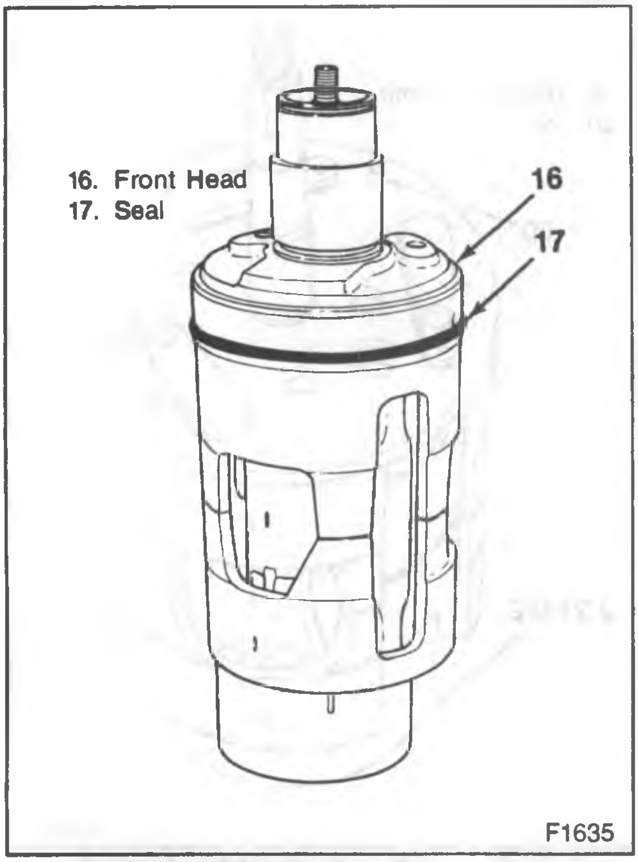


Figure 47—Installing the Front Head Seal

Important

- Do not let the sealing area around the center bore of the head touch the shaft as the head is lowered.
- Do not rotate the front head (16) to line up with the dowel pins because this will contact the reed container.

14. Seal (17) to the front head (16) (figure 47).
    - Lubricate the seal (17) and groove with clean 525 viscosity refrigerant oil.
15. Shell (9) to the internal assembly (figure 48).
    - Coat the inside of the shell (9) with clean 525 viscosity refrigerant oil.
    - Position the shell (9) on the internal assembly. Rest the shell (9) on the seal.
    - With the flat side of a small screwdriver, position the seal (17) in a round, circle shape to the inside of the shell (9).
    - Slide the shell (9) down. Line up the oil sump with the oil intake tube hole.
16. New dowel pins (20) to the rear cylinder half.
    - Remove J 21352.
    - Install the compressor into J 9396.
17. Seal (43) to oil pick-up tube (44).
18. Oil pick-up tube (44) to the compressor (figure 49).
    - Lubricate the oil pick-up tube (44) with clean 525 viscosity refrigerant oil.
    - Place the oil pick-up tube (44) in the cavity.
    - Rotate the compressor assembly to align the tube (44) with the hole in the shell baffle.
19. Seal (31) and bushing (30) to the rear of the discharge cross-over tube (26).

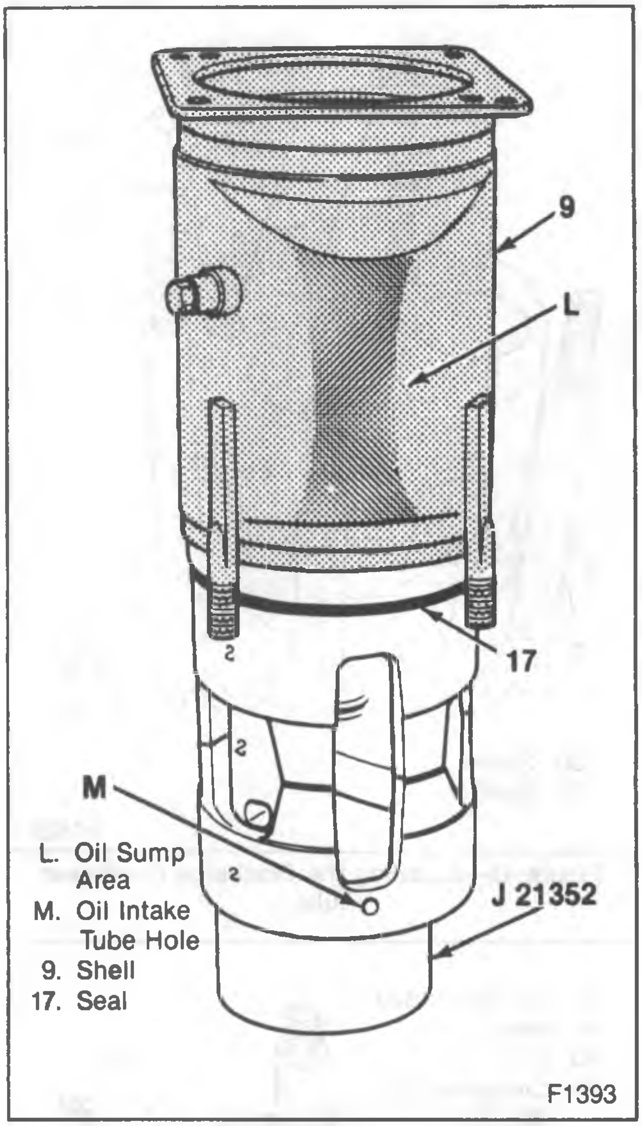


Figure 48—Installing the compressor Shell

20. Rear suction reed (48) over the dowel pins (45).
    - Place the slot toward the sump.
21. Rear discharge valve plate (49) over the dowel pins (45).
    - Place the reed retainer up.
22. Inner oil pump gar (50) over the shaft (39).
    - Line up the identification marks.
23. Outer oil pump gear (51) over the inner gear (figure 50).
    - Line up the identification marks.
    - Face the compressor oil sump and position the outer gear (51) so that it meshes with the inner gear (50) at the 9 o'clock position. The cavity between the gear teeth will be at the 3 o'clock position.
24. Seal (52) to the discharge valve plate (49).
    - Lubricate the seal (52), shell (9), discharge plate (49) and gears (50 and 51) with 525 viscosity refrigerant oil.
25. Suction screen (58) to the rear head (54).
    - Lubricate the surface of the rear head (54) with 525 viscosity refrigerant oil.

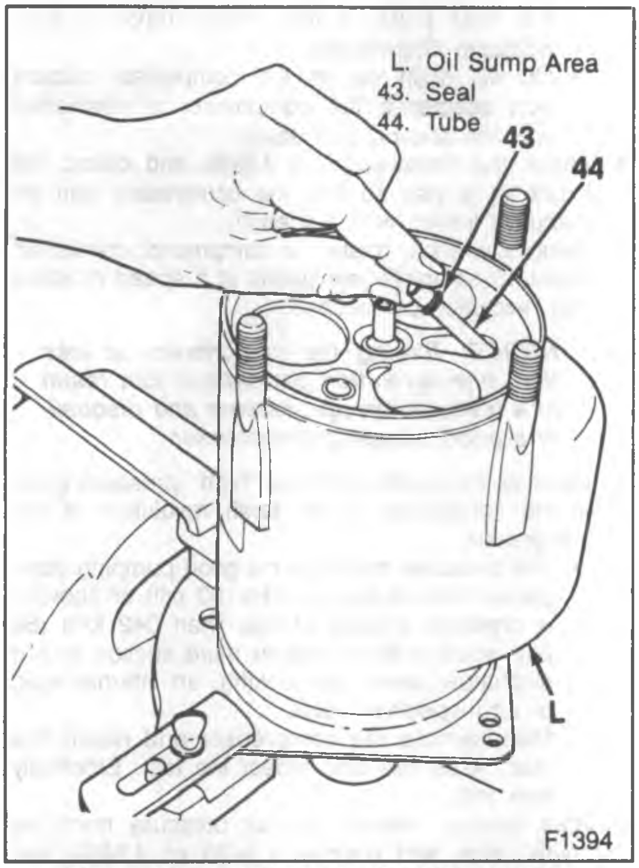


Figure 49—Installing the Oil Pick-Up Tube

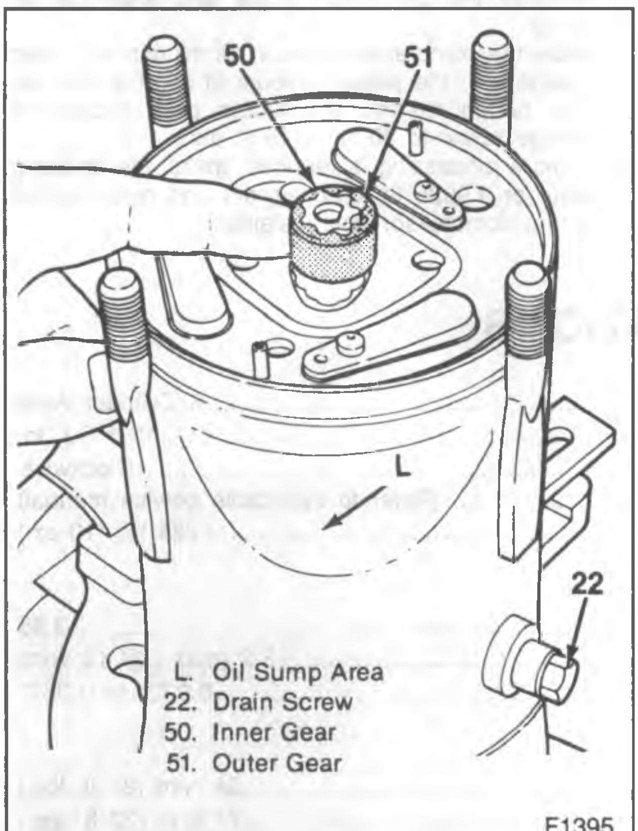


Figure 50-Position The Oil Pump Gears

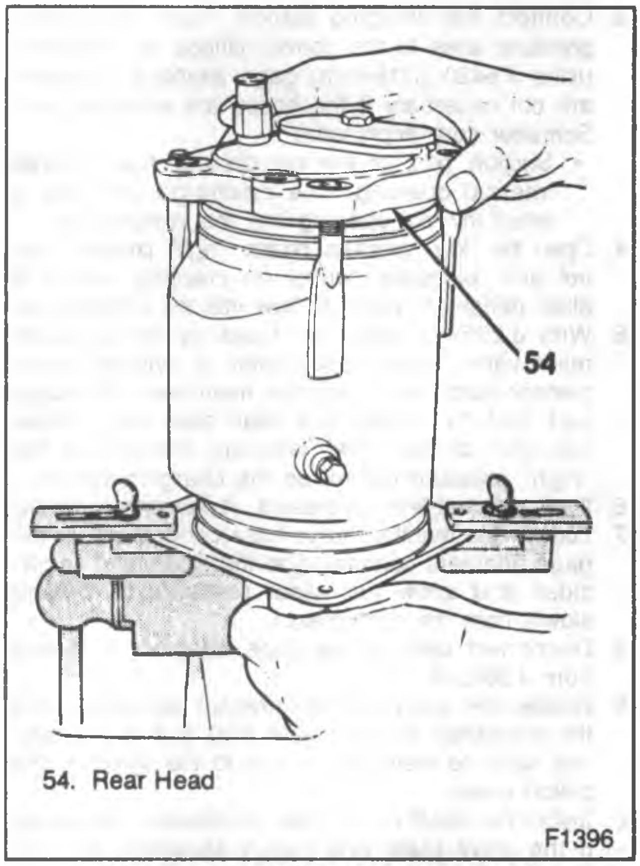


Figure 51-Installing The Rear Head

26. Rear head (54) to the shell (9) (figure 51).
    - Align the two lower threaded compressor mounting holes with the compressor sump.
    - Do not let the suction screen (58) fall out of the rear head (54).
    - If the rear head (54) will not slide down over the dowel pins (45), twist the front head (16) back and front by hand until the rear head (54) drops over the dowel pins (45).

Tighten

- Nuts (53) to 35 N·m (25 ft. lbs.).

27. Shaft seal (14).
    - Invert the compressor in J 9396.
28. Clutch coil (8).
29. Pulley (6).
30. Clutch (2).
31. Add the required amount of 525 viscosity refrigerant oil to the compressor.
32. Leak Test.
    Refer to "Leak Testing."

LEAK TESTING

Tools Required:

J 5420 Straight Adapter
J 9396 Compressor Holding Fixture
J 9459 90 Degree Adapter
J 9625-A Pressure Test Set with Schrader Valves

1. Install J 9625 on the rear head of the compressor.
2. Attach a center hose of manifold gage set on to a charging station with a refrigerant drum standing in an upright position and open the valve on the drum.

3. Connect the charging station "high" and "low" pressure lines to the correct fittings on J 9625-A, using J 5420 (7/16-inch) gage adapters. Adapters are not necessary if the hoses are equipped with Schrader core depressors.
   - Suction port of the compressor has a large internal opening. The discharge port has a small internal opening into the compressor.
4. Open the "low" pressure control, "high" pressure control and refrigerant control on charging station to allow refrigerant vapor to flow into the compressor.
5. With J 29547, check for leaks at the pressure relief valve, compressor shell to cylinder, compressor front head seal, rear head seal, oil charge port, and the compressor shaft seal. After checking, shut off the "low" pressure control and the "high" pressure control on the charging station.
6. If an external leak is present, repair and recheck.
7. Loosen the manifold gage hose connections to the gage adapters connected to the "low" and "high" sides and allow the vapor pressure to release slowly from the compressor.
8. Disconnect both of the gage adapters or hoses from J 9625-A.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) end to end several turns to distribute the oil to the cylinder and piston areas.
10. Install the shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft several turns to ensure the piston assembly lubrication.
12. Connect the charging station "high" pressure line or a "high" pressure gage and J 5420 or J 9459 to the J 9625 high side connector.
13. Attach J 5420 or J 9459 to the suction or "low" pressure port on J 9625-A to open the Schrader-type valve to atmosphere.
    - Gage adapters are not required to connect to the test plate if the hoses have built-in Schrader depressors.
    - Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port down.
14. Attach the compressor to J 9396 and clamp the fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft about 10 complete revolutions at a speed of about one revolution per second.

    NOTICE: Turning the compressor at less than one revolution per second can result in a lower pump up pressure and disqualify a good pumping compressor.

16. Observe the reading on the "high" pressure gage at the completion of the tenth revolution of the compressor.
    - The pressure reading for a good pumping compressor should be 430 kPa (60 psi) or above.
    - A pressure reading of less than 342 kPa (50 psi) would indicate one or more suction and/or discharge valves are leaking, an internal leak, or an inoperative valve.
    - Disassemble the compressor and repair the leak. Assemble and repeat the test. Externally leak test.
17. After testing, release the air pressure from the "high" side and remove J 5420 or J 9459 and J 9625-A.
18. Remove the oil charge screw and drain the oil sump.
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The new oil may be poured into the suction port. Torque the charge screw to 20 N·m (15 ft. lbs.).
20. If more processing is required, install the shipping plate or J 9625 to keep air, dirt and moisture out of the compressor until installed.

SPECIFICATIONS

COMPRESSOR

Type—Harrison A-6 Compressor	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise
Belt Tension	(Refer to applicable service manual)
Oil Capacity	0.284 Kg (10 oz.)

COMPRESSOR CLUTCH COIL

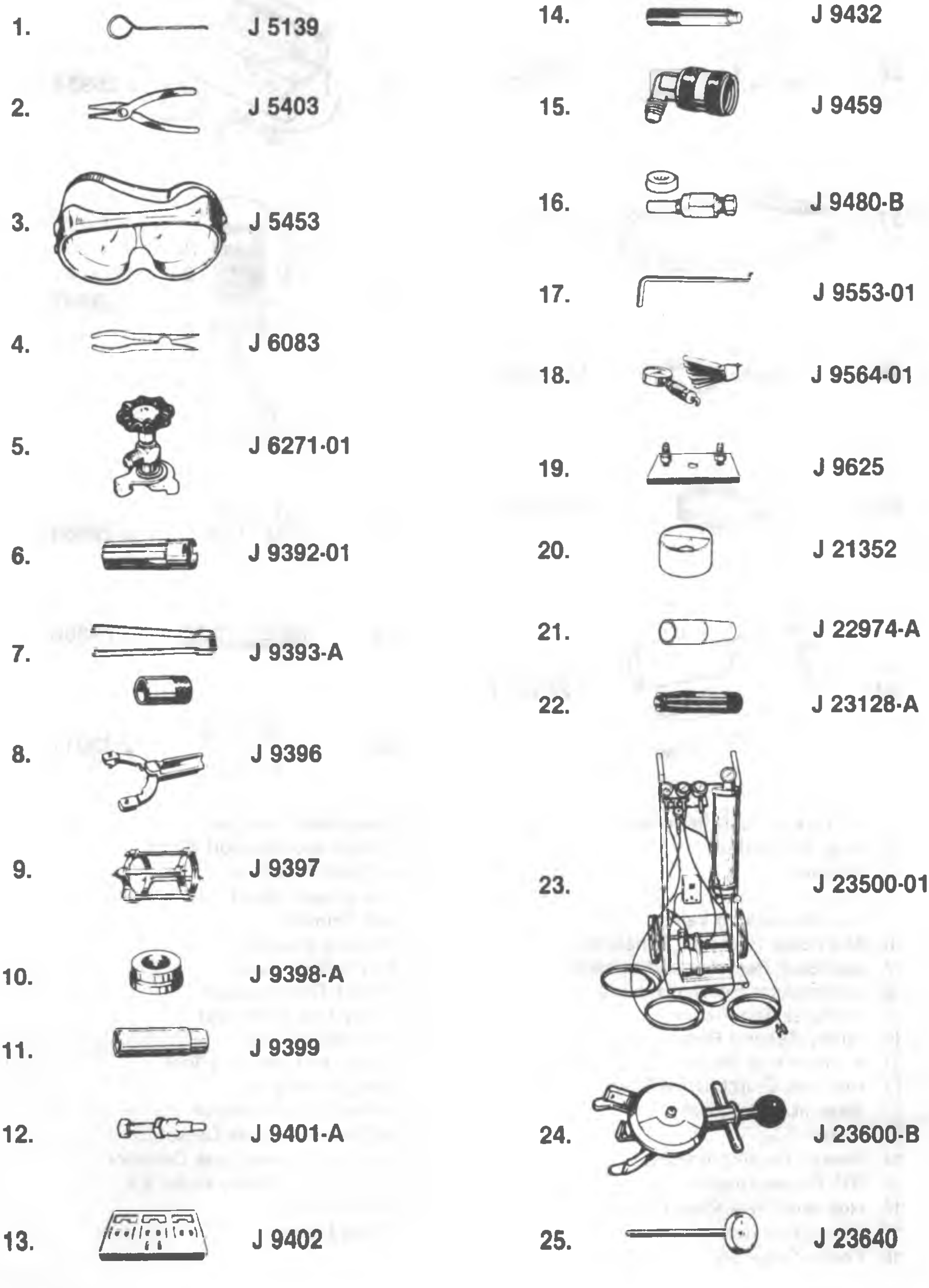
Ohms at 26°C (80°F)	3.85
Amps at 26°C (80°F)	3.2 (max.) @ 12 volts
Clutch	0.022" to 0.057"

TORQUE SPECIFICATIONS

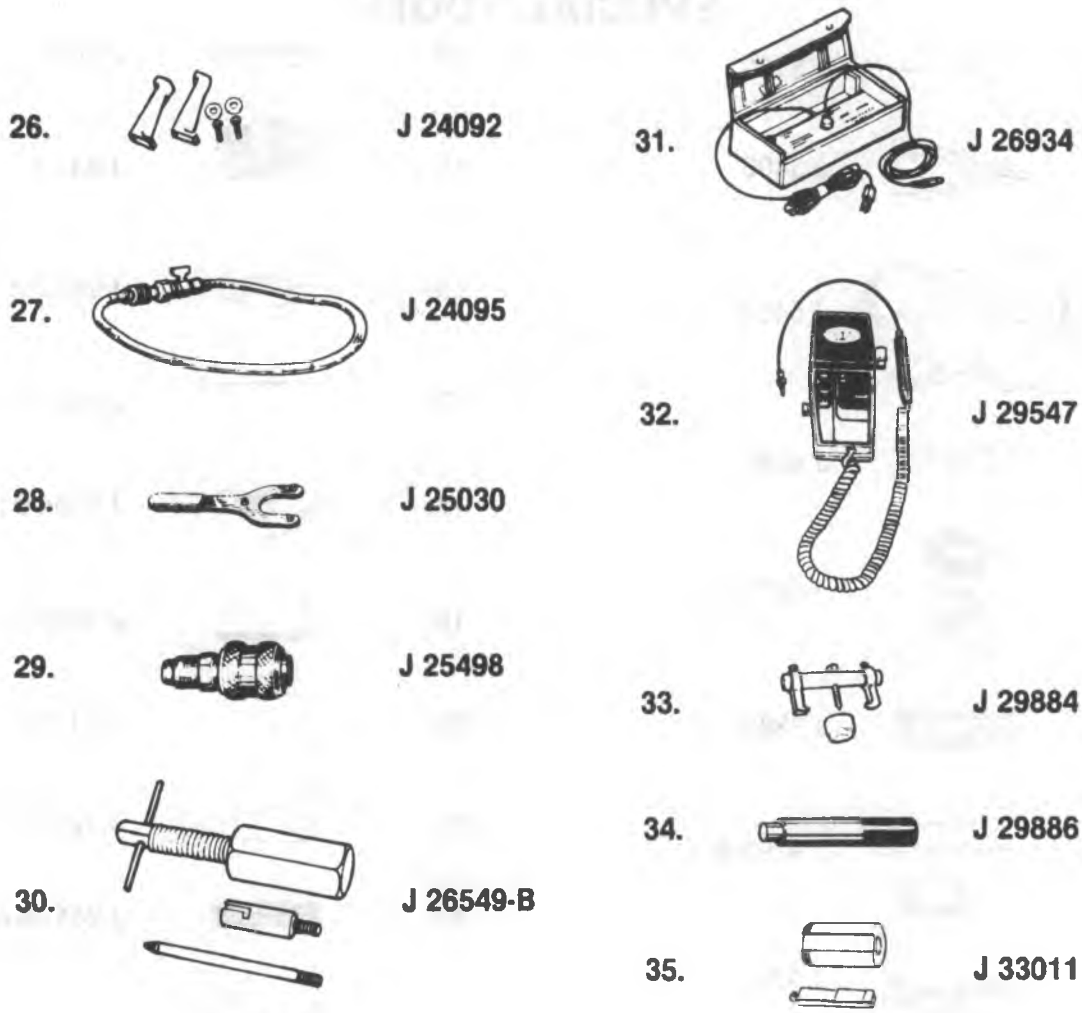
Rear Head to Shell Stud Nuts	34 N·m (25 ft. lbs.)
Shaft Mounting Nut	27 N·m (20 ft. lbs.)
Pressure Relief Valve	19 N·m (14 ft. lbs.)
Oil Drain Screw	20 N·m (15 ft. lbs.)

T2501

SPECIAL TOOLS



F4589



1. Oil Pickup Tube Remover
2. Snap Ring Pliers
3. Goggles
4. Snap Ring Pliers
5. R-12 Dispensing Valve
6. Shaft Seal Remover & Installer
7. Seal Seat Remover and Installer
8. Compressor Holding Fixture
9. Compressing Fixture
10. Pulley Bearing Remover
11. 9/16-Inch Nut Socket (Thin Walled)
12. Hub and Clutch Drive Plate Assembly Remover
13. Piston Tray
14. Needle Bearing Installer
15. 90° Elbow Adapter
16. Hub and Drive Plate Installer
17. O-ring Remover
18. Feeler Gage Set
19. Compressor Test Set
20. Compressor Support Block
21. Oil Seal Protector
22. Compressor Shaft Seal Installer and Remover
23. Portable Charging Station
24. Belt Tension Gage
25. Pocket Thermometer
26. Pulley Hub Puller Set
27. Oil Injector Line
28. Clutch Hub Holding Tool
29. Straight Adapter
30. Orifice Tube Extractor
31. A/C Powered Leak Detector
32. Battery Powered Leak Detector
33. Compressor Pulley Puller Kit
34. Driver Handle
35. O-ring Installer

F4590

SECTION 1B2

V5 AIR CONDITIONING COMPRESSOR

CONTENTS

V5 AIR CONDITIONING COMPRESSOR

DESCRIPTION

THEORY OF OPERATION

The V5 is a variable displacement compressor that can match all air conditioning demands under all conditions without cycling (figure 1). The basic compressor mechanism is a variable angle wobble-plate with five axially oriented cylinders. The center of control of the compressor displacement is a bellows actuated control valve located in the rear head of the compressor that senses compressor suction pressure. The wobble-plate angle and compressor displacement are controlled by the crankcase-suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point; the valve will maintain a bleed from crankcase to suction; no crankcase-suction pressure differential; and the compressor will have maximum displacement. When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The angle of the wobble-plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase-suction pressure differential creates a total force on the pistons resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

The crankcase-suction bleed is routed through the rotating wobble-plate for lubrication of the wobble-plate bearing. The rotation acts as an oil separator, which removes some of the oil from the crankcase-suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.

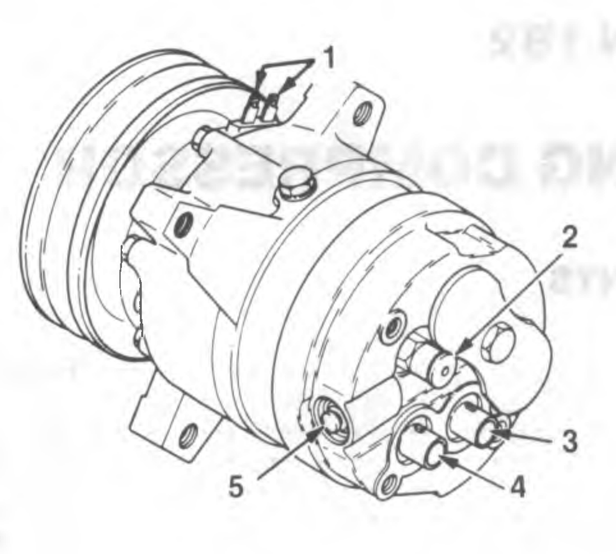
Up to 113 g (4 oz.) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor that the oil in the old compressor crankcase be drained through the drain plug and measured (discard after recording amount).

All replacement compressors will be shipped with 227 g (8 oz.) of oil in the crankcase. The oil must be drained and retained. Then replace the oil in the same amount as previously recorded from the old compressor. Refer to "Specifications."

IDENTIFICATION

An identification label attached to the compressor provides the name of the manufacturer, model number and build code.

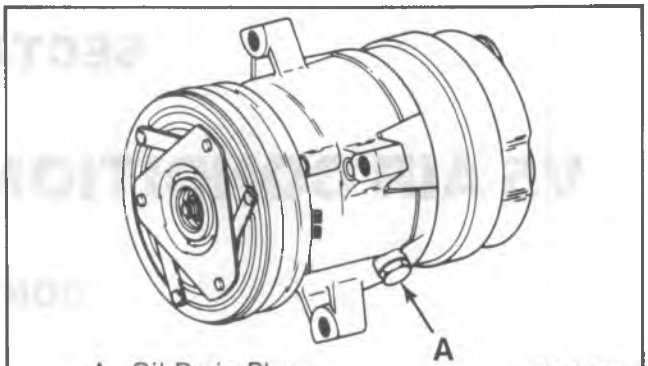
When servicing the V5 compressor, keep dirt and foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for



1. Clutch Coil Terminals
2. High Pressure Relief Valve
3. High Side Low Pressure Switch
4. High Side Cut-Off Switch
5. Compressor Control Valve

F-04535

Figure 1—Rear Head Details



A. Oil Drain Plug

F-04533

Figure 2—Mounting View

proper service. The compressor connections and the outside of the compressor should be cleaned before any "on vehicle" repairs, or before removal of the compressor.The parts must be kept clean at all times and any parts to be reassembled should be cleaned with Trichloroethane, naptha, stoddard solvant, kerosene or equivalent solvent and dried with dry air. Use only lint free cloths to wipe parts.

Drain the compressor and measure the amount of oil. Replace with new 525 viscosity refrigerant oil. Refer to "Specifications."

NOTICE: Remove the oil drain plug to make sure the compressor is drained completely of oil (figure 2).

MINOR REPAIR TO THE COMPRESSOR

CLUTCH PLATE AND HUB ASSEMBLY REPLACEMENT

Clean

- The compressor assembly with solvent and blow dry with dry air.

Remove or Disconnect (Figures 3, 4, and 5)

Tools Required:

J 33013-B Hub and Drive Plate Remover and Installer
J 33022 6-Point 13 mm Socket
J 33027 Clutch Hub Holding Tool
J 34992 Compressor Holding Fixture

- Clamp J 34992 in a vise and attach the compressor to the holding fixture with thumb screws.

1. Shaft nut (21) using J 33022 (figure 4).
   - Hold the clutch plate and hub assembly (22) using J 33027.
2. Clutch plate and hub assembly (22).
   - Thread J 33013-B into the clutch plate and hub assembly (22).
   - Hold the body of J 33013-B with a wrench and tighten the center screw into the remover body (figure 5).
3. Shaft key (23).
   - Retain shaft key (21) if useable.

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 3)

Tools Required:

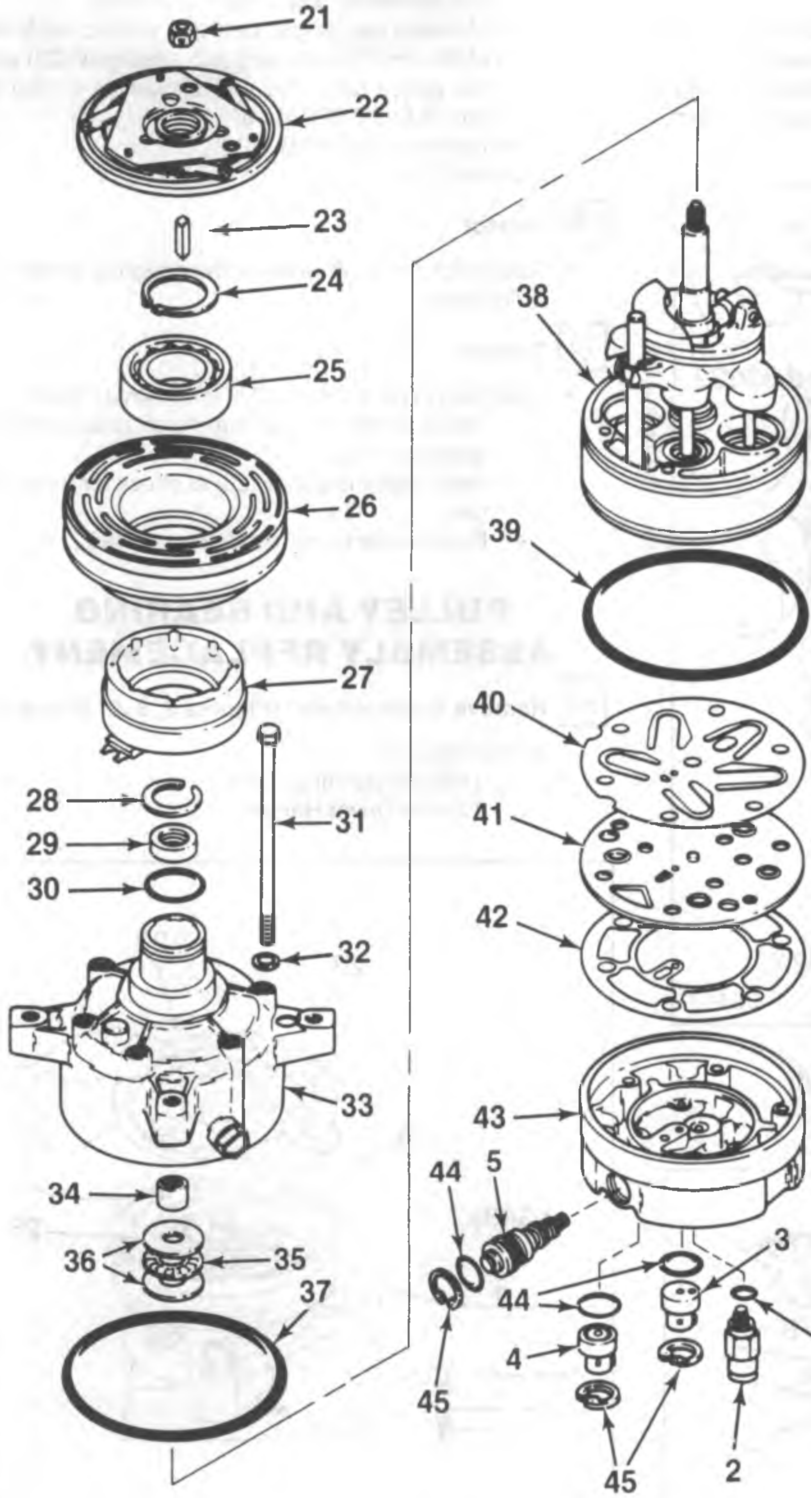
J 33013-B Hub and Drive Plate Remover and Installer
J 33022 6-Point 13 mm Socket
J 33027 Clutch Hub Holding Tool
J 34992 Compressor Holding Fixture

1. Shaft key (23).
   - Allow the shaft key (23) to extend 3.2 mm (1/8-inch) out of the bottom of the hub keyway (figure 6).
   - The shaft key (23) is curved slightly to give an interference fit in the groove.

Important

- Do not drive or pound on the clutch hub or the shaft. Internal damage to the compressor may result.

2. Clutch plate and hub assembly (22) (figure 7).
   - Make sure the contact surfaces of the clutch plate (22) and the pulley (26) are clean.
   - Remove the forcing screw tip from J 33013-B and reverse the body direction on the center screw.
   - Install J 33013-B with bearing (B) (figure 7).



2. High Pressure Relief Valve
3. High Side Low Pressure Valve
4. High Side Cut-Off Switch
5. Control Valve
21. Shaft Nut
22. Clutch Plate and Hub Assembly
23. Key
24. Pulley Bearing Retainer
25. Pulley Bearing
26. Pulley
27. Clutch Coil Assembly
28. Retainer
29. Seal
30. O-ring
31. Bolt
32. Gasket
33. Front Head
34. Shim
35. Bearing
36. Thrust Washer
37. Seal
38. Shaft and Cylinder Body
39. Seal
40. Suction Reed Plate
41. Valve Plate
42. Gasket
43. Rear Head
44. Seal
45. Retainer
46. Seal

F-06447

Figure 3—Compressor Components

- Back off J 33013-B body enough to allow the center screw to be threaded agianst the end of the compressor shaft.
- Hold the center screw with a wrench and tighten the hex portion of J 33013-B body while pressing the hub onto the shaft (38). After tightening the body several turns, remove J 33013-B and check that the shaft key (23) is properly in place in the keyway, then install the clutch plate and hub assembly (22) to its final position.
- Measure the air gap between contact surfaces of the clutch plate and hub assembly (22) and the pulley (26). The gap should be 0.38-0.64 mm (0.015-0.025-inch).
- Remove J 33013-B.

3. Shaft nut (21).

Inspect

- Position of the shaft (even with or slightly above the clutch hub).

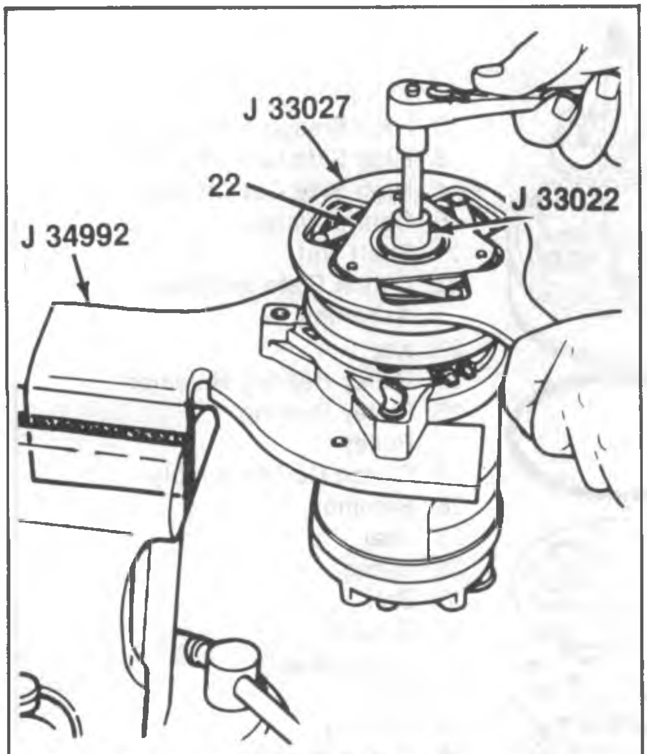
Tighten

- Shaft nut (21) to 17 N·m (12 ft. lbs.) with J 33022.
  — Use J 33027 to hold the clutch plate and hub assembly (22).
  — Hand spin the pulley (26) to check for free rotation.
  — Remove the compressor from J 34992.

PULLEY AND BEARING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 3, 8, 9, 10 and 11)

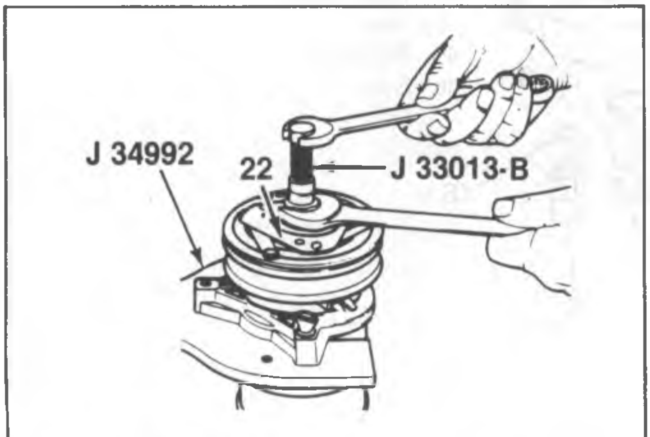
Tools Required:
J 6083 Snap Ring Pliers
J 29886 Driver Handle



22. Clutch Plate and Hub Assembly

F-06448

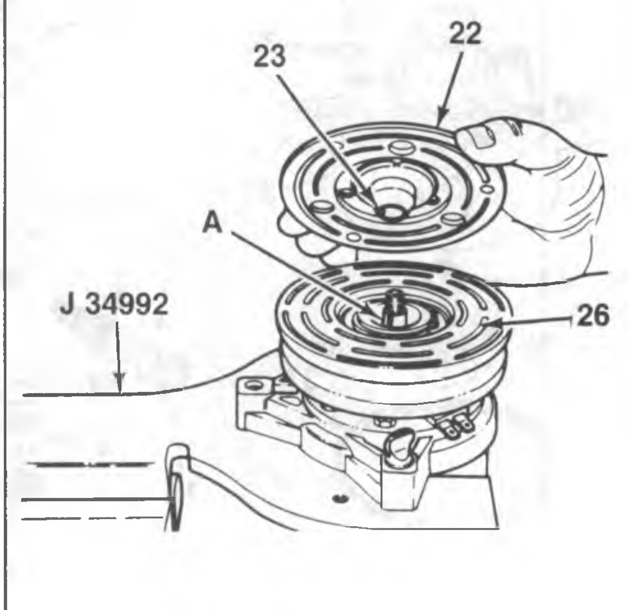
Figure 4—Removing the Shaft Nut



22. Clutch Plate and Hub Assembly

F-06449

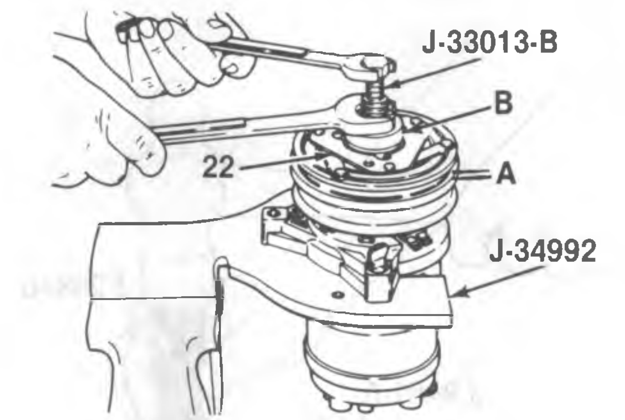
Figure 5—Removing the Clutch Plate and Hub Assembly



A. Keyway (Shaft)
22. Clutch Plate and Hub Assembly
23. Key
26. Pulley (Rotor)

F-06450

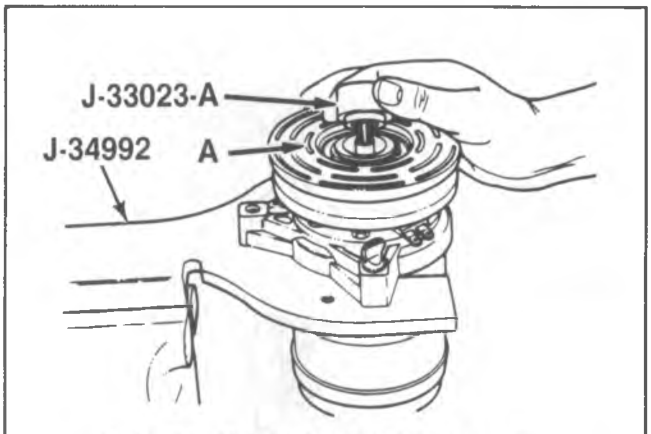
Figure 6—Removing the Clutch Plate and Hub and Shaft Key



22. Clutch Plate and Hub Assembly
A. Air Gap 0.38-0.64 mm (.015-.025-inch)
B. Bearing

F-04540

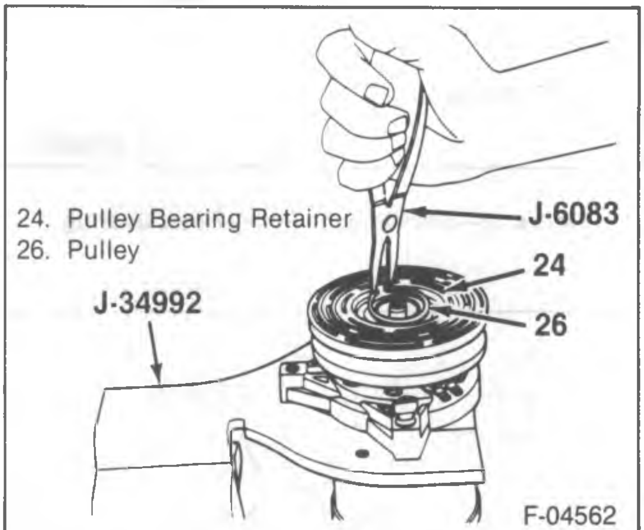
Figure 7—Installing the Clutch Plate and Hub Assembly



A. Pulley Puller J-33020 Engages in Inner Circle of Pulley Rotor Slots

F-04563

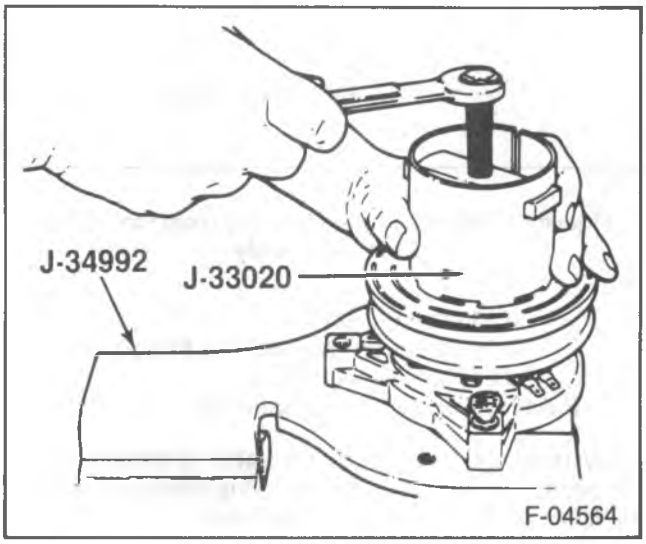
Figure 9—Installing the Pulley Rotor and Bearing Puller Guide



24. Pulley Bearing Retainer
26. Pulley

F-04562

Figure 8—Removing the Pulley Rotor and Bearing Assembly Retaining Ring



F-04564

Figure 10—Removing the Pulley Rotor and Bearing Assembly

J 9398-A Pulley Bearing Remover
J 33020 Pulley Puller
J 33023-A Puller Pilot

1. Clutch plate and hub assembly (22).
2. Pulley bearing retainer (24) using J 6083 (figure 8).
3. Pulley (26).
   - Install J 33023-A to the front head (figure 9).
   - Install J 33020 tangs into the inner circle of slots in the pulley (26) contact surface. Rotate J 33020 clockwise so the tangs will lock into the segments between the slots (figure 10).
   - Hold J 33020 in place and tighten the puller screw against J 33023-A puller pilot to remove the pulley (26) (figure 10).
4. Pulley bearing (25) from the pulley (26) using J 9398-A and J 29886 (figure 11).
   - Remove the forcing screw from J 33020 and with the puller tangs still in place in the pulley slots, turn the assembly upside down onto a flat surface (figure 11).
   - When removing the old pulley bearing (25), allow the staking to remain, then file away the old staked metal for proper fit when installing a new bearing (25) in the pulley bore.

Install or Connect (Figures 4, 12, 13, 14 and 15)

Tools Required:

J 6083 Snap Ring Pliers
J 8433 Puller Bar
J 9481-A Pulley Bearing Installer
J 29886 Threaded Driver Handle
J 33017 Pulley and Bearing Assembly Installer
J 33019 Bearing Staking Tool (with staking pin and retaining band)

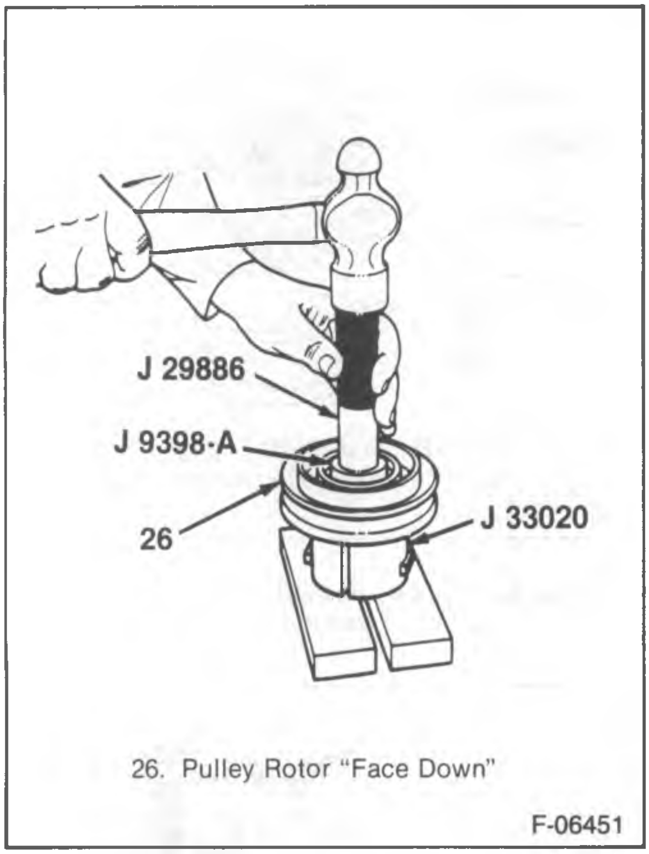


Figure 11—Removing the Bearing from the Pulley Rotor Assembly

J 33023-A Puller Pilot
J 34992 Compressor Holding Fixture
J 21352-A Support Block

1. Pulley (26) on J 21352-A (figure 12).

NOTICE: Do not support the rotor by resting the pulley rim on a flat surface during bearing installation or the rotor face will be bent.

2. Pulley bearing (25) into the hub using J 29886, J 9481-A and J 21352-A (figure 12).
   - J 33019 in the pulley bore (figure 12).
   - Seat the pulley and bearing assembly on J 21352-A to support to the hub under the staking pin location (figure 13).
   - Strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching the bearing.
     — Position the stake pin after striking.
     — The staked metal should not contact the outer race of the bearing to prevent the possibility of bending the outer race.
     — Stake 3 places 120 degrees apart (figure 14).
3. Pulley (26) on the front head.
   - Position J 33017 and J 33023-A over the inner race of the bearing (figure 15).
   - Position J 8433 on J 33023 and assemble the through bolts and washers through the puller bar slots and thread them into J 34992 (figure 15).

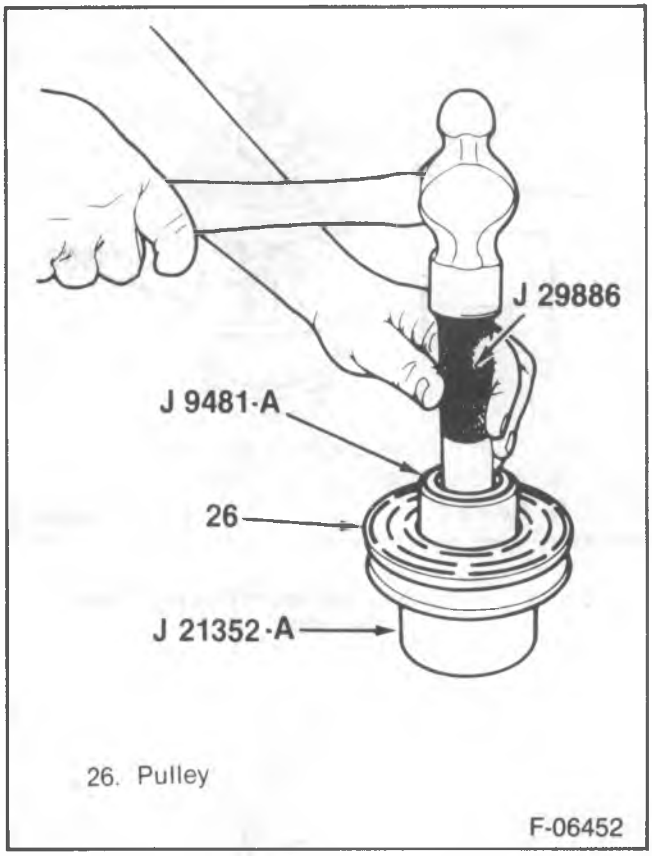


Figure 12—Installing the Pulley Rotor Bearing

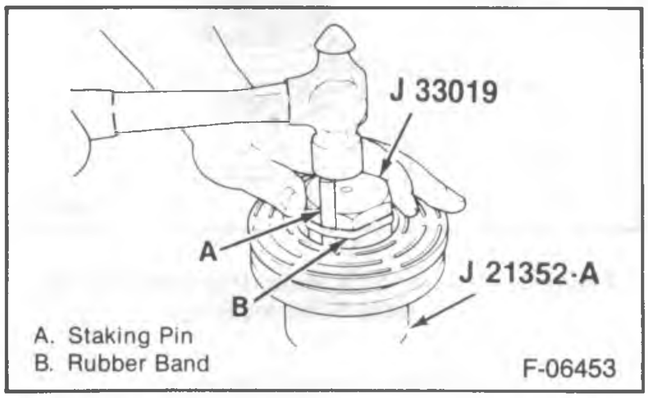


Figure 13—Staking the Pulley Bearing in the Pulley Bore

     — The thread of the through bolts should engage the full thickness of the compressor holding fixture.
   - Tighten the center screw in J 8433 to force the pulley and bearing assembly onto the compressor front head (33).
     — If J 33017 becomes misaligned with the inner race of the bearing, back off J 8433 and relocate center, then continue installation.
4. Pulley bearing retainer (24) using J 6083 (figure 8).
5. Clutch plate and hub assembly (22).

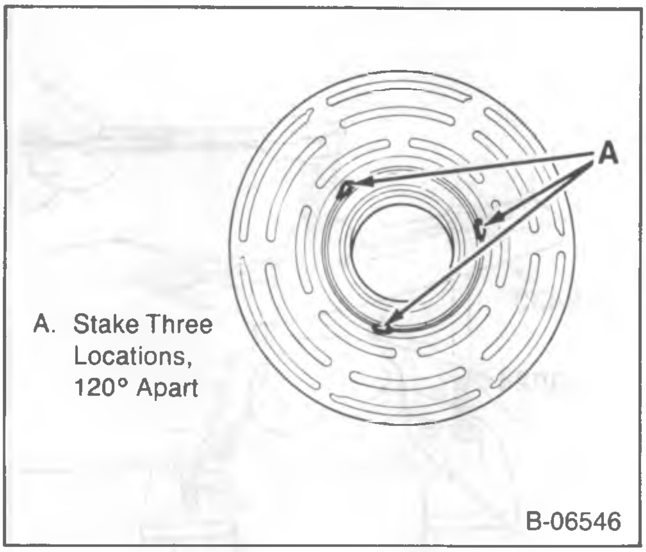


Figure 14—Bearing Stake Locations

CLUTCH COIL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 3 and 16)

Tools Required:
J 8433 Puller Bar
J 33023-A Puller Pilot
J 33025 Clutch Coil Puller Legs

1. Clutch plate and hub assembly (22).
2. Pulley (26).
   - Mark or scribe the location of the clutch coil (27) terminal on the compressor front head (33).
3. Clutch coil assembly (27).
   - Install J 33023-A on the head (33) of the compressor.
   - Install J 8433-1 with J 33025 (figure 16).
   - Tighten J 8433 forcing screw against J 33023-A.

Inspect

- Clutch coil assembly (27). Replace as necessary.

Install or Connect (Figures 3, 17, 18 and 19)

Tools Required:
J 8433 Puller Bar
J 33024 Clutch Coil Installer Adapter

1. Clutch coil assembly (27) onto the front head (33) with the terminals positioned at the "marked" location.
   - J 33024 over the internal opening of the clutch coil assembly (27) (figure 17).
   - J 8433 with through bolts, washers and forcing screw over J 33024.
   - Be sure J 8433 and the clutch coil assembly (27) stay "in line" during installation.
   - When the clutch coil assembly (27) is seated on the front head, use a 3 mm (1/8-inch) diameter drift punch to stake the head (33) at 3 places, 120 degrees apart to assure the clutch coil assembly (27) remains in position (figure 18).
     — Stake size should be one half the area of the punch tip and 0.28-0.35 mm (0.010-0.015-inch) deep (figure 19).
2. Pulley (26).
3. Clutch plate and hub assembly (22).

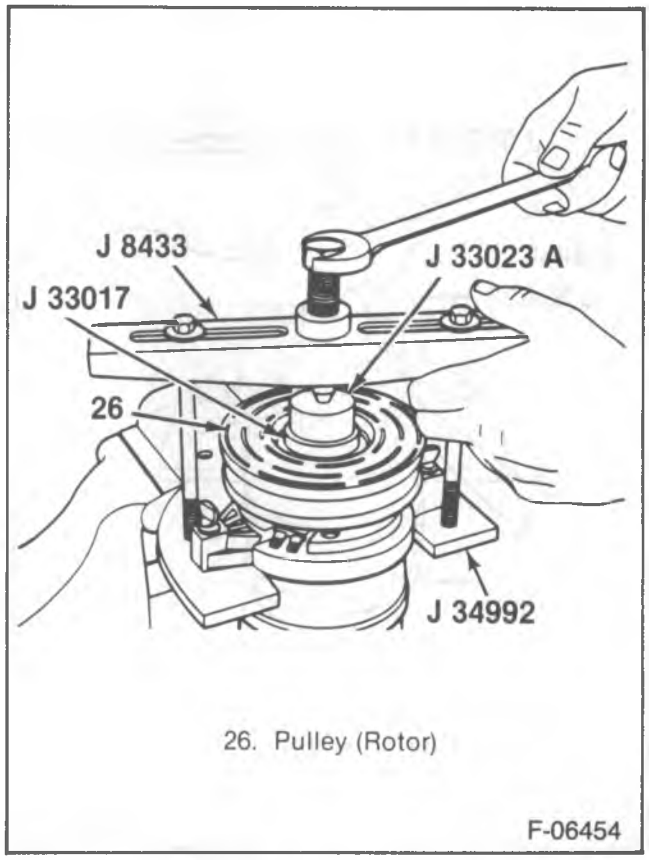


Figure 15—Installing the Pulley Bearing Assembly

PRESSURE RELIEF VALVE REPLACEMENT

Remove or Disconnect (Figures 1 and 3)

- Be sure the compressor has no charge.

1. Pressure relief valve (2).
2. O-ring seal (46).

Install or Connect (Figures 1 and 3)

- Lubricate the threads of the pressure relief valve (2) and new O-ring seal with 525 viscosity refrigerant oil.

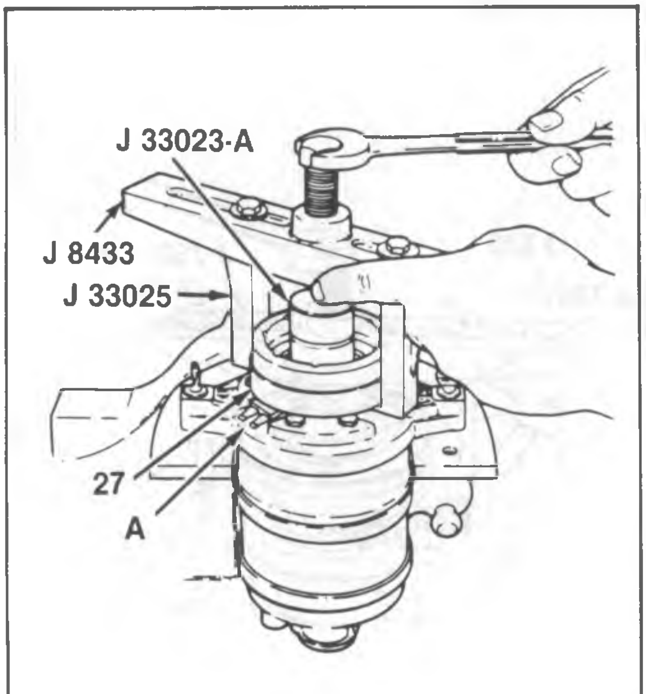
1. Pressure relief valve (2) with new O-ring seal.

Tighten

- Pressure relief valve (2) to 9 N·m (84 in. lbs.).

Important

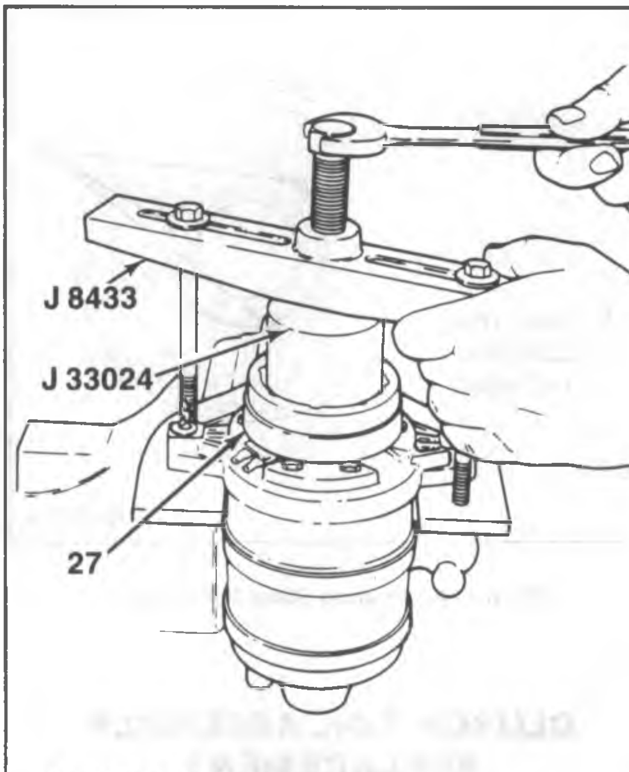
- Leak test the compressor.
- Refer to "Leak Testing."



A. Mark
27. Clutch Coil Assembly

F-06455

Figure 16—Removing the Clutch Coil Assembly



27. Clutch Coil Assembly

F-06456

Figure 17—Installing the Clutch Coil Assembly

HIGH-SIDE PRESSURE AND HIGH-SIDE LOW-PRESSURE CUTOFF SWITCHES REPLACEMENT

Remove or Disconnect (Figures 1 and 3)

Tool Required:

J 5403 Snap Ring Pliers

1. Retainers (45) from switches (3) and (4).
2. Switches (3) and (4).
3. O-ring seals (44) from the switch cavities.

Clean

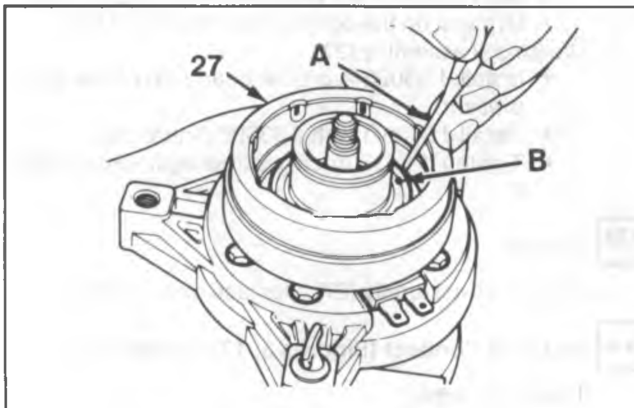
- Switch cavity and O-ring seal goove.

Install or Connect (Figures 1 and 3)

Tools Required:

J 5403 Snap Ring Pliers

1. O-ring seals (44) to the switch cavity.
   - Dip the O-ring seals into clean 525 refrigerant oil.
2. Switches (3) and (4).
3. Retainers (45).



27. Clutch Coil Assembly
A. Drift Punch 3 mm (1/8 inch)
B. Stake in Front Head (3 Places)

F-04570

Figure 18—Staking the Clutch Coil to the Front Head

CONTROL VALVE REPLACEMENT

Remove or Disconnect (Figures 1 and 3)

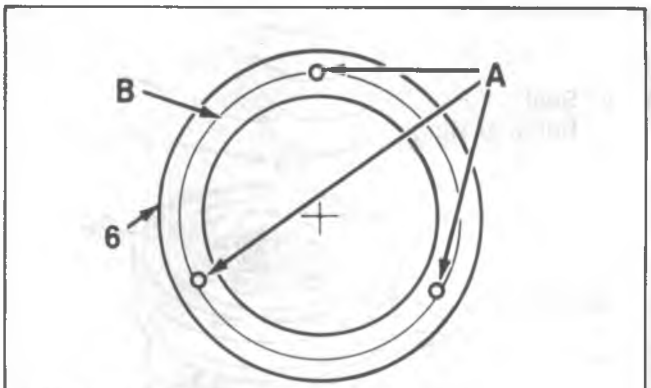
Tools Required:
J 5403 Snap Ring Pliers

1. Retainer ring with J 5403.
2. O-ring seal (44).
3. Valve (5).

Install or Connect (Figures 1 and 3)

Tools Required:
J 5403 Snap Ring Pliers

1. Valve (5).
2. O-ring seal (44).
   - Dip the seals into new clean 525 refrigerant oil.
3. Retainer (45) with J 5403.



A. Stake Front Head 0.28-0.35 mm (.010-.015 Inch)
B. Front Head Surface

B-06552

Figure 19—Clutch Coil Staking Locations

MAJOR REPAIR TO THE COMPRESSOR

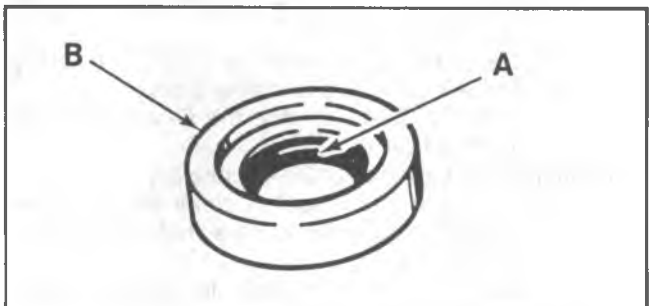
Replacement of the shaft seal assembly or the pressure relief valve will require the discharge of the vehicle's refrigerating system. Other than clutch repair procedures, the same holds true for any disassembly of the compressor. To discharge the refrigerant, refer to the vehicle service manual.

After servicing, add fresh 525 viscosity refrigerant oil equal to the amount drained from the compressor.

Keep the workbench and work area clean when servicing the compressor, and use proper, clean service tools.

NOTICE: Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

All parts used for servicing the compressor internally are protected by a preservative and packaged in a manner which does not require cleaning, washing or flushing. The parts can be used in the internal assembly as they are removed from the service package.



A. Steel Shell
B. Lip Seal

B-06551

Figure 20—Compressor Shaft Seal

SHAFT SEAL REPLACEMENT

Remove or Disconnect (Figures 3, 20, 21, 22 and 23)

Tools Required:
J 5403 Snap Ring Pliers
J 9553-01 O-Ring Seal Remover
J 23128-A Seal Remover and Installer
J 34614 Shaft Seal Protector

1. Clutch plate and hub assembly (22).
2. Shaft seal retainer ring using J 5403 (figure 22).
   - Clean the compressor neck area around the shaft (38), the exposed part of the shaft seal (29) and the O-ring seal groove.
3. Shaft lip seal using J 23128-A (figure 23).
   - Install J 34614 over the threaded end of the shaft.
   - Insert J 23128-A into the shaft lip seal, tighten and remove lip seal.
4. O-ring seal using J 9553-01 (figure 24).

Inspect

- Make sure the compressor neck area is clean.
- All parts. Replace as necessary.

Install or Connect (Figures 3, 20, 21, and 22)

Tools Required:
J 5403 Snap Ring Pliers
J 23128-A Seal Seat Remover and Installer
J 33011 O-Ring Seal Installer
J 34614 Shaft Seal Protector

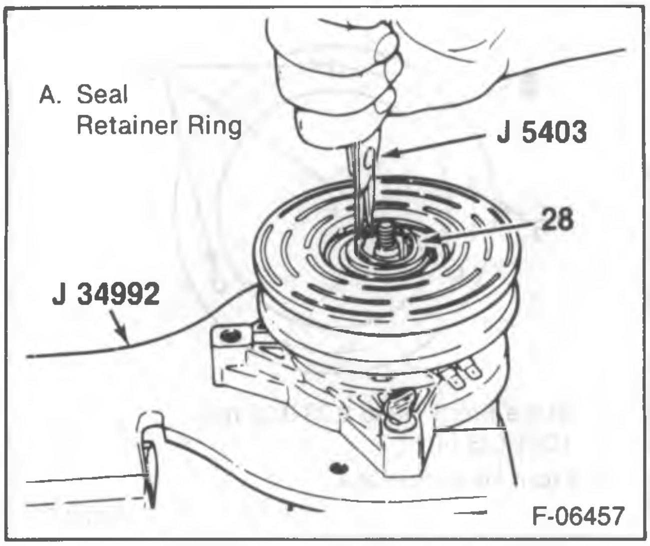


Figure 21—Removing or Installing the Shaft Seal Retainer

- Dip the new O-ring seal in clean 525 viscosity refrigerant oil.

1. J 34614 onto the shaft.
2. O-ring seal using J 33011 (figure 24).
   - Insert J 33011 into the compressor neck until the installer "bottoms."
   - Lower the movable slide of J 33011, releasing the O-ring seal into the lower groove.
   - Rotate J 33011 to seat the O-ring seal and remove J 33011.
3. Shaft lip seal using J 23128-A (figure 22).
   - Dip the shaft lip seal in clean 525 viscosity refrigerant oil and install the shaft lip seal on J 23128-A.
   - Bottom the shaft lip seal into the compressor neck area using J 23128-A.
4. Shaft seal retainer ring using J 5403 (figure 21).
   - Install the flat side of the shaft seal retainer ring against the lip seal.
   - Remove J 34614.

Important

- Leak test the compressor.
- Refer to "Leak Testing."

Clean

- Shaft and inside of the compressor neck area.

5. Clutch plate and hub assembly (22).

FRONT HEAD SEAL, REAR HEAD GASKET, REAR VALVE PLATE, SUCTION REED PLATE AND REAR HEAD SEAL REPLACEMENT

↔ Remove or Disconnect (Figures 3 and 25)

1. Clutch plate and hub assembly (22).

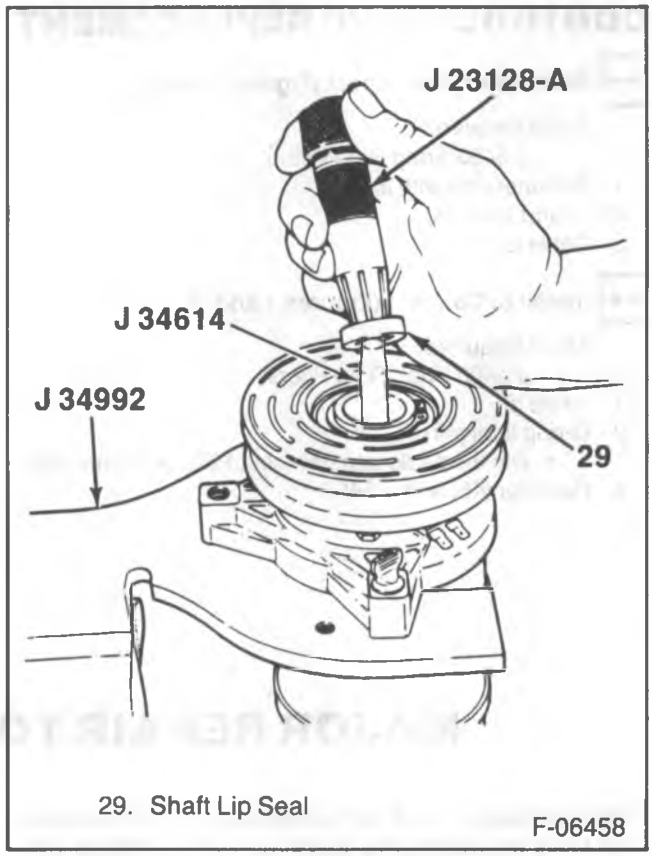


Figure 22—Removing or installing the Shaft Seal

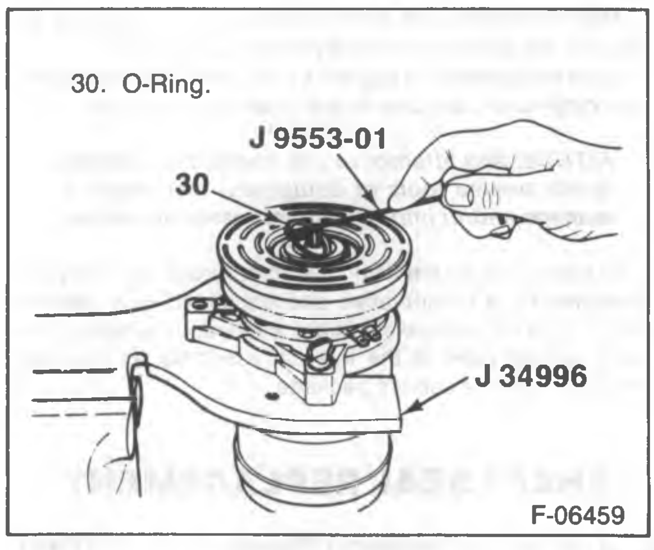
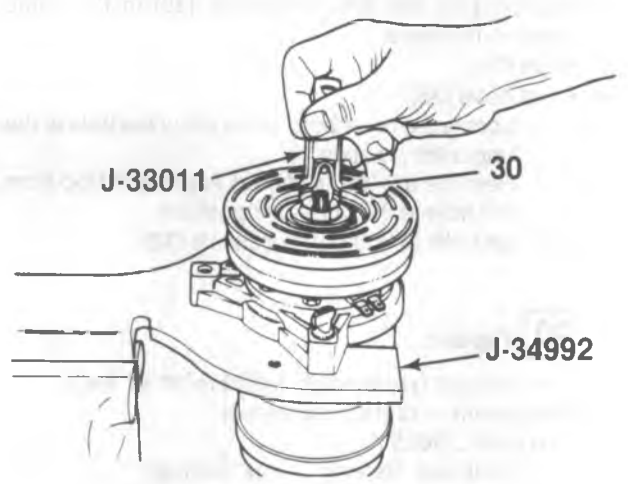


Figure 23—Removing the Shaft Seal Seat O-Ring

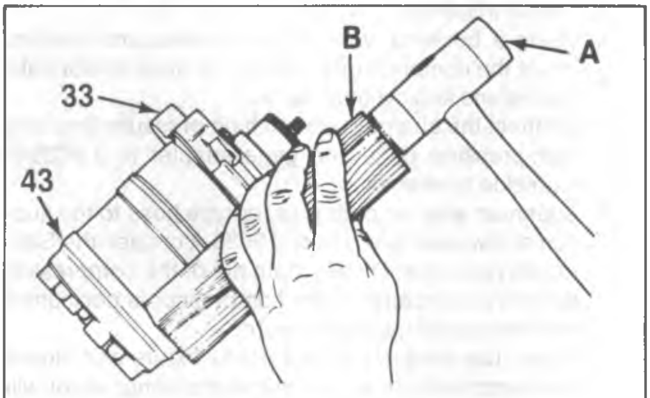
2. Pulley (26) and bearing (25) assembly.
3. Clutch coil assembly (27).
4. Shaft seal (29).
5. Through bolts (31).
6. Front head (33) from the shaft and cylinder body (38).
   - Using a wood block, tap around the edge of the front head (33) to remove.



30. Shaft Seal Seat O-Ring

F-04573

Figure 24—Installing the Shaft Seal Seat O-Ring



A. Plastic Headed Hammer
B. Wood Block
33. Front Head
43. Rear Head

F-04572

Figure 25—Tapping the Front or Rear Head Free of the Cylinder

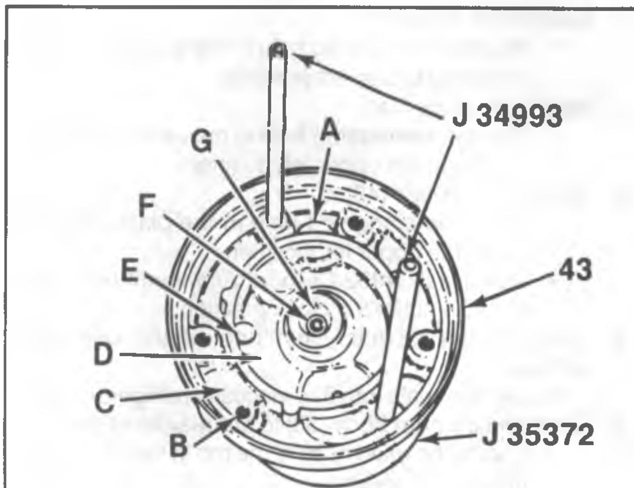
7. Rear head (43), head gasket (42), rear valve plate (41), suction reed plate (40) and cylinder-to-rear head seal (39).
   - Using a wood block, tap around the edge of the rear head to remove (figure 25).

Install or Connect (Figures 3, 26 and 27)

Tools Required:
J 9625-A Pressure Test Set with Schrader Valve
J 34993 Cylinder Alignment Rods
J 21352-A Support Block

- Use new seals and gaskets.
- Place the rear head on J 35372 with the control valve (5) at the 6 o'clock position.

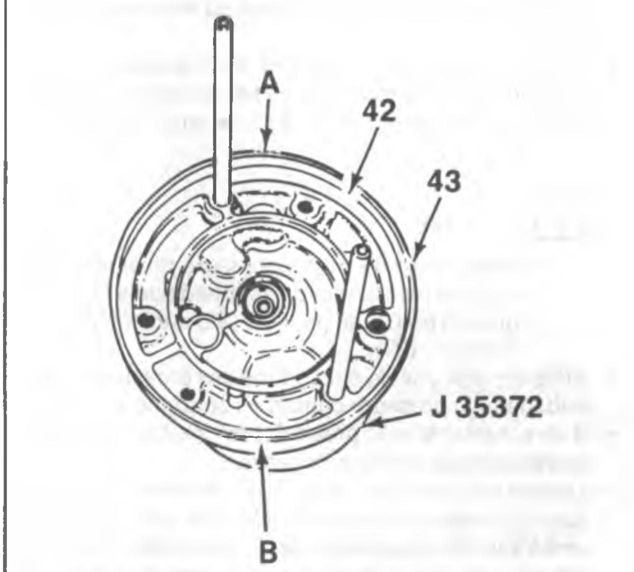
1. Cylinder Alignment Rods J 34993 in the mounting holes at the 5 and 11 o-clock positions (figure 26).



A. Opening to Rear Suction Port (12 O'Clock Position Assembly Reference)
B. Through Bolt Hole (6)
C. Suction Pressure (Outside Cavity)
D. Discharge Pressure (Inner Cavity)
E. Opening to Rear Discharge Port
F. High Pressure Relief Valve
G. Drilled Opening into High Pressure Relief Valve Area
43. Rear Head

F-06460

Figure 26—Positioning the J 34993 Guide Pins



A. 12 o'clock Reference Position
B. 6 o'clock Reference Position
42. Head Gasket
43. Rear Head

F-06461

Figure 27—Installing the Rear Head Gasket

2. Gasket (42) (figure 27).
   - Place the elongated hole in the gasket over the rod at the upper left position.
3. Rear valve plate (41).
   - Place the elongated hole in the valve plate over the rod at the upper left position.
4. Suction reed plate (40).
   - Place the elongated hole in the plate over the rod at the upper left position.
   - Remove J 34993 Cylinder Alignment Rod from the hole at the 5 o'clock position.
5. Seals (39 and 37) to the shaft and cylinder body (38) grooves.
   - Dip the seals into 525 viscosity refrigerant oil.
6. Shaft and cylinder body (38) to the rear head (43).
   - Locate the relief boss at the rod in the hole at the upper left position.
7. Bearing (35) and thrust washers (36) in the same order as removed.
8. Shim (34).
9. Front head (33).
   - Locate the relief boss at the pin in the hole at the upper left position.
   - Remove J 34993 Cylinder Alignment Rod from the hole at the upper left position.
10. Through bolts (31) and new gaskets (32).

Tighten

- Bolts (31) alternately to 9 N·m (80 in. lbs.).

11. Refrigerant oil to the compressor.
12. Test plate J 9625-A
    - Leak test. Refer to "Leak Testing."

LEAK TESTING

Tools Required:
J 9625-A Pressure Test Plate
J 23500-01 Portable Charging Station
J 34992 Compressor Holding Fixture

- Be sure the compressor has no oil internally.

1. Install J 9625-A on the rear head of the compressor.
2. Install the center hose of the manifold gage set on J 23500-01 to refrigerant drum standing in an upright position and open the valve on the drum.
3. Install the charging station high and low pressure lines to the corresponding fittings on J 9625-A using gage adapters or hoses equipped with valve depressors. The suction port (low side) of the compressor has a large internal opening. The discharge port (high side) has a smaller internal opening into the compressor.

- Open the low pressure control, high pressure control and the refrigerant control on the charging station to allow the refrigerant vapor to flow into the compressor.

Important

- Check for leaks at the pressure relief valve (2), compressor front and rear head seals (37) (39), through bolt head gaskets (32) and compressor shaft seal (29).

- After the leak check, shut off the low pressure control and the high pressure control on charging station.
- If an external leak is present, perform the necessary correction and recheck for leaks.
- Loosen the manifold gage hose connections to the gage adapters connected to the low and high sides and allow the vapor pressure to release from the compressor. If valve depressor type hoses are used, loosen the hose connections at the gage manifold to release the vapor pressure from the compressor.
- Disconnect both gage adapters or hoses from J 9625-A.
- Add 85 g (3 oz.) new 525 viscosity refrigerant oil to the compressor assembly. Rotate the complete compressor assembly (not the shaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
- Install the shaft nut (21) on the compressor shaft if the pulley assembly and clutch plate and hub assembly are not installed.
- Using a box-end wrench, or a socket and handle, rotate the compressor shaft several turns to lubricate the pistons and cylinder walls.
- Connect the charging station high-pressure line, or a high-pressure gage and gage adapter to J 9625-A high-side connector.
- Attach an adapter or depressor-type hose to the suction or low-pressure port of J 9625-A to open the Schrader-type valve. Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.
- Attach the compressor to J 34992 fixture and mount the compressor in a vise so that the compressor will be in a horizontal position and the shaft can be turned with a wrench.
- Rotate the compressor shaft or drive plate hub six to eight complete revolutions at a speed of approximately one revolution per second. A slower rotation can result in a lower pump-up pressure and disqualify a good pumping compressor.
- Observe the reading on the high-pressure gage at the completion of the tenth revolution of the compressor shaft. The pressure reading for a good pumping compressor should be 690 kPa (100 psi) or above. A pressure reading of less than 620 kPa (90 psi) would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve. Disassemble the compressor and repair as necessary. Reassemble and repeat the pump-up test.
- Following the pressure pump-up test, release the air pressure from the high side and remove the gage adapters and J 9625-A test plate.
- Tilt the compressor to place the suction and discharge ports downward to allow oil to drain from the compressor.
- Allow a 10-minute drain period and then charge the compressor with the proper amount of oil. Pour the new 525 viscosity refrigerant oil into the suction port.
- If further assembly or processing is required, install a shipping plate or test plate J 9625-A to protect the compressor from contamination.

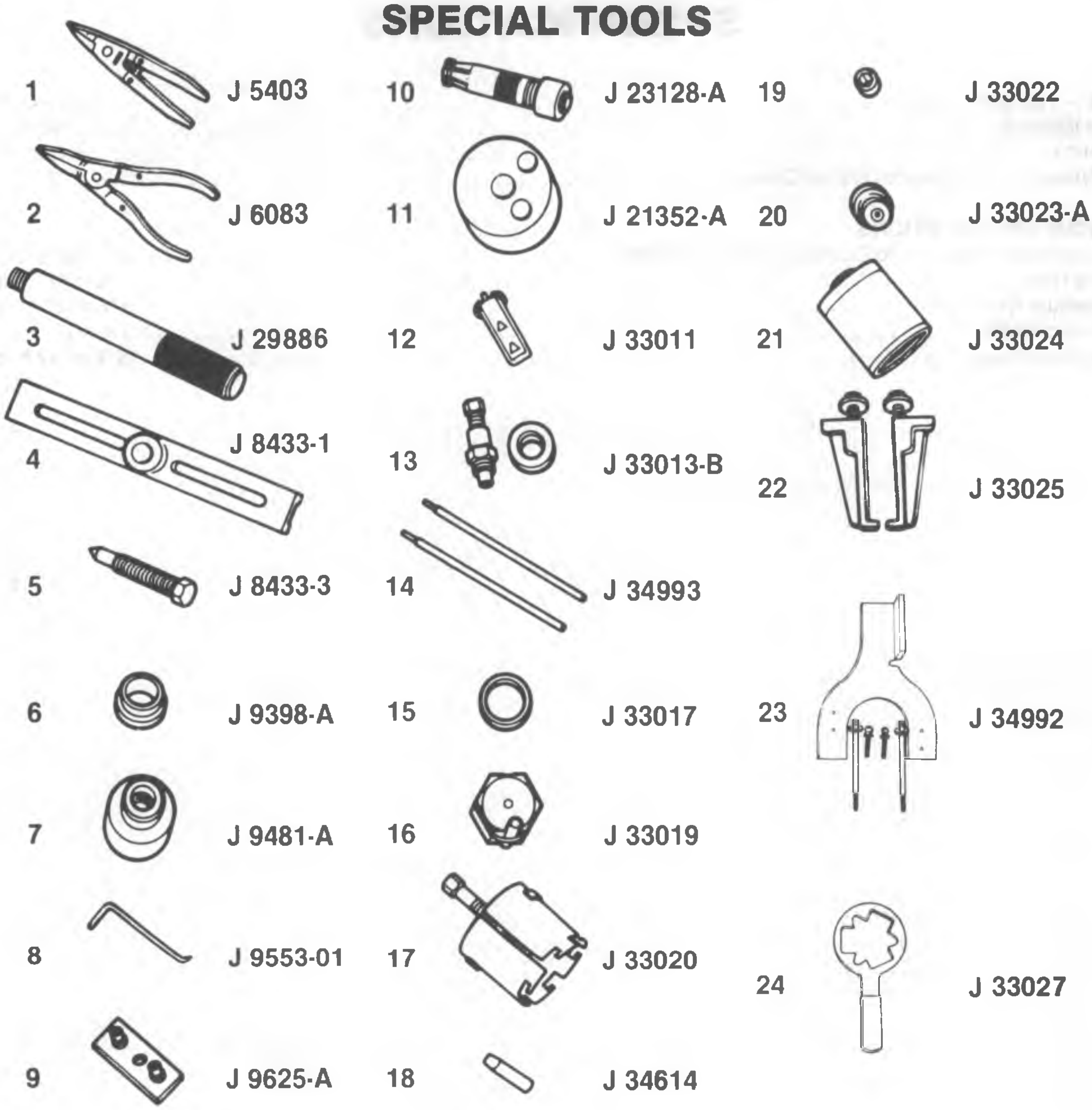
SPECIFICATIONS

Type — Harrison DA-V5 .... Cylinder Axial
Displacement .... 9.2 Cu. In.
Rotation .... Clockwise
525 Viscosity Compressor Oil (Full Charge) .... 227 g (8 oz.)

TORQUE SPECIFICATIONS

Compressor Suction and Discharge Connector Bolt .... 34 N·m (25 ft. lbs.)
Shaft Nut .... 17 N·m (12 ft. lbs.)
Pressure Relief Valve .... 9 N·m (80 in. lbs.)
Through Bolts .... 9 N·m (80 in. lbs.)
Oil Drain Plug .... 16 N·m (12 ft. lbs.)

SPECIAL TOOLS



1. J 5403 Snap Ring Pliers
2. J 6083 Snap Ring Pliers
3. J 29886 Driver Handle
4. J 8433-1 Puller Bar
5. J 8433-3 Forcing Screw
6. J 9398-A Pulley Bearing Remover
7. J 9481-A Pulley Bearing Installer
8. J 9553-01 O-ring Seal Remover
9. J 9625-A Pressure Test Plate
10. J 23128-A Seal Remover and Installer
11. J 21352-A Support Block
12. J 33011 O-ring Seal Installer
13. J 33013-B Hub and Drive Plate Remover and Installer
14. J 34993 Cylinder Alignment Rod
15. J 33017 Pulley and Bearing Assembly Installer
16. J 33019 Bearing Staking Tool
17. J 33020 Pulley Puller
18. J 34614 Shaft Seal Protector
19. J 33022 6 Point 13 mm Socket
20. J 33023-A Puller Pilot
21. J 33024 Clutch Coil Installer Adapter
22. J 33025 Clutch Coil Puller Legs
23. J 34992 Compressor Holding Fixture
24. J 33027 Clutch Hub Holding Tool

F-06462

SECTION 1B3

R-4 AIR CONDITIONING COMPRESSOR

CONTENTS

R-4 AIR CONDITIONING COMPRESSOR

GENERAL DESCRIPTION

The Harrison R-4 compressor is a four cylinder, radial opposed type with 10 cubic inch displacement.

There are two designs of the clutch driver which affect the overhaul procedure: The four pole clutch and the six pole clutch (figures 1 and 2). There are also two types of pulleys used with the R-4 which also affect some procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or assembly. Clean tools and clean work area are very important for proper service. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any repairs. Parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroenthane, naphtha, stoddard solvent, kerosene or equivalent solvent and blown dry with dry air. When necessary to use a cloth on any part, it should be of a nonlint producing type.

When the compressor is removed from the vehicle the oil in the compressor must be drained and measured. The oil should then be discarded. If less than 30 ml (1 oz.) is drained from the compressor add 60 ml (2 oz.) of new 525 viscosity oil to the assembly after overhaul. If more than

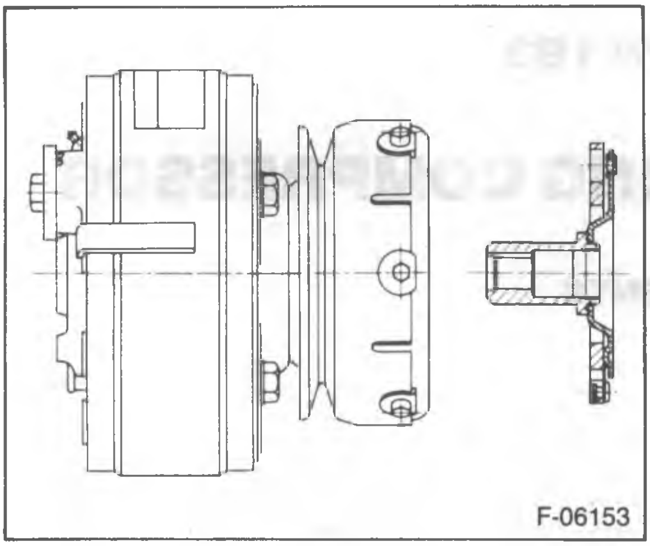


Figure 1—R-4 Compressor, V-Groove Pulley Type with 4 Pole Clutch and Driver Shown

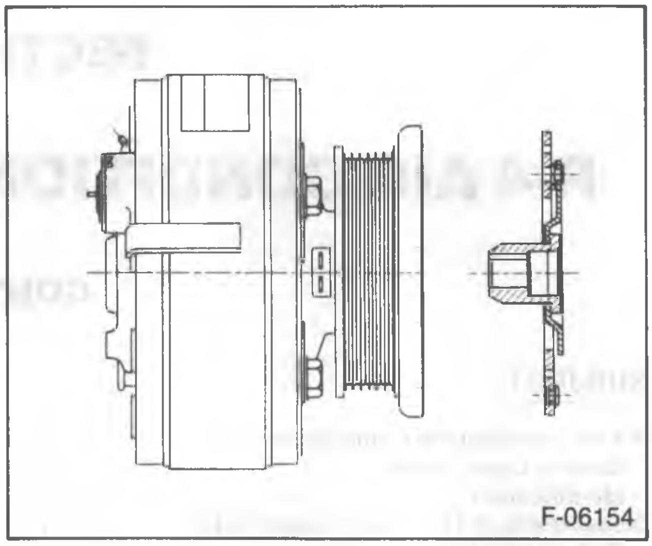


Figure 2—R-4 Compressor, Poly-Groove Pulley Type with 6 Pole Clutch and Driver Shown

30 ml (1 oz.) is drained from the compressor, add the same amount of new 525 viscosity oil to the overhauled assembly.

IDENTIFICATION

An identification label attached to the compressor provides the name of the manufacturer and model number (figure 3).

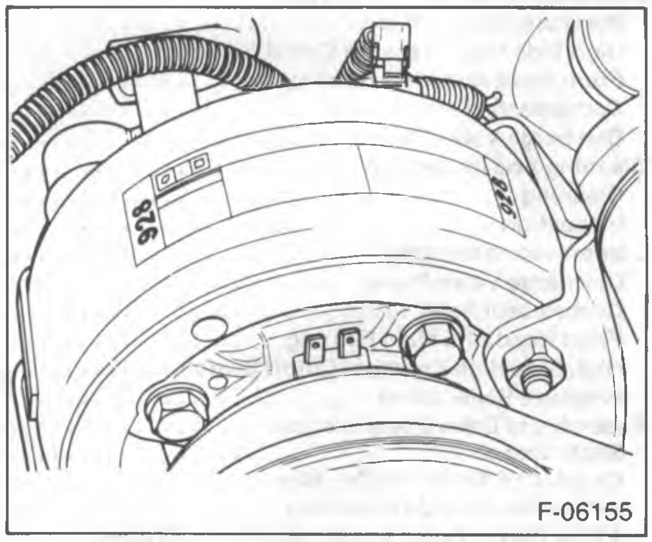


Figure 3—Identification Label

DISASSEMBLY OF THE DRIVE COMPONENTS

CLUTCH DRIVE HUB

↔ Remove or Disconnect (Figures 4, 5, 6 and 7)

Tools Required:
- J 9399 Thin Wall Socket
- J 25008-A Holding Fixture
- J 33027 Clutch Hub Holding Tool
- J 37707 Clutch Plate and Hub Assembly Remover

- Attach J 25008-A to the compressor (figure 5).
- Mount J 25008-A in a vise (figure 6).

1. Shaft nut with J 9399 (figure 6).
   - Hold the clutch plate with J 37707.
2. Clutch drive hub (figure 7).
   - Thread J 37707 into the clutch plate and hub assembly.
3. Shaft key.

4 POLE CLUTCH ROTOR AND/OR BEARING-V-GROOVE

↔ Remove or Disconnect (Figures 4, 8, 9, 10 and 11)

Tools required:
- J 6083 Snap Ring Pliers
- J 9398 Rotor Bearing Remover

J 25031 Rotor and Bearing Remover
J 29886 Driver Handle

1. Snap Ring with J 6038 (figure 8).
   - Mark the location of the clutch coil terminals.

Important

- If only the clutch rotor and/or rotor bearing are to be replaced, bend the screw head washer away from the pulley rim and remove the six mounting screws and washers. If the clutch coil or pulley rim is to be removed leave the screws in place.

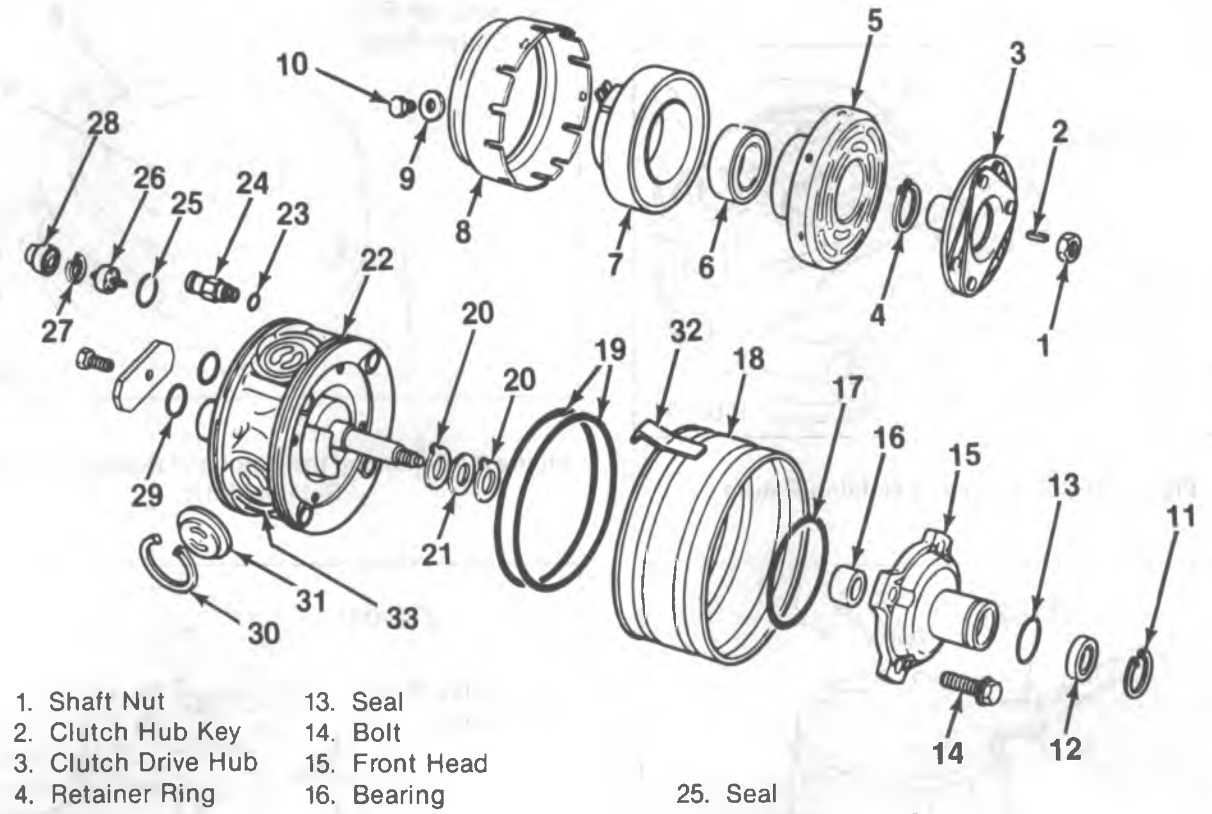
2. Rotor and bearing assembly.
   - Place J 25031 guide on the compressor shaft (figure 9).
   - Engage the legs of J 25031 into the recessed edge of the rotor hub (figure 10).
   - Tighten the puller screw and remove the clutch rotor and bearing. Do not drop the guide.
3. Bearing from the clutch rotor using J 29886 and J 9398-A (figure 11).
4. File away the old staked metal to provide a clearance for the new bearing.

6 POLE CLUTCH ROTOR AND/OR BEARING

Remove or Disconnect (Figures 4, 12 and 13)

Tools Required:
J 6083 Snap Ring Pliers
J 29886 Driver Handle
J 9398-A Rotor Bearing Remover
J 33020 Pulley Bearing Puller

1. Retainer ring using J 6083.
2. Rotor and bearing assembly.
   - Install J 33020 into the slots in the rotor and rotate the puller (figure 12). Remove the rotor and hub assembly.
4. Screw from the puller. Leave the puller in the rotor.
- Invert the puller and rotor assembly on a flat surface.



1. Shaft Nut
2. Clutch Hub Key
3. Clutch Drive Hub
4. Retainer Ring
5. Rotor
6. Bearing
7. Coil
8. Pulley
9. Washer
10. Screw
11. Retainer Ring
12. Shaft Seal
13. Seal
14. Bolt
15. Front Head
16. Bearing
17. Seal
18. Shell
19. Seals
20. Thrust Washer
21. Belleville Washer
22. Cylinder Body and Shaft
23. Seal
24. Pressure Relief Valve
25. Seal
26. High Pressure Switch
27. Retainer
28. Cap
29. Seals
30. Retainer
31. Valve Plate
32. Retaining Strap
33. Piston and Reed Assembly

B-08291

Figure 4—Compressor Component View

5. The bearing from the hub using J 9398-A and J 29886 (figure 13).
6. The staking metal.

CLUTCH COIL AND/OR PULLEY RIM

V-GROOVE DRIVE

Remove or Disconnect

1. Pulley rim mounting screws and washers.
2. Pulley rim off the rotor and hub assembly.

POLY-GROOVE DRIVE

Remove or Disconnect (Figure 14)

Tools Required:
J 8433 Puller
J 24092 Puller Legs
J 25031 Guide

- Clutch coil from the front head using the tools as shown in figure 14.

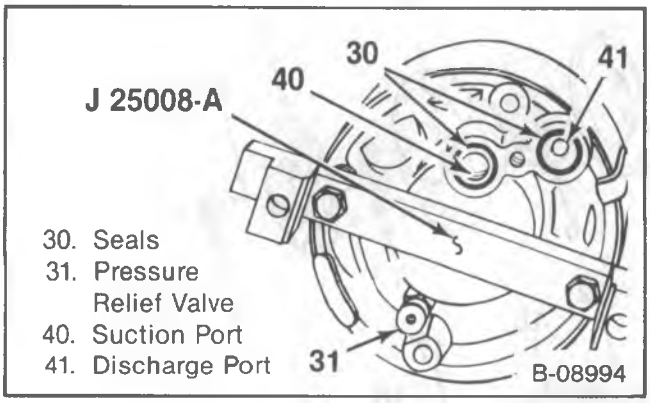


Figure 5—Compressor in Holding Fixture

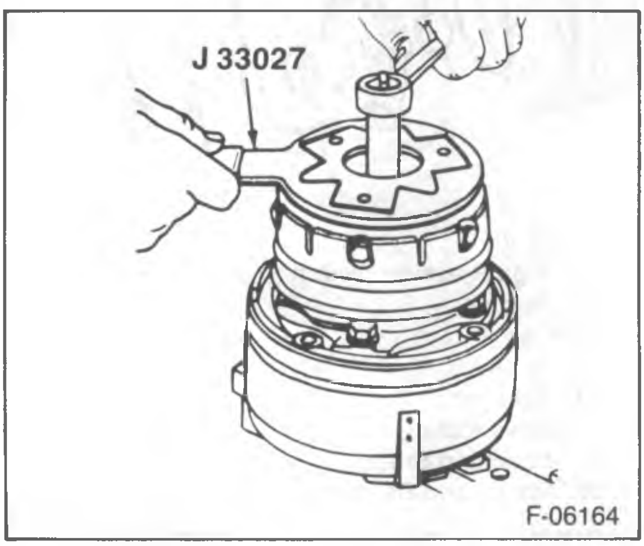


Figure 6—Removing the Shaft Nut

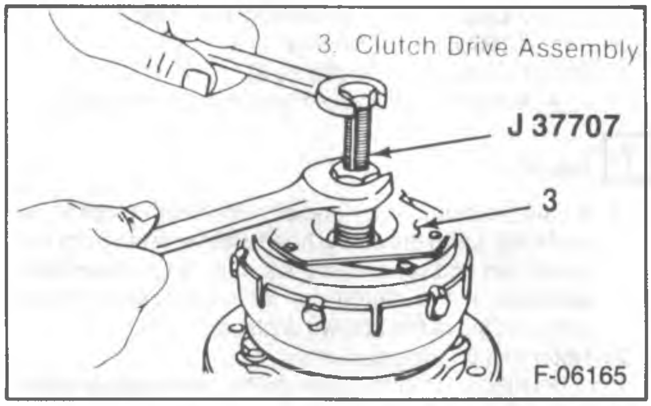


Figure 7—Clutch Plate and Hub Removal

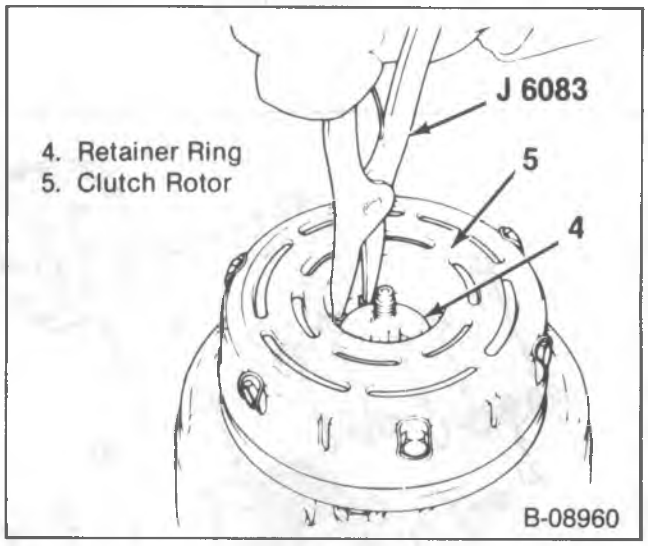


Figure 8—Removing the Rotor and Bearing Assembly Retainer Ring

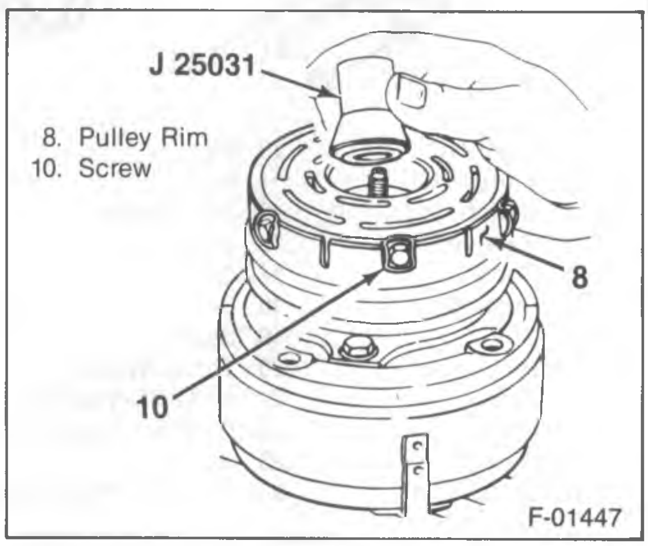


Figure 9—Installing the Rotor and Bearing Guide

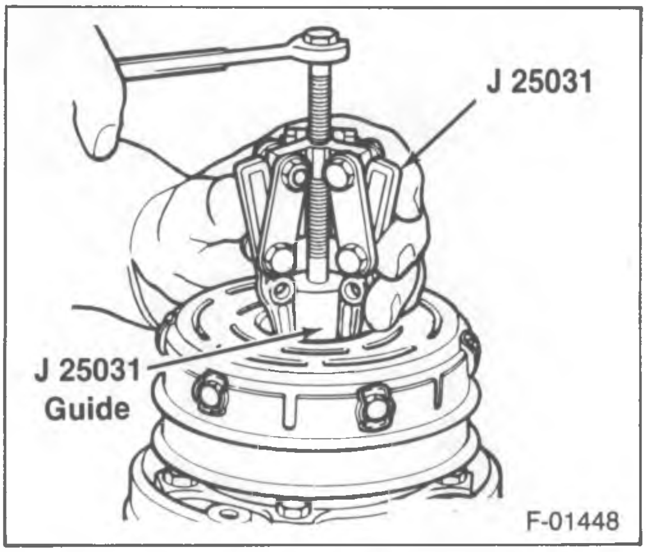


Figure 10—Removing the Clutch Rotor Assembly

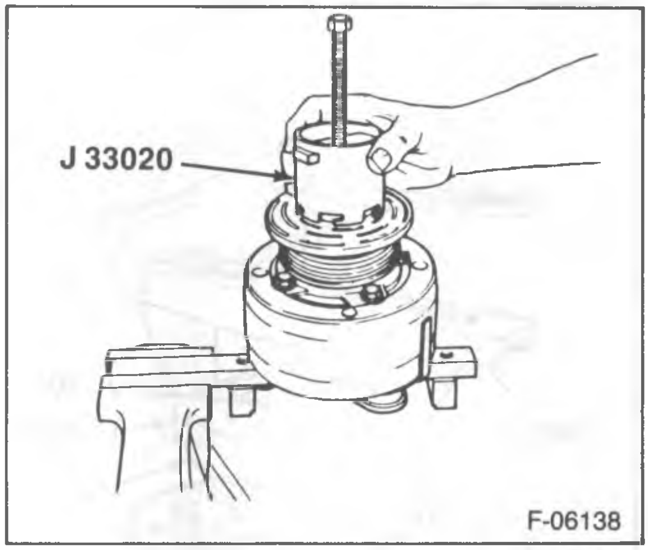


Figure 12—Pulley Rotor and Bearing Puller Installation

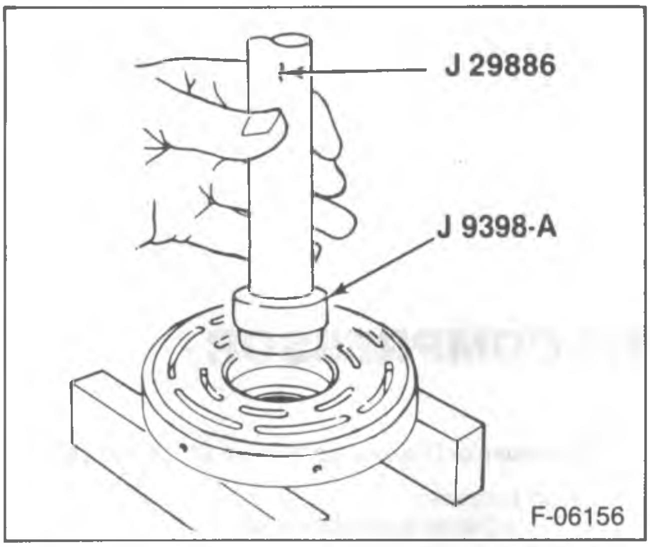


Figure 11—Removing the Clutch Rotor Bearing

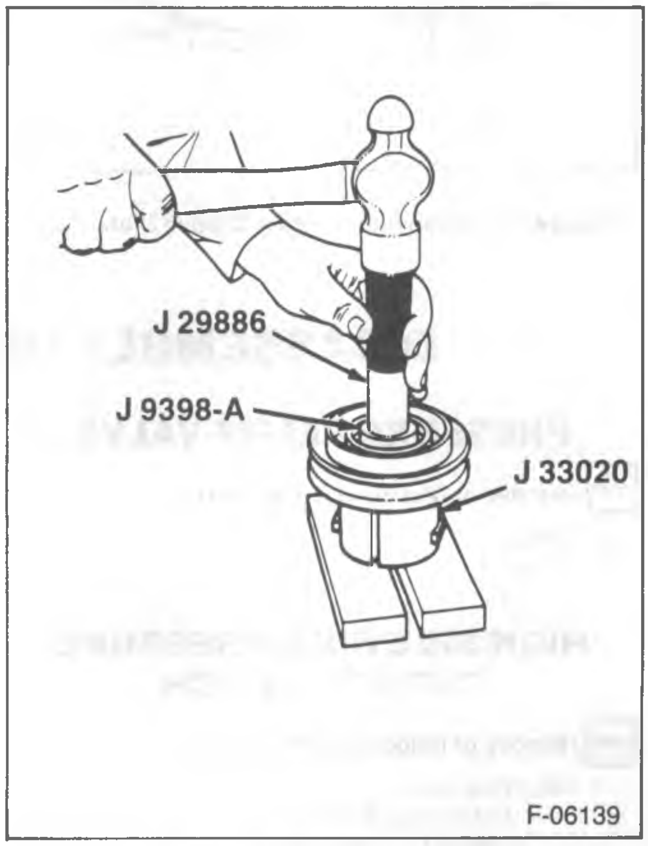


Figure 13—Bearing Removal

SHAFT SEAL

↔ Remove or Disconnect (Figures 15 and 16)

Tools required:
- J 5403 Snap Ring Pliers
- J 9553-01 O-ring Remover
- J 23128-A Seal Remover

1. Retainer ring using J 5403.
2. Shaft seal.
   - Engage the knurled tangs of J 23128-A into the recessed portion of the seal by turning the handle clockwise (figure 15).
3. O-ring using J 9553-01 (figure 16).

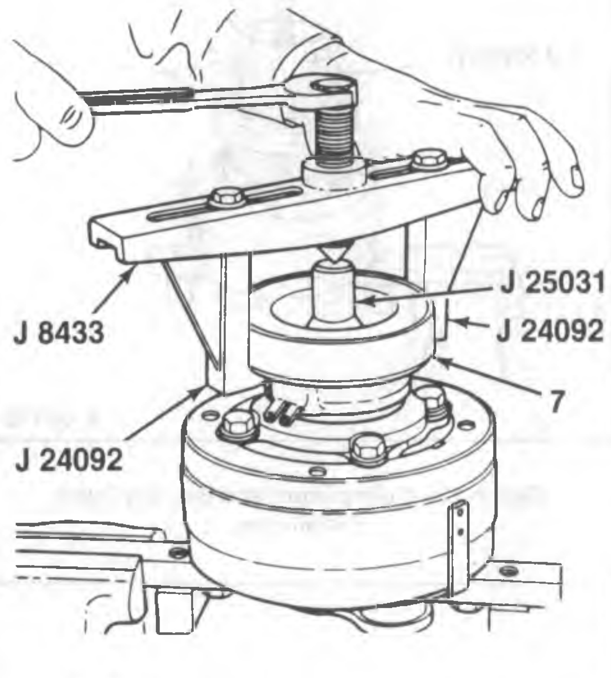


Figure 14—Removing the Poly-Groove Clutch Coil

DISASSEMBLY OF THE COMPRESSOR

PRESSURE RELIEF VALVE

Remove or Disconnect (Figure 4)

1. Valve.
2. O-ring.

HIGH SIDE HIGH PRESSURE CUTOFF SWITCH

Remove or Disconnect (Figure 4)

Tools Required:
J 5403 Snap Ring Pliers
J 9553-01 O-Ring Remover

1. Protective cap.
2. Retainer ring using J 5403.
3. Switch by pulling on the terminals.
4. O-ring from the switch cavity using J 9553-01.

FRONT HEAD AND MAIN BEARING

Before removing the front head make a mark on the cylinder next to the narrow front head leg position.

Remove or Disconnect (Figure 17, 18 and 19)

Tool Required:
J 24896 Bearing Remover

1. Head mounting screws (figure 17).
2. Front head (figure 18).
3. O-ring.
4. The thrust and belleville washers. Note the way the washers are installed.
5. Bearing from the head.
   - Place the head on two blocks and drive the bearing from the head using J 24896 (figure 19).

COMPRESSOR SHELL

Remove or Disconnect (Figure 20 and 21)

Tool Required: J 25008-A

1. Retainer strap by prying it up (figure 20).

- Install J 25008-A with the step block protrusions engaging the compressor shell. Install the medium length metric thread mounting bolts through the holding fixture and thread them finger tight until the step of the fixture protrusions contact the shell (figure 21). Make sure the step protrusions do not overlap the cylinder, but will pass both sides.

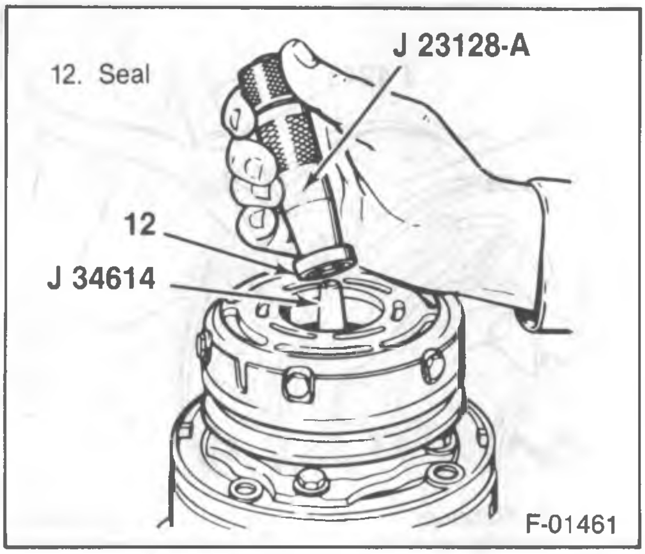


Figure 15—Removing the Shaft Seal with J 23128-A

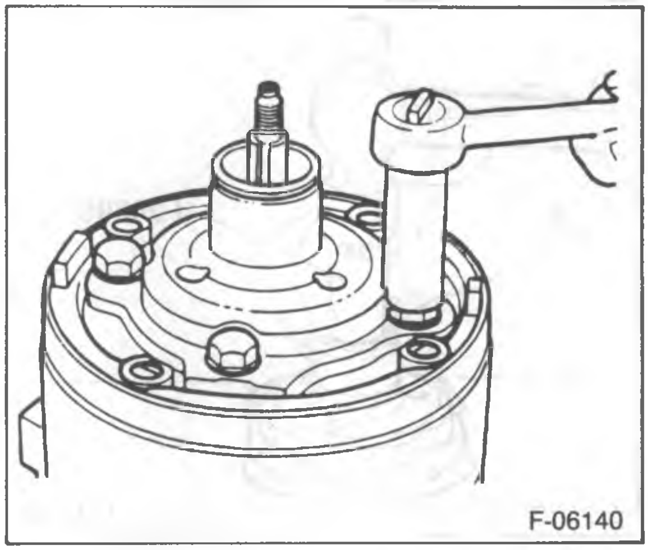


Figure 17—Removing the Front Head Mounting Screws

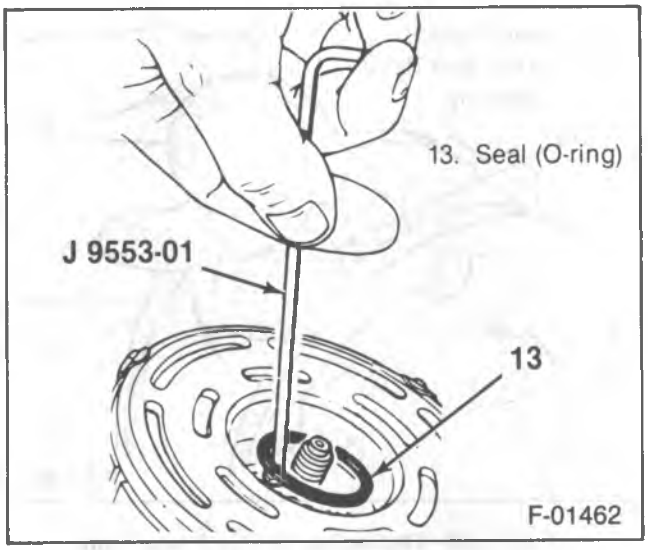


Figure 16—Removing and Installing the Shaft Seal

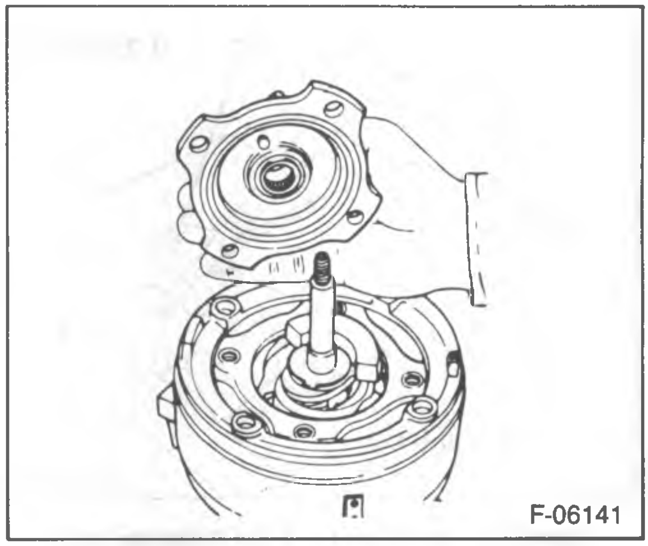


Figure 18—Removing the Front Head Assembly

2. Compressor shell.
   - Alternately tighten each screw 1/4 turn. Use care not to cock the shell, as normal removal should not be difficult.
   - Do not turn screws any further than needed. The shell should come off by hand once it clears the O-rings.
3. O-rings.
4. J 25008-A and install it on the opposite side of the cylinder using the short screws with the metric threads.

DISCHARGE VALVE PLATE

↔ Remove or Disconnect (Figures 22 and 23)

Tools Required:
J 4245 Snap Ring Pliers
J 25008-A Holding Fixture

1. Valve plate retainer ring using J 4245 (figure 22).
2. Discharge valve plates (figure 23).

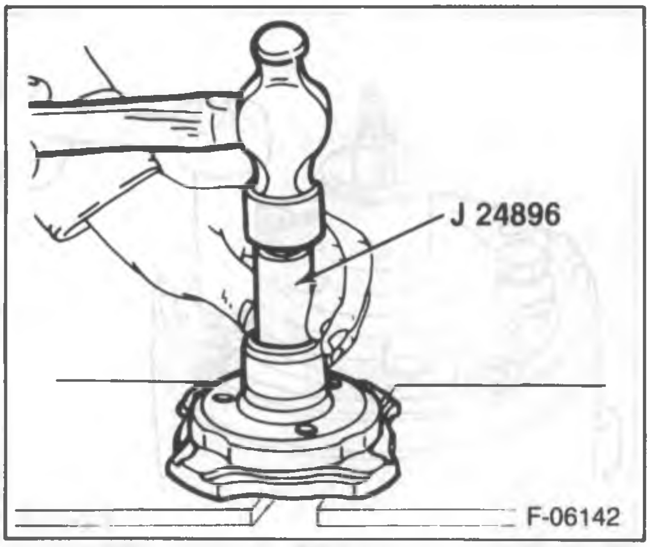


Figure 19—Removing the Bearing from the Front Head

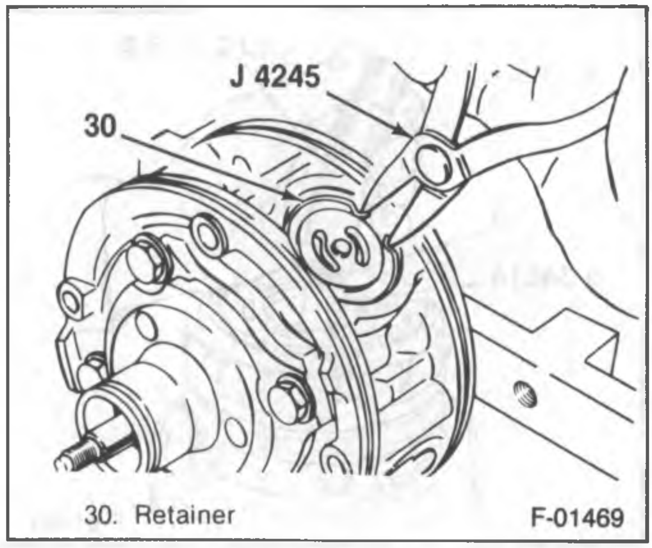


Figure 22—Replacing the Valve Plate Retainer

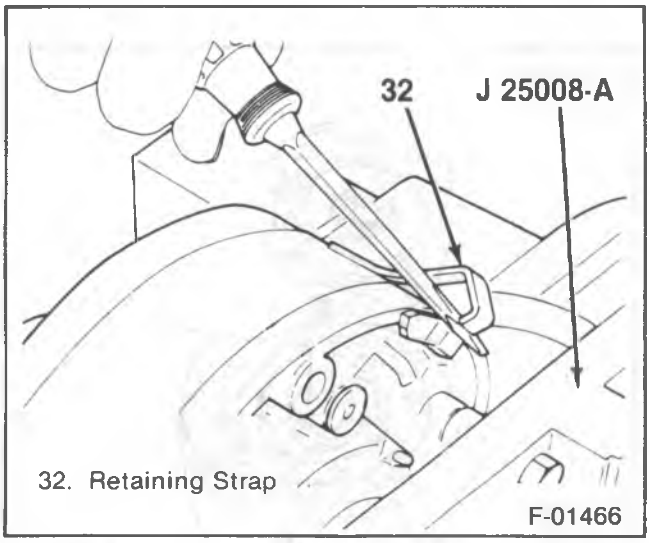


Figure 20—Releasing the Shell Retaining Strap

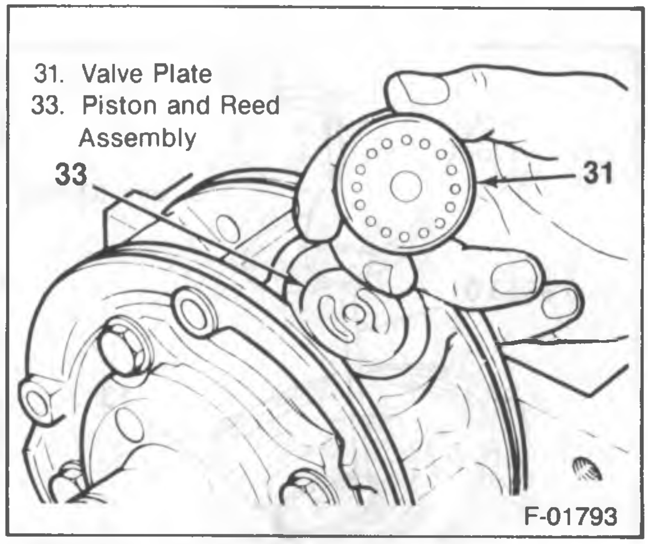


Figure 23—Replacing the Discharge Plate

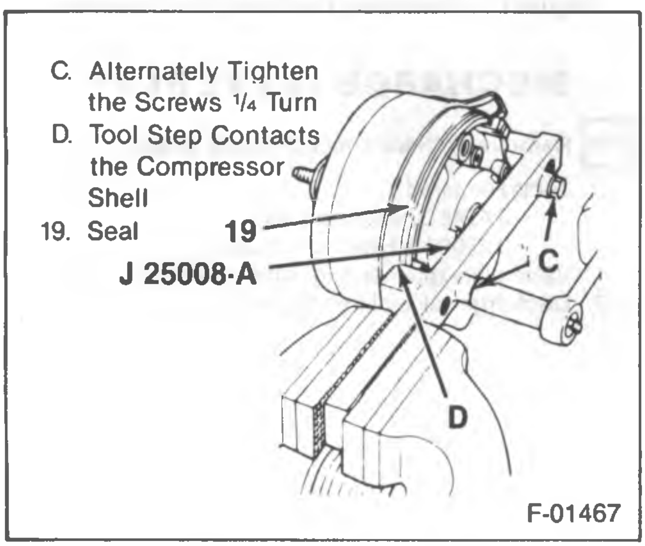


Figure 21—Removing the Shell

CLEANING AND INSPECTION

CLEANING

Clean

1. The frictional surfaces of the clutch plate and the clutch rotor.
2. Shaft seal area thoroughly.
3. Cavity and O-ring groove for the high side high pressure cut-off switch.
4. Front head and cylinder area. Remove any dirt or lint.
5. Compressor shell.

INSPECTION

Inspect

1. Front head for cracks or damage.
2. Compressor shell for cracks or burrs.
3. Staked areas for burrs.

COMPRESSOR ASSEMBLY

All parts required for servicing the internal compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the new parts. The parts can be used just as they are removed from the service package. Seals and protective packaging should be left intact until just prior to installation.

DISCHARGE VALVE PLATE

Install or Connect (Figures 22 and 23)

Tools Required:
J 4245 Snap Ring Pliers
J 25008-A Holding Fixture

1. Cylinder and shaft assembly in J 25008-A.
2. The discharge valve plates (figure 23).
3. Valve plate retainer rings using J 4245 (figure 22).
   - The valve plates must be tight after the snap rings are installed.

COMPRESSOR SHELL

Install or Connect (Figure 24)

Tools Required:
J 25008-A Holding Fixture and Shell Installer

1. 525 refrigerant oil to the O-rings.
2. O-rings in the grooves in the cylinder.
3. 525 refrigerant oil to the O-ring surfaces of the shell.
4. Shell on the cylinder. Snug it up to the O-ring.
5. Installer J 25008-A to the holding fixture using long bolts and plate washers. Make the bolts finger tight (figure 24).
   - Align the step projections of the installer to contact evenly on both sides of the shell.
   - Alternately tighten each bolt 1/4 turn. Use care not to cock the shell, as normal installation is not difficult if the shell remains even.
6. Bend the retaining strap down by tapping it gently with a hammer.

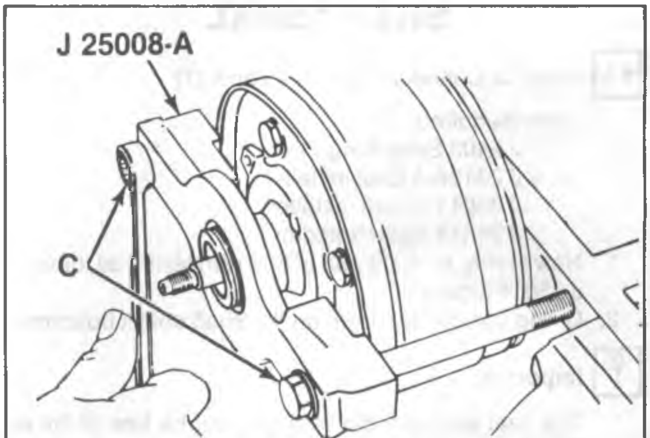
- Remove the shell installer.

FRONT HEAD AND MAIN BEARING

Install or Connect (Figures 17, 18, 25 and 26)

Tools Required:
J 24895 Bearing Installer

1. The front head, with the neck down, on a flat surface (figure 25).
2. The bearing using J 24895 (figure 25).
   - The installer must seat against the front head to ensure proper clearance.
3. 525 refrigerant oil on the belleville and thrust washers.
4. New thrust washer with the tang pointing up (figure 25).
5. New belleville washer with the high center in the up position (figure 26).
6. New thrust washer with the tang pointing down.
7. 525 refrigerant oil on the O-ring.



C. Alternately Tighten the Screws 1/4 Turn

F-01468

Figure 24—Installing the Shell

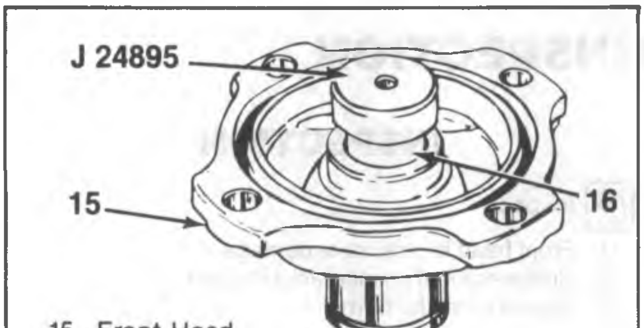


Figure 25—Installing the Bearing

8. O-ring into the groove of the front head (figure 18).
9. Front head aligning the marks made at disassembly.
10. Front head mounting screws (figure 17).

Tighten

Screws to 27 N·m (20 ft. lbs.)

HIGH SIDE HIGH PRESSURE CUTOFF SWITCH

Install or Connect (Figure 4)

Tool Required:
J 5403 Snap Ring Pliers

1. New O-ring coated with 525 refrigerant oil.
2. Refrigerant oil in the switch cavity.

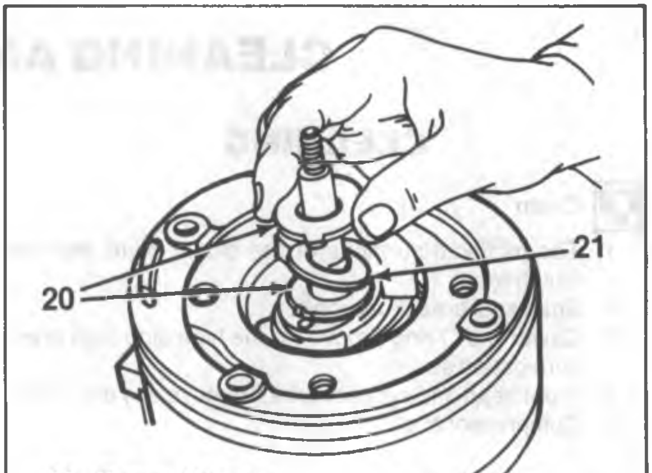


Figure 26—Replacing the Thrust and Belleville Washers

3. Switch in the cavity.
4. Retaining ring using J 5403.
   - The high point of the curved sides must be next to the switch housing.
   - The retaining ring must be seated in the ring groove.

PRESSURE RELIEF VALVE

Install or Connect (Figure 4)

1. New O-ring coated with 525 refrigerant oil.
2. Valve.

ASSEMBLY OF DRIVE COMPONENTS

SHAFT SEAL

Install or Connect (Figures 15 and 27)

Tools Required:
J 5403 Snap Ring Pliers
J 23128-A Seal Installer
J 33011 O-ring Installer
J 34614 Seal Protector

1. New O-ring seal, dipped in 525 refrigerant oil, onto J 33011 (figure 27).
2. O-ring completely down on the shaft until it bottoms.

Important

The seal seat and the seal lip must be free of lint or dirt.

3. Lip seal to J 23128-A.
   - The printed/stamped side of the seal must be engaged with the knurled tangs of J 23128-A so that the flared out side of the seal is facing the compressor.

NOTICE: Handling the care of seal protector is important. If the seal protector is nicked or the bottom flared, the new seal may be damaged during installation.

4. J 34614 on the shaft (figure 15).
5. Lip seal (figure 15). Disengage installer by turning it counter-clockwise.
6. Retainer ring, flat side against the seal seat using J 5403. Use J 33011 to seat the retainer in its groove.

CLUTCH COIL AND/OR PULLEY RIM

V-GROOVE DRIVE

Install or Connect (Figures 28 and 29)

Tools Required:
J 26271-A Rotor and Bearing Installer
J 29886 Driver Handle

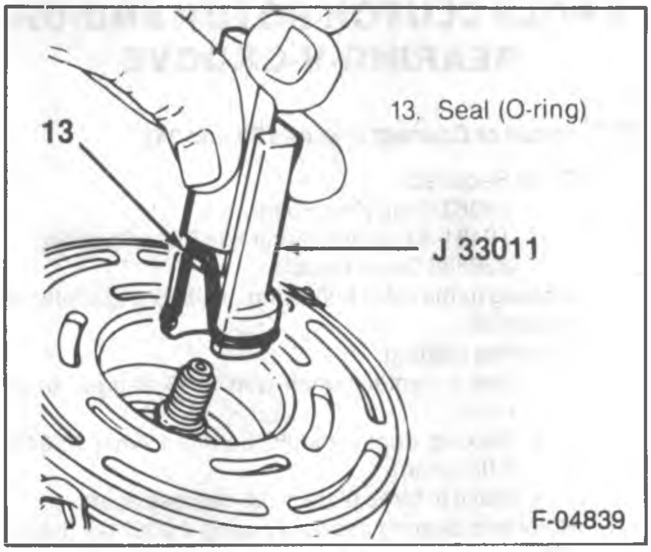


Figure 27—Installing the Seal

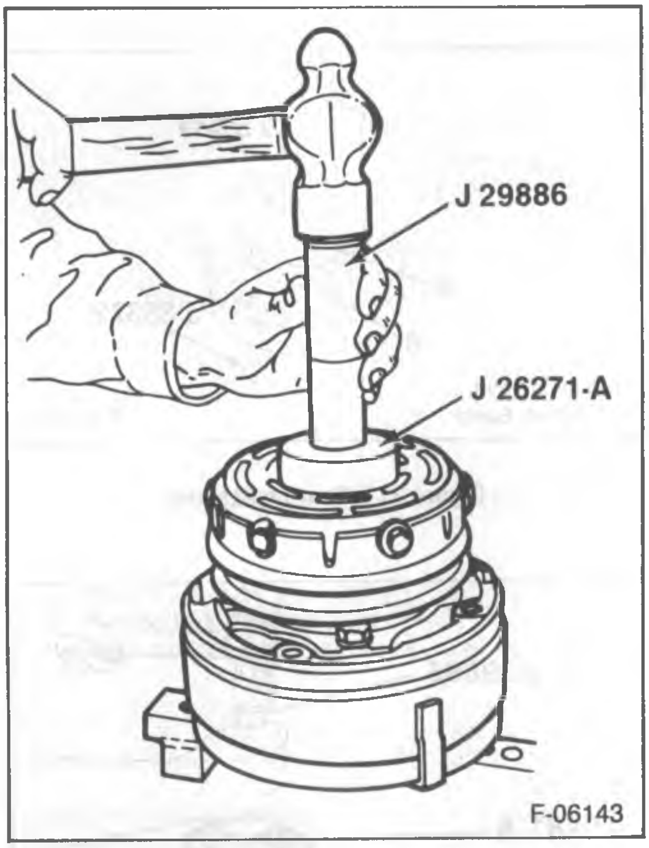


Figure 28—Installing the Rotor and Bearing Assembly — V-Groove Type

1. The coil, pulley rim and the rotor and bearing assembly (figure 28).
2. Loctite 601 or equivalent on the rim screw threads.
3. Screws. Do not tighten.
4. The assembly on the front head.
   - Make sure the clutch coil terminals are aligned correctly.

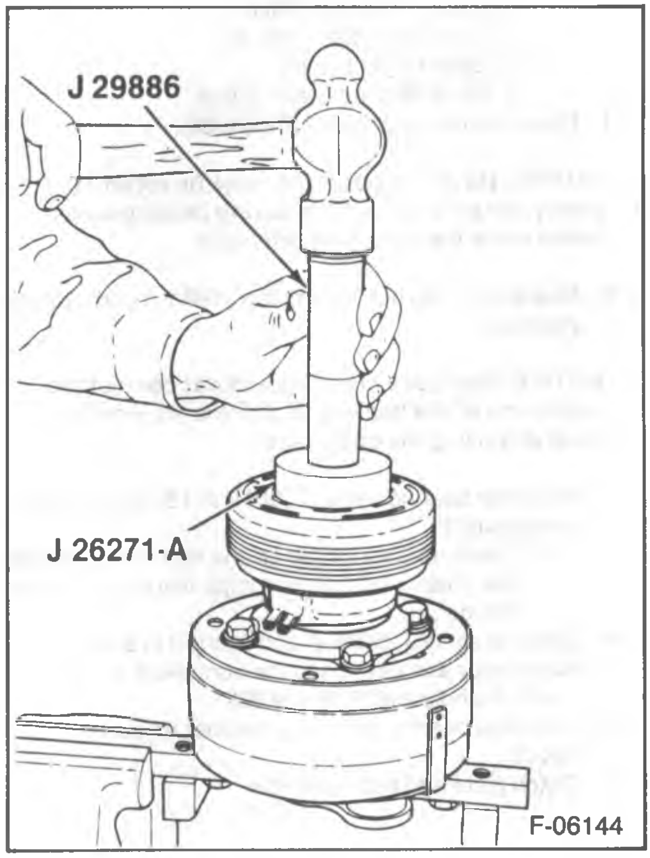


Figure 29—Installing the Rotor and Bearing Assembly — Poly-Groove Type

   - Make sure the protrusions on the rear of the coil align with the front head locator holes.
5. Clutch coil assembly using J 26271-A and J 29886 (figure 29).
6. Retaining ring.

POLY-GROOVE DRIVE

Install or Connect (Figure 30)

Tools Required:
- J 26271-A Rotor and Bearing Installer
- J 29886 Driver Handle

1. The coil assembly on the front head neck.
   - Align the marks made at disassembly.
2. Rotor and bearing assembly on the front head.
   - Make sure the clutch coil terminals are aligned correctly.
   - Make sure the protrusions on the rear of the coil align with the front head locator holes.
3. Clutch coil assembly using J 26271-A and J 29886 (figure 29).
4. Retaining ring.

6 POLE CLUTCH AND/OR BEARING

Install or Connect (Figures 31, 32 and 33)

Tools Required:
- J 6083 Snap Ring Pliers
- J 9481-A Pulley and Bearing Installer

J 21352-A Support Block
J 25008-A Holding Fixture
J 29886 Driver Handle
J 33019 Bearing Staking Tool

1. Pulley rotor on J 21352-A (Figure 30).

NOTICE: Do not support the rotor by resting the pulley rim on a flat surface during bearing installation since the rotor face will bend.

2. Bearing into the hub bore using J 9481-A and J 29886 (figure 31).

NOTICE: The stake metal should not contact the outer race of the bearing to prevent the possibility of distorting the outer race.

3. Stake the bearing using J 33019 at 120 degree intervals (figure 31).
   - Rotate the assembly on the tool to make sure the staking location is completely supported by the tool.
4. Compressor in J 25008-A and clamp it in a vise.
5. Pulley rotor and bearing to the front head using J 9481-A and J 29886 (figure 32).
6. Rotor and bearing assembly retainer ring using J 6083.
7. Clutch plate and hub assembly.

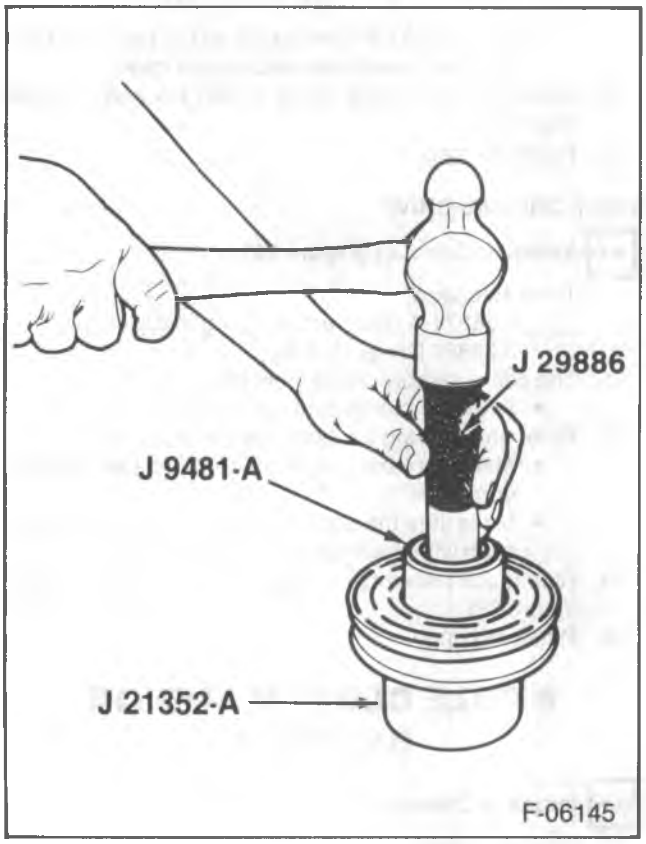


Figure 30—Bearing Installation

4 POLE CLUTCH ROTOR AND/OR BEARING-V-GROOVE

Install or Connect (Figures 28 and 34)

Tools Required:
J 6083 Snap Ring Pliers
J 9481-A Pulley Bearing and Pulley Installer
J 29886 Driver Handle

1. Bearing to the rotor hub using J 29886 and J 9481-A (figure 33).
2. Stake the bearing.
   - Use a center punch with a 45 degree angle point.
   - Staking depth should be 1.1-1.4mm (0.045-0.055-inch).
   - Stake in three places 120 degrees apart.
3. Rotor and bearing assembly using J 26271-A (figure 28).
4. Retainer ring using J 6083.
5. Loctite 601 or equivalent to screw threads.

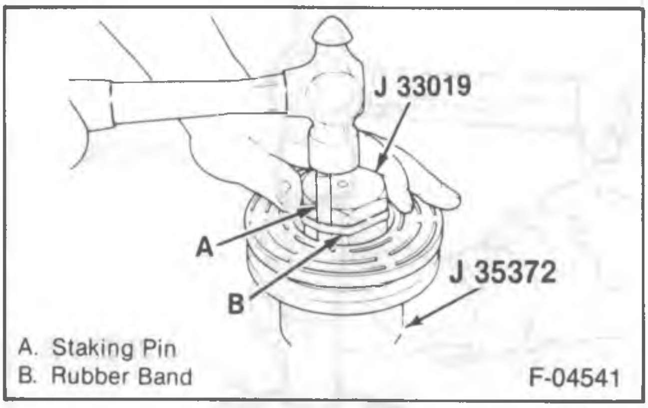


Figure 31—Bearing Staking

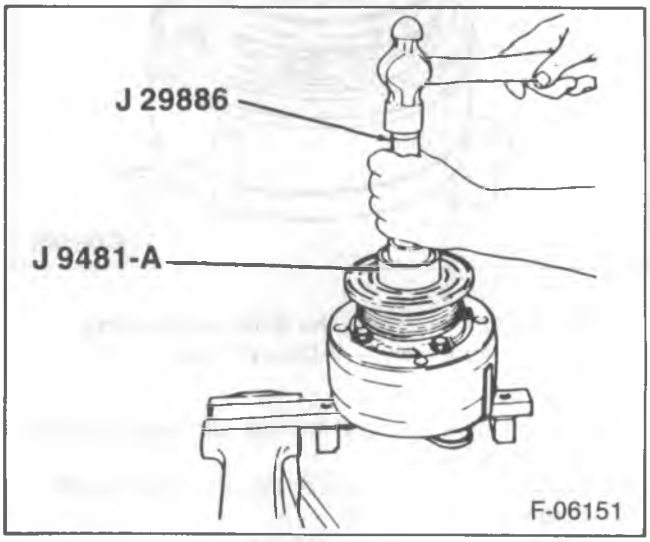


Figure 32—Pulley Rotor and Bearing Installation

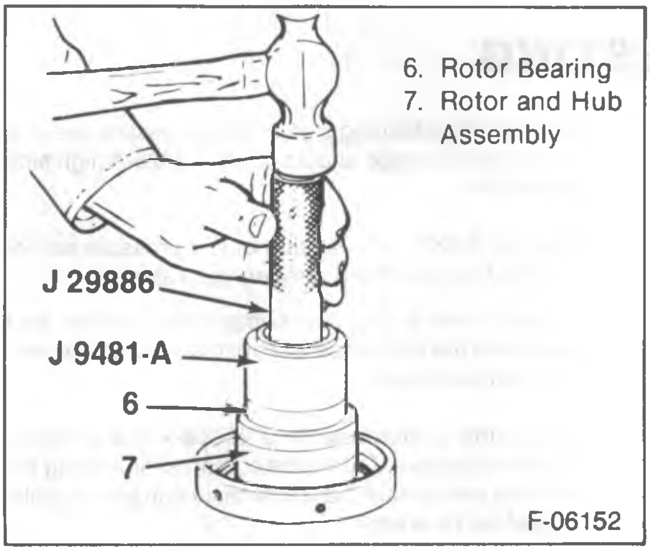


Figure 33—Installing the Clutch Rotor Bearing

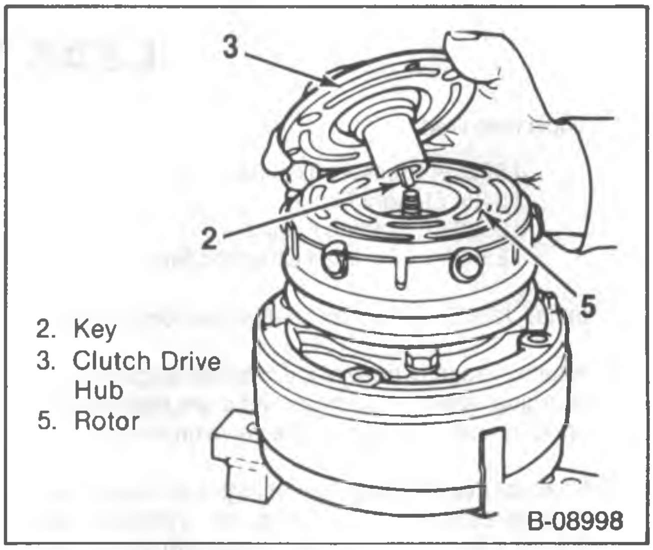


Figure 34—Installing the Shaft Key

6. Pulley rim mounting screws and washers. Do not tighten.
   - Check that the pulley rim is in line. Adjust if necessary.
7. Tighten the screws to 11 N·m (100 in. lb.).
   - Bend the screw head washers to secure them in place.

CLUTCH DRIVE HUB

Install or Connect (Figures 6, 34 and 35)

Tools Required:
- J 9399 Thin Wall Socket
- J 9480-B Clutch Plate and Hub Installer
- J 33027 Clutch Hub Holding Tool

1. Shaft key in the groove (figure 34).
   - Leave the key about 4.8mm (3/16-inch) out of the keyway.
2. Clutch plate and hub assembly on the shaft while aligning the shaft key and keyway.

NOTICE: To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

3. J 9480-B on the compressor (figure 35).
   - Tighten until there is 0.5-1.0mm (0.020-0.040-inch) gap between the frictional surfaces of the clutch plate and the clutch rotor.

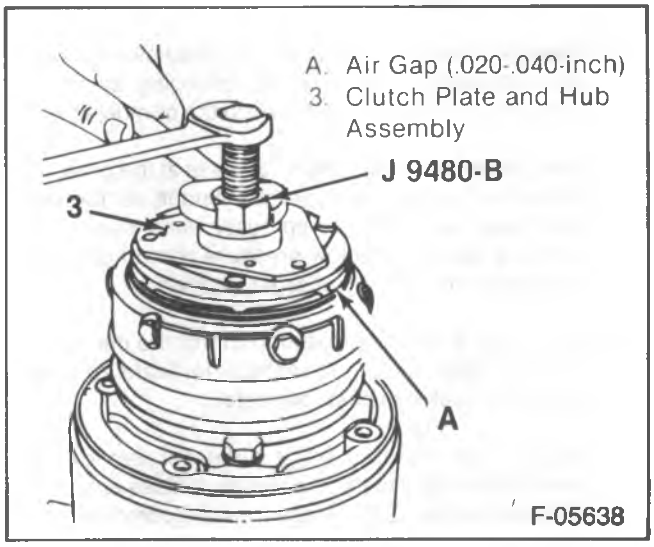


Figure 35—Installing the Clutch Plate and Hub Assembly

4. New shaft nut using J 9399.
   - The small diameter boss of the nut goes against the crankshaft shoulder.

Tighten

- Shaft nut to 14 N·m (10 ft. lb.) while holding the clutch plate and hub using J 33027 (figure 6).

LEAK TESTING

Tools Required:

J 9625-A Pressure Test Set
J 5420 Straight Fitting
J 25008-A Holding Fixture
J 23500-01 Portable Charging Station

1. Install J 9625 on the rear head of the compressor.
2. Attach the center hose of the manifold gage set on the charging station to a refrigerant drum standing in an upright position and open the valve on the drum.
3. Connect the charging station high and low pressure lines to corresponding fittings on J 9625-A, using J 5420 if hoses are not equipped with valve depressors.
   - Suction port (low-side) of the compressor has a large internal opening. The discharge port (hi-side) has a smaller internal opening into the compressor.
4. Open the low-pressure control, high-pressure control and refrigerant control on the charging station to allow refrigerant vapor to flow into the compressor.
5. Using a leak detector, check for leaks at the pressure relief valve, compressor shell to cylinder, compressor front head seal, and compressor shaft seal. After checking, shut off the low pressure control and high pressure control on the charging station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the manifold gage hose connections to J 5420 connected to the low and high sides and allow the vapor pressure to release from the compressor.
8. Disconnect J 5420 from J 9625-A.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.
12. Connect the charging station high pressure line or a high pressure gage and J 5420 to J 9625-A high side connector.
13. Attach J 5420 to the suction or low pressure port of J 9625-A to open the Schrader-type valve.

    Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.
14. Attach the compressor to J 25008-A using metric mounting screws. Clamp the compressor holding fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub 10 complete revolutions at a speed of approximately one-revolution per second.

    Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 344.75 kPa (50 psi) or above. A pressure reading of less than 310.275 kPa (45 psi) would indicate one or more suction and/or discharge valves leaking, an internal leak or an inoperative valve, and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.
17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove J 5420 and J 9625-A.
18. On the R-4 compressor, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

    If further assembly or processing is required, a shipping plate or J 9625-A should be installed to keep out air, dirt and moisture until the compressor is installed.

SPECIFICATIONS

Type Compressor	Harrison Radial 4 Cylinder
Part Numbers	1131593
	1131610
	1131611
	1131616
	1131623
	3090927
	3091278
Displacement	10 cubic inches
Rotation	Clockwise
Clutch Plate to Rotor Gap	0.5-1.0 mm (0.02-0.04 in.)

FASTENERS

Oil Drain Screw	17 N·m (13 ft. lbs.)
Pressure Switch	10 N·m (88 in. lbs.)
Shaft Nut	14 N·m (10 ft. lbs.)
Pressure Relief Valve	17 N·m (13 ft. lbs.)
Front Head Bolts	27 N·m (20 ft. lbs.)
Rim Mounting Screws	11 N·m (100 in. lbs.)

SPECIAL TOOLS

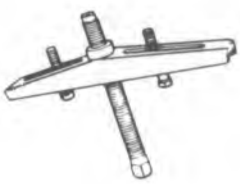
1.  J 4245

2.  J 5403

3.  J 5420

4.  J 6083

5.  J 8398

6.  J 8433

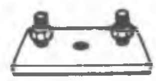
7.  J 9398-A

8.  J 9399

9.  J 9480-B

10.  J 9481-A

11.  J 9553-01

12.  J 9625-A

13.  J 21352-A

14.  J 23128-A

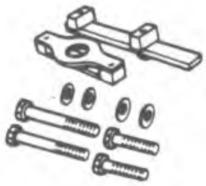
15.  J 24092

16.  J 24895

1. Snap Ring Pliers (#23 Internal)
2. Snap Ring Pliers (Internal)
3. Straight Connector
4. Snap Ring Pliers (#24 Internal)
5. Torque Wrench
6. Compressor Pulley Puller
7. Rotor Bearing Remover
8. 9/16 Inch Thin Wall Socket
9. Hub and Drive Plate Assembly Installer
10. Pulley Bearing and Pulley Installer
11. O-ring Remover
12. Pressure Plate Connector
13. Compressor Support Block
14. Seal Seat Remover and Installer
15. Pulley Hub Adapter Set
16. Bearing Installer

F-06187

17.  J 24896

18.  J 25008-A

19.  J 25031

20.  J 26271-A

21.  J 29886

22.  J 33011

23.  J 33019

24.  J 33020

25.  J 33027

26.  J 34614

27.  J 37707

17. Bearing Remover
18. Compressor Shell Remover, Installer and Holding Fixture
19. Rotor and Bearing Puller with Guide
20. Rotor and Bearing Installer
21. Threaded Driver Handle
22. O-ring Installer
23. Bearing Staking Tool
24. Pulley Puller
25. Clutch Hub Holding Tool
26. Shaft Seal Protector
27. Hub and Drive Plate Assembly Remover
28. Not shown: J 23500-01 Portable Charging Station

F-06229

SECTION 1B4

HR-6 AIR CONDITIONING COMPRESSOR

CONTENTS

DESCRIPTION

The Harrison HR-6 compressor is a fixed displacement axial piston pump, with three double-ended pistons actuated by an axial (swash) plate shaft assembly (figure 1). The main parts are the front and rear cylinder, the shaft and axial swash plate, piston group, and valve mechanisms. The cylinders and heads provide an integral external shell.

The piston group of the compressor is not serviceable. If piston, bearing, ball shoe, shaft and axial plate, or cylinder repair is needed, replace the internal cylinder assembly. All clutch parts, valve mechanisms, and head assemblies are serviceable, plus seals and gaskets.

Refrigerant oil, dispersed in the refrigerant vapor, lubricates the system.

The front head is shown with three integral mounting flange ears (figure 2). These ears have 19 mm flats cast to provide for a wrench to be used as a prying means when tensioning the compressor drive belt.

There are two clutch driver designs for the HR-6 compressor: The clutch driver without a torque cushion and the clutch driver having a thin torque cushion (figures 3 and 4).

Note: When servicing clutch drivers with a torque cushion, the clutch hub holding tool J 25030 is used in place of J 33027.

Keep dirt or foreign material from getting on or into the compressor parts and system. Keep the work area and tools clean.

Keep the parts clean at all times. Clean assembled parts with Trichloroethane, naphtha, Stoddard sovlent, kerosene or equivalent solvent and dry with dry air. Use only lint free cloths to wipe parts.

The operations described below are based on bench overhaul with the compressor removed from the truck, except as noted. They have been prepared in order of accessibility of the components. When a compressor is removed from the truck for servicing, the amount of oil remaining in the compressor should be drained, measured and recorded. This oil should then be discarded and an equal amount of new 525 viscosity refrigerant oil added to the compressor.

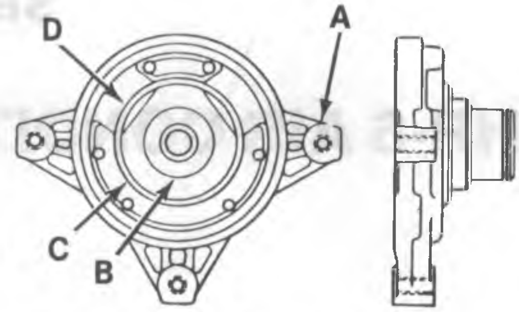
Note: The service compressor is shipped with 8 oz. of 525 viscosity refrigerant oil. This oil should be drained and retained for replacement oil when service procedures require addition of new oil to compressor.

Most minor repair procedures may be done on the truck without discharging the system. Major repair procedures require that the system be discharged of refrigerant.

IDENTIFICATION

An identification label attached to the compressor provides the name of the manufacturer, model number and build code. If the label is removed or becomes dislodged during service operation, reattach it using an adhesive sealant such as Loctite 312 or equivalent.

Figure 1 — HR-6 Compressor, V-Groove Pulley



A. 19 mm Mounting Flange Ear
B. Discharge Cavity
C. Suction
D. Relief

B-06542

Figure 2 — HR-6 Front Head Assembly

MINOR REPAIR TO THE COMPRESSOR

Illustrations show the compressor removed from the vehicle for easier viewing.

Remove only the parts that need servicing. Refer to figure 3 for part names and location.

CLUTCH PLATE AND HUB ASSEMBLY REPLACEMENT

Clean

- The compressor assembly with solvent and blow dry with dry air.

Remove or Disconnect (Figures 4, 5 and 6)

Tools Required:

J 33026 Compressor Holding Fixture
J 33027 Clutch Hub Holding Tool
J 33022 6-Point 13 mm Socket
J 33013-B Hub and Drive Plate Remover and Installer

- Clamp J 33026 in a vise and attach the compressor to the holding fixture with thumb screws (figure 5).

1. Shaft nut (1) using J 33022 (figure 5).
   - Hold the clutch plate and hub assembly (2) steady using J 33027.
2. Clutch plate and hub assembly (2).
   - Thread J 33013-B into the clutch plate and hub assembly (2).
   - Hold the body of J 33013-B with a wrench and tighten the center screw into the remover body (figure 6).
3. Shaft key (21).
   - Retain the shaft key (21) if usable.

Inspect

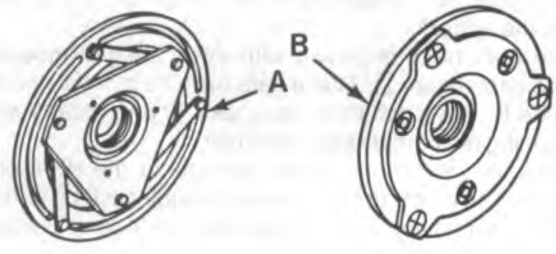
All parts and replace as necessary.

Install or Connect (Figures 4, 7 and 8)

Tools Required:

J 33026 Compressor Holding Fixture
J 33027 Clutch Hub Holding Tool
J 33022 6-Point 13 mm Socket
J 33013-B Hub and Drive Plate Remover and Installer

1. Shaft key (1).
   - Allow the shaft key (21) to extend 3.2 mm (1/8-inch) out of the bottom of the hub keyway (figure 7).
   - The shaft key is curved slightly to give an interference fit in the groove.



A. Without Torque Cushion
B. Thin Torque Cushion

F-05646

Figure 3 — HR-6 Clutch Driver Designs

1. Shaft Nut
2. Clutch Plate and Hub Assembly
3. Puiley Bearing Retainer
4. Pulley Bearing
5. Pulley
6. Clutch Coil Assembly
7. Through Bolts (6)
8. Shaft Seal Retainer Ring
9. Shaft Lip Seal
10. O-Ring Seal
11. Front Head
12. Head Gasket
13. Valve Plate (Discharge)
14. Suction Reed Plate
15. Cylinder Seal
16. Front Cylinder
18. Shaft Bearing (2)
19. Thrust Bearing and Races (2)
20. Axial Plate Shaft Assembly
21. Shaft Key
22. Cylinder Seal
23. Rear Seal
24. Cylinder Seal
25. Suction Reed Plate
26. Valve Plate (Discharge)
27. Head Gasket
28. Rear Head
29. Switch Seal
30. System Control Switch
31. Retainer Ring-Switch
32. High Pressure Relief Valve
33. Seal (O-ring)

A. Important: Shaded parts are not serviceable and must be replaced as a kit.

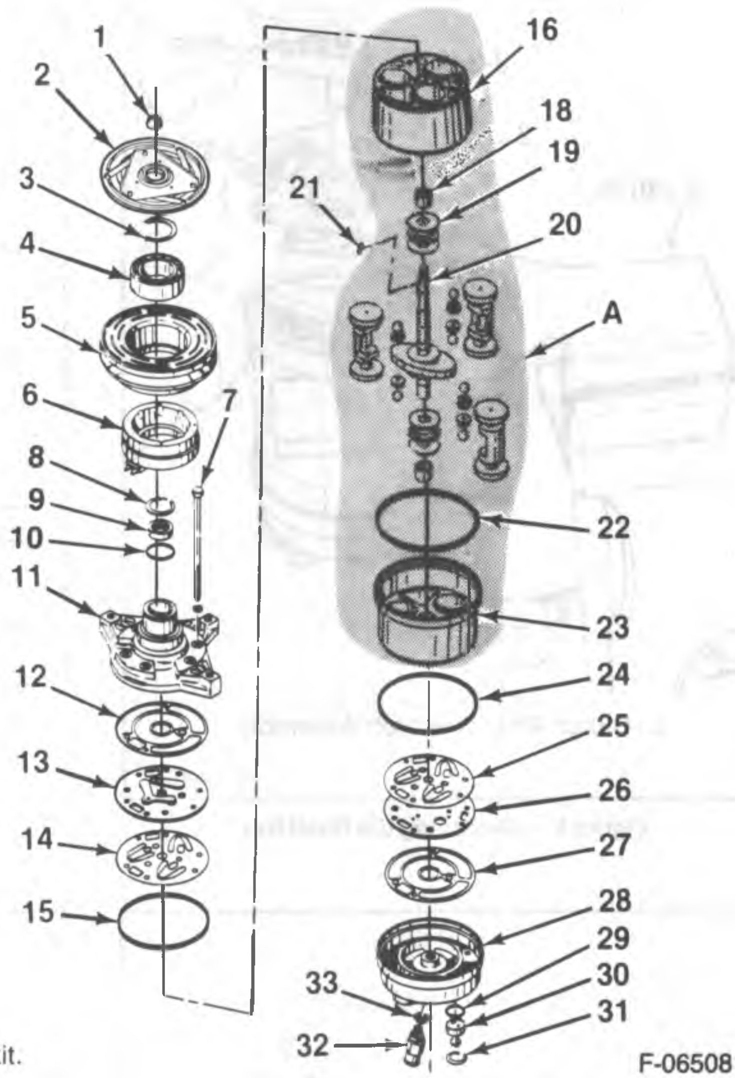


Figure 4 — HR-6 Component View

Important

- Do not drive or pound on the clutch hub or the shaft (20). Internal damage to the compressor may result.

2. Clutch plate and hub assembly (2) (figure 8).
   - Make sure the contact surfaces of the clutch plate (2) and the pulley (5) are clean.
   - Remove the forcing screw tip from J 33013-B and reverse the body direction on the center screw.
   - Install J 33013-B with bearing (figure 8).
   - Back off J 33013-B body enough to allow the center screw to be threaded against the end of the compressor shaft.
   - Hold the center screw with a wrench and tighten the hex portion of J 33013-B body while pressing the hub onto the shaft. After tightening the body several turns, remove J 33013-B and check that the shaft key (21) is properly in place in the keyway, then install the clutch plate and hub assembly (2) to its final position.
   - Measure the air gap between contact surfaces of the clutch plate and hub assembly (2) and the pulley (5). The gap should be 0.38-0.64 mm (0.015-0.025-inch) (figure 8).
   - Remove J 33013-B.

Inspect

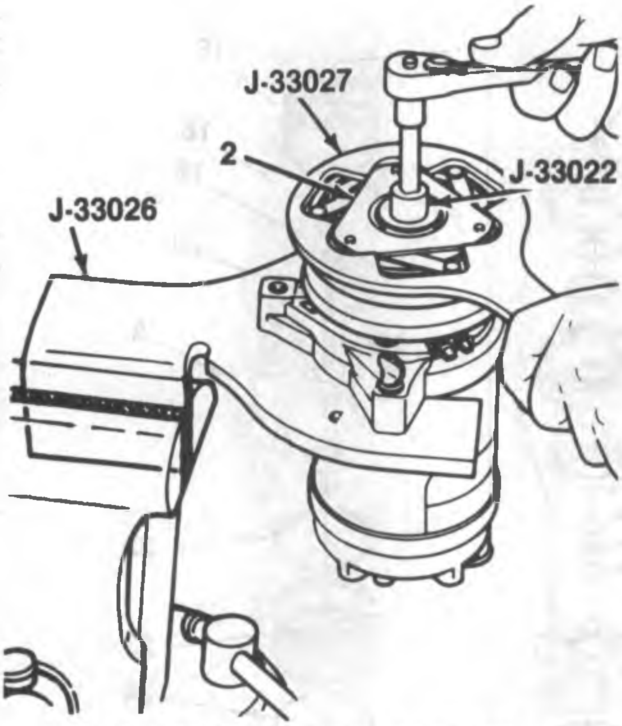
- Position of the shaft (20) (even with or slightly above the clutch hub).
- Use J 33027 to hold the clutch plate and hub assembly (2).

Tighten

- Shaft nut (1) to 16 N·m (12 ft. lbs.) with J 33022.

— Hand spin the pulley (5) to check for free rotation.

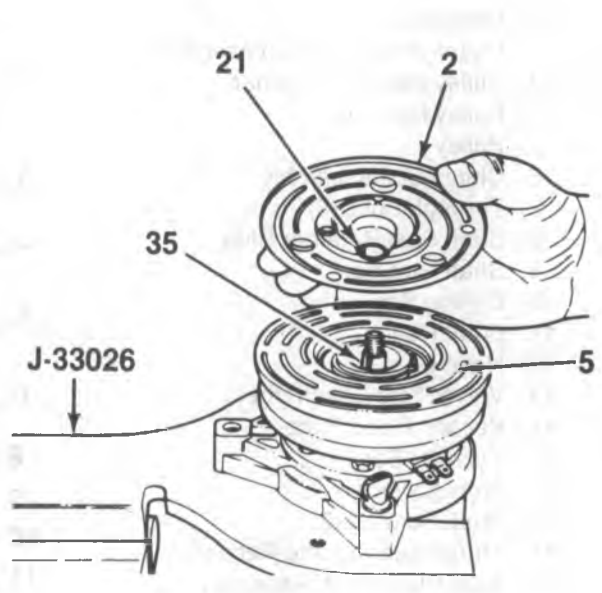
- Remove the assembly from J 33026.



2. Clutch Plate And Hub Assembly

F-04458

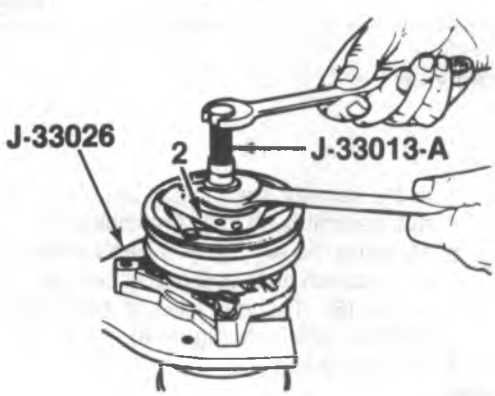
Figure 5 — Removing the Shaft Nut



2. Clutch Plate and Hub Assembly
5. Pulley (Rotor)
21. Key
35. Keyway (Shaft)

F-04459

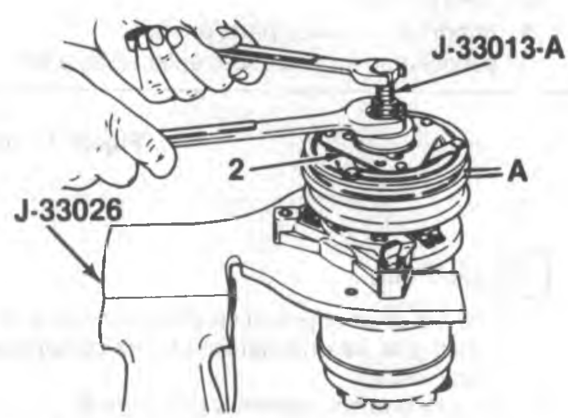
Figure 7 — Positioning the Shaft Key, Clutch Plate, and Hub Assembly



2. Clutch Plate And Hub Assembly

B-06574

Figure 6 — Removing the Clutch Plate and Hub Assembly



2. Clutch Plate and Hub Assembly
A. Air Gap 0.38-0.64 mm (.015-.025 inch)

F-04460

Figure 8 — Installing the Clutch Plate and Hub Assembly

PULLEY AND BEARING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 4, 9, 10, 11 and 12)

Tools Required:
- J 6983 Snap Ring Pliers
- J 29886 Driver Handle
- J 9398-A Pulley Bearing Remover
- J 33020 Pulley Puller
- J 33023-A Puller Pilot

1. Clutch plate and hub assembly (2).
2. Pulley bearing retainer (3) using J 6083 (figure 9).
3. Pulley (5).
   - Install J 33023-A to the front head (figure 10).
   - Install J 33020 tangs into the inner circle of slots in the pulley (5) contact surface. Rotate J 33020 clockwise so the tangs will lock into the segments between the slots (figure 11).
   - Hold J 33020 in place and tighten the puller screw against J 33023-A puller pilot to remove the pulley (5) (figures 11 and 12).
4. Pulley bearing (4) from the pulley (5) using J 9398-A and J 29886 (figure 12).
   - Remove the forcing screw from J 33020 and with the puller tangs still in place in the pulley slots, turn the assembly upside down onto a flat surface (figure 12).
   - When removing the old pulley bearing (5) allow the staking to remain, then file away the old staked metal for proper fit when installing a new bearing (5) in the pulley bore.

Install or Connect (Figures 4, 13, 14, 15 and 16)

Tools Required:
- J 21352-A Compressor Support Block
- J 9481-A Pulley Bearing Installer
- J 33019 Bearing Staking Tool (with staking pin and retaining band)
- J 33017 Pulley and Bearing Assembly Installer
- J 33023-A Puller Pilot
- J 8433-1 Puller Bar
- J 33026 Compressor Holding Fixture
- J 6083 Snap Ring Pliers

1. Pulley (5) on J 21352-A.

NOTICE: Do not support the rotor by resting the pulley rim on a flat surface during bearing installation or the rotor face will be bent.

2. Pulley bearing (4) into the hub using J 29886, J 9481-A and J 21352-A (figure 13).
   - J 33019-1 in the pulley bore (figure 14).
   - Seat the pulley and bearing assembly on J 21352-A to support to the hub under the staking pin location.

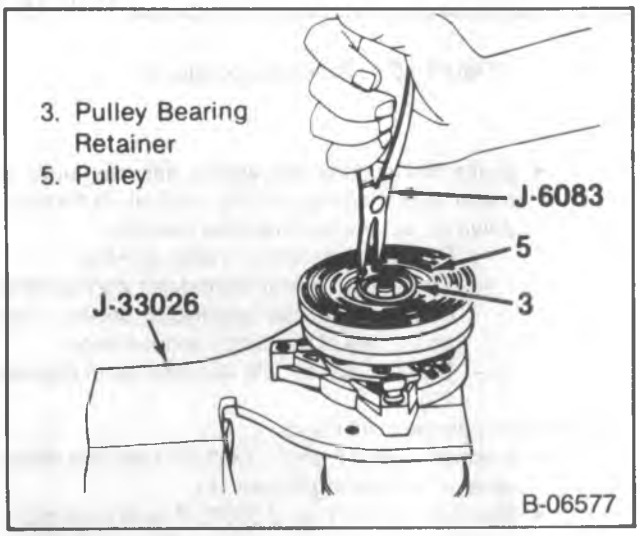
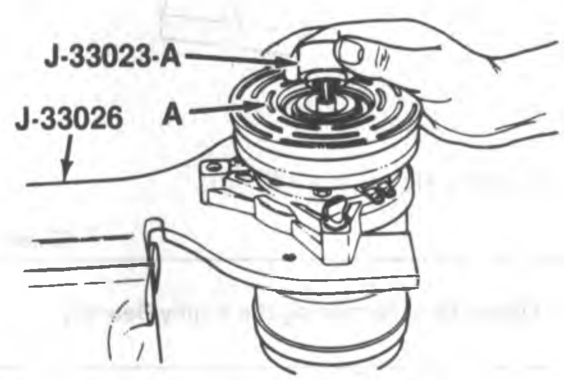


Figure 9 — Removing the Pulley Rotor and Bearing Retaining Ring



A. Pulley Puller J-33020 Engages in Inner Circle of Pulley Rotor Slots

F-04427

Figure 10 — Installing the Puller Pilot and Pulley Rotor Slot Location

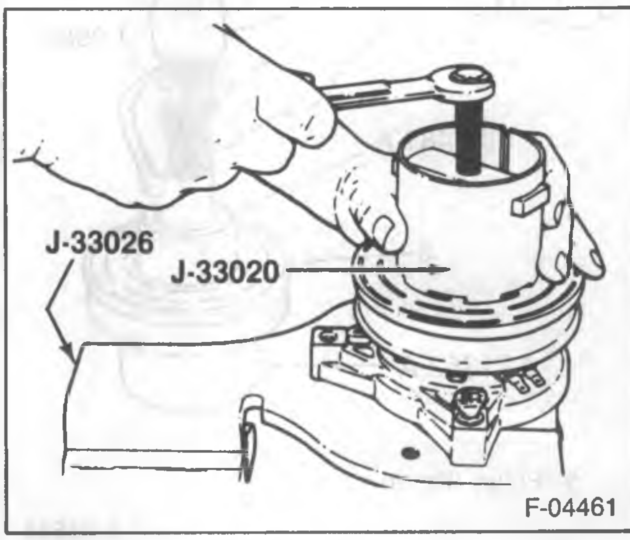


Figure 11 — Installing J-33020 in the Pulley Rotor Slots

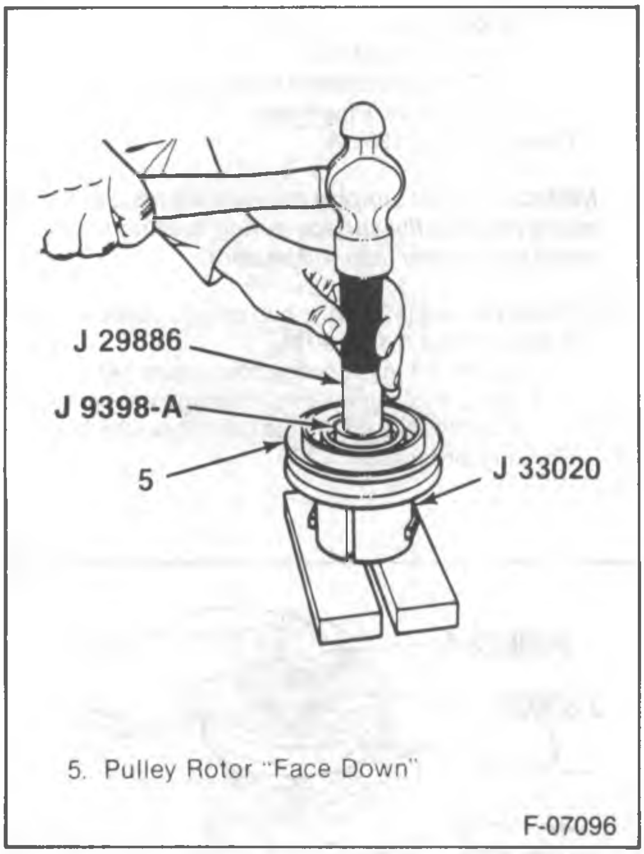


Figure 12 — Removing the Pulley Bearing

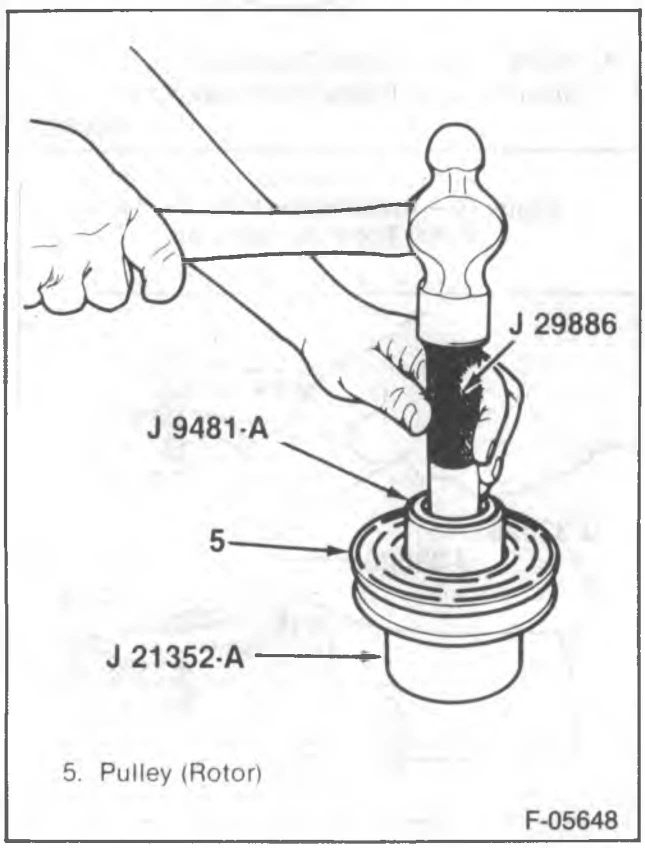


Figure 13 — Installing the Pulley Rotor Bearing

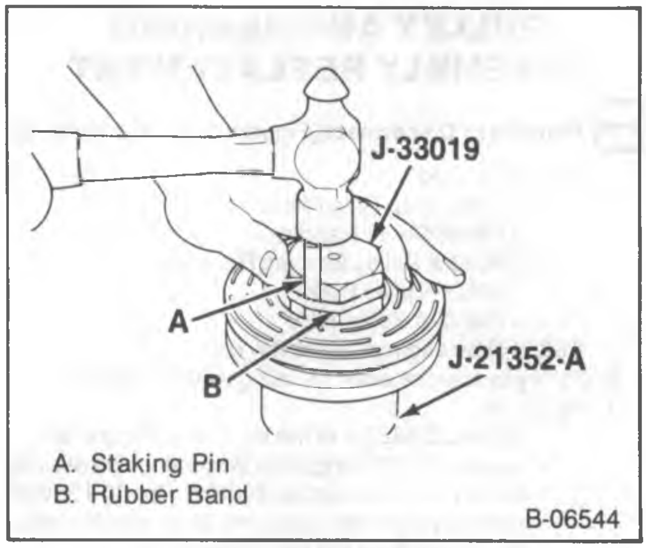


Figure 14 — Staking the Pulley Bearing in the Rotor Bore

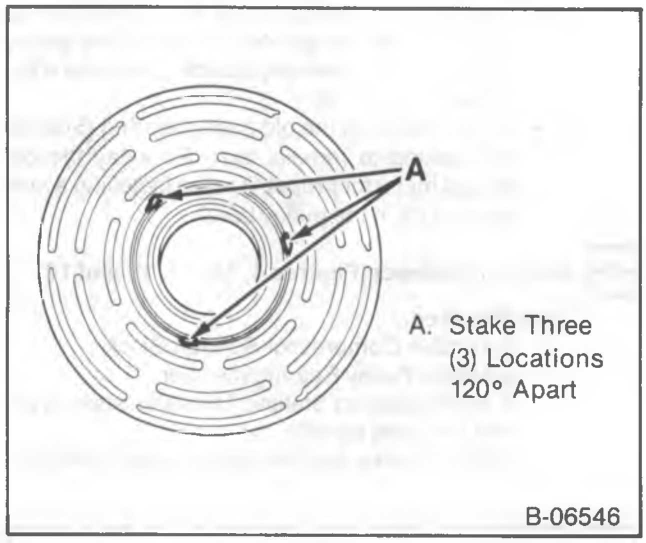
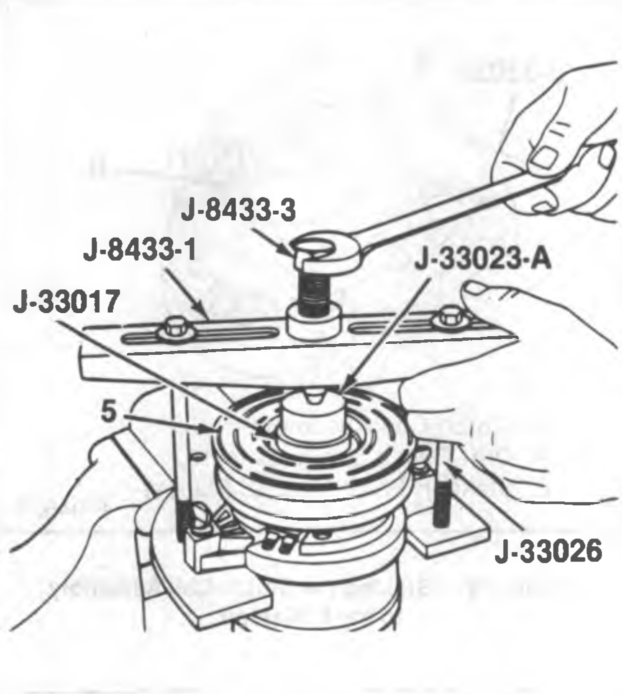


Figure 15 — Staking Locations

- Strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching the bearing.
  - Position the stake pin after striking.
  - The staked metal should not contact the outer race of the bearing to prevent the possibility of bending the outer race.
  - Stake 3 places 120 degrees apart (figure 15).

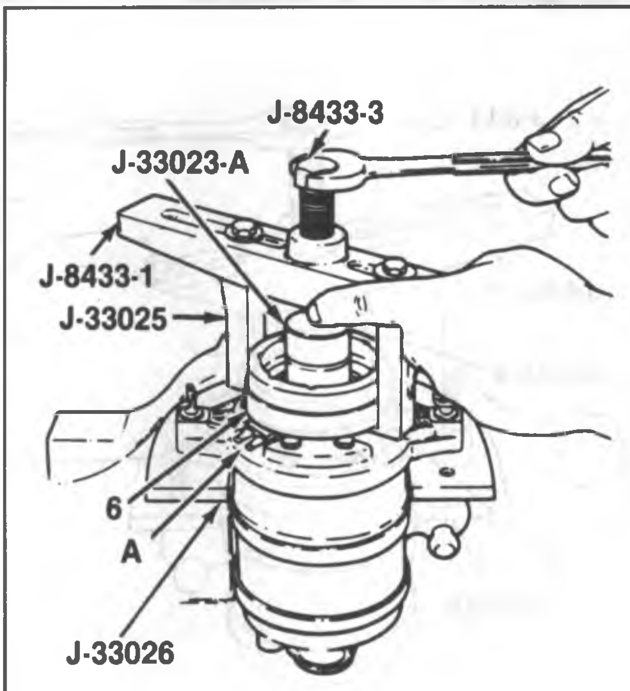
3. Pulley (5) on the front head.
   - Position J 33017 and J 33023-A over the inner race of the bearing (figure 16).
   - Position J 8433-1 on J 33023-A and assemble the through bolts and washers through the puller bar slots and thread them into J 33026 (figure 16).



5. Pulley (Rotor)

B-06547

Figure 16 — Installing the Pulley Bearing Assembly



6. Clutch Coil Assembly
A. Mark

F-04522

Figure 17 — Removing the Clutch Coil Assembly

— The thread of the through bolts should engage the full thickness of J 33026.

- Tighten the center screw in J 8433-1 to force the pulley and bearing assembly onto the compressor front head (11) (figure 16).
  — Should J 33017 become misaligned with the inner race of the bearing, back off J 8433-1 and relocate center, then continue installation.

4. Pulley bearing retainer (3) using J 6083 (figure 9).
5. Clutch plate and hub assembly (2).

CLUTCH COIL AND HOUSING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 4 and 17)

Tools Required:
J 8433-1 Puller Bar
J 08433-3 Puller Screw
J 33023-A Puller Pilot
J 33025 Clutch Coil Puller Legs

1. Clutch plate and hub assembly (2).
2. Pulley (5).
   - Mark or scribe the location of the clutch coil (6) to terminal on the compressor front head (11).
3. Clutch coil assembly (6).
   - Install J 33023-A on the head (11) of the compressor.
   - Install J 8433-1 with J-33025 (figure 17).
   - Tighten J 8433-1 forcing screw against J 33025-A.

Inspect

- Clutch coil assembly (6). Replace as necessary.

Install or Connect (Figures 4, 18, 19 and 20)

Tools Required:
J 8433-1 Puller Bar
J 33024 Clutch Coil Installer Adapter
J 33026 Compressor Holding Fixture

1. Compressor assembly on J 33026.
2. Clutch coil assembly (6) onto the front head (11) with the terminals positioned at the "marked" location.
   - J 33024 over the internal opening of the clutch coil assembly (6).
   - J 8433-1 with through bolts, washers and forcing screw over J 33024.
   - Thread through bolts into J 33026 to full fixture thickness (figure 18).
   - Be sure J 8433-1 and the clutch coil assembly (6) stay "in line" during installation.
   - When the clutch coil assembly (6) is seated on the front head (11), use a 3 mm (1/8-inch) diameter drift punch to stake the head (11) at 3 places, 120 degrees apart to assure the clutch coil assembly (6) remains in position (figure 19).
     — Stake size should be one half the area of the punch tip and 0.28-0.35 mm (0.010-0.015-inch) deep (figure 20).
3. Pulley (5).
4. Clutch plate and hub assembly (2).

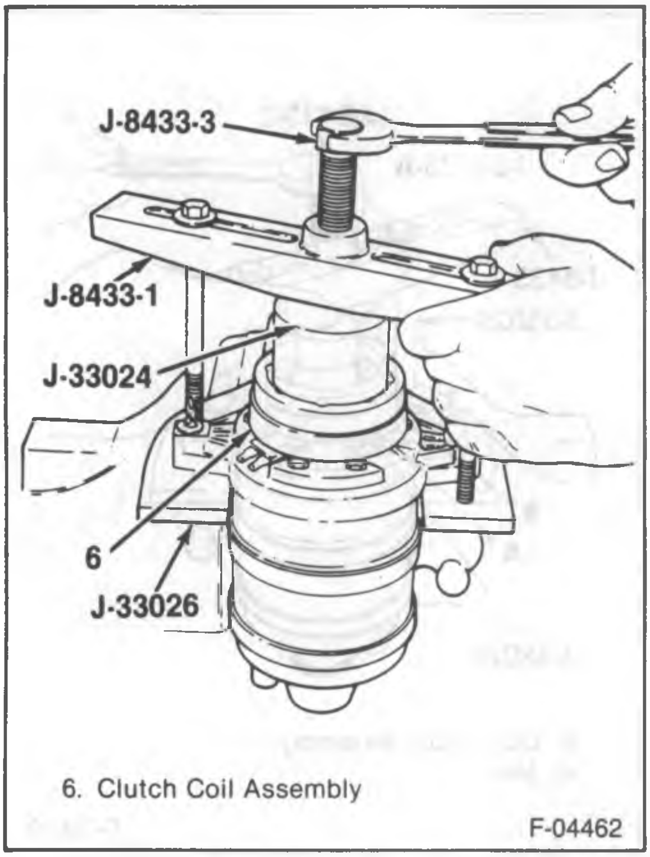


Figure 18 — Installing the Clutch Coil Assembly

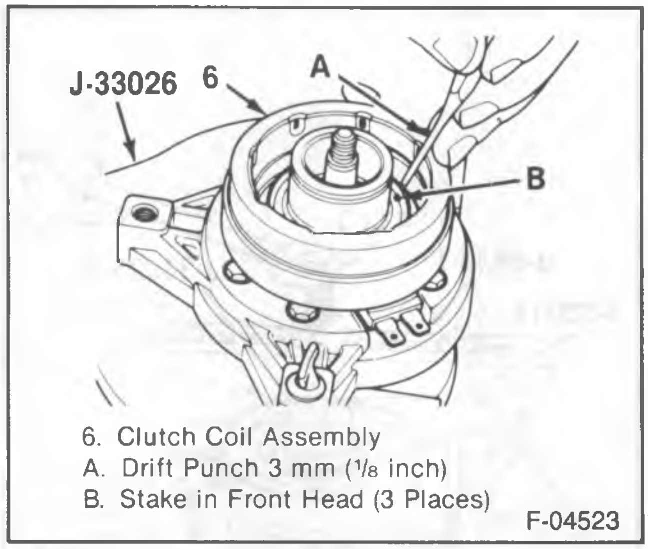


Figure 19 — Staking the Clutch Coil Assembly to the Coil Head

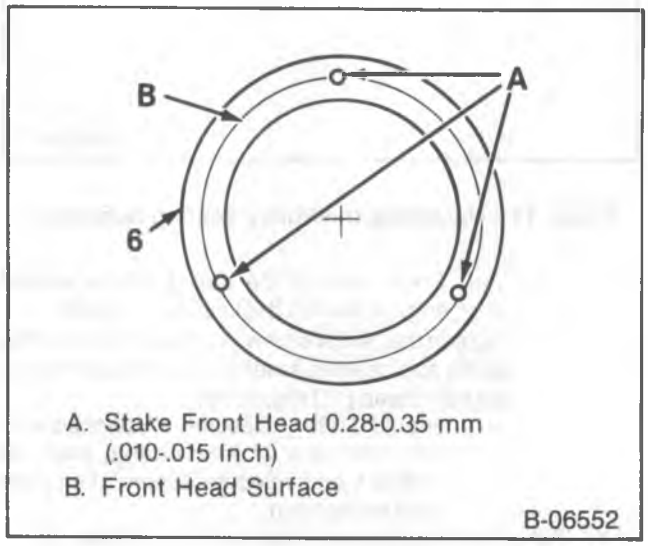


Figure 20 — Staking Locations on the Front Head

MAJOR REPAIR TO THE COMPRESSOR

Replacement of the shaft seal assembly (8, 9, 10) or the pressure relief valve will require the discharge of the vehicle's refrigerating system (figure 21). Other than clutch repair procedures, the same holds true for any disassembly of the compressor. To discharge the refrigerant, refer to the vehicle service manual.

After servicing or repairing the compressor, always add the proper amount of new 525 viscosity refrigerant oil. Refer to "Specifications."

Keep the workbench and work area clean when servicing the compressor, and use proper, clean service tools.

NOTICE: Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

All parts used for servicing the compressor internally are protected by a preservative and packaged in a manner which does not require cleaning, washing or flushing. The parts can be used in the internal assembly just as they are removed from the service package.

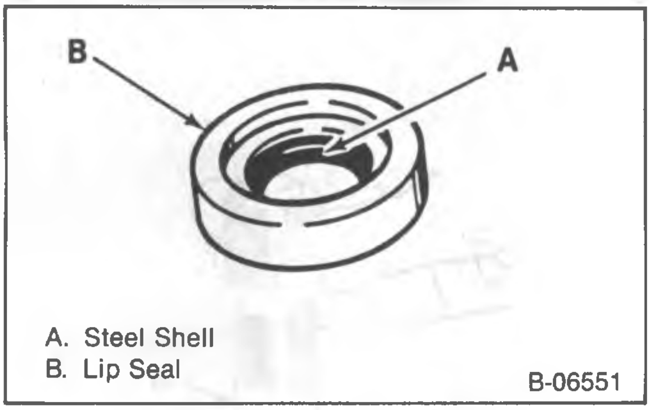


Figure 21 — Compressor Shaft Seal

SHAFT SEAL REPLACEMENT

Remove or Disconnect (Figures 4, 22, 23 and 24)

Tools Required:
- J 5403 Snap Ring Pliers
- J 34614 Shaft Seal Protector
- J 23128-A Seal Remover and Installer
- J 9553-01 O-Ring Seal Remover

1. Clutch plate and hub assembly (2).
   - Install J 34614 over the threaded end of the shaft (20).
2. Shaft seal retainer ring (8) using J 5403 (figure 22).
   - Clean the compressor neck area around the shaft (20), the exposed part of the shaft seal (9) and the O-ring seal groove.
3. Shaft lip seal (9) using J 23128-A (figure 23).
   - Insert J 23128-A into the shaft lip seal, tighten and remove lip seal.
4. O-ring seal (10) using J 9553-01 (figure 24).

Inspect

- Make sure the compressor neck area is clean.
- All parts. Replace as necessary.

Install or Connect (Figures 4 and 25)

Tools Required:
- J 33011 O-Ring Seal Installer
- J 23128-A Seal Seat Remover and Installer
- J 34614 Shaft Seal Protector
- J 5403 Snap Ring Pliers

- Dip the new O-ring seal in clean 525 viscosity refrigerant oil.
- J 34614 onto the shaft (20).

1. O-ring seal using J 33011 (figure 25).
   - Insert J 33011 into the compressor neck until the installer "bottoms."
   - Lower the movable slide of J 33011, releasing the O-ring seal into the lower groove.
   - Rotate J 33011 to seat the O-ring seal and remove J 33011.
2. Shaft lip seal using J 23128-A (figure 23).
- Dip the shaft lip seal in clean 525 viscosity refrigerant oil and install shaft lip seal on J 23128-A.
- Bottom the shaft lip seal into the compressor neck area using J 23128-A.

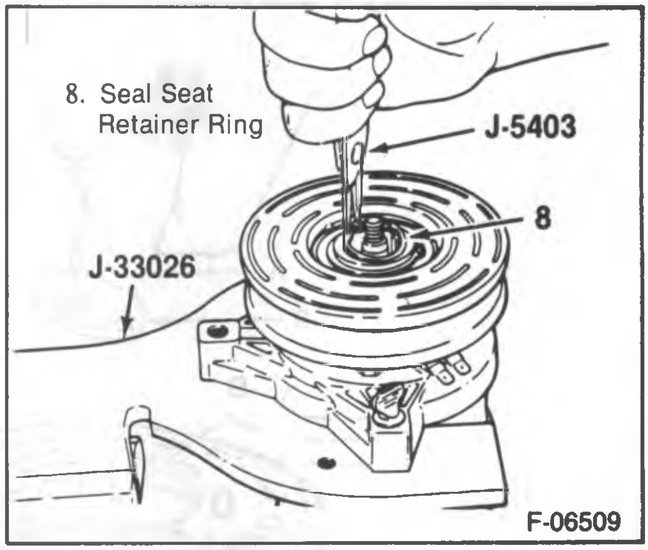


Figure 22 — Removing or Installing the Shaft Lip Seal Retaining Ring

- Release and remove J 23128-A.

3. Shaft seal retainer ring using J 5403 (figure 22).
   - Install flat side of shaft seal retainer ring against the lip seal.
   - Remove J 34614.

Important

- Leak test the compressor.
- Refer to "Leak Testing".

Clean

- Shaft (20) and inside the compressor neck area.

4. Clutch plate and hub assembly (2).

HIGH PRESSURE RELIEF VALVE REPLACEMENT

Remove or Disconnect (Figures 4 and 26)

- Be sure the compressor has no charge.

1. High pressure relief valve (32).
2. O-ring seal (33).

Install or Connect (Figures 4 and 26)

- Lubricate the threads of the high pressure relief valve (32) and new seal with 525 viscosity refrigerant oil.

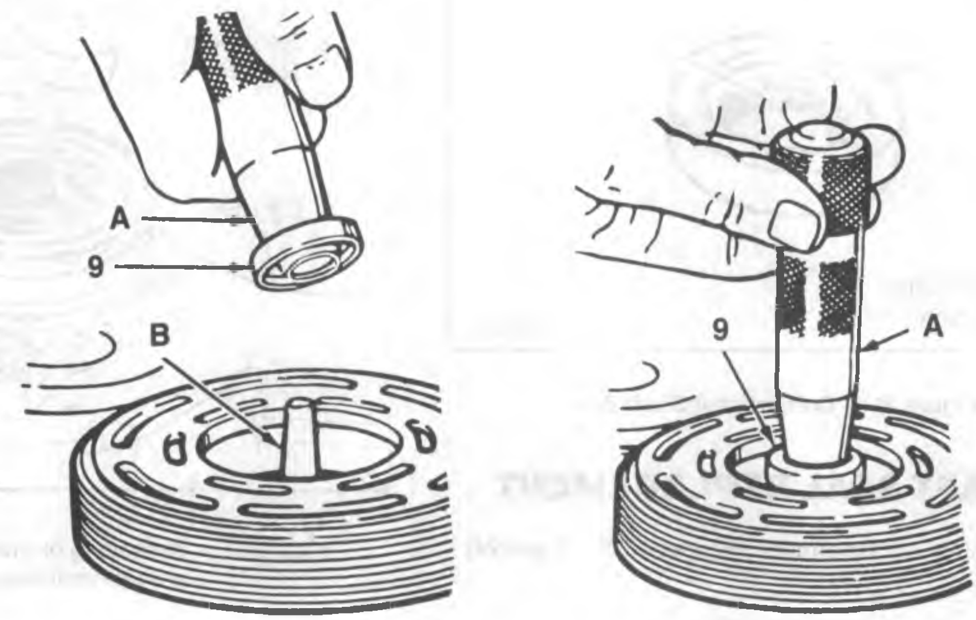
1. High pressure relief valve (32) with new seal.

Tighten

- High pressure relief valve (32) to 9 N·m (84 in. lbs.).

Important

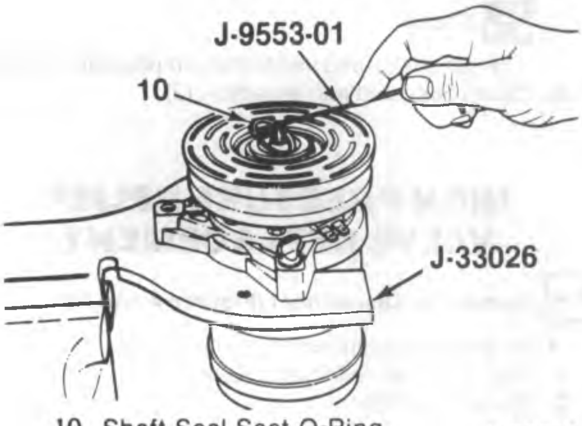
- Leak test the compressor.
- Refer to "Leak Testing."



9. One-Piece Seal
A. J 23128-A Seal Remover and Installer
B. J 34614 Shaft Seal Protector

F-06507

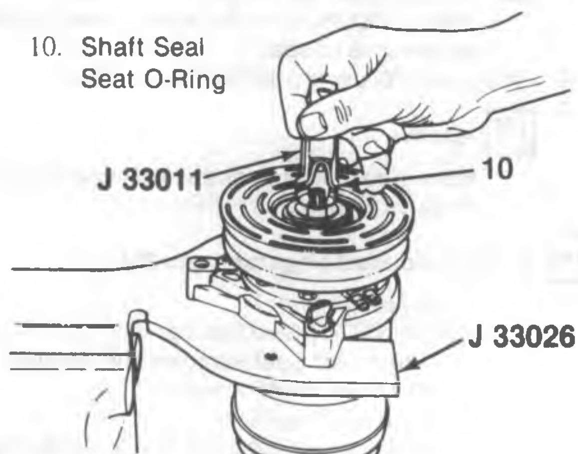
Figure 23 — Removing or Installing the Shaft Tip Seal



10. Shaft Seal Seat O-Ring

F-06510

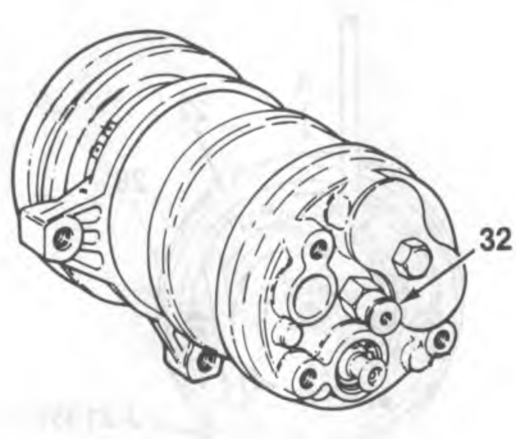
Figure 24 — Removing the Shaft Seal Seat O-Ring



10. Shaft Seal Seat O-Ring

F-06511

Figure 25 — Installing the Seal Seat O-Ring



32. High Pressure Relief Valve

B-06626

Figure 26 — HR-6 Compressor Rear Head Detail

A. Assembly Alignment Marks

B-06625

Figure 27 — Compressor Alignment Marks

COMPRESSOR DISASSEMBLY—INTERNAL CYLINDER AND SHAFT

Remove or Disconnect (Figures 4, 27, 28, 29 and 30)

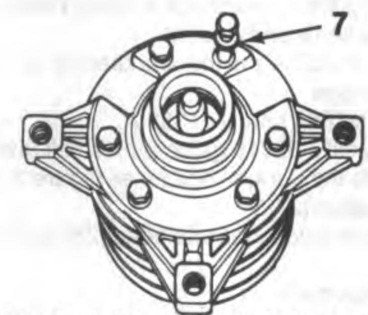
- Mark the front head (11) alignment with cylinders (16) (23) and rear head (28) alignment.

1. Clutch plate and hub assembly (2).
2. Pulley (5).
3. Clutch coil assembly (6).
4. Shaft seal parts (8, 9, 10)
   - Note the compressor alignment marks and use them as a reference for compressor assembly (figure 27).
5. Through bolts (7) and gaskets (figure 28).
   - Throw away the gaskets.
   - Hand-support the compressor from below.
   - Remove compressor assembly from J 33026.
6. Rear head (28) (figure 29).
   - Using a wood block, tap around the edge of the rear head (28) to ease removal.
   - Mount the compressor on J 33026 front head (11) down (figure 30).
7. Head gasket (27).
8. Valve plate (26).
9. Suction reed plate (25).
10. Cylinder seal (24).
11. Cylinder (23).

Important

- Shaded parts shown in figure 3 are not serviceable. A replacement kit (gut pack) is available.
- Cylinders (23) (16), cylinder seal (22), discharge crossover seal (17), piston group, axial plate shaft assemlby (20) and bearings; replace as a kit.

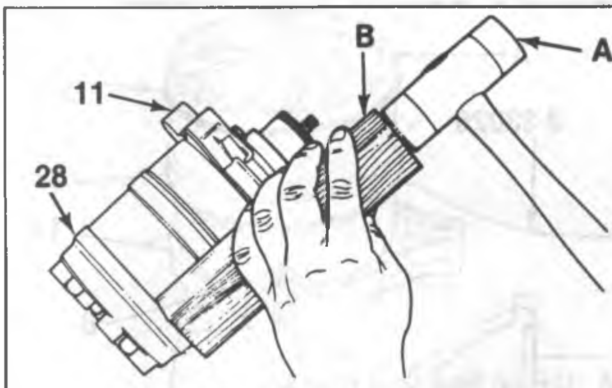
12. Cylinder seal (22).
13. Cylinder (16).



7. Through Bolt and Gasket (6 Required)

B-06627

Figure 28 — Removing and Installing the Through Bolts in the Front Head



A. Plastic Headed Hammer
B. Wood Block
11. Front Head
28. Rear Head

B-06177

Figure 29 — Tapping the Rear Head or Front Head Free of the Cylinder

14. Cylinder seal (15).
15. Suction reed plate (14).
16. Valve plate (13).
17. Head gasket (12).
18. Front head (11).

Clean

- All parts.

Inspect

- All parts and replace as necessary.

COMPRESSOR ASSEMBLY—INTERNAL CYLINDER AND SHAFT

Install or Connect (Figures 4, 31 through 39)

Tools Required:
J 21352-A Support Block
J 33016 Cylinder Alignment Rods
J 33026 Compressor Holding Fixture

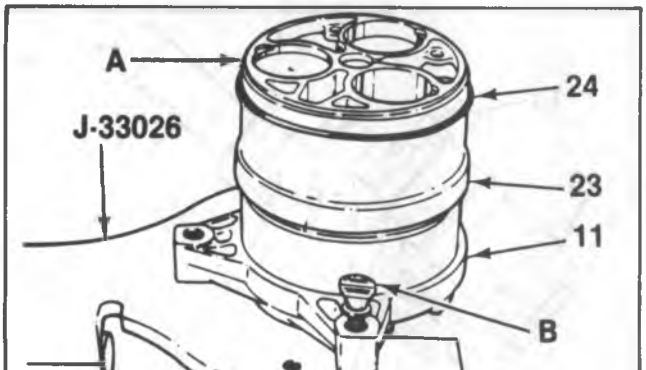
- Use new seals and gaskets.
- Place J 21352-A on the workbench or suitable flat work surface.

1. Rear head (28) onto J 21352-A.
   - Install J 33016 guide pins small diameter ends into the through bolt holes (figure 31).
2. Head gasket (27).
   - Over guide pins into head (28) (figure 32).

Important

- Locate the head gasket (27) to prevent the discharge valve reed retainer on the rear valve plate (26) from hitting the internal segment of the head gasket (27) (figure 32).

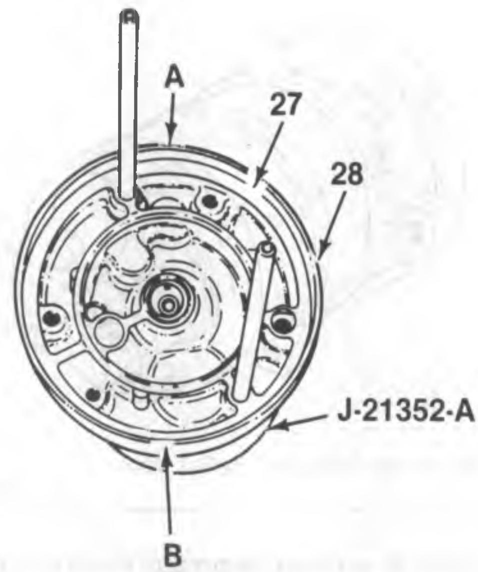
3. Valve plate (26).
   - Over the guide pins into position (figure 33).



A. O-Ring Seal Seat Recess
B. Thumb Screw
24. Cylinder Seal (Lubricated)
23. Rear Cylinder
11. Front Head

B-06476

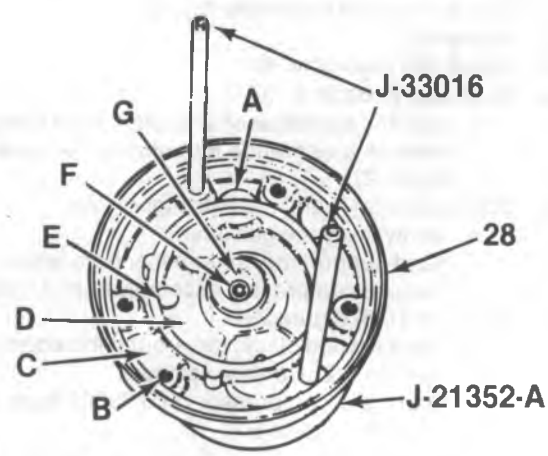
Figure 30 — Installing the O-Ring Seals on the Cylinder Seal Races



A. 12 o'clock Reference Position
B. 6 o'clock Reference Position
27. Head Gasket
28. Rear Head

B-06726

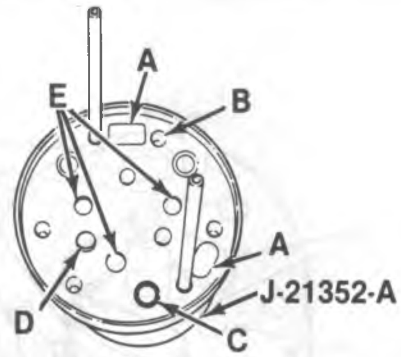
Figure 31 — Positioning the J 33016 Guide Pins



A. Opening to Rear Suction Port (12 O'Clock Position Assembly Reference)
B. Through Bolt Hole (6)
C. Suction Pressure (Outside Cavity)
D. Discharge Pressure (Inner Cavity)
E. Opening to Rear Discharge Port
F. High Pressure Relief Valve
G. Drilled Opening into High Pressure Relief Valve Area
28. Rear Head

B-06727

Figure 32 — Installing the Rear Head Gasket



A. Suction Crossover Openings
B. Through Bolt Hole (6)
C. Suction Port (3) in Valve Plate
D. Discharge Crossover Port
E. Discharge Ports (In Valve Plate)

B-06731

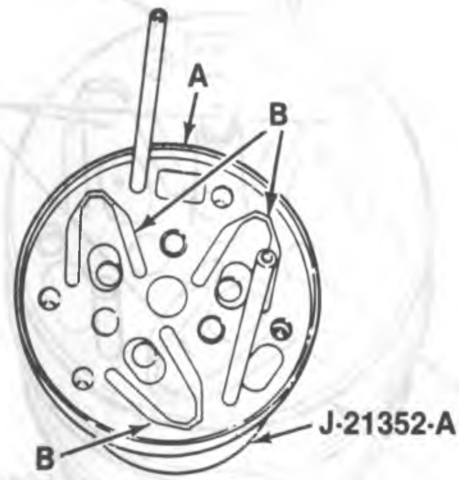
Figure 33 — Installing the Rear Valve Plate

4. Suction reed plate (25).
   - Over the guide pins into proper position (figure 34).
   - Be sure all three suction reed tips cover the suction ports in the rear valve plate (26).
5. Cylinder seal (24).
   - Lubricate a new cylinder seal (24) with clean 525 viscosity refrigerant oil and position the seal on the rear cylinder (23) (figure 30). Roll the cylinder seal into the groove. Cylinder (23) surface must be clean at the rear.
   - Apply refrigerant oil to the seal surface of the rear head to easy assembly.
6. Cylinder and shaft assembly (gut pack).
   - Shaded parts shown in figure 3 are not serviceable. A replacement kit (gut pack) is available for replacement.
   - Assemble cylinder and shaft assembly over the guide pins onto the rear head (28) (figure 35).
   - Using both hands, press the cylinder and shaft assembly down into the rear head (28).

Important

- Center cylinder seal (22) is not serviceable.

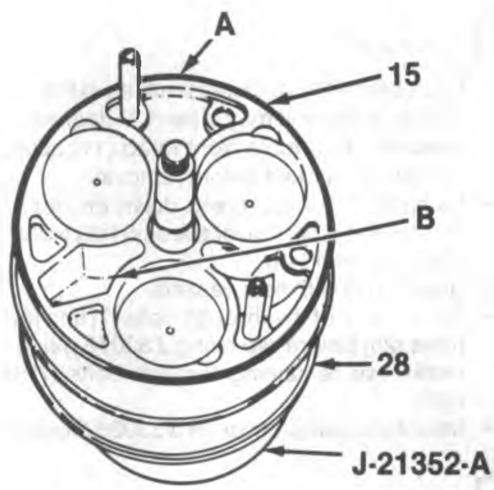
7. Cylinder seal (15).
   - Lubricate a new cylinder to front head seal with clean 525 viscosity refrigerant oil and install in the front seal groove (figure 35).
8. Suction reed plate (14).
   - Over J 33016 guide pins (figure 36).
   - Check the alignment.
9. Valve plate (13).
   - Over J 33016 guide pins (figure 37).
10. Head gasket (12).
    - Over J 33016 guide pins (figure 38).
11. Front head (11).
    - Line up mark on front head (11) with the alignment marks on the compressor cylinders and assemble head over J 33016 guide pins (figure 27).



A. 12 o-clock Reference Position
B. Suction Reed Tips (3) Must Cover Valve Plate Ports (3)

B-06732

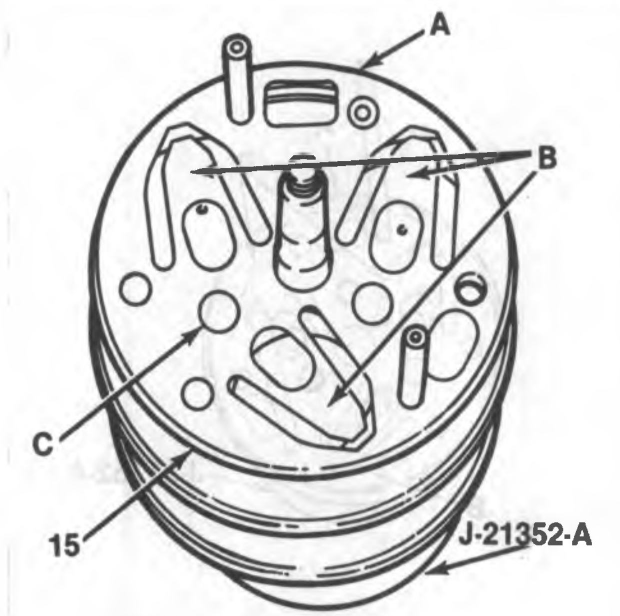
Figure 34 — Installing the Reed Plate



A. 12 o'clock Reference Position
B. Discharge Crossover Cavity (Front)
15. Cylinder to Head Seal Installed
28. Rear Head

B-06734

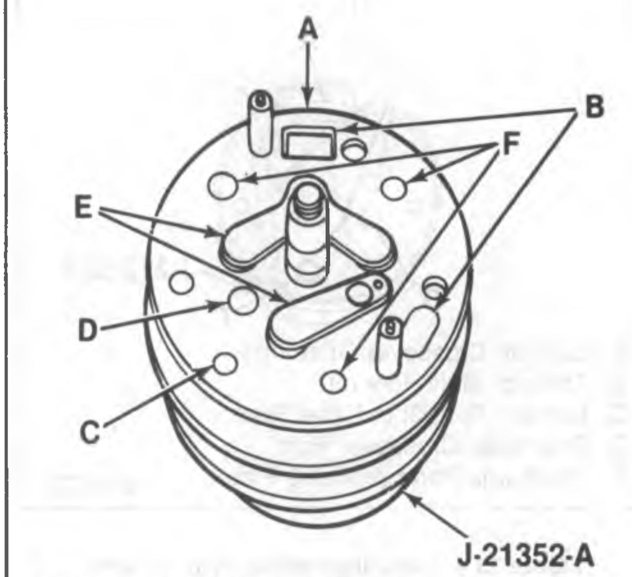
Figure 35 — Installing the Front Head



A. 12 o'clock Reference Position
B. Tips of Suction Reeds Must Locate Above Recess in Cylinder at Top
C. Discharge Crossover Opening
15. Cylinder Seal (Front)

B-06735

Figure 36 — Installing the Front Suction Reed Plate



A. 12 o'clock Reference Position
B. Suction Crossover Openings
C. Through Bolt Hole (6)
D. Discharge Crossover Opening
E. Discharge Valve Reed Retainers
F. Suction Intake Openings

B-06736

Figure 37 — Installing the Front Valve Plate

Important

- Front head (11) is now assembled in the "standard" position and may differ 120 degrees either direction. Assemble front head (11) according to location marked before removal.
- Using both hands, press down on front head (11) for installation over the seal (15) at the front of the cylinder (16).

12. Through bolts (7) with new gaskets.
    - Thread four of the through bolts (7) into the rear head (28) before removing J 33016 guide pins. Install two remaining through bolts (7) finger tight.
    - Mount the compressor on J 33026 (figure 39).

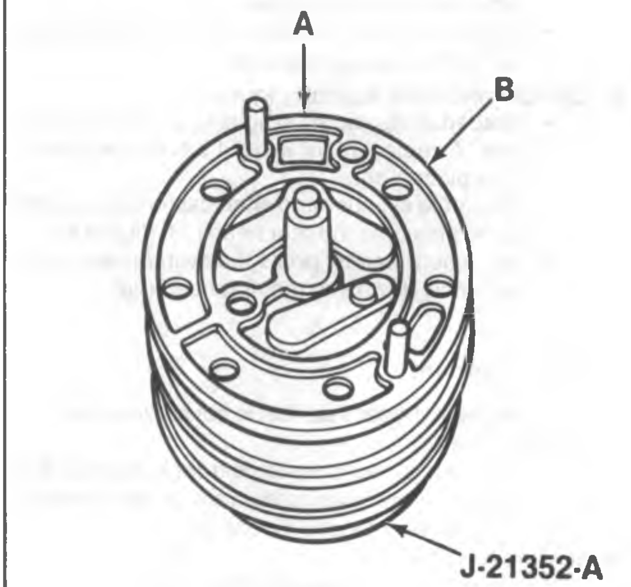
Tighten

- Six through bolts (7) alternately to 9 N·m (84 in. lbs.).

13. Shaft seal parts (8, 9, 10).

Important

- Add new 525 viscosity refrigerant oil.
- Refer to vehicle service manual for fill quantity.
- Place shaft nut (1) on the shaft (20) and rotate the compressor shaft (20) several times and remove nut (1).



A. 12 o'clock Reference Position
B. Head Gasket

B-06812

Figure 38 — Installing the Seal to the Front Head

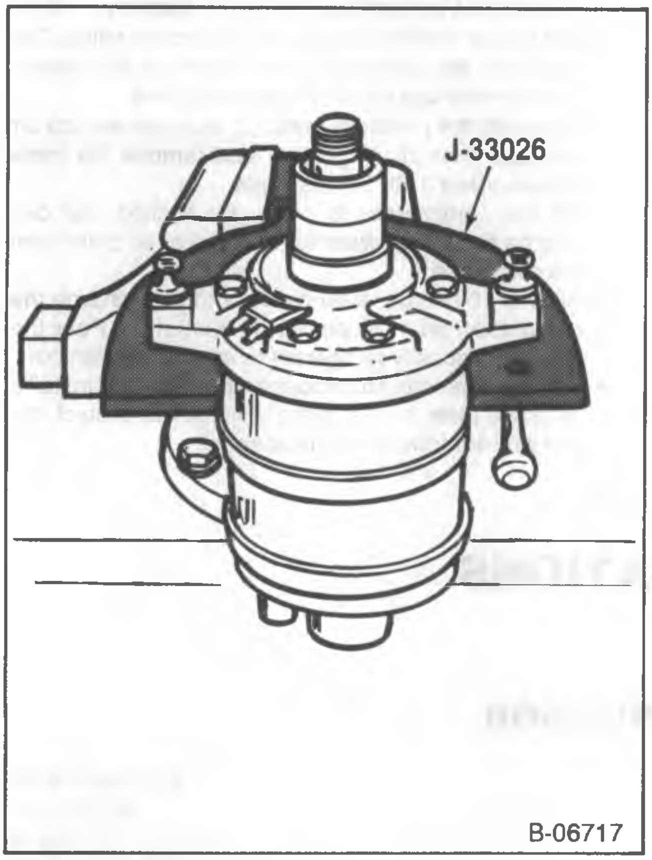


Figure 39 — Installing the Compressor to J 33026

- Leak test the compressor.
- Refer to "Leak Testing."

14. Clutch coil assembly (6).
15. Pulley (5).
16. Clutch plate and hub assembly (2).

LEAK TESTING

Tools Required:
J 9625-A Pressure Test Plate
J23500-01 Portable Charging Station
J 33026 Compressor Holding Fixture

- Be sure the compressor has no oil internally.

1. Install J 9625-A on the rear head of compressor (figure 3).
2. Install the center hose of the manifold gage set on J 23500-01 to a refrigerant drum standing in an upright position and open the valve on the drum.
3. Install the charging station high and low pressure lines to corresponding fittings on J 9625-A using J-5420 gage adapters or hoses equipped with valve depressors. Suction port (low side) of the compressor has large internal opening. Discharge port (high side) has a smaller internal opening into the compressor.

- Open the low pressure control, high pressure control and the refrigerant control on the charging station to allow refrigerant vapor to flow into the compressor.

Important

- Check for leaks at pressure relief valve (32), compressor front and rear head seals (15) (24), center cylinder seal (22), through bolt head gaskets and compressor shaft seal.
- After the leak check, shut off the low pressure control and the high pressure control on charging station.
- If an external leak is present, perform the necessary correction and recheck to assure the correction.
- Loosen the manifold gage hose connections to the gage adapters connected to the low and high sides and allow the vapor pressure to release from the compressor. If valve depressor type hoses are used, loosen the hose connections at gage manifold to release the vapor pressure from the compressor.
- Disconnect both gage adapters or hoses from J 9625-A.
- Add 89 ml (3 oz.) new 525 viscosity refrigerant oil to the compressor assembly. Rotate the complete compressor assembly (not the shaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
- Install the shaft nut (1) on the compressor shaft (20) if the pulley assembly and clutch plate and hub assembly are not installed.
- Using a box-end wrench, or a socket and handle, rotate the compressor shaft (20) or clutch plate on the shaft (20) several turns to lubricate the pistons and cylinder walls.
- Connect the charging station high-pressure line, or a high-pressure gage and gage adapter to J 9625-A high-side connector.
- Attach an adapter or depressor-type hose to the suction or low-pressure port of J 9625-A to open the Schrader-type valve. Oil will drain out of the compressor

suction port adapter if the compressor is positioned with the suction port downward.

- Attach the compressor to the J 33026 fixture and mount the compressor in a vise so that the compressor will be in a horizontal position and the shaft (20) can be turned with a wrench.
- Rotate the compressor shaft (20) or drive plate hub ten complete revolutions at a speed of approximately one revolution per second. A slower rotation can result in a lower pump-up pressure and disqualify a good pumping compressor.
- Observe the reading on the high-pressure gage at the completion of the tenth revolution of the compressor shaft (20). The pressure reading for a good pumping compressor should be 690 kPa (100 psi) or above. A pressure reading of less than 620 kPa (90 psi) would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve. Disassemble the compressor and repair as necessary. Reassemble and repeat the pump-up test.
- Following the pressure pump-up test, release the air pressure from the high side and remove the gage adapters and J 9625-A test plate.
- Tilt the compressor to place the suction and discharge ports downward to allow the oil to drain from the compressor.
- Allow a 10-minute drain period and then charge the compressor with the proper amount of oil. Pour the new 525 viscosity refrigerant oil into the suction port.
- If further assembly or processing is required, install a shipping plate or test plate J 9625-A to protect the compressor from contamination.

SPECIFICATIONS

HR-6 COMPRESSOR

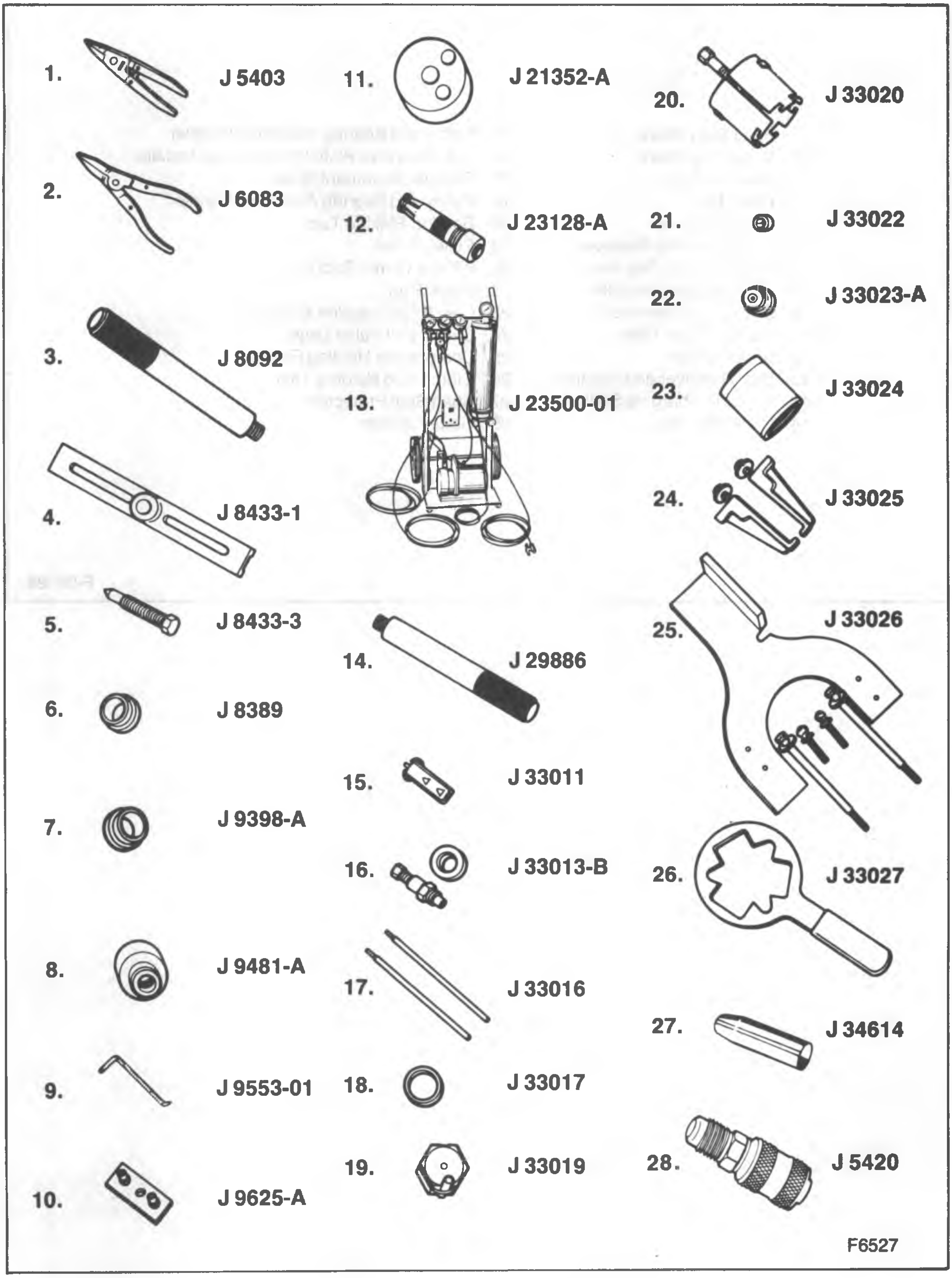
Type — Harrison HR-6	6 Cylinder Axial
Displacement	10.0 Cu. In.
Rotation	Clockwise
Clutch Plate Air Gap	0.38-0.64 mm (0.015-0.025 inch)
Oil Capacity	0.227 Kg (8 oz.)
Model Number (Gasoline Engine)	1131684
(Diesel Engine)	1131678

CLUTCH COIL

Ohms (at 27°C-80°F)	3.56-3.89
Amps (at 27°C-80°F)	3.2 @ 12 Volts

TORQUE SPECIFICATIONS

Compressor Suction and Discharge Connector Bolt	24 N·m (18 Ft. Lbs.)
Through Bolts	9 N·m (84 In. Lbs.)
Shaft Nut	16 N·m (12 Ft. Lbs.)
Pressure Relief Valve	9 N·m (84 In. Lbs.)



Special Tools

1. Snap Ring Pliers
2. Snap Ring Pliers
3. Driver Handle
4. Puller Bar
5. Forcing Screw
6. Pulley Bearing Remover
7. Rotor Bearing Remover
8. Pulley Bearing Installer
9. O-ring Seal Remover
10. Pressure Test Plate
11. Support Block
12. Seal Remover and Installer
13. Portable Charging Station
14. Driver Handle
15. Pulley and Bearing Assembly Installer
16. Hub and Drive Plate Remover and Installer
17. Cylinder Alignment Rods
18. Pulley and Bearing Assembly Installer
19. Bearing Staking Tool
20. Pulley Puller
21. 6 Point 13 mm Socket
22. Puller Pilot
23. Clutch Coil Installer Adapter
24. Clutch Coil Puller Legs
25. Compressor Holding Fixture
26. Clutch Hub Holding Tool
27. Shaft Seal Protector
28. Gage Adapter

F-06528

SECTION 1B5

SD-709 AIR CONDITIONING COMPRESSOR

CONTENTS

DESCRIPTION

The Sandon SD-709 is a belt-driven seven cylinder compressor with an integral clutch. The clutch, shaft seal, cylinder head and valve plate assemblies are fully serviceable.

The compressor can be identified by a label attached to the compressor body giving the part number, model, and manufacturer's name. The date code is stamped on the front left mounting ear viewed as facing the clutch (figure 1). It will be either a two-digit number or a number-letter combination. The first number gives the year of manufacture. This is followed by one of the numbers 1 through 9, indicating the months January through September. October, November or December are indicated by an X, Y, or Z.

INSPECTION

LEAK CHECK

Before disassembling any compressor components, check for leaks in the following areas:

1. Feel under the seal area between the clutch and compressor to check for oil seeping in the shaft seal area. If so, the seal will have to be replaced.
2. Check for dislocation of the front housing O-ring (protruding section). Replace the compressor.
3. Oil around the cylinder head gasket or fittings. Replace leaking component.
4. Oil around the filler hole. If the O-ring is damaged, it can be replaced. If the threads are stripped, replace the compressor.
5. Oil leaking from cracks in the cylinder block. Replace the compressor.

COMPRESSOR REPLACEMENT

If the compressor needs to be replaced, first drain and measure the oil in the old compressor. Then drain the oil from the new compressor. Measure the new oil equal to the amount drained from the old compressor. Then put the new oil back in the compressor.

DISASSEMBLY OF THE CLUTCH AND SHAFT SEAL

CLUTCH

Remove or Disconnect (Figures 2 through 9)

Tools Required:

J 37791 Clutch Front Plate Spanner Wrench
J 36045 Front Plate Puller
J 37792 Puller Fingers
J 8433 Puller Set
J 37795 Bearing Remover and Installer/Pulley Installer
J 29886 Driver Handle

- Insert the two pins of the J 37791 into any two threaded holes of the clutch front plate (2). Hold the clutch plate stationary (figure 3).

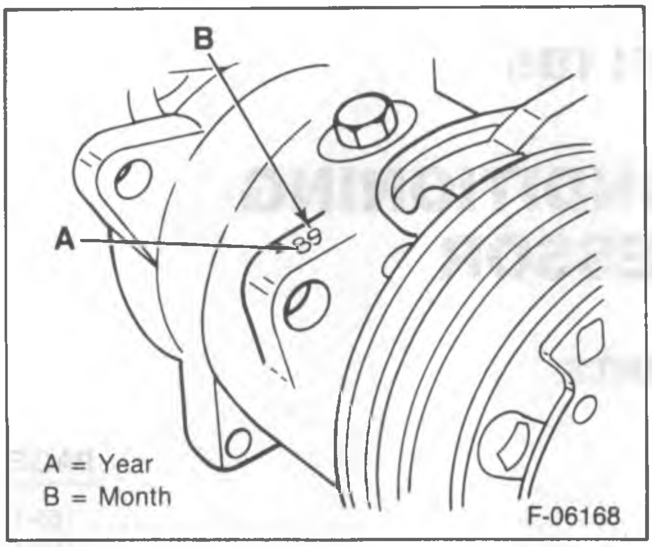


Figure 1—Date Code

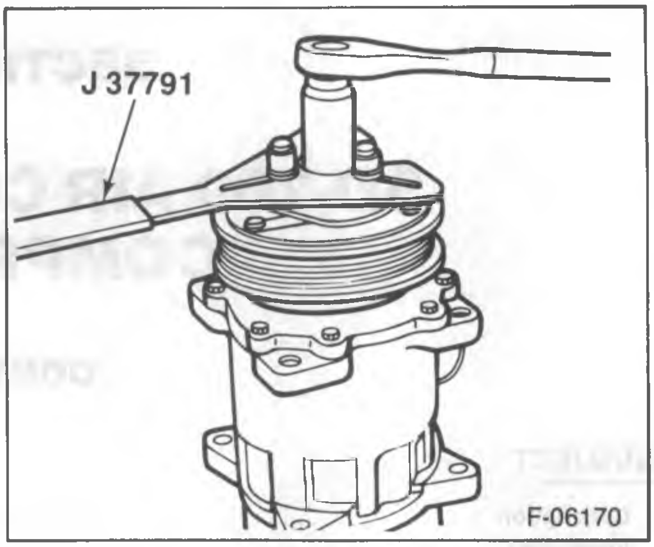
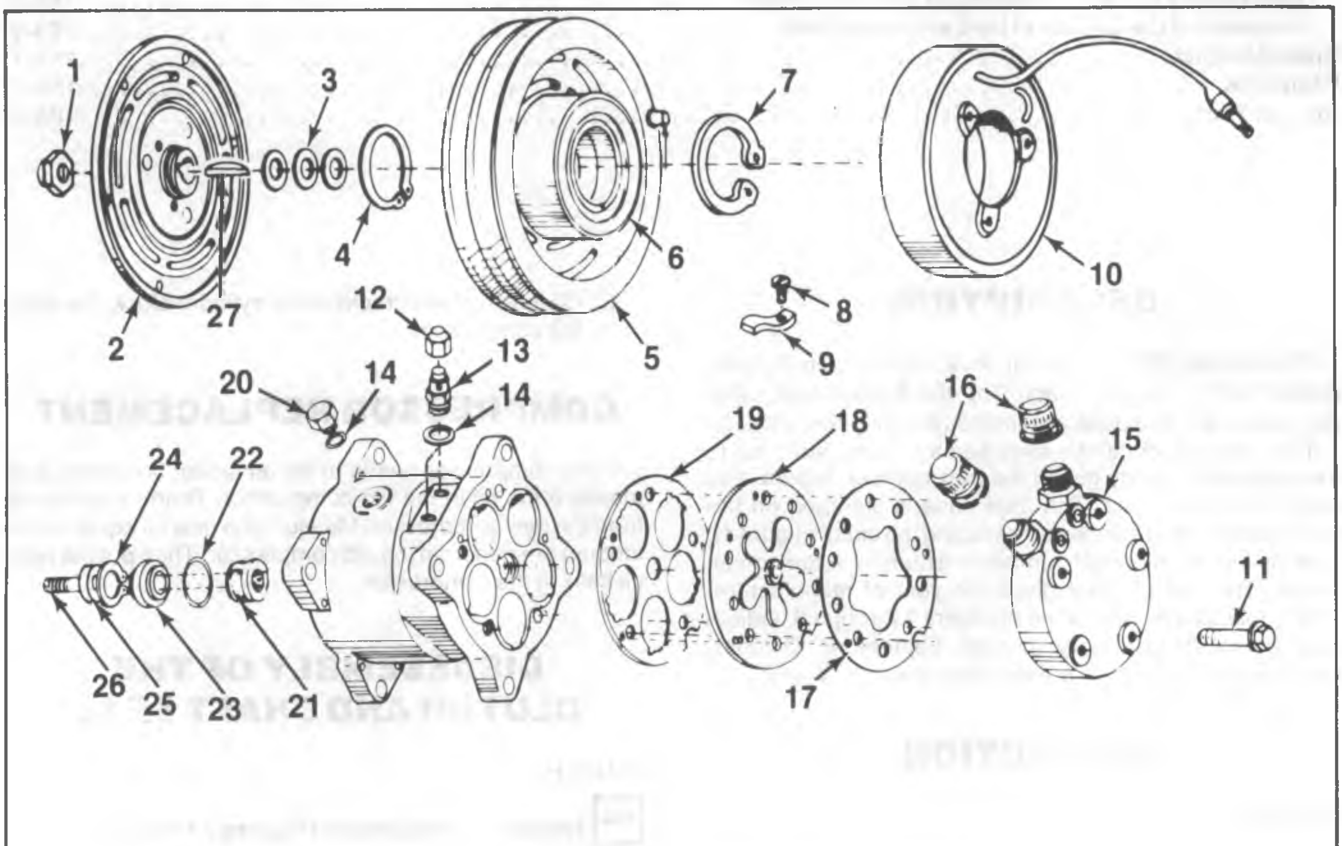


Figure 3—Removing the Nut



1. Nut
2. Clutch Plate and Hub Assembly
3. Shims
4. Snap Rings
5. Rotor Pulley
6. Bearing
7. Snap Ring
8. Coil Lead Wire Screw
9. Coil Lead Wire Clamp
10. Coil
11. Cap Screw
12. Cap
13. Valve
14. Seal
15. Cylinder Head
16. Cap
17. Valve Plate Gasket
18. Valve Plate
19. Cylinder Gasket
20. Oil Filler Plug
21. Seal Cage
22. Shaft O-Ring Seal
23. Shaft Seal Seat
24. Retainer
25. Felt Ring Metal Retainer
26. Shaft
27. Shaft Key

F-06169

Figure 2—Compressor Components

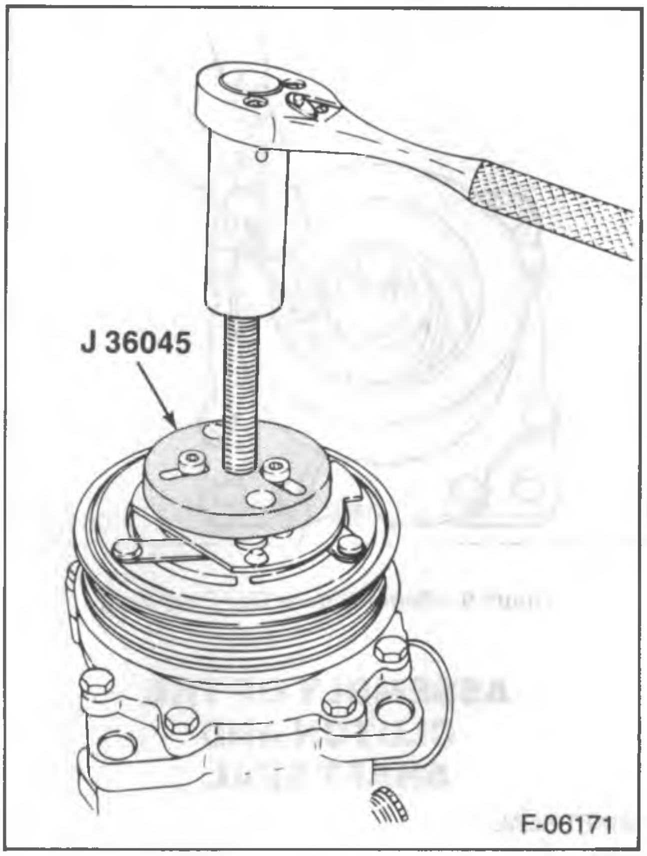


Figure 4—Removing the Clutch Plate

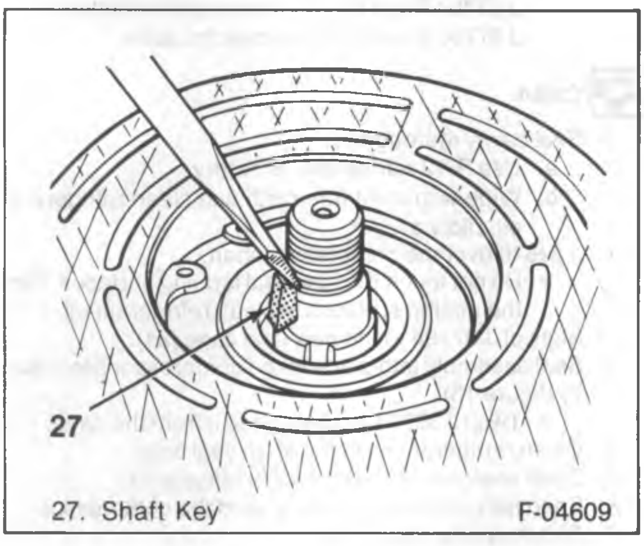


Figure 5—Removing the Shaft Key

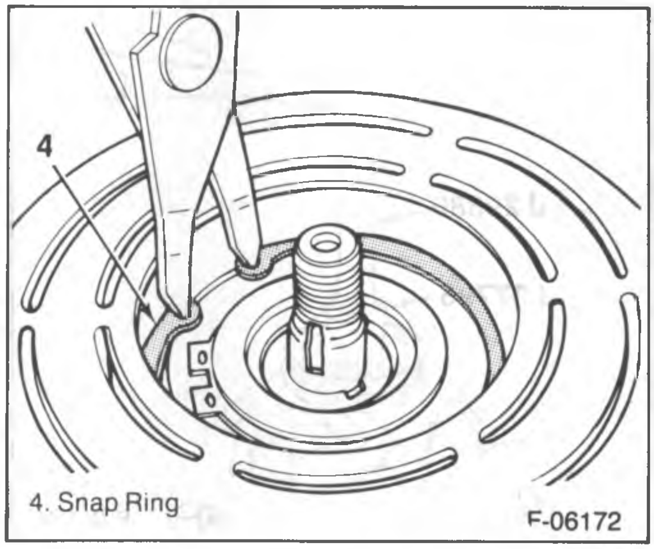


Figure 6—Removing the Internal Snap Ring

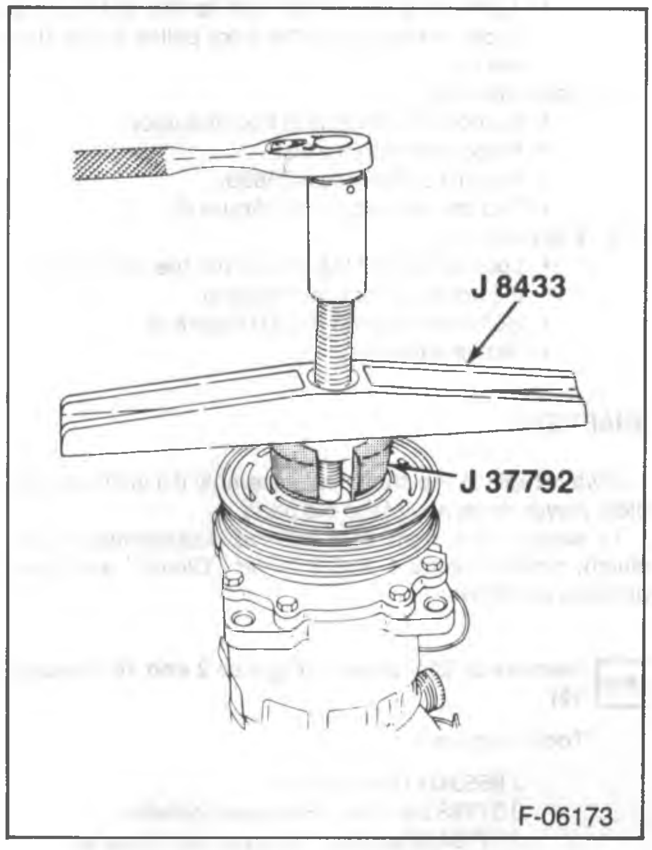


Figure 7—Removing the Rotor Pulley

1. Hex nut using a 19 mm socket.
2. Clutch front plate using J 36045 (figure 4).
   - Align the puller center bolt to the compressor shaft.
   - Thumb tighten the three puller bolts into the threaded holes.
   - Turn the center bolt to the right with the socket wrench until the front plate is loosened.
3. Shaft key (27) by lightly tapping it loose with a slot screw driver and hammer (figure 5).
4. Internal bearing snap ring (4) with internal type snap ring pliers (figure 6).
5. Rotor pulley assembly.
   - Insert J 37792 into the snap ring groove.
   - Align the thumb head bolts of J 8433 to the puller fingers and tighten.

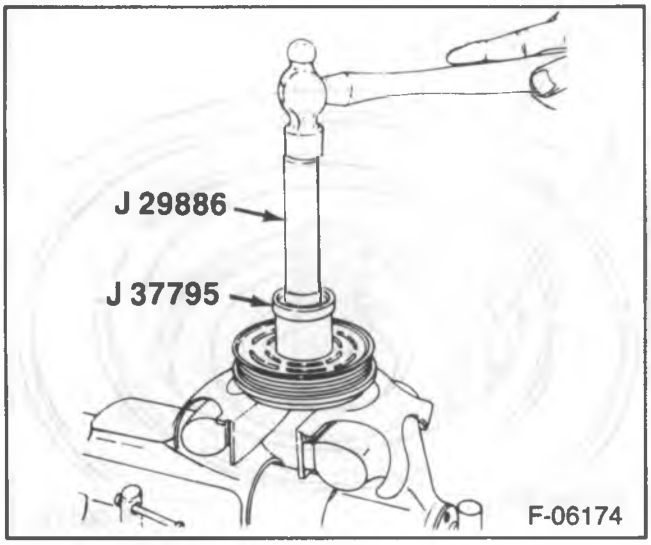


Figure 8—Removing the Bearing

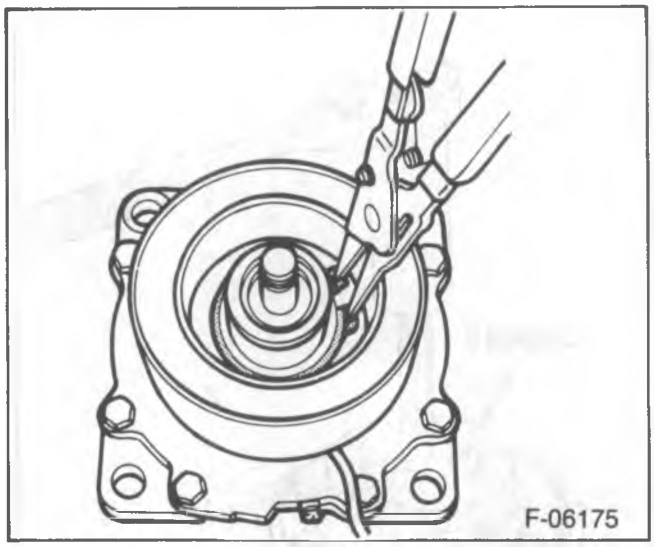


Figure 9—Removing the Coil Snap Ring

- Turn the puller center bolt to the right with a socket wrench until the rotor pulley is free (figure 7).

6. Rotor bearing.
   - Remove the snap ring from the rotor.
   - Place the rotor in a vise.
   - Install J 37795 and J 29886.
   - Tap the bearing (6) out (figure 8).
7. Field coil (10).
   - Loosen the coil lead wire from the clip on top of the compressor front housing.
   - Remove the snap ring (7) (figure 9).
   - Remove the coil.

SHAFT SEAL

Always replace the shaft seal assembly if it is disassembled. Never reuse any of the old parts.

To service the shaft seal without disassembling the clutch, perform steps 1 and 2 under "Clutch" and then proceed as follows.

Remove or Disconnect (Figures 2 and 10 through 12)

Tools Required:

J 9553-01 O-Ring Hook
J 37793 Seal Seat Remover/Installer
J 37794 Shaft Seal Remover and Installer

1. Clutch shims (3) using J 9553-01 and a small screwdriver.
2. Felt ring metal retainer (25).
   - Insert the points of a snap ring pliers into the holes in the retainer and lift out (figure 10).
3. Shaft seal seat snap ring.
4. Shaft seal seat (23) with J 37793 (figure 11).
5. Seal assembly.
   - Press J 37794 against the seal spring and twist the tool until it engages the slots of the seal cage (figure 12).

ASSEMBLY OF THE CLUTCH AND SHAFT SEAL

SHAFT SEAL

Install or Connect (Figures 2, 11 and 13)

Tools Required:

J 29640 Shaft Protector
J 37794 Shaft Seal Remover and Installer
J 37793 Seal Seat Remover/Installer

Clean

- Seal cavity thoroughly.
  a. Use R-12 refrigerant. Blow dry.
  b. Wipe with a lint free cloth and clean refrigerant oil. Blow dry.

1. J 29640 over the compressor shaft.
   - Do not touch the new seal lapping surfaces. Dip the mating surfaces in clean refrigerant oil.
2. Slots of J 37794 to the new seal cage (21).
3. Seal assembly into place in the compressor seal cavity (figure 13).
   - Twist J 37794 to disengage it from the cage.
4. Clean refrigerant oil to the shaft seal seat.
5. Shaft seal seat (23) with J 37793 (figure 11).
6. Snap ring with the flat side toward the compressor.
7. Clutch spacer shims (3).
8. Use the originals if possible to give the same gap.
9. New felt ring.
   - If the clutch was not disassembled, reinstall the clutch front plate.

CLUTCH

Install or Connect (Figures 2, 3, 14 and 15)

Tools Required:

J 37795 Bearing Remover and Installer/Pulley Installer

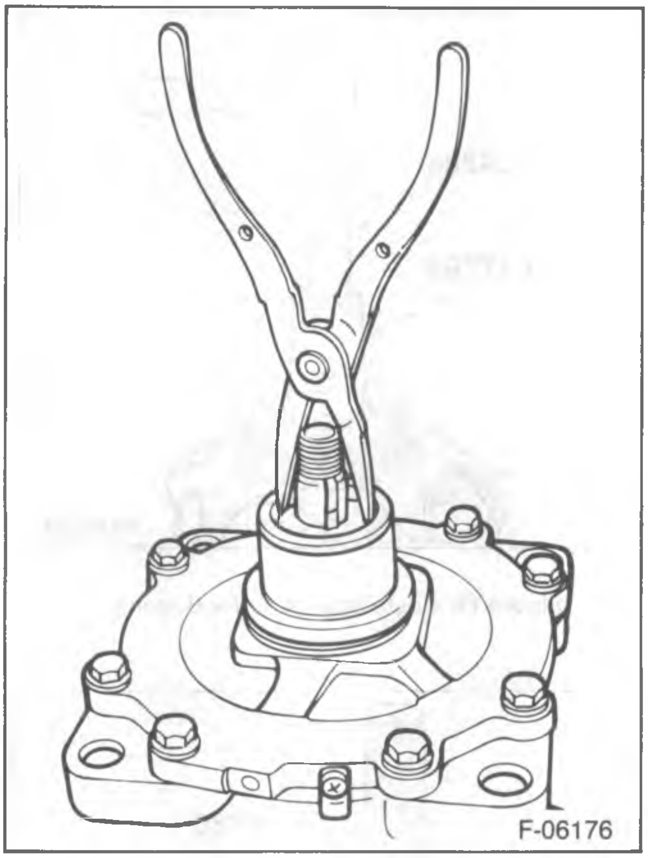


Figure 10—Removing the Felt Ring Metal Retainer

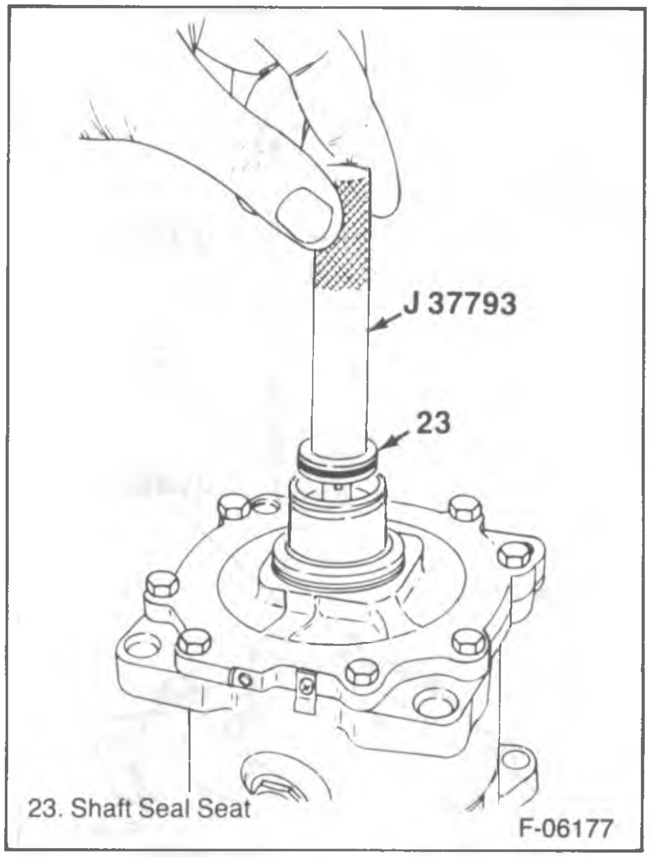


Figure 11—Removing the Shaft Seal Seat

J 29886 Driver Handle
J 37796 Shaft Protector
J 37791 Clutch Front Plate Spanner

1. Field coil and snap ring retainer.
   - The coil flange protrusion must match the hole in the front housing to prevent coil movement and to correctly place the lead wire.
2. Coil wire to clip.
- Clamp the compressor in a vise by the mounting ears or support the compressor on the four mounting ears at the rear of the compressor.
3. Bearing to the rotor with J 37795 and J 29886 (figure 14).
4. Snap ring to the rotor.
3. Rotor pulley (5) to the front housing hub and align.
   - Place J 37795 into the bearing cavity with the outer edge on the rotor bearing outer race.
   - Place J 29886 into the ring (figure 15).
   - Use a hammer to tap the end of J 29886 to guide the rotor until it bottoms out against the compressor front housing hub. Listen for a distinct change of sound during the tapping process.
4. Internal bearing snap ring.
5. Shaft key (27).
6. Front plate assembly.
   - Align the front plate keyway to the compressor shaft key.
7. J 37796 to the compressor shaft.
   - Tap the front plate to the shaft until the plate bottoms to the clutch shims.
8. Shaft hex nut.
   - Hold the plate with J 37791 (figure 3).

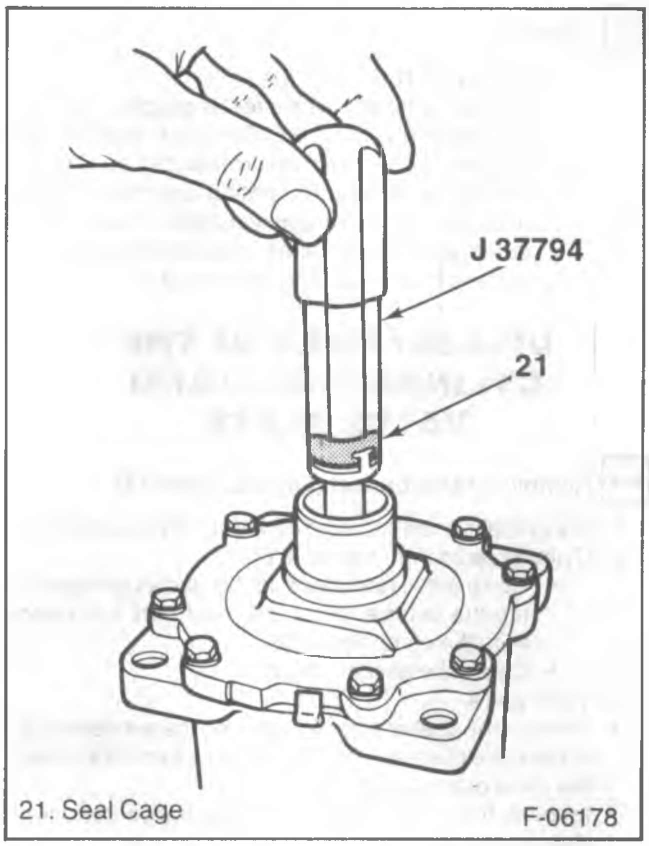


Figure 12—Removing the Seal Cage

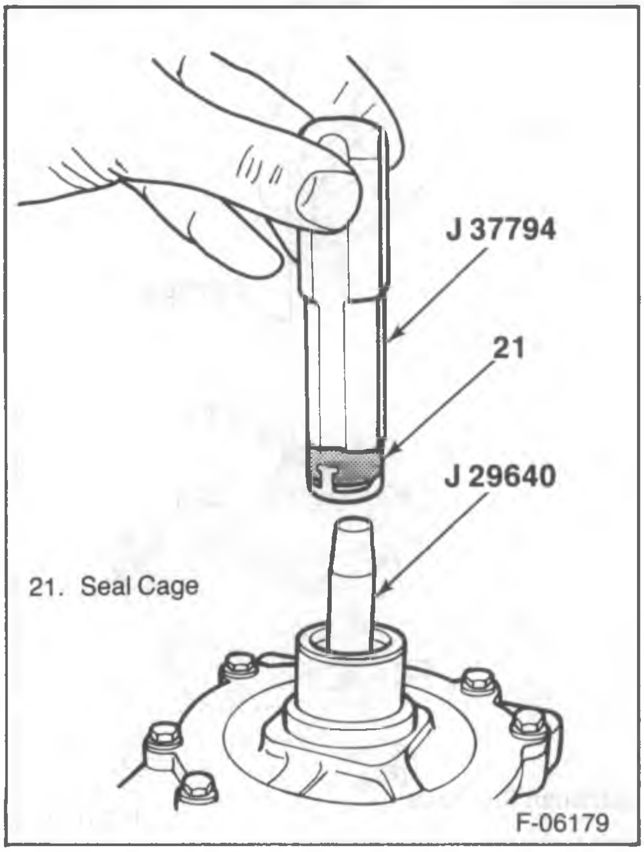


Figure 13—Installing the Seal Cage

Tighten

- Nut the 36 N·m (27 ft. lbs.).
- Check the air gap with a feeler gauge. It should be 0.49 to 0.79 mm (0.016 to 0.031 inch). If the gap is not consistent all around, pry up slightly at points of minimum variation. Lightly tap down at points of maximum variation. The gap is determined by the shims. If necessary, add to or remove shims from the shim stack.

DISASSEMBLY OF THE CYLINDER HEAD AND VALVE PLATE

Remove or Disconnect (Figures 2 and 16)

1. Six cylinder head cap screws with a 13 mm wrench.
2. Cylinder head from the valve plate.
   - Use a small hammer and the gasket scraper to tap the outer edge of the head until it is freed from the plate (figure 16).
   - Check the gasket for wear.
3. Valve plate.
   - Position the gasket scraper between the outside edge of the valve plate and the cylinder block and lightly tap the valve plate loose.
   - Inspect the reed valves and discharge retainer. Replace if worn.
4. Gasket material carefully from the valve plate and cylinder head with the gasket scraper.

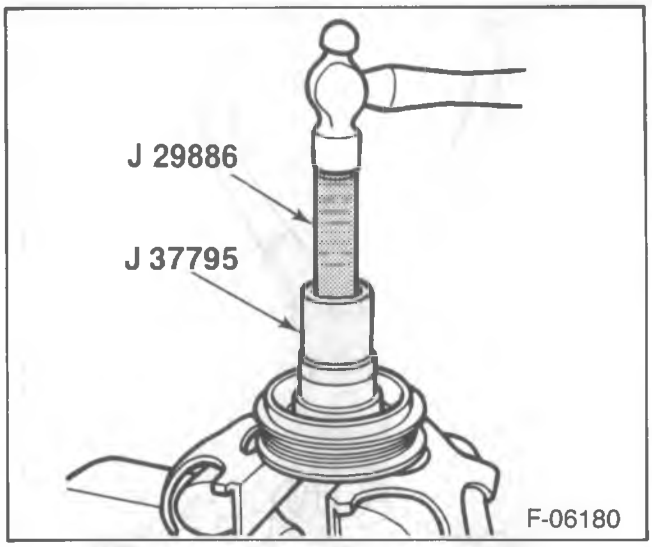


Figure 14—Installing the Rotor Bearing

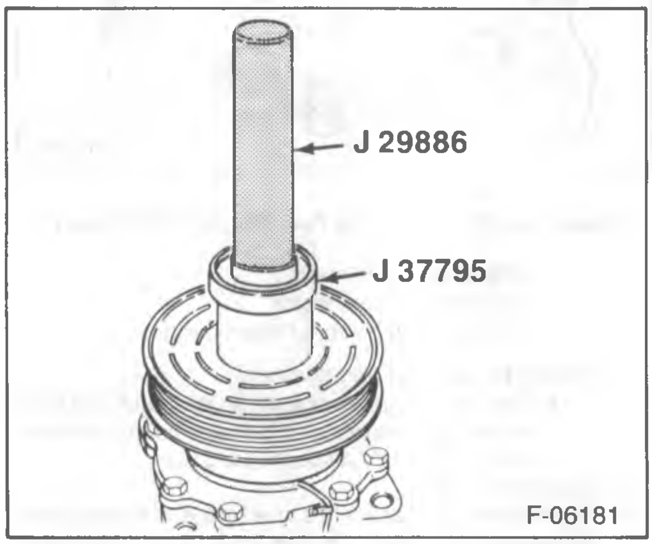


Figure 15—Installing the Rotor Pulley

ASSEMBLY OF THE CYLINDER HEAD AND VALVE PLATE

Important

- Use new gaskets for reassembly.

Install or Connect (Figures 2 and 17)

1. Clean refrigerant oil to the valve plate gasket (17).
2. Gasket to the locating pin holes and oil orifice in the cylinder block.
3. Valve plate (18).
   - Align the valve plate locating pins to the pin holes in the block.

4. Clean refrigerant oil to the top of the valve plate.
5. Clyinder head (15) and cap screws (11).

Tighten

- Screws to 32 N·m (24 ft. lbs.) using the star configuration as shown in figure 17.

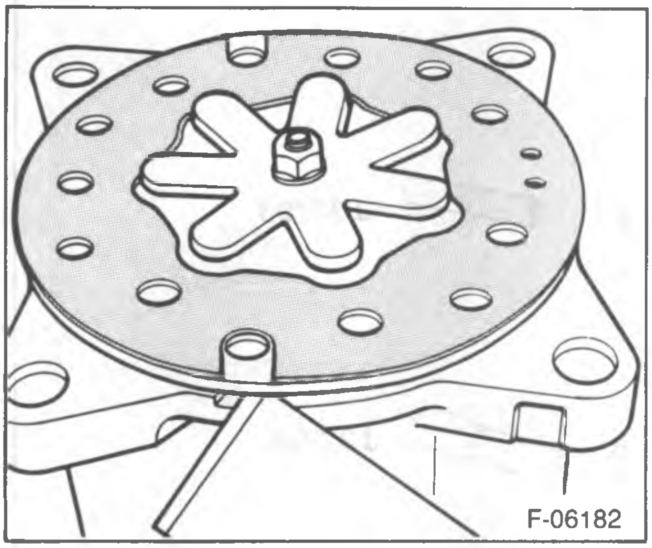


Figure 16—Loosening the Valve Plate

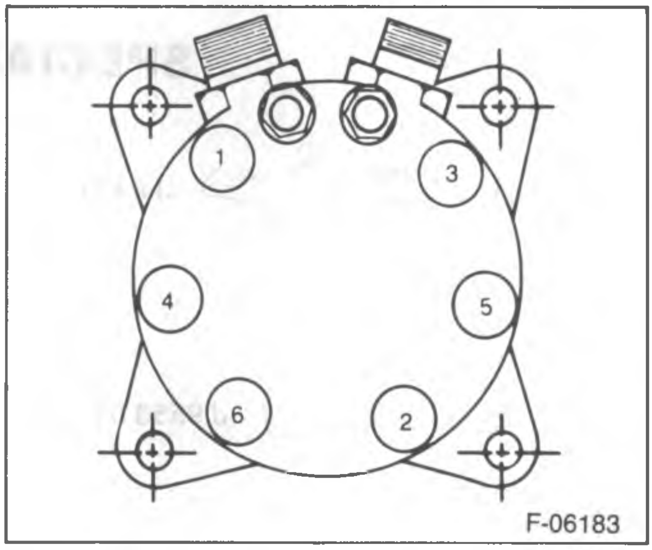


Figure 17—Torque Sequence

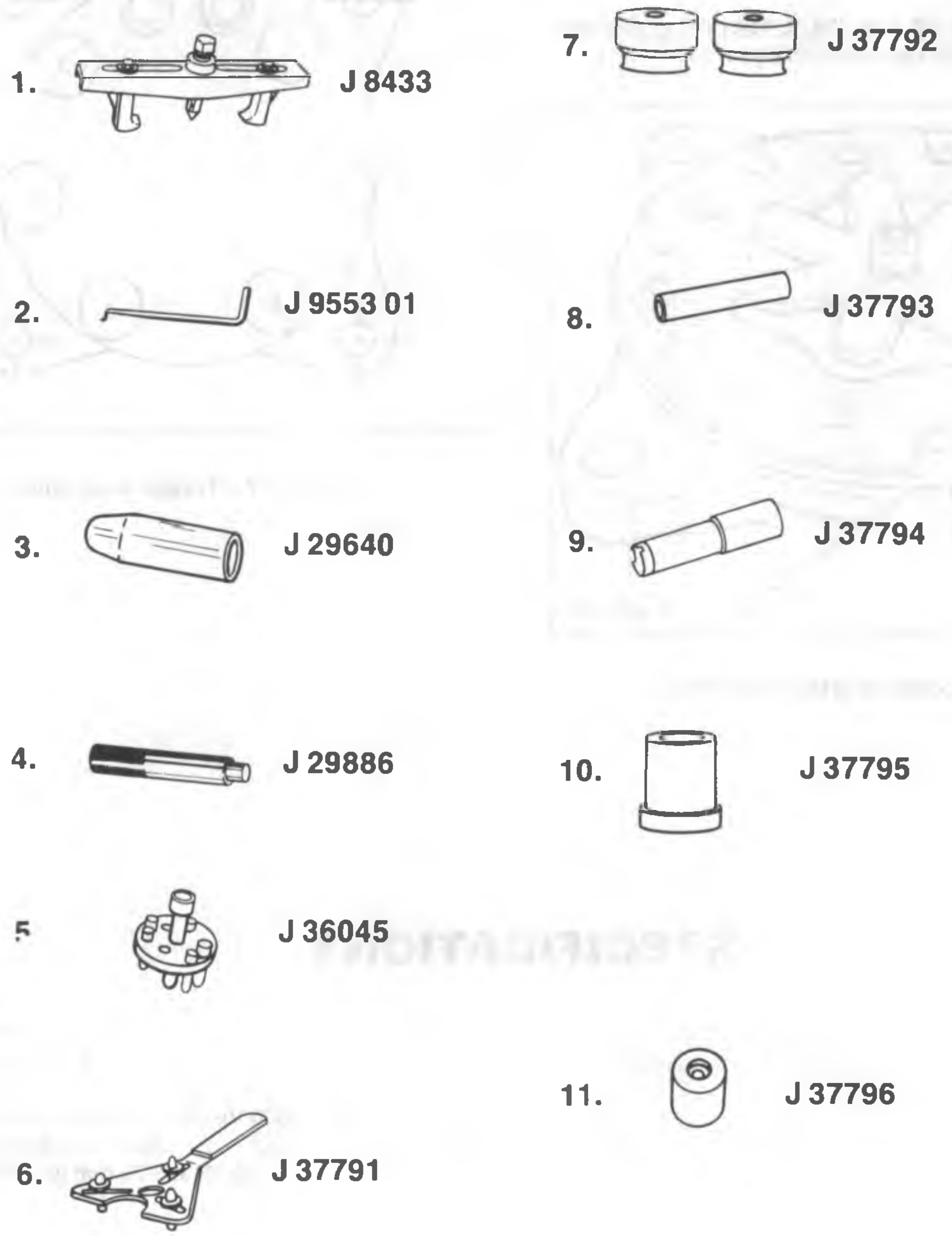
SPECIFICATIONS

Sanden SD 709	P/N 15573115
Application:	7.4L Engine, P Truck
Rotation:	Clockwise
Oil:	500 Viscosity Suniso 5GS or equivalent
Capacity:	Approx. 135 cc (4.6 ounces)
Clutch Hub Air Gap	0.49 to 0.79 mm (0.016 to 0.031 in.)

FASTENERS

Shaft Nut	36 N·m (27 ft. lbs.)
Cap Screws	32 N·m (24 ft. lbs.)
Oil Filler Plug	8 N·m (70.8 in. lbs.)
Charge Valve Cap	60 N·m (80 ft. lbs.)

SPECIAL TOOLS



1. Puller Set
2. O-Ring Hook
3. Shaft Protector
4. Driver Handle
5. Front Plate Puller
6. Clutch Plate Spanner Wrench
7. Puller Fingers
8. Seal Seat Remover/Installer
9. Seal Remover and Installer
10. Bearing Remover/Installer
11. Shaft Protector

F-06184

SECTION 3B2

MANUAL STEERING GEAR

CONTENTS

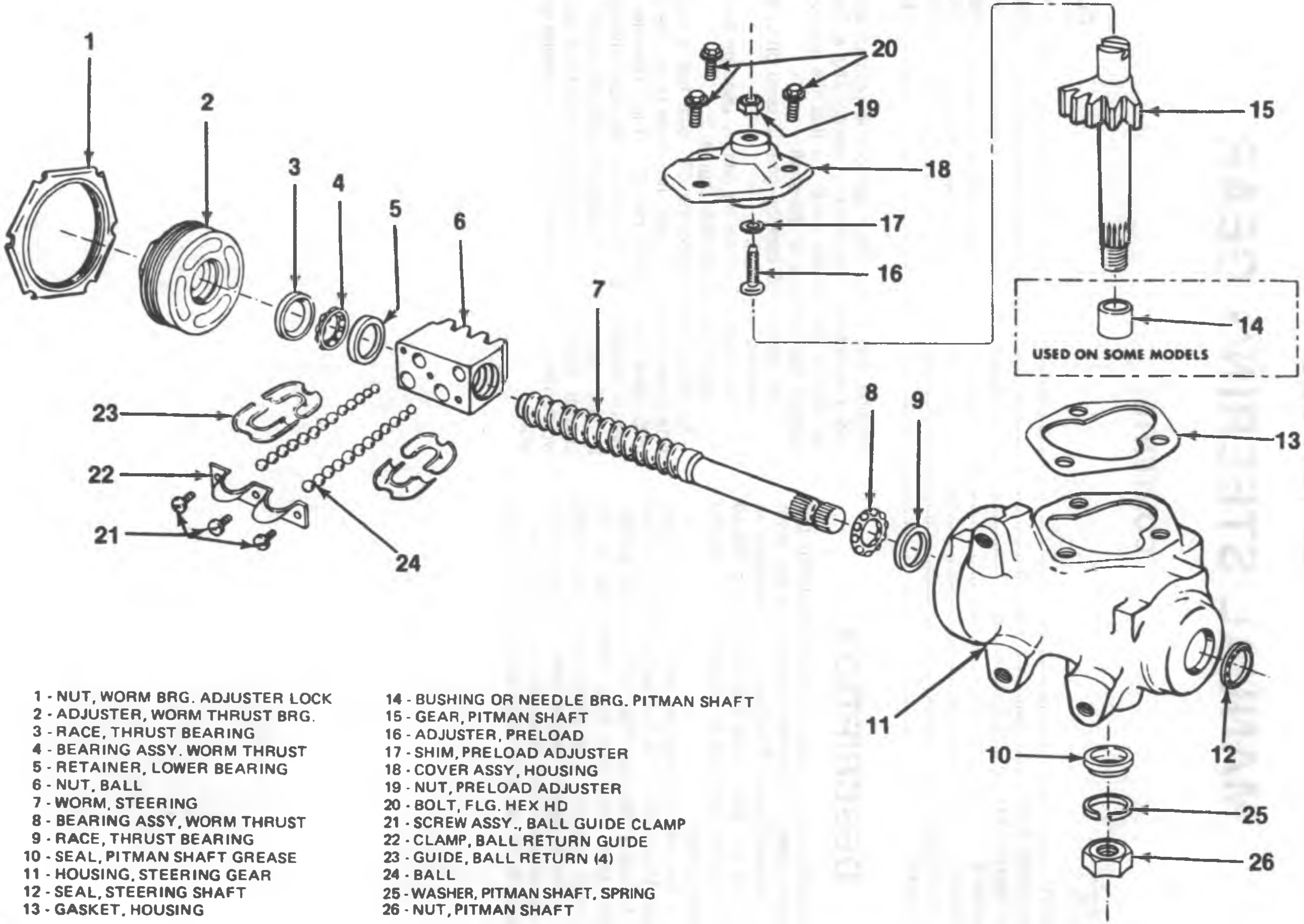
DESCRIPTION

The Saginaw steering gear is the recirculating ball nut and worm type. The worm is located on the lower end of the steering shaft. The ball nut is mounted on the worm and the steel balls act as a rolling thread between the worm and nut to provide a low friction drive between them.

Teeth on the ball nut engage teeth on the pitman shaft sector. The teeth on the ball nut are made so that a tighter fit exists between the ball nut and pitman shaft sector teeth when the front wheels are in the straight ahead position. The sector teeth are slightly tapered so that a proper preload may be obtained by moving the pitman shaft endways by means of a preload adjuster screw which extends through the gear housing side cover. The head of the preload adjuster and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls the end play of the shaft.

- The model 525 steering gear is used on G model vehicles, (figure 1).
- The model 535 steering gear is used on the S, T and M model vehicles, (figure 5).

For visual identification the 535 gear has a four bolt side cover and the 525 gear has three bolts. The larger (535) gear has a 28.8 mm (1.137-in.) diameter wormshaft measured on the O.D. of the worm thread and a 31.7 mm (1.25-in.) diameter pitman shaft. The smaller (525) gear has a 26.2 mm (1.034-in.) diameter wormshaft and a 28.5 mm (1.125-in.) diameter pitman shaft.



1 - NUT, WORM BRG. ADJUSTER LOCK
2 - ADJUSTER, WORM THRUST BRG.
3 - RACE, THRUST BEARING
4 - BEARING ASSY. WORM THRUST
5 - RETAINER, LOWER BEARING
6 - NUT, BALL
7 - WORM, STEERING
8 - BEARING ASSY, WORM THRUST
9 - RACE, THRUST BEARING
10 - SEAL, PITMAN SHAFT GREASE
11 - HOUSING, STEERING GEAR
12 - SEAL, STEERING SHAFT
13 - GASKET, HOUSING
14 - BUSHING OR NEEDLE BRG. PITMAN SHAFT
15 - GEAR, PITMAN SHAFT
16 - ADJUSTER, PRELOAD
17 - SHIM, PRELOAD ADJUSTER
18 - COVER ASSY, HOUSING
19 - NUT, PRELOAD ADJUSTER
20 - BOLT, FLG. HEX HD
21 - SCREW ASSY., BALL GUIDE CLAMP
22 - CLAMP, BALL RETURN GUIDE
23 - GUIDE, BALL RETURN (4)
24 - BALL
25 - WASHER, PITMAN SHAFT, SPRING
26 - NUT, PITMAN SHAFT

F6671

Figure 1—Steering Gear Components — Model 525

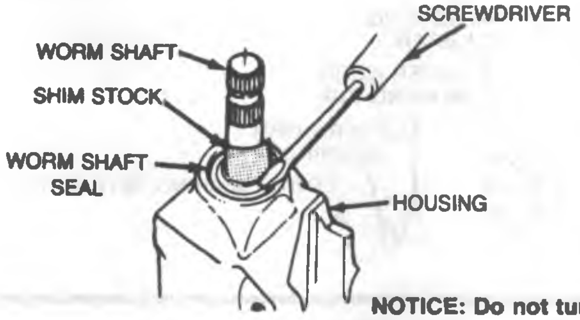
1. REMOVE AND INSTALL WORM SHAFT SEAL GEAR ASSEMBLED

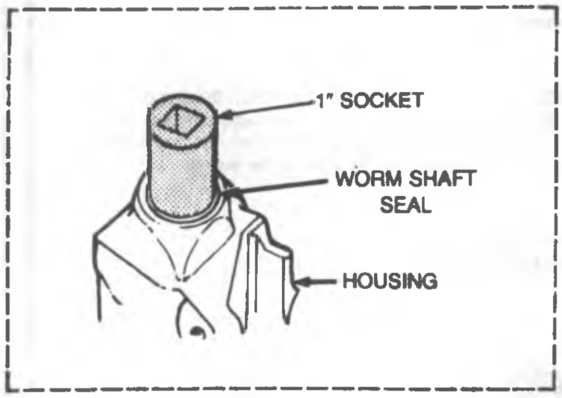
REMOVE

1. Wrap 0.1 mm to 0.2 mm (.005" to .008") shim stock around shaft and insert between shaft and seal. Pry seal out.

INSTALL

1. Install parts as shown.





Install seal.

NOTICE: Do not turn steering wheel hard against "stops" when linkage is disconnected.

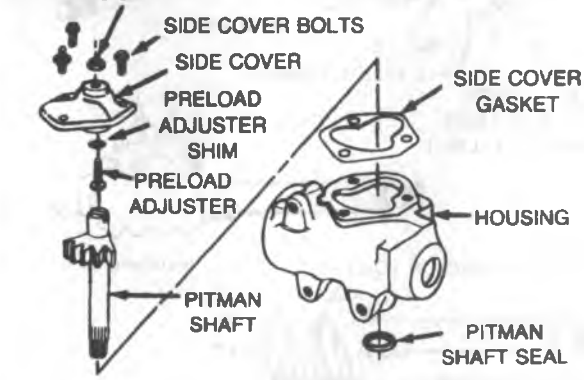
2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

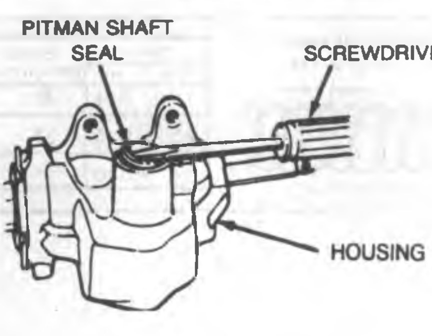
REMOVE

1. Center steering gear.
2. Remove parts as shown.

INSTALL

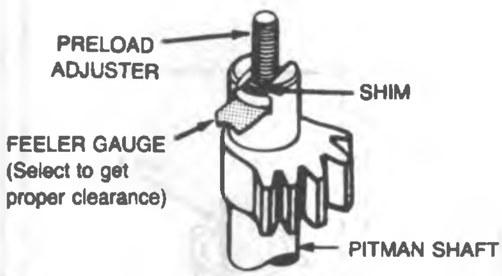
1. Before installing turn preload adjuster screw counter-clockwise until it bottoms, then back screw off one half turn.
2. Install parts as shown

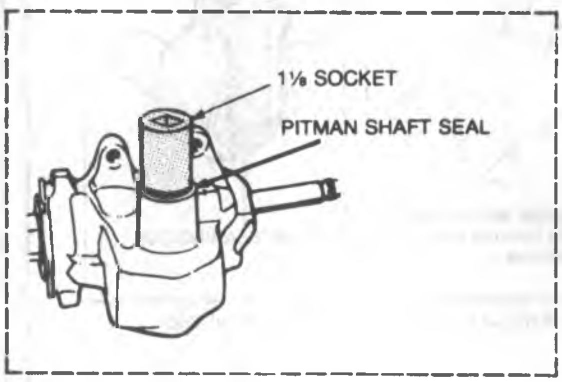




Checking end clearance

If clearance is greater than .05 mm (.002") a steering gear lash adjuster kit is available.





Install seal

LUBRICATION

The steering gear requires .312 kg (11 oz) of lubricant GM4673M or equivalent.

F4647

Figure 2—Model 525 — Chart A

REMOVE

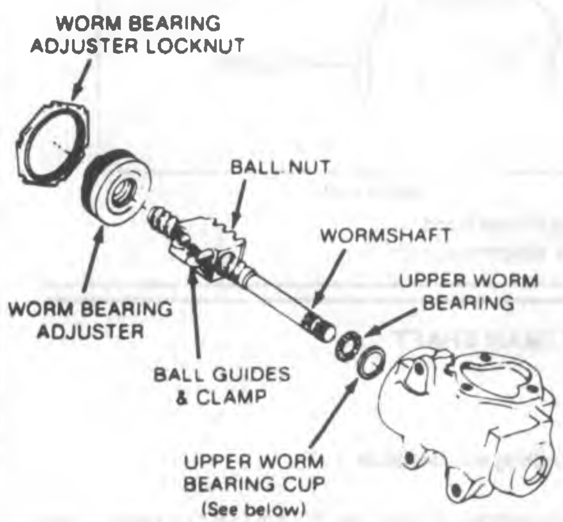
1 Loosen lock nut Use punch against edge of slot

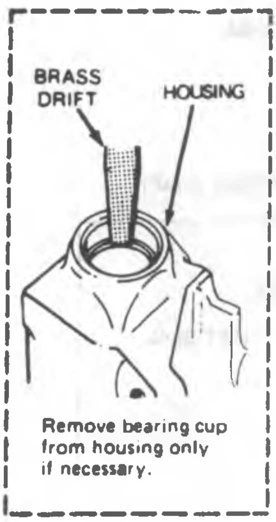
2 Remove parts as shown

INSTALL

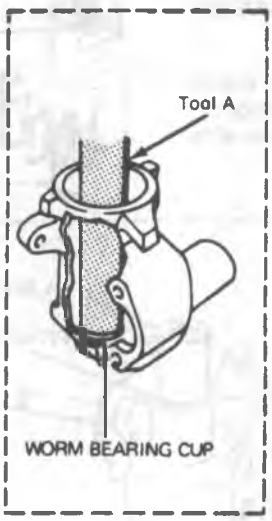
1 Install parts as shown

NOTICE: Use care that the ball nut does not run down to either end of the worm Damage may be done to the ends of the ball guides if the ball nut is allowed to rotate until stopped at the end of the worm





Remove Cup



Install Cup

DISASSEMBLE

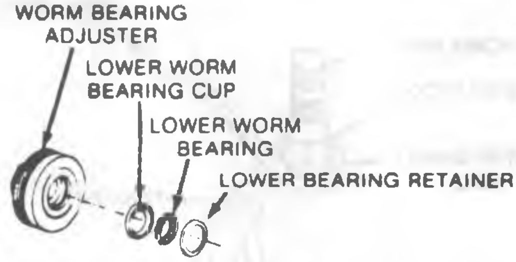
1. Pry lower bearing retainer out with screwdriver.

2. Remove cup using J 29369-1 puller and slide hammer.

ASSEMBLE

1. Press cup into adjuster using Tool A.

2. Install parts as shown.



5. DISASSEMBLE AND ASSEMBLE WORMSHAFT AND BALL NUT

DISASSEMBLE

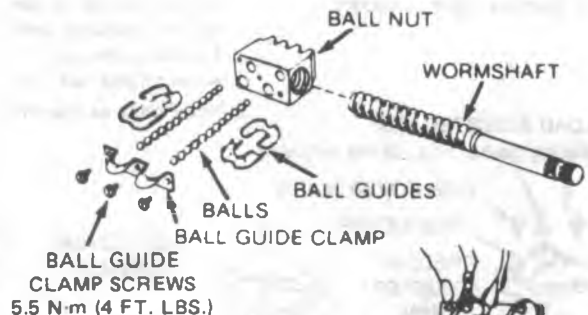
1 Disassemble parts as shown

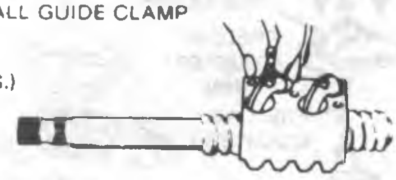
2 Clean and inspect all parts for excessive wear

ASSEMBLE

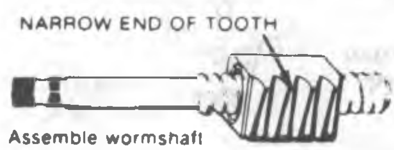
1 Assemble parts as shown

2 Refer to Fig A for number of balls used



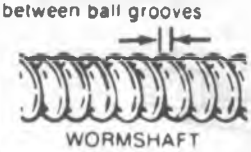


Installing Balls



Assemble wormshaft

Dimension A-Measure land between ball grooves



Dim A mm	Dim A in	Balls per circuit
1.0	0.04	25
2.5	0.10	27
5.0	0.20	27

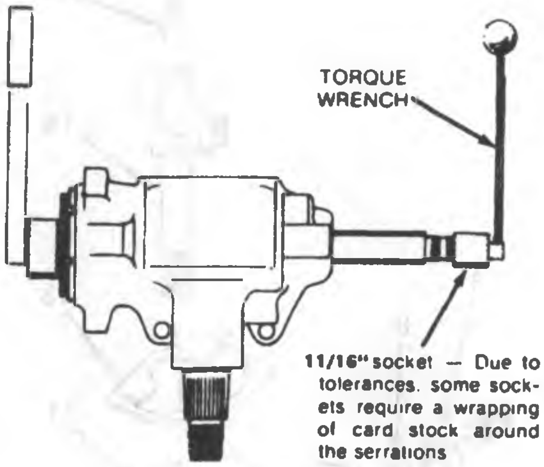
Fig A

F5903

Figure 3—Model 525 — Chart B

6. ADJUST WORM BEARING PRELOAD

1. Tighten worm bearing adjuster until it bottoms then loosen one-quarter turn
2. Carefully turn the wormshaft all the way to end of travel then turn back one-half turn
3. Tighten adjuster plug until torque wrench reads 0.6 to 1.0 N m (5 to 8 in. lbs.)
4. Tighten locknut using punch against edge of slot.



7. ADJUST "OVER CENTER" PRELOAD

A. Back off preload adjuster until it stops, then turn it in one full turn

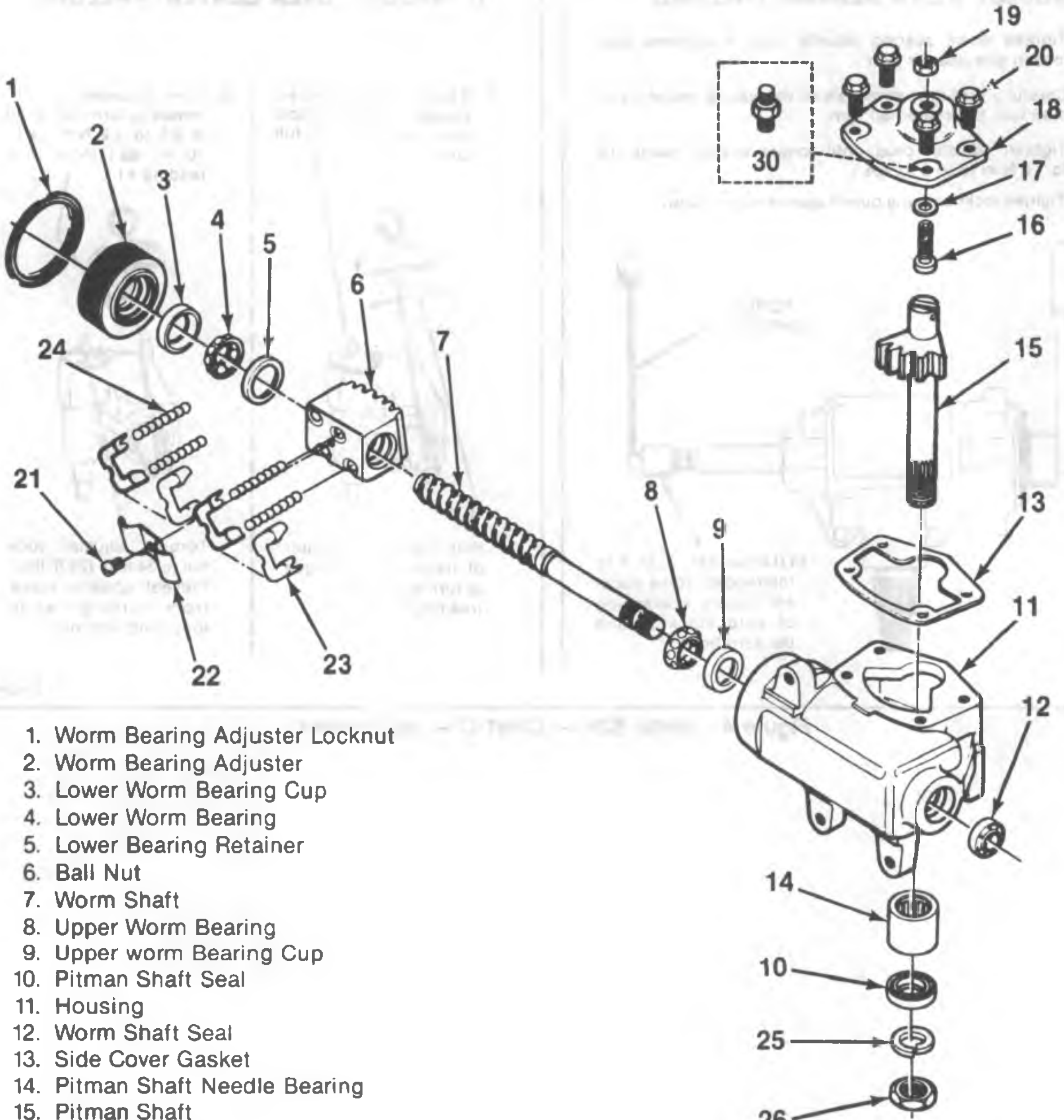
With gear at center of travel, check torque to turn stub shaft (reading #1)

B. Turn adjuster in until torque to turn stub shaft is 0.5 to 1.2 N m (4 to 10 in. lbs.) more than reading #1

Torque adjuster lock nut to 34 N m (25 ft lbs.) Prevent adjuster screw from turning while torqueing lock nut

F4649

Figure 4—Model 525 — Chart C — Adjustment



1. Worm Bearing Adjuster Locknut
2. Worm Bearing Adjuster
3. Lower Worm Bearing Cup
4. Lower Worm Bearing
5. Lower Bearing Retainer
6. Ball Nut
7. Worm Shaft
8. Upper Worm Bearing
9. Upper worm Bearing Cup
10. Pitman Shaft Seal
11. Housing
12. Worm Shaft Seal
13. Side Cover Gasket
14. Pitman Shaft Needle Bearing
15. Pitman Shaft
16. Preload Adjuster
17. Preload Adjuster Shim
18. Side Cover
19. Preload Adjuster Nut
20. Side Cover Bolts
21. Ball Guide Clamp Screw
22. Ball Guide Clamp
23. Ball Guide
24. Balls
25. Washer, Spring
26. Pitman Arm Nut
30. Top Studed Side Cover Bolt (Used on some models)

F6672

Figure 5—Steering Gear Components — Model 535

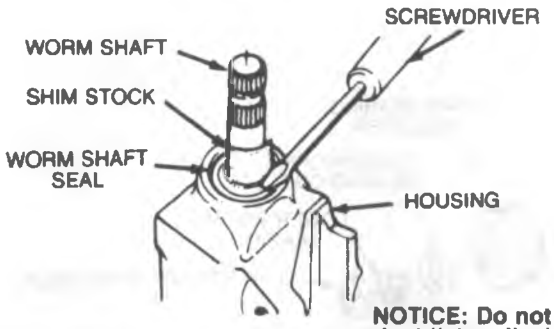
1. REMOVE AND INSTALL WORM SHAFT SEAL GEAR ASSEMBLED

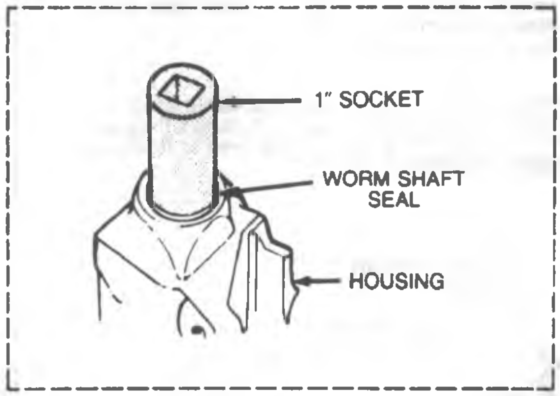
REMOVE

1. Wrap 0.1 mm to 0.2 mm (.005" to .008") shim stock around shaft and insert between shaft and seal. Pry seal out.

INSTALL

1. Install parts as shown.





Install seal.

NOTICE: Do not turn steering wheel hard against "stops" when linkage is disconnected.

2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

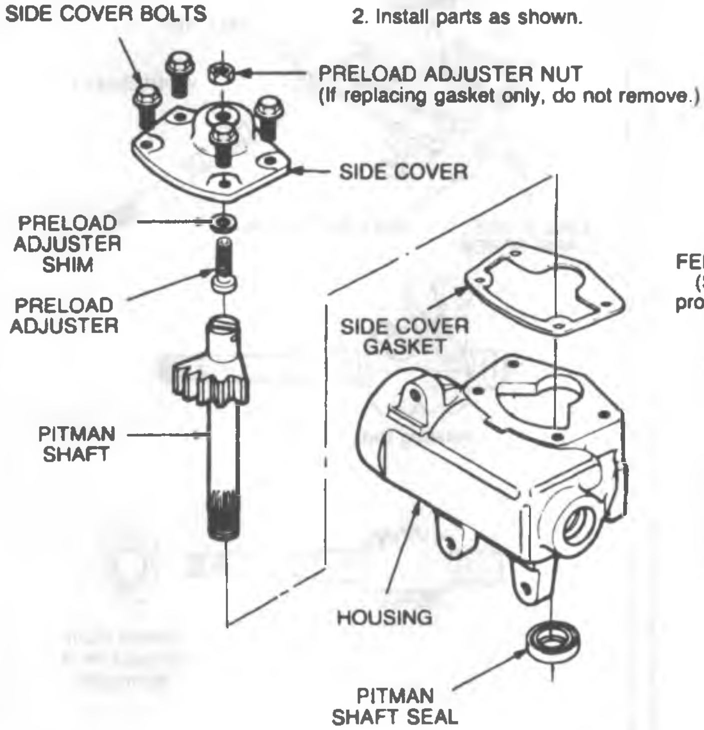
1. Center steering gear.
2. Remove parts as shown.

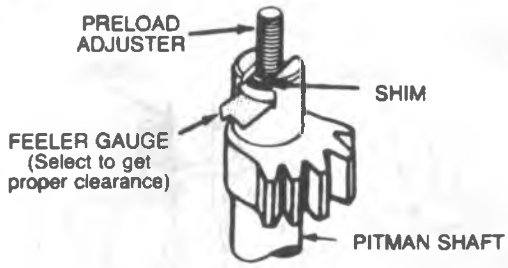
INSTALL

1. Before installing turn preload adjuster screw counterclockwise until it bottoms, then back screw off one half turn.
2. Install parts as shown.

Checking end clearance

If clearance is greater than .05 mm (.002") a steering gear lash adjuster kit is available





LUBRICATION

The steering gear requires .315 kg (11 oz) of lubricant GM4673M or equivalent.

F4651

Figure 6—Model 535 — Chart A

3. REMOVE AND INSTALL WORMSHAFT AND BALL NUT

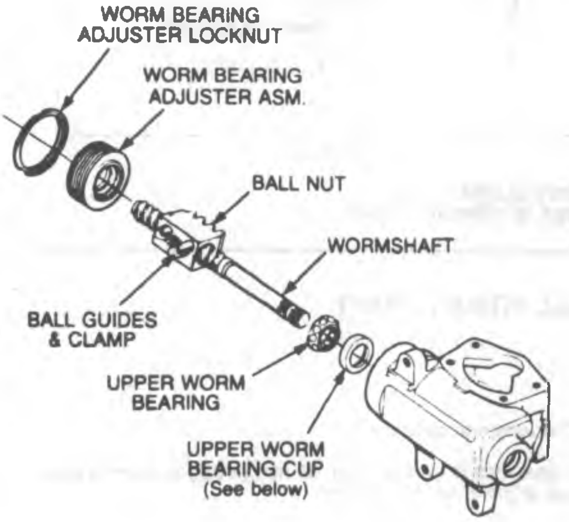
REMOVE

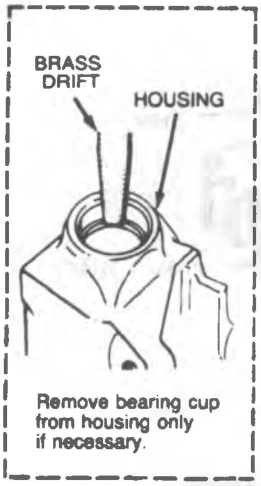
1. Loosen lock nut. Use punch against edge of slot.
2. Remove parts as shown.

INSTALL

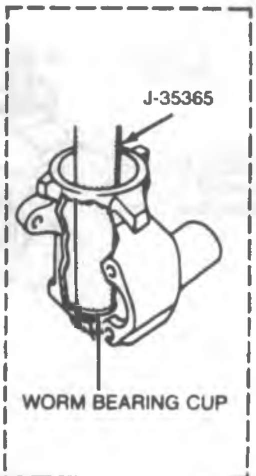
1. Install parts as shown.

NOTICE: Use care that the ball nut does not run down to either end of the worm. Damage may be done to the ends of the ball guides if the ball nut is allowed to rotate until stopped at the end of the worm.





Remove Cup



Install Cup

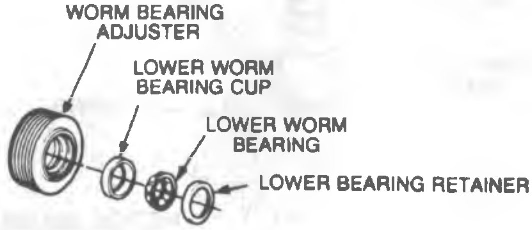
4. DISASSEMBLE AND ASSEMBLE WORM BEARING ADJUSTER

DISASSEMBLE

1. Pry lower bearing retainer out with screwdriver.
2. Remove cup using J 29369-1 puller and slide hammer.

ASSEMBLE

1. Press cup into adjust using Tool A
2. Install parts as shown.



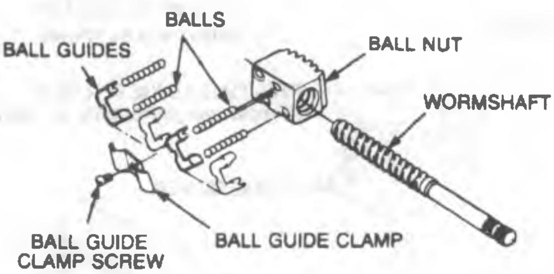
5. DISASSEMBLE AND ASSEMBLE WORMSHAFT AND BALL NUT

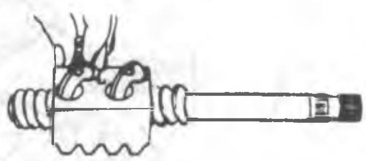
DISASSEMBLE

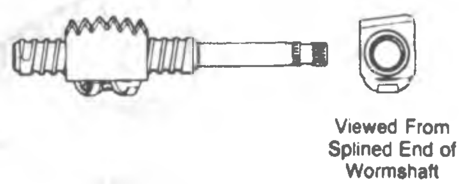
1. Disassemble parts as shown.
2. Clean and inspect all parts for excessive wear.

ASSEMBLE

1. Assemble parts as shown.
2. Refer to figure 3 (fig. A) for number of balls used.




Installing Balls



F5904

Figure 7—Model 535 — Chart B

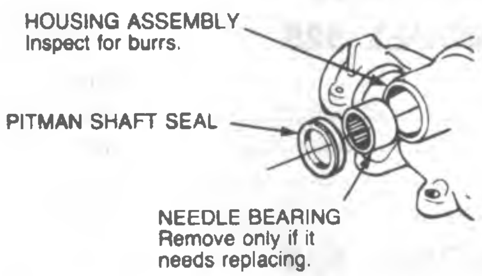
6. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

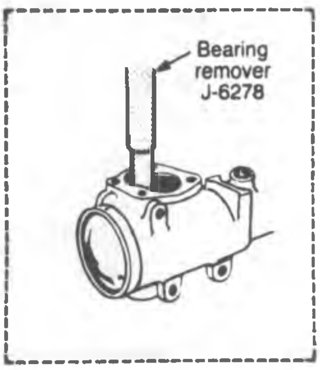
REMOVE

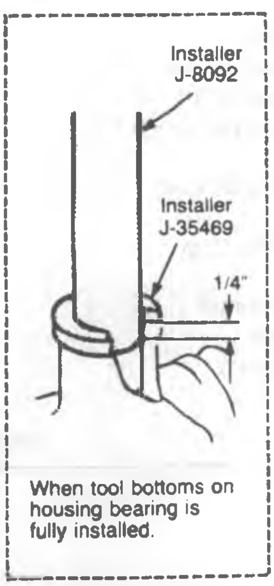
1. Clean end of housing thoroughly to prevent dirt from entering and be extremely careful not to score the housing bore.
2. Usine screwdriver, pry seal from bore.

INSTALL

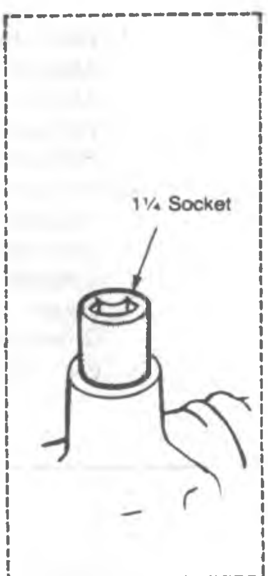
1. Install parts as shown.







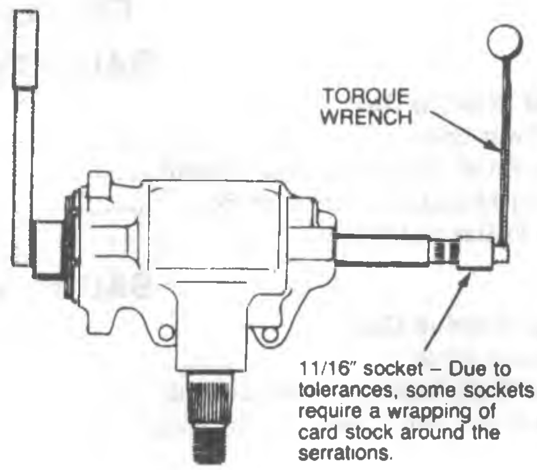
Install Pitman shaft bearing.



Install Pitman shaft seals.

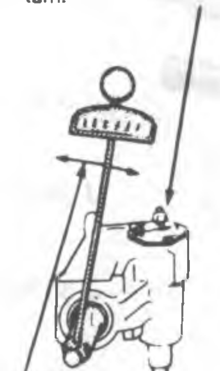
7. ADJUST WORM BEARING PRELOAD

1. Tighten worm bearing adjuster until it bottoms then loosen one-quarter turn.
2. Carefully turn the wormshaft all the way to end of travel then turn back one-half turn.
3. Tighten adjuster plug until torque wrench reads 0.6 to 1.0 N.m (5 to 8 in-lbs).
4. Tighten locknut using punch against edge of slot.



8. ADJUST "OVER CENTER" PRELOAD

A. Back off preload adjuster until it stops, then turn it in one full turn.



With gear at center of travel, check torque to turn stub shaft. (reading #1)

B. Turn adjuster in until torque to turn stub shaft is 0.5 to 1.2 N•m (4 to 10 in-lbs) more than reading #1.

Torque adjuster lock nut to 34 N•m (25 ft-lbs). Prevent adjuster screw from turning while torqueing lock nut.

F4653

Figure 8—Model 535 — Chart C — Adjustment

SPECIFICATIONS

ADJUSTMENT

Adjustment	Torque to Turn Worm Shaft N·m	In. Lbs.
Worm Bearing	0.6-1.0	5-8
Over Center Preload	0.5-1.2	4-10
	In Excess of Worm Bearing Preload	
Total Steering Gear Preload	1.8	16 max.

FASTENER TORQUE

SAGINAW MODEL 525

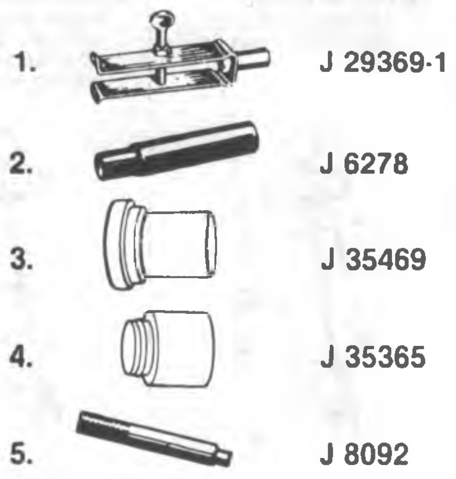
Manual Steering Gear	N·m	Ft. Lbs.
Side Cover Bolts	40	30
Pitman Shaft Adjusting Screw Locknut	34	25
Coupling Flange to Gear Pinch Bolt	40	30
Clamp to Ball Nut Screw	5.5	4

SAGINAW MODEL 535

Manual Steering Gear	N·m	Ft. Lbs.
Side Cover Bolts	18	13
Pitman Shaft Adjusting Screw Locknut	30	22
Clamp to Ball Nut Screw	5.5	4

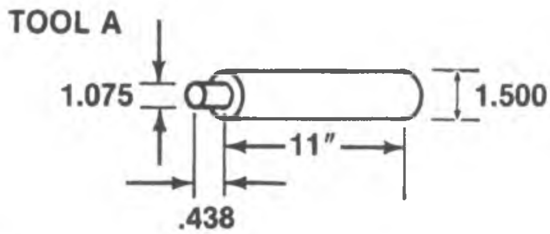
T2506

SPECIAL TOOLS



1. Worm Bearing Adjuster Cup Puller (Use with J-2619-01)
2. Pitman Shaft Bearing Remover
3. Pitman Shaft Bearing Installer
4. Worm Bearing Cup Installer
5. Treaded Universal Driver Handle (3/4" - 10 Thread)

F5814



A. Worm Bearing Cup Installer

F5905

SECTION 3B3

POWER STEERING

CONTENTS

DESCRIPTION

The hydraulic power steering system consists of a pump, an oil reservoir, a steering gear, a pressure hose, and a return hose.

The steering gear is made by Saginaw Division, General Motors. The steering gear is identified by a large S cast into the side of the housing. A building date is stamped in the cover. The building date is a four digit number. The first three digits are the Julian day of the year. The remaining digit is the last digit of the year.

The power steering pump is made by Saginaw Division, General Motors.

The power steering gear (figure 1) has a recirculating ball system which acts as a rolling thread between the wormshaft and the rack piston. The wormshaft is supported by a thrust bearing preload and two conical thrust races at the lower end, and a bearing assembly in the adjuster plug at the upper end. When the wormshaft is turned right, the rack piston moves up in gear. Turning the wormshaft left moves the rack piston down in gear. The rack piston teeth mesh with the sector, which is part of the pitman shaft. Turning the wormshaft turns the pitman shaft, which turns the wheels through the steering linkage.

The control valve in the steering gear directs the power steering fluid to either side of the rack piston. The rack piston converts the hydraulic pressure into a mechanical force. If the steering system becomes damaged and loses hydraulic pressure, the vehicle can be controlled manually.

The hydraulic pump is a vane-type design. There are two types, submerged and nonsubmerged. Submerged pump (P models) have a housing and internal parts that are inside the reservoir and operate submerged in fluid. The nonsubmerged pump (TC models with or without reservoir) function the same as the submerged pump except that the reservoir is separate from the housing and internal parts.

There are two bore openings at the rear of the pump housing. The larger opening contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve, and spring. The flow control orifice is part of the pressure line union. The pressure relief valve inside the flow control valve limits the pump pressure.

SAGINAW INTEGRAL POWER STEERING GEAR—RV, G, ST, M

NOTICE: Repair the steering gear in a clean, dust-free location, using clean tools and equipment. Dirt or grit will damage the machined surfaces and result in leakage or damage to the steering gear assembly.

If broken components or foreign materials are found during disassembly of the gear the hydraulic system should be disassembled, inspected, cleaned and flushed before servicing is complete.

The ball nut and control rings (seals) generally need not be replaced unless cut or damaged. If cut or damaged, inspect all mating parts for burrs, cracks, scratches, or damage. Replace or repair as needed.

In some instances, "power steering fluid" will be specified to lubricate parts upon assembly. In these cases, GM Power Steering Fluid, part no. 1050017 or

203. Nut
204. Spring Washer
205. Retaining Ring
207. Washer
208. Seal
209. Bearing
210. Screw
211. Clamp
212. Ball Guide
213. Balls
214. Rack Piston
215. Plug
216. Seal
217. Ring
218. Seal
219. Plug
220. Retaining Ring
221. Pitman Shaft
222. Adjuster Screw
224. Seal
225. Side Cover
226. Bolt
227. Nut
228. Housing
230. Seal
231. Seal
232. Rings
233. Spacer
234. Bearing Retainer
235. Spacer
236. Race
237. Bearing
238. Race
239. Seal
240. Adjuster Plug
241. Bearing
242. Seal
243. Washer
244. Retaining Ring
245. Nut
246. Races
247. Bearing
248. Worm Shaft
249. Seal
250. Valve Body
251. Stub Shaft
252. Valve Spool
253. Seal, Pitman Shaft Dust
254. Seal
A. 1989 Interim

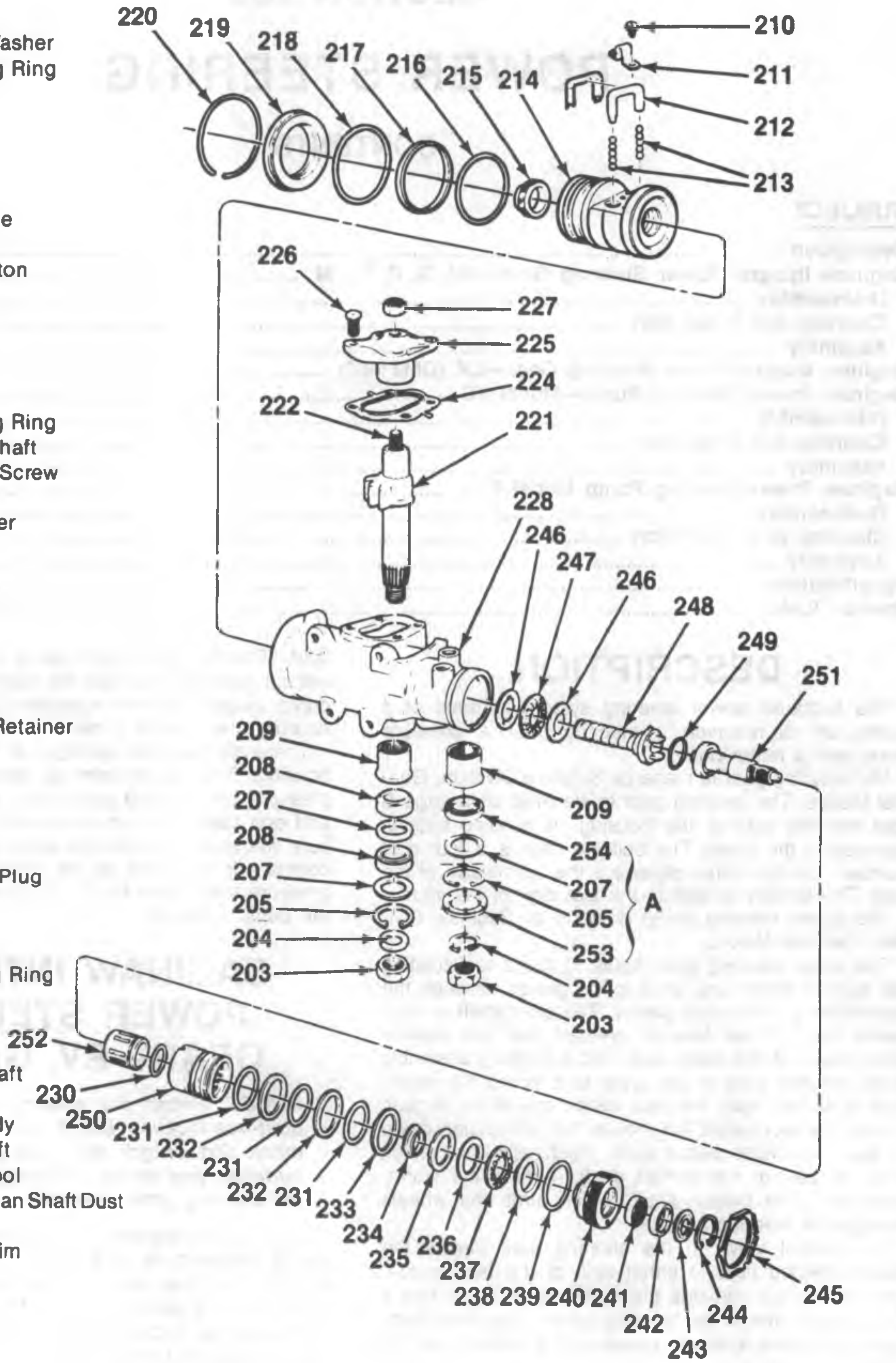


Figure 1—Integral Steering Gear Components — RV, G, P, ST and M Vehicles

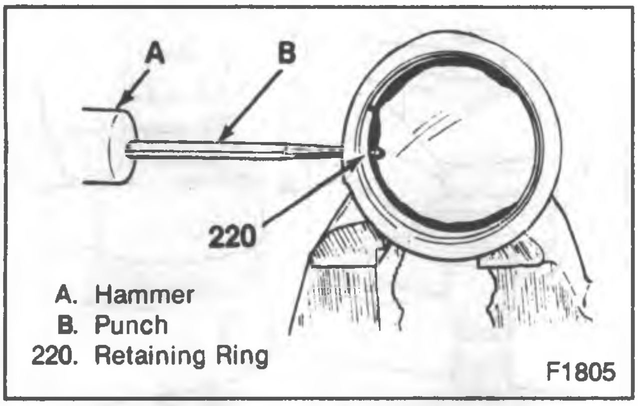


Figure 2—Unseating the Retaining Ring

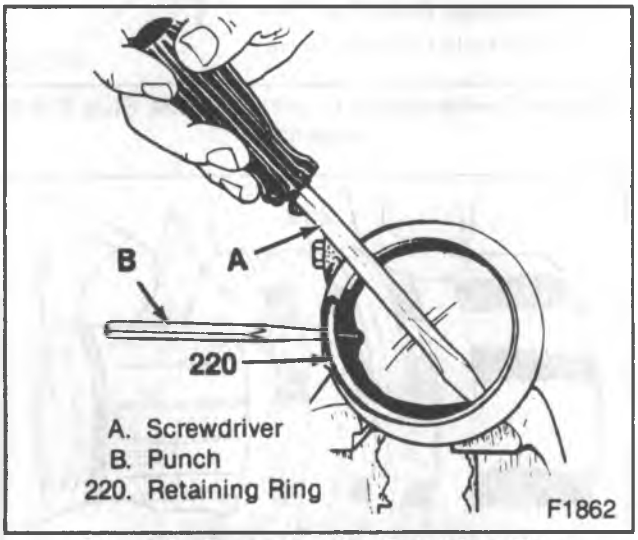


Figure 3—Removing the Retaining Ring

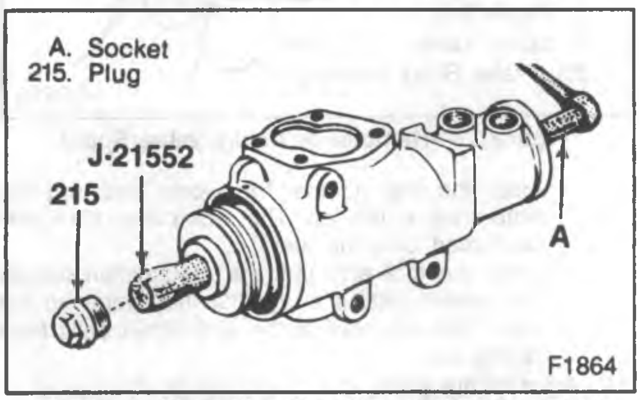


Figure 4—Removing the Plug and Piston Rack

equivalent should be used. DO NOT use brake fluid, automatic transmission fluid, or other non-approved fluids.

DISASSEMBLY

Remove or Disconnect (Figures 2 through 11)

Tools Required:

J 4245 Internal Snap Ring Pliers
J 21552 Ball Retainer Tool
J 8524-1 Bearing Remover

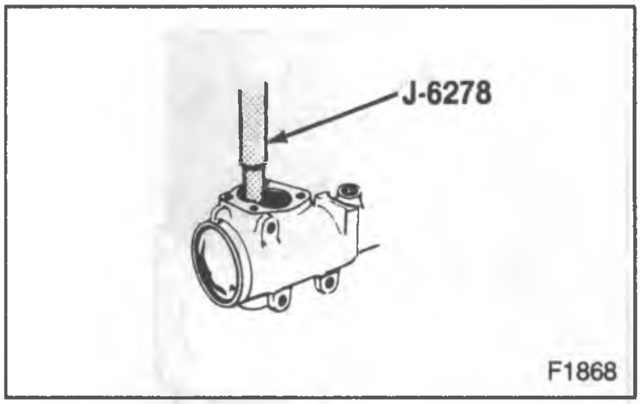


Figure 5—Removing the Pitman Shaft Bearing

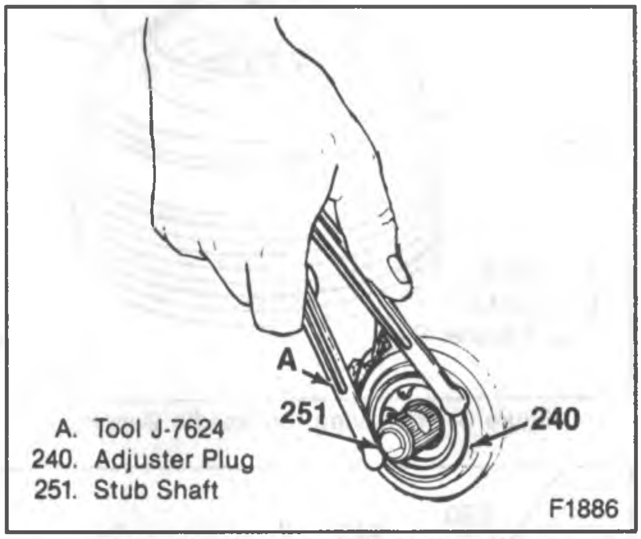


Figure 6—Removing the Adjust Plug

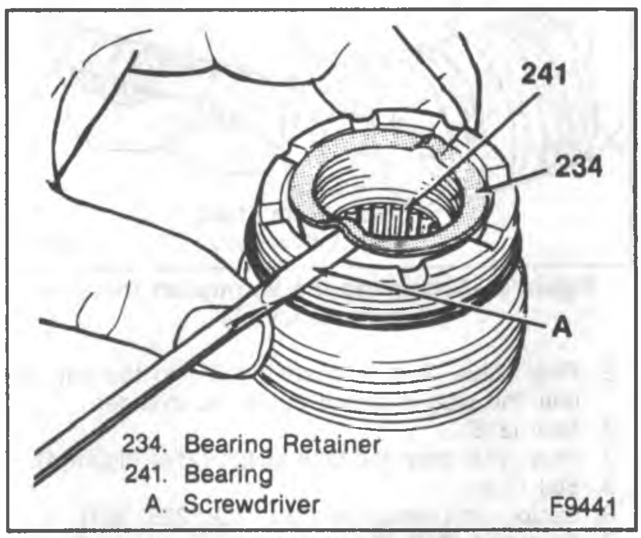


Figure 7—Removing the Bearing Retainer

J 7624 Spanner Wrench
J 7079-2 Driver
J 6278 Pitman Shaft Bearing Puller
J 21552 Rack Piston Arbor

1. Retaining Ring (220) (figure 2).
   - Pry retaining ring out of the housing groove with a screwdriver (figure 3).

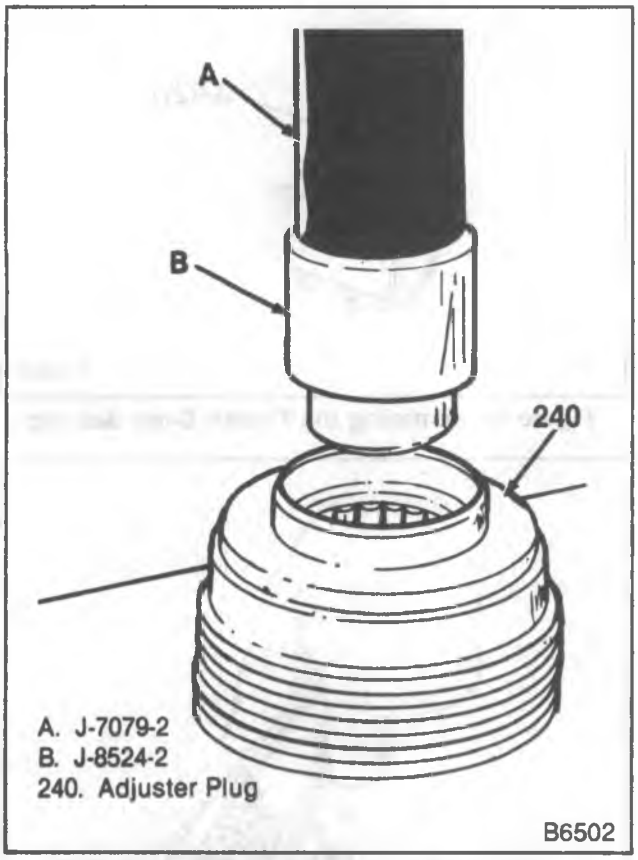


Figure 8—Removing the Needle Bearing

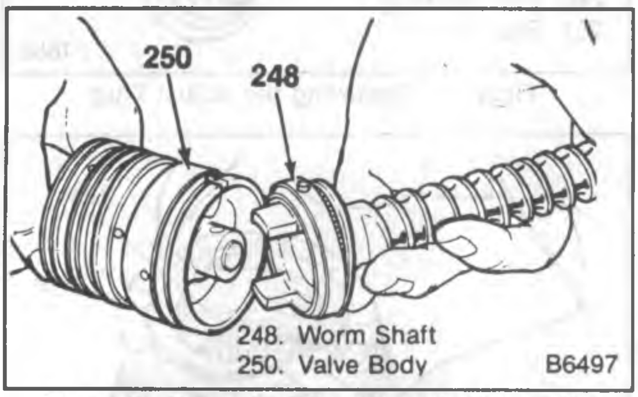


Figure 9—Separating the Wormshaft from the Valve Assembly

2. Plug (219). Turn stud shaft (251) to the left only until the plug is forced out of the cylinder.
3. Seal (218).
4. Plug (215) from the rack piston (214) (figure 4).
5. Bolt (226).
6. Sector shaft assembly (221, 222, 225, 227).
7. Dust seal (253) (figure 1).
8. Retaining ring (205) with J 4245.
9. Washers (207) and seal (254) (figure 1).
10. Bearing (209). If necessary, use tool J 6278 (figure 5).
11. Rack piston (214) and balls (213).
    - Insert tool J 21552 into the rack piston bore with the pilot of the tool seated into the end of the worm (248).

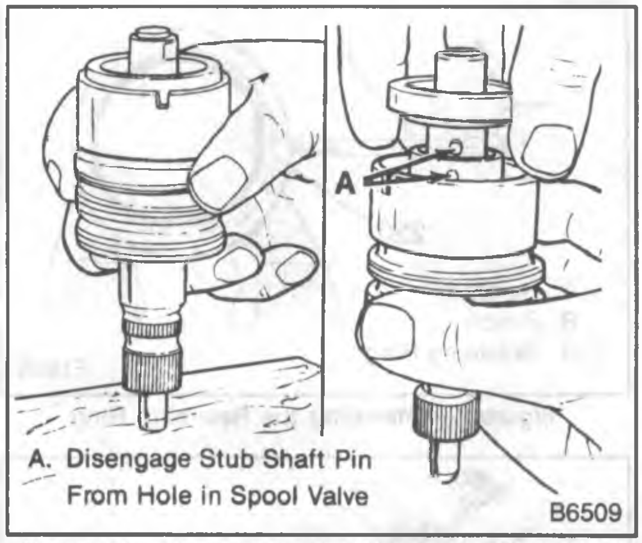


Figure 10—Removing or Installing the Stub Shaft Assembly

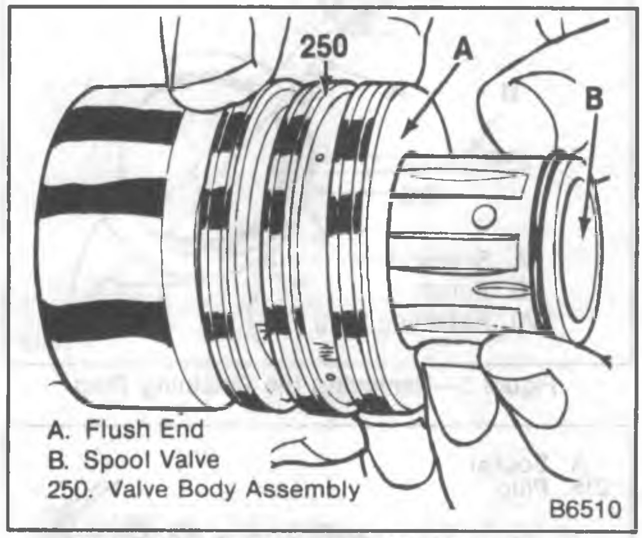
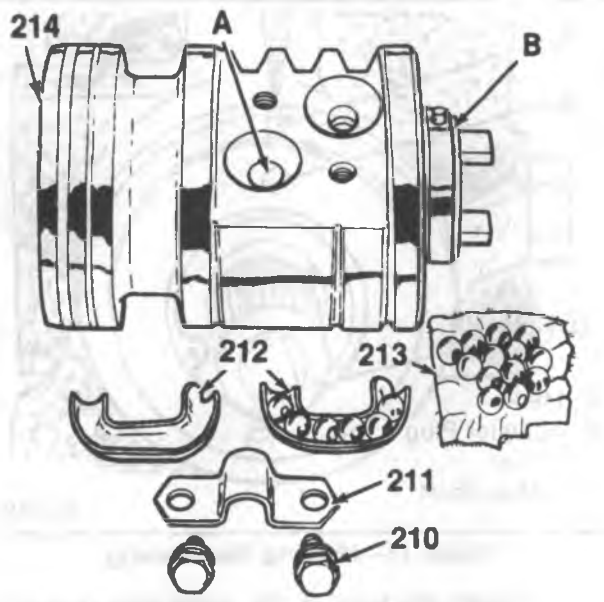


Figure 11—Remove or Install Valve Spool

    - Hold the tool against the worm and turn the stub shaft to the left. The rack piston (214) will be forced onto the tool.
    - Hold the tool and pull the rack piston toward the handle until it is against the flange on the tool. This will prevent the end circuit balls from falling out.
12. Adjuster nut (245).
13. Adjuster plug (240) using J 7624 (figure 6).
    - Retaining ring (244) using J 4245.
    - Washer (243), seal (242) and bearing (241).
    - Bearing retainer (234). Pry the retainer with a screwdriver at the raised area (figure 7).
    - Seal (239) and needle bearing (241). Use J 8524-1 and J 7079-2 (figure 8).
14. Valve (250) and wormshaft (248) as an assembly, with both races (246) and bearing (247).
    - Wormshaft (248) from valve assembly (figure 9).
    - Races (246) and bearing (247) from the wormshaft (248).
    - Seal (249).



A. Install Balls In This Hole While Slowly Rotating Worm Counterclockwise
B. Worm Flange
210. Screw
211. Clamp
212. Ball Guides
213. Balls
214. Rack Piston

B6517

Figure 12—Installing the Balls Into the Rack Piston

15. Stub shaft (251) from valve body (250) (figure 10).
    - Hold the assembly and lightly tap the stub shaft against the bench until the shaft cap is free from the valve body.
    - Pull the shaft assembly until the shaft cap clears the valve body by about 6 mm (1/4-inch).
    - Valve spool (252) and seals (230) and (231) (figure 11).
16. Screws (210), clamp (211) and ball guide (212).
    - Balls (213).

CLEANING AND INSPECTION

Clean

- All parts with solvent and blow dry.

Inspect (Figure 1)

1. Pitman shaft and side cover.
   — Bushing.
   — Bushing surfaces in the side cover (225) for scoring. Replace the side cover assembly if necessary.
   — Sealing and bearing surfaces of the pitman shaft (221) for roughness, nicks, or other damage. Replace the pitman shaft assembly if necessary.
   — Pitman shaft (221) for excessive wear or scoring. Check the sector gear teeth for wear. Replace the pitman shaft assembly if necessary.
   — Adjuster screw (222) threads for wear. The adjuster screw must be free to turn with no end play.
2. Rack piston.
   — Worm (248) and rack piston (214) grooves and all balls (213) for scoring. BOTH MUST BE REPLACED as a matched assembly.
   — Seal (216) and ring (217) for wear.
   — Ball return guide halves (212) for cracks and damage.
   — Bearing (247) and races (246) for scoring and excessive wear.
   — Rack piston (214) teeth and external ground surfaces for scoring or excessive wear. If either condition exists, replace the rack piston (214) and worm (248).
3. Adjuster plug.
   — Spacer (235) for wear or cracks.
   — Races (236, 238) for wear or scoring.
   — Adjuster plug (240) threads for wear.
   — Bearing (237) for wear or scoring.
   — Needle bearing (241) for wear, pitting or scoring. Replace if necessary.
4. Valve and stub shaft.
   — Seals (231) and rings (232).
   — Shaft pin for wear or cracks. If excessively worn or broken, replace the complete valve and shaft assembly.
   — Ground surface of the stub shaft (251). If a crocus cloth cannot clean the nicks or burrs, replace the entire valve assembly.
   — Outside diameter of the valve spool and inside diameter of the valve body (250). If a crocus cloth cannot clean the nicks or burrs, replace the entire shaft and valve assembly.
   — The small notch in the skirt of the valve for wear. If worn replace the complete valve assembly.
   — Valve spool inside the valve body (250). The valve spool, when lubricated with steering fluid, must rotate freely without binding. If binding occurs, replace the complete valve and shaft assembly.

ASSEMBLY

Install or Connect (Figures 1, 4, and 10 through 14)

Tools Required:
J 4245 Snap Ring Pliers
J 6217 Valve Connector
J 21552 Ball Retainer
J 22407 Bearing Installer
J 8092 Bearing Driver
J 7079 Bearing Remover and Installer
J 8524-1 Driver
J 7624 Bearing Preload Spanner Wrench

1. Balls (213), alternately by color, in the rack piston (214) (figure 12). Use J 21552 in the rack piston.
   - Lubricate the 24 balls with power steering fluid.
2. Balls (213), alternating by color, in the ball guide (212) (figure 13).

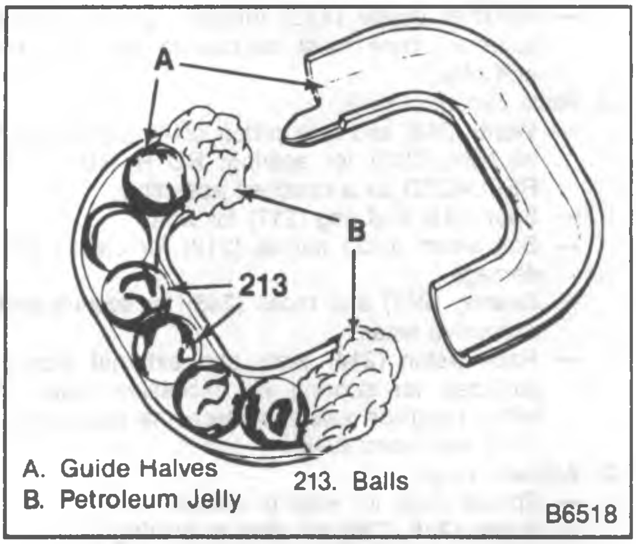


Figure 13—Retaining the Balls in the Ball Guide

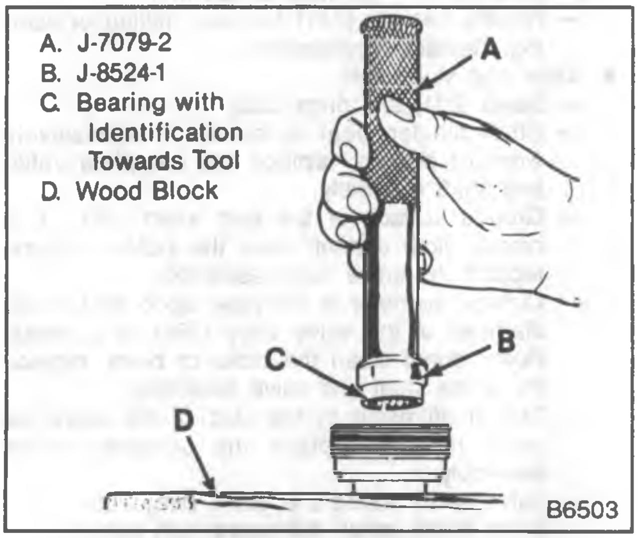


Figure 14—Installing the Needle Bearing

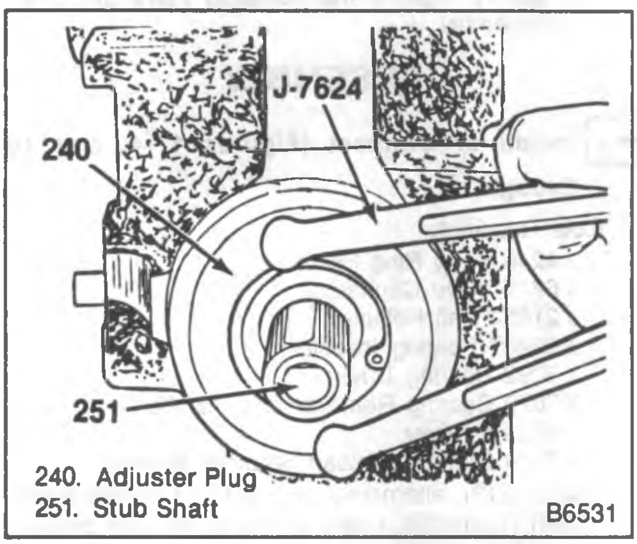


Figure 15—Bottoming the Adjuster Plug

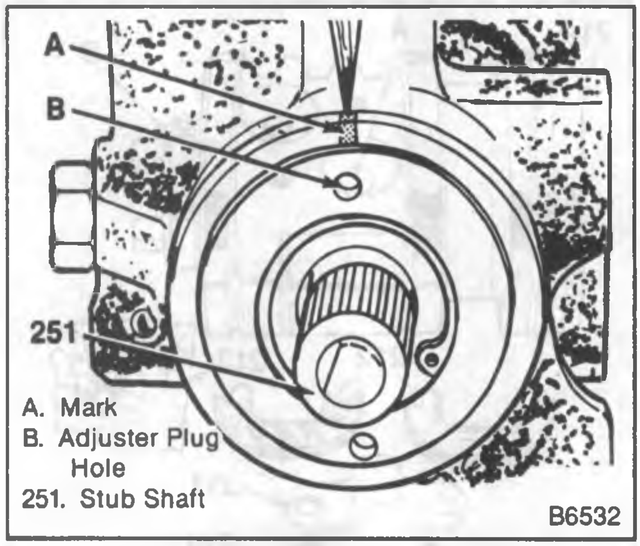


Figure 16—Marking the Housing

- Retain the balls in the guide with petroleum jelly.

3. Ball guide (212), clamp (211) and screws (210) to the rack piston (214).
4. Stub shaft (251) into the valve body (250) (figure 10).
   - Lubricate the stub shaft (251) with power steering fluid.
5. Valve spool (252) and seals (230, 231) into the valve body (250).
   - Lubricate the valve spool (252) and seals (230, 231) with power steering fluid before assembling.
6. Valve body (250), seal (249), wormshaft (248), bearing races (246) and roller bearing (247).
7. Seal (239) on the adjuster plug (240).
8. Needle bearing (241) in the adjuster plug. Use J 8524-1 and J 7079-2 (figure 14).
9. Seal (242), washer (243), and retaining ring (244) in the adjuster plug (240).

Important

- The retainer projections must not extend beyond the washer (243) when the retainer ring (244) is seated. The washer must be free to rotate.

10. Wormshaft, valve assembly into the steering gear housing.
11. Adjuster plug (240) into the steering gear housing. Use spanner wrench J 7624.

Adjust (Figures 15 through 22)

Tools Required:

J 7624 Spanner Wrench J 7754-01 Torque Wrench

1. Bearing preload:
   - Use tool J 7624. Turn the adjuster plug (240) to the left until the plug and bearing (237) are firmly bottomed - about 27 N·m (20 ft. lbs.) (figure 15).
   - Mark the housing in line with one of the holes in the adjuster plug (figure 16).

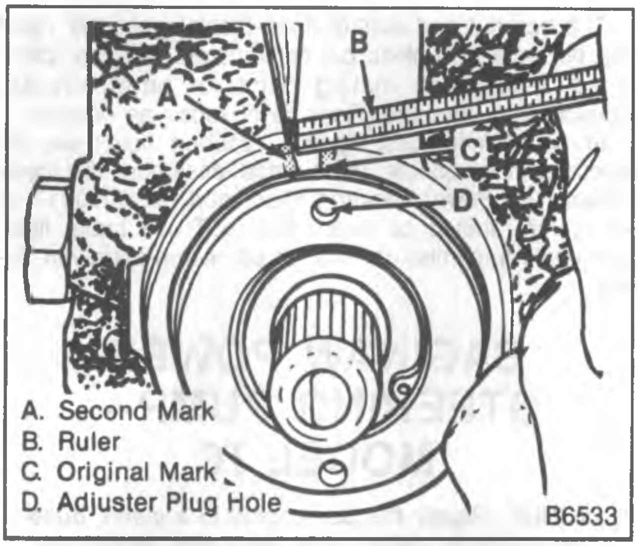


Figure 17—Remarking the Housing

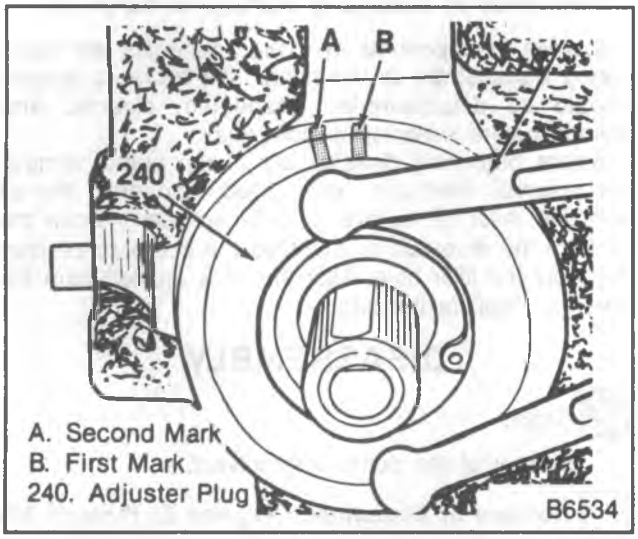


Figure 18—Aligning the Adjuster Hole with the Second Mark

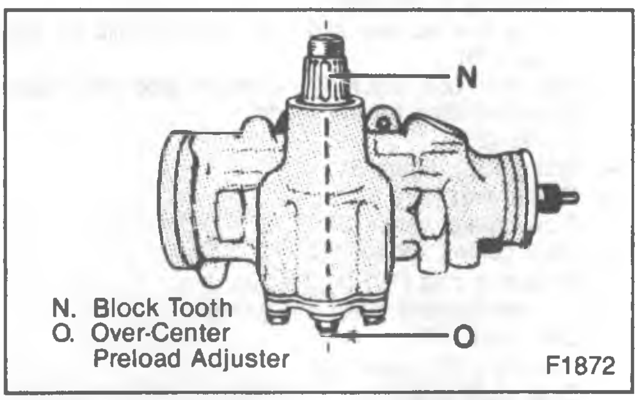


Figure 19—Pitman Shaft "Over-Center" Sector Adjustment

- Measure back (to the left) 13 mm (1/2-inch) and re-mark the housing (figure 17).
- Rotate the adjuster to the left until the hole in the adjuster is in line with the second mark (figure 18).

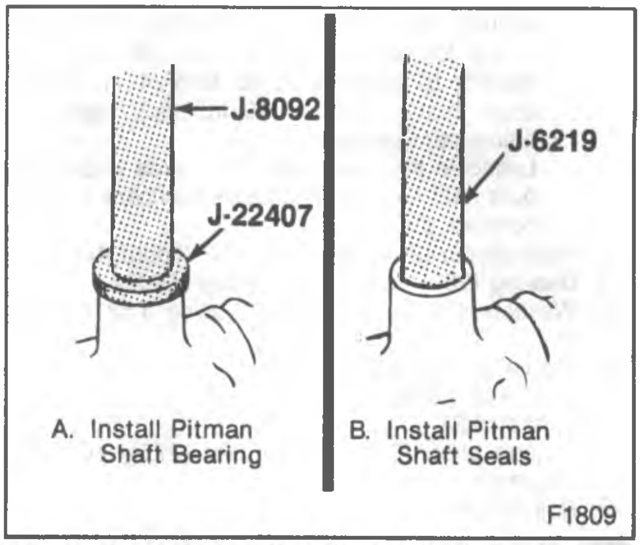


Figure 20—Installing the Pitman Shaft Bearing and Seals

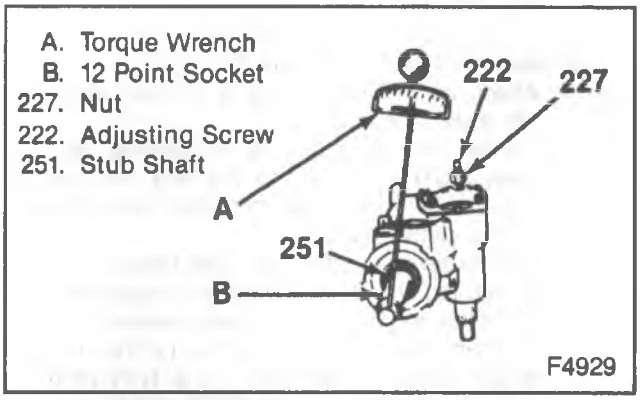


Figure 21—Aligning the Over-Center Preload

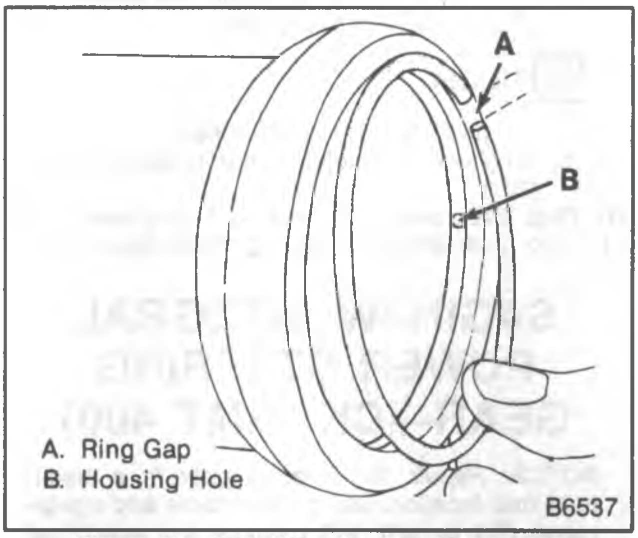


Figure 22—Installing the Retaining Ring

- Install the adjuster nut (245) and torque the nut to 108 N·m (80 ft. lbs.). Hold the adjuster plug to maintain alignment of the hole with the mark.
- Check the turning torque of the stub shaft, using J 7754-01 and a 12-point socket. The reading should be taken with the beam of the

wrench near vertical while turning the wrench to the left at an even rate (figure 19). If the reading is less than 0.45 N·m (4 in. lbs.) or more than 1.15 N·m (10 in. lbs.), repeat the adjustment procedure.
- Lubricate the stub shaft (251) area outside the dust seal (206) with chassis lubricant or an all purpose grease.

2. Rack piston (214) using J 21552 (figure 4).
3. Bearing (209) using J 22407 and J 8092.
4. Washers (207) and seal (254)using J 6219 (figure 1).
5. Retaining ring (205).
6. Dust seal (253).
7. Gasket (224).
8. Pitman shaft (221), side cover (225), nut (227) assembly.
9. Bolt (226).

Adjust (Figure 21)

Tool Required:
J 7754-01 Torque Wrench

- Pitman shaft preload (figure 21).
  1. Attach tool J 7754-01 and a 12-point socket on the stub shaft splines.
  2. Center the steering gear by turning the stub shaft (251) from right to left and counting the number of turns. Turn the shaft back halfway to the center position.
  3. Check the combined ball and bearing preload by turning the torque wrench through the center of travel. Note the highest reading.
  4. Tighten the adjusting screw (222) until the torque wrench reads 0.6 - 1.2 N·m (6-10 in. lbs.) higher than the reading noted in step "3."
     - The total reading should not exceed 2.25 N·m (20 in. lbs.) torque.

Tighten

- Nut (227) to 27 N·m (20 ft.lbs.).

5. Re-check the preload after tightening the nut (227).

10. Plug (215), seal (216), ring (217), and seal (218).
11. Plug (219) and retaining ring (220) (figure 22).

SAGINAW INTEGRAL POWER STEERING GEAR—CK (GMT 400)

NOTICE: Repair the steering gear in a clean, dust-free location, using clean tools and equipment. Dirt or grit will damage the machined surfaces and result in leakage or damage to the steering gear assembly.

If broken components or foreign materials are found during disassembly of the gear the hydraulic system should be disassembled, inspected, cleaned and flushed before servicing is complete.

Service information is shown in figures 23,24, 25, 26, and 27.

The ball nut and control rings (seals) generally need not be replaced unless cut or damaged. If cut or damaged, inspect all mating parts for burrs, cracks, scratches, or damage. Replace or repair as needed.

In some instances, "power steering fluid" will be specified to lubricate parts upon assembly. In these cases, GM Power Steering Fluid, part no. 1050017 or equivalent should be used. DO NOT use brake fluid, automatic transmission fluid, or other non-approved fluids.

SAGINAW POWER STEERING PUMP—MODEL TC

NOTICE: Repair the pump only in a clean, dust-free location, using clean tools and equipment. Dirt or grit will damage the machined surfaces and result in leakage or damage to the pump.

If broken components or foreign materials are found during disassembly of the pump, the hydraulic system should be disassembled, inspected, cleaned and flushed before servicing is complete.

Before beginning disassembly of the pump, remove the reservoir filler cap (when used) and drain the oil from the reservoir by filler cap (when used). Drain the oil from the reservoir by inverting the pump so oil may drain out the filler hole. After the oil is drained from the reservoir, replace the cap.

DISASSEMBLY

Clean

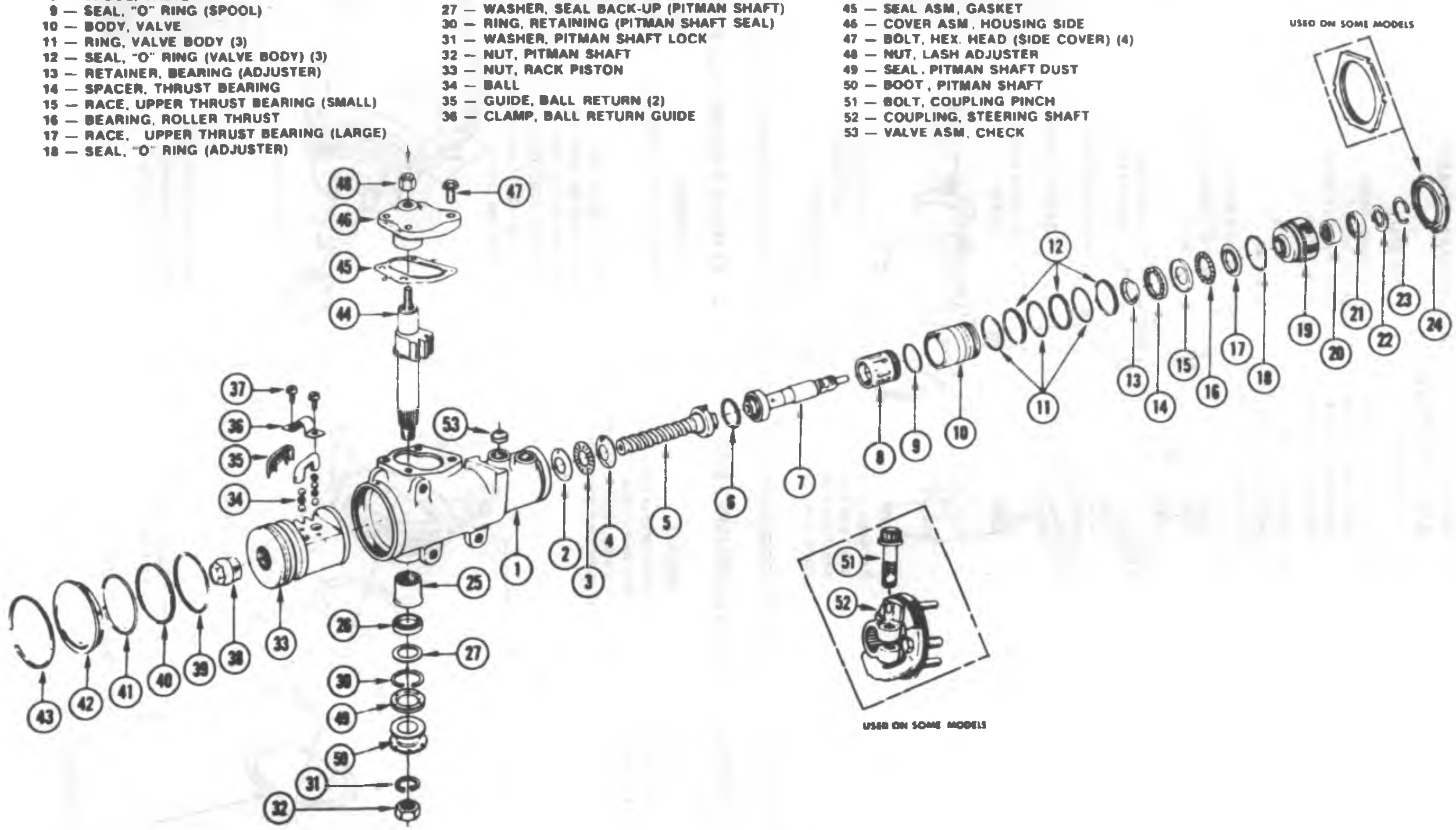
- Exterior of the pump with solvent.

Remove or Disconnect (Figures 28 through 39)

— Clamp the front hub of the pump in a soft jawed vise.

1. Clips (26), if equipped.
   - Pry the tab and slide the retaining clip off (figure 29).
2. Reservoir (24) (figure 30) or return tube (15) (figure 39) depending on the model.
3. O-ring (25).
4. Fitting (23) (figure 31).
5. O-ring seal (22).
6. Flow control valve (21).
7. Flow control spring (20).
8. Retaining ring (19) (figure 32).
   - Use suitable snap ring pliers.
9. Driveshaft (17).
10. Bearing (18) (figure 33).
11. Driveshaft seal (16).
    - Pry the seal loose with a flat head screwdriver (figure 34).
12. Retaining ring (14).
    - Insert a punch into the access hole and pry the ring loose (figure 35).
13. Thrust plate (13) (figure 36).
    - Use a 16 mm (5/8-inch) piece of bar stock or suitable brass drift.

Key No.	Part Name
1	HOUSING, STEERING GEAR
2	RACE, THRUST BEARING (WORM)
3	BEARING ASM., ROLLER THRUST (WORM)
4	RACE, THRUST BEARING (WORM)
5	WORM, STEERING
6	SEAL, "O" RING (STUB SHAFT)
7	SHAFT, STUB
8	SPOOL, VALVE
9	SEAL, "O" RING (SPOOL)
10	BODY, VALVE
11	RING, VALVE BODY (3)
12	SEAL, "O" RING (VALVE BODY) (3)
13	RETAINER, BEARING (ADJUSTER)
14	SPACER, THRUST BEARING
15	RACE, UPPER THRUST BEARING (SMALL)
16	BEARING, ROLLER THRUST
17	RACE, UPPER THRUST BEARING (LARGE)
18	SEAL, "O" RING (ADJUSTER)
19	PLUG, ADJUSTER
20	BEARING, NEEDLE
21	SEAL, STUB SHAFT
22	SEAL, STUB SHAFT DUST
23	RING, RETAINING
24	NUT, ADJUSTER PLUG LOCK
25	BEARING ASM., NEEDLE (PITMAN SHAFT)
26	SEAL, PITMAN SHAFT
27	WASHER, SEAL BACK-UP (PITMAN SHAFT)
30	RING, RETAINING (PITMAN SHAFT SEAL)
31	WASHER, PITMAN SHAFT LOCK
32	NUT, PITMAN SHAFT
33	NUT, RACK PISTON
34	BALL
35	GUIDE, BALL RETURN (2)
36	CLAMP, BALL RETURN GUIDE
37	SCREW ASM, LOCKWASHER & (2)
38	PLUG, RACK PISTON
39	SEAL, "O" RING (RACK PISTON)
40	RING, RACK PISTON
41	SEAL, "O" RING (HOUSING END PLUG)
42	PLUG, HOUSING END
43	RING, RETAINING (HOUSING END PLUG)
44	GEAR ASM., PITMAN SHAFT
45	SEAL ASM., GASKET
46	COVER ASM., HOUSING SIDE
47	BOLT, HEX. HEAD (SIDE COVER) (4)
48	NUT, LASH ADJUSTER
49	SEAL, PITMAN SHAFT DUST
50	BOOT, PITMAN SHAFT
51	BOLT, COUPLING PINCH
52	COUPLING, STEERING SHAFT
53	VALVE ASM., CHECK



F6799

Figure 23—Integral Steering Gear Components—CK (GMT 400)

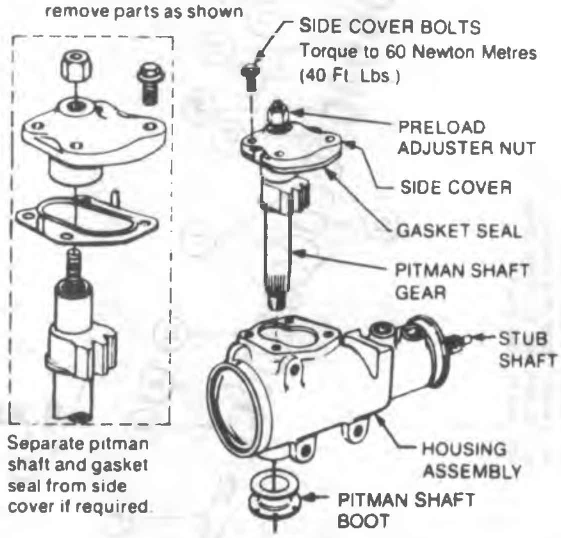
1. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

1. If pitman shaft and side cover are to be separated, remove preload adjuster nut.
2. Rotate stub shaft to center gear, then remove parts as shown

INSTALL

1. If removed, install gasket seal by bending tabs around cover edges
2. Install parts as shown



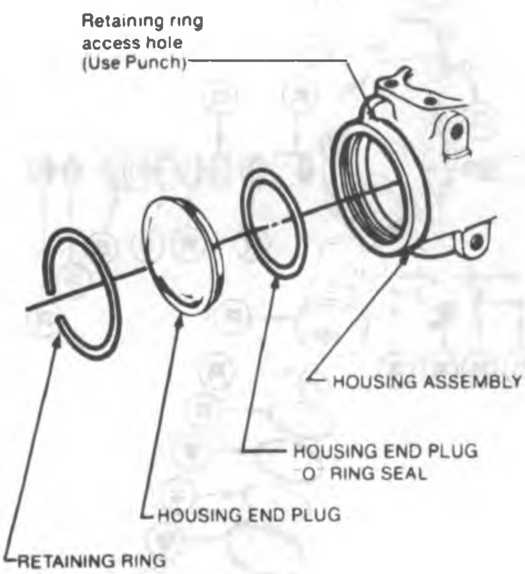
2. REMOVE AND INSTALL HOUSING END PLUG

REMOVE

1. Remove parts as shown

INSTALL

1. Install parts as shown. Open end of retaining ring to be approx. 25 mm (1 inch) from access hole



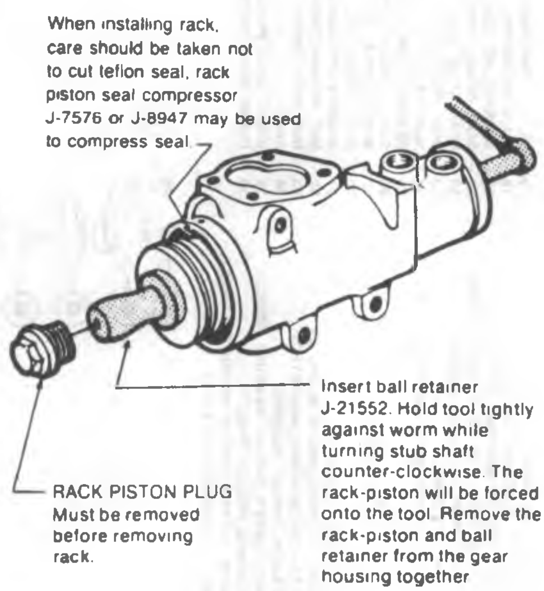
3. REMOVE AND INSTALL RACK PISTON

REMOVE

1. Remove parts as shown

INSTALL

1. Install parts as shown



F6800

Figure 24—Removing and installing the Pitman Shaft

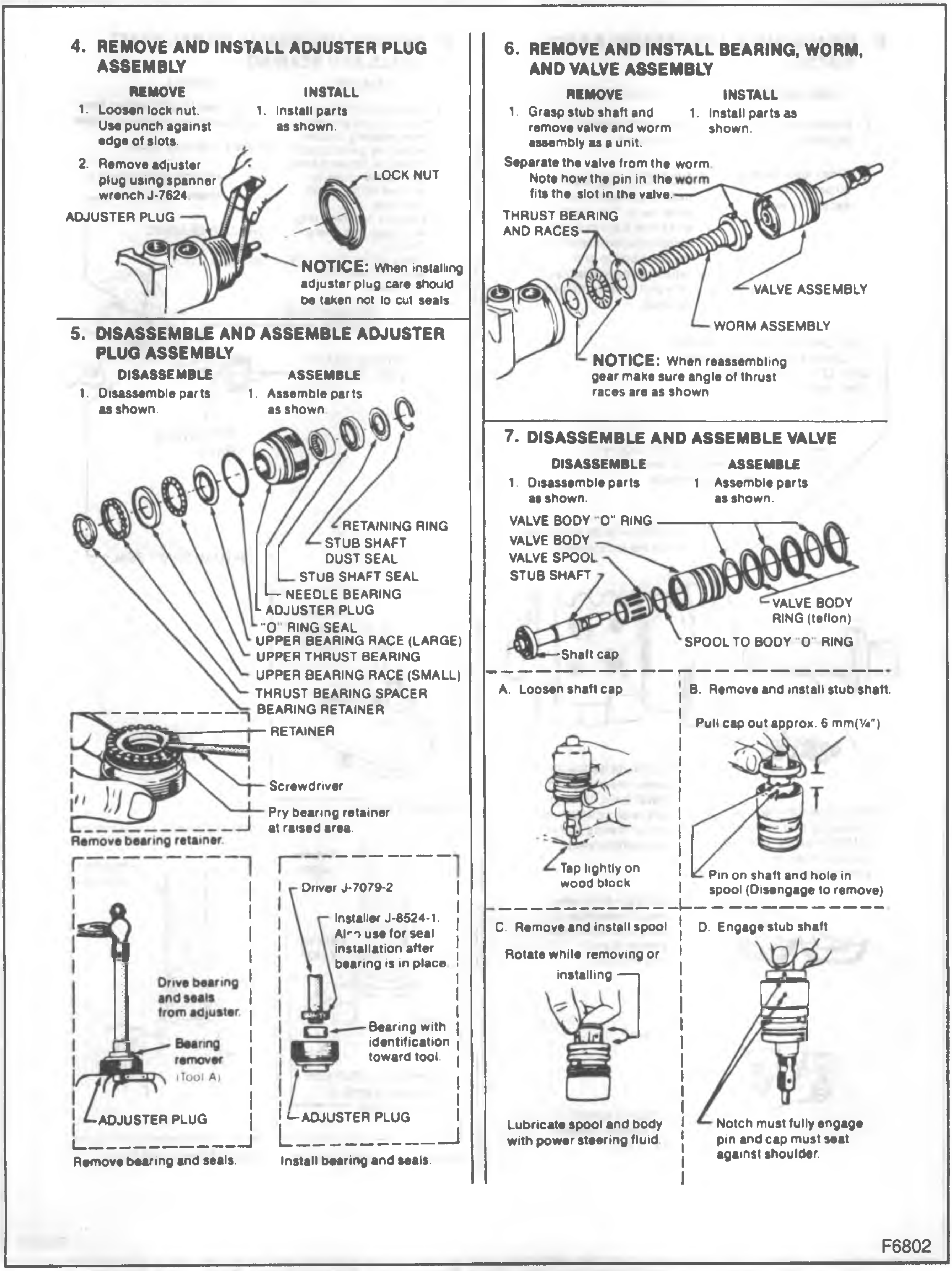


Figure 25—Removing and Installing the Adjuster Plug Assembly

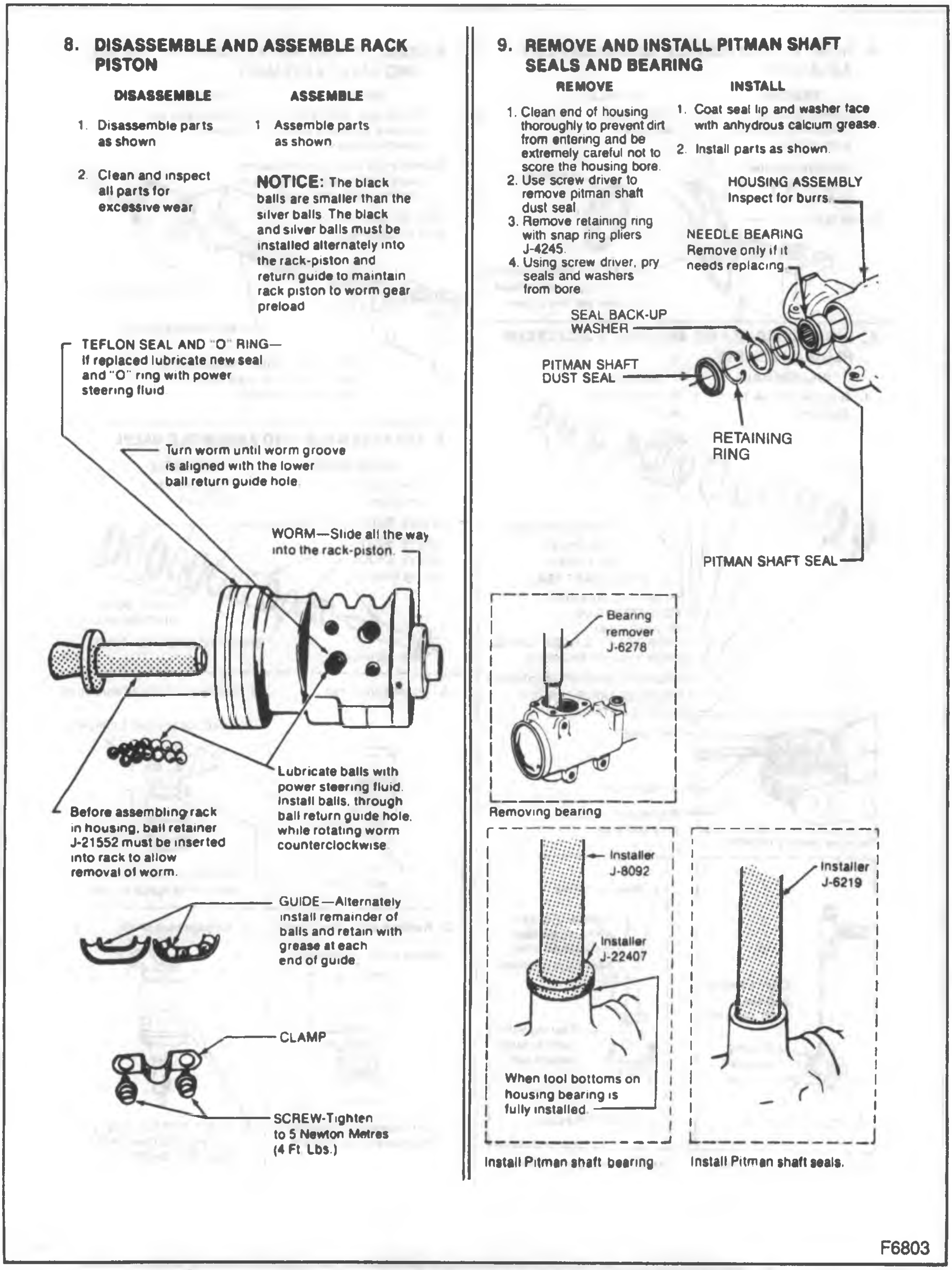


Figure 26—Removing and Installing the Rack Piston and Pitman Shaft Seals and Bearing

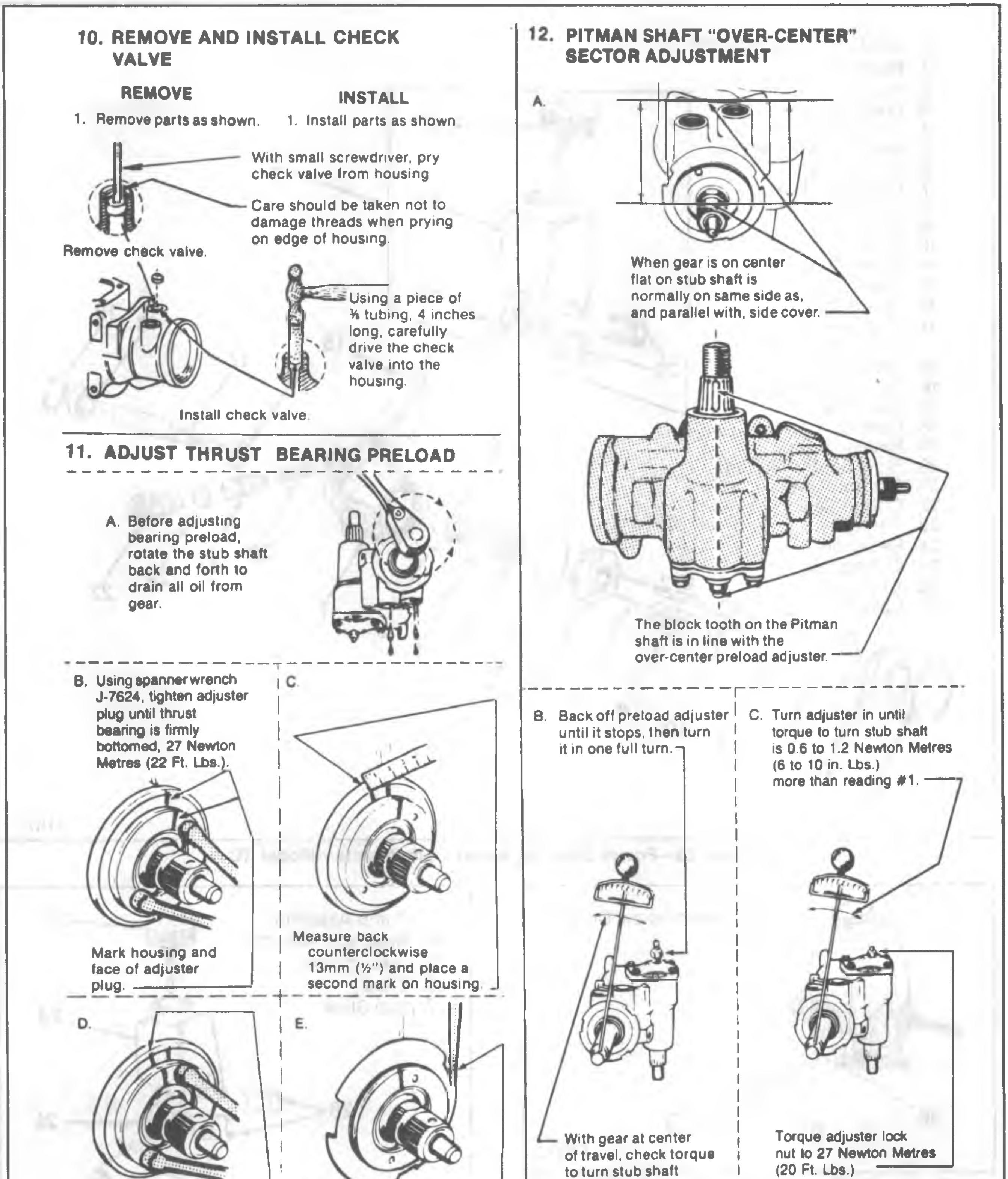


Figure 27—Removing and Installing the Check Valve . Adjusting the Thrust Bearing Preload and Pitman Shaft "Over-Center" Sector.

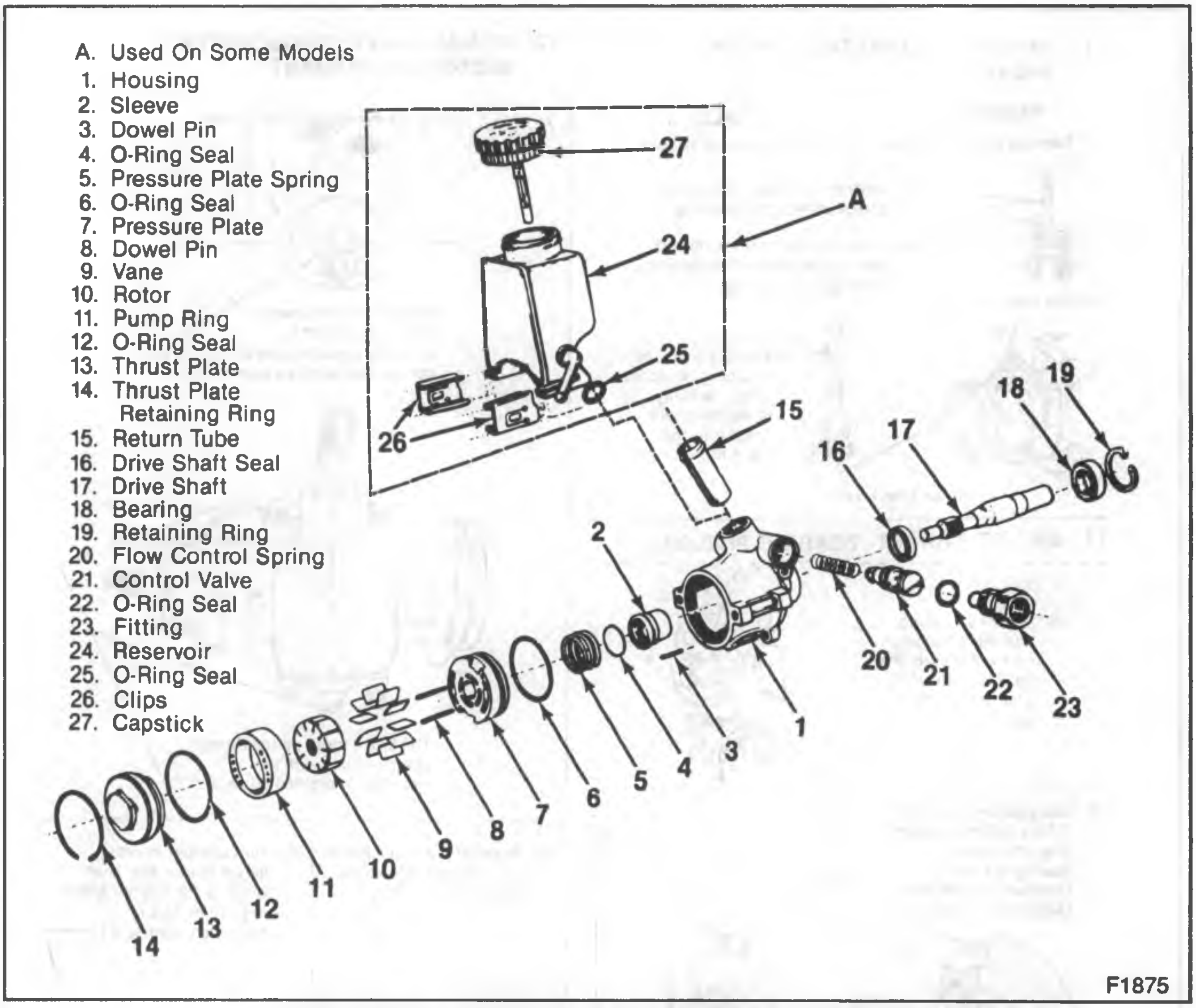


Figure 28—Power Steering Pump Components—Model TC

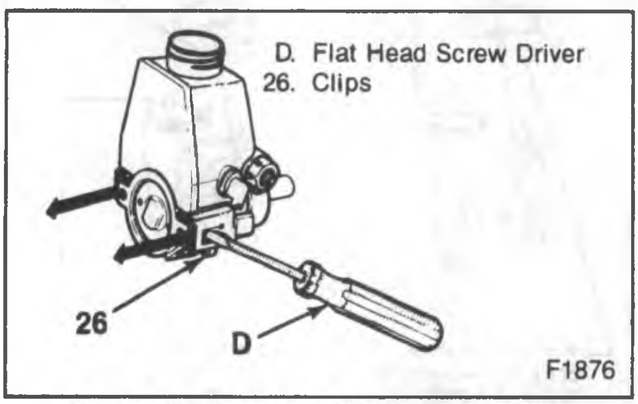


Figure 29—Removing the Reservoir Clips

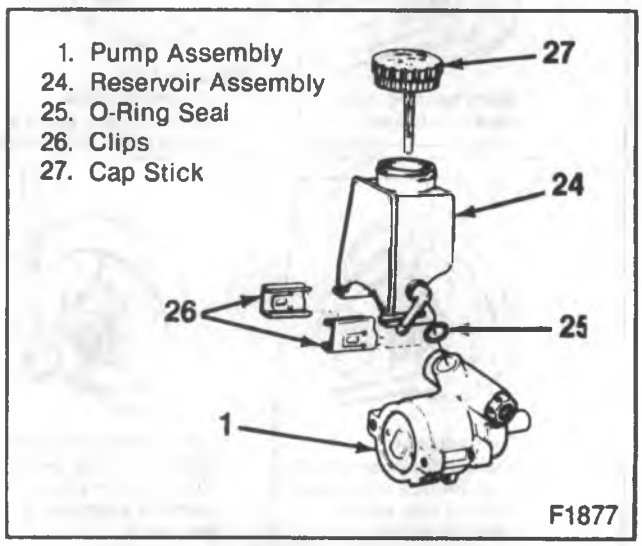


Figure 30—Removing the Reservoir

14. O-ring seal (12).
15. Pump ring (11) (figure 37).
16. Rotor (10).
17. Vanes (9).
18. Dowel pins (8).
19. Pressure plate (7).
20. O-ring (6).
21. Pressure plate spring (5).
22. O-ring seal (4).
23. Dowel pin (3).
24. Sleeve (2) (figure 38).

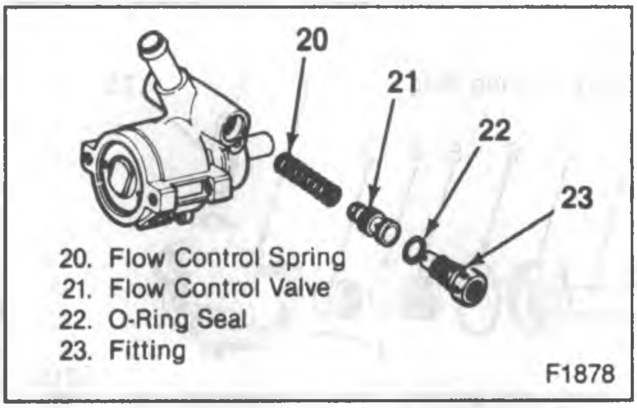


Figure 31—Removing the Fitting, Control Valve, Spring and Seal

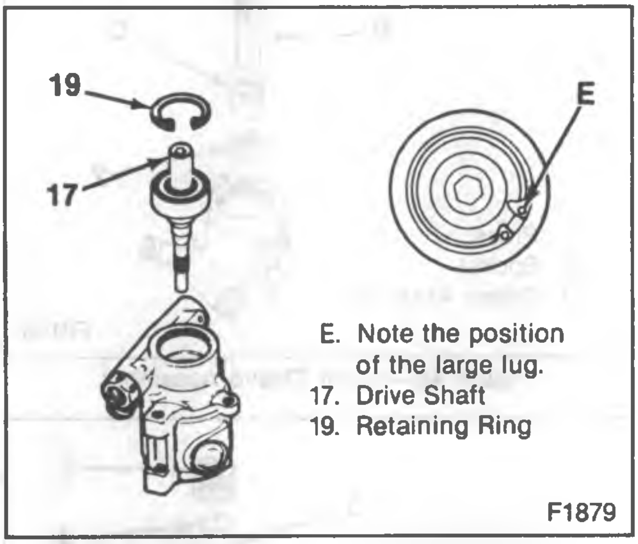


Figure 32—Remove and Install Retaining Ring

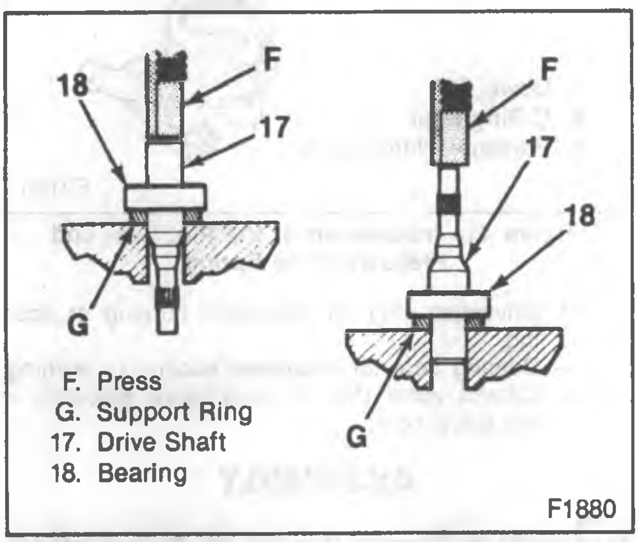


Figure 33—Remove and Install Driveshaft Bearing

CLEANING AND INSPECTION

Clean

- All parts with solvent and blow dry.

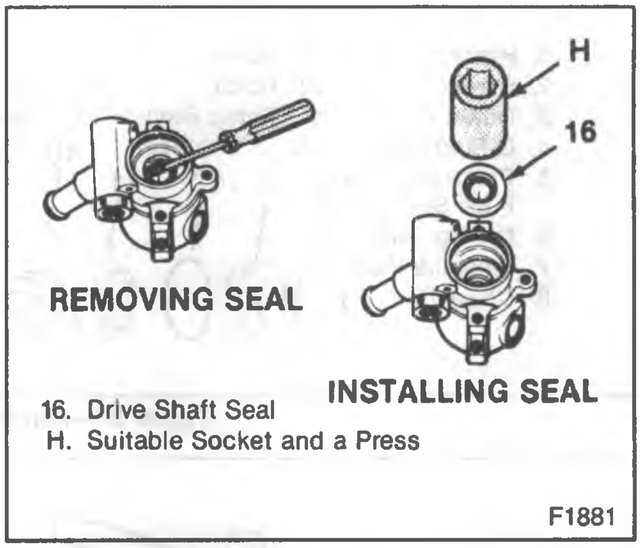


Figure 34—Remove and Install Driveshaft Seal

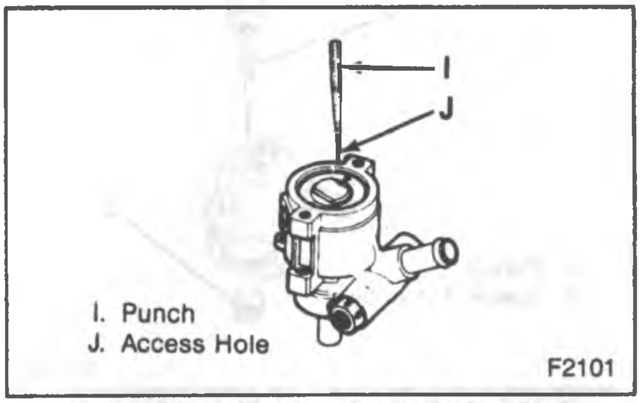


Figure 35—Removing the Retaining Ring

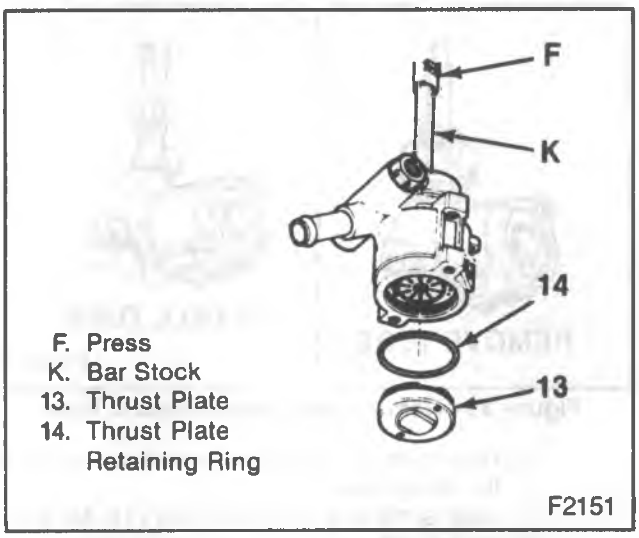


Figure 36—Removing the Thrust Plate

Inspect (Figure 38)

1. Rotating group components.
   — Vane (9) tips for scoring or wear.
   — Fit of vanes (9) in the rotor (10). The vanes must fit properly in the rotor slots, without sticking or excessive play.

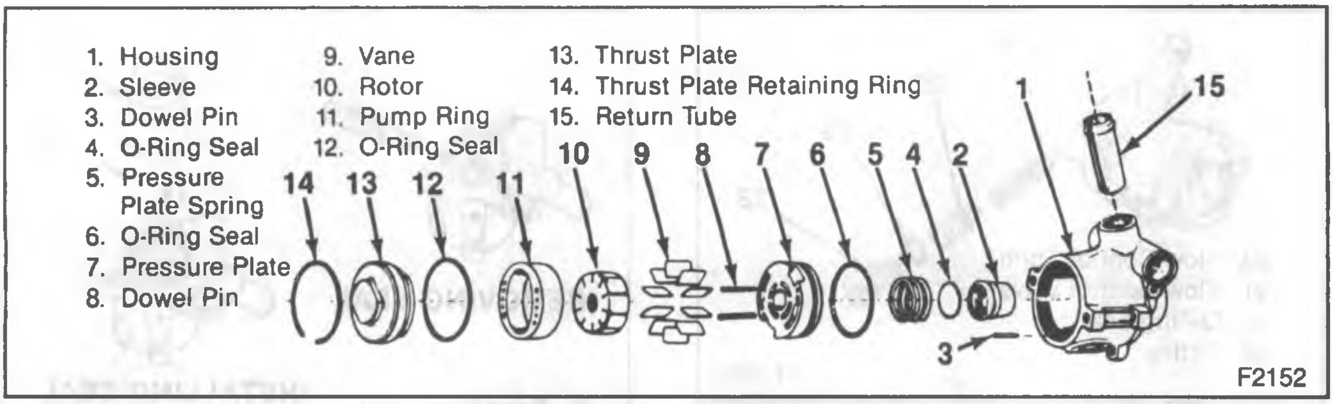


Figure 37—Pump Housing Components

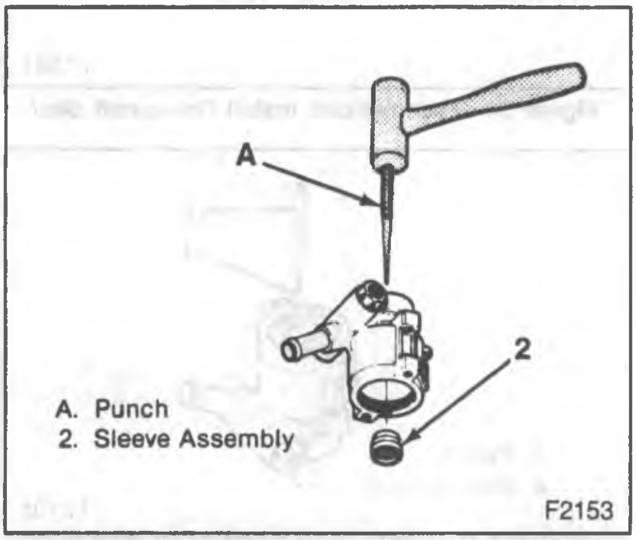


Figure 38—Removing the Sleeve Assembly

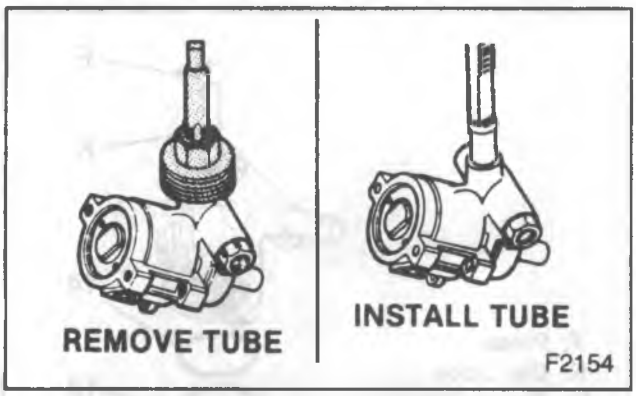


Figure 39—Remove and Install Return Tube

- — Rotor slots for burrs and excessive wear at the thrust faces.
- — Inner surface of the pump ring (11) for scoring or wear.
- — Thrust plate (13) and pressure plate (7) for wear on the plate surfaces.
- — If heavy wear is present, or parts are faulty, replace the entire rotating group.

2. Bearing (18). If the bearing is rough or loose, replace it.

— Seal (16)for leakage, cracking, or swelling. If so replace.

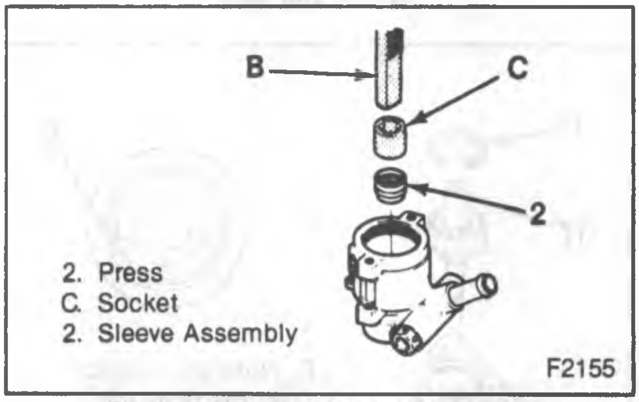


Figure 40—Install Sleeve Assembly

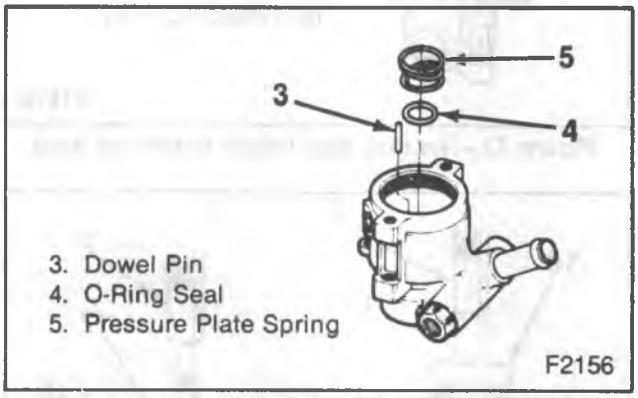


Figure 41—Installation of the Pin, Seal and Pressure Plate Spring

3. Driveshaft (17) for excessive burning or scoring.

— Bearing bore for excessive scoring or burning.

4. Control valve (15). It must move smoothly in the valve bore.

ASSEMBLY

Install or Connect (Figures 28, 39 through 45)

1. Return tube (15) (figure 39) or reservoir (24) (figure 28) depending on model.
2. Sleeve (2) (figure 40).
3. Dowel pin (3) (figure 41).
4. O-ring seal (4).
5. Pressure plate spring (5).

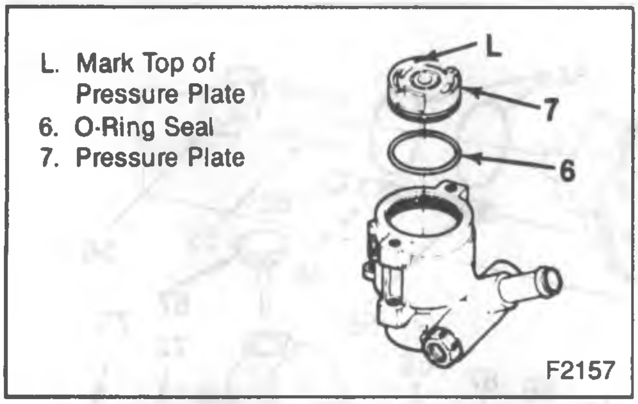


Figure 42—Installing of the Pressure Plate

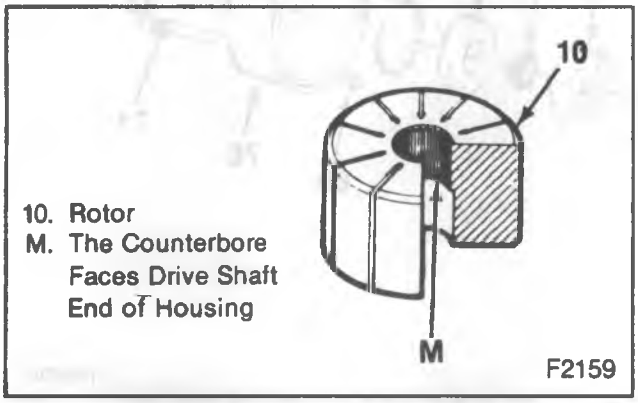


Figure 43—Installing the Rotor

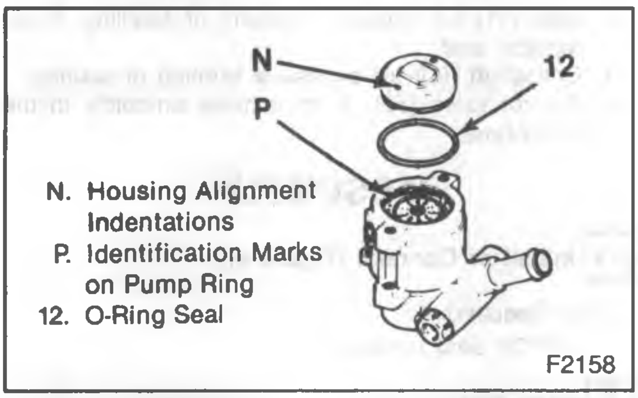


Figure 44—Aligning and Installing the Pump Ring

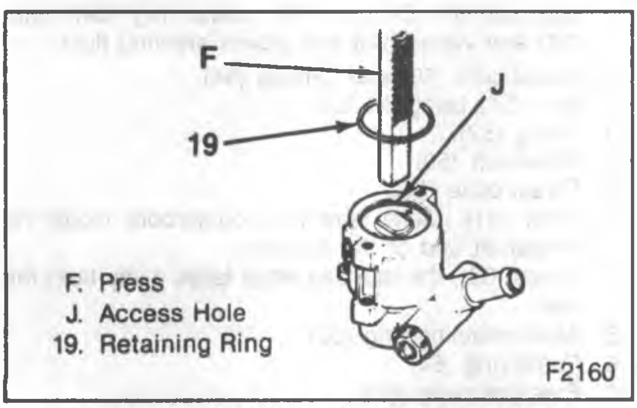


Figure 45—Installing the Retaining Ring

6. O-ring seal (6) (figure 42).
7. Pressure plate (7). Mark top of pressure plate directly over the pin hole in the plate.
8. Dowel pin (8).

Important

- Lubricate the O-ring (12), pump ring (11), rotor (10), and vanes (9) with power steering fluid.

9. Vane (9). The rounded edge of the vanes face away from the rotor.
10. Rotor (10). Make sure the counterbore faces the driveshaft end of the housing (figure 43).
11. Pump ring (11). Make sure the identification marks face up (figure 44).
12. O-ring seal (12).
13. Thrust plate (13).
    - The dimples in the thrust plate should line up with the bolt holes in the housing and that the thrust plate engages the pump ring dowel pins.
14. Retaining ring (14).
    - Use a press to compress the thrust plate (figure 45).
    - Opening of ring (14) centered with bolt hole nearest to access hole.
15. Driveshaft seal (16).
    - Use a suitable socket to press seal into housing until it bottoms (figure 34).
16. Bearing (18) onto the driveshaft (17) (figure 33).
    - Slide the assembly into the housing while rotating the driveshaft so that the shaft serrations engage with the rotor.
17. Retaining ring (19). Use a suitable pair of snap ring pliers (figure 32).
    - Make sure the beveled side of ring (19) is properly located.
18. Flow control spring (20).
19. Flow control valve (21).
20. O-ring seal (22).
21. O-ring (25).
22. Reservoir (24) (figure 30).
23. Clips (26) (figure 29).

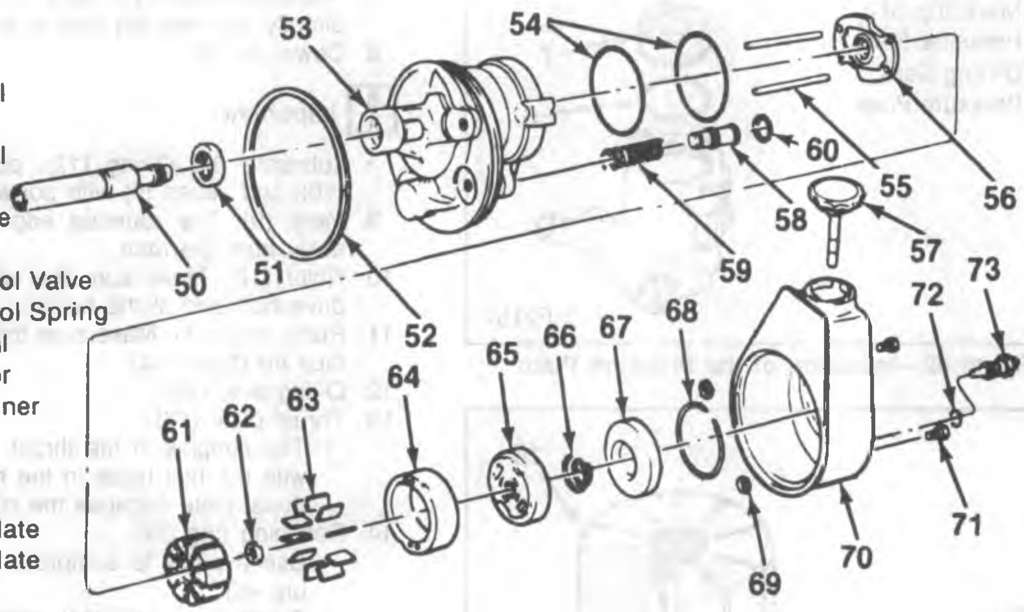
SAGINAW POWER STEERING PUMP—MODEL P

DISASSEMBLY

Remove or Disconnect (Figure 46)

- Clean the exterior of the pump with solvent and blow dry.

1. Bolt (71) and fitting (73).
2. Reservoir (70) and seals (69).
3. End plate retaining ring (68) using a screwdriver and punch.
4. End plate (67) and pressure plate spring (66).
5. O-ring (60).
6. Control valve (58).
7. Control valve spring (59).



50. Drive Shaft
51. Seal
52. O-Ring Seal
53. Housing
54. O-Ring Seal
55. Pin
56. Thrust Plate
57. Filler Cap
58. Flow Control Valve
59. Flow Control Spring
60. O-Ring Seal
61. Pump Rotor
62. Shaft Retainer Ring
63. Vane
64. Pump Ring
65. Pressure Plate
66. Pressure Plate Spring
67. Housing End Plate
68. End Plate Retaining Ring
69. Reservoir Seal
70. Reservoir Assembly
71. Bolt or Stud
72. Seal
73. Fitting

F6804

Figure 46—Power Steering Pump—Model P

8. Pressure plate (65). Tap lightly on the driveshaft with a rubber mallet.
9. Pump ring (64) and vanes (63).
10. Shaft retaining ring (62).
11. Pump rotor (61).
12. Thrust plate (56).
13. Driveshaft (50).
14. Seal (51) from the housing (53).
15. Dowel pins (55).
16. O-rings (54).
17. Seal (52).

CLEANING AND INSPECTION

Clean

- All parts with solvent and blow dry.

Inspect (Figure 46)

1. Rotating group components.
   — Vane (63) tips for scoring or wear.
   — Fit of vanes (63) in rotor (61) for sticking or excessive play.
   — Rotor slots for burrs and excessive wear at the thrust faces.
   — Inner surface of the pump ring (64) for scoring or wear.
   — Thrust plate (56) and pressure plate (65) for wear on plate surfaces.
   — If heavy wear is present, or parts are faulty, replace the entire rotating group.
2. Seal (51) for leakage, cracking or swelling. If so, replace seal.
3. Driveshaft (50) for excessive burning or scoring.
4. Control valve (58). It must move smoothly in the valve bore.

ASSEMBLY

Install or Connect (Figure 47)

Tool Required:

J-7728 Seal Installer

Important

- Lubricate the O-rings (54), pump ring (64), rotor (61) and vanes (63) with power steering fluid.

1. Dowel pins (55) and O-rings (54).
2. Seal (51) using J-7728.
3. O-ring (52).
4. Driveshaft (50)
5. Thrust plate (56).
6. Rotor (61). Make sure the counterbore faces the driveshaft end of the housing.
7. Vanes (63), the rounded edge faces away from the rotor.
8. Shaft retaining ring (62).
9. Pump ring (64).
10. Pressure plate (65).
11. O-ring (60).
12. Control valve spring (59).
13. Control valve (58).

14. Pressure plate spring (66).
15. End plate (67).
16. End plate retaining ring (68).
17. Seal (69).
18. Reservoir (70).
19. Bolt (71).
20. Fitting (73).

SPECIFICATIONS

FASTENER TORQUE

Integral Power Steering Gear

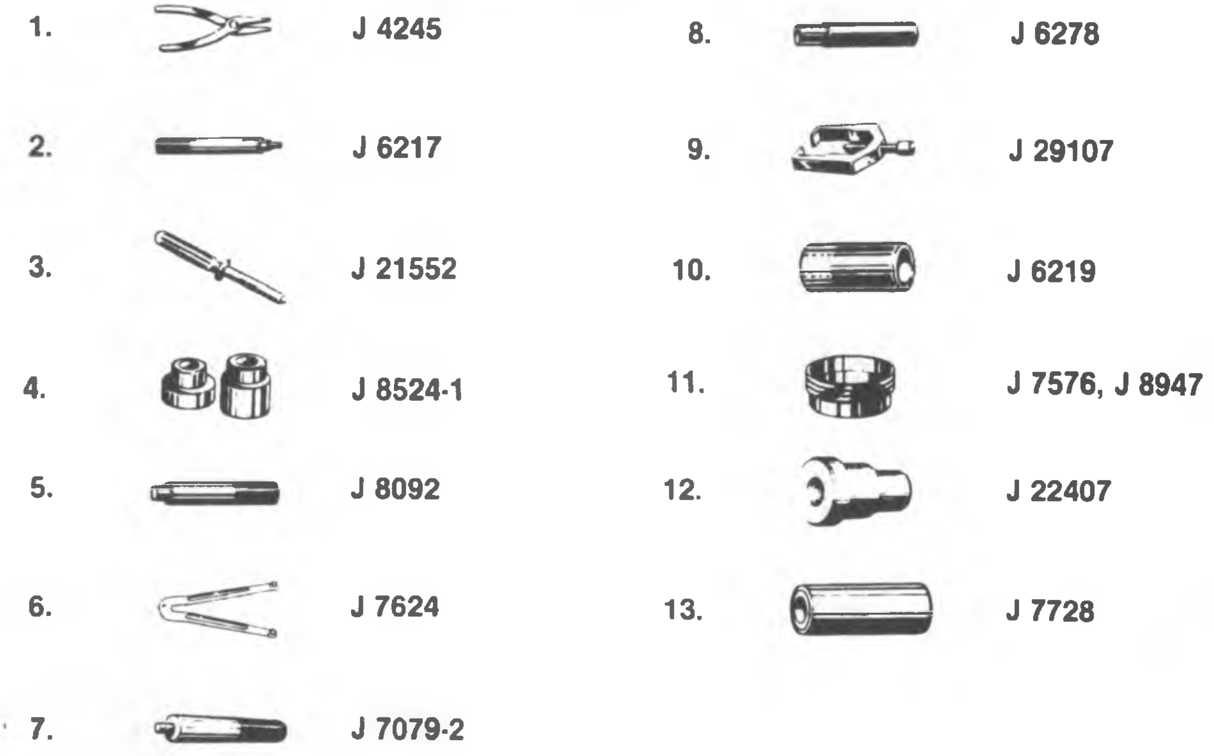
Pitman Shaft Over Center Preload	0.6-1.2 N·m (6-10 in. lbs.)
Pitman Shaft Preload Adjuster Screw Jam Nut	27 N·m (20 in. lbs.)
Side Cover Bolts	60 N·m (40 ft. lbs.)
Pitman Shaft Nut	244 N·m (180 ft. lbs.)
Ball Return Guide Screws	5 N·m (4 ft. lbs.)

Integral Power Steering Gear—CK (GMT 400)

Pitman Shaft Nut	250 N·m (180 ft. lbs.)
Side Cover Bolts	60 N·m (40 ft. lbs.)
Ball Return Guide Screws	5 N·m (4 ft. lbs.)
Pitman Shaft Preload Adjuster Screw Jam Nut	27 N·m (20 in. lbs.)

T2507

SPECIAL TOOLS



1. Snap Ring Pliers
2. Valve Connector Installer
3. Ball Retainer
4. Adjuster Plug Bearing Installer
5. Driver
6. Spanner Wrench
7. Driver
8. Pitman Shaft Bearing Puller
9. Puller (Formerly J 6632)
10. Seal Installer
11. Rack Piston Seal Compressor
12. Bearing Installer
13. Seal Installer

F5888

SECTION 4B

REAR AXLE

CONTENTS

SECTION 4B1

$7^1/_2$ AND $7^5/_8$-INCH RING GEAR AXLES

CONTENTS

DESCRIPTION

The corporate $7^1/_2$ and $7^5/_8$-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is semi-floating. The axle shafts are supported at the wheel end of the shaft by a roller bearing that is pressed into the housing. The shafts are retained into the housing by retaining clips within the differential. The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsable spacer between the bearings in the axle housing.

The ring gear is bolted onto the differential case with 10 left-hand thread bolts.

The differential case is supported in the axle housing by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims and spacers between the bearing and the axle housing. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. These shims are also used to preload the bearings which are pressed onto the differential case. Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a seal at each axle shaft end, and by a gasket between the rear cover and the axle housing.

All corporate rear axles are identified by the part number on the right axle tube near the carrier. The carrier cover does not have a drain plug.

CHECKING THE AXLE BEFORE DISASSEMBLY

Inspect

- Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. The ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing cage.

- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

Remove or Disconnect (Figure 1)

Tools Required:

J 8107-2 Differential Side Bearing Remover Plug
J 22888 Side Bearing Remover
J 8614-01 Pinion Flange Remover
J 25320 Rear Pinion Bearing Remover

- Place the rear axle in a suitable support.

1. The differential cover bolts (35) and the differential cover (34).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (2). Refer to the proper service manual.
3. Outer wheel bearings and seals. Refer to the proper service manual.
4. Pinion shaft lock screw (30).
5. Pinion shaft (29).
6. Differential pinion and side gears (26).
   - Roll the pinion gears out of the case with the pinion thrust washers (27).
   - Remove the side gears and the side gear thrust washers (28). Mark the gears and the differential case as left and right.
7. Differential bearing cap bolts (32).
8. Differential bearing caps (31).
   - Mark the caps and the housing as left and right.

NOTICE: Be careful when prying the differential case out of the axle housing so as not to damage the cover gasket surface. The differential case must be supported when it is being removed to prevent the case from falling and damaging the case.

9. Differential carrier (24).
   - Pry the case from the axle housing at the differential "window" (figure 2).
10. Bearing outer races (22), shims (21), and spacers (23).
    - Mark the races and the shims as left and right, and place them with the bearing caps.
11. Differential side bearings using J 8107-2 and J 22888 (figure 3).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage.
12. Ring gear bolts (25).
    - Ring gear bolts use left-handed threads.

NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

13. Ring gear (20) from the differential.
    - Drive the ring gear off with a brass drift if necessary.

Inspect

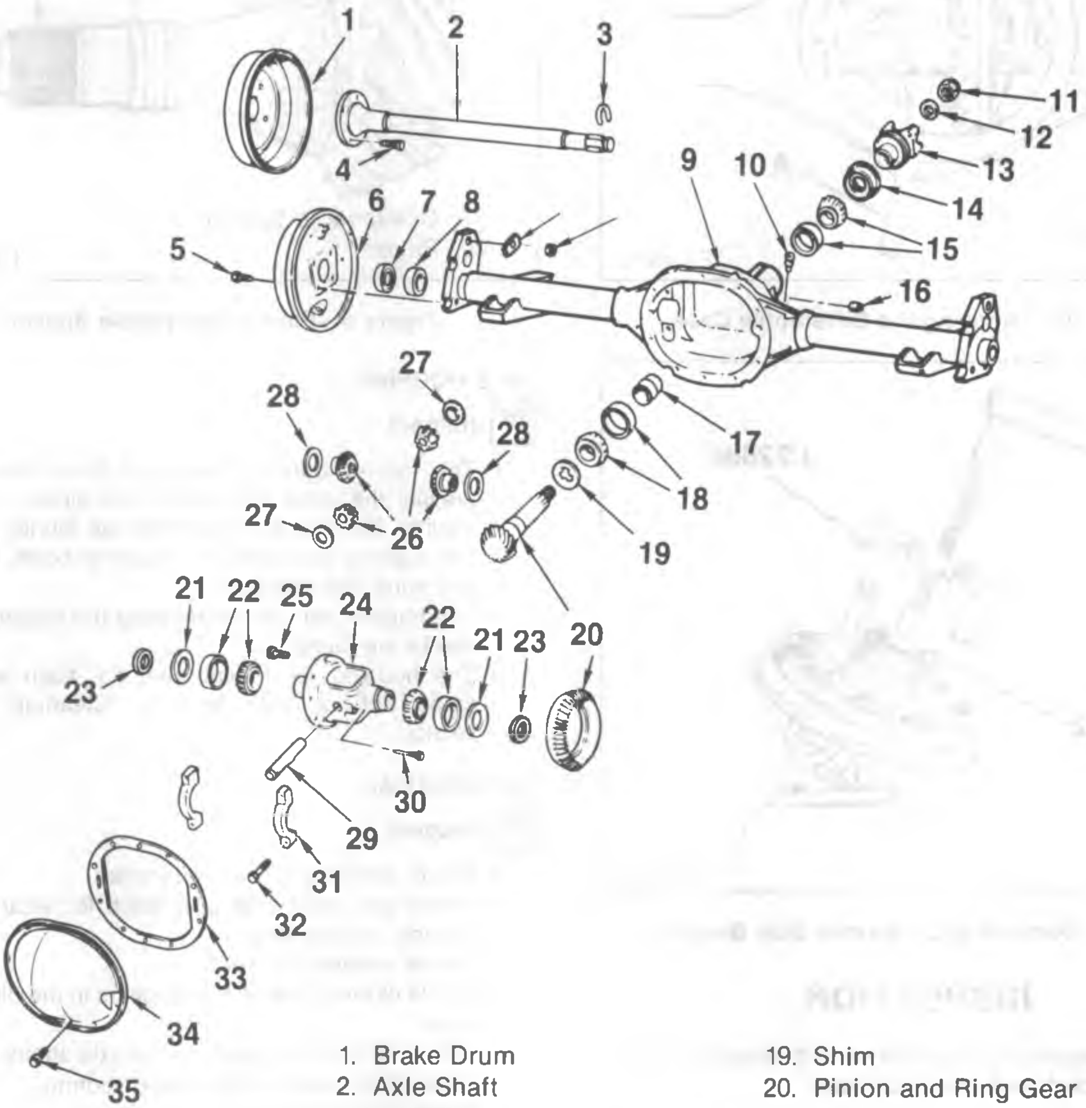
- Drive pinion bearing preload (figure 4).
- The pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear).

14. Pinion flange nut (11) and washer (12) using J 8614-01 to hold the pinion flange.
15. Pinion flange using J 8614-01.
16. Pinion (20) from the axle housing.
    - Thread the pinion nut halfway onto the pinion.
    - Replace the differential cover (34) with two bolts (35) to keep the pinion from falling to the floor.
    - Drive the pinion out of the housing with a hammer and a soft drift.
    - Remove the cover (34) and the pinion (20).
17. Collapsible spacer (17) from the pinion (figure 5).
18. Outer seal (14) and outer pinion bearing (15).
19. Inner bearing (18) and shim (19) from the pinion.
    - Press the bearing off the pinion using J 25320 (figure 6).
    - Remove the shim.
20. Bearing cups (15) and (18) from the axle housing using a hammer and a punch in the slots provided for this purpose.
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.



1. Brake Drum
2. Axle Shaft
3. "C" Lock
4. Wheel Stud
5. Backing Plate Bolt
6. Brake Assembly
7. Axle Shaft Oil Seal
8. Axle Shaft Bearing
9. Axle Housing
10. Axle Air Vent
11. Pinion Nut
12. Washer
13. Pinion Flange
14. Pinion Oil Seal
15. Pinion Outer Bearing
16. Plug
17. Collapsable Spacer
18. Pinion Inner Bearing
19. Shim
20. Pinion and Ring Gear Set
21. Shim
22. Differential Side Bearing
23. Spacer
24. Differential Case
25. Ring Gear Bolt
26. Differential Gears
27. Pinion Thrust Washers
28. Side Gear Thrust Washers
29. Pinion Shaft
30. Pinion Shaft Lock Bolt
31. Bearing Cap
32. Bolt
33. Gasket
34. Cover
35. Bolt

F-04673

Figure 1—Rear Axle Components

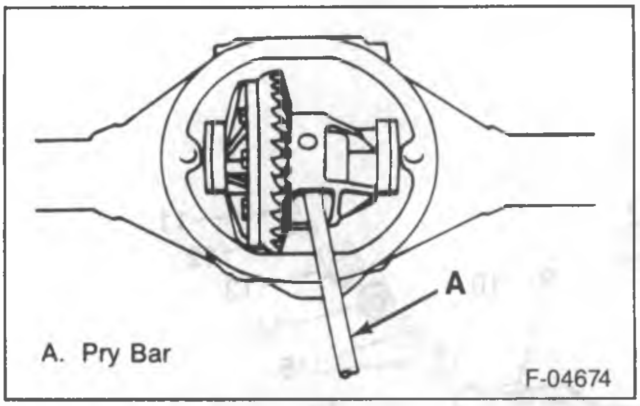


Figure 2—Removing the Differential Case

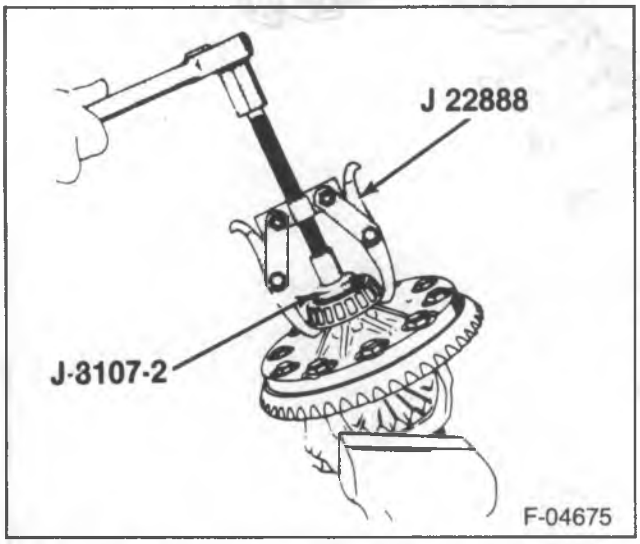


Figure 3—Removing Differential Side Bearings

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

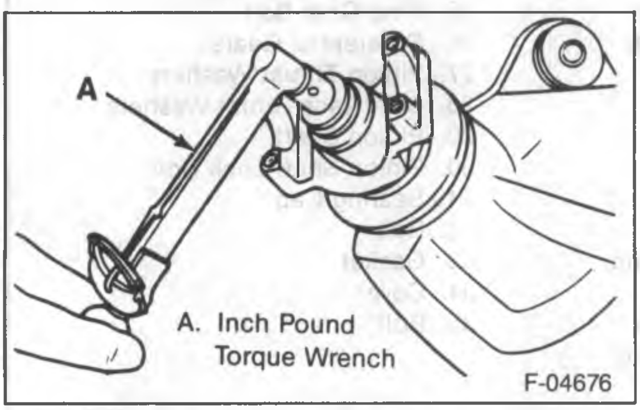


Figure 4—Checking Pinion Preload

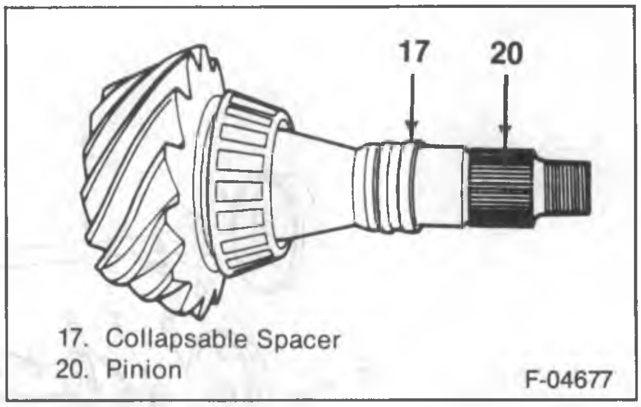


Figure 5—Pinion Collapsable Spacer

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

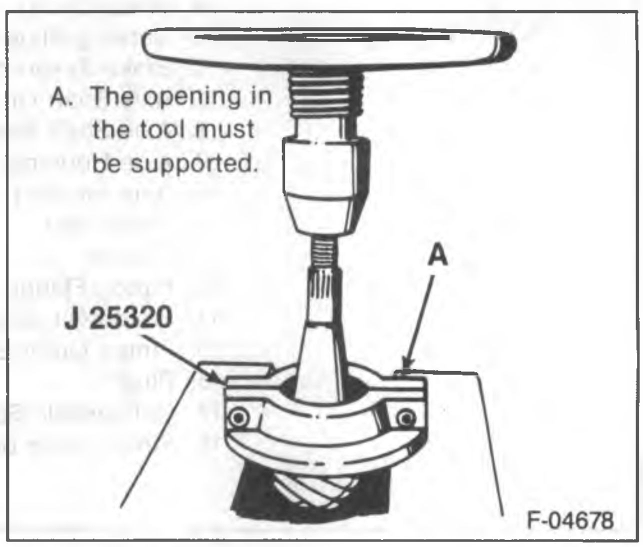


Figure 6—Removing the Pinion Rear Bearing

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial pre-load. Do not replace a bearing for this reason.
- Bearing cups for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

Install or Connect (Figures 1, 7 and 8)

Tools Required:
J 7817 Front Pinion Bearing Cup Installer
J 7818 Rear Pinion Bearing Cup Installer
J 8092 Driver Handle

- Pinion bearing cups (15) and (18) using J 7817, J 7818 and J 8092.

PINION DEPTH ADJUSTMENT (Figure 9)

Tools Required:
J 21777-40 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly — Bolt
J 21777-45 Side Bearing Discs
J 23597-1 Arbor
J 23597-11 Gage Plate
J 8001 Dial Indicator

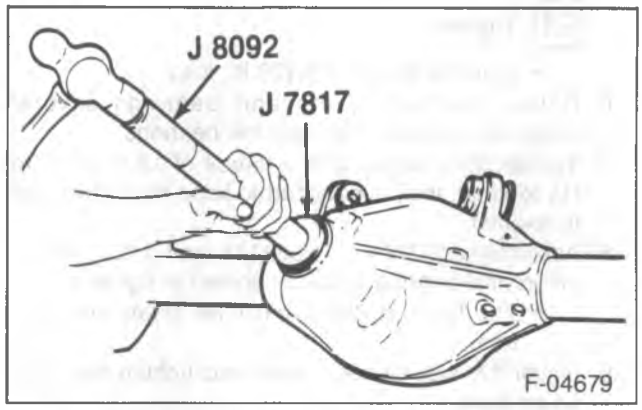


Figure 7—Installing the Front Pinion Bearing Cup

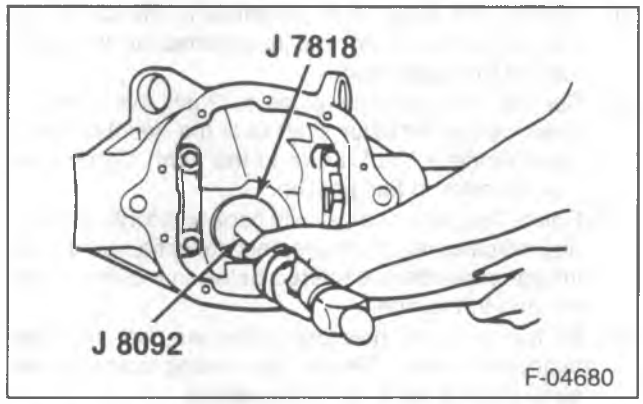


Figure 8—Installing the Rear Pinion Bearing Cup

1. Clean all the gage parts.
2. Lubricate the front and rear pinion bearings with axle lubricant.
3. Place the bearings (15) and (18) into the pinion bearing cups.
4. Install J 21777-40, J 21777-42, J 21777-43 and J 23597-11 to the pinion bore (figure 9).
5. Hold the stud stationary at the flats of the stud.

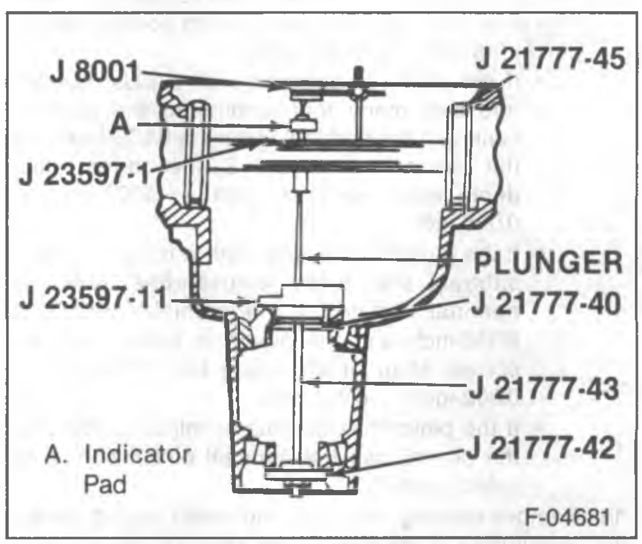


Figure 9—Pinion Depth Tools

Tighten

- Stud nut to 2.2 N·m (20 in. lbs.).

6. Rotate the gage plate and bearings several complete revolutions to seat the bearings.
7. Tighten the stud nut until a torque of 1.6 to 2.2 N·m (15 to 25 in. lbs.) is obtained to keep the gage plate in rotation.
8. Assembly J 21777-45, J 23597-11, and J 8001 to the differential bearing bores as shown in figure 9.
   - The bearing bores must be clean and burr free.
9. Install the side bearing caps and tighten the bolts finger tight.
10. Rotate the gage plate until the gaging areas are parallel with the disks.
11. Position the gage shaft assembly in the carrier so that the dial indicator rod is centered on the gage area of the gage block.
12. Set the dial indicator at zero. Push the indicator down on the indicator shaft until the needle rotates approximately ¾ of a turn to the right. Tighten the dial indicator in this postion.
13. Rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection (when the indicator needle is centered between moving to the left and to the right).
14. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the zero setting.
15. Rotate the gage shaft until the dial indicator rod does not touch the gage block.
16. Record the actual number on the dial indicator and not the number which represents how far the needle travels. This is the nominal pinion setting.
    EXAMPLE: If the indicator needle moved to the left 1.70 mm (0.067-inch) to a dial reading of 0.84 mm (0.033-inch) as shown in figure 10, record the dial reading of 0.84 mm (0.033-inch) not 1.70 mm (0.067-inch).
    The dial indicator should be in the 0.50 to the 1.27 mm (0.020 to 0.050-inch) range.
17. Check the pinion face for a pinion adjustment mark. This mark indicates the best running position for the pinion from the nominal setting.
    - If the pinion is stamped with a plus number, add that many thousandths to the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked +2, the correct shim depth would be 0.033-inch + 0.002-inch = 0.035-inch.
    - If the pinion is stamped with a minus number, subtract that many thousandths from the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked -2, the correct shim depth would be 0.033-inch − 0.002-inch = 0.031-inch.
    - If the pinion has no plus or minus marked on the pinion, use the nominal pinion setting to select a shim.
18. Remove bearing caps (31) and depth gaging tools.
19. Install the correct pinion shim (19) according to this procedure to the pinion.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tools Required:
J 25299 Differential Side Bearing Installer
J 8092 Driver Handle
J 8107-2 Differential Side Bearing Remover Plug

- Lubricate all parts with rear axle lubricant.

1. Side gear thrust washers (28) to the side gears (26).
2. Side gears (28) to the differential case (24).
   - Place the side gears in place on the same side as removed.
3. Pinion gears (28) to the differential without the thrust washers (27).
   - Place one pinion gear onto the side gears and rotate the gears until the pinion is exactly opposite from the differential opening.
   - Place the second pinion gear onto the side gears so that the pinion gear holes line up.
   - Rotate the pinion gears into place, and veryify that the pinion gears line up with the pinion shaft holes.
4. Pinion thrust washers (27).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
5. Pinion shaft.
6. Pinion shaft screw.

- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.

7. Ring gear (20) to the differential case (24) (figure 11).
   - Thread two left-hand threaded studs into the ring gear on opposite sides.
   - Place the ring gear onto the case, and align the studs with the holes in the case.
8. New ring gear bolts (25).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

   Tighten

   - The ring gear bolts in sequence to 120 N·m (90 ft. lbs.).
9. Differential side bearings (22) using J 25299, J 8092, and J 8107-2 (figure 12).
   - Place J 8107-2 into the differential on the side opposite of bearing installation to protect the differential case.
   - Drive the bearing onto the case using J 25299 and J 8092.
10. Differential case (24) to the axle housing. Refer to "Side Bearing Pre-Load Adjustment" in this section.

SIDE BEARING PRE-LOAD ADJUSTMENT

- The side bearing pre-load adjustment must be made before installing the pinion.
- The case side bearing pre-load is adjusted by changing the thickness of both the left and right shims equally. This will maintain the original backlash.

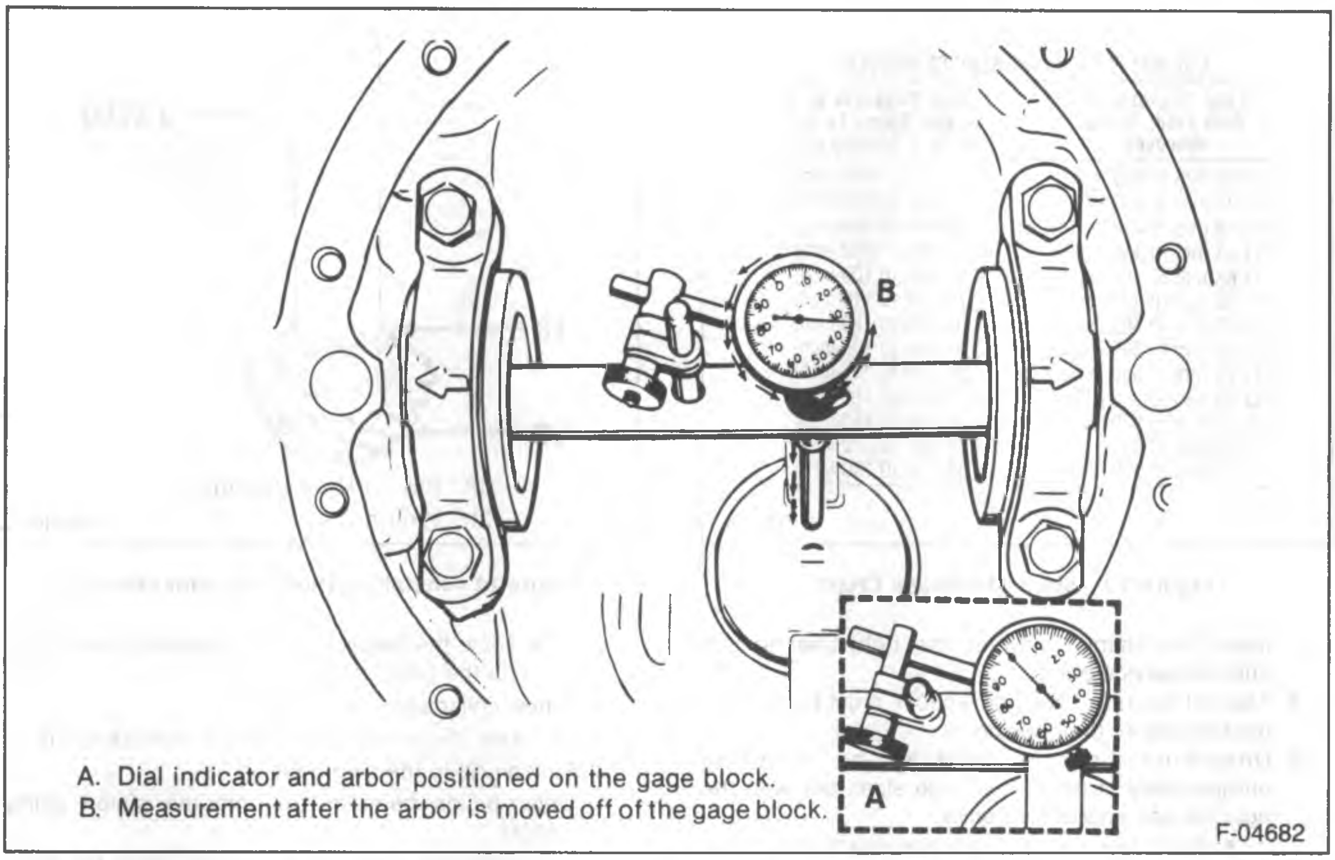


Figure 10—Checking Pinion Depth

- Production shims are cast iron and are not to be reused. Measure the production shims and spacers one at a time, and add the measurements together to obtain the sizes of the left and right shim packs.
- Service spacers are 4.32 to 4.37 mm (0.170 to 0.172-inch) thick.
- Service shims are available from 1.02 mm to 2.54 mm (0.040 to 0.100-inch) in increments of 0.101 mm (0.004-inch).
- Be sure that the side bearing surfaces are clean and free of burrs.

1. Place the case with the bearing cups installed into the axle housing (figure 1).
   - Lubricate the axle bearings with axle lubricant.
2. Insert the service spacer between the bearing cup and the axle housing. Place the chamfered edge against the housing.
3. Install the left bearing cap and bearing cap bolts. Do not tighten the bolts.
4. Select one or two shims totaling the amount needed as shown in figure 13.

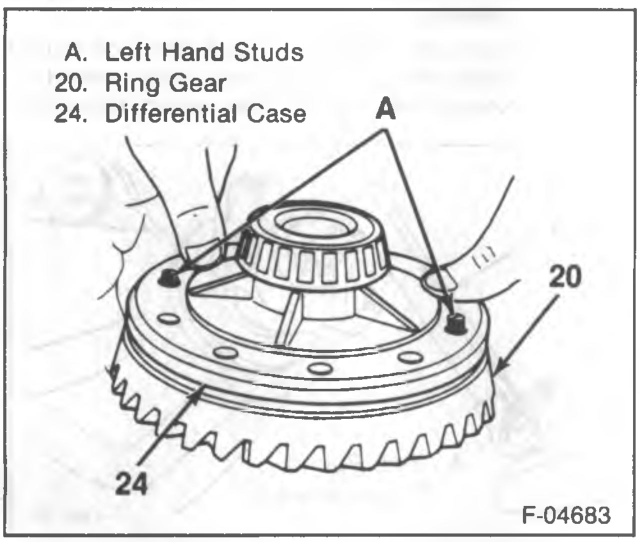


Figure 11—Aligning the Ring Gear Studs

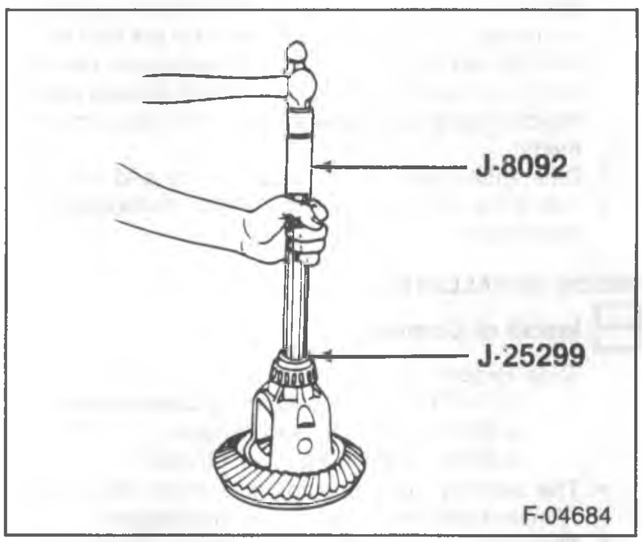


Figure 12—Installing the Side Bearing

4.32 MM (0.170-INCH) SERVICE SPACER

Total Thickness of Both Prod. Shims Removed	Total Thickness of Service Shims To Be Used As A Starting Point
10.57 mm (0.420-inch)	1.52 mm (0.060-inch)
10.92 mm (0.430-inch)	1.78 mm (0.070-inch)
11.18 mm (0.440-inch)	2.03 mm (0.080-inch)
11.43 mm (0.450-inch)	2.29 mm (0.090-inch)
11.68 mm (0.460-inch)	2.54 mm (0.100-inch)
11.94 mm (0.470-inch)	2.79 mm (0.110-inch)
12.19 mm (0.480-inch)	3.05 mm (0.120-inch)
12.45 mm (0.490-inch)	3.30 mm (0.130-inch)
12.70 mm (0.500-inch)	3.56 mm (0.140-inch)
12.95 mm (0.510-inch)	3.81 mm (0.150-inch)
13.21 mm (0.520-inch)	4.06 mm (0.160-inch)
13.46 mm (0.530-inch)	4.32 mm (0.170-inch)
13.97 mm (0.550-inch)	4.83 mm (0.190-inch)

F-04685

Figure 13—Shim Thickness Chart

5. Install the shim(s) between the right bearing cup and the service shim.
- The left bearing race and spacer must be against the left side of the housing.
6. Determine bearing pre-load by inserting progressively larger feeler gage sizes between the right service spacer and shim.
    - Push the feeler gage downward so that it contacts the shim at the top and bottom, and then contacts the axle housing.
    - Rotate the case while using the feeler gage. This will assure an accurate reading.
    - The weight of the case will cause a light drag. Do not mistake this drag for bearing preload.
    - Start with a thin feeler gage to obtain a feel for when preload begins. It will be necessary to work the case in or out and to the left in order to insert the feeler gage.
    - The point just before additional drag begins is the correct feeler gage thickness. This is the zero setting without pre-load.
7. Remove the left bearing cap and shim(s) from the axle housing. Measure the shims using a micrometer. The shim pack needed is the total of the shim(s) and the feeler gage. An additional pre-load of 0.10 mm (0.004-inch) will be added to each side of the differential case after the backlash adjustment is made.
8. Differential case, bearing cups, shims and spacers.
9. Install the pinion. Refer to "Pinion Installation" in this section.

PINION INSTALLATION

Install or Connect

Tools Required:
J 5590 Rear Pinion Bearing Cone Installer
J 23911 Pinion Oil Seal Installer
J 8614-01 Pinion Flange Remover

- The bearing cups should have been installed in "Pinion Depth Adjustment," in this section.
1. The pinion inner bearing (18) using J 5590 (figure 14).

Figure 14—Installing the Pinion Inner Bearing

- Drive the bearing until the bearing cone seats on the pinion shims.
2 A new collapsible spacer (17).
- Lubricate the pinion bearings with axle lubricant.
3. Pinion (20) to the axle housing.
4. Outer pinion bearing (15) onto the pinion using J 5590.
    - Hold the pinion forward from inside the case while driving the bearing onto the pinion.
5. Pinion oil seal (14) using J 23911.
6. The pinion flange (13) to the pinion by tapping it with a rawhide hammer until a few threads show through the pinion flange.
7. The pinion washer (12) and a new nut (11) while holding the pinion flange with J 8614-01.

Tighten

- The nut until the pinion end play is just taken up. Rotate the pinion while tightening the nut to seat the bearings. Once there is no end play in the pinion, the preload torque should be checked.
- Remove J 8614-01. Using an inch-pound torque wrench, check the pinion preload by rotating the pinion with the wrench (figure 15).

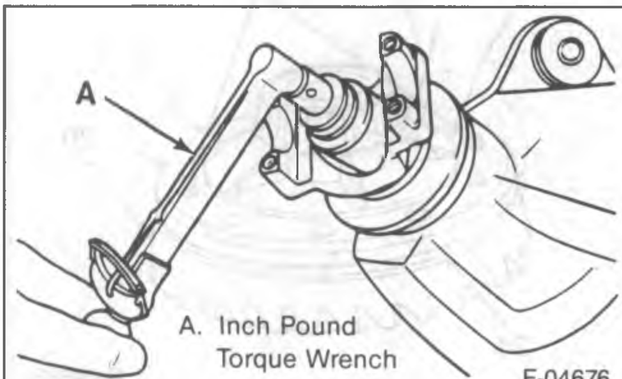


Figure 15—Checking Pinion Preload

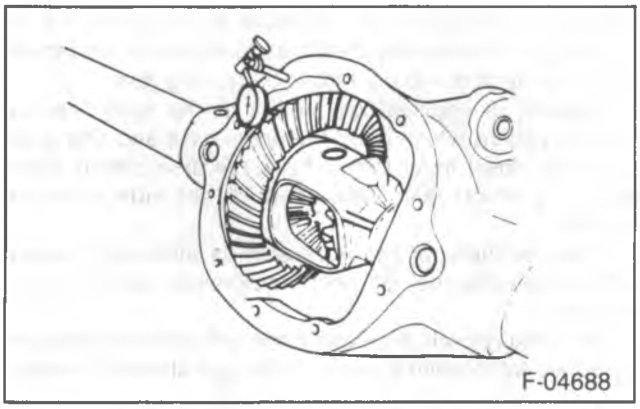


Figure 16—Checking Backlash

Preload should be at or below 2.7 to 3.6 N·m (24 to 32 in. lbs.) on new bearings, or 1.0 to 1.4 N·m (8 to 12 in. lbs.) for used bearings.

- If the preload torque is below the preloads given above, continue torquing the nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsable spacer installed.
- Once a preload of 2.7 to 3.6 N·m (24 to 32 in. lbs.) has been obtained, rotate the pinion several times to assure that the bearings have seated. Recheck the preload, and adjust if necessary.

8. Differential case. Refer to "Backlash Adjustment" in this section.

BACKLASH ADJUSTMENT

1. Install the differential case, bearing cups, spacers, and shims as determined from the "Side Bearing Preload Adjustment" earlier in this section.
2. Rotate the case several times to seat the bearings.
3. Install a dial indicator to the case using a magnetic base.
4. Place the indicator stem at the heel end of a tooth (figure 16).
   - Set the dial indicator so that the stem is in line with the gear rotation and perpendicular to the tooth angle.
5. Install the differential bearing caps (31) and bolts (32).

Tighten

- The bolts to 75 N·m (55 ft. lbs.).

6. Check and record the backlash at three or four points around the ring gear.
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, or uneven bolting conditions.
7. Backlash at the minimum lash point measured should be between 0.13 and 0.23 mm (0.005 and 0.009-inch) for all new gear sets.

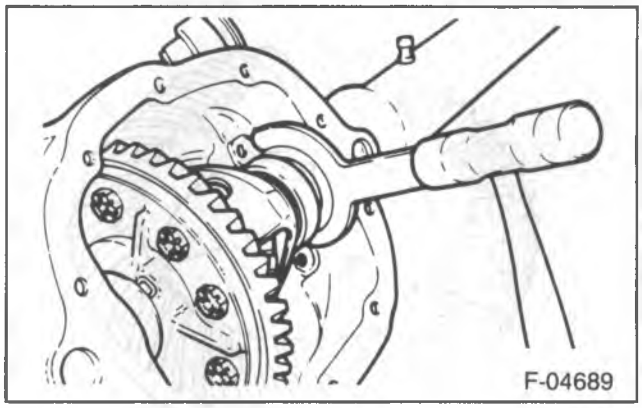


Figure 17—Installing the Differential Bearing Preload Shim

8. If the backlash is not within specifications, move the ring gear in or out from the pinion by increasing the thickness of one shim, and decreasing the thickness of the other shim by the same amount. This will maintain the correct rear axle side bearing preload.
   - Moving 0.05 mm (0.002-inch) worth of shim from one side of the differential to the other will change the backlash adjustment by 0.03 mm (0.001-inch).
9. When the backlash is correctly adjusted, remove the bearing caps and the shim packs.
10. Select a shim 0.10 mm (0.004-inch) thicker than the one removed from the left side. Insert this shim between the spacer and the left bearing race (figure 17).
11. Install the left bearing cap and bolts.
    - Do not tighten.
12. Select a shim 0.10 mm (0.004-inch) thicker than the one removed from the right side. Insert the shim between the spacer and the right bearing race, and drive the shim into place (figure 17).
13. Install the right side bearing cap, and bolts.

Tighten

- All bearing cap bolts to 75 N·m (55 ft. lbs.).

14. Recheck the backlash and correct as necessary.

FINAL ASSEMBLY

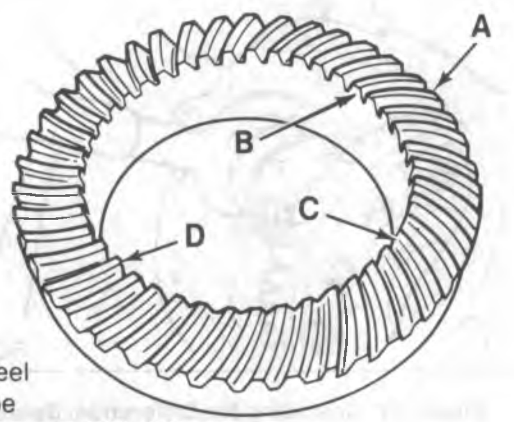
Install or Connect

1. Drive axles. Refer to the proper service manual.
2. A new cover gasket and the cover (34).

Tighten

- The cover bolts (35) to 27 N·m (20 ft. lbs.).

3. Axle housing to the vehicle. Refer to the proper service manual.
4. Lubricant to the rear axle.



A. Heel
B. Toe
C. Concave Side (Coast)
D. Convex Side (Drive)

F-02017

Figure 18—Gear Tooth Nomenclature

GEAR TOOTH PATTERN CHECK

Checking the ring gear to pinion tooth pattern is to be done only after setting up the axle according to the methods in this section. The pattern check is NEVER to be used as an initial check, or instead of checking pinion depth and backlash adjustments. This check is only to be used to verify the correct adjustment of the gear set after setup.

1. Wipe all oil out of the carrier, and carefully clean each tooth of the ring gear (figure 18).
2. Use gear marking compound 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium-stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten the bearing cap bolts to the specified torque.
4. Expand the brake shoes until a torque of 40 to 50 ft. lbs. is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the pinion flange with a wrench so that the ring gear rotates one full revolution, then reverse the rotation so that the ring gear rotates one revolution in the opposite direction.
5. Observe the pattern on the ring gear teeth and compare this with figure 19.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect tooth contact pattern: backlash, and the position of the drive pinion in the carrier. The effects of bearing preloads are not readily apparent on hand loaded tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

The position of the drive pinion is adjusted by increasing or decreasing the distance between the pinion head and the centerline of the ring gear. Decreasing the distance will move the pinion closer to the centerline of the ring gear. Increasing the distance will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which move the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload).

If the thickness of the right shim is increased (along with decreasing the left shim thickness), backlash will increase.

The backlash will decrease if the left shim thickness is increased (along with a decrease in right shim thickness).

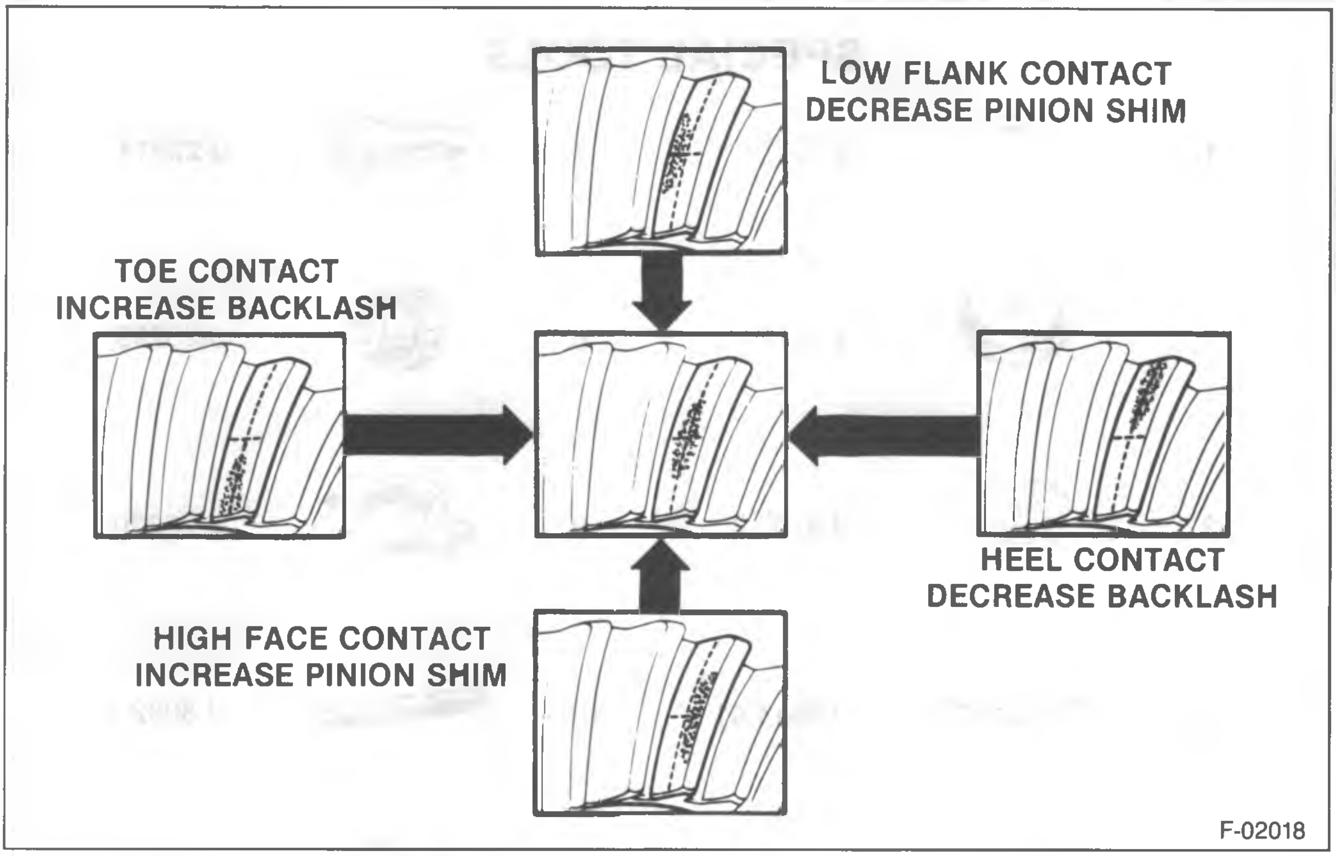


Figure 19—Gear Tooth Pattern

SPECIFICATIONS

$7^1/_2$ AND $7^5/_8$-INCH RING GEAR AXLE

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	120	90
Bearing Cap Bolts	75	55
Axle Cover Bolts	27	20

SPACER AND SHIM SIZES	SIZE
Differential Side Bearing Spacer	0.170-inch
Differential Side Bearing Shim Kits	0.040-0.044-inch
	0.046-0.050-inch
	0.052-0.056-inch
	0.058-0.062-inch
	0.064-0.070-inch
	0.072-0.078-inch
	0.080-0.086-inch
	0.088-0.094-inch
	0.096-0.100-inch
Pinion Bearing Shim Kits	0.025-0.029-inch
	0.030-0.034-inch
	0.035-0.039-inch
	0.040-0.045-inch
Lubricant	80W-90 GL-5

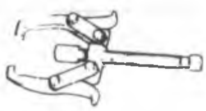
SPECIAL TOOLS

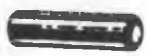
1.  J 7817

2.  J 7818

3.  J 8107-2

4.  J 8614-01

5.  J 22888

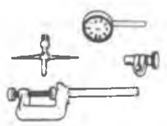
6.  J 5590

7.  J-23911

8.  J-25299

9.  J 25320

10.  J 8092

11.  J-8001

1. Front Pinion Bearing Cup Installer
2. Rear Pinion Bearing Cup Installer
3. Differential Side Bearing Remover Plug
4. Pinion Flange Remover
5. Side Bearing Remover
6. Rear Pinion Bearing Cone Installer
7. Pinion Oil Seal Installer
8. Differential Side Bearing Installer
9. Rear Pinion Bearing Remover
10. Driver Handle
11. Dial Indicator

Refer to Figure 9 for these tools:

J 21777-40 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly—Bolt
J 21777-45 Side Bearing Discs
J 23597-1 Arbor
J 23597-11 Gauge Plate

F-04794

SECTION 4B2

8½-INCH RING GEAR

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

The corporate 8½-inch ring gear rear axle uses a conventional ring gear and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is semi-floating. The axle shafts are supported at the wheel end of the shaft by a roller bearing that is pressed into the housing. The shafts are retained into the housing by retaining clips within the differential. The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsable spacer between the bearings in the axle housing.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the axle housing by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearing and the axle housing. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. These shims are also used to preload the bearings which are pressed onto the differential case. Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a seal at each axle shaft end, and by a gasket between the rear cover and the axle housing.

All corporate rear axles are identified by the part number on the right axle tube near the carrier. The carrier cover does not have a drain plug.

CHECKING THE AXLE BEFORE DISASSEMBLY

Inspect

- Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. The ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing cage.

- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

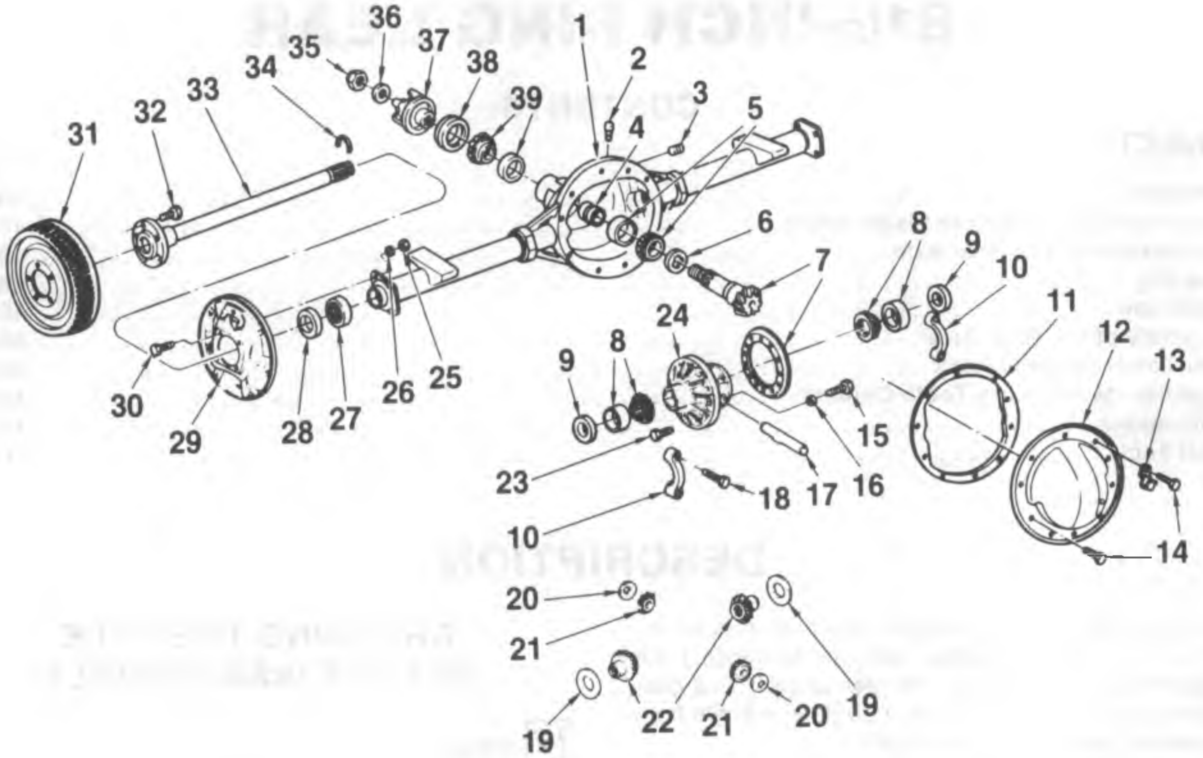
Remove or Disconnect (Figure 1)

Tools Required:

J 8107-4 Differential Side Bearing Remover Plug
J 22888 Side Bearing Remover
J 8614-01 Pinion Flange Remover
J 8612-B Rear Pinion Bearing Cone Remover

- Place the rear axle in a suitable support.

1. The differential cover bolts (14) and the differential cover (12).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (33). Refer to the proper service manual.
3. Rear axle seal (28) and bearing (27). Refer to the proper service manual.



1. Axle Housing
2. Air Vent
3. Plug
4. Collapsable Spacer
5. Inner Pinion Bearing
6. Shim
7. Ring and Pinion Gear Set
8. Differential Side Bearing
9. Shim Pack (including spacer)
10. Bearing Cap
11. Gasket
12. Cover
13. Brake Line Clip
14. Bolt
15. Pinion Shaft Lock Screw
16. Washer
17. Pinion Shaft
18. Bolt
19. Side Gear Thrust Washer
20. Pinion Thrust Washer
21. Pinion Gear
22. Side Gear
23. Ring Gear Bolt
24. Differential Case
25. Nut
26. Washer
27. Axle Shaft Bearing
28. Axle Shaft Seal
29. Brake Backing Plate
30. Bolt
31. Brake Drum
32. Wheel Stud
33. Axle Shaft
34. "C" Clip
35. Pinion Nut
36. Washer
37. Pinion Flange
38. Pinion Seal
39. Outer Pinion Bearing

F-04687

Figure 1—Rear Axle Components

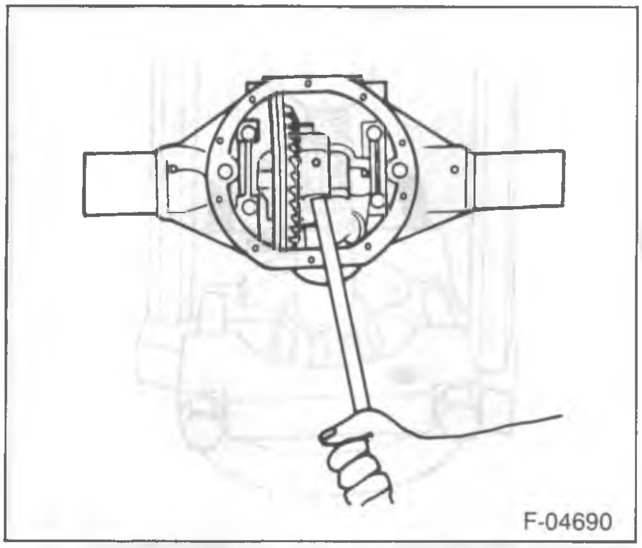


Figure 2—Prying the Differential Case

- Refer to "Checking the Axle Before Disassembly" in this section.

4. Pinion shaft lock screw (15).
5. Pinion shaft (17).
6. Differential pinion (21) and side gears (22).
   - Roll the pinion gears out of the case with the pinion thrust washers (20).
   - Remove the side gears and the side gear thrust washers (19). Mark the gears and the differential case as left and right.
7. Differential bearing cap bolts (18).
8. Differential bearing caps (10).
   - Mark the caps and the housing as left and right.

NOTICE: Be careful when prying the differential case out of the axle housing so as not to damage the cover gasket surface. The differential case must be supported when it is being removed to prevent the case from falling and damaging the case.

9. Differential carrier (24).
   - Pry the case from the axle housing at the differential "window" (figure 2).
10. Bearing outer races (8) and shims (9).
    - Mark the races and the shims as left and right, and place them with the bearing caps.
11. Differential side bearings (8) using J 8107-4 and J 22888 (figure 3).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage. Use the slots provided for the puller.
12. Ring gear bolts (23).
    - Ring gear bolts use left-handed threads.

NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

13. Ring gear (7) from the differential case.
    - Drive the ring gear off with a brass drift if necessary.

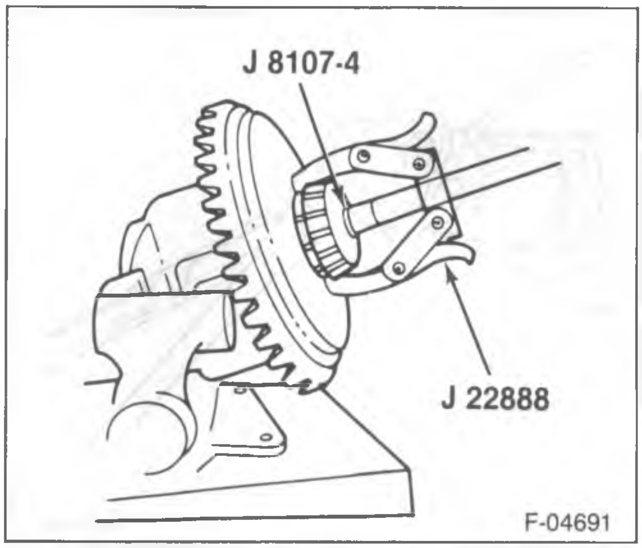


Figure 3—Removing Differential Side Bearing

Inspect

- Drive pinion bearing preload (figure 4).
- For looseness of pinion assembly by moving it back and forth. (This indicates excessive bearing wear).

14. Pinion flange nut (35) and washer (36) using J 8614-01 to hold the pinion flange (figure 5).
15. Pinion flange using J 8614-01 (figure 6).
16. Pinion (7) from the axle housing.
    - Thread the pinion nut halfway onto the pinion.
    - Replace the differential cover (12) with two bolts (14) to keep the pinion from falling to the floor.
    - Drive the pinion out of the housing with a hammer and a soft drift (figure 7).
17. Collapsable spacer (4) from the pinion.
18. Outer pinion seal (38) and bearing (39).
19. Inner bearing (5) and shim (6) from the pinion.
    - Press the bearing off the pinion using J 8612-B (figure 8).
    - Remove the shim.

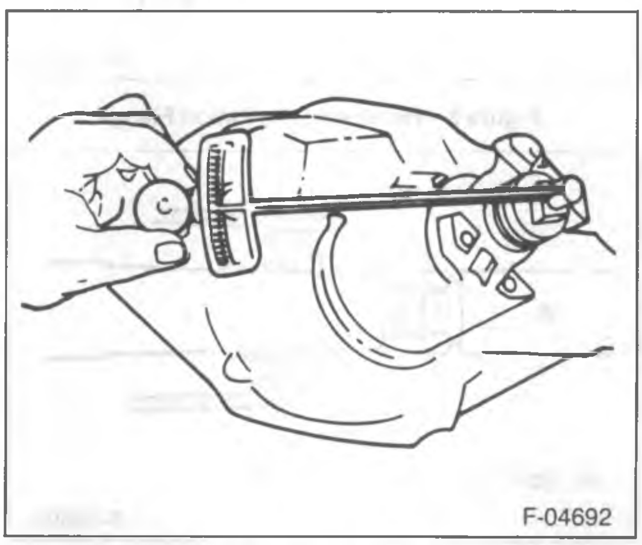


Figure 4—Checking Pinion Preload

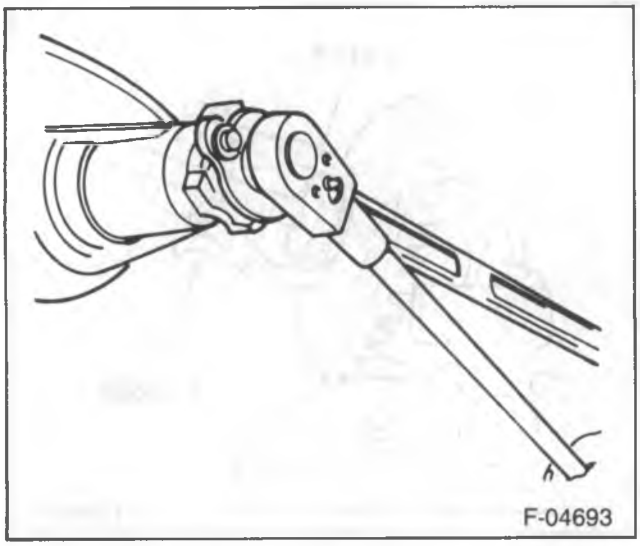


Figure 5—Removing the Drive Pinion Nut

20. Bearing cups (5) and (39) from the axle housing using a hammer and a punch.
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other. Use the slots provided for this purpose.

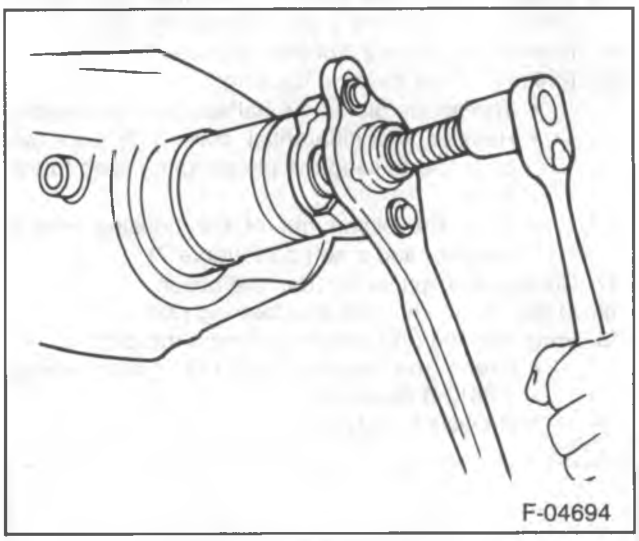


Figure 6—Removing the Pinion Flange

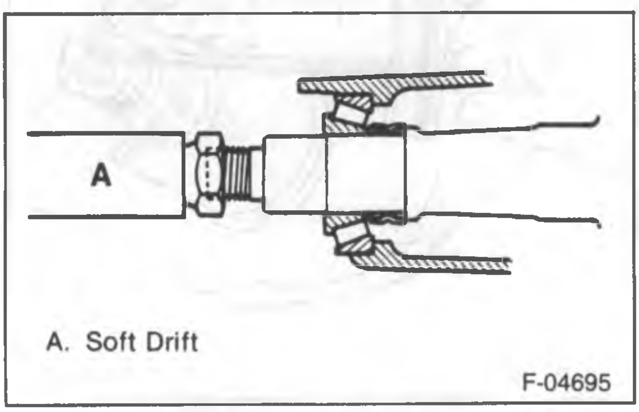


Figure 7—Removing the Drive Pinion

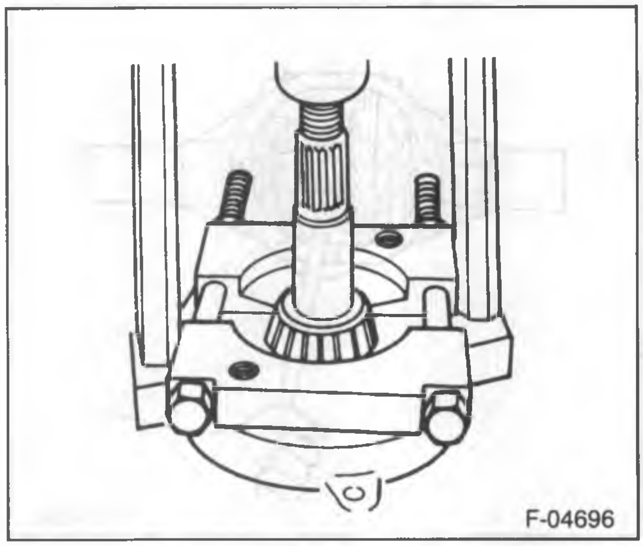


Figure 8—Removing the Pinion Rear Bearing

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.

- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

Install or Connect

Tools Required:

J 8608 Rear Pinion Bearing Cup Installer
J 8611-01 Front Pinion Bearing Cup Installer
J 8092 Driver Handle

1. Front pinion bearing cup (39) using J 8611-01 and J 8092 (figure 9).
2. Rear pinion bearing cup (5) using J 8608 and J 8092 (figure 10).

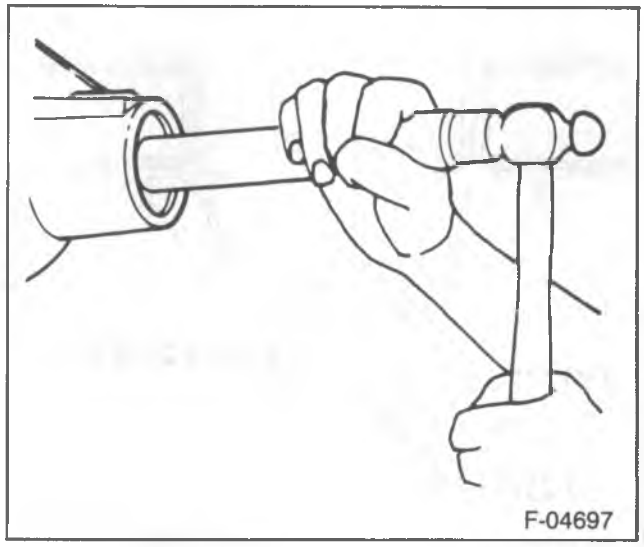


Figure 9—Installing the Front Pinion Bearing Cup

PINION DEPTH ADJUSTMENT

Tools Required:

J 8001 Dial Indicator Gage Set
J 21777-1 Arbor
J 21777-29 Gage Plate
J 21777-35 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly — Bolt
J 21777-45 Side Bearing Disc

1. Clean all the gage parts.
2. Lubricate the front and rear pinion bearings with axle lubricant.
3. Place the bearings (39) and (5) into the pinion bearing cups.
4. Install J 21777-35, J 21777-42, J 21777-29 and J 21777-43 to the pinion bore (figure 11).
5. Hold the stud stationary at the flats of the stud.

   Tighten

   - Stud nut to 2.2 N·m (20 in. lbs.).
6. Rotate the gage plate and bearings several complete revolutions to seat the bearings.

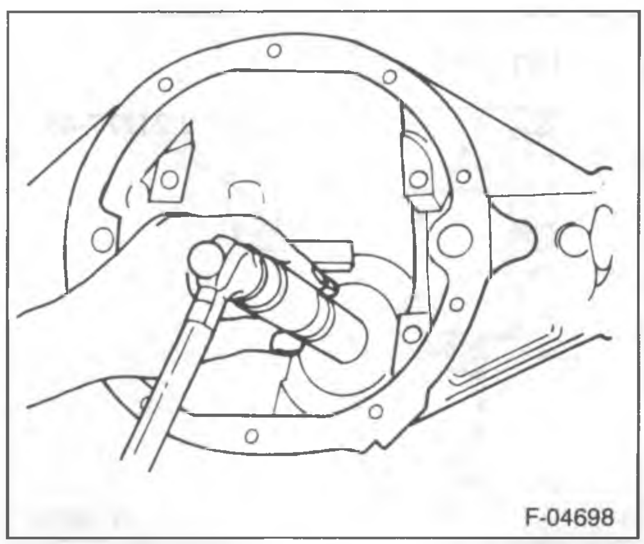


Figure 10—Installing the Rear Pinion Bearing Cup

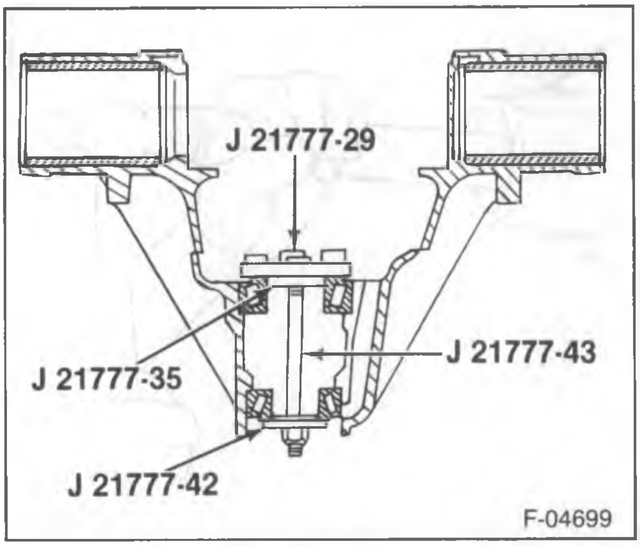


Figure 11—Gage Plate Tools

7. Tighten the stud nut until a torque of 1.6 to 2.2 N·m (15 to 25 in. lbs.) is obtained to keep the gage plate in rotation.
8. Assemble J 21777-45, J 21777-1 Arbor, and J 8001 to the differential bearing bore as shown in figure 12.
   - The bearing bores must be clean and burr free.
9. Install the side bearing caps, and tighten the bolts finger tight.
10. Rotate the gage plate until the proper gaging area is parallel with the disks.
11. Position the gage shaft assembly in the carrier so that the dial indicator rod is centered on the gage area of the gage block.
12. Set the dial indicator at zero. Push the indicator down on the indicator shaft until the needle rotates approximately ¾ of a turn to the right. Tighten the dial indicator in this postion.
13. Rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection (when the indicator needle is centered between movement to the left and to the right).

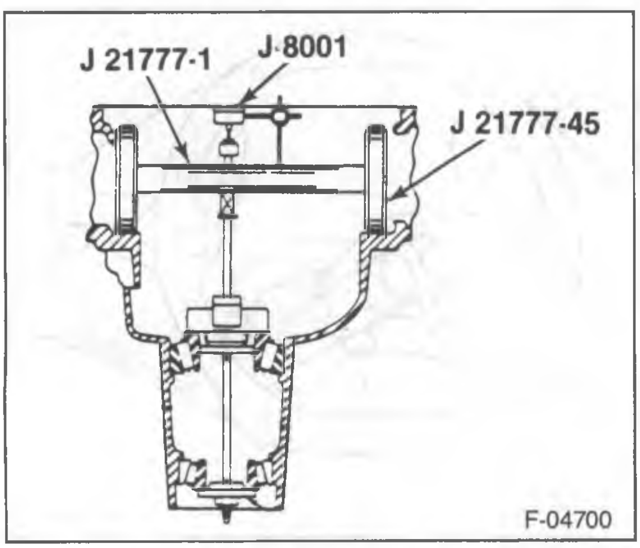


Figure 12—Pinion Depth Tools

14. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the zero setting.
15. Rotate the gage shaft until the dial indicator rod does not touch the gage block.
16. Record the actual number on the dial indicator and not the number which represents how far the needle travels. This is the nominal pinion setting.

    EXAMPLE: If the indicator needle moved to the left 1.70 mm (0.067-inch) to a dial reading of 0.84 mm (0.033-inch) as shown in figure 13, record the dial reading of 0.84 mm (0.033-inch) not 1.70 mm (0.067-inch).
17. Check the pinion face for a pinion adjustment mark. This mark indicates the best running position for the pinion from the nominal setting.
   - If the pinion is stamped with a plus number, add that many thousandths to the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked +2, the correct shim depth would be 0.033-inch + 0.002-inch = 0.035-inch.
   - If the pinion is stamped with a minus number, subtract that many thousandths from the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked -2, the correct shim depth would be 0.033-inch – 0.002-inch = 0.031-inch.
   - If the pinion has no plus or minus marked on the pinion, use the nominal pinion setting to select a shim.
18. Remove bearing caps (10) and depth gaging tools.
19. Install the correct pinion shim (6) to the pinion according to this procedure.

PINION INSTALLATION

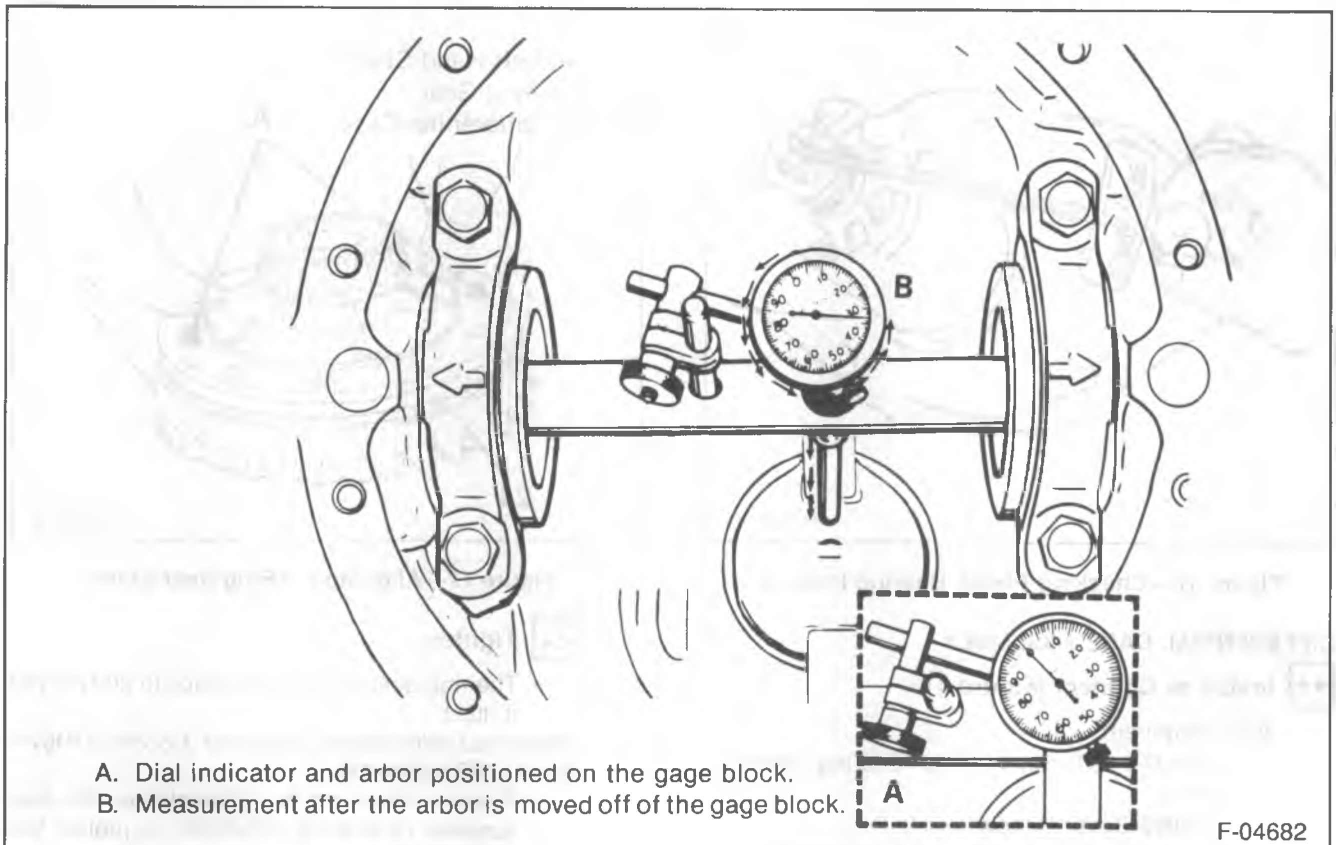
Install or Connect

Tools Required:

J 8809-01 Rear Pinion Bearing Cone Installer
J 22388 Pinion Oil Seal Installer
J 8614-01 Pinion Flange Remover
J 5590 Rear Pinion Bearing Cone Installer

- The bearing cups should have been installed in "Pinion Depth Adjustment" in this section.

1. The pinion inner bearing (5) using J 8609-01.
   - Press the bearing onto the pinion until the bearing cone seats on the pinion shims.
2. A new collapsable spacer (4).
   - Lubricate the pinion bearings with axle lubricant.
3. Pinion (7) to the axle housing.
4. Outer pinion bearing (39) onto the pinion using J 5590.
   - Hold the pinion forward from inside the case while driving the bearing onto the pinion.
5. Pinion oil seal (38) using J 22388 (figure 14).
6. Pinion flange (37) to the pinion by tapping it with a rawhide hammer until a few threads show through the pinion flange.
7. Pinion washer (36) and a new nut (35) while holding the pinion flange with J 8614-01 (figure 15).



A. Dial indicator and arbor positioned on the gage block.
B. Measurement after the arbor is moved off of the gage block.

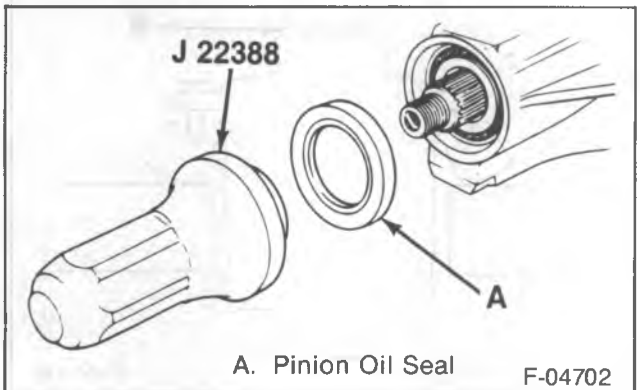
F-04682

Figure 13—Checking Pinion Depth

Tighten

- The nut until the pinion end play is just taken up. Rotate the pinion while tightening the nut to seat the bearings. Once there is no end play in the pinion, the preload torque should be rechecked.
- Remove J 8614-01. Using an inch-pound torque wrench, check the pinion preload by rotating the pinion with the wrench. Preload should be at or below 2.3 to 2.8 N·m (20 to 25 in. lbs.) on new bearings, or 1.1 to 1.7 N·m (10 to 15 in. lbs.) for used bearings (figure 16).
- If the preload torque is below the preloads given above, continue torquing the nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
- Once the preload has been obtained, rotate the pinion several times to assure that the bearings have seated. Recheck the preload, and adjust if necessary.

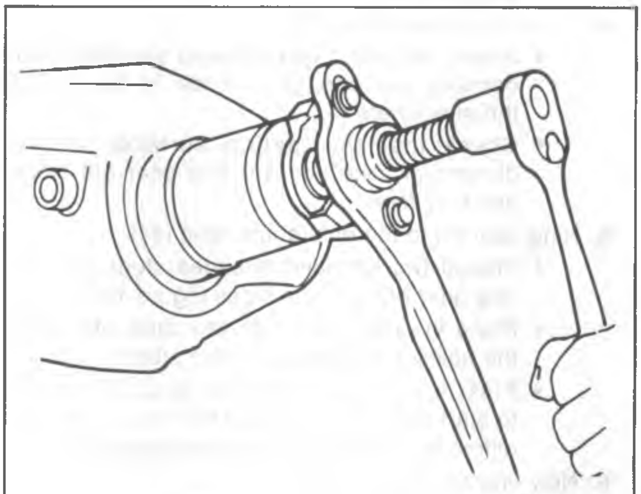
8. Differential case. Refer to "Backlash Adjustment" in this section.



A. Pinion Oil Seal

F-04702

Figure 14—Installing the Pinion Oil Seal



F-04694

Figure 15—Installing the Pinion Flange

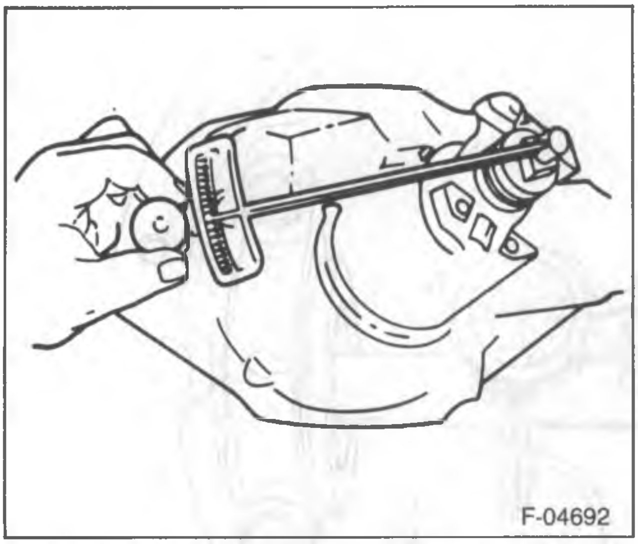


Figure 16—Checking Pinion Bearing Preload

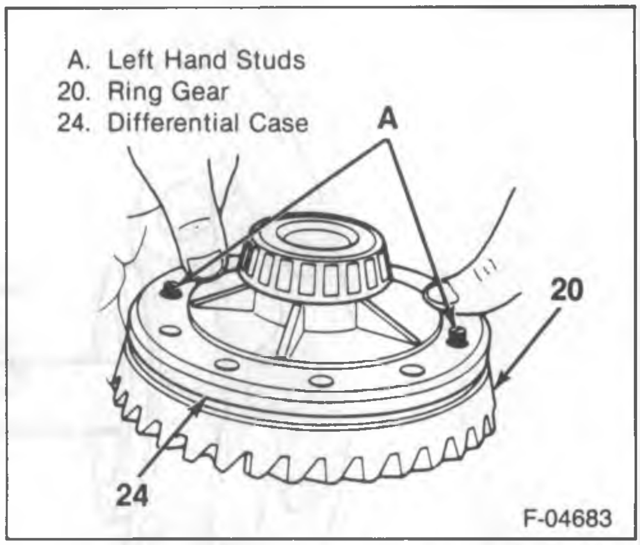


Figure 17—Aligning the Ring Gear Studs

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tools Required:

J 8107-4 Differential Side Bearing Remover Plug

J 8092 Driver Handle

J 22761 Differential Side Bearing Installer

- Lubricate all parts with rear axle lubricant.

1. Side gear thrust washers (19) to the side gears (22).
2. Side gears (22) to the differential case (24).
   - Place the side gears in place on the same side as removed.
3. Pinion gears (21) to the differential without the thrust washers (20).
   - Place one pinion gear onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
4. Pinion thrust washers (20).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
   - Check that the mating surfaces of the differential case and the ring gear are clean and burr free.
5. Ring gear (7) to the differential case (24).
   - Thread two left-hand threaded studs into the ring gear on opposite sides (figure 17).
   - Place the ring gear onto the case, and align the holes in the case with the studs.
   - Press the ring gear onto the case far enough to start the bolts using J 8107-4 to protect the differential from the press ram (figure 18).
6. New ring gear bolts (23).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

- The ring gear bolts in sequence to 80 N·m (60 ft. lbs.).

7. Differential side bearings (8) using J 22761, J 8107-4 and J 8092 (figure 19).
   - Place J 8107-4 into the differential on the side opposite of bearing installation to protect the differential case.
   - Drive the bearing onto the case using J 22761 and J 8092.
8. Differential case (24) to the axle housing. Refer to "Side Bearing Preload Adjustment" in this section.

SIDE BEARING PRE-LOAD ADJUSTMENT

- The differential side bearing preload is adjusted by changing the thickness of both the left and right shims equally. This will maintain the original backlash.
- Production shims are cast iron and are not to be reused.
- Service spacers are 0.170 to 0.172-inch thick.

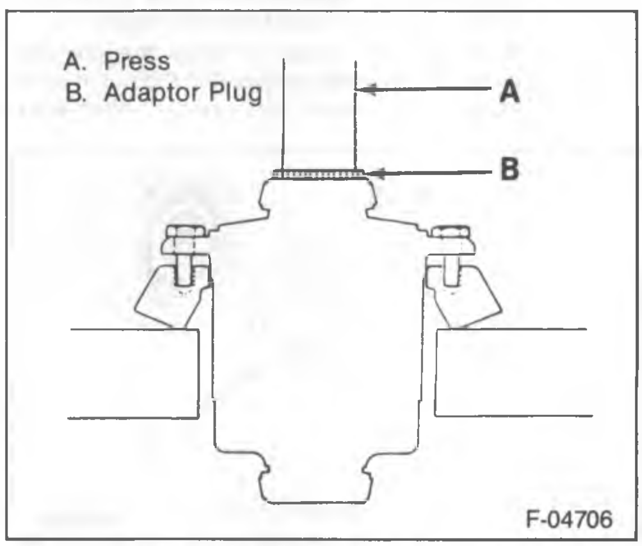


Figure 18—Installing the Ring Gear to the Case

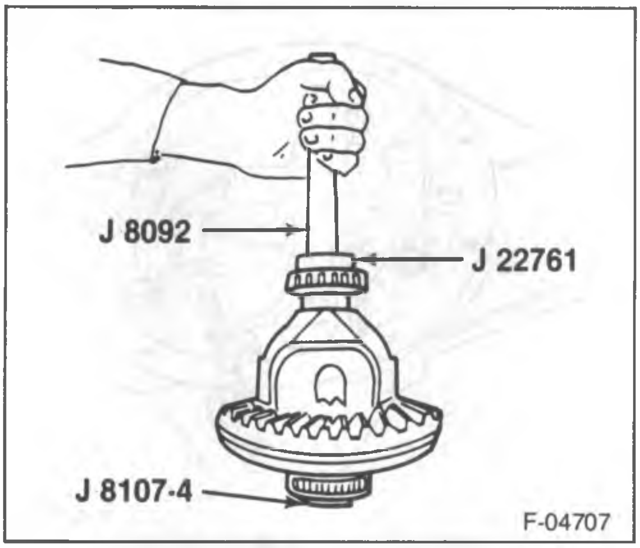


Figure 19—Installing the Side Bearing

- Service shims are available from 0.040 to 0.100-inch.
- Be sure that the side bearing surfaces are clean and free of burrs.

Tool Required:

J 22779 Side Bearing Backlash Gage

1. Place the differential case and the bearing cups into the axle housing.
   - Lubricate the axle bearings with axle lubricant.
   - Support the case to keep it from falling into the axle housing.
2. Install the strap from J 22779 on the left bearing with the cap bolts. Tighten the bolts snugly.
3. Push the ring gear towards the pinion.
   - Engage the ring gear with the pinion tightly, to a backlash of 0.000 to 0.001-inch.
4. Insert J 22779 between the axle housing and the left bearing cup (figure 20).
5. Move the tool back and forth in the bore while turning the adjusting nut to the right until a noticeable drag is produced (figure 21).
   - Tighten the lock bolt on the side of the tool.

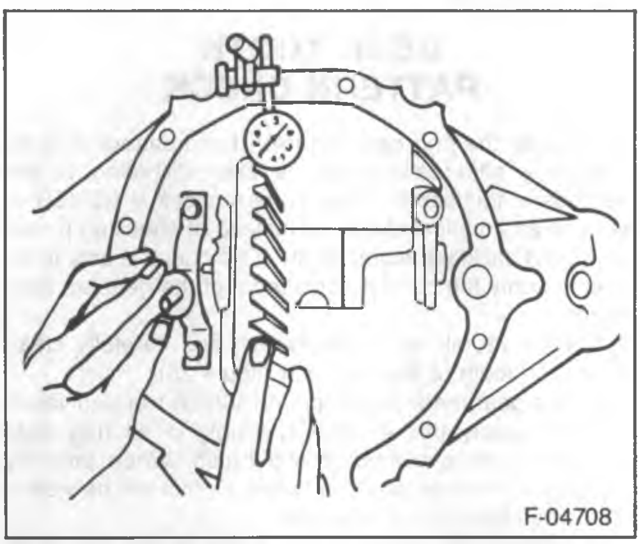


Figure 20—Installing Side Bearing Gaging Tool

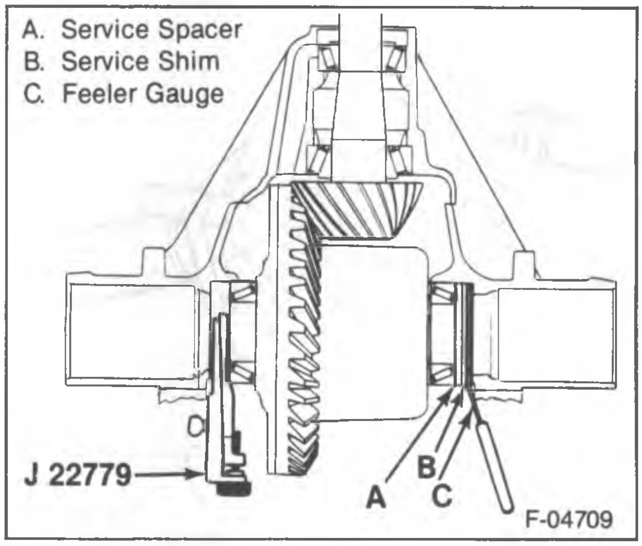


Figure 21—Measuring Side Bearing Shim Requirements

   - Leave the tool in place.
6. Install a service spacer (9) and a service shim (9) between the right bearing cup and the axle housing.
7. Determine bearing preload by inserting progressively larger feeler gage sizes between the carrier and the service shim.
   - Push the feeler gage downward so that it contacts the shim at the top and bottom, and then contacts the axle housing.
   - The point just before additional drag begins is the correct feeler gage thickness. This is the zero setting without preload.
8. Remove the strap, J 22779, the service spacer, service shim, feeler gage, and differential case from the axle housing.
9. Measure J 22779 in three places using a micrometer. Average the readings (figure 22).
10. Add the dimensions of the right side service spacer, service shim, and the feeler gage.

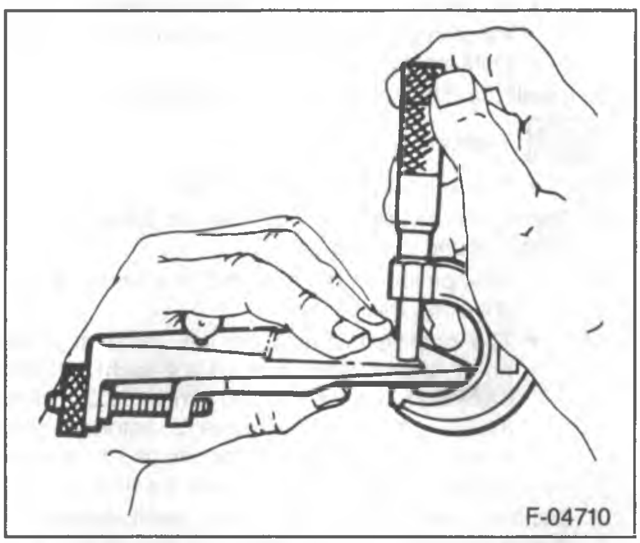


Figure 22—Measuring the Gage Plate Thickness

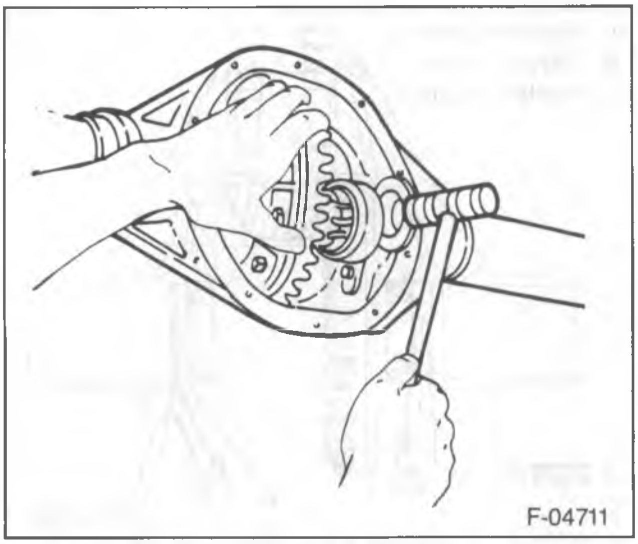


Figure 23—Installing the Final Preload Shim

11. For an initial backlash setting, move the ring gear away from the pinion by subtracting 0.010-inch from the ring gear side shim pack and adding 0.010-inch to the shim pack on the opposite side.
12. To obtain the proper preload on the side bearings add 0.10 mm (0.004-inch) to the measurement of each shim pack.
13. Install the differential. Refer to "Backlash Adjustment" in this section.

BACKLASH ADJUSTMENT

1. Install the differential case, bearing cups, spacers, and shims as determined from the "Side Bearing Preload Adjustment" earlier in this section (figure 23).
   - Tap the final shim into position, using a soft faced hammer.
2. Rotate the case several times to seat the bearings.
3. Install a dial indicator to the case using a magnetic base.
4. Place the indicator stem at the heel end of a tooth.
   - Set the dial indicator so that the stem is in line with the gear rotation and perpendicular to the tooth angle (figure 24).
5. Install the differential caps (10) and bolts (18).

   Tighten
   - The bolts to 80 N·m (60 ft. lbs.).
6. Check and record the backlash at three or four points around the ring gear.
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
7. Backlash at the minimum lash point measured should be between 0.13 and 0.23 mm (0.005 and 0.009-inch) for all new gear sets.

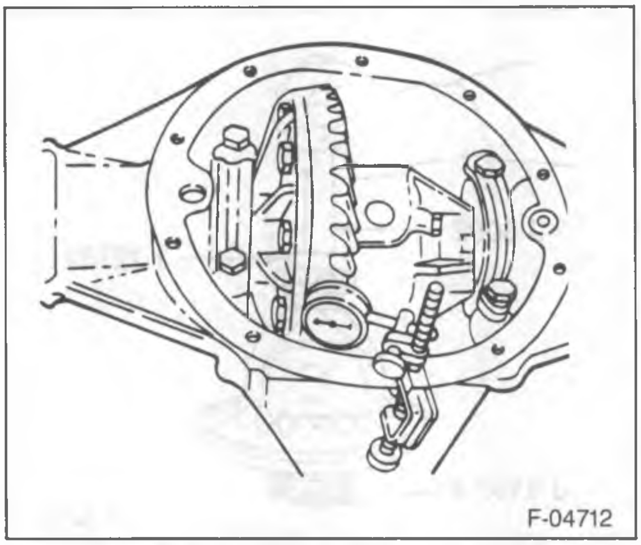


Figure 24—Checking Ring Gear Backlash

8. If the backlash is not within specifications, move the ring gear in or out from the pinion by increasing the thickness of one shim, and decreasing the thickness of the other shim by the same amount. This will maintain the correct rear axle side bearing preload.
   - Moving 0.003-inch worth of shim from one side of the differential to the other will change the backlash adjustment by 0.002-inch.
9. Recheck the backlash and correct as necessary.

FINAL ASSEMBLY

Install or Connect (Figure 1)

1. Drive axles. Refer to the proper service manual.
2. A new cover gasket and the cover (12).

   Tighten
   - The cover bolts (14) to 27 N·m (20 ft. lbs.).
3. Axle housing to the vehicle. Refer to the proper service manual.
4. Lubricant to the rear axle.

GEAR TOOTH PATTERN CHECK

Checking the ring gear to pinion tooth pattern is to be done only after setting up the axle according to the methods in this section. The pattern check is NEVER to be used as an initial check, or instead of checking pinion depth and backlash adjustments. This check is only to be used to verify the correct adjustment of the gear set after setup.

1. Wipe all oil out of the carrier, and carefully clean each tooth of the ring gear (figure 25).
2. Use gear marking compound 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium-stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten the bearing cap bolts to the specified torque.

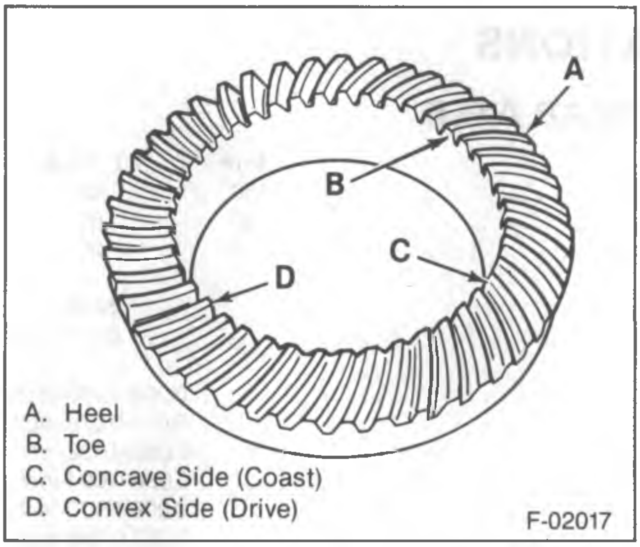


Figure 25—Gear Tooth Nomenclature

4. Expand the brake shoes until a torque of 40 to 50 ft. lbs. is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the pinion flange with a wrench so that the ring gear rotates one full revolution, then reverse the rotation so that the ring gear rotates one revolution in the opposite direction.

5. Observe the pattern on the ring gear teeth and compare this with figure 26.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect tooth contact pattern: backlash, and the position of the drive pinion in the carrier. The effects of bearing preloads are not readily apparent on hand loaded tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

The position of the drive pinion is adjusted by increasing or decreasing the distance between the pinion head and the centerline of the ring gear. Decreasing the distance will move the pinion closer to the centerline of the ring gear. Increasing the distance will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which move the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload).

If the thickness of the right shim is increased (along with decreasing the left shim thickness), backlash will increase.

The backlash will decrease if the left shim thickness is increased (along with a decrease in right shim thickness).

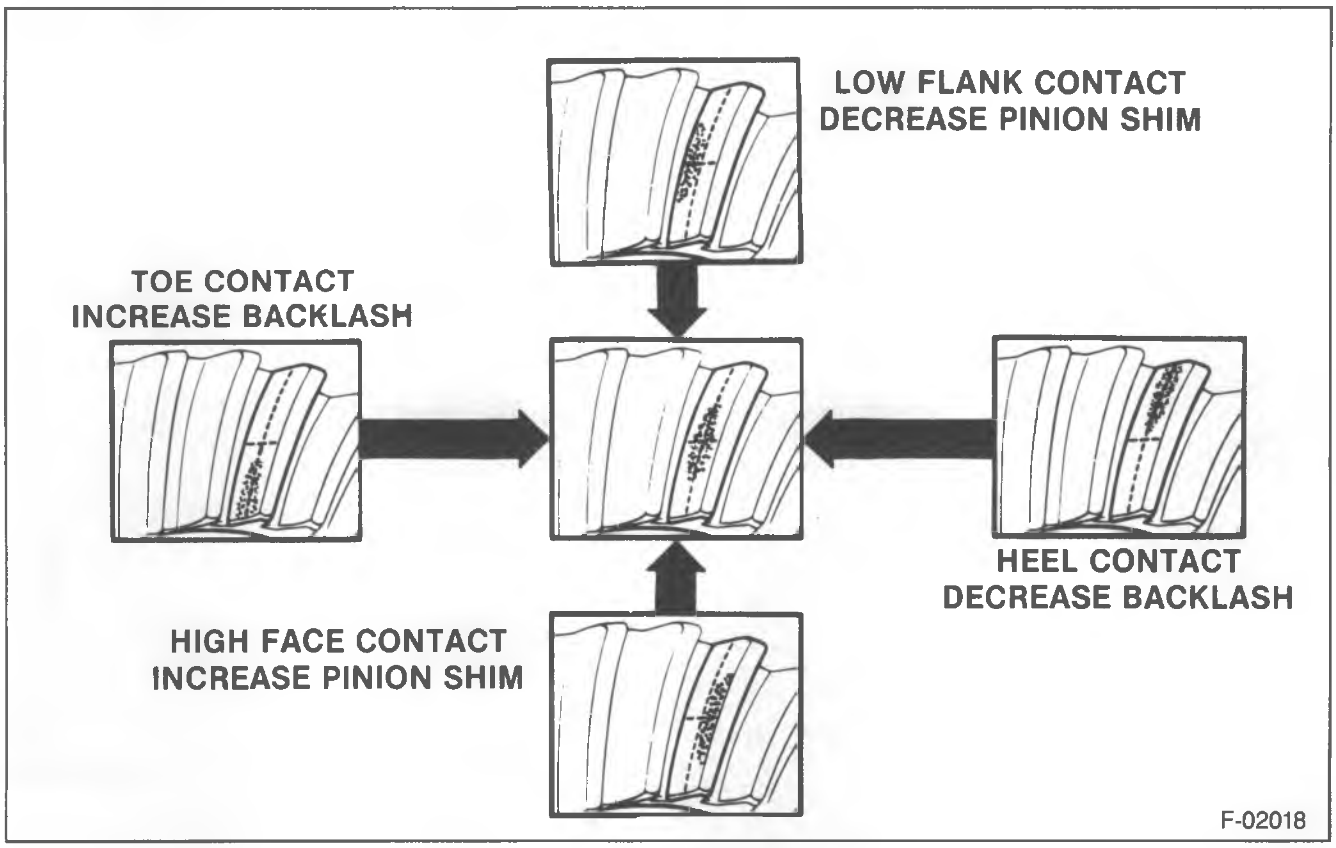


Figure 26—Gear Tooth Pattern

SPECIFICATIONS

8½-INCH RING GEAR AXLE

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	80	60
Bearing Cap Bolts	80	60
Axle Cover Bolts	27	20

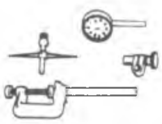
SPACER AND SHIM SIZES	SIZE
Differential Side Bearing Spacer	0.170-inch
Differential Side Bearing Shim Kits	0.064-0.070-inch
	0.072-0.078-inch
	0.080-0.086-inch
	0.088-0.094-inch
	0.096-0.100-inch
	0.052-0.056-inch
	0.058-0.063-inch
	0.040-0.044-inch
	0.046-0.050-inch
Pinion Bearing Shim Kits	0.020-0.024-inch
	0.025-0.029-inch
	0.030-0.034-inch
	0.035-0.039-inch
Lubricant	80W-90 GL-5

SPECIAL TOOLS

1.  J 8611-01

2.  J 8612-B

3.  J 8092

4.  J 8001

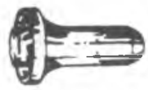
5.  J 8609-01

6.  J 8614-01

7.  J 8107-4

8.  J 8608

9.  J 22888

10.  J 22399

11.  J 22761

12.  J 22779

13.  J 5590

1. Front Pinion Bearing Cup Installer
2. Rear Pinion Bearing Cone Remover
3. Driver Handle
4. Dial Indicator Set
5. Rear Pinion Bearing Cone Installer
6. Pinion Flange Remover
7. Differential Side Bearing Remover Plug
8. Rear Pinion Bearing Remover Plug
9. Side Bearing Remover
10. Pinion Oil Seal Installer
11. Differential Side Bearing Installer
12. Side Bearing Backlash Gauge
13. Rear Pinion Bearing Cone Installer

Not Shown:

J 21777-1 Arbor
J 21777-29 Gauge Plate
J 21777-35 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly—Bolt
J 21777-45 Side Bearing Disc

F-04660

SECTION 4B3

9½-INCH RING GEAR

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

The corporate 9½-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is semi-floating. The axle shafts are supported at the wheel end of the shaft by a roller bearing that is pressed into the housing. The shafts are retained into the housing by retaining clips within the differential. The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsable spacer between the bearings in the axle housing.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearing and the axle housing. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. The differential bearing preload is set by a threaded differential bearing adjusting nut located between the axle housing and the differential bearing cap. Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a seal at each axle shaft end, and by RTV sealant between the rear cover and the axle housing.

All corporate rear axles are identified by the part number on the right axle tube near the carrier. The carrier cover does not have a drain plug.

CHECKING THE AXLE BEFORE DISASSEMBLY

Inspect

- Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. The ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing cage.

- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

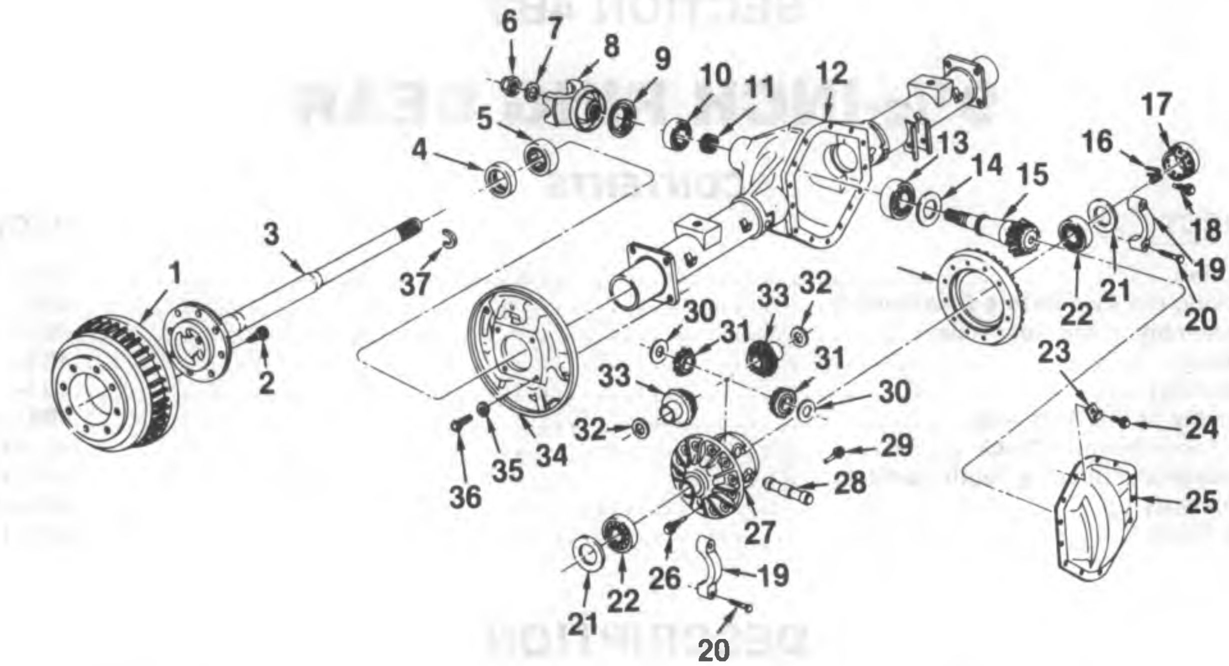
Remove or Disconnect (Figure 1)

Tools Required:

J 8107-3 Differential Side Bearing Remover Plug
J 22888 Differential Side Bearing Remover
J 8614-01 Pinion Flange Remover
J 22910-01 Rear Pinion Bearing Cone Remover

- Place the rear axle in a suitable support.

1. The differential cover bolts (24) and the differential cover (25).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (3). Refer to the proper service manual.
3. Outer wheel bearings (5) and seals (14). Refer to the proper service manual.



1. Brake Drum
2. Wheel Stud
3. Axle Shaft
4. Rear Axle Seal
5. Axle Shaft Bearing
6. Pinion Nut
7. Washer
8. Pinion Flange
9. Pinion Oil Seal
10. Pinion Front Bearing
11. Collapsable Spacer
12. Axle Housing
13. Pinion Rear Bearing
14. Shim
15. Ring and Pinion Gear Set
16. Adjusting Nut Lock
17. Bearing Adjusting Nut
18. Lock Bolt
19. Bearing Cap
20. Bolt
21. Shim Pack (including spacer)
22. Differential Side Bearing
23. Brake Line Clip
24. Bolt
25. Cover
26. Ring Gear Bolt
27. Differential Case
28. Pinion Shaft
29. Pinion Shaft Lock Screw
30. Pinion Thrust Washer
31. Pinion Gear
32. Side Gear Thrust Washer
33. Side Gear
34. Brake Backing Plate
35. Split Washer
36. Bolt
37. "C" Clip

F-04713

Figure 1—Rear Axle Components

4. Pinion shaft lock screw (29).
5. Pinion shaft (28).
6. Differential pinion (31) and side gears (33).
   - Roll the pinion gears out of the case with the pinion thrust washer (30).
   - Remove the side gears and the side gear thrust washers (32). Mark the gears and the differential case as left and right.
7. Adjusting nut lock bolt (18).
8. Adjusting nut lock (16).
   - Loosen the adjusting nut (17).
9. Differential bearing cap bolts (20).
10. Differential bearing caps (19).
    - Mark the caps and the housing as left and right.

NOTICE: Be careful when prying the differential case out of the axle housing so not to damage the cover gasket surface. The differential case must be supported when it is being removed to prevent the case from falling and damaging the case.

11. Differential carrier (27).
    - Pry the case from the axle housing at the differential "window" (figure 2).
12. Bearing outer races (21), shims (21) and bearing adjusting nut (17).
    - Mark the races and the shims as left and right, and place them with the bearing caps.
13. Differential side bearings using J 8107-3 and J 22888 (figure 3).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage. Use the slots provided for this purpose.
14. Ring gear bolts (26).
    - Ring gear bolts use left-handed threads.

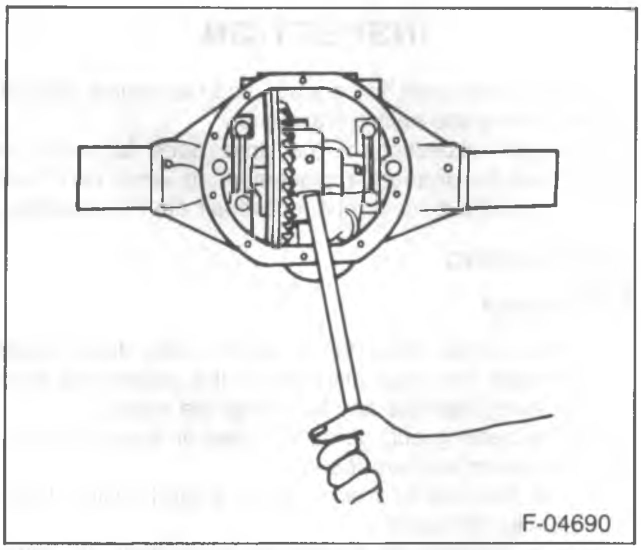


Figure 2—Removing the Differential Case

NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

15. Ring gear (15) from the differential.
    - Drive the ring gear off with a brass drift if necessary.

Inspect

- Drive pinion bearing preload (figure 4).
- Pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear).

16. Pinion flange nut (6) and washer (7) using J 8614-01 to hold the pinion flange (figure 5).
17. Pinion flange using J 8614-01 (figure 6).
18. Pinion (15) from the axle housing.
    - Thread the pinion nut halfway onto the pinion.
    - Replace the differential cover (34) with two bolts (35) to keep the pinion from falling to the floor.

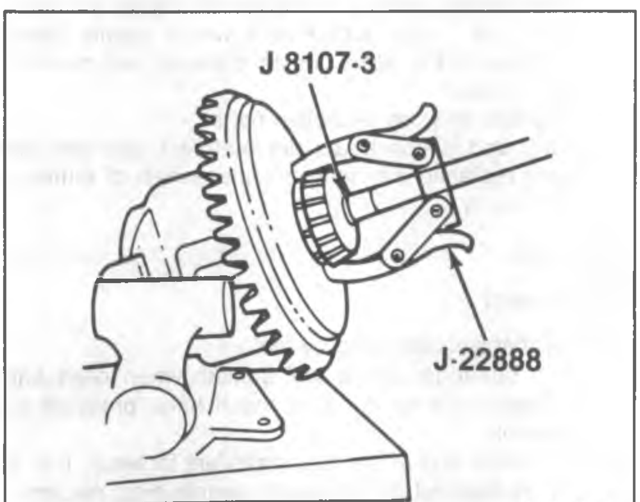


Figure 3—Removing Differential Side Bearings

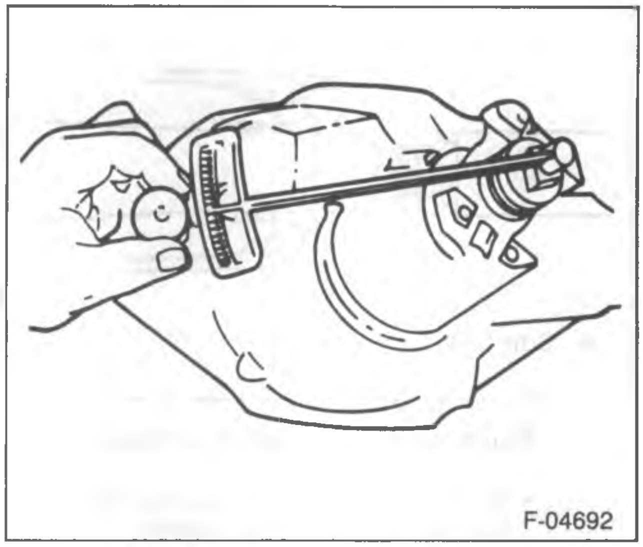


Figure 4—Checking Pinion Preload

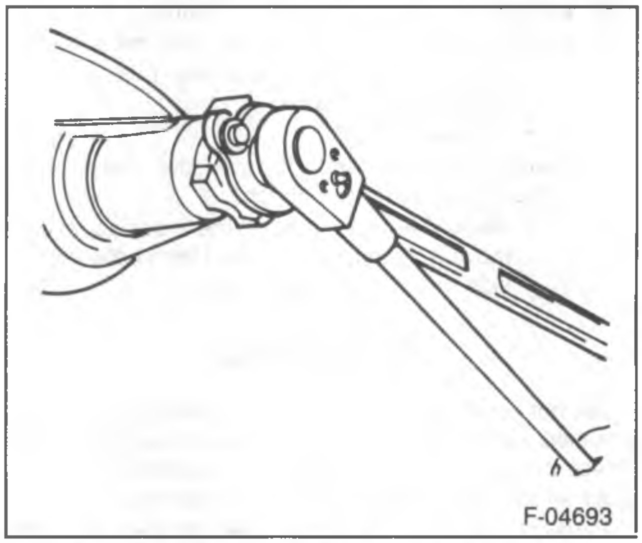


Figure 5—Removing the Drive Pinion Nut

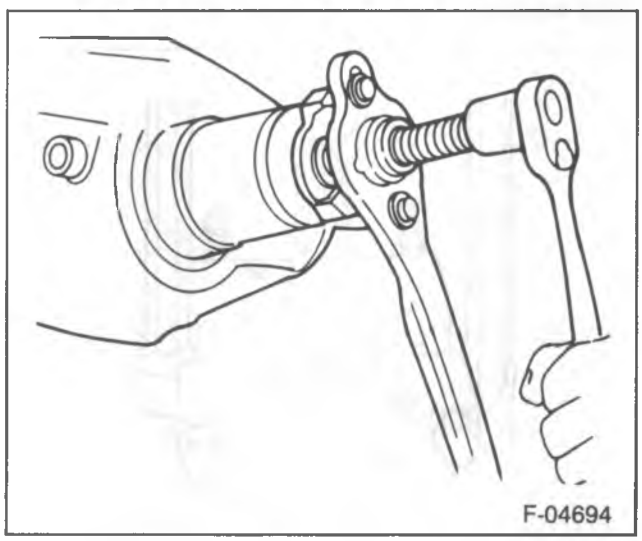
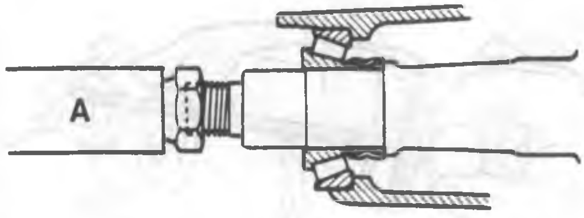


Figure 6—Removing the Pinion Flange



A. Soft Drift

F-04695

Figure 7—Removing the Drive Pinion

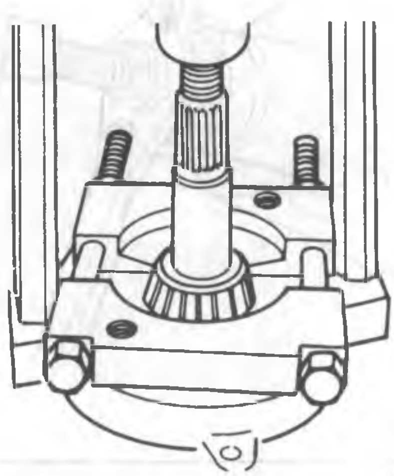
- Drive the pinion out of the housing with a hammer and a soft drift (figure 7).
- Remove the cover (25) and the pinion (15).

19. Collapsable spacer (11) from the pinion.
20. Outer seal (9) and outer pinion bearing (10).
21. Inner bearing (13) and shim (14) from the pinion.
    - Press the bearing off the pinion using J 22912-01 (figure 8).
    - Remove the shim.
22. Bearing cups (10) and (13) from the axle housing using a hammer and a punch.
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.



F-04696

Figure 8—Removing the Pinion Rear Bearing

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.

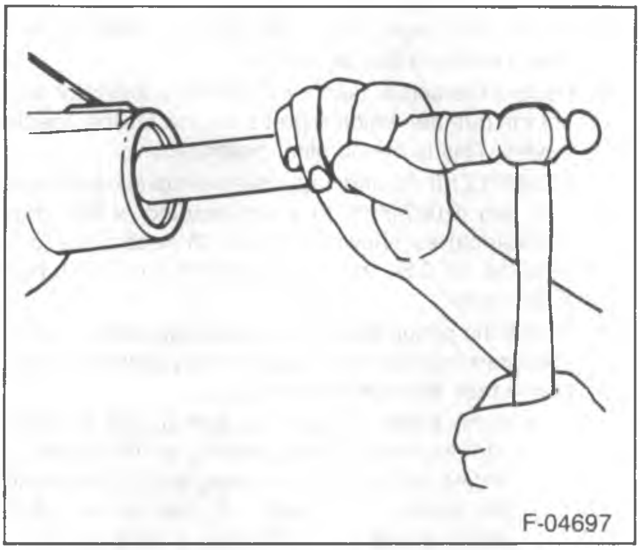


Figure 9—Installing the Front Pinion Bearing Cup

- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

Install or Connect (Figures 9 and 10)

Tools Required:
J 7817 Front Pinion Bearing Cup Installer
J 22306 Rear Pinion Bearing Cup Installer

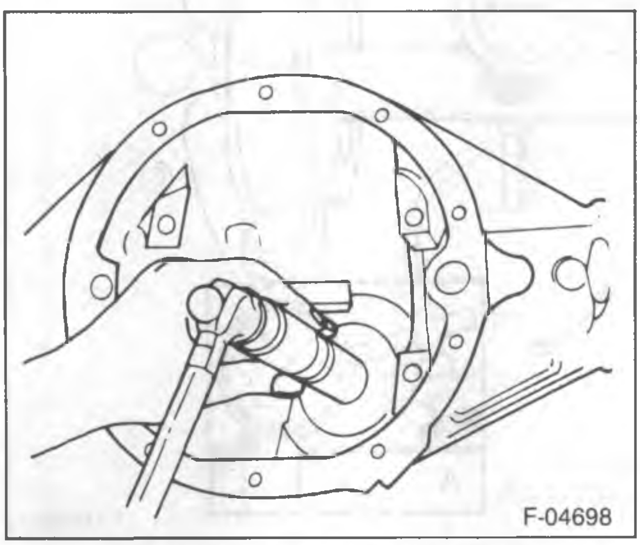


Figure 10—Installing the Rear Pinion Bearing Cup

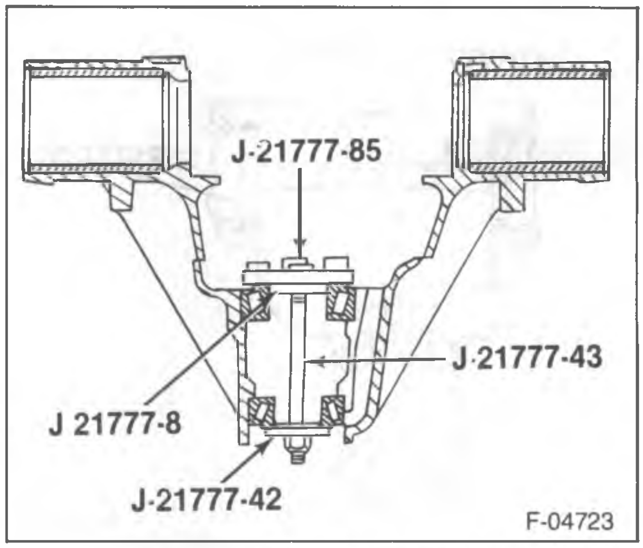


Figure 11—Gage Plate Tools

J 8092 Driver Handle

1. Front pinion bearing cup (10) using J 7817 and J 8092.
2. Rear pinion bearing cup (13) using J 22306 and J 8092.

PINION DEPTH ADJUSTMENT

Tools Required:
J 8001 Dial Indicator Gage Set
J 21777-1 Arbor
J 21777-8 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly — Bolt
J 21777-85 Gage Plate
J 21777-86 Side Bearing Disc

1. Clean all the gage parts.
2. Lubricate the front and rear pinion bearings with axle lubricant.
3. Place the bearings (10) and (13) into the pinion bearing cups.
4. Install J 21777-8, J 21777-42, J 21777-85 and J 21777-43 to the pinion bore (figure 11).
5. Hold the stud stationary at the flats of the stud.

   Tighten

   - Stud nut to 2.2 N·m (20 in. lbs.).
6. Rotate the gage plate and bearings several complete revolutions to seat the bearings.
7. Tighten the stud nut until a torque of 1.6 to 2.2 N·m (15 to 25 in. lbs.) is obtained to keep the gage plate in rotation.
8. Assemble J 21777-86, J 21777-1 Arbor, and J 8001 to the differential bearing bore as shown in figure 12.
   - The bearing bores must be clean and burr free.
9. Install the side bearing caps, and tighten the bolts finger tight.
10. Rotate the gage plate until the proper gaging area is parallel with the disks.
11. Position the gage shaft assembly in the carrier so that the dial indicator rod is centered on the gaging area of the gage block.

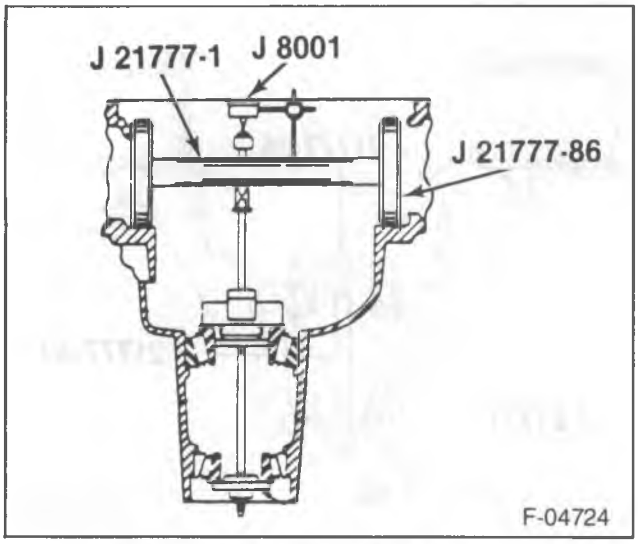


Figure 12—Pinion Depth Tools

12. Set the dial indicator at zero. Push the indicator down on the indicator shaft until the needle rotates approximately ¾ of a turn to the right. Tighten the dial indicator in this postion (figure 13).
13. Rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection (when the indicator needle is centered between movement to the left and to the right).
14. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the zero setting.
15. Rotate the gage shaft until the dial indicator rod does not touch the gage block.
16. Record the actual number on the dial indicator and not the number which represents how far the needle travels. This is the nominal pinion setting.

    EXAMPLE: If the indicator needle moved to the left 1.70 mm (0.067-inch) to a dial reading of 0.84 mm (0.033-inch) as shown in figure 13, record the dial reading of 0.84 mm (0.033-inch) not 1.70 mm (0.067-inch).
17. Check the pinion face for a pinion adjustment mark. This mark indicates the best running position for the pinion from the nominal setting.
    - If the pinion is stamped with a plus number, add that many thousandths to the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked +2, the correct shim depth would be 0.033-inch + 0.002-inch = 0.035-inch.
    - If the pinion is stamped with a minus number, subtract that many thousandths from the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked -2, the correct shim depth would be 0.033-inch – 0.002-inch = 0.031-inch.
    - If the pinion has no plus or minus marked on the pinion, use the nominal pinion setting to select a shim.
18. Remove bearing caps (10) and depth gaging tools.
19. Install the correct pinion shim (6) to the pinion according to this procedure.

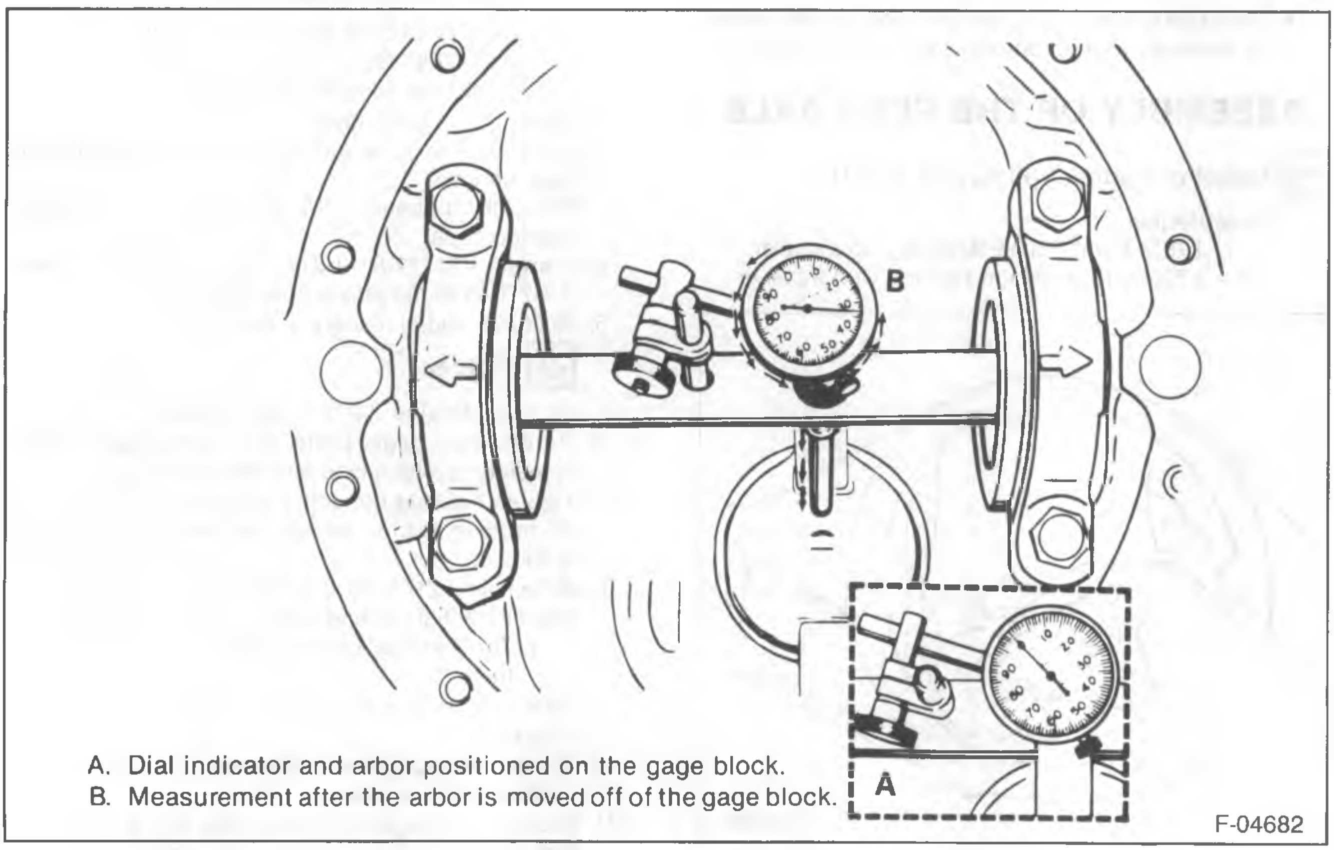


Figure 13—Checking Pinion Depth

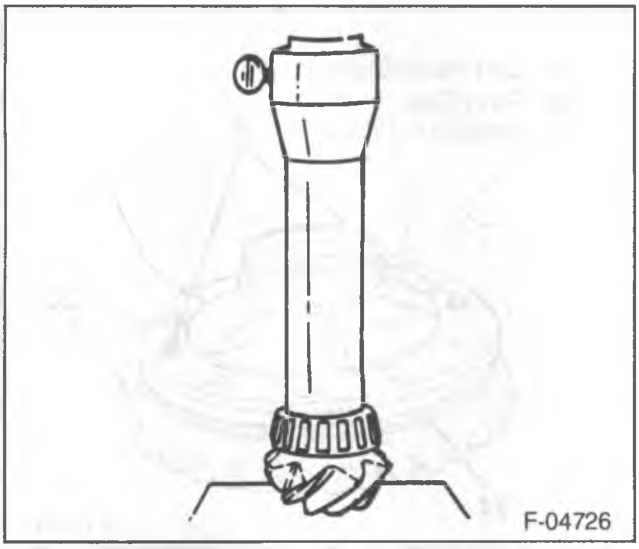


Figure 14—installing the Pinion Inner Bearing

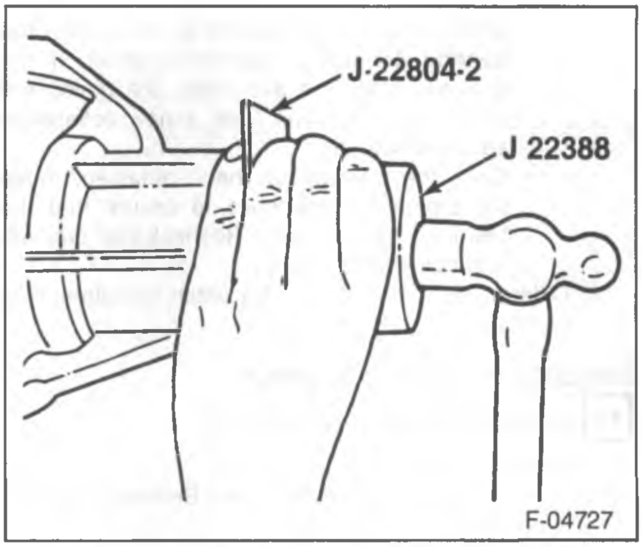


Figure 15—Installing the Pinion Oil Seal

PINION INSTALLATION

Install or Connect

Tools Required:

J 22388 Pinion Oil Seal Installer
J 22804-1 Pinion Oil Seal Spacer
J 5590 Rear Pinion Bearing Cone Installer

- The bearing cups should have been installed in "Pinion Depth Adjustment" in this section.

1. The pinion inner bearing (13) to the pinion.
   - Press the bearing onto the pinion until the bearing cone seats on the pinion shim(s) (figure 14).
2. A new collapsable spacer (11).
   - Lubricate the pinion bearings with axle lubricant.
3. Pinion (15) to the axle housing.
4. Outer pinion bearing (10) onto the pinion using J 5590.
   - Hold the pinion forward from inside the case while driving the bearing onto the pinion.
5. Pinion oil seal (9) using J 22388 and J 22804-01 (figure 15).
6. The pinion flange (8) to the pinion by tapping it with a rawhide hammer until a few threads show through the pinion flange.
7. The pinion washer (7) and a new nut (6) while holding the pinion flange with J 8614-01 (figure 16).

Tighten

- The nut until the pinion end play is just taken up. Rotate the pinion while tightening the nut to seat the bearings. Once there is no end play in the pinion, the preload torque should be rechecked.
- Remove J 8614-01. Using an inch-pound torque wrench, check the pinion preload by rotating the pinion with the wrench. Preload should be at or below 2.3 to 2.8 N·m (20 to 25 in. lbs.) on new bearings, or 1.1 to 1.7 N·m (10 to 15 in. lbs.) for used bearings (figure 17).
- If the preload torque is below the preloads given above, continue torquing the nut in small increments. Check the preload after each

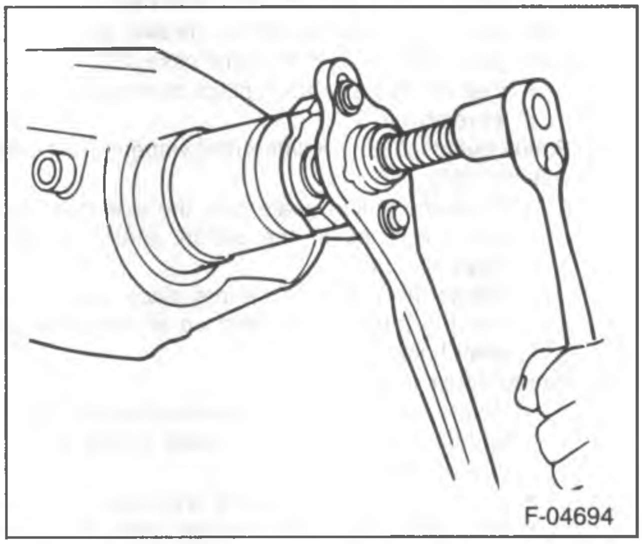


Figure 16—Installing the Pinion Flange

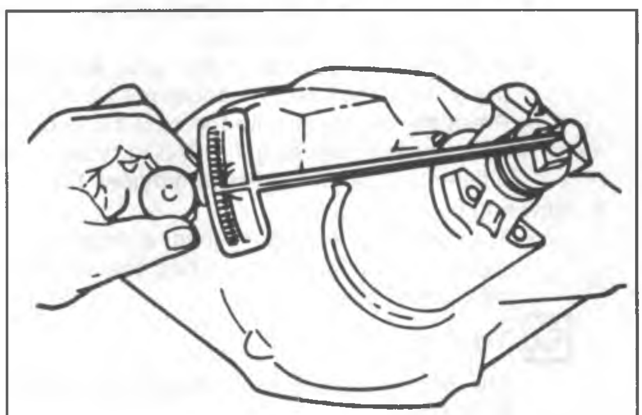


Figure 17—Checking Pinion Bearing Preload

tightening. Each tightening increases the bearing preload by several pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
  - Once the preload has been obtained, rotate the pinion several times to assure that the bearings have seated. Recheck the preload, and adjust if necessary.

8. Differential case. Refer to "Backlash Adjustment" in this section.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tools Required:
- J 8107-3 Differential Side Bearing Removal Plug
- J 8092 Driver Handle
- J 29710 Differential Side Bearing Installer

- Lubricate all parts with rear axle lubricant.

1. Side gear thrust washers (32) to the side gears (33).
2. Side gears (33) to the differential case (27).
   - Place the side gears in place on the same side as removed.
3. Pinion gears (31) to the differential without the thrust washers (30).
   - Place the pinion gears onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
4. Pinion thrust washers (30).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
   - Check that the mating surfaces of the differential case and the ring gear are clean and burr free.
5. Ring gear (15) to the differential case (27).
   - Thread two left-hand threaded studs into the ring gear on opposite sides.
   - Place the ring gear onto the case, and align the holes in the case with the studs (figure 18).
   - Press the ring gear onto the case far enough to start the bolts using J 8107-3 to protect the differential from the press ram (figure 19).
6. New ring gear bolts (26).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

- The ring gear bolts in sequence to 145 N·m (105 ft. lbs.).

7. Differential side bearings (22) using J 29710, J 8107-3 and J 8092 (figure 20).
   - Place J 8107-3 into the differential on the side opposite of bearing installation to protect the differential case.
   - Drive the bearing onto the case using J 29710 and J 8092.

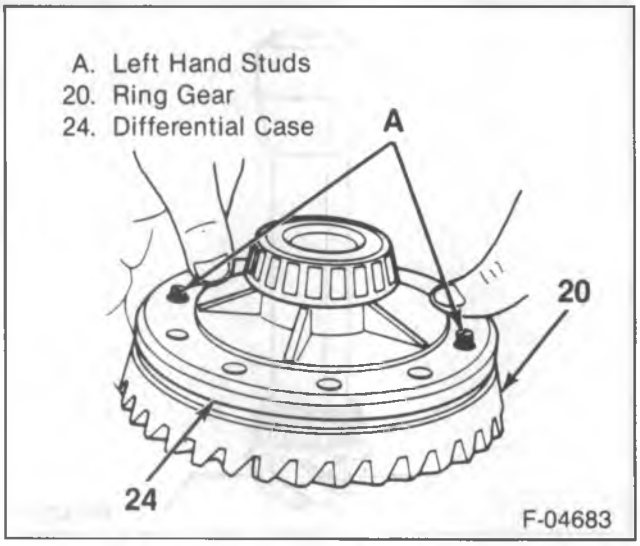


Figure 18—Aligning the Ring Gear Studs

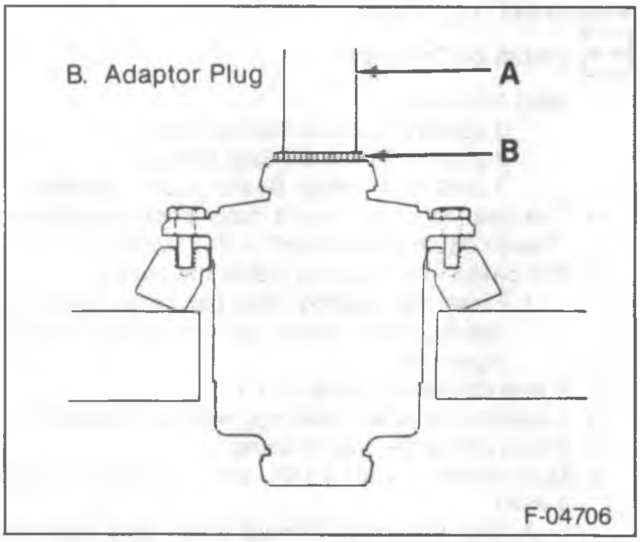


Figure 19—Installing the Ring Gear to the Case

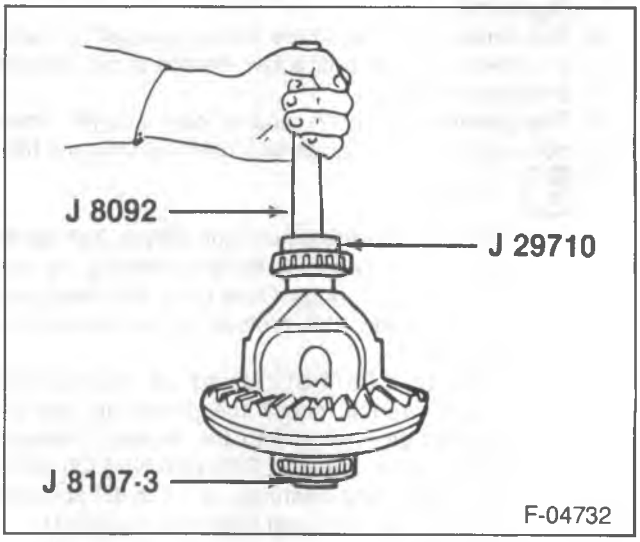


Figure 20—Installing the Side Bearing

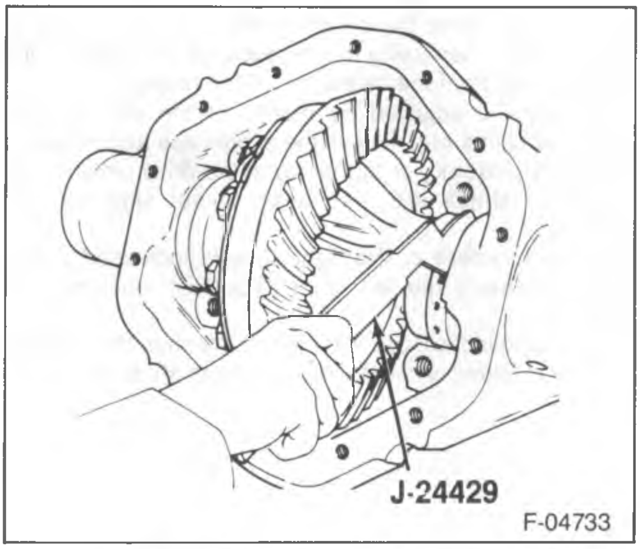


Figure 21—Adjusting the Nut

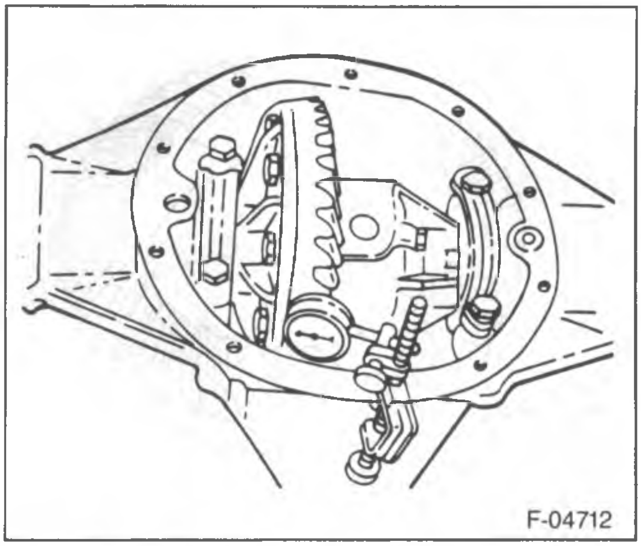


Figure 22—Checking Ring Gear Backlash

8. Differential case (27) to the axle housing. Refer to "Side Bearing Preload Adjustment" in this section.

SIDE BEARING PRELOAD ADJUSTMENT

- The differential side bearing preload is adjusted by an adjusting nut in the differential bearing bore. The bore and the bearing cap provide the mating threads for the bearing nut.
- The differential must be initially preloaded in order to determine the backlash of the gear set. After the backlash has been set, the final bearing preload is set.

Install or Connect

Tool Required:
J 24429 Side Bearing Backlash Spanner Wrench

1. The bearing cups (22) to the differential bearings in their original locations.
2. Differential assembly to the axle housing.
3. Bearing shims (21).
- Push the case away from the pinion towards the axle housing.
4. Adjusting nut (17).
- Tighten the adjusting nut using J 24429.
- Turn the pinion to seat the bearings.
- Back off the adjusting nut.
5. Bearing caps (19) and bolts (20) in their original positions.
  - Assemble the caps loosely.
- Turn the adjusting nut until the nut contacts the shim. Then tighten the nut three additional slots (figure 21).

Tighten

- The bearing cap bolts to 80 N·m (60 ft. lbs.).

6. Adjusting nut lock (16) and lock bolt (18).
- Measure the ring gear to pinion backlash. Refer to "Backlash Adjustment" in this section.

Tighten

- The lock bolt to 30 N·m (22 ft. lbs.) after setting the backlash.

BACKLASH ADJUSTMENT

1. Install a dial indicator to the case using a magnetic base.
2. Place the indicator stem at the heel end of a tooth.
   - Set the dial indicator so that the stem is in line with the gear rotation and perpendicular to the tooth angle.
3. Check and record the backlash at three or four points around the ring gear (figure 22).
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
4. Backlash at the minimum lash point measured should be between 0.125-0.200 mm ± 0.050 mm (0.005-0.008-inch ± 0.002-inch).
5. If the reading is too high, increase the shim pack between the differential flange side of the case and the axle housing (opposite the adjusting nut side).
6. If the reading is too low, decrease the shim pack between the differential flange side of the case and the axle housing (opposite the adjusting nut side).
7. Adjust the side bearing preload. Refer to "Side Bearing Preload Adjustment" earlier in this section.

FINAL ASSEMBLY

Install or Connect (Figure 1)

1. Drive axles. Refer to the proper service manual.
2. RTV to the axle housing cover.
3. Cover (25) and bolts (24) to the axle housing.

Tighten

- The cover bolts (24) to 27 N·m (20 ft. lbs.).

4. Axle housing to the vehicle. Refer to the proper service manual.
5. Lubricant to the rear axle.

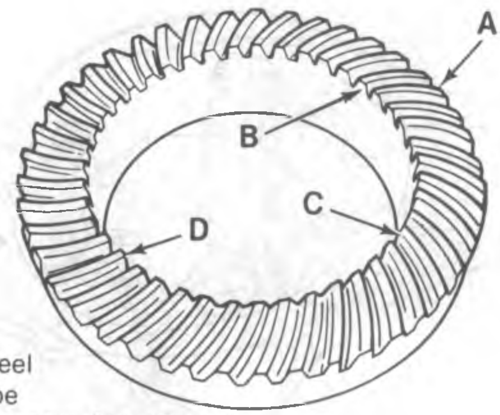


Figure 23—Gear Tooth Nomenclature

GEAR TOOTH PATTERN CHECK

Checking the ring gear to pinion tooth pattern is to be done only after setting up the axle according to the methods in this section. The pattern check is NEVER to be used as an initial check, or instead of checking pinion depth and backlash adjustments. This check is only to be used to verify the correct adjustment of the gear set after setup.

1. Wipe all oil out of the carrier, and carefully clean each tooth of the ring gear (figure 23).
2. Use gear marking compound 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium-stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten the bearing cap bolts to the specified torque.
4. Expand the brake shoes until a torque of 40 to 50 ft. lbs. is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the pinion flange with a wrench so that the ring gear rotates one full revolution, then reverse the rotation so that the ring gear rotates one revolution in the opposite direction.
5. Observe the pattern on the ring gear teeth and compare this with figure 24.

ADJUSTMENTS AFFECTING TOOTH CONTACT

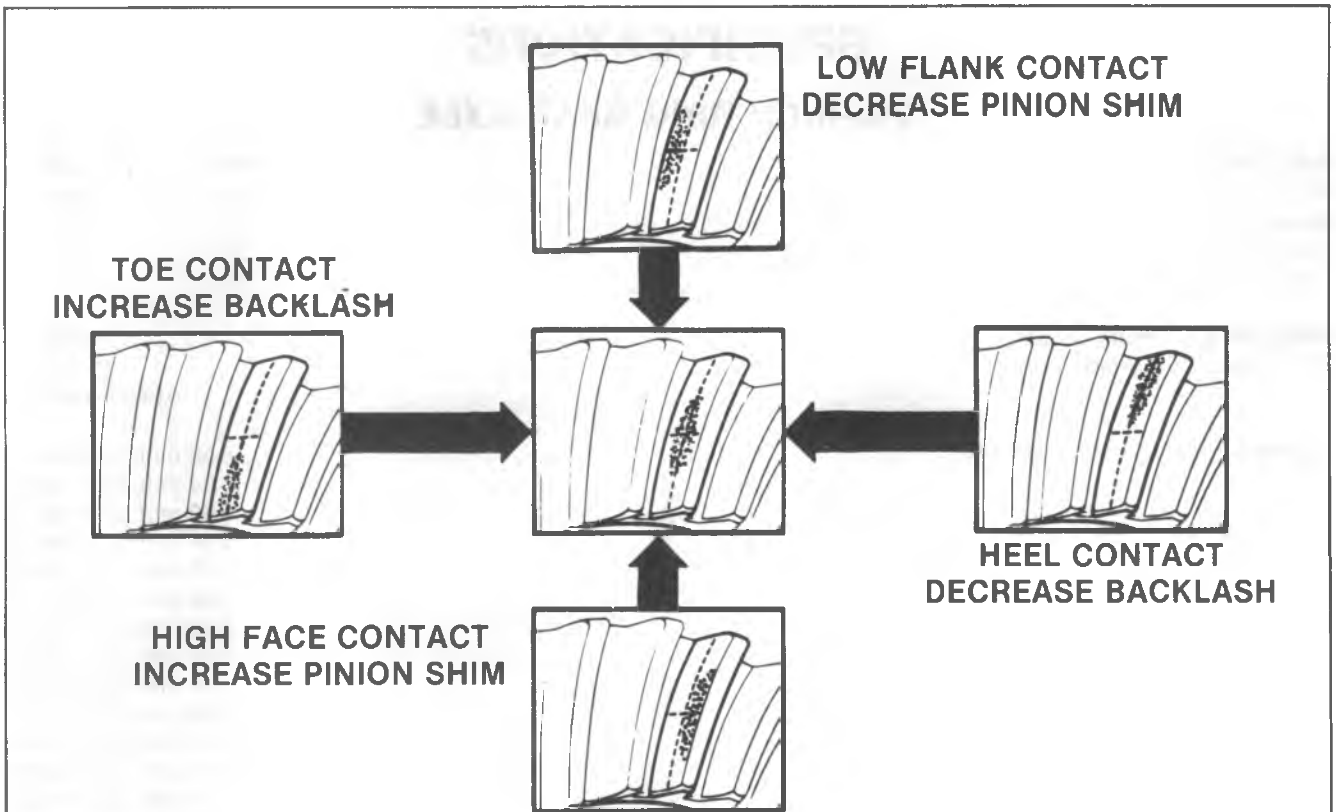
Two adjustments can be made which will affect tooth contact pattern: backlash, and the position of the drive pinion in the carrier. The effects of bearing preloads are not readily apparent on hand loaded tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

The position of the drive pinion is adjusted by increasing or decreasing the distance between the pinion head and the centerline of the ring gear. Decreasing the distance will move the pinion closer to the centerline of the ring gear. Increasing the distance will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which move the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload).

If the thickness of the right shim is increased (along with decreasing the left shim thickness), backlash will increase.

The backlash will decrease if the left shim thickness is increased (along with a decrease in right shim thickness).



F-02018

Figure 24—Gear Tooth Pattern

SPECIFICATIONS

9½-INCH RING GEAR AXLE

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	145	105
Bearing Cap Bolts	80	60
Axle Cover Bolts	27	20
Adjusting Nut Lock Bolt	30	22

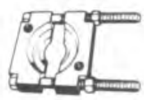
SPACER AND SHIM SIZES	SIZE
Differential Side Bearing Spacer	0.170-inch
	0.040-0.044-inch
Differential Side Bearing Shim Kits	5.59 mm (0.220-inch)
	5.64 mm (0.222-inch)
	5.69 mm (0.224-inch)
	5.74 mm (0.226-inch)
	5.79 mm (0.228-inch)
	5.84 mm (0.230-inch)
	5.89 mm (0.232-inch)
	5.94 mm (0.234-inch)
	5.99 mm (0.236-inch)
	6.05 mm (0.238-inch)
	6.10 mm (0.240-inch)
	6.15 mm (0.242-inch)
	6.20 mm (0.244-inch)
	6.25 mm (0.246-inch)
	6.30 mm (0.248-inch)
	6.35 mm (0.250-inch)
	6.40 mm (0.252-inch)
	6.45 mm (0.254-inch)
	6.50 mm (0.256-inch)
	6.55 mm (0.258-inch)
Pinion Bearing Shim Kit	0.5080-0.5842 mm (0.020-0.023-inch)
	0.6096-0.7112 mm (0.024-0.028-inch)
	0.7366-0.8382 mm (0.029-0.033-inch)
	0.8636-0.9398 mm (0.034-0.037-inch)
Lubricant	80W-90 GL-5

SPECIAL TOOLS

1.  J-8107-3

2.  J-22804-1

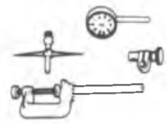
3.  J-24429

4.  J-22912-01

5.  J-5590

6.  J-7817

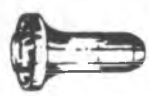
7.  J-8092

8.  J-8001-M

9.  J-29710

10.  J-22888

11.  J-24433

12.  J-22388

13.  J-8614-01

1. Differential Side Bearing Plug
2. Pinion Oil Seal Spacer
3. Side Bearing Adjustment Spanner
4. Rear Pinion Bearing Cone Remover
5. Rear Pinion Bearing Cone Installer
6. Front Pinion Bearing Cup Installer
7. Driver Handle
8. Dial Indicator
9. Differential Side Bearing Installer
10. Side Bearing Remover
11. Rear Pinion Bearing Cone Installer
12. Pinion Oil Seal Installer
13. Pinion Flange Remover
14. J-22306 Rear Pinion Bearing Cup Installer (Not Illustrated)

Refer to Figure 53 for these tools:

J-21777-1	Arbor
J-21777-8	Rear Pilot Washer
J-21777-42	Front Pilot Washer
J-21777-43	Stud Assembly — Bolt
J-21777-85	Gauge Plate
J-21777-86	Side Bearing Disc

F-04661

SECTION 4B4

10½-INCH RING GEAR

CONTENTS

DESCRIPTION

The corporate 10½-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is full-floating. The axle shaft is supported at the wheel ends by the wheel hubs. The bolts that attach the shaft to the hub, support the axle at the hub. The splined end of the shaft is supported by the differential.

The pinion gear is supported in a pinion cage by three bearings: a pinion front bearing, a pinion rear bearing, and pilot bearing. The pinion cage is separate from the axle housing. Selective shims are used between the pinion cage and the axle housing to set the pinion depth. The pinion bearing preload is set by crushing a collapsible spacer between the front and rear bearings in the pinion cage.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using two different bearing adjusting nuts. These allow the differential to be moved from side to side by adjusting the nuts in or out. The differential side bearing preload is accomplished by tightening the differential bearing adjusting nuts after the ring gear backlash has been set. Two bearing caps are used to hold the differential into the rear axle housing as well as to supply half of the threads for the bearing adjusting nuts.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a gasket at each axle shaft end, and by a gasket between the rear cover and the axle housing.

All corporate rear axles are identified by the part number on the right axle tube near the carrier. The carrier cover does not have a drain plug.

CHECKING THE AXLE BEFORE DISASSEMBLY

Inspect

Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. Ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.

2. Case for metal chips and shavings. Determine where these chips and shavings come from; such as a broken gear or bearing cage.

Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

Remove or Disconnect (Figure 1)

Tools Required:

J 8107 Side Bearing Remover Plug
J 22888 Differential Side Bearing Remover
J 8614-01 Pinion Flange Remover
J 22912-01 Rear Pinion Cone Remover

- Place the rear axle in a suitable support.

1. Differential cover bolts (25) and the differential cover (24).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (47). Refer to the proper service manual.
3. Adjusting nut lock bolts (22).
4. Adjusting nut lock (21).
   - Loosen the adjusting nuts (19).
5. Differential bearing cap bolts (28) and washers (27).
6. Differential bearing caps (20).
   - Mark the caps and the housing as left and right.
7. Adjusting nuts (19) and bearing cups (18).
   - Mark the nuts and cups as left and right.
8. Differential carrier (34).
9. Differential side bearings using J 23759-A and J 8107 (figure 2).
   - The jaws of J 22888 must pull from beneath the bearing cone and not the cage.
   - Scribe a mark across the differential case.
10. Ring gear bolts (36) and washers (35).

NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

11. Ring gear (14) from the differential.
    - Drive the ring gear off with a brass drift if necessary.
12. Case halves.
13. Differential side gears (29) and thrust washers (30).
    - Mark the gears and the case halves as left and right.
14. Differential pinion spider (33).
15. Differential pinion gears (32) and thrust washers (31) from the spider (33).

Inspect

- Drive pinion bearing preload (figure 3).
- For looseness of the pinion assembly by moving it back and forth. (Looseness indicates excessive bearing wear).

16. Pinion assembly cage bolts (7) and washers (8) (figure 4).
17. Pinion assembly cage (10).
    - Tap on the pilot end of the pinion with a hammer and a brass drift if necessary.
18. Pinion cage shims (11).
    - Keep the shims together for measurement later in the procedure.
    - Place the pinion cage in a soft-jawed vice.
19. Pinion flange nut (1) and washer (2) using J 8614-01 to hold the flange (figure 5).
20. Pinion flange using J 8614-01 (figure 6).
21. Pinion (14) from the pinion cage (10).
    - Place the cage into an arbor press as shown in figure 7 and press the pinion from the cage. Do not let the pinion fall to the floor.
22. Collapsible spacer (12) from the pinion.
23. Inner bearing (13) from the pinion (14).
    - Press the bearing from the pinion using J 22912-01 (figure 8).
24. Pinion seal (5) from the pinion cage.
    - Drive the seal from the cage with a hammer and punch.
25. Front bearing (6) from the cage.
26. Bearing cups from the pinion cage.
27. Pilot bearing (15) from the axle housing using a hammer and brass drift (figure 9).

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

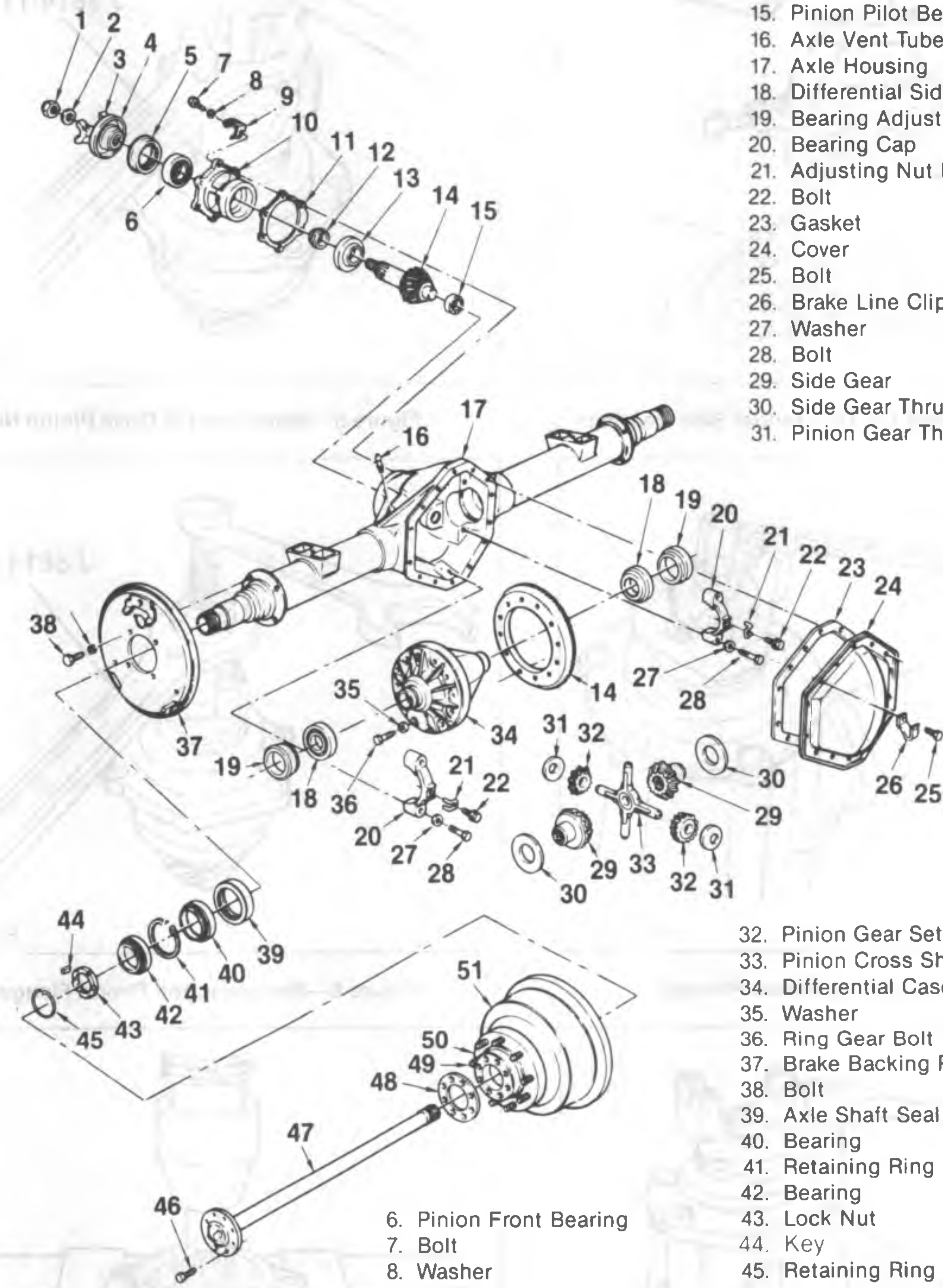
Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.



1. Pinion Nut
2. Washer
3. Pinion Flange
4. Slinger
5. Pinion Oil Seal
6. Pinion Front Bearing
7. Bolt
8. Washer
9. Brake Line Clip
10. Pinion Cage
11. Shim
12. Collapsable Spacer
13. Pinion Rear Bearing
14. Pinion and Ring Gear Set
15. Pinion Pilot Bearing
16. Axle Vent Tube
17. Axle Housing
18. Differential Side Bearing
19. Bearing Adjusting Nut
20. Bearing Cap
21. Adjusting Nut Lock
22. Bolt
23. Gasket
24. Cover
25. Bolt
26. Brake Line Clip
27. Washer
28. Bolt
29. Side Gear
30. Side Gear Thrust Washer
31. Pinion Gear Thrust Washer
32. Pinion Gear Set
33. Pinion Cross Shaft
34. Differential Case
35. Washer
36. Ring Gear Bolt
37. Brake Backing Plate
38. Bolt
39. Axle Shaft Seal
40. Bearing
41. Retaining Ring
42. Bearing
43. Lock Nut
44. Key
45. Retaining Ring
46. Bolt
47. Axle Shaft
48. Gasket
49. Wheel Stud
50. Wheel Hub
51. Brake Drum

F-05900

Figure 1—Rear Axle Components

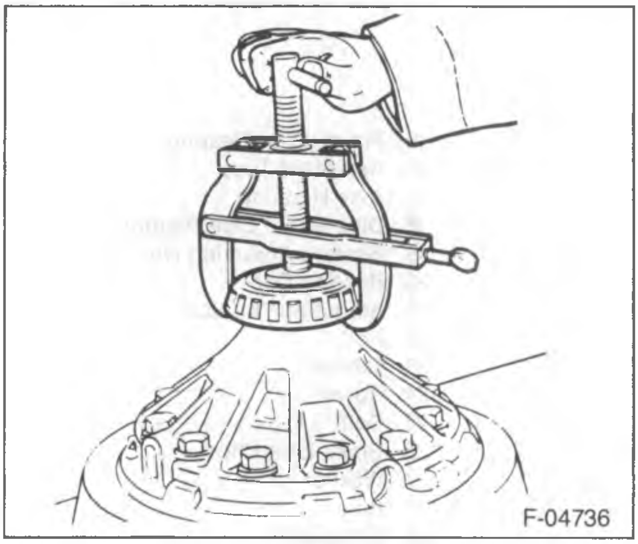


Figure 2—Removing the Differential Side Bearings

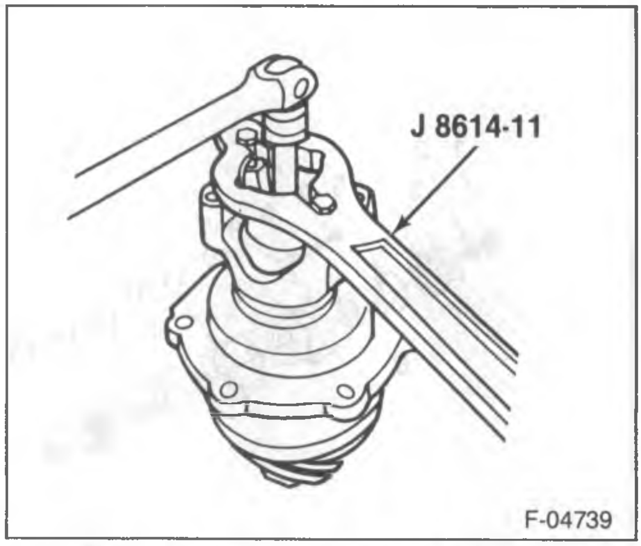


Figure 5—Removing the Drive Pinion Nut

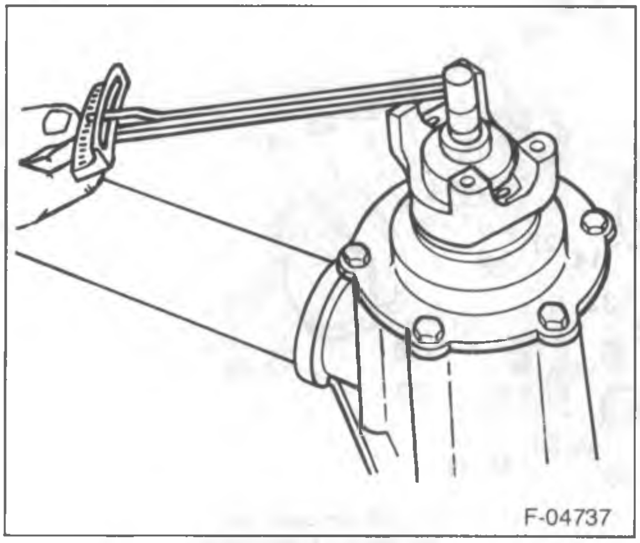


Figure 3—Checking Pinion Preload

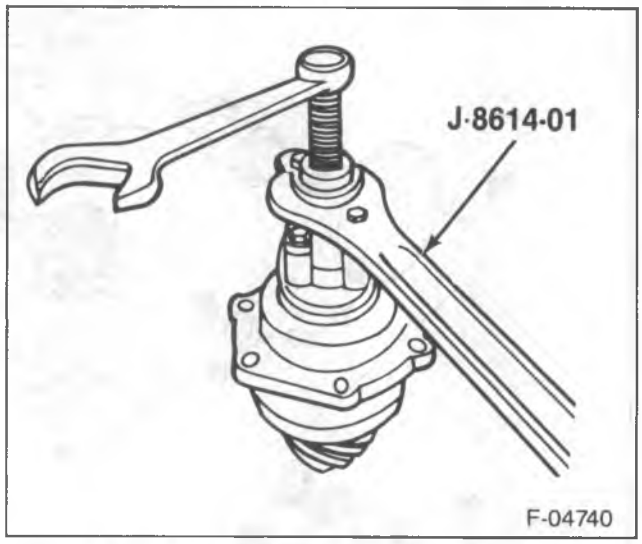


Figure 6—Removing the Pinion Flange

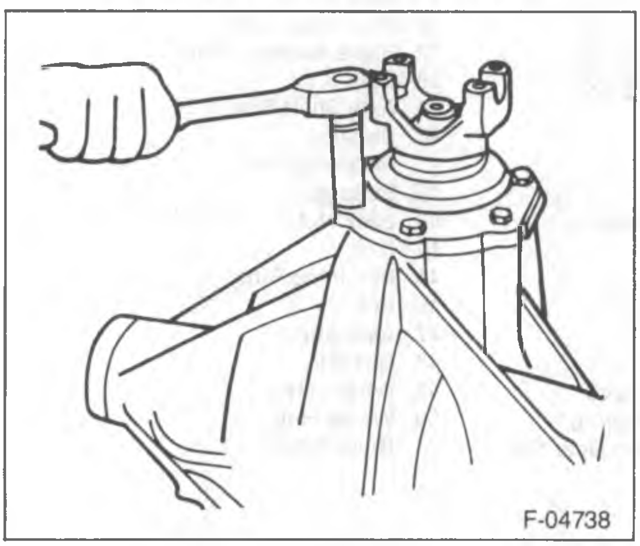


Figure 4—Removing the Pinion Cage

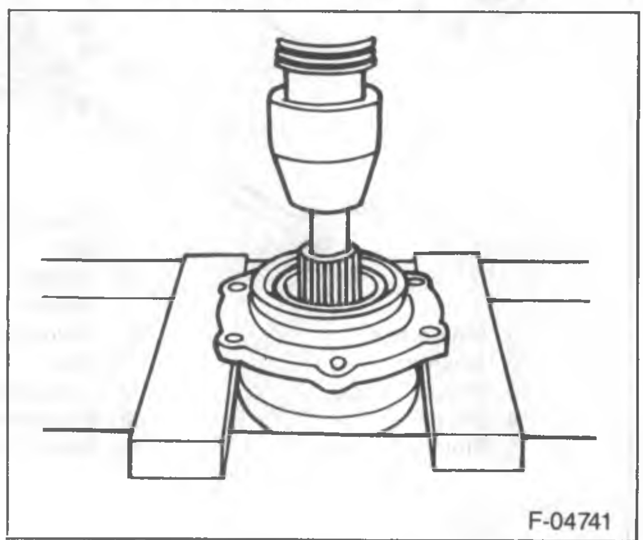


Figure 7—Pressing the Drive Pinion from the Cage

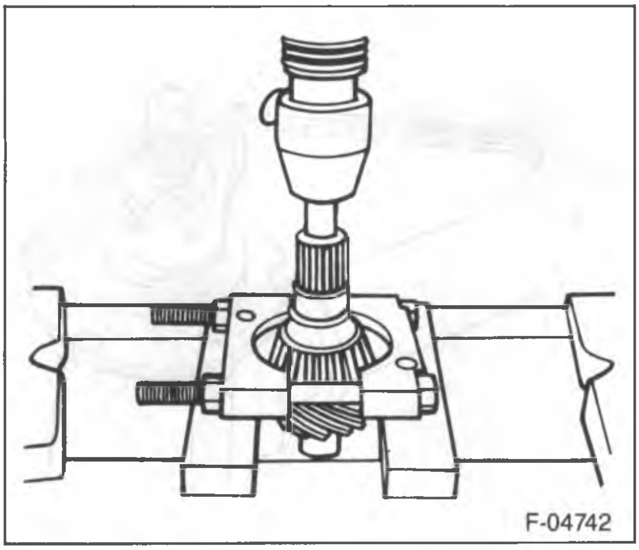


Figure 8—Removing the Pinion Inner Bearing

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

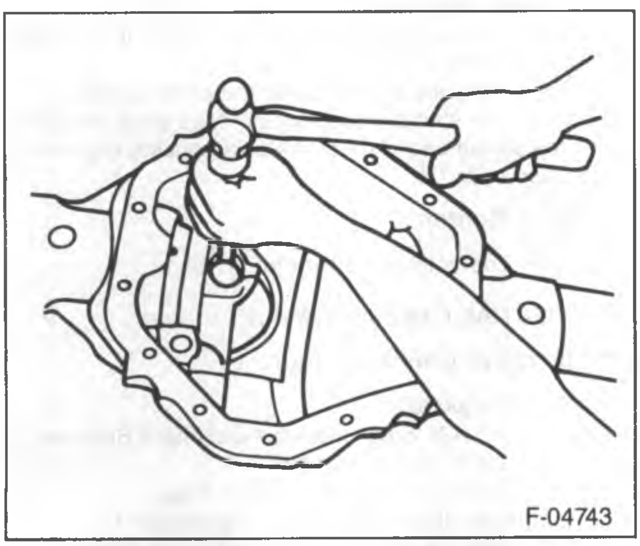


Figure 9—Removing the Pilot Bearing

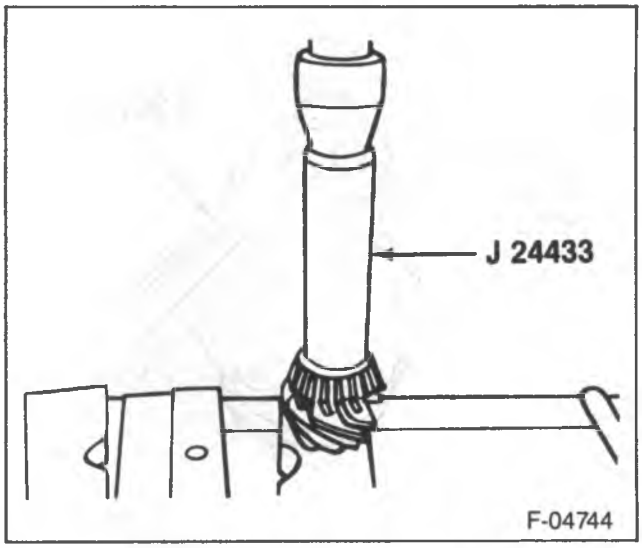


Figure 10—Installing the Inner Pinion Bearing

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

PINION ASSEMBLY

Install or Connect (Figure 1)

Tools Required:

J 24433 Rear Pinion Bearing Cone Installer
J 8092 Driver Handle
J 8608 Outer Pinion Bearing Cup Installer
J 8614-01 Pinion Flange Holder

- Lubricate all parts with axle lubricant.

1. Pinion rear bearing (13) onto the pinion.
   - Press the bearing onto the pinion using J 24433 (figure 10).

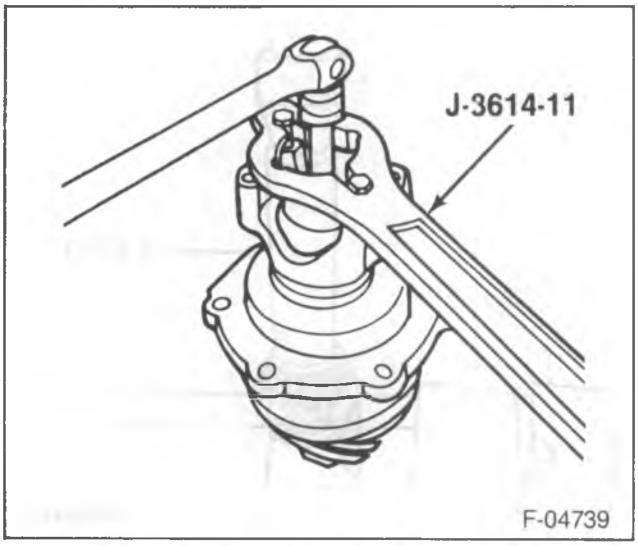


Figure 11—Installing the Pinion Nut

2. Outer pinion bearing cup (6) using J 8608 and J 8092.
3. Inner pinion bearing cup (13) using J 24432 and J 8092.
4. A new collapsible spacer (12) to the pinion.
5. Pinion (14) into the pinion gage (10).
6. Pinion outer bearing (6) onto the pinion.
   - Press the bearing onto the pinion.
7. Pinion oil seal (5) using J 24434 and J 8092.
8. Pinion flange oil deflector (4) and pinion flange (3) to the pinion splines.
9. Washer (2) and a new pinion nut (1).
- Place the pinion cage assembly into the vice.
10. Flange holder J 8614-01 to the pinion flange.

Tighten (Figure 11)

- The nut until the pinion end play is just taken up. Rotate the pinion while tightening in order to seat the bearings. Once there is no end play in the pinion, the preload torque should be checked.
- Remove J 8614-01. Using an inch-pound torque wrench, check the pinion preload by rotating the pinion with the wrench. Preload should be at or below 2.8 to 4.0 N·m (25 to 35 in. lbs.) for new bearings, or 0.56 to 1.7 N·m (5-15 in. lbs.) for used bearings (figure 12).
- If the preload torque is below the preloads given above, continue torquing the nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
- Once the preload has been obtained, rotate the pinion several times to assure that the bearings have seated. Recheck the preload, and adjust if necessary.

11. Pinion cage (10) to the axle housing. Refer to "Pinion Installation" in this section.

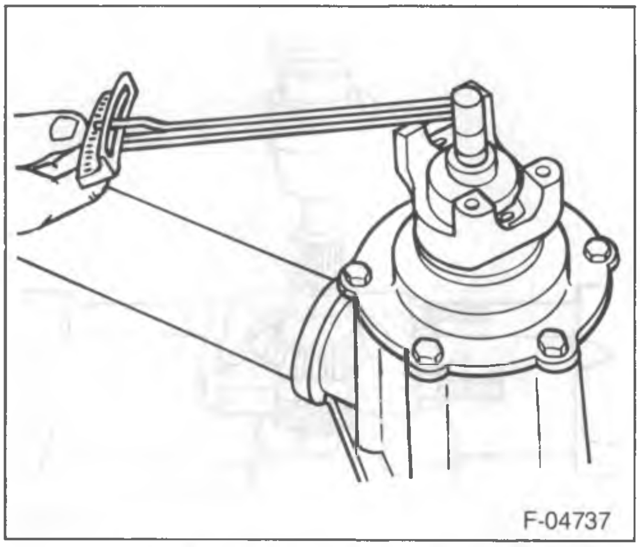


Figure 12—Checking Pinion Preload

PINION INSTALLATION

Install or Connect

Tools Required:
J 34943 Pinion Pilot Bearing Installer
J 8092 Driver Handle

1. Pinion pilot bearing (15) using J 34943 and J 8092 (figure 13).
   - Bolt the guide plate to the axle housing.
   - Place the bearing (15) onto the guide.
   - Drive the bearing into the housing. The part number of the bearing must face the pinion flange.
- Measure the pinion bearing shims (11). If a new pinion and ring gear set is installed, the pinion bearing shim pack must be adjusted.
- Examine the heads of the new and old drive pinions. Compare these codes, and adjust the pinion bearing shim pack accordingly. The chart in figure 14, shows the proper adjustment to be made to the shim pack.
- Pinion service shims are available in sizes from 0.006 to 0.024-inch.
- If the original pinion is being used, the original pinion shims should also be used.

2. Pinion bearing shims (11) to the pinion cage.
   - The shims, housing, and cage must be clean.
3. The pinion cage (10) to the axle housing (figure 15).
4. Cage bolts (7).

Tighten

- The bolts to 88 N·m (65 ft. lbs.).

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tools Required:
J 24429 Side Bearing Adjustment Spanner
J 8092 Driver Handle
J 8107 Side Bearing Puller Plug

- Lubricate all parts with rear axle lubricant.

1. Differential pinion gears (32) and thrust washers (31) to the spider (33).

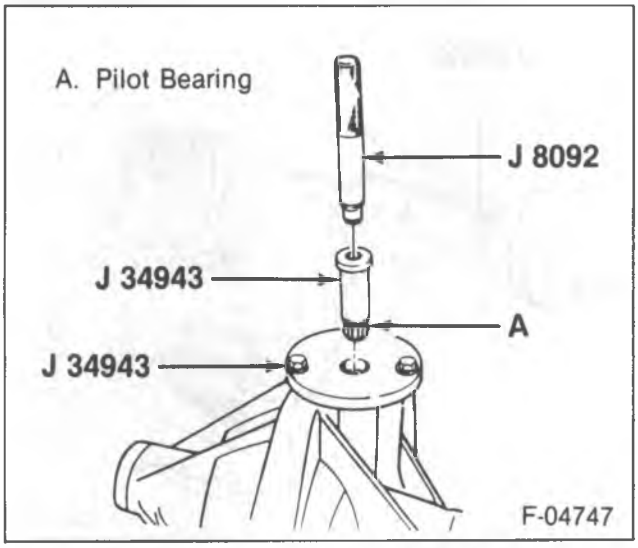


Figure 13—Installing the Pilot Bearing

		CODE NUMBER ON ORIGINAL PINION				
		+2	+1	0	-1	-2
Code Number On Service Pinion	+2	—	Add .001	Add .002	Add .003	Add .004
	+1	Subt. .001	—	Add .001	Add .002	Add .003
	0	Subt. .002	Subt. .001	—	Add .001	Add .002
	-1	Subt. .003	Subt. .002	Subt. .001	—	Add .001
	-2	Subt. .004	Subt. .003	Subt. .002	Subt. .001.	—

F-04748

Figure 14—Pinion Depth Codes

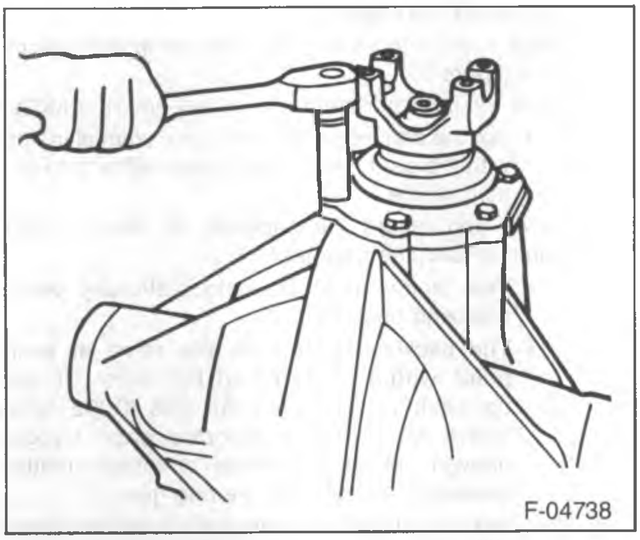


Figure 15—Installing the Pinion Cage

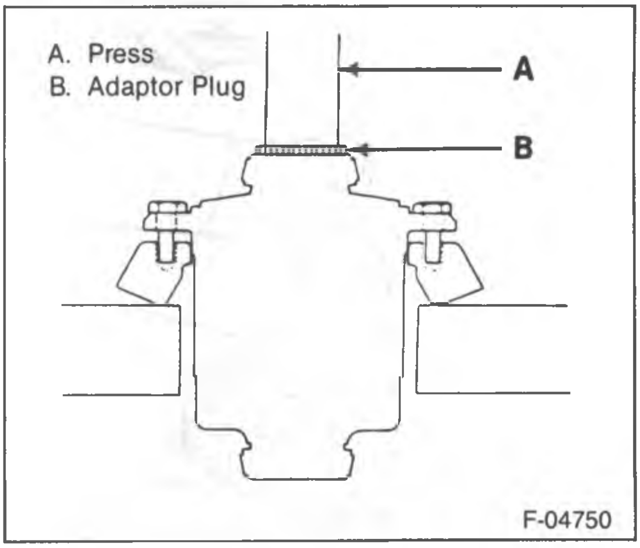


Figure 16—Installing the Ring Gear to Case

2. Differential side gears (29) and thrust washers (30) to the differential case halves in their original locations.
3. Differential spider (33) to the differential.
4. The case halves.
   - Align the scribe marks on the case halves.
- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.
5. Ring gear (14) to the differential (figure 16).
   - Thread two left-hand threaded studs into the ring gear on opposite sides.
   - Place the ring gear onto the case, and align the holes in the case with the studs.
   - Press the ring gear onto the case far enough to start the bolts using J 8107 to protect the differential from the press ram.
6. New ring gear bolts (36).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

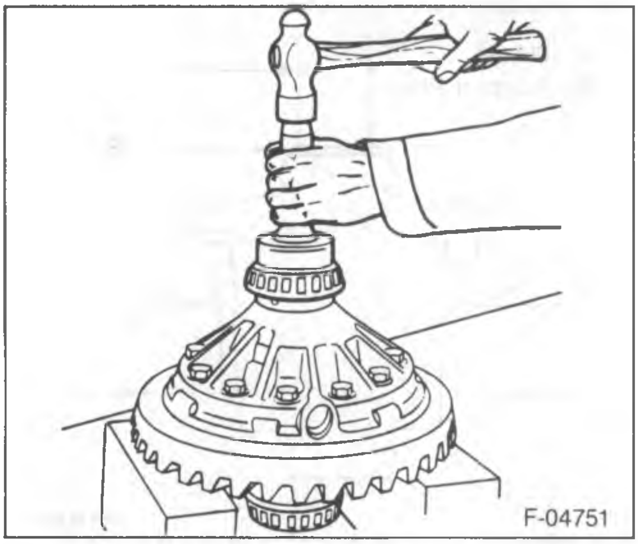


Figure 17—Installing Differential Bearings

Tighten

- The ring gear bolts in sequence to 163 N·m (120 ft. lbs.).

7. Differential side bearings (18) using J 24429 and J 8092 (figure 17).
   - Place J 8107 into the differential on the side opposite of bearing installation to protect the differential case.
   - Drive the bearing onto the case using J 24429 and J 8092.
8. Differential case (34) to the axle housing. Refer to "Side Bearing Preload Adjustment" in this section.

SIDE BEARING PRELOAD ADJUSTMENT

- The differential side bearing preload is adjusted by two adjusting nuts in the differential bearing bore. The bore and the bearing cap provide the mating threads for the bearing nut.
- The differential must be initially preloaded in order to determine the backlash of the gear set. After the backlash has been set, the final bearing preload is set.

Install or Connect (Figure 18)

Tool Required:

J 24429 Side Bearing Backlash Spanner Wrench

1. The bearing cups (20) to the differential bearings in their original locations.
2. Differential assembly to the axle housing.
3. Adjusting nuts (19).
4. Bearing caps (20) and bolts (28) in their original positions.
   - Assembly the caps loosely.

- Loosen the right side adjusting nut, and tighten the left side nut using J 24429 until the ring gear contacts the drive pinion. Do not force the gears into contact. This is the zero lash point.
- Back off the left adjusting nut approximately two slots to obtain the initial backlash adjustment.

5. Adjusting nut lock (21) and lock bolt (22) to the left nut.

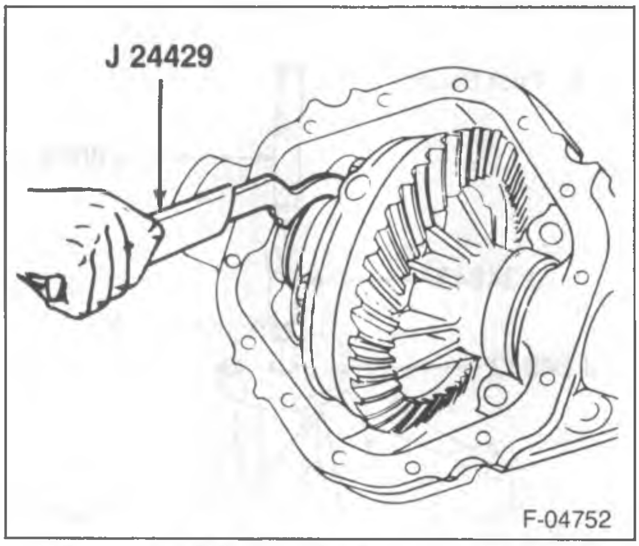


Figure 18—Adjusting the Differential Preload

   - Do not tighten.

- Tighten the right adjusting nut firmly to force the case into solid contact with the left adjusting nut. Rotate the pinion several times to seat the bearings.
- Loosen the right adjusting nut until it is free from its bearing.
- Tighten the right adjusting nut until it just contacts the bearing. Additionally tighten the nut two slots for used bearings, or three slots if new bearings are installed.

6. Adjusting nut lock (21) and lock bolt (22) to the left nut.
   - Do not tighten.

Tighten

- The bearing cap bolts (28) to 183 N·m (135 ft. lbs.).

- Measure the ring gear to pinion backlash. Refer to "Backlash Adjustment" in this section.

BACKLASH ADJUSTMENT

1. Install a dial indicator to the case using a magnetic base (figure 19).
2. Place the indicator stem at the heel end of a tooth.
   - Set the dial indicator so that the stem is in line with the gear rotation and perpendicular to the tooth angle.
3. Check and record the backlash at three or four points around the ring gear.
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
4. The backlash at the minimum lash point measured should be between 0.125-0.200 mm (0.005-0.008-inch). The maximum acceptable reading is 0.076-0.203 mm (0.003-0.008-inch).

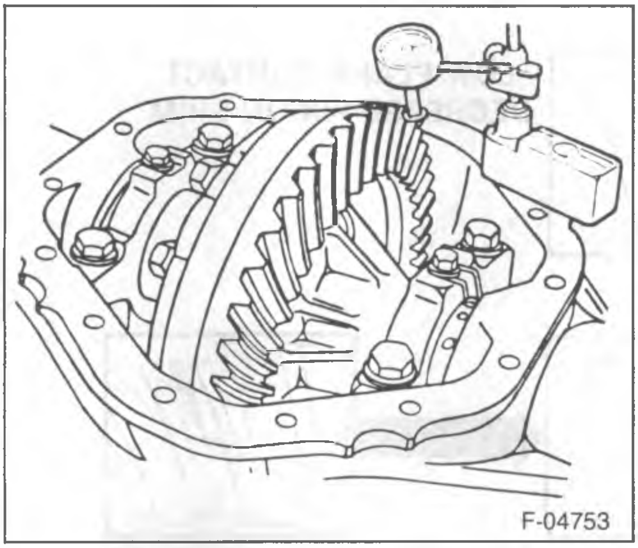


Figure 19—Measuring Gear Set Backlash

5. If the reading is too high, remove the adjusting nut locks, and loosen the right nut one slot, and tighten the left nut one slot (figure 18).
6. If the reading is too low, remove the adjusting nut locks, and loosen the left nut one slot, and tighten the right nut one slot.
- The side bearing preload will remain set, as long as the adjusting nut is tightened an equal amount to the nut which was loosened.

FINAL ASSEMBLY

Install or Connect (Figure 1)

1. Drive axles. Refer to the proper service manual.
2. Cover gasket (23) and cover (24) to the housing.
3. Cover bolts (25).

Tighten

- The cover bolts (25) to 27 N·m (20 ft. lbs.).

4. Axle housing to the vehicle. Refer to the proper service manual.
5. Lubricant to the rear axle.

GEAR TOOTH PATTERN CHECK

Checking the ring ger to pinion tooth pattern is to be done only after setting up the axle according to the methods in this section. The pattern check is NEVER to be used as an initial check, or instead of checking pinion depth and backlash adjustments. This check is only to be used to verify the correct adjustment of the gear set after setup.

1. Wipe all oil out of the carrier, and carefully clean each tooth of the ring gear (figure 20).
2. Use gear marking compond 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium-stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten the bearing cap bolts to the specified torque.

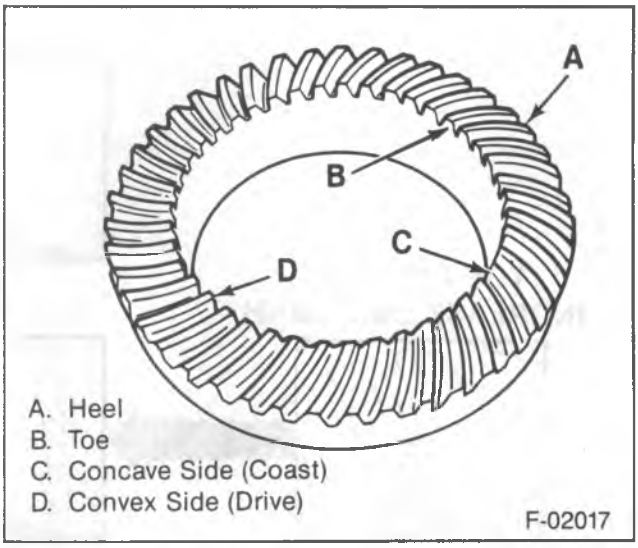


Figure 20—Gear Tooth Nomenclature

4. Expand the brake shoes until a torque of 40 to 50 ft. lbs. is required to turn the pinion.
   A test made without loading the gears will not give a satisfactory pattern. Turn the pinion flange with a wrench so that the ring gear rotates one full revolution, then reverse the rotation so that the ring gear rotates one revolution in the opposite direction.
5. Observe the pattern on the ring gear teeth and compare this with figure 21.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect tooth contact pattern: backlash, and the position of the drive pinion in the carrier. The effects of bearing preloads are not readily apparent on hand loaded tooth contact pattern tests; however, these adjustments should be within specifications before preceeding with backlash and drive pinion adjustments.

The position of the drive pinion is adjusted by increasing or decreasing the distance between the pinion head and the centerline of the ring gear. The shim is used in the rear axle to compensate for manufacturing tolerances. Decreasing the distance will move the pinion closer to the centerline of the ring gear. Increasing the distance will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims and/or adjusting nuts, which move the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload.)

If the thickness of the right shim is increased (along with decreasing the left shim thickness), backlash will increase.

The backlash will decrease if the left shim thickness is increased (along with a decrease in right shim thickness).

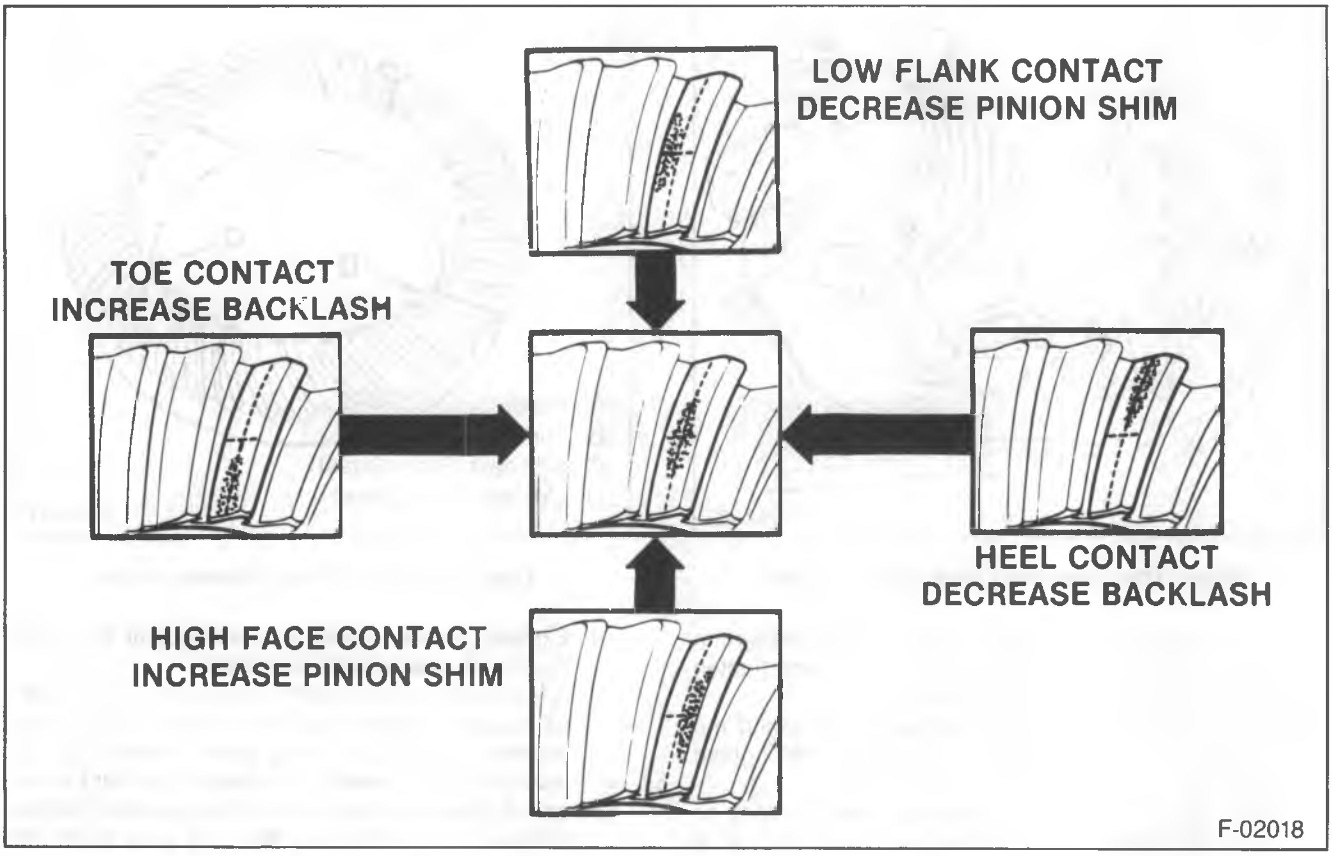


Figure 21—Gear Tooth Pattern

SPECIFICATIONS

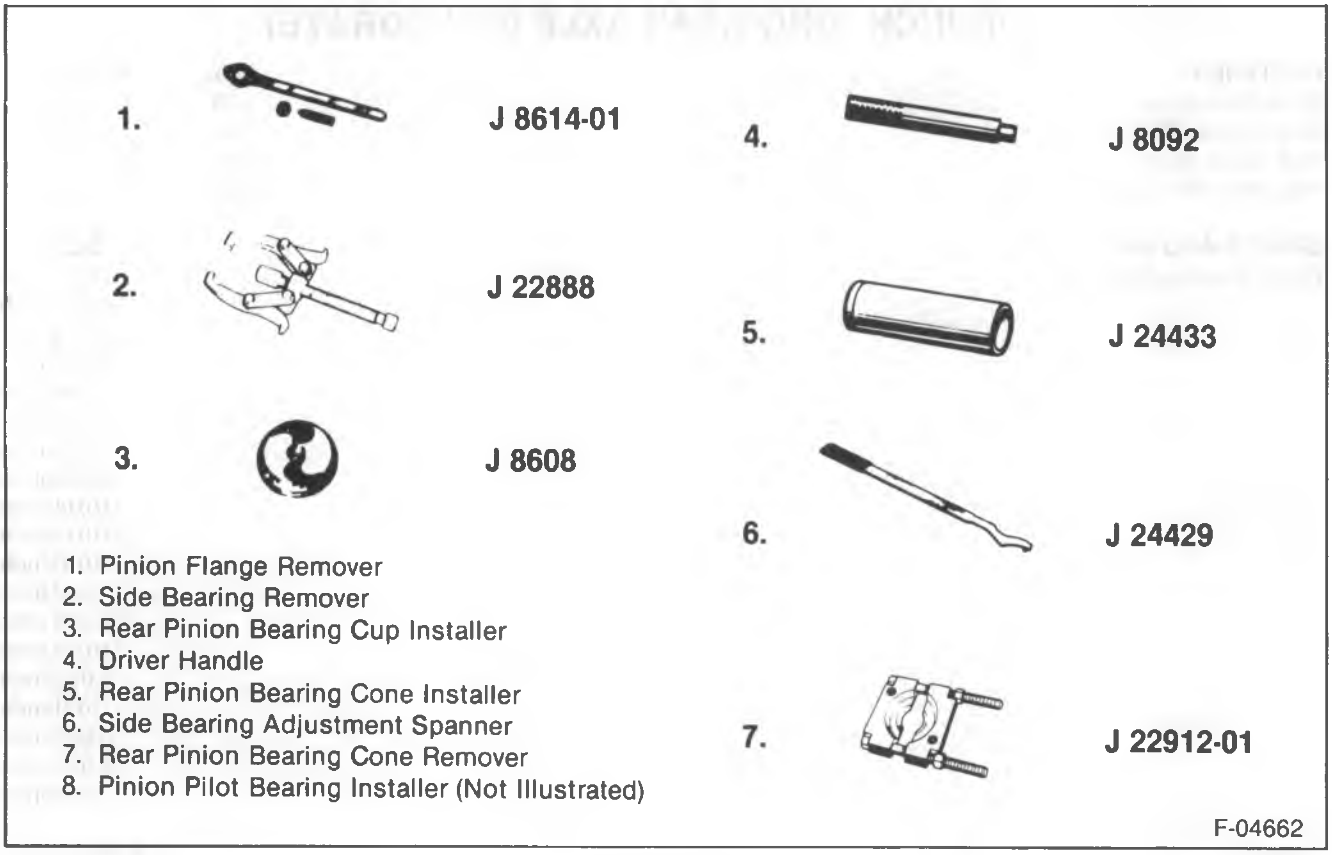
10½-INCH RING GEAR AXLE (CORPORATE)

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	163	120
Bearing Cap Bolts	183	135
Axle Cover Bolts	27	20
Adjusting Nut Lock Bolts	30	22

SPACER AND SHIM SIZES	SIZE
Pinion Bearing Shims	0.006-inch
	0.007-inch
	0.008-inch
	0.009-inch
	0.010-inch
	0.011-inch
	0.012-inch
	0.013-inch
	0.014-inch
	0.015-inch
	0.016-inch
	0.017-inch
	0.018-inch
	0.019-inch
	0.020-inch
	0.021-inch
	0.022-inch
	0.023-inch
	0.024-inch

Lubricant 80W-90 GL-5

SPECIAL TOOLS



Special Tools

SECTION 4B5

DANA REAR AXLES

CONTENTS

9¾-INCH RING GEAR

DESCRIPTION

The Dana 9¾-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is full-floating. The axle shaft is supported at the wheel ends by the wheel hubs. The bolts that attach the shaft to the hub, support the axle at the hub. The splined end of the shaft is supported by the differential.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack between the inner pinion bearing cup and the rear axle housing. The pinion bearing preload is set by a shim pack at the front of the axle housing between the bearing cone and the pinion gear.

The ring gear is bolted onto the differential case with right-hand thread bolts.

The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearings and the differential case. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. Differential side bearing preload is set by the axle housing. (The axle housing is spread to remove the differential from the housing). When the spreader is removed, the housing sets the bearing preload.

Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a hub seal, and RTV between the differential cover and the rear axle housing.

All Dana axles are identified by the part number on the right axle tube next to the manufacturing date which is next to the carrier. The model number is cast on the ear of the carrier. The carrier cover does not have a drain plug.

CHECK THE AXLE BEFORE DISASSEMBLY

Inspect

- Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. The ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing cage.

- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

Remove or Disconnect (Figure 1)

Tools Required:
- J 24385-01 Differential Housing Spreader
- J 29721 Differential Side Bearing Remover
- J 29721-70 Side Bearing Adapters
- J 8107-3 Side Bearing Puller Plug
- J 8614-01 Pinion Flange Holder

- Place the rear axle in a suitable support.

1. The differential cover bolts (17) and the differential cover (14) (figure 2).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (38). Refer to the proper service manual.
3. Bearing cap bolts (19) (figure 3).
4. Bearing caps (18).
   - The mating letters are stamped on the caps and the axle housing. The caps are to be reassembled exactly as removed.

- Assemble J 24385-01 to the differential housing as shown in figure 4.
- Assemble the dial indicator as shown in figure 4. Preset the gage at least 0.020-inch, and then rotate the gage housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

- Spread the carrier while examining the dial indicator. Do not spread the carrier more than 0.38 mm (0.015-inch).

5. Differential case (22) from the carrier (1) using two pry bars (figure 5).
6. The spreader J 24385-01 from the carrier (1).
7. Bearing cups (20).
   - Mark the cups as left and right, and place them with the proper bearing caps.
8. Differential side bearings (20) using J 29721, J 29721-70, and J 8107-3 (figure 6).
   - Mark the bearings as left and right, and place them with the proper bearing caps and cups.
9. Differential shims (21).
   - Mark the shims as left or right.
10. Ring gear bolts (23).

- Place shop towels over the vice jaws. Put the differential case in the vice (figure 7).

NOTICE: Do not pry the ring gear from the case, this will damage the ring gear and the differential case.

11. Ring gear (2) from the differential case using a rawhide hammer.
    - Ring gear (2) from the vise.

- Put the differential case in the vise.

12. Lock pin (29) from the differential using a hammer and a punch (figure 8).
13. Pinion shaft (28) using a hammer and a brass drift (figure 9).
14. Differential pinion gears (24) and thrust washers (26).
    - Rotate the side gears until the pinion gears are in the opening of the differential (figure 10).
15. Differential side gears (25) and thrust washers (27).
    - Mark the gears and washers as left and right.

- Replace the carrier cover (14) using two bolts (17) to keep the pinion from falling to the floor.

Inspect

- Drive pinion bearing preload (figure 11).
- For looseness of the pinion assembly by moving it back and forth. (Looseness indicates excessive bearing wear).

16. Pinion nut (12) and washer (11) using J 8614-01 to hold the pinion (figure 12).
17. Pinion flange (10) using J 8614-01 (figure 13).
18. Pinion (2) from the carrier using a rawhide hammer to tap the pinion (figure 14).
19. Carrier cover (14) and the pinion (2).
20. Pinion preload shims (6).
    - Keep the shims together on the bench.
21. Pinion seal (9).
22. Pinion outer bearing (7) and oil slinger (8).
23. Bearing cups (3) and (7) from the axle housing using a hammer and a punch (figure 15).
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.
24. Pinion adjusting shims (4) and baffle (5).
    - Keep the shims together on the bench.
25. Pinion inner bearing (3) using J 29721 and J 29721-70 (figure 16).

CLEANING

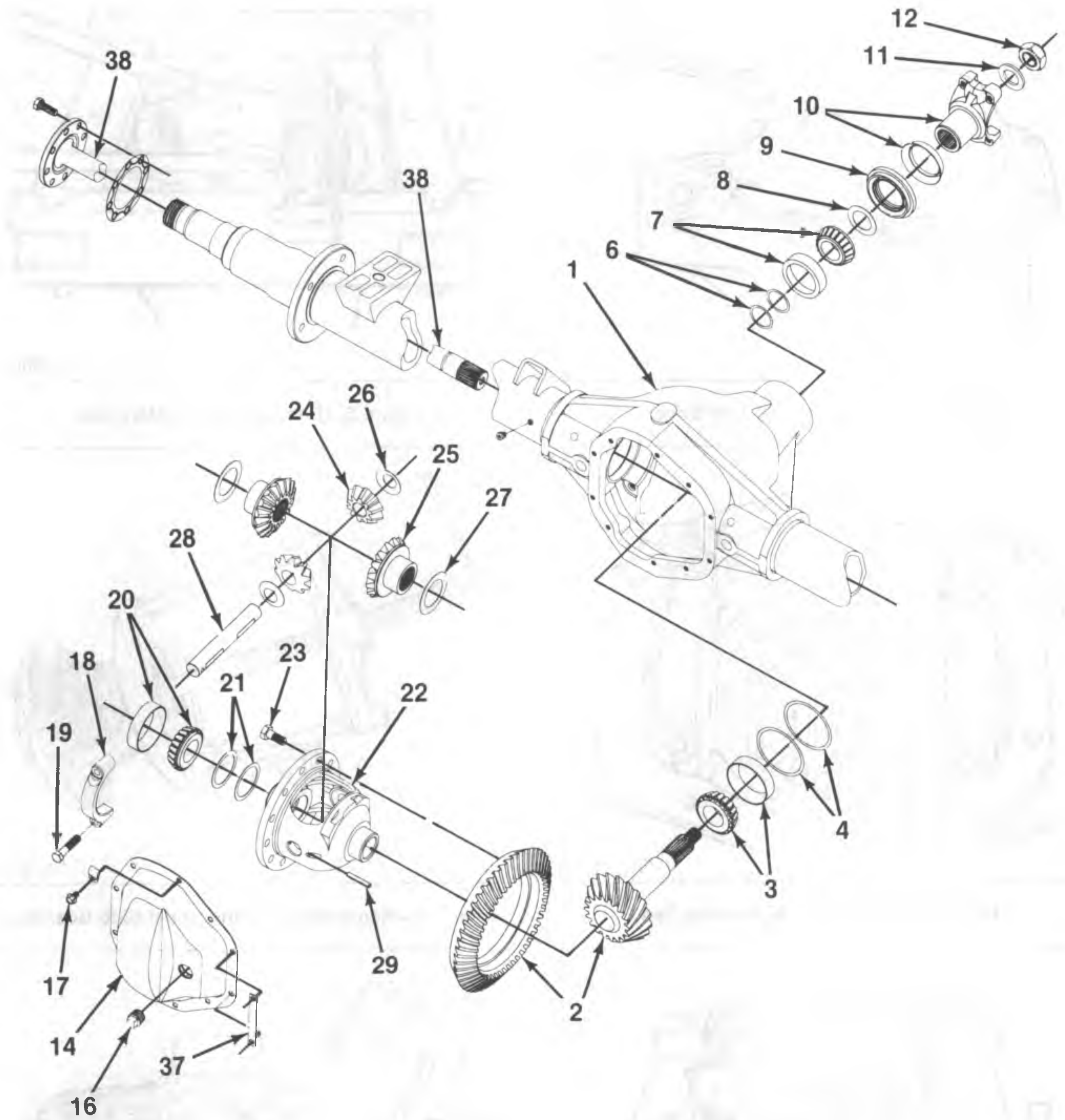
Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.



1. Axle Housing
2. Ring Gear and Pinion Set
3. Inner Pinion Bearing
4. Shims
6. Preload Shims
7. Bearing
8. Slinger
9. Pinion Oil Seal
10. Pinion Flange
11. Washer
12. Pinion Nut
14. Cover
16. Plug
17. Bolt
18. Bearing Cap
19. Bolt
20. Bearing
21. Shim
22. Differential Case
23. Ring Gear Bolt
24. Pinion Gear
25. Side Gear
26. Pinion Thrust Washer
27. Side Gear Thrust Washer
28. Pinion Shaft
29. Roll Pin
37. ID Tag

F-05909

Figure 1—Rear Axle Components

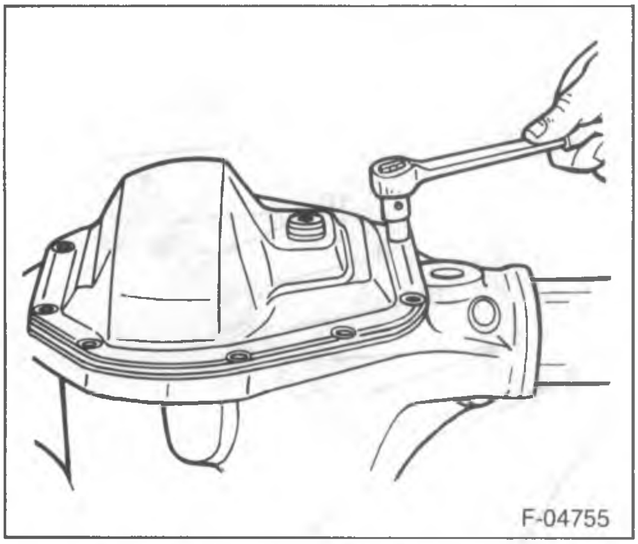


Figure 2—Removing the Axle Cover

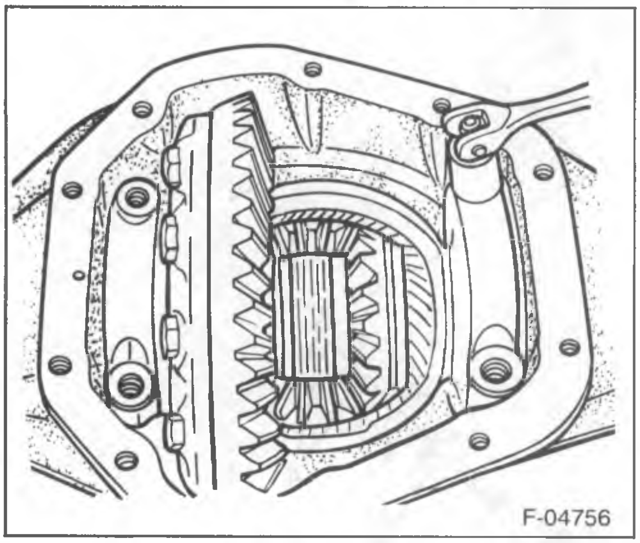


Figure 3—Removing the Bearing Cap

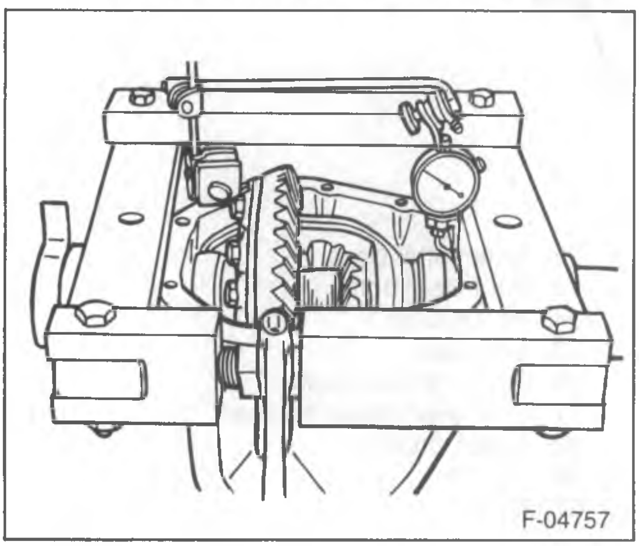


Figure 4—Spreading the Differential Case

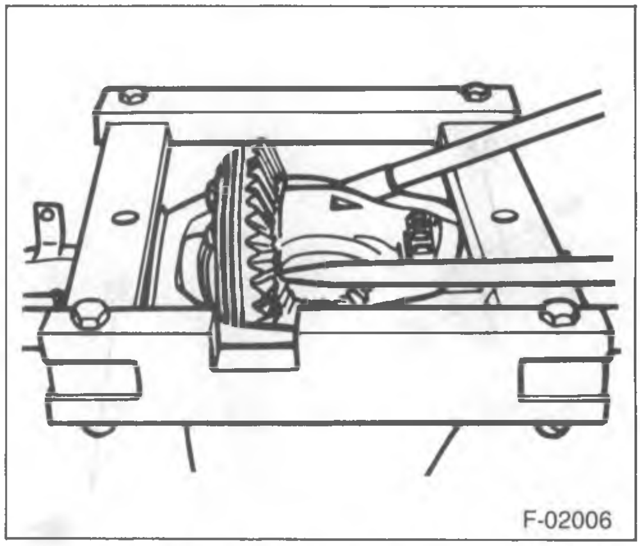


Figure 5—Removing the Differential

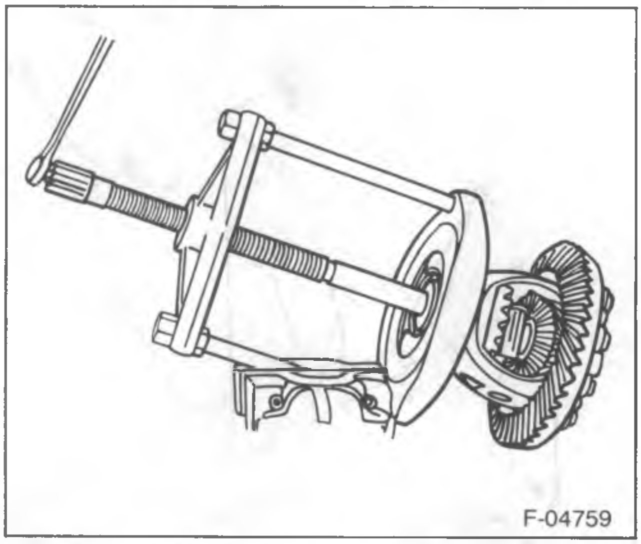


Figure 6—Removing the Differential Side Bearings

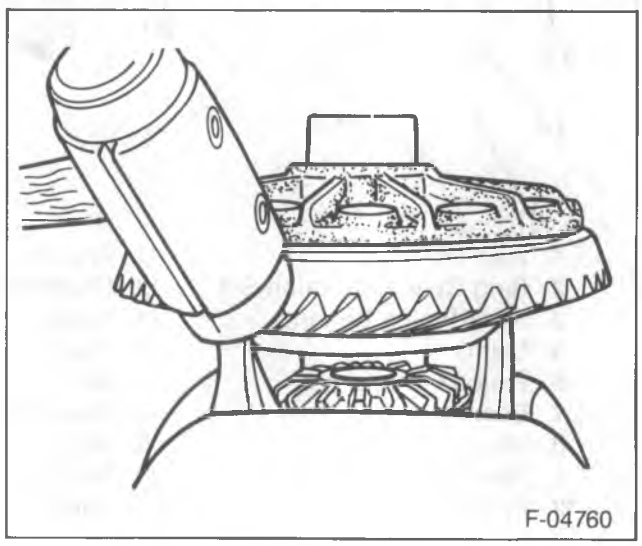


Figure 7—Removing the Ring Gear

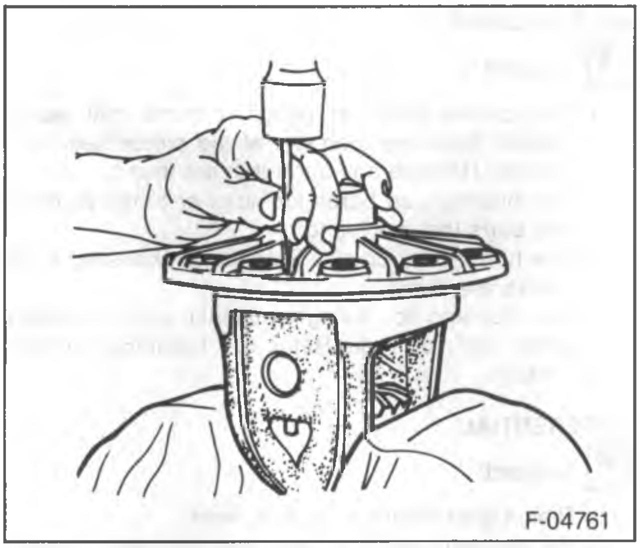


Figure 8—Removing the Lock Pin

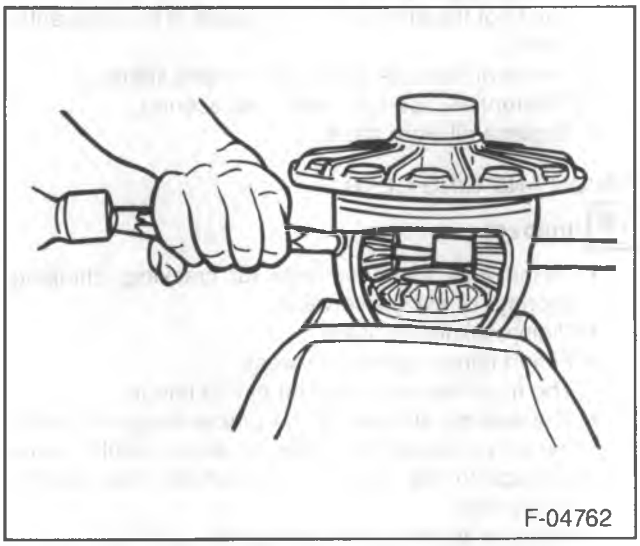


Figure 9—Removing the Pinion Shaft

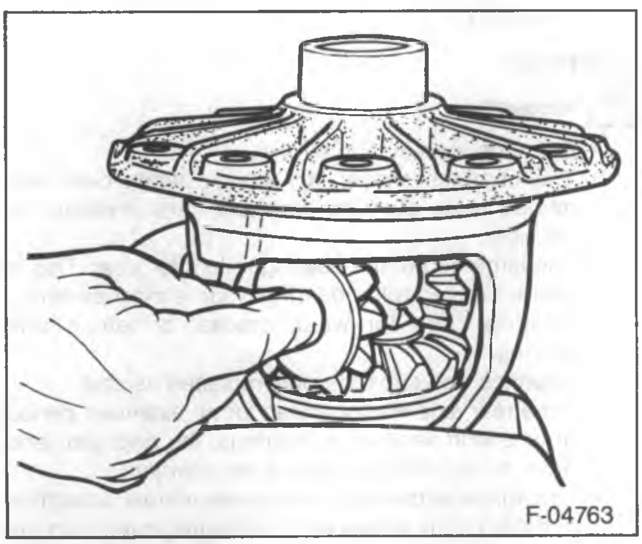


Figure 10—Removing the Pinion Gears

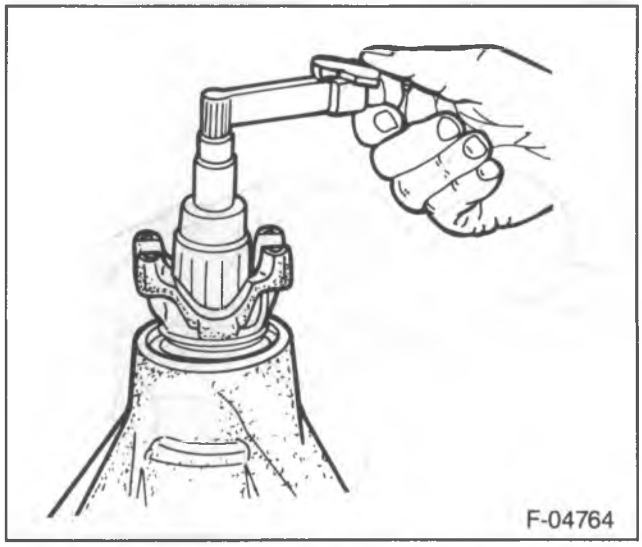


Figure 11—Checking the Pinion Preload

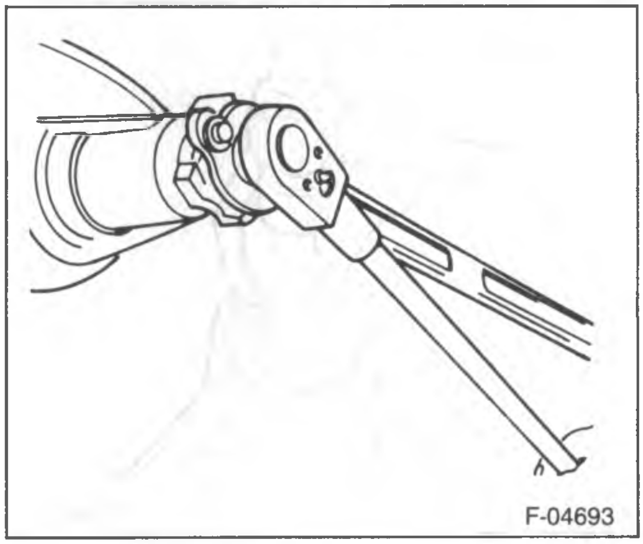


Figure 12—Removing the Drive Pinion Nut

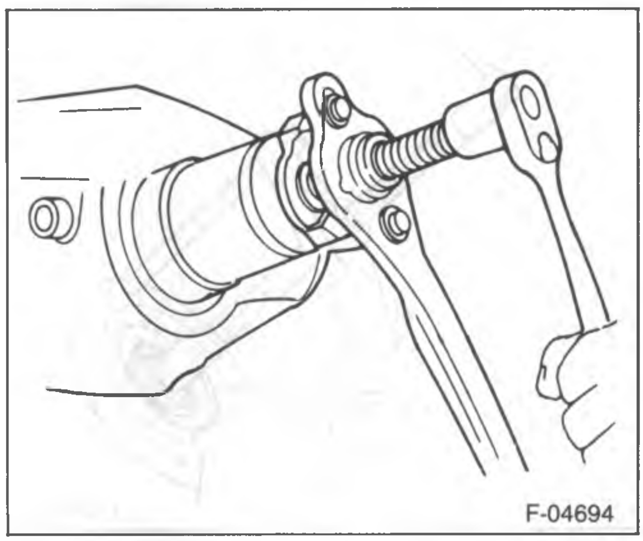


Figure 13—Removing the Pinion Flange

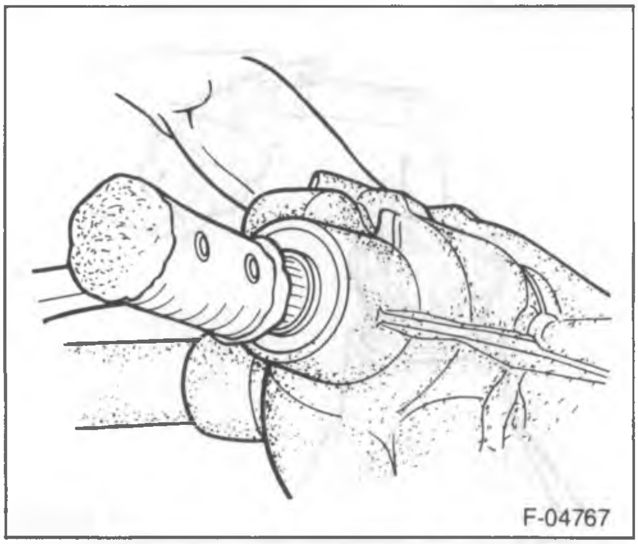


Figure 14—Removing the Pinion

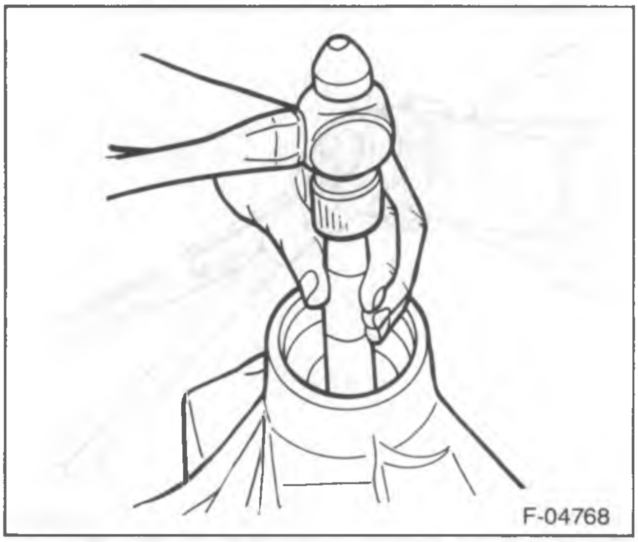


Figure 15—Removing the Bearing Cups

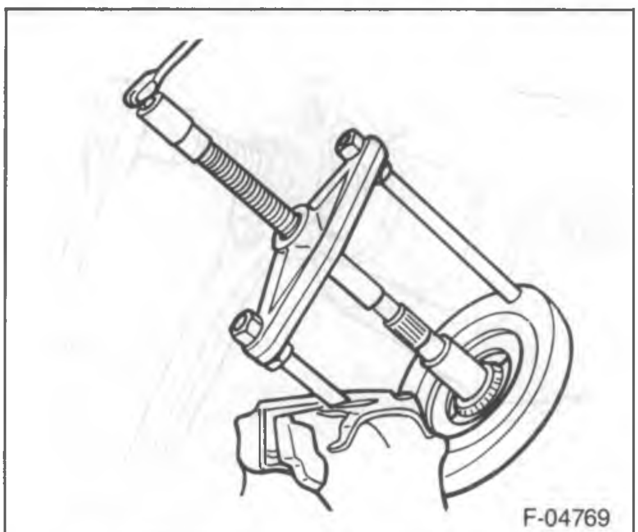


Figure 16—Removing the Pinion Inner Bearing

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

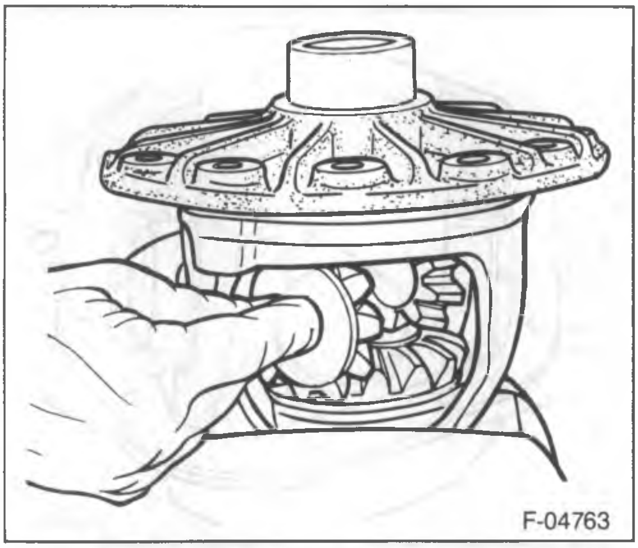


Figure 17—Installing the Pinion Gears

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

PINION ASSEMBLY

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

- Lubricate all parts with rear axle lubricant.

1. New side gear thrust washers (27) to the side gears (25).
2. Side gears (25) to the differential case.
   - Place the side gears in place on the same side as removed (figure 17).
3. Pinion gears (24) to the differential without the thrust washers (26).
   - Place the pinion gears onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
4. New pinion thrust washers (26).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
5. Pinion shaft (28).
   - Align the lock pin holes in the case and the shaft.
6. Lock pin (29) (figure 18).
   - Peen metal from the case over the lock pin.

- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.

7. Ring gear (20 to the differential case (22).
   - Thread two studs into the ring gear on opposite sides.

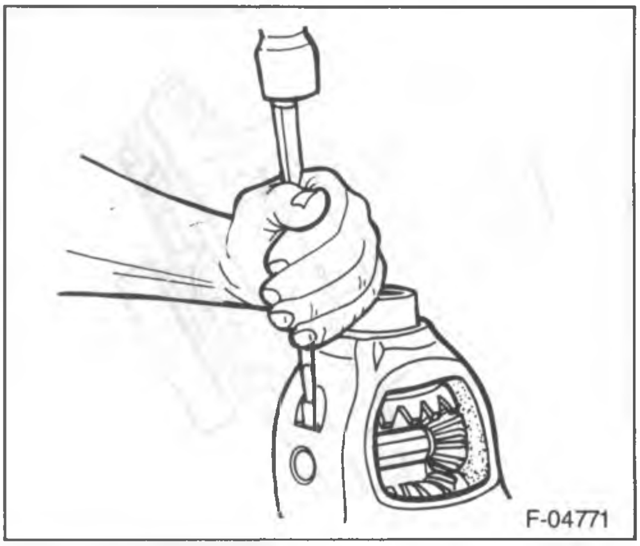


Figure 18—Installing the Lock Pin

   - Press the ring gear onto the case, and align the holes in the case with the studs.
8. New ring gear bolts (23) (figure 19).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

   - The new ring gear bolts in sequence to 150 N·m (110 ft. lbs.). Refer to "Specifications" for bolt information.
9. Master differential bearings D-117 (Miller Tools) to the differential (figure 20).

- Refer to "Determining Total Shim Pack Size" in this section.

DETERMINING TOTAL DIFFERENTIAL SHIM PACK SIZE

1. Assemble the differential case (22) to the axle housing. The pinion must not be installed.

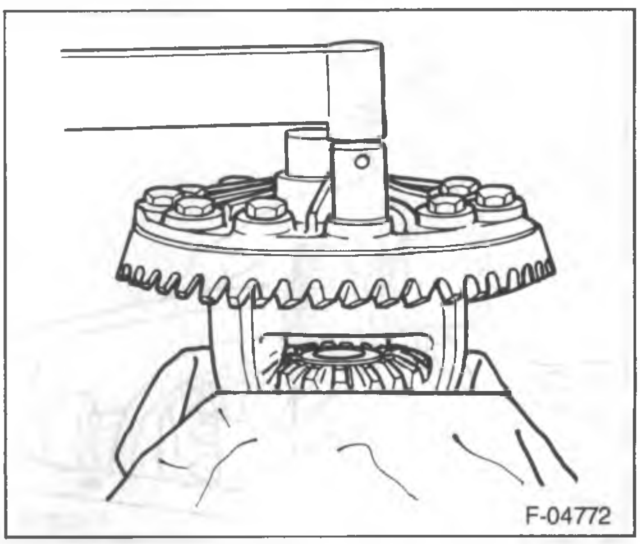


Figure 19—Installing the Ring Gear Bolts

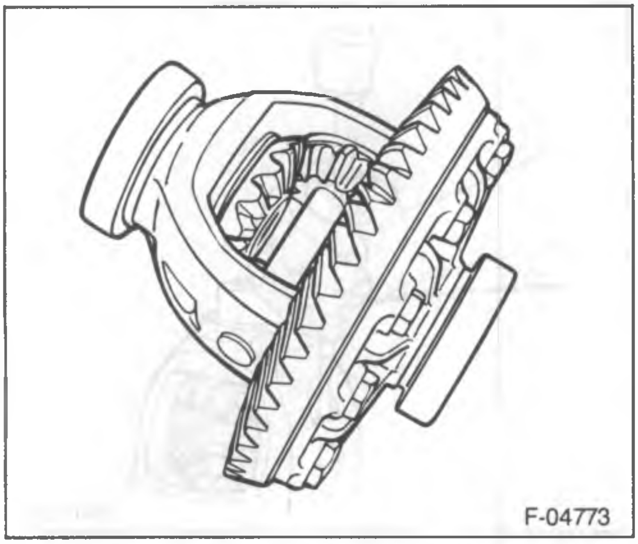


Figure 20—Differential with the Master Bearings

2. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 21).
3. Force the differential assembly as far as possible in the direction towards the indicator.
4. Preload the dial indicator one half of its travel. Place the tip of the indicator on a flat surface on the differential, just next to a ring gear bolt. Mark this location with a piece of chalk.
5. Zero the dial indicator.
6. Force the differential assembly in the opposite direction as far as it will go. Repeat this step until the same reading is obtained. Record the number of thousandths that the dial indicator traveled, not the reading on the dial. This will be the measurement of the shim pack without the bearing preload (which will be added later).
7. Remove the dial indicator from the axle.
8. Remove the differential case from the axle housing.

- Do not remove the master bearings from the differential.

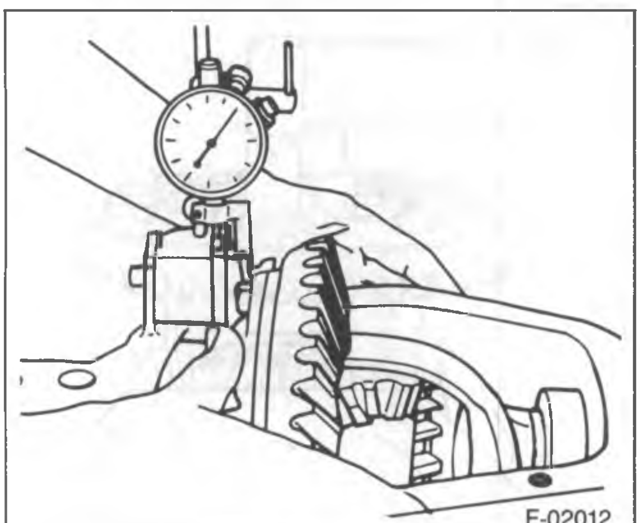


Figure 21—Determining Differential Shim Pack

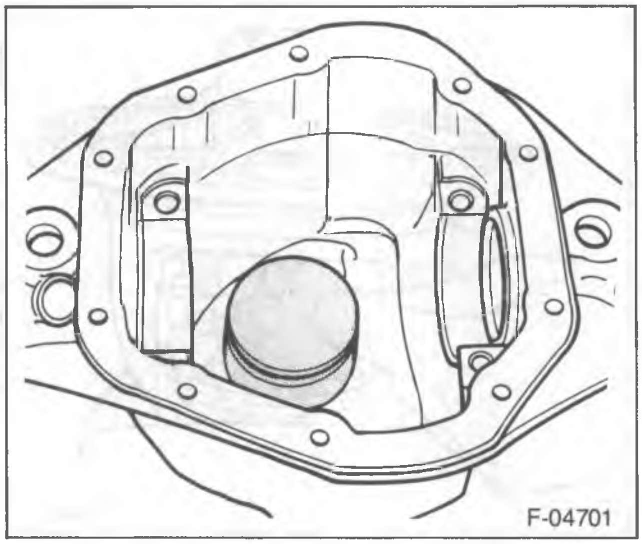


Figure 22—Master Pinion Block

PINION DEPTH ADJUSTMENT

Tools Required:

D-120 Master Pinion Block (Miller)
D-116-1 Pinion Height Block (Miller)
D-116-2 Master Discs (Miller)
D-115-3 Arbor (Miller)
D-115 Scooter Gage (Miller)

1. Clean the carrier bores and all the tools. The pinion bore must be free of nicks and dirt.
2. Install D-120 to the pinion bore (figure 22).
3. Place D-116-2 onto D-115-3.
4. Install the arbor and discs into the axle housing (figure 23).
5. Install D-116-1 onto D-120 and against the arbor (figure 24).
6. Place D-115 onto the height block (figure 25).
   - Place the gage on the lower step of the height block. Push the gage down on the height block. While applying pressure, set the dial indicator at zero.
7. Slide the gage over the arbor (figure 26).

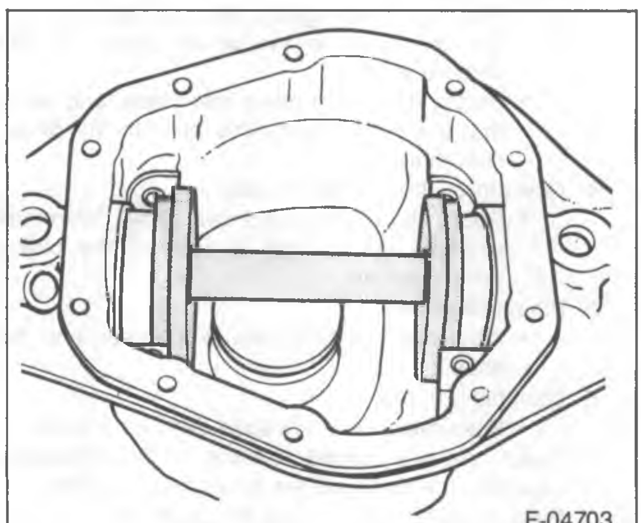


Figure 23—Arbor and Discs

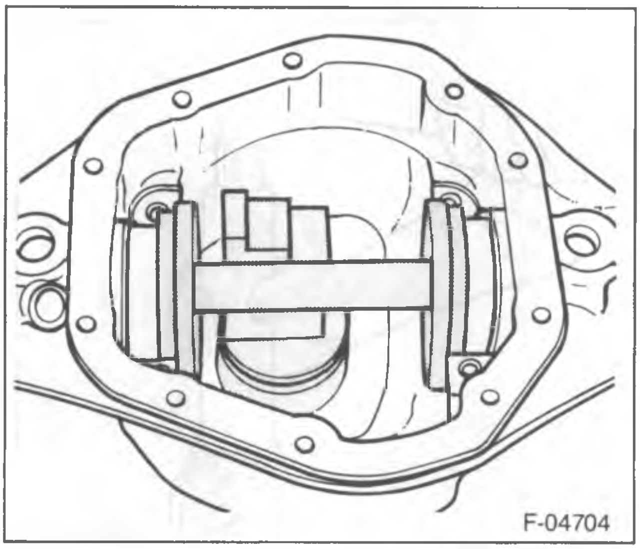


Figure 24—Pinion Height Block

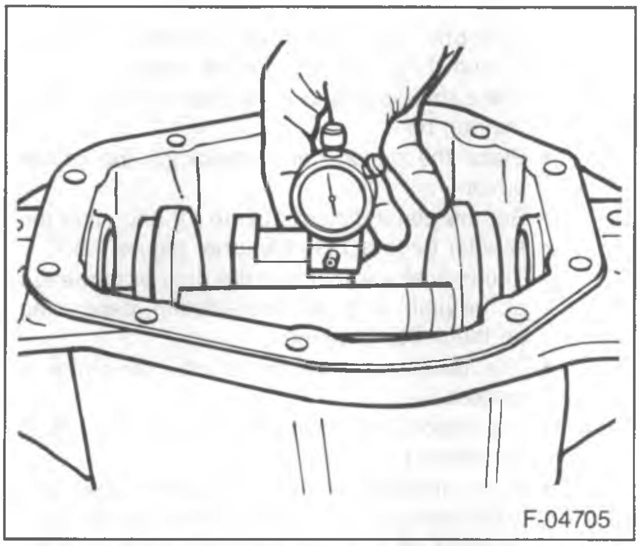


Figure 25—Scooter Gage on the Height Block

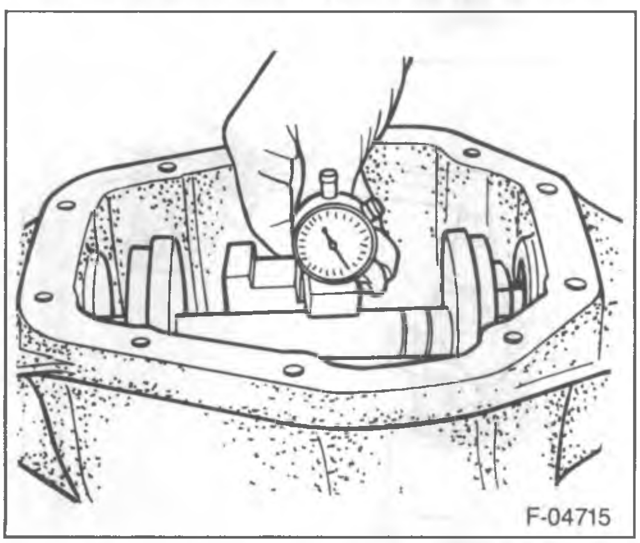


Figure 26—Scooter Gage on the Arbor

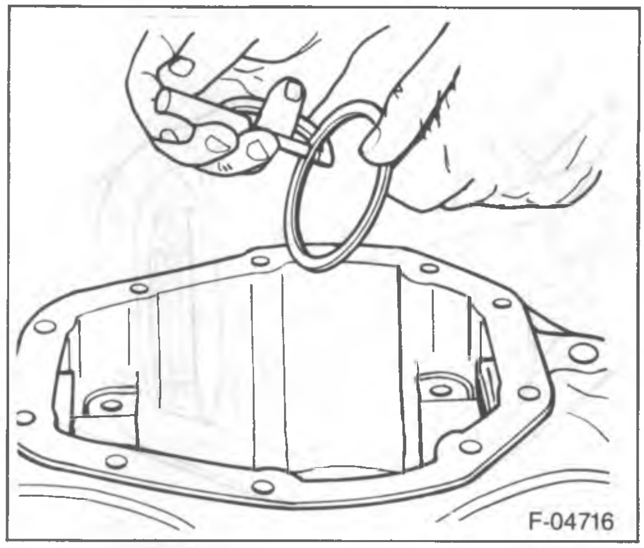


Figure 27—Measuring the Shims

8. Record the reading at the point of greatest deflection (when the dial indicator needle is centered between movement to the left and to the right).
   - This reading indicates the amount of shims needed for a nominal pinion setting. The pinion marking may change the pinion depth by adding or deleting shims from the nominal pinion setting.
- A positive (+) pinion marking indicates that the distance between the ring gear centerline and the pinion head must increase by the number of thousandths marked on the pinion. This means that the shim pack will decrease by the same number of thousandths.
- A negative (–) pinion marking indicates that the distance between the ring gear centerline and the pinion head must decrease by the number of thousandths marked on the pinion. This means that the shim pack will increase by the same number of thousandths.
- A pinion etched zero (0) will use the nominal setting as determined in this procedure.

9. Measure each shim separately with a micrometer and add them together to obtain the total shim pack thickness. If a baffle (5) or slinger is used, these must also be measured and included in the shim pack (figure 27).

PINION INSTALLATION

Install or Connect

Tools Required:

J 7818 Front Pinion Bearing Cup Installer
J 5590 Rear Pinion Bearing Cone Installer
D-111 Cup Installer (Miller)
C-4171 Handle (Miller)
J 8092 Handle
J 8614-01 Pinion Flange Remover

1. Place the required amount of shims (and baffle if used) in the inner bearing bore.

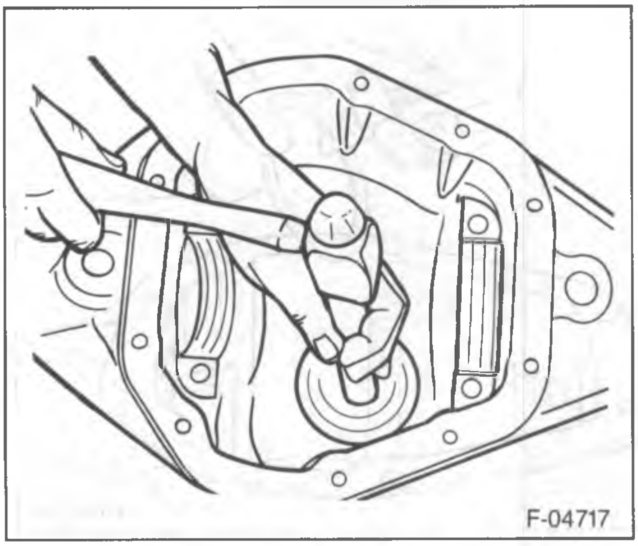


Figure 28—Installing the Pinion Inner Cup

2. Drive the inner bearing cup into the axle assembly using D-111 and C-4171. The cup must be seated on the shims (figure 28).
3. Drive the outer bearing cup into the axle assembly using J 7818 and J 8092 (figure 29).
4. Inner bearing cone (and slinger if used) on pinion. Drive the bearing onto the pinion shaft using J 5590 (figure 30).
5. Pinion into the axle housing.
6. Outer pinion bearing (7) (and slinger if used).
   - Do not assemble the preload shims or pinion oil seal at this time.
7. Pinion flange (10).
8. Washer (11) and pinion nut (12).

Tighten

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a torque of 1.13 N·m (10 in. lbs.) to rotate the pinion (figure 31). Rotate the pinion several times to seat the bearings and assure a more accurate reading pinion depth setting.

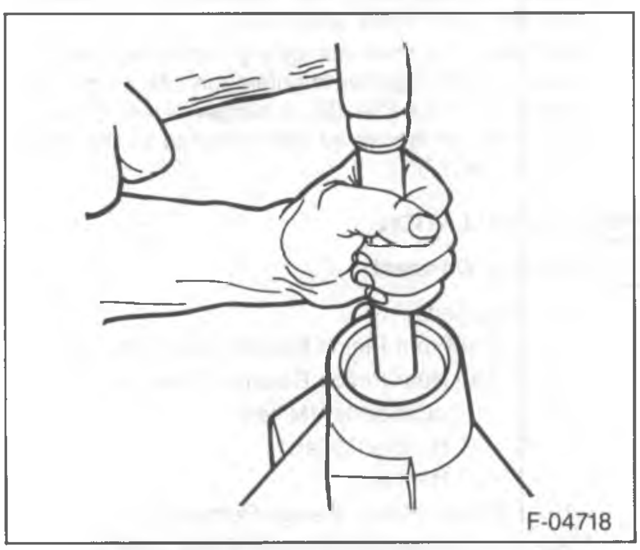


Figure 29—Installing the Pinion Front Cup

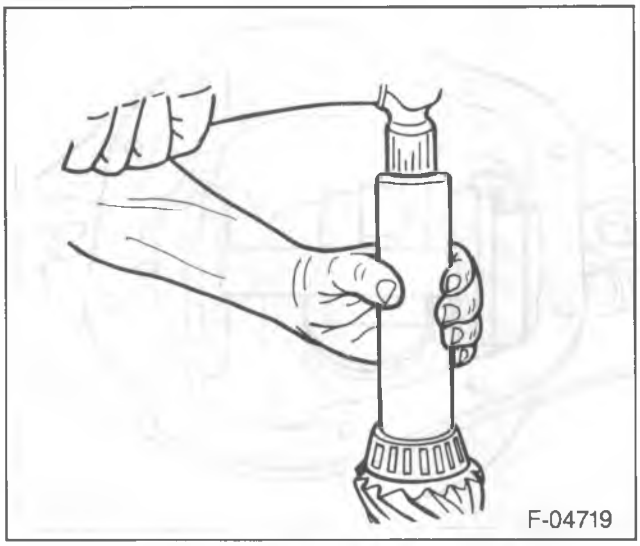


Figure 30—Installing the Inner Bearing

9. Pinion depth checking tools D-116-1, D-116-2, D-115-3, and D-115 to the top of the pinion.
   - Place the discs and arbor into the differential bearing bore.
   - Place the pinion height block on top of the pinion.
   - Set the dial indicator at zero (0) and slide the scooter gage across the arbor (figure 32).
   - The indicator will turn to the right or to the left at the point of greatest deflection, depending on the pinion marking.
   - The needle will move to the left if the pinion is marked (+).
   - The needle will move to the right if the pinion is marked (–).
   - If the indicator reading is within 0.05 mm (0.002-inch) of the pinion marking, the pinion is correctly set. If the pinion depth does not meet specifications, change the shim pack by the amount the indicator needle is from the pinion marking.

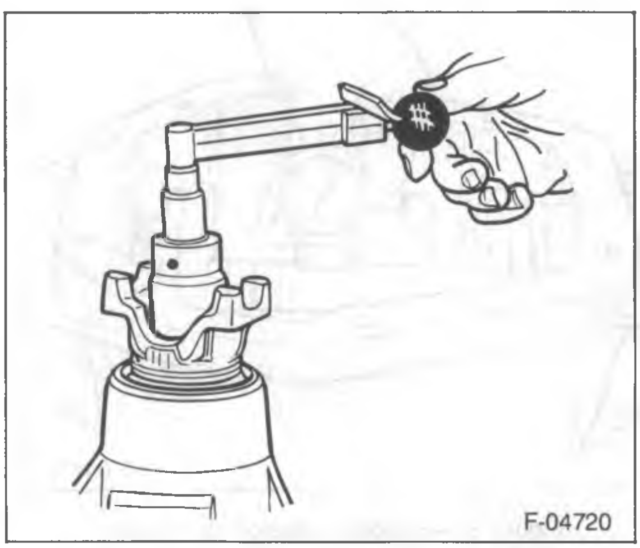


Figure 31—Checking the Pinion Preload

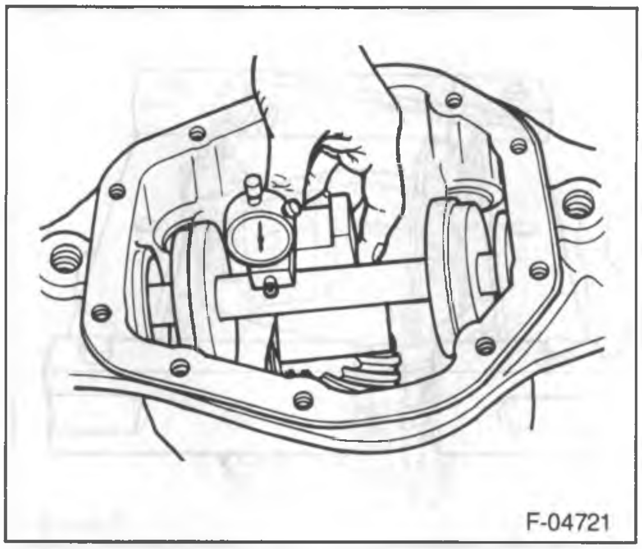


Figure 32—Checking the Pinion Depth Setting

- Remove the pinion nut (12), washer (11), pinion flange (10), slinger (8) and bearing cone (7).

10. Preload shims (6).
    - Install the shims that were removed, or measure the old shims and replace them with new shims if necessary.
11. Outer bearing (7) and slinger (8).
    - Apply a light coat of axle lubricant to the pinion seal lip.
12. Outer pinion oil seal (9) using D-163 (National) sealer installer (figure 33).
13. Pinion flange (10).
14. Washer (11) and a new pinion nut (12).

Tighten (Figures 34 and 35)

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a torque of 2.26-4.53 N·m (20-40 in. lbs.) to rotate the pinion.
- Remove shims to increase the preload.
- Add shims to decrease the preload.

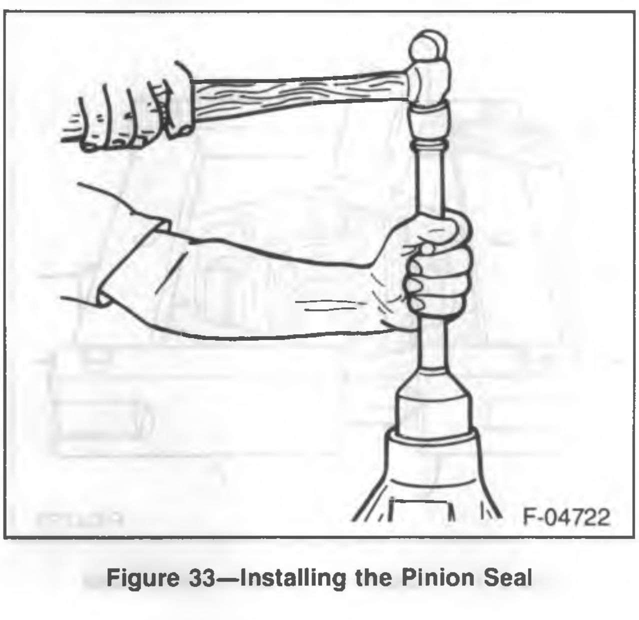


Figure 33—Installing the Pinion Seal

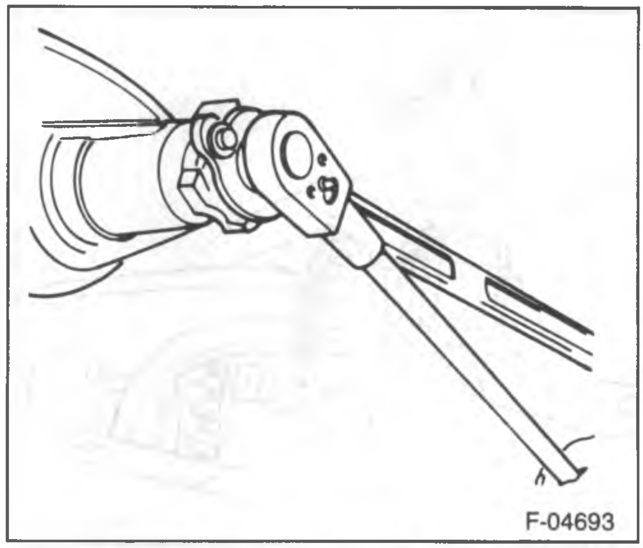


Figure 34—Tightening the Pinion Nut

ASSEMBLING THE DIFFERENTIAL TO THE AXLE HOUSING

Tools Required:

J 23690 Differential Side Bearing Installer
J 8092 Driver Handle
J 24385-01 Differential Carrier Spreader

1. Assemble the differential case (22) with master bearings installed to the axle housing. The pinion must be installed.
2. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 36).
3. Place the indicator tip on the chalk mark made earlier.
4. Force the ring gear into mesh with the pinion. Rock the ring gear to allow the teeth of the gears to mesh.
5. While the force is still applied to the differential case, set the dial indicator to zero.
6. Force the differential case away from the pinion gear to obtain an indicator reading. Repeat this action until a consistant reading is obtained. This will be the size of the left shim pack.

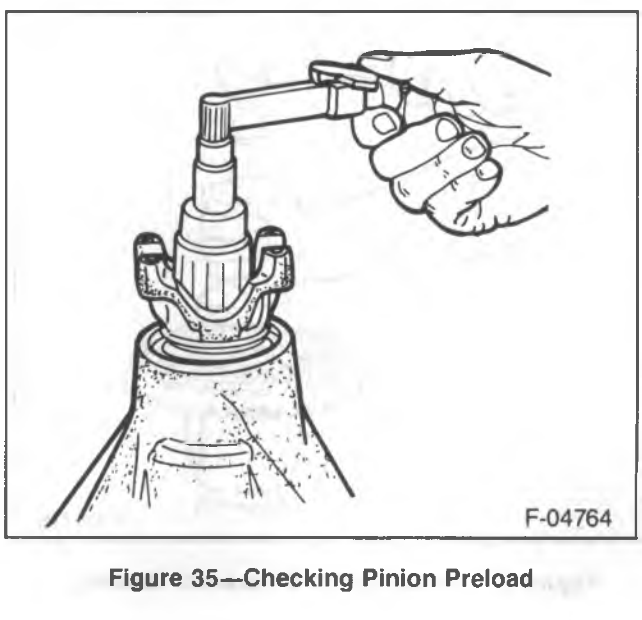


Figure 35—Checking Pinion Preload

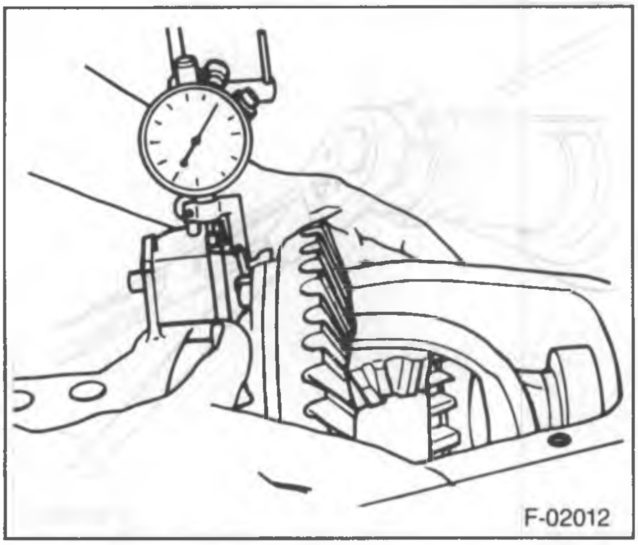


Figure 36—Measuring Differential Movement

7. Remove the indicator and the differential case from the carrier.
8. Remove the master bearings from the differential case.
9. Using the total shim pack size determined earlier, (Refer to "Determining Total Differential Shim Pack Size" in this section) subtract the reading found in step 6 from the total reading. The reading found in step 6 will be the shim size on the ring gear side. The remaining portion of the shim pack will be used on the side opposite the ring gear. Add an additional 0.38 mm (0.015-inch) of shims to the side opposite the ring gear to preload the bearings.
10. Place the proper shims on the differential side bearing hub (ring gear side) and drive the differential bearing onto the hub using J 23690 and J 8092 (figure 37).
11. Place the proper shims on the differential side bearing hub (opposite the ring gear) and drive the differential bearing onto the hub using J 23690 and J 8092.

Figure 37—Installing the Differential Bearings

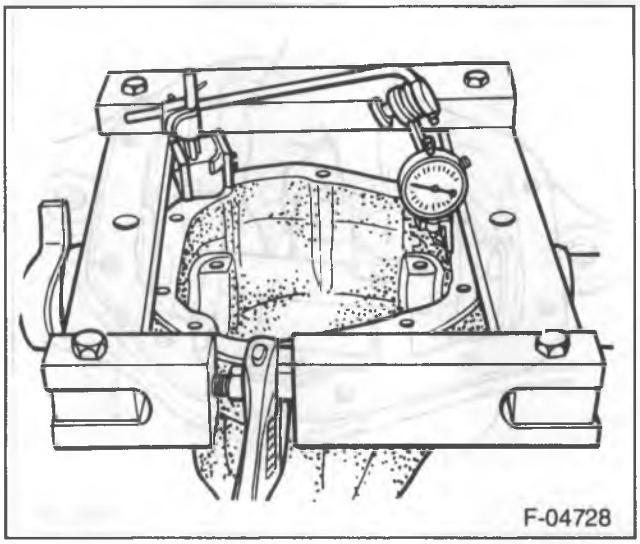


Figure 38—Mounting the Carrier Spreader

12. Assemble J 24385-01 to the axle housing as shown in figure 38.
13. Assemble the dial indicator as shown in figure 38. Preset the gage at least 0.020-inch, and then rotate the indicator housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch)., Over-spreading the carrier can damage or distort the carrier.

14. Spread the carrier while examining the dial indicator.
15. Remove the dial indicator.
16. Place the bearing cups (20) onto the bearings.
17. Install the differential assembly into the carrier.
    - Use a rawhide hammer to seat the differential assembly in the axle housing (figure 39).
18. Remove the spreader.
19. Install the bearing caps (18) in their original positions.
20. Install the bearing cap bolts (19).

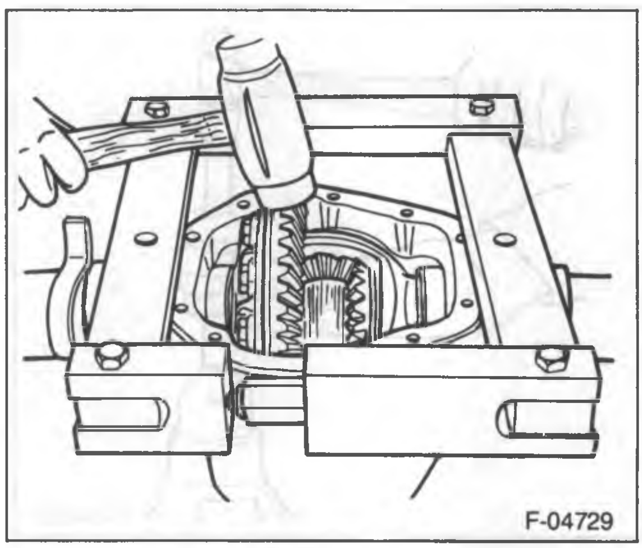


Figure 39—Installing the Differential Case

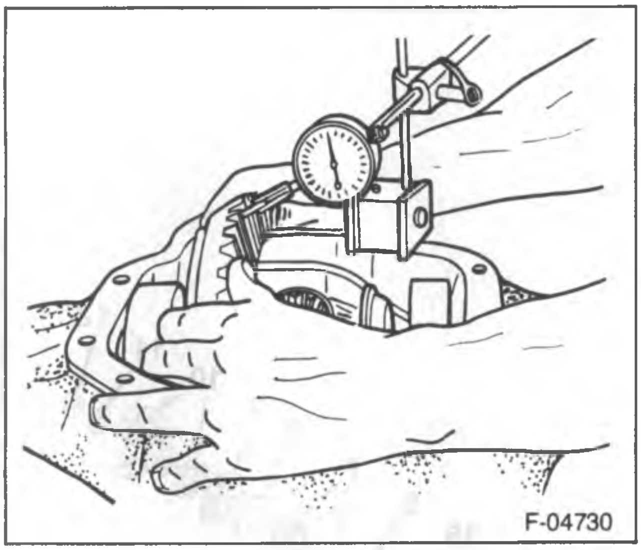


Figure 40—Measuring Backlash

Tighten

- The bearing cap bolts (19) to 115 N·m (85 ft. lbs.).

CHECKING BACKLASH

1. Mount a dial indicator with a magnetic base to the axle housing as shown in figure 40.
2. Place the indicator tip at the heel end of the tooth.
3. Check the backlash at three equally spaced points. The backlash should be 0.13-0.23 mm (0.005-0.009-inch). The measurement must not vary more than 0.05 mm (0.002-inch) between the points checked.
4. High backlash is corrected by moving the ring gear closer to the pinion.
5. Low backlash is corrected by moving the ring gear away from the pinion.

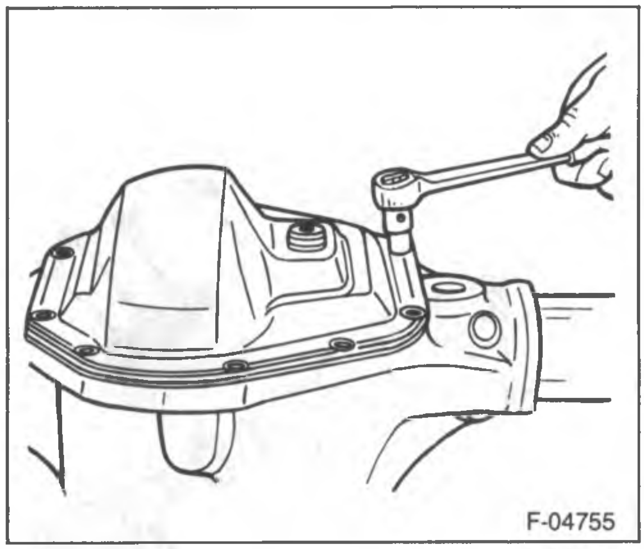


Figure 41—Installing the Axle Cover

6. To adjust the backlash, the differential case must be removed from the housing, then the differential bearings removed, and the proper number of shims moved from one side to the other.

FINAL ASSEMBLY

Install or Connect

1. Drive axles. Refer to the proper service manual.
2. RTV to the axle cover.
3. Axle cover (14) to the housing (figure 41).

   Tighten

   - The cover bolts (17) to 47 N·m (35 ft. lbs.).
4. Axle housing to the vehicle. Refer to the proper service manual.
5. Lubricant to the rear axle (after the RTV has cured).

10 1/2-INCH RING GEAR

DESCRIPTION

The Dana 10 1/2-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. The gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is full-floating. The axle shaft is supported at the wheel ends by the wheel hubs. The bolts that attach the shaft to the hub, support the axle at the hub. The splined end of the shaft is supported by the differential.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack between the inner pinion bearing cup and the rear axle housing. The pinion bearing preload is set by a shim pack at the front of the axle housing between the yoke and the pinion gear.

The ring gear is bolted onto the differential case with right-hand thread bolts.

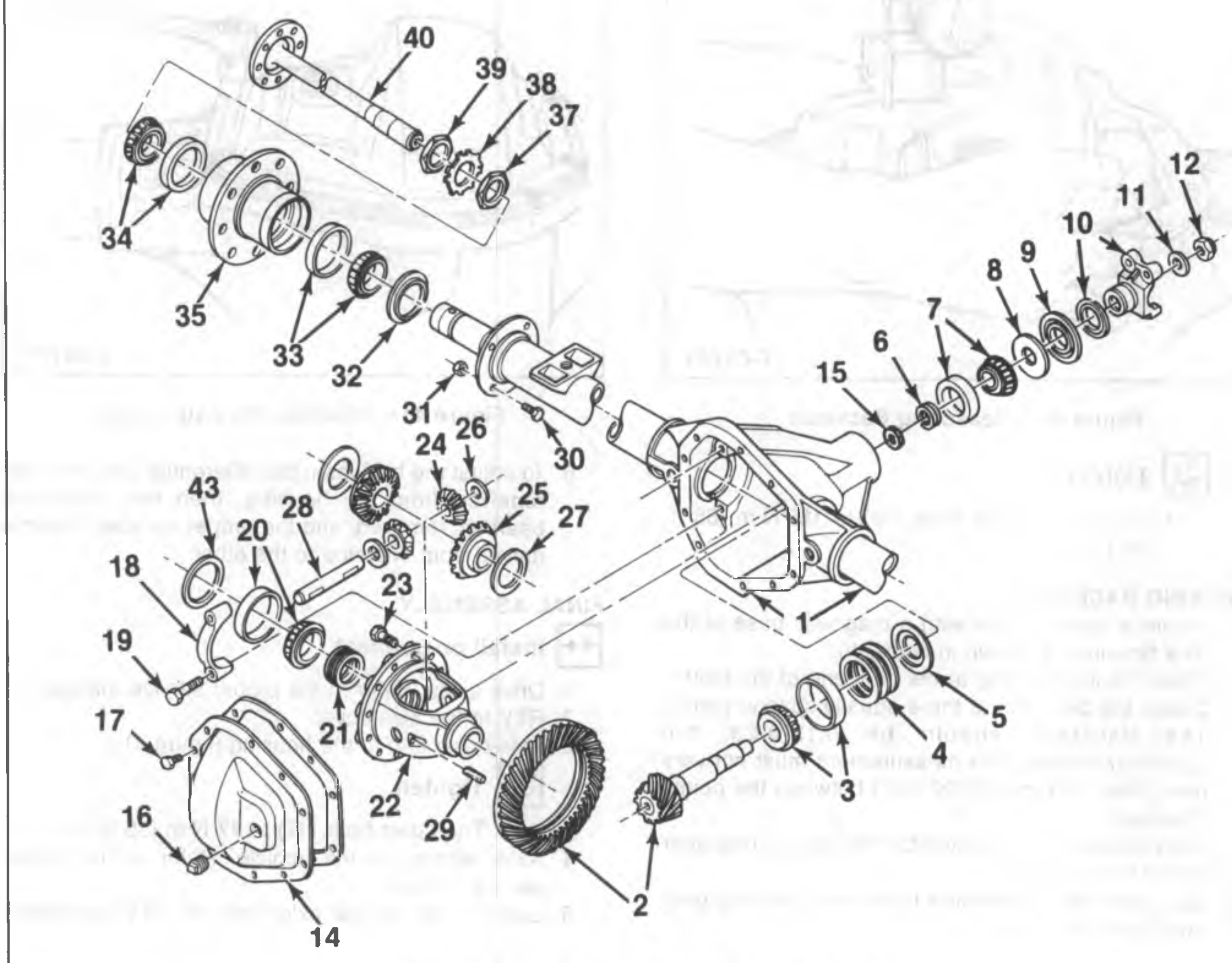
The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearings and the differential case. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. Differential side bearing preload is set by the differential shim packs.

Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a hub seal, and a gasket between the differential cover and the rear axle housing.

Two models of the Dana 10 1/2-inch are covered here: the B or U Model, and the Heavy Duty Model.



1. Axle Housing
2. Ring and Pinion Gear Set
3. Bearing
4. Shims
5. Baffle
6. Preload Shims
7. Bearing
8. Slinger
9. Pinion Oil Seal
10. Pinion Flange
11. Washer
12. Pinion Nut
14. Cover
15. Spacer
16. Plug
17. Bolt
18. Bearing Cap
19. Bolt
20. Bearing
21. Shims
22. Differential Case
23. Bolt
24. Pinion Gear
25. Side Gear
26. Pinion Thrust Washer
27. Side Gear Thrust Washer
28. Pinion Shaft
29. Roll Pin
30. Bolt
31. Nut
32. Hub Seal
33. Bearing
34. Bearing
35. Wheel Hub
37. Inner Lock Nut
38. Lock Washer
39. Outer Lock Nut
40. Axle Shaft
43. Differential Bearing Preload Shim

F-05910

Figure 42—Rear Axle Components

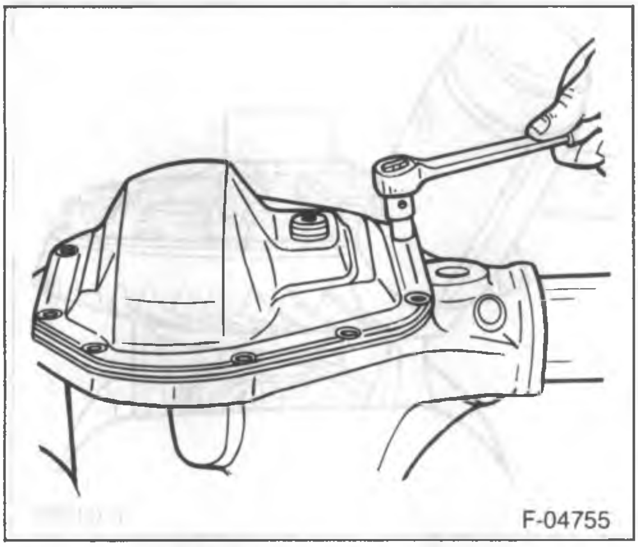


Figure 43—Removing the Axle Cover

All Dana axles are identified by the part number on the right axle tube next to the carrier. The model number is cast on the carrier. The carrier cover does not have a drain plug. There is a fill plug on the cover.

CHECK THE AXLE BEFORE DISASSEMBLY

Inspect

- Remove the axle cover from the rear axle and drain the axle lubricant into a suitable container.

1. The ring gear backlash. Refer to "Backlash Adjustment" in this section. This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing case.

- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

Remove or Disconnect (Figure 42)

Tools Required:

J 24385-01 Differential Housing Spreader
J 29721 Differential Side Bearing Remover
J 29721-70 Side Bearing Adapters
J 8107-3 Side Bearing Puller Plug
D-166 Differential Case Holding Fixture
J 8614-01 Pinion Flange Holder

- Place the axle in a suitable support.

1. The differential cover bolts (17) and the differential cover (14) (figure 43).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (40). Refer to the proper service manual.

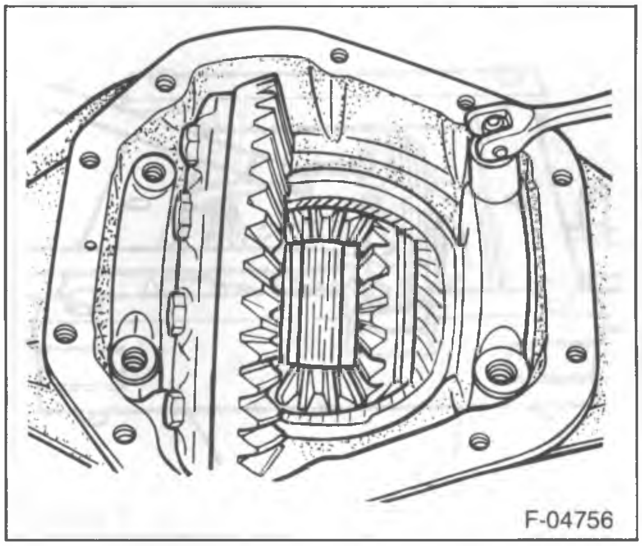


Figure 44—Removing the Bearing Cap

3. Bearing cap bolts (19) (figure 44).
4. Bearing caps (18).
   - The mating letters are stamped on the caps and the axle housing. The caps are to be reassembled exactly as removed.

- Assemble J 24385-01 to the differential housing as shown in figure 45.
- Assemble the dial indicator as shown in figure 45. Preset the gage at least 0.020-inch, and then rotate the gage housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

- Spread the carrier while examining the dial indicator. Do not spread the carrier more than 0.38 mm (0.015-inch).

5. Differential case (22) from the carrier (1) using two pry bars (figure 46).
6. The spreader J 24385-01 from the carrier (1).

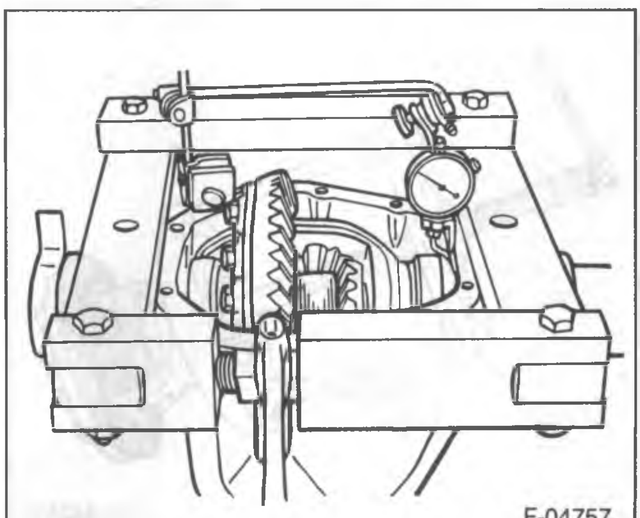


Figure 45—Spreading the Differential Case

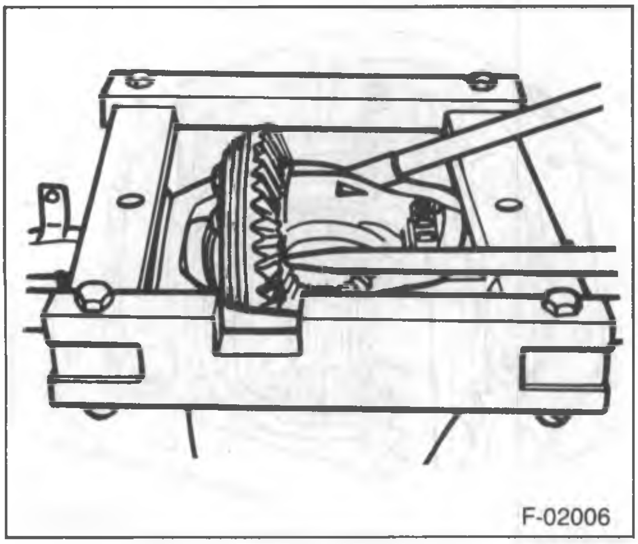


Figure 46—Removing the Differential

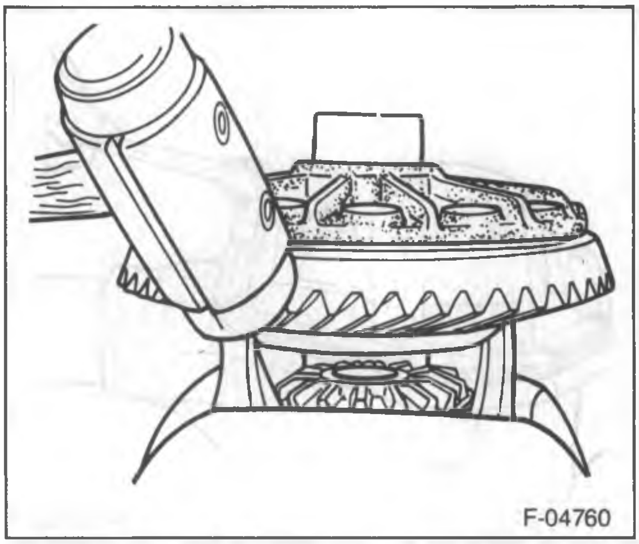


Figure 48—Removing the Ring Gear

7. Bearing cups (20).
   - Mark the cups as left and right, and place them with the proper bearing caps.
8. Differential side bearings (20) using J 29721, J 29721-70, and J 8107-3 (figure 47).
   - Mark the bearings as left and right, and place them with the proper bearing caps and cups.
9. Differential shims (21).
   - Mark the shims as left or right.
10. Ring gear bolts (23).
- Place shop towels over the vise jaws. Put the differential case in the vise (figure 48).

NOTICE: Do not pry the ring gear from the case, this will damage the ring gear and the differential case.

11. Ring gear (2) from the differential case using a rawhide hammer.
    - Ring gear (2) from the vise.
- Put the differential case on D-166 (Miller tool) and put the holding fixture into the vise.

12. Lock pin (29) from the differential using a hammer and a punch (figure 49).
- Turn the differential over on D-166.
13. Pinion shaft (28) using a hammer and a brass drift (figure 50).
14. Differential pinion gears (24) and thrust washers (26).
    - Rotate the side gears until the pinion gears are in the opening of the differential (figure 51).
15. Differential side gears (25) and thrust washers (27).
    - Mark the gears and washers as left and right.
- Replace the carrier cover (14) using two bolts (17) to keep the pinion from falling to the floor.

Inspect

- Drive pinion bearing preload (figure 52).
- Pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear).

16. Pinion nut (12) and washer (11) using J 8614-01 to hold the pinion (figure 53).

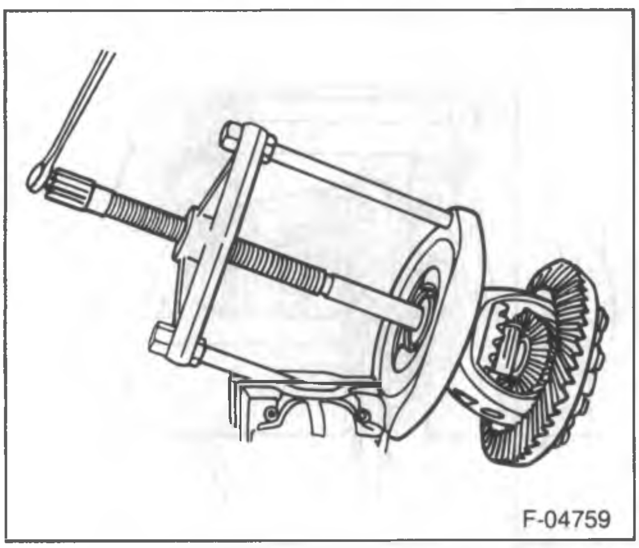


Figure 47—Removing the Differential Side Bearings

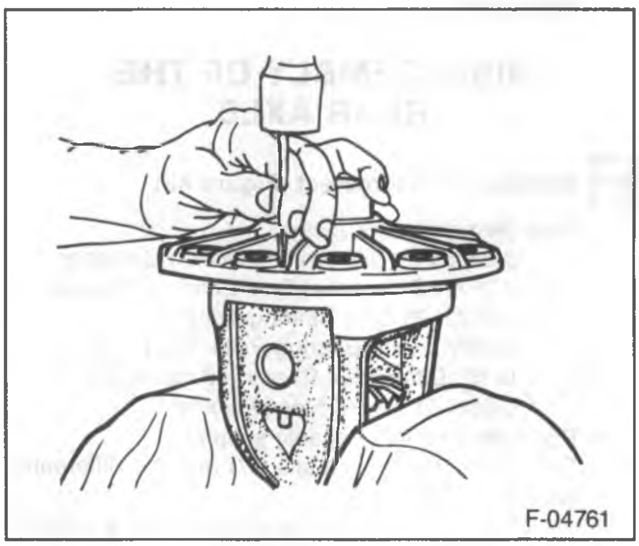


Figure 49—Removing the Lock Pin

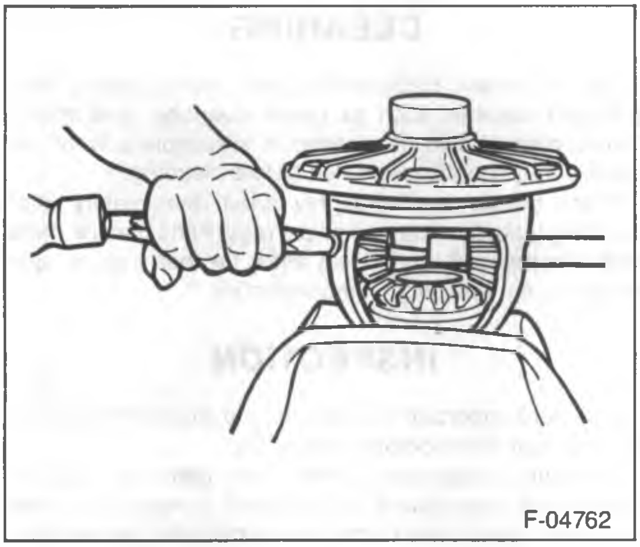


Figure 50—Removing the Pinion Shaft

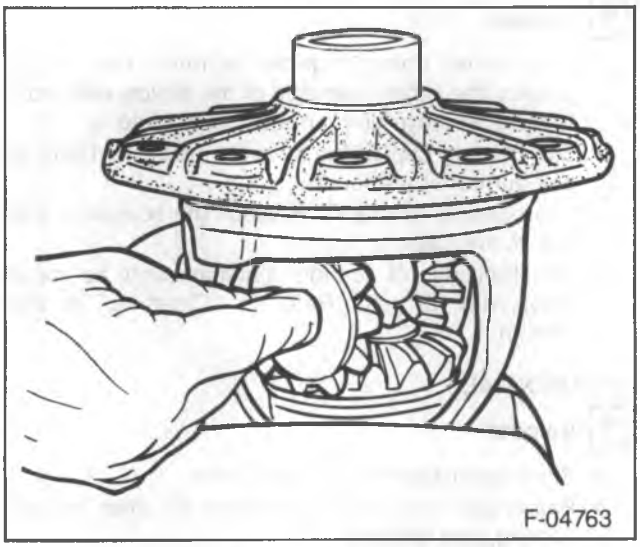


Figure 51—Removing the Pinion Gears

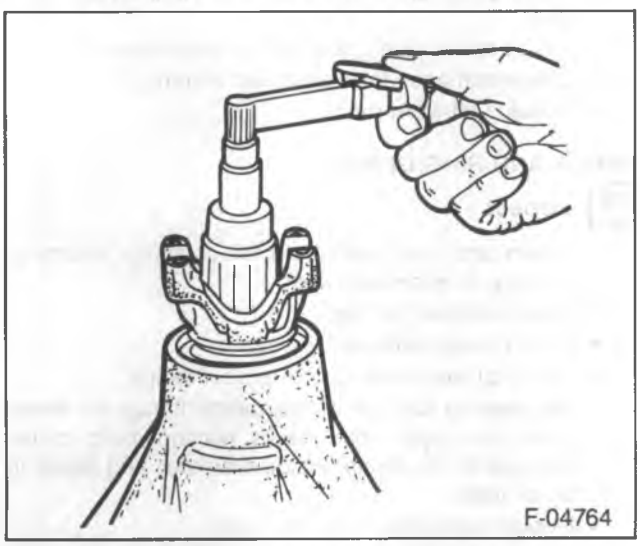


Figure 52—Checking the Pinion Preload

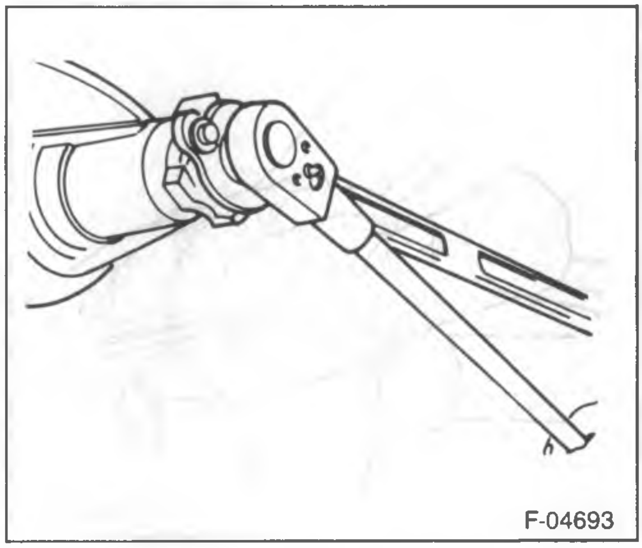


Figure 53—Removing the Drive Pinion Nut

17. Pinion flange (10) using J 8614-01 (figure 54).
18. Pinion (2) from the carrier using a rawhide hammer to tap the pinion (figure 55).
19. Carrier cover (14) and the pinion (2).
20. Pinion preload shims (6).
    - Keep the shims toether on the bench.
21. Pinion seal (9).
22. Pinion outer bearing (7) and oil slinger (8).
23. Bearing cups (3) and (7) from the axle housing using a hammer and a punch (figure 56).
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.
24. Pinion adjusting shims (4) and baffle (5).
    - Keep the shims together on the bench.
25. Pinion inner bearing (3) using J 29721 and J 29721-70 (figure 57).

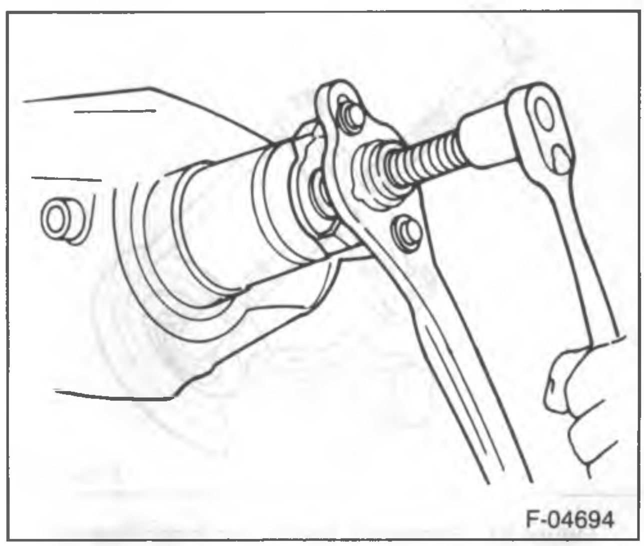


Figure 54—Removing the Pinion Flange

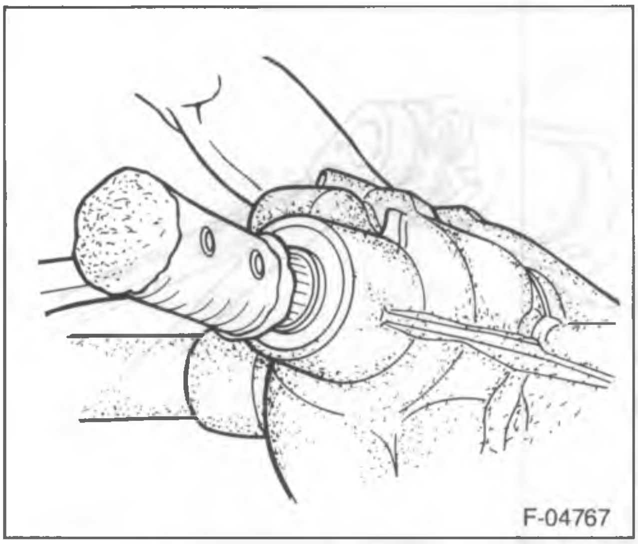


Figure 55—Removing the Pinion

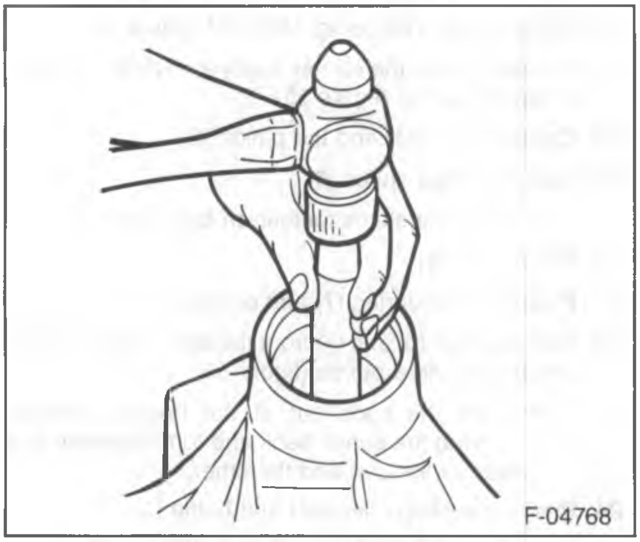


Figure 56—Removing the Bearing Cups

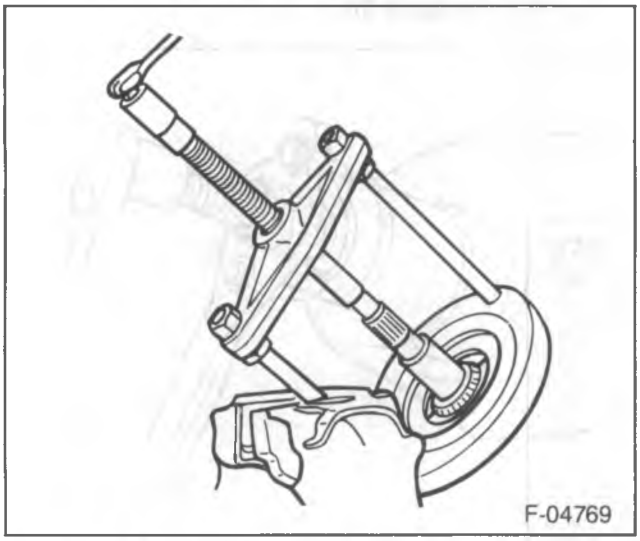


Figure 57—Removing the Pinion Inner Bearing

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

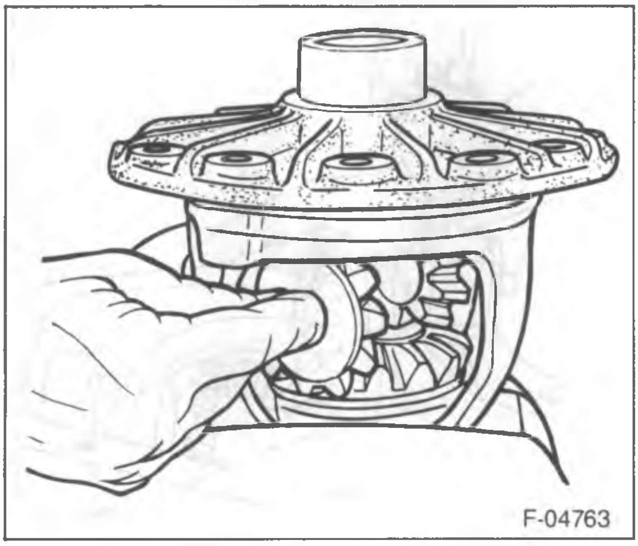


Figure 58—Installing the Pinion Gears

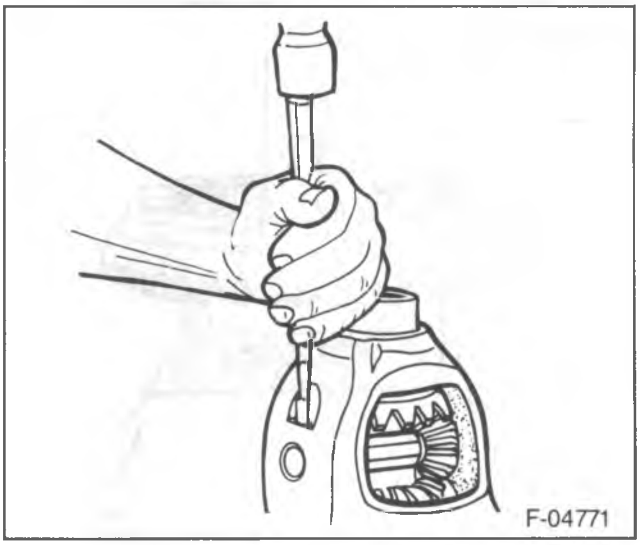


Figure 59—Installing the Lock Pin

BEARINGS

Inspect

- Bearings visually and by feel.
- The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 42)

Tools Required:
D-136 Master Differential Bearings (Miller) H.D.
D-117 Master Differential Bearings (Miller)

- Lubricate all parts with rear axle lubricant.

1. New side gear thrust washers (27) to the side gears (25).
2. Side gears (25) to the differential case.
   - Place the side gears in place on the same side as removed (figure 58).
3. Pinion gears (24) to the differential without the thrust washers (26).
   - Place the pinion gears onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
4. New pinion thrust washers (26).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
5. Pinion shaft (28).
   - Align the lock pin holes in the case and the shaft.
6. Lock pin (29) (figure 59).
   - Peen metal from the case over the lock pin.

- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.

7. Ring gear (2) to the differential case (22).
   - Thread two studs into the ring gear on opposite sides.
   - Press the ring gear onto the case, and align the holes in the case with the studs.
8. New ring gear bolts (23) (figure 60).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

   Tighten

   - The new ring gear bolts in sequence to 149 N·m (110 ft. lbs.). Refer to "Specifications" for bolt information.
9. Master differential bearings D-117 (Miller Tools) to the differential (figure 61). D-136 (Miller) for H.D. Axles.

- Refer to "Determining Total Shim Pack Size" in this section.

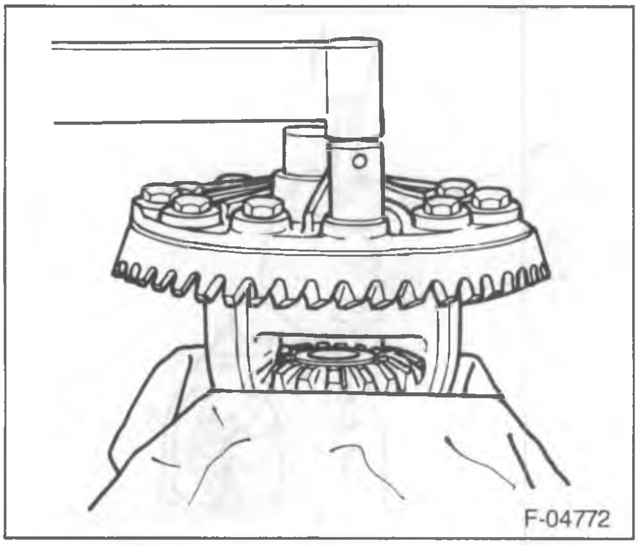


Figure 60—Installing the Ring Gear Bolts

DETERMINING TOTAL DIFFERENTIAL SHIM PACK SIZE — B OR U MODEL

1. Assemble the differential case (22) to the axle housing. The pinion must not be installed.
2. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 62).
3. Force the differential assembly as far as possible in the direction towards the indicator.
4. Preload the dial indicator one half of its travel. Place the tip of the indicator on a flat surface on the differential, just next to a ring gear bolt. Mark this location with a piece of chalk.
5. Zero the dial indicator, while still forcing the differential towards the dial indicator.
6. Force the differential assembly in the opposite direction as far as it will go. Repeat this step until the same reading is obtained. Record the number of thousandths that the dial indicator traveled, not the reading on the dial. This will be the measurement of the shim pack without the bearing preload (which will be added later).

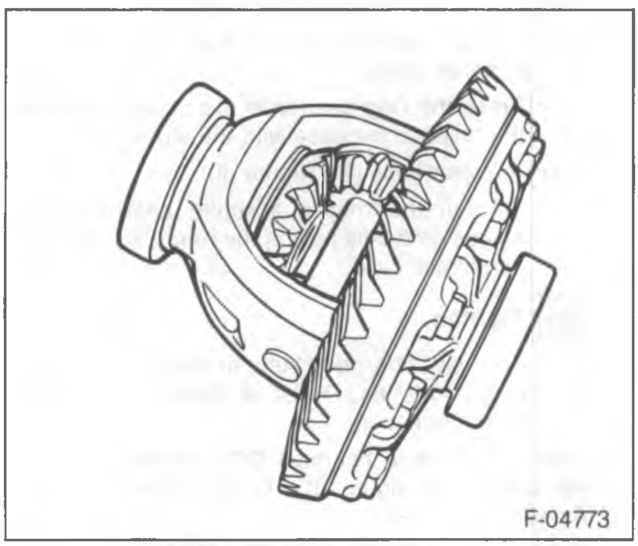


Figure 61—Differential with the Master Bearings

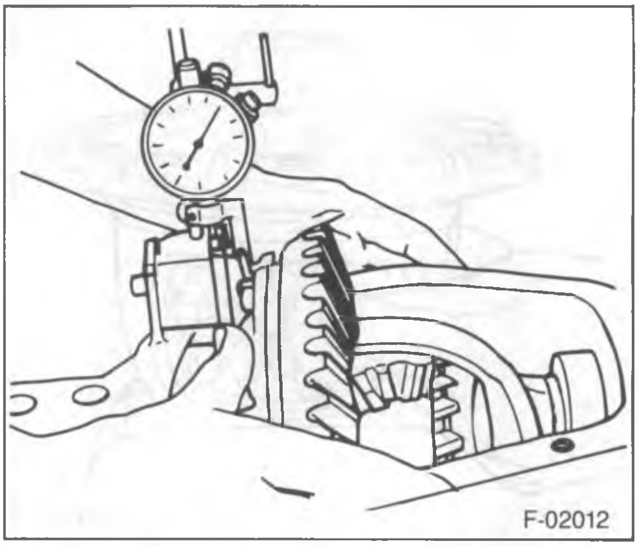


Figure 62—Determining Differential Shim Pack

7. Remove the dial indicator from the axle.
8. Remove the differential case from the axle housing.
- Do not remove the master bearings from the differential.

DETERMINING TOTAL DIFFERENTIAL SHIM PACK SIZE — HEAVY DUTY MODEL

1. Assemble the differential case (22) to the axle housing. The pinion must not be installed.
2. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 62).
3. Install the outboard spacer between the master bearing and the axle housing on the ring gear side.
4. Force the differential assembly as far as possible in the direction towards the indicator.
5. Preload the dial indicator one half of its travel. Place the tip of the indicator on a flat surface of the differential, just next to a ring gear bolt. Mark this location with a piece of chalk.
6. Zero the dial indicator, while still forcing the differential towards the indicator.
7. Force the differential assembly in the opposite direction as far as it will go. Repeat this step until the same reading is obtained. Record the number of thousandths that the dial indicator traveled, not the reading on the dial. This reading plus the spacer measurement will be the thickness of the spacer and shims required.
8. Remove the dial indicator from the axle.
9. Remove the differential case from the axle housing.
10. Remove the spacer (43) from the housing.
- Do not remove the master bearings from the differential.

PINION DEPTH ADJUSTMENT

Tools Required:

D-120 Master Pinion Block (Miller) (60 and 70U)
D-137 Master Pinion Block (70B and 70 H.D.)
D-116-1 Pinion Height Block (Miller)
D-116-2 Master Discs (Miller)
D-115-3 Arbor (Miller)

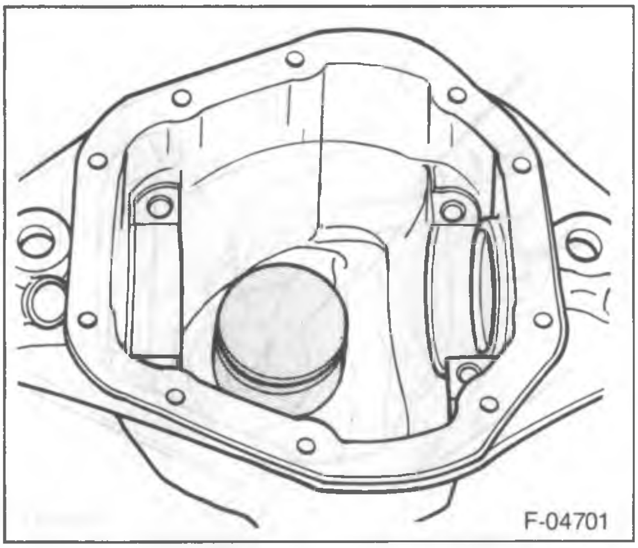


Figure 63—Master Pinion Block

D-115 Scooter Gage (Miller)

1. Clean the carrier bores and all the tools. The pinion bore must be free of nicks and dirt.
2. Install D-120 or D-137 to the pinion bore (figure 63).
3. Place D-116-2 onto D-115-3 (figure 64).
4. Install the arbor and discs into the axle housing.
5. Install D-116-1 onto D-120 and against the arbor (figure 65).
6. Place D-115 onto the height block (figure 66).
   - Place the gage on the upper step of the height block. Push the gage down on the height block. While applying pressure, set the dial indicator at zero.
7. Slide the gage over the arbor (figure 67).
8. Record the reading at the point of greatest deflection (when the dial indicator needle is centered between movement to the left and to the right).

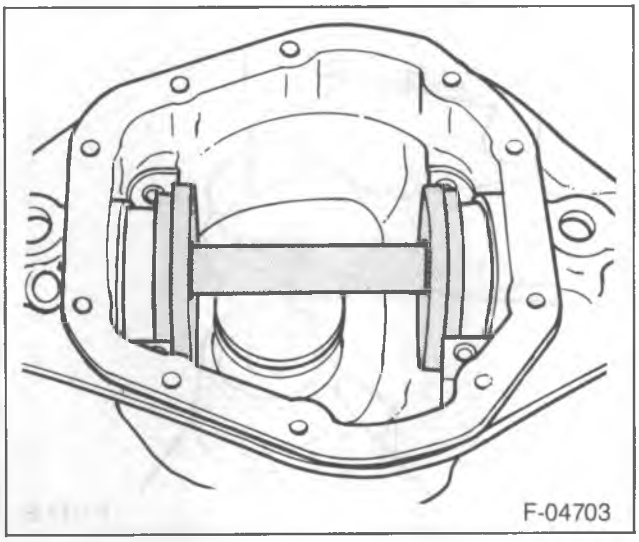


Figure 64—Arbor and Discs

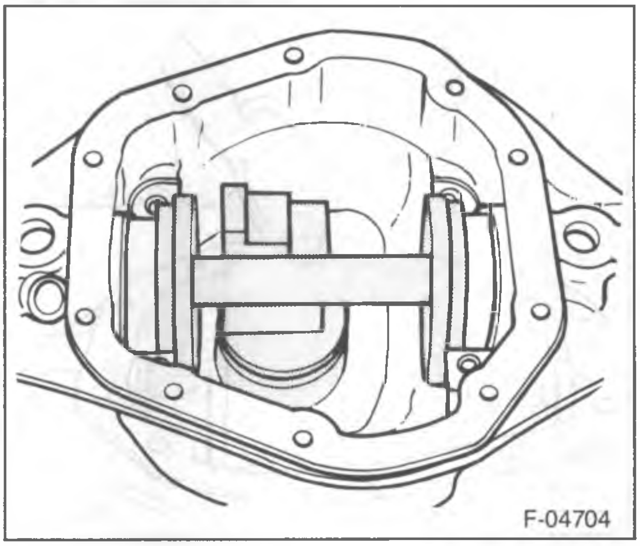


Figure 65—Pinion Height Block

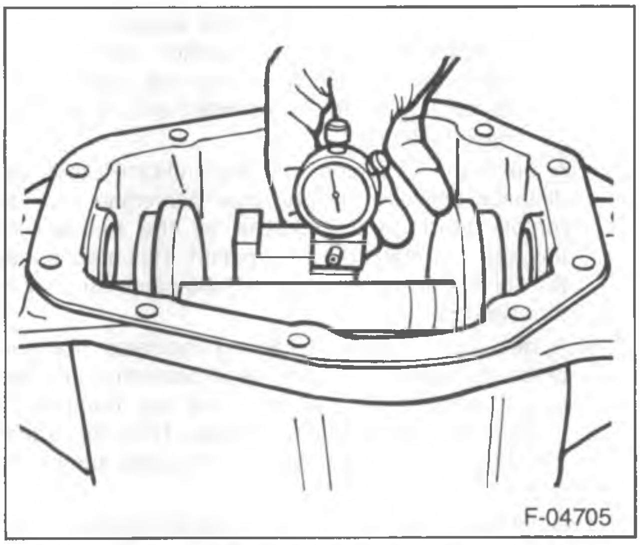


Figure 66—Scooter Gage on the Height Block

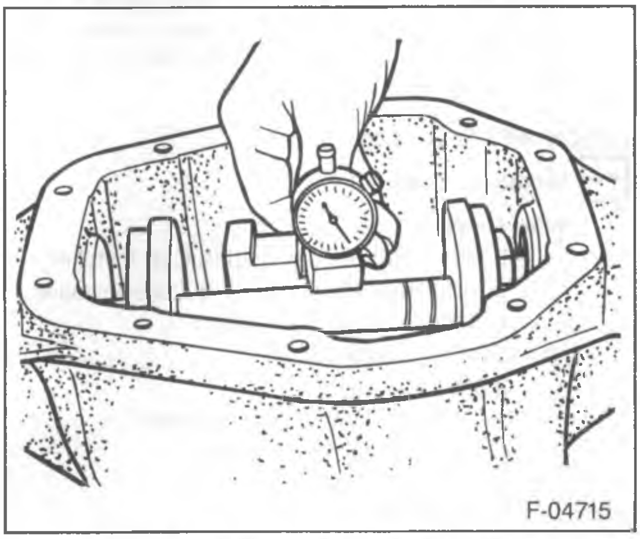


Figure 67—Scooter Gage on the Arbor

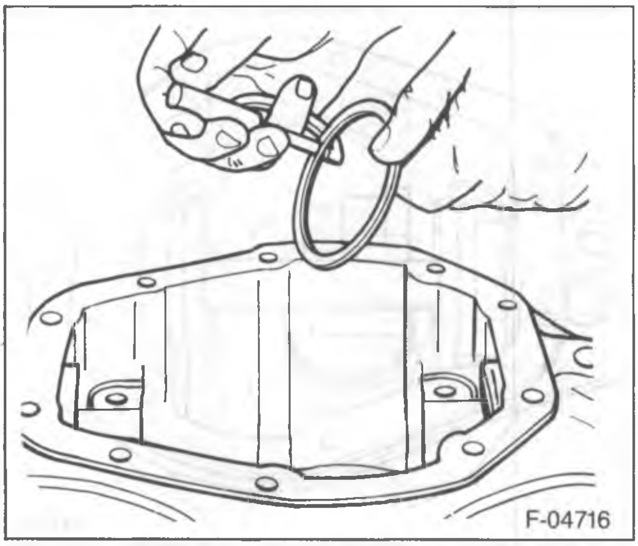


Figure 68—Measuring the Shims

- This reading indicates the amount of shims needed for a nominal pinion setting. The pinion marking may change the pinion depth by adding or deleting shims from the nominal pinion setting.
- A positive (+) pinion marking indicates that the distance between the ring gear centerline and the pinion head must increase by the number of thousandths marked on the pinion. This means that the shim pack will decrease by the same number of thousandths.
- A negative (–) pinion marking indicates that the distance between the ring gear centerline and the pinion head must decrease by the number of thousandths marked on the pinion. This means that the shim pack will increase by the same number of thousandths.
- A pinion etched zero (0) will use the nominal setting as determined in this procedure.

9. Measure each shim separately with a micrometer and add them together to obtain the total shim pack thickness. If a baffle (5) or slinger is used, these must also be measured and included in the shim pack (figure 68).

PINION INSTALLATION

Install or Connect

Tools Required:

J 7818 Front Pinion Bearing Cup Installer
J 5590 Rear Pinion Bearing Cone Installer
C-4204 Cup Installer (Miller)
C-4171 Handle (Miller)
J 8092 Handle
J 8614-01 Pinion Flange Remover
D-116-1 Pinion Height Block
D-116-2 Arbor Discs
D-115-3 Arbor
D-115-2 Scooter Gage Block

1. Place the required amount of shims (and baffle if used) in the inner bearing bore.

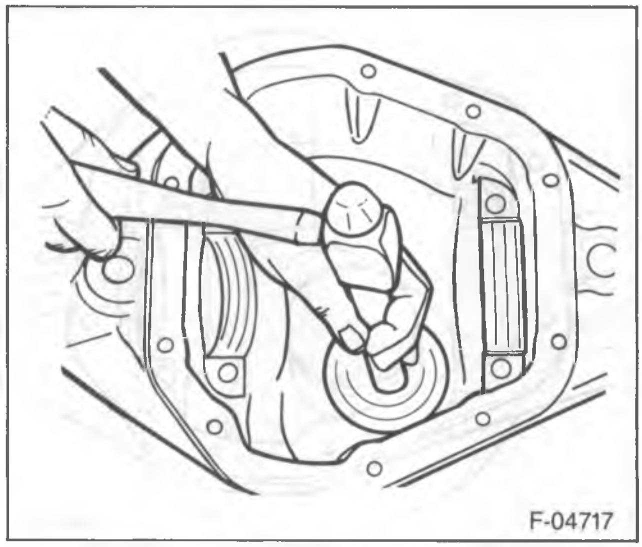


Figure 69—Installing the Pinion Inner Cup

2. Drive the inner bearing cup into the axle assembly using C-4204 and C-4171. The cup must be seated on the shims (figure 69).
3. Drive the outer bearing cup into the axle assembly using J 7818 and J 8092 (figure 70).
4. Inner bearing cone (and slinger if used) on pinion. Drive the bearing onto the pinion shaft using J 5590 (figure 71).
   - If installing a new bearing, be certain that it is the same width as the old bearing.
5. Pinion into the axle housing.
6. Outer pinion bearing (7) (and slinger if used).
   - Do not assemble the preload shims or pinion oil seal at this time.
7. Pinion flange (10).
8. Washer (11) and pinion nut (12).

Tighten

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a torque of 1.13 N·m (10 in. lbs.) to rotate the

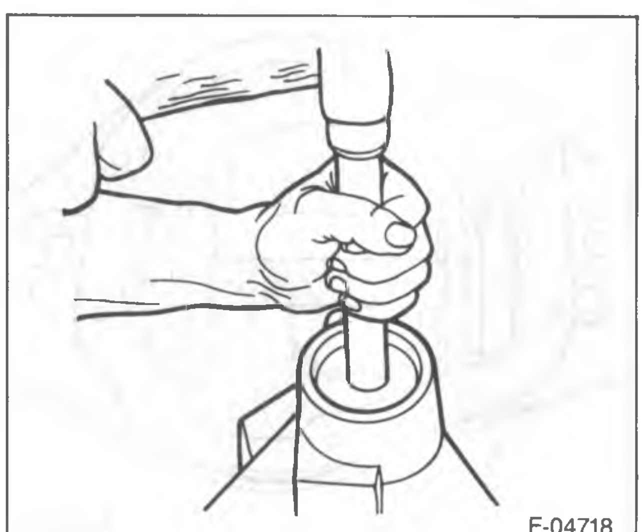


Figure 70—Installing the Pinion Front Cup

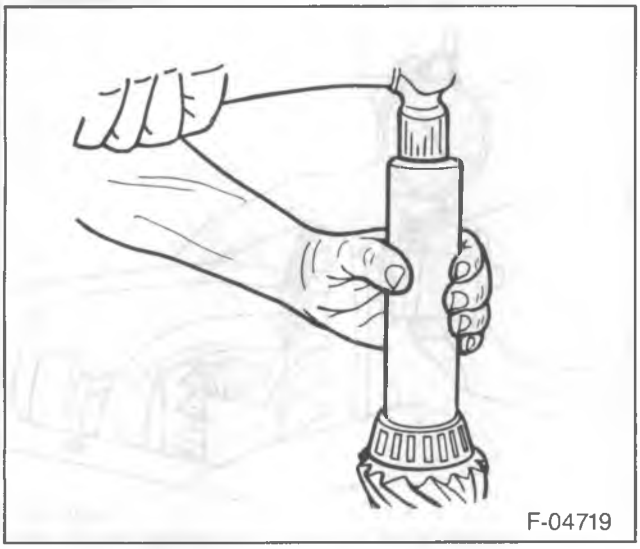


Figure 71—Installing the Inner Bearing

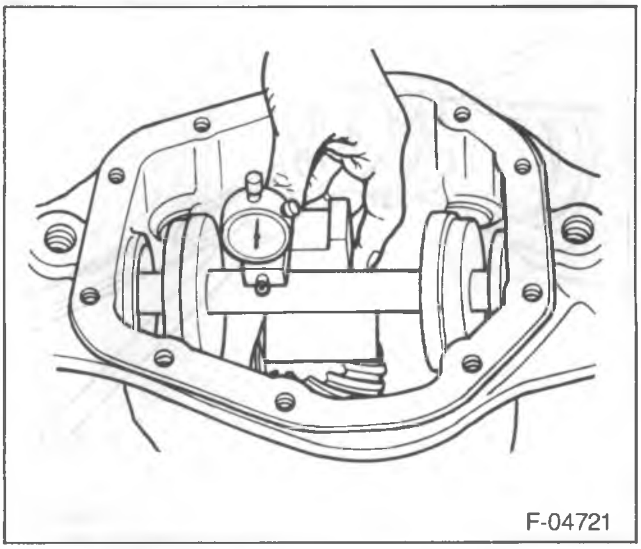


Figure 73—Checking the Pinion Depth Setting

pinion (figure 72). Rotate the pinion several times to seat the bearings and assure a more accurate reading pinion depth setting.

9. Pinion depth checking tools D-116-1, D-116-2, D-115-3, and D-115 to the top of the pinion.
   - Place the discs and arbor into the differential bearing bore.
   - Place the pinion height block on top of the pinion.
   - Set the dial indicator at zero (0) and slide the scooter gage across the arbor (figure 73).
   - The indicator will turn to the right or to the left at the point of greatest deflection, depending on the pinion marking.
   - The needle will move to the left if the pinion is marked (+).
   - The needle will move to the right if the pinion is marked (–).
   - If the indicator reading is within 0.05 mm (0.002-inch) of the pinion marking, the pinion is correctly set. If the pinion depth does not meet specifications, change the shim pack by the amount the indicator needle is from the pinion marking.
   - Remove the pinion nut (12), washer (11), pinion flange (10), slinger (8) and bearing cone (7).
10. Preload shims (6).
    - Install the shims that were removed, or measure the old shims and replace them with new shims if necessary.
11. Outer bearing (7) and slinger (8).
    - Apply a light coat of axle lubricant to the pinion seal lip.
12. Outer pinion oil seal (9) using D-163 (National) sealer installer (figure 74).
13. Pinion flange (10).
14. Washer (11) and a new pinion nut (12).

Tighten (Figures 75 and 76)

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a torque of 2.26-4.53 N·m (20-40 in. lbs.) to rotate the pinion.

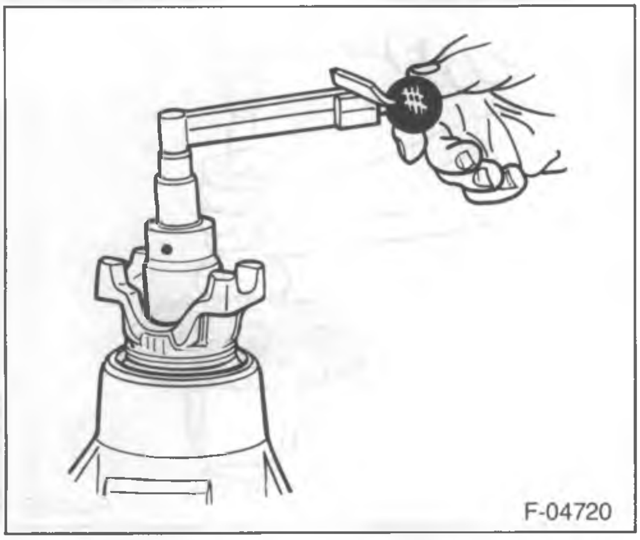


Figure 72—Checking the Pinion Preload

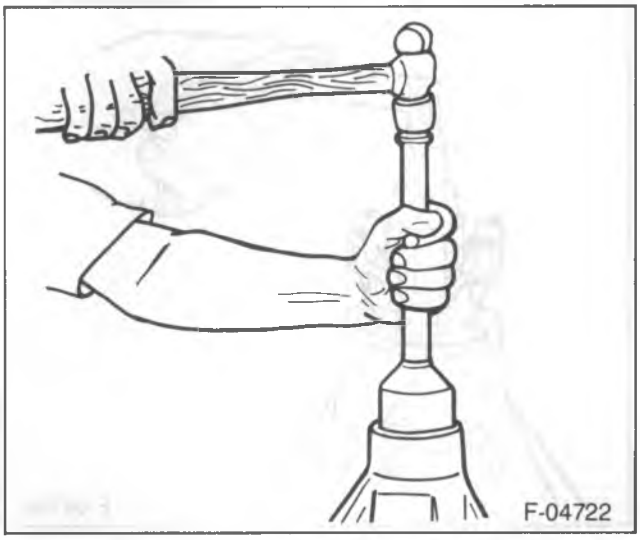


Figure 74—Installing the Pinion Seal

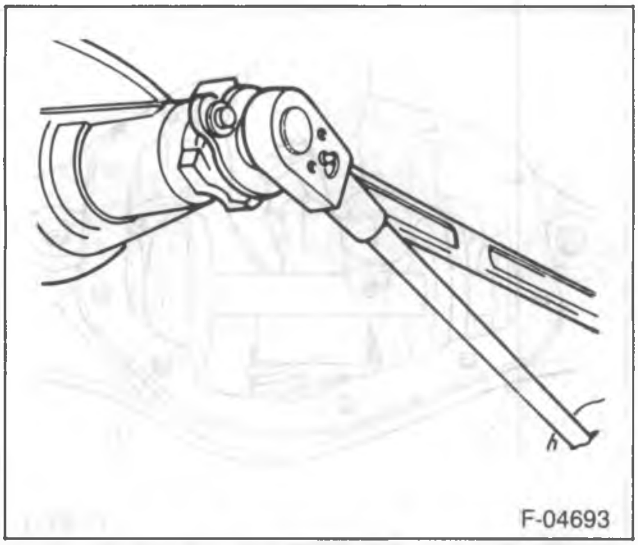


Figure 75—Tightening the Pinion Nut

- Remove shims to increase the preload.
- Add shims to decrease the preload.

ASSEMBLING THE DIFFERENTIAL TO THE AXLE HOUSING — B OR U MODEL

Tools Required:

J 23690 Differential Side Bearing Installer
J 8092 Driver Handle
J 24385-01 Differential Carrier Spreader

1. Assemble the differential case (22) with master bearings installed to the axle housing. The pinion must be installed.
2. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 77).
3. Place the indicator tip on the chalk mark made earlier.
4. Force the ring gear into mesh with the pinion. Rock the ring gear to allow the teeth of the gears to mesh.
5. With the force still applied to the differential case, set the dial indicator to zero.

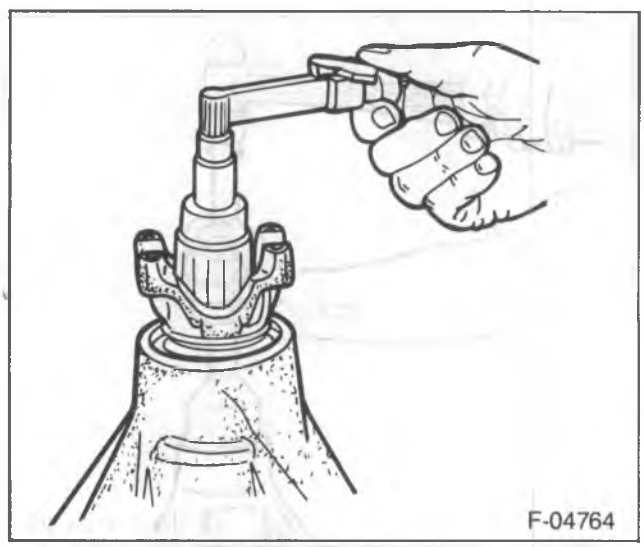


Figure 76—Checking Pinion Preload

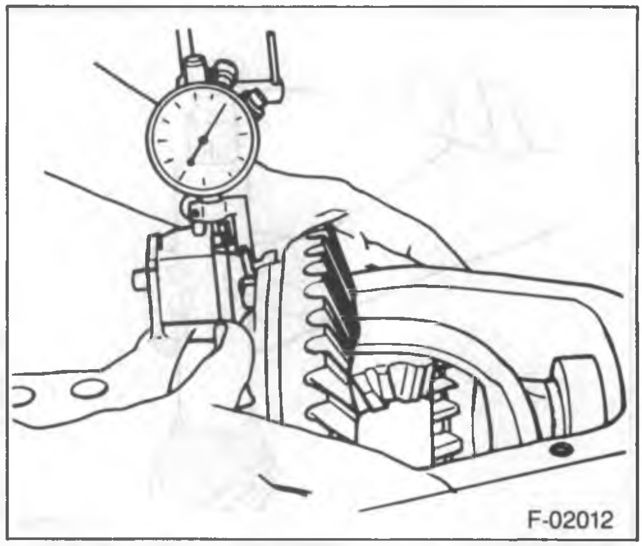


Figure 77—Measuring Differential Movement

6. Force the differential case away from the pinion gear to obtain an indicator reading. Repeat this action until a consistant reading is obtained.
7. Remove the indicator and the differential case from the carrier.
8. Remove the master bearings from the differential case.
9. Using the total shim pack size determined earlier, (Refer to "Determining Total Differential Shim Pack Size" in this section) subtract the reading found in step 6 from the total reading. The reading found in step 6 will be the shim size on the ring gear side. The remaining portion of the shim pack will be used on the side opposite the ring gear. Add an additional 0.38 mm (0.015-inch) of shims to the side opposite the ring gear to preload the bearings.
10. Place the proper shims on the differential side bearing hub (ring gear side) and drive the differential bearing onto the hub using J 23690 and J 8092 (figure 78).
    - If installing a new bearing, be certain that it is the same width as the old bearing.

Figure 78—Installing the Differential Bearings

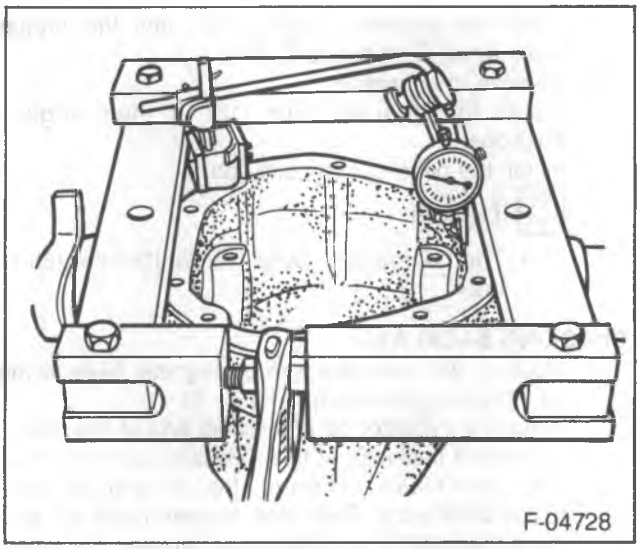


Figure 79—Mounting the Carrier Spreader

11. Place the proper shims on the differential side bearing hub (opposite the ring gear) and drive the differential bearing onto the hub using J 23690 and J 8092.
    - If installing a new bearing, be certain that it is the same width as the old bearing.
12. Assemble J 24385-01 to the axle housing as shown in figure 79.
13. Assemble the dial indicator as shown in figure 79. Preset the gage at least 0.020-inch, and then rotate the indicator housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

14. Spread the carrier while examining the dial indicator.
15. Remove the dial indicator.
16. Place the bearing cups (20) onto the bearings.
17. Install the differential assembly into the carrier.
    - Use a rawhide hammer to seat the differential assembly in the axle housing (figure 80).
18. Remove the spreader.
19. Install the bearing caps (18) in their original positions.
20. Install the bearing cap bolts (19).

Tighten

- The bearing cap bolts (19) to 115 N·m (85 ft. lbs.).

ASSEMBLING THE DIFFERENTIAL TO THE AXLE HOUSING — HEAVY DUTY MODELS

Tools Required:

J 23690 Differential Side Bearing Installer
J 8092 Driver Handle
J 24385-01 Differential Carrier Spreader
C-4205 Preload Shim Installer
C-4171 Universal Handle

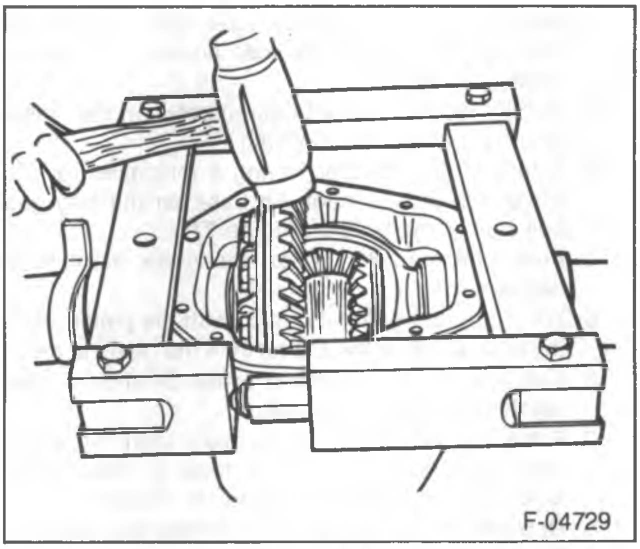


Figure 80—Installing the Differential Case

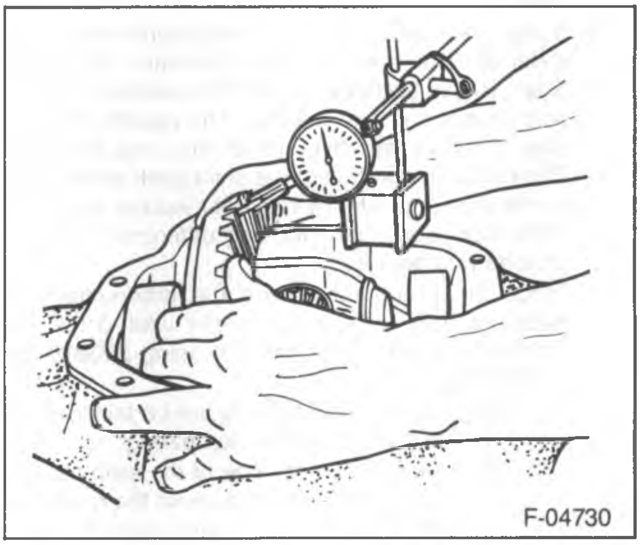


Figure 81—Measuring Backlash

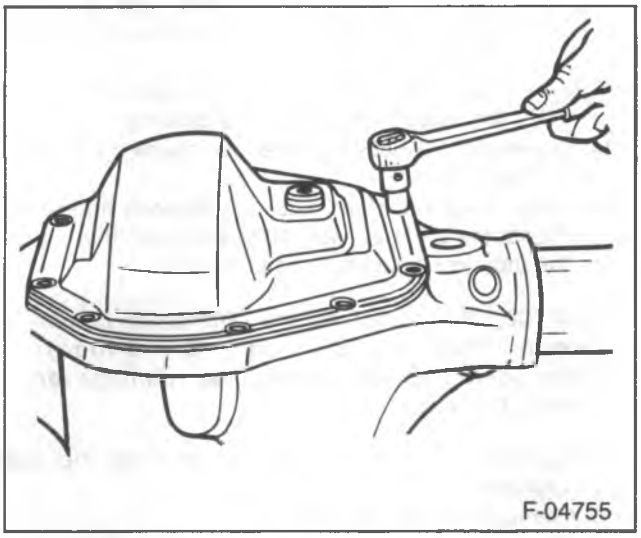


Figure 82—Installing the Axle Cover

1. Assemble the differential case (22) with master bearings installed to the axle housing. The pinion must be installed.
2. Install the spacer (used before) between the master bearing and the axle housing.
3. Mount a dial indicator having a minimum travel of 0.200-inch with a magnetic base on the ring gear bolt side of the housing (figure 77).
4. Place the indicator tip on the chalk mark made earlier.
5. Force the ring gear into mesh with the pinion. Rock the ring gear to allow the teeth of the gears to mesh.
6. With the force still applied to the differential case, set the dial indicator to zero.
7. Force the differential case away from the pinion gear to obtain an indicator reading. Repeat this action until a consistent reading is obtained.
8. Remove the indicator and the differential case from the carrier.
9. Remove the master bearings from the differential case.
10. Using the total shim pack size determined earlier, (refer to "Determining Total Differential Shim Pack Size" in this section) subtract the reading found in step 7 from the total reading. The reading found in step 7 will be the shim size on the ring gear side. The remaining portion of the shim pack will be used on the side opposite the ring gear. Add an additional 0.015-inch worth of shim for differential bearing preload and backlash.
11. Place the proper shims on the differential side bearing hub (ring gear side) and drive the differential bearing onto the hub using J 23690 and J 8092 (figure 78).
    - If installing a new bearing, be certain that it is the same width as the old bearing.
12. Determine the proper size of the shim pack by subtracting the spacer size from the remaining amount of shims necessary (determined in step 10).
13. Place the proper shims on the differential side bearing hub (ring gear side) and drive the differential bearing onto the hub using J 23690 and J 8092.
    - If installing a new bearing, be certain that it is the same width as the old bearing.
14. Assemble J 24385-01 to the axle housing as shown in figure 79.
15. Assemble the dial indicator as shown in figure 161. Preset the gage at least 0.020-inch, and then rotate the indicator housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

16. Spread the carrier while examining the dial indicator.
17. Remove the dial indicator.
18. Place the bearing cups (20) onto the bearings.
19. Install the differential assembly into the carrier (figure 80).
20. Drive the outboard spacers (43) into the proper sides using C-4205 and C-4171.
21. Remove the spreader.
22. Install the bearing caps (18) in their original positions.
23. Install the bearing cap bolts (19).

Tighten

- The bearing cap bolts (19) to 115 N·m (85 ft. lbs.).

CHECKING BACKLASH

1. Mount a dial indicator with a magnetic base to the axle housing as shown in figure 81.
2. Place the indicator tip at the heel end of the tooth.
3. Check the backlash at three equally spaced points. The backlash should be 0.13-0.23 mm (0.005-0.009-inch). The measurement must not vary more than 0.05 mm (0.002-inch) between the points checked.
4. High backlash is corrected by moving the ring gear closer to the pinion.
5. Low backlash is corrected by moving the ring gear away from the pinion.
6. To adjust the backlash, the differential case must be removed from the housing, then the differential bearings removed, and the proper number of shims moved from one side to the other.

FINAL ASSEMBLY

Install or Connect

1. Drive axles. Refer to the proper service manual.
2. RTV to the axle cover.
3. Axle cover (14) to the housing (figure 82).

Tighten

- The cover bolts (17) to 47 N·m (35 ft. lbs.).

4. Axle housing to the vehicle. Refer to the proper service manual.
5. Lubricant to the rear axle after the RTV has cured.

SPECIFICATIONS

9³/₄-INCH RING GEAR AXLE

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	150	110
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35

	SIZE
Differential Bearing Adjusting Shim	0.003-inch 0.005-inch 0.010-inch 0.030-inch
Outer Pinion Bearing Shim	0.003-inch 0.005-inch 0.010-inch 0.030-inch
Inner Pinion Bearing Shim	0.003-inch 0.005-inch 0.010-inch
Lubricant	80W-90 GL-5

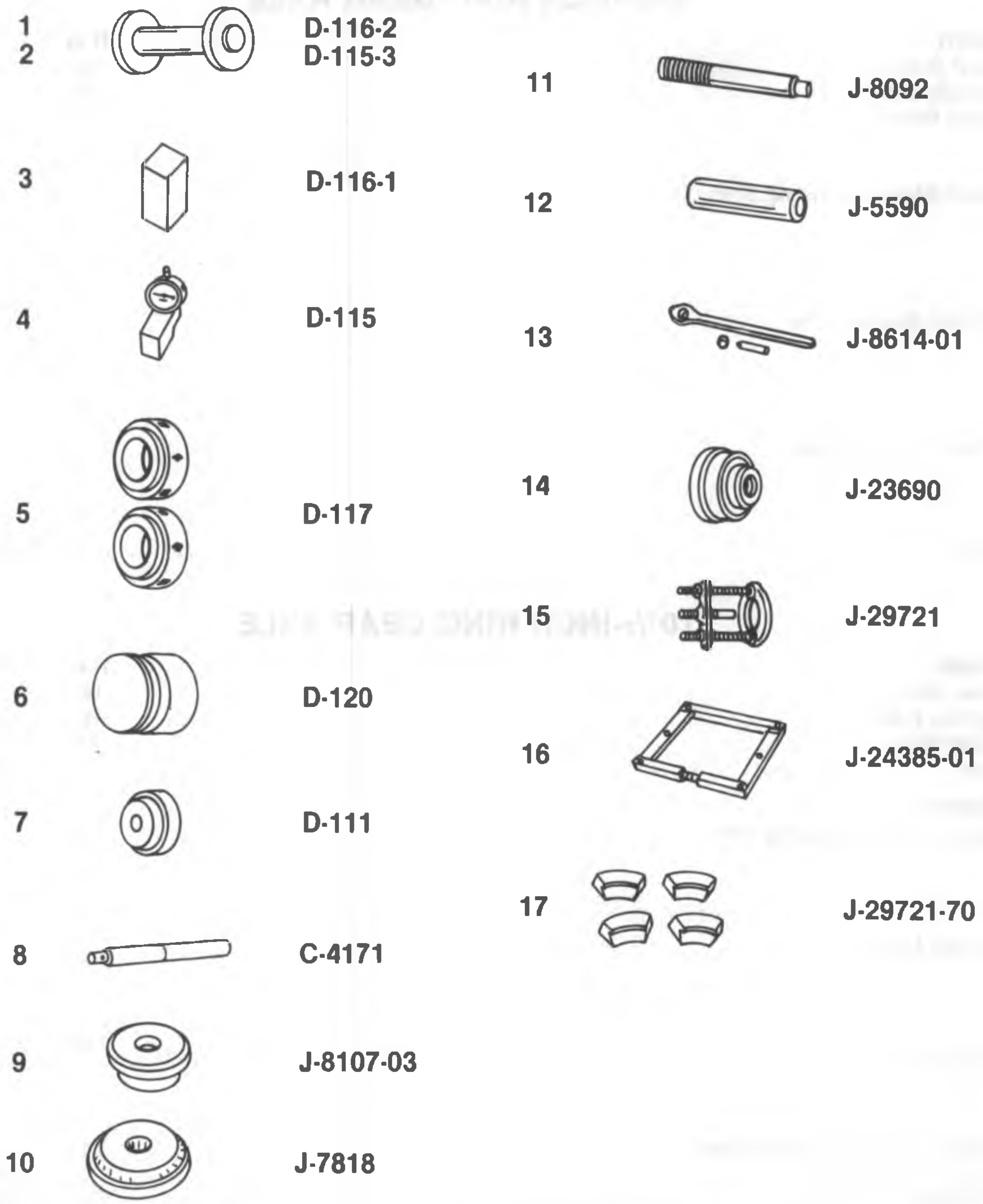
10¹/₂-INCH RING GEAR AXLE

FASTENER	N·m	FT. LBS.
Ring Gear Bolts	142	105
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35
Lubricant		80W-90 GL-5

SHIM SIZES	SIZE
Differential Bearing Adjusting Shim	0.003-inch 0.005-inch 0.010-inch 0.030-inch
Outer Pinion Bearing Shim	0.003-inch 0.005-inch 0.010-inch 0.030-inch
Inner Pinion Bearing Shim	0.003-inch 0.005-inch 0.010-inch

Inner Pinion Bearing Cup and Cone	
— B and H.D. Models	1.4375-inch wide
— U Model	1.1875-inch wide
Differential Bearing Cup and Cone	
— B and U Models	1.0000-inch wide
— H.D. Model	1.1875-inch wide

SPECIAL TOOLS



1. Master Discs (Miller)
2. Arbor (Miller)
3. Pinion Height Block (Miller)
4. Scooter Gage (Miller)
5. Master Pinion Bearings (Miller)
6. Master Pinion Block (Miller)
7. Cup Installer (Miller)
8. Handle (Miller)
9. Differential Side Bearing Removal Plug
10. Rear Pinion Bearing Cup Installer
11. Driver Handle
12. Rear Pinion Bearing Cone Installer
13. Pinion Flange Remover
14. Differential side Bearing Installer
15. Differential Side Bearing Remover
16. Differential Carrier Spreader
17. Side Bearing Adapters

F-04663

SPECIAL TOOLS

1. D-116-2
2. D-115-3

3. D-116-1

4. D-115

5. D-136 or D-117 (Heavy Duty Axles)

6. D-120

7. C-4204

8. C-4171

9. 4205

10. J-8107-3

11. J-8092

12. J-7817

13. J-5590

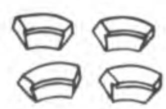
14. J-8614-01

15. J-23690

16. J-29721

17. J-24385-01

18. J-29721-70



1. Master Discs (Miller)
2. Arbor (Miller)
3. Pinion Height Block (Miller)
4. Scooter Gage (Miller)
5. Master Pinion Bearings (Miller)
6. Master Pinion Block (Miller)
7. Cup Installer (Miller)
8. Handle (Miller)
9. Preload Shim Installer (Miller)
10. Differential Side Bearing Remover Plug
11. Driver Handle
12. Front Pinion Bearing Cup Installer
13. Front Pinion Bearing Cone Installer
14. Pinion Flange Remover
15. Differential Side Bearing Installer
16. Differential Side Bearing Remover
17. Differential Carrier Spreader
18. Side Bearing Adapters

F-04664

SECTION 4B6

12-INCH RING GEAR (ROCKWELL)

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

The Rockwell 12-inch ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. this gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is full-floating. The axle shaft is supported at the wheel ends by the wheel hubs. The rear axle shaft is held into the rear axle by an axle cap bolted to the hub. The splined end of the shaft is supported by the differential.

This axle uses a differential carrier, separate from the axle housing. This differential carrier holds the entire drive gear set, the differential bearings and adjusting nuts, and the differential bearing caps. The pinion cage is bolted to the differential cage.

The pinion gear is supported in a pinion cage by three bearings: a pinion front bearing, a pinion inner bearing, and a pinion rear or pilot bearing. The pinion cage is separate from the axle housing. Selective shims are used between the pinion cage and the axle housing to set the pinion depth.

The ring gear is bolted onto the differential case with right-hand thread bolts.

The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using two differential bearing adjusting nuts. These allow the differential to be moved from side to side by adjusting the nuts in or out. The differential side bearing preload is accomplished by tightening the differential bearing adjusting nuts after the ring gear backlash has been set. Two bearing caps are used to hold the differential into the differential carrier as well as to supply half of the threads for the bearing adjusting nuts.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a gasket at each axle shaft end, and by a gasket between the rear axle housing and the differential carrier.

The Rockwell axle is identified by the model number on the carrier. This axle has a separate carrier, an overhung pinion, and incorporates disk brakes.

DISASSEMBLY OF THE REAR AXLE

↔ Remove or Disconnect (Figures 1 and 2)

Tools Required:

J 22912 Split Type Puller Plate
J 7804-01 Pinion Flange Puller
J 22912 Rear Pinion Bearing Remover
J 3453 Pinion Flange Holding Bar

- Drain the axle lubricant from the housing.

1. Axle shafts. Refer to the proper service manual.
2. Carrier to housing bolts (47) and washers (45).
   - Loosen but do not remove the two upper bolts to keep the carrier from falling.
3. Carrier (46) from the axle housing.
   - Using a roller jack, support the carrier, and remove it from the axle housing.
   - Use a rawhide hammer to break the carrier loose from the housing.
   - Remove the two upper bolts (47).

- Place the carrier in a suitable holding fixture (figure 3).

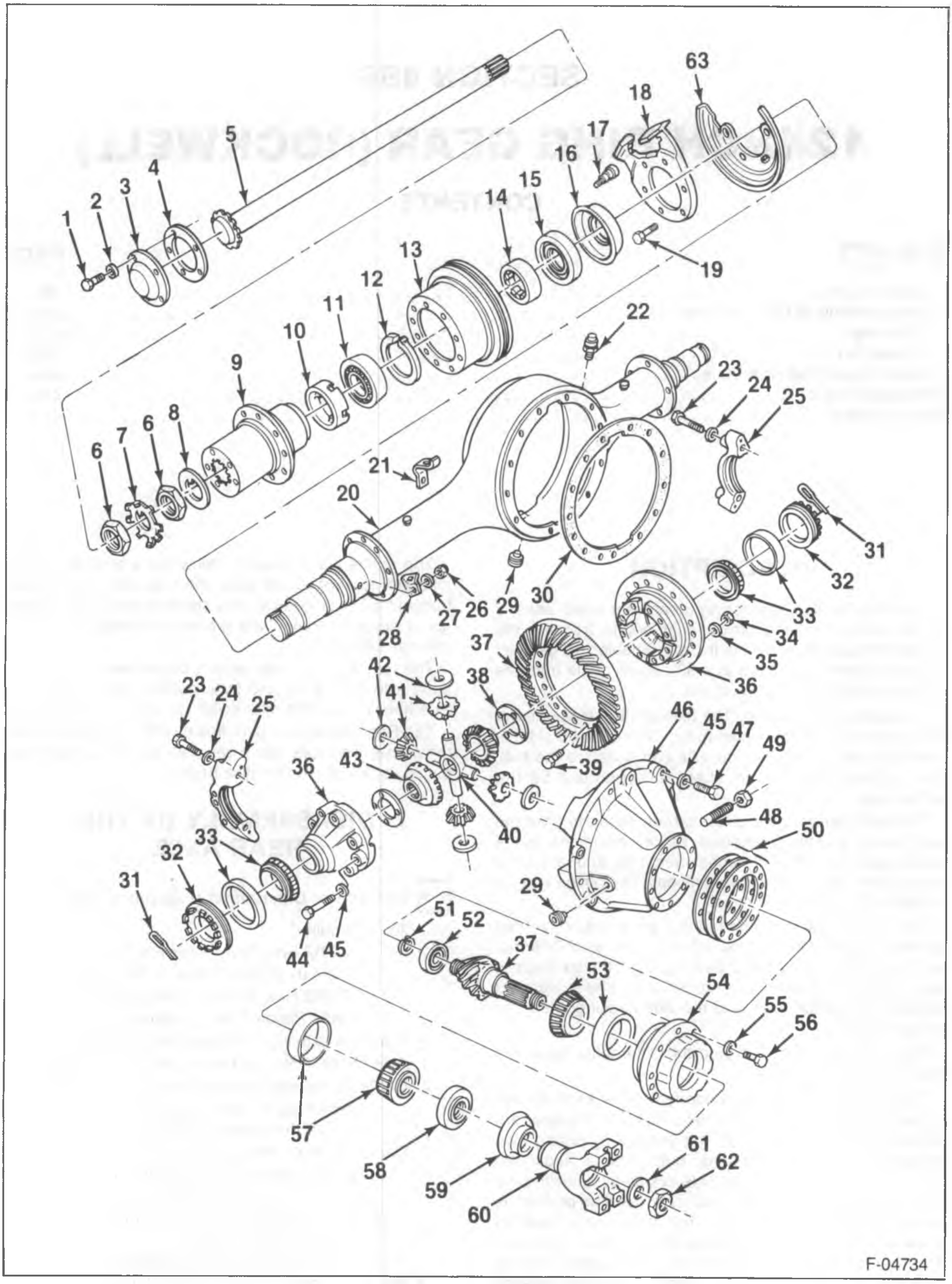


Figure 1—Rear Axle Components

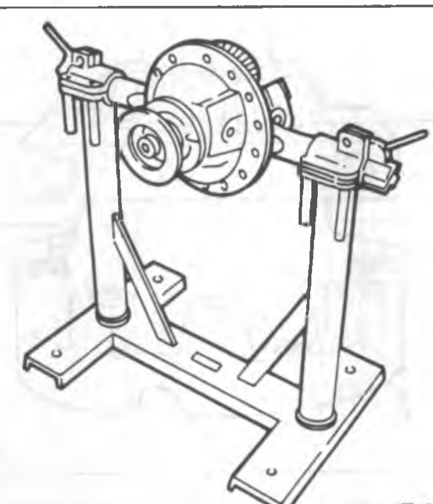
1. Bolt
2. Washer
3. Hub Cap
4. Gasket
5. Axle Shaft
6. Adjusting Nut
7. Lock Ring
8. Thrust Washer
9. Wheel Hub
10. Thrust Spacer
11. Bearing
12. Retaining Ring
13. Rotor
14. Bearing
15. Hub Oil Seal
16. Deflector
17. Bolt
18. Brake Caliper Bracket
19. Bolt
20. Axle Housing
21. Bracket
22. Axle Vent
23. Bolt
24. Washer
25. Bearing Cap
26. Nut
27. Washer
28. Bracket
29. Plug
30. Gasket
31. Pin
32. Adjusting Nut
33. Bearing
34. Nut
35. Washer
36. Differential Case
37. Pinion and Ring Gear Set
38. Side Gear Thrust Washer
39. Ring Gear Bolt
40. Pinion Spider
41. Pinion Gears
42. Pinion Thrust Washers
43. Side Gears
44. Bolt
45. Washer
46. Carrier
47. Bolt
48. Thrust Block Screw
49. Nut
50. Pinion Depth Shims
51. Retaining Ring
52. Bearing
53. Bearing
54. Pinion Cage
55. Washer
56. Bolt
57. Bearing
58. Pinion Oil Seal
59. Deflector
60. Pinion Flange
61. Washer
62. Nut
63. Backing Plate

F-04734

Figure 2—Rear Axle Components

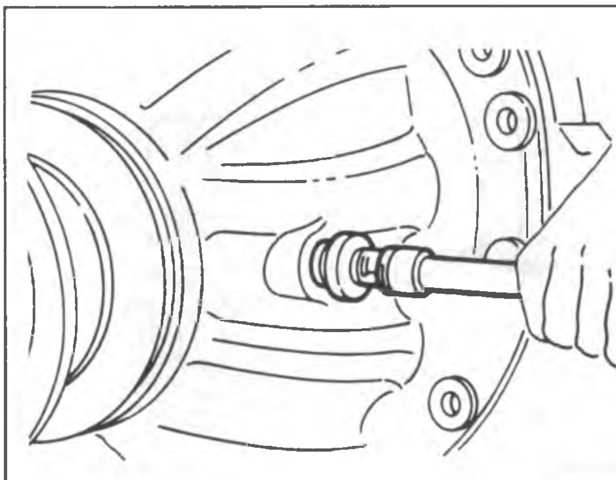
- Loosen the jam nut (49) and back off the thrust block adjusting screw (48) (figure 4).
- Center punch one differential carrier leg and bearing cap to identify the cap for reassembly (figure 5).

4. Bearing cap bolts (23).
5. Bearing caps (25) (figure 6).
6. Adjusting nuts (32).
7. Differential and gear assembly (36) from the carrier (figure 7).
   - Scribe a mark across the differential case halves.
8. Differential case bolts (44).
9. The top case half (36) (figure 8).
10. Side gears (43) and thrust washers (38) (figure 9).
11. Pinion gears (41) and thrust washers (42).
12. Differential pinion spider (40).
13. Ring gear nuts (34), washers (35), and bolts (39).
14. Ring gear (37) from the differential case.
15. Differential side bearings (33) using J 22912 and an arbor press (figure 10).
    - Mark the bearings as left and right.



F-04745

Figure 3—Carrier in the Repair Stand



F-04746

Figure 4 — Loosening the Thrust Adjusting Screw

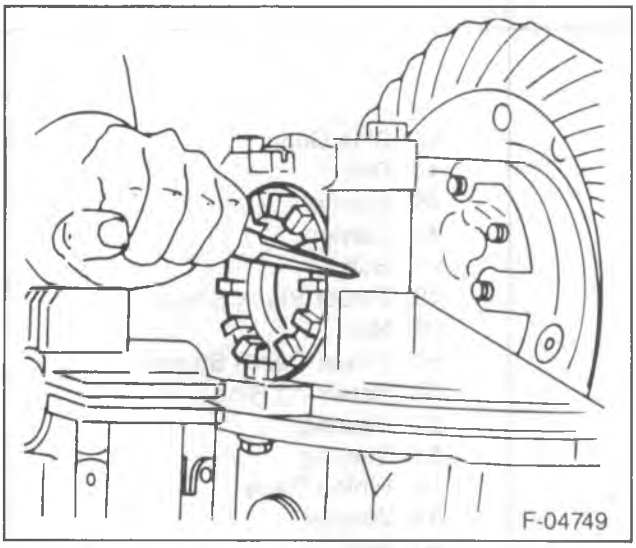


Figure 5—Punching the Carrier Leg

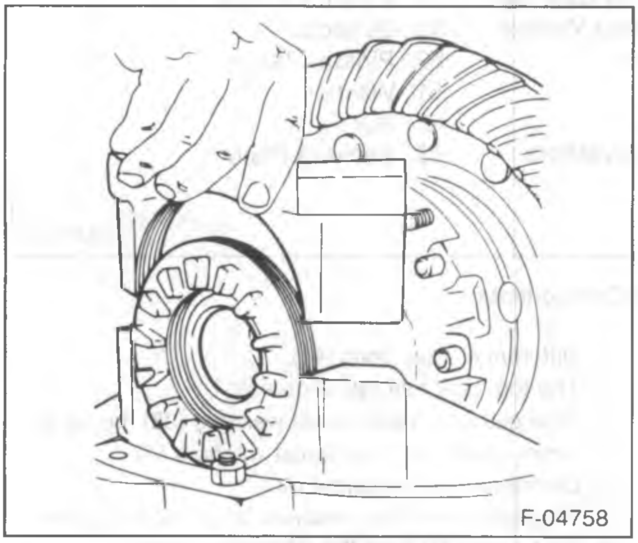


Figure 6—Removing the Bearing Cap

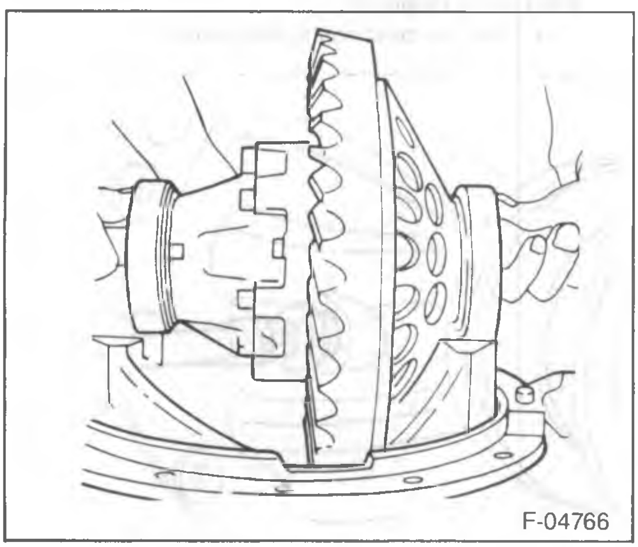


Figure 7—Removing the Differential

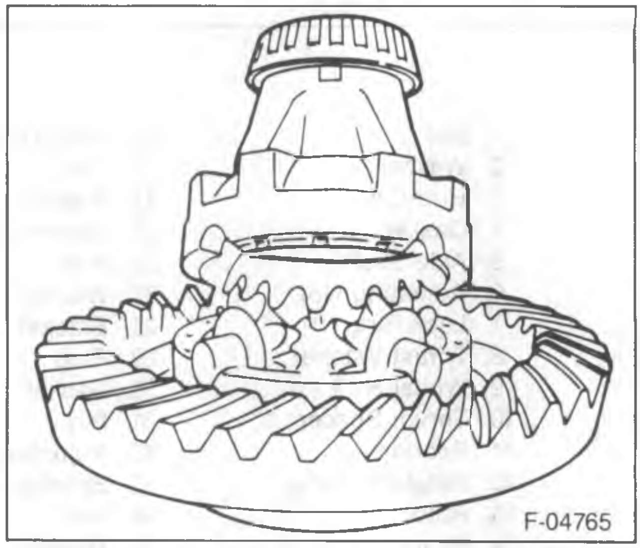


Figure 8—Differential Case Halves

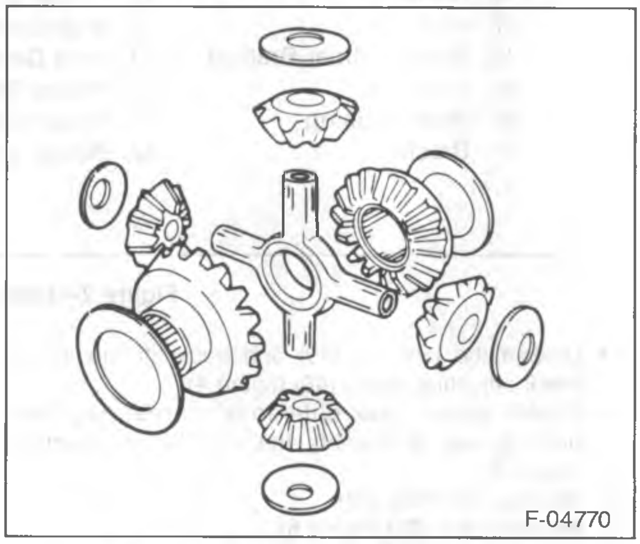


Figure 9—Differential Components

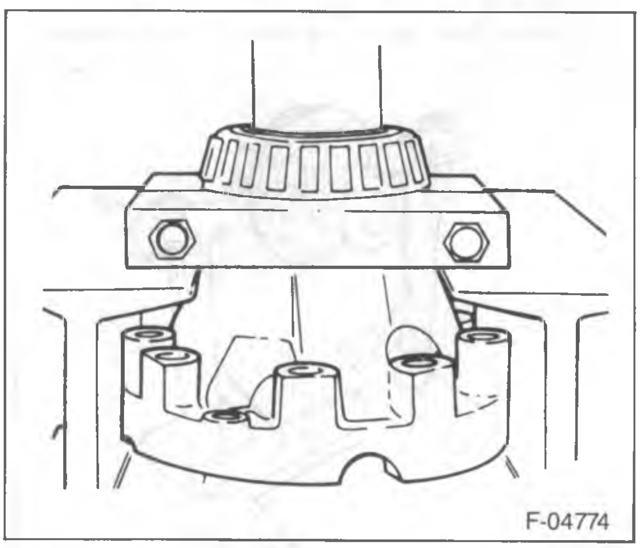


Figure 10—Removing the Differential Side Bearing

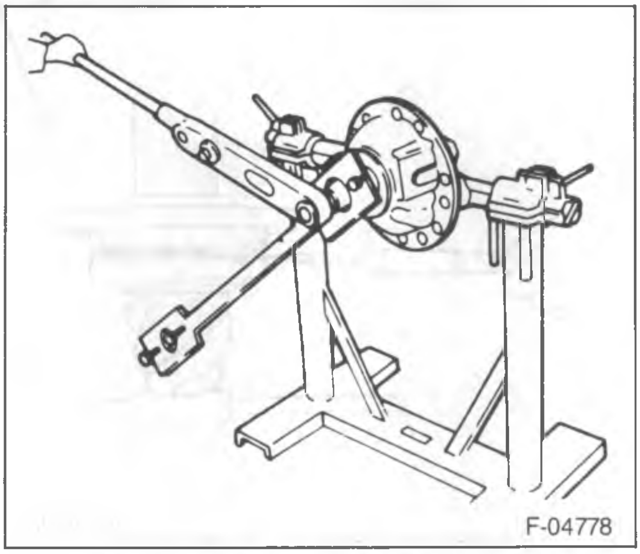


Figure 11—Removing the Pinion Nut

16. Pinion shaft nut (62) and washer (61) using J 3453 to hold the pinion yoke (figure 11).
17. Pinion yoke (60) using J 7804-01 (figure 12).
18. Pinion cage (54) from the carrier by using bolts in the puller holes of the cage. Thread the bolts in, to push the cage away from the carrier (figure 13).
19. Shim pack (50) from the cage.
    - Wire the shims together.
20. Pinion gear (37) from the cage by pressing it out in an arbor press.
21. Pinion oil seal (58) from the pinion cage.
22. Outer bearing (57) from the cage.
23. Inner bearing (53) from the pinion using J 22912 and an arbor press (figure 14).
24. Pilot bearing retaining ring (51).
25. Pilot bearing (52) from the pinion gear (37) using J 22912.

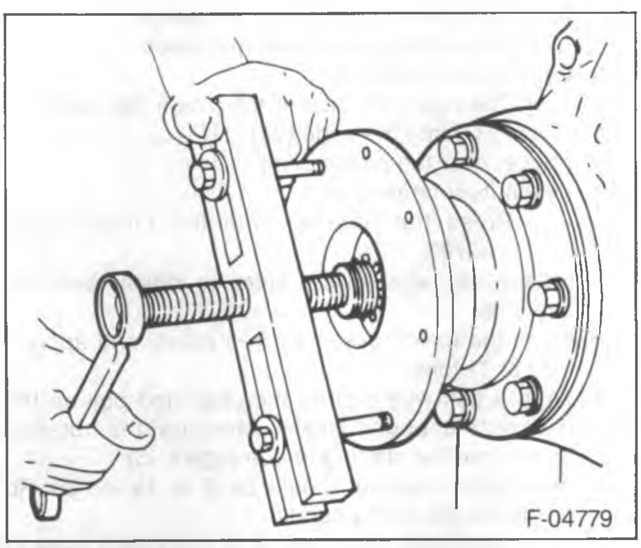


Figure 12—Removing the Pinion Flange

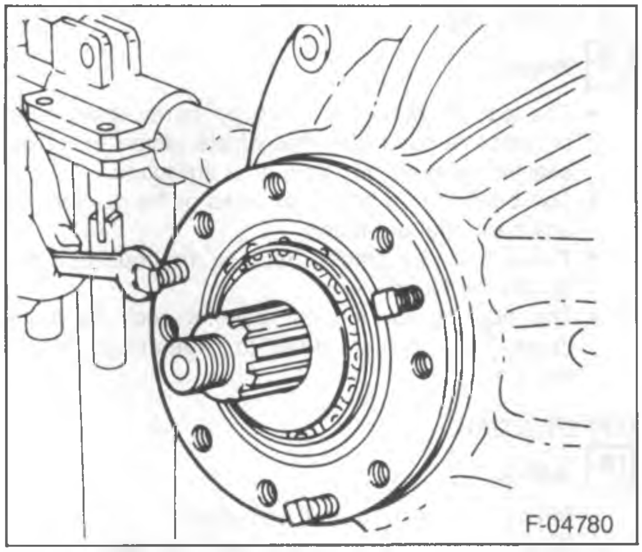


Figure 13—Removing the Pinion Cage

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with comressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

Through inspection of the drive parts for wear or stress ans subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

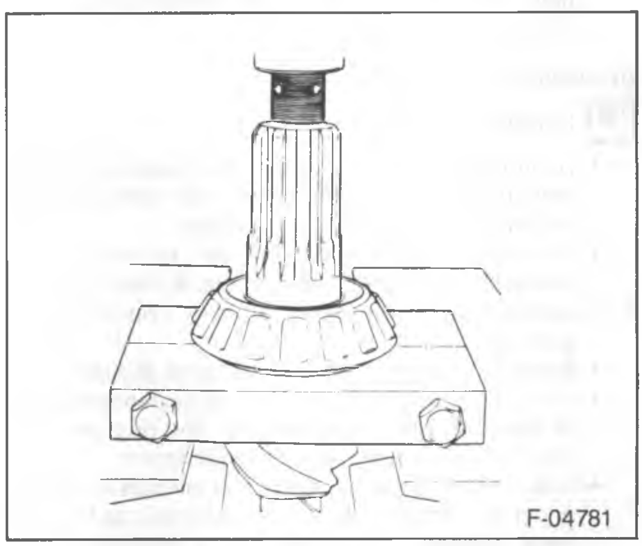


Figure 14—Removing the Pinion Inner Bearing

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup bores for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scorring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.
- Replace all worn parts.

PINION AND RING GEAR

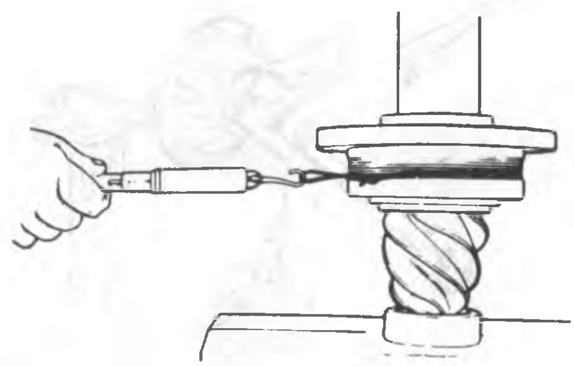
Inspect

- Pinion and ring gear teeth for cracking, chipping, scarring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Pinion cages for cracks, imperfections, corrosion, pits and grooves.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scorring.
- Bearings and cups are only replaced as sets.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minutes scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.



F-04782

Figure 15—Measuring the Preload Torque

- Bearing caps for cracks or chips.

SHIMS

Inspect

Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF THE REAR AXLE

PINION ASSEMBLY

Install or Connect (Figures 1 and 2)

Tools Required:
J 23723 Bearing Installer
J 3453 Flange Holding Bar
J 3154-04 Seal Installer

- Lubricate all parts with axle lubricant.

1. Pinion rear bearing (57) onto the pinion.
   - Press the bearing onto the pinion using J 23723.
2. Pinion pilot bearing (52) onto the pinion.
   - Press the bearing onto the pinion.
3. Bearing lock ring (51).
   - The ring must seat in the pinion ring land.
4. Pinion (37) into the cage (54).
5. Spacer over the pinion shaft.
6. Pinion front bearing (57).
   - Press the bearing onto the pinion using J 23723.

- Rotate the cage several times to initially seat the bearings.
- Place the pinion assembly in a press, and apply a load of 11 tons.
- Wrap a soft wire around the cage and pull on the line with a pound scale. Measure the rotating torque, not the starting torque (figure 15).
- The rotating torque should be 5 to 15 in. lbs. To determine the inch pounds:
  — Determine the diameter of the pinion cage in inches.

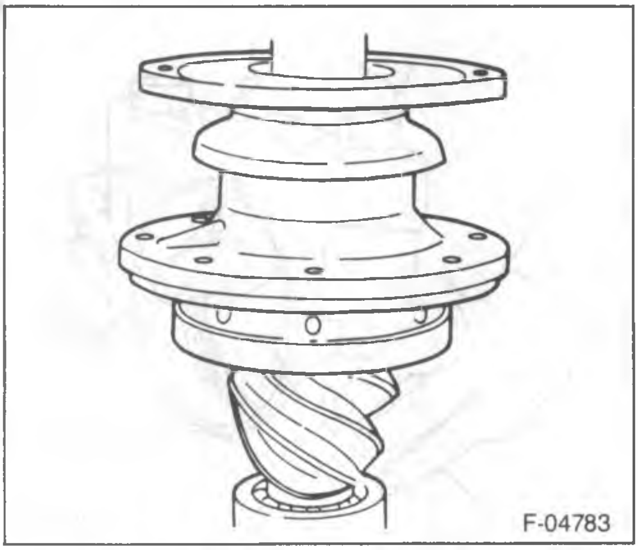


Figure 16—Installing the Pinion Flange

- — Divide the diameter by 2 to find the radius in inches.
- — Multiply the radius by the number of pounds on the scale.
- Use a thinner spacer to increase bearing preload, and a thicker spacer to decrease bearing preload.

7. Pinion flange (60) to the pinion (figure 16).
   - Press the flange onto the pinion.
8. Pinion washer (61) and nut (62) using J 3453 to hold the pinion (figure 17).

Tighten

- Nut (62) to 325 N·m (240 ft. lbs.).
- Remove J 3453, and recheck the rotation torque at the pinion nut. The torque should be 5 to 15 in. lbs. Adjust the preload if necessary.
- Remove the pinion nut (62), washer (61), and flange (60) (figure 18).

9. Pinion oil seal (58) using J 3154-04 (figure 19).
10. Pinion flange deflector (59).
11. Pinion flange (60) to the pinion (figure 16).
    - Press the flange onto the pinion.

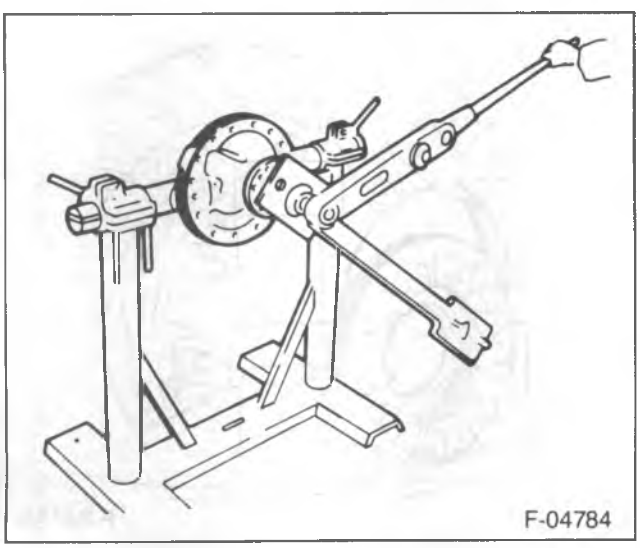


Figure 17—Installing the Pinion Nut

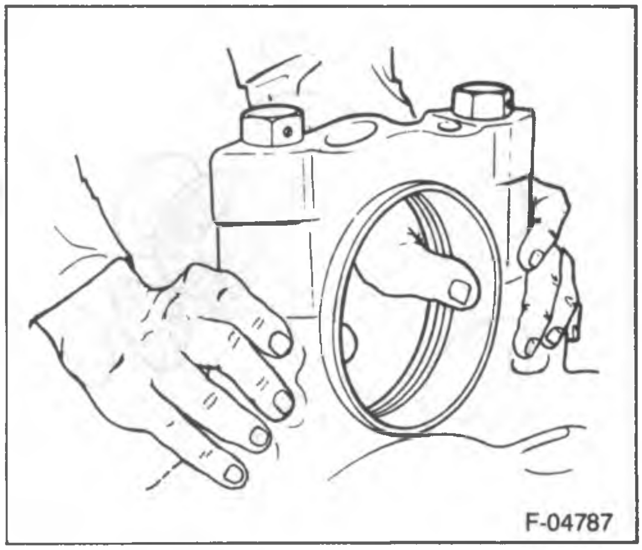


Figure 18—Removing the Pinion Nut

12. Pinion washer (61) and a new nut (62) using J 3453 to hold the pinion (figure 17).

Tighten

- Nut (62) to 325 N·m (240 ft. lbs.).

PINION INSTALLATION

Install or Connect

- Measure the pinion bearing shims (50). If a new pinion and ring gear set is installed, the pinion bearing shim pack must be adjusted.
- Examine the heads of the new and old drive pinions. Compare these codes, and adjust the pinion bearing shim pack accordingly. The chart in figure 20, shows the proper adjustment to be made to the shim pack.
- If the original pinion is being used, the original pinion shims should also be used.

1. Pinion bearing shims (50) to the pinion cage.
   - The shims, housing, and cage must be clean.
2. The pinion cage (54) to the axle housing.

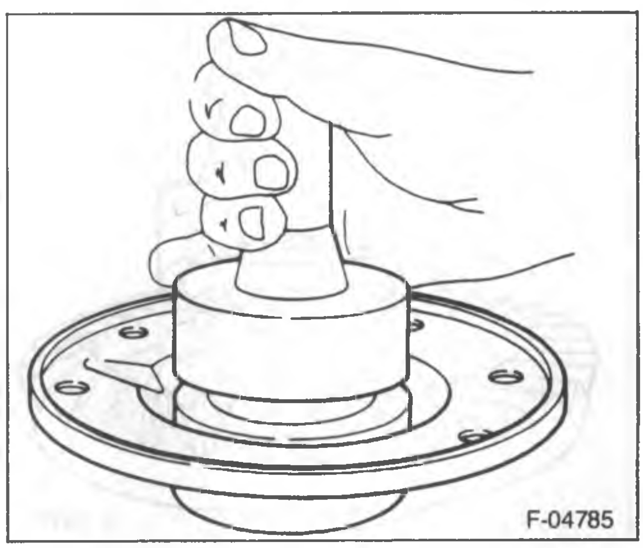


Figure 19—Installing the Seal

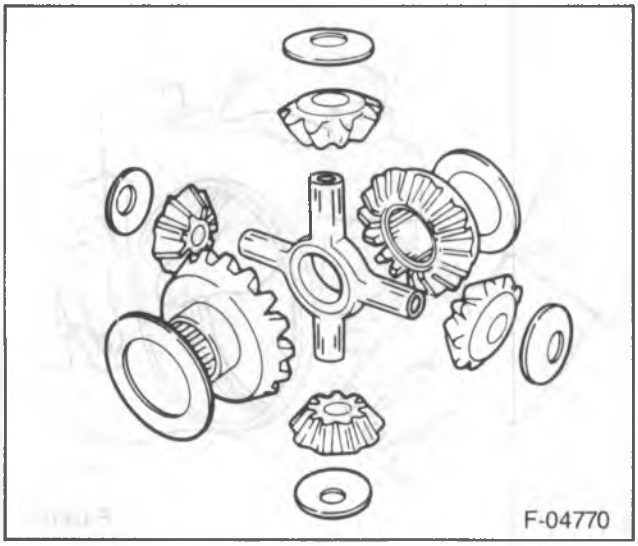


Figure 20—Differential Components

3. Cage bolts (56).

Tighten

- Bolts to 48 N·m (35 ft. lbs.).

DIFFERENTIAL CASE ASSEMBLY

Install or Connect

- Lubricate all parts with rear axle lubricant.

1. Differential pinion gears (41) and thrust washers (42) to the spider (40) (figure 21).
2. Differential side gears (43) and thrust washers (38) to the differential case halves in their original locations.
3. Differential spider (40) to the differential.
4. The case halves (figure 22).
   - Align the scribe marks on the case halves.
5. Case bolts (44).

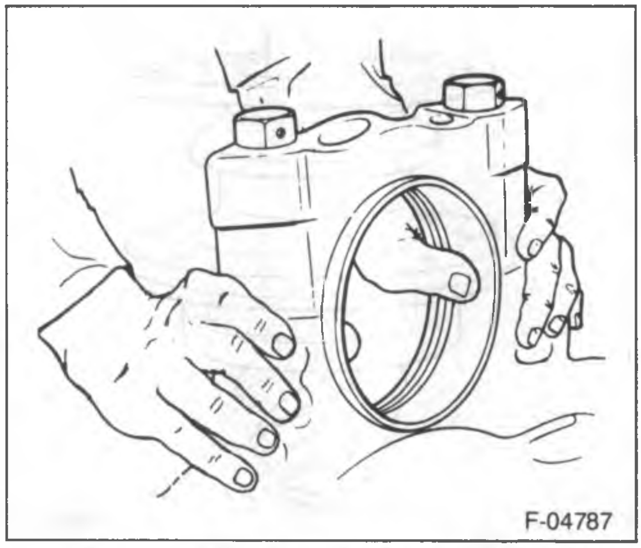


Figure 23—Checking the Bearing Cup Fit

Tighten

- Bolts (44) to 61 N·m (45 ft. lbs).

- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.
- The ring gear must be heated before assembly to the differential case. Heat the ring gear in water to 160° — 180° F for 10 minutes before assembly.

6. Ring gear (37) to the differential.
   - Thread two studs into the ring gear on opposite sides.
   - Place the ring gear onto the case, and align the holes in the c ase with the studs.
7. New ring gear bolts (44).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

- The ring gear bolts in sequence to 136 N·m (100 ft. lbs.).

8. Differential side bearings (33).

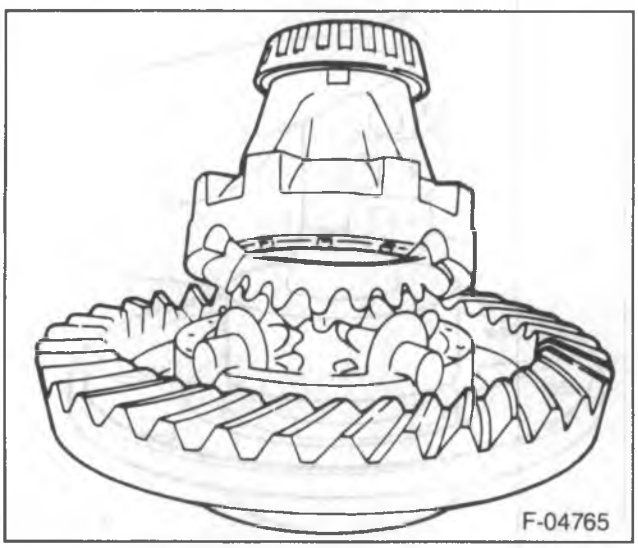


Figure 22—Installing the Case Halves

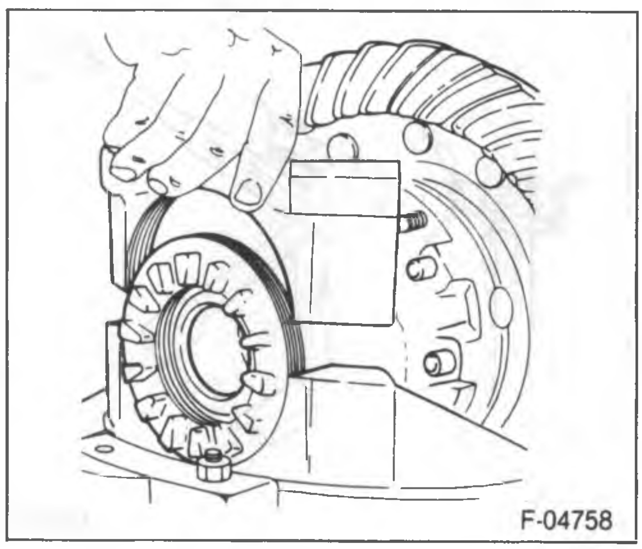


Figure 24—Installing the Bearing Cup

- Press the bearings on using a suitable tool.

DIFFERENTIAL INSTALLATION

Install or Connect

1. Bearing cups (33) to the carrier (36).
2. Adjusting nuts (32).
3. Bearing caps (25).
4. Cap bolts (23).

Tighten

- Bolts to 176 N·m (130 ft. lbs.).

- The bearing cups must have a hand fit in the bearing bores: If the fit is too tight, rework the bore with emery cloth, until a hand fit is obtained (figure 23).

Remove or Disconnect

1. Cap bolts (23).
2. Bearing caps (25).
3. Adjusting nuts (32).
4. Bearing cups (33).

Install or Connect

- Lubricate all parts with axle lubricant.

1. Bearing cups (33) onto the bearings.
2. Differential assembly (36) to the carrier.
3. Bearing adjusting nuts (32).
   - Turn the nuts hand-tight against the bearing cups.
4. Bearing caps (25) (figure 24).
   - Tap lightly into position.
5. Cap bolts (23).

Tighten

- Bolts to 176 N·m (130 ft. lbs.).

CHECKING RING GEAR RUN OUT

Measure

1. Ring gear run out.
   - Mount a dial indicator to the carrier. The dial indicator stem should rest on the back face of the ring gear.
   - Loosen the adjusting nut opposite the ring gear enough to notice end play on the indicator.
   - Tighten the same adjusting nut just enough to have 0.000-inch end play on the indicator.
   - Rotate the gear, and check for run out. If the run out exceeds 0.008-inch, remove the differential, and determine the cause.

BACKLASH ADJUSTMENT

- The differential side bearing preload is adjusted by two adjusting nuts in the differential bearing bore. The bore and the bearing cap provide the mating threads for the bearing nut.
- The differential must be initially preloaded in order to determine the backlash of the gear set. After the backlash has been set, the final bearing preload is set.

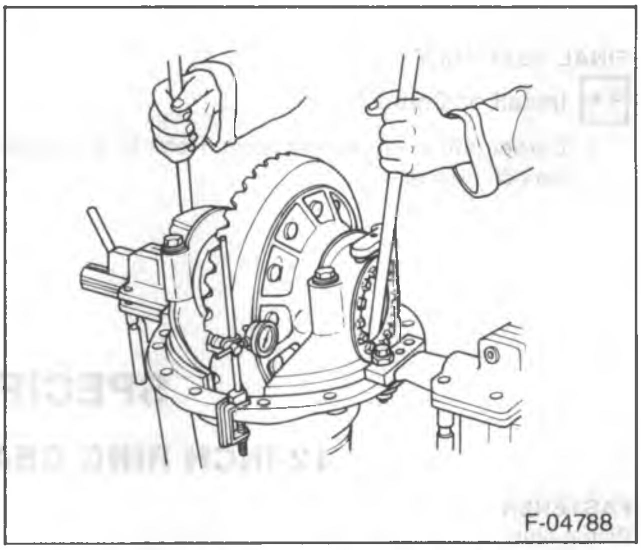


Figure 25—Adjusting Side Bearing Preload

Adjust

1. The bearing preload by tightening the adjusting nuts (32) one notch each from 0.000 end play. Refer to "Checking Ring Gear Run Out" (figure 25).

- Mount a dial indicator to the carrier (46). Place the stem of the indicator onto the toe end of a tooth (figure 26).

2. Backlash by moving the ring gear toward or away from the pinion.
   - If setting up the original ring and pinion gear set, use the backlash reading obtained earlier.
   - Set the backlash to 0.005 - 0.015-inch for new gear sets.
   - If the backlash is too high, move the ring gear toward the pinion.
   - If the backlash is too low, move the ring gear away from the pinion.

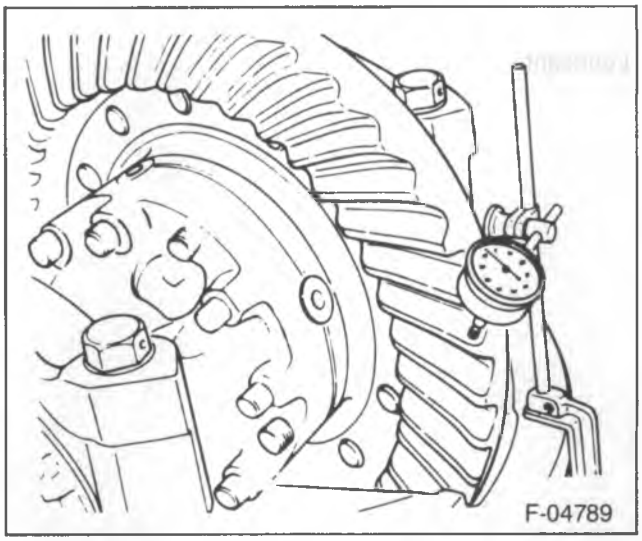


Figure 26—Checking Backlash

FINAL ASSEMBLY

Install or Connect

1. Carrier (46) to the axle housing. Refer to the proper service manual.
2. Drive axles. Refer to the proper service manual.
3. The axle housing to the v ehicle. Refer to the proper service manual.
4. Lubricant to the rear axle.

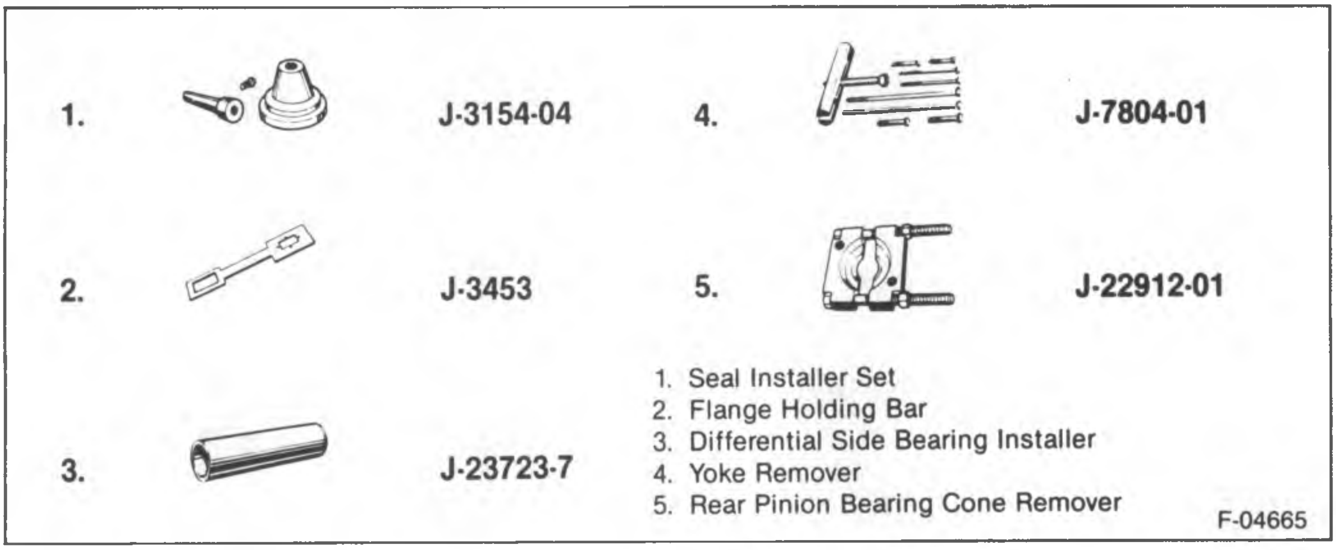
SPECIFICATIONS

12-INCH RING GEAR AXLE (ROCKWELL)

FASTENER	N·m	FT. LBS.
Piston Nut	325	240
Pinion Cage Bolts	48	35
Case Half Bolts	61	45
Ring Gear Bolts	136	100
Bearing Cap Bolts	176	130

SHIM SIZES	SIZE
Drive Pinion Bearing Retainer Shim	0.003-inch
	0.005-inch
Outer Pinion Bearing Shim	0.003-inch
	0.005-inch
	0.010-inch
	0.030-inch
Inner Pinion Bearing Shim	0.003-inch
	0.005-inch
	0.010-inch
Drive Pinion Bearing Spacer	0.172-inch
	0.173-inch
	0.174-inch
	0.175-inch
	0.176-inch
	0.177-inch
	0.183-inch
	0.189-inch
	0.195-inch
	0.201-inch
Lubricant	80W-90 GL-5

SPECIAL TOOLS



Special Tools

SECTION 4B7

LOCKING DIFFERENTIAL

CONTENTS

SUBJECT **PAGE**

LOCKING DIFFERENTIALS

$7^1/_2$, $7^5/_8$, $8^1/_2$ AND $9^1/_2$-INCH RING GEAR

DISASSEMBLY OF THE DIFFERENTIAL

↔ Remove or Disconnect (Figure 1)

Tools Required:
J 26252 Governor Remover

1. Governor bushing (4) using J 26252 (figure 2).
2. The C-clips that hold the latching bracket in place on the bracket shaft.
   - Move the bracket down the shaft.
3. Latching bracket bushing (5) using J 26252.
4. Latching bracket (11), shaft, and spring from the case.
5. Governor assembly (11) from the case.
6. Stop pin (2). ($9^1/_2$-inch only.)
7. Lockscrew (3).
8. Pinion shaft (18).
9. Differential pinion gears (7) and pinion thrust washers (6).
   - Roll the gears out of the case by rotating one of the side gears.
10. Thrust block (17).
11. Right side gear (10).
12. Right disc pack (9) and side thrust washer.
13. Left side gear (21), cam plate (16), and disc pack (12) as an assembly (cam unit).
14. Side gear thrust washer (13).

CAM UNIT DISASSEMBLY - $7^1/_2$ AND $8^1/_2$-INCH

↔ Remove or Disconnect (Figures 1 and 3)

1. Snap ring (22).
2. Clutch plates.
3. Guide clips (20).
4. Wave spring.
5. Cam plate (16).
6. Cam side gear (21).

CAM UNIT DISASSEMBLY - $9^1/_2$-INCH

↔ Remove or Disconnect

Tools Required:
J 22912-01 Bearing Remover

- Measure and record the overall length of the gear assembly from the front of the gear to the back of the thrust sleeve (14) including the side gear washer (13).

1. Guide clips (20).
2. Thrust sleeve (14) using J 22910-01.
   - Press the sleeve from the side gear (figure 4).
3. Lock plates.
4. Wave spring.
5. Cam plate (16).
6. Cam side gear (21).

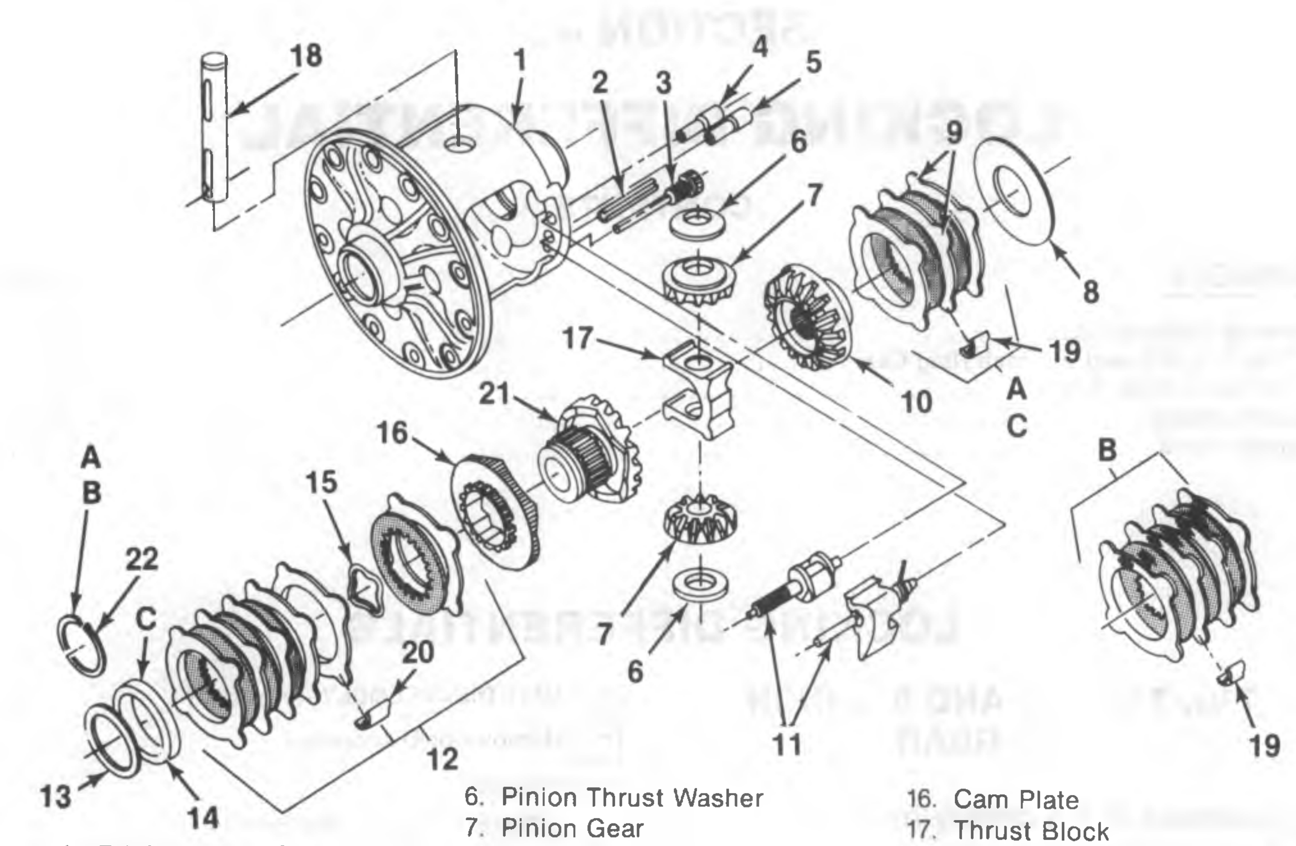
CLEANING AND INSPECTION

Clean

- All parts with solvent.

Inspect

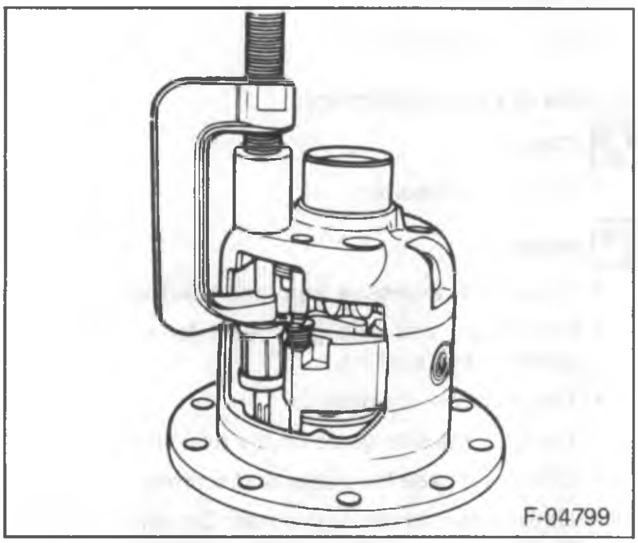
- All parts for excessive wear and breakage.
- Pinion gear and side gear teeth for wear, cracks, scorring, and spalling.
- Thrust washer for wear.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.
- Thrust sleeve for excessive wear. Do not replace the thrust sleeve unless necessary. Inspect the side gear bore for scorring. If scorring is present, replace the entire differential.
- Replace parts as necessary.



A. 7½-Inch Ring Gear
B. 8½-Inch Ring Gear
C. 9½-Inch Ring Gear
1. Differential Case
2. Stop Pin (9½ Only)
3. Lock Screw
4. Governor Bushing
5. Latching Bracket Bushing
6. Pinion Thrust Washer
7. Pinion Gear
8. Side Gear Thrust Washer
9. Clutch Plates
10. Side Gear
11. Latching Bracket
12. Clutch Plates
13. Side Gear Thrust Washer
14. Side Thrust Sleeve (9½ Only)
15. Wave Washer
16. Cam Plate
17. Thrust Block
18. Pinion Shaft
19. Guide Clip
20. Guide Clip
21. Side Cam Gear
22. Retaining Ring
23. Governor

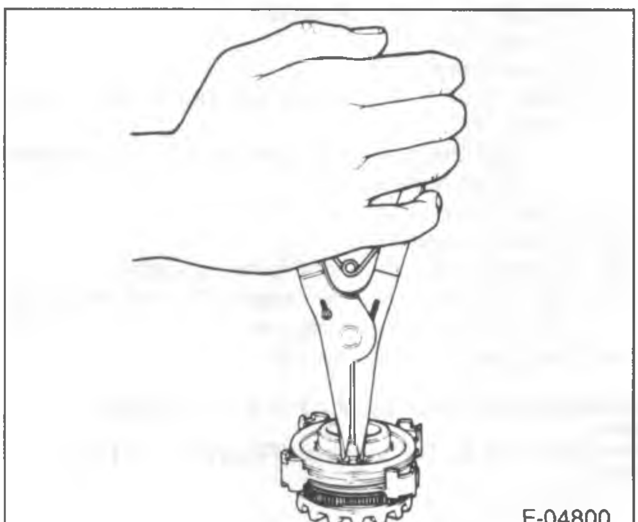
F-05914

Figure 1—Differential Components



F-04799

Figure 2—Removing the Governor Bushings



F-04800

Figure 3—Removing the Retaining Ring

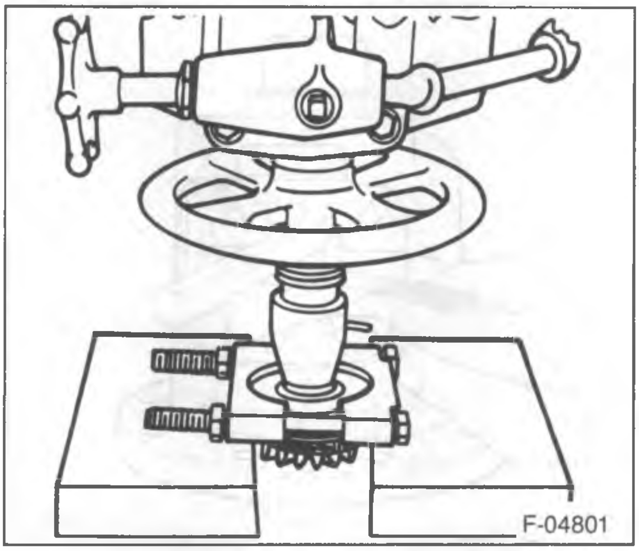


Figure 4—Removing the Thrust Ring

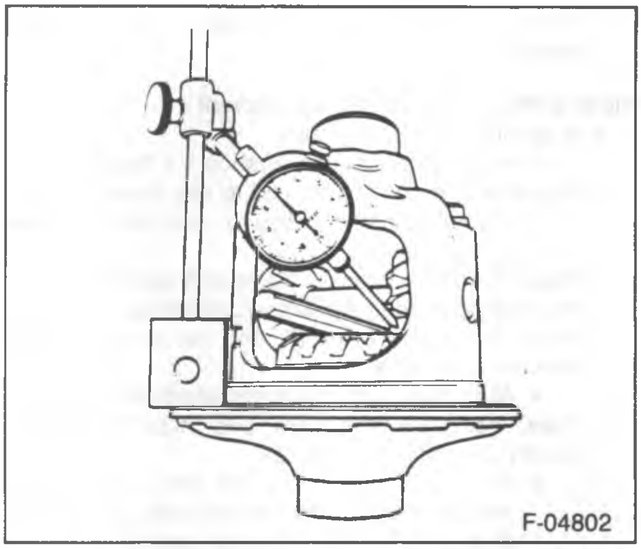


Figure 5—Checking Cam Gear Backlash

CAM UNIT ASSEMBLY - 7 1/2 AND 8 1/2-INCH

Install or Connect

1. Cam plate (16) to the cam side gear (21).
2. Wave spring.
3. Clutch plates (7 1/2 - 7 5/8 — 8 plates. 8 1/2 — 10 plates.
   - Alternate the plates as shown in figure 2.
4. Snap ring.
5. Guide clips (20) to the plates.
   - Use grease in the clips to hold them in place on the plates.

CAM UNIT ASEMBLY - 9 1/2-INCH

Install or Connect

1. Cam plate (16) to the cam side gear (21).
2. Wave spring.
3. Clutch plates.
   - Alternate the plates as shown in figure 1.
4. Thrust sleeve (14).
   - Press the thrust sleeve flush with the side gear disc splines.
5. Guide clips (20) to the plates.
   - Use grease in the clips to hold them in place on the plates.

- If the side gear or thrust sleeve has been replaced, measure and record the overall length of the gear assembly from the front of the gear to the back of the thrust sleeve (14) including the side gear washer (13).
- Compare this reading with the reading obtained earlier in this section.
- If the new reading is more than 0.003-inch higher or lower than the original, select a thrust washer that will return the reading closest to the original reading.

ADJUSTMENT OF THE DIFFERENTIAL

- If it is necessary to replace the cam gear, the right side gear, or the thrust block, the entire differential must be adjusted. The differential is adjusted by using selective thickness thrust washers behind each side gear, and a selective thickness thrust block between the side gears.
- It is important to build up the differential properly, as the proper clearances between parts is necessary for the proper operation of the units.
- There are three adjustments to be made:
  (1) Left side gear backlash.
  (2) Right side gear backlash.
  (3) Thrust block clearance.

Left Side Gear Backlash Adjustment

1. Install the cam unit and thrust washer (13) to the flange end of the case.
2. Place the pinion gears (7) and thrust washers into the differential.
   - Align them with the pinion shaft hole.
3. Press down the side gear, and install the pinion shaft (18) and lock screw (3).
   - If the side gear cannot be pressed down far enough to install the pinion shaft replace the thrust washer with a thinner washer.
4. Rotate the pinion gear closest to the lock screw so that one of the teeth is pointing downward (perpindicular to the ring gear flange).
5. Insert a large tapered tool such as a screwdriver firmly between the side gear and the pinion shaft.
6. Mount a dial indicator to the ring gear flange, and place the stem of the indicator on one of the teeth on the pinion gear closest to the lock screw (figure 5).
7. Pull the pinion gear firmly into its seat, and rotate the gear back and forth while reading the dial indicator. Record the reading.
8. Repeat steps 4 - 7 on the opposite pinion gear.
9. The backlash should be between 0.254 and 0.457 mm (0.010 and 0.018-inch).
10. If the backlash is too high, use a thicker thrust washer.

11. If the backlash is too low, use a thinner thrust washer.

Right Side Gear Backlash Adjustment

1. Assemble the clutch plates.
   - Alternate the plates as shown in figure 1.
2. Assemble the guide clips (19) to the plates.
   - Use grease in the clips to hold them in place on the plates.
3. Install the thrust washer (8), clutch plate assembly (9), and right side gear to the differential.
4. Place the pinion gears (7) and thrust washers (6) into the differential.
   - Align them with the pinion shaft hole.
5. Press down the side gear, and install the pinion shaft (18) and lock screw (3).
   - If the side gear cannot be pressed down far enough to install the pinion shaft, replace the thrust washer with a thinner washer.
6. Rotate the pinion gear closest to the lock screw so that one of the teeth is pointing downward (perpindicular to the ring gear flange).
7. Insert a large tapered tool such as a screwdriver firmly between the side gear and the pinion shaft.
8. Mount a dial indicator to the ring gear flange, and place the stem of the indicator on one of the teeth on the pinion gear closest to the lock screw (figure 5).
9. Pull the pinion gear firmly into its seat, and rotate the gear back and forth while reading the dial indicator. Record the reading.
10. Repeat steps 6 through 9 on the opposite pinion gear.
11. The backlash should be between 0.051 and 0.243 mm (0.002 - 0.010-inch).
12. If the backlash is too high, use a thicker thrust washer.
13. If the backlash is too low, use a thinner thrust washer.

Thrust Block Clearance Adjustment

Install or Connect

1. Left thrust washer (13) to the differential.
2. Cam unit to the differential.
3. Right thrust washer (8) to the differential.
4. Clutch plates with guide clips to the differential.
   - Assemble alternatively as shown in figure 1.
5. Right side gear (10) to the differential.
6. Pinion shaft (18) and lock screw (3). Insert a large tapered tool such as a screwdriver firmly between each side gear and the pinion shaft.
7. A 1 to 2-inch telescoping gage between the side gear faces, not the gear teeth.
   - Measure the side gear spread (figure 6).

Measure

- Remove the telescoping gage.

1. Measure the telescoping gage with a micrometer.
2. Measure the original thrust block at the outer corner with a micrometer (figure 7).

- If the thrust block thickness is not 0.000 to 0.006-inch less than the side gear spread, adjust the clearance by:

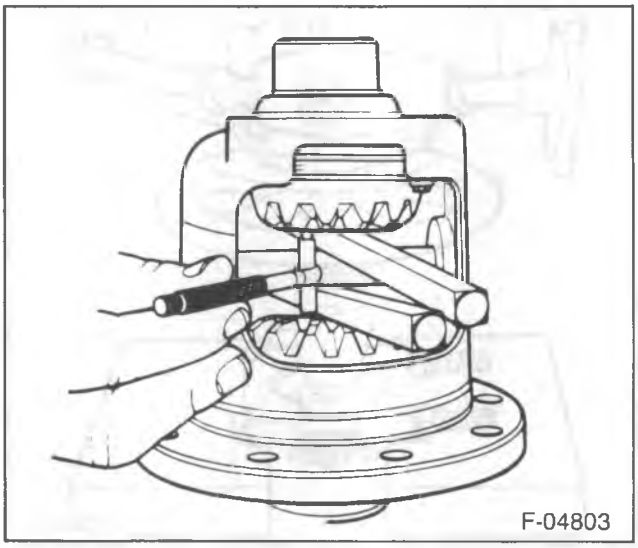


Figure 6—Measuring Side Gear Spread

— Selecting a new thrust block the correct size to obtain 0.000 to 0.006-inch clearance.

— Reshiming the right and/or left clutch disk pack. The backlash must remain 0.002 - 0.010-inch.

ASSEMBLY OF THE DIFFERENTIAL

Install or Connect (Figure 1)

1. Left thrust washer (13).
2. Cam unit. Refer to "Cam Unit Assembly" in this section.
3. Right thrust washer (8).
4. Right clutch plates with guide clips (19).
   - Assembly alternatively as shown in figure 1.
5. Right side gear (10).
6. Thrust block (17), thrust washer (6), and pinion gear (7).

- Place the pinion gears into the differential 180 degrees apart.
- Rotate the gears and thrust block into position.

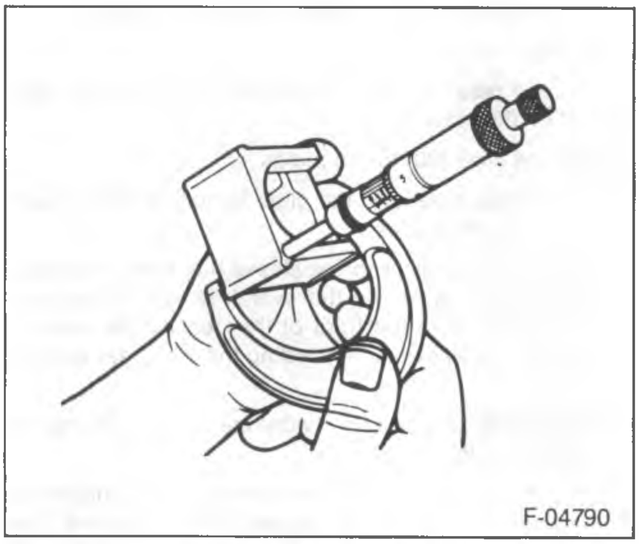


Figure 7—Measuring the Thrust Block

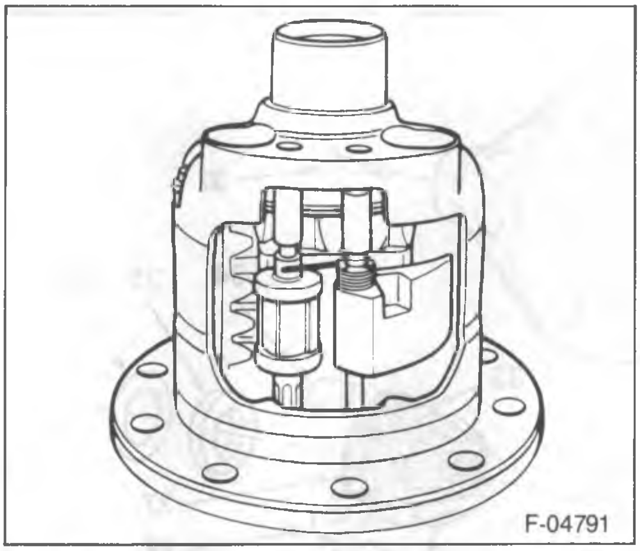


Figure 8—Governor and Latching Bracket

- The open side of the thrust block must face toward the small window opening.

7. Pinion shaft (18).
8. A new lockscrew (3). Install finger tight.
    - Tighten to specifications after its in the vehicle.
9. Governor assembly (23) and latching bracket (11).
    - The straight end of the latching bracket spring must be over and outside the governor assembly shaft (figure 8).
10. Stop pin (2) (9½-inch)
    - Press the pin flush with the case.
11. Governor bushing (4).
    - Use the bushing with a straight hole, not a tapered hole.
    - Press the bushing in far enough to give 0.004 to 0.020-inch shaft end play.
12. Latching bracket bushing (5).
    - Press in far enough to eliminate all end play.

10½-INCH RING GEAR

DISASSEMBLY OF THE DIFFERENTIAL

Remove or Disconnect (Figure 9)

Tools Required:
J 22912-01

1. The ring gear and differential side bearings. Refer to "Dissasembly of the Rear Axle" under the "10½-Inch Ring Gear" heading.
2. Case screws (32).
    — Set the unit on the right side case half.
3. Case halves (figure 10).
    - Pry the halves apart at the yoke hole location.
    - Hold the side gear in the left side case half.
4. Governor assembly (48).
5. Latching bracket assembly (43).
6. Left side gear (46).
7. Left side clutch pack and guide clips (47).
8. Left thrust washer (45).
9. Reaction blocks (41), pinion yoke (42), pinion gears (39), and pinion thrust washers (38).
10. Right cam unit from the differential.
11. Right thrust washer (36).
    - Measure and record the overall length of the gear assembly from the front of the gear to the back of the thrust sleeve (35) including the side gear washer (36).
12. Thrust sleeve (35) using J 22912-01.
    - Press the sleeve from the side gear (figure 11).
13. Clutch plates.
14. Guide clips (34).
15. Wave spring.
16. Cam plate (33).
17. Cam side gear (40)

CLEANING AND INSPECTION

Clean

- All parts with solvent.

Inspect

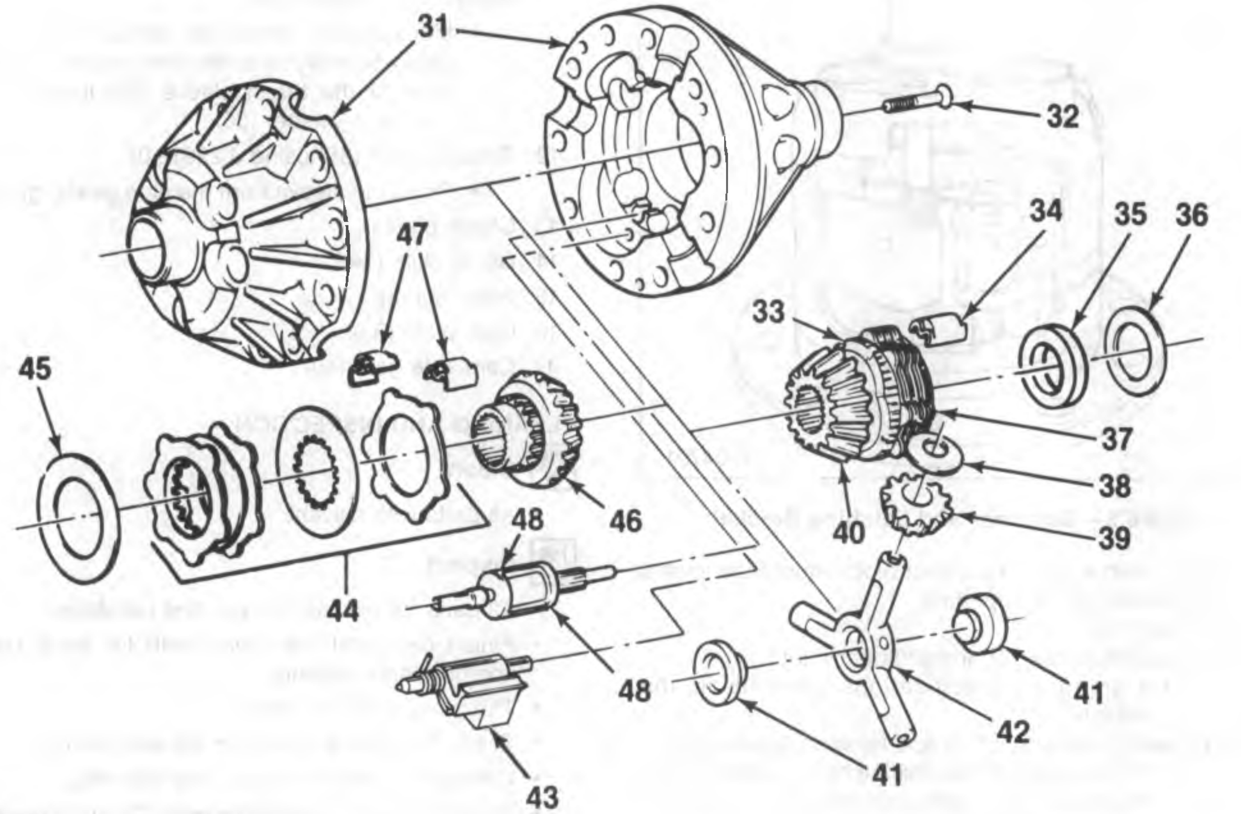
- All parts for excessive wear and breakage.
- Pinion gear and side gear teeth for wear, cracks, scorring, and spalling.
- Thrust washers for wear.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.
- Thrust sleeve for excessive wear. Do not replace the thrust sleeve unless necessary. Inspect the side gear bore for scorring. If scorring is present, replace the entire differential.
- If any damage to the differntial case is found, the entire differential must be replaced.
- Replace parts as necessary.

CAM UNIT ASSEMBLY

Install or Connect (Figure 9)

1. Cam plate (33) to the cam side gear (40).
2. Wave spring.
3. Clutch plates.
    - Alternate the plates, and position the wave spring as shown in figure 12.
4. Thrust sleeve (35).
    - Press the thrust sleeve flush with the side gear disc spline.
5. Guide clips (34) to the plates.
    - Use grease in the clips to hold them in place on the plates.

- If the side gear or thrust sleeve has been replaced, measure and record the overall length of the gear to the back of the thrust sleeve (35) including the side gear thrust washer (36).
- Compare this reading with the reading obtained earlier in this section.
- If the new reading is more than 0.003-inch higher or lower than the original, select a thrust washer that will return the reading closest to the original reading.



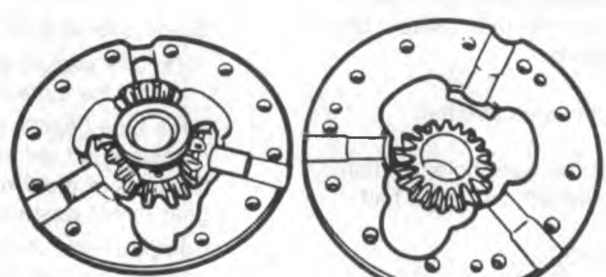
31. Differential Case Halves
32. Screw
33. Cam Plate
34. Guide Clip
35. Thrust Sleeve
36. Side Gear Thrust Washer
37. Plates
38. Pinion Thrust Washer
39. Pinion Gear
40. Side Cam Gear
41. Reaction Block
42. Pinion Yoke
43. Governor and Latching Bracket
44. Plates
45. Side Gear Thrust Washer
46. Side Gear
47. Guide Clip
48. Governor

F-05915

Figure 9—Differential Components

ADJUSTMENT OF THE DIFFERENTIAL

- If it is necessary to replace the cam gear, the right hand side gear, or the reaction blocks, the entire differential must be adjusted. The differential is adjusted by using selective thickness thrust washers behind each side gear, and selective thickness reaction blocks between the side gears.
- It is important to build up the differential properly. The proper clearance between parts is necessary for the proper operation of the unit.



F-04793

Figure 10—Differential Case Halves

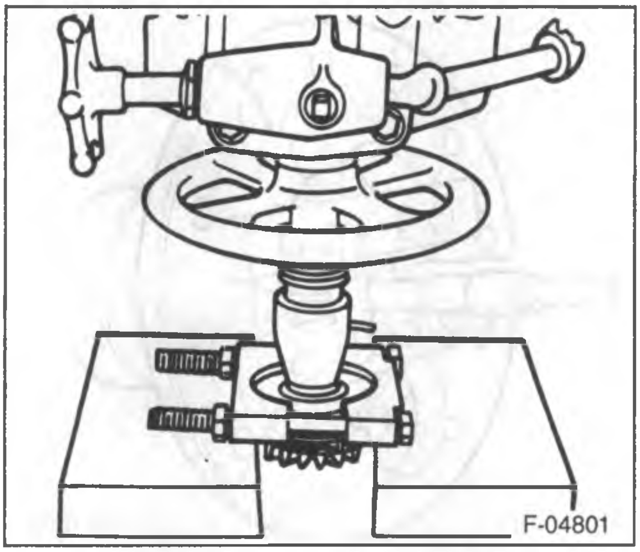


Figure 11—Removing the Thrust Sleeve

- There are three adjustments to be made:
  - (1) Left side gear backlash.
  - (2) Right side gear backlash.
  - (3) Thrust block clearance.

Right Side Gear Blacklash Adjustment

1. Install the cam unit and thrust washer (36) to the right case half.
2. Clamp the cam unit in place using a set of washers, nut, and a bolt long enough to hold the cam unit in place (figure 13).
3. Place the pinion gears and thrust washers on the pinion yoke.
4. Install the yoke firmly to the differential case half (figure 14).
5. Loosen the nut, and index one pinion gear tooth to point downward (perpindicular to the case half face). Tighten the nut.
6. Mount a dial indicator on the case half face using a magnetic base (figure 15).
7. Place the stem of the dial indicator on the pinion gear tooth.

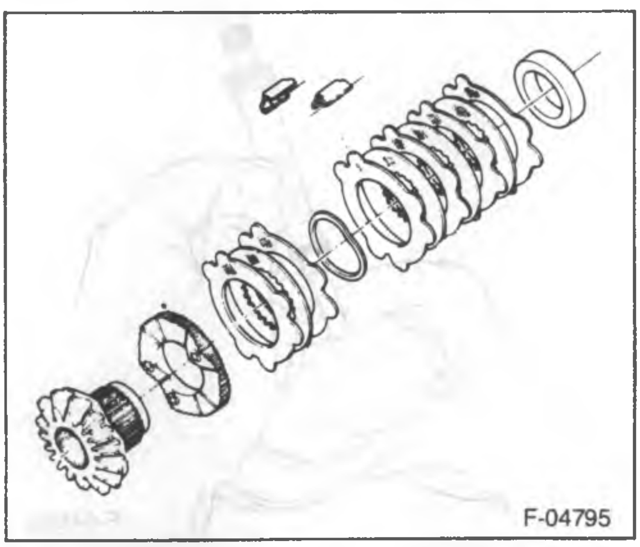


Figure 12—Cam Unit Components

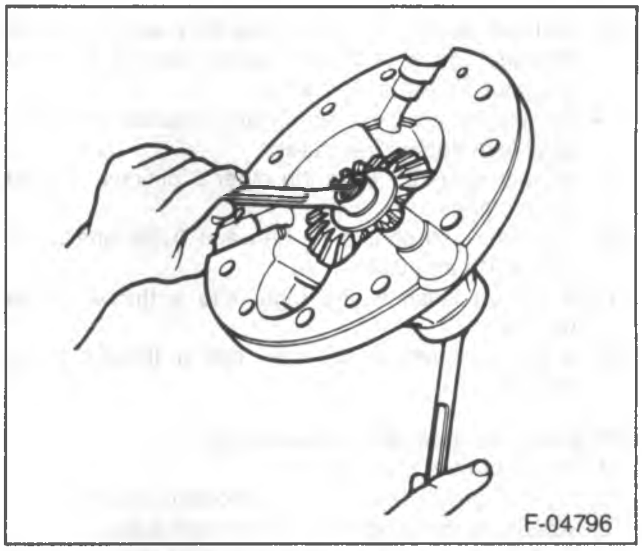


Figure 13—Clamping the Cam Unit In Place

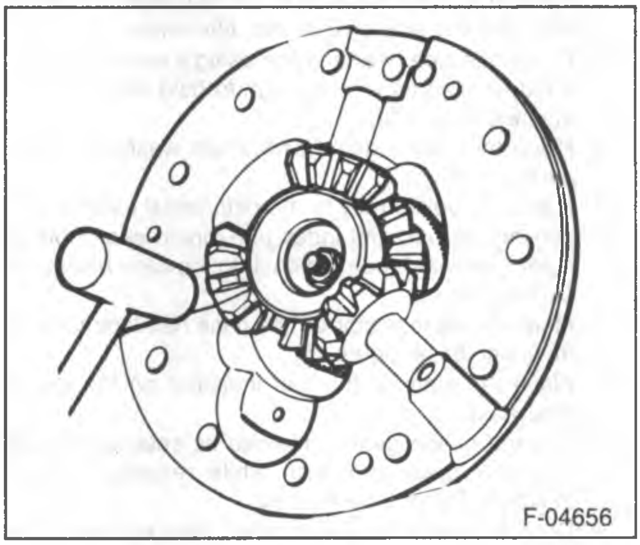


Figure 14—Installing the Pinion Yoke

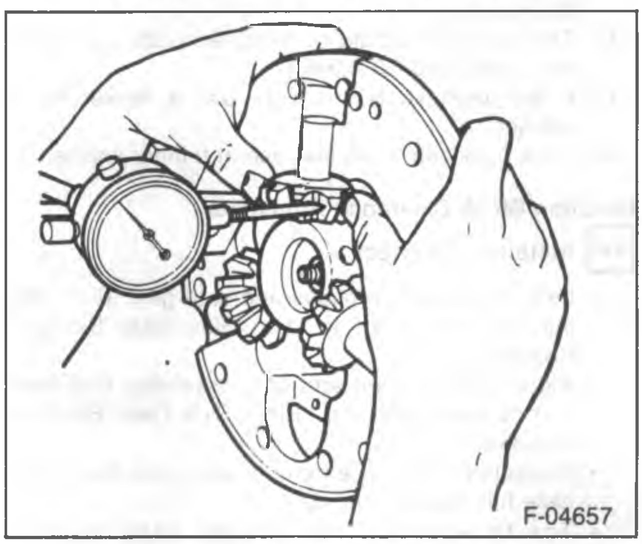


Figure 15—Measuring Backlash

8. Pull the pinion gear firmly into its seat, and rotate the gear back and forth while reading the dial indicator. Record the reading.
• Do not unseat the pinion yoke. This will make the backlash reading inaccurate.
9. Repeat steps 5 - 8 on the other 2 pinions. Record the readings.
10. The backlash should be between 0.254 and 0.457 mm (0.010 and 0.018-inch).
11. If the backlash is too high, use a thicker thrust washer.
12. If the backlash is too low, use a thinner thrust washer.

Left Side Gear Backlash Adjustment

1. Assemble the clutch plates.
   • Alternate the plates as shown in figure 12.
2. Assemble the guide clips (47) to the plates.
   • Use grease in the clips to hold them in place on the plates.
3. Install the thrust washer (45), clutch plate assembly (44), and left side gear to the differential.
4. Clamp the side gear in place using a set of washers, a nut, and a bolt long enough to hold the side gear in place (figure 13).
5. Place the pinion gears and thrust washers on the pinion yoke.
6. Install the yoke firmly to the differential case half.
7. Loosen the nut, and index one pinion gear tooth to point downward (perpindicular to the case half face). Tighten the nut.
8. Mount a dial indicator on the case half face using a magnetic base (figure 15).
9. Place the stem of the dial indicator on the pinion gear tooth.
10. Pull the pinion gear firmly into its seat, and rotate the gear back and forth while reading the dial indicator. Record the reading.
• Do not unseat the pinion yoke. This will make the backlash reading inaccurate.
11. Repeat steps 7 - 10 on the other 2 pinions. Record the readings.
12. The backlash should be between 0.051 and 0.254 mm (0.002 and 0.010-inch).
13. If the backlash is too high, use a thicker thrust washer.
14. If the backlash is too low, use at thinner washer.

Reaction Block Clearance Adjustment

Install or Connect

1. Left thrust washer, plates and side gear. Bolt them into position. Refer to "Left Side Gear Backlash Adjustment".
2. Right thrust washer and cam assembly. Bolt them into position. Refer to "Right Side Gear Backlash Adjustment".
• Measure the distance from the side gear face to the case half face (figure 16).
• The thickness of the straight edge must be subtracted from the reading.
• Add the measurement of both sides together. This is the side gear spread.

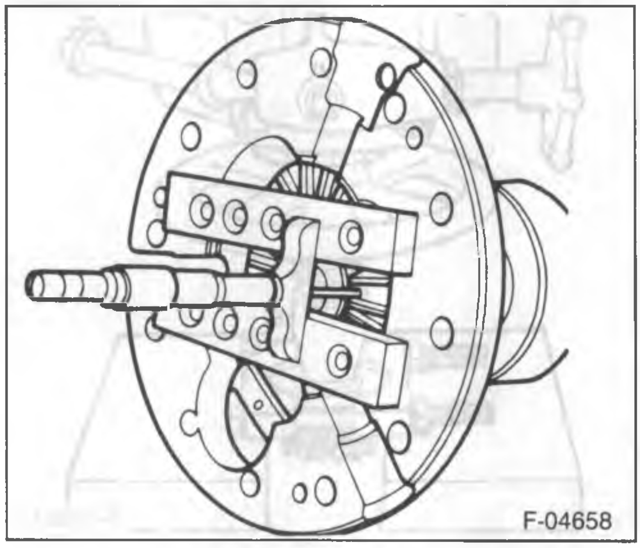


Figure 16—Side Gear Spread

• Measure the thickness of the original reaction blocks together (figure 17).
• If the reaction block thickness is not 0.000 to 0.006-inch less than the side gear spread, adjust the clearance by:
   — Selecting new reaction blocks of the correct thickness to obtain 0.000 to 0.006-inch clearance.
   — Reshiming the left and/or right clutch disk pack. The backlash must remain 0.002 - -.010-inch.

ASSEMBLY OF THE DIFFERENTIAL

Install or Connect (Figure 9)

1. Right thrust washer.
2. Right cam unit. Refer to "Cam Unit Assembly".
3. Reaction blocks (41), pinion yoke (42), pinion gears (39), and pinion thrust washers (38).
4. Left thrust washer (45).
   • Assemble the plates as shown in figure 9 and 12.

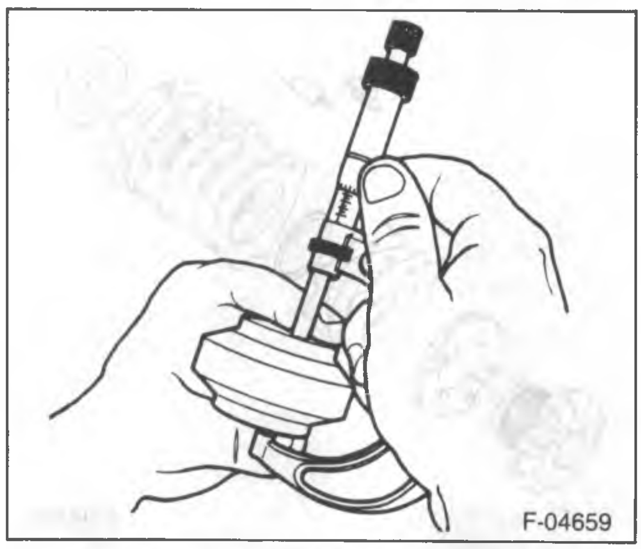


Figure 17—Measuring the Reaction Block

5. Left side gear (46)
6. Latching bracket assembly (43).
7. Governor assembly (48).
   - The straight end of the latching bracket spring must be over and outside the governor assembly shaft.
8. Case halves (31) together.
   - Hold the side gear in the left side case half.
9. Case screws (32).
10. The ring gear and differential side bearings. Refer to "Assembly of the Rear Axle" under the "10 1/2-Inch Ring Gear" heading.

SPECIFICATIONS

FASTENER	N·m	FT. LBS.
Differential Lockscrew		
7 1/2, 7 5/8, and 8 1/2-inch	36	27
9 1/2-inch	50	37

THRUST BLOCK SIZES

Color Code	7 1/2-, 7 5/8-Inch	8 1/2-Inch	9 1/2-Inch
Purple	1.260-inch	1.322-inch	1.598-inch
White	1.264-inch	1.326-inch	1.602-inch
Brown	1.268-inch	1.330-inch	1.606-inch
Yellow	1.272-inch	1.334-inch	1.610-inch
Orange	1.276-inch	1.338-inch	1.614-inch
Pink	1.280-inch	1.342-inch	1.618-inch
Green	1.284-inch	1.346-inch	1.622-inch
Blue	1.288-inch	1.350-inch	1.626-inch
Black	—	—	1.630-inch

REACTION BLOCK SIZES — 10 1/2-INCH

0.675-inch
0.672-inch
0.669-inch
0.666-inch

RIGHT HAND SIDE GEAR THRUST WASHER

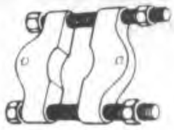
7 1/2, 7 5/8, 8 1/2 and 9 1/2 Inch Axles	10 1/2 Inch Axles
0.10-inch	0.027-inch
0.15-inch	0.032-inch
0.20-inch	0.037-inch
0.25-inch	0.040-inch
0.30-inch	0.042-inch
0.35-inch	0.044-inch
0.40-inch	0.048-inch
0.45-inch	

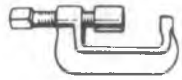
LEFT HAND SIDE GEAR THRUST WASHER

7 1/2-, 7 5/8-Inch	8 1/2-Inch	9 1/2-Inch	10 1/2-Inch
0.022-inch	0.022-inch	0.022-inch	0.022-inch
0.027-inch	0.027-inch	0.027-inch	0.027-inch
0.032-inch	0.032-inch	0.032-inch	0.032-inch
0.036-inch	0.036-inch	0.036-inch	0.036-inch
0.040-inch	0.040-inch	0.040-inch	0.040-inch
—	—	0.042-inch	0.042-inch
0.044-inch	0.044-inch	0.044-inch	0.044-inch
0.048-inch	0.048-inch	0.048-inch	0.048-inch
0.052-inch	0.052-inch	0.052-inch	0.052-inch

Lubricant 80w90 GL-5
(Do not use limited slip additive.)

SPECIAL TOOLS

1.  J-22912-01

2.  J-26252

1. Rear Pinion Bearing Cone Remover
2. Locking Differential Governor Remover

F-04804

Special Tools

SECTION 4C

FRONT AXLE

CONTENTS

SECTION 4C1

$8^1/_2$-INCH RING GEAR

CONTENTS

DESCRIPTION

DESCRIPTION

The GM $8^1/_2$-inch ring gear front axle uses a coventional ring gear and pinion gear set to transmit the driving force of the engine to the wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

This axle is full-floating. The shafts are retained in the housing by retaining clips in the hubs.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located bwtween the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsible spacer between the bearings in the axle housing.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the axle housing by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearing and the axle housing. To move the ring gear, shims are deleted from one side and an equal amount area added to the other side. These shims are also used to preload the bearings, which are pressed onto the differential case. Two bearing caps are used to hold the differential into the front axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the front axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The front axle is sealed with a pinion seal, a seal at each axle shaft, and by a gasket between the front cover and the axle housing.

All GM front axles are identified by the part number on the right axle tube near the carrier. The carrier cover does not have a drain plug.

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

1. Remove the axle cover from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Backlash Adjustment." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
3. Inspect the case for metal chips. Determine where the metal chips come from, such as a broken gear or bearing cage.
4. Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY

Remove or Disconnect (Figure 1)

Tools Required:

J 8107-4 Differential Side Bearing Remover Plug

J 22888 Differential Side Bearing Remover

J 8614-01 Pinion Flange Remover

J 8612-B Rear Pinion Bearing Cone Remover

- Place the axle in a suitable support.

1. Differential cover bolts (14) and differential cover (12).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (33). Refer to the proper Light Duty Truck Service Manual.
3. Pinion shaft lock screw (15).
4. Pinion shaft (17).
5. Differential pinion (21) and side gears (22).
   - Roll the pinion gears out of the case with the pinion thrust washers (20).
   - Remove the side gears and the side gear thrust washers (19). Mark the gears and the differential case as left and right.
6. Differential bearing cap bolts (18).
7. Differential bearing caps (10).
   - Mark the caps and the housing as left and right.

NOTICE: Be careful when prying the differential case out of the axle housing so as not to damage the cover gasket surface. The differential case must be supported when it is being removed to prevent the case from falling and damaging the case.

8. Differential carrier (24)
   - Pry the case from the axle housing at the differential "window" (figure 2).
9. Bearing outer races (8) and shims (9).
   - Mark the races and the shims as left and right, and place them with the bearing caps.
10. Differential side bearings (8) using J 8107-4 and J 22888 (figure 3).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage.
11. Ring gear bolts (23).
    - Ring gear bolts use left-hand threads.

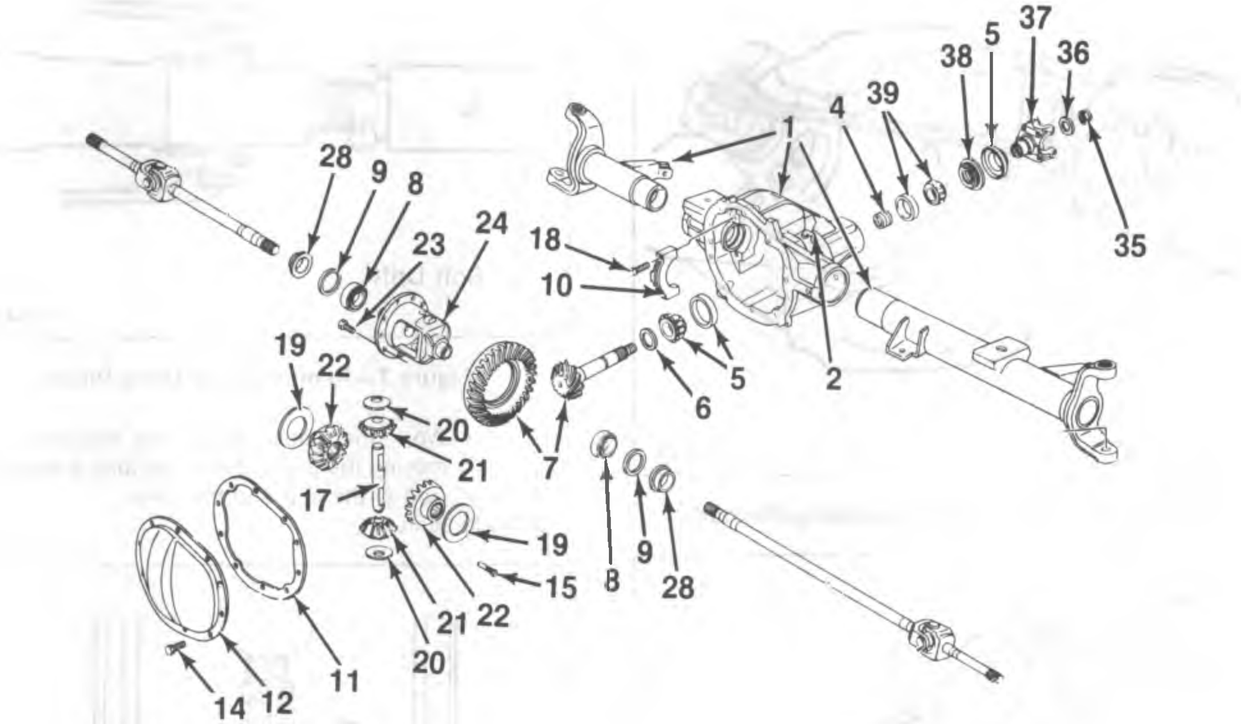
NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

12. Ring gear (7) from the differential case.
    - Drive the ring gear off with a brass drift.

Inspect

- Drive pinion bearing preload (figure 4).
- For looseness of pinion assembly by moving it back and forth. (This indicates excessive bearing wear.)

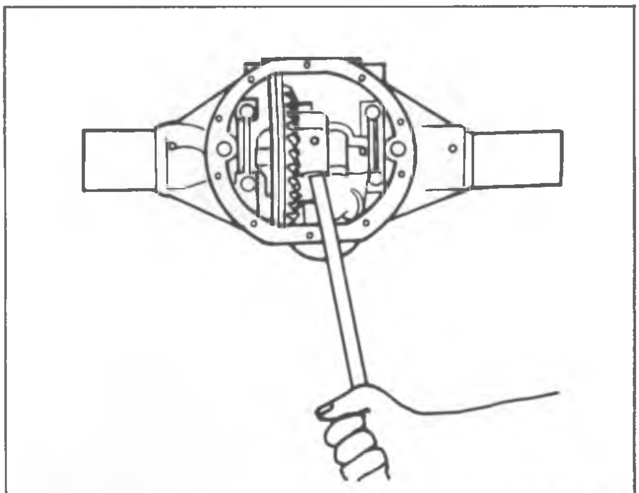
13. Pinion flange nut (35) and washer (36) using J 8614-01 to hold the pinion flange (figure 5).
14. Pinion flange using J 8614-01 (figure 6).
15. Pinion (7) from the axle housing.
    - Thread the pinion nut halfway onto the pinion.
    - Replace the differential cover (12) with two bolts (14) to keep the pinion from falling to the floor.
    - Drive the pinion out of the housing with a hammer and a soft drift (figure 7).
16. Collapsible spacer (4) from the pinion.
17. Outer pinion seal (38) and bearing (39).
18. Inner bearing (5) and shim (6) from the pinion.
    - Press the bearing off the pinion using J 8612-B (figure 8).
    - Remove the shim.
19. Bearing cups (5) and (39) from the axle housing using a hammer and a punch.



1. Axle Housing
2. Air Vent
4. Collapsable Spacer
5. Inner Pinion Bearing
6. Shim
7. Ring and Pinion Gear Set
8. Differential Side Bearing
9. Shim Pack (including spacer)
10. Bearing Cap
11. Gasket
12. Cover
14. Bolt
15. Pinion Shaft Lock Screw
17. Pinion Shaft
18. Bolt
19. Side Gear Thrust Washer
20. Pinion Thrust Washer
21. Pinion Gear
22. Side Gear
23. Ring Gear Bolt
24. Differential Case
28. Axle Shaft Seal
35. Pinion Nut
36. Washer
37. Pinion Flange
38. Pinion Seal
39. Outer Pinion Bearing

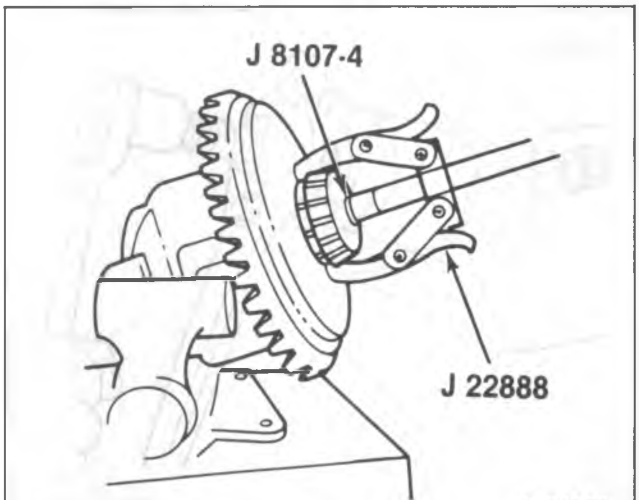
F-04548

Figure 1—Front Axle Components



F-04690

Figure 2—Prying the Differential Case from the Axle Housing



F-04691

Figure 3—Removing Differential Side Bearing

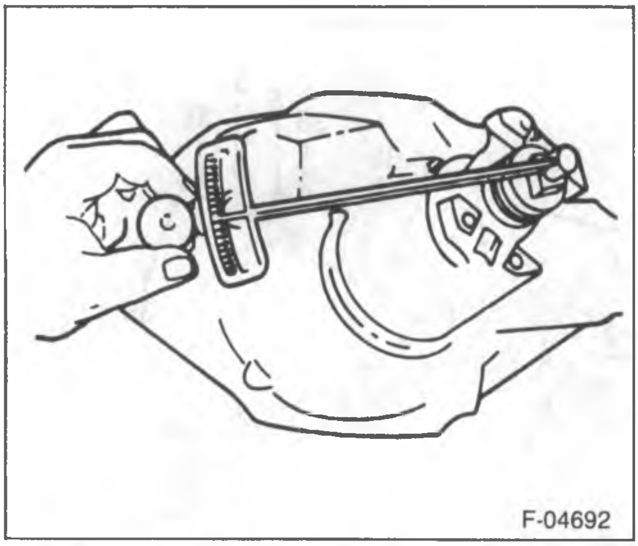


Figure 4—Checking Pinion Bearing Preload

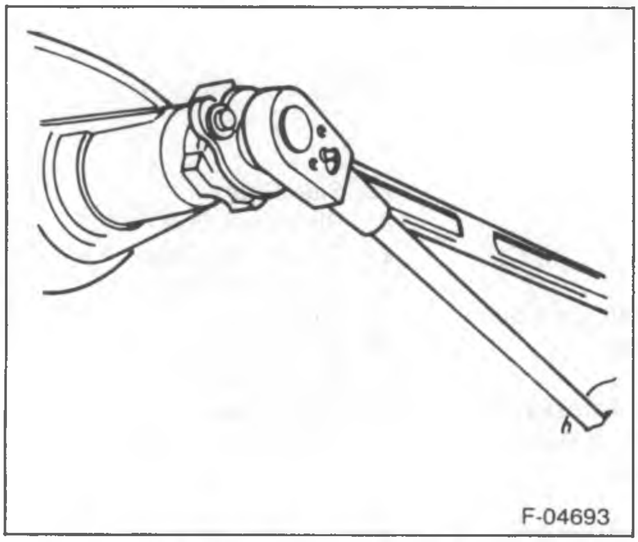


Figure 5—Pinion Flange Nut Removal

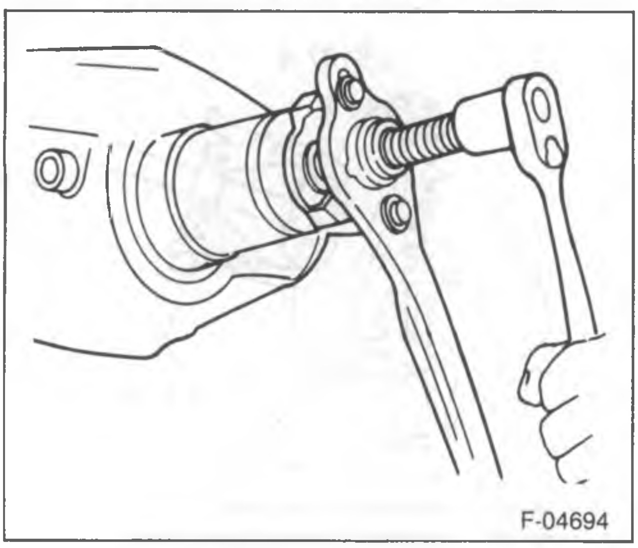


Figure 6—Pinion Flange Removal

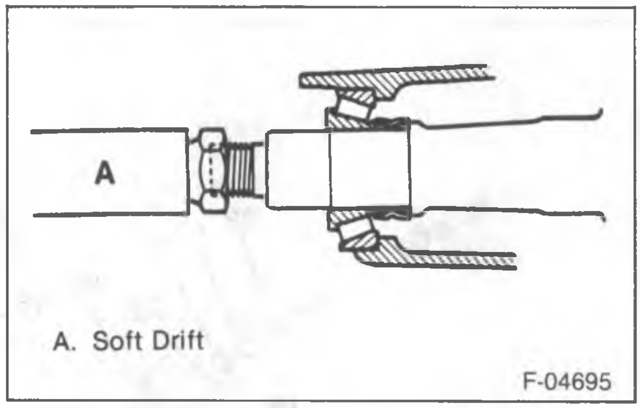


Figure 7—Removing the Drive Pinion

- Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.

20. Axle seals.

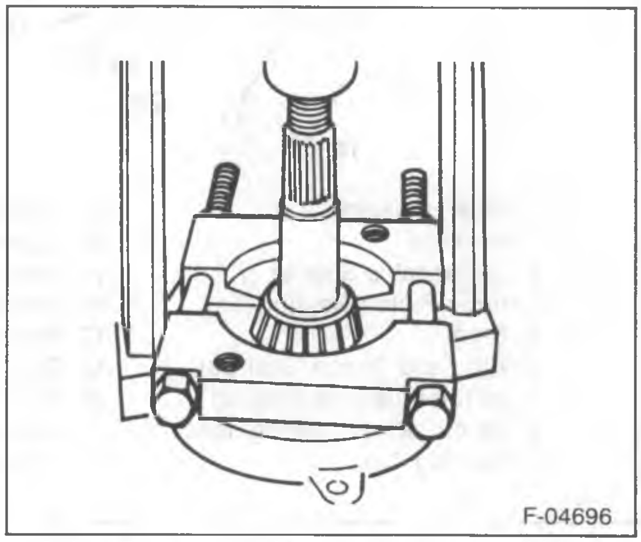


Figure 8—Removing Drive Pinion Rear Bearing

CLEANING AND INSPECTION

CLEANING

- Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.
- Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before assembly.

Through inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- Carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- Bearing cup surfaces for nicks or burrs. Remove any burrs that are found.
- Housing for cracks. Replace the housing if any cracks are found.
- Housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- Fit of the differential side gears in the differential case.
- Fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scorring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- Fit of the pinion on the pinion flange.
- Sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scorring.
- Bearings and cups are only replaced as sets.
- If the front axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS

Inspect

- Shims for cracks and chips. Damaged shims should be replaced with an equally sized service shim.

ASSEMBLY OF AXLE

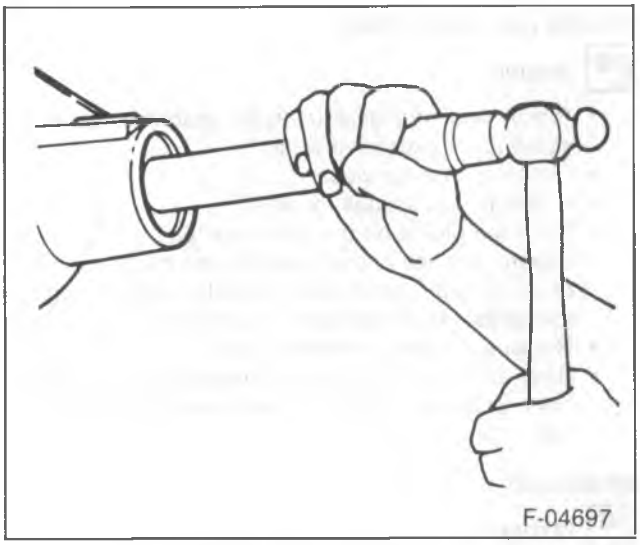


Figure 9—Installing Front Pinion Bearing Cup

Important

- Lubricate all seal lips, gears, and bearing surfaces with axle lubricant prior to assembly.

PINION BEARING CUP INSTALLATION

Install or Connect

Tools Required:
J 8608 Rear Pinion Bearing Cup Installer
J 8611-01 Front Pinion Bearing Cup Installer
J 8092 Driver Handle

1. Front pinion bearing cup using J 8611-01 and J 8092 (figure 9).
2. Rear pinion bearing cup using J 8608 and J 8092 (figure 10).

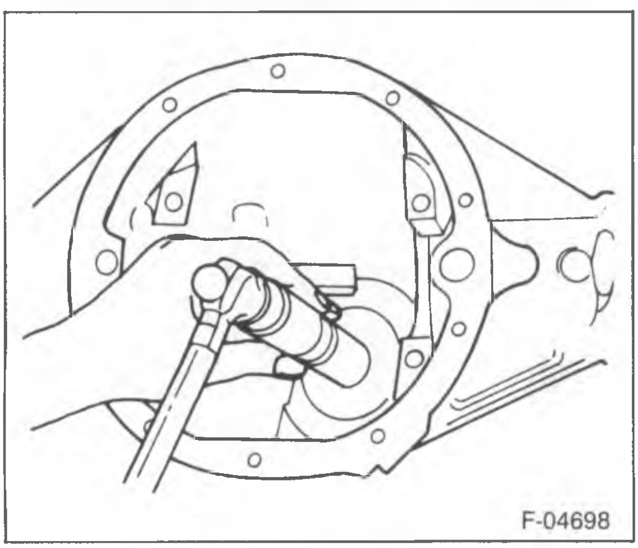


Figure 10—Installing Rear Pinion Bearing Cup

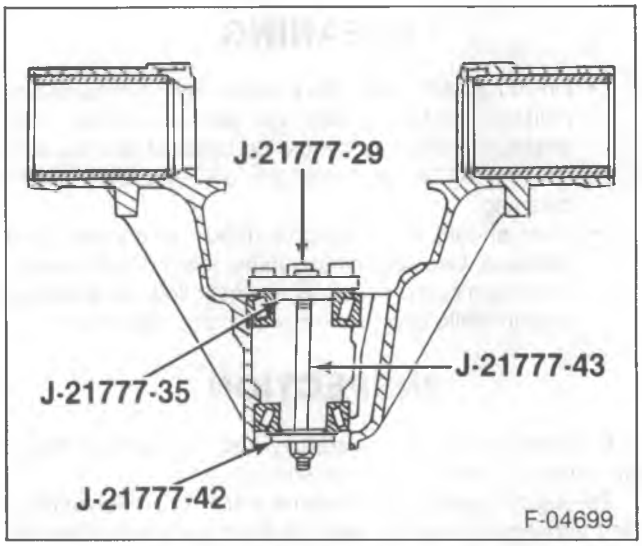


Figure 11—Gage Plate Components

PINION DEPTH ADJUSTMENT

Tools Required:
J 8001 Dial Indicator Set
J 21777-1 Arbor
J 21777-29 Plate
J 21777-35 Rear Pilot Washer
J 21777-42 Front Pilot Washer
J 21777-43 Stud Assembly - Bolt
J 21777-45 Side Bearing Disc

1. Clean all the gage parts.
2. Lubricate the front and rear pinion bearings with axle lubricant.
3. Place the bearings (5) and (39) into the pinion bearing cups.
4. Install J 21777-35, J 21777-42, J 21777-29, and J 21777-43 to the pinion bore (figure 11).
5. Hold the stud stationary at the flats of the stud. Tighten the stud nut to 2.2 N·m (20 in. lbs.).
6. Rotate the gage plate and bearings several complete revolutions to seat the bearings.
7. Tighten the stud nut until a torque of 1.6 to 2.8 N·m (15 to 25 in lbs.) is obtained to keep the gage plate in rotation.
8. Assemble J 21777-45, J 21777-1 Arbor, and J 8001 to the differential bearing bore as shown in figure 12.
   - The bearing bores must be clean and burr free.
9. Install the side bearing caps, and tighten the bolts finger tight.
10. Rotate the gage plate until the proper gaging area is parallel with the disks.
11. Position the gage shaft assembly in the carrier so that the dial indicator rod is centered on the gaging area of the gage block.
12. Set the dial indicator at zero. Push the indicator down on the indicator shaft until the needle rotates ¾ of a turn to the right. Tighten the dial indicator in this position.

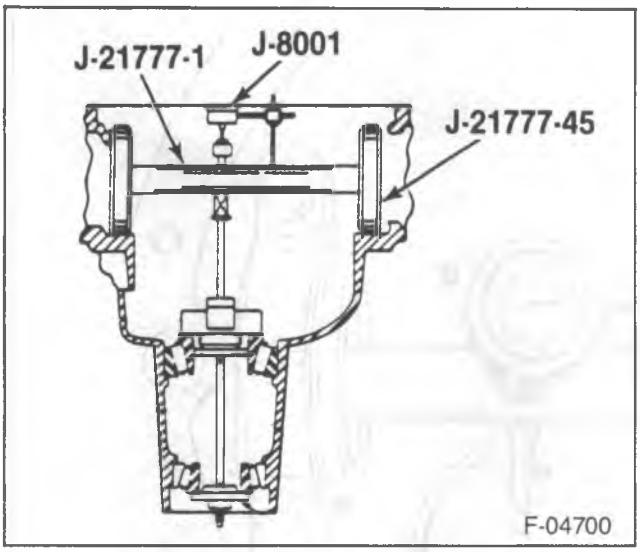


Figure 12—Pinion Gaging Tools

13. Rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection (when the indicator needle is centered between movement to the left and to the right).
14. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the zero setting.
15. Rotate the gage shaft until the dial indicator rod does not touch the gage block.
16. Record the actual number on the dial indicator and not the number which represents how far the needle travels. This is the nominal pinion setting.

    Example: If the indicator needle moved to the left 1.70 mm (0.067-inch) to a dial reading of 0.84 mm (0.033-inch) as shown in figure 13, record the dial reading of 0.84 mm (0.033-inch) not 1.70 mm (0.067-inch).
17. Check the pinion face for a pinion adjustment mark. This mark indicates the best running position for the pinion from the nominal setting.
    - If the pinion is stamped with a plus number, add that many thousandths to the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked +2, the correct shim depth would be 0.033-inch + 0.002-inch = 0.035-inch.
    - If the pinion is stamped with a minus number, subtract that many thousandths from the nominal setting. If the nominal setting is 0.033-inch and the pinion is marked -2, the correct shim depth would be 0.033-inch - 0.002-inch = 0.031-inch.
    - If the pinion has no plus or minus marked on the pinion, use the nominal pinion setting to select a shim.
18. Remove bearing caps and depth gaging tools.
19. Install the correct pinion shim to the pinion according to this procedure.

PINION INSTALLATION

Install or Connect

Tools Required:
- J 8609-01 Rear Pinion Bearing Cone Installer
- J 22388 Pinion Oil Seal Installer
- J 8614-01 Pinion Flange Remover
- J 5590 Rear Pinion Bearing Cone Installer

- The bearing cups should have been installed in "Pinion Depth Adjustment" in this section.

1. The pinion inner bearing (5) using J 8609-01.
    - Press the bearing onto the pinion until the bearing cone seats on the pinion shims.
2. A new collapsable spacer (4).
    - Lubricate the pinion bearings with axle lubricant.
3. Pinion (7) to the axle housing.
4. Outer pinion bearing (39) onto the pinion using J 5590.
    - Hold the pinion forward from inside the case while driving the bearing onto the pinion.
5. Pinion oil seal (38) using J 22388 (figure 14).
6. The pinion flange (37) to the pinion by tapping it with a rawhide hammer until a few threads show through the pinion flange.
7. The pinion washer (36) and a new nut (35) while holding the pinion flange with J 8614-01 (figure 15).

Tighten

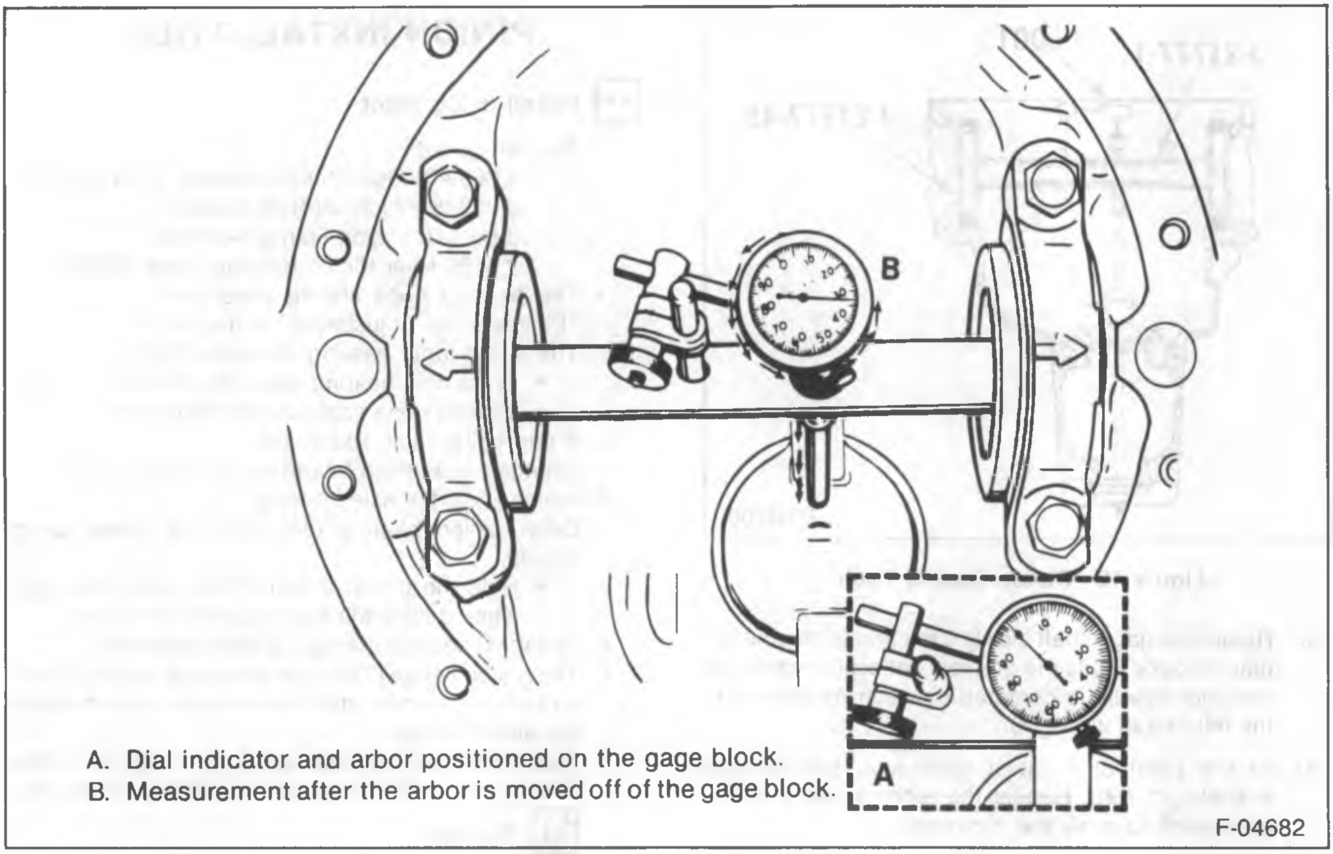
- The nut until the pinion end-play is just taken up. Rotate the pinion while tightening the nut to seat the bearings. Once there is no end-play in the pinion, the preload torque should be checked.
- Remove J 8614-01. Using an inch-pound torque wrench, check the pinion preload by rotating the pinion with the wrench. Preload should be 2.2 to 2.8 N·m (20 to 25 in. lbs.) on new bearings, or 1.1 to 1.6 N·m (10 to 15 in. lbs.) for used bearings (figure 16).
- If the preload torque is below the preloads given above, continue torquing the nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
- Once the preload has been obtained, rotate the pinion several times to make sure that the bearings have seated. Recheck the preload, and adjust if necessary.

8. Differential case. Refer to "Backlash Adjustment" in this section.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tools Required:
- J 8107-4 Differential Side Bearing Remover Plug
- J 8092 Driver Handle



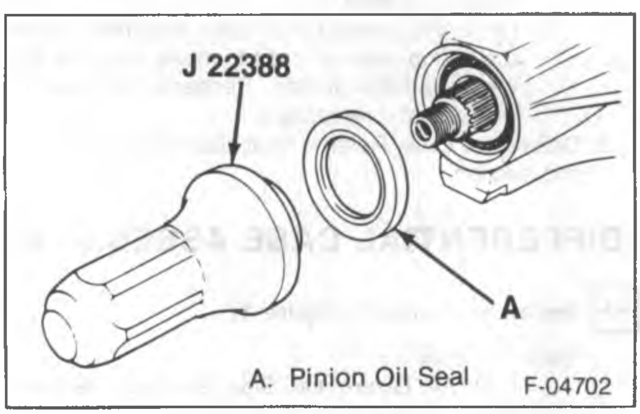
A. Dial indicator and arbor positioned on the gage block.
B. Measurement after the arbor is moved off of the gage block.

Figure 13—Checking Pinion Depth

J 22761 Differential Side Bearing Installer

- Lubricate all parts with rear axle lubricant.

1. Axle seals.
2. Side gear thrust washers (19) to the side gears (22).
3. Side gears (22) to the differential case (24).
   - Place the side gears in place on the same side as removed.
4. Pinion gears (21) to the differential without the thrust washers (20).
   - Place the pinion gears onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
5. Pinion thrust washers (20).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
   - Check that the mating surfaces of the differential case and the ring gear are clean and burr free.
6. Ring gear (7) to the differential case (24).
   - Thread two left-hand threaded studs into the ring gear on opposite sides (figure 17).
   - Place the ring gear onto the case, and align the holes in the case with the studs.



A. Pinion Oil Seal

Figure 14—Installing the Pinion Oil Seal

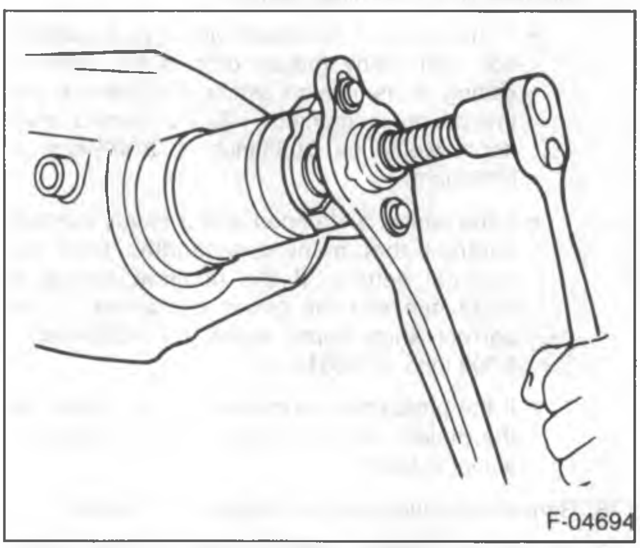


Figure 15—Installing the Pinion Flange

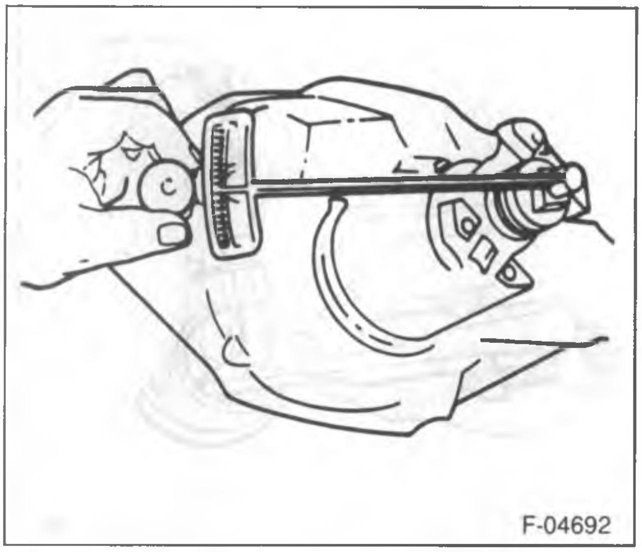


Figure 16—Checking Pinion Bearing Preload

- Press the ring gear onto the case far enough to start the bolts using J 8107-4 to protect the differential from the press ram (figure 18).

7. New ring gear bolts (23).
   - Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

- The ring gear bolts in sequence to 80 N·m (60 ft. lbs.).

8. Differential side bearings (8) using J 22761, J 8107-4 and J 8092 (figure 19).
   - Place J 8107-4 into the differential on the side opposite of the bearing installation to protect the differential case.
   - Drive the bearing onto the case using J 22761 and J 8092.
9. Differential case (24) to the axle housing. Refer to "Side Bearing Preload Adjustment" in this section.

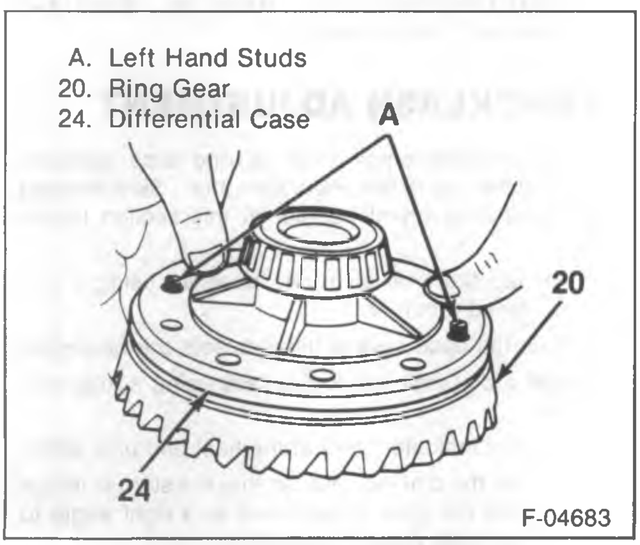


Figure 17—Ring Gear Studs

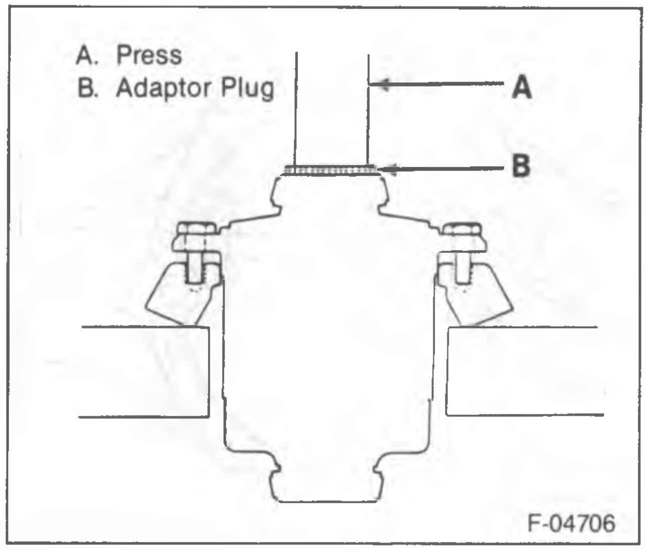


Figure 18—Installing the Ring Gear

SIDE BEARING PRELOAD ADJUSTMENT

Tool Required:

J 22779 Side Bearing Backlash Gage

- The differential side bearing preload is adjusted by changing the thickness of both the left and right shims equally. This will maintain the original backlash.
- Production shims are cast iron and are not to be reused.
- Service spacers are available from 4.32 to 4.37 mm (0.170 to 0.172-inch) thick.
- Service shims are available in kits from 0.040 to 0.070-inch.
- Be sure that the side bearing surfaces are clean and free of burrs.

1. Place the differential case and the bearing cups into the axle housing.
   - Lubricate the axle bearings with axle lubricant.

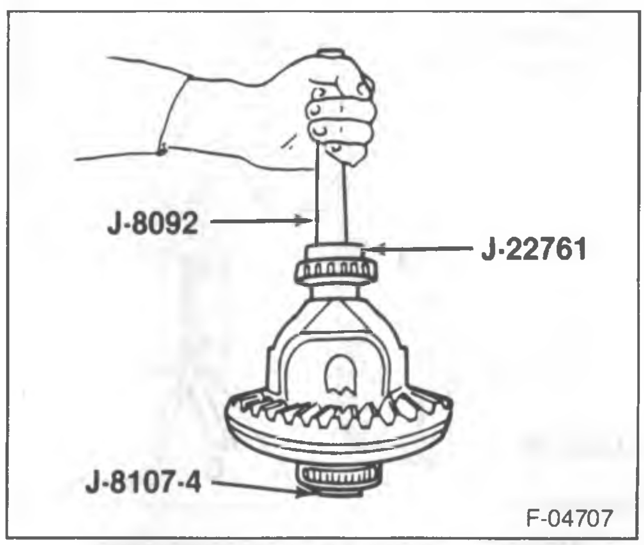


Figure 19—Differential Bearing Installation

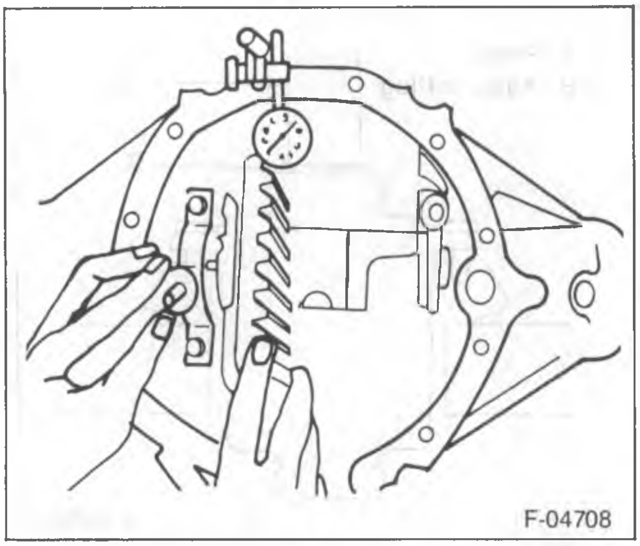


Figure 20—Installing Side Bearing Gaging Tools

- Support the case to keep it from falling into the axle housing.

2. Install the strap from J 22779 on the left bearing with the cap bolts. Tighten the bolts snuggly.
3. Push the ring gear towards the pinion.
   - Engage the ring gear with the pinion tightly to obtain a backlash of .000 mm to 0.0254 mm (0.000 to 0.001-inch).
4. Insert J 22779 between the axle housing and the left bearing cup (figure 20).
5. Move the tool back and forth in the bore while turning the adjusting nut to the right until a noticable drag is produced (figure 21).
   - Tighten the lock bolts on the side of the tool.
   - Leave the tool in place.
6. Install a service spacer (9) and a service shim (9) between the right bearing cup and the axle housing.
7. Determine bearing preload by inserting progresively larger feeler gage sizes between the carrier and the service shim.

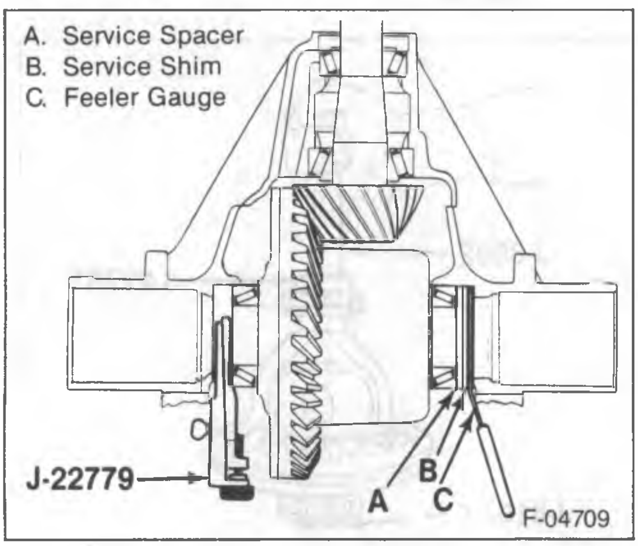


Figure 21—Measuring Side Bearing Shim Requirements

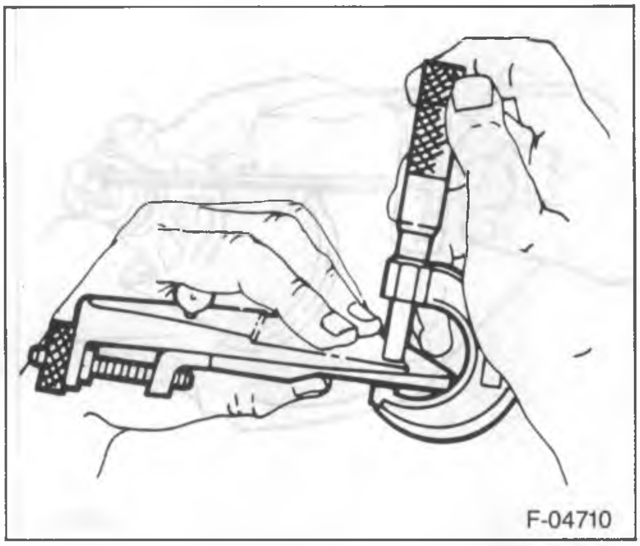


Figure 22—Measuring the Gage Plate Thickness

- Push the feeler gage downward so that it contacts the shim at the top and bottom, and then contacts the axle housing.
- The point just before additional drag begins is the correct feeler gage thickness. This is the zero setting without preload.

8. Remove the strap, J 22779, the service spacer, service shim, feeler gage, and differential case from the axle housing.
9. Measure J 22779 in three places using a micrometer. Average the readings (figure 22).
10. Add the dimensions of the service spacer, service shim, and the feeler gage.
11. For an initial backlash setting, move the ring gear away from the pinion by subtracting 0.010-inch from the ring gear side shim pack and adding 0.010-inch to the shim pack on the opposite side.
12. To obtain the proper preload on the side bearings add 0.10 mm (0.004-inch) to the measurement of each shim pack.
13. Install the differential. Refer to "Backlash Adjustment" in this section.

BACKLASH ADJUSTMENT

1. Install the differential case, bearing cups, spacers, and shims as determined from the "Side Bearing Preload Adjustment" earlier in this section (figure 23).
   - Tap the final shim into position, using a soft faced hammer.
2. Rotate the case several times to seat the bearings.
3. Install a dial indicator to the case using a magnetic base.
4. Place the indicator stem at the heel end of a tooth.
   - Set the dial indicator so that the stem is in line with the gear rotation and at a right angle to the tooth angle (figure 24).
5. Install the differential caps (10) and bolts (18).

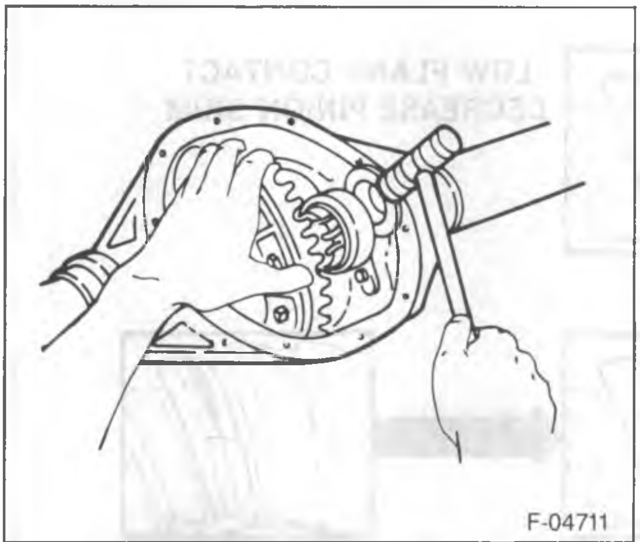


Figure 23—Installing the Final Preload Shim

Tighten

- The bolts to 80 N·m (60 ft. lbs.)

6. Check and record the backlash at three or four points around the ring gear.
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
7. The backlash at the minimum lash point measured should be between 0.13 and 0.23 mm (0.005 and 0.009) for all new gear sets, 0.08 and 0.28 mm (0.003 and 0.011-inch) for used gear sets.
8. If the backlash is not within specifications, move the ring gear in or out from the pinion by increasing the thickness of one shim, and decreasing the thickness of the other shim by the same amount. This will maintain the correct front axle side bearing preload.
   - Moving 0.003-inch worth of shims from one side of the differential to the other will change the backlash adjustment by approximately 0.002-inch.
9. Recheck the backlash and correct as necessary.

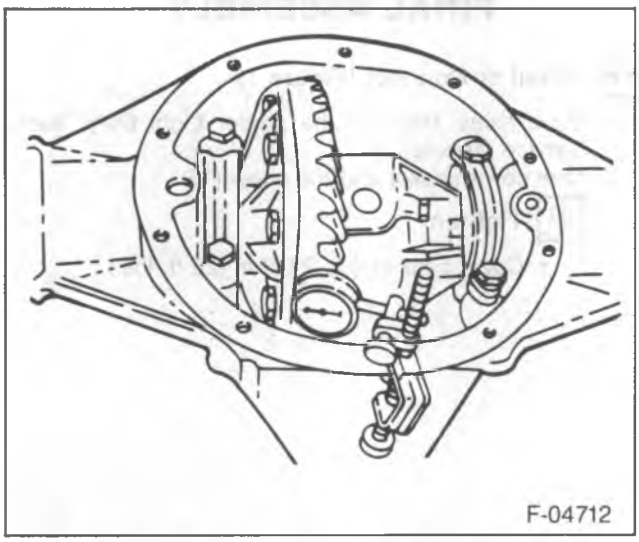


Figure 24—Checking Ring Gear Backlash

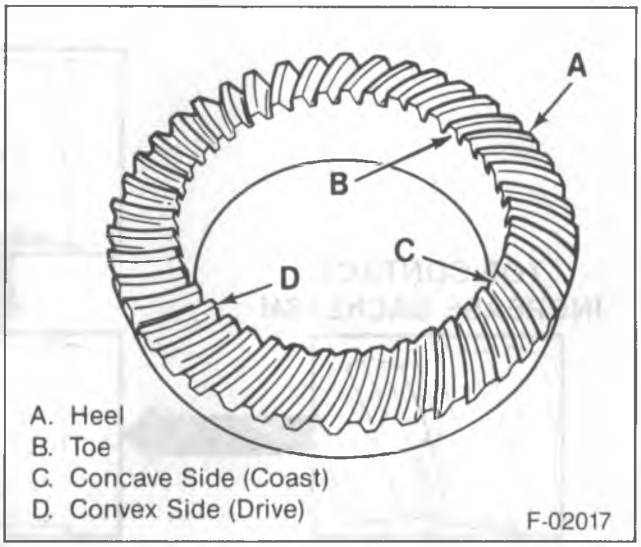


Figure 25—Gear Tooth Terms

GEAR TOOTH CONTACT PATTERN CHECK

Before final assembly of the differential, a gear tooth contact pattern check should be performed.

It should be noted that a gear tooth contact pattern check is NOT a substitute for adjusting pinion depth and backlash as previously outlined. It is a final check to veryify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy, or have a short life, or both. With a pattern check, the best contact between the ring gear and the drive pinion for low noise level and long life can be assured.

GEAR TOOTH TERMS

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. The toe end of tooth is smaller than the heel end, (figure 25).

TEST

1. Wipe oil out of carrier and carefully clean each tooth of the ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten the bearing cap bolts to specifications.

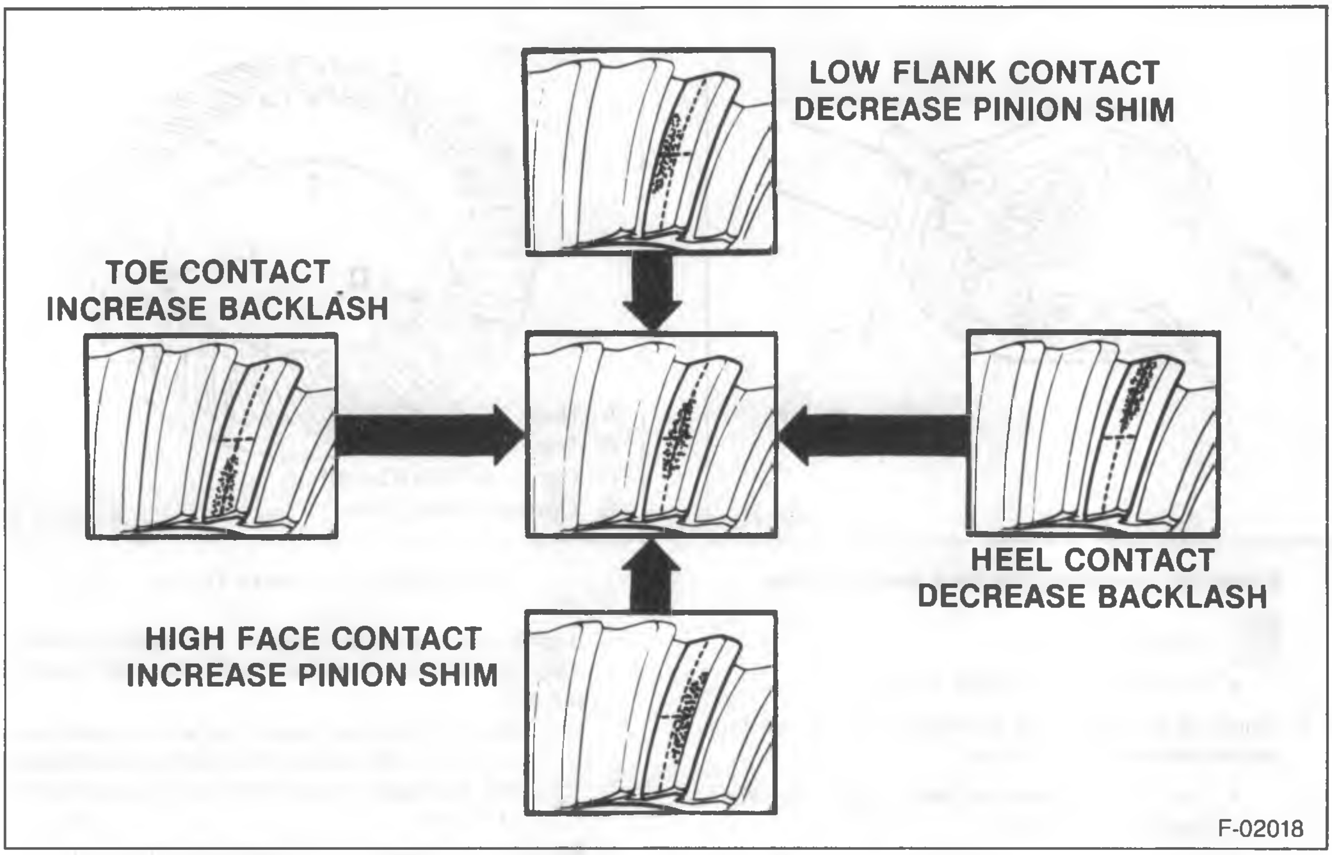


Figure 26—Gear Tooth Contact Pattern

4. Apply a load until a torque of 54-70 N·m (40-50 ft. lbs.) is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the companion flange with a wrench so that the ring gear rotates one full revolution then reverse the rotation so that the ring gear rotates one revolution in the opposite direction. Excessive turning of the ring gear is not recommended.

5. Observe the pattern on the ring gear teeth and compare with figure 26.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect the tooth contact pattern. These are backlash and the position of the drive pinion (pinion depth) in the carrier. The effects of bearing preloads are not easily seen on hand loaded teeth pattern tests: however, these adjustments should be within specifications before proceeding with the backlash and the drive pinion adjustments.

It may be necessary to adjust both pinion depth and the backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and the inner race of the rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing the shim thickness will move the pinion closer to the centerline of the ring gear. Decreasing the shim thickness will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting shims are also used to set side bearing preload). To incraese backlash, increase the right shim and decrease the left shim an equal amount. To decrease backlash decrease the right shim and increase the left shim an equal amount.

It is important that the contact pattern be centrally located up and down on the face of the ring gear teeth.

FINAL ASSEMBLY

Install or Connect (Figure 1)

1. Drive axles. Refer to the proper Light Duty Truck Service Manual.
2. New cover gasket and the cover (12).

   Tighten

   • Cover bolts (14) to 27 N·m (20 ft. lbs.).

SPECIFICATIONS

8½ INCH RING GEAR FRONT AXLE

TORQUE SPECIFICATIONS

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	80	60
Bearing Cap Bolts	80	60
Axle Cover Bolts	27	20

AVAILABLE SHIM AND SPACER SIZES

Differential Side Bearing Spacer	0.170-inch-0.172-inch
Differential Side Bearing Kits	0.064 - 0.070-inch
	0.040 - 0.044-inch
	0.046 - 0.050-inch
	0.052 - 0.056-inch
	0.058 - 0.063-inch
	0.072 - 0.078-inch
	0.080 - 0.086-inch
	0.088 - 0.094-inch
	0.096 - 0.100-inch
Pinion Bearing Shim Kits	0.020 - 0.024-inch
	0.025 - 0.029-inch
	0.030 - 0.034-inch
	0.035 - 0.039-inch

PINION PRELOAD AND BACKLASH

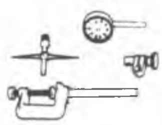
Pinion Preload (New Bearings)	2.2-2.8 N·m (20-25 in. lbs.)
(Used Bearings)	1.1-1.6 N·m (10-15 in. lbs.)
Backlash (New Gears)	0.13-0.23 mm (0.005-0.009-in.)
Backlash (Used Gears)	0.08-0.28 mm (0.003-0.011-in.)

SPECIAL TOOLS

1.  J 8611-01

2.  J 8612-B

3.  J 8092

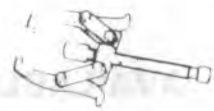
4.  J 8001

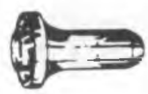
5.  J 8609-01

6.  J 8614-01

7.  J 8107-4

8.  J 8608

9.  J 22888

10.  J 22399

11.  J 22761

12.  J 22779

13.  J 5590

1. Front Pinion Bearing Cup Installer
2. Rear Pinion Bearing Cone Remover
3. Driver Handle
4. Dial Indicator Set
5. Rear Pinion Bearing Cone Installer
6. Pinion Flange Remover
7. Differential Side Bearing Remover Plug
8. Rear Pinion Bearing Remover Plug
9. Side Bearing Remover
10. Pinion Oil Seal Installer
11. Differential Side Bearing Installer
12. Side Bearing Backlash Gauge
13. Rear Pinion Bearing Cone Installer

Not Shown:

J-21777-1 Arbor
J-21777-29 Gauge Plate
J-21777-35 Rear Pilot Washer
J-21777-42 Front Pilot Washer
J-21777-43 Stud Assembly—Bolt
J-21777-45 Side Bearing Disc

F-04660

SECTION 4C2

9¾-INCH RING GEAR FRONT AXLE

CONTENTS

DESCRIPTION

The Dana 9¾-inch ring gear front axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the front wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack between the inner pinion bearing cup and the front axle housing. The pinion bearing preload is set by a shim pack at the front of the axle housing between the yoke and the pinion gear.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the case by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims between the bearings and the differential case. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. Differential side bearing preload is set by the axle housing. (The axle housing is spread to remove the differential from the housing.) When the spreader is removed, the housing sets the bearing preload.

Two bearing caps are used to hold the differential into the front axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the front axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The front axle is sealed with a pinion seal, an axle seal, and RTV sealer between the differential cover and front axle housing.

All Dana axles are identified by the part number located on the right axle tube next to the manufacturing date which is next to the carrier. The carrier cover does not have a drain plug. Oil is drained by removing the cover.

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

1. Remove the axle cover from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Backlash Adjustment." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
3. Inspect the case for metal chips. Determine where the metal chips come from, such as a broken gear or bearing cage.
4. Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY

Remove or Disconnect (Figure 1)

Tools Required:

J 24385-01 Differential Housing Spreader
J 29721 Differential Side Bearing Remover
J 29721-70 Side Bearing Adapters
J 8107-3 Side Bearing Puller Plug
J 8614-10 Pinion Flange Holder

- Place the axle in a suitable support.

1. The differential cover bolts (17) and the differential cover (14) (figure 2).
- Drain the gear lubricant into a proper container.
2. Axle shafts (38). Refer to the proper Light Duty Truck Service Manual.
3. Bearing cap bolts (19) (figure 3).
4. Bearing caps (18).
   - The mating letters are stamped on the caps and the axle housing. The caps are to be reassembled exactly as removed.
- Assemble J 24385-01 to the differential housing as shown in figure 4.
- Assemble the dial indicator as shown in figure 4. Preset the gage at least 0.50 mm (0.020-inch), and then rotate the gage housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

- Spread the carrier while examining the dial indicator. Do not spread the carrier more than 0.38 mm (0.015-inch).

5. Differential case (22) from the carrier (1) using two pry bars (figure 5).
6. The spreader J 24385-01 from the carrier (1).
7. Bearing cups (20).
   - Mark the cups as left and right, and place them with the proper bearing caps.
8. Differential side bearings (20) using J 29721, and J 29721-70 and J 8107-3 (figure 6).
   - Mark the bearings as left and right, and place them with the proper bearing caps and cups.
9. Differential shims (21).
   - Mark the shims as left or right.
10. Ring gear bolts (23), and discard.
- Place shop towels over the vise jaws. Put the differential case in the vise (figure 7).

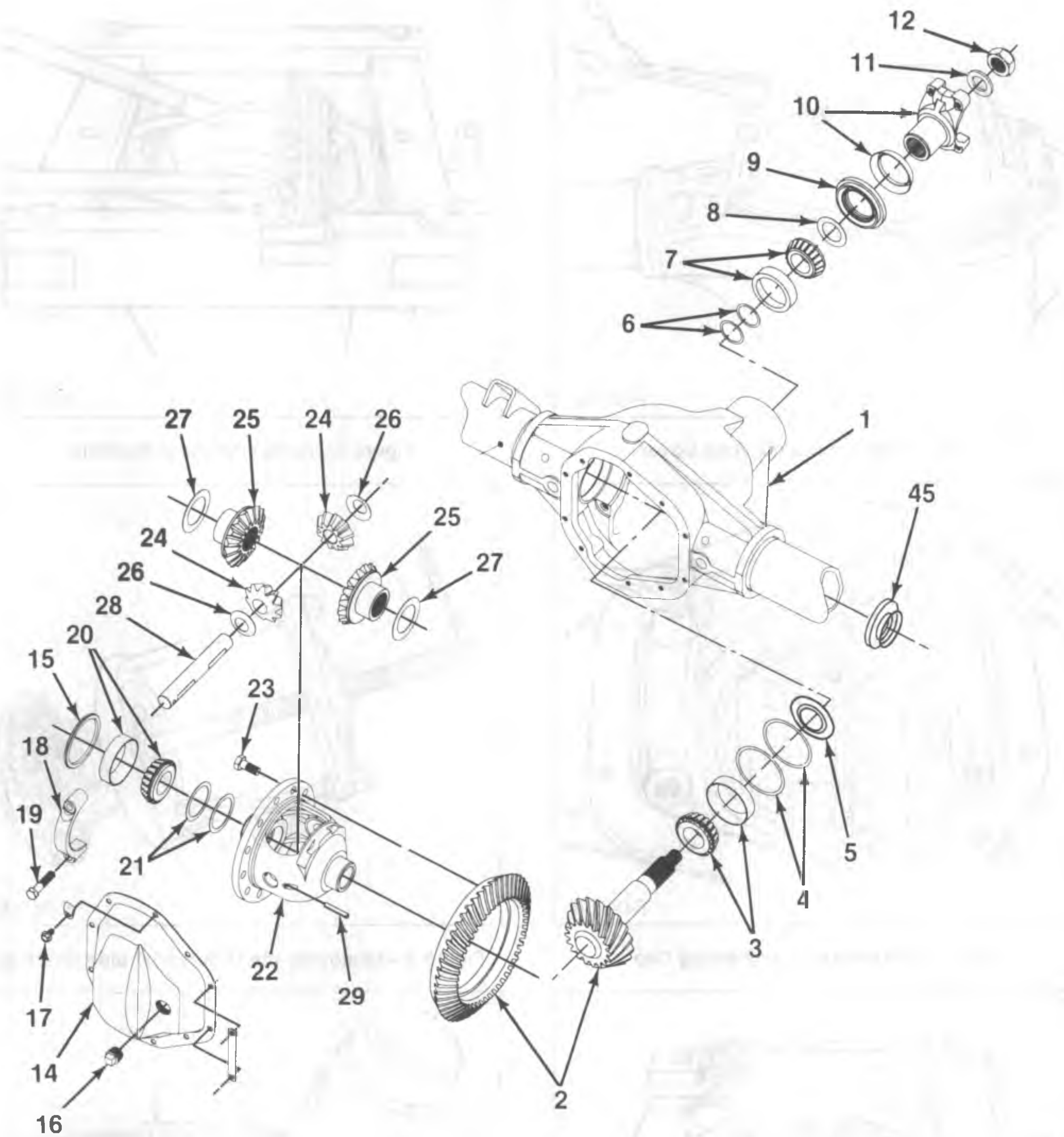
NOTICE: Do not pry the ring gear from the case; this will damage the ring gear and the differential case.

11. Ring gear (2) from the differential case using a rawhide hammer.
    - Ring gear (2) from the vise.
- Put the differential case in the vise.
12. Lock pin (29) from two differential using a hammer and a punch (figure 8).
13. Pinion shaft (28) using a hammer and a brass drift (figure 9).
14. Differential pinion gears (24) and thrust washers (26).
    - Rotate the side gears until the pinion gears are in the opening of the differential (figure 10).
15. Differential side gears (25) and thrust washers (27).
    - Mark the gears and washers as left and right.
- Replace the carrier cover (14) using two bolts (17) to keep the pinion from falling to the floor.

Inspect

- Drive pinion bearing preload (figure 11).
- Pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear.)

16. Pinion nut (12) and washer (11) using J 8614-01 to hold the pinion (figure 12).
17. Pinion flange (10) using J 8614-01 (figure 13).
18. Pinion (2) from the carrier using a rawhide hammer to tap the pinion (figure 14).
19. Carrier cover (14) and the pinion (2).
20. Pinion preload shims (6).
    - Keep the shims together on the bench.
21. Pinion seal (9).
22. Pinion outer bearing (7) and oil slinger (8).
23. Bearing cups (3) and (7) from the axle housing using a hammer or a punch (figure 15).
    - Work the cups out of the housing evenly, moving the punch back and forth between one side of the cup and the other.
24. Pinion adjusting shims (4) and baffle (5).
    - Keep the shims together on the bench.
25. Pinion inner bearing (3) using J 29721 and J 29721-70 (figure 16).
26. Axle shaft seals.



1. Axle Housing
2. Ring Gear and Pinion Set
3. Inner Pinion Bearing
4. Shims
5. Baffle
6. Preload Shims
7. Bearing
8. Thrust Washer
9. Pinion Oil Seal
10. Pinion Flange
11. Washer
12. Pinion Nut
14. Cover
15. Spacer
16. Plug
17. Bolt
18. Bearing Cap
19. Bolt
20. Bearing
21. Shim
22. Differential Case
23. Ring Gear Bolt
24. Pinion Gear
25. Side Gear
26. Pinion Thrust Washer
27. Side Gear Thrust Washer
28. Pinion Shaft
29. Roll Pin
44. Slinger
45. Axle Seal

F-05784

Figure 1—Front Axle Components

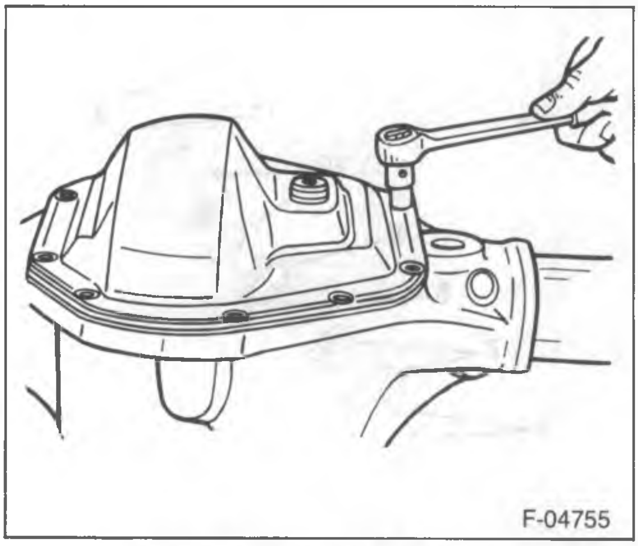


Figure 2—Removing the Axle Cover

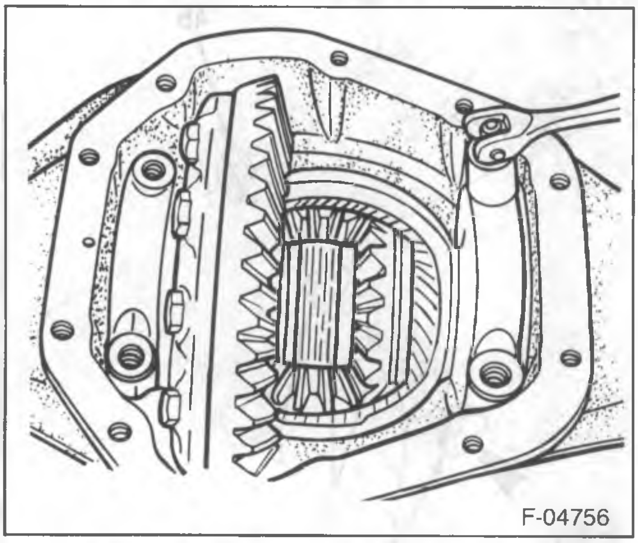


Figure 3—Removing the Bearing Cap

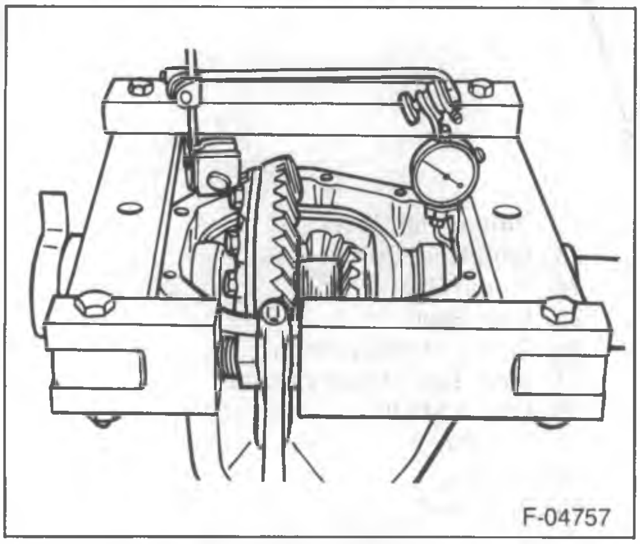


Figure 4—Spreading the Differential Case

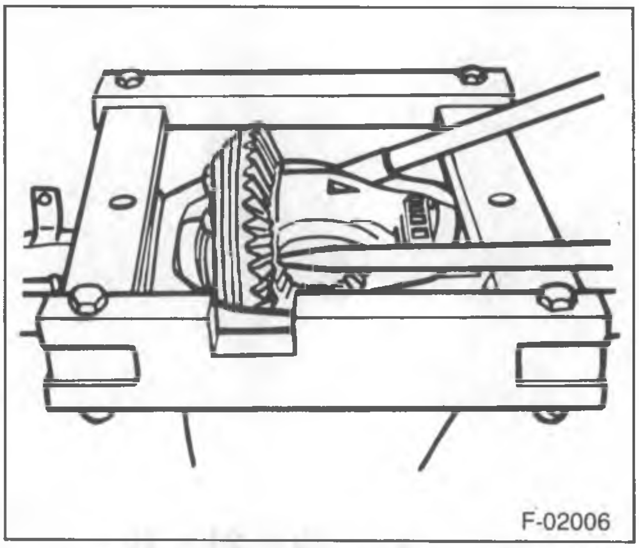


Figure 5—Removing the Differential

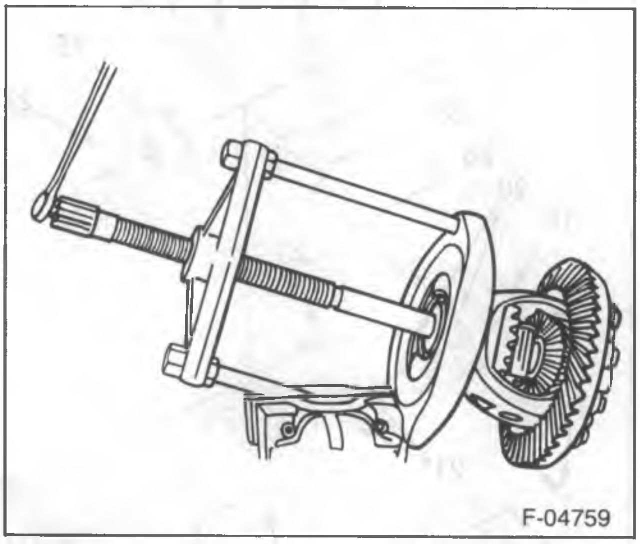


Figure 6—Removing the Differential Side Bearings

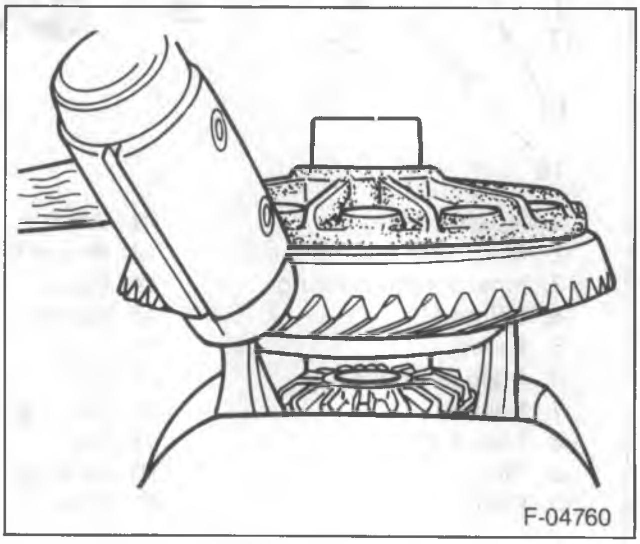


Figure 7—Removing the Ring Gear

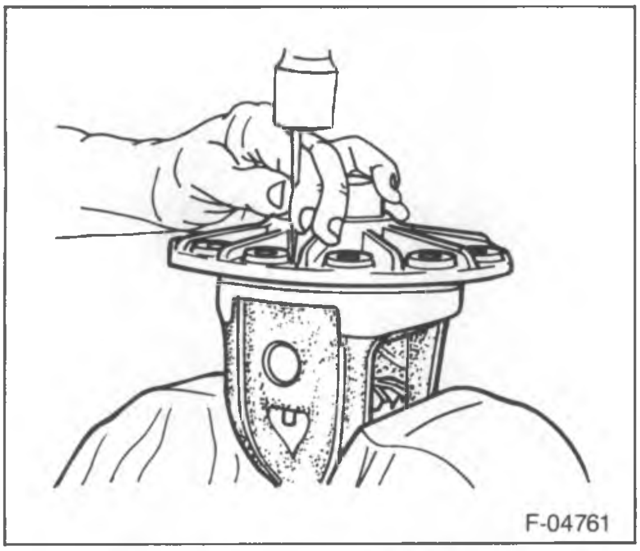


Figure 8—Removing the Lock Pin

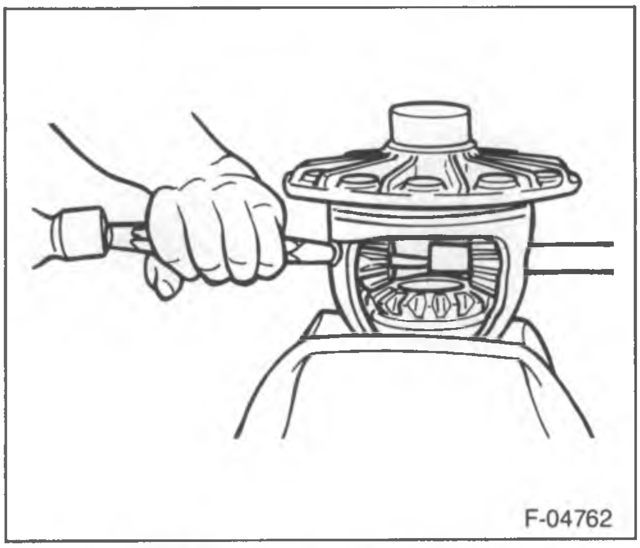


Figure 9—Removing the Pinion Shaft

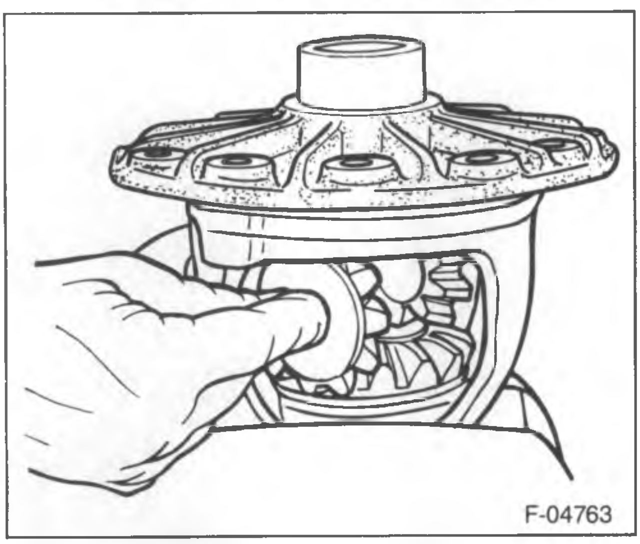


Figure 10—Removing the Pinion Gears

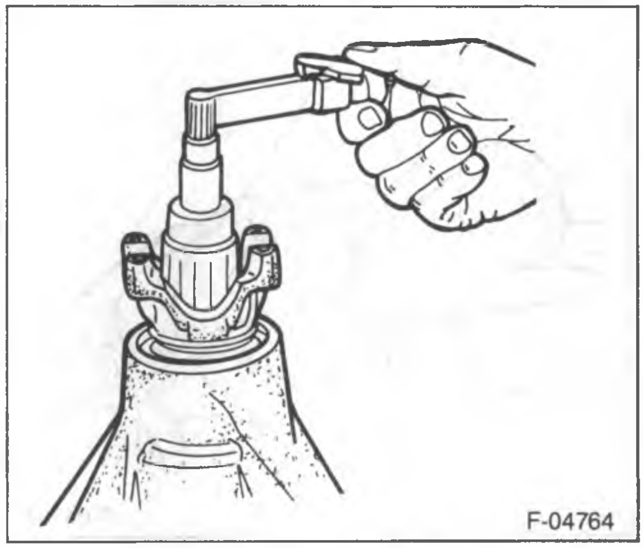


Figure 11—Checking the Pinion Preload

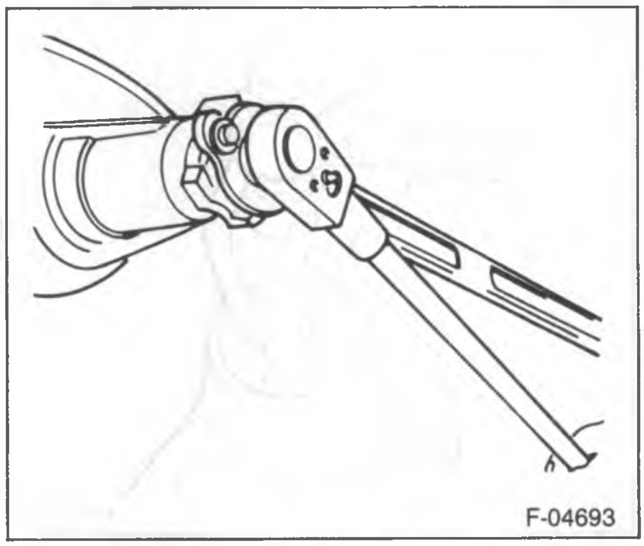


Figure 12—Drive Pinion Nut Removal

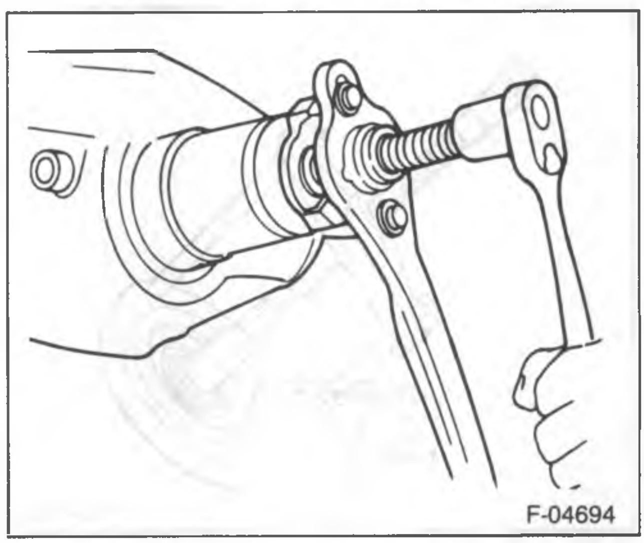


Figure 13—Pinion Flange Removal

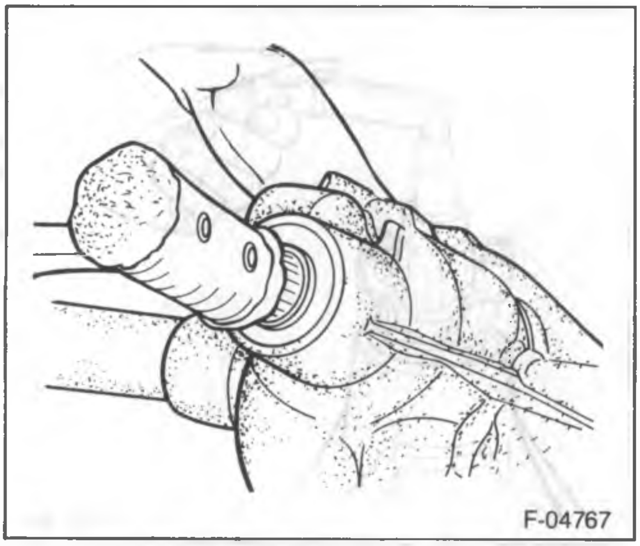


Figure 14—Removing the Pinion

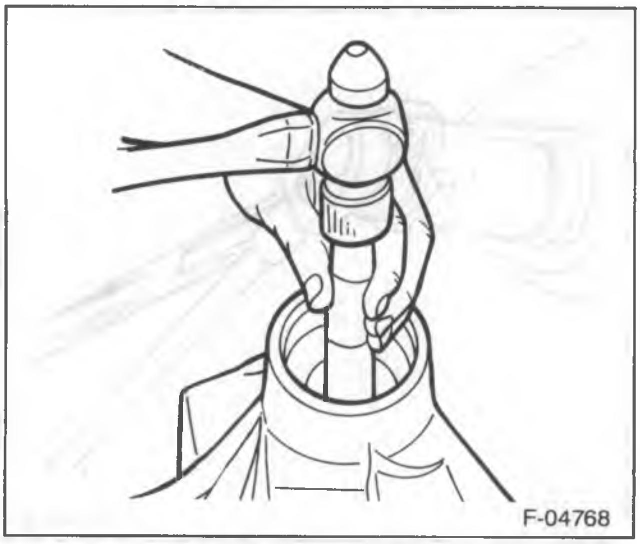


Figure 15—Removing the Bearing Cups

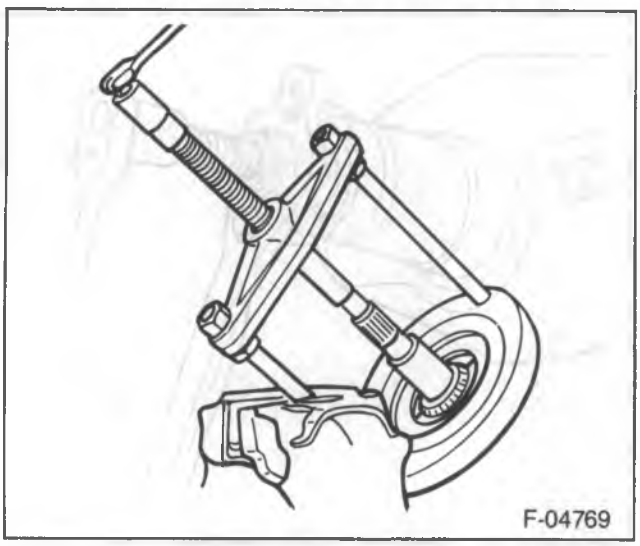


Figure 16—Removing the Pinion Inner Bearing

CLEANING AND INSPECTION

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

It is very important to carefully and thoroughly inspect all drive unit parts before reassembly. Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

INSPECTION

AXLE HOUSING

Inspect

- The carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- The bearing cup surfaces for nicks or burrs. Remove any burrs that are found.
- The housing for cracks. Replace the housing if any cracks are found.
- The housing for foreign material such as metal chips, dirt, or rust. Clean as necessary, as outlined previously.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scorring, and spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion on the pinion flange.
- The sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scorring.
- If the rear axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.
- Bearings and cups are only replaced as sets.

SHIMS

Inspect

- Shims for cracks and chips. Worn or damaged shims should be replaced with an equally sized servise shim.

ASSEMBLY OF AXLE

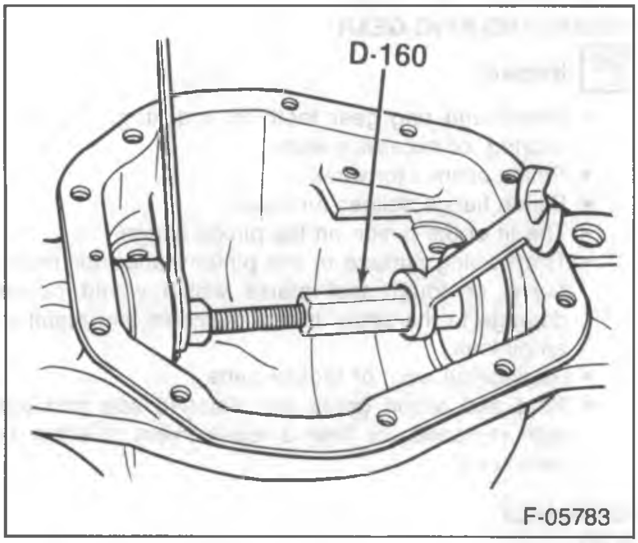


Figure 17—Installing the Axle Shaft Seals

Important

- Lubricate all seal lips, bearings, gears, and bearing surfaces with axle lubricant prior to assembly.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tool Required:

D-160, Axle Shaft Seal Installer (Miller)

- Lubricate all parts with front axle lubricant.

1. Axle shaft seals, using D-160 (figure 17).
2. New side gear thrust washer (27) to the side gears (25).
3. Side gears (25) to the differential case.
   - Place the side gears in place on the same side as removed (figure 18).

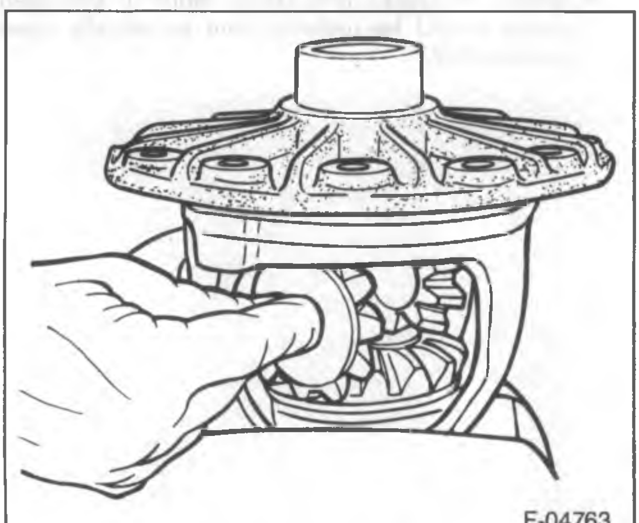


Figure 18—Installing the Pinion Gears

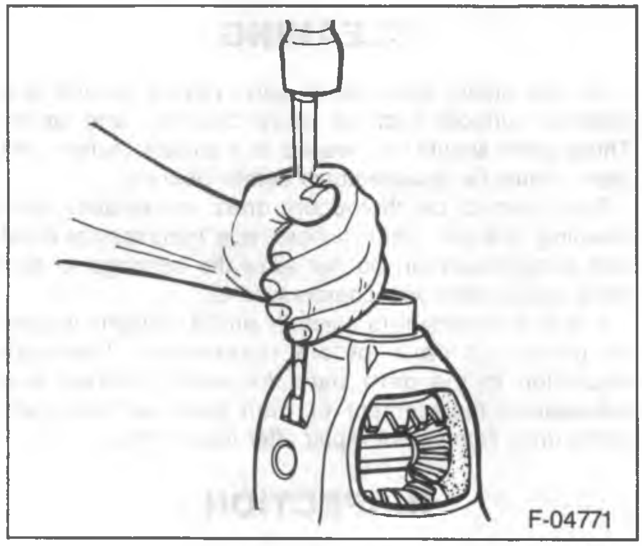


Figure 19—Installing the Lock Pin

4. Pinion gears (24) to the differential without the thrust washers (26).
   - Place the pinion gears onto the side gears so that the holes in the pinion gears are 180 degrees apart.
   - Rotate the pinion gears into place, and verify that the pinion gears line up with the pinion shaft holes.
5. New pinion thrust washers (26).
   - Rotate the pinion gears toward the differential opening just enough to slide in the pinion thrust washers.
6. Pinion shaft (28).
   - Align the lock pin holes in the case and the shaft.
7. Lock pin (29) (figure 19).
   - Peen metal from the case over the lock pin.

- Check that the mating surfaces of the differential case and the ring gear are clean and burr free.

8. Ring gear (2) to the differential case (22).
   - Thread two studs into the ring gear on opposite sides.
   - Press the ring gear onto the case, and align the holes in the case with the studs.
9. New ring gear bolts (23) (figure 20).

Important

- Always use new bolts at assembly.
- Always use the correct service bolts. Do not attempt to use a substitute bolt.
- Tighten the ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.

Tighten

- The ring gear bolts in sequence to 142-156 N·m (105 - 115 ft. lbs.).

10. Master differential bearings D-117 to the differential (figure 21).

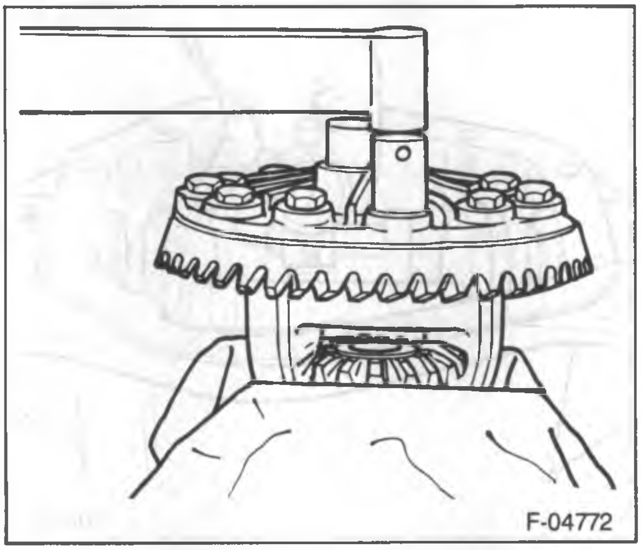


Figure 20—Installing the Ring Gear Bolts

- Refer to "Determining Total Shim Pack Size" in this section.

DETERMINING TOTAL DIFFERENTIAL SHIM PACK SIZE

1. Assemble the differential case (22) to the axle housing. The pinion must not be installed.
2. Mount a dial indicator having a minimum travel of 5 mm (0.200-inch) with a magnetic base on the ring gear bolt side of the housing (figure 22).
3. Force the differential assembly as far as possible in the direction towards the indicator.
4. Preload the dial indicator one half of its travel. Place the tip of the indicator on a flat surface of the differential, just next to a ring gear bolt. Mark this location with a piece of chalk.
5. Zero the dial indicator.

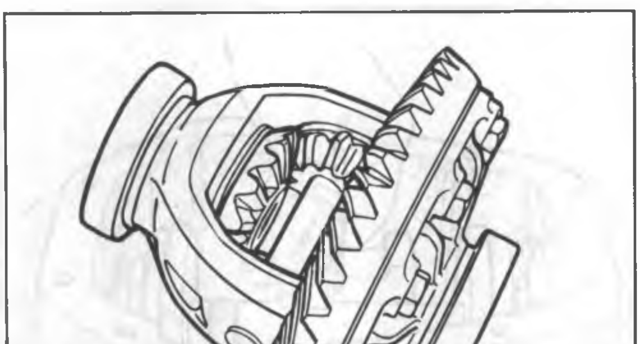


Figure 21—Differential with Master Bearings

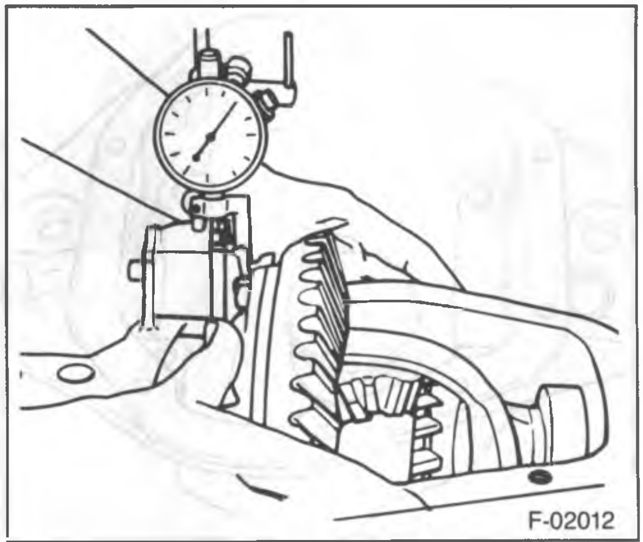


Figure 22—Determining Differential Shim Pack

6. Force the differential assembly in the opposite direction as far as it will go. Repeat this step until the same reading is obtained. Record the number of thousandths that the dial indicator traveled, not the reading on the dial. This will be the measurement of the shimpack without the bearing preload (which will be added later).
7. Remove the dial indicator from the axle.
8. Remove the differential case from the axle housing.
- Do not remove the master bearings from the differential.

PINION DEPTH ADJUSTMENT

Tools Required:

D-120 Master Pinion Block (Miller)
D-116-1 Pinon Height Block (Miller)
D-116-2 Master Discs (Miller)
D-115-3 Arbor (Miller)
D-115 Scooter Gage (Miller)

1. Clean the carrier bores and all the tools. The pinion bore must be free of nicks and dirt.
2. Install D-120 to the pinion bore (figure 23).
3. Place D-116-2 onto D-115-3.
4. Install the arbor and discs into the axle housing (figure 24).
5. Install D-116-1 onto D-120 and against the arbor (figure 25).
6. Place D-115 onto the height block (figure 26).
   - Place the gage on the lower step of the height block. Push the gage down on the height block. While applying pressure, set the dial indicator at zero.
7. Slide the gage over the arbor (figure 27).
8. Record the reading at the point of greatest defelection (when the dial indicator needle is centered between movement to the left and to the right).

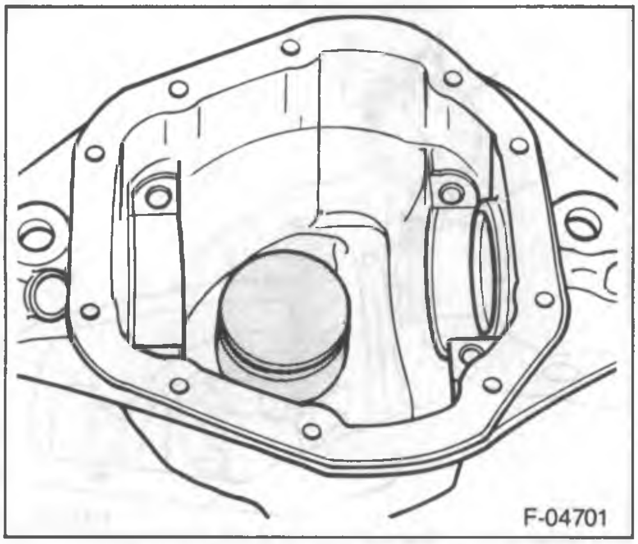


Figure 23—Master Pinion Block

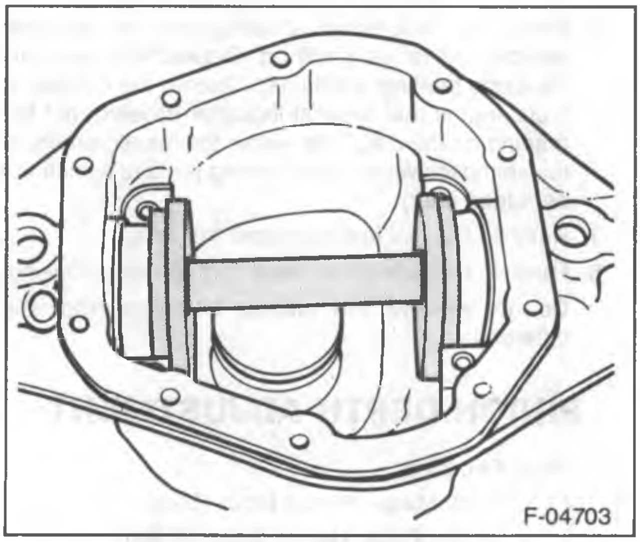


Figure 24—Arbor and Discs

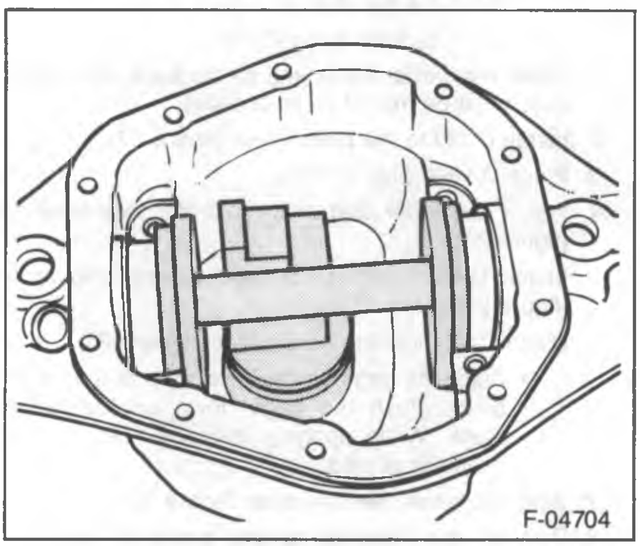


Figure 25—Pinion Height Block

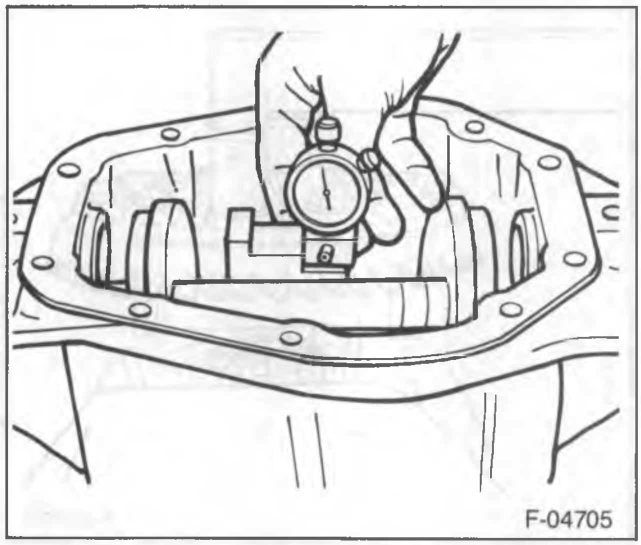


Figure 26—Scooter Gage on the Height Block

- This reading indicates the amount of shims needed for a nominal pinion setting. The pinion marking may change the pinion depth by adding or deleting shims from the nominal pinion setting.

- A positive (+) pinion marking indicates that the distance between the ring gear centerline and the pinion head must increase by the number of thousandths marked on the pinion. This means that the shim pack will decrease by the same number of thousandths.
- A negative (-) pinion marking indicates that the distance between the ring gear centerline and the pinion head must decrease by the number of thousandths marked on the pinion. This means that the shim pack will increase by the same number of thousandths.
- A pinion etched zero (0) will use the nominal setting as determined in this procedure.

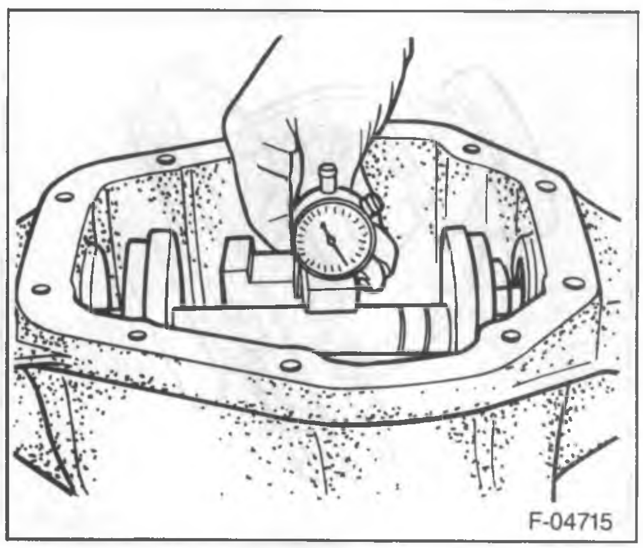


Figure 27—Scooter Gage on the Arbor

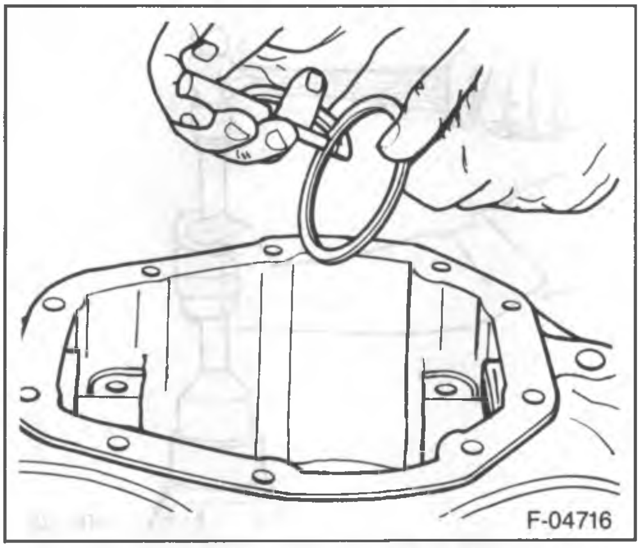


Figure 28—Measuring the Shims

9. Measure each shim separately with a micrometer and add them together to obtain the total shim pack thickness. If a baffle (5) or slinger is used, these must also be measured and included in the shim pack (figure 28).

PINION INSTALLATION

Install or Connect

Tools Required:

- J 7818 Front Pinion Bearing Cup Installer
- J 5590 Rear Pinion Bearing Cone Installer
- D-111 Rear Cup Installer (Miller)
- C-4171 Handle (Miller)
- J 8092 Handle
- J 8614-01 Pinion Flange Remover
- D-116-1 Pinion Height Block (Miller)
- D-116-2 Master Disc (Miller)
- D-115-3 Master Disc (Miller)
- D-115 Scooter Gage (Miller)
- D-163 Seal Installer (Miller)

1. Place the required amount of shims (and baffle if used) in the inner bearing bore.
2. Drive the inner bearing cup into the axle assembly using D-111 and C-4171. The cup must be seated on the shims (figure 29).
3. Drive the outer bearing cup into the axle assembly using J 7818 and J 8092 (figure 30).
4. Inner bearing cone (and slinger if used) on the pinion. Drive the bearing onto the pinion shaft using J 5590 (figure 31).
5. Pinion into the axle housing.
6. Outer pinion bearing (7) and thrust washer (8).
   - Do not assemble the preload shims or pinion oil seal at this time.
7. Pinion flange (10).
8. Washer (11) and pinion nut (12).

Tighten

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a

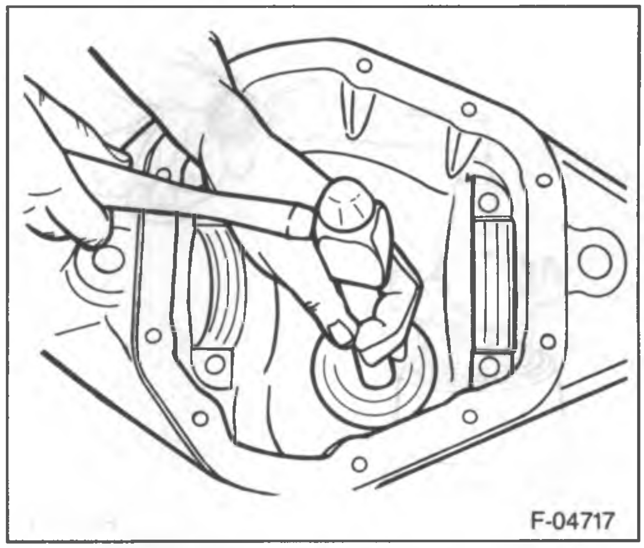


Figure 29—Installing the Pinion Inner Cup

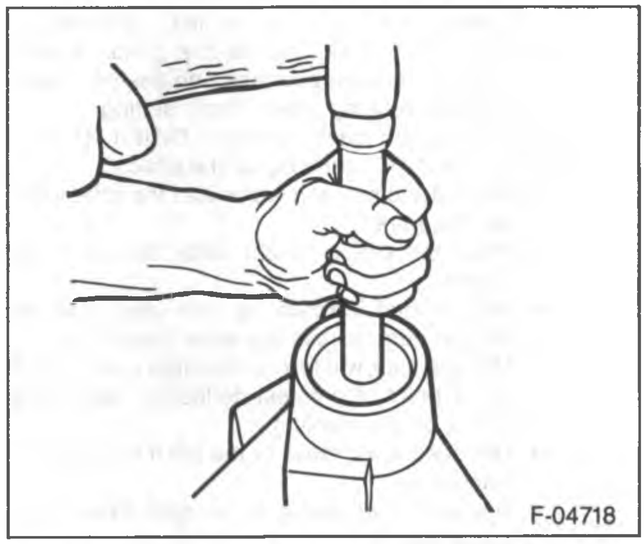


Figure 30—Installing the Pinion Front Cup

Figure 31—Installing the Inner Bearing

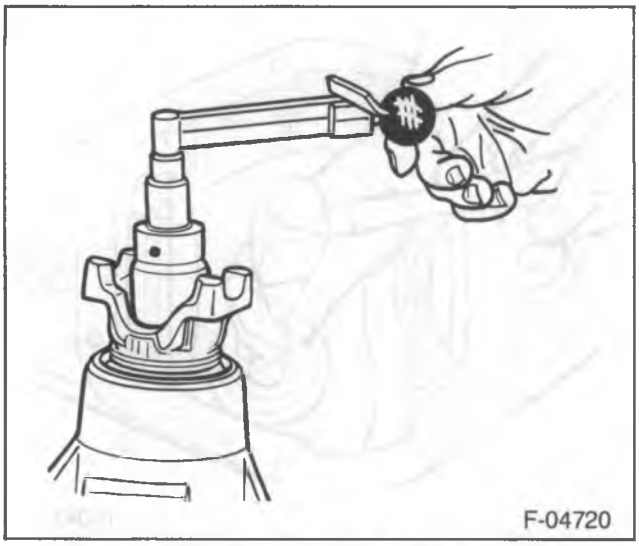


Figure 32—Checking the Pinion Preload

torque of 1.13 N·m (10 in. lbs.) to rotate the pinion (figure 32). Rotate the pinion several times to seat the bearings and assure a more accurate reading pinion depth setting.

9. The pinion depth checking tools D-116-1, D-116-2, D-115-3, and D-115 to the top of the pinion.
   - Place the discs and arbor into the differential bearing bore.
   - Place the pinion height block on top of the pinion.
   - Set the dial indicator at zero and slide the scooter gage across the arbor (figure 33).
   - The indicator will turn to the right or to the left at the point of greatest deflection, depending on the pinion marking.
   - The needle will move to the left if the pinion is marked (+).
   - The needle will move to the right if the pinion is marked (-).
   - If the indicator reading is within 0.05 mm (0.002-inch) of the pinion marking, the pinion is correctly set. If the pinion depth does not meet specifications, change the shim pack by the amount the indicator needle is from the pinion marking.
   - Remove the pinion nut (12), washer (11), pinion flange (10), slinger (8) and bearing cone (7).
10. Preload shims (6).
    - Install the shims that were removed, or measure the old shims and replace them with new shims if necessary.
11. Outer bearing (7) and slinger (8).
    - Apply a light coat of axle lubricant to the pinion seal lip.
12. Outer pinion oil seal (9) using D-163 (figure 34).
13. Pinion flange (10).
14. Washer (11) and a new pinion nut (12).

Tighten (Figure 35 and 36)

- The nut (12) while holding the pinion with J 8614-01. Tighten the nut until it requires a torque of 2.26 - 4.53 N·m (20 - 40 in. lbs.) to rotate the pinion.
- Remove shims to decrease the preload.

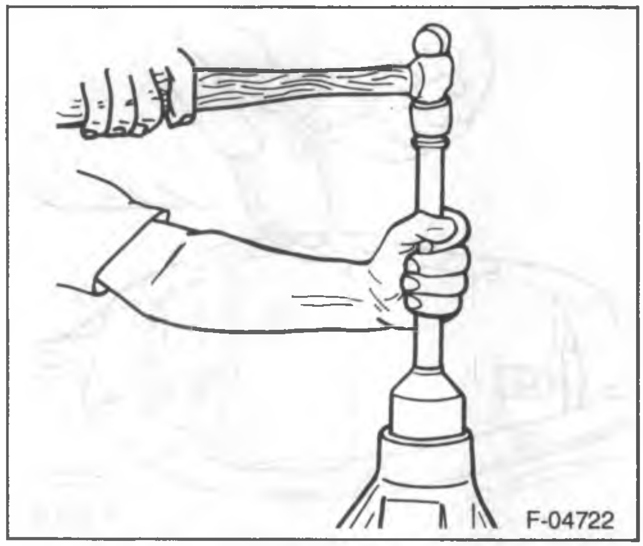


Figure 34—Installing the Pinion Seal

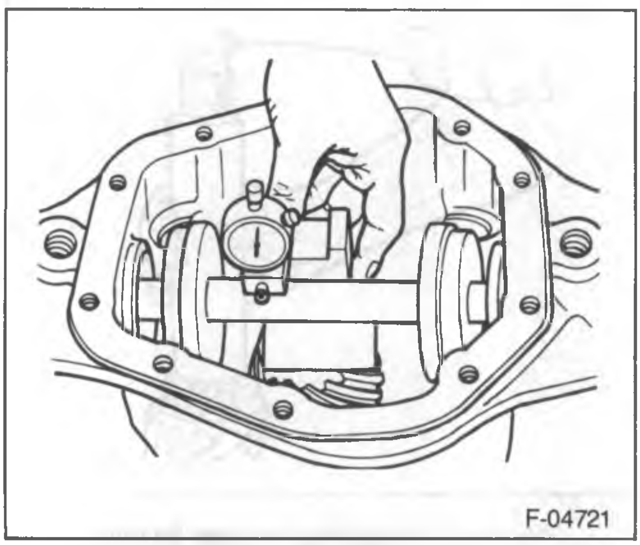


Figure 33—Checking the Pinion Depth Setting

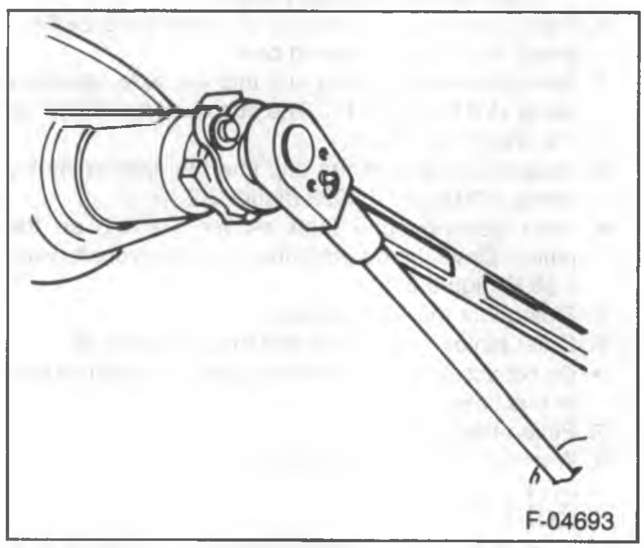


Figure 35—Tightening the Pinion Nut

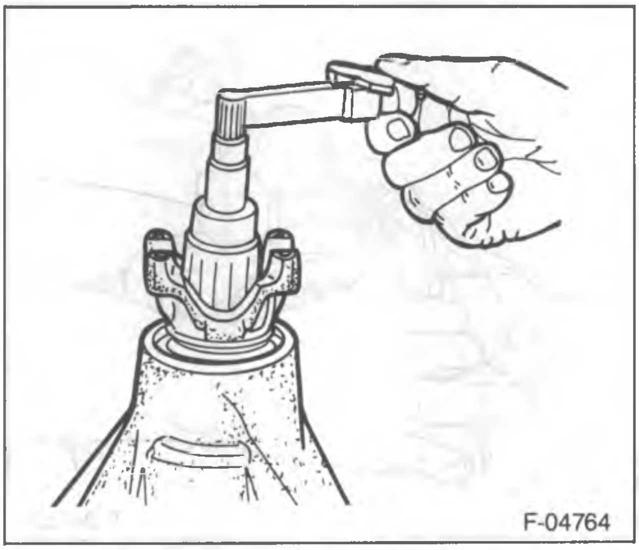


Figure 36—Checking Pinion Preload

- Add shims to increase the preload.

ASSEMBLING THE DIFFERENTIAL TO THE AXLE HOUSING

Tools Required:

J 23690 Differential Side Bearing Installer
J 8092 Driver Handle
J 24385-01 Differential Carrier Spreader

1. Assemble the differential case (22) with master bearings installed to the axle housing. The pinion must be installed.
2. Mount a dial indicator having a minimum travel of 5 mm (0.200-inch) with a magnetic base on the ring gear bolt side of the housing (figure 37).
3. Place the indicator tip on the chalk mark made earlier.
4. Force the ring gear into mesh with the pinion. Rock the ring gear to allow the teeth of the gears to mesh.

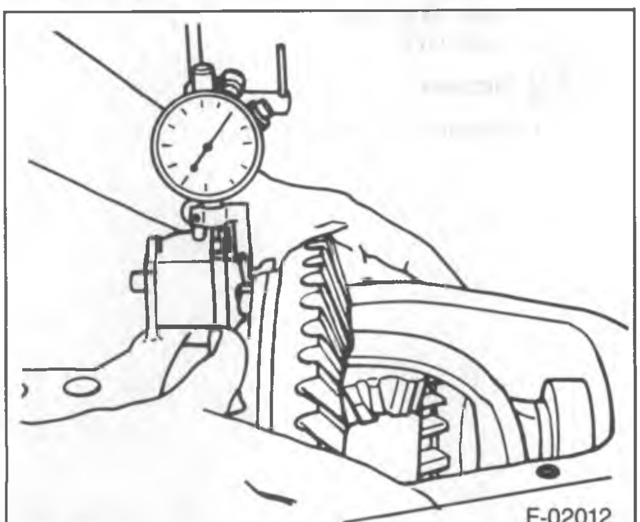


Figure 37—Measuring Differential Movement

Figure 38—Installing the Differential Bearings

5. With the force still applied to the differential case, set the dial indicator to zero.
6. Force the differential case away from the pinion gear to obtain an indicator reading. Repeat this action until a consistent reading is obtained. This will be the size of the left shim pack.
7. Remove the indicator and the differential case from the carrier.
8. Remove the master bearings from the differential case.
9. Using the total shim pack size determined earlier, (Refer to "Determining Total Differential Shim Pack Size" in this section) subtract the reading found in step 6 from the total reading. The reading found in step 6 will be the shim size on the ring gear side. The remaining portion of the shim pack will be used on the side opposite the ring gear. Add an additional 0.38 mm (0.015-inch) of shims to the side opposite the ring gear to preload the bearings.
10. Place the proper shims on the differential side bearing hub (ring gear side) and drive the differential bearing onto the hub using J 23690 and J 8092 (figure 38).
11. Place the proper shims on the differential side bearing hub (opposite the ring gear) and drive the differential bearing onto the hub using J 23690 and J 8092 (figure 38).
12. Assemble J 24385-01 to the axle housing as shown in figure 39.
13. Assemble the dial indicator as shown in figure 39. Preset the gage at least 5 mm (0.020-inch), and then rotate the indicator housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38 mm (0.015-inch). Over-spreading the carrier can damage or distort the carrier.

14. Spread the carrier while examining the dial indicator.
15. Remove the dial indicator.
16. Place the bearing cups (20) onto the bearings.
17. Install the differential assembly into the carrier.

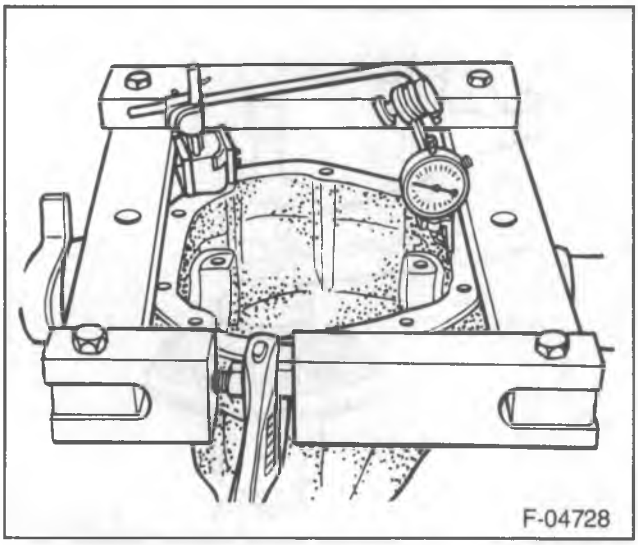


Figure 39—Mounting the Carrier Spreader

- Use a rawhide hammer to seat the differential assembly in the axle housing (figure 40).

18. Remove the spreader.
19. Install the bearing caps (18) in their original positions.
20. Install the bearing cap bolts (19).

Tighten

- Bearing cap bolts (19) to 115 N·m (85 ft. lbs.).

CHECKING BACKLASH

1. Mount a dial indicator with a magnetic base to the axle housing as shown in figure 41.
2. Place the indicator tip at the heel end of the tooth.
3. Check the backlash at three equally spaced points. The backlash should be 0.13 - 0.23 mm (0.005 - 0.009-inch). The measurement must not vary more than 0.05 mm (0.002-inch) between the points checked.

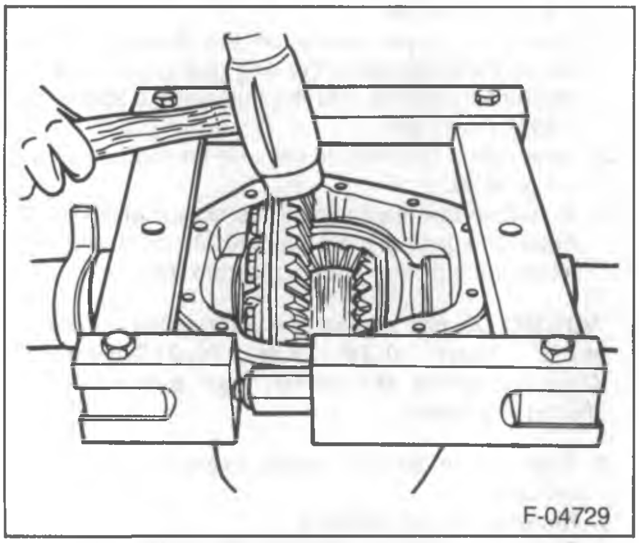


Figure 40—Installing the Differential Case

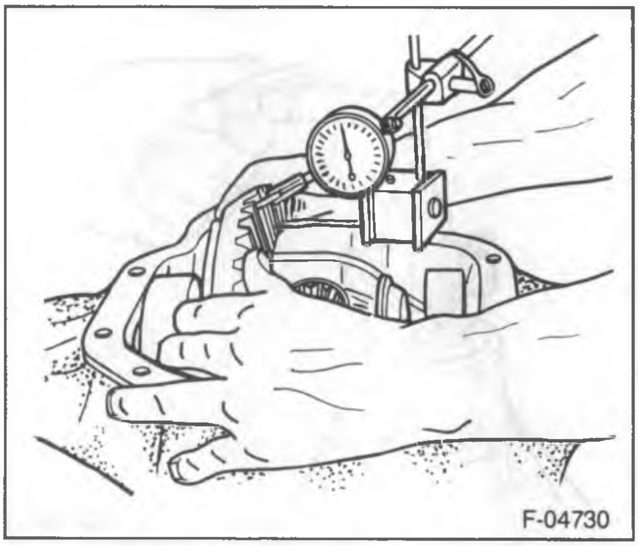


Figure 41—Measuring Backlash

4. High backlash is corrected by moving the ring gear closer to the pinion.
5. Low backlash is corrected by moving the ring gear away from the pinion.
6. To adjust the backlash, the differential case must be removed from the housing, then the differential bearings removed, and the proper number of shims moved from one side to the other.

FINAL ASSEMBLY

Install or Connect (Figure 1)

1. Drive axles, as outlined in the proper Light Duty Truck Service Manual.
2. Axle cover (14) to the housing.
   - Make sure the sealing surfaces on the cover and housing are clean and free of grease and oil.
   - Apply a bead of RTV sealer (GM part no. 1052366 or equivalent) to the cover, inboard of the bolt holes. Install the cover while the sealer is still wet.
3. Cover bolts (17).

Tighten

- Bolts to 47 N·m (35 ft. lbs.).

SPECIFICATIONS

TORQUE SPECIFICATIONS

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	150	110
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35

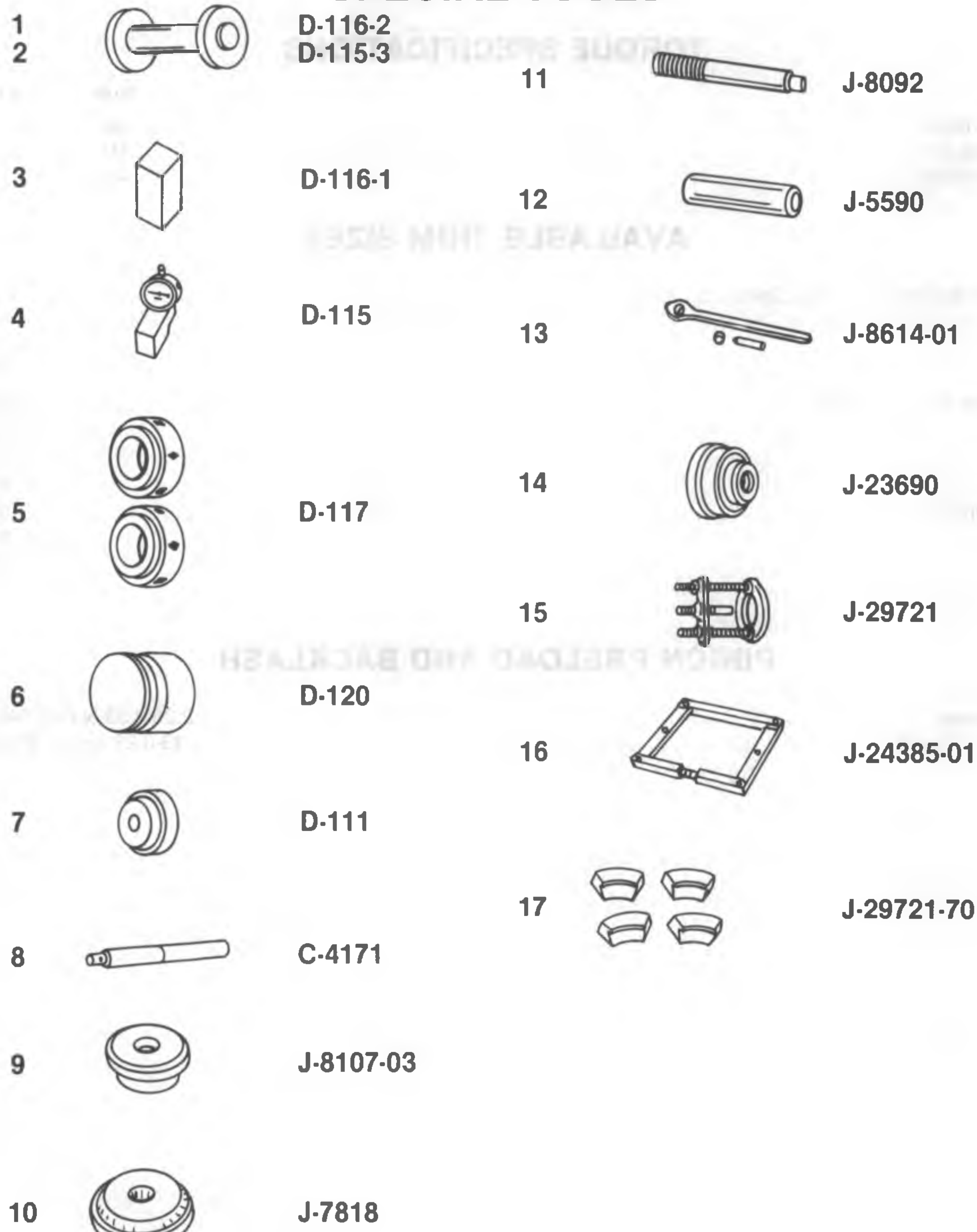
AVAILABLE SHIM SIZES

Differential Bearing Adjusting Shim	0.003-inch
	0.005-inch
	0.010-inch
	0.030-inch
Outer Pinion Bearing Shim	0.003-inch
	0.005-inch
	0.010-inch
	0.030-inch
Inner Pinion Bearing Shim	0.003-inch
	0.005-inch
	0.010-inch

PINION PRELOAD AND BACKLASH

Pinion Preload	2.26-4.53 N·m (20-40 in. lbs.)
Backlash	0.13-0.23 mm (0.005-0.009-in.)

SPECIAL TOOLS



1. Master Discs (Miller)
2. Arbor (Miller)
3. Pinion Height Block (Miller)
4. Scooter Gage (Miller)
5. Master Pinion Bearings (Miller)
6. Master Pinion Block (Miller)
7. Cup Installer (Miller)
8. Handle (Miller)
9. Differential Side Bearing Removal Plug
10. Rear Pinion Bearing Cup Installer
11. Driver Handle
12. Rear Pinion Bearing Cone Installer
13. Pinion Flange Remover
14. Differential side Bearing Installer
15. Differential Side Bearing Remover
16. Differential Carrier Spreader
17. Side Bearing Adapters

F-04663

SECTION 4C3

T TRUCK FRONT AXLE

CONTENTS

DESCRIPTION

The axle used on T model vehicles has a center disconnect feature which allows shifting into and out of four wheel drive when the vehicle is in motion under most conditions.

The axle uses a conventional ring gear and pinion gear set to transmit the driving force of the engine to the wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

The pinion gear is supported by two tapered roller bearing. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsible spacer between the pinion bearings in the axle housing.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential case is supported in the axle housing by two tapered roller bearings. The differnetial and ring gear are located in relationship to the pinion by using threaded adjusters.

The differential is used to allow the wheels to turn at different rates of speed while the front axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The axle identification number is located on a tag attached to the right axle tube.

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

1. Remove the fill plug from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Backlash Adjustment." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
3. Inspect the case and oil for metal chips. Determine where the metal chips come from, such as a broken gear or bearing cage.
4. Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY

Disassemble (Figue 1 through 15)

Tools Required:
- J 8614-01 Pinion Flange Remover
- J 21551 Bearing Remover
- J 22912-01 Pinion Bearing Cone Remover
- J 29307 Slide Hammer
- J 33791 Bushing Remover
- J 33792 Side Bearing Adjuster Wrench
- J 33837 Pinion Bearing Cup Remover Kit
- J 34011 Output Shaft Pilot Bearing Remover

1. Bolts (6), shift cable housing (11), and spring (14).
2. Tube (5) and thrust washer (7).
3. Spring (16) and shift shaft and fork (17).
4. Shaft (1) with deflector (2).
   - Clamp the axle tube (5) in a vise. Clamp ONLY on the mounting flange.
   - Strike the inside of the shaft flange with a brass hammer to dislodge the shaft.
5. Carrier connector (9) with retaining ring (8).
6. Right seal (3) and bearing (4), using J 29369-2 and J 29307 (figure 3).
7. Seal (15) from the tube (5). Pry out with a screwdriver.
8. Thrust washer (20).
9. Sleeve (22) and output shaft (23).
10. Differential pilot bearing (21) from the output shaft, using J 34011 (figure 4).
11. Washer (24).
12. Shaft (59), and deflector (2).
    - Pry with a screwdriver between the shaft flange and carrier head while striking the flange with a soft face hammer (figure 5).
13. Bolts (58) and cover (57).
14. Left seal (3).
15. Bolts (28).
16. Separate the carrier case (29).
    - Insert a screwdriver into the slots provided and pry to separate the case (figure 6).
17. Differential case (35).
18. Bolts (18) and lock tabs (19) from the side bearing adjuster sleeves (32) (figure 7).
19. Bearing cups (33) and sleeves (32) from the case.
    - Turn the sleeves (32) using J 33792 until the cups are pushed out of the case (figure 8).
20. Bearings (30) from the sleeves (32). Use J 21551 (figure 9).
21. Pinion flange nut (46) and washer (45) using J 8614-01 (figure 10).
    - Mount the left carrier case half in J 33837-1 (figure 11).
22. Flange (44) and deflector (43) using J 33837-1 and J 33837-3 (figure 11).
23. Pinion (37), with spacer (40), pinion bearing (39) and shim (38).
24. Spacer (40) from the pinion.
25. Bearing (39) from the pinion. Use J 22912-01 and a press (figure 12).
26. Shim (38).
27. Bearing and cup (41) and seal (42), using J 33837-1, J 33837-3, and J 33837-6.
    - Insert J 33837-6 into the pinion bore.
    - Thread the forcing screw (J 33837-3) into J 33837-6.
    - Turn the forcing screw to pull the parts from the case.
28. Inner bearing cup by pushing it out using J 33837-1, J 33837-3, and J 33837-6 (figure 13).
29. Bolt (36) and shaft (52) from the differential case (35).
30. Differential pinion gears (56) and thrust washers (55).
31. Side gears (54) and thrust washers (53).
    - Mark the side gears and case so they can be installed in their original location.
32. Bolts (34).
33. Ring gear (37).
    - Do not pry between the ring gear and the case. Drive the gear off with a brass drift and hammer.
34. Side bearings (33), using J 22912-01 (31) (figure 14).
35. Bushings (48). Use J 33791 (figure 15).

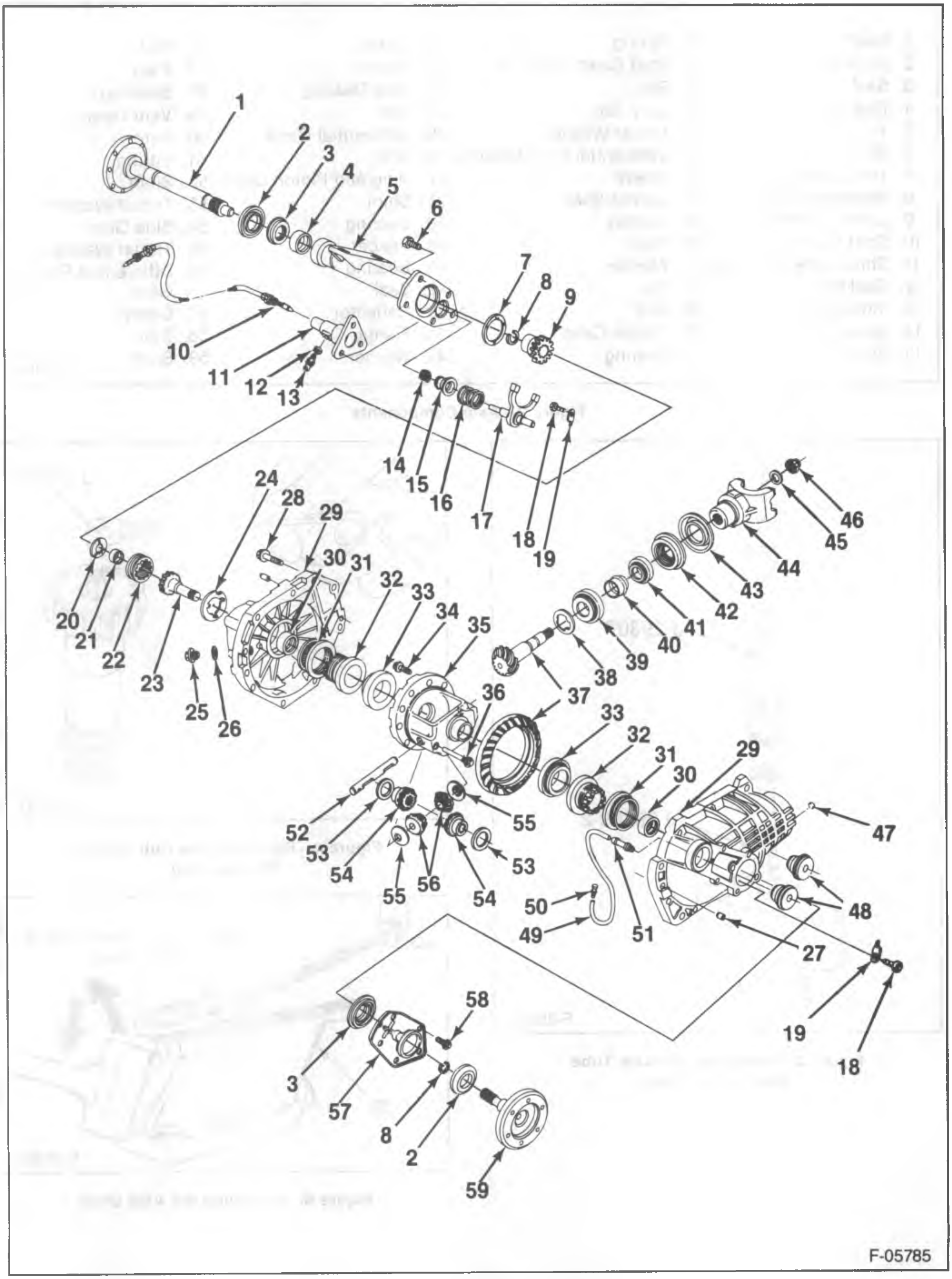


Figure 1—Axle Components

1. Shaft
2. Deflector
3. Seal
4. Bearing
5. Tube
6. Bolt
7. Thrust Washer
8. Retaining Ring
9. Carrier Connector
10. Shift Cable
11. Shift Cable Housing
12. Gasket
13. Indicator Switch
14. Spring
15. Seal
16. Spring
17. Shift Shaft and Fork
18. Bolt
19. Lock Tab
20. Thrust Washer
21. Differential Pilot Bearing
22. Sleeve
23. Output Shaft
24. Washer
25. Plug
26. Washer
27. Pin
28. Bolt
29. Carrier Case
30. Bearing
31. Insert
32. Sleeve
33. Side Bearing
34. Bolt
35. Differential Case
36. Bolt
37. Ring and Pinion Gears
38. Shim
39. Bearing
40. Spacer
41. Bearing
42. Seal
43. Deflector
44. Flange
45. Washer
46. Nut
47. Plug
48. Bushing
49. Vent Hose
50. Vent
51. Fitting
52. Shaft
53. Thrust Washer
54. Side Gear
55. Thrust Washer
56. Differential Pinion Gear
57. Cover
58. Bolt
59. Shaft

F-01388

Figure 2—Axle Components

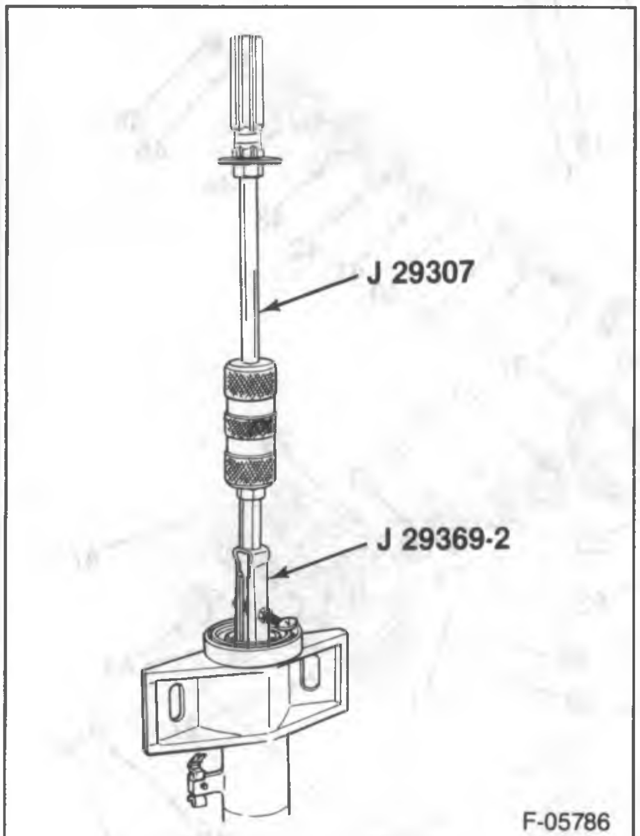


Figure 3—Removing the Axle Tube Bearing and Seal

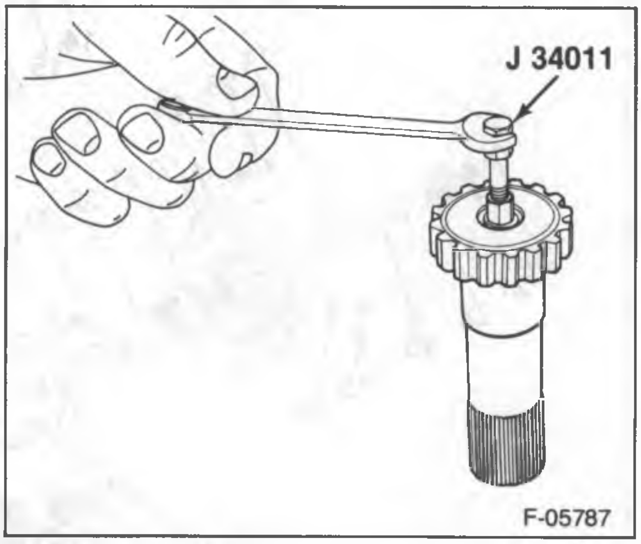


Figure 4—Removing the Output Shaft Pilot bearing

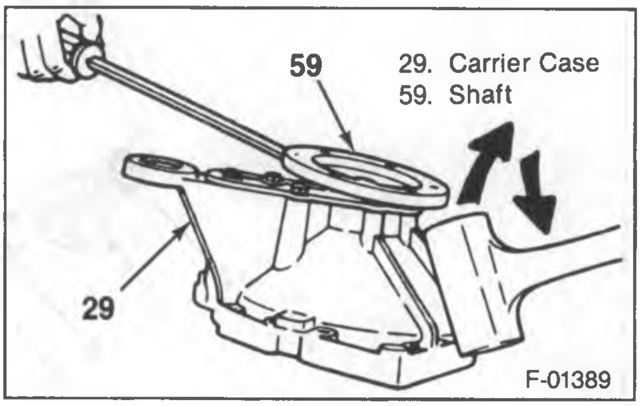


Figure 5—Removing the Axle Shaft

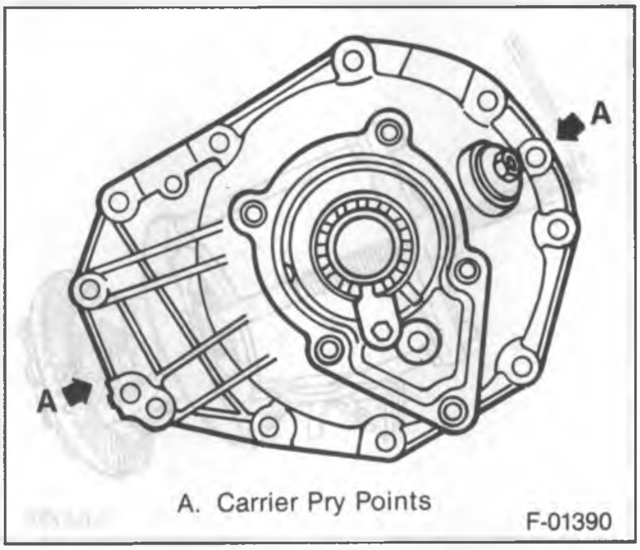


Figure 6—Separating the Carrier Case Halves

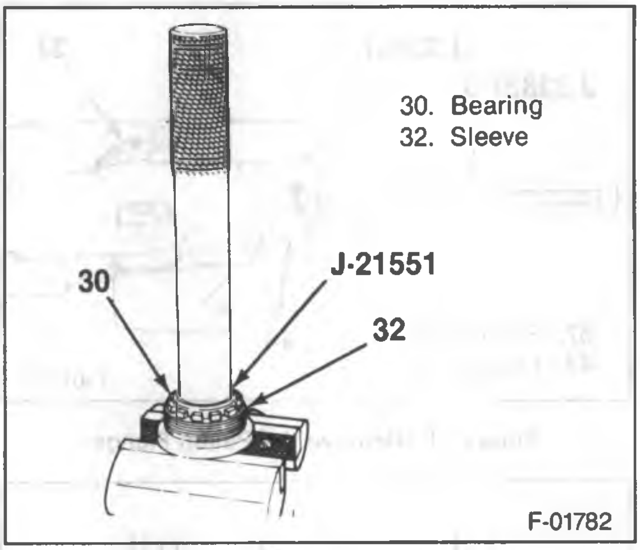


Figure 9—Remove the Sleeve Bearing

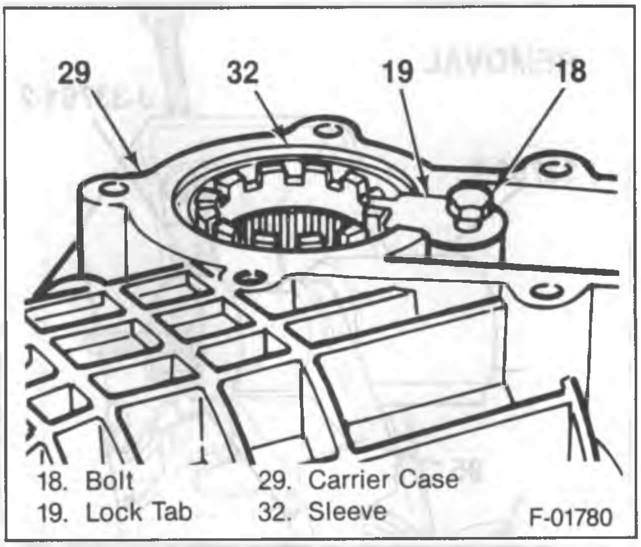


Figure 7—Removing the Lock Tabs

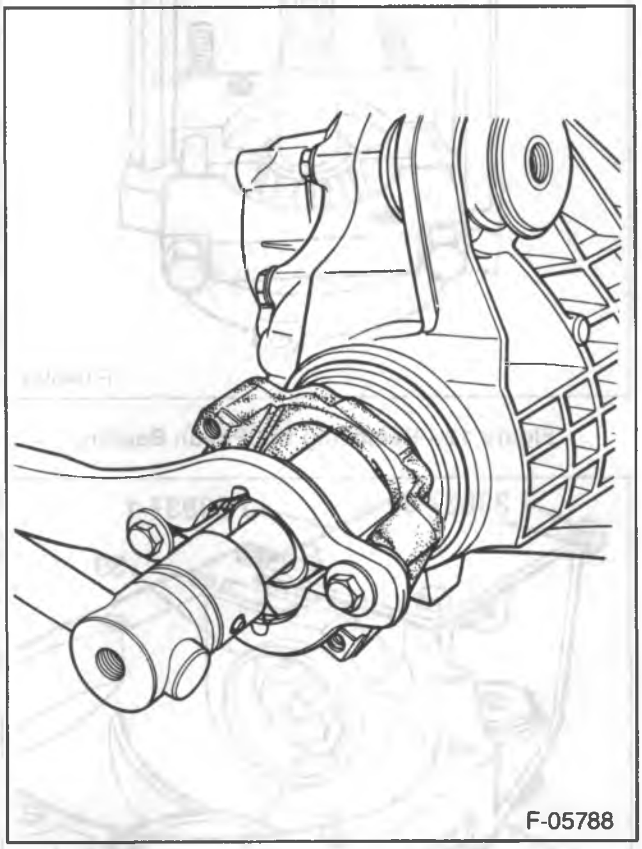


Figure 10—Removing the Pinion Nut

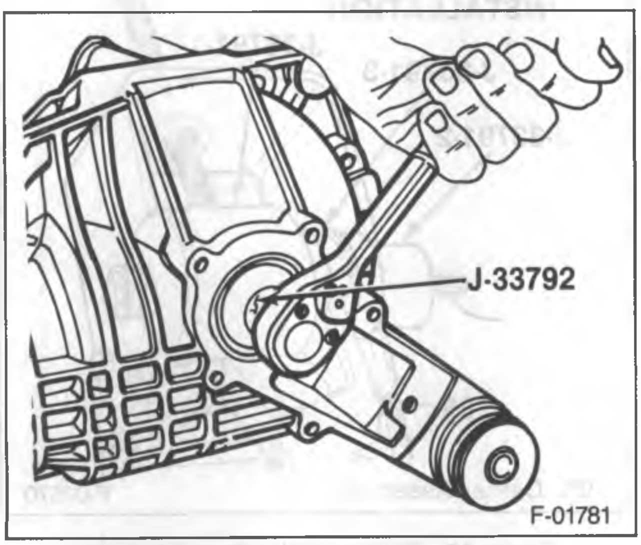


Figure 8—Removing the Side Bearing Cup

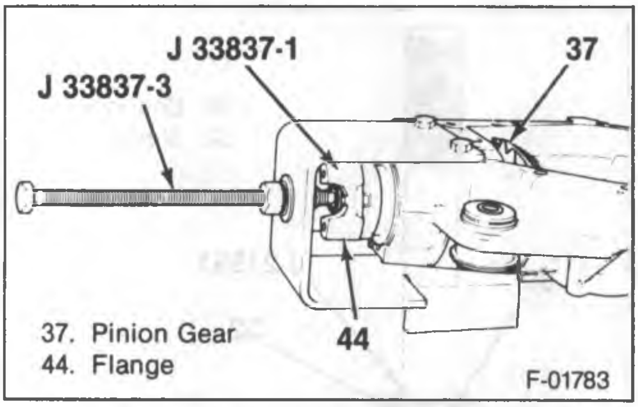


Figure 11—Remove the Pinion Flange

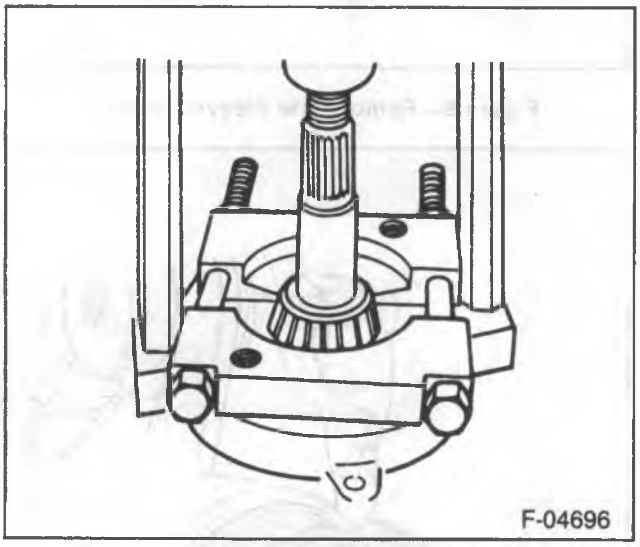


Figure 12—Removing the Pinion Bearing

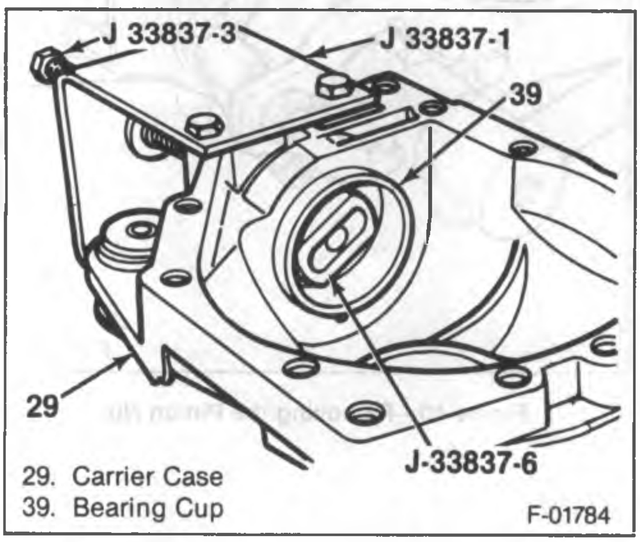


Figure 13—Removing the Inner Pinion Bearing Cup

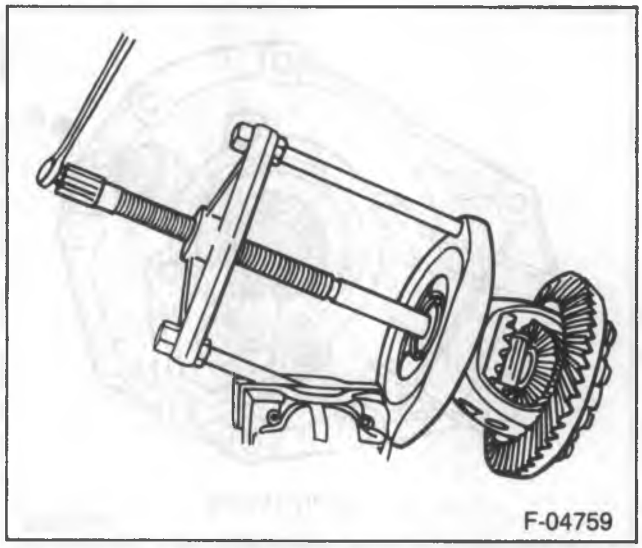


Figure 14—Removing the Differential Side Bearings

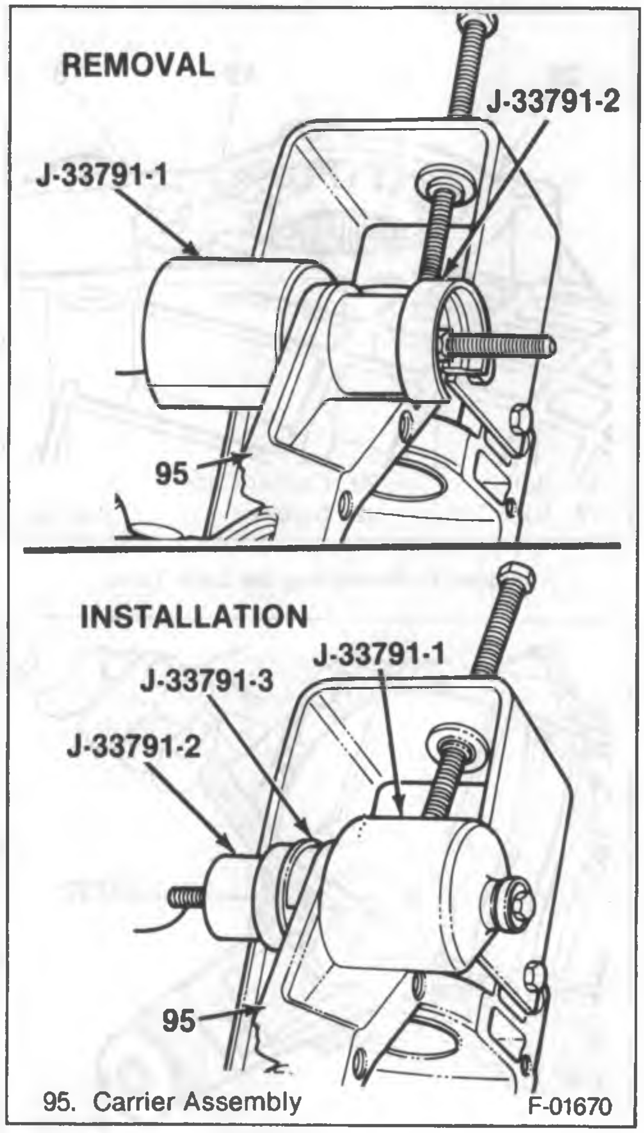


Figure 15—Replacing the Case Bushings

CLEANING AND INSPECTION

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before assembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- Carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- Bearing cup surfaces for nicks or burrs. Remove any burrs that are found.
- Housing for cracks. Replace the housing if any cracks are found.
- Housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scorring, spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- Fit of the side gear on the axle shafts.
- Differential case for cracks and scorring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scorring, or excessive wear.
- Pinion splines for wear.
- Pinion flanges splines for wear.
- Fit of the pinion on the pinion flange.
- Sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the front axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

THRUST WASHERS, SHIMS AND ADJUSTER SLEEVES

Inspect

- Shims and thrust washers for cracks and chips. Damaged shims should be replaced with an equally sized service shim.
- Adjuster sleeves for damaged threads. Replace if required.

SHIFT MECHANISM

Inspect (Figures 1 and 2)

- Carrier connector (9) for damaged splines and teeth. Replace as required.
- Shift fork (17) for wear, scoring, and damage to thrust surfaces. Replace if needed.
- Sleeve (22) and inner output shaft (23) for damaged splines and teeth. Replace if necessary.
- Spring (16) for breakage.

ASSEMBLY OF AXLE

Important

- Lubricant all the seal lips, bearings, gears, and bearing surfaces with axle lubricant prior to assembly.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figures 1, 2 and 16)

Tool Required:

J 33790 Side Bearing Installer

1. Thrust washers (53) and side gears (54) into the differential case (35).
   - If the same gears and washers are being used, install them on the same side as they were removed from.
2. Pinion gears (56).
   - Position one pinion gear (56) between the side gears and rotate the gears until the pinion gear is directly opposite the opening in the case.
   - Place the other pinion gear (56) between the side gears, making sure the hole in both pinion gears line up.
3. Thrust washers (55).
   - Rotate the pinion gears toward the opening just enough to permit the sliding in of the thrust washers.
4. Shaft (52) and bolt (36).
5. Ring gear (37) onto the differential case (35).
6. Bolts (34).

   Important

   - Always install new bolts. Never reuse the old bolts.

   Tighten

   - Bolts (34) alternating in progressive steps to 80 N·m (60 ft. lbs.).
7. Side bearings (33), using J 33790 (figure 16).

PINION BEARING CUP INSTALLATION

Install or Connect (Figures 1, 2, 17 and 18)

Tool Required:

J 33837 Pinion Bearing Remover and Installer

1. Bearing cup (41) into the case using J 33837-1, J 33837-3, and J 33837-4 (figure 17).
2. Bearing cup (39) into the case using J 33837-1, J 33837-3, and J 33837-4 (figure 18).

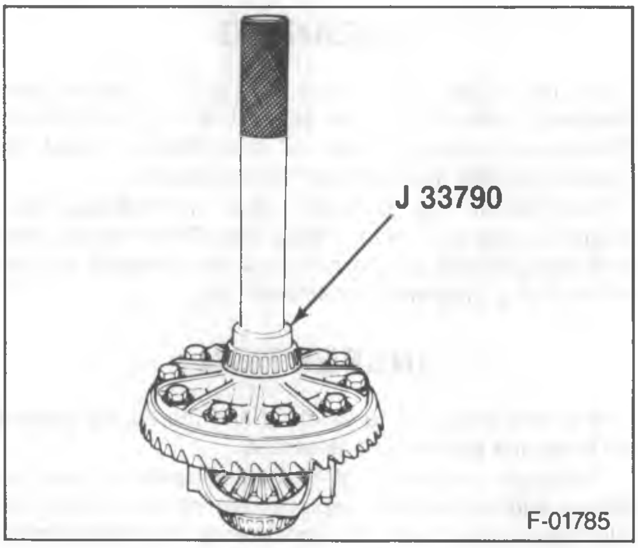


Figure 16—Installing the Differential Side Bearings

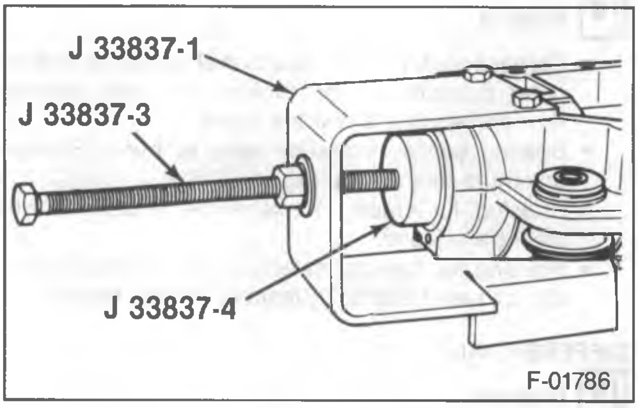


Figure 17—Installing the Outer Pinion Bearing Cup

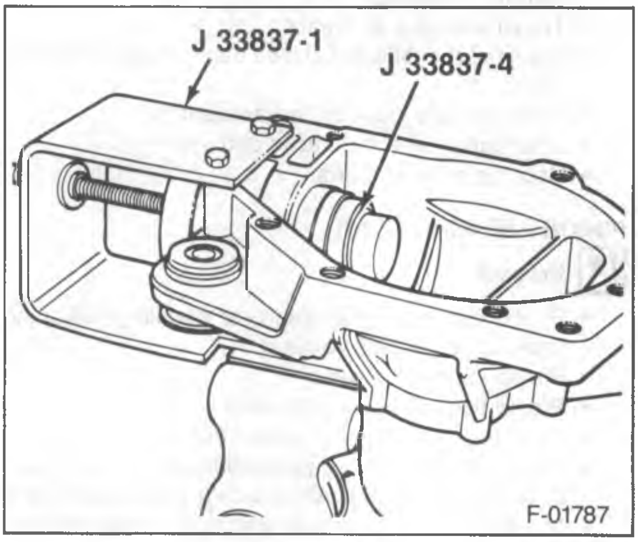


Figure 18—Installing the Inner Pinion Bearing Cup

PINION DEPTH ADJUSTMENT

Tools Required:
J 33838 Pinion Depth Setting Gage
J 29763 Dial Indicator

1. Refer to figure 1.
2. Pinion depth is adjusted by selecting a shim (38) of the proper thickness.
3. Lubricate the inner and outer pinion bearings liberally with axle lubricant.
4. Hold the pinion bearings in position and install J 33838 and J 29763 (figure 19). Set the dial indicator at ZERO, then position it in J 33838. Push the dial indicator downward until the needle rotates approximately three turns to the right.
5. Tighten the dial indicator in this position.
6. Set the button of J 33838 on the differential bearing bore (figure 19).
7. Rotate the tool slowly back and forth unitl the dial indicator reads the lowest point of the bore. Set the dial indicator to ZERO. Repeat the rocking action of the tool to verify the ZERO setting.
8. After the ZERO setting is obtained and verified, move the tool button out of the differential side bearing bore (figure 19). Record the dial indicator reading.
9. The dial indicator reading is equal to the required shim size. Example: If the dial indicator reads 0.84 mm in step 8, a 0.84 mm shim is required. Available shim sizes are listed in "Specifications."
10. Remove the tools and bearing cones.

PINION INSTALLATION

Install or Connect (Figure 1, 2, 10, 20 and 21)

Tools Required:
J 33785 Bearing Installer
J 8614-01 Pinion Flange Remover
J 33792 Seal Installer

1. Shim (38) to the pinion gear (37).
   - The shim must be of the proper size, as selected previously.
2. Bearing (39) onto the pinion gear (37) using J 33785 (figure 20).
3. New spacer (40) onto the pinion gear (37).
4. Bearing (41) into the case.
5. Seal (42) into the case using J 33782 (figure 21).
6. Pinion gear, with bearing and spacer, to the case.
7. Deflector (43), flange (44), washer (45) and nut (46).
   - Apply PST sealant (GM part number 1052080 or equivalent) to the pinion gear threads and on both sides of the washer.
   - Tighten nut (46) until no end play is detectable while holding the flange (44) with J 8614-01 (figue 10).
   - No further tightening should be attempted until bearing preload has been checked.

Measure

- Pinion bearing preload. Use an inch pourd torque wrench (figure 22). The correct preload is 1.7-2.8 N·m (15-25 in. lbs.).

1. Rotate the pinion with the torque wrench and observe the reading.
2. If the preload torque is below specifications, continue torquing the pinion nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several inch pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
3. Once the preload has been obtained rotate the pinion several times to make sure that the bearings have seated. Recheck the preload, and adjust if necessary.

DIFFERENTIAL ASSEMBLY INSTALLATION

Install or Connect (Figures 1, 2, 23, 24 and 25)

Tools Required:
J 33788 Bearing Installer
J 23423-A Bearing Cup Installer
J 33792 Side Bearing Adjuster Wrench

1. Bearings (30) into the sleeves (32) using J 33788 (figure 23).
2. Sleeves (32) into the carrier case (29). Thread in all the way.
3. Side bearing cups (33) into the carrier case (29) using J 23423-A.
4. Differential assembly to the carrier case.
   - Place the differential case assembly (35) into the carrier case half which contains the pinion gear.
   - Turn the left sleeve (32) in toward the differential case using J 33792 until backlash is felt between the ring and pinion gear.
5. Carrier case halves (29). Do not use any sealer at this time.
   - If the carrier halves do not make complete contact, back out the right hand adjusting sleeve (32). Use J 33792 (figure 24).
6. Four bolts (28) (figure 25).

Tighten

- Bolts (28) to 50N N·m (37 ft. lbs.).

ADJUSTING BACKLASH

Tools Required:
J 33792 Side Bearing Adjuster Wrench
J 34047 Dial Indicator Adapter
J 25025-1 Dial Indicator Stand
J 8001-1 Dial Indicator Clamp

1. Refer to figures 1 and 2.
2. Tiguten the right sleeve (32) to 140 N·m (100 ft. lbs.). Use J 33792 (figure 24).
3. Tighten the left sleeve (32) to 140 N·m (100 ft. lbs.). Use J 33792 (figure 24).
4. Mark the location of the adjusting sleeves in relation to the carrier halves (figure 26), so the notches in the adjusting sleeves can be counted when turned.
5. Turn the right adjusting sleeve OUT two notches using J 33792.

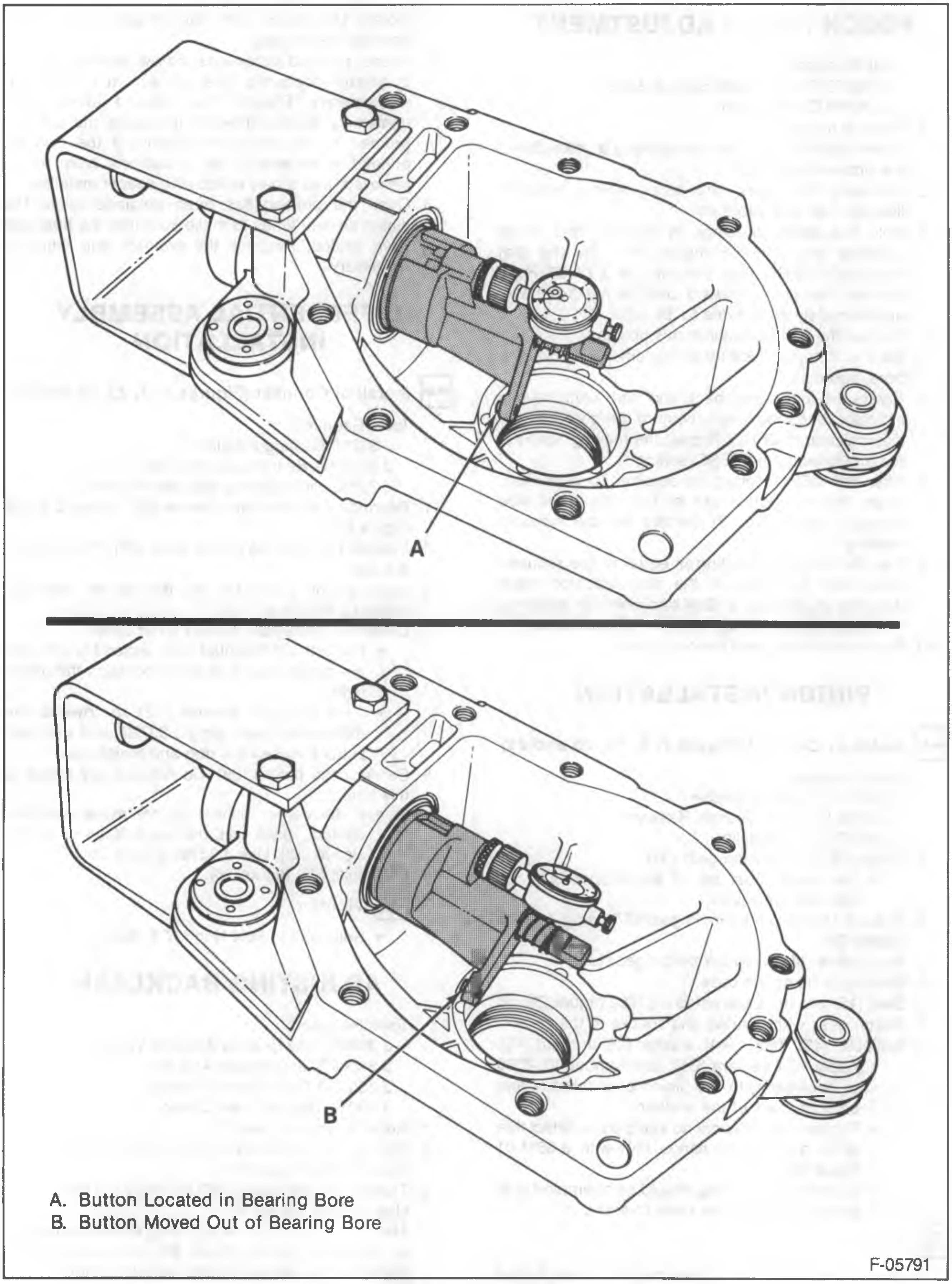


Figure 19—Measuring Pinion Depth

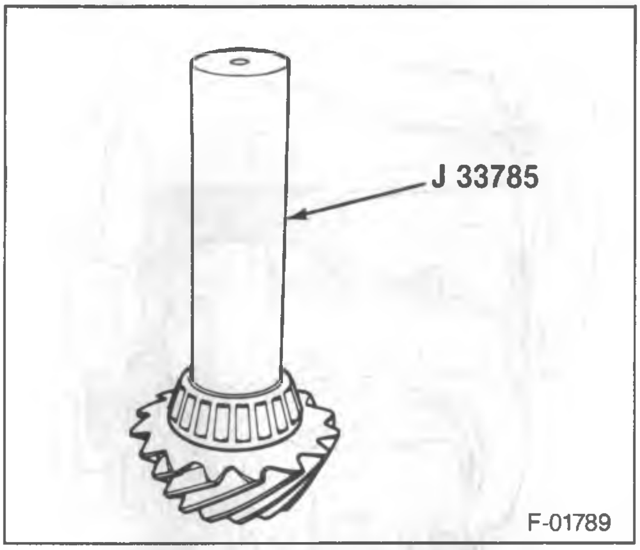


Figure 20—Installing the Pinion Bearing

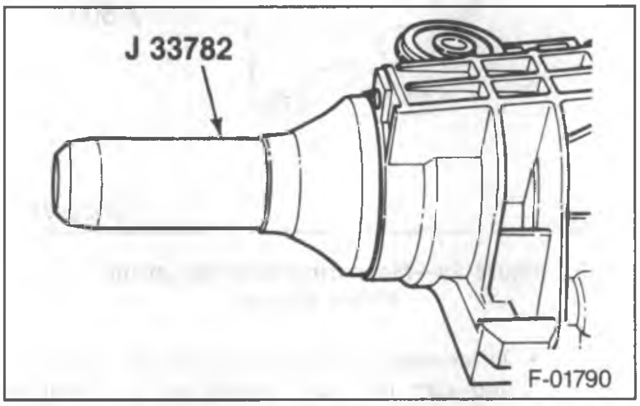


Figure 21—Installing the Pinion Seal

6. Turn the left adjusting sleeve IN one notch using J 33792.
7. Rotate the pinion several times to seat the bearings.
8. Install J 34047, J 25025-1 and J 8001-1 (figure 27).
9. Place the indicator stem at the heel end of a tooth.

Figure 22—Measuring Pinion Bearing Preload

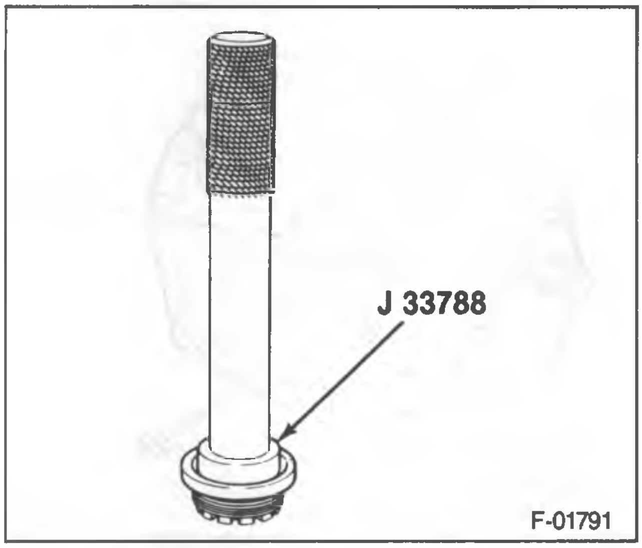


Figure 23—Installing the Sleeve Bearing

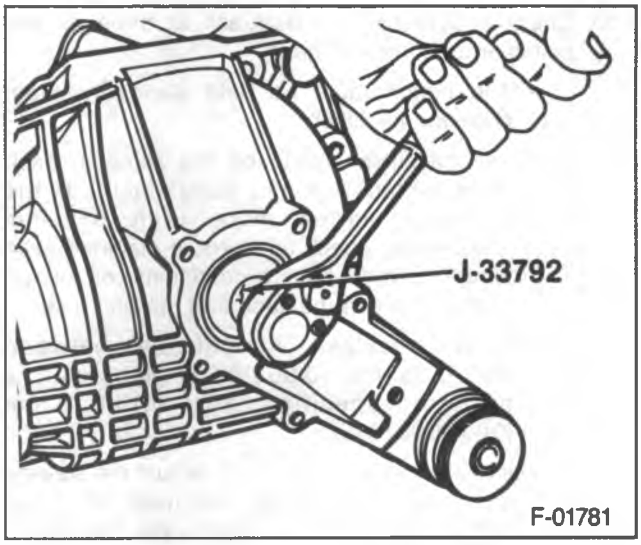


Figure 24—Adjusting the Sleeve

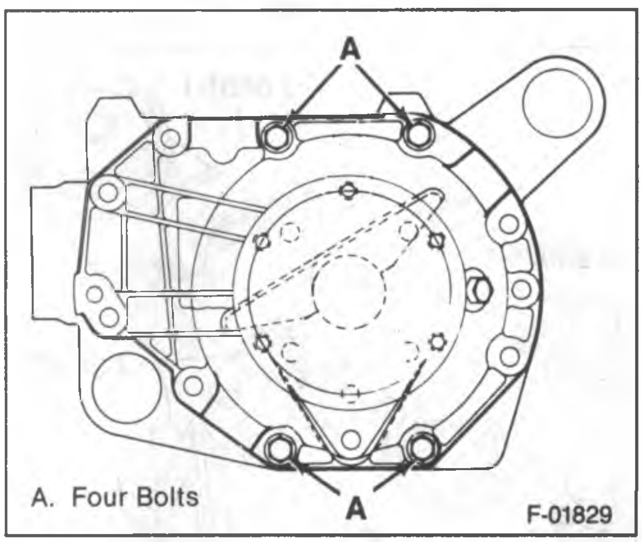


Figure 25—Carrier Case Bolts Installed

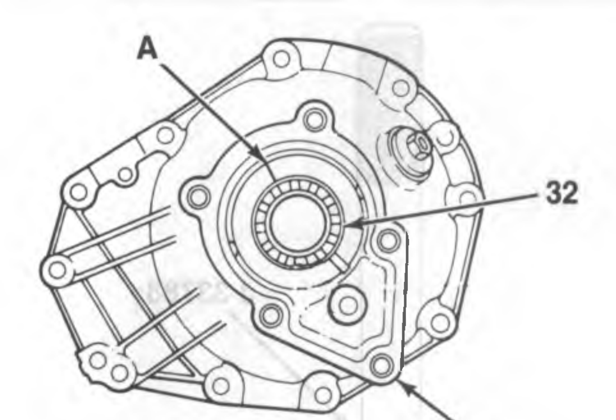


Figure 26—Marking Sleeve Location

10. Check and record the backlash at three or four points around the ring gear.
    - The pinion must be held stationary when checking backlash.
    - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
    - Gear backlash should be between 0.08-0.25 mm (0.003-0.010-inch) with a preferred specificaton of 0.13-0.18 mm (0.005-0.007-inch).
    - If the backlash is incorrect, adjust the sleeves as necessary. Always maintain the "one notch" preload on the side bearings. EXAMPLE: If it is necessary to turn the RIGHT sleeve IN one notch, the LEFT sleeve must be turned OUT one notch.

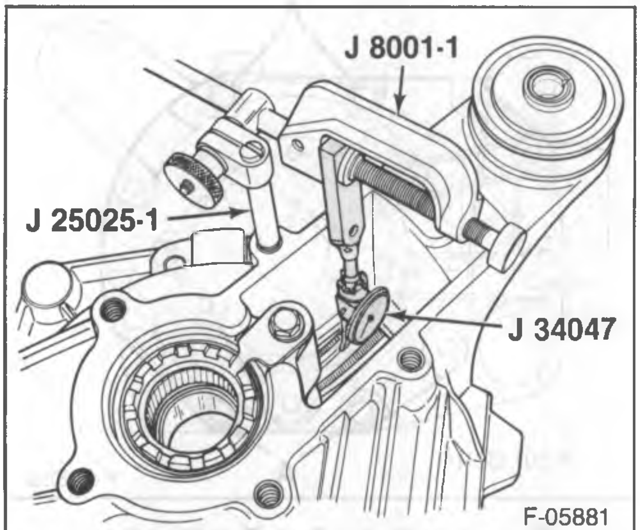


Figure 27—Measuring Backlash at the Ring Gear

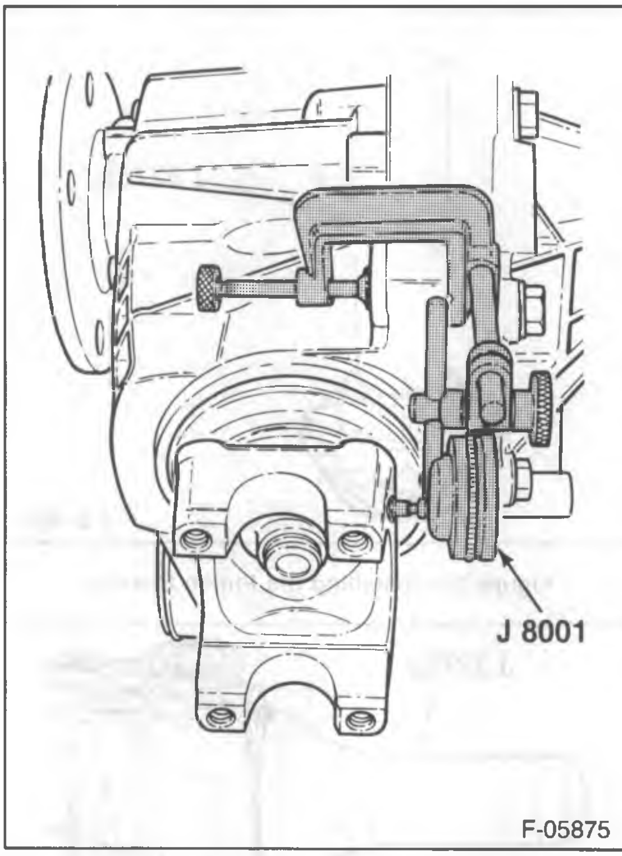


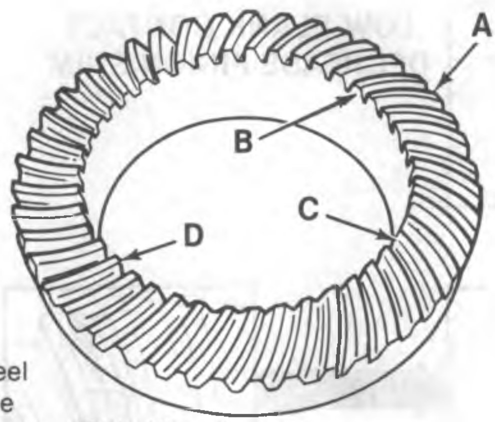
Figure 28—Measuring Backlash at the Pinion Flange

- To increase backlash, turn the left sleeve in, and turn the right sleeve out an identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

10. When the backlash is correct, mark the position of the sleeves so they can be kept in the same location.

MEASURING BACKLASH (ALTERNATE METHOD)

1. Use this method if the tools specified previously are not available.
2. If the specified tools are not available, it is possible to read backlash at the pinion flange as follows:
3. Install a dial indicator so the button contacts the outer edge of the pinion flange. The plunger must be at a right angle to the pinion flange (figure 28).
4. Move the pinion flange through its free play while holding the differential carrier. Record the dial indicator reading.
5. DIVIDE THE DIAL INDICATOR READING BY 2 to obtain the actual backlash when using this method. Example: A dial indicator reading of 0.16 mm means that there is actually 0.08 mm backlash.
6. Follw the steps for adjusting backlash outlined previously.



A. Heel
B. Toe
C. Concave Side (Coast)
D. Convex Side (Drive)

F-02017

Figure 29—Gear Tooth Terms

GEAR TOOTH CONTACT PATTERN CHECK

Before final assembly of the differential, a gear tooth contact pattern check should be performed.

It should be noted that a gear tooth contact pattern check is NOT a substitute for adjusting pinion depth and backlash as previously outlined. It is a method to verify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy, or have a short life, or both. With a pattern check, the best contact between the ring gear and the drive pinion for low noise level and long life can be assured.

GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest the center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. The toe end of the tooth is smaller than the heel end, (figure 29).

TEST

1. Wipe oil out of carrier and carefully clean each tooth of the ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Apply a load until a torque of 54-70 N·m (40-50 ft. lbs.) is required to turn the pinion.

   A test make without loading the gears will not give a satisfactory pattern. Turn the companion flange with a wrench so that the ring gear rotates one full revolution then reverse the rotation so that the ring gear rotates one revolution in the opposite direction. Excessive turning of the ring gear is not recommended.
4. Observe the pattern on the ring gear teeth and compare with figure 30.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect the tooth contact pattern. These are backlash and the position of the drive pinion (pinion depth) in the carrier. The effects of bearing preloads are not easily seen on hand loaded teeth pattern tests. These adjustments should be within specifications before proceeding with the backlash and the drive pinion adjustments.

It may be necessary to adjust both pinion depth and the backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and the inner race of the rear bearing. The shim is used in the differential to compensate for manufacturing tolerences. Increasing the shim thickness will move the pinion closer to the center line of the ring gear.

Backlash is adjusted by means of the side bearing adjusting sleeves which move the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting sleeves are also used to set side bearing preload.) To increase backlash, turn the left sleeve in and turn the right sleeve out an identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

It is important that the contact pattern be centrally located up and down on the face of the ring gear teeth.

FINAL ASSEMBLY

Remove or Disconnect (Figures 1, 2 and 25)

1. Four case bolts (figure 25).
2. Right carrier case half.

Clean

- Sealing surfaces on the carrier case halves. Remove all oil and grease. Use a chlorinated solvent, such as carburetor cleaner.

Install or Connect (Figure 1, 2 and 31 through 34)

Tools Required:

J 33844 Bearing Installer
J 33893 Axle Seal Installer
J 33799 Shift Housing Seal Installer
J 33842 Differential Pilot Bearing Installer
J 33791 Case Bushing Installer

- Apply a bead of sealer (GM part number 1052357 [Loctite 514] or equivalent) to one carrier case surface.

1. Right carrier case (29).
2. Bolts (28).

   Tighten

   - Bolts to 47 N·m (35 ft. lbs.).

- Make sure the sleeves (32) are in the proper position, as marked previously.

3. Bolts (18) and locks (19).

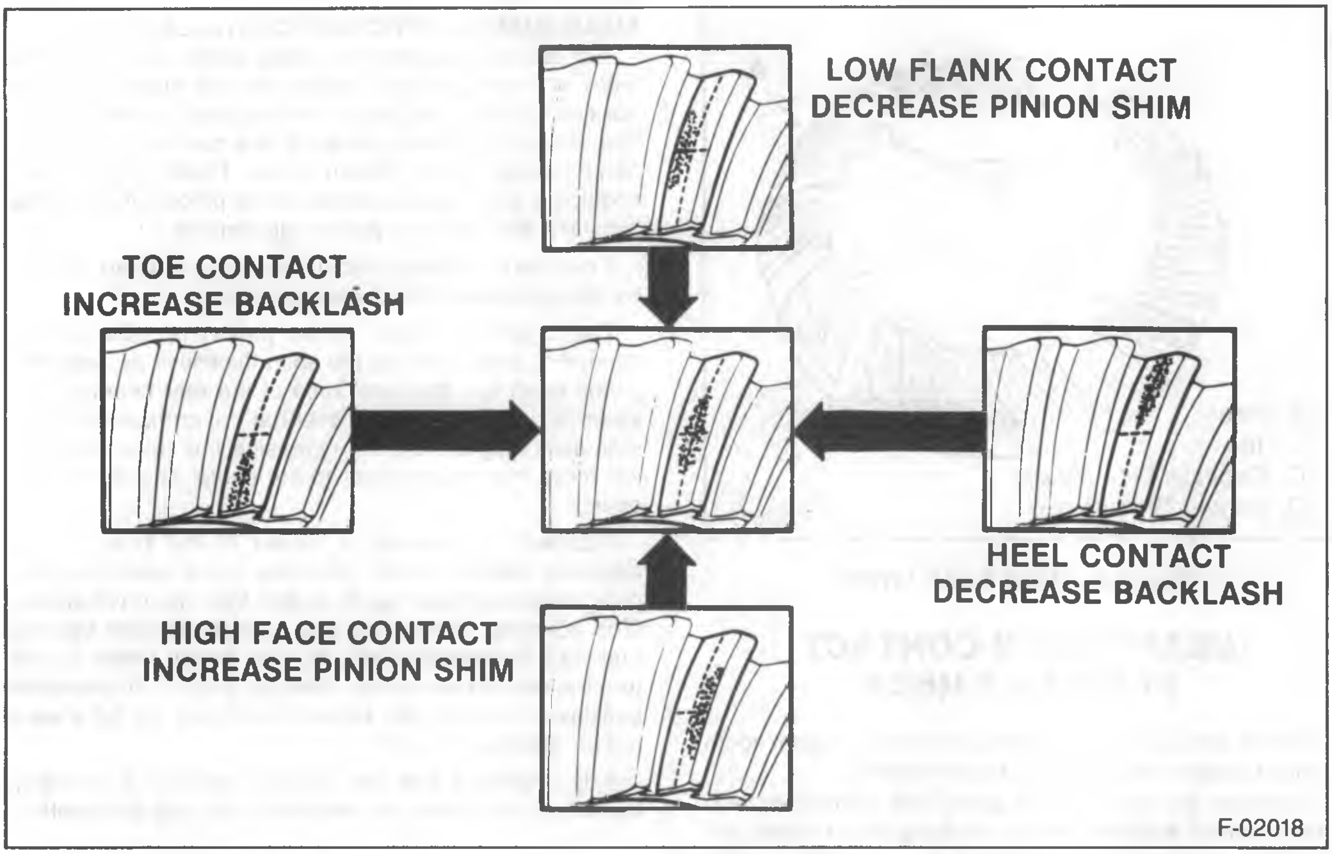


Figure 30—Gear Tooth Contact Pattern

Tighten

- Bolts to 8.0 N·m (70 in. lbs.).

4. Left seal (3) to the cover (57). Fully support the seal bore area of the cover while installing the seal.

Clean

- All oil and grease from the cover and carrier sealing surfaces. Use carburetor cleaner or equivalent.

- Apply sealer (GM part no 1052357 [Loctite 514] or equivalent) to the cover.

5. Cover (57) and bolts (58).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

6. Shaft (59) with deflector (2). Tap into place.
7. Bearing (4). Use J 33844.
8. Seal (3). Use J 33893 (figure 31).
9. Seal (15). Use J 33799 (fiuge 32).
10. Differential pilot bearing (21). Use J 33842 (figure 33).
11. Washer (24) to the output shaft (23).
12. Output shaft to the carrier assembly.
13. Sleeve (22).

- The flat, non-chamfered side faces the carrier. The chamfered side faces the axle tube.

14. Thrust washer (20). Use grease to hold it in place.
15. Spring (16) and shift shaft and fork (17).
16. Thrust washer (7). Use grease to hold it in place. Align the notch and tab (figure 34).
17. Shaft (1) to the tube (5).
18. Carrier connector (9) with retainer (8). Tap into place.

- Remove all oil and grease from the tube and carrier gasket surfaces. Use carburetor cleaner or equivalent.

- Apply sealer (GM part no. 1052357 [Loctite 514] or equivalent) to the carrier.

19. Tube assembly (5) to the carrier.
20. Two upper bolts (6). Leave finger tight.
21. Shift cable housing (11) and remaining bolts (6).

Tighten

- Bolts to 48 N·m (35 ft. lbs.).

22. Bushings (48). Use J 33791 (figure 15).

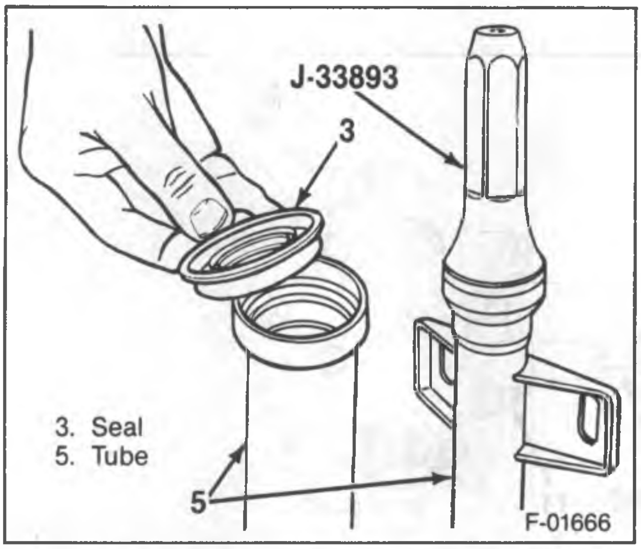


Figure 31—Installing the Shaft Seal

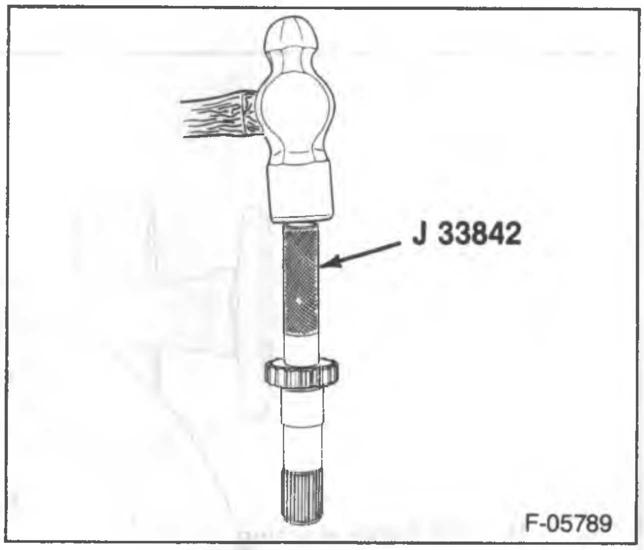


Figure 33—Installing the Differential Pilot Bearing

Inspect (Figure 35)

Tool Required:
J 33798 Engagement Tool

- Operation of the shift mechanism. Insert J 33798 into the shift fork. Turn the axle shaft while engaging and disengaging the shift mechanism with the tool. The mechanism should operate smoothly. If not, remove the tube and check for damaged or improperly installed parts.

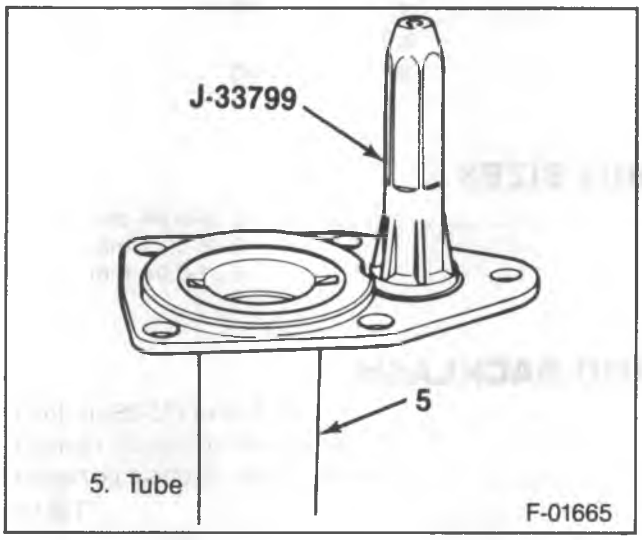


Figure 32—Installing the Shift Housing Seal

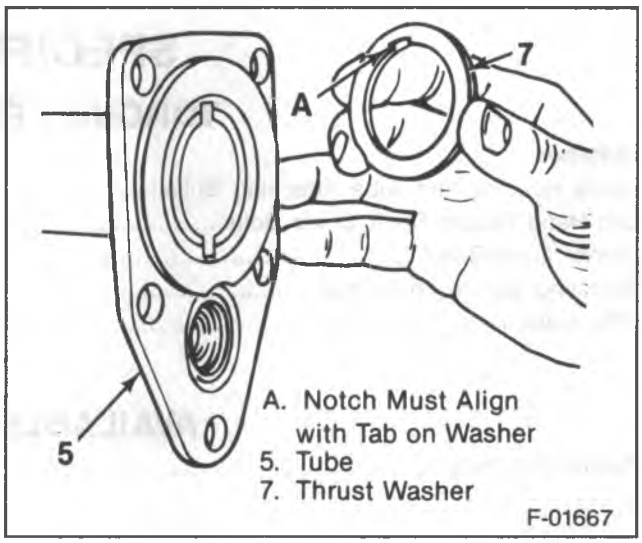


Figure 34—Installing the Thrust Washer

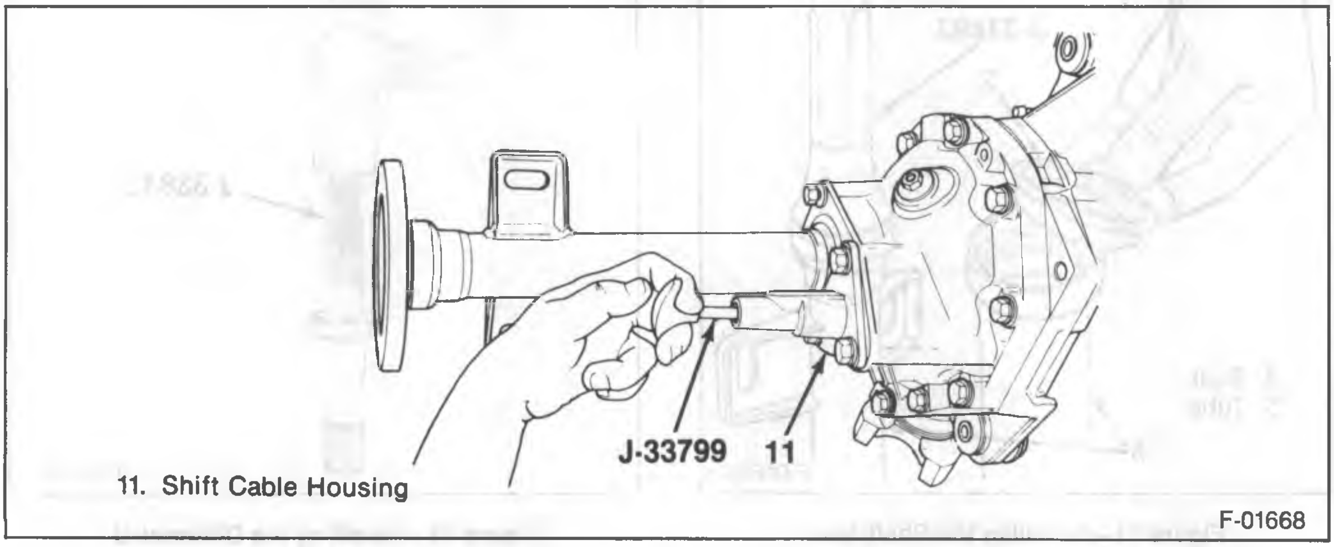


Figure 35—Checking the Shift Mechanism

SPECIFICATIONS

TORQUE SPECIFICATIONS

Fastener	N·m	Ft. Lbs.	In. Lbs.
Cable Housing and Tube Attaching Bolts	48	35	—
Left Hand Output Shaft Cover Bolts	25	18	—
Carrier Case Bolts	47	35	—
Adjusting Sleeve Lock Bolts	8.0	—	71
Differential Ring Gear Bolts	80	60	—

AVAILABLE SHIM SIZES

Pinion Shim Kits	0.53-0.64 mm
	0.66-0.79 mm
	0.81-0.94 mm

PINION PRELOAD AND BACKLASH

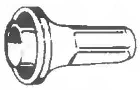
Pinion Preload	1.7-2.8 N·m (15-25 in. lbs.)
Backlash	0.08-0.25 mm (0.003-0.010-inch)
(Preferred)	0.13-0.18 mm (0.005-0.007-inch)

T2517

SPECIAL TOOLS

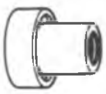
1.  J-21551

2.  J-29763

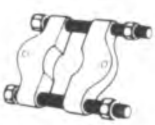
3.  J-33782

4.  J-33785

5.  J-33788

6.  J-33790

7.  J-33792

8.  J-22912-01

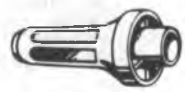
9.  J-33799

10.  J-33837

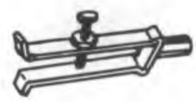
11.  J-33838

12.  J-33842

13.  J-33844

14.  J-33893

15.  J-34011

16.  J-29369-2

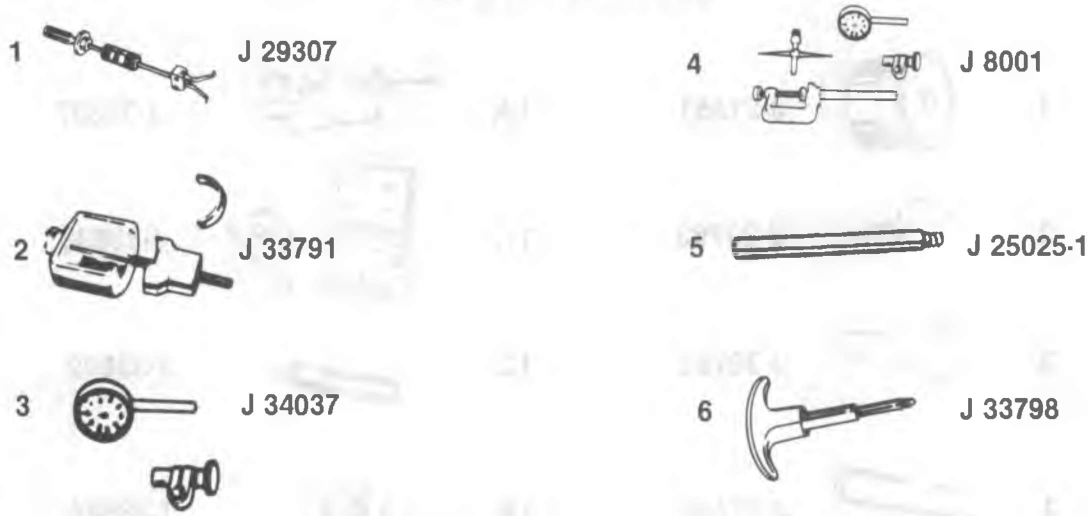
17.  J-8614-01

18.  J-23423-A

1. Output Shaft Bearing Remover
2. Dial Indicator
3. Pinion Oil Seal Installer
4. Pinion Bearing Installer
5. Output Shaft Bearing Installer
6. Differential Side Bearing Installer
7. Side Bearing Adjuster Wrench
8. Differential Side Bearing Remover
9. Axle Lock Cable Seal Installer
10. Pinion Bearing Cup Remover and Installer
11. Pinion Shim Setting Gage
12. Output Shaft Pilot Bearing Installer
13. Axle Tube Bearing Installer
14. Output Shaft Seal Installer
15. Output Shaft Pilot Bearing Remover
16. Countershaft Roller Bearing Remover
17. Pinion Flange Remover
18. Bearing Cup Installer

F-01831

SPECIAL TOOLS



1. Slide Hammer
2. Bushing Remover
3. Dial Indicator Set
4. Dial Indicator
5. Dial Indicator Stand (Part of J 25025-B)
6. Engagement Tool

F-05790

SECTION 4C4

K TRUCK FRONT AXLE

CONTENTS

DESCRIPTION

The front axle on K model vehicles has a center disconnect feature which, under most conditions, allows shifting into and out of four wheel drive when the vehicle is in motion. It is operated by a thermal actuator solenoid.

The axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the wheels. The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim located between the gear end of the pinion and the roller bearing that is presed onto the pinion. The pinion bearing preload is set by crushing a collapsible spacer between the pinion bearings in the axle housing.

The ring gear is bolted onto the differential case with left-hand thread bolts.

The differential is used to allow the wheels to turn at different rates of speed while the front axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The differential case is supported in the axle housing by two tapered roller bearings. The differential and ring are located in relationship to the pinion by using threaded adjusters.

The axle identification number is located on a tag attached to the right axle tube.

The axle is produced with 8¼ inch and 9¼ inch ring gears. The 8¼ inch ring gear is used on K15-25 models; the 9¼ inch ring gear is used on K35 models.

The drive axles are completely flexible assemblies consisting of inner and outer constant velocity (CV) joints protected by thermoplastic boots and connected by an axle shaft.

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

1. Remove the drain plug from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Adjusting Backlash." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
3. Inspect the case for metal chips. Determine where the metal chips come from, such as a broken gear or bearing cage.
4. Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY

↔ Remove or Disconnect (Figures 1 through 19)

Tools Required:

J 29369-1 Bearing Remover (K15-25 Models)
J 29369-2 Bearing Remover (K35 Models)
J 29307 Slide Hammer
J 34011 Pilot Bearing Remover
J 36599 Adjusting Sleeve Wrench
J 36615 Adjuster Wrench (K35 Models)
J 8614-01 Pinion Flange Remover
J 36598 Holding Fixture and Pinion Service Tool
J 8612-B Pinion Bearing Remover (K15-25 Models)
J 36606 Pinion Bearing Remover (K35 Models)
J 22888-D Side Bearing Puller
J 8107-2 Side Bearing Puller Pilot (K15-25 Models)
J 36597 Side Bearing Puller Pilot (K35 Models)
J 36616 Bushing Replacer

1. Solenoid (10)
2. Indicator Switch (13)
3. Bolts (6).
4. Tube (5) with shaft (1).
5. Sleeve (22).
6. Shift shaft (18), damper spring (17), shift fork (16), and clip (15) assembly.
7. Spring (14).
8. Shim (20).
9. Carrier connector (9) with retainer ring (8) (K15-25 models).
   - Clamp the tube (5) in a vise. Clamp only on the mounting flange.
   - Strike the inside of the shaft (1) flange with a brass hammer to dislodge the carrier connector.
10. Snap ring (12) and washer (11) and thrust washer (7) (K35 models) (figure 5).
11. Shaft (1) with deflector (2).
12. Seal (3) and bearing (4). Use J 29361-1 (K15-25 models) or J 29369-2 (K35 models) with J 29307 (figure 6).
13. Output shaft (23).
14. Differential pilot bearing (21). Use J 34011 (figure 7).
15. Shaft (59) with deflector (2). Pry on the shaft flange on one side while tapping with a soft faced hammer on the other side (figure 8).
16. Seal (3). Pry out with a screwdriver.
17. Bearings (30). Use the tools listed in step 10.
18. Bolts (28).
19. Right side carrier half (29). Tap on the cast lugs provided.
20. Differential assembly.
   - Pry up on the locks (51) (right side only on K35).
21. Bolt (64) and lock (63) (K35 models).

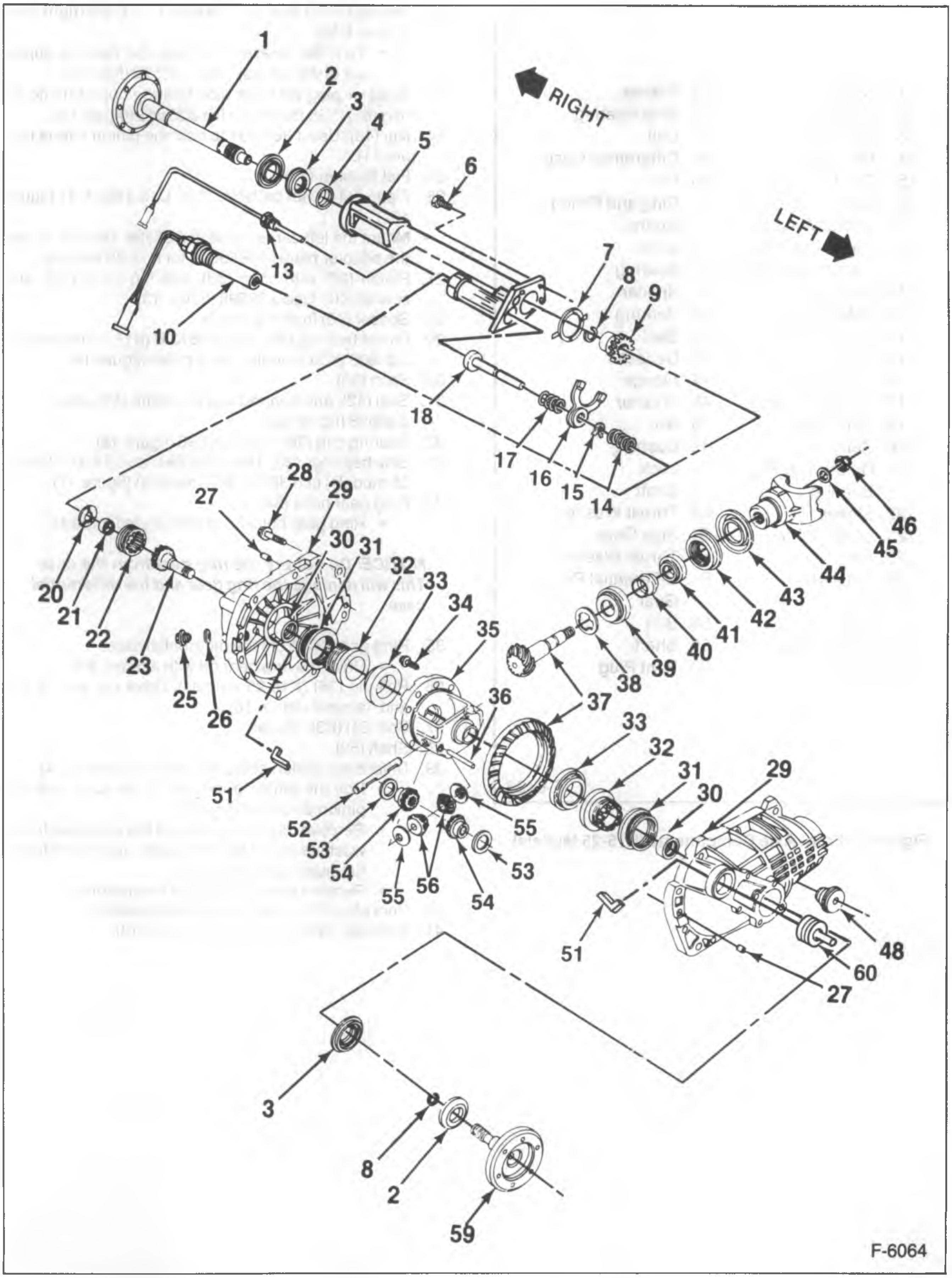


Figure 1—Front Axle Components (K-15-25 Models)

1. Shaft
2. Deflector
3. Seal
4. Bearing
5. Tube
6. Bolt
7. Thrust Washer
8. Retaining Ring
9. Carrier Connector
10. Solenoid
13. Indicator Switch
14. Spring
15. Clip
16. Shift Fork
17. Damper Spring
18. Shift Shaft
20. Shim
21. Differential Pilot Bearing
22. Sleeve
23. Output Shaft
25. Plug
26. Washer
27. Pin
28. Bolt
29. Carrier Case
30. Bearing
31. Insert
32. Sleeve
33. Side Bearing
34. Bolt
35. Differential Case
36. Pin
37. Ring and Pinion Gears
38. Shim
39. Bearing
40. Spacer
41. Bearing
42. Seal
43. Deflector
44. Flange
45. Washer
46. Nut
48. Bushing
51. Lock
52. Shaft
53. Thrust Washer
54. Side Gear
55. Thrust Washer
56. Differential Pinion Gear
58. Bolt
59. Shaft
60. Vent Plug

F-6498

Figure 2—Front Axle Components (K15-25 Models)

22. Sleeve(s) (32) and side bearing (33) cups (right side only on K35).
    - Turn the sleeve(s) to push the bearing cup(s) out of the bore(s). Use J 36599 (figure 9).
23. Adjuster plug (61) with side bearing cup (33) and O-ring (62) (K35 models). Use J 36615 (figure 10).
24. Nut (46). Use J 8614-01 to hold the pinion flange (figure 11).
25. Flat Washer (45).
26. Flange (44) with deflector (43). Use J 8614-01 (figure 12).
    - Mount the left carrier case in J 36598. Be sure to use the adapter plate (J 36598-6) for K15-25 models.
27. Pinion (37) with shim (38), bearing cone (39), and spacer (40). Use J 36598 (figure 13).
28. Spacer (40) from the pinion.
29. Pinion bearing (39). Use J 8612-B (K15-25 models) or J 36606 (K35 models) and a press (figure 14).
30. Shim (38).
31. Seal (42), and bearing cup and cone (41). Use J 36598 (figure 15).
32. Bearing cup (39). Use J 36598 (figure 16).
33. Side bearings (33). Use J 22888-D and J 8107-2 (K15-25 models) or J 36597 (K35 models) (figure 17).
34. Ring gear bolts (34).
    - Ring gear bolts have left-handed threads.

NOTICE: Do not pry the ring gear from the case. This will damage the ring gear and the differential case.

35. Ring gear (37) from the differential case.
    - Drive the ring gear off with a brass drift.
36. Roll pin (36) (K15-25 models). Drive out with a drift and hammer (figure 18).
37. Bolt (24) (K35 models).
38. Shaft (52).
39. Differential pinion gears (56) and side gears (54).
    - Roll the pinion gears out of the case with the pinion thrust washers (55).
    - Remove the side gears and the side gear thrust washers (53). Mark the gears and the differential case as left and right.
    - Remove spacer (57) (K35 models only).
40. Vent plug (60). Use a 6-point deep socket.
41. Bushings (48). Use J 36616 (figure 19).

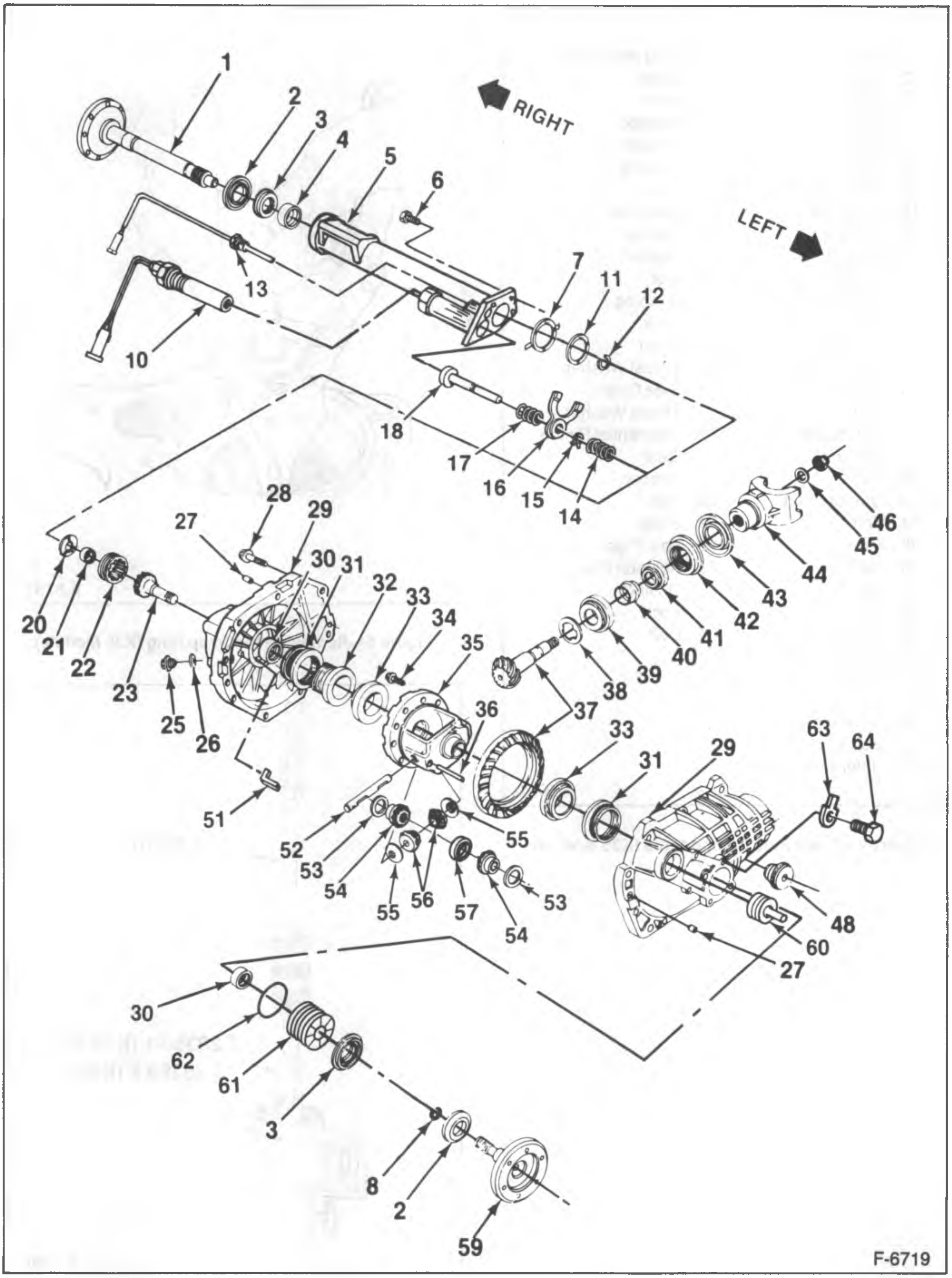


Figure 3—Front Axle Components (K35 Models)

1. Shaft
2. Deflector
3. Seal
4. Bearing
5. Tube
6. Bolt
7. Thrust Washer
10. Solenoid
11. Washer
12. Snap Ring
13. Indicator Switch
14. Spring
15. Clip
16. Shift Fork
17. Damper Spring
18. Shift Shaft
20. Shim
21. Differential Pilot Bearing
22. Sleeve
23. Output Shaft
24. Bolt
25. Plug
26. Washer
27. Pin
28. Bolt
29. Carrier Case
30. Bearing
31. Insert
32. Sleeve
33. Side Bearing
34. Bolt
35. Differential Case
37. Ring and Pinion Gears
38. Shim
39. Bearing
40. Spacer
41. Bearing
42. Seal
43. Deflector
44. Flange
45. Washer
46. Nut
48. Bushing
51. Lock
52. Shaft
53. Thrust Washer
54. Side Gear
55. Thrust Washer
56. Differential Pinion Gear
57. Spacer
58. Bolt
59. Shaft
60. Vent Plug
61. Adjuster Plug
62. O-Ring
63. Lock
64. Bolt

F-6720

Figure 4—Front Axle Components (K35 Models)

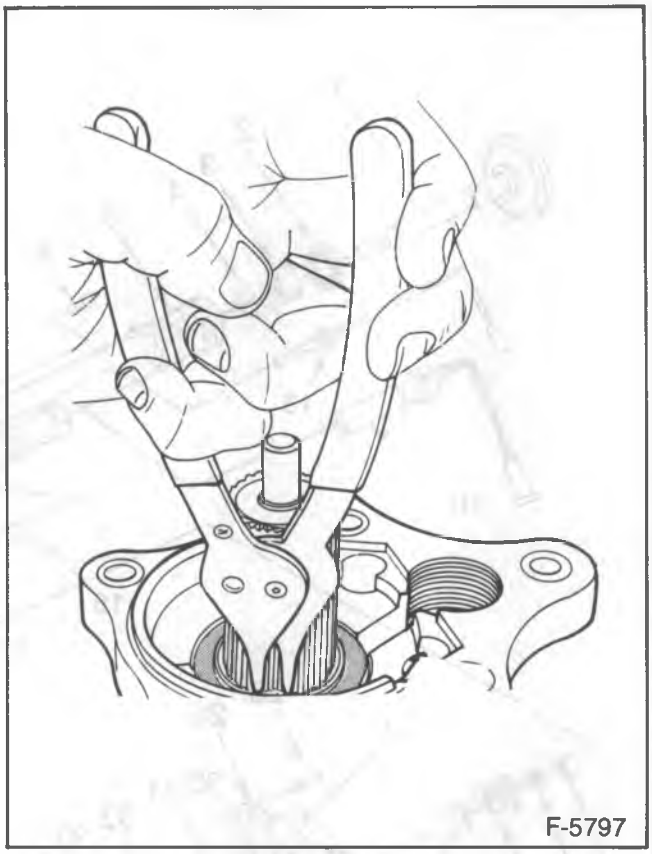


Figure 5—Removing the Snap Ring (K35 Models)

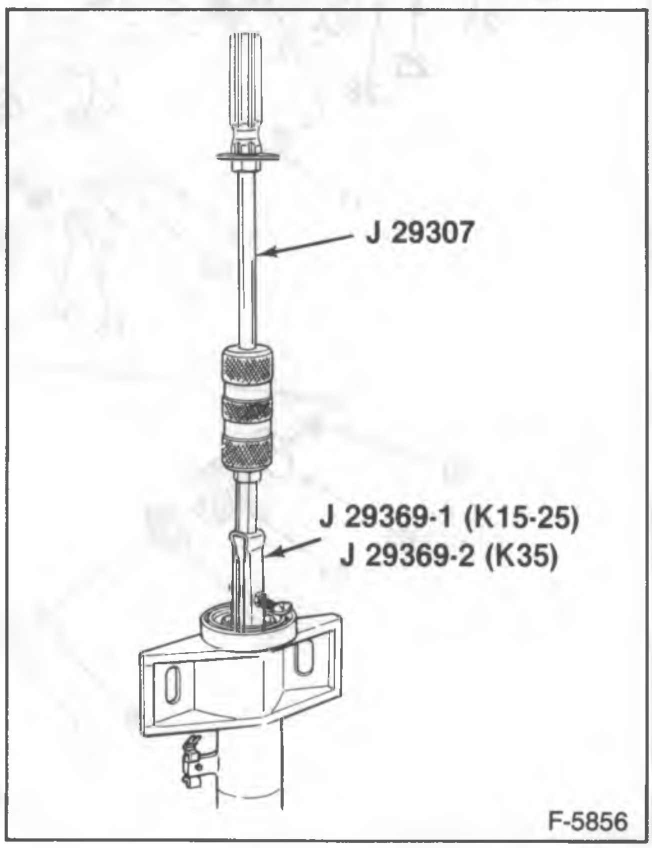


Figure 6—Removing the Axle Bearing

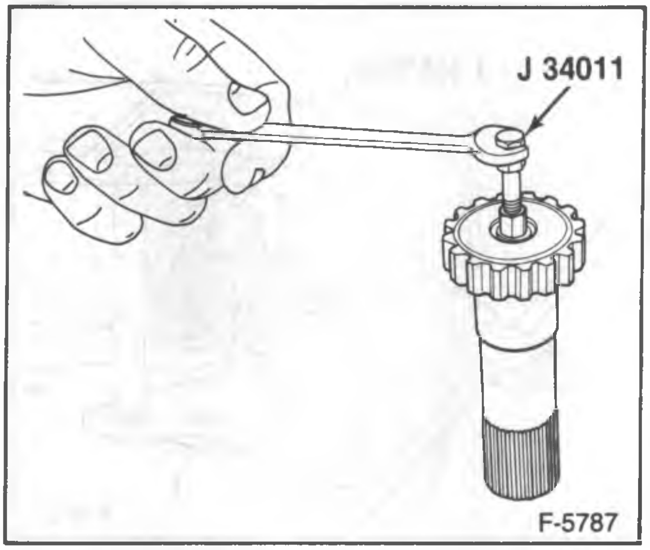


Figure 7—Removing the Pilot Bearing

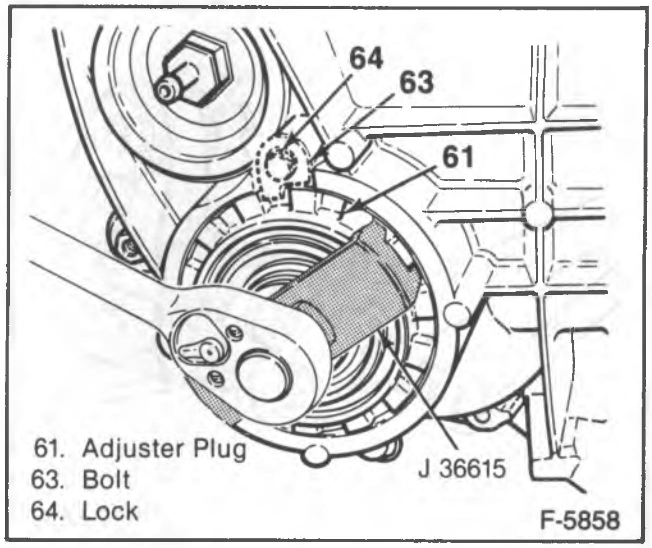


Figure 10—Turning the Adjuster Plug (K35 Models)

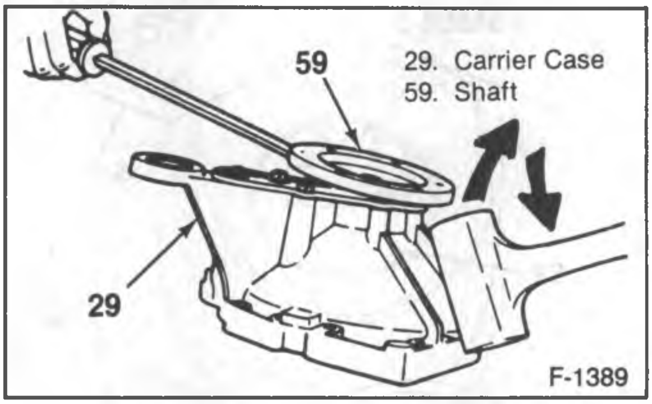


Figure 8—Removing the Left Shaft

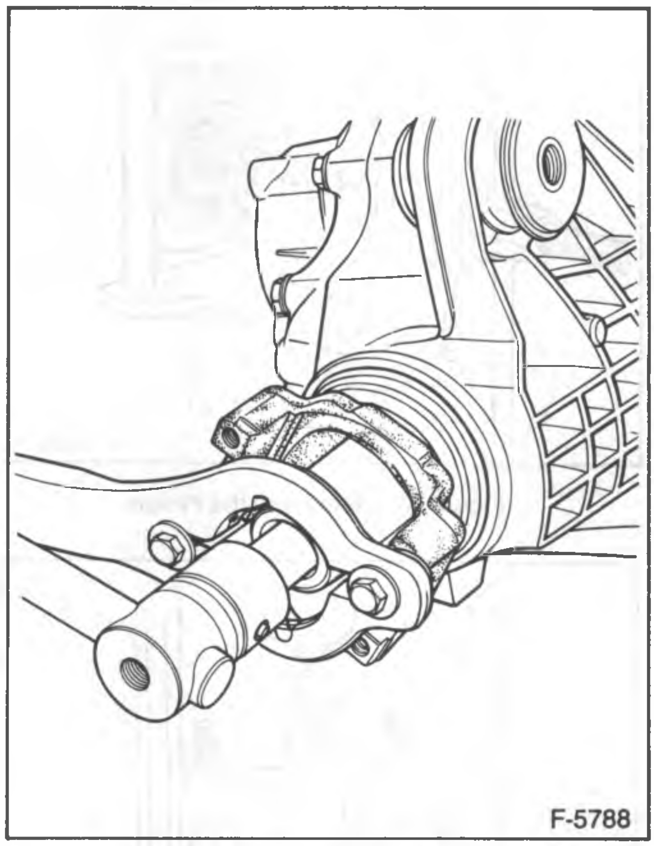


Figure 11—Removing the Pinion Nut

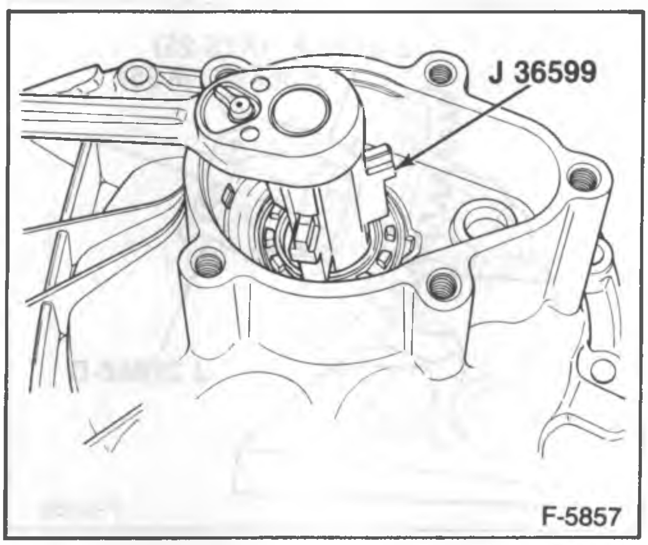


Figure 9—Turning the Adjuster Sleeve

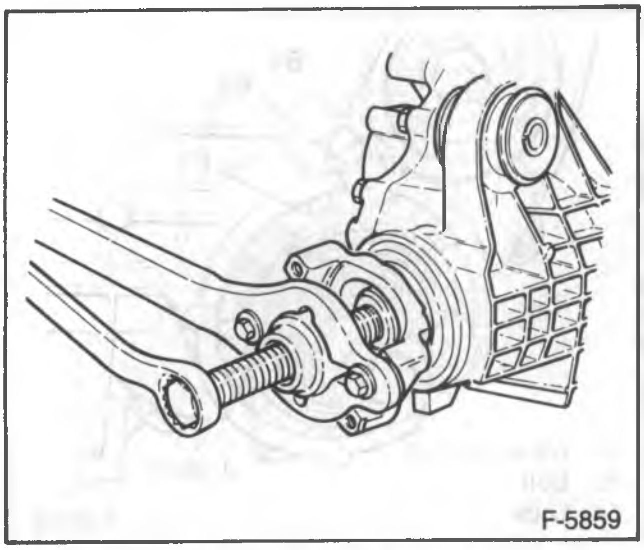


Figure 12—Removing the Pinion Flange

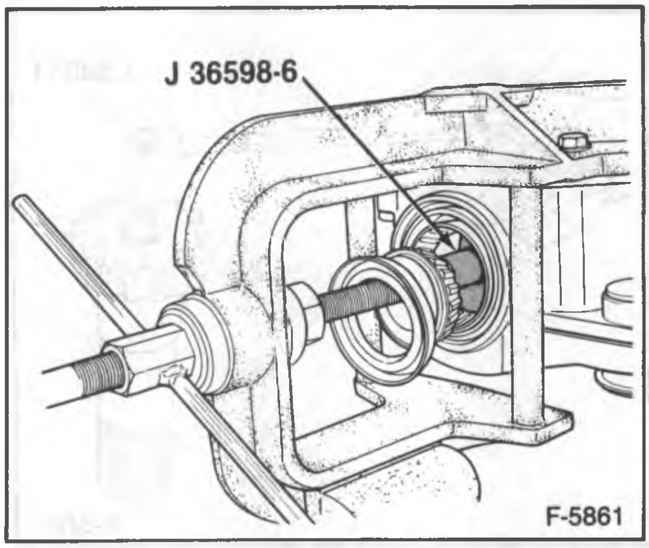


Figure 15—Removing the Outer Pinion Bearing and Seal

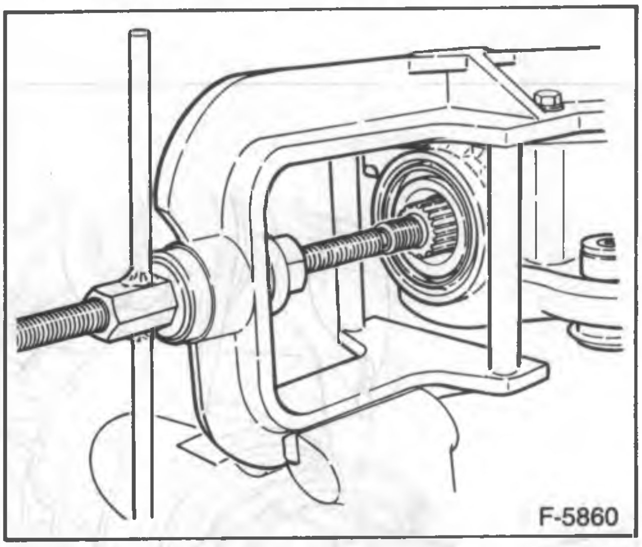


Figure 13—Removing the Pinion

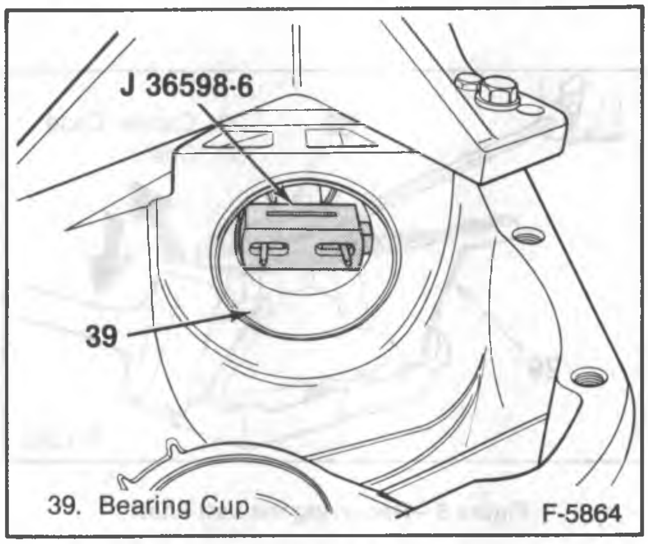


Figure 16—Removing the Inner Bearing Cup

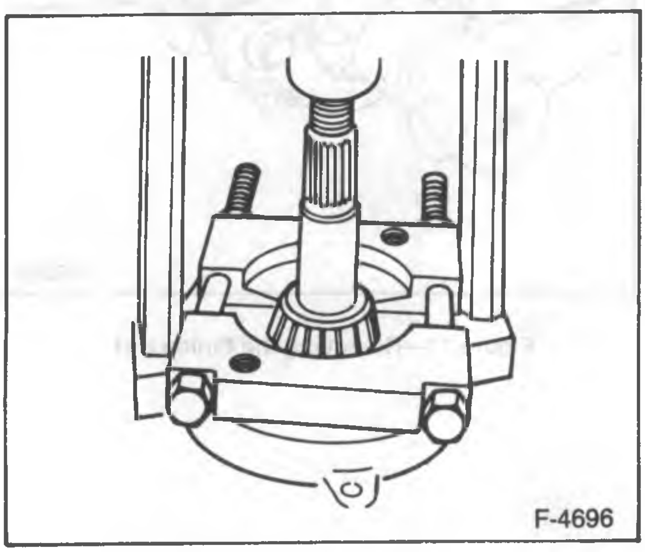


Figure 14—Removing the Pinion Bearing

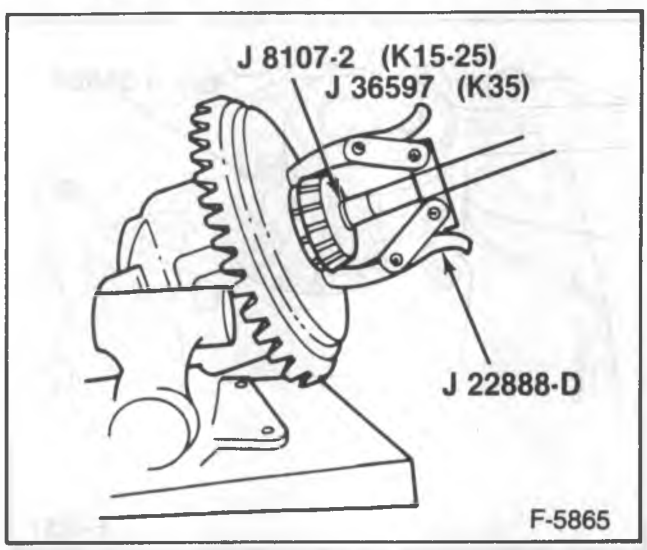


Figure 17—Removing the Side Bearings

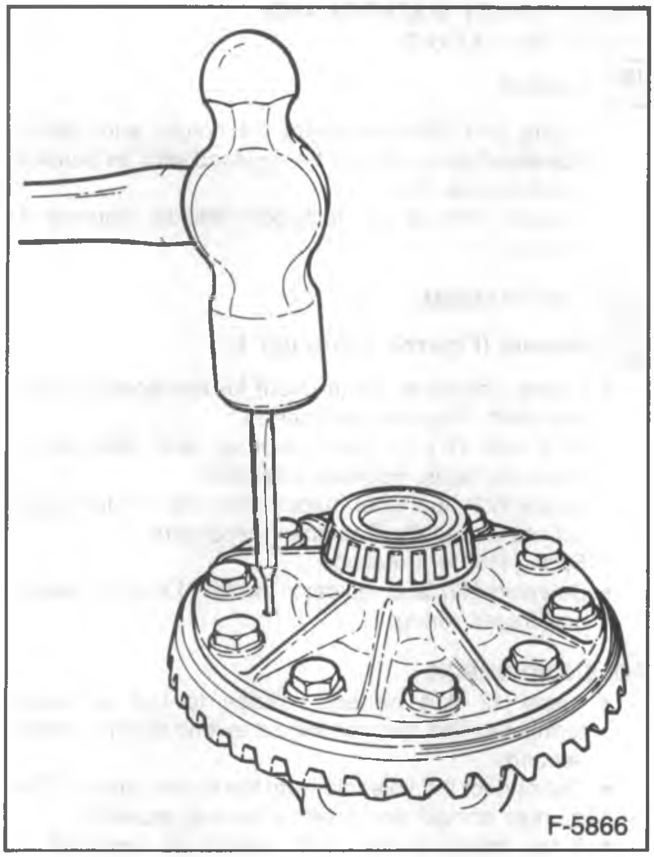


Figure 18—Removing the Pin (K15-25 Models)

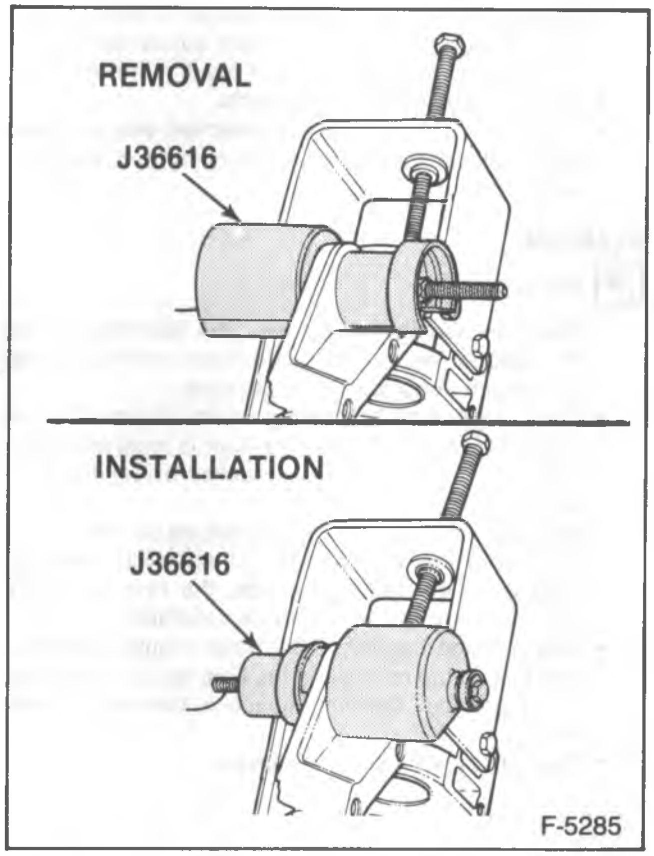


Figure 19—Replacing the Carrier Bushings

CLEANING AND INSPECTION

CLEANING

- Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.
- Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before assembly.

Through inspection of the parts for wear or stress and replacement of worn parts will help prevent costly drive component repair after reassembly.

AXLE HOUSING

Inspect

- Carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- Bearing cup surfaces for nicks or burrs. Remove any burrs that are found.
- Housing for cracks. Replace the housing if any cracks are found.
- Housing for foreign material such as metal chips, dirt, or rust. Refer to "Cleaning".

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, and spalling.
- Thrust washers for wear.
- Fit of the differential side gears in the differential case.
- Fit of the side gears on the axle shafts.
- Differential case for cracks and scorring.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scorring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- Fit of the pinion on the pinion flange.

- Sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seals' inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scorring.
- Bearings and cups are only replaced as sets.
- If the axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

SHIMS, THRUST WASHERS AND ADJUSTER SLEEVES

Inspect

- Shims and thrust washers for cracks and chips. Damaged shims should be replaced with an equally sized service shim.
- Adjuster sleeves for damaged threads. Replace if required.

SHIFT MECHANISM

Inspect (Figures 1 through 4)

- Carrier connector (9) (if used) for damaged splines and teeth. Replace as required.
- Shift fork (17) for wear, scoring, and damage to thrust surfaces. Replace if needed.
- Sleeve (22) and inner output shaft (23) for damaged splines and teeth. Replace if necessary.
- Spring (16) for breakage.
- Solenoid (13) and indicator switch (13) for damage and frayed wiring.

SOLENOID CHECK

- Apply 12 volt battery voltage to the solenoid terminals. The plunger should extend within several seconds.
- Disconnect the solenoid from the power source. The plunger should retract within several seconds.
- If the solenoid does not operate as specified, it should be replaced.

ASSEMBLY OF AXLE

Important

- Apply axle lubricant to all bearings, seal lips, gears, thrust washers, and bearing surfaces at assembly.

PINION BEARING CUP INSTALLATION

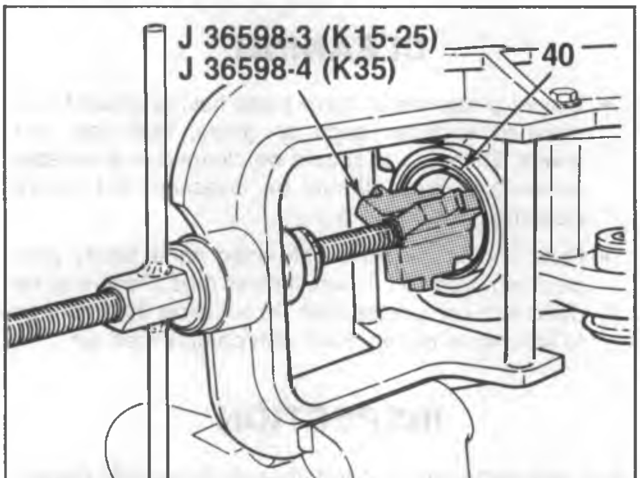
Install or Connect (Figures 1 through 4, 20, and 21)

Tool Required:

J 36598 Holding Fixture and Pinion Service Tool

- Mount the left carrier case in J 36598. Use the J 36598-6 adapter plate for K15-25 models. Tighten the attaching bolts securely.

1. Outer bearing cup (40). Use the forcing screw and J 36598-3 (K15-25) or J 36598-4 (K35) (figure 20).
2. Inner bearing cup (39).
   - Remove J 36598-3 or J 36598-4 from the forcing screw.
   - Place pilot J 36598-15 in the pinion seal bore.
   - Extend the forcing screw through the pinion bore.
   - Install J 36598-3 (K15-25 models) or J 36598-4 (K35 models) on the forcing screw (figure 21).



40. Bearing Cup

F-5867

Figure 20—Installing the Outer Pinion Bearing Cup

- Rotate the forcing screw until the installer is snug against the bearing cup. Rotate the tool several times to make sure the bearing cup is not cocked in the bore.

- Pull the bearing cup into place with the forcing screw (figure 21).

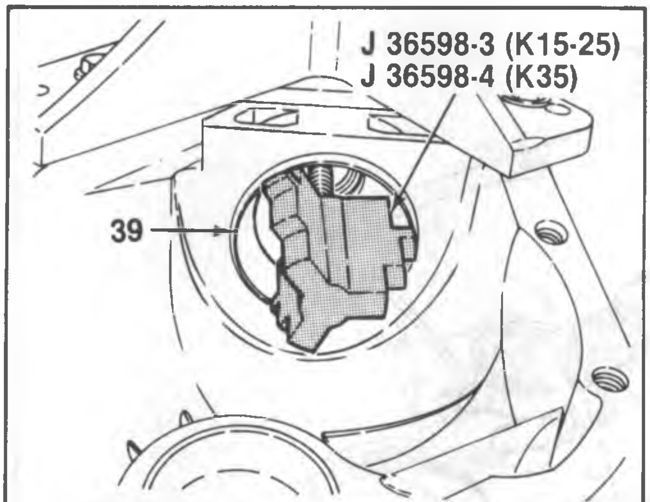


Figure 21—Installing the Inner Pinion Bearing Cup

PINION DEPTH ADJUSTMENT

Tools Required:
J 36601 Pinion Depth Setting Gage
J 29763 Dial Indicator

1. Refer to figures 1 through 4 and 22.
2. Pinion depth is adjusted by selecting a shim (38) of the proper thickness.
3. Lubricate the pinion bearings liberally with axle lubricant.
4. Assemble J 29763 to the proper gaging arm (J 36601-4 for K15-25 models, J 36601-3 for K35 models).
5. Install the pinion bearings and hold them in place.
6. Insert the threaded rod of J 36601 through the pinion bearings.
7. Install the proper pilot, flat washer, and nut.
8. Tighten the nut while holding the threaded rod with a wrench to adjust bearing preload. Adjust the nut to obtain a preload of 1.0-1.6 N·m (10-15 in. lbs.). Measure using an inch pound torque wrench. Rotate the shaft several times to make sure the bearings have seated, then measure again.
9. Push the dial indicator downward until the needle rotates about three turns.
10. Tighten the dial indicator in this position.
11. Set the button of J 36601 on the differential bearing bore (figure 22).
12. Rotate the tool slowly back and forth until the dial indicator reads the lowest point of the bore. Set the dial indicator to ZERO. Repeat the rocking action of the tool to verify the ZERO setting.
13. After the ZERO setting is obtained and verified, grasp the gaging arm by the flats and move the tool button out of the differential side bearing bore (figure 22). Record the dial indicator reading.
14. The dial indicator reading is equal to the required shim size. Example: If the dial indicator reads 0.508 mm in step 8, a 0.508 shim is required. Available shim sizes are listed in "Specifications."
15. Remove the tool and bearing cones.

PINION INSTALLATION

Install or Connect (Figures 1 through 4 and 11, 23 and 24)

Tools Required:
J 35512 Bearing Installer (K15-25 Models)
J 36614 Bearing Installer (K35 Models)
J 8614-01 Pinion Flange Remover
J 36333 Seal Installer

1. Shim (38) to the pinion gear (37).
   - The shim must be of the proper size, as selected previously.
2. Bearing (39) onto the pinion gear using J 35512 (K15-25 models) or J 36614 (K35 models) (figure 23).
3. New spacer (40) onto the pinion gear.
4. Bearing (41) into the case.
5. Seal (42) into the case using J 36366 (figure 24).
6. Pinion gear, with bearing and spacer, to the case.
7. Deflector (43), flange (44), washer (45) and nut (46).
   - Apply PST Sealant (GM part no. 1052080 or equivalent) to the pinion gear threads and on both sides of the washer.
   - Tighten nut (46) until no end play is detectable while holding the flange (44) with J 8614-01 (figure 11).
   - No further tightening should be attempted until the bearing preload has been checked.

Measure (Figure 25)

- Pinion bearing preload. Use an inch pound torque wrench (figure 25). The correct preload is 1.7-2.8 N·m (15-25 in. lbs.).
  1. Rotate the pinion with the torque wrench and observe the reading.
  2. If the preload torque is below specifications, continue torquing the pinion nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several inch pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
  3. Once the preload has been obtained, rotate the pinion several times to make sure that the bearings have seated. Recheck the preload, and adjust if necessary.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figures 1 through 4, and 26)

Tools Required:
J 22761 Side Bearing Installer (K15-25 Models)
J 29710 Side Bearing Installer (K35 Models)
J 8092 Driver Handle

1. Side gear spacer (57) (K-35 models only), thrust washers (53), and side gears (54) into the differential case (35).
   - Install the side gear spacer on the left-hand shaft. K15-25 models do not have a spacer.
   - If the same gears and washers are being used,

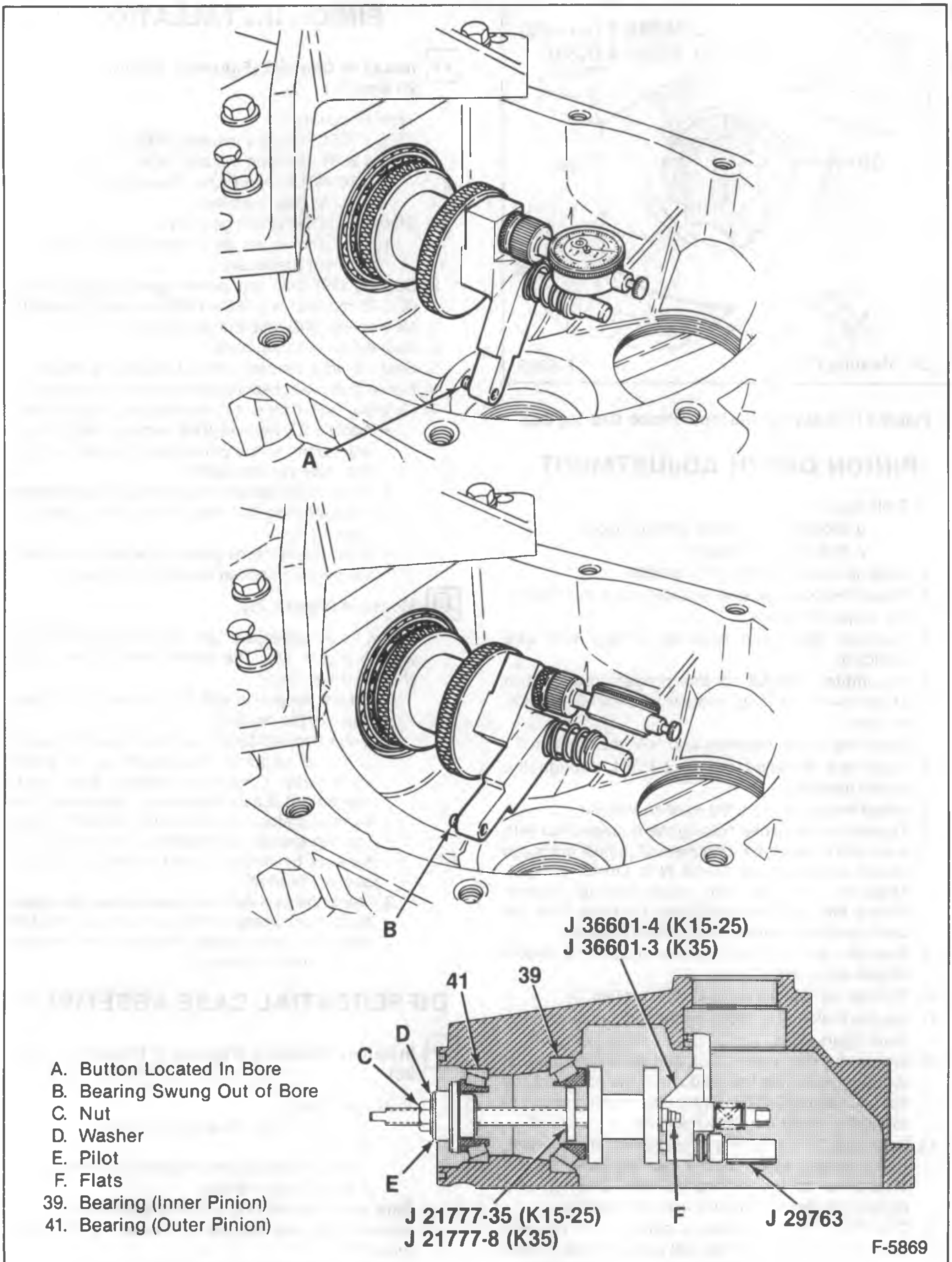


Figure 22—Measuring Pinion depth

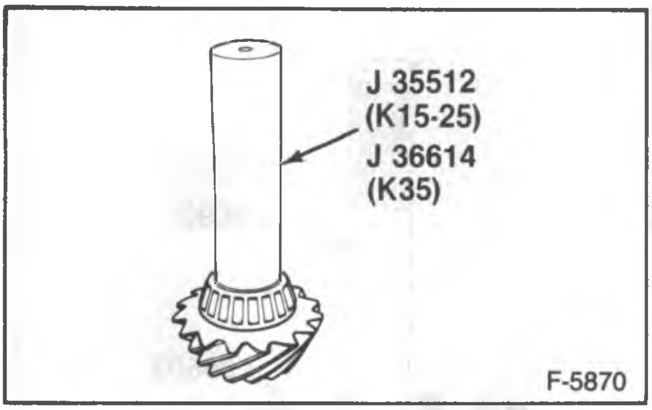


Figure 23—Installing the Pinion Bearing

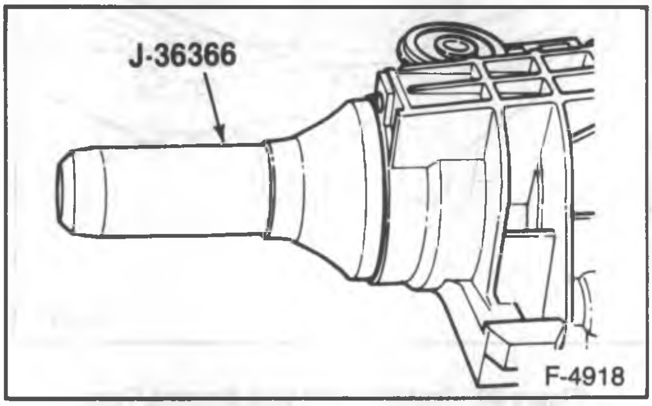


Figure 24—Installing the Pinion Seal

install them on the same side from which they were removed.

2. Pinion gears (56).
   - Position one pinion gear (56) between the side gears and rotate the gears until the pinion gear is directly opposite the opening in the case.
   - Place the other pinion gear (56) between the side gears, making sure the hole in both pinion gears line up.
3. Thrust washers (55).
- Rotate the pinion gears toward the opening just enough to permit the sliding in of the thrust washers.
4. Shaft (52) and pin (36) (K15-25 models) or bolt (24) (K35 models).
5. Ring gear (37) onto the differential case (35).
6. Bolts (34). The bolts have left hand threads.

Important

- Always install new bolts. Never reuse the old bolts.

Tighten

- Bolts (34) alternating in progressive steps to 120 N·m (88 ft. lbs.).

7. Side bearings (33), using J 22761 (K15-25 models) or J 29710 (K35 models) and J 8092 (figure 26).

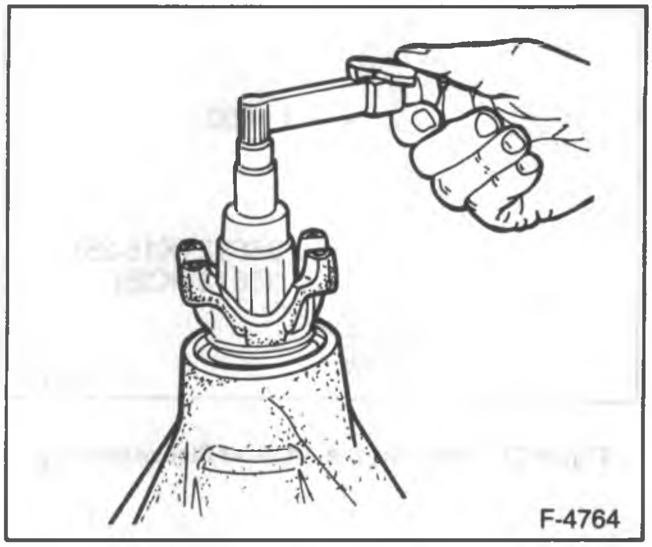


Figure 25—Measuring Pinion Preload

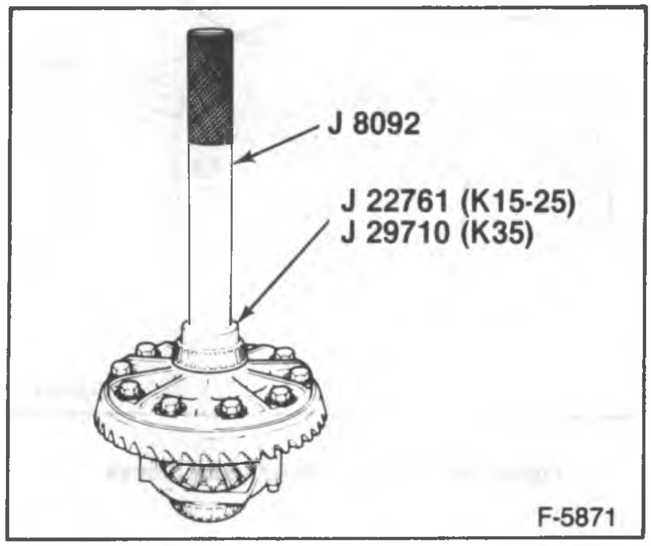


Figure 26—Installing the Differential Side Bearing

DIFFERENTIAL ASSEMBLY INSTALLATION

Install or Connect (Figures 1 through 4 and 27 through 30)

Tools Required:

J 36612 Bearing Installer (K15-25 Models)
J 36613 Bearing Installer (K35 Models)
J 8092 Driver Handle
J 36599 Sleeve Adjusting Wrench
J 36615 Adjuster Plug Wrench (K35 Models)
J 36603 Side Bearing Cup Installer

1. Bearings (30) to the sleeves (32) and/or adjuster plug (61) (K35 models). Use J 8092 and J 36612 (K15-25 models) or J 36613 (K35 models) (figure 27).

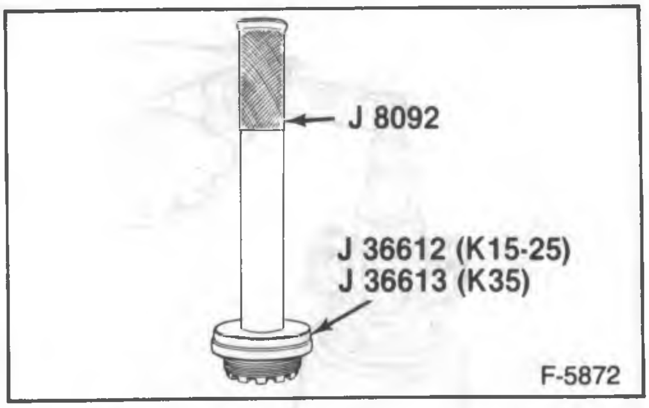


Figure 27—Installing the Adjuster Sleeve Bearing

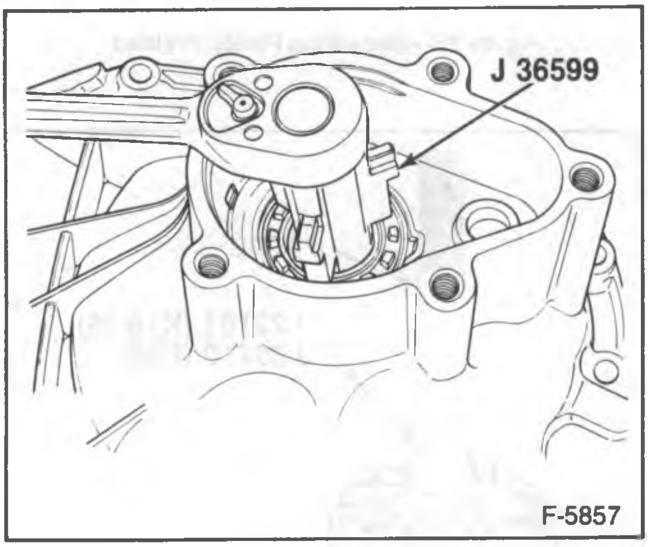


Figure 28—Turning the Adjuster Sleeve

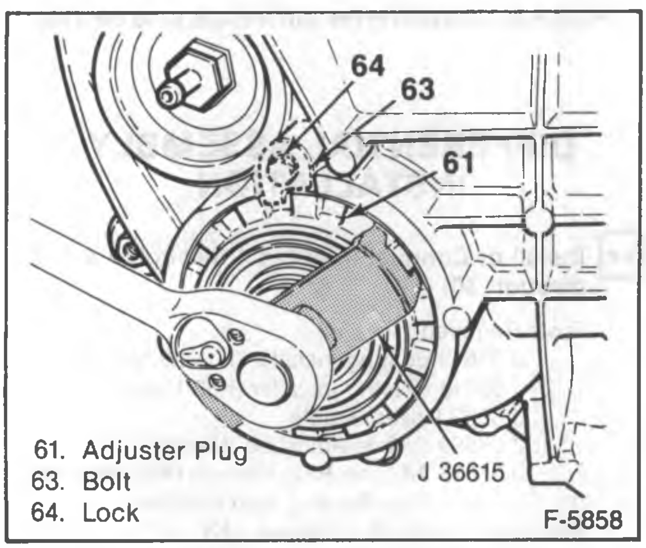


Figure 29—Turning the Adjuster Plug (K35 Models)

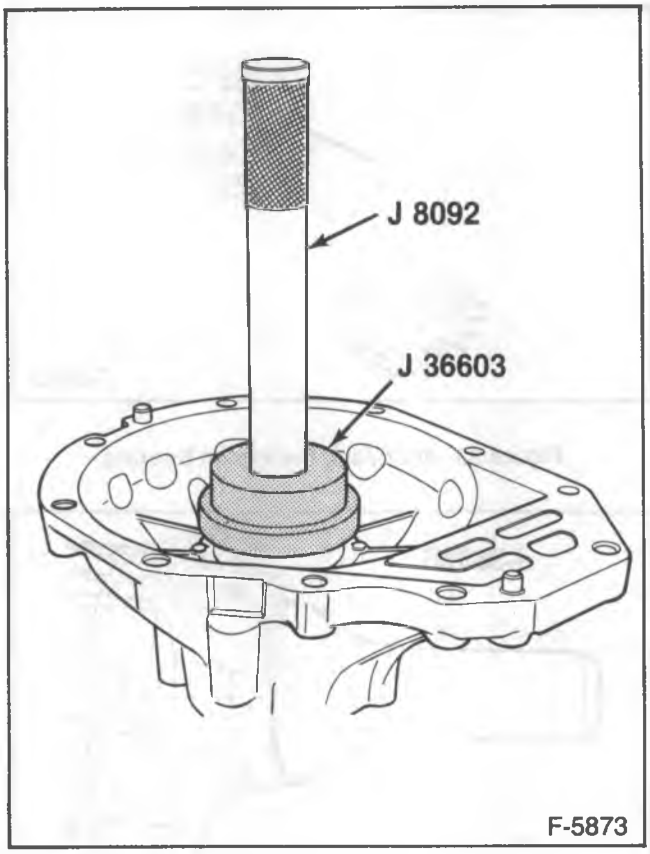


Figure 30—Installing the Side Bearing Cups

2. New O-ring (62) to the adjuster plug (61) (K35 models).
3. Sleeves (32) and/or adjuster plug (61) to the carrier case (29).
   - K15-25 models: Use J 36599 (figure 28).
   - K35 models: Use J 36599 for the right sleeve (figure 28). Use J 36615 for the adjuster plug (figure 29).
4. Side bearing cups (33). Use J 36603 with J 8092 (figure 30).
5. Differential assembly to the carrier case half.
   - Place the differential assembly into the carrier case half which contains the pinion gear.
   - Turn the left sleeve (32) (K15-25 models) or adjuster plug (61) (K35 models) in until backlash is felt between the ring and pinion.
     - K15-25 models: Use J 36599 (figure 28).
     - K35 models: Use J 36615 (figure 29).
   - Remove the carrier case from J 36598.
6. Carrier case halves. Do not use sealer at this time.
   - If the carrier halves do not make complete contact, back out the right sleeve (32). Use J 36599 (figure 28).
7. Bolts (28). Tighten to 47 N·m (35 ft. lbs.).

ADJUSTING BACKLASH

Tools Required:

J 34047 Dial Indicator Set
J 8001 Dial Indicator Set
J 34047-3 Dial Indicator Adapter

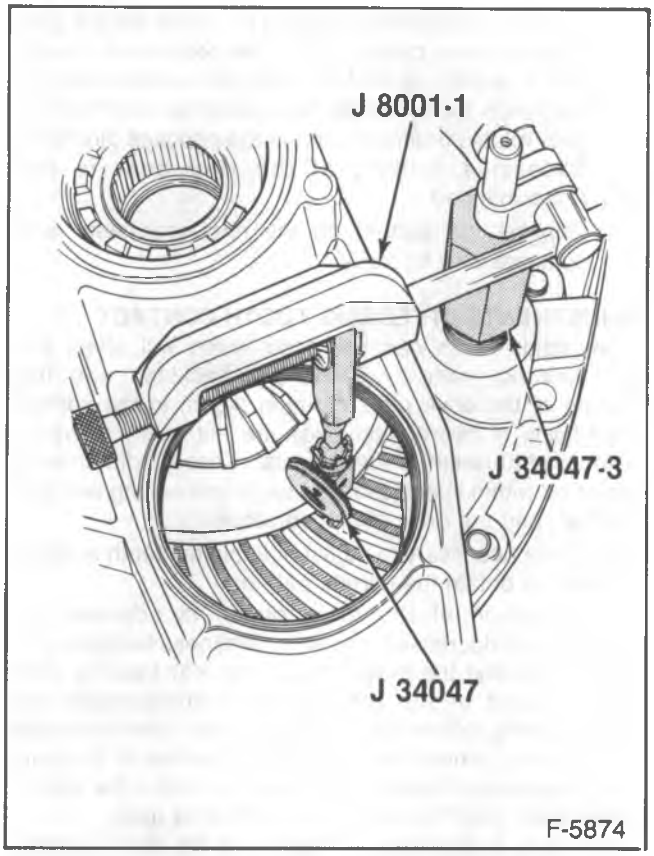


Figure 31—Measuring Backlash at the Ring Gear

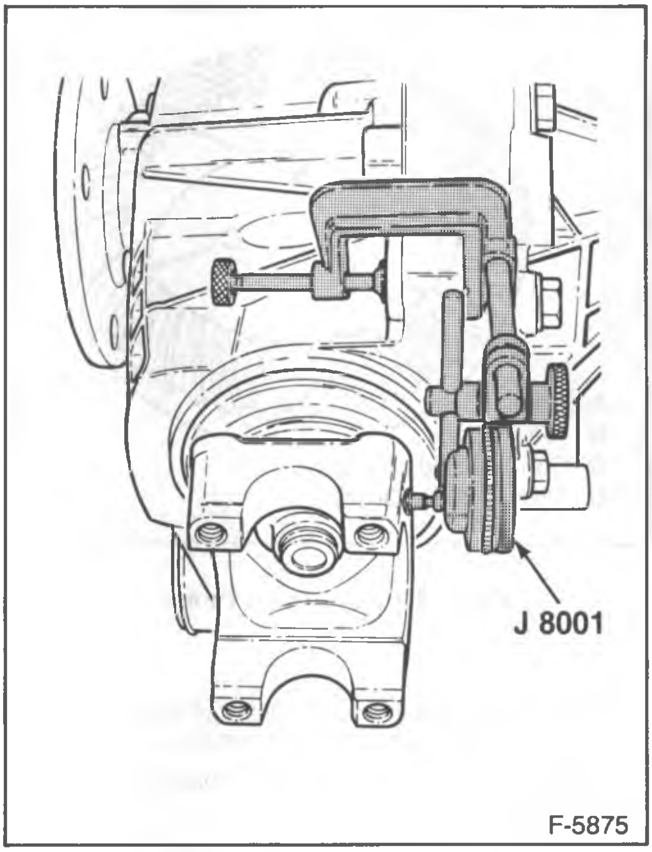
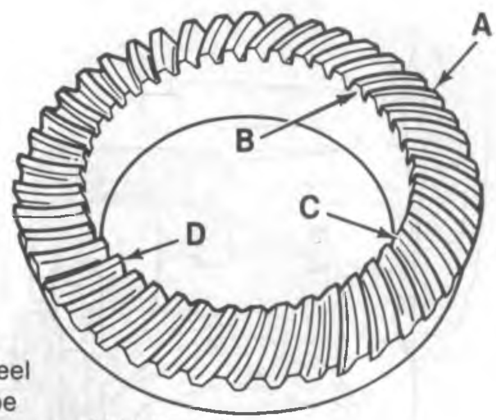


Figure 32—Measuring Backlash at the Pinion Flange

1. Refer to figures 1 through 4.
2. Tighten the right sleeve (32) to 140 N·m (100 ft. lbs.). Use J 36599 (figure 28).
3. Tighten the left sleeve (32) (K15-25 models) or adjuster plug (61) (K35 models) to 140 N·m (100 ft. lbs.).
   - Use J 36599 (K15-25 models) (figure 28).
   - Use J 36615 (K35 models) (figure 29).
4. Mark the location of the adjusting sleeves in relation to the carrier halves, so the notches in the adjusting sleeves can be counted when turned.
5. Turn the right sleeve OUT two notches.
6. Turn the left sleeve (K15-25 models) or adjuster plug (K35 models) IN one notch.
7. Rotate the pinion several times to seat the bearings.
8. Install J 34047-3 into the filler plug hole. Install J 34047-1 and J 8001-1 as shown in figure 31.
9. Place the indicator stem at the heel end of a tooth.
10. Check and record the backlash at three or four points around the ring gear.
    - The pinion must be held stationary when checking backlash.
    - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
    - Gear backlash should be between 0.08-0.25 mm (0.003-0.010 inch) with a preferred specification of 0.13-0.18 mm (0.005-0.007-inch).
    - If the backlash is incorrect, adjust the sleeves as necessary. Always maintain the "one notch" preload on the side bearings. Example: If it is necessary to turn the RIGHT sleeve IN one notch, the LEFT sleeve must be turned OUT one notch.
    - To increase backlash, turn the left sleeve in, and turn the right sleeve out an indentical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.
    - Changing the sleeves one notch will change backlash about 0.08 mm (0.003-inch).

MEASURING BACKLASH (ALTERNATE METHOD)

1. Use this method if the tools specified previously are not available.
2. If the specified tools are not available, it is possible to read backlash at the pinion flange, as follows:
3. Install a dial indicator so the button contacts the outer edge of the pinion flange. The plunger must be at a right angle to the pinion flange (figure 32).
4. Move the pinion flange through its free play while holding the differential carrier. Record the dial indicator reading.
5. DIVIDE THE DIAL INDICATOR READING BY 2 to obtain the actual backlash when using this method.



A. Heel
B. Toe
C. Concave Side (Coast)
D. Convex Side (Drive)

F-2017

Figure 33—Gear Tooth Terms

Example: A dial indicator reading of 0.16 mm means that there is actually 0.08 mm backlash.

6. Follow the steps for adjusting backlash outlined previously.

GEAR TOOTH CONTACT PATTERN CHECK

Before final assembly of the differential, a gear tooth contact pattern check should be performed.

It should be noted that a gear tooth contact pattern check is NOT a substitute for adjusting pinion depth and backlash as previously outlined. It is a final check to verify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy, or have a short life, or both. With a pattern check, the best contact between the ring gear and the drive pinion for low noise level and long life can be assured.

GEAR TOOTH TERMS

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. The toe end of the tooth is smaller than the heel end (figure 33).

TEST

1. Wipe oil out of carrier and carefully clean each tooth of the ring gear.
2. Apply gear marking compound sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Apply a load until a torque of 54-70 N·m (40-50 ft. lbs.) is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the companion flange with a wrench so that the ring gear rotates one full revolution then reverse the rotation so that the ring gear rotates one revolution in the opposite direction. Excessive turning of the ring gear is not recommended.
4. Observe the pattern on the ring gear teeth and compare with figure 34.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect the tooth contact pattern. These are backlash and the position of the drive pinion (pinion depth) in the carrier. The effects of bearing preloads are not easily seen on hand loaded teeth pattern tests. These adjustments should be within specifications before proceeding wiht the backlash and the drive pinion adjustments.

It may be necessary to adjust both pinion depth and the backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and the inner race of the rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing the shim thickness will move the pinion closer to the centerline of the ring gear. Decreasing the shim thickness will move the pinion farther away from the centerline of the ring gear.

Backlash is adjusted by means of the side bearing adjusting sleeves which move the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting sleeves are also used to set side bearing preload). To increase backlash turn the left sleeve in and turn the right sleeve out an identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

It is important that the contact pattern be centrally located up and down on the face of the ring gear teeth.

CARRIER CASE ASSEMBLY

Install or Connect (Figures 1 through 4)

- Bend the lock (51) over the sleeves (32). (Right side only on K35 models).
- Bolt (64) and lock (63) (K35 models).

Remove or Disconnect (Figures 1 through 4)

1. Bolts (28).
2. Right carrier case half.

Clean

- Carrier case and axle tube sealing surfaces. Remove all grease and oil. Use carburetor cleaner or equivalent.

Install or Connect (Figures 1 through 4, 19, and 35).

Tools Required:

J 36600 Output Shaft Seal Installer (K15-25)
J 22833 Output-Shaft Seal Installer (K35).
J 33842 Pilot Bearing Installer
J 36616 Bushing Replacer Set

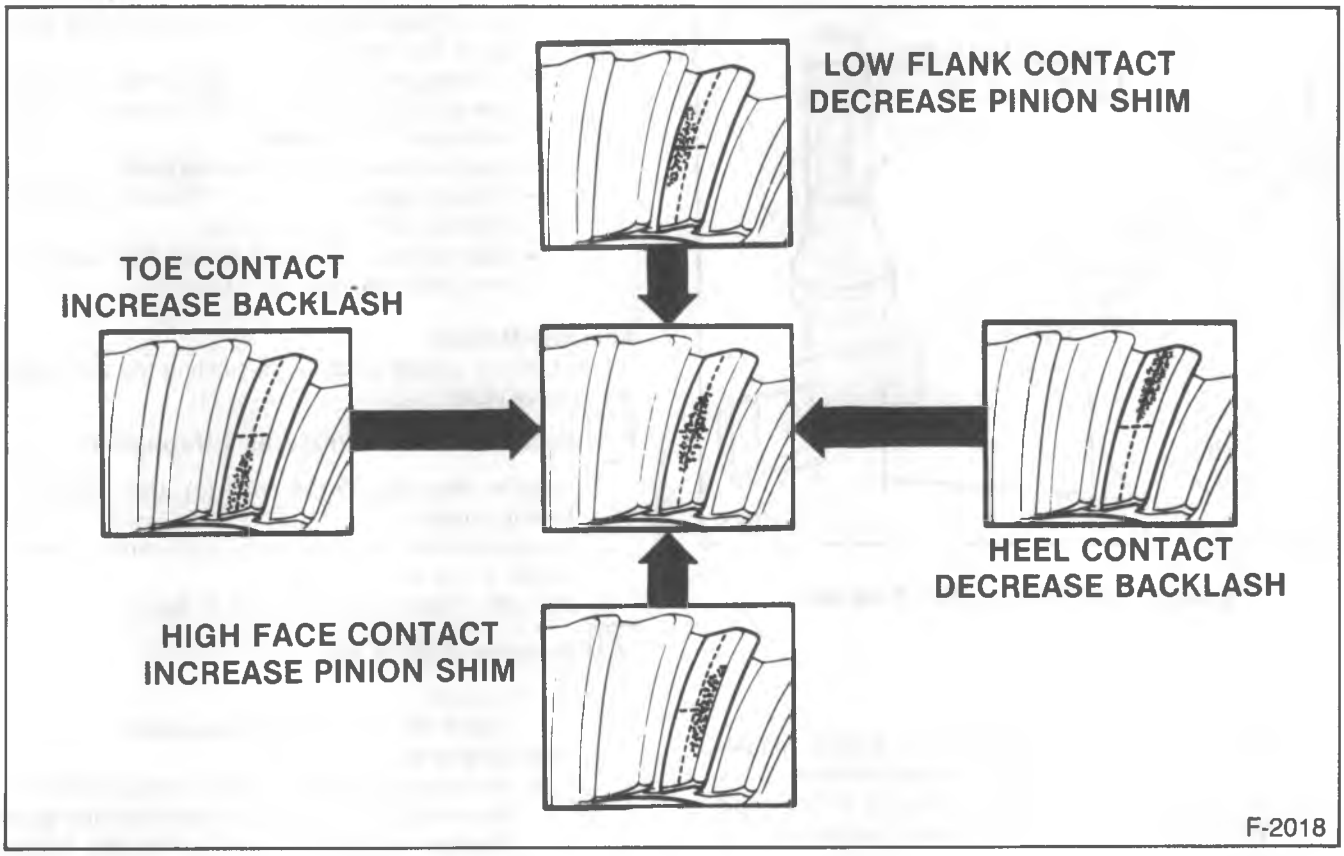


Figure 34—Gear Tooth Contact Pattern

- Apply a bead of sealer (GM part no. 1052942 [Loctite 518] or equivalent) to one carrier case half sealing surface.

1. Right carrier case half (29).
2. Bolts (28).

Tighten

- Bolts (28) to 47 N·m (35 ft. lbs.).

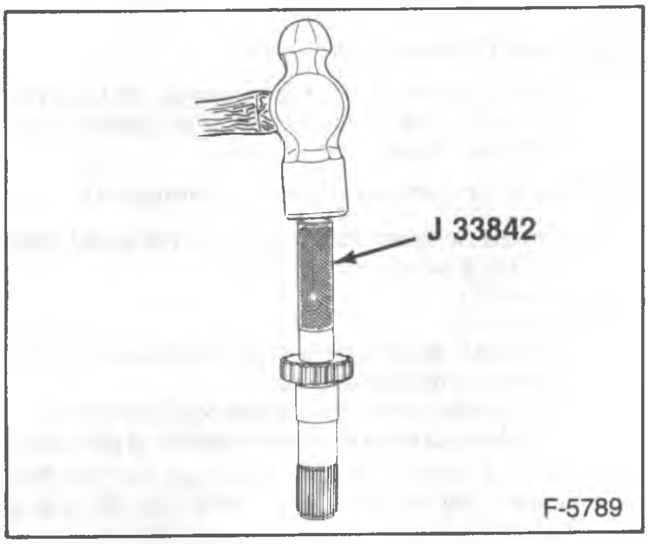


Figure 35—Installing the Pilot Bearing

3. Left seal (3). Use J 36600 (K15-25 models) or J 22833 (K35 models). Drive into place with a soft faced hammer.
4. Shaft (59) with deflector (2). Drive in place with a brass hammer.
5. Bearing (21) to the output shaft (23). Use J 33842 (figure 35).
6. Output shaft (23) to the carrier.
7. Vent plug (60). Use a small amount of sealer (GM part no. 1052942 [Loctite 518] or equivalent) on the threads.
8. Bushings (48). Use J 36616 (figure 19).

AXLE TUBE ASSEMBLY

ASSEMBLY

Install or Connect (Figures 1 through 4 and 36)

Tools Required:

J 36609 Bearing Installer

J 36600 Seal Installer (K15-25 Models)

J 22833 Seal Installer (K35 Models)

1. Bearing (4). Use J 36609. Drive into place with a hammer.
2. Seal (3). Use J 36600 (K15-25 models) or J 22833 (K35 models) (figure 36).
3. Shaft (1) with deflector (2) to the axle tube.
4. Washer (7). Align the tabs with the slots in the tube.

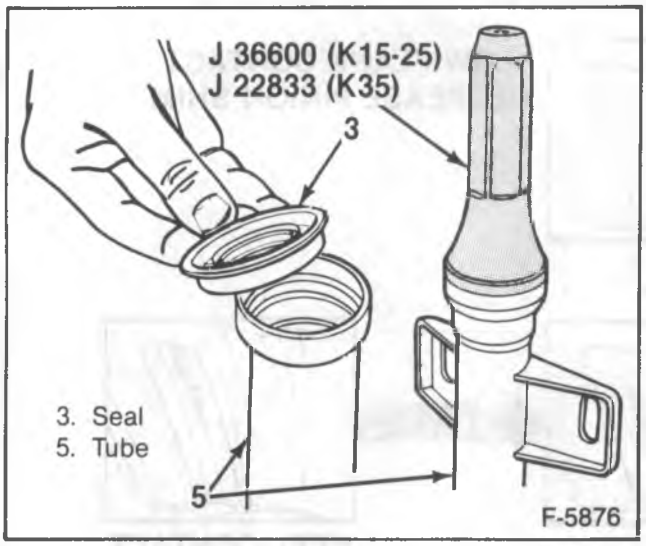


Figure 36—Installing the Axle Tube Seal

5. Gear (9) with retaining ring (8) (K15-25 models). Drive gear into place with a plastic hammer.
6. Washer (11) and new snap ring (12) (K35 models). Make sure the snap ring seats properly in the groove.

OUTPUT SHAFT SHIM SELECTION

- Refer to figures 1 through 4.
- It is necessary to select the proper size output shaft shim (20) if any of the following components were replaced:
  - Shaft (1).
  - Tube (5).
  - Output shaft (23).
  - Carrier case (29).
  - Ring and pinion gears (37).
  - Differential case (35).
  - Bearings (33).
  - Carrier connector (9) (K15-25 models).

Preferred Method:

Tool Required:

J 34672 Depth Gage (or equivalent)

1. Refer to figures 37 and 38.
2. Push on the inner end of the shaft (1), and move the shaft outboard as far as it will go. The shaft must be in this position when measuring dimension "A".
3. Measure dimension "A". Use J 34672 or equivalent (figure 38).
   - K15-25: Tube flange machined surface to inner surface of connector (9).
   - K35: Tube flange machined surface to inner surface of axle shaft shoulder.
4. Measure dimension "B."
   - Carrier machined surface to outer surface of output shaft (23).
5. Subtract dimension "A" from dimension "B."
6. The correct shim size will be one size smaller than the figure obtained in step 5. Examples:
   - If the figure obtained in step 5 was 3.53 mm, use a 3.30 mm shim.
   - If the figure obtained in step 5 was 3.30 mm, use a 2.70 mm shim (K15-25 models) or 2.80 mm shim (K35 models).
7. Shims are available in the following sizes:
   - K15-25 models: 1.27 mm 1.78 mm, 2.29 mm, 2.70 mm, 3.30 mm, 3.81 mm.
   - K35 models: 1.80 mm, 2.30 mm, 2.80 mm, 3.30 mm, 3.80 mm, 4.30 mm, 4.80 mm.

Alternate Method

Use ONLY if proper tools for calculating the shim size are not available.

Install or Connect (Figures 1 through 4)

1. Original shim (20) to the shaft (1). Use grease to hold it in place.
2. Assembled axle tube and shaft to the carrier. Use no sealer at this time.
3. Bolts (6). Tighten to 40 N·m (30 ft. lbs.).

Measure (Figure 39)

Tool Required:

J 8001 Dial Indicator (or equivalent)

- Shaft (1) end play.
  1. Install a dial indicator (J 8001 or equivalent) on the axle tube end. The plunger of the indicator must be at a right angle to the axle flange (figure 39).
  2. Move the shaft (1) back and forth and read the end play. Correct end play is 0.03-0.51 mm (0.001-0.020-inch).
  3. If end play is incorrect, install a thicker or thinner shim as needed to bring end play into the specified range.

Remove or Disconnect (Figures 1 through 4)

1. Bolts (6).
2. Axle tube assembly.

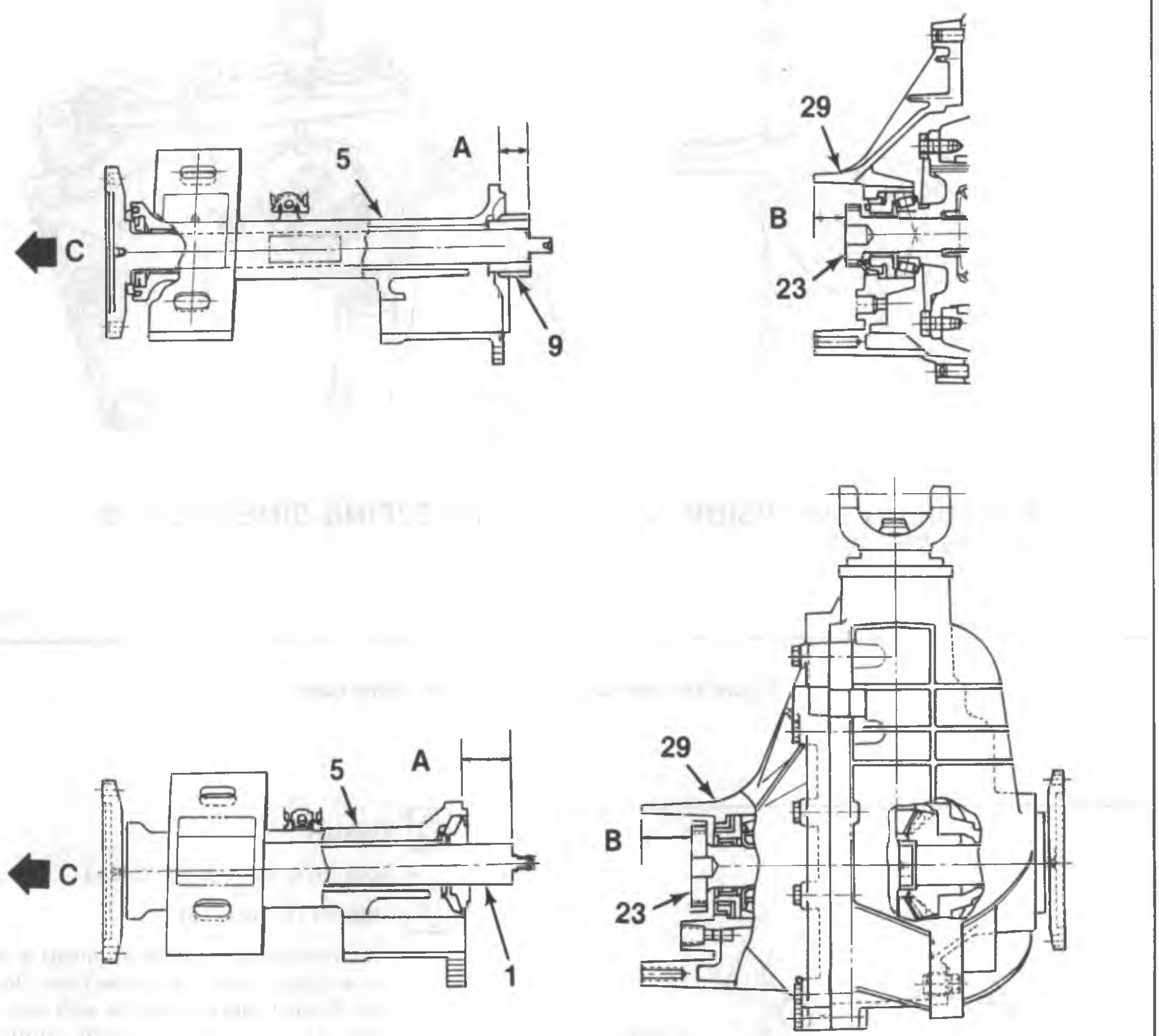
FINAL ASSEMBLY

Clean (Figures 1 through 4)

- Sealing surfaces of the tube (5) and carrier assembly. Remove all oil and grease. Use carburetor cleaner or equivalent.

Install or Connect (Figures 1 through 4)

1. Shim (20), as selected previously, to the output shaft (23). Use grease to hold it in place.
2. Sleeve (22).
3. Spring (14).
4. Shift shaft (18), spring (17), shift fork (16), and clip (15) assembly to the carrier case.
   - Damper spring fits into shift fork indentation.
   - Make sure clip is seated in groove of shift shaft.
- Apply a bead of sealer (GM part no. 1052942 [Loctite 518] or equivalent) to the tube (5) sealing surface.
3. Assembled tube (5) to the carrier assembly.
4. Bolts (6).



C. Measure with Axle Shaft Forced Outboard
1. Shaft
5. Tube
9. Carrier Connector
23. Output Shaft
29. Carrier Case

F-5877

Figure 37—Measuring to Calculate Shim Size

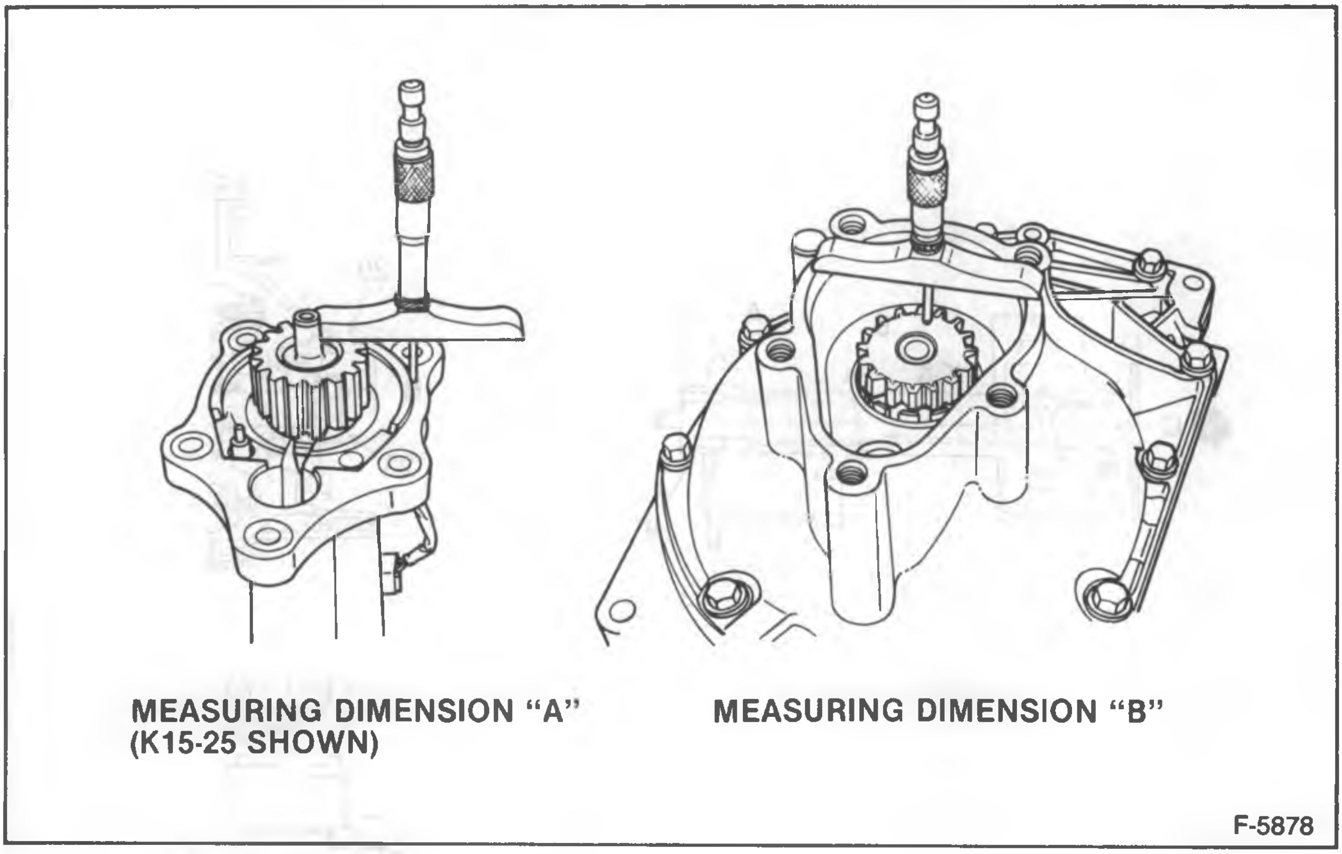


Figure 38—Measuring to Calculate Shim Size

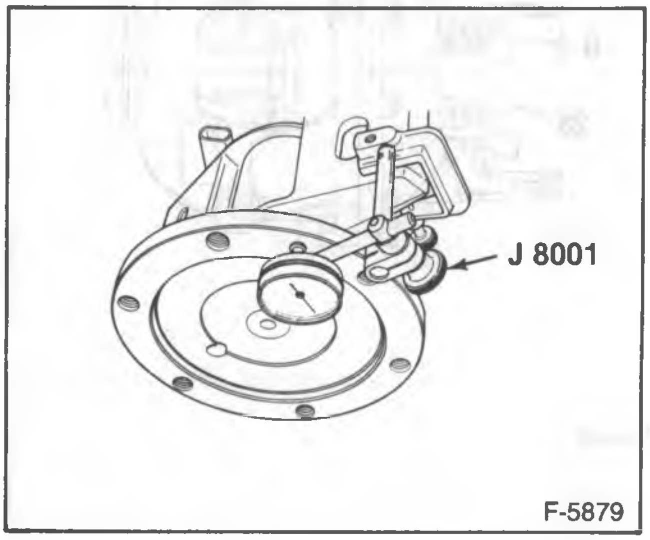


Figure 39—Measuring Axle Shaft End Play

Tighten

- Bolts (6) to 40 N·m (30 ft. lbs.).

Inspect (Figure 40)

- Shift mechanism operation. Insert a drift into the actuator hole in the axle tube. Rotate the axle flange while moving the shift fork with the drift. The shift mechanism should work smoothly, without bind.

5. Solenoid (10). Apply sealer (GM part no. 1052942 [Loctite 518] or equivalent) to the threads. Tighten to 22 N·m (16 ft. lbs.).
6. Switch (13). Apply sealer (GM part no. 1052942 [Loctite 518] or equivalent) to the threads. Tighten to 5.0 N·m (45 in. lbs.).
7. Axle lubricant, as specified in the proper Truck Service Manual.
8. Drain and fill plugs (25) with sealing washers (26). Tighten to 33 N·m (24 ft. lbs.).

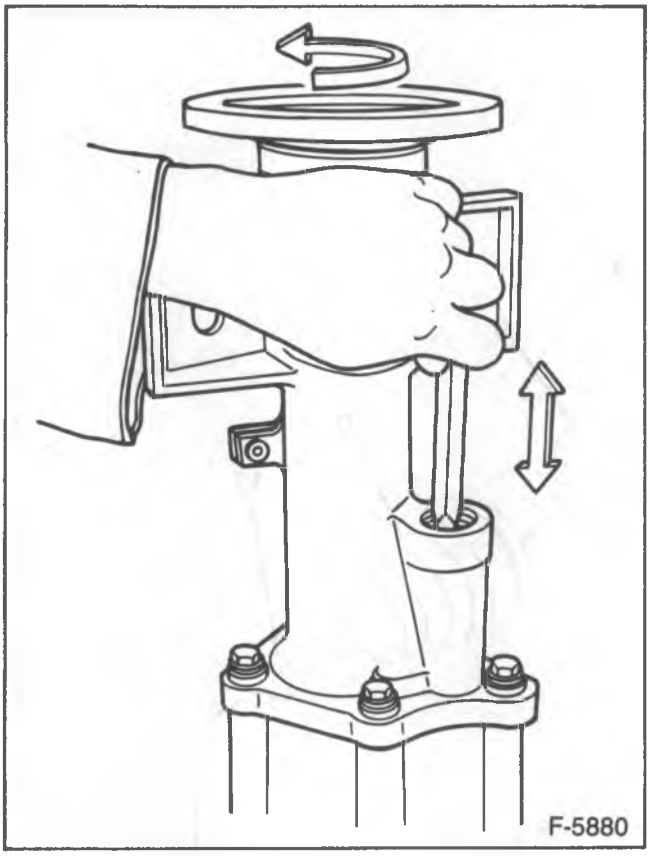


Figure 40—Checking the Shift Mechanism

DRIVE AXLE ASSEMBLY

OUTER DEFLECTING RING REPLACEMENT

Remove or Disconnect (Figures 41, 42 and 43)

- Clamp the axle shaft (12) in a vice.
  - Use soft metal or wood to protect the shaft.

1. Deflecting ring (19) from C/V outer race (18) with a brass drift and a hammer as shown and discard (figure 42).

Install or Connect

- Position and square up the deflecting ring (19) at the press diameter of C/V outer race (18).
- Using a 3" pipe coupling (K10/20) or 4" pipe coupling (K30), M24x2.0 nut and fabricated sheet metal sleeve as shown in figure 43, tighten nut until deflector (19) bottoms against shoulder of C/V outer race (18).

OUTER JOINT SEAL REPLACEMENT

Remove or Disconnect (Figures 41 and 44 through 47)

Tools Required:
- J 8059 Snap Ring Pliers
- J 35910 Seal Clamp Tool
- J 36652 Swage Clamp Tool

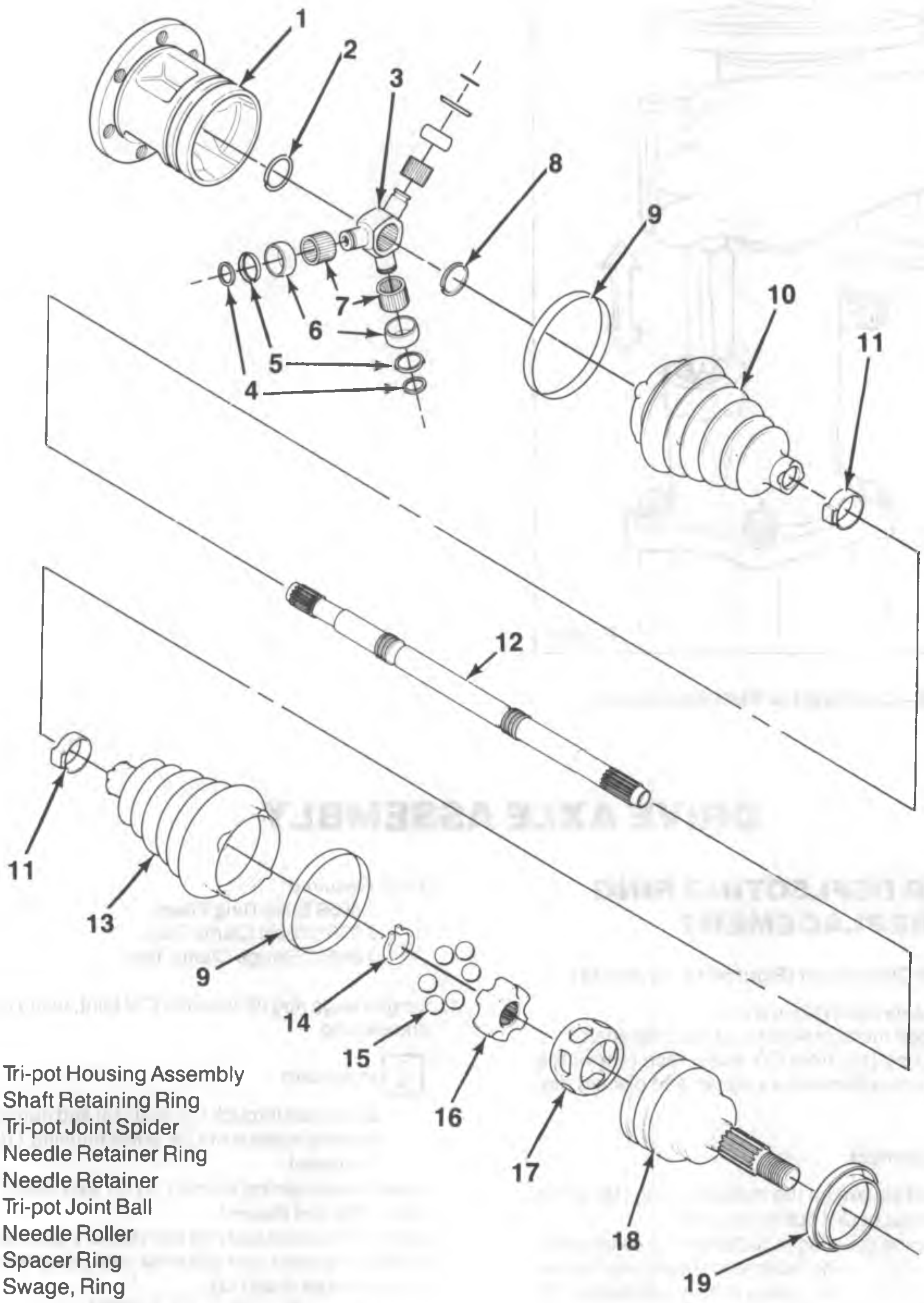
1. Large swage ring (9) from the C/V joint, using a chisel and discard.

Important

Do not cut through the seal (13) and damage the sealing surface of C/V outer housing (18) with the chisel.

2. Small seal-retaining clamp (11) on axle shaft with a side cutter and discard.
- Separate the joint seal (13) from the C/V joint race (18) at large diameter and slide the seal away from joint along the axle shaft (12).
- Wipe excess grease from face of C/V inner race (16).
- Spread the ears on the race retaining ring (14) with J 8059 as shown and remove the C/V joint assembly from the axle shaft (12).

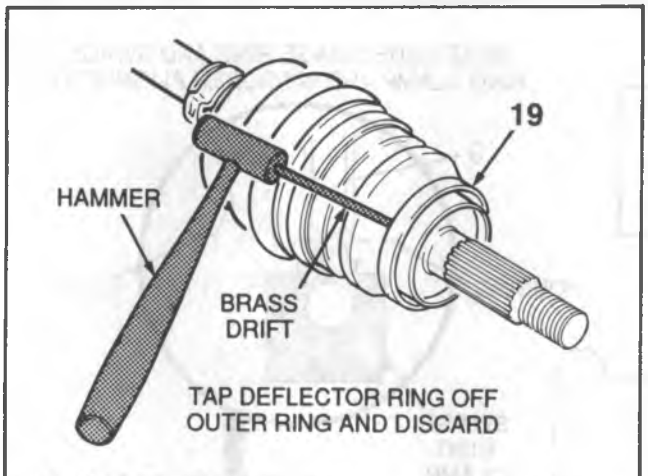
3. Seal (13) from the axle shaft (12).
- Disassemble the joint and flush grease prior to installing the new seal. Refer to "Outer Joint Assembly Replacement."



1. Tri-pot Housing Assembly
2. Shaft Retaining Ring
3. Tri-pot Joint Spider
4. Needle Retainer Ring
5. Needle Retainer
6. Tri-pot Joint Ball
7. Needle Roller
8. Spacer Ring
9. Swage, Ring
10. Tri-pot Joint Seal
11. Seal Retaining Clamp
12. Axle Shaft
13. C/V Joint Seal
14. Race Retaining Ring
15. Ball
16. C/V Joint Inner Race
17. C/V Joint Cage
18. C/V Joint Outer Race
19. Deflector Ring

F-6721

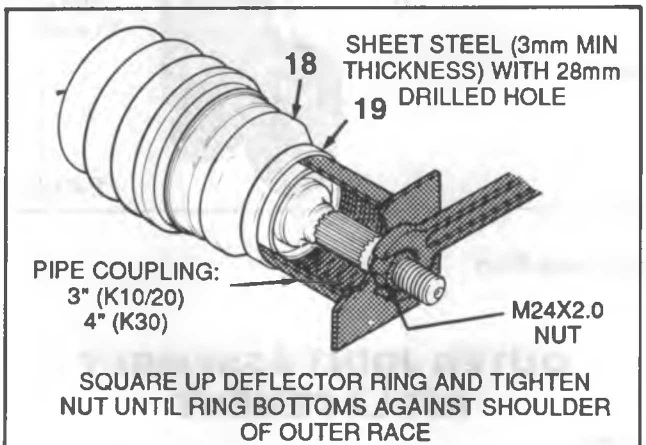
Figure 41—Front Drive Axle Components



19. Deflector Ring

F-6722

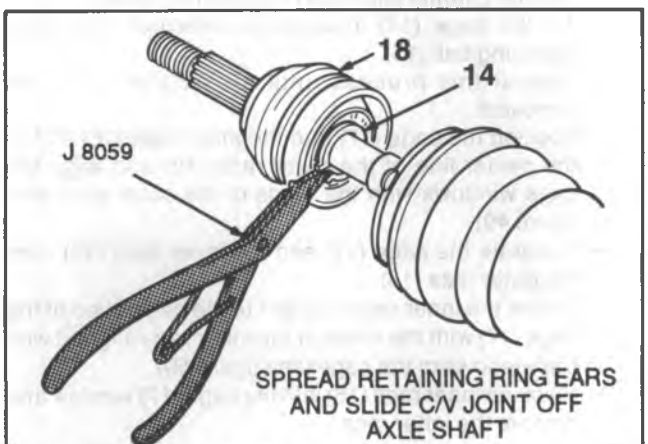
Figure 42—Removing Outer Deflector Ring



18. C/V Joint Outer Race
19. Deflector Ring

F-6723

Figure 43—Installing Outer Deflector Ring



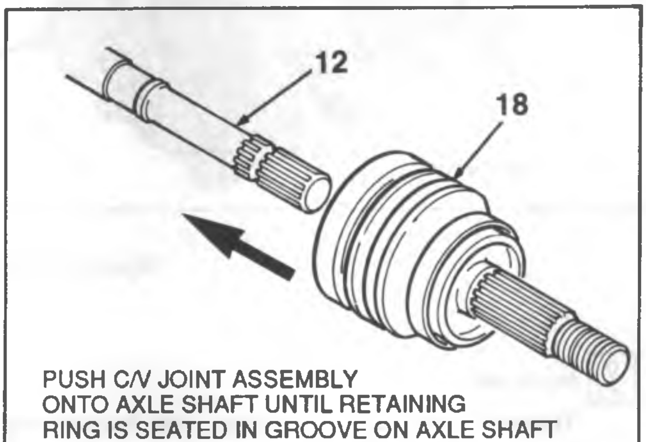
14. Race Retaining Ring
18. C/V Joint Outer Race

F-6724

Figure 44—Removing C/V Joint

Install or Connect

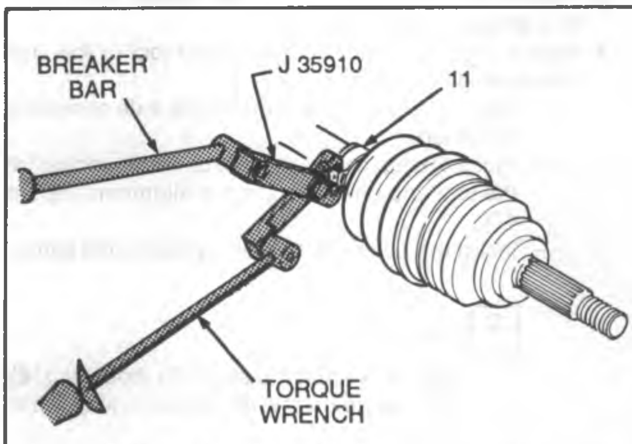
1. Small seal-retaining clamp (11) on the neck of the new seal (13). Do not crimp.
   - Slide the seal (13) onto the axle shaft (12) and position the neck of the seal in the seal groove on the axle shaft.
   - Crimp the seal-retaining clamp (11) with J 35910 to 136 N·m (100 ft. lbs.) (figure 46).
   - Place approximately half of the grease provided inside the seal (13) and repack the C/V with the remaining grease.
2. Swage ring (9).
   - Pinch by hand slightly to distort into an oval shape and slide onto large diameter of the seal (13).
   - Push C/V joint onto axle shaft (12) until retaining ring (14) is seated in groove on axle shaft.
   - Slide large diameter of the seal (13) with the large swage ring (9) in place over the outside of the C/V joint race (18) and locate the lip of the seal in the housing groove.



12. Axle Shaft
18. C/V Joint Outer Race

F-6725

Figure 45—Installing C/V Joint



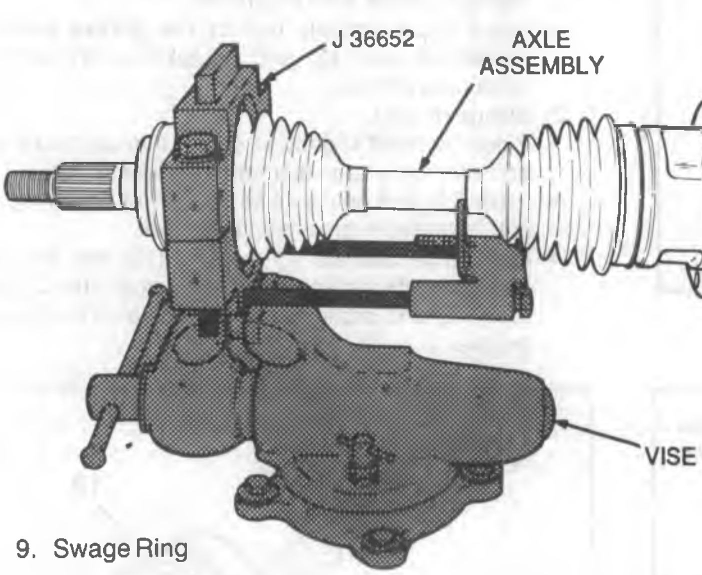
11. Seal Retaining Clamp

F-6726

Figure 46—Installing Seal Retaining Clamp

SWAGE CLAMP SIZE CHART

TOOL NO.	DESCRIPTION	APPLICATION
J 36652-1	Split Plate Swage Clamp	K 10/20
J 36652-2	Split Plate Swage Clamp	K 30 (Outboard)
J 36652-3	Split Plate Swage Clamp	K 30 (Inboard)



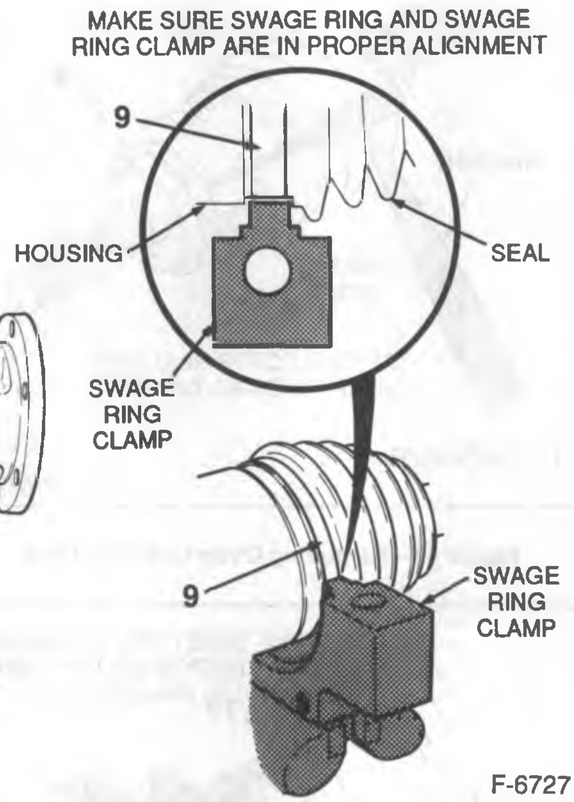


Figure 47—Installing Swage Ring

Important

The Seal (13) must not be dimpled, stretched or out of shape in any way. If the seal is not shaped correctly, carefully insert a thin flat blunt tool **(no sharp edges)** between the large seal opening and the outer race (18) at maximum clearance of oval ring (9) to equalize pressure. Shape the seal properly by hand and remove the tool.

- Refer to the chart in figure 47 and select the proper size swage clamp tool J 36652.
- Mount the proper size swage clamp tool in the vice and proceed as follows:
  - Position the **outboard** end of the axle assembly in the tool.
  - Place the top half of the tool on the lower half of the tool and check for proper alignment (figure 47).
  - Insert the bolts and tighten by hand until snug.

  Important

  Make sure that the seal (13), housing (18) and swage ring (9) all remain in alignment (figure 47).

  - Continue to tighten each bolt 180° at a time alternating until both sides are bottomed.
- Remove the axle assembly from the tool.

OUTER JOINT ASSEMBLY REPLACEMENT

Disassemble (Figures 41, 48, 49 and 50)

- Perform steps 1 through 3 in "Outer Joint Seal Replacement" in this section.
- Use a brass drift and a hammer to gently tap on the C/V joint cage (17) until it is tilted enough to remove the first chrome alloy ball (15) (see figure 48).
- Tilt the cage (17) in opposite direction to remove opposing ball (15).
- Repeat this process until all six balls (15) are removed.
- Position the cage (17) and the inner race (16) 90° to the center line of the outer race (18) and align the cage windows with the lands of the outer race (see figure 49).
- Separate the cage (17) and the inner race (16) from the outer race (18).
- Rotate the inner race (16) 90° to the center line of the cage (17) with the lands of the inner race aligned with the windows of the cage (see figure 50).
- Pivot the inner race (16) into the cage (17) window and remove the inner race.

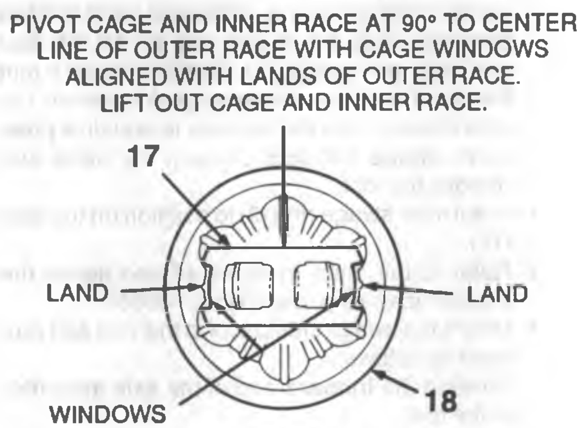
Assemble

- Put a light coat of recommended grease on the ball grooves of the inner race (16) and the outer race (18).
- Reverse the steps of the disassembly procedure.

15. Ball
16. Inner Race
17. Cage
18. Outer Race

F-6728

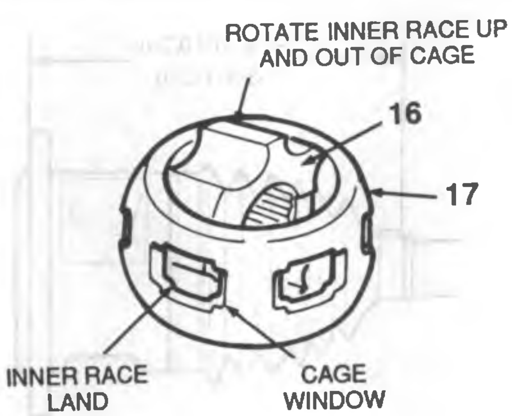
Figure 48—Removing C/V Joint Balls



17. Cage
18. Outer Race

F-6729

Figure 49—Separating Outer Race and Cage



16. Inner Race
17. Cage

F-6730

Figure 50—Separating Inner Race and Cage

Important

Be sure that the retaining ring side of the inner race (16) face the axle shaft (12).

- Perform steps 1 through 3 in "Outer Joint Seal Replacement" Install or Connect.

INNER TRI-POT SEAL REPLACEMENT

Remove or Disconnect (Figures 41, 47, 51, 52, 53 and 54)

Tools Required:
- J 8059 Snap Ring Pliers
- J 35910 Seal Clamp Tool
- J 36652 Swage Clamp Tool

1. Large swage ring (9) from the tri-pot joint, using a chisel, and discard.

Important

Do not cut through the seal (10) with the chisel and damage the sealing surface of the tri-pot outer housing (1).

2. Small seal-retaining clamp (11) from the axle shaft (12) with a side cutter and discard.
   - Separate seal (10) from the tri-pot housing (1) at the large diameter and slide the seal away from the joint along the axle shaft (12).
3. Tri-pot housing (1) from the spider (3) and shaft (12).
   - Spread the spacer ring (8) with J 8059 and slide the spacer ring and the tri-pot spider (3) back on the axle shaft (12) as shown (figure 51).
4. Shaft retaining ring (2) from the groove on the axle shaft (12) and slide the spider assembly off the shaft.

Important

Handle the tri-pot spider assembly with care or the tri-pot balls and needle rollers may separate from the spider trunions.

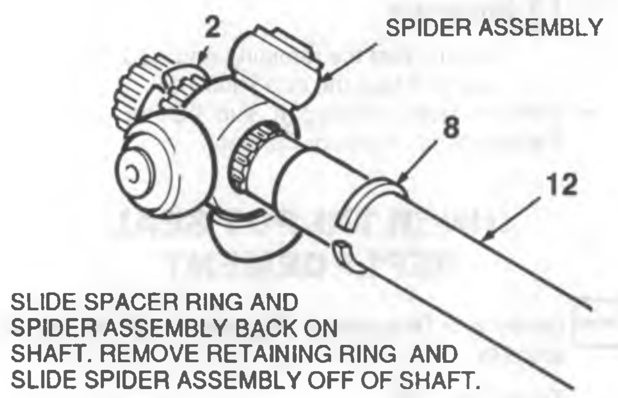
- Remove the spacer ring (8) and the seal (10) from the axle shaft (12).
- Flush grease from the housing.

Install or Connect

1. Small seal-retaining clamp (11) on the neck of the seal (10).
   - Do not crimp.
2. Slide the seal (10) onto the shaft (12) and position the neck of the seal in the seal groove on the axle shaft (12).
   - Crimp seal retaining clamp (11) with J 35910 to 136 N·m (100 Lbs. Ft.).
3. Spacer ring (8) on the axle shaft (12) and beyond the second groove as shown (figure 52).
   - Slide the tri-pot spider assembly against the spacer ring (8) and the shaft (12).

Important

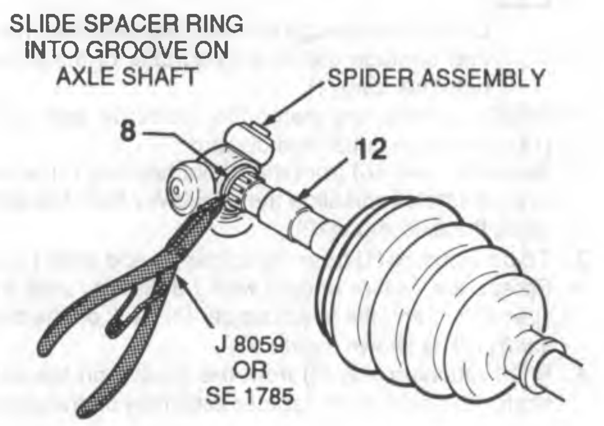
Be sure that the counterbored face of the tri-pot spider (3) faces the end of the shaft (12).



2. Shaft Retaining Ring
8. Spacer
12. Axle Shaft

F6731

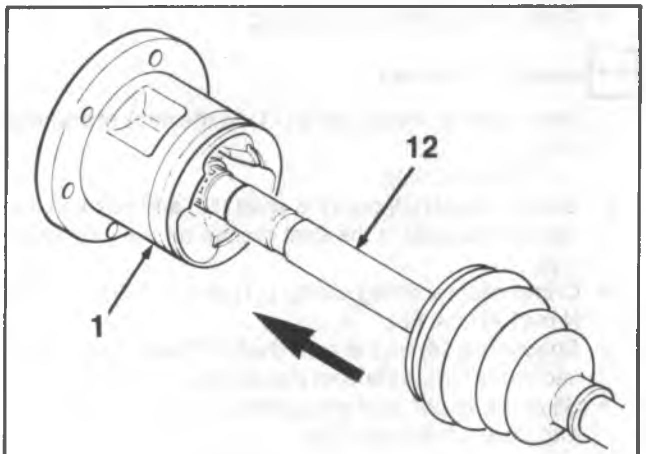
Figure 51—Removing Spider Assembly



8. Spacer Ring
12. Axle Shaft

F-6732

Figure 52—Installing Spider Assembly



1. Tri-Pot Housing Assembly
12. Axle Shaft

F-6733

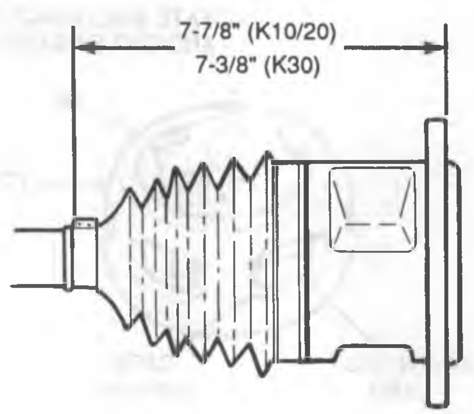
Figure 53—Installing Tri-pot to Housing

4. Shaft retaining ring (2) in the groove of the axle shaft (12) with J 8059.
- Slide the tri-pot spider (3) towards the end of the shaft (12) and reseat the spacer ring (8) in the groove on the axle.
- Place approximately half of the grease provided in the seal (10) and use the remainder to repack the tri-pot housing (1).
- Pinch the swage ring (9) by hand slightly to distort it into an oval shape and slide it onto the large diameter of the seal (13).
- Slide the tri-pot housing (1) over the tri-pot spider assembly on the shaft (12) (figure 53).
- Slide the large diameter of the seal (10) with the large swage ring (9) in place over the outside of the tri-pot housing (1) and locate the lip of the seal in the housing groove.
- Position the tri-pot assembly at the proper vehicle dimension as shown in figure 54.

Important:

The seal (13) must not be dimpled, stretched or out of shape in any way. If the seal is not shaped correctly, slide the swage ring (9) off the seal and onto the housing (1). Carefully insert a thin flat blunt tool **(no sharp edges)** between the seal opening and the housing to equalize pressure. Shape the seal properly by hand and remove the tool.

- Return the swage ring (9) to position on the seal (13).
- Refer to the chart in figure 47 and select the proper size swage clamp tool J 36652.
- Mount the swage clamp tool in the vice and proceed as follows:
  - — Position the **inboard** end of the axle assembly in the tool.
  - — Place the top half of the proper size tool on the lower half of tool and check for proper alignment and dimension (figures 47 and 54).
  - — Insert the bolts and tighten by hand until snug.



F-6734

Figure 54—Tri-pot Seal Installation Measurements

Important

Make sure that the seal (10), housing (1) and swage ring (9) all remain in alignment (figure 47).

— Continue to tighten each bolt 180° at a time, alternating until both sides are bottomed.

• Remove the axle assembly from the tool.

SPECIFICATIONS

TORQUE SPECIFICATIONS

FASTENER	N·m	Ft. Lbs.	In. Lbs.
Ring Gear Bolts	120	88	—
Carrier Case Bolts	47	35	—
Axle Tube Bolts	40	30	—
Actuator	22	16	—
Front Axle Switch	5.0	—	45
Drain and Fill Plugs	33	24	—
Seal Retaining Clamp	136	100	—

AVAILABLE SHIM SIZES

Pinion Shaft Shims	
(K15-25 Models)	0.020-0.024-inch
	0.025-0.029-inch
	0.030-0.034-inch
	0.035-0.039-inch
(K35 Models)	0.508-0.5842 mm
	0.6096-0.7112 mm
	0.7366-0.8382 mm
	0.8386-0.9398 mm
Output Shaft Shims	
K15-25 Models	1.27, 1.78, 2.29, 2.70, 3.30, 3.81 mm
K35 Models	1.80, 2.30, 2.80, 3.30, 3.80, 4.30, 4.80 mm

PINION PRELOAD AND BACKLASH

Pinion Preload	1.7-2.8 N·m (15-25 in. lbs.)
Backlash	0.08-0.25 mm (0.003-0.010-in.)
(Preferred)	0.13-0.18 mm (0.005-0.007-in.)

1. Slide Hammer
2. Output Shaft Bearing Installer (K15-25)
3. Output Shaft Bearing Installer (K35)
4. Driver Handle
5. Side Bearing Puller Pilot (K15-25)
6. Side Bearing Puller Pilot (K35)
7. Pinion Bearing Remover (K15-25 Models)
8. Pinion Bearing Remover (K35 Models)
9. Pinion Flange Remover
10. Case Bushing Replacer
11. Differential Side Bearing Installer (K15-25 Models)
12. Differential Side Bearing Installer (K35 Models)
13. Differential Side Bearing Puller
14. Axle Tube Bearing Installer
15. Axle Tube Bearing and Seal Remover (K15-25 Models)
16. Axle Tube Bearing and Seal Remover (K35 Models)
17. Differential Pilot Bearing Installer
18. Differential Pilot Bearing Remover

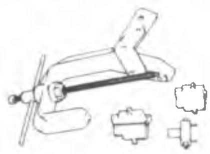
F-6761

19 / 20

J 35512 / J 36614

21 / 22 / 23

J 36366 / J 36600 / J 22833

24

J 36598

25

J 34047-3

26

J-36599

27

J 36601

28

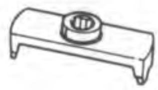
J 29763

29

J 34037

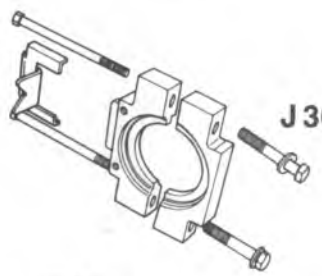
30

J 34672

31

J 36615

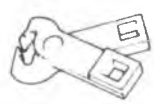
32

J 8001

33

J 36652

34

J 8059

35

J 35910

36

J 36603

19. Pinion Bearing Installer (K15-25 Models)
20. Pinion Bearing Installer (K35 Models)
21. Pinion Seal Installer
22. Axle Seal Installer (K15-25 Models)
23. Axle Seal Installer (K35 Models)
24. Holding Fixture and Pinion Service Tool
25. Dial Indicator Adapter
26. Side Bearing Adjuster Wrench
27. Pinion Depth Setting Gage
28. Dial Indicator
29. Dial Indicator
30. Depth Gage
31. Side Bearing Adjuster Wrench
32. Dial Indicator Set
33. Clamp Swage Tool Set
34. Snap Ring Pliers
35. Drive Axle Seal Clamp Pliers
36. Side Bearing Cup Installer

F-6762

SECTION 4C5

L-VAN FRONT AXLE

CONTENTS

DESCRIPTION

The front axle on the L-Van model utilizes a full-time four-wheel drive system, with no disengagement feature.

The axle uses a conventional ring gear and pinion gear set to transmit the driving force of the engine to the wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsible spacer between the pinion bearings in the axle housing.

The ring gear is bolted onto the differential case with left hand thread bolts.

The differential case is supported in the axle housing by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using thread adjusters.

The differential is used to allow the wheels to turn at different rates of speed while the front axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The axle identification code is stamped on the top of the carrier case, along the edge of the machined face of the left half.

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

1. Remove the fill plug from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Backlash Adjustment." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading the differential case.
3. Inspect the case and oil for metal chips. Determine where the metal chips come from, such as a broken gear or bearing cage.
4. Determine the cause of the axle problem before disassembly if possible.

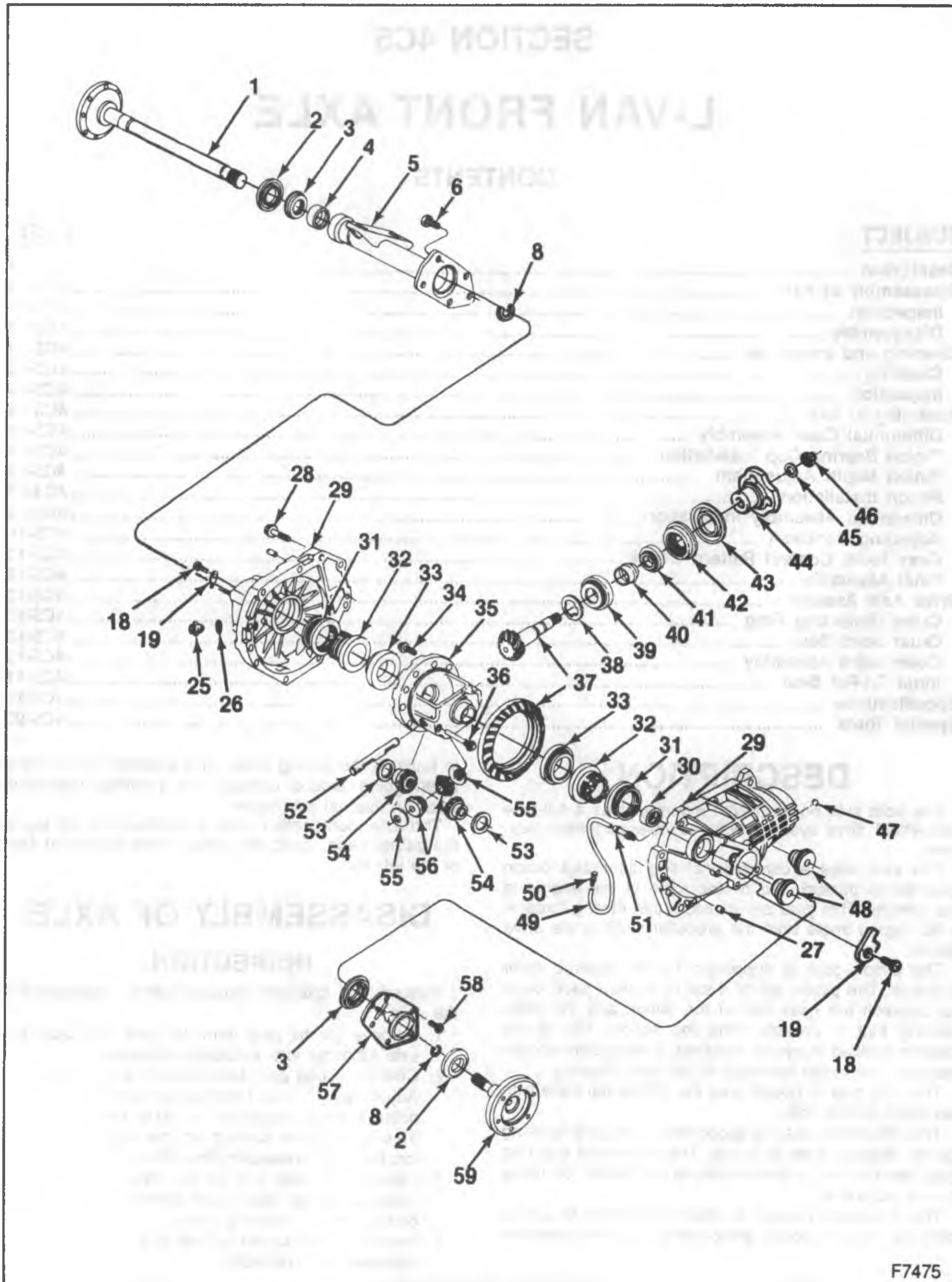


Figure 1—L-Van Front Axle

1. Shaft
2. Deflector
3. Seal
4. Bearing
5. Tube
6. Bolt
8. Retaining Ring
18. Bolt
19. Lock Tab
25. Plug
26. Washer
27. Pin
28. Bolt
29. Carrier Case
30. Bearing
31. Insert
32. Sleeve
33. Side Bearing
34. Bolt
35. Differential Case
36. Bolt
37. Ring and Pinion Gears
38. Shim
39. Bearing
40. Spacer
41. Bearing
42. Seal
43. Deflector
44. Flange
45. Washer
46. Nut
47. Plug
48. Bushing
49. Vent Hose
50. Vent
51. Fitting
52. Shaft
53. Thrust Washer
54. Side Gear
55. Thrust Washer
56. Differential Pinion Gear
57. Cover
58. Bolt
59. Shaft

F7476

Figure 2—L-Van Front Axle

DISASSEMBLY

Disassemble (Figures 1 through 14)

Tools Required:
- J 8614-01 Pinion Flange Remover
- J 21551 Bearing Remover
- J 22912-01 Pinion Bearing Cone Remover
- J 29307 Slide Hammer
- J 33791 Bushing Remover
- J 33792 Side Bearing Adjuster Wrench
- J 33837 Pinion Bearing Cup Remover Kit
- J 29369-2 Countershaft Roller Bearing Remover

1. Shaft (1) with deflector (2) and retaining ring (8).
   - Strike the inside of the shaft flange with a brass hammer to dislodge the shaft. Use care in pulling the splined shaft through the seal diameter to avoid cutting the seal.
2. Bolts (6).
3. Tube (5).
4. Right seal (3) and bearing (4), using J 29369-2 and J 29307 (figure 3).
5. Shaft (59), and deflector (2).
   - Pry with a screwdriver between the shaft flange and carrier head while striking the flange with a soft face hammer (figure 4).
6. Bolts (58) and cover (57).
7. Left seal (3).
8. Bolts (28).
9. Separate the carrier case (29).
   - Insert a screwdriver into the slots provided and pry to separate the case (figure 5).
10. Differential case (35).
11. Bolts (18) and lock tabs (19) from the side bearing adjuster sleeves (32) (figure 6).
12. Bearing cups (33) and sleeves (32) from the case.
    - Turn the sleeves (32) using J 33792 until the cups are pushed out of the case (figure 7).
13. Bearing (30) from the sleeve (32). Use J 21551 (figure 8).
14. Pinion flange nut (46) and washer (45) using J 8614-01 (figure 9).
    - Mount the left carrier case half in J 33837-1 (figure 10).
15. Flange (44) and deflector (43) using J 33837-1 and J 33837-3 (figure 10).
16. Pinion (37), with spacer (40), pinion bearing (39) and shim (38).
17. Spacer (40) from the pinion.
18. Bearing (39) from the pinion. Use J 22912-01 and a press (figure 11).
19. Shim (38).
20. Bearing and cup (41) and seal (42), using J 33837-1, J 33837-3 and J 33837-6.
    - Insert J 33837-6 into the pinion bore.
    - Thread the forcing screw (J 33837-3) into J 33837-6.
    - Turn the forcing screw to pull the parts from the case.
21. Inner bearing cup by pushing it out using J 33837-1, J 33837-3 and J 33837-6 (figure 12).
22. Bolt (36) and shaft (52) from the differential case (35).
23. Differential pinion gears (56) and thrust washers (55).
24. Side gears (54) and thrust washers (53).
    - Mark the side gears and case so they can be installed in their original location.
25. Bolts (34).
26. Ring gear (37).
    - Do not pry between the ring gear and the case. Drive the gear off with a brass drift and hammer.
27. Side bearings (33), using J 22912-01 (31) (figure 13).
28. Bushings (48). Use J 33791 (figure 14).

CLEANING AND INSPECTION

CLEANING

Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

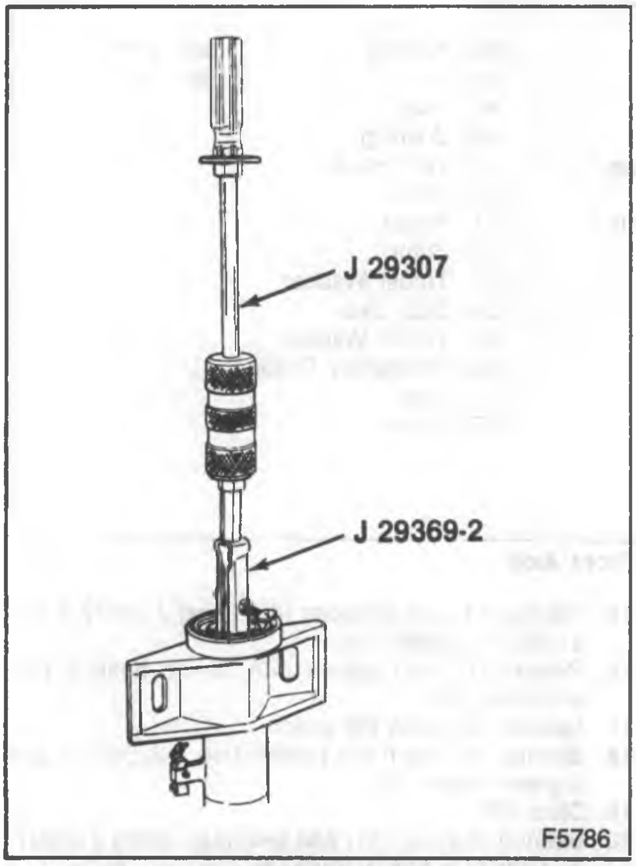


Figure 3—Removing the Axle Tube Bearing and Seal

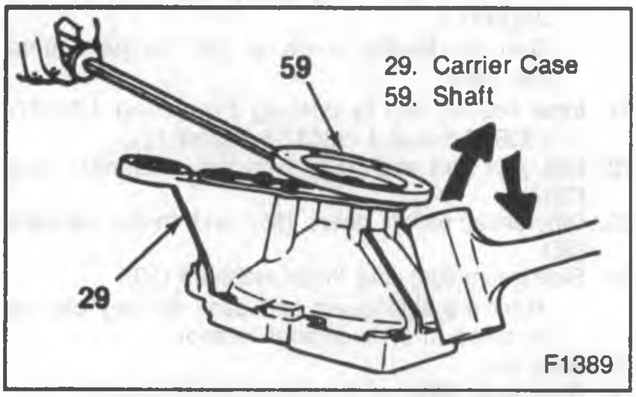


Figure 4—Removing the Axle Shaft

Parts should be thoroughly dried immediately after cleaning. Use soft, clean, lintless rags. Parts may be dried with compressed air. Do not allow the bearings to spin while drying them with compressed air.

INSPECTION

It is very important to carefully and thoroughly inspect all drive unit parts before assembly.

Thorough inspection of the drive parts for wear or stress and subsequent replacement of worn parts will eliminate costly drive component repair after reassembly.

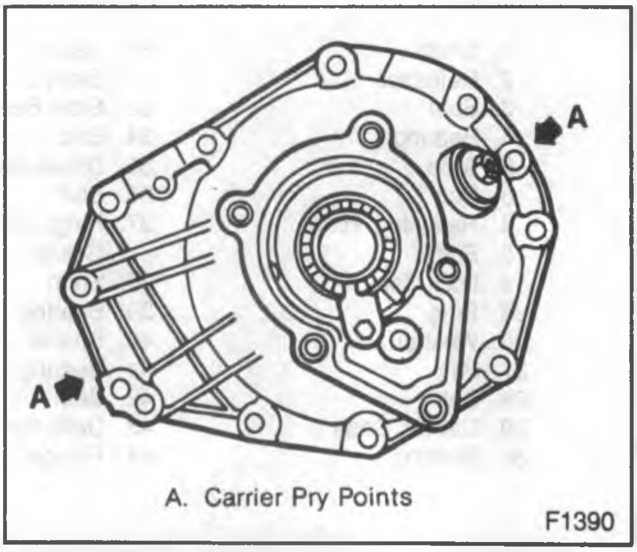


Figure 5—Separating the Carrier Case Halves

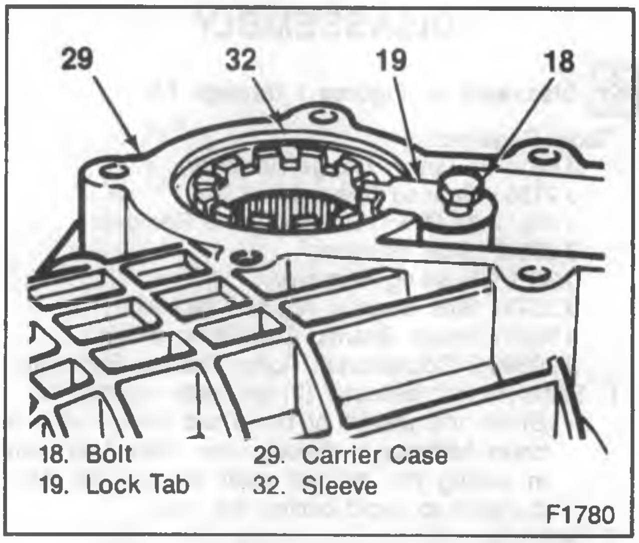


Figure 6—Removing the Lock Tabs

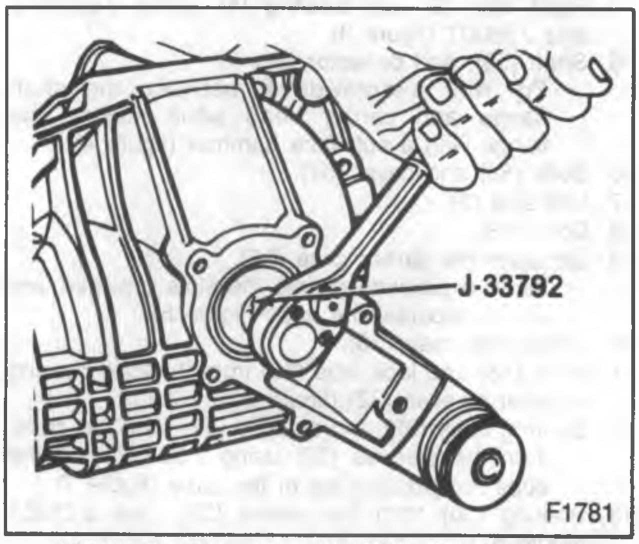


Figure 7—Removing the Side Bearing Cup

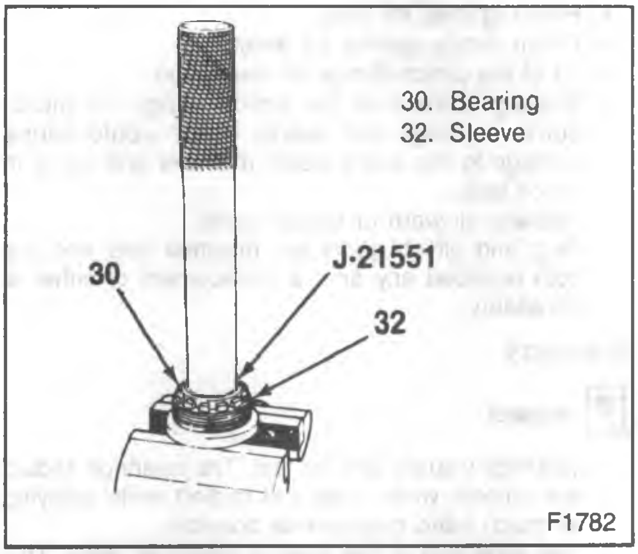


Figure 8—Removing the Sleeve Bearing

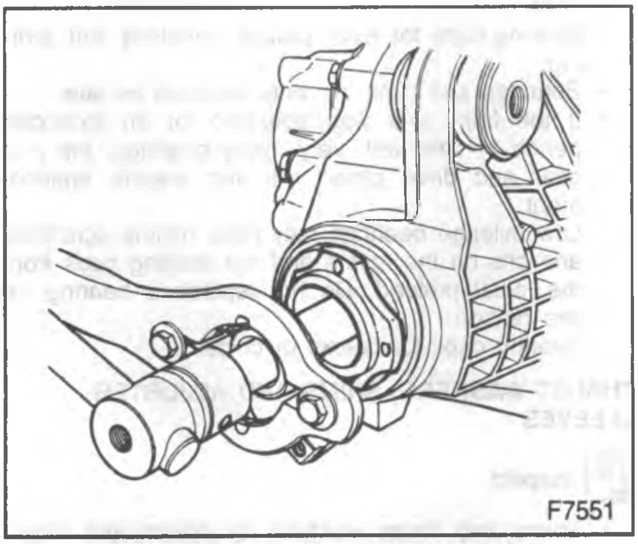


Figure 9—Removing the Pinion Nut

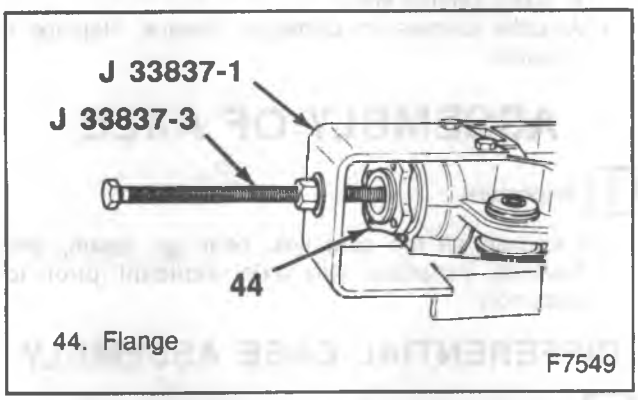


Figure 10—Removing the Pinion Flange

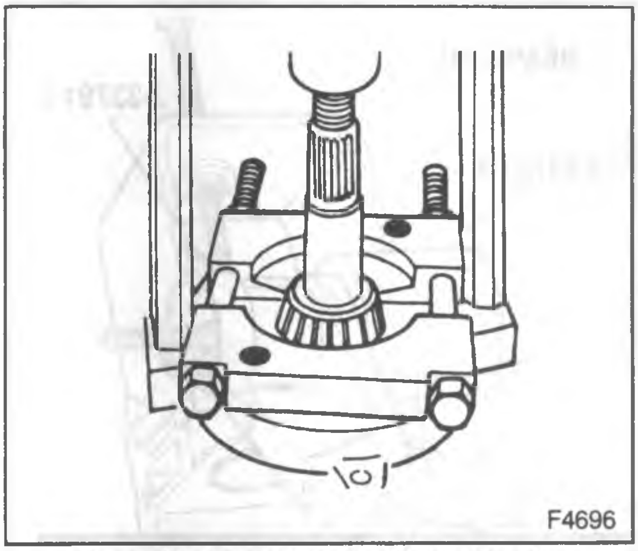


Figure 11—Removing the Pinion Bearing

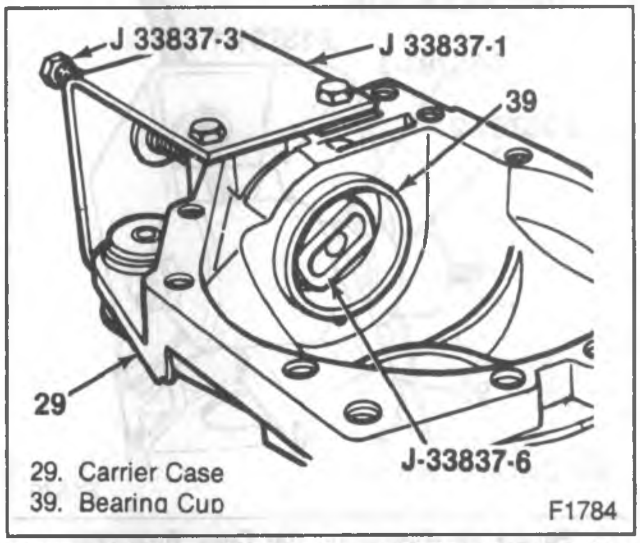


Figure 12—Removing the Inner Pinion Bearing Cup

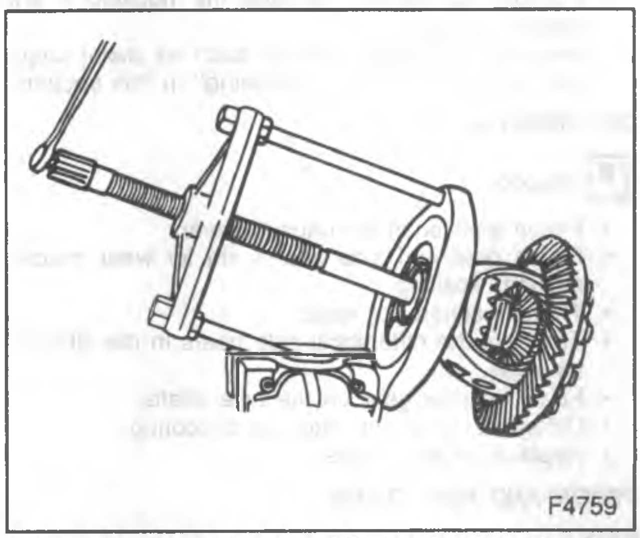


Figure 13—Removing the Differential Side Bearings

AXLE HOUSING

Inspect

- Carrier bore for nicks or burrs that would prevent the outer diameter of the pinion seal from sealing. Remove any burrs that are found.
- Bearing cup surfaces for nicks or burrs. Remove any burrs that are found.

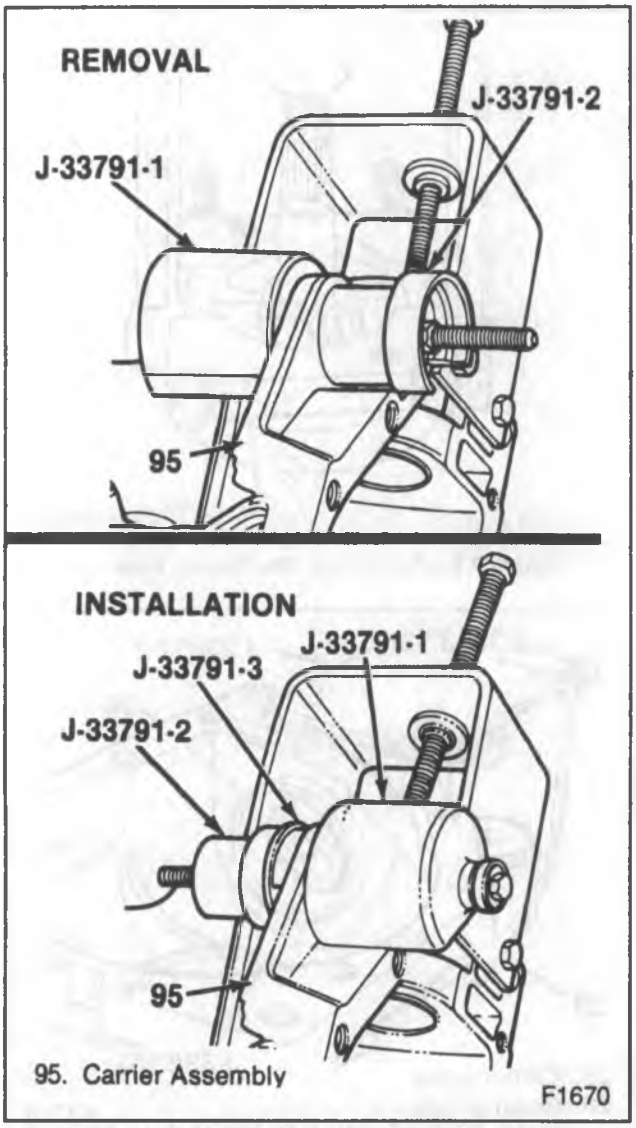


Figure 14—Replacing the Case Bushings

- Housing for cracks. Replace the housing if any cracks are found.
- Housing for foreign material such as metal chips, dirt, or rust. Refer to " Cleaning" in this section.

DIFFERENTIAL

Inspect

- Pinion gear shaft for unusual wear.
- Pinion gear and side gear teeth for wear, cracks, scoring, spalling.
- Thrust washers for wear.
- The fit of the differential side gears in the differential case.
- Fit of the side gear on the axle shafts.
- Differential case for cracks and scoring.
- Replace all worn parts.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion splines for wear.
- Pinion flange splines for wear.
- Fit of the pinion flange on the pinion.
- Sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the seal's inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and are both replaced any time a replacement of either is necessary.

BEARINGS

Inspect

- Bearings visually and by feel. The bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible.
- The large end of the bearing rollers for wear. This is where tapered roller bearing wear is most evident.
- Bearing cups for wear, cracks, brinelling and scoring.
- Bearings and cups are only replaced as sets.
- If the front axle was operated for an extended period of time with very loose bearings, the ring gear and drive pinion will also require replacement.
- Low mileage bearings may have minute scratches and pits on the rollers and the bearing cups from the initial preload. Do not replace a bearing for this reason.
- Bearing caps for cracks or chips.

THRUST WASHERS, SHIMS AND ADJUSTER SLEEVES

Inspect

- Shims and thrust washers for cracks and chips. Damaged shims should be replaced with an equally sized service shim.
- Adjuster sleeves for damaged threads. Replace if required.

ASSEMBLY OF AXLE

Important

- Lubricate all the seal lips, bearings, gears, and bearing surfaces with axle lubricant prior to assembly.

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figures 1, 2 and 15)

Tool Required:
J 33790 Side Bearing Installer

1. Thrust washers (53) and side gears (54) into the differential case (35).
   - If the same gears and washers are being used, install them on the same side from which they were removed.

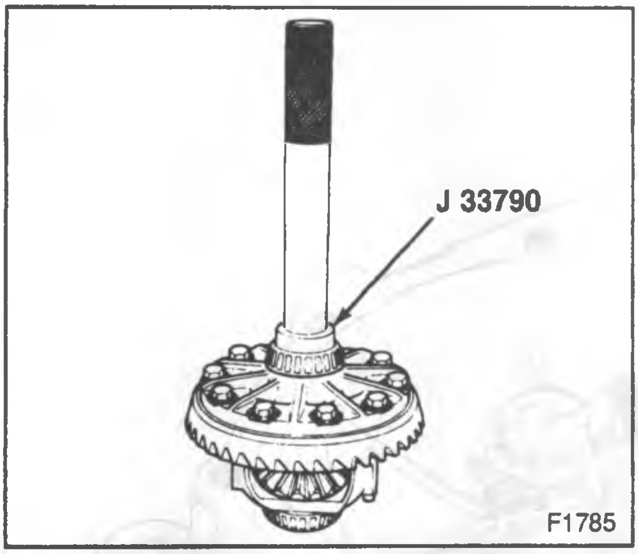


Figure 15—Installing the Differential Side Bearings

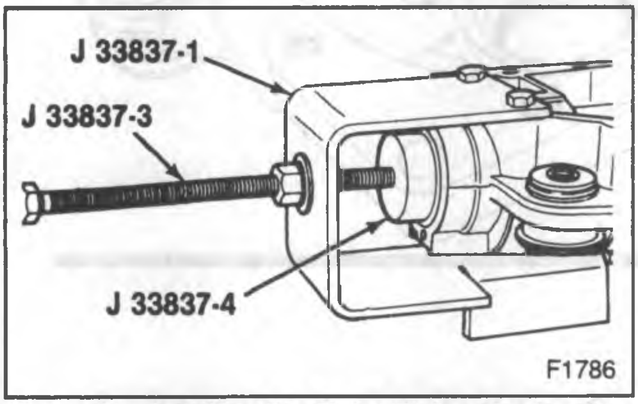


Figure 16—Installing the Outer Pinion Bearing Cup

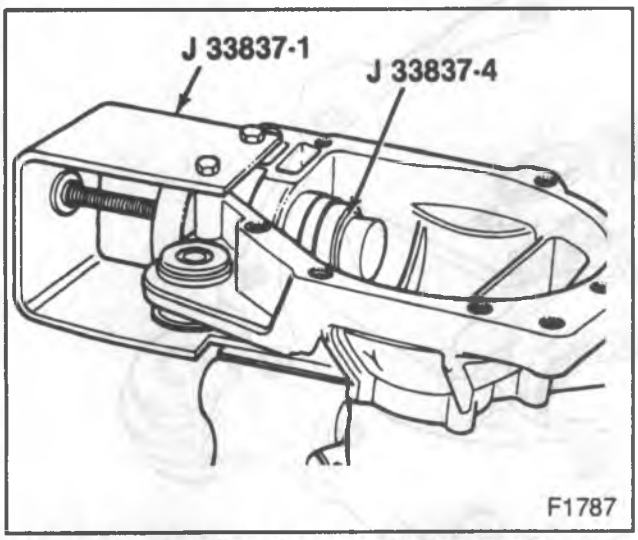


Figure 17—Installing the Inner Pinion Bearing Cup

2. Pinion gears (56).
   - Position one pinion gear (56) between the side gears and rotate the gears until the pinion gear is directly opposite the opening in the case.
   - Place the other pinion gear (56) between the side gears, making sure the hole in both pinion gears line up.
3. Thrust washers (55).
   - Rotate the pinion gears toward the opening just enough to permit the sliding in of the thrust washers.
4. Shaft (52) and bolt (36).
5. Ring gear (37) onto the differential case (35).
6. Bolts (34).

Important

- Always install new bolts. Never reuse the old bolts.

Tighten

- Bolts (34) alternating in progressive steps to 80 N·m (60 ft. lbs.).

7. Side bearings (33), using J 33790 (figure 15).

PINION BEARING CUP INSTALLATION

Install or Connect (Figures 1, 2, 15 and 17)

Tool Required:
J 33837 Pinion Bearing Remover and Installer

1. Bearing cup (41) into the case using J 33837-1, J 33837-3, and J 33837-4 (figure 16).
2. Bearing cup (39) into the case using J 33837-1, J 33837-3, and J 33837-4 (figure 17).

PINION DEPTH ADJUSTMENT

Tools Required:
J 33838 Pinion Depth Setting Gage
J 29763 Dial Indicator

1. Pinion depth is adjusted by selecting a shim (38) of the proper thickness.
2. Lubricate the inner and outer pinion bearings liberally with axle lubricant.
3. Hold the pinion bearings in position and install J 33838 and J 29763 (figure 18). Set the dial indicator at ZERO, then position it in J 33838. Push the dial indicator downward until the needle rotates approximately three turns to the right.
4. Tighten the dial indicator in this position.
5. Set the button of J 33838 on the differential bearing bore (figure 18).
6. Rotate the tool slowly back and forth until the dial indicator reads the lowest point of the bore. Set the dial indicator to ZERO. Repeat the rocking action of the tool to verify the ZERO setting.
7. After the ZERO setting is obtained and verified, move the tool button out of the differential side bearing bore (figure 18). Record the dial indicator reading.
8. The dial indicator reading is equal to the required shim size. Example: If the dial indicator reads 0.84 mm in step 8, a 0.84 mm shim is required. Available shim sizes are listed in "Specifications."
9. Remove the tools and bearing cones.

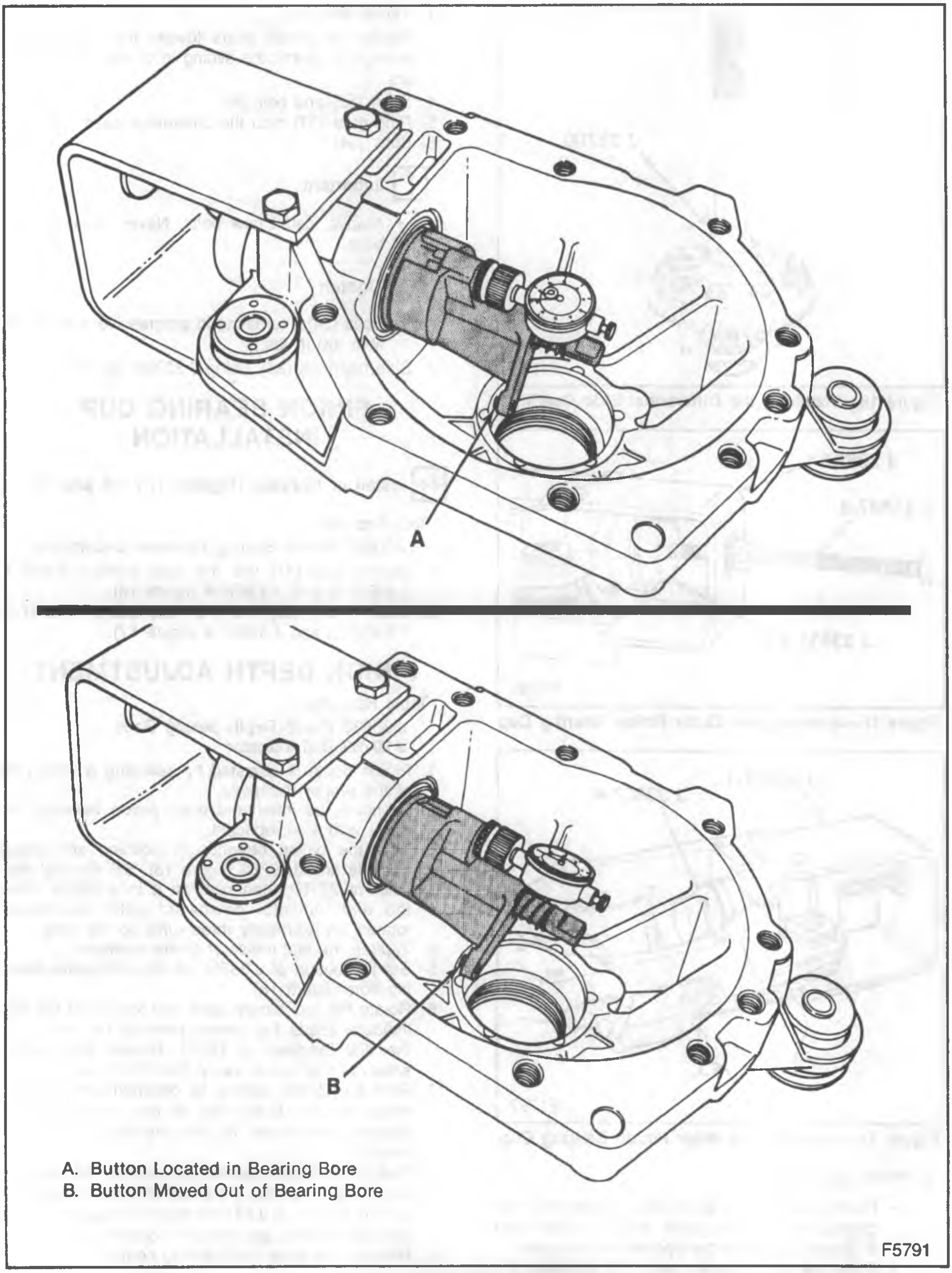


Figure 18—Measuring Pinion Depth

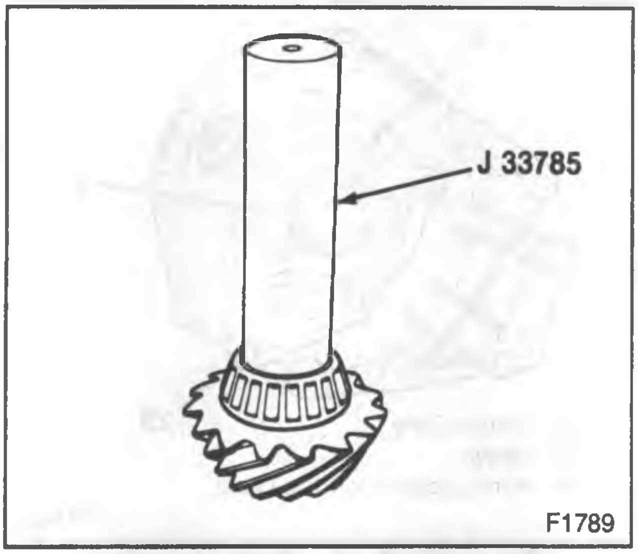


Figure 19—Installing the Pinion Bearing

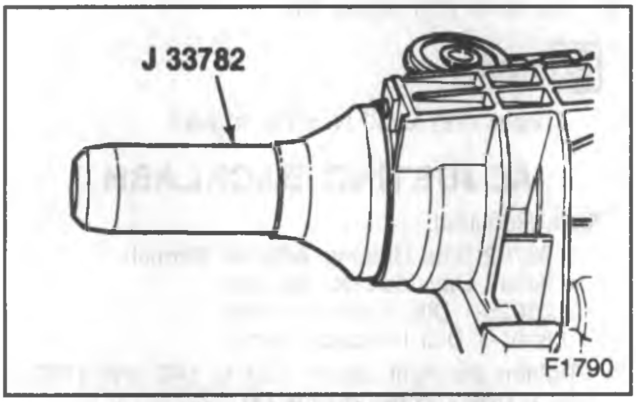


Figure 20—Installing the Pinion Seal

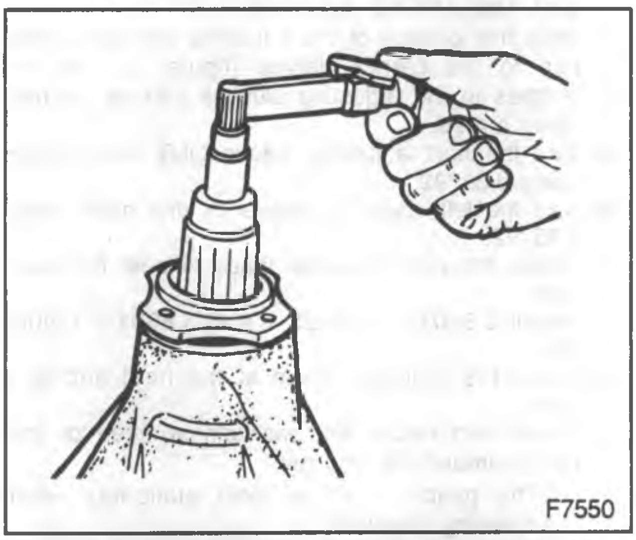


Figure 21—Measuring Pinion Bearing Preload

PINION INSTALLATION

Tools Required:

J 33785 Bearing Installer
J 8614-01 Pinion Flange Remover
J 33782 Seal Installer

1. Shim (38) to the pinion gear (37).
   - The shim must be of the proper size, as selected previously.
2. Bearing (39) onto the pinion gear (37) using J 33785 (figure 19).
3. New spacer (40) onto the pinion gear (37).
4. Bearing (41) into the case.
5. Seal (42) into the case using J 33782 (figure 20).
6. Pinion gear, with bearing and spacer, to the case.
7. Deflector (43), flange (44), washer (45) and nut (46).
   - Apply PST sealant (GM part number 1052080 or equivalent) to the pinion gear threads and on both sides of the washer.
   - Tighten nut (46) until no end play is detectable while holding the flange (44) with J 8614-01 (figure 9).
   - No further tightening should be attempted until bearing preload has been checked.

Measure

- Pinion bearing preload. Use an inch pound torque wrench (figure 21). The correct preload is 1.7-2.8 N·m (15-25 in. lbs.).

1. Rotate the pinion with the torque wrench and observe the reading.
2. If the preload torque is below specifications, continue torquing the pinion nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several inch pounds. If the bearing preload is exceeded, the pinion will have to be removed, and a new collapsible spacer installed.
3. Once the preload has been obtained rotate the pinion several times to make sure that the bearings have seated. Recheck the preload, and adjust if necessary.

DIFFERENTIAL ASSEMBLY INSTALLATION

Install or Connect (figures 1, 2, 22, 23 and 24)

Tools Required
J 33788 Bearing Installer
J 23423-A Bearing Cup Installer
J 33792 Side Bearing Adjuster Wrench

1. Bearing (30) into the sleeve (32) using J 33788 (figure 22).
2. Sleeves (32) into the carrier case (29). Thread in all the way.
3. Side bearing cups (33) into the carrier case (29) using J 23423-A.
4. Differential assembly to the carrier case.
   - Place the differential case assembly (35) into the carrier case half which contains the pinion gear.
   - Turn the left sleeve (32) in toward the differential case using J 33792 until backlash is felt between the ring and pinion gear.
5. Carrier case halves (29). Do not use any sealer at this time.
   - If the carrier halves do not make complete contact, back out the right hand adjusting sleeve (32). Use J 33792 (figure 23).

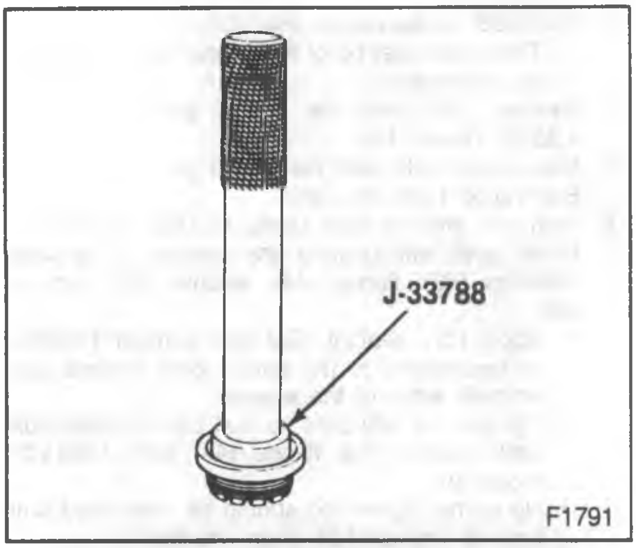


Figure 22—Installing the Sleeve Bearing

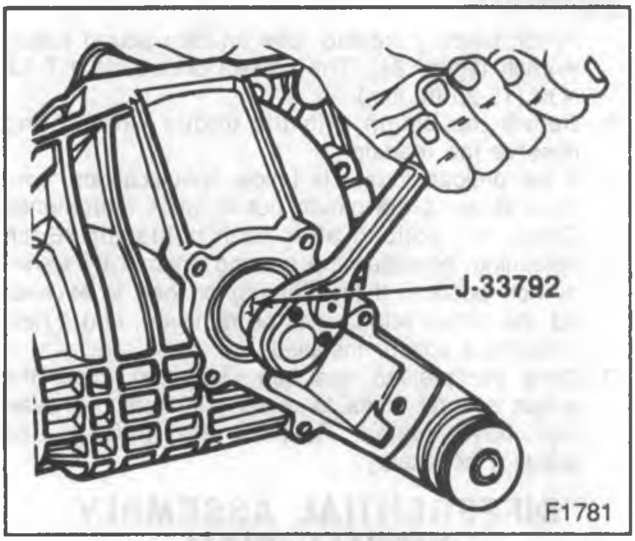
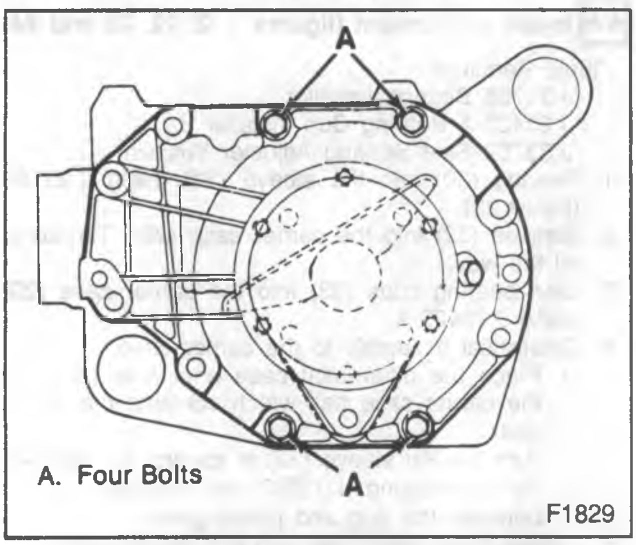
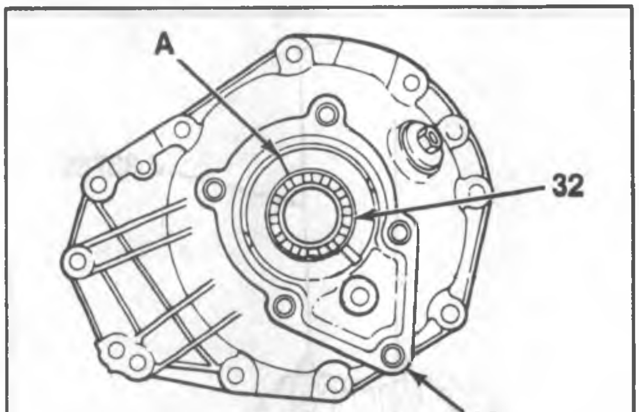


Figure 23—Adjusting the Sleeve



A. Four Bolts

Figure 24—Carrier Case Bolts Installed



29. Carrier Case
32. Sleeve
A. Mark Location on the Case

Figure 25—Marking Sleeve Location

6. Four bolts (28) (figure 24).

Tighten

- Bolts (28) to 50 N·m (37 ft. lbs.).

ADJUSTING BACKLASH

Tools Required:

J 33792 Side Bearing Adjuster Wrench
J 34047 Dial Indicator Adapter
J 25025-1 Dial Indicator Stand
J 8001-1 Dial Indicator Clamp

1. Tighten the right sleeve (32) to 140 N·m (100 ft. lbs.). Use J 33792 (figure 23).
2. Tighten the left sleeve (32) to 140 N·m (100 ft. lbs.). Use J 33792 (figure 23).
3. Mark the location of the adjusting sleeves in relation to the carrier halves (figure 25), so the notches in the adjusting sleeves can be counted when turned.
4. Turn the right adjusting sleeve OUT two notches using J 33792.
5. Turn the left adjusting sleeve IN one notch using J 33792.
6. Rotate the pinion several times to seat the bearings.
7. Install J 34047, J 25025-1 and J 8001-1 (figure 26).
8. Place the indicator stem at the heel end of a tooth.
9. Check and record the backlash at three or four points around the ring gear.
   - The pinion must be held stationary when checking backlash.
   - The backlash should be the same at each point within 0.05 mm (0.002-inch). If the backlash varies more than 0.05 mm (0.002-inch), check for burrs, a distorted case flange, uneven bolting conditions, or foreign matter between the case and the ring gear.
   - Gear backlash should be between 0.08-0.25 mm (0.003-0.010-inch) with a preferred specification of 0.13-0.18 mm (0.005-0.007-inch).

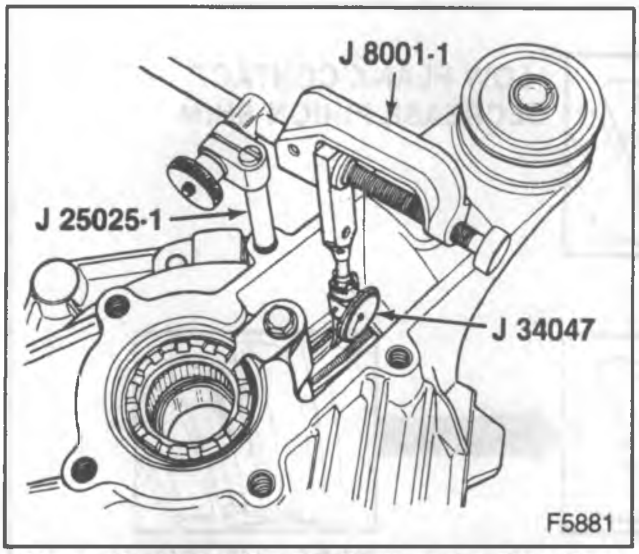


Figure 26—Measuring Backlash at the Ring Gear

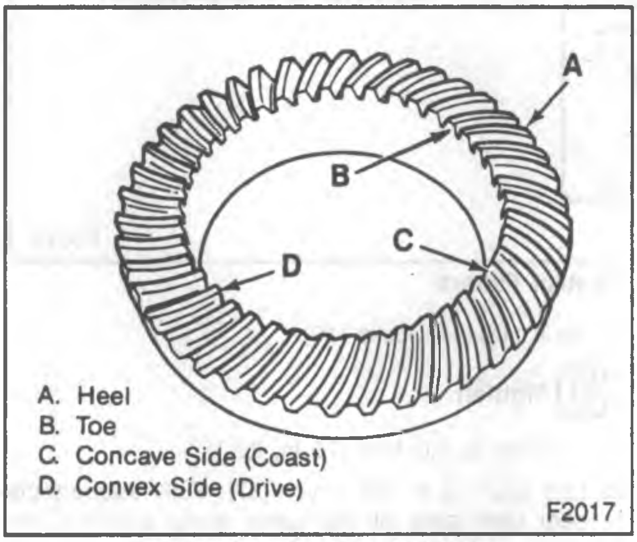


Figure 27—Gear Tooth Terms

- If the backlash is incorrect, adjust the sleeves as necessary. Always maintain the " one notch" preload on the side bearings. EXAMPLE. If it is necessary to turn the RIGHT sleeve IN one notch, the LEFT sleeve must be turned OUT one notch.
- To increase backlash, turn the left sleeve in, and turn the right sleeve out an identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

10. When the backlash is correct, mark the position of the sleeves so they can be kept in the same location.

GEAR TOOTH CONTACT PATTERN CHECK

Before final assembly of the differential, a gear tooth contact pattern check must be performed.

It should be noted that a gear tooth contact pattern check is NOT a substitute for adjusting pinion depth and backlash as previously outlined. It is a method to verify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy, or have a short life, or both. The best contact between the ring gear and the drive pinion for low noise level and long life can be assured with a pattern check.

GEAR TOOTH NOMENCLATURE

The side of the ring gear tooth which curves outward, or is convex, is referred to as the " drive" side. The concave side is the " coast" side. The end of the tooth nearest the center of ring gear is referred to as the " toe" end. The end of the tooth farthest away from the center is the " heel" end. The toe end of the tooth is smaller than the heel end, (figure 28).

TEST

1. Wipe oil out of carrier and carefully clean each tooth of the ring gear.
2. Use gear marking compound and apply this mixture sparingly to all ring gear teeth using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Apply a load until a torque of 54-70 N·m (40-50 ft. lbs.) is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn the companion flange with a wrench so that the ring gear rotates one full revolution then reverse the rotation so that the ring gear rotates one revolution in the opposite direction. Excessive turning of the ring gear is not recommended.
4. Observe the pattern on the ring gear teeth and compare with figure 29.

ADJUSTMENTS AFFECTING TOOTH CONTACT

Two adjustments can be made which will affect the tooth contact pattern. These are backlash and the position of the drive pinion (pinion depth) in the carrier. The effects of bearing preloads are not easily seen on hand loaded teeth pattern tests. These adjustments should be within specifications before proceeding with the backlash and the drive pinion adjustments.

It may be necessary to adjust both pinion depth and the backlash to obtain the correct pattern.

The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and the inner race of the rear bearing. The shim is used in the differential to compensate for manufacturing tolerances. Increasing the shim thickness will move the pinion closer to the center line of the ring gear.

Backlash is adjusted by means of the side bearing adjusting sleeves which move the entire case and ring gear assembly closer to, or farther from the drive pinion. (The adjusting sleeves are also used to set side bearing preload). To increase backlash, turn the left sleeve in and turn the right sleeve out an identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

It is important that the contact pattern be centrally located up and down on the face of the ring gear teeth.

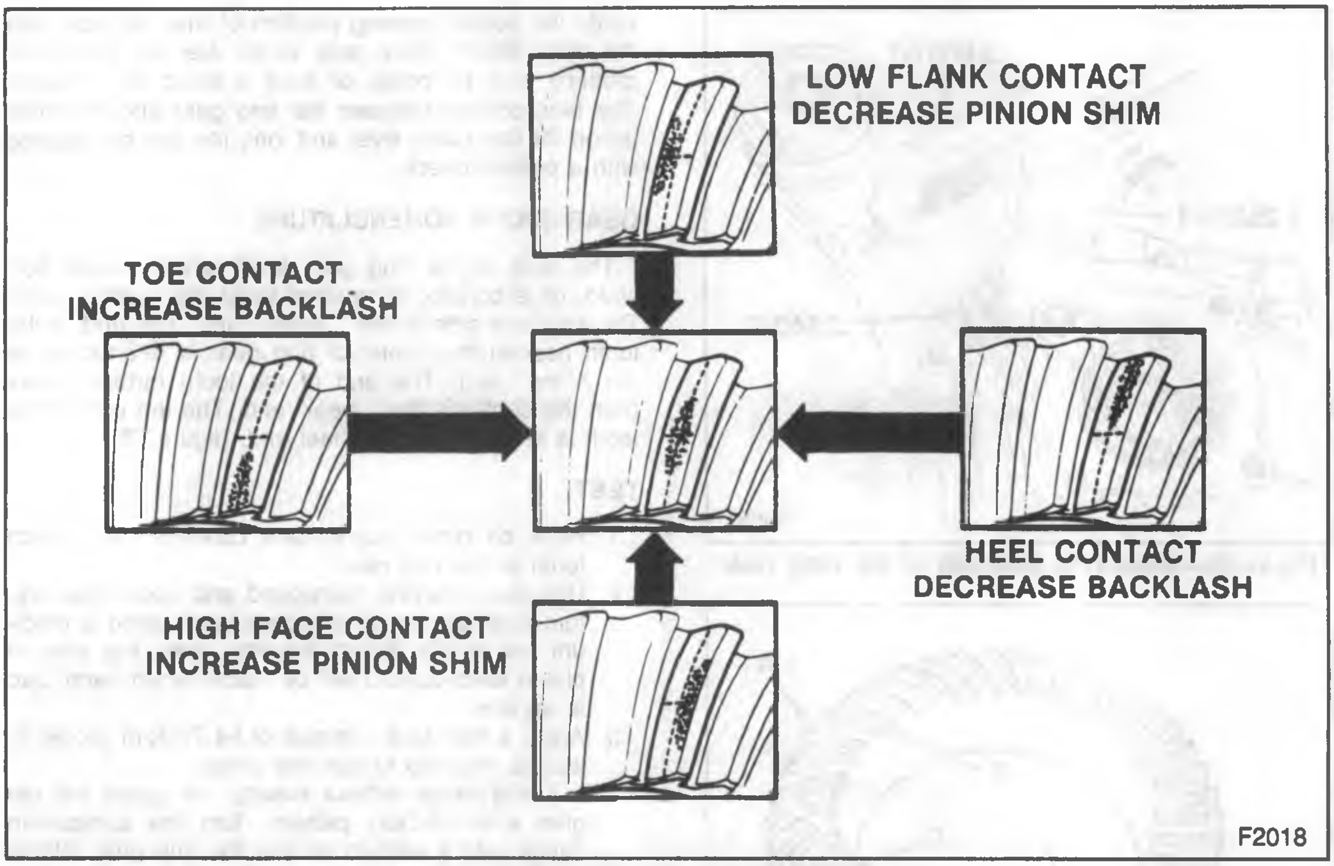


Figure 28—Gear Tooth Contact Pattern

FINAL ASSEMBLY

Remove or Disconnect (Figures 1, 2 and 24)

1. Four case bolts (figure 24).
2. Right carrier case half.

Clean

- Sealing surfaces on the carrier case halves. Remove all oil and grease. Use a chlorinated solvent, such as carburetor cleaner.

Install or Connect (Figures 1, 2 and 29)

Tools Required:
J 33844 Bearing Installer
J 33893 Axle Seal Installer
J 33791 Case Bushing Installer

- Apply a bead of sealer (GM part number 1052357 [Loctite 514] or equivalent) to one carrier case surface.

1. Right carrier case (29).
2. Bolts (28).

Tighten

- Bolts to 47 N·m (35 ft. lbs.).

- Make sure the sleeves (32) are in the proper position, as marked previously.

3. Bolts (18) and locks (19).

Tighten

- Bolts to 8.0 N·m (70 in. lbs.).

4. Left seal (3) to the cover (57). Fully support the seal bore area of the cover while installing the seal.

Clean

- All oil and grease from the cover and carrier sealing surfaces. Use carburetor cleaner or equivalent.

- Apply sealer (GM part no. 1052357 [Loctite 514] or equivalent) to the cover.

5. Cover (57) and bolts (58).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

6. Shaft (59) with deflector (2). Tap into place.
7. Bearing (4). Use J 33844.
8. Seal (3). Use J 33893 (figure 29).
   - Remove all oil and grease from the tube and carrier gasket surfaces. Use carburetor cleaner or equivalent.
   - Apply sealer (GM part no. 1052357 [Loctite 514]) or equivalent to the carrier.
9. Housing (5) to the carrier.

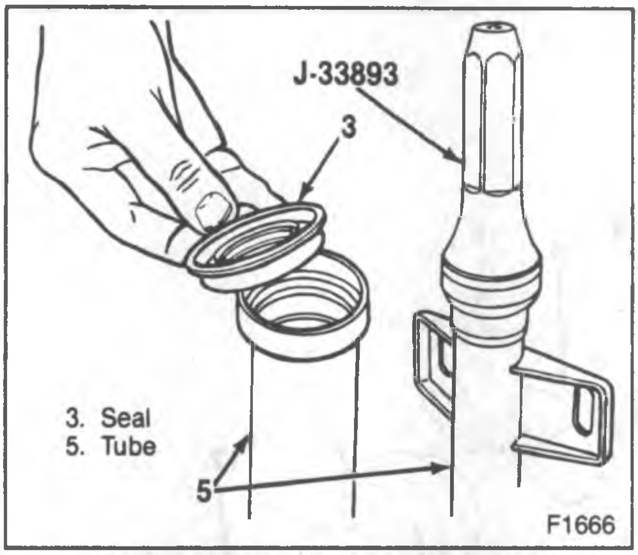


Figure 29—Installing the Shaft Seal

10. Bolts (6)

Tighten

- Bolts to 48 N·m (35 ft. lbs.).

11. Shaft (1).
    - Tap into place with a soft-faced mallet.
12. Bushings (48). Use J 33791 (figure 14).

DRIVE AXLE ASSEMBLY

OUTER DEFLECTING RING

Remove or Disconnect (Figures 30, 31 and 32)

1. Clamp the axle shaft (13) in a vice.
   - Use soft metal or wood to protect the shaft.
2. Deflecting ring (21) from C/V outer race (20) with a brass drift and a hammer as shown and discard.

Install or Connect

1. Position and square up deflecting ring (21) at press diameter of C/V outer race (20).
2. Using a 3" pipe coupling, M24x2.0 nut and fabricated sheet metal plate as shown in Figure 32, tighten nut until deflector (21) bottoms against shoulder of C/V outer race (20).

OUTER JOINT SEAL

Remove or Disconnect (Figures 30 and 33 through 36)

Tools Required:
J 8059 Snap Ring Pliers
J 35910 Seal Clamp Tool
J 36652 Swage Clamp Tool

1. Large swage ring (15) from C/V joint, using chisel and discard.

Important

- Do not cut through seal (14) and damage sealing surface of C/V outer housing (20) with chisel.

2. Small seal-retaining clamp (12) on axle shaft with side cutter and discard.
3. Separate joint seal (14) from C/V joint race (20) at large diameter and slide seal away from joint along axle shaft (13).
4. Wipe excess grease from face of C/V inner race (18).
5. Spread ears on race retaining ring (16) with J 8059 as shown and remove C/V joint assembly from axle shaft (13).
6. Seal (14) from axle shaft (13).
7. Disassemble joint and flush grease prior to installing new seal. See "Outer Joint Assembly" in this section.

Install or Connect

1. Small seal-retaining clamp (12) on neck of new seal (14). Do not crimp.
2. Slide seal (14) onto axle shaft (13) and position neck of seal in seal groove on axle shaft.
3. Crimp seal-retaining clamp (12) with J 35910 to 136 N·m (100 ft. lbs.). (See Figure 35).
4. Place approximately half of grease provided inside seal (14) and repack C/V with remaining grease.
5. Pinch swage ring (15) by hand slightly to distort into oval shape and slide onto large diameter of seal (14).
6. Push C/V joint onto axle shaft (13) until retaining ring (16) is seated in groove on axle shaft.
7. Slide large diameter of seal (14) with large swage ring (15) in place over outside of C/V joint race (20) and locate lip of seal in housing groove.

Important

- Seal (14) must not be dimpled, stretched or out of shape in any way. If seal is **not** shaped correctly, carefully insert a thin, flat, blunt tool **(no sharp edges)** between large seal opening and outer race (20) at a maximum clearance of oval ring (15) to equalize pressure. Shape seal properly by hand and remove tool.

8. Mount J 36652-1 swage clamp tool in vise and proceed as follows:
   — Position **outboard** end of axle assembly in tool.
   — Place top half of proper size tool on lower half of tool and check for proper alignment. (See Figure 36).
   — Insert bolts and tighten by hand until snug.

Important

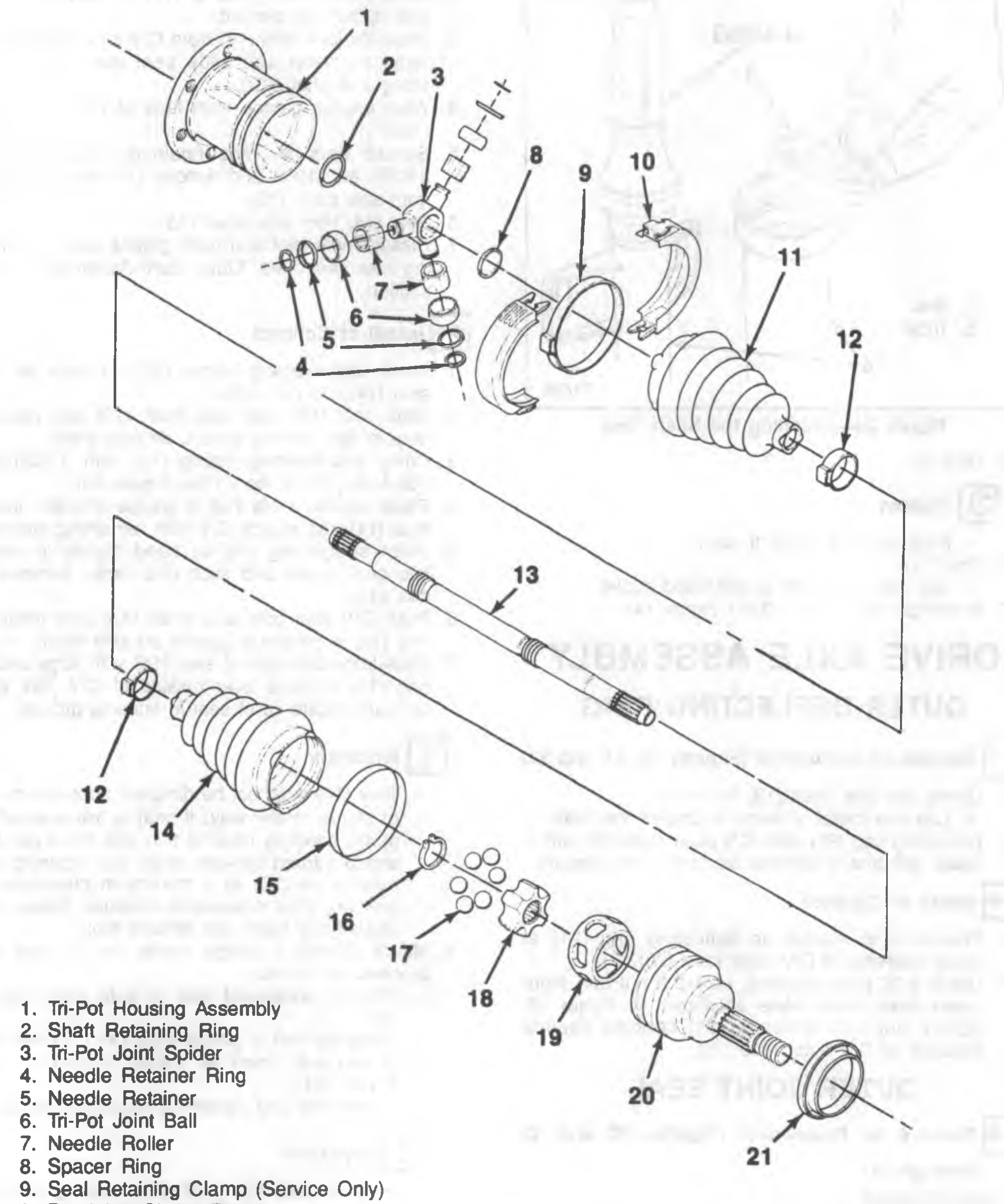
- Make sure that seal (14), housing (20) and swage ring (15) all remain in alignment. (See Figure 36).

   — Continue to tighten each bolt 180°at a time alternating until both sides are bottomed.
9. Remove axle assembly from tool.

OUTER JOINT ASSEMBLY

Disassemble (Figures 30, 37, 38, and 39)

1. Perform steps 1 through 7 in "Outer Joint Seal" Remove or Disconnect procedure in this section.



1. Tri-Pot Housing Assembly
2. Shaft Retaining Ring
3. Tri-Pot Joint Spider
4. Needle Retainer Ring
5. Needle Retainer
6. Tri-Pot Joint Ball
7. Needle Roller
8. Spacer Ring
9. Seal Retaining Clamp (Service Only)
10. Retaining Clamp Protector
11. Tri-Pot Joint Seal
12. Seal Retaining Clamp
13. Axle Shaft
14. C/V Joint Seal
15. Swage Ring
16. Race Retaining Ring
17. Ball
18. Inner Race
19. Cage
20. Outer Race
21. Deflector Ring

F7482

Figure 30—Front Drive Axle

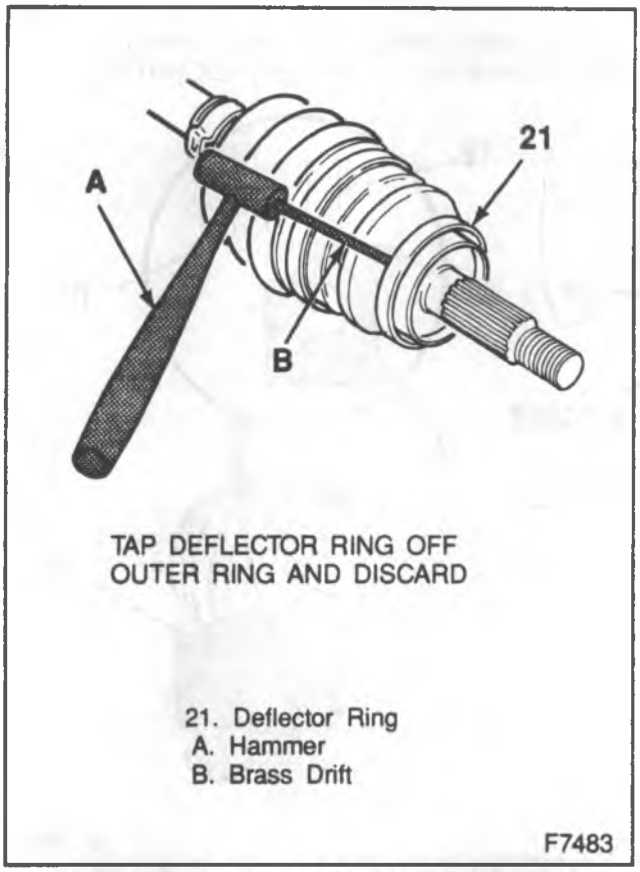


Figure 31—Removing Outer Deflector Ring

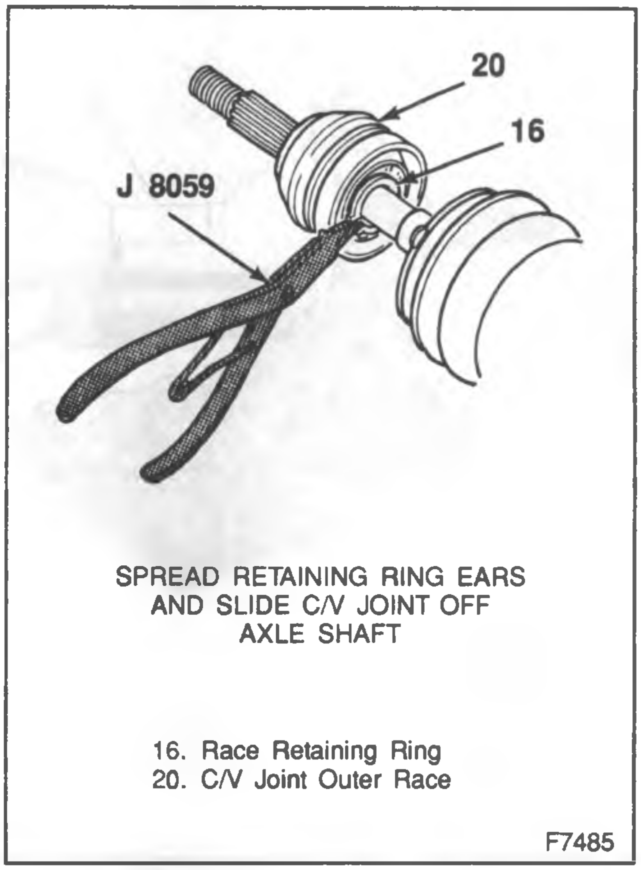


Figure 33—Separating C/V Joint and Axle

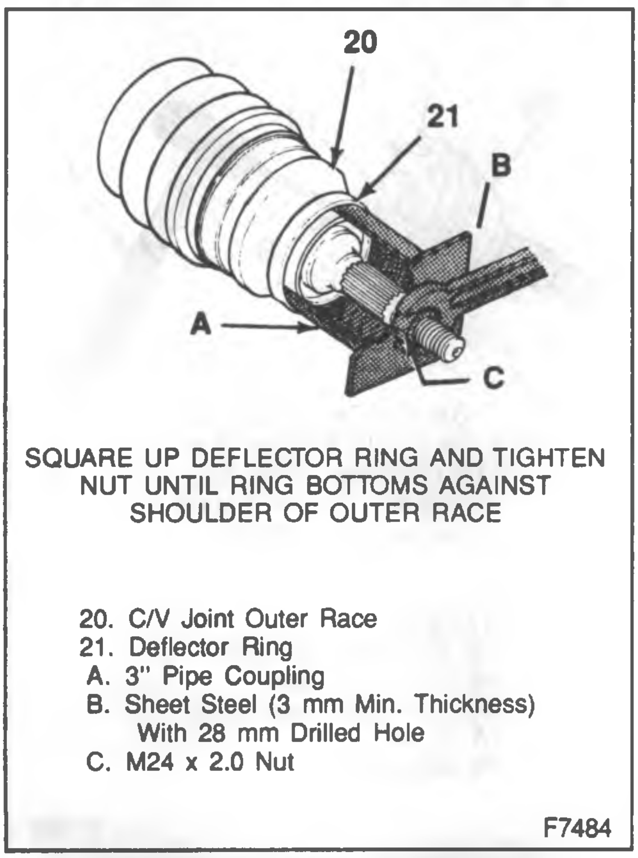


Figure 32—Installing Outer Deflector Ring

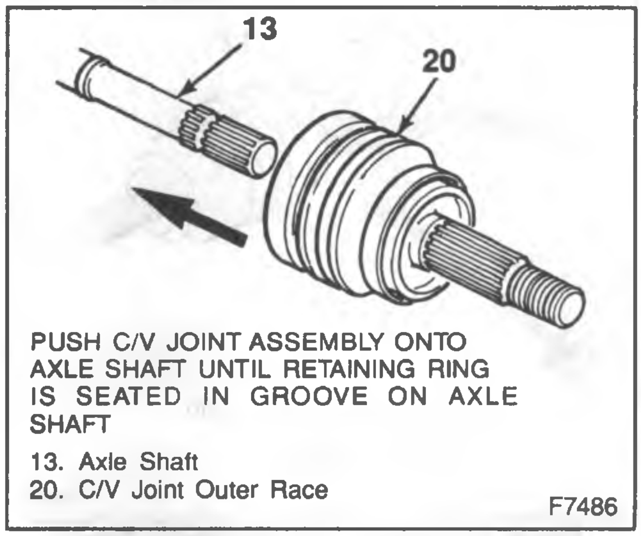


Figure 34—Installing C/V Joint to Axle

2. Use a brass drift and a hammer to gently tap on C/V joint cage (19) until it is tilted enough to remove first chrome alloy ball (17). (See Figure 37).
3. Tilt cage (19) in opposite direction to remove opposing ball (17).
4. Repeat this process until all six balls (17) are removed.
5. Position cage (19) and inner race (18) 90°to center line of outer race (20) and align cage windows with lands of outer race. (See Figure 38).

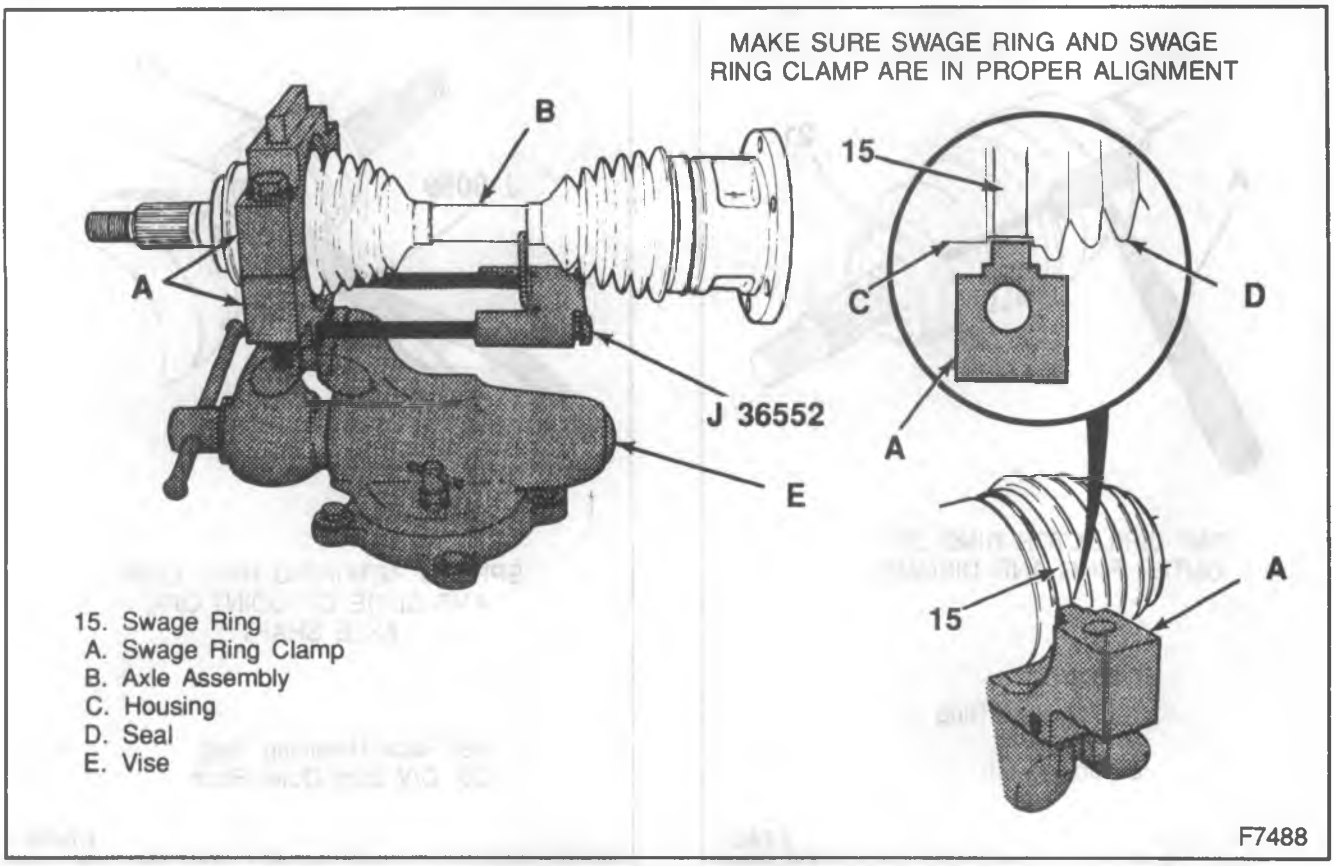


Figure 36—Installing Swage Ring

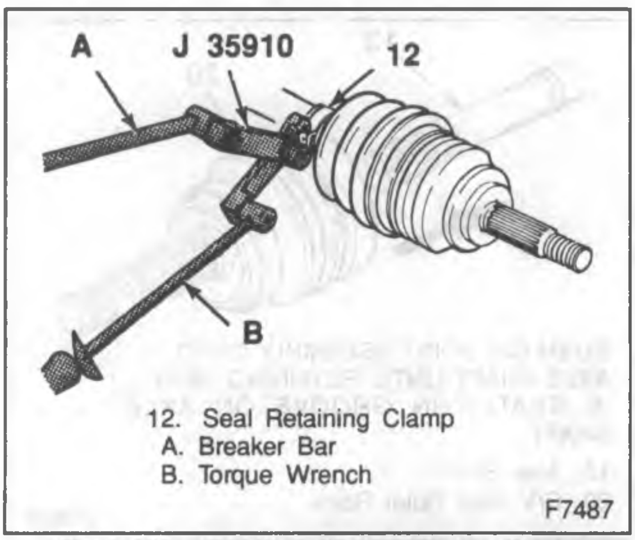


Figure 35—Installing Seal Retaining Clamp

6. Cage (19) and inner race (18) from outer race (20).
7. Rotate inner race (18) 90°to center line of cage (19) with lands of inner race aligned with windows of cage. (See figure 39).
8. Pivot inner race (18) into cage (19) window and remove inner race.

Assemble

1. Put a light coat of recommended grease on ball grooves of inner race (18) and outer race (20).
2. Reverse steps 1 through 8 of DISASSEMBLE procedure.

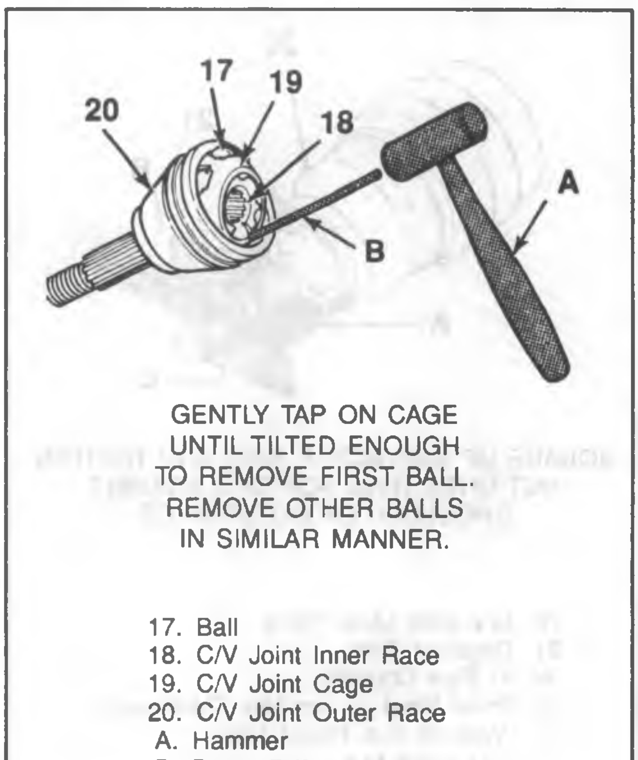
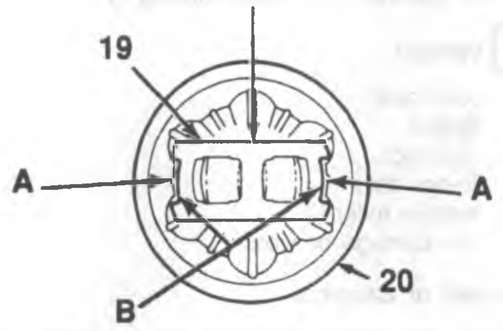


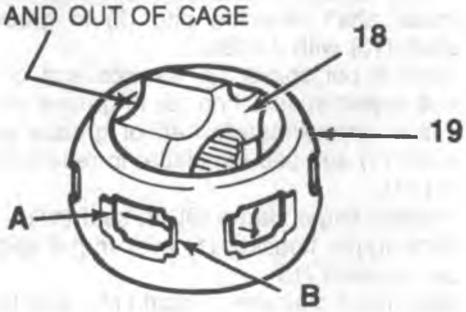
Figure 37—Removing C/V Joint Ball



19. C/V Joint Cage
20. C/V Joint Outer Race
A. Land
B. Window

F7490

Figure 38—Separating Outer Race and Cage



18. C/V Joint Inner Race
19. C/V Joint Cage
A. Inner Race Land
B. Cage Window

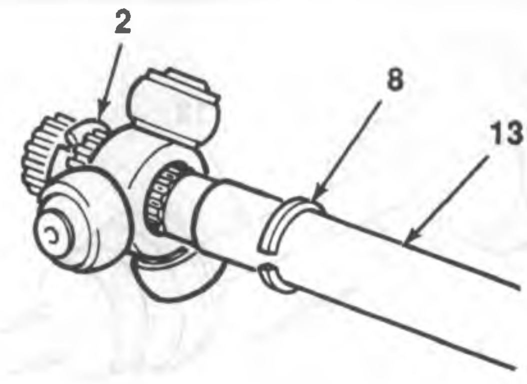
F7491

Figure 39—Separating Inner Race and Cage

Important

- Be sure that retaining ring side of inner race (18) faces axle shaft (13).

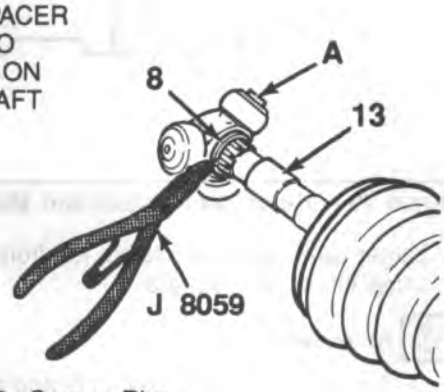
3. Perform steps 1 through 9 in "Outer Joint Seal" Install or Connect procedure in this section.



2. Shaft Retaining Ring
8. Spacer Ring
13. Axle Shaft
A. Spider Assembly

F7492

Figure 40—Removing Spider Assembly



8. Spacer Ring
13. Axle Shaft
A. Spider Assembly

F7493

Figure 41—Installing Spider Assembly

INNER TRI-POT SEAL

Remove or Disconnect (Figures 30, 35, 40, 41, 42 and 43)

Tools Required:
J 8059 Snap Ring Pliers
J 35910 Seal Clamp Tool

1. Retaining clamp protector (10) from larger seal retaining clamp (9) (if so equipped).

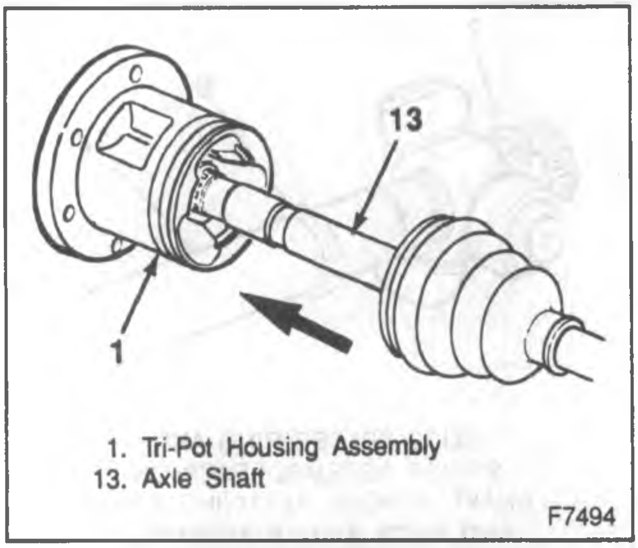


Figure 42—Installing Tri-pot to Housing

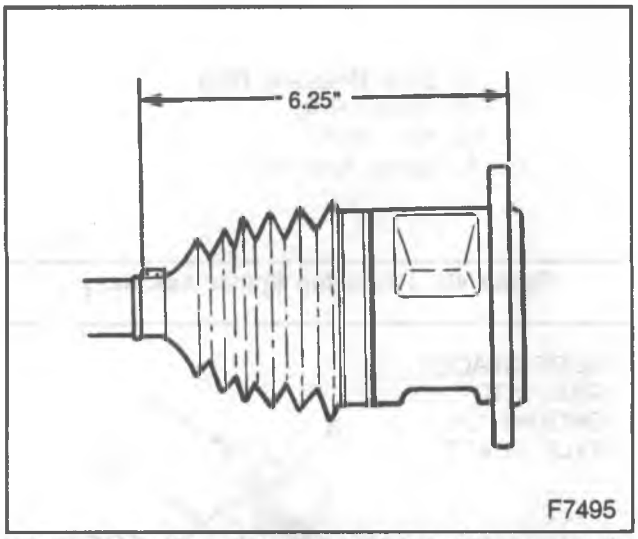


Figure 43—Tri-pot Seal Installation Measurement

2. Larger seal retaining clamp (9) from tri-pot joint, using chisel and discard.

Important

- Do not cut through seal (11) and damage sealing surface of tri-pot outer housing (1) with chisel.

3. Small seal-retaining clamp (12) from axle shaft (13) with side cutter and discard.
4. Seal (11) from tri-pot housing by separating (1) at large diameter and sliding seal away from joint along axle shaft (13).
5. Tri-pot housing (1) from spider (3) and shaft (13).
6. Spread spacer ring (8) with J 8059 and slide spacer ring and tri-pot spider (3) back on axle shaft (13) as shown.
7. Shaft retaining ring (2) from groove on axle shaft (13) and slide spider assembly off of shaft.

Inspect

- Tri-pot balls (6) and needle rollers (7) for damage and wear.

Important

- Handle the tri-pot spider assembly with care. Tri-pot balls and needle rollers may separate from spider trunnions.

8. Remove spacer ring (8) and seal (11) from axle shaft (13).
9. Flush grease from tri-pot housing (1).

Inspect

- Joint seal
- Spider
- Housing
- Tri-pot balls
- Needle roller

For damage or wear

Install or Connect

1. Small seal-retaining clamp (12) on neck of seal (11). **Do not crimp.**
2. Slide seal (11) onto shaft (13) and position neck of seal in seal groove on axle shaft (13).
3. Crimp seal retaining clamp (12) with J 35910 to 136 N·m (100 ft. lbs.) as shown (Figure 35).
4. Spacer ring (8) on axle shaft (13) and beyond 2nd groove as shown.
5. Slide tri-pot spider assembly against spacer ring (8) on shaft (13).

Important

- Be sure that counterbore face of tri-pot spider (3) faces end of shaft (13).

6. Install shaft retaining ring (2) in groove of axle shaft (13) with J 8059.
7. Slide tri-pot spider (3) towards end of shaft (13) and reseat spacer ring (8) in groove on shaft.
8. Place approximately half of grease provided in seal (11) and use remainder to repack tri-pot housing (1).
9. Position larger clamp (9) on seal (11).
10. Slide tri-pot housing (1) over tri-pot spider assembly on shaft (13).
11. Slide large diameter of seal (11), with larger clamp (9) in place, over outside of tri-pot housing (1) and locate lip of seal in housing groove.
12. Position the tri-pot assembly at the proper vehicle dimension as shown in Figure 43.

Important

- Seal (11) must not be dimpled, stretched or out of shape in any way. If seal is **not** shaped correctly, carefully insert a thin, flat, blunt tool **(no sharp edges)** between large seal opening and housing (1) to equalize pressure. Shape seal properly by hand and remove tool.

13. Crimp seal retaining clamp (9) with J 35910 to 176 N·m (130 ft. lbs.) (Figure 35).

Important

- Make sure that seal (11), housing (1) and large clamp (9) all remain in alignment while crimping.

14. Retaining clamp protector (10) over larger seal retaining clamp (9) and snap into position.

Important

- Due to possible road hazards, a retaining clamp protector (10) must be installed when inboard seal or clamp is serviced.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Fastener	N·m	Ft. Lbs.	In. Lbs.
Tube Attaching Bolts	48	35	—
Left Hand Output Shaft Cover Bolts	25	18	—
Carrier Case Bolts	47	35	—
Adjusting Sleeve Lock Bolts	8.0	—	71
Differential Ring Gear Bolts	80	60	—

AVAILABLE SHIM SIZES

Pinion Shim Kits	0.53-0.64 mm 0.66-0.79 mm 0.81-0.94 mm

PINION PRELOAD AND BACKLASH

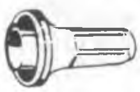
Pinion Preload	1.7-2.8 N·m (15-25 in. lbs.)
Backlash	0.08-0.25 mm (0.003-0.010-inch)
(Preferred)	0.13-0.18 mm (0.005-0.007-inch)

T2378

SPECIAL TOOLS

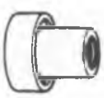
1.  J 21551

2.  J 29763

3.  J 33782

4.  J 33785

5.  J 33788

6.  J 33790

7.  J 33792

8.  J 22912-01

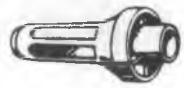
9.  J 23423-A

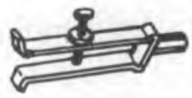
10.  J 33837

11.  J 33838

12.  J 8614-01

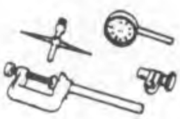
13.  J 33844

14.  J 33893

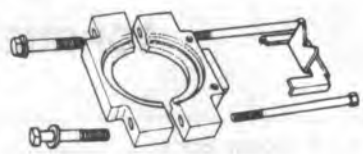
15.  J 29369-2

16.  J 29307

17.  J 33791

18.  J 8001

19.  J 25025-1

20.  J 36652

1. Output Shaft Bearing Remover
2. Dial Indicator
3. Pinion Oil Seal Installer
4. Pinion Bearing Installer
5. Output Shaft Bearing Installer
6. Differential Side Bearing Installer
7. Side Bearing Adjuster Wrench
8. Differential Side Bearing Installer
9. Bearing Cup Installer
10. Pinion Bearing Cup Remover and Installer
11. Pinion Shim Setting Gage
12. Pinion Flange Remover
13. Axle Tube Bearing Installer
14. Output Shaft Seal Installer
15. Countshaft Roller Bearing Remover
16. Slide Hammer
17. Bushing Remover
18. Dial Indicator Set
19. Dial Indicator Stand
20. Clamp Swage Tool Set

F7518

SECTION 5

BRAKES

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology NOTICE: See 'Notice' on page 5-1 of this section.

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense, it must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CONTENTS

HYDRAULIC BOOSTER

BENDIX HYRDO-BOOST

Remove or Disconnect (Figure 1)

Bendix Hydro Boost Model has identifying information stamped into the housing near the inlet line.

CAUTION: The accumulator contains compressed gas. Always use proper tools and follow recommended procedures or personal injury may result. Do not apply heat to accumulator. Do not attempt to repair an inoperative accumulator, always replace with a new accumulator. Dispose of an inoperative accumulator by drilling a $^{1}/_{16}$-inch diameter hole through the end of the accumulator can opposite the "O" ring.

Tools Required:
J 26889 Accumulator Compressor

- Place J 26889 over the end of the accumulator and install a nut onto the stud (figure 2).
- Depress the accumulator with a C-clamp.
- Insert a punch into the hole on the housing.

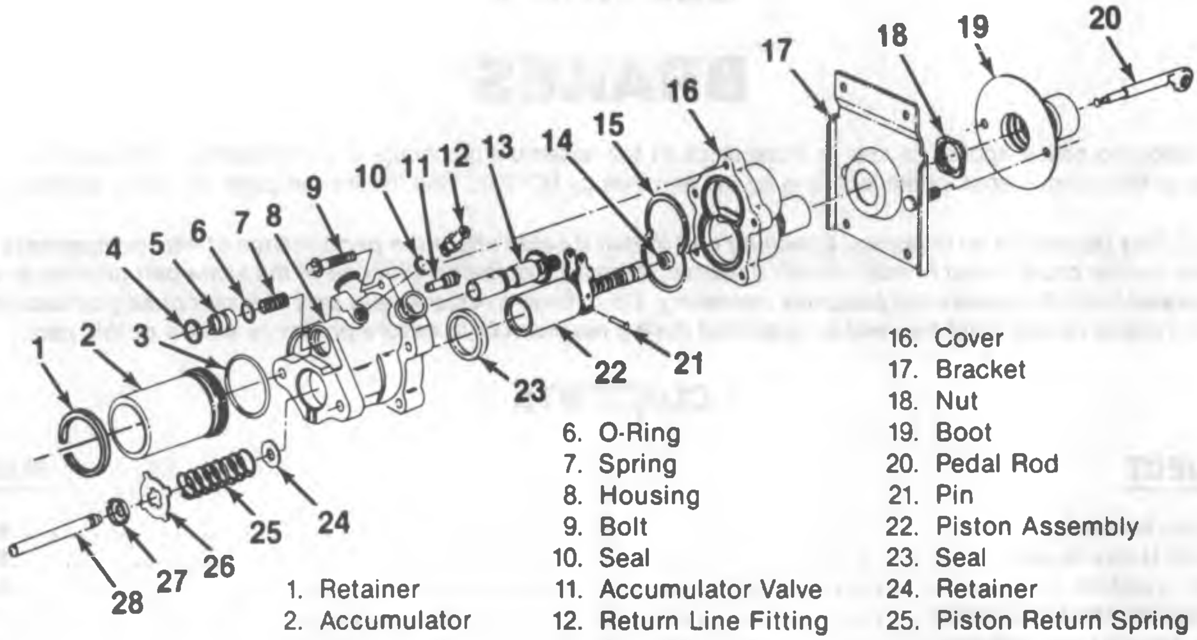
1. Retainer (1).
   - Release the C-clamp.
   - Remove J 26889.
2. Accumulator (2) and O-ring (3).
3. Retainer (4).
4. Plug (5), O-ring (6) and spring (7) (figure 3).
5. Retainer (26).
6. Output pushrod (28), baffle (27), piston return spring (25) and retainer (24).
   - Saw off the eyelet of the pedal rod (20).
7. Boot (19).
8. Nut (18) and bracket (17).
9. Bolts (9).
   - Separate the cover (16) from the housing (8).
10. Seals (14 and 15).
11. Piston assembly (22) and seal (23).
12. Spool valve (13).
13. Accumulator valve (11) (figure 4).
    - Make a wire hook to aid in the removal.
14. Return line fitting (12) and seal (10).

Clean

- All the parts with power steering fluid.

Inspect

- Spool valve and spool valve bore for corrosion, nicks and scoring. If found, replace the complete booster. Discoloration of the spool or bore is not harmful and is no cause for replacement.
- Housing and cover sealing surface for corrosion, or nicks.
- Tube seat in the housing for burrs, nicks or corrosion. Replace if needed (figures 5 and 6).



1. Retainer
2. Accumulator
3. O-Ring
4. Retainer
5. Plug
6. O-Ring
7. Spring
8. Housing
9. Bolt
10. Seal
11. Accumulator Valve
12. Return Line Fitting
13. Spool Valve
14. Seal
15. Seal
16. Cover
17. Bracket
18. Nut
19. Boot
20. Pedal Rod
21. Pin
22. Piston Assembly
23. Seal
24. Retainer
25. Piston Return Spring
26. Retainer
27. Baffle
28. Output Pushrod

F-00761

Figure 1—Hydro-Boost Components

Install or Connect (Figure 1)

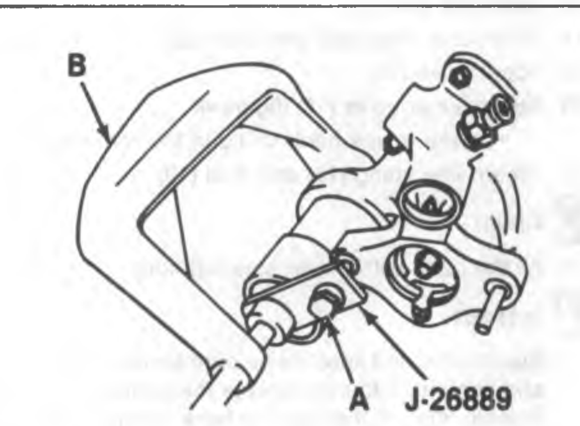
Tools Required:

J 26889 Accumulator Compressor
J 24551-A Seal Protector
J 25083 Seal Protector

NOTICE: For steps 8 and 9 see "Notice" on page 5-1 of this section.

- Lubricate all the seals and metal friction points with power steering fluid.

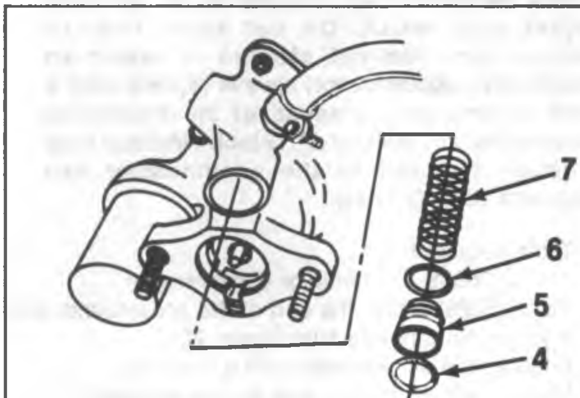
1. Seal (10) and return line fitting (12).
2. Accumulator valve (11).
3. Spool valve (13).
4. Seal (23) and piston assembly (22) by using J 24551-A or J 25083 (figure 7).
   - Lubricate the tool with clean power steering fluid.
5. Seal (14) onto the piston assembly (22).
6. Seal (15) onto the housing (8).
7. Cover (16).
8. Bolts (9).



A. Nut
B. C-clamp

F-00762

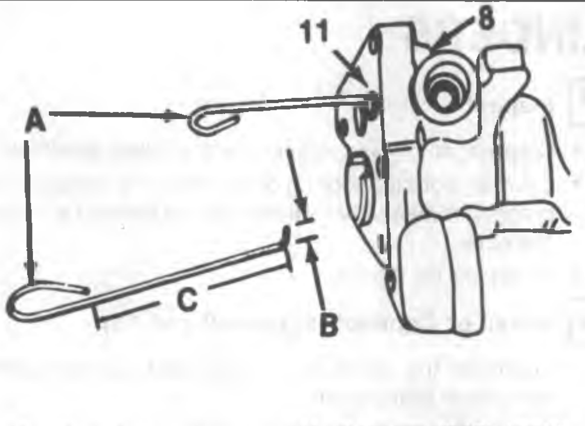
Figure 2—Removing the Accumulator



4. Retainer
5. Plug
6. O-Ring
7. Spring

F-00763

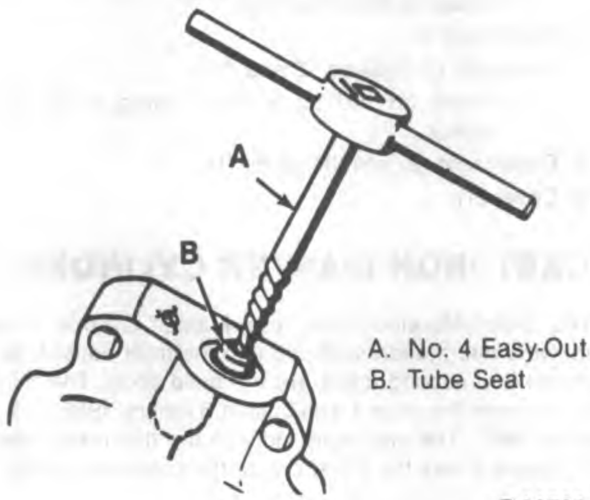
Figure 3—Removing the Plug and Spring



8. Housing
11. Accumulator Valve
A. Wire Hook
B. 3.0 mm (0.125-inch)
C. 57 mm (2.25-inches)

F-00768

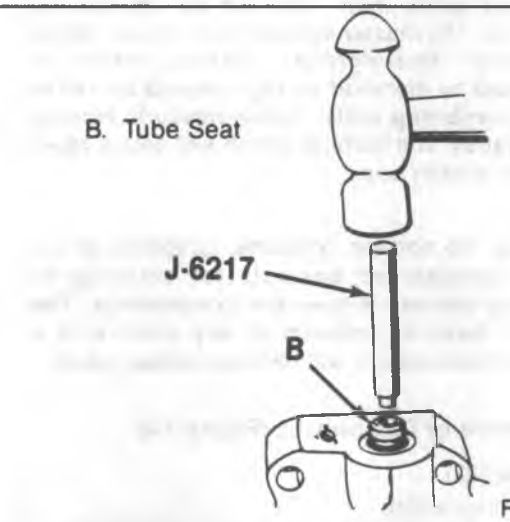
Figure 4—Removing the Accumulator Valve



A. No. 4 Easy-Out
B. Tube Seat

F-00765

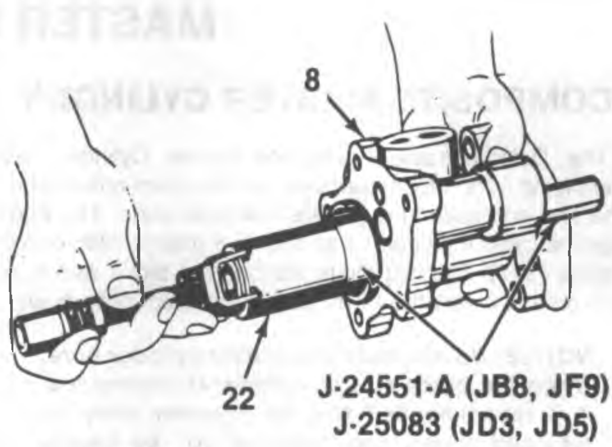
Figure 5—Removing the Tube Seat



B. Tube Seat

F-00764

Figure 6—Installing the Tube Seat



8. Housing
22. Piston Assembly

F-00766

Figure 7—Installing the Piston Assembly

Tighten

- Bolts to 30 N·m (22 ft. lbs.).

9. Bracket (17) and nut (18).

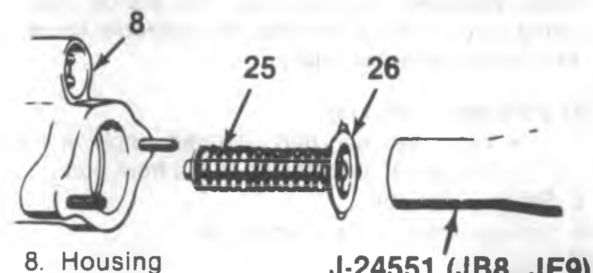
Tighten

- Nut to 149 N·m (110 ft. lbs.).

10. Boot (19).
11. Output pushrod (28), baffle (27), piston return spring (25) and retainer (24) by using J 24551-A or J 25083 (figure 8).
12. Retainer (26).
13. Spring (7), O-ring (6) and plug (5) (figure 3).
14. Retainer (4).
15. O-ring (3) and accumulator (2) by using J 26889 and a C-clamp (figure 2).
    - Depress the accumulator (2).
16. Retainer (1).
    - Release the C-clamp.
    - Remove J 26889.
17. Jam nut from the repair kit onto the pedal rod.
18. Eyelet onto the pedal rod.

Adjust

- Eyelet to the required length. Refer to HYDRAULIC BRAKES (SEC. 5A) in the 1989 Light Duty Truck Service Manual.



8. Housing
25. Piston Return Spring
26. Retainer

F-00767

Figure 8—Installing the Output Rod Retainer

MASTER CYLINDERS

COMPOSITE MASTER CYLINDER

The Delco-Moraine Composite Master Cylinder has identifying information stamped into the front outlet tube. The first and second digits are the build code. The third digit indicates the year it was built (a 5 means 1985 or a 6 means 1987). The last digits indicate the day it was built (271 means it was the 271st day of the production year).

NOTICE: Do not hone the master cylinder bore. When the brake master cylinder is overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. The master cylinder has a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this surface which will cause rapid wear of rubber cups.

NOTICE: Do not use kerosene, gasoline, or any other unapproved solvents for cleaning or flushing master cylinder and components. The use of these as solvents or any other with a trace of mineral oil will damage rubber parts.

Remove or Disconnect (Figures 9 and 10)

1. Cover (1).
2. Diaphragm (2).
- Drain all the brake fluid from the reservoir.
3. Reservoir (3) and grommets (4) (figure 11).
   - Clamp the mounting flange of the cylinder in a vise and pry the reservoir off with a bar.
4. Snap ring (11).
5. Primary piston assembly (12).

CAUTION: In the following step if air pressure is used to remove the secondary piston, place the open end of the cylinder bore approximately 25 mm (1-inch) from a padded workbench or other surface to catch the piston when it comes out of the bore. Apply low air pressure very carefully to ease the piston out of the bore. Never point the open end of the bore at anyone when applying air pressure. The piston may come out of the bore with considerable force and cause personal injury.

6. Secondary piston (9).
   - With the rear port plugged apply a small amount of air pressure to the front port.
7. Seals (8 and 10).
8. Spring retainer (7) and spring (6).

Clean

- All the metal parts in denatured alcohol.
- All the rubber parts in clean brake fluid.
- Stained or discolored cylinder bore with crocus cloth.

Inspect

- Diaphragm for cuts, cracks, or a swollen condition.
- Cylinder bore for scoring or corrosion. If corrosion is present, replace the cylinder. Do not attempt to hone the bore.
- Reservoir for cracks.

Install or Connect (Figures 9 and 10)

- Lubricate the grommets, seals, and cylinder bore with clean brake fluid.

1. Spring (6) and spring retainer (7).
2. Seals (8 and 10) onto the secondary piston (9).
3. Secondary piston (9).
4. Primary piston assembly (12).
5. Snap ring (11).
   - The primary piston must be compressed when installing the snap ring.
6. Grommets (4).
7. Reservoir (3) (figures 12 and 13).
   - Press on the body while using a rocking motion.
8. Diaphragm (2) into the cover (1).
9. Cover (1).

CAST IRON MASTER CYLINDER

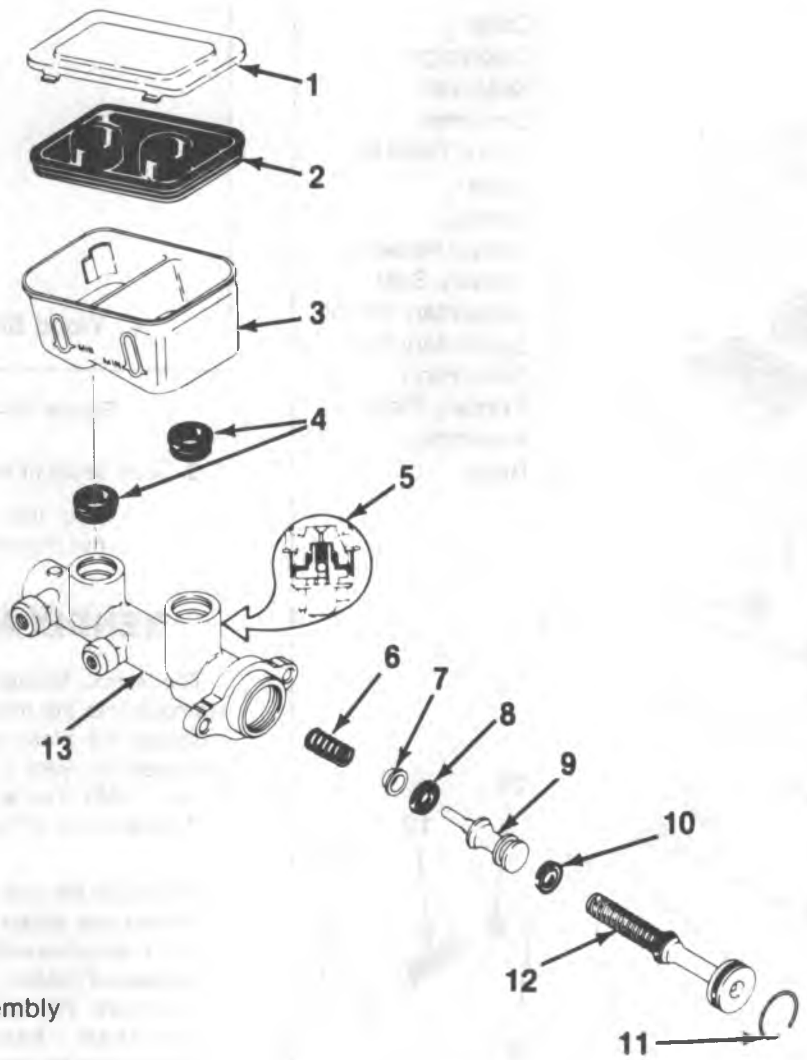
The Delco-Moraine Cast Iron Master Cylinder has identifying information stamped into the front outlet tube. The first and second digits are the build code. The third digit indicates the year it was built (a 5 means 1985 or a 7 means 1987). The last digits indicate the day it was built (271 means it was the 271st day of the production year).

NOTICE: Do not hone the master cylinder bore. When the brake master cylinder is overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. The master cylinder has a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this surface which will cause rapid wear of rubber cups.

NOTICE: Do not use kerosene, gasoline, or any other unapproved solvents for cleaning or flushing master cylinder and components. The use of these as solvents or any other with a trace of mineral oil, will damage rubber parts.

Remove or Disconnect (Figure 14)

1. Cover (22).
2. Diaphragm (23).
- Drain all the brake fluid from the reservoir.
3. Snap ring (31).
4. Primary piston assembly (30) (figure 15).



1. Cover
2. Diaphragm
3. Reservoir
4. Grommet
5. Quick Take-Up Valve
6. Spring
7. Spring Retainer
8. Primary Seal
9. Secondary Piston
10. Secondary Seal
11. Snap Ring
12. Primary Piston Assembly
13. Body

Figure 9—Composite Master Cylinder Components

CAUTION: In the following step if air pressure is used to remove the secondary piston, place the open end of the cylinder bore approximately 25 mm (1-inch) from a padded workbench or other surface to catch the piston when it comes out of the bore. Apply low air pressure very carefully to ease the piston out of the bore. Never point the open end of the bore at anyone when applying air pressure. The piston may come out of the bore with considerable force and cause personal injury.

5. Secondary piston (28).
   - With the rear port plugged apply a small amount of air pressure to the front port.
6. Secondary seals (29) from the secondary piston (28) (figure 16).
7. Spring retainer (26) and primary seal (27).
8. Spring (25).
9. Tube seats (if necessary) (figure 17).
   - Thread a self-tapping screw into the tube seat and remove with locking jaw pliers.

Clean

- All the metal parts in denatured alcohol.
- All the rubber parts in clean brake fluid.
- Stained or discolored cylinder bore with crocus cloth.

Inspect

- Diaphragm for cuts, cracks, or a swollen condition.
- Cylinder bore for scoring or corrosion. If corrosion is present, replace the cylinder. Do not attempt to hone the bore.

Install or Connect (Figure 14)

- Lubricate all the seals and cylinder bore with clean brake fluid.

1. Spring (25).
2. Primary seal (27) and spring retainer (26) onto the secondary piston (28) (figure 16).
3. Secondary seals (29) onto the secondary piston (28).
4. Secondary piston (28).

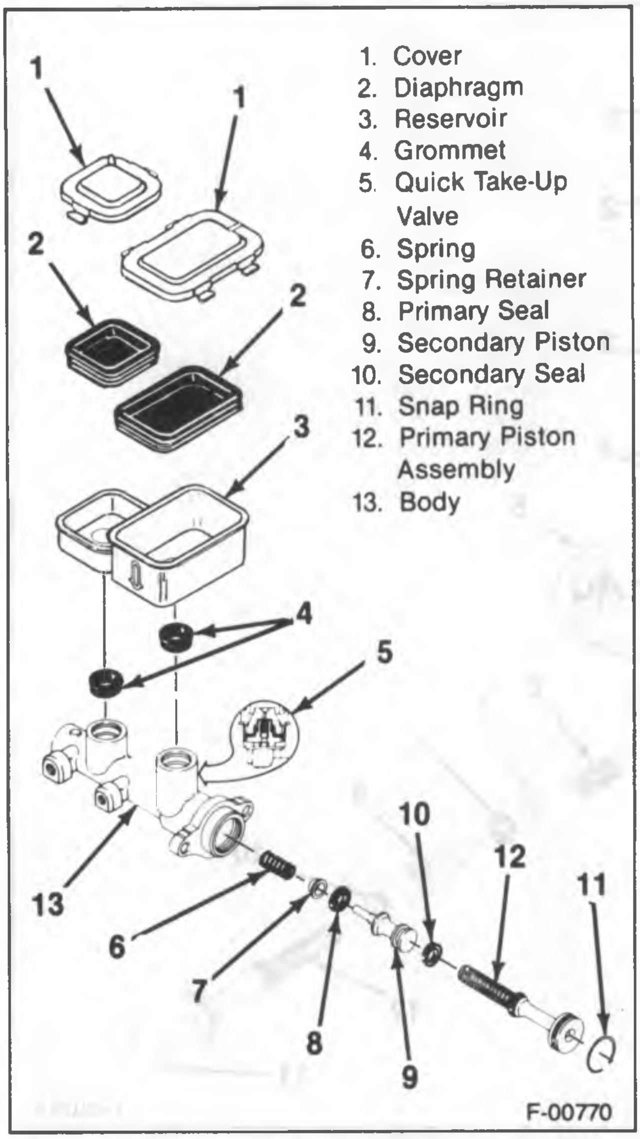


Figure 10—Composite Master Cylinder Components

5. Primary piston assembly (30).
6. Snap ring (31).
   - The primary piston must be compressed to install the snap ring.
7. Diaphragm (23) into the cover (22).
8. Cover (22).

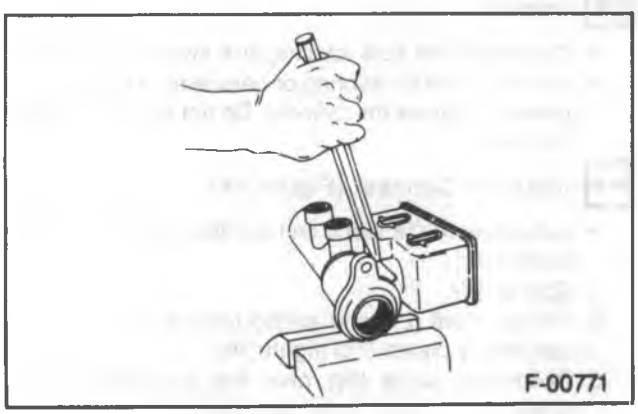


Figure 11—Removing the Reservoir

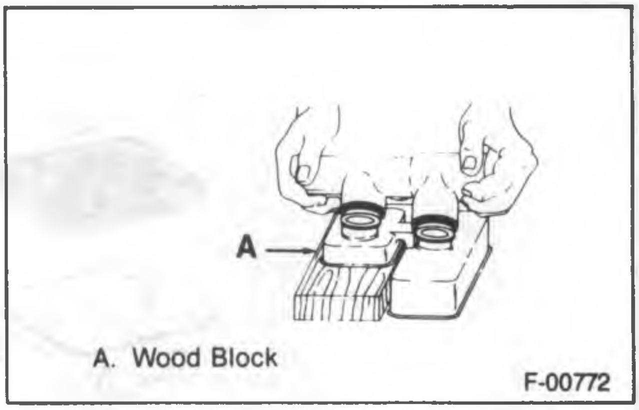


Figure 12—Installing the Reservoir

9. Tube seats (if removed).
   - Seat the tube seats with a spare brake tube nut (figure 18).

BENDIX MASTER CYLINDER

The Bendix Master Cylinder has identifying information stamped into the front surface of the body. The first digit indicates the plant where it was built. The second digit indicates the year it was built (a 5 means 1985 or a 6 means 1986). The last digits indicate the day it was built (271 means the 271st day of the production year).

NOTICE: Do not hone the master cylinder bore. When the brake master cylinder is overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. The master cylinder has a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this surface which will cause rapid wear of rubber cups.

NOTICE: Do not use kerosene, gasoline, or any other unapproved solvents for cleaning or flushing master cylinder and components. The use of these as solvents or any other with a trace of mineral oil will damage rubber parts.

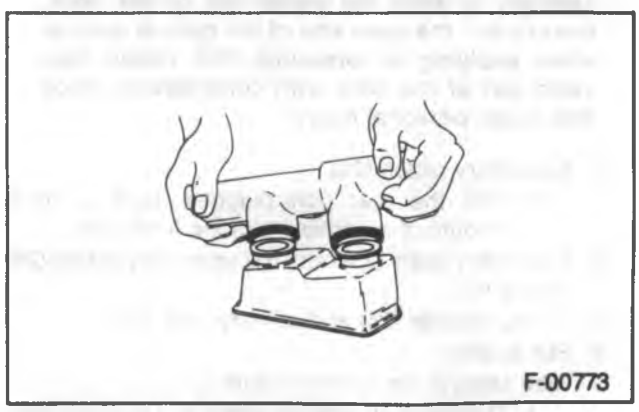


Figure 13—Installing the Reservoir

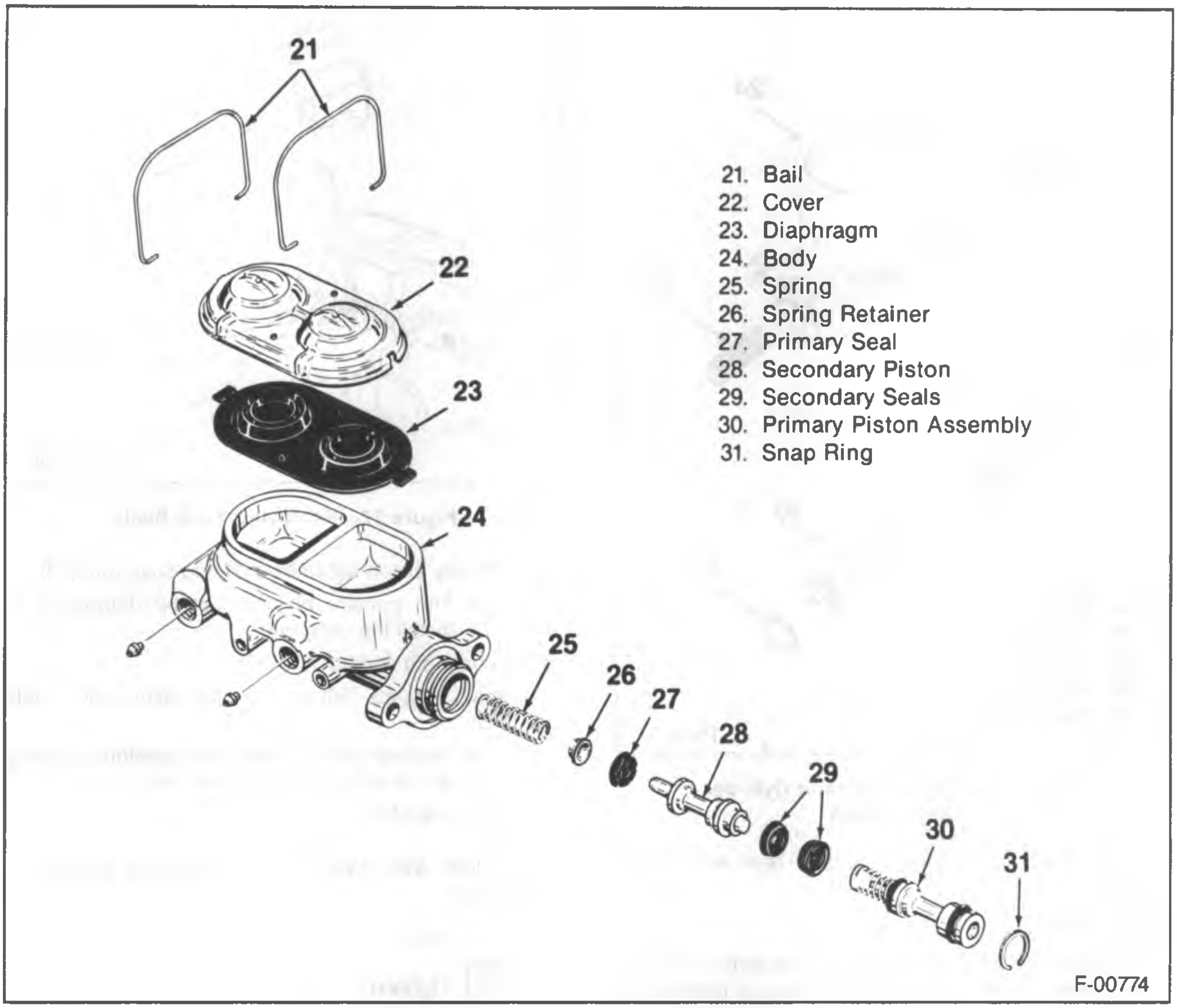


Figure 14—Cast Iron Master Cylinder Components

Remove or Disconnect (Figure 19)

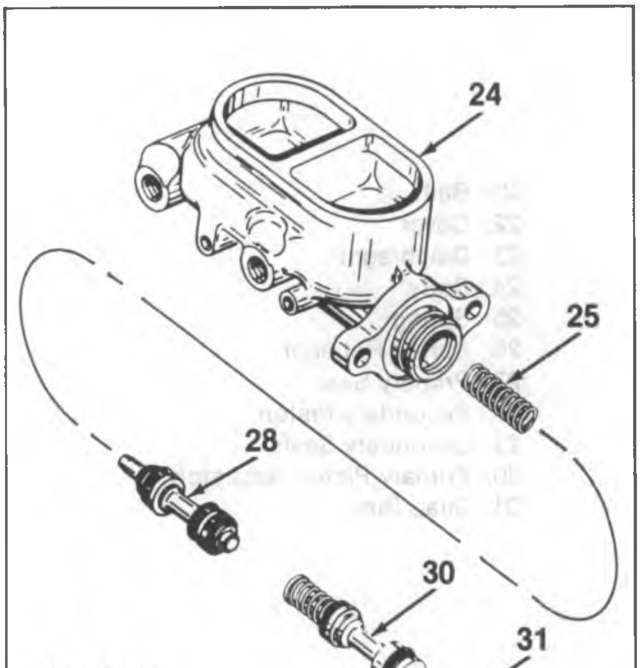
1. Cover (41).
2. Diaphragm (42).
   - Drain all the brake fluid from the reservoir.
3. Bolts (54) and reservoir (44).
4. O-ring (55) and compensating valve seals (45).
5. Valve poppets (46) and springs (47).
   - Depress the primary piston with a smooth rounded end tool.
6. Snap ring (52).
7. Primary piston assembly (51) and piston return spring (50).

CAUTION: In the following step if air pressure is used to remove the secondary piston, place the open end of the cylinder bore approximately 25 mm (1-inch) from a padded workbench or other surface to catch the piston when it comes out of the bore. Apply low air pressure very carefully to ease the piston out of the bore. Never point the open end of the bore at anyone when applying air pressure. The piston may come out of the bore with considerable force and cause personal injury.

8. Secondary piston assembly (49).
   - With the front port plugged, apply a small amount of air pressure to the front compensating valve port.
9. Secondary spring (48).

Clean

- All the metal parts in denatured alcohol.
- All the rubber parts in clean brake fluid.



24. Body
25. Spring
28. Secondary Piston
30. Primary Piston Assembly
31. Snap Ring

Figure 15—Cast Iron Master Cylinder Components

- A stained or discolored cylinder bore with crocus cloth.

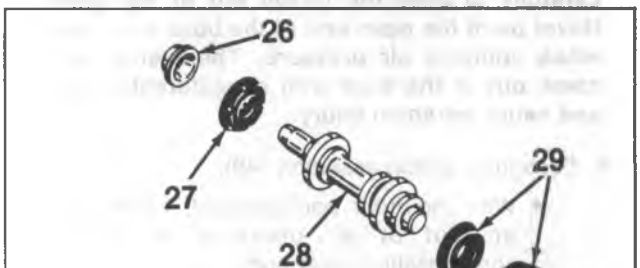
Inspect

- Diaphragm for cuts, cracks, or a swollen condition.
- Cylinder bore for scoring or corrosion. If corrosion is present, replace the cylinder. Do not attempt to hone the bore.

Install or Connect (Figure 19)

- Lubricate all the seals and cylinder bore with clean brake fluid.

1. Secondary spring (48).
2. Secondary piston assembly (49).
3. Piston return spring (50).



26. Spring Retainer
27. Primary Seal
28. Secondary Piston
29. Secondary Seals

Figure 16—Secondary Piston Assembly

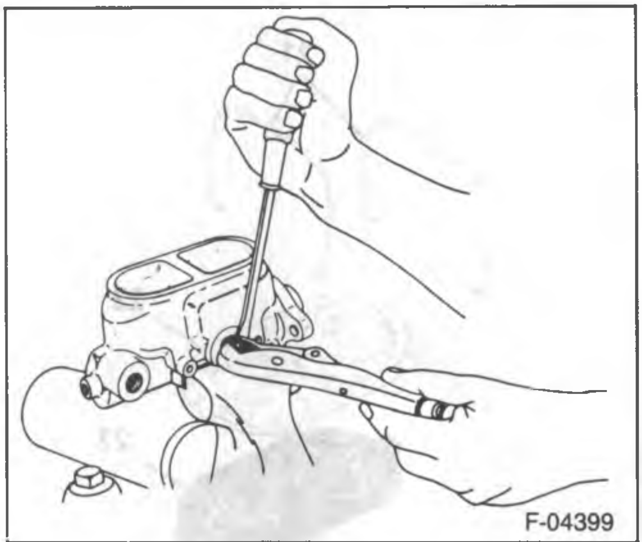


Figure 17—Removing Tube Seats

4. Primary piston assembly (51) and snap ring (52).
   - The primary piston must be depressed to install the snap ring.
5. O-ring (55) and springs (47).
6. Valve poppets (46) and compensating valve seals (45).
   - Depress and hold the primary piston assembly with a smooth rounded end tool.
7. Reservoir (44).

NOTICE: See "Notice" on page 5-1 of this section.

8. Bolts (54).

Tighten

- Bolts to 18 N·m (13 ft. lbs.).

9. Diaphragm (42) into the cover (41).
10. Cover (41).

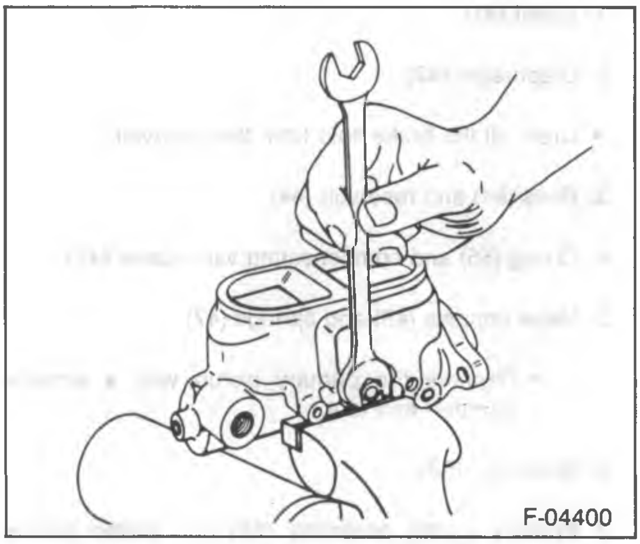
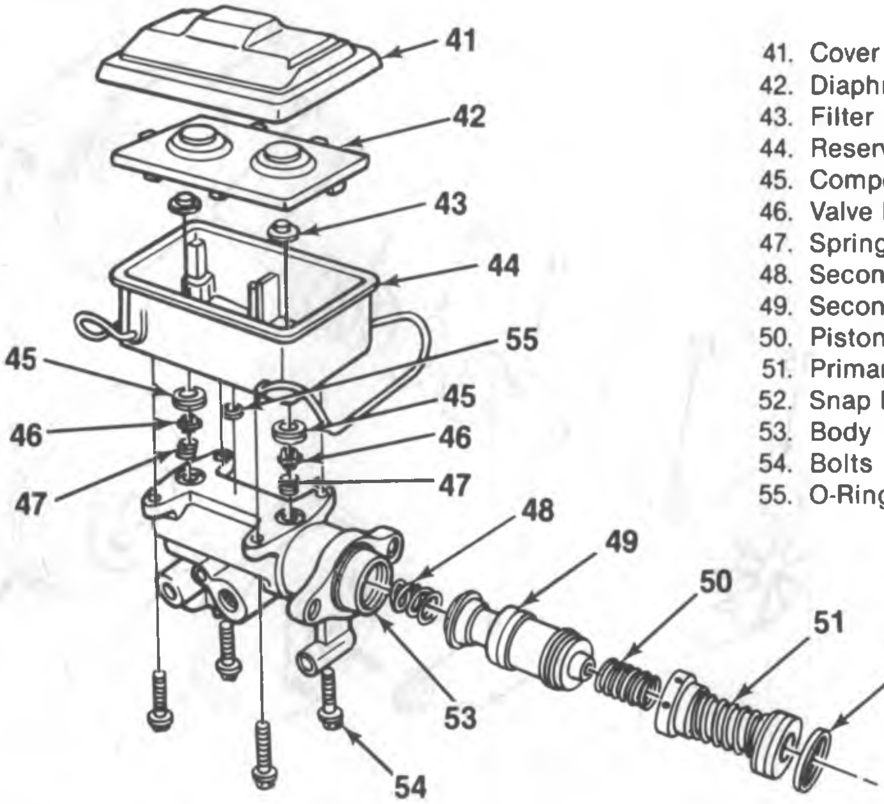


Figure 18—Installing Tube Seats



41. Cover
42. Diaphragm
43. Filter
44. Reservoir
45. Compensating Valve Seal
46. Valve Poppet
47. Spring
48. Secondary Spring
49. Secondary Piston
50. Piston Return Spring
51. Primary Piston
52. Snap Ring
53. Body
54. Bolts
55. O-Ring

Figure 19—Bendix Master Cylinder Components

VACUUM BOOSTERS

Delco-Moraine Vacuum Boosters have a build date on a small paper label glued onto the front housing. The first digit indicates the year it was built (a 5 means 1985 or a 6 means 1986). The last digits indicate the day it was built (271 means the 271st day of production year).

SINGLE DIAPHRAGM VACUUM BOOSTER

Remove or Disconnect (Figure 20)

Tool Required:

J 23456 Power Brake Booster Disassembly and Reassembly Fixture

1. Boot (1) and silencer (2).
2. Vacuum check valve (3) and grommet (4).
3. Front housing seal (5).
   - Scribe a mark across the front and rear housings to aid in assembly.
   - Use J 23456 to apply force in a counter clockwise direction to unlock the housings (figure 21).
4. Return spring (9) and power piston group.
5. Power piston bearing (6) from the rear housing (7).
6. Reaction body retainer (25).
7. Piston rod (10) and reaction retainer (11).
8. Filter (12) using an awl or similar tool.
9. Power piston and pushrod assembly (16).
   - Grasp the outside edge of the diaphragm support (15) and diaphragm (14). Hold the pushrod (19) down against a hard surface.
   - Use a slight force or impact to dislodge the diaphragm retainer (13).
10. Diaphragm (14) from the diaphragm support (15).

Inspect

- All parts for corrosion, nicks, cracks, cuts, scoring, distortion or excessive wear. Replace parts as necessary.
- Use crocus cloth to polish away minor corrosion of the housings or diaphragm support.

Clean

- All parts in clean denatured alcohol.
  — Do not immerse the power piston and pushrod assembly in alcohol.
- Dry with unlubricated compressed air.

1. Boot
2. Silencer
3. Vacuum check Valve
4. Grommet
5. Front Housing Seal
6. Power Piston Bearing
7. Rear Housing
8. Front Housing
9. Return Spring
10. Piston Rod (Gaged)
11. Reaction Retainer
12. Filter
13. Diaphragm Retainer
14. Diaghragm
15. Diaphragm Support
16. Power Piston and Pushrod Assembly
19. Pushrod
25. Reaction Body Retainer

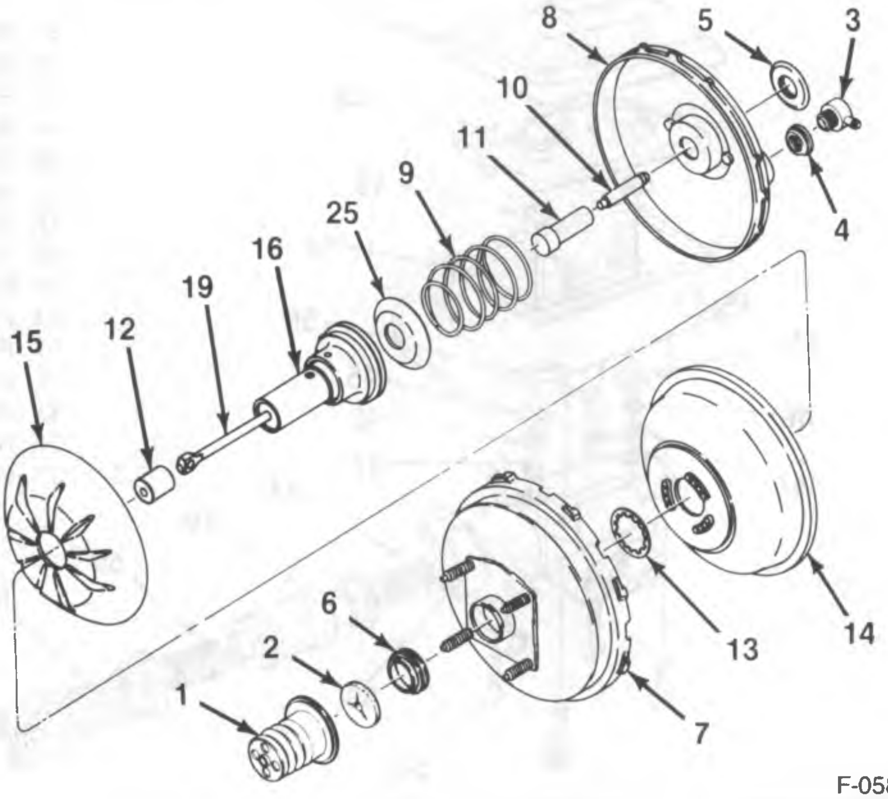


Figure 20—Single Diaphragm Vacuum Booster Components

Install or Connect (Figure 20)

Tools Required:
J 23456 Power Brake Booster Disassembly and Reassembly Tool
J 28458 Power Piston Seal Protector
J 37839 Pushrod Height Gage

1. Diaphragm (14) into the diaphragm support (15).
   - Lubricate the inside diameter of the diaphragm lip with a thin layer of silicone grease.
2. Diaphragm and diaphragm support onto the power piston and pushrod assembly.
3. New diaphragm retainer (13) (figure 22).
   - Seat the retainer using J 28458.
4. Filter (12), reaction retainer (11) and piston rod (10).
5. Reaction body retainer (25).
6. Power piston bearing (6) into the rear housing.
   - Lubricate the inside and outside of the bearing with silicone grease.
7. Power piston group into the rear housing (7).
8. Return spring (9).
9. Front housing to the rear housing.
   - Align the marks made during disassembly.
   - Use J 23456 to apply force in a clockwise direction to lock the front and rear housings.
   - Stake the housing at two tabs 180 degrees apart (figure 23).
     — Do not stake a tab that has previously been staked.
   - Assembly can be aided by connecting a vacuum source to the booster.
10. Grommet (4) and vacuum check valve (3).

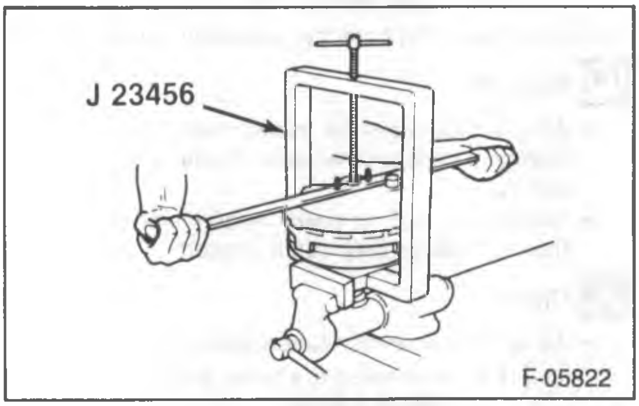


Figure 21—Unlocking and Locking Booster

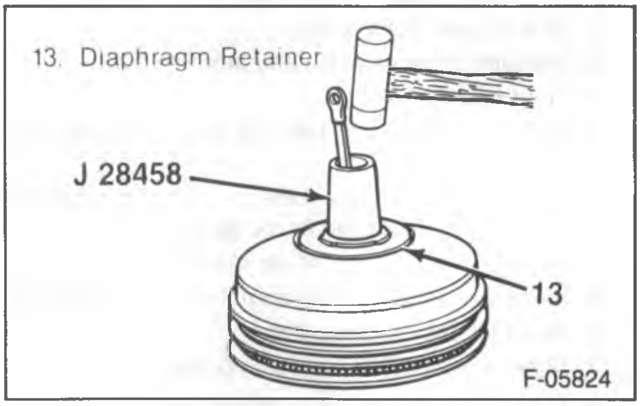


Figure 22—Installing the Diaphragm Retainer

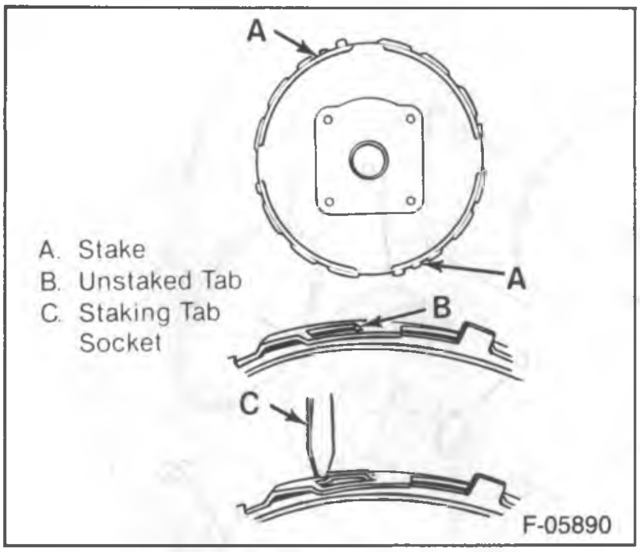


Figure 23—Staking the Tabs

- Lubricate the inside and outside diameters of the grommet and front housing seal with a thin layer of silicone.

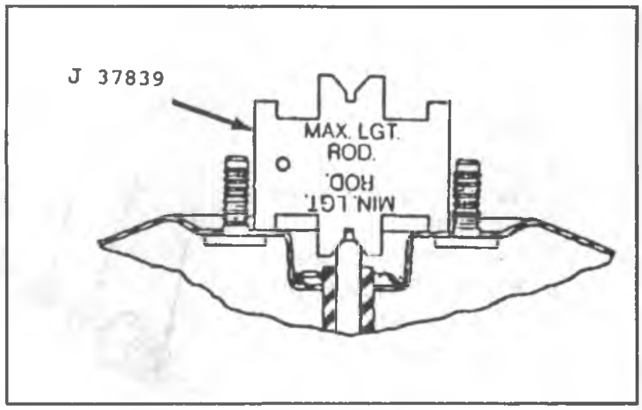


Figure 24—Gaging the Piston Rod

11. Front housing seal (5).
12. Silencer (2) and boot (1).
    - Gage the piston rod using J 37839 (figure 24). If not within limits, obtain a service adjustable piston rod.

TANDEM DIAPHRAGM VACUUM BOOSTER

Remove or Disconnect (Figure 25)

Tool Required:

J 23456 Power Brake Booster Disassembly and Reassembly Fixture

1. Boot (1) and silencer (2).
2. Vacuum check valve (3) and grommet (4).
3. Front housing seal (7).
   - Scribe a mark on the front and rear housings to aid in assembly.
   - Unlock the front and rear housings using J 23456 (figure 21).
4. Return spring (11) and power piston group (38) (figure 26).
5. Primary piston bearing (8) from the rear housing (9).
6. Piston rod (12), reaction retainer (13) and power head silencer (14).
7. Power piston assembly (41) along with the pushrod (32) (figure 27).
   - Grasp the assembly at the outside edge of the housing divider (19) and diaphragms (16 and 20).
   - Hold with the pushrod (32) down against a hard surface.
   - Use a slight force or impact to dislodge the diaphragm retainer (15).
8. Primary diaphragm (16) and primary support plate (17) from the housing divider (19).
9. Primary diaphragm (16) from the primary support plate (17).
10. Secondary diaphragm (20) and secondary support plate (21) from the housing divider (19).
11. Secondary piston bearing (18) from the housing divider (19).
12. Secondary diaphragm (20) from the secondary support plate (21).
13. Reaction body retainer (24).
14. Reaction body (25).
15. Reaction disc (22) and reaction piston (23) from the reaction body (25).
16. Air valve spring (26) and reaction bumper (27) from the end of the air valve pushrod (32).
17. Retaining ring (28) from the air valve pushrod assembly (32).
18. Air valve pushrod assembly (32) by inserting a screwdriver through the pushrod eyelet and pulling it straight out.
    - Considerable force will be required.
19. Filter (29), retainer (30) and O-ring (31) from the air valve pushrod assembly (32).

Inspect

- All parts for corrosion, nicks, cracks, cuts, scoring, distortion or excessive wear. Replace parts as necessary.
- Use crocus cloth to polish away minor corrosion of the housings or diaphragm support.

Clean

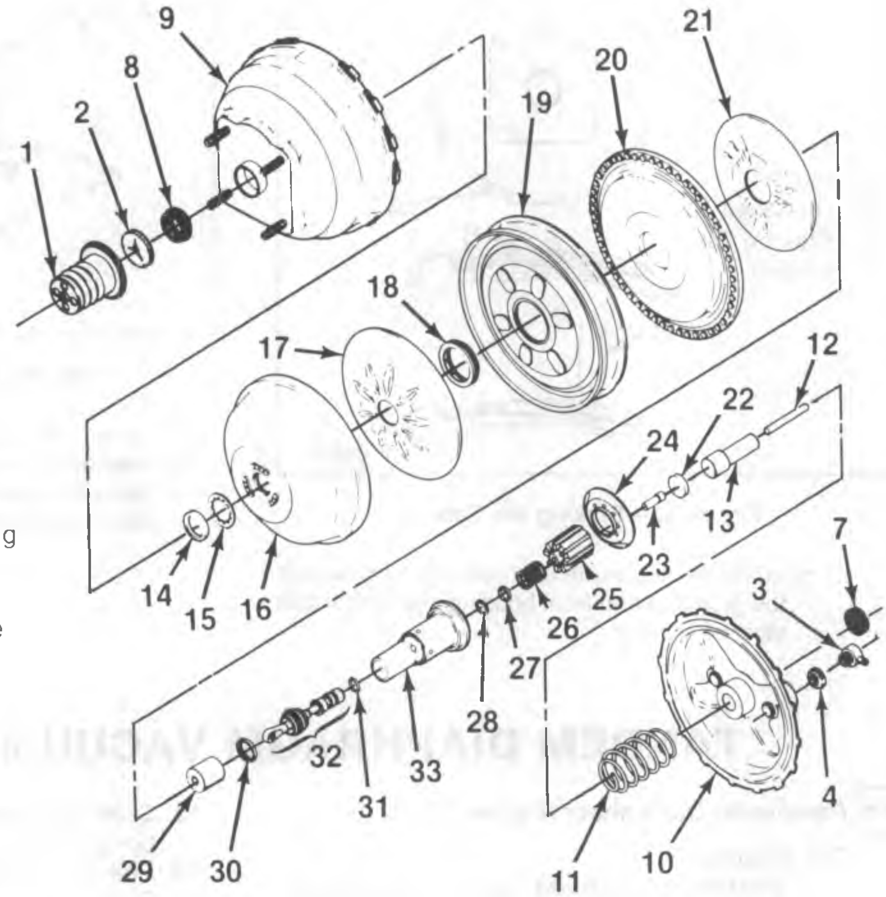
- All parts in clean denatured alcohol.
  — Do not immerse the power piston and pushrod assembly in alcohol.
- Dry with unlubricated compressed air.

Install or Connect (Figure 25)

Tools Required:

J 23456 Power Brake Booster Disassembly and Reassembly Fixture

1. Boot
2. Silencer
3. Vacuum Check Valve
4. Grommet
7. Front Housing Seal
8. Primary Piston Bearing
9. Rear Housing
10. Front Housing
11. Return Spring
12. Piston Rod (Gaged)
13. Reaction Retainer
14. Power Head Silencer
15. Diaphragm Retainer
16. Primary Diaphragm
17. Primary Support Plate
18. Secondary Piston Bearing
19. Housing Divider
20. Secondary Diaphragm
21. Secondary Support Plate
22. Reaction Disc
23. Reaction Piston
24. Reaction Body Retainer
25. Reaction Body
26. Air Valve Spring
27. Reaction Bumper
28. Retaining Ring
29. Filter
30. Retainer
31. O-Ring
32. Air Valve Push Rod Assembly
33. Power Piston



F-05892

Figure 25—Tandem Vacuum Booster Components

J 28458 Power Piston Seal Protector
J 37839 Pushrod Height Gage

1. Lubricated O-ring (31) onto the air valve pushrod assembly (32).
2. Air valve pushrod assembly (32) into the power piston (41).
3. Retainer (30) and seat.
4. Filter (29) over the pushrod eyelet and into the power piston (41) (figure 27).
5. Retaining ring (28) onto the air valve pushrod assembly (32).
6. Reaction bumper (27) and air valve spring (26).
7. Reaction piston (23) and reaction disc (22) into the reaction body (25).
8. Reaction body (25).
9. Reaction body retainer (24).
- Lubricate the inside diameter of the secondary diaphragm (20) lip, inside diameter of the primary diaphragm (16) lip and the secondary piston bearing (18) with a thin layer of silicone grease.
10. Secondary diaphragm (20) into the secondary support plate (21).
11. Secondary diaphragm (20) and support plate (21) over the power piston assembly (41) and pushrod (32) (figure 28).
    - Use J 28458 as a guide to protect the power piston.
12. Secondary piston bearing (18) into the housing divider (19) with the flat surface of the bearing on the same side as the six raised lugs on the divider.
13. Secondary piston bearing (18) and housing divider (19) over the power piston assembly (41) and pushrod (32). Use J 28458 as a guide (figure 29).
14. Primary diaphragm (16) into the primary support plate (17).
- Fold the primary diaphragm (16) up, away from the primary support plate (17).
15. Primary diaphragm (16) and support plate (17) over the power piston assembly (41) and pushrod (32).
- Fold the primary diaphragm (16) back into position and pull the outside edge of the diaphragm over the formed flange of the housing divider (19).

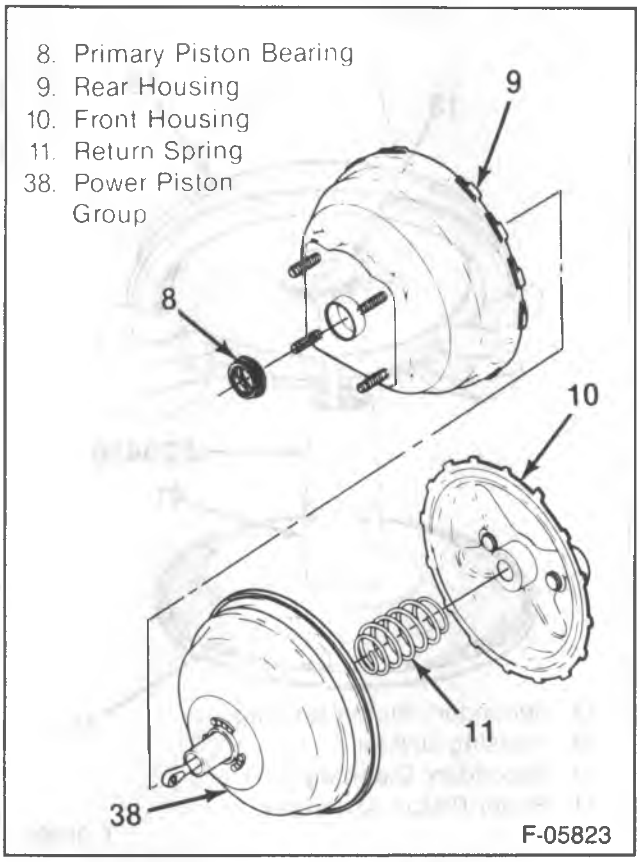


Figure 26—Booster Inner Components

- Check that the beads on the secondary diaphragm (20) are seated evenly around the complete circumference.

16. New diaphragm retainer (15) and seat using J 28458.
17. Silencer (14), reaction retainer (13) and piston rod (12).
    - Lubricate the inside and outside diameters of primary piston bearing (8) with silicone grease.
18. Primary piston bearing (8) into the rear housing (9).
19. Power piston group (38) into the rear housing (9).
20. Return spring (11).
    - Align the scribe marks on housings (9 and 10).
    - Lock the front and rear housings using J 23456 (figure 21).
        - Stake the housing after locking. Stake two tabs 180 degrees apart (figure 23).
        - Do not stake a tab that has been previously staked.
        - Assembly can be aided by connecting a vacuum source to the booster.
    - Lubricate the inside and outside diameters of the grommet (4) and front housing seal (7) with a thin layer of silicone grease.
21. Grommet (4) and vacuum check valve (3).
22. Front housing seal (7).
23. Silencer (2) and boot (1).
    - Gage the piston rod (figure 24).

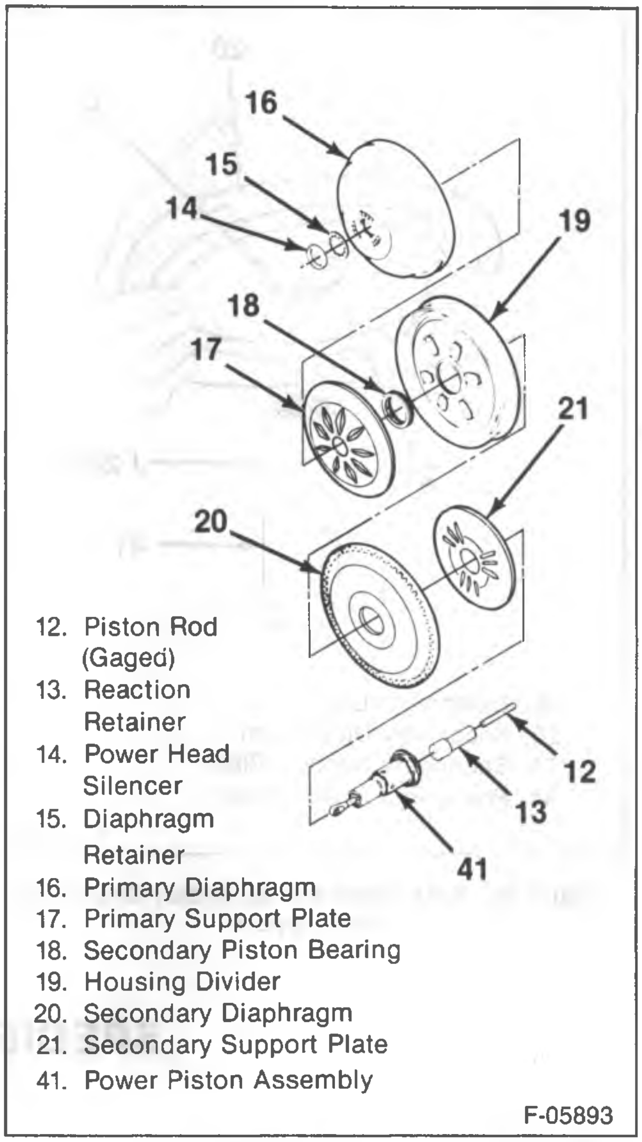
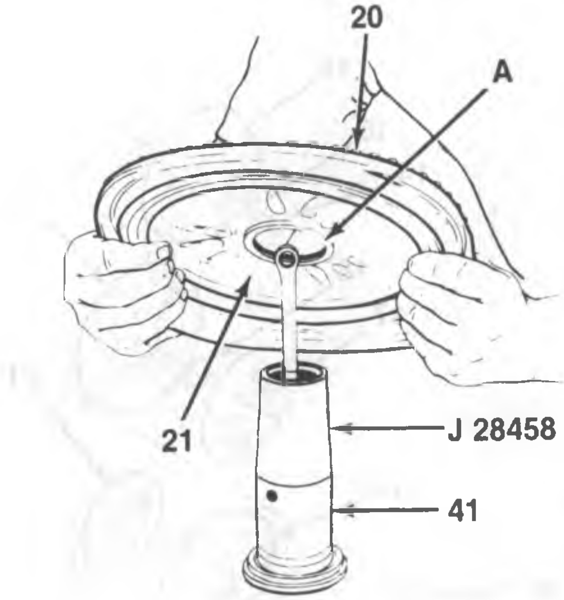


Figure 27—Power Piston Group

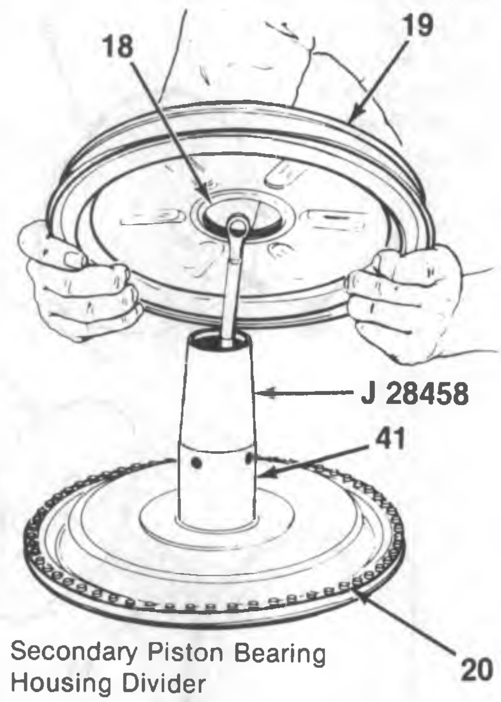
- Use J 37839 If not within limits, obtain a service adjustable piston rod.



A. Diaphragm Lip
20. Secondary Diaphragm
21. Secondary Support Plate
41. Power Piston Assembly

F-05894

Figure 28—Assembling the Secondary Diaphragm and Support



18. Secondary Piston Bearing
19. Housing Divider
20. Secondary Diaphragm
41. Power Piston Assembly

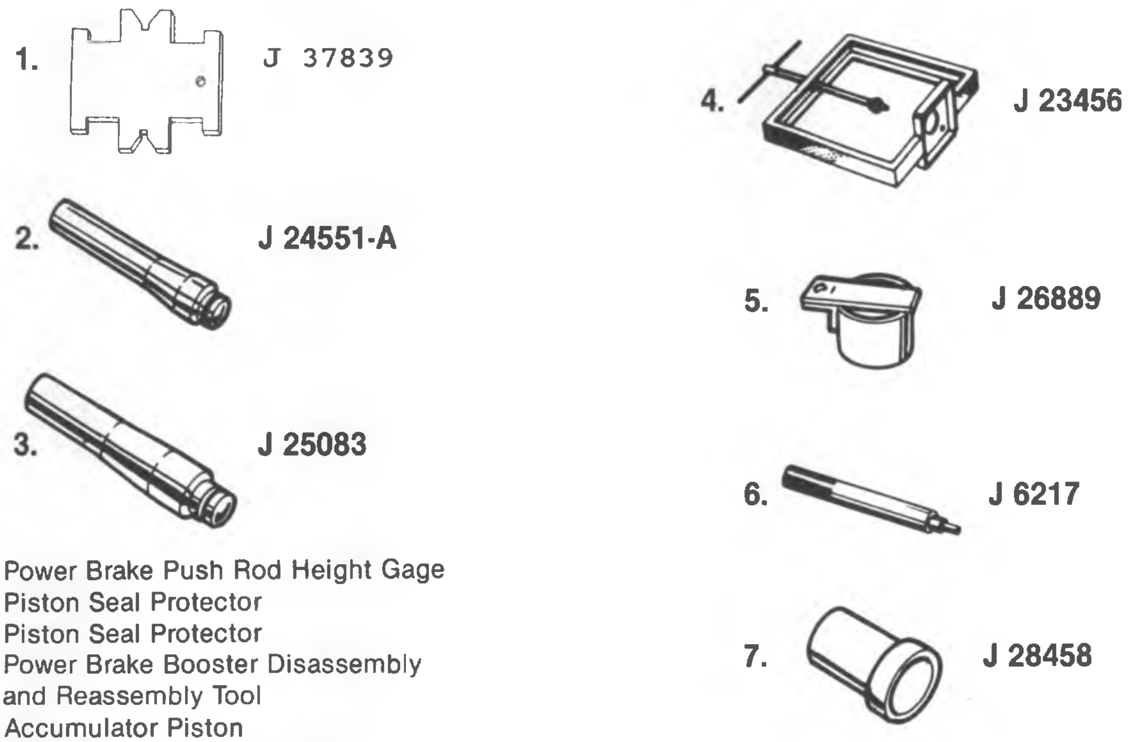
F-05895

Figure 29—Assembling the Housing Divider

SPECIFICATIONS

	N·m	Ft. Lbs.
Hydro-Boost Housing to Cover Bolts	30	22
Hydro-Boost Nut	149	110

SPECIAL TOOLS



1. Power Brake Push Rod Height Gage
2. Piston Seal Protector
3. Piston Seal Protector
4. Power Brake Booster Disassembly and Reassembly Tool
5. Accumulator Piston
6. Valve Connector Seat Installer
7. Power Piston Seal Protector

F-05896

SECTION 6
ENGINE

CONTENTS

SECTION 6A
GENERAL ENGINE MECHANICAL

CONTENTS

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

- An engine is a combination of many machined, honed, polished and lapped surfaces with very fine tolerances.
- Whenever valve train components, cylinder head, cylinder, crankshaft, or connecting rod components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Any time air cleaner, carburetor, or TBI unit is removed, the intake opening must be covered. If a diesel engine is being serviced, the recommended cover (J 29664-2) should be used. This will protect against the entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.
- When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.
- On diesel engines, whenever the fuel injection pump or lines are removed or disconnected, care must be taken to prevent the entry of dirt into the pump, lines, and injectors. The entry of even small amounts of dirt or other foreign material into the fuel injection system may cause serious damage.

USE OF RTV SEALER AND ANAEROBIC GASKET ELIMINATOR

Two types of sealer are commonly used in engines covered by this manual. These are RTV sealer and anaerobic "gasket eliminator" sealer.

It is important that these sealers be applied properly and in the proper place to prevent oil leaks. THE TWO TYPES OF SEALER ARE NOT INTERCHANGEABLE. Use the sealer recommended in the procedure.

- RTV (room temperature vulcanizing) sealer is used where a non-rigid part is assembled to a rigid part. Common examples are oil pans and rocker arm covers.
- Anaerobic gasket eliminator hardens in the absence of air. This sealer is used where two rigid parts (such as castings) are assembled together. When two rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using gasket eliminator.

USING RTV SEALER

1. Do not use RTV when extreme temperatures are expected, such as exhaust manifold, head gasket or where gasket eliminator is specified.
2. When separating components sealed with RTV, use a rubber mallet and "bump" the part sideways to shear the RTV sealer. "Bumping" should be done at bends or reinforced areas to prevent distortion of parts. RTV is weaker in shear (lateral) strength than in tensile (vertical) strength.
   Attempting to pry or pull components apart may result in damage to the part.
3. Surfaces to be resealed must be clean and dry. Remove all traces of oil and RTV. Clean with a chlorinated solvent such as carburetor spray cleaner. Do not use petroleum cleaners such as mineral spirits; they leave a film onto which RTV will not stick.
4. Apply RTV to one of the clean surfaces. Use a bead size as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer in any blind threaded holes, as it may prevent the bolt from seating properly or cause damage when the bolt is tightened.
5. Assemble while RTV is still wet (within 3 minutes). Do not wait for RTV to skin over.
6. Torque bolts to specifications. Do not over-torque.

USING ANAEROBIC GASKET ELIMINATOR

1. Clean surfaces to be resealed with a chlorinated solvent to remove all oil, grease and old material.
2. Apply a continous bead of gasket eliminator to one flange.
3. Spread bead evenly with your finger to get a uniform coating on the complete flange.
4. Assemble parts in the normal manner and torque immediately to specifications.

Important

- Anaerobic sealed joints that are partially torqued and allowed to cure more than five minutes may result in incorrect shimming of the joint.

REPLACING ENGINE GASKETS

CAUTION: Composite type gaskets are used in some areas of the engine assembly. These gaskets have a thin metal core. Use caution when removing or handling composite gaskets to help avoid personal injury.

CYLINDER BORES, PISTONS, RINGS, AND CONNECTING RODS

MEASURING CYLINDER BORE TAPER AND OUT-OF-ROUND (ALL MODELS)

Tool Required:
J 8087 Cylinder Bore Gage
(or equivalent)

- If one or more cylinder bores are rough, scored or worn beyond limits, it will be necessary to smooth or true up such bores to fit new pistons.
- No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

1. Refer to "Specifications" in the proper section for tolerances.
2. Set the gage so that the thrust pin must be forced in about 7 mm (1/4-inch) to enter the gage in the cylinder bore.
3. Center the gage in the cylinder and turn the dial to "0."
4. Carefully work the gage up and down the cylinder to determine taper and turn it to different points around the cylinder wall to determine the out-of-round condition (figure 1). Measure the bore both parallel to and at right angles to the engine centerline. Measure at the top, middle and bottom of the bore and note the readings.
5. Recondition the cylinder bore as necessary, as outlined later.

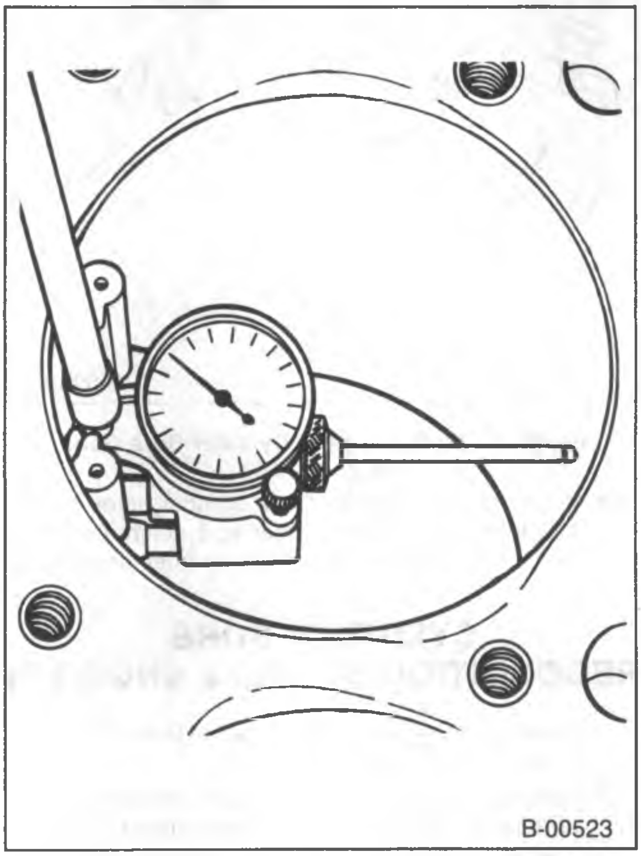


Figure 1—Checking the Cylinder Bore

CYLINDER BORE RECONDITIONING (2.5 L ENGINES)

1. Measure the cylinder bore for out of round and taper as outlined previously.
2. Refer to figure 2. Measure dimension "A" at 13 mm (1/2-inch) below the head gasket surface. Measure dimension "B" at 100 mm (4-inches) below the head gasket surface.

   Cylinder bores can be measured by setting the cylinder gage dial at zero in the cylinder at the point of desired measurement. Lock the dial indicator at zero before removing from the cylinder, and measure across the gage contact points with outside micrometer, with the gage at the same zero setting when removed from the cylinder (figure 3).
3. If dimension "A" is larger than dimension "B" by 0.13 mm (0.005-inch), the cylinder should be bored for oversized piston and rings.

   If relatively few bores require correction, it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance. All oversize service pistons are held to the same weights as standard size pistons.
4. Fine vertical scratches made by ring ends will not, by themselves, cause excessive oil consumption; therefore, honing to remove them is unnecessary.
5. If the bore is glazed but otherwise serviceable, break the glaze lightly with a hone and replace the piston rings. Refer to "Honing." Make sure the honing stones are clean, sharp and straight. Move the hone slowly up and down to produce a 45 degree cross-hatch pattern. Clean the bore thoroughly with soap and water. Dry and rub in clean engine oil, then remeasure.

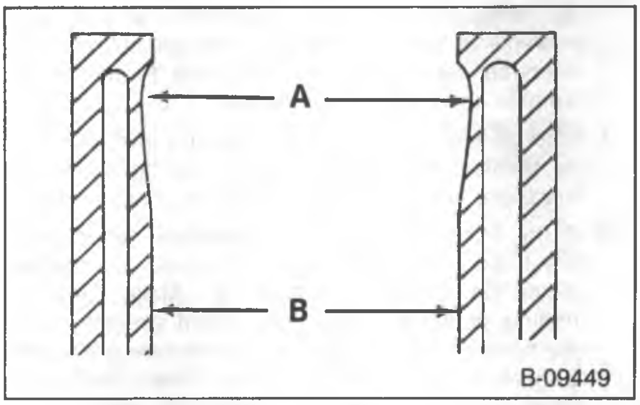


Figure 2—Typical Wear Pattern

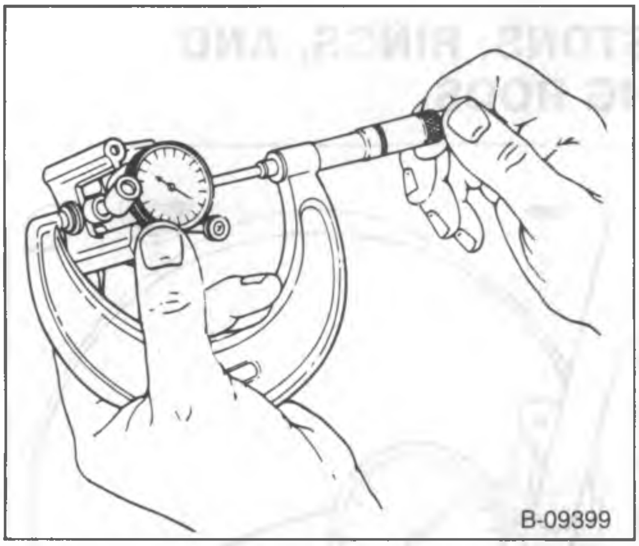


Figure 3—Measuring the Cylinder Bore Gage

6. If honing is not required, the cylinder bores should be cleaned with a hot water and detergent wash. Apply clean engine oil to the bore after cleaning.

CYLINDER BORE RECONDITIONING (2.8 L ENGINES)

1. Measure the cylinder bore for out of round and taper as outlined previously.
2. Refer to figure 2. Measure for wear at the top of the bore (point "A"), and at the bottom (point "B").

   Cylinder bores can be measured by setting the cylinder gage dial at zero in the cylinder at the point of desired measurement. Lock the dial indicator at zero before removing from the cylinder, and measure across the gage contact points with outside micrometer, with the gage at the same zero setting when removed from the cylinder (figure 3).
3. If wear at the top of the cylinder does not exceed 0.10 mm (0.004-inch) out-of-round, honing is recommended for truing the bore. If wear or out-of-round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

   If relatively few bores require correction, it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance. All oversize service pistons are held to the same weights as standard size pistons.
4. Fine vertical scratches made by ring ends will not, by themselves, cause excessive oil consumption; therefore, honing to remove them is unnecessary.
5. If the bore is glazed but otherwise serviceable, break the glaze lightly with a hone and replace the piston rings. Refer to "Honing." Make sure the honing stones are clean, sharp and straight. Move the hone slowly up and down to produce a 20 to 32 degree cross-hatch pattern. Clean the bore thoroughly with soap and water. Dry and rub in clean engine oil, then re-measure.
6. If honing is not required, the cylinder bores should be cleaned with a hot water and detergent wash. Apply clean engine oil to the bore after cleaning.

CYLINDER BORE RECONDITIONING (ALL EXCEPT 2.5 L AND 2.8 L ENGINES)

1. Measure the cylinder bore for out of round and taper as outlined previously.
2. Refer to figure 2. Measure for wear at the top of the bore (point "A") and at the bottom (point "B").

   Cylinder bores can be measured by setting the cylinder gage dial at zero in the cylinder at the point of desired measurement. Lock the dial indicator at zero before removing from the cylinder, and measure across the gage contact points with outside micrometer, with the gage at the same zero setting when removed from the cylinder (figure 3).
3. If the cylinders are found to exceed the specified out-of-round or taper, honing or boring will be necessary. Any cylinders that were found to have less than 0.13 mm (0.005-inch) wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than 0.13 mm (0.005-inch) taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.
4. Fine vertical scratches made by ring ends will not, by themselves, cause excessive oil consumption; therefore, honing to remove them is unnecessary.
5. If the bore is glazed but otherwise serviceable, break the glaze lightly with a hone and replace the piston rings.

   Make sure the honing stones are clean, sharp and straight. Move the hone slowly up and down to produce a 45 to 65 degree cross-hatch pattern. Clean the bore thoroughly with soap and water. Dry and rub in clean engine oil, then re-measure.
6. If honing is not required, the cylinder bores should be cleaned with a hot water and detergent wash. Apply clean engine oil to the bore after cleaning.

BORING

1. Before the honing or reboring operation is started, measure all new pistons with the micrometer contacting at points exactly 90 degrees from the piston pin centerline. Some pistons must be measured at a specified distance from the piston crown. Refer to the proper section for additional instructions. Then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.
2. Before using any type of boring bar, the top of the cylinder block should be filed to remove any dirt or burrs. This is very important. If not checked, the

boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.

3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.
4. When reboring cylinders, all crankshaft bearing caps must be in place and tightened to the proper torque to avoid distortion of bores in the final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during the boring or honing operation.
5. When taking the final cut with a boring bar, leave 0.03 mm (0.001-inch) on the diameter for finish honing to give the required position to the cylinder clearance specifications. (The honing or boring operation must be done carefully so that the specified clearance between pistons, rings, and cylinder bores is maintained.)

Important

- Refer to the proper section for additional information.

HONING

1. When the cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing. Use only clean, sharp stones of the proper grade for the amount of material to be removed. Dull, dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder check for correct fit.
3. When honing to eliminate taper in the cylinder, full strokes of the hone in the cylinder should be made in addition to checking measurement at the top, middle and bottom of the bore repeatedly.

NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to the correct size as the piston can be distorted through careless handling.

4. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of the specified angle.
    - 2.5 L: 45 degrees
    - 2.8 L: 20 to 32 degrees
    - All others: 45 to 65 degrees
5. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
6. By measuring the piston to be installed at the sizing point specified in the proper section, and adding the average of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature.
7. It is of the greatest importance that refinished cylinder bores are trued up to have the less than the specified out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface.
8. Refer to "Specifications" in the proper section for piston to bore clearance tolerances.
9. After final honing and before the piston is checked for fit, clean the bores with hot water and detergent. Scrub with a stiff bristle brush and rinse thoroughly with hot water. It is essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil. After washing, the dry bore should then be brushed clean with a power-driven fiber brush.
10. Permanently mark the piston for the cylinder to which it has been fitted.
11. Apply clean engine oil to each bore to prevent rusting.

PISTON AND CONNECTING ROD ASSEMBLIES

DISASSEMBLY (ALL EXCEPT 6.2 L ENGINES)

Remove or Disconnect (Figures 4, 5 and 6)

Tools Required
- J 25220 Ring Expander (or equivalent)
- J 24086 Piston Pin Remover and Installer

1. Piston rings. Use J 25220 (or equivalent) (figure 5). In most cases the rings should be discarded and replaced with new ones at assembly.
2. Connecting rod bearing inserts. If the inserts are to be reused, place them in a rack so they may be reinstalled in their original connecting rod and cap.
3. Piston pin (figure 6).
    - Place the piston/connecting rod on support fixture J 24086-20. Make sure the connecting rod is fully supported. Use J 24086-900 and J 24086-280 for 2.8 L pistons.
    - Place remover J 24086-8 (J 24086-88A for 2.8 L pistons) on the support fixture.
    - Press out the piston pin.

DISASSEMBLY (6.2 L ENGINES)

Disassemble (Figures 5 and 7)

Tool Required:
- J 25220 Ring Expander (or equivalent)

1. Piston rings. Use J 25220 (figure 5).

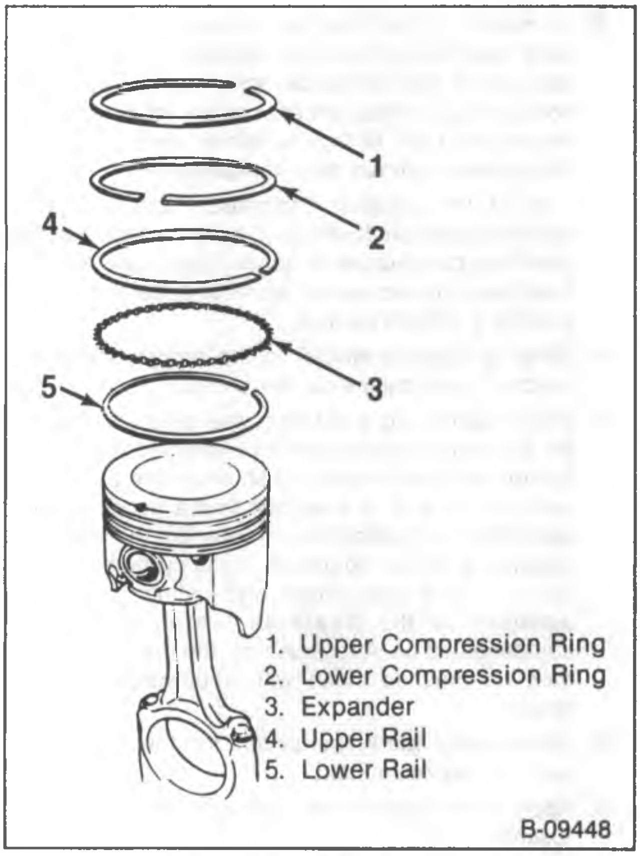


Figure 4—Piston Rings

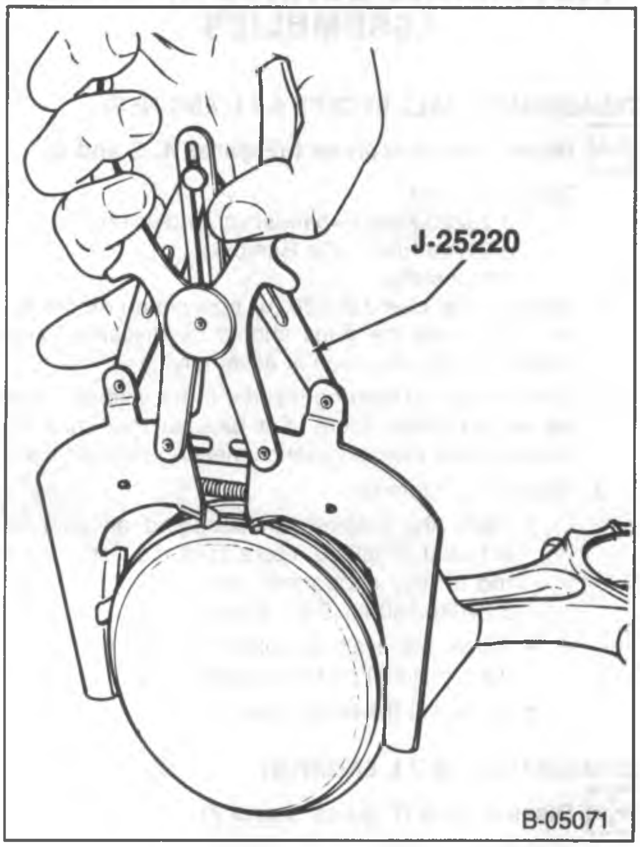


Figure 5—Removing the Piston Rings

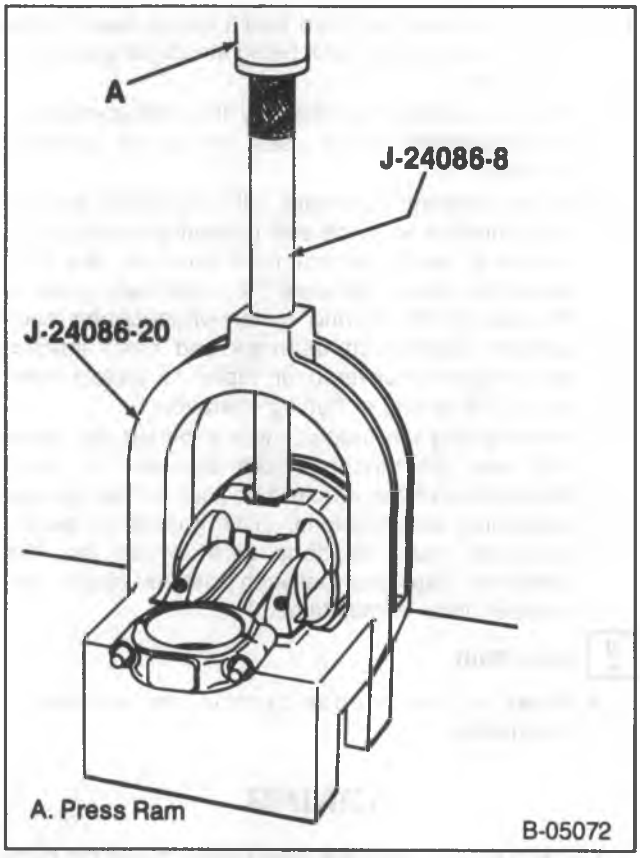


Figure 6—Removing the Piston Pin

2. Connecting rod bearing inserts. If the inserts are to be reused, place them in a rack so they can be installed in their original connecting rod and cap.
3. Snap rings. Use snap ring pliers.
4. Piston pin. Slide the pin from the piston.
5. Piston from the connecting rod.

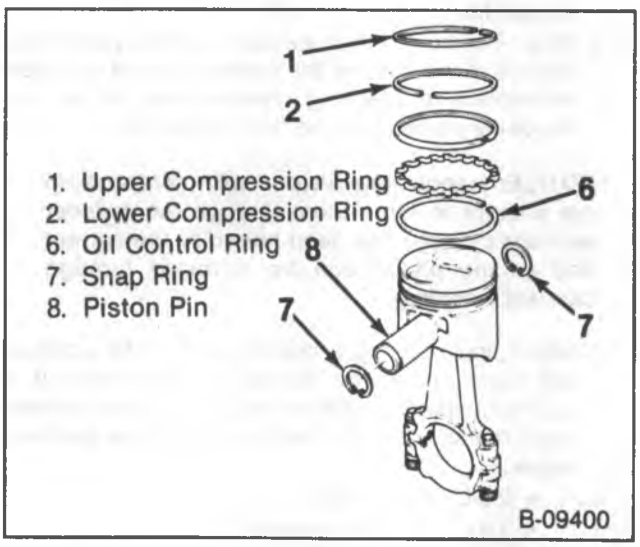


Figure 7—Piston and Components — 6.2 L

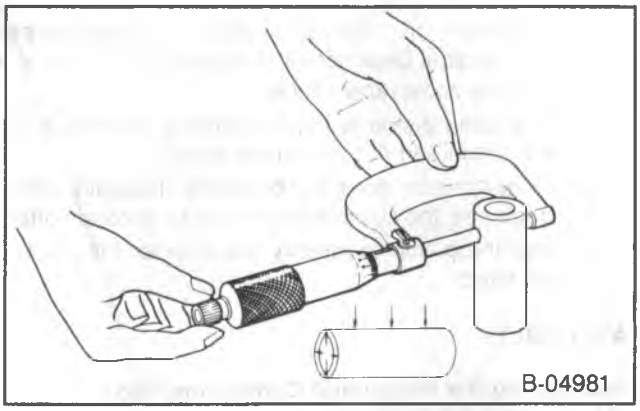


Figure 8—Measuring Piston Pin Diameter

CLEANING AND INSPECTION

Clean

— Piston.
  — Remove all varnish and carbon deposits. DO NOT USE A WIRE BRUSH.
  — Remove the carbon from the ring grooves. Use a ring groove cleaning tool.
  — Oil control ring groove holes.

Inspect

— Piston pin bore in the piston and connecting rod. Check for scuffing, burrs, etc.
— Piston for scratches, wear, etc.
— Connecting rod for cranks, nicks, etc. If a suitable jig is available, check the connecting rod for a bent or twisted condition.
— Piston.
  — Ring land for cracking, wear, etc.
  — Ring grooves for burrs, nicks, etc.
  — Skirts and pin bosses for cracking.
  — Skirts for scuffing.
— Connecting rod bearing inserts for scratches or deep pitting.

MEASURING PISTON PIN TO PISTON CLEARANCE (ALL EXCEPT 6.2 L)

Measure (Figures 8 and 9)

1. Piston pin diameter (figure 8). Check against "Specifications."
2. Piston pin to piston clearance.
   - Measure the piston pin hole diameter (figure 9).
   - Subtract the piston pin diameter from the piston pin hole diameter to obtain the clearance.
   - Replace the piston and piston pin if the clearance exceeds specifications. The piston and piston pin are a matched set and are not available separately.

MEASURING PISTON PIN TO PISTON PIN BUSHING CLEARANCE (6.2 L ENGINES)

Clean

- Piston pin and bushing. The parts must be free of oil and dirt.

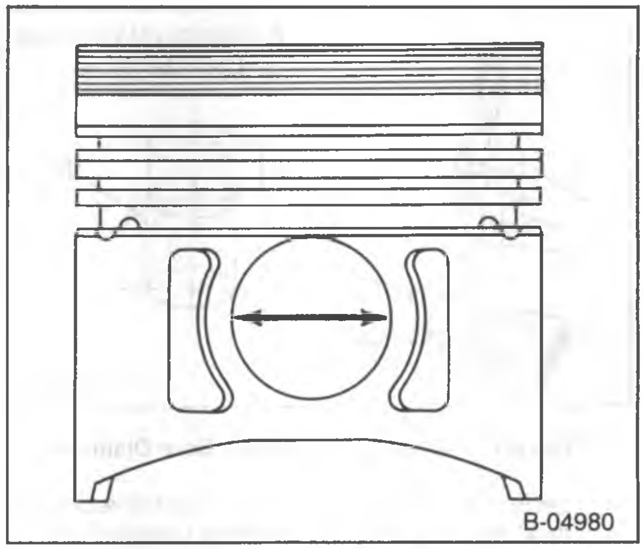


Figure 9—Piston Pin Hole Diameter

Measure (Figures 8 and 10)

1. Piston pin diameter (figure 8). Check against "Specifications."
2. Piston pin bushing ID. Use an inside micrometer (figure 10).
3. Piston pin to bushing clearance. Subtract the piston pin diameter from the piston pin bushing ID. Compare with "Specifications." If the clearance is excessive, try a new piston pin. If the clearance is

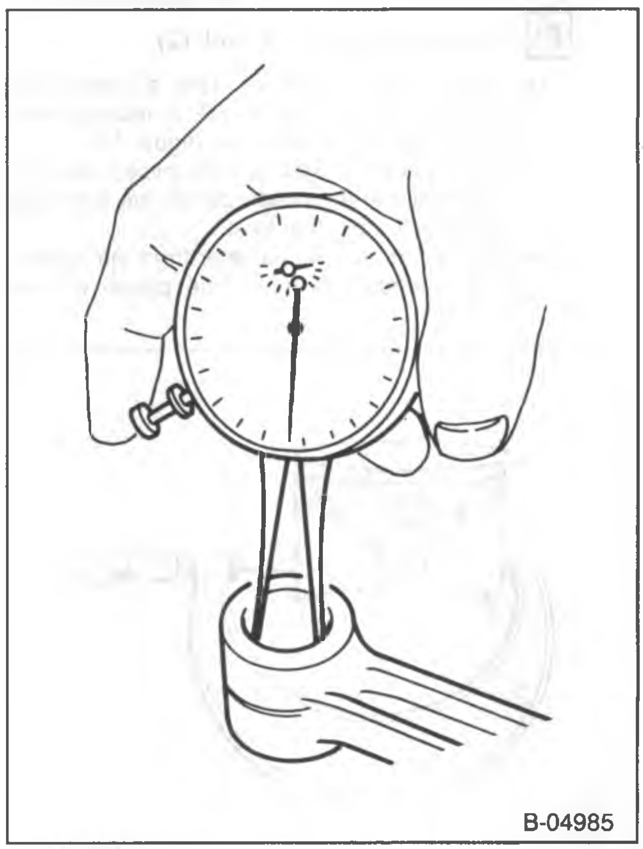


Figure 10—Measuring Piston Pin Bushing Inside Diameter

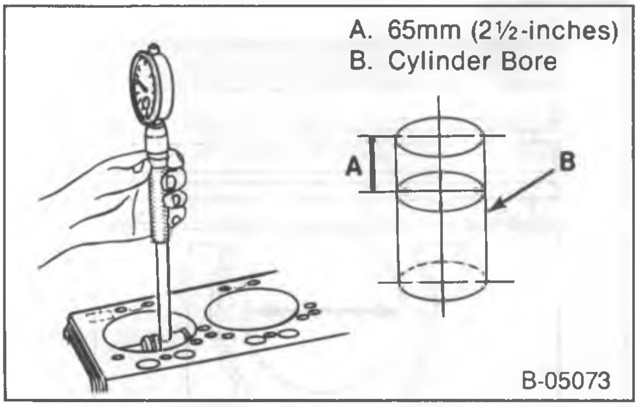


Figure 11—Measuring Cylinder Bore Diameter

excessive with a new piston pin, the connecting rod must be replaced. Replacement bushings are not available.

PISTON SELECTION (2.5 L AND 2.8 L ENGINES)

Refer to the proper section.

PISTON SELECTION (ALL EXCEPT 2.5 L AND 2.8 L ENGINES)

1. Check the used piston to cylinder bore clearance.

Measure (Figures 11 and 12)

- Cylinder bore diameter. Use a telescoping bore gage, located 65 mm (2 ½-inches) below the top of the cylinder bore (figure 11).
- Piston diameter. Measure the piston skirt at a right angle to the piston pin, at the centerline of the piston pin (figure 12).
- Subtract the piston diameter from the cylinder bore diameter to determine piston to bore clearance.

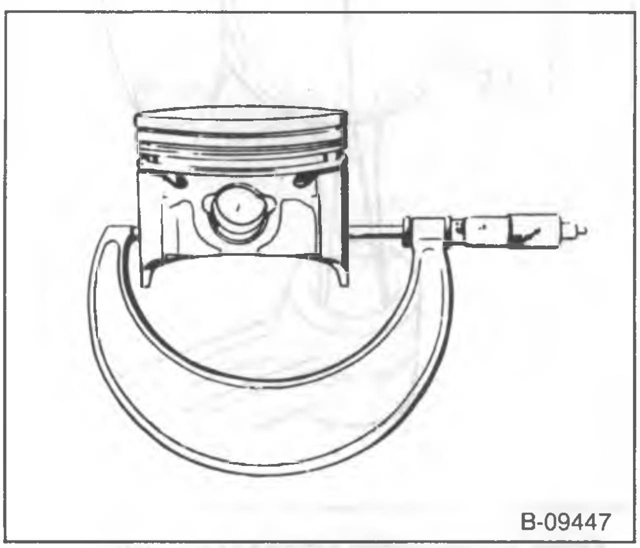


Figure 12—Measuring the Piston Skirt

- Refer to "Specifications" in the proper section. Determine if the piston clearance is in the acceptable range.

2. If the used piston is not acceptable, determine if a new piston can fit the cylinder bore.
3. If a new piston does not bring the clearance within tolerances, the cylinder bore must be reconditioned.
4. Mark the piston to identify the cylinder for which it was fitted.

ASSEMBLY

Assembling the Piston and Connecting Rod (All except 6.2 L Engines)

Assemble (Figure 13)

Tool Required:
J 24086 Piston Pin Remover and Installer Set

1. Piston and connecting rod.
   - The piston and connecting rod must be installed in the proper position.
     - 2.5 L Engines: The raised notch side of the connecting rod must be opposite the notch in the piston crown.
     - 2.8 L Engines: The bevel on the connecting rod should face the outside of the engine.
     - 4.8 L Engines: The flat side of the piston crown depression and the connecting rod bearing tang slot must be on the same side.
     - All Others: The valve cutouts in the piston crown must be opposite the connecting rod bearing tangs.
   - Lubricate the piston pin holes in the piston and connecting rod with engine oil.
   - Install the pin guide (item E, figure 13) to hold the piston and connecting rod together. Be sure to use the proper pin guide. Refer to the instructions supplied with the tool.
2. Piston pin.
   - Insert the piston pin into the piston pin hole.
   - Place the assembly on the support fixture (figure 13).
   - Adjust the piston pin installer (J 24086-9) to the correct length, using the letter-number scale on the installer adjuster (figure 13). This is necessary to insure that the piston pin is pressed into the piston to the correct depth. Refer to the instructions supplied with the tool for the proper setting.
   - Lock the adjuster in place with the lock ring.

NOTICE: After the installer hub bottoms on the support assembly, do not exceed 35 000 kPa (5,000 psi) pressure, as this could cause damage to the tool.

- Place the adjuster in the support fixture. Press the piston pin into place (until the adjustable installer bottoms in the support fixture).

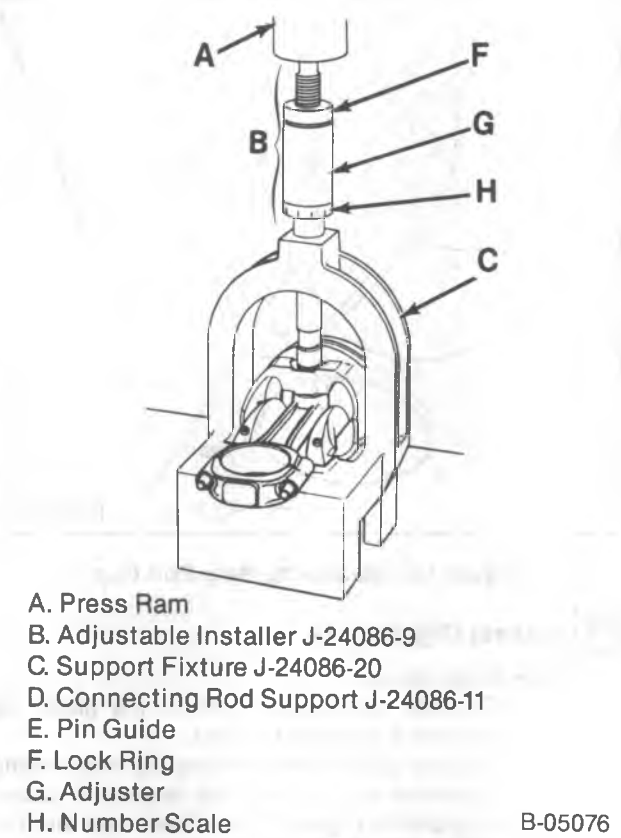


Figure 13—Installing the Piston Pin

- Remove the piston and connecting rod assembly from the tool and check the piston for freedom of movement on the piston pin.

Assembling the Piston and Connecting Rod (6.2 L Engines)

Assemble (Figures 7, 14, and 15)

Tool Required
J 29134-A Piston Pin Clip Installer

1. Piston to the connecting rod.

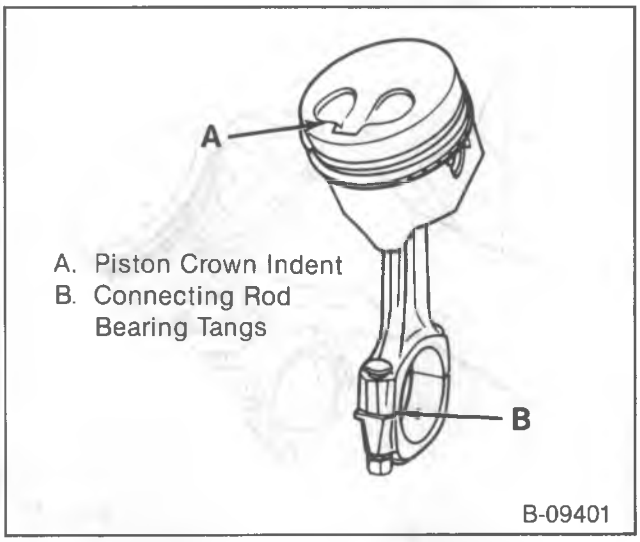


Figure 14—Aligning the Piston and Connecting Rod

- The piston must be installed with the piston crown indent on the same side as the connecting rod bearing tang slots (figure 14).

2. Piston pin. Apply engine oil to the pin and push into place.
3. Snap rings. Use J 29134-A (figure 15).

Inspect

- Snap rings for proper assembly. Rotate the snap rings to make sure that they are seated in their grooves.

Installing the Piston Rings (All Except 6.2 L)

Measure (Figures 4 and 16)

- Ring end gap as follows:
  1. Select rings comparable in size to the piston being used.
  2. Slip the compressing ring in the cylinder bore: then press the ring down into the cylinder bore about 7 mm (1/4-inch) above ring travel. Be sure the ring is square with the cylinder wall.
  3. Measure the space or gap between the ends of the ring with a feeler gage (figure 16).
  4. Refer to "Specifications" in the proper section for correct gap.
  5. If the gap between the ends of the ring is not as specified, remove the ring and try another for fit.

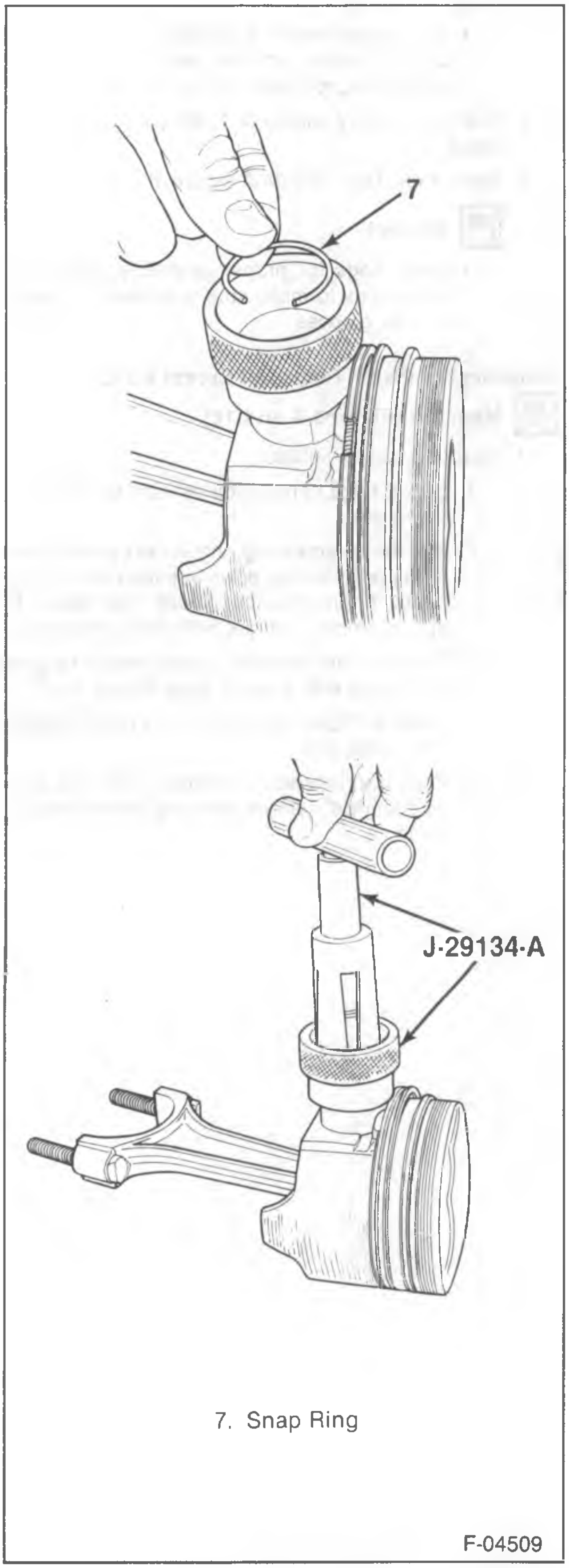


Figure 15—Installing the Piston Ring Snap Ring (6.2 L Engines)

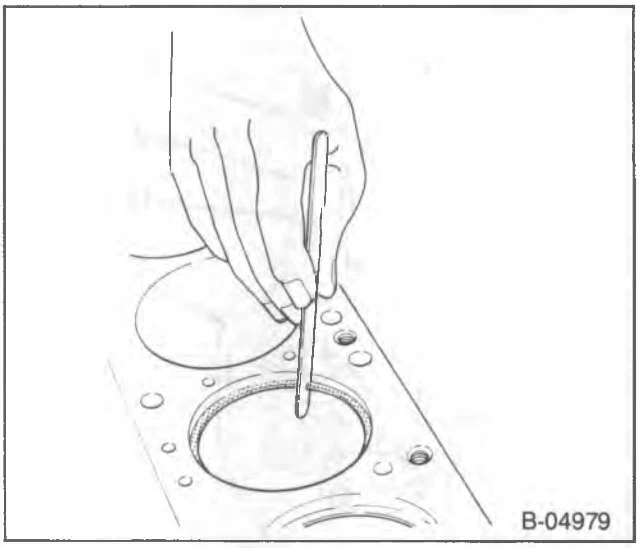


Figure 16—Measuring Ring End Gap

Inspect (Figures 17)

- Ring fit as follows:
  1. Fit each compression ring to the piston on which it is going to be used.
  2. Slip the outer surface of the top and second compression ring into the respective piston ring groove (figure 17), to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by the ring groove, correct by depressing the groove with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

Assemble (Figures 4 and 5)

Tool Required:
J 25220 Ring Expander (or equivalent)

- All compression rings are marked on the upper side of the ring. When installing the compression rings, make sure the MARKED SIDE IS TOWARD THE TOP OF THE PISTON.

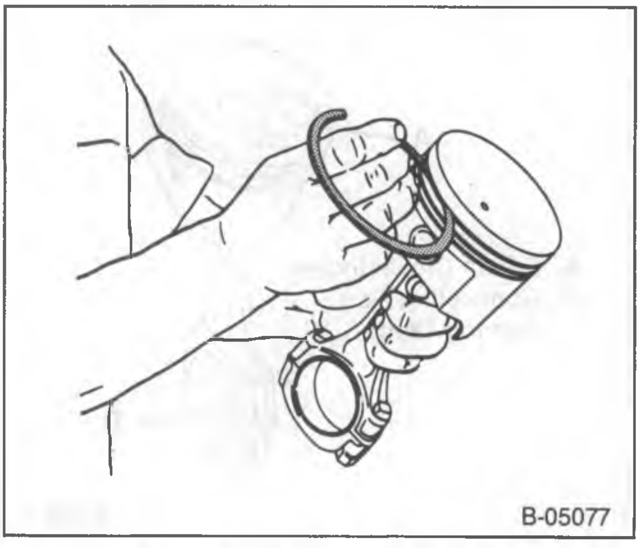


Figure 17—Checking Ring Fit

Figure 18—Measuring Ring Clearance

- The oil control rings are three piece types, consisting of two rails and an expander.

1. Expander.
2. Lower rail.
3. Upper rail.
4. Upper compression ring. Use J 25220 (figure 5).
5. Lower compression ring. Use J 25220 (figure 5). Flex all rings to make sure the rings are free. If binding occurs at any point the cause should be determined. If binding is caused by the ring groove, correct by dressing the groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.

Measure (Figure 18)

- Ring clearance. Use a feeler gage as shown in figure 18. Compare with "Specifications" in the proper section.

Installing the Piston Rings (6.2 L Engines)

- All compression rings are marked on the upper side of the ring. When installing the compression rings, make sure the MARKED SIDE IS TOWARD THE TOP OF THE PISTON.
- The top compression ring is a keystone type.
- The oil ring is a two-piece type, consisting of an expander and a scraper ring.

Measure (Figures 7 and 16)

- Ring end gap as follows:
  1. Select rings comparable in size to the piston being used.
  2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 7 mm (1/4-inch) above ring travel. Be sure the ring is square with the cylinder wall.
  3. Measure the space or gap between the ends of the ring with a feeler gage (figure 16).
  4. Refer to "Specifications" in the proper section.
  5. If the gap between the ends of the ring is not as specified, remove the ring and try another for fit.

Inspect (Figure 17)

- Ring fit as follows:
  1. Fit each compression ring to the piston on which it is going to be used.
  2. Slip the outer surface of the top and second compression ring into the respective piston ring groove (figure 17), to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by the ring groove, correct by dressing the groove with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

Assemble

- Piston rings. Refer to the instructions furnished with the parts package.

Measure (Figure 18)

- Ring clearance. Use a feeler gage as shown in figure 18. Compare with "Specifications" in the proper section.

CAMSHAFT BEARINGS

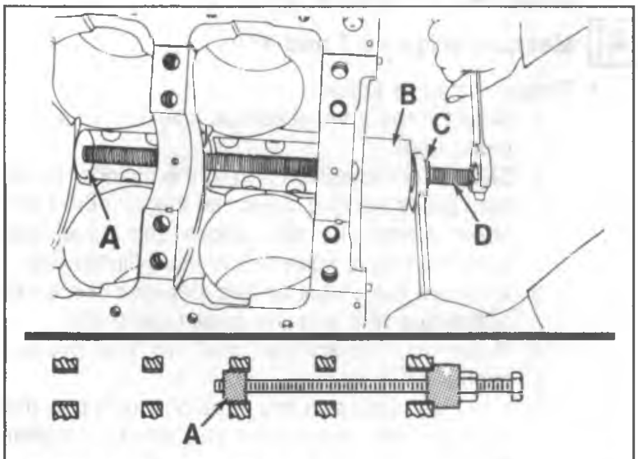


Figure 19—Removing or Installing the Inner Camshaft Bearings

CAMSHAFT BEARING REPLACEMENT (2.5 L AND 6.2 L ENGINES)

Refer to the proper section.

CAMSHAFT BEARING REPLACEMENT (ALL EXCEPT 2.5 L AND 6.2 L ENGINES)

Inspect

- Camshaft bearings for scratches, pits, or loose fit in their bores. Replace the camshaft bearings if necessary.

Disassemble (Figures 19 and 20)

Tool Required
J 6098-01 Camshaft Bearing Remover and Installer

1. Rear camshaft plug or cap.
2. Inner camshaft bearings. Use J 6098-01 (figure 19).
   - Insert the pilot into the front camshaft bearing bore.
   - Slide the puller screw, with the nut and washer, through the pilot.
   - Insert the bearing tool into the inner camshaft bearing bore, with the shoulder of the tool against the bearing.
   - Hold the puller screw with a wrench. Turn the nut with a second wrench to pull the camshaft bearing from its bore.
   - Repeat this procedure to remove the remaining inner camshaft bearings. Note that the rear inner bearing must be removed with the pilot fitted into the rear camshaft bearing.
3. Outer camshaft bearing. Use J 6098-01 (figure 20).

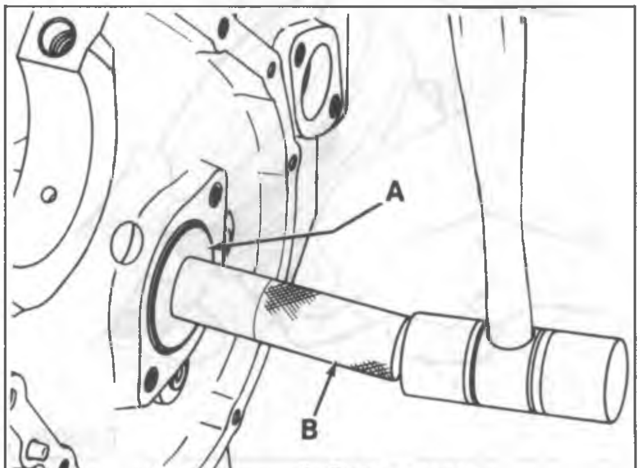


Figure 20—Removing or Installing the Outer Camshaft Bearings

- Assemble the bearing tool and driver handle.
- Drive the outer camshaft bearings out of the block.

Clean

- Camshaft bearing bores in the block.

Assemble (Figures 19, 20, and 21)

Tool Required
J 6098-01 Camshaft Bearing Remover and Installer

- The outer camshaft bearings must be installed first. These bearings serve as guides for the pilot, and help center the inner bearings during the installation process.
- Be sure to fit the correct cam bearing into the bore. The cam bearing bores vary in size.

A. Checking oil hole alignment with brass rod. Make rod as shown using 3/32" rod about 762 mm (30") long.

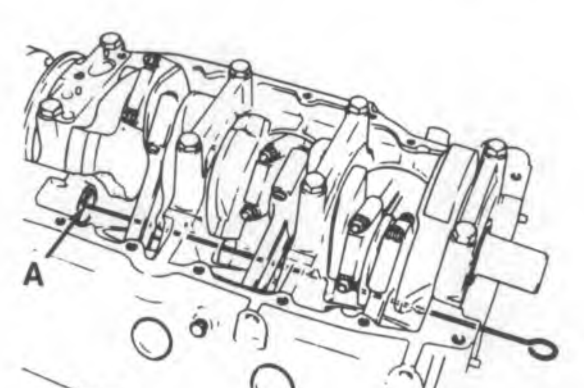


Figure 21—Checking Camshaft Bearing Oil Hole Alignment (Typical)

1. Outer camshaft bearings. Drive the bearings into place using J 6098-01 (figure 20).

Important

- Make sure the camshaft bearing hole (or holes) align with the oil hole (or holes) in the block. On some engines, the oil holes may be difficult to see. If so, use a piece of 2 mm 3/32-inch) rod as shown in figure 21 to check alignment.

2. Inner camshaft bearing. Use tool J 6098-01 (figure 19).
   - Assemble the tool with the pilot engaged in the front bearing and the pilot flange against the front face of the block.
   - Slide the puller screw, with nut and washer, through the pilot.
   - Place the new bearing on the bearing tool. Hold the bearing tool and bearing against the bearing bore. Align the bearing oil hole with the oil hole in the block.
   - Thread the puller screw into the bearing tool enough to hold the tool and bearing in place.
   - Holding the puller screw with a wrench, turn the nut with a second wrench to pull the camshaft bearing into place.
   - Remove the puller screw, pilot, and bearing tool.

Important

- Make sure the camshaft bearing hole (or holes) align with the oil hole (or holes) in the block. If it is difficult to see the alignment, use a piece of brass rod as described in step 1.

3. Camshaft rear plug or cap.
   — All engines except 2.8 L engines:
   - Coat a new camshaft plug with sealer (Loctite #592 or equivalent).
   - Install the plug flush to 0.80 mm (1/32-inch) deep.

   — 2.8 L engines:
   - Clean all RTV from the cap and block.
   - Apply a 3 mm (1/8-inch) bead of RTV sealant (GM part no. 1052366 or equivalent) to the machined groove on the block.
   - Install the cap while the RTV is still wet.
   - Install the retaining bolts and tighten.

HYDRAULIC LIFTERS

Two types of hydraulic lifters are used in engines covered by this manual – flat type and roller type. Service procedures are similar for both types.

Hydraulic lifters are serviced only as an assembly. No internal parts are available. Service is limited to a disassembly, cleaning and test operation. It is understood that most technicians discard any suspicious valve lifters. This information is offered for those who may wish to overhaul and test valve lifters.

Important

- Whenever the camshaft needs to be replaced, a new set of hydraulic lifters must also be installed (except 2.5 L engines).

INSPECTION BEFORE DISASSEMBLY

Inspect (Figures 22, 23, and 24)

— Lifter body (221) for scuffing and scoring. If the lifter body wall is worn or damaged, the mating hydraulic lifter bore in the cylinder block should also be checked.

— Check the fit of each valve lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.

— Push rod seat. If worn, inspect the pushrod. Replace the pushrod, if worn.

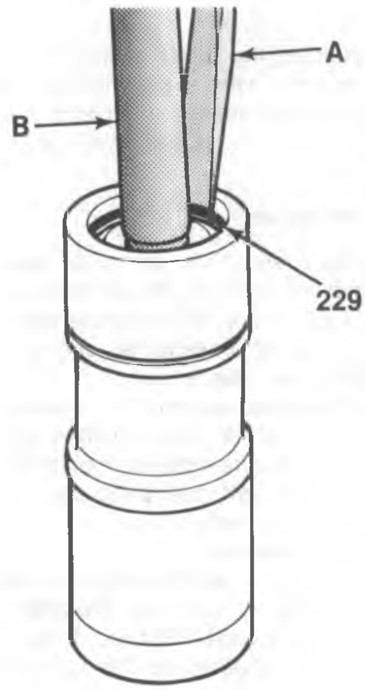
— Lifter foot (flat type lifters). The lifter foot must be smooth and slightly convex. If worn, pitted, or damaged the mating camshaft lobe should also be checked.

— Roller (roller type lifters) for:
  — Freedom of movement. Free-up or replace the lifter.
  — Flat spots. Replace the lifter, if worn.
  — Pitting, replace the lifter if pitted.
  — Missing or broken needle bearings.

HYDRAULIC LIFTER OVERHAUL

Disassemble (Figures 21 through 26)

1. Retainer (figure 25).
   - Push the pushrod seat (228) down, using a pushrod.
   - Pry out the retainer with a screwdriver.
2. Pushrod seat (228).
3. Metering valve (227).
4. Plunger (226) and plunger spring (222).
   - If the plunger is stuck, turn the lifter body upside down and tap it on a flat surface.
5. Check ball retainer (223), check ball spring (224), and check ball (225). Pry the check ball retainer from the plunger, using a small screwdriver (figure 26).



A. Screwdriver
B. Pushrod
229. Retainer

B-05237

Figure 22—Flat Type Hydraulic Lifter Assembly

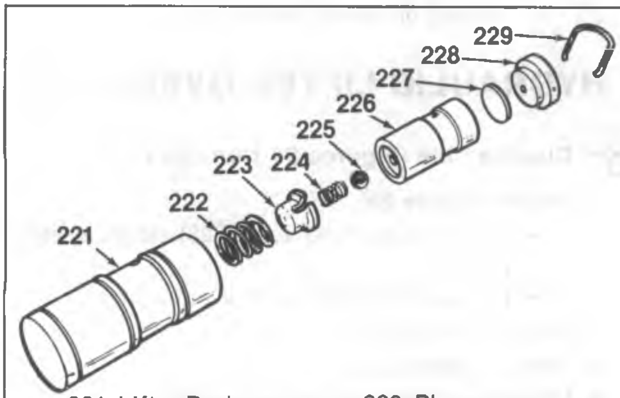
Clean

- All parts in CLEAN solvent. Remove all gum and varnish deposits.

Inspect (Figures 22, 23, and 24)

— Plunger (226) for scoring and wear.

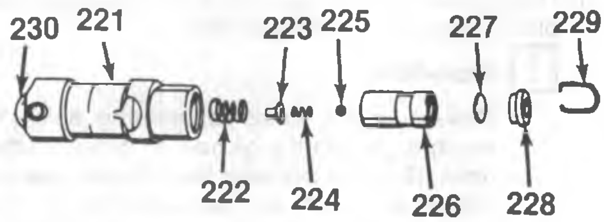
— Pushrod seat (228). If worn or rough, also check the mating pushrod.



221. Lifter Body	226. Plunger
222. Plunger Spring	227. Metering Valve
223. Check Ball Retainer	228. Pushrod Seat
224. Check Ball Spring	229. Retainer
225. Check Ball	

B-05236

Figure 23—Flat Type Hydraulic Lifter Components



221. Lifter Body	226. Plunger
222. Plunger Spring	227. Metering Valve
223. Check Ball Retainer	228. Pushrod Seat
224. Check Ball Spring	229. Retainer
225. Check Ball	230. Roller

B-09402

Figure 24—Roller Type Hydraulic Lifter Components

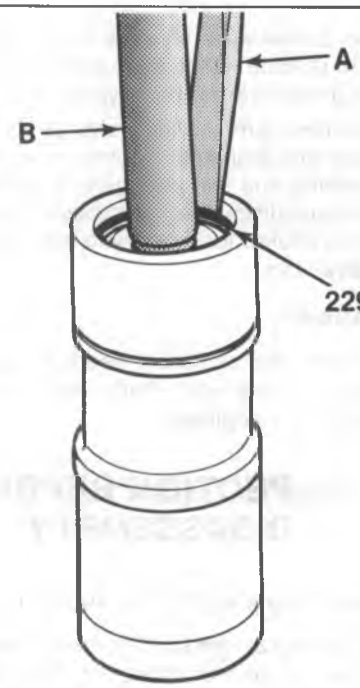
Important

- Do not attempt re-conditioning by taking parts from other unserviceable lifters.

Assemble (Figures 22, 23, 24, 27, and 28)

Important

- Absolute cleanliness is necessary when assembling the hydraulic lifters. Use only



A. Screwdriver
B. Pushrod
229. Retainer

B-05238

Figure 25—Removing the Retainer (Typical)

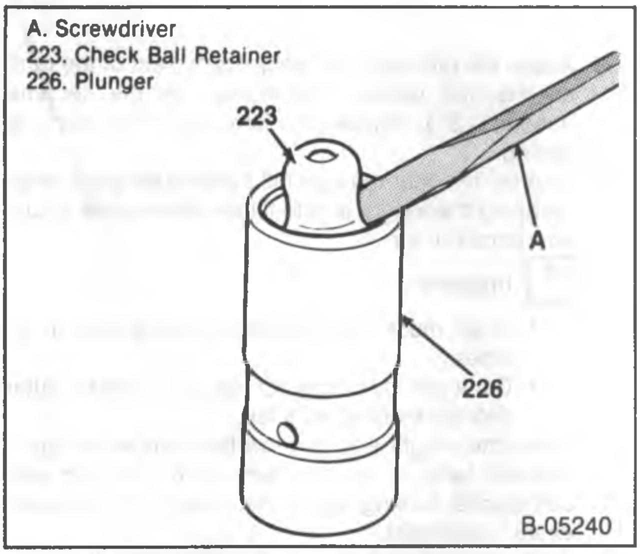


Figure 26—Removing the Check Ball Retainer (Typical)

clean, lint-free shop rags. Work with clean hands, on a clean work surface.

1. Check ball (225) to the small hole in the bottom of the plunger (226).
2. Check ball spring (225) to the check ball retainer (223).
3. Check ball retainer (223) with check ball spring (224) to the plunger (226). Make sure the spring rests on the ball. Carefully press the retainer into position in the plunger with the blade of a small screwdriver (figure 27). Make sure it seats tightly against the plunger.
4. Plunger spring (222) to the check ball retainer (223).
5. Lifter body (221) to the plunger (226).
   - Slide the lifter body over the plunger, being careful to line up the oil feed holes in the lifter body and plunger.
   - Invert the assembly (open end up).
   - Fill the assembly with SAE 10 oil.

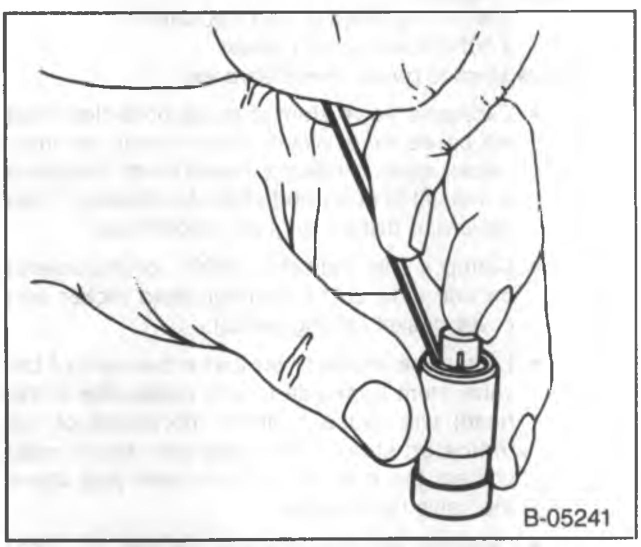


Figure 27—Installing the Check Ball Retainer (Typical)

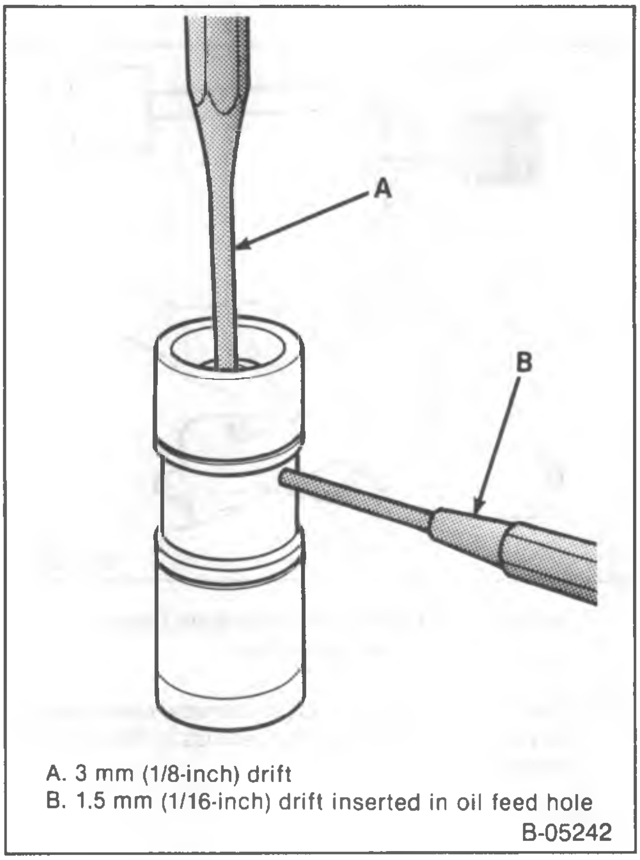


Figure 28—Assembling the Hydraulic Lifter (Typical)

   - Insert the end of a 3 mm (1/8-inch) drift into the plunger and press down solidly. Do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned.
   - Insert a 1.5 mm (1/16-inch) drift through both oil holes to hold the plunger down against the plunger spring tension (figure 28).
   - Remove the 3 mm (1/8-inch) drift. Refill the assembly with SAE 10 oil.
6. Metering valve (227) and pushrod seat (228).
7. Retainer.
   - Push down on the pushrod seat (228), using a pushrod. Remove the 1.5 mm (1/16-inch) drift.
   - The lifter is completely assembled, and ready to be installed or tested.

VALVE LIFTER LEAK-DOWN RATE TEST (FLAT TYPE LIFTERS ONLY)

Tool Required:

J 5790 Hydraulic Lifter Leakdown Tester

Tool J 5790 (figure 29) is available for very accurately checking the leakdown rate of the overhauled valve lifters. This tool applies a measured load to the valve lifter, and measures the amount of valve lifter travel under load. Instructions for use are furnished with the tool, along with a supply of special test oil.

1. Fill tester cup to approximately one inch from top with the special fluid which is available from tester manufacturer.

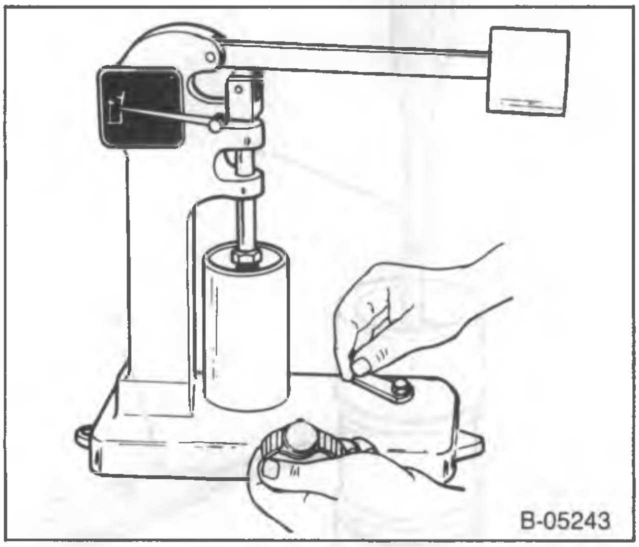


Figure 29—Testing the Hydraulic Lifter — Flat Type Only

2. Swing the weight arm out of the way, raise the arm, and position the lifter into the boss in the center of the tester cup.
3. Adjust the ram (with the weight arm clear of the ram) so that the point is positioned on the set line (marked "S"). Tighten the jam nut to maintain the setting.
4. Operate the lifter through full travel of the plunger by pumping the weight arm to fill the lifter with test fluid and force out air.

Important

- Lifter must be completely submerged at all times.
- Continue pumping for several strokes after definite resistance is felt.

5. Raise the weight arm to allow the plunger spring to expand fully; lower the arm onto the ram and commence turning the crank slowly (1 revolution every 2 seconds).
6. Time indicator travel from the lower line (first line above the set line) to the line marked 0.094 or 3/32-inch, while rotating the cup with crank. The lifter is satisfactory if the rate is between 12 and 90 seconds.

CYLINDER HEAD

DISASSEMBLY

Disassemble

- Valves and components. Refer to the proper section.

CLEANING AND INSPECTION

Clean (Figures 30 and 31)

Tools Required:
J 8089 Wire Brush
J 8101 Valve Guide Cleaning Tool

— Carbon from the combustion chambers. Use J 8089 (figure 30).

— Valve guides. Use J 8101 (figure 31).

— Valve stems and heads on a wire wheel.

— Carbon and old gasket from the cylinder head gasket surface.

Inspect

— Cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the coolant chamber. Gasket surfaces should be free of damage.

— Valves for burning, pitting, or warpage. Grind or replace as needed. Refer to "Valve Grinding." Check the valve stems for scoring or excessive wear. Stems must not be bent.

— Rocker arm studs (if used) for wear, damage or improper fit.

— Valve seats for pitting or other damage. Grind or reface as needed.

— Rotators (if used). The rotators should rotate smoothly, without bind.

Measure (Figures 32, 33, and 34)

Tools Required:
J 8001 Dial Indicator (or equivalent)
J 8056 Valve Spring Tester

— Valve stem to guide bore clearance.

- Excessive valve stem to guide bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engines smoothness.
- Clamp a Dial Indicator J 8001 (or equivalent) on one side of the cylinder head rocker arm cover gasket rail (figure 32).
- Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide bore.
- Drop the valve head about 1.6 mm (1/16-inch) off the valve seat.

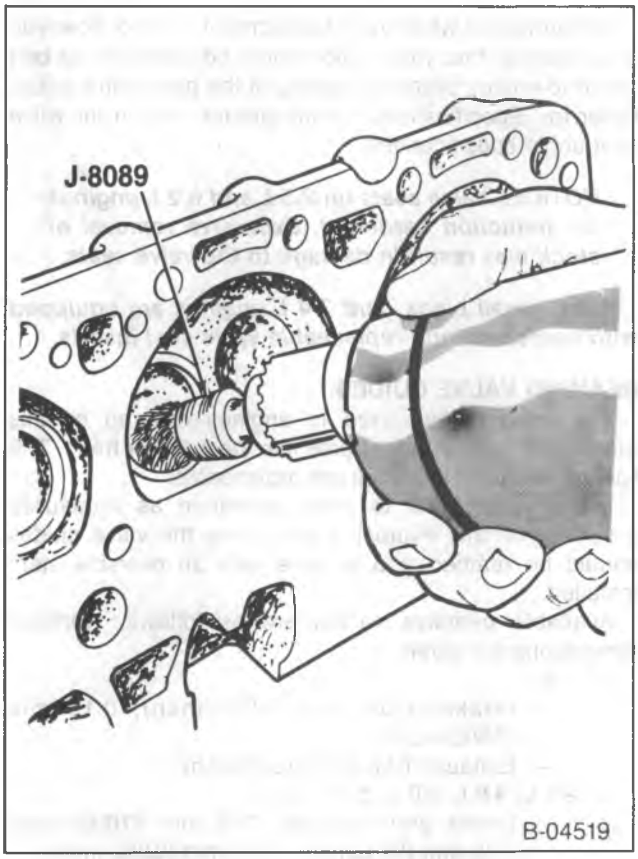


Figure 30—Cleaning the Combustion Chambers (Typical)

- Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guide bores for oversize valves as outlined later in this manual.

— Valve spring tension. Use J 8056 or equivalent (figure 33).

- Compress the springs, with dampers removed, to the specified height and check against the specifications chart. Springs should be replaced if not within 44 N (10 lbs.) of the specified load.

— Valve spring length (figure 34). Replace the spring if the length is not as specified.

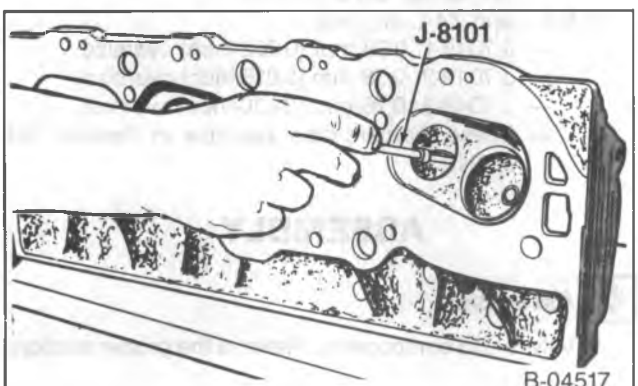


Figure 31—Cleaning the Valve Guides (Typical)

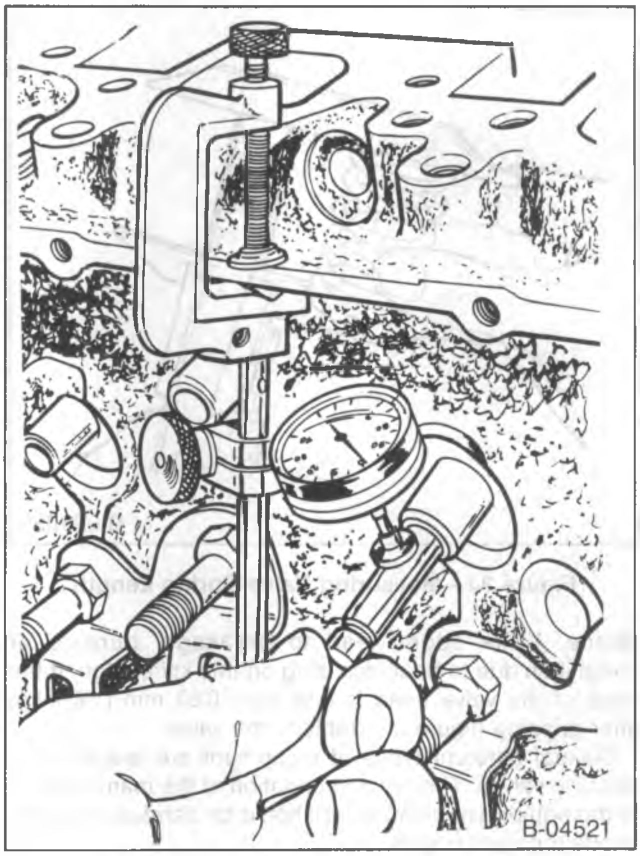


Figure 32—Measuring Stem to Bore Clearance (Typical)

REPAIR

VALVE GRINDING

Valves that are pitted must be refaced to the proper angle. Valve stems which show excessive wear, or valves that are warped excessively must be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely

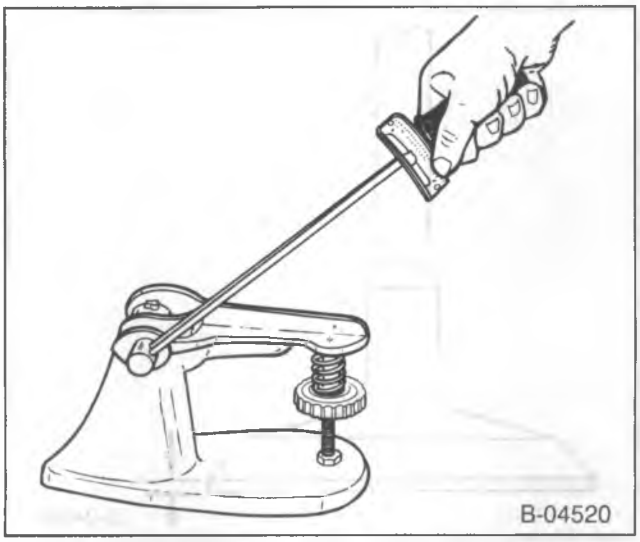


Figure 33—Measuring Valve Spring Tension

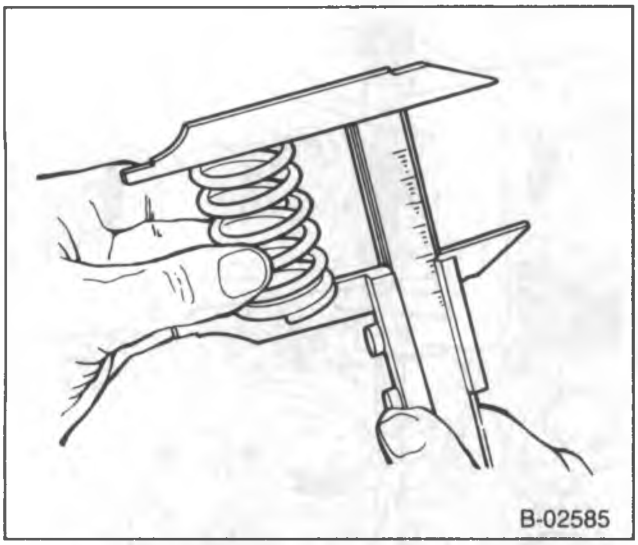


Figure 34—Measuring Valve Spring Length

reface. Knife edges lead to breakage, burning or preignition due to heat localizing on this knife edge. If the edge of the valve head is less than 0.80 mm (1/32-inch) after grinding (figure 35), replace the valve.

Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Refer to "Specifications" in the proper section for valve face angle specifications.

VALVE SEAT GRINDING

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another inportant factor is the cooling of the valve head. Good contact between each valve and its seat will insure that heat will be properly carried away.

Several different types of equipment are available for reseating valve seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

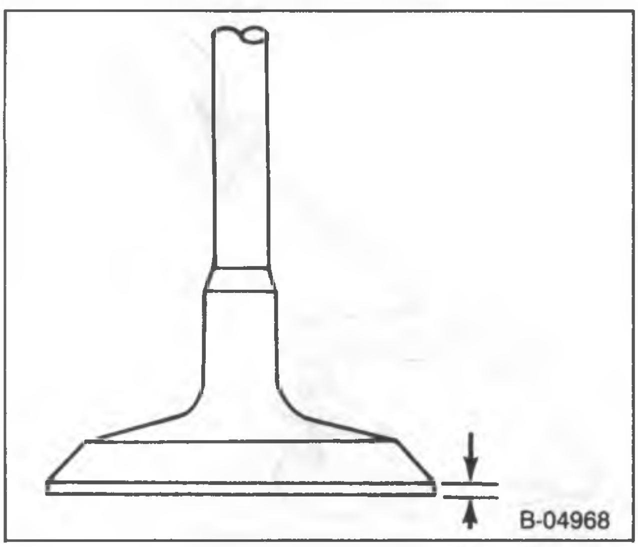


Figure 35—Valve Head Measurement

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of the pilot in the guide. Refer to "Specifications" in the proper section for valve seat angle specifications.

NOTICE: Valve seats on 2.5 L and 6.2 L engines are induction hardened. Excessive removal of stock may result in damage to the valve seats.

4.8 L, small block, and 7.4 L engines are equipped with hardened, non-replaceable valve seat inserts.

REAMING VALVE GUIDES

The valve guides used in engines covered by this manual are simply holes bores into the cylinder head. The valve guides are therefore not replaceable.

If the valve stem to bore clearance as measured previously in this manual is excessive, the valve guides should be reamed and a valve with an oversize stem installed.

Available oversize valves are as follows. Nominal dimensions are given.

- 2.5 L:
  - Intake: 0.08 mm (0.003-inch), 0.13 mm (0.005-inch).
  - Exhaust: 0.08 mm (0.003-inch).
- 2.8 L, 4.8 L, 5.0 L, 5.7 L, 7.4 L:
  - Intake and exhaust: 0.08 mm (0.003-inch), 0.38 mm (0.015-inch), 0.76 mm (0.030-inch).
- 4.3 L:
  - Intake: 0.08 mm (0.003-inch), 0.38 mm (0.015-inch), 0.76 mm (0.030-inch).
  - Exhaust: 0.08 mm (0.003-inch), 0.38 mm (0.015-inch).
- 6.2 L:
  - Intake and exhaust: 0.08 mm (0.003-inch), 0.38 mm (0.015-inch).

Select a reamer which will provide a straight, clean bore through the guide's entire length (figure 36).

Reamer availability is as follows. Sizes given are nominal.

- All engines except 6.2 L and 7.4 L:
  - J 5830-1: 0.08 mm (0.003-inch) oversize.
  - J 6621: 0.13 mm (0.005-inch) oversize.
  - J 5830-2: 0.38 mm (0.015-inch) oversize.
  - J 5830-3: 0.76 mm (0.030-inch) oversize.
  - These reamers (except J 6621) also available in Reamer Set J 5830-02.
- 6.2 L and 7.4 L engines:
  - J 7049-1: 0.08 mm (0.003-inch) oversize.
  - J 7049-2: 0.38 mm (0.015-inch) oversize.
  - J 7049-3: 0.76 mm (0.030-inch) oversize.
  - These reamers also available in Reamer Set J 7049.

ASSEMBLY

Assemble

- Valves and components. Refer to the proper section.

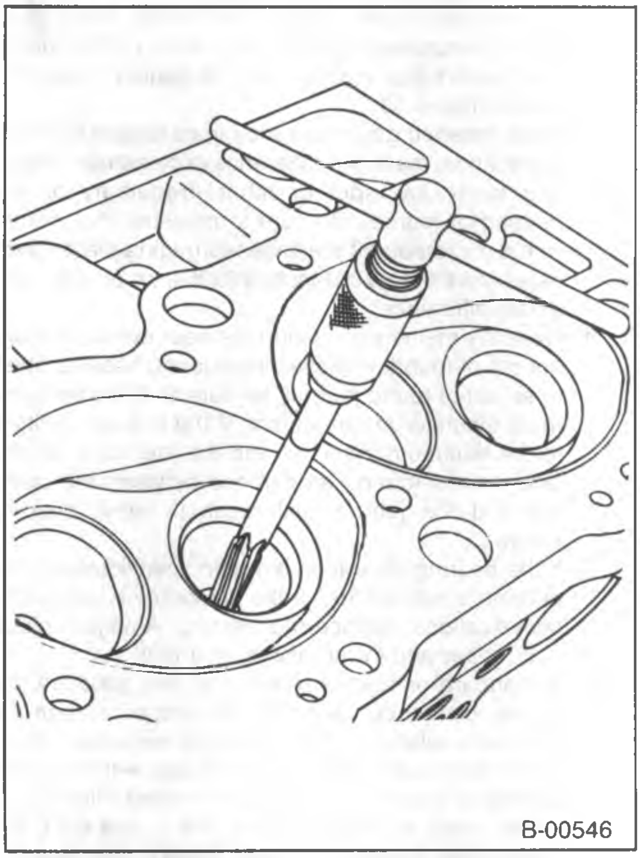


Figure 36—Reaming the Valve Guides (Typical)

MEASURING MAIN BEARING CLEARANCE

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are found to be excessive, new upper and lower inserts will be required.

The simplest, most accurate way to measure main bearing clearance is with the use of gaging plastic. This wax-like material compresses evenly between the bearing and journal surfaces without damaging them. Proceed as follows:

Clean

- All oil from the crankshaft journal and main bearing inserts.

Install or Connect (Figure 37)

- Refer to the proper section for additional information.

1. Main bearing inserts and crankshaft, as outlined in the proper section.
2. Gaging plastic.
   - Begin with the rear main bearing.
   - Wipe the oil from the crankshaft journal and the lower main bearing insert.

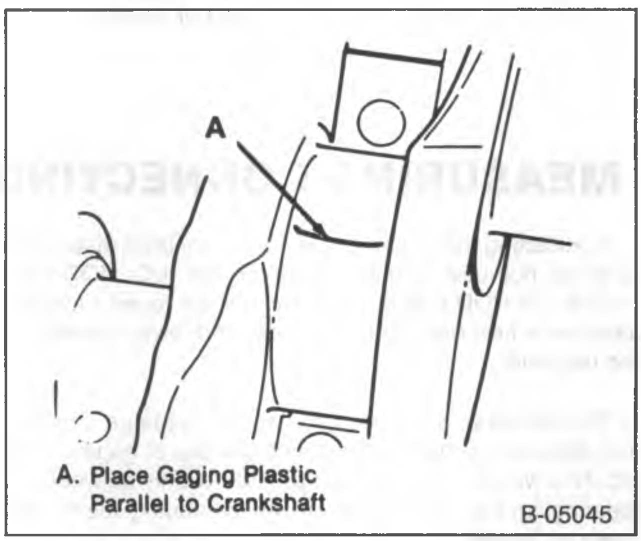


Figure 37—Placing the Gaging Plastic on the Bearing Journal

- Place a piece of gaging plastic the full width of the lower bearing insert (parallel to the crankshaft) on the journal (figure 37). Do not rotate

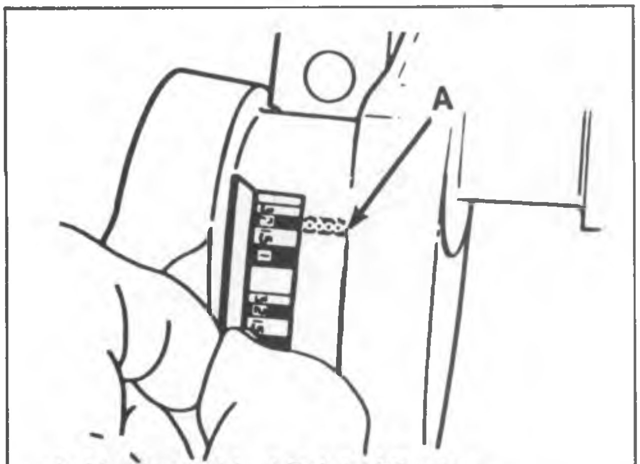


Figure 38—Measuring the Gaging Plastic

the crankshaft while the gaging plastic is between the bearing and journal.

3. Main bearing cap and bolts.

Tighten

- Bolts to "Specifications."

Remove or Disconnect

- Main bearing cap.
  DO NOT REMOVE THE GAGING PLASTIC FROM THE JOURNAL OR LOWER MAIN BEARING INSERT.

Measure (Figure 38)

- Gaging plastic as follows:

1. The flattened gaging plastic will be found adhering to either the lower bearing insert or journal.
2. On the edge of the gaging plastic envelope there is a graduated scale. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (figure 38).
3. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than 0.001-inch (0.0005-inch on 2.5 L engines) difference.
4. Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal, be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is excessively out-of-round, interference between the bearing and the journal will result in rapid bearing failure.
5. If the bearing clearance is within specifications, the bearing is satisfactory. If the clearance is not within specifications, replace the bearing. Always replace both upper and lower inserts as a unit.
6. A standard or undersize bearing may produce the proper clearance. Refer to the proper section for bearing availability. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing. Do not grind rolled fillet crankshafts, such as used on 2.5 L, 2.8 L, and 6.2 L engines. After selecting the new bearing, recheck the clearance.
7. Remove the flattened gaging plastc.
8. Perform the preceding steps on the remaining main bearings.

MEASURING CONNECTING ROD BEARING CLEARANCE

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing (both upper and lower halves) will be required.

The simplest, most accurate way to measure connecting rod bearing clerarance is with the use of gaging plastic. This wax-like material compresses evenly between the bearing and journal surfaces with damaging them. Proceed as follows.

Clean

- All oil from the crankshaft journal and the connecting rod bearing inserts.

Install or Connect (Figure 39)

- Refer to the proper section for additional information on connecting rod bearing sizing.

1. Connecting rod with the upper connecting rod bearing insert to the crankshaft journal.
2. A piece of gaging plastic the length of the bearing (parallel to the crankshaft) on the journal (figure 39). The plastic gage should be positioned in the middle of the upper and lower bearing insert. (Bearings are eccentric and false readings could occur if placed elsewhere.)

Important

- If a bearing is being fitted to an out-of-round crankpin, be sure to fit the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is exces-

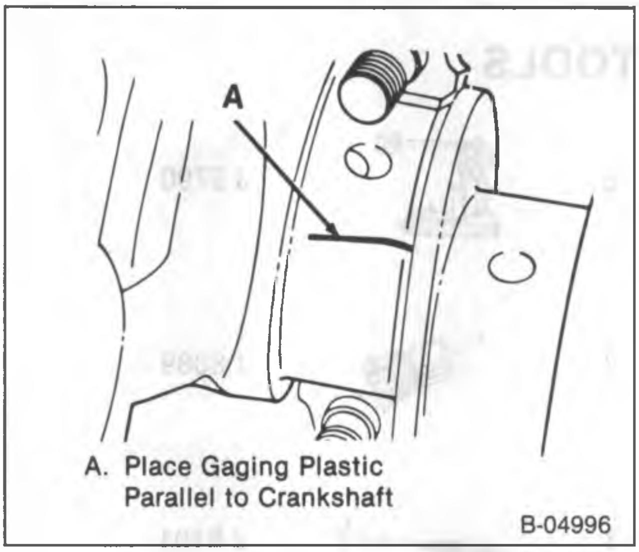


Figure 39—Placing the Gaging Plastic on the Connecting Rod Journal

sively out-of-round, interference between the bearing and the crankpin will result in rapid bearing failure.

3. Connecting rod cap with the lower connecting rod bearing insert. DO NOT TURN THE CRANKSHAFT WITH THE GAGING PLASTIC INSTALLED.
4. Connecting rod cap nuts.

Tighten

- Nuts to "Specifications." Refer to the proper section.

Important

- The gaging plastic will be found sticking either to the journal or lower connecting rod bearing insert. Do not remove it at this time.

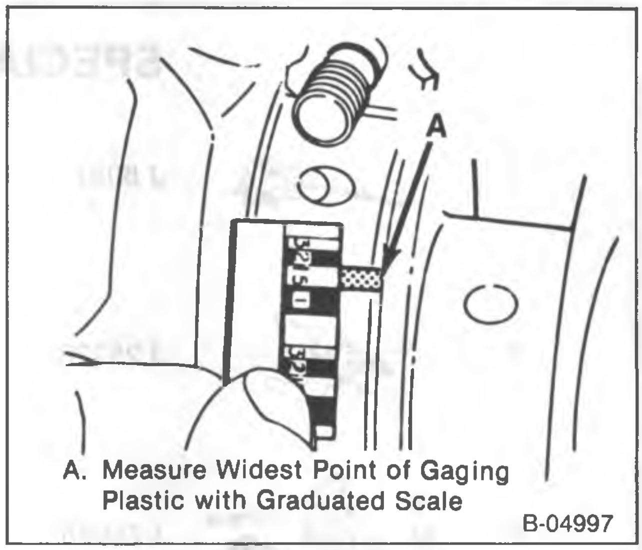


Figure 40—Measuring the Gaging Plastic

Measure (Figure 40)

- Gaging plastic at its widest point, using the scale at the gaging plastic envelope (figure 40).
- If the clearance exceeds specifictions, select a new, correct size, connecting rod bearing and remeasure the clearance.
- A standard or undersize bearing may produce the proper clearance. Refer to the proper section for bearing availability.
- Do not attempt to use shims or file the bearing to obtain the needed clearance.
- If clearance cannot be brought to within specifications, recondition or replace the crankshaft. (Do not recondition a rolled fillet crankshaft, such as used on 2.5 L, 2.8 L, and 6.2 L engines.)

Remove or Disconnect

- Gaging plastic.

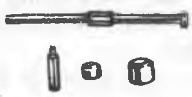
SPECIAL TOOLS

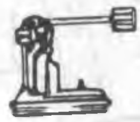
1  J 8087

2  J 25220

3  J 24086

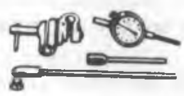
4  J 29134-A

5  J 6098-01

6  J 5790

7  J 8089

8  J 8101

9  J 8001

10  J 8056

11  J 29664

12, 13, 14  J 6621, J 5830-02, J 7049

1. Cylinder Bore Gage
2. Ring Expander
3. Piston Pin Replacer Set
4. Piston Pin Clip Installer
5. Camshaft Bearing Replacer
6. Hydraulic Lifter Leakdown Tester
7. Wire Brush
8. Valve Guide Cleaning Tool
9. Dial Indicator
10. Valve Spring Tester
11. Intake Opening Cover
12. 0.13 mm (0.005-inch) Oversize Valve Guide Reamer (2.5 L Engines)
13. Valve Guide Reamer Set (All Engines Except 6.2 L and 7.4 L). Consists of:
    - J-5830-1: 0.08 mm (0.003-inch) oversize
    - J-5830-2: 0.38 mm (0.015-inch) oversize
    - J-5830-3: 0.76 mm (0.030-inch) oversize
14. Valve Guide Reamer Set (6.2 L and 7.4 L Engines). Consists of:
    - J-7049-1: 0.08 mm (0.003-inch) oversize
    - J-7049-2: 0.38 mm (0.015-inch) oversize
    - J-7049-3: 0.76 mm (0.030-inch) oversize

F-04508

SECTION 6A1

2.5 LITER L4 ENGINE

CONTENTS

CONTENTS (CONT.)

DESCRIPTION

The GM 2.5 L engine is an inline four cylinder, overhead valve, with cast iron block and head.

The crankshaft is supported by five main bearings, with crankshaft thrust taken at the number five (rear) bearing.

The camshaft is supported by three bearings and is gear driven.

The valve train consists of roller type hydraulic lifters, pushrods, and ball pivot type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods have precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the pistions.

For engine identification information, refer to GENERAL INFORMATION (SEC. 0A).

ENGINE LUBRICATION

The oil pump is gear driven from the camshaft (figure 1). Oil is drawn from the oil pan through a pickup screen and tube. A bypass valve in the pickup screen insures adequate oil flow if the screen becomes restricted. The gear type oil pump has a pressure regulator valve which controls lubrication system pressure by bypassing excess oil back to the oil pan sump.

Pressurized oil from the oil pump flows to the full flow filter. A bypass valve allows oil to bypass the filter if it becomes clogged or restricted. Oil then flows into an oil passage which runs along the right side of the block and intersects the lifter bosses. Oil from this passage is then routed to the crankshaft main bearings and camshaft bearings through smaller drilled passages. Oil is supplied to the connecting rod bearings by holes drilled in the crankshaft. Oil is supplied to the rocker arms through holes in the hydraulic lifters which feed oil up the pushrods to the rocker arms. The oil is metered by discs under the pushrod seat.

Many internal engine parts have no direct oil feed and are supplied by either gravity or splash from other direct feed components. Timing gears are lubricated by oil which is supplied through a passage from the front of the camshaft to a calibrated nozzle above the crankshaft gear.

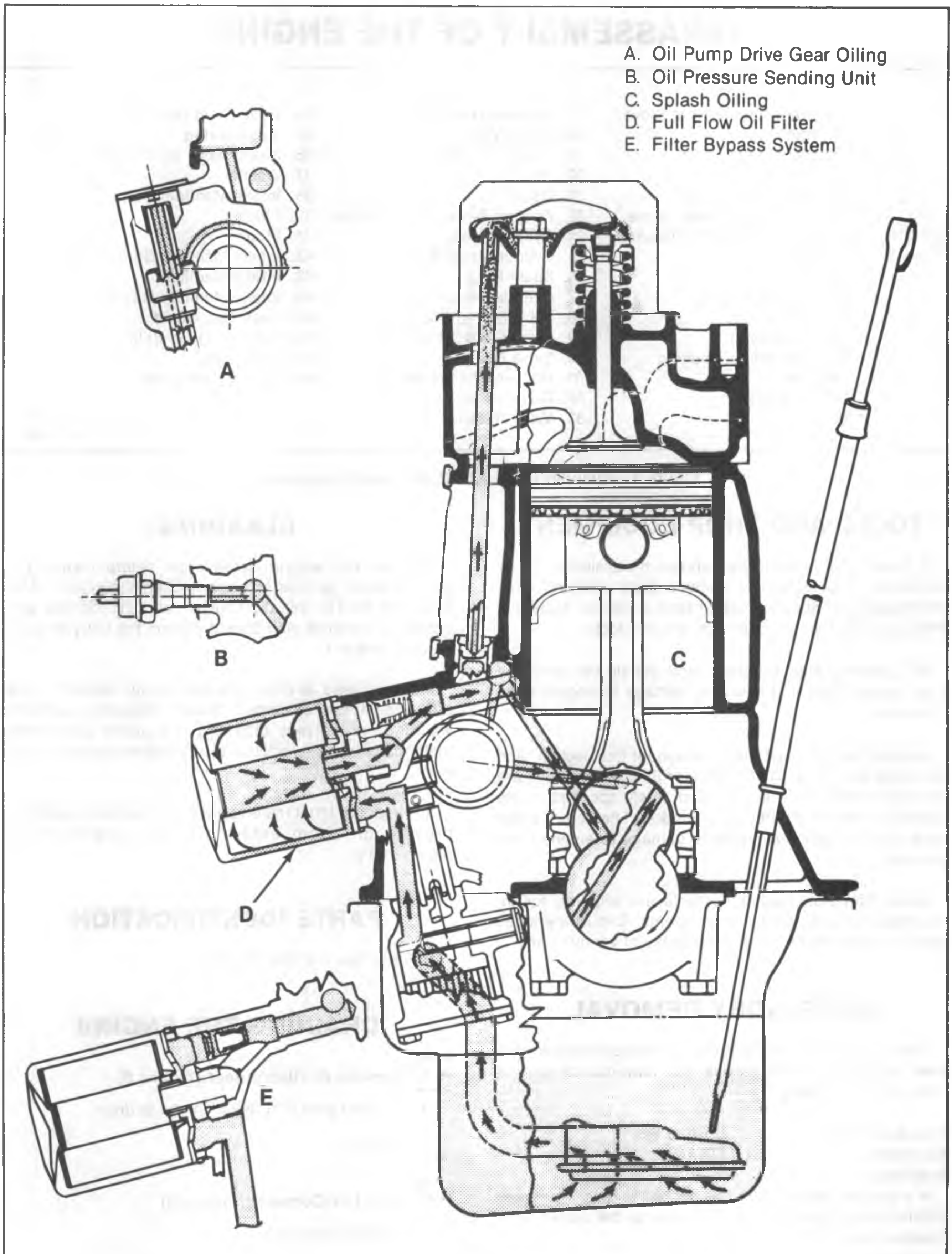


Figure 1—Engine Lubrication Diagram

DISASSEMBLY OF THE ENGINE

1. Outer Engine Heat Stove
2. Bolt
3. Stud
4. Stud
5. Exhaust Manifold
6. Inner Engine Heat Stove
7. Exhaust Manifold Gasket
8. Stud
9. Bolt
10. Coolant Fitting
11. Gasket
12. Thermostat
13. Thermostat Housing
14. Bolt
15. Hose Clamp
16. Hose
17. Cylinder Head Gasket
18. Intake Valve
19. Exhaust Valve
20. Plug
21. Gasket
22. Coolant Temperature Sensor
24. Cylinder Head
25. Cylinder Head Bolt
26. Spark Plug
27. Cylinder Head Bolt
28. Valve Spring Cap
29. Valve Stem Oil Seal
30. Valve Keys
31. Rocker Arm Ball Bolt
32. Rocker Arm Ball
33. Valve Rocker Arm
34. Valve Stem Oil Shield
35. Valve Spring
36. Intake Valve Stem Seal
37. Washer
38. Intake Manifold Bolt
39. Plug
41. Plug
42. Intake Manifold Stud
43. Intake Manifold
44. Intake Manifold Gasket
45. Push Rod Guide
46. Cylinder Head Bolt
47. Push Rod
48. Rocker Arm Cover

F-01980

Figure 2—Cylinder Head, Manifolds, and Components

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary aids include: a suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine compartments.

Special tool are illustrated throughout this section, and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

Hydraulic Pump
Generator
Distributor
Cooling Fan
TBI Unit

It is beyond the scope of this section to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routings, accessory drive belt layout, etc., should be made before removing accessories.

CLEANING

Remove the engine accessories before cleaning to provide better access to engine exterior surfaces. After removing the TBI unit, distributor, fuel pump, oil filter, etc., cover the openings with tape to prevent the entry of water, solvent, and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

PARTS IDENTIFICATION

Refer to figure 2 through 5.

DRAINING THE ENGINE

Remove or Disconnect (Figure 5)

- Oil drain plug (73). Allow the oil to drain.
- Oil filter.

Install or Connect (Figure 5)

1. Oil drain plug (73).

Tighten

- Oil pan drain plug to 34 N·m (25 ft. lbs.).

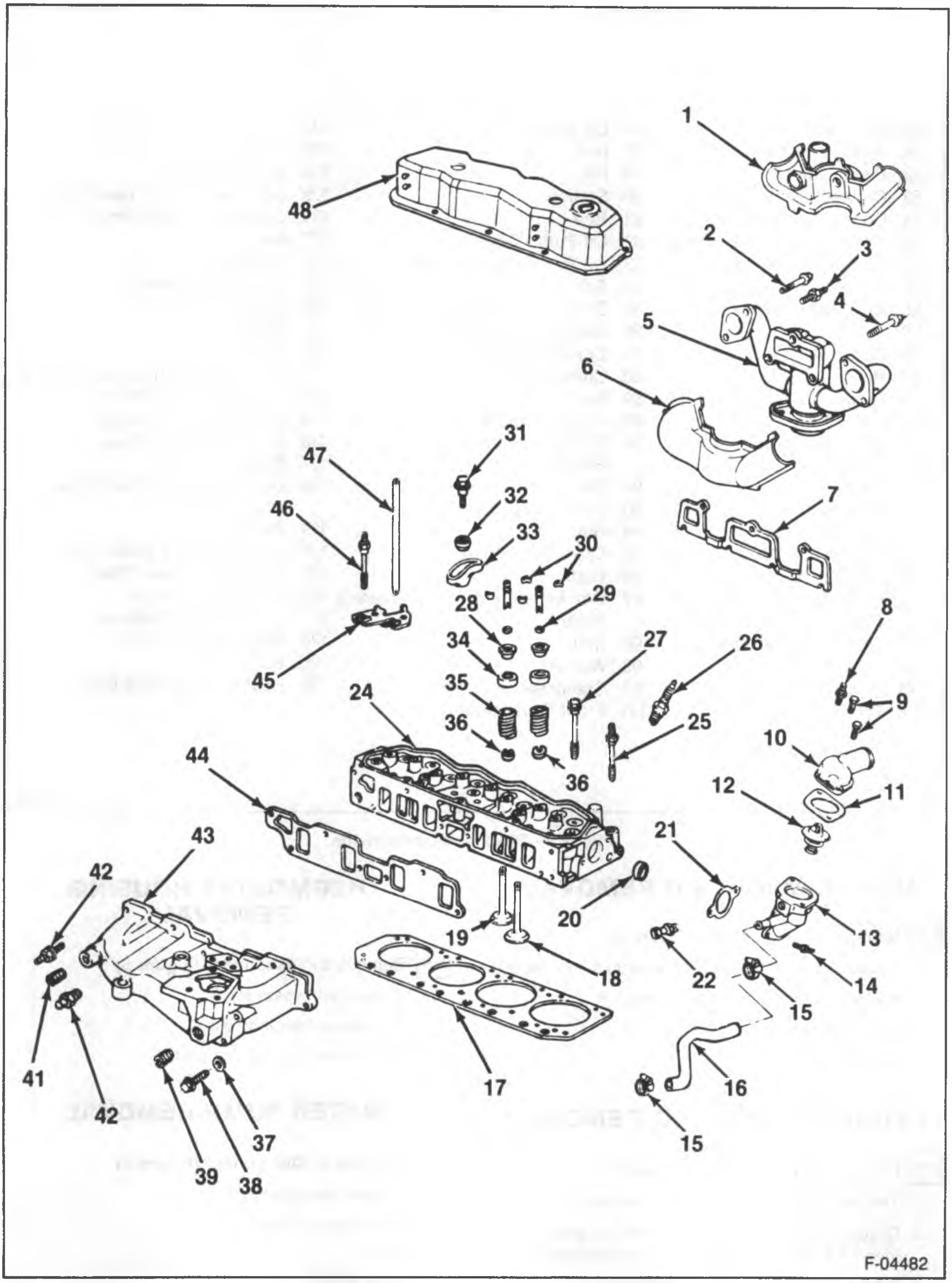


Figure 3—Cylinder Head, Manifolds, and Components

50. Push Rod Cover
51. Piston and Pin
52. Piston Rings
53. Connecting Rod
54. Connecting Rod Bolt
55. Connecting Rod Bearings
56. Connecting Rod Nut
57. Oil Level Indicator
58. Oil Level Indicator Tube
59. Seal
60. Guide Retainer Stud
61. Plug
62. Plug
63. Pin
64. Block Drain Bolt
65. Timing Indicator Stud
66. Bolt
67. Flywheel
68. Spacer
69. Clutch Pilot Bearing
70. Crankshaft Insert
71. Crankshaft Rear Oil Seal
72. Crankshaft Rear Bearing
73. Oil Pan Drain Screw
74. Gasket
75. Bolt
76. Oil Pan
77. Oil Pump
78. Nut
79. Pin
80. Spring
81. Bolt
82. Oil Pump Cover
83. Oil Pump Cover Gasket
84. Bolt
85. Oil Pressure Regulator Valve
86. Crankshaft Bearings
87. Crankshaft Gear
88. Crankshaft
89. Key
90. Timing Indicator
91. Oil Pump Shaft Lower Bearing
92. Plug
93. Timing Gear Oil Nozzle
94. Bolt
95. Crankshaft Pulley
96. Bolt
97. Crankshaft and Power Steering Pulley
98. Bolt
99. Washer
100. Crankshaft Pulley Hub
101. Front Cover Seal
102. Front Cover
103. Screw
104. Camshaft Gear
105. Camshaft Thrust Bearing
106. Camshaft Gear Spacing Ring
107. Key
108. Camshaft
109. Camshaft Bearing
110. Bolt
111. Coolant Pump
112. Gasket
113. Oil Pump Shaft Upper Bearing
114. Oil Pump Drive Shaft Gear
115. Oil Pump Drive Shaft
116. Connecting Rod Cap
117. Bolt
118. Oil Pump Drive Shaft Cover Plate
119. Block
120. Cylinder Head Dowel Pin
121. Hydraulic Roller Lifter
122. Valve Lifter Guide
123. Lifter Guide Retainer
124. Main Bearing Cap
125. Bolt
126. Rear Main Bearing Cap

F-01982

Figure 4—Block and Components

INTAKE MANIFOLD REMOVAL

↔ Remove or Disconnect (Figure 6)

1. Vacuum lines and electrical connectors, as needed.
2. Intake manifold bolts and washers.
3. Intake manifold.
4. Gasket.

EXHAUST MANIFOLD REMOVAL

↔ Remove or Disconnect (Figure 7)

1. Thermac heat stove pipe at the exhaust manifold.
2. Oxygen sensor wire. Remove the oxygen sensor only if the exhaust manifold is to be replaced.
3. Exhaust manifold bolts and washers.
4. Exhaust manifold and gasket.

THERMOSTAT HOUSING REMOVAL

↔ Remove or Disconnect (Figure 5)

1. Thermostat bypass hose.
2. Thermostat housing bolts.
3. Thermostat housing and gasket.

WATER PUMP REMOVAL

↔ Remove or Disconnect (Figure 8)

1. Fan and fan clutch.
2. Water pump pulley.
3. Bolts.
4. Water pump.
5. Gasket.

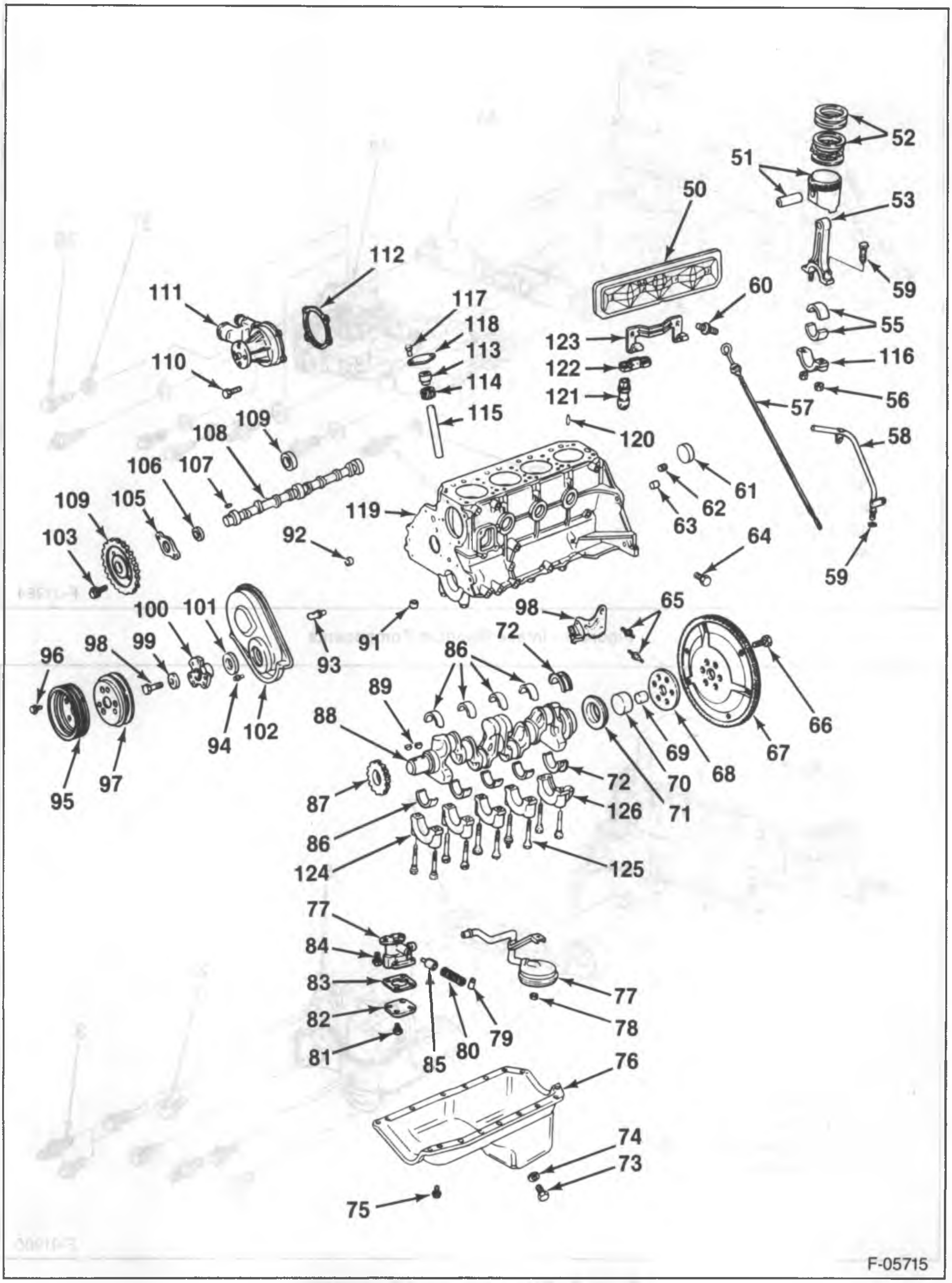


Figure 5—Block and Components

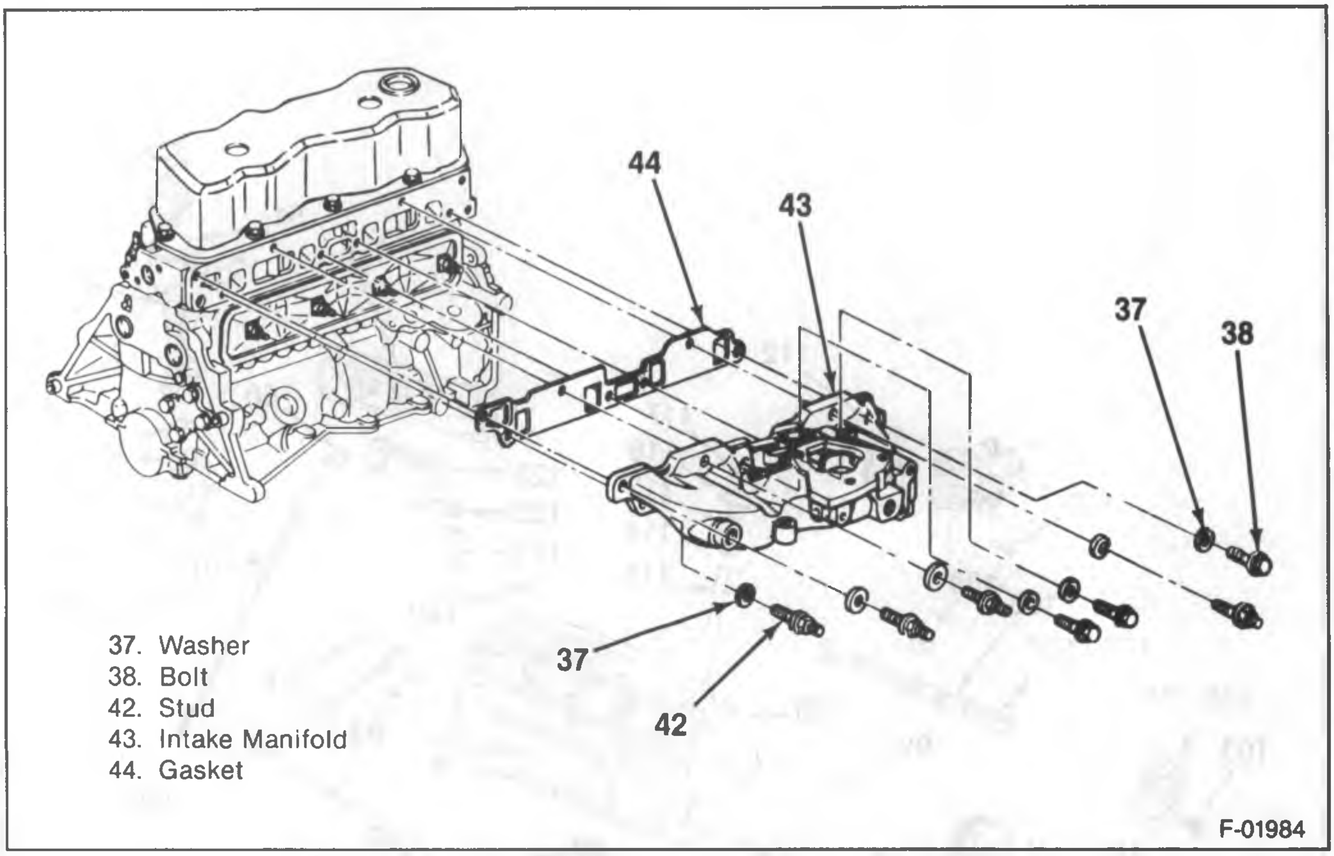


Figure 6—Intake Manifold Components

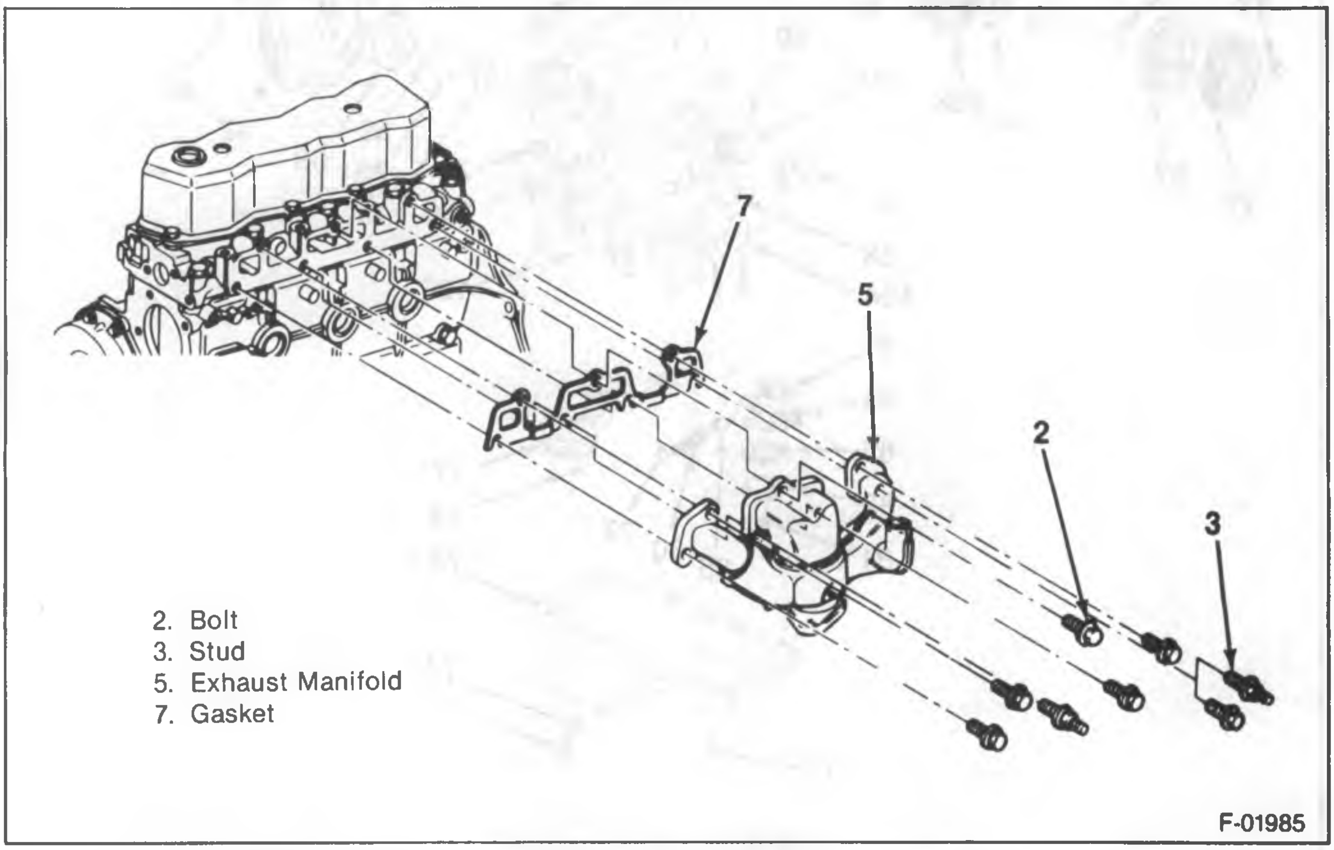


Figure 7—Exhaust Manifold Components

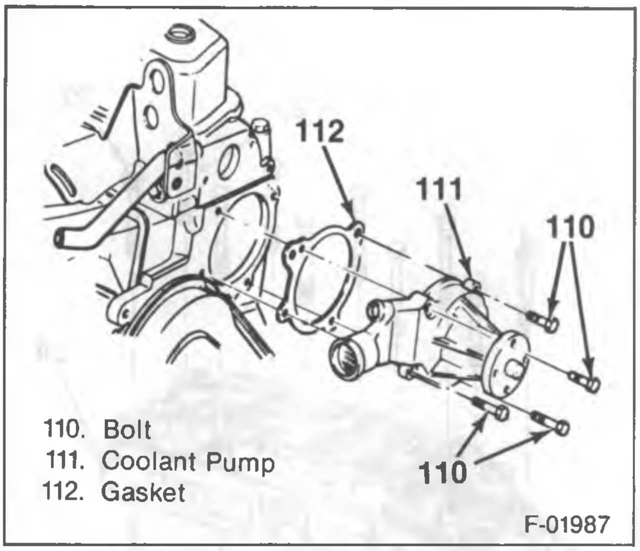


Figure 8—Water Pump

VALVE TRAIN COMPONENT REMOVAL

Tools Required:
J 34144-A Rocker Arm Cover Remover
J 3049 Valve Lifter Remover (Plier Type)

Remove or Disconnect (Figures 2, 3, 9, 10, 11, and 12)

1. Rocker arm cover bolts.

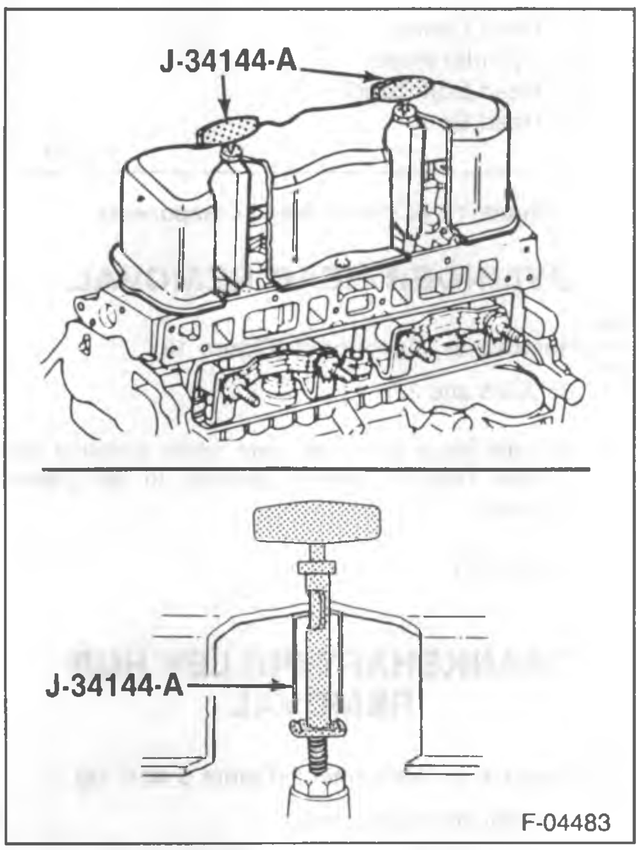


Figure 9—Removing the Rocker Arm Cover

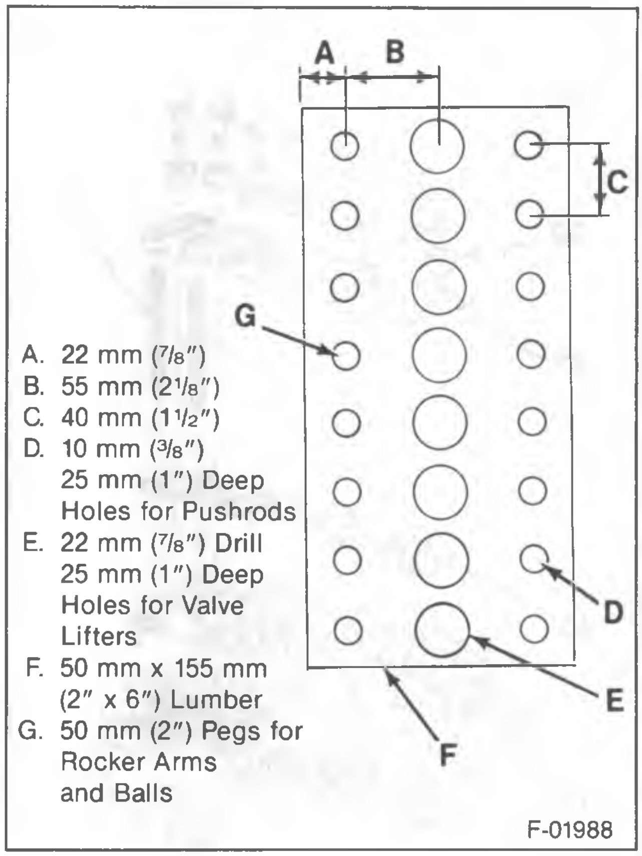
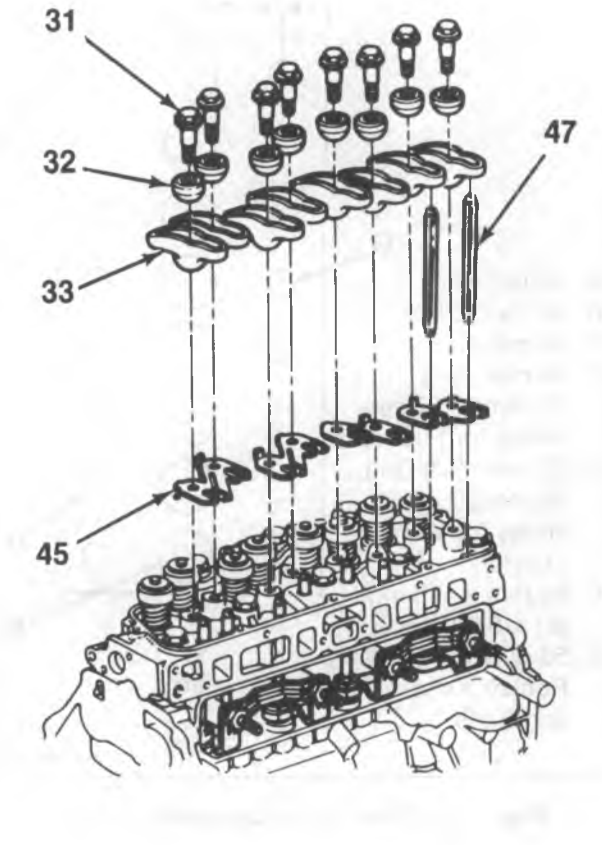


Figure 10—Valve Train Component Rack

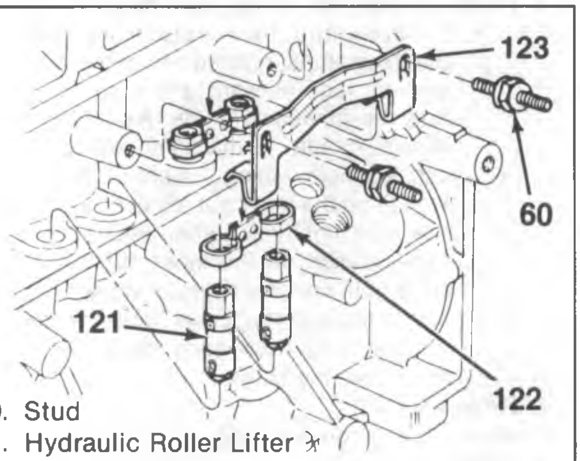
2. Rocker arm cover. Use J 34144-A (figure 9).
3. Bolts (31), balls (32), rocker arms (33), pushrods (47) and pushrod guides (45).
   - Every effort should be made to insure that these mating parts are installed in their original locations during assembly. A simple valve train component organizer rack can be made from a piece of wood, as shown in figure 10.
4. Pushrod cover nuts, studs, and the cover (50).
   - Unscrew the four nuts from the cover attaching studs, reverse two of the nuts so the washers face outward and screw them back onto the inner two studs. Assemble the two remaining nuts to the same two inner studs with washers facing inward. Using a small wrench on the inner nut, on each stud, jam the two nuts tightly together. Again, using the small wrench on the inner nut, unscrew the studs until the cover breaks loose.
   - After breaking the cover loose, remove the jammed nuts from each stud. Remove the cover from the studs.
5. Retainers (123).
6. Hydraulic lifter guides (122).
7. Hydraulic lifters.
   - Remove the valve lifters one at a time and place them in the organizer rack. The valve lifters must be installed in the same bore from which they were removed.
   - A stuck valve lifter can be removed using J 3049.



31. Bolt
32. Rocker Arm Ball
33. Rocker Arm
45. Push Rod Guide
47. Push Rod

F-01989

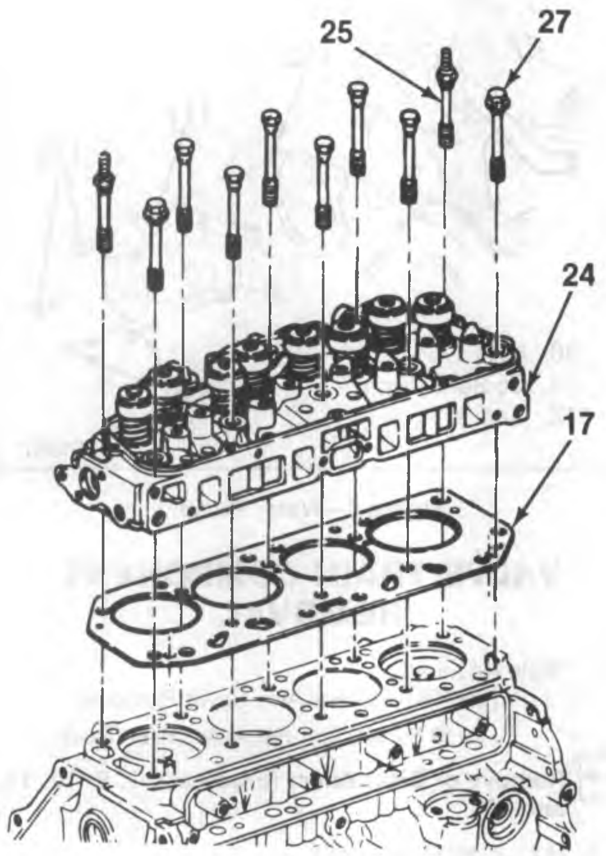
Figure 11—Valve Train Components



60. Stud
121. Hydraulic Roller Lifter
122. Valve Lifter Guide
123. Lifter Guide Retainer

F-01990

Figure 12—Hydraulic Lifters and Components



17. Head Gasket
24. Cylinder Head
25. Head Bolt (Stud)
27. Head Bolt

F-01991

Figure 13—Cylinder Head Components

CYLINDER HEAD REMOVAL

↔ Remove or Disconnect (Figure 13)

1. Bolts (25 and 27).
2. Cylinder head (24). Use care when handling the cylinder head to prevent damage to the gasket surfaces.
3. Gasket (17).

CRANKSHAFT PULLEY HUB REMOVAL

↔ Remove or Disconnect (Figure 5 and 14)

1. Bolt (98) and washer (99).
2. Pulleys (96 and 97) and hub (100).

89. Key
94. Bolt
95. Crankshaft Pulley
96. Bolt
97. Crankshaft and Power Steering Pulley
98. Bolt
99. Washer
100. Crankshaft Pulley Hub

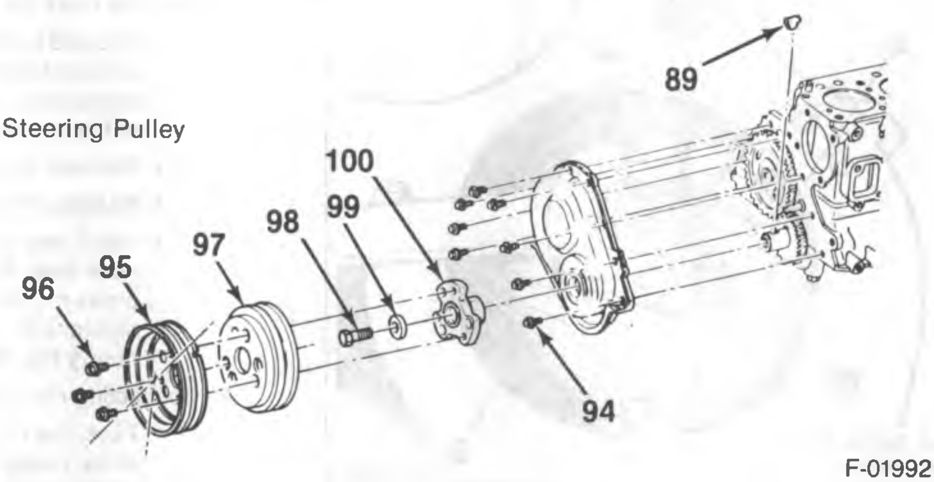


Figure 14—Timing Gear Cover and Components

OIL PAN REMOVAL

Remove or Disconnect (Figure 5)

1. Bolts (75).
2. Oil pan (76).
   - If the rocker arm cover adheres to the block, try to shear the sealant from the block by bumping the end of the oil pan with a rubber mallet. If the cover will not come loose, carefully pry until loose. DO NOT DISTORT THE SEALING FLANGE.

OIL PUMP DRIVESHAFT REMOVAL

Remove or Disconnect (Figures 5 and 15)

1. Bolts (117).
2. Plate (118).
3. Bearing (113).
4. Shaft and gear assembly (115 and 114).

OIL PUMP REMOVAL

Remove or Disconnect (Figure 5)

1. Bolts (84) and nut (78) at oil screen bracket.
2. Oil pump (77).

FRONT COVER REMOVAL

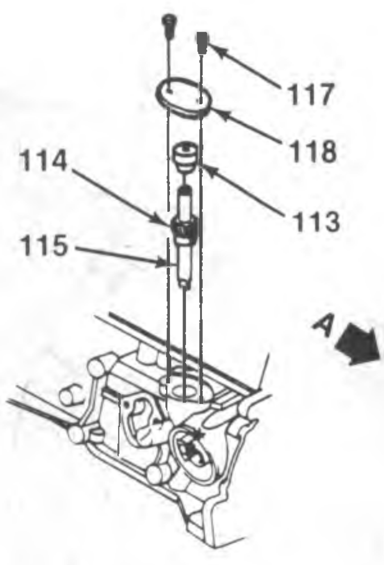
Remove or Disconnect (Figures 5 and 14)

1. Timing gear cover bolts (94).
2. Timing gear cover (102).
   - If the timing gear cover adheres to the cylinder head, carefully pry it loose. DO NOT DISTORT THE SEALING FLANGE.

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 5, 16 and 17)

1. Ridge (or deposits) at the top of the cylinder as follows:
   - Turn the crankshaft until one piston is at the bottom of its stroke. Place a soft cloth on top of the piston.



113. Bearing
114. Gear
115. Shaft
117. Bolt
118. Plate

F-05716

Figure 15—Oil Pump Drive Shaft

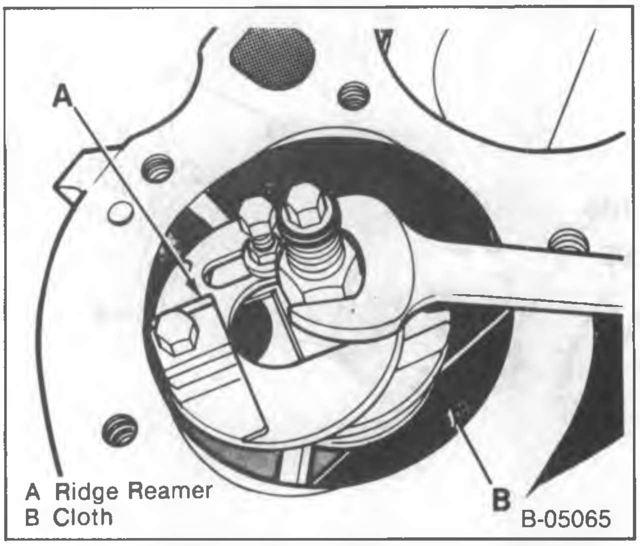


Figure 16—Removing the Cylinder Ridge

- Using the manufacturer's directions, install a ridge reamer into the top of the cylinder. Perform the cutting operation.
- After the ridge and/or deposits are removed, remove the ridge reamer. Turn the crankshaft until the piston is at the top of its stroke. Remove the cloth and the cuttings.
- Repeat this procedure for each piston.

2. Connecting rod caps (116) as follows: Take note of the arrangement of the connecting rod (53) markings, to insure proper reassembly. Use a silver pencil to mark the parts if necessary.
   - To avoid mismatching the connecting rods and connecting rod caps, remove only one connecting rod cap at a time. Place the piston at the bottom of its stroke.
   - Remove the nuts (56).
   - Remove the connecting rod cap.
   - Install two sections of 10 mm (3/8-inch) rubber hose over the connecting rod studs. This will prevent the connecting rod studs from scratching the bore or crankshaft journal during the removal process.
3. Connecting rod (53) and piston (51) from the block.
   - Push the connecting rod and piston from the block being careful not to let the connecting rod contact the cylinder bore.
   - Loosely assemble the connecting rod cap (116) onto the connecting rod.
   - Take note of, or mark the connecting rod and piston assembly and the cylinder bore to assure that each assembly is returned to its original bore.
   - Repeat this procedure on the remaining connecting rod assemblies.

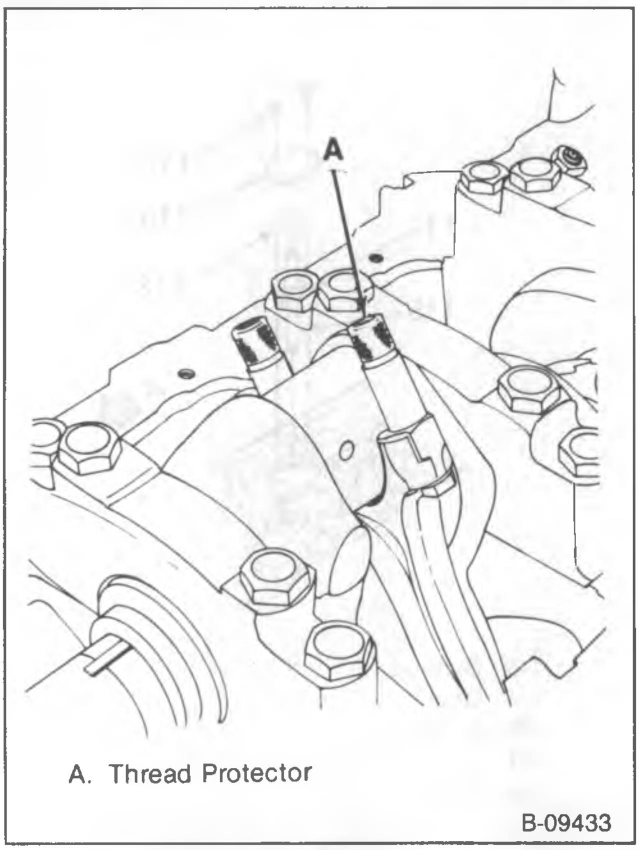


Figure 17—Connecting Rod Thread Protectors

FLYWHEEL REMOVAL

Remove or Disconnect (Figure 5)

1. Flywheel bolts (66).
2. Flywheel (67).
3. Spacer (68).

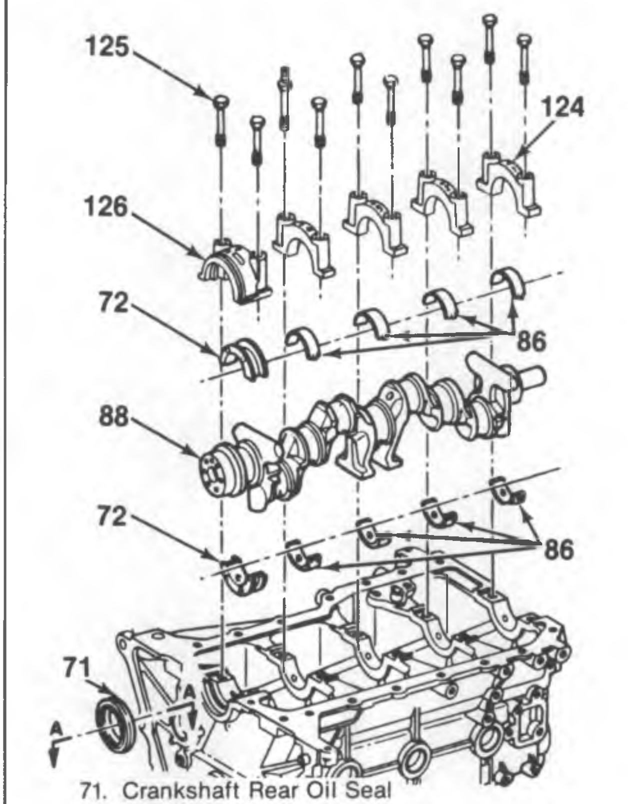
CRANKSHAFT REMOVAL

The main bearings and rear oil seal can be replaced without removing the crankshaft, as outlined later in this section.

Remove or Disconnect (Figures 5, 18 and 19)

- Check the main bearing caps (124 and 126) location markings. The main bearing caps are numbered 1 through 5 from the front to the rear of the engine. The caps must be returned to their original locations during engine assembly.

1. Crankshaft timing gear (87).
2. Bolts (125).
3. Main bearing caps (124 and 126).
4. Crankshaft (88). Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange surfaces.
5. Seal (71).
6. Main bearing inserts (figure 19).
   - If the main bearing inserts are to be reused, mark them to insure they are installed in their original positions before removal.



71. Crankshaft Rear Oil Seal
72. Crankshaft Rear Bearing
86. Crankshaft Bearings
88. Crankshaft
124. Main Bearing Cap
125. Bolt
126. Rear Main Bearing Cap

F-01994

Figure 18—Crankshaft and Bearing Components

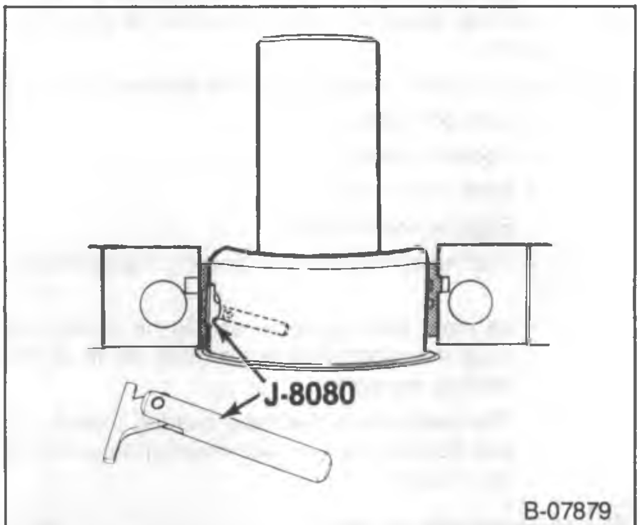


Figure 19—Removing the Upper Main Bearing Insert

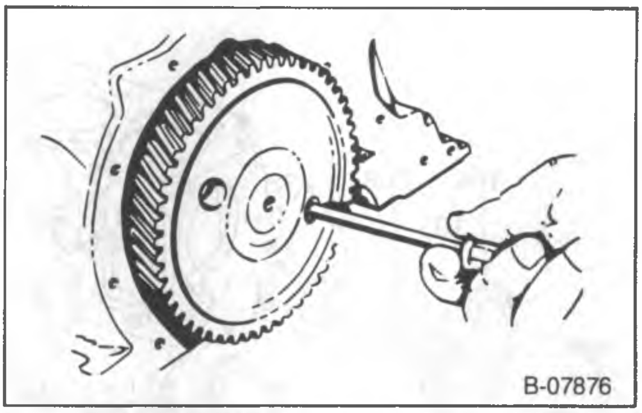


Figure 20—Removing the Camshaft Thrust Plate Bolts

CRANKSHAFT REAR OIL SEAL REMOVAL (WITHOUT REMOVING CRANKSHAFT)

↔ Remove or Disconnect (Figure 5)

NOTICE: Care must be taken not to damage the crankshaft outside diameter surface with the pry tool.

1. Rear crankshaft oil seal.
   - Pry the seal out with a screwdriver. Take care not to scratch the crankshaft.

MAIN BEARING REMOVAL (WITHOUT REMOVING THE CRANKSHAFT)

↔ Remove or Disconnect

Tool Required:
J 8080 Main Bearing Remover/Installer

1. Main bearing caps (124 and 126).
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
2. Lower main bearing inserts (86) from the main bearing caps.
3. Upper main bearing inserts (86).
   - Insert J 8080 into the crankshaft oil hole.
   - Rotate the crankshaft to "turn" the bearing out of the block.

CAMSHAFT REMOVAL

↔ Remove or Disconnect (Figures 5, 20 and 21)

- Turn the camshaft (108) until the bolts (103) are visible through the holes in the camshaft gear (104).

1. Bolts (103).
2. Camshaft (108). Pull the camshaft out of the block. **Support the camshaft carefully when removing to prevent damage to the camshaft bearings.**

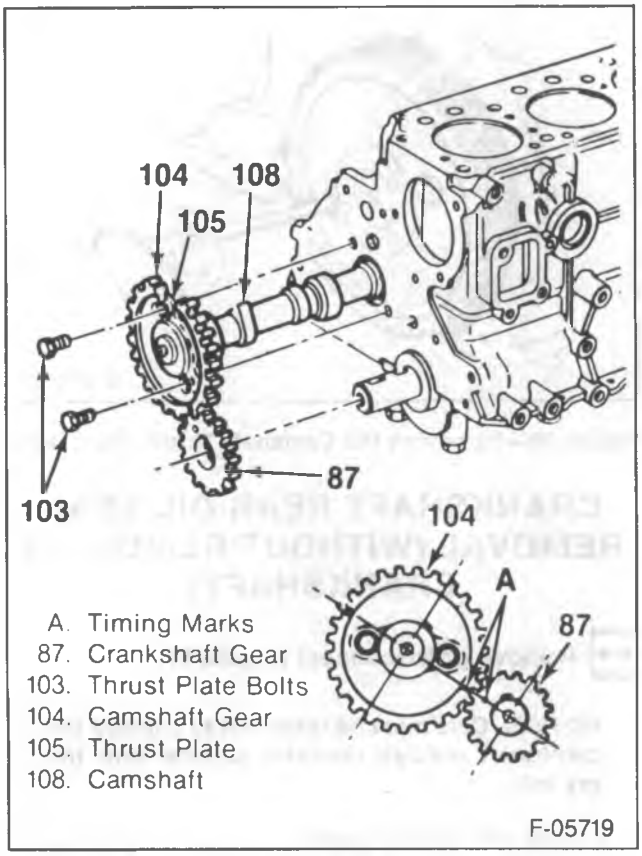


Figure 21—Camshaft and Timing Gears

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean (Figure 5)

1. Block (119) in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
5. Scale deposits from the coolant passages.

Inspect

1. All expansion plugs for looseness or leakage.
2. Valve lifter bores for deep scratches and varnish deposits.
3. Block for cracks, especially in the following areas:
   - Cylinder walls.
   - Coolant jackets.
   - Main bearing webs.
   - Engine mount bosses.
4. Main bearing bores and main bearing caps (124 and 126).
   - All main bearing bores should be round and have a uniform inside diameter at all of the bearing supports.
   - The area where the main bearing inserts (86 and 72) contact the main bearing bore should be smooth.

Measure (Figure 22)

- Head gasket surface distortion. Use a straight edge and a feeler gage to check for flatness of the milled surface at the top of the cylinder block. The surface

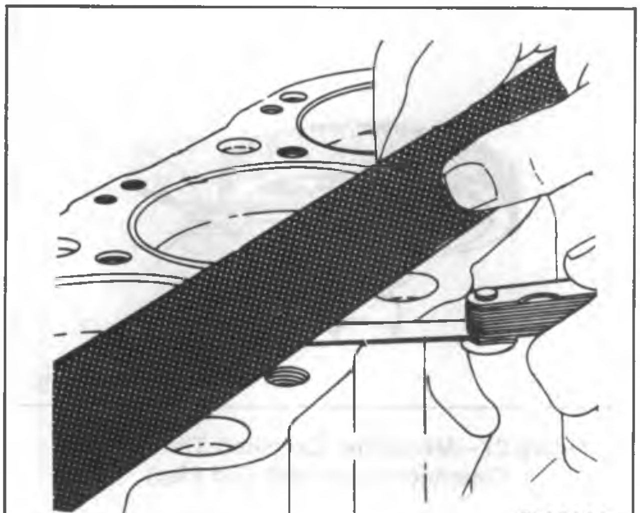


Figure 22—Checking the Block Gasket Surface

must be flat within 0.10 mm (0.004-inch) to assure that the gasket will provide a tight seal between the cylinder head and the block.

CYLINDER BORES

For information regarding cylinder bore measuring and reconditioning, refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

For information regarding disassembly, cleaning and inspection and assembly of piston and connecting rod assemblies, refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

For piston selection information, refer to "Piston Selection" in this section.

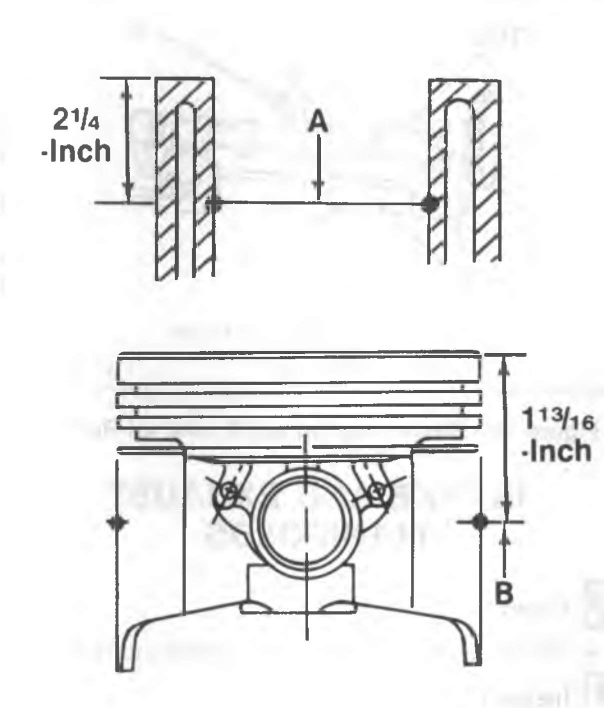
PISTON SELECTION

In order to select the proper piston for each bore, it is necessary to measure the outside diameter of the piston and the inside diameter of the bore. Once the diameters have been measured, the difference between the bore diameter and the piston diameter will be the piston to bore clearance.

1. Check the used piston to cylinder bore clearance.

   Measure (Figures 23 and 24)

   - Cylinder bore diameter using a telescoping bore gage. Measure the bore parallel to the crankshaft at the gaging point which is 57.15 mm (2.25-inch) from the top of the cylinder bore. By measuring at this point, the smallest bore diameter will be obtained.
   - Piston diameter with a micrometer. Measure the piston skirt at a right angle to the piston pin, at the centerline of the piston pin, which is 46.037 mm (1 13/16-inch) from the piston crown. By measuring at this point, the largest piston diameter will be obtained.

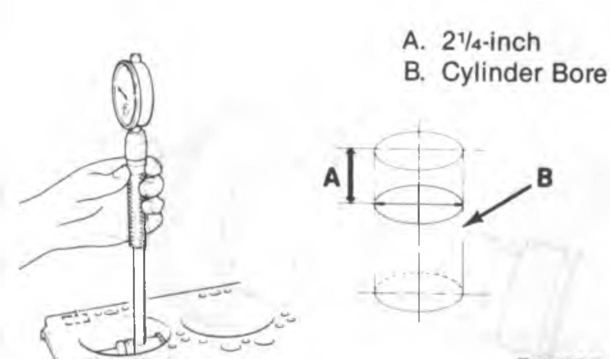


A. Bore Gaging Point
B. Piston Gaging Point

F-01996

Figure 23—Measuring the Piston Diameter

   - Subtract the piston diameter from the cylinder bore diameter to determine the piston to bore clearance.
   - Refer to "Specifications" at the end of this section to determine if the piston clearance is in the acceptable range.
2. If the used piston is not acceptable, determine if a new piston can fit the cylinder bore.
3. If a new piston does not bring the clearance within tolerances, the cylinder bore must be reconditioned.
4. Mark the piston to identify the cylinder for which it was fitted.



A. 2 1/4-inch
B. Cylinder Bore

F-01997

Figure 24—Measuring Cylinder Bore Diameter

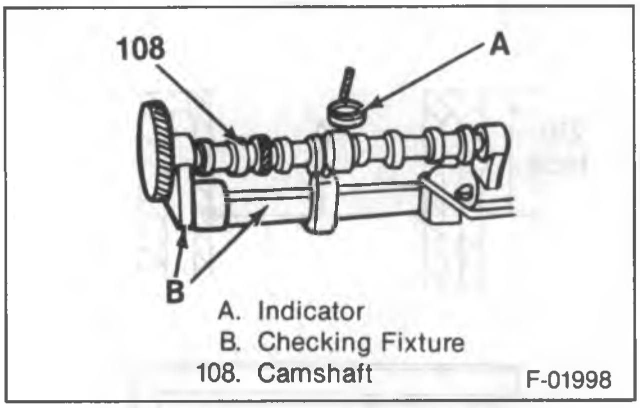


Figure 25—Measuring Camshaft Journal Runout

INTAKE AND EXHAUST MANIFOLDS

Clean

- Old pieces of gasket from the gasket surfaces.

Inspect

- Manifolds for cracks, broken flanges, etc.
- Gasket surfaces for heavy scratches.

CAMSHAFT

Inspect (Figure 5)

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.
- Timing gear for damaged or missing teeth.

Measure (Figures 25 through 27)

Tool Required:
J 7872 Dial Indicator (or equivalent)

- Camshaft runout. Mount the camshaft between centers or in V-blocks. Using tool J 7872 (or equivalent), check the intermediate camshaft journals. If runout exceeds 0.020-inch, the camshaft is excessively bent and should be replaced, along with the camshaft bearings.

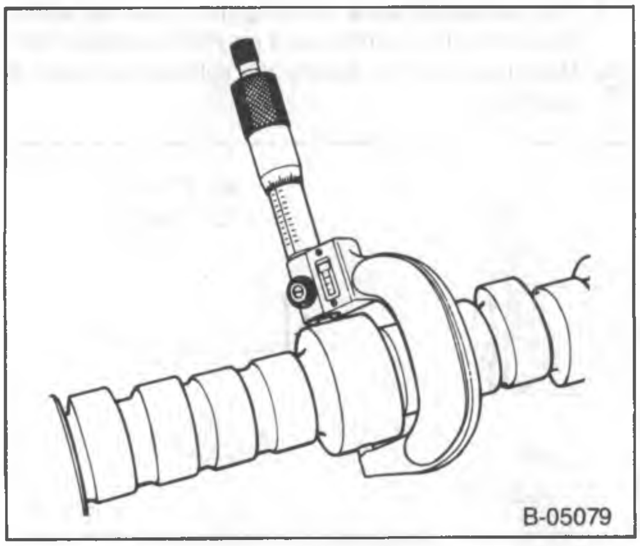


Figure 26—Checking the Camshaft Journals

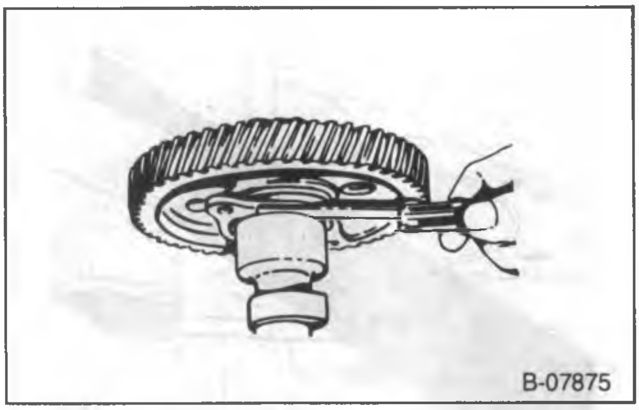


Figure 27—Measuring Camshaft Thrust Plate Clearance (Camshaft End Play)

- Camshaft journal out of round. Use a micrometer. If the journals are more than 0.001-inch out of round, replace the camshaft.
- Camshaft journal diameter. Use a micrometer. The proper diameter is 1.869-inch.
- Thrust plate (105) to camshaft (108) clearance. This clearance governs camshaft end play. Use a feeler gage. The proper clearance is 0.0015-inch to 0.0050-inch. If the clearance is less than 0.0015-inch replace the spacer ring (106). If the clearance is more than 0.0050-inch, replace the thrust plate (105).

Disassemble (Figure 28)

1. Gear (104) from the camshaft.
   - Place the camshaft gear in a press. Support the camshaft gear. DO NOT support the thrust plate.

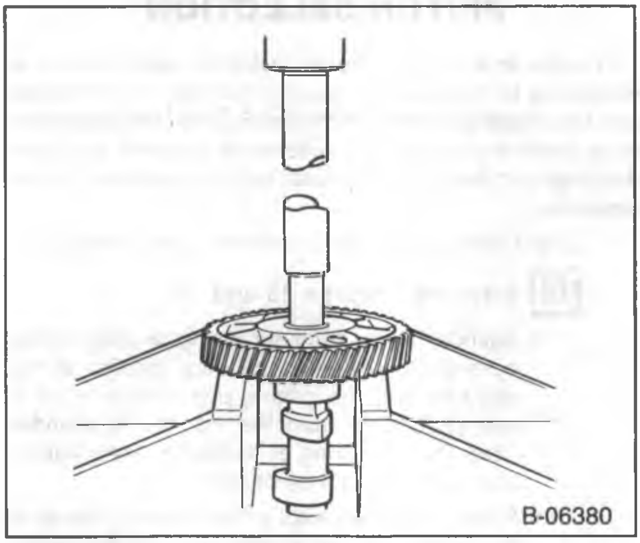


Figure 28—Removing the Camshaft Gear

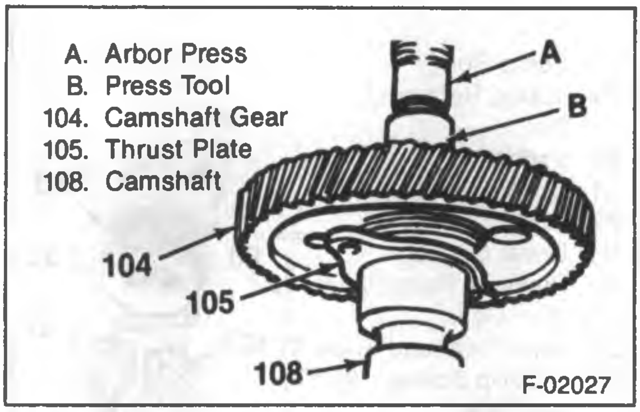


Figure 29—Installing the Camshaft Gear

NOTICE: The thrust plate must be positioned so that the woodruff key (107) does not damage it during the removal operation.

- Press the camshaft (108) out of the camshaft gear.

2. Thrust plate (105).
3. Spacer (106).

Assemble (Figure 29)

- Support the camshaft on the back of the front journal in an arbor press using press plate adapters.
- Lubricate the thrust plate with engine oil.

1. Woodruff key (107).
2. Spacer (106).
3. Thrust plate (105).
4. Camshaft gear (104).
   - Make sure that the timing mark is to the outside.
   - Press the camshaft gear onto the camshaft until it bottoms on the spacer (106).
   - Remove the camshaft from the press.

Measure (Figure 27)

- Camshaft to thrust plate clearance using a feeler gage.The correct clearance is 0.0015-inch to 0.0050-inch.

CAMSHAFT BEARINGS

Remove or Disconnect (Figure 30)

Tool Required:
J 33049 Universal Camshaft Bearing Remover and Installer

1. Expansion plug.
   - Drive out the plug from inside the block at the rear camshaft bearing.
2. Front and rear bearings (109) using J 33049.
   - Drive the bearings towards the center of the block.
3. Center bearing using J 33049.
   - Drive the bearing towards the rear of the engine.

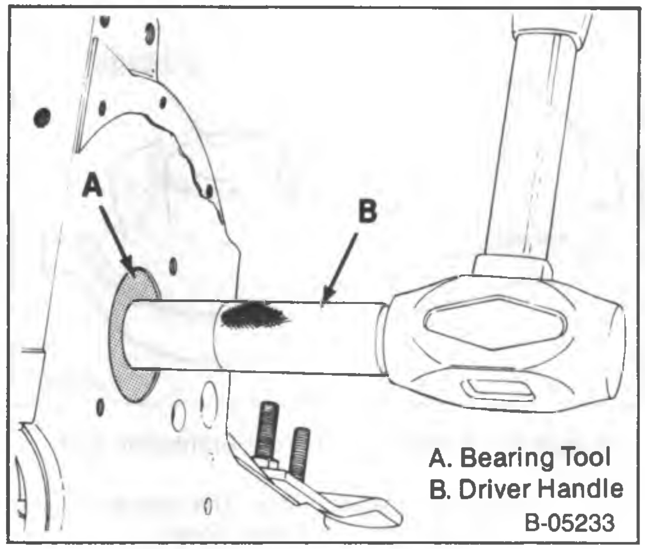


Figure 30—Removing or Installing Camshaft Bearings

Install or Connect (Figure 30)

Tool Required:
J 33049 Universal Camshaft Bearing Remover and Installer

1. Center bearing using J 33049.
   - Install the bearing from the front of the engine.
   - Make sure that the oil holes in the bearing are aligned with the oil holes in the block.
2. Rear bearing (109) and expansion plug.
   - Drive the bearing in from the rear of the engine.
   - Make sure that the oil holes in the bearing are aligned with the oil holes in the block.
   - Drive the expansion plug into the block from the rear of the engine.
3. Front bearing (109).
   - Drive the bearing into the block, and approximately 3.18 mm (1/8-inch) past the front surface of the block. This uncovers the timing gear oil nozzle hole.

FRONT COVER

Clean

- Old RTV sealant from the sealing flange.

Inspect

- Front cover for cracks, large dents, etc.
- Sealing flange for straightness.

Disassemble (Figure 5)

- Seal (101). Pry the seal out with a screwdriver.

Assemble (Figure 31)

Tool Required:
J 34995 Crankshaft Front Cover Oil Seal Installer

- New seal (101) using tool J 34995.
  — Support the inside of the front cover around the seal bore area.

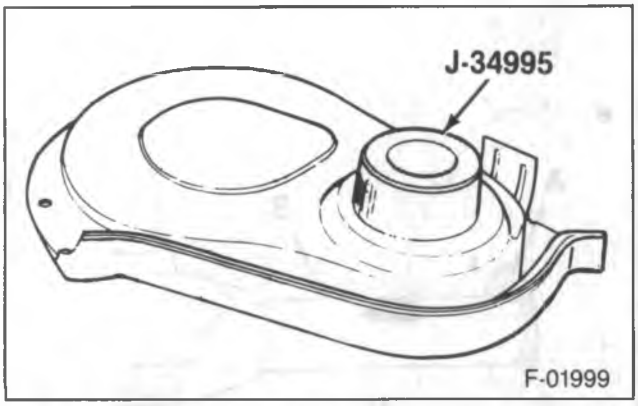


Figure 31—Installing the Front Crankshaft Seal

— Press the seal into place. The open end of the seal faces inside the front cover.

- Lubricate the seal lips with grease.

WATER PUMP

Clean

- Old gasket from the gasket surface.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings' lubricant supply, and cause premature bearing failure.

Inspect

— Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.

— Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking, and the water pump should be replaced.

OIL PAN AND ROCKER ARM COVER

Clean

- Parts in solvent. Remove all sludge and varnish.
- Old RTV sealant from the sealing flange.

Inspect

- Gasket flanges for bending or damage.
- Oil pan for rock damage or cracks.
- Drain plug threads for stripping.

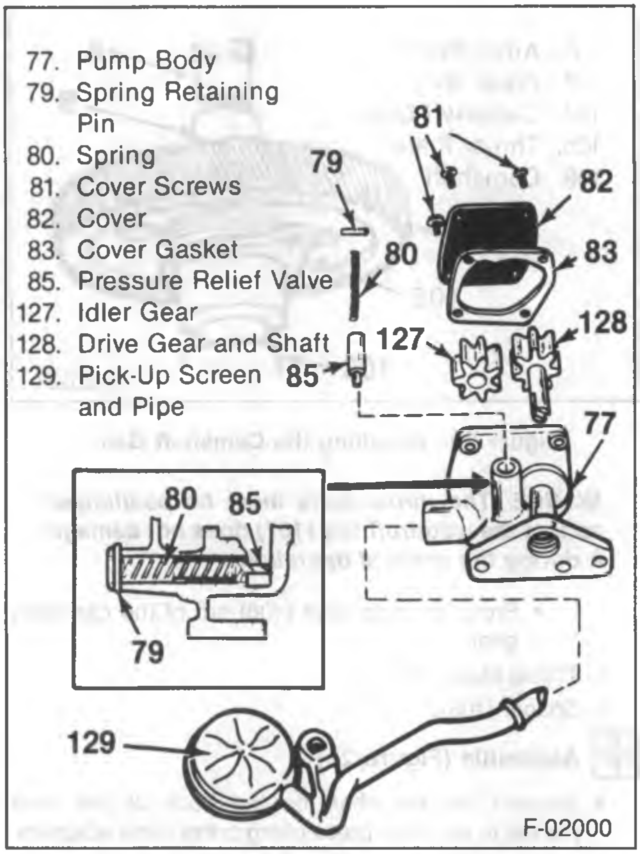


Figure 32—Oil Pump Components

OIL PUMP

Disassemble (Figure 32)

1. Cover screws (81).
2. Cover (82).
3. Gasket (83).
   - Mark the gear teeth so the pump gears can be installed with the same gear teeth indexed.
4. Drive gear and shaft (128).
5. Idler gear (127).
6. Spring retaining pin (79).
7. Spring (80).
8. Pressure relief valve (85).
9. Pickup screen and pipe (129).
   - Do not remove the pickup screen and pipe unless replacement is required.
   - The pickup pipe is a press fit in the pump body.
   - Do not try to remove the screen from the pipe. The pickup screen and pipe is serviced as an assembly only.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect

— Pump body (77) and cover (82) for cracks or other damage.
— Gears (127 and 128) for wear.

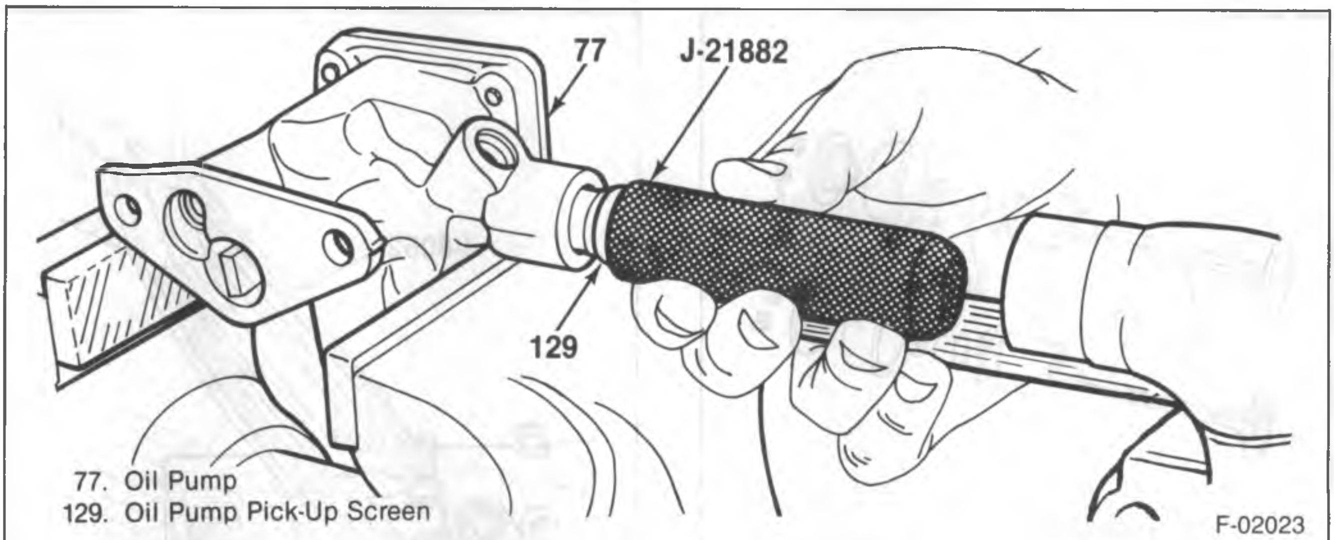


Figure 33—Installing the Oil Suction Pipe

— Drive gear and shaft (128) for looseness in the pump body (77).
— Inside of the cover (82) for wear that would permit oil to leak past the ends of the gears.
— The pump gears and body are not serviced separately.
— Pressure relief valve (85) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Assemble (Figures 32 and 33)

Tool Required:
J 21882 Oil Suction Pipe Installer

1. Pressure relief valve (85).
2. Spring (80).
3. Spring retaining pin (79).
4. Drive gear and shaft (128).
5. Idler gear (127) in the pump body (77) with the smooth side of the gear toward the pump cover opening. Index the marks made during disassembly.
6. Gasket (83).
7. Cover (82) and screws (81).

Tighten

- Screws to 14 N·m (10 ft. lbs.).

- Turn the driveshaft by hand to check for smooth operation.

NOTICE: Be careful of twisting, shearing or collapsing the pipe while installing in the pump.

8. Pick-up screen and pipe (129) (if removed).
   - If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure.
   - Mount the oil pump in a soft-jawed vise.
   - Apply sealer to the end of the pipe.
   - Tap the pickup screen and pipe into place, using tool J 21882 and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.

VALVE TRAIN COMPONENTS

PUSHRODS, PUSHROD GUIDES, ROCKER ARMS AND BALLS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Inspect (Figures 3 and 10)

— Rocker arms (33) and balls (32) at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.

— Rocker arm (33) areas which contact the valve stems, and the sockets which contact the pushrods (47). These areas should be smooth and free of damage and wear.

— Pushrods (47) for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

— Ends of the pushrods (47) for scoring or roughness.

VALVE LIFTERS

For information regarding valve lifters refer to GENERAL ENGINE MECHANICAL (SEC. 6A) of this manual.

CYLINDER HEAD

Information regarding cylinder head disasembly and assembly is covered under this procedure. For information regarding cleaning and inspection, and measuring of the cylinder head as well as valve measuring and grinding and valve guide reconditioning, refer to GENERAL ENGINE MECHANICAL (SEC. 6A) in this manual.

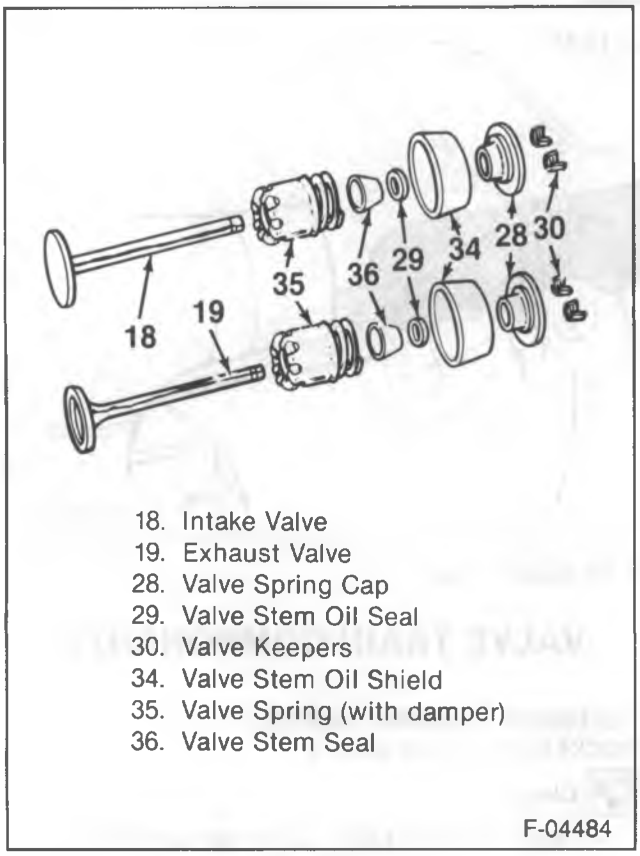


Figure 34—Valves and Components

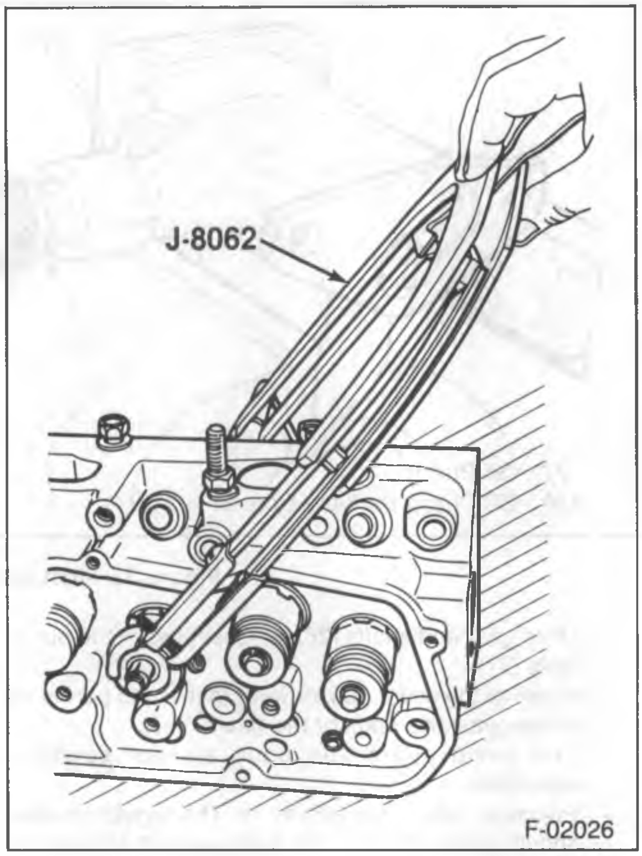


Figure 35—Compressing the Valve Springs

Disassemble (Figures 34 and 35)

Tool Required:

J 8062 Valve Spring Compressor

1. Valve keepers (30).
   - Compress the valve spring using J 8062.
   - Remove the valve keepers.
   - Remove the tool.
2. Cap (28).
3. Valve spring (35) and shield (34).
4. Valve stem oil seals (29).
5. Valves (18 and 19). Place them in a rack so they can be returned to their original position at assembly.
6. Valve stem seal (36).

For information on cylinder head measuring and reconditioning, refer to GENERAL ENGINE MECHANICAL (SEC. 6A) in this manual.

Assemble (Figures 34, 35 and 36)

Tools Required:

J 8062 Valve Spring Compressor
J 22330 Valve Stem Seal Checker and Tester

1. New valve stem seals (36).
   - Lubricate the seal in order to aid in assembly.
2. Valves (18 and 19).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper ports.
3. Valve spring (35) and shield (34).
4. Cap (28).
5. Valve keepers (30).
   - Compress the valve springs using J 8062. Compress the spring enough so the lower valve stem groove can be clearly seen.
   - Push a new valve stem oil seal (29) onto the valve stem. The seal is to be installed on the lower groove of the stem. Make sure the seal is flat and not twisted.
   - Apply grease to the area of the upper valve stem groove. Assemble the two valve keepers, using the grease to hold the keepers in place.

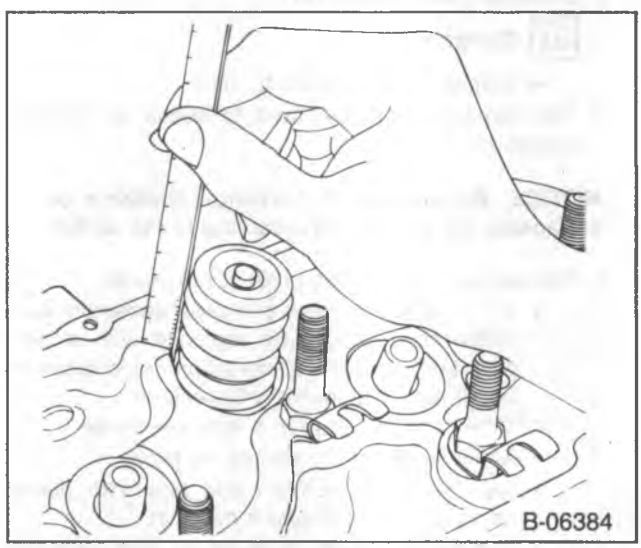


Figure 36—Measuring Valve Spring Installed Height

Make sure that the keepers seat properly in the groove.

- Repeat the preceding steps on the remaining valves.
- Check each valve seal using J 22330. Wet the suction cup portion of the tool lightly with engine oil. Place the suction cup over the valve stem cover and push the tool down to create a vacuum. If the vacuum remains at the tool, the seal is properly installed. If a vacuum cannot be obtained, or if the seal will not hold a vacuum, it may have been damaged or improperly installed.

Measure

- Valve spring installed height.
  - — Use a narrow, thin scale. A cutaway scale may be helpful.
  - — Measure from the valve shim or spring seat to the top of the valve cap.
  - — If this measurement exceeds the figure given in "Specifications," install valve spring seat shims of sufficient thickness (between the spring and cylinder head) to give the desired measurement. Never shim the spring to give an installed height under the specified figure.

THERMOSTAT AND HOUSING

The thermostat is located in a housing bolted to the front of the cylinder head.

A thermostat consists of a restriction valve controlled by a thermostatic element. The restriction valve cranks or just starts to open at a predetermined temperature and continues to open as the engine coolant temperature increases. To assure proper cooling and engine warm-up it is important that the correct thermostat be used. Refer to the proper Truck Service Manual for the correct thermostat application.

Disassemble (Figure 3)

1. Bolts (8 and 9).
2. Water outlet (10).
3. Thermostat (12).
4. Gasket (11).

Inspect (Figure 3)

- Water outlet (10) and housing (13) for cracks or damage.

Assemble (Figure 3)

1. Thermostat (12).
2. Gasket (11).
3. Water outlet (10).
4. Bolts (8 and 9).

Tighten

- Bolts (8 and 9) to 23 N·m (17 ft. lbs.).

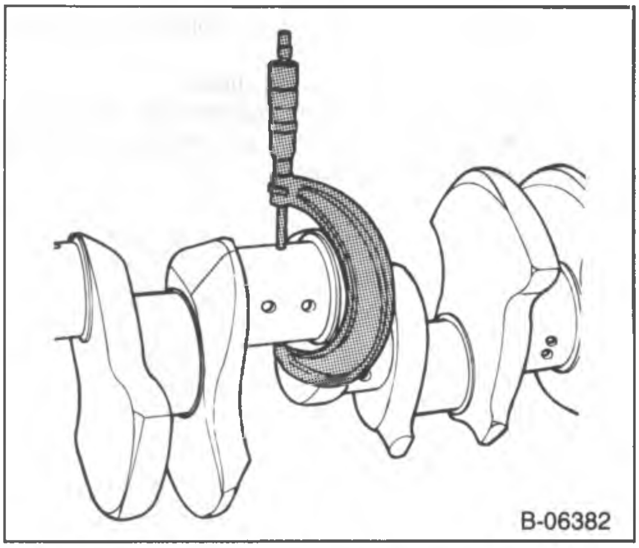


Figure 37—Measuring the Crankshaft Journals

CRANKSHAFT AND BEARINGS

Clean (Figure 5)

— Crankshaft (88) with solvent.

- — Do not scratch the bearing journals.
- — Blow all sludge from the oil passages with compressed air.

— Main bearing inserts. Wipe free of oil with a soft cloth.

Inspect (Figure 5)

— Crankshaft (88) for cracks. Use the magnaflux method, if available.

— Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.

— Main bearing inserts (86 and 72) for scoring or other damage.

In general, the lower inserts (except the #1 bearing) show a greater wear and the most distress from fatigue. If, upon inspection, the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert shows evidence of wear or damage, both upper and lower inserts must be replaced.

— Crankshaft gear (87) for chipped or damaged teeth.

Measure (Figures 37 and 38)

— Main bearing and connecting rod journal diameters. Compare with "Specifications" at the end of this section.

Because the 2.5 L engine crankshaft is of the rolled fillet type, the crankshaft cannot be reground. If the measurements do not meet the specifications, replace the crankshaft.

— Main bearing and connecting rod journals for taper and out of round. If the journals are tapered or out of round more than 0.0005-inch, replace the crankshaft.

— Crankshaft runout.

- Mount the crankshaft in V-blocks or between centers.
- Use a dial indicator as shown.
- If the main bearing journals are misaligned, the crankshaft is bent and must be replaced along with the main bearings.

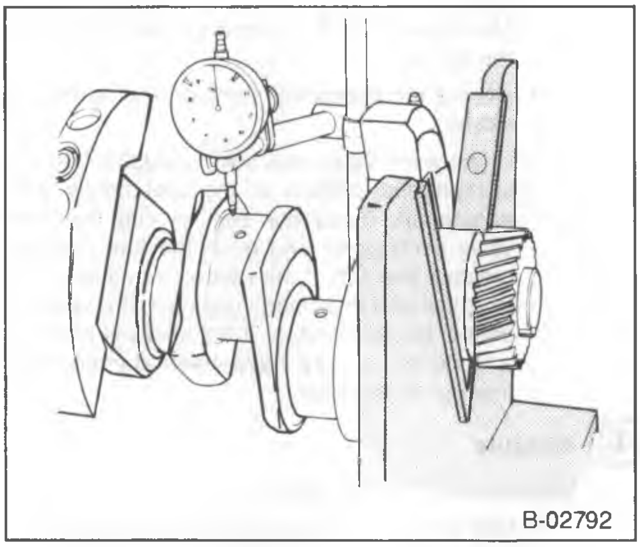


Figure 38—Checking Crankshaft Runout

ASSEMBLY OF ENGINE

PRIOR TO ASSEMBLY

The importance of cleanliness during the assembly procedure cannot be overstressed. Dirt will cause premature wear of the rebuilt engine.

Lubricate all moving parts lightly with engine oil or engine assembly lubricant (unless specified otherwise) during assembly. This will provide initial lubrication when the engine is started.

CRANKSHAFT AND MAIN BEARING INSTALLATION

Service bearing inserts are available in standard size and 0.001-inch undersize.

Install or Connect (Figures 5 and 39)

1. Upper main bearing inserts (86 and 72) to the block.
   - If any previously used or undersized bearings are used, make absolutely certain that they are fitted to the proper journal.
2. Crankshaft (88). Take care not to damage the thrust areas.
3. Lower bearing inserts (86 and 72) to the bearing caps.

Measure

- Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) in this manual.

3. Engine oil to the lower main bearing inserts.
4. Main bearing caps (except the rear cap) with the selected lower main bering inserts (86 and 72). Be sure to put the main bearing cap in their original positions, with the arrows facing the front of the engine.
5. Bolts (125). Make sure the special bolt, which retains the oil pump pickup tube and screen is installed in the proper position. (#4 main bearing cap, camshaft side hole.)

Tighten

- Main bearing cap bolts to 88 N·m (65 ft. lbs.).

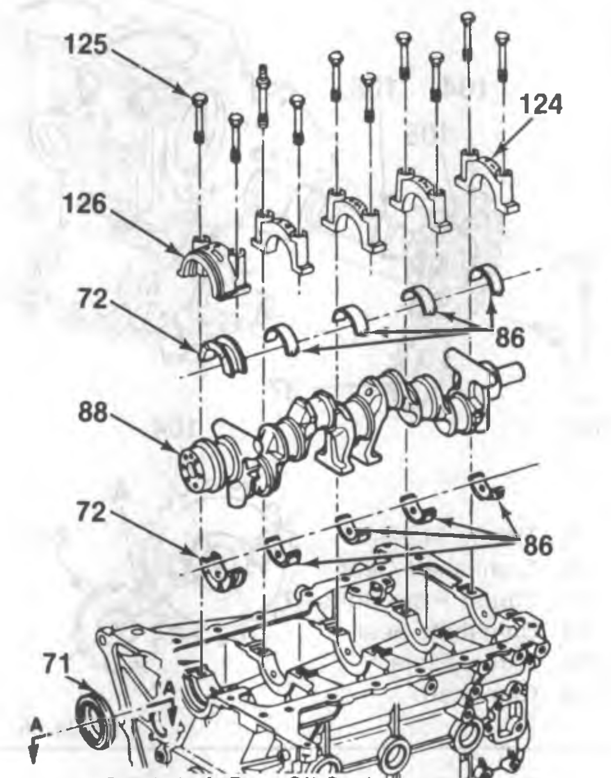
6. Rear main bearing cap to the block.
7. Rear main bearing cap bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure (Figure 40)

- Crankshaft end play, as follows:
- Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
- Tighten the rear main bearing cap bolts to 88 N·m (65 ft. lbs.).
- With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage. The proper clearance is 0.09 – 0.20 mm (0.0035 – 0.0085-inch).

Inspect

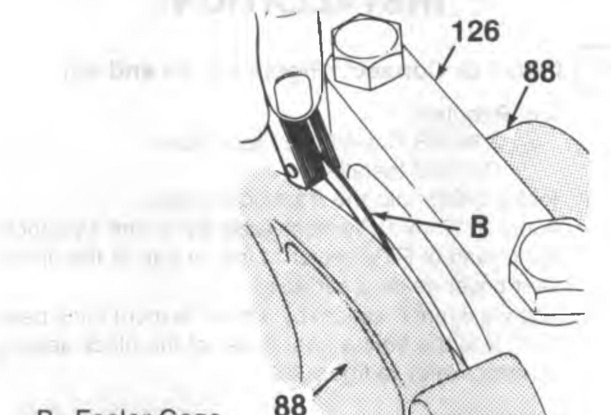
- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the



71. Crankshaft Rear Oil Seal
72. Crankshaft Rear Bearing
86. Crankshaft Bearings
88. Crankshaft
124. Main Bearing Cap
125. Bolt
126. Rear Main Bearing Cap

F-01994

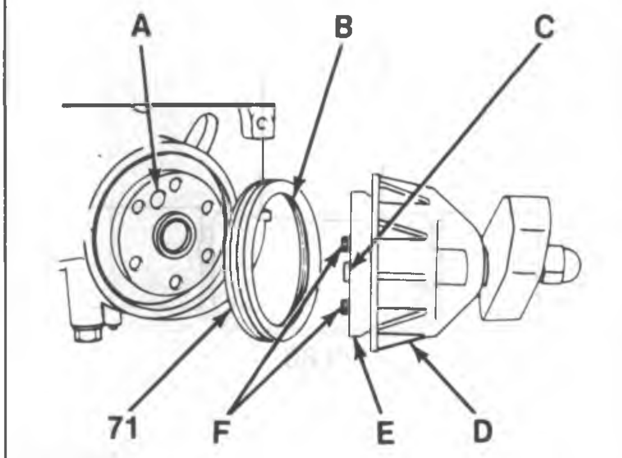
Figure 39—Crankshaft and Bearing Components



B. Feeler Gage
88. Crankshaft
126. Rear Main Bearing Cap

F-02028

Figure 40—Measuring Crankshaft End Play



A. Alignment Hole in Crankshaft
B. Dust Lip
C. Dowel Pin
D. Collar
E. Mandrel
F. Screws
71. Crankshaft Rear Oil Seal

F-02029

Figure 41—Installing the Rear Crankshaft Oil Seal

bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

CRANKSHAFT REAR OIL SEAL INSTALLATION

Install or Connect (Figures 5 and 41)

Tool Required:
J 34924-A Seal Installer

- Crankshaft rear oil seal using J 34924.

1. Lubricate the seal inside diameter with engine oil.
2. Slide the seal over the mandrel of the tool, until the dust lip (back of seal), mates squarely against the collar.
3. Lubricate the seal outside diameter with engine oil.
4. Position the tool with the seal in place against the crankshaft. Align the dowel with the alignment hole in the crankshaft. Tighten the screws firmly.
5. Turn the T-handle of the tool until the collar seats firmly against the crankcase. This will insure that the seal is seated properly.
6. Loosen the T-handle fully. Loosen the screws and remove the tool.

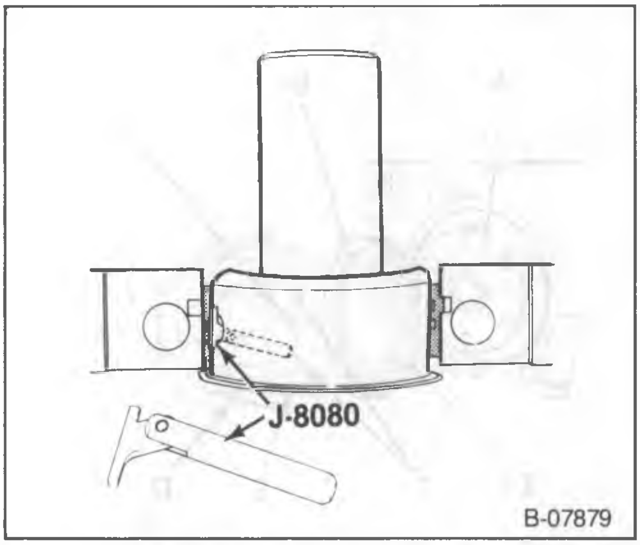


Figure 42—Installing the Upper Main Bearing Insert

MAIN BEARING INSTALLATION (WITHOUT REMOVING THE CRANKSHAFT)

Install or Connect (Figures 5 and 42)

Tool Required:
J 8080 Main Bearing Remover/Installer

1. Upper main bearing inserts.
   - Insert tool J 8080 into a crankshaft main bearing hole.
   - Apply engine oil to the proper sized inserts.
   - Insert the plain end of the insert (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
   - Rotate the crankshaft to "roll" the insert into the block.
   - Remove the tool.
2. Lower main bearing inserts to the main bearing caps.
   - Make sure the inserts are of the proper size.
   - Apply engine oil to the inserts.

Measure

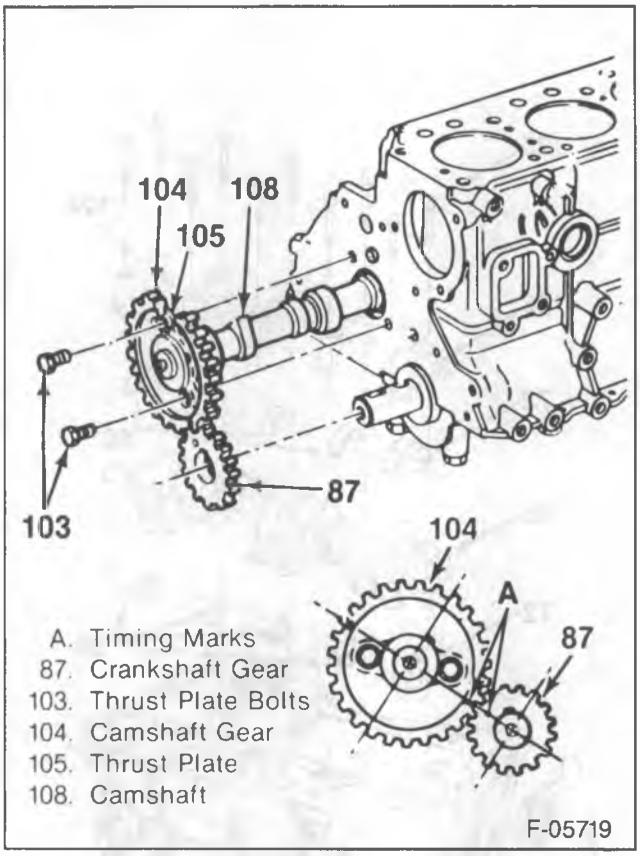
- Main bearing clearance and crankshaft end play. Refer to "Crankshaft and Main Bearing Installation" in this section.

CAMSHAFT INSTALLATION

Install or Connect (Figure 3, 43, and 44)

- Coat the camshaft lobes with Engine Oil Supplement (GM part number 1051396) or equivalent. Coat the bearing journals with engine oil.

1. Camshaft (108) into the block (119). Take care not to damage the camshaft bearings (109).



A. Timing Marks
87. Crankshaft Gear
103. Thrust Plate Bolts
104. Camshaft Gear
105. Thrust Plate
108. Camshaft

Figure 43—Camshaft and Timing Gears

Important

- Align the timing marks.

2. Screws (103).

Tighten

- Screws (103) to 9.0 N·m (80 in. lbs.).

FRONT COVER INSTALLATION

Install or Connect (Figures 5, 45 and 46)

Tool Required:
J 34995 Crankshaft Front Cover Oil Seal Installer

1. Tool J 34995 into the front cover seal.

- Apply a 10 mm (3/8-inch) wide by 5 mm (3/16-inch) thick bead of RTV sealer to the oil pan at the timing gear cover sealing surface.
- Apply a 6 mm (1/4-inch) by 3 mm (1/8-inch) thick bead of RTV to the timing gear cover at the block sealing surface. Refer to figure 45.

NOTICE: The correct tool must be used to align the timing gear cover so that the front crankshaft seal is properly centered around the crankshaft. The seal must be centered to prevent damage during hub installation.

2. Timing gear cover, with J 34995 in place, to the block.

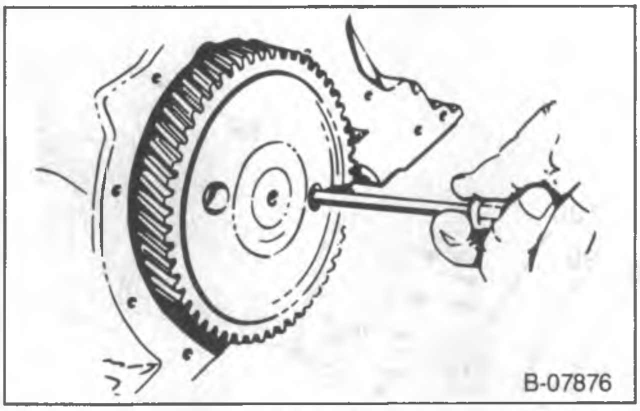


Figure 44—Installing the Camshaft Thrust Plate Bolts

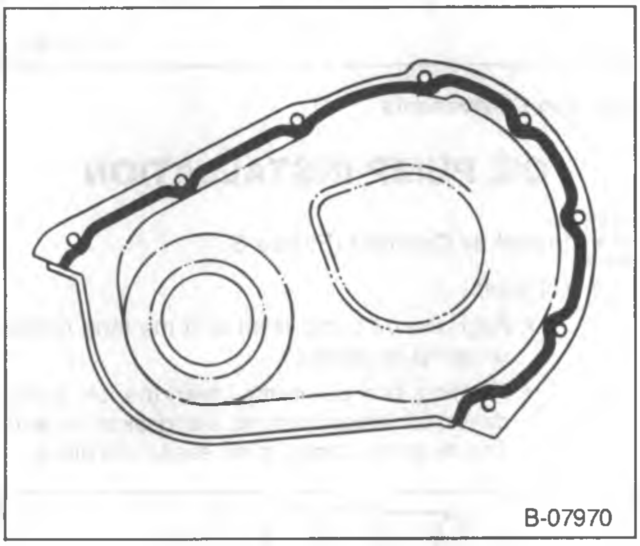


Figure 45—Applying RTV to the Timing Gear Cover

3. Bolts (94).

Tighten

- Bolts to 10.0 N·m (90 in. lbs.).

- Remove J 34995 from the timing gear cover.

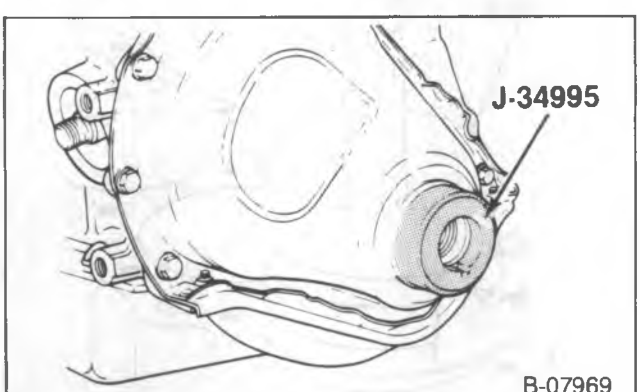


Figure 46—Installing the Timing Gear Cover

CRANKSHAFT PULLEY HUB INSTALLATION

Install or Connect (Figures 5 and 47)

1. Crankshaft pulley and hub. Slide the hub on the crankshaft until it bottoms against the crankshaft gear.
2. Bolt (98) and washer (99).

Tighten

- Hub retaining bolt to 220 N·m (160 ft. lbs.).

PISTON AND CONNECTING ROD INSTALLATION

Install or Connect (Figures 5, 48 and 49)

Tool Required:
J 8037 Piston Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder. Refer to "Piston and Connecting Rod Assemblies" in this section.

1. Connecting rod bearing inserts (55).
   - Be certain that the inserts are the proper size.
   - Install the bearing inserts in the connecting rod and connecting rod cap.
   - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap removed. Install two sections of 10 mm (3/8-inch) rubber hose over the connecting rod studs.
   - Locate the piston ring end gaps as shown in figure 48. Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston.
   - The piston must be installed so that the notch in the piston faces the front of the engine.
   - Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore. At the same time, guide the connecting rod into position on the crankpin. Hold the ring compressor against the block until all the rings have entered the cylinder bore.

CONNECTING ROD BEARING SELECTION

Service bearings are available in standard size and 0.001-inch undersize for use with new and used standard sized crankshafts. The 2.5 L engine is designed with a rolled fillet on the crankshaft journal to increase crankshaft strength. Do not grind a crankshaft with a rolled fillet. Undersize bearings other than 0.001-inch undersize are not available.

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

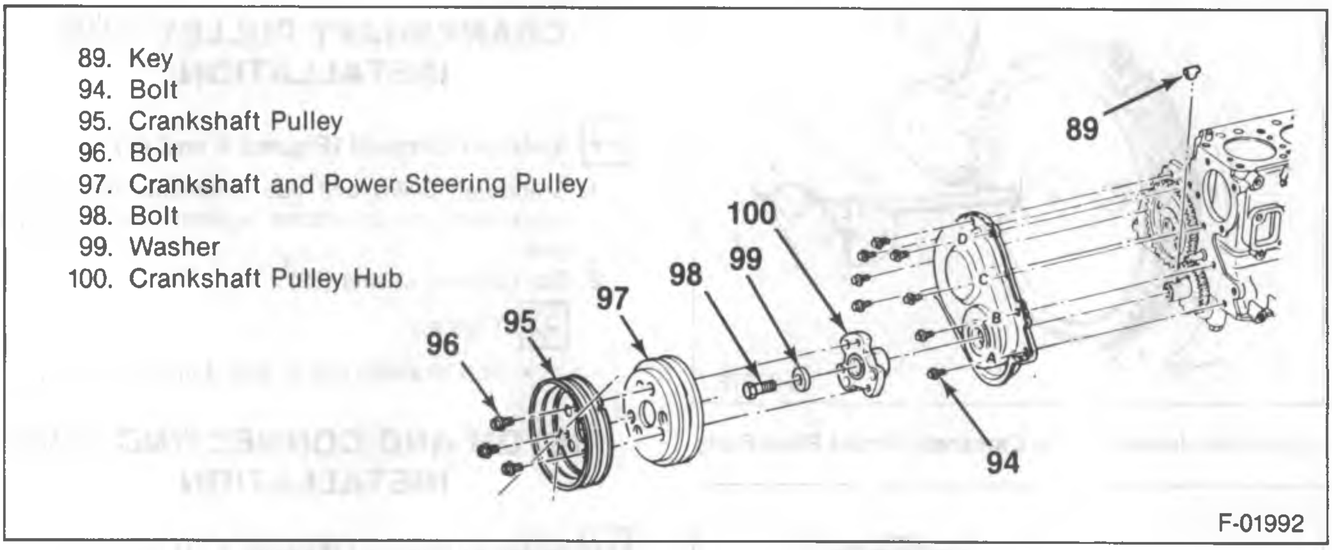


Figure 47—Timing Gear Cover and Components

FINAL ASSEMBLY

Install or Connect (Figure 5)

- Apply engine oil to the connecting rod bearing inserts (55) and crankshaft journal.

1. Connecting rod cap (116) with the lower connecting rod bearing insert (55).
2. Nuts (56).

Tighten

- Nuts (56) to 40 N·m (30 ft. lbs.).

Measure (Figure 50)

- Connecting rod side clearance. Use a feeler gage between the connecting rod and the crankshaft. The correct clearance is 0.15–0.60 mm (0.006–0.022-inch).

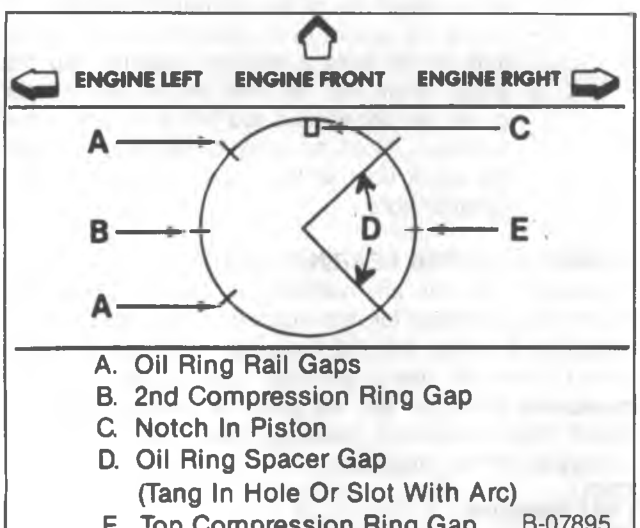


Figure 48—Piston Ring Gap Location

OIL PUMP INSTALLATION

Install or Connect (Figure 5)

1. Oil pump.
   - Align the oil pump shaft with the tang on the oil pump driveshaft.
   - Position the oil pump over the oil pump driveshaft lower bushing. No gasket is used. The oil pump should slide easily into place.

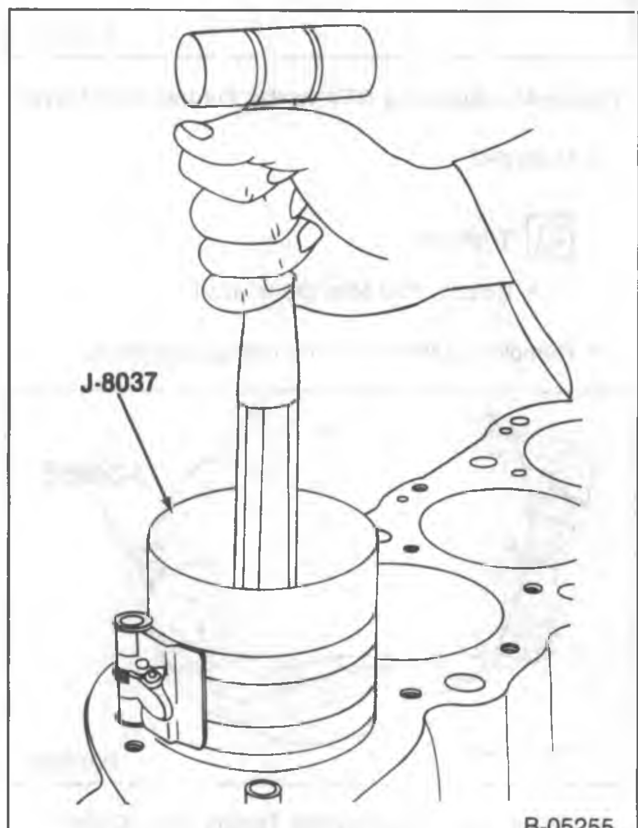


Figure 49—Installing the Piston

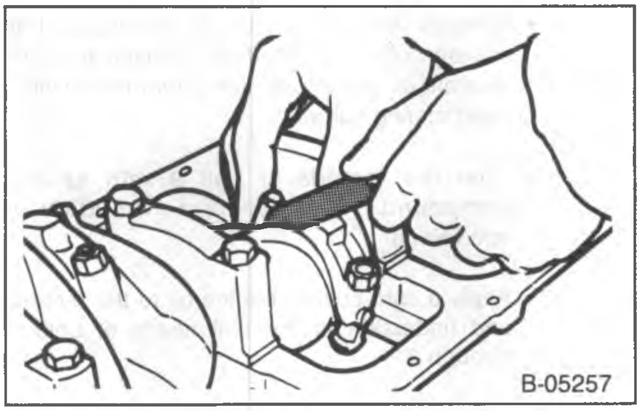


Figure 50—Measuring Connecting Rod Side Clearance

2. Oil pump bolts (84) and nut (78).

Tighten

- Bolts to 25 N·m (18 ft. lbs.)
- Nut to 42 N·m (31 ft. lbs.)

OIL PAN INSTALLATION

Install or Connect (Figures 5 and 51)

- Apply RTV sealant to the oil pan flange and block. Refer to figure 51.

1. Oil pan (76).
2. Bolts (75).

Tighten

- Oil pan bolts to 10.0 N·m (90 in. lbs.).

OIL PUMP DRIVESHAFT INSTALLATION

Install or Connect (Figures 5 and 52)

1. Shaft and gear assembly (115 and 114). Turn the shaft until it indexes the oil pump shaft pilot properly in the oil pump body.
2. Bearing (113).
3. Plate (118). Apply RTV to the plate as shown in figure 52.
4. Bolts (117).

Tighten

- Bolts to 14 N·m (120 in. lbs.).

CYLINDER HEAD INSTALLATION

Install or Connect (Figures 3 and 53)

- Make sure the block and cylinder head sealing surfaces are clean.

1. Head gasket to the block. Install over the dowel pins.
2. Cylinder head. Carefully guide the head into place over the dowel pins. This may require an assistant.
3. Cylinder head bolts. Refer to figure 53.

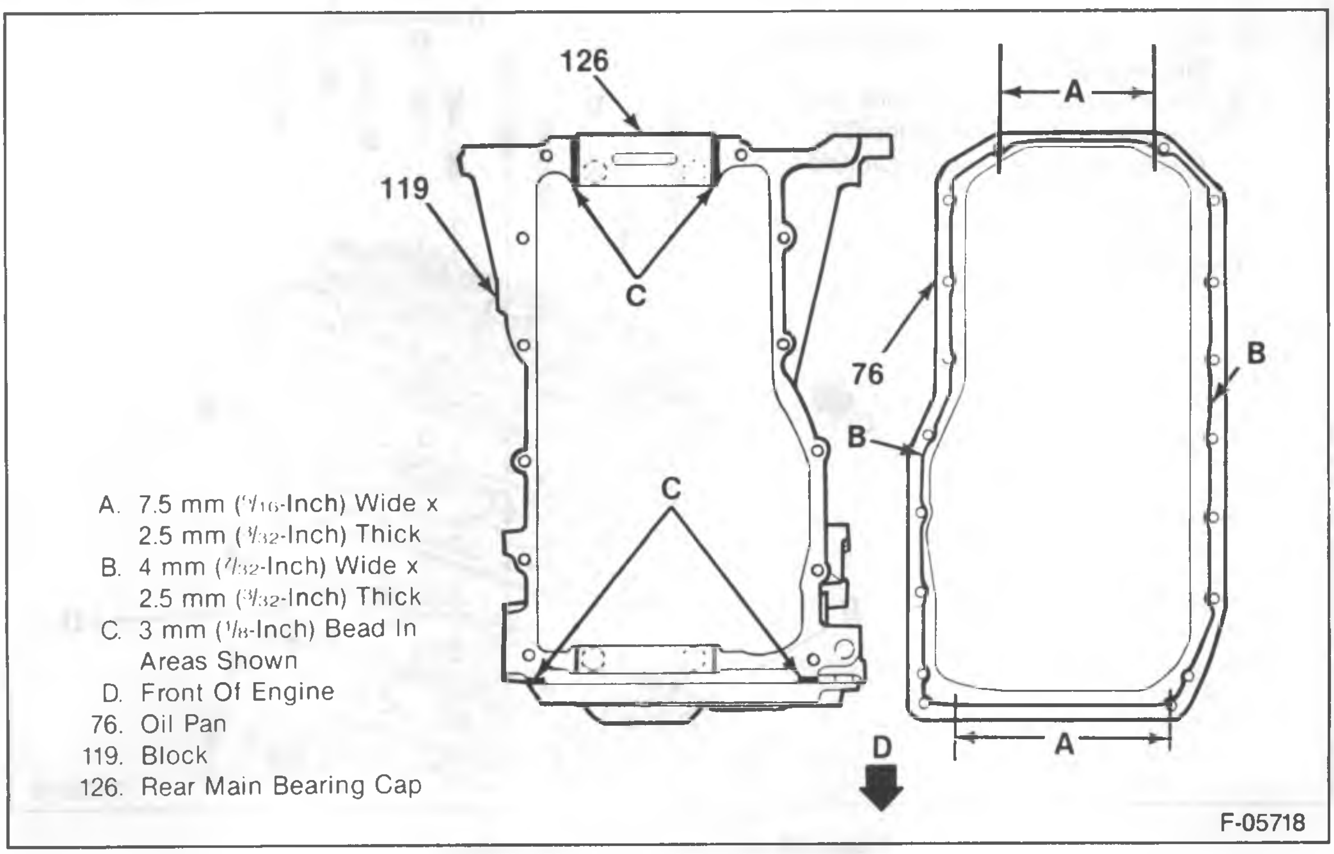


Figure 51—Applying RTV to the Oil Pan and Block

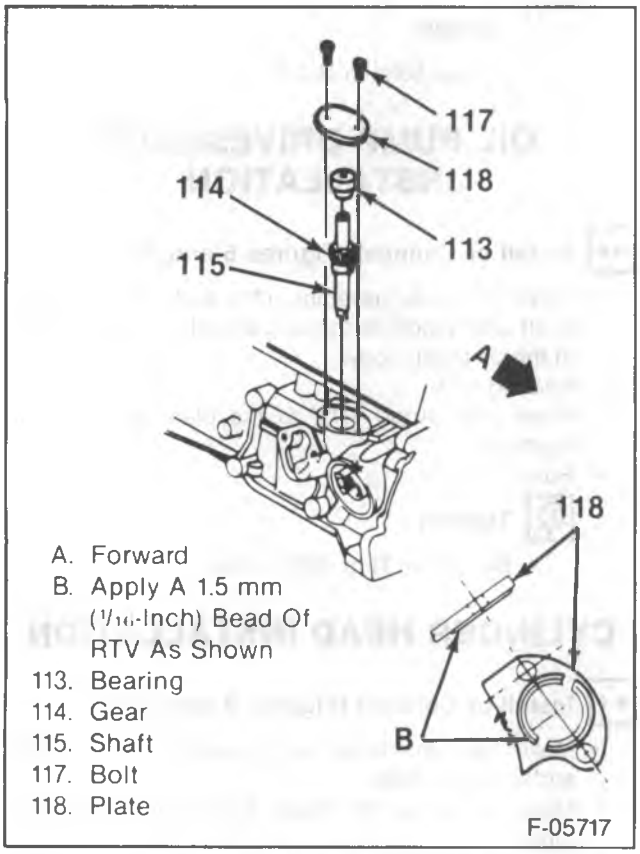


Figure 52—Oil Pump Drive Shaft

- Cylinder head bolts should be washed in solvent and dry at the time of installation. All residual oil should be wiped from the cylinder head mating surfaces.
- Coat the threads of bolt 9 with sealing compound (Part Number 1052080 or equivalent).
- Apply a light coat of engine oil to the threads and underside of the bolt heads of bolts 1 through 8.

Tighten

1. All head bolts to 25 N·m (18 ft. lbs.) in the specified sequence (refer to figure 53).
2. All head bolts except number 9 to 35 N·m (26 ft. lbs.). Number 9 bolt should be tightened to 25 N·m (18 ft. lbs.). Tighten the bolts in the specified sequence.

- Draw a line across the head of each bolt with a marking crayon to mark the position of each bolt.

3. All head bolts, 90 degrees (1/4 turn). Tighten the bolts in the specified sequence.

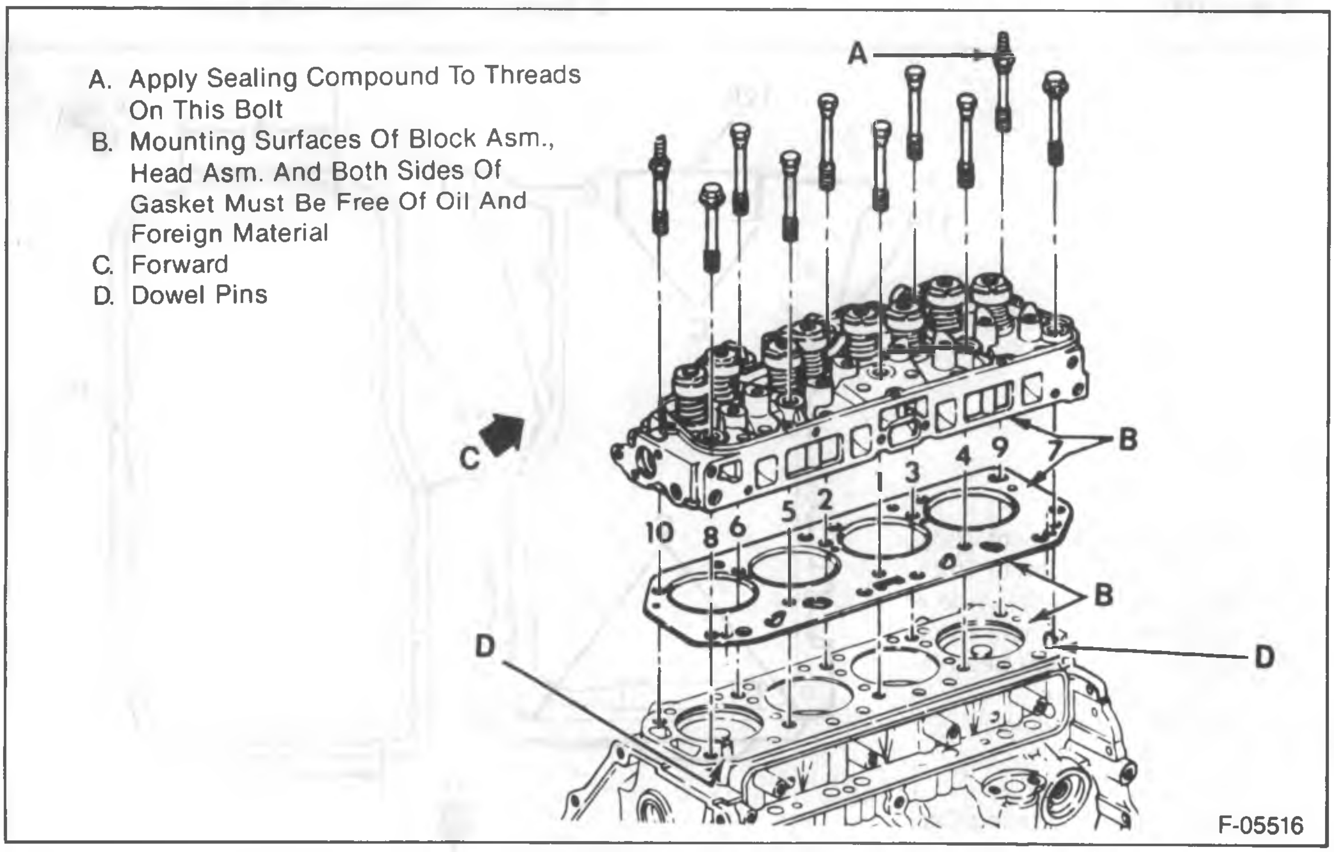
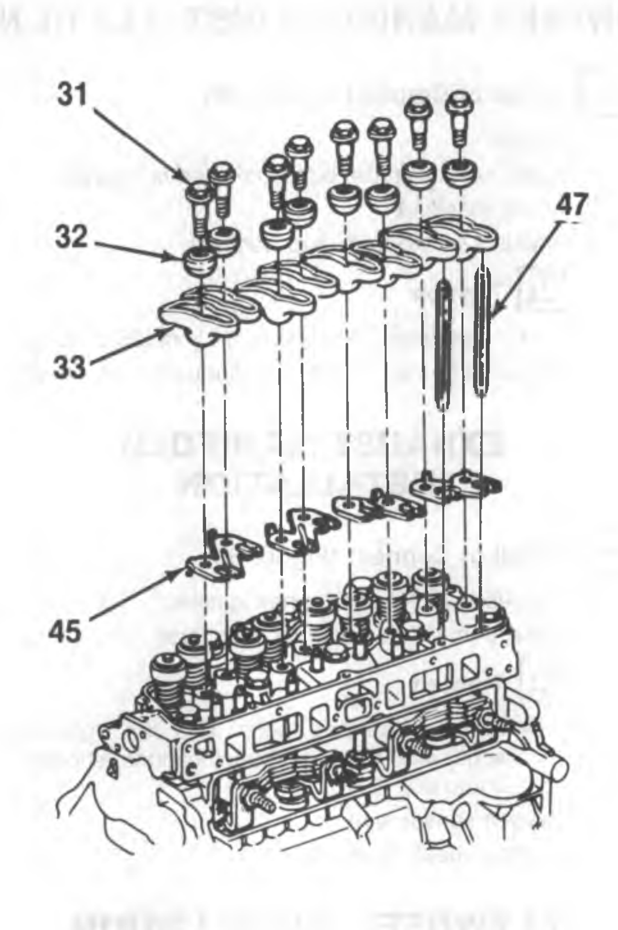


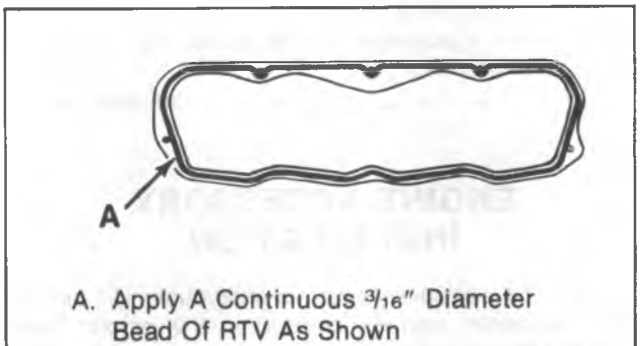
Figure 53—Cylinder Head Installation



31. Bolt
32. Rocker Arm Ball
33. Rocker Arm
45. Push Rod Guide
47. Push Rod

F-01989

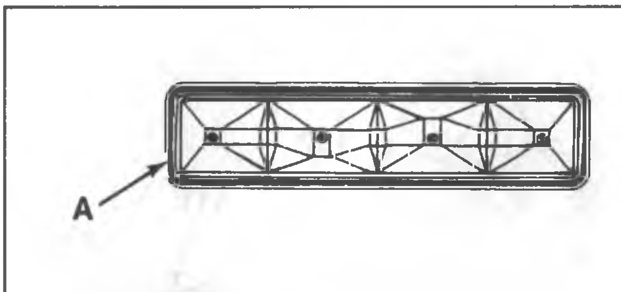
Figure 54—Valve Train Components



A. Apply A Continuous 3/16" Diameter Bead Of RTV As Shown

B-07958

Figure 55—Applying Sealant to the Rocker Arm Cover



A. Apply A Continuous (5 mm 3/16-Inch) Diameter Bead Of RTV As Shown

B-07963

Figure 56—Applying RTV to the Pushrod Cover

VALVE TRAIN COMPONENT INSTALLATION

Install or Connect (Figures 3, 5, 54, 55 and 56)

- Lubricate the hydraulic lifters (121) with Engine Oil Supplement (GM part number 1051396) or equivalent.

1. Hydraulic lifters (121) into their mating bores in the block.
2. Hydraulic lifter guides (122).
3. Retainers (123) and studs (60).

Tighten

- Studs (60) to 10.0 N·m (90 in. lbs.).

4. Pushrod cover (50).
   - Apply a 5mm (3/16-inch) bead of RTV sealant to the pushrod cover as shown in figure 56.
5. Pushrod cover nuts.
6. Pushrods (47). Seat the pushrods into the sockets of the hydraulic lifters.

- Coat the mating surfaces of the rocker arms (33) and balls (32) with a molybdenum disulfide grease.

7. Rocker arms (33).
8. Balls (32).
9. Bolts (31).

Tighten

- Bolts to 30 N·m (22 ft. lbs.). DO NOT OVERTIGHTEN.

- Apply a 5 mm (3/16-inch) bead of RTV sealant to the rocker arm cover, inboard of the bolt holes.

10. Rocker arm cover to the cylinder head. Install the cover while the RTV is still wet (within 10 minutes).
11. Rocker arm cover bolts.

Tighten

- Bolts to 8.5 N·m (75 in. lbs.)

WATER PUMP INSTALLATION

Install or Connect (Figure 57 and 58)

1. Gasket.
2. Water pump.
3. Bolts.
4. Water pump pulley.

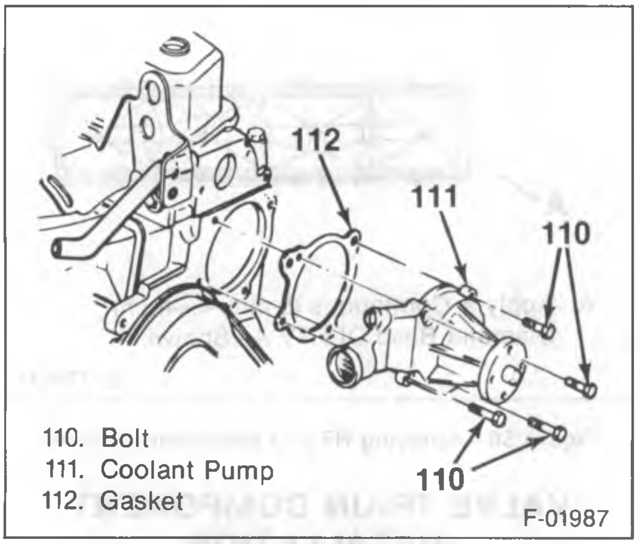


Figure 57—Water Pump Components

5. Fan and fan clutch.

THERMOSTAT HOUSING INSTALLATION

Install or Connect (Figure 58)

1. Thermostat housing and new gasket.
2. Thermostat housing bolts.
3. Thermostat bypass hose.

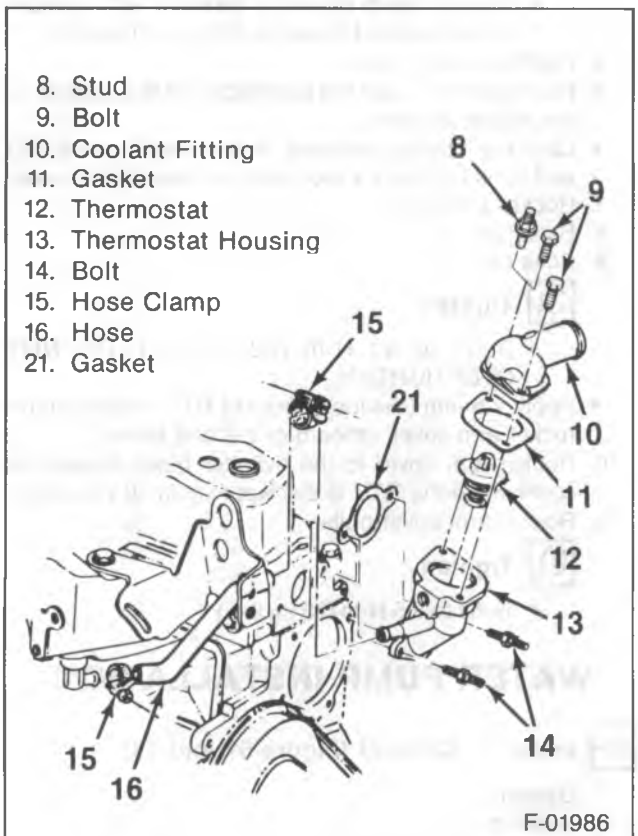


Figure 58—Thermostat Housing Components

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figure 59)

1. Gasket.
 - Apply sealant to the bolts indicated in figure 59.
2. Intake manifold.
3. Intake manifold bolts and washers.

Tighten

- Intake manifold bolts to 34 N·m (25 ft. lbs.).

4. Vacuum lines and electrical connectors, as needed.

EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figure 60)

1. Exhaust manifold and a new gasket.
2. Exhaust manifold bolts and washers.

Tighten

- Exhaust manifold bolts. Use the tightening sequence and the specifications shown in figure 60.

3. Oxygen sensor wire.
4. Thermac heat stove pipe.

FLYWHEEL INSTALLATION

Install or Connect (Figure 5)

1. Spacer (68).
2. Flywheel (67).
3. Bolts (66).

Tighten

- Flywheel bolts (66).
 — Automatic transmissions: 75 N·m (55 ft. lbs.).
 — Manual transmissions: 90 N·m (65 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (distributor, TBI unit oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

ENGINE SETUP AND TESTING

1. After overhaul, the engine should be tested before installing it in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.

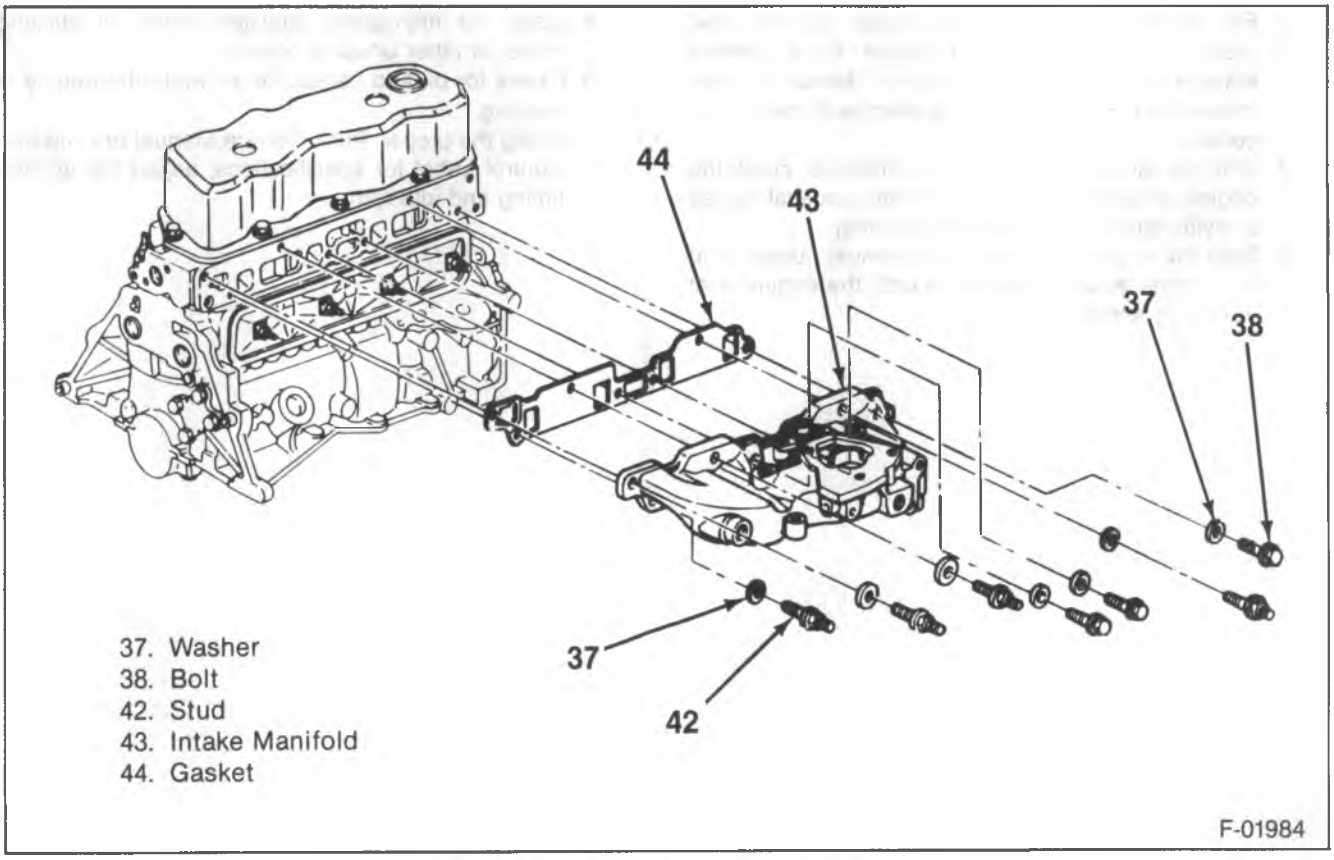


Figure 59—Intake Manifold Installation

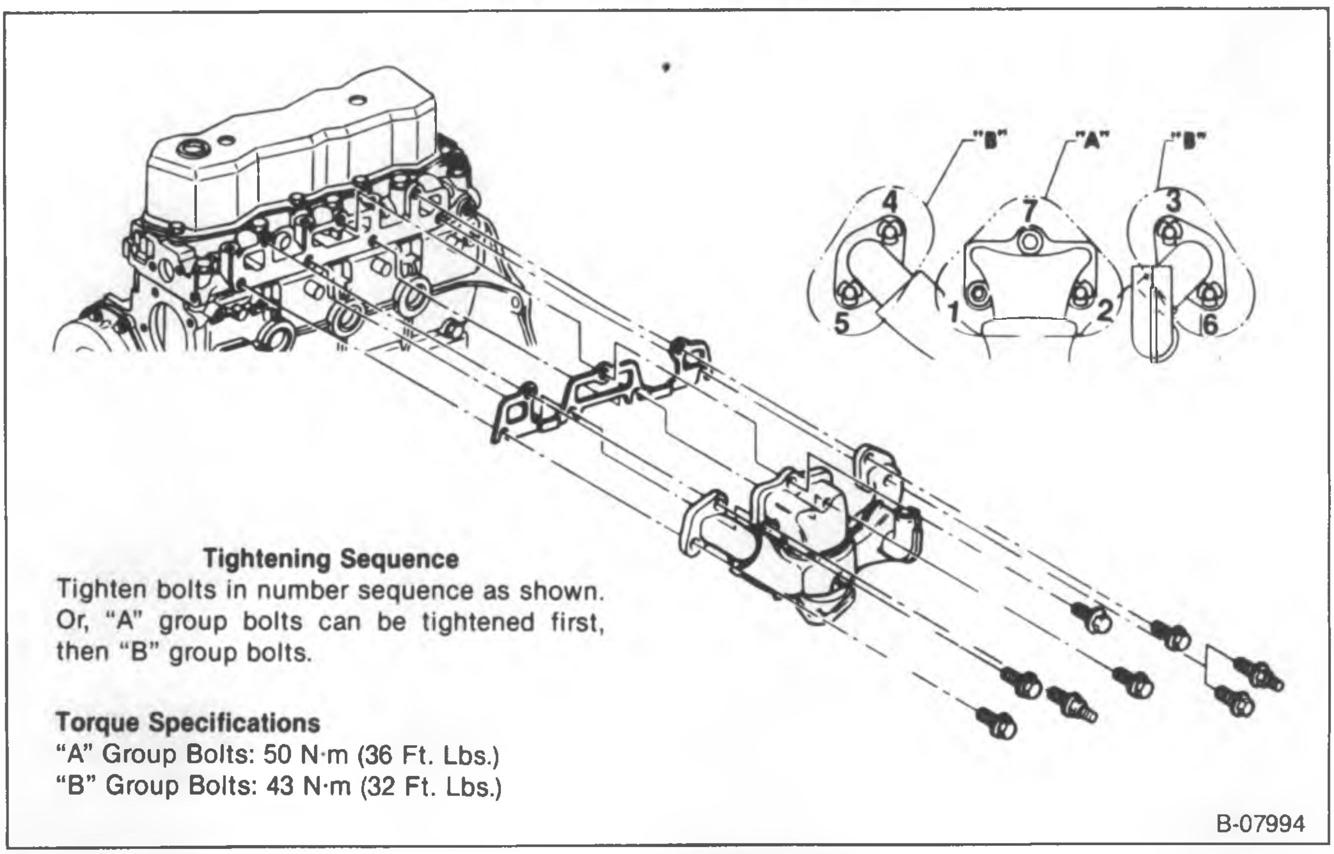


Figure 60—Exhaust Manifold Installation

2. Fill the crankcase with the proper quantity and grade of oil. Refer to the proper Truck Service Manual or Owner's and Driver's Manual for this information. Fill the cooling system with the proper coolant.
3. With the ignition "OFF" or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
4. Start the engine and listen for unusual noises. Run the engine at about 1000 rpm until the engine is at operating temperature.
5. Listen for improperly adjusted valves or sticking lifters, or other unusual noises.
6. Check for oil and coolant leaks while the engine is running.
7. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing and idle rpm.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:			
Type			L-4
Displacement			2.5L
RPO			LN8
Bore			4.00
Stroke			3.00
Compression Ratio			8.3:1
Firing Order			1-3-4-2
Oil Pressure			36–41 psi @ 2000 RPM
CYLINDER BORE:			
Diameter			4.000
Out Of Round			0.001 (Maximum)
Taper—Thrust Side			0.005 (Maximum)
PISTON:			
Clearance			0.00098-0.0022
PISTON RING:			
COMPRESSION	Groove Clearance	Top	0.002–0.003
		Second	0.001–0.003
	Gap	Top	0.010–0.020
		Second	0.010–0.020
OIL	Groove Clearance		0.015–0.0.55
	Gap		0.020–0.060
PISTON PIN:			
Diameter			0.938–0.942
Clearance in Piston			0.0002–0.0004
Fit In Rod			Production: 0.0002-0.0007 Service: 0.0004-0.0007
OIL PUMP			
Gear Lash			0.009–0.015
Gear Pocket Depth			0.995–0.998
Gear Pocket Diameter			1.503–1.506
Gear Length			0.999–1.002
Gear Diameter			1.496–1.500
Gear Side Clearance			0.004 (Maximum)
End Clearance			0.002–0.005

F6340

SPECIFICATIONS (CONT.)

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

CRANKSHAFT:			
Main Journal	Diameter		2.300
	Taper		0.0005
	Out of Round		0.0005
Main Bearing Clearance			0.0005–0.0022
Crankshaft End Play			0.0035–0.0085
Crankpin	Diameter		2.000
	Taper		0.0005
	Out of Round		0.0005
Rod Bearing Clearance			0.0005–0.0026
Rod Side Clearance			0.006–0.002
CAMSHAFT:			
Lobe Lift (Intake and Exhaust)			0.232
End Play			0.015–0.0050
Journal Diameter			1.869
Journal Clearance			0.0007–0.0027
VALVE SYSTEM:			
Lifter Type			Hydraulic
Lifter Leak — Down Rate			12–90 Seconds with 50 lb. load
Lifter Body Diameter			0.8420–0.8427
Lifter Bore Diameter			0.8435–0.8445
Lifter Clearance in Bore			0.0025
Plunger Travel			0.125
Pushrod Length			8.299
Valve Lash			NOT ADJUSTABLE
Rocker Arm Ratio			1.75:1
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002
Seat Width	Intake		0.035-0.075
	Exhaust		0.058-0.097
Stem Clearance		Intake	0.0010–0.0025
		Exhaust	0.0013–0.0030
Stem Diameter		Intake	0.3133–0.3138
		Exhaust	0.3128–0.3135
Valve Spring	Free Length		1.78
	Pressure N @ mm	Closed	71–78 lbs. @ 1.440
		Open	158–170 lbs. @ 1.040
	Installed Height		1.440

F6339

SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Main Bearing Cap Bolts	88	65	—
Connecting Rod Nuts	40	30	—
Oil Pan Bolts (All)	10.0	—	90
Oil Pump to Block Bolts	25	18	—
Oil Pickup Tube Nut	42	31	—
Oil Pump Cover Bolts	14.0	—	120
Pushrod Cover Nuts	10.0	—	90
Crankshaft Pulley to Hub Bolts	34	25	—
Crankshaft Pulley Hub to Crankshaft Bolt	220	160	—
Flywheel Bolts (Automatic)	75	55	—
Flywheel Bolts (Manual)	90	65	—
Intake Manifold Bolts	34	25	—
Exhaust Manifold Bolts (Front and Rear Exhaust Tubes)	43	32	—
(Center Exhaust Tube)	50	36	—
Distributor Clamp Bolt	17	13	—
Water Outlet Housing Bolts	25	18	—
Thermostat Housing Bolts	33	24	—
Water Pump	23	17	—
Timing Gear Cover Bolts	10.0	—	90
Rocker Arm Bolts	30	22	—
Cylinder Head Bolts - See Text	—	—	—
Camshaft Thrust Plate Bolts	10.0	—	90
Rocker Arm Cover Bolts	8.5	—	75
Hydraulic Lifter Guide Retainer Stud	10.0	—	90

SPECIAL TOOLS

1

J-8037

6

J-21882

2

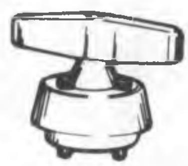
J-34995

7

J-34144-A

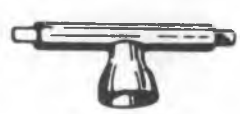
3

J-8080

8

J-34924-A

4

J-8062

9

J-22330

5

J-33049

10

J-3049

11

J-7872

1. Piston Ring Compressor
2. Front Crankshaft Seal Installer
3. Main Bearing Replacer
4. Valve Spring Compressor
5. Cam Bearing Replacer
6. Oil Pump Pickup Tube Installer
7. Rocker Arm Cover Remover
8. Rear Crankshaft Oil Seal Installer
9. Valve Seal Checker
10. Hydraulic Lifter Remover
11. Dial Indicator

F-04487

SECTION 6A2

2.8 LITER V-6

CONTENTS

CONTENTS (CONTINUED)

SUBJECT **PAGE**

DESCRIPTION

GM 2.8L engines are 60-degree V6 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by four precision insert main bearings, with crankshaft thrust taken at the number three bearing.

The camshaft is supported by four plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

For Engine Identification, refer to GENERAL INFORMATION (SEC. 0A) in this manual.

ENGINE LUBRICATION

Lubrication schematics are shown in figures 1 through 4. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. From the filter, oil is routed to the main oil gallery which supplies the left bank valve lifters with oil. From the left gallery, oil is directed to the camshaft bearings and the right oil gallery.

Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

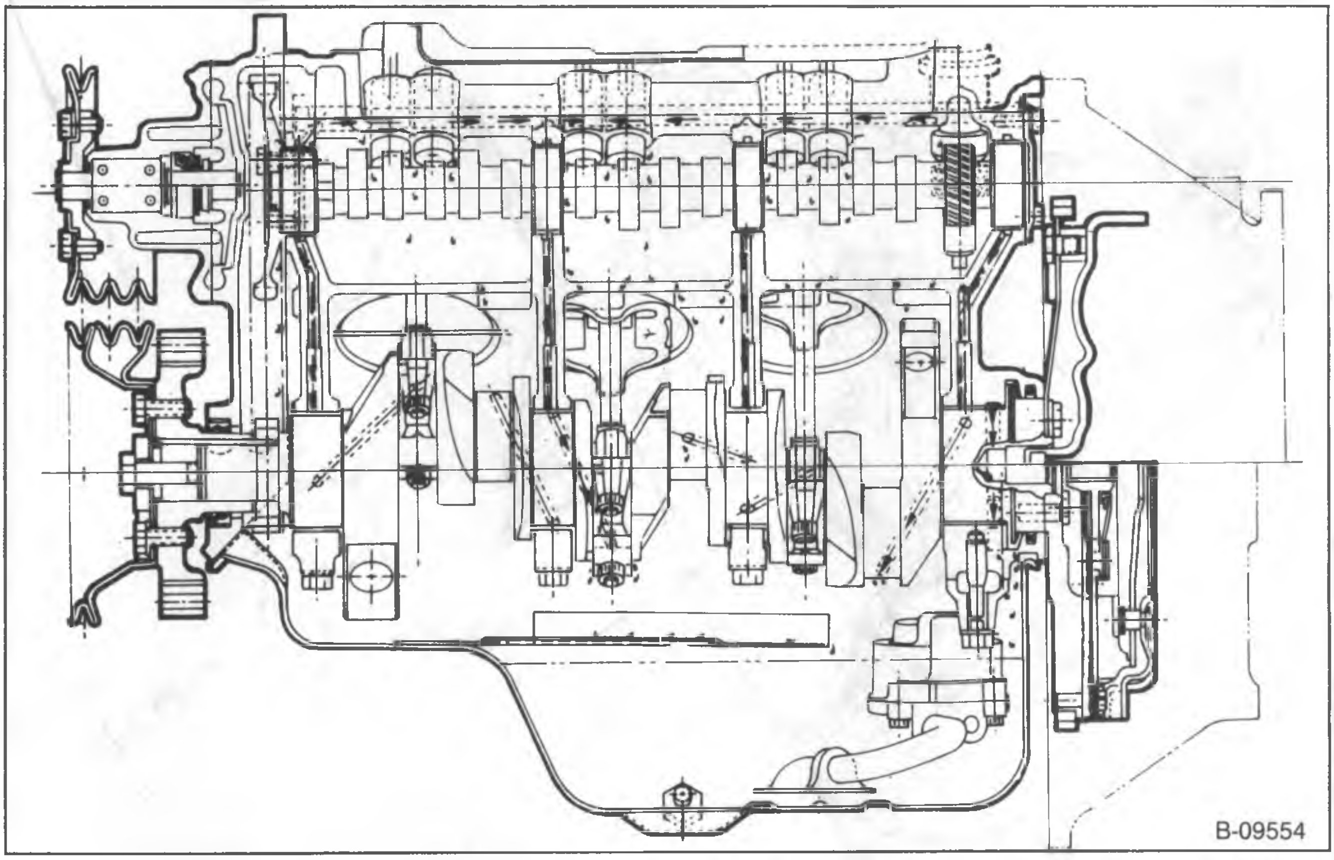


Figure 1—Engine Lubrication Diagram

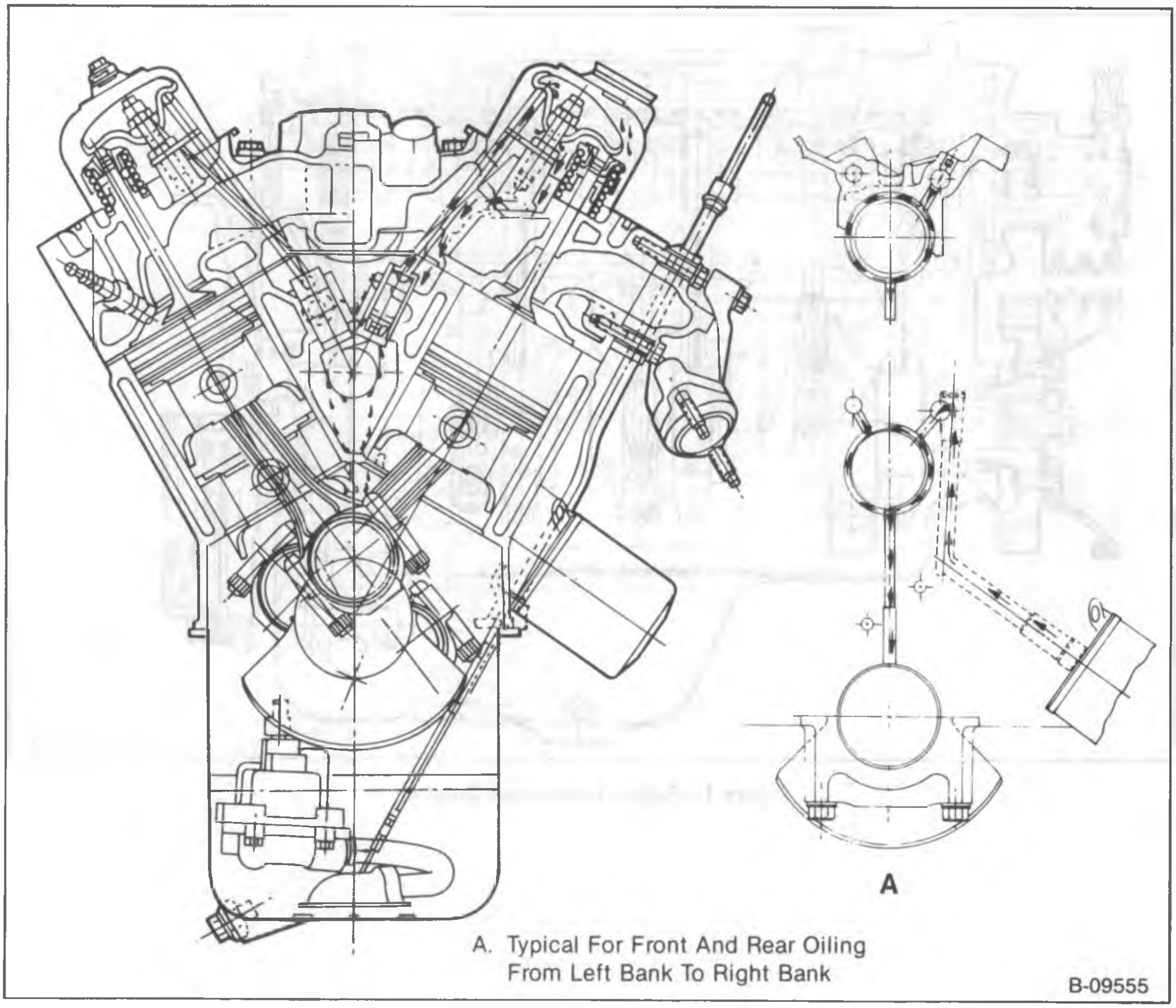
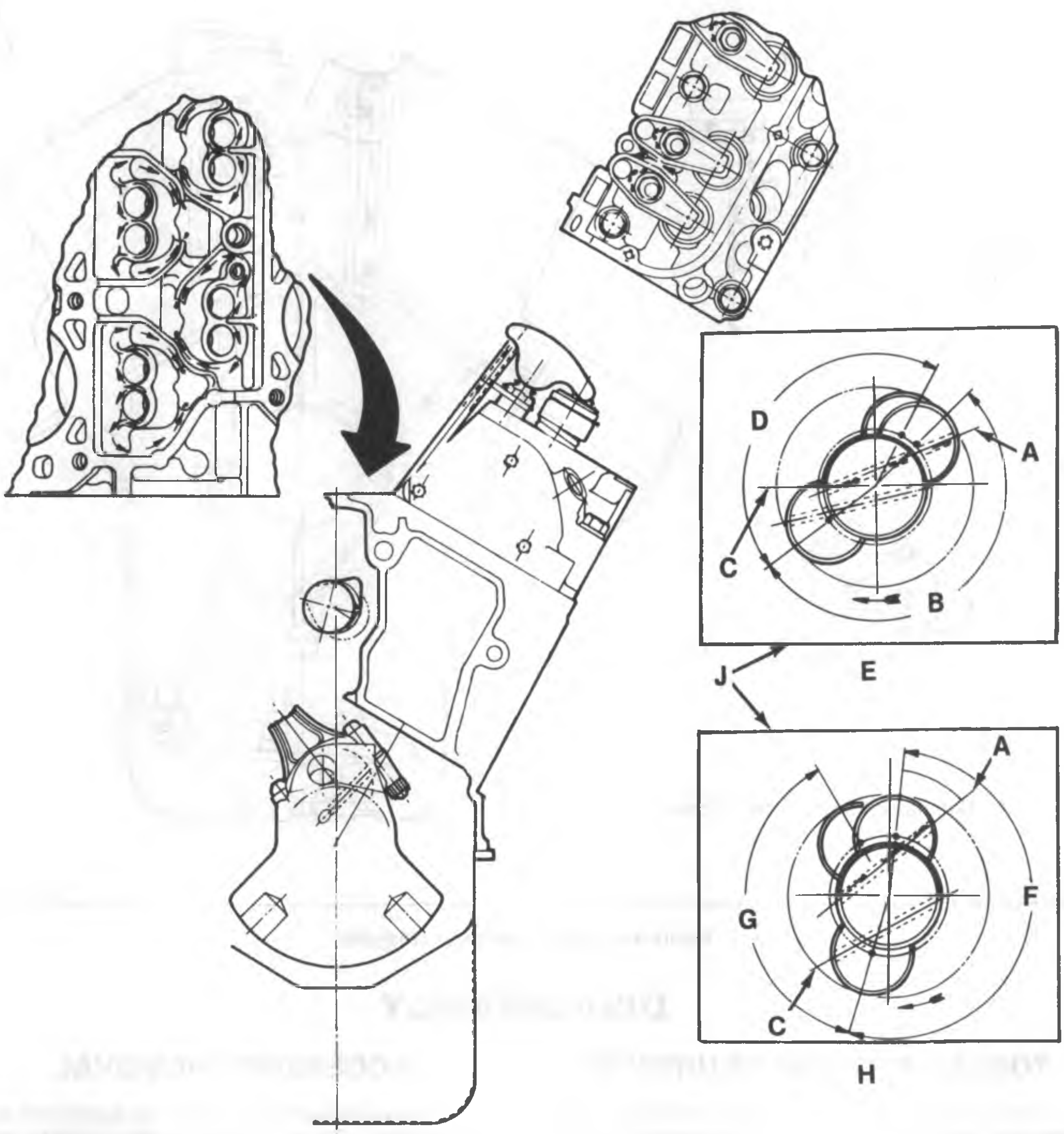


Figure 2—Engine Lubrication Diagram



A. Lubrication Begins
B. 189° Duration Of Lubrication
C. End Of Lubrication
D. Lubrication Ends 154° BTDC
E. Cylinders 2, 4 And 6
F. 190° Duration Of Lubrication
G. Lubrication Ends 134° BTDC
H. For Cylinders 1, 3 And 5
J. Views Showing Intermittent Oiling Of Connecting Rod Bearing Through Groove On Upper Half Of Main Bearings

B-09548

Figure 3—Engine Lubrication Diagram

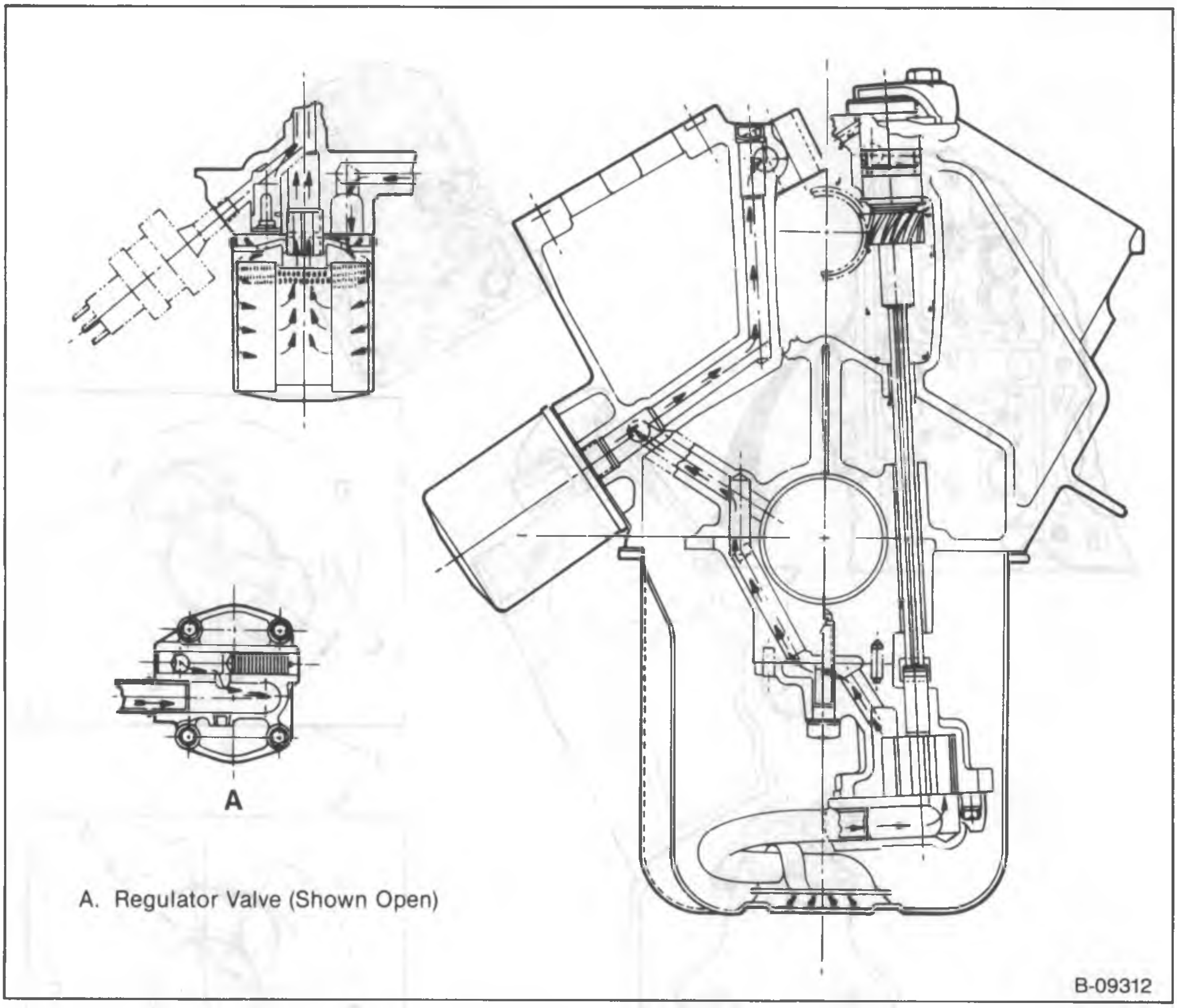


Figure 4—Engine Lubrication Diagram

DISASSEMBLY

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary equipment includes: A suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine components.

Special tools are illustrated throughout this section, and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

- Hydraulic Pump
- AIR Pump
- Generator
- Air Conditioning Compressor
- Cooling Fan
- Distributor
- TBI Unit

It is beyond the scope of this section to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routing, accessory drive belt layout, etc., should be made before removing accessories.

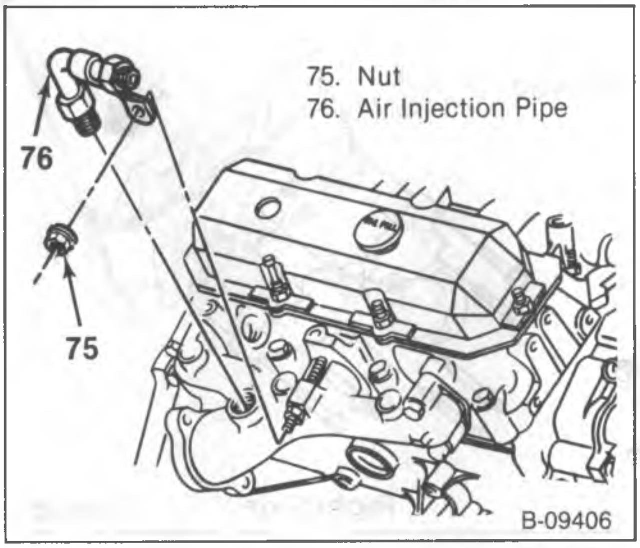


Figure 5—Air Injection Tube

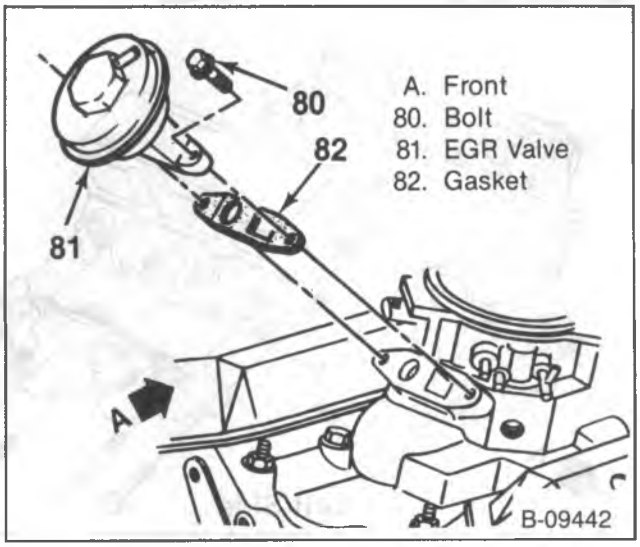


Figure 6—EGR Valve

CLEANING

Remove the engine accessories before cleaning, to provide better access to engine exterior surfaces. After removing the TBI unit, distributor, etc., cover the openings with tape to prevent the entry of water, solvent, and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan plug and allow the oil pan to drain.
2. Oil filter.
3. Block drains and allow the coolant to drain.

Install or Connect

1. Oil pan drain plug and washer.
2. Block drain plugs.

Tighten

- Block drain plug to 12 N·m (9 ft. lbs.).

AIR INJECTION TUBE REMOVAL

Remove or Disconnect (Figure 5)

1. Nut (75).
2. Air injection tube from the manifold.

EGR VALVE REMOVAL

Remove or Disconnect (Figure 6)

1. Bolts (80).
2. EGR valve (81).
3. Gasket (82).

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect (Figure 7)

1. Oil dipstick tube.
2. Bolts or studs.
3. Exhaust manifold.

ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figure 8)

1. Rocker arm cover nuts (1) and reinforcements (2).
2. Rocker arm cover and gasket.
   - If the cover sticks to the head, bump the end of the cover. If the cover still does not come loose, carefully pry until loose. DO NOT DISTORT THE SEALING FLANGE.

INTAKE MANIFOLD REMOVAL

Remove or Disconnect

1. Intake manifold bolts and nuts.
2. Intake manifold.
   - Pull the intake manifold up.
   - Do not attempt to loosen the manifold by prying under the gasket surface with any tool.
3. Gaskets.

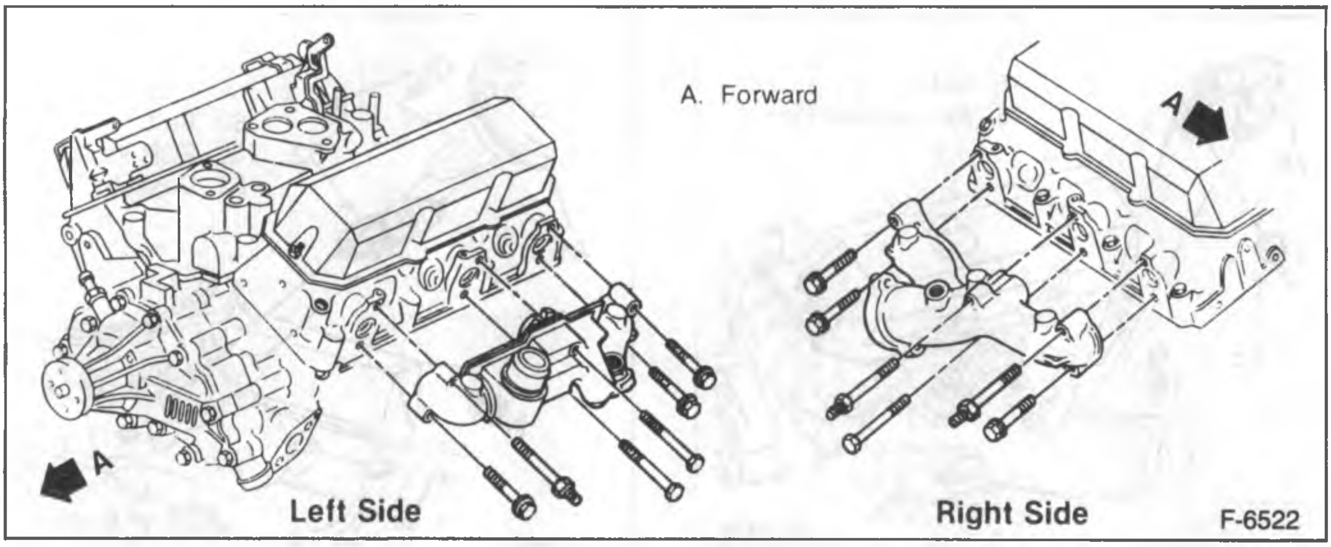


Figure 7—Exhaust Manifold Installation

VALVE TRAIN COMPONENT REMOVAL

Remove or Disconnect (Figure 9)

Tools Required:

J 3049, Hydraulic Lifter Remover (Plier Type)

or

J 9290-1, Hydraulic Lifter Remover (Slide Hammer Type)

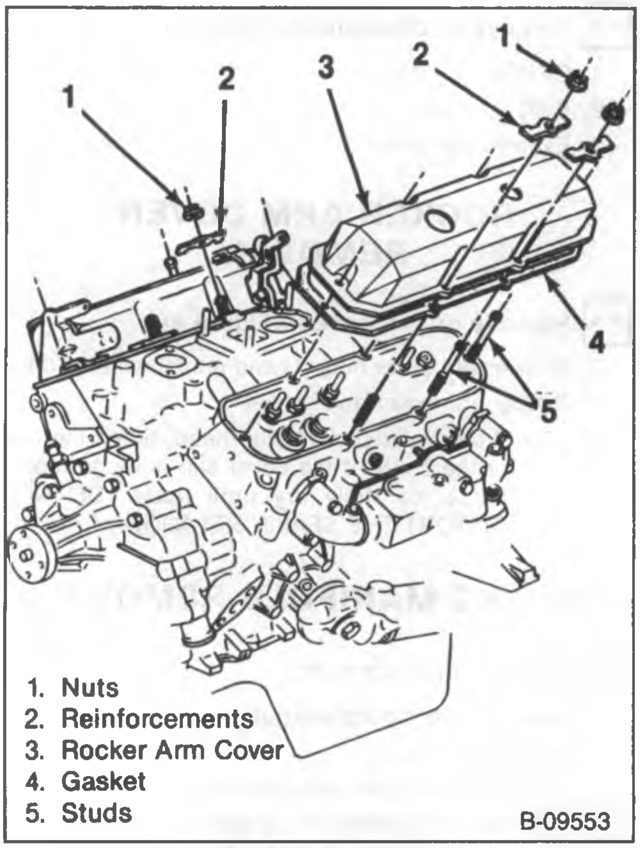


Figure 8—Rocker Arm Cover Installation

1. Nuts (6), balls (8), rocker arms (7), and pushrods (9).
   - Every effort should be made to insure that these mating parts are installed in their original locations during assembly. A simple valve train organizer can be made from a piece of wood.
2. Lifters (10).
   - Remove the lifters one at a time and place them in an organizer rack. The lifters must be installed into the same bore from which they were removed.
   - A stuck lifter can be removed using J 3049 (figure 10) or J 9290-01 (figure 11).

CYLINDER HEAD REMOVAL

Remove or Disconnect

1. Bolts.
2. Cylinder heads.
   - Use care when handling the cylinder heads to prevent damage to rocker arm studs or gasket sealing surface.
3. Gaskets.

TORSIONAL DAMPER REMOVAL

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The removal and installation procedures must be followed (with proper tools) or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper and the engine timing reference.

The torsional damper has three timing notches on the inertia ring. The number one cylinder timing reference mark will be identified by a dab of white paint. If a new damper assembly is installed, mark the new assembly in

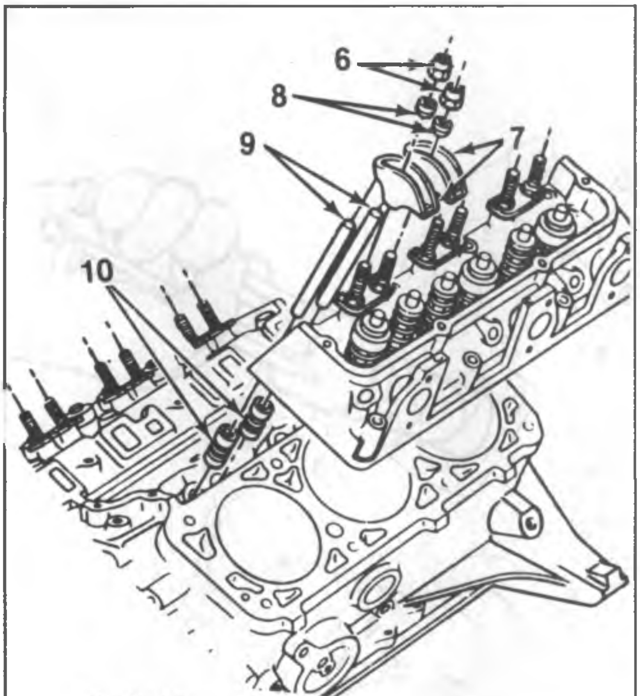


Figure 9—Valve Train Components

the same place for future reference. Number one cylinder reference is the first clockwise mark from the keyway when viewing the engine from the front.

Remove or Disconnect

Tool Required:

J 23523-E or J 24420-B, Puller

1. Torsional damper retaining bolt.
2. Drive pulley from the damper.
3. Damper using J 23523-E or J 24420-B.

Figure 10—Removing the Hydraulic Lifter with J 3049

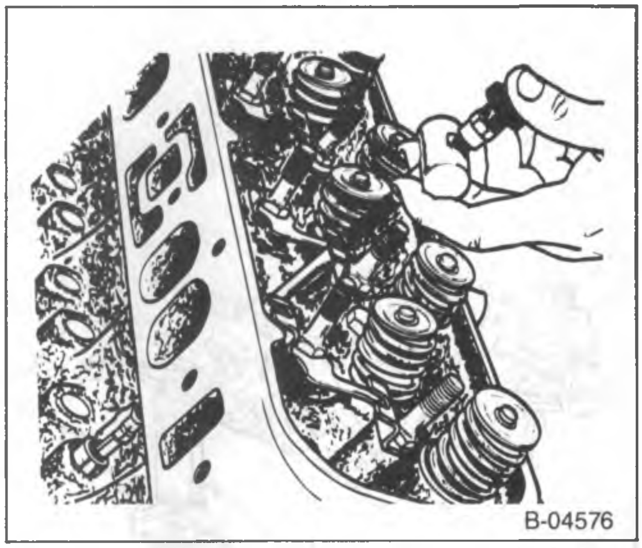


Figure 11—Removing the Hydraulic Lifter (Typical)

FRONT COVER AND WATER PUMP REMOVAL

Remove or Disconnect

1. Water pump.
2. Front cover bolts.
3. Front cover.
4. Gasket.

OIL PAN REMOVAL

Remove or Disconnect

1. Bolts and studs from the oil pan.
2. Oil pan.

OIL PUMP REMOVAL

Remove or Disconnect (Figure 12)

1. Bolt (40).
2. Pump (41).
3. Shaft (42).

TIMING CHAIN AND CAMSHAFT SPROCKET REMOVAL

Remove or Disconnect

1. Chain damper.
2. Sprocket to camshaft bolts.
3. Camshaft sprocket and chain.
   - If the sprocket does not come off easily, a light blow on the lower edge of the sprocket (with a plastic mallet only) should dislodge the sprocket.

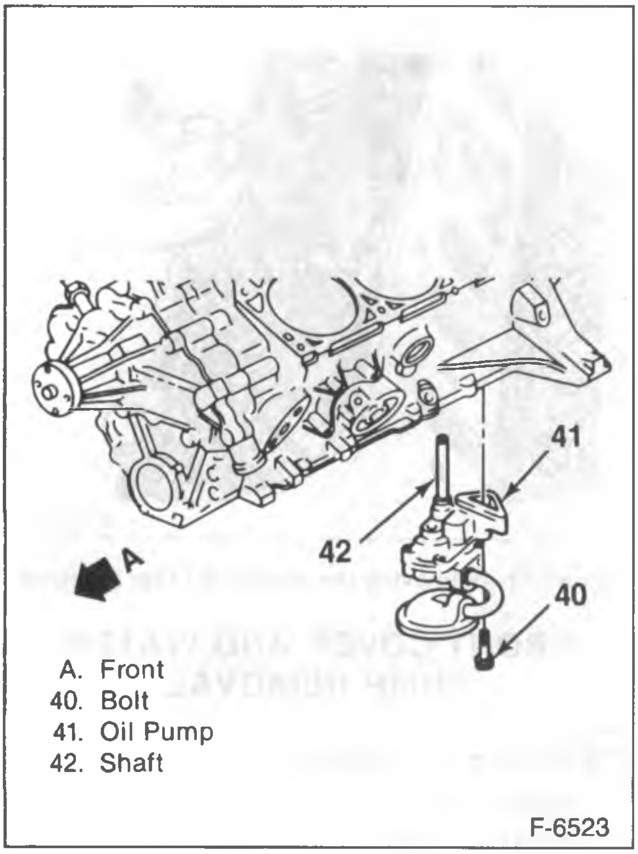


Figure 12—Oil Pump Installation

CAMSHAFT REMOVAL

Remove or Disconnect (Figure 13)

- Camshaft by pulling lightly and turning.

Important

- All camshaft bearing journals are the same diameter and care must be exercised in removing the camshaft to avoid bearing damage.

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect

1. Ridge or deposits from the upper end of the cylinder bores.
   - Turn the crankshaft until the piston is at BDC.
   - Place a cloth on top of the piston.
   - Perform the cutting operation with a ridge reamer (figure 14).
   - Turn the crankshaft until the piston is at TDC.
   - Remove the cloth and cuttings.
- Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods, and caps. Starting at the front of the crankcase, the cylinders in the right bank are numbered 1-3-5 and the left bank is numbered 2-4-6.
2. Connecting rod cap and bearing.

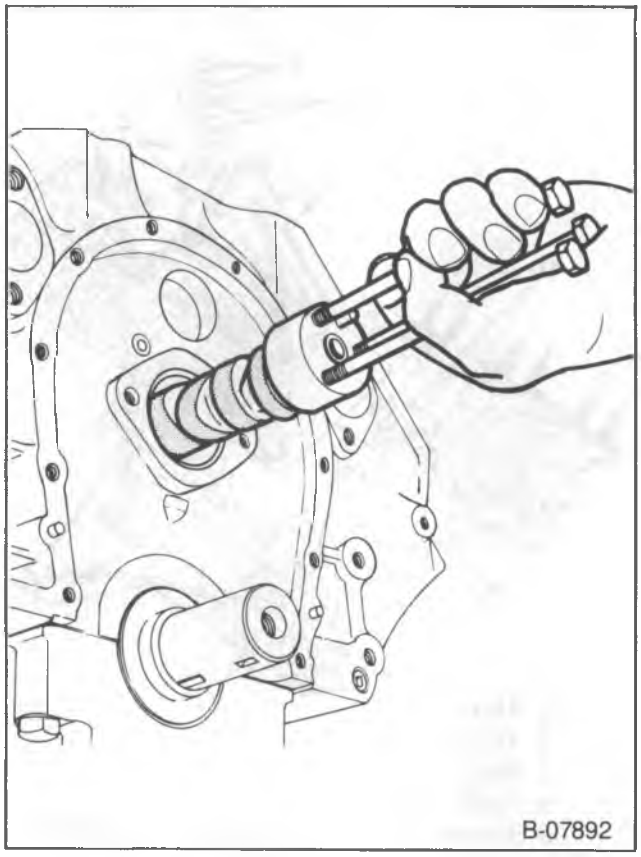


Figure 13—Replacing the Camshaft (Typical)

3. Connecting rod and piston (figure 15).
   - Install guide hose over the threads of the rod studs to prevent damage to the bearing journal and rod studs.
4. Connecting rod bearing.

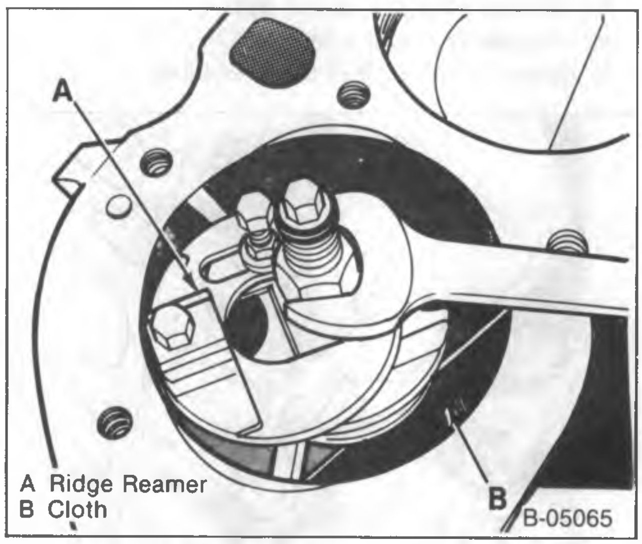


Figure 14—Removing the Cylinder Ridge

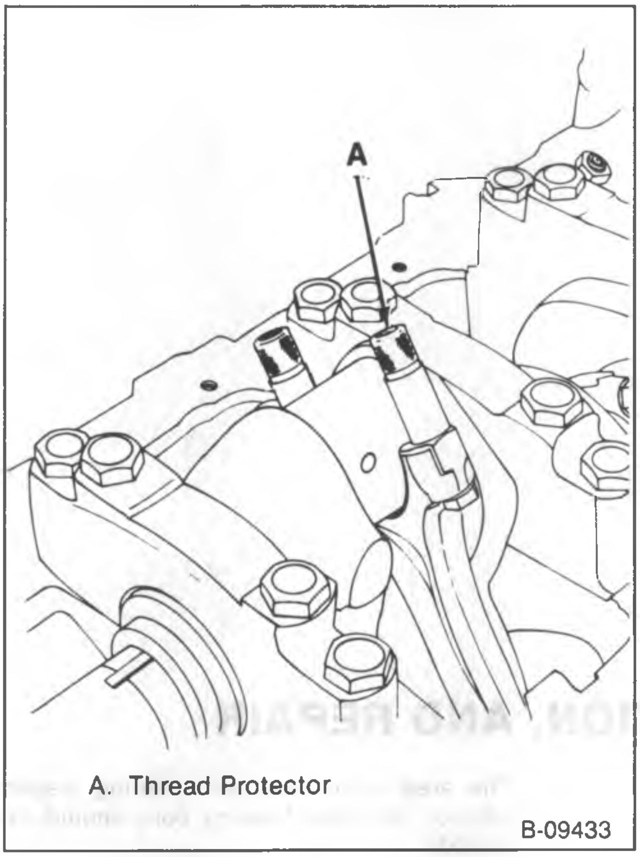


Figure 15—Replacing the Piston and Connecting Rod (Typical)

FLYWHEEL REMOVAL

Remove or Disconnect

1. Bolts.
2. Retainer (automatic transmisison only).
3. Flywheel.

CRANKSHAFT REMOVAL

Remove or Disconnect (Figure 16)

- Check the main bearing clearance before removing the crankshaft. Refer to "Crankshaft and Main Bearing Installation" later in this section.
- The main bearings and rear oil seal can be replaced without removing the crankshaft as outlined later in this section.

1. Bolts (85).
2. Main bearing caps (86).
3. Crankshaft from the cylinder block.
   - Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange surfaces.

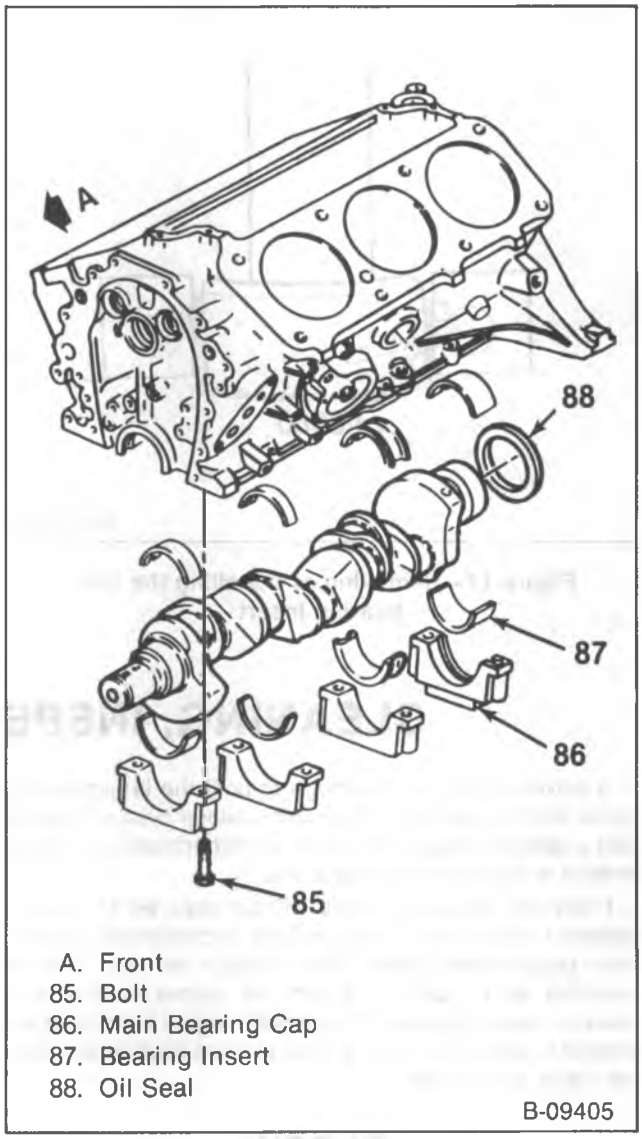


Figure 16—Crankshaft Installation

MAIN BEARING REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect

Tool Required:

J 8080, Main Bearing Remover/Installer

1. Main bearing caps.
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
2. Lower main bearing inserts from the main bearing caps.
3. Upper main bearing inserts.
   - Insert J 8080 into the crankshaft oil hole (figure 17).
   - Rotate the crankshaft to turn the bearing insert out of the block.

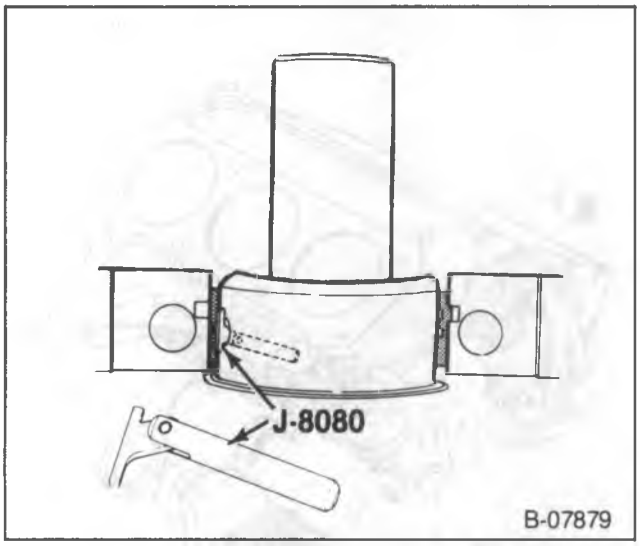


Figure 17—Removing or Installing the Main Bearing Insert

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean

1. Block in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
   - Remove the oil gallery plugs.
5. Scale deposits from the coolant passages.

Inspect

1. All expansion plugs for lack of fit or leakage.
2. Valve lifter bores for deep scratches and varnish deposits.
3. Block for cracks.
   - — Cylinder walls.
   - — Coolant jackets.
   - — Main bearing webs.
   - — Engine mount bosses.
4. Main bearing bores and main bearing caps.
   - — All main bearing bores should be rounded and uniform in ID at all bearing supports.
   - — The area where the main bearing inserts contact the main bearing bore should be smooth.
   - — If a main bearing cap is damaged and requires replacement, replace it.
5. Deck surface for flatness. Use a straightedge and feeler gage. Minor irregularities may be carefully machined. If more than 0.25 mm (0.010-inch) must be removed, replace the block.
6. Oil pan rail and timing cover attaching area for nicks. Minor irregularities may be cleaned up with a flat file.
7. Transmission case mating surface.

Important

- If the transmission case mounting surface is not flat, a broken flexplate may result.

CYLINDER BORES

Inspect

- Cylinder bores for scoring or other damage.

Measure

- Cylinder bore taper and out-of-round. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Cylinder Bore Reconditioning

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Disassemble

- Components as required.

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Piston pin diameter and clearance.
- Piston to bore clearance, and fit the pistons.
  1. Remove rings from the pistons to be fitted.
     - It is not necessary to remove the connecting rods from the pistons.
     - If an excessive amount of varnish or carbon appears as a ridge at the top of the cylinder, remove it by scraping or sanding.
  2. Wipe the bores and pistons clean. Select a piston and rod assembly for the bore to be fitted and position it down into the bore with the top of the piston down. The piston should slide freely through the bore by its own weight when the piston skirt is 12 to 25 mm from the top of the block. Use care to make sure the piston is not damaged when it slides through the bore. If the piston does not slide through the bore, it is too tight and another piston should be selected. Mark the proper piston and bore for assembly.
  3. After a piston has been selected which will slide freely through the bore, determine if it is too loose.
     - Place a feeler gage (0.060 mm for used pistons, 0.050 mm for new pistons) at least 150 mm long and not over 12 mm wide into the bore with the selected piston. Hold the feeler gage to the top of the bore.
     - Position the selected piston into the bore (top down) until the skirt is 12 to 25 mm from the top of the block. The feeler gage must be 90 degrees from the piston pin. If the piston hangs on the feeler gage and does not fall free, the piston is correctly fitted to the bore. If the piston slides freely through the bore, it is too small and a larger piston is required. Mark the proper piston and bore for assembly.
  4. When checking more than one bore, it is possible that a piston that does not fit one bore will fit another.

Assemble

- Components as outlined.

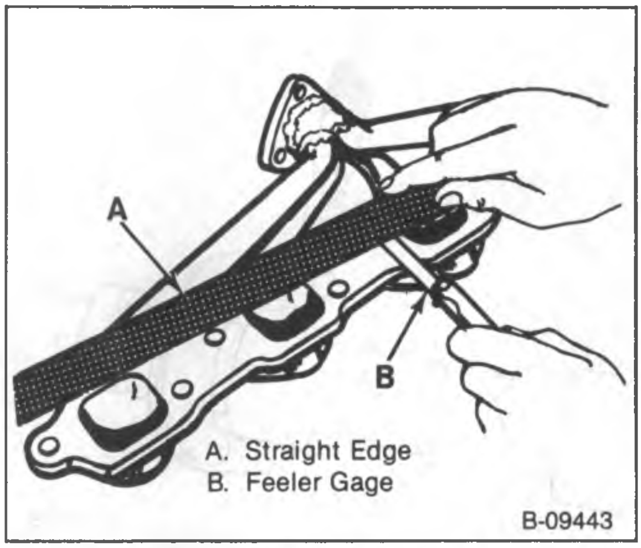


Figure 18—Checking Manifold Flange Alignment

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 2, 4 and 6 are at the left bank and, 1, 3 and 5 are the right bank. 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 block or cylinder to another, new connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

INTAKE AND EXHAUST MANIFOLDS

Clean

- Old pieces of gasket from the gasket surfaces.
- Excessive carbon build-up in the exhaust passages of the intake manifold.
- Scale and deposits from the coolant passages of the intake manifold.
- EGR passage of excessive carbon deposits.

Inspect (Figure 18)

- Manifolds for cracks, broken flanges, and gasket surface damage.
- Alignment of manifold flanges. Use a straight edge and feeler gage. If the flanges are out of alignment by more than 0.1 mm (0.005-inch), the manifold is warped and should be replaced.

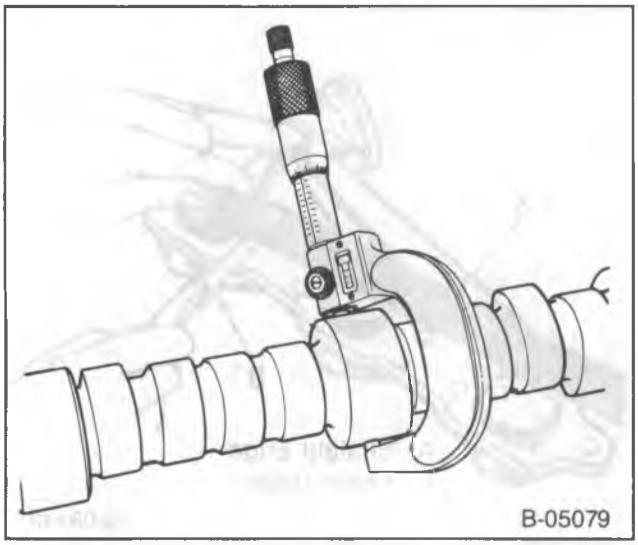


Figure 19—Checking the Camshaft Journals

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of lifters must also be installed.

Inspect

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.

Measure

- Camshaft journal diameter (figure 19). The proper diameter is listed in "Specifications."

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) for replacement procedures.

TIMING CHAIN AND SPROCKETS

Inspect

- Sprockets for chipped teeth and wear.
- Timing chain for damage.
- It should be noted that excessively worn sprockets will rapidly wear a new chain. Likewise, an excessively worn chain will rapidly wear a new set of sprockets.
- Timing chain for wear.
  - — If the chain can be pulled out more than 9.5 mm (3/8-inch), from the damper, replace the chain.

CRANKSHAFT SPROCKET REPLACEMENT

Remove or Disconnect (Figure 20)

Tool Required:
J 5825-A Crankshaft Sprocket Puller

1. Crankshaft sprocket using J 5825-A.
2. Key (if necessary).

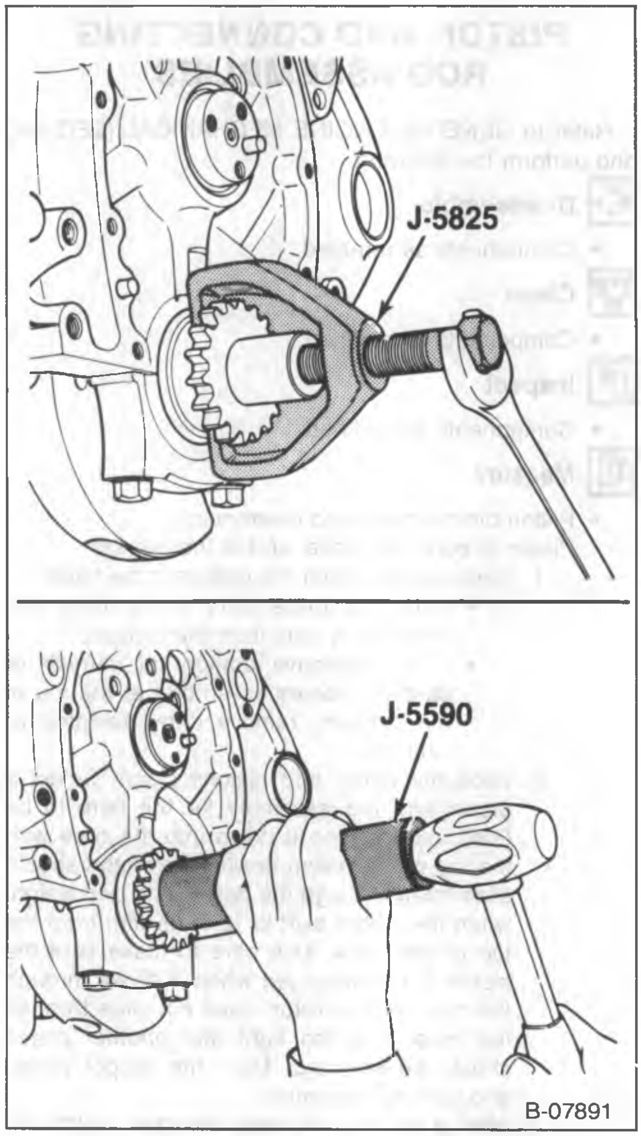


Figure 20—Replacing the Crankshaft Sprocket

Install or Connect (Figure 20)

Tool Required:
J 5590, Crankshaft Sprocket Installer

1. Key (if removed).
2. Crankshaft sprocket using J 5590.

FRONT COVER

Clean

- Old gasket from the gasket surfaces.

Inspect

- Timing tab marker for damage.
- Front cover for damage, dents, or cracks.

Remove or Disconnect

- Oil seal from the front cover.
  - — Pry the seal out with a large screw driver.

Install or Connect

Tool Required:

J 35468, Seal Installer

- New seal so that the open end of the seal is toward the inside of the cover.
  — Drive the seal into position with J 35468.
  — Support the cover at the seal area.
- Lubricate the seal with engine oil before installing the torsional damper.

WATER PUMP

Clean

- Old gasket from the gasket surface.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings' lubricant supply, and cause premature bearing failure.

Inspect

- Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.
- Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking and the water pump should be replaced.

OIL PAN AND ROCKER ARM COVERS

Clean

- Parts in solvent. Remove all sludge and varnish.
- Old gaskets from the gasket surfaces.

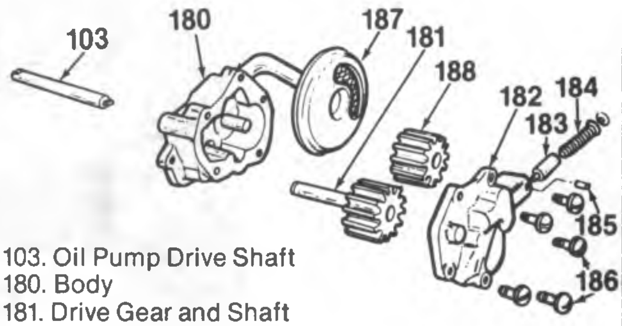
Inspect

- Gasket flanges for bending or damage.
- Rubber grommets and parts on the rocker arm cover for deterioration.
- Oil pan for rock damage or cracks.
- Oil pan baffle for lack of fit.
- Drain plug threads for stripping.

OIL PUMP

Remove or Disconnect (Figure 21)

1. Pump cover attaching bolts (186) and the pump cover (182).
   - Mark the gear teeth so the pump gears can be installed with the same gear teeth indexed.
2. Idler gear (188), drive gear (181) and shaft (103) from the pump body.
3. Pressure relief valve retaining pin (185).
4. Pressure relief valve spring (184).
5. Pressure relief valve (183).



103. Oil Pump Drive Shaft
180. Body
181. Drive Gear and Shaft
182. Cover
183. Pressure Relief Valve
184. Spring
185. Spring Retaining Pin
186. Cover Screws
187. Pick-up Screen and Pipe
188. Idler Gear

B-09404

Figure 21—Oil Pump Components (Typical)

6. Pick-up screen and pipe (187).
   - Do not remove the pick-up screen and pipe unless replacement is required.
   - The pick-up pipe is a press fit in the pump body (180).
   - Do not try to remove the screen from the pipe. The pick-up screen and pipe is serviced as an assembly only.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect (Figure 21)

- Pump body (180) and cover (182) for cracks or other damage.
- Gears (181 and 188) for wear.
- Drive gear and shaft (181) for lack of fit in the pump body (180).
- Inside of the cover (182) for wear that would permit oil to leak past the ends of the gears. The pump gears, cover, and body are not serviced separately. If the parts are damaged or worn, replace the entire oil pump assembly.
- Pick-up screen and pipe (187) for damage to the screen, pipe or relief grommet.
- Pressure relief valve (183) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Install or Connect (Figure 21)

Tool Required:

J 21882, Pick-Up Tube and Screen Installer

1. Pressure regulator valve.
2. Spring.
3. Spring retaining pin.
4. Drive gear and shaft.
5. Idler gear.
   - Index the marks made during disassembly.
6. Cover and screws.

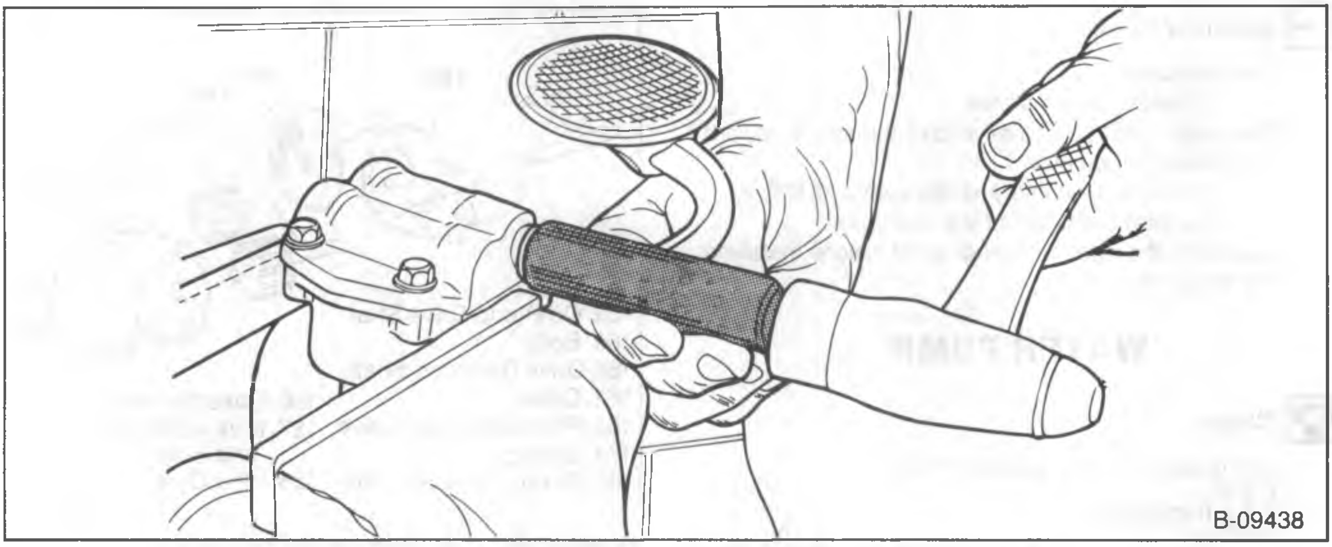


Figure 22—Installing the Oil Pump Screen

Tighten

- Screws to 9.0 N·m (80 in. lbs.).
- Turn the drive shaft by hand to check for smooth operation.

NOTICE: Be careful of twisting, shearing or collapsing the pipe while installing in the pump.

7. Pick-up screen and pipe (if removed) (figure 22).
   - If the pick-up screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure.
   - Mount the oil pump in a soft jawed vise.
   - Apply sealer to the end of the pipe.
   - Tap the pick-up screen and pipe into place, using J 21882 and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.
8. Oil pump drive shaft (103) and connector (104).

VALVE TRAIN COMPONENTS

PUSHRODS, ROCKER ARMS, BALLS, AND NUTS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Inspect

- Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
- Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.
- Rocker arm nuts.
- Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
- Pushrod ends for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

DISASSEMBLY

Remove or Disconnect (Figures 23 and 24)

Tool Required:
J 8062, Valve Spring Compressor

1. Valve keepers (22).
   - Compress the springs with J 8062 (figure 24).
   - Remove the keepers.
   - Remove J 8062.
2. Caps (23), oil shedder (24), and springs.
3. O-ring seals (26) and seals (25) (if used).
4. Valves (20 and 21).
   - Place the valves in a rack so they can be returned to their original position at assembly.

CLEANING AND INSPECTION OF COMPONENTS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following.

Clean

- Components as outlined.

Inspect

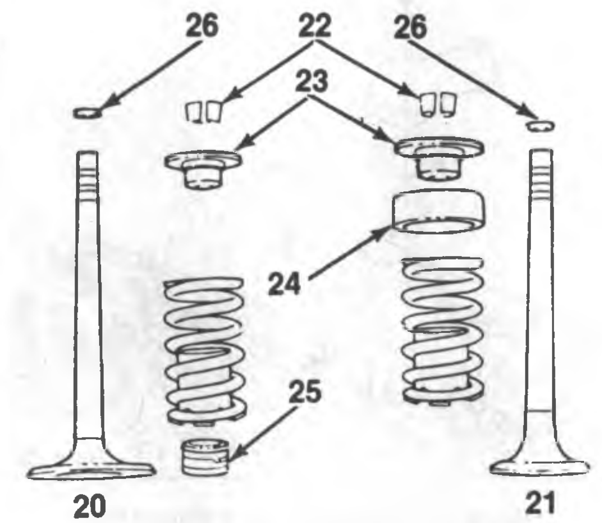
- Components as outlined.

Measure

- Valve stem clearance.
- Valve spring tension and free length.

Other information outlined includes:

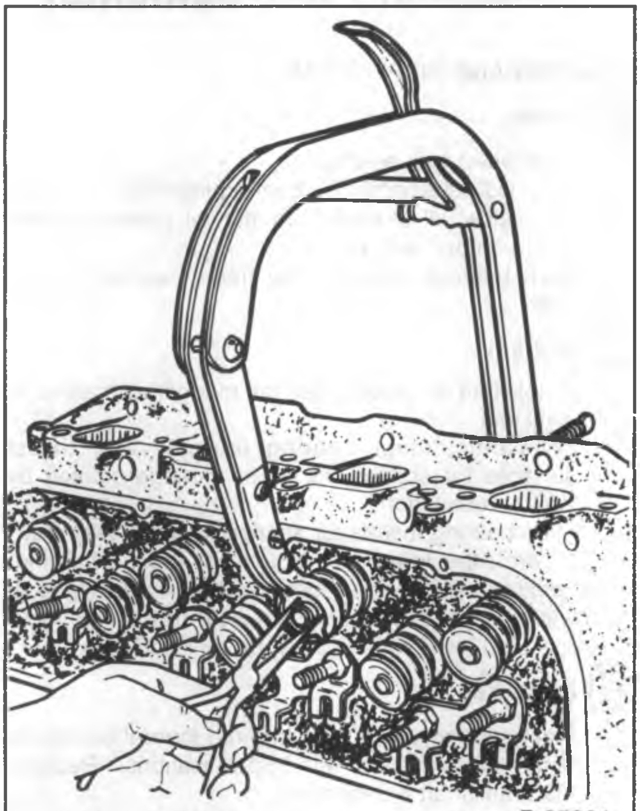
- Valve and seat grinding.



20. Intake Valve
21. Exhaust Valve
22. Valve Keepers
23. Valve Cap
24. Oil Shedder
25. Seal
26. O-Ring

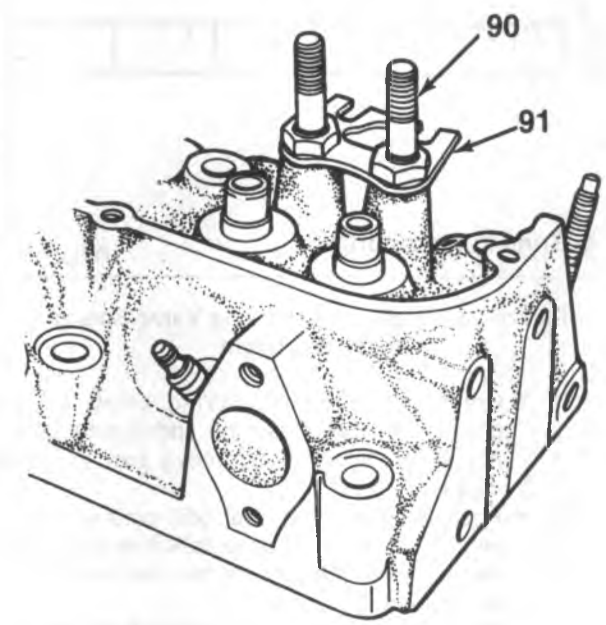
B-09551

Figure 23—Valves and Components



B-05284

Figure 24—Compressing the Valve Springs



90. Rocker Arm Stud
91. Pushrod Guide

B-09444

Figure 25—Rocker Arm Studs

- Valve guide reaming.

ROCKER ARM STUD AND PUSHROD GUIDE REPLACEMENT

The rocker arm studs are threaded in place.

Remove or Disconnect (Figure 25)

1. Rocker arm studs (90) using a deep socket.
2. Pushrod guide (91).

Install or Connect

1. Pushrod guide (91).
2. Rocker arm studs (90) using a deep socket.

Tighten

- Rocker arm studs to 65 N·m (48 ft. lbs.).

ASSEMBLY

Install or Connect (Figures 23 and 24)

Tool Required:
J 8062, Valve Spring Compressor

1. Valves (20 and 21).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper seats.
2. Seals (25) (intake only).
   - Install the seals over the valve stems and seat them against the head.
3. Springs.
4. Oil shedder (24).
5. Caps (23).
6. O-ring seals (26) and valve keepers (22).

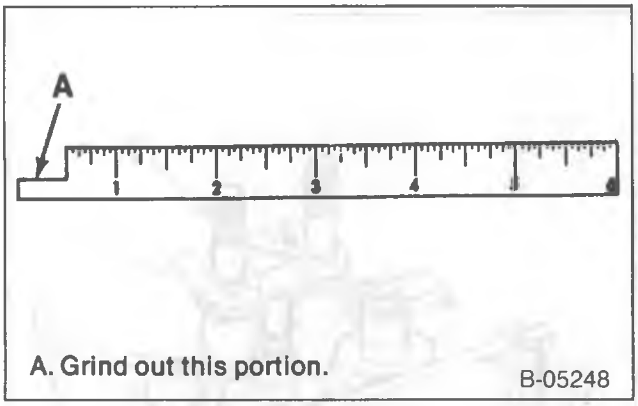


Figure 26—Scale for Checking Valve Spring Installed Height

- Compress the valve spring using J 8062 (figure 24). Compress the spring enough so the lower valve stem groove can be seen clearly.
- Push a new O-ring seal (26) onto the valve stem. The seal is to be installed on the stem's lower groove. Make sure the seal is flat and not twisted.
- Apply a small amount of grease to the area of the upper valve stem groove. Assemble the two valve keepers using the grease to hold the keys in place. Make sure the keepers seat properly in the groove.
- Release the compressor tool. Make sure the valve keepers stay in place.
- Repeat the preceding steps on the remaining valves.

Measure

- Valve spring installed height of each valve spring as follows.
  1. Use a narrow thin scale. A cutaway scale (figure 26) may be helpful.
  2. Measure from the top of the spring damper "feet" to the bottom of the oil shedder on the exhaust valve or to the bottom of the valve cap on the intake valve.
  3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims approximately 0.75 mm (0.03-inch) thickness (between the spring and cylinder head). NEVER shim the spring so as to give an installed height under the specified figure.

THERMOSTAT AND WATER OUTLET

Remove or Disconnect (Figure 27)

1. Bolts.
2. Water outlet.
3. Gasket.
4. Thermostat.

Inspect

- Water outlet for cracks.

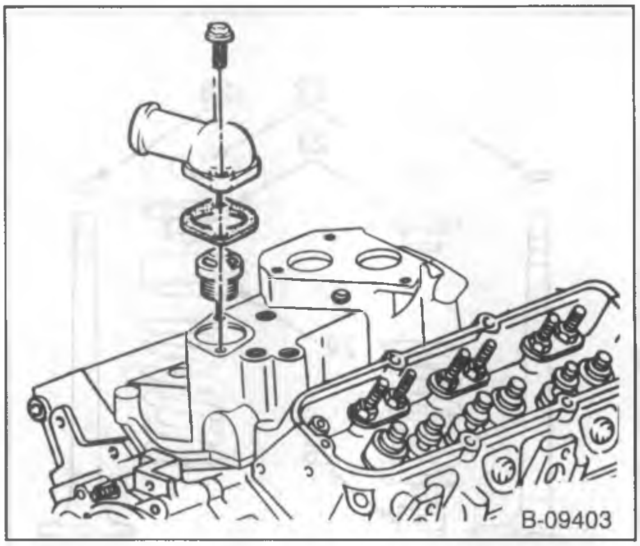


Figure 27—Thermostat and Water Outlet

Install or Connect (Figure 27)

1. Thermostat.
2. New gasket.
3. Water outlet.
4. Bolts.

Tighten

- Bolts for 21 N·m (15 ft. lbs.).

CRANKSHAFT AND BEARINGS

CLEANING AND INSPECTION

Clean

- Crankshaft with solvent.
  — Do not scratch the bearing journals.
  — Blow all sludge from the oil passages with compressed air.
- Main bearing inserts. Wipe free of oil with a soft cloth.

Inspect

- Crankshaft for cracks. Use the magnaflux method, if available.
- Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.
- Main bearing inserts for scoring or other damage.

In general, the lower inserts (except the #1 bearing) show greater wear and the most distress from fatigue. If the lower insert shows evidence of wear or damage, both the upper and lower inserts must be replaced.

Measure

- Main bearing and connecting rod journal diameters (figure 28). Compare with "Specifications." Replace the crankshaft if necessary.
- Main bearing and connecting rod journals for taper and out-of-round (figure 28). If the journals are tapered or out-of-round more than 0.005 mm, replace the crankshaft.

- Crankshaft run-out.
  - Mount the crankshaft in V-blocks or between centers.
  - Use a dial indicator.
  - If the main journals are misaligned more than 0.025 mm, the crankshaft is bent and must be replaced, along with the main bearing.

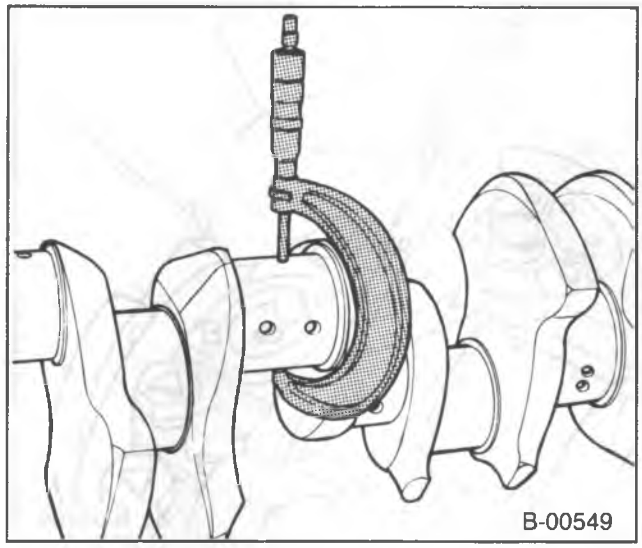


Figure 28—Measuring the Crankshaft Journals

ASSEMBLY OF ENGINE

PRIOR TO ASSEMBLY

The importance of cleanliness during the assembly procedure cannot be overstressed. Dirt will cause premature wear of the rebuilt engine.

Lubricate all moving parts lightly with engine oil or engine assembly lubricant (unless specified otherwise) during assembly. This will provide initial lubrication when the engine is started.

CRANKSHAFT AND MAIN BEARING INSTALLATION

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are excessive, a new bearing plus both upper and lower inserts will be required. Service main bearings are available in standard size, 0.016, and 0.032 mm undersize. Service rod bearings are available in standard size and 0.026 mm undersize.

Selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a 0.032 mm undersize insert which will decrease the clearance 0.016 mm from using a full standard bearing.

Install or Connect

1. Upper main bearing inserts to the block.

   Important

   - If any undersized bearings are used, make sure they are fitted to the proper journals.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps.

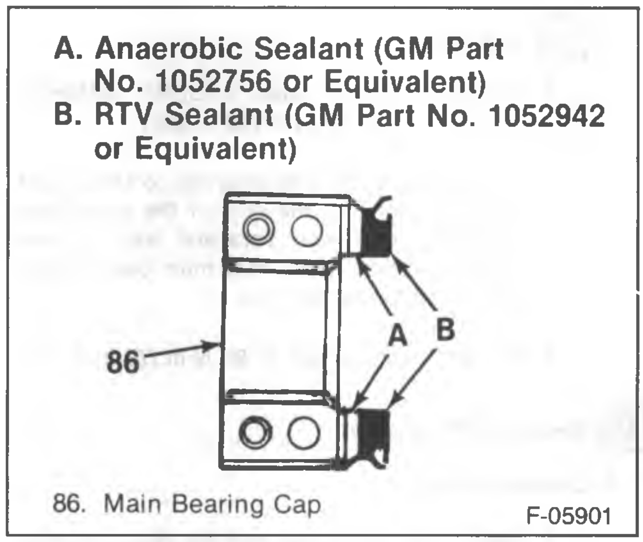


Figure 29—Applying Sealer to Rear Main Bearing Cap

Measure

- Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

- Apply engine oil to the main bearing inserts.

4. New O-ring (if used) into the rear main bearing cap.
5. Thin coat of anaerobic sealant (GM Part No. 1052756 or equivalent) to the rear main bearing cap (figure 29).
   - Do not allow sealer on the crankshaft or the seal.
6. A small amount of RTV sealant (GM Part No. 1052942 or equivalent) to the rear 4 mm of the rear bearing cap sealing surface (figure 29).
   - Do not allow sealer on the crankshaft or the seal.

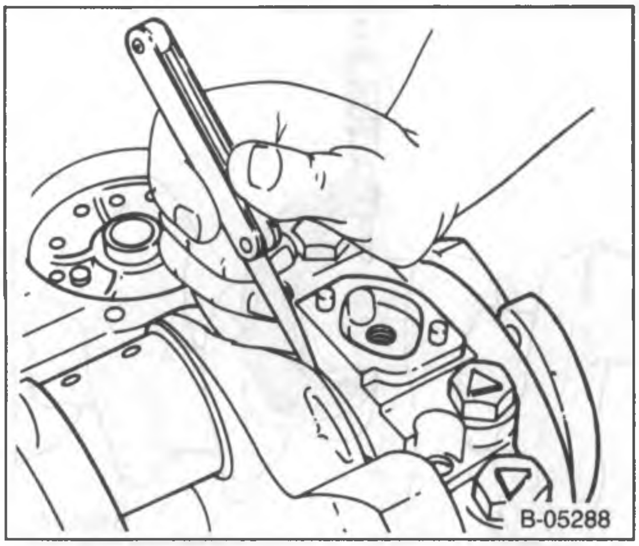


Figure 30—Measuring Crankshaft End Play

7. Main bearing caps with arrows pointing toward the front of the engine.

8. Main bearing cap bolts.

Tighten

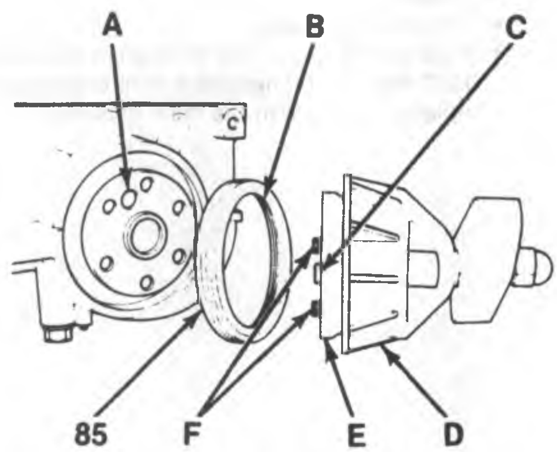
- All main bearing caps EXCEPT NUMBER THREE CAP to 95 N·m (70 ft. lbs.).
- Number three main bearing cap to 15 N·m (11 ft. lbs.). Then tap the end of the crankshaft rearward and then **forward** with a lead hammer to line up the rear main bearing and crankshaft thrust surfaces.
- All main bearing caps to 95 N·m (70 ft. lbs.).

Measure (Figure 30)

- Crankshaft end play.
  1. Tap the end the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  2. With the crankshaft forced forward, measure at the front end of the number three main bearing with a feeler gage (figure 30). The proper clearance is 0.06 to 0.21 mm.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.



A. Alignment Hole In Crankshaft
B. Dust Lip
C. Dowel Pin
D. Collar
E. Mandrel
F. Screws
85 Crankshaft Rear Oil Seal

B-07973

Figure 31—Installing the Crankshaft Oil Seal

REAR CRANKSHAFT OIL SEAL INSTALLATION

Install or Connect

Tool Required:

J 34686, Seal Installer

1. Light coat of oil to the inside diameter of the new seal.
2. New seal over the mandril of J 34686 until the dust lip (back of the seal) bottoms against the collar of the tool (figure 31).
3. J 34686 to the crankshaft by hand or torque the attaching screws to 4 N·m (3 ft. lbs.).
   - Align the dowel pin of J 34686 with the dowel pin hole in the crankshaft.
4. Light coat of oil to the outside diameter of the seal.
5. Seal into the bore.
   - Turn the "T" handle of the tool so the collar pushes the seal into the bore.
   - Turn the handle until the collar of the tool is tight against the cylinder block to seat the seal properly.

- Loosen the "T" handle until it comes to a stop.
- Remove the attaching screws.

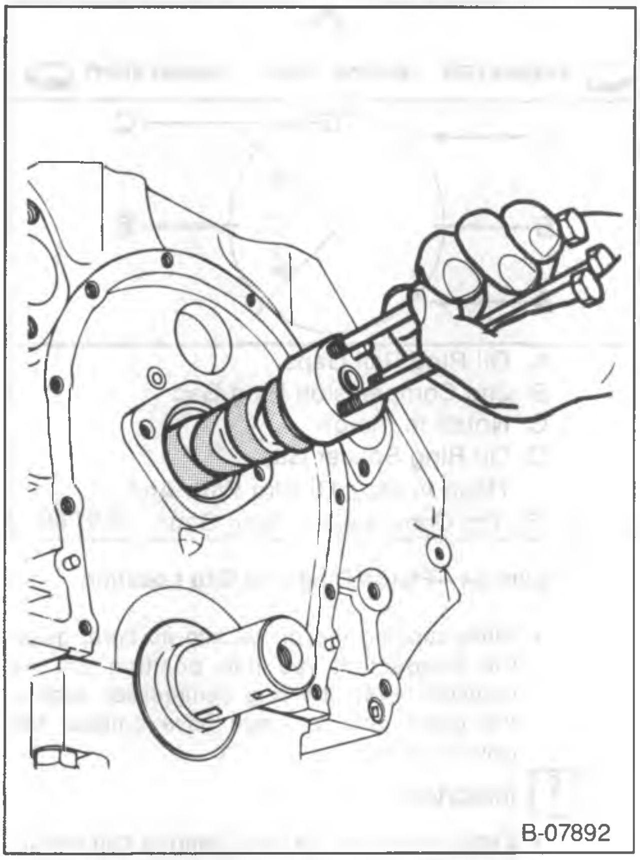


Figure 32—Replacing the Camshaft

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 32 and 33)

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).
- When a new camshaft is installed, install new oil and filter. It is also recommended that all valve lifters

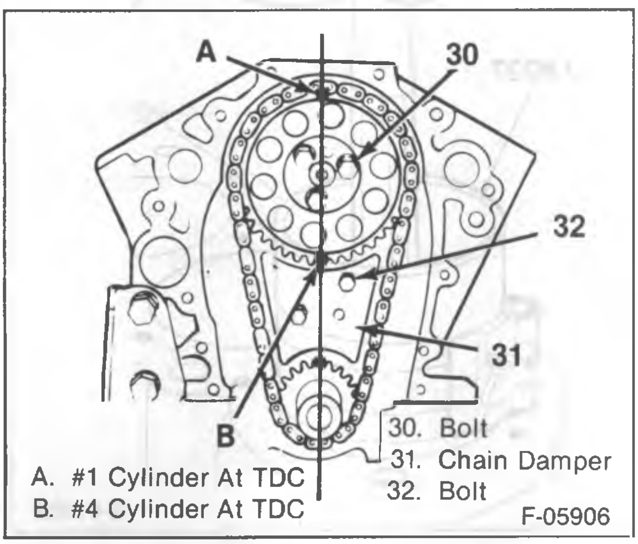


Figure 33—Camshaft Timing Marks

be replaced to insure durability of the camshaft lobes and lifter feet.

1. Camshaft.

Important

- All camshaft bearing journals are the same diameter and care must be exercised in installing the camshaft to avoid bearing damage.

2. Timing chain onto the sprocket.
   - Lubricate the thrust surface with "Molykote" or equivalent.
3. Sprocket onto the camshaft.
   - Hold the sprocket vertically with the chain hanging down and align the marks on the camshaft and crankshaft sprockets.
   - Align the dowl in the camshaft with the dowel hole in the sprocket.
4. Bolts (30).
   - Draw the camshaft sprocket onto the camshaft using the mounting bolts.

Tighten

- Bolts (30) to 23 N·m (17 ft. lbs.).

5. Chain damper (31).
6. Bolts (32).

Tighten

- Bolts (32) to 21 N·m (15 ft. lbs.).

FRONT COVER AND WATER PUMP INSTALLATION

Install or Connect

- Lubricate the lips of the front crankshaft oil seal with engine oil.

1. New gasket.
   - Make sure all sealing surfaces are clean.
   - Take care not to damage sealing surfaces.
   - Lightly coat both sides of the lower 5 mm of the gasket with anaerobic sealant (GM Part No. 1052080 or equivalent).
2. Front cover.
3. Water pump.
4. Bolts and stud.

Tighten

- Bolts and stud to specification.

TORSIONAL DAMPER INSTALLATION

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The installation procedure must be followed (with proper tools) or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper and the engine timing reference.

The torsional damper has three timing notches on the inertia ring. The number one cylinder timing reference mark will be identified by a dab of white paint. If a new damper assembly is installed, mark the new assembly in the same place for future reference. Number one cylinder reference is the first clockwise mark from the keyway when viewing the engine from the front.

Install or Connect

Tool Required:
J 29113, Torsional Damper Installer

1. Engine oil to the front cover seal contact area on the damper.
2. Sealant (GM Part No. 1052366 or equivalent) on the key and the keyway.
3. Damper over the key on the crankshaft.
4. Pull the damper onto the crankshaft.
   - Install J 29113 into the crankshaft so at least 6 mm (1/4-inch) of thread is engaged.
   - Pull damper into position and remove J 29113 from the damper.
5. Torsional damper retaining bolt.

Tighten

   - Bolt to 95 N·m (75 ft. lbs.).
6. Drive pulley to the damper.

PISTON AND CONNECTING ROD INSTALLATION

CONNECTING ROD BEARING SELECTION

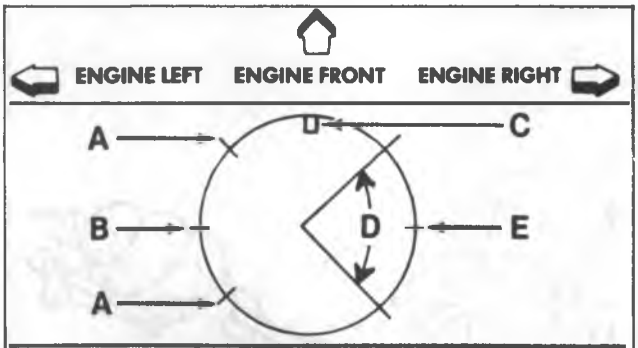
Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are excessive install a new bearing. Service bearings are available in standard size and 0.013 mm and 0.026 mm undersize for use with new and used standard size crankshafts.

Install or Connect

Tool Required:
J 8037, Ring Compressor

- Lubricate the cylinder walls lightly with engine oil.
- Make sure the piston is installed in the proper cylinder with the notch forward.

1. Connecting rod bearing inserts.
   - Be certain that the inserts are of the proper size.
   - Install the inserts in the connecting rod and connecting rod cap.
2. Piston and connecting rod to the proper bore.
   - Install guide hose over the threads of the rod studs to prevent damage to the bearing journal and rod studs.
   - Locate the ring end gaps as shown in figure 34.
   - Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston.
   - Use a hammer handle to tap the piston down into its matching bore (figure 35).
     — The notch in the piston crown must face the front of the engine.



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Notch In Piston
D. Oil Ring Spacer Gap (Tang In Hole Or Slot With Arc)
E. Top Compression Ring Gap

B-07895

Figure 34—Piston Ring End Gap Location

- While tapping the piston into its bore, guide the connecting rod into position on the crankpin. Hold the ring compressor against the block until all rings have entered the cylinder bore.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 2, 4, and 6 are the left bank and, 1, 3, and 5 are the right bank. The

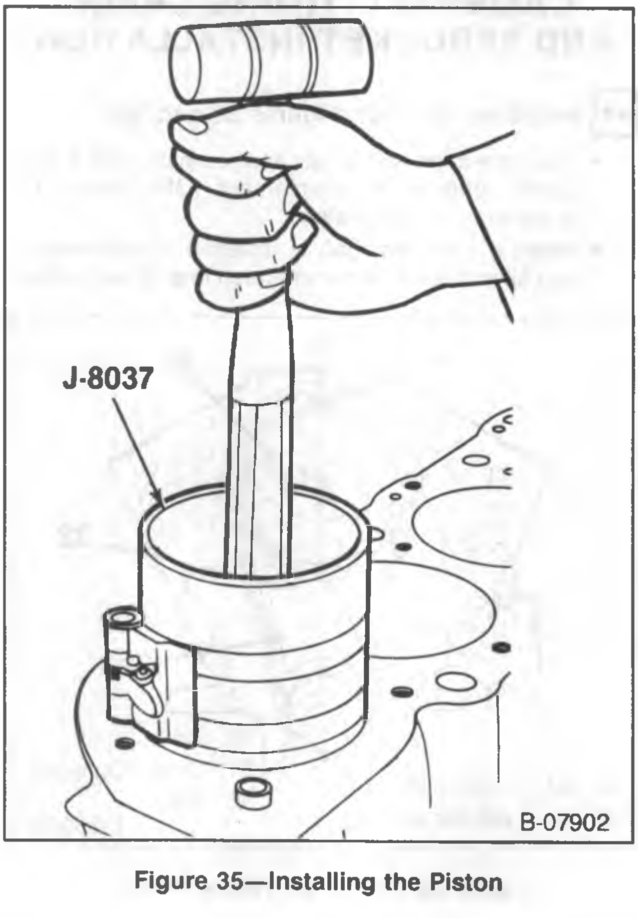


Figure 35—Installing the Piston

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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

3. Connecting rod cap with bearing insert.

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Tighten

- Connecting rod cap nuts to 53 N·m (39 ft. lbs.).

Measure

- Connecting rod side clearance (figure 36). The proper clearance is 0.16 to 0.64 mm.

OIL PUMP INSTALLATION

Install or Connect (Figure 37)

1. Pump and shaft with retainer to the rear main bearing cap.
   - Align the top end of the hexagon extension shaft with the hexagon socket on the lower end of the distributor drive gear.
2. Bolt (40).

Tighten

- Bolt to 41 N·m (30 ft. lbs.).

OIL PAN INSTALLATION

Clean

- Sealing surfaces on the engine and oil pan.

Install or Connect (Figure 38)

NOTICE: Before installing the oil pan, check that the sealing surfaces on the pan, cylinder case, and front cover are clean and free of oil. Make sure that all RTV is removed from blind attaching holes.

1. Gasket.
   - Apply sealer (GM Part No. 1052914 or equivalent) to the area shown in figure 38.
2. Oil pan to the cylinder block.
3. Reinforcement (37), nuts, bolts, and studs.

Tighten

- Bolts (36) to 25 N·m (18 ft. lbs.).
- Bolts and studs (35) and nuts (38) to 10 N·m (7 ft. lbs.).

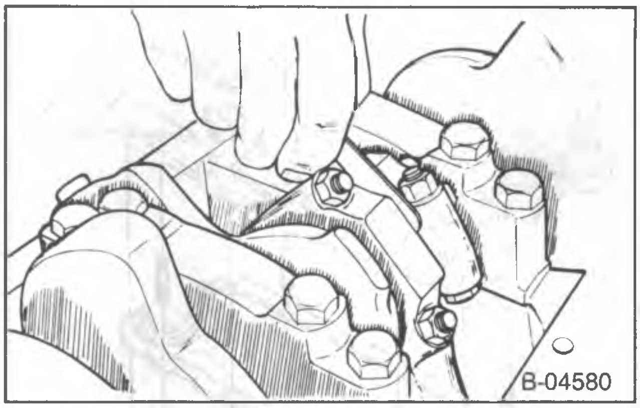


Figure 36—Measuring Connecting Rod Side Clearance

CYLINDER HEAD INSTALLATION

Clean

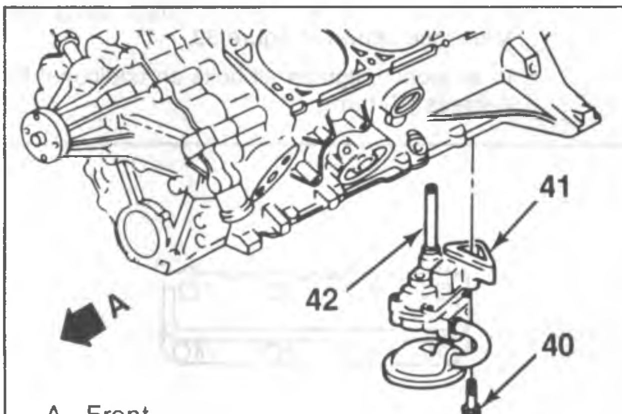
- Carbon deposits from combustion chambers.
- All traces of old head gasket from the cylinder head and block.
- Cylinder head bolt threads and threads in the block.

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Install or Connect

1. Gasket in place over the dowel pins with the note "This Side Up" showing.
2. Cylinder head.
   - Gasket must be fully seated on the block before head installation.
3. Head bolts.
   - Coat the bolt threads with sealing compound (GM part no. 1052080 or equivalent).
   - Install all bolts finger tight.



A. Front
40. Bolt
41. Oil Pump
42. Shaft

F-6523

Figure 37—Oil Pump Installation

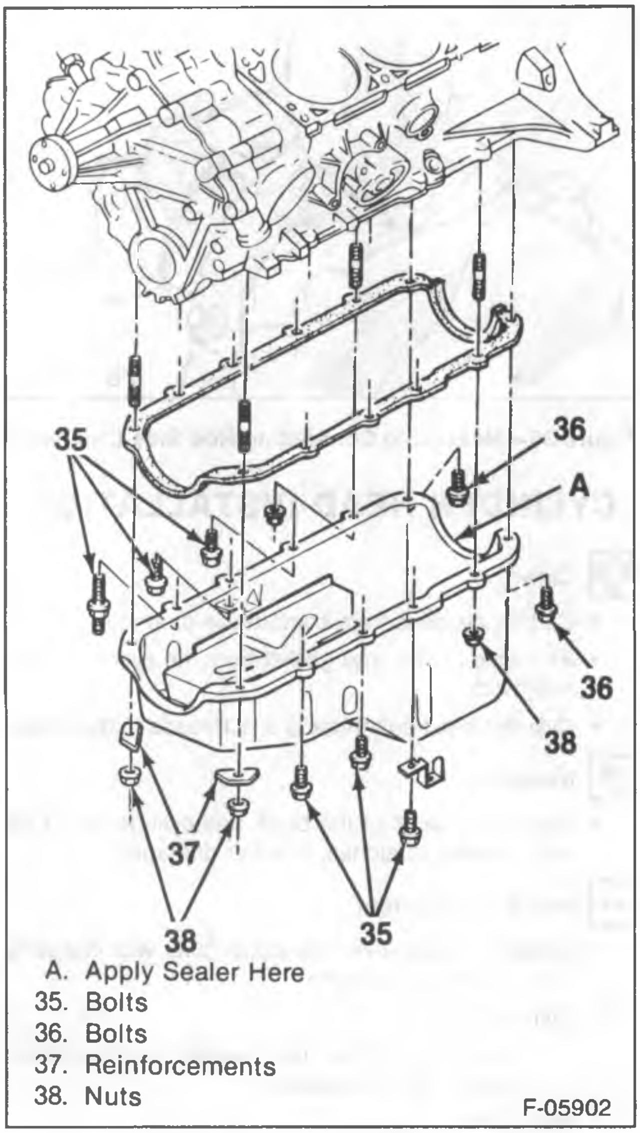


Figure 38—Oil Pan Installation

Tighten

- All bolts to 55 N·m (40 ft. lbs.), using the sequence shown in figure 39.
- In sequence, tighten all bolts an additional 90 degrees (1/4-turn).

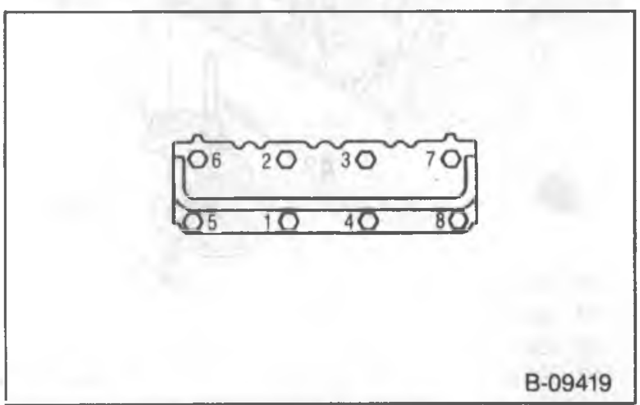


Figure 39—Cylinder Head Bolt Tightening Sequence

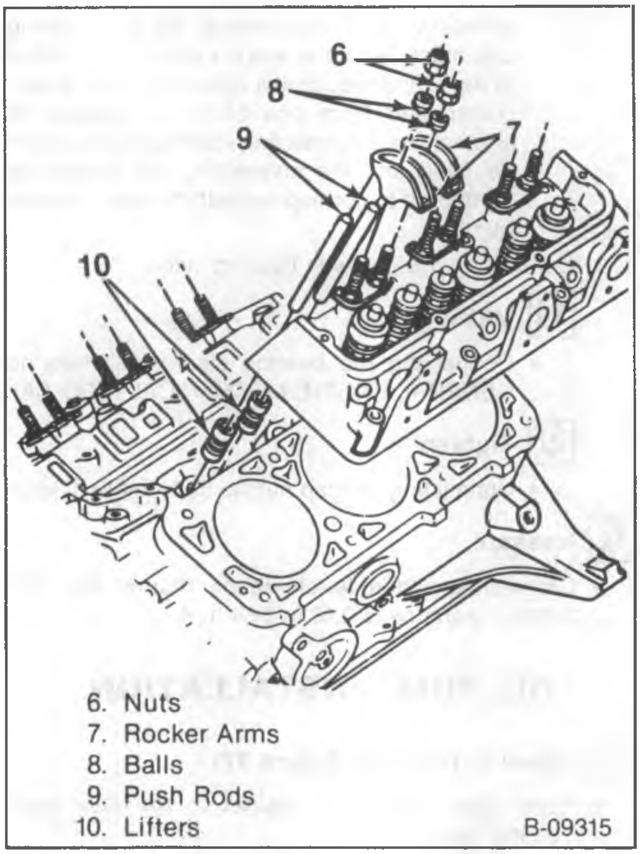


Figure 40—Rocker Arms and Pushrods

VALVE TRAIN COMPONENT INSTALLATION

If lifter replacement is necessary, use new lifters with a narrow flat along the lower 3/4 of the body length. This provides additional oil to the cam lobe and lifter surfaces.

Important

- Replace all hydraulic lifters if a new camshaft was installed.

Install or Connect (Figure 40)

- Lubricate the hydraulic lifter bodies and feet with Engine Oil Supplement (GM Part No. 1051396 or equivalent).

1. Hydraulic lifters (10) to the block.
2. Pushrods (9).
   - Seat the pushrods into the socket in the hydraulic lifters.
- Coat the mating surfaces of the rocker arms (7) and balls (8) with "Molykote" or equivalent.
3. Rocker arms.
4. Balls (8).
5. Nuts (6).

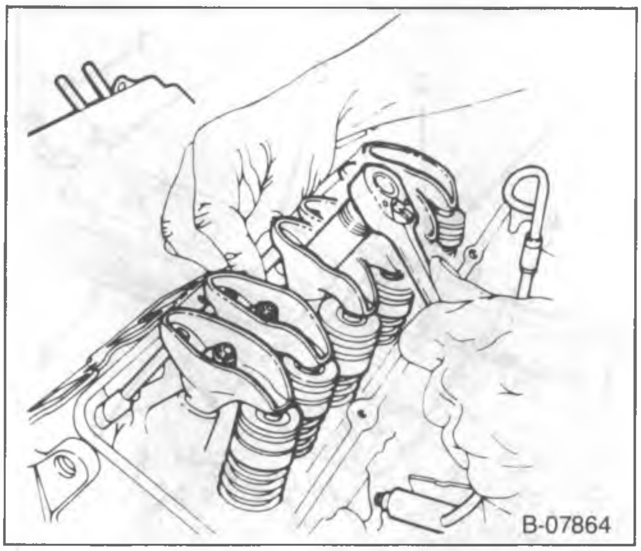


Figure 41—Adjusting the Valves

VALVE ADJUSTMENT

1. Crank the engine until the mark on the torsional damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number four firing position and should be turned over one more time to reach the number one position.

2. With the engine in the number one firing position as determined above, the following valves may be adjusted:

   — Exhaust: 1, 2, 3

   — Intake: 1, 5, 6

   (Even numbered cylinders are in the left bank; odd numbered cylinders are in the right bank, when viewed from the rear of the engine).

3. Back out the adjusting nut until lash if felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 41). When the play has been removed, turn the adjusting nut in one and one-half additional turns (to center the lifter plunger).

4. Crank the engine one revolution until the timing tab "O" mark and vibration damper mark are again in alignment. This is the number four firing position. The following valves may be adjusted:

   — Exhaust: 4, 5, 6

   — Intake: 2, 3, 4

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figure 42)

1. RTV to the front and rear sealing surfaces on the block. Apply a 5 mm (3/16-inch) bead of RTV (part number 1052917 or equivalent) to the front and rear of the block as shown.
   - Make sure that no oil or water is present on the surfaces to be sealed.
2. Gaskets to the cylinder head.
   - Gaskets are marked Right Side or Left Side and "This Side Up". Use them only as indicated to maintain design efficiency of the engine.
   - Hold the gaskets in place by extending the bead of RTV 6 mm (1/4-inch) from the block sealing surfaces up onto the gasket ends.
   - The new gaskets will have to be cut where indicated to install behind the pushrods. Cut only the areas where necessary.
3. Intake manifold.
   - Make sure the areas between the case ridges and the intake manifold are completely sealed.
4. Intake manifold bolts and nuts.

Tighten

- Nuts and bolts to 21 N·m (15 ft. lbs.) in the sequence shown in figure 42. Then re-torque in the same sequence.

ROCKER ARM COVER INSTALLATION

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surfaces for distortion. Replace if necessary.

Install or Connect (Figure 43)

1. Rocker arm cover and gasket.
   - Apply a 5 mm (3/16-inch) dab of RTV sealant (GM Part No. 1052917 or equivalent) at the point where the inlet manifold meets the head.
2. Rocker arm cover nuts and reinforcements.

Tighten

- Nuts to 8 N·m (6 ft. lbs.).

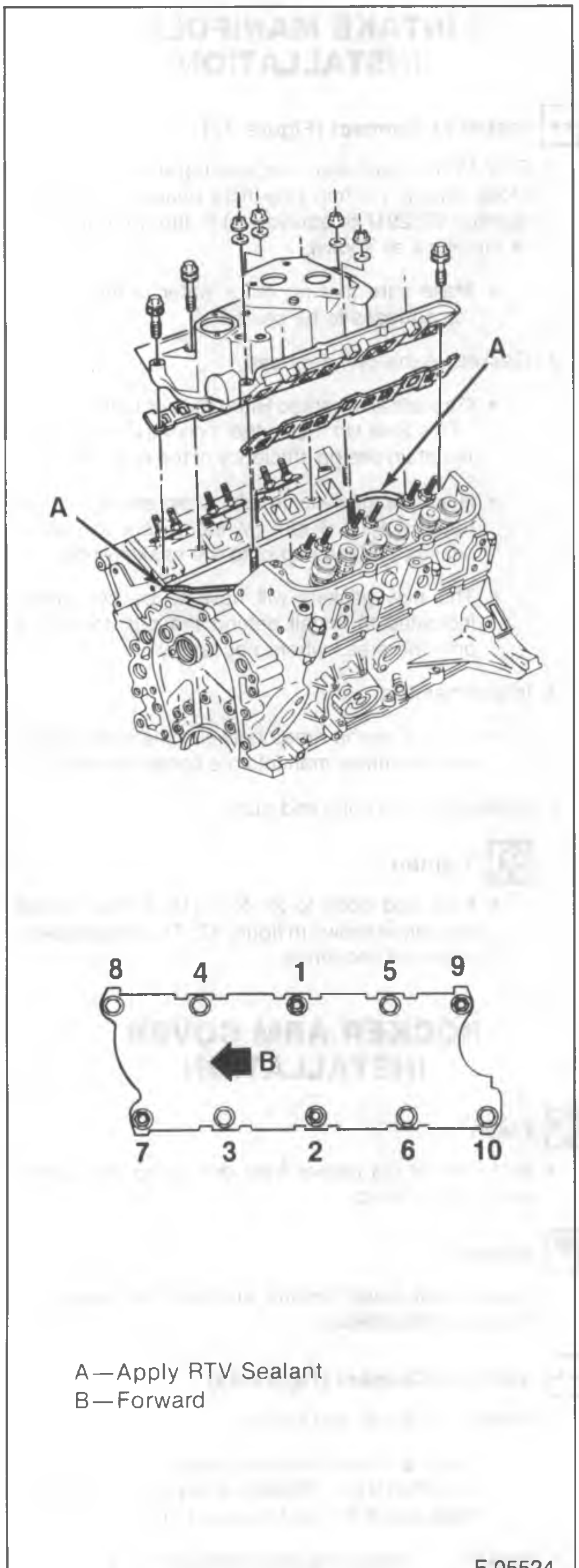


Figure 42—Intake Manifold Installation

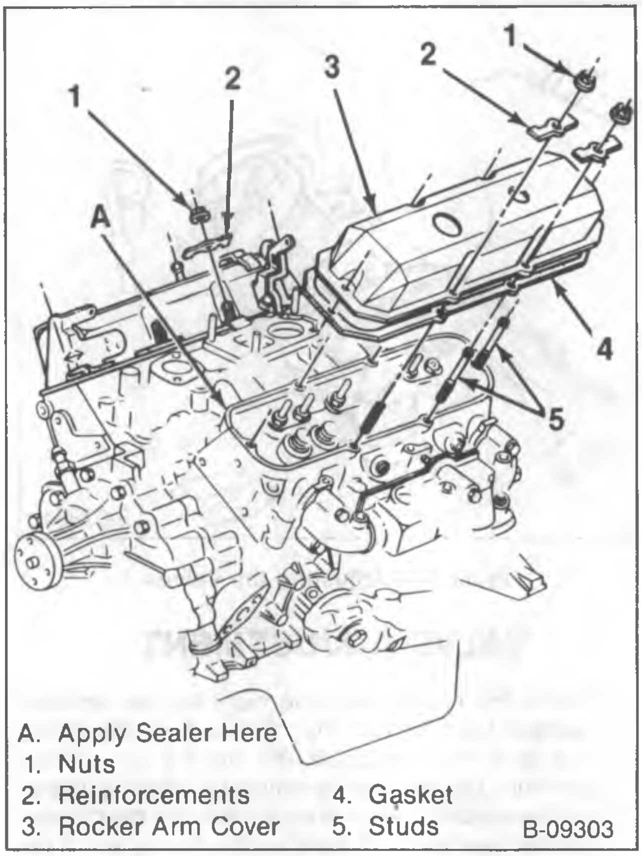


Figure 43—Rocker Arm Cover Installation

EXHAUST MANIFOLD INSTALLATION

Clean

- Mating surfaces of the manifold and cylinder head.

Install or Connect (Figure 44)

1. Manifold.
2. Bolts and studs.

Tighten

- Bolts to 34 N·m (25 ft. lbs.).

EGR VALVE INSTALLATION

Install or Connect (Figure 6)

1. Gasket (82).
2. EGR valve (81).
3. Bolts (80).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

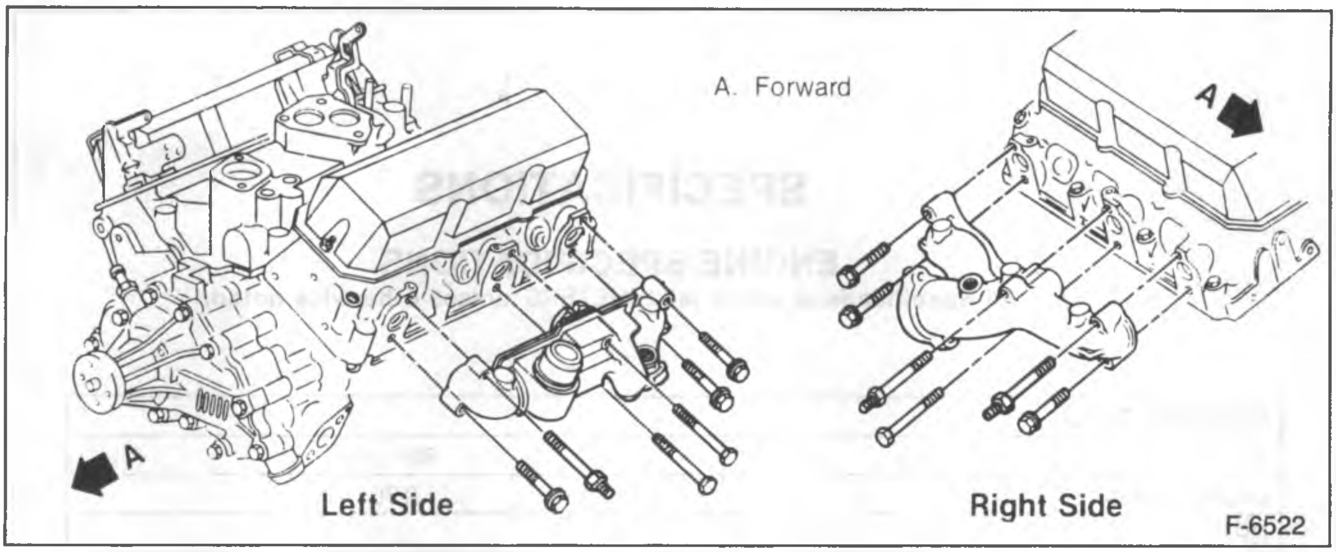


Figure 44—Exhaust Manifold Installation

AIR INJECTION TUBE INSTALLATION

Install or Connect (Figure 5)

1. Air injection tube (76).
2. Nut (75).

Tighten

- Air injection tube to 34 N·m (25 ft. lbs.).
- Nuts (75) to 25 N·m (18 ft. lbs.).

FLYWHEEL INSTALLATION

Install or Connect

1. Flywheel.
2. Retainer (automatic transmission only).
3. Bolts.

Tighten

- Bolts to 70 N·m (52 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (distributor, TBI unit, oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

ENGINE SET-UP AND TESTING

1. After overhaul, the engine should be tested before installation in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.
2. Fill the crankcase with the proper quantity and grade of oil.

Important

- If a new camshaft or hydraulic lifters were installed, add Engine Oil Supplement (GM Part No. 1051396) or equivalent to the engine oil.

3. Fill the cooling system with the proper coolant.
4. With the ignition "OFF," or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
5. Start the engine and listen for unusual noises.
6. Run the engine at about 1000 RPM until the engine is at operating temperature.
7. Listen for improperly adjusted valves or sticking lifters, and other unusual noises.
8. Check for oil and coolant leaks while the engine is running.
9. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing and idle speed.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in MILLIMETERS unless otherwise noted.

GENERAL DATA:			
Type			60° V-6
Displacement			2.8L
RPO			LL2
Bore			89.0
Stroke			76.0
Compression Ratio			8.9:1
Firing Order			1-2-3-4-5-6
Oil Pressure			69 kPa @ 500 RPM; 205-380 kPa @ 2000 RPM (10 psi @ 500 RPM; 30-55 psi @ 2000 RPM)
CYLINDER BORE:			
Diameter			88.992–89.070
Out Of Round			0.02 (Maximum)
Taper—Thrust Side			0.02 (Maximum)
PISTON:			
Clearance			0.017–0.043
PISTON RING:			
COMPRESSION	Groove Clearance	Top	0.030–0.070
		Second	0.040–0.095
	Gap	Top	0.25–0.50
		Second	0.25–0.50
OIL	Groove Clearance		0.199 (Maximum)
	Gap		0.51–1.40
PISTON PIN:			
Diameter			22.9937–23.0015
Clearance			0.0065–0.0091
Fit In Rod			0.0187–0.0515 (Press)

F-6524

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in MILLIMETERS unless otherwise noted.

CRANKSHAFT

Main Journal	Diameter - 3 Dots		67.241-67.249
	Diameter - 2 Dots		67.249-67.257
	Diameter - 1 Dot		67.257-67.265
	Taper		0.005 (Maximum)
	Out of Round		0.005 (Maximum)
Main Bearing Clearance			0.041–0.081
Crankshaft End Play			0.06–0.21
Crankpin	Diameter — 2 Dots		50.758–50.771
	Diameter — 1 Dot		50.771–50.784
	Taper		0.005 (Maximum)
	Out of Round		0.005 (Maximum)
Rod Bearing Clearance			0.035–0.095
Rod Side Clearance			0.16–0.64
CAMSHAFT:			
Lift	Intake		6.65
	Exhaust		6.94
Journal Diameter			47.44–47.49
Journal Clearance			0.026–0.101
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.50:1
Valve Lash	Intake		One And One Half Turns
	Exhaust		Down From Zero Lash
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.05
Seat Width	Intake		1.25–1.50
	Exhaust		1.60–1.90
Stem Clearance			0.026–0.068
Valve Spring	Free Length		48.5
	Pressure N @ mm	Closed	391 @ 40
		Open	867 @ 30
	Installed height		40
Valve Spring Damper	Free Length		47.2
	Approx. # of Coils		4

F-05525

SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

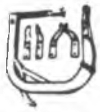
Item	N·m	Ft. Lbs.
Rocker Arm Cover Bolts	8	6
Intake Manifold Bolts	21	15
Exhaust Manifold Bolts	34	25
Cylinder Head Bolts	95	70
Torsional Damper Bolt	95	70
Timing Chain Damper	21	15
Front Cover Bolt	24	18
Oil Pan Bolts (Rear Two)	25	18
Oil Pan Bolts, Studs and Nuts	10	7
Oil Pump Bolt	41	30
Camshaft Sprocket Bolts	23	17
Connecting Rod Cap Nuts	53	39
Oil Filter Adapter	85	63
Main Bearing Cap Bolts	95	70
Flywheel Bolts	70	52
Spark Plugs	30	22
Water Outlet Bolts	21	15
Water Pump Nut	10	7
Water Pump Bolt (M6 x 1.0)	10	7
Water Pump Bolts (M8 x 1.25)	24	18
EGR Valve	25	18
Oil Pump Cover Screws	9	7
Rocker Arm Studs	65	48
Air Injection Tube	34	25
Air Injection Tube Nut	25	18

SPECIAL TOOLS

1.  J-3049

2.  J-5590

3.  J-5825-A

4.  J-8062

5.  J-8037

6.  J-8080

7.  J-21882

8.  J-9290-1

9.  J-23523-E

10.  J-24420-B

11.  J-29113

12.  J-34686

13.  J-35468

1. Hydraulic Lifter Remover (Plier Type)
2. Crankshaft Sprocket Installer
3. Crankshaft Sprocket Puller
4. Valve Spring Compressor
5. Ring Compressor
6. Main Bearing Remover/Installer
7. Pick-up Tube and Screen Installer
8. Hydraulic Lifter Remover (Slide Hammer Type)
9. Puller
10. Puller
11. Torsional Damper Installer
12. Seal Installer
13. Seal Installer

F-04357

SECTION 6A3

4.3 LITER V-6

CONTENTS

SUBJECT **PAGE**

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

GM 4.3L engines are 90-degree V6 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by four precision insert main bearings, with crankshaft thrust taken at the number four (rear) bearing.

The camshaft is supported by four plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

For identification, refer to GENERAL INFORMATION (SEC. 0B).

ENGINE LUBRICATION

Lubrication schematics are shown in figures 1 and 2. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. Filtered oil flows into the main gallery and then to the camshaft and crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

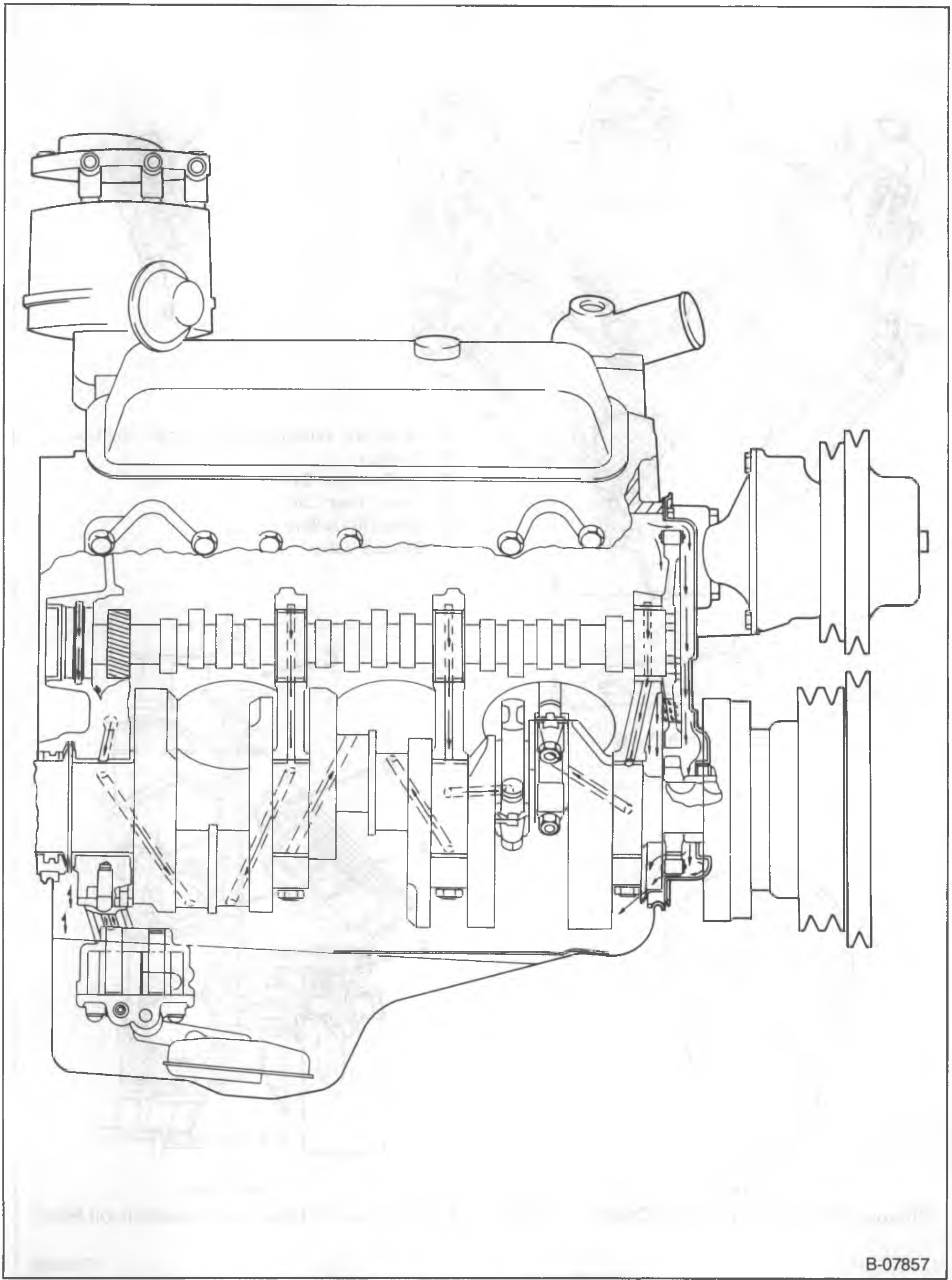
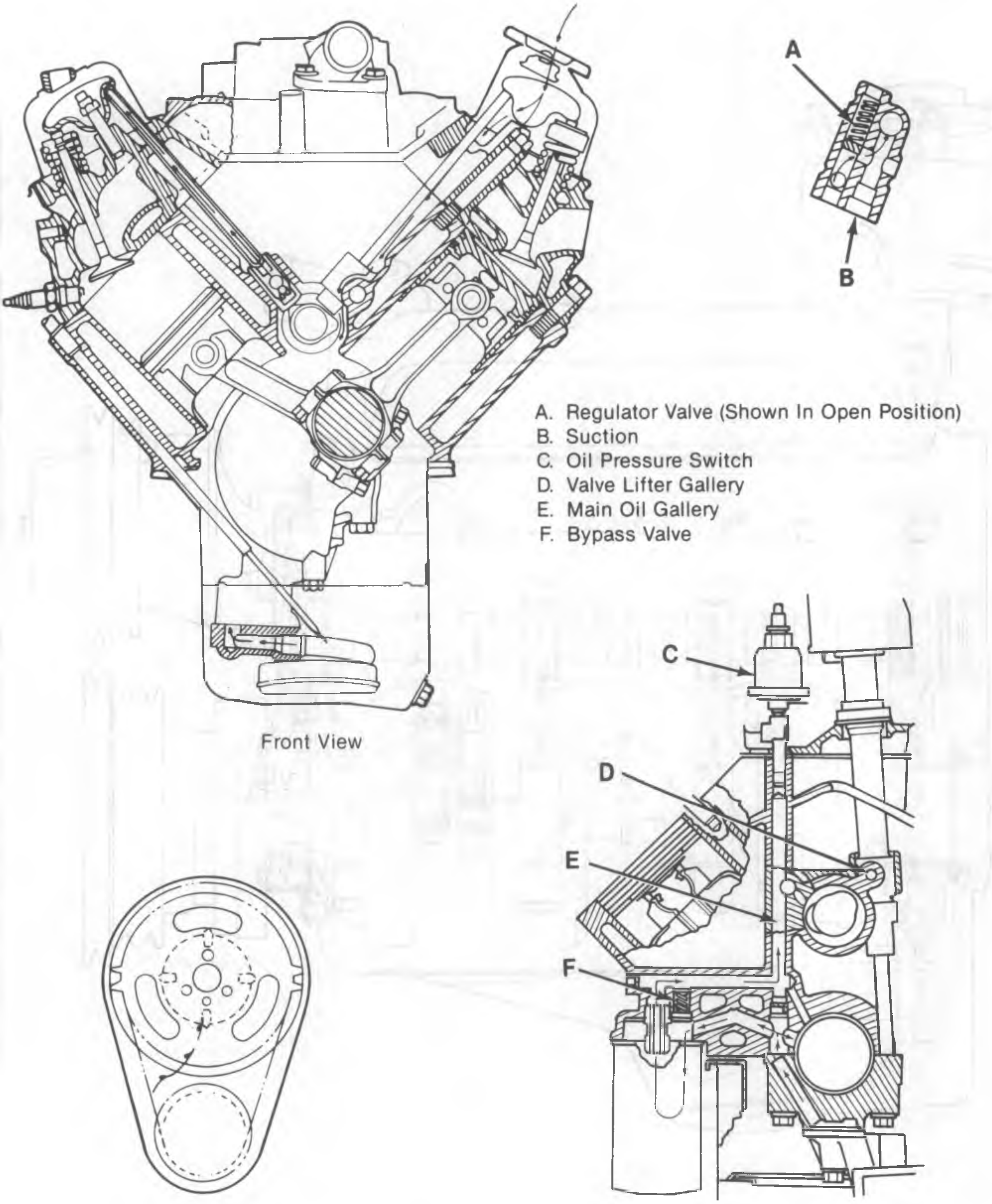


Figure 1—Engine Lubrication Diagram



Front View
Showing Path Of Oil To Timing Chain.

Rear View
Showing Main Gallery, Oil Filter And Crankshaft Oil Feed.

F-05526

Figure 2—Engine Lubrication Diagram

DISASSEMBLY

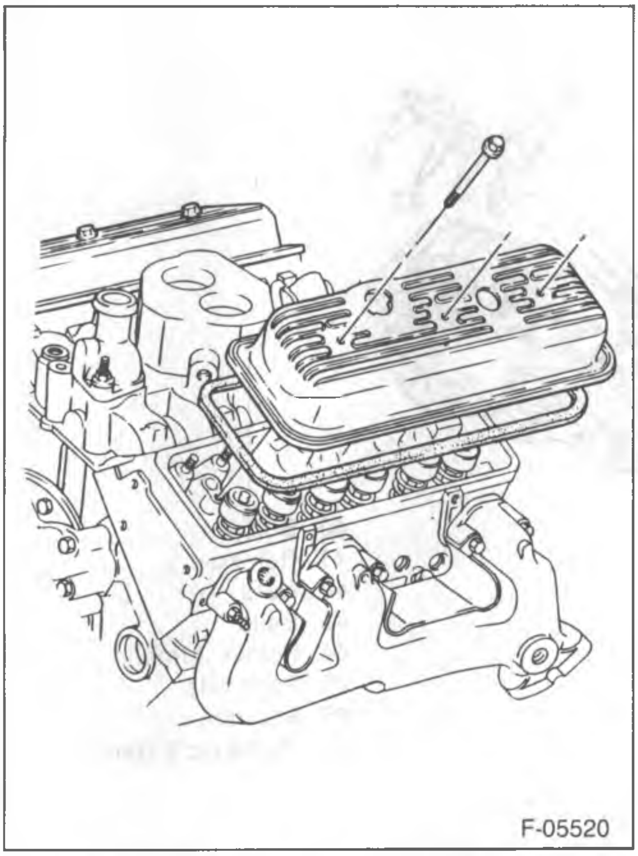


Figure 3—Rocker Arm Cover Installation

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary equipment includes: A suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine components.

Special tools are illustrated throughout this section. and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

Hydraulic Pump
AIR Pump
Generator
Air Conditioning Compressor
Cooling Fan
Distributor
Carburetor
TBI Unit

It is beyond the scope of this section to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routing, accessory drive belt layout, etc., should be made before removing accessories.

CLEANING

Remove the engine accessories before cleaning, to provide better access to engine exterior surfaces. After removing the carburetor, TBI unit, distributor, fuel pump, etc., cover the openings with tape to prevent the entry of water, solvent and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan plug and allow the oil pan to drain.
2. Oil filter.
3. Block drains and allow the coolant to drain.

Install or Connect

1. Oil pan plug and washer.
2. Block drain plugs.

Tighten

- Block drain plugs to 14 N·m (10 ft. lbs.).

EGR VALVE REMOVAL

Remove or Disconnect

1. Bolts.
2. EGR valve.
3. Gasket.

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect

1. Exhaust manifold bolts, washers, and tab washers.
2. Heat shield (if equipped).
3. Exhaust manifold.

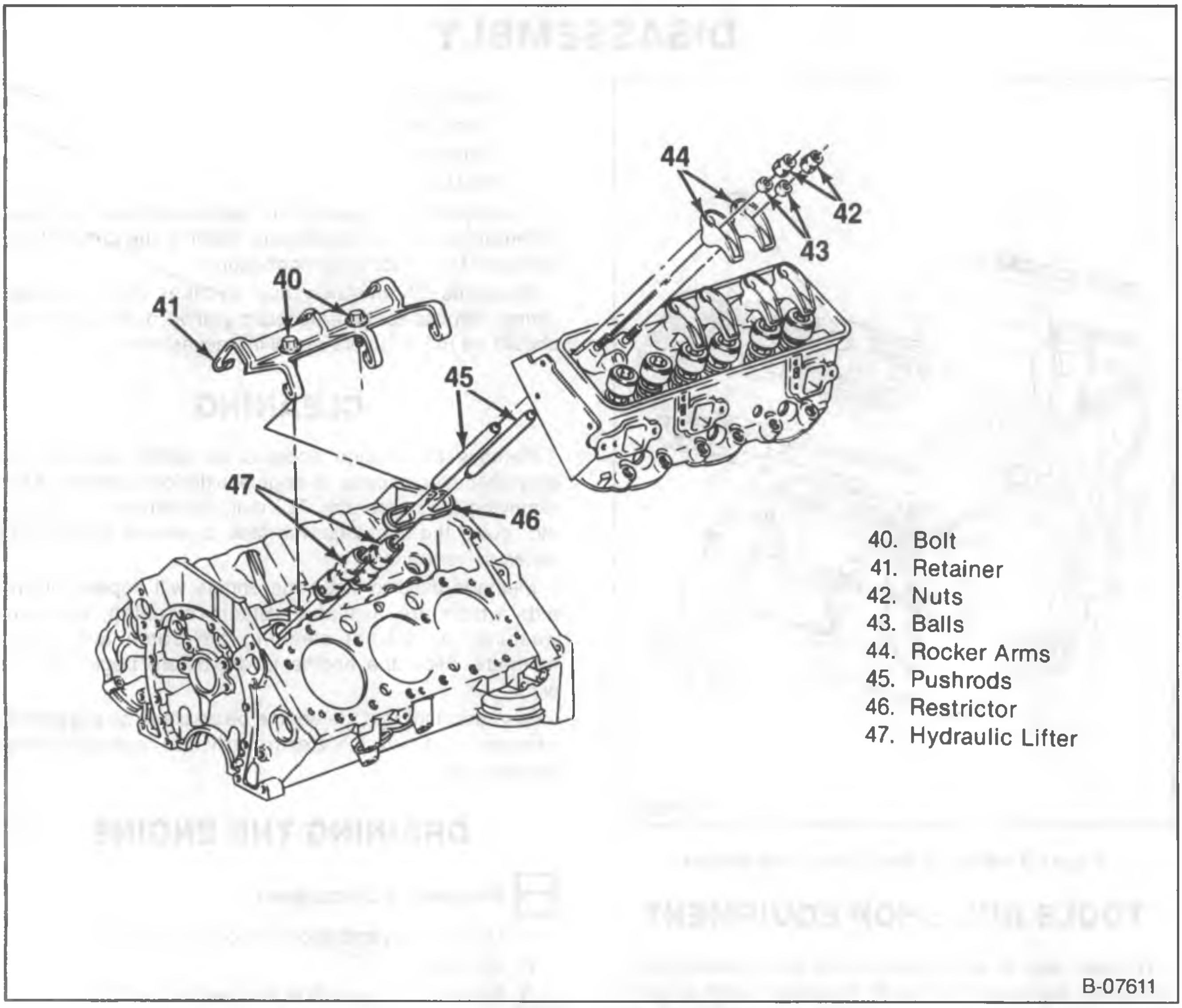


Figure 4—Valve Train Components

ROCKER ARM COVER REMOVAL

↔ Remove or Disconnect (Figure 3)

1. Rocker arm cover bolts.
2. Rocker arm cover and gaskets.

INTAKE MANIFOLD REMOVAL

↔ Remove or Disconnect

1. Intake manifold bolts.
2. Intake manifold and gaskets.

VALVE TRAIN COMPONENT REMOVAL

↔ Remove or Disconnect (Figure 4)

1. Rocker arm nuts, balls, rocker arms, and pushrods.

! Important

- Store used components in order so they can be reassembled in the same location.

2. Bolts (40).
3. Retainer (41) with restrictors (46).
4. Hydraulic lifters.
   - Remove the lifters one at a time and place them in an organizer rack. The lifters must be installed into the same bore from which they were removed.

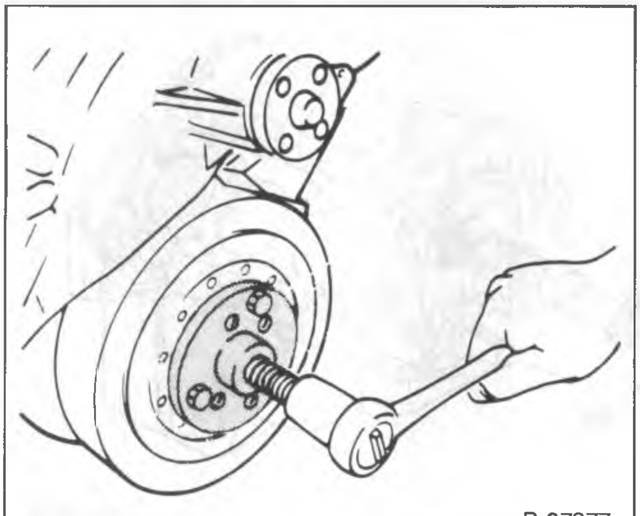


Figure 5—Removing the Torsional Damper

CYLINDER HEAD REMOVAL

Remove or Disconnect

1. Spark plugs.
2. Cylinder head bolts.
3. Cylinder heads.
4. Head gaskets.

TORSIONAL DAMPER REMOVAL

Remove or Disconnect (Figure 5)

Tool Required:
J 23523-E, Torsional Damper Puller and Installer

1. Torsional damper bolt.
2. Torsional damper using J 23523-E.
3. Crankshaft key (if necessary).

OIL PAN REMOVAL

Remove or Disconnect (Figure 6)

1. Oil pan bolts, nuts, and reinforcements.
2. Oil pan and gasket.

OIL PUMP REMOVAL

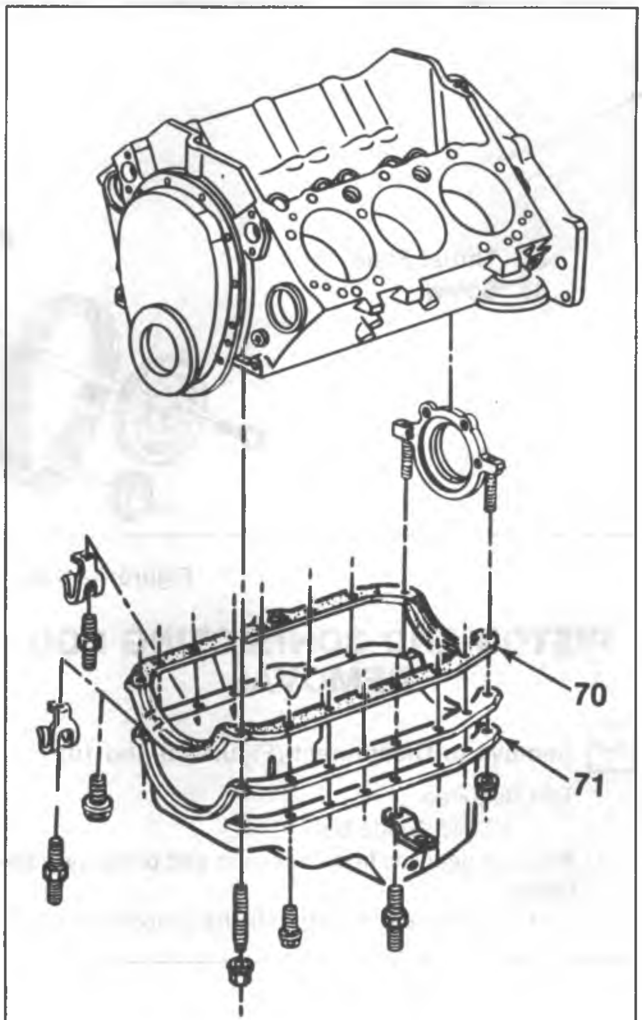
Remove or Disconnect

1. Oil pump to main bearing cap bolt.
2. Oil pump.

FRONT COVER REMOVAL

Remove or Disconnect

1. Front cover bolts and reinforcements.
2. Front cover.
3. Front cover to block gasket.



70. Gasket
71. Reinforcement

B-07884

Figure 6—Oil Pan Installation

CAMSHAFT REMOVAL

Remove or Disconnect (Figures 7 and 8)

1. Camshaft sprocket bolts.
2. Camshaft sprocket and timing chain. The sprocket is a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
3. Screws (88) and thrust plate (87).
4. Camshaft.
   - Install two or three 5/16-18 inch bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft (figure 8).
   - Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

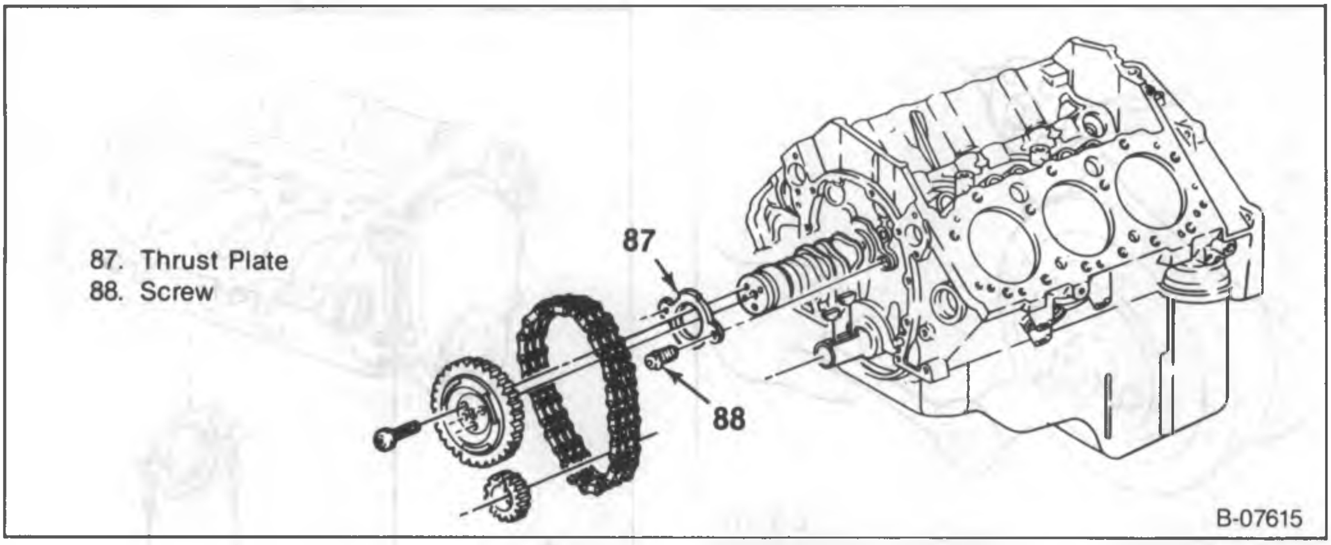


Figure 7—Camshaft and Components

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 9 and 10)

Tool Required:
J 5239, Guide Set.

1. Ridge or deposits from the upper end of the cylinder bores.
   - Turn the crankshaft until the piston is at BDC.
   - Place a cloth on top of the piston.
   - Perform the cutting operation with a ridge reamer (figure 9).
   - Turn the crankshaft until the piston is at TDC.
   - Remove the cloth and cuttings.
   - Mark the cylinder number on all pistons, connecting rods, and caps. Starting at the front, the cylinders on the left bank are numbered 1-3-5 and the right bank is numbered 2-4-6.
2. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
3. Connecting rod and piston.
   - Attach J 5239 to the connecting rod bolts (figure 10).
   - Use the long guide rod of J 5239 to push the connecting rod and piston out of the bore.
4. Connecting rod bearing.

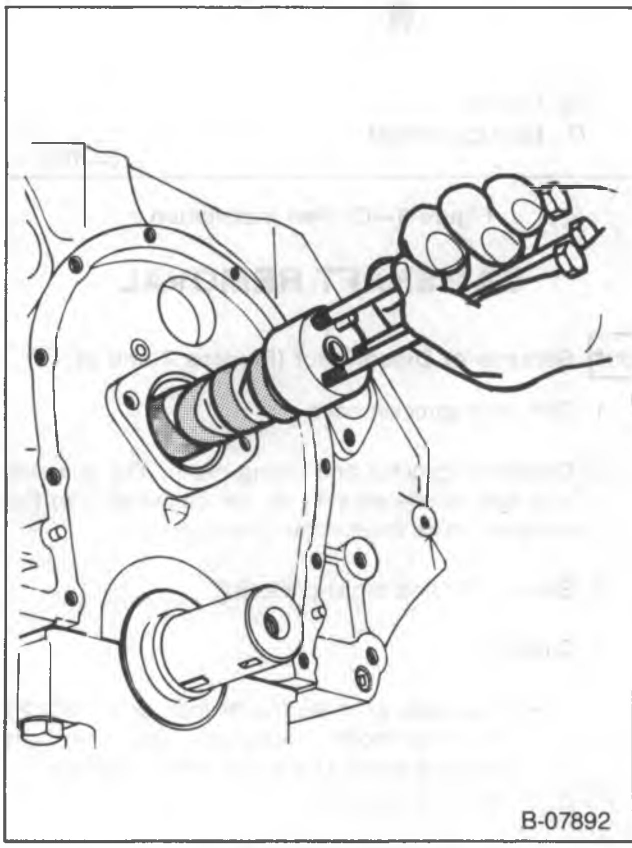


Figure 8—Replacing the Camshaft

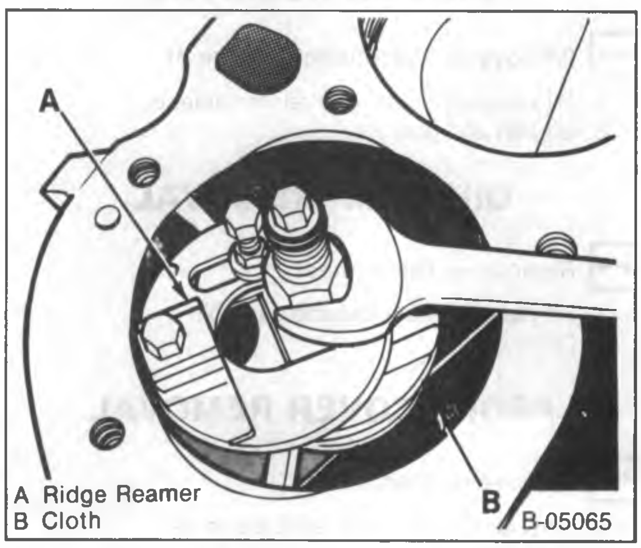


Figure 9—Removing the Cylinder Ridge

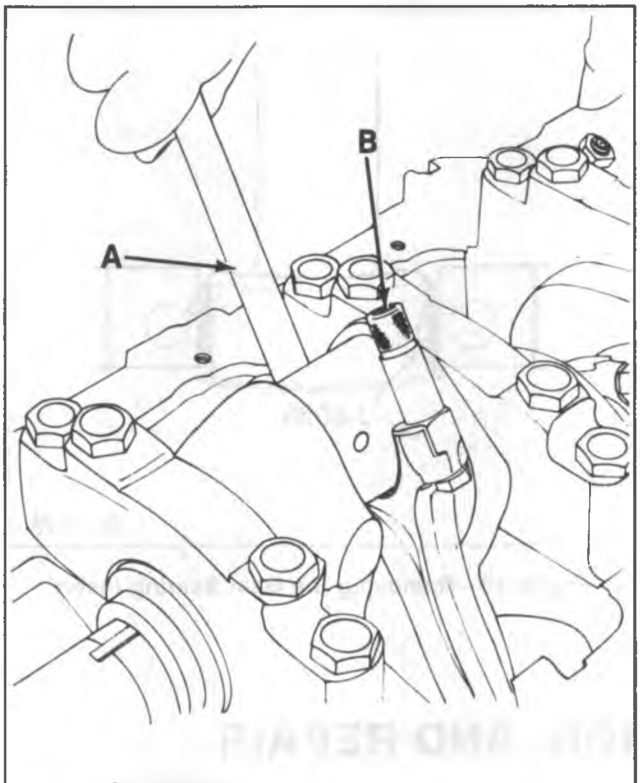


Figure 10—Replacing the Piston and Connecting Rod (Typical)

FLYWHEEL REMOVAL

Remove or Disconnect

1. Flywheel bolts.
2. Flywheel.

REAR CRANKSHAFT OIL SEAL REMOVAL

Remove or Disconnect

NOTICE: Care should be taken when removing the rear crankshaft oil seal so as not to nick the crankshaft sealing surface.

- Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 11).

REAR CRANKSHAFT OIL SEAL RETAINER REMOVAL

Remove or Disconnect (Figure 12)

1. Screws (81).
2. Seal retainer (82).
3. Gasket (84).

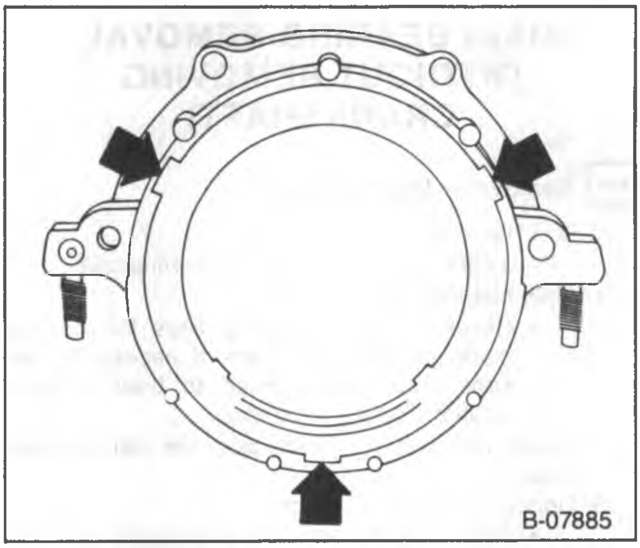


Figure 11—Seal Removal Notches

CRANKSHAFT REMOVAL

Remove or Disconnect

- Check the main bearing clearance before removing the crankshaft. Refer to "Crankshaft and Main Bearing Installation" later in this section.
- The main bearings and rear oil seal can be replaced without removing the crankshaft as outlined later in this section.

1. Main bearing cap bolts.
2. Main bearing caps.
3. Crankshaft from the cylinder block.
   - Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange surfaces.

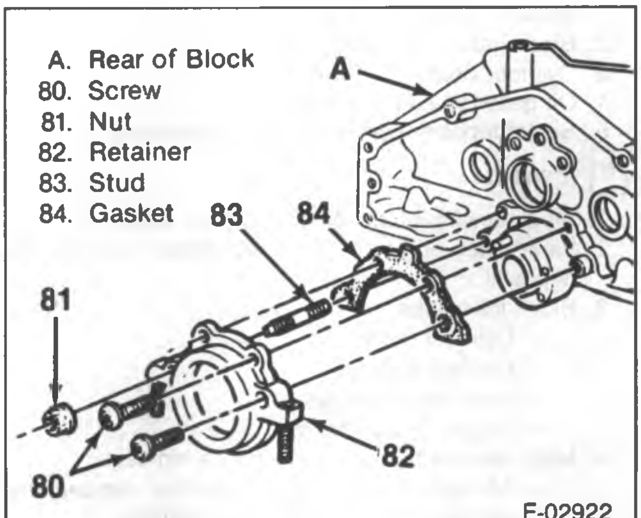


Figure 12—Rear Crankshaft Oil Seal Retainer Installation

MAIN BEARING REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect

Tool Required:
J 8080, Main Bearing Remover/Installer

1. Main bearing caps.
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
2. Lower main bearing inserts from the main bearing caps.
3. Upper main bearing inserts.
   - Insert J 8080 into the crankshaft oil hole (figure 13).
   - Rotate the crankshaft to turn the bearing insert out of the block.

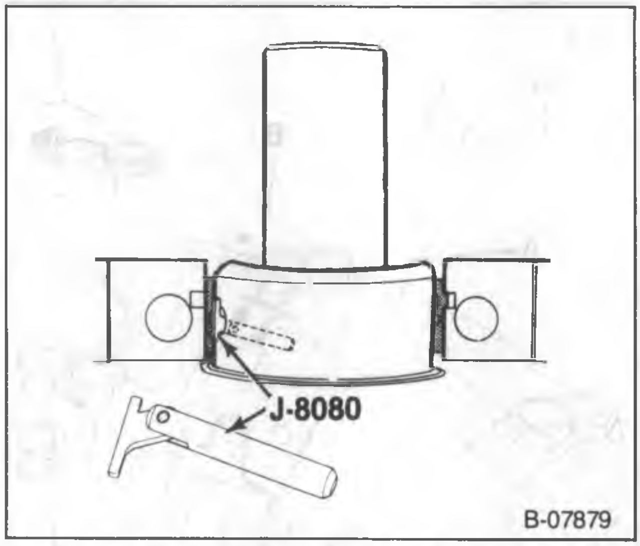


Figure 13—Removing the Main Bearing Insert

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean

1. Block in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
5. Scale deposits from the coolant passages.

Inspect

1. All expansion plugs for lack of fit or leakage.
2. Valve lifter bores for deep scratches and varnish deposits.
3. Block for cracks.
   — Cylinder walls.
   — Coolant jackets.
   — Main bearing webs.
   — Engine mount bosses.
4. Main bearing bores and main bearing caps.
   — All main bearing bores should be rounded and uniform in ID at all bearing supports.
   — The area where the main bearing inserts contact the main bearing bore should be smooth.
   — If a main bearing cap is damaged and requires replacement, replace it.
5. Head gasket surface for flatness. Use a straightedge and feeler gage. Minor irregularities may be carefully machined. If more than 0.25 mm (0.010-inch) must be removed, replace the block.
6. Oil pan rail and timing cover attaching area for nicks. Minor irregularities may be cleaned up with a flat file.

CYLINDER BORE

Inspect

- Cylinder bores for scoring or other damage.

Measure

- Cylinder bore taper and out-of-round. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Cylinder Bore Reconditioning

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLY

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Disassemble

- Components as required.

Clean

- Components as outlined.

Inspect

- Components as outlined.

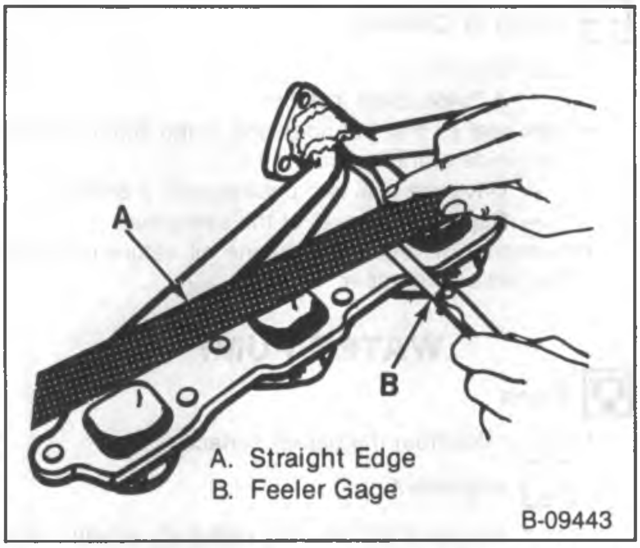


Figure 14—Checking Alignment of Manifold Flanges

Measure

- Piston pin diameter and clearance.
- Piston to bore clearance, and fit pistons as outlined.

Assemble

- Components as outlined.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3 and 5 are at the left bank, and 2, 4 and 6 are the right bank. 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 block or cylinder to another, new connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

INTAKE AND EXHAUST MANIFOLDS

Clean

- Old pieces of gasket from the gasket surfaces.
- Excessive carbon build-up in the exhaust passages of the intake manifold.
- Scale and deposits from the coolant passages of the intake manifold.
- EGR passage of excessive carbon deposits.

Inspect (Figure 14)

- Manifolds for cracks, broken flanges, and gasket surface damage.

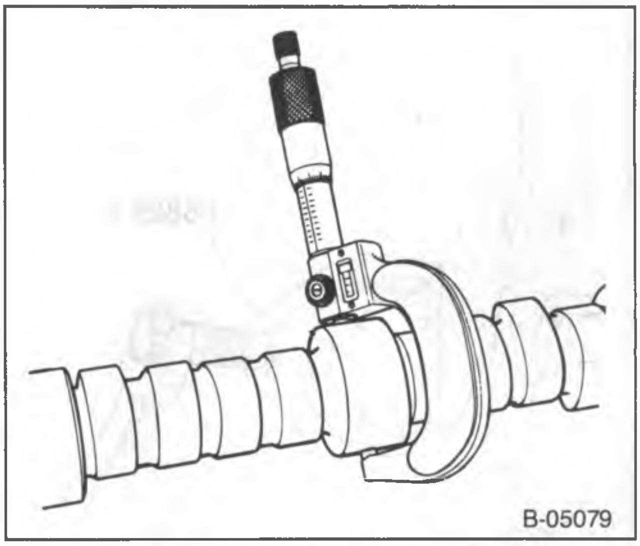


Figure 15—Checking the Camshaft Journals

- Alignment of manifold flanges. Use a straight edge and feeler gage. If the flanges do not align, the manifold is warped and should be replaced.

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of lifters must also be installed.

Inspect

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.

Measure

- Camshaft journal diameter (figure 15). The proper diameter is listed in "Specifications."

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) for replacement procedures.

TIMING CHAIN AND SPROCKETS

Inspect

- Sprockets for chipped teeth and wear.
- Timing chain for damage.
- It should be noted that excessively worn sprockets will rapidly wear a new chain. Likewise, an excessively worn chain will rapidly wear a new set of sprockets.

CRANKSHAFT SPROCKET REPLACEMENT

Remove or Disconnect (Figure 16)

Tool Required:

J 5825-A Crankshaft Sprocket Puller

1. Crankshaft sprocket using J 5825-A.
2. Key (if necessary).

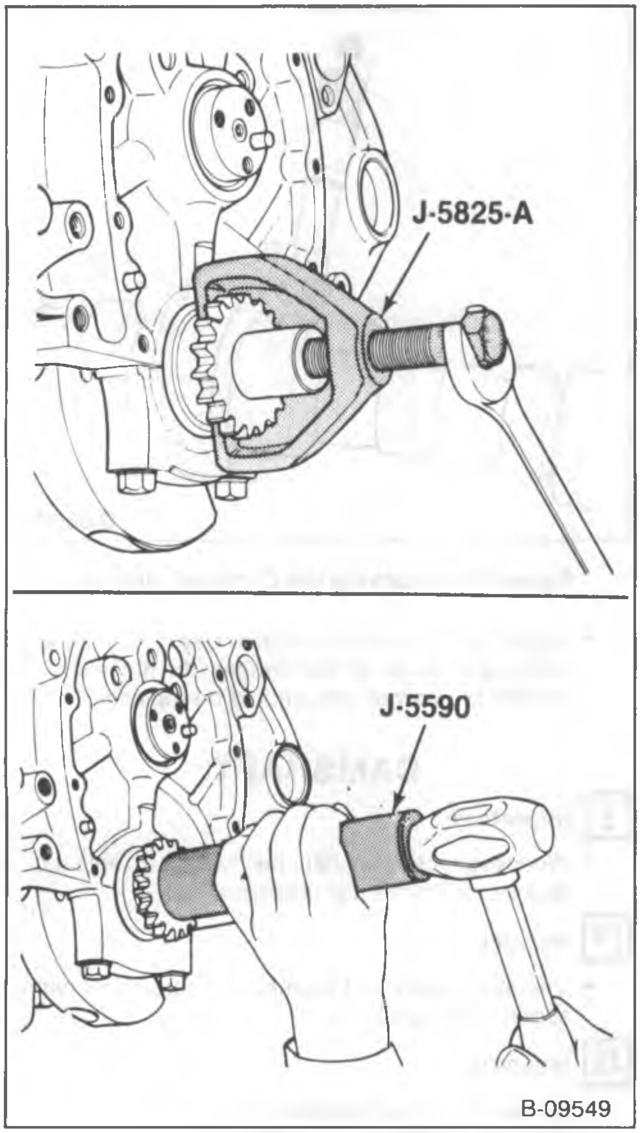


Figure 16—Replacing the Crankshaft Sprocket

Install or Connect (Figure 16)

Tool Required:

J 5590, Crankshaft Sprocket Installer

1. Key (if removed).
2. Crankshaft sprocket using J 5590.

FRONT COVER

Clean

- Old gasket from the gasket surfaces.

Inspect

- Front cover for damage, dents, or cracks.

Remove or Disconnect

- Oil seal from the front cover.
  — Pry the seal out with a large screw driver.
  — Be careful not to distort the front cover.

Install or Connect

Tool Required:

J 35468, Seal Installer

- New seal so that the open end of the seal is toward the inside of the cover.
  — Drive the seal into position with J 35468.
  — Support the cover at the seal area.
- Lubricate the seal with engine oil before installing the torsional damper.

WATER PUMP

Clean

- Old gasket from the gasket surface.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings; lubricant supply, and cause premature bearing failure.

Inspect

- Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.
- Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking and the water pump should be replaced.

OIL PAN AND ROCKER ARM COVERS

Clean

- Parts in solvent. Remove all sludge and varnish.
- Old gaskets from the gasket surfaces.

Inspect

- Gasket flanges for bending or damage.
- Rubber grommets and parts on the rocker arm cover for deterioration.
- Oil pan for rock damage or cracks.
- Oil pan baffle for lack of fit.
- Drain plug threads for stripping.

OIL PUMP

Remove or Disconnect (Figure 17)

1. Pump cover attaching bolts (9) and the pump cover (5).
   - Mark the teeth so the pump gears can be installed with the same gear teeth indexed.
2. Idler gear (4), drive gear (3), and shaft and retainer (1) from the pump body.
3. Pressure relief valve retaining pin (8).
4. Spring (7) and pressure relief valve (6).
5. Pickup screen and pipe.
   - Do not remove the pickup screen and pipe unless replacement is required.

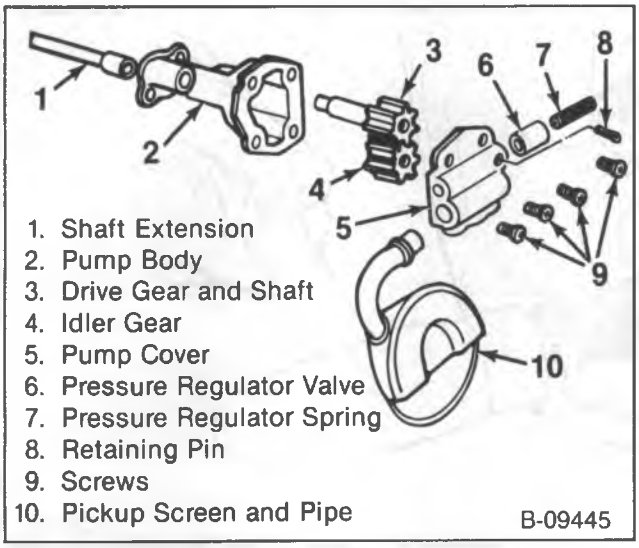


Figure 17—Oil Pump Components

- The pickup pipe is a press fit in the pump body.
- Do not try to remove the screen from the pipe. The pickup screen and pipe is serviced as an assembly only.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect (Figure 17)

- Pump body (2) and cover (5) for cracks or other damage.
- Gears (3 and 4) for wear.
- Drive gear and shaft (3) for lack of fit in the pump body (2).
- Inside of the cover (5) for wear that would permit oil to leak past the ends of the gears. The pump gears, cover, and body are not serviced separately. If the parts are damaged or worn, replace the entire oil pump assembly.
- Pickup screen and pipe (10) for damage to the screen, pipe or relief grommet.
- Pressure relief valve (6) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Install or Connect (Figure 17)

Tool Required:

J 21882, Pickup Tube and Screen Installer

1. Pressure regulator valve.
2. Spring.
3. Spring retaining pin.
4. Drive gear and shaft.
5. Idler gear.
   - Index the marks made during disassembly.
6. Cover and screws.

   Tighten

   - Screws to 5.0 N·m (84 in. lbs.).
- Turn the drive shaft by hand to check for smooth operation.

NOTICE: Be careful of twisting, shearing or collapsing the pipe while installing the pump.

7. Pickup screen and pipe (if removed) (figure 18).
   - If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure.
   - Mount the oil pump in a soft jawed vise.
   - Apply sealer to the end of the pipe.
   - Tap the pickup screen and pipe into place, using J 21882 and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.
8. Oil pump drive shaft and connector (1).

VALVE TRAIN COMPONENTS

PUSHRODS, ROCKER ARMS, BALLS, AND NUTS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Inspect

- Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
- Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.
- Rocker arm nuts.
- Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
- Pushrod ends for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

Remove or Disconnect (Figures 19 and 20)

Tool Required:

J 8062, Valve Spring Compressor

1. Valve keepers (20).
   - Compress the springs with J 8062 (figure 20).
   - Remove the keepers.
   - Remove J 8062.
2. Cap (21), shield (22), seal (24), and damper (25), and spring (26) (intake valve).
3. Rotator (28), shield (22), seal (24), and damper (25), and spring (26) (exhaust valve).
4. O-ring seals (23).
5. Valves (27 and 29).
   - Place the valves in a rack so they can be returned to their original position at assembly.

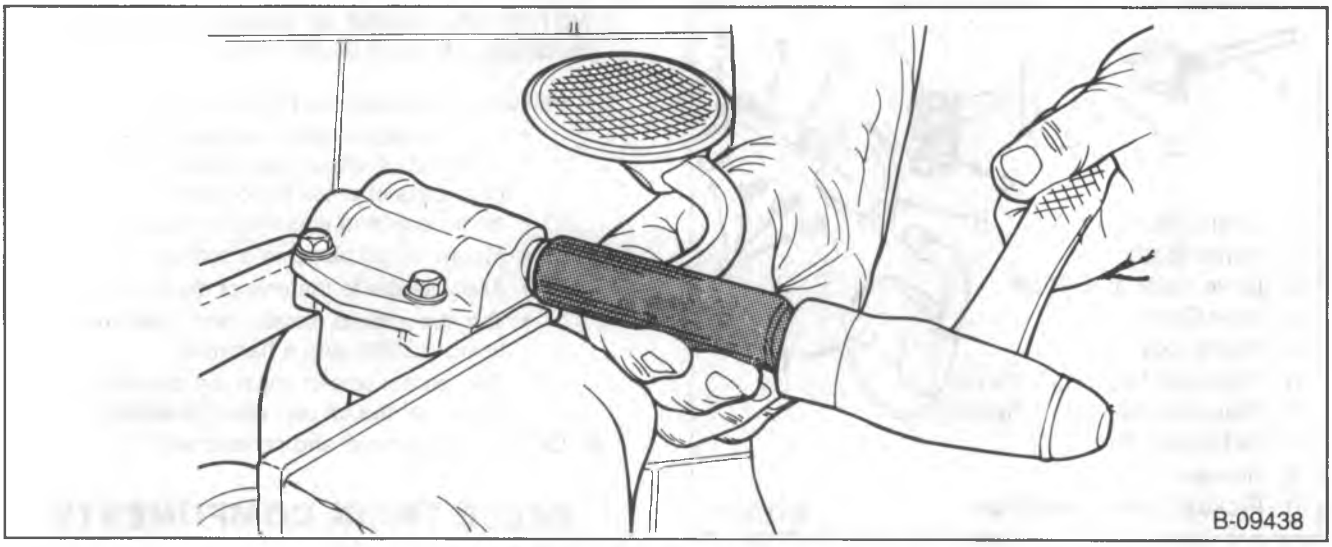


Figure 18—Installing the Oil Pump Screen

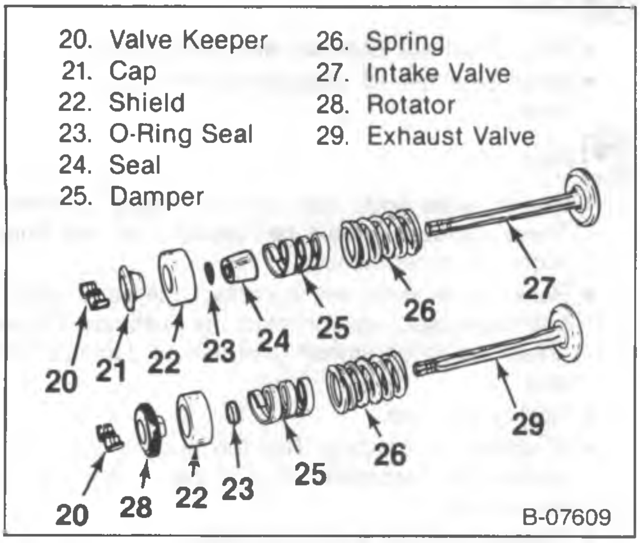


Figure 19—Valves and Components

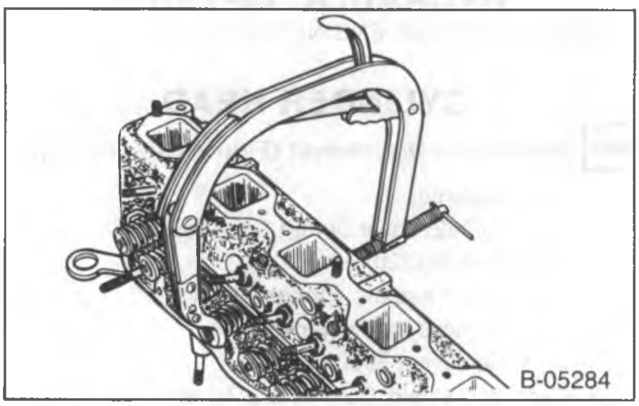


Figure 20—Compressing the Valve Springs

CLEANING AND INSPECTION OF COMPONENTS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following.

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Valve stem clearance.
- Valve spring tension and free length.

Other information outlined includes:

- Valve and seat grinding.
- Valve guide reaming.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect (Figure 21)

Tool Required:

J 5802-01, Rocker Arm Stud Remover

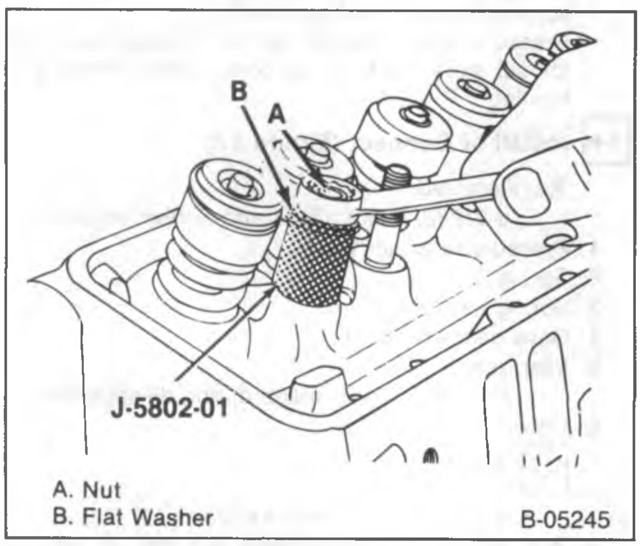


Figure 21—Removing the Rocker Arm Stud

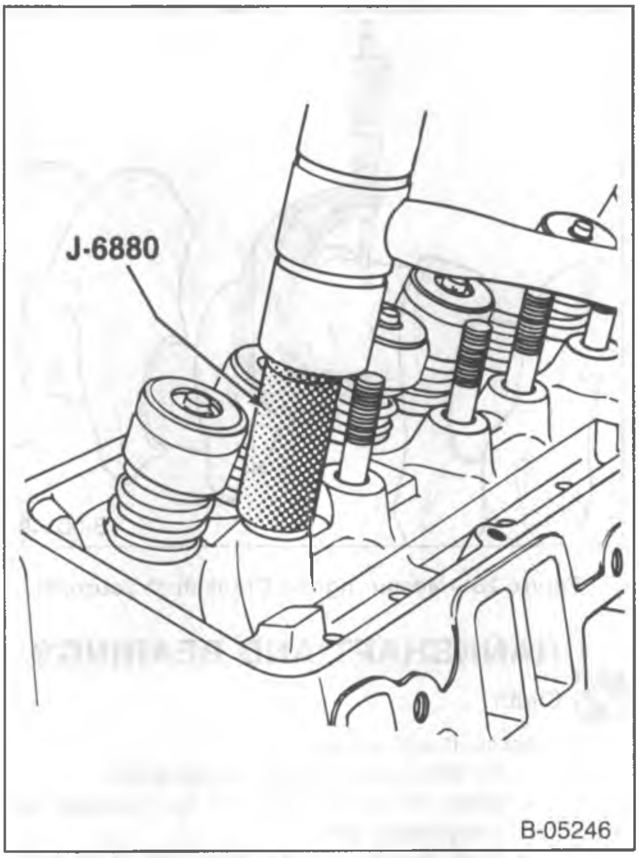


Figure 22—Installing the Rocker Arm Stud

- Rocker arm stud.
  - Place J 5802-01 over the rocker arm stud.
  - Install a nut and flat washer.
  - Turn the nut to remove the stud.

Install or Connect (Figure 22)

Tools Required:
J 5715, Reamer (0.003-inch oversize)
or
J 6036, Reamer (0.013-inch oversize)
J 6880, Rocker Arm Stud Installer

NOTICE: Do not attempt to install an oversize rocker arm stud without reaming the stud hole as this could damage the cylinder head.

- Ream the hole to the proper size for the replacement oversize rocker arm stud. Use J 5715 for 0.003-inch oversize studs; J 6036 for 0.013-inch oversize stud (figure 23).
- Coat lower end (press-fit area) of rocker arm stud with hypoid axle lubricant.
- Rocker arm stud. Use J 6880 (figure 22). Stud is installed to proper depth when the tool bottoms on the cylinder head.

ASSEMBLY

Install or Connect (Figures 19, 20, and 24)

Tools Required:
J 8062, Valve Spring Compressor
J 23738-A, Vacuum Pump

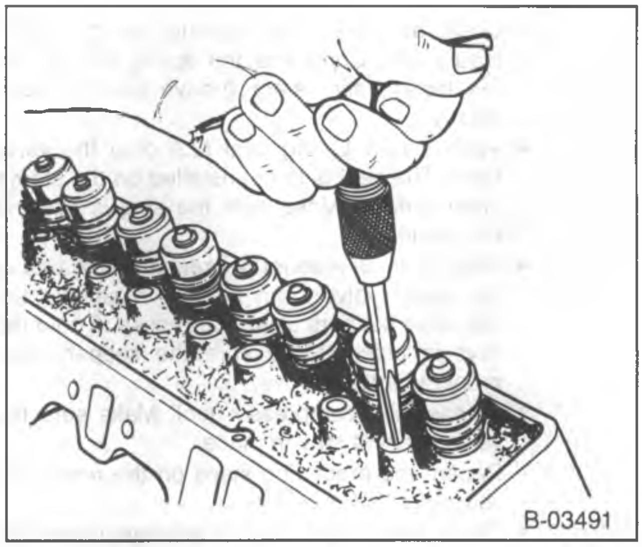


Figure 23—Reaming the Rocker Arm Stud Bore

1. Valves (27 and 29).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper seats.
2. Seal (24) (intake valve only).
   - Install the seal over the valve stem and seat it against the head.
3. Springs and dampers.
4. Shields (22).
5. Cap (21) or rotator (28).
6. O-ring seals (23) and valve keepers (20).

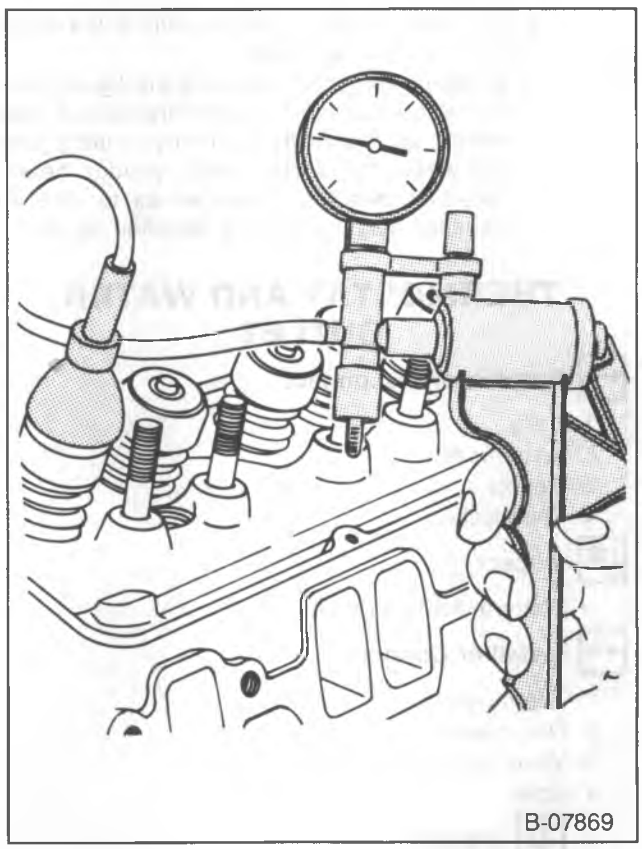


Figure 24—Checking the Valve Seals

- Compress the valve spring using J 8062 (figure 20). Compress the spring enough so the lower valve stem groove can be seen clearly.
- Push a new O-ring seal (23) onto the valve stem. The seal is to be installed on the stem's lower groove. Make sure the seal is flat and not twisted.
- Apply a small amount of grease to the area of the upper valve stem groove. Assemble the two valve keepers using the grease to hold the keys in place. Make sure the keepers seat properly in the groove.
- Release the compressor tool. Make sure the valve keepers stay in place.
- Repeat the preceding steps on the remaining valves.
- Check each O-ring seal for leakage (figure 24).
  - Place the suction cup supplied with J 23738-A over the shield.
  - Connect J 23738-A to the suction cup and apply a vacuum. Watch the vacuum pump gage. No air should be able to leak past the seal. If the seal will not hold a vacuum, it may have been damaged or improperly installed.

Measure

- Valve spring installed height of each spring as follows.
  1. Use a narrow thin scale. A cutaway scale may be helpful.
  2. Measure from the top of the shim or the spring to the top of the shield.
  3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims approximately 1.6 mm (1/16-inch) thick (between the spring and cylinder head). NEVER shim the spring so as to give an installed height under the specified figure.

THERMOSTAT AND WATER OUTLET

Remove or Disconnect

1. Bolts.
2. Water outlet.
3. Gasket.
4. Thermostat.

Inspect

- Water outlet for cracks.

install or Connect

1. Thermostat.
2. New gasket.
3. Water outlet.
4. Bolts.

Tighten

- Bolts to 28 N·m (21 ft. lbs.).

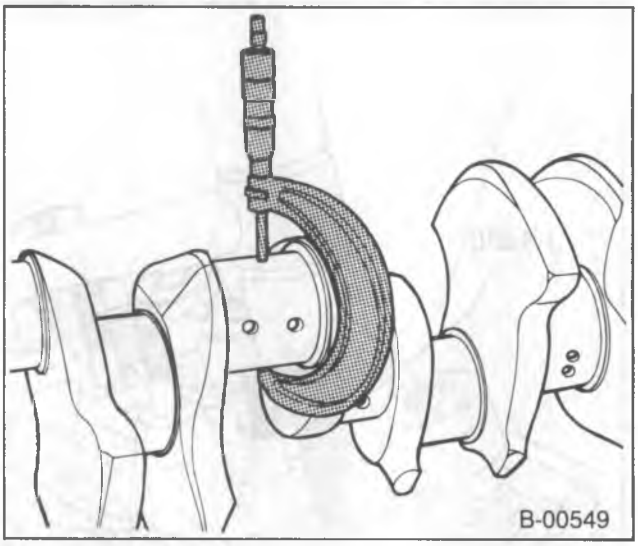


Figure 25—Measuring the Crankshaft Journals

CRANKSHAFT AND BEARINGS

Clean

- Crankshaft with solvent.
  - — Do not scratch the bearing journals.
  - — Blow all sludge from the oil passages with compressed air.
  - Main bearing inserts. Wipe free of oil with a soft cloth.

Inspect

- Crankshaft for cracks. Use the magnaflux method, if available.
- Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.
- Main bearing inserts for scoring or other damage.

In general, the lower inserts (except the #1 bearing), show greater wear and the most distress from fatigue. If, upon inspection, the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert shows evidence of wear or damage, both the upper and lower inserts must be replaced.

Measure

- Main bearing and connecting rod journal diameters (figure 25). Compare with "Specifications." Grind or replace the crankshaft if necessary.
- Main bearing and connecting rod journals for taper and out-of-round (figure 25). If the journals are tapered more than 0.001-inch or out-of-round more than 0.002-inch, grind or replace the crankshaft.
- Crankshaft run-out.
  - Mount the crankshaft in V-blocks or between centers.
  - Use a dial indicator.
  - If the main journals are misaligned, the crankshaft is bent and must be replaced, along with the main bearing.

ASSEMBLY OF ENGINE

PRIOR TO ASSEMBLY

The importance of cleanliness during the assembly procedure cannot be overstressed. Dirt will cause premature wear of the rebuilt engine.

Lubricate all moving parts lightly with engine oil or engine assembly lubricant (unless specified otherwise) during assembly. This will provide initial lubrication when the engine is started.

CRANKSHAFT AND MAIN BEARING INSTALLATION

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are excessive, a new bearing plus both upper and lower inserts will be required. Service bearings are available in standard size and 0.001-inch, 0.002-inch, 0.009-inch, 0.010-inch, and 0.020-inch undersize.

Selective fitting of both rod and main bearing inserts is necessary in production to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a 0.001-inch undersize insert which will decrease the clearance 0.0005-inch from using a full standard bearing.

Some engines may have rear main bearings that are 0.008-inch wider than standard across the thrust faces.

- The crankshaft on these engines can be identified by ".008" stamped on the rear counterweight.
- If the rear main bearings are replaced, they must have the proper distance between thrust faces to obtain proper crankshaft end play.

Install or Connect

1. Upper main bearing inserts to the block.

   Important

   - If any undersized bearings are used, make sure they are fitted to the proper journals.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps.

   Measure

   - Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

- Apply engine oil to the main bearing inserts.

4. Main bearing caps (except rear cap) and bolts to the block.

   Tighten

   - Main bearing cap bolts to 100 N·m (75 ft. lbs.).
5. Rear main bearing cap.
   - Apply engine oil to the bearing inserts.
6. Rear main bearing cap bolts.

   Tighten

   - Bolts to 14 N·m (10 ft. lbs.).

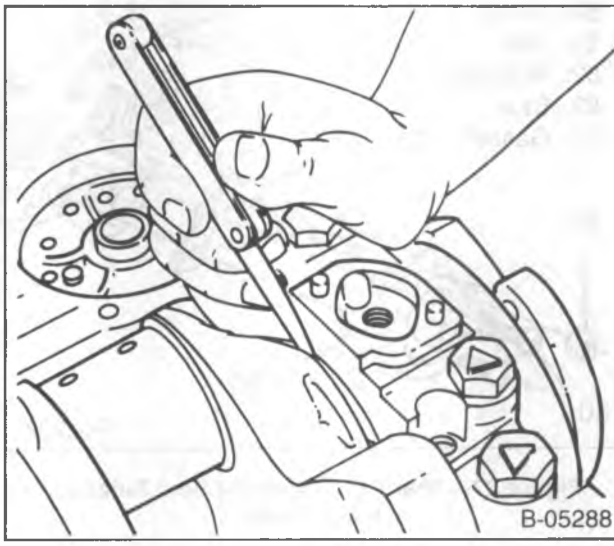


Figure 26—Measuring Crankshaft End Play

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 110 N·m (80 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 26). The proper clearance is 0.002-0.006-inch.
  - If correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

REAR CRANKSHAFT OIL SEAL RETAINER INSTALLATION

Clean

- Gasket surfaces on the block and seal retainer.

Install or Connect (Figure 27)

1. New gasket (84) to the block.
   - It is not necessary to use sealant to hold the gasket in place.

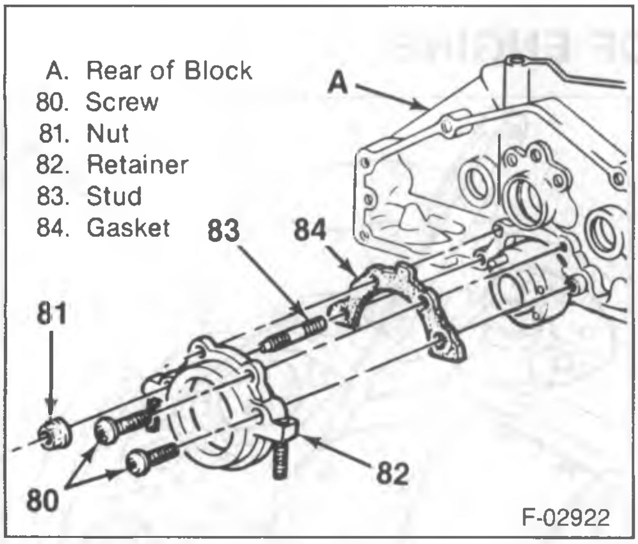


Figure 27—Rear Crankshaft Oil Seal Retainer Installation

2. Seal retainer (82).
3. Screws (80) and nuts (81).

Tighten

- Screws and nuts to 15.3 N·m (135 in. lbs.).

REAR CRANKSHAFT OIL SEAL INSTALLATION

Install or Connect (Figure 28)

Tool Required:

J 35621 Seal Installer

- Rear crankshaft oil seal.
  - Lubricate the inner and outer diameter of the seal with engine oil.
  - Install the seal on J 35621.
  - Position J 35621 against the crankshaft. Thread the attaching screws into the tapped holes in the crankshaft.

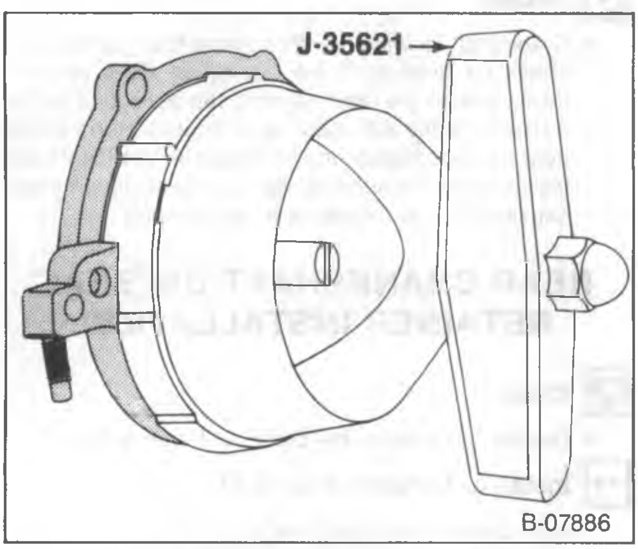


Figure 28—Installing the Rear Crankshaft Oil Seal

- Tighten the screws securely with a screwdriver. This will ensure that the seal is installed squarely over the crankshaft.
- Turn the handle until it bottoms.
- Remove J 35621.

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 29, 30, and 31)

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).

1. Two or three 5/16-18 bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft.
2. Camshaft to the engine (figure 30). Handle the camshaft carefully to prevent damage to the camshaft bearings.
3. Thrust plate (87) and screws (88).

Tighten

- Screws to 11.9 N·m (105 in. lbs.).

4. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 31).

5. Camshaft sprocket bolts.

Tighten

- Camshaft sprocket bolts to 28 N·m (21 ft. lbs.).

FRONT COVER INSTALLATION

Install or Connect

1. Front cover gasket to the front cover.
   - Use gasket cement to hold the gasket in place.
2. Front cover to the engine.
3. Front cover bolts and reinforcements.

Tighten

- Front cover to block bolts to 13.6 N·m (120 in. lbs.).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figure 32)

Tool Required:

J 23523-E, Torsional Damper Puller and Installer

1. Crankshaft key (if removed).

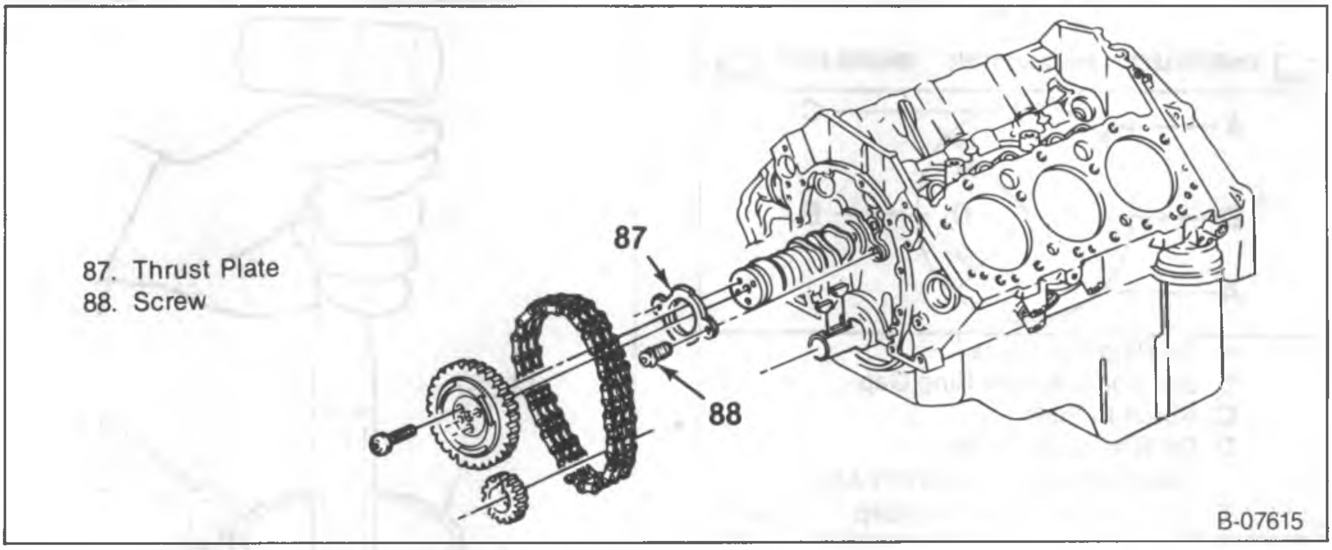


Figure 29—Camshaft and Components

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

2. Stud (item A, figure 32) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.

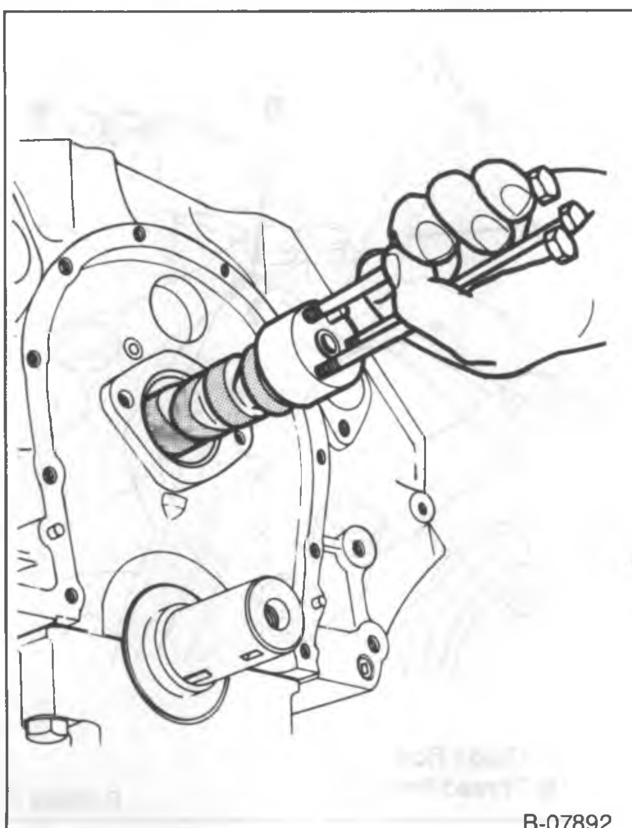


Figure 30—Installing the Camshaft

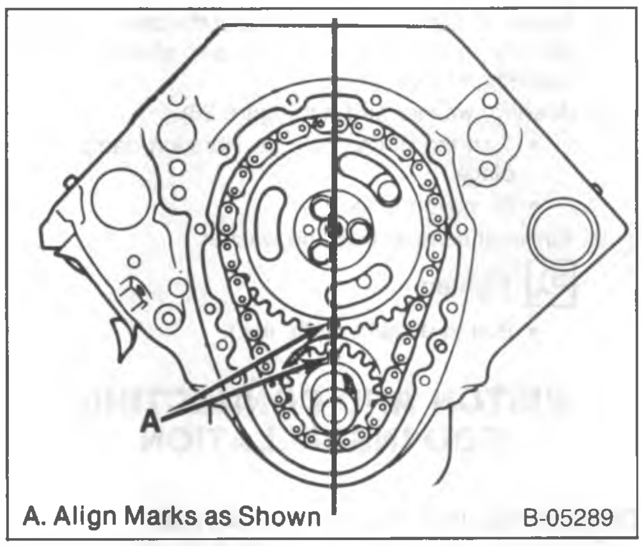


Figure 31—Timing Marks

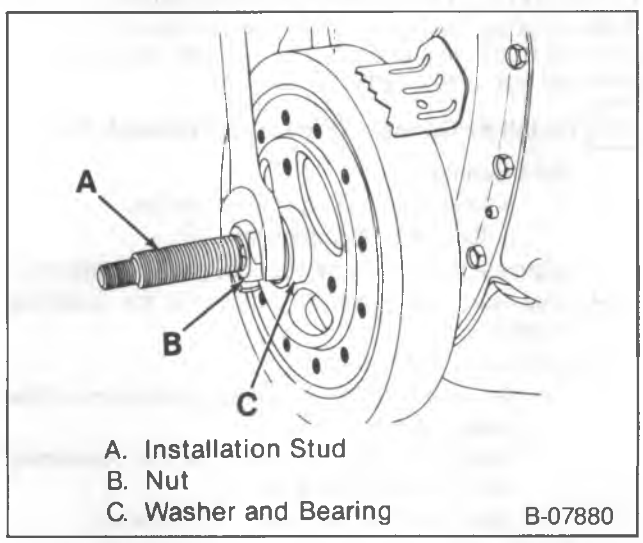


Figure 32—Installing the Torsional Damper

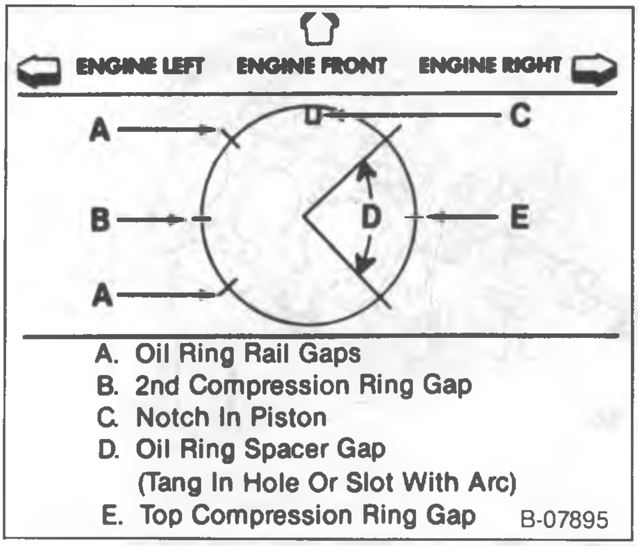


Figure 33—Piston Ring End Gap Locations

3. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
4. Bearing, washer and nut (figure 28).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
5. Torsional damper bolt and washer.

Tighten

- Bolt to 95 N·m (70 ft. lbs.).

PISTON AND CONNECTING ROD INSTALLATION

CONNECTING ROD BEARING SELECTION

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are excessive install a new bearing. Service bearings are available in standard size and 0.0014 mm undersize for use with new and used standard size crankshafts.

Install or Connect (Figures 33 through 35)

Tools Required:

J 5239, Connecting Rod Guide Set
J 8037, Ring Compressor

- Lubricate the cylinder walls lightly with engine oil.
- Make sure the piston is installed in the matching cylinder.

1. Connecting rod bearings.
   - Be certain that the bearing inserts are of the proper size.
   - Install the bearing inserts in the connecting rod and connecting rod cap.
   - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap removed, install J 5239 onto the connecting rod studs.

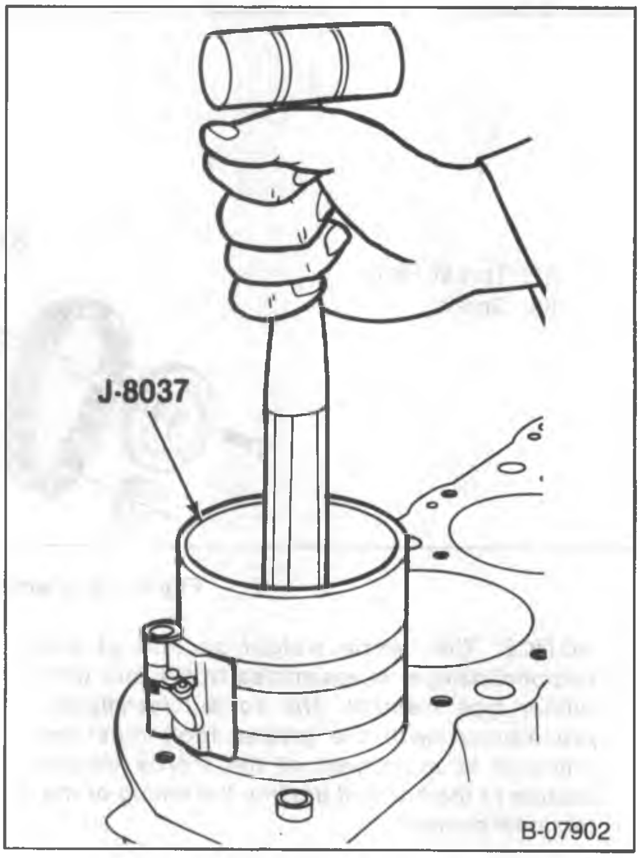


Figure 34—Installing the Piston

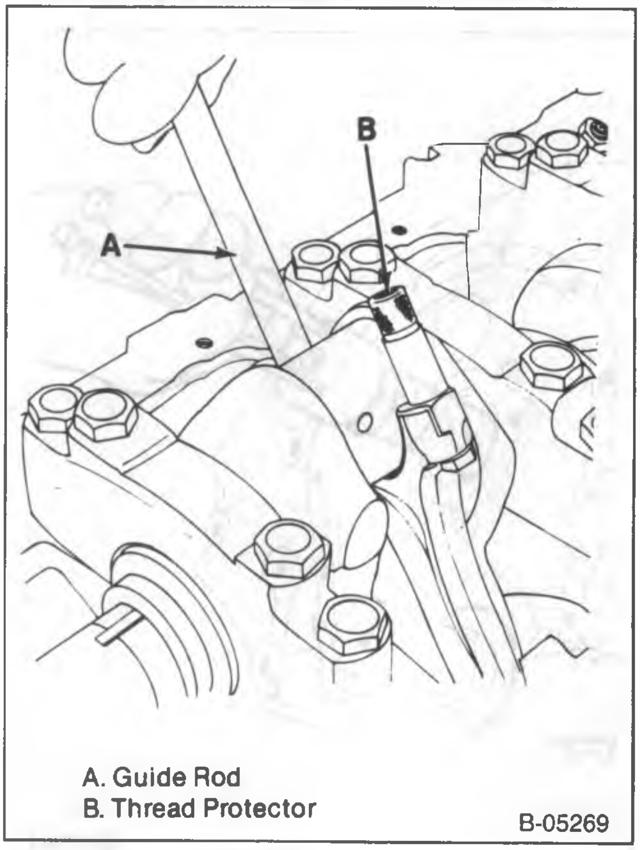


Figure 35—Guiding the Connecting Rod

- Locate the piston ring end gaps as shown in figure 33. Lubricate the piston and rings with engine oil.
- Without disturbing the ring end gap location, install J 8037 over the piston (figure 34).
- The piston must be installed so that the notch in the piston faces the front of the engine (figure 33).
- Place the piston in its matching bore. The connecting rod bearing tang slots must be on the side opposite the camshaft. Using light blows with a hammer handle, tap the piston down into its bore (figure 34). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J 5239 (figure 35). Hold the ring compressor against the block until all rings have entered the cylinder bore.
- Remove J 5239 from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3 and 5 are at the left bank and 2, 4 and 6 are the right bank. 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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

3. Connecting rod cap with bearing insert.

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Tighten

- Connecting rod cap nuts to 60 N·m (45 ft. lbs.).

Measure

- Connecting rod side clearance (figure 36). The proper clearance is 0.006 to 0.014-inch.

OIL PUMP INSTALLATION

Install or Connect

1. Oil pump to the engine.
   - Align the slot in the oil pump shaft with the tang on the distributor shaft.
   - The oil pump should slide easily into place.
   - No gasket is used.
2. Oil pump to main bearing cap bolt.

Tighten

- Oil pump to main bearing cap bolt to 90 N·m (65 ft. lbs.).

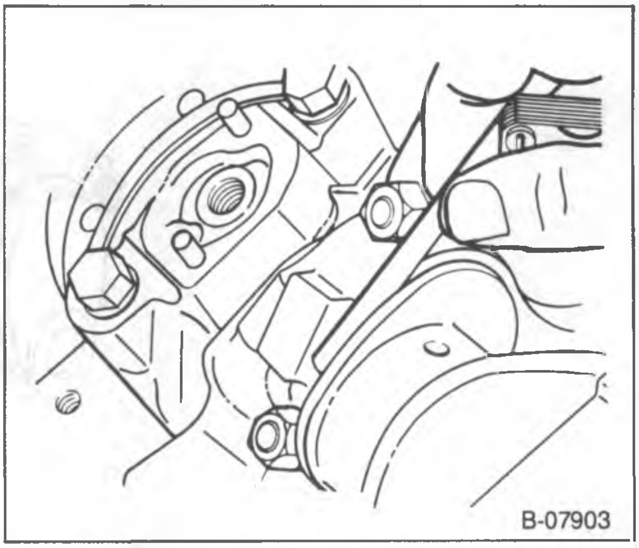


Figure 36—Measuring Connecting Rod Side Clearance

OIL PAN INSTALLATION

Install or Connect (Figure 37)

- Apply PST sealant (GM part number 1052080 or equivalent) to the front cover to block joint and to the rear crankshaft retainer seal to block joint. Apply the sealant about 25 mm (1-inch) in both directions from each of the four corners (figure 37).

1. Oil pan gasket to the oil pan.
2. Oil pan to the engine.
3. Oil pan reinforcements, bolts and nuts.

Tighten

- Bolts to 11.3 N·m (100 in. lbs.).
- Nuts to 22.6 N·m (200 in. lbs.).

CYLINDER HEAD INSTALLATION

Clean

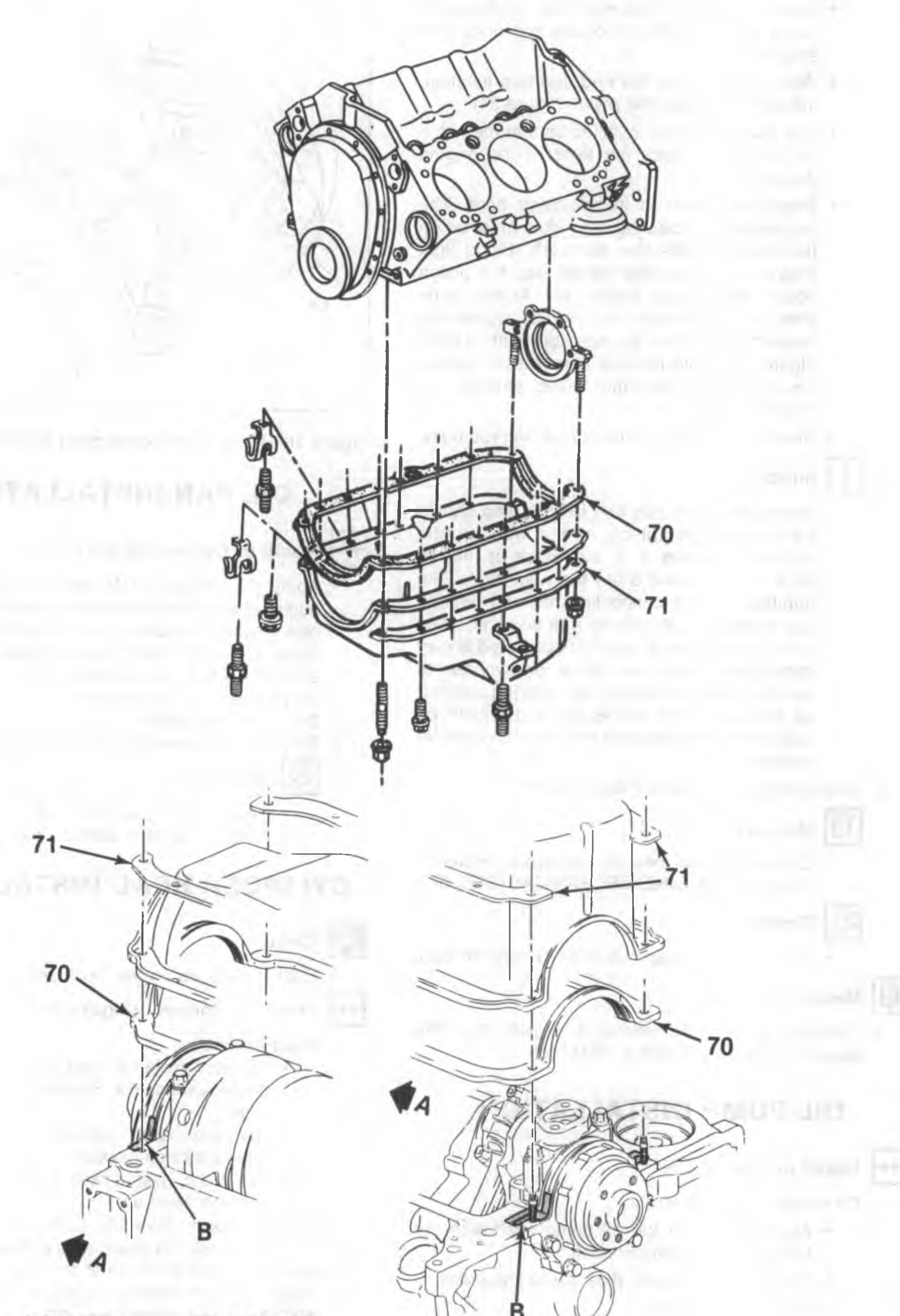
- Gasket surfaces on the block and cylinder head.

Install or Connect (Figure 38)

1. Head gasket.
   - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
   - Do not use sealer on composition steel-asbestos gaskets.
   - Place the gasket over the block dowel pins with the head up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound (GM part number 1052080 or equivalent) and install finger-tight.

Tighten

- Cylinder head bolts, a little at a time, using the sequence shown in figure 38. The proper torque is 90 N·m (65 ft. lbs.).



A-Forward
B-Sealant

70. Gasket
71. Reinforcement

F-04488

Figure 37—Oil Pan Installation

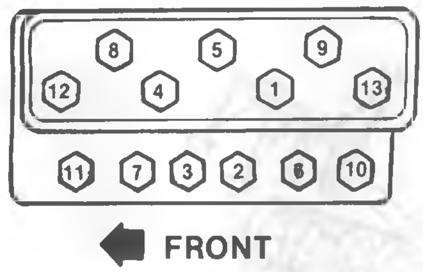


Figure 38—Cylinder Head Bolt Tightening Sequence

VALVE TRAIN COMPONENT INSTALLATION

Important

- Replace all hydraulic lifters if a new camshaft was installed.

Install or Connect (Figure 39)

- Lubricate the hydraulic lifter bodies and feet with Engine Oil Supplement (GM Part N0. 1051396 or equivalent).

1. Hydraulic lifters to the block.
2. Restrictors (46) and retainer (41) with bolts (40).

   Tighten

   - Bolts (40) to 16.4 N·m (145 in. lbs.).

3. Pushrods.
   - Seat the pushrods into the socket in the hydraulic lifters.

- Coat the mating surfaces of the rocker arms and balls with "Molykote" or equivalent.

4. Rocker arms.
5. Balls.
6. Nuts.

VALVE ADJUSTMENT

1. Crank the engine until the mark on the torsional damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number four firing position and should be turned over one more time to reach the number one position.
2. With the engine in the number one firing position as determined above, the following valves may be adjusted:
   — Exhaust: 1, 5, 6.
   — Intake; 1, 2, 3.
   (Even numbered cylinders are in the right bank; odd numbered cylinders are in the left bank, when viewed from the rear of the engine).
3. Back out the adjusting nut until lash is felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut. When the play has been removed, turn the adjusting nut in one full additional turn (to center the lifter plunger).
4. Crank the engine one revolution until the timing tab "O" mark and torsional damper mark are again in alignment. This is the number four firing position. The following valves may be adjusted:
   — Exhaust: 2, 3, 4.
   — Intake: 4, 5, 6.

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figures 40 and 41)

1. Gaskets to the cylinder head with the port blocking plates facing the rear of the engine.
2. RTV to the front and rear sealing surfaces on the block. Apply a 5 mm (3/16-inch) bead of RTV (GM Part No. 1052366 or equivalent) to the front and rear of the block as shown in figure 40. Extend the bead 13 mm (1/2-inch) up each cylinder head to seal and retain the gaskets.
3. Intake manifold to the engine.
4. Intake manifold bolts.

   Tighten

   - Bolts to 48 N·m (35 ft. lbs.) using the tightening sequence shown in figure 41.

ROCKER ARM COVER INSTALLATION

Install or Connect (Figure 42)

1. Rocker arm cover and new gasket.
2. Rocker arm cover bolts and washers.

   Tighten

   - Rocker arm cover bolts to 10.2 N·m (90 in. lbs.).

EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figure 43)

1. Exhaust manifold.
2. Heat shield (if removed).
3. Exhaust manifold bolts, washers, and tab washers.

   Tighten

   - Bolts on center exhaust tube to 36 N·m (26 ft. lbs.).

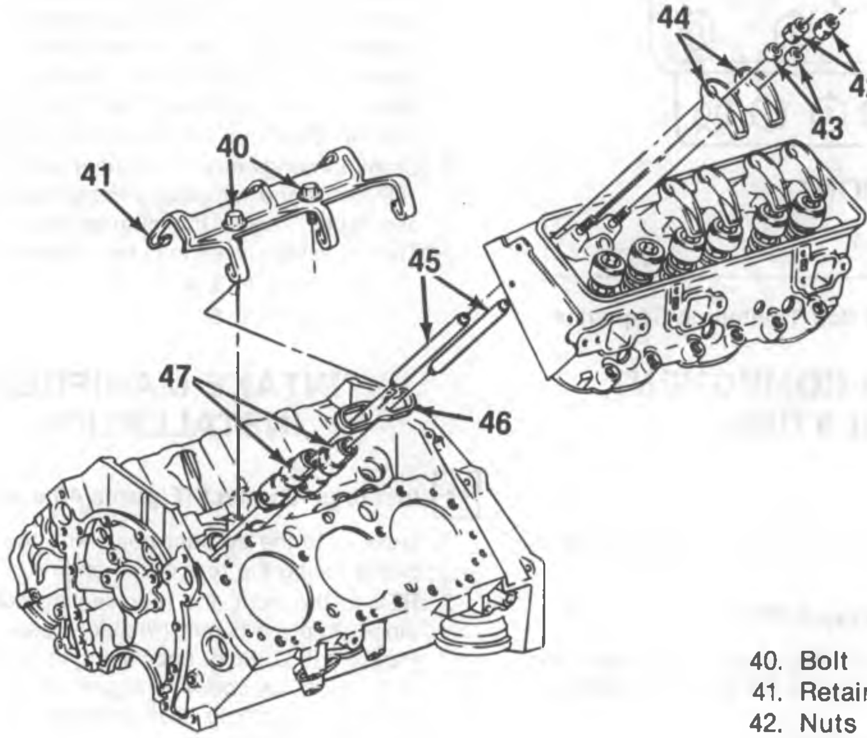


Figure 39—Valve Train Components

- Bolts on front and rear exhaust tubes to 28 N·m (20 ft. lbs.).
- Bend the tab washers over the heads of all bolts.

EGR VALVE INSTALLATION

Install or Connect

1. New gasket.
2. EGR valve.
3. Bolts.

Tighten

- Bolts to 31 N·m (23 ft. lbs.).

FLYWHEEL INSTALLATION

Install or Connect

1. Flywheel.
2. Flywheel bolts.

Tighten

- Bolts to 100 N·m (75 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (distributor, carburetor, oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

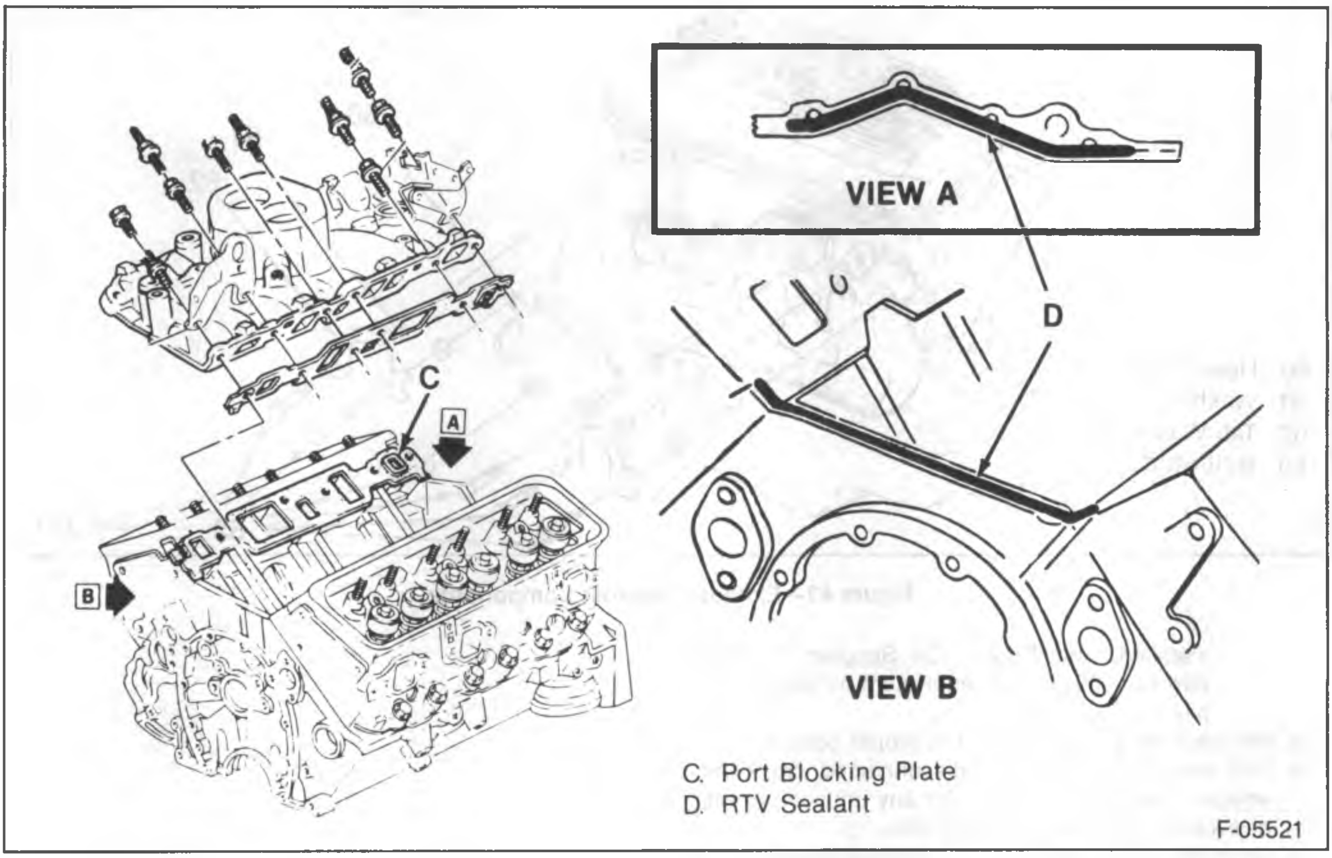


Figure 40—Intake Manifold Installation

ENGINE SET-UP AND TESTING

1. After overhaul, the engine should be tested before installation in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.
2. Fill the crankcase with the proper quantity and grade of oil.

Important

- If a new camshaft or hydraulic lifters were

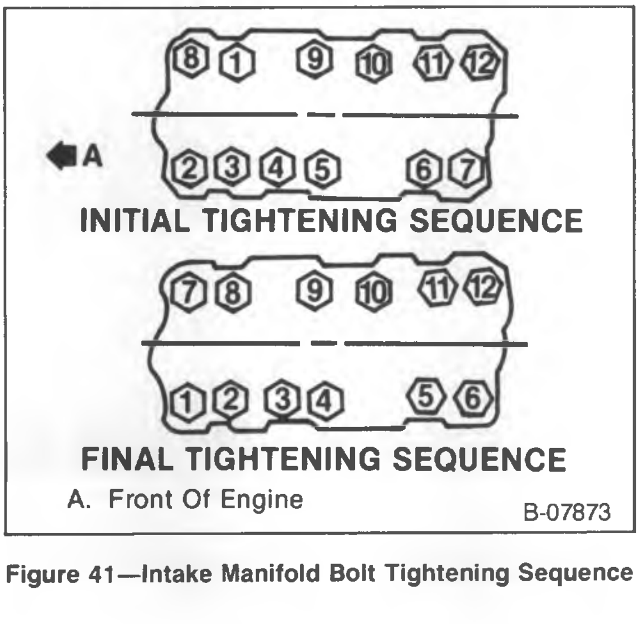


Figure 41—Intake Manifold Bolt Tightening Sequence

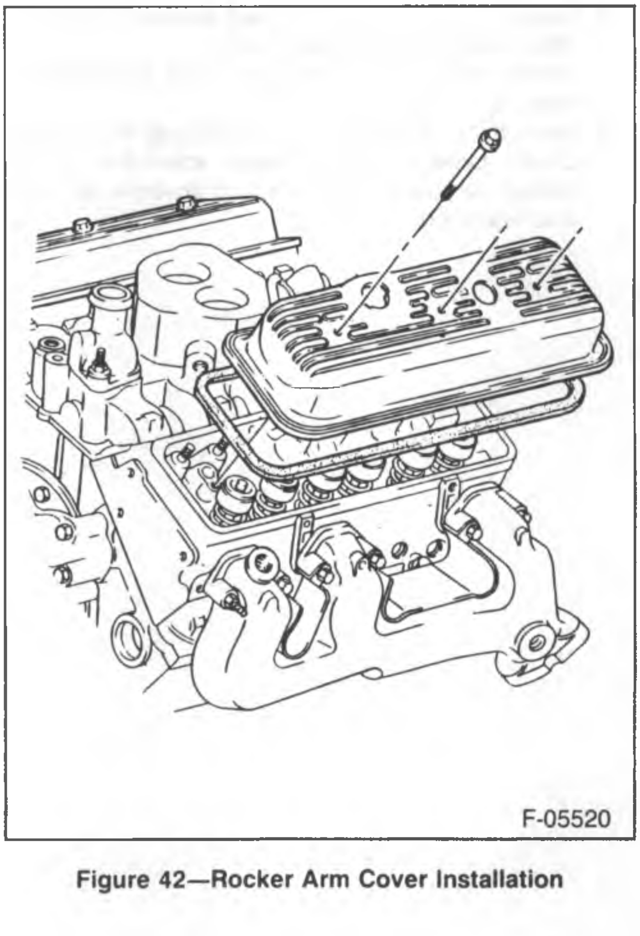


Figure 42—Rocker Arm Cover Installation

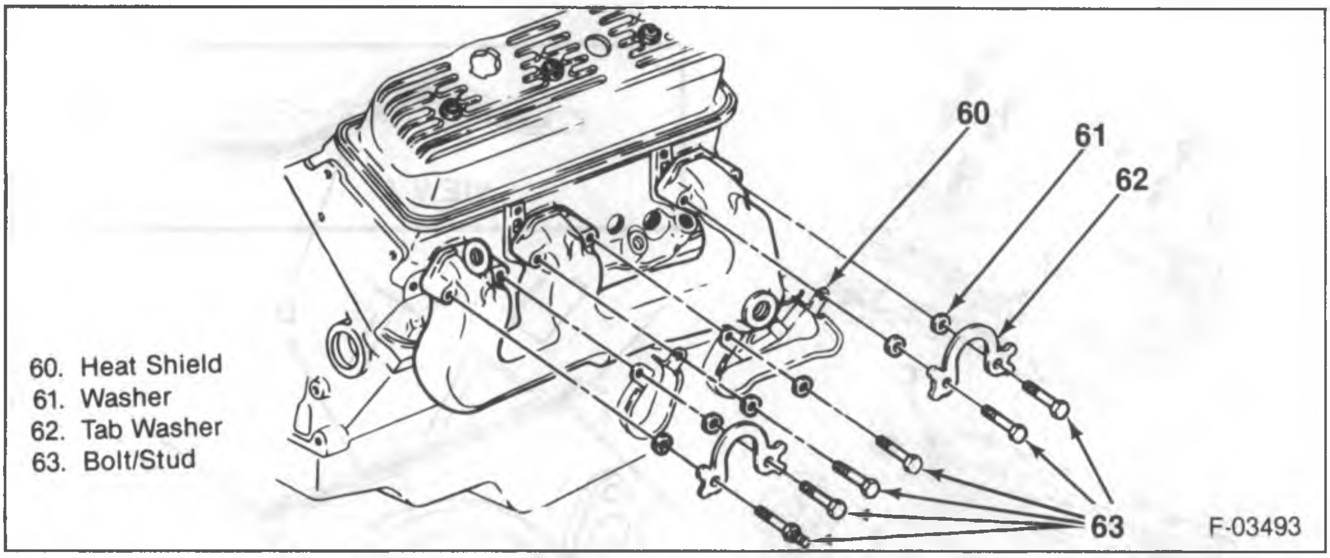


Figure 43—Exhaust Manifold Components

installed, add Engine Oil Supplement (GM part no. 1051396) or equivalent to the engine oil.

3. Fill the cooling system with the proper coolant.
4. With the ignition "OFF," or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
5. Start the engine and listen for unusual noises.
6. Run the engine at about 1000 rpm until the engine is at operating temperature.
7. Listen for improperly adjusted valves or sticking lifters, and other unusual noises.
8. Check for oil and coolant leaks while the engine is running.
9. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing, idle rpm and mixture, and governor settings, if so equipped.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				V6
Displacement				4.3L (262 Cu. In.)
RPO				LB4
Bore				4.00
Stroke				3.48
Compression Ratio				9.3:1
Firing Order				1 - 6 - 5 - 4 - 3 - 2
Oil Pressure (Minimum)				6 psi @ 1000 RPM; 18 psi @ 2000 RPM; 24 psi @ 4000 RPM
CYLINDER BORE:				
Diameter				3.9995-4.0025
Out Of Round	Production			0.001 (Maximum)
	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
		Relief Side		0.001 (Maximum)
	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.0007-0.0017
	Service Limit			0.0027 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0012-0.0032
			2nd	
		Service Limit		Hi Limit Production + 0.001
	Gap	Production	Top	0.010-0.020
			2nd	0.010-0.025
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.002-0.007
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.015-0.055
		Service Limit		Hi Production + 0.010
PISTON PIN:				
Diameter				0.9270-0.09273
Clearance In Piston	Production			0.0002-0.0007
	Service Limit			0.001 (Maximum)
Fit In Rod				0.0008-0.0016 Interference

F-6344

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT:			4.3L
CRANKSHAFT:			
Main Journal	Diameter	#1	2.4484-2.4493
		#2, #3	2.4481-2.4490
		#4	2.4479-2.4488
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production	#1	0.0008-0.0020
		#2, #3	0.0011-0.0023
		#4	0.0017-0.0032
	Service Limit	#1	0.0010-0.0015
		#2, #3	0.0010-0.0025
		#4	0.0025-0.0035
Crankshaft End Play			0.002-0.006
Crankpin	Diameter		2.2487-2.2497
	Taper	Production	0.0005
		Service Limit	0.001 (Maximum)
	Out Round	Production	0.0005
		Service Limit	0.001 (Maximum)
Rod Bearing Clearance	Production		0.0013-0.0035
	Service Limit		0.0030
Rod Side Clearance			0.006-0.014
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.357
	Exhaust		0.390
Journal Diameter			1.8682-1.8692
Camshaft End Play			0.004-0.012
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.50:1
Valve Lash		Intake	One Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	1/32-1/16
		Exhaust	1/16-3/32
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0010-0.0027
	Service	Intake	High Limit Production + 0.001
		Exhaust	High Limit Production + 0.002
Valve Spring (Outer)	Free Length		2.03
	Pressure lbs. @ in.	Closed	76-84 lbs. @ 1.70-in.
		Open	194-206 lbs. @ 1.25-in.
	Installed Height ± 1/32"		1 23/32
Valve Spring Damper	Free Length		1.86
	Approx. # of Coils		4

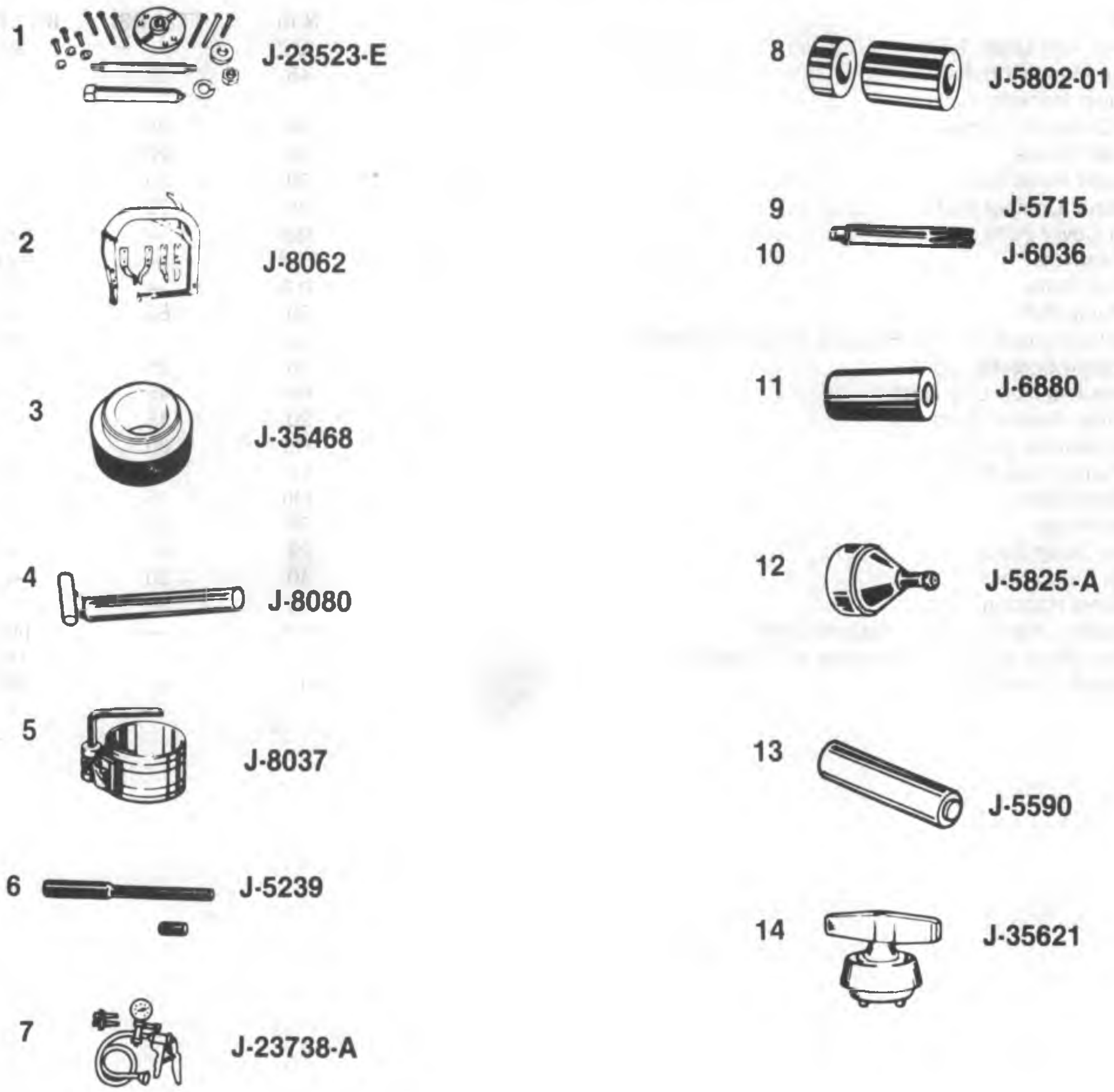
B-07912

SPECIFICATIONS (CONTINUED)

TORQUE SPECIFICATIONS

ITEM	N·m	FT. LBS.	IN. LBS.
Rocker Arm Cover Bolts	10.2	—	90
Intake Manifold Bolts	48	35	—
Exhaust Manifold Bolts			
Center Two Bolts	36	26	—
All Others	28	20	—
Cylinder Head Bolts	90	65	—
Torsional Damper Bolt	95	70	—
Front Cover Bolts	13.6	—	120
Oil Pan Nuts	22.6	—	200
Oil Pan Bolts	11.3	—	100
Oil Pump Bolt	90	65	—
Rear Crankshaft Oil Seal Retainer Screws and Nuts	15.3	—	135
Camshaft Sprocket Bolts	28	21	—
Connecting Rod Cap Nuts	60	45	—
Oil Filter Adapter Bolts	20	15	—
Main Bearing Cap Bolts	110	80	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Bolts	100	75	—
Spark Plugs	30	22	—
Water Outlet Bolts	28	21	—
Water Pump Bolts	40	30	—
Flywheel Housing Bolts	44	32	—
Hydraulic Lifter Restrictor Retainer Bolts	16.4	—	145
Oil Pan Studs to Oil Seal Retainer or Crankcase	1.7	—	15
Camshaft Thrust Plate	11.9	—	105

SPECIAL TOOLS



1. Torsional Damper Remover and Installer
2. Valve Spring Compressor
3. Crankshaft Seal Installer
4. Main Bearing Replacer
5. Piston Ring Compressor
6. Guide Set
7. Vacuum Pump
8. Stud Remover
9. Reamer (0.003-inch oversize)
10. Reamer (0.013-inch oversize)
11. Stud Installer
12. Crankshaft Gear Puller
13. Crankshaft Gear Installer
14. Rear Crankshaft Seal Installer

F-04490

SECTION 6A4

4.8 LITER L6

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONTINUED)

DESCRIPTION

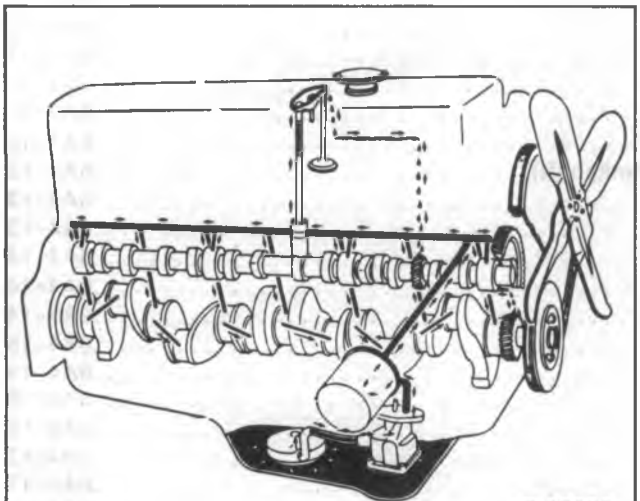


Figure 1—Lubrication Diagram (Side View)

GM 4.8L engines are inline six cylinder type, overhead valve, water cooled, with cast iron block and head.

The crankshaft is supported by seven precision insert main bearings, with crankshaft thrust taken at the number seven (rear) bearing.

The camshaft is supported by four plain type bearings and is gear driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball-type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are case aluminum alloy. The piston pins are a floating fit in the pistons.

Lubrication schematics are shown in figures 1 and 2. The gear type oil pump is driven through an extension shaft from the distributor drive shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe (figure 2). Pressurized oil is routed to the oil filter. In case of excessive backpressure at the oil filter, a bypass valve is provided. This valve will allow oil flow to the main oil gallery at the right side of the block (figure 1). This gallery supplies oil to the camshaft bearings, hydraulic lifters, and main bearings. The connecting rods are supplied oil from the main bearings by means of drilled passages in the crankshaft. The valve train is supplied with oil by the hydraulic lifers. Oil is pumped from the lifters through the hollow pushrods to the rocker arms. Oil drains back to the crankcase through oil drain holes and the pushrod holes. The piston, piston pin, and timing gears are lubricated by oil splash.

For engine identification, refer to GENERAL INFORMATION (SEC. 6A).

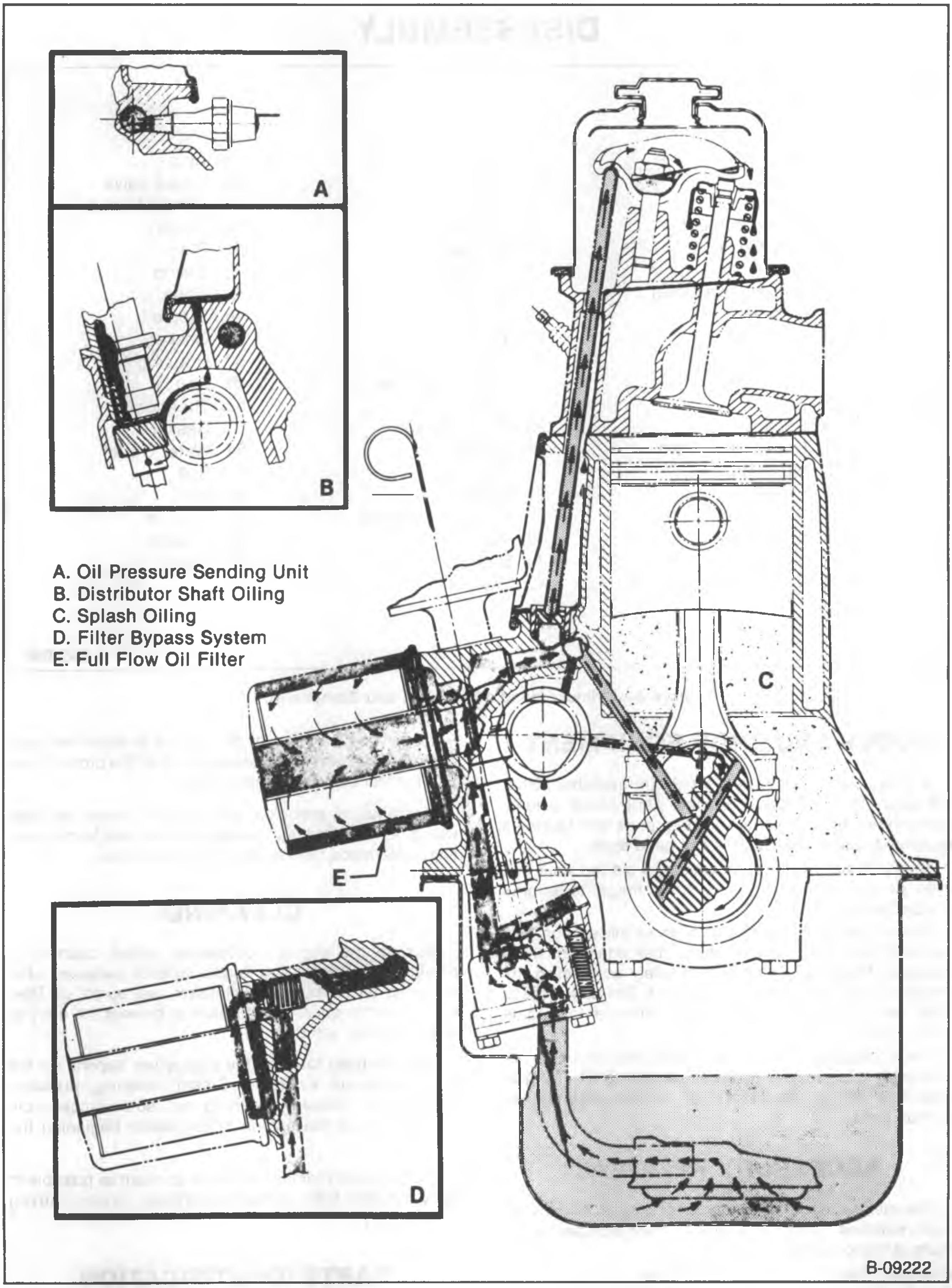


Figure 2—Lubrication Diagram (Front View)

DISASSEMBLY

1. Oil Cap	21. Pushrod	41. Stud
2. Clip	22. Bolt	42. Intake Valve
3. Screw	23. Bolt	43. Exhaust Valve
4. Reinforcement	24. Washer	44. Switch
5. PCV Valve	25. Bracket	45. Plug
6. Seal	26. Cylinder Head	46. Clamp
7. Rocker Arm Cover	27. Gasket	47. Hose
8. Gasket	28. Stud	48. Nipple
9. Grommet	29. Washer	49. Gasket
10. Connector	30. Nut	50. Housing
11. Nut	31. Intake Manifold	51. Bolt
12. Ball	32. Nut	52. Thermostat
13. Rocker Arm	33. Head Gasket	53. Gasket
14. Rocker Arm Stud	34. Clamp	54. Water Outlet
15. Valve Key	35. Bolt	55. Bolt
16. O-ring Seal	36. Gasket	56. Stud
17. Rotator	37. Exhaust Manifold	57. Washer
18. Shield	38. Stud	58. Bracket
19. Seal	39. Bolt	59. Stud
20. Valve Spring	40. Washer	

B-07995

Figure 3—Cylinder Head, Manifolds, and Components

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary aids include: A suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine compartments.

Special tools are illustrated throughout this section, and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

Hydraulic Pump	AIR Pump
Generator	Cooling Fan
Distributor	Carburetor

It is beyond the score of this manual to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routings, accessory drive belt layout, etc., should be made before removing accessories.

CLEANING

Remove the engine accessories before cleaning to provide better access to engine exterior surfaces. After removing the carburetor, distributor, fuel pump, oil filter, etc., cover the openings with tape to prevent the entry of water, solvent, and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

PARTS IDENTIFICATION

Refer to figures 3 through 6.

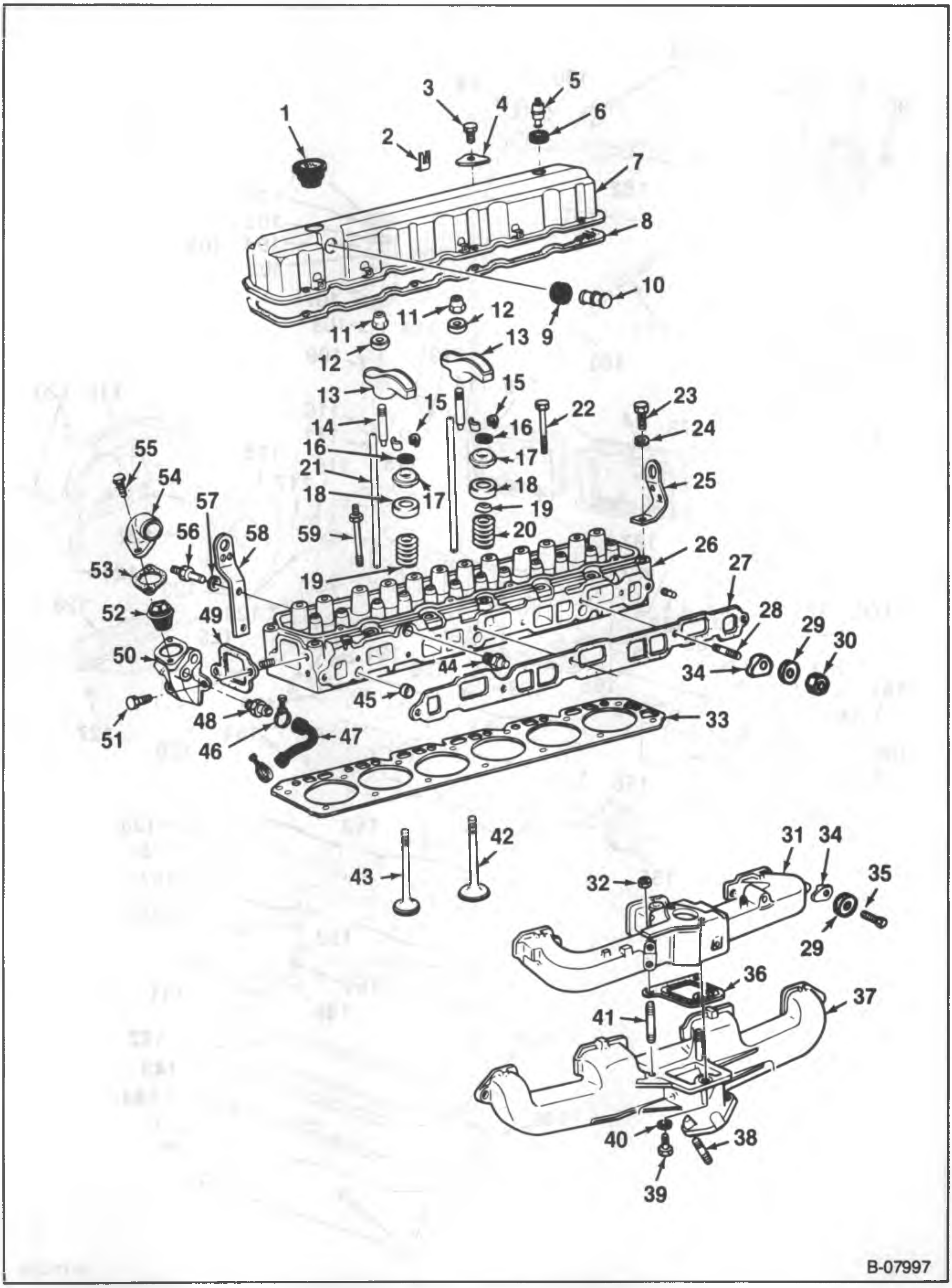


Figure 4—Cylinder Head, Manifolds, and Components

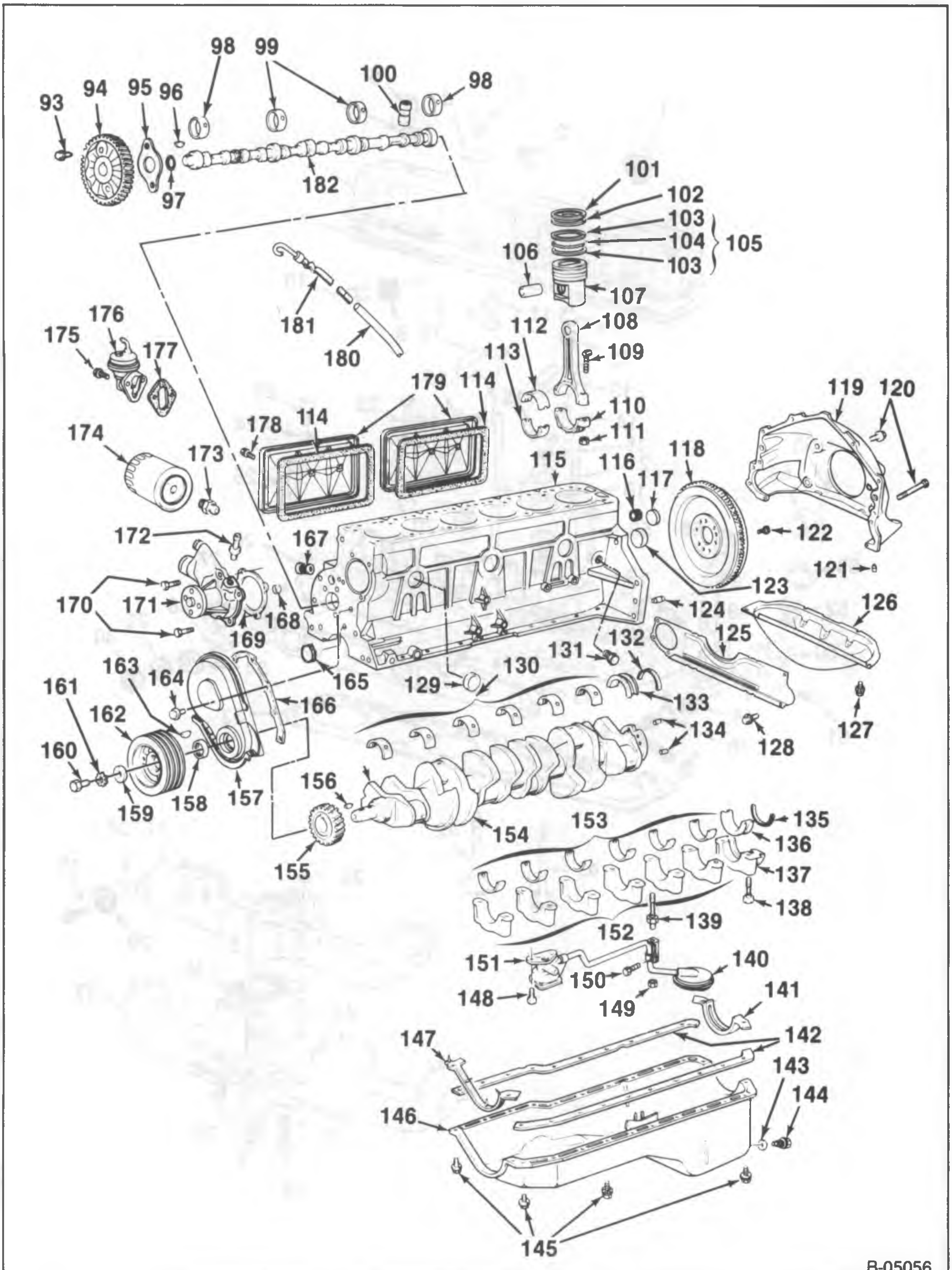


Figure 5—Block and Components

93. Screw
94. Camshaft Gear
95. Thrust Plate
96. Key
97. Spacer
98. Outer Camshaft Bearing
99. Inner Camshaft Bearing
100. Hydraulic Lifter
101. Top Compression Ring
102. Second Compression Ring
103. Rail
104. Expander
105. Oil Control Ring
106. Piston Pin
107. Piston
108. Connecting Rod
109. Connecting Rod Stud
110. Connecting Rod Cap
111. Nut
112. Upper Connecting Rod Bearing Insert
113. Lower Connecting Rod Bearing Insert
114. Gasket
115. Block
116. Plug
117. Rear Camshaft Plug
118. Flywheel
119. Flywheel Housing
120. Bolt
121. Dowel
122. Bolt
123. Plug
124. Dowel
125. Extention
126. Inspection Cover
127. Bolt
128. Bolt
129. Plug
130. Upper Main Bearing Inserts
131. Drain Plug
132. Upper Seal Half
133. Upper Rear Main Bearing Insert
134. Dowel Pin
135. Lower Seal Half
136. Lower Rear Main Bearing Insert
137. Rear Main Bearing Cap
138. Bolt
139. Bolt (Special)
140. Screen
141. Rear Oil Pan Seal
142. Gasket
143. Washer
144. Drain Plug
145. Bolt
146. Oil Pan
147. Front Oil Pan Seal
148. Bolt
149. Nut
150. Bolt
151. Oil Pump
152. Main Bearing Caps
153. Lower Main Bearing Inserts
154. Crankshaft
155. Crankshaft Gear
156. Key
157. Timing Gear Cover
158. Seal
159. Washer
160. Bolt
161. Washer
162. Torsional Damper
163. Key
164. Bolt
165. Plug
166. Gasket
167. Nipple
168. Plug
169. Gasket
170. Bolt
171. Water Pump
172. Nipple
173. Connector
174. Oil Filter
175. Bolt
176. Fuel Pump
177. Gasket
178. Bolt
179. Pushrod Cover
180. Dipstick Tube
181. Dipstick
182. Camshaft

F-04941

Figure 6—Block and Components

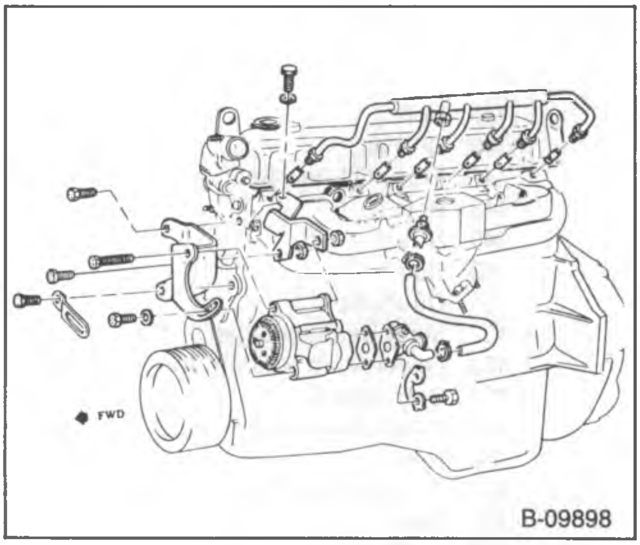


Figure 7—AIR System Components

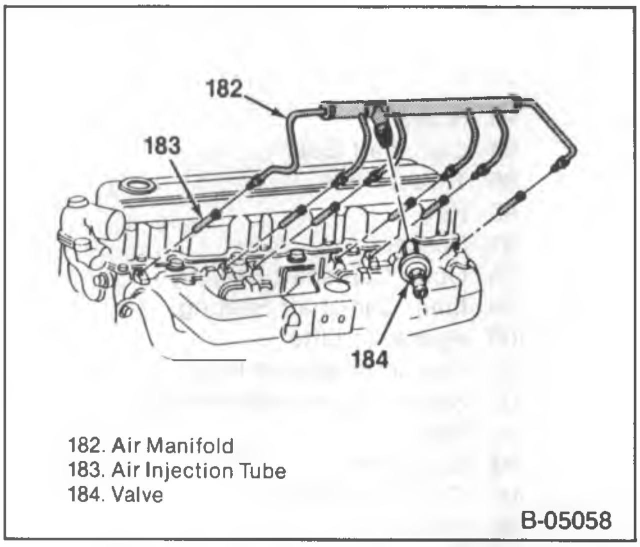


Figure 8—AIR Manifold Installation

DRAINING THE ENGINE

Remove or Disconnect (Figure 5)

- Oil pan drain plug (144). Allow the oil to drain.
- Oil filter (174).
- Block drain plug (131). Allow the coolant to drain.

Install or Connect (Figure 5)

- Oil pan drain plug (144) and washer (143).

  Tighten

  - Oil pan drain plug (144) to 24 N·m (18 ft. lbs.).
- Block drain plug (31).

  Tighten

  - Block drain plug (131) to 12.7 N·m (112 in. lbs.).

AIR MANIFOLD AND INJECTION TUBE REMOVAL

Remove or Disconnect (Figures 7 and 8)

1. Air manifold (182).
   - Unscrew the fittings.
   - Remove the air manifold.
2. Air injection tubes (183).
   - The air injection tubes are a push fit.
   - If the air injection tubes will not come out, they may be easier to remove after the manifolds (31 and 37) are removed, as described later.

MANIFOLD REMOVAL

The intake and exhaust manifolds are removed as an assembly. Instructions for separating and replacing the manifolds are outlined later in this section.

Remove or Disconnect (Figures 4, 9, and 10)

1. Heat stove (191) if used (figure 9).
   - Remove the bolt (190).

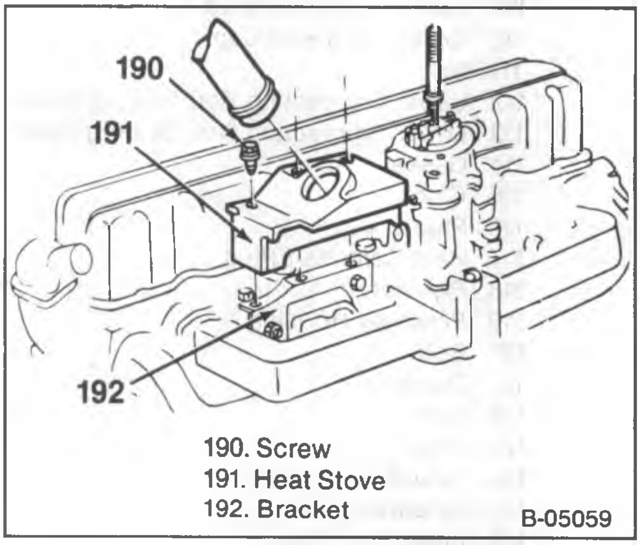


Figure 9—Manifold Heat Stove

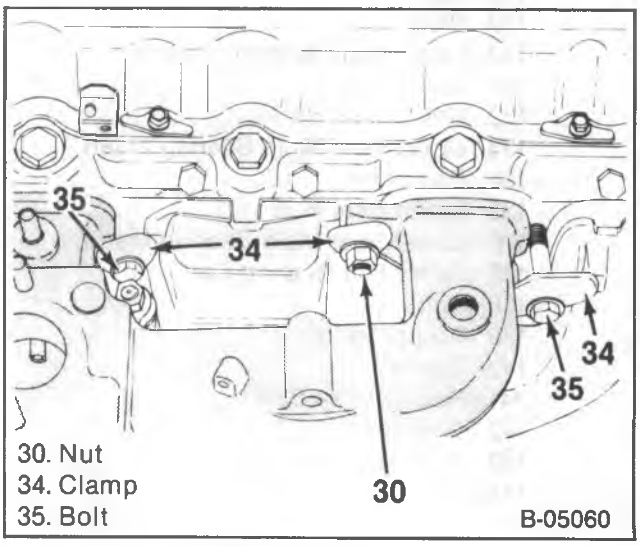
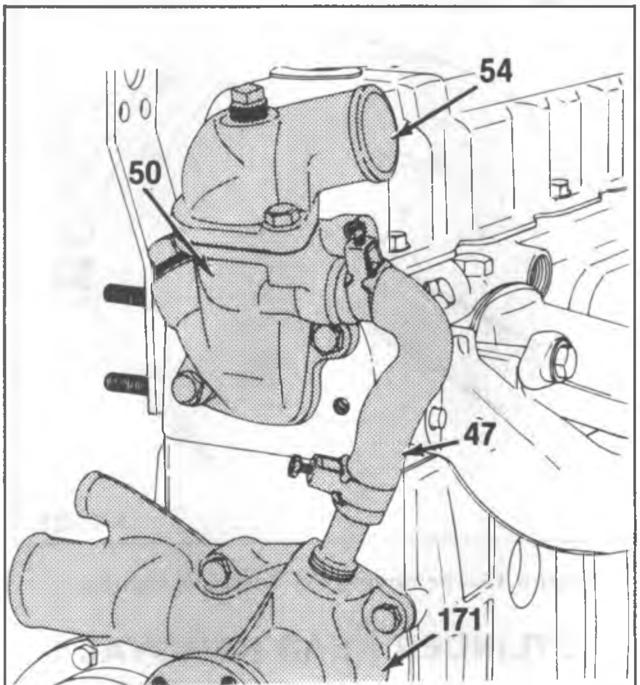


Figure 10—Manifolds Installed



47. Water Pump Bypass Hose
50. Thermostat Housing
54. Water Outlet
171. Water Pump

B-05061

Figure 11—Thermostat Housing and Water Pump Installed

- Remove the heat stove (191).

2. PCV hose.
3. Bolts (35), nuts (30), washers (29) and clamps (34).
4. Intake manifold (31) and exhaust manifold (37) as an assembly.
5. Gasket (27).

THERMOSTAT HOUSING REMOVAL

↔ Remove or Disconnect (Figures 4 and 11)

1. Bolts (51).
2. Thermostat housing (50).
3. Gasket (49).

WATER PUMP REMOVAL

↔ Remove or Disconnect (Figures 5 and 11)

1. Bolts (170).
2. Water pump (171).
3. Gasket (169).

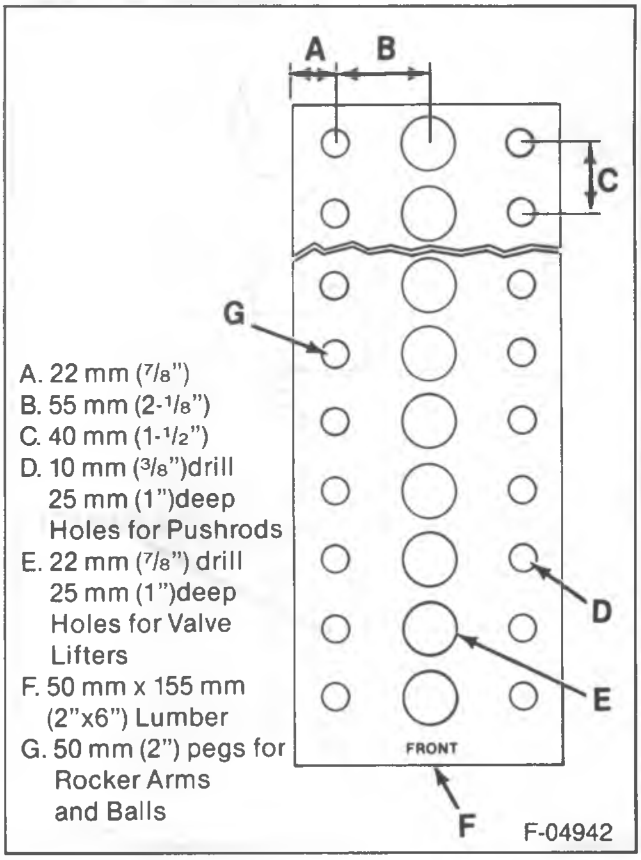


Figure 12—Valve Train Component Rack

VALVE TRAIN COMPONENT REMOVAL

↔ Remove or Disconnect (Figures 3, 4, 12, 13, and 14)

Tools Required:

J-3049 Valve Lifter Remover (Plier Type)
J-9290-01 Valve Lifter Remover (Slide Hammer Type)

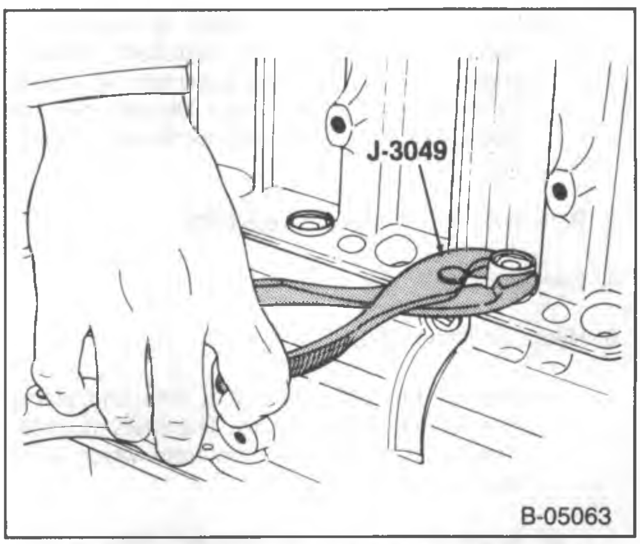


Figure 13—Removing the Valve Lifters

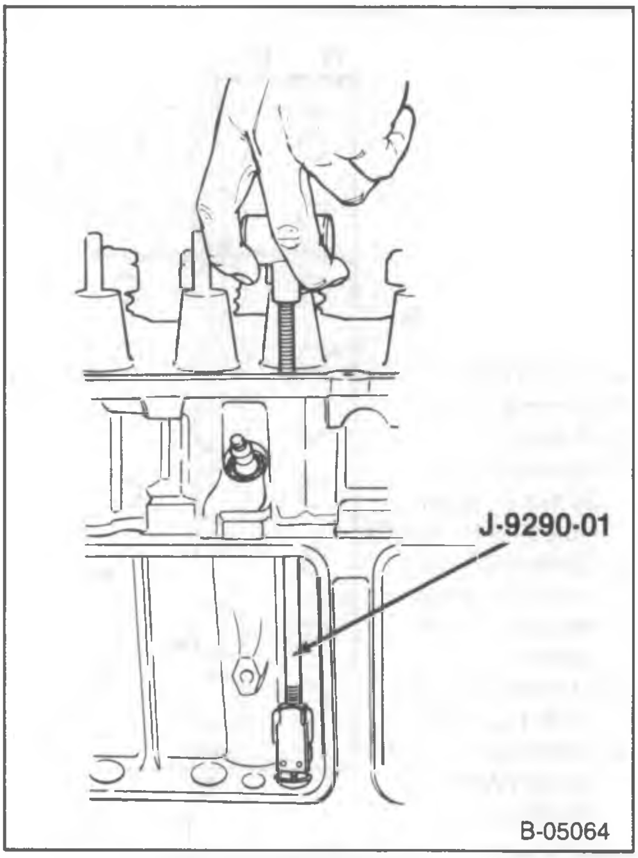


Figure 14—Removing the Valve Lifters

1. Rocker arm cover (7).
   - If the rocker arm cover adheres to the cylinder head (26), try to shear the gasket by bumping the end of the cover with a rubber mallet. If the cover will not come loose, carefully pry until loose. DO NOT DISTORT THE SEALING FLANGE.
2. Nuts (11), balls (12), rocker arms (13) and pushrods (20).
   - Every effort should be made to insure that these mating parts are installed in their original locations during assembly. A simple valve train component organizer rack can be made from a piece of wood, as shown in figure 12.
3. Bolts (178) and pushrod covers (179).
4. Gaskets (114).
5. Hydraulic lifters (100).
   — Remove the lifters one at a time and place them in the organizer rack. The lifters must be installed in the same bore from which they were removed.

   — A stuck lifter can be removed using J-3049 (figure 13) or J-9290-01 (figure 14).

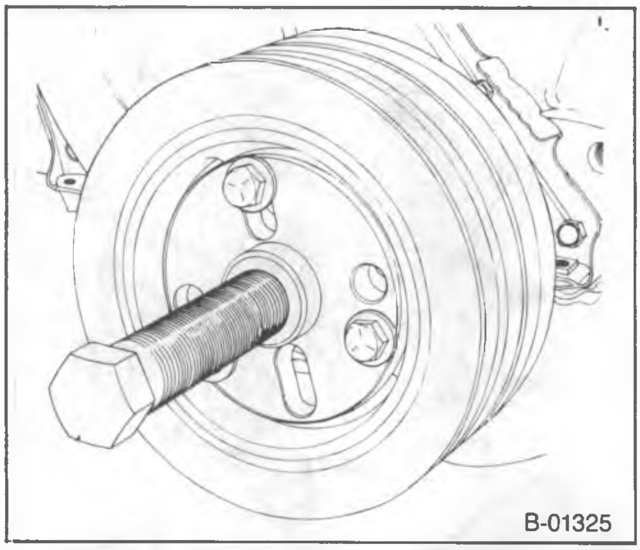


Figure 15—Removing the Torsional Damper

CYLINDER HEAD REMOVAL

↔ Remove or Disconnect (Figure 4)

1. Bolts (21).
2. Cylinder head (26). Use care when handling the cylinder head to prevent damage to the gasket surfaces.
3. Gasket (33).

TORSIONAL DAMPER REMOVAL

↔ Remove or Disconnect (Figures 5 and 15)

Tool Required:

J-23523-E Torsional Damper Remover/Installer

1. Bolt (160) and washers (159 and 161).
2. Torsional damper (162). Use J-23523-E (figure 15).

OIL PAN REMOVAL

↔ Remove or Disconnect (Figure 5)

1. Bolts (145).
2. Oil pan (146).
3. Gaskets (142).
4. Front and rear oil pan seals (141 and 147).

OIL PUMP REMOVAL

↔ Remove or Disconnect (Figure 5)

1. Bolt (164).
2. Front cover (157).
3. Gasket (166).

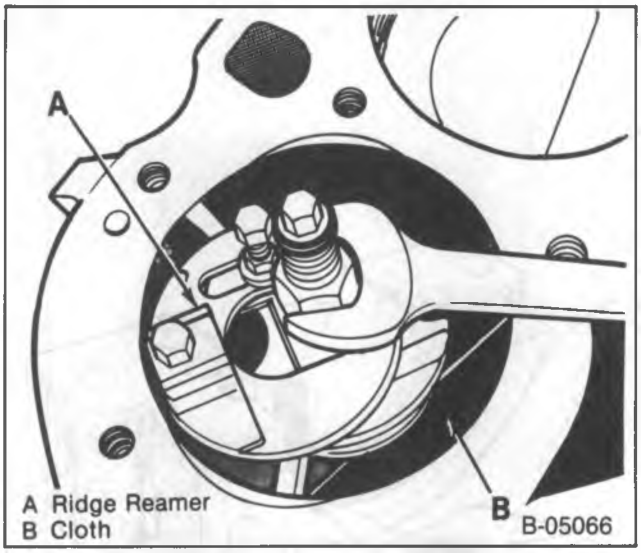


Figure 16—Removing the Cylinder Ridge

TIMING GEAR COVER REMOVAL

Remove or Disconnect (Figure 5)

1. Bolt (164).
2. Timing gear cover (157).
3. Gasket (166).

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 5, 16, and 17)

Tool Required:

J-5239 Connecting Rod Guide Set

1. Ridge (or deposits) at the top of the cylinder as follows:
   - Turn the crankshaft (154) until one piston (107) is at the bottom of its stroke. Place a soft cloth on top of the piston.

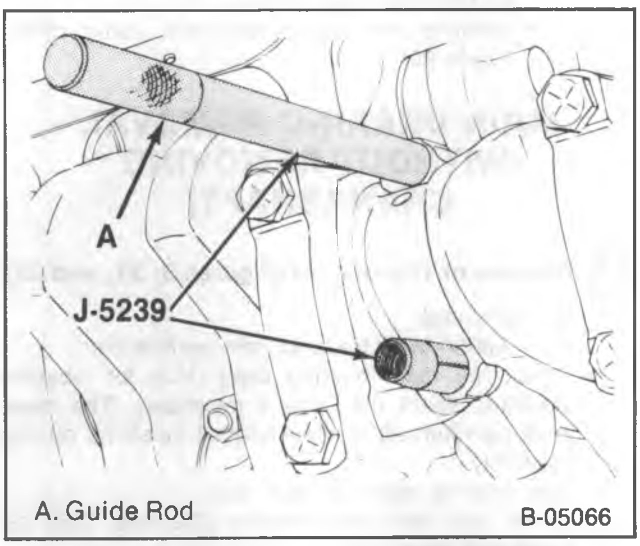


Figure 17—Removing the Piston and Connecting Rod

   - Using the manufacturer's directions, install a ridge reamer into the top of the cylinder (figure 16). Perform the cutting operation.
   - After the ridge and/or deposits are removed, remove the ridge reamer. Turn the crankshaft until the piston is at the top of its stroke. Remove the cloth and cuttings.
   - Repeat this procedure for each piston.
2. Connecting rod caps (110) as follows:
   - Make note of the arrangement of the connecting rod (108) markings, to insure that they will be returned to their proper position during assembly. Mark the connecting rods with a scratch awl if necessary.
   - Remove the nuts (111).
   - To avoid mismatching the connecting rods and connecting rod caps, remove only one connecting rod cap at a time. Place the piston (107) at the bottom of its stroke.
   - Remove the connecting rod cap.
   - Install J-5239 onto the studs (109) (figure 17).

     Use of the specified guide set will prevent the connecting rod from scratching the bore or crankshaft journal during the removal process. The tool will also prevent the rod bearing half from falling out of the connecting rod during removal.
3. Connecting rod (108) and piston (107) from the block (115).
   - Push on the guide rod (item A, figure 17) to push the piston and connecting rod out. Use the guide rod to prevent the connecting rod from scoring the cylinder bore.
   - Loosely assemble the connecting rod cap (110) onto the connecting rod.
   - Repeat this procedure on the remaining piston and connecting rod assemblies.

FLYWHEEL REMOVAL

The crankshaft can be removed from the block without removing the flywheel. If the flywheel is removed, the dowel holes must be reamed oversize and oversized dowel pins installed, as outlined later. If flywheel removal is necessary, proceed as follows:

Remove or Disconnect (Figures 5 and 18)

- Mark the crankshaft (154) and flywheel (118) so that the dowel holes can be aligned in their original positions at the assembly.

1. Flywheel housing (119).
2. Rear main bearing cap (137).
3. Dowel pins (134).
   - With the block (115) inverted, turn the crankshaft (154) so that a dowel pin is at the 12 o'clock position.
   - Drive the dowel pin out, using a hammer and drift.
   - Repeat the preceding steps to drive out the remaining dowel pins. The crankshaft must be turned each time so that the pin can be driven out without contacting the block.

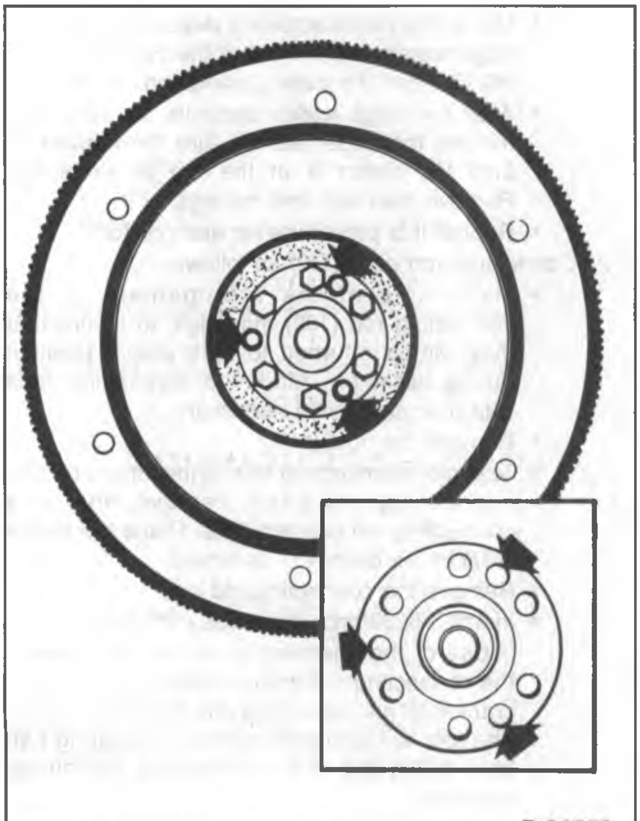


Figure 18—Flywheel Installed

4. Bolts (122).
5. Flywheel (118).

CRANKSHAFT REMOVAL

The main bearings and rear oil seal can be replaced without removing the crankshaft, as outlined later in this section.

Remove or Disconnect (Figures 5 and 19)

- Check the main bearing caps (152) for location markings. Mark the caps if necessary. The caps must be returned to their original locations during the engine assembly.

1. Bolts (138) and stud (139).
2. Main bearing caps (137 and 152).
3. Crankshaft (154). Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange surfaces.
4. Upper and lower seal halves (132 and 135). Pry the seal halves out with a screwdriver (figure 19).
5. Main bearing inserts (130, 133, 136, and 153). If the main bearing inserts are to be reused, mark them to insure they are installed in their original positions before removal.

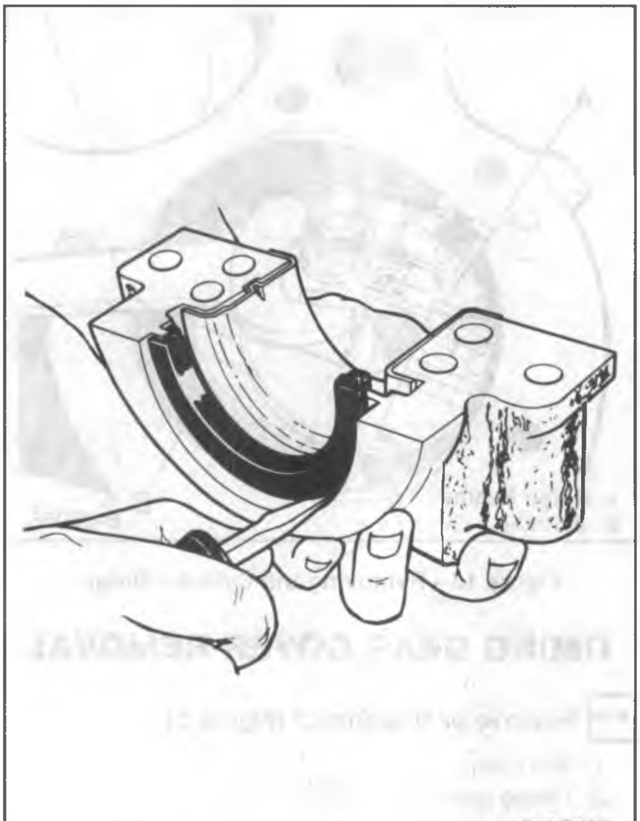


Figure 19—Removing the Lower Seal Half

CRANKSHAFT REAR OIL SEAL REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect (Figures 5, 19, and 20)

1. Rear main bearing cap (137).
2. Lower seal half (135) (figure 19).
3. Upper seal half (132).
   - Tap on the upper seal half, using a small drift and hammer (figure 20).
   - Remove the upper seal half, using pliers (figure 20).

MAIN BEARING REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect (Figures 5, 21, and 22)

Tool Required:

J-8080 Main Bearing Remover/Installer

- Check the main bearing caps (152) for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.

1. Main bearing caps (137 and 152).
2. Upper and lower seal halves (132 and 135), as previously described.
3. Upper rear main bearing insert (133).

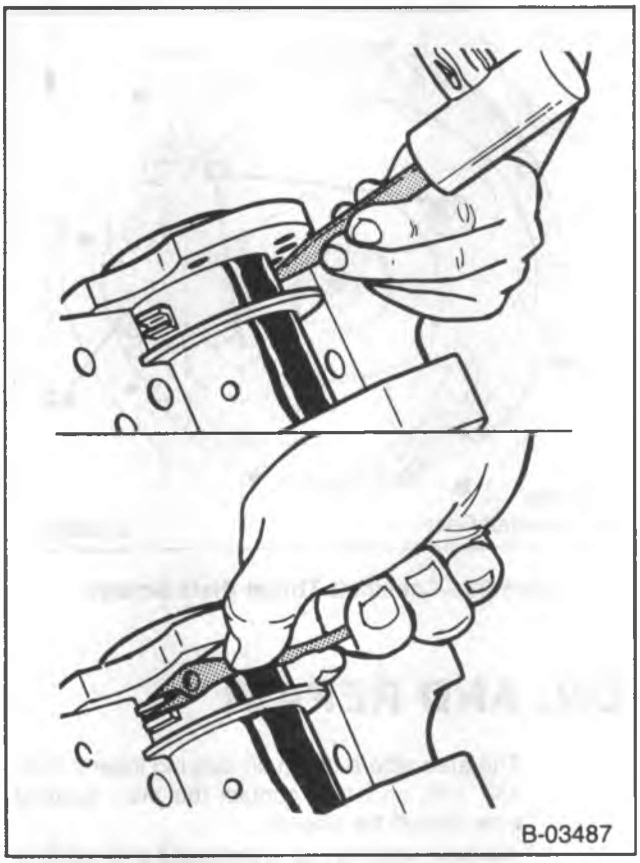


Figure 20—Removing the Upper Seal Half

- Use a small brass drift and hammer. Tap on the insert, on the side opposite the bearing tang, until the insert rotates out of position (figure 21).
- Use a pair of pliers with the jaws taped to prevent damage to the crankshaft. Clamp the insert to the crankshaft flange (figure 21). Rotate the crankshaft (154) to remove the bearing insert.

4. Upper main bearing inserts (130).
   - Insert J-8080 into the crankshaft (154) oil hole (figure 22).
   - Rotate the crankshaft to "turn" the bearing insert out of the block.

CAMSHAFT REMOVAL

Remove or Disconnect (Figures 5 and 23)

- Turn the camshaft (182) until the screws (93) are visible through the holes in the camshaft gear (94) (figure 23).

1. Screws (93).
2. Camshaft (182). Pull the camshaft out of the block. **Support the camshaft carefully when removing to prevent damage to the camshaft bearings.**

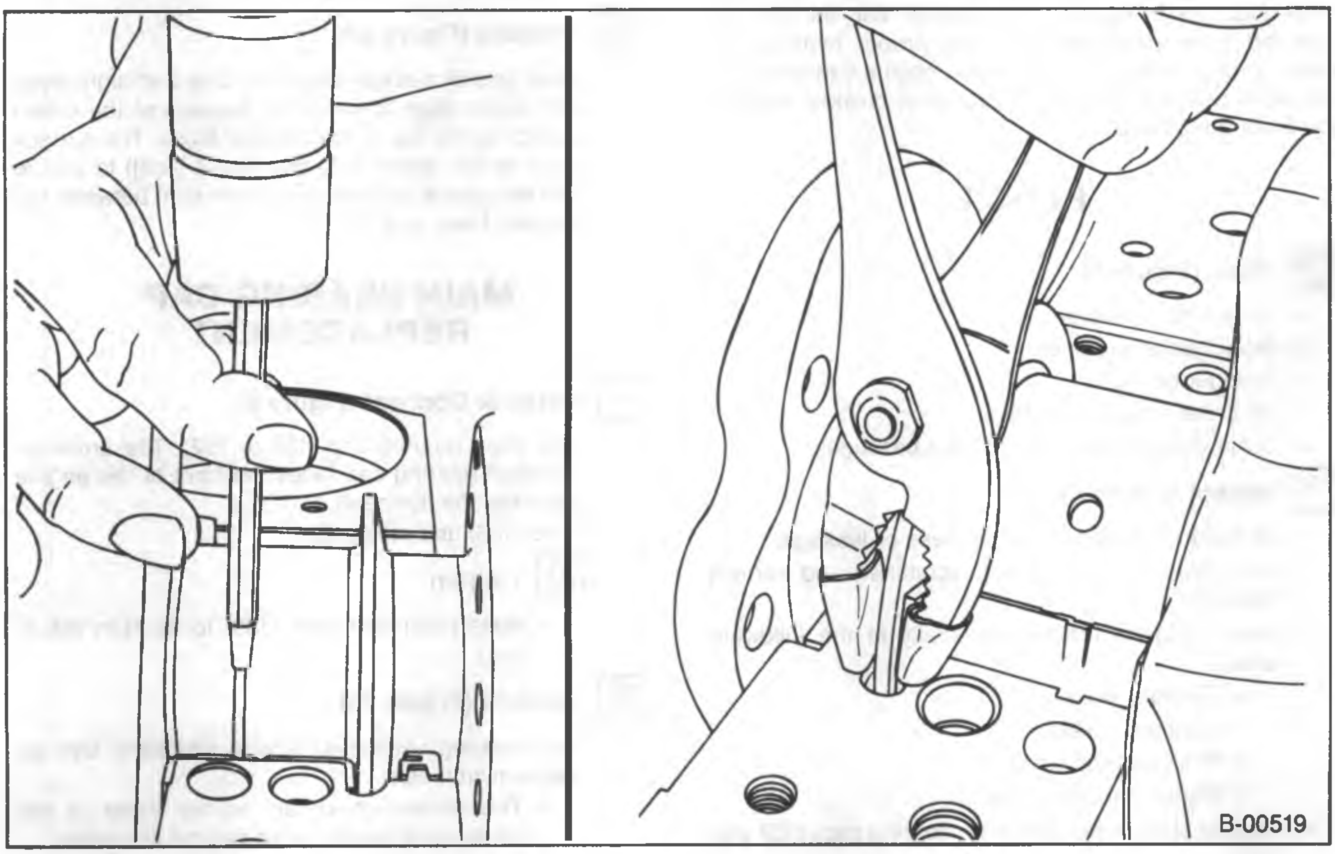


Figure 21—Removing the Upper Rear Main Bearing Insert

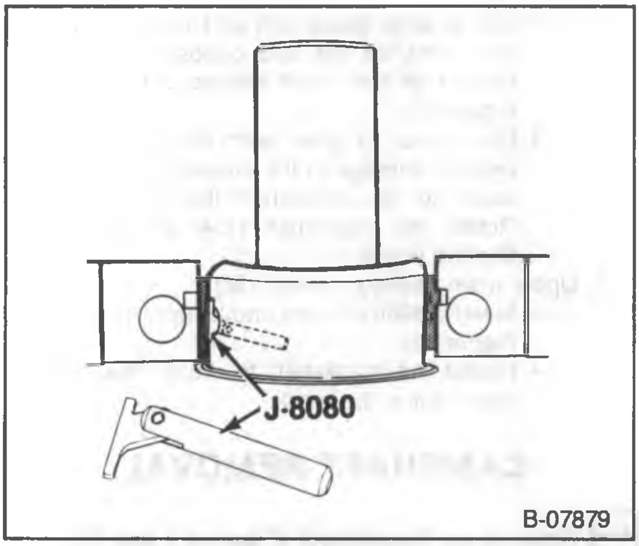


Figure 22—Removing the Upper Main Bearing Inserts

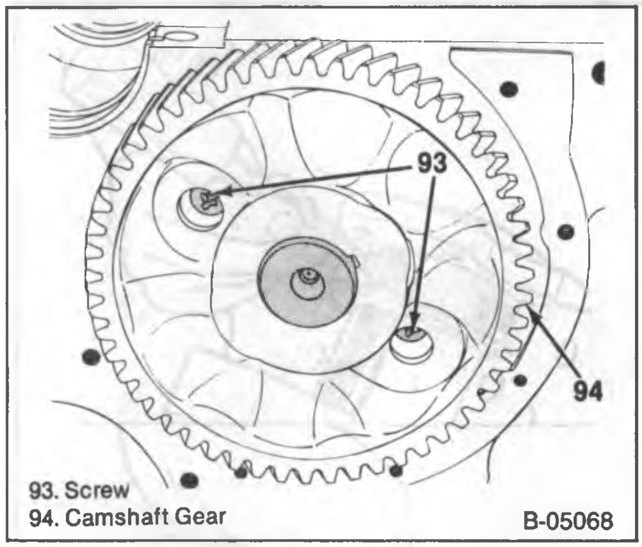


Figure 23—Camshaft Thrust Plate Screws

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean (Figure 5)

1. Block (115) in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
5. Scale deposits from the coolant passages.

Inspect (Figure 5)

1. All expansion plugs for looseness or leakage.
2. Valve lifter bores for deep scratches and varnish deposits.
3. Block (115) for cracks, especially in the following areas:
   - Cylinder walls.
   - Coolant jackets.
   - Main bearing webs.
   - Engine mount bosses.
4. Main bearing bores and main bearing caps (137 and 152).
   - All main bearing bores should be round and uniform in ID at all bearing supports.
   - The area where the main bearing inserts (130, 133, 136, and 153) contact the main bearing bore should be smooth.
   - If a main bearing cap is damaged and requires replacement, replace it as outlined later in this section.

Measure (Figure 24)

- Head gasket surface distortion. Use a straight edge and feeler gage to check for flatness of the milled surface at the top of the cylinder block. The surface must be flat (within 0.10 mm [0.004-inch]) to assure that the gasket will provide a tight seal between the cylinder head and block.

MAIN BEARING CAP REPLACEMENT

Install or Connect (Figure 5)

1. New main bearing cap (137 or 152). The arrow on the main bearing cap faces the front of the engine (opposite the flywheel).
2. Bolts (138) and stud (139).

Tighten

- Bolts (138) and stud (139) to 90 N·m (65 ft. lbs.).

Measure (Figure 25)

- Main bearing vertical ID (inside diameter). Use an inside micrometer.
  - This dimension should be the same as the other main bearing bore vertical diameters.
  - If it is necessary to increase the vertical ID, use an equal thickness of special service bearing cap shims at each side of the cap to

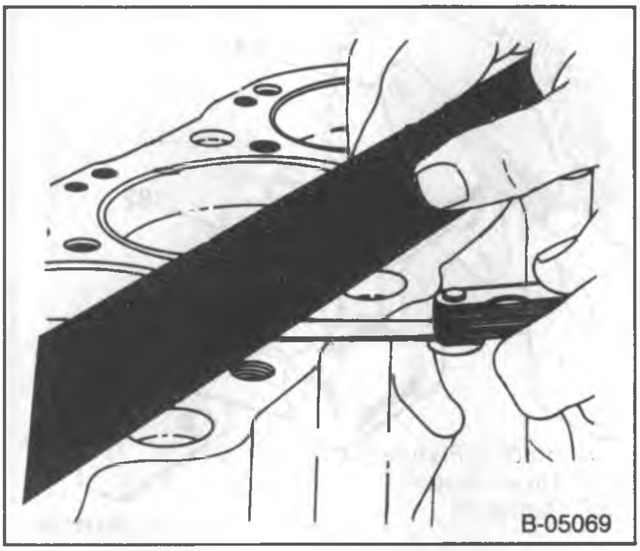


Figure 24—Checking the Block Gasket Surface

provide the same dimension as at the other bores. This is necessary to assure the proper "crush" on bearing inserts when the engine is assembled.

CYLINDER BORES

Inspect

- Cylinder walls for scoring or other damage.

Measure

- Cylinder out of round and taper. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER BORE RECONDITIONING

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

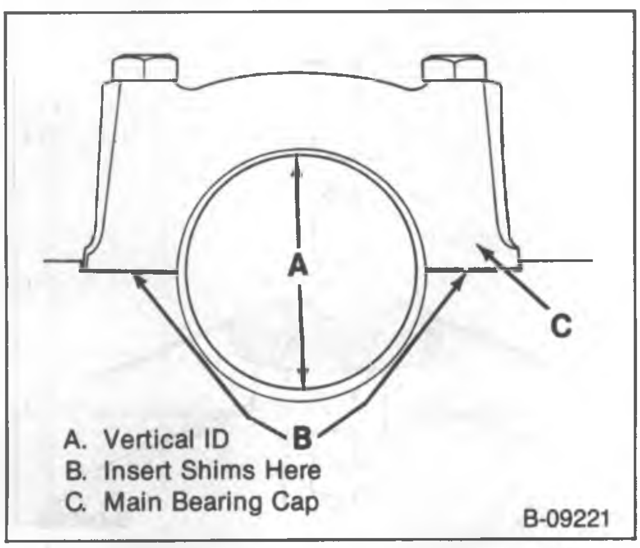


Figure 25—Main Bearing Cap Shim Location

PISTON AND CONNECTING ROD ASSEMBLIES

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Disassemble

- Components as required.

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Piston pin diameter and pin to piston clearance.
- Piston to bore clearance, and fit pistons as outlined.

Assemble

- Components as outlined.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

INTAKE AND EXHAUST MANIFOLDS

Disassemble (Figure 4)

1. Bolts (39) and washers (40).
2. Nuts (32).
3. Intake manifold (31) and exhaust manifold (37).
4. Gasket (36).

Clean

- Old pieces of gasket from the gasket surfaces.

Inspect

— Manifolds for cracks, broken flanges, etc.
— Gasket surfaces for heavy scratches.
— Manifold heat control valve (if used). The heat control valve is in the exhaust manifold. The thermostatic spring and anti-rattle spring must be in place and in good condition. The shaft should turn freely when weight is moved and the spring should return the shaft to its original position.

Measure

- Manifold distortion. Lay a straight edge along the full length of the exhaust port faces and measure any gaps between the straight edge and the port faces. If at any point a gap of 0.80 mm (0.030-inch) or more exists, it is likely that the manifold has distorted to a point where it will not seal properly. If a good exhaust seal is to be expected, the exhaust manifold must be replaced.

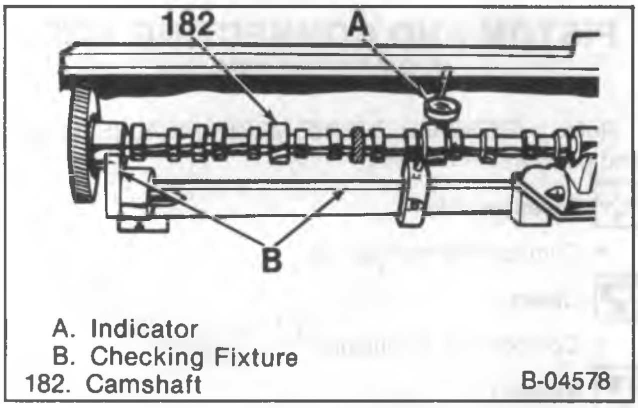


Figure 26—Measuring Camshaft Journal Runout

Assemble (Figure 4)

1. Gasket (36) to the exhaust manifold (37).
2. Intake manifold (31) and exhaust manifold (37).
3. Nuts (32), bolts (39) and washers (40). Leave the fasteners hand-tight until the manifold to cylinder head bolts are torqued. Refer to "Intake and Exhaust Manifold Installation."

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of hydraulic lifters must also be installed.

Inspect (Figures 5, 26, 27, and 28)

— Camshaft (182) lobes and journals for scratches, pitting, scoring, and wear.

— Timing gear (94) for damaged or missing teeth.

Measure (Figures 26, 27, and 28)

Tool Required:

J-7872 Dial Indicator (or equivalent)

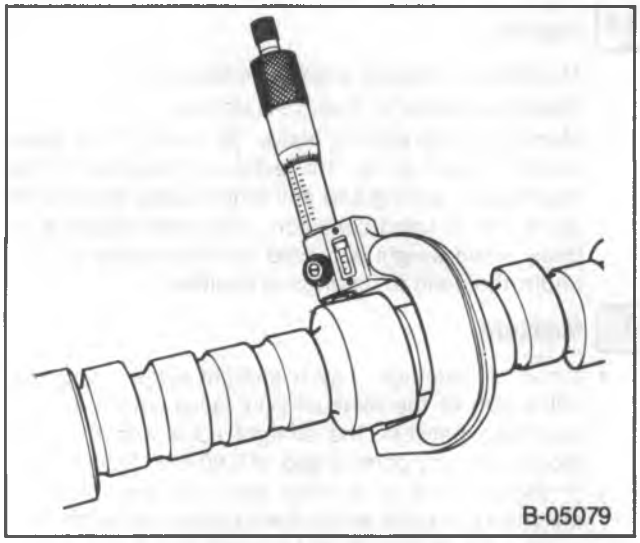


Figure 27—Checking the Camshaft Journals

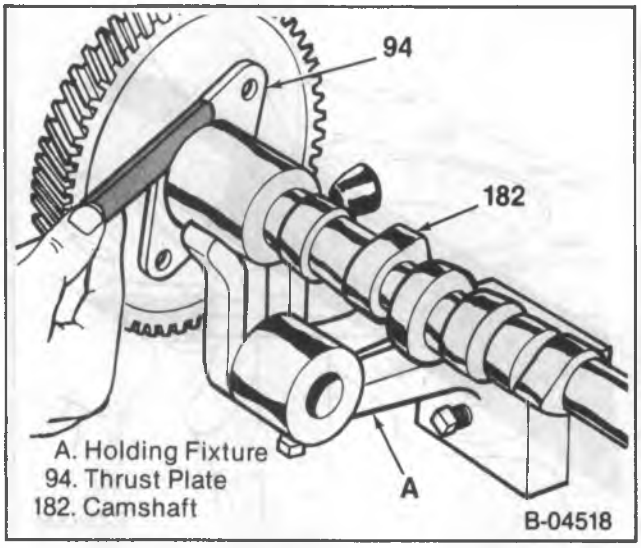


Figure 28—Measuring Camshaft Thrust Plate Clearance (Camshaft End Play)

— Camshaft (182) runout (figure 26). Mount the camshaft between centers or in V-blocks. Using J-7872 (or equivalent), check the intermediate camshaft journals. If runout exceeds 0.020-inch, the camshaft is excessively bent and should be replaced, along with the camshaft bearings.

— Camshaft journal out of round. Use a micrometer (figure 27). The proper diameter is 1.8677-1.8697-inch.

— Thrust plate (94) to camshaft (182) clearance. This clearance governs camshaft end play. Use a feeler gage (figure 28). Proper clearance is 0.003-0.008-inch. Excessive clearance indicates that the thrust plate is worn and should be replaced, as outlined following:

CAMSHAFT GEAR AND THRUST PLATE REPLACEMENT

Disassemble (Figures 5 and 29)

1. Camshaft gear (94).

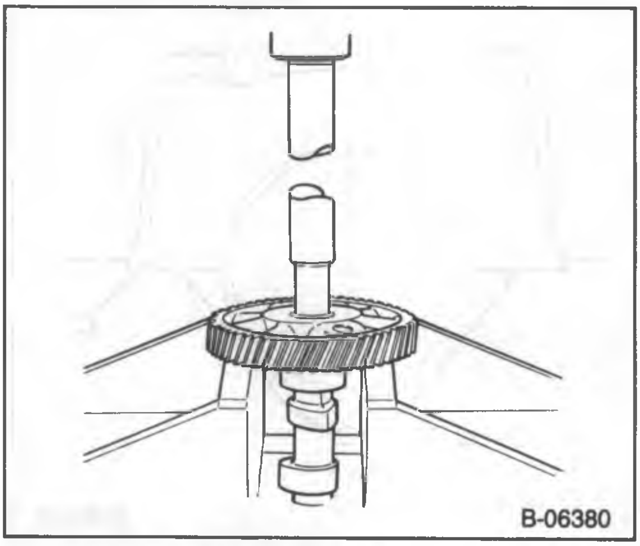
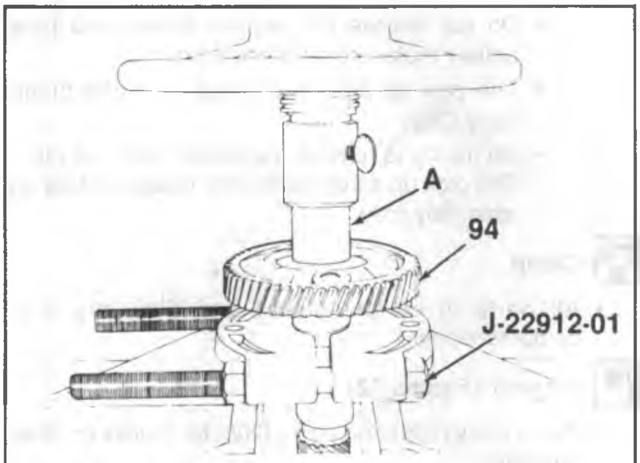


Figure 29—Removing the Camshaft Gear



A. Hollow Tube
94. Camshaft Gear
B-05080

Figure 30—Installing the Camshaft Gear

- Place the camshaft (182) in a press. Support the camshaft gear. DO NOT support the thrust plate (95).

NOTICE: The thrust plate must be positioned so that the key (96) does not damage it during the removal operation.

- Press the camshaft out of the camshaft gear.

2. Thrust plate.
3. Spacer (97).

Assemble (Figures 5 and 30)

Tool Required:

J-22912-01 Support Plate (or equivalent)

- Support the camshaft (182) at the front journal with tool J-22912-01 (or equivalent) (figure 30). Mount the camshaft in a press as shown.
- Lubricate the thrust plate (95) with engine oil.

1. Key (96) (if removed).
2. Spacer (97). Make sure the chamfer in the spacer faces towards the journal radius.
3. Thrust plate.
4. Camshaft gear (94).
   - MAKE SURE THAT THE TIMING MARK IS TO THE OUTSIDE.
   - Press the camshaft gear onto the camshaft until it bottoms on the spacer (figure 30).
   - Remove the camshaft from the press.

Measure (Figure 28)

- Camshaft to thrust plate clearance. Use a feeler gage (figure 28). The correct clearance is 0.003-0.008-inch.

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

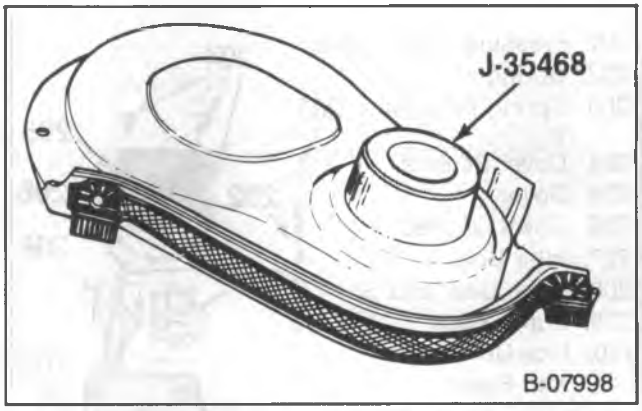


Figure 31—Installing the Front Crankshaft Gear

TIMING GEAR COVER

Clean

- Old gasket from the gasket surfaces.

Inspect

— Timing tab for damage.

— Timing gear cover for cracks, large dents, etc.

Disassemble (Figure 5)

- Seal (158). Pry the seal out with a screwdriver.

Assemble (Figure 31)

Tool Required:

J-35468 Seal Installer

- Seal (158). Use J-35468.
  - Support the inside of the front cover around the seal bore area.
  - Press the seal into place. The open end of the seal faces inside the front cover.
  - Lubricate the seal lips with grease.

WATER PUMP

Clean

- Old gasket from the gasket surface.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings' lubricant supply, and cause premature bearing failure.

Inspect

— Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.

— Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking, and the water pump should be replaced.

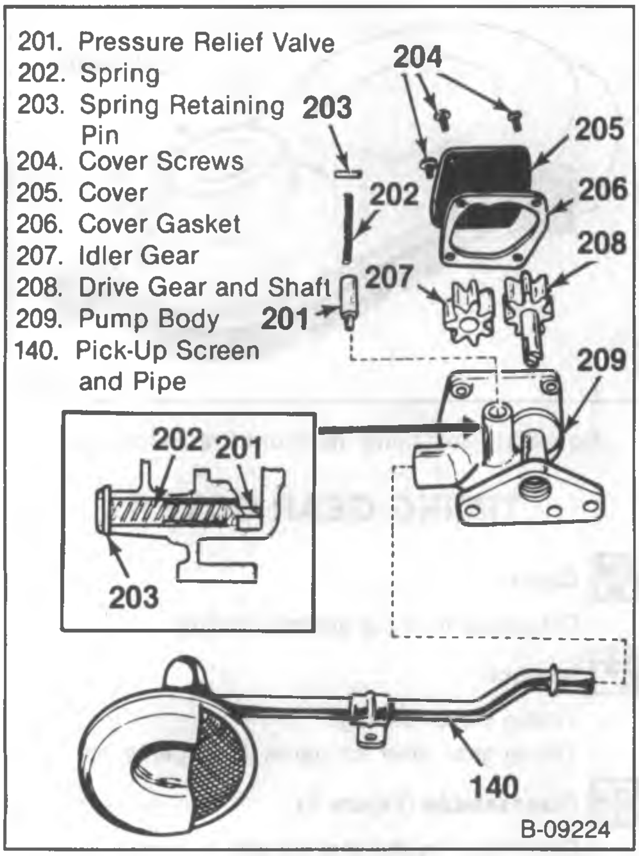


Figure 32—Oil Pump Components

OIL PAN AND ROCKER ARM COVER

Clean

- — Parts in solvent. Remove all sludge and varnish.
- — Old gaskets from the gasket surfaces.

Inspect

- — Gasket flanges for bending or damage.
- — Rubber grommets and parts on the rocker arm cover for deterioration.
- — Oil pan for rock damage or cracks.
- — Oil pan baffle for looseness.
- — Drain plug threads for stripping.

OIL PUMP

Disassemble (Figure 32)

1. Cover screws (204).
2. Cover (205).
3. Gasket (206).
   - Mark the gear teeth so the pump gears can be installed with the same gear teeth indexed.
4. Drive gear and shaft (208).
5. Idler gear (207).
6. Spring retaining pin (203).
7. Spring (202).
8. Pressure relief valve (201).
9. Pick-up screen and pipe (140).
   - Do not remove the pick-up screen and pipe unless replacement is required.
   - The pick-up pipe is a press fit in the pump body (209).
   - Do not try to remove the screen from the pipe. The pick-up screen and pipe is serviced as an assembly only.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect (Figure 32)

- — Pump body (209) and cover (205) for cracks or other damage.
- — Gears (207 and 208) for wear.
- — Drive gear and shaft (208) for looseness in the pump body (209).
- — Inside of the cover (205) for wear that would permit oil to leak past the ends of the gears.
- — The pump gears, cover, and body are not serviced separately.
- — Pressure relief valve (201) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Assemble (Figures 32 and 33)

Tool Required:

J-21882 Pick-up Tube and Screen Installer

1. Pressure relief valve (201).
2. Spring (202).
3. Spring retaining pin (203).
4. Drive gear and shaft (208).
5. Idler gear (207) in the pump body (209) with the smooth side of the gear toward the pump cover opening. Index the marks made during disassembly.
6. Gasket (206).
7. Cover (205) and screws (204).

   Tighten

   - Screws (204) to 7.9 N·m (70 in. lbs.).
- Turn the drive shaft by hand to check for smooth operation.

NOTICE: Be careful not to twist, shear or collapse the pipe while installing.

8. Pick-up screen and pipe (140) (if removed) (figure 33).
   - If the pick-up screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure.
   - Mount the oil pump in a soft-jawed vise.
   - Apply sealer to the end of the pipe.
   - Tap the pick-up screen and pipe into place, using J-21882 and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.

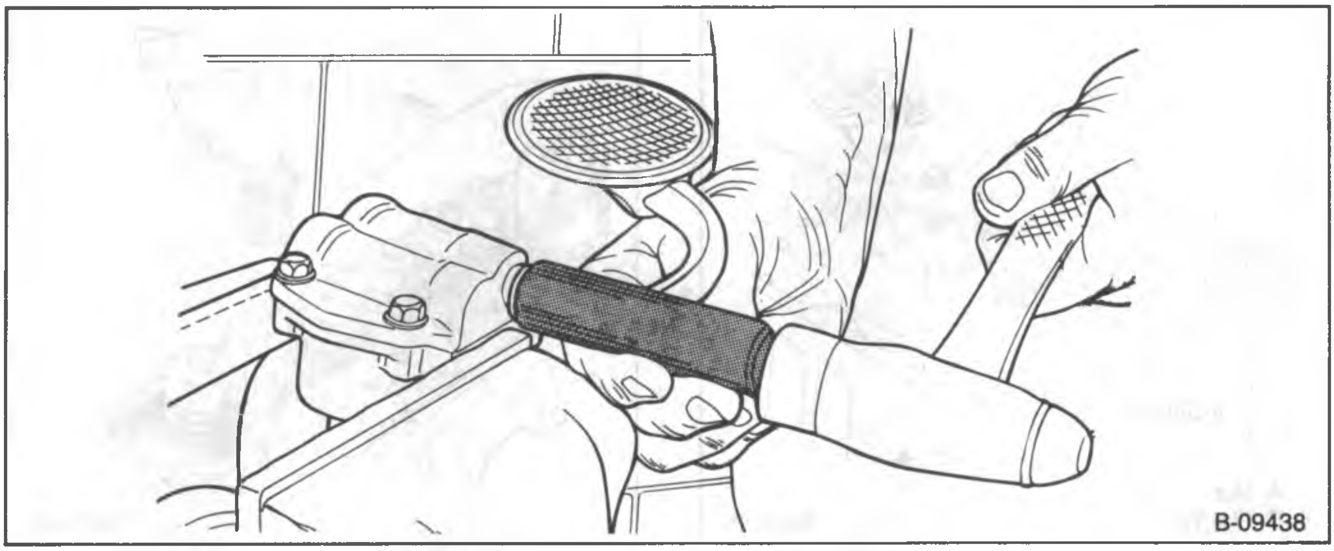


Figure 33—Installing the Oil Pump Screen and Pipe

VALVE TRAIN COMPONENTS

PUSHRODS, ROCKER ARMS, BALLS, AND NUTS

Clean

- Parts in solvent. Blow dry with compressed air. Make sure the oil passages in the pushrods are clear.

Inspect (Figure 4)

— Rocker arms (13) and balls (12) at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.

— Rocker arm areas which contact the valve stems, and the sockets which contact the pushrods (20). These areas should be smooth and free of damage and wear.

— Nuts (11). The nuts are prevailing torque nuts. At least 6.2 N·m (55 in. lbs.) torque should be required to thread the nuts onto the rocker arm studs. If not, it is possible that the nut(s) could back off during engine operation, causing loss of lash and valve train noise.

— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

— Ends of the pushrods for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

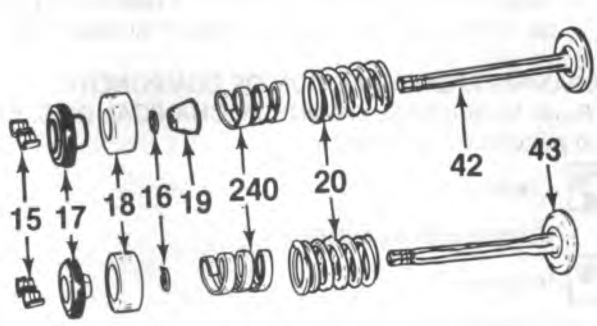
DISASSEMBLY

Disassemble (Figures 34, and 35)

Tool Required:

J-8062 Valve Spring Compressor

1. Valve keys (15).
   - Compress the valve springs (19), using J-8062 (figure 35).
   - Remove the valve keys.
   - Remove the tool.
2. Rotators (17), and shields (18).
3. Valve springs (20) and dampers (240).
4. O-ring seals (16) and seals (19).



15. Valve Key
16. O-ring Seal
17. Rotator
18. Shield
19. Seal
20. Spring
42. Intake Valve
43. Exhaust Valve
240. Damper

B-07999

Figure 34—Valves and Components

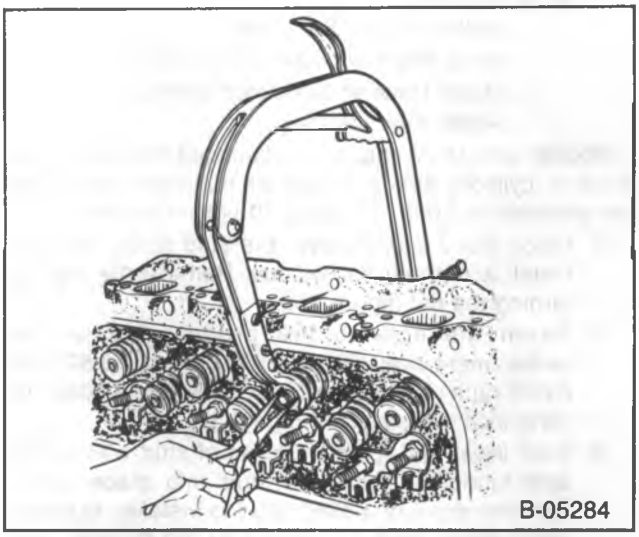


Figure 35—Compressing the Valve Springs

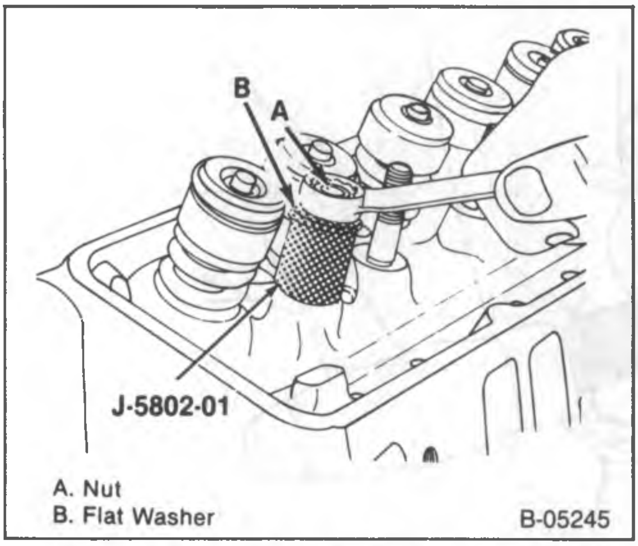


Figure 36—Removing the Rocker Arm Stud

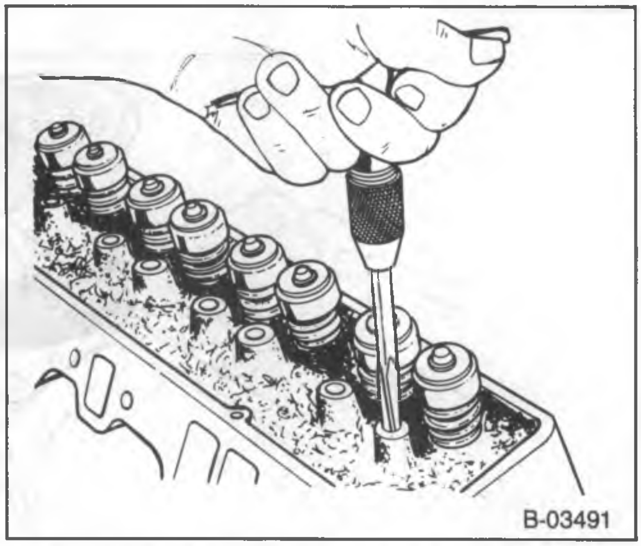


Figure 37—Reaming the Rocker Arm Stud Bore

5. Valves (42 and 43). Place them in a rack so they can be returned to their original position at assembly.

CLEANING AND INSPECTION OF COMPONENTS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Valve stem clearance.
- Valve spring tension and free length.

Other information outlined includes:

- Valve and seat grinding.
- Valve guide reaming.

ROCKER ARM STUD REPLACEMENT

Tools Required:

J-5802-01 Stud Remover
J-5715 Reamer (0.003-inch oversize) or
J-6036 Reamer (0.013-inch oversize)
J-6880 Stud Installer

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced. New studs are available in 0.003-inch and 0.013-inch oversize.

1. Place tool J-5802-01 over the stud to be removed. Install a nut and flat washer. Remove the stud by turning the nut (figure 36).
2. Ream the hole to the proper size for the replacement oversize stud. Use reamer J-5715 for 0.003-inch oversize studs; reamer J-6036 for 0.013-inch oversize stud (figure 37).
3. Coat lower end (press-fit area) of stud with hypoid axle lubricant. Drive the stud into place with a hammer and tool J-6880. Stud is installed to proper depth when the tool bottoms on the cylinder head (figure 38).

ASSEMBLY

Assemble (Figures 34, 35, and 39)

Tools Required:

J-8062 Valve Spring Compressor
J-23738-A Vacuum Pump

1. New seals (19) (intake valves only). Install the seals over the valve guides and seat them against the head.
2. Valves (42 and 43).
   - Lubricate the valve stems with engine oil.

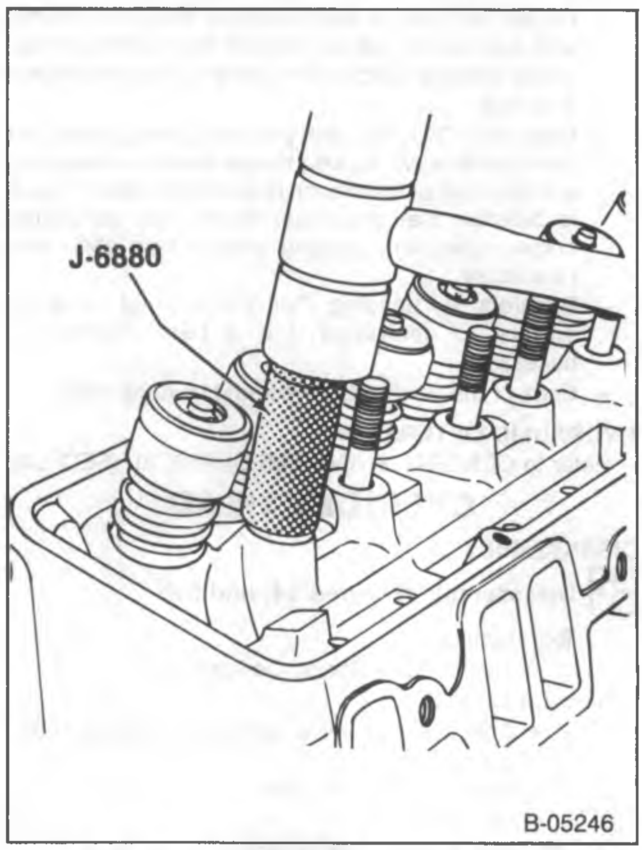


Figure 38—Installing the Rocker Arm Stud

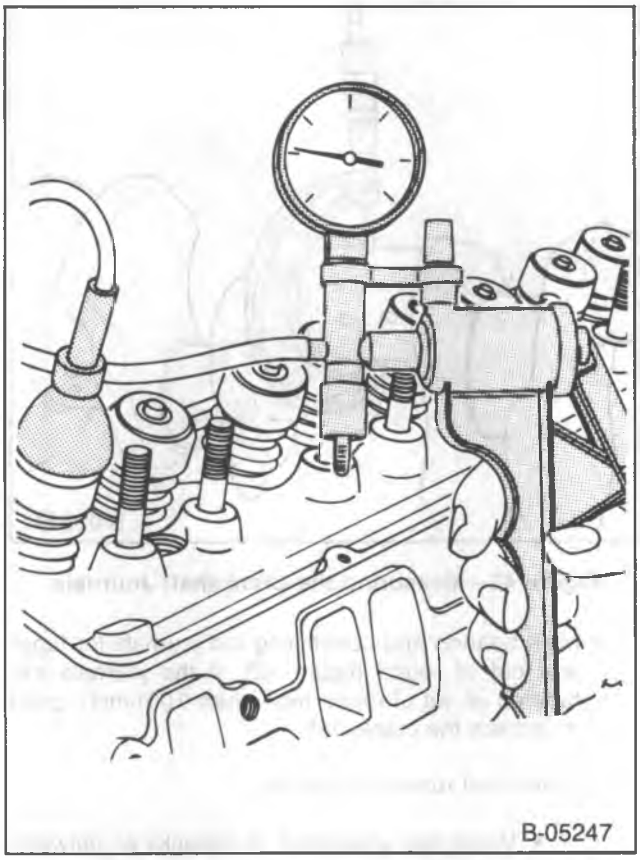


Figure 39—Checking the Valve Seals

- Insert the valves into the proper ports.

3. Valve spring shims (if used).
4. Valve springs (20) with dampers (240).
5. Shields (18).
6. Rotators (17).
7. O-ring seals (16) and valve keys (15).
   - Compress the valve spring, using J-8062 (figure 35). Compress the spring enough so the lower valve stem groove can be clearly seen.
   - Push a new O-ring seal onto the valve stem. The seal is to be installed on the stem's lower groove. Make sure the seal is flat and not twisted.
   - Apply grease to the area of the upper valve stem groove. Assemble the two valve keys, using the grease to hold the keys in place. Make sure the keys seat properly in the groove.
   - Release the compressor tool. Make sure the valve keys stay in place.
   - Repeat the preceding steps on the remaining valves.
   - Check each valve stem seal, using J-23738-A (figure 39). Place the adapter cup over the shield (18). Operate the vacuum pump. Observe the vacuum pump gage. No air should be able to leak past the seal. If the O-ring seal will not hold a vacuum, it may have been damaged or improperly installed.

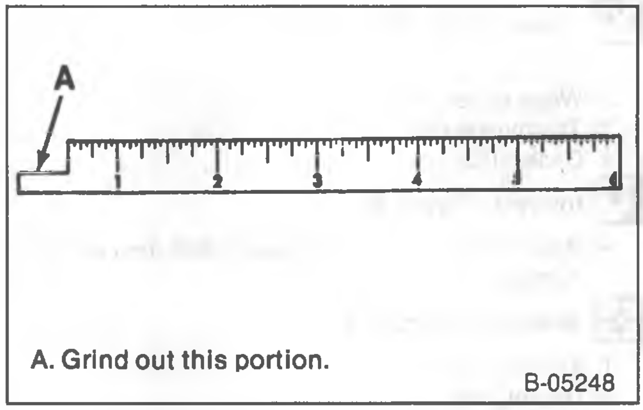


Figure 40—Scale for Checking Valve Spring Installed Height

Measure (Figures 34, 40, and 41)

- Valve spring installed height of each valve spring.

1. Use a narrow, thin scale. A cutaway scale (figure 40) may be helpful.
2. Measure from the valve shim or spring seat to the top of the shield (18) (figure 41).
3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims of sufficient thickness (between the spring and cylinder head) to give the desired measurement. NEVER shim the spring so as to give an installed height under the specified figure.

THERMOSTAT AND HOUSING

The thermostat is located in a housing bolted to the front of the cylinder head (figure 4).

Thermostats consist of a restriction valve controlled by a thermostatic element. The restriction valve cracks or just starts to open at a predetermined temperature and continues to open as the engine coolant temperature increases. To assure proper cooling and engine warm-up it is important that the correct thermostat be used. Refer to the proper Truck Service Manual for the correct thermostat application.

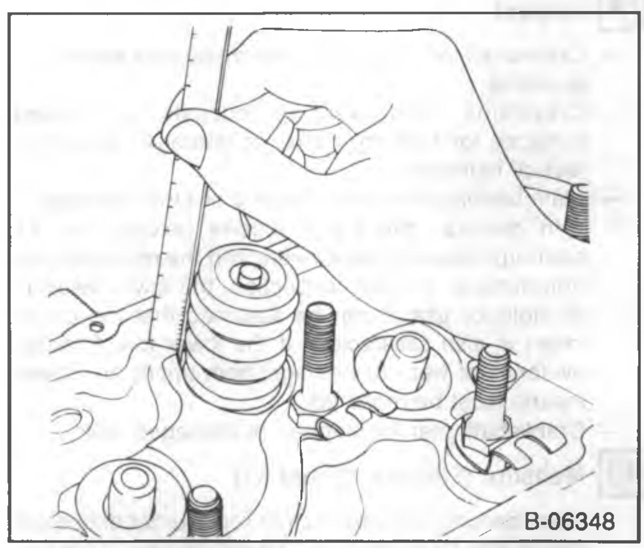


Figure 41—Measuring Valve Spring Installed Height

Disassemble (Figure 4)

1. Bolts (55).
2. Water outlet (54).
3. Thermostat (52).
4. Gasket (53).

Inspect (Figure 4)

- Water outlet (54) and housing (50) for cracks or damage.

Assemble (Figure 4)

1. Thermostat (52).
2. Gasket (53).
3. Water outlet (54).
4. Bolts (55).

Tighten

- Bolts (55) to 40 N·m (30 ft. lbs.).

TORSIONAL DAMPER

inspect

— Torsional damper weight for looseness or signs of shifting on the hub. Replace as needed.

— Area of the torsional damper hub shaft which contacts the front crankshaft seal for roughness or nicks. Replace the damper if this condition exists.

CRANKSHAFT AND BEARINGS

CLEANING AND INSPECTION

Clean

— Crankshaft with solvent.
  — Do not scratch the bearing journals.
  — Blow all sludge from the oil passages with compressed air.

— Main bearing inserts. Wipe free of oil with a soft cloth.

Inspect

— Crankshaft for cracks. Use the magnaflux method, if available.

— Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.

— Main bearing inserts for scoring or other damage.

In general, the lower inserts (except the #1 bearing) shows a greater wear and the most distress from fatigue. If, upon inspection, the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert shows evidence of wear or damage, both upper and lower inserts must be replaced.

— Crankshaft gear for chipped or damaged teeth.

Measure (Figures 42 and 43)

— Main bearing and connecting rod journal diameters (figure 42). Compare with "Specifications." Grind or replace the crankshaft if necessary.

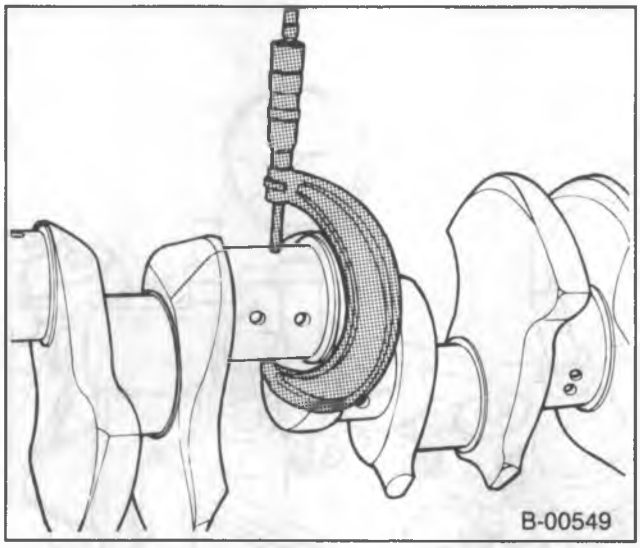


Figure 42—Measuring the Crankshaft Journals

— Main bearing and connecting rod journals for taper and out of round (figure 42). If the journals are tapered or out of round more than 0.001-inch, grind or replace the crankshaft.

— Crankshaft runout (figure 43).

- Mount the crankshaft in V-blocks or between centers.
- Use a dial indicator as shown.
- If the main bearing journals are misaligned, the crankshaft is bent and must be replaced along with the main bearings.

CRANKSHAFT GRINDING

A "tufftriding" hardening process is applied to crankshaft journals used in engines covered by this manual. The crankshaft should not be reground unless it can be tufftrided after grinding.

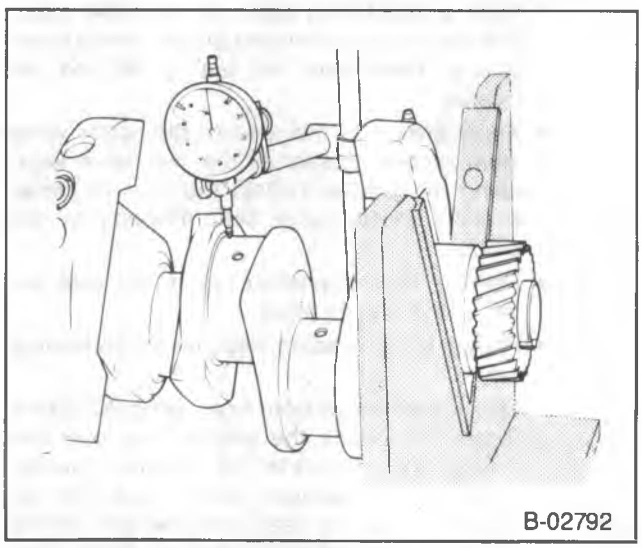


Figure 43—Checking Crankshaft Runout

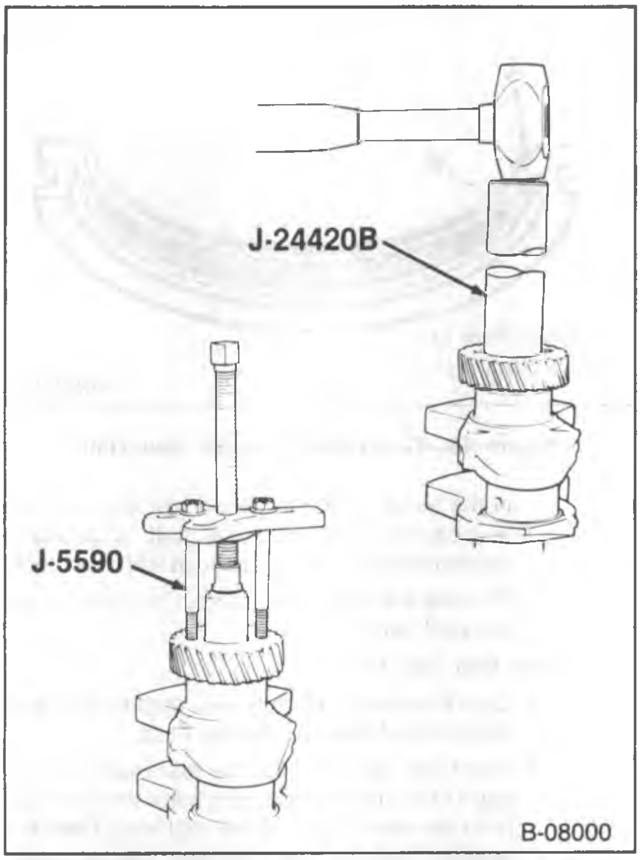


Figure 44—Replacing the Crankshaft Gear

CRANKSHAFT BEARING AVAILABILITY

Main bearings are available in standard and 0.001, 0.002, 0.010, 0.020, and 0.030-inch undersizes. Connecting rod bearings are available in standard and 0.001, 0.002, 0.010, and 0.020-inch undersizes.

CRANKSHAFT GEAR REPLACEMENT

Disassemble (Figure 44)

Tool Required:
J-24420-B Puller

- Crankshaft gear, using J-24420-B.

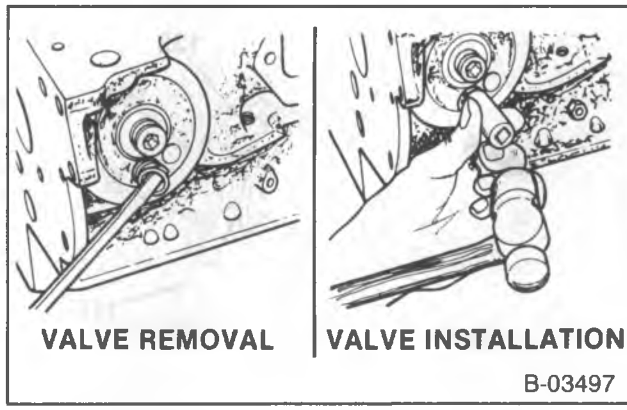


Figure 45—Replacing the Oil Filter Bypass Valve

Assemble (Figure 44)

Tool Required:
J-5590 Gear Installer

- Crankshaft gear, using J-5590.
- Make sure the timing mark faces outside.

OIL FILTER RELIEF VALVE REPLACEMENT

Disassemble (Figure 45)

- Oil pressure relief valve. Use a screwdriver to pry it from the block.

Assemble (Figure 45)

- Oil pressure relief valve. Use a $^{9}/_{16}$-inch, thin wall, deep socket to tap it into place.

ASSEMBLY OF ENGINE

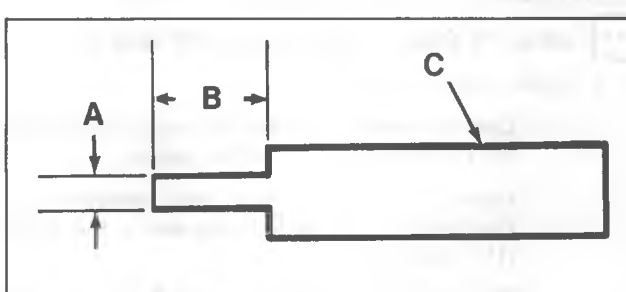
PRIOR TO ASSEMBLY

The importance of cleanliness during the assembly procedure cannot be overstressed. Dirt will cause premature wear of the rebuilt engine.

Lubricate all moving parts lightly with engine oil or engine assembly lubricant (unless specified otherwise) during assembly. This will provide initial lubrication when the engine is started.

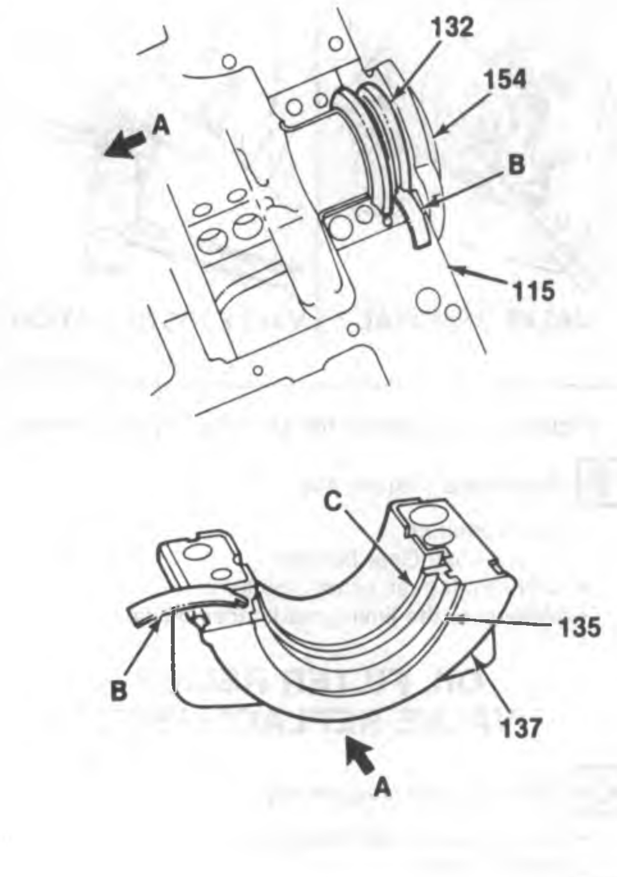
CRANKSHAFT REAR OIL SEAL INSTALLATION

An oil seal installation tool (figure 46) should be fabricated (if not provided in the seal kit) to prevent seal damage during installation. Extreme care should be



A. 4 mm ($^{11}/_{64}$-inch)
B. 13 mm ($^{1}/_{2}$-inch)
C. 0.10 mm (0.004-inch) shim stock
B-05250

Figure 46—Oil Seal Installation Tool



A. Forward
B. Fabricated Tool
C. Oil Seal Lip
115. Block
132. Upper Seal Half
135. Lower Seal Half
137. Rear Main Bearing Cap
154. Crankshaft

B-05251

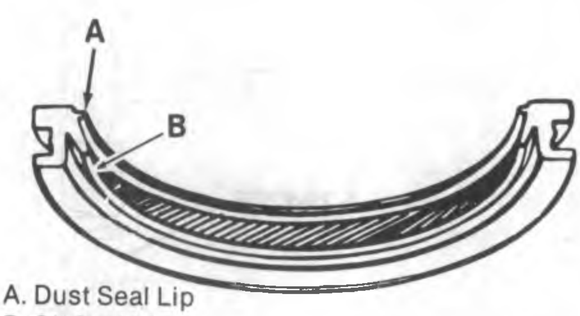
Figure 47—Crankshaft Rear Oil Seal Installation

exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal.

WITH CRANKSHAFT INSTALLED

Install or Connect (Figures 5, 47, and 48)

1. Upper seal half (132).
   - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
   - Position the tip of the tool between the crankshaft (154) and the seal seat in the block (115) (figure 47).
   - Position the seal half between the crankshaft and tip of the tool. Make sure that the oil seal lip is positioned toward the front of the engine (figure 47).
   - Roll the seal around the crankshaft using the tool as a "shoe-horn" to protect the seal bead from the sharp corner of the seal seat surface



A. Dust Seal Lip
B. Oil Seal Lip

B-05252

Figure 48—Crankshaft Rear Oil Seal Half

in the block. The installation tool must remain in position until the seal half is properly positioned with both ends flush with the block.
   - Remove the tool, being careful not to withdraw the seal half.
2. Lower seal half (135).
   - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
   - Insert the seal half into the rear main bearing cap (135). Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure. Make sure the oil seal lip faces the front of the engine (figure 48).
3. Rear main bearing cap (135) as outlined later.

WITH CRANKSHAFT REMOVED

Install or Connect (Figures 5 and 48)

1. Upper seal half (132).
   - Insert the seal half in the block (115), using the installation tool to protect the back sealing bead of the seal from the sharp corner of the block. Position the seal and the tip of the tool so that the seal contacts the tool. Make sure that the oil seal lip is positioned toward the front of the engine (figure 79).
   - Feed the seal into position gradually, using the tool as a "shoe-horn" to protect the seal outer diameter from damage. The tool must remain in position until the seal is properly in position, with both ends flush with the block.
   - Remove the tool, being careful not to withdraw the seal.
2. Lower seal half (135).
   - Insert the seal half into the rear main bearing cap (135). Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure.
   - Make sure the oil seal lip faces the front of the engine (figure 48).
   - Coat the seal lips lightly with engine oil. Keep the oil off of the oil seal mating ends.

MAIN BEARING INSTALLATION (WITH CRANKSHAFT INSTALLED)

Refer to "Crankshaft and Main Bearing Installation," later in this section for main bearing insert sizing information.

Install or Connect (Figures 5 and 21)

Tool Required:
J-8080 Main Bearing Remover/Installer

1. Upper rear main bearing insert (133).
   - Apply engine oil to an insert of the proper size.
   - Insert the plain end (without the bearing tang) of the insert between the crankshaft journal and the notched side of the block (115).
   - Use pliers with taped jaws to clamp the bearing to the crankshaft (154) as shown in figure 21. Rotate the crankshaft to "roll" the insert into the block. Then seat the insert using a small drift and hammer.
2. Lower rear main bearing insert (136).
   - Apply engine oil to an insert of the proper size.
   - Press the insert into the rear main bearing cap (137).
3. Upper main bearing inserts (130).
   - Insert J-8080 into a crankshaft main bearing oil hole.
   - Apply engine oil to inserts of the proper size.
   - Insert the plain end (without the bearing tang) of the insert between the crankshaft (154) and the notched side of the block (115).
   - Rotate the crankshaft (154) to "roll" the insert into the block.
   - Remove J-8080.
4. Lower main bearing inserts (153) to the main bearing caps (152).
   - Make sure the inserts are of the proper size.
   - Apply engine oil to the inserts.
5. Main bearing caps (137 and 152). Refer to "Crankshaft and Main Bearing Installation" later in this section.

Measure

- Main bearing clearance and crankshaft end play. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CRANKSHAFT AND MAIN BEARING INSTALLATION

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are found to be excessive, a new bearing, plus both upper and lower inserts will be required. Service main bearings are available in standard size and 0.001-inch, 0.002-inch, 0.010-inch, 0.020-inch and 0.030-inch undersize.

Selective fitting of the main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may use one standard insert with one 0.001-inch undersize insert which will decrease the clearance 0.0005-inch from using two standard inserts.

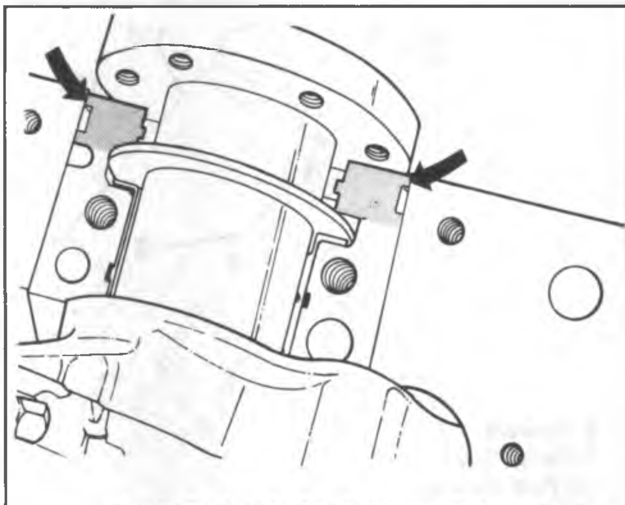


Figure 49—Applying Sealant to the Block

MAIN BEARING SELECTION

The simplest, most accurate way to measure main bearing clearance is with the use of gaging plastic. This wax-like material compresses evenly between the bearing and journal surfaces without damaging them. Proceed as follows:

Install or Connect (Figure 5)

1. Upper main bearing inserts (130 and 133) to the block (115).
   - If any undersized bearings are used, make absolutely certain they are fitted to the proper journal.
2. Crankshaft (154). Take care not to damage the thrust areas.
3. Lower bearing inserts (136 and 153) to the bearing caps (137 and 153).

   Measure

   - Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

- Apply oil to the main bearing inserts.

4. Rear main bearing cap (137).
   - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 49). Do not allow any sealant on either crankshaft or rear oil seal.
   - Install the rear main bearing cap.
5. Bolts (138).

   Tighten

   - Bolts (138) to 14 N·m (10 ft. lbs.).
6. Main bearing caps (152) with the selected lower main bearing inserts (153). Be sure to put the main bearing caps in their original locations, with the arrows facing the front of the engine.
7. Bolts (138 and 139). Make sure the special bolt (139), which retains the oil pump screen bracket, is installed in the proper position. (#5 main bearing cap, camshaft side hole.)

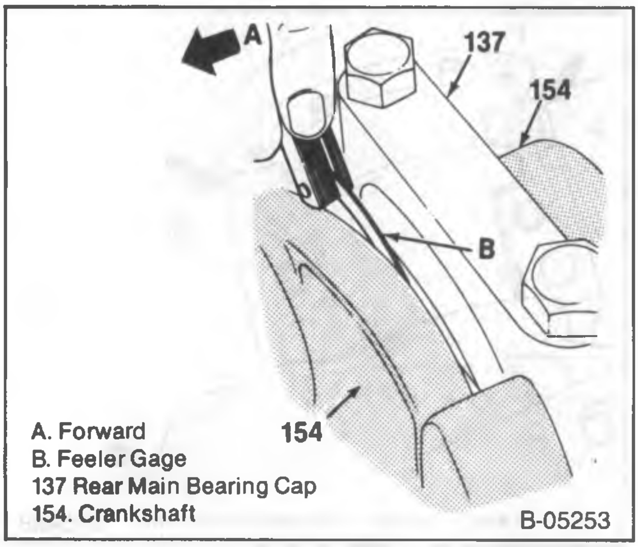


Figure 50—Measuring Crankshaft End Play

Tighten

- All bolts (138 and 139) EXCEPT THE REAR MAIN BEARING CAP BOLTS to 90 N·m (65 ft. lbs.).

Measure (Figure 50)

- Crankshaft end play.
  1. Tap the end of the crankshaft (154) first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  2. Tighten the rear main bearing cap bolts (138) to 90 N·m (65 ft. lbs.).
  3. With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 50). The proper clearance is 0.002-0.006-inch.

Inspect

- Crankshaft (154) for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the bolts (138 and 139), one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

CAMSHAFT INSTALLATION

Install or Connect (Figures 5 and 51)

- Coat the camshaft lobes with Engine Oil Supplement (GM part number 1051396) or equivalent. Coat the bearing journals with engine oil.

1. Camshaft (182) into the block (115). Take care not to damage the camshaft bearings (98 and 99).

Important

- Align the timing marks (figure 51).

2. Screws (93).

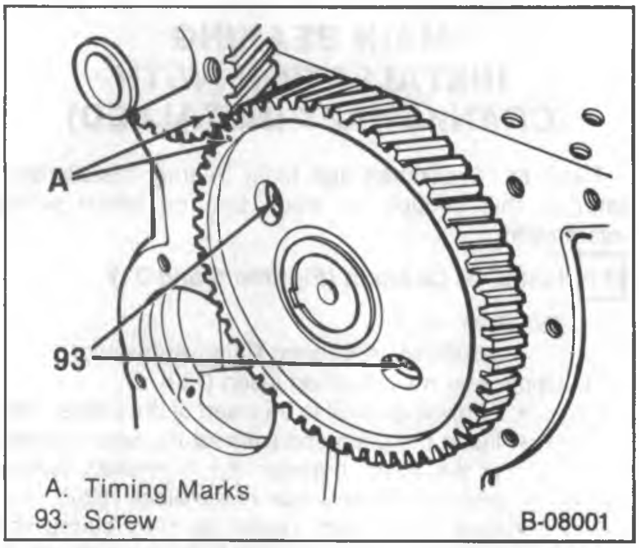


Figure 51—Timing Marks and Thrust Plate Screws

Tighten

- Screws (93) to 9.0 N·m (80 in. lbs.).

TIMING GEAR COVER INSTALLATION

Install or Connect (Figures 5 and 52)

Tool Required:

J-35468 Seal Installer and Centering Tool

- Apply engine oil to the lips of the seal (158).

1. J-35468 to the seal (158). The tool is necessary to properly "center" the front seal on the crankshaft. If the seal is not centered, it may be damaged when the vibration damper is installed, or it may fail prematurely.
2. Gasket (166) to the block (115).
3. Timing gear cover (157), with the tool, to the block (115) (figure 52).
4. Bolts (164).

Tighten

- Bolts (164) to 9.0 N·m (80 in. lbs.).

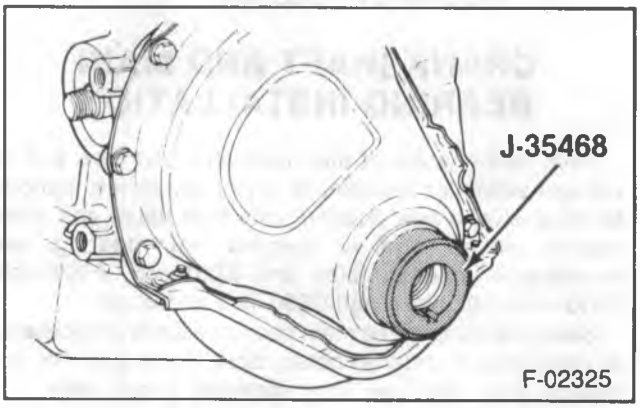


Figure 52—Front Cover Centering Tool

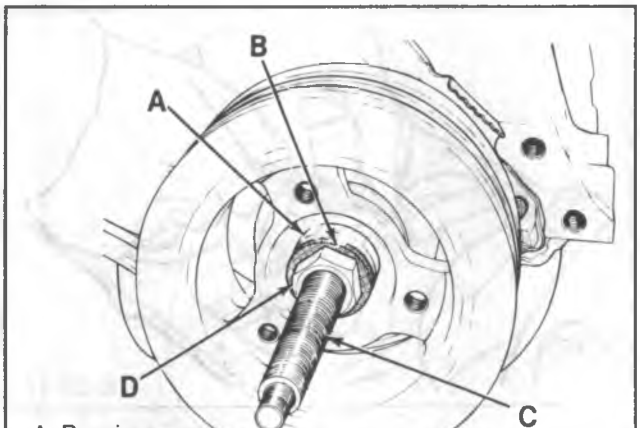


Figure 53—Installing the Torsional Damper

Remove or Disconnect (Figure 5)

- J-35468 from the seal (158).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figures 5 and 53)

Tool Required:

J-23523-E Torsional Damper Remover/Installer

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the damper.

1. Key (163).
2. Stud (item C, figure 53) to the crankshaft (154). Thread the stud fully into the tapped end of the crankshaft.
3. Torsional damper (162) over the end of the stud. Align the keyway in the vibration damper shaft with the crankshaft key.
4. Bearing, washer, and nut (figure 53).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
5. Bolt (160) and washer (161).

Tighten

- Bolt (160) to 80 N·m (60 ft. lbs.).

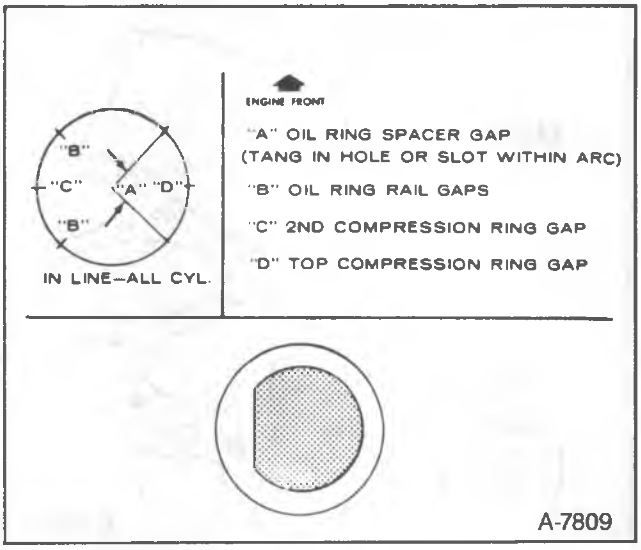


Figure 54—Piston Ring Gap Location

PISTON AND CONNECTING ROD INSTALLATION

CONNECTING ROD BEARING SELECTION

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.001-inch and 0.002-inch undersize for use with new and used standard size crankshafts, and in 0.010-inch and 0.020-inch undersize for use with reconditioned crankshafts.

The simplest, most accurate way to measure connecting rod bearing clearance is with the use of gaging plastic. This wax-like material compresses evenly between the bearing and journal surfaces without damaging them.

Selective fitting of the bearing inserts is necessary to obtain close tolerances. For this reason you may use, for example, one standard insert with one 0.001-inch undersize insert, which will decrease the clearance 0.0005-inch from using two standard inserts.

Install or Connect (Figures 5 and 54 through 56)

Tools Required:

J-5329 Connecting Rod Guide Set
J-8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder. Refer to "Piston and Connecting Rod Assemblies," previously in this section.

1. Connecting rod bearing inserts (112 and 113).
   - Be certain that the inserts are of the proper size.
   - Install the inserts in the connecting rod (108) and connecting rod cap (110).
2. Piston (107) and connecting rod (108) to the proper bore.

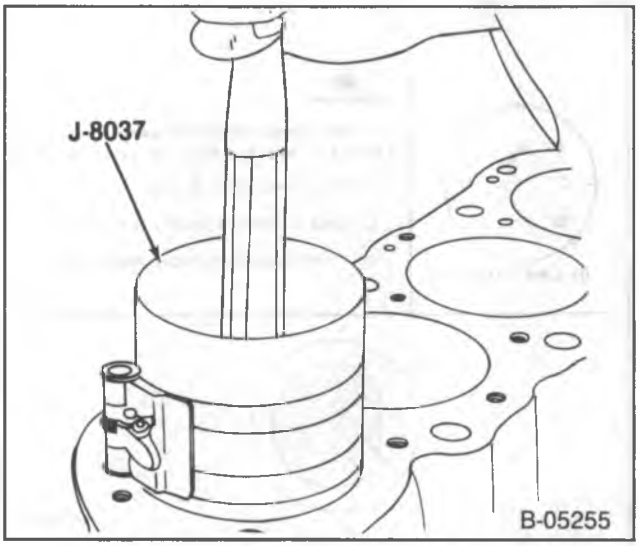


Figure 55—Installing the Piston

- With the connecting rod cap removed, install J-5329 onto the connecting rod studs (69).
- Locate the piston ring end gaps as shown in figure 87. Lubricate the piston and rings (101, 102, and 105) with engine oil.
- Locate the ring end gaps as shown in figure 54.
- Without disturbing the ring end gap location, install J-8037 over the piston (figure 55).
- The piston must be installed so that the piston crown depression's flat side faces to the engine's left side (figure 56).
- Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 55). At the same time, guide the connecting rod into piston on the crankpin, using the J-5329 Guide Tool. Hold the ring compressor against the block until all rings have entered the cylinder bore.

3. Connecting rod cap (110) with the lower connecting rod bearing insert.

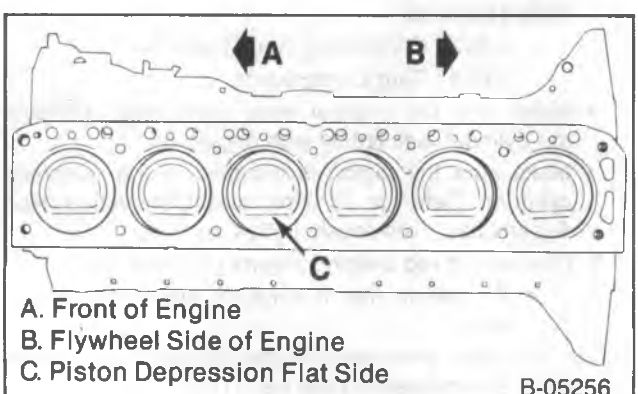


Figure 56—Pistons Installed

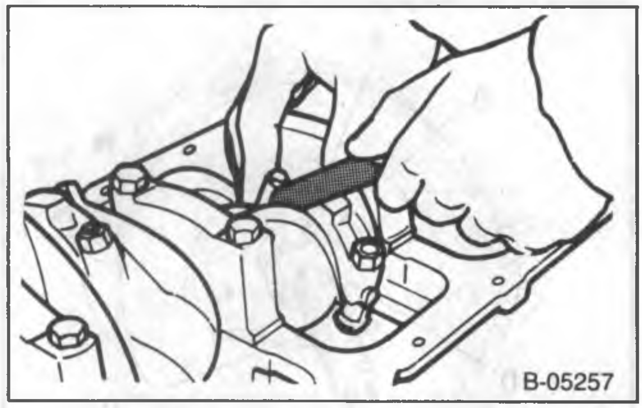


Figure 57—Measuring Connecting Rod Side Clearance

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A). Then apply engine oil to the connecting rod bearing.

4. Nuts (111).

Tighten

- Nuts (111) to 80 N·m (60 ft. lbs.).

Measure (Figure 57)

- Connecting rod side clearance. Use a feeler gage. The proper clearance is 0.006-0.017-inch.

OIL PUMP INSTALLATION

Install or Connect (Figure 5)

1. Oil pump (151).
2. Bolts (148) and nut (149).

Tighten

- Bolts (148) to 13.0 N·m (115 in. lbs.).
- Nut (149) to 34 N·m (26 ft. lbs.).

OIL PAN INSTALLATION

Install or Connect (Figure 5)

1. Rear oil pan seal (141).
2. Front oil pan seal (147).
3. Gaskets (142).
4. Oil pan (146).
5. Bolts (145).

Tighten

— 1/4-20 bolts to 9.0 N·m (80 in. lbs.).

— 5/16-18 bolts (except oil pan [146] to front cover [157] bolts) to 18.6 N·m (165 in. lbs.).

— Oil pan (146) to front cover (157) bolts to 5.1 N·m (45 in. lbs.).

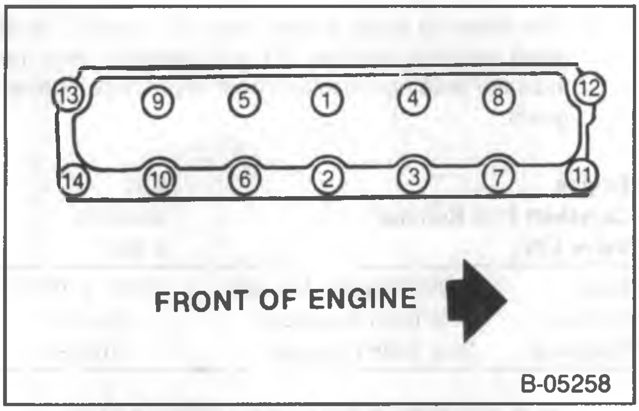


Figure 58—Cylinder Head Bolt Tightening Sequence

CYLINDER HEAD INSTALLATION

Clean (Figures 4 and 5)

— Gasket surfaces on the block (115) and cylinder head (26).

— Threads for cylinder head bolts in the block (115).

Install or Connect (Figures 4, 5 and 58)

1. Head gasket (33).
   - On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

     Use no sealer on engines using a composition STEEL ASBESTOS gasket.
   - Place the gasket in position over the dowel pins with the bead up.
2. Cylinder head (26). Carefully guide the cylinder head into place over the dowel pins and head gasket (33).
3. Bolts (21) and stud (59).
   - Coat the threads of the cylinder head bolts and stud with sealing compound (Loctite #592 or equivalent).
   - Install finger tight.

Tighten

- Bolts (21) and stud (59) a little at a time, using the sequence shown in figure 58. The proper torques are as follows:
  - — Left-hand front bolt 115 N·m (85 ft. lbs.).
  - — All others: 130 N·m (95 ft. lbs.).

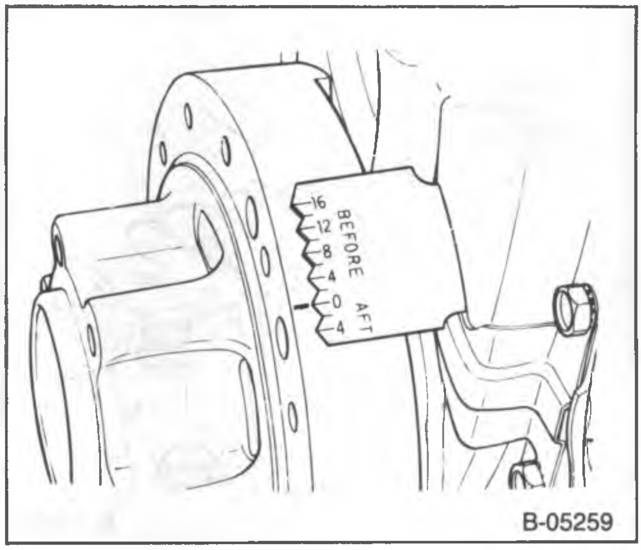


Figure 59—Timing Marks (Typical)

VALVE TRAIN COMPONENT INSTALLATION

Important

- Replace all hydraulic lifters if a new camshaft was installed.

Install or Connect (Figures 4 and 5)

- Lubricate the hydraulic lifters (100) with Engine Oil Supplement (GM part number 1051396) or equivalent.

1. Hydraulic lifters (100) into their mating bores in the block (115).
2. Pushrods (20). Seat the pushrods into the socket in the lifters (100).
   - Coat the mating surfaces of the rocker arms (13) and balls (12) with a molybdenum disulfide grease.
3. Rocker arms (13).
4. Balls (12).
5. Nuts (11).

VALVE ADJUSTMENT

Adjust the valves when in contact with the cam base circle, as follows:

1. Turn the crankshaft until the timing mark on the vibration damper is lined up with the "0" mark on the timing marker (figure 59) and cam lobes #7 and #9 (counted from the front of the engine) are up.
2. Turn the adjusting nuts for rocker arm numbers 4, 6, 8, 10, 11, and 12 (counted from the front of the engine) until there is no free lash at the pushrod (figure 60). Then tighten the nut one full additional turn (to center the lifter plunger).
3. Crank the engine one full turn (360 degrees) until the damper timing mark and the "0" mark on the timing marker are again in alignment. Cam lobes #4 and #6 are now up.
4. Adjust rocker arm numbers 1, 2, 3, 5, 7, and 9 as outlined in step 2 above.

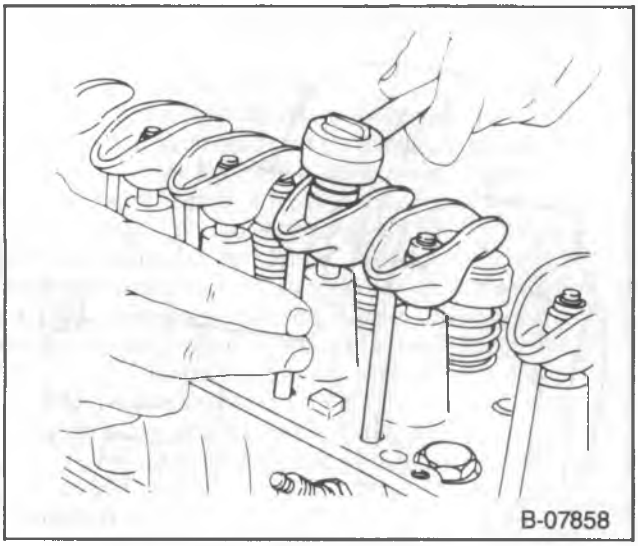


Figure 60—Adjusting the Valves

CHECKING VALVE TIMING

Tool Required:
J-8520 Dial Indicator Adaptor

When it becomes necessary to make a check of valve timing, the procedure following may be used:

1. Loosen the nut at the #1 intake valve rocker arm, swing the rocker arm away from the pushrod, then remove the pushrod.
2. Install a dial indicator, along with J-8520 (figure 61). Turn the crankshaft until the #2 exhaust valve opens and the timing mark on the vibration damper is aligned with the "0" mark on the timing marker.
3. Position the dial indicator to measure lifter movement and set indicator at zero. Turn the crankshaft 360 degrees and read the indicator. On correctly time engines the indicator will read 0.012-0.020-inch.
4. If the reading is not as shown, reset the indicator at zero and turn the crankshaft 360 degrees, then read the indicator again. If reading is now within specifications, the engine is timed properly.

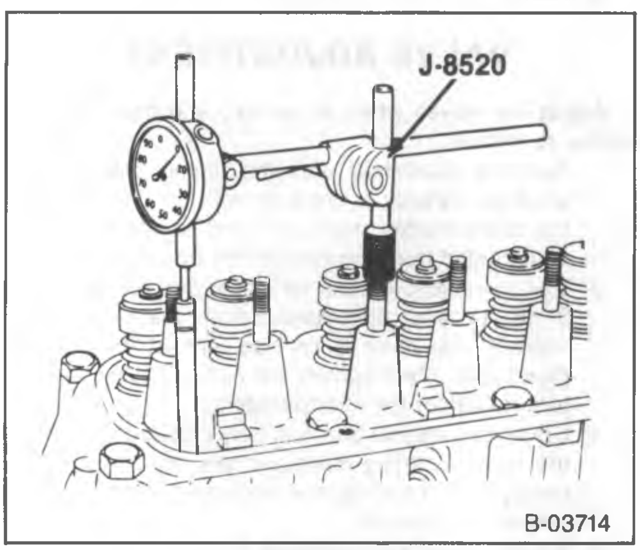


Figure 61—Measuring Camshaft Lobe Lift

5. The following chart shows indicator readings with gears properly indexed for 4.8L engines and the indicator readings resulting from improperly indexed gears.

Engine		**4.8L**
Camshaft Part Number		**3848000**
Valve Lift		**0.405"**
Dial	Gears Properly Indexed	0.016" ± 0.004"
Indicator	One Tooth Advanced	0.0379"
Readings	One Tooth Retarded	0.0068"

ROCKER ARM COVER AND PUSHROD COVER INSTALLATION

INSTALLATION

Install or Connect (Figures 4 and 5)

1. Gasket (8).
2. Rocker arm cover (7).
3. Bolts (3), clips (2) and reinforcements (4).

Tighten

- Bolts (3) to 4.3 N·m (38 in. lbs.).

4. Gaskets (114).
5. Pushrod covers (179).
6. Bolts (178).

Tighten

- Bolts (178) to 9.0 N·m (80 in. lbs.).

WATER PUMP INSTALLATION

Install or Connect (Figure 5)

1. Gasket (169).
2. Water pump (171).
3. Bolts (170).

Tighten

- Bolts (170) to 20 N·m (15 ft. lbs.).

THERMOSTAT HOUSING INSTALLATION

Install or Connect (Figure 4)

1. Gasket (49).
2. Thermostat housing (50).
3. Bolts (51).

Tighten

- Bolts (51) to 38 N·m (28 ft. lbs.).

4. Hose (47).

INTAKE AND EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figure 4)

- The manifold attaching bolt (39) and nuts (32) must be finger tight ONLY. Do not tighten the manifold attaching bolt and nuts until the manifold to head bolts and nuts (30 and 35) have been tightened.

1. Gasket (27).
2. Intake and exhaust manifold assembly.
3. Clamps (34), washers (29), bolts (35) and nuts (30).

Tighten

- Nuts (30) and bolts (35) to 52 N·m (38 ft. lbs.).
- Nuts (32) and bolts (39) to 60 N·m (44 ft. lbs.).

AIR MANIFOLD INSTALLATION

Install or Connect (Figures 7 and 8)

1. Air injection tubes (183).
2. Air manifold (182).

FLYWHEEL INSTALLATION

Clean (Figure 5)

- Mating surfaces of the flywheel (118) and crankshaft (154).

Install or Connect (Figures 5 and 18)

1. Flywheel (118) to the crankshaft (154). Align the marks made at disassembly. Make sure the dowel holes in the crankshaft and flywheel are aligned.
2. Bolts (122).

Tighten

- Bolts (122) to 150 N·m (110 ft. lbs.).

3. Dowel pins (134).
   - The interference fit dowel pins must be replaced with an oversized dowel pin when installing the flywheel.
   - Ream the dowel pin holes to the proper size (0.4510-0.4517-inch).
   - Tap the dowel pins into place, flush with the flywheel retaining bolt surface.

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (distributor, carburetor, oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

ENGINE SET-UP AND TESTING

1. After overhaul, the engine should be tested before installing in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.
2. Fill the crankcase with the proper quantity and grade of oil. Refer to the proper Truck Service Manual or Owner's and Driver's Manual for this information. If a new camshaft or hydraulic lifters were installed, add Engine Oil Supplement (GM part no. 1051396 or equivalent) to the engine oil. Fill the cooling system with the proper coolant.
3. With the ignition "OFF," or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
4. Start the engine and listen for unusual noises. Run the engine at about 1000 rpm until the engine is at operating temperature.
5. Listen for improperly adjusted valves or sticking lifters, and other unusual noises.
6. Check for oil and coolant leaks while the engine is running.
7. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing, and idle rpm and mixture.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				In Line
Displacement				4.8L (292 Cu. In.)
No. Of Cylinders				6
Bore				3.876
Stroke				4.12
Compression Ratio				8.0:1
Firing Order				1 - 5 - 3 - 6 - 2 - 4
Oil Pressure				16 psi @ 700 RPM; 30-45 psi @ 1500 RPM
CYLINDER BORE:				
Diameter				3.8750-3.8780
Out Of Round	Production			0.0005 (Maximum)
	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
		Relief Side		0.0005 (Maximum)
	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.0026-0.0036
	Service Limit			0.0045 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0020-0.0040
			2nd	
		Service Limit		Hi Limit Production ± 0.001
	Gap	Production	Top	0.010-0.020
			2nd	0.010-0.020
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.005-0.0055
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.015-0.055
		Service Limit		Hi Production + 0.010
PISTON PIN:				
Diameter				0.9270-0.09273
Clearance In Piston	Production			0.00015-0.00025
	Service Limit			0.001 (Maximum)
Fit In Rod				0.0008-0.0016 Interference

B-07896

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

CRANKSHAFT:			
Main Journal	Diameter		All 2.2979-2.2994
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production		#1-#6: 0.0010-0.0024 #7: 0.0016-0.0035
	Service Limit		#1-#6: 0.0010-0.0025 #7: 0.0015-0.0035
Crankshaft End Play			0.002-0.006
Crankpin	Diameter		2.099-2.100
	Taper	Production	0.0005 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Round	Production	0.0005 (Maximum)
		Service Limit	0.001 (Maximum)
Rod Bearing Clearance	Production		0.0010-0.0026
	Service Limit		0.0030 (Maximum)
Rod Side Clearance			0.006-0.017
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.2315
	Exhaust		0.2315
Journal Diameter			1.8677-1.8697
Camshaft Runout			0.020 (Maximum)
Camshaft End Play			0.003-0.008
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.75:1
Valve Lash		Intake	One Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			46°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	0.035-0.060
		Exhaust	0.062-0.093
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0015-0.0032
	Service	Intake	High Limit Production +0.001
		Exhaust	High Limit Production +0.002
Valve Spring (Outer)	Free Length		2.08
	Pressure lbs. @ in.	Closed	78-86 lbs. @ 1.66"
		Open	170-180 lbs. @ 1.26"
	Installed Height ± $\frac{1}{32}$"		$1\frac{21}{32}$
Valve Spring Damper	Free Length		1.94
	Approx. # of Coils		4

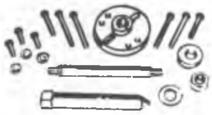
B-07898

SPECIFICATIONS (CONT.)

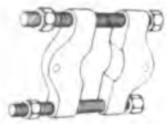
TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Flywheel Bolts	150	110	—
Flywheel Housing Bolts	40	30	—
Main Bearing Cap Bolts	90	65	—
Camshaft Thrust Plate Screws	9.0	—	80
Front Cover Bolts	9.0	—	80
Torsional Damper Bolt	70	50	—
Connecting Rod Cap Nuts	60	44	—
Oil Pump Bolts	13.0	—	115
Oil Pump Bracket Nut (to Main Bearing Cap Bolt)	34	25	—
Oil Pump Cover Bolts	7.9	—	70
Oil Pan Bolts (to front cover)	5.1	—	45
(to block [1/4-20])	9.0	—	80
(to block [5/16-18])	18.6	—	165
Cylinder Head Bolts (left-front bolt)	115	85	—
(all others)	130	95	—
Rocker Arm Cover Bolts	4.3	—	38
Pushrod Cover Bolts	9.0	—	80
Water Pump Bolts	20	15	—
Thermostat Housing to Block Bolts	38	28	—
Water Outlet to Thermostat Housing Bolts	28	20	—
Intake Manifold to Exhaust Manifold Bolts and Nuts	60	44	—
Manifold to Cylinder Head Bolts and Nuts	52	38	—
Spark Plug	20	15	—

SPECIAL TOOLS

1.  J-23523-E

2.  J-8062

3.  J-22912-01

4.  J-35468

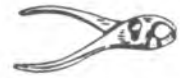
5.  J-8080

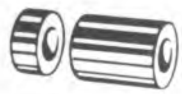
6.  J-8037

7.  J-5239

8.  J-23738-A

9.  J-9290-01

10.  J-3049

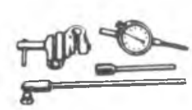
11.  J-5802-01

12. 13.  J-5715 J-6036

14.  J-6880

15.  J-24420-A

16.  J-5590

17.  J-8520

18.  J-21882

1. Torsional Damper Remover and Installer
2. Valve Spring Compressor
3. Support Plate
4. Crankshaft Seal Installer and Centering Tool
5. Main Bearing Replacer
6. Piston Ring Compressor
7. Guide Set
8. Vacuum Pump
9. Hydraulic Lifter Remover (Slide Hammer Type)
10. Hydraulic Lifter Remover (Plier Type)
11. Stud Remover
12. Reamer (0.003-inch oversize)
13. Reamer (0.013-inch oversize)
14. Stud Installer
15. Crankshaft Gear Puller
16. Crankshaft Gear Installer
17. Dial Indicator Adapter
18. Oil Pump Suction Pipe Installer

F-04493

SECTION 6A5

V8 ENGINE 5.0 LITER (305 Cu. In.) 5.7 LITER (350 Cu. In.) 7.4 LITER (454 Cu. In.)

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONT.)

DESCRIPTION

GM V8 engines covered by this section are 90-degree V8 type, overhead valve, water cooled, with cast iron block and heads.

The camshaft is supported by five plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball-pivot type rocker arms. The valve guides are integral in the cylinder head.

The crankshaft is supported by five precision insert type bearings, with crankshaft thrust taken at the number five (rear) bearing.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the pistons.

The gear type oil pump is driven through an extension shaft from the distributor driveshaft which is gear driven from the camshaft. The oil is drawn from the engine oil pan through a pickup screen and tube. Pressurized oil is delivered through internal passages to the camshaft and crankshaft to lubricate the bearings. Lubrication diagrams are shown in figure 1, 2, and 3.

ENGINE IDENTIFICATION

Two basic types of engines, with three different displacements, are covered in this section.

The first type is the "small block" engine, which is available in 5.0 L (305 cu. in.) and 5.7 L (350 cu. in.) displacements.

The second type is the 7.4 L (454 cu. in.) engine, which is sometimes referred to as the "Mark IV" engine.

To determine the displacement of the engine, use the Vehicle Identification (VIN) of the vehicle the engine was removed from. Refer to "Specifications" at the end of this section. If the VIN is not available, the bore and stroke of the engine involved can be measured and compared against "Specifications" to determine the engine model.

Refer to General Information (Section 0A) in this manual for further information.

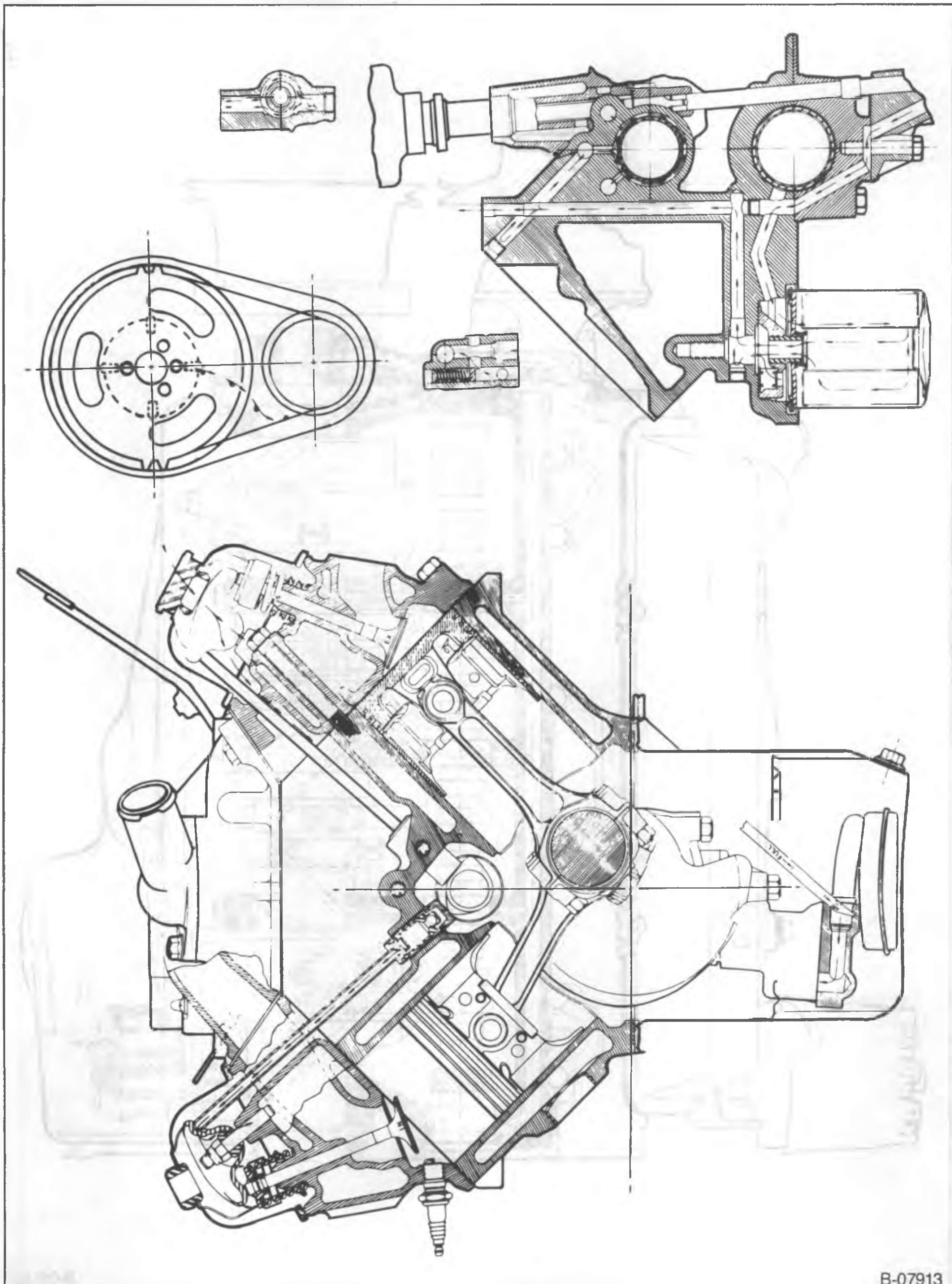


Figure 1—Lubrication Diagram (5.0L and 5.7L Engines)

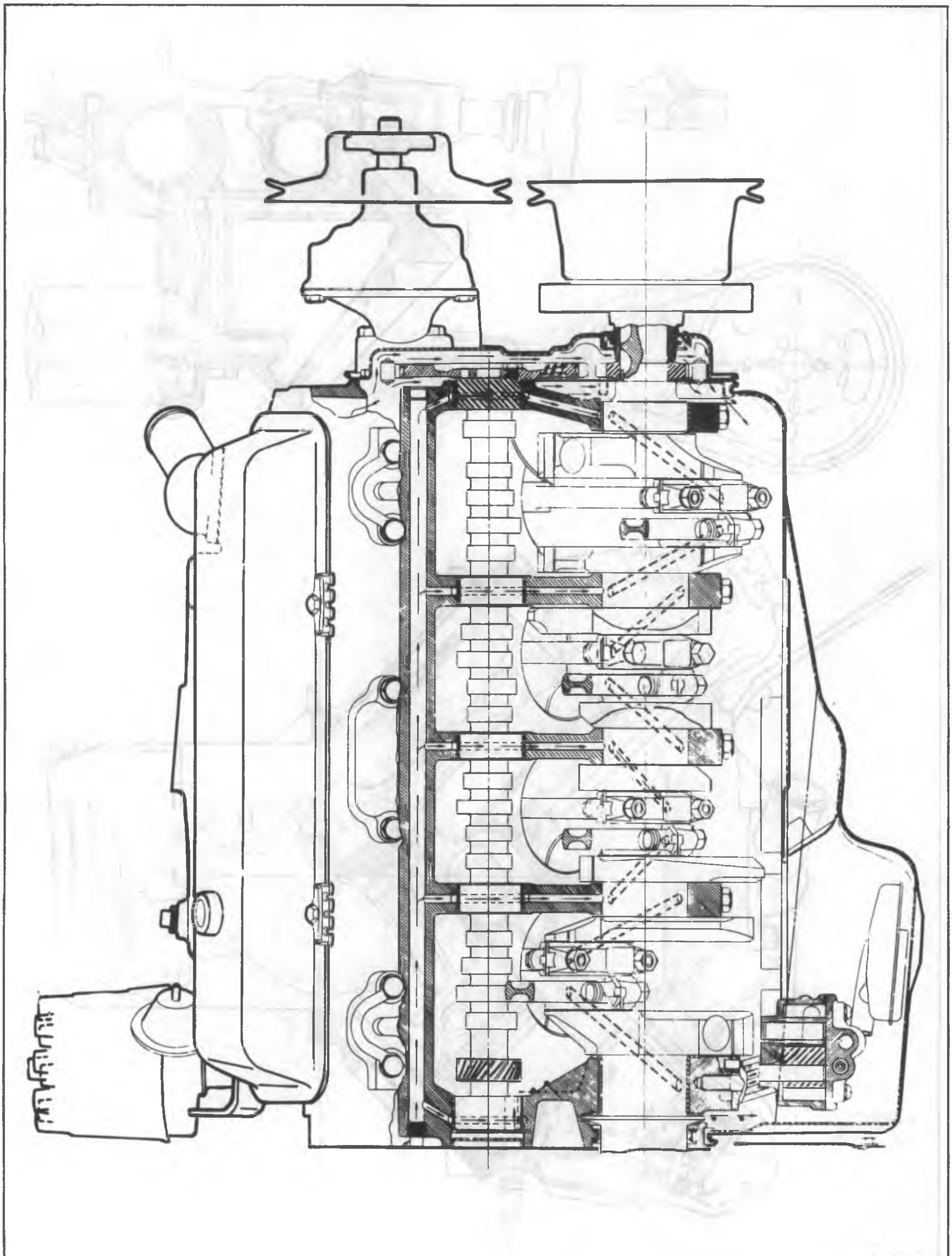


Figure 2—Lubrication Diagram (5.0L and 5.7L Engines)

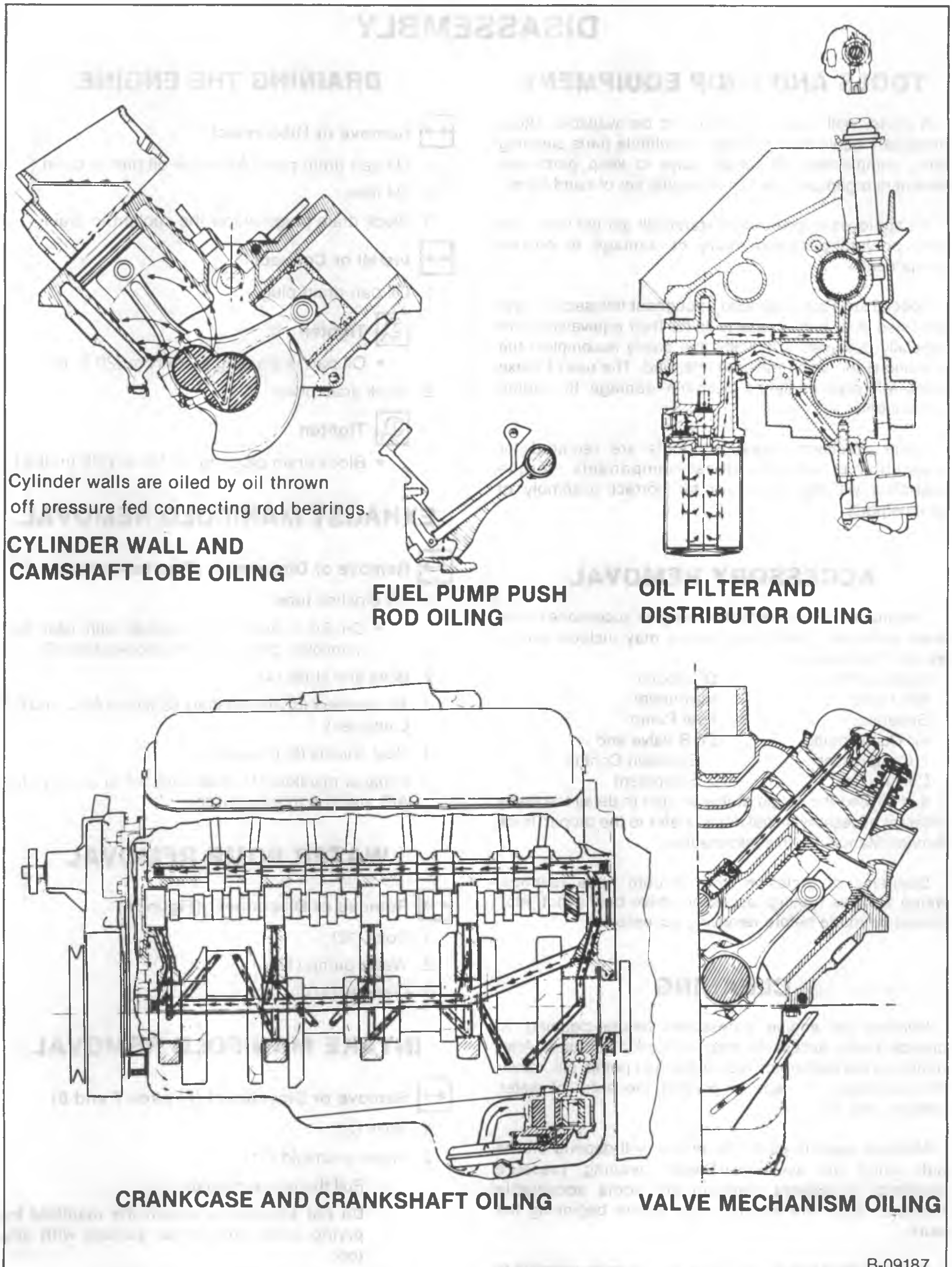


Figure 3—Lubrication Diagram (7.4L Engines)

DISASSEMBLY

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary equipment includes: A suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine components.

Special tools are illustrated throughout this section, and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

Hydraulic Pump	Distributor
AIR Pump	Carburetor
Generator	Fuel Pump
Air Conditioning Compressor	EGR Valve and Emission Control Equipment
Cooling Fan	

It is beyond the scope of this section to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routing, accessory drive belt layout, etc., should be made before removing accessories.

CLEANING

Remove the engine accessories before cleaning, to provide better access to engine exterior surfaces. After removing the carburetor, distributor, fuel pump, etc., cover the openings with tape to prevent the entry of water, solvent, and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan drain plug. Allow the oil pan to drain.
2. Oil filter.
3. Block drain plugs. Allow the coolant to drain.

install or Connect

1. Oil pan drain plug.

   Tighten

   - Oil pan drain plug to 28 N·m (20 ft. lbs.).
2. Block drain plugs.

   Tighten

   - Block drain plugs to 12.7 N·m (112 in. lbs.).

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect (Figures 4 and 5)

1. Oil dipstick tube.
   - On 5.0 L and 5.7 L engines with cast iron manifolds, bend back the tab washers (3).
2. Bolts and studs (4).
3. Tab washers (3) and washers (2) (some 5.0 L and 5.7 L engines).
4. Heat shields (6) (if used).
5. Exhaust manifold (1). Take care not to damage the AIR injection tubes (if used).

WATER PUMP REMOVAL

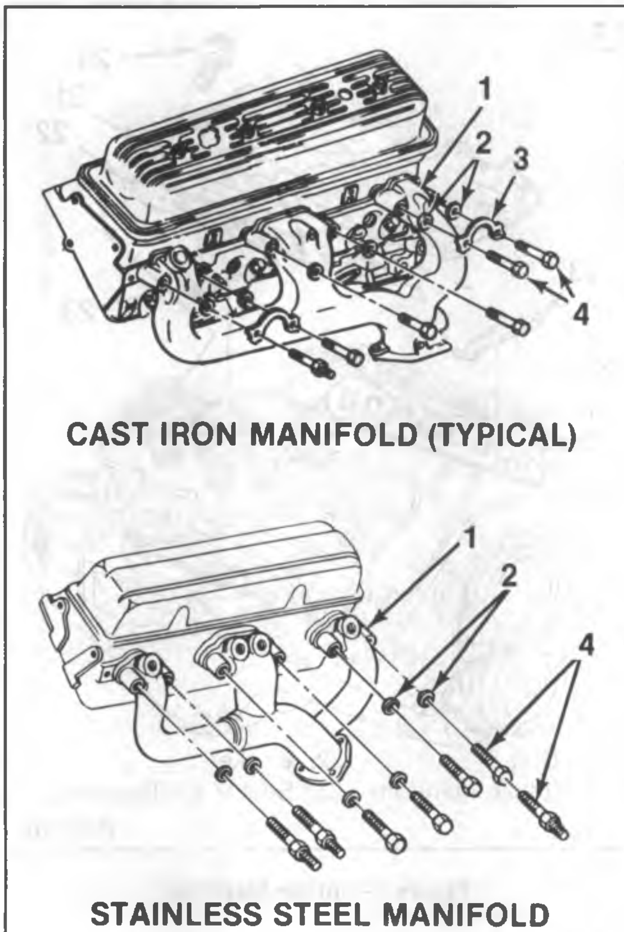
Remove or Disconnect (Figure 6)

1. Bolts (12).
2. Water pump (10).
3. Gaskets (11).

INTAKE MANIFOLD REMOVAL

Remove or Disconnect (Figures 7 and 8)

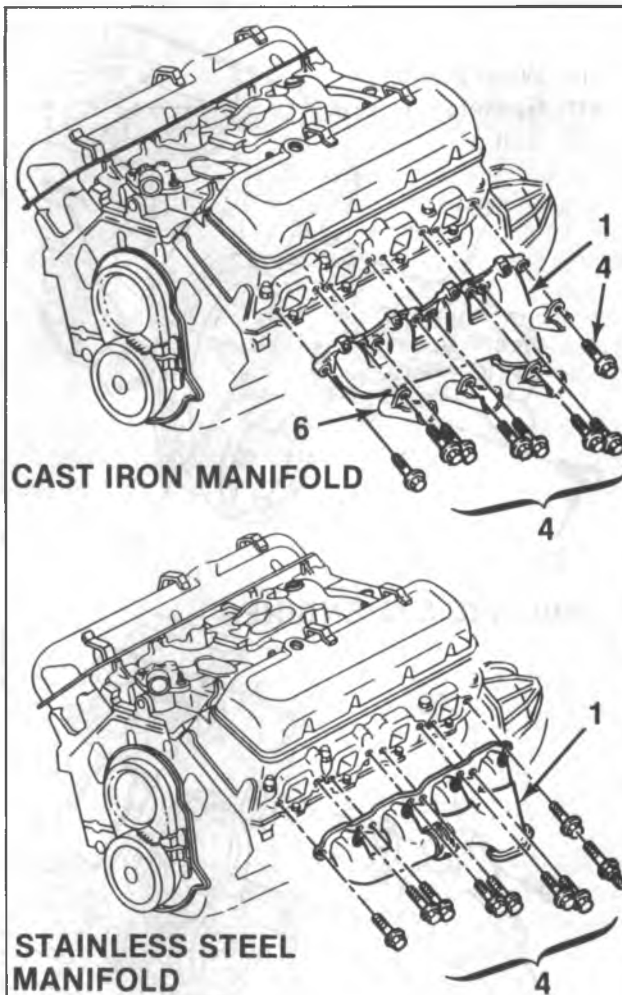
1. Bolts (20).
2. Intake manifold (21).
   - — Pull the intake manifold up.
   - — **Do not attempt to loosen the manifold by prying under the gasket surface with any tool.**
3. Gaskets (22).
4. Seals (23) (7.4 L engines).



1. Exhaust Manifold
2. Washer
3. Tab Washer
4. Bolt/Stud

F-04502

Figure 4—Exhaust Manifold (5.0L and 5.7L Engines)



1. Exhaust Manifold
4. Bolt/Stud
6. Spark Plug Wire Heat Shield

B-08004

Figure 5—Exhaust Manifold (7.4L Engines)

ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figure 9)

1. Nuts (30), clips (35), and reinforcements (31) or bolts (36) and washers (37).
2. Rocker arm covers (32). If the rocker arm cover adheres to the cylinder head, try to shear the gasket by bumping the end of the cover with a rubber mallet. If the cover will not come loose, carefully pry until loose. DO NOT DISTORT THE SEALING FLANGE.
3. Gaskets (34).

VALVE TRAIN COMPONENT REMOVAL

Remove or Disconnect (Figures 10 through 13)

Tools Required:

J 3049 Valve Lifter Remover (Plier Type)

J 9290-01 Valve Lifter Remover (Slide Hammer Type)

1. Nuts (40), balls (41), rocker arms (42) and pushrods (43).
   - Note that on 7.4 L engines, the exhaust valve pushrods are longer than the intake valve pushrods.
   - Every effort should be made to insure that these mating parts are installed in their original locations during assembly. A simple valve train component organizer rack can be made from a piece of wood, as shown in figure 11.
2. Hydraulic lifters (44).
   - Remove the lifters one at a time, using a magnet. Place the lifters in the organizer rack, or tag them in some way to insure that they can be returned to the valve lifter bore from which they were removed.

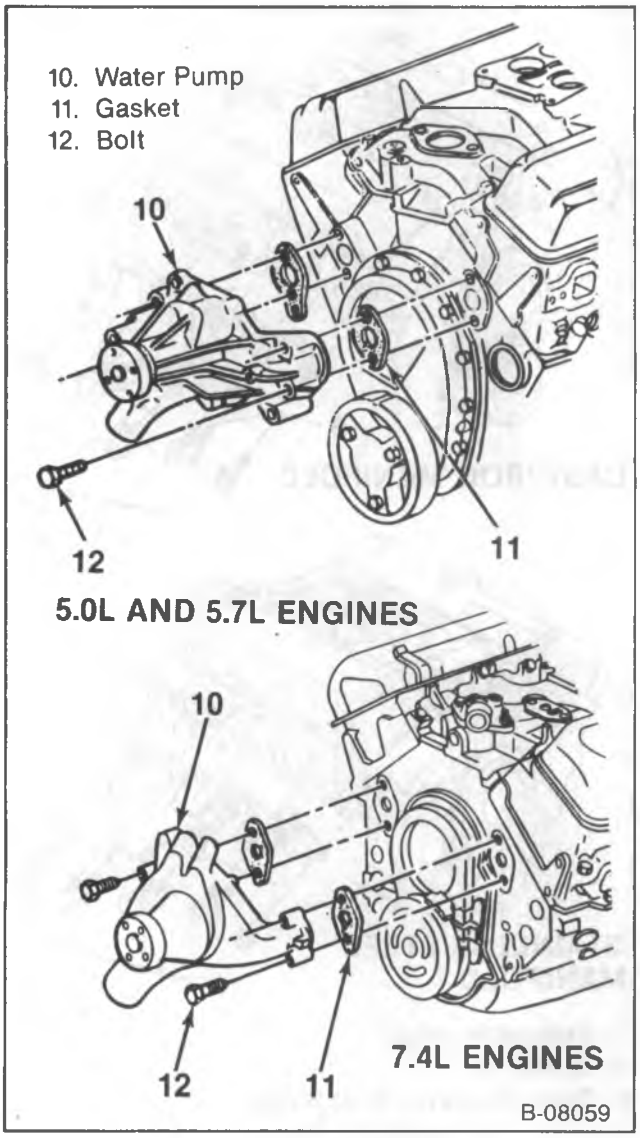


Figure 6—Water Pumps

— Some lifters may be stuck in their bores due to gum or varnish deposits. These lifters can be removed using either J 3049 (figure 12) or J 9290-01 (figure 13).

CYLINDER HEAD REMOVAL

Remove or Disconnect (Figure 10)

1. Bolts (45).
2. Cylinder heads (46). Use care when handling the cylinder heads, to prevent damage to rocker arm studs or gasket sealing surfaces.
3. Gaskets (47).

TORSIONAL DAMPER REMOVAL

Remove or Disconnect (Figure 14)

Tool Required:
J 23523-E Torsional Damper Puller and Installer

1. Crankshaft pulley.

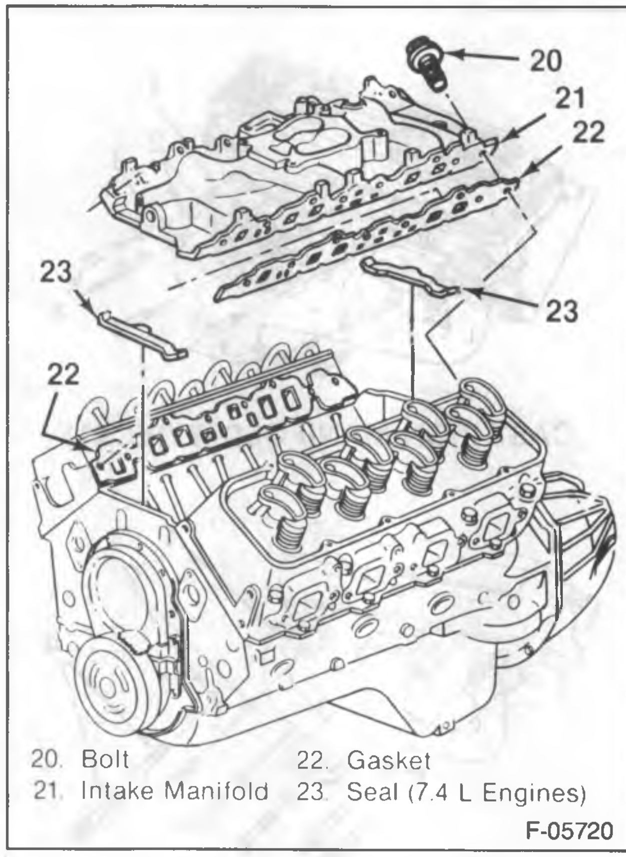


Figure 7—Intake Manifold

2. Torsional damper retaining bolt and washer.
3. Torsional damper. Use J 23523-E (figure 14).

OIL PAN REMOVAL

Remove or Disconnect (Figures 15 and 16)

1. Oil pan bolts, timing marker (if used), clips and reinforcements.
2. Oil pan.
3. Gasket or gaskets.
4. Front and rear oil pan seals (7.4 L engines).

OIL PUMP REMOVAL

Remove or Disconnect (Figure 15)

1. Bolt (72).
2. Oil pump, with drive shaft and connector.

FRONT COVER REMOVAL

Remove or Disconnect (Figure 17)

1. Bolts (93).
2. Timing tab (92) (7.4 L engines).
3. Front cover (91).
4. Gasket (90).

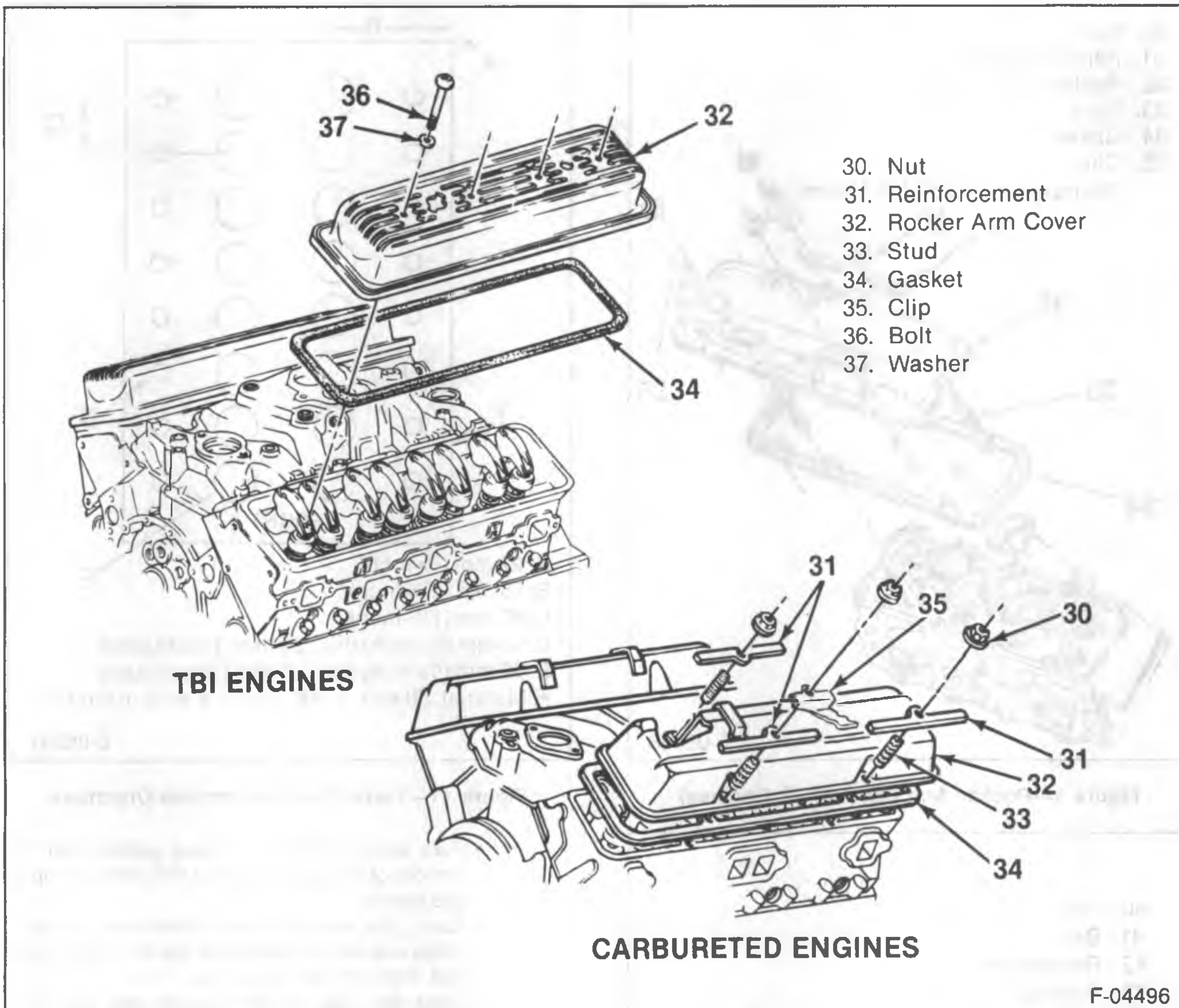


Figure 8—Rocker Arm Cover (5.0L and 5.7L Engines)

TIMING CHAIN AND CAMSHAFT SPROCKET REMOVAL

Remove or Disconnect (Figure 18)

- Timing chain free play. If the chain can be moved back and forth in excess of 16 mm (5/8-inch), make a note that the timing chain should be replaced during assembly.

Remove or Disconnect (Figure 18)

1. Bolts (100).
2. Camshaft sprocket (101) and timing chain (102) together.

CAMSHAFT REMOVAL

Remove or Disconnect (Figure 19)

- Camshaft.
- Install three 5/16-18 bolts 100–125 mm (4–5-inches) long into the camshaft tapped holes. Use these bolts to handle the camshaft.
- Pull the camshaft from the block.
- Use care to prevent damage to the camshaft and bearings.

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 20 and 21)

Tool Required:
J 5239 Connecting Rod Guide Set

1. Ridge (or deposits) at the top of the cylinder as follows:

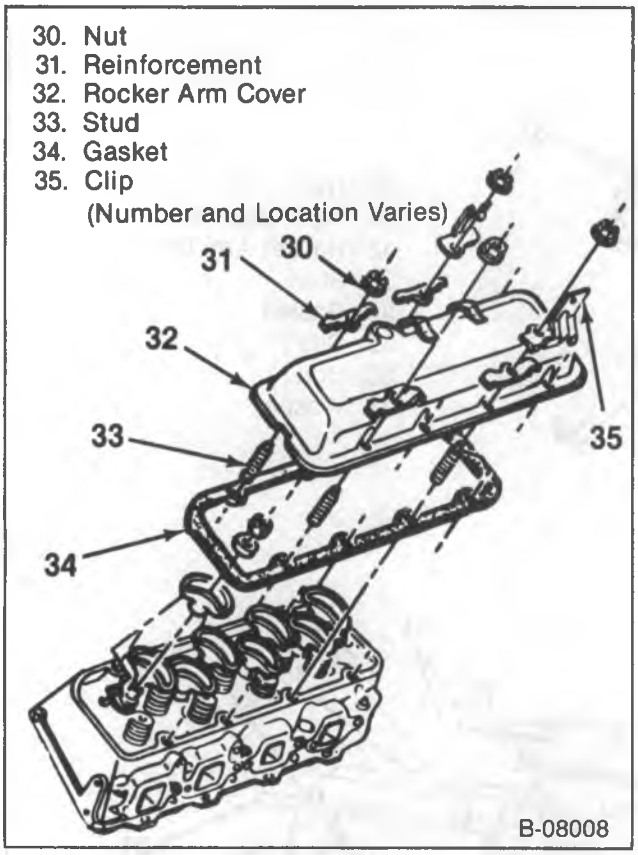


Figure 9—Rocker Arm Cover (7.4L Engines)

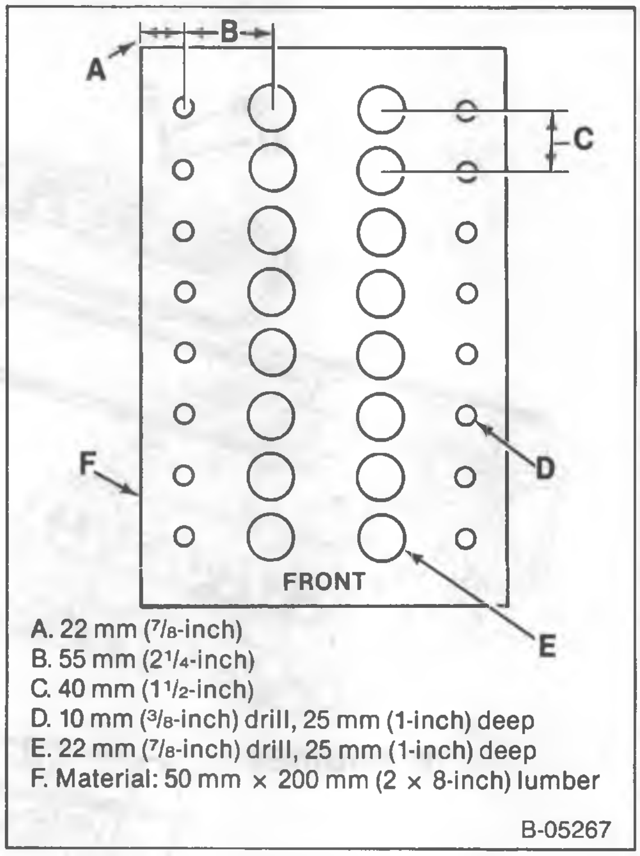


Figure 11—Valve Train Component Organizer

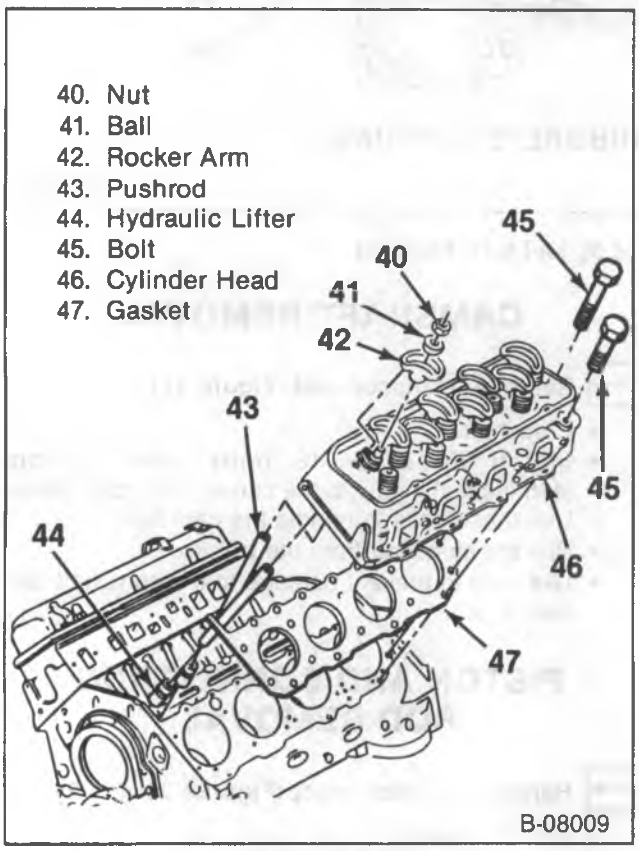


Figure 10—Cylinder Head and Components (Typical)

- Turn the crankshaft until one piston is at the bottom of its stroke. Place a soft cloth on top of the piston.
- Using the manufacturer's directions, install a ridge reamer into the top of the cylinder (figure 20). Perform the cutting operation.
- After the ridge and/or deposits are removed, remove the ridge reamer. Turn the crankshaft until the piston is at the top of its stroke. Remove the cloth and cuttings.
- Repeat this procedure for each piston.

Figure 12—Removing the Hydraulic Lifter

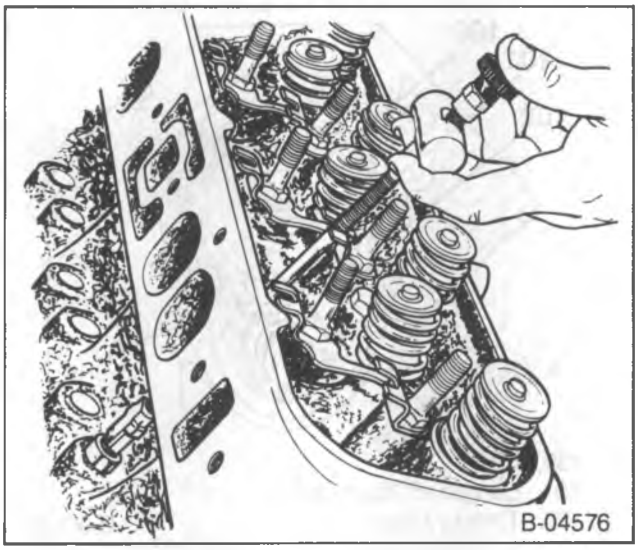


Figure 13—Removing the Hydraulic Lifter

2. Connecting rod caps as follows:
   - Make note of the arrangement of the connecting rod markings, to insure that they will be returned to their proper position during assembly. Mark the connecting rods with a scratch awl if necessary.
   - Remove the connecting rod nuts.
   - To avoid mismatching the connecting rods and connecting rod cap, remove only one connecting rod cap at a time. Place the piston at the bottom of its stroke.
   - Remove the connecting rod cap.
   - Install J 5239 onto the studs. Use of the specified guide set will prevent the connecting rod from scratching the bore or crankshaft journal during the removal process. The tool will also prevent the rod bearing half from falling out of the connecting rod during removal.
3. Connecting rod and piston from the block.
   - Push on the guide rod (item A, figure 21) to push the piston and connecting rod out.

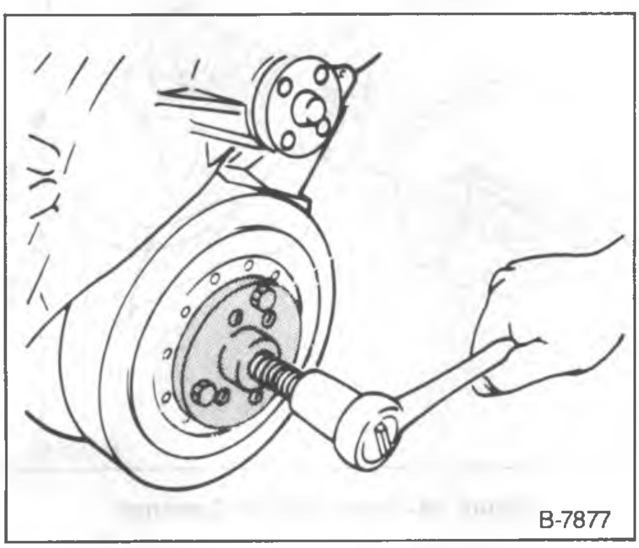


Figure 14—Removing the Torsional Damper

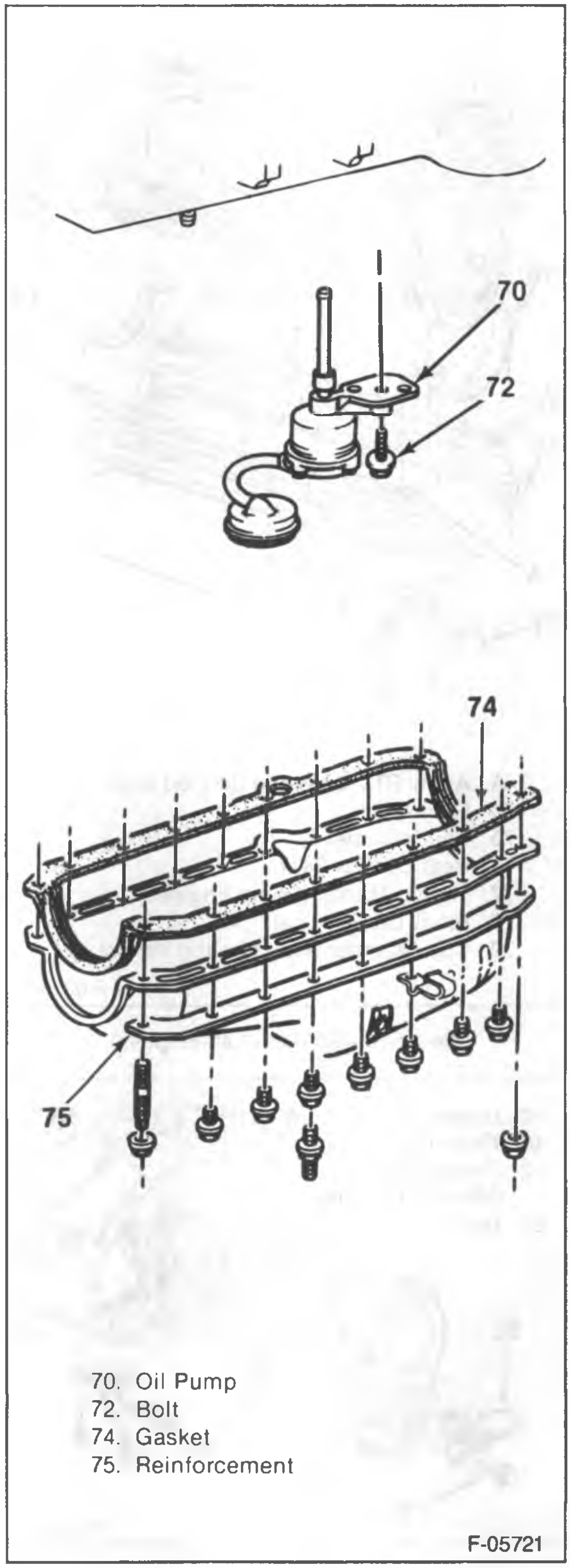
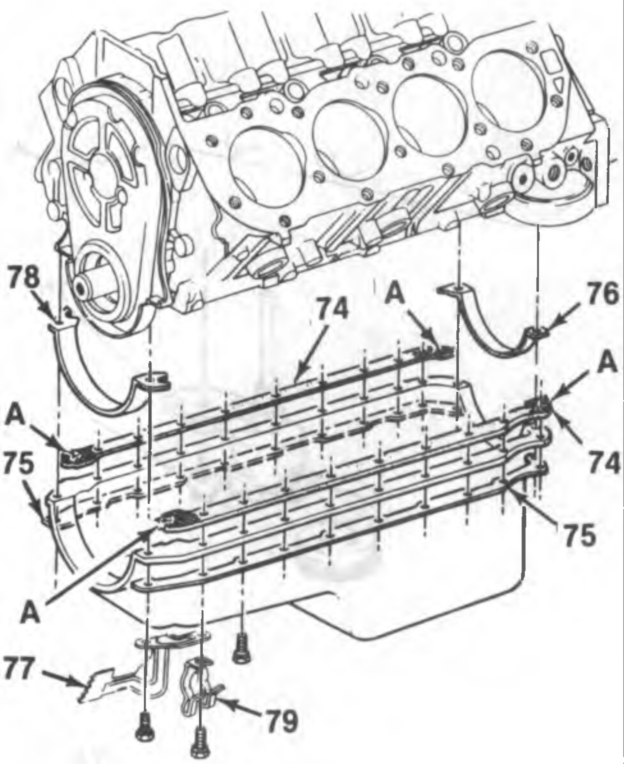


Figure 15—Oil Pan (5.0L and 5.7L Engines)

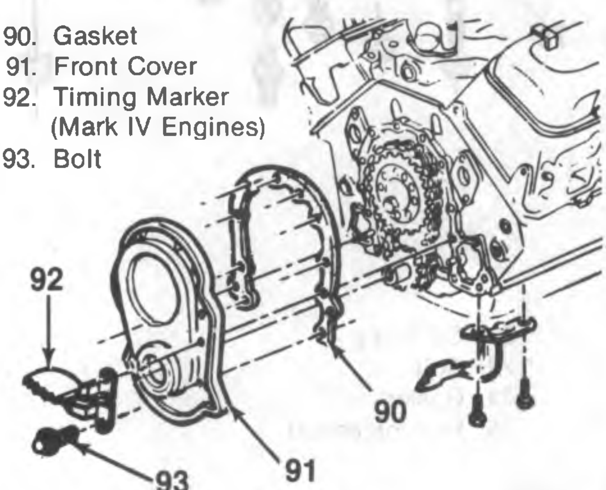


A. Apply RTV Sealer to Shaded Area
74. Gasket
75. Reinforcement
76. Rear Oil Pan Seal
77. Timing Marker (Some Engines)
78. Front Oil Pan Seal
79. Clip (Number and Location Varies)

F-02382

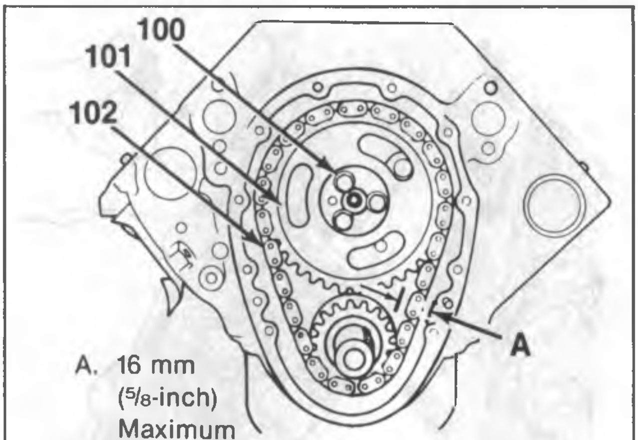
Figure 16—Oil Pan (7.4L Engines)

90. Gasket
91. Front Cover
92. Timing Marker (Mark IV Engines)
93. Bolt



B-08011

Figure 17—Front Cover

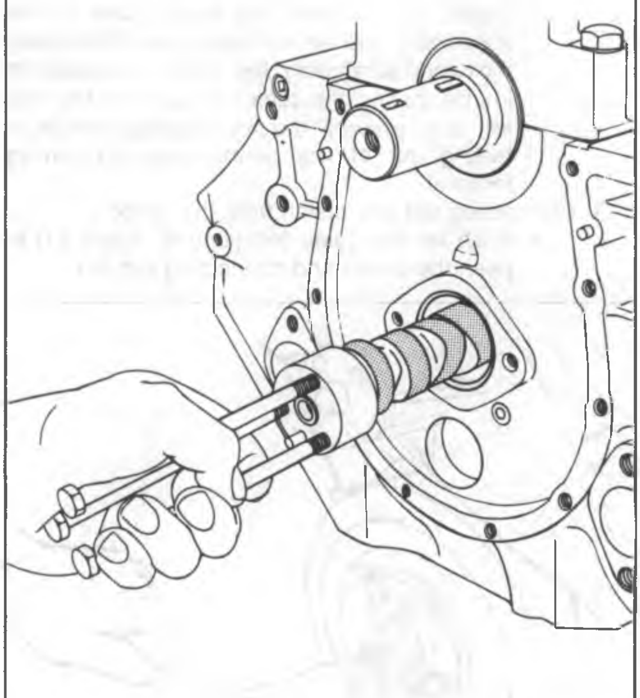


A. 16 mm (5/8-inch) Maximum
100. Bolt
101. Camshaft Sprocket
102. Timing Chain

B-08012

Figure 18—Timing Chain and Sprockets

- Use the guide rod to prevent the connecting rod from scoring the cylinder bore.
- Assemble the connecting rod cap onto the connecting rod. Do not tighten.
- Repeat this procedure on the remaining piston and connecting rod assemblies.



B-00515

Figure 19—Removing the Camshaft

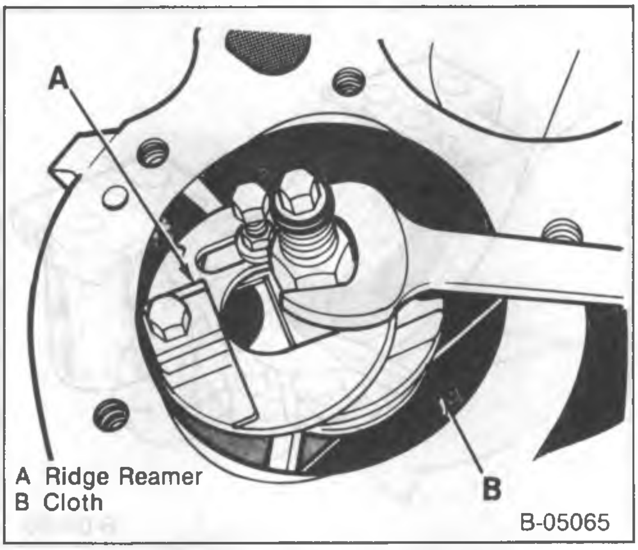


Figure 20—Removing the Cylinder Ridge

FLYWHEEL REMOVAL

↔ Remove or Disconnect (Figure 22)

1. Bolts (111).
2. Flywheel (110).

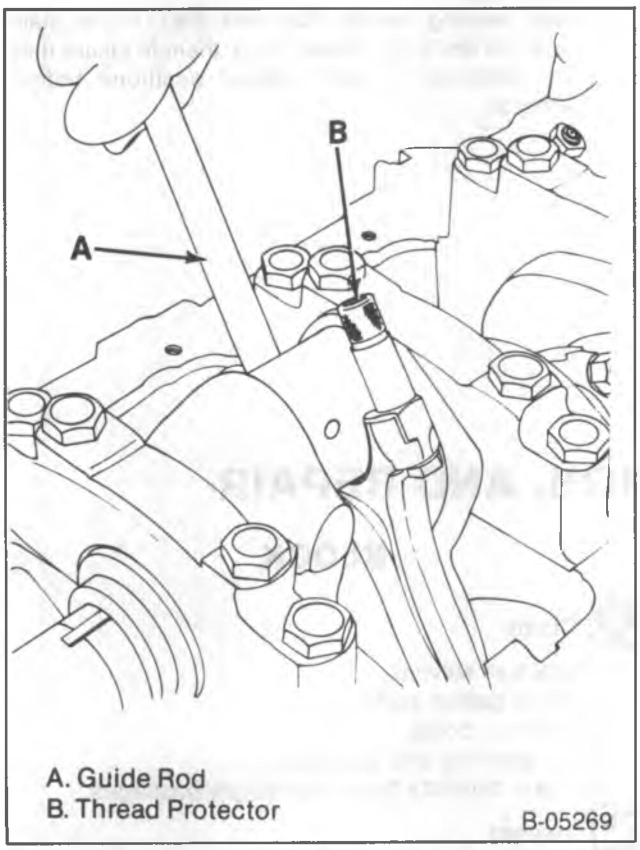


Figure 21—Removing the Piston and Connecting Rod

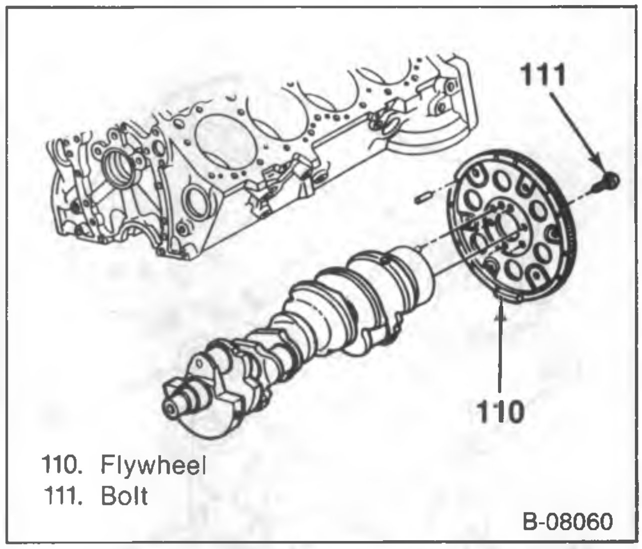


Figure 22—Flywheel (5.0L and 5.7L Shown)

REAR CRANKSHAFT OIL SEAL RETAINER REMOVAL (5.0 L and 5.7 L ENGINES)

↔ Remove or Disconnect (Figure 23)

1. Screws and nuts.
2. Seal retainer (121).
3. Gasket (120).

CRANKSHAFT REMOVAL

↔ Remove or Disconnect (Figures 24 and 25)

- Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.

1. Bolts (134).

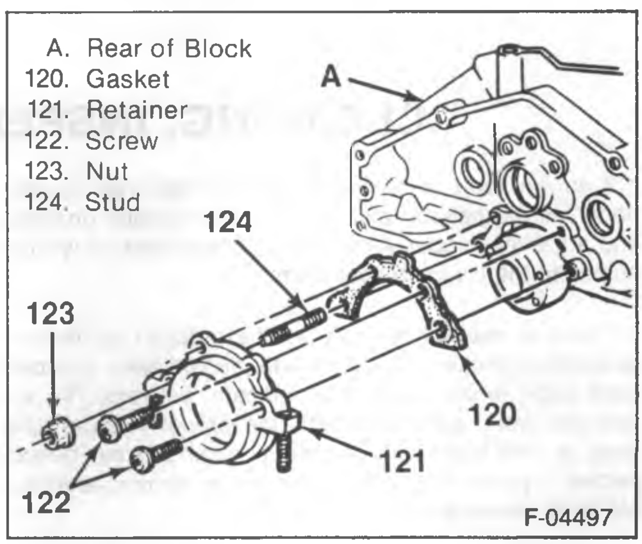
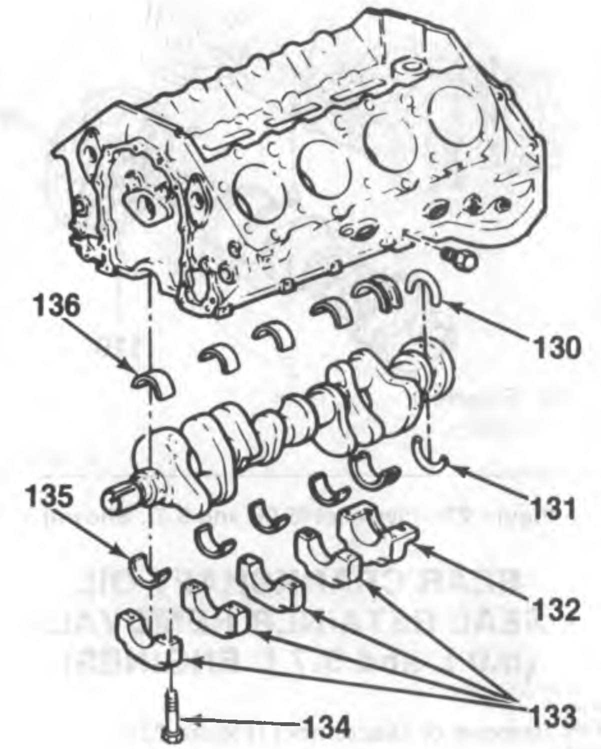


Figure 23—Rear Crankshaft Oil Seal Retainer (5.0L and 5.7L Engines)



130. Upper Seal Half (Mark IV Engines)
131. Lower Seal Half (Mark IV Engines)
132. Rear Main Bearing Cap
133. Main Bearing Cap
134. Bolt
135. Lower Main Bearing Insert
136. Upper Main Bearing Insert

B-08015

Figure 24—Crankshaft and Components (Typical)

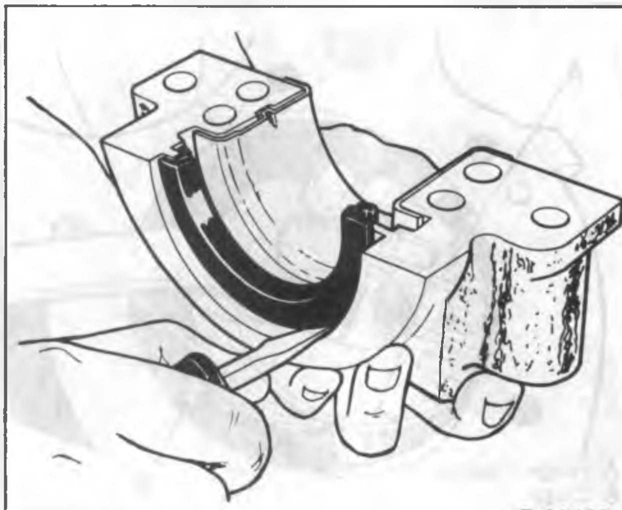


Figure 25—Removing the Rear Crankshaft Seal (7.4L Engines)

2. Main bearing caps (132 and 133).
3. Crankshaft. Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange surfaces.
4. Upper and lower seal halves (130 and 131) (7.4 L engines). Pry the seal halves out with a screwdriver (figure 25).
5. Main bearing inserts (136 and 136). If the main bearings are to be reused, mark them to insure they are installed in their original positions before removal.

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean

1. Block in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
5. Scale deposits from the coolant passages.

Inspect

1. All expansion plugs for poor fit or leakage.
2. Hydraulic lifter bores for deep scratches and varnish deposits.
3. Block for cracks.

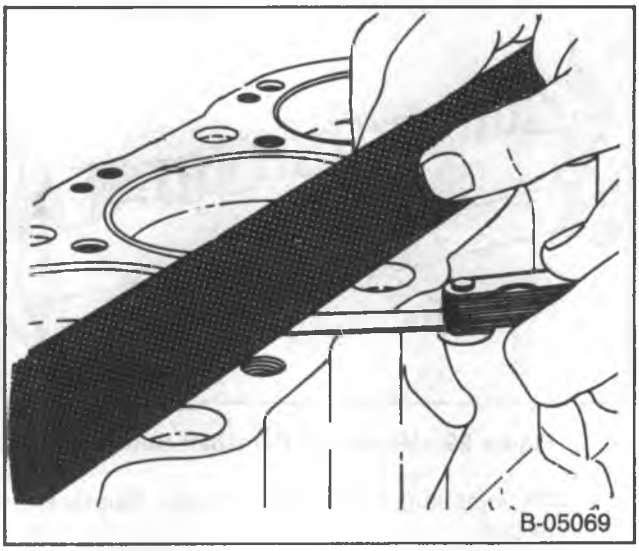


Figure 26—Checking the Block Gasket Surface

— Cylinder walls.
— Coolant jackets.
— Main bearing webs.
— Engine mount bosses.

4. Main bearing bores and main bearing caps.
   — All main bearing bores should be round and uniform in ID at all bearing supports.
   — The area where the main bearing inserts contact the main bearing bore should be smooth.
   — If a main bearing cap is damaged and requires replacement, replace it as outlined later.

Measure (Figure 26)

- Head gasket surface distortion. Use a straight edge and feeler gage to check for flatness of the milled surface at the top of the cylinder block. The surface must be flat (within 0.10mm [0.004-inch]) to assure proper head gasket sealing.

MAIN BEARING CAP REPLACEMENT

Install or Connect

1. New main bearing cap. The arrow on the main bearing cap faces the front of the engine (opposite the flywheel).
2. Main bearing cap bolts.

   Tighten

   - Bolts to "Specifications."

   Measure (Figure 27)

   - Main bearing vertical ID (inside diameter). Use an inside micrometer.
   - This dimension should be the same as the other main bearing bore vertical diameters.
   - If it is necessary to increase the vertical ID, use an equal thickness of special service bearing cap shims at each side of the cap to provide the same dimension as at the other bores. This is necessary to assure the proper crush on the bearing inserts when the engine is assembled.

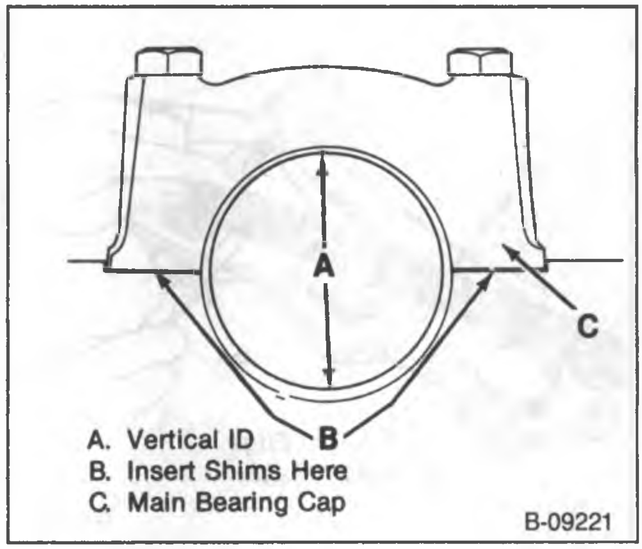


Figure 27—Main Bearing Cap Shim Location (Typical)

CYLINDER BORES

Inspect

- Cylinder bores for scoring and other damage.

Measure

- Cylinder out of round and taper. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Cylinder Bore Reconditioning

- Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Disassemble

- Components as required.

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Piston pin diameter and pin to piston clearance.
- Piston to bore clearance, and fit pistons as outlined.

Assemble

- Components as outlined.

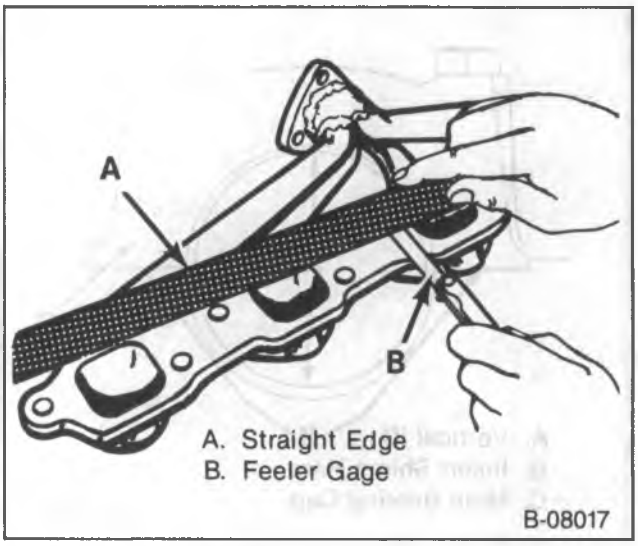


Figure 28—Checking Alignment of Manifold Flanges (Typical)

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 are the left bank and 2, 4, 6, and 8 are the right bank. 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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

INTAKE AND EXHAUST MANIFOLD

Clean

— Old pieces of gasket from the gasket surfaces.
— Excessive carbon build-up in the exhaust passages of the intake manifold.
— Scale and deposits from the coolant passages of the intake manifold.
— EGR passage (if used) of excessive carbon deposits.

Inspect (Figure 28)

— Manifolds for cracks, broken flanges, and gasket surface damage.
— Alignment of exhaust manifold flanges. Use a straight edge and feeler gage (figure 28). If the flanges do not align, the manifold is warped and should be replaced.

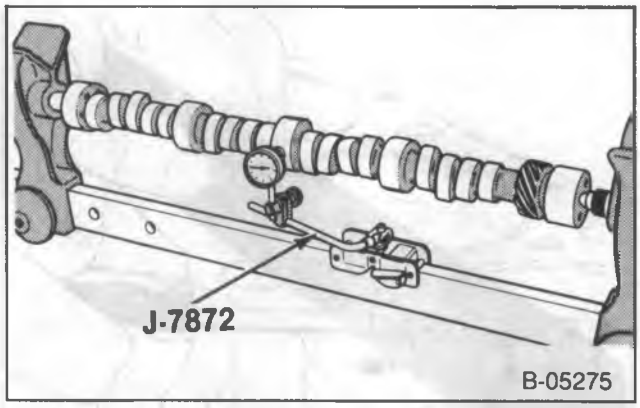


Figure 29—Measuring Camshaft Run-Out

— AIR injection tubes for damage. Replace as needed.

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of valve lifters must also be installed.

Inspect

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.

Measure (Figures 29 and 30)

Tool Required:
J 7872 Dial Indicator (or equivalent)

— Camshaft runout (figure 29). Mount the camshaft in V-blocks or between centers. Using J 7872, check the intermediate camshaft journal. If runout exceeds (0.0015-inch), the camshaft is excessively bent and should be replaced along with the camshaft bearings.
— Camshaft journal out-of-round. Use a micrometer (figure 30). If the journals are more than 0.001-inch out-of-round, replace the camshaft.

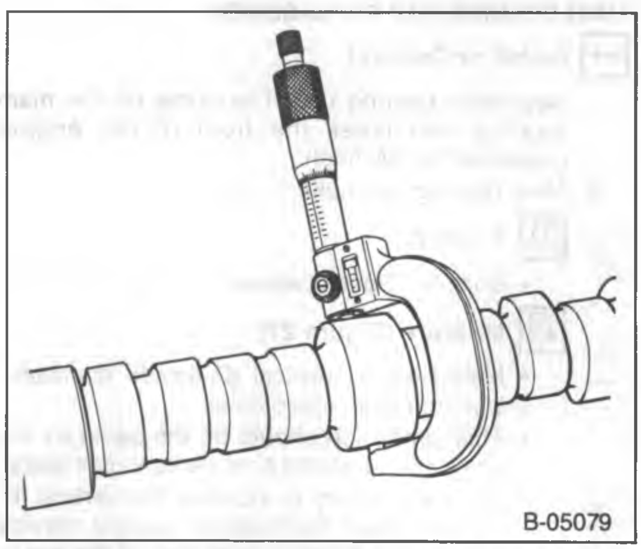


Figure 30—Checking the Camshaft Journals

— Camshaft journal diameter. Use a micrometer (figure 30). The proper diameter is listed in "Specifications."

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) for replacement procedures.

TIMING CHAIN AND SPROCKETS

Inspect

— Sprockets for chipped teeth and wear.

— Timing chain for damage.

— It should be noted that excessively worn sprockets will rapidly wear a new chain. Likewise, an excessively worn chain will rapidly wear a new set of sprockets.

CRANKSHAFT SPROCKET REPLACEMENT

Disassemble (Figures 31 and 32)

Tools Required:
J 5825 Crankshaft Sprocket Puller (5.0 L and 5.7 L engines)
J1619 Crankshaft Sprocket Puller (7.4L engines)

1. Crankshaft sprocket. On 5.0 L and 5.7 L engines, use J 5825 (figure 31). On 7.4 L engines, use J 1619 (figure 32).
2. Key, if necessary.

Assemble (Figures 31 and 32)

Tools Required:
J 5590 Crankshaft Sprocket Installer (5.0 L and 5.7 L engines)
J 22102 Crankshaft Sprocket Installer (7.4 L engines)

1. Key, if removed.
2. Crankshaft sprocket. Use J 5590 (5.0 L and 5.7 L engines) or J 22102 (7.4 L engines). Make sure the timing mark faces outside.

FRONT COVER

Clean

- Old gasket from the gasket surfaces.

Inspect

— Timing marker for damage.

— Front cover for damage, dents, or cracks.

Disassemble

- Front crankshaft seal. Pry the seal out with a screwdriver.

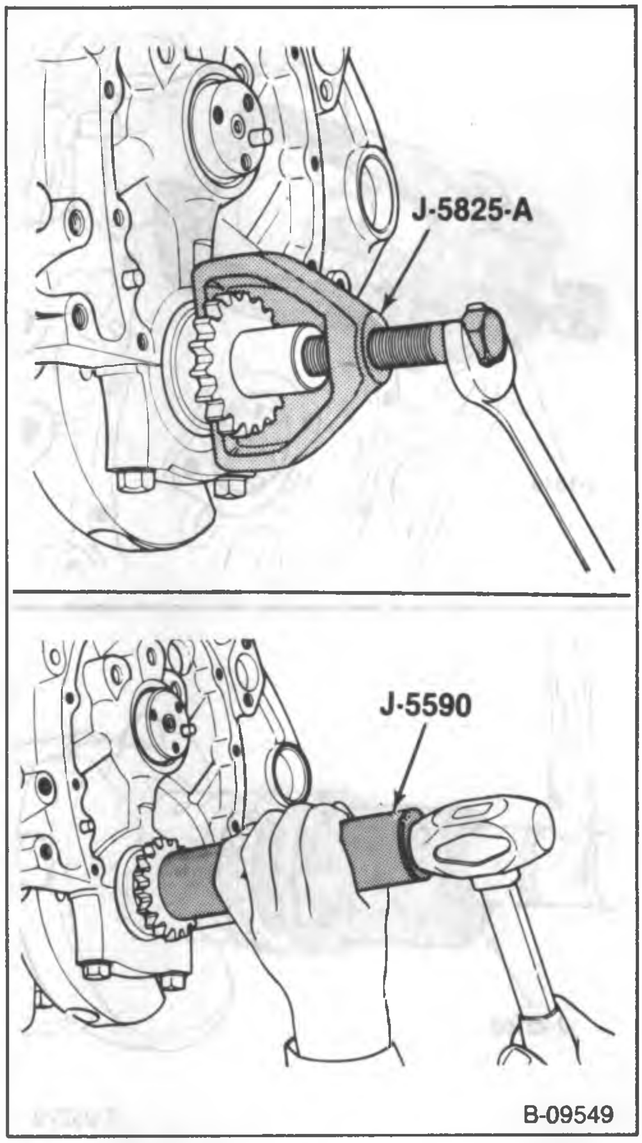


Figure 31—Crankshaft Sprocket Replacement (5.0L and 5.7L Engines)

Assemble (Figure 33)

- Front crankshaft seal. Use J 35468 (5.0 L and 5.7 L engines) or J 22102 (7.4 L engines) (figure 33). The open end of the seal must be facing the inside of the front cover.
- Lightly coat the seal lips with grease.

WATER PUMP

Clean

- Old gasket from the gasket surface.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings' lubricant supply, and cause premature bearing failure.

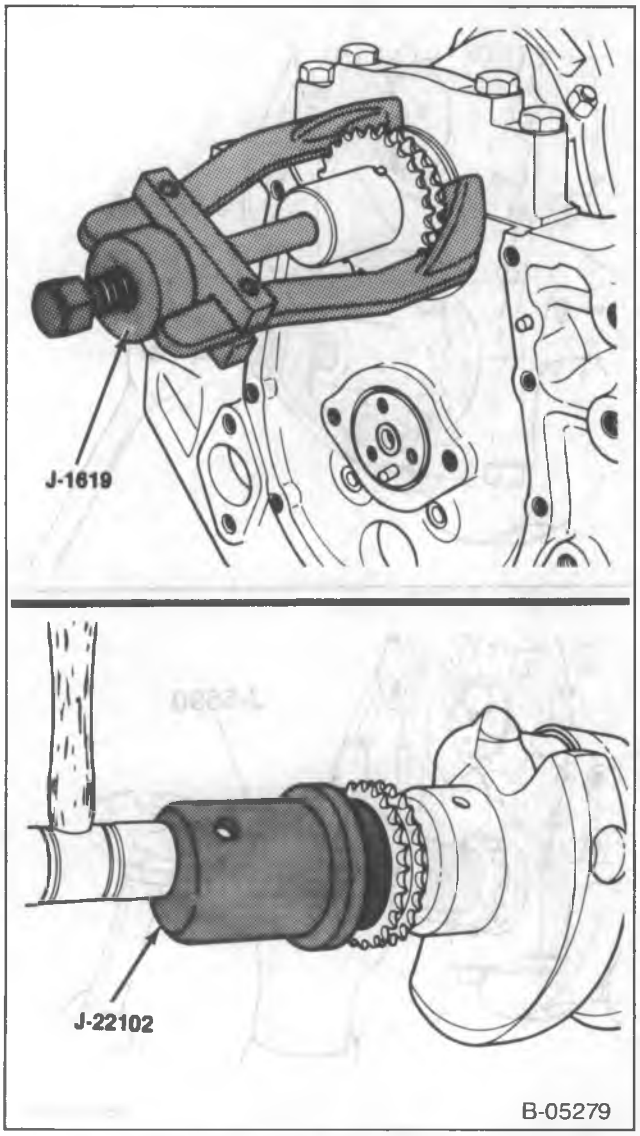


Figure 32—Crankshaft Sprocket Replacement (7.4L Engines)

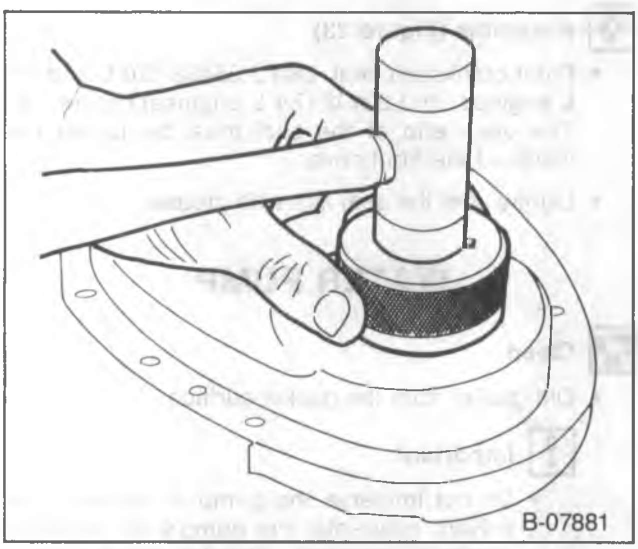


Figure 33—Installing the Front Crankshaft Seal (Typical)

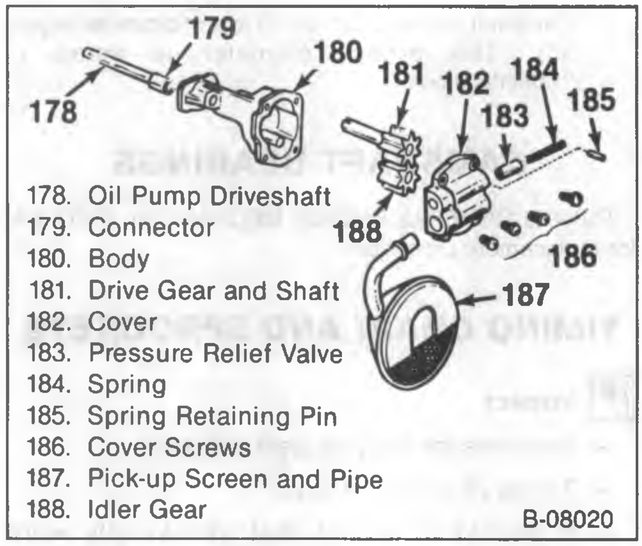


Figure 34—Oil Pump Components (5.0L and 5.7L Engines)

Inspect

- Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.
- Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking and the water pump should be replaced.

OIL PAN AND ROCKER ARM COVERS

Clean

— Parts in solvent. Remove all sludge and varnish.
— Old gaskets from the gasket surfaces.

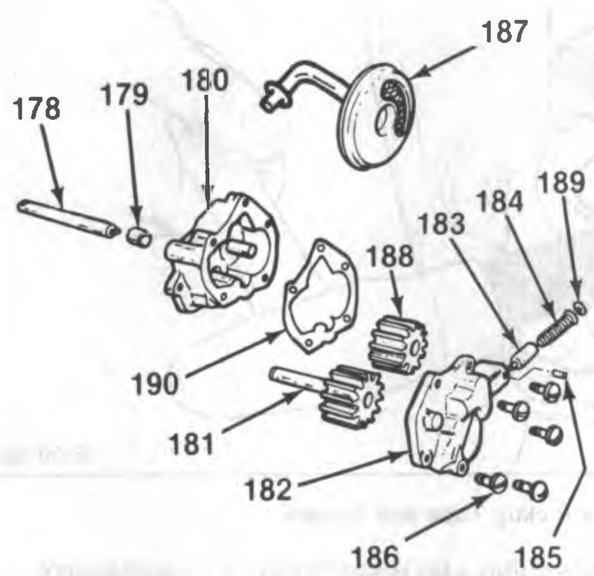
Inspect

— Gakset flanges for bending or damage.
— Rubber grommets and parts on the rocker arm cover for deterioration.
— Oil pan for rock damage or cracks.
— Oil pan baffle for lack of fit.
— Drain plug threads for stripping.

OIL PUMP

Disassemble (Figures 34 and 35)

1. Oil pump driveshaft (178) and connector (179).
2. Cover screws (186).
3. Cover (182) and gasket (180) (7.4L engines).
   - Mark the gear teeth so the pump gears can be installed with the same gear teeth indexed.
4. Drive gear and shaft (181).
5. Idler gear (181).
6. Spring retaining pin (185).
7. Washer (189) (7.4 L engines).
8. Spring (184).
9. Pressure relief valve (183).



178. Oil Pump Driveshaft
179. Connector
180. Body
181. Drive Gear and Shaft
182. Cover
183. Pressure Relief Valve
184. Spring
185. Spring Retaining Pin
186. Cover Screws
187. Pick-up Screen and Pipe
188. Idler Gear
189. Washer
190. Gasket

F-05722

Figure 35—Oil Pump Components (7.4L Engines)

10. Pickup screen and pipe (187).
    - Do not remove the pickup screen and pipe unless replacement is required.
    - The pickup pipe is a press fit in the pump body (182).
    - Do not try to remove the screen from the pipe. The pickup screen and pipe is serviced as an assembly only.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect

— Pump body (180) and cover (182) for cracks or other damage.

— Gears (181 and 188) for wear.

— Drive gear and shaft (181) for lack of fit in the pump body (180).

— Inside of the cover (182) for wear that would permit oil to leak past the ends of the gears. The pump gears, cover, and body are not serviced separately. If the parts are damaged or worn, replace the entire oil pump assembly.

— Pressure relief valve (183) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Assemble (Figures 34, 35, and 36)

Tool Required:
J 21882 Pickup Tube and Screen Installer (5.0 L and 5.7 L engines)
J 22144 Pickup Tube and Screen Installer (7.4L engines)

1. Pressure relief valve (183).
2. Spring (184).
3. Washer (189) (7.4 L engines).
4. Spring retaining pin (185).
5. Drive gear and shaft (181).
6. Idler gear (188) in the pump body (180) with the smooth side of the gear toward the pump cover opening. Index the marks made during disassembly.
7. Cover (182), gasket (190) (7.4L engines) and screws (186).

   Tighten

   - Screws (186) to 9.0 N·m (80 in. lbs.).

- Turn the driveshaft by hand to check for smooth operation.

NOTICE: Be careful of twisting, shearing or collapsing the pipe while installing in the pump.

8. Pickup screen and pipe (187) (if removed) (figure 36).
   - If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure.
   - Mount the oil pump in a soft jawed vise.
   - Apply sealer to the end of the pipe.
   - Tap the pickup screen and pipe into place, using J 21882 (5.0 L and 5.7 L engines) or J 22144 (7.4 L engines), and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.
9. Oil pump driveshaft (178) and connector (179).

VALVE TRAIN COMPONENTS

PUSHRODS, ROCKER ARMS, BALL, AND NUTS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Inspect

— Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.

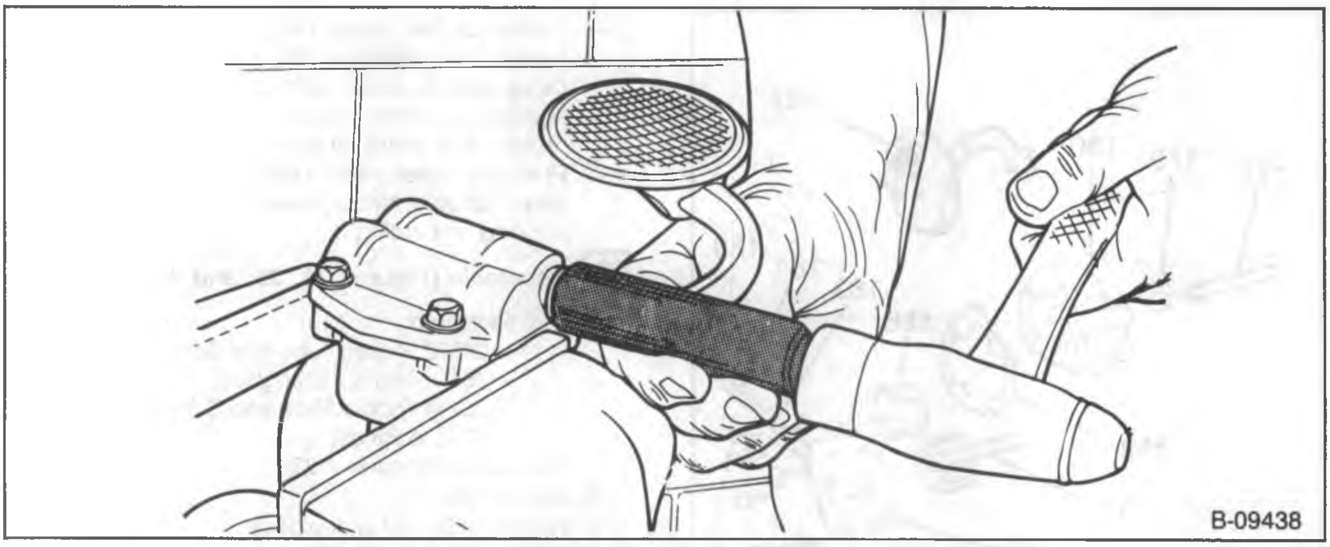


Figure 36—Installing the Oil Pump Pickup Tube and Screen

— Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.

— Rocker arm nuts.

- The nuts are prevailing torque nuts. At least 6.2 N·m (55 in. lbs.) torque should be required to thread the nuts onto the rocker arm studs. If not, it is possible that the nut(s) could back off during engine operation, causing loss of lash and valve train noise.

— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

— Ends of the pushrods for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

Disassemble (Figures 37, 38 and 39)

Tool Required:
J 8062 Valve Spring Compressor

1. Valve keepers (251).
   - Compress the springs (256) with J 8062 (figure 39).
   - Remove the valve keepers.
   - Remove J 8062.
2. Caps (253), shields (255), springs with dampers (256) and rotators (254).
3. O-ring seals (252) (if used) and seals (257).
4. Valves (258 and 259). Place them in a rack so they can be returned to their original position at assembly.

CLEANING AND INSPECTION OF COMPONENTS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Valve stem clearance.
- Valve spring tension and free length.

Other information outlined includes:

- Valve and seat grinding.
- Valve guide reaming.

ROCKER ARM STUD REPLACEMENT (5.0 L AND 5.7 L ENGINES)

Tools Required:
J 5802-01 Stud Remover
J 5715 Reamer (0.003-inch oversize) or
J 6036 Reamer (0.013-inch oversize)
J 6880 Stud Installer

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced. New studs are available in 0.003-inch and 0.013-inch oversize.

1. Place J 5802-01 over the stud to be removed. Install a nut and flat washer. Remove the stud by turning the nut (figure 40).
2. Ream the hole to the proper size for the replacement oversize stud. Use J 5715 for 0.003-inch oversize studs; J 6036 for 0.013-inch oversize studs (figure 41).
3. Coat lower end (press-fit area) of stud with hypoid axle lubricant. Drive the stud into place with a hammer and J 6880. Stud is installed to proper depth when the tool bottoms on the cylinder head (figure 42).

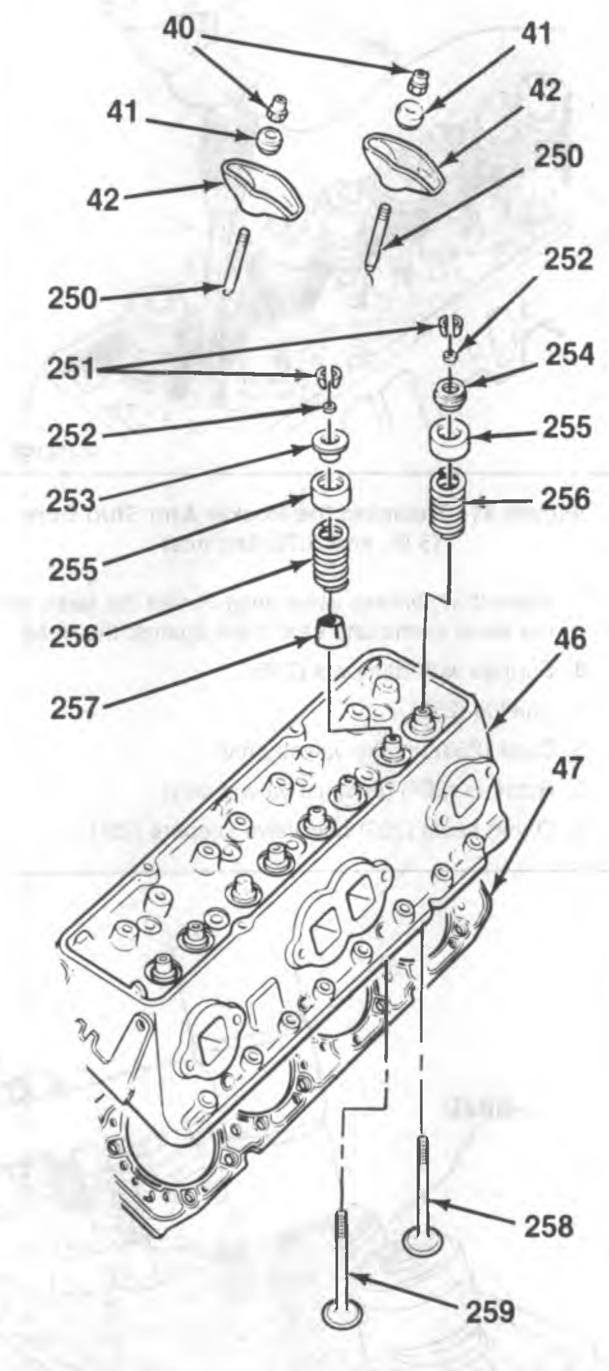


Figure 37—Cylinder Head and Components (5.0L and 5.7L Engines)

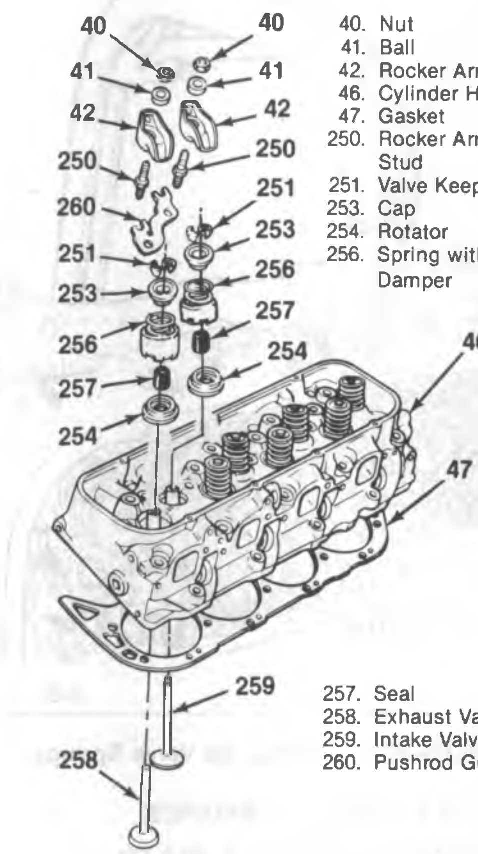


Figure 38—Cylinder Head and Components (7.4L Engines)

ROCKER ARM STUD AND PUSHROD GUIDE REPLACEMENT (7.4 L ENGINES)

The rocker arm studs used in 7.4 L engines are threaded in place.

Disassemble (Figure 38)

1. Rocker arm studs (250). Use a deep socket.
2. Pushrod guide (260).

Assemble (Figure 38)

1. Pushrod guide.
2. Rocker arm studs. Use a deep socket.

Tighten

- Rocker arm studs to 68 N·m (50 ft. lbs.).

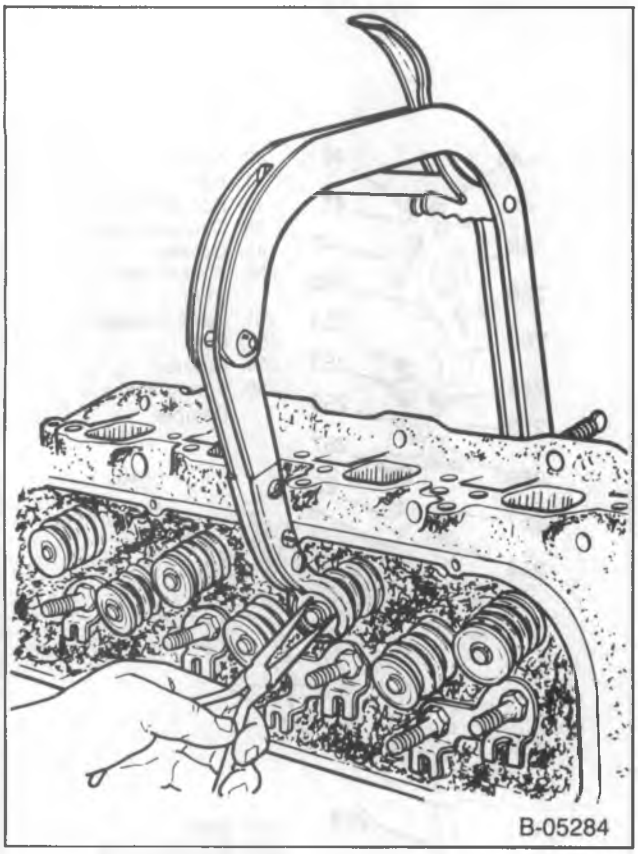


Figure 39—Compressing the Valve Springs

ASSEMBLY (5.0 L AND 5.7 L ENGINES)

Assemble (Figures 37, 39, and 43)

Tools Required:
J 8062 Valve Spring Compressor
J 23738-A Valve Seal Leak Detector

1. Valves (258 and 259).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper ports.

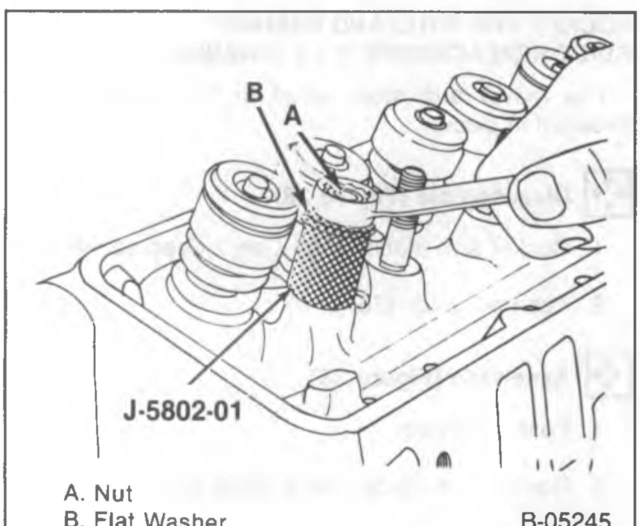


Figure 40—Removing the Rocker Arm Stud (5.0L and 5.7L Engines)

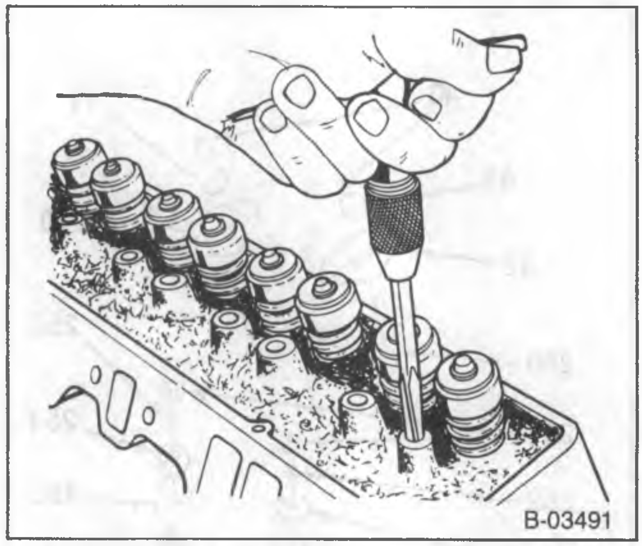


Figure 41—Reaming the Rocker Arm Stud Bore (5.0L and 5.7L Engines)

2. Seals (257) (intake valve only). Install the seals over the valve stems and seat them against the head.
3. Springs with dampers (256).
4. Shields (255).
5. Caps (253) (intake valves only).
6. Rotators (254) (exhaust valves only).
7. O-ring seals (252) and valve keepers (251).

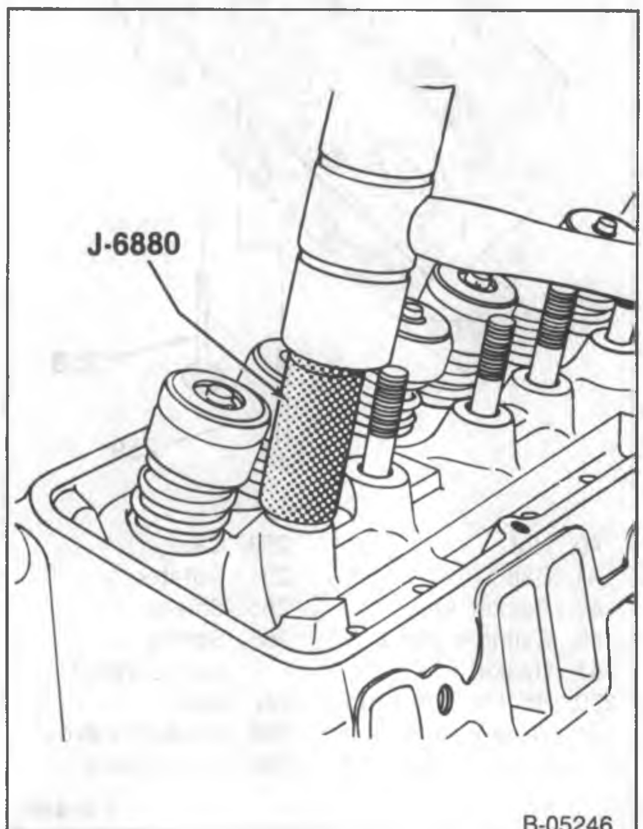


Figure 42—Installing the Rocker Arm Stud (5.0L and 5.7L Engines)

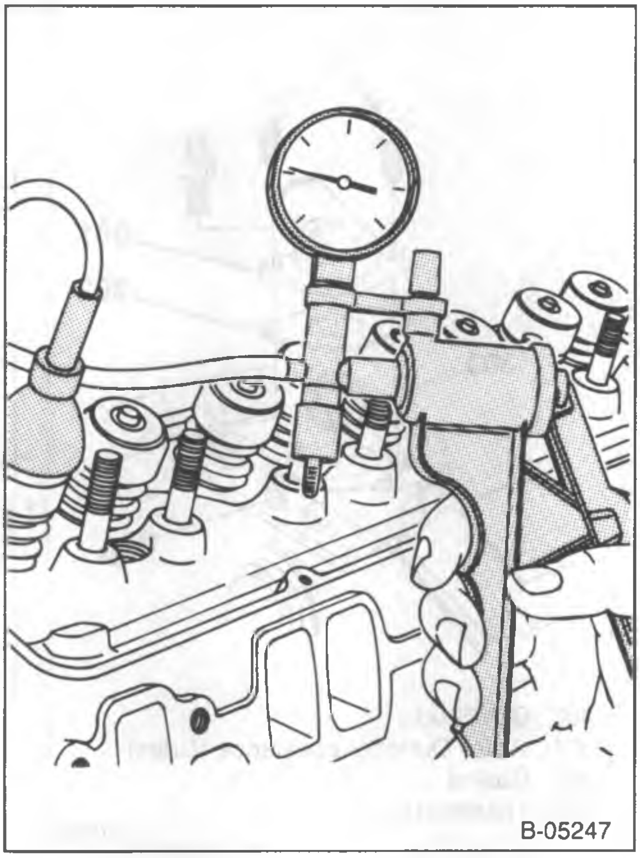


Figure 43—Checking the Valve Seal (5.0L and 5.7L Engines)

- Compress the valve spring, using J 8062 (figure 39). Compress the spring enough so the lower valve stem groove can be clearly seen.
- Push a new O-ring seal onto the valve stem. The seal is to be installed on the stem's lower groove. Make sure the seal is flat and not twisted.
- Apply a small amount of grease to the area of the upper valve stem groove. Assemble the two valve keepers using the grease to hold the keys in place. Make sure the keepers seat properly in the groove.
- Release the compressor tool. Make sure the valve keepers stay in place.
- Repeat the preceding steps on the remaining valves.
- Check each seal, using J 23738-A (figure 43). Place the adapter cup over the shield. Operate the vacuum pump. Observe the vacuum pump gage. No air should be able to leak past the seal. If the seal will not hold a vacuum, it may have been damaged or improperly installed.

Measure (Figures 44 and 45)

- Valve spring installed height of each valve spring as follows:
  1. Use a narrow, thin scale. A cutaway scale (figure 44) may be helpful.
  2. Measure from the valve shim or spring seat to the top of the shield (255) (figure 45).

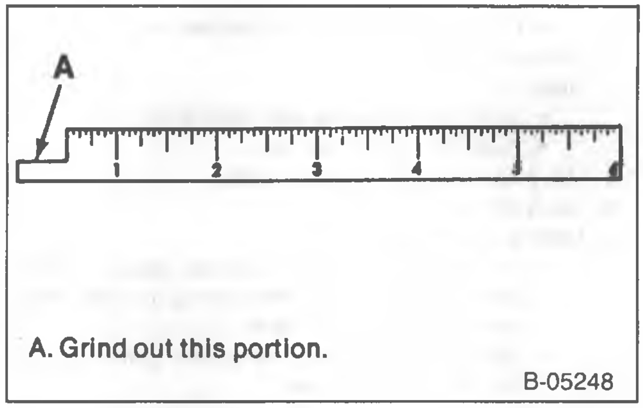


Figure 44—Cutaway Scale

3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims of sufficient thickness (between the spring and cylinder head) to give the desired measurement. NEVER shim the spring so as to give an installed height under the specified figure.

ASSEMBLY (7.4 L ENGINES)

Assemble (Figures 38 and 39)

Tool Required:
J 8062 Valve Spring Compressor

1. Valves (258 and 259).
   - Lubricate the valve stems with engine oil.

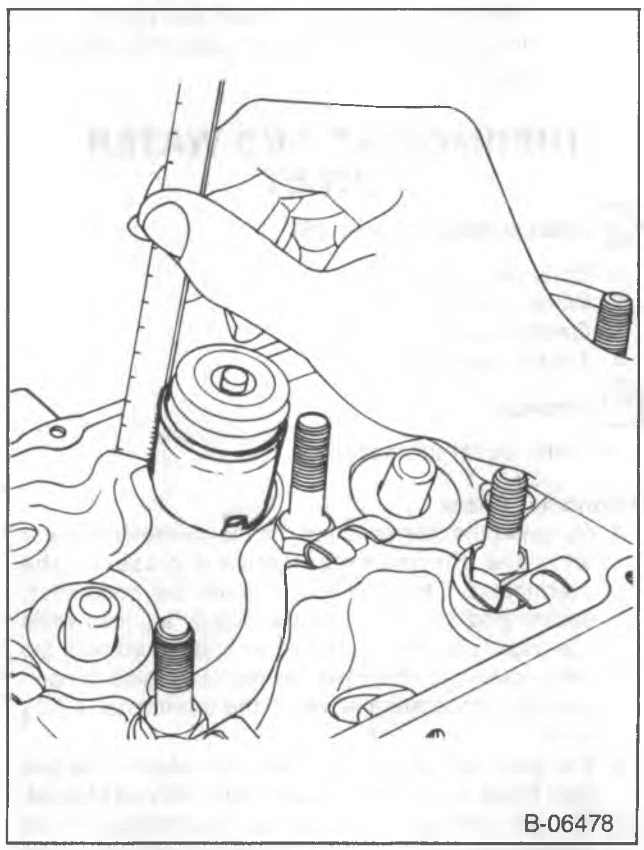


Figure 45—Measuring Valve Spring Installed Height (7.4L Engine Shown)

- Insert the valve into the proper port.

2. Rotators (254).
3. Seals (257).
   - Lubricate the seals with engine oil.
   - Push the seals into place.
4. Valve springs with dampers (256).
5. Caps (253).
6. Valve keepers (251).
   - Compress the valve spring using J 8062 (figure 39). Compress the spring until the valve stem groove can be seen.
   - Apply a small amount of grease to the area of the valve stem groove.
   - Assemble the valve keepers, using the grease to hold the keys in place. Make sure the keepers seat properly in the groove.
   - Release the compressor tools. Make sure the valve keepers stay in place.
   - Repeat this procedure on the remaining valves.

Measure (Figures 44 and 45)

- Valve spring installed height of each valve spring.
  1. Use a narrow, thin scale. A cutaway scale (figure 44) may be helpful.
  2. Measure from the spring seat to the top of the valve spring (figure 45).
  3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims of sufficient thickness (between the spring and cylinder head) to give the desired measurement. NEVER shim the spring so as to give an installed height under the specified figure.

THERMOSTAT AND WATER OUTLET

Disassemble (Figure 46)

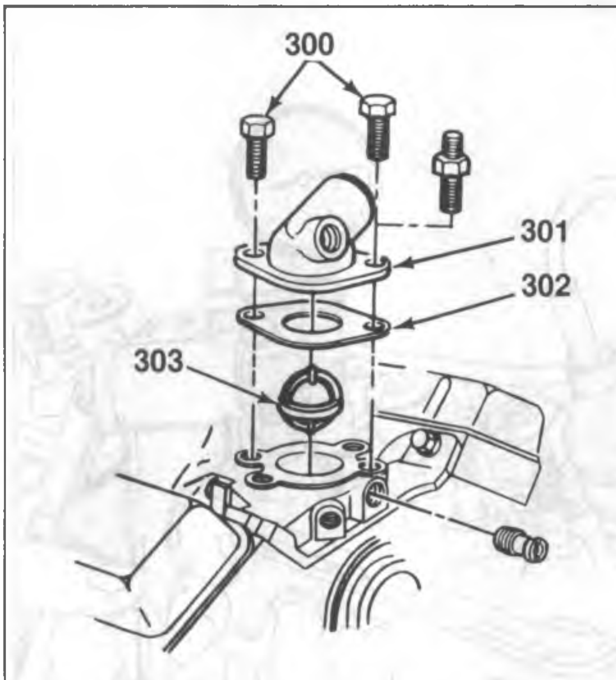
1. Bolts or studs (300).
2. Water outlet (301).
3. Gasket (302).
4. Thermostat (303).

Inspect

- Water outlet for cracks.

Thermostat Check

1. Suspend the thermostat and a thermometer in water with the thermometer located close to the thermostat. The thermostat must be completely submerged and the water thoroughly agitated while heating. Apply heat to the water and record both the temperature at which the thermostat begins to open and the temperature at which the thermostat is fully open.
2. Compare the temperature readings taken in the test with those given in the proper Truck Service Manual.
3. Do not attempt to repair the thermostat. If the thermostat does not function properly, replace it with a new unit which has been checked as directed previously.



300. Bolt/Stud
301. Water Outlet (Appearance Varies)
302. Gasket
303. Thermostat

B-08061

Figure 46—Thermostat and Components

Install or Connect (Figure 46)

1. Thermostat (303).
2. Gasket (302).
3. Water outlet (301).
4. Bolts or studs (300).

Tighten

- Bolts or studs to specifications.
  — 5.0 L and 5.7 L engines: 28 N·m (21 ft. lbs.).
  — 7.4 L engines: 40 N·m (30 ft. lbs.).

TORSIONAL DAMPER

Inspect

— Torsional damper weight for lack of fit or signs of shifting on the hub. Replace as needed.
— Area of the torsional damper hub shaft which contacts the front crankshaft seal for roughness or nicks. Replace the damper if this condition exists.

CRANKSHAFT AND BEARINGS

Clean

— Crankshaft with solvent.
— Blow all sludge from the oil passages with compressed air.
— Main bearing inserts. Wipe free of oil with a soft cloth.

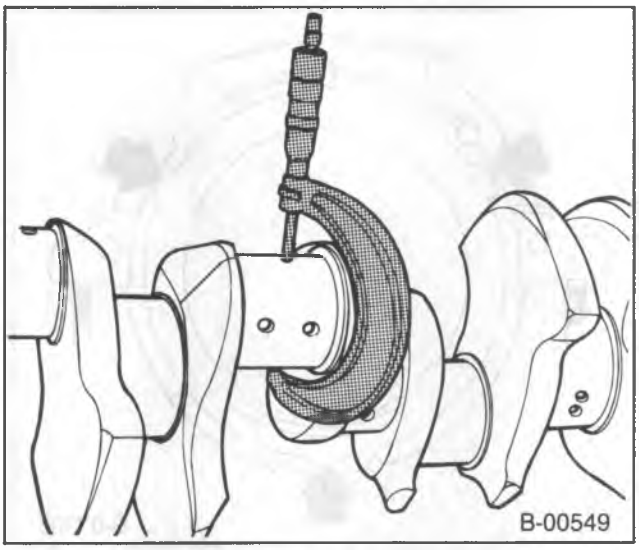


Figure 47—Measuring the Crankshaft Journals

— Seal running surfaces with a non-abrasive cleaner.

Inspect

— Crankshaft for cracks. Use the magnaflux method, if available.

— Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.

— Main bearing inserts for scoring or other damage.

In general, the lower inserts (except the #1 bearing) show greater wear and the most distress from fatigue. If, upon inspection, the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert shows evidence of wear or damage, both the upper and lower inserts must be replaced.

Measure (Figures 47 and 48)

— Main bearing and connecting rod journal diameters (figure 47). Compare with "Specifications." Grind or replace the crankshaft if necessary.

— Main bearing and connecting rod journals for taper and out-of-round (figure 47). If the journals are tapered or out-of-round more than 0.001-inch, grind or replace the crankshaft.

— Crankshaft run-out (figure 48).

- Mount the crankshaft in V-blocks or between centers.
- Use a dial indicator as shown.
- If the main journals are misaligned, the crankshaft is bent and must be replaced, along with the main bearing.

Crankshaft Bearing Availability

Crankshaft main and connecting rod bearings are available in 0.001, 0.002, 0.010, and 0.020-inch undersizes.

OIL FILTER BYPASS VALVE

Disassemble (Figure 49)

1. Bolts (321).
2. Oil filter bypass valve (320).

Clean

— Oil filter bypass valve.

— Oil passages in the block.

Inspect (Figure 49)

- Valve disc (item A) and spring for damage or sticky operation. Replace the assembly if faulty.

Assemble (Figure 49)

1. Oil filter bypass valve (320).
2. Bolts (321).

Tighten

- Bolts (321) to 9.0 N·m (80 in. lbs.).

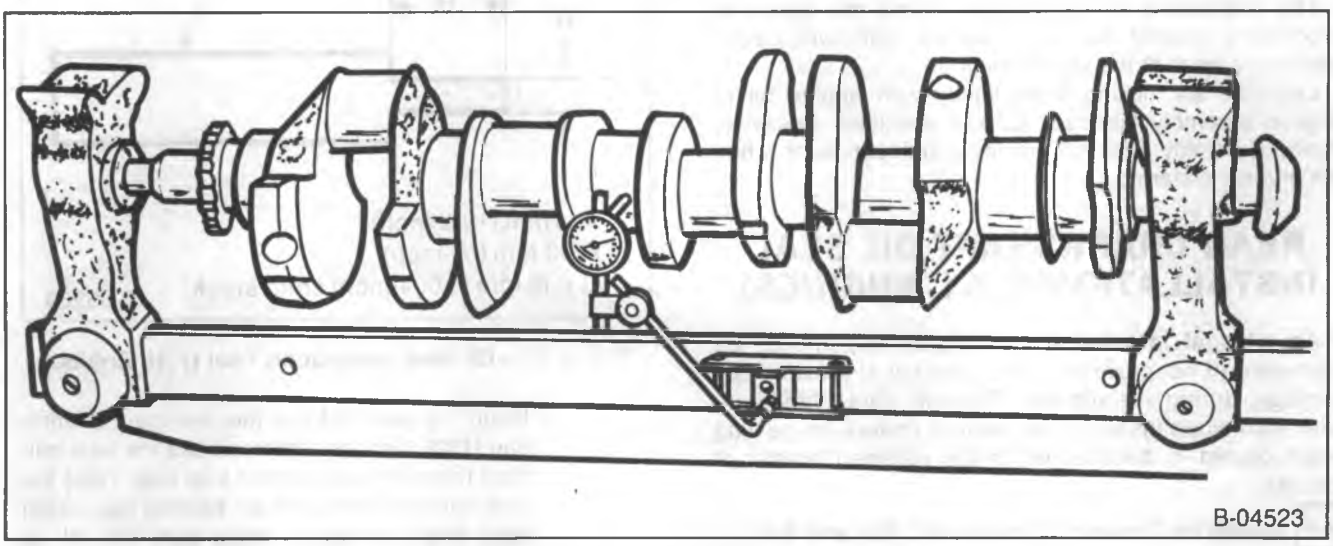


Figure 48—Checking Crankshaft Run-Out

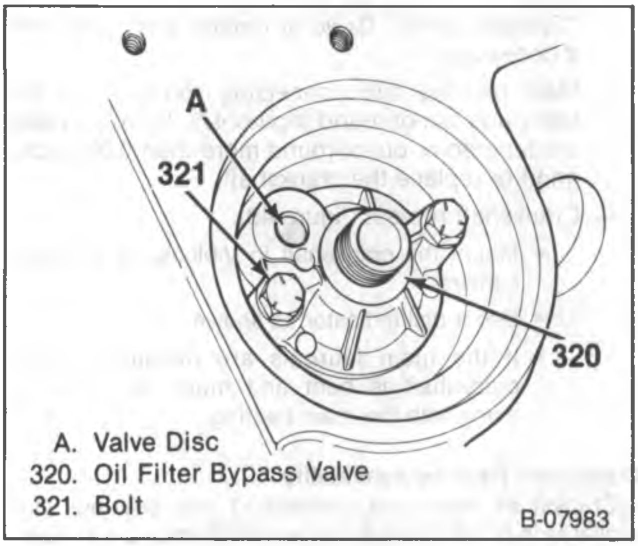


Figure 49—Oil Filter Bypass Valve

REAR CRANKSHAFT OIL SEAL RETAINER (5.0 L AND 5.7 L ENGINES)

Disassemble (Figure 50)

- Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 50).

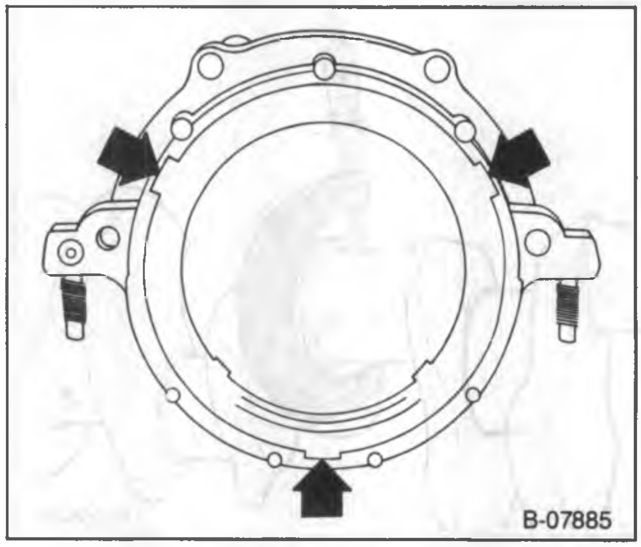


Figure 50—Seal Removal Notches

Clean

- All traces of old gasket from the retainer.

Inspect

- Retainer for cracks, porosity, and damage to the sealing surfaces.

Important

- Install the new rear crankshaft oil seal with the proper tool, after the retainer is assembled to the engine, as outlined later.

ASSEMBLY OF ENGINE

PRIOR TO ASSEMBLY

The importance of cleanliness during the assembly procedure cannot be overstressed. Dirt will cause premature wear of the rebuilt engine.

Lubricate all moving parts lightly with engine oil or engine assembly lubricant (unless specified otherwise) during assembly. This will provide initial lubrication when the engine is started.

REAR CRANKSHAFT OIL SEAL INSTALLATION (7.4 L ENGINES)

An oil seal installation tool (figure 51) should be fabricated (if not provided in the seal kit) to prevent seal damage during installation. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal.

Install or Connect (Figures 51, 52, and 53)

1. Lower seal (131) (figure 52).

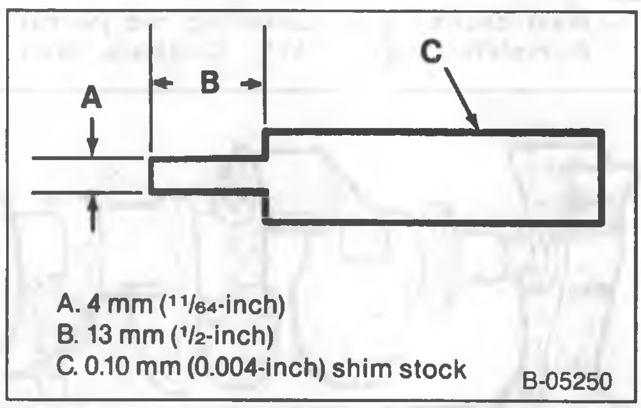
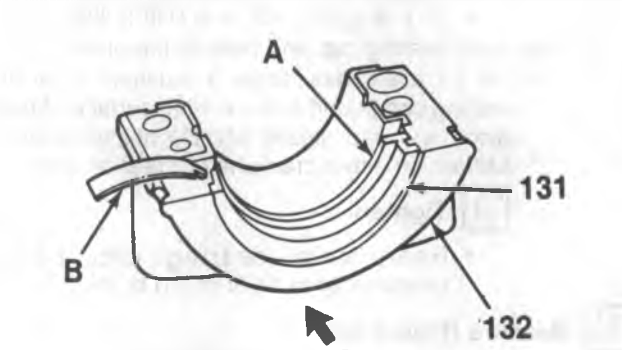


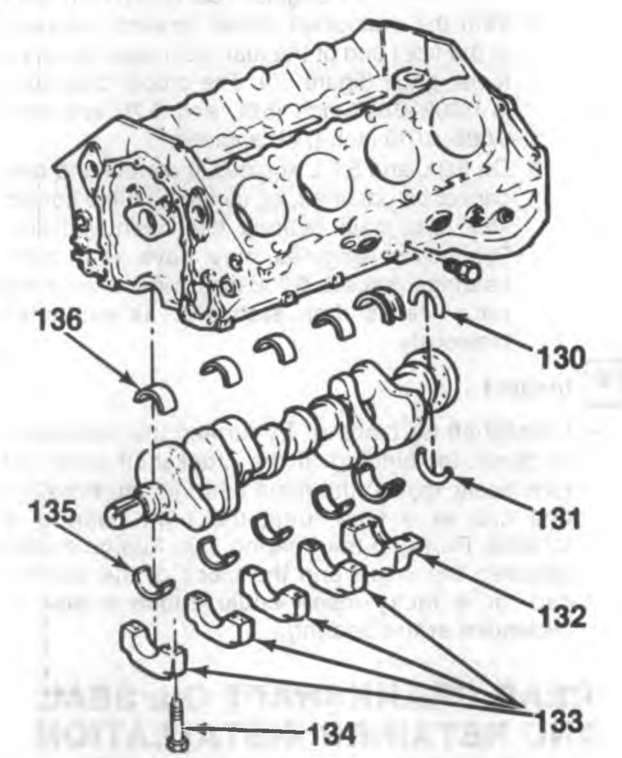
Figure 51—Oil Seal Installation Tool (7.4L Engine)

- Insert the seal half into the rear main bearing cap (132). Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure. Make sure the oil lip faces the front of the engine.



A. Oil Seal Lip
B. Oil Seal Tool
C. Forward
131. Lower Seal Half
132. Rear Main Bearing Cap

Figure 52—Crankshaft Rear Oil Seal Installation (7.4L Engines)



130. Upper Seal Half (Mark IV Engines)
131. Lower Seal Half (Mark IV Engines)
132. Rear Main Bearing Cap
133. Main Bearing Cap
134. Bolt
135. Lower Main Bearing Insert
136. Upper Main Bearing Insert

Figure 53—Crankshaft and Components (Typical)

- Coat the seal lips lightly with engine oil. Keep the oil off the oil seal mating ends.

2. Upper seal half (130).
   - Insert the seal half in the block using the installation tool to protect the back sealing bead of the seal from the sharp corner of the block. Position the seal and the tip of the tool so that the seal contacts the tool. Make sure that the oil seal lip is positioned toward the front of the engine.
   - Feed the seal into position the same way as for the main bearing cap, gradually, using the tool as a "shoe-horn" to protect the seal outer diameter from damage. The tool must remain in position until the seal is properly in position, with both ends flush with the block.
   - Remove the tool, being careful not to withdraw the seal.

CRANKSHAFT AND MAIN BEARING INSTALLATION

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are excessive, a new bearing plus both upper and lower inserts will be required. Service bearings are available in standard size and 0.001-inch, 0.002-inch, 0.010-inch, and 0.020-inch undersize. 0.009 inch is available for 5.0L and 5.7L engines only.

Selective fitting of both rod and main bearing inserts is necessary obtain close tolerances. For this reason you may use, for example, one half of a 0.001-inch undersize insert which will decrease the clearance 0.0005-inch from using a full standard bearing.

UNDERSIZE MAIN JOURNALS (5.0 L AND 5.7 L ENGINES)

- On 5.0 L and 5.7 L engines, when a production crankshaft cannot be precision fit by the method described previously, it is then ground 0.009-inch undersize **ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT BE NECESSARILY BE GROUND.** A 0.009-inch undersize bearing or 0.010-inch undersize bearing will then be used for precision fitting in the same manner as previously described.

OVERSIZE REAR MAIN BEARING THRUST FACES (5.0 L AND 5.7 L ENGINES)

- Some 5.0 L and 5.7 L production engines may have rear main bearings that are 0.008-inch wider than standard across the thrust faces.
- The crankshaft on these engines can be identified by ".008" stamped on the rear counterweight.
- If the rear main bearings are replaced, they must have the proper distance between thrust faces to obtain correct crankshaft end play.

Install or Connect (Figures 53, 54, and 55)

1. Upper main bearing inserts to the block.

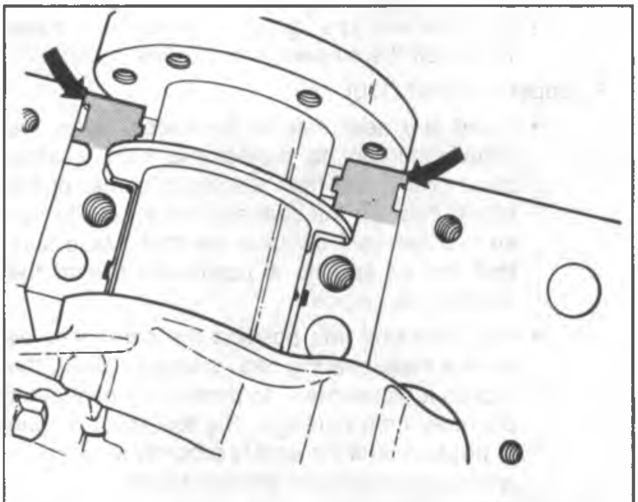


Figure 54—Applying Sealant to the Block (7.4L Engines)

Important

- If any undersized bearings are used, make sure they are fitted to the proper journals.

2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps.

Measure

- Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

- Apply engine oil to the main bearing inserts.

4. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to specifications.
  - 5.0 L and 5.7 L engines:
    - — Outer bolts on #2, #3, and #4 main bearing caps: 95 N·m (70 ft. lbs.).
    - — All others: 110 N·m (80 ft. lbs.).

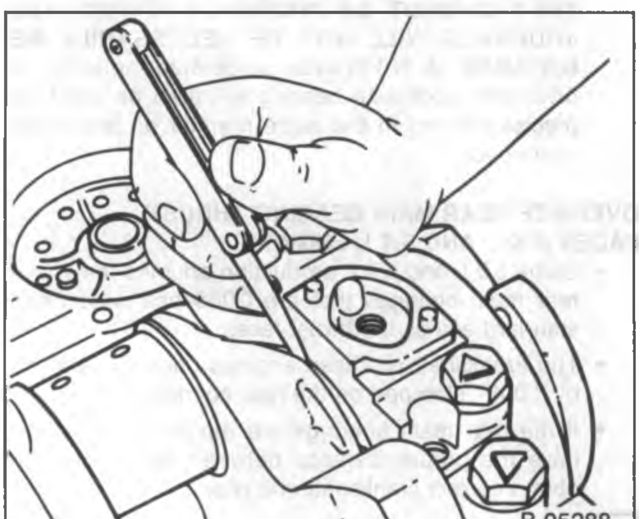


Figure 55—Measuring Crankshaft End Play

  - 7.4 L engines: 150 N·m (110 ft. lbs.).

5. Rear main bearing cap and bolts to the block.
   - On 7.4 L engines, apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 54). Do not allow any sealant on either crankshaft or rear oil seal.

Tighten

- Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).

Measure (Figure 55)

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.

Tighten

- Rear main bearing cap bolts to specifications:
  - — 5.0 L and 5.7 L engines: 110 N·m (80 ft. lbs.).
  - — 7.4 L engines 135: N·m (100 ft. lbs.).

2. With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 55). The proper clearance is 0.002–0.006-inch (5.0L and 5.7L engines), 0.006–0.010-inch (7.4L engines).
3. On 5.0 L and 5.7 L engines, if correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard, as explained previously.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, on one cap at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

REAR CRANKSHAFT OIL SEAL AND RETAINER INSTALLATION (5.0 L AND 5.7 L ENGINES)

Install or Connect (Figures 56 and 57)

Tool Required:
J 35621 Seal Installer

- Whenever the seal retainer is removed, a new retainer gasket and rear crankshaft oil seal must be installed.

1. Gasket (120) to the block. It is not necessary to use sealant to hold the gasket in place.
2. Seal retainer (121).
3. Screws and nuts.

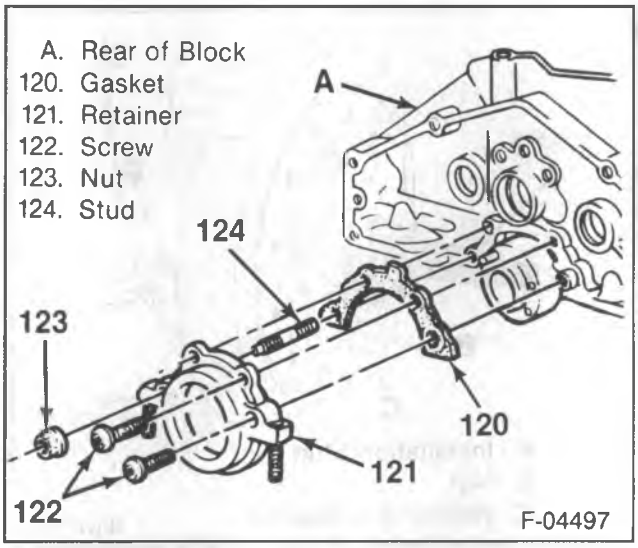


Figure 56—Rear Crankshaft Oil Seal Retainer (5.0L and 5.7L Engines)

Tighten

- Screws and nuts to 15.3 N·m (135 in. lbs.).

4. Rear crankshaft oil seal (figure 57).
   - Make sure the crankshaft rear chamfer is free of grit, loose rust, and burrs. Correct as needed.
   - Lubricate the inner and outer diameter of the seal with engine oil.
   - Install the seal on J 35621.
   - Position J 35621 against the crankshaft. Thread the attaching screws into the tapped holes in the crankshaft.
   - Tighten the screws securely with a screwdriver. This will ensure that the seal is installed squarely over the crankshaft.
   - Turn the handle until it bottoms.
   - Remove J 35621.

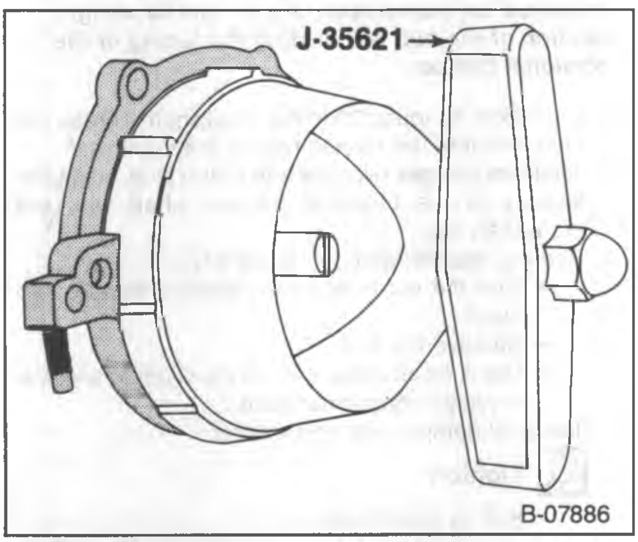


Figure 57—Installing the Rear Crankshaft Oil Seal (5.0L and 5.7L Engines)

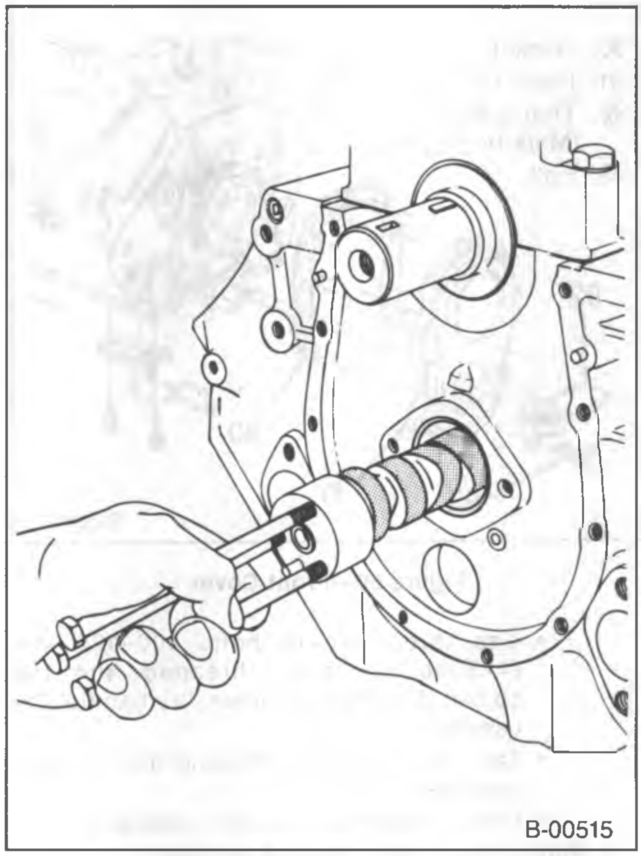


Figure 58—Installing the Camshaft

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 58 and 59)

- Coat the camshaft lobes and journals with Engine Oil Supplement (GM part number 1051396) or equivalent.

1. Camshaft (figure 58).

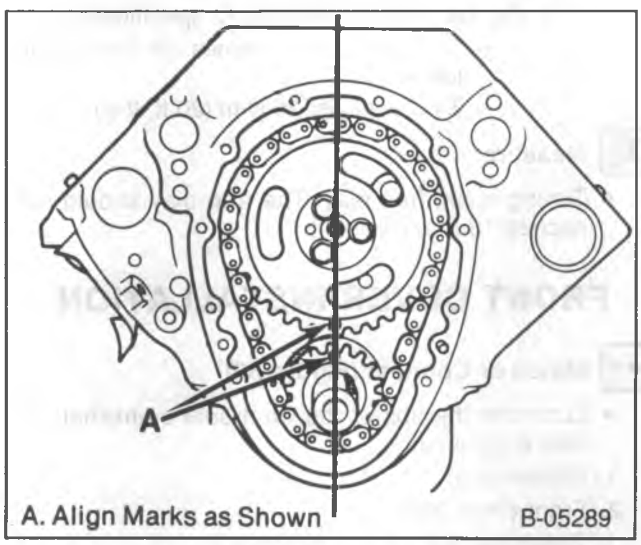


Figure 59—Timing Marks

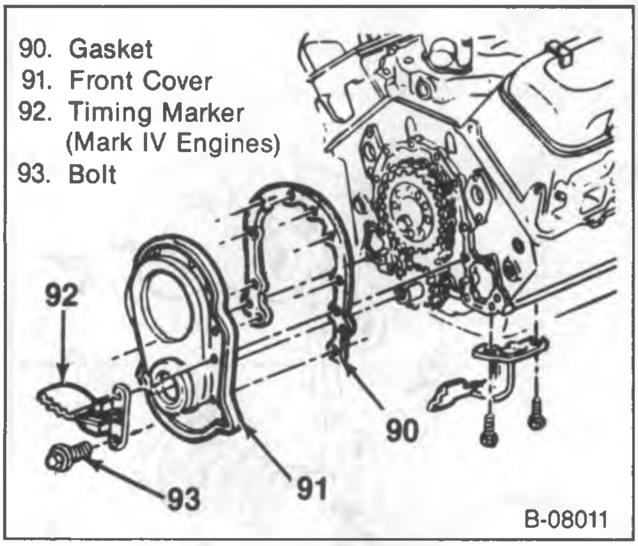


Figure 60—Front Cover

- Use three 5/16-18 bolts 100-125 mm (4-5-inches) long, threaded into the camshaft's tapped holes, to handle the camshaft.
- Take care to avoid damaging the camshaft bearings.
- Remove the three bolts after installation.

2. Timing chain to the camshaft sprocket.
3. Camshaft sprocket and timing chain to the engine.

Important

- Align the timing marks on the camshaft sprocket and crankshaft sprocket (figure 59).

4. Camshaft sprocket bolts. Use the bolts to draw the camshaft sprocket onto the camshaft. DO NOT ATTEMPT TO HAMMER THE CAMSHAFT SPROCKET ONTO THE CAMSHAFT TO DO SO MAY DISLODGE THE REAR CAMSHAFT PLUG.

Tighten

- Camshaft sprocket bolts to specifications.
  - 5.0 L and 5.7 L engines: 28 N·m (21 ft. lbs.).
  - 7.4 L engines: 26 N·m (20 ft. lbs.).

Measure

- Timing chain free play. The free play should not exceed 16 mm (5/8-inch).

FRONT COVER INSTALLATION

Install or Connect (Figure 60)

- Lubricate the lips of the front seal crankshaft oil with engine oil.

1. Gasket (90).
2. Front cover (91).
3. Timing tab (92) (7.4 L engines).
4. Bolts (93).

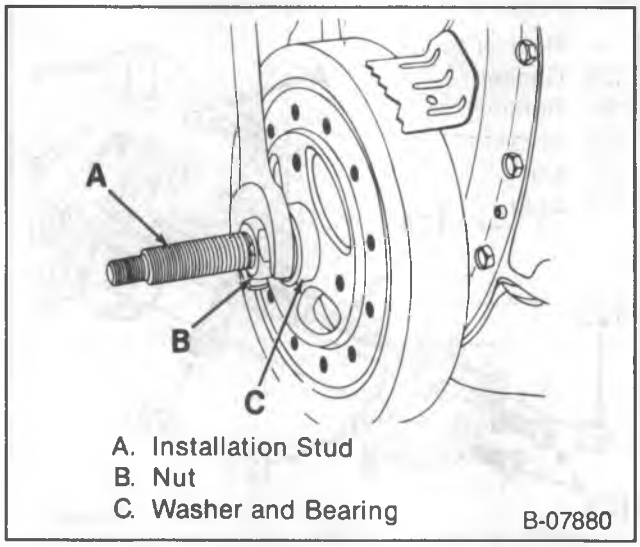


Figure 61—Installing the Torsional Damper

Tighten

- Bolts (93) to specifications:
  - 5.0 L and 5.7 L engines: 10.8 N·m (96 in. lbs.).
  - 7.4 L engines: 11.3 N·m (100 in. lbs.).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figure 61)

Tools Required:
J 23523-E Torsional Damper Puller and Installer

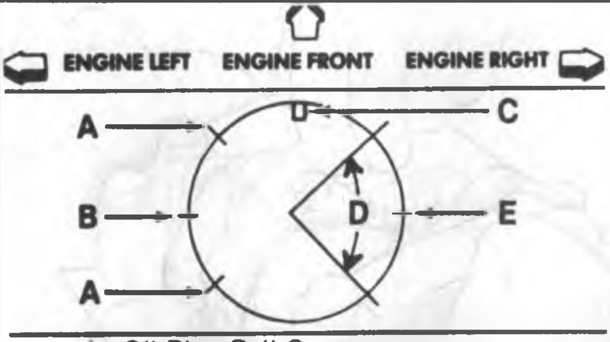
1. Crankshaft key.

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

2. Stud (item A, figure 61) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.
3. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
4. Bearing, washer and nut (figure 61).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
   - Use a small amount of RTV sealant to seal the keyway to crankshaft joint.
5. Torsional damper bolt and washer.

Tighten

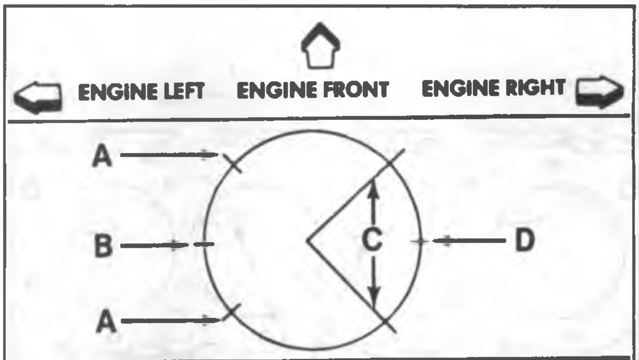
- Bolt to specifications.
  - 5.0 L and 5.7 L engines: 95 N·m (70 ft. lbs.).
  - 7.4 L engines: 115 N·m (85 ft. lbs.).



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Notch In Piston
D. Oil Ring Spacer Gap (Tang In Hole Or Slot With Arc)
E. Top Compression Ring Gap

B-07895

Figure 62—Piston Ring End Gap Location (5.0L and 5.7L Engines)



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Oil Ring Spacer Gap (Tang In Hole Or Slot With Arc)
D. Top Compression Ring Gap

B-07935

Figure 63—Piston Ring End Gap Location (7.4L Engines)

PISTON AND CONNECTING ROD INSTALLATION

CONNECTING ROD BEARING SELECTION

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are excessive install a new bearing. Service bearings are available in standard size and 0.001-inch and 0.002-inch undersize for use with new and used standard size crankshafts, and in 0.010-inch and 0.020-inch undersize for use with reconditioned crankshafts.

On production 5.0 L and 5.7 L engines, it is possible to find an 0.010-inch undersize bearing. These are used in manufacturing for selective fitting.

Selective fitting of both rod and main bearing inserts is necessary to obtain close tolerances. For this reason you may use, for example, one half of a standard insert with one half of a 0.001-inch undersize insert which will decrease the clearance 0.0005-inch from using a full standard bearing.

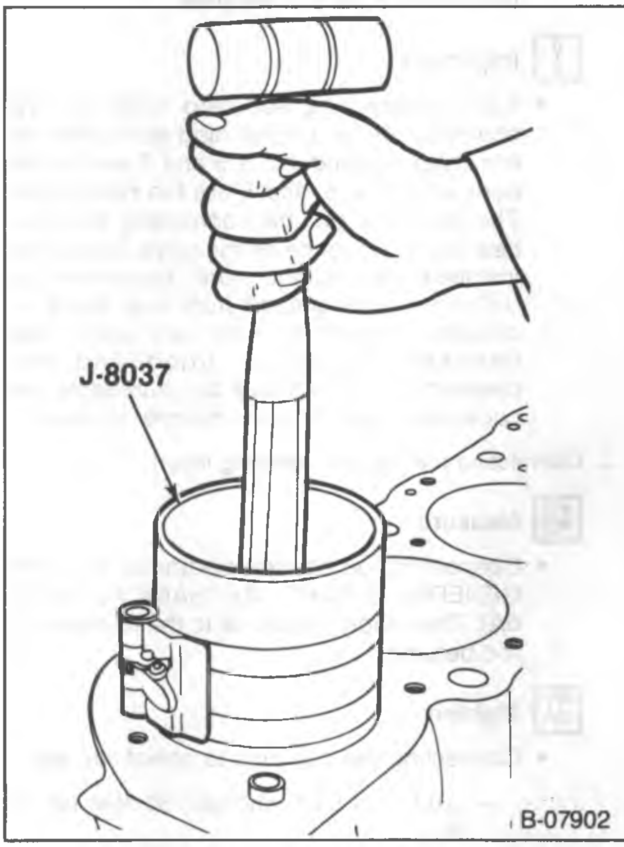
INSTALLATION

Install or Connect (Figures 62 through 65)

Tools Required:
- J 5239 Connecting Rod Guide Set
- J 8037 Ring Compressor

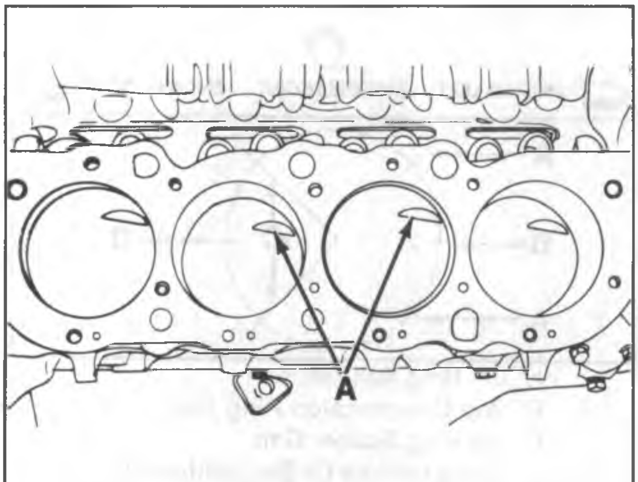
- Lubricate the cylinder walls lightly with engine oil.
- Make sure the piston is installed in the matching cylinder.

1. Connecting rod bearing inserts.
   - Be certain that the inserts are of the proper size.
   - Install the inserts in the connecting rod and connecting rod cap.
2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap removed, install J 5239 onto the connecting rod studs.
   - Locate the piston ring end gaps as shown in figure 62 (5.0 L and 5.7 L engines) or figure 63 (7.4 L engines).
   - Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston (figure 64).
   - Use a hammer handle to tap the piston down into its matching bore.



B-07902

Figure 64—Installing the Piston



A. Valve Clearance Notch B-07936

Figure 65—Piston Installed (7.4L Engines)

- On 5.0 L and 5.7 L engines, the notch in the piston crown (figure 62) must face the front of the engine.
- On 7.4 L engines, the valve clearance notches must face the top of the block (figure 65).

- While tapping the piston into its bore, guide the connecting rod into position on the crankpin, using J 5239. Hold the ring compressor against the block until all rings have entered the cylinder bore.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinder 1, 3, 5 and 7 are the left bank and 2, 4, 6, and 8 are the right bank. 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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

3. Connecting rod cap with bearing insert.

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A). Then apply engine oil to the connecting rod bearing.

Tighten

- Connecting rod cap nuts to specifications.
  - 5.0 L and 5.7 L engines: 60 N·m (45 ft. lbs.).
  - 7.0 L engines: 66 N·m (48 ft. lbs.).

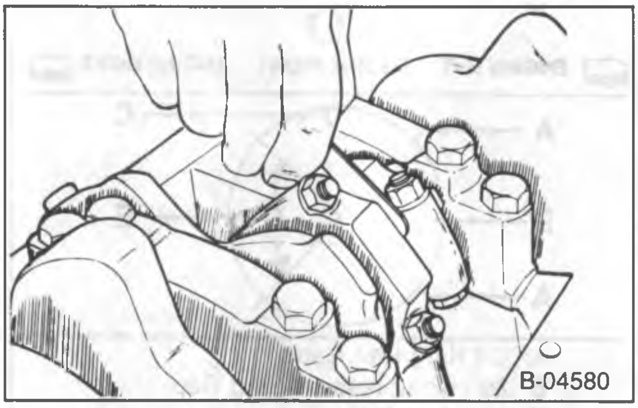


Figure 66—Measuring Connecting Rod Side Clearance

Measure (Figure 66)

- Connecting rod side clearance. Use a feeler gage between the connecting rods (figure 66).The proper clearance is as follows:
  - 5.0 L and 5.7 L engines: 0.006–0.014-inch.
  - 7.4 L engines: 0.013–0.023-inch.

OIL PUMP INSTALLATION

Install or Connect

1. Oil pump with connector and oil pump driveshaft.
2. Oil pump to main bearing cap bolt.

Tighten

- Bolt to 90 N·m (65 ft. lbs.).

OIL PAN INSTALLATION

5.0 L AND 5.7 L ENGINES

Install or Connect (Figure 67)

- Apply PST sealer (GM part no. 1052080 or equivalent) to the front cover to block joint and rear crankshaft seal retainer to block joint as shown in figure 67.

1. Oil pan gasket to the oil pan.
2. Oil pan to the engine.
3. Oil pan bolts, nuts, and reinforcements.

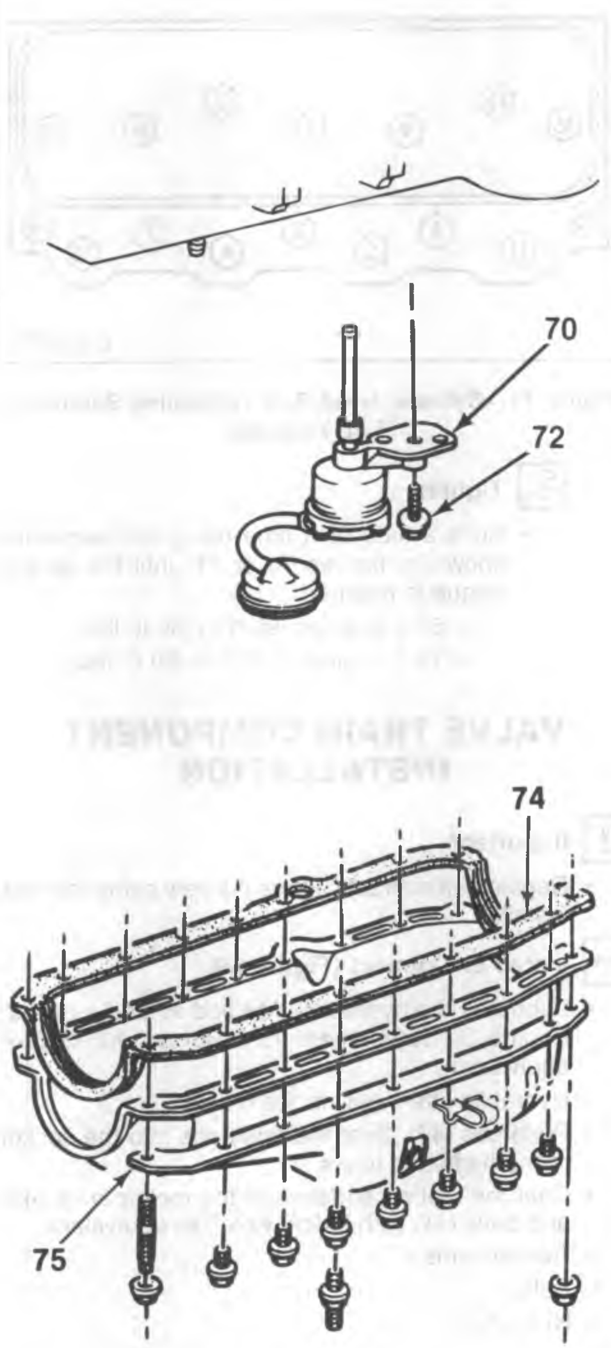
Tighten

- Oil pan bolts to 11.3 N·m (100 in. lbs.).
- Oil pan nuts to 22.6 N·m (200 in. lbs.).

7.4 L ENGINES

Install or Connect (Figure 68)

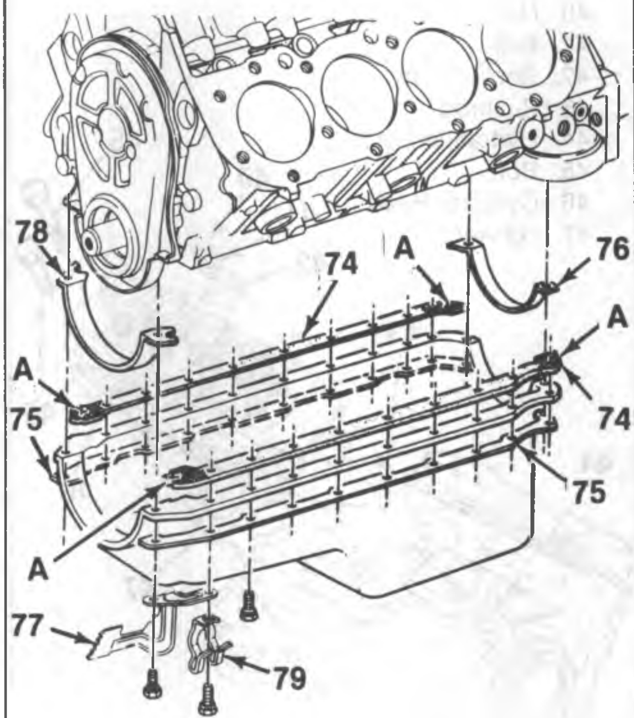
1. Gaskets (74) to the block. Retain with gasket cement.
2. Rear oil pan seal (76) to the rear main bearing cap. The ends of the seal should mate against the gaskets (74).
3. Front oil pan seal (78) to the front cover. The ends of the seal should mate against the gaskets (74).



70. Oil Pump
72. Bolt
74. Gasket
75. Reinforcement

F-05721

Figure 67—Oil Pan (5.0L and 5.7L Engines)



A. Apply RTV Sealer to Shaded Area
74. Gasket
75. Reinforcement
76. Rear Oil Pan Seal
77. Timing Marker (Some Engines)
78. Front Oil Pan Seal
79. Clip (Number and Location Varies)

F-02382

Figure 68—Oil Pan (7.4L Engines)

4. Oil pan. Make sure the gasket and seals stay in place.
5. Clips (79), reinforcements (75) and bolts.

Tighten

- Bolts to specifications:
  - — Oil pan to block bolts: 18.1 N·m (160 in. lbs.).
  - — Oil pan to front cover bolts: 7.9 N·m (70 in. lbs.).

CYLINDER HEAD INSTALLATION

Clean

— Gasket surfaces on block and cylinder head.

Install or Connect (Figures 69, 70, and 71)

1. Head gasket.
   - On engines using a STEEL gasket, coat both sides of the new gasket with a good sealer. Spread the sealer thin and even. One method

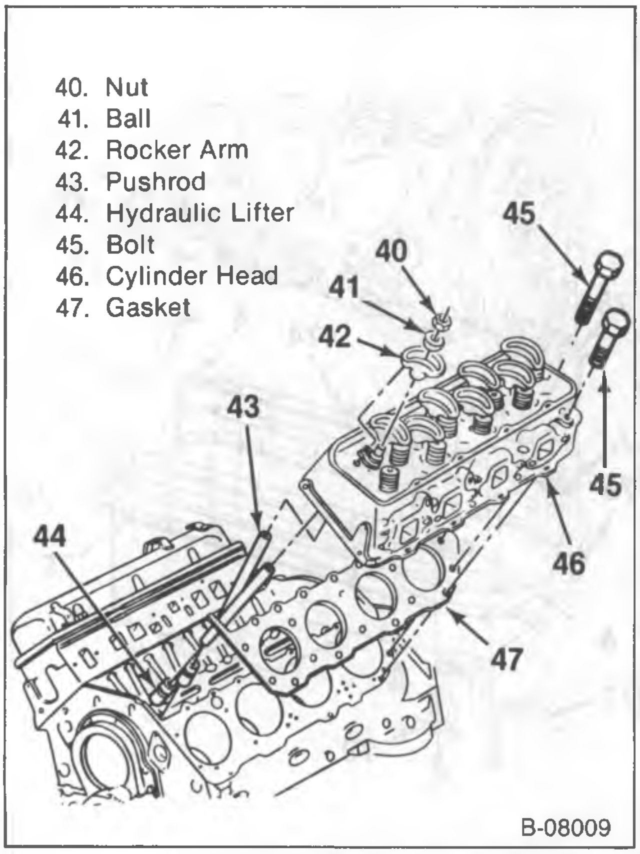


Figure 69—Cylinder Head and Components

of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

- Use no sealer on engines using a composition STEEL ASBESTOS gasket.
- Place the gasket in position over the dowel pins with the bead up.

2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and head gaskets.
3. Cylinder head bolts. Coat the threads of the bolts with sealing compound (Loctite #592 or equivalent) and install finger tight.

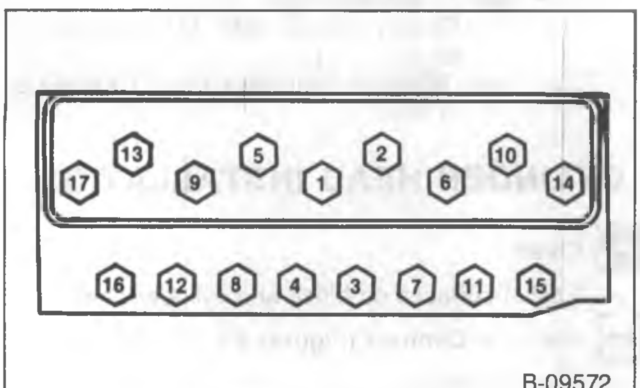


Figure 70—Cylinder Head Bolt Tightening Sequence (5.0L and 5.7L Engines)

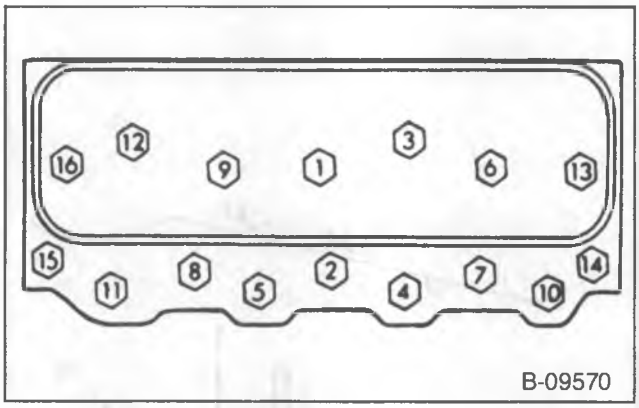


Figure 71—Cylinder Head Bolt Tightening Sequence (7.4L Engines)

Tighten

- Bolts a little at a time using the sequence shown in figures 70 or 71 until the proper torque is reached:
  - — 5.7 L engines: 90 N·m (65 ft. lbs.).
  - — 7.4 L engines: 110 N·m (80 ft. lbs.).

VALVE TRAIN COMPONENT INSTALLATION

Important

- Replace all hydraulic lifters if a new camshaft was installed.

Install or Connect (Figure 69)

- Lubricate the hydraulic lifter bodies and feet with Engine Oil Supplement (GM part no. 1051396 or equivalent).

1. Hydraulic lifters (44) to the block.
2. Pushrods (43). Seat the pushrods into the socket in the hydraulic lifters.
   - Coat the mating surfaces of the rocker arms (42) and balls (41) with "Moly Kote" or equivalent.
3. Rocker arms.
4. Balls.
5. Nuts (40).

VALVE ADJUSTMENT

1. Remove the rocker arm covers.
2. Crank the engine until the mark on the torsional damper lines up with the center or "0" mark on the timing tab (figure 72). The engine must be in the number one firing position. This may be determined by placing fingers on the number one cylinder's valves as the mark on the damper comes near the "0" mark on the crankcase front cover. If the valves are not moving, the engine is in the number one firing position. If the valves move as the mark comes up to the timing tab, the engine is in the number six firing position and should be turned over one more time to reach the number one position.

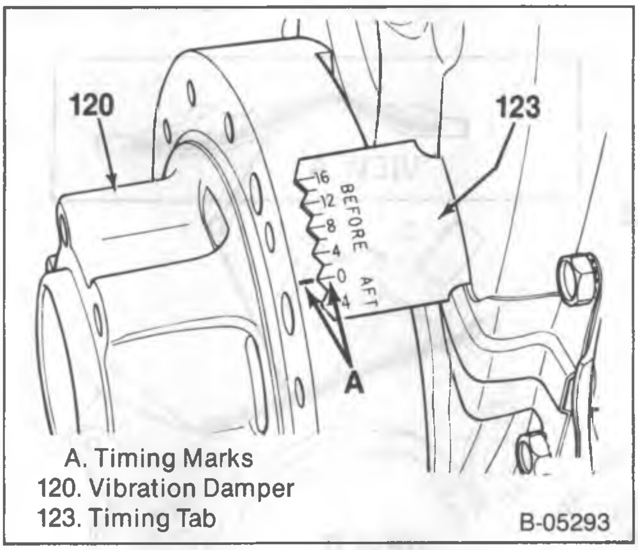


Figure 72—Timing Mark

3. With the engine in the number one firing position as determined above, the following valves may be adjusted:
   — Exhaust - 1, 3, 4, 8
   — Intake - 1, 2, 5, 7
   (Even numbered cylinders are in the right bank; odd numbered cylinders are in the left bank, when viewed from the rear of the engine.)
4. Back out the adjusting nut until lash is felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 73). When the play has been removed, turn the adjusting nut in as follows:
   — 5.0 L and 5.7 L engines: One full turn.
   — 7.4 L engines: 3/4 turn.
5. Crank the engine one revolution until the pointer "0" mark and torsional damper mark are again in alignment. This is the number six firing position. With the engine in this position the following valves may be adjusted:
   — Exhaust - 2, 5, 6, 7
   — Intake - 3, 4, 6, 8

INTAKE MANIFOLD INSTALLATION

5.0 L AND 5.7 L ENGINES

Install or Connect (Figures 74 and 75)

1. Gaskets to the cylinder heads.
   - On TBI engines, make sure the tab and/or arrow faces the front of the engine. The side stamped "This Side Down" must face the cylinder head.
2. RTV sealant to the front and rear intake manifold sealing surfaces on the block as follows:
   - Refer to figure 74.

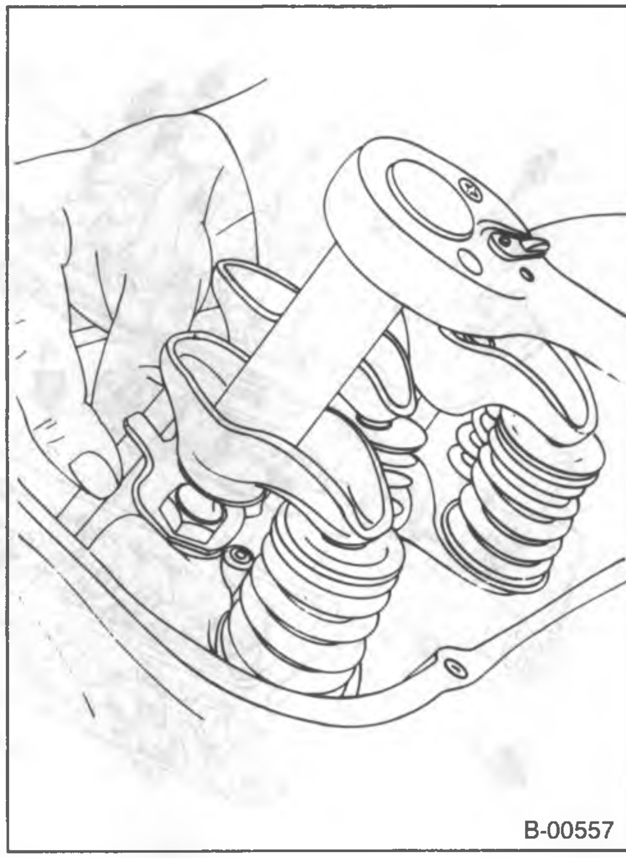


Figure 73—Adjusting the Valves

   - Apply a 5 mm (3/16-inch) bead of RTV sealer (part number 1052289 or equivalent) on the front and rear of the block. Extend the bead 13 mm (1/2-inch) up each cylinder head to seal and retain the gaskets.
3. Intake manifold to the engine.
4. Intake manifold bolts.

Tighten
- Bolts to 48 N·m (35 ft. lbs.). Use the tightening sequence shown in figure 75.

7.4 L ENGINES

Install or Connect (Figures 76 and 77)

1. Gaskets (22) to the cylinder heads.
2. Seals (23) to the block.
3. Intake manifold (21).
4. Bolts (20).

Tighten
- Bolts (20) to 40 N·m (30 ft. lbs.). Use the tightening sequence shown in figure 77.

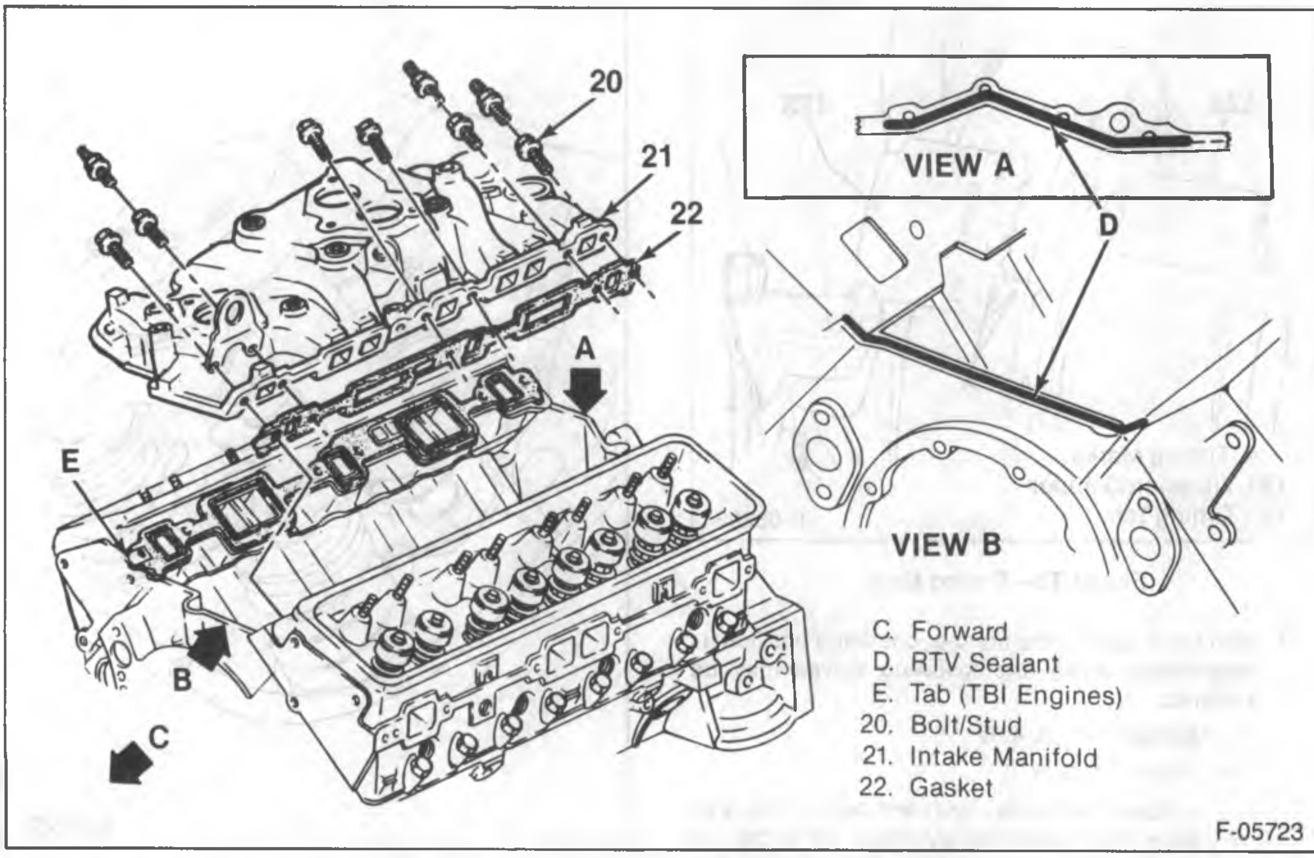


Figure 74—Intake Manifold (5.0L and 5.7L Engines)

ROCKER ARM COVER INSTALLATION

5.0L AND 5.7L TBI ENGINES

Install or Connect (Figure 78)

1. Gaskets (34).
2. Rocker arem covers (32).
3. Bolts (36) and washers (37).

Tighten

- Bolts to 10.2 N·m (90 in. lbs.)

ALL OTHERS

Install or Connect (Figure 79)

1. Gaskets (34).
2. Rocker arm covers (32).
3. Reinforcements (31) and clips.
4. Nuts (30).

Tighten

- Nuts (30) to specification:
  — 5.0 L and 5.7 L engines: 7.3 N·m (65 in. lbs.).
  — 7.4 L engines: 13.0 N·m (115 in. lbs.).

EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figures 80 and 81)

1. Exhaust manifold (1).
2. Spark plug wire heat shields (if used).
3. Washers (2), tab washers (3) (5.0 L and 5.7 L engines) and bolts or studs (4).

Tighten

- Bolts or studs to specifications:

— 5.0 L and 5.7 L engines with cast iron manifolds:

- Two center bolts: 36 N·m (26 ft. lbs.).
- Outside bolts: 28 N·m (20 ft. lbs.).
- Bend the tab washers against the bolt heads.

— 5.0 L and 5.7 L engines with stainless steel manifolds: 36 N·m (26 ft. lbs.).

— 7.4 L engines: 54 N·m (40 ft. lbs.).

WATER PUMP INSTALLATION

Install or Connect (Figure 82)

1. Gaskets (11).
2. Water pump (10).
3. Bolts (12).

Tighten

- Bolts (12) to 40 N·m (30 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (distributor, carburetor, oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

ENGINE SETUP AND TESTING

1. After overhaul, the engine should be tested before installation in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.
2. Fill the crankcase with the proper quantity and grade of oil.

Important

- If a new camshaft or hydraulic lifters were installed, add Engine Oil Supplement (GM part no. 1051396) or equivalent to the engine oil.

3. Fill the coolant system with the proper coolant.
4. With the ignition "OFF," or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
5. Start the engine and listen for unusual noses.
6. Run the engine at about 1000 until the engine is at operating temperature.
7. Listen for improperly adjusted valves or sticking lifters, and other unusual noises.
8. Check for oil and coolant leaks while the engine is running.
9. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing, idle and mixture, and governor settings, if so equipped.

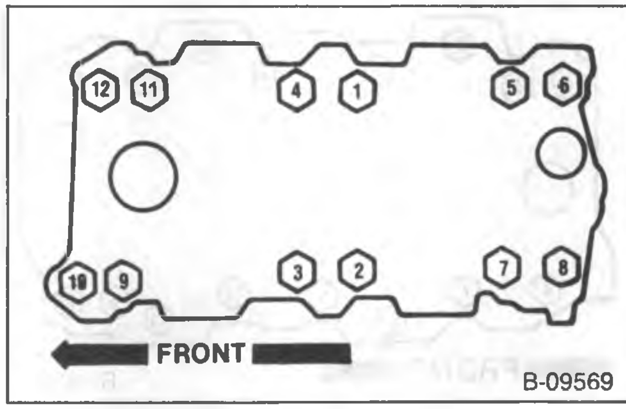


Figure 75—Intake Manifold Bolt Tightening Sequence (5.0L and 5.7L Engines)

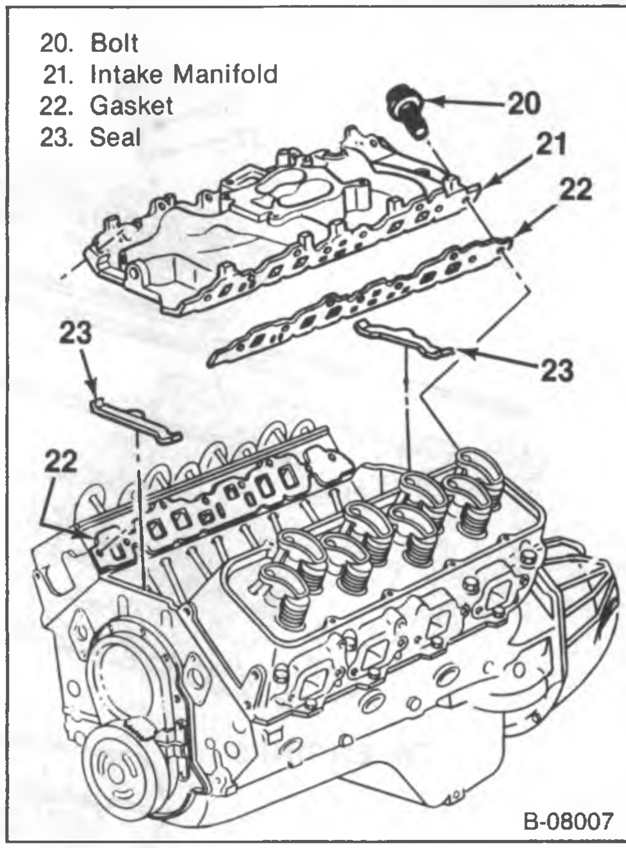


Figure 76—Intake Manifold (7.4L Engines)

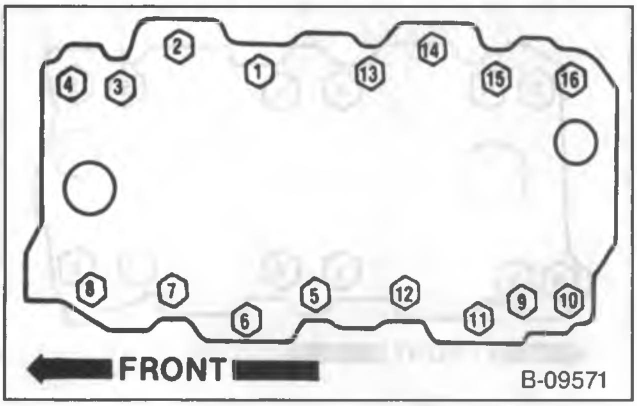


Figure 77—Intake Manifold Bolt Tightening Sequence (7.4L Engines)

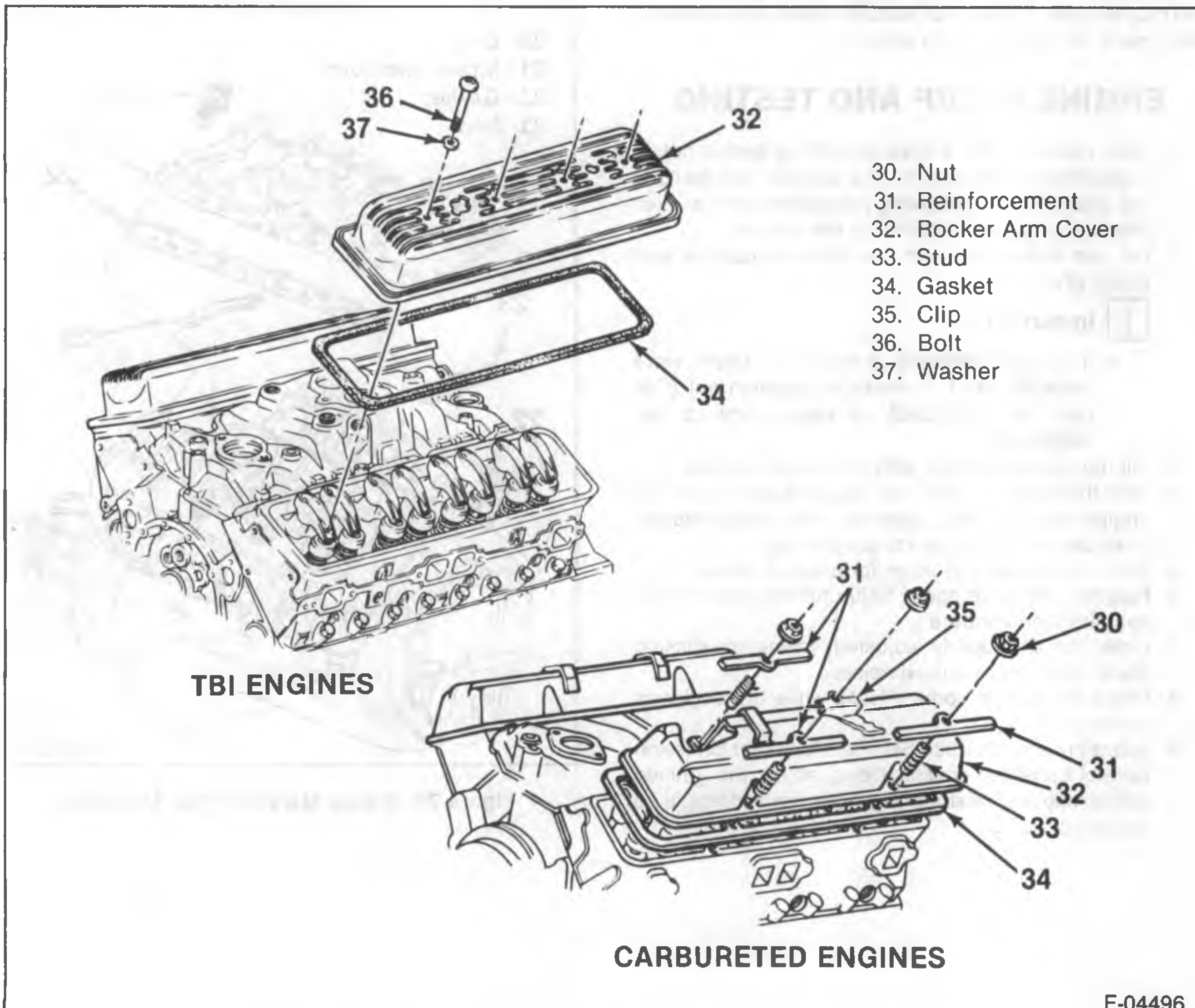


Figure 78—Rocker Arm Cover Installation (5.0L and 5.7L Engines)

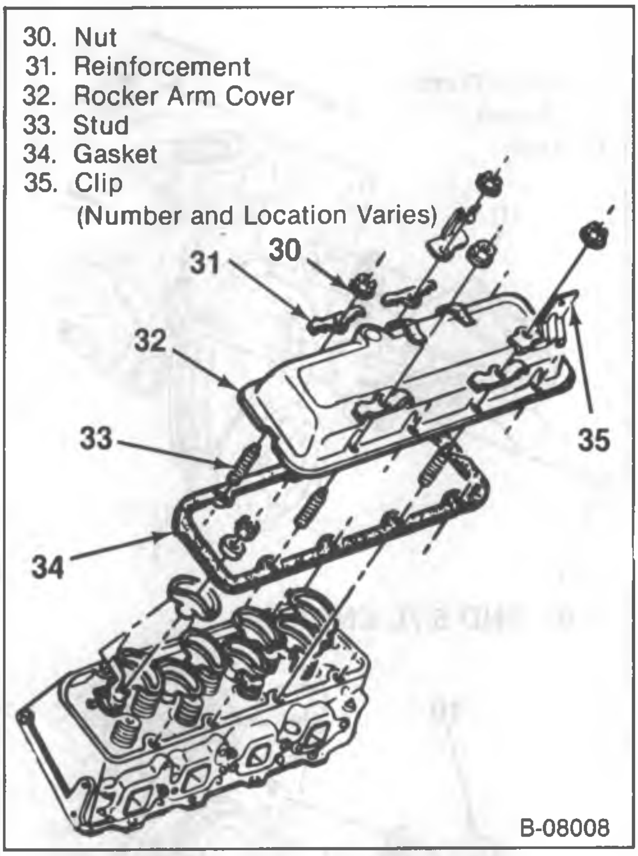


Figure 79—Rocker Arm Cover Installation (7.4L Engines)

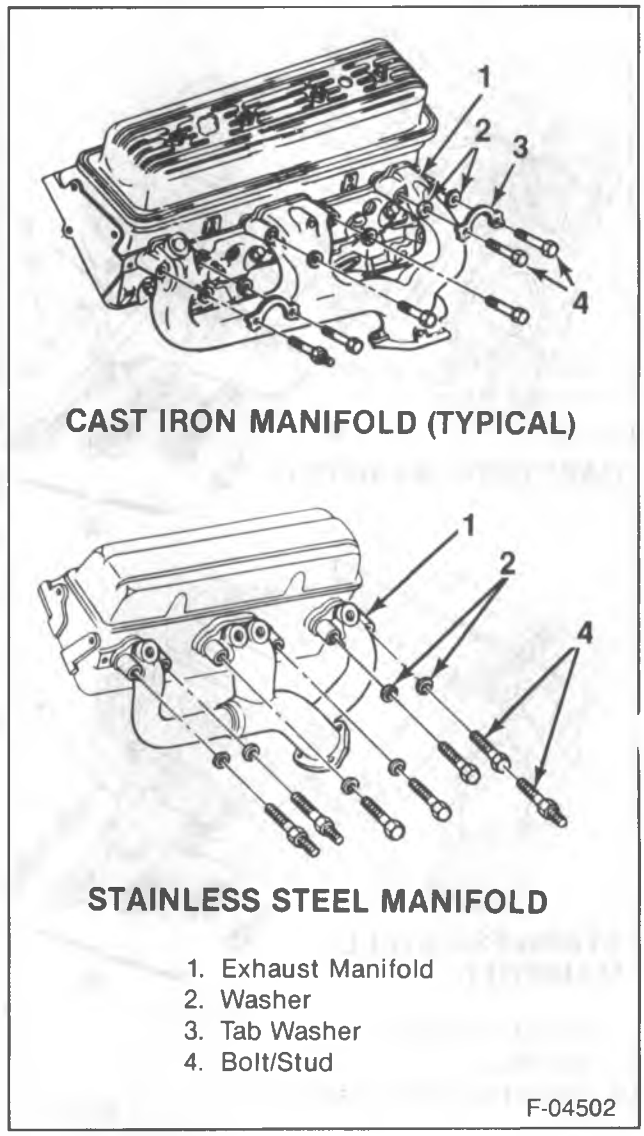


Figure 80—Exhaust Manifold (5.0L and 5.7L Engines)

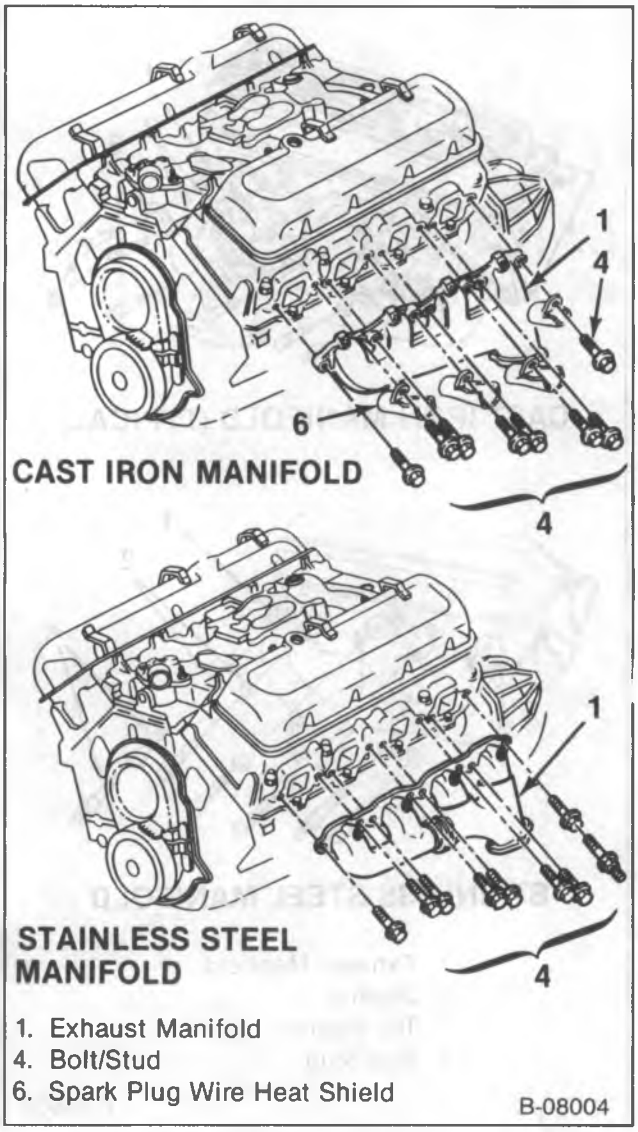


Figure 81—Exhaust Manifold (7.4L Engines)

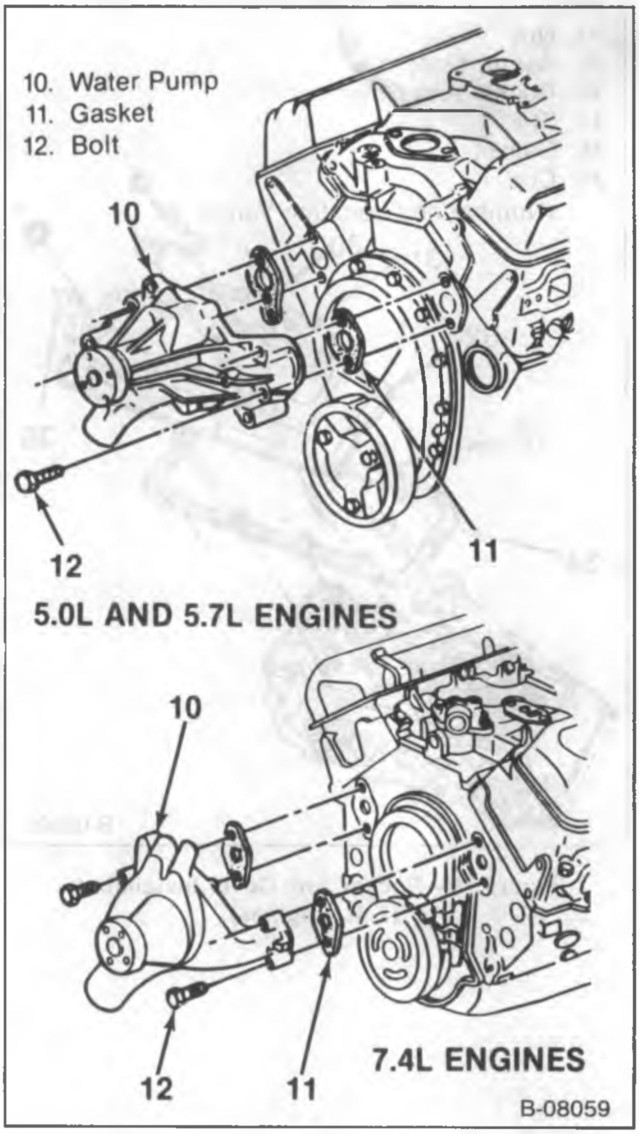


Figure 82—Water Pumps and Components

SPECIFICATIONS

ENGINE SPECIFICATIONS (5.0 L/5.7 L)

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:						
Type				V8		
Displacement				5.0L (305 Cu. In.)	5.7L (350 Cu. In.)	
RPO (VIN Code)				L03 (H)	L05 (K)	LT9 (M)
Bore				3.736	4.00	
Stroke				3.480		
Compression Ratio				9.3:1	*	8.2:1
Firing Order				1 - 8 - 4 - 3 - 6 - 5 - 7 - 2		
Oil Pressure (Minimum)				6 PSI @ 1000 RPM; 18 PSI min @ 2000 RPM; 24 PSI min. @ 4000 RPM		
CYLINDER BORE:						
Diameter				3.7350-3.7385	3.9995-4.0025	
Out Of Round	Production			0.001 (Maximum)		
Out Of Round	Service			0.002 (Maximum)		
Taper	Production	Thrust Side		0.0005 (Maximum)		
Taper	Production	Relief Side		0.001 (Maximum)		
Taper	Service			0.001 (Maximum)		
PISTON:						
Clearance	Production			0.0007-0.0017		
Clearance	Service Limit			0.0027 (Maximum)		
PISTON RING:						
COMPRESSION	Groove Clearance	Production	Top	0.0012-0.0032		
COMPRESSION	Groove Clearance	Production	2nd	0.0012-0.0032		
COMPRESSION		Service Limit		Hi Limit Production + 0.001		
COMPRESSION	Gap	Production	Top	0.010-0.020		
COMPRESSION	Gap	Production	2nd	0.010-0.025		
COMPRESSION	Gap	Service Limit		Hi Limit Production + 0.010		
OIL	Groove Clearance	Production		0.002-0.007		
OIL	Groove Clearance	Service Limit		Hi Limit Production + 0.001		
OIL	Gap	Production		0.015-0.055		
OIL	Gap	Service Limit		Hi Production + 0.010		
PISTON PIN:						
Diameter				0.9269-0.9271		
Clearance In Piston	Production			0.0002-0.0007		
Clearance In Piston	Service Limit			0.001 (Maximum)		
Fit In Rod				0.0008-0.0016 Interference		

*8.6:1 (Over 8500-lb. GVW)
9.3:1 (Under 8500-lb. GVW)

F-6342

SPECIFICATIONS

ENGINE SPECIFICATIONS (5.0 L/5.7 L) (Cont.)

All specifications are in INCHES unless otherwise noted.

<table>
<tr><td colspan="3">DISPLACEMENT</td><td>5.0L (305 Cu. In.)</td><td>5.7L (350 Cu. In.)</td></tr>
<tr><td colspan="5">CRANKSHAFT:</td></tr>
<tr><td rowspan="7">Main Journal</td><td rowspan="3">Diameter</td><td>#1</td><td colspan="2">2.4484-2.4493</td></tr>
<tr><td>#2, #3, #4</td><td colspan="2">2.4481-2.4490</td></tr>
<tr><td>#5</td><td colspan="2">2.4479-2.4488</td></tr>
<tr><td rowspan="2">Taper</td><td>Production</td><td colspan="2">0.0002 (Maximum)</td></tr>
<tr><td>Service Limit</td><td colspan="2">0.001 (Maximum)</td></tr>
<tr><td rowspan="2">Out Of Round</td><td>Production</td><td colspan="2">0.0002 (Maximum)</td></tr>
<tr><td>Service Limit</td><td colspan="2">0.001 (Maximum)</td></tr>
<tr><td rowspan="6">Main Bearing Clearance</td><td rowspan="3">Production</td><td>#1</td><td colspan="2">0.0008-0.0020</td></tr>
<tr><td>#2, #3, #4</td><td colspan="2">0.0011-0.0023</td></tr>
<tr><td>#5</td><td colspan="2">0.0017-0.0032</td></tr>
<tr><td rowspan="3">Service Limit</td><td>#1</td><td colspan="2">0.0010-0.0015</td></tr>
<tr><td>#2, #3, #4</td><td colspan="2">0.0010-0.0025</td></tr>
<tr><td>#5</td><td colspan="2">0.0025-0.0035</td></tr>
<tr><td colspan="3">Crankshaft End Play</td><td colspan="2">0.002-0.006</td></tr>
<tr><td rowspan="5">Crankpin</td><td colspan="2">Diameter</td><td colspan="2">2.0988-2.0998</td></tr>
<tr><td rowspan="2">Taper</td><td>Production</td><td colspan="2">0.0005 (Maximum)</td></tr>
<tr><td>Service Limit</td><td colspan="2">0.001 (Maximum)</td></tr>
<tr><td rowspan="2">Out Round</td><td>Production</td><td colspan="2">0.0005 (Maximum)</td></tr>
<tr><td>Service Limit</td><td colspan="2">0.001 (Maximum)</td></tr>
<tr><td rowspan="2">Rod Bearing Clearance</td><td colspan="2">Production</td><td colspan="2">0.0013-0.0035</td></tr>
<tr><td colspan="2">Service Limit</td><td colspan="2">0.003 (Maximum)</td></tr>
<tr><td colspan="3">Rod Side Clearance</td><td colspan="2">0.006-0.014</td></tr>
<tr><td colspan="5">CAMSHAFT:</td></tr>
<tr><td rowspan="2">Lobe Lift ± 0.002</td><td colspan="2">Intake</td><td>0.2336</td><td>0.2565</td></tr>
<tr><td colspan="2">Exhaust</td><td>0.2565</td><td>0.2690</td></tr>
<tr><td colspan="3">Journal Diameter</td><td colspan="2">1.8682-1.8692</td></tr>
<tr><td colspan="3">Camshaft End Play</td><td colspan="2">0.004-0.012</td></tr>
<tr><td colspan="5">VALVE SYSTEM:</td></tr>
<tr><td colspan="3">Lifter</td><td colspan="2">Hydraulic</td></tr>
<tr><td colspan="3">Rocker Arm Ratio</td><td colspan="2">1.50:1</td></tr>
<tr><td colspan="2" rowspan="2">Valve Lash</td><td>Intake</td><td colspan="2" rowspan="2">One Turn Down From Zero Lash</td></tr>
<tr><td>Exhaust</td></tr>
<tr><td colspan="3">Face Angle (Intake & Exhaust)</td><td colspan="2">45°</td></tr>
<tr><td colspan="3">Seat Angle (Intake & Exhaust)</td><td colspan="2">46°</td></tr>
<tr><td colspan="3">Seat Runout (Intake & Exhaust)</td><td colspan="2">0.002 (Maximum)</td></tr>
<tr><td colspan="2" rowspan="2">Seat Width</td><td>Intake</td><td colspan="2">$1/32$-$1/16$</td></tr>
<tr><td>Exhaust</td><td colspan="2">$1/16$-$3/32$</td></tr>
<tr><td rowspan="4">Stem Clearance</td><td rowspan="2">Production</td><td>Intake</td><td colspan="2">0.0010-0.0027</td></tr>
<tr><td>Exhaust</td><td colspan="2">0.0010-0.0027</td></tr>
<tr><td rowspan="2">Service</td><td>Intake</td><td colspan="2">High Limit Production +0.001</td></tr>
<tr><td>Exhaust</td><td colspan="2">High Limit Production +0.002</td></tr>
<tr><td rowspan="4">Valve Spring (Outer)</td><td colspan="2">Free Length</td><td colspan="2">2.03</td></tr>
<tr><td rowspan="2">Pressure lbs. @ in.</td><td>Closed</td><td colspan="2">76-84 lbs. @ 1.70"</td></tr>
<tr><td>Open</td><td colspan="2">194-206 lbs. @ 1.25"</td></tr>
<tr><td colspan="2">Installed Height $\pm 1/32$"</td><td colspan="2">$1\frac{23}{32}$</td></tr>
<tr><td rowspan="2">Valve Spring Damper</td><td colspan="2">Free Length</td><td colspan="2">1.86</td></tr>
<tr><td colspan="2">Approx. # of Coils</td><td colspan="2">4</td></tr>
</table>

F-04504

SPECIFICATIONS

ENGINE SPECIFICATIONS (7.4 L)

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				V8
Displacement				7.4L (454 Cu. In.)
RPO				L19, LE8
Bore				4.25
Stroke				4.00
Compression Ratio				7.9:1
Firing Order				1 - 8 - 4 - 3 - 6 - 5 - 7 - 2
Oil Pressure				10 psi @ 500 RPM Minimum; 40-60 psi @ 2000 RPM
CYLINDER BORE:				
Diameter				4.2495-4.2525
Out Of Round	Production			0.001 (Maximum)
Out Of Round	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
Taper	Production	Relief Side		0.001 (Maximum)
Taper	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.003-0.004
Clearance	Service Limit			0.005 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0017-0.0032
COMPRESSION	Groove Clearance	Production	2nd	0.0017-0.0032
COMPRESSION	Groove Clearance	Service Limit		Hi Limit Production +0.001
COMPRESSION	Gap	Production	Top	0.010-0.018
COMPRESSION	Gap	Production	2nd	0.016-0.024
COMPRESSION	Gap	Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.0050-0.0065
OIL	Groove Clearance	Service Limit		Hi Limit Production + 0.001
OIL	Gap	Production		0.015-0.055
OIL	Gap	Service Limit		Hi Limit Production + 0.010
PISTON PIN:				
Diameter				0.9895-0.9898
Clearance In Piston	Production			0.00025-0.00035
Clearance In Piston	Service Limit			0.001 (Maximum)
Fit In Rod				0.0013-0.0021 Interference

F-05725

SPECIFICATIONS

ENGINE SPECIFICATIONS (7.4 L) (Cont.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT			7.4L
CRANKSHAFT:			
Main Journal	Diameter	#1, #2, #3, #4	2.7481-2.7490
		#5	2.7476-2.7486
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production	#1,#2, #3, #4	0.0013-0.0025
		#5	0.0024-0.0040
	Service Limit	#1, #2, #3, #4	0.0010-0.0025
		#5	0.0025-0.0035
Crankshaft End Play			0.006-0.010
Crankpin	Diameter		2.1990-2.200
	Taper	Production	0.0005
		Service Limit	0.001
	Out Round	Production	0.0005
		Service Limit	0.001
Rod Bearing Clearance	Production		0.0009-0.0025
	Service Limit		0.003 (Maximum)
Rod Side Clearance			0.0013-0.023
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.2343
	Exhaust		0.2530
Journal Diameter			1.9482-1.9492
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.70:1
Valve Lash		Intake	3/4 Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	1/32-1/16
		Exhaust	1/16-3/32
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0012-0.0029
	Service	Intake	High Limit Production +0.001
		Exhaust	High Limit Production +0.002
Valve Spring	Free Length		2.12
	Pressure lbs. @ in.	Closed	74-86 lbs. @ 1.80 in.
		Open	195-215 lbs. @ 1.40 in.
	Installed Height ± 1/32"		1 51/64
	Valve Spring Fit In Damper		0.042-0.094 Interference

F-04506

SPECIFICATIONS (CONT.)

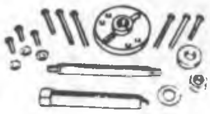
TORQUE SPECIFICATIONS (5.0 L AND 5.7 L ENGINES)

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Nuts (Carbureted Engines)	7.3	—	65
Rocker Arm Cover Bolt (TBI Engines)	10.2	—	90
Intake Manifold Bolts	48	35	—
Exhaust Manifold Bolts			
Cast Manifolds:			
Two Center Bolts	36	26	—
All Others	28	20	—
Tubular (Stainless Steel) Manifolds (All Bolts)	36	26	—
Cylinder Head Bolts	90	65	—
Torsional Damper Bolt	95	70	—
Front Cover Bolts	11.3	—	100
Oil Pan Nuts at Corners	22.6	—	200
Oil Pan Bolts	11.3	—	100
Oil Pump Bolt	90	65	—
Oil Pan Baffle Nuts (Some 5.7 L Engines)	36	26	—
Rear Crankshaft Oil Seal Retainer Screws and Nuts	15.3	—	135
Camshaft Sprocket Bolts	28	21	—
Connecting Rod Cap Nuts	60	45	—
Oil Filter Bypass Valve Bolts	26	20	—
Main Bearing Cap Bolts:			
Outer Bolts on #2, #3, and #4 Caps	95	70	
All Others	110	80	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Bolts	100	75	—
Spark Plugs	30	22	—
Water Outlet Bolts	28	21	—
Water Pump Bolts	40	30	—
Flywheel Housing Bolts	44	32	—
Oil Pan Drain Plug	28	20	—
Block Drain Plug	12.7	—	112
Rocker Arm Cover Studs to Head (Carbureted Engines)	1.7	—	15

(7.4 L ENGINES)

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Nuts	13.0	—	115
Intake Manifold Bolts	40	30	—
Rocker Arm Studs	68	50	—
Exhaust Manifold Bolts	54	40	—
Cylinder Head Bolts	110	80	—
Torsional Damper Bolts	115	85	—
Front Cover to Block Bolts	10.8	—	96
Oil Pan to Front Cover Bolts	7.9	—	70
Oil Pan to Block Bolts	18.1	—	160
Oil Pump Bolt	90	65	—
Main Bearing Caps	150	110	—
Camshaft Sprocket Bolts	26	20	—
Connecting Rod Cap Nuts	66	48	—
Oil Filter Bypass Valve Bolts	26	20	—
Flywheel Bolts	90	65	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Housing Bolts	40	30	—
Water Pump Bolts	40	30	—
Water Outlet Bolts	40	30	—
Spark Plugs	30	22	—
Oil Pan Drain Plug	28	20	—
Block Drain Plug	12.7	—	112
TBI Adapter to Intake Manifold Bolts	23	17	—

SPECIAL TOOLS

1.  J-23523-E

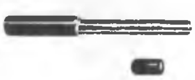
2.  J-8062

3.  J-23590

4. J-22144

5.  J-35468 J-22102

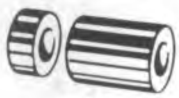
6.  J-8037

7.  J-5239

8.  J-23738-A

9.  J-9290-01

10.  J-3049

11.  J-5802-01

12. J-5715

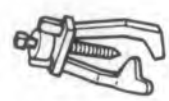
13.  J-6036

14.  J-6880

15.  J-5825-A

16.  J-5590

17.  J-35621

18.  J-1619

1. Torsional Damper Remover and Installer
2. Valve Spring Compressor
3. Oil Pump Pick-Up Tube Installer (Small Block Engines)
4. Oil Pump Pick-Up Tube Installer (Mark IV Engines)
5. Crankshaft Seal Installer
6. Piston Ring Compressor
7. Guide Set
8. Vacuum Pump
9. Hydraulic Lifter Remover (Slide Hammer Type)
10. Hydraulic Lifter Remover (Plier Type)
11. Stud Remover
12. Reamer (0.003-inch oversize)
13. Reamer (0.013-inch oversize)
14. Stud Installer
15. Crankshaft Sprocket Puller (Small Block Engines)
16. Crankshaft Sprocket Installer (Small Block Engines)
17. Rear Oil Seal Installer (Small Block Engines)
18. Crankshaft Sprocket Puller (Mark IV Engines)

F-04507

SECTION 6A7

6.2 LITER DIESEL

CONTENTS

CONTENTS (CONTINUED)

DESCRIPTION

GM 6.2L diesel engines are 90 degree V8 type, naturally aspirated, with indirect type combustion chambers.

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number three (center) main bearing.

The camshaft is supported by five plain type bearings and is chain driven. Motion from the camshaft is transmitted to the overhead valves by roller type hydraulic lifters, pushrods, and shaft mounted rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are retained by snap ring retainers.

For engine identification information, refer to GENERAL INFORMATION (SEC. 0A).

ENGINE LUBRICATION

A lubrication schematic is shown in figure 1.

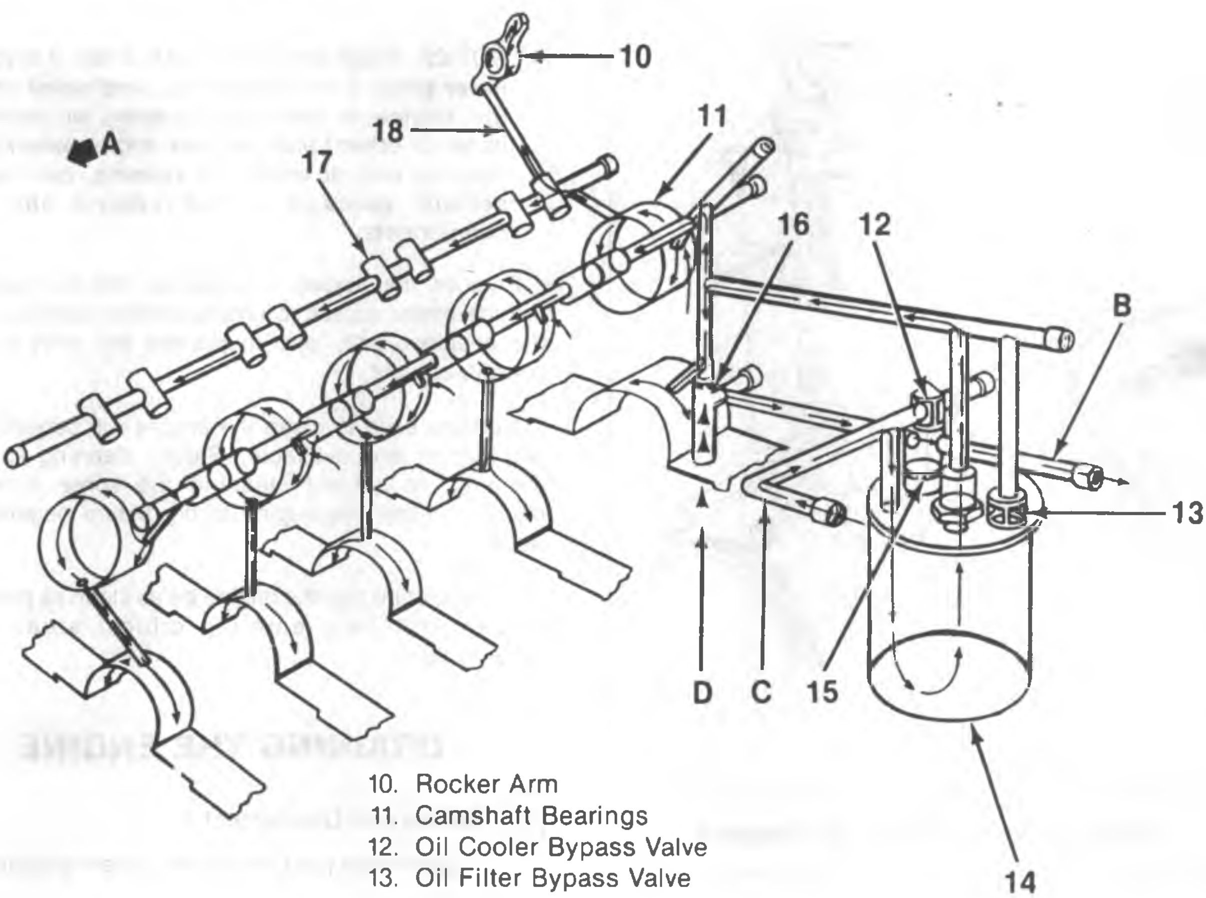
The gear type oil pump is driven from either the vacuum pump shaft or from a drive gear, depending on engine application. The vacuum pump or drive gear is driven by the camshaft. Oil is drawn into the pump through a pickup screen and pipe.

Pressurized oil is routed to the oil cooler, located in the radiator. A bypass valve is provided should the oil cooler become restricted. Oil flows from the cooler to a full flow oil filter. An oil filter bypass valve is provided should the oil filter become restricted.

Oil flows from the oil filter to the oil galleries, providing pressurized lubrication to various components.

The hydraulic valve lifters receive oil from the oil galleries. Oil flows from the hydraulic lifters through hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The pistons, rings, piston rings, cylinder walls, and connecting rod small end bearings are lubricated by oil splash.



10. Rocker Arm
11. Camshaft Bearings
12. Oil Cooler Bypass Valve
13. Oil Filter Bypass Valve
14. Oil Filter
15. Cup Plug
16. Plug
17. Valve Lifters
18. Pushrod

A. Forward
B. To Oil Cooler
C. From Oil Cooler
D. From Oil Pump

F-08022

Figure 1—Lubrication Diagram

DISASSEMBLY

TOOLS AND SHOP EQUIPMENT

A clean, well lit work area should be available. Other necessary equipment includes: A suitable parts cleaning tank, compressed air supply, trays to keep parts and fasteners organized, and an adequate set of hand tools.

An approved engine repair stand will aid the work and help prevent personal injury or damage to engine components.

Special tools are illustrated throughout this section, and are listed at its end. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they were intended. The use of these tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain components. Torque wrenches will be necessary for correct assembly of various parts.

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

- Hydraulic Pump
- Generator
- Air Conditioning Compressor
- Cooling Fan
- Fuel Pump
- CDR Valve, EGR Valve, and other emisssions equipment

It is beyond the scope of this section to detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

Diagrams of emission and vacuum hose routings, wiring harness routing, accessory drive belt layout, etc., should be made before removing accessories.

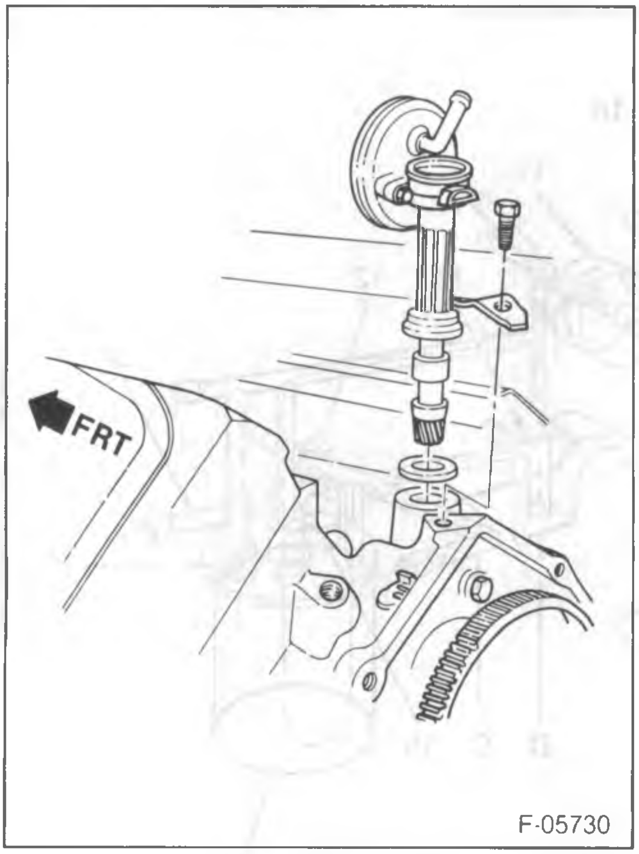


Figure 2—Vacuum Pump (R-V Models)

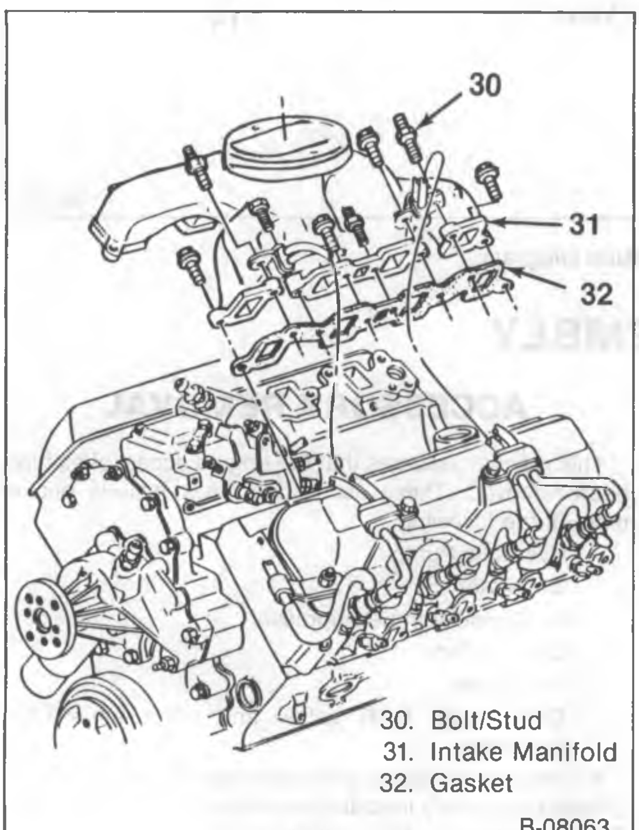


Figure 3—Intake Manifold

CLEANING

NOTICE: Clean the engine only when it is cold, never when it is warm or hot, and never when the engine is running. Spraying or pouring water or other fluids on your engine when it is warm or hot, or when it is running, can cause serious damage to the engine and its components.

Remove the engine accessories before cleaning to provide better access to engine exterior surfaces. Cover the openings with tape to prevent the entry of water, solvent, and dirt.

Methods used to clean the engine will depend on the aids which are available. Steam cleaning, pressure washing, or solvent cleaning are some acceptable methods. Allow the engine to dry before beginning the work.

It is important that the engine be as clean as possible to prevent dirt from entering critical areas during disassembly.

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan drain plug. Allow the oil pan to drain.
2. Oil filter.
3. Block drain plugs. Allow the coolant to drain.

Install or Connect

1. Oil pan drain plug.

   Tighten

   - Oil pan drain plug to 10.0 N·m (90 in. lbs.).

2. Block drain plugs.

   Tighten

   - Block drain plugs to 22 N·m (16 ft. lbs.).

VACUUM PUMP/OIL PUMP DRIVE REMOVAL

Remove or Disconnect (Figure 2)

1. Hold down clamp and bolt.
2. Speed sensor wire.
3. Vacuum pump or oil pump drive. Pull out to remove.
4. Gasket.

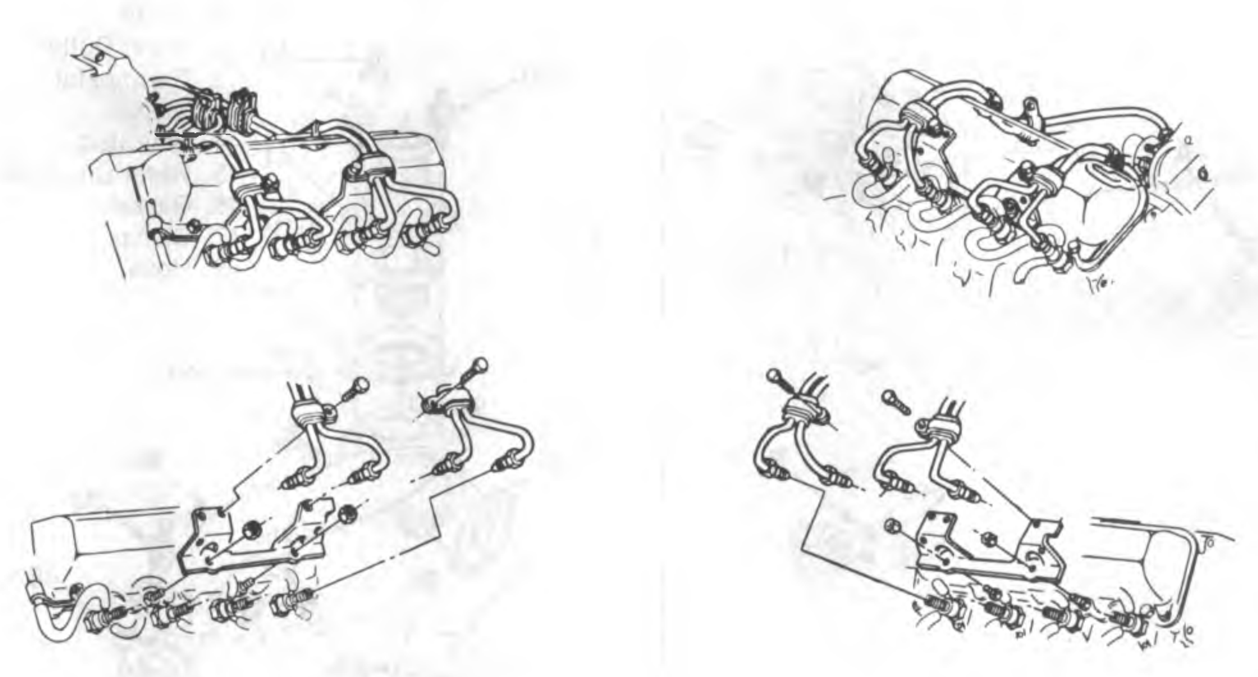


Figure 4—Injection Lines

INTAKE MANIFOLD REMOVAL

Remove or Disconnect (Figure 3)

1. Intake manifold bolts and fuel line clips.
2. Intake manifold.
3. Gaskets.

Install or Connect

Tool Required:

J 29664 Manifold Cover Set

- J 29664-1 to the intake ports.

INJECTION LINE REMOVAL

Clean

- All injection line fittings at the nozzles and injection pump.

Remove or Disconnect (Figure 4)

1. Injection line clips at the brackets.
2. Injection lines at the nozzles.
   - Cap the lines and nozzles immediately.
   - Do not bend injection lines.
3. Injection lines at the pump.
   - Cap the lines and pump fittings immediately.
   - Tag the lines for installation.
4. Injection line brackets.

INJECTION NOZZLE REMOVAL

Remove or Disconnect (Figure 5)

Tool Required:

J 29873, Nozzle Socket

1. Fuel line clip.
2. Fuel return hose.

NOTICE: When removing an injection nozzle, use J 29873. Remove the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

3. Injection nozzle using J 29873. Store the nozzles in a clean place.
4. Gaskets.

GLOW PLUG REMOVAL

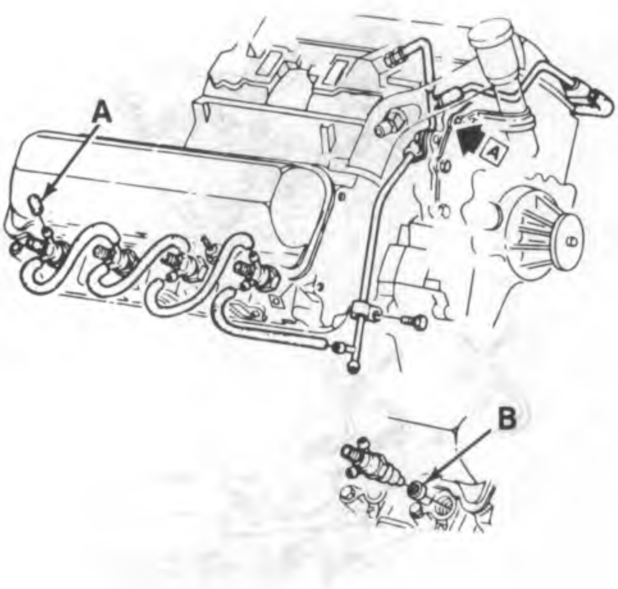
Remove or Disconnect

- Glow plugs. Use a suitable socket.

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect

1. Exhaust manifold bolts.
2. Exhaust manifolds.



A. Cap
B. Gasket

B-08138

Figure 5—Injection Nozzles

DIPSTICK TUBE REMOVAL

Remove or Disconnect

1. Dipstick bracket bolt.
2. Dipstick tube. Pull out to remove.
2. O-ring from the dipstick tube.

WATER CROSSOVER REMOVAL

Remove or Disconnect (Figure 6)

1. Glow plug inhibit switch wire.
2. Clamps (47).
3. Bolts or studs (44).
4. Water crossover (45).
5. Gaskets (46).
6. Hose (48).

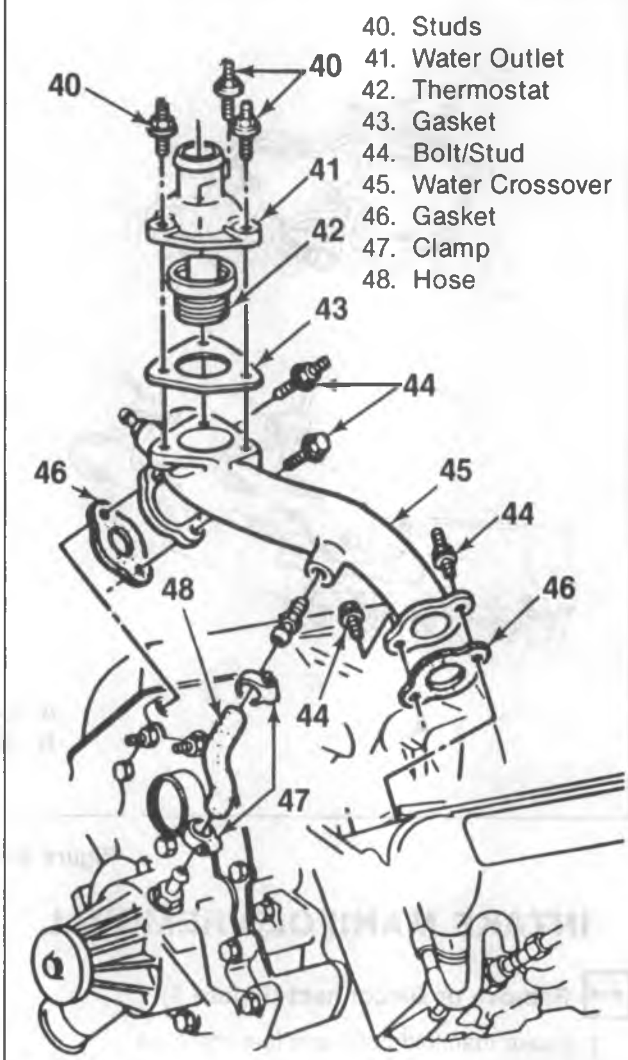
ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figure 7)

1. Bolts (58).

NOTICE: Do not pry on the rocker arm cover. Damage to sealing surfaces may result.

2. Rocker arm covers (57).



B-08064

Figure 6—Thermostat and Water Crossover

ROCKER ARM AND PUSHROD REMOVAL

Remove or Disconnect (Figure 7)

1. Bolts (54).
2. Rocker arm assemblies (55). Mark the assemblies so they can be returned to the original location at assembly.
3. Pushrods (18).

Important

- The pushrods must be installed in the original direction at assembly. This is because the pushrods have a different degree of hardness at each end. A paint stripe identifies the upper end of the pushrod. If the paint stripe is not visible, mark the pushrods on the upper end as they are removed.
- Mark the pushrods so they can be installed in the same location at assembly.

17. Hydraulic Lifter
18. Pushrod
50. Guide Plate
51. Clamp
52. Head Gasket
53. Cylinder Head
54. Bolt
55. Rocker Arm Assembly
56. Bolt
57. Rocker Arm Cover
58. Bolt

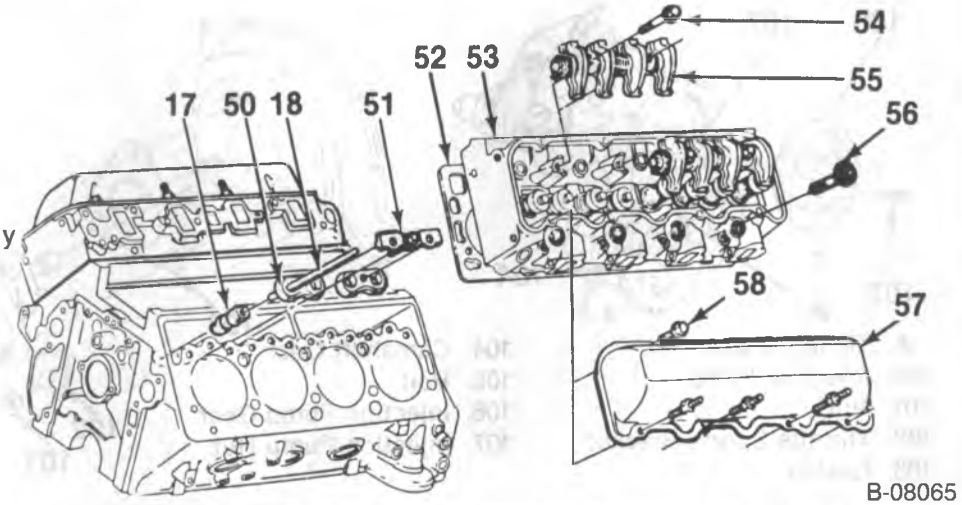
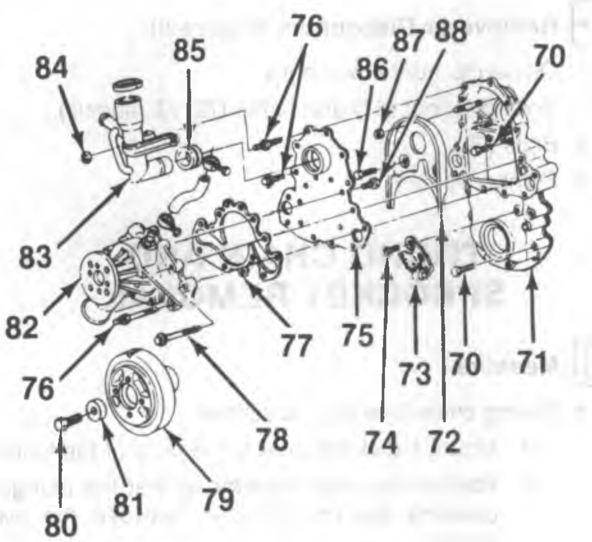


Figure 7—Cylinder Head and Components



70. Bolt
71. Front Cover
72. Baffle (G Models)
73. Timing Pointer
74. Screw
75. Water Pump Plate
76. Bolt/Stud
77. Gasket
78. Bolt
79. Torsional Damper
80. Bolt
81. Washer
82. Water Pump
83. Oil Filler Neck
84. Nut
85. Grommet
86. Bolt (G Models)
87. Nut (G Models)
88. Bolt

Figure 8—Front Cover and Components

CYLINDER HEAD REMOVAL

↔ Remove or Disconnect (Figure 7)

1. Fuel return line bolts.
2. Bolts (56).
3. Cylinder heads (53).
4. Head gaskets (52).

HYDRAULIC LIFTER REMOVAL

↔ Remove or Disconnect (Figure 7)

1. Clamps (51).
2. Guide plates (50).
3. Hydraulic lifters (17). Place the lifters in an organizer rack. The lifters must be installed in the same bore from which they were removed.

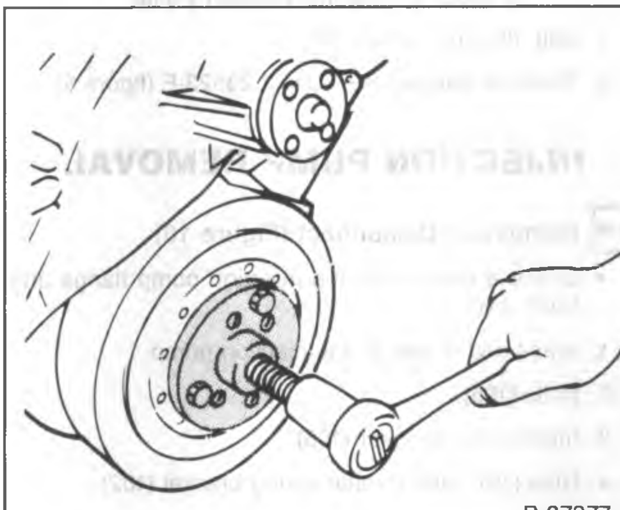
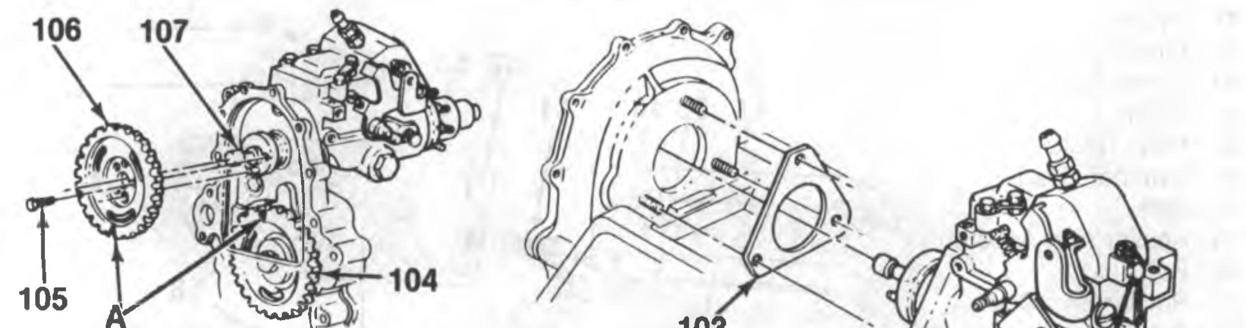


Figure 9—Removing the Torsional Damper (Typical)



A. Timing Marks
100. Injection Pump
101. Nut
102. Throttle Spring Bracket
103. Gasket
104. Camshaft Gear
105. Bolt
106. Injection Pump Gear
107. Injection Pump Hub

Figure 10—Injection Pump

WATER PUMP REMOVAL

Remove or Disconnect (Figure 8)

1. Nuts (84).
2. Oil filler neck (83).
3. Bolts and studs (76).
4. Water pump (82) with water pump plate (75).
5. Bolts (88).
6. Water pump from the water pump plate.
7. Gasket (77).

TORSIONAL DAMPER REMOVAL

Remove or Disconnect (Figures 8 and 9)

Tool Required:

J 23523-E Torsional Damper Puller

1. Bolt (80) and washer (81).
2. Torsional damper (79). Use J 23523-E (figure 9).

INJECTION PUMP REMOVAL

Remove or Disconnect (Figure 10)

- Scribe a line across the injection pump flange and front cover.

1. Wires and hoses at the injection pump.
2. Bolts (105).
3. Injection pump gear (106).
4. Nuts (101), and throttle spring bracket (102).
5. Injection pump (100).
6. Gasket (103).

FRONT COVER REMOVAL

Remove or Disconnect (Figure 8)

1. Oil pan to front cover bolts.
2. Bolts (86), nut (87) and baffle (72) (G models).
3. Bolts (70).
4. Front cover (71).

TIMING CHAIN AND SPROCKET REMOVAL

Measure

- Timing chain free play as follows:
  1. Mount a dial indicator to the front of the block.
  2. Position the dial indicator so that the plunger contacts the timing chain between the two gears.
  3. Pull the chain outward (parallel to the front face of the block) the maximum amount with finger pressure on the inside of the chain.
  4. Set the dial indicator to zero.
  5. Move the chain inward (parallel to the front face of the block) the maximum amount with finger pressure on the outside of the chain.
  6. The total indicator travel can be noted. With used parts, the deflection must not exceed 20.3 mm (0.80 inch). If the deflection exceeds this limit, the sprockets and timing chain must be inspected for wear and replaced as necessary.

Remove or Disconnect (Figure 11)

1. Bolt (119) and washer (118).
2. Camshaft gear (104).
3. Camshaft sprocket (115) with timing chain (116).
4. Crankshaft sprocket (117).

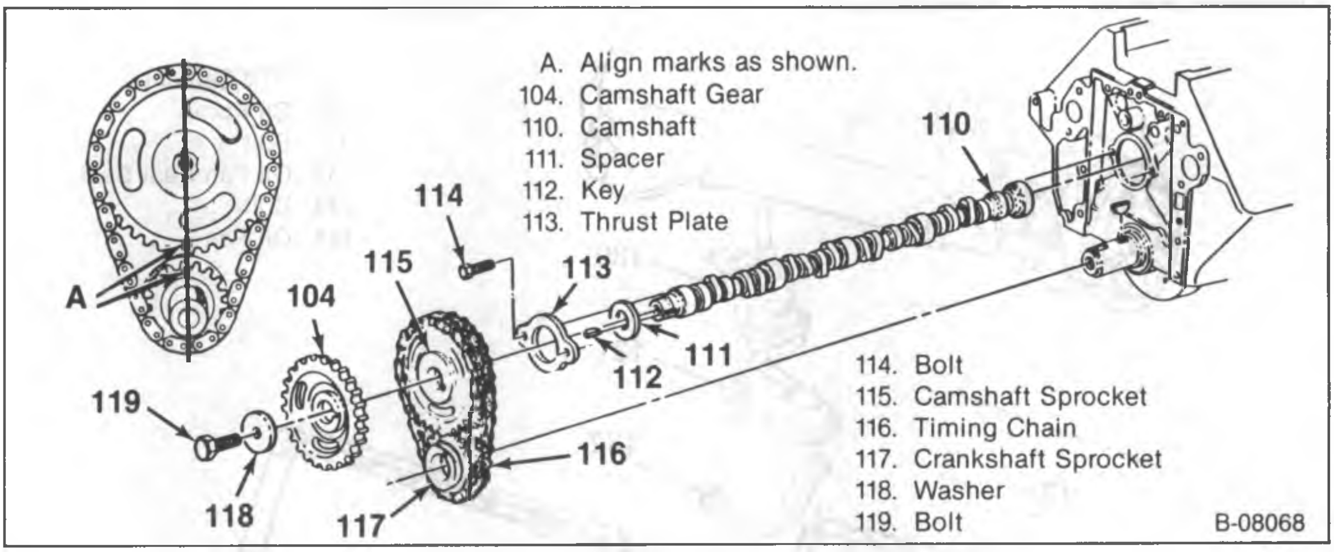


Figure 11—Camshaft and Components

CAMSHAFT REMOVAL

Remove or Disconnect (Figure 11)

1. Bolts (114) and thrust plate (113).
2. Camshaft (110).
   - The fuel pump (lift pump) and pushrod must be removed to remove the camshaft.
   - Pull the camshaft from the block carefully to avoid damage to the camshaft bearings.

OIL PAN REMOVAL

Remove or Disconnect (Figure 12)

1. Bolts (133).
2. Oil Pan (134).
3. Oil pan rear seal (132).

OIL PUMP REMOVAL

Remove or Disconnect (Figure 12)

1. Bolt (131).
2. Oil pump (130).

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 13 and 14)

1. Ridge or deposits from the upper end of the cylinder bores.
   - Turn the crankshaft until the piston is at BDC.
   - Place a cloth on top of the piston.
   - Perform the cutting operation with a ridge reamer (figure 13).
   - Turn the crankshaft until the piston is at TDC.
   - Remove the cloth and cuttings.
2. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
3. Connecting rod and piston.
   - Attach two short pieces of 10 mm (3/8-inch) hose to the connecting rod bolts (figure 14). This will protect the crankshaft journal during removal.
   - Push the connecting rod and piston out of the bore.
   - After removal, assemble the connecting rod and cap.

FLYWHEEL REMOVAL

Remove or Disconnect (Figure 15)

1. Bolts (141).
2. Flywheel (140).

CRANKSHAFT REMOVAL

Remove or Disconnect (Figure 15)

- Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during the engine assembly.

1. Bolts (146).
2. Main bearing caps (147).
3. Crankshaft (148). Lift the crankshaft straight up, taking care to avoid damage to the crankshaft journals and thrust flange suraces.
4. Rear crankshaft seal halves (142 and 145).
5. Main bearing inserts (143 and 144).

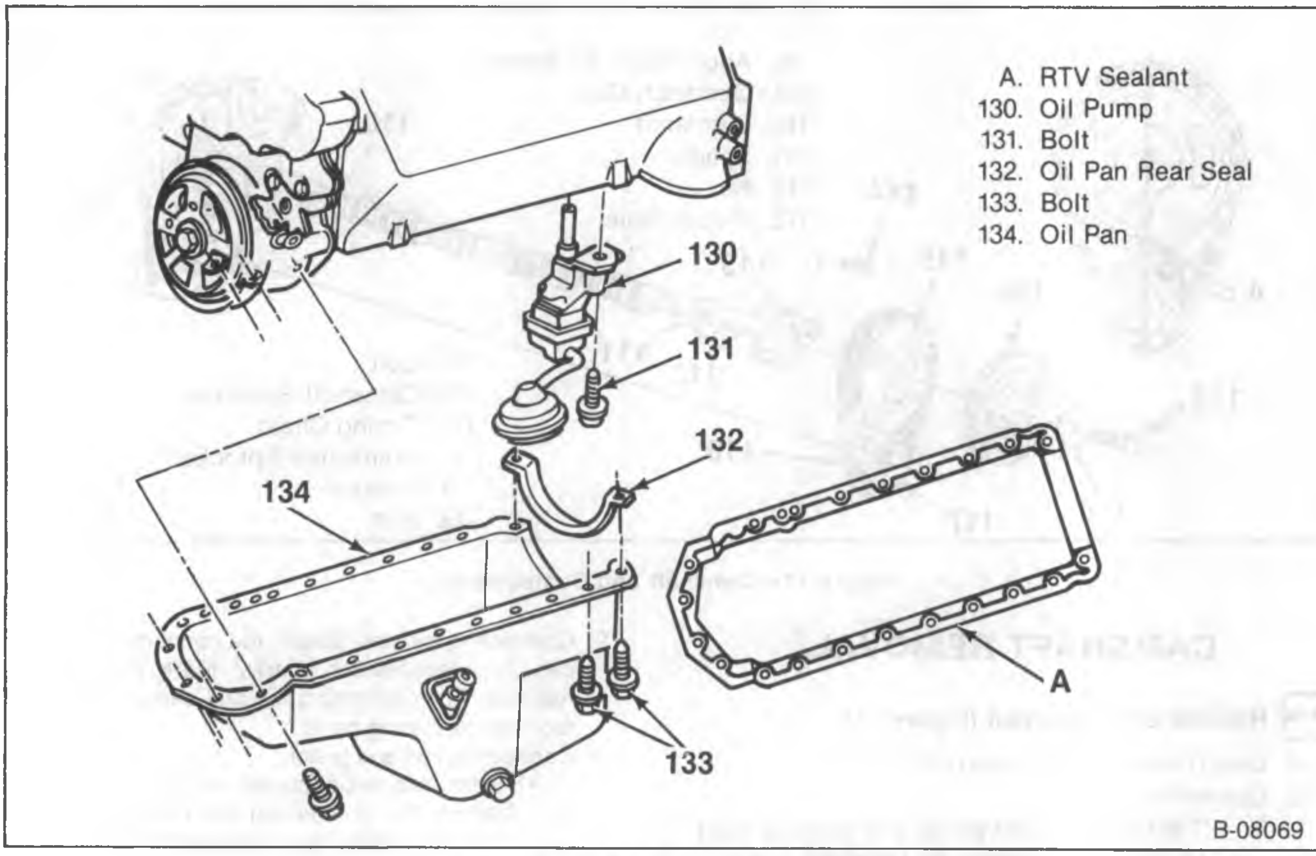


Figure 12—Oil Pan and Oil Pump

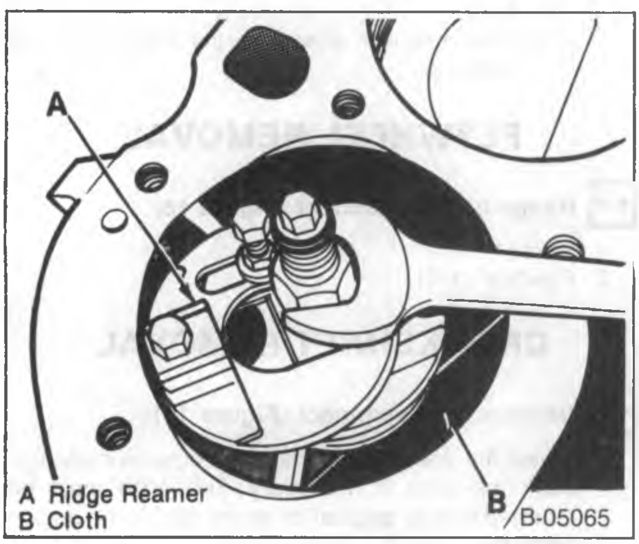


Figure 13—Removing the Cylinder Ridge

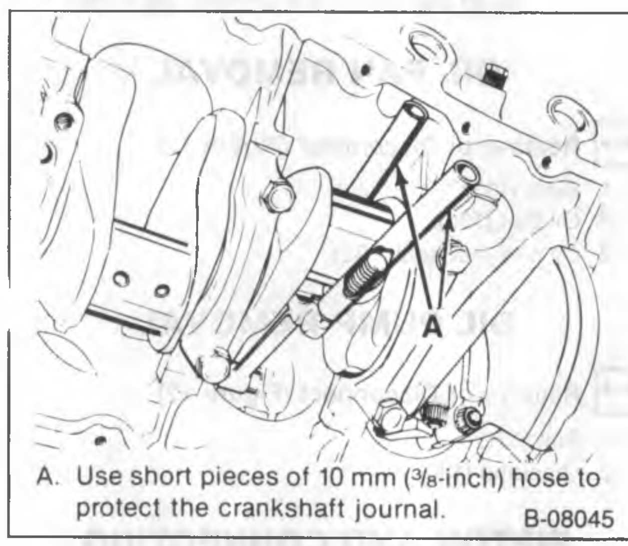


Figure 14—Removing the Piston and Connecting Rod

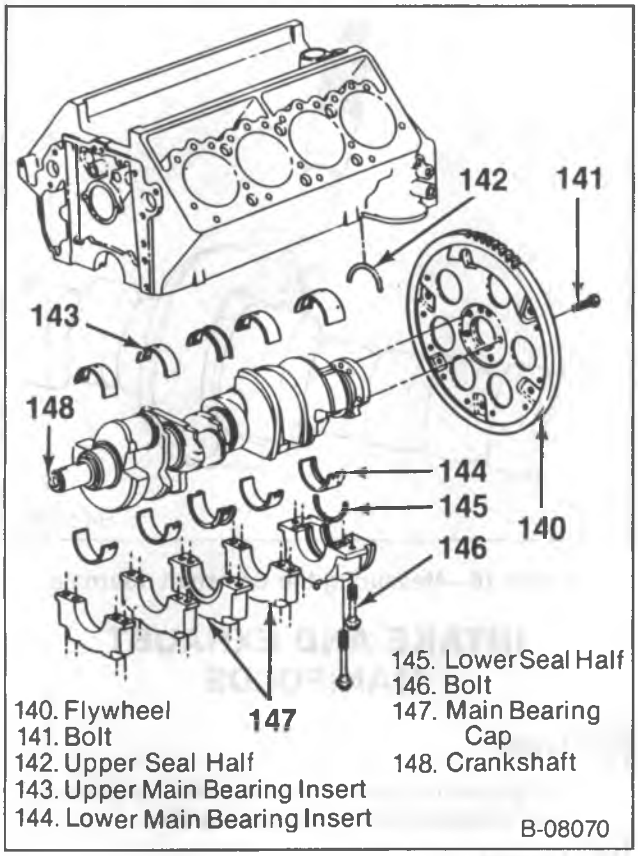


Figure 15—Crankshaft and Components

CLEANING, INSPECTION, AND REPAIR

A solvent tank, large enough to hold the larger engine parts, will be needed along with various bristle brushes and a gasket scraper. A source of compressed air will be helpful in the cleaning operations.

Precision measuring tools will be required for the inspection procedure. These include: micrometers, cylinder bore gage, feeler gages, dial indicator set, etc. The inspection work, performed with the proper method and tools, is most important. The rebuilt engine cannot be expected to perform properly if parts worn beyond acceptable limits are reused.

BLOCK

Clean

1. Block in solvent.
2. Block gasket surfaces.
3. Cylinder bores.
4. Oil galleries and passages.
5. Scale deposits from the coolant passages.

Inspect

1. All expansion plugs for poor fit or leakage.
2. Hydraulic lifter bores for deep scratches and varnish deposits.
3. Block for cracks.
   - — Cylinder walls.
   - — Coolant jackets.
   - — Main bearing webs.
   - — Engine mount bosses.
4. Main bearing bores and main bearing caps.
   - — All main bearing bores should be round and uniform in ID at all bearing supports.
   - — The area where the main bearing inserts contact the main bearing bore must be free of burrs and scratches.
5. Head gasket surface for scratches, burrs and damage.

Measure

- Fire deck warpage. Use a straightedge and feeler gage. If the block is warped more than 0.15 mm (0.006-inch) longitudinally or 0.08 mm (0.003-inch) transversely, it should be replaced. Do not attempt to resurface the fire deck or cylinder head.

CYLINDER BORES

Inspect

- Cylinder bores for scoring and other damage.

Measure

- Cylinder out of round and taper. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Cylinder Bore Recomditioning
- Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) and perform the following:

Disassemble

- Components as required.

Clean

- Components as outlined.

Inspect

- Components as outlined.

Measure

- Piston pin diameter and pin to connecting rod bushing.
- Piston to bore clearance, and fit pistons as outlined.

Assemble

- Components as outlined.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 are the left bank and, 2, 4, 6, and 8 are the right bank. 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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

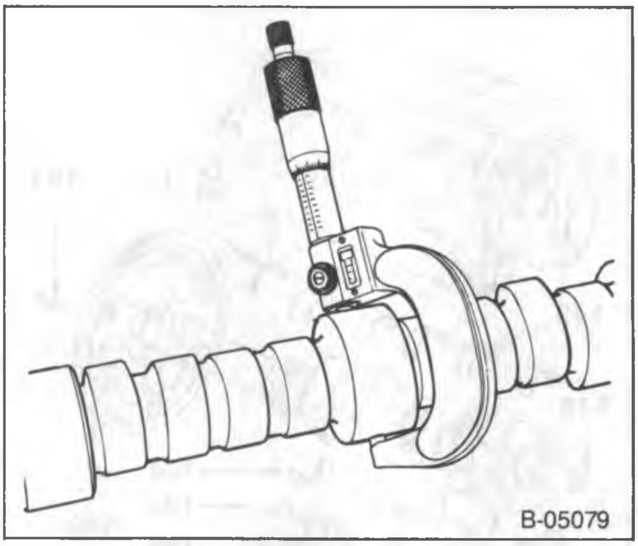


Figure 16—Measuring the Camshaft Journals

INTAKE AND EXHAUST MANIFOLDS

Clean

- Old pieces of gasket from the gasket surfaces.
- Soot deposits from the intake manifold.

Inspect

- Manifolds for cracks, broken flanges, and gasket surface damage.

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of hydraulic lifters must also be installed.

Inspect (Figure 11)

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.
- Thrust plate (113) for wear and scoring.

Measure (Figure 16)

- Camshaft journals. Use a micrometer (figure 16). The proper journal dimensions are as follows:
  - — #5 (rear) journal: 50.975-51.025 mm.
  - — All others: 54.975-55.025 mm.

CAMSHAFT BEARINGS

Inspect

- Camshaft bearings for scratches, pits, or loose fit in their bores. Replace the camshaft bearings if necessary.

Disassemble (Figures 17 and 18)

Tools Required:

J 6098-01 Camshaft Bearing Remover and Installer

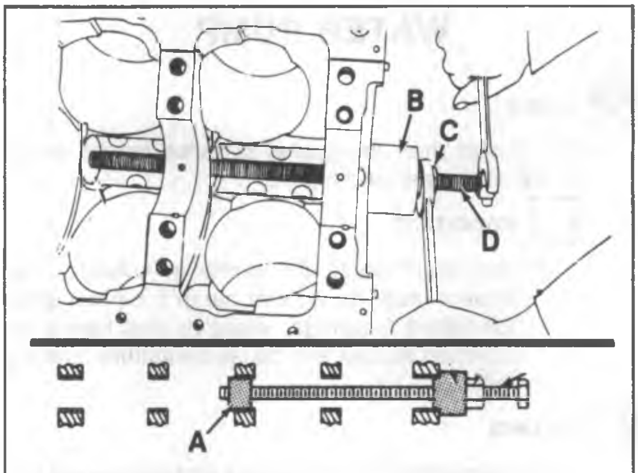


Figure 17—Replacing the Inner Camshaft Bearings

J 6098-10 Adapter Set

1. Rear camshaft plug.
2. Inner camshaft bearings. Use J 6098-01 and J 6098-10 (figure 17).
   - Insert the pilot into the front camshaft bearing bore.
   - Slide the puller screw, with the nut and washer, through the pilot.
   - Insert the bearing tool (J 6098-11) into the inner camshaft bearing bore, with the shoulder of the tool against the bearing.
   - Thread the puller screw into the bearing tool. Make sure enough threads are engaged.
   - Hold the puller screw with a wrench. Turn the nut with a second wrench to pull the camshaft bearing from its bore.
   - Repeat this procedure to remove the remaining inner camshaft bearings. Note that the rear inner bearing must be removed with the pilot fitted into the rear camshaft bearing.
3. Front camshaft bearing. Use J 6098-01 and J 6098-10 (figure 18).

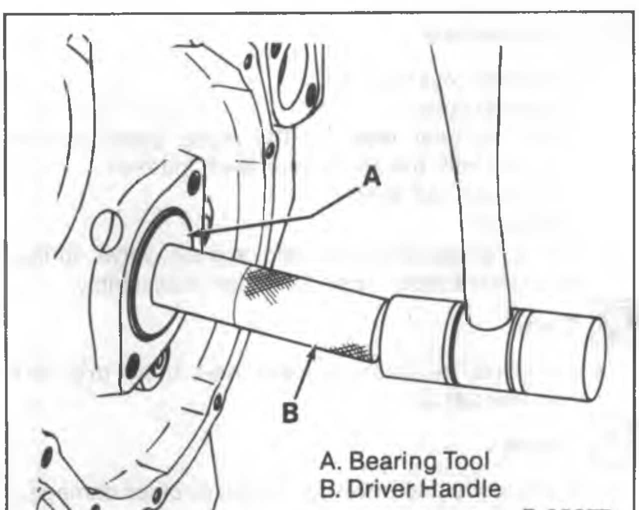


Figure 18—Replacing the Outer Camshaft Bearings

   - Assemble the bearing tool (J 6098-11) and driver handle.
   - Drive the outer camshaft bearings out of the block.
4. Rear camshaft bearing, as described in step 3. Use the driver handle and bearing tool J 6098-12 (figure 18).

Clean

- Camshaft bearing bores in the block.

Assemble (Figures 17 and 18)

Tool Required:

J 6098-01 Camshaft Bearing Remover and Installer

J 6098-10 Adapter Set

- The outer camshaft bearings must be installed first. These bearings serve as guides for the pilot, and help center the innter bearings during the installation process.
- Be sure to fit the correct cam bearing into the bore. The cam bearing bores vary in size.

1. Rear camshaft bearing. Drive the bearing into place using the driver handle and J 6098-12 (figure 18).

   Important

   - The bearing oil hole MUST align with the oil hole in the block. This hole is located at about the 4 o'clock position from the block upright (viewed from the front of the block).
   - The seam in the bearing must be in the upper half of the block face.
2. Front camshaft bearing. Drive the bearing into place with the driver handle and J 6098-11 (figure 18).

   Important

   - The notch in the bearing must face the front of the block.
   - There are two oil holes in the bearing. One hole is located at about the 4 o'clock position; the other is located between the 12 o'clock and 1 o'clock position (block upright). The bearing oil holes MUST align with the holes in the block.
   - The seam in the bearing must be in the upper half of the block face.
3. Inner camshaft bearings. Use J 6098-01 and J 6098-10 (figure 17).
   - Assemble the tool with the pilot engaged in the front bearing and the pilot flange against the front face of the block.
   - Slide the puller screw, with nut and washer, through the pilot.
   - Place the new bearing on the bearing tool (J 6098-011). Hold the bearing tool and bearing against the bearing bore. Align the bearing oil hole with the oil hole in the block.
   - Thread the puller screw into the bearing tool enough to hold the tool and bearing in place.
   - Holding the puller screw with a wrench, turn the nut with a second wrench to pull the camshaft bearing into place.

- Remove the puller screw, pilot, and bearing tool.

Important

- The bearing oil hole MUST align with the oil hole in the block. This hole is located at about the 4 o'clock position with the block upright (viewed from the front of the block).
- The seam in the bearing must be in the upper half of the block face.

4. New rear camshaft plug.
   - Coat the camshaft plug with sealer (Loctite #592 or equivalent).
   - Install the plug flush to 0.80 mm (1/32-inch) deep.

TIMING CHAIN, SPROCKETS AND TIMING GEARS

Inspect

— Sprockets for chipped teeth and wear.
— Timing chain for damage.

- It should be noted that excessively worn sprockets will rapidly wear a new chain. Likewise, an excessively worn chain will rapidly wear a new set of sprockets.

— Timing gears on the injection pump and camshaft for wear and broken teeth.

Important

- If the timing chain, sprockets, or gears are replaced, it will be necessary to re-time the engine, as outlined later.

FRONT COVER

Clean

- Old sealer from the sealing surfaces.

Inspect

— Baffle for damage.
— Front cover for cracks and damage to the sealing surfaces.

Disassemble

- Front crankshaft seal. Pry the seal out with a large screwdriver.

Assemble

Tool Required:
J 22102 Seal Installer

- Front crankshaft seal. Use J 22102. The open end of the seal must face inside the cover.
- Coat the seal lips with grease.

Important

- If a new front cover is installed, the engine must be re-timed, as outlined later.

WATER PUMP

Clean

- Old gasket from the gasket surfaces on the water pump and water pump plate.

Important

- Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings, dissolve the bearings' lubricant supply, and cause premature bearing failure.

Inspect

- Water pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the water pump.
- Water pump body at the drain hole. If there is evidence of coolant leakage, the water pump shaft seal is leaking and the water pump should be replaced.
- Water pump plate for damage.

OIL PAN AND ROCKER ARM COVERS

Clean

— Parts in solvent. Remove all sludge and varnish.
— Old sealer from the sealing surfaces.

Inspect

— Sealing flanges for bending or damage.
— Rubber grommets and parts on the rocker arm cover for deterioration.
— Oil pan for rock damage or cracks.
— Oil pan baffle for loose fit.
— Drain plug threads for stripping.

OIL PUMP

Disassemble

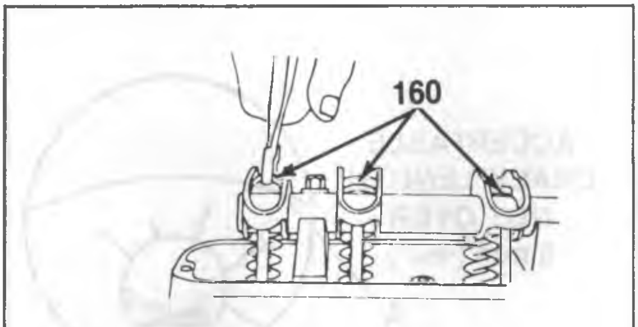
1. Oil pump cover screws.
2. Oil pump cover.
   - Mark the gear teeth so the pump gears can be installed with the same gear teeth indexed.
3. Drive gear and shaft.
4. Idler gear.
5. Pressure regulator valve retaining pin, valve, spring, and related parts. Note the order of assembly.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect

— Pump body and cover for cracks or other damage.
— Gears for wear.
— Drive gear and shaft for improper fit in the pump body.



160. Rocker Arm Retainers

Figure 19—Removing the Rocker Arm Retainers

- — Inside of the cover for wear that would permit oil to leak past the ends of the gears. The pump gears, cover, and body are not serviced separately. If the parts are damaged or worn, replace the entire oil pump assembly.
- — Pickup screen and pipe for damage to the screen, pipe or relief grommet.

Assemble

1. Pressure regulator valve and related parts.
2. Idler gear and drive gear with shaft. Align the marks made during disassembly.
3. Oil pump cover.
4. Oil pump cover screws.

Inspect

- Oil pump operation. Turn the drive shaft by hand and check for smooth rotation.

VALVE TRAIN COMPONENTS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Disassemble (Figure 19)

1. Rocker arm retainers (160).
   - Insert a screwdriver into the rocker arm shaft bore and break off the end of the retainers.
   - Pull the rocker arm retainers out with pliers (figure 19).
2. Rocker arms from the rocker arm shaft. Mark the rocker arms so they can be returned to their original locations at assembly.

Inspect

- — Rocker arms and shafts at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
- — Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.

170. Valve Keeper
171. Rotator
172. Shield
173. O-Ring Seal
174. Seal
175. Valve Spring and Damper
176. Shim
177. Exhaust Valve
178. Cap
179. Intake Valve

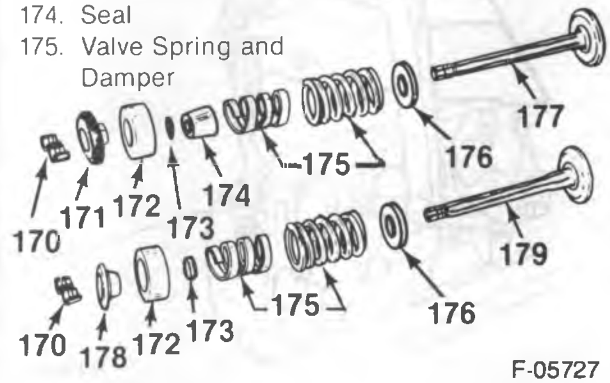


Figure 20—Valves and Components

- — Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
- — Ends of the pushrods for scoring or roughness.
- — Hydraulic lifter guide plates and clamps for damage.

Assemble

1. Rocker arms to the rocker arm shaft. Used rocker arms must be returned to their original locations.

   Important

   - Lubricate the rocker arms with engine oil before installing.
2. New rocker arm retainers (160).
   - Center the rocker arms on the corresponding holes in the rocker arm shaft.
   - Install the retainers with a drift of at least 13 mm (1/2-inch) diameter.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Important

- Some engines will have both standard 0.010-inch oversize hydraulic lifters. The oversize lifter will have a "10" etched on the side. The block will be stamped "O.S." on the cast pad adjacent to the lifter bore and on the top rail of the cylinder case above the lifter bore.

CYLINDER HEAD

Disassemble (Figures 20, 21, and 22)

Tool Required:

J 8062 Valve Spring Compressor

1. Valve keepers (170).
   - Compress the valve springs with J 8062 (figure 21).
   - Remove the valve keepers.
   - Remove J 8062.

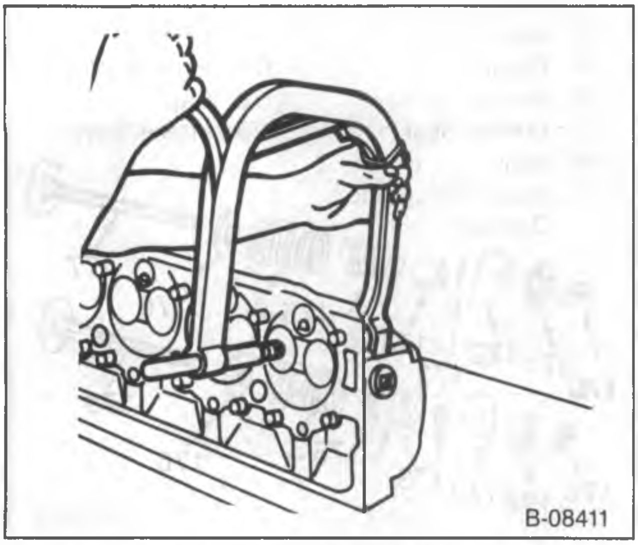


Figure 21—Compressing the Valve Springs

2. Caps (178), rotators (171), shields (172), valve springs with dampers (175) and shims (176).
3. Valve seals (174) and O-ring seals (173).
4. Valves (177 and 179). Place them in a rack so they can be returned to their original position at assembly.
5. Pre-chambers (180) (if required) (figure 22). Drive out with a small nylon drift inserted through the injection nozzle hole.

Cleaning and Inspection of Components

Clean

- Components as outlined in GENERAL ENGINE MECHANICAL (SEC. 6A).

Inspect (Figure 23)

1. Components outlined in GENERAL ENGINE MECHANICAL (SEC. 6A). Replace all valve springs at overhaul.

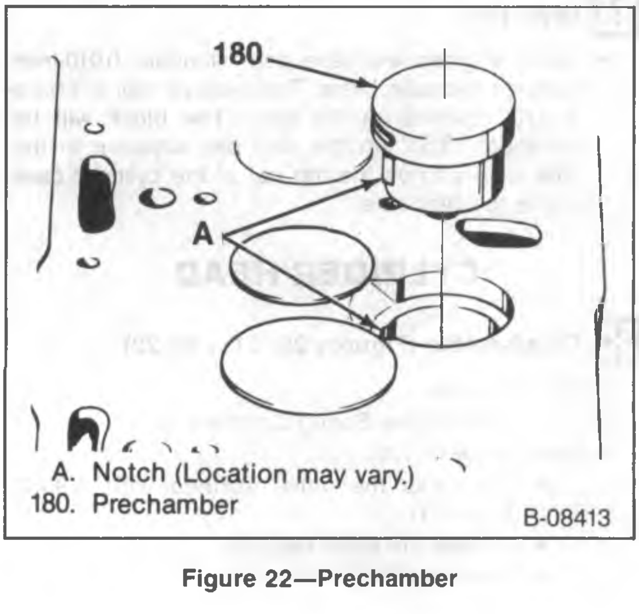


Figure 22—Prechamber

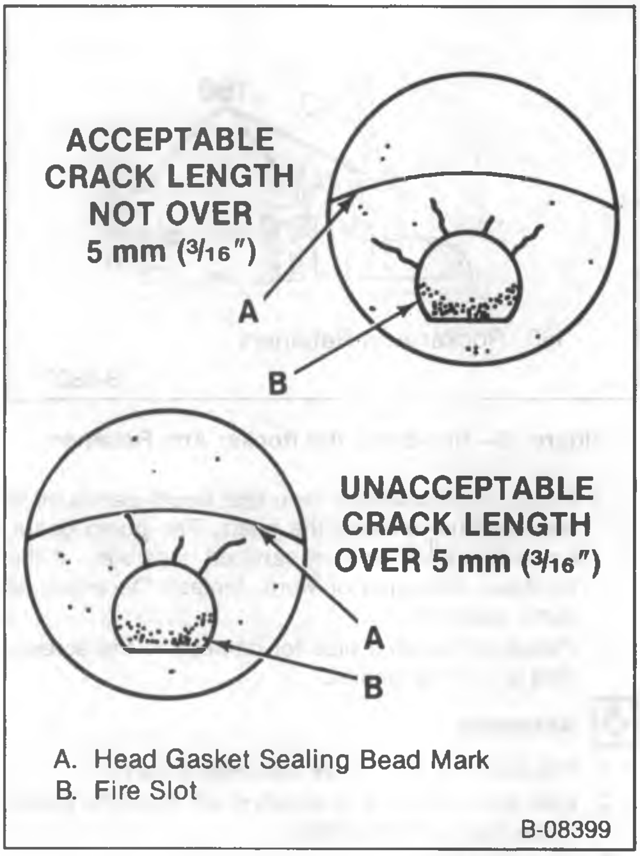


Figure 23—Prechamber Inspection

2. Pre-chambers for cracks. Replace any pre-chambers with facial cracks longer than 5 mm (3/16-inch) (figure 23). Service pre-chambers are available in standard and 0.254 mm oversize.

Measure (Figure 24)

1. Valve stem clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).
2. Cylinder head warpage. Use a straightedge and a feeler gage (figure 24). If the head is warped more than 0.15 mm (0.006-inch) longitudinally or 0.08 mm (0.003-inch) transversely, replace the cylinder head. Resurfacing is not recommended.
3. Cylinder head thickness (rocker arm cover gasket rail to head gasket surface) must be at least 97.87 mm (3.853-inch).

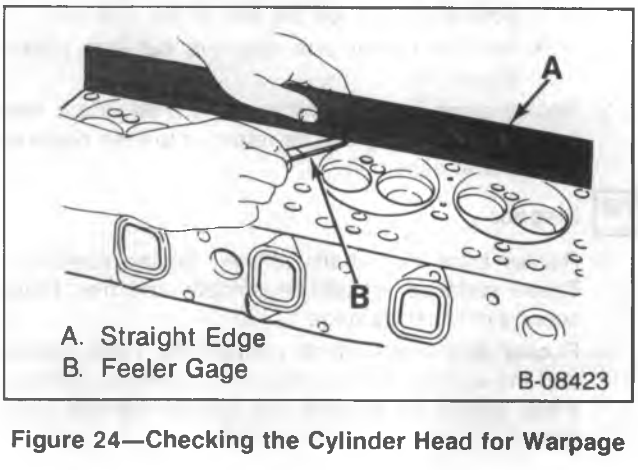


Figure 24—Checking the Cylinder Head for Warpage

Valve Guides and Valve Seats

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

NOTICE: Valve seats on 6.2L engines are induction hardened. Excessive removal of stock may result in damage to the valve seats.

Assemble (Figures 20, 21 and 22)

Tool Required:

J 8062 Valve Spring Compressor

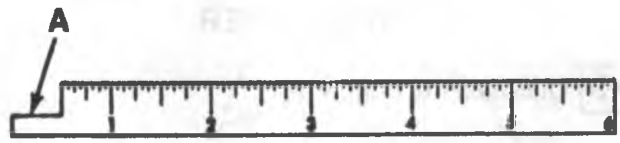
1. Pre-chambers (180) (if removed) (figure 22).
   - Align the locating notches. The pre-chamber will fit correctly in only one position.
   - Tap into place. Use a 32 mm (1 1/4-inch) socket.

   Measure

   - Pre-chamber installed depth. The pre-chamber should be flush to a maximum of 0.05 mm (0.002-inch) protrusion.
     - Make the measurement at two or more points on the pre-chamber where the prechamber seats on the head gasket shield and sealing ring.
     - Measure the difference between the flat of the pre-chamber and the flat surface of the cylinder head.
     - The pre-chamber must not protrude out of the cylinder head more than 0.05 mm (0.002-inch).
     - The pre-chamber must not be recessed into the cylinder head.
2. Valves (177 and 179).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper ports.
3. Shims (176).
4. Valve seals (174) (exhaust valves only). Install the vale seals over the valve stems and seat them against the heads.
5. New valve springs with dampers (175).
6. Shields (172).
7. Caps (178) (intake valves only).
8. Rotators (171) (exhaust valves only).
9. O-ring seals (173) and valve keepers (170).
   - Compress the valve spring, using J 8062 (figure 21). Compress the spring enough so the lower valve stem groove can be clearly seen.
   - Push a new seal onto the valve stem. The seal is to be installed on the stem's lower groove. Make sure the seal is flat and not twisted.
   - Apply a small amount of grease to the area of the upper valve stem groove. Assemble the two valve keepers using the grease to hold the keepers in place. Make sure the keepers seat properly in the groove.
   - Release the compressor tool. Make sure the valve keepers stay in place.
   - Repeat the preceding steps on the remaining valves.

Measure (Figures 25 and 26)

- Valve spring installed height of each valve spring, as follows:



A. Grind out this portion.

B-05248

Figure 25—Cutaway Scale

1. Use a narrow, thin scale. A cutaway scale (figure 25) may be helpful.
2. Measure from the valve shim or spring seat to the top of the shield (figure 26).
3. If this measurement exceeds the figure given in "Specifications," install valve spring seat shims of sufficient thickness (between the spring and cylinder head) to give the desired measurement. NEVER shim the spring so as to give an installed height under the specified figure.

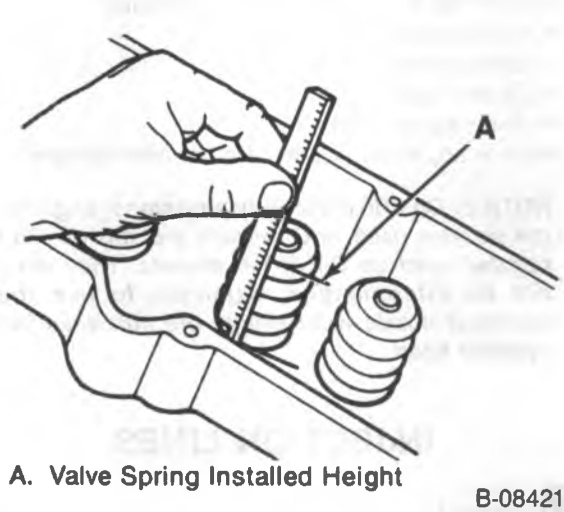
GLOW PLUGS

Inspect

- Glow plugs for stripped threads and damage. Replace the glow plugs if the tips are cracked, bulged, or broken.

Measure

- Glow plug resistance. Connect an ohmmeter between the electrical connector blade and the glow plug body. Replace any glow plug with a resistance greater than 2 ohms.



A. Valve Spring Installed Height

B-08421

Figure 26—Measuring Valve Spring Installed Height (Typical)

THERMOSTAT AND WATER CROSSOVER

Disassemble (Figure 6)

1. Bolts or studs (40).
2. Water outlet (41).
3. Thermostat (42).
4. Gasket (43).

Inspect

- Water outlet and water crossover for cracks.

Thermostat Check

1. Suspend the thermostat and a thermometer in water with the thermometer located close to the thermostat. The thermostat must be completely submerged and the water throughly agitated while heating. Apply heat to the water and record both the temperature at which the thermostat begins to open and the temperature at which the thermostat is fully open.
2. Compare the temperature readings taken in the test with those given in the proper Truck Service Manual.
3. Do not attempt to repair the thermostat. If the thermostat does not function properly, replace it with a new unit which has been checked as directed previously.

Install or Connect (Figure 6)

1. Gasket (43).
2. Thermostat (42).
3. Water outlet (41).
4. Bolts or studs (40).

Tighten

- Bolts or studs to 47 N·m (35 ft. lbs.).

INJECTION NOZZLES

Perform the following tests on the injection nozzles as outlined in the proper truck service manual:

- Nozzle opening pressure.
- Leakage test.
- Chatter test.
- Spray pattern test.

Replace any faulty nozzles. Do not attempt repairs.

NOTICE: On LH6 (light duty emissions) engines, the nozzles used in G models are shorter than nozzles used on C-K-R-V-P models. They must not be interchanged. Attempts to use the incorrect nozzle will damage the nozzle and/or cylinder head.

INJECTION LINES

Inspect

- Injection lines for kinks and damaged fittings. Replace any damaged lines.

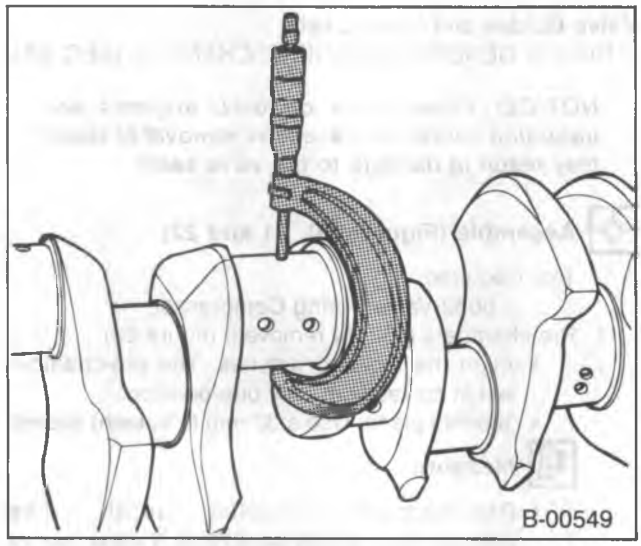


Figure 27—Measuring the Crankshaft Journals

INJECTION PUMP

Inspect

- Injection pump body and mounting flange for damage.
- Injection pump for evidence of fuel leakage.
- Injection line fittings for stripping.

Injection Pump Repair

Refer to the proper truck service manual for allowable repairs. If necessary, have the pump repaired by an authorized repair station.

CRANKSHAFT AND BEARINGS

CLEANING AND INSPECTION

Clean

— Crankshaft with solvent.
  — Do not scratch the bearing journals.
  — Blow all sludge from the oil passages with compressed air.
— Main bearing inserts. Wipe free of oil with a soft cloth.

Inspect

— Crankshaft for cracks. Use the magnaflux method, if available.
— Crankpins, main bearing journals and thrust surfaces for scoring, nicks, or damage caused by lack of lubrication.
— Main bearing inserts for scoring or other damage.

In general, the lower inserts (except the #1 bearing) show greater wear and the most distress from fatigue. If, upon inspection, the lower insert is suitable for use, it can be assumed that the upper insert is also satisfactory. If the lower insert shows eivdence of wear or damage, both the upper and lower inserts must be replaced.

Measure (Figures 27 and 28)

— Main bearing and connecting rod journal diameters

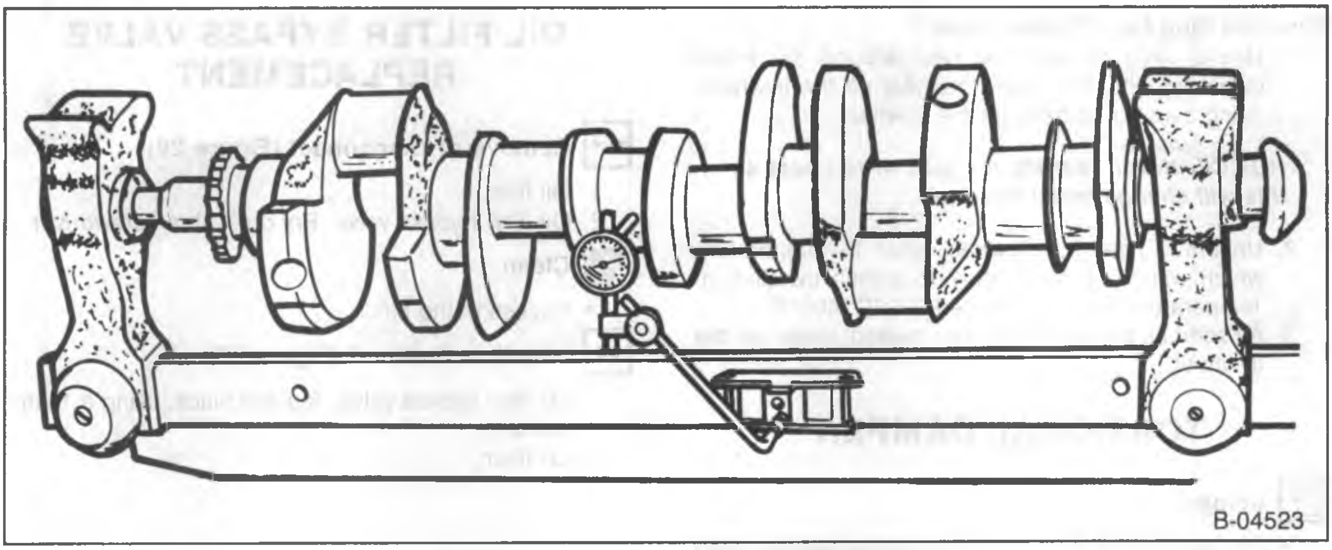


Figure 28—Checking Crankshaft Run-Out

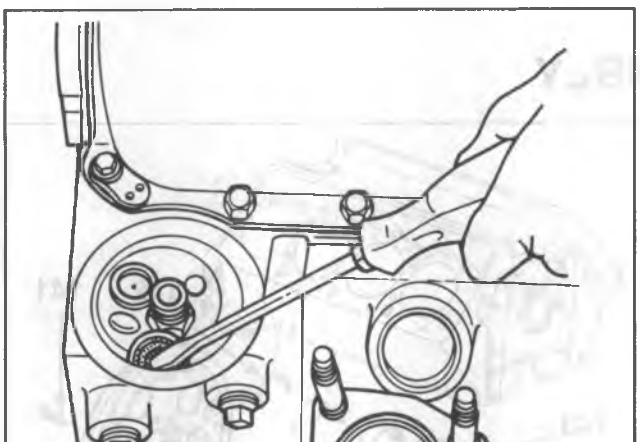


Figure 29—Oil Filter Bypass Valve Replacement

(figure 27). Compare with "Specifications." Grind or replace the crankshaft if necessary.

— Main bearing and connecting rod journals for taper and out-of-round (figure 27). If the journals are tapered or out-of-round more than 0.001-inch, replace the crankshaft.

— Crankshaft run-out (figure 28).
  - Mount the crankshaft in V-blocks or between centers.
  - Use a dial indicator as shown.
  - If the main journals are misaligned, the crankshaft is bent and must be replaced, along with the main bearings.

AVAILABLE BEARING SIZES

- Main bearings are available in 0.013 mm (0.0005-inch) and 0.026 mm (0.001-inch) undersizes for select fitting to attain proper main bearing clearance.
- Connecting rod bearings are available in 0.026 mm (0.001-inch) undersizes for select fitting.
  - Some VIN Code C (RPO LH6) (light duty emissions) engines may have both standard and 0.08 mm (0.003-inch) OVERSIZE connecting rod bearings. The oversize connecting rods are stamped "O.S." on the cap's lower end.

FLYWHEEL

Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

Inspect

— Flywheel for burning, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.

— Flywheel ring gear for worn or broken teeth.

Flywheel Ring Gear Replacement

1. Use a torch to heat the gear around the entire circumference, then drive the gear off the flywheel, using care not to damage the flywheel.

NOTICE: Never heat starter gear to red heat as this will change metal structure.

2. Uniformly heat the flywheel gear to temperature which will expand the gear to permit installation. Temperature must not exceed 200°C (400°F).
3. As soon as the gear has been heated, install on the flywheel.

TORSIONAL DAMPER

Inspect

- Oil seal contact area on the torsional damper shaft for grooving and roughness. Replace if necessary.

OIL FILTER BYPASS VALVE REPLACEMENT

Remove or Disconnect (Figure 29)

1. Oil filter.
2. Oil filter bypass valve. Pry out with a screwdriver.

Clean

- Recess in the block.

Install or Connect (Figure 29)

1. Oil filter bypass valve. Tap into place, using a 16 mm socket.
2. Oil filter.

ASSEMBLY

CRANKSHAFT INSTALLATION

MAIN BEARING SELECTION

Main bearings are of the precision insert type and do not use shims for adjustment. If clearances are excessive, a new bearing, both upper and lower inserts, will be required. Service bearings are available in standard size and 0.013 mm (0.0005-inch) and 0.026 mm (0.001-inch) undersizes.

Selective fitting of both rod and main bearings inserts is necessary to obtain close tolerances. For this reason you may use, for example, one half of a standard insert with one half of a 0.026 mm (0.001-inch) undersize insert which will decrease the clearance 0.013 mm (0.0005-inch) from using a full standard bearing.

REAR CRANKSHAFT OIL SEAL

The production rear crankshaft oil seal is a "rope" type seal. The rope seal is replaced with a two piece type seal for service.

INSTALLATION

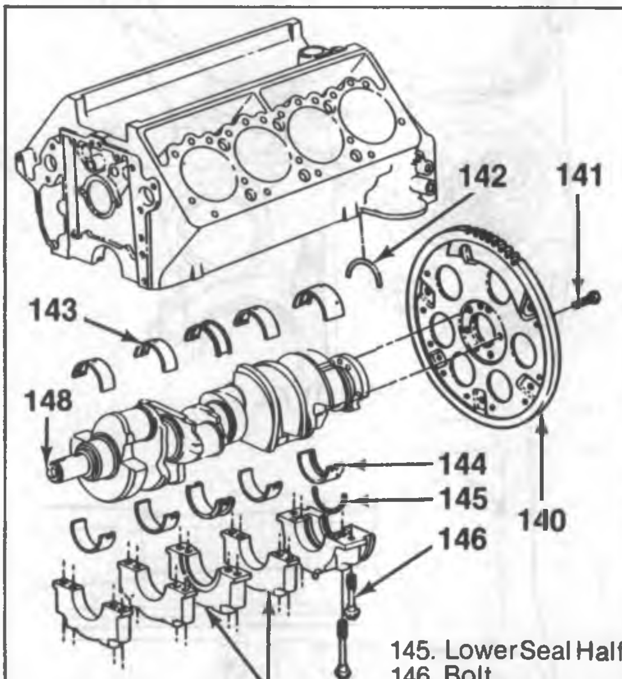
Clean

— Main bearing cap and block mating surfaces with carburetor cleaner or equivalent.

— Seal grooves in the block and main bearing cap with carburetor cleaner of equivalent.

Install or Connect (Figures 30 through 33)

1. Upper main bearing inserts to the block.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps.



140. Flywheel
141. Bolt
142. Upper Seal Half
143. Upper Main Bearing Insert
144. Lower Main Bearing Insert
145. Lower Seal Half
146. Bolt
147. Main Bearing Cap
148. Crankshaft

B-08070

Figure 30—Crankshaft and Components

Measure

- Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A). If clearance is out of specification at the rear main bearing, and a rope type seal is being

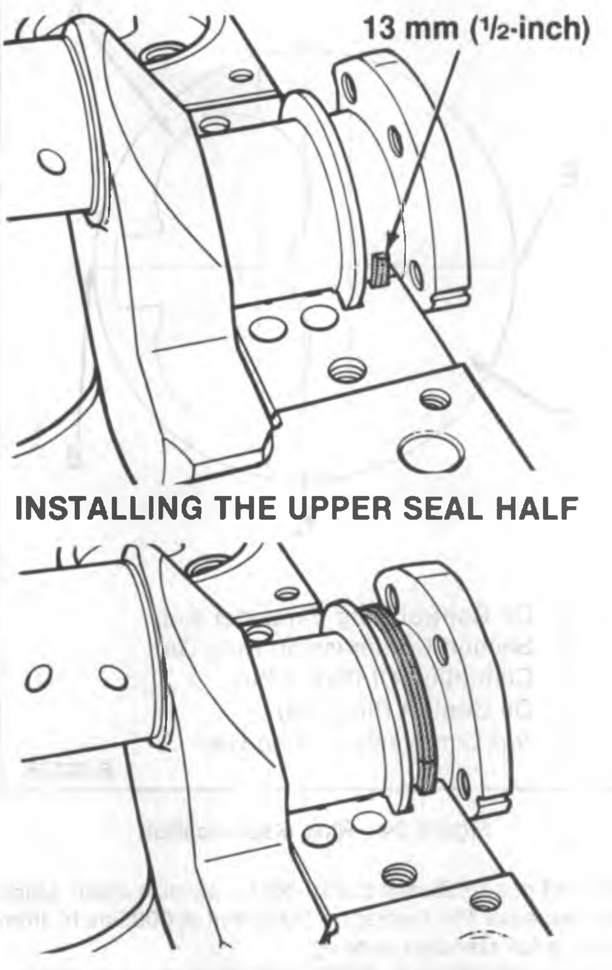


Figure 31—Installing the Two-Piece Rear Oil Seal

installed, check for fraying that may prevent the bearing cap from seating.

- Apply engine oil to the main bearings.

4. Rear crankshaft oil seal halves to the block.
   - Apply a light coat of engine oil to the seal lips where they contact the crankshaft.

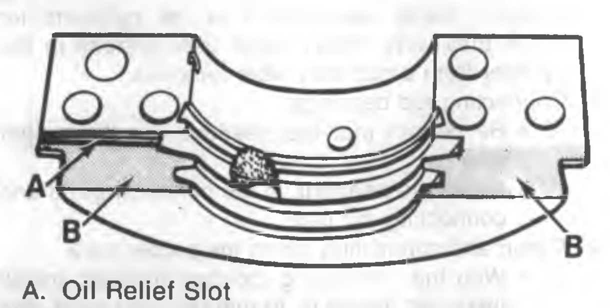


Figure 32—Applying Sealant to the Main Bearing Cap

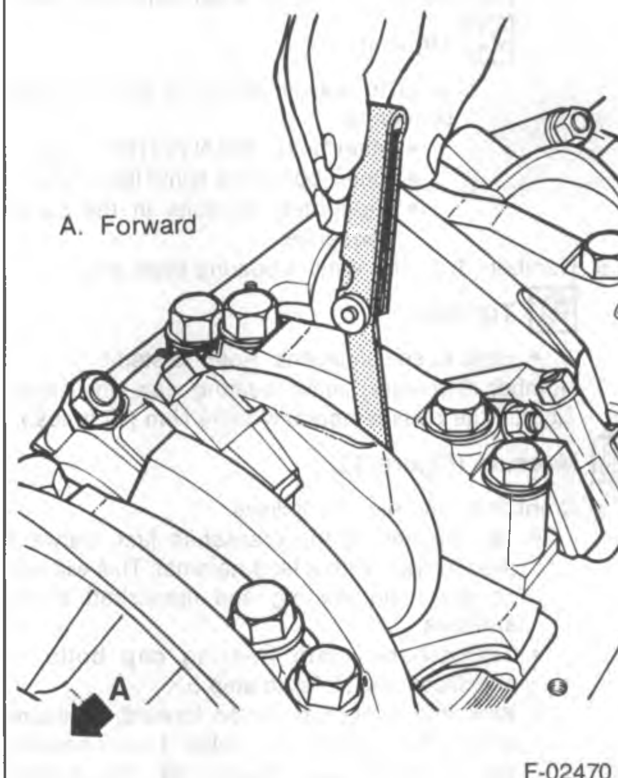


Figure 33—Measuring Crankshaft End Play

- "Roll" one seal half into the block seal groove until 13 mm (1/2-inch) of the seal's one end is extending out of the block (figure 31).
- Insert the other seal half into the opposite side of the seal groove in the block (figure 31).

Important

- The contact ends of the seal halves should now be at the four and ten o'clock positions, or at the eight and two o'clock positions. This is necessary to align the rear main bearing cap and seal lips.

NOTICE: The main bearing caps are to be tapped into place with a brass or leather mallet before the attaching bolts are installed. Do not use the attaching bolts to pull the main bearing caps into their seats, as this may damage the bearing cap and/or block.

5. Number 5 (rear) main bearing cap.
   - If a two piece type seal is to be installed, lightly coat the seal groove in the cap with adhesive (GM part number 1052621 [Loctite 414] or equivalent).
   - Apply a thin film of anaerobic sealant (GM part number 1052756 or equivalent) to the bearing cap as shown in figure 32. Keep the sealant off the seal and bearing. Do not put sealant in the bearing cap oil relief slot.
   - Apply engine oil to the main bearing cap bolt threads.

- Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.

Tighten

- Bolts to specifications, in the following sequence:
  - Inner bolts: 150 N·m (110 ft. lbs.).
  - Outer bolts: 135 N·m (100 ft. lbs.).
  - Re-tighten all bolts in the same sequence.

6. Numbers 1, 2, and 4 main bearing caps and bolts.

Tighten

- Bolts to specifications. Refer to step 5.

7. Number 3 (center) main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure (Figure 33)

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the main bearing and crankshaft thrust surfaces.
  - Tighten the main bearing cap bolts to specifications. Refer to step 5.
  - With the crankshaft forced forward, measure at the front end of the number 3 main bearing with a feeler gage (figure 33). The proper clearance is 0.10-0.25 mm.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

FLYWHEEL INSTALLATION

Install or Connect (Figure 30)

1. Flywheel (140).
2. Bolts (141).

Tighten

- Bolts (141) to 90 N·m (65 ft. lbs.).

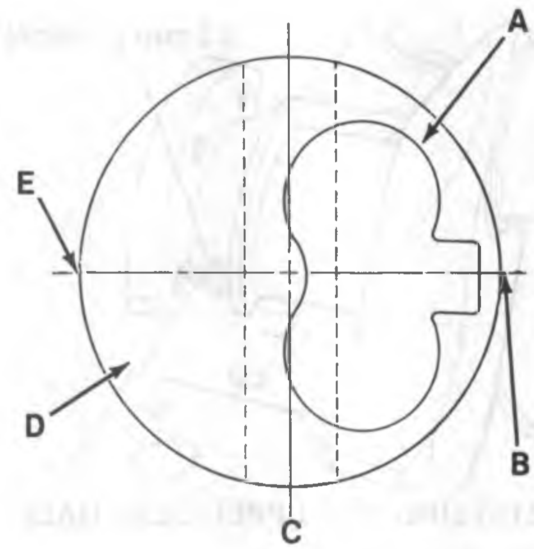
CONNECTING ROD AND PISTON INSTALLATION

CONNECTING ROD BEARING SELECTION

Connecting rod bearings are of the precision insert type and do not use shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are excessive install a new bearing. Service bearings are available in standard size and 0.026 mm (0.001-inch) undersizes.

Selective fitting of both rod and main bearing inserts is necessary to obtain close tolerances. For this reason you may use, for example, one half of a standard insert with one half of a 0.026 mm (0.001-inch) undersize insert which will decrease the clearance 0.013 mm (0.0005-inch) from using a full standard bearing.

Some VIN Code C (RPO LH6) (light duty emissions) engines may have both standard and 0.08 mm (0.003-inch) oversize connecting rod bearings. The oversize connecting rods are stamped "O.S." on the cap's lower end.



A. Oil Control Ring Expander Gap
B. Second Compression Ring Gap
C. Centerline Of Piston Pin
D. Oil Control Ring Gap
E. Top Compression Ring Gap

B-08046

Figure 34—Ring Gap Location

INSTALLATION

Install or Connect (Figures 34, 35, and 36)

Tool Required:
J 8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder. Install new pistons in the cylinders for which they were fitted. Install used pistons in the cylinder from which they were removed.

1. Connecting rod bearings.
   - Be certain that the bearings are the proper size.
   - Install the bearings in the connecting rod and connecting rod cap.
2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap rmeoved, install two short pieces of 10 mm (3/8-inch) hose onto the connecting rod studs.
   - Locate the piston ring end gaps as shown in figure 34. Lubricate the piston and rings with engine oil.

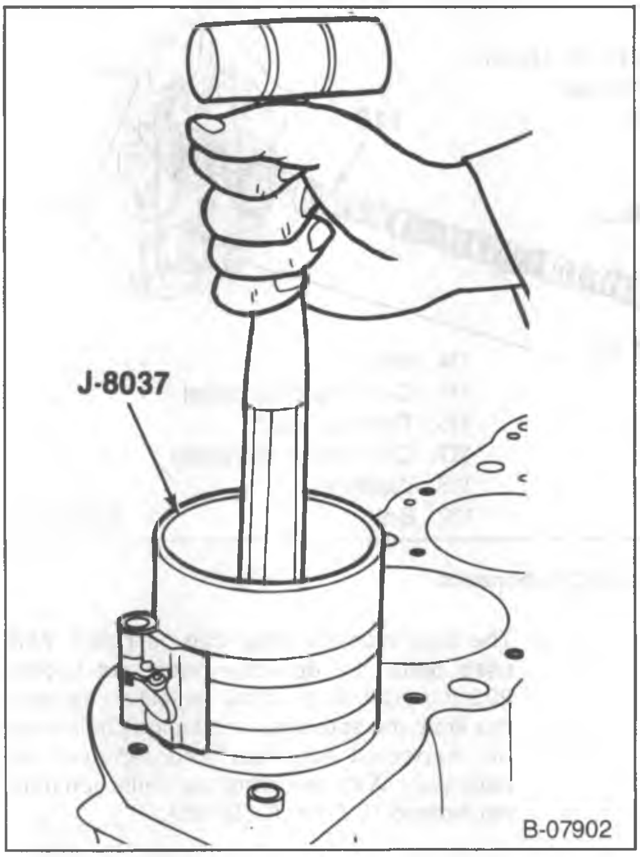
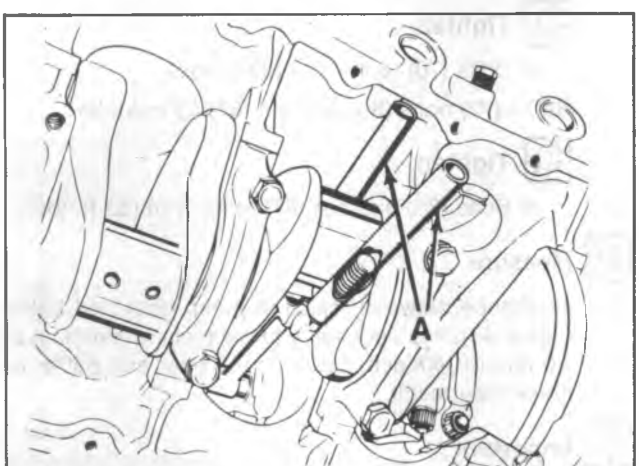


Figure 35—Installing the Piston and Connecting Rod

- Without disturbing the ring end gap location, install J 8037 over the piston (figure 35).
- The piston must be installed so that the depression in the piston crown is towards the outside of the engine. The connecting rod bearing tang slots must be opposite the camshaft.
- Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 35). At the same time, from beneath the engine guide the connecting rod to the journal with the pieces of hose (figure 36). Hold the ring compressor against the block until all rings have entered the cylinder bore.



A. Use short pieces of 10 mm (3/8-inch) hose to protect the crankshaft journal.

Figure 36—Installing the Connecting Rod and Piston

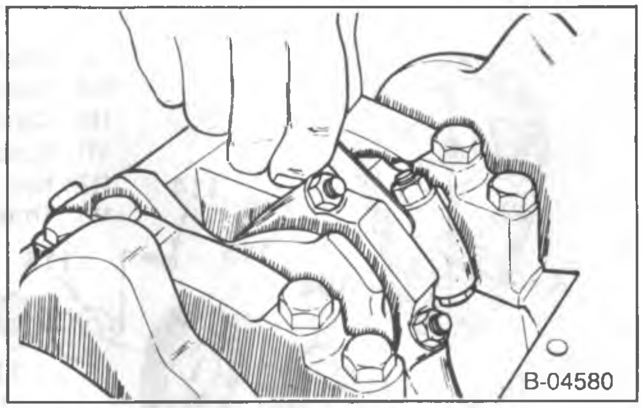


Figure 37—Checking Connecting Rod Side Clearance

- Remove the hoses from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 are the left bank and, 2, 4, 6 and 8 are the right bank. 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 connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Connecting rod bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

- Apply engine oil to the connecting rod bearings.

3. Connecting rod cap with bearing.
4. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 65 N·m (48 ft. lbs.).

Measure (Figure 37)

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 37). The correct clearance is 0.17-0.63 mm.

CAMSHAFT INSTALLATION

Install or Connect (Figure 38)

- When a new camshaft is installed, replacement of all hydraulic lifters, engine oil, and oil filter is recommended.

1. Key (112).
2. Spacer (111), with the ID chamfer towards the camshaft (110).

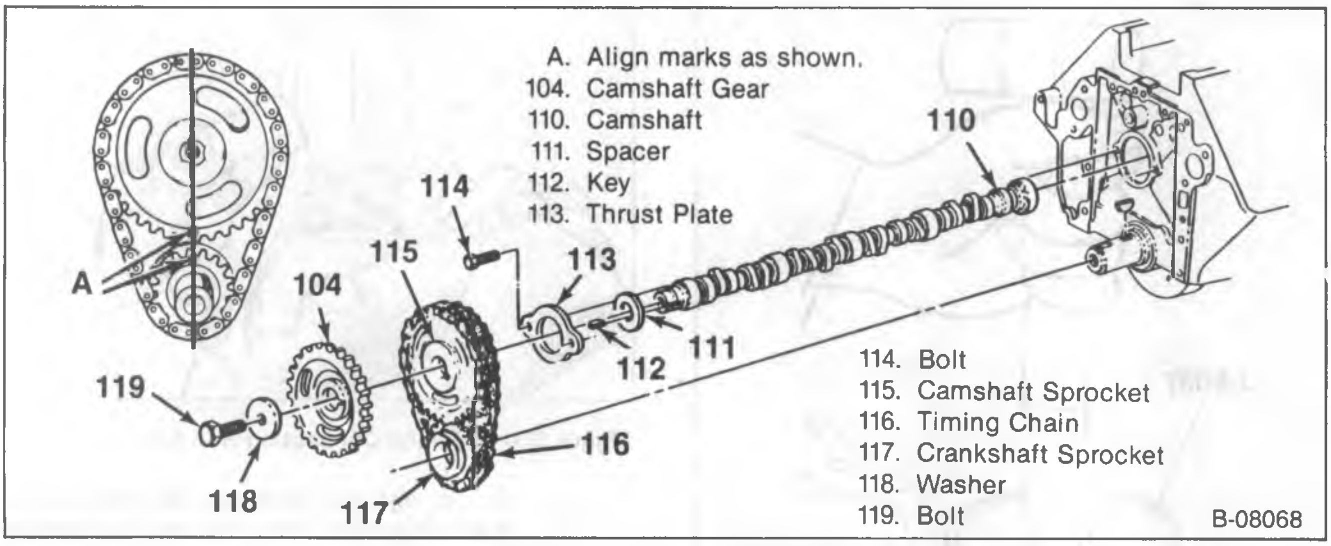


Figure 38—Camshaft and Components

3. Camshaft.
   - Coat the camshaft lobes with "Molykote" or equivalent.
   - Lubricate the camshaft bearing journals with engine oil.
   - Insert the camshaft carefully into the block to avoid damage to the camshaft bearings.
4. Thrust plate (113) and bolts (114).

Tighten

- Bolts (114) to 23 N·m (17 ft. lbs.).

TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figure 38)

1. Crankshaft sprocket (117).
2. Camshaft sprocket (115) with timing chain (116).

Important

- Align the timing marks (figure 38).

3. Camshaft gear (104), washer (118) and bolts (119).

Tighten

- Bolt (119) to 100 N·m (75 ft. lbs.).

Measure

- Timing chain free play as follows:
  1. Mount a dial indicator to the front of the block.
  2. Position the dial indicator so that the plunger contacts the timing chain between the two sprockets.
  3. Pull the chain outward (parallel to the front face of the block) the maximum amount with finger pressure on the inside of the chain.
  4. Set the dial indicator to zero.
  5. Move the chain inward (parallel to the front face of the block) the maximum amount with finger pressure on the outside of the chain.
  6. The total indicator travel can be noted. With used parts, the deflection must not exceed 20.3 mm (0.80-inch). If the deflection exceeds this limit, the sprockets and timing chain must be inspected for wear and replaced as necessary. With new parts, the deflection must not exceed 12.7 mm (0.50-inch).

FRONT COVER INSTALLATION

Clean

- Sealing surfaces on the block and front cover with carburetor cleaner or equivalent.

Install or Connect (Figures 39 and 40)

- Apply a 2 mm (3/32-inch) bead of anaerobic sealant (GM part number 1052357 or equivalent) to the front cover sealing area shown in figure 40.

1. Front cover to the engine. Install the bolts (70).

Tighten

- Bolts (70) to 45 N·m (33 ft. lbs.).

2. Baffle (72) bolts (86) and nut (87) (G models).

Tighten

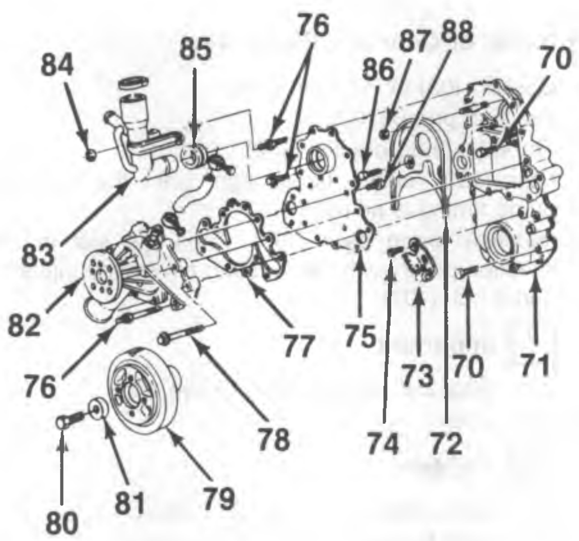
- Bolts (86) and nut (87) to 45 N·m (33 ft. lbs.).

Measure

- Clearance between injection pump gear and baffle (figure 40). It is necessary to maintain a minimum of 1.0 mm (0.040-inch) between the gear and baffle, or noise may result.

Important

- If a new front cover was installed, mark TDC on the cover as outlined following. This is necessary to provide a reference mark for timing the injection pump.



70. Bolt
71. Front Cover
72. Baffle (G Models)
73. Timing Pointer
74. Screw
75. Water Pump Plate
76. Bolt/Stud
77. Gasket
78. Bolt
79. Torsional Damper
80. Bolt
81. Washer
82. Water Pump
83. Oil Filler Neck
84. Nut
85. Grommet
86. Bolt (G Models)
87. Nut (G Models)
88. Bolt

F-05726

Figure 39—Front Cover and Components

MARKING TDC ON THE FRONT COVER

Tool Required:

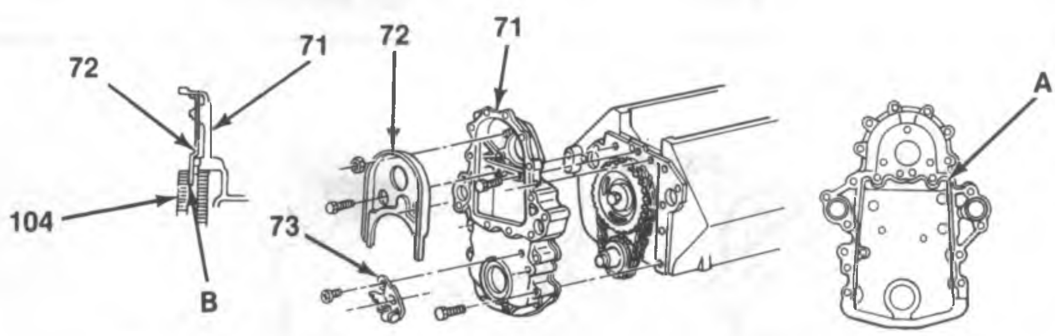
J 33042, Timing Fixture

1. Set the engine so that number 1 cylinder is at TDC (firing).
2. Install J 33042 in the injection pump location.
   - Do not use the gasket.
3. Set the injection pump gear (106) (figure 44) in place, aligning the timing marks on the injection pump and camshaft gears, as shown. The slot in the injection pump gear should be in the vertical 6 o'clock position (figure 41). If not, remove J 333042 and rotate the engine crankshaft 360 degrees.
4. Fasten J 33042 to the injection pump gear and tighten (figure 42).
5. Install one 10 mm nut to the upper housing stud to hold the tool flange.
   - The nut should be finger tight.
6. Tighten the large bolt (18 mm head) clockwise (looking at the front of the engine) to 48 N·m (35 ft. lbs.).
7. Tighten the 10 mm nut.
8. Check that the crankshaft has not rotated and that the tools did not bind.
9. Strike the scriber with a mallet to mark TDC on the front cover.
10. Remove J 33042.

OIL PUMP INSTALLATION

Install or Connect (Figure 43)

1. Oil pump with extension.
2. Bolt (131).



A. Apply anaerobic sealer.
B. Minimum clearance 1.0 mm (0.040-inch).
71. Front Cover
72. Baffle (G Models)
73. Probe Holder
104. Camshaft Gear

F-05728

Figure 40—Front Cover Installation

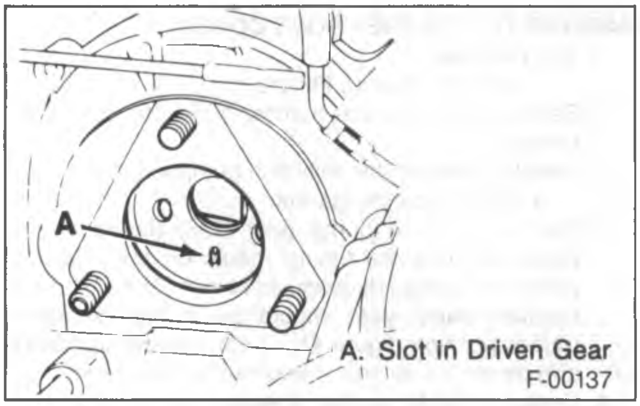


Figure 41—Slot in Injection Pump Gear

Tighten

- Bolt (131) to 90 N·m (65 ft. lbs.).

OIL PAN INSTALLATION

Install or Connect (Figure 43)

- Apply a 5 mm (3/16-inch) bead of RTV sealant (GM part number 1052915 or equivalent) to the oil pan sealing surface, inboard of the bolt holes (figure 40). The sealer must be wet to the touch when the oil pan is installed.

1. Oil pan rear seal to the oil pan.
2. Oil pan to the engine.
3. Bolts (133).

Tighten

— All except rear two bolts to 10.0 N·m (84 in. lbs.).

— Rear two bolts to 23 N·m (17 ft. lbs.).

INJECTION PUMP INSTALLATION

Install or Connect (Figure 44)

1. Gasket (103) to the front cover.
2. Injection pump (100).
3. Throttle spring bracket (102).
4. Nuts (101). Leave finger tight until the injection pump timing is adjusted.
5. Injection pump gear (106). Align the slot in the injection pump with the locating pin on the injection pump hub (107).

Important

- Align the timing marks (figure 44).

6. Bolts (105).

Tighten

- Bolts (105) to 25 N·m (20 ft. lbs.).

7. Wires and hoses at the injection pump.

Adjust (Figure 45)

- Injection pump timing. For the engine to be properly timed, the marks on the top of the engine front cover must be aligned with the marks on the injection pump flange (figure 45). The engine must be off when the timing is reset.

Tighten (Figure 44)

- Nuts (101) to 40 N·m (30 ft. lbs.).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figure 39)

1. Torsional damper (79). Tap into place with a mallet. Make sure the key is in place. Make sure the damper is all the way on the crankshaft.
2. Bolt (80) and washer (81).

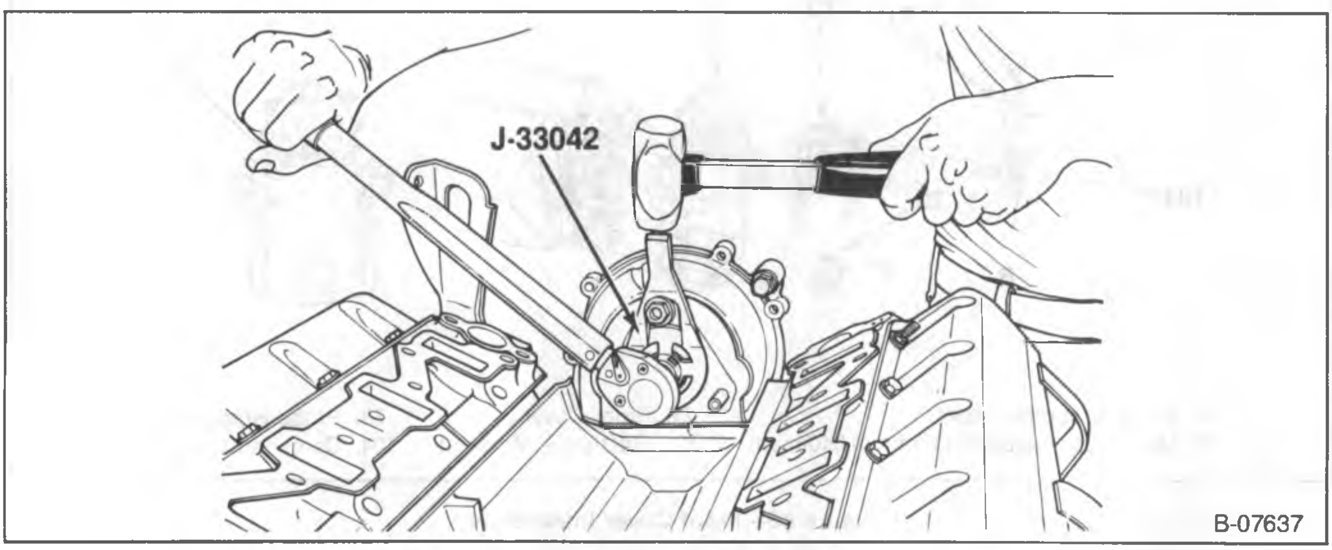


Figure 42—Marking TDC on the Front Cover

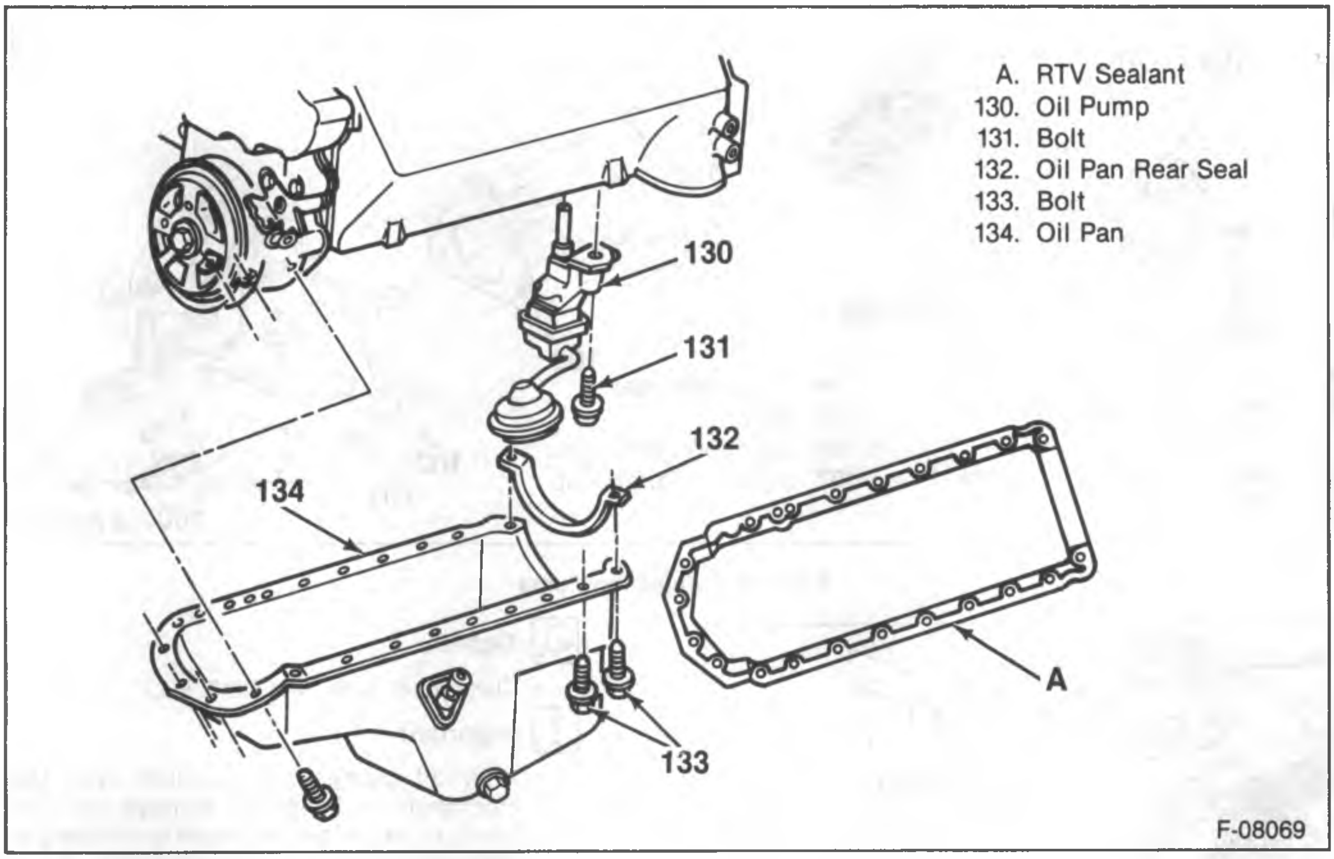


Figure 43—Oil Pan and Oil Pump

Tighten

- Bolt (80) to 270 N·m (200 ft. lbs.).

WATER PUMP INSTALLATION

Clean

- Sealing surfaces on the water pump plate and block. Use carburetor cleaner or equivalent.

Install or Connect (Figures 39 and 46)

1. Water pump (82) and gasket (77) to the water pump plate (75).
2. Bolts (88).

Tighten

- Bolts (88) to 22 N·m (16 ft. lbs.).

- Apply a bead of anaerobic sealer (GM part no. 1052357 or equivalent) to the water pump plate as shown in figure 46.

3. Water pump plate to the engine. The sealer must be wet to the touch when installing the plate.

- Apply sealant (GM Part no. 1052080 or equivalent) to the threads of bolts and studs (76).

4. Bolts and studs (76).

Tighten

— Water pump to front cover bolts to 42 N·m (32 ft. lbs.).
— Water pump plate to front cover bolts to 22 N·m (16 ft. lbs.).

5. Oil filler neck (83) and nuts (84).

HYDRAULIC LIFTER INSTALLATION

Important

- Some engines will have both standard and 0.010-inch oversize hydraulic lifters. The oversize lifter will have a "10" etched on the side. The block will be stamped "O.S." on the cast pad adjacent to the lifter bore and on the top rail of the cylinder case above the lifter bore.

Install or Connect (Figure 47)

NOTICE: New hydraulic lifters must be primed before installation. Damage to the lifters may result if dry when the engine is started.

1. Hydraulic lifters to the engine.
   - Prime new hydraulic lifters before installation by working the lifter plunger while submerged in clean kerosene or diesel fuel.
   - Coat the lifter roller and bearings with lubricant (GM part number 1052365 or equivalent).
   - Lifters MUST be installed in their original locations.
2. Guide plates (50).
3. Clamps (51).

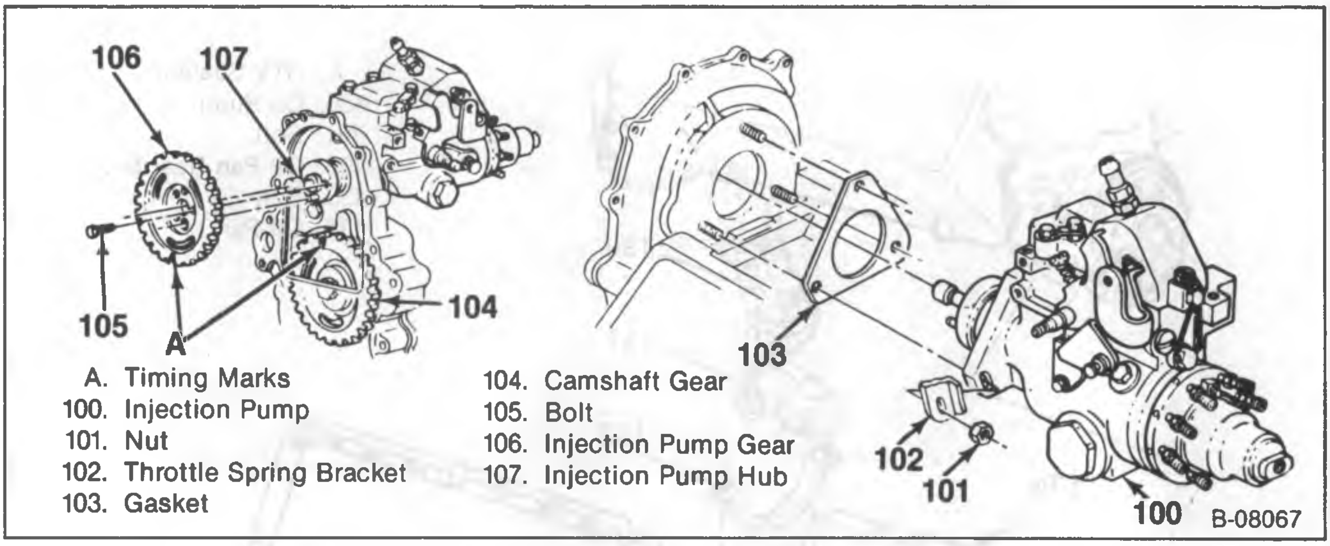


Figure 44—Injection Pump

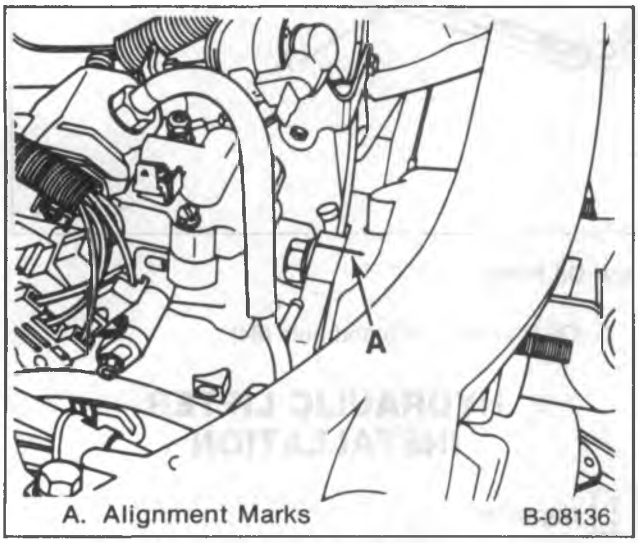


Figure 45—Injection Pump Timing Marks

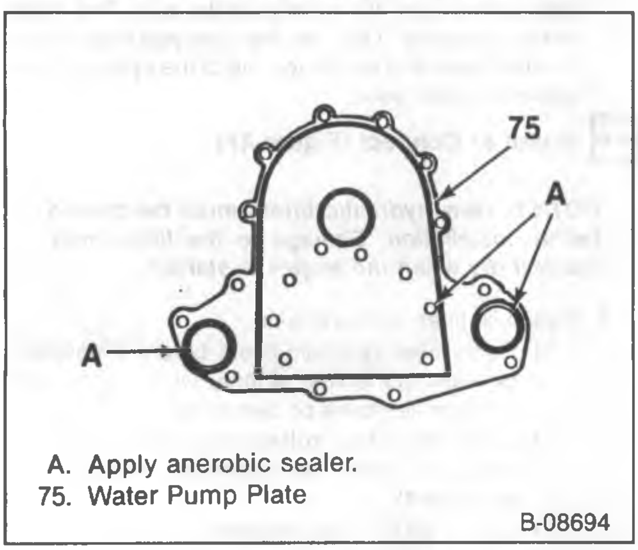


Figure 46—Applying Sealer to the Water Pump Plate

Tighten

- Clamp bolts to 26 N·m (18 ft. lbs.).

Important

- After all clamps are installed, turn the crankshaft by hand 720 degrees (two full turns), to insure free movement of the lifters in the guide plates. If the engine will not turn over by hand, one or more of the lifters may be binding in the guide plate.

CYLINDER HEAD INSTALLATION

Install or Connect (Figures 47 and 48)

Tool Required:
J 29664 Manifold Cover Set

1. Head gasket to the block, over the dowel pins.

   Important

   - The block gasket surfaces must be clean.
   - DO NOT use a sealer on the head gasket. The head gasket is manufactured with the proper amount of sealant "printed" on its surface. Additional sealer may cause leakage or malfunction. In addition, some sealers may attack the sealant already on the head gasket.
2. Cylinder head. Make sure the gasket surfaces are clean. Guide the head carefully into place over the dowel pins.
3. Bolts (56).
   - Make sure the bolt threads are clean.
   - Apply sealant (GM part number 1052080 or equivalent) to the bolt threads and under the bolt heads.

   Tighten

   - Bolts (56).
   - Using the sequence shown in figure 48, tighten all bolts to 25 N·m (20 ft. lbs.).

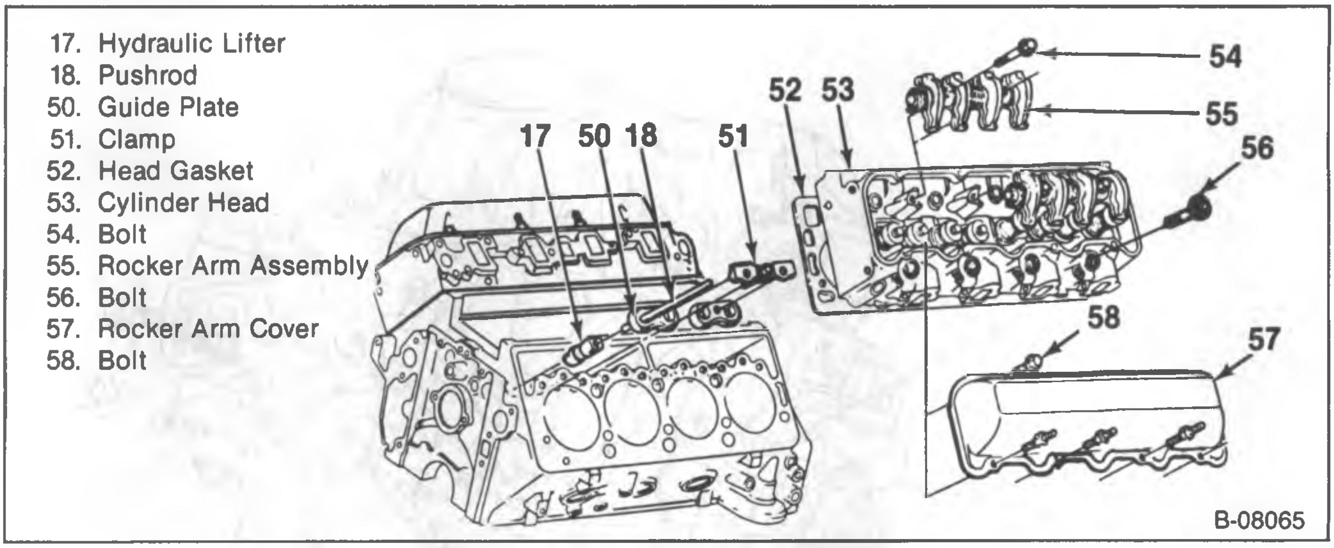


Figure 47—Cylinder Head and Components

- In sequence, tighten all bolts to 65 N·m (50 ft. lbs.).
- In sequence, tighten all bolts an additional 90 degrees (1/4 turn).

4. J 29664-1 to the intake ports.

PUSHROD AND ROCKER ARM INSTALLATION

Install or Connect (Figures 47 and 49)

NOTICE: The pushrods must be installed with the marked or painted end up. Failure to do so may result in damage or premature wear.

1. Pushrods, with the painted or marked end up.
2. Rocker arm shaft assembly. Make sure the ball ends of the pushrods seat in the rocker arms.

NOTICE: Improper installation of the rocker arm shaft bolts may cause rocker arm shaft breakage and/or piston to valve contact.

3. Bolts (54).

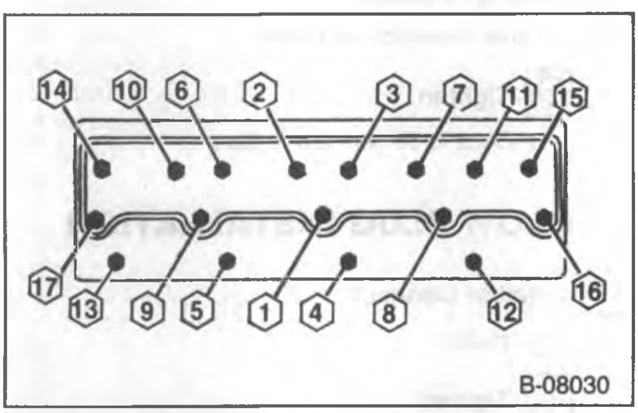


Figure 48—Head Bolt Tightening Sequence

- Rotate the engine until the mark on the torsisonal damper aligns with the "0" mark on the timing tab.
- Rotate the engine counterclockwise 88 mm (3 1/2-inches), measured at the torsional damper. This measurement can be estimated by aligning the torsional damper mark with the first lower water pump bolt (figure 49). This procedure will position the engine so no valves are close to a piston crown.
- Install the bolts finger tight.

Tighten

- Bolts (54) alternately to 55 N·m (40 ft. lbs.).

ROCKER ARM COVER INSTALLATION

Clean

- Sealing surfaces on the cylinder head and rocker arm cover with carburetor cleaner or equivalent.

Install or Connect (Figure 50)

NOTICE: Do not allow RTV sealant into the rocker arm cover bolt holes. This may cause a "hydraulic lock" condition when the bolts are tightened, damaging the cylinder head casting.

- Apply a 5 mm (3/16-inch) bead of RTV sealant (GM part number 1052915 or equivalent) to the rocker arm covers, inboard of the bolt holes. Refer to figure 50. The sealer must be wet to the touch when the bolts are torqued.

1. Rocker arm covers.
2. Bolts (58).

Tighten

- Bolts (58) to 22 N·m (16 ft. lbs.).

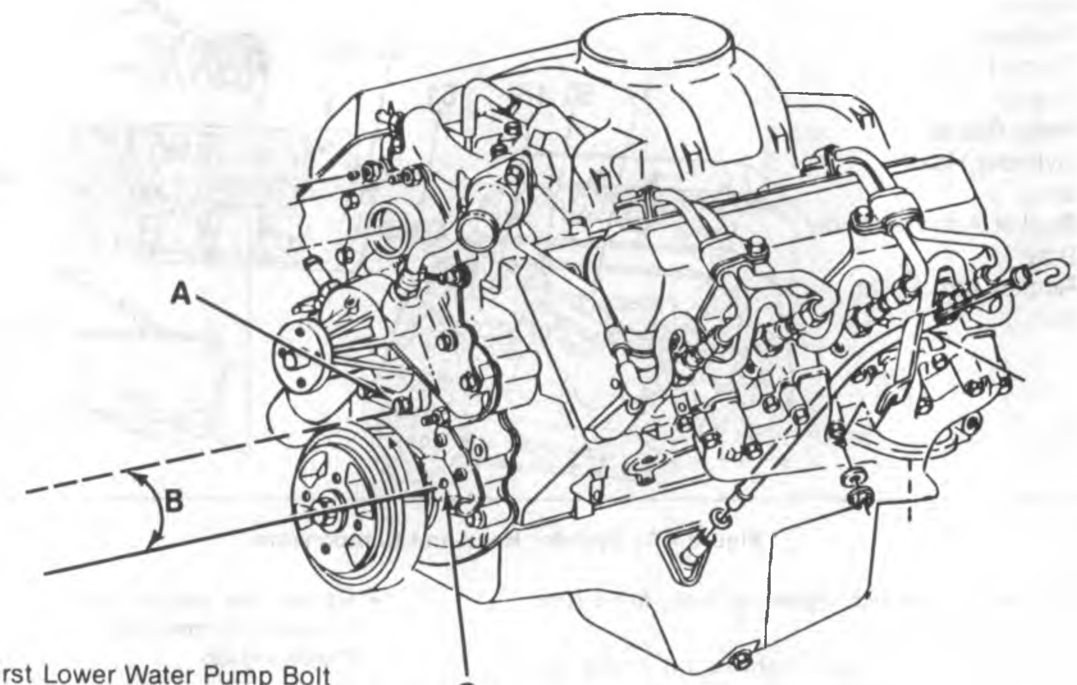


Figure 49—Aligning the Timing Mark

WATER CROSSOVER INSTALLATION

Install or Connect (Figure 51)

1. Gaskets (46).
2. Water crossover.
3. Bolts and studs (44).

Tighten

- Bolts and studs (44) to 42 N·m (31 ft. lbs.).

4. Hose (48) and clamps (47).
5. Glow plug inhibit switch wire.

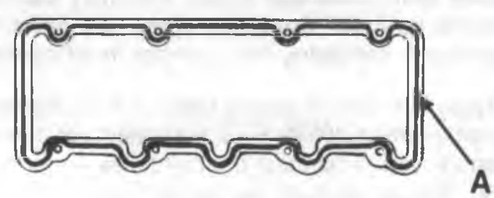


Figure 50—Applying Sealant to the Rocker Arm Cover

DIPSTICK TUBE INSTALLATION

Install or Connect

1. New O-ring to the dipstick.
2. Dipstick to the engine.
3. Dipstick bracket bolt.

EXHAUST MANIFOLD INSTALLATION

Install or Connect

- Exhaust manifolds and bolts.

Tighten

- Bolts to 35 N·m (26 ft. lbs.).

GLOW PLUG INSTALLATION

Install or Connect

- Glow plugs.

Tighten

- Glow plugs to 14 N·m (10 ft. lbs.).

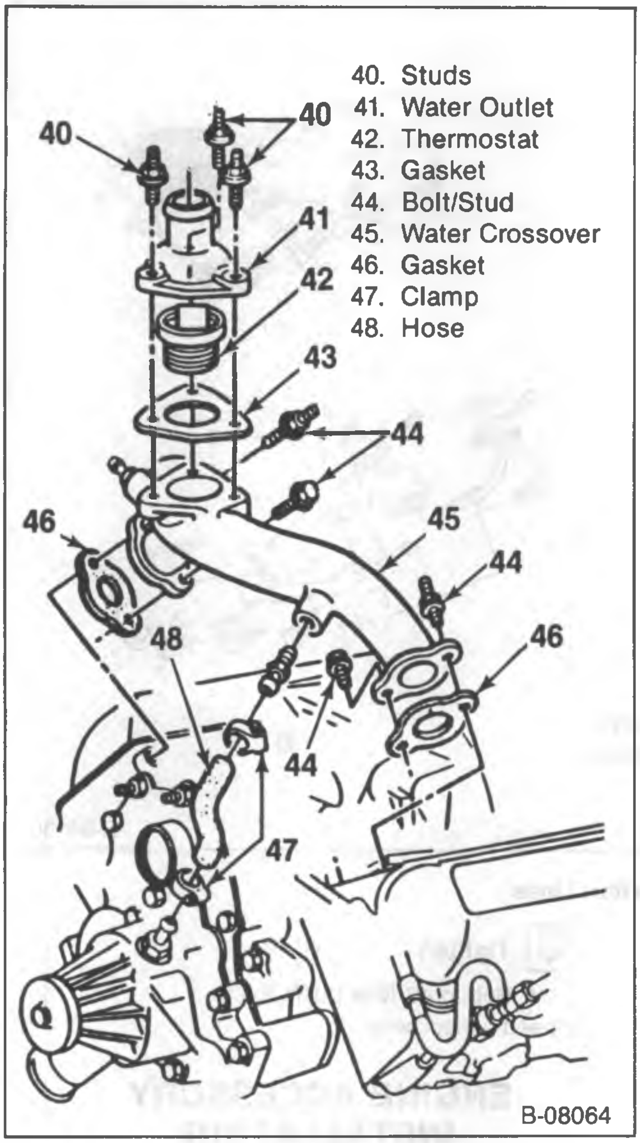


Figure 51—Thermostat and Water Crossover

INJECTION NOZZLE INSTALLATION

Install or Connect (Figure 52)

Tool Required:

J 29873, Nozzle Socket

NOTICE: Nozzles used in LH6 (light duty emissions) engines used in G models are shorter than nozzles used in other models. Attempts to intall an incorrect nozzle will damage the cylinder heads.

NOTICE: When installing an injection nozzle, use J 29873. Install the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

1. Injection nozzle with gasket using J 29873.

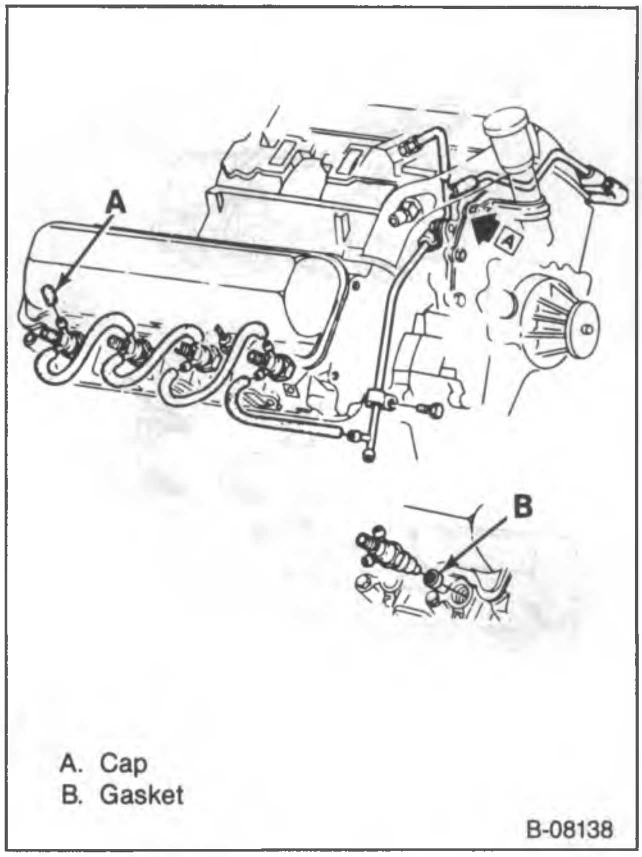


Figure 52—Injection Nozzles

Tighten

- Nozzle to 70 N·m (50 ft. lbs.).

2. Fuel return hose.
3. Fuel line clip.

INJECTION LINE INSTALLATION

Install or Connect (Figures 53 and 54)

1. Injection line brackets.
2. Injection lines to the pump. Uncap the lines before assembly. Do not bend the injection lines.
3. Injection lines to the nozzles. Uncap the lines before assembly. Do not bend the injection lines.

Tighten

- Injection line fittings at both ends of the lines to 25 N·m (19 ft. lbs.).

4. Injection line clips to the brackets.

INTAKE MANIFOLD INSTALLATION

Remove or Disconnect

- J 29664-1 from the intake ports.

Install or Connect (Figure 55)

Tool Required:
J 29664 Manifold Cover Set

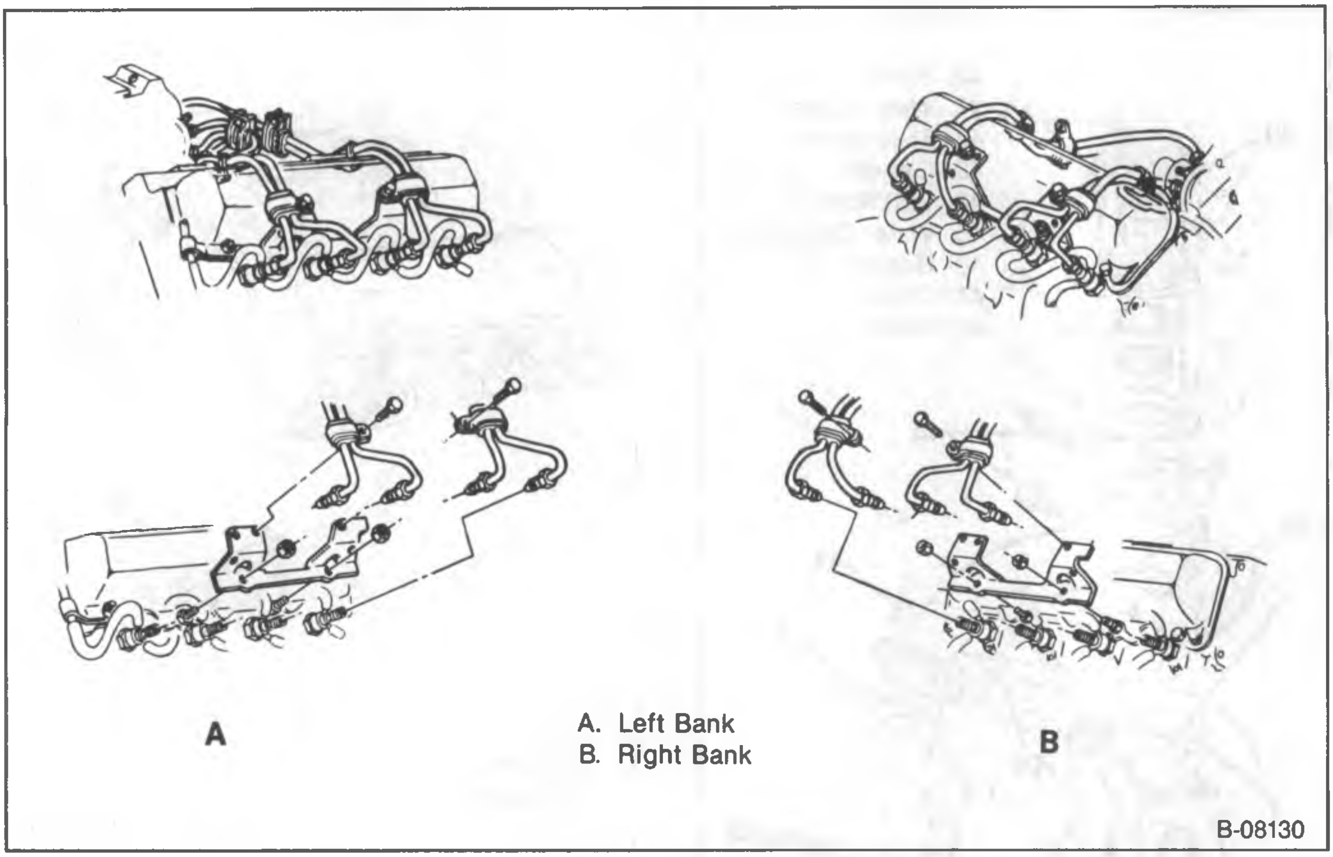


Figure 53—Injection Lines

1. New gaskets. Be sure to use the correct gasket. The gaskets for light duty emissions models have openings for the EGR, the gaskets for heavy duty emissions models do not.
2. Intake manifold.
3. Intake manifold bolts and fuel line clips.

Tighten

- Intake manifold bolts to 42 N·m (31 ft. lbs.). Use the tightening sequence shown in figure 55.

4. J 29664-2 to the mouth of the intake manifold.

OIL PUMP DRIVE OR VACUUM PUMP INSTALLATION

NOTICE: Do not run the engine without the gear driven vacuum pump or oil pump drive in place. This will cause extensive engine damage.

Install or Connect (Figures 56, 57, and 58)

1. New gasket to the oil pump drive or vacuum pump.
2. Oil pump drive or vacuum pump to the engine. Index the drive or pump with the camshaft gear and oil pump drive shaft. Make sure the drive or pump seats fully.

- Rotate the vacuum pump (if used) to its correct position (figure 58).

3. Clamp and bolt.

Tighten

- Bolt to 42 N·m (31 ft. lbs.).

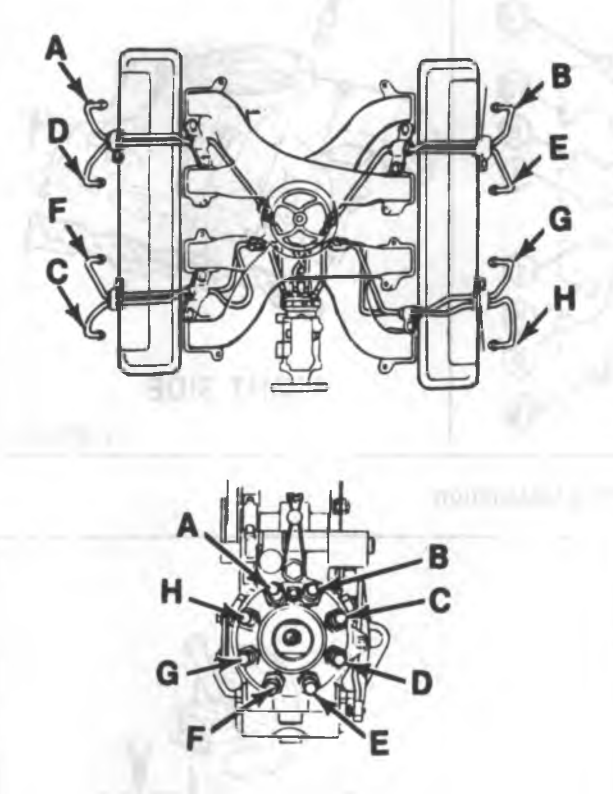
4. Speed sensor wire.

ENGINE ACCESSORY INSTALLATION

Install the engine accessories as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.

ENGINE SET-UP AND TESTING

1. After overhaul, the engine should be tested before installation in the vehicle. If a suitable test stand is not available, the following procedure can be used after the engine is installed in the vehicle.
2. Fill the crankcase with the proper quantity and grade of oil and install a new oil filter. Refer to the proper Truck Service Manual or Owner's and Driver's Manual for this information. Replacement of the engine oil and filter is recommended, especially if a new camshaft was installed.
3. Fill the cooling system with the proper coolant.
4. With the shutdown solenoid disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
5. Start the engine and listen for unusual noises. Run the engine at about 1000 rpm until the engine is at operating temperature.



A. Cylinder Number 8
B. Cylinder Number 7
C. Cylinder Number 2
D. Cylinder Number 6
E. Cylinder Number 5
F. Cylinder Number 4
G. Cylinder Number 3
H. Cylinder Number 1

B-08131

Figure 54—Injection Line Routing

Listen for sticking lifters, and other unusual noises. Check for oil and coolant leaks while the engine is running.

Using the proper Truck Service Manual or Emission Control Label for specifications, adjust idle speed, fast idle speed, etc. as required.

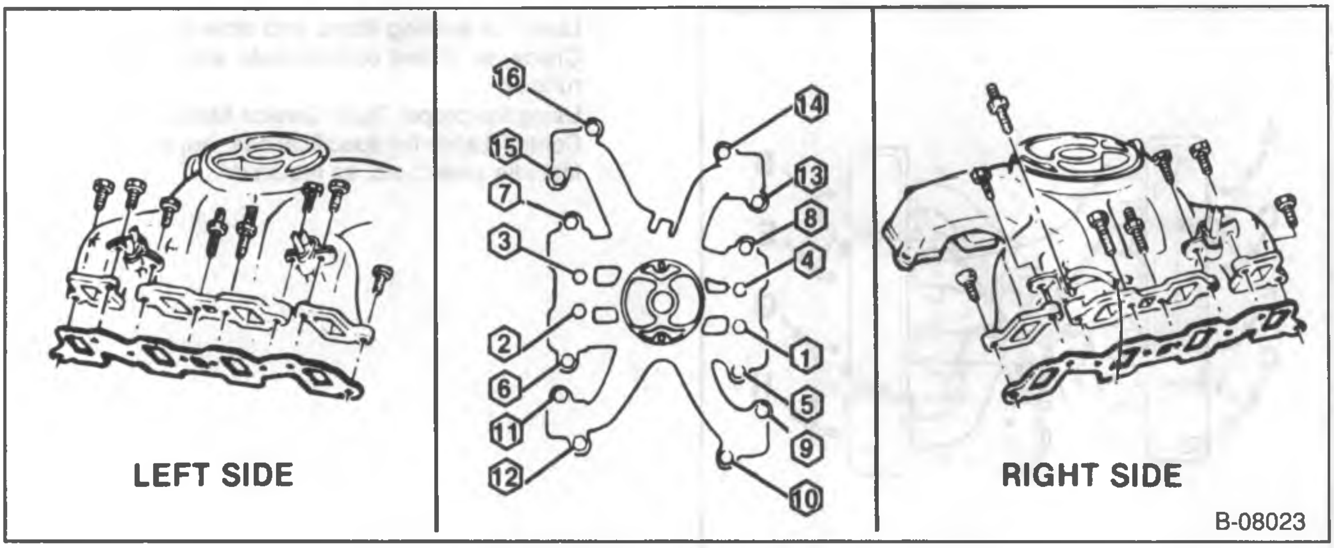


Figure 55—Intake Manifold Installation

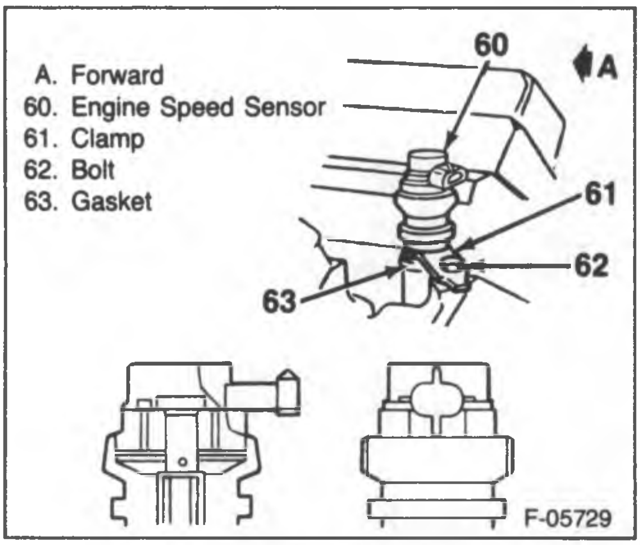


Figure 56—Oil Pump Drive Installed

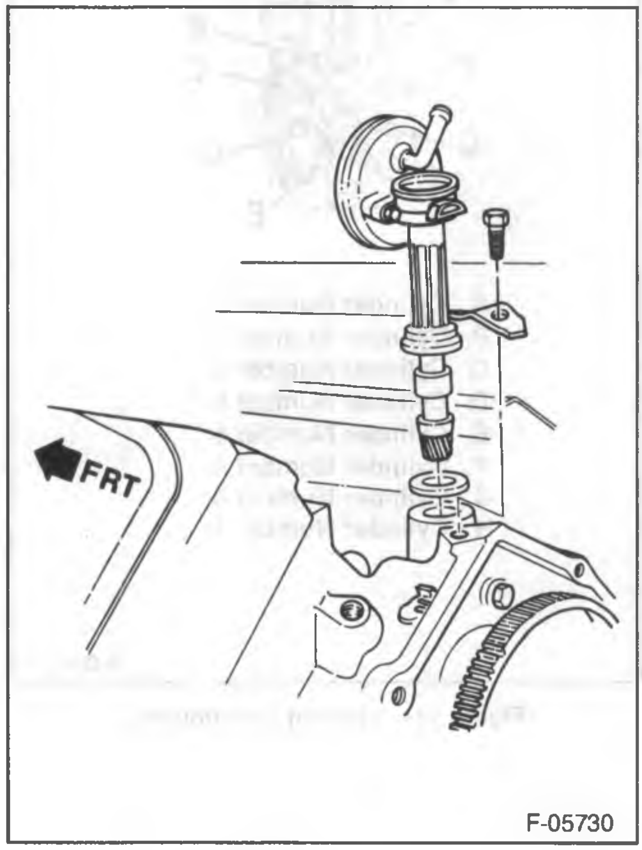


Figure 57—Vacuum Pump

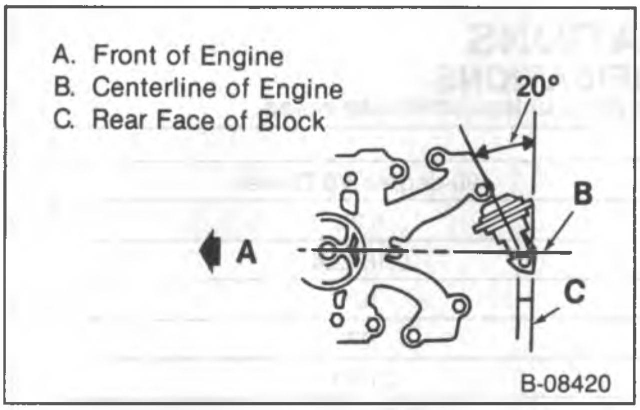


Figure 58—Vacuum Pump Installed

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in millimeters (mm) unless otherwise noted.

<table>
<tr><td colspan="4">GENERAL DATA:</td></tr>
<tr><td colspan="3">Type</td><td>90-degree V8 Diesel</td></tr>
<tr><td colspan="3">Displacement</td><td>6.2L</td></tr>
<tr><td colspan="3">RPO</td><td>LH6 LL4</td></tr>
<tr><td colspan="3">Bore</td><td>101</td></tr>
<tr><td colspan="3">Stroke</td><td>97</td></tr>
<tr><td colspan="3">Compression Ratio</td><td>21.3:1</td></tr>
<tr><td colspan="3">Firing Order</td><td>1-8-7-2-6-5-4-3</td></tr>
<tr><td colspan="3">Oil Pressure</td><td>10 psi at idle (hot); 40–45 psi at 2000 RPM</td></tr>
<tr><td colspan="4">CYLINDER BORE:</td></tr>
<tr><td colspan="3">Diameter</td><td>100.987–101.065</td></tr>
<tr><td colspan="3">Diameter</td><td>0.02 (Maximum)</td></tr>
<tr><td colspan="3">Taper (Thrust Side)</td><td>0.02 (Maximum)</td></tr>
<tr><td colspan="4">PISTON:</td></tr>
<tr><td rowspan="4">Clearance</td><td rowspan="2">Bohn Pistons</td><td>Bores 1 through 6</td><td>0.089–0.115</td></tr>
<tr><td>Bores 7 and 8</td><td>0.102–0.128</td></tr>
<tr><td rowspan="2">Zollner Pistons</td><td>Bores 1 through 6</td><td>0.112–0.138</td></tr>
<tr><td>Bores 7 and 8</td><td>0.125–0.151</td></tr>
<tr><td colspan="4">PISTON RING:</td></tr>
<tr><td rowspan="4">Compression</td><td rowspan="2">Groove Clearance</td><td>Top</td><td>0.076–0.178</td></tr>
<tr><td>2nd</td><td>0.039-0.080</td></tr>
<tr><td rowspan="2">Gap</td><td>Top</td><td>0.30–0.55</td></tr>
<tr><td>2nd</td><td>0.75–1.00</td></tr>
<tr><td rowspan="2">Oil</td><td colspan="2">Groove Clearance</td><td>0.040–0.096</td></tr>
<tr><td colspan="2">Gap</td><td>0.25–0.51</td></tr>
<tr><td colspan="4">PISTON PIN:</td></tr>
<tr><td colspan="3">Diameter</td><td>30.9961–31.0039</td></tr>
<tr><td colspan="3">Clearance</td><td>0.0101-0.0153</td></tr>
<tr><td colspan="3">Fit in Rod</td><td>0.0081–0.0309</td></tr>
<tr><td colspan="4">CRANKSHAFT</td></tr>
<tr><td rowspan="4">Main Journal</td><td rowspan="2">Diameter</td><td>#1, 2, 3, 4</td><td>74.917–74.941</td></tr>
<tr><td>#5</td><td>74.912–74.936</td></tr>
<tr><td colspan="2">Taper</td><td>0.005 (Maximum)</td></tr>
<tr><td colspan="2">Out of Round</td><td>0.005 (Maximum)</td></tr>
<tr><td rowspan="2" colspan="2">Main Bearing Clearance</td><td>#1, 2, 3, 4</td><td>0.045–0.083</td></tr>
<tr><td>#5</td><td>0.055–0.093</td></tr>
<tr><td colspan="3">Crankshaft End Play</td><td>0.10–0.25</td></tr>
<tr><td rowspan="3" colspan="2">Crankpin</td><td>Diameter</td><td>60.913–60.939</td></tr>
<tr><td>Taper</td><td>0.005 (Maximum)</td></tr>
<tr><td>Out-of-Round</td><td>0.005 (Maximum)</td></tr>
<tr><td colspan="3">Rod Bearing Clearance</td><td>0.045–0.100</td></tr>
<tr><td colspan="3">Rod Side Clearance</td><td>0.17–0.63</td></tr>
</table>

B-08051

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All Specifications are in millimeters (mm) unless otherwise noted.

DISPLACEMENT		6.2 L
CAMSHAFT:		
Lobe Lift ± 0.05	Intake	7.133
Lobe Lift ± 0.05	Exhaust	7.133
Journal Diameter	#1, 2, 3, 4	54.970-55.025
Journal Diameter	#5	50.970-51.025
Journal Clearance	#1, 2, 3, 4	0.025-0.118
Journal Clearance	#5	0.020-0.113
Camshaft End Play		0.051-0.305
VALVE SYSTEM:		
Lifter		Hydraulic Roller
Rocker Arm Ratio		1.5 : 1
Valve Lash	Intake	Not Adjustable
Valve Lash	Exhaust	Not Adjustable
Face Angle (Intake & Exhaust)		45°
Seat Angle (Intake & Exhaust)		46°
Seat Runout (Intake & Exhaust		0.05
Seat Width	Intake	0.89-1.53
Seat Width	Exhaust	1.57-2.36
Stem Clearance	Intake	0.026-0.069
Stem Clearance	Exhaust	0.026-0.069
Valve Spring — Pressure Newtons @ mm	Closed	356 N @ 46.0 mm
Valve Spring — Pressure Newtons @ mm	Open	1025 N @ 35.3 mm
Valve Spring — Installed Height		46
Timing Chain Free Play	New Chain	12.7 mm (0.500-inch)
Timing Chain Free Play	Used Chain	20.3 mm (0.800-inch)
Hydraulic Lifter Diameter	Standard	23.39-23.41
Hydraulic Lifter Diameter	0.010-inch Oversize	23.64-23.66
Lifter Bore Diameter	Standard	23.45-23.47
Lifter Bore Diameter	0.010-inch Oversize	23.70-23.72
Lifter to Bore Clearance		0.040-0.080*

*An oversize lifter can be used to replace a standard lifter, if resulting clearance is as specified.

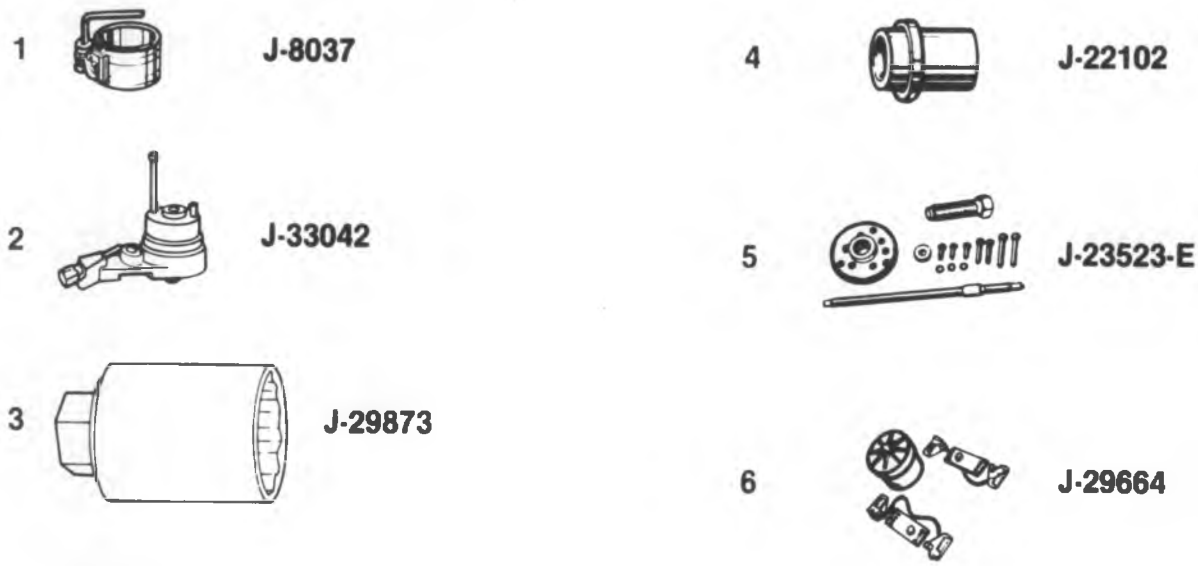
F-05782

SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Water Outlet Bolts/Studs	47	35	—
Water Crossover to Cylinder Head Bolts/Studs	42	31	—
Main Bearing Cap Bolts			
(Inner)	150	110	—
(Outer)	135	100	—
Flywheel Bolts	90	65	—
Connecting Rod Cap Nuts	65	48	—
Camshaft Thrust Plate Bolts	23	17	—
Camshaft Gear Bolt	100	75	—
Front Cover to Block Bolts	45	33	—
Injection Pump Gear Baffle Bolts and Nut	45	33	—
Oil Pump to Bearing Cap Bolt	90	65	—
Oil Pan Bolts			
All except Rear Two Bolts	10.0	—	84
Rear Two Bolts	23	17	—
Injection Pump Gear Bolts	25	20	—
Injection Pump Flange Nuts	40	30	—
Oil Pan Drain Plug	10.0	—	90
Block Drain Plug	22	16	—
Torsional Damper Bolt	270	200	—
Water Pump Plate to Water Pump Bolts	22	16	—
Water Pump to Front Cover Bolts	42	32	—
Water Pump Plate to Front Cover Bolts	22	16	—
Hydraulic Lifter Guide Plate Clamp Bolts	26	18	—
Cylinder Head Bolts — See Text	—	—	—
Rocker Arm Assembly Bolts	55	40	—
Rocker Arm Cover Bolts	22	16	—
Exhaust Manifold Bolts	35	26	—
Glow Plugs	14	10	—
Injection Nozzles	70	50	—
Injection Line Fittings	25	19	—
Intake Manifold Bolts	42	31	—
Vacuum Pump/Oil Pump Drive Clamp Bolt	42	31	—

SPECIAL TOOLS



1. Ring Compressor
2. Timing Fixture
3. Nozzle Socket
4. Seal Installer
5. Torsional Damper Remover
6. Manifold Cover Set

F-05731

SECTION 6C

CARBURETOR AND TBI UNIT

CONTENTS

SECTION 6C1

MODEL 1MEF CARBURETOR

CONTENTS

CARBURETOR IDENTIFICATION

Model Number: 17086101
Applications: Federal (Non-California), and Canada
4.8 Liter L6 engine

The carburetor identification number is stamped vertically on the float bowl, next to the fuel inlet nut (Figure 1). Refer to this number when servicing the carburetor.

Carburetor parts are shown in the disassembled view (Figure 9), and are identified by name on the facing page (Figure 10).

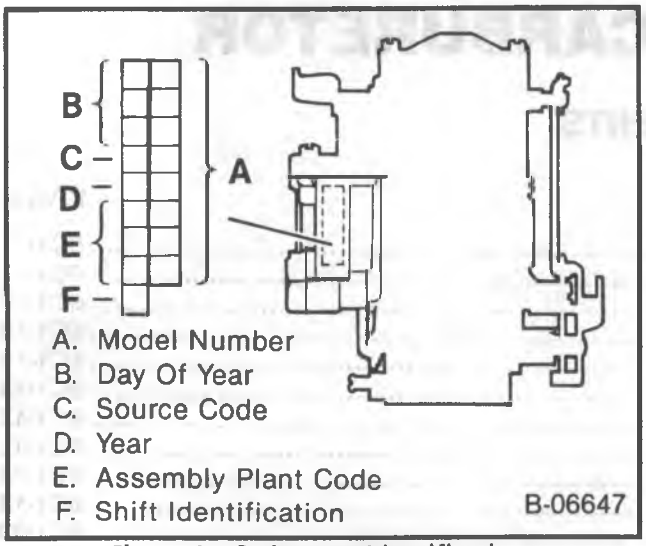


Figure 1 – Carburetor Identification

GENERAL DESCRIPTION

Model 1MEF is a single stage, single barrel carburetor of the "1M" family (Figure 2). Letters following the "1M" designate these features:

E: It has an integral Electric choke.
F: It has adjustable wide open throttle mixture control.

Model 1MEF has three major assemblies: an air horn, a float bowl and a throttle body. It has the six operating systems shown in Figures 3 through 8:

Figure 3	Float	Figure 6	Power
Figure 4	Idle	Figure 7	Pump
Figure 5	Main Metering	Figure 8	Choke

NOTICE: *The factory-set metering rod adjusting screw, located in the air horn (Figure 6), controls the position of the enrichment portion of the metering rod in the jet. Any attempt to readjust this screw could result in engine damage or excessive emissions.*

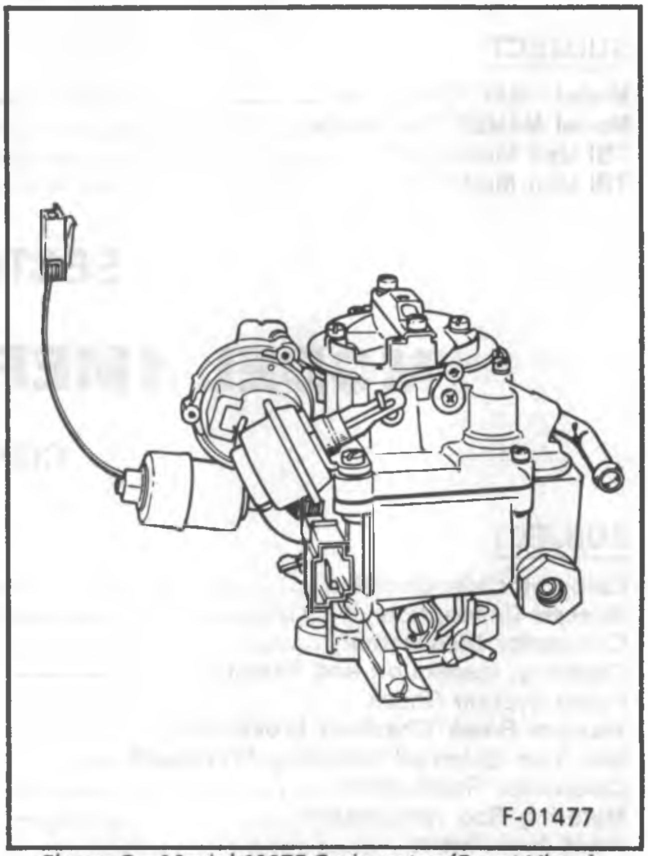


Figure 2 – Model 1MEF Carburetor (Front View)

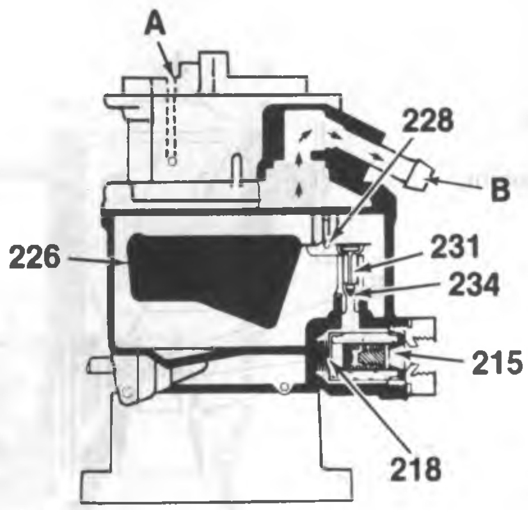
IDLE STOP SOLENOID (ISS)

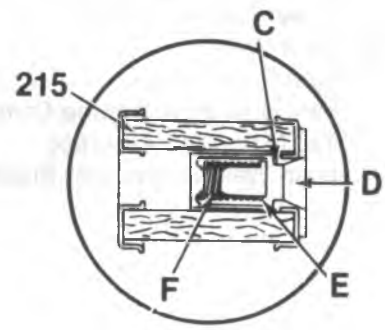
The electric idle stop solenoid (ISS) is used to provide the desired engine idle speed, and to prevent "dieseling" when the ignition is switched off.

UNIT REPAIR

The information that follows applies to a complete overhaul, after the carburetor has been removed from the engine, and includes disassembly, thorough cleaning, inspection and replacement of all gaskets, seals, worn or damaged parts, and adjustment of individual systems.

Refer to the disassembled view (Figure 9), and parts list (Figure 10), for parts identification.



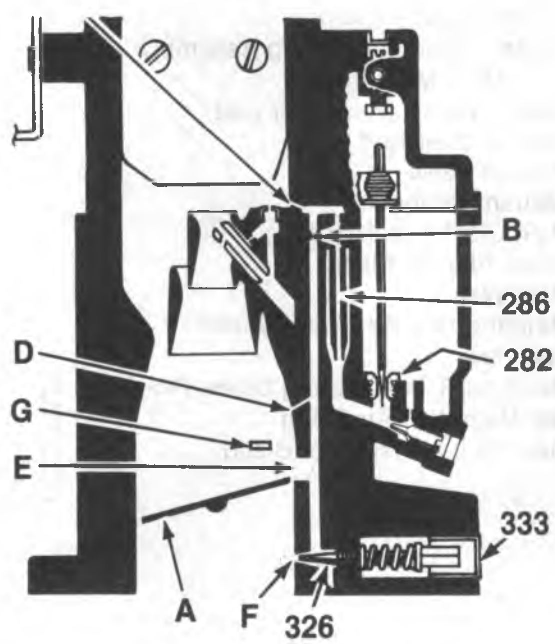


215. Fuel Inlet Filter
218. Fuel Filter Spring
226. Float
228. Float Hinge Pin
231. Float Needle
234. Float Needle Seat

A. Internal Vent
B. Vent Tube to Canister
C. Check Valve Seat
D. Fuel In
E. Check Valve
F. Valve Closing Spring

F-01479

Figure 3 – Float System



282. Jet-Main Metering
286. Idle Tube Assembly
326. Needle-Idle Mixture
333. Plug-Idle Mixture Needle
A. Throttle Valve
B. Idle Channel Restriction
C. Top Idle Air Bleed
D. Lower Idle Air Bleed
E. Off-Idle Port
F. Idle Discharge Orifice
G. Timed Vacuum Port

B-06642

Figure 4 – Idle System

266. Rod - Power Piston
274. Power Valve Piston Assembly
276. Spring - Power Piston
279. Metering Rod and Spring Assembly
282. Jet - Main Metering
A. Throttle Valve
B. Vacuum Channel
C. Main Venturi
D. Boost Venturi
E. Main Discharge Nozzle
F. Lower Idle Air Bleed
G. Main Well
H. Fuel Feed Orifice
I. Part Throttle Adjusting Screw
J. Top Main Well Air Bleed
K. Main Well to Aspirator Bleed

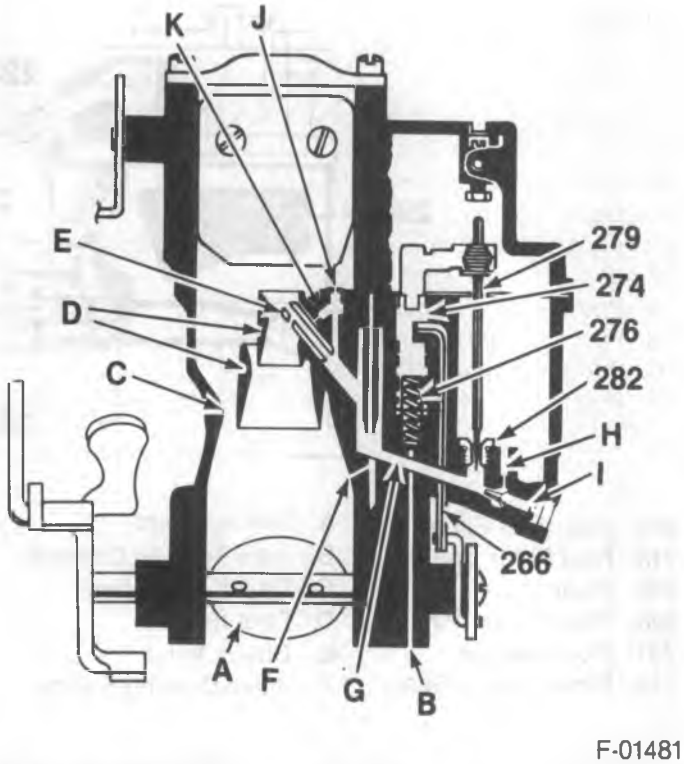


Figure 5 – Main Metering System

266. Rod - Power Piston
274. Power Valve Piston Assembly
276. Spring - Power Piston
279. Metering Rod and Spring Assembly
282. Jet - Main Metering
310. Lever - Pump and Power Rod
314. Link - Power Rod
A. Throttle Valve
B. Vacuum Channel
C. Main Discharge Nozzle
D. Lower Idle Air Bleed
E. Main Well
F. Metering Rod Adjusting Screw
G. Setscrew
H. Metering Rod Adjusting Screw Plug
I. Top Main Well Air Bleed
J. Main Well to Aspirator Bleed

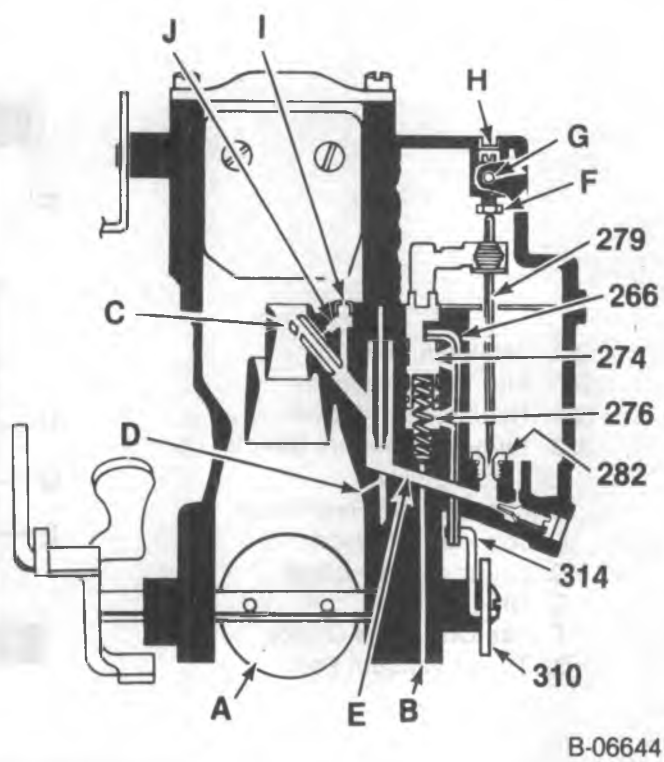
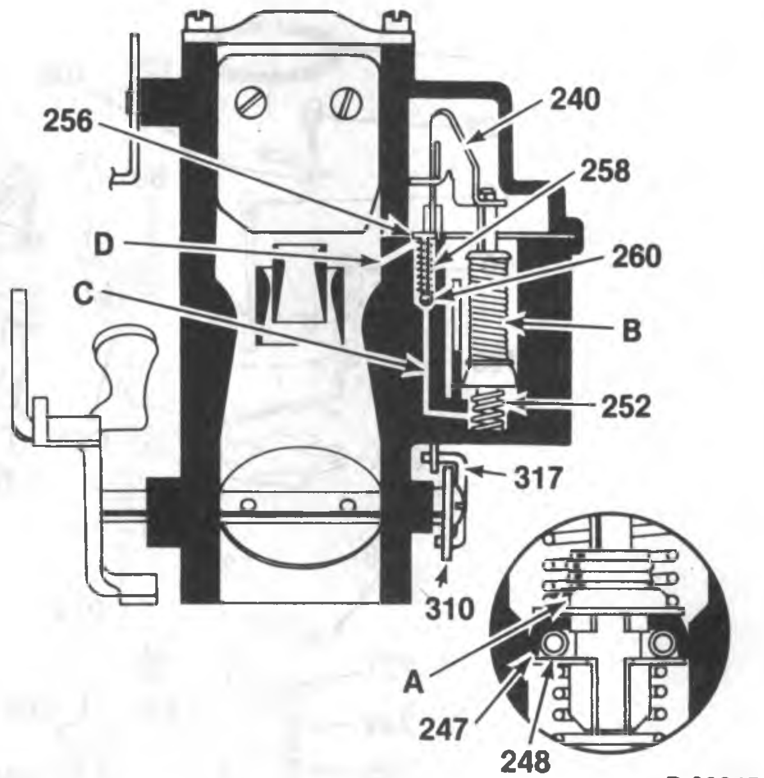


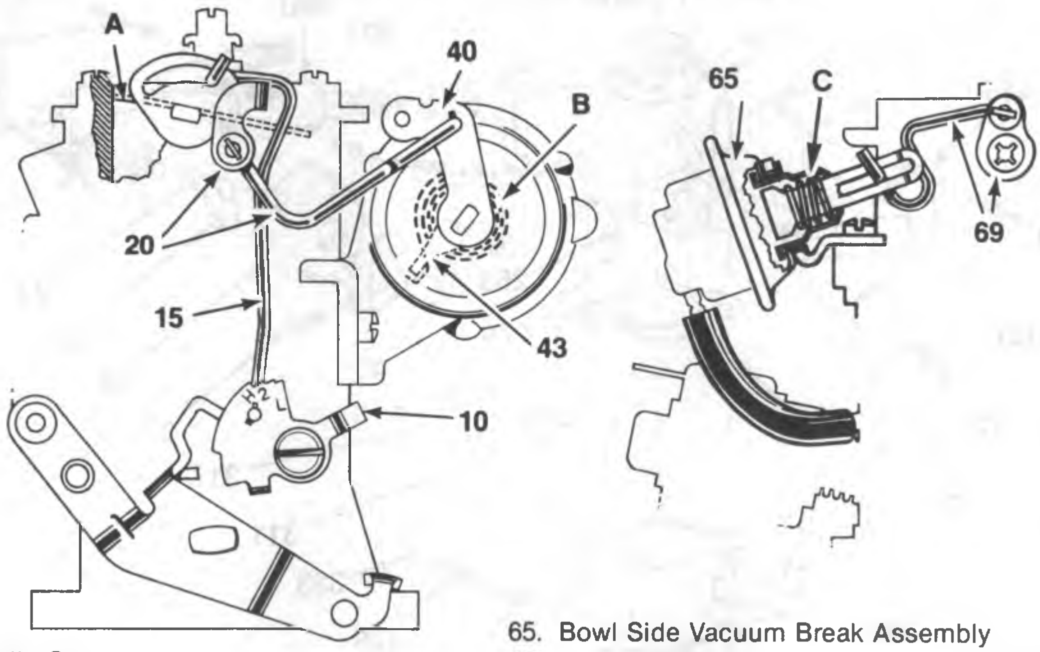
Figure 6 – Power System

240. Rod - Pump
247. Cup - Pump Plunger
248. Spring - Pump Plunger
252. Spring - Pump Return
256. Guide - Pump Discharge Spring
258. Spring - Pump Discharge Ball
260. Ball - Pump Discharge
310. Lever - Pump and Power Rod
317. Link - Pump
A. Pump Plunger Head
B. Pump Duration Spring
C. Pump Discharge Channel
D. Pump Jet



B-06645

Figure 7 – Pump System



10. Fast Idle Cam
15. Fast Idle Cam Link
20. Choke Shaft, Lever and Link Assembly
40. Choke Shaft and Lever Assembly
43. Choke Stat Lever

65. Bowl Side Vacuum Break Assembly
69. Vacuum Break Lever and Link Assembly
A. Choke Valve
B. Thermostatic Coil
C. Plunger Bucking Spring (not used on all models)

F-01482

Figure 8 – Choke System - Electric

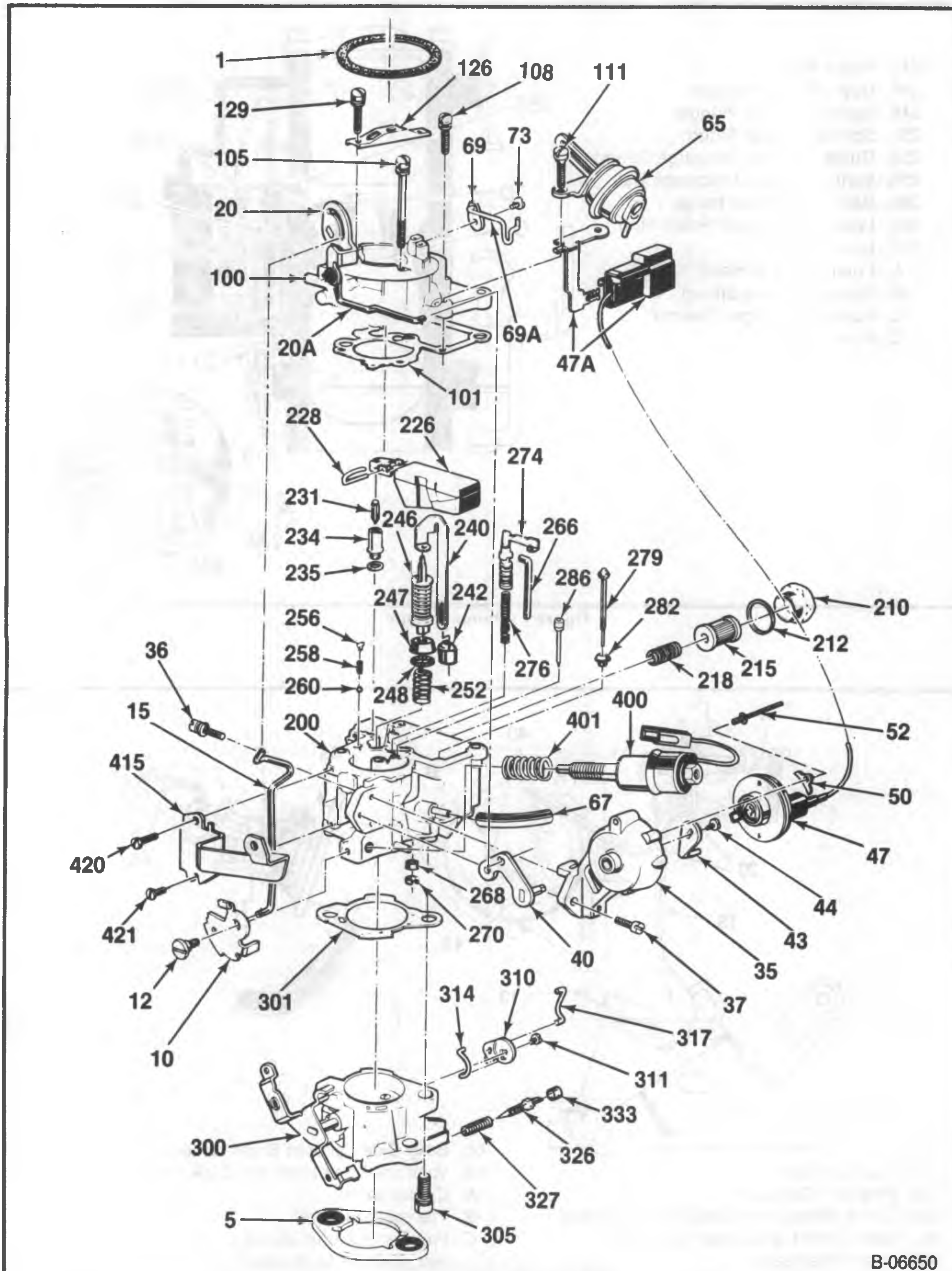


Figure 9 – Monojet - Model 1MEF

MODEL 1MEF CARBURETOR

Parts Identification

1	GASKET - AIR CLEANER	228	HINGE PIN - FLOAT
5	GASKET - FLANGE	231	NEEDLE - FLOAT
10	CAM - FAST IDLE	234	SEAT - FLOAT NEEDLE
12	SCREW - FAST IDLE CAM ATTACHING	235	GASKET - FLOAT NEEDLE SEAT
15	LINK - FAST IDLE CAM	240	ROD - PUMP
20	CHOKE SHAFT, LEVER AND LINK ASSEMBLY	242	SEAL - PUMP ROD
20A	LINK - CHOKE	246	PUMP ASSEMBLY
35	CHOKE HOUSING AND BEARING ASSEMBLY	247	CUP - PUMP PLUNGER
36	SCREW ASSEMBLY - CHOKE HOUSING ATTACHING	248	SPRING - PUMP PLUNGER
37	SCREW - CHOKE HOUSING ATTACHING	252	SPRING - PUMP RETURN
40	CHOKE SHAFT AND LEVER ASSEMBLY	256	GUIDE - PUMP DISCHARGE SPRING
43	LEVER - CHOKE STAT	258	SPRING - PUMP DISCHARGE BALL
44	SCREW - STAT LEVER ATTACHING	260	BALL - PUMP DISCHARGE
47	ELECTRIC CHOKE COVER AND STAT ASSEMBLY	266	ROD - POWER PISTON
47A	CONNECTOR AND BRACKET ASSEMBLY	268	SEAL - POWER PISTON ROD
50	RETAINER - CHOKE COVER	270	RETAINER - POWER PISTON ROD SEAL
52	RIVET - CHOKE COVER ATTACHING	274	POWER VALVE PISTON ASSEMBLY
65	VACUUM BREAK ASSEMBLY - BOWL SIDE	276	SPRING - POWER PISTON
67	HOSE - VACUUM BREAK	279	METERING ROD AND SPRING ASSEMBLY
69	VACUUM BREAK LEVER & LINK ASSEMBLY	282	JET - MAIN METERING
69A	LINK - VACUUM BREAK	286	IDLE TUBE ASSEMBLY
73	SCREW - LEVER ATTACHING	300	THROTTLE BODY ASSEMBLY
100	AIR HORN ASSEMBLY	301	GASKET - FLOAT BOWL TO THROTTLE BODY
101	GASKET - AIR HORN TO FLOAT BOWL	305	SCREW ASSEMBLY - FLOAT BOWL TO THROTTLE BODY
105	SCREW ASSEMBLY - AIR HORN TO FLOAT BOWL (LONG)	310	LEVER - PUMP AND POWER ROD
108	SCREW ASSEMBLY - AIR HORN TO FLOAT BOWL	311	SCREW - PUMP LEVER ATTACHING
111	SCREW - AIR HORN TO FLOAT BOWL (COUNTERSUNK)	314	LINK - POWER ROD
126	BRACKET - AIR CLEANER	317	LINK - PUMP
129	SCREW ASSEMBLY - AIR CLEANER BRACKET ATTACHING	326	NEEDLE - IDLE MIXTURE
		327	SPRING - IDLE MIXTURE NEEDLE
200	FLOAT BOWL ASSEMBLY	332	LIMITER - IDLE MIXTURE NEEDLE
210	NUT - FUEL INLET	333	PLUG - IDLE MIXTURE NEEDLE
212	GASKET - FUEL INLET NUT	400	SOLENOID - IDLE STOP
215	FILTER - FUEL INLET	401	SPRING - IDLE STOP SOLENOID
218	SPRING - FUEL FILTER	415	BRACKET - THROTTLE RETURN SPRING ANCHOR
226	FLOAT	420	SCREW - BRACKET ATTACHING (COUNTERSUNK)
		421	SCREW - BRACKET ATTACHING

B-06651

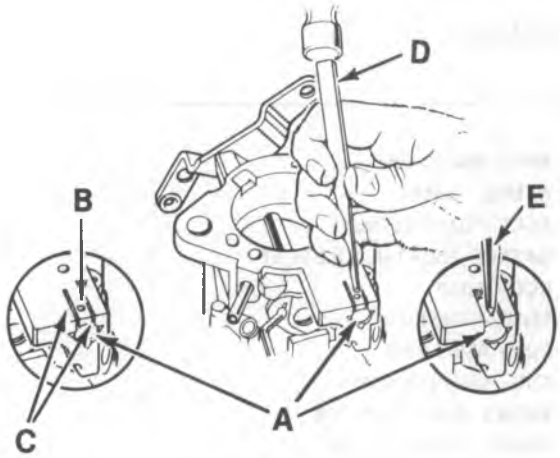
Figure 10 – Monojet - Model 1MEF

CARBURETOR DISASSEMBLY

IDLE MIXTURE NEEDLE PLUG

Remove or Disconnect (Figure 11)

1. Invert carburetor, and support it, to avoid damaging external components.
2. Make two parallel hacksaw cuts (C) in the throttle body, one on each side of the locator point (B) above idle mixture needle plug (333).
   - Cut down to the plug, but not more than 1/8" beyond the locator point.
3. Place a flat punch (D) at a point near the ends of the saw marks. Hold the punch at a 45° angle, and drive it into the throttle body to break casting away, to expose the plug.



A. Idle Mixture Needle Plug
B. Locator Point
C. Hacksaw Slots
D. Flat Punch
E. Center Punch

B-06652

Figure 11 – Removing Idle Mixture Needle Plug

4. Use center punch (E) to break plug apart, to uncover idle mixture needle.

5. Remove all loose pieces of plug.

FUEL INLET NUT AND FILTER

- Support carburetor to avoid damaging external components.

Remove or Disconnect (Figure 12)

1. Fuel inlet nut (210).

2. Fuel inlet filter (215), inlet nut gasket (212), and filter spring (218).
   - Discard gasket.

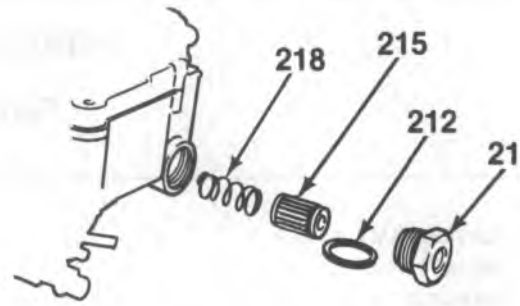
Inspect

- Cut filter open. If clogged, check tank(s) and fuel lines for source of material.

IDLE STOP SOLENOID

Remove or Disconnect (Figures 9, 10)

- Idle stop solenoid (400), and idle stop solenoid spring (401).
  - Use 9/16" socket or hex wrench on end of of solenoid body.



210. Fuel Inlet Nut
212. Fuel Inlet Nut Gasket
215. Fuel Inlet Filter
218. Fuel Filter Spring

F-01483

Figure 12 – Fuel Inlet Nut and Filter

THROTTLE RETURN SPRING BRACKET

Remove or Disconnect (Figures 9, 10)

1. Loosen bracket attaching screw (421)(bottom).

2. Remove bracket attaching screws (420) and throttle return spring anchor bracket (415).

CHOKE COMPONENTS

Vacuum Break Assembly

Remove or Disconnect (Figure 13)

1. Vacuum break hose (67).

2. Air horn to float bowl (vacuum break attaching) screws (111) and bowl side vacuum break assembly (65).
   - Disconnect vacuum break from vacuum break link (69A).
   - Allow choke wire connector bracket assembly (47A) to hang freely.

Choke Housing

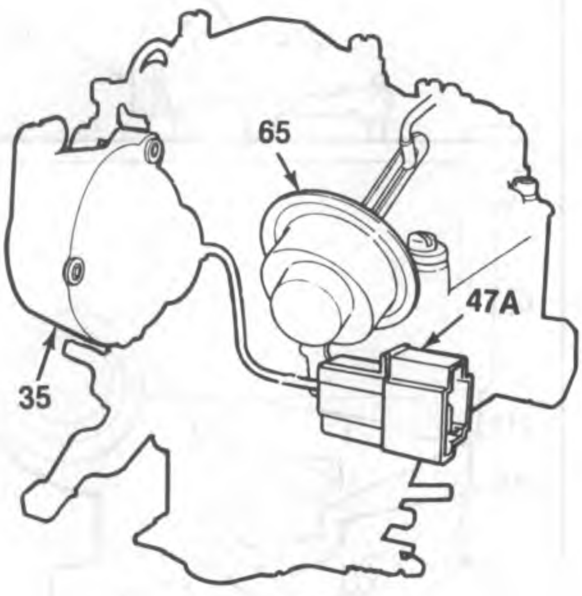
Remove or Disconnect (Figure 14)

- Choke housing attaching screws (36, 37), and choke housing and bearing assembly (35).
  - Disconnect choke housing from choke link (20A).

Fast Idle Cam and Link

Remove or Disconnect (Figure 15)

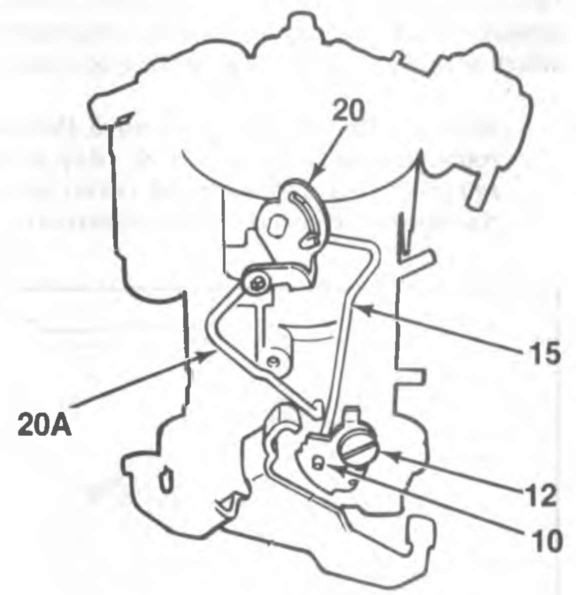
- Fast idle cam attaching screw (12), cam (10) and cam link (15).
  - Disconnect fast idle cam link from choke shaft lever (20).



35. Choke Housing and Bearing Assembly
47A Connector and Bracket Assembly
65. Bowl Side Vacuum Break Assembly

F-01484

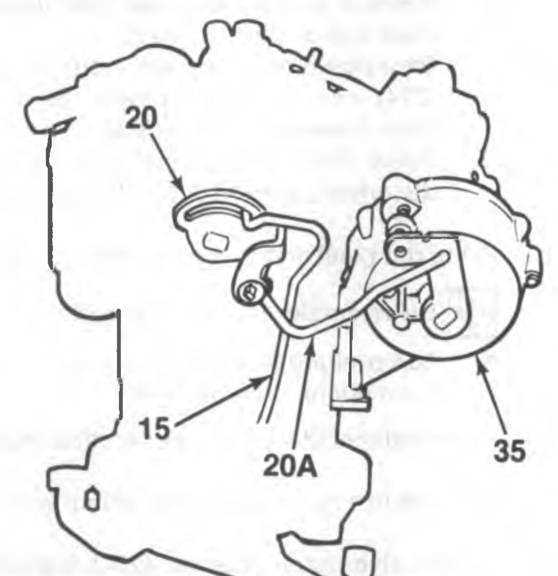
Figure 13 – Choke Components



10. Fast Idle Cam
12. Fast Idle Cam Attaching Screw
15. Fast Idle Cam Link
20. Choke Shaft, Lever and Link Assembly
20A. Choke Link

F-01486

Figure 15 – Fast Idle Cam and Cam Link



15. Fast Idle Cam Link
20. Choke Shaft, Lever and Link Assembly
20A. Choke Link
35. Choke Housing and Bearing Assembly

F-01485

Figure 14 – Choke Housing Assembly

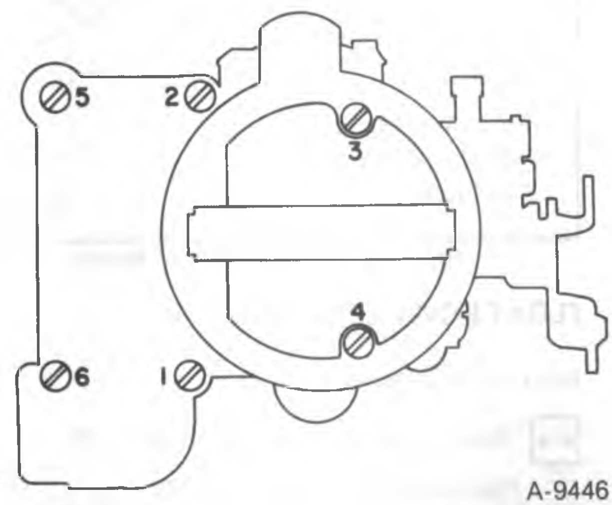


Figure 16 – Air Horn Screw Location and Tightening Sequence

AIR HORN COMPONENTS

↔ Remove or Disconnect (Figure 16)

1. Air horn to float bowl screw assemblies (105, 108).
2. Air horn assembly (100).
3. Air horn to float bowl gasket (101).
   - Discard gasket.

Further disassembly of the air horn is not required. Do not remove the staked choke valve screws, or the vacuum break lever attaching screw, which is installed with thread locking compound.

NOTICE: Do not turn or remove the metering rod adjusting screw (Figure 6). Any attempt to readjust this screw could result in engine damage or increased exhaust emissions.

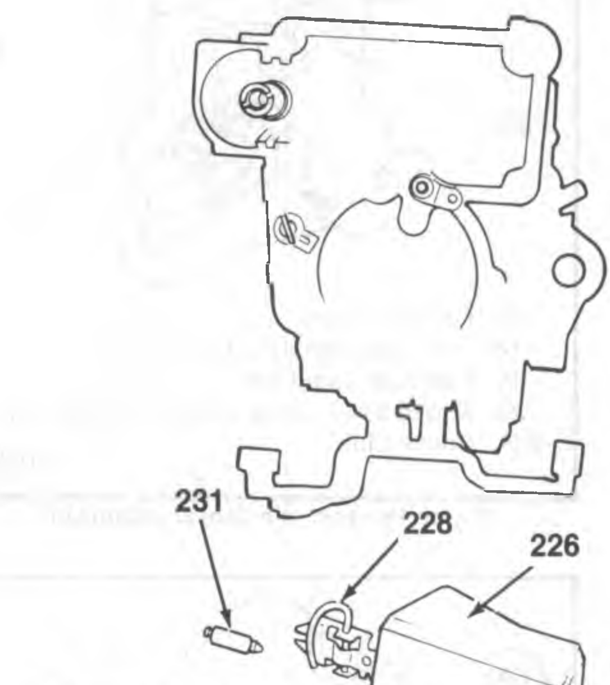


Figure 17 – Float and Float Needle

FLOAT BOWL COMPONENTS

Float and Float Needle

Remove or Disconnect **(Figure 17)**

1. Float (226) and hinge pin (228).
   - Pull up on hinge pin.
2. Float needle (231) from needle seat (234).

Pump and Power Piston

Remove or Disconnect **(Figures 18 - 22)**

1. Pump lever attaching screw (311).
2. Pump and power rod lever (310), power rod link (314), and pump link (317) as follows:
   A. Close throttle.

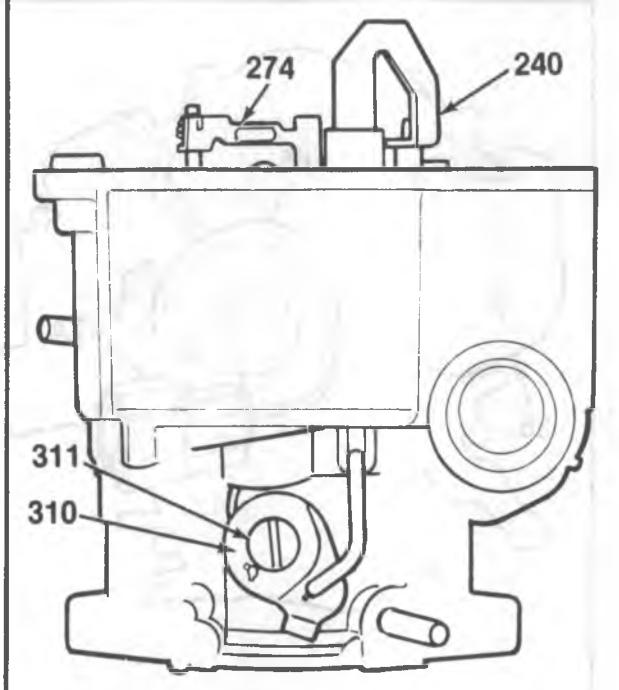


Figure 18 – Pump and Power Rod Lever

   B. Remove pump and power rod lever (310) from end of throttle shaft.
   C. Press down on power valve piston assembly (274), and disconnect power rod link (314) from power piston rod (266).
   D. Press down on pump rod (240), and disconnect pump link (317) from slot in rod.

3. Pump rod (240) and pump assembly (246).

Disassemble **(Figure 21)**

- Pump plunger spring (248) and cup (247) from pump assembly (246).

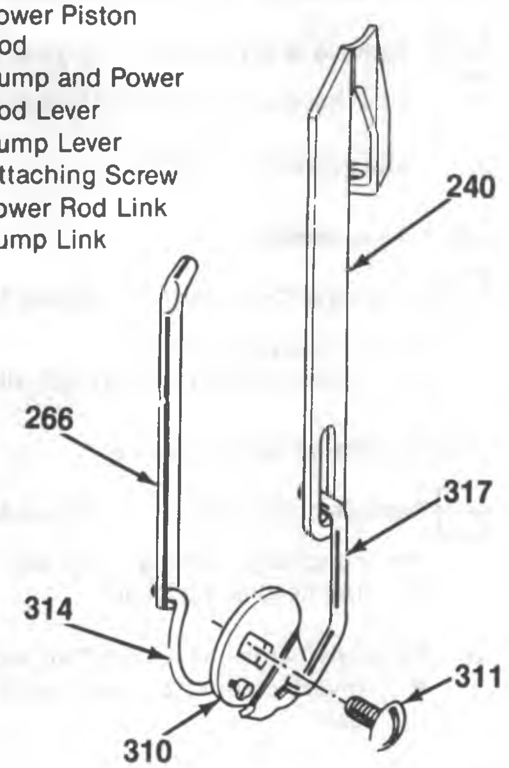
4. Pump rod seal (242) from boss on float bowl.
5. Pump return spring (252) from pump well.
6. Power valve piston assembly (274), metering rod and spring assembly (279), and power piston rod (266).

Disassemble **(Figure 22)**

- Metering rod and spring assembly (279) from metering rod hanger.

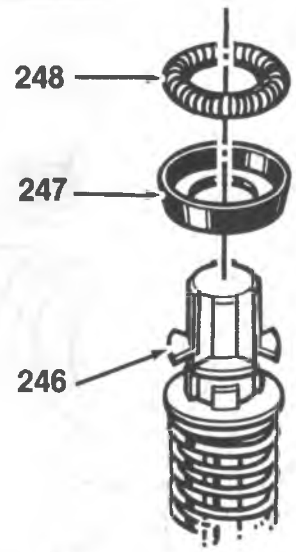
7. Power piston spring (276) from float bowl.

240. Pump Rod
266. Power Piston Rod
310. Pump and Power Rod Lever
311. Pump Lever Attaching Screw
314. Power Rod Link
317. Pump Link



F-01498

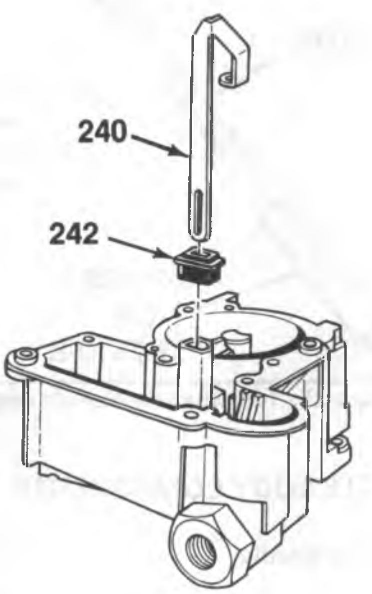
Figure 19 – Pump and Power Piston Linkage



246. Pump Assembly
247. Pump Plunger Cup
248. Pump Plunger Spring

F-04359

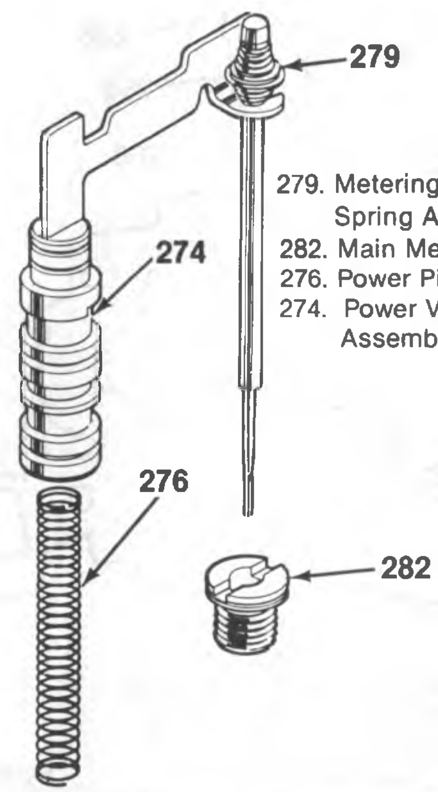
Figure 21 – Pump Plunger Cup and Spring



240. Pump Rod
242. Pump Rod Seal

F-01490

Figure 20 – Pump Rod Seal



279. Metering Rod and Spring Assembly
282. Main Metering Jet
276. Power Piston Spring
274. Power Valve Piston Assembly

F-01491

Figure 22 – Power Piston, Metering Rod and Jet

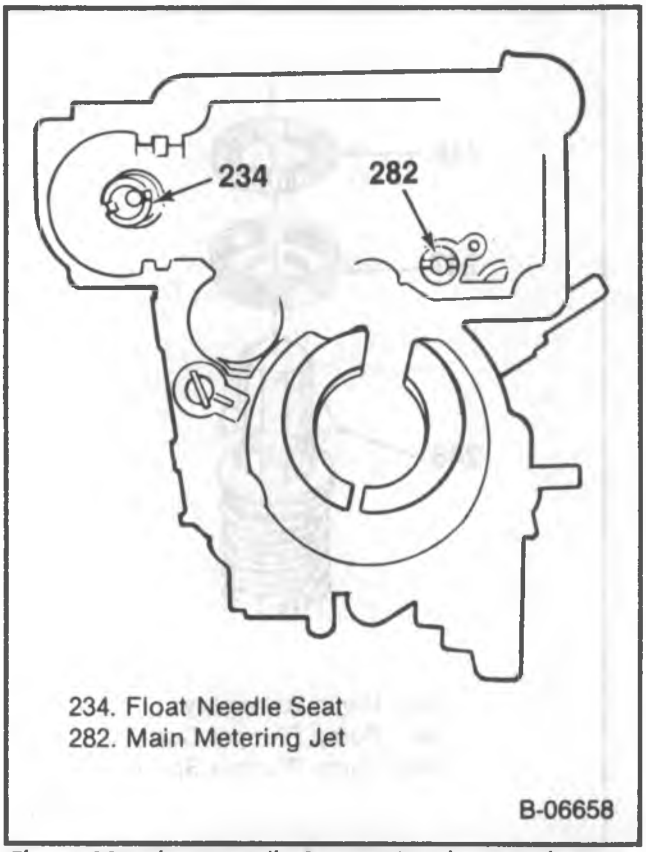


Figure 23 – Float Needle Seat and Main Metering Jet

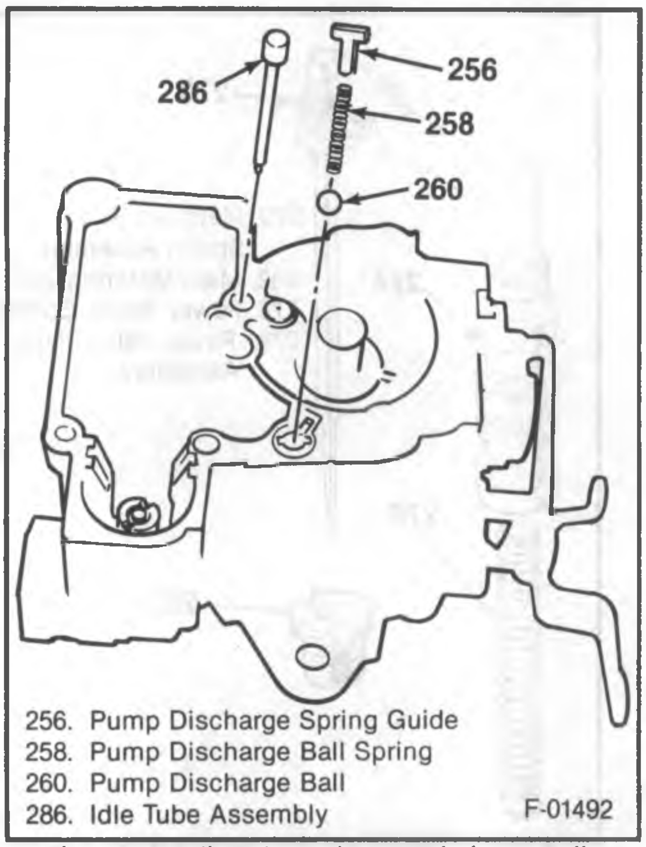


Figure 24 – Idle Tube and Pump Discharge Ball

Float Needle Seat and Main Metering Jet

Remove or Disconnect **(Figures 23, 22)**

1. Float needle seat (234) and seat gasket (235).
2. Main metering jet (282).

Idle Tube Assembly

Remove or Disconnect **(Figure 24)**

- Idle tube assembly (286).
  - Invert carburetor, and catch idle tube.

Pump Discharge Ball and Spring

Remove or Disconnect **(Figure 24)**

1. Pump discharge spring guide (256).
   - Use needle nose pliers.
2. Pump discharge ball spring (258), and ball (260).
   - Invert carburetor, and catch spring and ball.

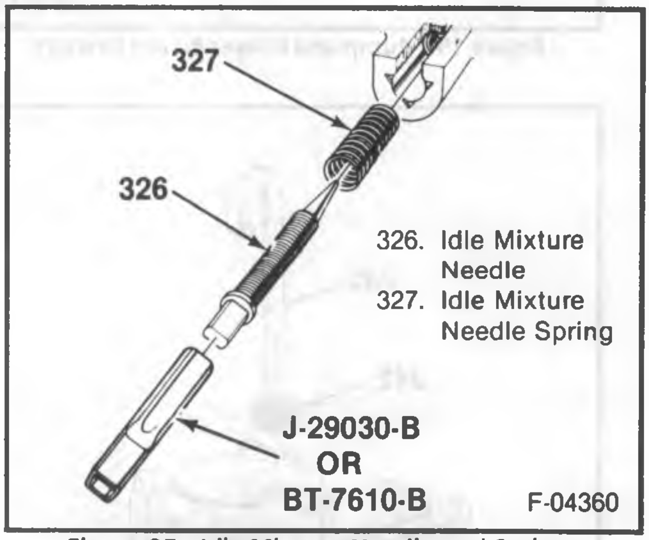


Figure 25 – Idle Mixture Needle and Spring

THROTTLE BODY COMPONENTS

Idle Mixture Needle

Remove or Disconnect **(Figure 25)**

Tool required:

J 29030-B or BT-7610B, Idle Mixture Socket (Adjusting Tool).

- Idle mixture needle (326) and spring (327).
  - Count, and make a record of, number of turns needed to lightly bottom needle, for use in reassembly.

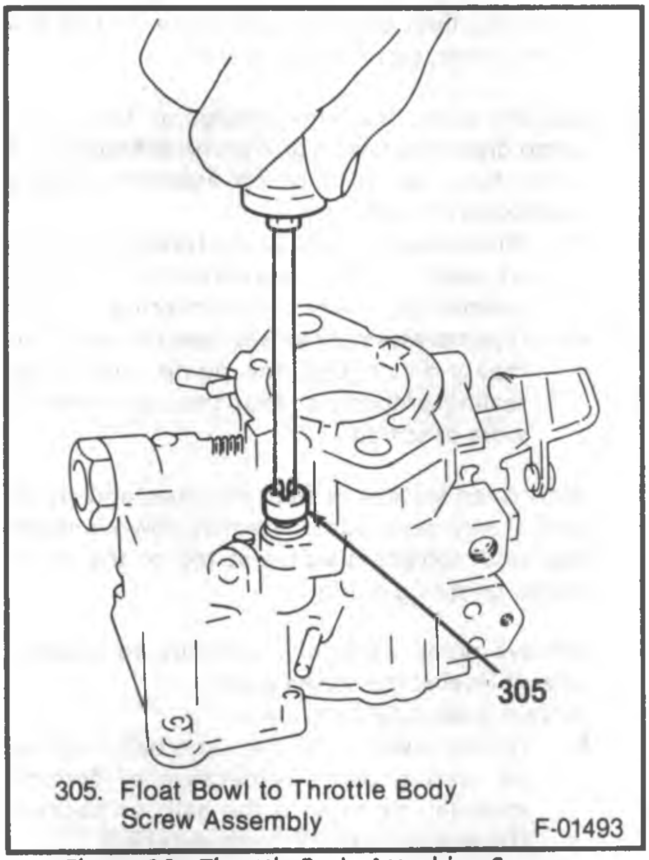


Figure 26 – Throttle Body Attaching Screws

Inspect (Figure 25)

- Idle mixture needle for damaged tip or threads.
  - If damaged, replacement is required.

Throttle Body

- Invert carburetor.

Remove or Disconnect (Figure 26)

1. Float bowl to throttle body screw assemblies (305).
2. Throttle body assembly (300), and float bowl to throttle body gasket (301).

- Do not disassemble throttle body further. The throttle body is serviced as a complete assembly.

POWER PISTON SEAL

- Invert float bowl.

Remove or Disconnect (Figure 27)

1. Power piston rod seal retainer (270).
   - Use small screwdriver or awl.
2. Power piston rod seal (268).

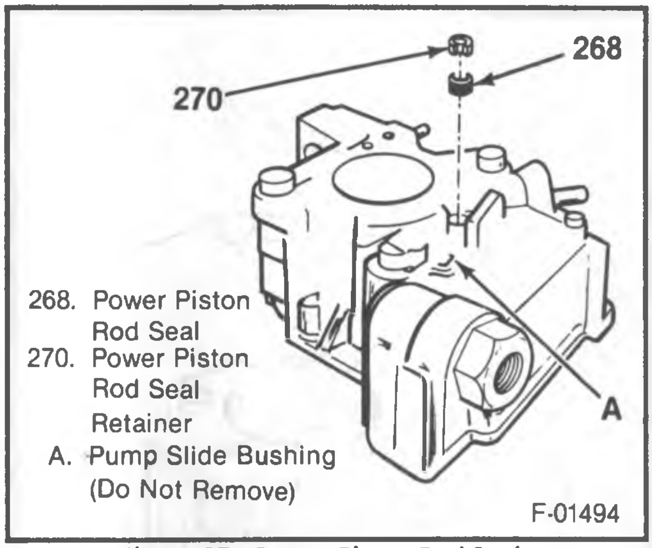


Figure 27 – Power Piston Rod Seal

CLEANING, INSPECTION AND REPAIR

Inspect

- If an excessive amount of foreign material is found in the float bowl, check tank(s) and fuel lines for the source.

Clean (Figure 28)

1. Power piston bore of float bowl.
   - Use 0.375 inch soft wire brush. Turn clockwise through full length of the power piston bore. Turn brush several more turns, to remove dirt and varnish.
2. Metal carburetor parts in cold immersion type cleaner, Carbon X (X-55) or equivalent.

NOTICE: Do not immerse idle stop solenoid, electric choke cover and stat assembly, vacuum break, float, pump plunger, and seals in cleaner, as they may become non-functional, swell, harden or distort.

3. Blow out all passages in the castings with compressed air.
   - Do Not pass drill bits or wire through main metering jet or other passages.

Inspect

Check the following items, and if the condition listed is noted, clean, repair or replace the components.

- Air and fuel passages, and metering parts, for dirt or burrs.
- Mating surfaces of castings, for nicks or damage that would prevent sealing air or fuel.
- Power valve piston assembly for sticking in bore.

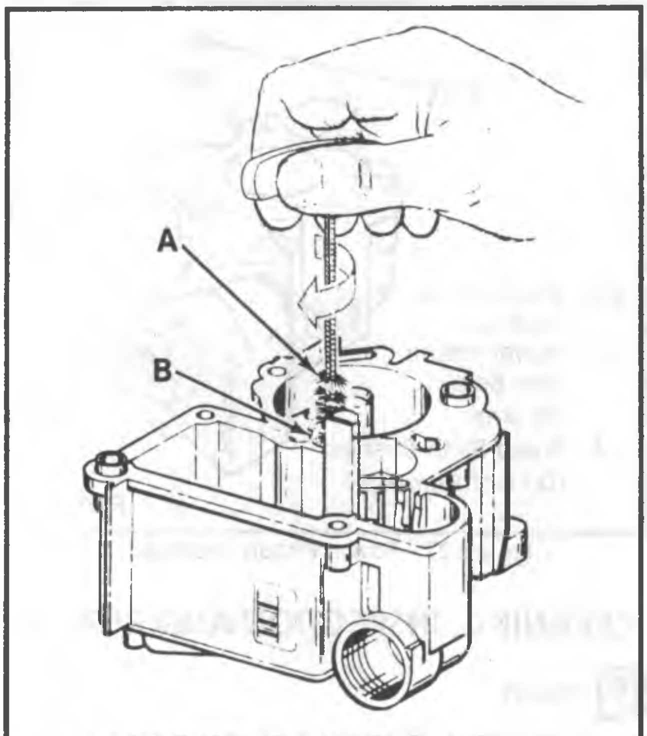


Figure 28 – Cleaning Power Piston Bore

- Power piston spring for being distorted.
- Choke valve for freedom of movement.
- Throttle shaft for freedom of movement. If cleaning does not correct condition, replace throttle body assembly.
- Throttle valve for nicks or damage. If noted, replace throttle body assembly.
- Idle mixture needle for grooves, ridges or bends.
- Levers for looseness on shafts, or wear in holes. If throttle lever is loose, replace throttle body assembly.
- Links for wear or rubbing against other components.
  - Correct cause, and replace if necessary.
- Float, float lever and hinge pin for distortion, binds and burrs.
- The float for being loaded.
  - Check weight of float in comparison with a new float, and replace if heavier.
- Plastic parts for cracks, damage, etc.

PUMP SYSTEM CHECK

Inspect (Figures 21, 24, 7)

- Perform this check with a new pump cup installed on the pump plunger, and with the pump discharge ball, ball spring and spring guide installed.

1. Fill empty float chamber and pump well with a clean solvent, such as mineral spirits.
2. Seal the pump discharge passage on top of the pump discharge spring guide with a finger. Use other hand to push pump assembly slowly downward in pump well.
   - Pump assembly should not travel to bottom of well. Only movement should be compressing of the duration spring.
   - If pump assembly moves down in well, this may indicate that the pump cup is not sealing properly or that the pump well is worn or scored.
3. With clean solvent in float chamber and pump well, slowly move pump assembly down in pump well until solvent is visible at top of the pump discharge spring guide.
4. Remove pump assembly, continue to observe solvent level at the spring guide.
   Solvent level should not lower.
   - If level lowers, the discharge ball may not be seating correctly because of foreign material, damage to the ball, or because the seat for the ball needs restaking.
5. Satisfactory pump system operation requires that these checks be successful. After cleaning or parts replacement, repeat procedure.

VACUUM BREAK CHECKING PROCEDURE

Inspect (Figures 29, 30)

Tool required:
J 23738-A or BT-7517 - Hand Operated Vacuum Pump.

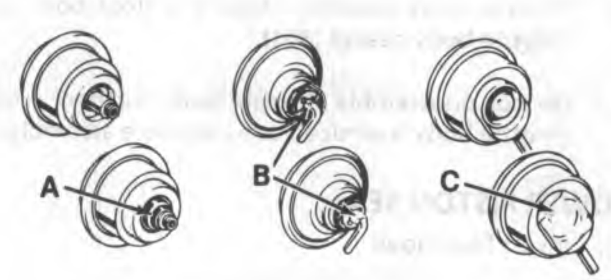


Figure 29 – Vacuum Break Information

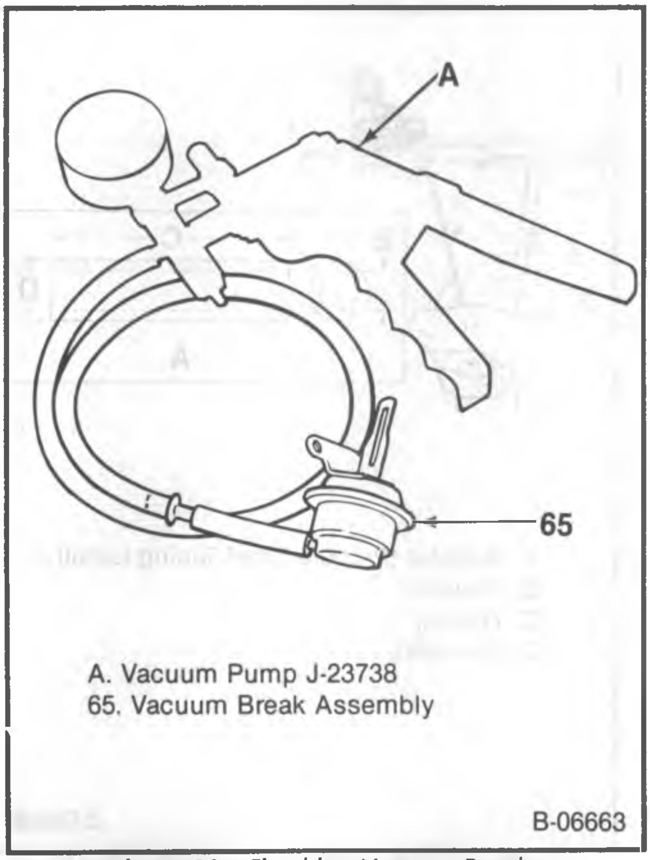


Figure 30 – Checking Vacuum Break

1. If the vacuum break has an air bleed hole, plug it as shown, during this checking procedure.
2. Apply 51kPa (15" Hg) vacuum to the vacuum break.
   - Apply finger pressure to the plunger to see if it has moved through full travel. If not, replace the vacuum break.
   - Observe vacuum gage. Vacuum should hold for at least twenty seconds. If not, replace the vacuum break.
3. Replace vacuum break hose if it is cracked, cut or hardened.

IDLE STOP SOLENOID CHECKING PROCEDURE

Check the idle stop solenoid (400) electrically, using a 12 volt automotive battery.

1. Hold the solenoid plunger in (against the internal stop), using finger pressure.
2. Apply + 12 volts to the terminal and -12 volts to the solenoid body.
3. If the solenoid plunger does not extend when the voltage is applied, replace the solenoid.

ELECTRIC CHOKE COVER AND STAT ASSEMBLY REPLACEMENT

The electric choke cover and stat assembly may be removed for replacement or to access the choke shaft and lever assembly as follows:

Electric Choke Cover and Stat

Remove or Disconnect (Figure 31)

1. Heads of choke cover attaching rivets (52).
   - Use 4 mm (5/32") drill bit.
2. Choke cover retainers (50).
3. Electric choke cover and stat assembly (47).
4. Remaining pieces of rivets in housing.
   - Use punch to drive out.

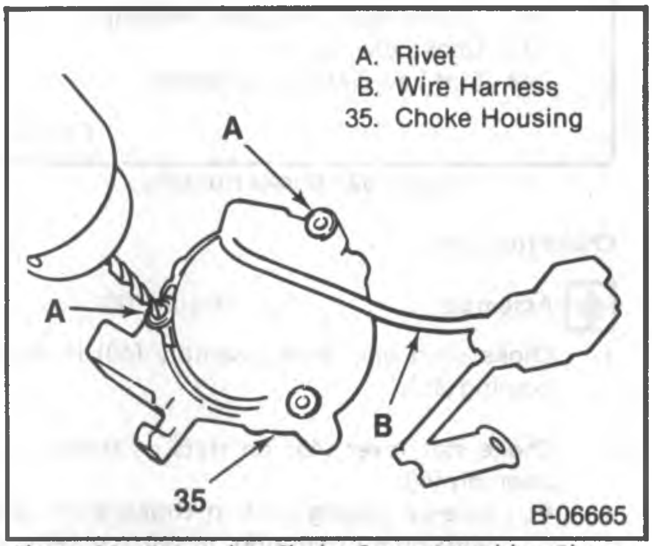


Figure 31 – Removing Choke Cover Attaching Rivets

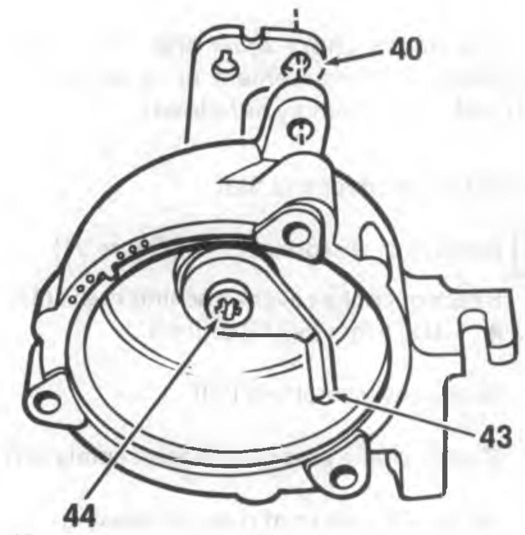
Choke Housing (Disassemble For Cleaning)

Disassemble (Figure 32)

1. Stat lever attaching screw (44).
2. Choke stat lever (43).
3. Choke shaft and lever assembly (40).

Clean

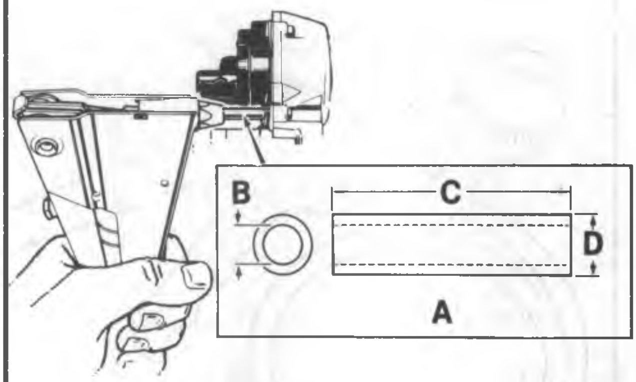
- Choke housing and bearing assembly (35), in cold immersion type cleaner, Carbon X (X-55) or equivalent.



40. Choke Shaft and Lever Assembly
43. Choke Stat Lever
44. Stat Lever Attaching Screw

F-04361

Figure 32 – Choke Housing



A. Adapter (Procure Steel Tubing Locally)
B. (1/8-inch)
C. (1-inch)
D. (3/16-inch)

B-06666

Figure 33 – Installing Choke Cover Attaching Rivets

Choke Housing

Assemble **(Figure 32)**

1. Choke shaft and lever assembly (40) in choke housing (35).

2. Choke stat lever (43) on flats of choke shaft assembly (40).
   - Line-up gaging hole in choke shaft lever with hole in housing, install stat lever on shaft in the four o'clock position.

3. Stat lever attaching screw (44).

Electric Choke Cover and Stat

Install or Connect **(Figures 32, 33)**

1. Electric choke cover and stat assembly (47) in choke housing (35) as follows:
   A. Line up gaging hole in choke shaft lever (40) with hole in housing, install choke cover with stat tang under stat lever.
   B. Rotate choke cover to line-up notch in the cover with the projection on the housing.

2. Choke cover retainers (50) and attaching rivets (52).
   - Use blind rivet tool to install rivets.
   - It may be necessary to use an adapter (tube) if the tool interferes with the electrical connector on the electric choke cover and stat (47).
   - Instructions are included in choke cover retainer kit.

CARBURETOR REASSEMBLY

POWER PISTON ROD SEAL (In Float Bowl)

Install or Connect **(Figure 27)**

1. New power piston rod seal (268) in float bowl.

2. New power piston rod seal retainer (270).
   - Install flush with casting surface.

THROTTLE BODY COMPONENTS

Throttle Body

- Invert float bowl (200).

Install or Connect **(Figure 26)**

1. New float bowl to throttle body gasket (301).
   - Install over locator bosses on float bowl.

2. Throttle body assembly (300).

3. Float bowl to throttle body screw assemblies (305).

Tighten

- Screw assemblies to 20N · m (15 lb.ft.).

Idle Mixture Needle

- Support carburetor.

Install or Connect (Figure 25)

Tool required:
J 29030-B or BT-7610B, Idle Mixture Socket (Adjusting Tool).

- Idle mixture needle (326) and spring (327).
  - Turn needle in to lightly bottom, then back out number of turns counted during disassembly.
  - Final idle mixture adjustment is made on the vehicle. For information on this adjustment procedure, refer to Carburetors (SEC. 6C1) in the 1989 Light Duty Truck Service Manual.

FLOAT BOWL COMPONENTS

If replacing the float bowl assembly, transfer the identification number to the new float bowl at location shown, (Figure 1). Follow the instructions on the envelope included in the service package.

Pump Discharge Ball and Spring

Install or Connect (Figure 24)

1. Pump discharge ball (260).

2. Pump discharge ball spring (258).

3. Pump discharge spring guide (256).
   - Install flush with casting surface.

Idle Tube Assembly

Install or Connect (Figure 24)

- Idle tube assembly (286).
  - Should be flush with casting surface.

Main Metering Jet and Float Needle Seat

Install or Connect (Figures 34, 23)

1. Main metering jet (282).

2. Float needle seat (234) with new gasket (235).

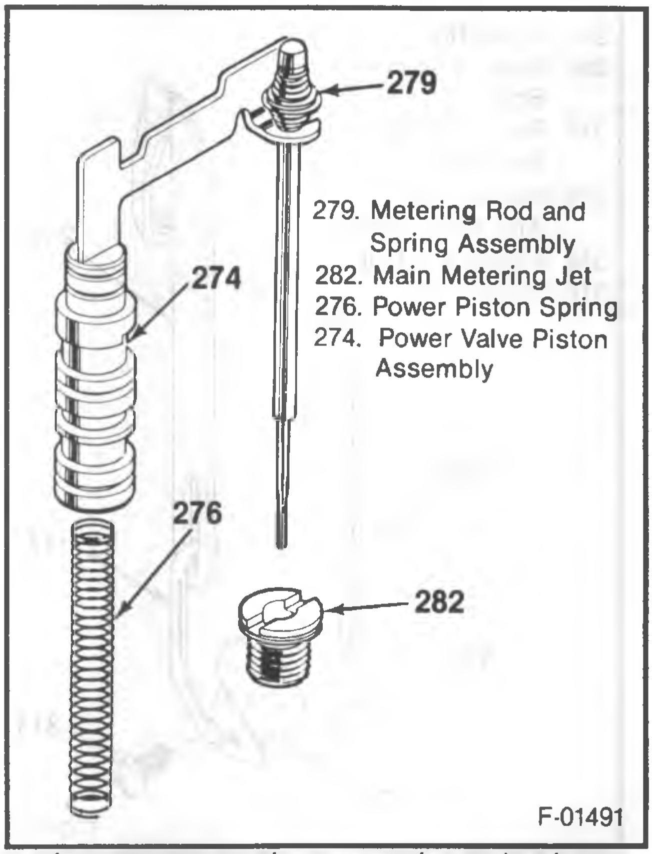


Figure 34 – Power Piston, Metering Rod and Jet

POWER PISTON AND PUMP

Install or Connect (Figures 34, 20, 35)

1. Power piston spring (276) in float bowl.

2. Power piston rod (266) with piston drive end facing away from piston cavity.

3. Power valve piston assembly (274), *without* the metering rod spring assembly (279).
   - Press down on piston and rotate piston rod to engage slot in piston.

   Assemble (Figure 21)

   - Pump assembly (246), with new pump plunger cup (247), and spring (248), (if not installed for pump system check).

4. Pump return spring (252) in pump well.

5. New pump rod seal (242) over boss on float bowl.

6. Pump assembly (246) and pump rod (240).

   Assemble (Figure 35)

   - Pump link (317) and power rod link (314) to pump and power rod lever (310) as shown in Figure 35.

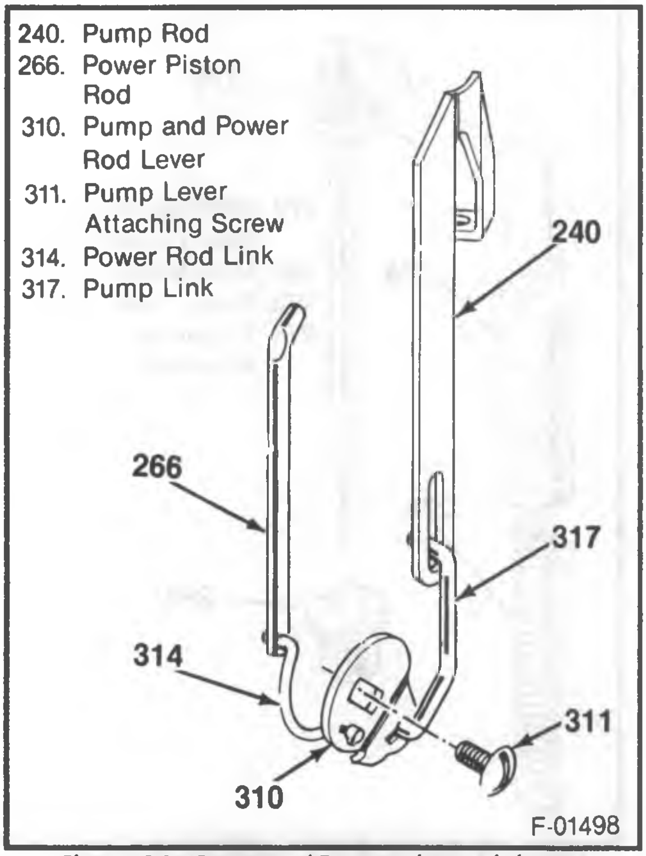


Figure 35 – Pump and Power Piston Linkage

7. Pump and power rod lever and links to carburetor as follows:
   A. Press down on pump rod (240) and connect pump link (317) to pump rod.
   B. Press down on power valve piston assembly (274) and connect power rod link (314) to power piston rod (266).
   C. Close throttle and install pump and power rod lever (310) on flats of throttle shaft.

8. Pump lever attaching screw (311).

METERING ROD ADJUSTMENT

Adjust (Figures 36, 44)

Tool Required:
J 9789-D or BT-3005A, Universal Carburetor Gage Set

- Metering Rod
  - Specification is in Figure 44.
  - Close the throttle valve completely, and press the power valve piston down against its stop.
  - Swing the metering rod hanger over the flat bowl surface next to the carburetor bore.
  - Gage between the end of the metering rod hanger and the top of the casting.

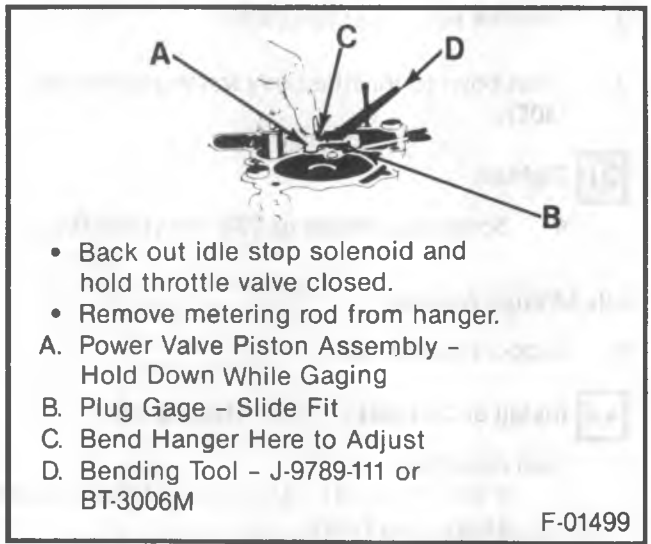


Figure 36 – Metering Rod Adjustment

  - Use the specified plug gage.
  - Gage should have a slide fit.
- If an adjustment is needed, bend at point "C" shown in Figure 36.

9. Install metering rod and spring assembly (279) as follows:
   A. Hold throttle wide open.
   B. Position metering rod in main metering jet, then connect to power piston metering rod hanger, with metering rod spring on *top* of hanger.

FLOAT AND FLOAT NEEDLE

Install or Connect (Figure 17)

1. Float needle (231) in seat (234).
2. Float hinge pin (228) through float lever.
3. Float (226) and hinge pin.

FLOAT ADJUSTMENT

Adjust (Figures 37, 44)

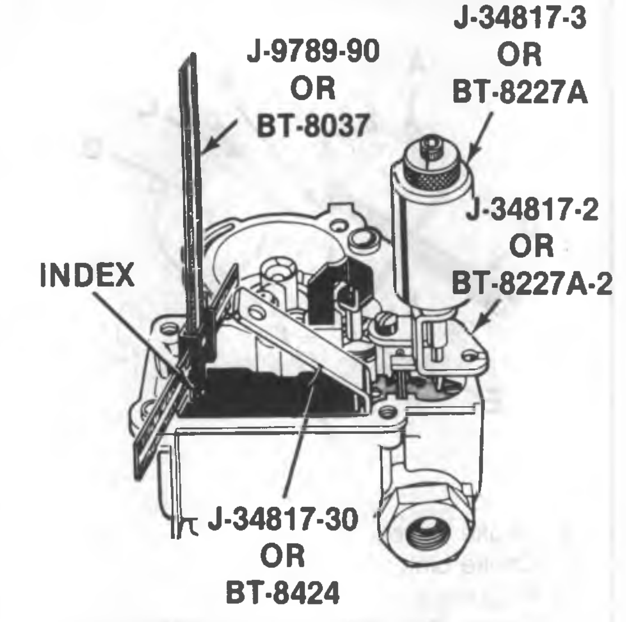
Tool Required:
J 34817-A or BT-8426, Float Positioning Tool Kit

- Float Level.
  - Specification is in Figure 44.

AIR HORN COMPONENTS

Install or Connect (Figure 38)

1. Air horn to float bowl gasket (101).
   - Slit portion over metering rod hanger.
2. Air horn assembly (100).



A. Remove air horn and gasket.
B. Attach J-34817-2 or BT-8227A-2 to float bowl using an air horn attaching screw.
C. Place J-34817-3 or BT-8227A in base with contact pin resting on outer edge of float lever.
D. Measure distance from top of casting to top of Index at toe of float. Use J-9789-90 or BT-8037.
E. If more than ±2/32" from specification, use J-34817-30 or BT-8424 to bend lever up or down. Remove bending tool and measure, repeating until within specification.
F. Check float alignment.
G. Reassemble carburetor. B-06669

Figure 37 – Float Adjustment

3. Long air horn to float bowl screw assemblies (105) at locations #1, 3 and 4, short screw assembly (108) at location #6.
   - Finger tighten only.

CHOKE COMPONENTS

Fast Idle Cam and Link

Install or Connect (Figure 15)

1. Fast idle cam link (15) through slot in choke shaft lever (20).
2. Attach fast idle cam (10) to cam link (15).
   - Unloader tang on cam should face outward.
3. Fast idle cam attaching screw (12).

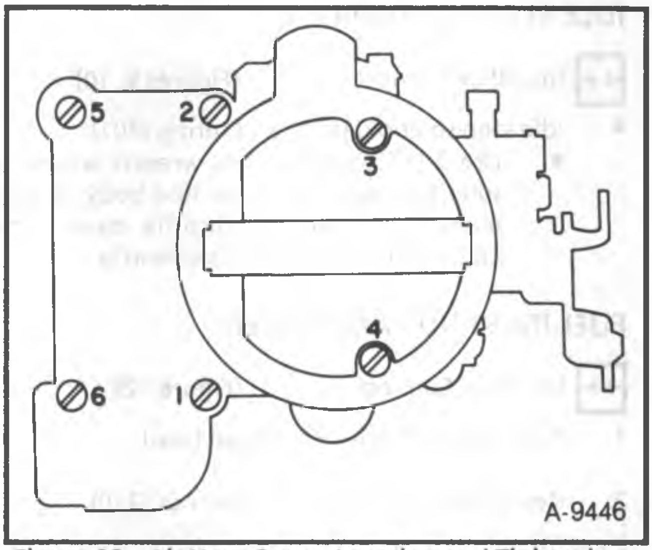


Figure 38 – Air Horn Screw Location and Tightening Sequence

Choke Housing

Install or Connect (Figure 14)

1. Connect choke link (20A) to choke shaft and lever assembly (40), then position choke housing and bearing assembly (35) on float bowl.
   - Choke shaft lever should be facing upward.
2. Install choke housing attaching screws as follows:
   A. Start countersunk attaching screw (37). It is slightly longer than throttle return spring anchor bracket attaching screws (420).
   B. Start attaching screw assemblies (36).
   C. Tighten countersunk screw (37), then tighten screw assemblies (36).

Vacuum Break

Install or Connect (Figures 13, 38)

1. Connect bowl side vacuum break assembly (65) to vacuum break link (69A).
2. Position choke wire connector and bracket assembly (47A) under vacuum break bracket.
3. Install air horn to float bowl (vacuum break attaching) screws (111).
   - Tighten all air horn to float bowl screws (in sequence shown in Figure 38.)

THROTTLE RETURN SPRING BRACKET

Install or Connect (Figures 9, 10)

- Throttle return spring anchor bracket (415) with bracket attaching screws (420, 421).

IDLE STOP SOLENOID

Install or Connect (Figures 9, 10)

- Idle stop solenoid (400) and spring (401).
  - Use 9/16" socket or hex wrench on end of solenoid body. Turn solenoid body in, until plunger just contacts throttle lever. Final adjustment is made on the vehicle.

FUEL INLET NUT AND FILTER

Install or Connect (Figure 12)

1. Fuel filter spring (218), in float bowl.
2. New gasket (212), on fuel inlet nut (210).
3. Inlet nut with new filter (215).

Tighten

- Fuel inlet nut to 45 N · m (33 lb.ft.).

CHOKE ADJUSTMENTS

- Tools required:
  J 9879-D or BT-3005A, Universal Carburetor Gage Set
  J 23738-A or BT-7517, Hand Operated Vacuum Pump
- Specifications are in Figure 44.

CHOKE STAT LEVER ADJUSTMENT

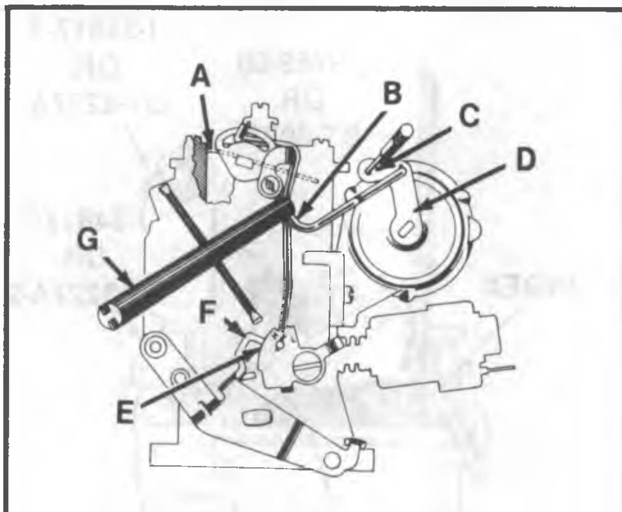
Adjust (Figure 39)

- Place the fast idle cam follower on the highest step of the fast idle cam.
- Hold the choke valve completely closed.
- Insert a 3 mm (0.120 inch) plug gage through the hole in the lever, into hole in the choke housing.
- If gage does not pass freely through both holes, bend choke link at point shown in Figure 39 to align the holes.

CHOKE LINK (FAST IDLE CAM) ADJUSTMENT

Adjust (Figures 40, 44)

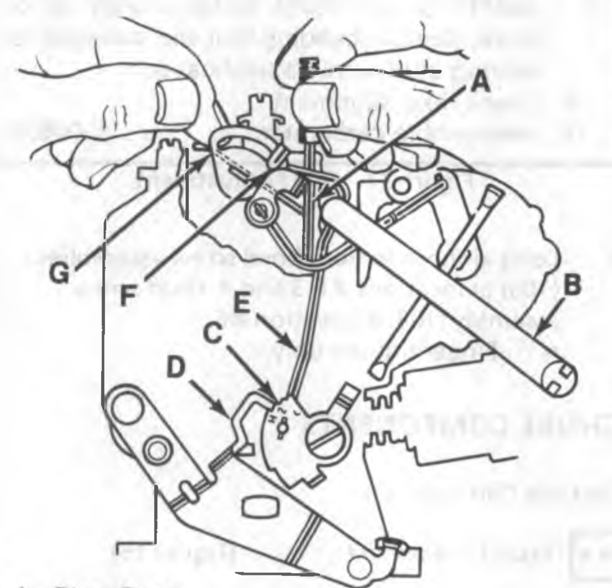
- Position the fast idle cam follower on the second step of the fast idle cam against the rise of the high step.
- Hold down on the choke valve with the fast idle cam link in the end of the choke lever slot.
- Check the gap between the lower edge of the choke valve and the air horn wall.
- If an adjustment is needed, bend the fast idle cam link at the point shown in Figure 40.



A. Choke Valve
B. Choke Link
C. Plug Gage
D. Choke Shaft and Lever Assembly
E. Fast Idle Cam
F. Fast Idle Cam Follower
G. Bending Tool J-9789-111 or BT-3006M

F-01501

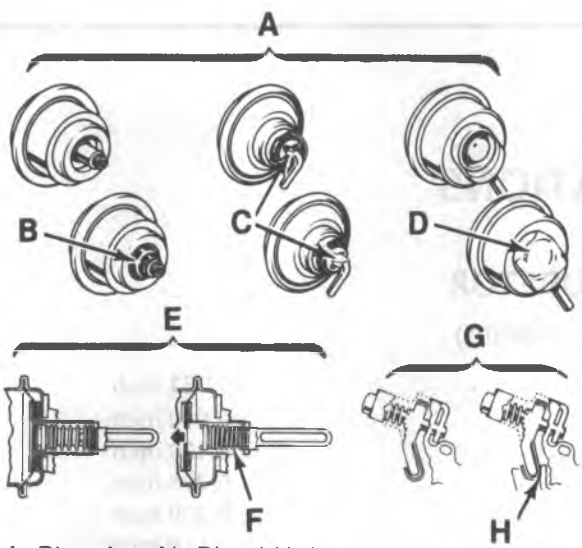
Figure 39 – Choke Stat Lever Adjustment



A. Plug Gage
B. Bending Tool J-9789-111 or BT-3006M
C. Fast Idle Cam (on second step)
D. Fast Idle Cam Follower
E. Fast Idle Cam Link
F. Choke Shaft, Lever and Link Assembly
G. Choke Valve

F-01502

Figure 40 – Choke Link (Fast Idle Cam) Adjustment



A. Plugging Air Bleed Holes
B. Pump Cup or Valve Stem Seal
C. Tape Hole in Tube
D. Tape End of Cover
E. Plunger Bucking Spring
F. Plunger Stem Extended (Spring Compressed)
G. Leaf Type Bucking Spring
H. Spring Seated

B-06662

Figure 41 – Vacuum Break Adjustment Information

VACUUM BREAK ADJUSTMENT

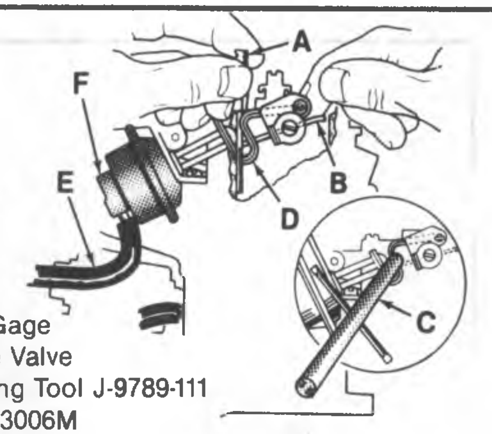
Adjust (Figures 41, 42, 44)

- Place the fast idle cam follower on the highest step of the cam.
- If vacuum break has a bleed orifice (hole), plug it as shown, during the adjustment.
- Apply 51kPa (15" Hg) vacuum to the vacuum break. Push down on the choke valve. (Compress the plunger bucking spring and seat the plunger stem.)
- Check the gap between the lower edge of the choke valve and the air horn wall.
- If an adjustment is needed, bend the vacuum break link at the point shown in inset, Figure 42.
- Release the vacuum source and apply it again.
- Check the gap once more, and adjust as needed.

CHOKE UNLOADER ADJUSTMENT

Adjust (Figures 43, 44)

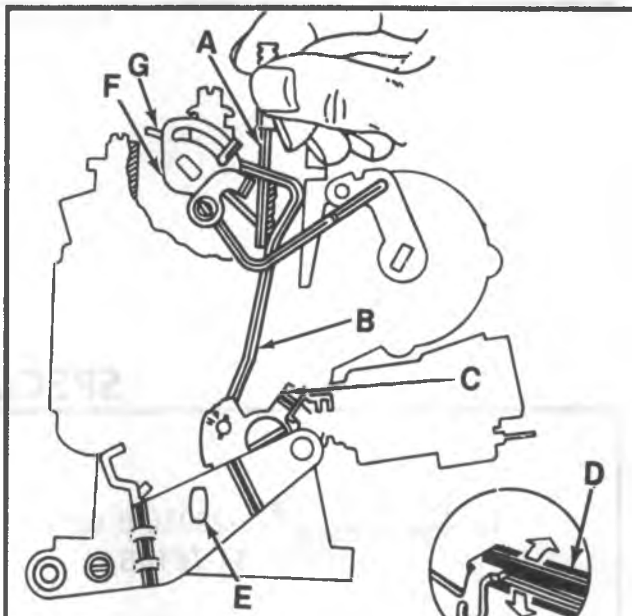
- Hold the throttle lever in the wide open throttle position.
- Hold down on the choke valve with the fast idle cam link in the end of the choke lever slot.
- Check the gap between the lower edge of the choke valve and the air horn wall.
- If adjustment is needed, bend the unloader tang on throttle lever as shown in inset of Figure 43.



A. Plug Gage
B. Choke Valve
C. Bending Tool J-9789-111 or BT-3006M
D. Vacuum Break Link
E. Vacuum Hose
F. Vacuum Break Assembly

F-04362

Figure 42 – Vacuum Break Adjustment



A. Plug Gage
B. Fast Idle Cam Link
C. Unloader Tang
D. Bending Tool – J-9789-111 or BT-3006M
E. Throttle Lever
F. Choke Shaft, Lever and Link Assembly
G. Choke Valve

F-01504

Figure 43 – Unloader Adjustment

CARBURETOR INSTALLATION AND ON-VEHICLE ADJUSTMENTS

Refer to Carburetors (SEC. 6C1) in the 1989 Light Duty Truck Service Manual for the remaining procedures:

- Carburetor Installation
- Idle Mixture Adjustment
- Idle Speed and Fast Idle Adjustment

SPECIFICATIONS

1MEF CARBURETOR

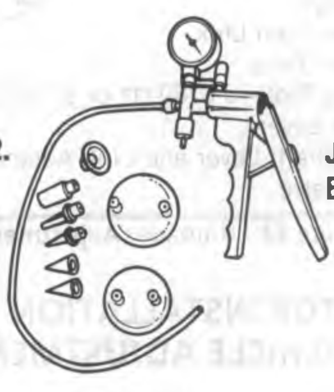
(Model Number 17086101)

Float Level	11/32 inch
Metering Rod	0.090 inch
Choke Stat Lever	0.120 inch
Choke Link - Fast Idle Cam	0.275 inch
Vacuum Break	0.200 inch
Unloader	0.520 inch

Figure 44 – Specifications

SPECIAL TOOLS

1.  J-29030-B or BT-7610B

2.  J-23738-A or BT-7517

3.  J-9789-D or BT-3005A

4.  J-34817-A or BT-8426

1. Idle Mixture Socket (Adjusting Tool)
2. Hand Operated Vacuum Pump
3. Universal Carburetor Gauged Set
4. Float Positioning Tool Set

F-04263

SECTION 6C2

MODEL M4MEF CARBURETOR

CONTENTS

CARBURETOR IDENTIFICATION

The Model M4MEF carburetor is used on the 7.4L V8 engine for vehicles with a Gross Vehicle Weight (GVW) above 10,000 pounds. Listed below are the model identification numbers and additional application information. "Federal" indicates usage in all states *except* California.

MODEL	MODEL NUMBER	APPLICATIONS
M4MEF	17085004	Federal & Canada, with Manual Transmission
M4MEF	17085212	Federal & Canada, with Automatic Transmission

The carburetor model identification number is stamped vertically on the float bowl, near the secondary throttle lever, as shown, (Figure 1). Refer to this part number when servicing the carburetor. If replacing the float bowl assembly, transfer the identification number to the new float bowl. Follow instructions on the envelope included in the service package.

Carburetor parts are shown in the disassembled view (Figure 9) and are identified by name on the facing page (Figure 10).

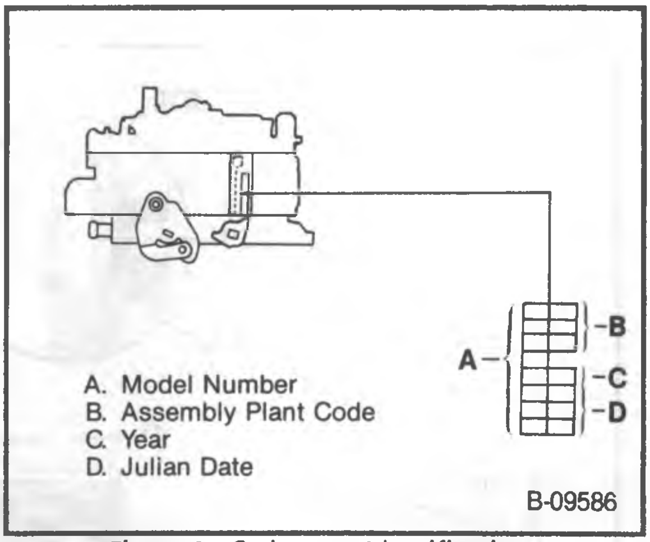


Figure 1 – Carburetor Identification

GENERAL DESCRIPTION

The letters and number in the model name M4MEF describe specific features of the carburetor:

- **M:** It has a **Modified** open-loop primary metering system.
- **4M:** A member of the **Quadrajet** (four barrel, two stage) carburetor family.
- **E:** It has an integral **Electric** choke.
- **F:** It has adjustable wide open throttle mixture control.

Model M4MEF is a four barrel, two stage carburetor, with three major sub-assemblies: the air horn, float bowl and throttle body. Each has six basic operating systems, shown in Figures 2 through 7:

- FLOAT
- IDLE
- MAIN METERING
- POWER
- PUMP
- CHOKE

Important

The part throttle adjusting screw was set at the factory and then plugged. Any attempt to readjust this screw could result in increased exhaust emissions.

NOTICE: The rich stop adjusting bushing and the secondary well bleed adjusting screw (Figure 5) are also factory set. Any attempt to readjust them could result in engine damage or increased exhaust emissions.

IDLE STOP SOLENOID (ISS)

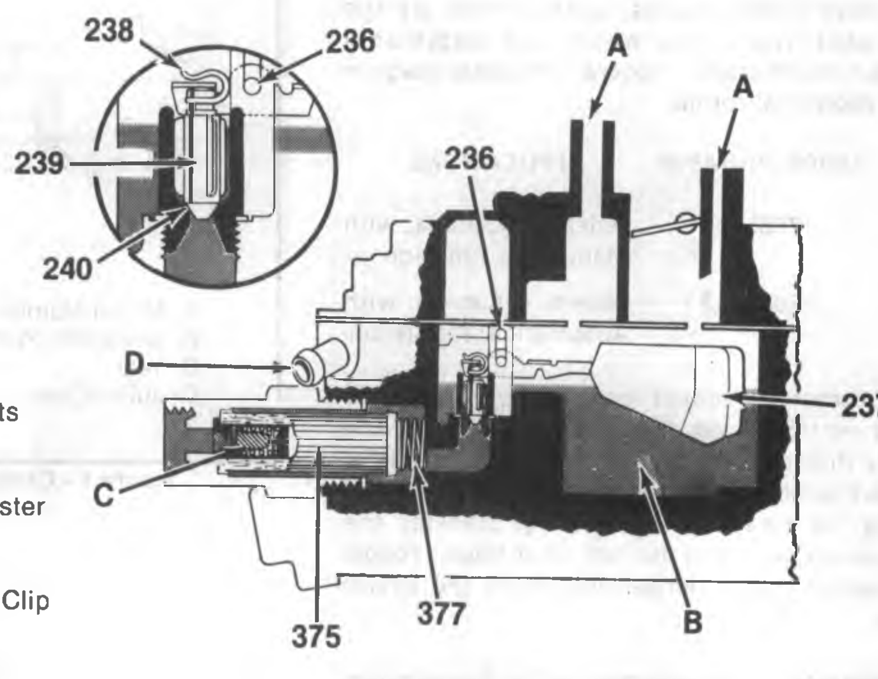
Engines With Manual Transmission.

The electric Idle Stop Solenoid (ISS) found on these applications is used to provide the desired engine idle speed, and to prevent "dieseling" when the ignition is switched off.

UNIT REPAIR

The information that follows applies to a complete overhaul, after the carburetor has been removed from the engine, and includes: disassembly, thorough cleaning, inspection and replacement of all gaskets, seals, worn or damaged parts, and adjustment of individual systems.

Refer to Figures 9 and 10 for parts identification.



A. Internal Bowl Vents
B. Float Chamber
C. Inlet Check Valve
D. Vent Tube to Canister
236. Float Hinge Pin
237. Float
238. Float Needle Pull Clip
239. Float Needle
240. Float Needle Seat
375. Fuel Inlet Filter
377. Fuel Filter Spring

F-01883

Figure 2 – Float System

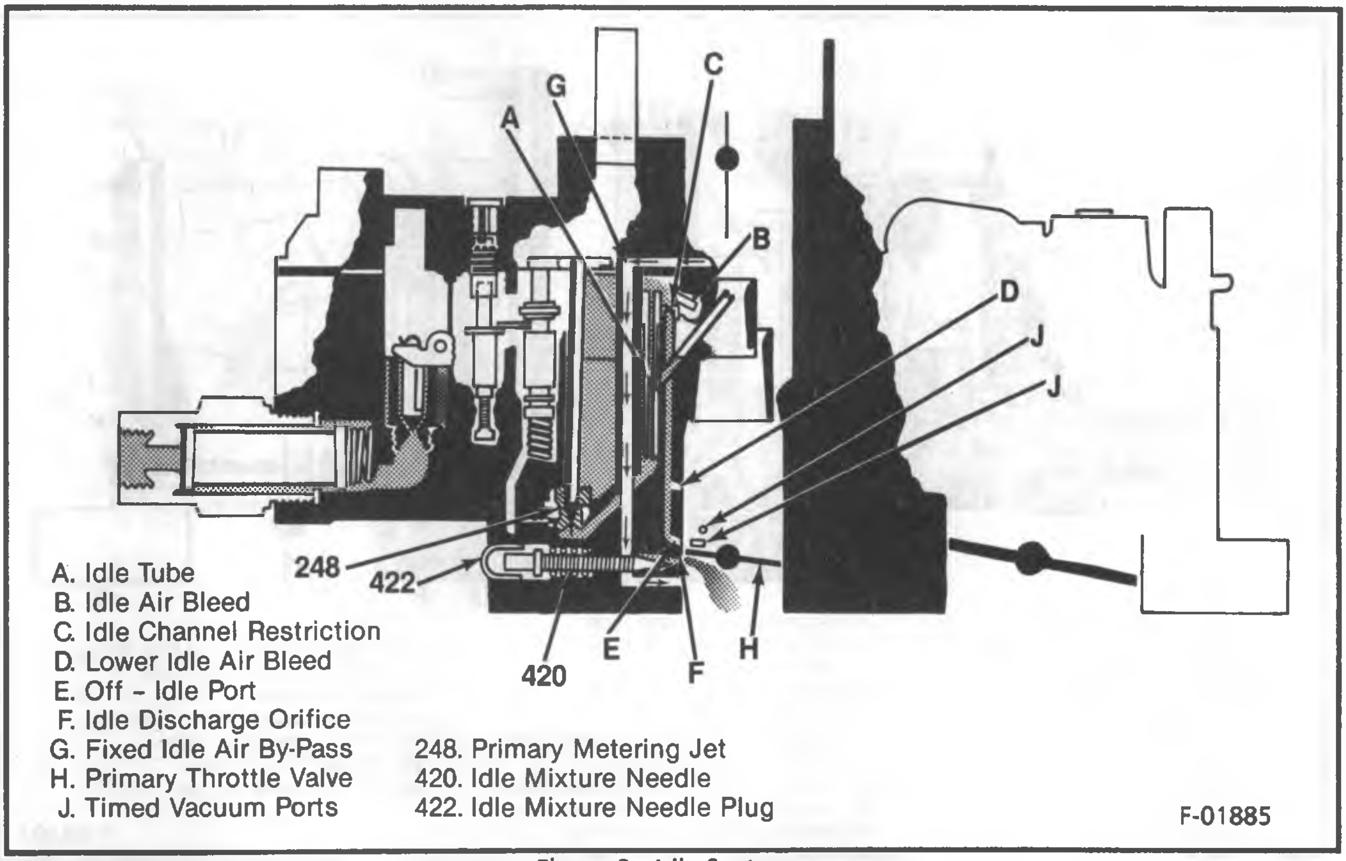


Figure 3 – Idle System

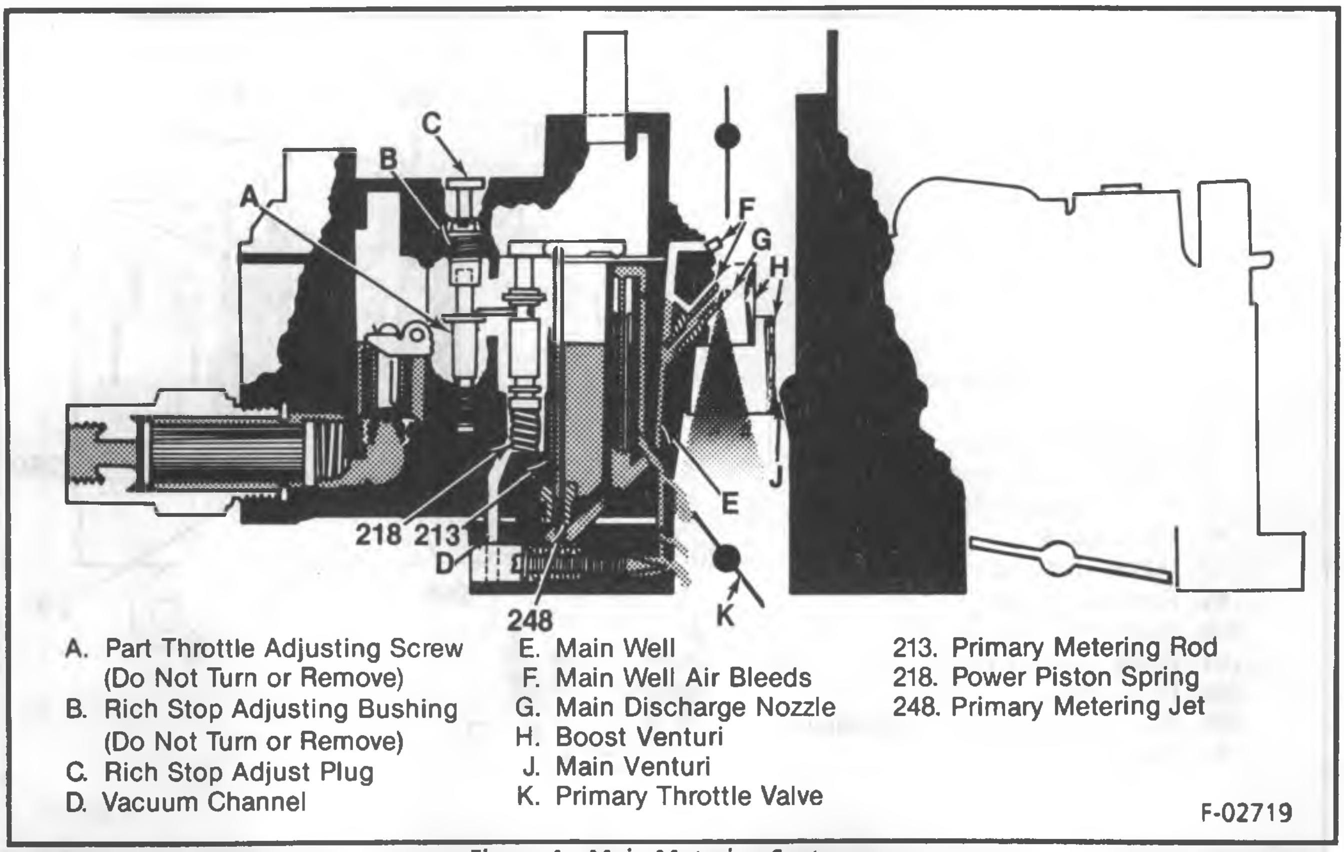


Figure 4 – Main Metering System

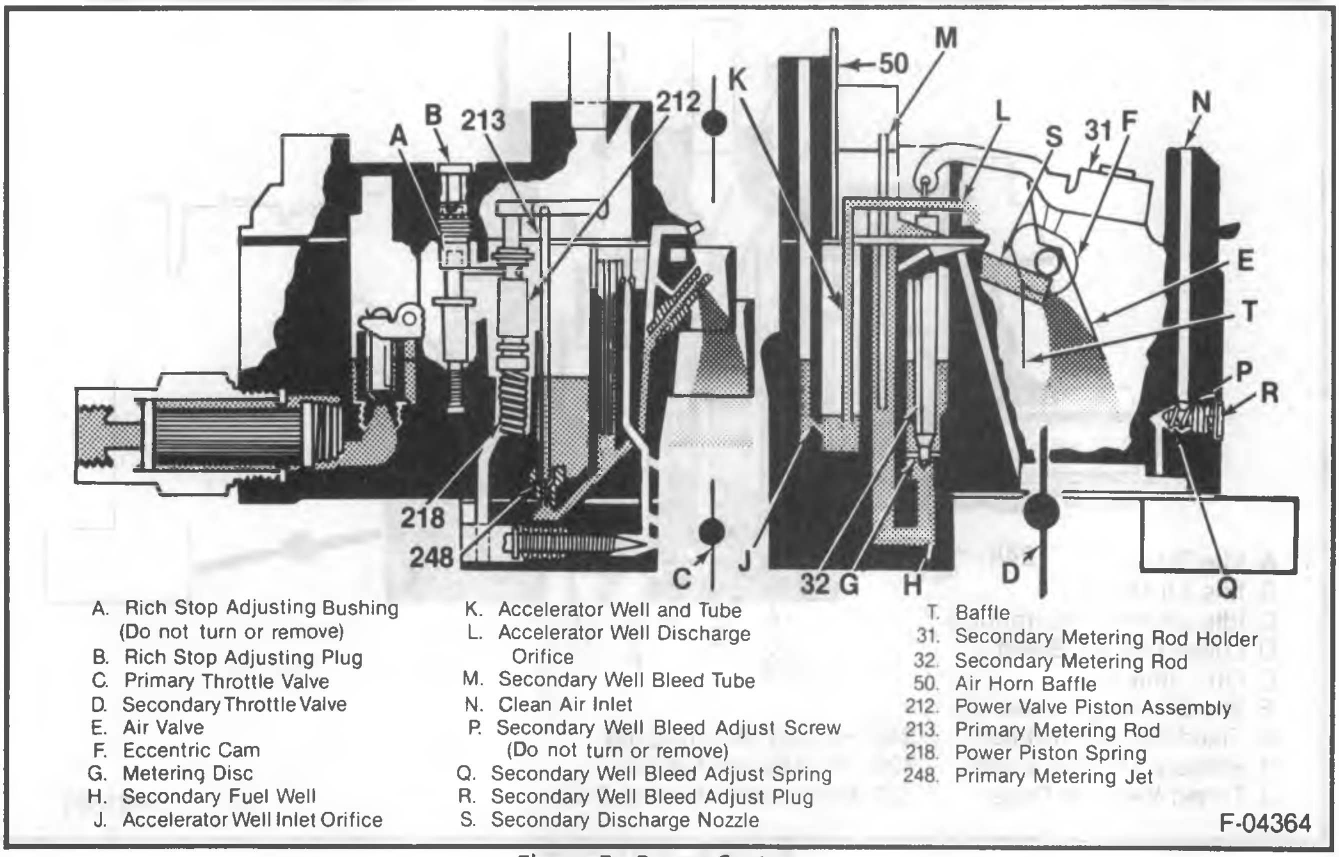


Figure 5 – Power System

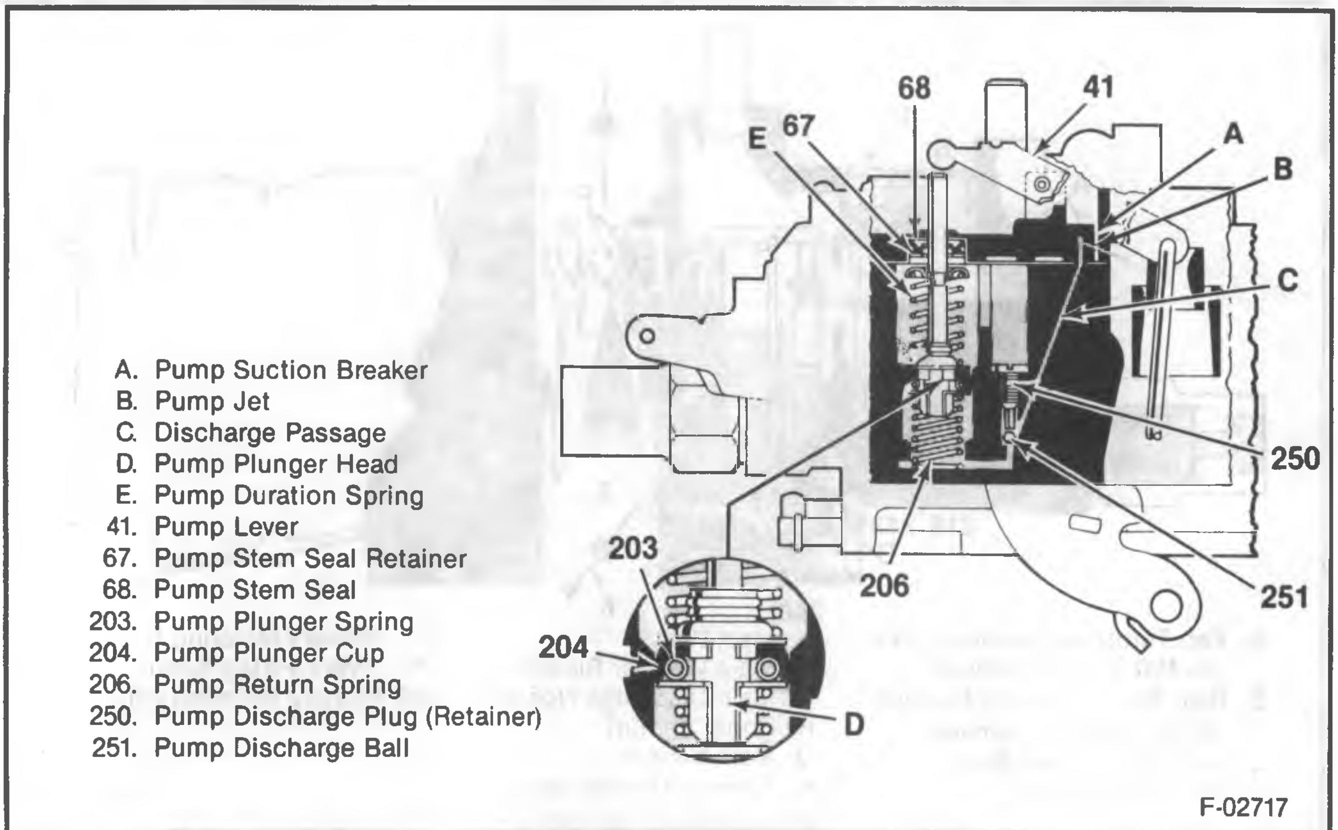


Figure 6 – Pump System

A. Choke Valve
B. Vacuum Break Adjusting Screw
C. Leaf-Type Bucking Spring
D. Unloader Tang
E. Fast Idle Cam Follower
F. Thermostatic Coil
G. Air Valve
55. Primary Side Vacuum Break Assembly
58. Primary Side Vacuum Break—Air Valve Lever Link
356. Choke Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

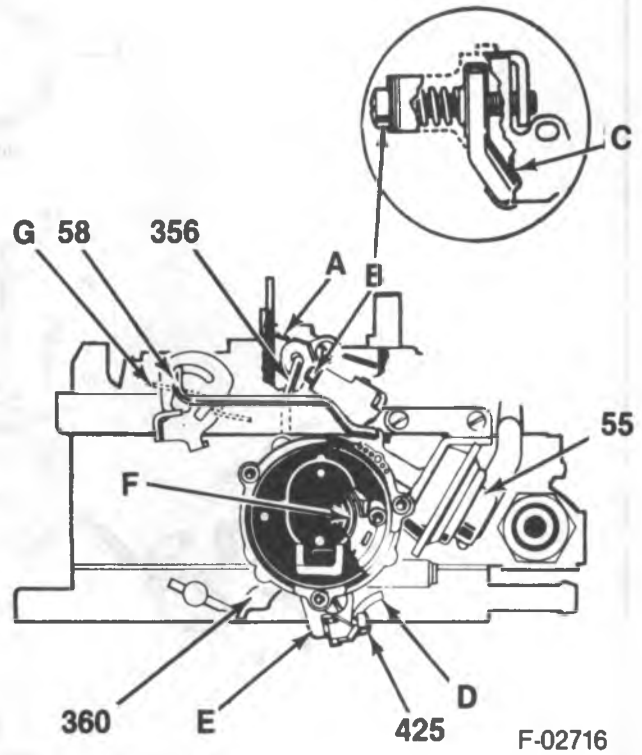


Figure 7 – Choke System - Electric - With Primary Side Vacuum Break Only

CARBURETOR DISASSEMBLY

IDLE MIXTURE NEEDLE PLUGS

←→ Remove or Disconnect (Figure 8)

1. Invert and support carburetor to avoid damaging external components.
2. Make two parallel hacksaw cuts in the throttle body, between the locator points near one idle mixture needle plug (422). The distance between the cuts depends on the size of the punch to be used.
   - Cut down to the plug, but not more than 1/8" beyond the locator points.
3. Place a flat punch at a point near the ends of the saw marks. Hold the punch at a 45° angle, and drive it into the throttle body to break casting away and expose the plug.
4. Use center punch to break plug apart and uncover idle mixture needle.
   - Remove all loose pieces of plug.
5. Repeat steps 2 through 4 for other needle plug.

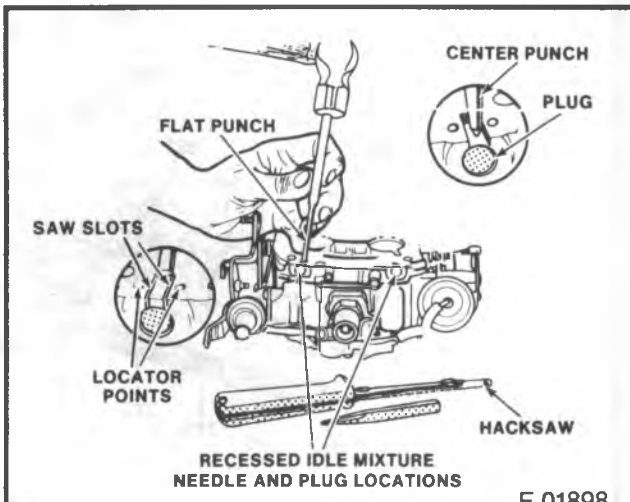


Figure 8 – Removing Idle Mixture Needle Plugs

CARBURETOR HOLDING STAND (Figure 11)

Tool Required:
J 9789-118 or BT-3553 - Carburetor Holding Stand.

- Place carburetor on holding stand.

NOTICE: Failure to place carburetor on holding stand could cause damage to throttle valves.

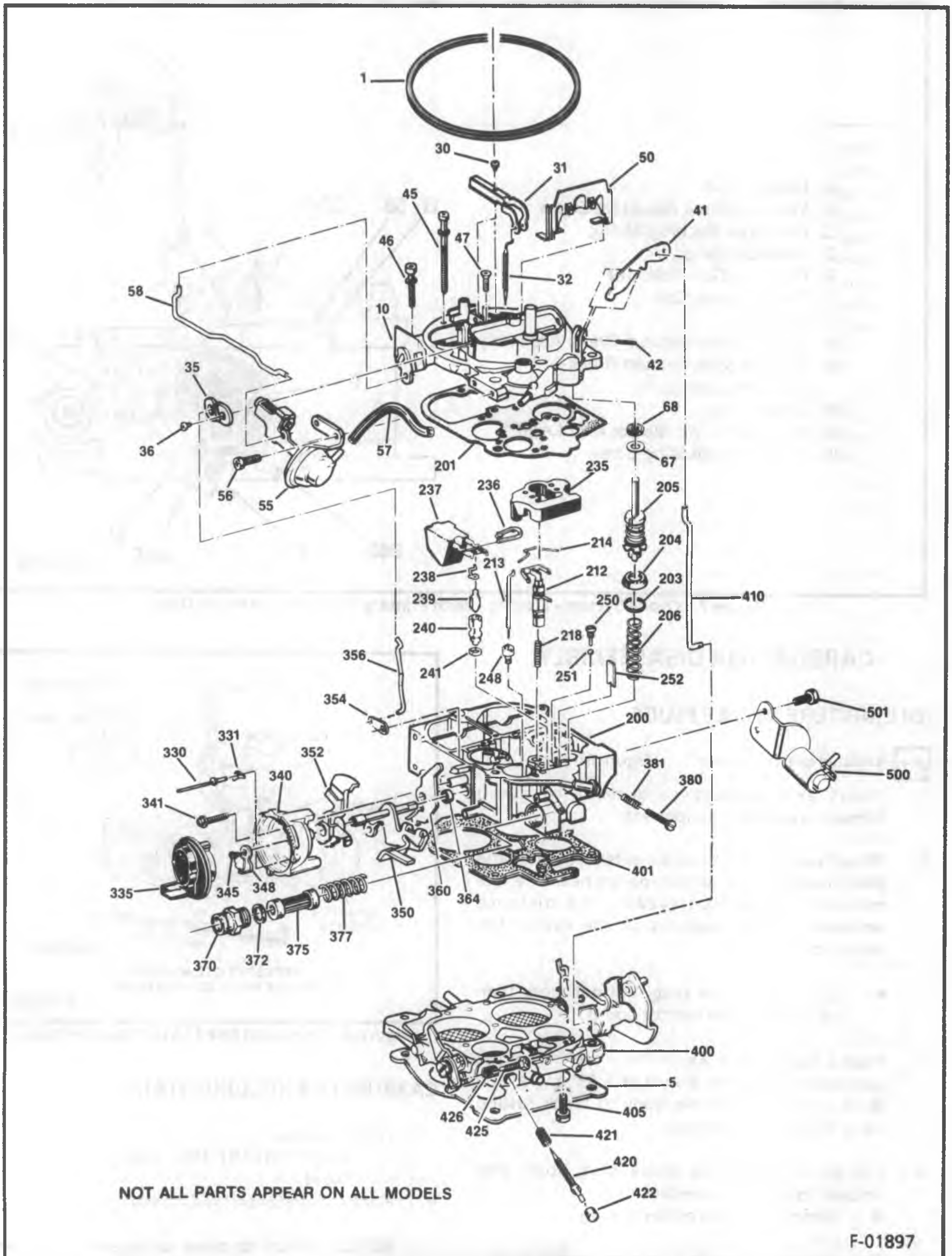


Figure 9 – Model M4MEF

CARBURETOR MODEL M4MEF

Parts Identification

1	Gasket - Air Cleaner	240	Seat - Float Needle
5	Gasket - Flange	241	Gasket - Float Needle Seat
10	Air Horn Assembly	248	Jet - Primary Metering
30	Screw - Secondary Metering Rod Holder Attaching	250	Plug - Pump Discharge (Retainer)
31	Holder - Secondary Metering Rod	251	Ball - Pump Discharge
32	Rod - Secondary Metering	252	Baffle - Pump Well
35	Lever - Choke	330	Rivet - Choke Cover Attaching
36	Screw - Choke Lever Attaching	331	Retainer - Choke Cover
41	Lever - Pump	335	Electric Choke Cover and Stat Assembly
42	Pin - Pump Lever Hinge	340	Choke Housing Assembly
45	Screw Assembly - Air Horn to Throttle Body	341	Screw and Washer Assembly - Choke Housing to Float Bowl
46	Screw Assembly - Air Horn to Float Bowl	345	Screw - Choke Stat Lever Attaching
47	Screw - Air Horn to Float Bowl (Countersunk)	348	Lever - Choke Stat
50	Baffle - Air Horn	350	Intermediate Choke Shaft, Lever and Link Assembly
55	Vacuum Break Assembly - Primary Side (Front)	352	Fast Idle Cam Assembly
56	Screw - Primary Side (Front) Vacuum Break Assembly Attaching	354	Lever - Intermediate Choke
57	Hose - Primary Side (Front) Vacuum Break	356	Link - Choke
58	Link - Primary Side Vacuum Break - Air Valve Lever	360	Lever - Secondary Throttle Lockout
67	Retainer - Pump Stem Seal	364	Seal - Intermediate Choke Shaft
68	Seal - Pump Stem	370	Nut - Fuel Inlet
200	Float Bowl Assembly	372	Gasket - Fuel Inlet Nut
201	Gasket - Air Horn to Float Bowl	375	Filter - Fuel Inlet
203	Spring - Pump Plunger	377	Spring - Fuel Filter
204	Cup - Pump Plunger	380	Screw - Throttle Stop
205	Pump Assembly	381	Spring - Throttle Stop Screw
206	Spring - Pump Return	400	Throttle Body Assembly
212	Power Valve Piston Assembly	401	Gasket - Float Bowl to Throttle Body
213	Rod - Primary Metering	405	Screw Assembly - Float Bowl to Throttle Body
214	Spring - Primary Metering Rod	410	Link - Pump
218	Spring - Power Piston	420	Needle - Idle Mixture
235	Insert - Float Bowl	421	Spring - Idle Mixture Needle
236	Hinge Pin - Float	422	Plug - Idle Mixture Needle
237	Float	425	Screw - Fast Idle Adjusting
238	Pull Clip - Float Needle	426	Spring - Fast Idle Adjusting Screw
239	Needle - Float	500	Solenoid and Bracket Assembly
		501	Screw - Bracket Attaching

Figure 10 – Model M4MEF

FUEL INLET NUT AND FILTER

Remove or Disconnect (Figure 12)

1. Fuel inlet nut (370).
2. Fuel inlet filter (375), inlet nut gasket (372), and filter spring (377).
   - Discard gasket.

Inspect

- Cut filter open. If clogged, check tank(s) and fuel lines for source of material.

SOLENOID AND BRACKET ASSEMBLY

Remove or Disconnect (Figures 9, 10)

- Bracket attaching screws (501), and solenoid and bracket assembly (500).

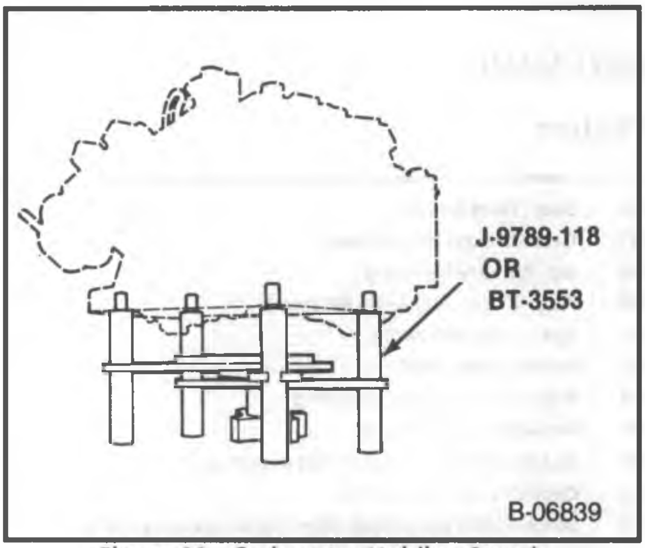


Figure 11 – Carburetor Holding Stand

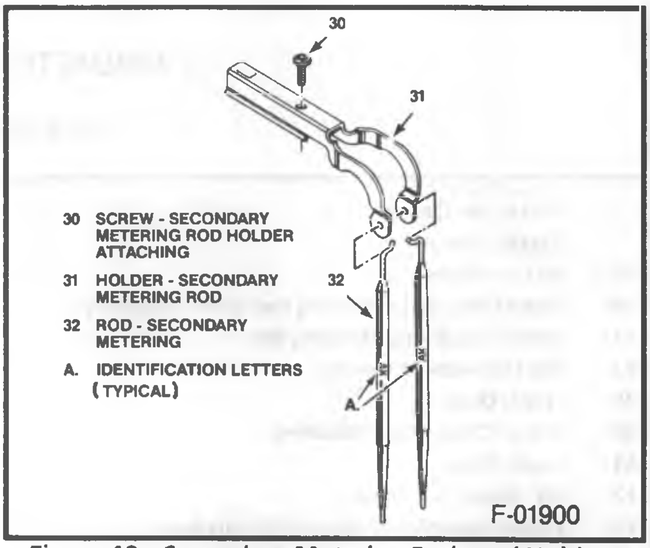


Figure 13 – Secondary Metering Rods and Holder

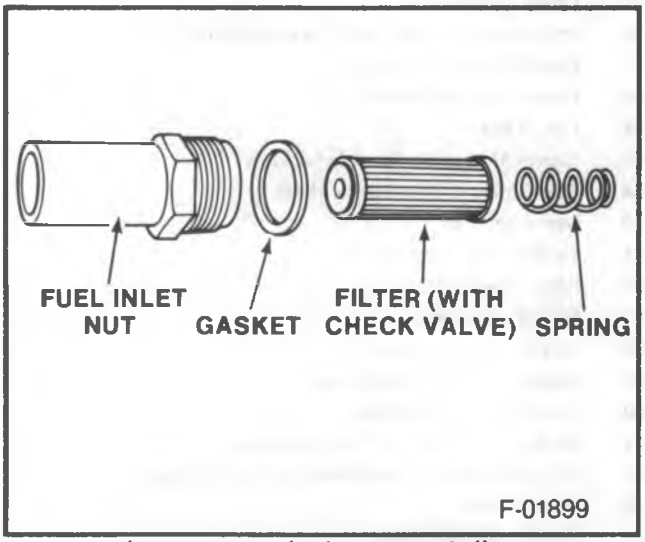


Figure 12 – Fuel Inlet Nut and Filter

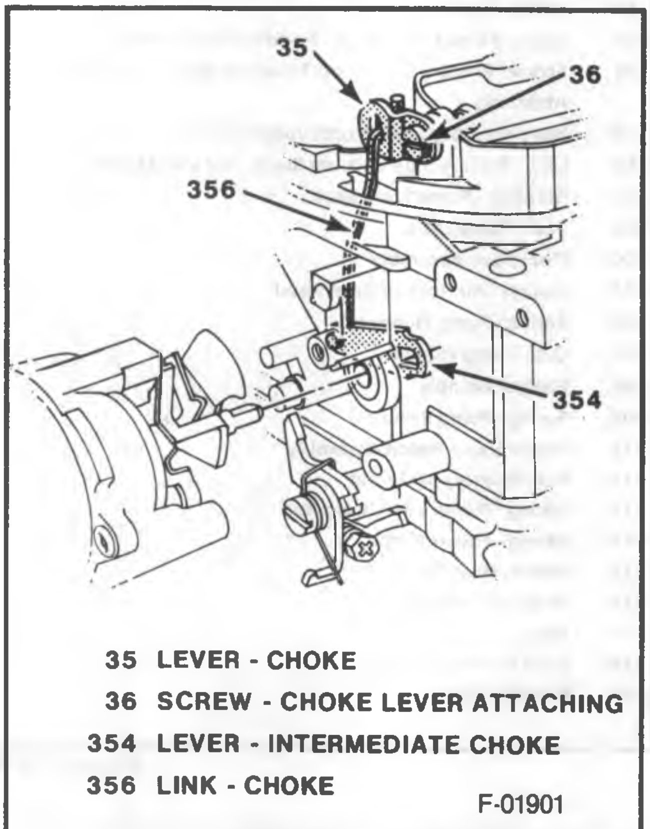


Figure 14 – Choke Lever and Link

VACUUM BREAK ASSEMBLY

Remove or Disconnect (Figures 9, 10)

1. Primary side vacuum break hose (57).
2. Primary side vacuum break attaching screws (56).
3. Primary side vacuum break assembly (55) and primary side vacuum break-air valve lever link (58).

AIR HORN COMPONENTS

Secondary Metering Rods

Remove or Disconnect (Figure 13)

1. Secondary metering rod holder attaching screw (30).
2. Metering rod holder (31), and metering rods (32).

Choke Lever and Link

Remove or Disconnect (Figure 14)

1. Choke lever attaching screw (36).
2. Choke lever (35).

3. Choke link (356).
   - Pull up on link, hold intermediate choke lever (354) outward with screwdriver. Twist link from lever.

Pump Lever and Link

Remove or Disconnect (Figure 15)

Tool Required:
J 25322 or BT-7523 - Pump Lever Pin Punch.

1. Pump lever (41).
   - Use tool J 25322 or BT-7523, or small punch, to drive pump lever hinge pin (42) inward, to release pump lever.
2. Pump link (410), from throttle lever.

Air Horn

Remove or Disconnect (Figure 16)

1. Air horn screws:
   - Air horn to throttle body screw assemblies (45).
   - Air horn to float bowl screw assemblies (46).
     - Air horn baffle (50), if used.
   - Air horn to float bowl (countersunk) screws (47).
2. Air horn assembly (10).
   - Lift straight up.
   - Leave air horn gasket (201) on float bowl.

NOTICE: Use care when removing air horn, to prevent damaging tubes pressed into the air horn casting. (DO NOT remove tubes).

Pump Stem Seal

- Invert air horn assembly.

Remove or Disconnect (Figure 17)

- Pump stem seal (68).
  - Use small screwdriver to remove the seal retainer (67).
  - Use suitable tool to remove old staking.
- Do not disassemble air horn further.
  - If it is necessary to replace the air valve return spring or secondary cam; a repair kit, with instructions, is available.

NOTICE: Do not turn nor remove the rich stop adjusting bushing (Figure 5). Any attempt to readjust this bushing could result in engine damage or increased exhaust emissions.

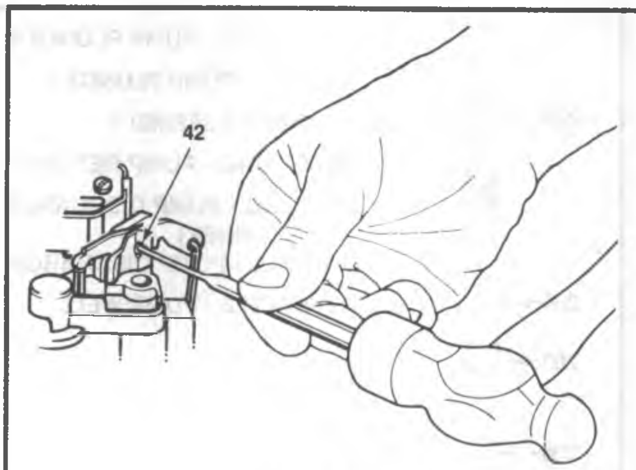


Figure 15 – Removing Pump Lever

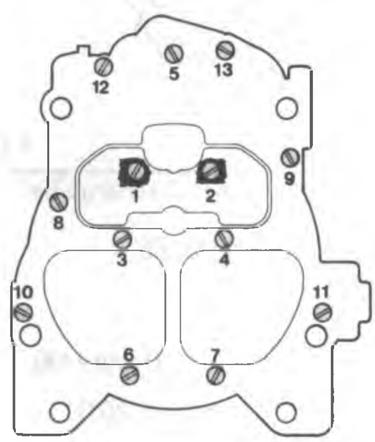


Figure 16 – Air Horn Screw Location and Tightening Sequence

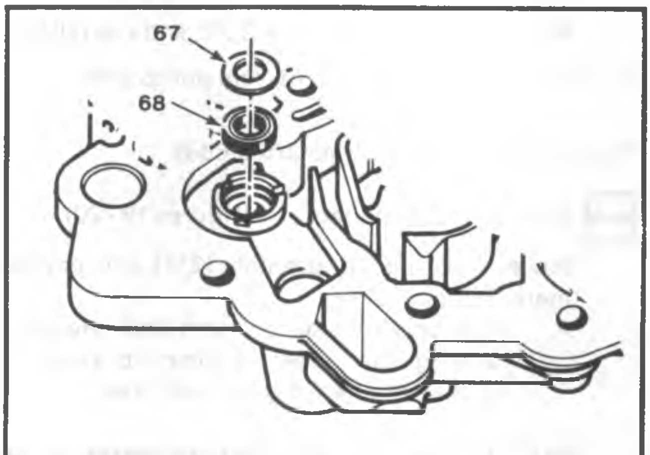


Figure 17 – Pump Stem Seal

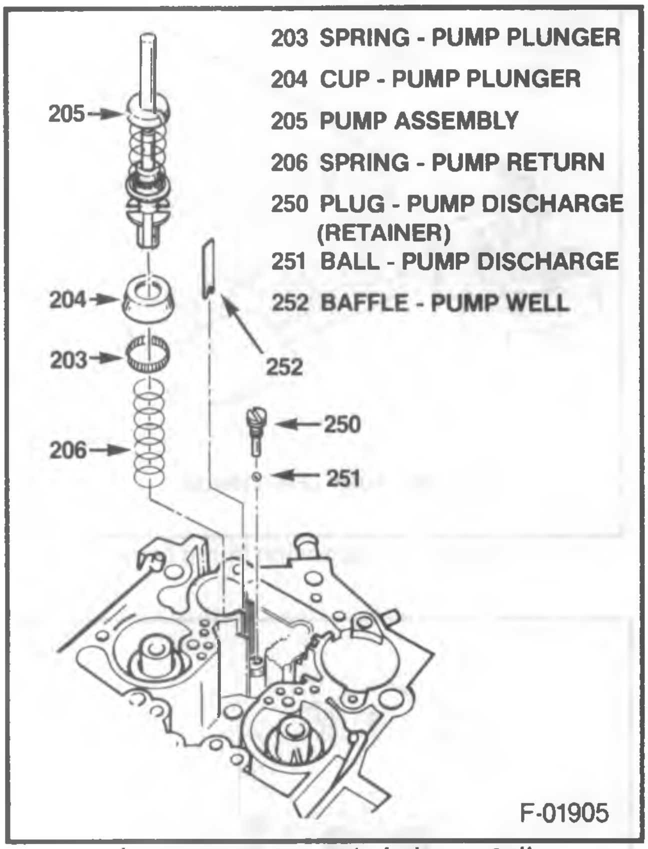


Figure 18 – Pump and Discharge Ball

FLOAT BOWL COMPONENTS

Pump

Remove or Disconnect (Figure 18)

1. Air horn to float bowl gasket (201).
   - Discard.
2. Pump assembly (205).

   Disassemble (Figure 18)

   - Pump plunger spring (203), and cup (204).
3. Pump return spring (206) from pump well.

Power Valve Piston and Metering Rods

Remove or Disconnect (Figures 19 - 20)

1. Power valve piston assembly (212) and primary metering rods (213).
   - Press down on piston stem and release it, causing the power piston to snap up against retainer. Repeat until free.

NOTICE: Do not use pliers on metering rod holder to remove power valve piston, as the holder could come loose from piston.

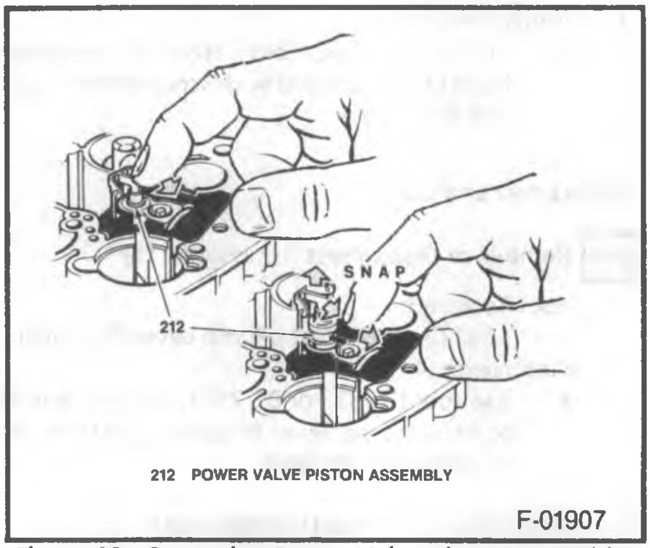


Figure 19 – Removing Power Valve Piston Assembly

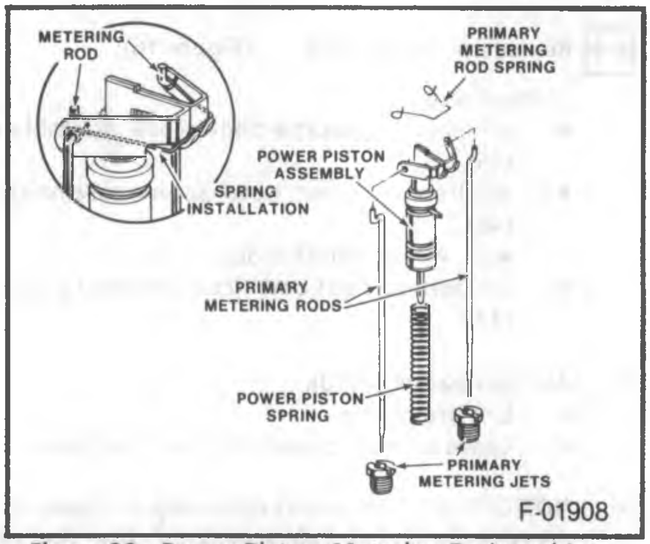


Figure 20 – Power Piston, Metering Rods and Jets

Important (Figure 21)

Do not remove nor adjust the factory set part throttle adjusting (APT) screw, which could result in increased exhaust emissions.

- If required, a replacement float bowl contains a preset APT adjusting screw.

Disassemble (Figure 20)

- Primary metering rods (213) and metering rod spring (214), from power valve piston assembly (212).
- Note the position of the metering rod spring for reassembly.

2. Remove power piston spring (218) from float bowl.

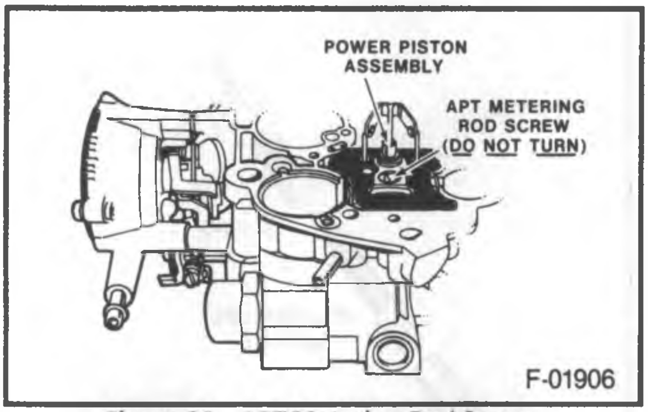


Figure 21 – APT Metering Rod Screw

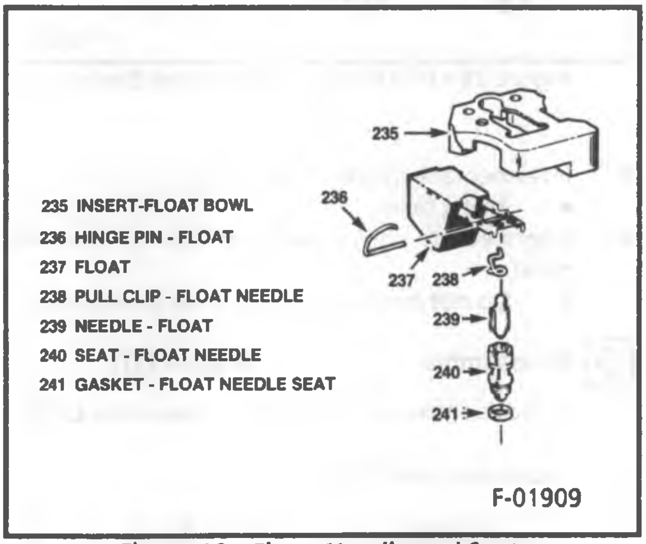


Figure 22 – Float, Needle and Seat

Float, Needle and Seat

Remove or Disconnect (Figure 22)

Tool Required:
J 22769 or BT-3006M - Needle Seat Tool.

1. Float bowl insert (235).
2. Float (237), hinge pin (236), float needle (239) and pull clip (238).
   - Pull up on float hinge pin (236).
3. Float needle seat (240), and gasket (241).

Primary Metering Jets

Remove or Disconnect (Figure 20)

- Primary metering jets (248) from float bowl.

NOTICE: Do not remove secondary metering discs. They are pressed into place, and if damaged, entire bowl replacement is required.

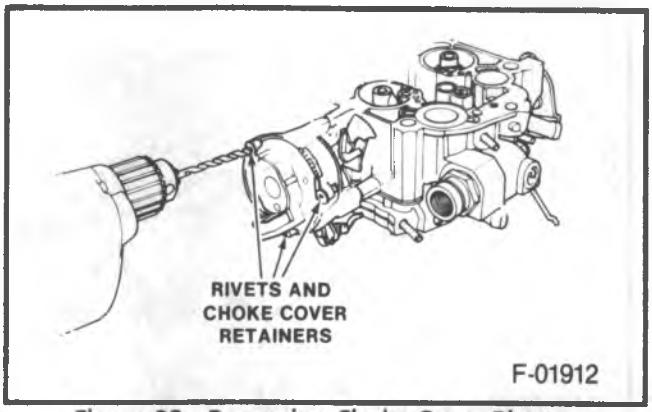


Figure 23 – Removing Choke Cover Rivets

Pump Discharge Ball and Pump Well Baffle

Remove or Disconnect (Figure 18)

1. Pump discharge plug (retainer) (250).
2. Pump discharge ball (251).
   - Invert bowl and catch ball.
3. Pump well baffle (252).

CHOKE COMPONENTS

The tamper resistant choke cover discourages unnecessary readjustment of the choke cover and stat assembly. However, for overhaul, it is necessary to remove this assembly.

Electric Choke Cover and Stat

Remove or Disconnect (Figure 23)

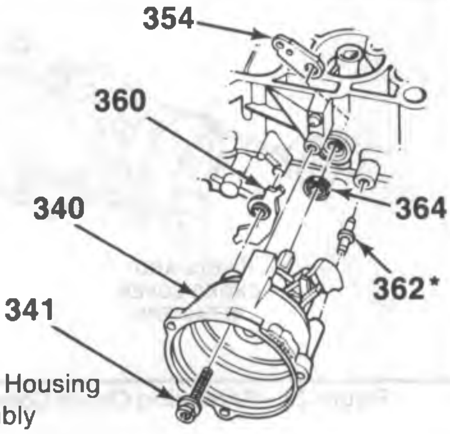
1. Heads of choke cover attaching rivets (330).
   - Use a 4 mm (5/32") drill bit.
2. Choke cover retainers (331).
3. Electric choke cover and stat assembly (335).
4. Remaining pieces of rivets in housing.
   - Use punch to drive out.

Choke Housing

Remove or Disconnect (Figure 24)

1. Choke housing to float bowl screw and washer assembly (341).
2. Choke housing assembly (340).

- Secondary throttle lockout lever (360).

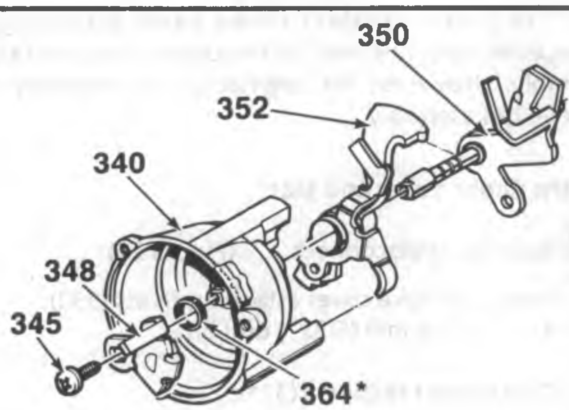


340 Choke Housing Assembly
341 Screw and Washer Assembly - Choke Housing to Float Bowl
354 Lever - Intermediate Choke
360 Lever - Secondary Throttle Lockout (4 Barrel Only)
*362 Seal - Choke Housing to Float Bowl
364 Seal - Intermediate Choke Shaft (Sealing Lip Faces Outward)

*Hot Air Choke Models Only

F-06384

Figure 24 – Removing Choke Housing Assembly

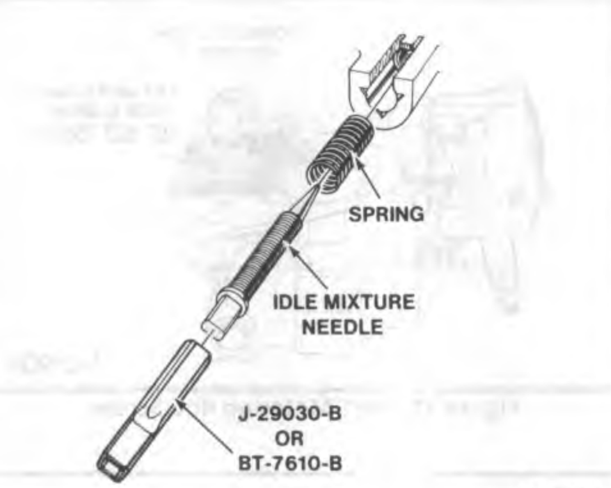


340 Choke Housing Assembly
345 Screw - Choke Stat Lever Attaching
348 Lever - Choke Stat
350 Intermediate Choke Shaft, Lever and Link Assembly
352 Fast Idle Cam Assembly
*364 Seal - Intermediate Choke Shaft (Sealing Lip Faces Inward)

*HOT AIR CHOKE MODELS ONLY

F-06385

Figure 25 – Choke Housing Assembly



F-01914

Figure 26 – Idle Mixture Needle and Spring

- Intermediate choke lever (354).
  - Invert bowl.
- Intermediate choke shaft seal (364), from float bowl.
  - **Do not** remove bushing from float bowl.

Disassemble (Figure 25)

1. Remove choke stat lever attaching screw (345).
2. Choke stat lever (348).
3. Intermediate choke shaft, lever and link assembly (350).
4. Fast idle cam assembly (352).

THROTTLE BODY COMPONENTS

Idle Mixture Needles

Remove or Disconnect (Figure 26)

Tool Required:
J 29030-B or BT-7610B, Idle Mixture Socket (Adjusting Tool).

- Idle mixture needles (420), and springs (421).
  - Count, and make a record of, number of turns needed to lightly bottom needles, for use in reassembly.

Inspect (Figure 26)

- Needles for damaged tip or threads.
  - If damaged, replacement is required.

Throttle Body

- Invert carburetor.

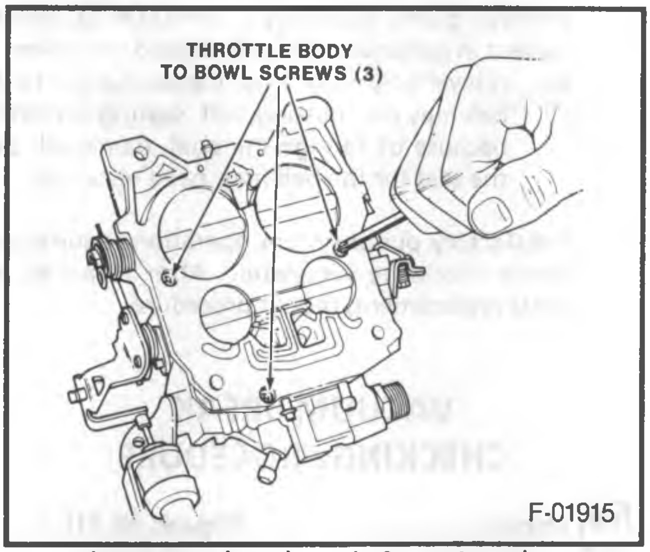


Figure 27 – Throttle Body Screw Location

Remove or Disconnect (Figure 27)

1. Float bowl to throttle body screw assemblies (405).
2. Throttle body assembly (400), and float bowl to throttle body gasket (401).
   Discard gasket.

- Do not disassemble throttle body further. The throttle body is serviced as a complete assembly.

CLEANING AND INSPECTION

If an excessive amount of foreign material is found in float bowl, check tank(s) and fuel lines for the source.

Clean (Figure 28)

1. Power piston bore of float bowl.
   - Use 0.375 inch soft wire brush. Turn clockwise through full length of the power piston bore. Turn brush several more turns, to remove dirt and varnish.
2. Metal parts in cold immersion cleaner, X-55 or equivalent.

NOTICE: Do not immerse ISS, vacuum break, electric choke cover and stat assembly, float and float bowl insert, pump plunger, seals, etc., in cleaner as they may become non-functional, swell, harden, or distort.

   - The plastic cam on the air valve shaft will withstand normal cleaning.

3. Rinse thoroughly after soaking.

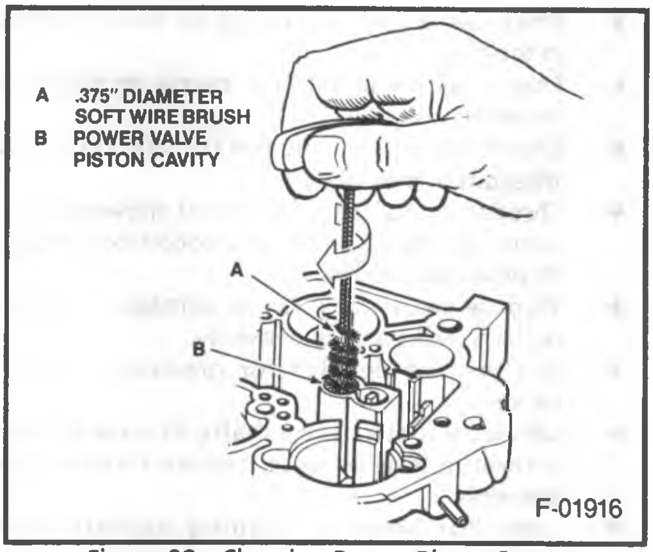


Figure 28 – Cleaning Power Piston Bore

4. Blow dry with compressed air.
   - Do Not pass drill bits or wire through jets or other passages.

Inspect

Check the following items and if the condition listed is noted: clean, repair or replace components.

- Air and fuel passages, and metering parts, for dirt or burrs.
- Mating surfaces of castings for nicks or damage that would prevent sealing air or fuel.

IMPORTANT (Figure 29)

If replacing float bowl, look for letters "MW", which indicate **Machined** pump **Well**, and determine the type of pump that can be used. If present, a new bowl must also have the letters .

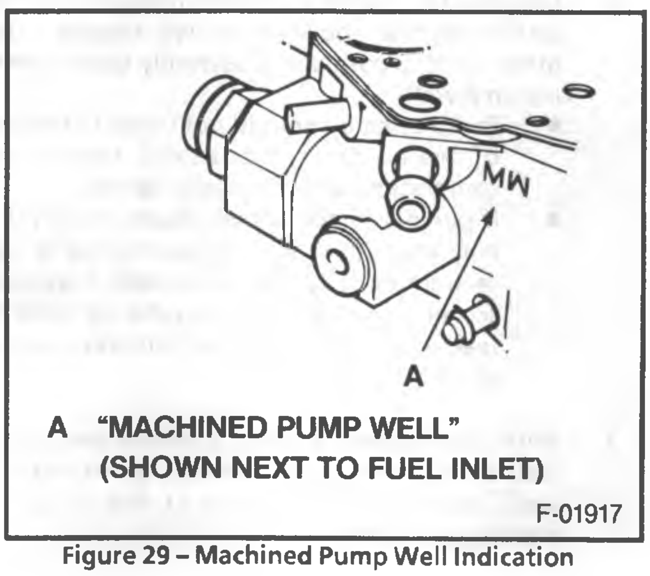


Figure 29 – Machined Pump Well Indication

- Power valve piston assembly for free movement in the bore.
- Power piston spring for being stretched or distorted.
- Choke valve and secondary air valves for freedom of movement.
- Throttle shafts for freedom of movement. If cleaning does not correct condition, replace throttle body assembly.
- Throttle valves for nicks or damage. If noted, replace throttle body assembly.
- Idle mixture needles for grooves, ridges or bends.
- Levers for looseness on shafts, or wear in holes. If throttle lever is loose, replace throttle body assembly.
- Links for wear or rubbing against other components.
  - Correct cause, and replace if necessary.
- Float, float lever and hinge pin for distortion, binds and burrs.
- The float for being loaded.
  - Check weight of float in comparison with a new float, and replace if heavier.
- Plastic parts for cracks, damage, etc.

PUMP SYSTEM CHECKING PROCEDURE

Inspect **(Figures 18, 6)**

- Perform this check with a new pump cup installed on the pump plunger, and with the pump discharge ball, plug (retainer), and pump well baffle installed.

1. Fill empty float chamber and pump well with a clean solvent, such as mineral spirits.

2. Seal the two pump discharge passages on top surface of float bowl with two fingers. Use other hand to push pump assembly down slowly in pump well.
   - Pump assembly should not travel to bottom of well. Only movement should be compressing of the duration spring.
   - If pump assembly moves down in well, this may indicate that: the pump cup is not sealing properly, the pump well is worn or scored, or the pump discharge plug is leaking (as indicated by bubbles around plug).

3. With clean solvent in float chamber and pump well, slowly move pump assembly down in pump well until solvent is visible at top of pump discharge passages.

4. Remove pump assembly. Continue to watch solvent in passages. The level should not lower.
   - If level begins to drop, the discharge check ball may be: missing, not seating correctly because of foreign material, damaged, or, the seat for the ball may need restaking.

5. Satisfactory pump system operation requires all above checks be successful. After cleaning or parts replacement, repeat procedure.

VACUUM BREAK CHECKING PROCEDURE

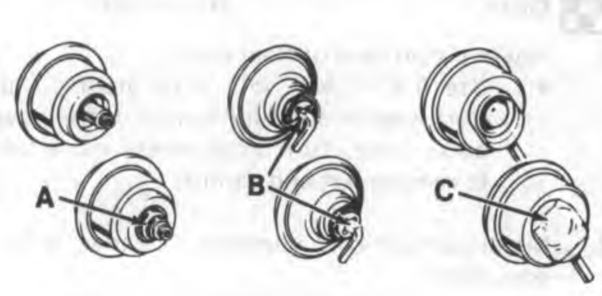
Inspect **(Figures 30, 31)**

Tool required:
J 23738-A or BT-7517 - Hand Operated Vacuum Pump.

1. If the vacuum break has an air bleed hole, plug it as shown, during this checking procedure.

2. Apply 15" Hg (51kPa) vacuum to the vacuum break.
   - Apply finger pressure to the plunger to see if it has moved through full travel. If not, replace the vacuum break.
   - Observe vacuum gage. Vacuum should hold for at least twenty seconds. If not, replace the vacuum break.

3. Replace vacuum break hoses that are cracked, cut or hardened.



A. Pump Cup or Valve Stem Seal
B. Tape Hole in Tube
C. Tape End of Cover

B-06210

Figure 30 – Vacuum Break Information

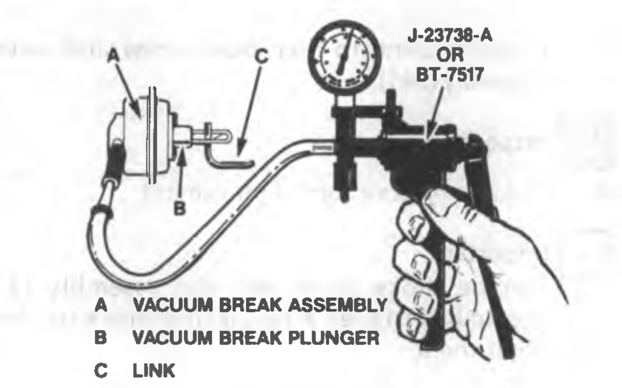


Figure 31 - Checking Vacuum Break

IDLE STOP SOLENOID CHECKING PROCEDURE

Inspect

Check the idle stop solenoid (500) electrically, using a 12 volt automotive battery:

1. Retract solenoid plunger, using finger pressure.
2. Apply + 12 volts to the terminal and -12 volts to the solenoid body.
3. If the solenoid plunger does not extend when the voltage is applied, replace the solenoid with a new one.

CARBURETOR REASSEMBLY

THROTTLE BODY COMPONENTS

Throttle Body

- Invert float bowl (200).

Install or Connect (Figure 27)

1. New float bowl to throttle body gasket (401).
   - Install over locator pins on float bowl.
2. Throttle body assembly (400).
3. Float bowl to throttle body screw assemblies (405).

Idle Mixture Needles

Install or Connect (Figures 11, 26)

Tools Required:
J 9789-118 or BT-3553 - Carburetor Holding Stand.
J 29030-B or BT-7610B - Idle Mixture Socket (Adjusting tool).

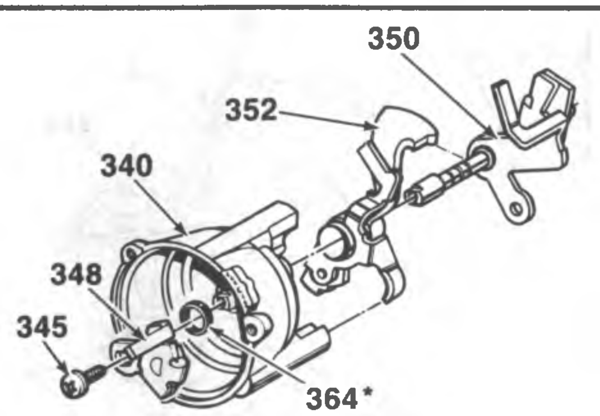
1. Place carburetor on J 9789-118 or BT-3553.
2. Idle mixture needles (420), and springs (421).
   - Use J 29030-B or BT-7610B to lightly seat each needle, then back out the number of turns counted during disassembly.
   - Final idle mixture adjustment is made on the vehicle. For information on this adjustment procedure, refer to Carburetors (SEC. 6C1) in the 1989 Light Duty Truck Service Manual.

CHOKE COMPONENTS

Choke Housing

Assemble (Figure 32)

1. Fast idle cam assembly (352) to choke housing (340), with cam bushing facing away from housing.



340 Choke Housing Assembly
345 Screw - Choke Stat Lever Attaching
348 Lever - Choke Stat
350 Intermediate Choke Shaft, Lever and Link Assembly
352 Fast Idle Cam Assembly
*364 Seal - Intermediate Choke Shaft (Sealing Lip Faces Inward)

*HOT AIR CHOKE MODELS ONLY

F-06385

Figure 32 - Choke Housing Assembly

- Position tail of cam (weighted end) in line with housing attaching screw hole.

2. Intermediate choke shaft assembly (350) into the choke housing, so the vacuum break lever will surround the tail of the fast idle cam.

3. Choke stat lever (348) on flats of intermediate choke shaft, with stat lever tang lined up with vacuum break lever of intermediate choke shaft.

4. Install choke stat lever attaching screw (345).

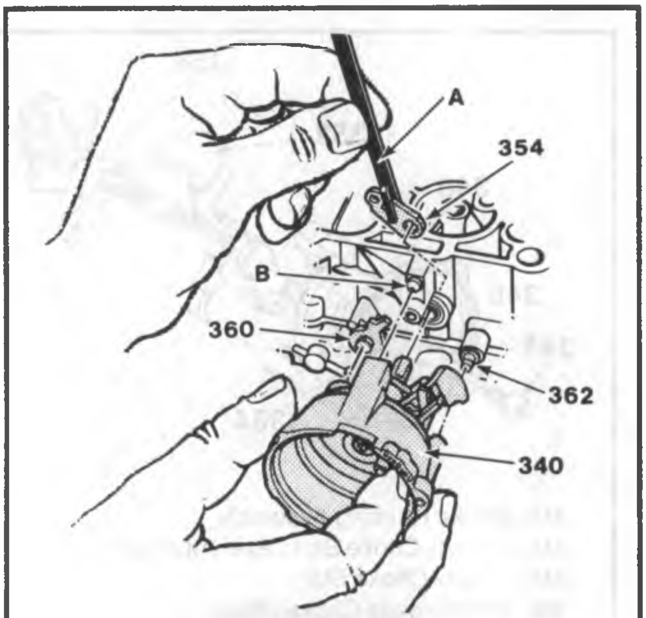
Install or Connect (Figures 24, 33)

Tool Required:
J 23417 or BT-6911 - Choke Lever Installing Tool.

1. New intermediate choke shaft seal (364) in float bowl.
   - Sealing lip faces outward.

2. Secondary throttle lockout lever (360).

3. Choke housing assembly (340) as follows:
   A. Position intermediate choke lever (354) in bowl cavity, using J 23417 or BT-6911.



340 CHOKE HOUSING ASSEMBLY
354 LEVER - INTERMEDIATE CHOKE
360 LEVER - SECONDARY THROTTLE LOCKOUT
362 SEAL - CHOKE HOUSING TO FLOAT BOWL (HOT AIR CHOKE MODELS ONLY)
A TOOL J-23417 OR BT-6911
B LOCATING POINT
F-01920

Figure 33 - Installing Choke Housing Assembly

   B. Guide intermediate choke shaft through slot in intermediate choke lever.

4. Choke housing to float bowl screw and washer assembly (341).

Inspect

- Linkage for freedom of movement.

Important
Electric choke cover and stat assembly (335) should be installed *after* making choke stat lever adjustment.

FLOAT BOWL COMPONENTS

If replacing the float bowl assembly, transfer the identification number on the new float bowl at location shown, (Figure 1). Follow the instructions on the envelope included in the service package.

Pump Discharge Ball and Pump Well Baffle

Install or Connect (Figure 18)

1. Pump well baffle (252).
   - Slot toward bottom.

2. Pump discharge ball (251).

3. Pump discharge plug (retainer) (250).

Primary Metering Jets

Install or Connect (Figure 34)

- Primary metering jets (248) in float bowl.

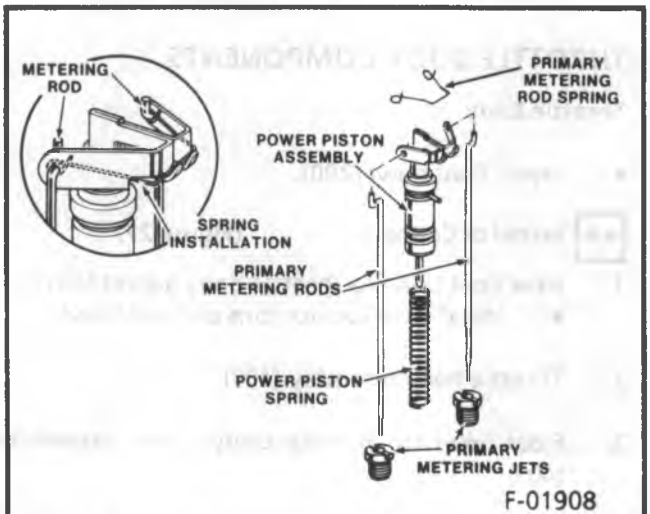


Figure 34 - Power Piston, Metering Rods and Jets

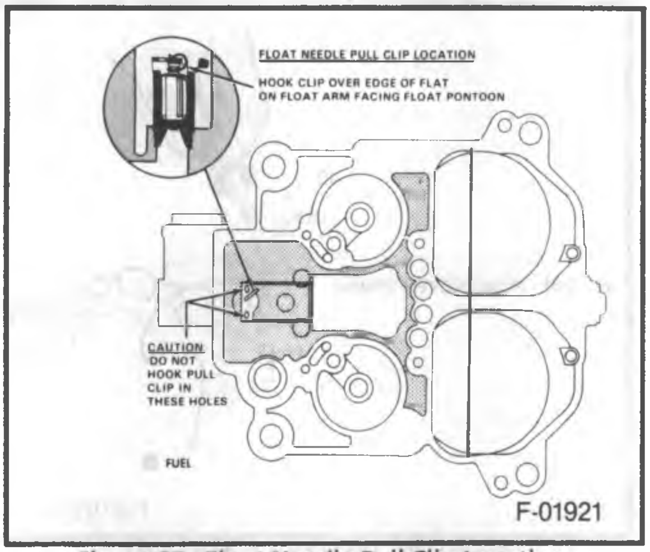


Figure 35 - Float Needle Pull Clip Location

Float, Needle and Seat

Install or Connect (Figures 22, 35)

Tool Required:

J 22769 or BT-3006M - Needle Seat Tool

1. Float needle seat (240) with new gasket (241).

Assemble (Figures 22, 35)

A. Float needle pull clip (238) to float needle (239).
B. Float needle onto float lever as shown in Figure 35.
C. Hinge pin (236) through float lever.
   - Open end faces pump well.

2. Install float, needle, and hinge pin.

Adjust (Figures 40, 51)

Tools Required:

J 9789-90 or BT-8037 - Float Level T-Scale.

J 34817-A or BT-8426 - Float Positioning Tool Kit.

- Float Level.
  - Specification is in Figure 51.

3. Install float bowl insert (235).

Power Valve Piston and Metering Rods

Assemble (Figure 34)

- Primary metering rods (213), and metering rod spring (214), to power valve piston assembly (212).

Install or Connect (Figure 34)

1. Power piston spring (218).
2. Install power valve piston assembly and primary metering rods, as follows:
   A. Align pin on piston with slot in bore, and primary metering rods in jets.
   B. Press plastic retainer flush with top of float bowl.
      - If necessary, use a small punch and hammer.

Pump

Assemble (Figure 18)

- Pump assembly (205) with new pump plunger cup (204), and spring (203).

Install or Connect (Figure 18)

1. Pump return spring (206).
2. Pump assembly (205).
3. New air horn to float bowl gasket (201).

AIR HORN COMPONENTS

Pump Stem Seal

Install or Connect (Figure 17)

1. New pump stem seal (68) in air horn.
   - Sealing lip faces outward.
2. New seal retainer (67).
   - Lightly stake retainer in three different places than original stakings.

Lubricating Air Valve Spring Pin

Install or Connect (Figure 36)

- Apply lithium grease to the air valve shaft pin where it contacts the air valve return spring.

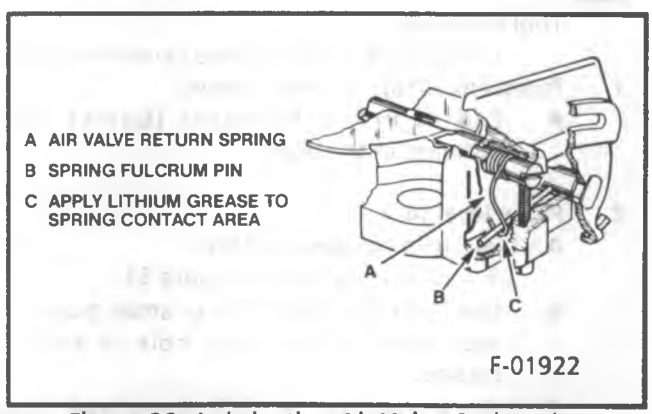


Figure 36 - Lubricating Air Valve Spring Pin

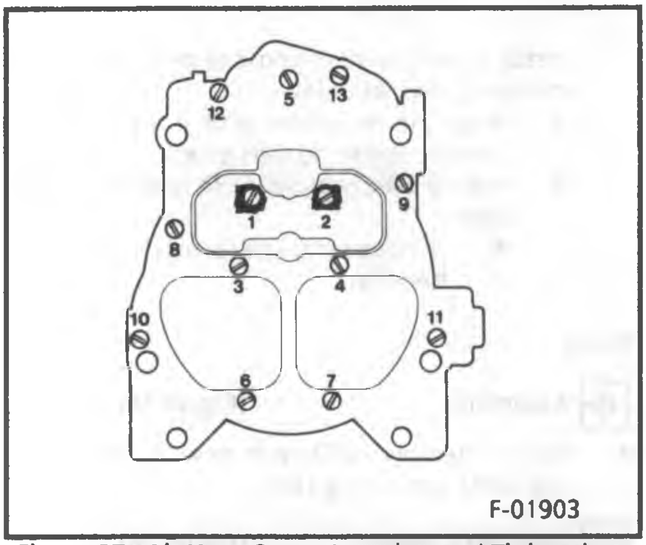


Figure 37 - Air Horn Screw Location and Tightening Sequence

Air Horn

Install or Connect (Figure 37)

1. Air horn assembly (10).
   - Hold air horn gasket (201) down at pump location, guide pump stem through air horn.
   - Be sure that tubes are positioned properly through the holes in the air horn gasket.
2. Air horn screws, in sequence shown:
   - Two countersunk screws (47) (locations #1 & 2), located next to the venturi area.
   - Air horn to float bowl screw assemblies (46).
     - Air horn baffle (50), if used, under screw assemblies in locations #3 and 4.
   - Air horn to throttle body screw assemblies (45).

Pump Lever and Link

Install or Connect (Figures 38, 51)

Tool Required:
J 25322 or BT-7523 - Pump Lever Pin Punch

1. Pump link (410), in throttle lever.
   - End of link with squirt (bump) faces outward in the lever.
2. Pump lever (41).
   A. Pump link in specified hole.
      - Specification is in figure 51.
   B. Use J 25322 or BT-7523, or small punch, to align hole in lever with hole in air horn casting.
   C. Use screwdriver to push pump lever hinge pin (42) in until flush with casting boss.

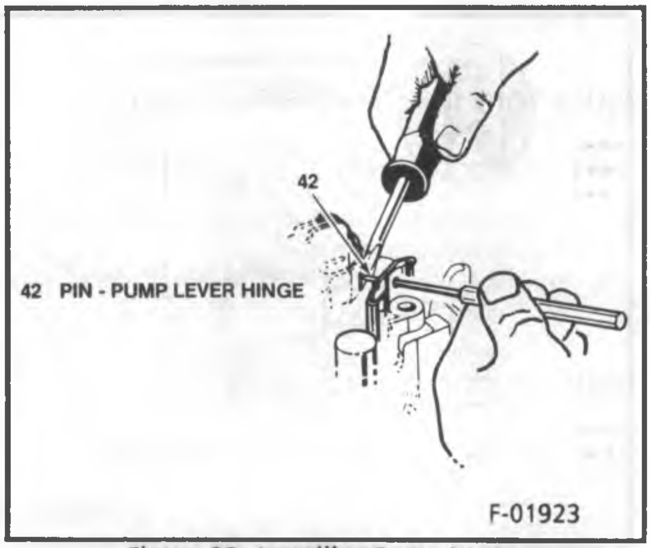


Figure 38 - Installing Pump Lever

Choke Lever and Link

Install or Connect (Figure 14)

1. Choke link (356) into intermediate choke lever (354).
   - Hold fast idle cam (352) down to rotate lever up for easier installation.
2. Choke lever (35).
   - Connect lever to choke link, and install on end of choke shaft.
3. Choke lever attaching screw (36).

Secondary Metering Rods

Install or Connect (Figure 13)

1. Secondary metering rods (32), and holder (31).
   - Ends of rods face each other.
2. Holder attaching screw (30).

- Work air valves up and down several times, to be sure they move freely both ways.

VACUUM BREAK ASSEMBLY

Install or Connect (Figures 9, 10)

1. Primary side vacuum break - air valve lever link (58) to air valve lever.
2. Primary side vacuum break assembly (55).
   - Connect plunger to air valve lever link.
3. Vacuum break attaching screws (56).

4. Primary side vacuum break hose (57).

SOLENOID AND BRACKET ASSEMBLY

Install or Connect (Figures 9, 10)

- Solenoid and bracket assembly (500) with bracket attaching screws (501).
  - Adjust solenoid after reinstalling carburetor on engine.

FUEL INLET NUT AND FILTER

Install or Connect (Figure 12)

1. Fuel filter spring (377), in float bowl.
2. New gasket (372), on inlet nut (370).
3. Inlet nut with new filter (375).

Tighten

- Nut to 62 N · m (46 lb.ft.).

ADJUSTMENT PROCEDURES

If you are following the unit repair procedures, proceed with adjustments in Figures 40 - 51.

Adjust (Figures 40 through 51)

Tools Required:

J 9789-D or BT-3005A, Universal Carburetor Gage Set.
J 9789-90 or BT-8037, Float Level T-Scale.
J 9789-111 or BT-3006M, Linkage Bending Tool.
J 26701-A or BT-7704, Choke Valve Angle Gage.
J 23738-A or BT-7517, Hand Operated Vacuum Pump.

- Float, Figure 40.
- Pump, Figure 41.
- Air Valve Return Spring, Figure 42.
- Choke Stat Lever, Figure 43.
- Choke Valve Angle Gage, Figure 44.
- Choke Link - Fast Idle Cam, Figure 45.
- Vacuum Break Information, Figure 46.
- Primary Side Vacuum Break, Figure 47.
- Air Valve Link, Figure 48.
- Unloader, Figure 49.
- Secondary Throttle Lockout, Figure 50.
- Specifications are in Figure 51.

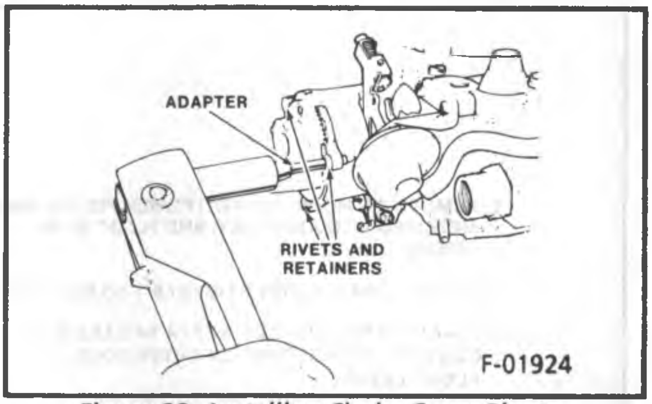


Figure 39 - Installing Choke Cover Rivets

ELECTRIC CHOKE COVER AND STAT

Install or Connect (Figure 43, 39)

1. Place fast idle cam (352) on high step, against cam follower lever.
2. Electric choke cover and stat assembly (335) in the choke housing (340).
   - Be sure coil tang engages the choke stat lever, and notch in cover lines up with projection on housing.

Important
Ground contact for the electric choke is provided by the metal plate on the back side of the choke cover assembly. Do Not install a stat cover gasket.

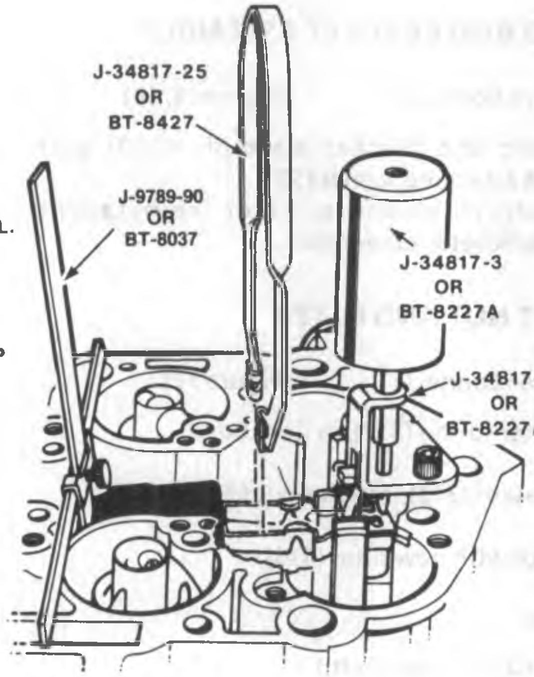
3. Choke cover retainers (331) and attaching rivets (330).
   - Use blind rivet tool to install rivets.
   - It may be necessary to use an adapter (tube) if the tool interferes with the electrical connector on the electric choke cover and stat (335).
   - Instructions are included in choke cover retainer kit.

CARBURETOR INSTALLATION AND ON-VEHICLE ADJUSTMENTS

Refer to Carburetors (SEC. 6C1) in the 1989 Light Duty Truck Service Manual for the remaining procedures:

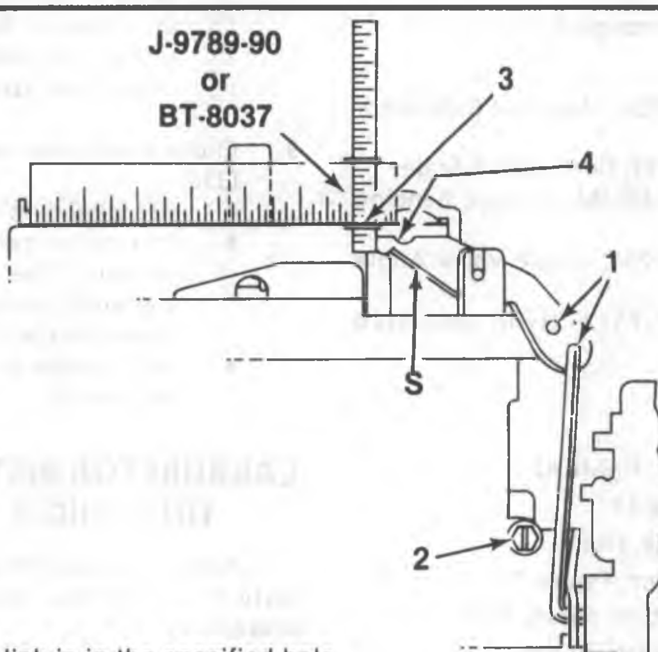
- Carburetor Installation
- Idle Mixture Adjustment
- Idle Speed Adjustments

1. REMOVE AIR HORN, GASKET, POWER PISTON AND METERING ROD ASSEMBLY, AND FLOAT BOWL INSERT.
2. ATTACH J-34817-1 OR BT-8227A-1 TO FLOAT BOWL.
3. PLACE J-34817-3 OR BT-8227A IN BASE WITH CONTACT PIN RESTING ON OUTER EDGE OF FLOAT LEVER.
4. MEASURE DISTANCE FROM TOP OF CASTING TO TOP OF FLOAT, AT POINT 3/16" FROM LARGE END OF FLOAT. USE J-9789-90 OR BT-8037.
5. IF MORE THAN ±2/32" FROM SPECIFICATION, USE J-34817-25 OR BT-8427 TO BEND LEVER UP OR DOWN. REMOVE BENDING TOOL AND MEASURE, REPEATING UNTIL WITHIN SPECIFICATION.
6. CHECK FLOAT ALIGNMENT.
7. REASSEMBLE CARBURETOR.



F-01925

Figure 40 - Float Adjustment



1. Make sure the pump link is in the specified hole.
2. With the fast idle cam off the cam follower lever, turn the throttle stop screw out so it does not touch the throttle lever.
3. Measure the distance from the top of the choke valve wall to the top of the pump stem.
4. Adjust, if necessary, by supporting the pump lever at **S** and bending at the notch.

F-04367

Figure 41 - Pump Adjustment

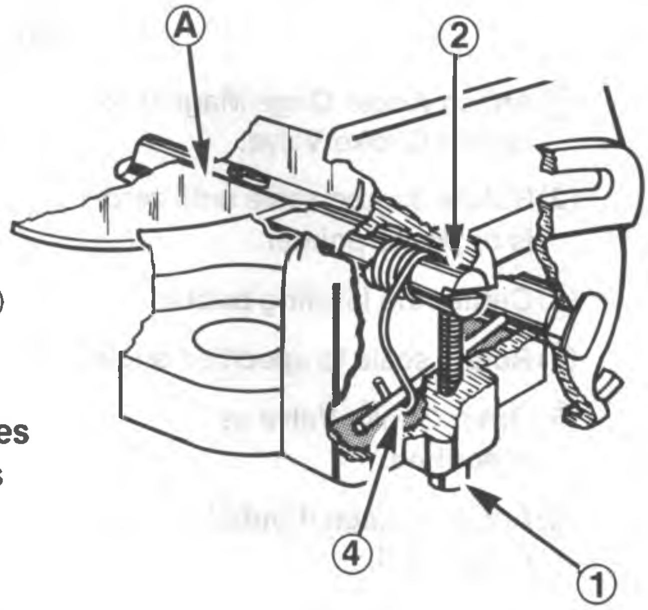
① Loosen set screw.

(2a) Turn Spring Fulcrum Pin ↺ until Air Valves (A) open.

(2b) Turn pin ↻ until Air Valves close, then additional turns specified.

③ Tighten set screw.

④ Apply Lithium grease to spring contact area.



F-01927

Figure 42 - Air Valve Return Spring Adjustment

① If riveted, drill out and remove rivets. Remove Choke Cover and Stat Assembly.

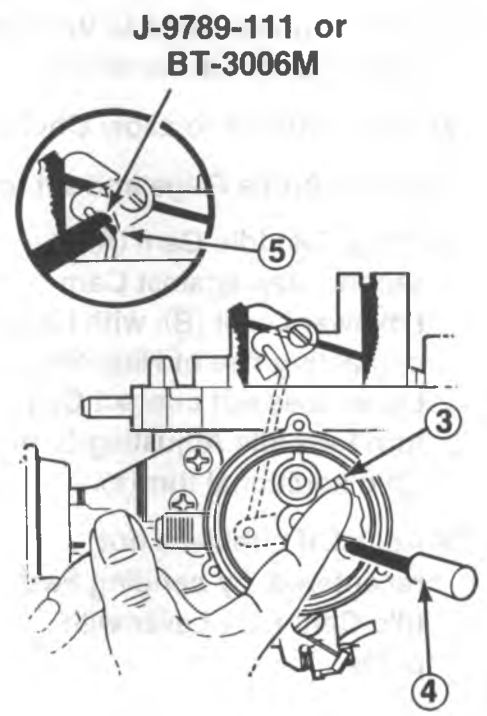
② Place Fast Idle Cam on high step against Cam Follower Lever.

③ Push up on Choke Stat Lever to close Choke Valve.

④ Check Stat Lever for correct orientation by inserting .120" plug gage in hole.

Gage should fit in hole and touch edge of lever.

⑤ Adjust, if necessary, by bending Choke Link.



F-01928

Figure 43 - Choke Stat Lever Adjustment

1. Attach Angle Gage Magnet to closed Choke Valve.
2. Rotate degree scale until zero is opposite pointer.
3. Center the leveling bubble.
4. Rotate scale to specified angle.
5. Open Choke Valve as described.
6. Adjust linkage if bubble is not recentered.

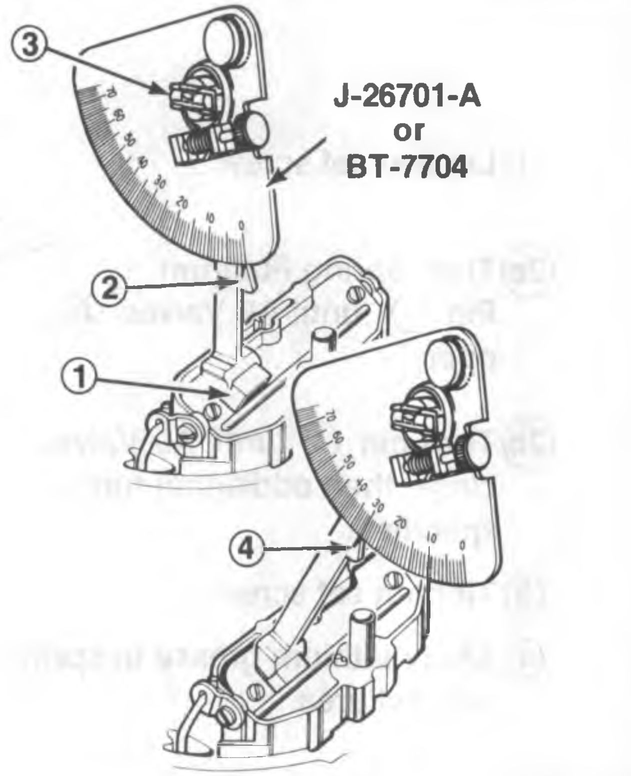


Figure 44 - Choke Valve Angle Gage

1. Attach rubber band to Vacuum Break Lever of Intermediate Choke Shaft.
2. Open Throttle to allow Choke Valve to close.
3. Set up Angle Gage and set to specification.
4. Place Fast Idle Cam (A) on second step against Cam Follower Lever (B), with Lever contacting rise of High Step. If Lever does not contact Cam, turn Fast Idle Adjusting Screw (C) in additional turn(s).
5. Adjust, if bubble is not recentered, by bending Fast Idle Cam Kick Lever with pliers.

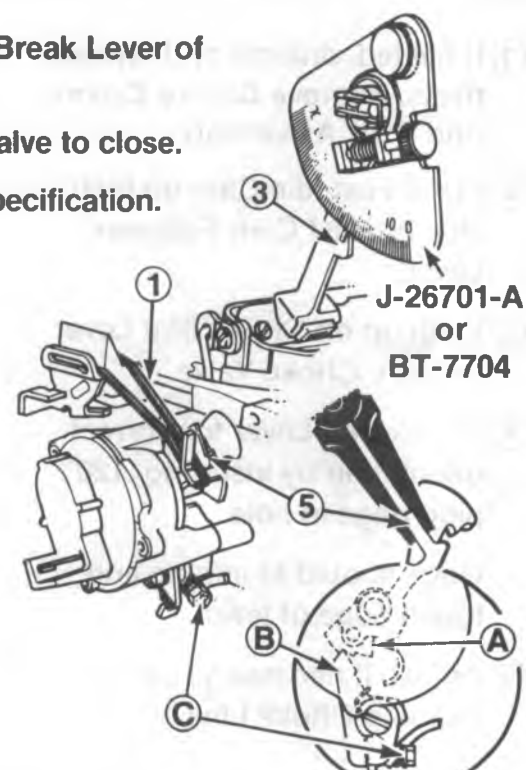


Figure 45 - Choke Link - Fast Idle Cam Adjustment

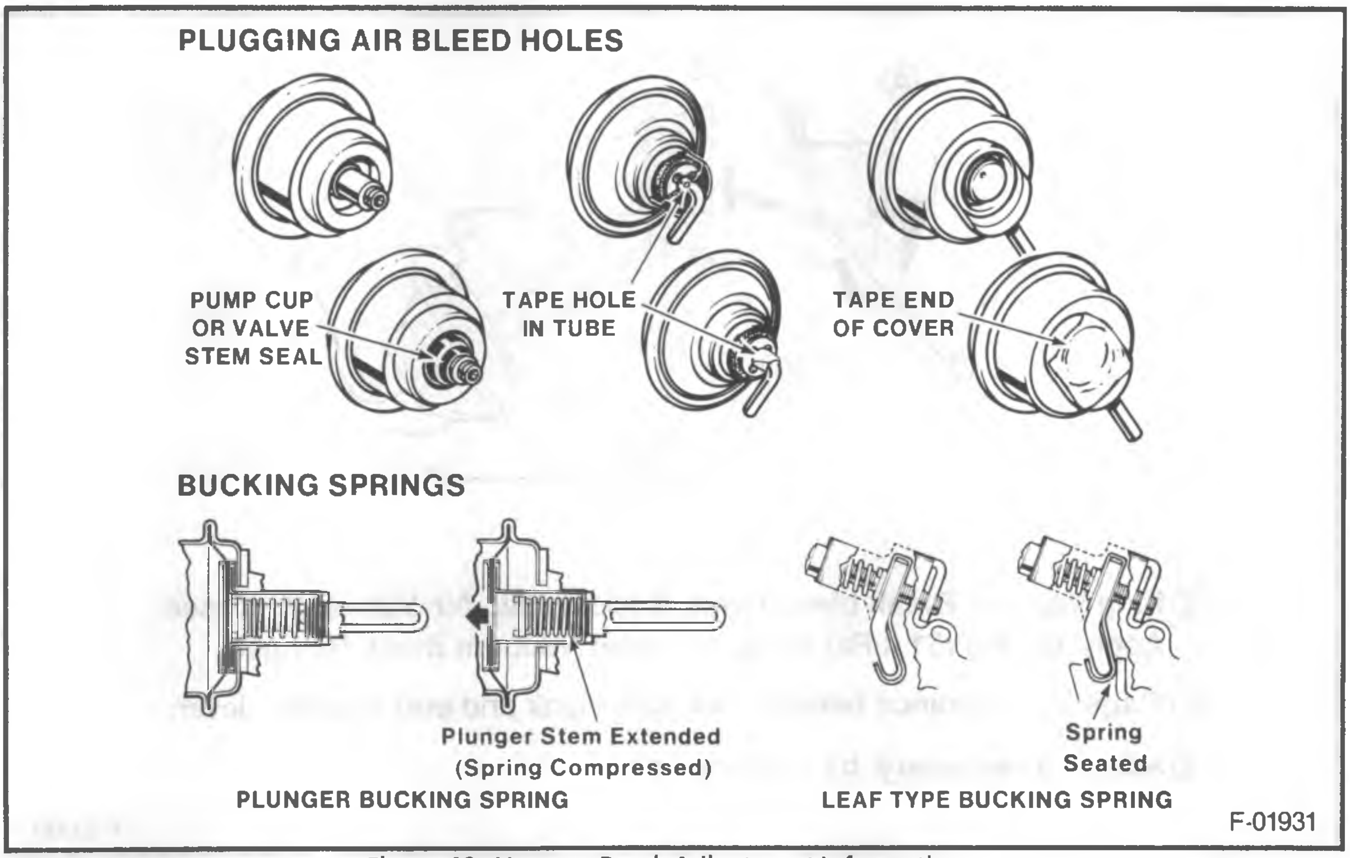


Figure 46 - Vacuum Break Adjustment Information

1. Attach rubber band to Vacuum Break Lever of Intermediate Choke Shaft.
2. Open Throttle to allow Choke Valve to close.
3. Set up Angle Gage and set to specification.
4. Plug Vacuum Break Bleed Holes, if applicable.

   Apply 15" Hg (51 k Pa) vacuum to seat Vacuum Break Plunger.

   Seat Bucking Spring (A), if applicable.

   On Quadrajets, if necessary:
   - Bend Air Valve Link (B) to permit full plunger travel.
   - Reapply vacuum.
5. Adjust, if bubble is not recentered, by turning screw.

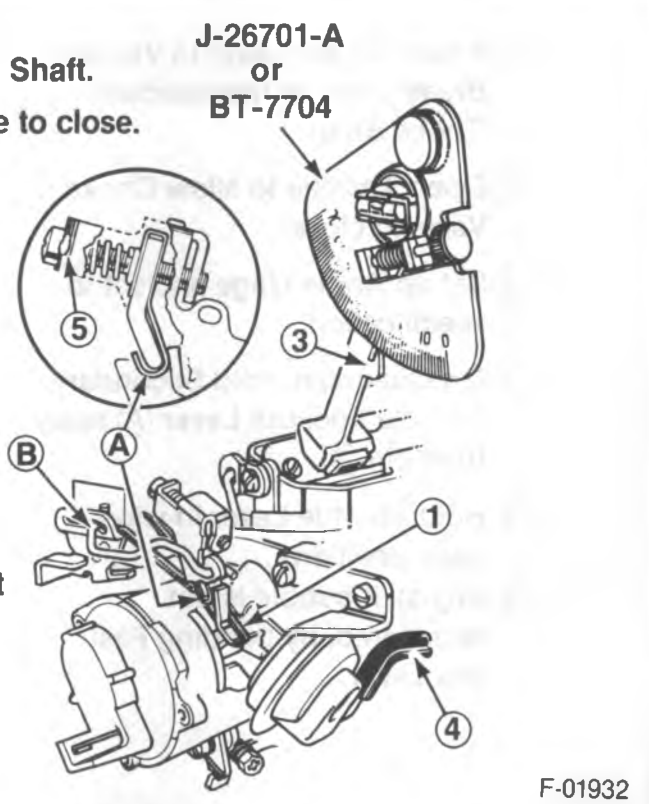
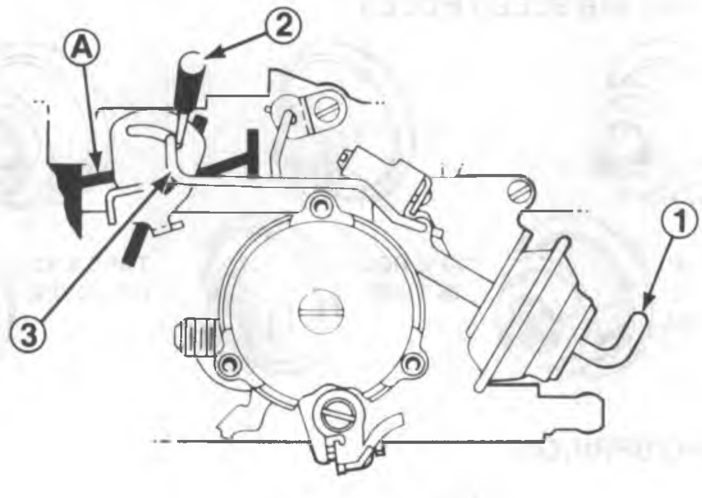


Figure 47 - Primary Side (Front) Vacuum Break Adjustment



①Plug Vacuum Break bleed holes, if applicable. Air Valves Ⓐ closed. Apply 15" Hg (51 k Pa) vacuum to seat Vacuum Break Plunger.

②Gage the clearance between Air Valve Link and end of slot in lever.

③Adjust, if necessary, by bending link.

F-01934

Figure 48 - Air Valve Link Adjustment

①Attach rubber band to Vacuum Break Lever of Intermediate Choke Shaft.

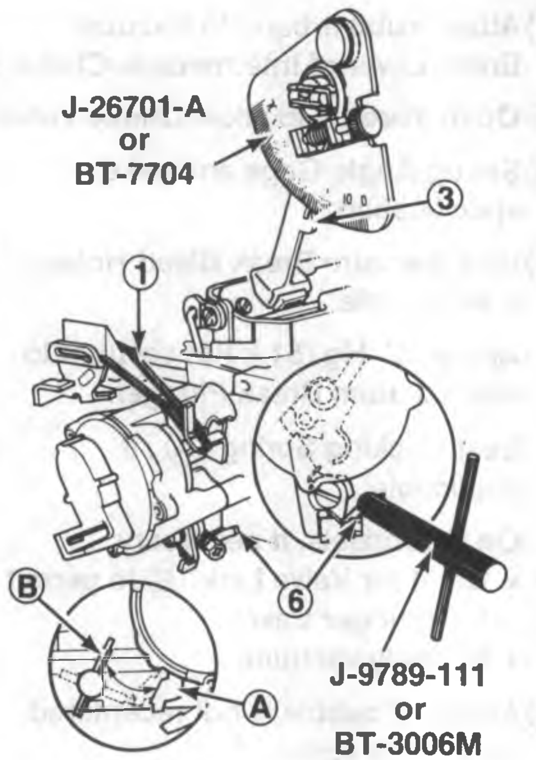
②Open Throttle to allow Choke Valve to close.

③Set up Angle Gage and set to specification.

④On Quadrajet, hold Secondary Throttle Lockout Lever Ⓐ away from pin Ⓑ.

⑤Hold Throttle Lever in wide open position.

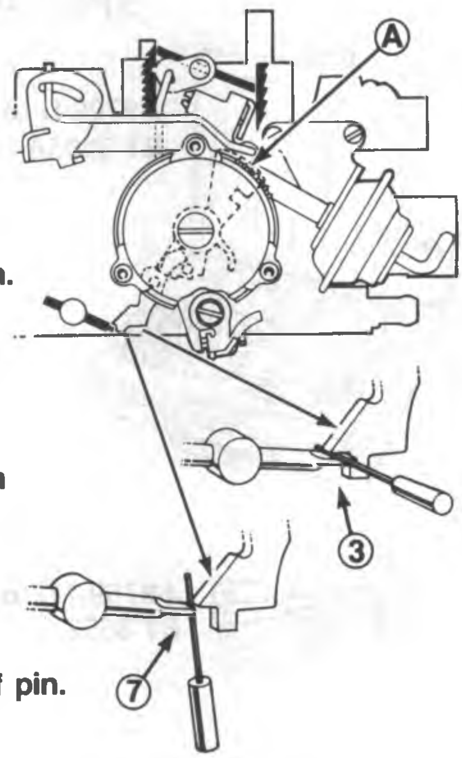
⑥Adjust, if bubble is not recentered, by bending Fast Idle Lever.



F-01936

Figure 49 - Unloader Adjustment

1. Place Fast Idle Cam Ⓐ on high step against Cam Follower Lever.
2. Hold Throttle Lever closed.
3. Gage the clearance between Lockout Lever and pin. It must be .015" ±.005".
4. Adjust, if necessary, by bending pin.
5. Push down on tail of Fast Idle Cam Ⓐ to move Lockout Lever away from pin.
6. Rotate Throttle Lever to bring Lockout Pin to position of minimum clearance with Lockout Lever.
7. Gage the clearance between Lockout Lever and pin. Minimum must be .015".
8. Adjust, if necessary, by filing end of pin.



F-01937

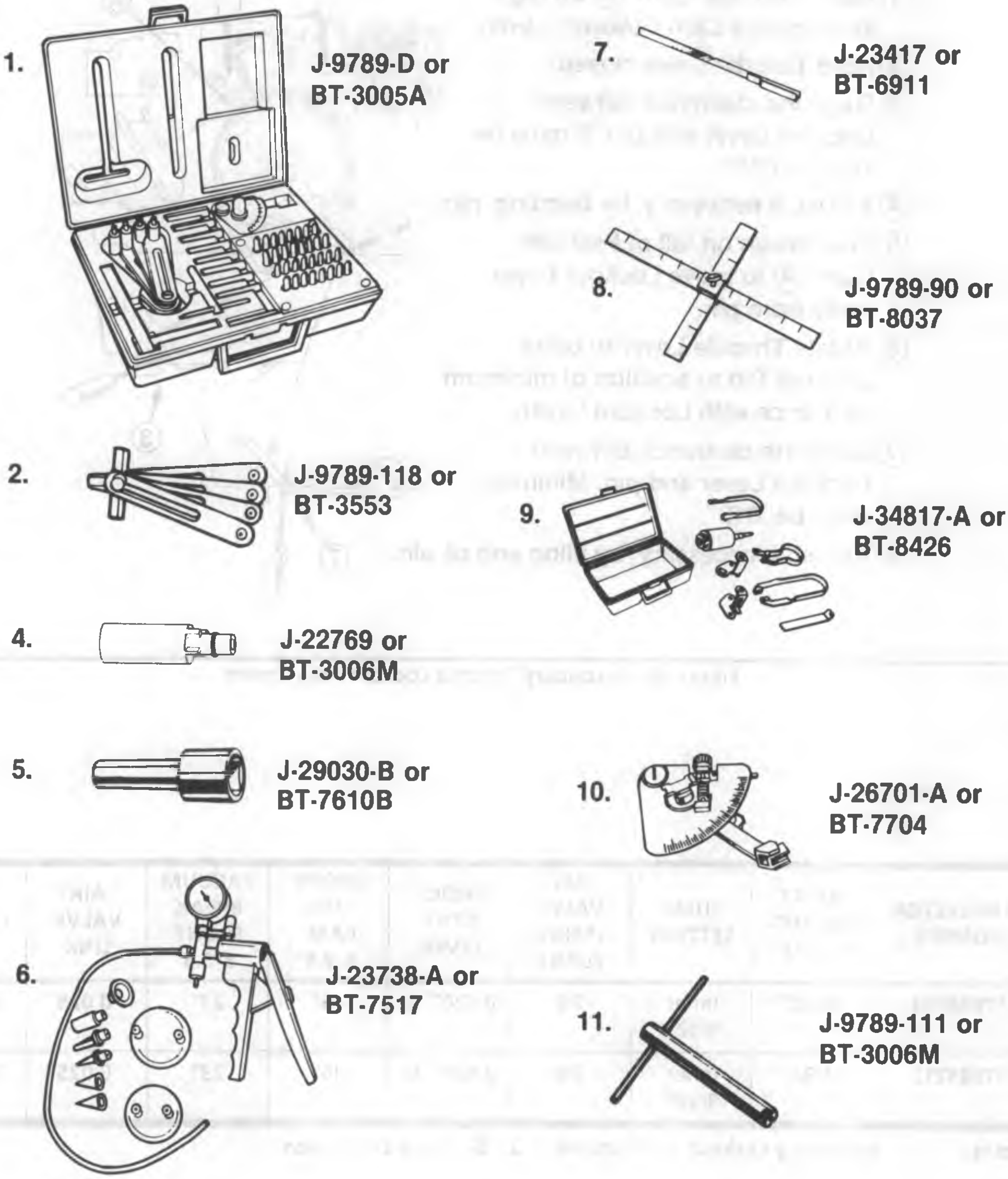
Figure 50 - Secondary Throttle Lockout Adjustment

CARBURETOR NUMBER	FLOAT SETTING ± 2/32"	PUMP SETTING	AIR VALVE SPRING TURNS	CHOKE STAT LEVER	CHOKE LINK CAM ± 2.5°	VACUUM BREAK FRONT ± 2.5°	AIR VALVE LINK	UN-LOADER ± 4°
17085004	13/32"	Inner 9/32"	7/8	0.120" G	46°	23°	0.025"	35°
17085212	13/32"	Inner 9/32"	7/8	0.120" G	46°	23°	0.025"	35°

Notes: 1. Secondary Lockout 0.015 inches 2. G = Gage Dimension

Figure 51 - Specifications

SPECIAL TOOLS



1. Universal Carburetor Gage Set
2. Carburetor Holding Stand
3. Pump Lever Pin Punch (Not Shown)
4. Needle Seat Tool
5. Idle Mixture Socket (Adjusting Tool)
6. Hand Operated Vacuum Pump
7. Choke Lever Installer
8. Float Level T-Scale
9. Float Positioning Tool Set
10. Choke Valve Angle Gage
11. Linkage Bending Tool

F-04264

SECTION 6C3

MODEL 220 THROTTLE BODY

CONTENTS

IDENTIFICATION

The throttle body identification number is stamped vertically on the throttle body next to the vacuum ports (figure 1). Refer to this number when servicing the throttle body. If replacing the throttle body, transfer the identification number to the new throttle body if not there.

Throttle body parts are shown in the disassembled view (figure 2).

Listed below are model identification numbers for Model 220 TBI Units.

Model Number	Application
17087087	S Truck w/2.8L
17087088	T Truck w/2.8L
17087162	C/K Truck w/4.3L
17089027	G, M Van w/4.3L
17089018	S/T Truck w/4.3L
17087019	C/K Truck w/5.0L
17087004	G Van w/5.0L
17087101	All w/5.7L (below 8600 GVW)
17087005	G Van w/5.7L (8600-10,000 GVW)
17089045	All w/5.7L and A.T. (8600-14,000 GVW)
17089046	All w/5.7L and M.T. (8600-14,000 GVW)
17087021	All w/7.4L and A.T.
17087257	All w/7.4L and M.T.

DESCRIPTION

The fuel control system has an electric fuel pump, located in the fuel tank with the gage sending unit, which pumps fuel to the TBI through the fuel supply line, then through and in-line fuel filter. The pump is designed to provide pressurized fuel at about 125 kPa (18 psi). On vehicles with two fuel tanks, there is an electric fuel pump and gage sending unit in each fuel tank.

A pressure regulator in the TBI keeps fuel available to the injectors at a constant pressure between 62 and 90Kpa (9 and 13 psi). Fuel in excess of injector needs is returned to the fuel tank by a separate line.

The ECM controls the injectors that are located in the fuel meter body assembly of the TBI. The injectors deliver fuel in one of several modes.

In order to properly control the fuel supply, the fuel pump is operated by the ECM through the fuel pump relay and oil pressure switch.

MODEL 220 TBI UNIT

Model 220, used on V6 and V8 engines consists of three major casting assemblies:

- Fuel meter cover with:
  - Pressure regulator
- Fuel meter body with:
  - Fuel injectors
- Throttle body with:
  - Idle air control (IAC) valve
  - Throttle position sensor (TPS)

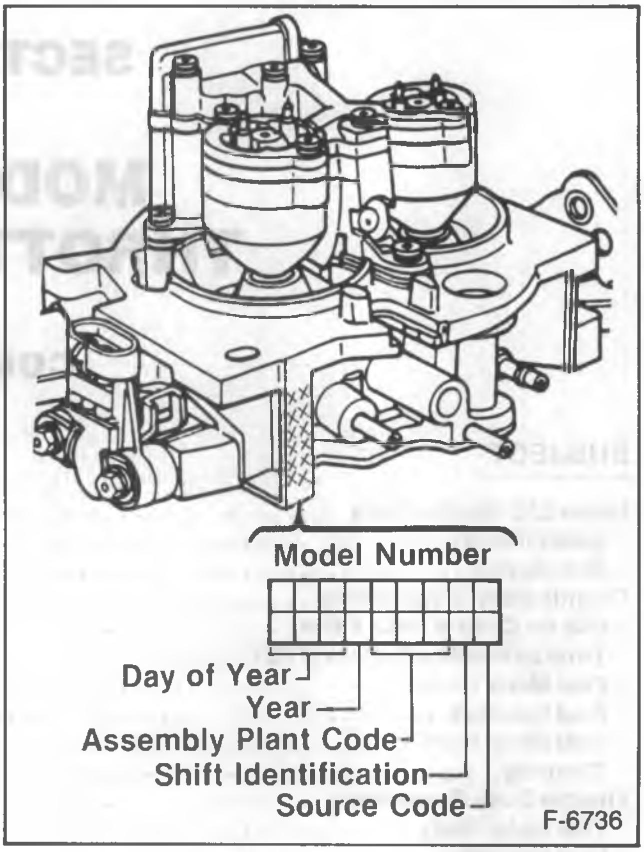


Figure 1—TBI Identification

THROTTLE BODY DISASSEMBLY

IDLE AIR CONTROL (IAC) VALVE

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent. Otherwise damage could result.

Important

All IAC valves on TBI Model 220 units (except those on the 7.4L engine) are thread-mounted and have a dual taper, 10mm diameter, pintle. On the 7.4L engine, the IAC valve is flange-mounted and has a 12mm diameter, dual taper pintle. Any replacement of an IAC valve must have the correct part number, with the appropriate pintle taper and diameter for proper seating of the valve in the throttle body.

Remove or Disconnect (Figures 3 and 4)

1. IAC valve.
   - On thread mounted units, use a 32mm (1¼″) wrench (figure 3).
   - On flange-mounted units, remove screw assemblies (figure 4).
2. IAC valve gasket or O-ring and discard.

THROTTLE POSITION SENSOR (TPS)

NOTICE: The TPS is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may result.

Important (Figure 5)

On 2.8L (V-6) engines, the TPS is adjustable, and is supplied with attaching screw retainers. On all other engines, it is non-adjustable, without retainers. In addition, on 2.8L (V-6) and 7.4 (V8) engines, the TPS has a horizontal electrical connector; whereas, on all other engines, the connector is a vertical one. Since these TPS configurations can be mounted interchangeably, be sure to order the correct one for your engine with the identical part number if being replaced.

Remove or Disconnect

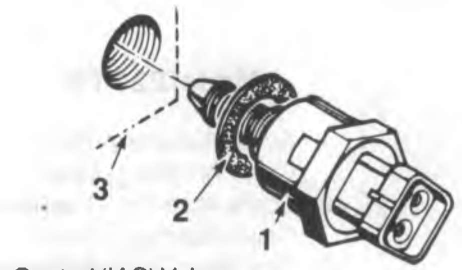
1. Two TPS attaching screw assemblies and retainers, (if applicable).
2. TPS from throttle body assembly.

Model 220 TBI

1. Screw Assembly - Fuel Meter Cover Attaching - Long
2. Screw Assembly - Fuel Meter Cover Attaching - Short
3. Fuel Meter Cover Assembly
4. Gasket - Fuel Meter Cover
5. Gasket - Fuel Meter Outlet
6. Seal - Pressure Regulator
7. Pressure Regulator
8. Injector - Fuel
9. Filter - Fuel Injector - Lower
10. O-Ring - Fuel Injector - Lower
11. O-Ring - Fuel Injector - Upper
12. Washer - Fuel Injector
13. Screw Assembly - Fuel Meter Body - Throttle Body Attaching
14. Fuel Meter Body Assembly
15. Gasket - Throttle Body to Fuel Meter Body
16. Gasket - Air Cleaner
17. O-Ring - Fuel Return Line
18. Nut - Fuel Outlet
19. O-Ring - Fuel Inlet Line
20. Nut - Fuel Inlet
21. Gasket - Fuel Outlet Nut
22. Gasket - Fuel Inlet Nut
23. Screw Assembly - TPS Attaching
24. Retainer - TPS Attaching Screw
25. Sensor - Throttle Position (TPS)
26. Plug - Idle Stop Screw
27. Screw Assembly - Idle Stop
28. Spring - Idle Stop Screw
29. Throttle Body Assembly
30. Gasket - Flange
31. Valve Assembly - Idle Air Control (IAC)
32. Gasket - Idle Air Control Valve Assembly
33. O-Ring - IACV
34. Screw Assembly - IACV Attaching

F-6737

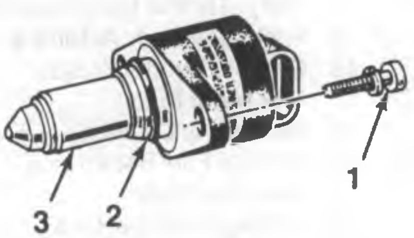
Figure 2—Model 220 TBI Parts Identification



1. Idle Air Control (IAC) Valve
2. IAC Valve Gasket
3. Throttle Body Assembly

F-6738

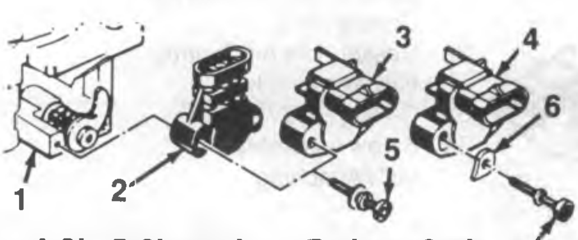
Figure 3—Thread Mounted Type IAC Valve



1. IACV Attaching Screw Assembly
2. External IACV O-Ring
3. Grime Shield

F-6739

Figure 4—Flange Mounted Type IAC Valve



1. Throttle Body Assembly
2. Throttle Position Sensor - Non-Adjustable
3. Throttle Position Sensor - Non-Adjustable
4. Throttle Position Sensor - Adjustable
5. Screw Assembly
6. Retainer

F-6740

Figure 5—TBI Model 220 TPS Configuration

FUEL METER COVER

The fuel meter cover assembly contains the fuel pressure regulator assembly. The regulator has been adjusted at the factory and should only be serviced as a complete preset assembly.

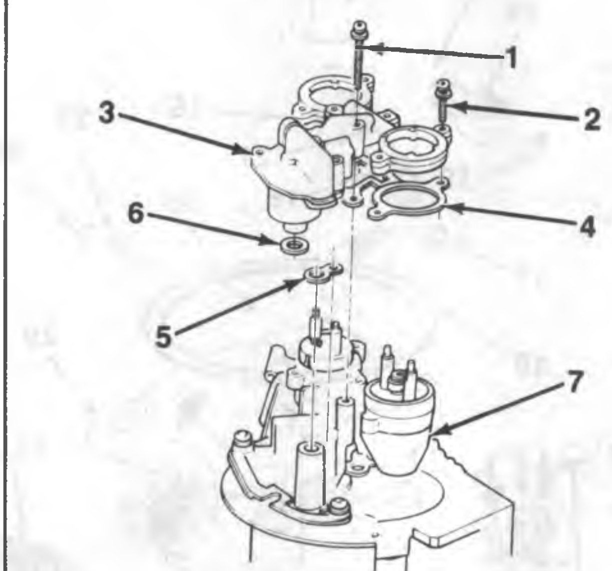
CAUTION: DO NOT remove the four screws securing the pressure regulator to the fuel meter cover. The fuel pressure regulator includes a large spring under heavy compression which, if accidentally released, could cause personal injury. Disassembly might also result in a fuel leak between the diaphragm and the regulator container.

Remove or Disconnect (Figure 6)

1. Long and short fuel meter cover screw assemblies.
2. Fuel meter cover assembly.

NOTICE: DO NOT immerse the fuel meter cover (with pressure regulator) in cleaner, as damage to the regulator diaphragm and gasket could occur.

3. Fuel meter outlet gasket and pressure regulator seal. Discard gaskets and seal.



1 ATTACHING SCREW-LONG
2 ATTACHING SCREW-SHORT
3 FUEL METER COVER ASSEMBLY
4 COVER GASKET
5 OUTLET GASKET
6 DUST SEAL
7 FUEL METER BODY ASSEMBLY

F-6741

Figure 6—Replacing Model 220 Fuel Meter Cover

FUEL INJECTORS

Each fuel injector (refer to figure 7) is serviced as a complete assembly only.

NOTICE: Use care in removing the fuel injectors to prevent damage to the electrical connector terminals, the injector filter, and the fuel nozzle. The fuel injector is serviced as a complete assembly only. Also, since the injectors are electrical components, they should not be immersed in any type of liquid solvent or cleaner as damage may occur.

Remove or Disconnect (Figures 7 and 8)

- With fuel meter cover gasket in place to prevent damage to casting, use a screwdriver and fulcrum to carefully lift out each injector (Figure 8).

1. Lower (small) O-rings from nozzle of injectors and discard.
2. Fuel meter cover gasket and discard.
3. Upper (large) O-rings and steel backup washers from top of fuel injector cavity and discard.

Inspect

- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

FUEL METER BODY

Remove or Disconnect (Figure 9)

1. Fuel inlet and outlet nuts and gaskets from the fuel meter body assembly. Discard gaskets.

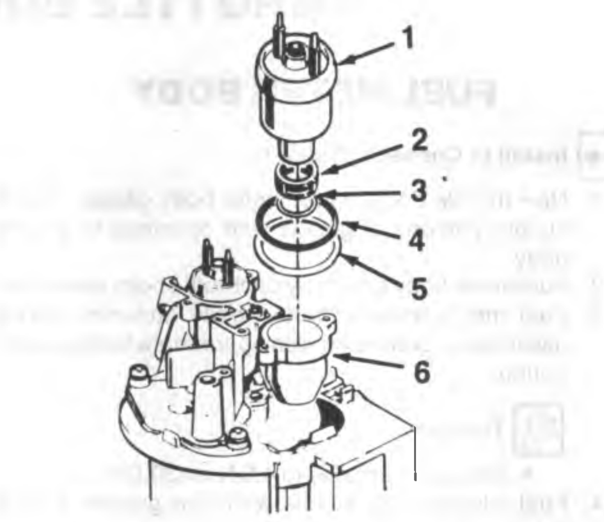
Important

Note locations of nuts, for proper reassembly later. Inlet nut has a larger passage than outlet nut.

2. Fuel meter body to throttle body attaching screw assemblies.
3. Fuel meter body assembly from throttle body assembly.
4. Throttle body to fuel meter body gasket and discard.

Inspect

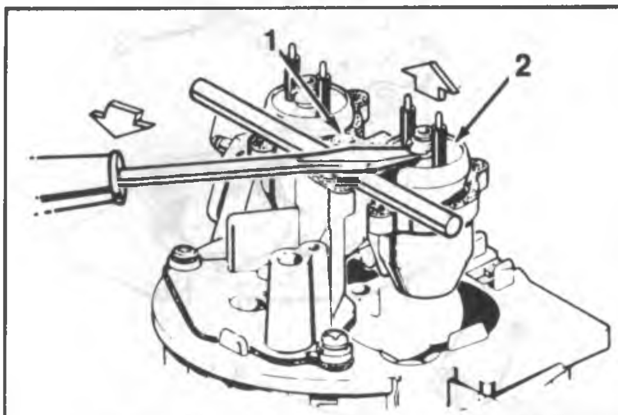
- For dirt, foreign material and casting warpage.



1. Fuel Injector
2. Inlet Filter
3. Lower "O" Ring
4. Upper "O" Ring
5. Washer
6. Fuel Meter Body Assembly

F-6742

Figure 7—Model 220 Fuel Injection Parts



1. Fuel Meter Cover Gasket
2. Removing Fuel Injector

F-6743

Figure 8—Removing TBI 220 Fuel Injector

CLEANING

1. Metal throttle body parts in cold immersion type cleaner, Carbon X(X-55) or equivalent.

NOTICE: Do not immerse IAC valve, Throttle Position Sensor, Fuel Meter Cover Assembly, or Fuel Injector Assemblies in cleaner as they may become non-functional.

2. Blow out all passages in the castings with compressed air.
    - Do not pass drill bits or wire through passages.

THROTTLE BODY REASSEMBLY

FUEL METER BODY

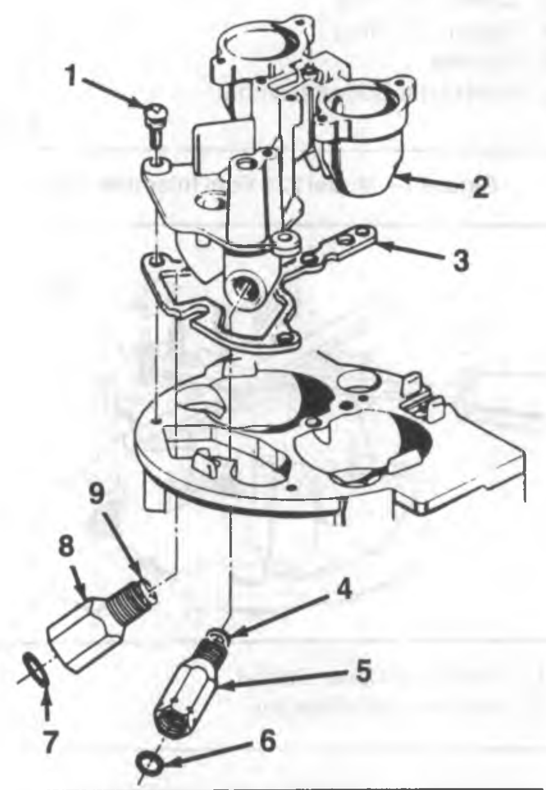
Install or Connect (Figure 9)

1. New throttle body to fuel meter body gasket. Match cut-out portions in gasket with openings in throttle body.
2. Fuel meter body assembly on throttle body assembly.
3. Fuel meter body-to-throttle body attaching screw assemblies, precoated with appropriate locking compound.

Tighten

- Screw assemblies to 4.0 N·m (30.0 lb. in.).

4. Fuel inlet and outlet nuts with new gaskets to fuel meter body assembly.



1. Attaching Screw Assembly
2. Fuel Meter Body Assembly
3. Gasket
4. Outlet Nut Gasket
5. Outlet Nut
6. Outlet "O" Ring
7. Inlet "O" Ring
8. Inlet Nut
9. Inlet Nut Gasket

F-6744

Figure 9—Fuel Meter Body Assembly

Tighten

- Inlet nut to 40.0 N·m (30.0 lb. ft.)
- Outlet nut to 29.0 N·m (21.0 lb. ft.)

FUEL INJECTORS

Install or Connect (Figure 10)

- Lubricate new lower (small) O-rings with automatic transmission fluid and push on nozzle end of injector until it presses against injector fuel filter.

1. Steel injector backup washer in counterbore of fuel meter body.

- Lubricate new upper (large) O-ring with automatic transmission fluid and install directly over the backup washer. Be sure O-ring is seated properly and is flush with top of fuel meter body surface.

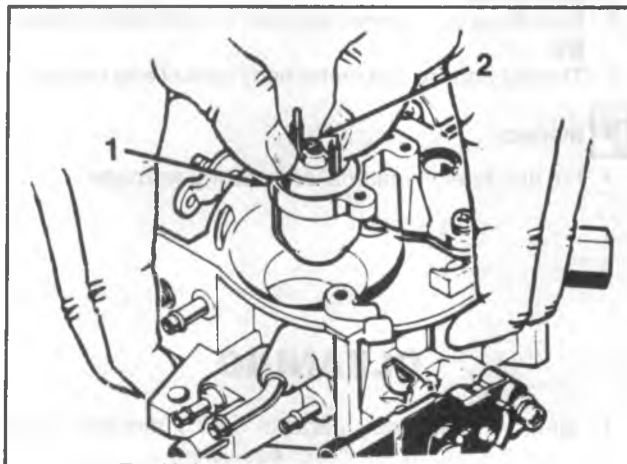
NOTICE: Backup washers and O-rings must be installed before injectors, or improper seating of large O-ring could cause fuel to leak.

2. Injector, aligning raised lug on each injector base with notch in fuel meter body cavity. Push down on injector until it is fully seated in fuel meter body (figure 10). (Electrical terminals of injector should be parallel with throttle shaft).

FUEL METER COVER

Install or Connect (Figure 6)

1. New pressure regulator seal, fuel meter outlet passage gasket, and cover gasket.
2. Fuel meter cover assembly.



1. Fuel Injector
2. Fuel Meter Body

F-6745

Figure 10—Installing Fuel Injector — TBI 220

3. Attaching screw assemblies, precoated with appropriate locking compound to threads. (Short screws are next to injectors.)

Tighten

- Screw assemblies to 3.0 N·m (28.0 lb. in.).

THROTTLE POSITION SENSOR

Install or Connect

1. TPS on throttle body assembly, while lining up TPS lever with TPS drive lever on throttle body.
2. Two TPS attaching screw assemblies.

Tighten

- Screw assemblies to 2.0 N·m (18.0 lb. in.).

3. Electrical connector.
4. Check for TPS output as outlined in Section 4 of the Light Duty Truck Fuel and Emissions Manual.

IDLE AIR CONTROL VALVE

NOTICE: Since the IAC valve was removed during service, it's operation should be tested electrically with the IAC/ISC Motor Tester (J-37027 or BT-8256K). However, if the valve pintle is extended electrically, it must also be retracted electrically. Before installing a IAC valve, measure the distance between the tip of the valve pintle and the mounting surface. If the dimension is greater than 28mm (1.10 inches), it must be reduced to prevent damage to the valve. This may be done electrically using an IAC/ISC motor tester (J-37027 or BT-8256K) or manually by exerting firm pressure, as shown in figure 11 or 12, with a slight side-to-side movement on valve pintle to retract it.

Important

No physical adjustment of the IAC valve assembly is required after installation. The IAC valve pintle is reset by turning the ignition "ON" for ten seconds and then "OFF". The ECM then resets the pintle to the correct position. Proper idle regulation should result.

Install or Connect (Figures 3 and 4)

1. IAC valve into throttle body as follows:
   - Thread-mounted valve — install with new gasket.
   - Flange-mounted valve — install with new lubricated O-ring, using attaching screw assemblies.

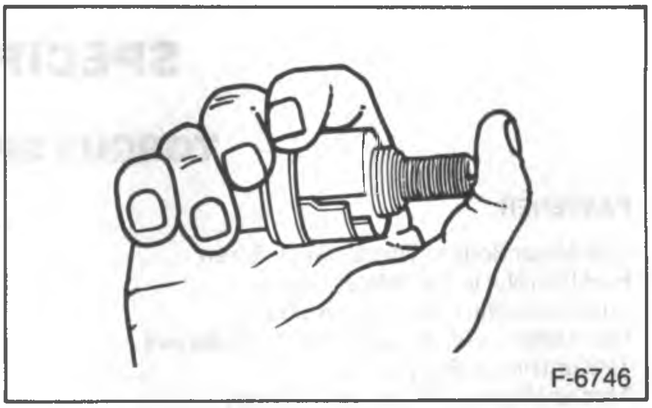


Figure 11—Adjusting Valve Pintle — Thread Type

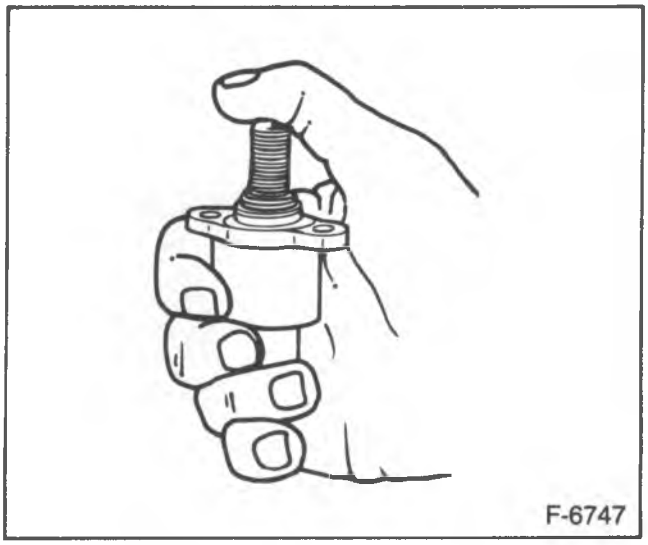


Figure 12—Adjusting Valve Pintle — Flange Type

NOTICE: New IAC valves have been reset at the factory and should be installed in the throttle body in an "as is" condition, without any adjustment.

Tighten

- Thread-mounted IAC valve assembly to 18.0 N·m (13.0 lb. ft.) with 32mm (1 1/4") wrench.
- Flange-mounted attaching screw assemblies to 3.2 N·m (28.0 lbs. in.)

SPECIFICATIONS

TORQUE SPECIFICATIONS

FASTENER	N·m	Ft. Lbs.	In. Lbs.
Fuel Meter Body to Throttle Body Screw	4.0		35
Fuel Inlet Nut to Fuel Meter Body	40.0	30	
Fuel Outlet Nut to Fuel Meter Body	29.0	21	
Fuel Meter Cover to Fuel Meter Body Screws	3.0		28
TPS to Throttle Body Screw	2.0		18
Thread-Mounted IAC to Throttle Body	18.0	13	
Flange-Mounted IAC to Throttle Body Screw	3.2		28

SECTION 6C4

MODEL 700 THROTTLE BODY

CONTENTS

IDENTIFICATION

The throttle body identification number is stamped on the fuel meter assembly below the fuel pressure regulator (figure 1). Refer to this number when servicing the throttle body.

If replacing the throttle body or fuel meter assembly, transfer the identification number to the new throttle body or fuel meter cover if not there.

Throttle body parts are shown in disassembled view (figure 2).

Listed below are model identification numbers for Model 700 TBI Units.

Model Number	Application
17087282	S/T w/2.5L
17087283	M w/2.5L

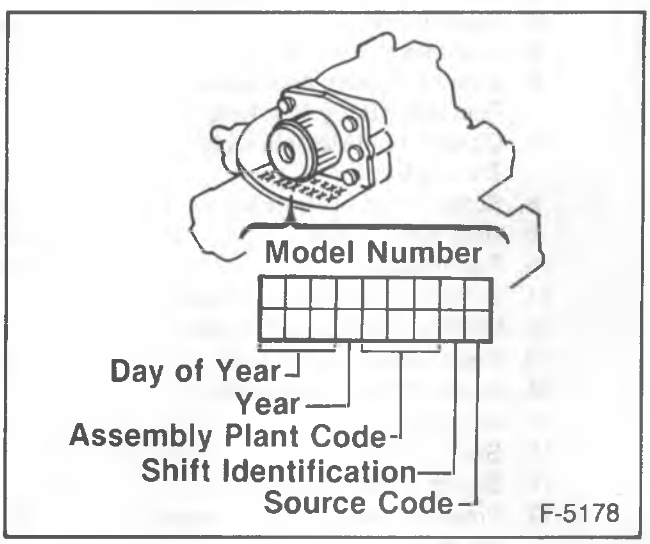
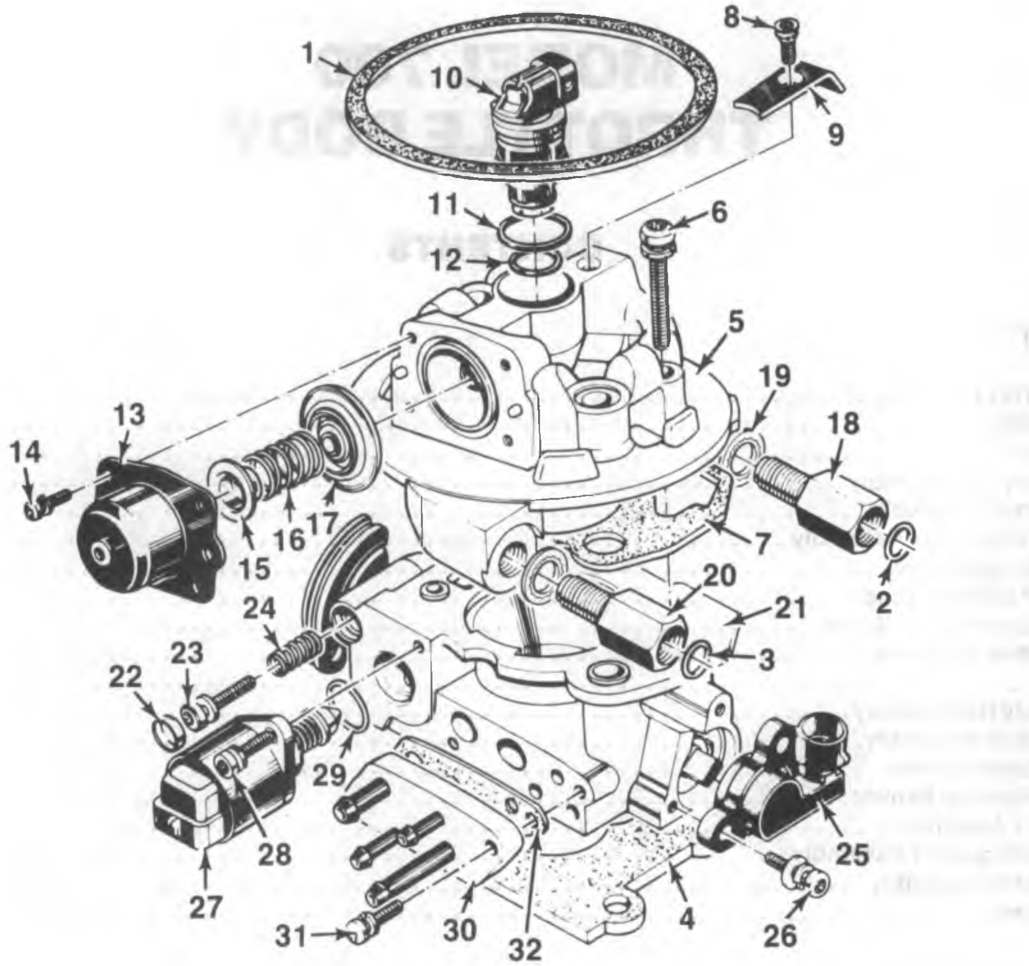


Figure 1—TBI Identification



1. Gasket - Air Cleaner
2. O-Ring - Fuel Line Inlet Nut
3. O-Ring - Fuel Line Outlet Nut
4. Gasket - Flange
5. Fuel Meter Assembly
6. Screw & Washer Assembly - Fuel Meter Body Attaching
7. Gasket - Fuel Meter Body to Throttle Body
8. Screw - Injector Retainer
9. Retainer - Injector
10. Fuel Injector
11. O-Ring - Fuel Injector - Upper
12. O-Ring - Fuel Injector - Lower
13. Pressure Regulator Cover
14. Screw - Pressure Regulator Attaching
15. Seat - Spring
16. Spring - Pressure Regulator
17. Pressure Regulator Diaphragm Assembly
18. Nut - Fuel Inlet
19. Seal - Fuel Nut
20. Nut - Fuel Outlet
21. Throttle Body Assembly
22. Plug - Idle Stop Screw
23. Screw & Washer Assembly - Idle Stop
24. Spring - Idle Stop Screw
25. Sensor - Throttle Position (TPS)
26. Screw & Washer Assembly - TPS Attaching
27. Idle Air Control Valve (IACV)
28. Screw - IACV Attaching
29. O-Ring - IACV
30. Tube Module Assembly
31. Screw Assembly - Tube Module Assy.
32. Gasket - Tube Module Asembly

F-6749

Figure 2—Model 700 TBI Parts Identification

DESCRIPTION

The fuel control system has an electric fuel pump, located in the fuel tank on the gage sending unit, which pumps fuel to the TBI through the fuel supply line, then through an in-line fuel filter. The pump is designed to provide pressurized fuel at about 125 kPa (18 psi).

A pressure regulator in the TBI keeps fuel available to the injectors at a constant pressure between 62 and 90 kpa (9 and 13 psi). Fuel in excess of injector needs is returned to the fuel tank by a separate line.

The ECM controls the injectors that are located in the fuel meter body assembly of the TBI. The injectors deliver fuel in one of several modes.

In order to properly control the fuel supply, the fuel pump is operated by the ECM through the fuel pump relay and oil pressure switch.

MODEL 700 TBI UNIT

Model 700, used on the L4 engine, is made up of two major casting assemblies:

- Fuel meter assembly with:
  - Pressure regulator
  - Fuel injector
- Throttle body with:
  - Idle air control (IAC)
  - Throttle position sensor (TPS)

THROTTLE BODY DISASSEMBLY

FUEL INJECTOR ASSEMBLY

The fuel injector (refer to Figure 3) is serviced only as a complete assembly.

NOTICE: Use care in removing injector, to prevent damage to the electrical connector on top of the injector, and nozzle. Also, because the fuel injector is an electrical component, it should not be immersed in any type of liquid solvent or cleaner, as damage may occur.

Remove or Disconnect (Figures 3 through 5)

1. Electrical connector to fuel injector.
2. Injector retainer screw and retainer.
   - Using a fulcrum, place a screwdriver blade under ridge opposite connector end and carefully pry injector out (refer to figure 4).
3. Upper and lower O-rings from injector and in fuel injector cavity and discard.

Inspect

- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

Important

Be sure to replace the injector with an identical part. Injectors from other models can fit in the Model 700 TBI, but are calibrated for different flow rates. (Refer to figure 5 for part number location.)

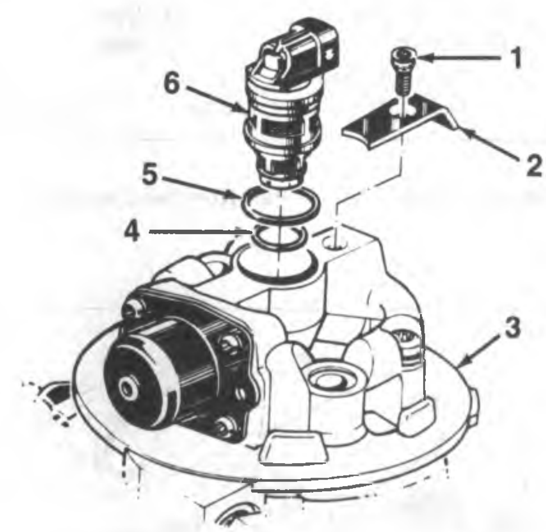
PRESSURE REGULATOR ASSEMBLY

NOTICE: To prevent leaks, the pressure regulator diaphragm assembly must be replaced whenever the cover is removed.

Remove or Disconnect (Figure 6)

1. Four pressure regulator attaching screws, while keeping pressure regulator compressed.

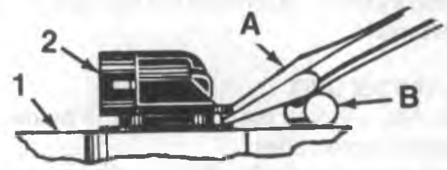
CAUTION: The pressure regulator contains a large spring under heavy compression. Use care when removing the screws to prevent personal injury.



1. Screw Assembly
2. Retainer
3. Fuel Meter Assembly
4. Lower "O" Ring
5. Upper "O" Ring
6. Injector

F-6750

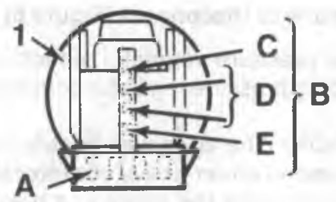
Figure 3—Model 700 Fuel Injection Parts



1. Fuel Meter Body
2. Fuel Injector
A. Screwdriver
B. Fulcrum

F-6751

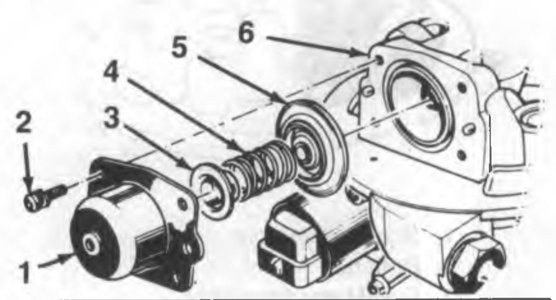
Figure 4—Removing TBI 700 Fuel Injector



1. Fuel Injector (Top View)
A. Part Number
B. Build Date Code
C. Month
   1-9 (Jan.-Sept.)
   O, N, D (Oct., Nov., Dec.)
D. Day
E. Year

F-6752

Figure 5—Fuel Injector Part Number Location



1. Pressure Regulator Cover
2. Screw Assembly
3. Spring - Seat
4. Spring
5. Diaphragm
6. Fuel Meter Assembly

F-6753

Figure 6—TBI 700 Pressure Regulator

2. Pressure regulator cover assembly.
3. Pressure regulator spring.
4. Spring seat.
5. Pressure regulator diaphragm assembly.

Inspect

- Pressure regulator seat in fuel meter body cavity for pitting, nicks, or irregularities, (Use magnifying glass if necessary.) If any of above is present, the whole fuel body casting must be replaced.

FUEL METER ASSEMBLY

Remove or Disconnect (Figure 7)

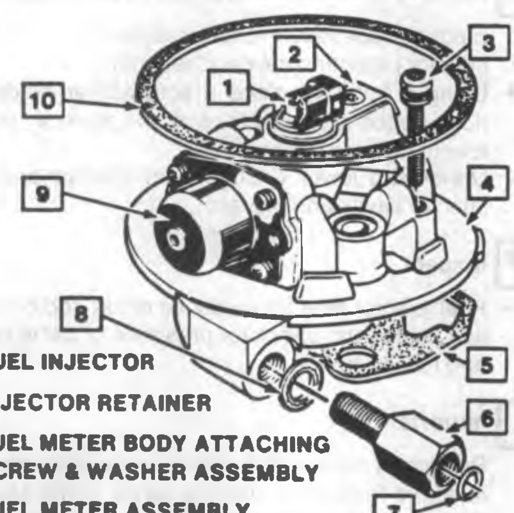
1. Two fuel meter body attaching screw and washer assemblies.
2. Fuel meter assembly from throttle body assembly.
3. Fuel meter body to throttle body gasket and discard.

THROTTLE POSITION SENSOR

Remove or Disconnect (Figure 8)

1. Screw assemblies.
2. Throttle Position Sensor.

NOTICE: The throttle position sensor is an electrical component, and should not be immersed in any type of liquid solvent or cleaner, as damage may result.



1 FUEL INJECTOR
2 INJECTOR RETAINER
3 FUEL METER BODY ATTACHING SCREW & WASHER ASSEMBLY
4 FUEL METER ASSEMBLY
5 FUEL METER BODY TO THROTTLE BODY GASKET
6 FUEL OUTLET NUT
7 FUEL LINE OUTLET NUT O-RING
8 FUEL NUT SEAL
9 PRESSURE REGULATOR COVER ASSEMBLY
10 AIR FILTER GASKET

F-6754

Figure 7—Fuel Meter Assembly — TBI 700

IDLE AIR CONTROL (IAC) VALVE

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent. Otherwise damage could result.

Important

On TBI Model 700, the IAC valve is flange-mounted, with dual taper, 10mm diameter pintle. If replacement is necessary, only an IAC valve identified with the correct part number (having the appropriate pintle shape and diameter) should be used.

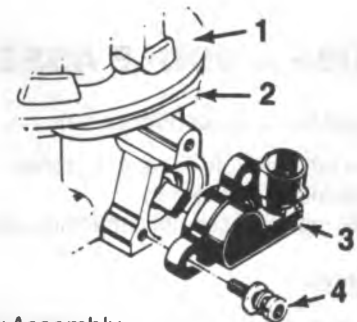
Remove or Disconnect (Figure 9)

1. Screw assemblies and IAC valve.
2. IAC valve o-ring and discard.

TUBE MODULE ASSEMBLY

Remove or Disconnect (Figure 10)

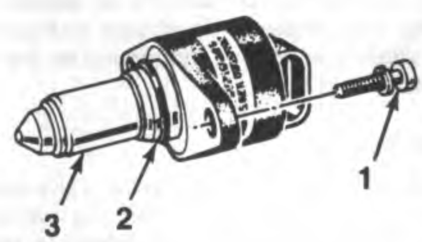
1. Tube module assembly attaching screws.
2. Tube module assembly.
3. Tube module assembly gasket and discard.



1. Fuel Meter Assembly
2. Throttle Body Assembly
3. Throttle Position Sensor
4. TPS Attaching Screw & Washer Assembly

F-6755

Figure 8—Throttle Position Sensor (TPS) TBI 700



1. IACV Attaching Screw Assembly
2. External IACV O-Ring
3. Grime Shield

F-6739

Figure 9—Flange Mounted IAC Valve — TBI 700

CLEANING

Clean

- Metal throttle body parts in cold immersion type cleaner, Carbon X (X-55) or equivalent.

NOTICE: Do not immerse IAC Valve, Throttle Position Sensor, Fuel Injector or Pressure Regulator in cleaner as they may become non-functional.

- Old gasket material from surface of throttle body assembly to insure proper seal of new gaskets.
- IAC valve seating surfaces on throttle body to assure proper seal of new O-ring and contact of IAC valve flange.
- Blow out all passages in the castings with compressed air. Do not pass drill bits or wire through passages.

THROTTLE BODY REASSEMBLY

TUBE MODULE ASSEMBLY

Install or Connect (Figure 10)

1. New tube module assembly gasket.
2. Tube module assembly.
3. Tube module assembly attaching screws.

Tighten

- Screw assemblies to 3.0 N·m (28.0 lb. in.).

IDLE AIR CONTROL (IAC) VALVE

NOTICE: Before installing an IAC valve, measure the distance between the tip of the valve pintle and the mounting surface. If the dimension is greater than 28mm (1.10 inches) it must be reduced to prevent damage to the valve. This may be done electrically using an IAC/ISC Motor Tester (J-37027 or BT-8256K) or manually be exerting firm pressure as shown in Figure 11, with a slight side-to-side movement on the valve pintle to retract it.

Important

No physical adjustment of the IAC valve assembly is required after installation. The IAC valve pintle is reset by the ECM. When the vehicle is operated at normal engine temperature at approximately 30 mph (48 km/hr.), the ECM causes the valve pintle to seat in the throttle body. The ECM then has a reset procedure to set the correct pintle position. Proper idle regulation should result.

Install or Connect (Figure 9)

1. Lubricate new O-ring with transmission fluid and install on IAC valve.
2. IAC valve to throttle body.

NOTICE: New IAC valves that have been preset at the factory should be installed in the throttle body in an "as is" condition, without any adjustment.

3. IAC valve attaching screw assemblies that have been coated with appropriate thread locking compound.

Tighten

- Screw assemblies to 3.2 N·m (28.0 lb. in.).

THROTTLE POSITION SENSOR

Install or Connect (Figure 8)

1. With throttle valve in normally closed position, install TPS on throttle shaft and rotate counterclockwise to align mounting holes.
2. Attaching screw and washer assemblies.

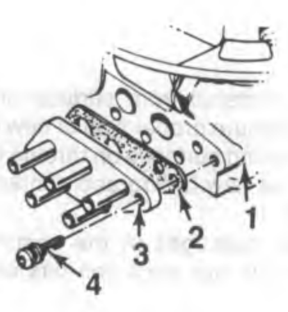
Tighten

- Screw assemblies to 2.0 N·m (18.0 lb. in.).

FUEL METER ASSEMBLY

Install or Connect (Figure 7)

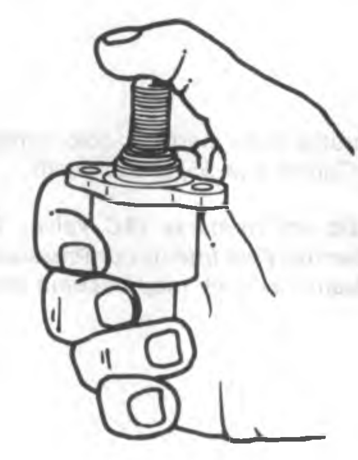
1. New fuel meter body to throttle body gasket. Match cut-out portions of gasket with openings in throttle body assembly.
2. Fuel meter assembly.
3. Two fuel meter body attaching screw and washer assemblies that have been coated with appropriate locking compound.



1. Throttle Body Assembly
2. Tube Module Assembly Gasket
3. Tube Module Assembly
4. Tube Module Screw Assembly

F-6757

Figure 10—Tube Module Assembly — TBI 700



F-6747

Figure 11—Adjusting Valve Pintle — TBI 700

Tighten

- Attaching screws to 6.0 N·m (53 lb. in.).

PRESSURE REGULATOR ASSEMBLY

Install or Connect (Figure 6)

1. New pressure regulator diaphragm assembly, making sure it is seated in groove in fuel meter body.
2. Regulator spring seat and spring into cover assembly.
3. Cover assembly over diaphragm, while aligning mounting holes.

NOTICE: Use care while installing the pressure regulator to prevent misalignment of diaphragm and possible leaks.

4. Four screw assemblies that have been coated with appropriate thread locking compound, while maintaining pressure on regulator spring.

Tighten

- Attaching screw assemblies to 2.5 N·m (22.0 lb. in.).

FUEL INJECTOR ASSEMBLY

Install or Connect (Figure 3)

- Lubricate new upper and lower O-rings with automatic transmission fluid and place them on injector. (Make sure upper O-ring is in groove and lower one is flush up against filter.)

1. Injector assembly, pushing it straight into fuel injector cavity.

Important

Be sure the electrical connector end on the injector is facing in the general direction of the cut-out in the fuel meter body for the wire grommet.

2. Injector retainer, using appropriate thread locking compound on retainer attaching screw.

Tighten

- Injector retainer attaching screw to 3.0 N·m (27.0 lb. in.).

TORQUE SPECIFICATIONS

FASTENER	N·m	Lb. In.
Tube Module to Throttle Body Screw	3.0	28.0
IAC Valve to Throttle Body Screw	3.0	28.0
TPS to Throttle Body Screw	2.0	18.0
Fuel Meter Body to Throttle Body Screw	6.0	53.0
Pressure Regulator Cover to Fuel Meter Body Screw	2.5	22.0
Injector Retainer to Fuel Meter Body Screw	3.0	28.0

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

SECTION 6D1

SI SERIES GENERATORS

CONTENTS

DELCO-REMY 12-SI 100 AND 17-SI 100 GENERATORS

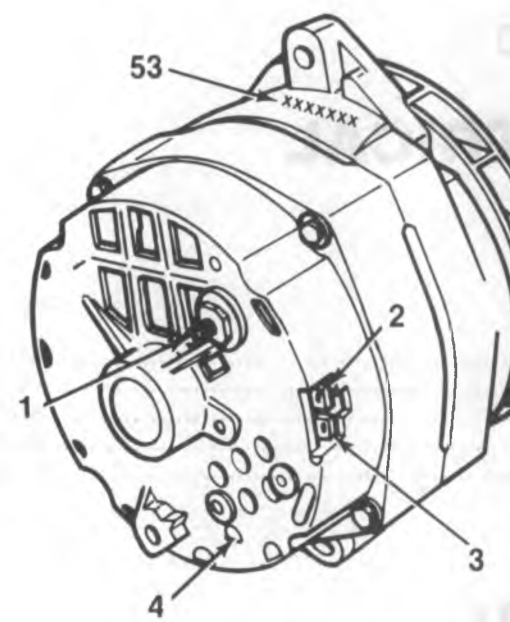
DESCRIPTION

The generators shown in figures 1 and 2 feature a solid state regulator mounted inside the slip ring end frame. The SI-series indicates "Systems Integral" (generator with built-in regulator). All regulator components are enclosed in a solid mold. This unit, along with the brush holder assembly, is attached to the slip ring end frame. The regulator voltage setting is not adjustable.

The generator rotor bearings contain enough grease to eliminate periodic lubrication. Two brushes carry current through two slip rings to the field coil.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator AC voltages to a DC voltage which appears at the generator output "BAT" terminal. Generator field current is supplied through a diode trio connected to the stator windings. A capacitor, or condenser, mounted to the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

The generator part number is the seven-digit number stamped on the drive end frame above the build date (figure 1).



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Test Hole
53. Part Number

F-04478

Figure 1—12-SI Series 100 Generator

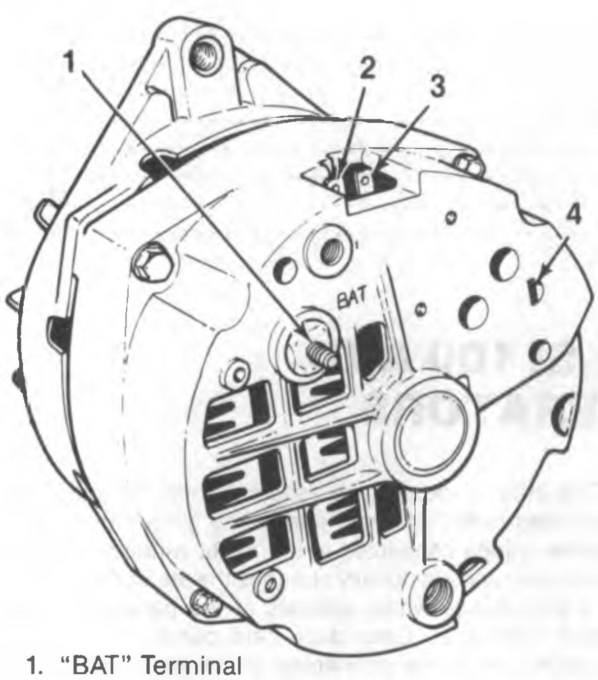
OPERATING PRINCIPLES (Figure 3)

The battery is directly connected to the No. 2 terminal on the generator. This supplies voltage through resistor R5 to the base-emitter of transistor TR3. Transistor TR3 turns on which then turns on transistor TR1 which allows field current to flow through to ground. Also, resistors R2 and R3 are connected to the battery through terminal No. 2, but the discharge current of the battery is very low because of the resistance values of R2, R3, R5, TR1 and TR3.

At this point, transistors TR3 and TR1 are turned on, but no current is flowing through them. Now the engine control switch is closed, allowing current to flow from the battery through the indicator lamp to the No. 1 terminal on the generator. From No.1 terminal, the current goes through resistor R1, transistors TR3 and TR1 to ground, turning on the indicator lamp. Resistor R6 carries some of the indicator lamp current.

When the generator is spinning, AC voltages are generated in the "Y" stator windings (delta windings on the 17-SI). The AC is converted to DC current in the diode trio, and is then fed through to the field to transistor TR1 and to ground. At the same time, the DC voltage from the diode trio causes the indicator lamp current to stop, making the indicator lamp go out.

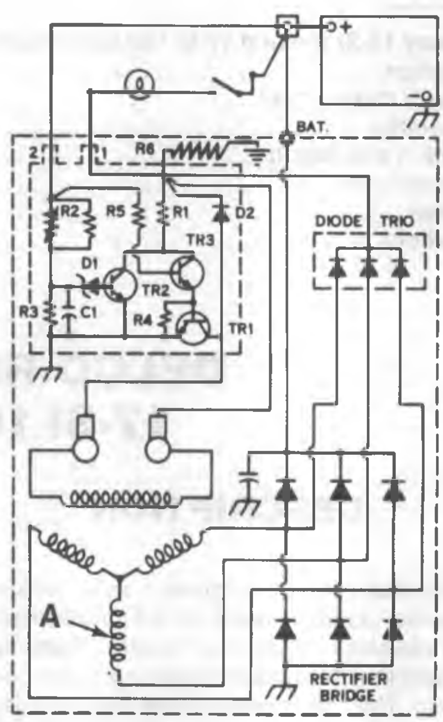
Now the AC voltages are converted to DC in the rectifier bridge. This DC voltage is then fed through the "BAT" terminal to the battery, thus keeping the battery charged and supplying electricity to the vehicle electrical loads.



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Field Ground Hole

F-04193

Figure 2—17-SI Series 100 Generator



A. "Y" Stator. (Stator is Delta Wound on the 17-SI 100.)

F-04194

Figure 3—Generator Schematic

As the generator speed and voltage increase, the voltage between R2 and R3 increases to the point where the zener diode D1 conducts.This turns on transistor TR2 which causes TR3 and TR1 to turn off. With TR1 off, the field current and system voltage decrease. D2 stops conducting when the voltage drops to a certian level, causing TR3 and TR1 to turn back on. This cycle repeats many times per second to limit the generator voltage to a preset value.

Capacitor C1 smoothes out the voltage across R3. Resistor R4 prevents excessive current through TR1 at high temperatures. Diode D2 prevents induced high voltages in the field windings when TR1 turns off. Resistor R2 is a thermister which causes the regulated voltage to vary with temperature, thus providing the optimum voltage for charging the battery.

Some installations do not use an indicator lamp. Instead a resistor or resistance wire is used in its place. The charge rate is then indicated by a voltmeter.

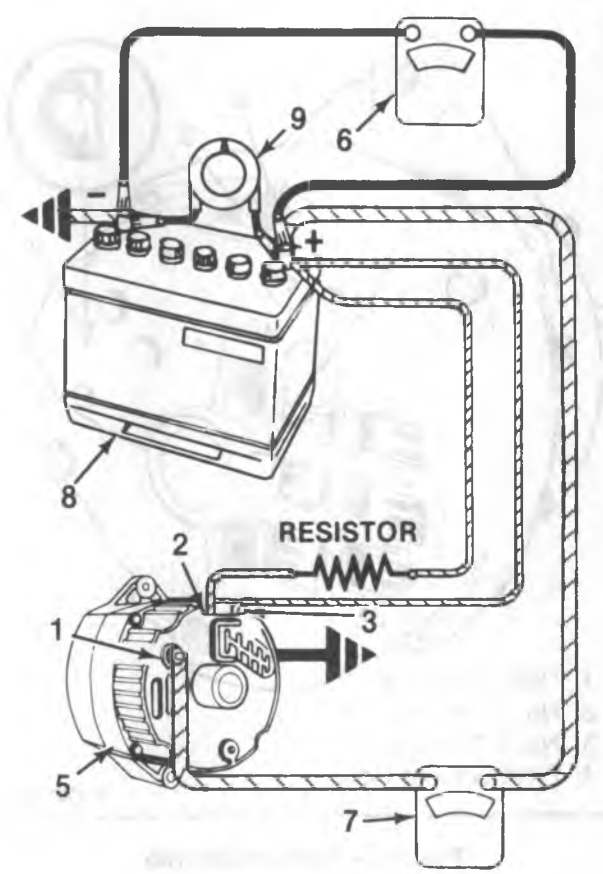
If an open should occur in the No. 2 terminal circuit, TR3 and TR1 will turn off, field current will stop and the indicator lamp current will flow through R6 to ground, causing the indicator lamp to come on. Also, an open in the field circuit will cause the indicator lamp to turn on because indicator lamp current will flow through R6 to ground.

If an open should occur in the No. 1 terminal circuit, the indicator lamp will stay off, and the generator will not generate current.

GENERATOR OUTPUT TEST

To check the generator in a test stand, proceed as follows:

1. Make the connections as shown in figure 4, except leave the carbon pile disconnected.
   - The ground polarity of the battery and the generator must be the same.
   - Use a fully charged battery, and a 10 ohm resistor rated at six watts or more between the generator No. 1 terminal and the battery.
2. Slowly increase the generator speed and observe the voltage.
3. If the voltage is uncontrolled with speed and increases above 15.5 volts on a 12-volt system, replace the regulator and check the field winding.
4. If the voltage is below 15.5 volts on a 12-volt system, connect the carbon pile as shown.
5. Operate the generator at moderate speed as required and adjust the carbon pile as required to obtain maximum current output.
6. If the output is within 10 amperes of the rated output as stamped on the generator frame, the generator is good.
7. If the output is not within 10 amperes of the rated output, keep the battery loaded with the carbon pile, and ground the generator field (figure 5).
   - The field ground tab is within 25 mm (1-inch) of the casting surface. DO NOT force the screwdriver deeper into the end frame.
8. Operate the generator at a moderate speed and adjust the carbon pile as required to obtain maximum output.
9. If the output is within 10 amperes of the rated output, replace the regulator and check the field winding.



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
5. Generator
6. Voltmeter
7. Ammeter
8. Battery
9. Carbon Pile

F-04195

Figure 4—Generator Bench Check

10. If the output is not within 10 amperes of the rated output, check the field winding, diode trio, rectifier bridge, and stator as described later under "Inspection and Repair" and "Electrical Tests."

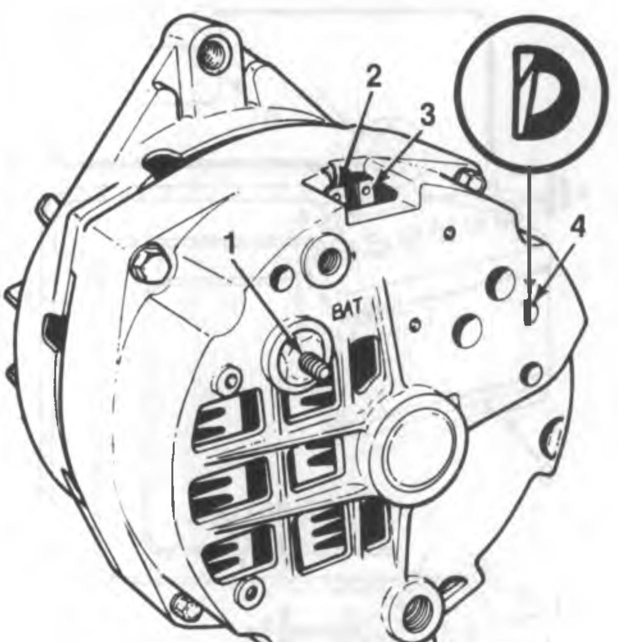
DISASSEMBLY

SLIP RING END FRAME

Disassemble (Figures 6, 7, 8, and 9)

- Hold the generator in a vise, clamping the mount flange lengthwise.
- Make a scribe mark to help locate the frame end parts in the same position during assembly.

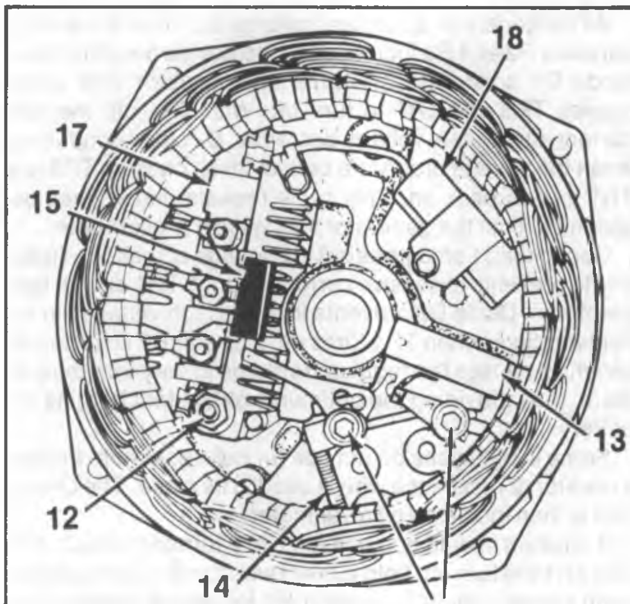
1. Four through bolts (27).
2. Slip ring housing (40) and stator (41).
3. Stator lead nuts.
4. Stator from the end frame.
5. Insulated screws (30) and ground screw (29) from the brush holder (13).
6. Wire resistor (14).



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Field Ground Hole

F-04196

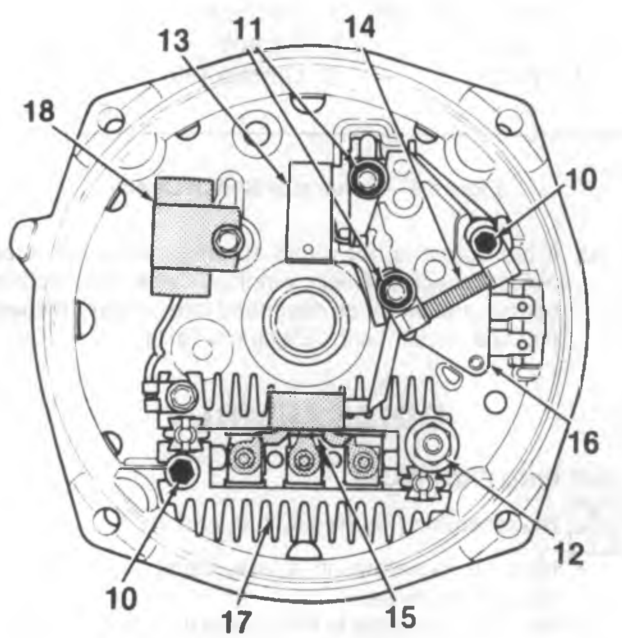
Figure 5—Field Ground Tab



11. Insulated Screws
12. "BAT" Terminal Stud
13. Brush Holder
14. Resistor
15. Diode Trio
17. Rectifier Bridge
18. Capacitor

F-04198

Figure 7—Slip Ring End Frame: 17-SI 100



10. Ground Screw
11. Insulated Screw
12. "BAT" Terminal Stud
13. Brush Holder
14. Resistor
15. Diode Trio
16. Regulator
17. Rectifier Bridge
18. Capacitor

F-04197

Figure 6—Slip Ring End Frame: 12-SI 100

7. Diode trio (15).
8. Brush holder (13).
9. Regulator (16).
10. Capacitor lead bolt.
11. Capacitor strap bolt.
12. Capacitor (18).

12-SI Series (Figures 6 and 8)

13. Ground screw (29) from the rectifier bridge (17).
14. "BAT" terminal stud nut (20) from the rectifier bridge.
15. Rectifier bridge (17), "BAT" terminal (1), and insulator (36) from the end frame.

17-SI Series (Figures 7 and 9)

16. Two ground screws from the rectifier bridge (17).
17. "BAT" terminal stud nut (20) from the rectifier bridge.
18. Rectifier bridge, "BAT" terminal (1), and insulator (36) from the end frame.

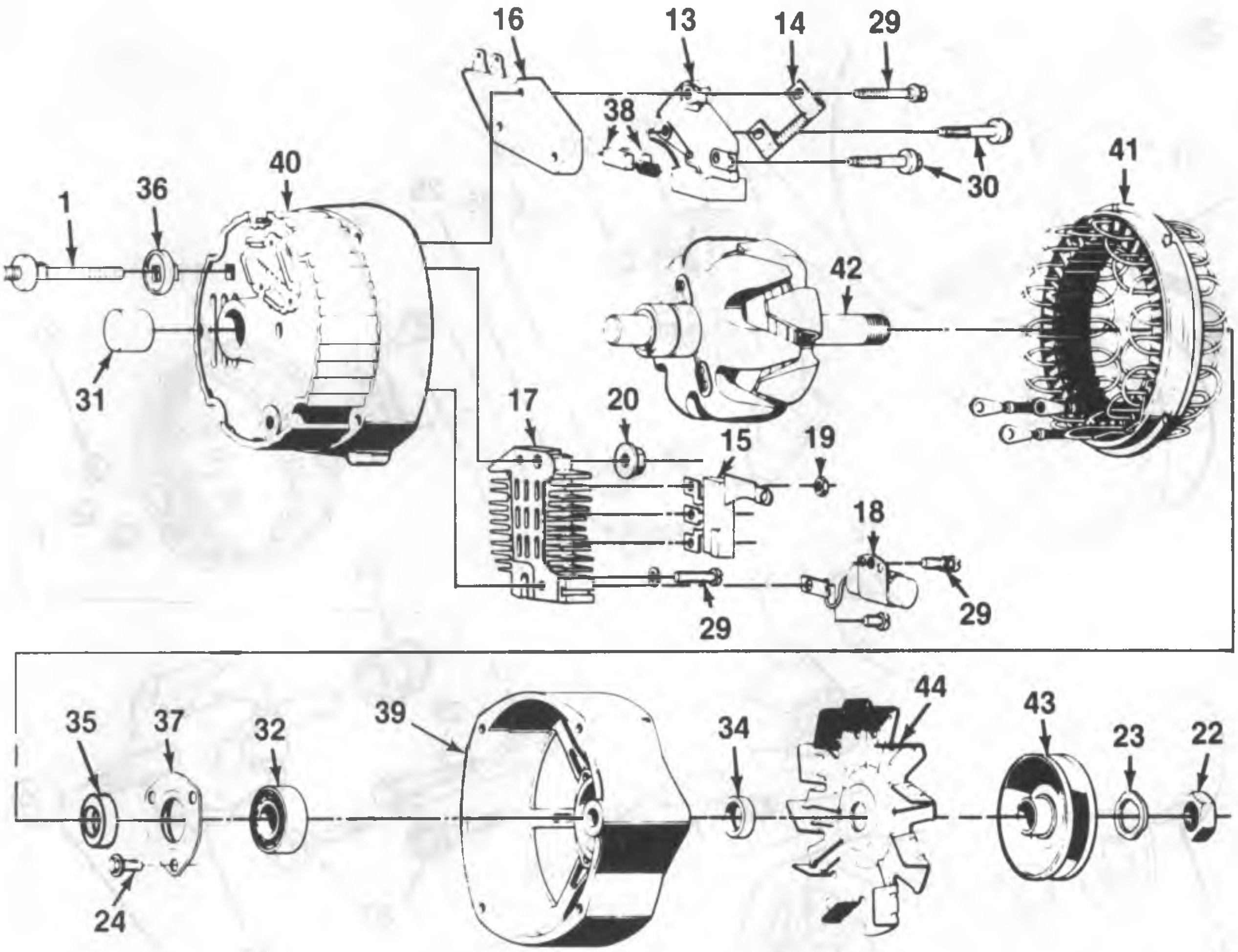
Both Models

19. Bearing (31).
    - Support the bearing housing from the inside.
    - Press out the bearing, using a tube slightly smaller than the bearing shell.
        — Press out the bearing from the outside toward the inside.

DRIVE END FRAME

Disassemble (Figures 9 and 10)

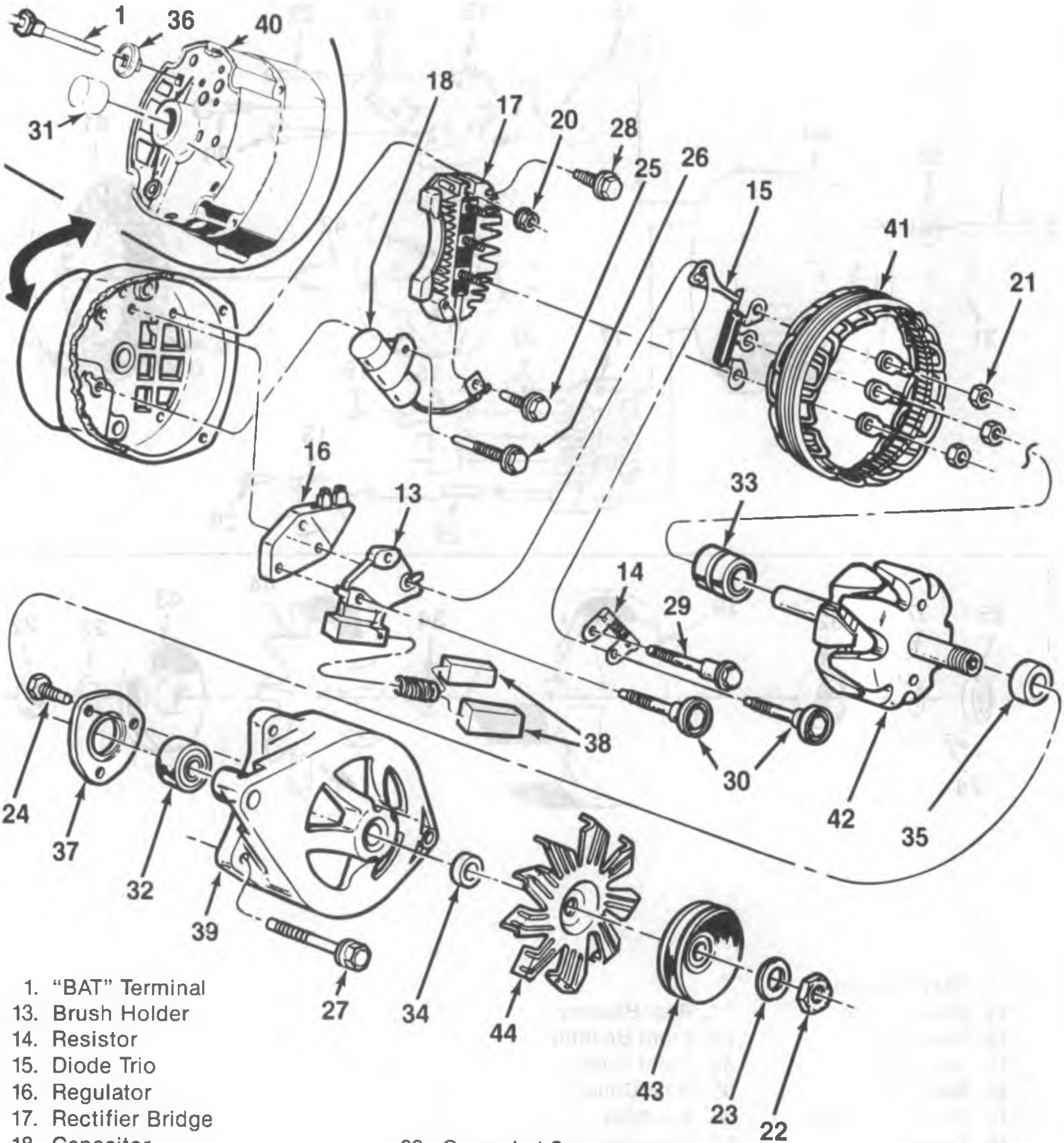
- Place the rotor, but not the rotor shaft, in a vise and tighten only enough to permit removal of the pulley nut.



1. "BAT" Terminal
13. Brush Holder
14. Resistor
15. Diode Trio
16. Regulator
17. Rectifier Bridge
18. Capacitor
19. Nut
20. "BAT" Terminal Nut
22. Pulley Nut
23. Washer
24. Bolt
29. Grounded Screw
30. Insulated Screw
31. Rear Bearing
32. Front Bearing
34. Front Collar
35. Rear Collar
36. Insulator
37. Retainer
38. Brushes
39. Drive End Frame
40. Slip Ring End Frame
41. Stator
42. Rotor
43. Pulley
44. Fan

F-04199

Figure 8 - 12-SI Series 100 Components



1. "BAT" Terminal
13. Brush Holder
14. Resistor
15. Diode Trio
16. Regulator
17. Rectifier Bridge
18. Capacitor
20. "BAT" Terminal Nut
21. Rectifier Bridge Terminal Nut
22. Pulley Nut
23. Wave Washer
24. Bolt
25. Short Bolt
26. Long Bolt
27. Through Bolt
28. Rectifier Bridge Retainer Bolt
29. Grounded Screw
30. Insulated Screw
31. Rear Bearing
32. Front Bearing
33. Slip Ring
34. Front Collar
35. Rear Collar
36. Insulator
37. Retainer
38. Brushes
39. Drive End Frame
40. Slip Ring End Frame
41. Stator
42. Rotor
43. Pulley
44. Fan

F-04200

Figure 9—17-SI Series 100 Components

NOTICE: The rotor may be distorted if the vise is overtightened.

1. Pulley nut (22).
   - Insert a hex head wrench in the end of the rotor shaft to counteract the force of rotation when removing the pulley nut.
2. Washer (23).
3. Pulley (43).
4. Fan (44).
5. Front collar (34).
6. Rotor (42).
7. Rear collar (35).
8. Bearing retainer bolts (24).
9. Bearing retainer (37).
10. Bearing (32).
    - Support the bearing housing when pressing out the bearing.

INSPECTION AND REPAIR

Clean

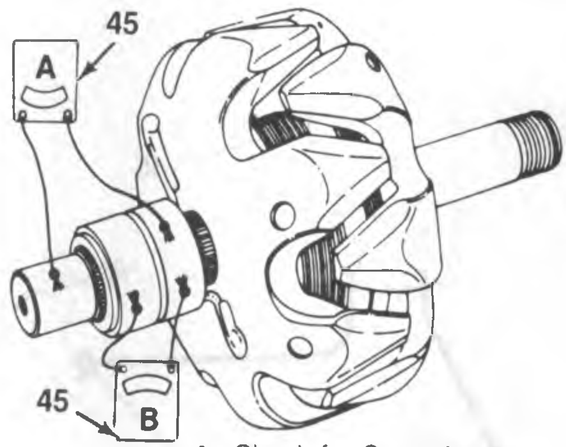
- All metal parts except the voltage regulator, rectifier bridge, stator, rotor and bearing assemblies in a suitable solvent.
  — Wipe or blow the parts dry.

Inspect

1. Brush holder for damage.

   Clean

   — Brush holder. Make sure the brush pockets are clean.
   — Brushes with a soft dry cloth.
2. Insulating sleeves on the insulated screws for splits or wear.
3. Brushes for wear. If the brushes are worn to one half or less of their original length, replace them.
4. Brush leads for broken wires, corrosion or chafing.
5. Slip ring end bearing for grease. If the grease supply is used up, replace the bearing. DO NOT relubricate the bearing.
6. Slip ring end of the rotor shaft for overheating or scoring. If the signs of overheating or scoring are present, replace the bearing and rotor.
7. Drive end bearing for roughness, looseness, and seal condition. If the condition of the bearing is doubtful, replace it.
8. Windings for burned insulation. Replace the rotor or stator if either looks burned.
   - Burned insulation appears as a very dark or blackened wiring. A strong acrid odor will be apparent.
9. Terminal connectors for corrosion or breaks.
10. Windings on the stator for chipped insulation. If the chipped area is small and the rest of the stator is OK, repair the stator with insulating varnish.
11. Slip rings for scoring, wear or pitting.
    - If the rings are dirty, clean with a 400 grain, or finer, polishing cloth.
      — Spin the rotor and hold the polishing cloth against the slip rings until they are clean.
    - If scored, worn, or pitted, true the rings in a lathe to 0.05 mm (0.002-inch).
      — Finish with 400 grain or finer polishing cloth. Blow away all dust.
12. Rotor and stator windings electrically as described later under "Electrical Tests."
13. Generator housing for cracks, warping, or other damage.



45. Ohmmeter
A. Check for Grounds
B. Check for Opens

F-04201

Figure 10—Checking Rotor Field Windings

ELECTRICAL TESTS

Except as stated, make the following tests with an ohmmeter on the low range scale.

ROTOR FIELD WINDING CHECKS (Figure 10)

The rotor may be checked electrically with a 110-volt test lamp or an ohmmeter.

Open Winding

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open.

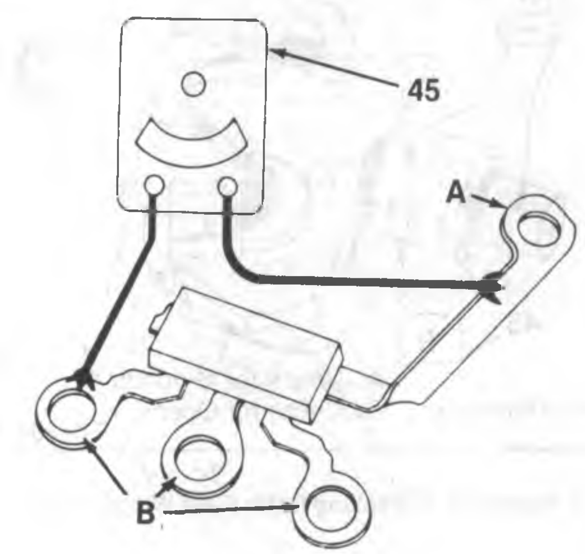
Ground Winding

Connect a test lamp or ohmmeter from one slip ring to the shaft. If the lamp lights, or if the reading is low, the rotor winding is grounded.

Short Circuit or Resistance Check

The winding is checked for short-circuits or excessive resistance by connecting a battery and ammeter in series with the edge of the two slip rings. Note the ammeter reading and refer to "Specifications" at the end of this section.

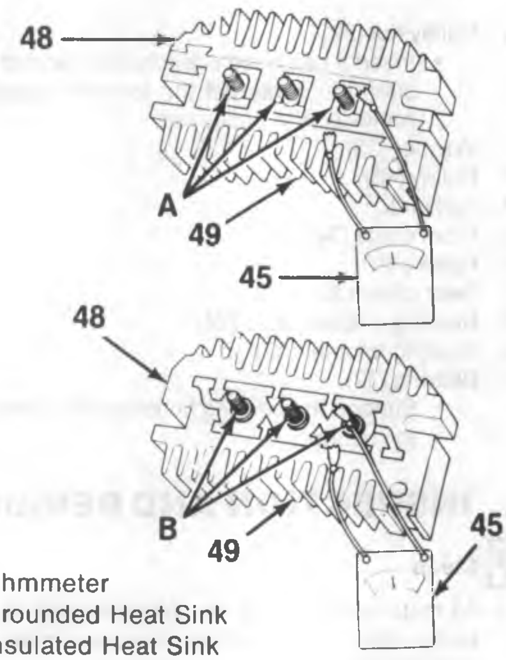
An ammeter reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. If the resistance reading is above the specified value the winding has excessive resistance. Note the reading and refer to "Specifications" at the end of this section.



A. Single Connector
B. Three Connectors
45. Ohmmeter

F-04202

Figure 11—Diode Trio Check



45. Ohmmeter
48. Grounded Heat Sink
49. Insulated Heat Sink
A. Connect to metal connector, not to threaded stud.
B. Connect to threaded stud.

F-04203

Figure 12—Rectifier Bridge Check

Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is all right, but the generator fails to supply rated output, the problem is in the diode trio, rectifier bridge, stator or regulator.

If the rotor is bad, replace it.

DIODE TRIO CHECK (Figure 11)

Connect an ohmmeter having a 1.5-volt cell, and using the lowest range scale, to the single connector and to one of the three connectors (figure 11). Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors. Also, connect the ohmmeter to each pair of the three connectors (not illustrated). If any reading is zero, replace the diode trio.

RECTIFIER BRIDGE CHECK (Figure 12)

To check the rectifier bridge, connect the ohmmeter to the grounded heat sink and one of the three flat metal connectors or threaded studs, depending on the type of regulator. Refer to figure 12.

Observe the ohmmeter reading and reverse the lead connectors to the ground heat sink and the same flat metal connector or stud. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals or connectors, and between the insulated heat sink and each of three terminals or connectors. This makes a total of six checks, with two readings taken for each check.

The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.

STATOR CHECKS (Figure 13)

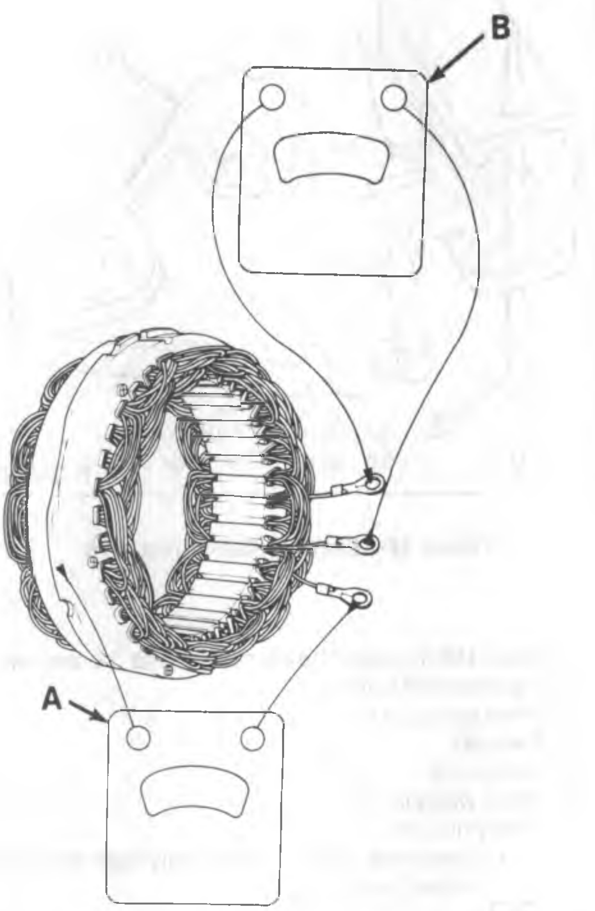
The stator windings may be checked with a 110-volt test lamp or ohmmeter. If the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if the meter reading is high when successively connected between each pair of stator leads, the windings are open.

Delta windings on the 17-SI Series cannot be checked for opens. Check the windings for ground only.

A short circuit in the delta stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings or an open delta winding is indicated. Also a shorted stator can cause the indicator lamp to be on with the engine at low speed. Check the regulator before replacing the stator.

TESTING THE VOLTAGE REGULATOR (Figure 14)

1. Connect the voltmeter and the fast charger to the 12-volt battery.
2. Connect the regulator and the test lamp as shown. Observe battery polarity.
3. Test lamp should be on.



A. Ohmmeter Connections Checking for Grounds
B. Ohmmeter Connections Checking for Opens

F-07074

Figure 13—Checking the Stator

4. Turn on the fast charger and slowly increase the charge rate. Observe the voltmeter. The lamp should go out at the voltage regulator setting. The voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

The test lamp is connected into the circuit, exactly as the rotor is when the regulator is inside the generator. The regulator shuts off the current to the test lamp when the regulator setting is reached. This voltage will vary with temperature differences.

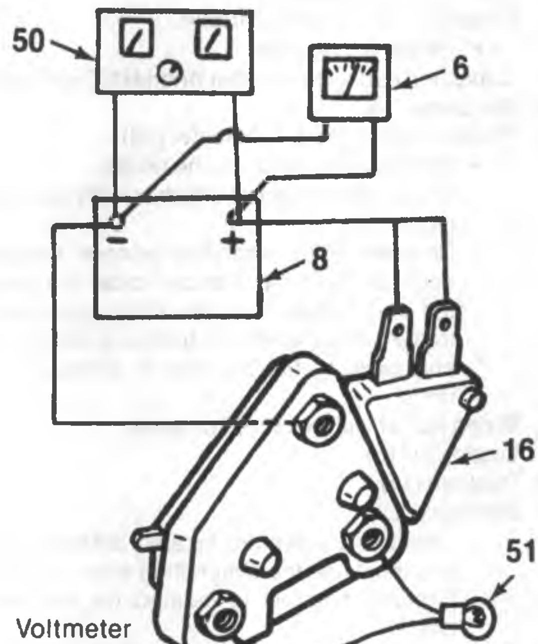
ASSEMBLY

SLIP RING END FRAME

Install or Connect (Figures 8, 9 and 15)

- If the old bearing is dry, do not lubricate or reinstall it. Replace the bearing.

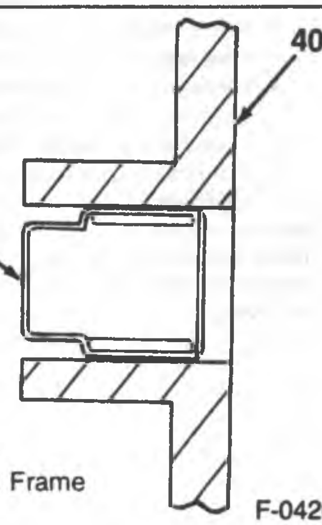
1. Bearing (31).
   - Support the inside of the frame.



6. Voltmeter
8. Battery
16. Regulator
50. Fast Charger
51. Test Lamp

F-04204

Figure 14—Testing the Voltage Regulator



31. Rear Bearing
40. Slip Ring End Frame

F-04205

Figure 15—Slip Ring End Frame Bearing

- **Place a flat plate over the bearing and press in from the outside to the inside of the end frame housing.**
- **Press the bearing flush with the outside of the end frame (figure 15).**

2. **Rectifier bridge (17) (figures 7 and 8).**
3. **Ground screw(s) (29) in the rectifier bridge.**

4. "BAT" terminal (1) and insulator (36).
5. "BAT" terminal nut (20).
6. Capacitor (18) in the end frame.
   - Retain with a screw.
7. Capacitor lead to the rectifier bridge (17) with a screw.
8. Regulator (16).
9. Brushes (38) in the brush holder (13).
   - Retract the brushes in the holder.
   - Retain the retracted brushes with a toothpick (figure 16).
   - Be sure that the toothpick extends through the end frame when the brush holder is in place in the end frame. After the rotor and drive end frame are installed, the toothpick will be pulled out, allowing the brushes to contact the slip rings.
10. Brush holder with retracted brushes.
11. Diode trio (15).
12. Resistor (14).
13. Retaining screws.
   — Insulated screws are located at the brush clip and the diode trio connecting strap.
   — Grounded screw is located on the resistor mount.
14. Stator (41) to the end frame, aligning the three stator leads to the three rectifier bridge terminals.
15. Three terminal nuts. Tighten the nuts securely.

DRIVE END FRAME

Assemble (Figures 8 and 9)

1. Bearing (32).
   - Support the end frame.
   - Position the bearing with the sealed end toward the outside of the generator.
   - Press the bearing into the bore using a metal tube against the bearing outer race.
   - Fill the cavity between the retainer plate and the bearing with specified lubricant. Refer to "Lubrication" later in this section.
   - If the bearing is sealed on both sides, do not add lubricant.
2. Bearing retainer (37).
3. Three attaching bolts (24).
4. Rear collar (35) in the bearing retainer, if previously removed.

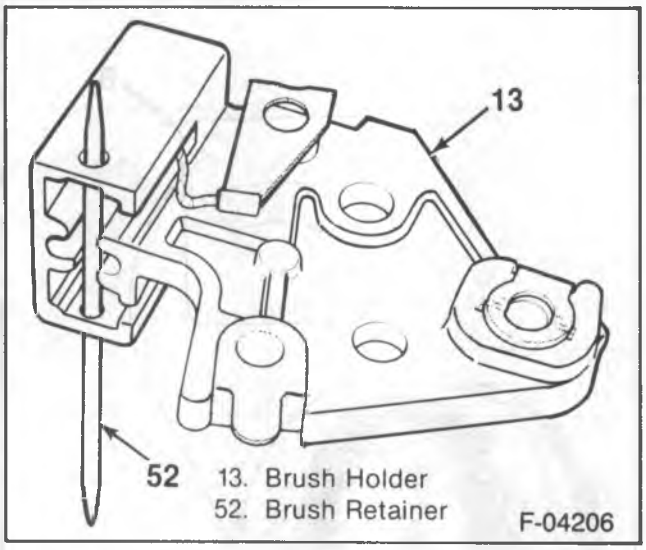


Figure 16—Brush Retainer Installed

5. Rotor (42) through the rear collar and the bearing in the drive end frame.
6. Front collar (34).
7. Fan (44).
8. Pulley (43).
9. Wave washer (23).
10. Pulley nut (22).
   - Clamp the rotor in a vise only tight enough to torque the nut.

Tighten

- Pulley nut to 68 N·m (50 ft. lbs.).

MAIN ASSEMBLY

Install or Connect

1 Drive end frame (39) and rotor assembly to the slip ring end.
2. Four through bolts (27). Tighten securely.
- Remove the brush retainer (toothpick) from the end frame.
- Test the generator output.

SPECIFICATIONS

SPECIFICATIONS

GENERATOR SPECIFICATIONS

Part No.	Series (Type 100)	Rotation Viewing Dr. End	Field-Ohms 27°C (80°F)	Field Current @ 12 Volts 27°C (80°F) AMPS	Cold Output				Hot Output AMPS
					AMPS	RPM	AMPS	RPM	
1101215	17 SI	CW	1.7-2.1	5.7-7.1	50	1600	120	6500	120
1101240	12 SI	CW	2.4-2.8	4.2-5.0	30	1600	94	6500	94
1101243	12 SI	CW	2.4-2.8	4.2-5.0	23	1600	66	6500	66
1101244	12 SI	CW	2.4-2.8	4.0-5.0	23	1600	66	6500	66
1101245	12 SI	CW	2.4-2.8	4.2-5.0	30	1600	94	6500	94
1105628	12 SI	CW	2.4-2.7	4.5-5.0	30	1600	81	6500	78
1105632	12 SI	CW	2.4-2.7	4.5-5.0	23	1600	70	6500	66

LUBRICATION

For generator bearing lubrication, use only Delco-Remy Lubricant No. 1948791 or equivalent. This lubricant is a premium type lithium soap-mineral oil grease made especially for ball and roller bearings.

T2531

SECTION 6D2

CS-144 GENERATOR

CONTENTS

SUBJECT **PAGE**

DELCO REMY CS-144 GENERATOR

DESCRIPTION

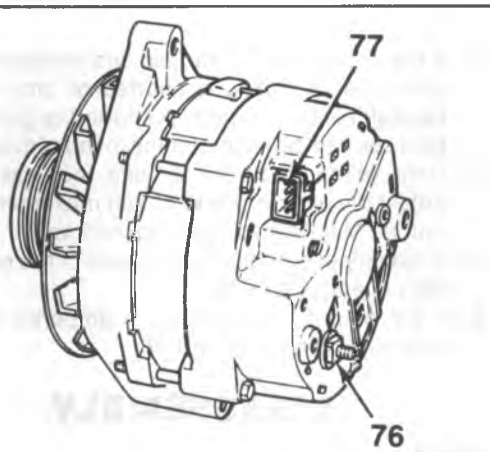
The generator with integral regulator shown in figure 1 features a high ampere output per pound of weight. It does not use a diode trio. The delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to other generators. The CS stands for Charging System, and 144 indicates the outside diameter of the stator laminations in millimeters. The bearings are sealed with lifetime lubrication in both end frames. No periodic maintenance is required.

OPERATING PRINCIPLES

The regulator voltage setting varies with temperature and limits system voltage by controlling rotor field current. It switches rotor field current on or off at a fixed frequency of about 400 cycles per second. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10 percent and the off-time 90 percent. At low speeds, with high electrical loads, on-off time may be 90 percent and 10 percent respectively.

A basic wiring circuit for the "PLIS" regulator is shown in figure 2. The "P" terminal is connected to the stator. The "S" terminal may be connected externally to a voltage, such as battery voltage, to sense the voltage to be controlled.

Both the "L" and "I" terminals serve to turn on the regulator and allow field current to flow when the switch is closed. The "I" terminal may be connected either directly to the switch, or through a resistor. The "I" circuit may be used with or without the "L" circuit; that is, with or without anything connected to the "L" circuit.



76. "BAT" Terminal
77. Terminals P, L, I, S

F-07079

Figure 1—CS-144 Generator

GENERATOR OUTPUT TEST

1. Put the generator in a test stand and make connections as shown in figure 3, except leave the carbon pile disconnected. The ground polarity of the generator and battery must be the same. The battery must be fully charged. Use a 30 to 500 ohm resistor between the battery and the "L" terminal.
2. Slowly increase the generator speed and observe the voltage.

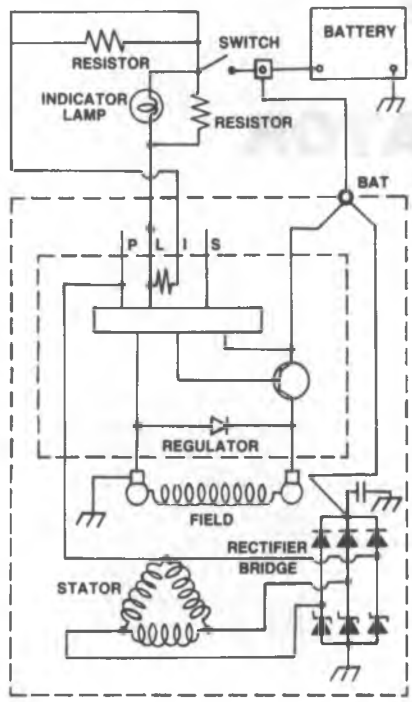


Figure 2—Generator Schematic

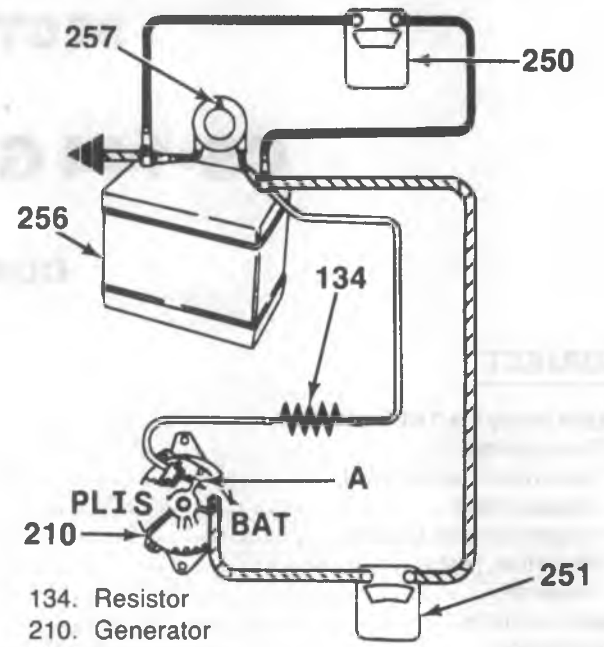


Figure 3—Connections for Generator Output Test

3. If the voltage is uncontrolled and increases above 16 volts, the rotor field is shorted or grounded or the regulator is bad, or both. A shorted or grounded rotor field coil can cause problems in the regulator.
4. If the voltage is below 16 volts, increase speed and adjust the carbon pile to obtain maximum amperage output. Maintain voltage above 13 volts.
5. If the output is within 15 amperes of the rated output, the generator is good.
6. If the output is not within 15 amperes of the rated output, repair the generator.

DISASSEMBLY

DRIVE END FRAME

Remove or Disconnect (Figures 4, 5 and 6)

Tool Required:
J 28509-A Bearing Remover

- Hold the generator in a vise, clamping the mount flange lengthwise.
- Scribe a mark to help locate the frame end parts in the same position during assembly.

1. Four through bolts (28).
2. Rotor and the drive end frame from the slip ring end frame.

- Place the rotor in a vise and tighten only enough to permit removal of the pulley nut.

NOTICE: The rotor may be distorted if the vise is overtightened.

3. Pulley nut (1) and the washer from the shaft.
4. Pulley (229), collar (306), fan (230) and outside collar from the shaft.
5. End frame (216) and the inside collar (116) from the rotor shaft.
6. Three screws and the retainer (128) from the end frame (figure 5).

- Press the bearing from the end frame.

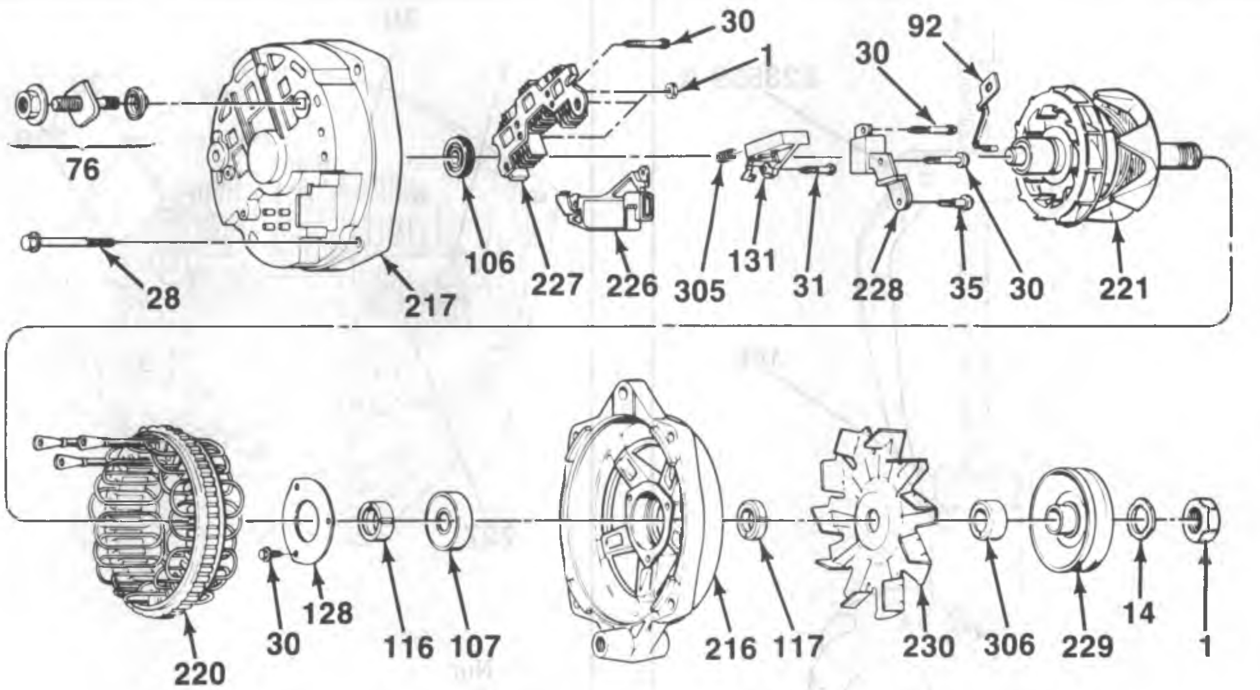
7. Slip ring end bearing (106) from the rotor using J 28509-A (figure 6).

SLIP RING END FRAME

Remove or Disconnect (Figures 7 and 8)

Tool Required:
J 28509-A Bearing Remover

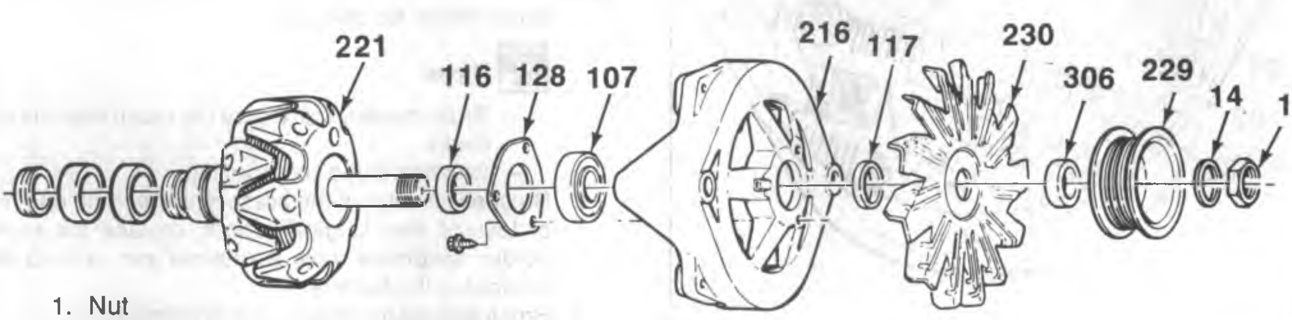
1. Three stator lead nuts.
2. Stator (220).
3. One screw (30) from the brush holder and two insulated screws (35) from the regulator connector.
4. Brush holder (131), regulator (226) and connector (92) from the end frame (figure 7).
5. BAT terminal nut (1) from the insulated heat sink.
6. Two screws and washers (30) from the grounded heat sink.
7. Capacitor (228) and rectifier bridge (227) from the frame (figure 8).
8. "BAT" terminal from the outside of the frame.



1. Nut
14. Washer
28. Through Bolt
30. Screw
31. Grounded Screw
35. Insulated Screw
76. "BAT" Terminal
92. Regulator Connector
106. Slip Ring End Bearing
107. Drive End Bearing
116. Inside Collar
117. Outside Collar
128. Retainer
131. Brush Holder
216. Drive End Frame
217. Slip Ring End Frame
220. Stator
221. Rotor
226. Regulator
227. Rectifier Bridge
228. Capacitor
229. Pulley
230. Fan
305. Spring
306. Fan Collar

F-07091

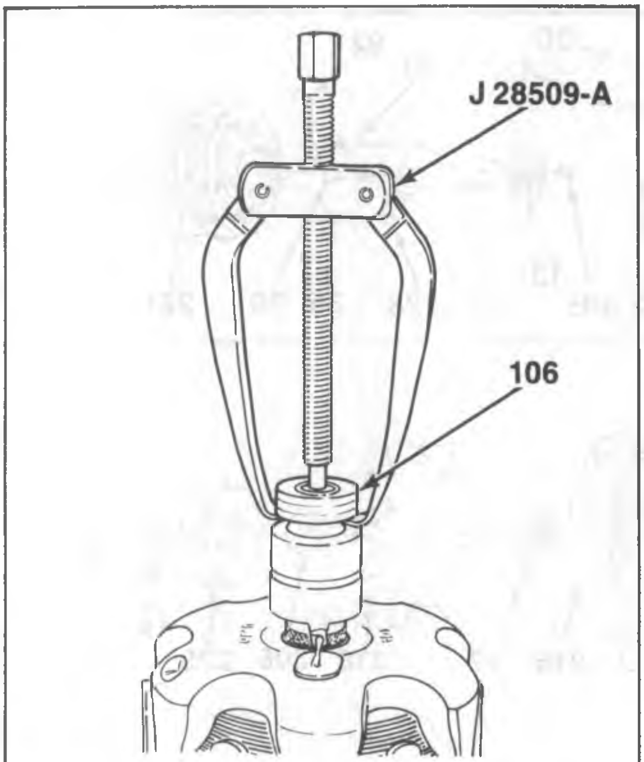
Figure 4—CS-144 Components



1. Nut
14. Washer
107. Drive End Bearing
116. Inside Collar
117. Outside Collar
128. Retainer
216. Drive End Frame
221. Rotor
229. Pulley
230. Fan
306. Fan Collar

F-07082

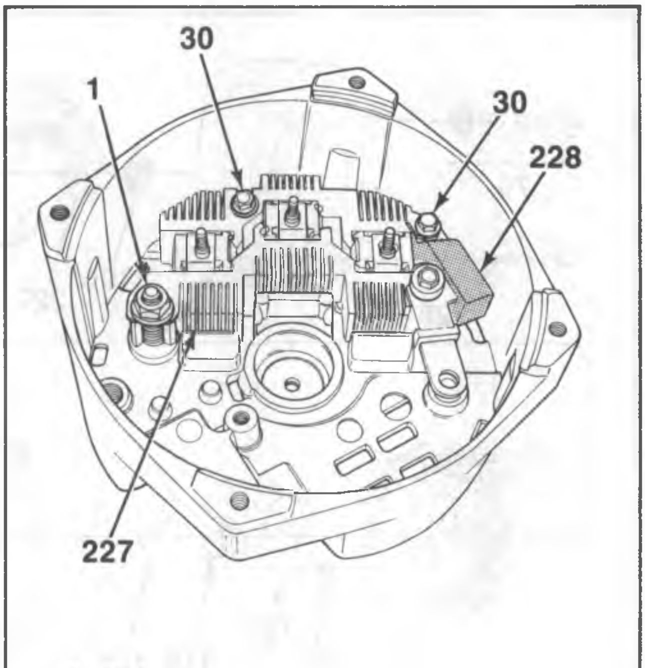
Figure 5—Drive End Frame Components



106. Slip Ring End Bearing

F-07083

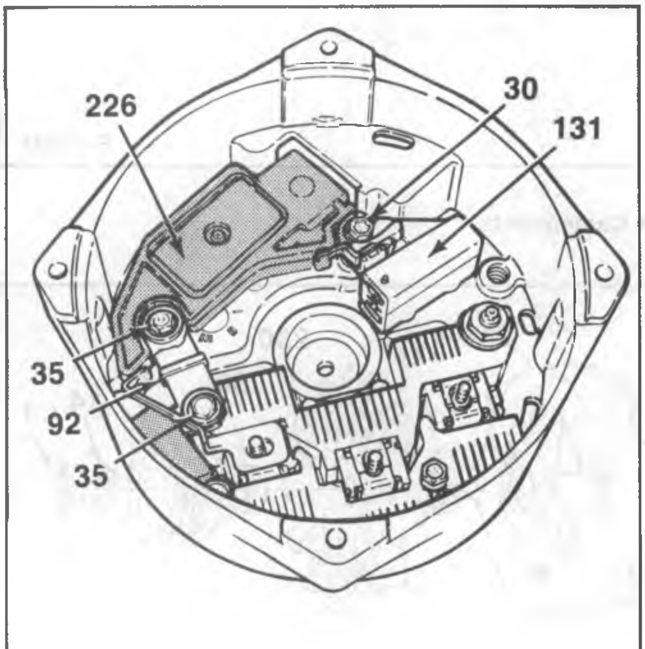
Figure 6—Removing the Slip Ring End Bearing



1. Nut
30. Screw
227. Rectifier Bridge
228. Capacitor

F-07085

Figure 8—Rectifier Bridge in End Frame



30. Screw
35. Insulated Screw
92. Regulator Connector
131. Brush Holder
226. Regulator

F-07084

Figure 7—Slip Ring End Frame with Stator Removed

INSPECTION AND REPAIR

Clean

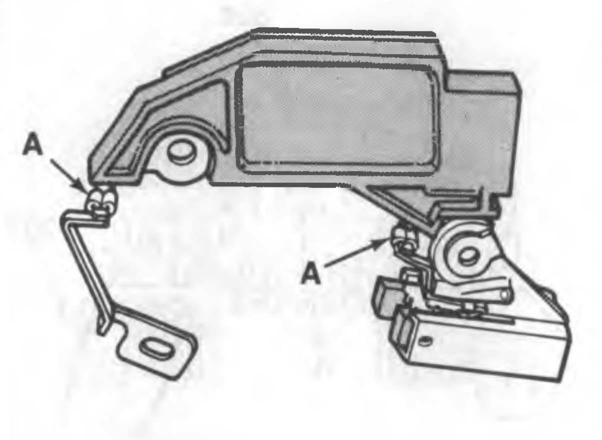
- All metal parts except the voltage regulator, rectifier bridge, stator, rotor and bearing assemblies in a suitable solvent.
  — Wipe or blow the parts dry.

Inspect

1. Brush holder for damage.

   Clean

   — Brush holder. Make sure the brush pockets are clean.
   — Brushes with a soft dry cloth.
2. Brushes for wear. If the brushes are worn to one half or less of their original length, replace the brush holder assembly. Use a retainer pin to hold the brushes in the holders.
3. Brush springs for broken wire or corrosion.
4. Slip ring end of the rotor shaft for overheating or scoring. If signs of overheating or scoring are present, replace the rotor. The slip ring end bearing must be replaced any time the two halves of the generator are separated.
5. Drive end bearing for roughness, looseness, or wear. If the condition of the bearing is doubtful, replace it.
6. Windings for burned insulation. Replace the rotor or stator if either looks burned.



A. Connections crimped and soldered.

Figure 9—Regulator Connections

- Burned insulation appears as very dark or blackened wiring. A strong acid odor will be apparent.

7. Terminal connectors for corrosion or breaks.
8. Windings on the stator for chipped insulation. If the chipped area is small and the rest of the stator is OK, repair the stator with insulating varnish.
9. Slip rings for scoring, wear or pitting.
   - If the rings are dirty, clean with a 400 grain, or finer, polishing cloth.
   - Spin the rotor and hold the polishing cloth against the slip rings until they are clean.
   - If scored, worn, or pitted, true the rings in a lathe to 0.05 mm (0.002 inch).
   - Finish with 400 grain or finer polishing cloth. Blow away all dust.
10. Rotor and stator windings electrically as described later under "Electrical Tests".
11. Generator housing for cracks, warping, or other damage.
12. If the regulator, brush assembly or connector needs replacing, it will have to be unsoldered from the other two components. Use as little heat as possible to protect the regulator (figure 9).

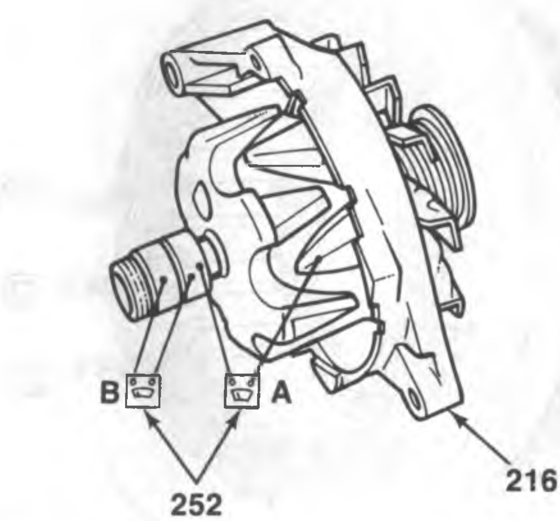
ELECTRICAL TESTS

Except as stated, make the following tests with an ohmmeter on the low range scale.

ROTOR FIELD WINDING CHECKS (Figure 10)

The rotor may be checked electrically with a 110-volt test lamp or an ohmmeter.

Open Winding
To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open.



216. Drive End Frame
252. Ohmmeter
A. Check for Grounds
B. Check for Opens

Figure 10—Checking the Rotor Field Windings

Grounded Winding
Connect a test lamp or ohmmeter from one slip ring to the shaft. If the lamp lights, or if the reading is low, the rotor winding is grounded.

Short Circuit or Resistance Check
The winding is checked for short circuits or excessive resistance by connecting a battery and ammeter in series with the edge of the two slip rings. Note the ammeter reading and refer to "Specifications" later in this section.

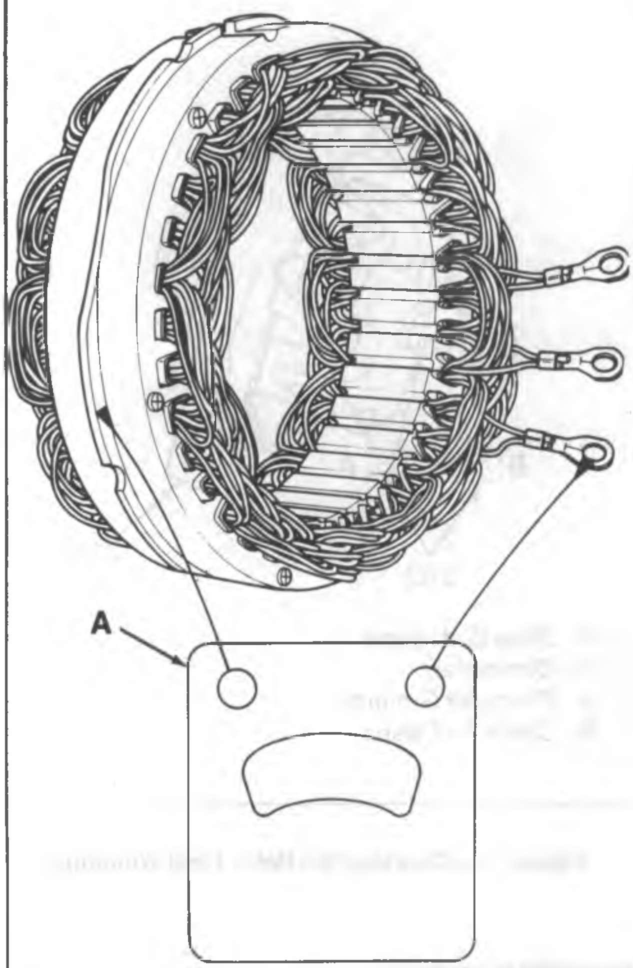
An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. If the resistance reading is above the specified value the winding has excessive resistance; if below the specified value the winding is shorted. The specified resistance value can be determined by dividing the voltage by the current.

Remember that the winding resistance and ammeter readings will vary slightly with winding temperature changes. If the rotor is not defective, but the generator fails to supply rated output, the problem is in the rectifier bridge, stator or regulator.

If the rotor fails any of the above checks, replace it.

STATOR CHECKS (Figure 11)

The stator may be checked with a 110-volt test lamp or ohmmeter. If the ohmmeter reads low or if the lamp lights when connected from any stator lead to bare metal on the stator frame, the stator is grounded.



A. Ohmmeter Connections Checking For Grounds

F-06292

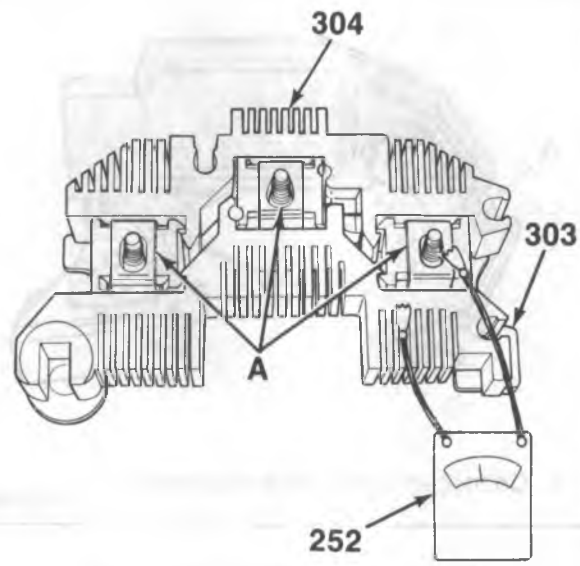
Figure 11—Checking the Stator

An ohmmeter can not be used to test the delta stator for shorts or opens. Noticeable discoloration at any place on the assembly usually indicates a problem in the stator windings.

RECTIFIER BRIDGE CHECK (Figure 12)

To check the rectifier bridge, connect the ohmmeter to the grounded heat sink and one of the three terminals, pressing down firmly on the flat metal clip. Observe the ohmmeter reading and reverse the lead connectors to the grounded heat sink and the same metal clip. If both readings are the same, replace the rectifier bridge. A good rectifier bridge will give one high and one low reading. Repeat this same test between the grounded heat sink and the other two terminals, and between the insulated heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check.

Some digital ohmmeters cannot be used to check diodes in the rectifier bridge. Consult ohmmeter manufacturers to determine ohmmeter capabilities.



252. Ohmmeter
303. Insulated Heat Sink
304. Grounded Heat Sink
A. Connect to Metal Clip, Not to Threaded Stud

F-07088

Figure 12—Rectifier Bridge Check

REGULATOR

The regulator cannot be checked with an ohmmeter. Use only an approved tester to test regulators of this type.

ASSEMBLY

BRUSH HOLDER REPLACEMENT

Important

A design change in the brush holder and slip ring end frame prevents early design brush holders from being installed in later design S.R.E. frames unless the brush holder assembly is modified (figure 13).

Remove or Disconnect

1. Two locators from the brush holder with needle nose pliers or side cutters.
   - File the jagged edges down to the level of the surrounding material keeping loose particles away from the brush slots.
- Blow away any dust.

SLIP RING END FRAME

Install or Connect (Figures 4, 7, 8, 9 and 14)

1. "BAT" terminal (76) into the end frame.
2. Rectifier bridge (227).
3. Capacitor.

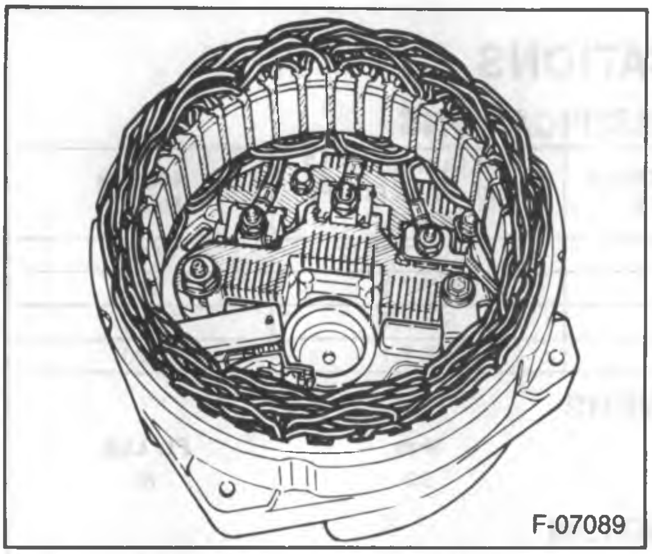


Figure 13—Stator in the Slip Ring End Frame

- Make sure the side with the insulator material is placed against the end frame (ground).

4. Two screws and washers through the grounded heat sink.
5. "BAT" terminal nut (1) with the flat side down to the insulated heat sink (figure 8).
   - If the brush holder, regulator, or connector has been replaced, connect it by crimping the connector(s) to the other component(s). Then solder the connection using as little heat as possible to avoid heat damage to the regulator (figure 9).
6. Brush holder (131), regulator (226) and connector assembly into the end frame (figure 7).
   - The metal side of the capacitor strap should rest against the regulator connection.
7. One screw into the brush holder.
   - If a brush holder with locator bosses is being replaced with a holder without locators, be sure to align the brush holder assembly and hold it with your fingers while tightening the brush holder attaching screw.
8. Two insulated screws through the regulator connector.
9. Brushes (130) into the brush holder (131).
   - Retract the brushes in the holder.
   - Retain the retracted brushes with a toothpick or retaining pin.
   - Be sure that the pin or toothpick extends through the end frame when the brush holder is in place. After the rotor and drive end frame are installed, the pin or toothpick will be pulled out, allowing the brushes to contact the slip rings.
10. Stator (220) into the end frame, aligning the three stator leads to the three rectifier bridge terminals (figure 14).
11. Three terminal nuts. Tighten the nuts securely.

DRIVE END FRAME

Install or Connect (Figures 4 and 15)

1. Drive end bearing (107) into the frame.

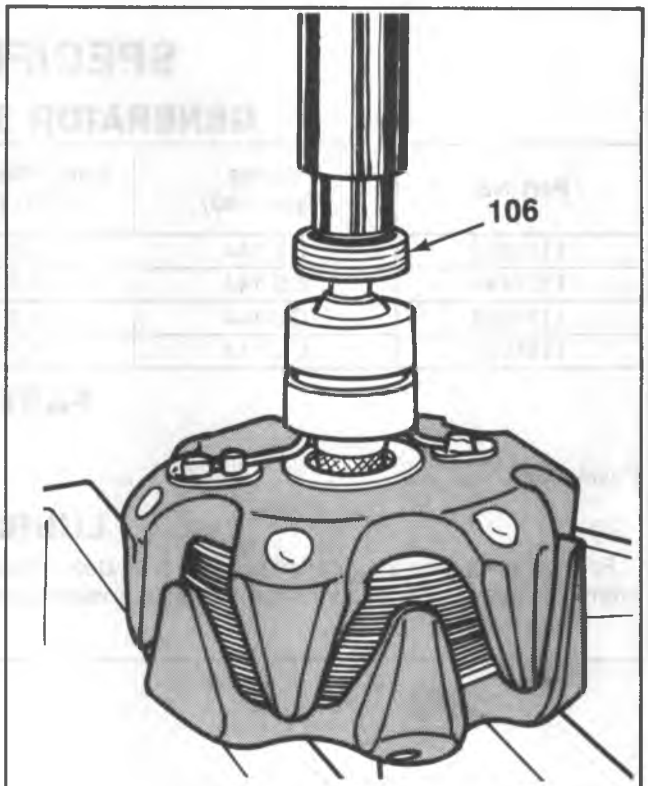


Figure 14—Installing the Slip Ring End Bearing

- Press against the outer race to press the bearing into place.

2. Retainer (128) with three screws.
3. Slip ring end bearing (106) onto the rotor (figure 15).
   - Press against the inner race until the stop is reached.
   - This bearing must be replaced any time the two halves of the generator are separated.
4. Rotor shaft through the inside collar (116) and through the end frame (216).
5. Outside collar (117), fan (230) and fan collar (306) onto the shaft (figure 5).
6. Pulley (229), washer (14) and pulley nut (1) onto the shaft.

Tighten
Nut to 100 N·m (75 ft. lbs.).

MAIN ASSEMBLY

Assemble

1. Drive end frame (216) and rotor assembly to the slip ring end frame, lining up the marks.
   - Carefully guide the slip ring end bearing into the slip ring end frame.
   - Be sure the tolerance rings on the S.R.E. bearing outer race are not damaged.
2. Four through bolts (28). Tighten securely.
   - Remove the brush retainer from the end frame.
   - Test the generator output.

SPECIFICATIONS

GENERATOR SPECIFICATIONS

Part No.	Series (Type 100)	Rotor Field-Ohms 27°C (80°F)	Field Current @ 12 Volts 27°C (80°F) AMPS	Ampere Rating
1101263	CS-144	1.7-2.1	5.7-7.1	120
1101491	CS-144	1.7-2.1	5.7-7.1	120
1101493	CS-144	1.7-2.1	5.7-7.1	120
1101561	CS-144	1.7-2.1	5.7-7.1	120

FASTENERS

	N·m	Ft. Lbs.
Pulley Nut	80	60

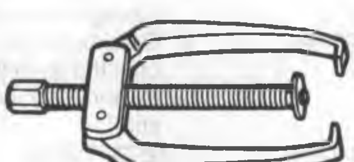
LUBRICATION

For generator bearing lubrication, use only Delco-Remy Lubricant No. 1948791 or equivalent. This lubricant is a premium type lithium soap-mineral oil grease made especially for ball and roller bearings.

T2532

SPECIAL TOOLS

1



J 28509-A

1. Bearing Remover

F-07092

SECTION 6D3

SD STARTING MOTORS

CONTENTS

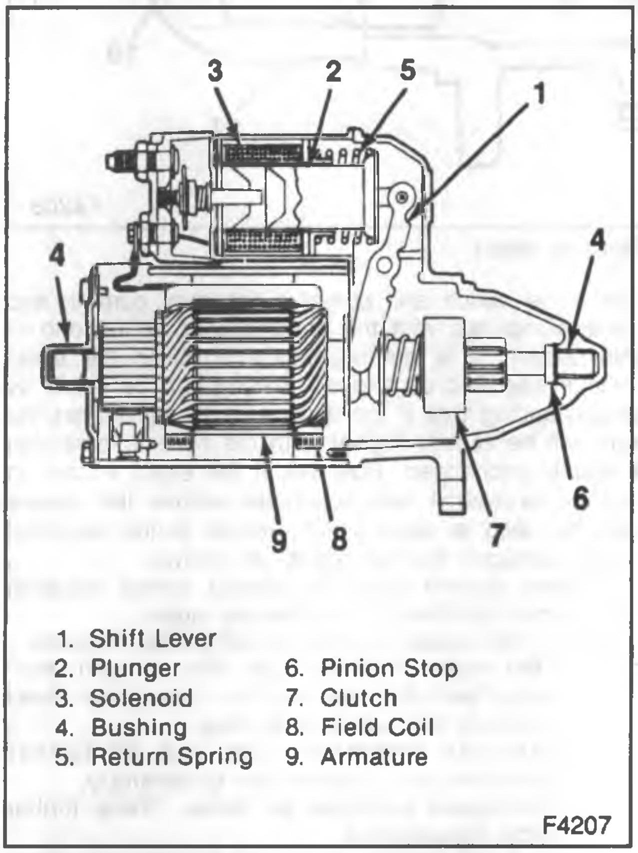


Figure 1—SD-200 and SD-260 Starting Motor

DELCO-REMY SD STARTING MOTORS

DESCRIPTION

The overrunning-clutch type starting motors covered in this section are the enclosed shift lever type (figures 1 and 2).

The starter motor bearings are lubricated during motor assembly and do not require service except during motor repair.

The part number can be found either stamped on the outside of the frame or on an identification label attached to the frame.

DIAGNOSIS OF THE STARTING MOTOR

STARTING MOTOR TESTS

Before disassembling the starting motor for repair, the following tests should be made.

NOTICE: Never operate the starting motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by too much cranking, will damage the starting motor.

Inspect

1. Pinion for freedom of operation by turning it on the spline shaft.
2. Armature for freedom of rotation by prying the pinion with a screwdriver.
   - Tight bearings, a bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely.
   - If the armature does not turn freely, the motor should be disassembled.
   - If the armature does rotate freely, the motor should be given a no-load test before disassembly.

NO LOAD TEST (Figure 3)

Connect a voltmeter from the motor terminal to the motor frame and an rpm indicator to measure armature speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch in the open position switch terminal.

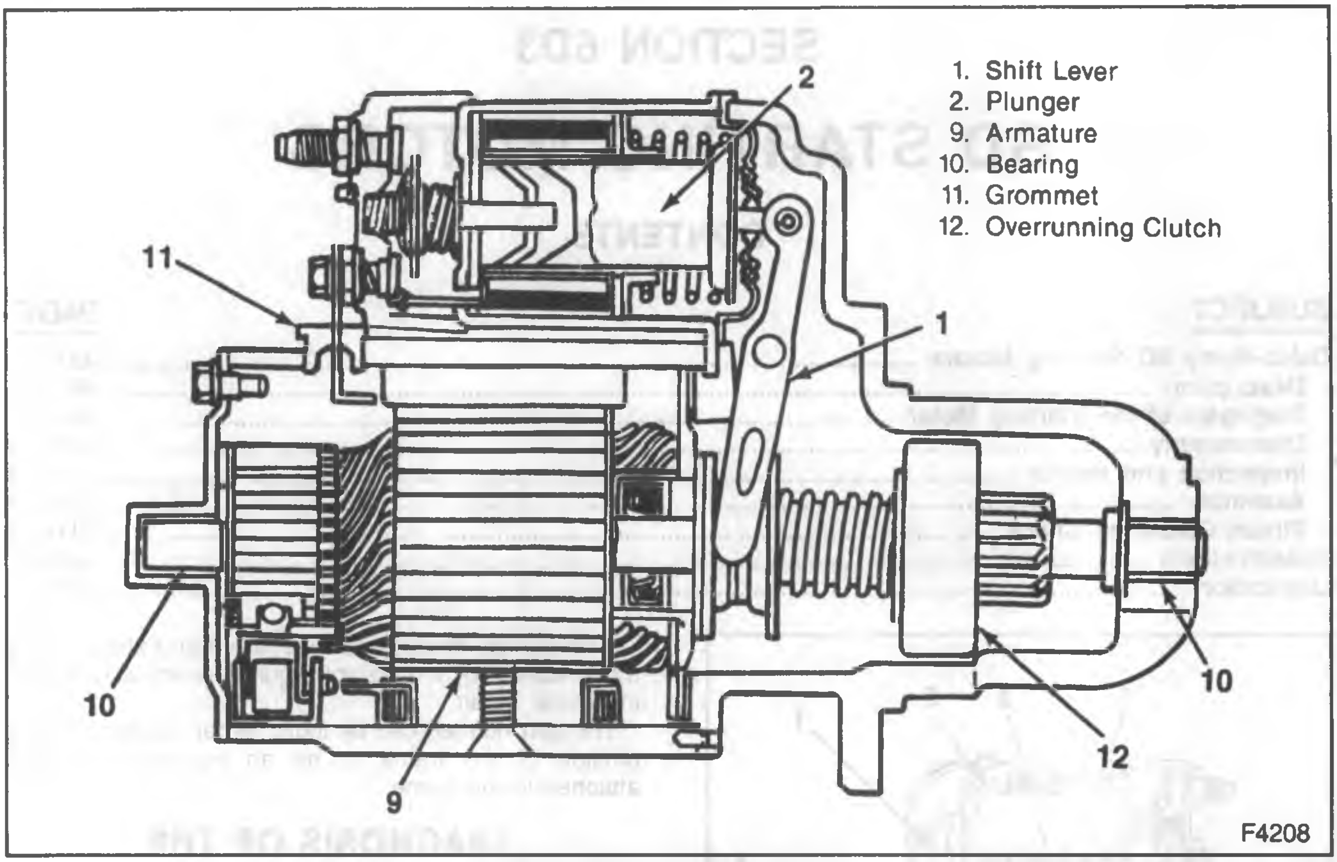


Figure 2—SD-300 Starting Motor

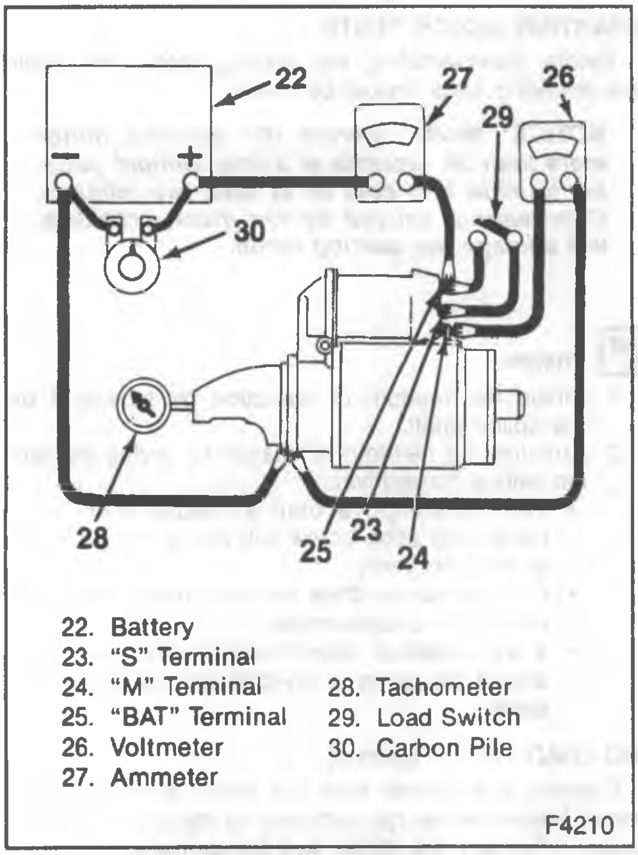
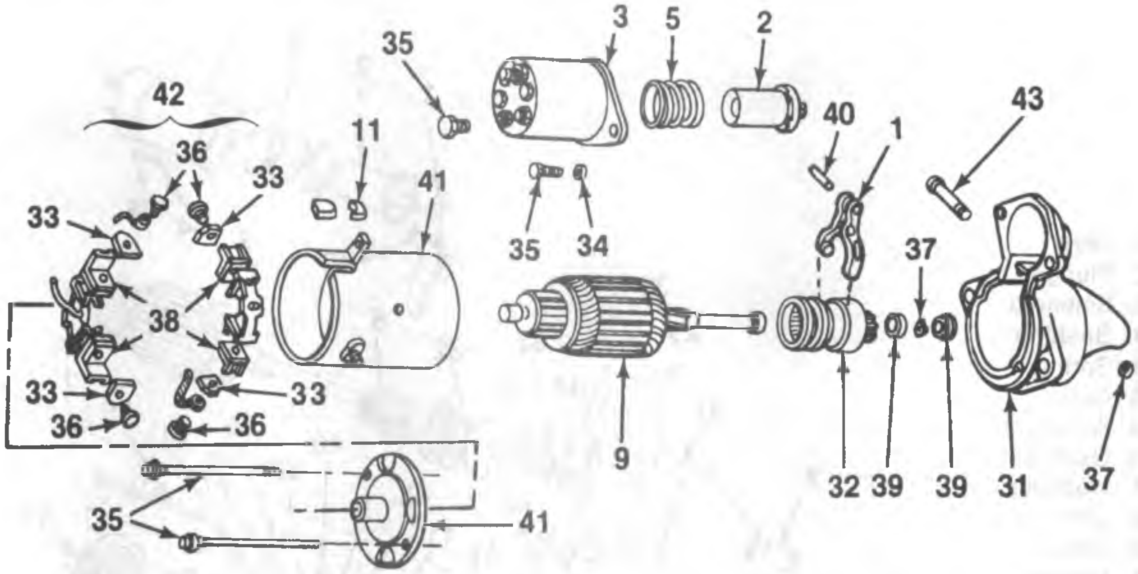


Figure 3—No-Load Test Hookup

Close the switch and compare the rpm, current, and voltage readings with the specifications at the end of this section. It is not necessary to obtain the exact voltage specified as a good reading can be made by understanding that if the voltage is slightly higher the rpm will be slightly higher, with the current remaining basically unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. Compare the test results as follows:

1. Rated current draw an no-load speed indicates normal condition of the starting motor.
2. Low free speed and high current draw indicates:
   a. **Too much friction.** Tight, dirty or worn bearings, bent armature shaft or loose pole shoes allowing the armature to drag.
   b. **Shorted armature.** This can be further checked on a growler after disassembly.
   c. **Grounded armature or fields.** Check further after disassembly.
3. Failure to operate with high current draw indicates:
   a. **A direct ground** in the terminal or fields.
   b. **Seized bearings.** This should have been noted by turning the armature by hand.
4. Failure to operate with no current draw indicates:
   a. **Open field circuit.** This can be checked after disassembly by inspecting internal connections and tracing the circuit with a test lamp.
   b. **Open armature coils.** Inspect the commutator for badly burned bars after disassembly.



1. Shift Lever
2. Plunger
3. Solenoid
5. Spring
9. Armature Assembly
11. Grommet
31. Housing
32. Drive
33. Brush
34. Washer
35. Bolt
36. Screw
37. Ring
38. Holder
39. Collar
40. Pin
41. Frame
42. Brushes and Holders
43. Shaft

F4211

Figure 4—SD-200 and SD-260 Components

c. **Broken brush springs, worn brushes.** High insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicates a higher internal resistance due to poor connections, defective leads, dirty commutator and causes listed under step 4.
6. High free speed and high current draw indicates shorted fields. If shorted fields are suspected, replace the field coil assembly and check for improved performance.

DISASSEMBLY

If the motor does not perform to specifications, it may need to be disassembled for further testing of the components. Normally the starting motor should be disassembled only so far as is necessary to make repair or replacement of parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the starting motor.

FIELD FRAME

Disassemble (Figures 4 and 5)

- Clean the outside of the starter housing, removing grease, oil, mud, etc.
- Make scribe marks to show the relationship of the nose housing, lever housing, field frame, and end frame to aid in assembly.

1. Field coil strap (51) from the solenoid motor terminal (figure 6)
2. Through bolts (35).
3. End frame (41).
4. Washer (34) from the commutator end of the armature shaft (SD-300).
5. Field frame (41) from the drive housing (31) and the armature assembly (9).
6. Armature from the drive housing by tilting the armature to disengage the shift lever fingers (1) from the drive collar (32) (figure 7).

LEVER HOUSING

Disassemble

1. Drive assembly (32) from the armature shaft (9) as follows:
   - Remove the pinion stop washer (34) or thrust collar (39) from the armature shaft.
   - Drive the stop collar (39) away from the pinion stop retainer ring (37) by sliding a metal cylinder onto the armature shaft and with a hammer, striking the metal cylinder against the stop collar (figures 8 and 9).
   - Remove the pinion stop retainer ring form the groove in the armature shaft. If the retainer ring is distorted during removal, it must be replaced.
   - Slide the drive assembly and the stop collar off the armature shaft.
2. Bolts (35) attaching the solenoid (3) to the drive housing.

1. Lever
2. Plunger
3. Solenoid
4. Bushing
5. Spring
8. Coil
9. Armature
11. Grommet
31. Housing
32. Drive
33. Brushes
34. Washer
35. Bolt
36. Screw
37. Ring
38. Holder
39. Collar
40. Pin
41. Frame
44. Nut
45. Lead
46. Insulator
47. Shoe
48. Plate

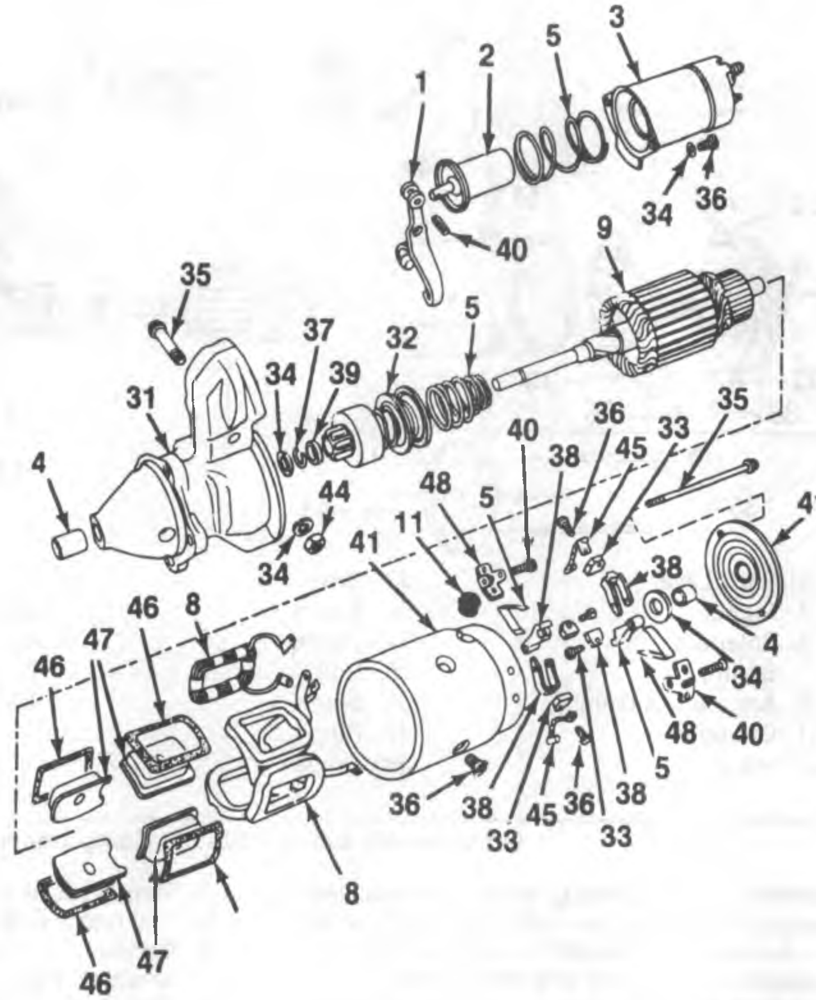


Figure 5—SD-300 Components

3. Bolt and nut (44) and washer on the SD-300 or the retainer ring (37) and shaft (43) attaching the shift lever to the drive housing on the SD-200 and SD-260.
4. Shift lever (1) and the attached solenoid plunger (2) from the drive housing.
5. Roll pin (40) in order to separate the shift lever from the solenoid plunger (2).

BRUSHES

Disassemble

SD-200 and SD-260 (Figure 10)

1. Brush holders (38) from the brush supports (62).
2. Screws from the brush holders.
3. Brushes (33) from the holders.

SD-300 (Figure 11)

1. Brush holder pivot pins (63).
2. Brush springs (64).
3. Brushes (33) from the brush holders.

SOLENOID

First perform the electrical tests on the solenoid described under "Inspection and Repair" later in this section. Then disassemble the solenoid to inspect the contact disc and terminals.

Remove or Disconnect (Figure 12)

1. Nuts from the "S" terminal (23) and the motor terminal (24).
2. Screws attaching the end cover (67).
3. End cover from the solenoid body.

Inspect

1. Contact disc for wear.
   - Replace if worn.

INSPECTION AND REPAIR

Clean

- All parts, except the drive, with mineral spirits. Do not clean the parts in a degreasing tank or with grease dissolving solvents.

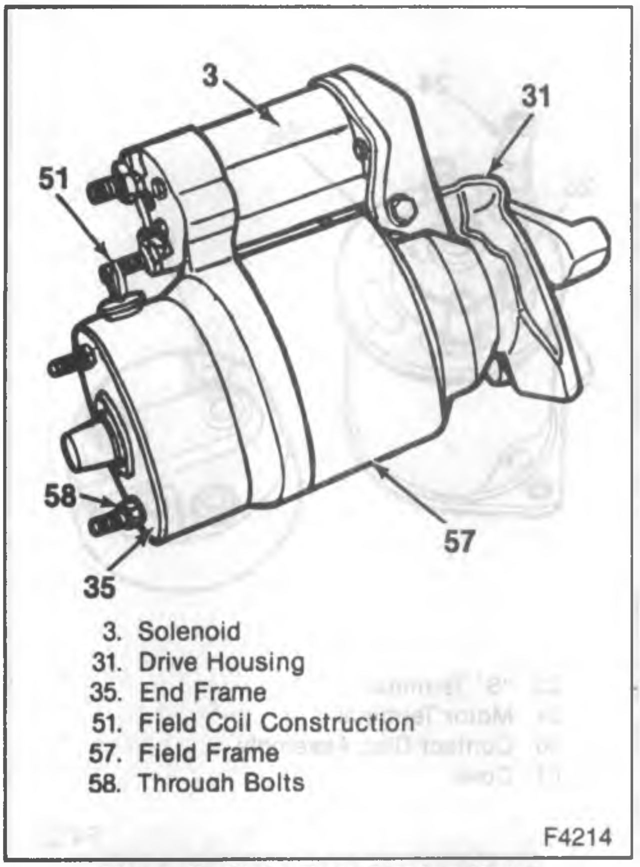


Figure 6—Light Duty Starting Motor

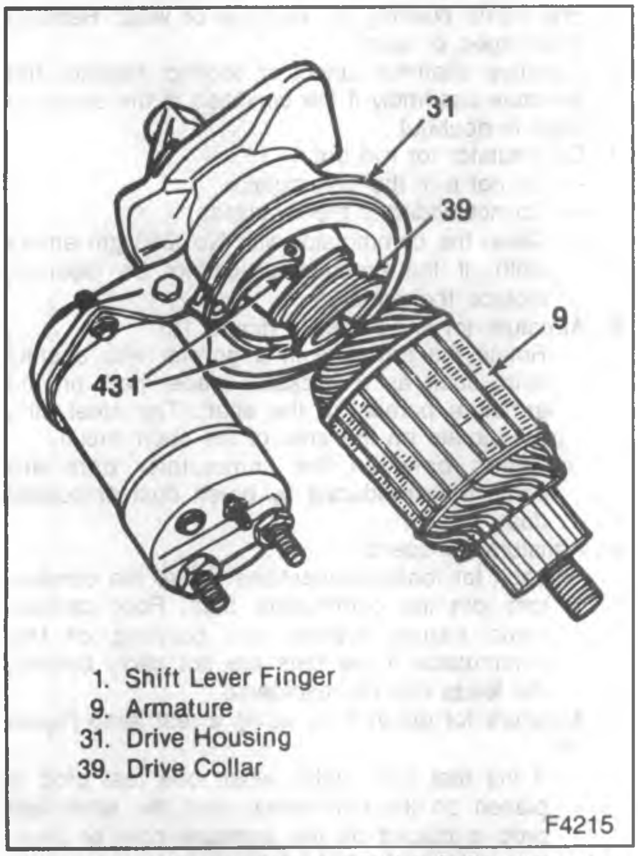


Figure 7—Disengaging the Drive Collar from the Shift Lever Fingers

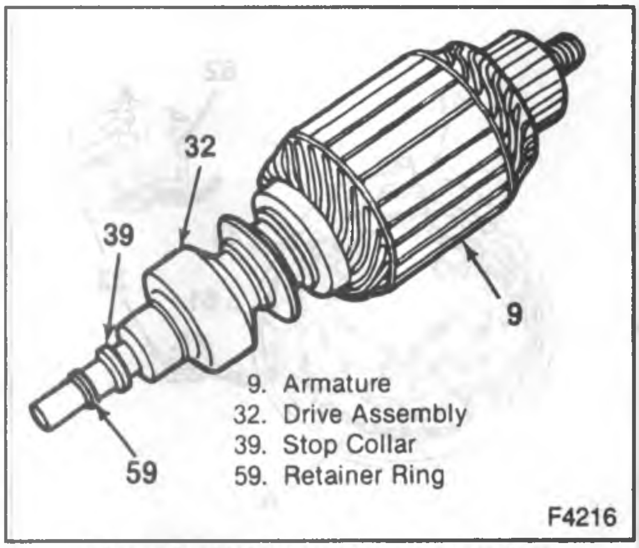


Figure 8—Retaining Ring on Armature

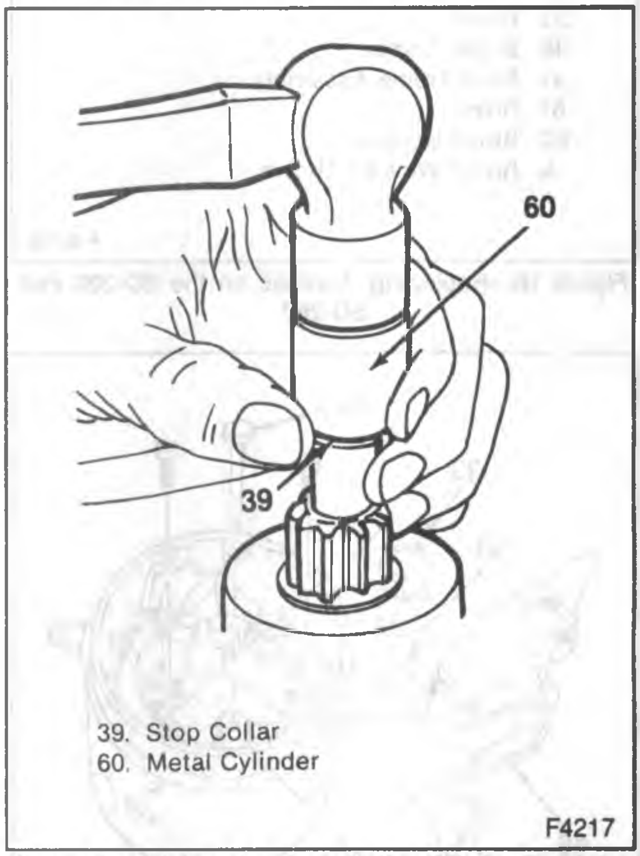
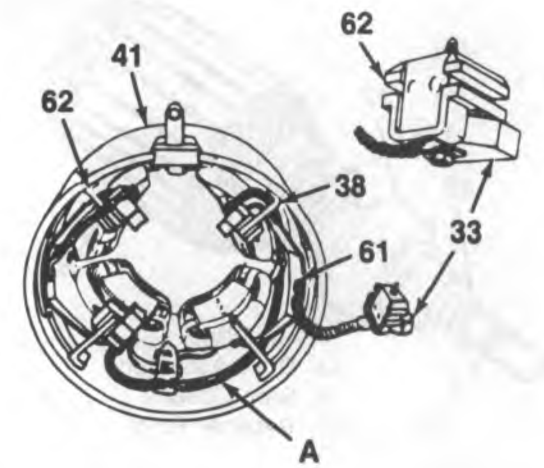


Figure 9—Driving the Stop Collar Off the Retaining Ring

— Dry by wiping with a clean cloth.

Inspect

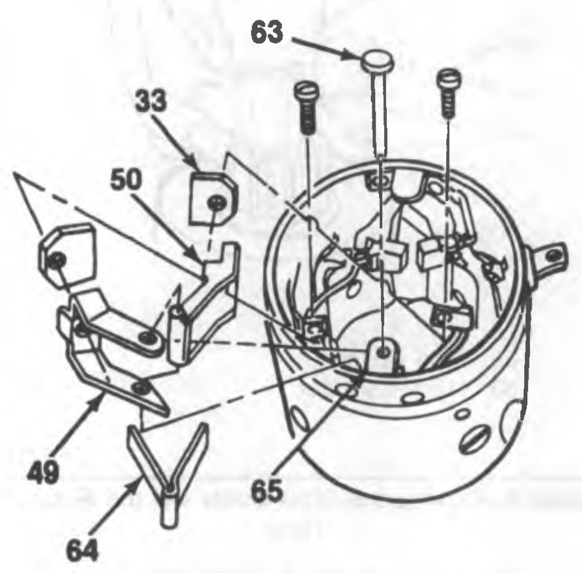
1. Armature bearing fit in the end frame, lever housing, and nose housing. On models with busings, check them. If the bushings are worn, replace them. Also replace the oil wicks when a bushing is replaced.
   - Lubricate the oil wicks and bushings before assembling the starter motor.



33. Brush
38. Brush Holder
41. Field Frame Assembly
61. Rivet
62. Brush Support
A. Route Wire As Shown

F4218

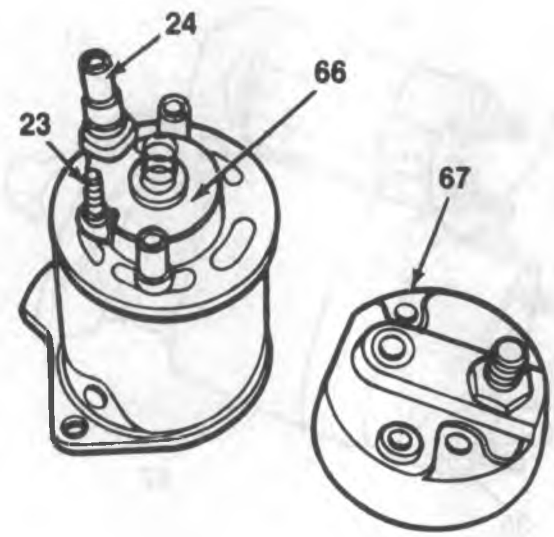
Figure 10—Replacing Brushes on the SD-200 and SD-260



33. Brush
49. Grounded Brush Holder
50. Insulated Brush Holder
63. Pivot Pin
64. Brush Holder Spring
65. Brush Holder Support

F4219

Figure 11—Replacing Brushes on the SD-300

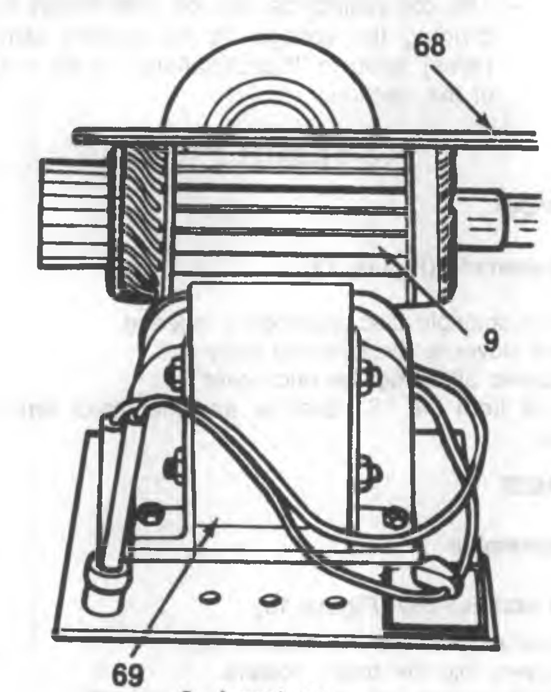


23. "S" Terminal
24. Motor Terminal
66. Contact Disc Assembly
67. Cover

F4220

Figure 12—Solenoid Disassembled

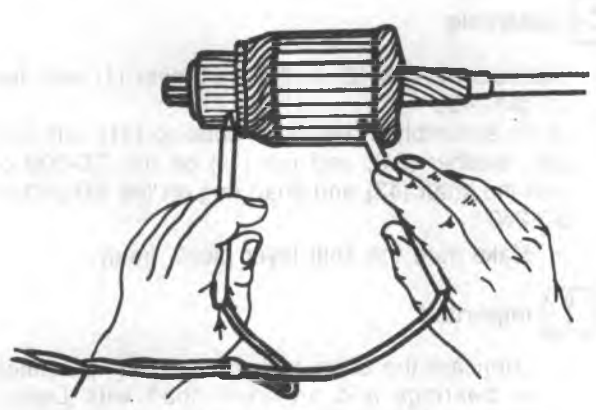
2. End frame bushing for damage or wear. Replace if damaged or worn.
3. Armature shaft for runout or scoring. Replace the armature assembly if the condition of the armature shaft is doubtful.
4. Commutator for run out.
   — Do not turn the commutator.
   — Do not undercut the insulation.
   — Clean the commutator with No. 240 grit emery cloth. If the commutator cannot be cleaned, replace the armature.
5. Armature for short circuits (figure 13).
   - Rotate the armature in a growler with a steel strip, such as a hacksaw blade, held on the armature parallel to the shaft. The steel strip will vibrate on the area of the short circuit.
   - Shorts between the commutator bars are sometimes produced by brush dust or copper dust.
6. Armature for opens.
   - Look for loose connections where the conductors join the commutator bars. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, the leads can be resoldered.
7. Armature for grounds by using a test lamp (figure 14).
   - If the test lamp lights when one test prod is placed on the commutator and the other test prod is placed on the armature core or shaft, the armature is grounded.
8. Motor housing and solenoid housing for oil and water.



9. Armature
68. Saw Blade
69. Growler

F4221

Figure 13—Testing the Armature for Short Circuits



F1970

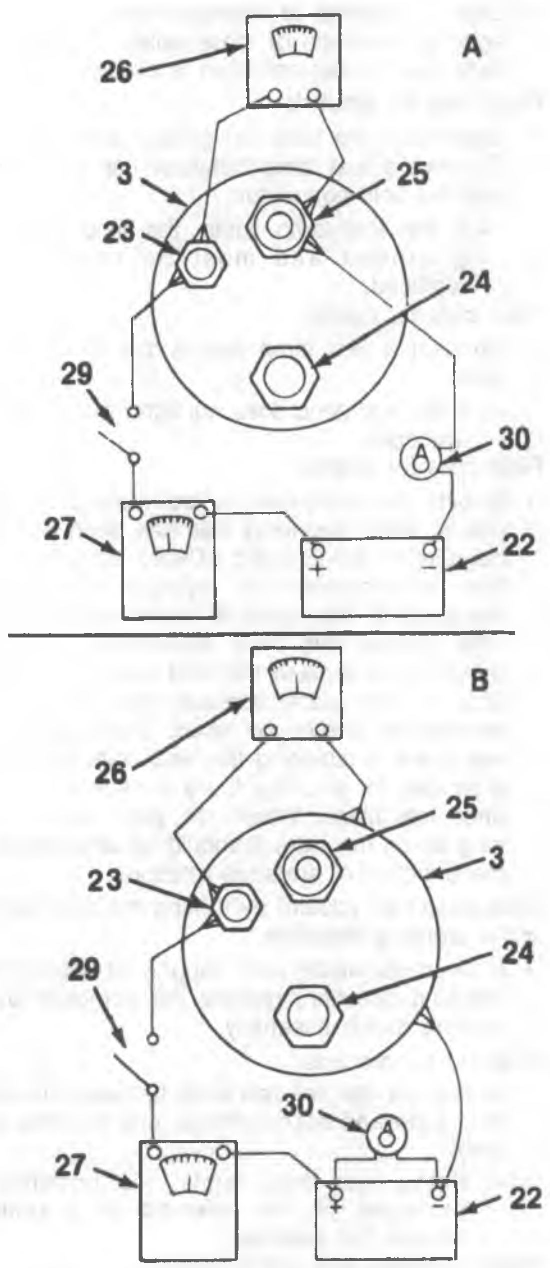
Figure 14—Testing the Armature for Grounds

- If oil or water is present, this indicates broken O-rings, leaking gaskets, or oil seal wear. Replace all seals and gaskets as required.

9. Brushes for wear. If the brushes are worn to half the size of a new brush, replace the brushes.
10. Brush holders for dirt or damage.
    - Make sure that the brushes are not binding in the holders.
11. Brush springs for distortion or discoloring. If the springs are weak, bent, or discolored, replace them.
12. Field coils.
    - Look for burned or damaged insulation, damaged connections or loose poles. Replace the field coils if their condition is doubtful.
13. Field coils for grounds.
    - Disconnect the field coil ground connections.
    - Connect a test lamp between the field frame and the field connector.
      — If the test lamp lights, the field coils are grounded and must be repaired or replaced.
14. Field coils for opens.
    - Connect a test lamp across the ends of the coils.
      — If the test lamp does not light, the field coils are open.
15. Field coils for shorts.
    - Shorts are indicated by poor motor performance after everything else has been checked out. On the SD-200 and SD-260 starter motors, the coils cannot be replaced separately because of the integral frame construction. The frame and field assembly must be replaced. To replace the field coils on the SD-300, a pole shoe spreader and pole shoe screwdriver should be used. Care should be exercised in replacing the field coils to prevent grounding or shorting them as they are tightened into place. Where the pole shoe has a long lip on the side, it should be assembled in the direction of armature rotation.
16. Drive assembly (clutch) by turning the drive pinion in the cranking direction.
    - If the drive pinion turns roughly or slips in the cranking direction, replace the complete overrunning clutch assembly.
17. Solenoid for grounds.
    - Connect a 100 volt test lamp between the solenoid case and each terminal, one terminal at a time.
      — If the test lamp lights, the terminal is grounded. If the solenoid is grounded, replace the solenoid.
18. Hold-in winding and pull-in winding.
    - With all the leads disconnected from the solenoid, make the test connections as shown in figure 15.

NOTICE: To prevent overheating the pull-in winding, do not leave the winding energized more than 15 seconds. The current draw will decrease as the winding temperature increases.

- Turn the switch on and adjust the carbon pile to lower the battery voltage to the value shown in "Specifications" at the end of this section.
- Note the ampere reading; a high reading indicates a shorted or grounded winding, and a low reading indicates excessive resistance.
  — The windings resistance can be read directly using a digital ohmmeter that can measure tenths of an ohm.



3. Solenoid
22. Battery
23. "S" Terminal
24. "M" Terminal
25. "BAT" Terminal
26. Voltmeter
27. Ammeter
29. Switch
30. Carbon Pile
A. Checking Solenoid Pull-in Winding
B. Checking Solenoid Hold-in Winding

F4222

Figure 15—Solenoid Test Connections

— The coil resistance can be determined by dividing the voltage by the current (amperes) listed in "Specifications" at the end of this section.

ASSEMBLY

SOLENOID

Assemble (Figure 12)

1. New solenoid disc assembly if needed.
2. End cover to the solenoid body.
3. Screws attaching the end cover.
4. Nuts from the "S" terminal and the motor terminal.

BRUSHES

Assemble

SD200 and SD-260 (Figure 10)

1. Brushes (33) into the holders (38).
2. Screws into the brush holders.
3. Brush holders into the brush supports (62).

SD-300 (Figure 11)

1. Brushes (33) into the brush holders.
2. Brush springs (64).
3. Brush holder pivot pins (63).

LEVER HOUSING AND FIELD FRAME (Figures 4 and 5)

Assemble

1. Solenoid plunger (2) to the shift lever (1) with the roll pin (40).
2. Lever assembly in the drive housing (31) with bolt (35), washer (34), and nut (44) on the SD-300 or with the shaft (43) and snap ring on the SD-200 or SD-260.
   - Make sure the shift lever pivots freely.

Important

- Lubricate the drive end, commutator, bushings or bearings and armature shaft with Delco-Remy Lubricant No. 1960954 or equivalent.
- On starters with bronze bearings and oil wicks, soak the wicks and bearing surfaces with non-detergent SAE #20 oil. Do not drill, ream or machine sintered bronze bearings in any way. Oil from the wick will bleed through the highly porous bearing to lubricate the shaft.
- Lubricate the shaft underneath the overrunning clutch assembly with a silicone, grease, such as General Electric CG321, or Dow Doming 33 medium, or equivalent. The overrunning clutch does not require lubrication.

3. Drive assembly (32) on the armature shaft.
   - Slide the drive assembly on the shaft with the pinion gear toward the shaft end.

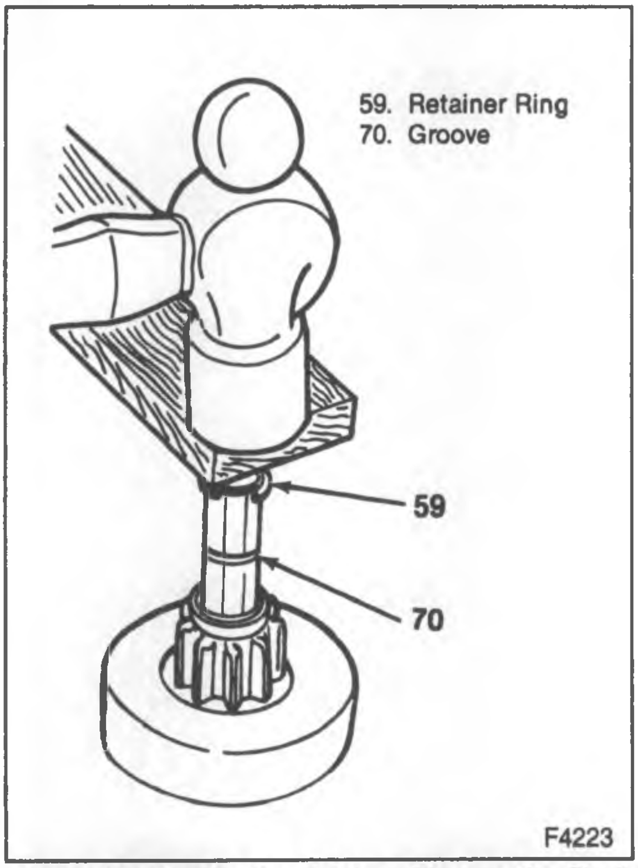


Figure 16—Forcing the Retainer Ring on the Shaft

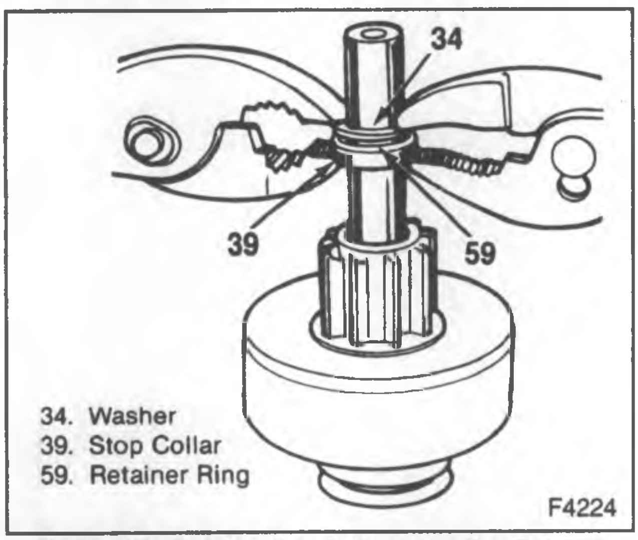


Figure 17—Forcing the Collar over the Retainer Ring

4. Stop collar (39) on the shaft with the cupped end away from the pinion gear.
5. Retainer ring (37) on the shaft (figure 16).
   - Place the ring on the end of the shaft.
   - With a wood block on the top of the ring, force the ring onto the shaft with a light hammer blow.
   - Slide the ring down and into the shaft groove. Do not distort the retainer ring when installing it.
6. Stop collar with the retainer ring (figure 17).
   - Place a suitable washer over the retainer ring end and squeeze the collar and washer together.
   - Remove the washer.
7. Thrust collar (39) or pinion stop washer (34) with the flat side away from the pinion.
   - Apply sealing compound to the solenoid flange, just under the solenoid.
   - Spread the brush assemblies using a tool socket slightly larger in diameter than the commutator.
   - Slide the field frame over the armature. The brush retaining tool socket will slide out as the field frame bottoms.
   - Install the washer, end frame and the two through bolts.
8. Brake washer (34) on the commutator end of the armature shaft (SD-300).
9. Solenoid (3) and the solenoid return spring (5) with the drive end housing (31).
10. Solenoid retaining screws.
11. Drive assembly collar to the shift lever fingers.
12. Armature shaft into the drive end bearing.
13. Field frame to the drive end assembly.
14. Field coil strap to the solenoid motor terminal.

PINION CLEARANCE CHECK

The pinion clearance cannot be adjusted but should be checked after reassembly of the motor. Improper clearance is an indication of worn parts.

To check pinion clearance, perform the following steps (figures 18 and 19).

1. Disconnect the motor field connector from the solenoid motor terminal and **Insulate it carefully.**
2. Connect a battery of the same voltage as the solenoid from the solenoid switch terminal to the solenoid frame.
3. **Momentarily** flash a jumper lead from the solenoid motor terminal to the solenoid frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.
4. Push the pinion back toward the commutator end to eliminate stack movement.
5. Measure the distance between pinion and pinion stop.
   - Clearance should be 0.25 mm to 4.06 mm (0.010 inch to 0.160 inch).

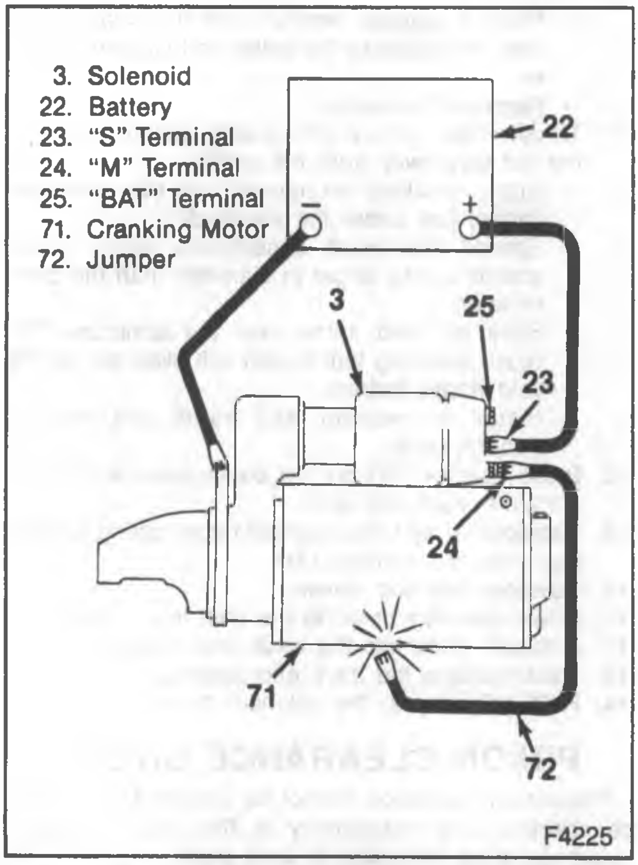


Figure 18—Pinion Clearance Circuit

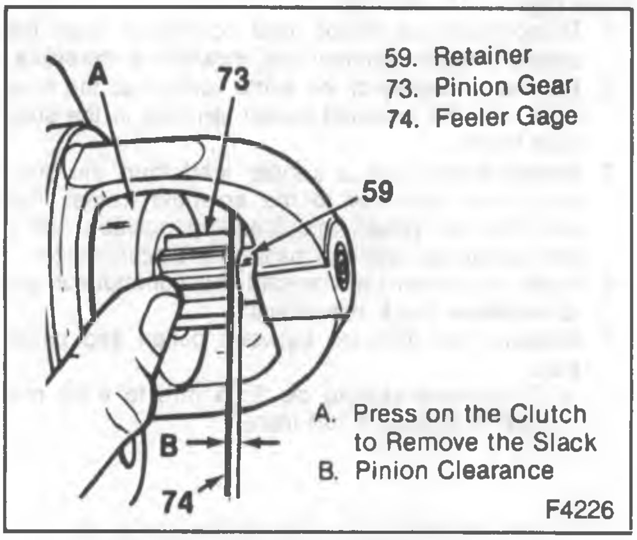


Figure 19—Measuring Pinion Clearance

SPECIFICATIONS

STARTER

No Load Test @ 10 Volts						
Starter		AMPS		RPM		Solenoid
Part No.	Series	Minimum	Maximum	Minimum	Maximum	Part No.
1998440	SD-300	70	110	6500	10700	1114489
1998583	SD-300	70	110	6500	10700	1114520
1998584	SD-300	70	110	6500	10700	1114520
1998588	SD300	70	110	6500	10700	1114563
1998589	SD-300	70	110	6500	10700	1114563
1998590	SD-300	70	110	6500	10700	1114520
1998598	SD-300	70	110	6500	10700	1114520
10455013	SD-260	50	62	8500	10700	10469039
10455017	SD-200	50	75	6000	11900	1114530
10455018	SD-200	50	75	6500	11900	1114530

SOLENOID SWITCHES

Switch		Pull-In Winding		Hold-In Winding	
Part No.	Volts	Amps	Volts	Amps	Volts
1114489	12	11-18	5	13-18	10
1114520	12	23-30	5	13-19	10
1114530	12	23-30	5	13-19	10
1114563	12	26-30	5	14-18	10
10469039	12	31-36	5	13-15	10

LUBRICATION

Use Delco-Remy Gear and Shift Lubricant No. 1960954 or equivalent.

T2533

SECTION 6D4

PG-200 (PMGR) STARTING MOTOR

CONTENTS

DELCO-REMY PG-200 (PMGR) STARTING MOTOR

DESCRIPTION

The PG-200 (PMGR) starting motor features small permanent magnets mounted inside the field frame (figure 1). These magnets take the place of current-carrying field coils mounted on iron pole pieces.

The use of MAGNEQUENCH® permanent magnets permits the design of a gear reduction motor that is about half as large and half the weight of a field coil motor having the same cranking performance. Internal gear reduction through planetary gears results in armature speeds in the 7000 rpm range. This higher armature speed may result in a noticeable difference in sound during cranking. The armature and drive shaft are mounted on roller or ball bearings in place of bushings.

Electrically the motor consists of the brush assembly and the armature. The solenoid contains pull-in and hold-in windings, and the motor external wiring is the same as field-coil motors. No periodic lubrication is required except during motor repair.

The part number and the date code are stamped on the outside of the end plate.The date code shows the year, month and day of month of production.

DIAGNOSIS OF THE STARTING MOTOR

STARTING MOTOR TESTS

Before disassembling the starting motor for repair, the following tests should be made.

NOTICE: Never operate the starting motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by too much cranking, will damage the starting motor.

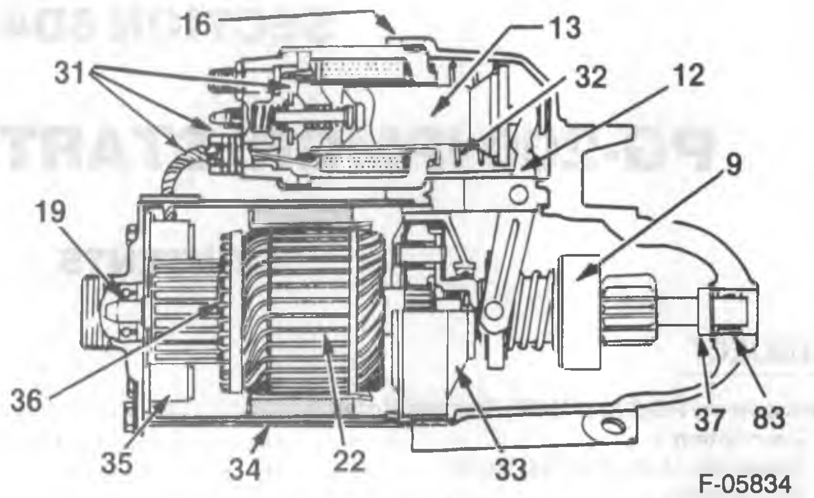
Inspect

1. Pinion for freedom of operation by turning it on the screw shaft.
2. Armature for freedom of rotation by prying the pinion with a screwdriver.
   - Tight bearings or a bent armature shaft will cause the armature to not turn freely.
   - If the armature does not turn freely, the motor should be disassembled.
   - If the armature does not rotate freely, the motor should be given a no-load test before disassembly.

NO LOAD TEST (Figure 2)

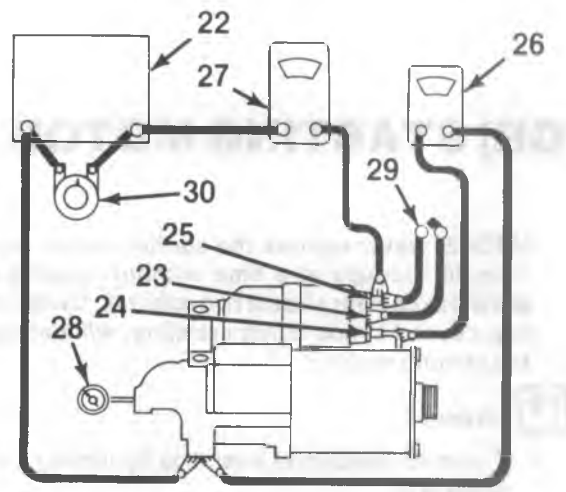
Connect a voltmeter from the motor terminal to the motor frame and an rpm indicator to measure drive speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch in the open position switch terminal. Close the switch and compare the rpm, current, and voltage readings with the specifications at the end of this section. It is not necessary to obtain the exact voltage specified as a good reading can be made by understanding that if the voltage is slightly higher the rpm will be slightly higher, with the current remaining basically unchanged. However, if the exact voltage is

9. Clutch
12. Shift Lever
13. Plunger
16. Solenoid
19. Bearing
22. Armature
31. TIG Welds
32. Return Spring
33. Planetary Gear Reduction Assembly
34. Permanent Magnet Field
35. Brushes
36. Welded Connections
37. Pinion Stop
83. Drive End Bearing



F-05834

Figure 1—PG-200 (PMGR) Starting Motor



22. Battery
23. "S" Terminal
24. "M" Terminal
25. "BAT" Terminal
26. Voltmeter
27. Ammeter
28. Tachometer
29. Load Switch
30. Carbon Pile

F-05835

Figure 2—No Load Test Hookup

desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. Compare the test results as follows:

1. Rated current draw and no-load speed indicates normal condition of the starting motor.
2. Low free speed and high current draw indicates:
   a. **Too much friction.** Tight, dirty, or worn bearings or bent armature shaft allowing the armature to drag.
   b. **Shorted armature.** This can be further checked on a growler after disassembly.
   c. **Grounded armature or fields.** Check further after disassembly.
3. Failure to operate with high current draw indicates:
   a. **A direct ground** in the terminal or brush assembly.
   b. **Seized bearings.** This should have been noted by turning the armature by hand.
4. Failure to operate with no current draw indicates:
   a. **Open brush leads.**
   b. **Open armature coils.** Inspect the commutator for badly burned bars after disassembly.
   c. **Broken brush springs, worn brushes, high insulation between the commutator bars.** Look for these or other causes which would prevent good contact between the brushes and commutator.
5. Low no-load speed and low current draw indicates a high internal resistance due to poor connections, worn leads, dirty commutator and causes listed under step 4.

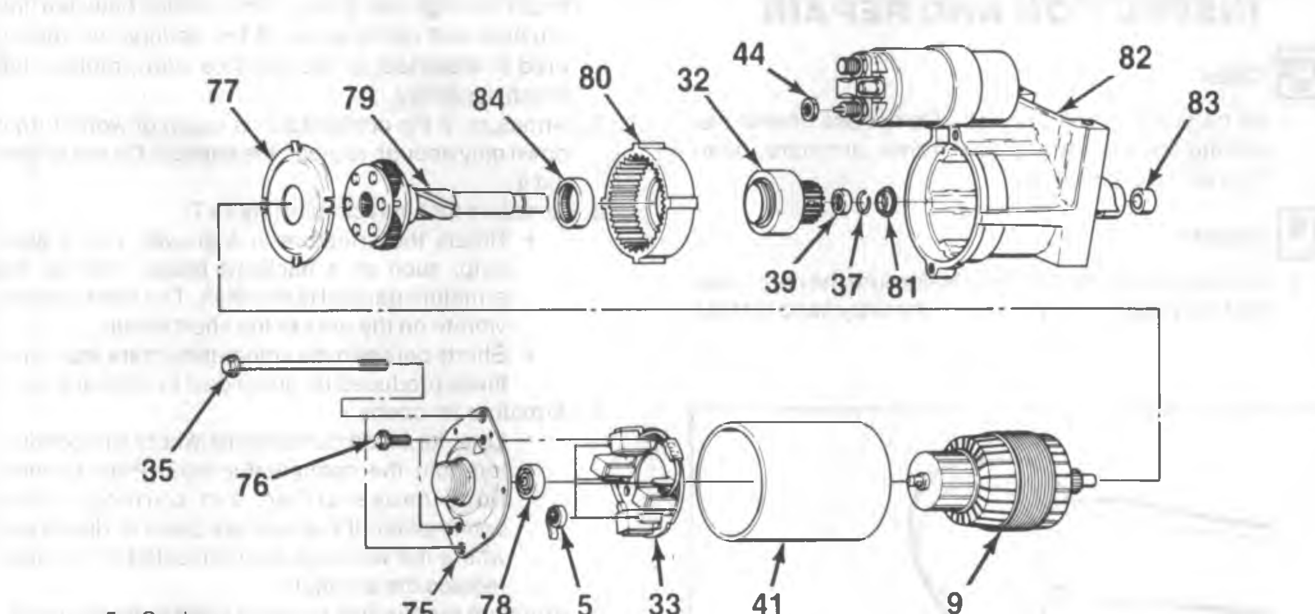
DISASSEMBLY

If the motor does not perform to specifications, it may need to be disassembled for further testing of the components. Normally the starting motor should be disassembled only so far as is necessary to make repair or replacement of parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the starting motor.

Remove or Disconnect (Figures 3 through 6)

Tool Required:

J 28509-A Bearing Puller



5. Spring
9. Armature Assembly
32. Drive Assembly
33. Brush Assembly
35. Bolt
37. Pinion Stop Ring
39. Pinion Stop Collar
41. Frame
44. Nut
75. End Plate
76. Screw
77. Shield
78. Commutator End Bearing
79. Shaft and Gear Assembly
80. Gear and Bearing Assembly
81. Thrust Collar
82. Drive Housing Assembly
83. Drive End Bearing
84. Gearing Bearing

F-05836

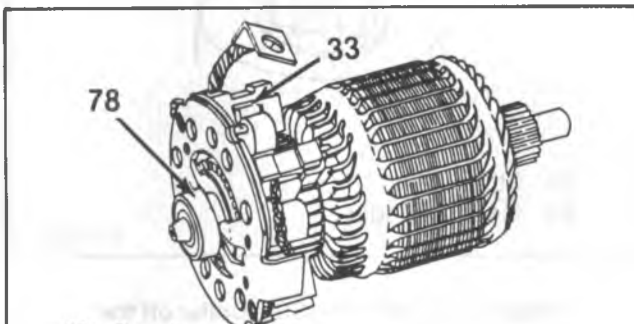
Figure 3—PG-200 Starting Motor Components

- Clean the outside of the starter housing, removing grease, oil, mud, etc.
- Make scribe marks to show the relationship of the lever housing, field frame, and end plate to aid in assembly.

1. Nut (44) and lead at solenoid terminal.
2. Through bolts (35).
3. Two screws and end plate (75).

CAUTION: The magnets in the frame have a strong attraction to metal parts. Do not put your fingers between the armature and frame when removing or installing the armature assembly or injury could result.

4. Field frame with armature and shield (77) from the drive end.
5. Armature (9) from the field frame (41).
6. Commutator end bearing (78) from the armature shaft with J 28509-A or equivalent.
   - Lift the brushes so each spring rests against the brush to prevent brush damage during brush assembly removal (figure 4).
7. Brush assembly from the commutator.
8. Gear and drive from the drive housing assembly (82).
   - Use a screwdriver to pry the shift lever off the drive pins.
9. Thrust collar (81) from the drive shaft.
   - Slide a deep socket over the shaft and tap the socket to drive the stop collar (39) off the pinion stop ring (37) (figure 5).
10. Stop collar and stop ring.
11. Drive and gear from the shaft.
12. Bearing (83) from the drive housing assembly (figure 6).
    - The assembly, including the solenoid, plunger, return spring, shift lever, and drive housing, cannot be disassembled.



33. Brush
78. Commutator End Bearing

F-05837

Figure 4—Armature Assembly

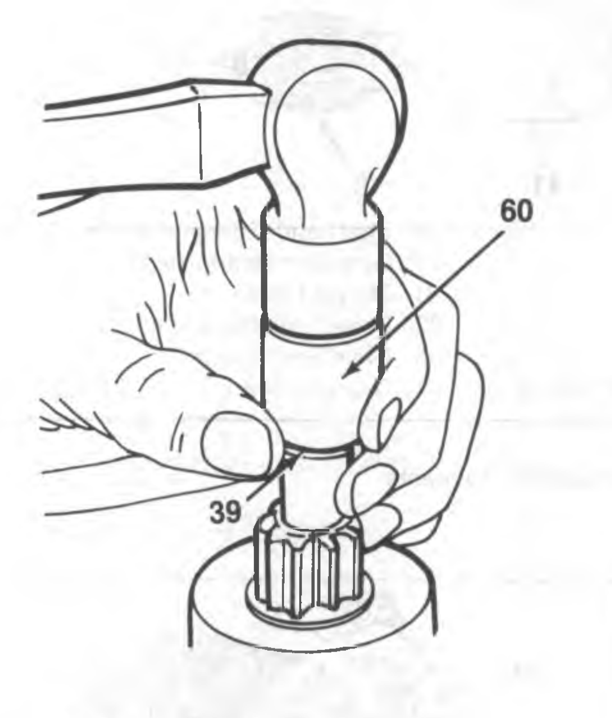
INSPECTION AND REPAIR

Clean

- All parts with a soft dry cloth. Do not use grease dissolving solvents on the field frame, armature, bearings or drive assembly.

Inspect

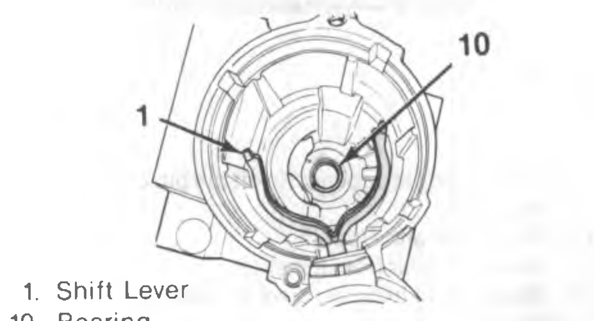
1. Brushes and brush holders. Make sure they are clean and the brushes are not worn. Check by hand that the brush springs are giving firm contact between the brushes and commutator. If the springs are discolored or distorted, or the brushes worn, replace the brush assembly.
2. Armature. If the commutator is rough or worn, turn it down only enough to clean the surface. Do not undercut it.
3. Armature for short circuits (figure 7).
   - Rotate the armature in a growler with a steel strip, such as a hacksaw blade, held on the armature parallel to the shaft. The steel strip will vibrate on the area of the short circuit.
   - Shorts between the commutator bars are sometimes produced by brush dust or copper dust.
4. Armature for opens.
   - Look for loose connections where the conductors join the commutator bars. Poor connections cause arcing and burning of the commutator. If the bars are black or discolored where the windings are connected to the bars, replace the armature.
5. Armature for grounds by using a test lamp (figure 8).
   - If the test lamp lights when one test prod is placed on the commutator and the other test prod is placed on the armature core or shaft, the armature is grounded.
6. Shaft, bearings, pinion and gears for wear and discoloration. Replace as necessary.
7. Solenoid hold-in winding.
   - With all the leaks disconnected from the solenoid, make the test connections as shown in figure 9.



39. Stop Collar
60. Metal Cylinder

F-04217

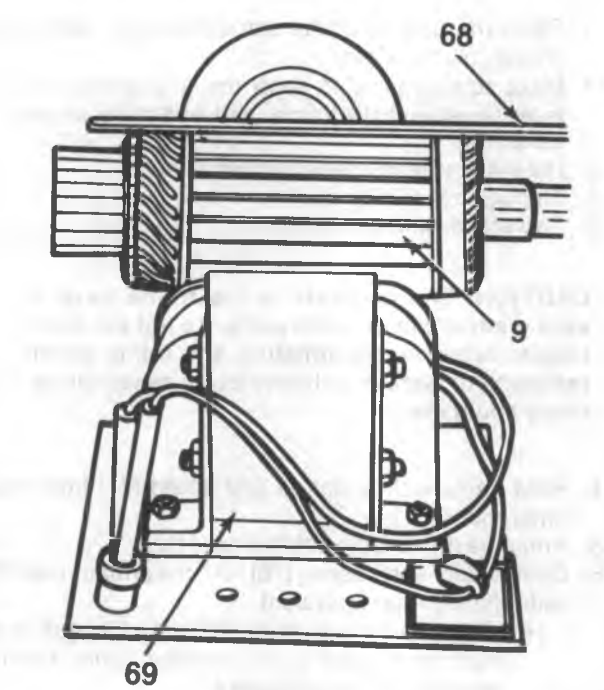
Figure 5—Driving the Stop Collar off the Pinion Stop Ring



1. Shift Lever
10. Bearing

F-05838

Figure 6—Drive End Bearing



9. Armature
68. Saw Blade
69. Growler

F-04221

Figure 7—Testing the Armature for Short Circuits

- Turn the switch on and adjust the carbon pile to lower the battery voltage to the value shown in "Specifications" at the end of this section.
- Note the ampere reading; a high reading indicates a shorted or grounded winding, and a low reading indicates excessive resistance.

8. Solenoid pull-in winding.
   - With all the leads disconnected from the solenoid, make the test connections as shown in figure 10.

NOTICE: To prevent overheating the pull-in winding, do not leave the winding energized more than 15 seconds. The current draw will decrease as the winding temperature increases.

- Turn the switch on and adjust the carbon pile to lower the battery voltage to the value shown in "Specifications" at the end of this section.
- Note the ampere reading; a high reading indicates a shorted or grounded winding, and a low reading indicates excessive resistance.

ASSEMBLY

Install or Connect (Figures 3, 4, 11 through 15)

- Lift the brushes up in the holders with the springs resting against the sides of the brushes.

1. Brush assembly onto the commutator.
2. Commutator end bearing inner race onto the shaft by pressing until the inner race contacts the stop shoulder.
   - The bearing is sealed and does not need lubrication.

- Lift the springs and allow the brushes to drop onto the commutator.

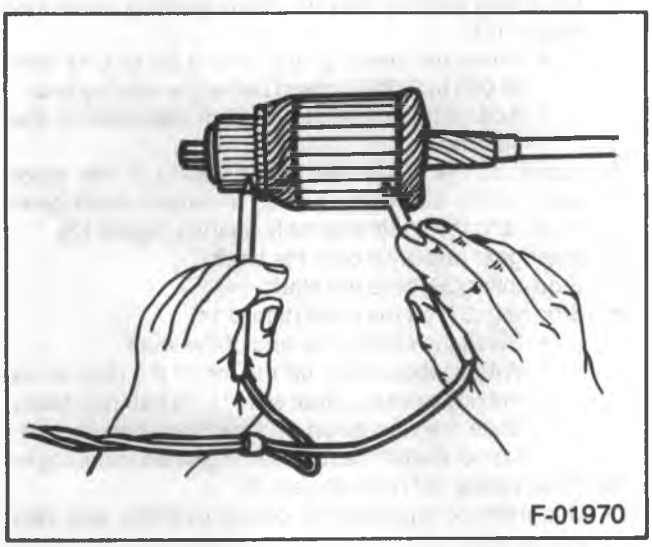


Figure 8—Testing the Armature for Grounds

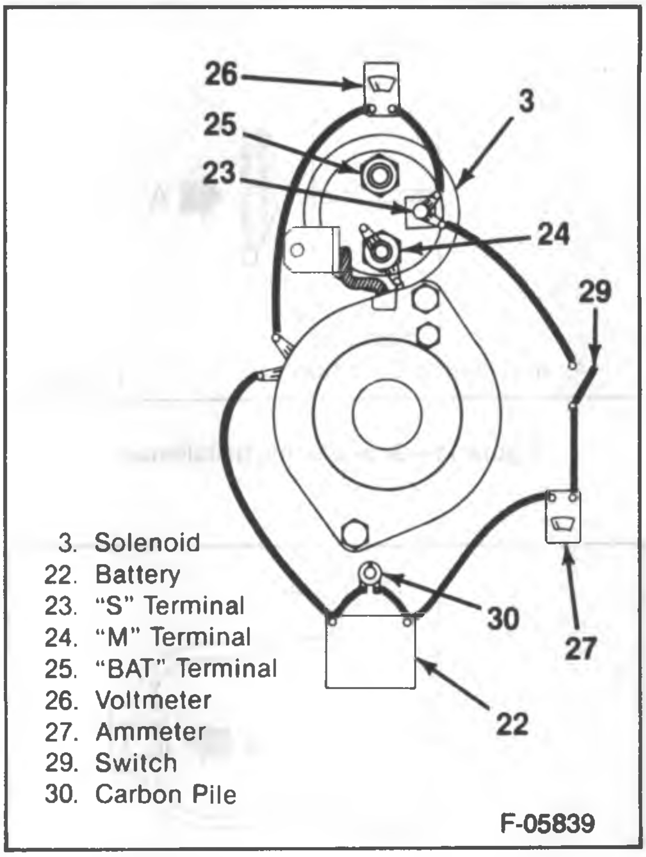


Figure 9—Hold-In Winding Test Connections

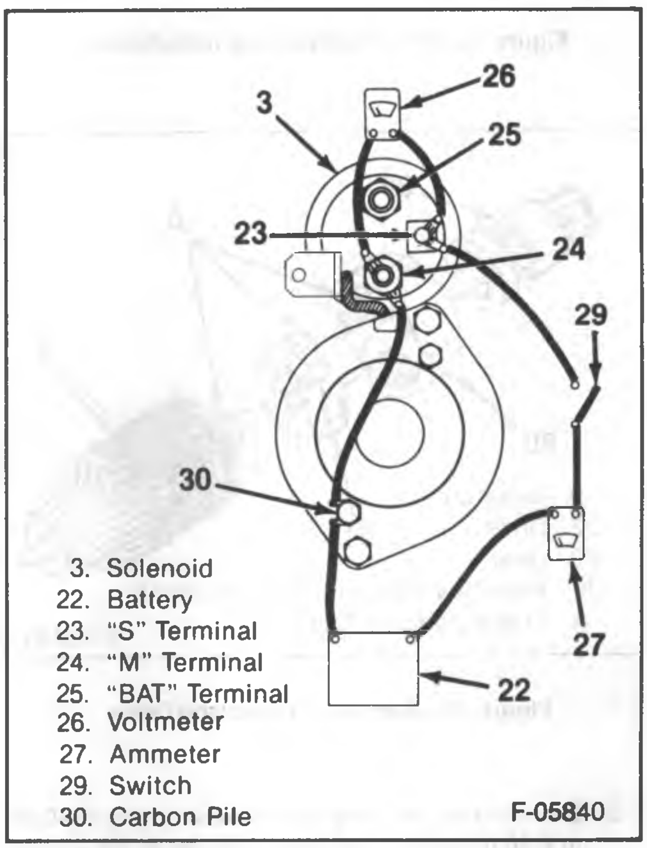


Figure 10—Pull-In Winding Test Connections

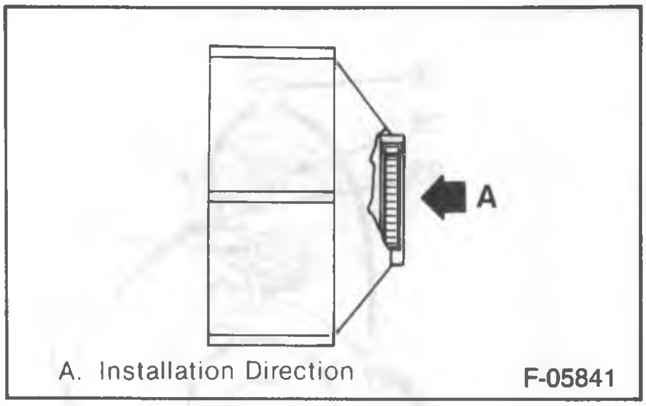


Figure 11—Gear Bearing installation

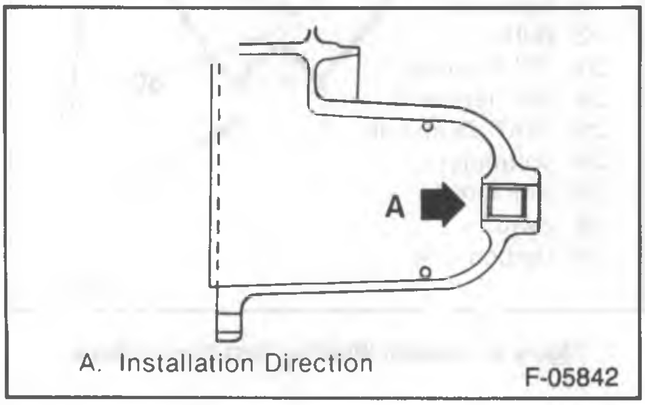


Figure 12—Drive End Bearing Installation

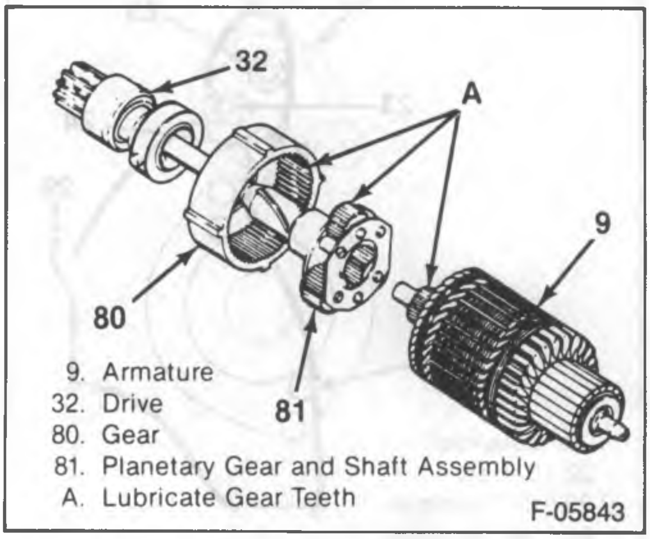


Figure 13—Armature, Gears and Drive

3. Gear bearing into the gear by pressing until it is 0.28 to 0.38 mm (0.011 to 0.014 inch) below the casting surface (figure 11).
   - Lubricate the bearing with lubricant PN 10497186 or equivalent if needed. This gease maintains lubricating qualities even at temperature extremes.

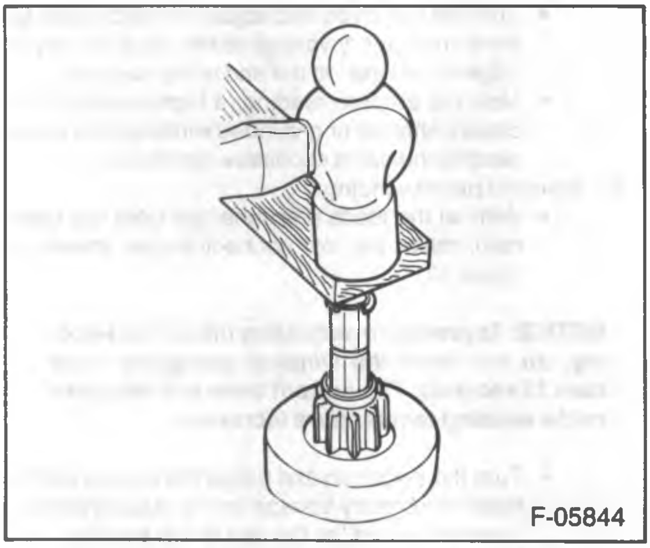


Figure 14—Forcing the Stop Ring on the Shaft

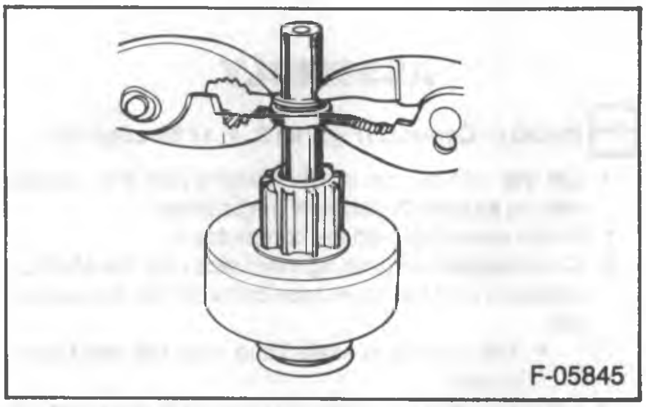


Figure 15—Forcing the Collars over the Stop Ring

4. Drive end bearing into the drive housing assembly (figure 12).
   - Press the bearing until it is 0.25 to 0.45 mm (0.009 to 0.010 inches) below the casting face.
   - Add lubricant PN 10497186 or equivalent to the bearing.
5. Lubricant PN 10497186 or equivalent to the inner gear teeth, planetary gears, armature shaft gear teeth, and the shaft assembly bearing (figure 13).
6. Inner gear and drive over the shaft.
7. Stop collar (39) onto the shaft.
8. Stop ring (37) on the shaft (figure 14).
   - Place the ring on the end of the shaft.
   - With a wood block on the top of the ring, force the ring onto the shaft with a light hammer blow.
   - Slide the ring down and into the shaft groove. Do not distort the retainer ring when installing it.
9. Thrust collar (81) onto the shaft.
   - Use pliers to squeeze the collars over the stop ring (figure 15).
10. Drive and shaft assembly into the drive housing assembly.

- With a screwdriver, guide the shift lever over the shift collar pins on the drive assembly.

11. Shield (77) to the drive housing assembly.

CAUTION: The magnets in the frame have a strong attraction to metal parts. Do not put your fingers between the armature and frame when removing or installing the armature assembly or injury could result.

12. Armature assembly (9) into the frame.
13. Frame to the drive housing assembly.
14. End plate (75) to the brush assembly with two screws.
15. Two bolts (35) to the starter assembly.
16. Nut (44) and lead to the solenoid terminal.

PINION CLEARANCE CHECK

The pinion clearance cannot be adjusted but should be checked after reassembly of the motor. Improper clearance is an indication of worn parts.

To check pinion clearance, perform the following steps (figures 16 and 17).

1. Disconnect the motor lead connector from the solenoid motor terminal.
2. Connect a 12-volt battery from the solenoid switch terminal to the drive housing.
3. **Momentarily** flash a jumper lead from the solenoid motor terminal to the drive housing. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.
4. Push the pinion back toward the commutator end to eliminate slack movement.
5. Measure the distance between pinion and pinion stop.
   - Clearance should be 0.25 mm to 3.56 mm (0.010 to 0.160 inch).
6. The clearance is not adjustable. If it is not within limits, check for improper assembly.

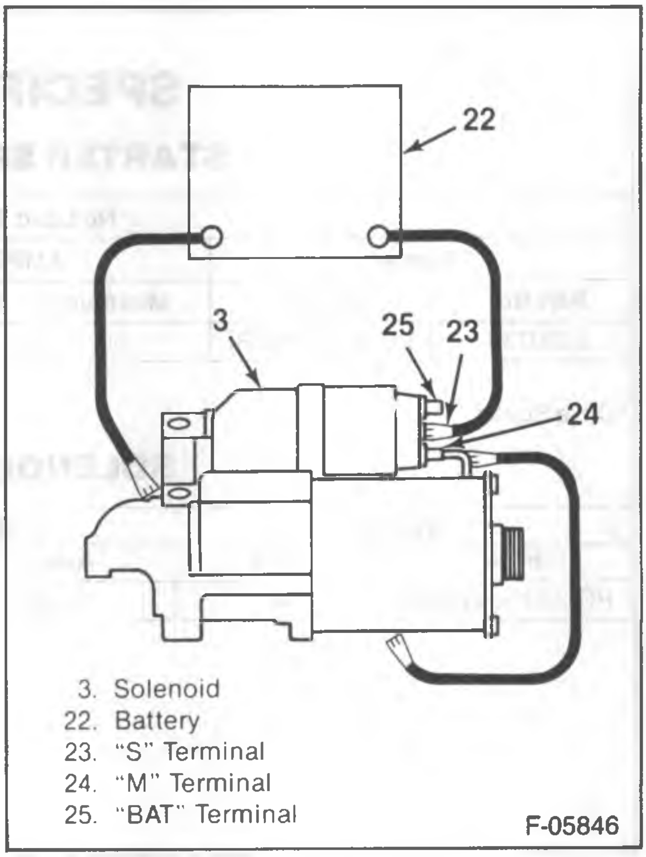


Figure 16—Pinion Clearance Check Circuit

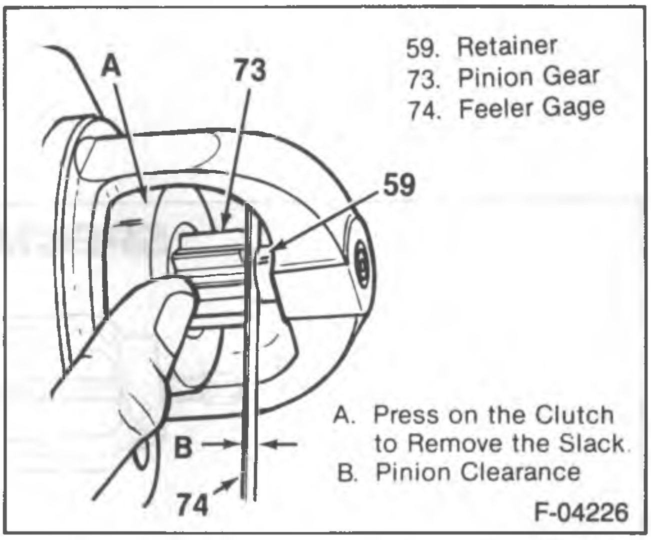


Figure 17—Measuring Pinion Clearance

SPECIFICATIONS

STARTER SPECIFICATIONS

No Load Test @ 10 Volts						
Starter		AMPS		RPM		Solenoid
Part No.	Series	Minimum	Maximum	Minimum	Maximum	Part No.
9000735	PG-200 (PMGR)	50	90	2300*	26600*	—

*Drive Speed

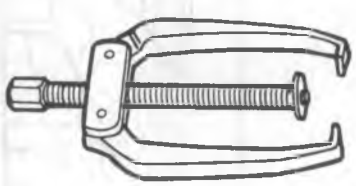
SOLENOID SWITCHES

Switch		Pull-In Winding		Hold-In Winding	
Part No.	Volts	Amps	Volts	Amps	Volts
PG-200 Solenoid	12	31-36	5	13-15	10

F-06387

SPECIAL TOOLS

1



J 28509-A

1. Bearing Puller

F-06388

SECTION 6D5

DISTRIBUTORS

CONTENTS

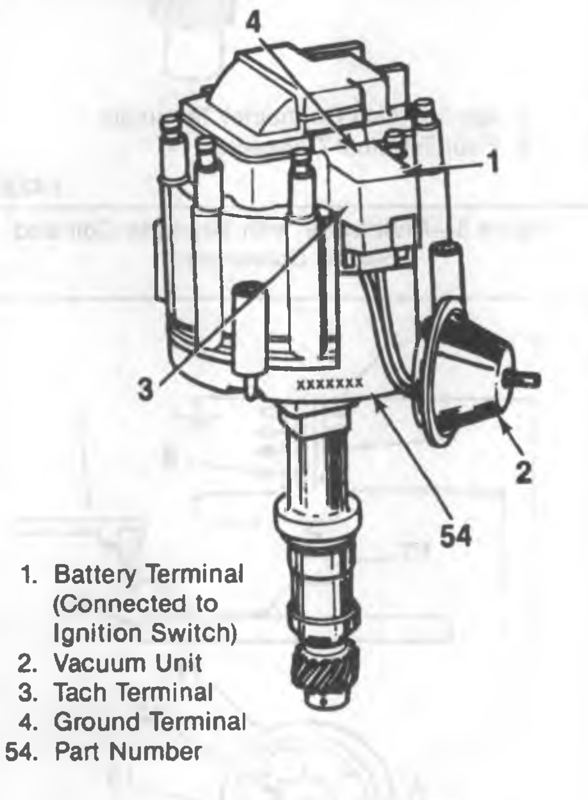


Figure 1—Distributor with Integral Coil

DELCO-REMY DISTRIBUTORS

DESCRIPTION

This distributor is a magnetic pulse triggered, transistor controlled, inductive, discharge distributor (figures 1 through 4). The magnetic pickup assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth, and a pickup coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage in the pickup coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage of up to 35,000 volts is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

The magnetic pickup assembly is mounted over the main bearing on the distributor housing. The electronic module within the distributor automatically controls the dwell period.

A distributor with an integral coil is used on engines without TBI (Throttle Body Injection). A distributor with a separate coil is used on engines with TBI, and the ignition system is then controlled by the computer. This EST (Electronic Spark Timing) system may include ESC (Electronic Spark Control). Refer to IGNITION SYSTEM (SEC. 6D4) in the applicable truck service manual for a description of these systems.

On a distributor with an integral coil, the part number (seven digits) is tamped on the distributor housing (figure 1). On a distributor with a separate coil, it is located on a label on the distributor cap (figure 2).

IGNITION COIL

The coil is built like a transformer with the winding surrounded by a laminated iron frame. It generates a high secondary voltage (up to 35,000 volts) when the primary circuit is broken. It may be contained in the cap or mounted separately and connected to the distributor by a high tension wire.

ELECTRONIC MODULE

The electronic module is a solid state unit containing many complete circuits. The circuits control spark triggering, switching, current limiting, dwell control and distributor pickup. The dwell angle is controlled by the module and is varied in direct relation to engine speed.

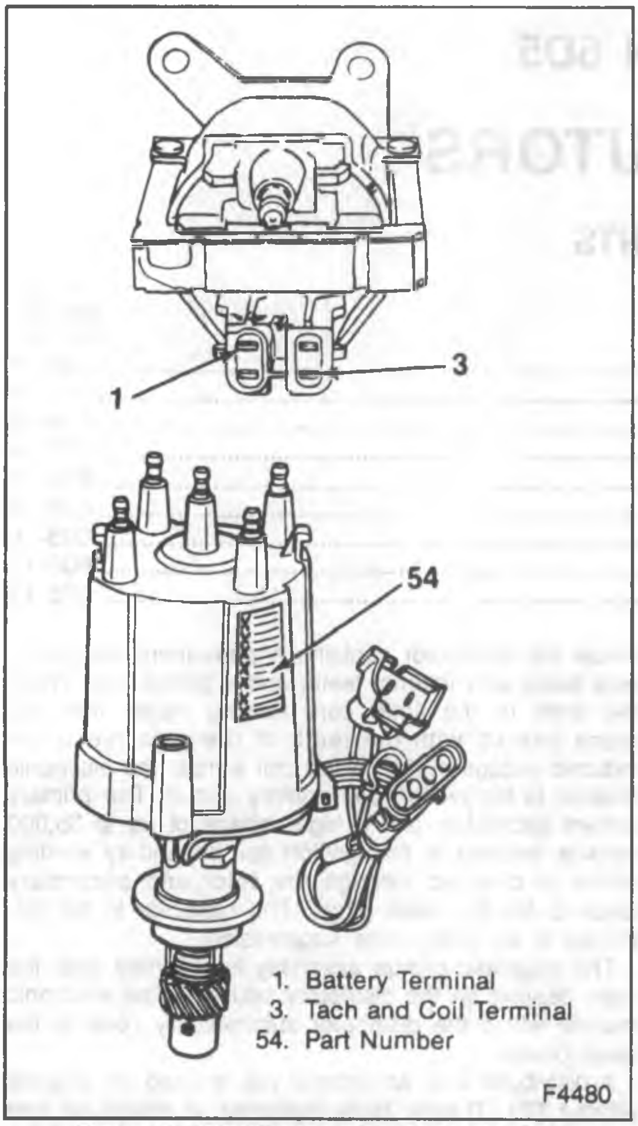


Figure 2—Distributor with Separate Coil

With an EST system, the computer sends signals to the module to control dwell and spark timing. The module may have from four to eight terminals, depending on the ignition system.

POLE PIECE AND COIL ASSEMBLY (Figure 5)

The pole piece and plate assembly (often referred to as the pickup coil assembly) consists of the following: A stationary pole piece with internal teeth and a pickup coil and magnet which are located between the pole piece and a bottom plate.

CENTRIFUGAL AND VACUUM ADVANCE (Figures 5 and 6)

Distributors without EST systems have centrifugal advance weights and springs. Some also have vacuum advance units.

Centrifugal advance is achieved through the rotation of the timer core in relation to the distributor shaft. Vacuum advance is achieved by attaching the pickup coil and pole piece to the vacuum advance unit actuating arm.

On distributors without the vacuum unit, a plastic retainer is installed to hold the pickup coil and pole piece to the vacuum advance unit actuating arm.

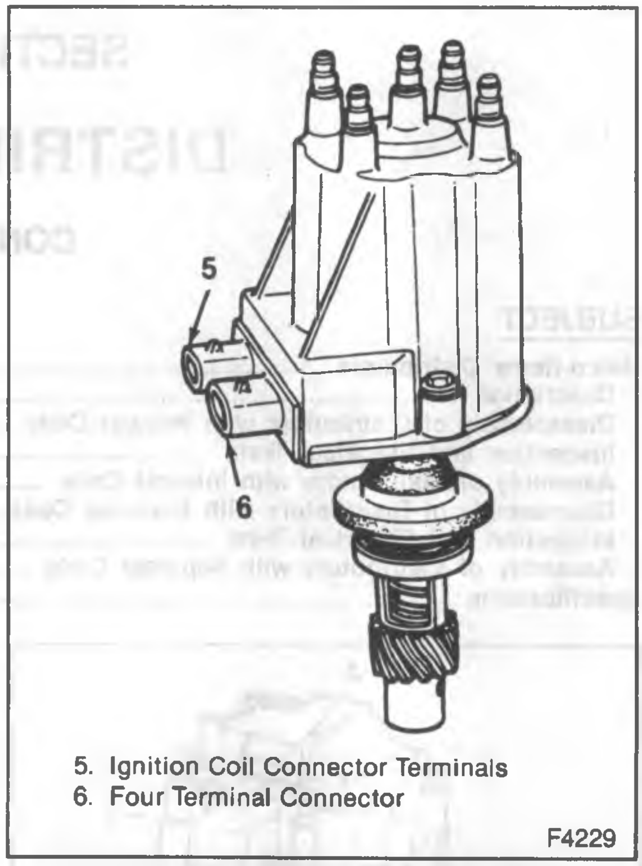


Figure 3—Distributor with Separate Coil and Sealed Connectors

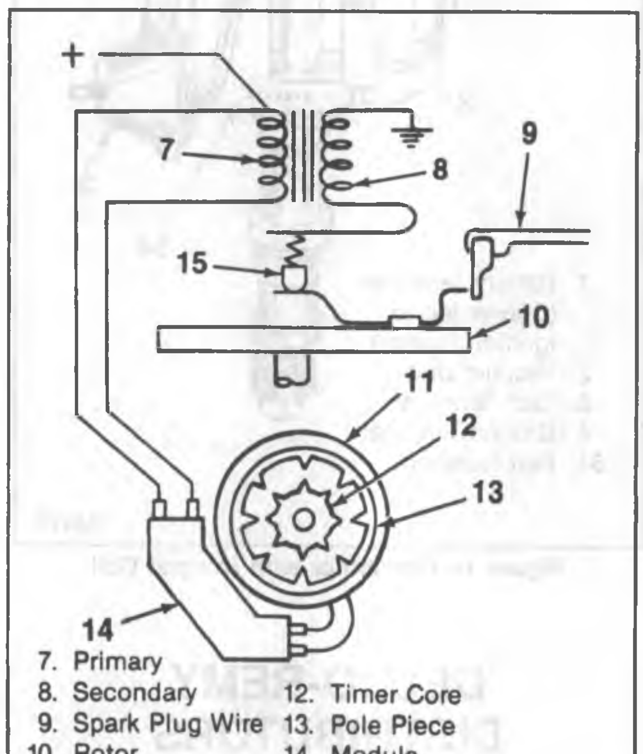
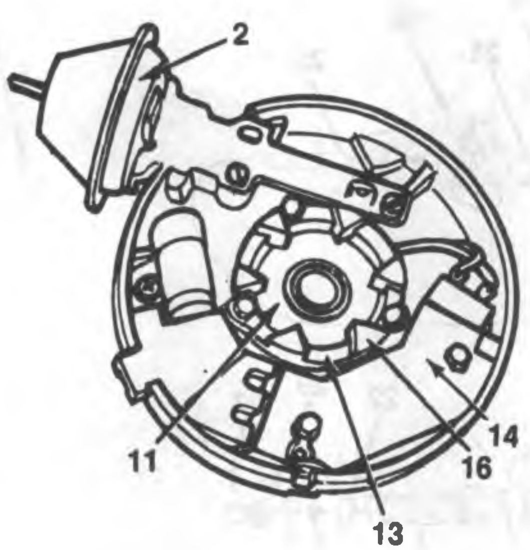


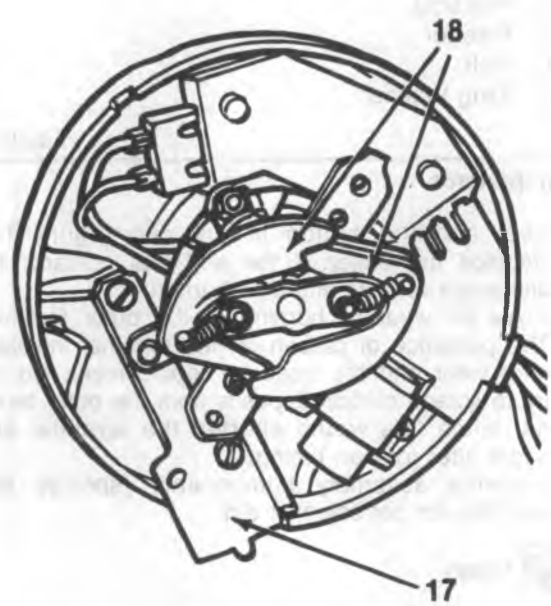
Figure 4—Basic Wiring Schematic



2. Vacuum Unit
11. Pickup Coil
13. Pole Piece
14. Module
16. Internal Teeth

F4231

Figure 5—Top View of Distributor



17. Plastic Retainers
18. Advance Weights

F4232

Figure 6—Distributor with Centrifugal Advance Weights

On distributors without the vacuum unit, a plastic retainer is installed to hole the pickup coil assembly stationary. Only centrifugal advance is used on these models.

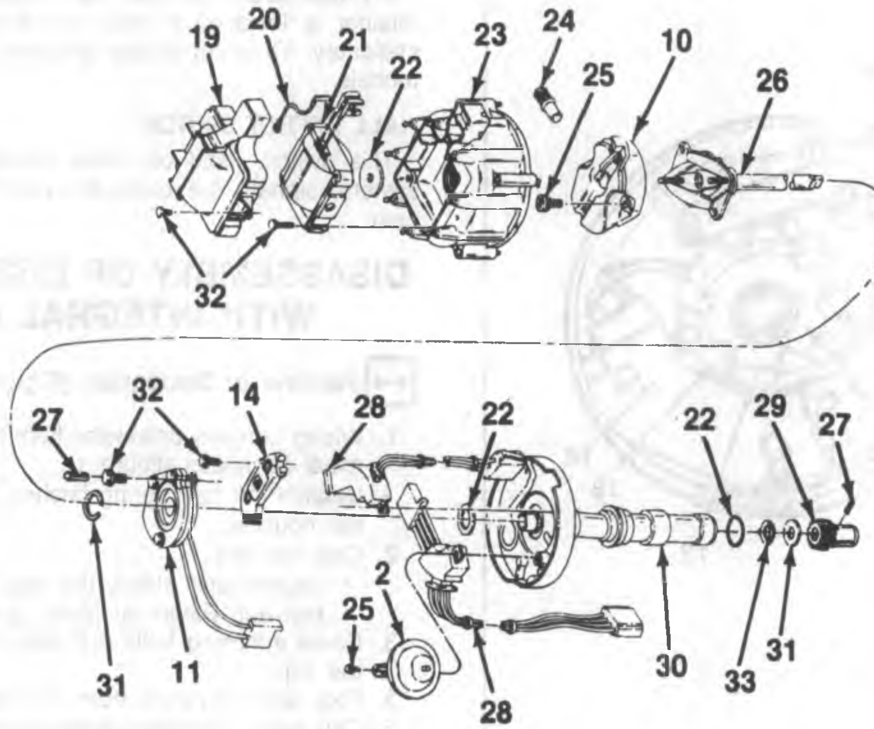
HALL EFFECT SWITCH

This switch, used on some distributors in the EST system, signals the computer which cylinder will fire next.

DISASSEMBLY OF DISTRIBUTORS WITH INTEGRAL COILS

Remove or Disconnect (Figure 7)

1. Wiring harness connector from the ignition coil terminal connector (figure 1).
   - Unlatch the four spring latches holding the cap to the housing.
2. Cap and coil.
   - Inspect and check the coil. Refer to "Inspection and Electrical Tests" later in this section.
3. Cover attaching bolts (32) and the cover (19) from the cap.
4. Four attaching bolts from the coil (21).
5. Coil wires from the connector housing with needle nose pliers (figure 8).
6. Coil and wiring from the cap.
7. Arc seal (22) and the ground wire (20) from the cap (23).
   - Refer to "Inspection and Electrical Tests" later in this section.
8. Two bolts (32) holding the rotor (10) to the shaft (26).
9. Rotor.
10. Two bolts holding the Hall Effect switch to the housing (if equipped).
11. Hall Effect switch (35) if equipped (figure 9).
    - Refer to "Inspection and Electrical Tests" later in this section.
12. Roll pin (27) from the shaft (26) (figure 10).
    - Mark the shaft and driven gear so they can be aligned for assembly.
    - Drive out the roll pin with a small punch.
13. Driven gear (29) on distributor for a 6-cylinder engine.
14. Driven gear (29), shim washer (31) and thrust washer on distributor for an 8-cylinder engine.
15. Timer core shaft (26) from the housing (30).
    - Distributors for non-EST ignition systems have centrifugal advance weights and springs. These are part of the shaft assembly and are not serviceable.
16. Four-wire connector from the pickup coil connector on distributors with ESC (figure 11).
17. Pickup coil connector from the module (figure 12).
    - Check the vacuum advance unit (if equipped) and the pickup coil. Refer to "Inspection and Electrical Tests" later in this section.



2. Vacuum Unit
10. Rotor
11. Pickup Coil Assembly (Pole Piece and Plate)
14. Module
19. Cover
20. Ground Strap
21. Ignition Coil Assembly
22. Seal
23. Cap
24. Resistor
25. Screw
26. Shaft Assembly
27. Pin
28. Terminal Block
29. Gear
30. Housing
31. Washer
32. Bolt
33. Tang Washer

F4233

Figure 7—Distributor Components

18. Screw holding the capacitor to the housing.
19. Capacitor (36), wiring harness connector (40) and module (14) from the housing (figure 13).
20. Connector from the module.
    - Check the module. Refer to "Inspection and Electrical Tests" later in this section.
21. Magnetic shield (if equipped)
22. Thin washer (31) from the housing.
23. Pickup coil assembly (11).
    - Do not disassemble. The coil is serviced only as an assembly.
24. Vacuum unit (2) (if equipped) or plastic retainer and two bolts.

INSPECTION AND ELECTRICAL TESTS

Inspect

1. Cap for cracks or holes. Replace the cap if it is damaged at all.
2. Metal terminals in the cap for corrosion. Scrape them clean with a knife or replace the cap.
3. Seal and the button in the cap (figure 15). Replace the button if the end that contacts the distributor rotor is pitted or burned.
4. Rotor for wear or burning at the outer terminal. The presence of carbon on the terminal indicates rotor wear and the need for replacement. Do not try to scrape carbon deposits from the outer terminal since this would shorten the terminal and might alter ignition timing.
5. Advance assembly components (springs and weights) for corrosion or dirt.

Clean

- The advance components and rotor shaft in a solvent.
- The advance components and shaft can only be replaced as an assembly.

6. Distributor shaft for shaft-to-bushing looseness. Insert the shaft in the housing. If the shaft wobbles in the bushings, replace the housing and/or shaft. The bushings are not serviceable.
7. Housing for cracks or damage.

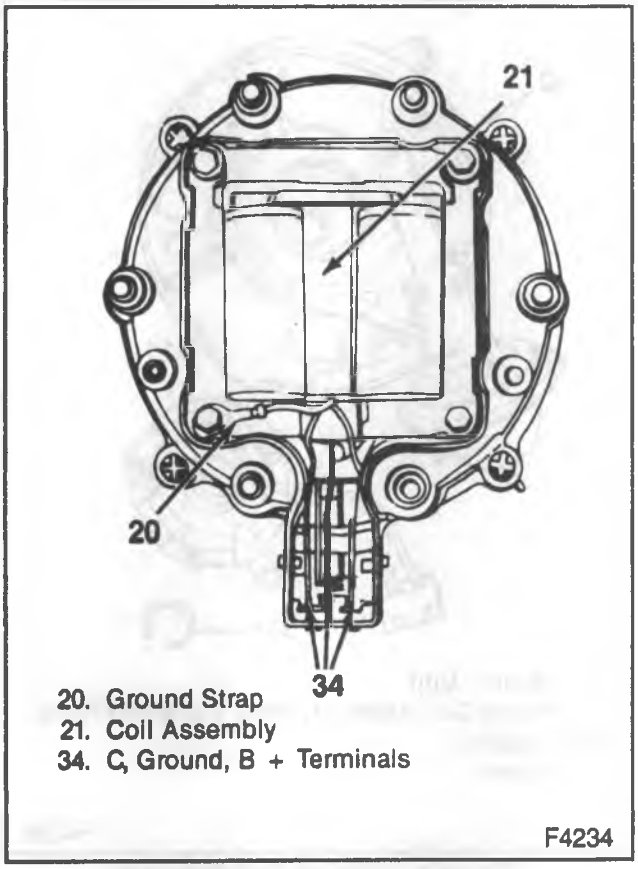


Figure 8—Ignition Coil

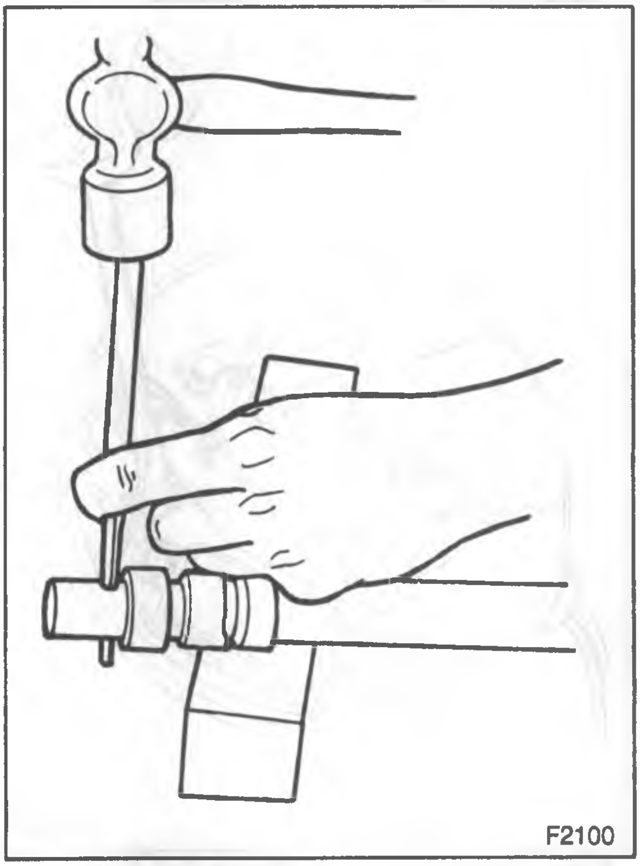


Figure 10—Removing the Roll Pin

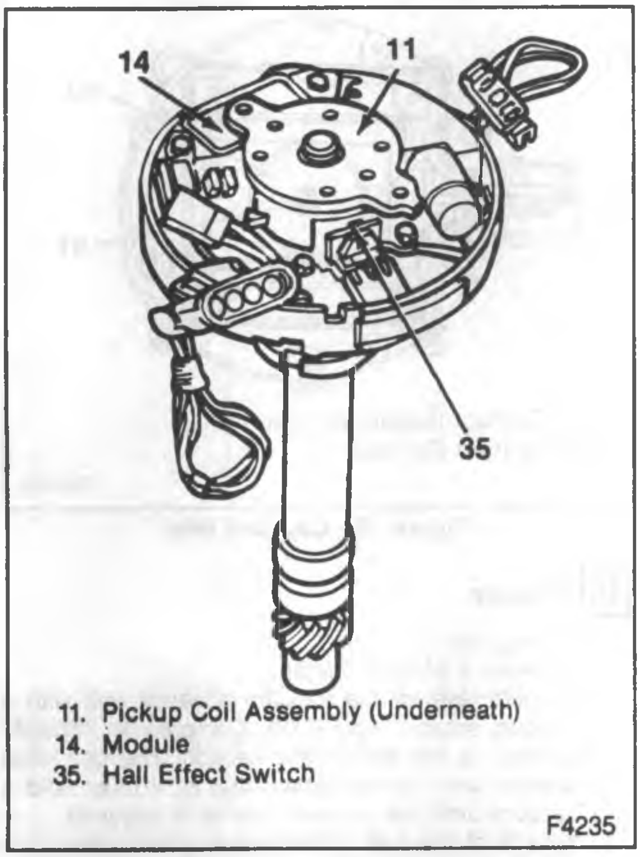


Figure 9—Distributor with Hall Effect Switch

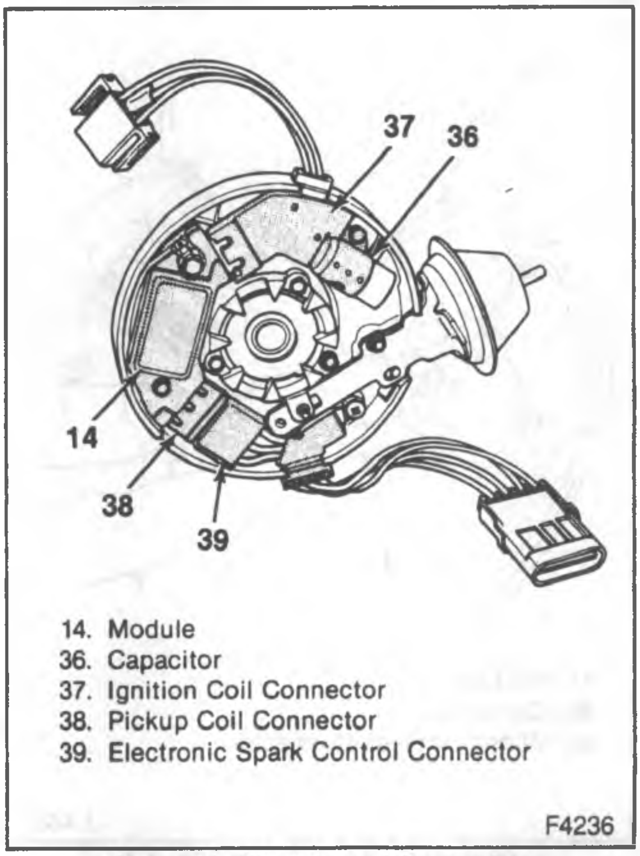
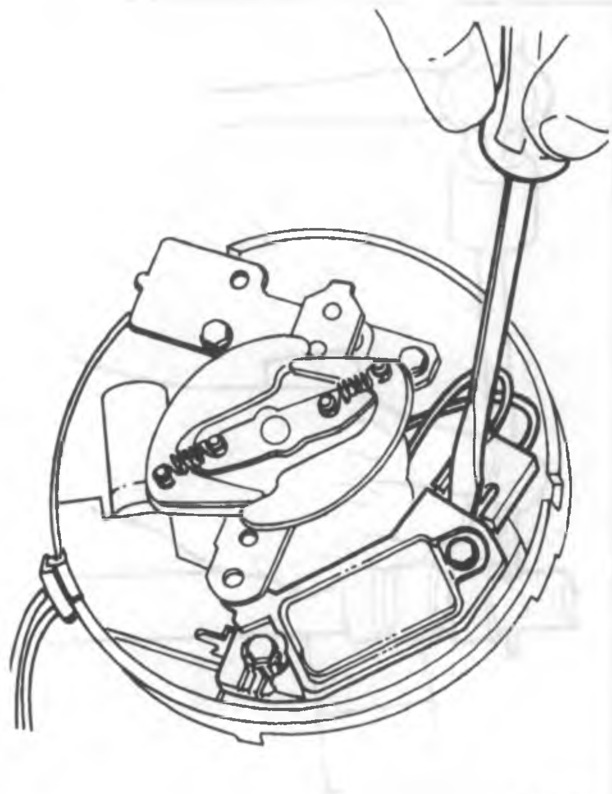
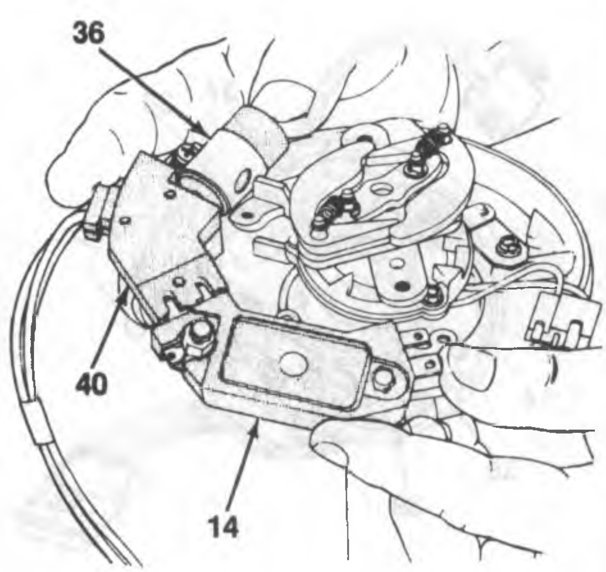


Figure 11—Module and Connectors



F2102

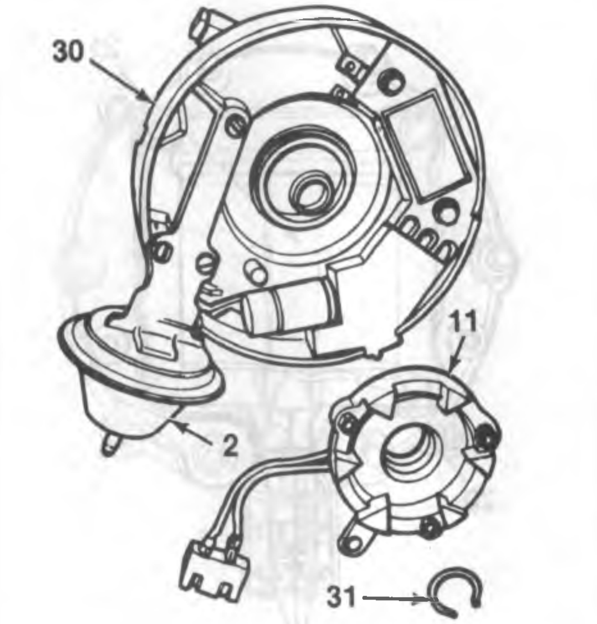
Figure 12—Removing the Pickup Coil Connector



14. Module
36. Capacitor
40. Wiring Harness Connector

F4237

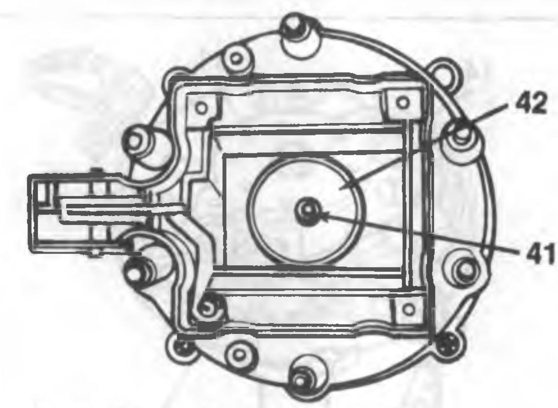
Figure 13—Removing the Module



2. Vacuum Unit
11. Pickup Coil Assembly (Pole Piece and Plate)
30. Housing
31. Washer

F4238

Figure 14—Pickup Coil Removed



41. Contact Button and Spring
42. Ignition Coil Seal

F4239

Figure 15—Cap and Seal

Measure

Tool Required:
J 24642-F Module Tester

1. Vacuum level of the vacuum advance unit with a vacuum source (figure 16). Compare to "Specifications" at the end of this section. The unit must function with no leak-down; that is, if must hold a vacuum until the vacuum source is released.
2. Voltage of the Hall Effect switch (if equipped).
   - Connect a 12 volt battery and voltmeter as shown in figure 17.

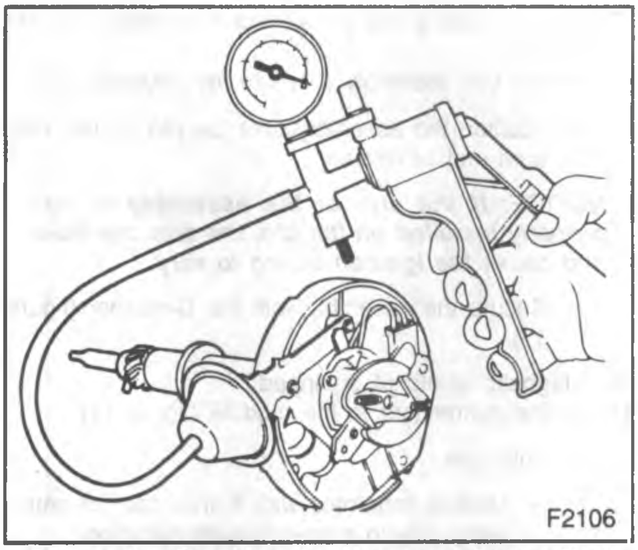


Figure 16—Checking the Vacuum Advance Unit

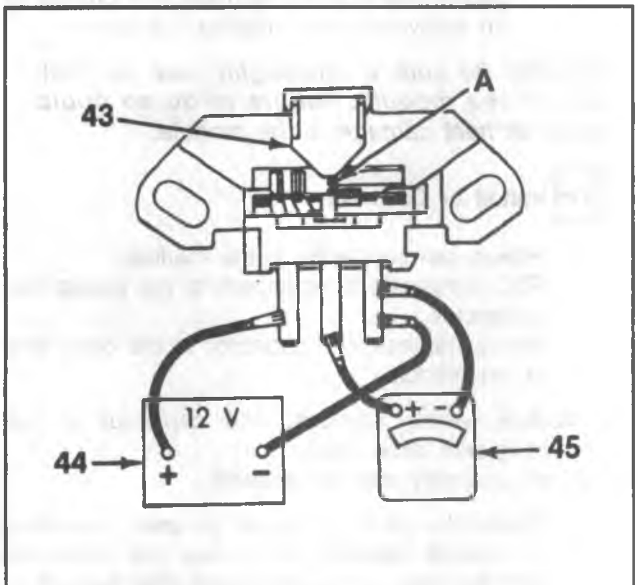


Figure 17—Testing the Hall Effect Switch

- With a knife blade inserted and held against the magnet the voltmeter should read within 0.5 volts of the battery voltage. If not, replace the switch.
- Remove the knife blade. The voltmeter should read less than 0.5 volts. If not, replace the switch.

3. Resistance of the pickup coil with an ohmmeter.
   - Connect an ohmmeter as shown in figure 18, step 1. If the ohmmeter reads less than 500 ohms or more than 1500 ohms while flexing the leads, replace the pickup coil.

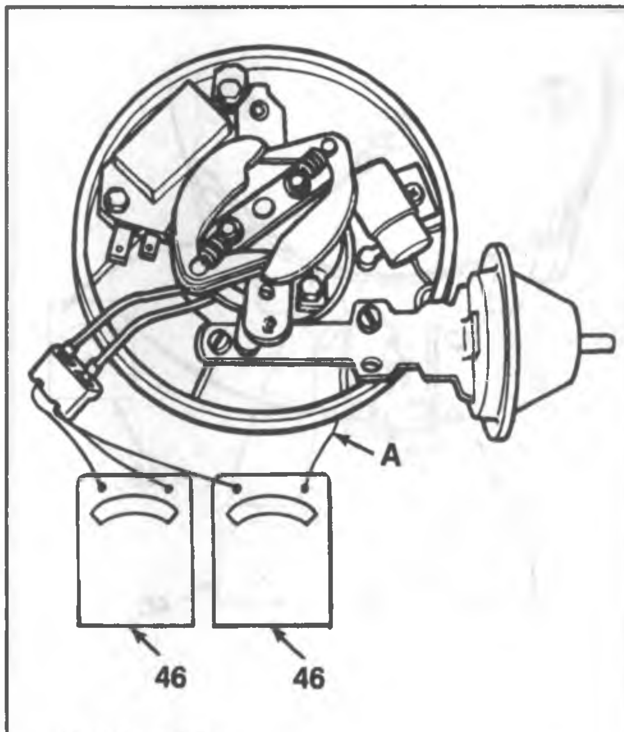


Figure 18—Checking the Pickup Coil

   - If the coil does not have an open, check for ground as shown in step 2. The reading should be infinite.
4. Resistance of the ignition coil with an ohmmeter.
   - Connect the ohmmeter as shown in figure 19, step 1. The reading should be zero or nearly zero. If not, replace the coil.
   - Connect the ohmmeter as shown in steps 2 and 3. Use the high scale. Replace the coil only if both readings are infinite.
5. Electrical performance of the module. The module can only be checked with an approved module tester, such as J 24642-F or equivalent. Follow the directions exactly that come with the tester.

ASSEMBLY OF DISTRIBUTORS WITH INTEGRAL COILS

Install or Connect (Figure 7)

1. Spring, button (41) and seal (42) into the cap (figure 15).
2. Coil (21) and wiring into the cap (figure 8).
3. Four bolts holding the coil to the cap.
4. Cover (19) to the cap (23) with two bolts.
5. Lubricant into the lube cavity of the housing (30) only if needed.
   - Refer to "Specifications" at the end of this section.
6. Vacuum unit (2) if equipped or plastic retainer.

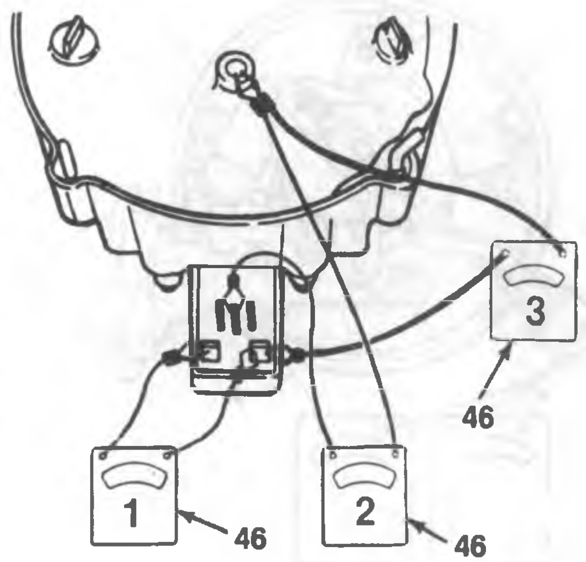


Figure 19—Checking the Ignition Coil

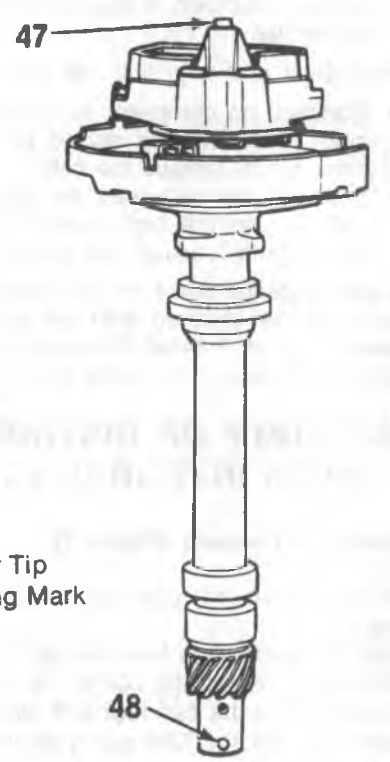


Figure 20—Timing Mark and Rotor Alignment

7. Screws holding the vacuum unit or retainer to the housing.
8. Pickup coil assembly (11) into the housing (30).
   - Position the assembly over the pin on the vacuum unit or retainer.

NOTICE: If the arm of the assembly is not properly installed on the pin, the arm can float and cause the ignition timing to vary.

   - Secure the assembly with the C-washer (figure 17).

9. Magnetic shield (if equipped).
10. Wiring connectors to the module (figure 11).
    - Lubricate.
      - Module terminals with a thin coat of petroleum jelly to prevent future oxidation.
      - Bottom of the module and the module rest pad in the housing with silicone grease or an equivalent heat transfer substance.

NOTICE: Be sure to thoroughly coat the bottom of the module. Failure to do so could result in heat damage to the module.

Install or Connect

— Pickup coil connector to the module.
— ESC connector (if equipped) to the pickup coil connector.
— Wiring harness and capacitor to the other end of the module.

11. Module, wiring harness, and capacitor to the housing with three bolts.
12. Shaft assembly into the housing.
    - Rotate the shaft to check for even clearance all around between the pickup coil assembly and the teeth on the distributor shaft assembly. If interference exists, loosen the three bolts on the pickup coil assembly and move the pole piece (teeth) to provide an even clearance and tighten the three bolts.
13. Hall Effect switch (if equipped) to the housing with two bolts.
14. Rotor to the shaft assembly with two screws.
15. Driven gear (29) onto the shaft. (6 cylinder engines).
16. Seal (22), thrust washer, washer (31), and driven gear (29) onto the shaft. (8 cylinder engines).

- Align the timing mark (48) on the drive gear with the rotor tip (47) (figure 20).

17. Roll pin into the driven gear (figure 21).
18. Distributor cap (23) onto the housing (30) with the tab on the rim of the cap in the notch of the housing.
19. Four spring clips on the cap onto the rim of the housing.
20. Wiring harness connector to the terminal on the side of the distributor cap (figure 22).

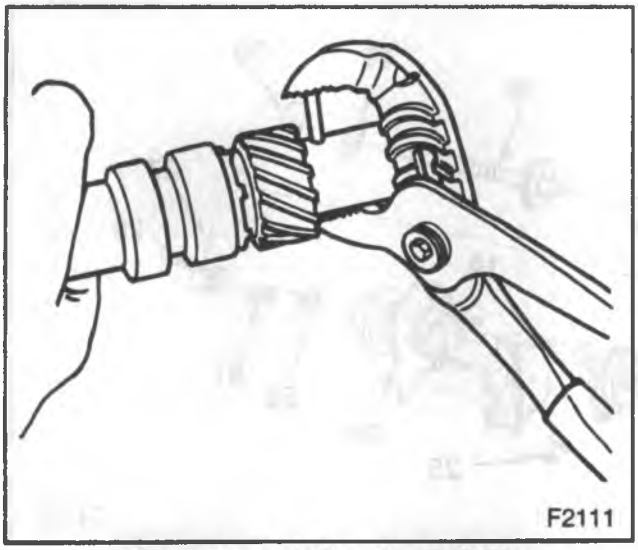


Figure 21—Installing the Roll Pin

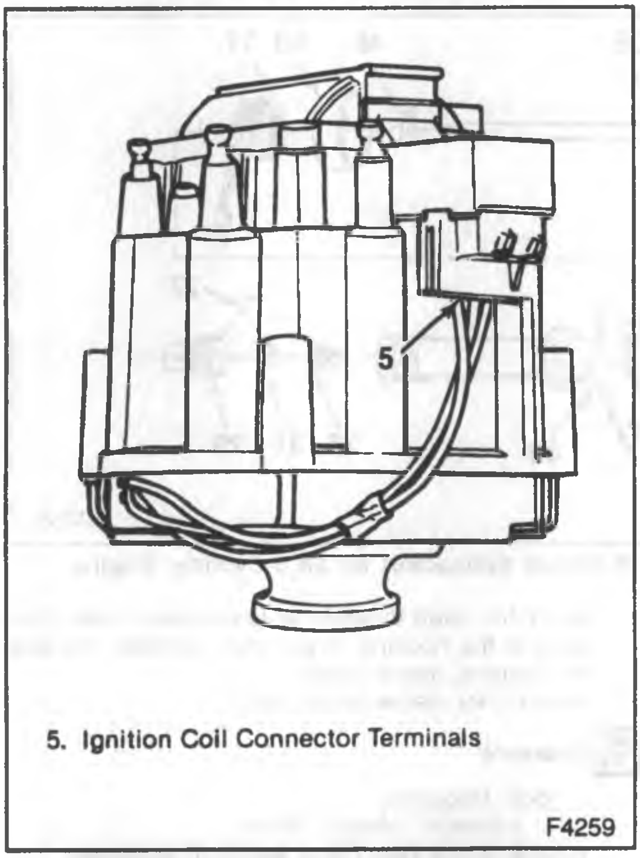


Figure 22—Wiring Harness Connector

DISASSEMBLY OF DISTRIBUTORS WITH SEPARATE COILS

DISTRIBUTORS WITH SEALED MODULE CONNECTORS (Figure 3)

Remove or Disconnect (Figure 23 and 24)

Any time the distributor is disassembled, the retainer (49) must be replaced. Do not attempt to reuse the old retainer.

1. Screws and washers holding the cap to the housing.
2. Cap (29) from the housing.
   - Place marks on the rotor and the shaft assembly to help line up the rotor during assembly.
3. Rotor (10) from the shaft by lifting or prying straight up.
4. Roll pin (27) from the shaft (26).
   - Mark the shaft and driven gear for reassembly.
   - Drive out the roll pin with a small punch (figure 25).
5. Driven gear (29), washer or spring, and spring retainer (52) or tan washer (33).
6. Shaft (26) with the pole piece and plate from the housing (30).
7. Retainer (49) from the housing (30) by prying it with a screwdriver.
8. Shield (50).
9. Pickup coil connector from the module (14).
   - Lift the locking tab with a screwdriver.
10. Pickup coil (11).
11. Two screws holding the module to the housing.
12. Module (14).

DISTRIBUTORS WITHOUT SEALED MODULE CONNECTORS

Remove or Disconnect (Figure 26)

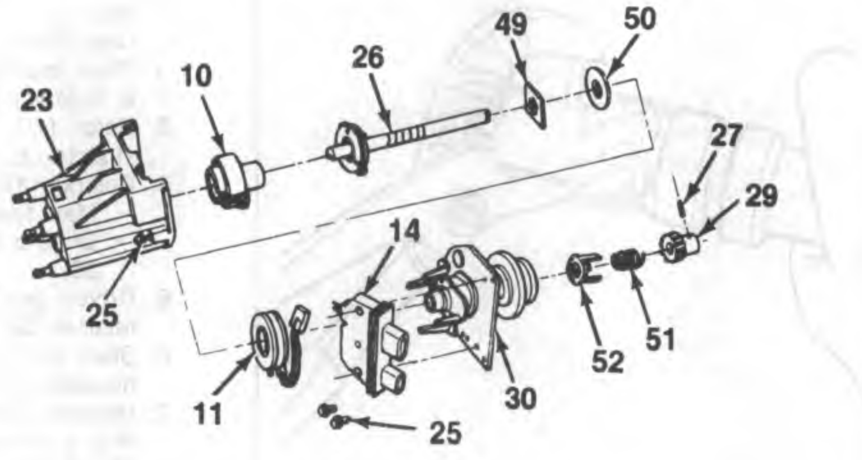
1. Cap.
   - Unlatch the spring latches holding the cap to the housing.
1. Place a mark on the rotor and on the shaft assembly to help line up the rotor during reassembly.
2. Rotor (10).
3. Two bolts holding the Hall Effect switch (if equipped) to the housing.
   - Lift away the locking tab of the connector to the switch.
4. Hall Effect switch (35) by lifting straight up.
5. Roll pin (26) from the shaft (27).
   - Mark the shaft and driven gear so they can be aligned for assembly.
   - Drive out the roll pin with a small punch (figure 25).
6. Driven gear (29), washer (31), spring (51), retainer (52), and tang washer (33).
7. Shaft (27) from the housing (30).
   - Pry straight up.
8. Thin "C" retaining washer (53) from inside the pickup coil assembly.
9. Pickup coil connector from the module (14).
10. Pickup coil assembly (11) from the housing.
11. Wiring harness connectors from the module (14).
12. Two screws holding the module to the housing.
13. Module (14).
14. Bolt holding the wiring harness to the housing.
15. Wiring harness.

INSPECTION AND ELECTRICAL TESTS

Inspect

1. Cap for cracks or tiny holes. Replace the cap if it is damaged at all.

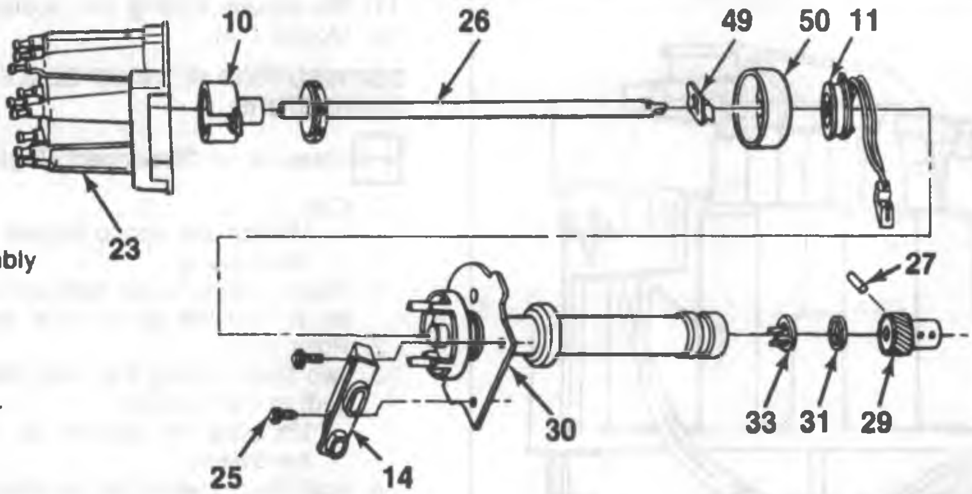
10. Rotor
11. Pickup Coil
14. Module
23. Cap
25. Screw
26. Shaft Assembly
27. Pin
29. Gear
30. Housing
49. Retainer
50. Shield
51. Spring
52. Spring Retainer



F4260

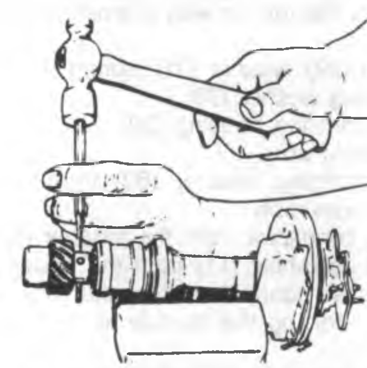
Figure 23—Distributor Components (Separate Coil and Sealed Connector)

10. Rotor
11. Pickup Coil
14. Module
23. Cap
25. Screw
26. Shaft Assembly
27. Pin
29. Gear
30. Housing
31. Washer
33. Tang Washer
49. Retainer
50. Shield



F4261

Figure 24—Distributor Components (separate Coil and Sealed Connector) for an 8-Cylinder Engine



F2114

Figure 25—Removing the Roll Pin

2. Metal terminals in the cap for corrosion. Scrape them clean with a knife or replace the cap.
3. Rotor for wear or burning at the outer terminal. The presence of carbon on the terminal indicates rotor wear and the need for replacement.
4. Shaft for shaft-to-bushing looseness. Insert the shaft in the housing. If the shaft wobbles, replace the housing and/or shaft.
5. Housing for cracks or damage.

Measure

Tools Required:
J 24642-F Module Tester

1. Voltage of the Hall Effect switch (if equipped).
   - Connect a 12 volt battery and voltmeter as shown in figure 17.
   - With a knife blade inserted and held against the magnet, the voltmeter should read within 0.5 volts of the battery voltage. If not, replace the switch.
   - Remove the knife blade. The voltmeter should read less than 0.5 volts. If not, replace the switch.
2. Resistance of the pickup coil with an ohmmeter.
   - Connect an ohmmeter to either pickup coil lead and the housing as shown in figure 27,

step 1. The reading should be infinite. If not, replace the coil.
- Connect an ohmmeter to both pickup coil leads as shown in figure 27, step 2. Flex the leads by hand at the coil and the connector to locate any intermittent opens. The ohmmeter should read a constant unchanging value in the 500 to 1500 ohm/range. If not, replace the coil.

3. Electrical performance of the module. The module can only be checked with an approved module tester, such as J 24642 or equivalent. Follow the directions exactly that come with the tester.
4. Resistance of the ignition coil with an ohmmeter.
   - Connect the ohmmeter as shown in figure 28, step 1. Use the high scale. The reading should be infinite. If not, replace the coil.
   - Connect the ohmmeter as shown in step 2. Use the low scale. The reading should be very low or zero. If not, replace the coil.
   - Connect the ohmmeter as shown in step 3. Use the high scale. The meter should not read infinite. If it does, replace the coil.

ASSEMBLY OF DISTRIBUTORS WITH SEPARATE COILS

DISTRIBUTORS WITH SEALED MODULE CONNECTORS (Figure 3)

Install or Connect (Figure 23 and 24)

- Lubricate
  - Bottom of the module and the module rest pad in the housing with silicone grease or an equivalent heat transfer substance.

NOTICE: Be sure to thoroughly coat the bottom of the module. Failure to do so could result in heat damage to the module.

1. Module (14) to the housing (30) with two screws.
2. Pickup coil (11).
   - Fit the tab on the bottom of the coil into the anchor hole in the housing.
3. Pickup coil wiring connector to the module.
   - Make sure the locking tab is in place.
4. Shield (50) onto the coil.
5. Retainer (49) onto the shield.
6. Shaft assembly (26) into the housing (30).
7. Spring retainer (52), spring (51), washer and driven gear (29) onto the bottom of the shaft.
   - Align the marks on the driven gear, housing, and shaft assembly.
8. Roll pin (27) into the gear.
   - Spin the shaft and make sure the teeth on the shaft assembly do not touch the pole piece.
9. Rotor (10) onto the shaft.
   - Fit the tab in the rotor into the shot on the shaft.
10. Cap (23) to the housing with screws and washers.

DISTRIBUTORS WITHOUT SEALED CONNECTOR (Figure 26)

Install or Connect

- Lubricate
  - Bottom of the module and the module rest pad in the housing with silicone grease or an equivalent heat transfer substance.

NOTICE: Be sure to thoroughly coat the bottom of the module. Failure to do so could result in heat damage to the module.

1. Module (14) to the housing (30) with two screws.
2. Wiring harness into the housing.
3. Two harness mounting tabs to the housing with one bolt.
4. Two wiring connectors to the module.
   - Be sure the locking tabs are in place.
5. Pickup coil (11) to the housing.
   - Fit the tab on the bottom of the coil into the anchor hole in the housing.
6. Pickup coil wiring connector to the module.
7. Thin "C" washer into the coil.
8. Shaft (26) into the housing.
9. Tan washer (33), spring retainer (52), spring (51), and driven gear (29) onto the shaft.
   - Align the marks on the driven gear, housing, and shaft assembly.
10. Roll pin into the driven gear.
    - After assembly, turn the shaft by hand to check tooth clearance between the shaft and pickup coil assembly. If the clearance needs adjustment, loosen and retighten the three pickup coil bolts.
11. Wiring connector the the Hall Effect switch (if equipped).
12. Hall Effect switch to the housing with two bolts.
    - The teeth on the shaft should rotate between the back plate and the magnet of the switch without touching.
13. Rotor (10) onto the shaft.
    - Fit the tab in the rotor into the slot on the shaft.
14. Cap (23) onto the housing.
    - Fit the tab inside the rim of the cap into the slot on the rim of the housing.
15. Spring clips on the cap onto the rim of the housing.

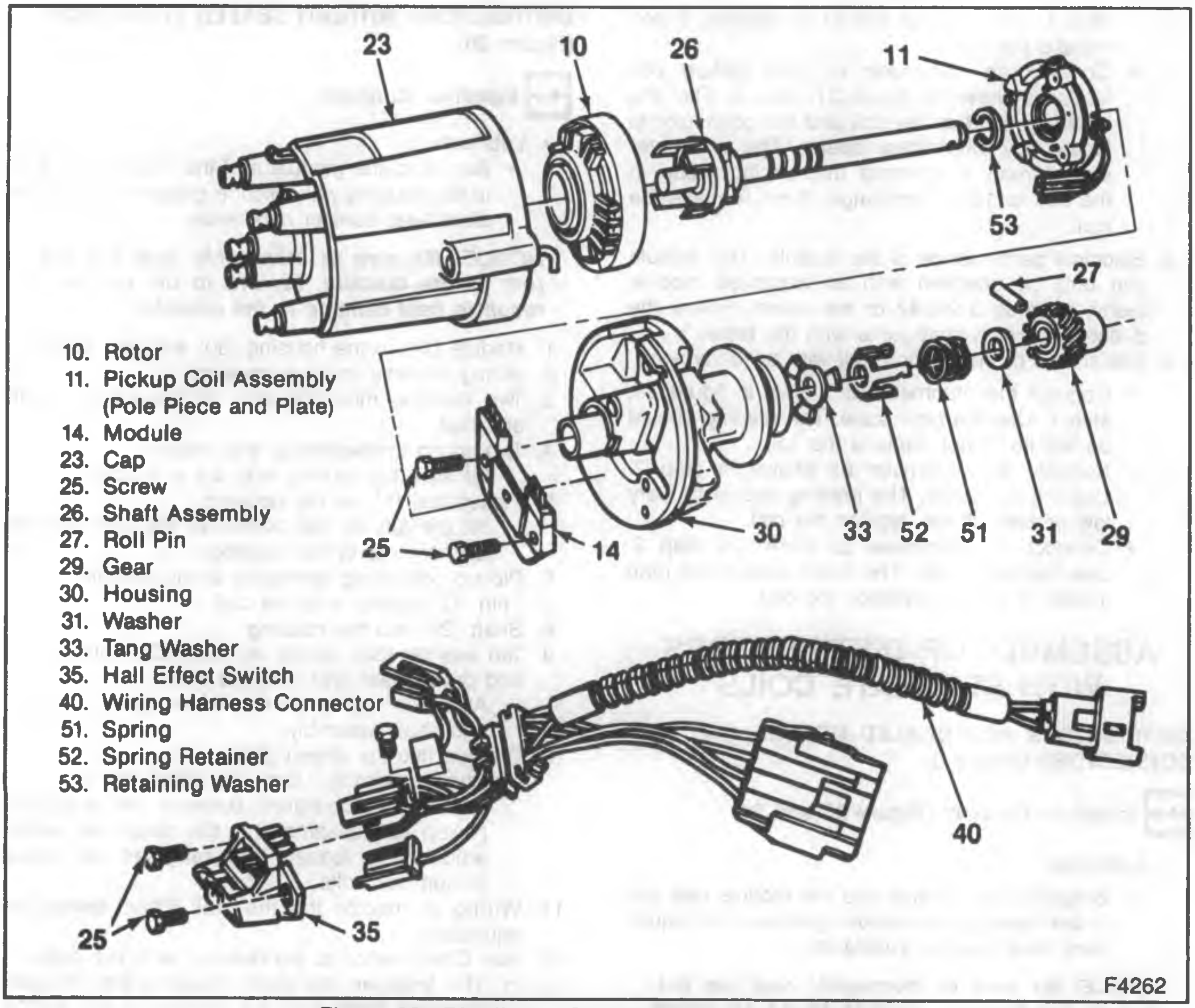


Figure 26—Distributor Components (Separate Coil)

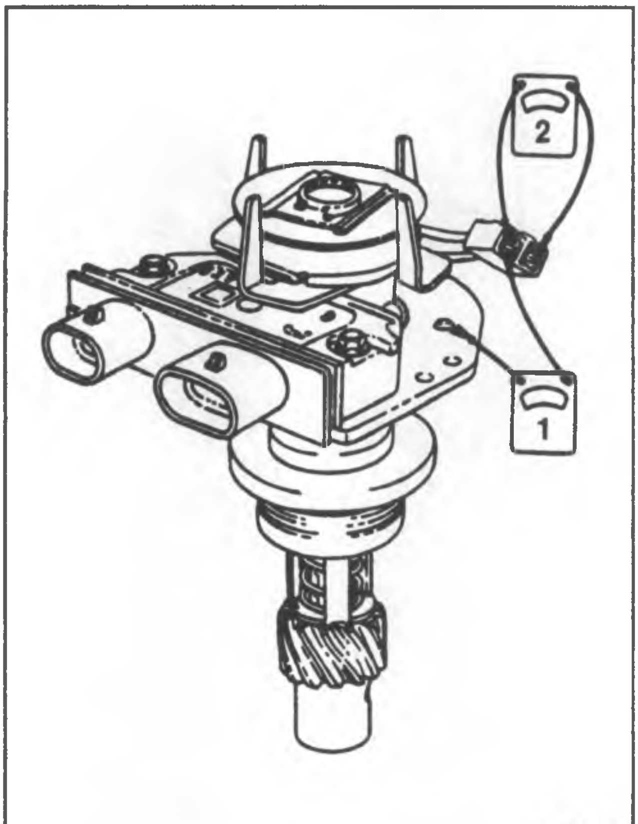


Figure 27—Testing the Pickup Coil

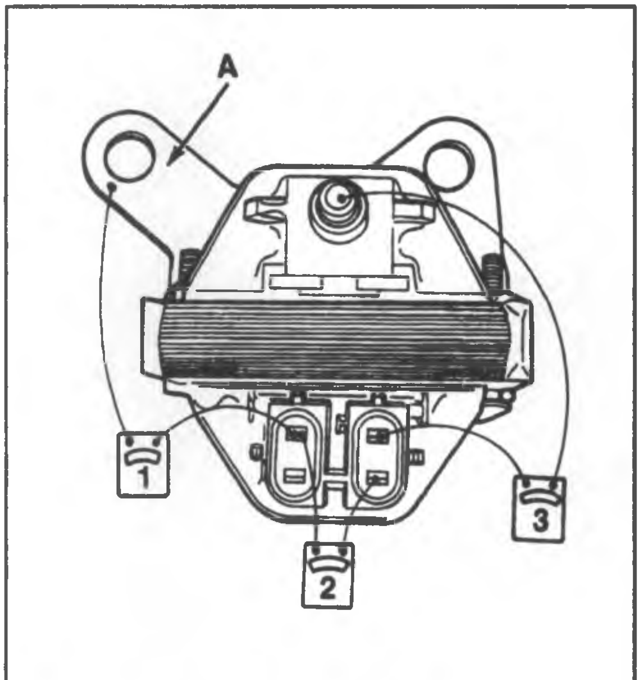


Figure 28—Testing the Ignition Coil

SPECIFICATIONS

DISTRIBUTOR

Model No.	Start Distributor		Intermediate Distributor		Maximum Distributor		Vacuum Model
	RPM	Degree	RPM	Degree	RPM	Degree	
1103717	650	0-3	1200	6-6	2050	11-3	1973682
1103719	700	0-2	1000	2-5	3000	4-8	1973682

VACUUM ADVANCE

	Start		Maximum		Maximum Dist.
Vacuum Model	Inches Hg.	-kPa	Inches Hg.	-kPa	(Degree)
1973682	7-9	24-32	13-14	42-46	5

T2535

SECTION 7

TRANSMISSION

CONTENTS

SECTION/HYDRA-MATIC 4L60 (FORMERLY THM 700-R4)

AUTOMATIC TRANSMISSION UNIT REPAIR

RPO MD8

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

***Designates significant product changes since the publication of the 1989 Service Manual.**

TRANSMISSION DISASSEMBLY

General Service Information

- Teflon Oil Seal Rings
  If any seal rings are damaged, cut, or do not rotate freely in their groove be certain to check the ring groove for debris, burrs, or damage.
- Thrust Washer Surfaces
  The thrust washer and thrust bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

- Torque Converter (1)

Install or Connect

Figure 1

Tools Required:

J 8763-02 Holding Fixture and Base

1. J 8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid.

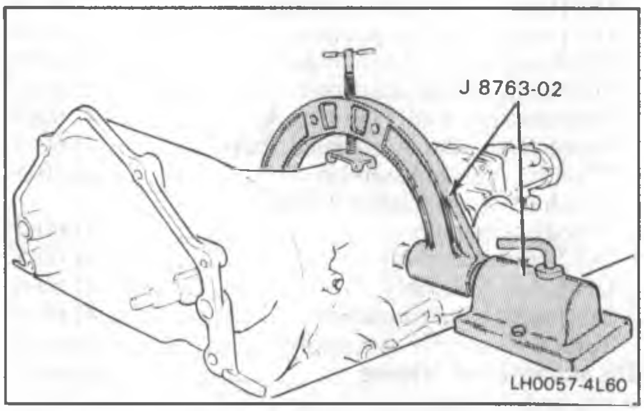


Figure 1 Holding Fixture

2-4 Servo Assembly

Figures 2, 3

Remove or Disconnect

Tool Required:

J 29714 Servo Cover Compressor

1. Install J 29714.
2. Servo cover retaining ring (13)
3. Servo cover and O-ring seal (14 and 15)
4. 2-4 servo assembly (16-31)

Servo Pin Length

As a diagnostic aid, the servo pin length should now be checked. If the pin length is too short or too long, be certain to inspect the 2-4 band and reverse input drum for damage or wear when disassembled.

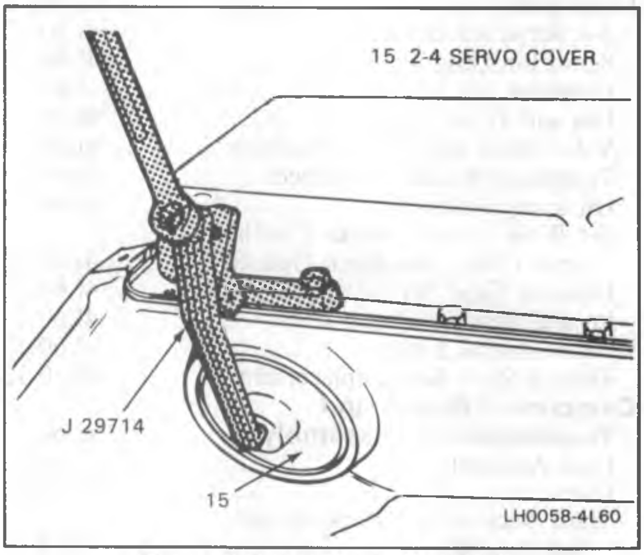
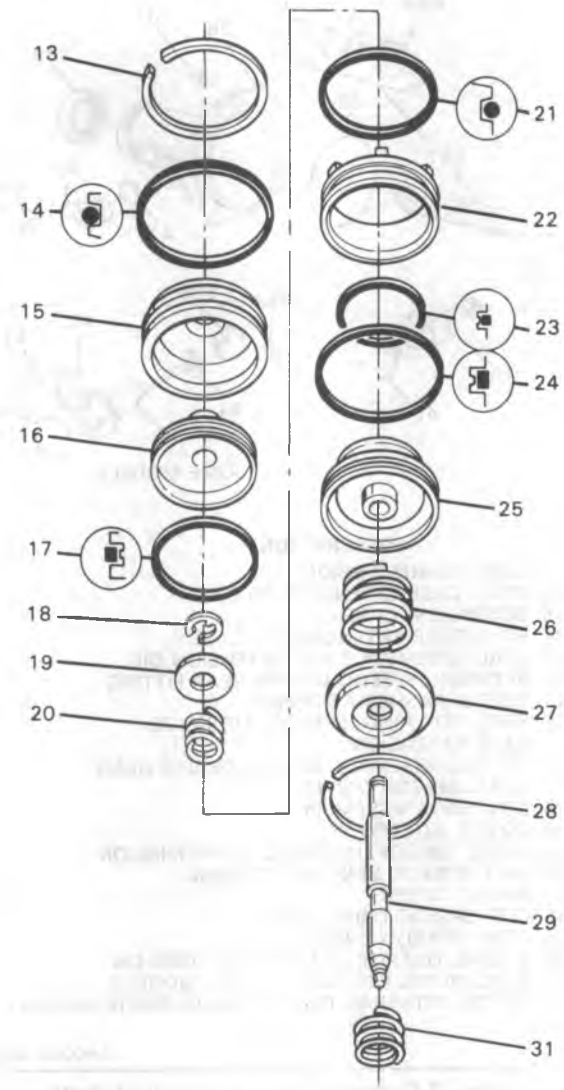


Figure 2 Servo Cover Removal



ILL. NO.	DESCRIPTION
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18	RING, RETAINER (APPLY PIN)
19	WASHER, SERVO APPLY PIN
20	SPRING, SERVO APPLY PIN
21	SEAL, "O" RING
22	HOUSING, SERVO PISTON (INNER)
23	RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25	PISTON, 2ND APPLY
26	SPRING, SERVO CUSHION
27	RETAINER, SERVO CUSHION SPRING
28	RING, RETAINER (2ND APPLY PISTON)
29	PIN, 2ND APPLY PISTON
31	SPRING, SERVO RETURN

LH0059-4L60

Figure 3 Servo Assembly

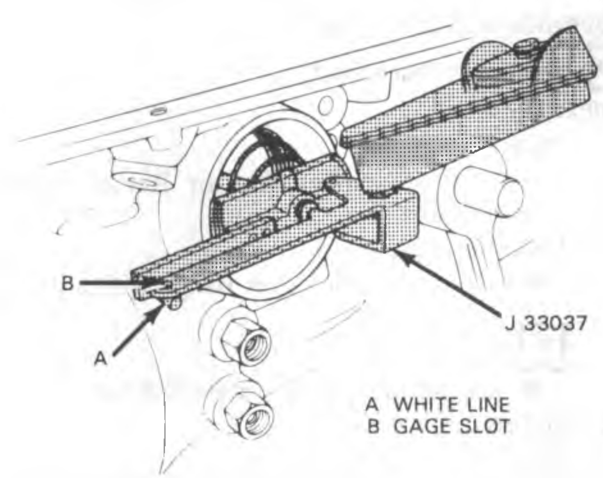
Measure

Figure 4

Tool Required:

J 33037 Band Apply Pin Tool

1. Install J 33037 as shown with apply pin (29).
2. Install Servo Cover Retaining Ring (13) to secure tool.
3. Apply 11 N·m (98 lb.-in.) torque.
4. If white line "A" appears in gage slot "B" pin length is correct.
5. Use pin selection chart to determine correct pin length if new pin is needed.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH mm	PIN LENGTH INCH	PIN I.D.
66.37 - 66.67	2.61 - 2.62	2 RINGS
67.74 - 68.04	2.67 - 2.68	3 RINGS
69.11 - 69.41	2.72 - 2.73	WIDE BAND

LH0060-4L60

Figure 4 Servo Pin Length

Remove or Disconnect

Figures 3, 5

Tool Required:

J 22269-01 Piston Compressor

1. 4th apply piston (16)
2. Servo return spring (31)
3. Servo pin retainer ring (18), washer (19), and apply pin spring (20)
4. 2nd apply piston pin (29).
5. Install J 22269-01.
6. Retainer ring (28)
7. Cushion spring retainer (27) and cushion spring (26)

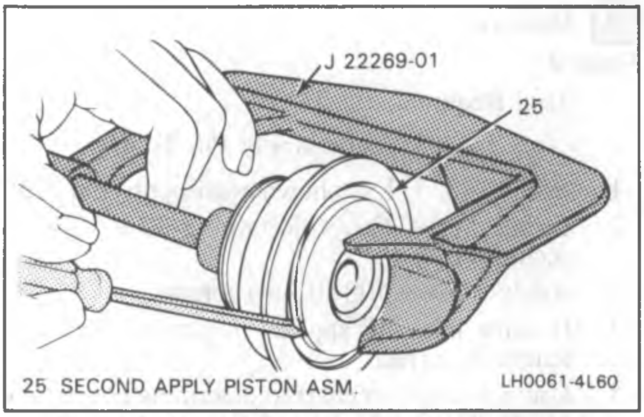


Figure 5 Second Servo Piston Retaining Ring Removal

Governor and Extension

Remove or Disconnect

Figures 6, 7

Tool Required:

J 38417 Speed Sensor Remover and Installer

1. Governor cover (46)
   - tap around the cover flange with a punch to remove

   Important
   - Do not damage the governor cover
2. Governor assembly (45)

   Mechanical Speedometer:
3. Bolt and washer assembly (41) and retainer (40)
4. Speedometer driven gear assembly (43), speedo driven gear(44) and o-ring seal (42)

   Internal Transmission Speed Sensor (I.T.S.S.)
5. Speed sensor retaining bolt (100)
6. Speed sensor assembly (99) and o-ring seal (42) with J 38417
7. Case extension bolts (37) and case extension (36) Extension seal ring (35)
8. Output shaft sleeve (690) and output shaft o-ring seal (691)
   - not all models use an output shaft sleeve and seal

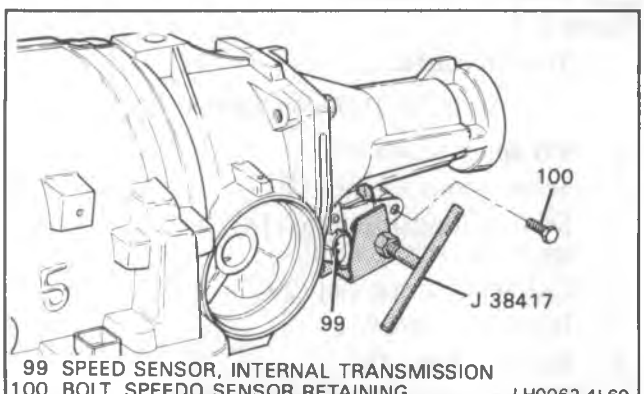
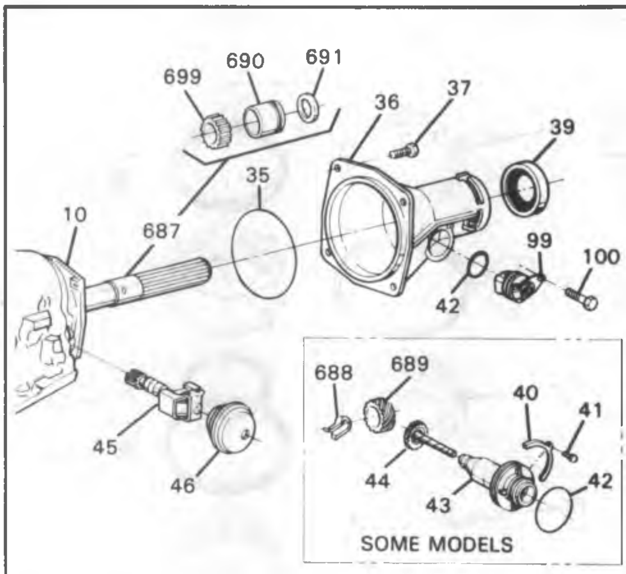


Figure 6 Speed Sensor Removal



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT — NOT USED ON
691	SEAL, OUTPUT SHAFT — ALL MODELS
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

LH0063-4L60

Figure 7 Extension and Associated Parts

Remove or Disconnect

Figure 7

Models with Mechanical Speedometer

1. Speedometer drive gear (689) and clip (688)
   - use care not to damage the speedo gear
   - push tab of retaining clip and tap speedometer gear off the output shaft.

Pan And Filter Assembly

Remove or Disconnect

Figure 8

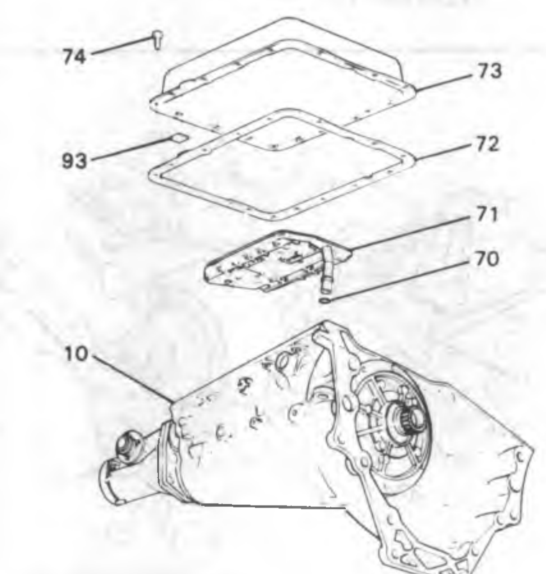
1. Screws (74), oil pan (73), and gasket (72).
2. Oil filter (71) and filter seal (70).
   - filter seal may be stuck in the pump
3. Outside electrical connector (33) and o-ring seal (34).

Valve Body And Wiring Harness

Figures 9 and 10

Remove or Disconnect

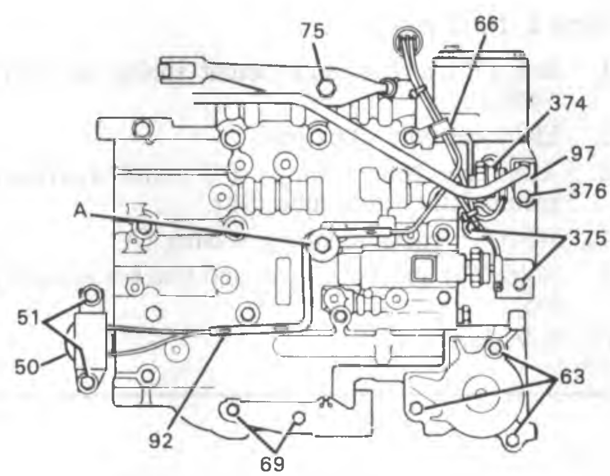
1. Electrical connections from switches.
   - refer to wiring diagrams in the Diagnosis Section for specific model applications
2. Solenoid bolts (51) and solenoid assembly (50) with o-ring seal (49) and wiring harness.
3. Accumulator cover bolts (63) and 1-2 accumulator cover and pin assembly (62).
4. 1-2 accumulator piston (61) and seal (60).
5. Spring (59).



10 CASE, TRANSMISSION
70 SEAL, FILTER
71 FILTER ASSEMBLY, TRANSMISSION OIL
72 GASKET, TRANSMISSION OIL PAN
73 PAN, TRANSMISSION OIL
74 SCREW, SPEC. HEX WASHER HEAD (PAN)
93 MAGNET, CHIP COLLECTOR

LH0064-4L60

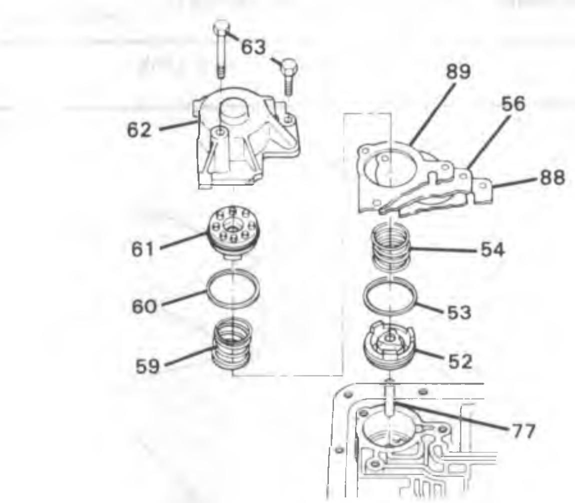
Figure 8 Pan, Filter & Seal Remove



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
92 CONDUIT, SOLENOID WIRE
97 CLAMP, AUXILIARY TUBE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 18)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

LH0065-4L60

Figure 9 Valve Body Bolt Locations



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUM. PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUM.
63 BOLT, ACCUMULATOR COVER
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

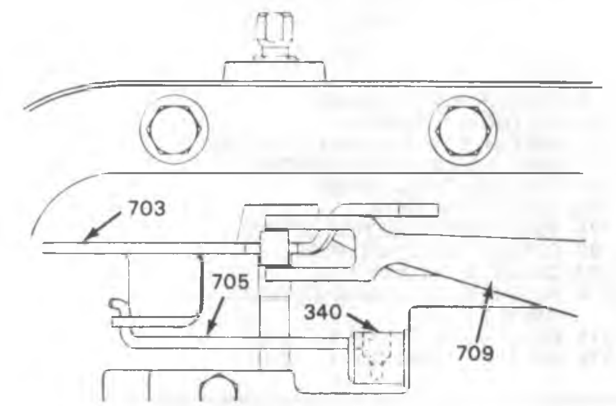
LH0066-4L60

Figure 10 Accumulator Assembly

Remove or Disconnect

Figures 9, 11, 12 and 13

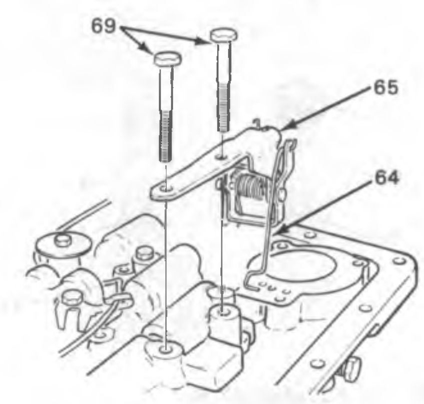
1. Bolt (75) and manual detent spring assembly (709).
2. Electrical wire clips (66).
3. Auxiliary tube clamps (97) and auxiliary accumulator valve tube (96).
4. Wiring harness retaining washer (A).
5. Bolts (69) and T.V. lever and bracket assembly (65)
6. T.V. link (64)



340 VALVE, MANUAL
703 LEVER, DETENT (INNER)
705 LINK, MANUAL VALVE
709 SPRING ASSEMBLY, MANUAL DETENT

LH0067-4L60

Figure 11 Manual Valve Link



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

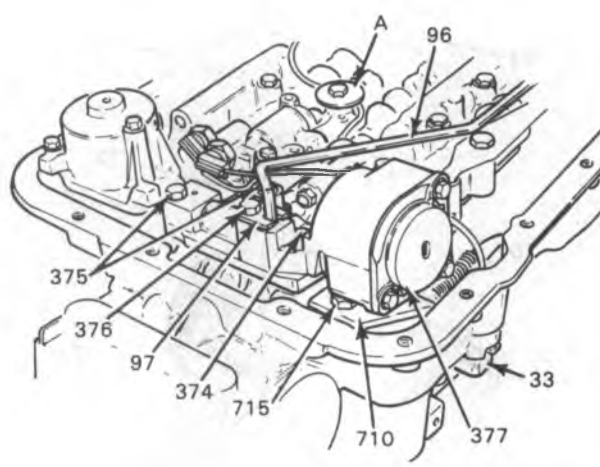
LH0068-4L60

Figure 12 T.V. Lever and Bracket

Remove or Disconnect

Figures 11, 13, 14, 15, and 16

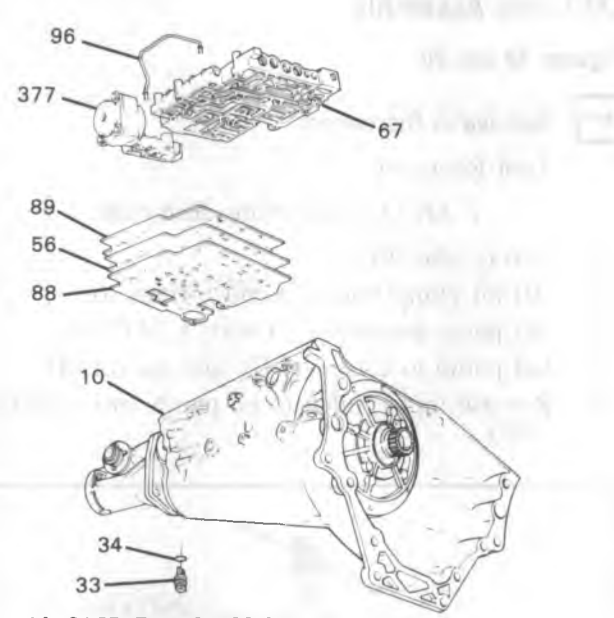
1. Remaining valve body bolts (69)
2. Manual valve link (705)
3. Control valve assembly (67)
4. Bolts (374-375), auxiliary valve body (377), and check ball (55B)
5. Spacer plate (56) and spacer plate gaskets (88 and 89)
6. Check balls (55A, 55C and 91) spring (54), piston (52), seal (53) and pin
   - Three checkballs are located under the valve body, one in the auxiliary valve body and four are located in the case. The large copper flash colored ball is #10 checkball (91)



ILL. NO.	DESCRIPTION
A	WASHER, WIRE RETAINING
33	CONNECTOR, ELECTRICAL
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, AUXILIARY TUBE
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUM. VALVE BODY ASM.
710	BRACKET, PARKING LOCK
715	BOLT, PARKING LOCK BRACKET

LH0069-4L60

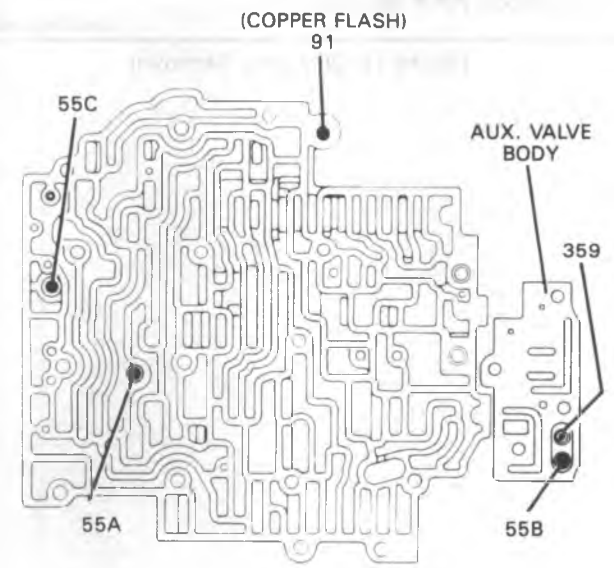
Figure 13 Removing Auxiliary Valve Body Assembly



10 CASE, TRANSMISSION
33 CONNECTOR, ELECTRICAL
34 SEAL, "O" RING (ELECTRICAL CONNECTION)
56 PLATE, VALVE BODY SPACER
67 VALVE ASSEMBLY, CONTROL BODY
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY
96 TUBE, AUXILIARY ACCUMULATOR VALVE
377 AUXILIARY ACCUMULATOR VALVE BODY ASSEMBLY

LH0070-4L60

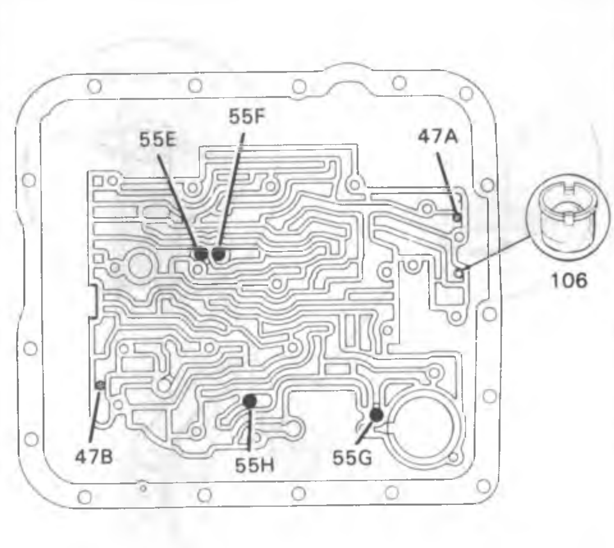
Figure 14 Control Valve, Auxiliary Valve Body, Spacer Plate and Gaskets



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #12 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)
359 CUP PLUG — ORIFICE

LH0071-4L60

Figure 15 Valve Body Checkballs



ILL. NO.	DESCRIPTION
47A	GOVERNOR FILTER LOCATION
47B	CONVERTER CLUTCH FILTER LOCATION
55E	#4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F	#8 CHECK BALL (2ND/1-2)
55G	#1 CHECK BALL (4TH ACCUMULATOR)
55H	#3 CHECK BALL (PART THROTTLE/DRIVE 3)
106	RETAINER & BALL ASM. (DOUBLE ORIFICE)

LH0072-4L60

Figure 16 Case Checkballs and Filters

Transmission End Play Check

As a diagnostic aid transmission end play should be checked prior to removing the internal parts. If the end play is not within specifications you should watch for possible worn or misassembled parts during disassembly.

Measure

Figures 17 and 18

Tools Required:

- J 24773-A Oil Pump Remover
- J 25022-A End Play Adaptor (245 mm)
- J 34725 End Play Adaptor (298 mm)
- J 25025-7A Post
- Dial indicator

1. Remove an oil pump bolt (5) and install a 278 mm (11 in.) bolt and locknut or J 25025-7A.
2. Install J 25022-A or J 34725 as shown.
3. Install J 24773-A as shown.
4. Install dial indicator.
   - set to zero
   - pull up on J 24773-A
   - end play should be .13-.92 mm (.005-.036").

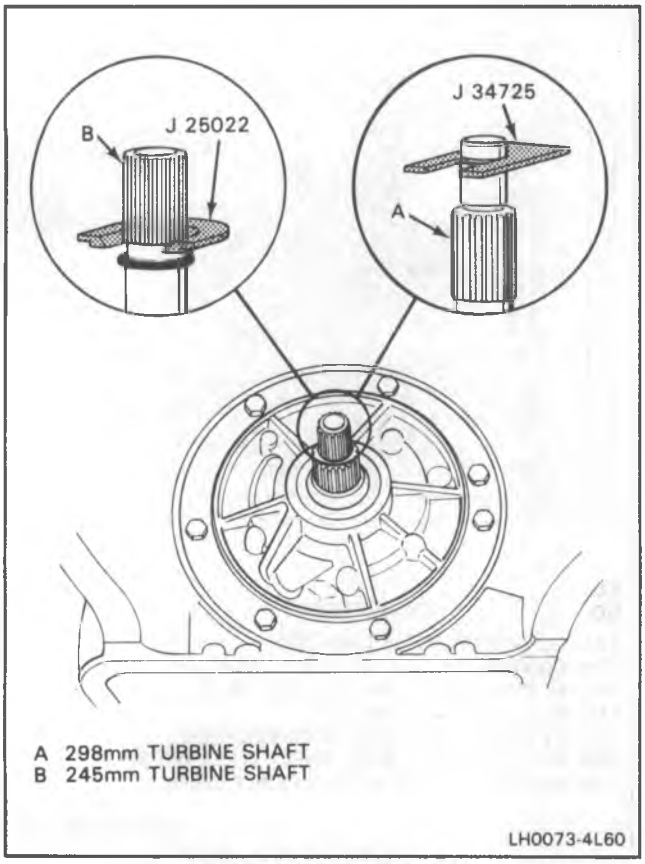


Figure 17 End Play Tool

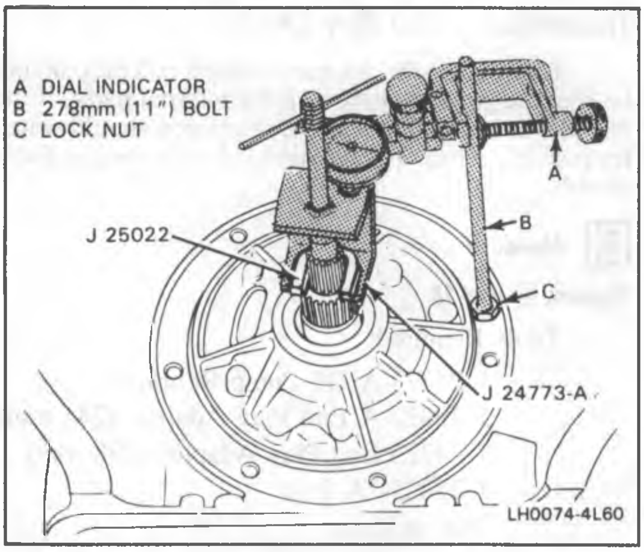


Figure 18 End Play Check

Oil Pump Assembly

Figures 19 and 20

Remove or Disconnect

Tool Required:

J 24773-A Oil Pump Remover

1. O-ring seal (618)
2. All oil pump bolts (5) and o-rings (6)
3. Oil pump assembly (7) with J 24773-A
4. Oil pump to case seal (8) and gasket (9)
5. Reverse input clutch to oil pump thrust washer (601)

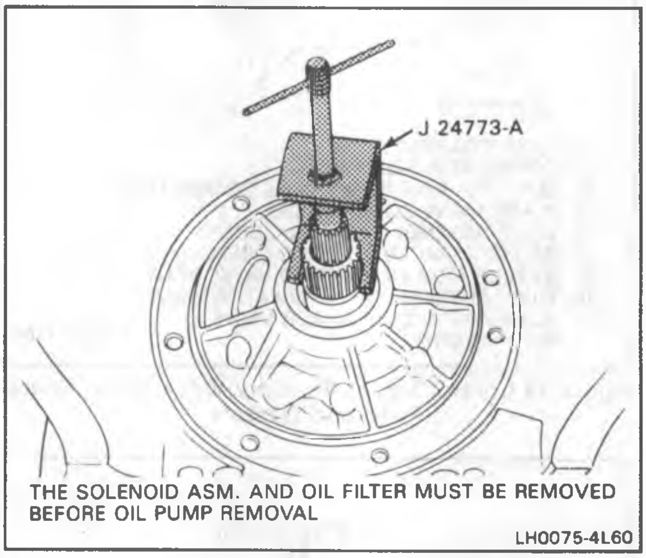
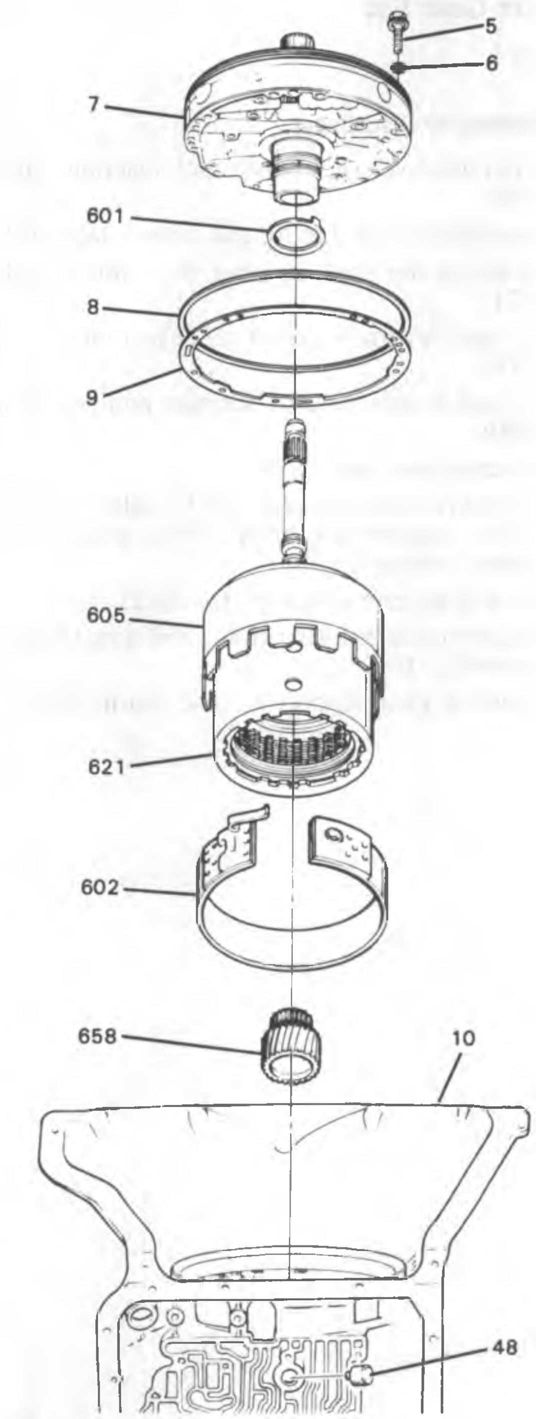


Figure 19 Oil Pump Removal



ILL. NO.	DESCRIPTION
5	BOLT, PUMP TO CASE
6	O-RING, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
48	PIN, BAND ANCHOR
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
605	HOUSING & DRUM ASM., REVERSE INPUT CLUTCH
621	HOUSING & SHAFT ASSEMBLY, INPUT
658	GEAR, INPUT SUN

LH0076-4L60

Figure 20 Input Clutch Removal

2-4 Band, Reverse Input Clutch, Input Clutch And Input Gear Set

Figures 20, 22

1. Reverse input clutch (605) and input clutch (62) together
   - Grasp the turbine shaft and lift
2. Band assembly pin (48)
3. The 2-4 band assembly (602)
4. Input sun gear (658)

Install or Connect

Figure 21 and 22

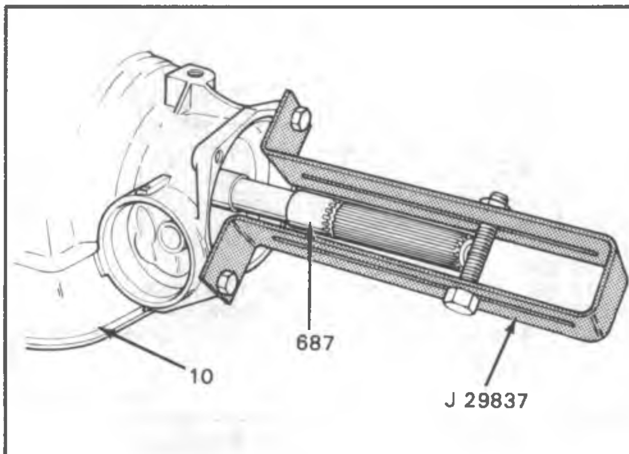
Tool Required:

J 29837 Output Shaft Support Fixture

- J 29837 as shown

Important

- Output shaft (687) may fall free when retaining ring (661) is removed if J 29837 is not used.



10 CASE, TRANSMISSION
687 SHAFT, OUTPUT

LH0077-4L60

Figure 21 Output Shaft Support Fixture

Remove or Disconnect

Figure 22

Tool Required:

J 34627 Snap Ring Pliers

1. Retaining ring (661) with J 34627. Do not overexpand the ring.
2. Input carrier assembly (662)

3. J 29837 and output shaft (687)

Important

- The manufacturer assembles the output shaft and reaction internal gear with adhesive for ease of assembly. If these parts have not become separated during use, the output shaft will come out later along with the reaction internal gear.

4. Thrust bearing assembly (663)

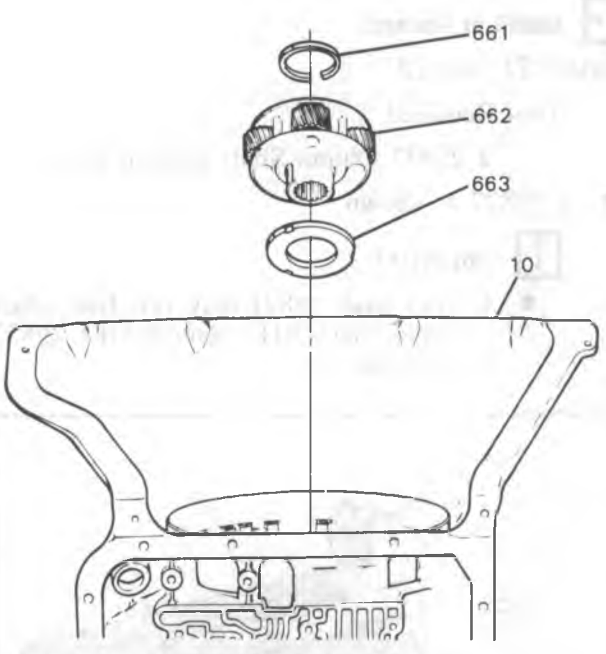


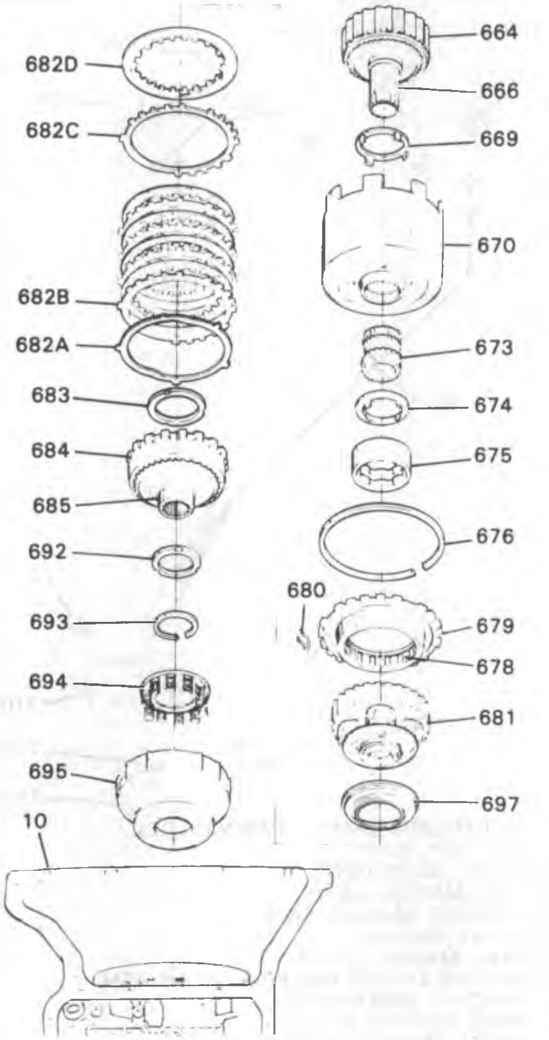
Figure 22 Input Carrier Removal

Reaction Gear Set

Figure 23

Remove or Disconnect

1. Input internal gear (664) and reaction carrier (666)
2. Reaction sun shell (670) and thrust washer (669)
3. Reaction sun shell to inner race thrust washer (674)
4. Lo and reverse support to case retainer ring (676)
5. Lo and reverse clutch support retainer spring (680)
6. Reaction sun gear (673)
7. Lo and reverse inner race (675), roller assembly (678), support assembly (679), and reaction carrier assembly (681)
8. Lo and reverse clutch plates (682)
9. Reaction internal gear (684) and thrust bearing assembly (683)
10. Reaction gear support to case bearing (692)



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
664	GEAR, INPUT INTERNAL
666	SHAFT, REACTION CARRIER
669	WASHER, THRUST (REACTION SHAFT/SHELL)
670	SHELL, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER
678	CLUTCH ASM., LO & REVERSE ROLLER
679	SUPPORT ASM., LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)
681	CARRIER ASSEMBLY, REACTION
682A	PLATE, LO & REVERSE CLUTCH (WAVED)
682B	PLATE, LO & REVERSE CL. (SELECTIVE)
682C	PLATE ASM., LO & REVERSE CLUTCH (FIBER)
682D	PLATE, LO & REVERSE CLUTCH (FLAT STEEL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO & REVERSE CLUTCH RETAINER
694	SPRING ASM., LO & REVERSE CLUTCH
695	PISTON, LO & REVERSE CLUTCH
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

LH0079-4L60

Figure 23 Reaction Gear Set Removal

Lo And Reverse Clutch Parts

Figures 24, 25 and 27

Remove or Disconnect

Tools Required:

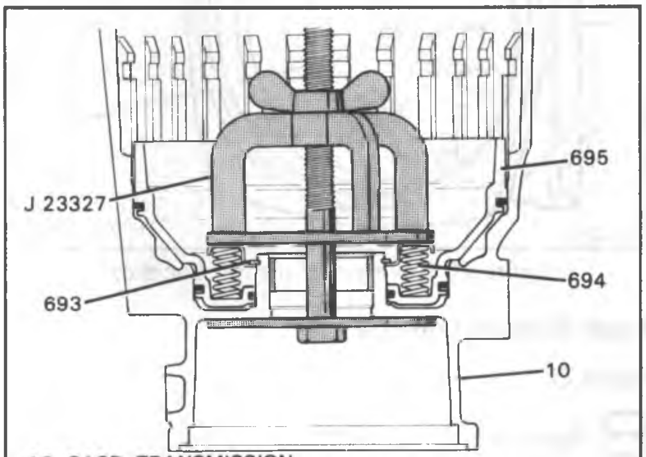
J 34627 Snap Ring Remover/Installer
J 23327 Clutch Spring Compressor

1. Bolts (715) and parking lock bracket (710)

Important

- Due to interference, the parking pawl may have to be removed before removing or installing the low and reverse piston.

2. Parking pawl shaft plug (713) with a #4 screw extractor
3. Parking pawl pivot shaft (712) with a magnet
4. Parking pawl (711) and return spring (714)
5. Install tool J 23327.
6. Lo and reverse clutch retainer ring (693) with J 34627
7. Lo and reverse clutch spring assembly (694)
8. Lo and reverse clutch piston (695)
   - apply air pressure in the case apply passage



10 CASE, TRANSMISSION
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
LH0080-4L60

Figure 24 Lo and Reverse Snap Ring Removal

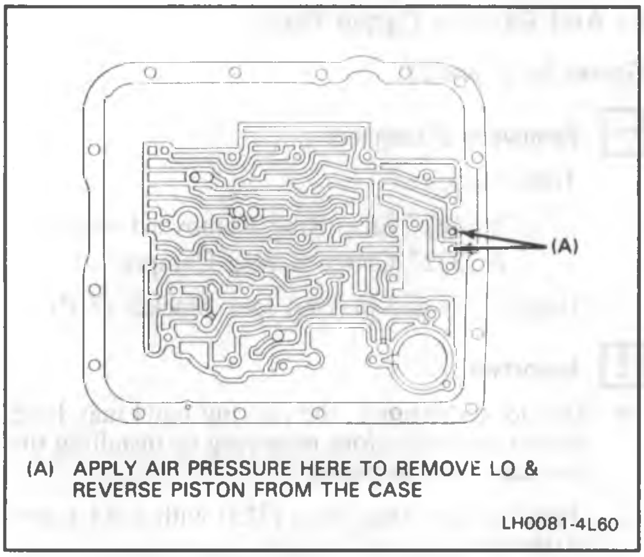


Figure 25 Lo and Reverse Piston Removal

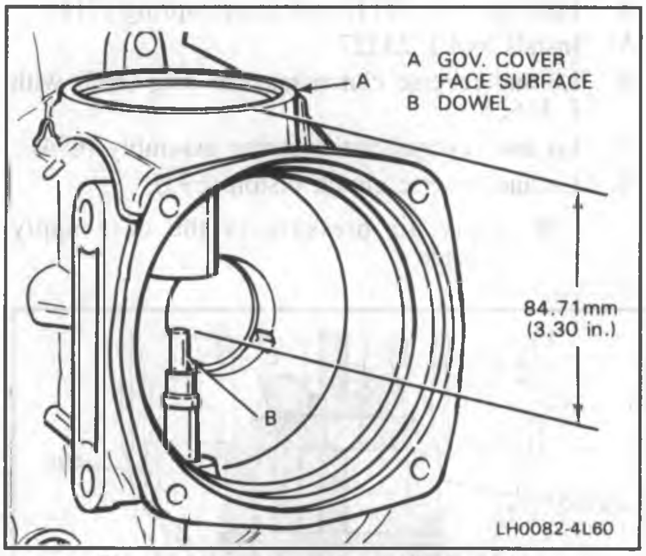


Figure 26 Governor Bore Pin Location

Inner Manual Linkage

Figure 27

Remove or Disconnect

1. Inside manual shaft nut (702)
2. Manual shaft (707) and manual shaft retainer (706)
3. Parking lock actuator assembly (701) and inside detent level (703)

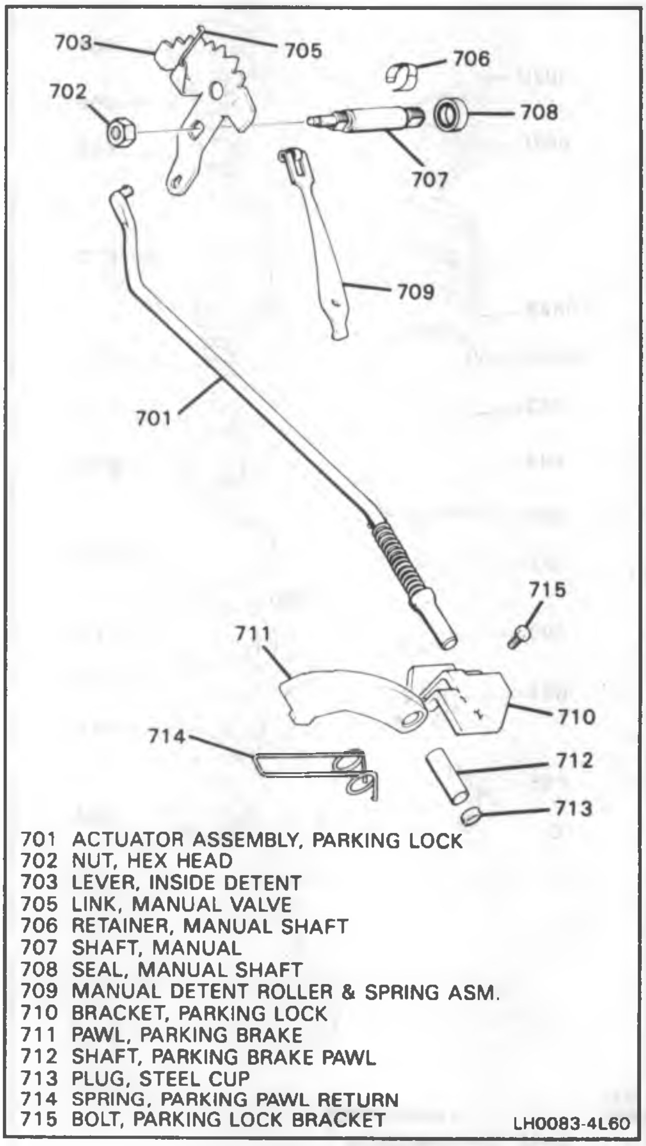


Figure 27 Parking Linkage

Manual Shaft Seal Replacement

Figure 28

Remove or Disconnect

- Manual shaft seal (708)
  - — pry out with a screwdriver

Install or Connect

- New manual shaft seal (708)
  - — tap into place using a 14 mm socket

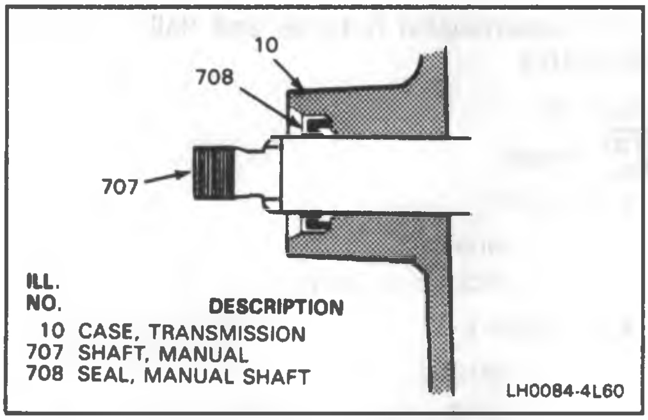


Figure 28 Manual Shaft Seal

Inspect

Figure 27

- Actuator rod (701) for damage
- Inside detent lever (703) for damage or cracks
- Manual shaft (707) for damage or burrs
- Manual detent spring assembly (709) for roller freeness or damage

Install or Connect

Figure 27

- Parking lock actuator (701) onto inside detent lever (703)
- Manual shaft (707) into case (10) and inside detent lever (703)
- Inside manual shaft nut (702) onto manual shaft (707)

  Tighten

  - torque to 31 N·m (23 lb. ft.)

- Manual shaft retainer (706) onto manual shaft (707)

COMPONENT REPAIR AND TRANSMISSION REASSEMBLY

- The assembly of some components will require use of an assembly lube. It is recommended that TRANSJEL™ J 36850 or equivalent be used during assembly.

  NOTICE: Do not use any type of grease to retain parts during assembly of this unit. Greases other than the recommended assembly lube will change transmission/transaxle fluid characteristics and cause undesirable shift conditions and/or filter clogging.

Case Assembly

Clean

- Thoroughly with solvent
- Air dry
  - do not wipe with cloth.

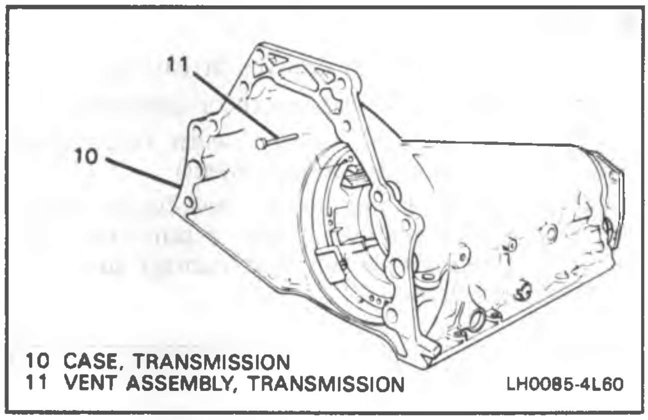


Figure 29 Case Vent Assembly

Case

Figures 26, 29, 30 and 31

Inspect

- Case (10) exterior for cracks or porosity
- Case to valve body face for damage, interconnected oil passages and flatness
  - face flatness can be checked by inspecting the spacer plate to case gasket for proper land impressions.
- Vent assembly (11) for damage
- Air check all oil passages.
  - see diagnosis section for oil passage identification.
- 2-4 servo bore for:
  - damage, porosity, or burrs
  - any sharp edges (i.e. — oil passages, slots for retaining ring removal — remove if found)
- Orifice cup plug (86) in servo bore for debris or damage
- Third accumulator bore for:
  - porosity, damage, or burrs
  - pin damage (77)
  - orifice cup plug (81) damaged or plugged
- Speedometer bore for:
  - damage
  - sharp edges
  - porosity
- All bolt holes for thread damage
  - Heli-coil to repair
- Cooler connectors (12) for:
  - damage
  - proper torque 38 N·m (28 lb. ft.)

- Case interior for:
  - damaged ring grooves or casting flash
  - clutch plate lugs worn or damaged
  - bushing (767) scored, worn, or damaged (see Bushing Replacement)
  - governor support pin installation depth. (Incorrect installation depth will cause governor driven gear damage and shift problems.)

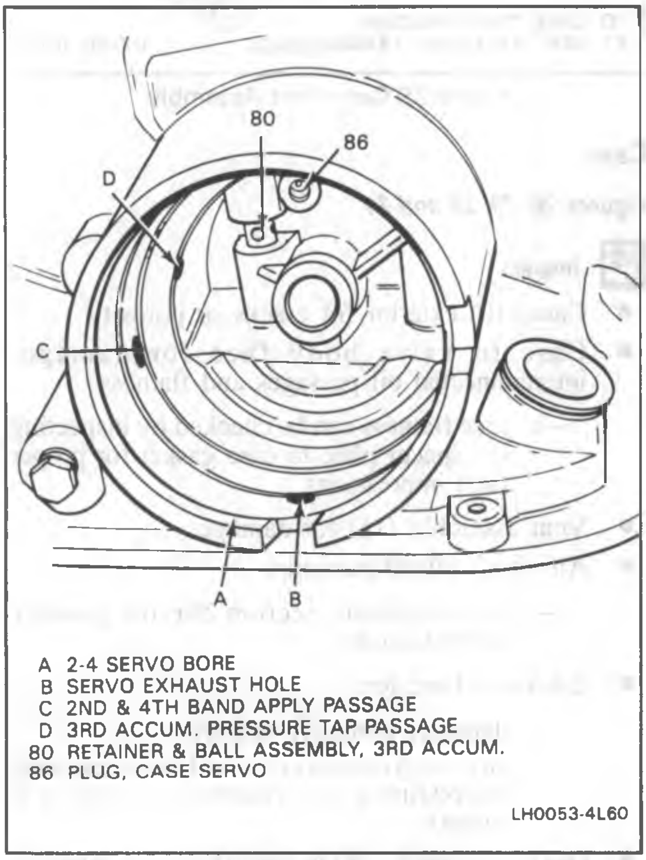


Figure 30 2-4 Servo Bore

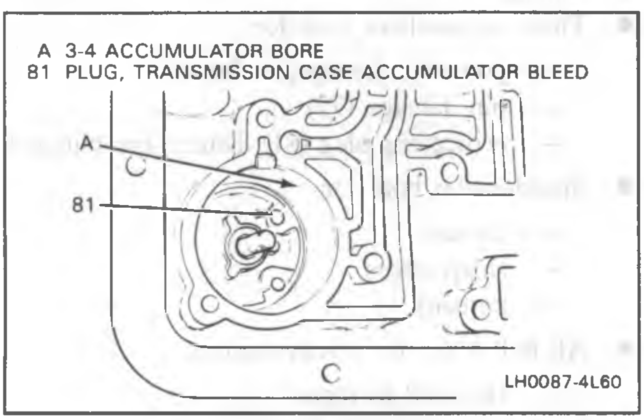


Figure 31 Third Accumulator Bore

Third Accumulator Retainer and Ball Assembly

Figure 32

Inspect

- Ball for:
  - missing
  - sticking or leaking
- Retainer for:
  - missing
  - loose
  - not seated correctly
  - feed slots restricted

Retainer and Ball Assembly Leak Check Procedure

Figure 32

1. Install the servo assembly (16-31) into the servo bore.
2. Install the servo cover (15) and retainer (13).
3. Pour a suitable solvent into the accumulator bore.

Inspect

- Watch for leakage inside the case.
- If leakage is observed, replace the third accumulator retainer and ball assembly.

Replacement Procedure — Third Accumulator Retainer and Ball Assembly

Figures 32 and 33

Remove or Disconnect

Tool Required:

6.3 mm (#4) Screw Extractor

- Third accumulator retainer and ball assembly (80)
  - use 6.3 mm (#4) screw extractor

Install or Connect

Figure 32 and 33

Tool Required:

9. 5 mm (3/8 in.) diameter metal rod

- A new third accumulator retainer and ball assembly
  - oil feed slots in the retainer must line up with oil passage in the servo bore. To be certain of correct installation depth, scribe a mark at 42.0 mm (1.653") on the 9.5 mm (3/8 in.) diameter metal rod. Use it to seat the third accumulator and ball assembly as shown. When the scribed line is flush with the case face, installation depth is correct.

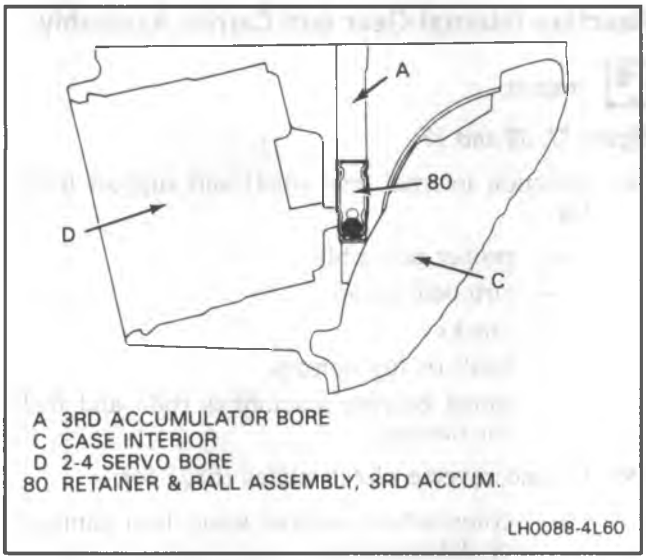


Figure 32 Leak Check — 3rd Accumulator

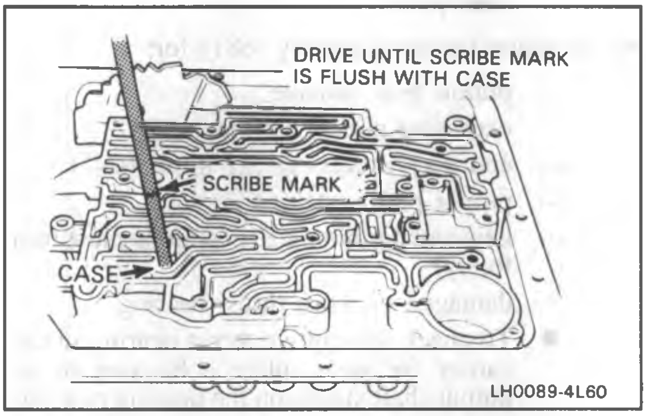


Figure 33 Third Accumulator Retainer and Ball Asm. - -Installation

Lo and Reverse Clutch Piston

Figure 34

Inspect

- Lo and reverse piston (695) for:
  - — porosity or damage
  - — ring groove damage
- Piston seals (696) for nicks or cuts
- Spring assembly (694) for damage
- Retainer ring (693) overstressed

Install or Connect

Figure 35

Tools Required:

J 34627 Snap Ring Remover/Installer
J 23327 Clutch Spring Compressor

1. Piston seals (696) onto the piston (695)
   - lubricate with transmission fluid
2. Piston (695) into the case
   - index the piston with the notch in the bottom of the case.
3. Spring assembly (694) onto the piston
   - flat side of the retainer upward
4. J 23327 over the spring assembly
   - compress the spring assembly past the ring groove in the case hub.
5. Retainer ring (693) into the case hub ring groove with J 34627.

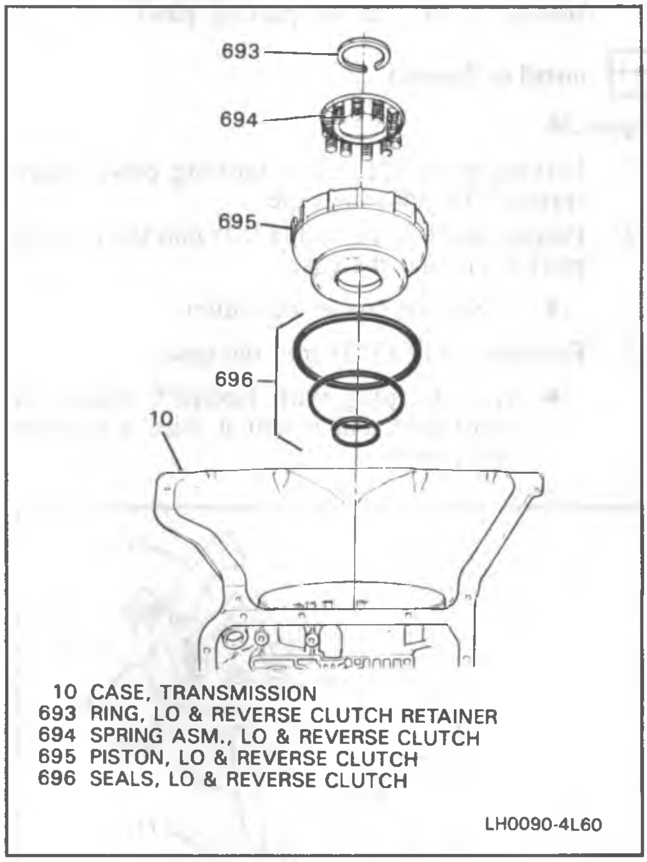


Figure 34 Lo and Reverse Piston

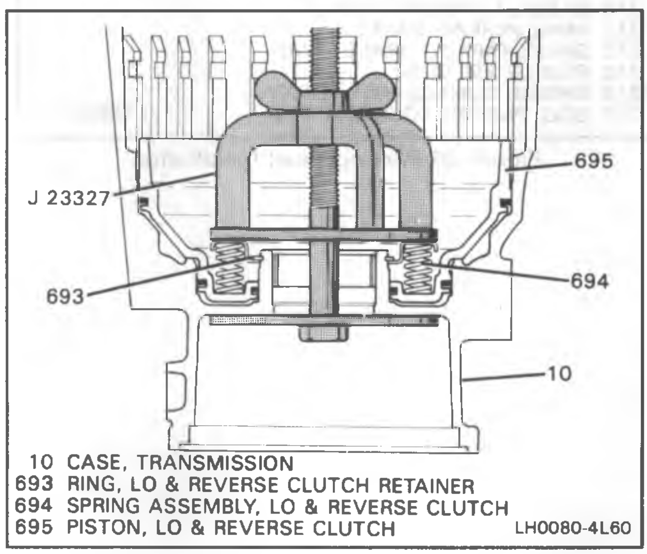


Figure 35 Installing Lo and Reverse Snap Ring

Parking Pawl

Figure 36

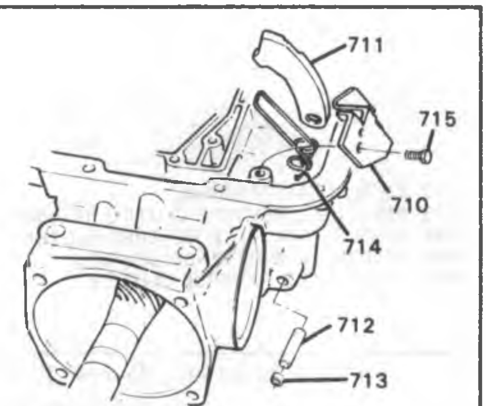
Inspect

- Parking pawl (711) for cracks, burrs, or damage
- Parking pawl return spring (714) for distortion or damage
- Parking pawl pivot shaft (712) for damage and freeness of fit with the parking pawl

Install or Connect

Figure 36

1. Parking pawl (711) and parking pawl return spring (714) into the case
2. Parking pawl pivot shaft (712) into the parking pawl (711) and the case
   - check for proper operation
3. Retaining plug (713) into the case
   - coat the plug with Loctite® sealant or equivalent and install it with a hammer and punch.



710 BRACKET, PARKING LOCK
711 PAWL, PARKING BRAKE
712 SHAFT, PARKING BRAKE PAWL
713 PLUG, STEEL CUP
714 SPRING, PARKING PAWL RETURN
715 BOLT, PARKING LOCK BRACKET

LH0092-4L60

Figure 36 Parking Pawl Installation

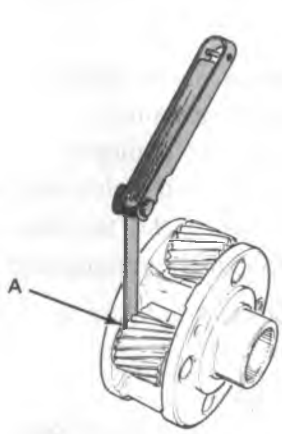
Reaction Internal Gear and Carrier Assembly

Inspect

Figure 37, 38 and 39

- Reaction internal gear (684) and support (685) for:
  - — proper assembly
  - — stripped splines
  - — cracks
  - — teeth or lug damage

  thrust bearing assemblies (683 and 692) for damage
- Lo and reverse clutch plates (682) for:
  - — composition material wear, heat damage, or delamination
  - — heat damage or surface finish damage to steel plates
- Reaction carrier assembly (681) for:
  - — pinion gear damage
  - — excessive pinion washer wear
  - — end play exceeding .61 mm (.024")
  - — proper pinion staking
  - — keystoned pinion gears (pinions must turn freely)
  - — damaged or worn thrust bearing
    - To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.



A PINION GEAR END PLAY — .20mm/.60mm (.008"/.024")

LH0093-4L60

Figure 37 Pinion End Play Check

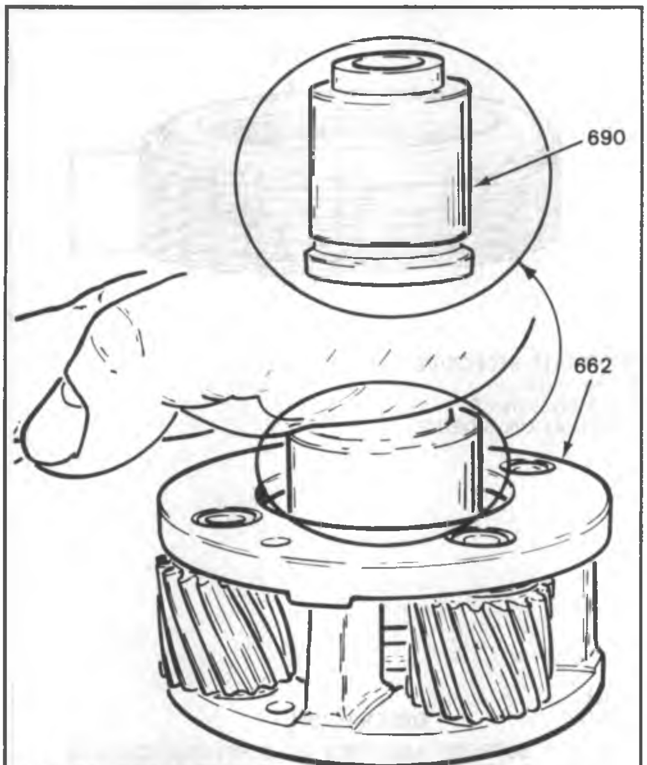


Figure 38 Captive Thrust Bearing Check

Reaction Internal Gear and Support

Figure 44

Install or Connect

1. Reaction gear support to case bearing (692) onto the case hub as shown
   - outside bearing race goes toward case hub.
   - retain with TRANSJEL™ J 36850 or equivalent.
2. Reaction internal gear and support (684 and 685) onto the bearing as shown
3. Reaction carrier to support thrust bearing assembly (683) onto the support (685)
   - outer bearing race goes toward the support
4. Reaction carrier (681) onto the thrust bearing

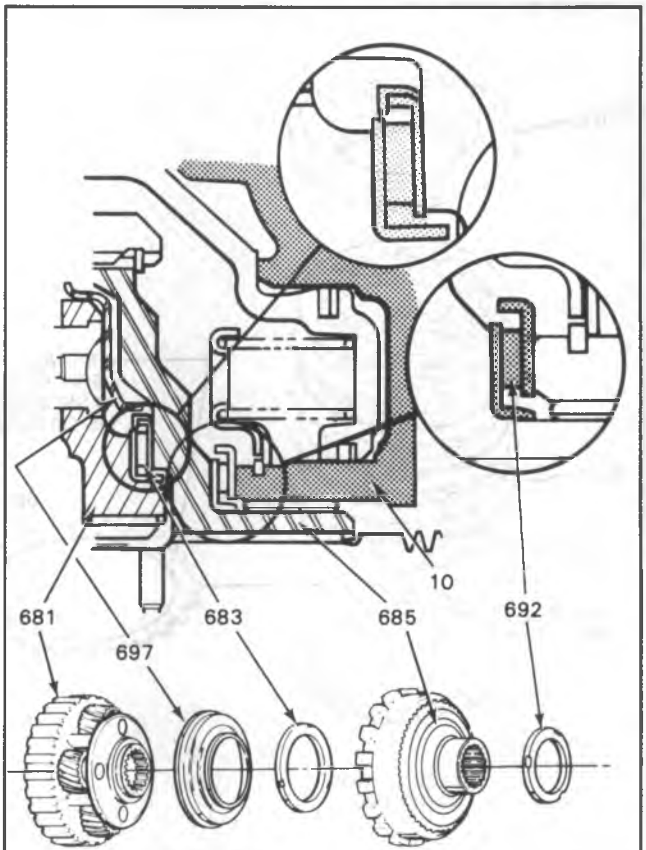


Figure 39 Reaction Internal Gear and Carrier Bearing Locations

Lo and Reverse Clutch Spacer Plate Selection

Figures 40, 41 and 42

Measure

Tools Required:

Scale

Straight edge

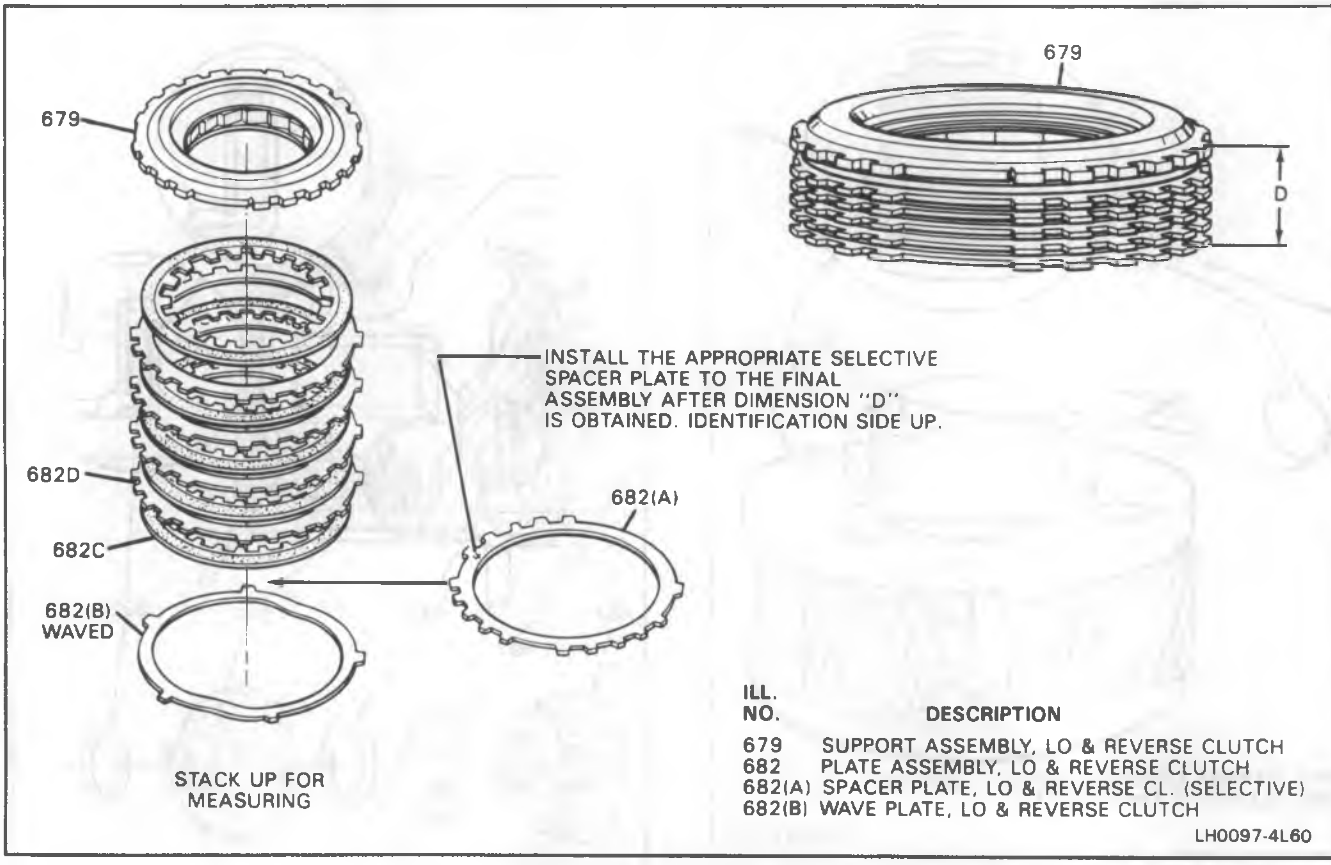


Figure 40 Measuring For Spacer Plate Selection

1. To measure for proper selective spacer plate, stack the lo and reverse assembly on a flat surface in the following order:
   - 1 waved plate (682B)
   - 5 composition and 4 steel plates (682), starting with one composition plate and alternating with steel.
   - lo and reverse clutch support (679)
2. Apply an evenly distributed load to the top of the lo and reverse support assembly (679). Light pressure (approximately 22 N or 55 lbs.) on the lo and reverse support assembly (679) will provide the correct dimension for measurement.

CAUTION: Excessive pressure will start to flatten the wave plate resulting in an inaccurate measurement

3. Measure the height of the clutch pack from the work surface to the top of the lo and reverse clutch support (dimension D)
4. Use dimension D to select the proper thickness of the selective spacer plate for assembly.
5. Install the proper selective spacer plate between the wave plate and the first composition clutch plate with the identification side up.
6. The overall height for dimension D with the selective spacer plate included should be 30.515 — 31.401 mm (1.20-1.24").

Install or Connect

Figures 41 and 43

1. Waved plate (682A)
2. Correct selective spacer plate (682B), from selection procedure.
3. Lo and reverse clutch plates (682) into case lugs
   - start with a composition plate and alternate with steel.
   - index with the splines of the reaction carrier and the case as shown.

LO & REVERSE CLUTCH

	QTY.	THICKNESS
PLATE—WAVED	1	2.43mm (.096")
PLATE—SELECTIVE	1	SEE FIG. 42
PLATE—COMP. FACED	5	2.25mm (.088")
PLATE—FLAT STEEL	4	1.77mm (.069")

LH0096-4L60

Figure 41 Lo and Reverse Clutch Plate Chart

LO & REVERSE CLUTCH SPACER PLATE SELECTION CHART

IF GAGE DIMENSIONS 'D' IS		USE THIS SELECTIVE PLATE		
FROM	TO	IDENTIFICATION	PLATE THICKNESS	
29.559mm (1.164")	28.844mm (1.136")	NONE	1.671mm (.066")	1.842mm (.073")
28.844mm (1.136")	28.129mm (1.107")	4	2.386mm (.094")	2.557mm (.101")
28.129mm (1.107")	27.414mm (1.079")	5	3.101mm (.122")	3.272mm (.129")

LH0098-4L60

Figure 42 Lo and Reverse Spacer Plate Selection Chart

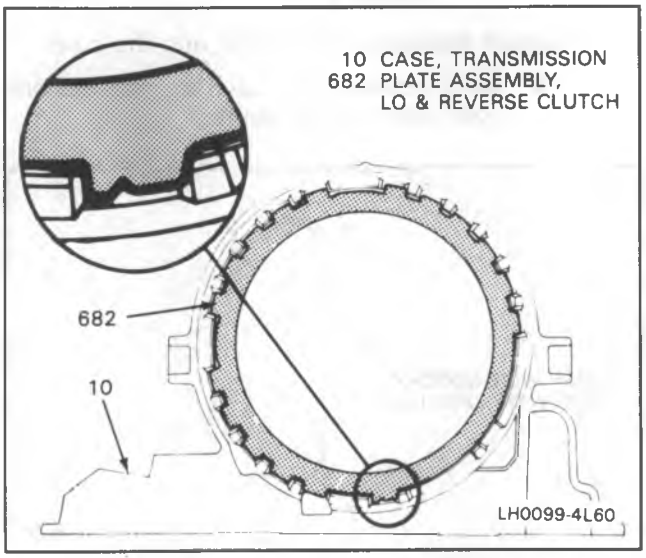
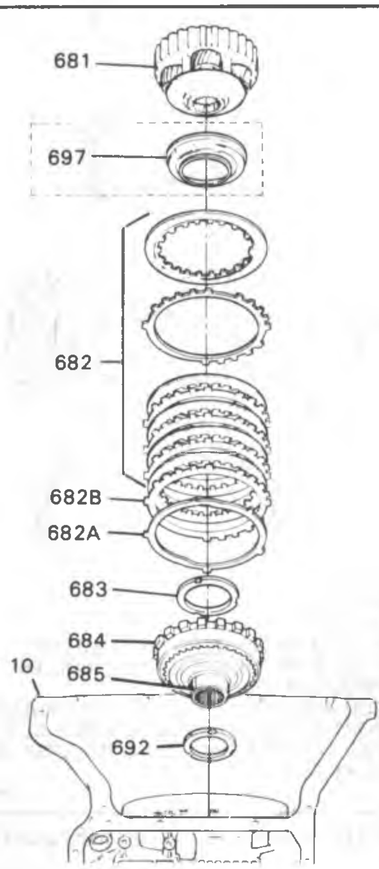


Figure 43 Lo and Reverse Clutch Plates Properly Installed



10 CASE, TRANSMISSION
681 CARRIER ASSEMBLY, REACTION
682 PLATE ASSEMBLY, LO & REVERSE CLUTCH
682A PLATE, LO & REVERSE CLUTCH (WAVED)
682B PLATE, LO & REVERSE CL. (SELECTIVE)
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684 GEAR, INTERNAL REACTION
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
697 DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

LH0100-4L60

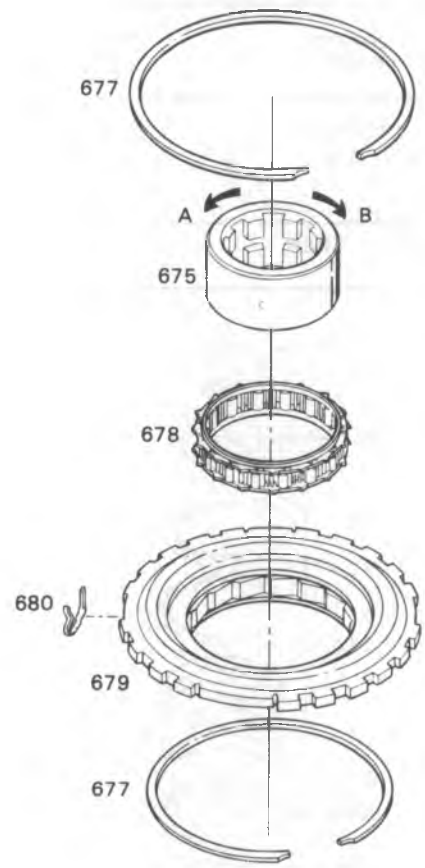
Figure 44 Reaction Internal Gear and Carrier Assembly Installation

Lo and Reverse Clutch Support Assembly

Figure 45

Remove or Disconnect

1. Inner race (675) from the support assembly
2. One retainer ring (677)
3. Roller clutch assembly (678)



A LOCKED UP
B FREE WHEELS
675 RACE, LO & REVERSE ROLLER CLUTCH
677 RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

LH0101-4L60

Figure 45 Lo and Reverse Clutch Support Assembly

Inspect

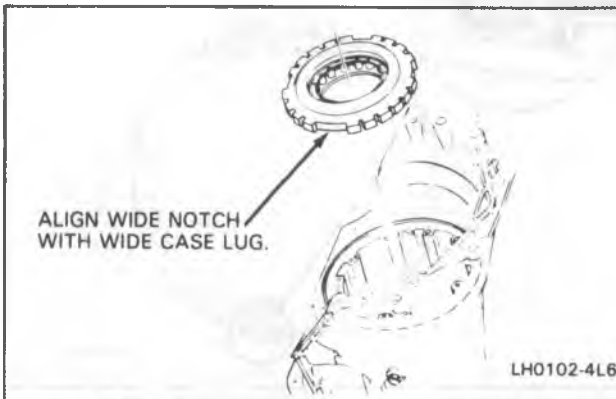
Figure 45

- Inner race (675) for damage and surface finish
- Roller clutch assembly (678) for:
  - — damaged rollers
  - — broken springs
- Cam for:
  - — loose cam
  - — surface finish
- Support assembly for:
  - — cracks or damaged lugs

Install or Connect

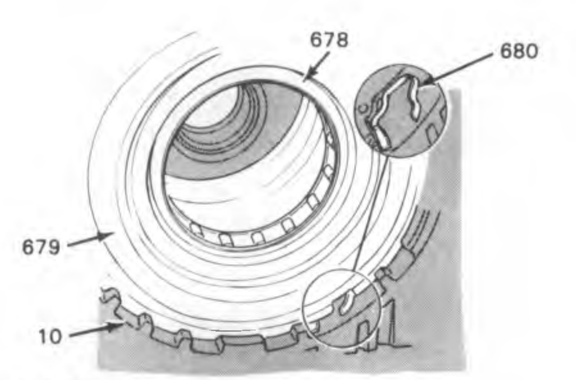
Figures 45, 46 and 47

1. Roller clutch assembly (678) into the cam and support assembly (679)
2. Support and roller assembly into the case with the hub down
3. Inner race (675) into the roller assembly
   - turn inner race (675) while inserting
     - — push down for full engagement.
     - — bottom tangs will be flush with carrier hub when properly installed.
     - — check for proper operation by rotating the inner race as shown in Figure 45.
4. Support retainer spring (680) into the case
   - insert between the case lug and the one open notch in the support.



LH0102-4L60

Figure 46 Lo and Reverse Support and Roller Asm. Installation



10 CASE, TRANSMISSION
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASM., LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)

LH0103-4L60

Figure 47 Support Spring — Installed

Reaction Sun Gear and Shell

Figure 48

Inspect

- Reaction sun gear (673) for:
  - nicked, scored, or worn bushing. (See Bushing Replacement).
  - damaged spline or teeth
  - loose or weak retaining ring (do not remove this ring, except to replace it.)
- Reaction sun shell (670) for:
  - stripped or worn splines
  - broken hub
  - bent tangs
- Lo and reverse inner race to reaction sun gear shell thrust washer (674) for wear or damage
- Reaction shaft to reaction sun gear shell bronze thrust washer (669) for wear or damage

Install or Connect

Figure 48

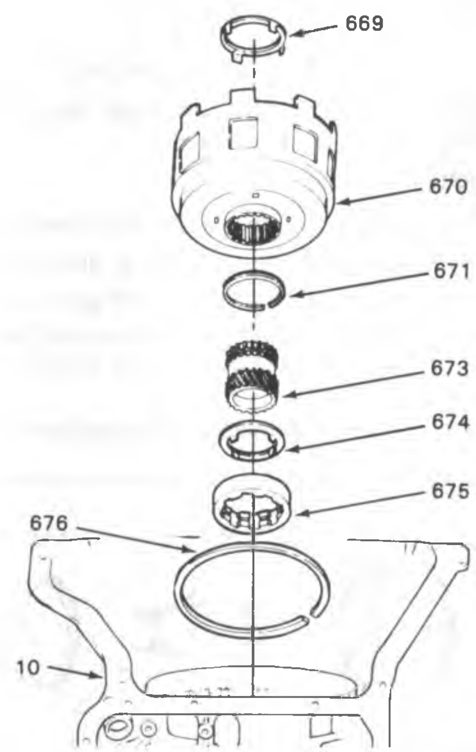
1. Reaction sun gear retainer ring (671) onto the reaction sun gear, if previously removed.
2. Reaction sun gear (673) into the reaction carrier
   - index the teeth with the pinion gears.
3. Thrust washer (674) onto the lo and reverse support inner race
   - index the four locating ears into the inner race.
4. Reaction sun gear shell (670) onto the reaction sun gear
5. Bronze thrust washer (669) onto the reaction sun gear shell
   - index tangs into the shell.

Input Internal Gear and Reaction Shaft

Figure 49

Remove or Disconnect

1. Retainer ring (668) from input internal gear (664)
2. Reaction carrier shaft (666) from the input internal gear



10 CASE, TRANSMISSION
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
671 RING, REACTION SUN GEAR RETAINER
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER

LH0105-4L60

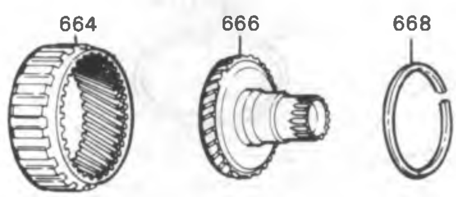
Figure 48 Reaction Sun Gear and Shell Installation

Inspect

Figure 49 and 50

- Reaction carrier shaft (666) for:
  - scored, damaged, or worn bushings (see Bushing Replacement)
  - cracked shaft
  - damaged spline or gear teeth
  - under cut around the shaft from interference with the sun gear

- Input internal gear (664) for:
  - — cracks
  - — damaged spline or gear teeth
- Input carrier to reaction shaft thrust bearing (663) for wear or damage
- Output shaft (687) for:
  - — plugged or restricted lube passages
  - — damaged splines or ring groove
  - — damaged governor drive gear teeth
  - — burrs or damage to the front of the shaft at seal area. (Polish with crocus cloth if necessary)
  - — burrs or damage to bearing journals



664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER

LH0106-4L60

Figure 49 Input Internal Gear and Reaction Shaft

Internal Transmission Speed Sensor Rotor

Inspect

Figure 50

- Speed sensor rotor on output shaft for tooth damage

Important

- If rotor is damaged, replace it. Do not reuse a rotor that has been removed.

Remove or Disconnect

Figure 50

Tools Required:

J 21427-01 Speedometer Gear Puller Adapter

J 8433 Speedometer Gear Puller

- Install J 21427 with J 8433 and remove rotor.

Install or Connect

Figure 50

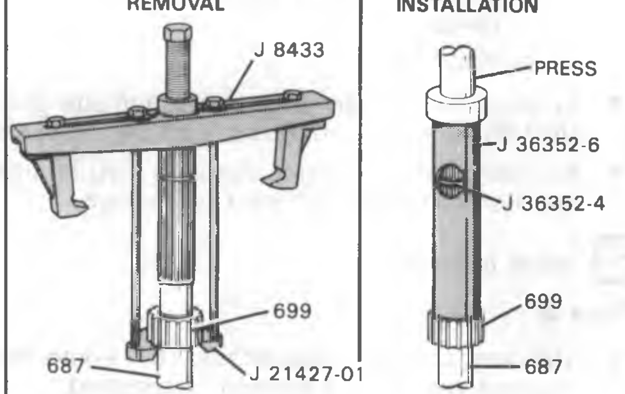
Tools Required:

J 36352-6 "C" Washer

J 36352-4 Rotor Installer

Mechanical press

1. Place new rotor over output shaft.
2. Place J 36352-4 in groove on output shaft.
3. Place J 36352-6 on shaft and press to make contact with J 36352-4.



687 SHAFT, OUTPUT
699 ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

LH0107-4L60

Figure 50 Internal Transmission Speed Sensor Rotor

Input Internal Gear and Output Shaft

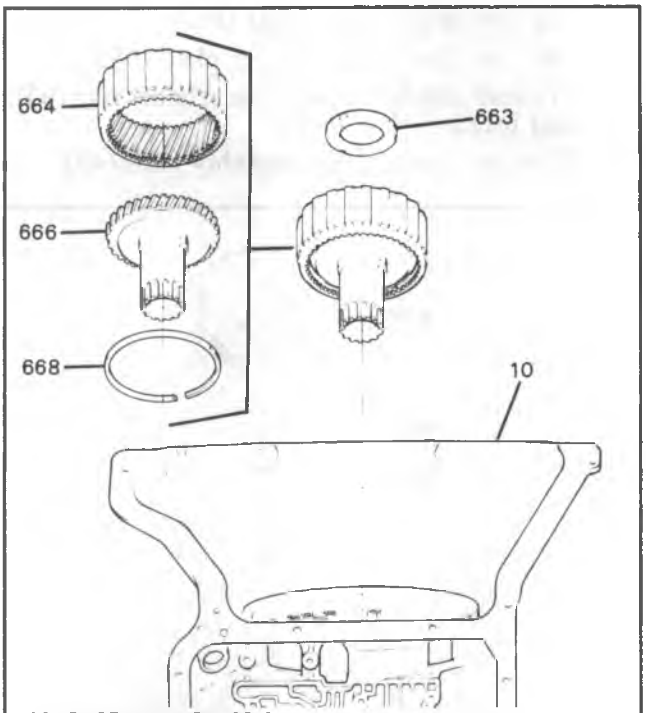
Install or Connect

Figures 51 and 52

Tool Required:

J 29837 Output Shaft Support Fixture

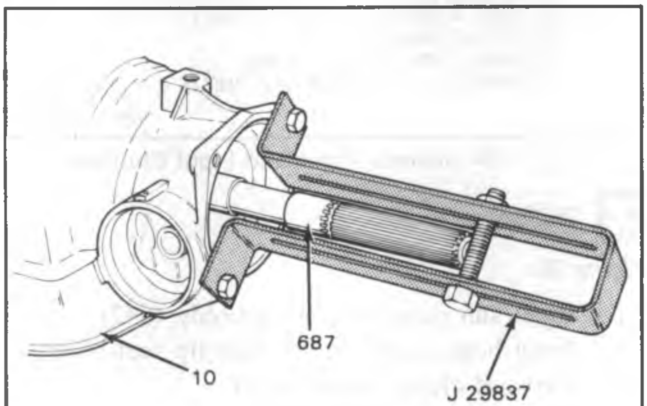
1. Reaction shaft (666) into the input internal gear (664)
2. Retainer ring (668) into the input internal gear
3. Input internal gear and shaft assembly into the sun gear shell
   - index the shaft spline into the reaction carrier.
4. Thrust bearing (663) onto the reaction carrier shaft.
   - outer race goes toward the reaction carrier shaft.
5. Output shaft (687) into the transmission
   - index the splines with the mating parts.
6. J 29837 onto the case
   - position upwards as far as possible to support the output shaft.



10 CASE, TRANSMISSION
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER

LH0108-4L60

Figure 51 Input Internal Gear Installation



10 CASE, TRANSMISSION
687 SHAFT, OUTPUT

LH0077-4L60

Figure 52 Output Shaft — Installation

Input Carrier and Sun Gear

Figure 53

Inspect

- Input carrier assembly (662) for:
  - — pinion gear damage
  - — excessive pinion washer wear — end play should be .20-.61 mm (.008-.024")
  - — proper pin stake
  - — keystoned pinion gears (pinion gears must rotate freely)
  - — damaged or worn thrust bearing
    - To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.
- Input sun gear (658) for:
  - — bushing damage or wear (see Bushing Replacement Procedure)
  - — cracks
  - — damaged spline or gear teeth

Install or Connect

Figure 53

Tool Required:

J 34627 Snap Ring Pliers

1. Input carrier assembly (662) onto the output shaft
2. Retainer ring (661) into the output shaft ring groove
   - Use care not to overexpand the ring during installation.
   - Do not reuse the old retainer ring if it has been overexpanded.
3. Remove J 29837.
4. Input sun gear (658) into the input carrier
   - rotate the sun gear teeth into the pinion gear teeth

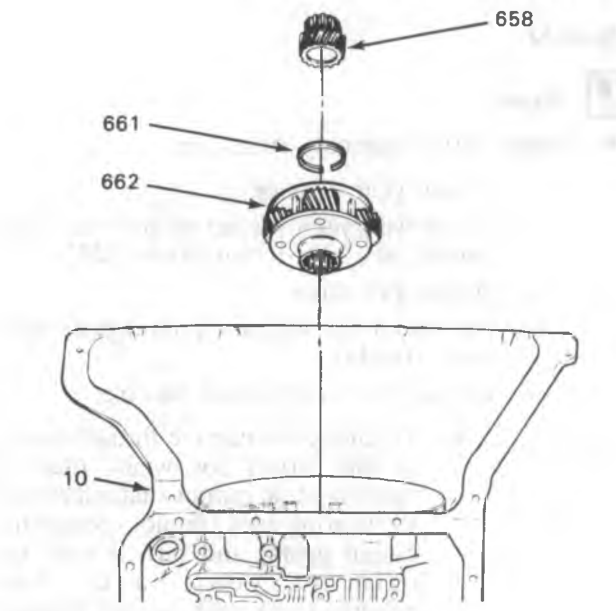


Figure 53 Input Carrier and Sun Gear — Installation

Input Clutch Assembly

Figure 54 and 56

Remove or Disconnect

- Reverse input clutch assembly (605) from the input clutch assembly (621)
- Oil pump to selective washer thrust bearing (615)
- Selective washer (616)

Disassemble

Figures 55 and 56

Place the input clutch assembly (621) on the bench with the turbine shaft through the bench hole.

Tools Required:

J 23456 Clutch Spring Compressor Press

J 23327-1 Clutch Spring Compressor

J 25018-A Clutch Spring Compressor Adaptor

1. The 3-4 clutch plate retainer ring (656) and the backing plate (655)
2. The 3-4 clutch plates (654)
3. Five 3-4 clutch boost spring assemblies (600)
4. The 3-4 clutch apply plate (653)
5. The 3-4 clutch ring retainer plate (652)
6. Forward clutch backing plate retainer ring (651) and backing plate (650)
7. Forward clutch sprag assembly (638-648)

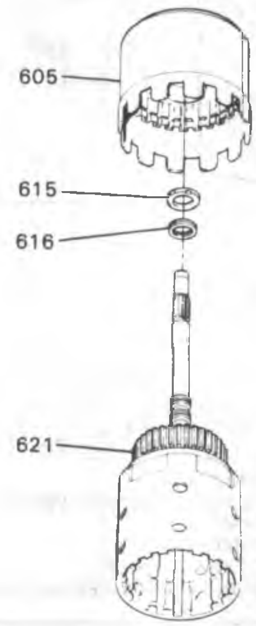


Figure 54 Reverse Input and Input Clutches

Disassemble

Figure 56

1. Input sun gear bearing assembly (637)
2. Input housing to output shaft lip seal (636).
3. Forward clutch plates (649)
4. Forward wave plate (648)
5. Forward clutch apply plate (646)
6. Overrun clutch plates (645)

Disassemble

Figure 55

1. Install J 23456 and J 23327-1 with J 25018-A
   - compress overrun clutch spring assembly (634).
2. Overrun clutch retainer ring (635).
3. Overrun clutch spring assembly (634).
4. Overrun clutch piston (632)
   - inner and outer lip seals (631)

5. Forward clutch piston assembly (630)
   - inner and outer lip seals (629)
6. Forward clutch housing (628)
7. The 3-4 clutch spring assembly (626)
8. The 3-4 clutch apply ring (625) and piston (623)
   - inner and outer lip seals (624) from piston
9. Forward clutch to input housing O-ring seal (622)
10. Four turbine shaft oil seal rings (619)

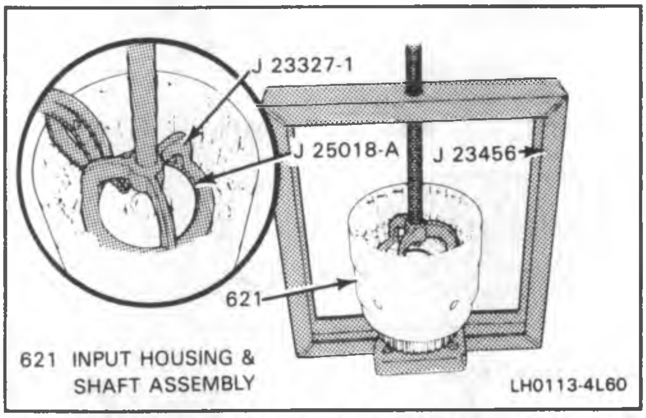


Figure 55 Overrun Clutch Retainer Ring — Removal

Inspect

Figures 57 and 58

- Input housing for porosity or damage
- Input housing and shaft assembly (621) for:
  - — spline wear or damage
  - — three turbine shaft check balls
    - The balls must **not** be loose or leaking.
    - The open hole is the lube oil passage which feeds the output shaft.
- presence of orificed cup plug (698)
- cracks at lube holes.
- four turbine shaft oil seal ring grooves for damage or burrs
  - — Seals must fit freely into the ring grooves.
- Check valve retainer and ball assembly (617) for:
  - — damage
  - — the ball must move freely in the retainer.
  - — the retainer must be tight in the turbine shaft.
- Feed passages for:
  - — obstructions — blow air through passages

Check Valve Retainer and Ball Assembly — Replacement Procedures

Figure 58

Remove or Disconnect

Tool Required:

6.3 mm (#4) Screw extractor

1. Straighten the tangs of the retainer and remove the ball.
2. Check valve retainer
   - use 6.3 mm (#4) Screw extractor

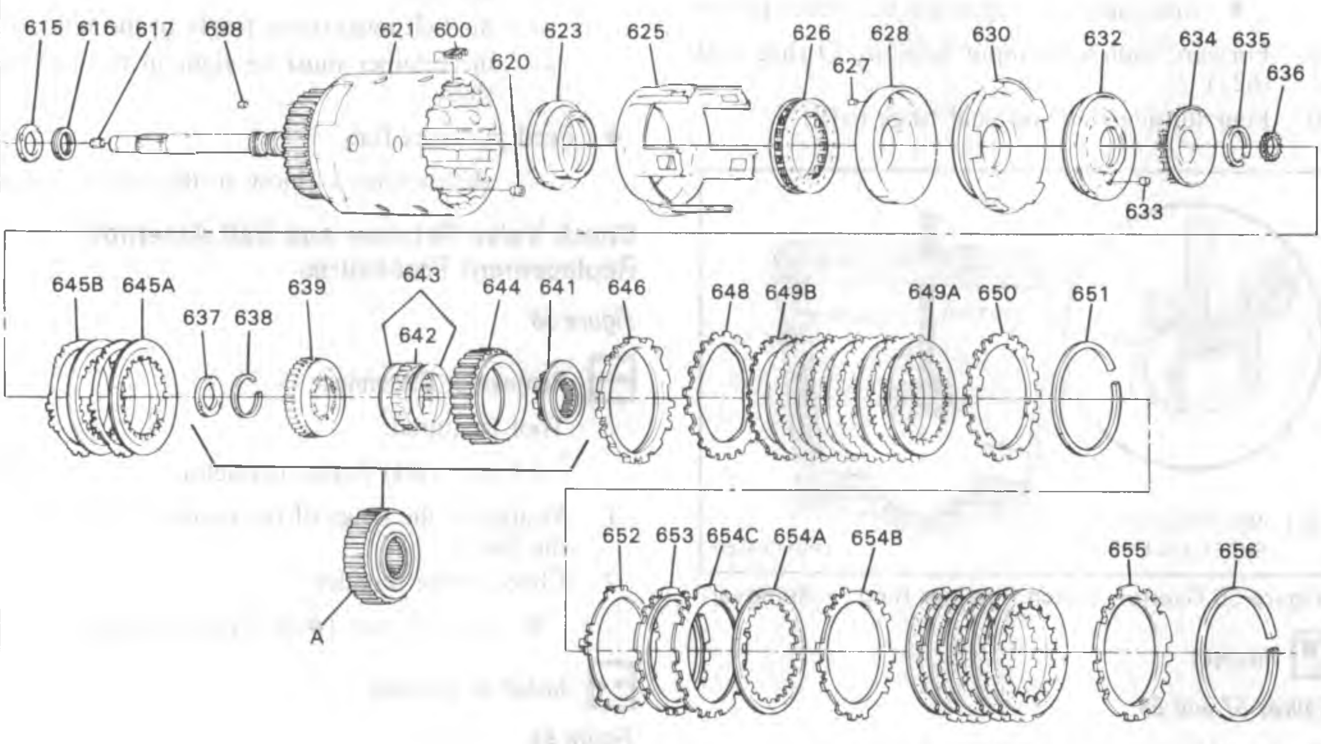
Install or Connect

Figure 58

Tool Required:

9.5 mm (3/8 in.) diameter metal rod

- New check valve retainer and ball assembly (617)
  - — use the 9.5 mm (3/8 in.) metal rod.
  - — seat the retainer 3.0 mm (1/8 in.) below top surface of the turbine shaft.
  - — be certain the ball is loose.



ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASSEMBLY, CHECK VALVE
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
627	RETAINER & BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
645A	PLATE ASSEMBLY, OVERRUN CLUTCH (FIBER)
645B	PLATE, OVERRUN CLUTCH (STEEL)
A	FORWARD CLUTCH SPRAG ASSEMBLY
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RET.
639	HUB, OVERRUN CLUTCH
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)

ILL. NO.	DESCRIPTION
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649A	PLATE ASSEMBLY, FORWARD CLUTCH (FIBER)
649B	PLATE, FORWARD CLUTCH (STEEL)
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)
654A	PLATE ASSEMBLY, 3RD & 4TH CLUTCH (FIBER)
654B	PLATE, 3RD & 4TH CLUTCH (FLAT STEEL)
654C	PLATE, 3RD & 4TH CLUTCH (STEEL)
655	PLATE, 3RD & 4TH CLUTCH BACKING (SELECTIVE)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
698	PLUG, ORIFICED CUP

LH0114-4L60

Figure 56 Input Clutch Assembly

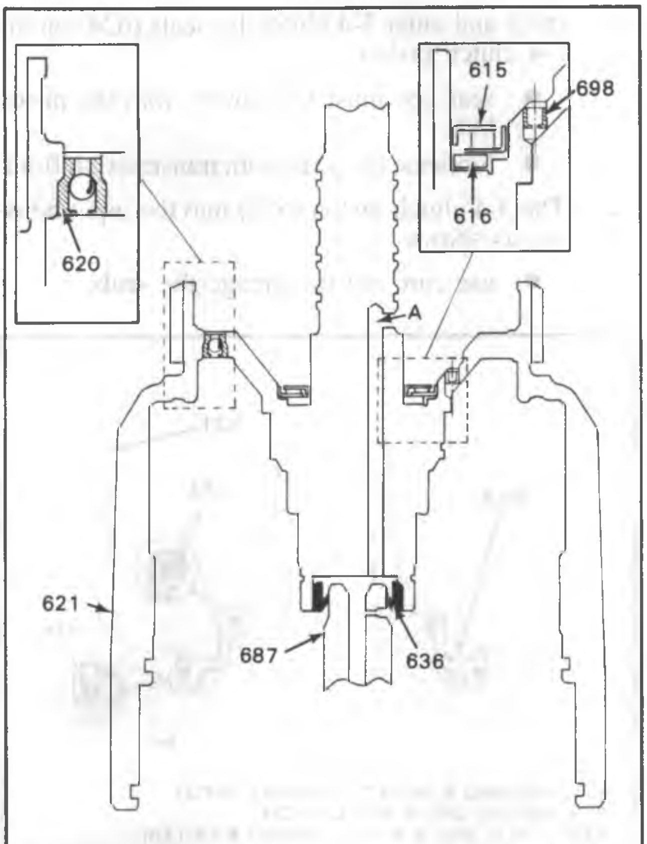


Figure 57 Input Housing Check Valve Ball

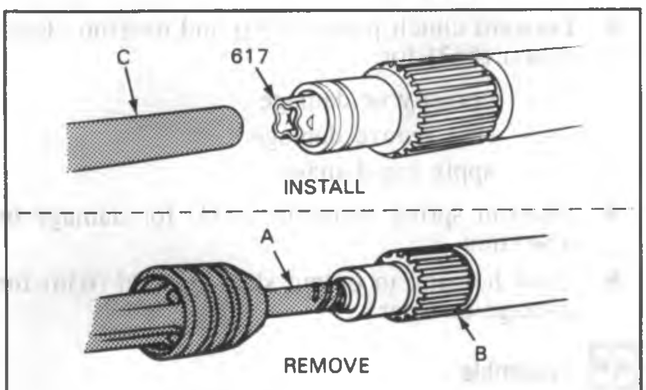


Figure 58 Retainer and Ball Assembly — Replacement

Inspect

Figures 57 and 59

- Turbine shaft O-ring seal (618) for:
  - — damage
  - — nicks or cuts
- Input housing check valve ball (620)
  - — the ball must move freely.
  - — leak check the ball with solvent.

Important

- If the 3-4 clutch plates are burned or worn and a cause is not found during diagnosis or disassembly, replacement of the retainer and check ball assembly may be required (Figure 58).

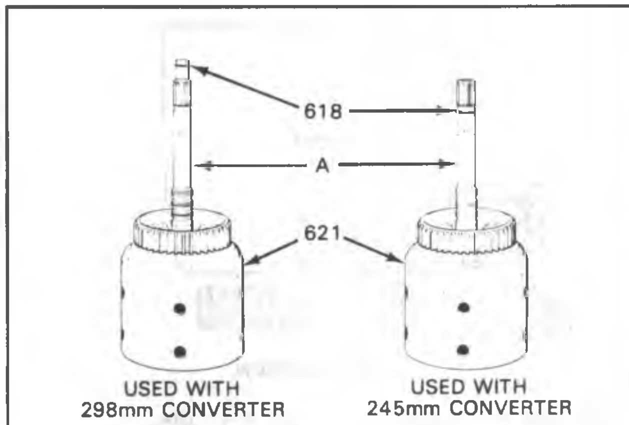


Figure 59 Views of the Input Housing

Remove or Disconnect

Figure 60

Tool Required:

6.35 mm (1/4 in.) diameter rod or drift hammer

- Tap out retainer and ball assembly.

Install or Connect

Figures 58 and 60

- Using same tools, tap in retainer and ball assembly until shoulder is seated in housing.

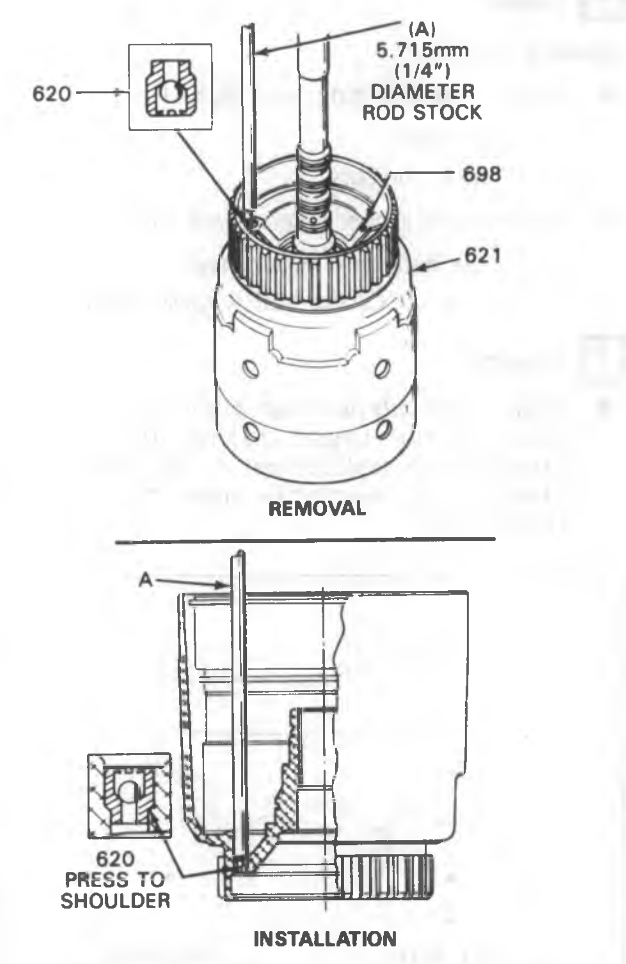


Figure 60 Retainer and Check Ball Removal/Installation

Inspect

Figure 56

- The 3-4 clutch piston (623) for damage or porosity
- The 3-4 clutch apply ring (625) for:
  - — bent tangs
- The 3-4 clutch spring assembly (626) for damage or distortion
- The 3-4 clutch boost spring assemblies (600) for damage or distortion

Assemble

Figure 61

Position the input housing and shaft assembly on the bench with the turbine shaft through a bench hole.

1. Inner and outer 3-4 clutch lip seals (624) on the 3-4 clutch piston
   - seal lips must face away from the piston hub.
   - lubricate the seals with transmission fluid.
2. The 3-4 clutch piston (623) into the input housing as shown
   - use care not to damage the seals.

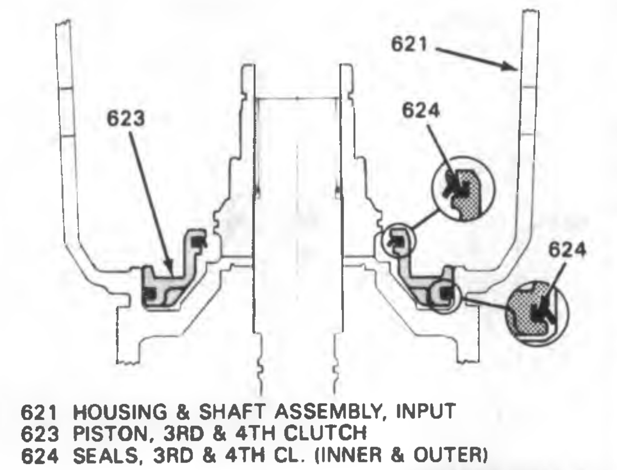


Figure 61 Input Housing and 3-4 Piston

Inspect

Figures 62 and 63

- Forward clutch housing (628) for:
  - — proper check ball operation
  - — damage or distortion
  - — burrs in seal areas
  - — cracks
- Forward clutch piston (630) and overrun clutch piston (632) for:
  - — porosity or damage
  - — ring groove damage
  - — apply leg damage
- Overrun spring assembly (634) for damage or distortion
- Input housing to output shaft lip seal (636) for damage or wear

Assemble

Figures 62 and 63

Tools Required:

J 23456 Clutch Spring Compressor Press
J 23327-1 Clutch Spring Compressor
J 25018-A Clutch Spring Compressor Adaptor

J 29882 Overrun Clutch Inner Seal Protector

J 29883 Forward Clutch Inner Seal Protector

1. Forward clutch housing to input clutch housing O-ring seal (622) as shown
   - lubricate with Transjel™ J36850 or equivalent.

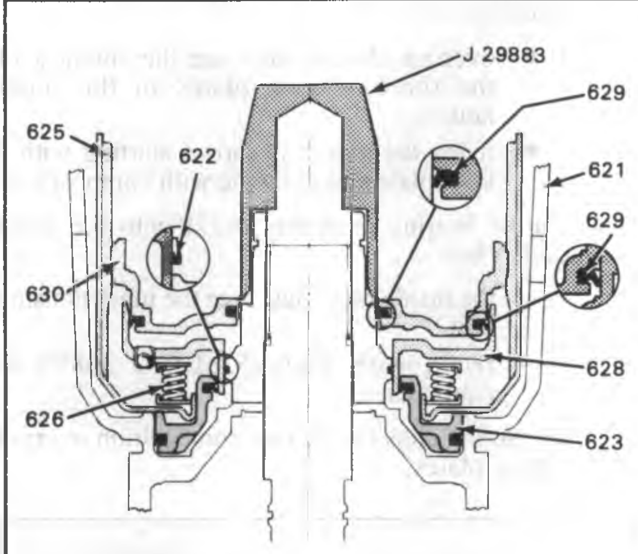


Figure 62 Forward Clutch and 3-4 Apply Ring — Installed

2. Inner and outer seals (629) on forward clutch piston
   - seal lips must face away from the piston tangs as shown.
   - lubricate with Transjel™ J36850 or equivalent.
3. Forward clutch piston (630) into the forward clutch housing
   - use care not to damage the outer lip seal.
4. The 3-4 clutch spring assembly (626) onto the 3-4 clutch apply ring
5. Forward clutch assembly onto the 3-4 clutch spring assembly
   - the forward clutch piston apply legs must be indexed with the 3-4 clutch apply ring legs.
6. J 29883 on the input housing as shown
7. Apply ring and forward clutch assembly into the input housing as shown
   - hold the assembly by the apply ring legs during installation.
   - do not let the forward clutch piston separate from the housing.
   - firmly seat the assembly.

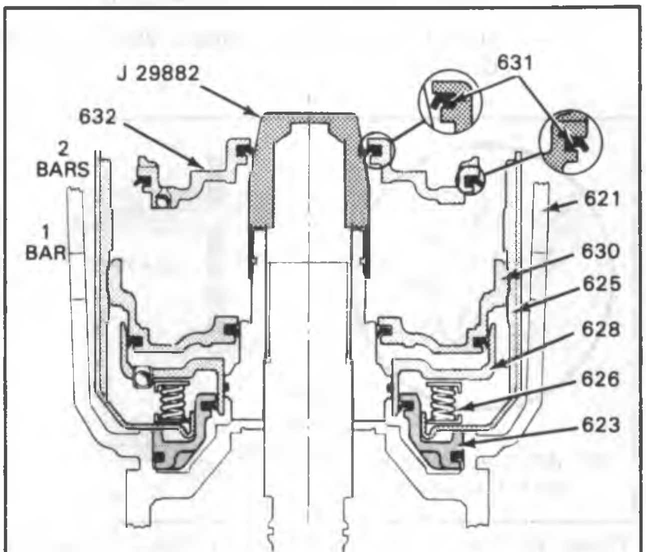


Figure 63 Overrun Piston — Installed

8. J 29882 on the input housing as shown
9. Overrun clutch piston (632)
   - hub facing upward as shown.
   - if all parts are properly seated to this point, the overrun piston hub will be approximately 4.7 mm (3/16 in.) below the snap ring groove in the input housing hub.

Assemble

Figures 64 and 65

1. Overrun clutch spring assembly (634) onto the overrun clutch piston.
   - locate the springs on the piston tabs
2. J 23456 and J 23327-1 with J 25018-A onto the overrun spring assembly.
   - compress springs (Do not over-compress).

3. Retainer snap ring (635) into the snap ring groove
4. Input housing to output shaft lip seal (636)

Inspect

- Overrun clutch plates (645) for:
  - — composition plate damaged tangs, delamination, or excessive wear
  - — steel plate damaged tangs, wear, or heat damage

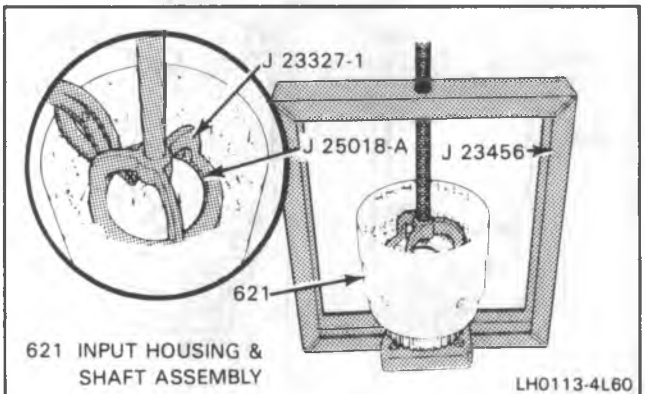


Figure 64 Overrun Clutch Retaining Ring — Installed

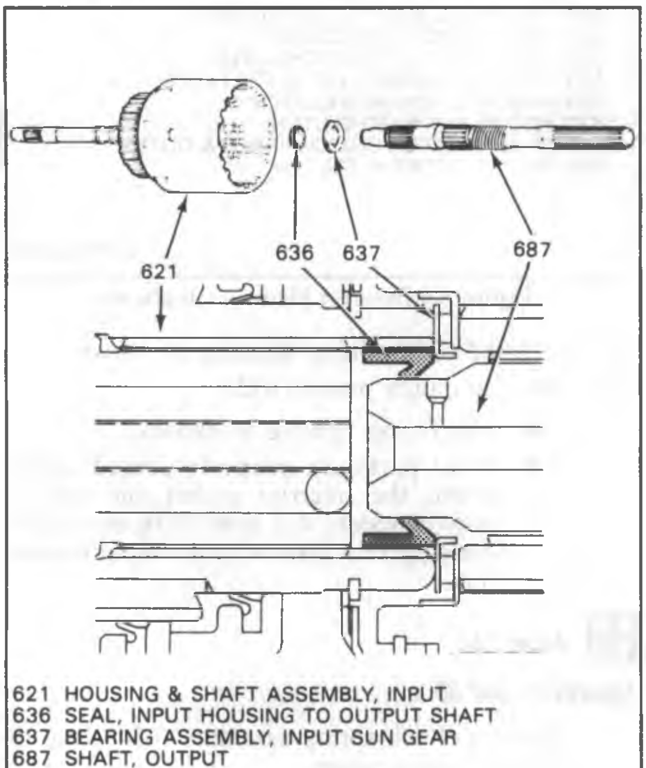


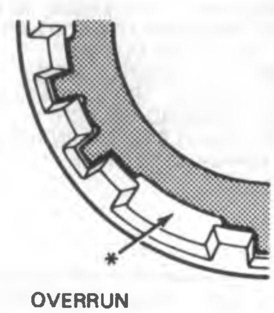
Figure 65 Input Hsg. to Output Shaft Lip Seal

- Input sun gear bearing assembly (637) for:
  - — wear
  - — flatness
  - — damage

Assemble

Figures 66 and 67

1. Overrun clutch plates (645) into the input housing.
   - overrun clutch plates are the smallest of the three sets of plates in the input housing.
   - index the plates as shown starting with a steel plate and alternate with composition.
2. Thrust bearing assembly (637) onto the input clutch hub
   - — the inside race must face the input housing hub.
   - — retain with TRANSJEL™ J 36850 or equivalent.
3. Align the tangs on the two composition overrun clutch plates.



*ALIGN WIDE NOTCHES TO CASE LUGS

OVERRUN CLUTCH

MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
ALL MODELS	2	2.34 mm (.091")	2	2.03 mm (.079")

LH0124-4L60

Figure 66 Overrun Clutch Plate Chart

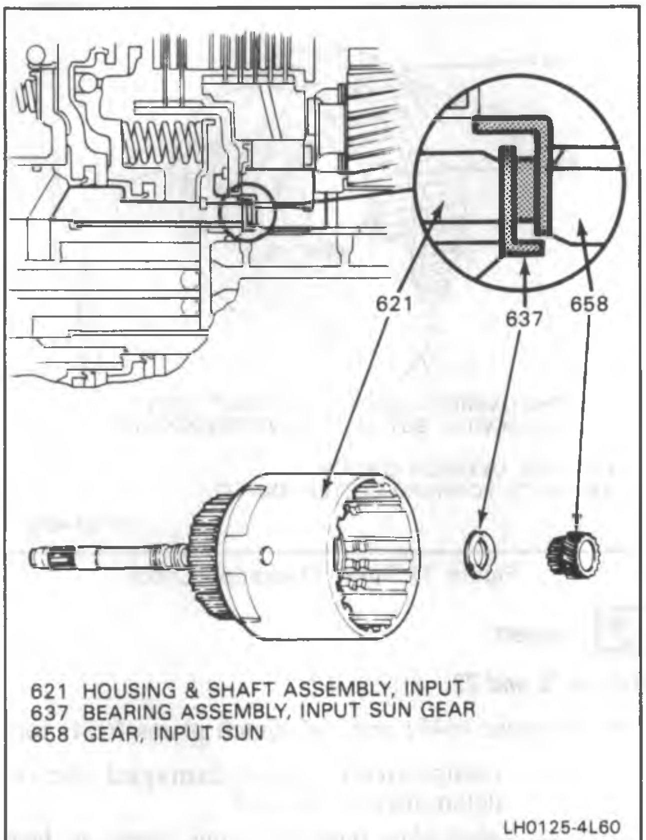


Figure 67 Input Sun Gear Thrust Bearing

Forward Clutch Sprag Assembly

Figure 68

Disassemble

1. Forward sprag outer race (644)
2. Overrun clutch hub retaining snap ring (638) and clutch hub (639)
3. Forward clutch retainer and race assembly (641)

Inspect

- Forward clutch sprag assembly (642) for:
  - — wear or damage
  - — weak or broken springs
  - — damaged or missing retainer caps (brass)
- Overrun clutch hub (639) for:
  - — spline damage
  - — plugged lubrication holes
  - — damaged tangs
  - — cracks
- Forward clutch retainer and race assembly (641) for:
  - — spline damage
  - — ring groove damage
  - — surface finish damage
  - — loose retainer
- Forward sprag outer race (644) for:
  - — spline damage
  - — surface finish damage
  - — plugged lubrication holes

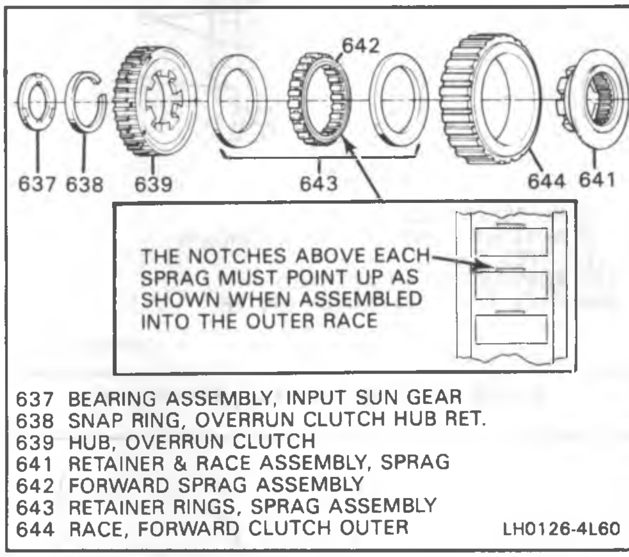


Figure 68 Forward Clutch Sprag Assembly

Assemble

Figures 69, 70 and 71

1. Forward clutch sprag assembly (642) into the outer race
   - to correctly install, the notches in the sprag cage must face upward as shown.
2. One sprag retainer ring (643) onto the race and retainer assembly
   - the flange on the retainer ring must face away from the retainer.
3. Race and retainer assembly into the sprag assembly
   - to assemble, hold the outer race in your left hand with your fingers supporting the sprag at the recessed side of the outer race.
   - insert the race and retainer assembly by pushing in and turning to the left.
4. The remaining retainer ring onto the sprag assembly
5. Overrun clutch hub (639)
6. Overrun clutch hub retaining snap ring (638) into the snap ring groove of the race and retainer assembly
7. Test the assembly for proper operation as shown (Figure 71).

Important

- If the assembly operates backwards, you have installed the sprag backwards. Reassemble correctly.

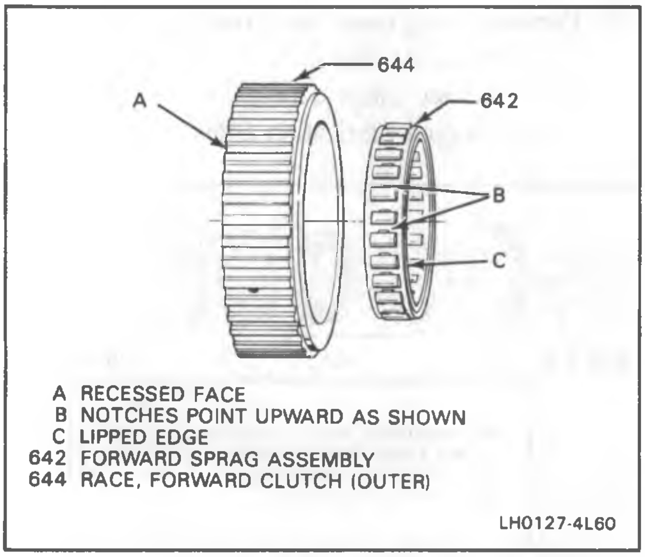


Figure 69 Sprag Assembly Procedure

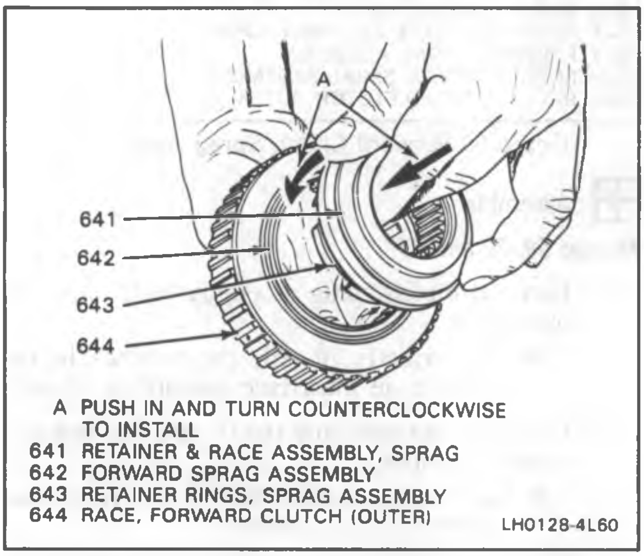


Figure 70 Sprag Race and Retainer Assembly Procedure

Assemble

- Forward clutch sprag assembly into the input clutch housing
  — index the overrun clutch hub into the overrun clutch plates.

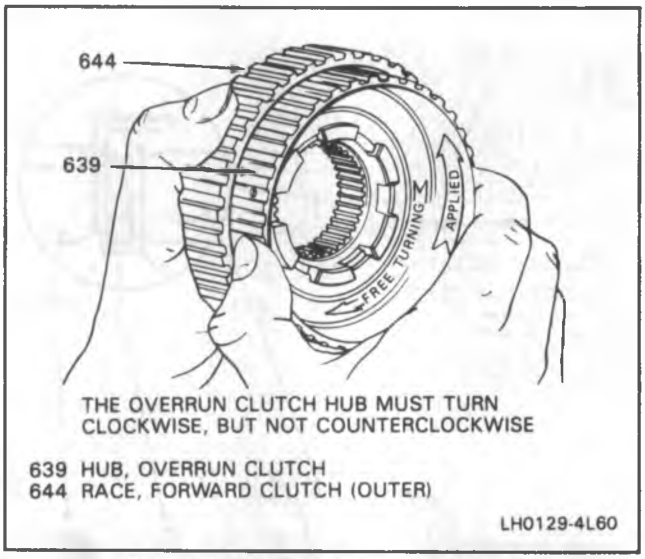


Figure 71 Sprag Operation Check

Inspect

Figure 72 and 73

- Forward (649) and 3-4 clutch plates (654) for:
  — composition plate damaged tangs, delamination, or wear
  — steel plate damaged tangs, wear, or heat damage
- Forward (650) and 3-4 clutch backing plates (655) for:
  — flatness
  — surface finish damage
  — burrs or nicks
- Forward clutch apply plate (646) and spacer plate (647) for:
  — flatness
  — surface finish damage
  — burrs or nicks
- The 3-4 clutch apply plate (653) for:
  — flatness
  — surface finish damage
- The 3-4 clutch ring retainer plate (652) for:
  — bent tangs
  — flatness

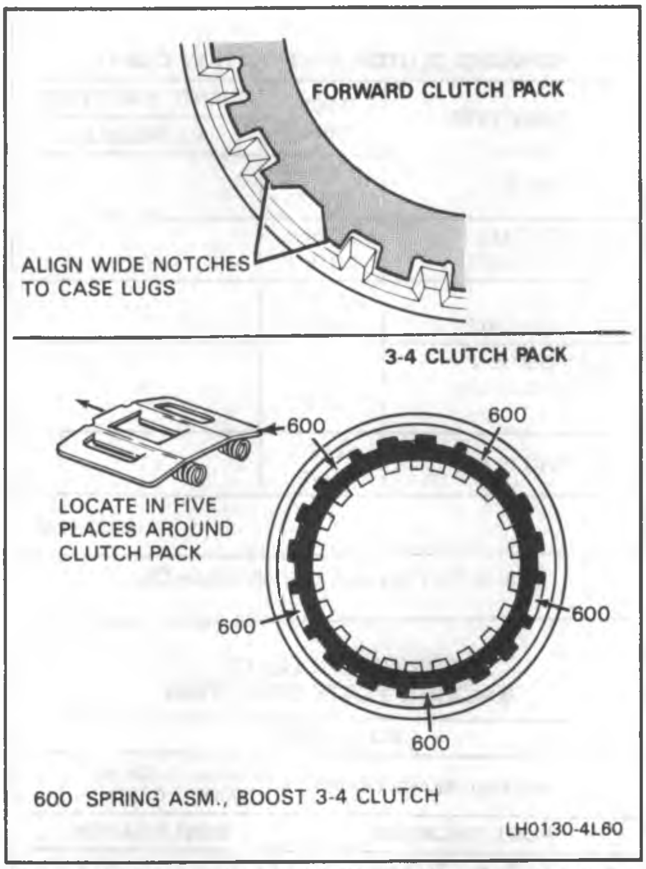


Figure 72 Forward and 3-4 Clutch Plates — Installed

Assemble

Figures 72, 73, 74 and 75

1. Forward clutch apply plate (646) into the input clutch housing
   - index as shown.
2. Waved steel forward clutch plate (648) into the input clutch housing
   - index as shown.
3. The remaining forward clutch plates (649) into the input clutch housing
   - start with a steel plate and alternate with composition
4. Forward clutch selective backing plate (650)
5. Forward clutch retaining ring (651)

Forward Clutch Piston Travel Check

Figure 75

Measure

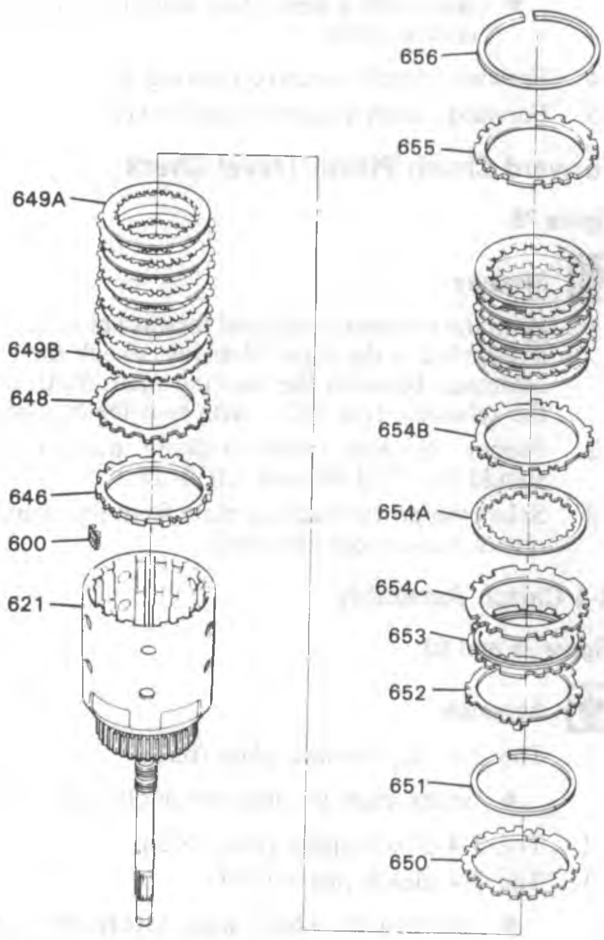
1. With the overrun clutch and forward clutch fully assembled in the Input Housing, check the end clearance between the backing plate (650) and the retaining ring (651) with two feeler gages.
2. Proper forward clutch backing plate travel should be .75-1.60 mm (.030-.063").
3. Select the proper backing plate from the chart to obtain the correct clearance.

3-4 Clutch Assembly

Figure 76 and 80

Assemble

1. The 3-4 ring retainer plate (652)
   - index each leg into the apply ring legs.
2. The 3-4 clutch apply plate (653)
3. The 3-4 clutch plates (654)
   - start with steel and alternate with composition as shown in (Figure 80)
   - first steel plate has the same spline configuration as apply plate
4. The 3-4 boost springs (600)
5. The 3-4 clutch backing plate (655) and retainer ring (656)
   - chamfered side up.



ILL. NO. DESCRIPTION
600 SPRING ASSEMBLY, 3-4 CLUTCH BOOST (5)
621 HOUSING & SHAFT ASSEMBLY, INPUT
646 PLATE, FORWARD CLUTCH APPLY
648 PLATE, FORWARD CLUTCH (WAVED)
649A PLATE ASSEMBLY, FORWARD CLUTCH (FIBER)
649B PLATE, FORWARD CLUTCH (STEEL)
650 PLATE, FORWARD CLUTCH BACKING (SELECTIVE)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
652 PLATE, 3RD & 4TH CLUTCH RING RETAINER
653 PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)
654A PLATE ASSEMBLY, 3RD & 4TH CLUTCH (FIBER)
654B PLATE, 3RD & 4TH CLUTCH (STEEL)
654C PLATE, 3RD & 4TH CLUTCH (STEEL)
655 PLATE, 3RD & 4TH CLUTCH BACKING (SELECTIVE)
656 RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

LH0131-4L60

Figure 73 Input Housing with Forward and 3-4 Clutch Plates

FORWARD CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED ALL MODELS
APPLY PLATE	6.44mm (2.51")	1
WAVED STEEL CLUTCH PLATE	2.03mm (.079")	1
FLAT STEEL CLUTCH PLATE	2.29mm (.090")	5
COMPOSITION FACED CLUTCH PLATE	1.78mm (.070")	5
BACKING PLATE	SELEC-TIVE	1

LH0132-4L60

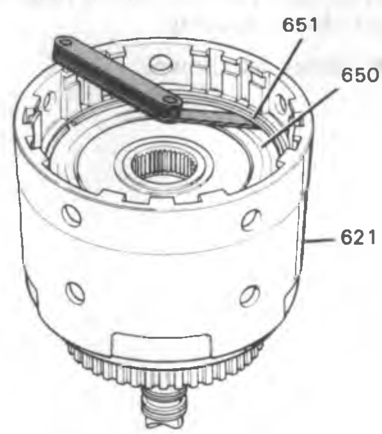
Figure 74 Forward Clutch Plate Chart

FORWARD CLUTCH BACKING PLATE SELECTION

ALL MODELS

BACKING PLATE TRAVEL = .75mm - 1.60mm (.030" - .063")

PLATE THICKNESS	IDENTIFICATION
6.97mm - 7.07mm (.274" - .278")	A
6.38mm - 6.48mm (.250" - .255")	B
5.79mm - 5.89mm (.227" - .232")	C
5.20mm - 5.30mm (.205" - .208")	D
4.61mm - 4.71mm (.180" - 185")	E



621 HOUSING & SHAFT ASSEMBLY, INPUT
650 PLATE, FORWARD CLUTCH BACKING
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER

LH0133-4L60

Figure 75 Forward Clutch Backing Plate Travel

3-4 CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED	
		*A-MODELS	*B-MODELS
STEPPED APPLY PLATE	3.30mm (.130")	1	1
†FLAT STEEL CLUTCH PLATES	1.78mm (.070")	1	1
FLAT STEEL CLUTCH PLATE	1.78mm (.070")	6	5
COMPOSITION FACED CLUTCH PLATES	2.03mm (0.79")	5	6
BACKING PLATE	SELEC-TIVE	1	1
*A-MODELS	FBM, MBM, SAM		
*B-MODELS	ALL OTHERS		

†SAME SPLINE CONFIGURATION AS APPLY PLATE

LH0134-4L60

Figure 76 3-4 Clutch Plate Chart

3-4 Clutch Piston Travel Check

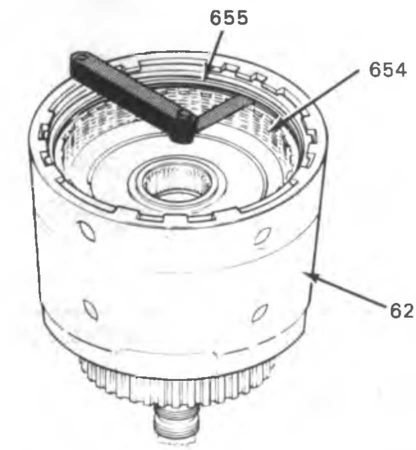
Figure 77

Measure

- Check the end clearance between the backing plate (655) and the first composition plate with a feeler gage.
- Select the proper backing plate from the chart to obtain the correct clearance for model you are working on.

3-4 BACKING PLATE SELECTION

MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM.	I.D.
FBM, MBM, SAM	2.42mm - 1.61mm (.095" - .063")	6.58mm-6.38mm (.259"-.251")	5
		5.75mm-5.55mm (.226"-.218")	6
ALL OTHERS	2.40mm - 1.52mm (.094" - .060")	4.92mm-4.72mm (.194"-.186")	7
		4.09mm-3.89mm (.161"-.153")	8



621 HOUSING & SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING

LH0135-4L60

Figure 77 3-4 Backing Plate Selection Chart

Clutch Air Check

Figure 78

Air check the 3-4, forward, and overrun clutches by applying air pressure at the feed holes in the turbine shaft. (When the overrun clutch is checked, the air will blow by the forward clutch piston lip seals and exit out the forward clutch feed hole in the turbine shaft.)

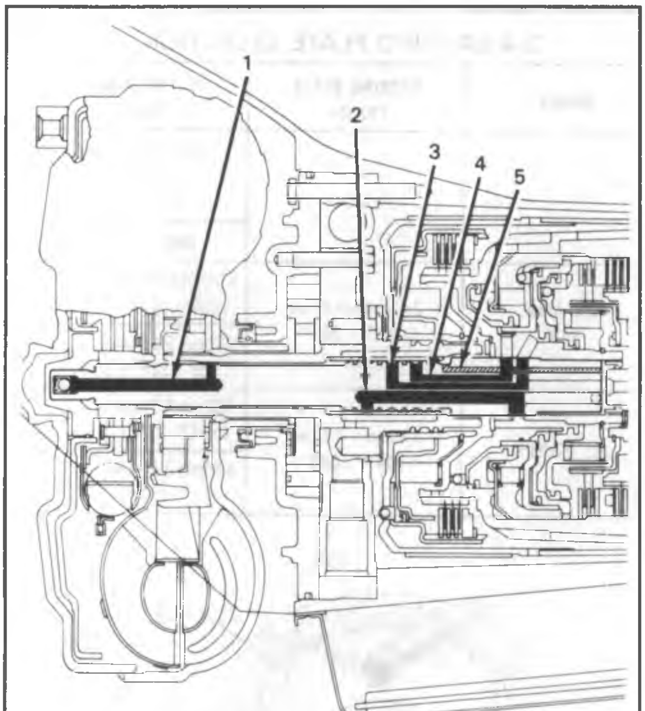


Figure 78 Turbine Shaft Fluid Passages

Turbine Shaft Seals

Assemble

Figure 79

Tools Required:

J 36418-1 SEAL INSTALLER
J 36418-2A SEAL SIZER

1. Install four turbine shaft oil seal rings (619) using J-36418-1

Adjust

- Adjust screw to obtain proper height

2. Use J 36418-2A to size the seals after installation

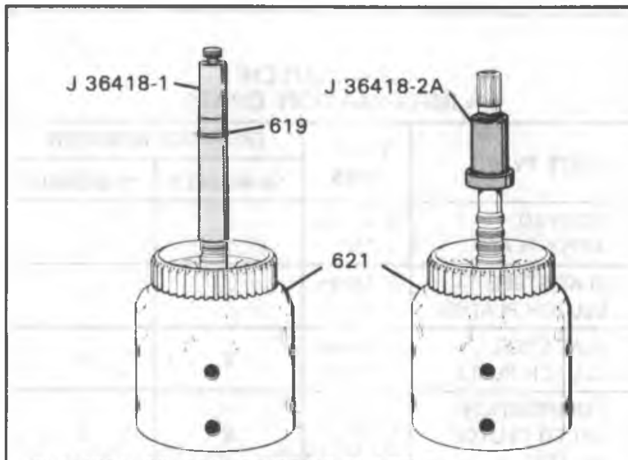


Figure 79 Turbine Shaft Oil Seal Rings

Reverse Input Clutch Assembly

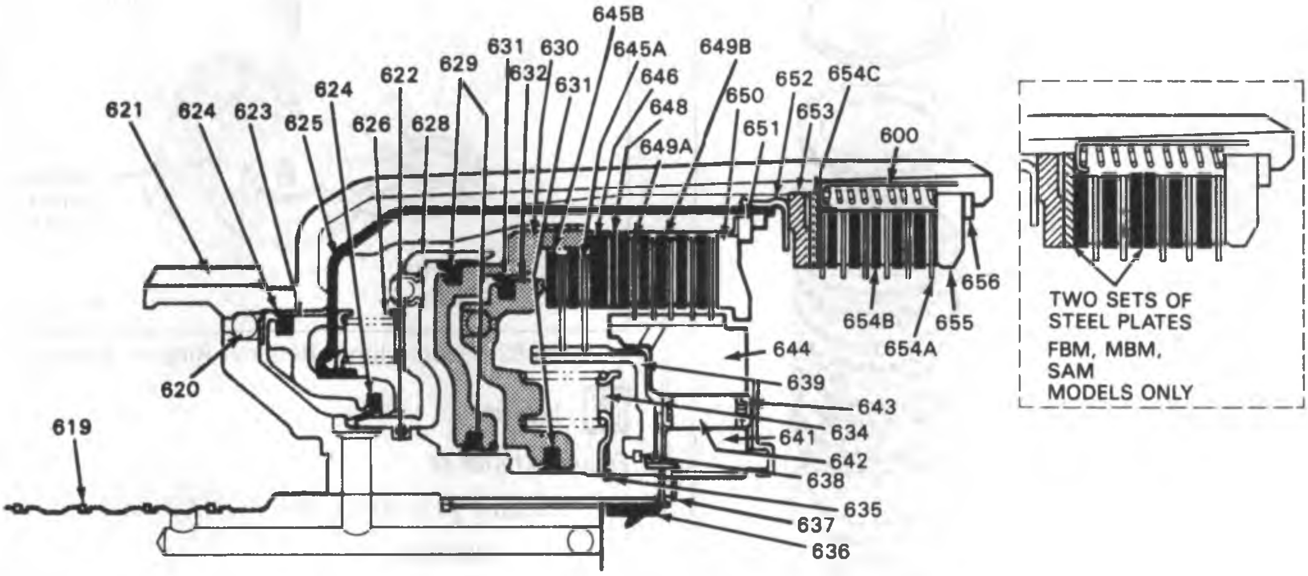
Figures 81 and 82

Disassemble

Tools Required:

J 23327-1 Clutch Spring Compressor
J 25018-A Clutch Spring Compressor Adaptor

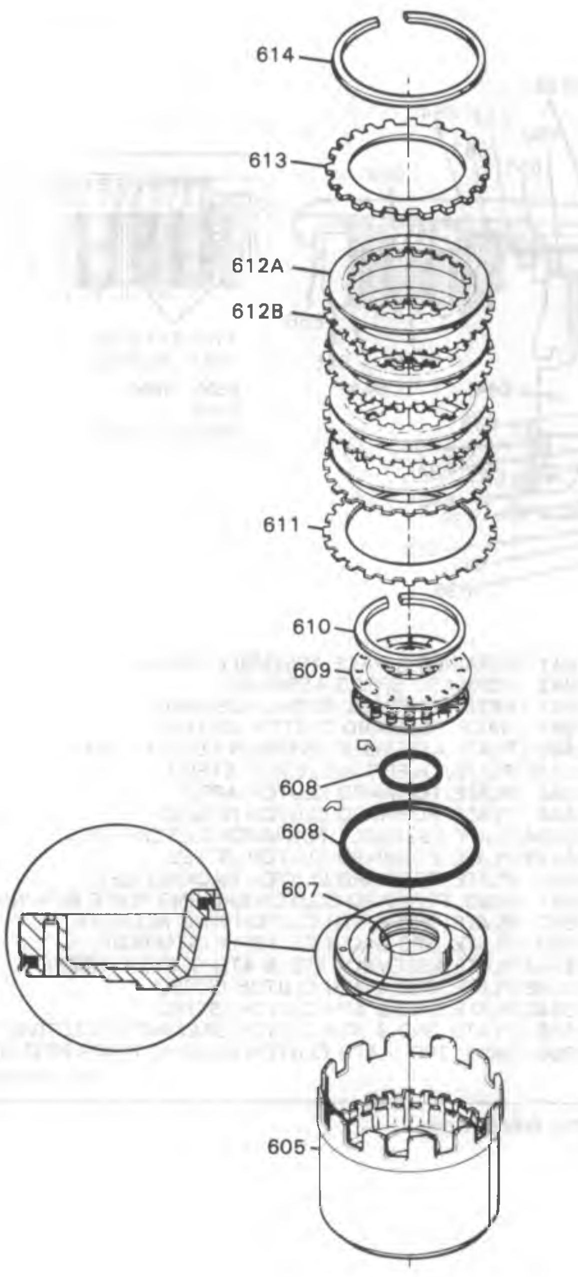
1. Retaining ring (614) from reverse input housing
2. Backing plate (613)
3. Clutch plates (612) and Belleville steel plate (611)
4. Install J 23327-1 and J 25018-A.
   - compress the spring assembly.
5. Spring assembly retainer ring (610) and spring assembly (609)
6. Reverse input clutch piston (607)
   - inner and outer lip seals (608)



600 SPRING ASM., BOOST 3-4 CLUTCH
619 RING, OIL SEAL (TURBINE SHAFT)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, "O" RING INPUT TO FORWARD HSG.
623 PISTON, 3RD & 4TH CLUTCH
624 SEAL, 3RD & 4TH CL. (INNER & OUTER)
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEAL, FORWARD CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER & OUTER)
632 PISTON, OVERRUN CLUTCH
634 SPRING ASSEMBLY, OVERRUN CLUTCH
635 SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RETAINING
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
645A PLATE ASSEMBLY, OVERRUN CLUTCH (FIBER)
645B PLATE, OVERRUN CLUTCH (STEEL)
646 PLATE, FORWARD CLUTCH APPLY
648 PLATE, FORWARD CLUTCH (WAVED)
649A PLATE ASSEMBLY, FORWARD CLUTCH (FIBER)
649B PLATE, FORWARD CLUTCH (STEEL)
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
652 PLATE, 3RD & 4TH CLUTCH RING RETAINER
653 PLATE, 3RD & 4TH CL. APPLY (STEPPED)
654A PLATE ASSEMBLY, 3RD & 4TH CLUTCH (FIBER)
654B PLATE, 3RD & 4TH CLUTCH (STEEL)
654C PLATE, 3RD & 4TH CLUTCH (STEEL)
655 PLATE, 3RD & 4TH CLUTCH BACKING (SELECTIVE)
656 RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

LH0138-4L60

Figure 80 Input Clutch Assembly



ILL. NO. DESCRIPTION
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607 PISTON ASM., REVERSE INPUT CLUTCH
608 SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
609 SPRING ASM., REVERSE INPUT CLUTCH
610 RING, REVERSE INPUT CLUTCH SPRING RETAINER
611 PLATE, REVERSE INPUT CL. (BELLEVILLE)
612A PLATE ASM., REVERSE INPUT CLUTCH (FIBER)
612B PLATE, REVERSE INPUT CLUTCH (STEEL)
613 PLATE, REVERSE INPUT CLUTCH BACKING
614 RING, REVERSE INPUT CL. RETAINING

LH0139-4L60

Figure 81 Reverse Input Clutch Assembly

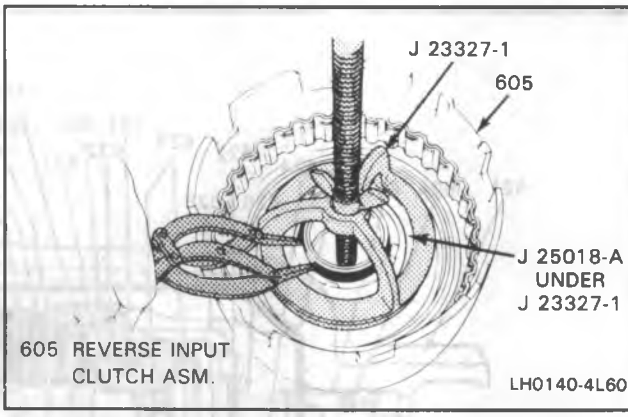
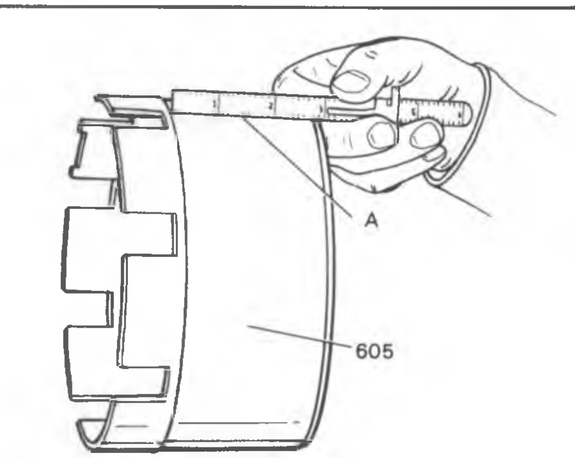


Figure 82 Reverse Input Retainer Ring — Removal

Inspect

Figures 81 and 83

- Backing plate (613) for:
  - — damage
  - — distortion or flatness
  - — burrs or surface finish damage
- Clutch Plates (612) for:
  - — composition plate tang damage, delamination, or wear
  - — steel plate tang damage, wear, or heat damage
- Spring assembly (609) for distortion or damage
- Piston (607) for:
  - — damage or porosity
  - — ring groove damage
- Housing and drum assembly (605) for:
  - — damaged or worn bushings (603 and 606)
  - — surface on the hub and outer housing
  - — leak at the weld



A CHECK FOR DISHING AT THIS POINT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH

LH0141-4L60

Figure 83 Check Reverse Input Housing For Dishing

Assemble

Figures 81, 82, 84, 85 and 86

Tools Required:

J 23327-1 Clutch Spring Compressor
J 25018-A Clutch Spring Compressor Adaptor

1. Inner and outer seals (608) on the piston
   - lips must face away from the hub as shown.
   - lubricate with transmission fluid.
2. Piston (607) into the housing and drum assembly
   - use an 8 mm feeler gage to position the lip seals.
   - use care not to damage the seals.
3. Spring assembly (609)
   - large opening in the assembly goes towards the piston.
4. Install J 23327-1 and J 25018-A.
   - compress the spring assembly
   - install the retainer ring (610).
5. Belleville steel clutch plate (611)
6. Clutch plates (612). (4 steel and 4 composition plates required)
   - start with a steel and alternate with composition
7. Backing plate (613)
   - chamfered side up
8. Retaining ring (614)

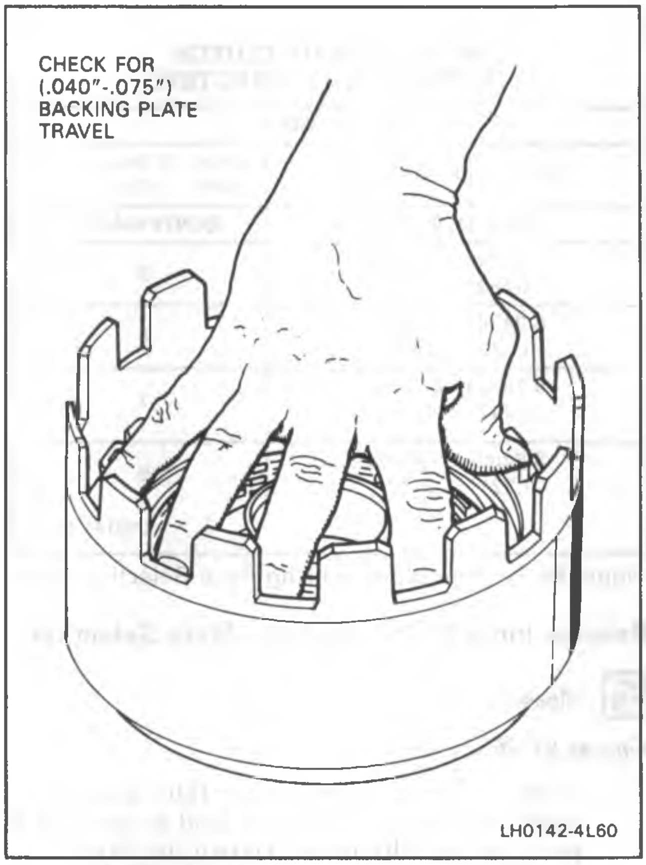


Figure 84 Reverse Input Backing Plate Selection

REVERSE INPUT CLUTCH

	NO.	THICKNESS
BELLEVILLE PLATE	1	2.311mm (.091") 2.210mm (.087")
FLAT STEEL CLUTCH PLATE	4	2.045mm (.081") 1.892mm (.075")
COMPOSITION FACED CLUTCH PLATE	4	1.880mm (.074") 1.730mm (.068")
BACKING PLATE	1	SELECTIVE

LH0143-4L60

Figure 85 Reverse Input Clutch Plate Chart

REVERSE INPUT CLUTCH BACKING PLATE SELECTION	
ALL MODELS	
BACKING PLATE TRAVEL = 1.02mm - 1.94mm (0.40" - .076")	
PLATE THICKNESS	IDENTIFICATION
7.60mm - 7.45mm (.299" - .293")	5
6.94mm - 6.79mm (.273" - .267")	6
6.28mm - 6.13mm (.247" - .241")	7
5.62mm - 5.47mm (.221" - .215")	8

LH0144-4L60

Figure 86 Reverse Input Backing Plate Selection Chart

Reverse Input Clutch Backing Plate Selection

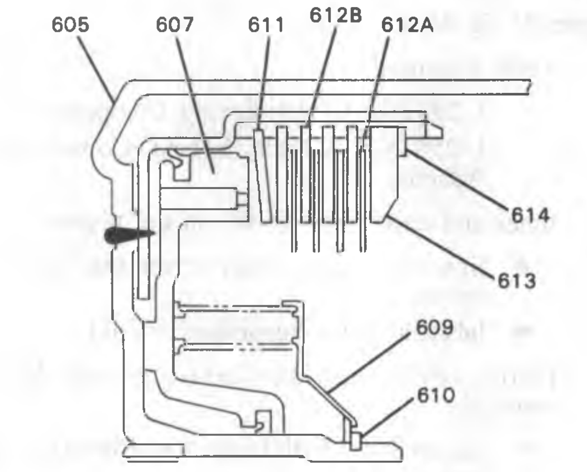
Measure

Figures 84, 85 and 86

1. With the reverse input clutch fully assembled, apply an evenly distributed load to the clutch pack in the direction shown in Figure 1. Medium pressure (approximately 89 N or 20 lbs.) on the backing plate applied by hand on five evenly distributed points will obtain the backing plate travel for measurement.

CAUTION: Excessive pressure will distort the Belleville plate resulting in an inaccurate measurement.

2. Using a feeler gage, measure between the snap ring and the backing plate. Backing plate travel should be 1.02 - 1.94 mm (.040 - .076").
3. Select the proper backing plate to obtain the specified travel.



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607 PISTON ASM., REVERSE INPUT CLUTCH
609 SPRING ASM., REVERSE INPUT CLUTCH
610 RING, REVERSE INPUT CLUTCH SPRING RETAINER
611 PLATE, REVERSE INPUT CL. (BELLEVILLE)
612A PLATE ASM., REVERSE INPUT CLUTCH (FIBER)
612B PLATE, REVERSE INPUT CLUTCH (STEEL)
613 PLATE, REVERSE INPUT CLUTCH BACKING
614 RING, REVERSE INPUT CL. RETAINING

LH0145-4L60

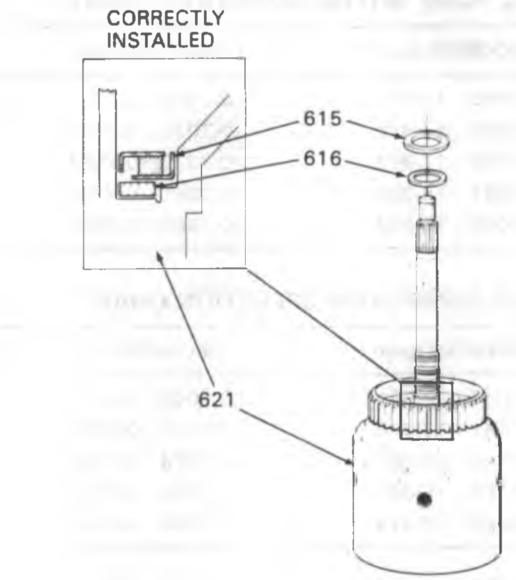
Figure 87 Reverse Input Clutch

Reverse Input and Input Clutches

Figures 88 and 89

Assemble

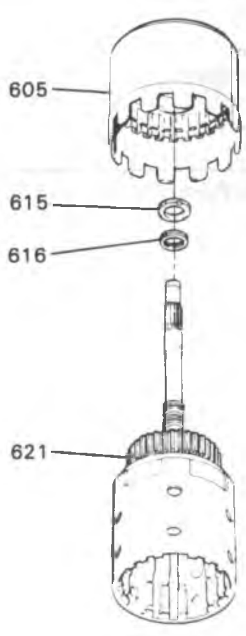
1. Selective thrust washer (616) onto the input housing
2. Bearing assembly (615)
   - inside (black race) goes toward the oil pump.
3. Reverse input clutch assembly (605) onto the input clutch assembly
   - index the reverse input clutch plates with the input clutch hub.
   - make certain all clutch plates are fully engaged.



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT

LH0146-4L60

Figure 88 Thrust Bearing and Selective Washer Location



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

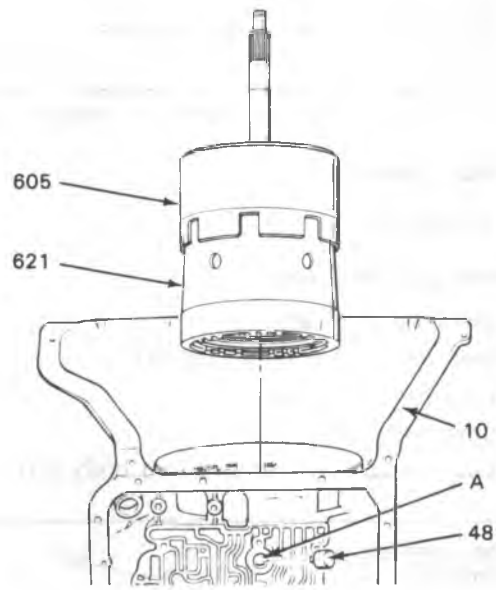
LH0112-4L60

Figure 89 Reverse Input and Input Clutches

Assemble

Figure 90

- Reverse input and input clutch assembly into the transmission case
  - — index the 3-4 clutch plates with the input internal gear.
  - — make sure all clutch plates are fully engaged.
  - — when properly assembled, the reverse input clutch housing will be located just below the case oil pump face.



A BAND ANCHOR PIN LOCATION
10 CASE, TRANSMISSION
48 PIN, BAND ANCHOR
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING & SHAFT ASSEMBLY, INPUT

LH0148-4L60

Figure 90 Installing Input Clutch

2-4 Band Assembly

Inspect

- 2-4 band assembly (602) for damage or wear

Assemble

Figure 90 and 91

1. Align the band anchor pin end with the case pin hole.
2. Band anchor pin (48) into the case
   - index the pin into the 2-4 band.

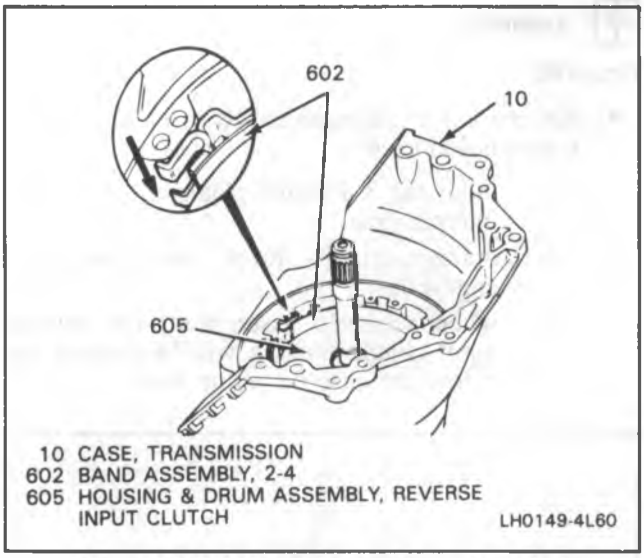


Figure 91 2-4 Band Assembly — Installed

Oil Pump Assembly

Figures 92 and 94

Remove or Disconnect

1. Thrust washer (601)
2. Pump cover to case gasket (9)
3. Pump to case oil seal (8)
4. Pump cover bolts (236)
5. Pump cover (217) from pump body (203)

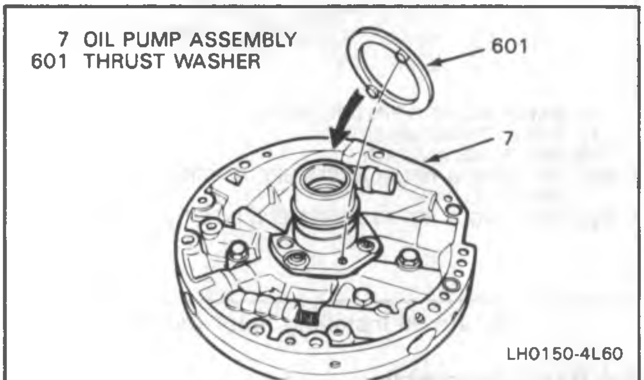


Figure 92 Oil Pump Thrust Washer Location

OIL PUMP ROTOR SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

OIL PUMP SLIDE SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

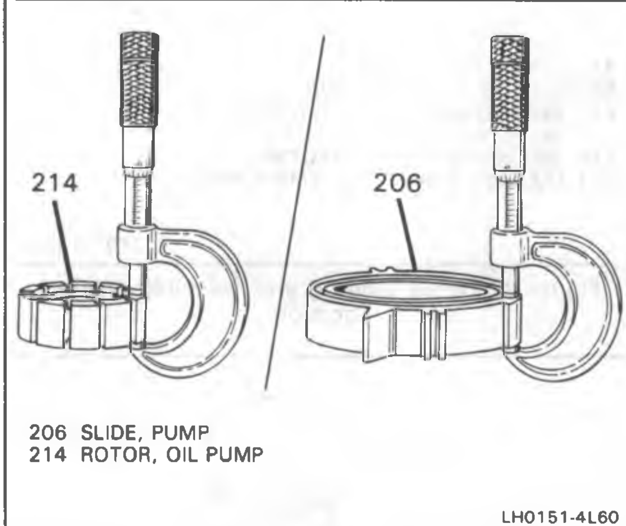
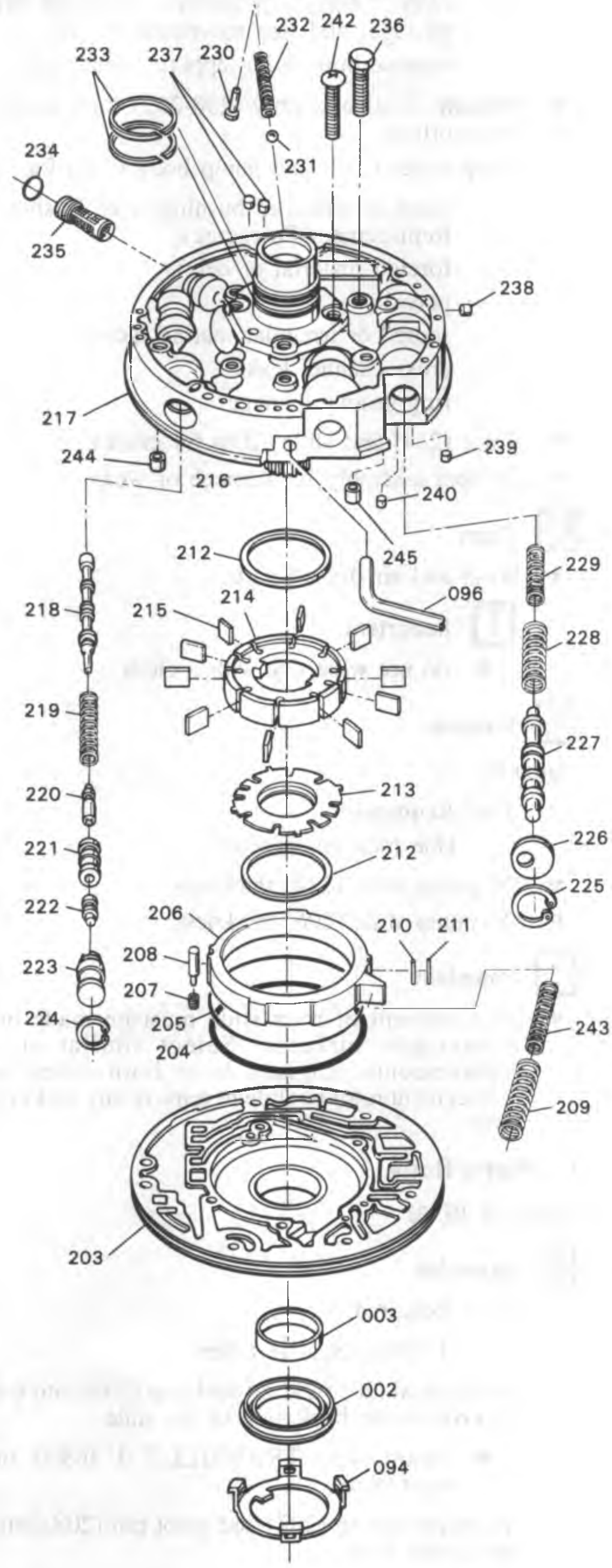


Figure 93 Oil Pump Rotor and Slide Selection



ILL. NO.	DESCRIPTION
002	SEAL ASSEMBLY, OIL
003	BUSHING, PUMP BODY
094	RETAINER, FRONT HELIX SEAL
096	TUBE, AUXILIARY ACCUMULATOR VALVE
203	BODY, PUMP
204	RING, OIL SEAL (SLIDE TO WEAR PLATE)
205	SEAL, "O" RING (SLIDE SEAL BACK-UP)
206	SLIDE, PUMP
207	SPRING, PIVOT PIN
208	PIN, PIVOT SLIDE
209	SPRING, PUMP SLIDE (OUTER)
210	SUPPORT, PUMP SLIDE SEAL
211	SEAL, PUMP SLIDE
212	RING, PUMP VANE
213	GUIDE, ROTOR
214	ROTOR, OIL PUMP
215	VANE, PUMP
216	SHAFT, STATOR
217	COVER, PUMP
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	VALVE, STOP
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)
230	RIVET, PRESSURE RELIEF BOLT
231	BALL, PRESSURE RELIEF
232	SPRING, PRESSURE RELIEF
233	RING, OIL SEAL (STATOR SHAFT)
234	SEAL, OIL PUMP COVER SCREEN
235	SCREEN, OIL PUMP COVER
236	BOLT, M8 x 1.25 x 40 (COVER TO BODY)
237	PLUG, OIL PUMP AIR BLEED
238	PLUG, OIL PUMP COVER
239	PLUG, OIL PUMP COOLER FEED
240	PLUG, OIL PUMP CONVERTER CLUTCH SIGNAL
242	SCREW, STATOR SHAFT (M6 x 1 x 16.0)
243	SPRING, PUMP SLIDE (INNER)
244	RETAINER & BALL ASSEMBLY, (REVERSE CLUTCH)
245	RETAINER & BALL ASSEMBLY, (OVERRUN CLUTCH)

LH0152-4L60

Figure 94 Oil Pump Assembly

Oil Pump Body

Figure 94

Disassemble

1. Pump slide spring (209)

   CAUTION: Spring is under very high pressure. Place covering over spring to prevent possible injury.

   - compress with needle nose pliers.
   - pull straight out.
2. From the pump pocket.
   - pump guide rings (212)
   - pump vanes (215)
   - pump rotor (214)
   - pump guide (213)
   - slide (206)
   - slide seal (211)
   - seal support (210)
   - pivot slide pin (208) and spring (207)
   - slide seal ring (204) and slide back up seal (205)
3. Retainer (94), oil seal assembly (2)
   - pry out with a screwdriver.

Oil Pump Cover

Figure 94 and 97

Disassemble

1. Converter clutch apply valve train
   - compress converter clutch apply valve spring (228) with a screwdriver.
   - remove retaining ring (225).
   - slowly release the spring tension.
   - stop valve (226), converter clutch apply valve (227), and two converter clutch valve springs.
2. Pressure relief ball (231)
   - ball is under strong spring pressure.
   - cover the ball with a cloth when removed.
3. Pressure regulator assembly (218-224).
   - follow the same procedure used to remove the converter clutch valve.

Inspect

Figure 94

- Pressure regulator valve assembly (218-224) and converter clutch apply valve assembly (225-229) for:
  - — chips, burrs, distortion, plugged oil passage, and free movement in bore
  - — remove burrs with lapping compound
- Pressure relief assembly (230-232) for damage or distortion
- Pump cover (217) and pump body (203) for:
  - — worn or damaged bushings (see Bushing Replacement Procedure)
  - — foreign material or debris
  - — porosity
  - — scored or irregular mating faces
  - — cross channel leaks
  - — ring groove damage
- Rotor (214) and slide (206) for cracks
- Oil seal assembly for damage or wear

Clean

- Wash and air dry all parts.

  Important

  - do not wipe dry with a cloth.

Measure

Figure 93

Tool Required:

One inch micrometer

- Oil pump rotor (214) thickness
- Oil pump slide (206) thickness

Important

- Measurement of rotor/slide must be made on undamaged surfaces. Select similar size replacements. Lightly hone both sides of replacement rotor or slide to remove any nicks or burrs.

Oil Pump Body

Figure 94, 95, 96

Assemble

Tool Required:

J 25016 Seal Installer

1. O-ring seal (205) and oil seal ring (204) into the groove on the back side of the slide
   - retain with TRANSJEL™ J 36850 or equivalent.
2. Pivot pin spring (207) and pivot pin (208) into the pump body
3. Slide (206)
   - index the notch in the slide with the pivot pin.

- the oil seal ring must face downward into the pump pocket.

4. Slide seal (211) and support (210)
5. Vane guide ring (212)
6. Rotor guide (213) onto the rotor
   - retain with TRANSJEL™ J 36850 or equivalent.
7. Rotor (214)
   - with guide toward the pump pocket.
8. Vanes (215)
9. Vane guide ring (212)
10. Pump slide spring (209)
11. Oil seal assembly (2), retainer (94).
    - use J 25016

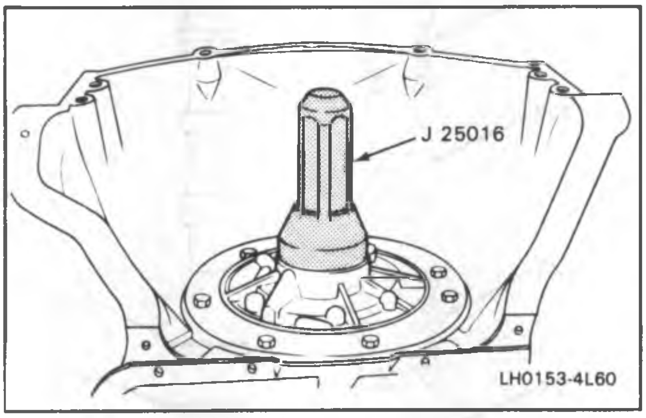


Figure 95 Oil Pump Seal

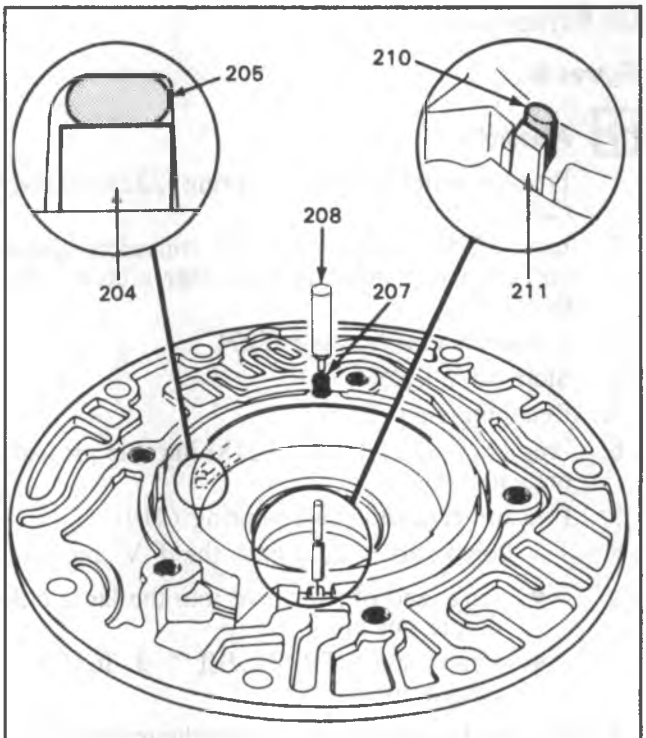


Figure 96 Slide Back Up and Slide Seal

Oil Pump Cover

Figures 94

Assemble

1. Pressure relief ball (231), spring (232) and rivet (230)
2. Inner (229) and outer (228) converter clutch valve springs into the converter clutch valve bore
3. Converter clutch valve (227)
4. Stop valve (226)
5. Retaining ring (225)
6. Pressure regulator valve (218) into the pressure regulator bore
7. Pressure regulator valve spring (219)
8. T.V boost valve (222) onto the T.V. bushing
   - long land of the valve into the large hole of the bushing.
   - retain with TRANSJEL™ J 36850 or equivalent.
9. Reverse boost valve (220) into the reverse boost valve sleeve
   - small end of the valve first.
   - retain with TRANSJEL™ J 36850 or equivalent.
10. Reverse boost valve sleeve (221) into the pressure regulator bore
11. T.V. boost valve sleeve (223) into the pressure regulator bore
12. Retainer ring (224)

Oil Pump Cover and Body

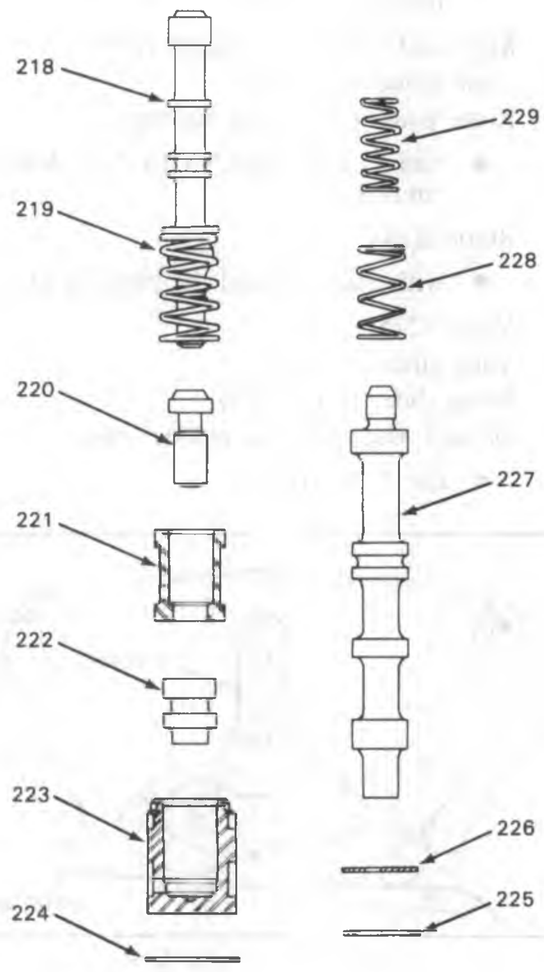
Figures 94, 98, 99 and 100

Assemble

Tools Required:

J 21368 Oil Pump Body and Cover Alignment Band

1. Oil pump cover (217) onto oil pump body
   - stator shaft through a bench hole.
2. Pump cover bolts (236)
   - leave finger tight.
3. Align pump cover and pump body with J 21368.
   - place a screwdriver through a bolt hole and into a hole in the bench.



ILL. NO.	DESCRIPTION
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	VALVE, STOP
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)

LH0155-4L60

Figure 97 Pressure Regulator and Converter Clutch Apply Valve Trains

Tighten

- Torque attaching bolts to 22 N·m (16 lb. ft.)

4. Pump to case gasket (9) onto case
   - retain with TRANSJEL™ J 36850 or equivalent.
5. Oil seal rings (233), if removed previously, onto the pump cover hub
   - retain with TRANSJEL™ J 36850 or equivalent.
6. Pump to case oil seal (8)
   — do not twist the seal.
   — lubricate with transmission fluid.
7. Thrust washer (601)

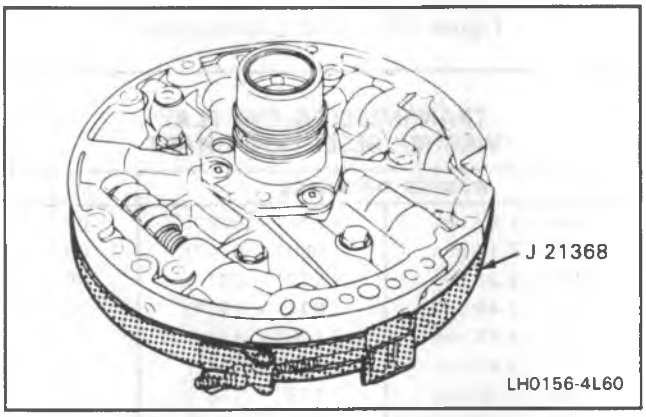


Figure 98 Oil Pump Alignment Band

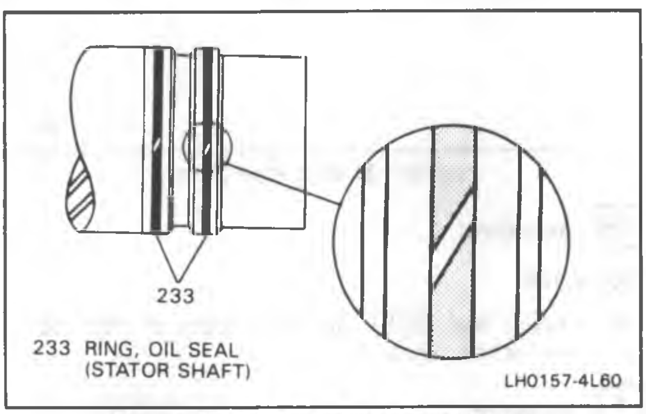


Figure 99 Oil Pump Hub Seal Rings

Install or Connect

Figure 101

Tools Required:

J 25025-1 Alignment Pins

1. J 25025-1 into the case as shown
2. Oil pump assembly into the case
   - align all holes properly.
3. Bolts and O-rings (5 and 6)

Tighten

- torque to 22 N·m (16 lb. ft.)

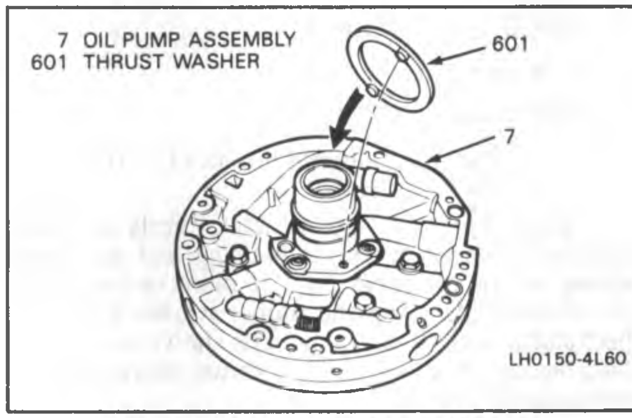


Figure 100 Oil Pump Thrust Washer

Important

- Rotate the transmission to a horizontal position. If the transmission is assembled properly the turbine shaft should turn by hand. If not identify and correct the misassembly now.

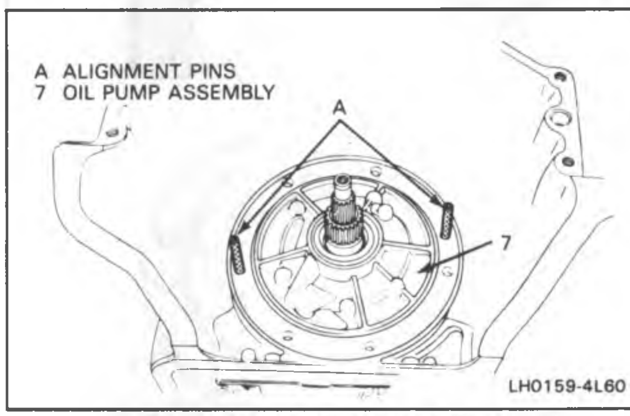


Figure 101 Oil Pump and Case

Transmission End Play Check

Figures 102, 103, 104 and 105

Measure

Tools Required:

J 24773-A End Play Checking Fixture

J 25022 End Play Checking Fixture Adaptor (245 mm)

J 34725 End Play Checking Fixture Adaptor (298 mm)

J 25025-7A Post or 278 mm (11 in.) Bolt and Nut

Dial indicator

1. Remove an oil pump to case bolt and install a 278 mm (11 in.) bolt and lock nut or J 25025-7A.
2. Install J 25022-A or J 34725 as shown.
3. Install J 24773-A as shown.
4. Install a dial indicator.
   - set to zero.
5. Pull up on J 24773-A.
   - End play should be 0.13 - 0.92 mm (.005 - .036").

The selective washer which controls end play is located between the input housing and the thrust bearing on the oil pump hub. If more or less end play is required, select the proper washer from the chart and install. If dial indicator shows no end play, the selective washer and thrust bearing have been misassembled.

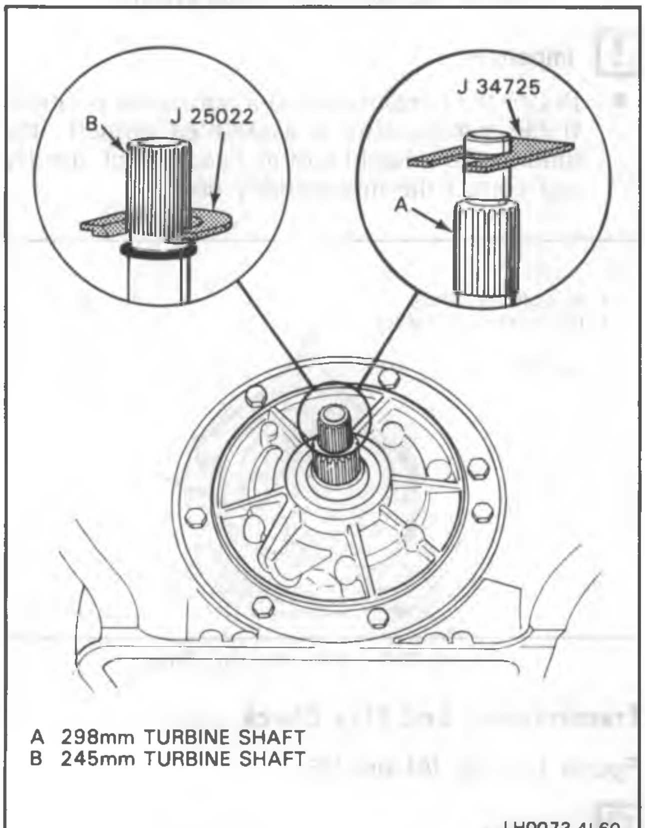


Figure 102 End Play Tool

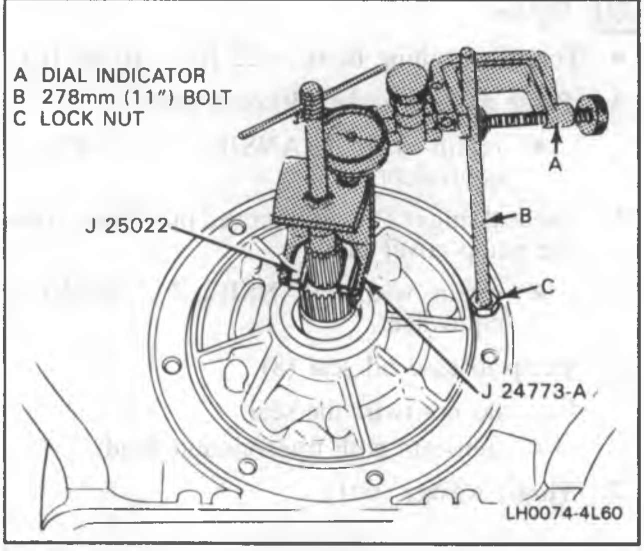


Figure 103 J 25022-A Installed

TRANSMISSION END PLAY WASHER SELECTION CHART

WASHER THICKNESS		I.D.
1.87 - 1.97 mm	(.074" - .078")	67
2.04 - 2.14 mm	(.080" - .084")	68
2.21 - 2.31 mm	(.087" - .091")	69
2.38 - 2.48 mm	(.094" - .098")	70
2.55 - 2.65 mm	(.100" - .104")	71
2.72 - 2.82 mm	(.107" - .111")	72
2.89 - 2.99 mm	(.113" - .118")	73
3.06 - 3.16 mm	(.120" - .124")	74

LH0162-4L60

Figure 104 End Play Chart

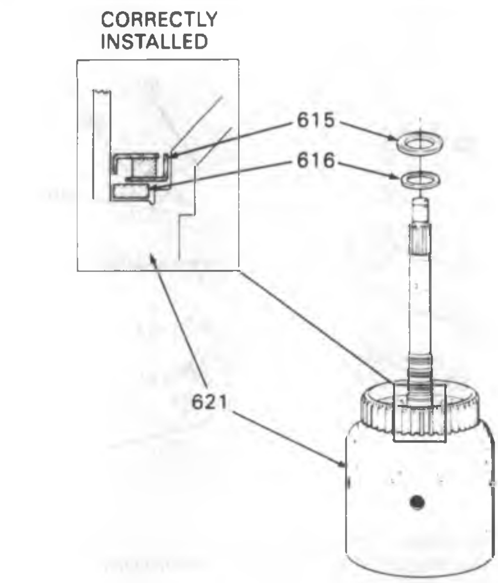
Assemble

Figure 106

- O-ring seal (618) into the groove in the end of the turbine shaft.

Important

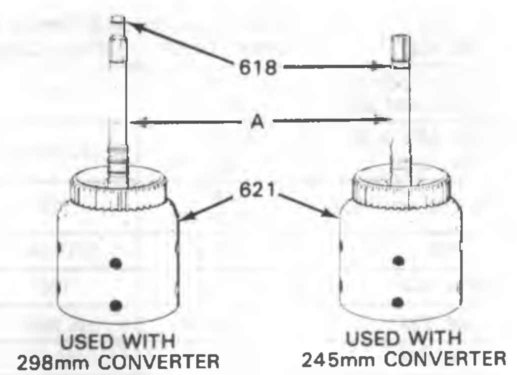
- There should be clearance between the reverse input clutch and the reaction sun gear shell. This clearance can be observed at the point shown in Figure 108. **Do not** try to shim the internal parts because of this clearance (Figure 107).



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT

LH0146-4L60

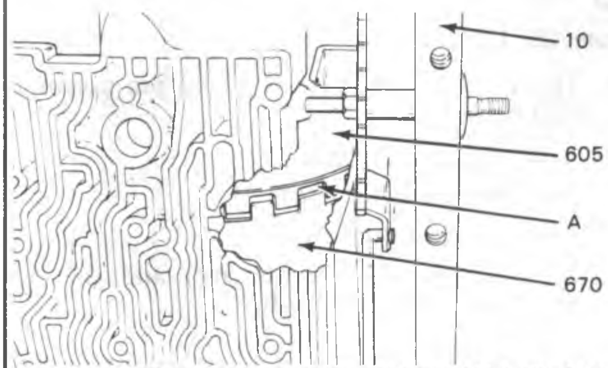
Figure 105 Selective Washer and Thrust Bearing Properly Installed



A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT

LH0117-4L60

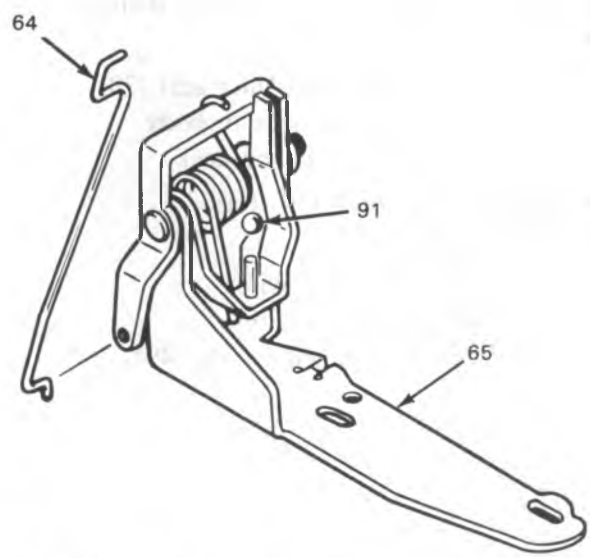
Figure 106 Turbine Shaft O-Ring Seal



A AS INSTALLED THESE TWO PARTS HAVE A NORMAL END CLEARANCE OF APPROX. 3.8MM (.150 IN.)
10 CASE, TRANSMISSION
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
670 SHELL, REACTION SUN

LH0165-4L60

Figure 107 Clearance Between Reverse Input Clutch and the Sun Gear Shell



64 THROTTLE LINK
65 LEVER AND BRACKET ASSEMBLY, THROTTLE
91 BALL, CARBON STEEL – T.V. EXHAUST (LOCATED IN VALVE BODY)

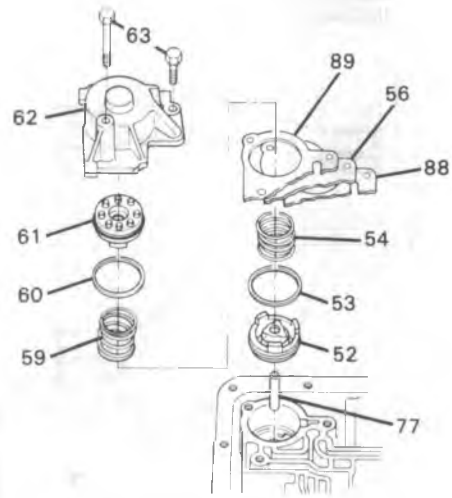
LH0166-4L60

Figure 108 Throttle Lever and Bracket Assembly

Inspect

Figure 109, 110 and 111

- The 1-2 accumulator cover and pin assembly (62) for:
  - — porosity or damage
  - — scored piston wall
  - — plugged oil passage
- 1-2 accumulator piston (61) and the 3-4 accumulator piston (52) for:
  - — porosity
  - — ring groove damage
  - — pin hole damage
- 1-2 accumulator spring (59) and 3-4 accumulator spring (54) for distortion or damage
- Spacer plate (56) and gaskets (88 and 89) for damage
- Checkballs (55) for damage
- T.V. link (64) for damage
- Manual detent spring (709) for damage
- Oil filter (71) for:
  - — cut or damaged filter seal (70)
  - — cracks in the neck or body
  - — casting flash in the neck
- Solenoid assembly (50) for:
  - — damage
  - — cut or pinched wires
  - — damaged connectors
  - — cut or damaged O-ring (49)



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUM. PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUM.
63 BOLT, ACCUMULATOR COVER
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

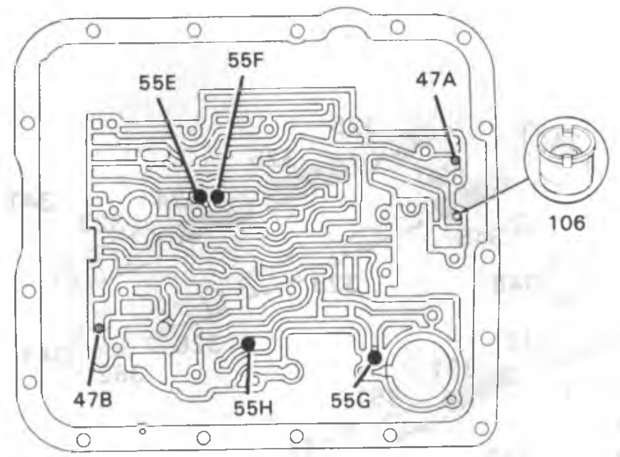
LH0066-4L60

Figure 109 1-2 and 3-4 Accumulator Assembly

1989 MODELS	1-2 ACCUMULATOR SPRING COLOR	3-4 ACCUMULATOR SPRING COLOR
CHM, CJM, KCM, LAM, LBM, LCM, LDM, LFM, RAM, WCM	ORANGE (LT. GREEN OPT.)	VIOLET
CAM, CBM, KAM, MJM, MNM, WAM	ORANGE (LT. GREEN OPT.)	DK. GREEN
CCM, CFM, FTM, KBM, WBM	ORANGE (LT. GREEN OPT.)	RED
FUM	YELLOW	YELLOW
MBM, SAM	YELLOW	RED
SHM, TLM	DK. GREEN	LT. BLUE
BAM, FZM	YELLOW	VIOLET
HBM, HFM, HHM	DK. GREEN	YELLOW
HDM	DK. GREEN	RED
BPM	DK. GREEN	ORANGE (LT. GREEN OPT.)
FBM, HCM	DK. GREEN	RED
DBM, YDM	YELLOW	ORANGE (LT. GREEN OPT.)
MSM	ORANGE (LT. GREEN OPT.)	YELLOW

LH0168-4L60

Figure 110 1-2 and 3-4 Accumulator Spring Chart



ILL. NO.	DESCRIPTION
47A	GOVERNOR FILTER LOCATION
47B	CONVERTER CLUTCH FILTER LOCATION
55E	#4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F	#8 CHECK BALL (2ND/1-2)
55G	#1 CHECK BALL (4TH ACCUMULATOR)
55H	#3 CHECK BALL (PART THROTTLE/DRIVE 3)
106	RETAINER & BALL ASM. (DOUBLE ORIFICE)

LH0072-4L60

Figure 111 Case Checkballs and Oil Screens — Location

Valve Body and Associated Parts

NOTICE: The use of a honing stone, fine sandpaper or crocus cloth is not recommended for servicing stuck valves. All valve lands have sharply machined corners that are necessary for "cleaning" the bore. If these corners are rounded, foreign material could wedge between the valve and bore causing the valve to stick.

If it is found necessary to clean a valve, "micro fine" lapping compound 900 grit or finer should be used.

Too much "lapping" of a valve will cause excessive clearances and increase the chance of a valve not operating.

Install or Connect

Figure 109

1. The 3-4 accumulator pin (77) into the case
2. The 3-4 accumulator piston seal (53) onto the 3-4 accumulator piston
3. The 3-4 accumulator piston (52) onto the pin
   - the end with three legs must face the valve body.
4. The 3-4 accumulator piston spring (54)

Install or Connect

Figure 111

Tool Required:

J 25025-5 Guide Pins

1. Governor and converter clutch oil screens (47)
2. Four checkballs (55) into the case as shown
   - retain with TRANSJEL ™ J 36850 or equivalent
3. J 25025-5 into the case
4. Spacer plate to case gasket (88)
   - gasket identified by a "C"
5. Spacer plate (56)
6. Valve body to spacer plate gasket (89)
   - gasket identified by a "V"

Control Valve Assembly

Clean

- Control valve assembly (67) thoroughly in clean solvent
  — move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
  — air dry

Disassemble

Figures 112 and 113

Position as shown on a clean surface

- Valve trains beginning with the upper left hand corner

  Important

  - some valves are under pressure — cover the bores while removing the roll pins
  - valves, springs and bushings must be laid out on a clean surface in the exact sequence they are removed
- Blind hole roll pins with a modified drill bit
- Pressure switches

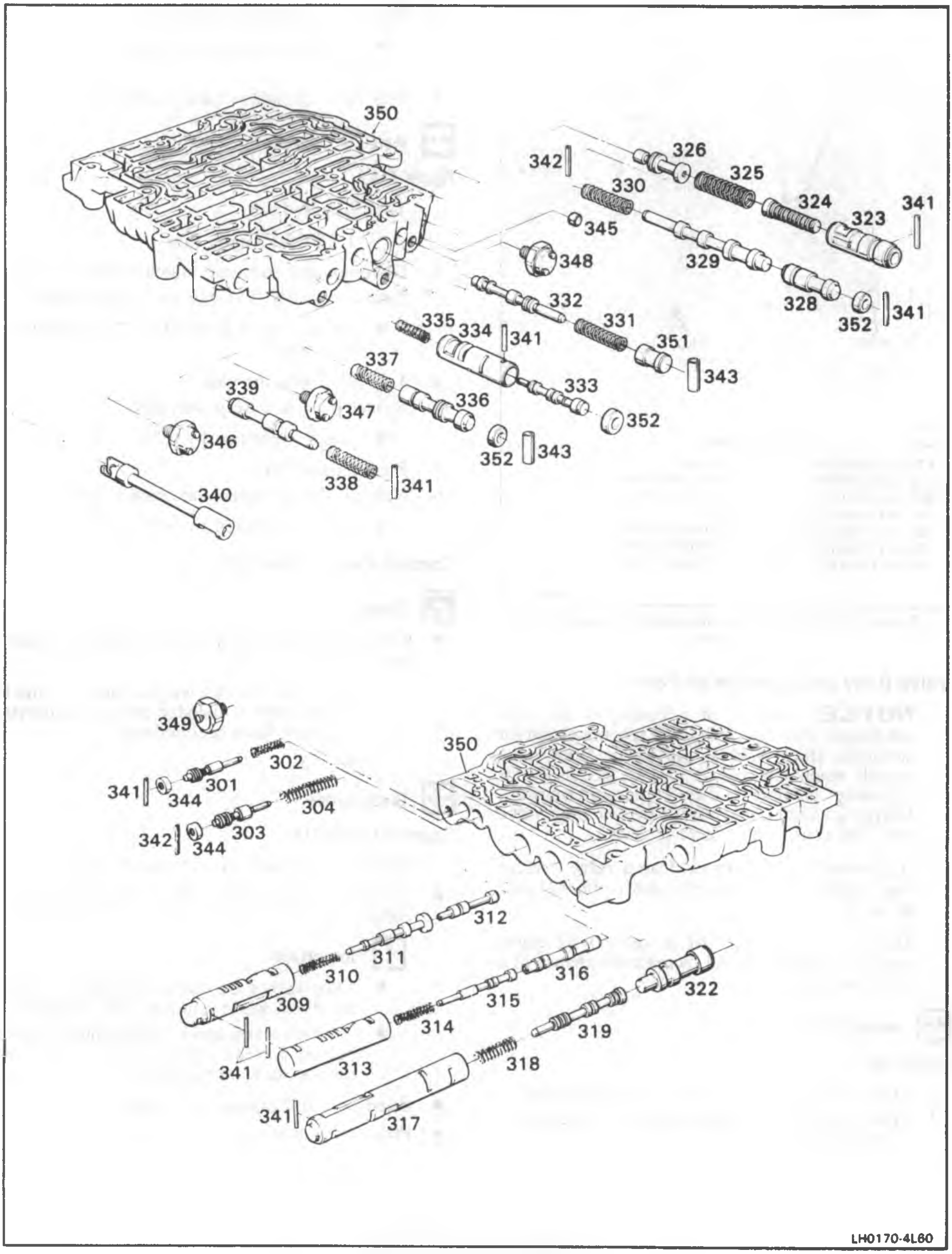


Figure 112 Control Valve Assembly

ILL. NO.	DESCRIPTION
301	VALVE, T.V. MODULATOR DOWNSHIFT
302	SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303	VALVE, T.V. MODULATOR UPSHIFT
304	SPRING, T.V. MODULATOR UPSHIFT VALVE
309	SLEEVE, 3-4 THROTTLE VALVE
310	SPRING, 3-4 THROTTLE VALVE
311	VALVE, 3-4 THROTTLE
312	VALVE, 3-4 SHIFT
313	SLEEVE, 2-3 THROTTLE VALVE
314	SPRING, 2-3 THROTTLE VALVE
315	VALVE, 2-3 THROTTLE
316	VALVE, 2-3 SHIFT
317	SLEEVE, 1-2 THROTTLE VALVE
318	SPRING, 1-2 THROTTLE VALVE
319	VALVE, 1-2 THROTTLE
322	VALVE, 1-2 SHIFT
323	SLEEVE, THROTTLE VALVE PLUNGER
324	PLUNGER, THROTTLE VALVE
325	SPRING, THROTTLE VALVE
326	VALVE, THROTTLE
328	VALVE, 3-4 RELAY
329	VALVE, 4-3 SEQUENCE
330	SPRING, 4-3 SEQUENCE VALVE
331	SPRING, T.V. LIMIT VALVE
332	VALVE, T.V. LIMIT
333	VALVE, 1-2 ACCUMULATOR
334	SLEEVE, 1-2 ACCUMULATOR VALVE
335	SPRING, 1-2 ACCUMULATOR VALVE
336	VALVE, LINE BIAS
337	SPRING, LINE BIAS VALVE
338	SPRING, 3-2 CONTROL
339	VALVE, 3-2 CONTROL
340	VALVE, MANUAL
341	PIN, COILED SPRING
342	PIN, COILED SPRING
343	RETAINER, SPRING (SLEEVE)
344	PLUG, VALVE BORE
345	PLUG, CUP (.33 DIA.)
346	SWITCH ASM., PRESSURE (3RD CLUTCH)
347	SWITCH ASM., PRESSURE (4-3 PULSE)
348	SWITCH ASM., PRESSURE (4TH CLUTCH)
349	SWITCH ASM., PRESSURE (T.C.C. SIGNAL)
350	BODY, CONTROL VALVE
351	PLUG, T.V. LIMIT
352	PLUG, VALVE BORE (12.5 - O.D.)

LH0171-4L60

Figure 113 Control Valve Assembly — Legend

Clean

- All valves, springs, bushings and control valve body in clean solvent
- Dry using compressed air

Inspect

- All valves and bushings for:
  - — porosity
  - — scoring
  - — nicks
  - — scratches
- Springs for damaged or distorted coils
- Valve body casting for:
  - — porosity
  - — cracks
  - — interconnected oil passages
  - — damaged machined surfaces

Assemble

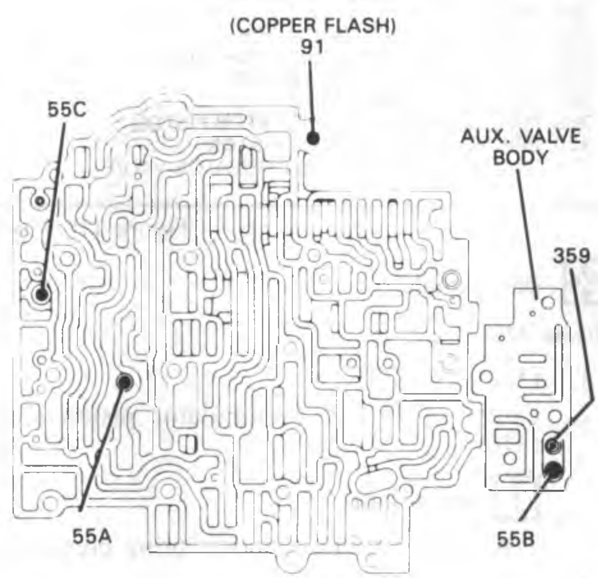
Figures 112 and 113

- Control valve assembly (67) exactly as shown.
  - — notice the position of the valve lands and bushing passages.

Install or Connect

Figures 114 and 116

1. Three checkballs (55A), (55C), and (91) into the valve body assembly. Checkball (91) is the larger copper colored ball shown in Figure 114.
   - retain with TRANSJEL ™ J 36850 or equivalent.
2. Valve body assembly (67)
   - connect the manual valve link (705) to the inside detent lever (703).



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #12 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)
359 CUP PLUG – ORIFICE

LH0071-4L60

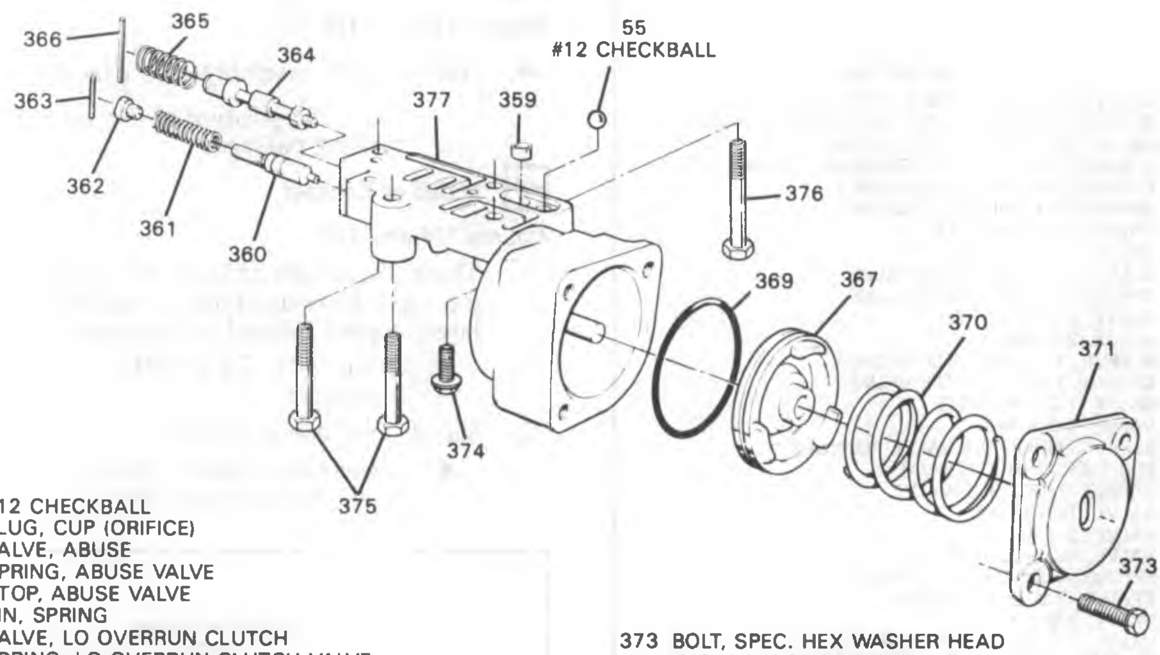
Figure 114 Valve Body Checkball Locations

Auxiliary Accumulator Valve Body Assembly

Figure 115

Clean

- Auxiliary valve assembly (377) thoroughly in clean solvent
  - — move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
  - — air dry



55 #12 CHECKBALL
359 PLUG, CUP (ORIFICE)
360 VALVE, ABUSE
361 SPRING, ABUSE VALVE
362 STOP, ABUSE VALVE
363 PIN, SPRING
364 VALVE, LO OVERRUN CLUTCH
365 SPRING, LO OVERRUN CLUTCH VALVE
366 PIN, SPRING VALVE RETAINING
367 PISTON, ACCUMULATOR
369 RING, OIL SEAL ACCUMULATOR PISTON
370 SPRING, ACCUMULATOR PISTON
371 COVER, AUXILIARY ACCUMULATOR VALVE
373 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 24)
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 40)
376 BOLT, HEX HEAD (M6 X 1 X 45)
377 AUXILIARY ACCUM. VALVE BODY ASM.

LH0173-4L60

Figure 115 Auxiliary Valve Body Assembly

Disassemble

Figure 115

1. (3) Bolts (373)
2. Cover (371) and accumulator piston spring (370)

Important

- Cover (371) is under spring pressure

3. Piston (367)
4. Piston oil seal ring (53)

Disassemble

Figure 115

Position the auxiliary accumulator valve body on a clean surface. Remove valve trains beginning with the lower left hand corner. NOTE: valves are under pressure-cover bores while removing the roll pin.

Important

- Valves and springs must be laid out on a clean surface in the exact sequence as they are removed

Clean

- All valves and springs in clean solvent
- Air dry

Inspect

- Piston (367) for:
  - cracks
  - porosity
  - damage
- Valves for:
  - scoring
  - nicks
  - scratches
- Springs for damaged or distorted coils
- Auxiliary valve body (377) for:
  - porosity
  - damaged machined surfaces
- Orifice cup plug (359)
  - replace only if damaged

Remove or Disconnect

Tool Required:

#3 Screw Extractor

- Orifice cup plug (359). Use modified #3 screw extractor.

Install or Connect

Tool Required:

9.5 mm (3/8 in.) rod

- Orifice cup plug (359). Use 9.5 mm (3/8 in.) rod.
  — seat flush

Assemble

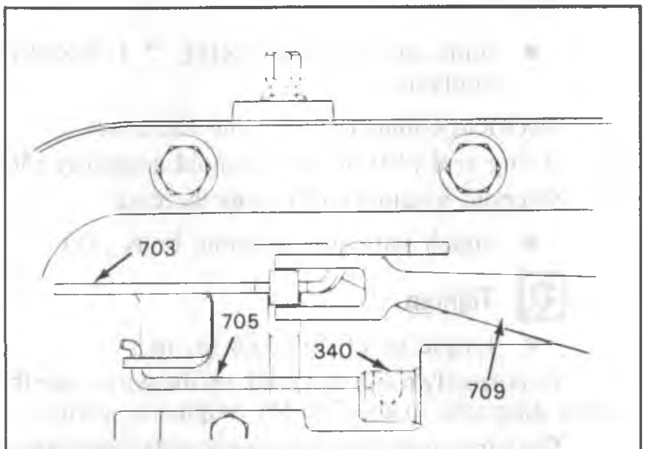
Figure 115

- Auxiliary accumulator valve train exactly as shown. Notice the valve lands

Assemble

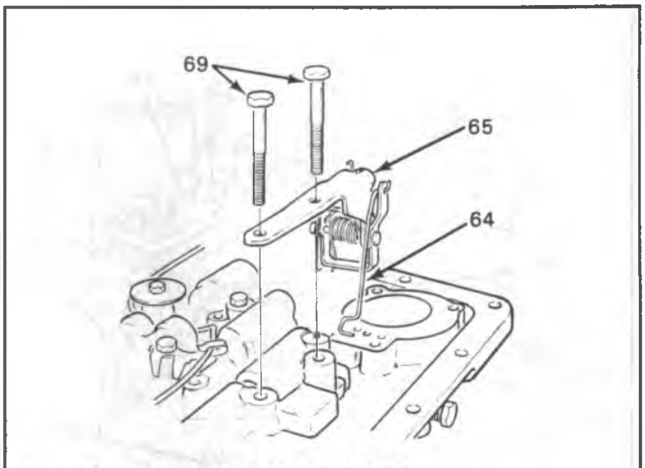
Figure 115

1. Piston oil seal ring (369) onto piston (367)
   - lubricate with TRANSJEL™ J 36850 or equivalent
2. Piston (367)
3. Accumulator spring (370)
4. Cover (371) and (3) bolts (373)



340 VALVE, MANUAL
703 LEVER, DETENT (INNER)
705 LINK, MANUAL VALVE
709 SPRING ASSEMBLY, MANUAL DETENT
LH0067-4L60

Figure 116 Manual Valve Link



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY
LH0068-4L60

Figure 117 T.V. Lever and Bracket

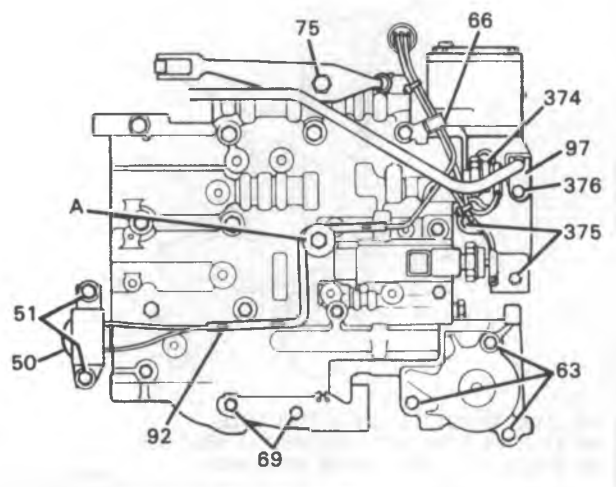
Install or Connect

Figures 115, 118 and 119

1. Check ball (55B) into auxiliary accumulator valve body (377) as shown in Figure 115.
   - do not block orifice cup plug
   - retain with TRANSJEL ™ J 36850 or equivalent
2. Auxiliary valve body (377)
3. Bolts (374) and (375) finger tight
4. Auxiliary accumulator valve tube (96)
5. Bolt (376) with tube clamp (97)

Tighten

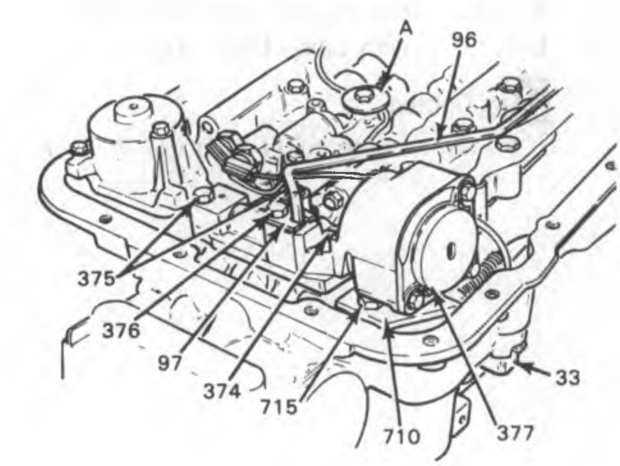
- torque bolts to 11 N·m (98 lb. in.)



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
92 CONDUIT, SOLENOID WIRE
97 CLAMP, AUXILIARY TUBE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 18)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

LH0065-4L60

Figure 118 Valve Body Bolt Locations



ILL. NO.	DESCRIPTION
A	WASHER, WIRE RETAINING
33	CONNECTOR, ELECTRICAL
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, AUXILIARY TUBE
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUM. VALVE BODY ASM.
710	BRACKET, PARKING LOCK
715	BOLT, PARKING LOCK BRACKET

LH0069-4L60

Figure 119 Outside Electrical Connector

Inspect

Figure 108

- Throttle lever and bracket assembly (65) for
  - — sticking, binding or damage
- Make sure it operates freely
- Replace if necessary

Install or Connect

Figures 117, 118 and 119

1. T.V. link (64) onto the T.V. lever and bracket as shown
2. T.V. lever and bracket assembly (65) onto the valve body as shown
   - attach with two valve body to case bolts (69)
3. Wire harness clips (66), manual spring assembly (68), wire retaining washer, and all remaining valve body to case bolts (69)

   Tighten
   - torque to 11 N·m (98 lb. in.)
4. O-ring seal (34) onto the electrical connector (33)
   - lubricate with TRANSJEL ™ J 36850 or equivalent.
5. Electrical connector (33) into the case
6. O-ring seal (49) on the solenoid assembly (50)
7. Solenoid assembly (50) into the case
   - attach with two solenoid bolts (51)

   Tighten
   - torque to 11 N·m (98 lb. in.)

To correctly route and hook up the wires, see the wiring diagrams in the 700-R4 diagnosis section.

The wire connectors are color coded to correspond to the information in the wiring diagram. On switches which take two connectors, the terminals are reversible. It will be necessary to identify and use the wiring diagram chart which corresponds to the model you are working on. (See the Diagnosis Section for the wiring diagrams.)

Install or Connect

Figures 109, 117 and 118

1. Parking bracket (710)

   Tighten
   - torque to 22 N·m (16 lb. ft.)
2. The 1-2 accumulator piston seal (60) onto the 1-2 accumulator piston (61)
3. The 1-2 accumulator piston (61) into the 1-2 accumulator cover and pin assembly (62)

- the three legs on the piston must face up toward the case when installed.

4. The 1-2 accumulator spring (59) onto the piston
5. The 1-2 accumulator cover and pin assembly (62) onto the case

Tighten

- torque to 11 N·m (98 lb. in.)

Install or Connect

Figure 120

1. Filter seal (70) onto the oil filter
   - lubricate with TRANSJEL ™ J 36850 or equivalent.
2. Oil filter (71)
3. Oil pan gasket (72)
4. Chip magnet (93) onto oil pan (73)
5. Oil pan (73) and bolts (74)

Tighten

- torque to 16 N·m (12 lb. ft.)

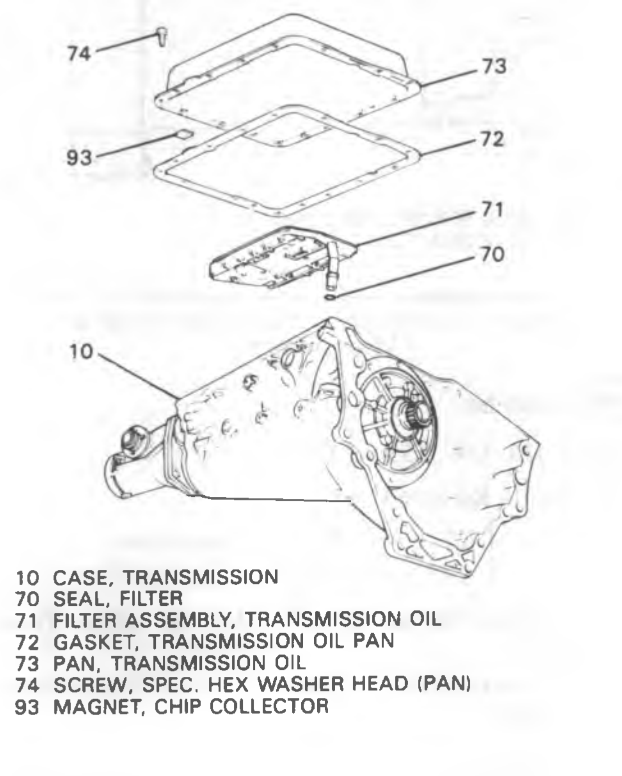


Figure 120 Case, Pan and Filter Assembly

2-4 Servo Assembly

Figure 121

Measure

Tool Required:

J 33037 Band Apply Pin Tool

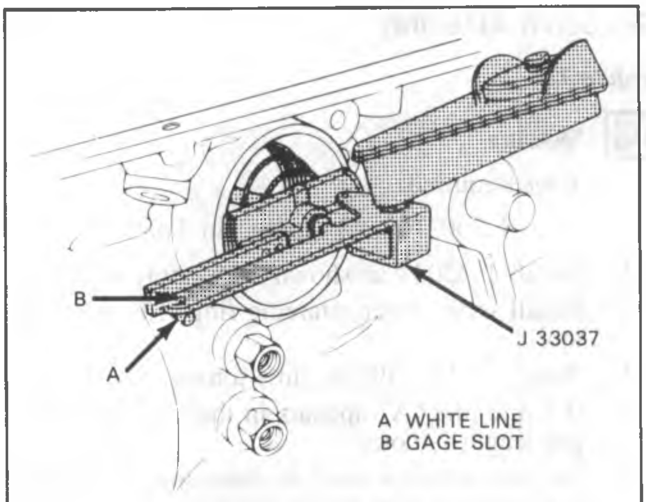
1. Install J 33037 as shown with apply pin (29).
2. Install servo cover retaining ring (13) to secure tool.
3. Apply 11 N·m (98 lb. in.) torque.
4. If white line "A" appears in the gage slot "B", pin length is correct.
5. Use pin selection chart to determine the correct pin length if new pin is needed.

Inspect

- Pistons for:
  — porosity or damage
  — ring groove damage
- Cover (15) for porosity or damage
- Seals for:
  — nicks or cuts
  — freeness in the seal groove
- Springs for distortion
- Pin for wear or burrs

Important

- Check servo bore in the case for any wear which may cut the servo seals.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION		
PIN LENGTH		PIN I.D.
mm	INCH	
66.37 - 66.67	2.61 - 2.62	2 RINGS
67.74 - 68.04	2.67 - 2.68	3 RINGS
69.11 - 69.41	2.72 - 2.73	WIDE BAND

LH0060-4L60

Figure 121 Servo Pin Length

Measure

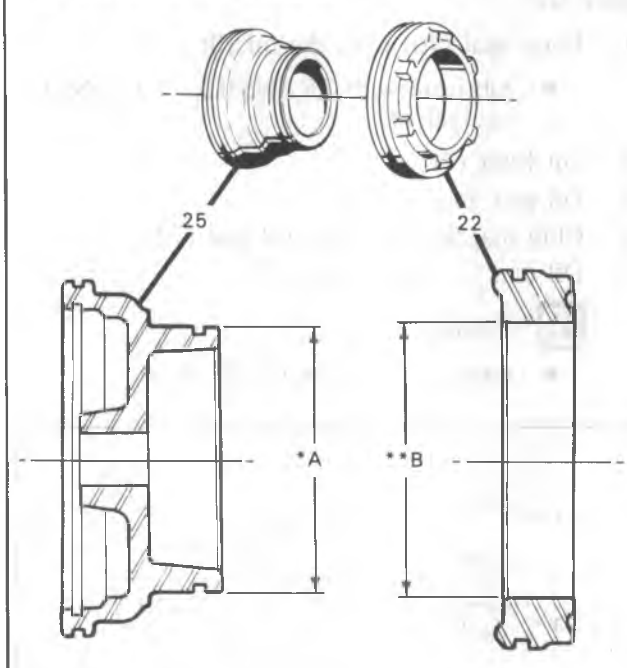
Figure 122

Tools Required:

Vernier calipers
Scale

1. Measure piston (25) dimension *A
2. Measure housing (22) dimension **B
3. Check model application

2ND APPLY PISTON & HOUSING APPLICATION		
MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
YDM	44.64 mm (1.78")	45.54 mm (1.79")
CHM, CJM, DBM, FUM, FZM, HBM, HFM, HHM, KCM, LAM, LBM, LCM, LDM, LFM, RAM, WCM	57.85 mm (2.28")	58.74 mm (2.31")
BAM, BPM, CAM, CBM, CCM, CFM, FBM, FTM, HCM, HDM, KAM, KBM, MBM, MJM, MNM, MSM, SAM, SHM, TLM, WAM, WBM	63.10 mm (2.48")	64.00 mm (2.52")



22 HOUSING, SERVO PISTON (INNER)
25 PISTON, 2ND APPLY

LH0180-4L60

Figure 122 2nd Apply Piston and Housing Measurement

Assemble

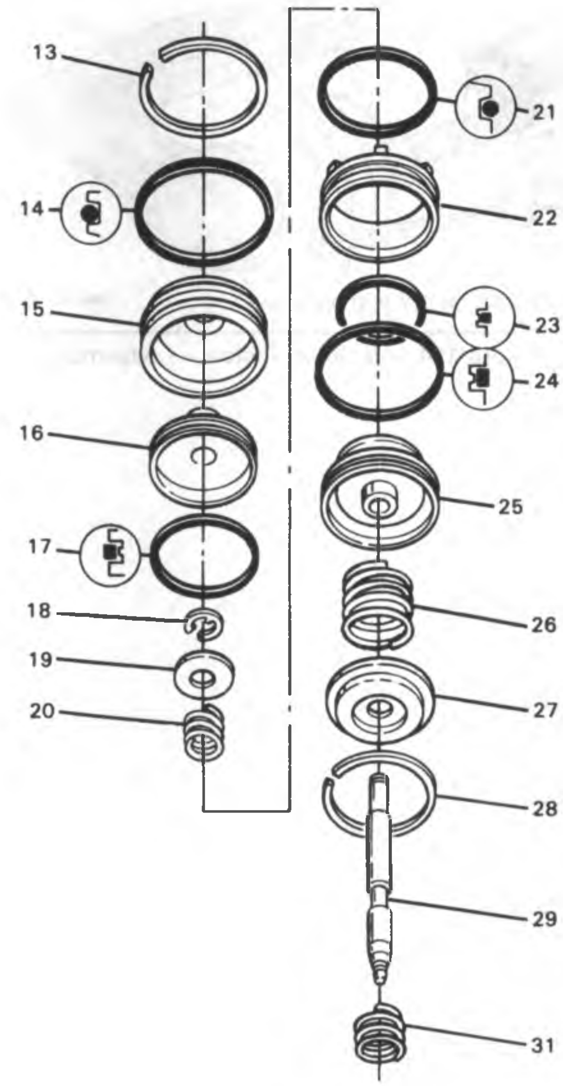
Figures 123, 124, 125 and 126

Tools Required:

J 22269-01 Piston Compressor
J 29714 Servo Cover Compressor

1. Cushion spring (26) into the 2nd apply piston (25)
2. Cushion spring retainer (27) on the cushion spring

3. Install J 22269-01.
   - compress the retainer past the snap ring groove in the 2nd apply piston.
   - install the retainer ring (28).
4. The 2nd apply piston (25) onto the apply pin (29)
   - retainer goes toward the shoulder of the pin.
5. Servo apply pin spring (20) on the pin
6. Servo apply pin washer (19) and retaining clip (18)
7. Inner (23) and outer (24) seals on the 2nd apply piston
   - retain with TRANSJEL ™ J 36850 or equivalent
8. O-ring seal (21) on servo piston housing
9. Servo piston inner housing (22) on the 2nd apply piston
10. Seal ring (17) onto the 4th apply piston
11. The 4th apply piston (16) onto the apply pin
12. Return spring (31) on the pin
13. Servo piston assembly into the servo bore
14. O-ring seal (14) on the servo cover
    - lubricate the seal with transmission fluid.
15. Servo cover (15) into the servo bore
16. Install J 29714.
    - compress the servo cover.
    - install the retainer ring (13)



ILL. NO.	DESCRIPTION
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18	RING, RETAINER (APPLY PIN)
19	WASHER, SERVO APPLY PIN
20	SPRING, SERVO APPLY PIN
21	SEAL, "O" RING
22	HOUSING, SERVO PISTON (INNER)
23	RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25	PISTON, 2ND APPLY
26	SPRING, SERVO CUSHION
27	RETAINER, SERVO CUSHION SPRING
28	RING, RETAINER (2ND APPLY PISTON)
29	PIN, 2ND APPLY PISTON
31	SPRING, SERVO RETURN

LH0059-4L60

Figure 123 2-4 Servo Assembly

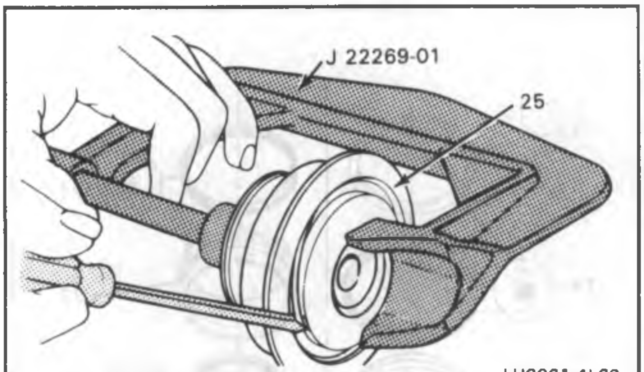


Figure 124 2nd Servo Piston — Assembly

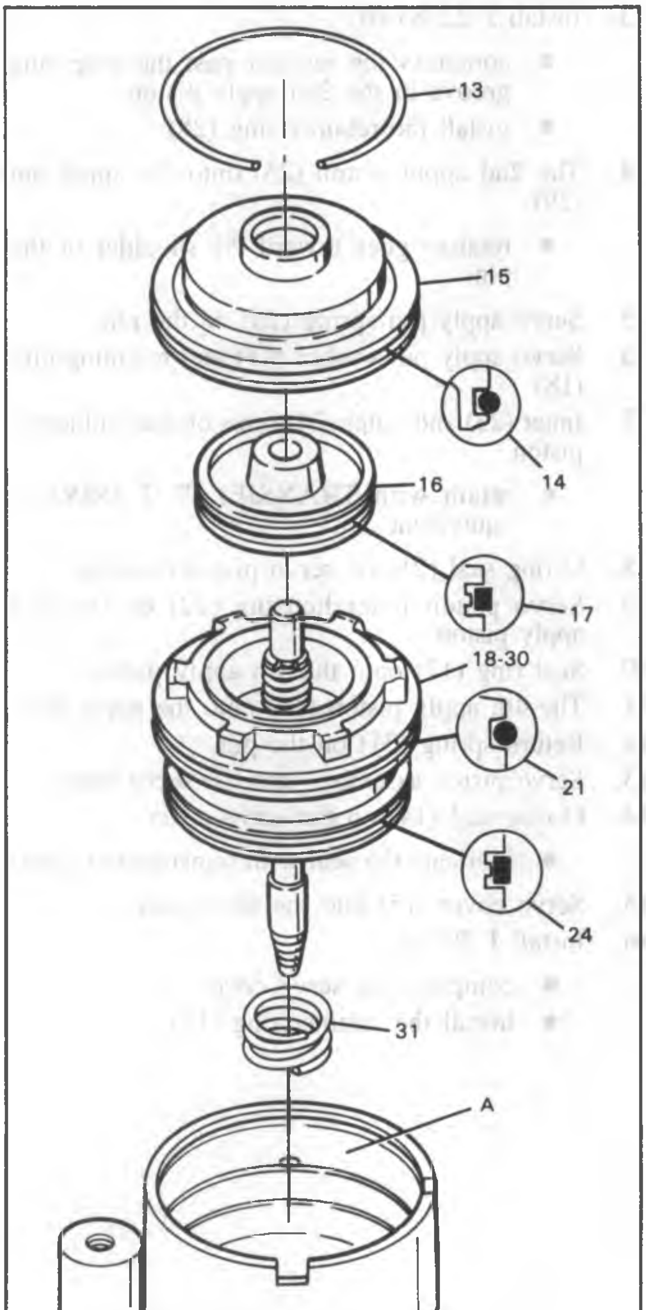


Figure 125 2-4 Servo Bore

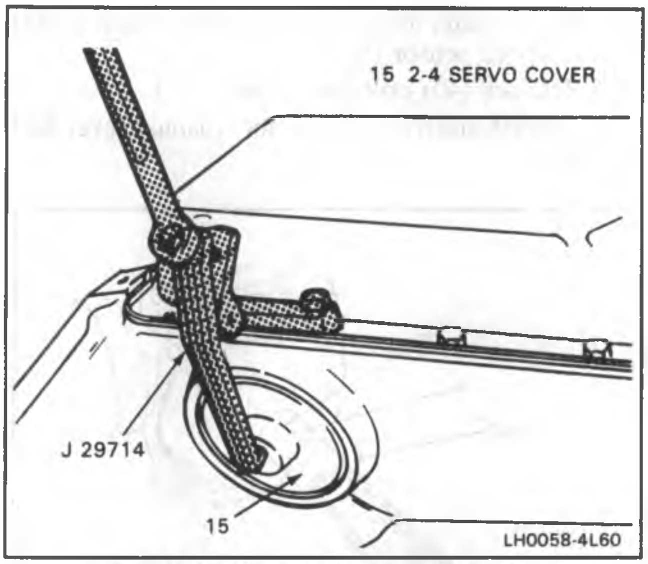


Figure 126 Servo Cover — Installed

Governor Assembly

Figure 127

Inspect

- Valve for free operation
- Weights for free operation
- Springs - missing or distorted
- Sleeve for nicks, burrs, scores or delamination
- Driven gear for damage

Disassemble

DO NOT DISASSEMBLE EXCEPT FOR CLEANING OR PART REPLACEMENT.

1. Cut off one end of each governor weight pin.
2. Pins (84)
3. Weights
4. Valve
5. Driven gear (83)
   - Drive out the retainer pin (82) with a small punch.
   - Support the governor assembly sleeve on plates installed in the exhaust slots. Push out the gear with an arbor press and a long punch.

Clean

- Wash all parts in solvent.
- Air dry and blow out passages.

Assemble

1. Install a new governor driven gear.
   - support the governor or plates through the exhaust slots.
   - press gear (83) into the sleeve until seated.
   - drill a new retaining pin hole in the sleeve ninety degrees from the existing hole. Use a 3.1 mm (1/8 in.) drill.
   - install retainer pin (82) and stake.
2. Valve into the sleeve
3. Weights, springs, and thrust cap onto the governor assembly
4. Retaining pins (84) into the thrust cap (85) and governor assembly
5. Stake the retaining pins (84).
6. Check for free operation of the valve and weights.

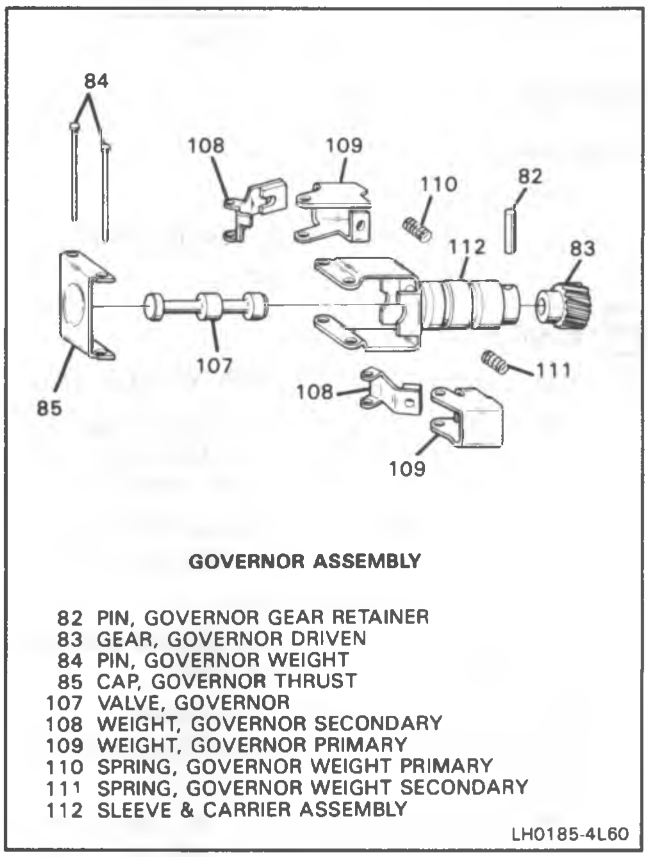


Figure 127 Governor Assembly

Install or Connect

Figures 127 and 128

1. Governor assembly (45) into the governor bore
2. Governor cover (46)

- apply sealant, such as Loctite cup plug sealant #11 or equivalent, to cover flange before installation.

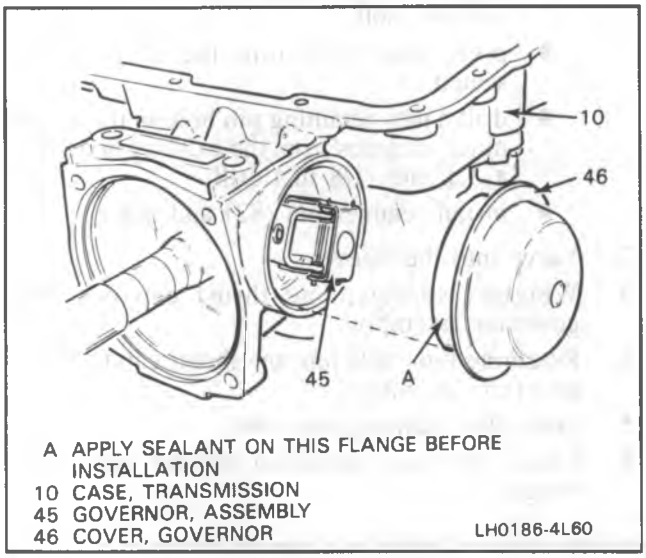


Figure 128 Governor Cover

Mechanical Speedometer

Figures 129 and 134

Tools Required:

J 23103 or J 25016 Seal Installer
J 21426 Seal Installer

Install or Connect

1. Speedometer drive gear (689) and clip (688)
   - if the output shaft has two speedometer locating holes, use the hole nearest the yoke spline for Corvette vehicles only.
2. O-ring seal (691) on the output shaft sleeve
3. Output shaft sleeve (690) on the output shaft
   - use J 25016 or J 23103
   - do not push the sleeve past the machined surface on the output shaft.
4. Seal ring (35) on the case extension
5. Case extension (36) and bolts (37) or, stud (100) and nut (98)
   - position extension so the speedometer bore is on the governor side of the case.

Tighten

- torque to 35 N·m (26 lb. ft.)

6. Remove case extension oil seal (39)
   - pry out with a screwdriver
   - install new seal with J 21426
7. Speedometer driven gear (44) and assembly (43) or speed sensor (99)
8. Retainer (40) bolt and washer (41)
9. Outside electrical connector, manual lever and nut

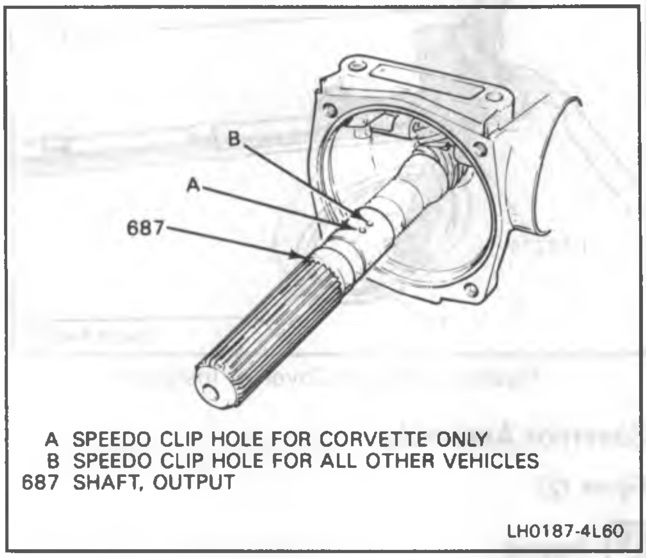


Figure 129 Speedometer Clip Holes

Torque Converter Assembly

Inspect

The torque converter assembly must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly
- Metal particles are found after flushing the cooler and cooler lines
- External leaks in hub weld area
- Converter pilot is broken, damaged or poor fit into crankshaft
- Converter hub is scored or damaged
- Internal damage to stator
- Contamination from engine coolant
- Excess end play

Measure

Figure 137

Tool Required:

J 35138 Torque Converter End Play Checking Tool

- Install J 35138 and measure end play
  — 0 - .5 mm (.000-.020") for 245 mm torque converters
  — 0 - .6 mm (.000-.024") for 298 mm torque converters

The Torque Converter should not be replaced

If:

- The fluid has an odor, discoloration or no evidence of metal or clutch plate material
  - drain out as much fluid as possible
  - replace the oil filter and pan gasket
  - fill to proper level (Refer to Section 7A)
- The converter bolt hole threads are damaged
  - correct with thread insert (Refer to Section 6A)

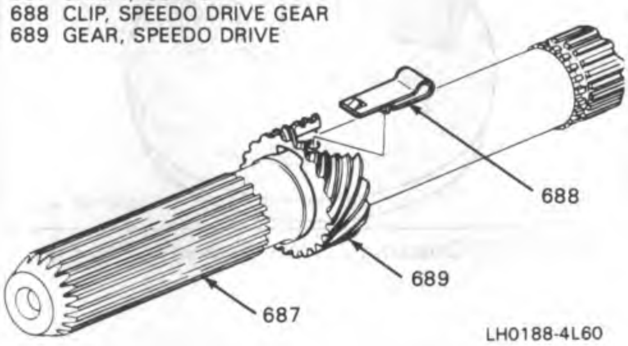
Important

- Flushing the torque converter is not recommended.

Install or Connect

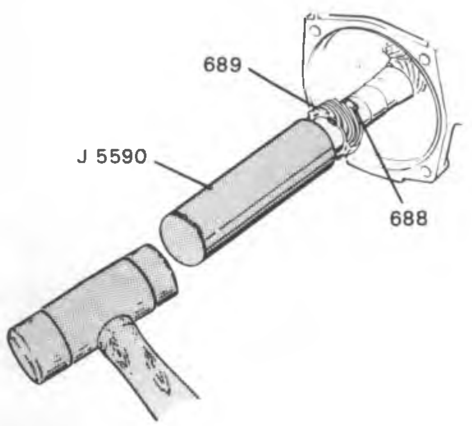
1. Torque converter
2. J 21366 converter holding strap
3. Remove transmission from holding fixture

687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE



LH0188-4L60

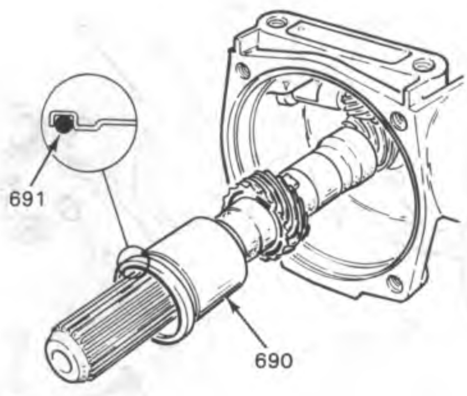
Figure 130 Speedometer Gear



688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE

LH0191-4L60

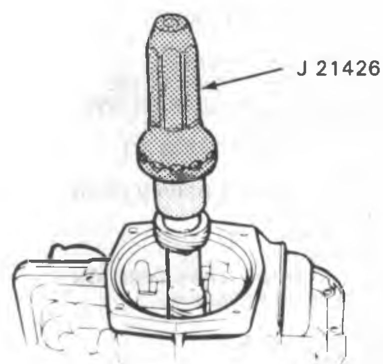
Figure 131 Speedometer Gear — Installation



690 SLEEVE, OUTPUT SHAFT
691 SEAL, OUTPUT SHAFT

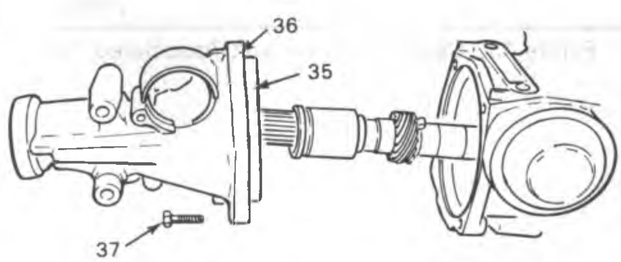
LH0189-4L60

Figure 132 Output Shaft Sleeve and Seal



LH0192-4L60

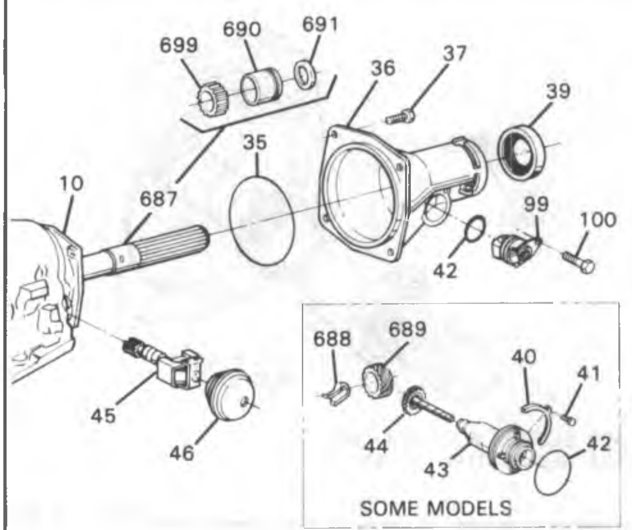
Figure 133 Output Shaft Sleeve — Installation



35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE
37 BOLTS, CASE EXTENSION

LH0190-4L60

Figure 134 Case Extension and Seal



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT NOT USED ON
691	SEAL, OUTPUT SHAFT ALL MODELS
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

LH0063-4L60

Figure 135 Case Extension and Associated Parts

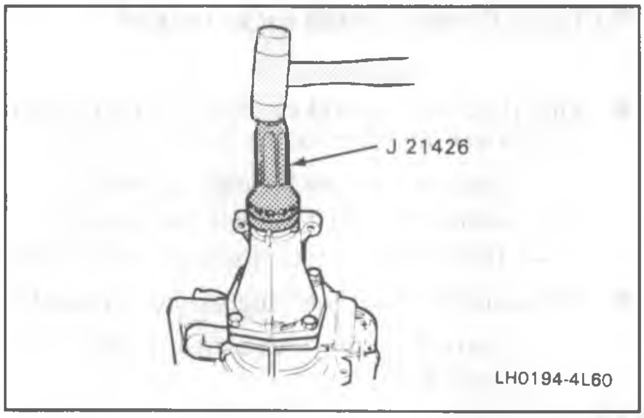


Figure 136 Case Extension Oil Seal Assembly

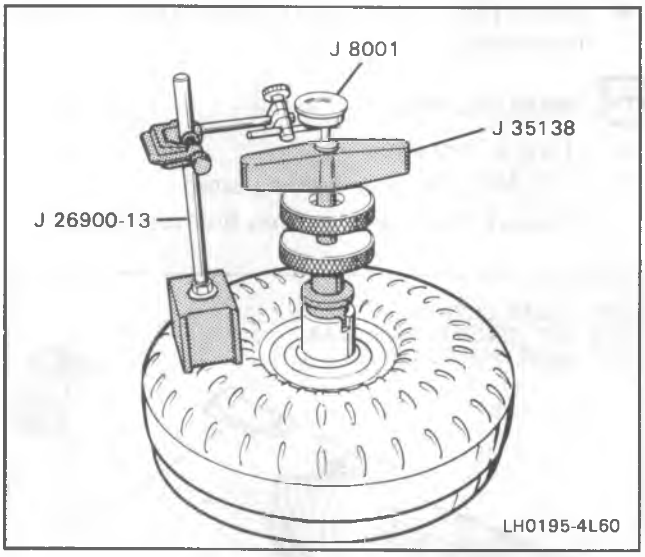


Figure 137 Checking Torque Converter End Play

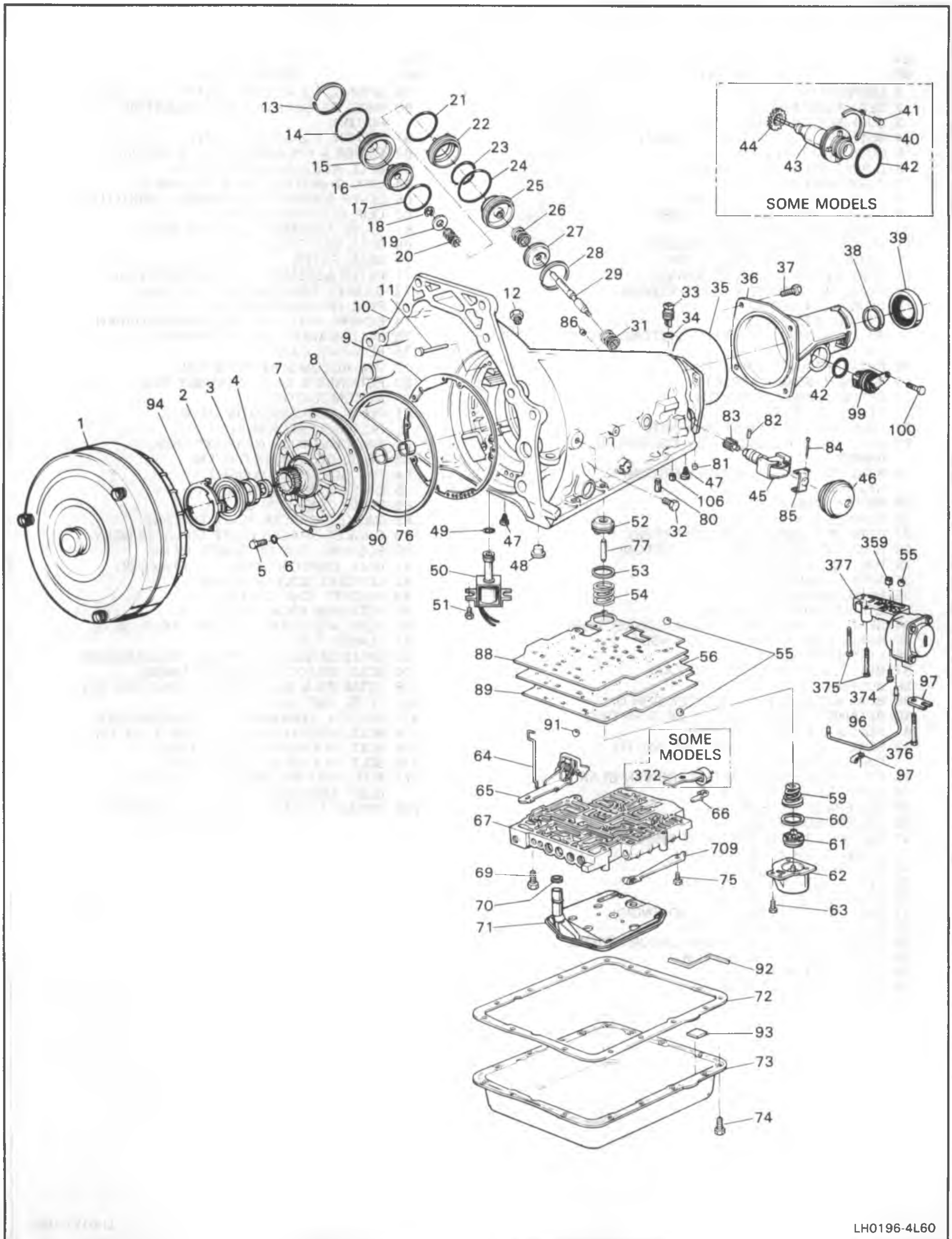


Figure 138 Case and External Parts

ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY
2	SEAL ASSEMBLY, OIL
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (FRONT)
5	BOLT, PUMP TO CASE
6	O-RING, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
11	VENT ASSEMBLY, TRANSMISSION
12	CONNECTOR, OIL COOLER PIPE
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18	RING, RETAINER (APPLY PIN)
19	WASHER, SERVO APPLY PIN
20	SPRING, SERVO APPLY PIN
21	SEAL, "O" RING
22	HOUSING, SERVO PISTON (INNER)
23	RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25	PISTON, 2ND APPLY
26	SPRING, SERVO CUSHION
27	RETAINER, SERVO CUSHION SPRING
28	RING, RETAINER (2ND APPLY PISTON)
29	PIN, 2ND APPLY PISTON
31	SPRING, SERVO RETURN
32	PLUG, PRESSURE
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING (ELECTRICAL CONNECTION)
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
38	BUSHING, CASE EXTENSION
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
47	SCREEN, TRANSMISSION OIL PRESSURE (CONVERTER & GOVERNOR)
48	PIN, BAND ANCHOR
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
51	BOLT, HEX WASHER HEAD (SOLENOID)
52	PISTON, 3-4 ACCUMULATOR
53	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54	SPRING, 3-4 ACCUMULATOR
55	BALL, .25 DIAMETER
56	PLATE, VALVE BODY SPACER

ILL. NO.	DESCRIPTION
59	SPRING, 1-2 ACCUMULATOR
60	RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61	PISTON, 1-2 ACCUMULATOR
62	COVER & PIN ASSEMBLY, 1-2 ACCUM.
63	BOLT, ACCUMULATOR COVER
64	LINK, THROTTLE LEVER TO CABLE
65	LEVER & BRACKET ASSEMBLY, THROTTLE
66	CLIP, ELECTRICAL WIRE
67	VALVE ASSEMBLY, CONTROL BODY
69	BOLT, VALVE BODY
70	SEAL, FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
74	SCREW, SPEC. HEX WASHER HEAD (PAN)
75	BOLT, MANUAL DETENT SPRING
76	BUSHING, CASE
77	PIN, ACCUMULATOR PISTON
80	RETAINER & BALL ASSEMBLY, 3RD ACCUMULATOR
81	PLUG, TRANSMISSION CASE (ACCUMULATOR BLEED)
82	PIN, GOVERNOR GEAR RETAINER
83	GEAR, GOVERNOR DRIVEN
84	PIN, GOVERNOR WEIGHT
85	CAP, GOVERNOR THRUST
86	PLUG, CASE SERVO
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
90	BUSHING, STATOR SHAFT (REAR)
91	BALL, CARBON STEEL (T.V. EXHAUST)
92	CONDUIT, SOLENOID WIRE
93	MAGNET, CHIP COLLECTOR
94	RETAINER, FRONT HELIX SEAL
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, TUBE
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
106	RETAINER & BALL ASM. (DOUBLE ORIFICE)
359	PLUG, CUP (ORIFICE)
372	SWITCH, TEMPERATURE (SOME MODELS)
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUMULATOR VALVE BODY ASSEMBLY
709	SPRING ASSEMBLY, MANUAL DETENT

LH0197-4L60

Figure 139 Case and External Parts — Legend

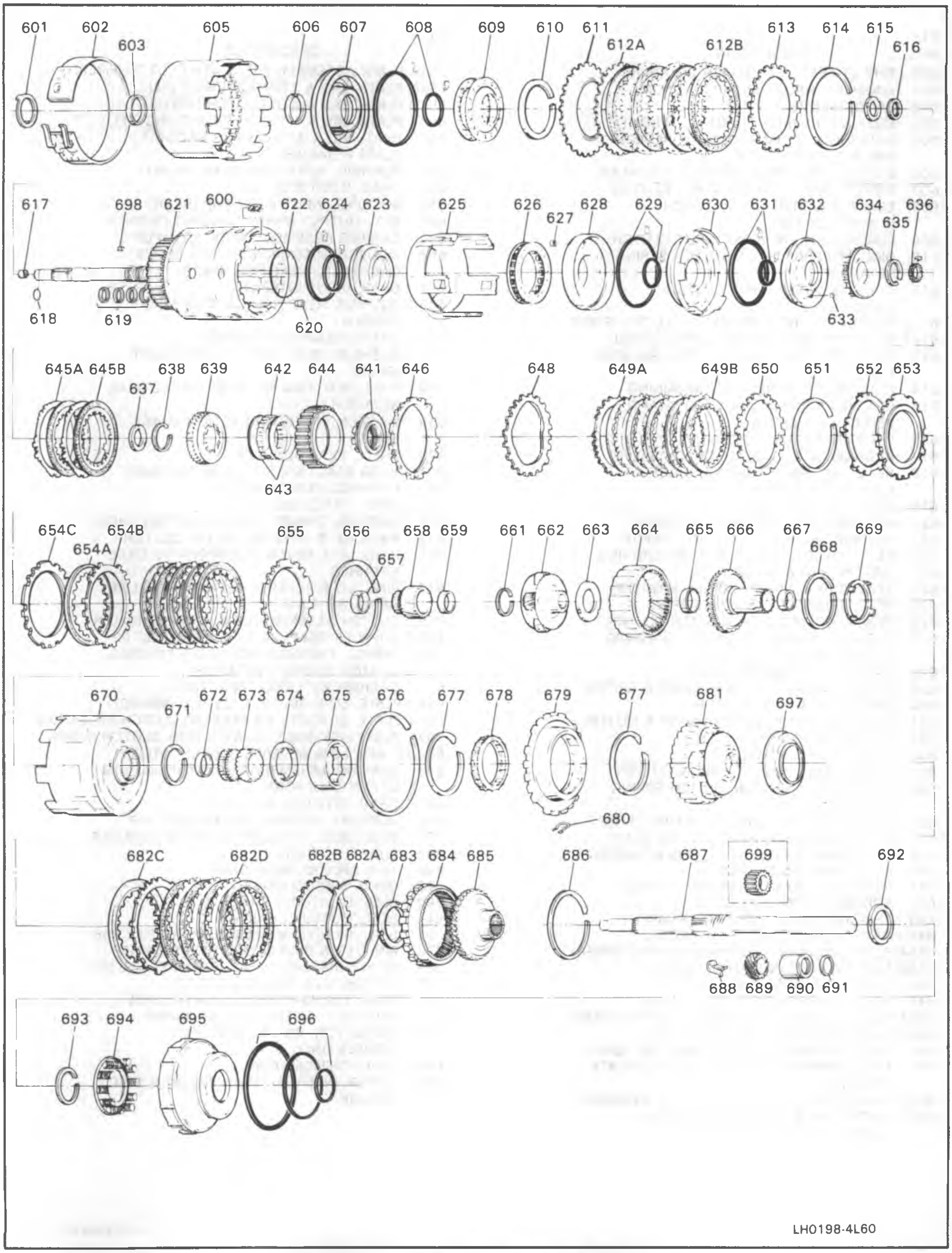


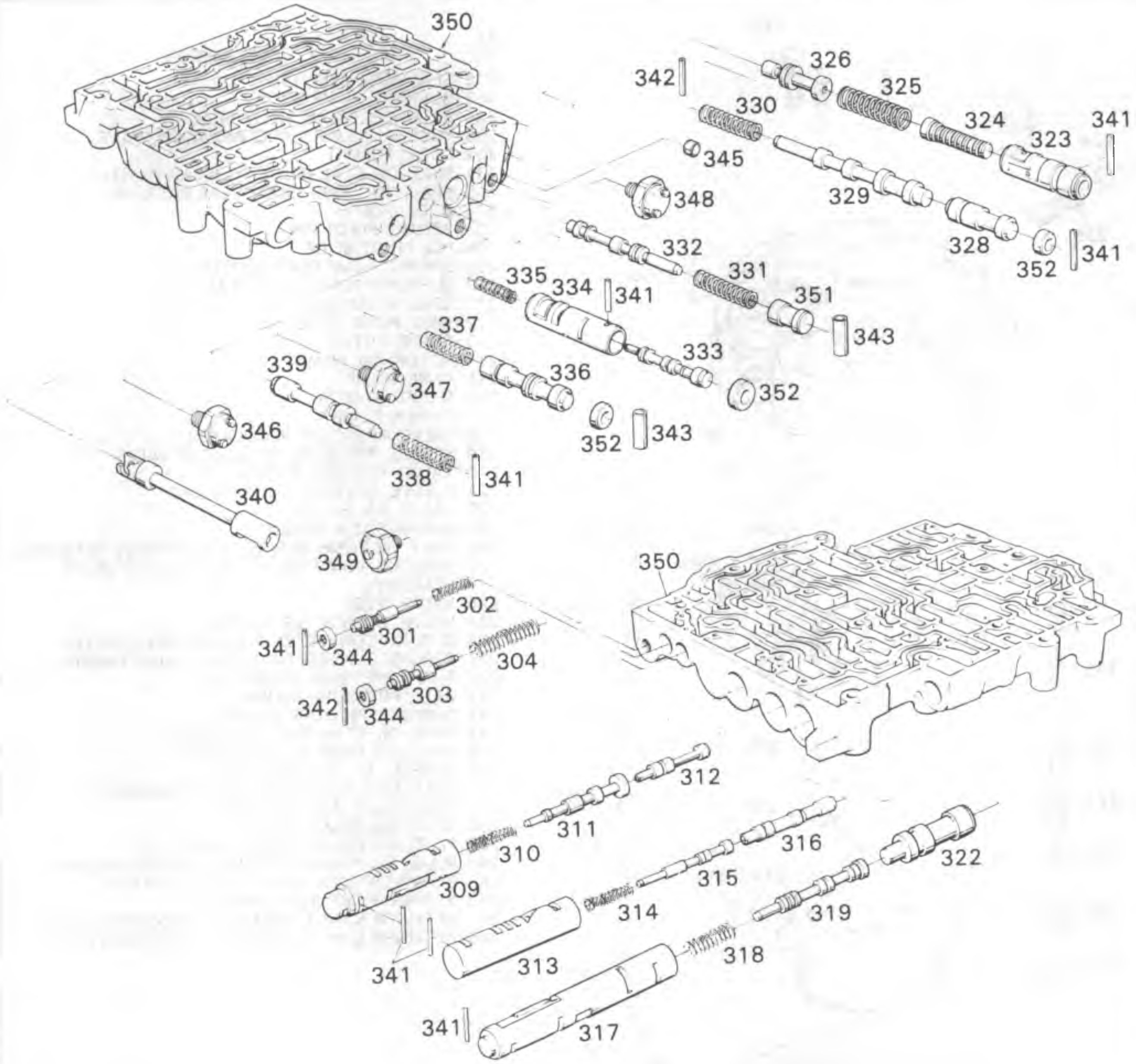
Figure 140 Transmission Internal Parts

ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
603	BUSHING, REVERSE INPUT CL. (FRONT)
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (BELLEVILLE)
612A	PLATE ASM., REVERSE INPUT CLUTCH (FIBER)
612B	PLATE, REVERSE INPUT CLUTCH (STEEL)
613	PLATE, REVERSE INPUT CLUTCH BACKING (SELECTIVE)
614	RING, REVERSE INPUT CL. RETAINING
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASM., CHECK VALVE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
619	RING, OIL SEAL (SOLID)
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
622	SEAL, "O" RING INPUT TO FORWARD HSG.
623	PISTON, 3RD & 4TH CLUTCH
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
627	RETAINER & BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH (INNER & OUTER)
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)
645A	PLATE ASSEMBLY, OVERRUN CLUTCH (FIBER)
645B	PLATE, OVERRUN CLUTCH (STEEL)
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649A	PLATE ASSEMBLY, FORWARD CLUTCH (FIBER)
649B	PLATE, FORWARD CLUTCH (STEEL)
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)

ILL. NO.	DESCRIPTION
654A	PLATE ASSEMBLY, 3RD & 4TH CLUTCH (FIBER)
654B	PLATE, 3RD & 4TH CLUTCH (STEEL)
654C	PLATE, 3RD & 4TH CLUTCH (STEEL)
655	PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR (FRONT)
658	GEAR, INPUT SUN
659	BUSHING, INPUT SUN GEAR (REAR)
661	RET., OUTPUT SHAFT TO INPUT CARRIER
662	CARRIER ASSEMBLY, INPUT (COMPLETE)
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664	GEAR, INPUT INTERNAL
665	BUSHING, REACTION CARRIER SHAFT (FRONT)
666	SHAFT, REACTION CARRIER
667	BUSHING, REACTION CARRIER SHAFT (REAR)
668	RING, REACTION SHAFT/INTERNAL GEAR RETAINER
669	WASHER, THRUST (REACTION SHAFT/ SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RETAINER
672	BUSHING, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASM., LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)
681	CARRIER ASSEMBLY, REACTION
682A	PLATE, LO & REVERSE CLUTCH (WAVED)
682B	PLATE, SPACER LO & REVERSE CLUTCH (SELECTIVE)
682C	PLATE ASSEMBLY, LO & REVERSE CLUTCH (FIBER)
682D	PLATE, LO & REVERSE CLUTCH (STEEL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
686	RING, REACTION GEAR/SUPPORT RETAINER
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT
691	SEAL, OUTPUT SHAFT
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO & REVERSE CLUTCH RETAINER
694	SPRING ASSEMBLY, LO & REVERSE CLUTCH
695	PISTON, LO & REVERSE CLUTCH
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH — OUTER, CENTER, INNER)
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)
698	PLUG, ORIFICED CUP
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

LH0199-4L60

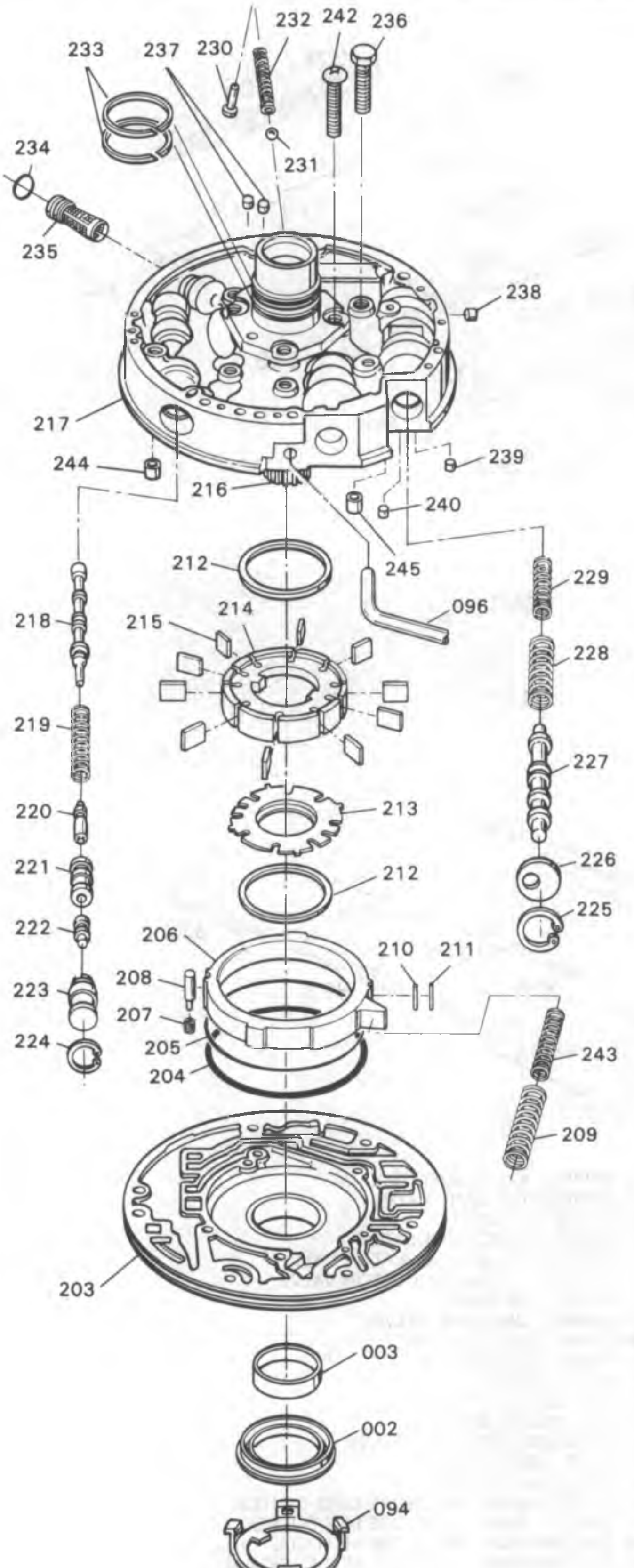
Figure 141 Transmission Internal Parts — Legend



ILL. NO.	DESCRIPTION
301	VALVE, T.V. MODULATOR DOWNSHIFT
302	SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303	VALVE, T.V. MODULATOR UPSHIFT
304	SPRING, T.V. MODULATOR UPSHIFT VALVE
309	SLEEVE, 3-4 THROTTLE VALVE
310	SPRING, 3-4 THROTTLE VALVE
311	VALVE, 3-4 THROTTLE
312	VALVE, 3-4 SHIFT
313	SLEEVE, 2-3 THROTTLE VALVE
314	SPRING, 2-3 THROTTLE VALVE
315	VALVE, 2-3 THROTTLE
316	VALVE, 2-3 SHIFT
317	SLEEVE, 1-2 THROTTLE VALVE
318	SPRING, 1-2 THROTTLE VALVE
319	VALVE, 1-2 THROTTLE
322	VALVE, 1-2 SHIFT
323	SLEEVE, THROTTLE VALVE PLUNGER
324	PLUNGER, THROTTLE VALVE
325	SPRING, THROTTLE VALVE
326	VALVE, THROTTLE
328	VALVE, 3-4 RELAY
329	VALVE, 4-3 SEQUENCE
330	SPRING, 4-3 SEQUENCE VALVE
331	SPRING, T.V. LIMIT VALVE
332	VALVE, T.V. LIMIT
333	VALVE, 1-2 ACCUMULATOR
334	SLEEVE, 1-2 ACCUMULATOR VALVE
335	SPRING, 1-2 ACCUMULATOR VALVE
336	VALVE, LINE BIAS
337	SPRING, LINE BIAS VALVE
338	SPRING, 3-2 CONTROL
339	VALVE, 3-2 CONTROL
340	VALVE, MANUAL
341	PIN, COILED SPRING
342	PIN, COILED SPRING
343	RETAINER, SPRING (SLEEVE)
344	PLUG, VALVE BORE
345	PLUG, CUP (.33 DIA.)
346	SWITCH ASM., PRESSURE (3RD CLUTCH)
347	SWITCH ASM., PRESSURE (4-3 PULSE)
348	SWITCH ASM., PRESSURE (4TH CLUTCH)
349	SWITCH ASM., PRESSURE (T.C.C. SIGNAL)
350	BODY, CONTROL VALVE
351	PLUG, T.V. LIMIT
352	PLUG, VALVE BORE (12.5 - O.D.)

LH0170-4L60-R1

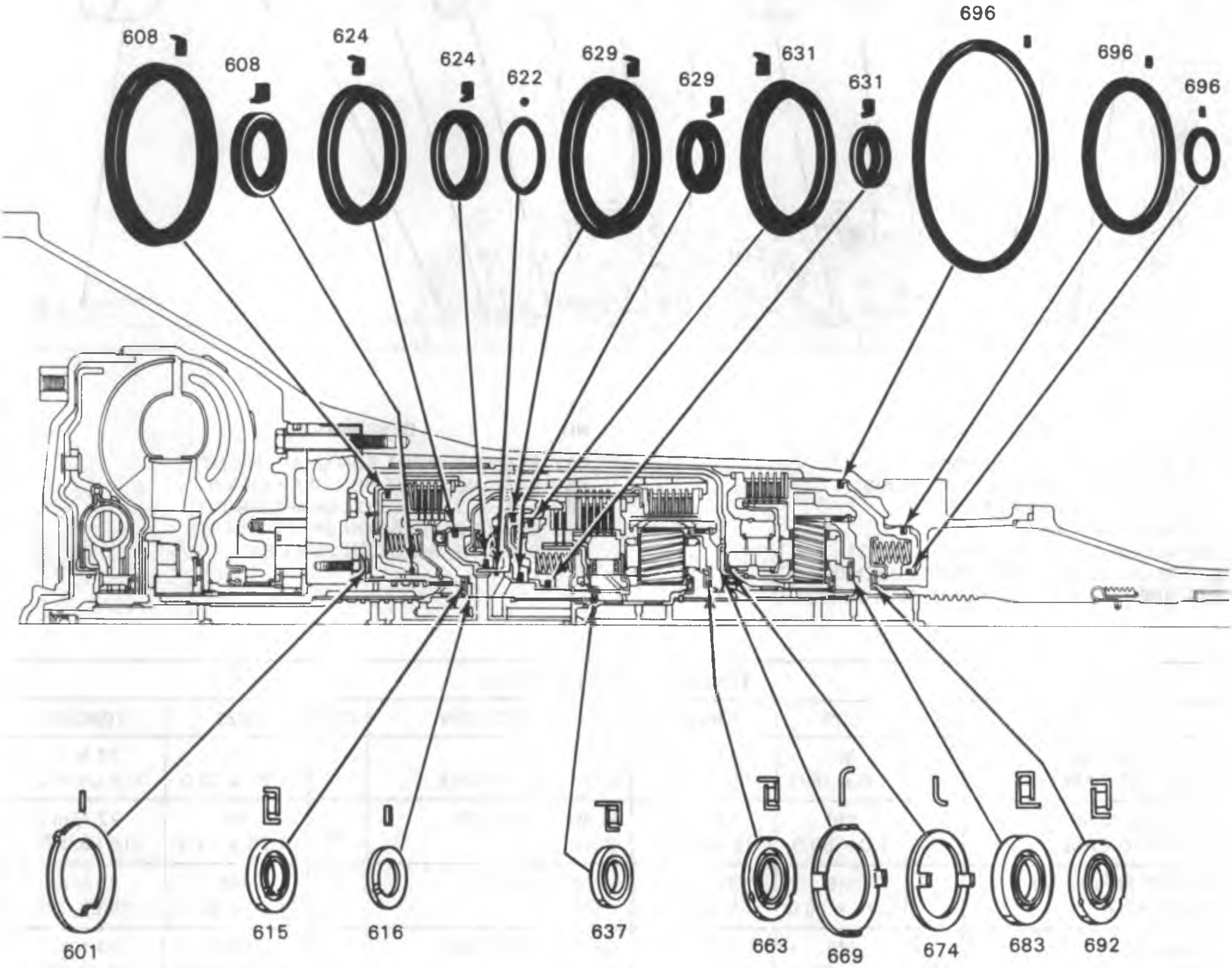
Figure 142 Control Valve Assembly



ILL. NO.	DESCRIPTION
002	SEAL ASSEMBLY, OIL
003	BUSHING, PUMP BODY
094	RETAINER, FRONT HELIX SEAL
096	TUBE, AUXILIARY ACCUMULATOR VALVE
203	BODY, PUMP
204	RING, OIL SEAL (SLIDE TO WEAR PLATE)
205	SEAL, "O" RING (SLIDE SEAL BACK-UP)
206	SLIDE, PUMP
207	SPRING, PIVOT PIN
208	PIN, PIVOT SLIDE
209	SPRING, PUMP SLIDE (OUTER)
210	SUPPORT, PUMP SLIDE SEAL
211	SEAL, PUMP SLIDE
212	RING, PUMP VANE
213	GUIDE, ROTOR
214	ROTOR, OIL PUMP
215	VANE, PUMP
216	SHAFT, STATOR
217	COVER, PUMP
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	VALVE, STOP
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)
230	RIVET, PRESSURE RELIEF BOLT
231	BALL, PRESSURE RELIEF
232	SPRING, PRESSURE RELIEF
233	RING, OIL SEAL (STATOR SHAFT)
234	SEAL, OIL PUMP COVER SCREEN
235	SCREEN, OIL PUMP COVER
236	BOLT, M8 x 1.25 x 40 (COVER TO BODY)
237	PLUG, OIL PUMP AIR BLEED
238	PLUG, OIL PUMP COVER
239	PLUG, OIL PUMP COOLER FEED
240	PLUG, OIL PUMP CONVERTER CLUTCH SIGNAL
242	SCREW, STATOR SHAFT (M6 x 1 x 16.0)
243	SPRING, PUMP SLIDE (INNER)
244	RETAINER & BALL ASSEMBLY, (REVERSE CLUTCH)
245	RETAINER & BALL ASSEMBLY, (OVERRUN CLUTCH)

LH0152-4L60

Figure 143 Oil Pump Assembly

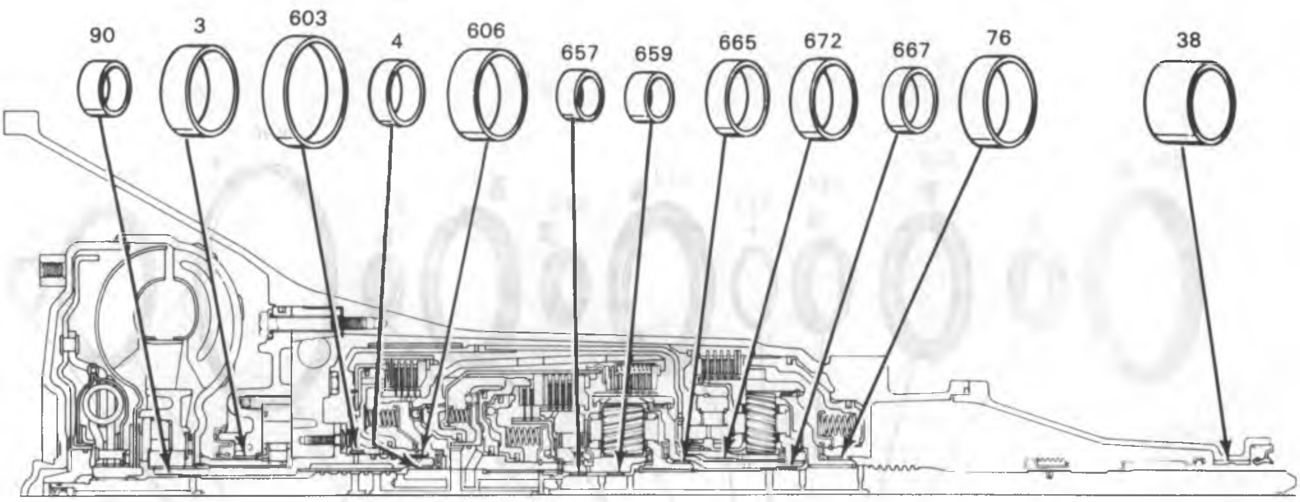


ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
622	SEAL, "O" RING INPUT TO FORWARD HSG.
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
629	SEAL, FORWARD CLUTCH (INNER & OUTER)
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
637	BEARING ASSEMBLY, INPUT SUN GEAR

ILL. NO.	DESCRIPTION
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
669	WASHER, THRUST (REACTION SHAFT/ SHELL)
674	WASHER, THRUST (RACE/REACTION SHELL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
692	BRG., REACTION GEAR SUPPORT TO CASE
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH – OUTER, CENTER, INNER)

LH0203-4L60

Figure 144 Seals and Bearing Locations



ILL. NO.	DESCRIPTION
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (REAR)
38	BUSHING, CASE EXTENSION
76	BUSHING, CASE
90	BUSHING, STATOR SHAFT (FRONT)
603	BUSHING, REVERSE INPUT CLUTCH (FRONT)
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
657	BUSHING, INPUT SUN GEAR (FRONT)
659	BUSHING, INPUT SUN GEAR (REAR)
665	BUSHING, REACTION SHAFT (FRONT)
667	BUSHING, REACTION SHAFT (REAR)
672	BUSHING, REACTION SUN GEAR

TORQUE SPECIFICATIONS

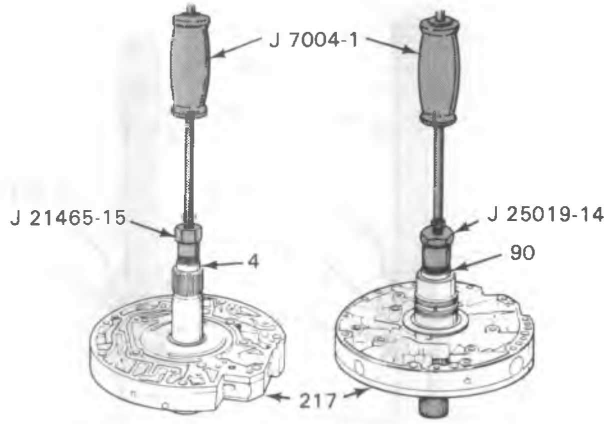
LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	M6 1.0 x 35.0	11 N·m (8 LB.-FT.)	PARK BRAKE BRACKET TO CASE	2	M8 1.25 x 20.0	22 N·m (18 LB.-FT.)
ACCUMULATOR COVER TO CASE	1	M6 1.0 x 65.0	11 N·m (8 LB.-FT.)	PUMP COVER TO BODY	5	M8 1.25 x 40.0	22 N·m (18 LB.-FT.)
DETENT SPRING TO VALVE BODY	1	M8 1.75 x 20.0	22 N·m (18 LB.-FT.)	PUMP ASSY. TO CASE	7	M8 1.25 x 60.0	22 N·m (18 LB.-FT.)
VALVE BODY TO CASE	15	M6 1.0 x 50.0	11 N·m (8 LB.-FT.)	CASE EXTENSION TO CASE	4	M10 1.50 x 30.0	34 N·m (26 LB.-FT.)
OIL PASSAGE COVER TO CASE	3	M6 1.0 x 16.0	11 N·m (8 LB.-FT.)	MANUAL SHAFT TO INSIDE DET. LEVER	1	M10 1.50 NUT	31 N·m (23 LB.-FT.)
SOLENOID ASSY. TO PUMP	2	M6 1.0 x 12.0	11 N·m (8 LB.-FT.)	PRESSURE PLUGS	1-4	⅛ - 27	11 N·m (8 LB.-FT.)
TRANSMISSION OIL PAN TO CASE	16	M8 1.25 x 19.3	11 N·m (8 LB.-FT.)	PRESSURE PLUGS	3	¼ - 18	24 N·m (18 LB.-FT.)
PRESSURE SWITCHES	1-3	⅛ - 27	11 N·m (8 LB.-FT.)	CONNECTOR COOLER PIPE	2	¼ - 18	38 N·m (28 LB.-FT.)
AUXILIARY VALVE BODY TO CASE	1	M6 1.0 x 18	11 N·m (8 LB-FT.)				
AUXILIARY VALVE BODY TO CASE	1	M6 1.0 x 35	11 N·m (8 LB.-FT.)				
AUXILIARY VALVE BODY TO CASE	1	M6 1.0 x 45	11 N·m (8 LB.-FT.)				

LH0204-4L60

Figure 145 Torque Specifications and Bushing Locations

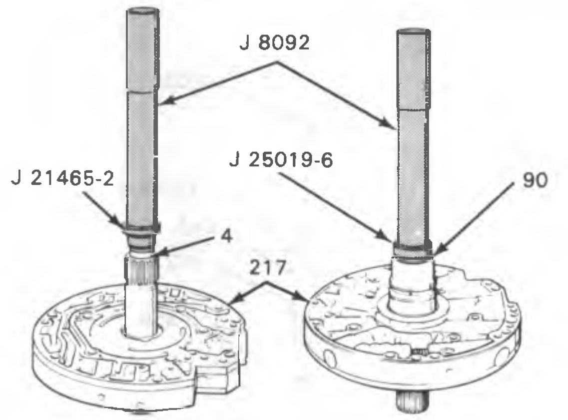
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

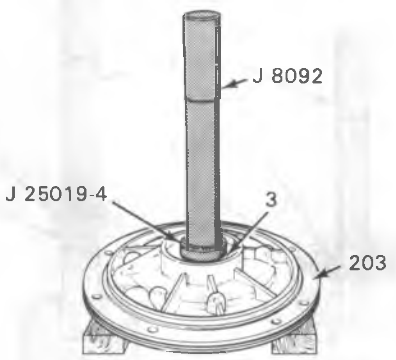


4 BUSHING, STATOR SHAFT — FRONT
90 BUSHING, STATOR SHAFT — REAR
217 COVER, PUMP

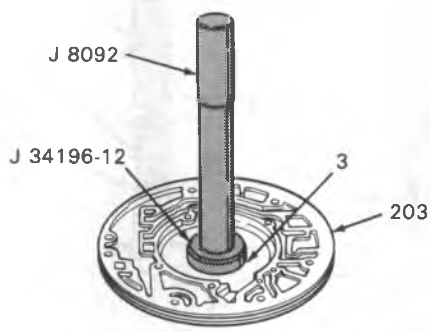
INSTALL AS SHOWN



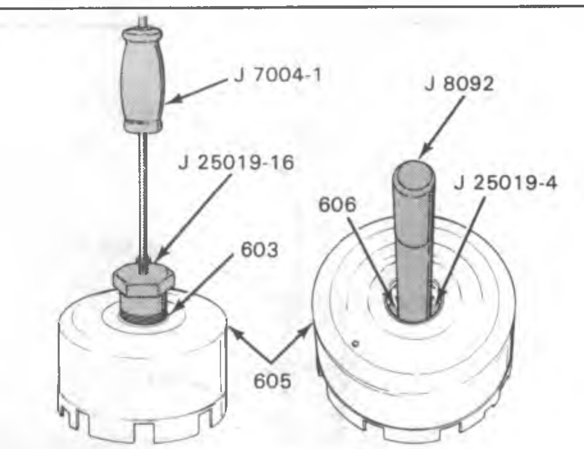
4 BUSHING, STATOR SHAFT — FRONT
90 BUSHING, STATOR SHAFT — REAR
217 COVER, PUMP



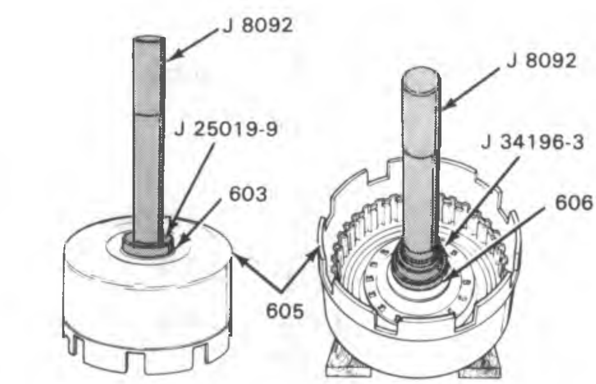
3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



603 BUSHING, REVERSE INPUT CLUTCH — FRONT
605 HOUSING & DRUM ASM., REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH — REAR



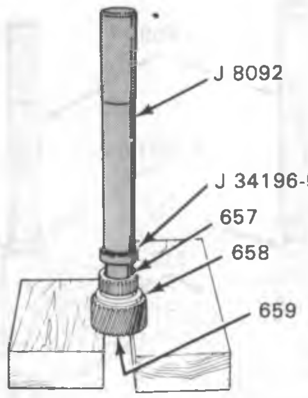
603 BUSHING, REVERSE INPUT CLUTCH — FRONT
605 HOUSING & DRUM ASM., REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH — REAR

LH0205-4L60

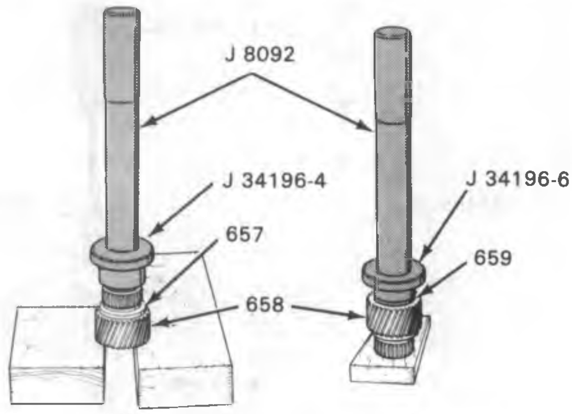
Figure 146 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

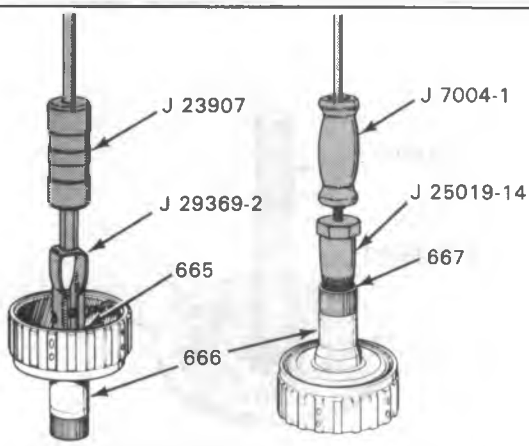
REMOVE AS SHOWN | **INSTALL AS SHOWN**



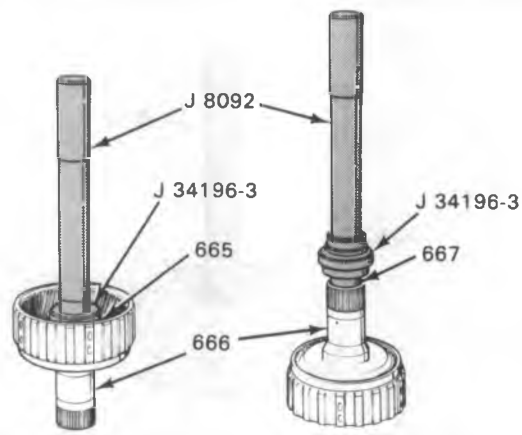
657 BUSHING, INPUT SUN GEAR — FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR — REAR



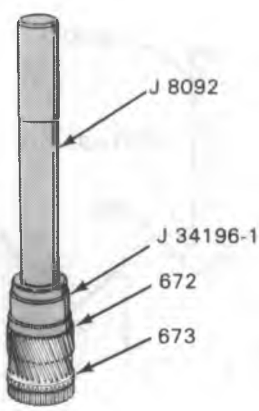
657 BUSHING, INPUT SUN GEAR — FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR — REAR



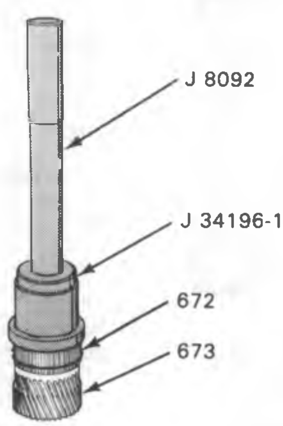
665 BUSHING, REACTION CARRIER SHAFT — FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT — REAR



665 BUSHING, REACTION CARRIER SHAFT — FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT — REAR



672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN



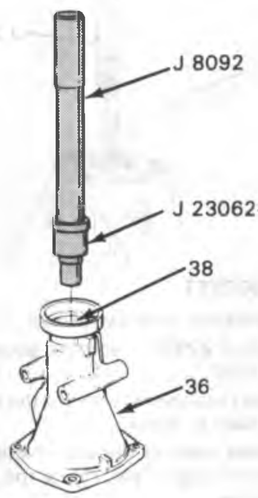
672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

LH0206-4L60

Figure 147 Bushing Replacement Procedure

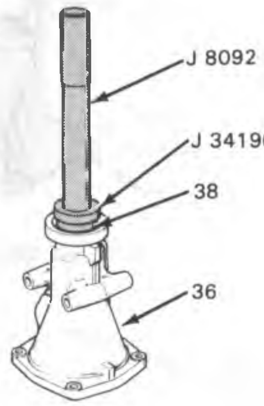
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

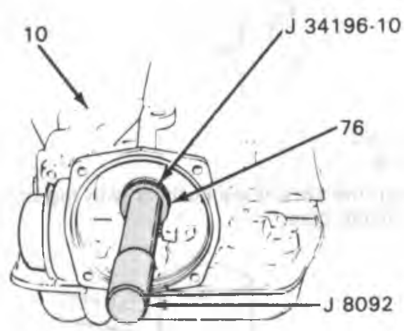


36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION

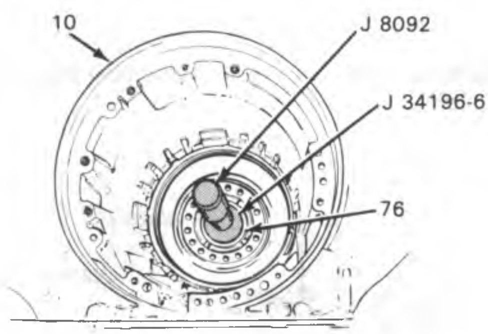
INSTALL AS SHOWN



36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION



10 CASE, TRANSMISSION
76 BUSHING, CASE



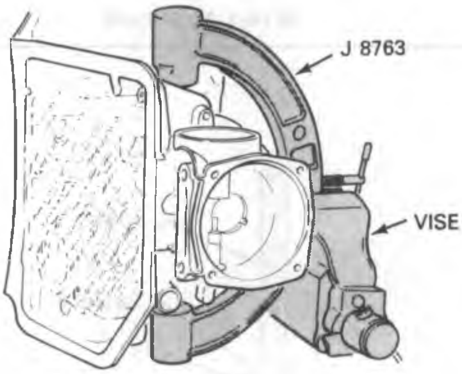
10 CASE, TRANSMISSION
76 BUSHING, CASE

LH0207-4L60

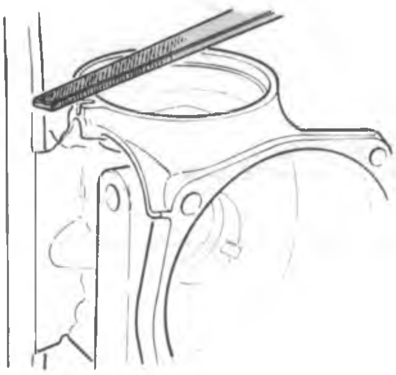
Figure 148 Bushing Replacement Procedure

GOVERNOR BORE REPAIR PROCEDURE

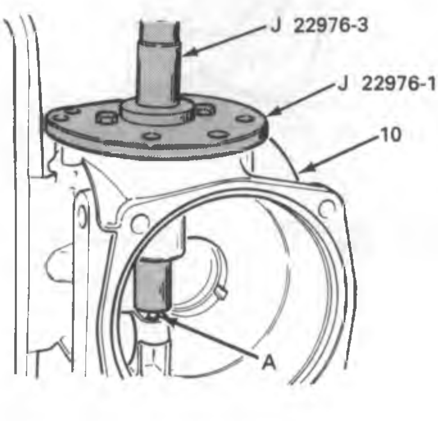
FOLLOW STEPS 1-6 TO REPA'R THE GOVERNOR BORE



STEP 1 Install holding fixture J 8763 and mount in vise.

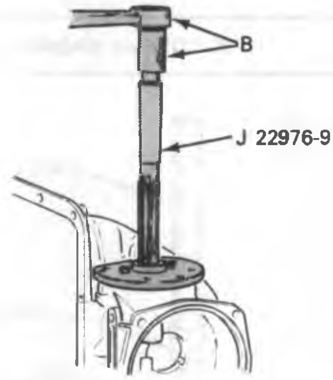


STEP 2 Remove (file) any excess material from the governor face.



A PIN, GOVERNOR SUPPORT
10 CASE, TRANSMISSION

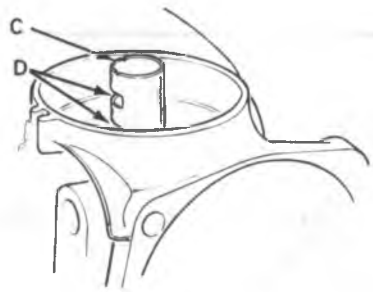
STEP 3 Install J 22976-3 and J 22976-1. Torque bolts to 13 N·m (10 ft.-lbs.). Make sure J 22976-3 rotates freely and then remove it.



B RATCHET & SOCKET

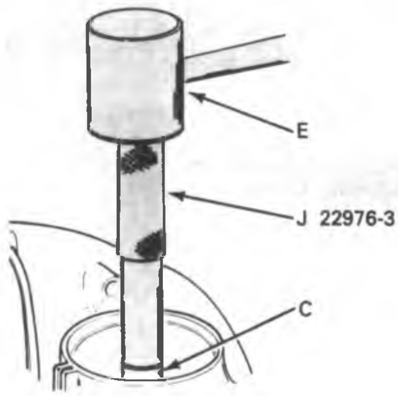
STEP 4 Ream the governor bore as follows:

- Oil J 22976-9, J 22976-1 and the governor bore with transmission fluid.
- After each ten revolutions, remove the reamer and dip in transmission fluid to clean.
- After the reamer reaches the end of the bore and bottoms on the governor support pin, rotate the reamer ten additional revolutions.
- Remove the reamer. Be certain to rotate during removal to prevent scoring the bore.
- Remove the tools and thorougly clean the case.



C BUSHING
D SLOTS

STEP 5 Align the slots in the bushing with the slots in the governor bore.



C BUSHING
E BRASS HAMMER

STEP 6 Install the bushing until the slots in the bushing align with the feed holes in the governor bore.

LH0208-4L60

Figure 149 Governor Bore Repair Procedure

Figure 150 Special Tools

SECTION/HYDRA-MATIC 3L80/3L80-HD (FORMERLY THM 400/475)

AUTOMATIC TRANSMISSION UNIT REPAIR

RPO M40

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

TRANSMISSION DISASSEMBLY

GENERAL SERVICE INFORMATION

- Teflon Seal Rings: During disassembly, check seals for damage and make sure that they rotate freely in their grooves. Inspect the grooves for dirt, burrs or other damage.
- Thrust washers and surfaces: These washers and the surfaces they engage may appear polished. This is a normal condition and does not indicate damage.
- Thoroughly clean the exterior of the transmission.
- As the unit is disassembled clean the assemblies or components so that proper inspection can be made.

Remove or Disconnect

- Torque converter (1).

Install or Connect

Figure 1

Tools Required:

J 3289-20 Base
J 8763-02 Holding Fixture

1. J 8763-02 onto transmission case.

Important

- Do not overtighten the tool as case damage may result.

2. Transmission and holding fixture into J 3289-20.

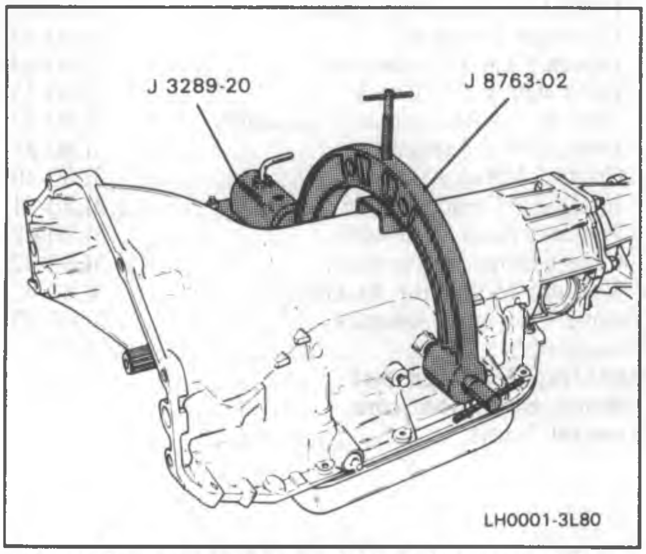


Figure 1 — Transmission Holding Fixture and Base

3. Fixture pin.
4. Drain transmission fluid.

DISASSEMBLY

Vacuum Modulator Assembly

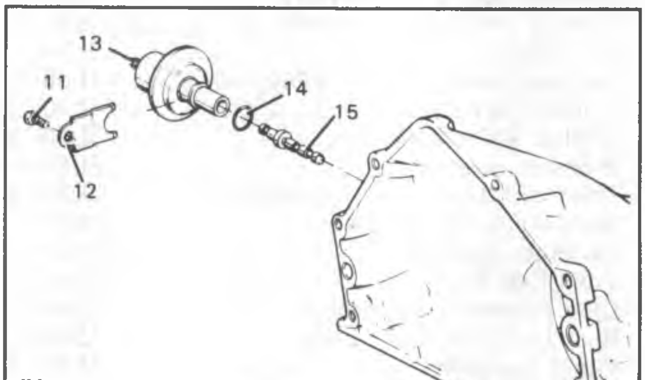
Figure 2

Remove or Disconnect

Tool Required:

Magnet to capture modulator valve

1. Bolt (11) and retainer (12).
2. Vacuum modulator assembly (13), and O-ring seal (14)
   - O-ring seal may be stuck in case
3. Modulator valve (15) with magnet.



ILL. NO.	DESCRIPTION
11	SCREW, HEX HD 5/16-18 X .62
12	RETAINER, MODULATOR
13	VACUUM MODULATOR ASSEMBLY
14	SEAL, O-RING
15	VALVE, VACUUM MODULATOR

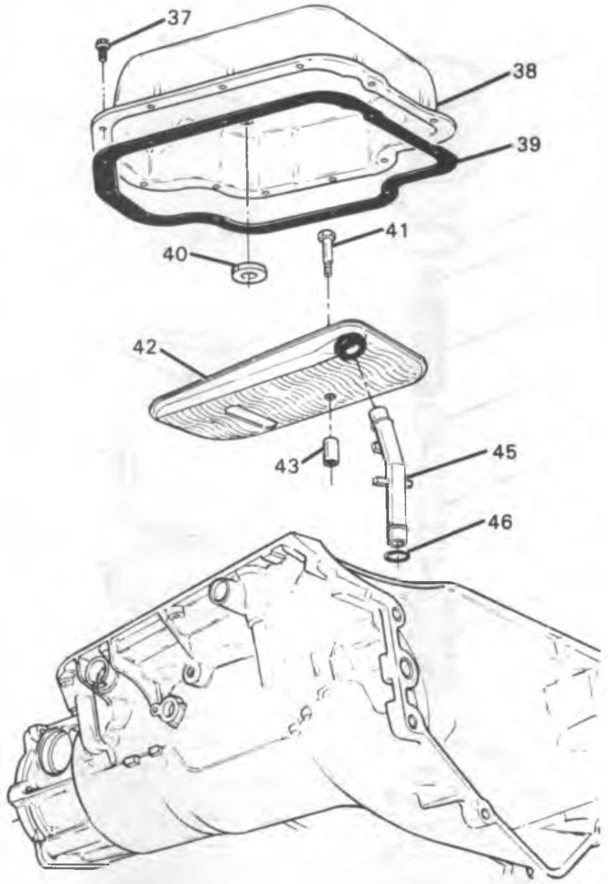
Figure 2 — Removing Vacuum Modulator Assembly

Pan & Filter Assembly

Figure 3

Remove or Disconnect

1. Rotate transmission upside down and lock in place with base pin.
2. Screw & conical washer assembly (37)
3. Pan (38), gasket (39) and magnet (40).
4. Filter bolt (41), spacer (43), filter (42), intake pipe (45), and O-ring seal (46)
   - O-ring seal may be stuck in case



37 SCREW & CONICAL WASHER ASSEMBLY, 5/16-18 X .69
38 PAN, TRANSMISSION
39 GASKET, TRANSMISSION PAN
40 MAGNET, CHIP COLLECTOR
41 BOLT, SHOULDER (FILTER TO VALVE BODY)
42 FILTER ASSEMBLY, TRANSMISSION
43 SPACER, VALVE BODY TO FILTER
45 PIPE, INTAKE
46 SEAL, O-RING (STRAINER TO CASE) LH0003-3L80

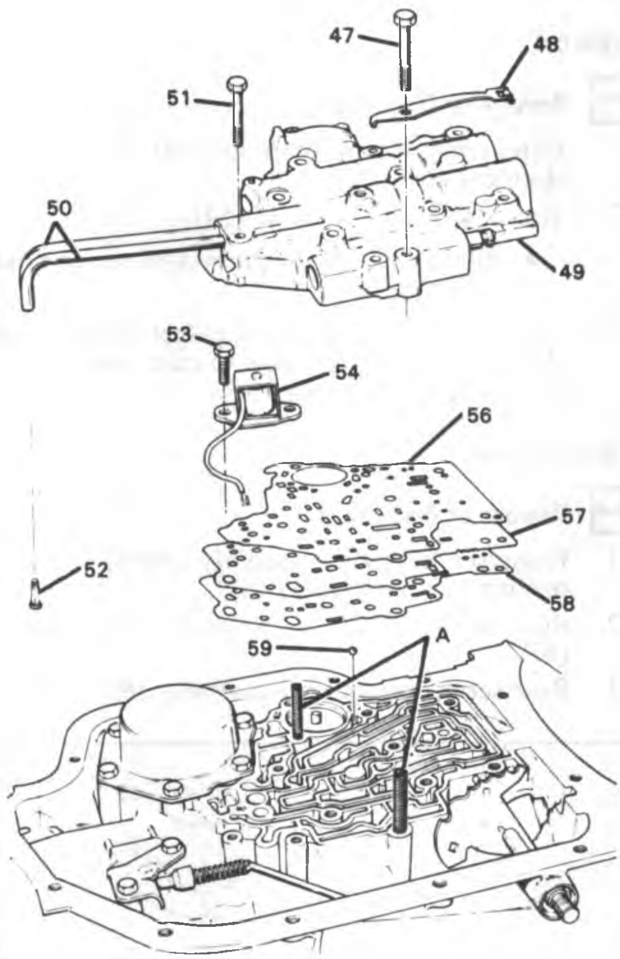
Figure 3 — Removing Pan & Filter Assembly

Control Valve Assembly

Figure 4

Remove or Disconnect

1. Bolts (47), manual detent spring and roller (48).
2. Bolts (51)
3. Governor pipes (50) up from case and rotate them away from their holes.
4. Governor screen (52) from the inboard hole.
5. Control valve assembly (49).



ILL. NO.	DESCRIPTION
A	GUIDE PINS
47	SCREW, HEX HD 5/16-18 X 1.875 (V.B. TO CASE)
48	MANUAL DETENT ROLLER & SPRING ASSEMBLY
49	CONTROL VALVE ASSEMBLY
50	PIPE, GOVERNOR
51	SCREW, HEX HD 1/4-20 X 1.62 (V.B. TO CASE)
52	SCREEN ASSEMBLY, GOVERNOR
53	SCREW, HEX WASHER HD 1/4-20 X .75
54	SOLENOID ASSEMBLY
56	GASKET, VALVE BODY TO SPACER PLATE
57	PLATE, VALVE BODY SPACER
58	GASKET, SPACER PLATE TO CASE
59	BALL, (.25" DIA.)

LH0004-3L80

Figure 4 — Removing Control Valve Assembly

Solenoid Assembly

Figure 4

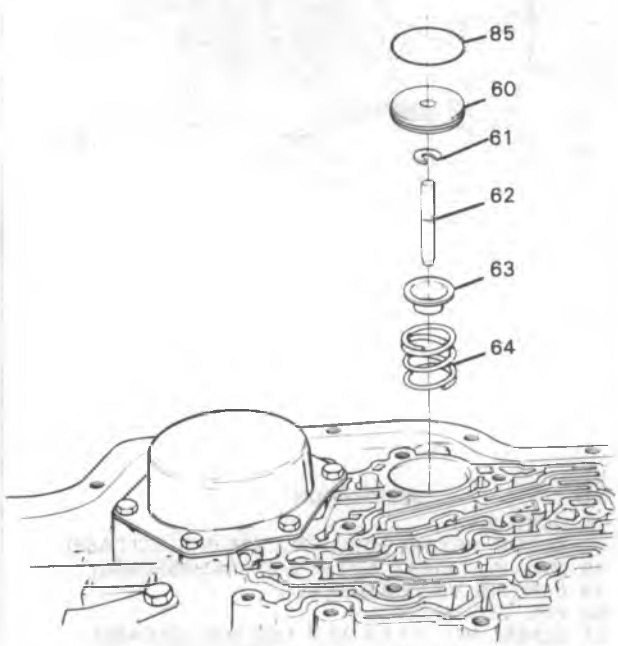
Remove or Disconnect

1. Wire connecting solenoid (54) to exterior electrical connector.
2. Screws (53) and solenoid (54).
   - Be careful not to press against solenoid cover.
3. Valve body to spacer plate gasket (56), spacer plate (57) and spacer plate to case gasket (58).
4. Seven check balls (59)

Figures 5 and 6

Remove or Disconnect

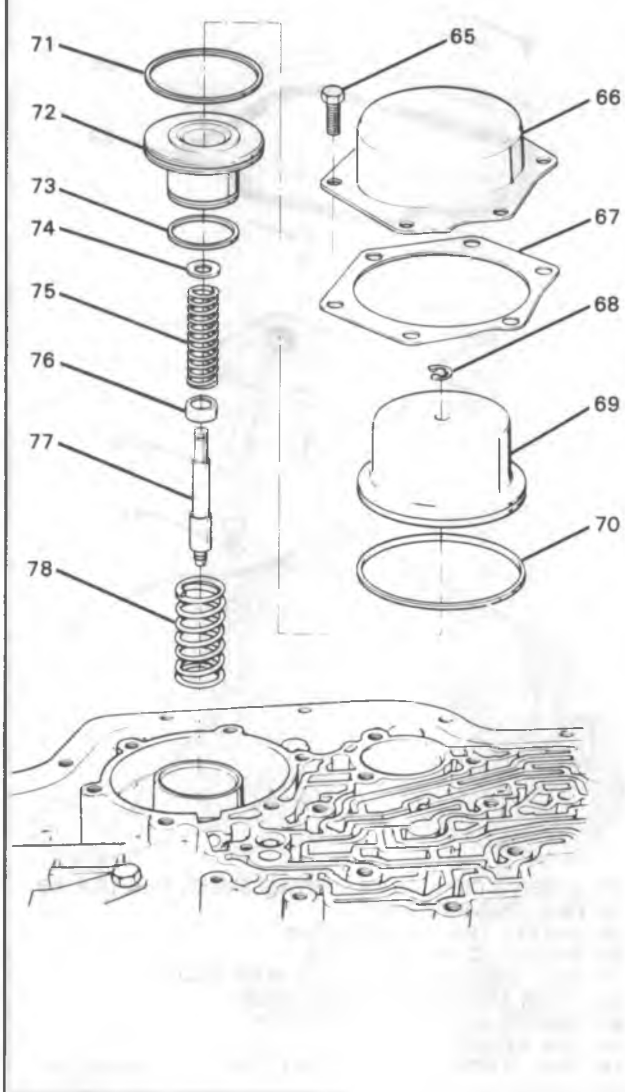
1. Front servo piston assembly (60-62 & 85), retainer (63) and spring (64).
2. Rear servo bolts (65), cover (66) and gasket (67).
3. Rear servo accumulator assembly (68 - 78)



60 PISTON, FRONT SERVO
61 RING, FRONT SERVO
62 PIN, FRONT SERVO PISTON
63 RETAINER, FRONT SERVO SPRING
64 SPRING, FRONT SERVO PISTON
85 RING, SEAL (FRONT SERVO PISTON)

LH0005-3L80

Figure 5 — Front Servo Assembly



65 SCREW, HEX HD 5/16-18 X .62
66 COVER, REAR SERVO
67 GASKET, REAR SERVO COVER
68 CLIP, RETAINING (SERVO PISTON)
69 PISTON, REAR SERVO
70 SEAL, REVERSE SERVO PISTON
71 RING, SEAL (ACCUMULATOR PISTON – OUTER)
72 PISTON, ACCUMULATOR
73 RING, SEAL (ACCUMULATOR PISTON – INNER)
74 WASHER, SERVO PISTON
75 SPRING, REAR SERVO
76 RETAINER, REAR SERVO SPRING
77 PIN, REAR BAND APPLY
78 SPRING, REAR ACCUMULATOR

LH0006-3L80

Figure 6 — Rear Servo Assembly

Band Apply Pin Check

Figures 7, 8 and 9

Measure

Tools Required:

J 21370-10 Gage Pin
J 21370-6 Selector Gage

1. Place J 21370-10 in the servo pin bore.
2. Position J 21370-6 over the bore with the hex nut facing the parking pawl linkage.
3. Fasten with two 5/16-18 X 1″ screws and torque to 24 N·m (18 lb. ft.)
4. Make sure J 21370-10 moves freely in the tool and pin bore.
5. To determine correct pin length apply 34 N·m (25 lb. ft.) torque to the nut on the gage.
6. For pin selection, see Figure 9.

Figure 7 — Installing Servo Pin Gage

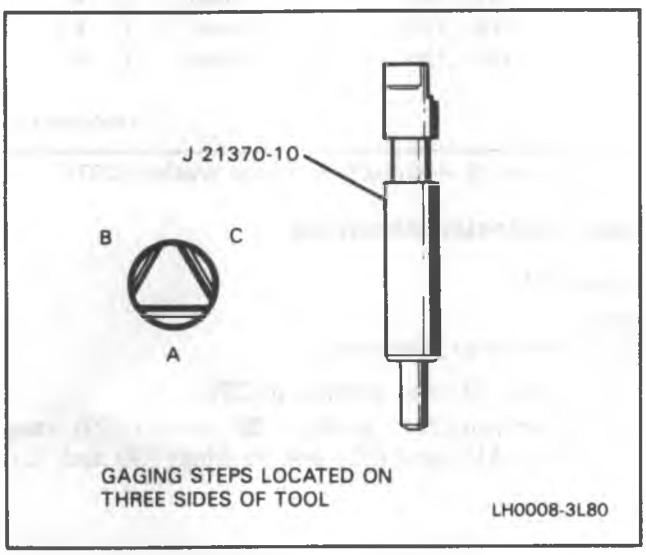


Figure 8 — Gage Pin

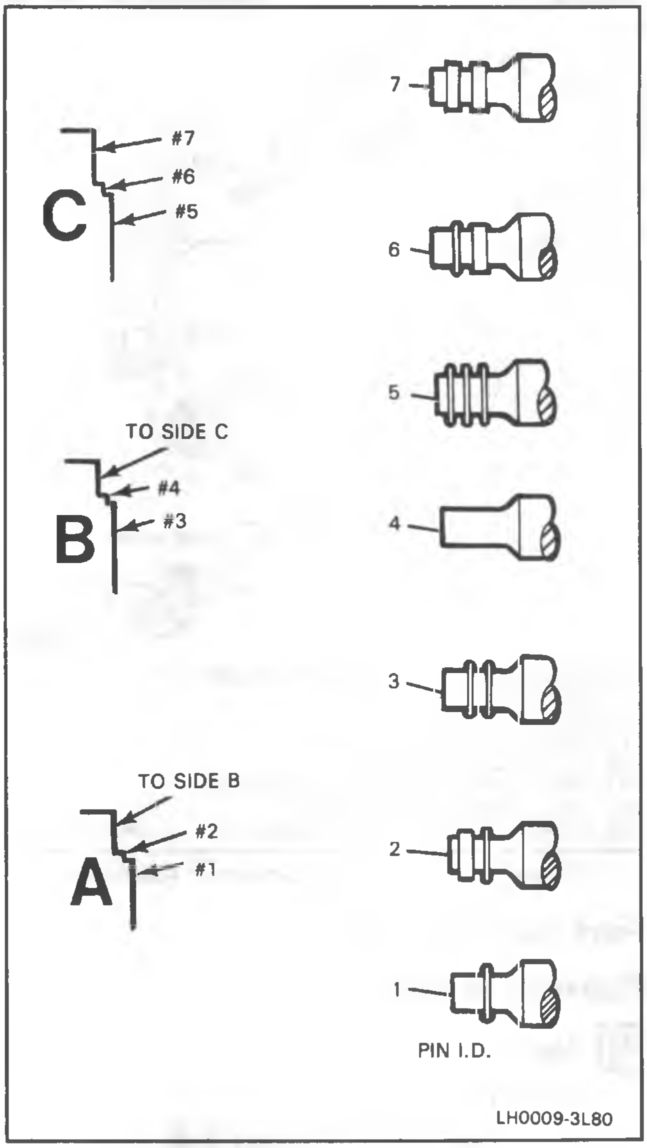


Figure 9 — Band Apply Pin Selection Chart

Governor Assembly

Figure 10

Remove or Disconnect

1. Bolts (19), cover (20) and gasket (21)
2. Governor assembly (22)

   Internal Transmission Speed Sensor (I.T.S.S.) Models
3. Retaining bolt (83)
4. Speed sensor (81) with O-ring (82)

NOTICE: Do not twist speed sensor when removing from case.

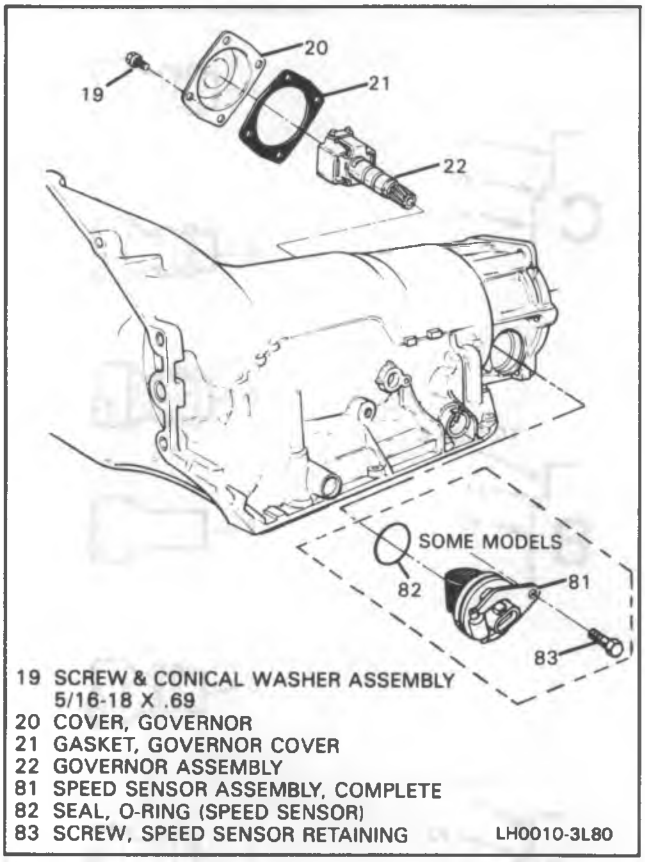


Figure 10 — Removing Governor Assembly

Front End Play Check

Figures 11, 12 and 17

Measure

Tools Required:

J 6125 Slide Hammer Bolt
J 8001 Dial Indicator

1. Remove pump bolt & O-ring assembly (4) at the 10-o'clock position as shown and install J 6125.
2. Attach J 8001.
3. Eliminate slack by pressing turbine shaft to the rear and output shaft (691) forward.
4. Index J 8001 against the end of turbine shaft and set dial to "0".
5. Pull out on the turbine shaft and note the measurement on J 8001. End play should be between .076-.610 mm (.003" and .024").
6. Select correct washer from chart (Figure 12).
7. Remove tools.

Important

- During reassembly Front End Play Check must be repeated to verify accuracy of selective thrust washer (207) Figure 17.

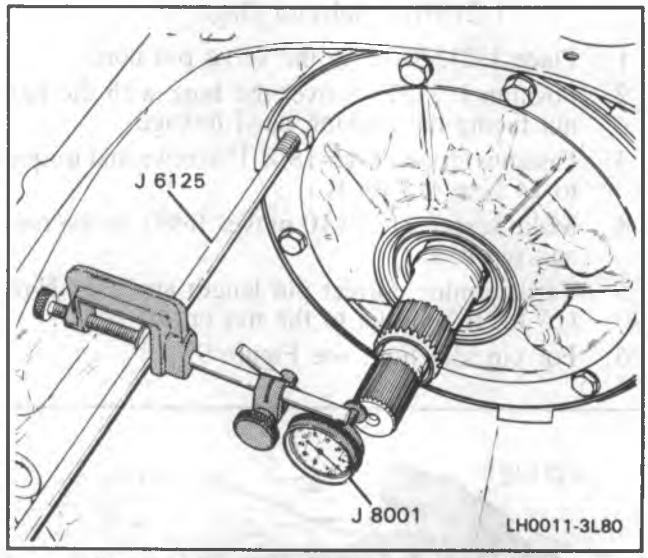


Figure 11 — Front Unit End Play Check

THICKNESS (INCH)	COLOR	NO.
.060 - .064	Yellow	0
.071 - .075	Blue	1
.082 - .086	Red	2
.093 - .097	Brown	3
.104 - .108	Green	4
.115 - .119	Black	5
.126 - .130	Purple	6

LH0012-3L80

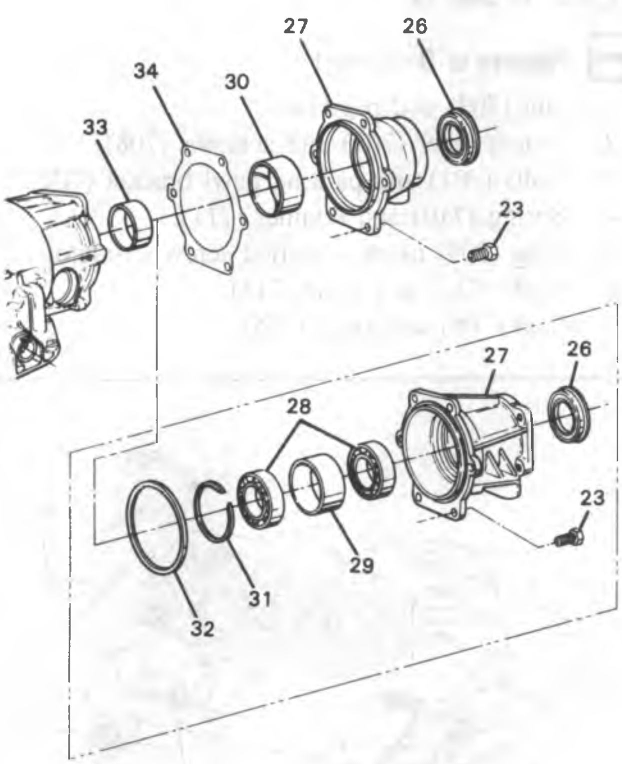
Figure 12 — Selective Thrust Washer (207)

Case Extension Assembly

Figure 13

Remove or Disconnect

1. Bolts (23) and extension (27).
2. Rear seal (26), bearings (28), spacer (29), snap ring (31), seal (32) and bushings (30 and 33).



23 SCREW, HEX HD 3/8-16 X 1 (CASE EXTENSION TO CASE)
26 SEAL, CASE EXTENSION
27 CASE EXTENSION ASSEMBLY
28 BEARING ASSEMBLY, BALL
29 SPACER, BEARING
30 BUSHING, CASE EXTENSION
31 RING, INTERNAL SNAP
32 SEAL, CASE EXTENSION TO CASE
33 BUSHING, CASE
34 GASKET, CASE TO EXTENSION

LH0013-3L80

Figure 13 — Removing Case Extension Assembly

Rear Unit End Play Check

Figures 14 and 15

Measure

Tools Required:

J 6125-B Slide Hammer Rod
J 8001 Dial Indicator

1. Attach J 6125-B to one of the bolt holes at the end of the transmission case (10).
2. Mount J 8001 on the bolt and index it to the end of the output shaft (691).
   - set the indicator to "0".
3. Move the output shaft in and out noting the amount of end play.
   - correct end play is between .178-.483 mm (.007" and .019")

Important

- During reassembly, Rear End Play Check must be repeated to verify accuracy of selective thrust washer (696) Figure 30.

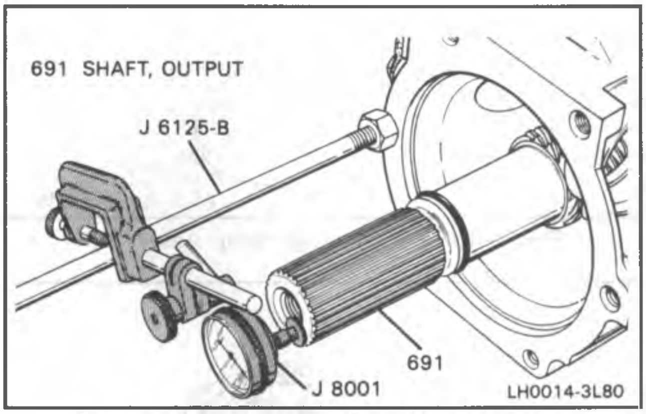


Figure 14 — Checking Rear Unit End Play

THICKNESS (INCH)	IDENTIFICATION NOTCH AND/OR NUMERAL	
.074 - .078	None	1
.082 - .086	ON SIDE OF 1 TAB	2
.090 - .094	ON SIDE OF 2 TABS	3
.098 - .102	ONE END OF 1 TAB	4
.106 - .110	ON END OF 2 TABS	5
.114 - .118	ON END OF 3 TABS	6

LH0015-3L80

Figure 15 — Output/Case Selective Thrust Washer (696)

Pump Assembly

Figures 16 and 17

Remove or Disconnect

Tool Required:

J 24773-A Pump Remover

1. Bolt & O-ring assembly (4)
2. Attach J 24773-A
3. Pump assembly (6).
4. Remove J 24773-A
5. Pump seal (7) and gasket (8).

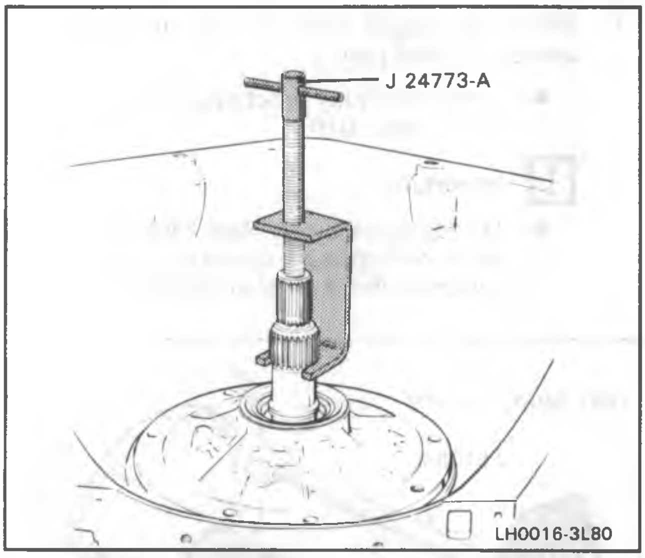
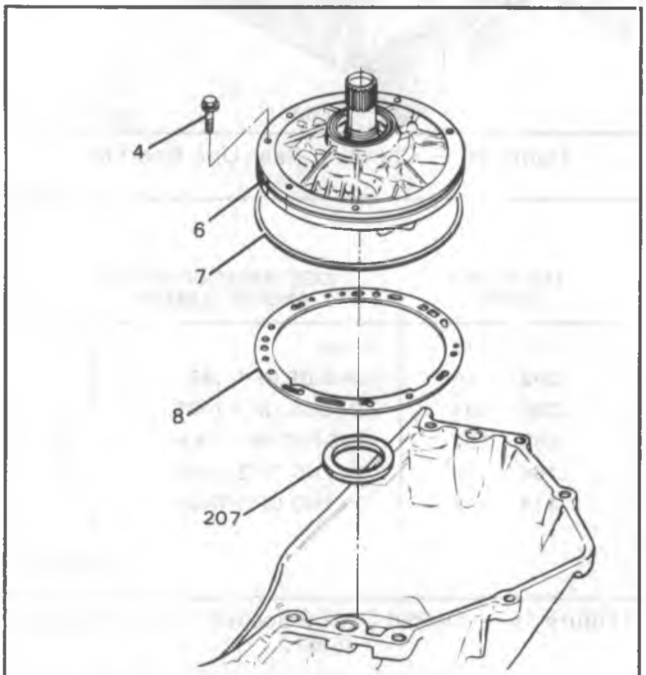


Figure 16 — Removing Pump Assembly



4 SCREW & O-RING ASSEMBLY, HEX HD 5/16-18 X 1.406 (PUMP TO CASE)
6 PUMP ASSEMBLY, COMPLETE
7 SEAL, PUMP TO CASE
8 GASKET, PUMP COVER TO CASE
207 WASHER, THRUST (SELECTIVE)

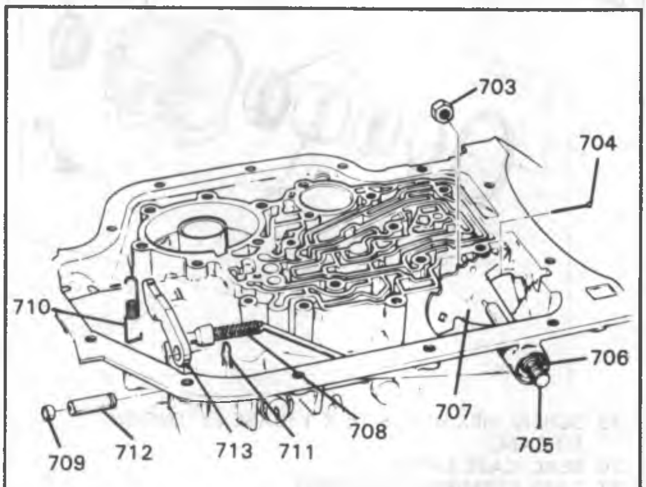
Figure 17 — Pump Assembly and Selective Thrust Washer

Parking Lock Pawl and Actuator Assembly

Figures 18 and 19

Remove or Disconnect

1. Nut (703) and pin (704).
2. Detent lever (707) and actuator (708).
3. Bolts (701) and parking pawl bracket (702).
4. Spring (710) and retainer (711).
5. Plug (709) using modified screw extractor.
6. Shaft (712) and pawl (713).
7. Seal (706) and shaft (705)



ILL. NO.	DESCRIPTION
703	NUT, HEX 3/8-24
704	PIN, INSIDE DETENT LEVER
705	SHAFT, MANUAL
706	SEAL ASSEMBLY, MANUAL SHAFT/CASE
707	LEVER, INSIDE DETENT
708	ACTUATOR ASSEMBLY, PARKING LOCK
709	PLUG, PARKING PAWL SHAFT
710	SPRING, PARKING PAWL RETURN
711	RETAINER, PARKING PAWL SHAFT
712	SHAFT, PARKING PAWL LOCK
713	PAWL, PARKING LOCK

Figure 18 — Removing Parking Lock and Actuator Assembly

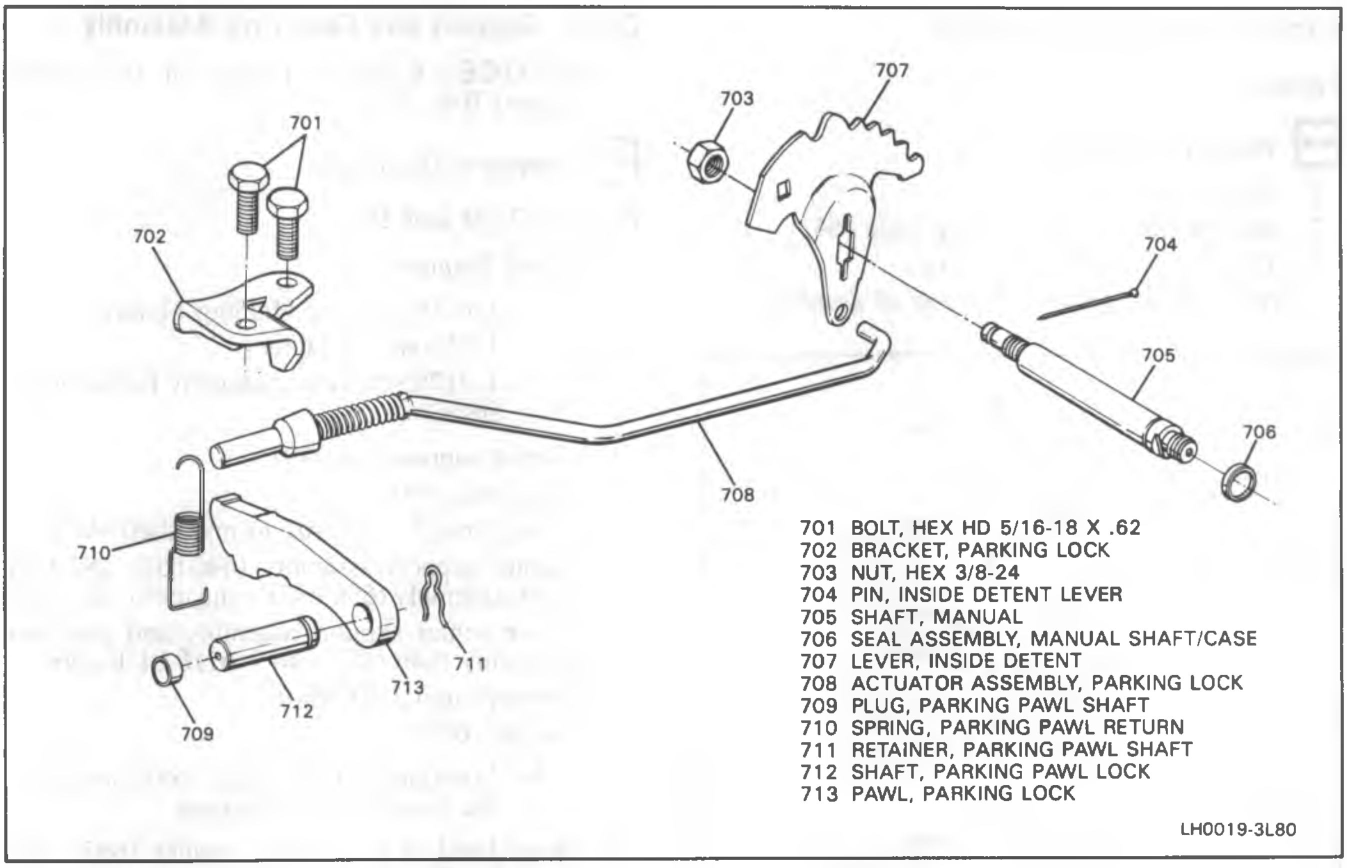


Figure 19 — Park Lock Pawl and Actuator Assembly

Forward Clutch Assembly

Figure 20

Remove or Disconnect

- Forward clutch assembly (601-619).
  - Grasp turbine shaft and lift.

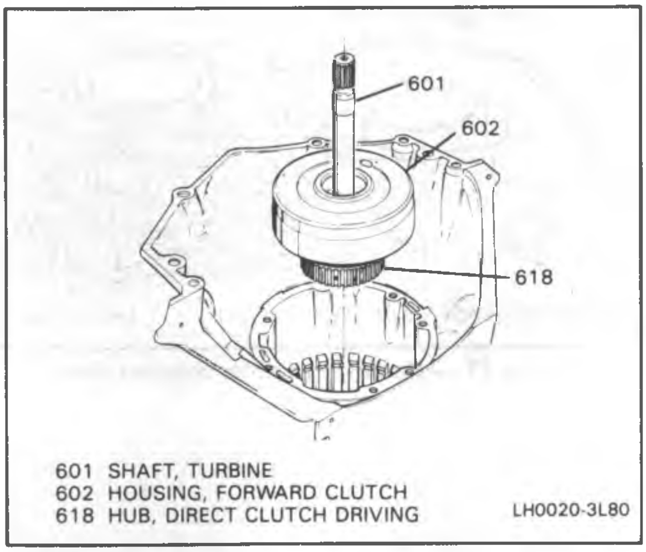


Figure 20 — Removing Forward Clutch Assembly

Direct Clutch Assembly

Figure 21

Remove or Disconnect

1. Direct clutch assembly (619 - 638)
2. Front band (639)

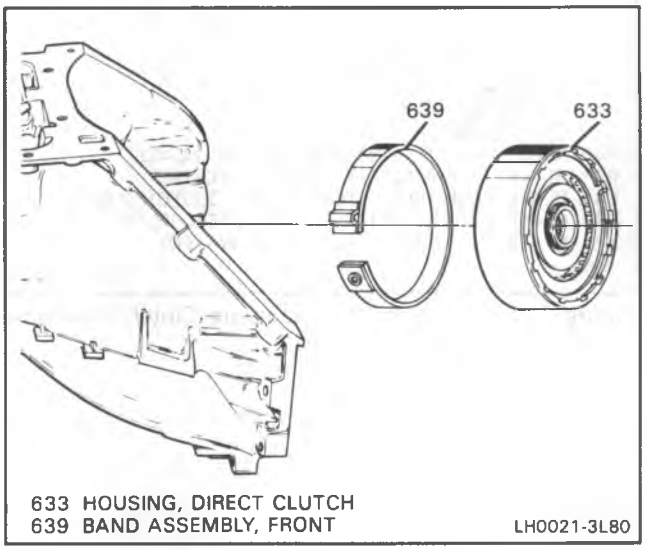


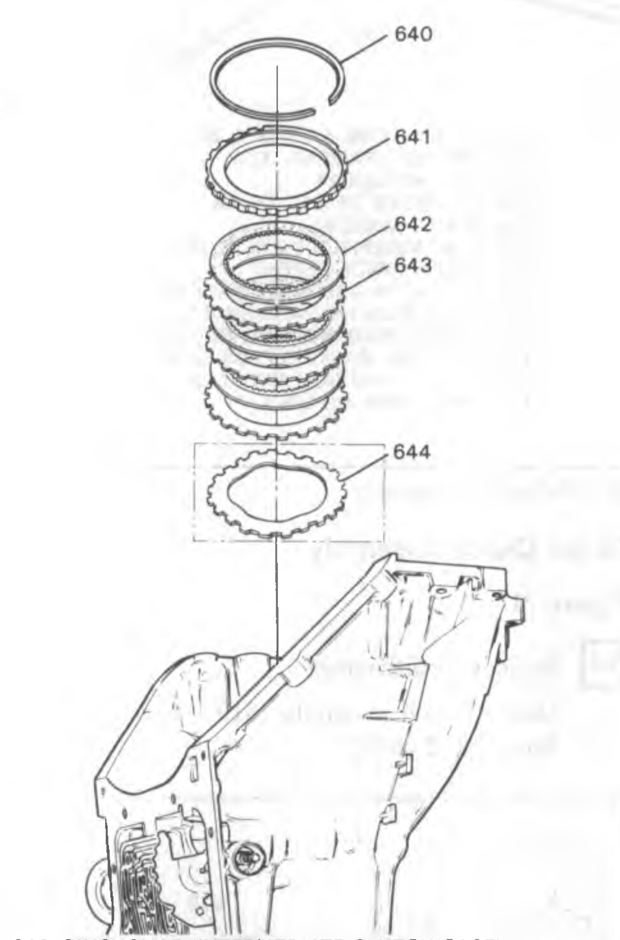
Figure 21 — Removing Direct Clutch Housing

Intermediate Clutch Assembly

Figure 22

Remove or Disconnect

1. Snap ring (640).
2. Intermediate clutch backing plate (641).
3. Clutch plates (642 and 643).
4. Waved plate (644) when part of assembly.



640 RING, SNAP (INTERMEDIATE CLUTCH/CASE)
641 PLATE, INTERMEDIATE CLUTCH BACKING
642 PLATE ASSEMBLY, INTERMEDIATE CLUTCH (FIBER)
643 PLATE, INTERMEDIATE CLUTCH STEEL (FLAT)
644 PLATE, INTERMEDIATE CLUTCH (WAVED)

LH0022-3L80

Figure 22 — Removing Intermediate Clutch Assembly

Center Support and Gear Unit Assembly

NOTICE: Recheck Torque of the Center Support Bolt (79)

Remove or Disconnect

Figures 23, 24 and 25

Tools Required:

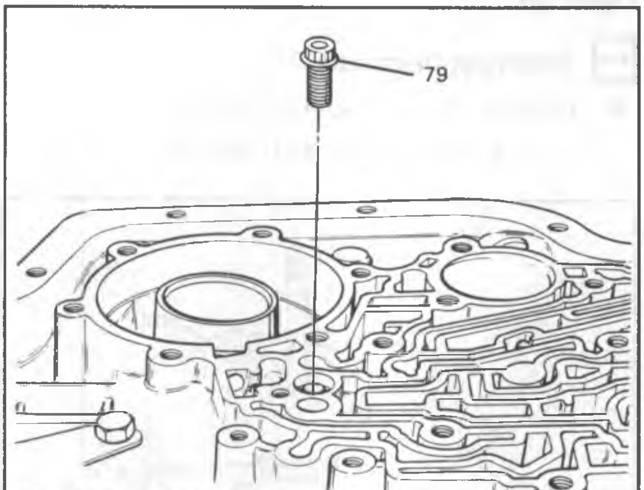
J 6116-01 Gear Holding Fixture

J 21364-A Adapter

J 21795-02 Gear Assembly Remover and Installer

1. Center support bolt (79).
2. Snap ring (645).
3. Attach tool J 21795-02 to mainshaft (681).
4. Center support assembly (646-655) and Gear Unit Assembly (656-697) using tool J 21795-02
5. Place center support assembly and gear unit assembly (646-697) into J 6116-01 fixture.
6. Remove tool J 21795-02.
7. Spacer (657).
   - Location of thin spacer (657) located at the bottom of case splines.
8. Rear band (672), thrust washer (695), and selective thrust washer (696).

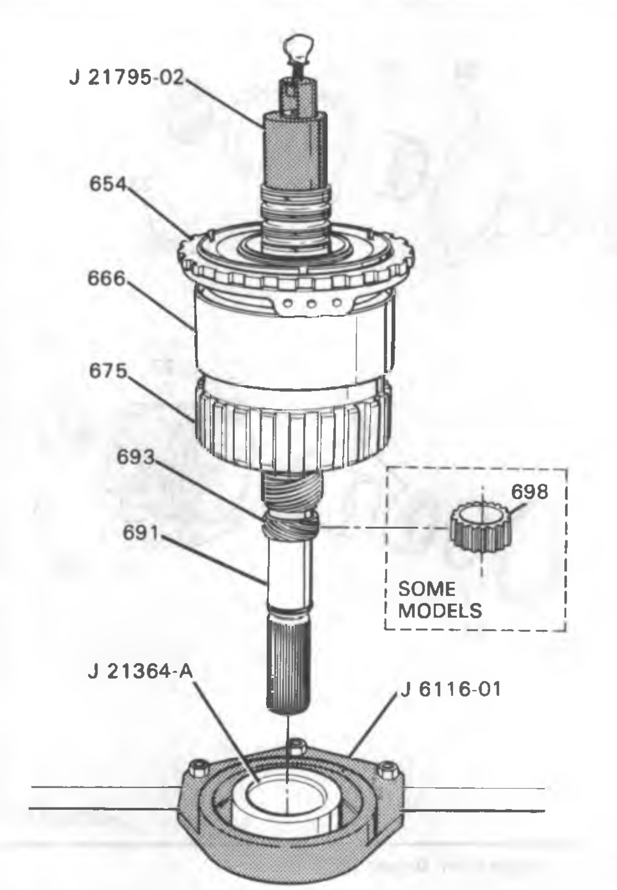
NOTICE: Thrust washer (695) may be attached to the output shaft (691).



79 SCREW, CASE TO CENTER SUPPORT

LH0023-3L80

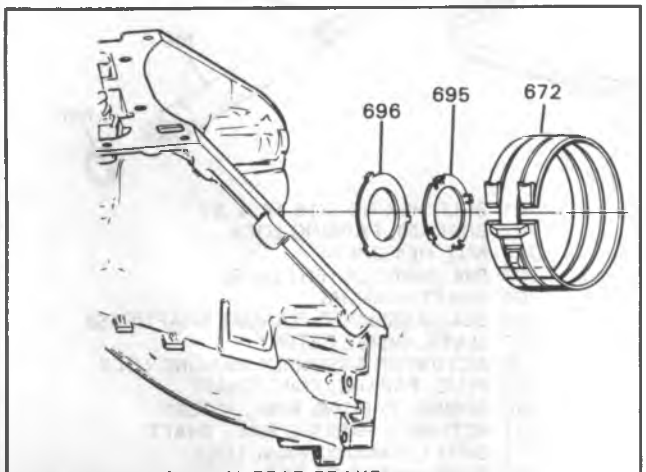
Figure 23 — Removing Center Support Bolt



ILL. NO.	DESCRIPTION
654	SUPPORT ASSEMBLY, CENTER
666	CARRIER ASSEMBLY, REACTION
675	CARRIER ASSEMBLY, OUTPUT
691	SHAFT, OUTPUT
693	GEAR, SPEEDOMETER DRIVE
698	ROTOR, SPEED SENSOR

LH0024-3L80

Figure 24 — Removing Center Support and Gear Unit Assembly



672	BAND ASSEMBLY, REAR BRAKE
695	WASHER, THRUST (OUTPUT SHAFT/SELECTIVE)
696	WASHER, THRUST SELECTIVE

LH0025-3L80

Figure 25 — Removing Rear Band and Selective Thrust Washer

Transmission Case

Figure 26

Inspect

- Case (10) for cracks, porosity and connected passages. Scored bushing (33).
- Case extension (27) for cracks, porosity, scored bushing (30).
- All threaded holes for damage.
  — Heli-coil to repair.
- Air check all fluid passages
  — see Diagnosis Section for fluid passage identification.
- Front and rear servo bores for damage, porosity, or burrs.
- Cooler connectors (16) for
  — damage
  — proper torque 38 N·m (28 lb. ft.)
- Intermediate clutch plate lugs for damage or hardening (brinelling).
- Snap ring grooves for damage.
- Governor and modulator bores for scoring or damage.
- Case center support bolt hole for damage (Figure 23).
- Clean all components.

TRANSMISSION ASSEMBLY

- The assembly of some components will require use of an assembly lube. It is recommended the TRANSJEL ™ J 36850 or equivalent be used during assembly.

NOTICE: Do not use any type of grease to retain parts during assembly of this unit. Greases other than the recommended assembly lube will change transmission fluid characteristics and cause undesirable shift conditions and/or filter clogging.

Park Lock Pawl and Actuator Assembly

Inspect

- Parking pawl (713) for cracks, burrs, damage
- Parking pawl shaft (712) for damage and freeness of fit
- Parking pawl return spring (710) for distortion or damage
- Detent lever (707) and actuator (708) for:
  — Damage or cracks
- Manual shaft for damage

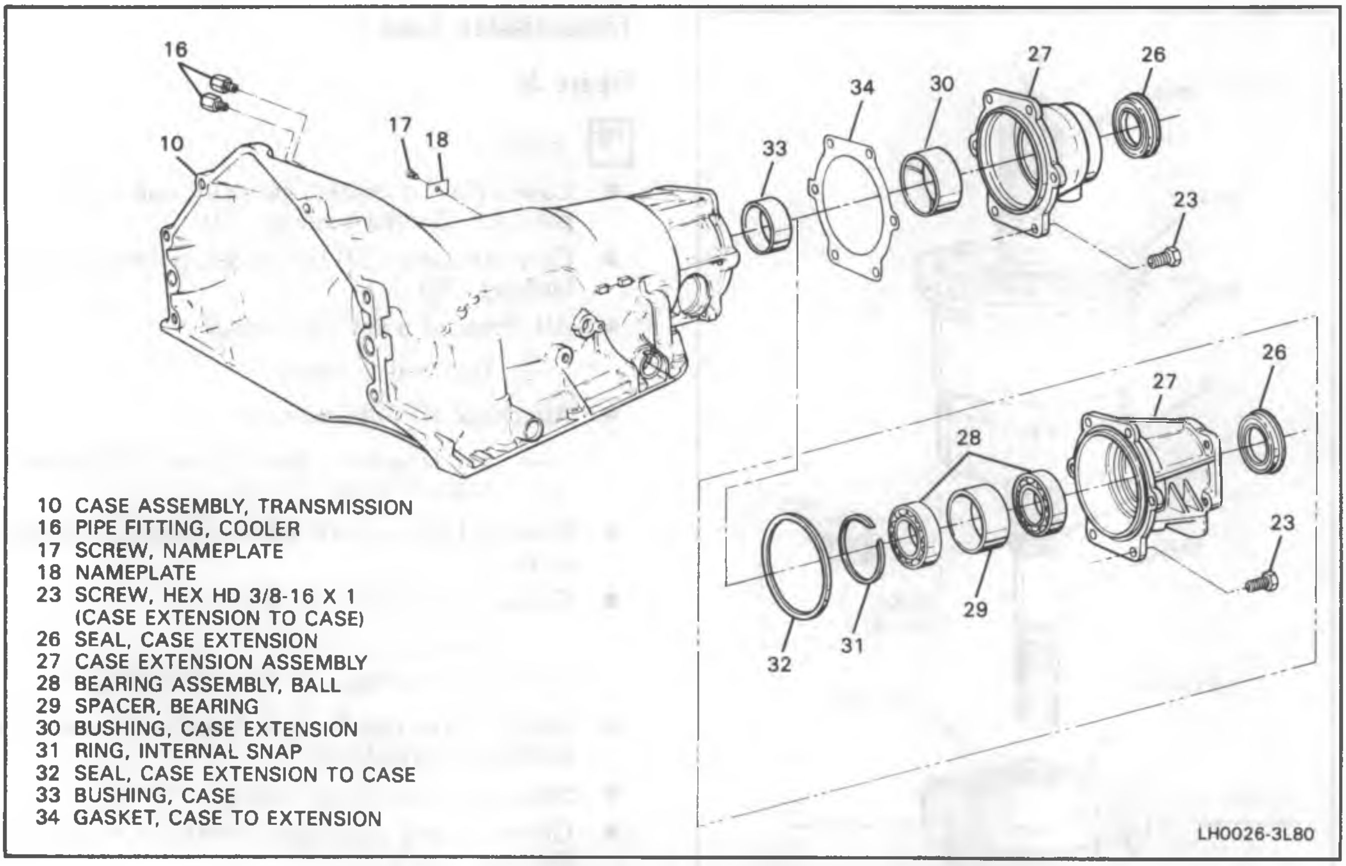


Figure 26 — Transmission Case and Extension Assembly

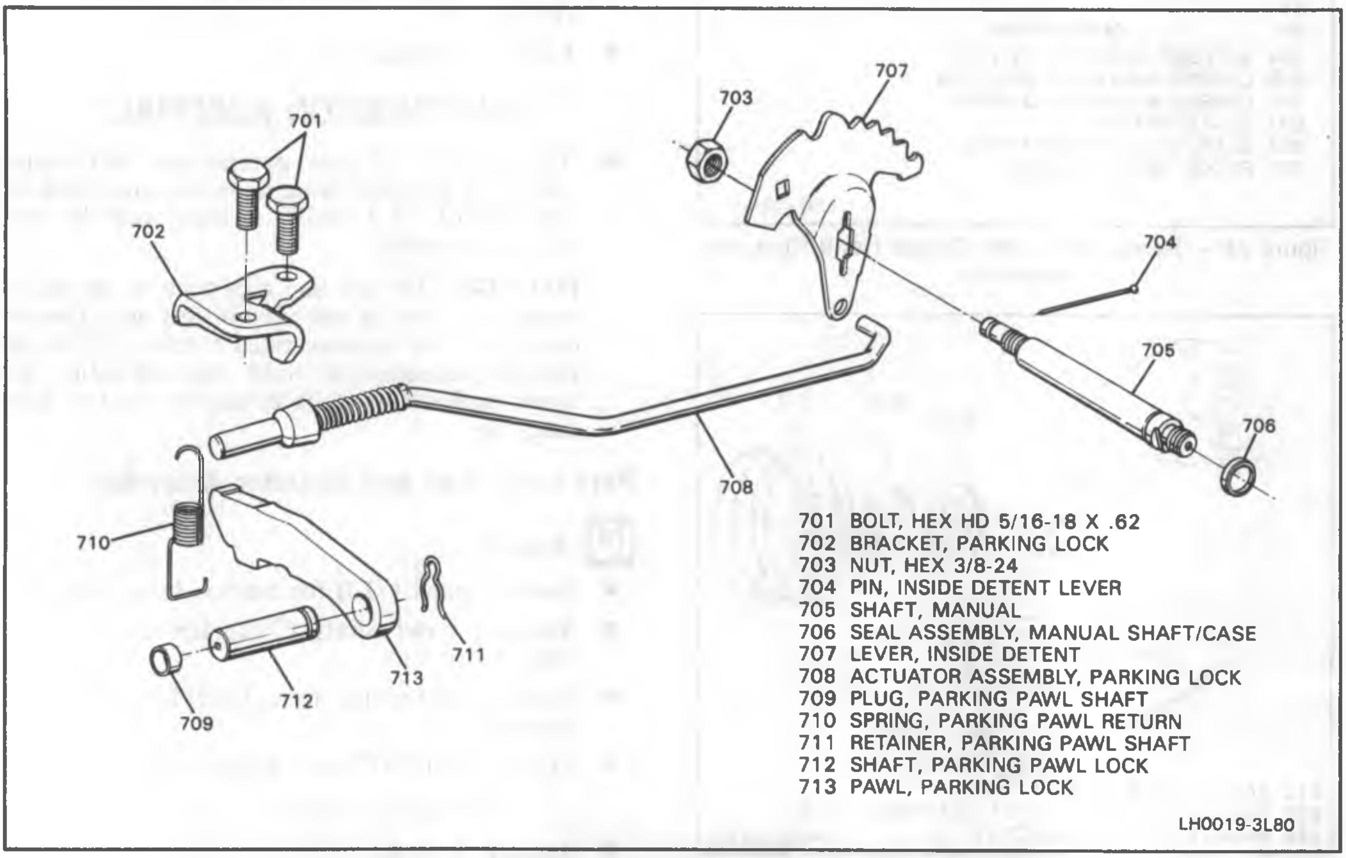
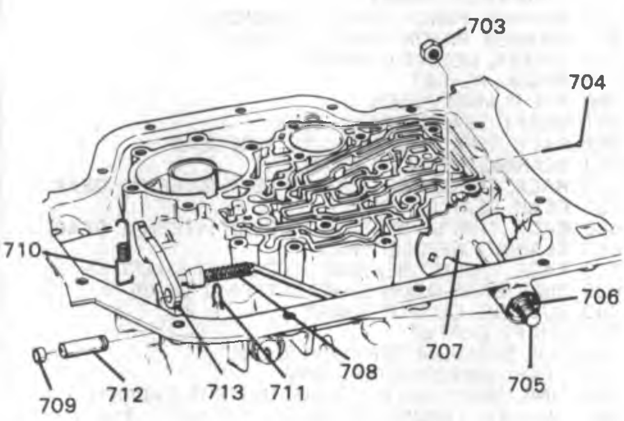


Figure 27 — Park Lock Pawl and Actuator Assembly

Install or Connect

Figures 27 and 28

1. Parking pawl (713).
2. Pawl shaft (712).
3. Plug (709) (Using 5/16 rod).
4. Retainer (711).
5. Pawl return spring (710).
6. Detent lever (707) to actuator (708).
7. Actuator (708) over parking pawl (713).
8. Manual shaft (705) and seal (706).
9. Nut (703) on shaft (705).
10. Pin (704).
11. Parking lock bracket (702) with bolts (701)
    - Torque to 23 N·m (17 lb. ft.)



ILL. NO.	DESCRIPTION
703	NUT, HEX 3/8-24
704	PIN, INSIDE DETENT LEVER
705	SHAFT, MANUAL
706	SEAL ASSEMBLY, MANUAL SHAFT/CASE
707	LEVER, INSIDE DETENT
708	ACTUATOR ASSEMBLY, PARKING LOCK
709	PLUG, PARKING PAWL SHAFT
710	SPRING, PARKING PAWL RETURN
711	RETAINER, PARKING PAWL SHAFT
712	SHAFT, PARKING PAWL LOCK
713	PAWL, PARKING LOCK

LH0018-3L80

Figure 28 — Installing Park Lock Assembly

Rear Band and Selective Thrust Washer

Figure 29

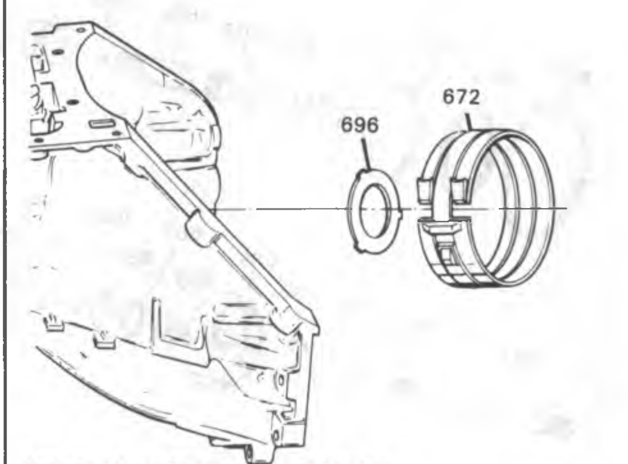
Inspect

- Rear band (672) and selective thrust washer (696) for:
  - — wear or damage

Install or Connect

Figure 29

1. Selective thrust washer (696) from Rear End Play Check.
2. Rear band (672).



672 BAND ASSEMBLY, REAR BRAKE
696 WASHER, THRUST SELECTIVE

LH0029-3L80

Figure 29 — Installing Rear Band and Selective Thrust Washer

Gear Unit and Output Carrier Assemblies

Figure 30

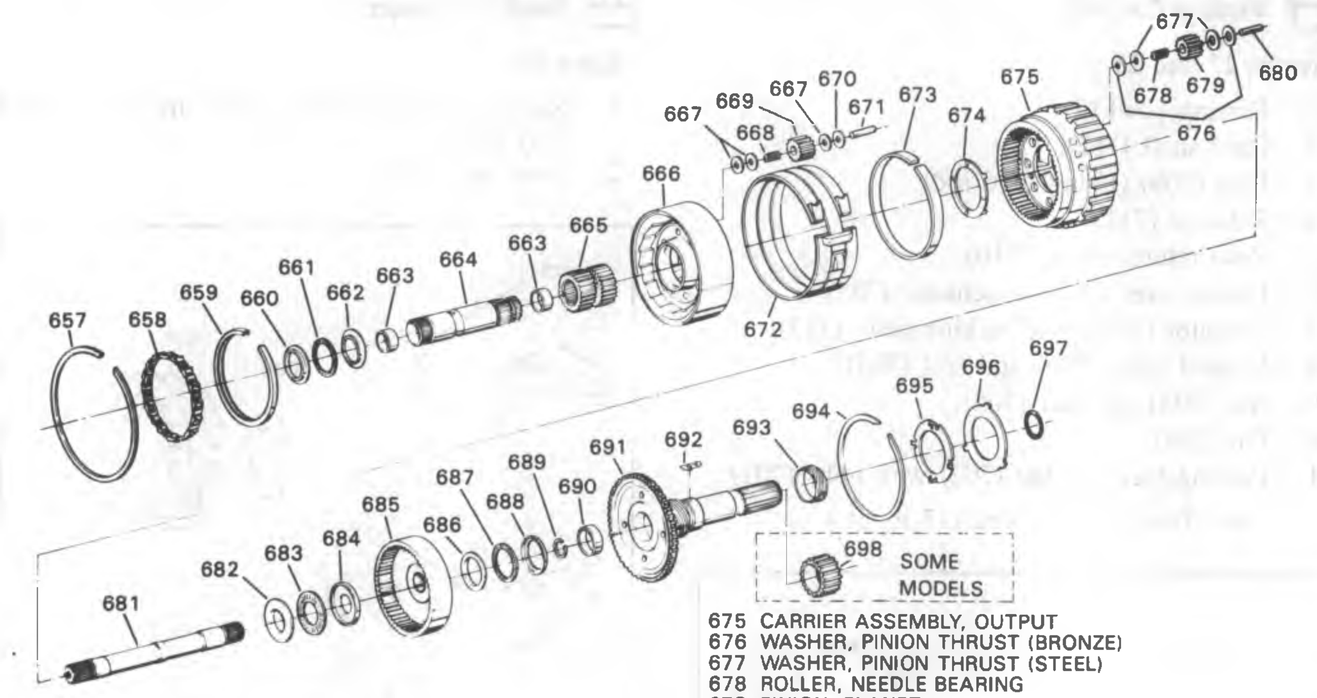
Disassemble

1. Center support (654).
2. Sun gear shaft (664).
3. Reaction carrier assembly (666).
4. Thrust bearing (661) and races (660 and 662).
5. Sun gear (665), thrust washer (674) and front internal gear ring (673).
6. Snap ring (694), output shaft (691) and O-ring (697).
7. Thrust bearing (687) and races (686 and 688).
8. Rear internal gear (685) and main shaft (681).
9. Snap ring (689) from main shaft (681).
10. Main shaft (681).
11. Thrust bearing (683) and races (682 and 684).

Inspect

Figures 30 and 31

- Main shaft (681) for:
  - — damaged splines
  - — wear

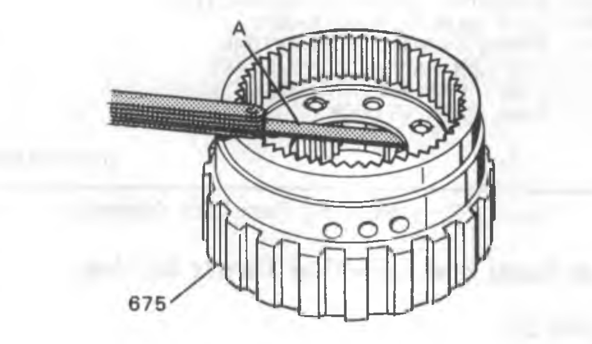


657 SPACER, CENTER SUPPORT/CASE
658 ROLLER ASSEMBLY, LOW CLUTCH
659 RING, REACTION DRUM SPACER
660 RACE, THRUST BEARING TO CENTER SUPPORT
661 BEARING, NEEDLE THRUST
662 RACE, THRUST BEARING TO SUN GEAR
663 BUSHING, 1.12 O.D. X .50
664 SHAFT, SUN GEAR
665 GEAR, SUN
666 CARRIER ASSEMBLY, REACTION
667 WASHER, PINION THRUST (STEEL)
668 ROLLER, NEEDLE BEARING
669 PINION, PLANET
670 WASHER, PINION THRUST (BRONZE)
671 PIN, PLANET PINION
672 BAND ASSEMBLY, REAR BRAKE
673 RING, FRONT INTERNAL GEAR
674 WASHER, FRONT INTERNAL/REACTION CARRIER
675 CARRIER ASSEMBLY, OUTPUT
676 WASHER, PINION THRUST (BRONZE)
677 WASHER, PINION THRUST (STEEL)
678 ROLLER, NEEDLE BEARING
679 PINION, PLANET
680 PIN, PLANET PINION
681 SHAFT, TRANSMISSION MAIN
682 RACE, THRUST BEARING TO SUN GEAR
683 BEARING, NEEDLE THRUST
684 RACE, THRUST BEARING TO REAR INTERNAL GEAR
685 GEAR, REAR INTERNAL
686 RACE, THRUST BEARING TO REAR INTERNAL GEAR
687 BEARING, NEEDLE THRUST
688 RACE, THRUST BEARING TO OUTPUT SHAFT
689 RING, SNAP (MAIN SHAFT/INTERNAL GEAR)
690 BUSHING, OUTPUT SHAFT
691 SHAFT, OUTPUT
692 CLIP, SPEEDOMETER DRIVE GEAR
693 GEAR, SPEEDOMETER DRIVE
694 RING, SNAP (OUTPUT SHAFT/OUTPUT CARRIER)
695 WASHER, THRUST (OUTPUT SHAFT/SELECTIVE)
696 WASHER, THRUST (SELECTIVE)
697 SEAL, O-RING (OUTPUT SHAFT)
698 ROTOR, SPEED SENSOR

LH0030-3L80

Figure 30 — Gear Unit Assembly

- Rear internal gear (685) for:
  - — stripped splines
  - — damaged teeth
  - — cracks
- Output carrier assembly (675) for:
  - — damaged lugs
  - — pinion gear damage
  - — excess pinion washer wear (end play should be .228-.610 mm (.009" - .024")
- Front internal gear ring (673) for:
  - — damage
  - — cracks
- Thrust washers, bearings and races:
  - — damage



A (.009"-.024")
675 CARRIER ASSEMBLY, OUTPUT

LH0031-3L80

Figure 31 — Measuring Pinion End Play

SPEEDOMETER DRIVE GEAR/SPEED SENSOR ROTOR REPLACEMENT

Figure 32

Tools Required:

J 21427-01 Speedometer Gear Puller Adapter

J 8433 Speedometer Gear Puller

J 36352-3 Rotor Installer/Mechanical Press

J 36352-2 Rotor Installer/Mechanical Press

Do not remove rotor (698) unless damaged. After removal, a new rotor must be installed to insure press fit to output shaft.

1. Install J 21427-01 adapter and J 8433 puller.
2. Depress clip (692) and remove gear (693) or rotor (698).
3. Install rotor (698) using J 36352-3 or J 36352-2.

Install speedometer drive gear (693) and clip (692)

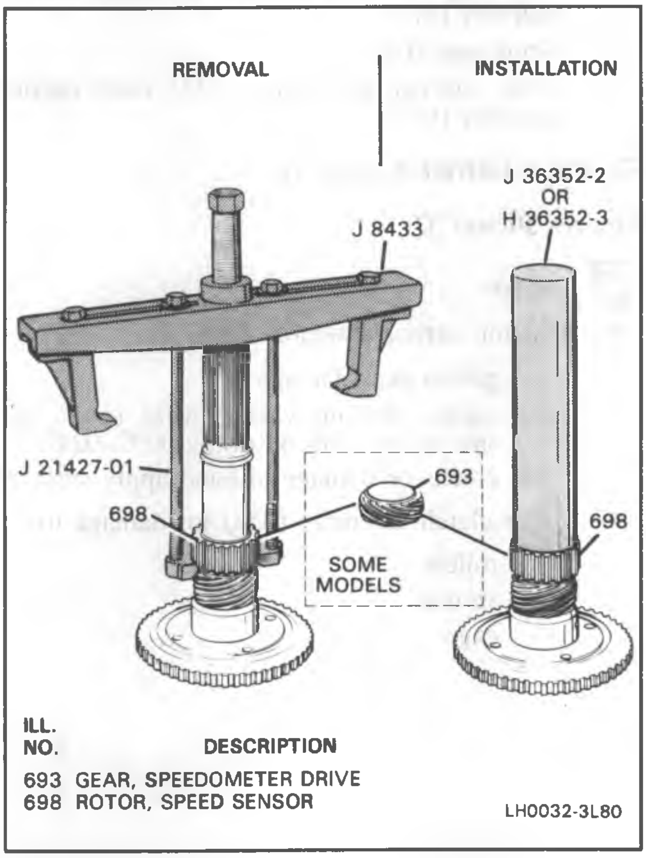


Figure 32 — Removing Steel Speedometer Drive Gear

Pinion Gear Replacement Procedure — Output Carrier Assembly

Figures 33 and 34

Remove or Disconnect

1. Stake marks from pinion pins (680) with 1/2 in. drill.

Important

- Do not allow drill to remove stock from carrier. Excessive removal of material will weaken carrier.

2. Pinion pins (680) from carrier (675).
3. Pinion gears (679), thrust washers (676, 677) and roller needle bearings (678).

Inspect

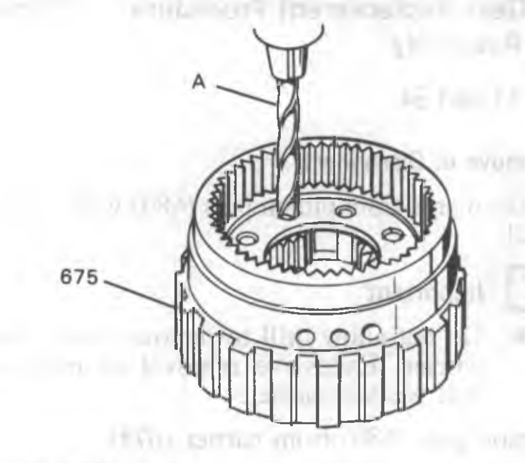
Figures 34 and 35

- Pinion pocket thrust faces for burrs.
- Output carrier (675) for:
  — cracks, damage or wear

Assemble

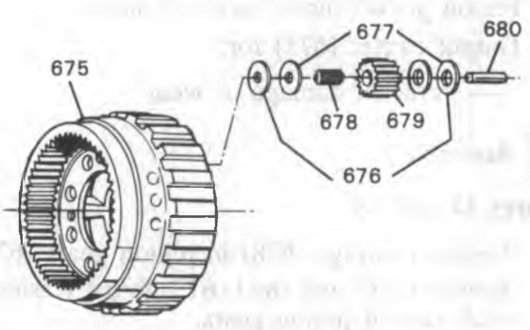
Figures 34 and 35

1. Needle bearings (678) in pinion gears (679).
2. Bronze (676) and steel (677) thrust washers on each side of pinion gears.
   - steel washers are next to pinion gears
3. Pinion gear assemblies into carriers (675).
4. Pinion pins (680)
   - headed end of pins must be flush with carrier face.
5. Stake pins at three points with blunt chisel.
   - pins must not extend beyond carrier surface



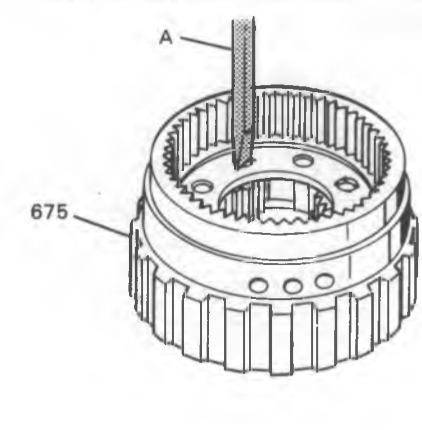
A 1/2" DRILL
675 CARRIER ASSEMBLY, OUTPUT
LH0033-3L80

Figure 33 — Removing Pinion Pins from Output Carrier



675 CARRIER ASSEMBLY, OUTPUT
676 WASHER, PINION THRUST (BRONZE)
677 WASHER, PINION THRUST (STEEL)
678 ROLLER, NEEDLE BEARING
679 PINION, PLANET
680 PIN, PLANET PINION
LH0034-3L80

Figure 34 — Output Carrier Assembly



A CHISEL
675 CARRIER ASSEMBLY, OUTPUT
LH0035-3L80

Figure 35 — Staking Pinion Pin

Gear Unit Assembly

Figures 30, 36 and 41

Assemble

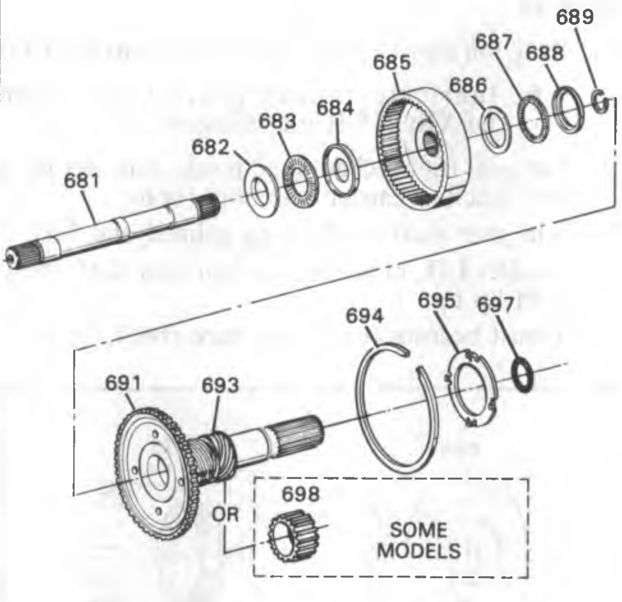
1. Main shaft (681) into rear internal gear (685).
2. Snap ring (689) onto main shaft (681).
3. Inner Race (686), lip up, thrust bearing (687) and outer race (688), lip down, onto rear internal gear hub (685), retain with TRANSJEL™ J 36850 or equivalent.
4. Outer race (684), lip up, thrust bearing (683) and inner race (682), lip down.
5. Thrust washer (674) onto output carrier assembly (675) with tabs in pockets. Retain with TRANSJEL ™ J 36850 or equivalent.
6. Main shaft (681) and rear internal gear (685) assembly into output carrier assembly (675).
   - Lubricate pinion gears (679) with DEXRON®-II transmission fluid.
7. Thrust washer (695) onto output shaft (691).
8. Output shaft (691) into output carrier assembly (675).
9. Snap ring (694) in groove of output carrier assembly (675).
10. O-ring seal (697).
11. Front internal gear ring (673) onto carrier assembly (675).

Reaction Carrier Assembly

Figures 30 and 37

Inspect

- Reaction carrier assembly (666) for:
  - — pinion gear damage
  - — excess pinion washer wear (end play should be .228-.610 mm/.009"-.024")
  - — cracks or damage to band apply surface
- Roller clutch assembly (658) for damage to:
  - — rollers
  - — springs
  - — cage

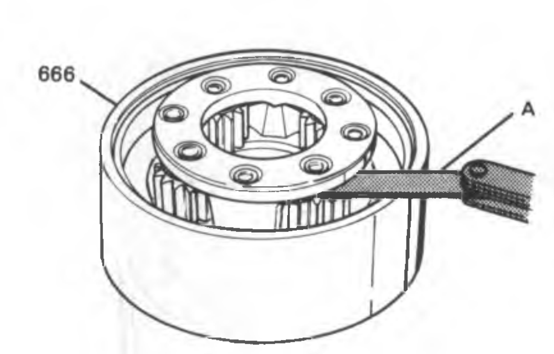


681 SHAFT, TRANSMISSION MAIN
682 RACE, THRUST BEARING TO SUN GEAR
683 BEARING, NEEDLE THRUST
684 RACE, THRUST BEARING TO REAR INTERNAL GEAR
685 GEAR, REAR INTERNAL
686 RACE, THRUST BEARING TO REAR INTERNAL GEAR
687 BEARING, NEEDLE THRUST
688 RACE, THRUST BEARING TO OUTPUT SHAFT
689 RING, SNAP (MAIN SHAFT/INTERNAL GEAR)
691 SHAFT, OUTPUT
693 GEAR, SPEEDOMETER DRIVE
694 RING, SNAP (OUTPUT/OUTPUT CARRIER)
695 WASHER, THRUST (OUTPUT SHAFT/SELECTIVE)
697 SEAL, O-RING (OUTPUT SHAFT)
698 ROTOR, SPEED SENSOR

LH0036-3L80

Figure 36 — Assembling Output Shaft and Rear Internal Gear

- Reaction drum spacer ring (659) for damage
- Sun gear (665) and sun gear shaft (664) for:
  - — nicked, scored or worn bushings (663) (see Bushing Replacement Procedure)
  - — damaged splines or teeth
  - — cracks



ILL. NO. DESCRIPTION
A (.009-.024)
666 CARRIER ASSEMBLY, REACTION

LH0037-3L80

Figure 37 — Measuring Reaction Carrier Pinion Gears

Pinion Gear Replacement Procedure

Figures 38, 39 and 40

Remove or Disconnect

1. Stake marks from pinion pins (671) with 1/2 in. drill

   Important

   - DO NOT ALLOW DRILL TO REMOVE STOCK FROM CARRIER. EXCESSIVE REMOVAL OF MATERIAL WILL WEAKEN CARRIER.

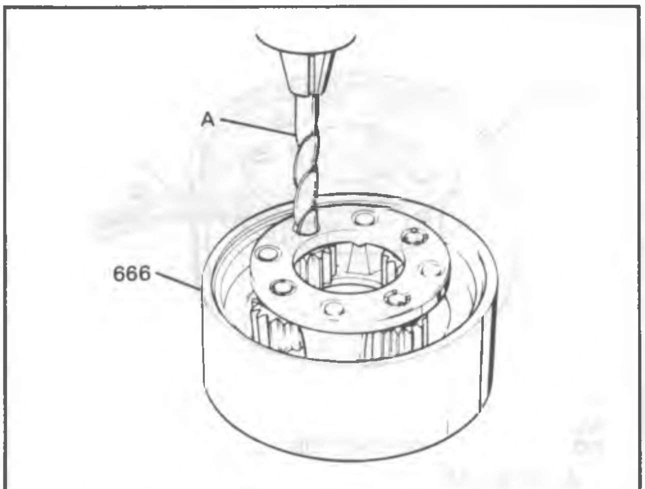
2. Pinion pins (671) from carrier (666).
3. Pinion gears (669), thrust washers (667, 670) and roller needle bearings (668)

Inspect

- Pinion pocket thrust surfaces for burrs.
- Reaction carrier (666) for:
  - — cracks, damage or wear

Assemble

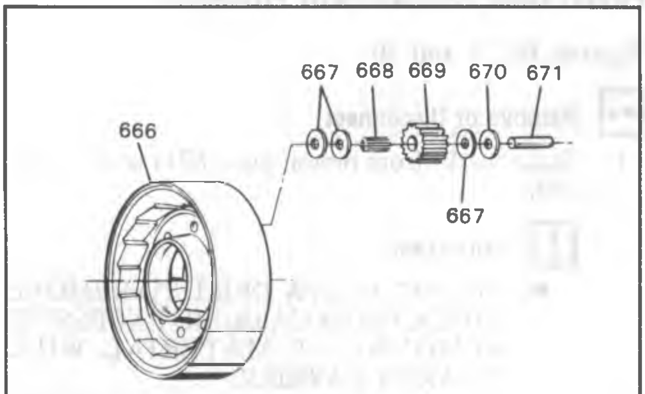
1. Needle bearings (668) in pinion gears (669)
2. Bronze washers (670) and steel washers (667) as shown
3. Pinion gear assemblies into carrier (666)
4. Pinion pins (671)
   - headed end of pins must be flush with carrier face
5. Stake pins at three points with blunt chisel



A 1/2" DRILL
666 CARRIER ASSEMBLY, REACTION

LH0038-3L80

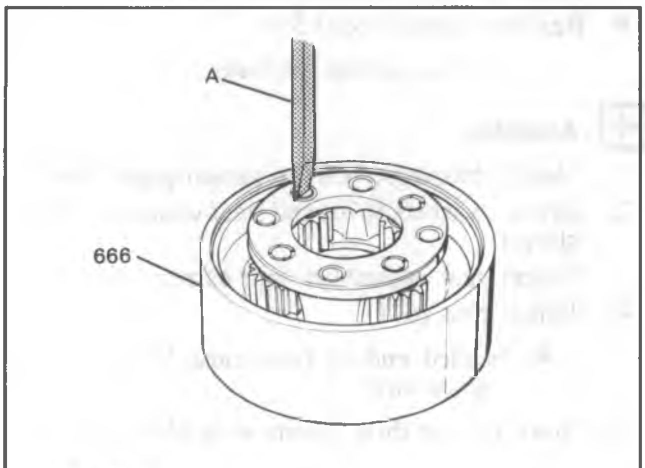
Figure 38 — Removing Pinion Pins from Reaction Carrier



666 CARRIER ASSEMBLY, REACTION
667 WASHER, PINION THRUST (STEEL)
668 ROLLER, NEEDLE BEARING
669 PINION, PLANET
670 WASHER, PINION THRUST (BRONZE)
671 PIN, PLANET PINION

LH0039-3L80

Figure 39 — Reaction Carrier Assembly



A CHISEL
666 CARRIER ASSEMBLY, REACTION

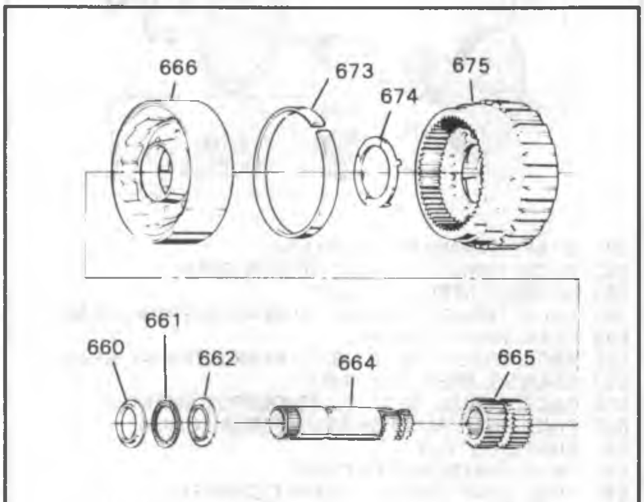
LH0040-3L80

Figure 40 — Staking Pinion Pins

Assemble

Figure 41

1. Reaction carrier (666) into output carrier (675)
   - lubricate pinion gears (669) with DEXRON®-II transmission fluid
2. Sun gear (665) (chamfered inside diameter first) into reaction carrier assembly (666).
3. Sun gear shaft (664), long splined end first.
4. Smaller I.D. race (662) on sun gear shaft (664) with lip up.
5. Thrust bearing (661), and race (660), lip up.



ILL. NO.	DESCRIPTION
660	RACE, THRUST BEARING TO CENTER SUPPORT
661	BEARING, NEEDLE THRUST
662	RACE, THRUST BEARING TO SUN GEAR
664	SHAFT, SUN GEAR
665	GEAR, SUN
666	CARRIER ASSEMBLY, REACTION
673	RING, FRONT INTERNAL GEAR
674	WASHER, FRONT INTERNAL/REACTION CARRIER
675	CARRIER ASSEMBLY, OUTPUT

LH0041-3L80

Figure 41 — Assembling Output and Reaction Carriers

Intermediate Clutch Piston

Figure 42

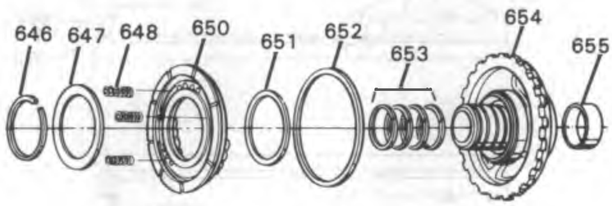
Remove or Disconnect

1. Rings (653) from center support (654).
2. Press in on spring retainer (647) and remove snap ring (646).
3. Retainer (647) and three clutch release springs (648).

4. Clutch piston (650).
5. Inner seal (651) and outer seal (652) from clutch piston (650).

Important

- Do not remove three screws holding roller clutch race to center support (654).



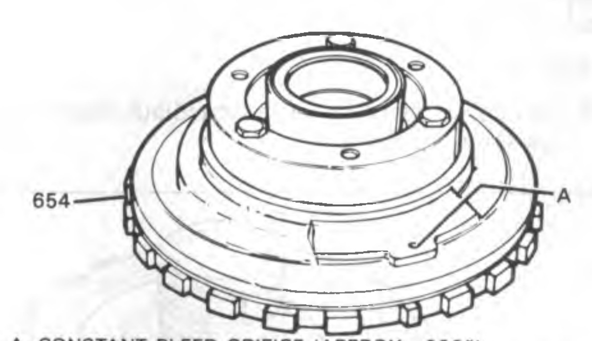
646 RING, SNAP (INTERMEDIATE CLUTCH/RETAINER)
647 RETAINER, INTERMEDIATE CLUTCH SPRING
648 SPRING, INTERMEDIATE CLUTCH RELEASE
650 PISTON, INTERMEDIATE CLUTCH
651 SEAL, INTERMEDIATE CLUTCH (INNER)
652 SEAL, INTERMEDIATE CLUTCH (OUTER)
653 RING, SEAL
654 SUPPORT ASSEMBLY, CENTER
655 BUSHING, CENTER SUPPORT
LH0042-3L80

Figure 42 — Center Support and Intermediate Clutch Piston

Inspect

Figures 42 and 43

- Roller clutch race on center support (654) for scratches, wear or damage.
- Center support (654) for:
  - — cracks
  - — damaged lugs
  - — damaged center support bolt threads
- Seal rings (653) and ring grooves for damage, burrs or cuts.
- Air check passages (Figure 45).
- Intermediate clutch piston (650) for cracks or damage.
- Sealing surfaces and seal grooves for scratches or other damage.
- Springs (648) for collapsed coils or distortion.
- Constant bleed orifice is open approximately .020" (.51 mm).
- Bushing (665) scored, damage
- Clean all components



A CONSTANT BLEED ORIFICE (APPROX. .020")
654 SUPPORT ASSEMBLY, CENTER
LH0043-3L80

Figure 43 — Constant Bleed Orifice

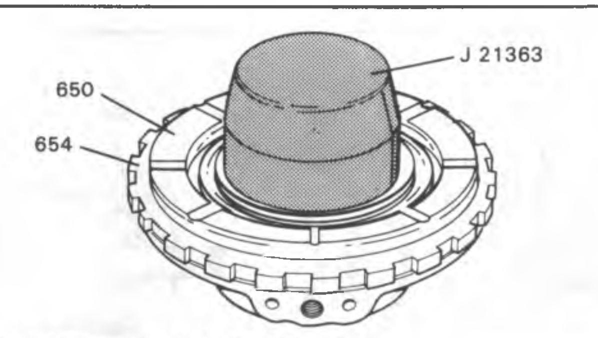
Assemble

Figures 42, 44 and 45

Tool Required:

J 21363 Intermediate Clutch Inner Seal Protector

1. Lubricate new inner and outer clutch piston seals (651 and 652) and grooves with DEXRON®-II transmission fluid.
2. Seals (651 and 652) on piston (650) with lips facing away from spring pockets
3. Clutch piston (650) on center support (654) with J 21363.
4. Clutch release springs (648).
5. Spring retainer (647) and snap ring (646).
6. Seal rings (653) on center support hub (654).
   - Use TRANSJEL ™ J 36850 or equivalent to keep rings (653) tightly sealed.
   - Check for proper lap of seals.



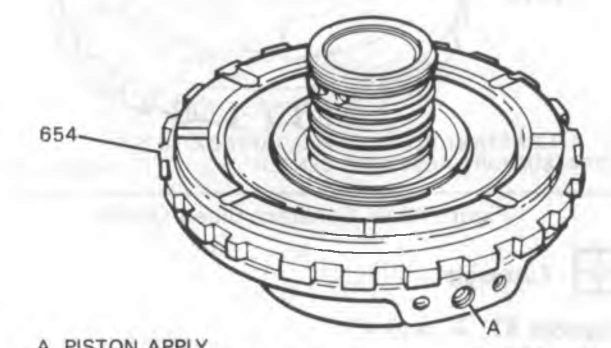
650 PISTON, INTERMEDIATE CLUTCH
654 SUPPORT ASSEMBLY, CENTER
LH0044-3L80

Figure 44 — Installing Intermediate Clutch Piston Seals

Inspect

Figure 45

- Air check operation of intermediate clutch piston as shown in Hole A.



A PISTON APPLY
654 SUPPORT ASSEMBLY, CENTER
LH0045-3L80

Figure 45 — Air Checking Intermediate Clutch

Low Roller Clutch Assembly

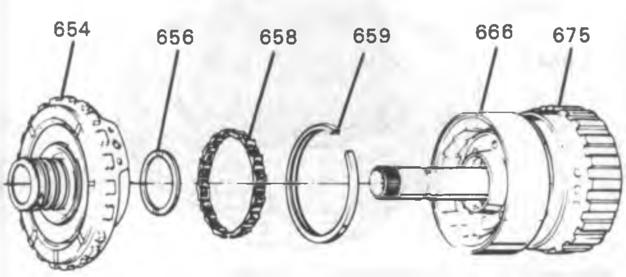
Figures 46 and 47

Install or Connect

1. Thrust washer (656) in recess of center support (654).
2. Spacer (659) and roller assembly (658) into reaction carrier (666).
3. Center support (654) into reaction carrier (666).

Important

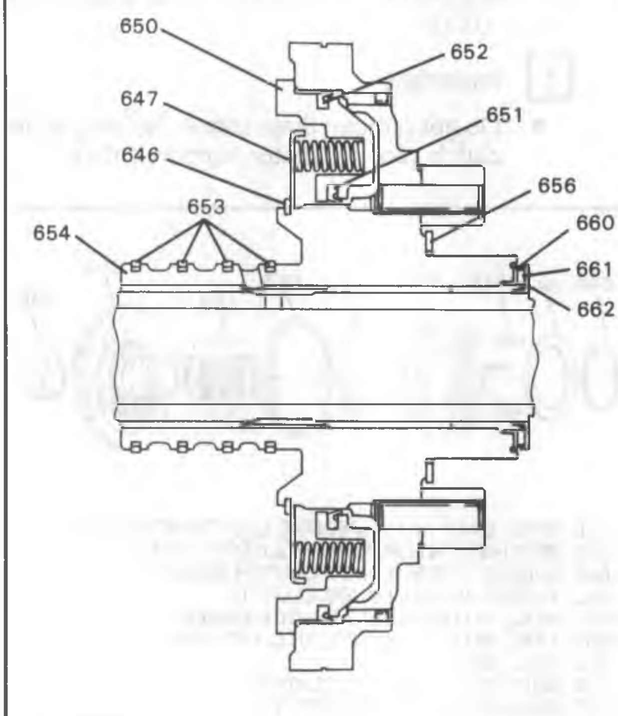
- To verify correct assembly, hold reaction carrier (666) stationary. Center support (654) should turn counterclockwise only.



ILL. NO.	DESCRIPTION
654	SUPPORT ASSEMBLY, CENTER
656	WASHER, THRUST (SUPPORT/REACTION DRUM)
658	ROLLER ASSEMBLY, LOW CLUTCH
659	RING, REACTION DRUM SPACER
666	CARRIER ASSEMBLY, REACTION
675	CARRIER ASSEMBLY, OUTPUT

LH0046-3L80

Figure 46 — Installing Spacer Ring and Roller Clutch Assembly



ILL. NO.	DESCRIPTION
646	RING, SNAP (INTERMEDIATE CLUTCH/RETAINER)
647	RETAINER, INTERMEDIATE CLUTCH SPRING
650	PISTON, INTERMEDIATE CLUTCH
651	SEAL, INTERMEDIATE CLUTCH (INNER)
652	SEAL, INTERMEDIATE CLUTCH (OUTER)
653	RING, SEAL
654	SUPPORT ASSEMBLY, CENTER
656	WASHER, THRUST (SUPPORT/REACTION DRUM)
660	RACE, THRUST BEARING TO CENTER SUPPORT
661	BEARING, NEEDLE THRUST
662	RACE, THRUST BEARING TO SUN GEAR

LH0047-3L80

Figure 47 — Center Support and Reaction Carrier Assembly

Direct Clutch and Intermediate Roller Assembly

Figures 48 and 49

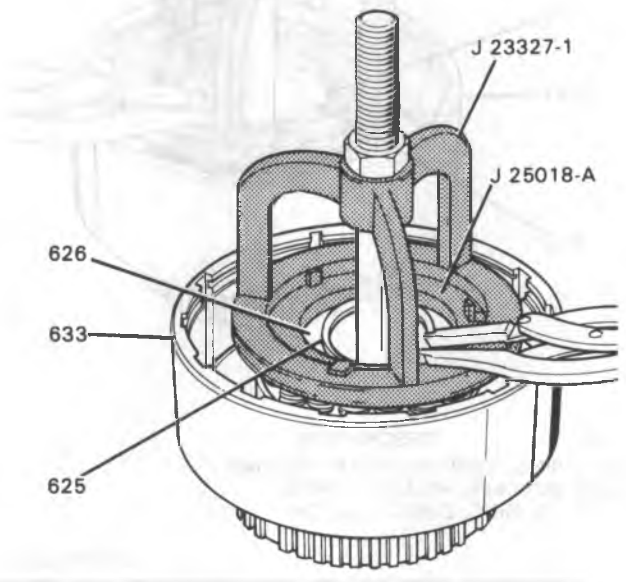
Disassemble

Tools Required:

J 23327-1 Spring Compressor
J 25018-A Adapter
Mechanical Press

1. Snap ring (638) and clutch retainer (637).
2. Race (636) and roller assembly (634) (or sprag assembly 635).
3. Snap ring (619).
4. Direct clutch backing plate (620) and clutch plates (621 and 622).
5. Wave plate (623), if used, and dish plate (624) if used.

6. Snap ring (625) with J 23327-1 and J 25018-A.
7. Retainer (626) and clutch release springs (627).
8. Piston (629).
9. Inner seal (630) and outer seal (631) from piston (629).
10. Center seal (632) from housing (633).



ILL. NO.	DESCRIPTION
625	RING, SNAP (RETAINER/HOUSING)
626	RETAINER, RELEASE SPRING
633	HOUSING, DIRECT CLUTCH

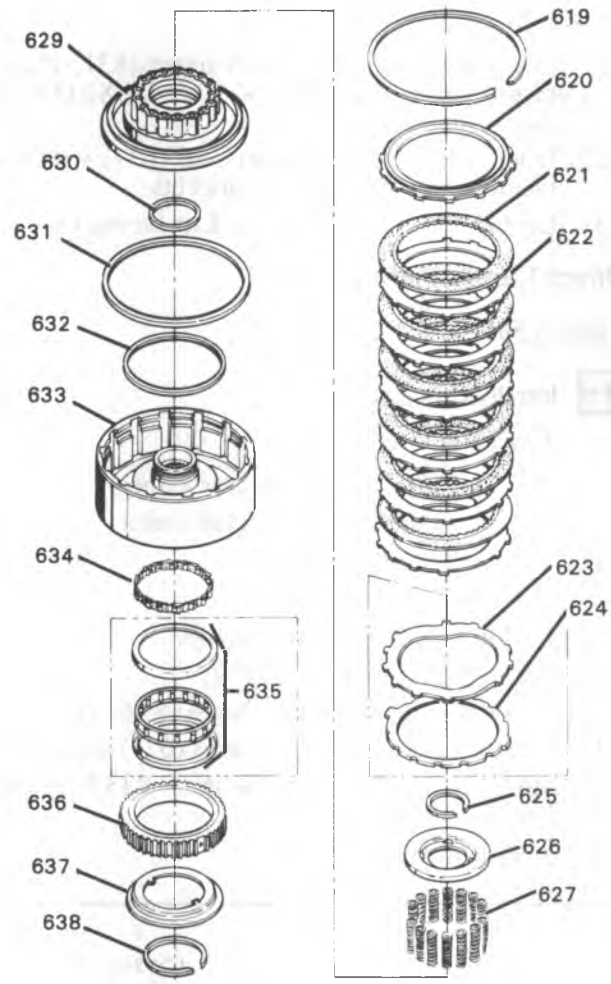
LH0048-3L80

Figure 48 — Disassembly of Direct Clutch Housing

Inspect

Figure 48

- Roller assembly (634) for damaged rollers, cage or distorted springs or sprag assembly (635).
- Clutch housing (633) for cracks, wear and proper opening of oil passages.
- Clutch plates (621 and 622) for:
  - — wear
  - — burned
  - — flaking
- Backing plate (620) and piston (629) for damage or cracks.
- Clutch springs (627) for collapsed coils or distortion.
  - — replace if necessary
- Housing (633) for correct operation of check ball.
- Clean all components



ILL. NO.	DESCRIPTION
619	RING, SNAP (FORWARD & DIRECT CLUTCHES)
620	PLATE, DIRECT CLUTCH BACKING
621	PLATE ASSEMBLY, CLUTCH (FIBER)
622	PLATE, CLUTCH STEEL (FLAT)
623	PLATE, CLUTCH (WAVED)
624	PLATE, CLUTCH (DISHED)
625	RING, SNAP (RETAINER/HOUSING)
626	RETAINER, RELEASE SPRING
627	SPRING, PISTON RELEASE
629	PISTON, DIRECT CLUTCH
630	SEAL, CLUTCH PISTON (INNER)
631	SEAL, CLUTCH PISTON (OUTER)
632	SEAL, CLUTCH HOUSING (INNER)
633	HOUSING, DIRECT CLUTCH
634	ROLLER ASSEMBLY, INTERMEDIATE CLUTCH
635	SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
636	RACE, INTERMEDIATE CLUTCH
637	RETAINER, INTERMEDIATE CLUTCH
638	RING, SNAP (RETAINER/DIRECT CLUTCH)

LH0049-3L80

Figure 49 — Direct Clutch and Intermediate Roller Assembly

Assemble

Figure 49

1. Lubricate inner (630) and outer (631) clutch piston seals and grooves with DEXRON®-II transmission fluid.
2. Inner seal (630) and outer seal (631) with lips facing away from spring pockets.
3. Center housing seal (632). Lip facing up.

Direct Clutch Piston

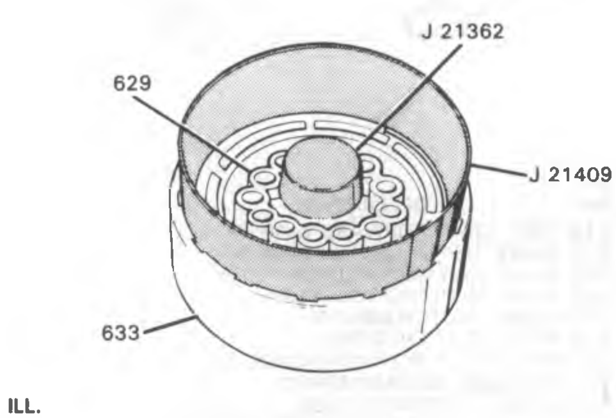
Figures 50 and 51

Install or Connect

Tools Required:

- J 21362 Seal Protector (inner)
- J 21409 Seal Protector (outer)
- J 23327-1 Bridge
- J 25018-A Adapter

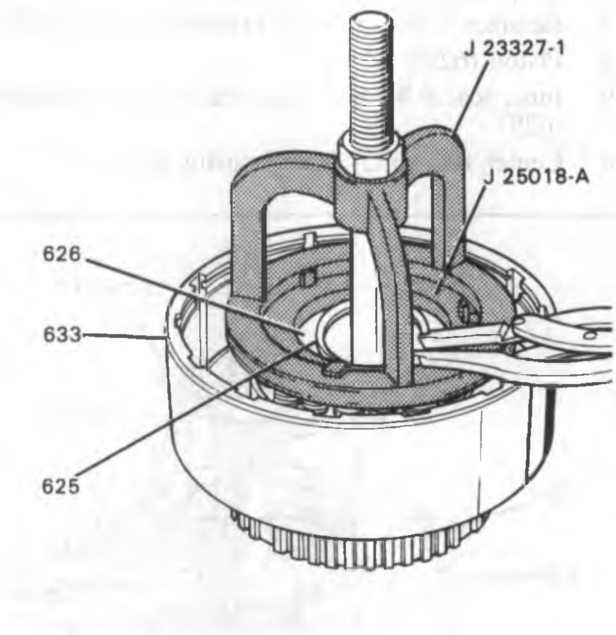
1. J 21362 on housing (633) hub.
2. Piston (629) inside J 21409.
3. J 21409 and piston into housing (633).
4. Fourteen clutch release springs (627) in pockets.
5. Spring retainer (626) with J 23327-1 and J 25018-A.
6. Snap ring (625).



ILL. NO.	DESCRIPTION
629	PISTON, DIRECT CLUTCH
633	HOUSING, DIRECT CLUTCH

LH0050-3L80

Figure 50 — Installing Direct Clutch Piston



ILL. NO.	DESCRIPTION
625	RING, SNAP (RETAINER/HOUSING)
626	RETAINER, RELEASE SPRING
633	HOUSING, DIRECT CLUTCH

LH0048-3L80

Figure 51 — Installing Piston Release Spring Retainer

Direct Clutch Assembly

Figures 52, 53 and 54

Install or Connect

NOTICE: Dip all clutch plates in DEXRON®-II transmission fluid prior to assembling, to aid lubrication during start up.

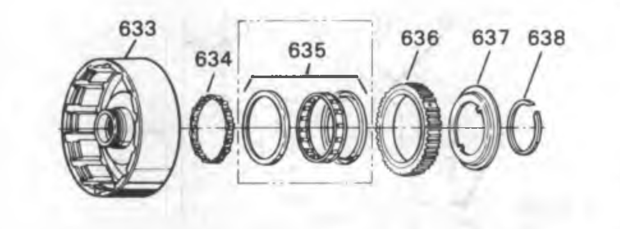
1. Waved clutch plate (623) or dished clutch plate (624) into direct clutch housing (633).
   - dished plate facing up
2. Clutch plates (621 and 622).
   - alternate steel and composition plates as shown in chart
3. Direct clutch backing plate (620) and snap ring (619).
4. Roller assembly (634) or sprag assembly (635).
5. Intermediate clutch race (636) with clockwise motion. When properly installed, it should not rotate counterclockwise.
6. Intermediate clutch retainer (637) and snap ring (638).

1990 HYRA-MATIC 3L80 CLUTCH PLATE APPLICATION CHART
DIRECT CLUTCH

MODELS	NO. OF FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK (INCHES)
THICKNESS	2.32 MM (.0915")	1.97 MM (.0775")	1.54 MM (.0605")	1.37 MM (.054")	2.03 MM (.080")	
FAA, HCA, HFA, HHA, HLA, LXA, MTA, MWA, MXA, MZA, SBA, SHA, SJA, TAA, TBA, TDA, TFA, TKA, TMA, TNA, TRA	5				5	.017-.078
FBA, FEA, FKA, HAA, MAA, MSA, ZSA	6				6	.026-.087
RMA	4		1		5	.047-.110
RDA, RLA	5		1		6	.041-.111
ALL OTHERS	2	3		1	5	.071-.140

LH0052-3L80

Figure 52 — Direct Clutch Plate Chart



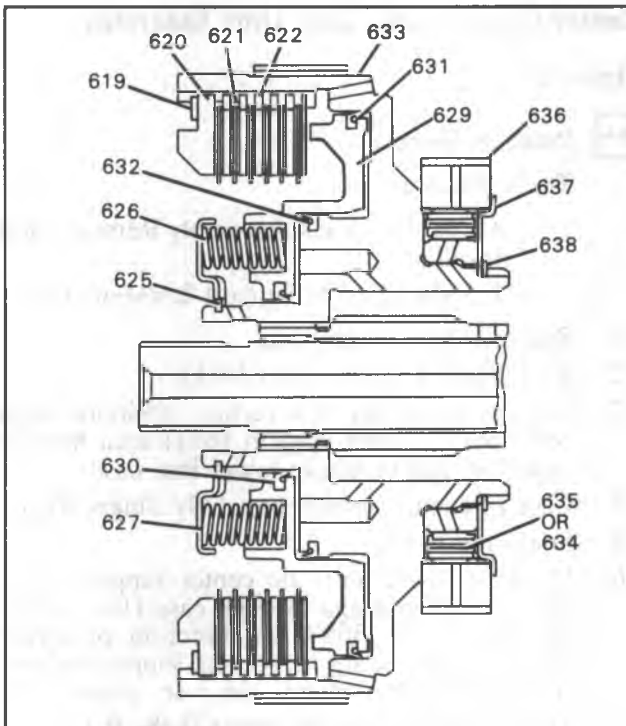
633 HOUSING, DIRECT CLUTCH
634 ROLLER ASSEMBLY, INTERMEDIATE CLUTCH
635 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
636 RACE, INTERMEDIATE CLUTCH
637 RETAINER, INTERMEDIATE CLUTCH
638 RING, SNAP (RETAINER/DIRECT CLUTCH) LH0053-3L80

Figure 53 — Installing Roller Assembly

Inspect

Figure 55

1. Place direct clutch assembly on center support (654) for air check operation.
2. Air applied to reverse passage will escape from direct passage. This condition is normal. Apply air to direct passage to actuate piston and move clutch plates.
3. Remove direct clutch



619 RING, SNAP (FORWARD & DIRECT CLUTCHES)
620 PLATE, DIRECT CLUTCH BACKING
621 PLATE ASSEMBLY, CLUTCH (FIBER)
622 PLATE, CLUTCH STEEL (FLAT)
623 PLATE, CLUTCH (WAVED)
625 RING, SNAP (RETAINER/HOUSING)
626 RETAINER, RELEASE SPRING
627 SPRING, PISTON RELEASE
629 PISTON, DIRECT CLUTCH
630 SEAL, CLUTCH PISTON (INNER)
631 SEAL, CLUTCH PISTON (OUTER)
632 SEAL, CLUTCH HOUSING (INNER)
633 HOUSING, DIRECT CLUTCH
634 ROLLER ASSEMBLY, INTERMEDIATE CLUTCH
635 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
636 RACE, INTERMEDIATE CLUTCH
637 RETAINER, INTERMEDIATE CLUTCH LH0054-3L80
638 RING, SNAP (RETAINER/DIRECT CLUTCH)

Figure 54 — Direct and Intermediate Roller Clutch Assembly

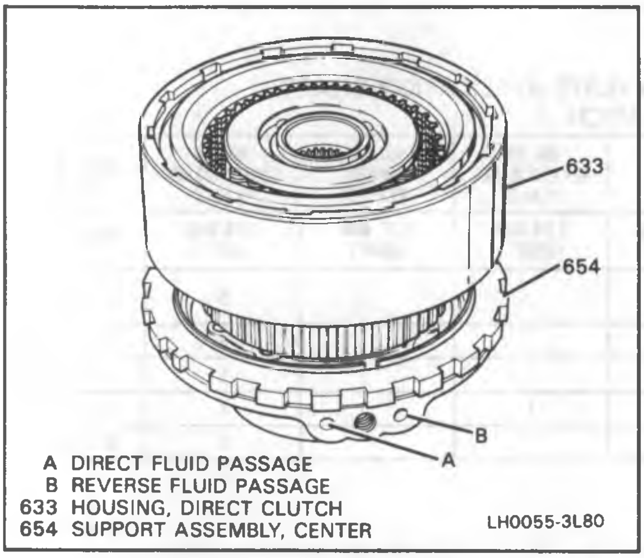


Figure 55 — Air Check Direct Clutch

Center Support and Gear Unit Assembly

Figure 56

Install or Connect

Tools Required:

J 21795-02 Gear Assembly Remover and Installer

J 23093 Center Support Locating Tool

1. Spacer (657), if removed.
2. J 21795-02 to main shaft (681).
3. With transmission in a vertical position, align bolt hole in center support (654) with hole in case (10) and carefully lower into case.
4. Case to center support bolt (79), finger tight.
5. Snap ring (645).
6. Locate J 23093 into the center support (654) direct clutch passage through case (10). Apply pressure on J 23093, in direction of arrow (Figure 56), seating the center support splines counterclockwise against the case splines.
7. Torque bolt (79) to 30 N·m (22 lb. ft.)

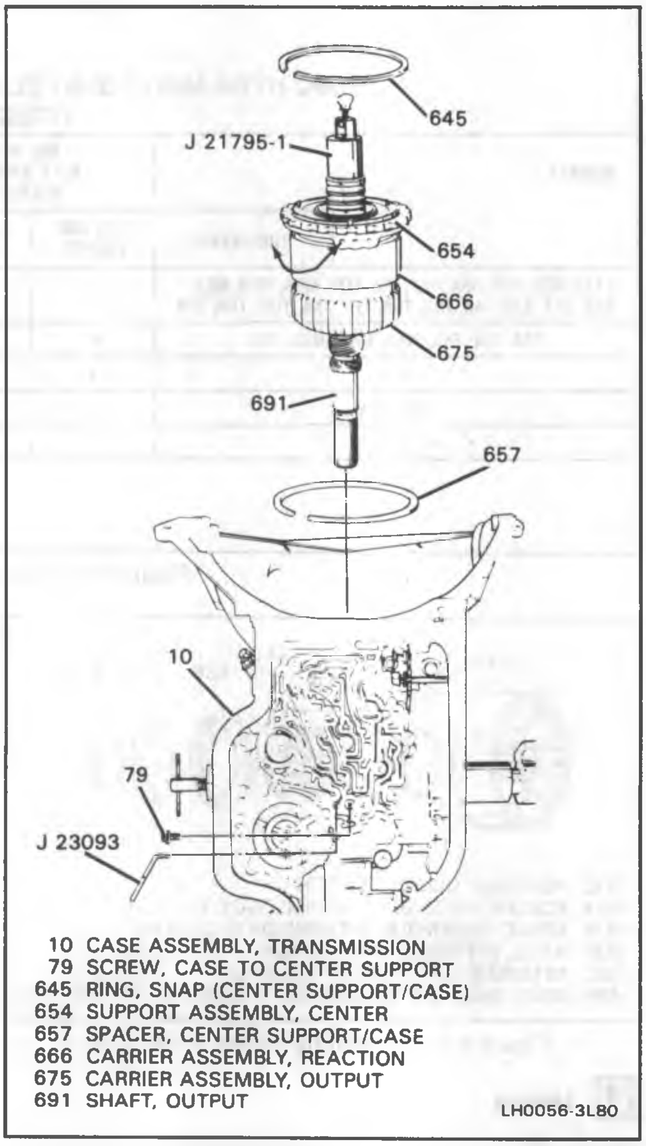


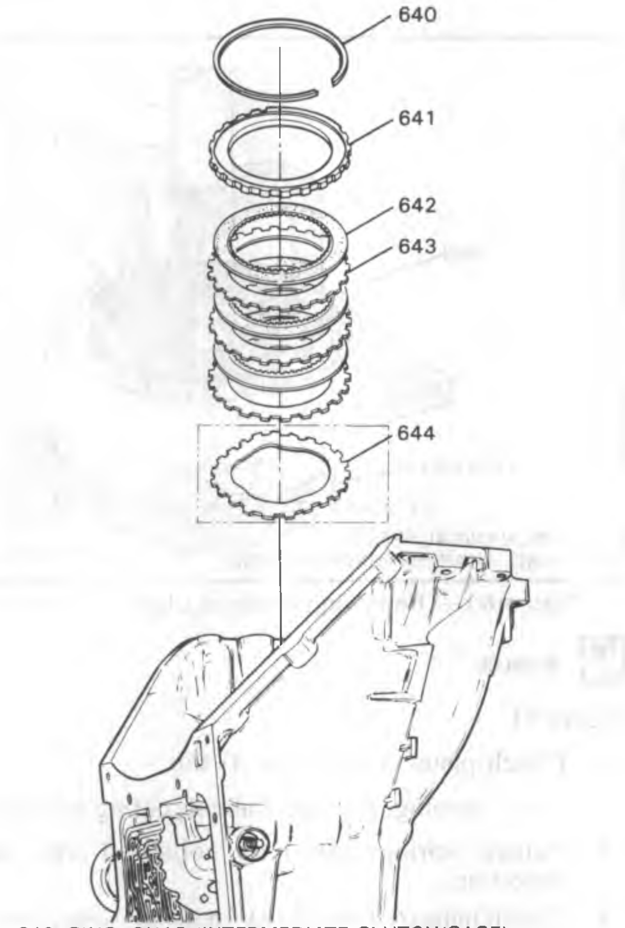
Figure 56 — Installing Center Support and Gear Unit Assembly

Intermediate Clutch Assembly

Figure 57

Inspect

- Clutch plates (642) for:
  - — wear, pitting, flaking or cracks in lining
- Clutch plates (643) for:
  - — discoloration, scoring or cracks
- Backing plate (641) for burrs and dirt.
- Front band for:
  - — wear, pitting, flaking or cracks in lining



640 RING, SNAP (INTERMEDIATE CLUTCH/CASE)
641 PLATE, INTERMEDIATE CLUTCH BACKING
642 PLATE ASSEMBLY, INTERMEDIATE CLUTCH (FIBER)
643 PLATE, INTERMEDIATE CLUTCH STEEL (FLAT)
644 PLATE, INTERMEDIATE CLUTCH (WAVED)

LH0022-3L80

Figure 57 — Intermediate Clutch Plates

Assemble

Figures 57 and 58

Tool Required:

J 24396 Intermediate Clutch Pack Alignment Tool

NOTICE: Dip all clutch plates in DEXRON®-II transmission fluid.

1. Waved plate (644), if used.
2. Steel plates (643) and composition plates (642) alternately.
   - refer to chart
3. Intermediate clutch backing plate (641).
4. Snap ring (640), thin.
5. Use J 24396 to align clutch plates.

Direct Clutch Assembly and Front Band

Figure 59

Install or Connect

1. Front band (639).
2. Direct clutch assembly (633) onto the intermediate clutch.

1990 HYDRA-MATIC 3L80 CLUTCH PLATE APPLICATION CHART
INTERMEDIATE CLUTCH

MODELS		NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK (INCHES)
	THICKNESS	2.51 MM (.099")	1.74 MM (.0685")		
FBA, FEA, FGA, FKA, HAA, MAA, MSA, ZDA, ZRA, ZSA, ZXA		3		3	.0575-.1575
ALL OTHERS		2	1	3	.0895-.1865

LH0058-3L80

Figure 58 — Intermediate Clutch Plate Chart

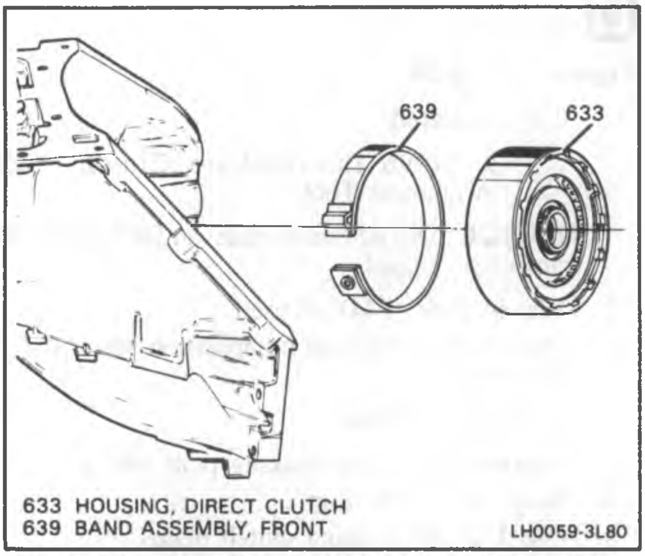


Figure 59 — Installing Direct Clutch and Front Band

Forward Clutch Assembly

Figures 60 and 61

Disassemble

Tools Required:

J 23327-1 Spring Compressor
J 25018-A Adapter
J 6116-01 Holding Fixture
J 21664 Adapter

1. Snap ring (619) and direct clutch driving hub (618) from forward clutch housing (602).
2. Forward clutch hub (616).
3. Thrust washers (615 and 617).
4. Clutch plates (613 and 614).
5. Waved clutch plate (611) or dished plate (612).
6. Snap ring (609) and release spring retainer (608) with J 23327-1 and J 25018-A.
7. Piston release springs (607), piston (606).

Important

- Unless forward clutch housing (602) and turbine shaft (601) are damaged, disassembly is not necessary.

Turbine Shaft Removal

1. Place housing (602) in mechanical press with turbine shaft (601) down.
2. Remove turbine shaft (601) by placing 3/8 in. drive extension on end of shaft and pressing out.

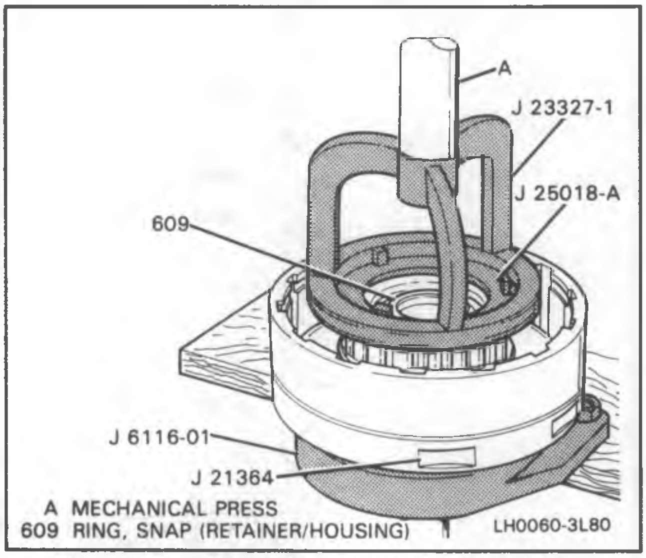


Figure 60 — Removing Forward Clutch Piston

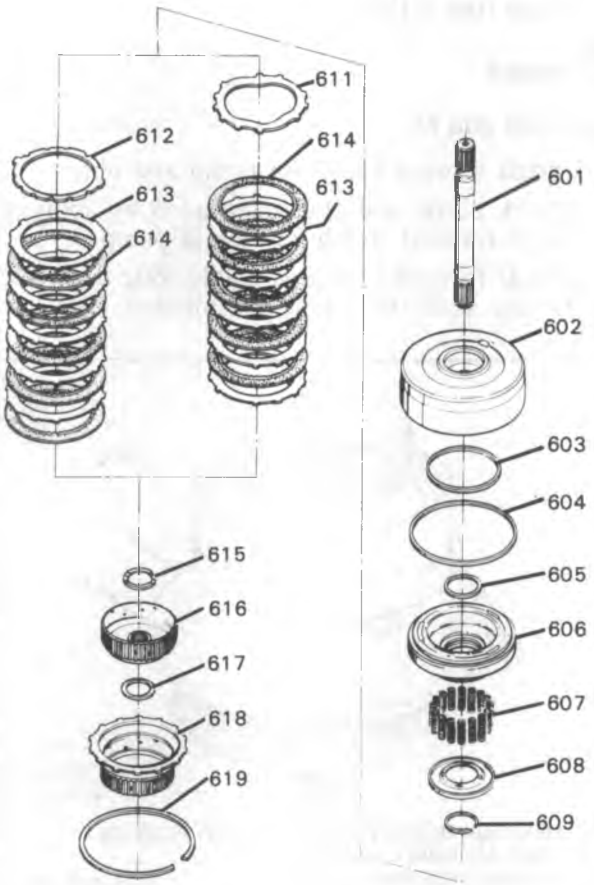
Inspect

Figure 61

- Clutch plates (613 and 614) for:
  — burning, scoring, flaking, pitting or wear.
- Release springs (607) for collapsed coils or distortion.
- Clutch hubs (616 and 618) for spline wear, open lubrication holes and damaged thrust faces.
- Piston (606) for cracks.
- Forward clutch housing (602) for wear, scoring, cracks and open fluid passages.
- Free operation of check ball.
- Turbine shaft (601) for spline damage, open fluid passages, cracks or distortion.
- Clean all components

Install or Connect

1. Forward clutch housing (602) in press facing up.
2. Turbine shaft (601) in clutch housing (602) approximately 1/8 in.
3. Continue installing in small steps, checking frequently to make sure connection is straight.



ILL. NO.	DESCRIPTION
601	SHAFT, TURBINE
602	HOUSING, FORWARD CLUTCH
603	SEAL, CLUTCH HOUSING (CENTER)
604	SEAL, CLUTCH PISTON (OUTER)
605	SEAL, CLUTCH PISTON (INNER)
606	PISTON, FORWARD CLUTCH
607	SPRING, PISTON RELEASE
608	RETAINER, RELEASE SPRING
609	RING, SNAP (RETAINER/HOUSING)
611	PLATE, CLUTCH (WAVED)
612	PLATE, CLUTCH (DISHED)
613	PLATE, CLUTCH STEEL (FLAT)
614	PLATE ASSEMBLY, CLUTCH (FIBER)
615	WASHER, THRUST (CLUTCH HUB TO HOUSING)
616	HUB, FORWARD CLUTCH
617	WASHER, THRUST (FWD. CL. HUB/DIR. CL. HSG.)
618	HUB, DIRECT CLUTCH DRIVING
619	RING, SNAP (FORWARD & DIRECT CLUTCHES)

LH0061-3L80

Figure 61 — Forward Clutch Assembly

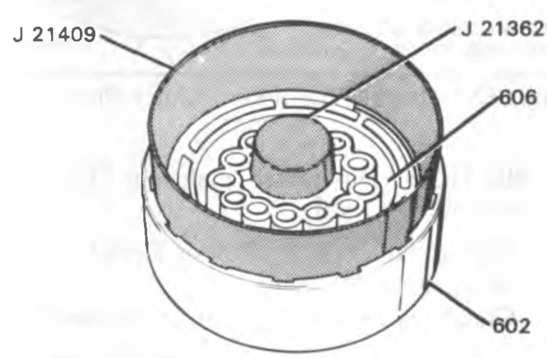
Assemble

Figures 60, 61 and 62

Tools Required:

J 21409 Seal Protector (outer)
J 21362 Seal Protector (inner)

1. Lubricate new inner seal (605) and outer seal (604) with DEXRON®-II transmission fluid. Lubricate seal grooves with TRANSJEL™ J 36850 or equivalent.
2. Seals (604) and (605) on piston (606) with lips facing away from spring pockets.
3. Lubricate center housing seal (603) and groove.
4. Center housing seal (603) onto clutch housing (602) with lip facing up.
5. J 21362 over clutch hub.
6. Piston (606) inside J 21409 and insert assembly into housing (602) rotating slightly clockwise until seated.



ILL. NO.	DESCRIPTION
602	HOUSING, FORWARD CLUTCH
606	PISTON, FORWARD CLUTCH
616	HUB, FORWARD CLUTCH

LH0062-3L80

Figure 62 — Installing Forward Clutch Piston

Assemble

Figures 61, 63 and 64

Tools Required:

J 23327-1 Spring Compressor
J 25018-A Adapter

1. Sixteen clutch release springs (607) in piston (606).
2. Retainer (608) on springs (607) with J 23327-1 and J 25018-A.
3. Snap ring (609).
4. Thrust washer (617) on outside of forward clutch hub (616).

5. Bronze thrust washer (615) on inside of hub (616).
   - retain with TRANSJEL ™ J 36850 or equivalent
6. Forward clutch hub (616) in clutch housing (602).

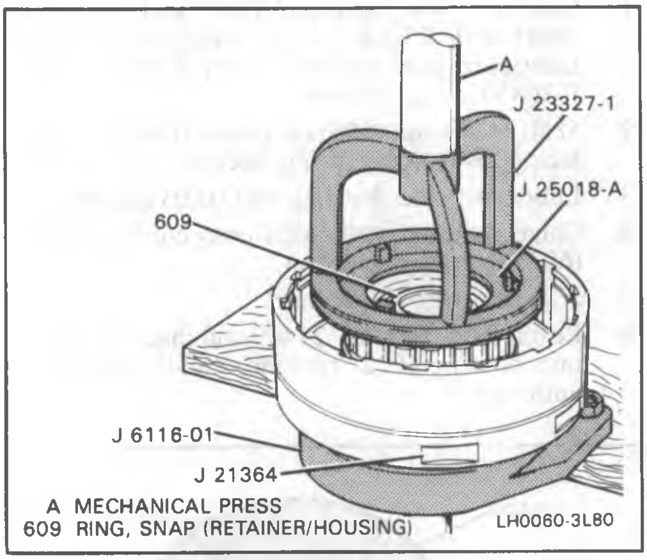


Figure 63 — Installing Forward Clutch Piston Release Springs

NOTICE: Dip clutch plates in DEXRON®-II transmission fluid.

7. Waved clutch plate (611) or dished clutch plate (612) facing outward.
8. Clutch plates (614 and 613) alternately.
   - refer to chart for model application (Figure 64)
9. Direct clutch hub (618) in forward clutch housing (602) (over clutch plates).
10. Snap ring (619).

Inspect

Figures 65 and 66

- Install forward clutch on pump assembly.
- Check piston and clutch operation by applying air to forward clutch passage in pump.
- Install forward clutch assembly (602-619) with turbine shaft (601) into transmission.

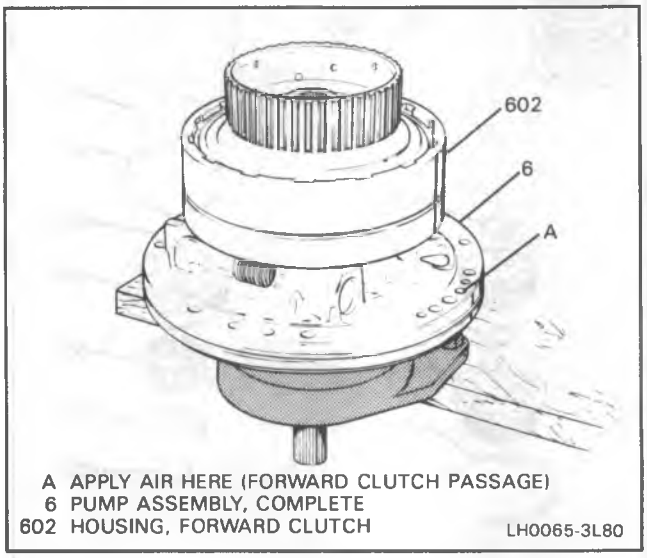


Figure 65 — Air Checking Forward Clutch

1990 HYDRA-MATIC 3L80 CLUTCH PLATE APPLICATION CHART
FORWARD CLUTCH

MODELS	NO. OF FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK
THICKNESS	2.32 MM (.0915")	1.97 MM (.0775")	1.54 MM (.0605")	1.37 MM (.054")	2.03 MM (.080")	(INCHES)
FBA, FEA, FKA, HAA, MAA, MSA, ZSA	5				5	.020-.081
FAA, HCA, HHA, LXA, MTA, MWA, MXA, MZA, SBA, SHA, SJA, TAA, TBA, TDA, TFA, TKA, TMA, TNA, TRA		4	1		5	.045-.108
ALL OTHER MODELS	5			1	5	.068-.133

LH0064-3L80

Figure 64 — Forward Clutch Plate Chart

Pump Assembly

Figure 67

Disassemble

Tools Required:

J 23129 Seal Remover
J 6125-IB Slide Hammer

1. Use J 23129 and J 6125 to remove seal (2).

NOTICE: Regulator spring (214) is tightly compressed. Use care when removing retaining ring (211).

2. Retaining ring (211).
3. Pressure regulator and boost valve assemblies (212-217).
4. Bolts (203, 204 and 205).

Important

- Before removing gears (209) and (210) from pump body, mark gear faces to ensure reassembly to same position.

5. Pump drive gear (209) and driven gear (210).
6. Straight pin (219) and valve bore plug (218).
7. Seal rings (208) and thrust washer (207).
8. Seal ring (7).

Pump Body

Figure 67

Inspect

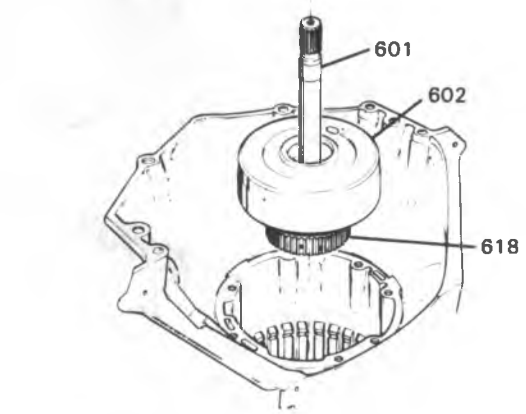
- Gear pockets, crescent, pump body face, and bushing for:
  — scoring
  — nicks
  — wear
- Fluid passages for:
  — foreign material or debris
  — porosity
  — scored or irregular mating surfaces
  — cross channel leaks
- Pump body bolt threads for damage.
- Bushing (3) for wear or damage.
  — see bushing replacement procedure
- Seal ring (7) and groove in pump body (201) for nicks or damage.
- Clean all components

Gear Clearance

Figure 68

Measure

1. Install pump gears (209 and 210) in body (201) as marked.
2. Measure clearance between gears and body.
   - .0008"-.0035" (.02 mm-.09 mm) maximum clearance
3. Pump body with straight edge to assure it is flat.



601 SHAFT, TURBINE
602 HOUSING, FORWARD CLUTCH
618 HUB, DIRECT CLUTCH DRIVING
LH0066-3L80

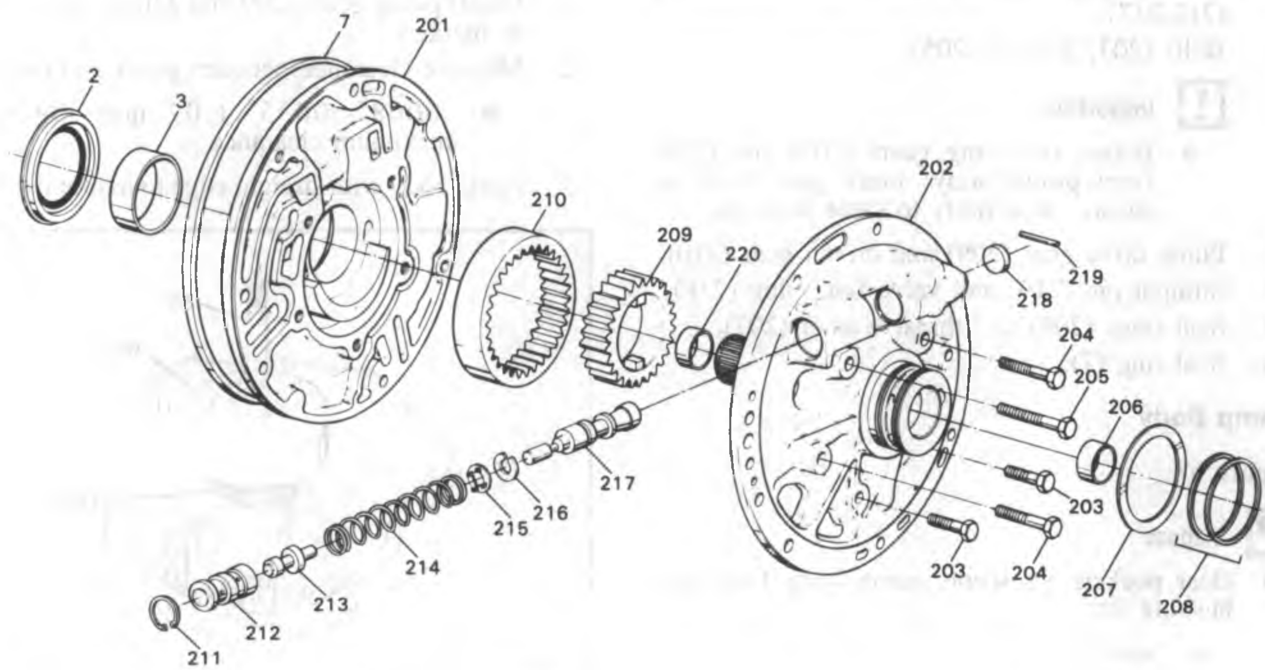
Figure 66 — Installing Forward Clutch Housing

Pump Cover

Figure 67

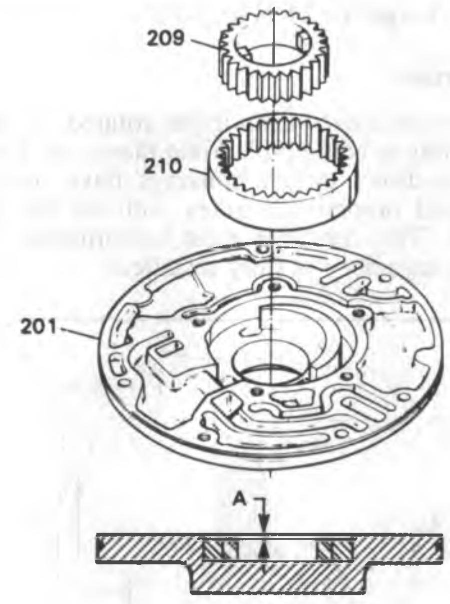
Inspect

- Pump gear face for:
  - — wear
  - — scoring
- Stripped or damaged stator shaft splines
- Bushings (220) and (206) for:
  - — wear, galling
- Ring grooves for nicks, burrs or debris
- Pressure regulator (217) and boost regulator valves (213) for:
  - — free movement in regulator bore.
  - — chips, burrs, distortion or plugged passages
- Vent hole in pump cover blocked (Figure 69).
- Clean all components



ILL. NO.	DESCRIPTION
2	HELIX SEAL ASSEMBLY
3	BUSHING, PUMP BODY
7	SEAL, PUMP/CASE
201	BODY, PUMP
202	COVER, PUMP
203	BOLT, 5/16-18 X 1.00 (COVER TO BODY)
204	BOLT, 5/16-18 X 1.50 (COVER TO BODY)
205	BOLT, 5/16-18 X 1.75 (COVER TO BODY)
206	BUSHING, STATOR SHAFT (REAR)
207	WASHER, THRUST (SELECTIVE)
208	RING, OIL SEAL
209	GEAR, PUMP DRIVE
210	GEAR, PUMP DRIVEN
211	RING, RETAINING
212	BUSHING, REGULATOR BOOST VALVE
213	VALVE, REGULATOR BOOST
214	SPRING, PRESSURE REGULATOR
215	WASHER, SPRING RETAINER
216	SPACER, PRESSURE REGULATOR SPRING
217	VALVE, PRESSURE REGULATOR
218	PLUG, VALVE BORE
219	PIN, STRAIGHT (0.12 DIA. X 1.32)
220	BUSHING, 1.12 O.D. X .50

Figure 67 — Pump Assembly



ILL. NO.	DESCRIPTION
A	.018mm - .066mm (.0007" - .0026")
201	BODY, PUMP
209	GEAR, PUMP DRIVE
210	GEAR, PUMP DRIVEN

LH0068-3L80

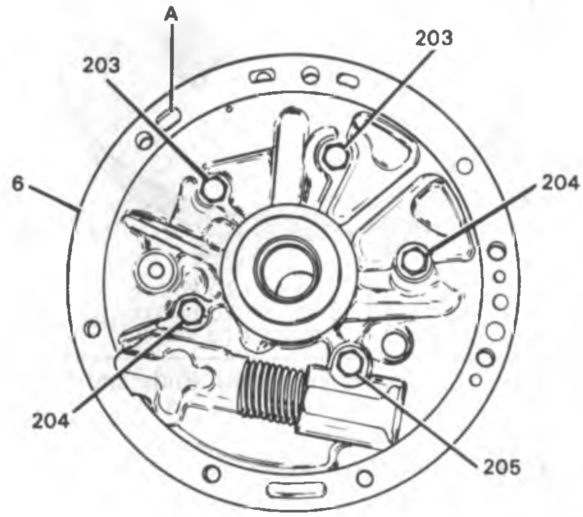
Figure 68 — Pump Body Face to Gear Face Clearance

Pump Assembly

Figures 67 and 69

Assemble

1. Drive gear (209) and driven gear (210) with alignment marks in correct position.
   - lugs on drive gear should be flush with pump body (201).
   - lubricate drive gear (209) and driven gear (210) with DEXRON®-II transmission fluid.
2. Bore plug (218) and valve straight pin (219).
3. Pressure regulator valve (217) into bore.
4. Pressure regulator spring spacer(s) (216), if used.
5. Spring retainer washer (215) and spring (214) in pressure regulator bore.
6. Regulator boost valve (213) into boost valve bushing (212), stem out against spring (214).
7. Snap ring (211).
8. Cover (202) on body (201).
9. Bolts (203, 204 and 205).
   - do not fully torque



ILL. NO.	DESCRIPTION
A	VENT HOLE
6	PUMP ASSEMBLY, COMPLETE
203	BOLT, 5/16-18 X 1.00 (COVER TO BODY)
204	BOLT, 5/16-18 X 1.50 (COVER TO BODY)
205	BOLT, 5/16-18 X 1.75 (COVER TO BODY)

LH0069-3L80

Figure 69 — Pump Cover Attaching Screws

Assemble

Figures 67, 70 and 72

Tools Required:

J 21368 Alignment Band
J 21359 Seal Installer

1. J 21368 on pump assembly.
   - torque bolts 24 N·m (18 lb. ft.)
2. New seal O-ring (7) and seal (2)
   - use J 21359
   - Apply TRANSJEL™ J 36850 or equivalent to seal (2) spring pocket.
3. Correct thrust washer (207) as determined by Front End Play Check during disassembly.
4. Two seals (208).
   - lubricate with DEXRON®-II transmission fluid

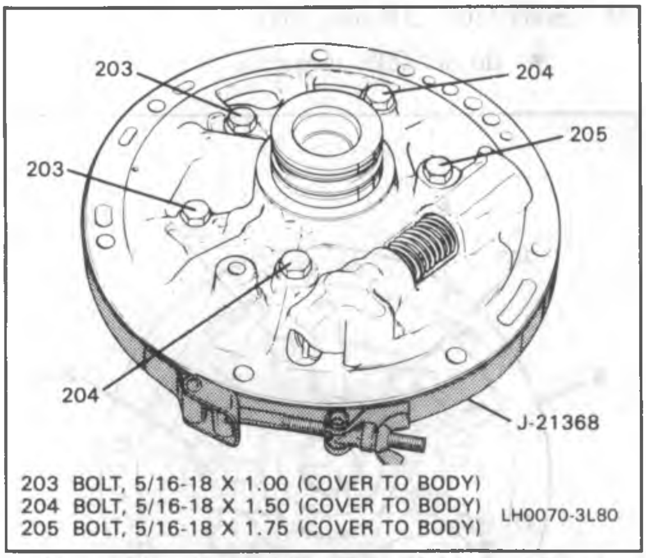


Figure 70 — Assembling Pump Body and Pump Cover

Install or Connect

Figure 71

1. Gasket (8) on transmission case (10).
2. Pump assembly (6) in transmission case (10).

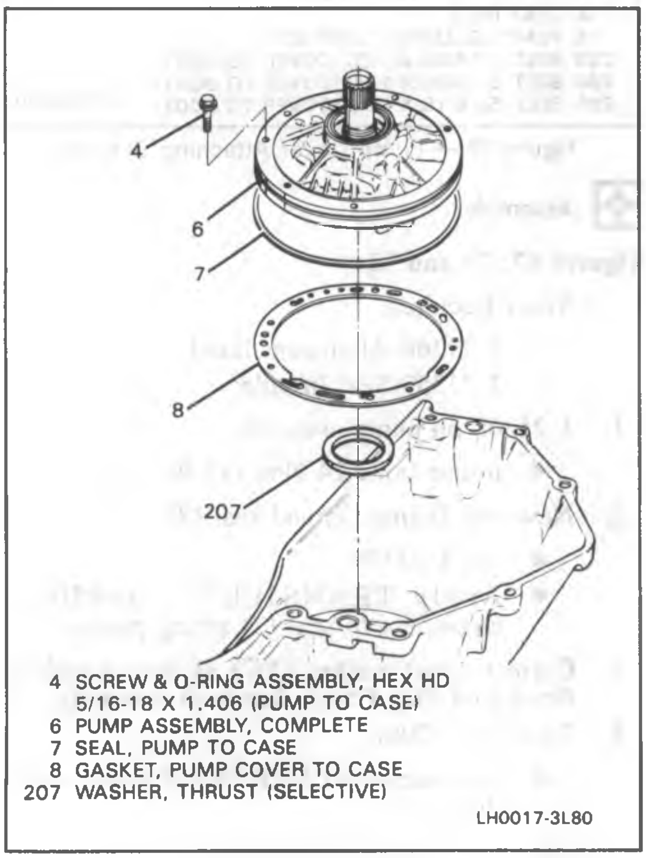


Figure 71 — Gasket and Pump Assembly

3. Bolts (4) except bolt in 10 o'clock position.
   - torque to 24 N·m (18 lb. ft.)

Important

- If turbine shaft cannot be rotated as pump assembly is being pulled into place, the forward and/or direct clutch housings have not been installed properly to index with all the clutch plates. This condition must be corrected before pump assembly is fully installed.

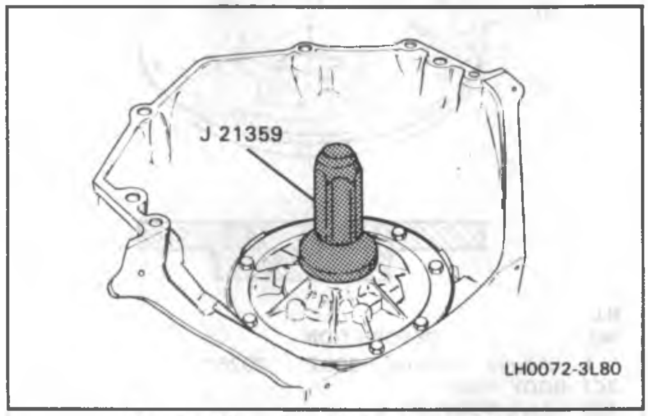


Figure 72 — Installing Pump Seal

Rear Unit End Play Check

Figures 73 and 74

Measure

Tools Required:

J 6125-B Slide Hammer
J 8001 Dial Indicator

1. Install J 8001 on the bolt and index it to the end of the output shaft (691).
   - set indicator to "0"
2. Move output shaft (691) in and out.
   - proper end play is .178 mm-.483 mm (.007" -.019")
3. Remove tools and correct if necessary.

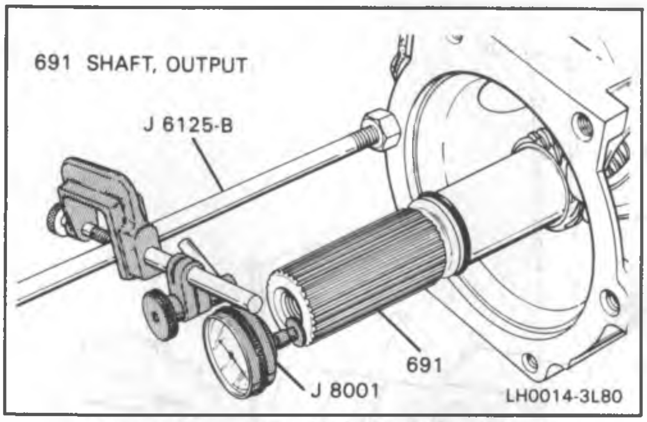


Figure 73 — Rear Unit End Play Check

THICKNESS (INCH)	IDENTIFICATION NOTCH AND/OR NUMERAL	
.074 - .078	None	1
.082 - .086	ON SIDE OF 1 TAB	2
.090 - .094	ON SIDE OF 2 TABS	3
.098 - .102	ONE END OF 1 TAB	4
.106 - .110	ON END OF 2 TABS	5
.114 - .118	ON END OF 3 TABS	6

LH0015-3L80

Figure 74 — Output/Case Selective Thrust Washer (696)

Front End Play Check

Figures 75 and 76

Measure

Tools Required:

J 6125 Slide Hammer Bolt
J 8001 Dial Indicator

1. Install J 6125.
2. Attach J 8001.
3. Eliminate slack by pressing turbine shaft to the rear and output shaft (691) forward.
4. Index J 8001 against the end of turbine shaft and set dial to "0".
5. Pull out on the turbine shaft and note the measurement on J 8001. End play should be between .076-.610 mm (.003-.024")
6. Remove tools and correct end play if necessary.
7. Add screw and O-ring assembly
   - torque to 2 N·m (18 lb. in.)

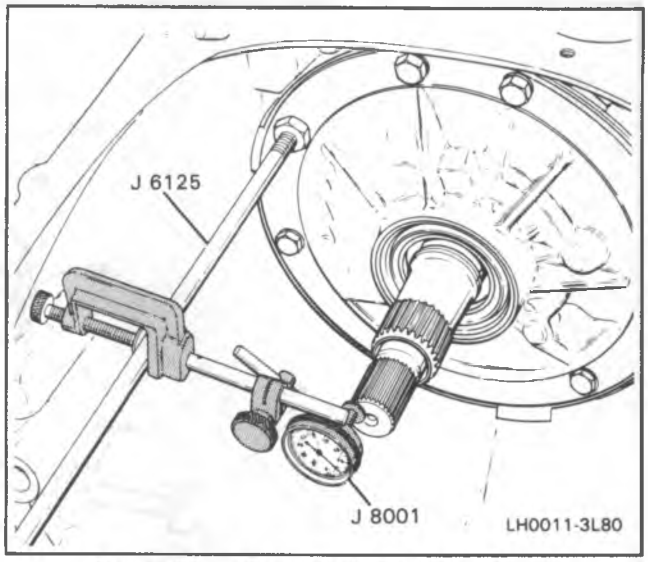


Figure 75 — Front Unit End Play Check

THICKNESS (INCH)	COLOR	NO.
.060 - .064	Yellow	0
.071 - .075	Blue	1
.082 - .086	Red	2
.093 - .097	Brown	3
.104 - .108	Green	4
.115 - .119	Black	5
.126 - .130	Purple	6

LH0012-3L80

Figure 76 — Selective Thrust Washer (207)

Governor Assembly

Important

- Governor assembly is calibrated and is serviced as an assembly. However, driven gear (409) may be serviced separately and unit may be disassembled for cleaning.

Disassemble

Figure 77

1. Governor pins (406).
   - use diagonal cutting pliers
2. Thrust cap (401), weights (404 and 405) and springs (403).
3. Governor valve (402) from sleeve (407).
4. Clean all parts in solvent and air dry.

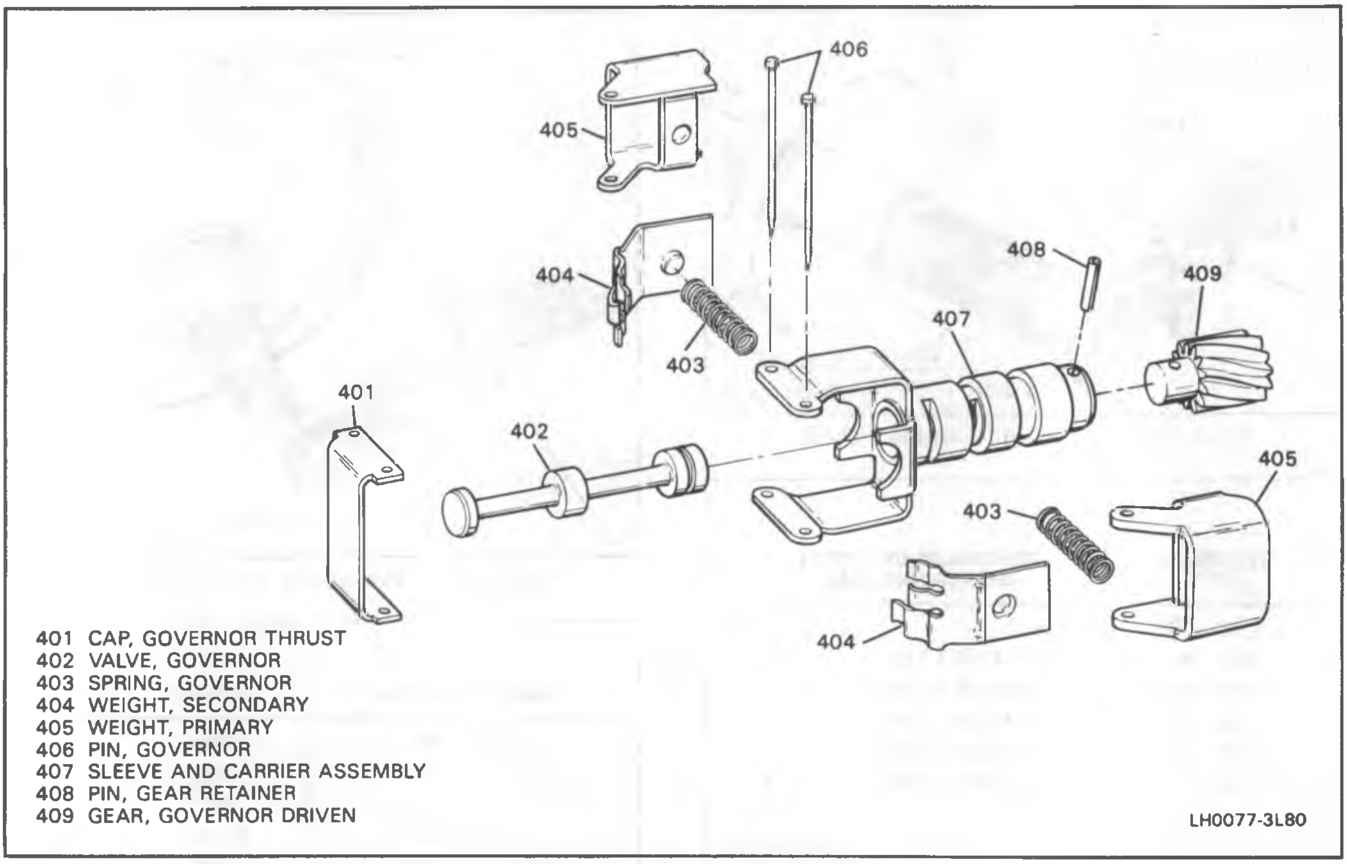


Figure 77 — Governor Assembly

Inspect

- Sleeve (407) for nicks, burrs or galling and free operation in case bore.
- Valve (402) for damage and free operation in bore of sleeve (407).
- Driven gear (409) for damage.
- Springs (403) for distortion or damage.
- Weights (404 and 405) for free operation in retainers.

Measure

Figure 78

- Valve opening at entry with weights
  — minimum clearance is .020" (.51 mm).
- Valve opening at exhaust with weights inward.
  — minimum clearance is .020" (.51 mm).

Driven Gear Replacement

Figure 77

Disassemble

1. Driven gear retaining pin (408).
   - use small punch or 1/8 in (.125") diameter rod
2. Driven gear (409) from sleeve and carrier assembly (407) with long punch and mechanical press.

Clean

- Chips or residue from sleeve and carrier assembly (407).

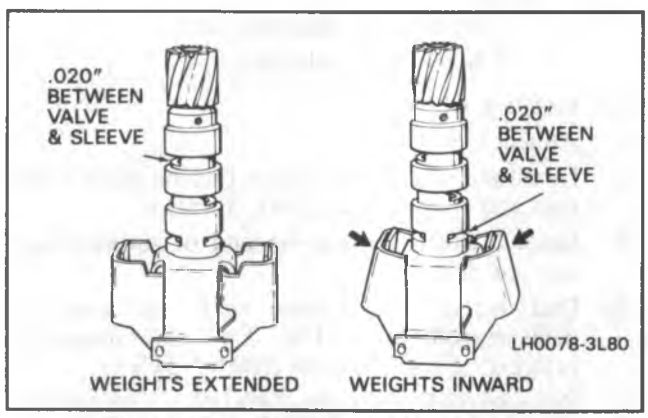


Figure 78 — Checking Valve Opening

Assemble

Figures 79 and 80

Important

- Support governor with plates set into exhaust slots of sleeve.

1. Governor driven gear (409) in sleeve and carrier assembly (407).
2. Drill new 1/8 in. (.125 ") hole in sleeve and carrier assembly (407) and governor driven gear (409), 90 degrees from original hole.
3. Pin (408) in new 1/8 in. hole.
4. Valve (402) in bore of sleeve (407).
5. Weights (404 and 405), springs (403) and thrust cap (401) on sleeve (407).
6. New pins (406).

Inspect

- Weight assemblies (404 and 405) for free movement on pins.
- Valve (402) for free movement in sleeve bore.

  Internal Transmission Speed Sensor (I.T.S.S.) models.

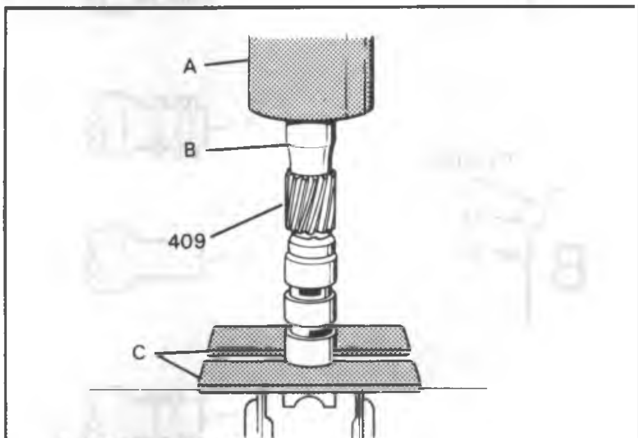


Figure 79 — Installing Driven Gear

Inspect

Figure 81

- Sensor (81) for porosity, cracks or damage
- O-ring (82) and O-ring groove for nicks or damage
- Speed sensor bore in case for porosity, scoring or damage

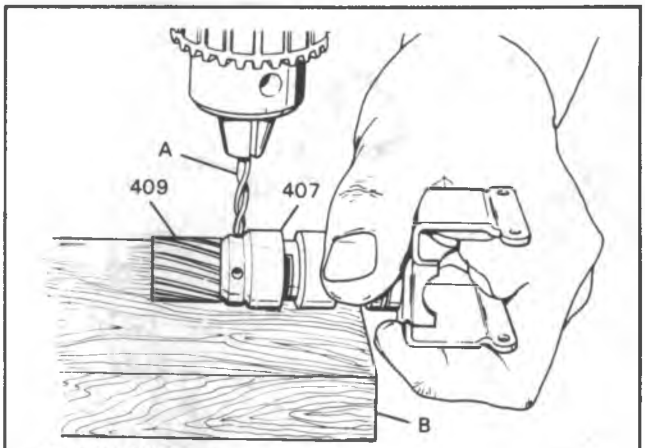


Figure 80 — Drilling Hole in Driven Gear

Install or Connect

Figure 81

1. Governor assembly (22) into case (10).
2. Governor cover (20) and gasket (21) with bolts (19).
   - torque to 14 N·m (125 lb. in.)
3. Lubricate speed sensor bore in case with TRANSJEL ™ J 36850 or equivalent.
4. Speed sensor (81) with new O-ring (82) into case.
   - torque to 7 N·m (62 lb. in.)

   NOTICE: Properly align the speed sensor before installing into the case to prevent damage to the rotor or sensor.
5. Retain sensor with bolt (83).

Band Apply Pin Check

Figures 82, 83 and 84

Measure

Tools Required:

J 21370-10 Gage Pin

J 21370-6 Selector Gage

1. Place J 21370-10 in the servo pin bore.
2. Position J 21370-6 over the bore with the hex nut facing the parking pawl linkage.
3. Fasten with two 5/16-18 x 1" screws and torque to 24 N·m (18 lb. ft.)
4. Make sure J 21370-10 moves freely in the tool and pin bore.
5. To determine correct pin length, apply 25 lb. ft. Torque to the nut on the gage.
6. For pin selection, see Figure 84.

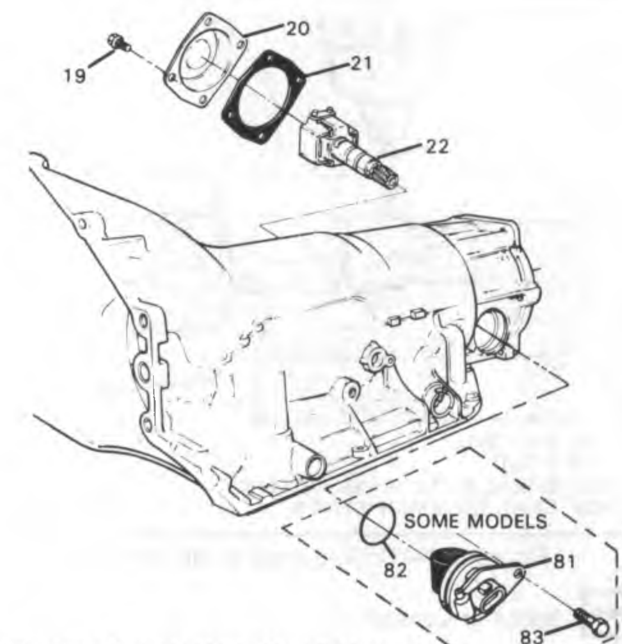


Figure 81 — Installing Governor Assembly

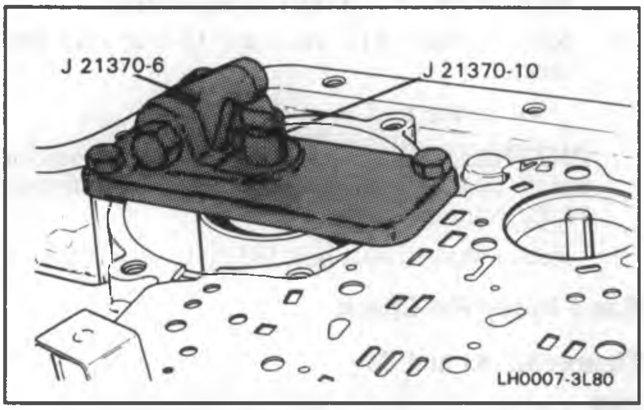


Figure 82 — Installing Servo Pin Gage

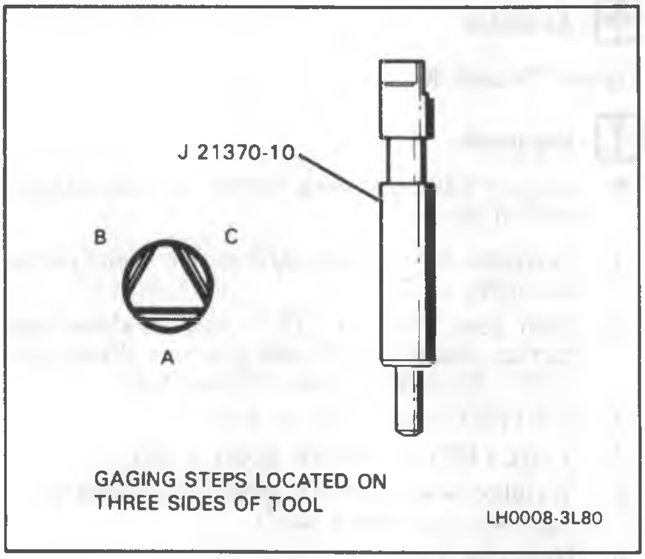


Figure 83 — Gage Pin

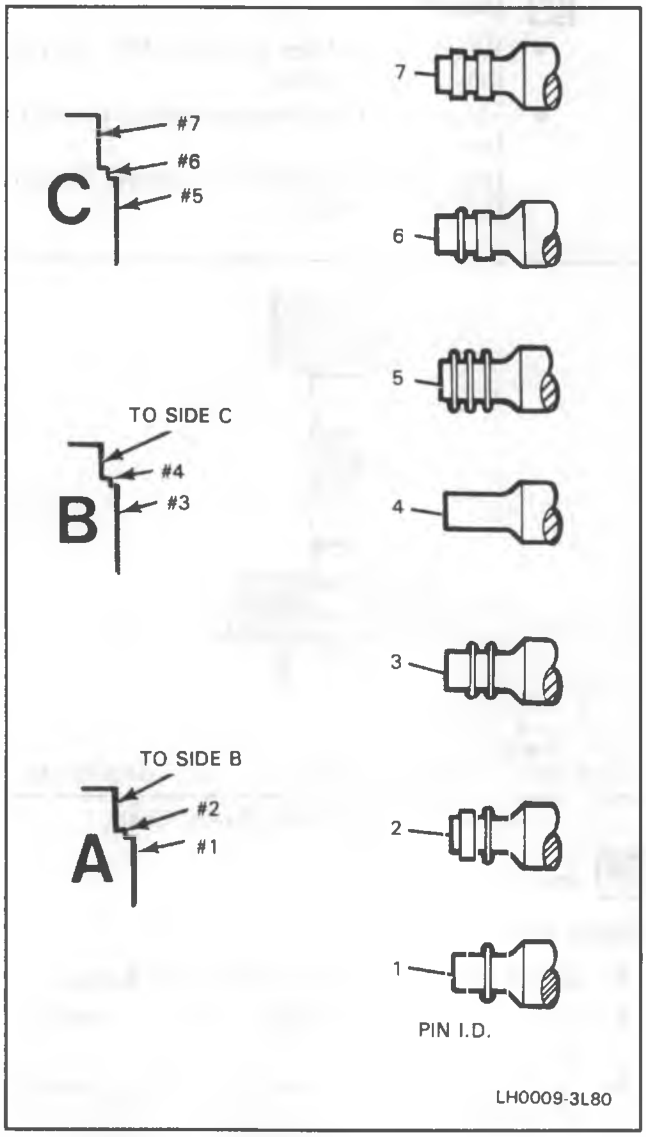


Figure 84 — Band Apply Pin Selection Chart

Rear Servo Accumulator

Figure 85

Disassemble

- Remove retaining ring (68) from rear band apply pin (77) and inspect

Inspect

- Accumulator pistons (69 and 72) for:
  - — porosity or damage
  - — ring groove damage
- Seals (70, 71, 73) for:
  - — nicks or cuts
- Cover (66) for:
  - — porosity
  - — scored or damaged
- Springs (75, 78) for distortion
- Pin (77) for wear
- Servo bore for wear or scoring

Assemble

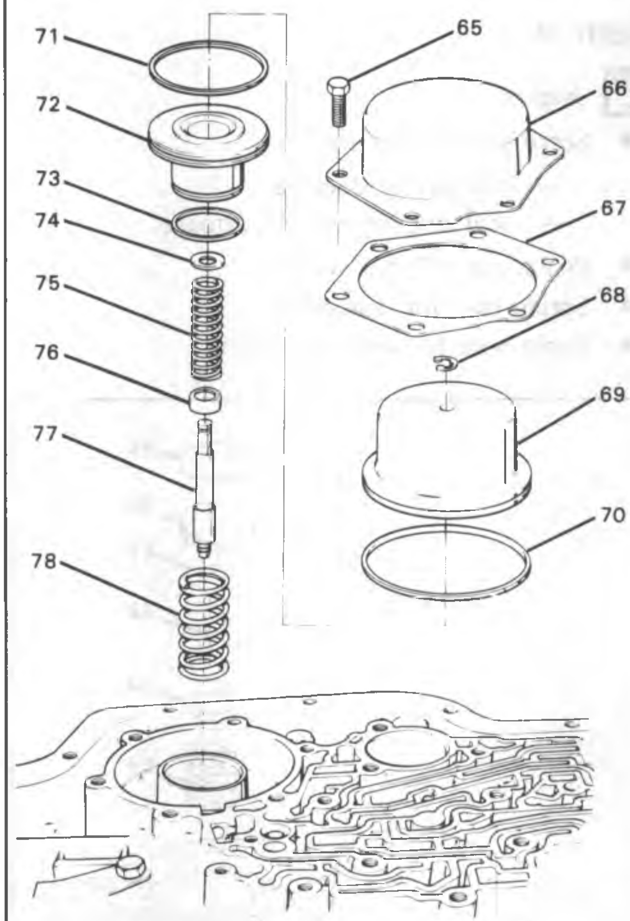
Figure 85

1. Rear servo spring retainer (76), rear servo spring (75) and servo washer (74) on rear band apply pin (77).
2. Inner (73) and outer (71) accumulator piston seals on accumulator piston (72). Place on rear band apply pin assembly.
3. Reverse servo piston seal (70) on rear servo piston (69) and press onto rear band apply pin (77).
4. Retaining ring (68).

Install or Connect

Figure 85

1. Rear accumulator spring (78).
2. Gasket (67), cover (66) and bolts (65).
   - torque to 24 N·m (18 lb. ft.)



65 SCREW, HEX HD 5/16-18 X .62
66 COVER, REAR SERVO
67 GASKET, REAR SERVO COVER
68 CLIP, RETAINING (SERVO PISTON)
69 PISTON, REAR SERVO
70 SEAL, REVERSE SERVO PISTON
71 RING, SEAL (ACCUMULATOR PISTON — OUTER)
72 PISTON, ACCUMULATOR
73 RING, SEAL (ACCUMULATOR PISTON — INNER)
74 WASHER, SERVO PISTON
75 SPRING, REAR SERVO
76 RETAINER, REAR SERVO SPRING
77 PIN, REAR BAND APPLY
78 SPRING, REAR ACCUMULATOR

LH0006-3L80

Figure 85 — Rear Servo Assembly

Front Servo Assembly

Figure 86

Inspect

- Servo piston (60) for:
  - — porosity or damage
  - — seal ring groove for damage
- Piston pin (62) for wear
- Spring (64) for distortion
- Servo bore for wear or scoring

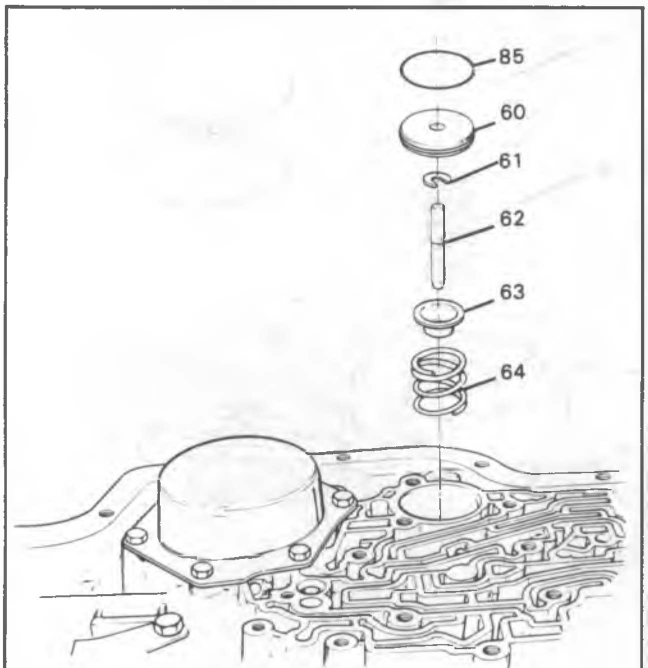


Figure 86 — Front Servo Assembly

Install or Connect

Figures 86, 87 and 88

1. New seal (85) onto piston (60)
2. Front servo piston spring (64) and retainer (63).
3. Ring (61), piston pin (62) and piston (60).
   - make certain tapered end contacts band
4. Front servo assembly into case.
5. Seven check balls (59) in case.
6. Spacer plate to case gasket (58) using guide pins.

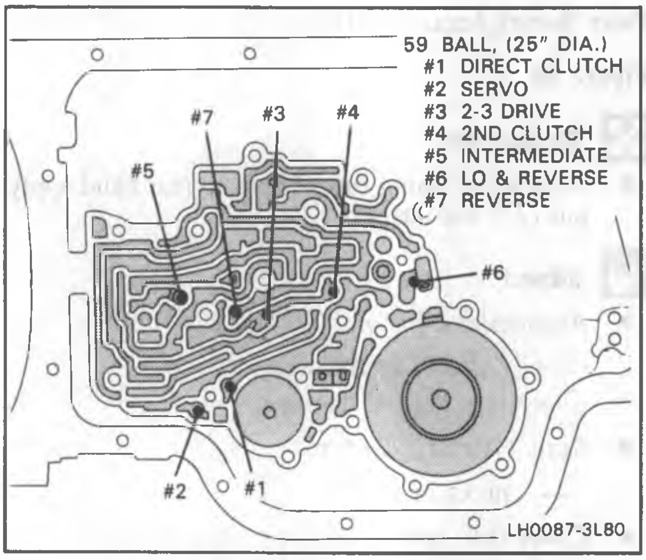


Figure 87 — Check Ball Location

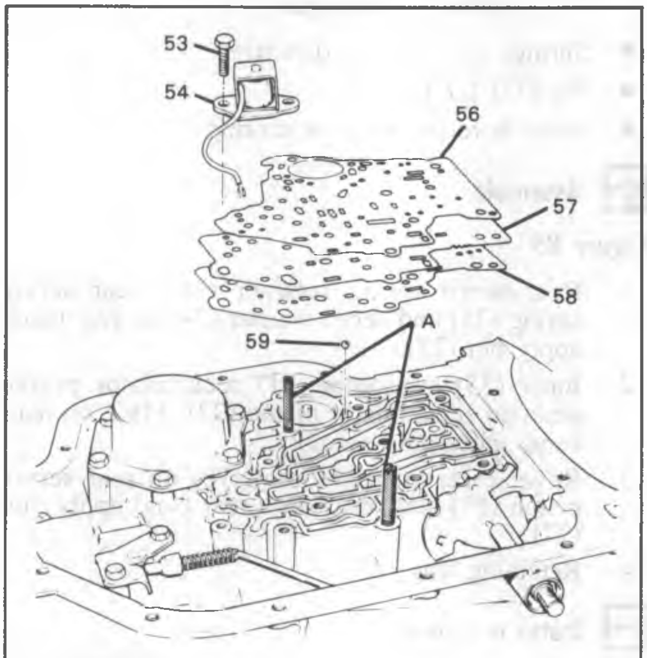


Figure 88 — Installing Solenoid and Spacer Plate

7. Valve body spacer plate (57).
8. Valve body to spacer plate gasket (56).
9. Solenoid assembly (54) with screw (53)
   - finger tight
10. Wire connector to case connector

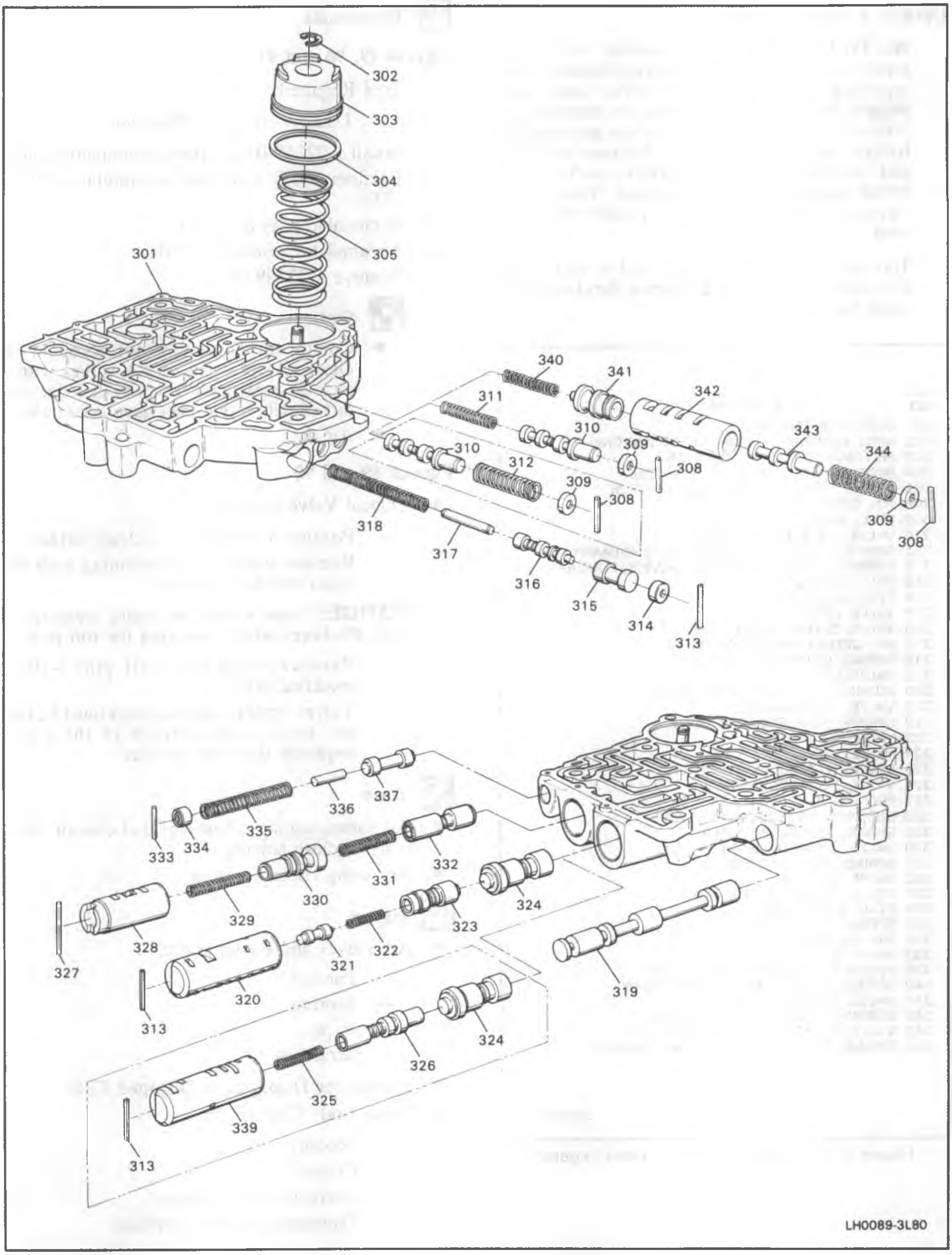


Figure 89 — Control Valve Assembly

Control Valve Assembly

NOTICE: The use of a honing stone, fine sandpaper or crocus cloth is not recommended for servicing stuck valves. All valve lands have sharply machined corners that are necessary to "cleaning" the bore. If these corners are rounded, foreign material could wedge between the valve and the bore causing the valve to stick. If it is found necessary to clean a valve "micro fine" lapping compound 900 grit or finer should be used.

Too much "lapping" of the valve will cause excessive clearances and increase the chance of a valve not operating.

ILL. NO.	DESCRIPTION
301	BODY, CONTROL VALVE
302	RING, RETAINER (ACCUMULATOR PISTON)
303	PISTON, FRONT ACCUMULATOR
304	RING, SEAL (ACCUMULATOR PISTON)
305	SPRING, FRONT ACCUMULATOR PISTON
308	PIN, GROOVED
309	PLUG, VALVE BORE (.56 O.D.)
310	VALVE, 1-2 ACCUMULATOR
311	SPRING, 1-2 ACCUMULATOR VALVE PRIMARY
312	SPRING, 1-2 ACCUMULATOR VALVE SECONDARY
313	PIN, COILED SPRING
314	PLUG, VALVE BORE (.50)
315	VALVE, DETENT
316	VALVE, DETENT REGULATOR
317	PIN, DETENT REGULATOR VALVE
318	SPRING, DETENT REGULATOR
319	VALVE, MANUAL
320	BUSHING, 1-2 MODULATOR VALVE
321	VALVE, 1-2 REGULATOR
322	SPRING, 1-2 REGULATOR VALVE
323	VALVE, 1-2 DETENT
324	VALVE, 1-2
325	SPRING, 1-2 MODULATOR VALVE
326	VALVE, 1-2 MODULATOR
327	PIN, STRAIGHT .12 DIA. X 1.32
328	BUSHING, 2-3 MODULATOR VALVE
329	SPRING, 2-3 VALVE (OUTER)
330	VALVE, 2-3 MODULATOR
331	SPRING, 2-3 VALVE (INNER)
332	VALVE, 2-3
333	PIN, STRAIGHT .12 DIA. X .82
334	PLUG, VALVE BORE (.437)
335	SPRING, 3-2 VALVE
336	PIN, 3-2 VALVE
337	VALVE, 3-2
339	BUSHING, 1-2 MODULATOR VALVE
340	SPRING, 1-2 ACCUMULATOR PRIMARY
341	VALVE, 1-2 ACCUMULATOR
342	BUSHING, 1-2 ACCUMULATOR VALVE
343	VALVE, 1-2 ACCUMULATOR PRIMARY
344	SPRING, 1-2 ACCUMULATOR SECONDARY

LH0090-3L80

Figure 90 — Control Valve Assembly Legend

Disassemble

Figures 89, 90 and 91

Tool Required:

J 22269-01 Piston Remover

1. Install J 22269-01 on front accumulator piston.
2. Retainer (302) and front accumulator piston (303).
3. Accumulator spring (305).
4. Accumulator piston seal (304).
5. Remove J 22269-01.

Clean

- Control valve assembly (49) thoroughly in clean solvent — move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
- Air dry

Figures 89 and 90

- Control Valve Assembly
  - — Position as shown on a clean surface
  - — Remove valve trains beginning with the upper left hand corner.

NOTICE: Some valves are under pressure — cover the bores while removing the roll pins

  - — Remove blind hole roll pins with a modified drill bit
  - — Valves, springs and bushings must be laid out on a clean surface in the exact sequence they are removed

Clean

- All valves, springs, bushings and control valve body in clean solvent
- Dry using compressed air

Inspect

- All Valves and Bushings for:
  - — Porosity
  - — Scoring
  - — Nicks
  - — Scratches
- Springs for Damaged or Distorted Coils
- Valve Body Casting for:
  - — Porosity
  - — Cracks
  - — Interconnected passages
  - — Damaged machined surfaces

Assemble

Figures 89 and 90

- Control valve assembly components exactly as shown. Notice the position of the valve lands and bushing passages.

Installing Control Valve Assembly

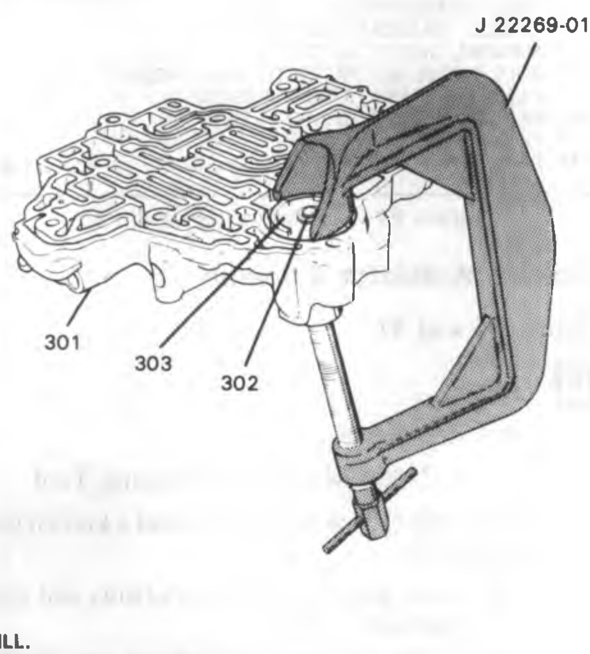
Figures 91, 92 and 93

Assemble

Tool Required:

J 22269-01 Piston Remover

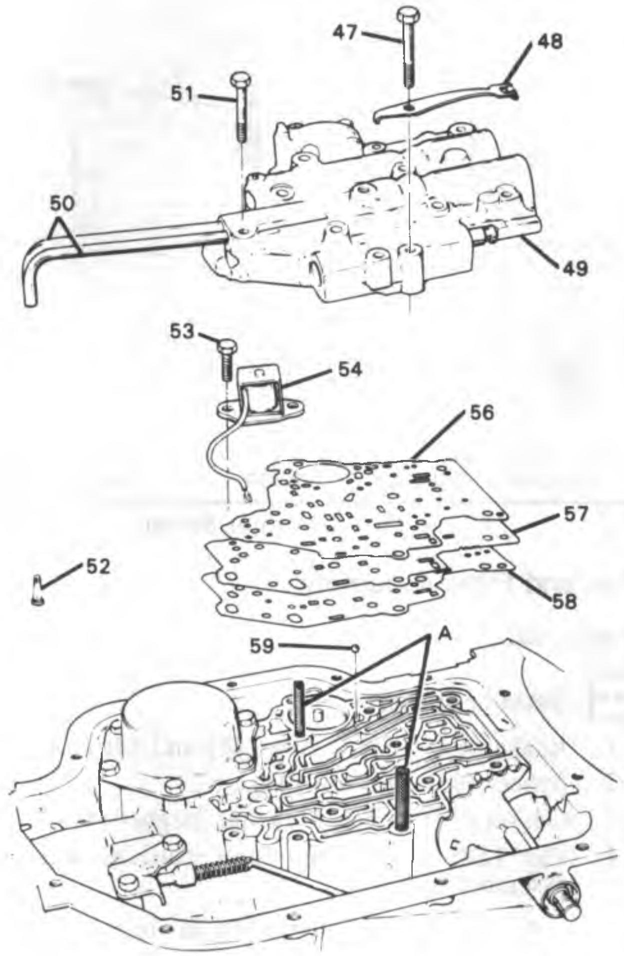
1. Front accumulator piston spring (305).
2. Front accumulator piston (303) and retainer ring (302) with J 22269-01.
3. Governor screen (52), pointed end up.
4. Governor pipes (50).
5. Control valve assembly (49).
6. Bolts (47) and (51)
7. Detent spring and roller assembly (48) and bolt (47).
   - torque bolts (47 and 51) 11 N·m (98 lb. in.)
   - torque bolt (53) 10 N·m (89 lb. in.)



ILL. NO.	DESCRIPTION
301	BODY, CONTROL VALVE
302	RING, RETAINER (ACCUMULATOR PISTON)
303	PISTON, FRONT ACCUMULATOR

LH0091-3L80

Figure 91 — Removing Front Accumulator Piston



ILL. NO.	DESCRIPTION
A	GUIDE PINS
47	SCREW, HEX HD 5/16-18 X 1.875 (V.B. TO CASE)
48	MANUAL DETENT ROLLER & SPRING ASSEMBLY
49	CONTROL VALVE ASSEMBLY
50	PIPE, GOVERNOR
51	SCREW, HEX HD 1/4-20 X 1.62 (V.B. TO CASE)
52	SCREEN ASSEMBLY, GOVERNOR
53	SCREW, HEX WASHER HD 1/4-20 X .75
54	SOLENOID ASSEMBLY
56	GASKET, VALVE BODY TO SPACER PLATE
57	PLATE, VALVE BODY SPACER
58	GASKET, SPACER PLATE TO CASE
59	BALL, (.25" DIA.)

LH0004-3L80

Figure 92 — Installing Control Valve Assembly

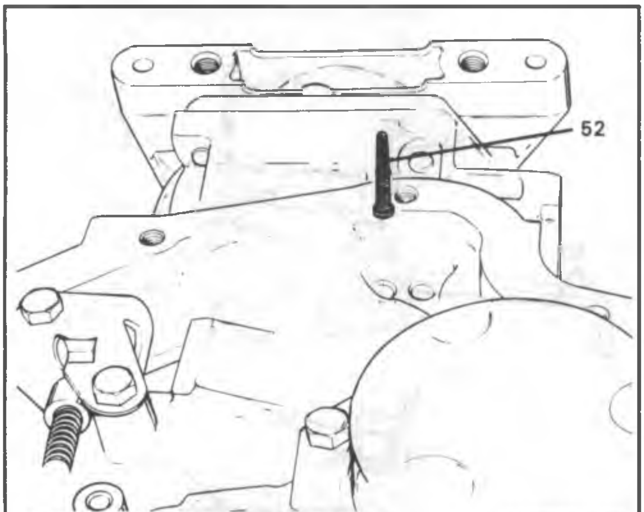


Figure 93 — Governor Screen

Pan and Filter Assembly

Figure 94

Install or Connect

1. Intake pipe (45), O-ring (46) and filter (42).
2. Spacer (43) and bolt (41).
3. Gasket (39) to pan (38) and magnet (40)
4. Pan (38) with screw and conical washer assembly (37).
   - torque to 13 N·m (116 lb. in.)

Case Extension Assembly

Figure 95

Inspect

- for wear or damage
  - — bearings (28)
  - — spacer (29)
  - — bushings (30) and (33) (See Bushing Replacement)

Install or Connect

Tool Required:

J 21359 Seal Installer

1. New rear seal (26) with J 21359.

- Apply TRANSJEL ™ J 36850 or equivalent to spring pocket

2. Extension to case seal (32).
3. Gaskets (34) to extension (27).
4. Extension (27) to case (10) with bolts (23).

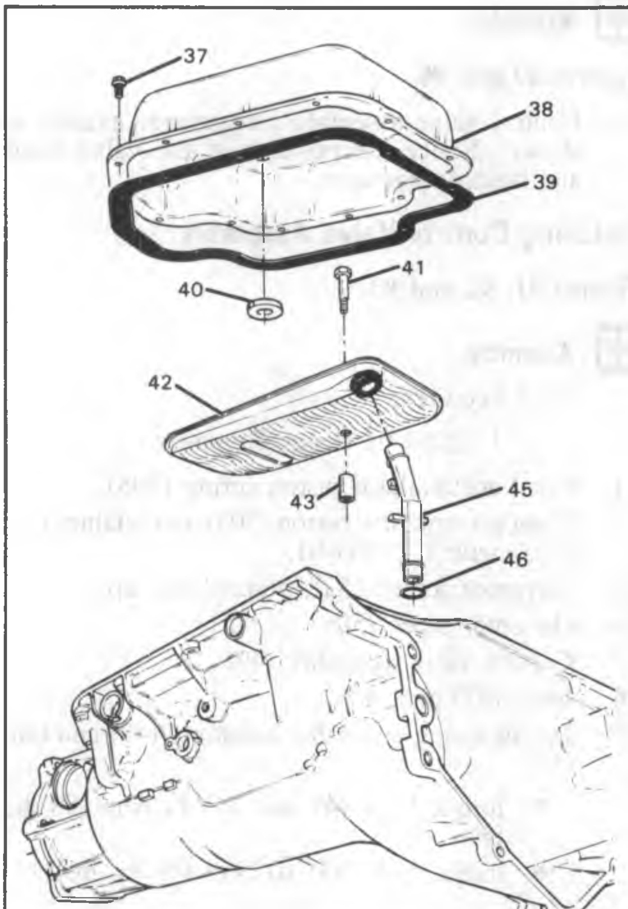


Figure 94 — Installing Filter & Pan

Vacuum Modulator Assembly

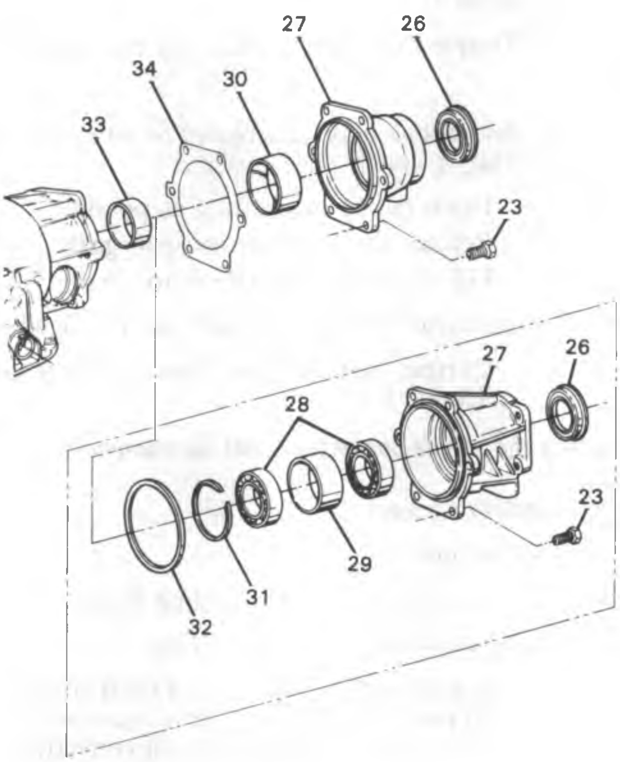
Figures 96 and 97

Inspect

Tool Required:

J 24466 Modulator Checking Tool

1. Modulator (13) with J 24466 and a known good modulator
   - place gage between modulators and apply pressure to both
   - if the indicator line moves out of view replace the modulator
2. Modulator valve (15) for nicks or damage
3. Modulator valve bore in the case for burrs, porosity or scoring



23 SCREW, HEX HD 3/8-16 X 1 (CASE EXTENSION TO CASE)
26 SEAL, CASE EXTENSION
27 CASE EXTENSION ASSEMBLY
28 BEARING ASSEMBLY, BALL
29 SPACER, BEARING
30 BUSHING, CASE EXTENSION
31 RING, INTERNAL SNAP
32 SEAL, CASE EXTENSION TO CASE
33 BUSHING, CASE
34 GASKET, CASE TO EXTENSION

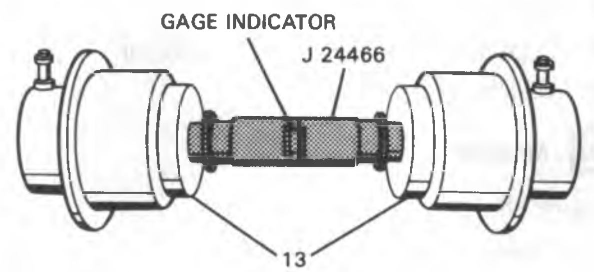
LH0013-3L80

Figure 95 — Installing Case Extension

Install or Connect

Figure 97

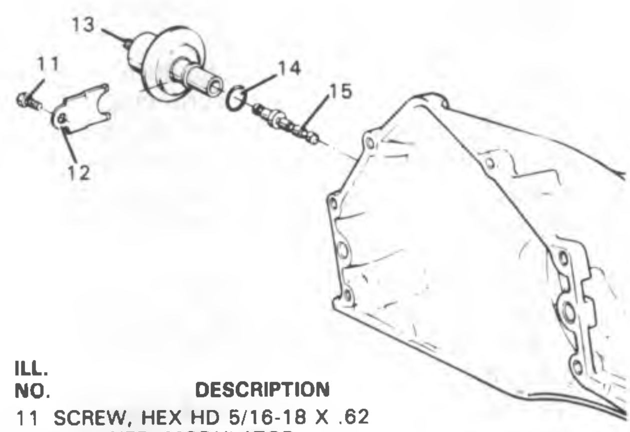
1. Modulator valve (15).
   - small end first
2. New O-ring seal (14) onto modulator assembly (13).
3. Modulator assembly (13) into case.
4. Retainer (12) and bolt (11).
   - torque to 24 N·m (18 lb. ft.)



ILL. NO.	DESCRIPTION
13	VACUUM MODULATOR ASSEMBLY

LH0096-3L80

Figure 96 — Checking Modulator Assembly



ILL. NO.	DESCRIPTION
11	SCREW, HEX HD 5/16-18 X .62
12	RETAINER, MODULATOR
13	VACUUM MODULATOR ASSEMBLY
14	SEAL, O-RING
15	VALVE, VACUUM MODULATOR

LH0002-3L80

Figure 97 — Vacuum Modulator Assembly

TORQUE CONVERTER ASSEMBLY

Inspect

The torque converter assembly (1) must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly
- Metal particles are found after flushing the cooler and cooler lines
- External leaks in hub weld area
- Converter pilot is broken, damaged or poor fit into crankshaft

- Converter hub is scored or damaged
- Internal failure to stator
- Contamination from engine coolant
- Excess end play

Measure

Figure 98

Tools Required:

J 35138 Torque Converter End Play Checking Tool

J 26900-13 Magnetic Base

J 8001 or J 8001 M Dial Indicator Set

- Install J 35138 and measure end play

1. Screw upper and lower knurled knobs together.
2. Insert J 35138 into torque converter. Be sure collet is not expanded.
3. Slide tapered plug into torque converter hub. Plug is for alignment of tool.
4. Hold upper knurled knob and turn wing nut clockwise to expand collet. Turn wing nut until tight. Then back off 2 1/2 turns, or until tool is loose but unremovable from converter.
5. Hold upper knurled knob and turn lower knurled knob clockwise until snug. Turbine hub is now wedged in tool.
6. Attach magnetic base (J 26900-13) to torque converter and set up dial indicator (J 8001 or J 8001 M) so that indicator tip is in center of wing nut.
7. To make end play check, push upper knurled knob down, zero out indicator and pull lower knurled knob up. Be sure tapered plug stays wedged in hub. End play is the difference between up and down positions. DO NOT ALLOW WING NUT TO TURN DURING MEASURING. Measurements should be within specifications given below:
   - 0 mm - .6 mm (.024″)
8. Remove tool by turning wing nut counter-clockwise and pulling tool out.

- If end play measurement is not within the specifications listed above, the converter should be replaced.

The Torque Converter Should Not Be Replaced *If:*

- the fluid has an odor, discolored or no evidence of metal or clutch plate material
  - — Drain out as much fluid as possible
  - — Replace the oil filter and pan gasket
  - — Fill to proper level (Refer to Section 7A)
- The converter bolt hole threads are damaged
  - — Correct with thread insert (Refer to Section 6A)

Flushing the torque converter is not recommended.

Install or Connect

Tool Required:

J 21366 Converter Holding Strap

- Torque converter (1) with J 21366
  - — Engage turbine shaft, stator shaft and lugs on pump driven gear. Three clicks will be felt as each engages slots in converter.

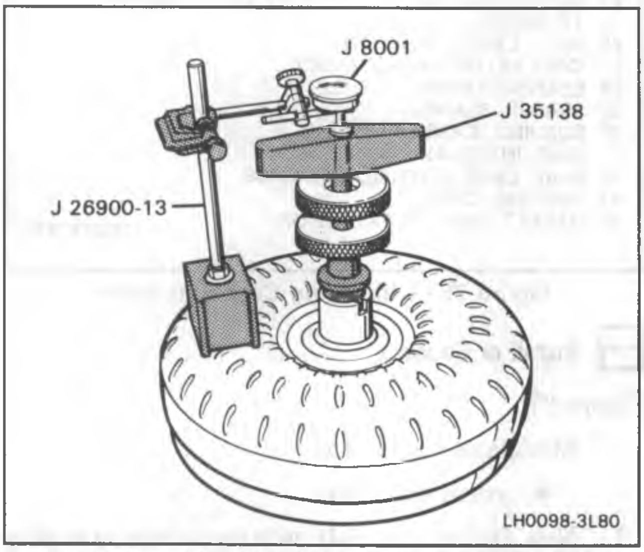


Figure 98 — Checking Torque Converter End Play

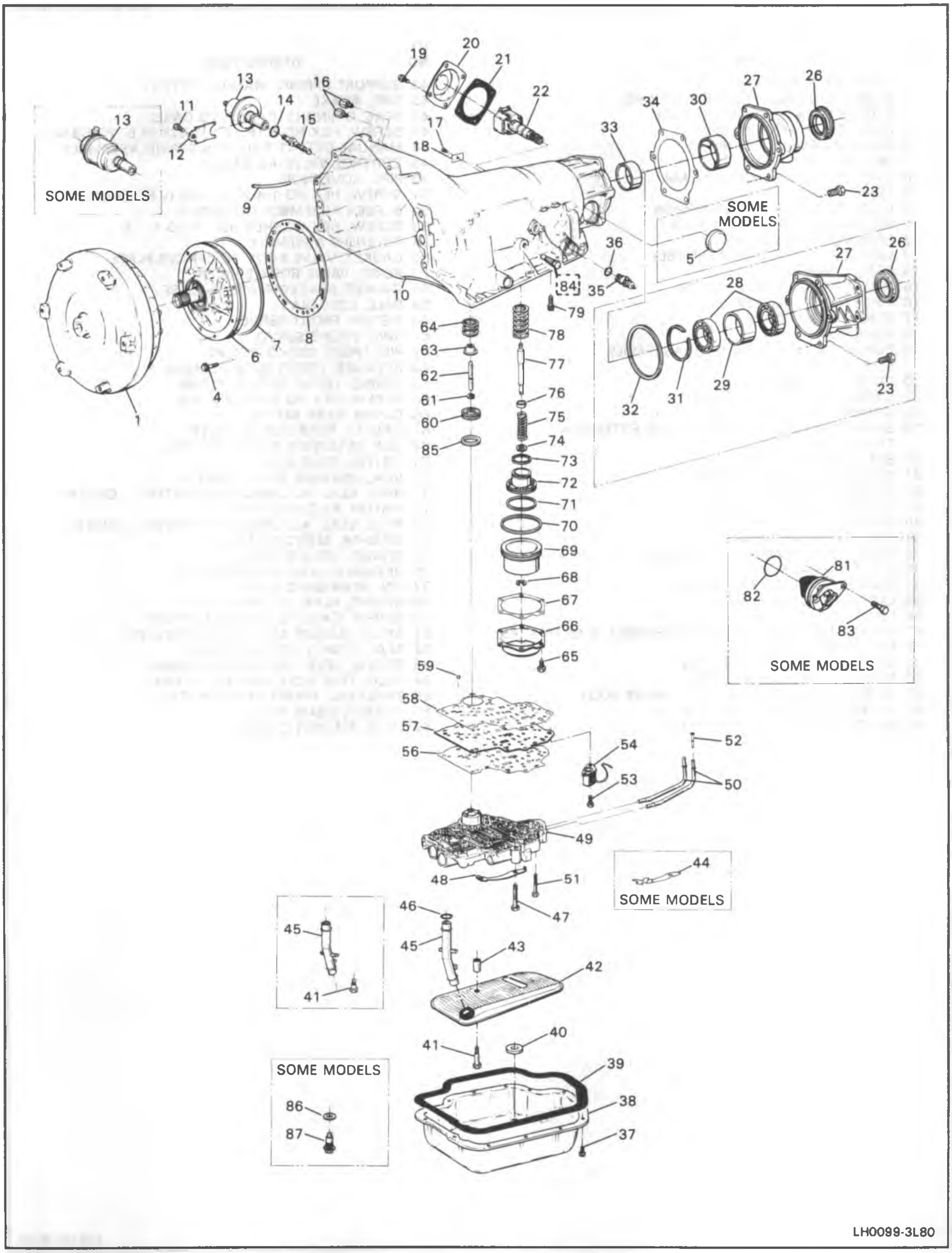
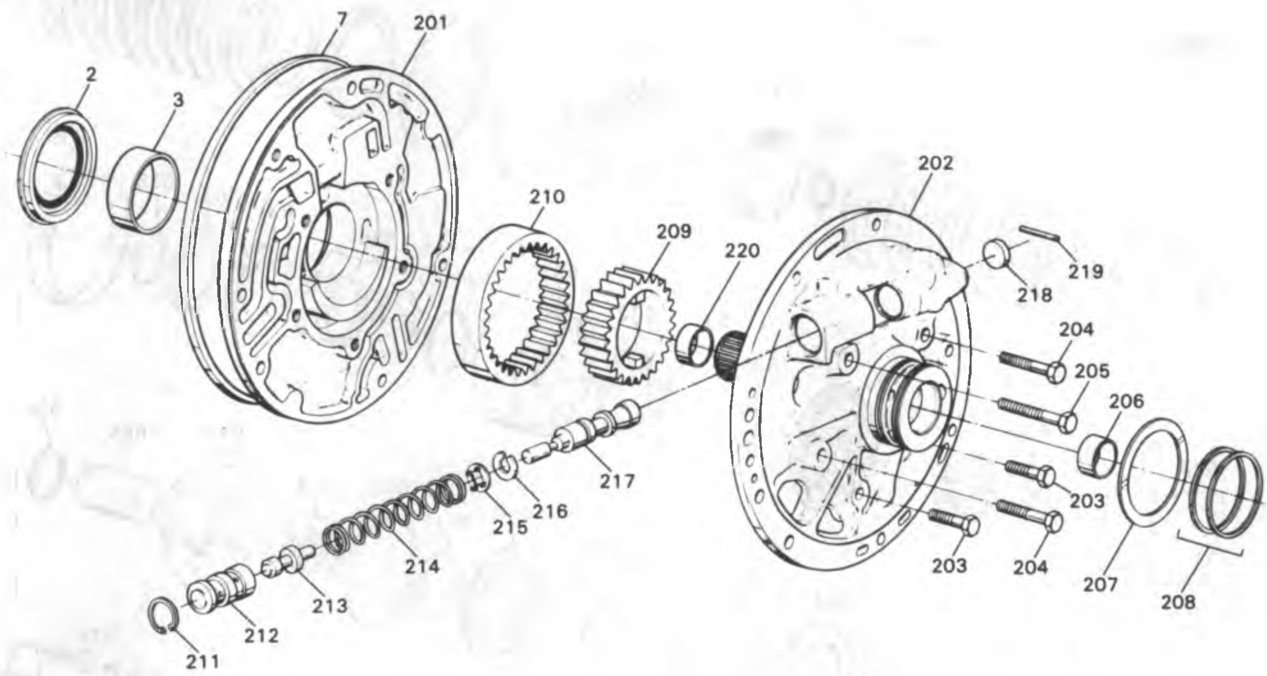


Figure 99 — Case and External Parts

ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY
4	SCREW & O-RING ASSEMBLY, HEX HD 5/16-18 X 1.406 (PUMP TO CASE)
5	PLUG, SPEED HOLE (STEEL)
6	PUMP ASSEMBLY, COMPLETE
7	SEAL, PUMP TO CASE
8	GASKET, PUMP COVER TO CASE
9	VENT, PIPE
10	CASE ASSEMBLY, TRANSMISSION
11	SCREW, HEX HD 5/16-18 X .62
12	RETAINER, MODULATOR
13	VACUUM MODULATOR ASSEMBLY
14	SEAL, O-RING
15	VALVE, VACUUM MODULATOR
16	PIPE FITTING, COOLER
17	SCREW, NAMEPLATE
18	NAMEPLATE
19	SCREW & CONICAL WASHER ASSEMBLY 5/16-18 X .69
20	COVER, GOVERNOR
21	GASKET, GOVERNOR COVER
22	GOVERNOR ASSEMBLY
23	SCREW, HEX HD 3/8-16 X 1 (CASE EXTENSION TO CASE)
26	SEAL, CASE EXTENSION
27	CASE EXTENSION ASSEMBLY
28	BEARING ASSEMBLY, BALL
29	SPACER, BEARING
30	BUSHING, CASE EXTENSION
31	RING, INTERNAL SNAP
32	SEAL, CASE EXTENSION TO CASE
33	BUSHING, CASE
34	GASKET, CASE TO EXTENSION
35	CONNECTOR, ELECTRICAL
36	SEAL, O-RING
37	SCREW & CONICAL WASHER ASSEMBLY, 5/16-18 X .69
38	PAN, TRANSMISSION
39	GASKET, TRANSMISSION PAN
40	MAGNET, CHIP COLLECTOR
41	SCREW, SHOULDER (FILTER TO VALVE BODY)
42	FILTER ASSEMBLY, TRANSMISSION
43	SPACER, VALVE BODY TO FILTER
44	SUPPORT SPRING, MANUAL DETENT
45	PIPE, INTAKE
46	SEAL, O-RING (STRAINER TO CASE)
47	SCREW, HEX HD 5/16-18 X 1.875 (V.B. TO CASE)
48	MANUAL DETENT ROLLER & SPRING ASSEMBLY
49	CONTROL VALVE ASSEMBLY
50	PIPE, GOVERNOR
51	SCREW, HEX HD 1/4-20 X 1.62 (V.B. TO CASE)
52	SCREEN ASSEMBLY, GOVERNOR
53	SCREW, HEX WASHER HD 1/4-20 X .75
54	SOLENOID ASSEMBLY
56	GASKET, VALVE BODY TO SPACER PLATE
57	PLATE, VALVE BODY SPACER
58	GASKET, SPACER PLATE TO CASE
59	BALL, (.25" DIA.)
60	PISTON, FRONT SERVO
61	RING, FRONT SERVO
62	PIN, FRONT SERVO PISTON
63	RETAINER, FRONT SERVO SPRING
64	SPRING, FRONT SERVO PISTON
65	SCREW, HEX HD 5/16-18 X .62
66	COVER, REAR SERVO
67	GASKET, REAR SERVO COVER
68	CLIP, RETAINING (SERVO PISTON)
69	PISTON, REAR SERVO
70	SEAL, REVERSE SERVO PISTON
71	RING, SEAL (ACCUMULATOR PISTON — OUTER)
72	PISTON, ACCUMULATOR
73	RING, SEAL (ACCUMULATOR PISTON — INNER)
74	WASHER, SERVO PISTON
75	SPRING, REAR SERVO
76	RETAINER, REAR SERVO SPRING
77	PIN, REAR BAND APPLY
78	SPRING, REAR ACCUMULATOR
79	SCREW, CASE TO CENTER SUPPORT
81	SPEED SENSOR ASSEMBLY, COMPLETE
82	SEAL, O-RING (SPEED SENSOR)
83	SCREW, SPEED SENSOR RETAINING
84	PLUG, TEST HOLE HEX HD 1/8 PIPE
85	RING SEAL, FRONT SERVO PISTON
86	GASKET, DRAIN PLUG
87	PLUG, MAGNETIC DRAIN

LH0100-3L80

Figure 100 — Case and External Parts — Legend



ILL. NO.	DESCRIPTION
2	HELIX SEAL ASSEMBLY
3	BUSHING, PUMP BODY
7	SEAL, PUMP/CASE
201	BODY, PUMP
202	COVER, PUMP
203	BOLT, 5/16-18 X 1.00 (COVER TO BODY)
204	BOLT, 5/16-18 X 1.50 (COVER TO BODY)
205	BOLT, 5/16-18 X 1.75 (COVER TO BODY)
206	BUSHING, STATOR SHAFT (REAR)
207	WASHER, THRUST (SELECTIVE)
208	RING, OIL SEAL
209	GEAR, PUMP DRIVE
210	GEAR, PUMP DRIVEN
211	RING, RETAINING
212	BUSHING, REGULATOR BOOST VALVE
213	VALVE, REGULATOR BOOST
214	SPRING, PRESSURE REGULATOR
215	WASHER, SPRING RETAINER
216	SPACER, PRESSURE REGULATOR SPRING
217	VALVE, PRESSURE REGULATOR
218	PLUG, VALVE BORE
219	PIN, STRAIGHT (0.12 DIA. X 1.32)
220	BUSHING, 1.12 O.D. X .50

LH0067-3L80

Figure 101 — Pump Assembly

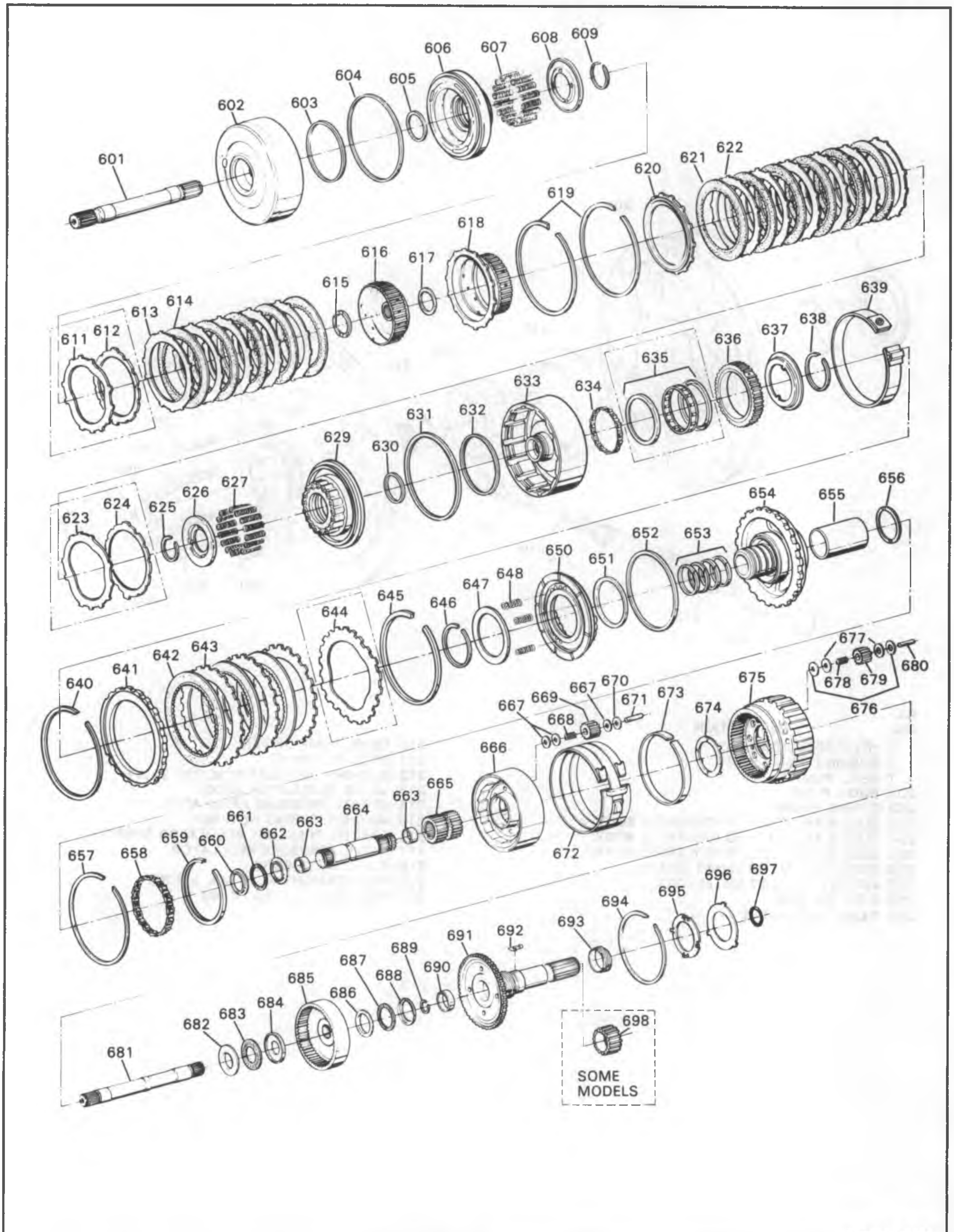


Figure 102 — Internal Components

ILL. NO.	DESCRIPTION
601	SHAFT, TURBINE
602	HOUSING, FORWARD CLUTCH
603	SEAL, CLUTCH HOUSING (CENTER)
604	SEAL, CLUTCH PISTON (OUTER)
605	SEAL, CLUTCH PISTON (INNER)
606	PISTON, FORWARD CLUTCH
607	SPRING, PISTON RELEASE
608	RETAINER, RELEASE SPRING
609	RING, SNAP (RETAINER/HOUSING)
611	PLATE, CLUTCH (WAVED)
612	PLATE, CLUTCH (DISHED)
613	PLATE, CLUTCH STEEL (FLAT)
614	PLATE ASSEMBLY, CLUTCH (FIBER)
615	WASHER, THRUST (CLUTCH HUB TO HOUSING)
616	HUB, FORWARD CLUTCH
617	WASHER, THRUST (FWD. CL. HUB/DIR. CL. HSG.)
618	HUB, DIRECT CLUTCH DRIVING
619	RING, SNAP (FORWARD & DIRECT CLUTCHES)
620	PLATE, DIRECT CLUTCH BACKING
621	PLATE ASSEMBLY, CLUTCH (FIBER)
622	PLATE, CLUTCH STEEL (FLAT)
623	PLATE, CLUTCH (WAVED)
624	PLATE, CLUTCH (DISHED)
625	RING, SNAP (RETAINER/HOUSING)
626	RETAINER, RELEASE SPRING
627	SPRING, PISTON RELEASE
629	PISTON, DIRECT CLUTCH
630	SEAL, CLUTCH PISTON (INNER)
631	SEAL, CLUTCH PISTON (OUTER)
632	SEAL, CLUTCH HOUSING (INNER)
633	HOUSING, DIRECT CLUTCH
634	ROLLER ASSEMBLY, INTERMEDIATE CLUTCH
635	SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
636	RACE, INTERMEDIATE CLUTCH
637	RETAINER, INTERMEDIATE CLUTCH
638	RING, SNAP (RETAINER/DIRECT CLUTCH)
639	BAND ASSEMBLY, FRONT
640	RING, SNAP (INTERMEDIATE CLUTCH/CASE)
641	PLATE, INTERMEDIATE CLUTCH BACKING
642	PLATE ASSEMBLY, INTERMEDIATE CLUTCH (FIBER)
643	PLATE, INTERMEDIATE CLUTCH STEEL (FLAT)
644	PLATE, INTERMEDIATE CLUTCH (WAVED)
645	RING, SNAP (CENTER SUPPORT/CASE)
646	RING, SNAP (INTERMEDIATE CLUTCH/RETAINER)
647	RETAINER, INTERMEDIATE CLUTCH SPRING
648	SPRING, INTERMEDIATE CLUTCH RELEASE
650	PISTON, INTERMEDIATE CLUTCH
651	SEAL, INTERMEDIATE CLUTCH (INNER)

ILL. NO.	DESCRIPTION
652	SEAL, INTERMEDIATE CLUTCH (OUTER)
653	RING, SEAL
654	SUPPORT ASSEMBLY, CENTER
655	BUSHING, CENTER SUPPORT
656	WASHER, THRUST (SUPPORT/REACTION DRUM)
657	SPACER, CENTER SUPPORT/CASE
658	ROLLER ASSEMBLY, LOW CLUTCH
659	RING, REACTION DRUM SPACER
660	RACE, THRUST BEARING TO CENTER SUPPORT
661	BEARING, NEEDLE THRUST
662	RACE, THRUST BEARING TO SUN GEAR
663	BUSHING, 1.12 O.D. X .50
664	SHAFT, SUN GEAR
665	GEAR, SUN
666	CARRIER ASSEMBLY, REACTION
667	WASHER, PINION THRUST (STEEL)
668	ROLLER, NEEDLE BEARING
669	PINION, PLANET
670	WASHER, PINION THRUST (BRONZE)
671	PIN, PLANET PINION
672	BAND ASSEMBLY, REAR BRAKE
673	RING, FRONT INTERNAL GEAR
674	WASHER, FRONT INTERNAL/REACTION CARRIER
675	CARRIER ASSEMBLY, OUTPUT
676	WASHER, PINION THRUST (BRONZE)
677	WASHER, PINION THRUST (STEEL)
678	ROLLER, NEEDLE BEARING
679	PINION, PLANET
680	PIN, PLANET PINION
681	SHAFT, TRANSMISSION MAIN
682	RACE, THRUST BEARING TO SUN GEAR
683	BEARING, NEEDLE THRUST
684	RACE, THRUST BEARING TO REAR INTERNAL GEAR
685	GEAR, REAR INTERNAL
686	RACE, THRUST BEARING TO REAR INTERNAL GEAR
687	BEARING, NEEDLE THRUST
688	RACE, THRUST BEARING TO OUTPUT SHAFT
689	RING, SNAP (MAIN SHAFT/INTERNAL GEAR)
690	BUSHING, OUTPUT SHAFT
691	SHAFT, OUTPUT
692	CLIP, SPEEDOMETER DRIVE GEAR
693	GEAR, SPEEDOMETER DRIVE
694	RING, SNAP (OUTPUT/OUTPUT CARRIER)
695	WASHER, THRUST (OUTPUT SHAFT/SELECTIVE)
696	WASHER, THRUST SELECTIVE
697	SEAL, O-RING (OUTPUT SHAFT)
698	ROTOR, SPEED SENSOR

LH0102-3L80

Figure 103 — Internal Components — Legend

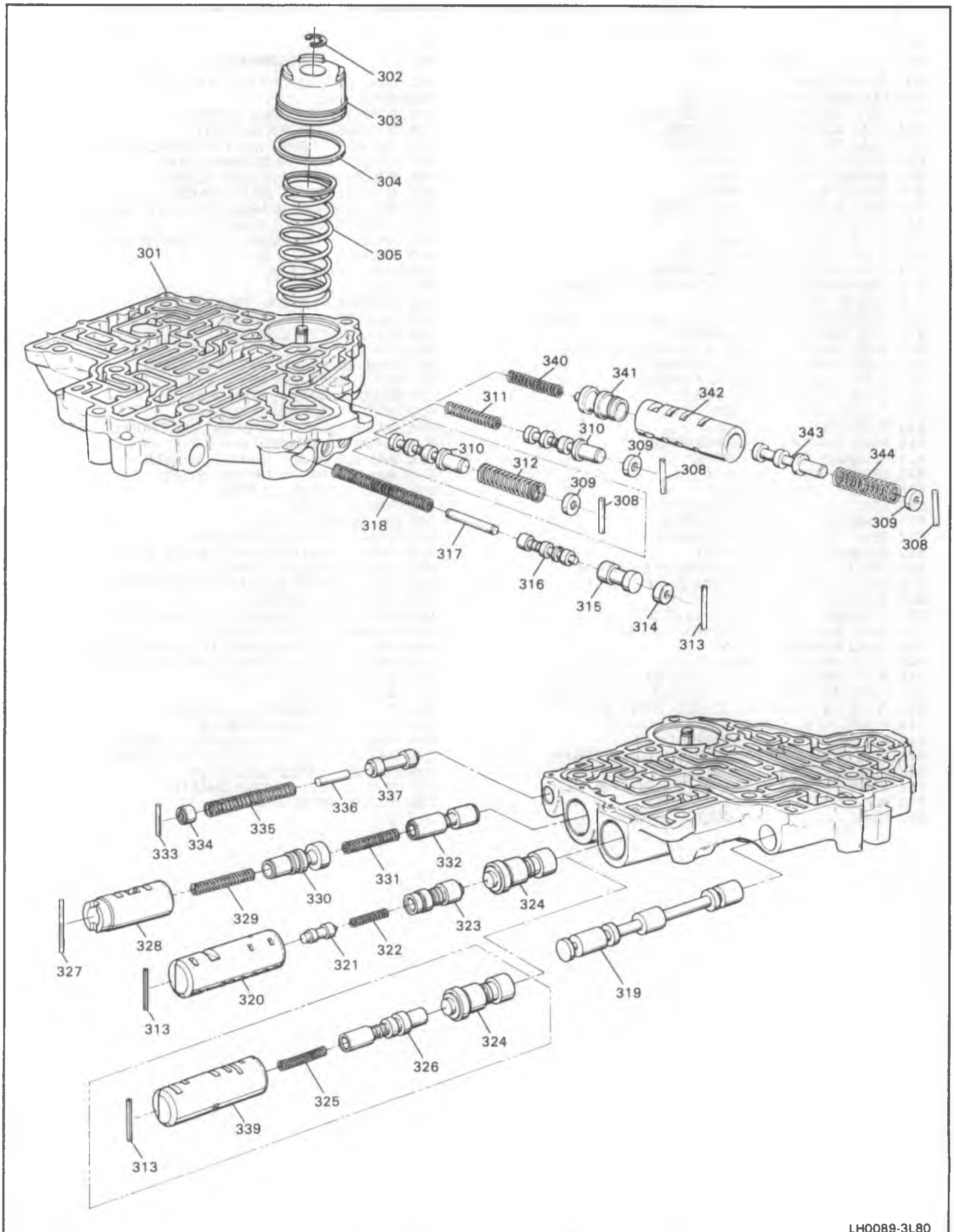


Figure 104 — Valve Body Assembly

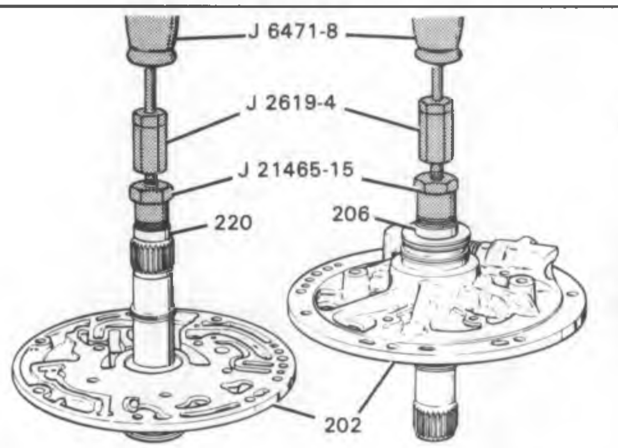
ILL. NO.	DESCRIPTION
301	BODY, CONTROL VALVE
302	RING, RETAINER (ACCUMULATOR PISTON)
303	PISTON, FRONT ACCUMULATOR
304	RING, SEAL (ACCUMULATOR PISTON)
305	SPRING, FRONT ACCUMULATOR PISTON
308	PIN, GROOVED
309	PLUG, VALVE BORE (.56 O.D.)
310	VALVE, 1-2 ACCUMULATOR
311	SPRING, 1-2 ACCUMULATOR VALVE PRIMARY
312	SPRING, 1-2 ACCUMULATOR VALVE SECONDARY
313	PIN, COILED SPRING
314	PLUG, VALVE BORE (.50)
315	VALVE, DETENT
316	VALVE, DETENT REGULATOR
317	PIN, DETENT REGULATOR VALVE
318	SPRING, DETENT REGULATOR
319	VALVE, MANUAL
320	BUSHING, 1-2 MODULATOR VALVE
321	VALVE, 1-2 REGULATOR
322	SPRING, 1-2 REGULATOR VALVE
323	VALVE, 1-2 DETENT
324	VALVE, 1-2
325	SPRING, 1-2 MODULATOR VALVE
326	VALVE, 1-2 MODULATOR
327	PIN, STRAIGHT .12 DIA. X 1.32
328	BUSHING, 2-3 MODULATOR VALVE
329	SPRING, 2-3 VALVE (OUTER)
330	VALVE, 2-3 MODULATOR
331	SPRING, 2-3 VALVE (INNER)
332	VALVE, 2-3
333	PIN, STRAIGHT .12 DIA. X .82
334	PLUG, VALVE BORE (.437)
335	SPRING, 3-2 VALVE
336	PIN, 3-2 VALVE
337	VALVE, 3-2
339	BUSHING, 1-2 MODULATOR VALVE
340	SPRING, 1-2 ACCUMULATOR PRIMARY
341	VALVE, 1-2 ACCUMULATOR
342	BUSHING, 1-2 ACCUMULATOR VALVE
343	VALVE, 1-2 ACCUMULATOR PRIMARY
344	SPRING, 1-2 ACCUMULATOR SECONDARY

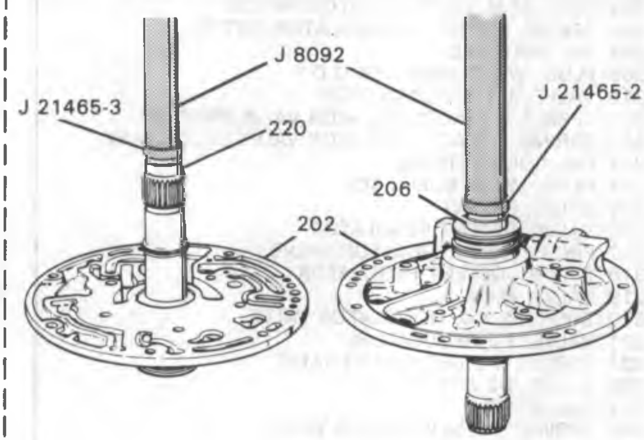
LH0090-3L80

Figure 105 — Valve Body Assembly — Legend

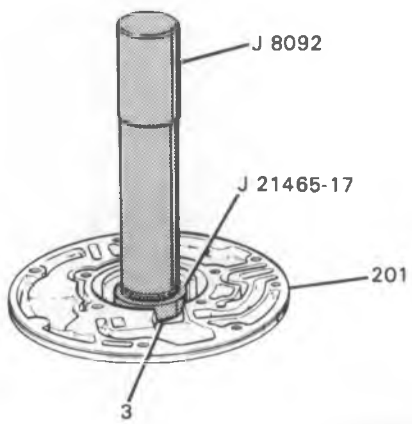
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS
OR CLOTH AS NECESSARY

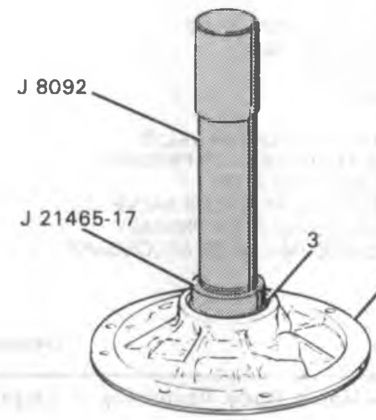
REMOVE AS SHOWN	INSTALL AS SHOWN



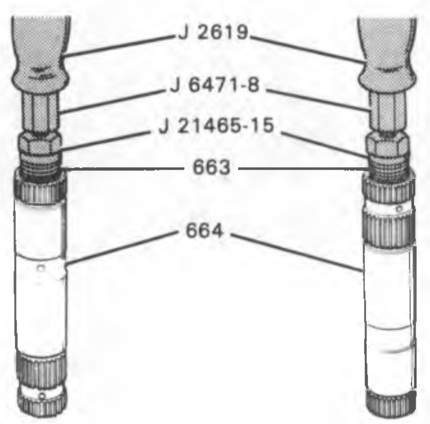


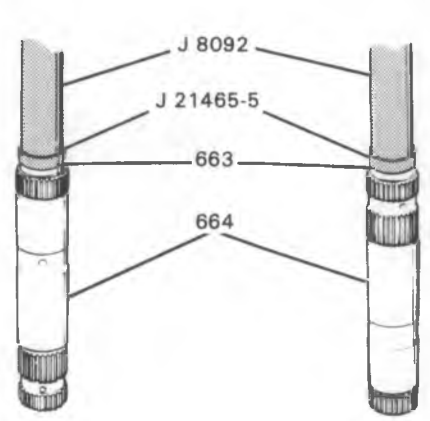
202 COVER, PUMP
206 BUSHING, STATOR SHAFT (REAR)
220 BUSHING, 1.12 O.D. X .50





3 BUSHING, PUMP BODY
201 BODY, PUMP





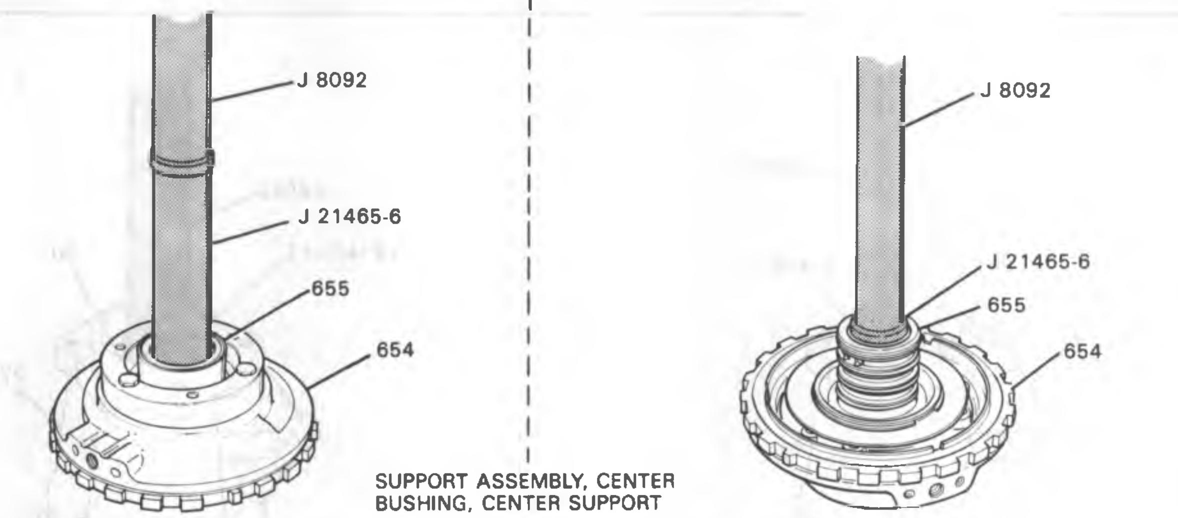
663 BUSHING, 1.12 O.D. X .50
664 SHAFT, SUN GEAR

LH0103-3L80

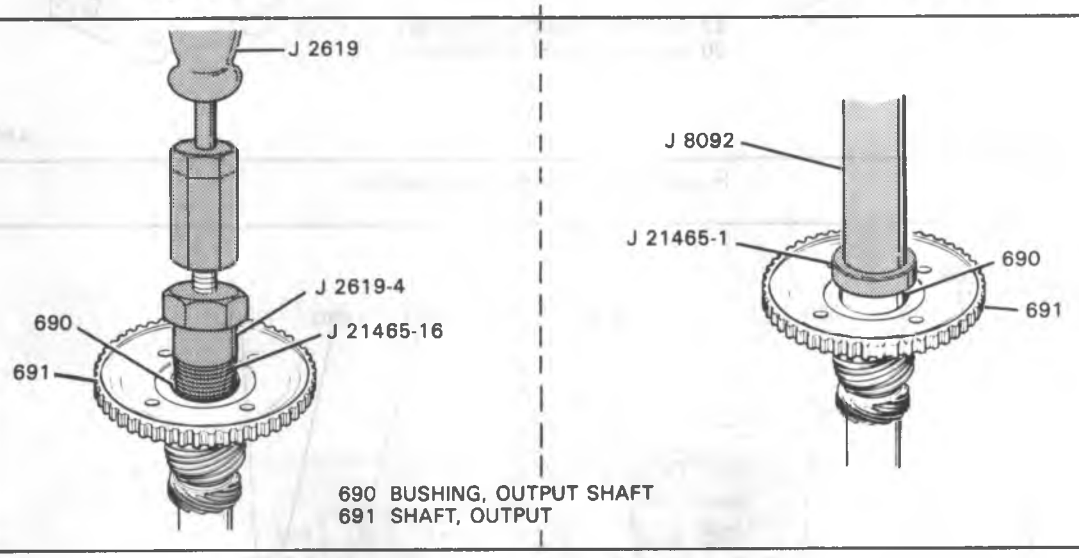
Figure 106 — Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS
OR CLOTH AS NECESSARY

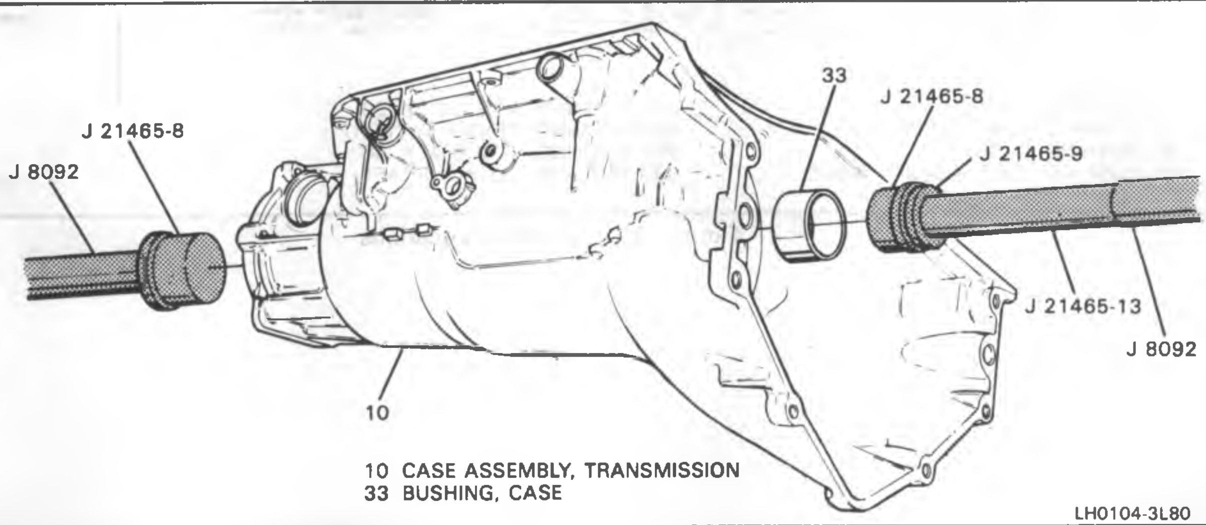
REMOVE AS SHOWN	INSTALL AS SHOWN



SUPPORT ASSEMBLY, CENTER
BUSHING, CENTER SUPPORT



690 BUSHING, OUTPUT SHAFT
691 SHAFT, OUTPUT



10 CASE ASSEMBLY, TRANSMISSION
33 BUSHING, CASE

LH0104-3L80

Figure 107 — Bushing Replacement Procedure

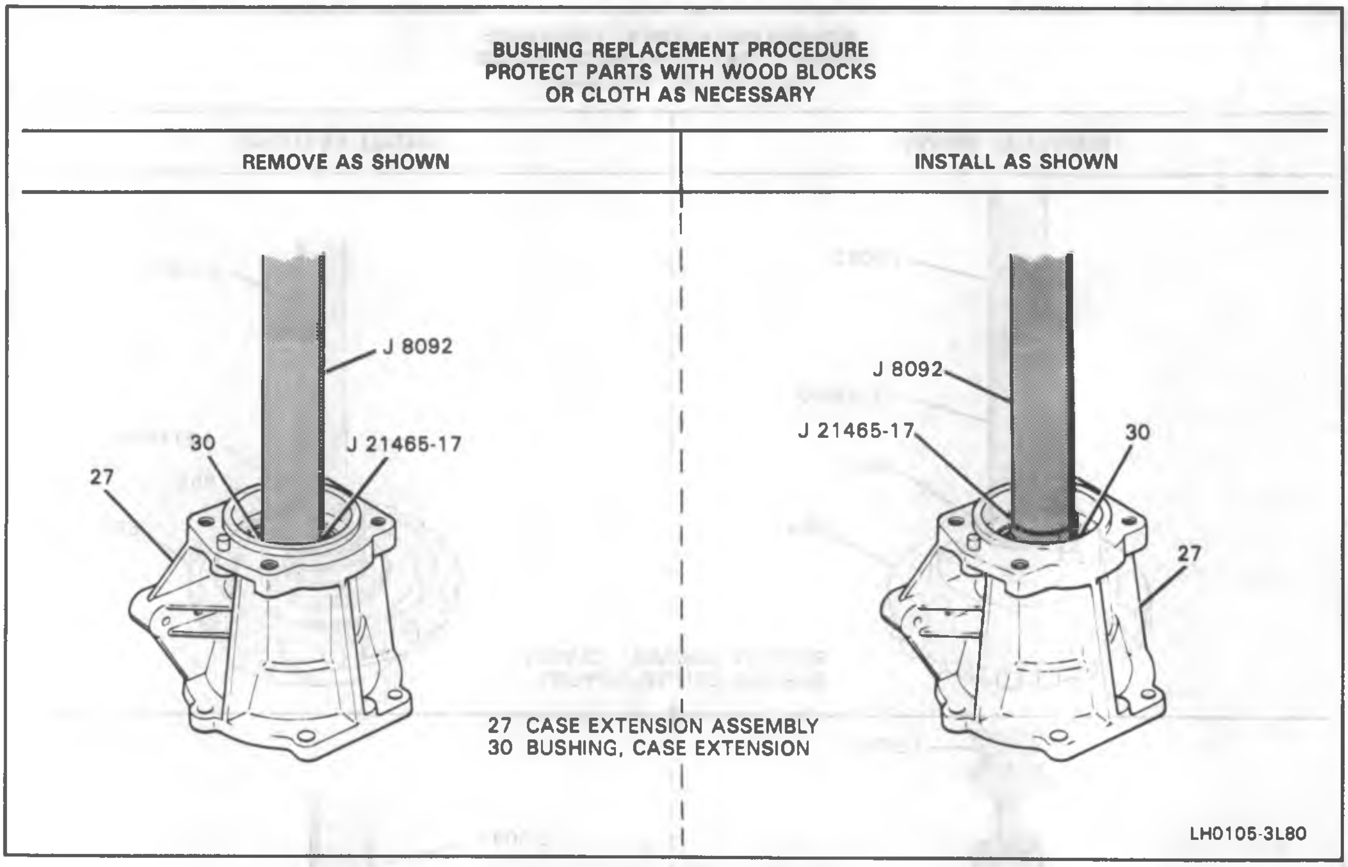


Figure 108 — Bushing Locations

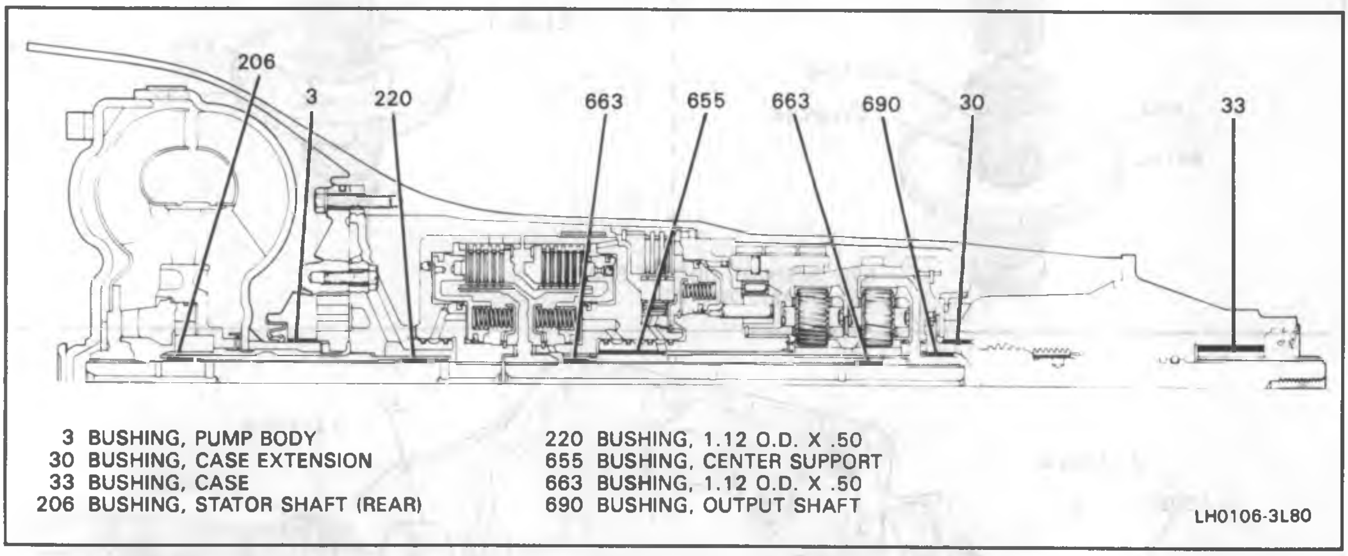


Figure 109 — Bushing Locations

FASTENER APPLICATION	ASSEMBLY TORQUE		RECHECK TORQUE	
	N·m	LB.-FT.	N·m	LB.-FT.
FILTER TO VALVE BODY SCREW	8-14	6-10	8-27	6-20
SOLENOID TO CASE SCREW	5-14	4-10	5-20	4-15
CONTROL VALVE ASSEMBLY TO CASE SCREW	8-14	6-10	8-27	6-20
LINE PRESSURE PLUG	7-14	5-10	7-14	5-10
FLYWHEEL HOUSING COVER TO TRANSMISSION SCREW	5-8	4-6	5-8	4-6
PUMP BODY TO COVER SCREW	20-27	15-20	20-34	15-25
PUMP ASSEMBLY TO CASE SCREW	20-27	15-20	14-41	11-31
REAR SERVO COVER TO CASE SCREW	20-27	15-20	20-27	15-20
GOVERNOR COVER TO CASE	11-16	8-12	5 -21	4-16
PARKING PAWL BRACKET TO CASE SCREW	20-27	15-20	20-41	15-30
VACUUM MODULATOR RETAINER TO CASE SCREW	20-27	15-20	20-27	15-20
SPEEDOMETER DRIVEN GEAR RETAINER TO CASE SCREW	5-8	4-6	5-8	4-6
PAN TO CASE SCREW	8-14	6-10	4-21	3-16
EXTENSION HOUSING TO CASE SCREW	27-34	20-25	20 MIN.	15 MIN.
MANUAL SHAFT TO DETENT LEVER NUT	20-27	15-20	20-34	15-26
MANUAL YOKE TO MANUAL SHAFT NUT	18-24	13-18	18-24	13-18
CASE TO CENTER SUPPORT SCREW	27-34	20-25	27-51	20-39
FLYWHEEL TO CONVERTER SCREW	41-47	30-35	41-47	30-35
TRANSMISSION CASE TO ENGINE SCREW	41-47	30-35	41-47	30-35
COOLER PIPE CONNECTOR NUT AT CASE & RADIATOR	35-41	26-30	35-41	26-30
COOLER PIPE CONNECTOR AT CASE	35-41	26-30	35-41	26-30
ENGINE REAR MOUNT TO TRANSMISSION BOLT	41-47	30-35	41-47	30-35
ENGINE REAR SUPPORT BRACKET TO FRAME NUT	41-47	30-35	41-47	30-35
SWITCH ASSEMBLY	3-5	2-3.5	3-5	2-3.5

LH0107-3L80

Figure 110 — Torque Specs

Figure 111 — Special Tools

SECTION/HYDRA-MATIC 3L30 (FORMALLY THM 180C)

AUTOMATIC TRANSMISSION UNIT REPAIR

RPO MD2

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result:

CONTENTS

TRANSMISSION DISASSEMBLY

GENERAL SERVICE INFORMATION

- Seal rings
  - — If any seal rings are damaged, cut, or do not rotate freely in their grooves, be certain to check the ring groove for debris, burrs, or damage.
- Thrust washer surfaces
  - — The thrust washers and bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.
- Snap rings
  - — Do not over expand snap rings when removing or installing.

EXTERNAL PARTS

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

Figure 1

- Torque converter

Install or Connect

Tools Required:

J 3289-20 Base
J 8763-01 Holding Fixture

1. J 8763-01 onto transmission case.

- Do not over torque holding fixture screw.

2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid through the rear extension.

Remove or Disconnect

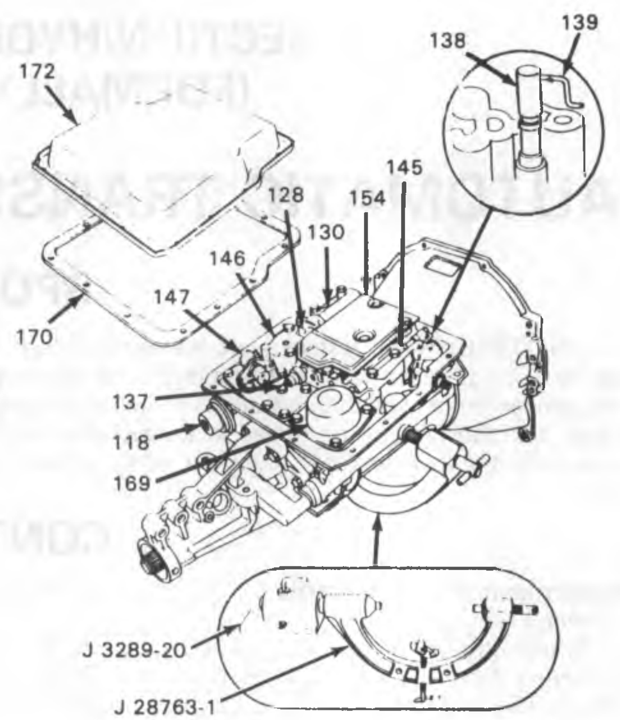
Figure 1

1. Bolts, oil pan and gasket.
2. Bolts, oil filter and gasket.
3. Manual detent roller and spring assembly.
4. Electrical connections at the governor pressure switch, solenoid and case.
5. Solenoid from transfer plate reinforcement.
6. Solenoid from the solenoid pipes.
7. Solenoid pipes from the valve body and the case.
   - Check for proper fit

Remove or Disconnect

Figure 2

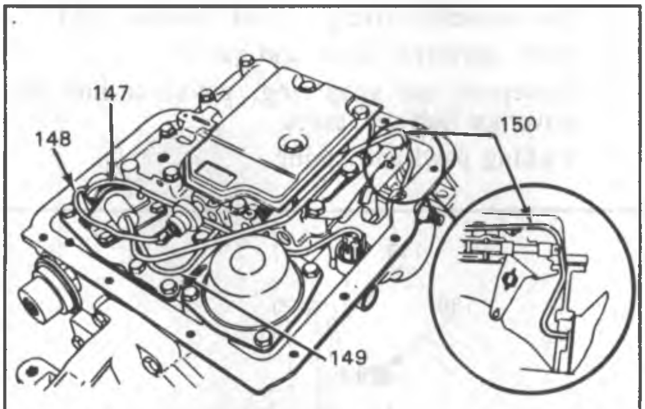
1. Governor pressure switch using a 1-1/16 in. pressure switch socket.
2. Bolts, transfer plate reinforcement.
3. Bolts, servo cover, and gasket.
4. Bolts, valve body, and manual valve link.
5. Check balls.



118 MODULATOR
128 VALVE BODY & ACCUMULATOR PISTON ASSEMBLY
130 PLATE, TRANSFER
137 SWITCH, OIL PRESSURE
138 VALVE, MANUAL
139 LINK, MANUAL VALVE
145 ROLLER, MANUAL DETENT
146 PLATE, REINFORCEMENT
147 SOLENOID & BRACKET ASSEMBLY
154 SCREEN, OIL PUMP
169 COVER, SERVO PISTON
170 GASKET, OIL PAN
172 PAN, OIL

LH0034-3L30

Figure 1 Disassembled View — External Parts



147 SOLENOID & BRACKET ASSEMBLY
148 WIRING HARNESS
149 TUBE, SOLENOID TO VALVE BODY
150 TUBE, SOLENOID TO OIL PUMP

LH0035-3L30

Figure 2 Hookup of Solenoid Pipes and Electrical Wires

Servo Piston Removal

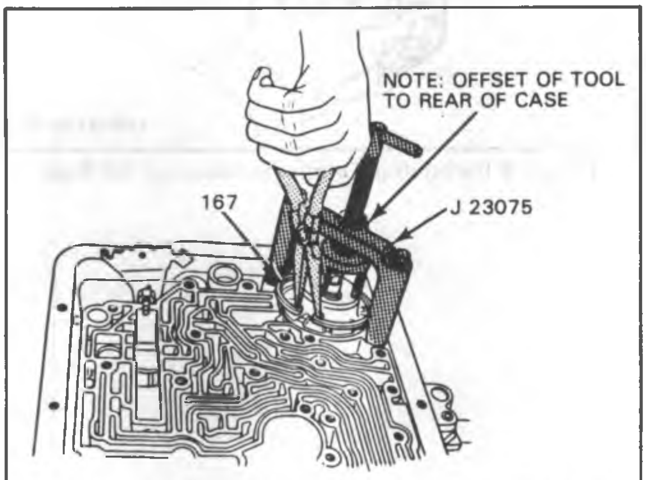
Figures 3 and 4

Remove or Disconnect

Tools Required:

J-23075 Servo/3rd Clutch Piston Spring Compressor

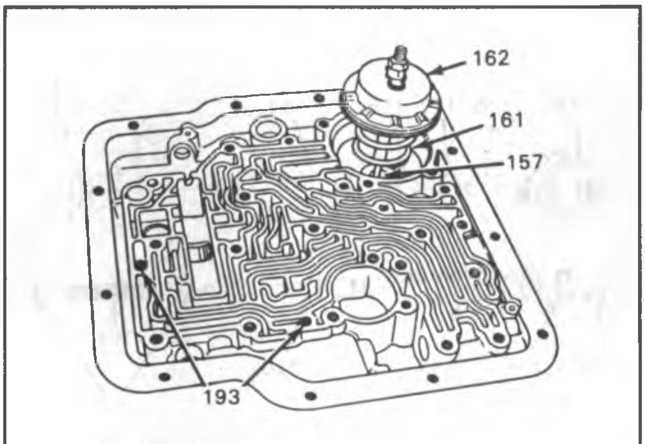
1. Install J 23075 with tool offset to the rear case.
   - Loosen the compression screw to receive servo spring tension.
2. Compress servo piston.
3. Servo piston snap ring.
4. Slowly release servo piston.
5. Remove J 23075, servo piston, return spring, and the servo apply rod.



167 RING, SERVO PISTON RETAINING

LH0036-3L30

Figure 3 Compressing the Servo Piston



157 ROD, SERVO PISTON
161 SPRING, SERVO PISTON CUSHION
162 PISTON, SERVO
193 BALL, CHECK

LH0037-3L30

Figure 4 Check Balls and Servo Piston

Modulator and Detent Valve Assemblies

Figures 5 and 6

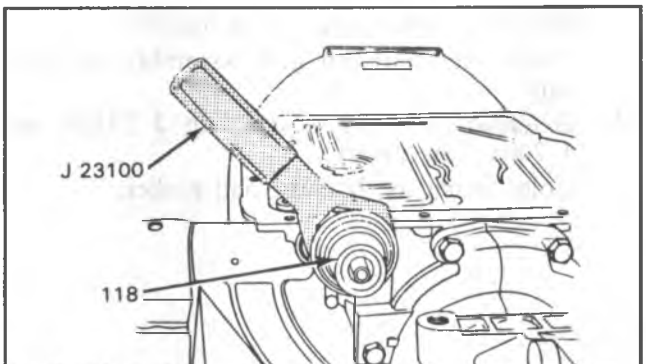
Remove or Disconnect

Tool Required:

J 23100 Vacuum Modulator Wrench

NOTICE: Use of another tool to remove the vacuum modulator may result in internal damage to the modulator.

1. Vacuum modulator, O-ring, and modulator plunger.
2. Modulator valve and sleeve.
3. Detent valve retaining pin using diagonal pliers. Insert a wire in the center of the spring pin to prevent it from collapsing during removal.
4. Detent sleeve, valve, and spring.
5. O-ring.



118 MODULATOR

LH0038-3L30

Figure 5 Vacuum Modulator

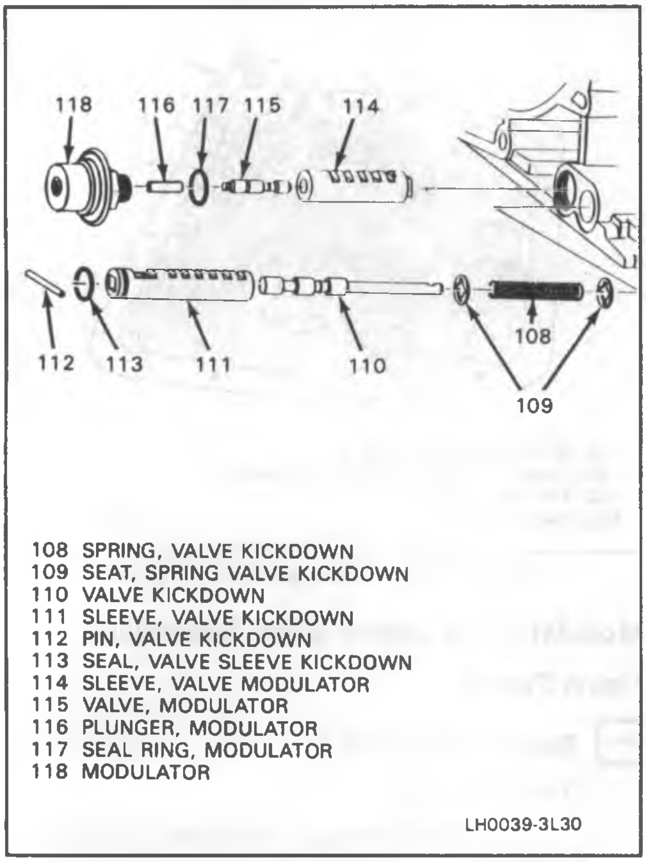


Figure 6 Detent Valve and Modulator Valve

Extension Housing, Speedometer, Driven Gear and Governor Assembly

Figures 7, 8, 9 and 10

Remove or Disconnect

Tools Required:

J 7004 Slide Hammer

J 23129 Converter Housing Seal Remover

1. Bolt and speedometer guide bracket.
2. Speedometer driven gear assembly and seal ring.
3. Extension housing seal using J 23129 and J 7004 if necessary.
4. Bolts, extension housing and gasket.
5. Speedometer drive gear and retaining clip.
6. Bolts, governor body and gasket.
7. Governor hub snap ring, governor hub and governor hub oil screen.
8. Parking pawl and spring.

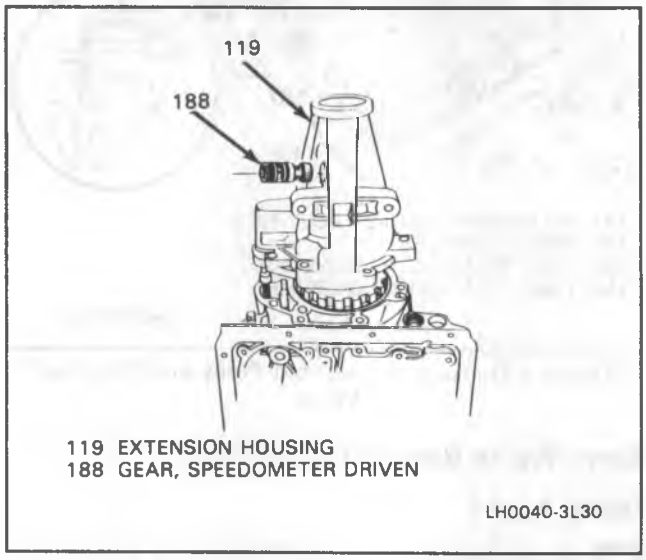


Figure 7 Extension Housing and Speedometer Drive Gear

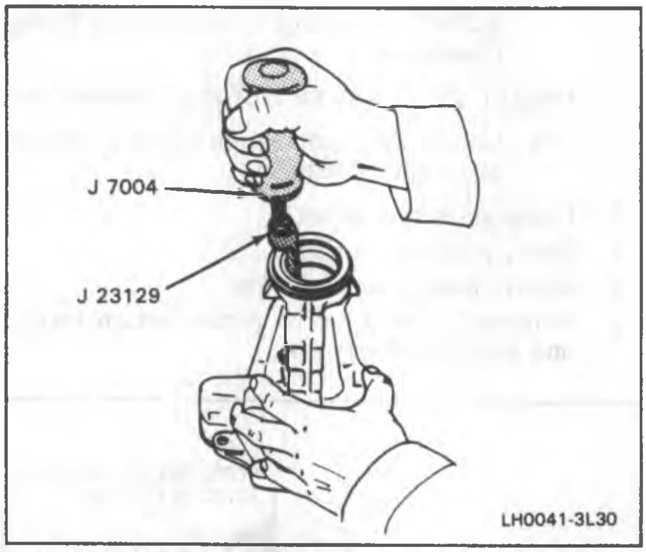


Figure 8 Removing Extension Housing Oil Seal

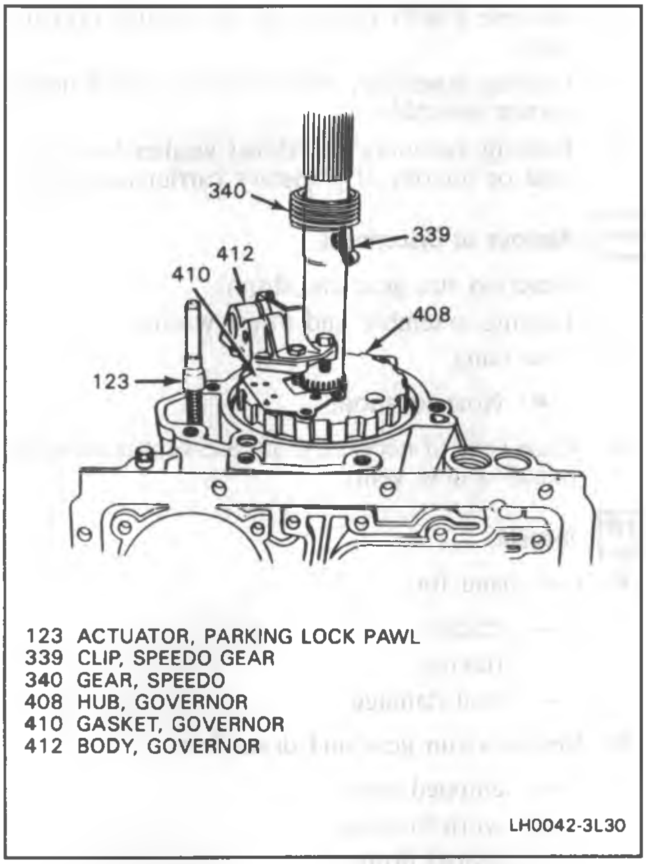


Figure 9 Speedometer Drive Gear and Governor

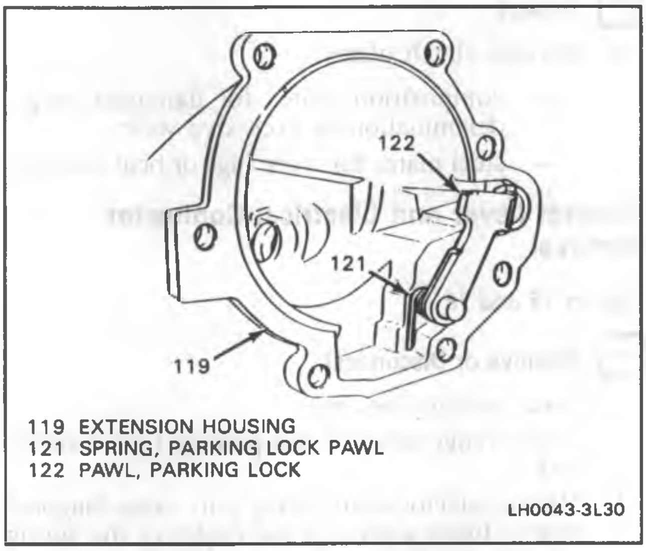


Figure 10 Extension Housing and Parking Pawl

INTERNAL PARTS

Figures 11, 12 and 13

Remove or Disconnect

Tools Required:

J 7004 Slide Hammer

J 23129 Converter Housing Seal Remover

1. Converter housing oil seal using J 7004 and J 23129, if necessary.
2. Seven outer bolts.
3. Loosen five inner bolts.
4. O-ring from input shaft.

CAUTION: If the O-ring is not removed, the second speed clutch and the third speed clutch will come out with the converter housing. The O-ring may shear while the parts are being held, allowing the second and the third speed clutches to fall, causing personal injury.

5. Converter housing with the pump assembly and reverse clutch assembly.
6. Selective washer.

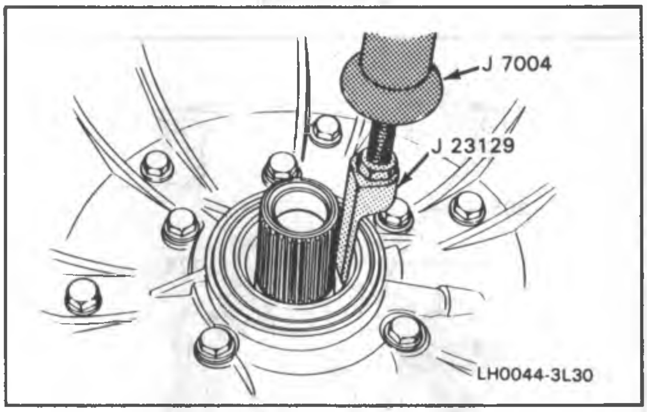


Figure 11 Removing Converter Housing Oil Seal

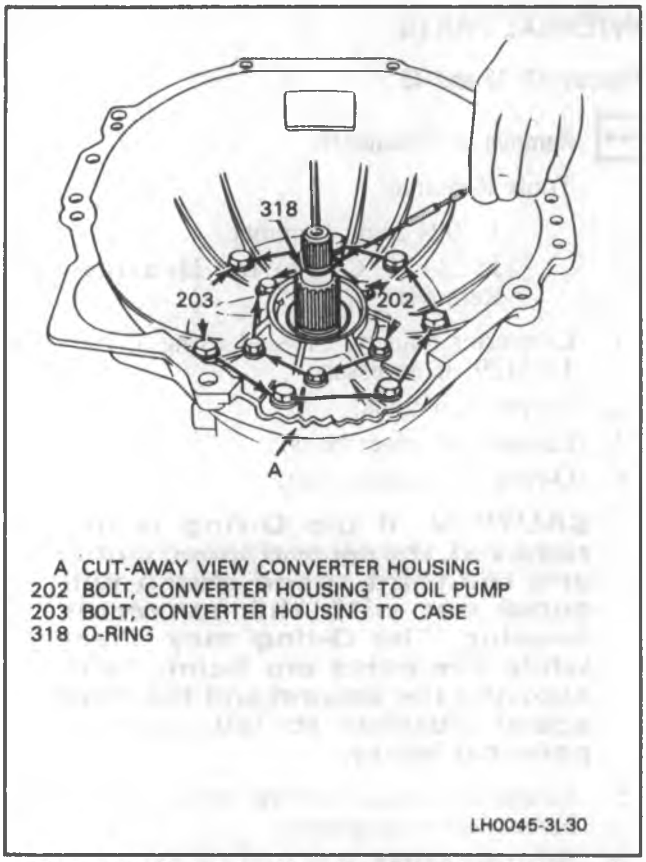


Figure 12 Converter Housing Attaching Bolts and O-Ring Seal

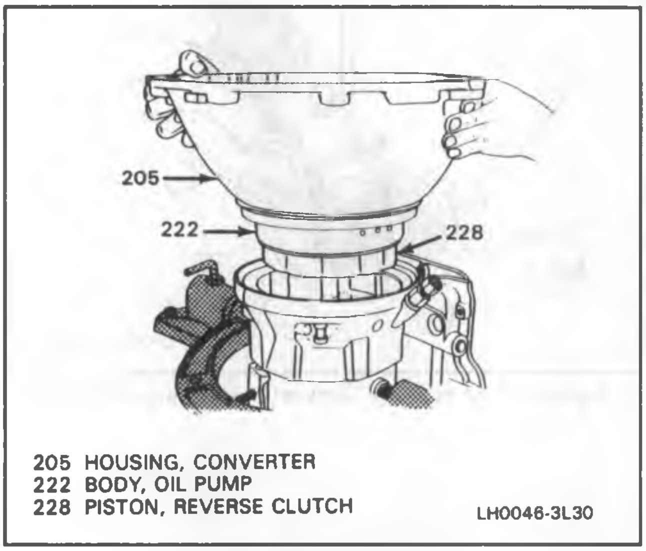


Figure 13 Removing Converter Housing

Remove or Disconnect

Figure 14

1. Second and third clutch assemblies.
2. Separate the second clutch and the third clutch assemblies.

NOTICE: If the reverse clutch plates are not being replaced, they must be installed in their original position.

3. Reverse clutch plates and aluminum pressure plate.
4. Bearing assembly, thrust washer and planetary carrier assembly.
5. Bearing assembly and thrust washer located in case or bottom of planetary carrier assembly.

Remove or Disconnect

1. Reaction sun gear and drum.
2. Bearing assembly and thrust washer.
3. Low band.
   - Note location.
4. Case vent, if necessary. If case vent is removed install a new vent.

Inspect

- Low band for:
  - — cracks
  - — flaking
  - — heat damage
- Reaction sun gear and drum for:
  - — chipped teeth
  - — worn bushing
  - — scored drum

Inspect

- Reverse clutch plates
  - — composition plates for damaged tangs, delamination or excessive wear
  - — steel plates for worn lugs or heat damage.

Selector Lever and Electrical Connector Removal

Figures 15 and 16

Remove or Disconnect

1. Inner selector hex nut.
2. Inside range selector and parking lock actuator rod.
3. Range selector shaft spring pin, using diagonal pliers. Insert a wire in the center of the spring pin to prevent it from collapsing during removal.

NOTICE: Inspect the range shaft for burrs before removing shaft to prevent damage to the case.

4. Range selector shaft.
5. Selector shaft seal, if necessary.
6. Electrical connector and O-ring if necessary.

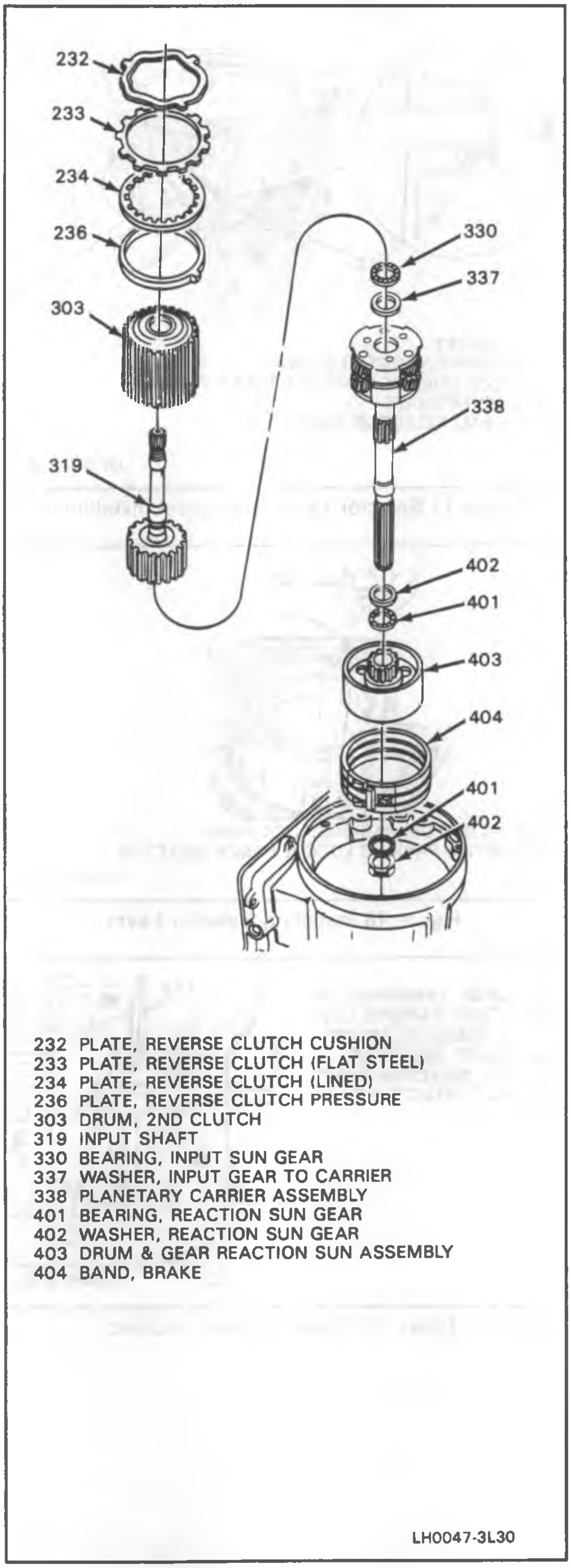


Figure 14 Internal Parts

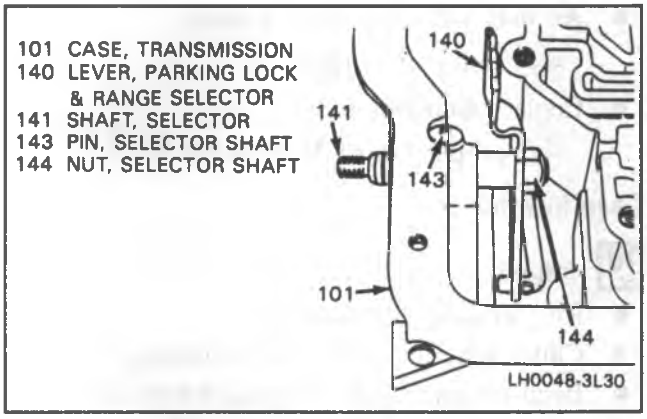


Figure 15 Selector Lever

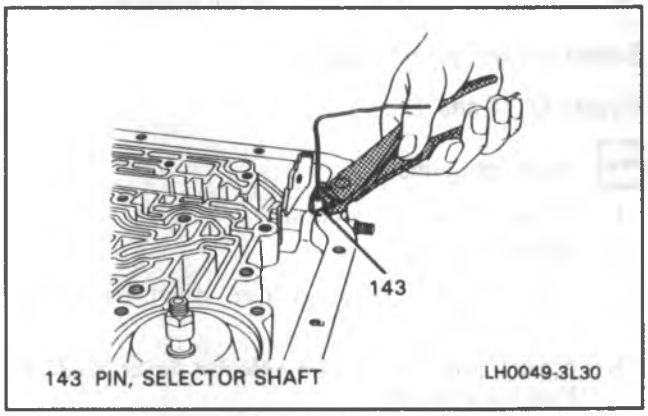


Figure 16 Removing Spring Pin

COMPONENT REPAIR AND TRANSMISSION ASSEMBLY

- The assembly for some components will require use of an assembly lube. It is recommended the TRANSJEL ™ J 36850 or equivalent be used during assembly.

NOTICE: Do not use any type of grease to retain parts during assembly of this unit. Greases other than the recommended assembly lube will change transmission fluid characteristics and cause undesirable shift conditions and/or filter clogging.

When assembling the transmission, do not use any O-rings, gaskets, or oil seals that have been removed.

Case

Inspect

- Case exterior for cracks or porosity
- Case to valve body face for damage
- Interconnected fluid passages for damage
- Servo bore for
  - — sharp edges
  - — porosity

- All bolt holes for thread damage
  - — Heli-coil to repair
- Cooler conditions for
  - — proper torque 38 N·m (28 lb. ft.)

Case Interior

Inspect

- Ring grooves for damage
- Clutch plate lugs for wear or damage
- Band retaining pins for good retention
- Detent bore for scoring or scratches
- Modulator bore for scoring or scratches

Selector Lever and Shaft

Figures 17, 18 and 19

Install or Connect

1. Selector seal, if necessary.
2. Selector shaft.
   - identification groove must be on the outside.
3. Spring pin. Check the selector lever shaft for free movement.
4. Inside selector lever and parking pawl actuator assembly.
5. Inside selector lever.
6. Electrical connector with a new O-ring if necessary.

Install or Connect

Figure 14

1. Thrust washer and bearing.
   - The case bushing acts as a guide for the thrust washer and the bearing.
2. Band
3. Reaction sun gear and drum assembly.
4. Bearing and thrust washer.

- Retain with TRANSJEL ™ J 36850 or equivalent.

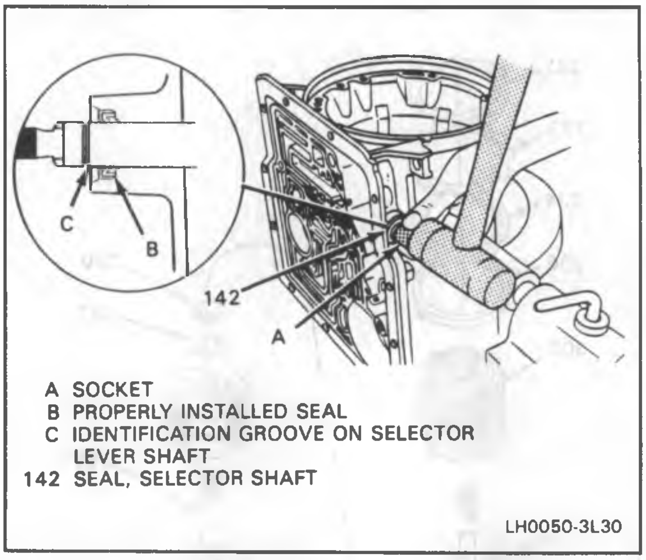


Figure 17 Selector Lever Shaft Seal Installation

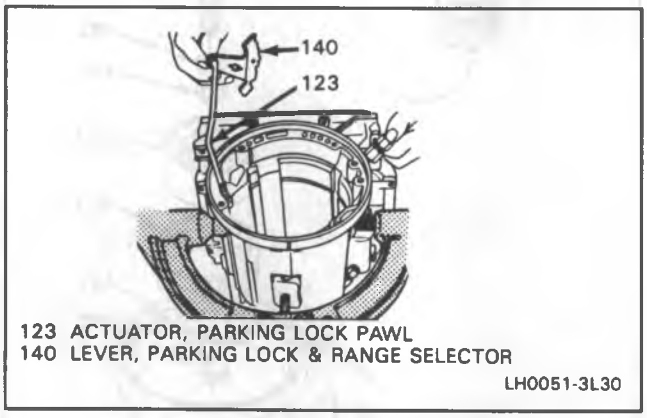


Figure 18 Installing Selector Lever

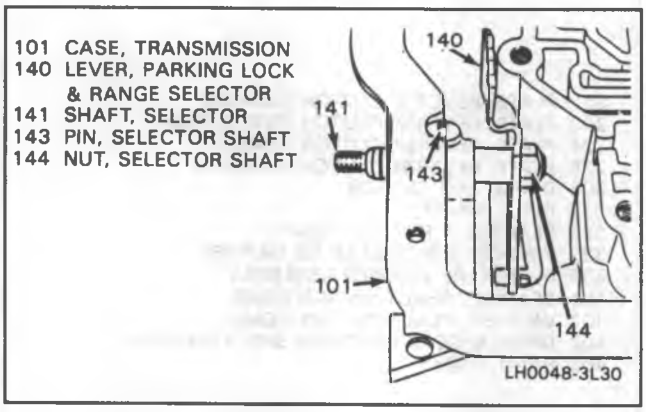


Figure 19 Selector Lever Installed

Planetary Carrier

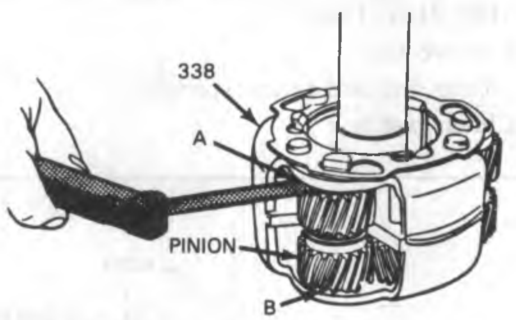
Figure 20

Inspect

- Planetary carrier and output shaft for:
  - — damage
  - — distortion
- Planetary pinions for:
  - — damage
  - — chipped teeth

Measure

- Pinion clearance at points A and B with a feeler gage. Clearance should be .127-.889 mm (.005"-.035").



338 PLANETARY CARRIER ASSEMBLY LH0053-3L30

Figure 20 Planetary Carrier and Pinion Clearance

Install or Connect

Figure 21

1. Planetary carrier and output shaft assembly.
2. Thrust washer and bearing.
   - Use TRANSJEL™ J 36850 or equivalent to hold the thrust washer and bearing in place.

Third Clutch Assembly

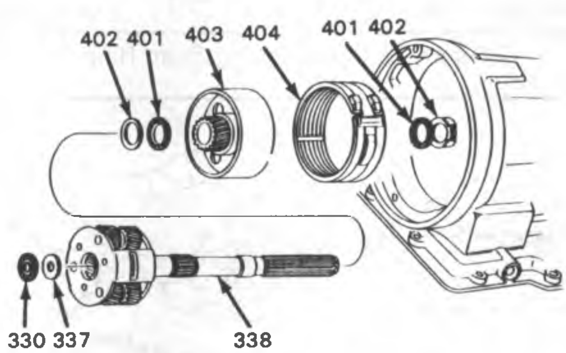
Figures 22, 23 and 24

Disassemble

Tools Required:

J 38450 Third Clutch Sprag Retaining Ring Tool

1. Place the third clutch housing and intermediate shaft assembly upright using a soft jawed vise as a support.
2. Locate the end of the sprag retaining ring. Compress near the end using a screwdriver through the side slot and slide one tool blade between ring and housing to hold the ring clear of the groove.
3. Repeat with a second tool blade near the other end of the retaining ring.
4. Repeat with a third tool blade opposite the first two.
5. Repeat with two further blades equally spaced.



330 BEARING, INPUT SUN GEAR
337 WASHER, INPUT GEAR TO CARRIER
338 PLANETARY CARRIER ASSEMBLY
401 BEARING, REACTION SUN GEAR
402 WASHER, REACTION SUN GEAR
403 DRUM & GEAR REACTION SUN ASSEMBLY
404 BAND, BRAKE

LH0054-3L30

Figure 21 Installing Planetary Carrier

6. Pull the input sun gear assembly until the sprag retaining ring clears and ring groove.
7. Remove the tool blades.
8. Sprag race assembly from third clutch drum assembly.
9. Bearing and thrust washer.
10. Clutch plates.

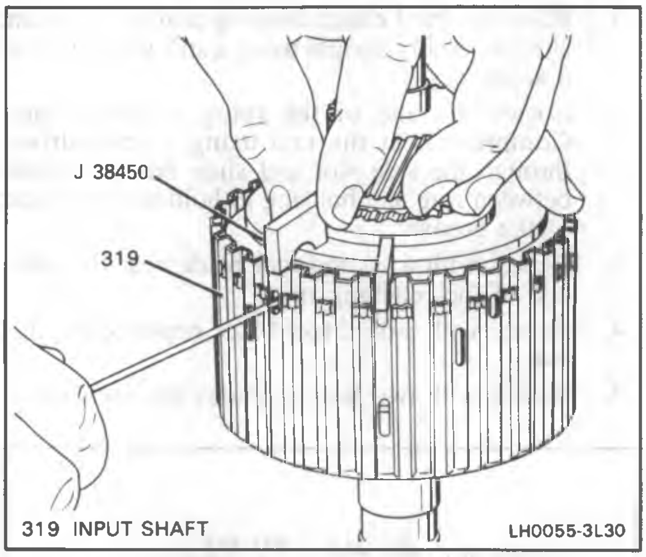


Figure 22 Compressing Snap Ring

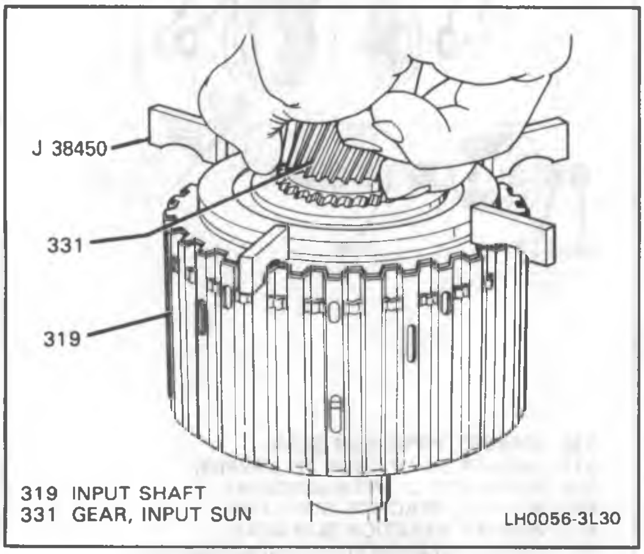


Figure 23 Removing Sprag Assembly

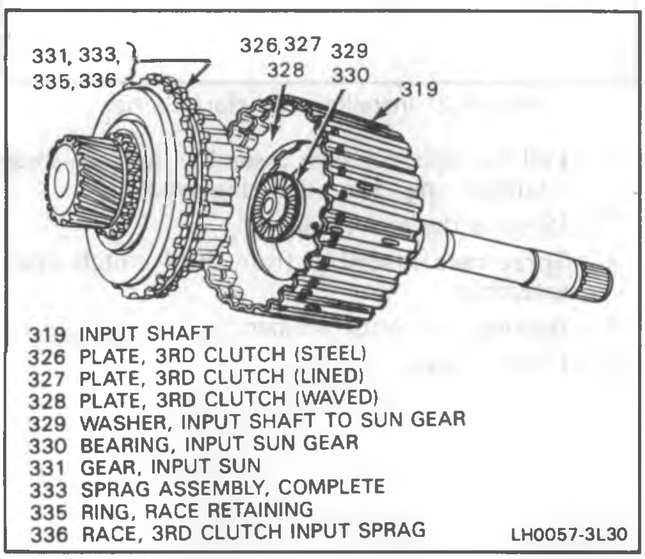


Figure 24 Sprag Assembly and Third Clutch Assembly

NOTICE: If the third clutch plates are not being replaced, they must be installed in their original position.

Disassemble

Figures 25 and 26

Tools Required:

J 23075 Servo/Third Clutch Piston Spring Compressor

1. Position third clutch and input shaft assembly in a press with the input shaft facing down.
2. Compress third clutch piston using J 23075.

NOTICE: Do not overstress the springs and seat. This will cause damage to the spring seat.

3. Spring seat snap ring.
4. Release the clutch piston.

   DO NOT LET THE SPRING SEAT CATCH IN THE RING GROOVE.
5. Remove tool.
6. Spring seat and return springs.
7. Clutch piston.

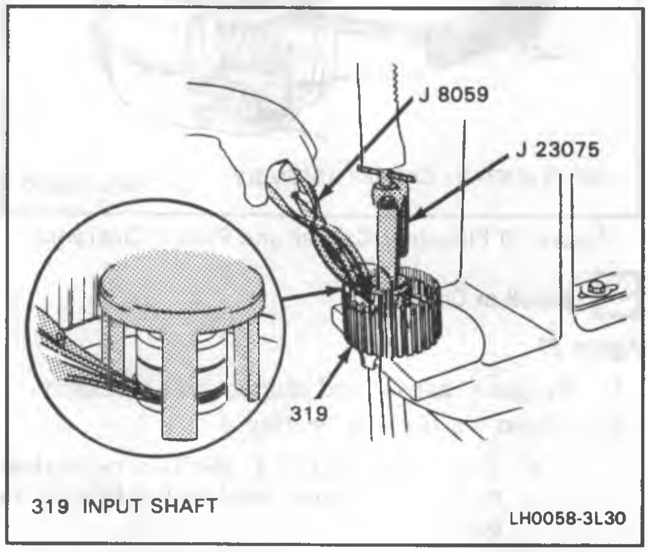


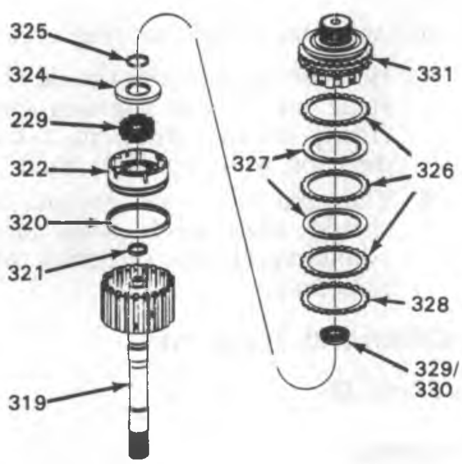
Figure 25 Removing or Installing Third Clutch Piston

Inspect

Figure 26

- Third clutch piston check ball
  - — Shake the piston and listen for check ball movement.
  - — Replace the piston if check ball is missing or falls out.
- Clutch piston lip seal for nicks, cuts, or damage.
- Input shaft lip seal for nicks, cuts, or damage.

- Clutch plates
  - — composite plates for damage tangs, delamination or excessive wear.
  - — steel plates for damaged lugs, or heat damage.
- Third clutch drum for damage or worn clutch splines.
- Thrust washer and bearing for damage.



229 SPRING, CLUTCH PISTON RETURN
319 INPUT SHAFT
320 SEAL, 3RD CLUTCH PISTON (OUTER)
321 SEAL, 3RD CLUTCH PISTON (INNER)
322 PISTON, 3RD CLUTCH
324 SEAT, 3RD CLUTCH PISTON SPRING RETAINER
325 RING, CLUTCH PISTON SPRING SEAT RETAINER
326 PLATE, 3RD CLUTCH (STEEL)
327 PLATE, 3RD CLUTCH (LINED)
328 PLATE, 3RD CLUTCH (WAVED)
329 WASHER, INPUT SHAFT TO SUN GEAR
330 BEARING, INPUT SUN GEAR
331 GEAR, INPUT SUN

LH0059-3L30

Figure 26 Third Clutch

Assemble

Figures 25, 26, 27 and 28

Tools Required:

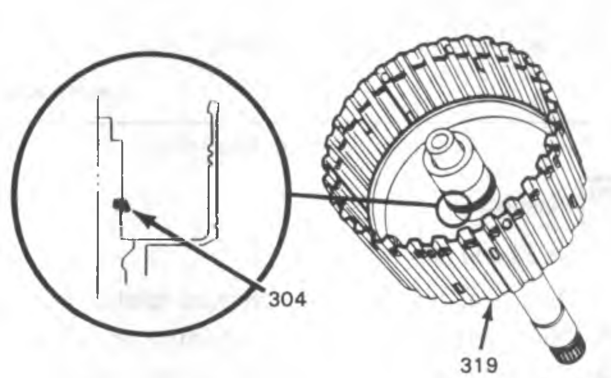
J 23075 Third Clutch Piston Spring Compressor

J 23084 Third Clutch Seal Protector

1. Input shaft lip seal. Lip seal must point toward the input shaft. Lubricate the lip seal with DEXRON ®-II transmission fluid.
2. Piston lip seal onto the piston as shown.
   - Lubricate the lip seal with DEXRON ®-II transmission fluid. Use J 23084 to protect the seal during installing.
3. Piston into the clutch drum.
4. Remove J 23084.
5. Third clutch piston return spring.
6. Spring seat.
7. Position the third clutch and input shaft assembly in a press with the input shaft pointing down.
8. Compress the piston return springs using J 23075.

NOTICE: Do not overstress the springs and seat. This will cause damage to the spring seat.

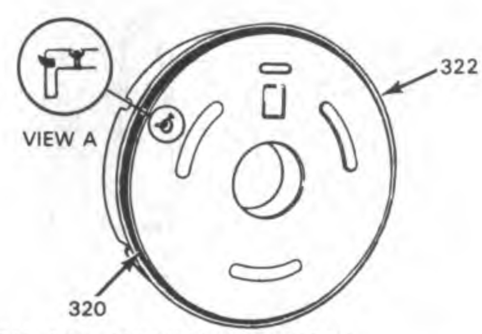
9. Spring seat snap ring.
10. Remove J 23075.



304 SEAL, 2ND CLUTCH PISTON (INNER)
319 INPUT SHAFT

LH0060-3L30

Figure 27 Input Shaft Lip Seal



320 SEAL, 3RD CLUTCH PISTON (OUTER)
322 PISTON, 3RD CLUTCH

LH0061-3L30

Figure 28 Third Clutch Piston

Sprag Unit

Figure 29

Disassemble

1. Sprag assembly from the third speed clutch sun gear.
2. Sprag cage and retaining washers from the outer sprag race.

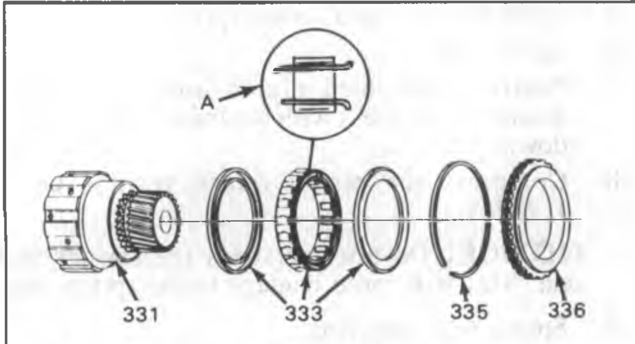


Figure 29 Sprag Assembly

Inspect

Figures 29 and 30

- Sun gear for nicked or chipped teeth.
- Sun gear sprag surface for pitting or damage.
- Outer sprag race for pitting or heat damage.
- Retaining ring damage.

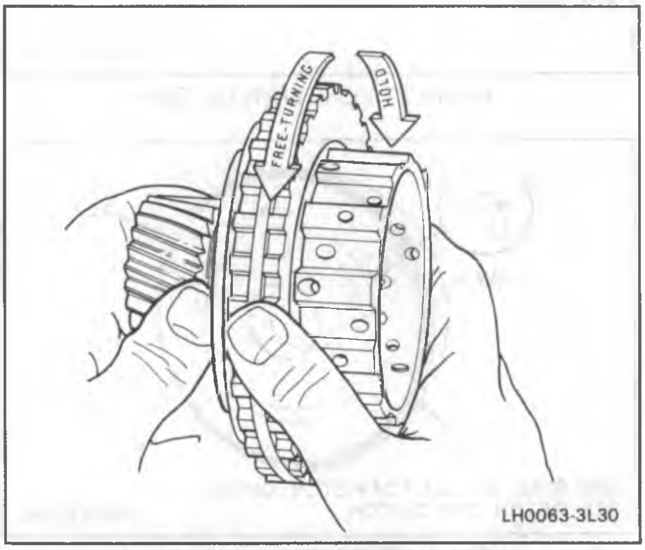


Figure 30 Testing Sprag Assembly

Assemble

Figure 29

1. Retaining rings and sprag cage onto the sun gear. Flared shoulder of the sprag cage faces the sun gear.

Important

- This procedure must be followed exactly to be sure that the sprag assembly is installed properly.

2. Outer sprag race over the sprag cage.
   - Hold the sun gear with your left hand. The sprag and retainer assembly should hold firmly when turned in a clockwise direction with your right hand.
   - The sprag race and retainer assembly should rotate freely when turned in a counterclockwise direction with your right hand.

Third Clutch and Sprag Unit

Figures 31 and 32

Assemble

Tool Required:

J 38450 Third Clutch Sprag Retaining Ring Tool

1. Place third clutch housing and intermediate shaft assembly upright using a soft jawed vise as a support.
2. Third clutch spring cushion plate, bevel face down.
3. Third clutch plates into clutch housing. Starting with the steel clutch plate and alternate with lined plates.
4. Thrust washer and bearing.
5. Align third clutch inner tangs.
6. Fully engaged the sprag assembly hub splines into the third clutch inner tangs. Simultaneously rotate the outer sprag race to engage into the third clutch housing.
7. Install a tool blade at each extremity of the retaining ring (Fig. 32).
8. Compress the retaining ring with a screwdriver opposite the tool blades while pushing down on the outer sprag race.
9. Engage retaining ring into groove.
10. Remove tool blades.

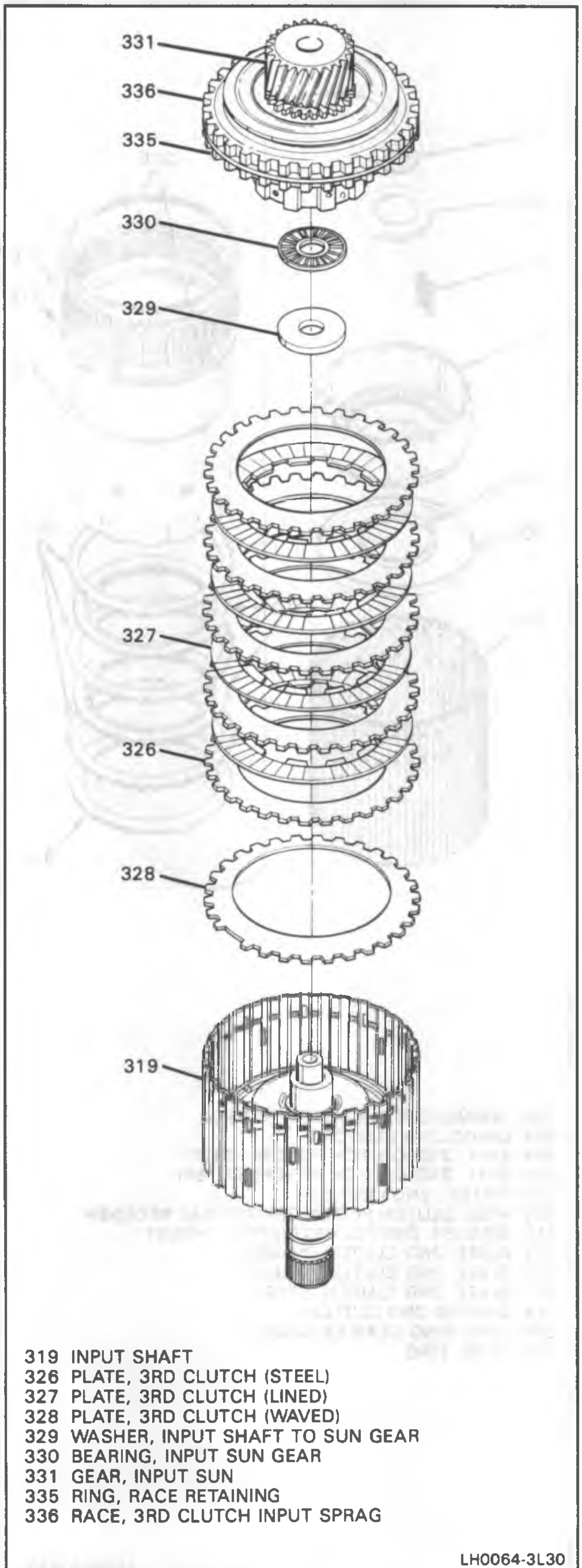


Figure 31 3rd Clutch and Sprag Assembly

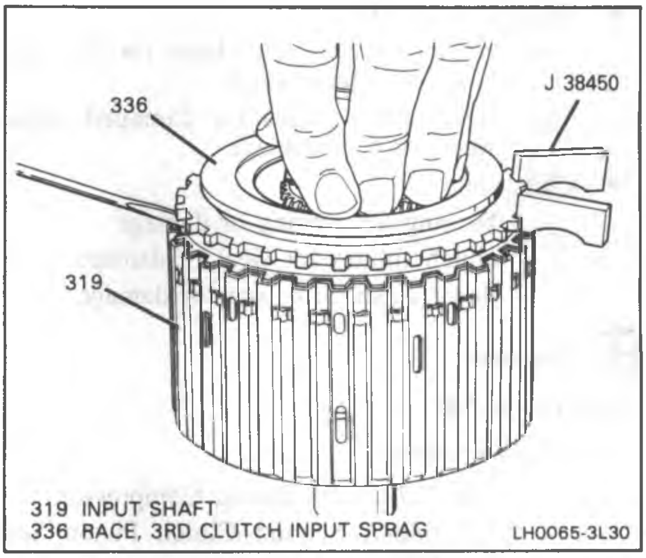


Figure 32 Third Clutch

Second Clutch

Figure 33

Disassemble

1. Retaining ring from the second clutch drum.
2. Ring gear, retaining ring, and spacer.

NOTICE: If the second speed clutch plates are not being replaced, they must be installed in their original position.

3. Second clutch plates.
4. Thrust washer.

Disassemble

Figures 33, 34 and 35

Tool Required:

J 23327 Clutch Spring Compressor

1. Install J 23327.
2. Compress the piston return springs.
3. Retaining snap ring.
4. Clutch piston. Remove J 23327
5. Spring seal and return springs.
6. Clutch piston.
7. Piston lip seal and the clutch drum lip seal if nicked, cut or damaged.

Inspect

- Second clutch piston
  — Shake the piston and listen for check ball movement. Movement indicates proper check ball operation. Replace the piston if check ball is missing or falls out.

- Second clutch plates
  - — composition clutch plates for damaged tangs or delamination
  - — steel clutch plates for damaged tangs, wear, or heat damage
- Clutch hub
  - — bushing for scoring or damage
  - — clutch splines for wear or damage
  - — thrust washer for wear or damage

Assemble

Figures 35 and 36

Tools Required:

J 23327 Clutch Spring Compressor

J 23080-A Second Clutch Piston Seal Installer

1. Clutch drum lip seal with the lip facing down, if necessary. Lubricate the lip seal with DEXRON®-II transmission fluid.
2. Outer piston lip seal with the lip facing down, if necessary. Lubricate the lip seal with DEXRON®-II transmission fluid.
3. Second clutch piston into the clutch drum. Lubricate the lip seals with liberal amounts of DEXRON®-II transmission fluid. Use J 23080-A to protect the outer piston lip seal.
4. Remove J 23080-A.

Assemble

Figure 34

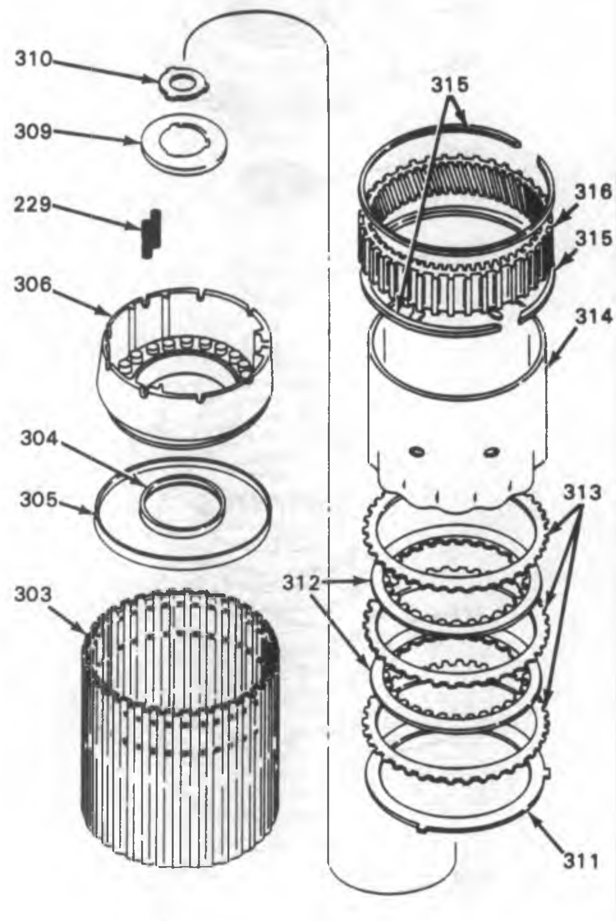
Tools Required:

J 23327 Clutch Spring Compressor

J 23080-A Second Clutch Piston Seal Installer

1. Piston return springs and spring seat on the second clutch piston.
2. Use J 23327 to compress the second clutch piston return springs.

   DO NOT LET SPRING SEAT CATCH IN RING GROOVE.
3. Snap ring.
4. Remove J 23327
5. Thrust washer. Seat the tang in the slot on the second clutch hub.
   - Retain washer with TRANSJEL ™ J 36850 or equivalent.
6. Clutch plates into the second clutch drum in the following order:
   - Waved plate
   - Steel plate
   - Composition plate
   - Steel plate



229 SPRING, CLUTCH PISTON RETURN
303 DRUM, 2ND CLUTCH
304 SEAL, 2ND CLUTCH PISTON (INNER)
305 SEAL, 2ND CLUTCH PISTON (OUTER)
306 PISTON, 2ND CLUTCH
309 RING, CLUTCH PISTON SPRING SEAT RETAINER
310 WASHER, 2ND TO 3RD CLUTCH THRUST
311 PLATE, 2ND CLUTCH (WAVED)
312 PLATE, 2ND CLUTCH (LINED)
313 PLATE, 2ND CLUTCH (STEEL)
314 SPACER, 2ND CLUTCH
315 RING, RING GEAR RETAINER
316 GEAR, RING

LH0066-3L30

Figure 33 Second Clutch

7. Align the internal splines of the clutch plates.

Assemble

Figure 33

1. Ring gear spacer.
   - wavy end toward the clutch plates.
2. Spacer retaining ring.
3. Ring gear.
   - grooved edge facing up.
4. Ring gear retaining ring.

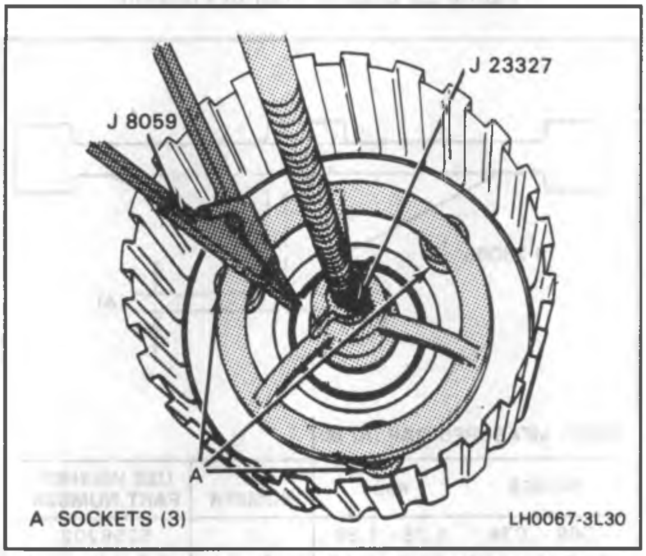


Figure 34 Removing Snap Ring From Second Clutch Piston

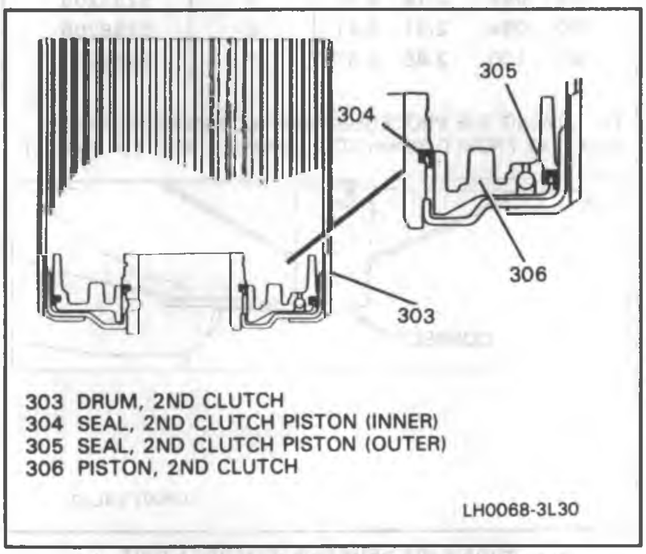


Figure 35 Second Clutch Piston Lip Seals

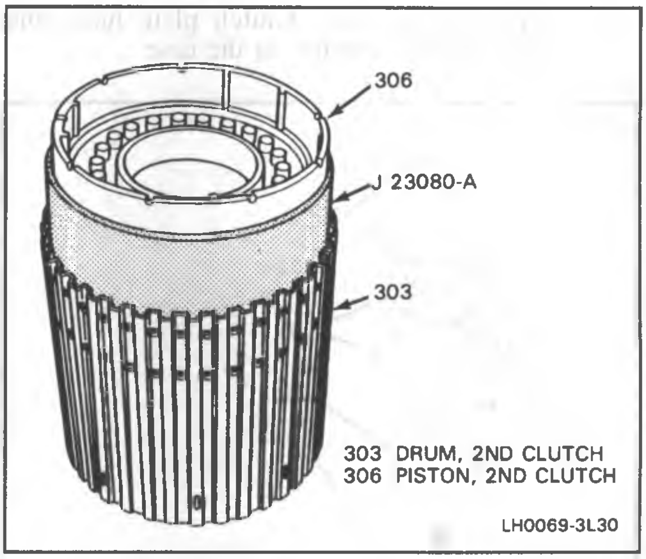


Figure 36 Installing Second Clutch Piston Into Second Clutch Drum

Assemble

Figure 37

1. Third clutch and input shaft assembly into the second clutch drum.
2. Second and third clutch assembly.

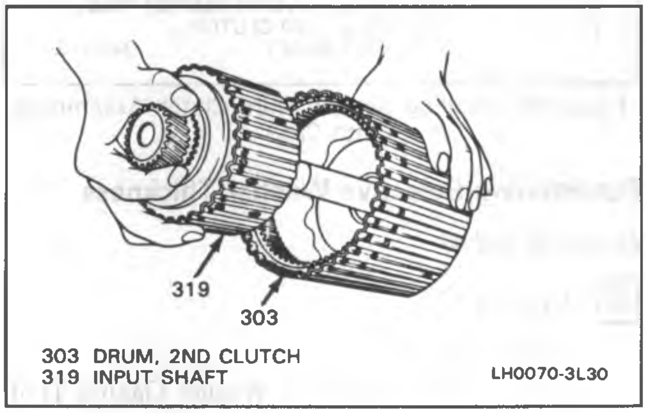


Figure 37 Installing Third Clutch Assembly Into Second Clutch Assembly

Reverse Clutch Parts

Figure 38

Assemble

1. Aluminum pressure plate with the flat side up. LUGS ON PRESSURE PLATE MUST ENGAGE NARROW NOTCH IN THE CASE.
2. Reverse clutch plates.
   - start with a steel plate and alternate with a composition plate.

3. Waved clutch plate. Clutch plate lugs must engage narrow notches in the case.

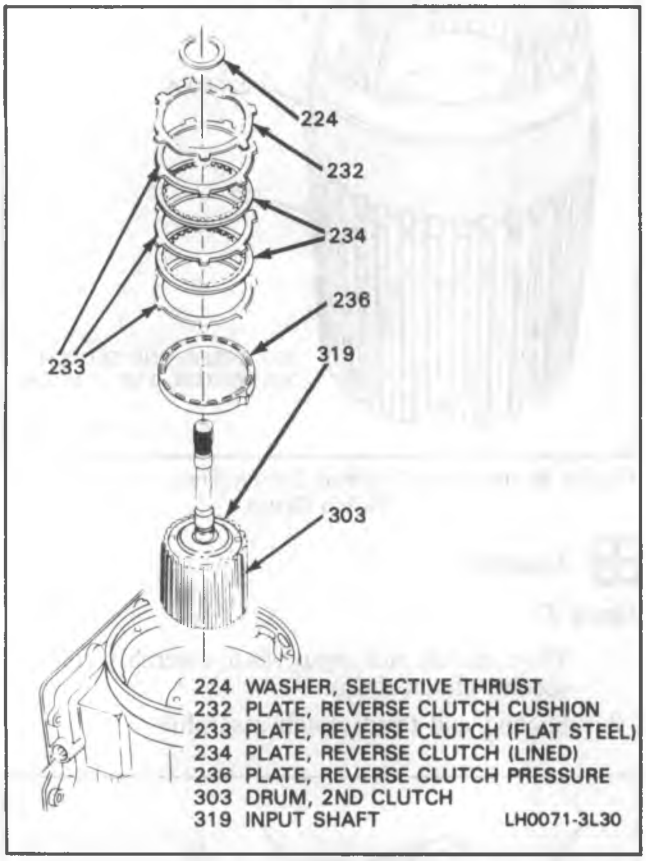


Figure 38 Installing Second/Third Clutch Assemblies Into Case

Determining Selective Washer Thickness

Figures 39 and 40

Measure

Tool Required:

J 23085 Selective Washer Gaging Tool

1. Install J 23085 on the case flange and against the input shaft.
2. Position the inner shaft of J 23085 against the thrust surface of the second speed clutch hub.
3. Tighten thumb screw. Remove J 23085.
4. Measure gap "A". Compare measurement "A" to the chart.

   Selective the thickness washer available without exceeding measurement "A".

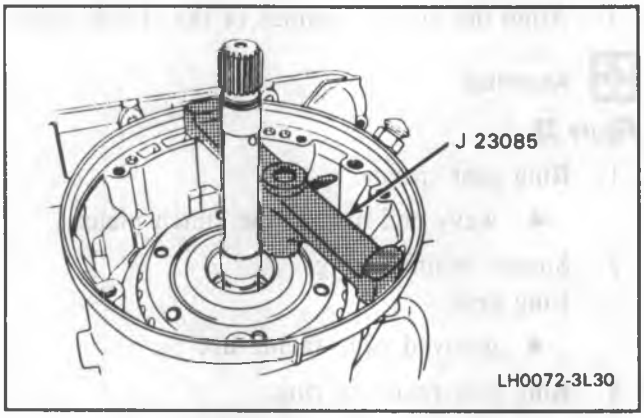
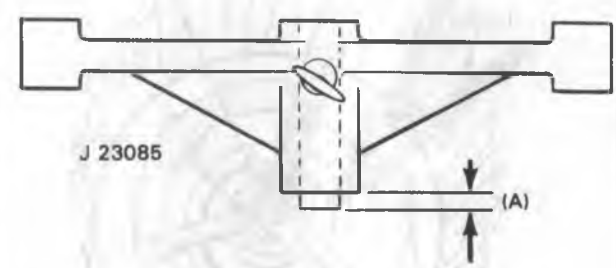


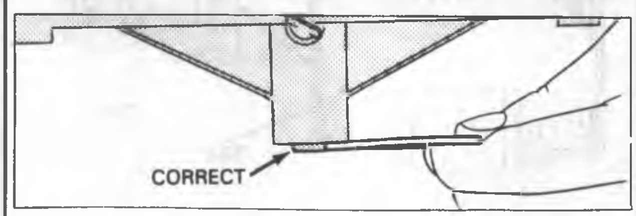
Figure 39 Gaging Tool in Position



WHEN MEASURED GAP (A) IS:

INCHES	mm	I.D. NUMBER	USE WASHER PART NUMBER
.069 - .074	1.78 - 1.88	2	5258202
.075 - .079	1.93 - 2.03	3	5258203
.080 - .084	2.06 - 2.16	4	5258204
.085 - .089	2.18 - 2.29	4	5258205
.090 - .094	2.31 - 2.41	6	5258206
.095 - .100	2.46 - 2.57	7	5258207

FOLLOWING THE PROCEDURE SHOULD RESULT IN FINAL END-PLAY FROM 0.36mm TO 0.79mm (.014 in. TO .031 in.)



LH0073-3L30

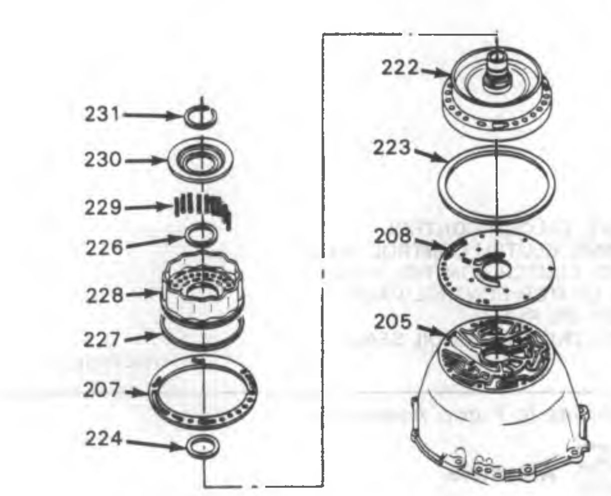
Figure 40 Selective Washer Chart

Converter Housing, Pump Assembly and Reverse Clutch

Figures 41 and 42

Remove or Disconnect

1. Pump to case gasket.
2. Pump outer square cut gasket.
3. Five pump to converter bolts.
4. Separate the pump from the converter housing.
5. Pump wear plate.
6. Pump gears.



205 HOUSING, CONVERTER
207 GASKET, OIL PUMP
208 PLATE, OIL PUMP WEIR
222 BODY, OIL PUMP
223 SEAL, OIL PUMP (OUTER)
224 WASHER, SELECTIVE THRUST
226 SEAL, REVERSE CLUTCH PISTON (INNER)
227 SEAL, REVERSE CLUTCH PISTON (OUTER)
228 PISTON, REVERSE CLUTCH
229 SPRING, CLUTCH PISTON RETURN
230 SEAT, REVERSE CLUTCH PISTON RETURN SPRING
231 RING, CLUTCH PISTON SPRING SEAT RETAINER

LH0074-3L30

Figure 41 Disassemble View of Converter Housing, Pump Assembly and Reverse Clutch

Disassemble

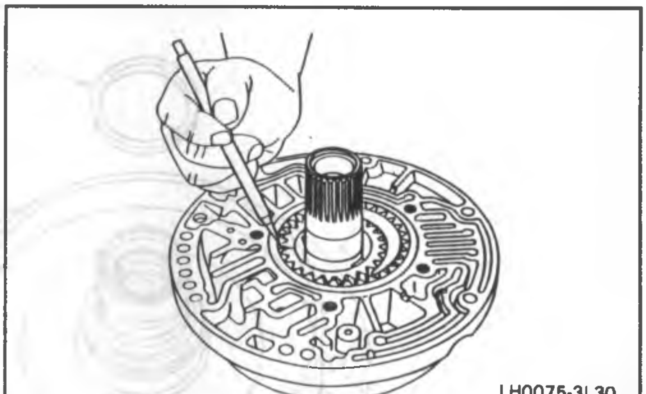
Figures 41 and 43

Tool Required:

J 23327 Clutch Spring Compressor

1. Install J 23327.
2. Compress the reverse clutch return springs.
3. Retaining ring.
4. Release the reverse clutch return springs.

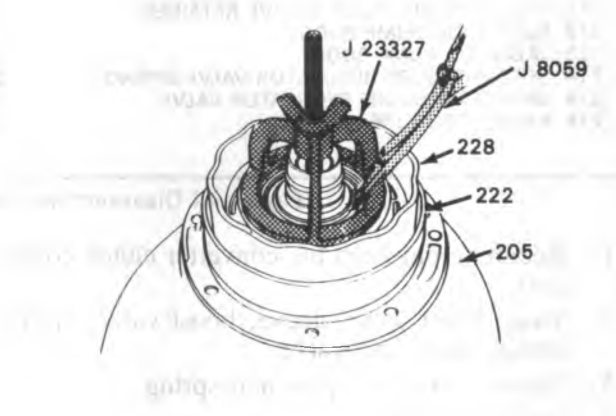
   DO NOT LET SPRING SEAT CATCH IN RING GROOVE.



LH0075-3L30

Figure 42 Marking Location of Pump Gear

5. Remove J 23327, spring seat, and return springs.
6. Reverse clutch piston. Apply compressed air to the "apply" fluid passage.
7. Inner and outer piston oil seals if necessary.



205 HOUSING, CONVERTER
222 BODY, OIL PUMP
228 PISTON, REVERSE CLUTCH

LH0076-3L30

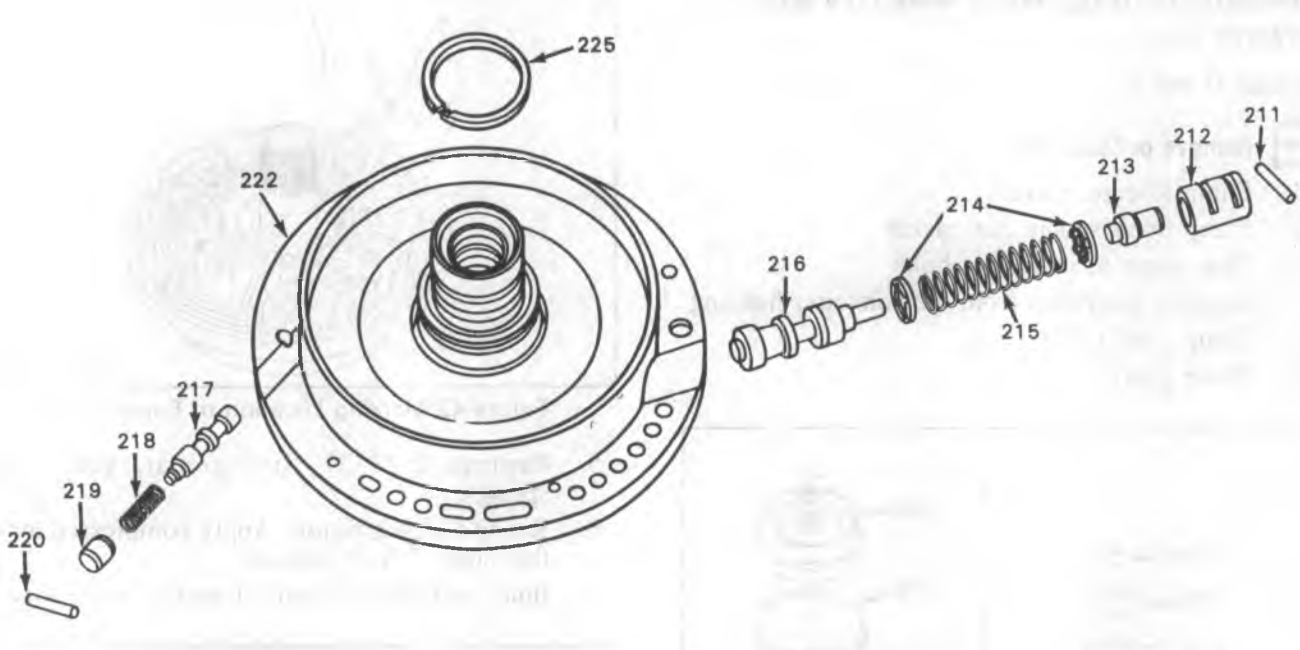
Figure 43 Compressing Reverse Clutch Piston Retainer

Disassemble

Figure 44

Do not remove the converter clutch control valve, pressure regulator valve, or the reverse boost valve, unless determined by fluid pressure checks to be malfunctioning.

CAUTION: Valves are under spring pressure, use caution when disassembling.



211 PIN, OIL PUMP BOOST SLEEVE RETAINER
212 SLEEVE, OIL PUMP BOOST
213 VALVE, OIL PUMP BOOST
214 SEAT, PRESSURE REGULATOR VALVE SPRING
215 SPRING, PRESSURE REGULATOR VALVE
216 VALVE, PRESSURE
217 VALVE, CLUTCH CONTROL
218 SPRING, CLUTCH CONTROL VALVE
219 PLUG, CLUTCH CONTROL VALVE
220 PIN, CLUTCH CONTROL VALVE
222 BODY, OIL PUMP
225 RING, 2ND CLUTCH OIL SEAL

LH0077-3L30

Figure 44 Disassemble View — Valves in Pump Assembly

1. Retaining pin from the converter clutch control port.
2. Pump boost valve sleeve, boost valve, spring, spring seats, and valve.
3. Screen, retainer, valve and spring.
4. Pump seal rings.

Inspect

Figures 44 and 45

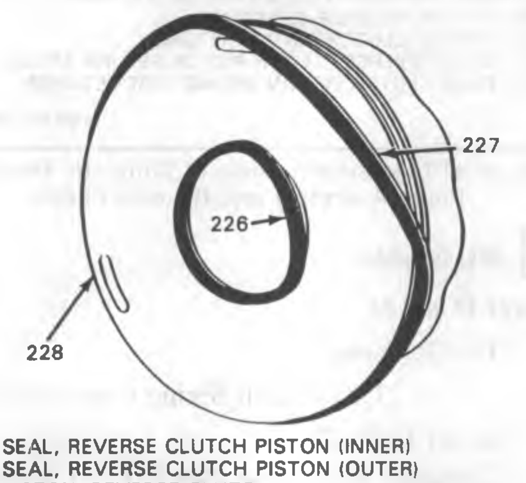
- Reverse boost valve, pressure regulator valve, and the converter clutch control valve for:
  - — nicks
  - — scoring
  - — damage
- Pump seal rings for:
  - — side wear
  - — damage

Clean

- Thoroughly clean the pressure regulator valve, reverse boost valve, and the converter clutch control valve.
- Soak valves in Dexron®-II transmission fluid.

Assemble

1. Spring, valve, retainer and screen.
2. Plug, valve, spring seats, spring, pump boost valve, sleeve, and retaining ring.
3. (2) Piston seals.



226 SEAL, REVERSE CLUTCH PISTON (INNER)
227 SEAL, REVERSE CLUTCH PISTON (OUTER)
228 PISTON, REVERSE CLUTCH

LH0078-3L30

Figure 45 Reverse Clutch Piston

Assemble

Figures 46 and 47

Tool Required:

J 23327 Clutch Spring Compressor

1. Inner and outer piston seals.
2. Reverse clutch piston onto the rear face of the pump assembly.
3. Clutch return springs.
4. Spring seat and snap ring.
5. Install J 23327.
6. Compress clutch piston return springs.
7. Snap ring. Remove J 23327.

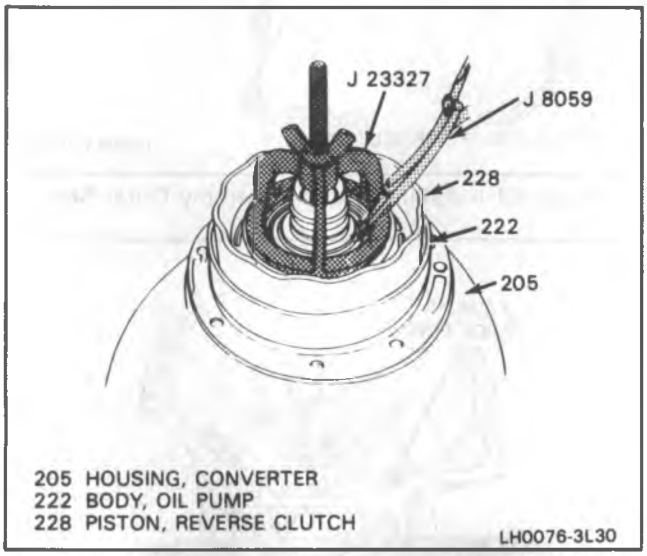


Figure 46 Compressing Reverse Clutch Piston Retainer

Assemble

- Pump gears with marks on the driven gear facing up.

Measure

Figure 48

- Use a straight edge and a feeler gage to measure between the gear face and the pump face.

  Clearance should be .0127-.0839 mm (.0005"-.00325").

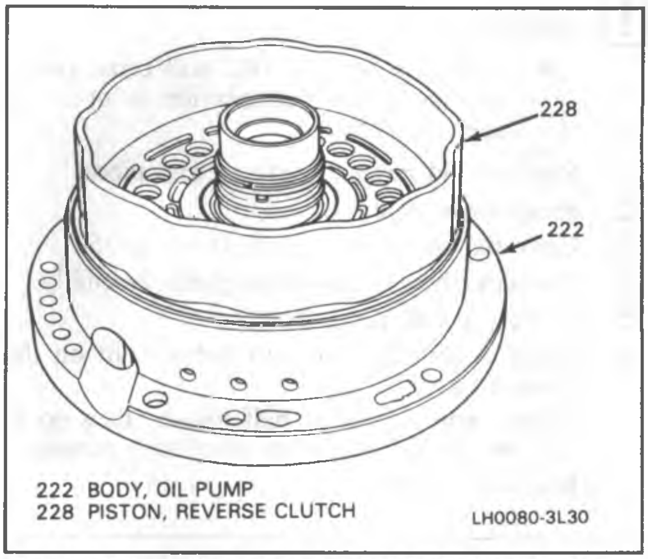


Figure 47 Installing Reverse Clutch Piston Into Pump Assembly

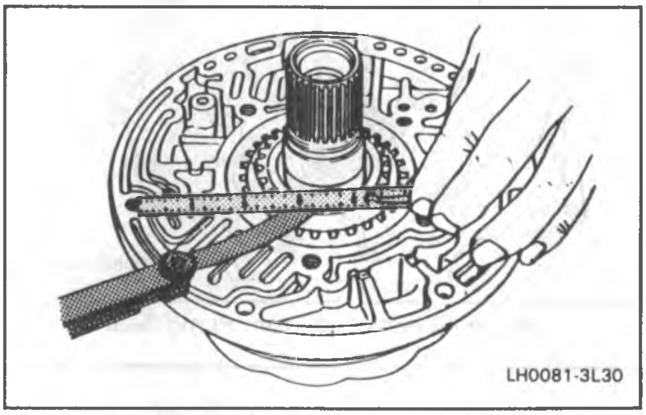


Figure 48 Checking Pump Gear Clearance

- Pump rotating checking tool
- Pump gear centering tool

Assemble

Figures 49 and 50

Tools Required:

J 23082 Converter Housing to Pump Assembly Alignment Tool

J 21359 Seal Installation Tool

Important

- Failure to use J 23082 will cause pump damage when transmission is operated after assembly.

1. Remove and replace O-rings from pipes.
2. Pump wear plate.
3. Converter housing oil seal. Use J 21359.
4. Converter housing onto the pump assembly.
5. Loosely install pump bolt.
6. Install J 23082. Tool will bottom out on the pump gear.
7. Tighten pump bolts to half torque, then go to 19 N·m (14 lb. ft.) in an alternating pattern.
8. Remove J 23082.

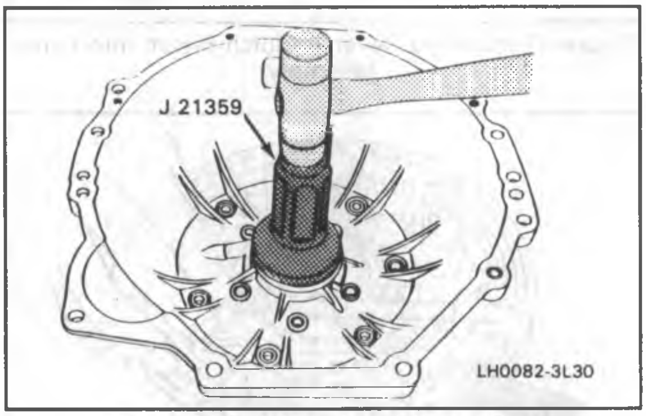


Figure 49 Installing Front Pump Seal

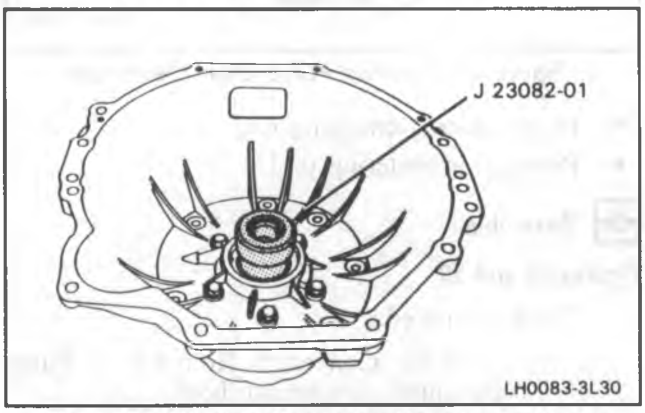


Figure 50 Aligning Converter Housing to Pump Assembly

Assemble

Figures 51 and 52

1. Pump to case gasket.
   - Retain with TRANSJEL ™ J36850 or equivalent.
2. Pump outer square cut seal.
3. Converter housing and reverse clutch assembly. Use guide pins.
4. Converter to case bolts.

Tighten

- Torque bolt to 33 N·m (24 lb. ft.)

  Rotate input shaft to check for proper assembly.

Install or Connect

- Input O-ring.

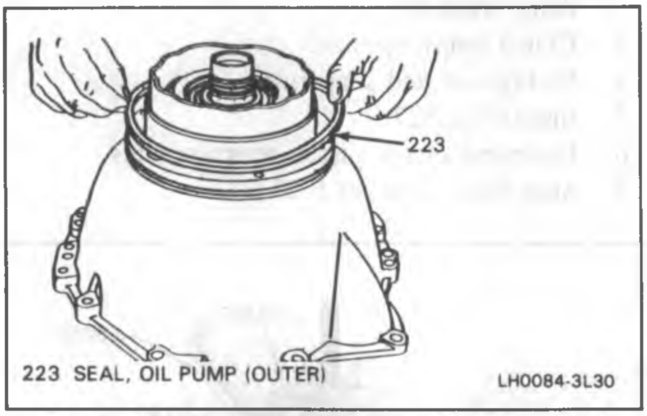


Figure 51 Installing Pump Assembly Outer Seal

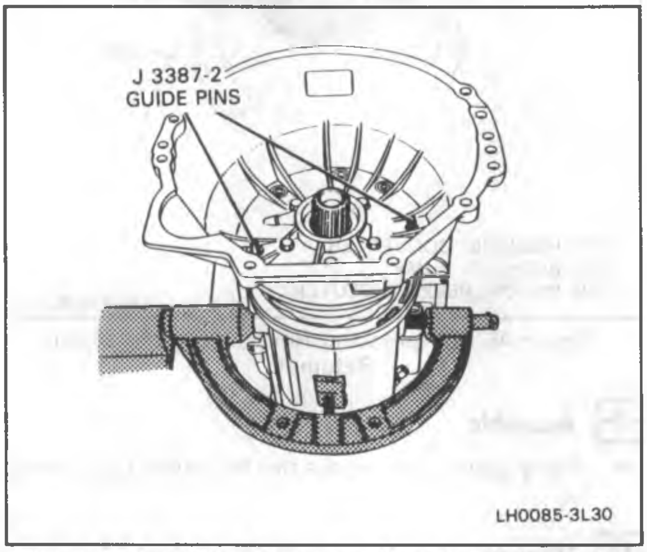


Figure 52 Installing Converter Housing Using Guide Pins

Governor Hub

Figures 53 and 54

Inspect

- Seal rings for nicks, burrs, or damage.
- Governor hub oil screen.
- Governor hub splines for;
  - — cracks
  - — chipped teeth

Assemble

1. Oil screen flush with the governor hub.

2. Seal rings if necessary
3. Governor hub.
4. Snap ring.

Governor Body and Speedometer Drive Gear

Disassemble

1. Secondary valve spring retainer.
2. Secondary valve spring, secondary valve, and the primary valve.

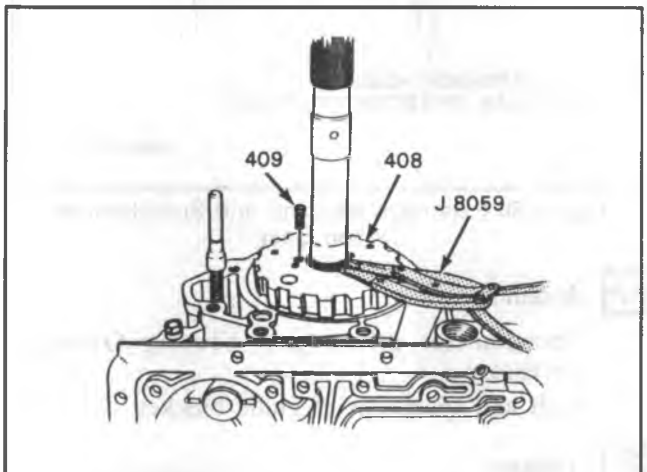


Figure 53 Installing Snap Ring to Governor Hub and Oil Screen

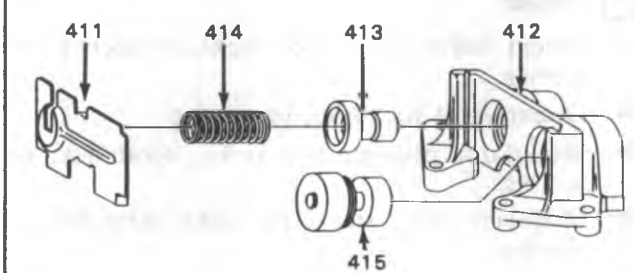


Figure 54 Governor Assembly — Disassembled View

Inspect

Figure 55

- Primary and secondary valves (small end first) for:
  - — nicks
  - — burrs
- Fluid passages and valve bores for:
  - — nicks
  - — burrs
  - — varnish
- Secondary spring and retainer.
- Governor body, gasket, bolts.

Tighten

- Torque bolts to 8 N·m (71 lb. in.) Valve should move freely.

Assemble

- Speedometer drive gear and retaining clip.

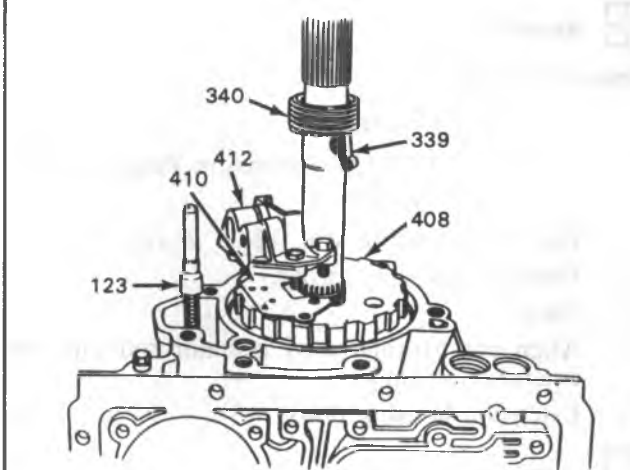


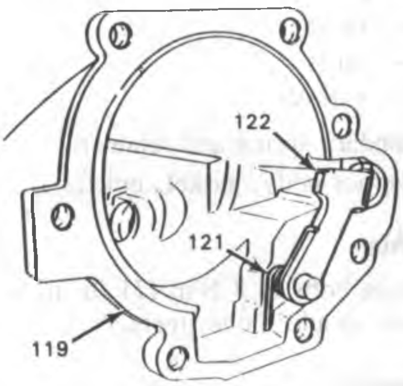
Figure 55 Installing Governor Body and Speedometer Drive Gear

Extension Housing and Speedometer Drive Gear

Figure 56

Inspect

- Extension housing for cracks or porosity.
- Parking pawl and spring



119 EXTENSION HOUSING
121 SPRING, PARKING LOCK PAWL
122 PAWL, PARKING LOCK

Figure 56 Extension Housing and Parking Pawl

Assemble

Figure 57 and 58

Tool Required:

J 21426 Extension Housing Seal Installer

1. Extension housing seal, use J 21426.
2. Parking pawl and spring.
3. Gasket.
4. Align the parking pawl actuator rod into the extension housing.
5. Extension housing bolts.

Tighten

- Extension housing bolts to 31 N·m (23 lb. ft.).

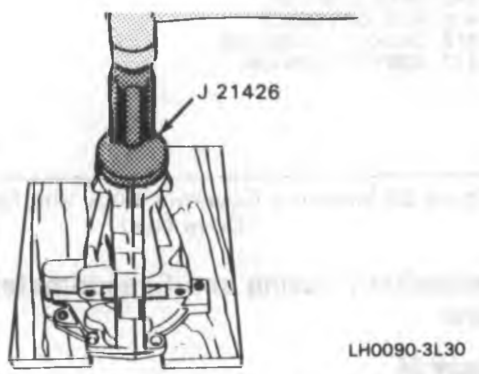
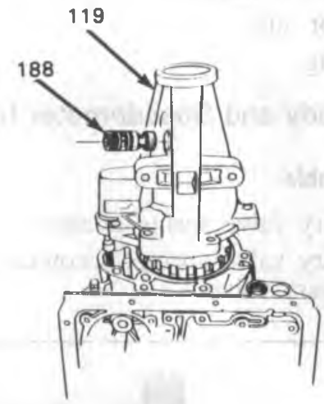


Figure 57 Installing Extension Housing Seal



119 EXTENSION HOUSING
188 GEAR, SPEEDOMETER DRIVEN

Figure 58 Extension Housing and Speedometer Driven Gear

Assemble

1. Speedometer driven gear housing O-ring if necessary.
2. Bolt and speedometer guide bracket.

Tighten

- Torque bolt to 9.5 N·m (85 lb. in.).

Detent Valve and Modulator

Figures 59 and 60

Inspect

- Detent valve sleeve for nicks, scratches, or scoring.
- Detent valve for nicks, or scoring.
- Modulator plunger for nicks, scratches, or scoring.
- Modulator valve sleeve for nicks, scratches, or scoring.
- Modulator valve for nicks, scratches, or scoring.

Assemble

Tool Required:

J 23100 Modulator Wrench

1. Spring seats, spring, detent valve, SLOTS FACE PAN. Detent valve sleeve, seal, and retaining pin.
   - Lubricate with DEXRON®-II transmission fluid.

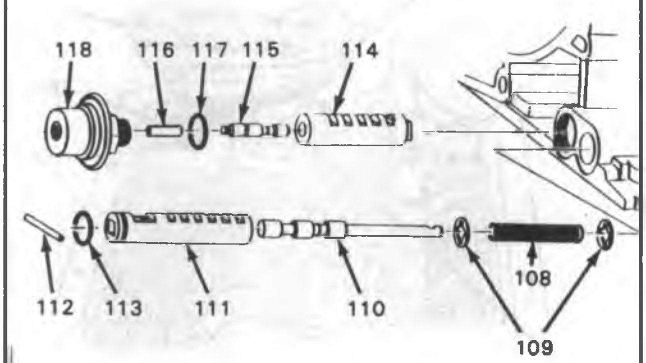
2. Modulator valve sleeve, small end first.
   - TAB MUST ENGAGE SLOT IN MODULATOR BORE.
3. Modulator valve and plunger.
4. O-ring onto the modulator assembly.

NOTICE: Use of another tool to install the vacuum modulator may result in internal damage to the modulator.

5. Modulator assembly.

Tighten

- Torque modulator to 52 N·m (38 lb. ft.)



108 SPRING, VALVE KICKDOWN
109 SEAT, SPRING VALVE KICKDOWN
110 VALVE KICKDOWN
111 SLEEVE, VALVE KICKDOWN
112 PIN, VALVE KICKDOWN
113 SEAL, VALVE SLEEVE KICKDOWN
114 SLEEVE, VALVE MODULATOR
115 VALVE, MODULATOR
116 PLUNGER, MODULATOR
117 SEAL RING, MODULATOR
118 MODULATOR

LH0039-3L30

Figure 59 Installing Detent Valve and Modulator Valve

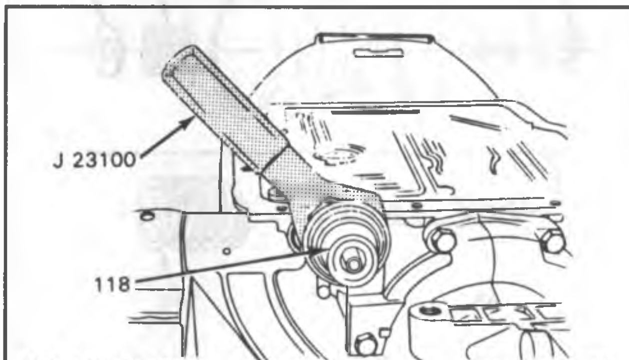
Servo Piston

Figure 61

Disassemble

NOTICE: Band assembly should be in the correct position.

1. Servo piston and apply rod.
2. Locknut.
3. Position servo piston and sleeve in a press.
4. Compress the cushion spring.
5. Retaining clip.
6. Release the cushion spring.
7. Sleeve, spring seat, cushion spring and adjusting bolt.



118 MODULATOR

LH0038-3L30

Figure 60 Installing Vacuum Modulator

Inspect

- Servo piston ring for:
  — nicks, burrs, or side damage
- Piston sleeve for nicks or burrs
- Apply rod for nicks, burrs, or scoring

Assemble

1. Spring seat and cushion spring onto the sleeve.
2. Insert the sleeve into the piston.
3. Position the piston and sleeve in a press.
4. Compress the cushion spring.
5. Retaining clip.
6. Release the cushion spring.
7. Adjust ring bolt into the sleeve.
8. Locknut. Do not tighten.
9. Piston ring, if necessary.

Install or Connect

Figures 62, 63, and 64

Tool Required:

J 23075 Servo and Clutch Piston Compressor

J 38428 Servo Piston Ring Sleeve

1. Servo apply rod, turn spring, and piston.
   - Round end goes into case.
2. Install J 23075 with tool offset toward the rear of the case. Place J 38428 sleeve inside J 23075.
3. Place piston inside J 38428 sleeve.
4. Compress the servo piston return spring using J 23075.
5. Retaining ring.

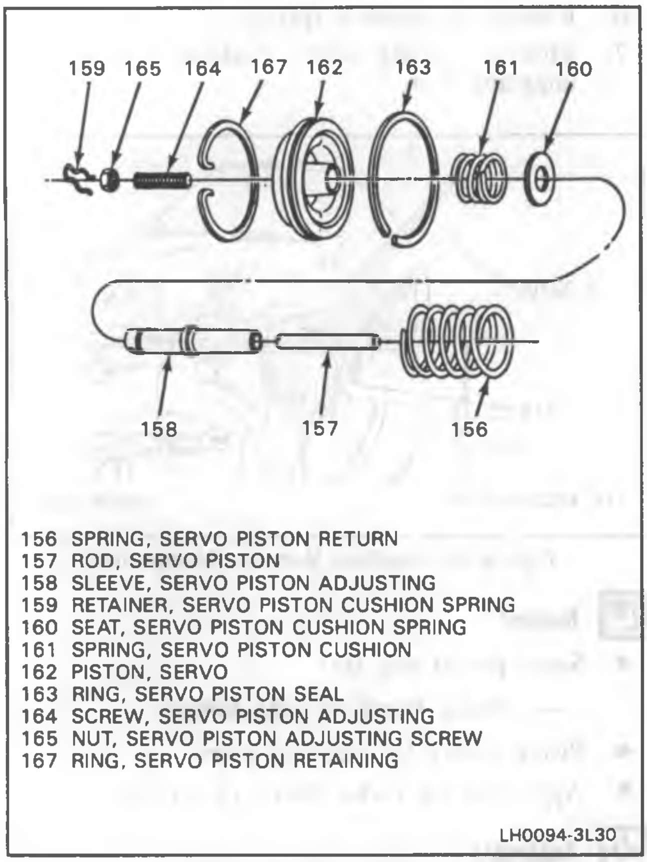


Figure 61 Servo Piston — Disassemble View

6. Remove J 23075 and J 38428.

Adjust

1. Hold the servo piston sleeve.
   proceed with the adjusting operation by using a special torque wrench with a 3/16 in. hex head.
2. Loosen the servo lock nut.
3. Tighten the adjusting bolt up to 4.5 N·m (40 lb. in.)
4. Be certain that the lock nut remains loose.
5. Back off the adjusting bolt five turns exactly.
6. Retighten the lock nut at 18.9 N·m (14 lb. ft.) by holding the adjusting bolt and sleeve firmly.
7. Install a new servo cover gasket.
8. Install the servo cover, torque to 24.4 N·m (18 lb. ft.)

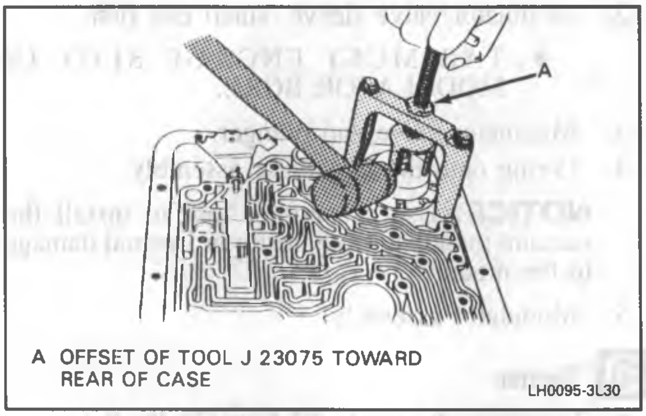


Figure 62 Installing Servo Assembly

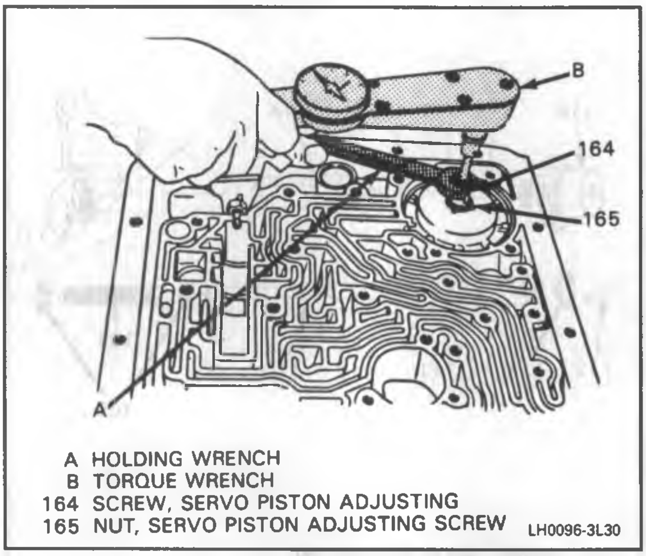


Figure 63 Adjusting Servo Apply Rod

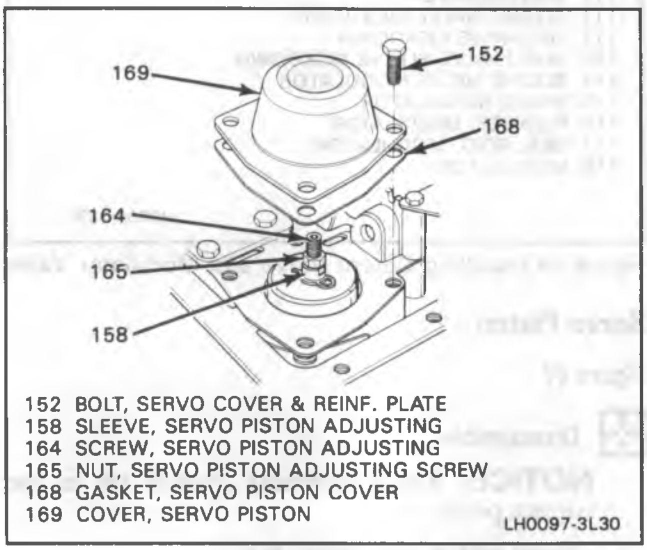


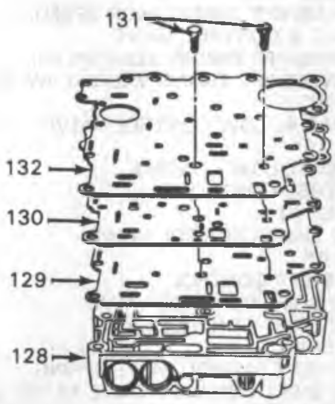
Figure 64 Tighten Servo Nut

Control Valve Assembly

Figure 65

Disassemble

1. Manual valve and manual valve link.
2. Bolts, transfer plate and gaskets.



128 VALVE BODY & ACCUMULATOR PISTON ASSEMBLY
129 GASKET, TRANSFER PLATE
130 PLATE, TRANSFER
131 BOLT, TRANSFER PLATE TO VALVE BODY
132 GASKET, TRANSFER PLATE TO CASE LH0098-3L30

Figure 65 Removing Transfer Plate

NOTICE: The use of a honing stone, fine sandpaper or crocus cloth is not recommended for servicing stuck valves. All valve lands have sharply machined corners that are necessary to "cleaning" the bore. If these corners are rounded, foreign material could wedge between the valve and the bore causing the valve to stick. If it is found necessary to clean a valve "micro fine" lapping compound 900 grit or finer should be used.

Too much "lapping" of the valve will cause excessive clearances and increase the chance of a valve not operating.

Clean

Figure 66

- Control valve assembly thoroughly in cleaning solvent. Move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated.

Disassemble

- Position the control valve as shown on a clean surface.
  - — Remove the valve trains beginning with the upper left hand corner.
  - — Some of the valves are under pressure — cover the bores while removing the retaining pins.
  - — Remove blind hole roll pins with a modified drill bit.
  - — Valves, springs, and sleeves must be laid out on a clean surface in the exact sequence they are removed.

Clean

- All valves, springs, sleeves and control valve body.
- Dry using compressed air.

Inspect

- All valves and sleeves for:
  - — porosity
  - — scoring
  - — nicks
  - — scratches
- Springs for damaged or distorted coils
- Valve body casting for:
  - — porosity
  - — cracks
  - — interconnected fluid passages
  - — damaged machined surfaces

Assemble

- Control valve assembly exactly as shown.
- Notice the position of the valve lands and sleeves position.

Assemble

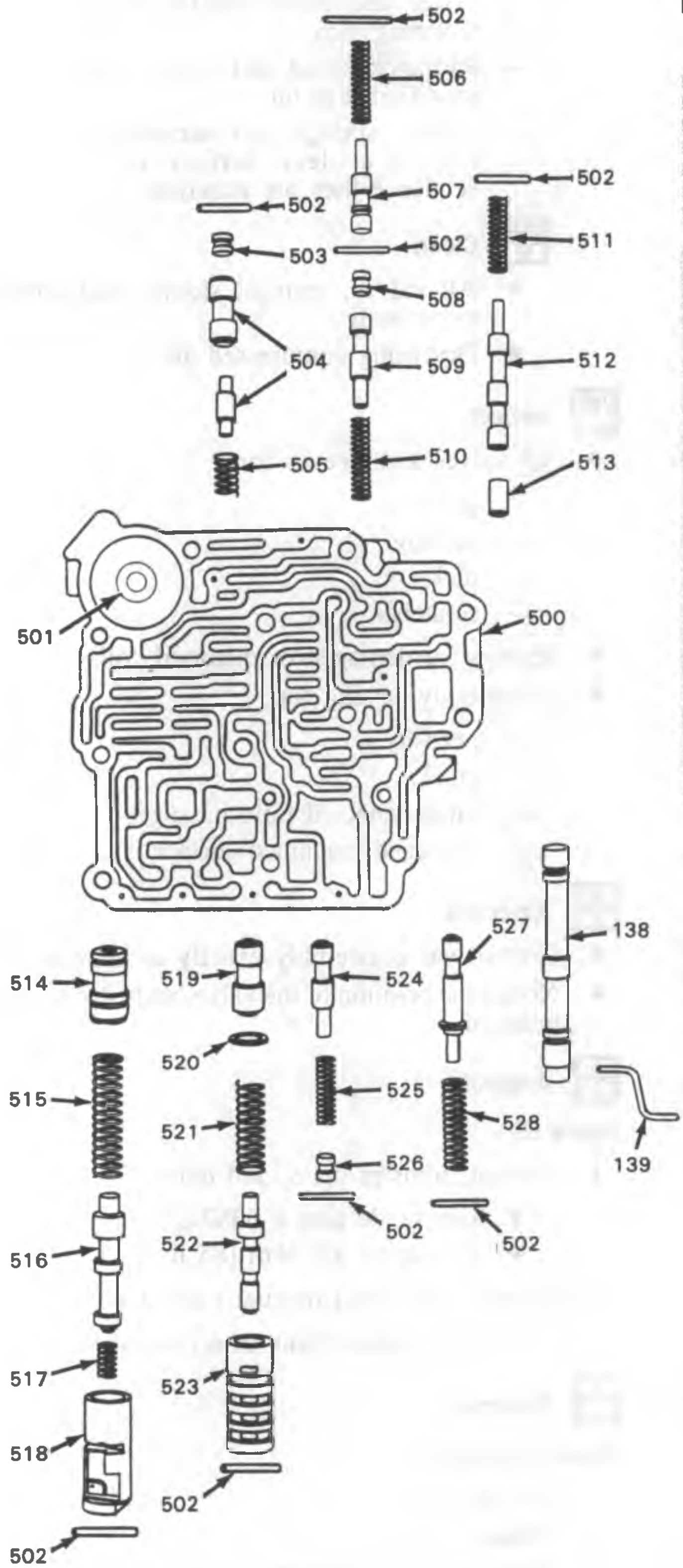
Figure 65

1. Gasket, transfer plate, and bolts.
   - Use guide pins J 3387-2
   - Torque to 9.5 N·m (85 lb. in.)
2. Manual valve and manual valve link.
   - Long side of link into manual valve

Assemble

Figure 67 and 68

1. Check balls.
2. Gasket
3. Control valve. Position manual valve link as shown.
4. Bolts
   - Torque to 19 N·m (14 lb. ft.).



ILL. NO.	DESCRIPTION
138	VALVE, MANUAL
139	LINK, MANUAL
500	VALVE BODY
501	1-2 ACCUMULATOR PISTON ASSEMBLY
502	PIN, RETAINING
503	PLUG, 1-2 ACCUMULATOR VALVE
504	VALVE, 1-2 ACCUMULATOR
505	SPRING, 1-2 ACCUMULATOR VALVE 1/2" x 1-1/16"
506	SPRING, DOWNSHIFT TIMING VALVE (HIGH SPEED) 7/16" x 1-5/16"
507	VALVE, DOWNSHIFT TIMING (HIGH SPEED)
508	PLUG, TIMING & CONTROL VALVE
509	VALVE, DOWNSHIFT TIMING (LOW SPEED)
510	SPRING, DOWNSHIFT TIMING VALVE (LOW SPEED) 7/16" x 1-3/8"
511	SPRING, MANUAL LOW CONTROL VALVE 7/16" x 1-5/16"
512	VALVE, MANUAL LOW CONTROL
513	VALVE, REVERSE CONTROL
514	VALVE, 1-2 SHIFT
515	SPRING, 1-2 SHIFT CONTROL VALVE 3/4" x 2-7/16"
516	VALVE, 1-2 SHIFT CONTROL
517	SPRING, 1-2 SHIFT CONTROL VALVE
518	SLEEVE, 1-2 SHIFT CONTROL VALVE
519	VALVE, 2-3 SHIFT
520	SEAT, 2-3 SHIFT CONTROL VALVE SPRING
521	SPRING, 2-3 SHIFT CONTROL VALVE 11/16" x 1-3/4"
522	VALVE, 2-3 SHIFT CONTROL
523	SLEEVE, 2-3 SHIFT CONTROL VALVE
524	VALVE, 3-2 CONTROL
525	SPRING, 3-2 CONTROL VALVE 7/16" x 1-3/4"
526	PLUG, 3-2 CONTROL VALVE
527	VALVE, DETENT PRESSURE REGULATOR
528	SPRING, DETENT PRESSURE REGULATOR VALVE 1/2" x 1-5/8"

LH0099-3L30

Figure 66 Typical Valve Body

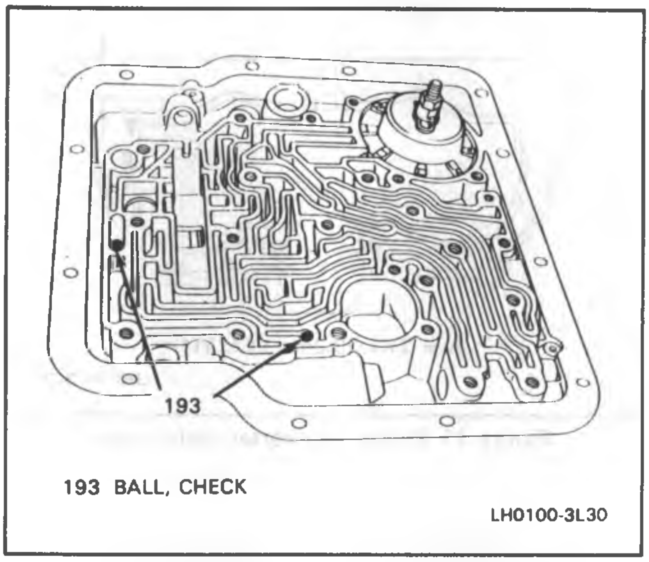


Figure 67 Installing Check Balls in Fluid Passages

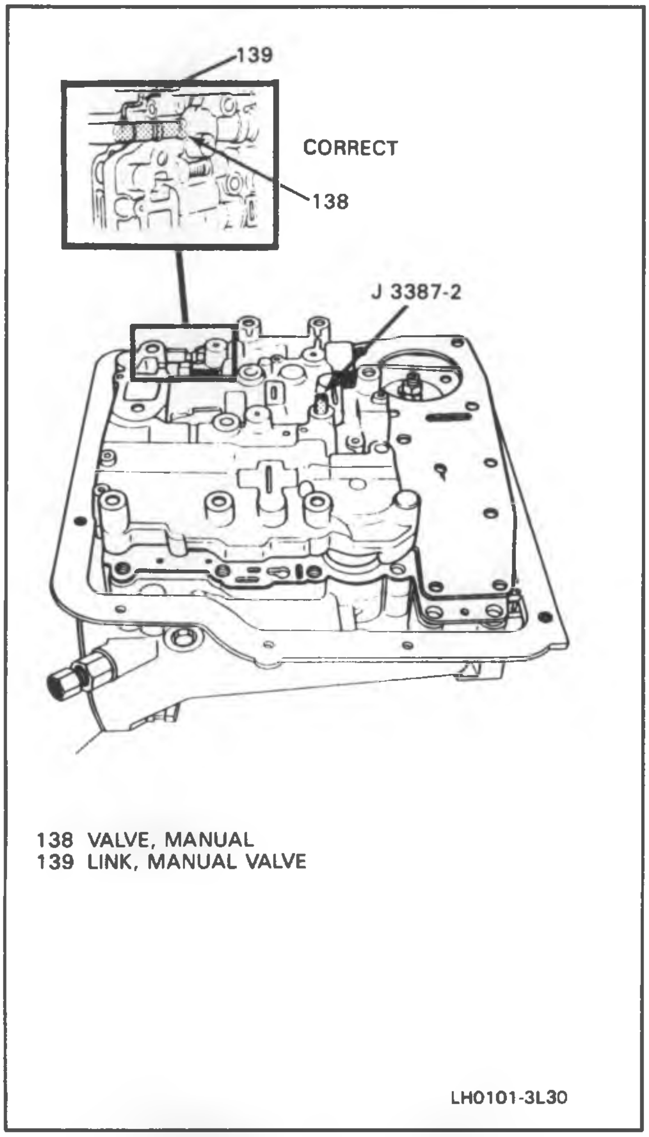


Figure 68 Installing Valve Body

External Parts

Figure 69

Install or Connect

1. Bolts and selector lever roller and spring.
   - torque to 13 N·m (116 lb. in.)
2. Bolts, reinforcement plate, and ground wire.
   - torque to 19 N·m (14 lb. ft.)
3. Governor pressure switch.
   - torque to 10 N·m (89 lb. in.)
4. Solenoid tubing, solenoid and bolts.
   - O-ring onto tubes, tubes into solenoid
   - torque to 19 N·m (14 lb. ft.).
   - make sure tubing does not interfere with manual valve operation.
5. Electrical connections at solenoid, governor pressure switch and case connector.

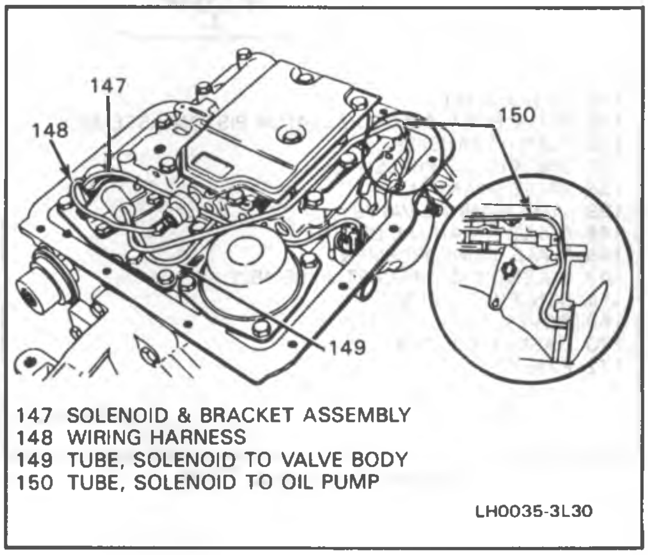
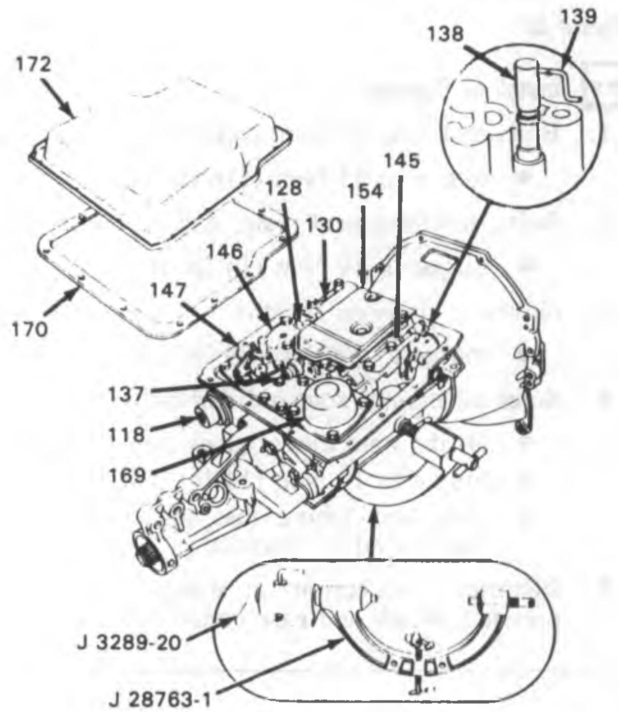


Figure 69 Hookup of Solenoid Pipes and Electrical Wires

Install or Connect

Figures 70 and 71

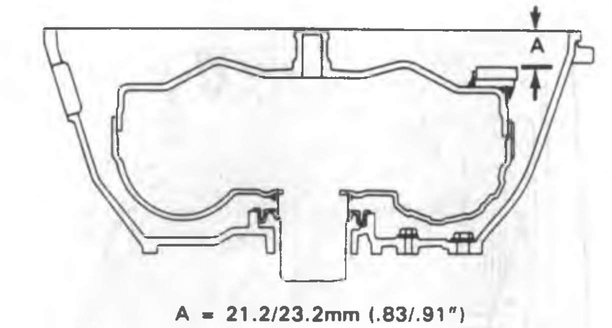
1. Servo cover, gasket and bolts
   - torque to 24.4 N·m (18 lb. ft.).
2. Oil strainer, gasket, and bolts.
   - torque to 18.9 N·m (14 lb. ft.).
3. Oil pan, gasket, and bolts.
   - torque to 11 N·m (98 lb. in.).
4. Torque converter.



118 MODULATOR
128 VALVE BODY & ACCUMULATOR PISTON ASSEMBLY
130 PLATE, TRANSFER
137 SWITCH, OIL PRESSURE
138 VALVE, MANUAL
139 LINK, MANUAL VALVE
145 ROLLER, MANUAL DETENT
146 PLATE, REINFORCEMENT
147 SOLENOID & BRACKET ASSEMBLY
154 SCREEN, OIL PUMP
169 COVER, SERVO PISTON
170 GASKET, OIL PAN
172 PAN, OIL

LH0034-3L30

Figure 70 External Parts



LH0104-3L30

Figure 71 Proper Converter Installation

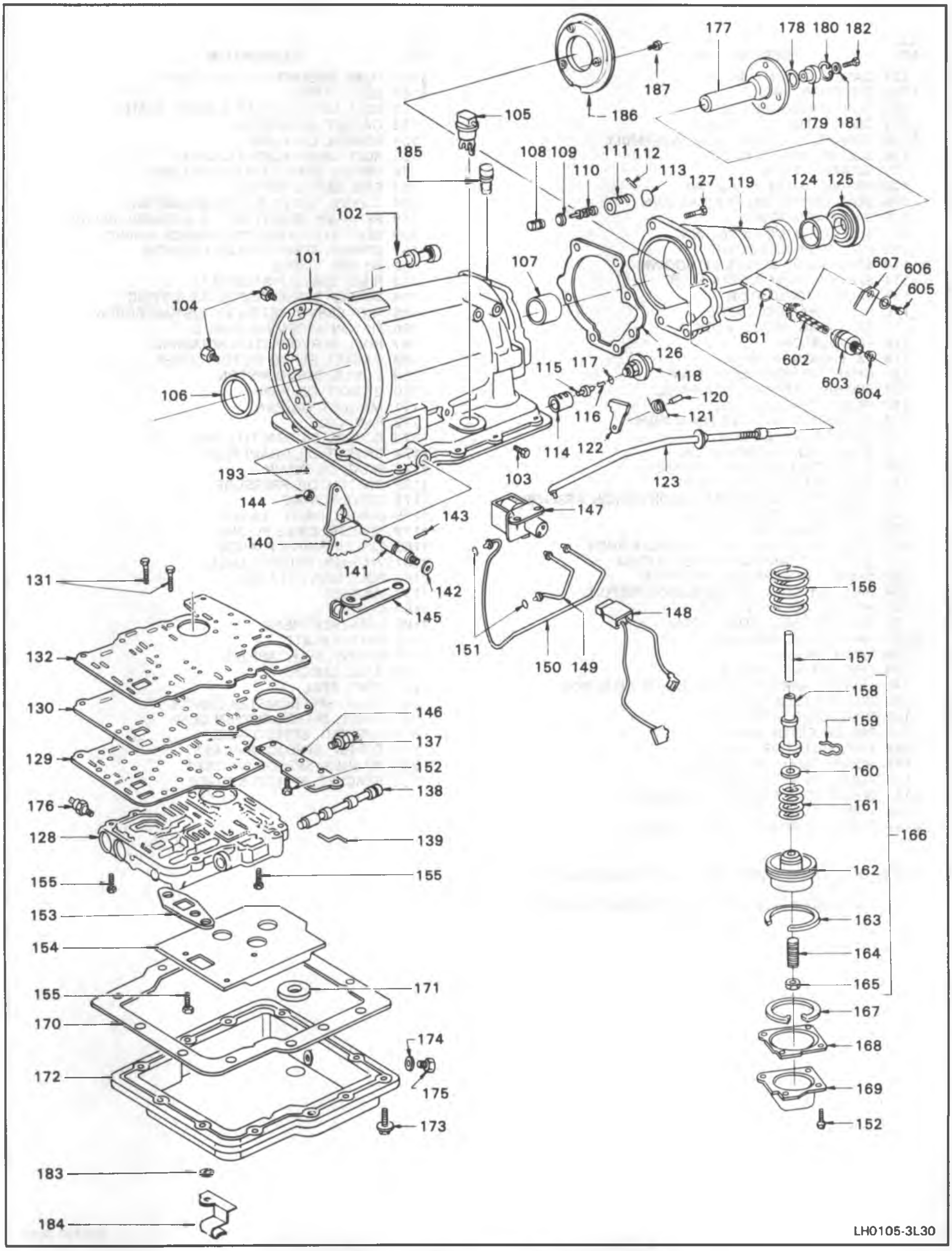


Figure 72 Case, Valve Body and Lo Servo Piston

ILL. NO.	DESCRIPTION
101	CASE, TRANSMISSION
†102	BREATHER, FRONT
103	PLUG, PRESSURE CHECK
104	CONNECTOR, OIL COOLER
§105	CONNECTOR, ELECTRICAL ASSEMBLY
106	SLEEVE, REACTION SUN
107	BUSHING, CASE
108	SPRING, VALVE KICKDOWN
109	SEAT, SPRING VALVE KICKDOWN
110	VALVE KICKDOWN
111	SLEEVE, VALVE KICKDOWN
112	PIN, VALVE KICKDOWN
113	SEAL, VALVE SLEEVE KICKDOWN
114	SLEEVE, VALVE MODULATOR
115	VALVE, MODULATOR
116	PLUNGER, MODULATOR
117	SEAL RING, MODULATOR
118	MODULATOR
119	EXTENSION HOUSING
120	SHAFT, PARKING LOCK PAWL
121	SPRING, PARKING LOCK PAWL
122	PAWL, PARKING LOCK
123	ACTUATOR, PARKING LOCK PAWL
124	BEARING, EXTENSION
125	SEAL RING, EXTENSION OIL
126	GASKET, EXTENSION TO CASE
127	BOLT, EXTENSION TO CASE
128	VALVE BODY & ACCUMULATOR PISTON ASSEMBLY
129	GASKET, TRANSFER PLATE
130	PLATE, TRANSFER
131	BOLT, TRANSFER PLATE TO VALVE BODY
132	GASKET, TRANSFER PLATE TO CASE
133	SPRING, ACCUMULATOR PISTON
134	RING, OIL SEAL ACCUMULATOR PISTON
135	PISTON, ACCUMULATOR
136	PIN, ACCUMULATOR PISTON
§137	SWITCH, OIL PRESSURE
138	VALVE, MANUAL
139	LINK, MANUAL VALVE
140	LEVER, PARKING LOCK & RANGE SELECTOR
141	SHAFT, SELECTOR
142	SEAL, SELECTOR SHAFT
143	PIN, SELECTOR SHAFT
144	NUT, SELECTOR SHAFT
145	ROLLER, MANUAL DETENT
146	PLATE, REINFORCEMENT
§147	SOLENOID & BRACKET ASSEMBLY
§148	WIRING HARNESS
§149	TUBE, SOLENOID TO VALVE BODY

ILL. NO.	DESCRIPTION
§150	TUBE, SOLENOID TO OIL PUMP
§151	SEAL, O-RING
152	BOLT, SERVO COVER & REINF. PLATE
153	GASKET, OIL SCREEN
154	SCREEN, OIL PUMP
155	BOLT, VALVE BODY TO CASE
156	SPRING, SERVO PISTON RETURN
157	ROD, SERVO PISTON
158	SLEEVE, SERVO PISTON ADJUSTING
159	RETAINER, SERVO PISTON CUSHION SPRING
160	SEAT, SERVO PISTON CUSHION SPRING
161	SPRING, SERVO PISTON CUSHION
162	PISTON, SERVO
163	RING, SERVO PISTON SEAL
164	SCREW, SERVO PISTON ADJUSTING
165	NUT, SERVO PISTON ADJUSTING SCREW
166	PISTON ASSEMBLY, SERVO
167	RING, SERVO PISTON RETAINING
168	GASKET, SERVO PISTON COVER
169	COVER, SERVO PISTON
170	GASKET, OIL PAN
171	MAGNET, OIL PAN
172	PAN, OIL
173	SCREW, OIL PAN TO CASE
†174	GASKET, OIL DRAIN PLUG
†175	PLUG, OIL DRAIN
‡176	SWITCH, OIL PRESSURE
†177	DRIVE FLANGE
†178	O-RING, DRIVE FLANGE
†179	SPACER, DRIVE FLANGE
†180	CIRCLIP, DRIVE FLANGE
†181	WASHER, DRIVE FLANGE
†182	BOLT, DRIVE FLANGE
†183	WASHER
†184	CLIPS
†185	BREATHER, REAR
†186	BAFFLE PLATE
†187	SCREW, SELF TAPPING
193	BALL, CHECK
601	RING, SEAL
602	GEAR, SPEEDOMETER DRIVEN
603	GUIDE, SPEEDO DRIVEN GEAR
604	BUSHING, SPEEDO GUIDE
605	SCREW, SPEEDO BRACKET
606	WASHER, SPEEDO BRACKET
607	BRACKET, SPEEDO & GUIDE

NOTE: §: 245MM CONVERTER CLUTCH MODELS ONLY
†: OPTIONAL
‡: 245MM DIESEL CONVERTER CLUTCH MODELS ONLY

LH0106-3L30

Figure 73 Case, Valve Body and Lo Servo Piston — Legend

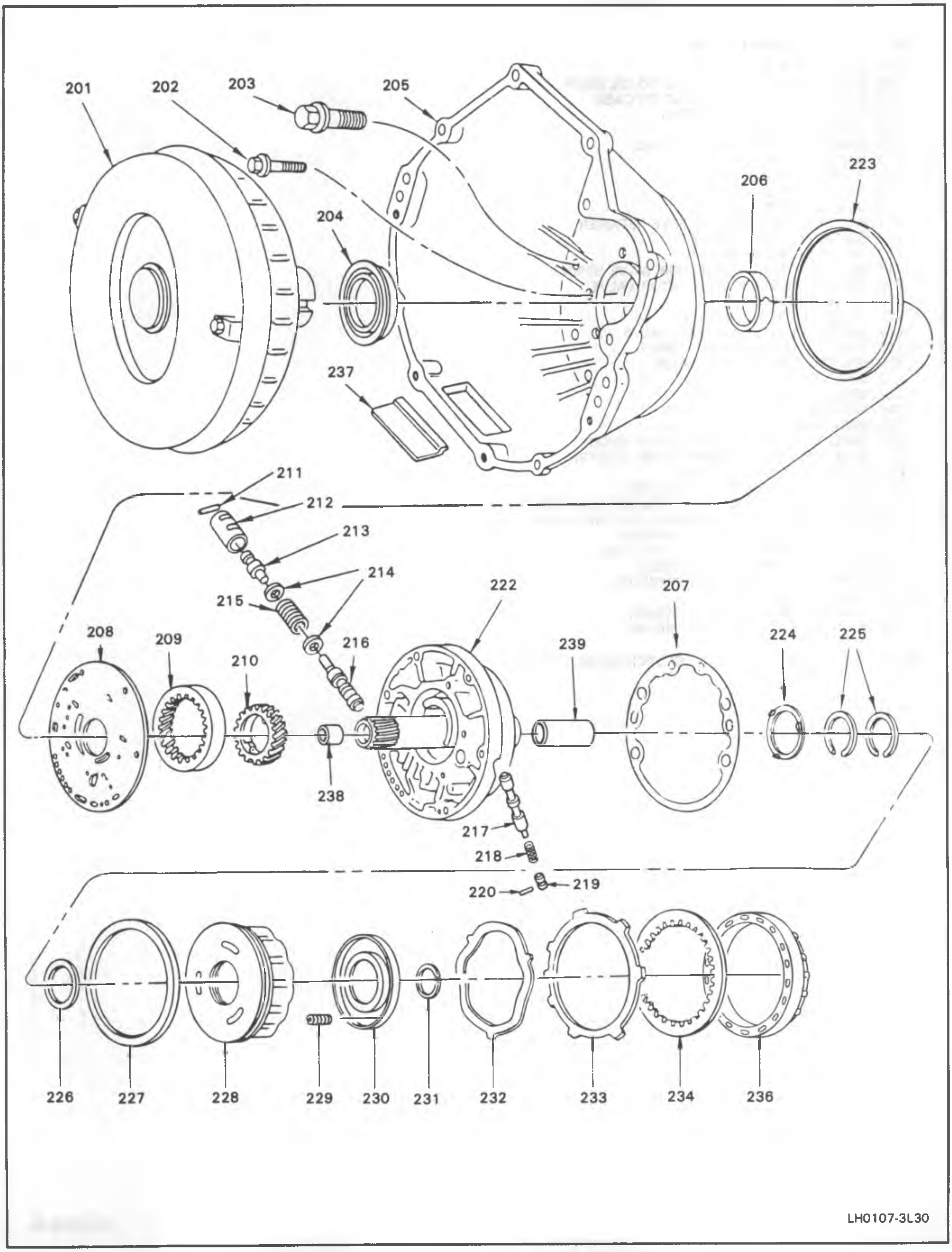


Figure 74 Converter, Pump Assembly and Reverse Clutch

ILL. NO.	DESCRIPTION
201	CONVERTER ASSEMBLY
202	BOLT, CONVERTER HOUSING TO OIL PUMP
203	BOLT, CONVERTER HOUSING TO CASE
204	SEAL, CONVERTER HOUSING
205	HOUSING, CONVERTER
206	BUSHING, CONVERTER HOUSING
207	GASKET, OIL PUMP
208	PLATE, OIL PUMP WEIR
209	GEAR, PUMP DRIVEN
210	GEAR, PUMP DRIVE
211	PIN, OIL PUMP BOOST SLEEVE RETAINER
212	SLEEVE, OIL PUMP BOOST
213	VALVE, OIL PUMP BOOST
214	SEAT, PRESSURE REGULATOR VALVE SPRING
215	SPRING, PRESSURE REGULATOR VALVE
216	VALVE, PRESSURE
§217	VALVE, CLUTCH CONTROL
§218	SPRING, CLUTCH CONTROL VALVE
§219	PLUG, CLUTCH CONTROL VALVE
§220	PIN, CLUTCH CONTROL VALVE
222	BODY, OIL PUMP
223	SEAL, OIL PUMP (OUTER)
224	WASHER, SELECTIVE THRUST
225	RING, 2ND CLUTCH OIL SEAL
226	SEAL, REVERSE CLUTCH PISTON (INNER)
227	SEAL, REVERSE CLUTCH PISTON (OUTER)
228	PISTON, REVERSE CLUTCH
229	SPRING, CLUTCH PISTON RETURN
230	SEAT, REVERSE CLUTCH PISTON RETURN SPRING
231	RING, CLUTCH PISTON SPRING SEAT RETAINER
232	PLATE, REVERSE CLUTCH CUSHION
233	PLATE, REVERSE CLUTCH (FLAT STEEL)
234	PLATE, REVERSE CLUTCH (LINED)
236	PLATE, REVERSE CLUTCH PRESSURE
†237	COVER, PLASTIC
238	BUSHING, OIL PUMP HUB (FRONT)
239	BUSHING, OIL PUMP BODY (REAR)

NOTE: §: 245MM CONVERTER CLUTCH MODELS ONLY
†: OPTIONAL

LH0108-3L30

Figure 75 Converter, Pump Assembly and Reverse Clutch — Legend

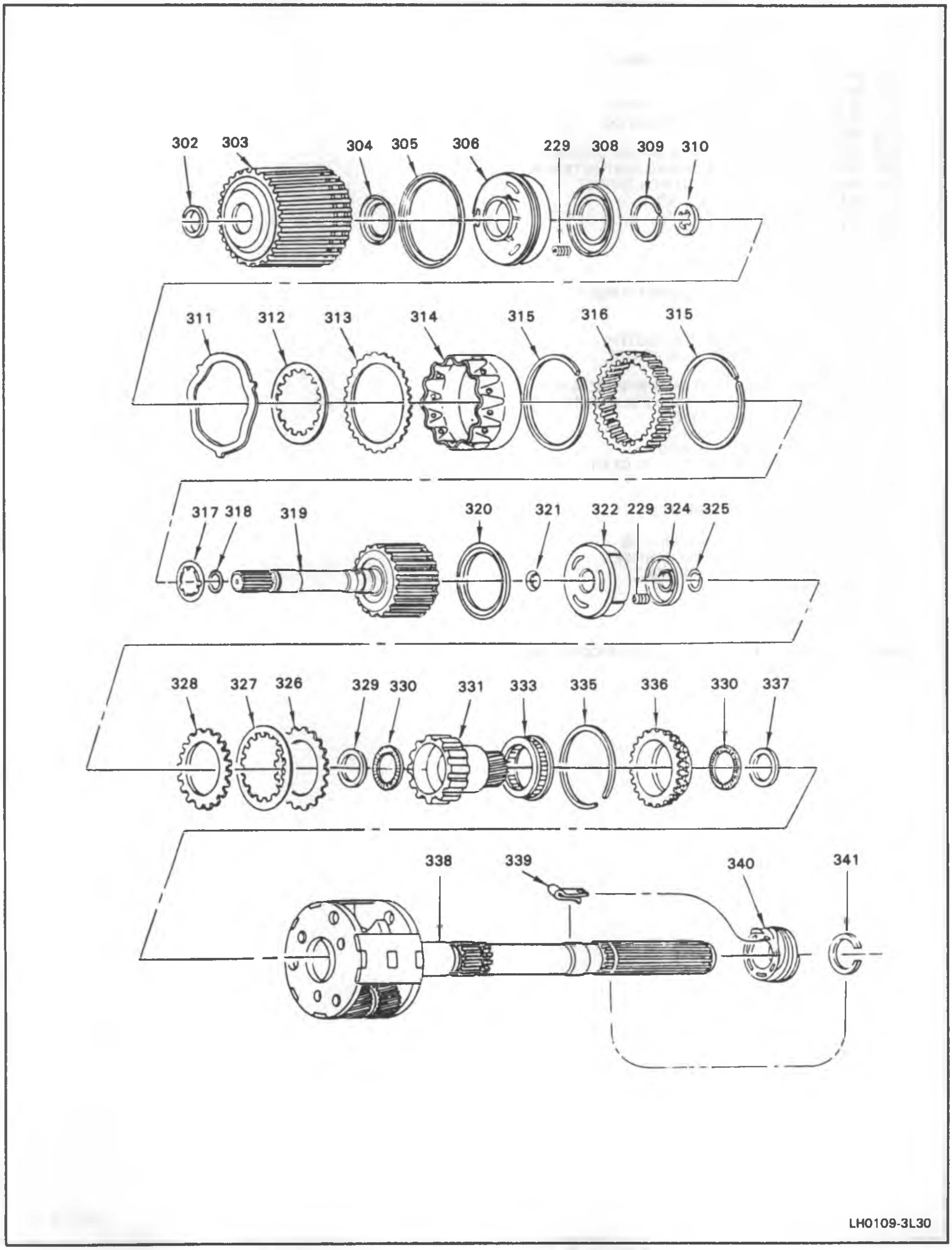


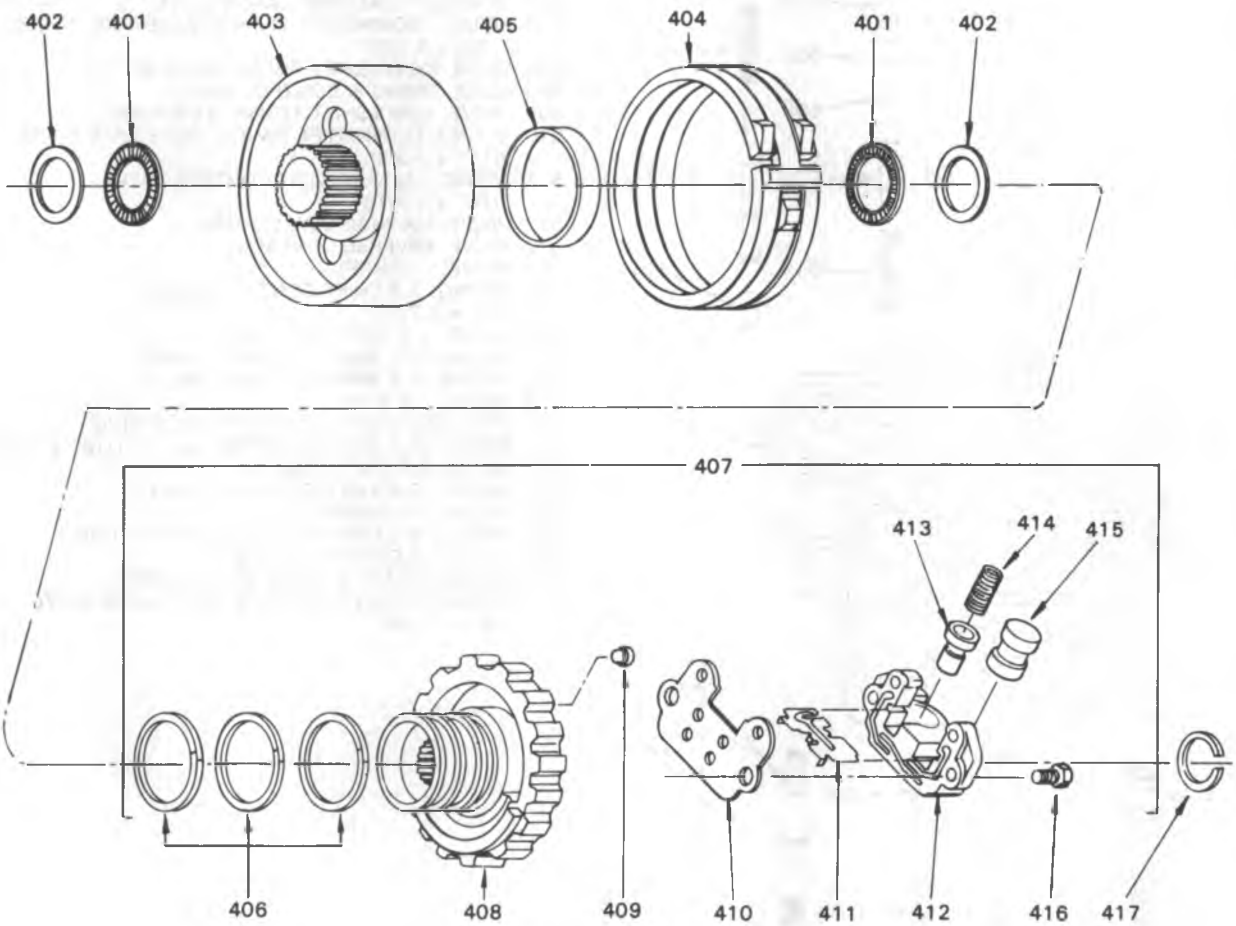
Figure 76 Clutch, Sun Gear and Planetary Carrier

ILL. NO.	DESCRIPTION
229	SPRING, CLUTCH PISTON RETURN
302	BUSHING, 2ND CLUTCH HUB
303	DRUM, 2ND CLUTCH
304	SEAL, 2ND CLUTCH PISTON (INNER)
305	SEAL, 2ND CLUTCH PISTON (OUTER)
306	PISTON, 2ND CLUTCH
308	SEAT, 2ND CLUTCH PISTON SPRING RETAINER
309	RING, CLUTCH PISTON SPRING SEAT RETAINER
310	WASHER, 2ND TO 3RD CLUTCH THRUST
311	PLATE, 2ND CLUTCH (WAVED)
312	PLATE, 2ND CLUTCH (LINED)
313	PLATE, 2ND CLUTCH (STEEL)
314	SPACER, 2ND CLUTCH
315	RING, RING GEAR RETAINER
316	GEAR, RING
317	WASHER, 2ND TO 3RD CLUTCH THRUST
§318	O-RING
319	INPUT SHAFT
320	SEAL, 3RD CLUTCH PISTON (OUTER)
321	SEAL, 3RD CLUTCH PISTON (INNER)
322	PISTON, 3RD CLUTCH
324	SEAT, 3RD CLUTCH PISTON SPRING RETAINER
325	RING, CLUTCH PISTON SPRING SEAT RETAINER
326	PLATE, 3RD CLUTCH (STEEL)
327	PLATE, 3RD CLUTCH (LINED)
328	PLATE, 3RD CLUTCH (WAVED)
329	WASHER, INPUT SHAFT TO SUN GEAR
330	BEARING, INPUT SUN GEAR
331	GEAR, INPUT SUN
333	SPRAG ASSEMBLY, COMPLETE
335	RING, RACE RETAINING
336	RACE, 3RD CLUTCH INPUT SPRAG
337	WASHER, INPUT GEAR TO CARRIER
338	PLANETARY CARRIER ASSEMBLY
339	CLIP, SPEEDO GEAR
340	GEAR, SPEEDO
†341	RING, RETAINING

NOTE: §: 245MM CONVERTER CLUTCH MODELS ONLY
†: OPTIONAL

LH0110-3L30

Figure 77 Clutch Sun Gear and Planetary Carrier — Legend

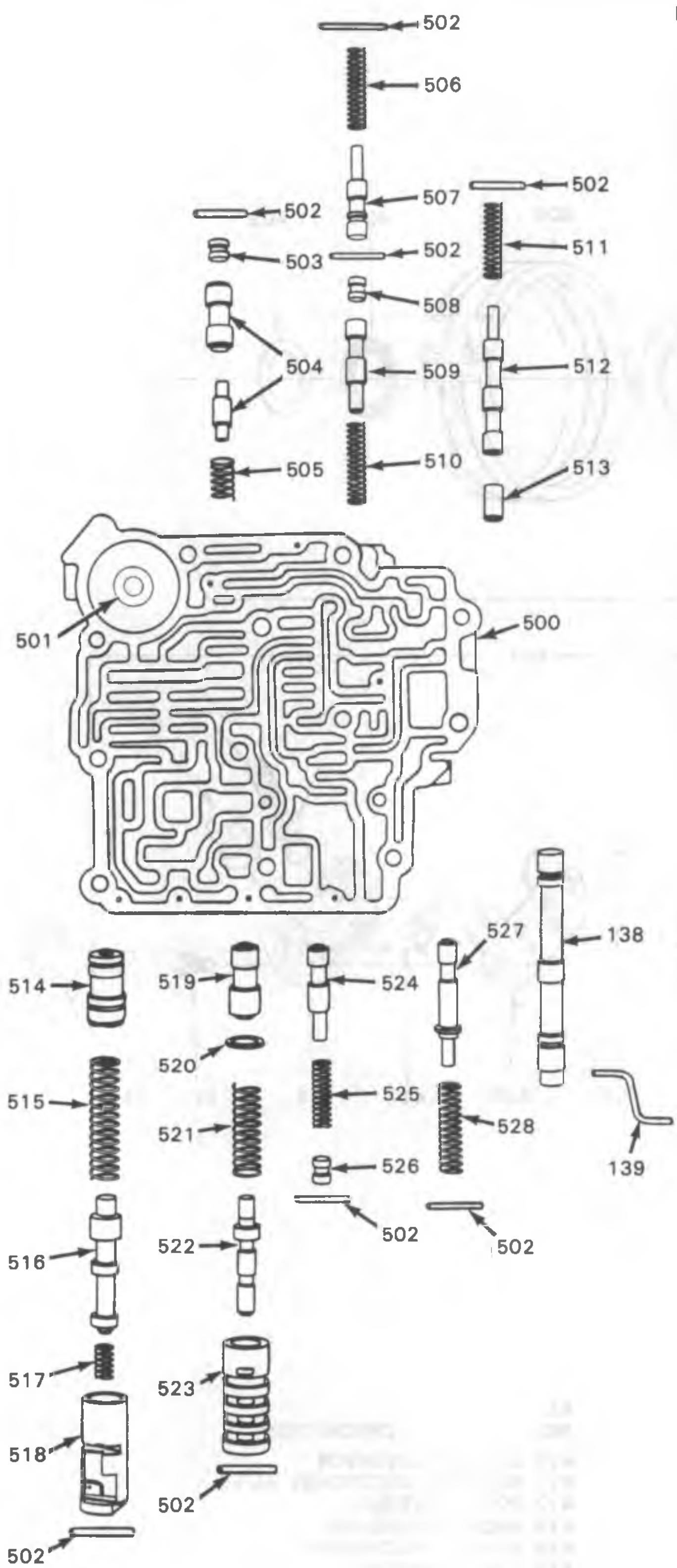


ILL. NO.	DESCRIPTION
401	BEARING, REACTION SUN GEAR
402	WASHER, REACTION SUN GEAR
403	DRUM & GEAR REACTION SUN ASSEMBLY
404	BAND, BRAKE
405	BUSHING, REACTION DRUM
406	RING, GOVERNOR SEAL
407	GOVERNOR ASSEMBLY
408	HUB, GOVERNOR
409	SCREEN, GOVERNOR OIL

ILL. NO.	DESCRIPTION
410	GASKET, GOVERNOR
411	RETAINER, SECONDARY VALVE
412	BODY, GOVERNOR
413	VALVE, SECONDARY
414	SPRING, SECONDARY
415	VALVE, PRIMARY
416	SCREW, GOVERNOR
417	RING, GOVERNOR

LH0111-3L30

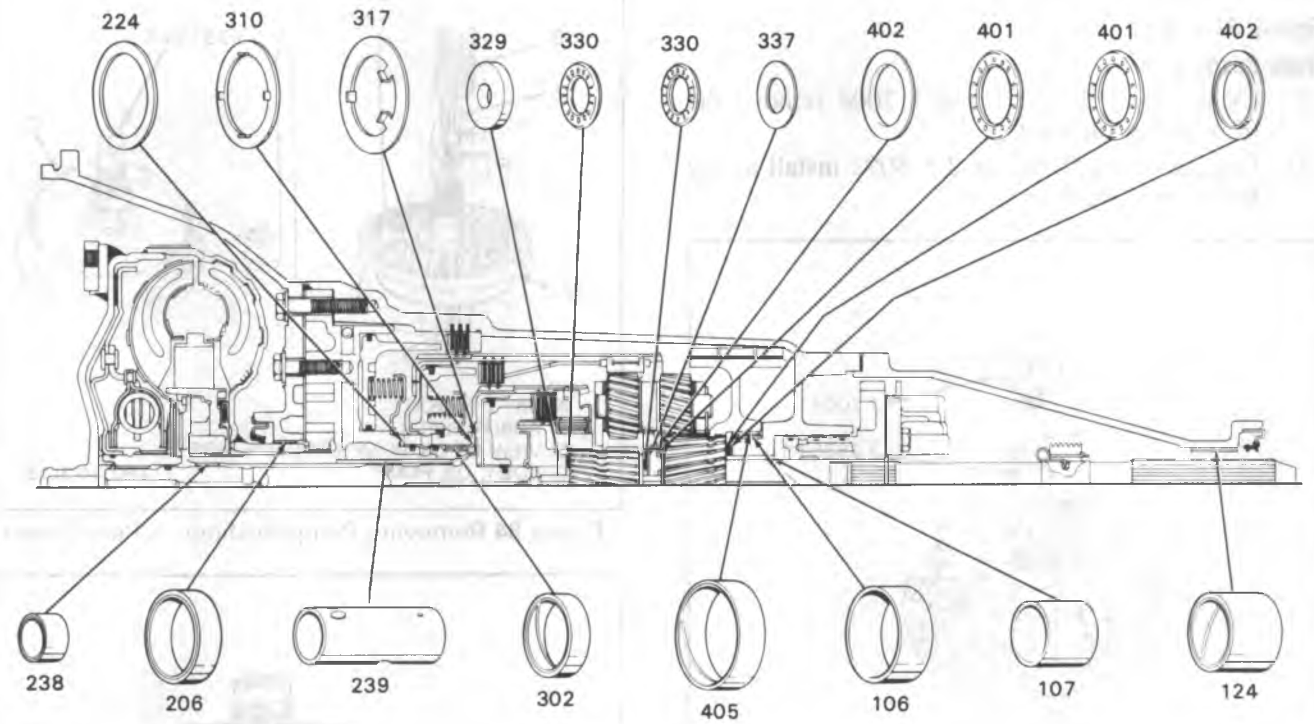
Figure 78 Reaction Sun Gear and Governor



ILL. NO.	DESCRIPTION
138	VALVE, MANUAL
139	LINK, MANUAL
500	VALVE BODY
501	1-2 ACCUMULATOR PISTON ASSEMBLY
502	PIN, RETAINING
503	PLUG, 1-2 ACCUMULATOR VALVE
504	VALVE, 1-2 ACCUMULATOR
505	SPRING, 1-2 ACCUMULATOR VALVE 1/2" x 1-1/16"
506	SPRING, DOWNSHIFT TIMING VALVE (HIGH SPEED) 7/16" x 1-5/16"
507	VALVE, DOWNSHIFT TIMING (HIGH SPEED)
508	PLUG, TIMING & CONTROL VALVE
509	VALVE, DOWNSHIFT TIMING (LOW SPEED)
510	SPRING, DOWNSHIFT TIMING VALVE (LOW SPEED) 7/16" x 1-3/8"
511	SPRING, MANUAL LOW CONTROL VALVE 7/16" x 1-5/16"
512	VALVE, MANUAL LOW CONTROL
513	VALVE, REVERSE CONTROL
514	VALVE, 1-2 SHIFT
515	SPRING, 1-2 SHIFT CONTROL VALVE 3/4" x 2-7/16"
516	VALVE, 1-2 SHIFT CONTROL
517	SPRING, 1-2 SHIFT CONTROL VALVE
518	SLEEVE, 1-2 SHIFT CONTROL VALVE
519	VALVE, 2-3 SHIFT
520	SEAT, 2-3 SHIFT CONTROL VALVE SPRING
521	SPRING, 2-3 SHIFT CONTROL VALVE 11/16" x 1-3/4"
522	VALVE, 2-3 SHIFT CONTROL
523	SLEEVE, 2-3 SHIFT CONTROL VALVE
524	VALVE, 3-2 CONTROL
525	SPRING, 3-2 CONTROL VALVE 7/16" x 1-3/4"
526	PLUG, 3-2 CONTROL VALVE
527	VALVE, DETENT PRESSURE REGULATOR
528	SPRING, DETENT PRESSURE REGULATOR VALVE 1/2" x 1-5/8"

LH0099-3L30

Figure 79 Typical Valve Body



106 SLEEVE, REACTION SUN
107 BUSHING, CASE
124 BEARING, EXTENSION
206 BUSHING, CONVERTER HOUSING
224 WASHER, SELECTIVE THRUST
238 BUSHING, OIL PUMP HUB (FRONT)
239 BUSHING, OIL PUMP BODY (REAR)
302 BUSHING, 2ND CLUTCH HUB

310 WASHER, 2ND TO 3RD CLUTCH THRUST
317 WASHER, 2ND TO 3RD CLUTCH THRUST
329 WASHER, INPUT SHAFT TO SUN GEAR
330 BEARING, INPUT SUN GEAR
337 WASHER, INPUT GEAR TO CARRIER
401 BEARING, REACTION SUN GEAR
402 WASHER, REACTION SUN GEAR
405 BUSHING, REACTION DRUM

LH0112-3L30

Figure 80 Washer and Bushing Location

BUSHING REPLACEMENT PROCEDURES

If during disassembly and inspection of the transmission, a bushing is found galled, scored or excessively worn, replace the bushing using the following procedures.

The replacement bushings used for field service are precision fit and do not require boring or reaming after installation.

Converter Housing Bushing

Figure 81

1. Remove the converter housing bushing, using tool J 21465-17 with driver handle J 8092, from the converter side of the housing.
2. Clean the converter housing thoroughly. Install a new converter housing bushing flush with the front face of the housing using tool J 21465-17 and driver handle J 8092.

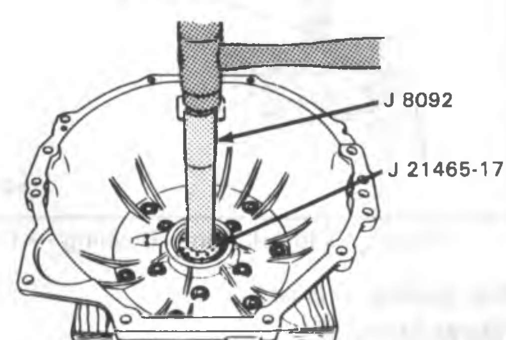


Figure 81 Removing or Installing Converter Housing Bushing

Pump Assembly Bushing

Figures 82 and 83

Front Bushing

1. Using tool J 29369-1 and J 7004 remove the front pump bushing.
2. Using tool J 25019-2 and J 8092 install a new front pump bushing.

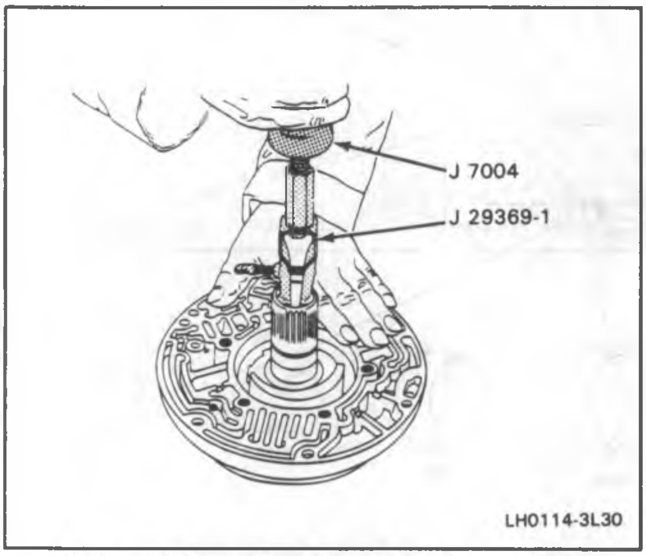


Figure 82 Removing Pump Bushing — Front

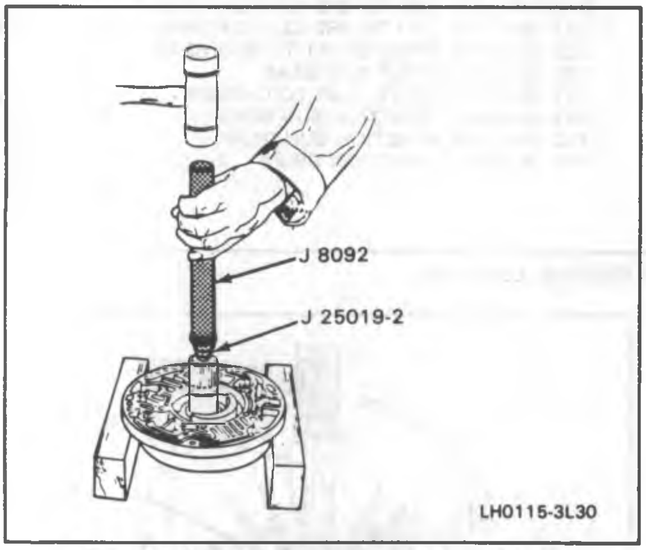


Figure 83 Install Pump Bushing — Front

Rear Bushing — Inner

Figures 84 and 85

1. Inspect, and if necessary, replace the inner pump hub bushing by threading a 3/4 in. standard pipe tap such as tool J 23130-5 into bushing.
2. Place the pump on an arbor press with the hub down and insert a drift punch through the stator shaft. Apply pressure on the drift punch, with the arbor press, to remove the bushing. Use rag or cloth to protect pump face.

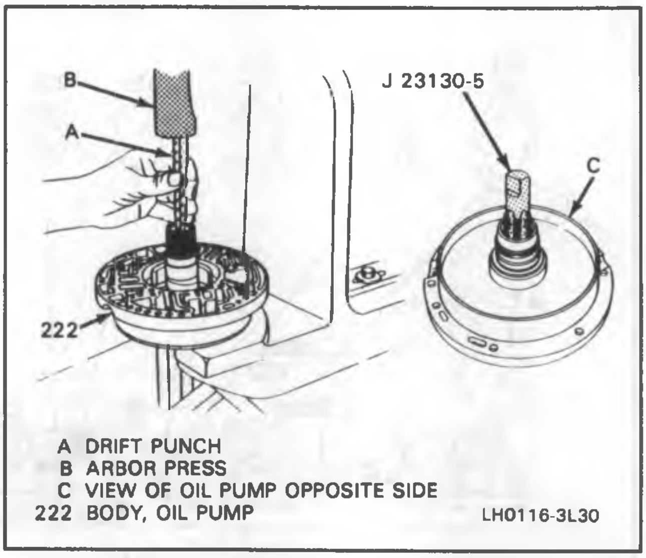


Figure 84 Removing Pump Bushing — Rear (Inner)

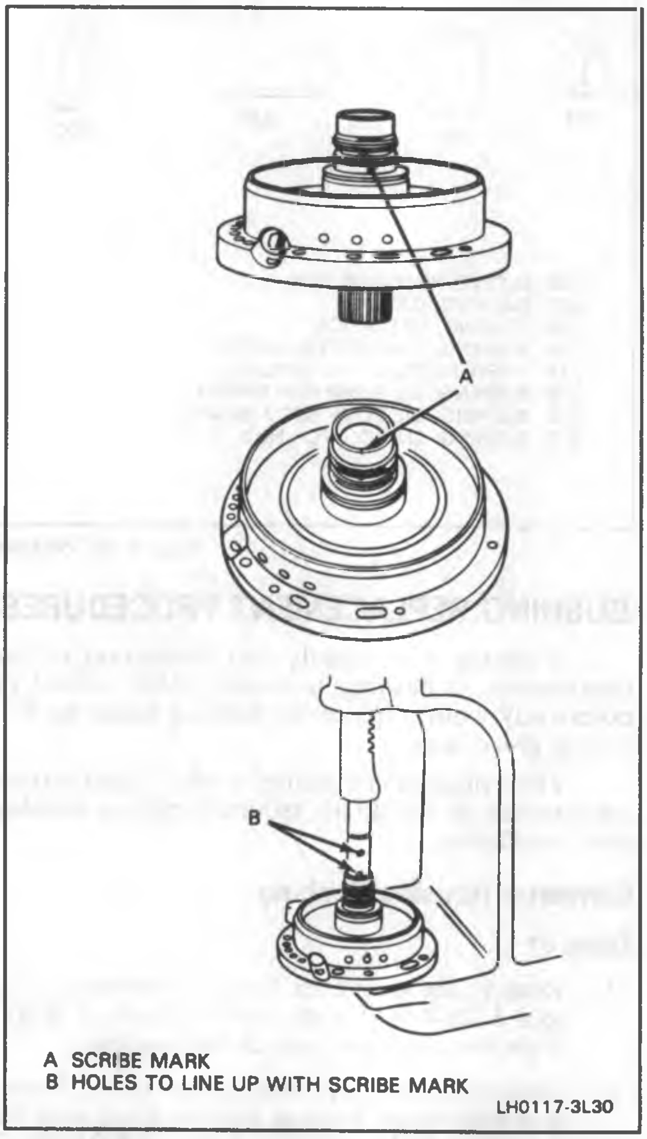


Figure 85 Installing Pump Housing — Rear (Inner)

3. Install a new pump hub bushing with the arbor press and tool J 23130-1 (Figure 81) as follows:
   - Clean the pump body, including all holes and pockets thoroughly. Place the pump on a bench with hole "A" facing downward, scribe a mark on the pump shaft inner diameter at the center of the oil groove to the right of hole "A". Scribe a mark on the outer diameter of the bushing through the center of the small and large drilled holes "B". Place the bushing into the pump hub with the small hole up and align the scribe mark on the bushing with the scribe mark made in the pump shaft. Use the arbor press and tool J 23130-1 to drive the bushing into the pump shaft until it is seated in the bore.
   - Care must be taken so that the bushing is pressed in straight, using the scribe marks as a guide until firmly seated.

Second Clutch Bushing

Figure 86

1. If necessary, remove the second clutch hub bushing using remover and installer J 23130-6 with driver handle J 8092.
2. Clean in solvent to remove any foreign matter. Install a new second clutch hub bushing using tool J 23130-6 and driver handle J 8092. Bushing must be driven in until tool bottoms on bench.

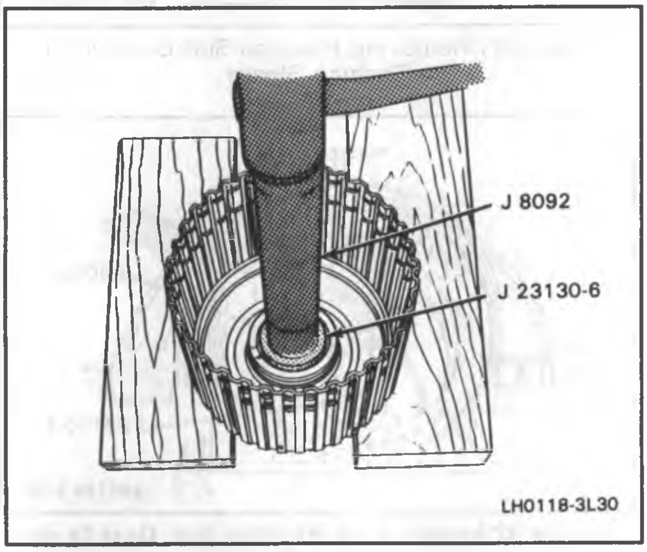


Figure 86 Removing or Installing Second Clutch Bushing

Reaction Sun Gear Drum Bushing

Figures 87 and 88

1. Remove the reaction sun gear drum bushing with either tool J 8400-1 at the bushing joint or with tools J 29369-3 and J 7004.
2. Install a new bushing with installer tool J 23130-2 and driver handle J 8092. Bushing must be installed flush with rear face of the sun gear drum hub.

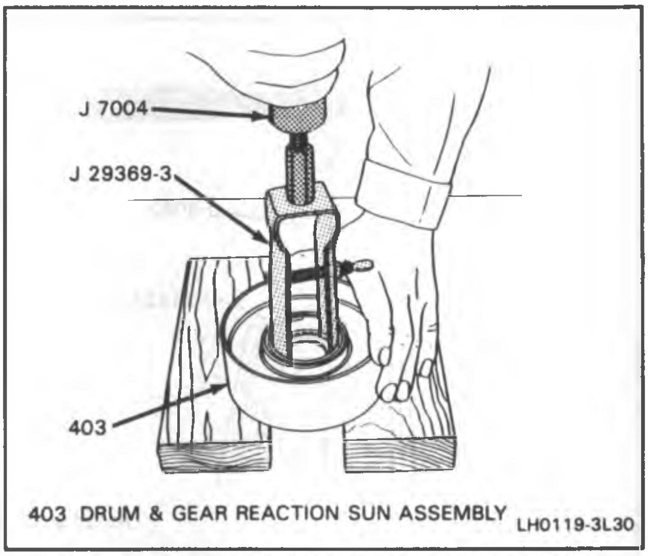


Figure 87 Removing Reaction Sun Gear Drum Bushing

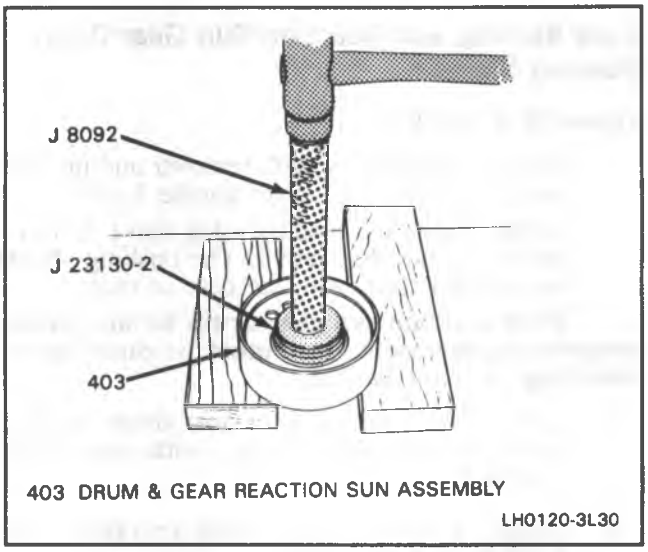


Figure 88 Installing Sun Gear Drum Bushing

Extension Housing Bushing

Figure 89

1. Inspect the extension housing bushing. If worn, scored or damaged, the bushing can be removed with tool J 21424-9 and driver handle J 8092.
2. Clean the extension housing of dirt or foreign matter. Install a new extension housing bushing using J 21424-9 with driver handle J 8092. The bushing must be installed flush to the shoulder of the extension housing.

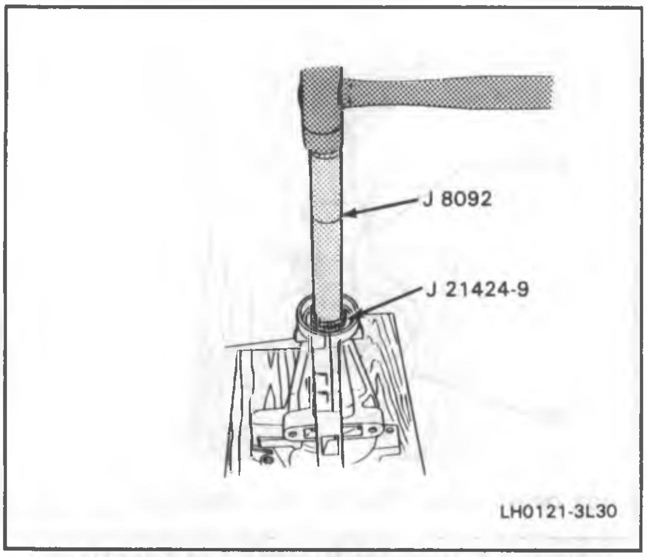


Figure 89 Removing or Installing Extension Housing Bushing

Case Bushing and Reaction Sun Gear Drum Bushing Sleeve

Figures 90, 91 and 92

1. Remove the bushing with remover and installer tool J 23130-3 and driver handle J 8092.
2. Install a new case bushing using tool J 23130-3 and driver handle J 8092. The bushing should be installed flush with the case at rear.

If the reaction sun gear drum bushing sleeve requires replacement, this must be done before installing the case bushing.

3. Remove the reaction sun gear drum bushing sleeve, inside rear of case, with cape chisel J 8400-1.
4. Install a new sleeve with installer tool J 23130-7 and J 8092.

The case bushing must be removed before installing the reaction sun gear drum bushing sleeve, because J 23130-7 pilots in the bushing bore, not the bushing itself.

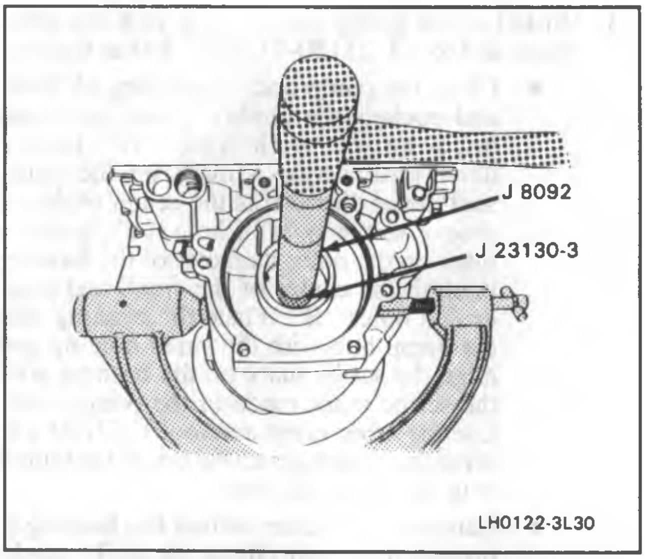


Figure 90 Removing or Installing Case Bushing

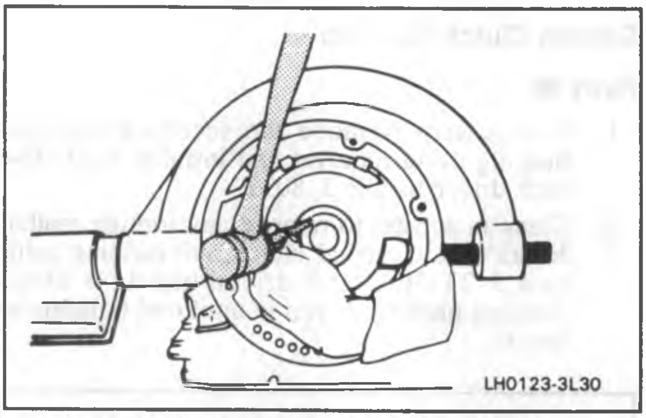


Figure 91 Removing Reaction Sun Gear Drum Bushing Sleeve

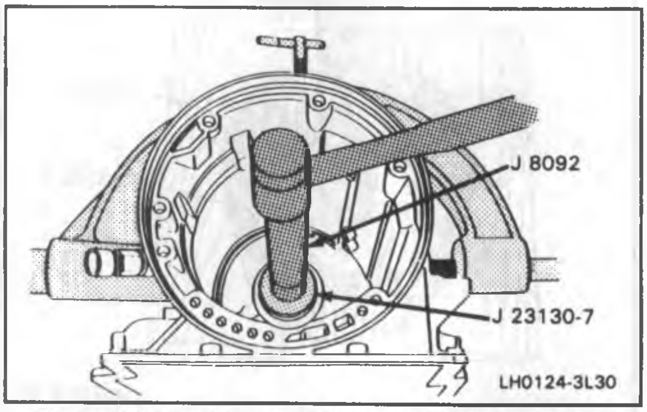


Figure 92 Installing the Reaction Sun Gear Drum Bushing Sleeve

TORQUE SPECIFICATIONS

ITEM	N·m	LB.-FT.
OIL PAN-TO-CASE	11	8
MODULATOR ASSEMBLY	52	33
EXTENSION HOUSING-TO-CASE	31	23
OIL PRESSURE CHECK PLUG	8	6
CONVERTER HOUSING-TO-CYLINDER BLOCK	34	25
TRANSMISSION SUPPORT-TO-EXTENSION	44	33
SHIFT LEVER-TO-SELECTOR LEVER SHAFT	27	20
DETENT CABLE, RETAINER-TO-CASE	9	6
OIL COOLER FITTINGS-TO-CASE	20	15
OIL COOLER FITTINGS-TO-RADIATOR	27	20
OIL COOLER HOSE CLAMPS-TO-COOLER LINES	1	7
SHIFTER ASSEMBLY-TO-CONSOLE	9	7
NEUTRAL SAFETY SWITCH-TO-BRACKET	2	1
LOWER COVER-TO-CONVERTER HOUSING	10	7
FLEXPLATE-TO-CONVERTER	48	35
TRANSFER PLATE-TO-VALVE BODY	9	7
REINFORCEMENT PLATE-TO-CASE	19	14
VALVE BODY-TO-CASE	19	14
SERVO COVER-TO-CASE	24	18
CONVERTER HOUSING-TO-OIL PUMP	19	14
CONVERTER HOUSING-TO-CASE	33	25
SELECTOR LEVER LOCKNUT	12	9
GOVERNOR BODY-TO-GOVERNOR HUB	8	6
SERVO ADJUSTING BOLT LOCKNUT	18	14
GOVERNOR PRESSURE SWITCH	10	7
SOLENOID	19	14
OIL STRAINER	18.9	14

LH0125-3L30

Figure 93 Torque Specifications

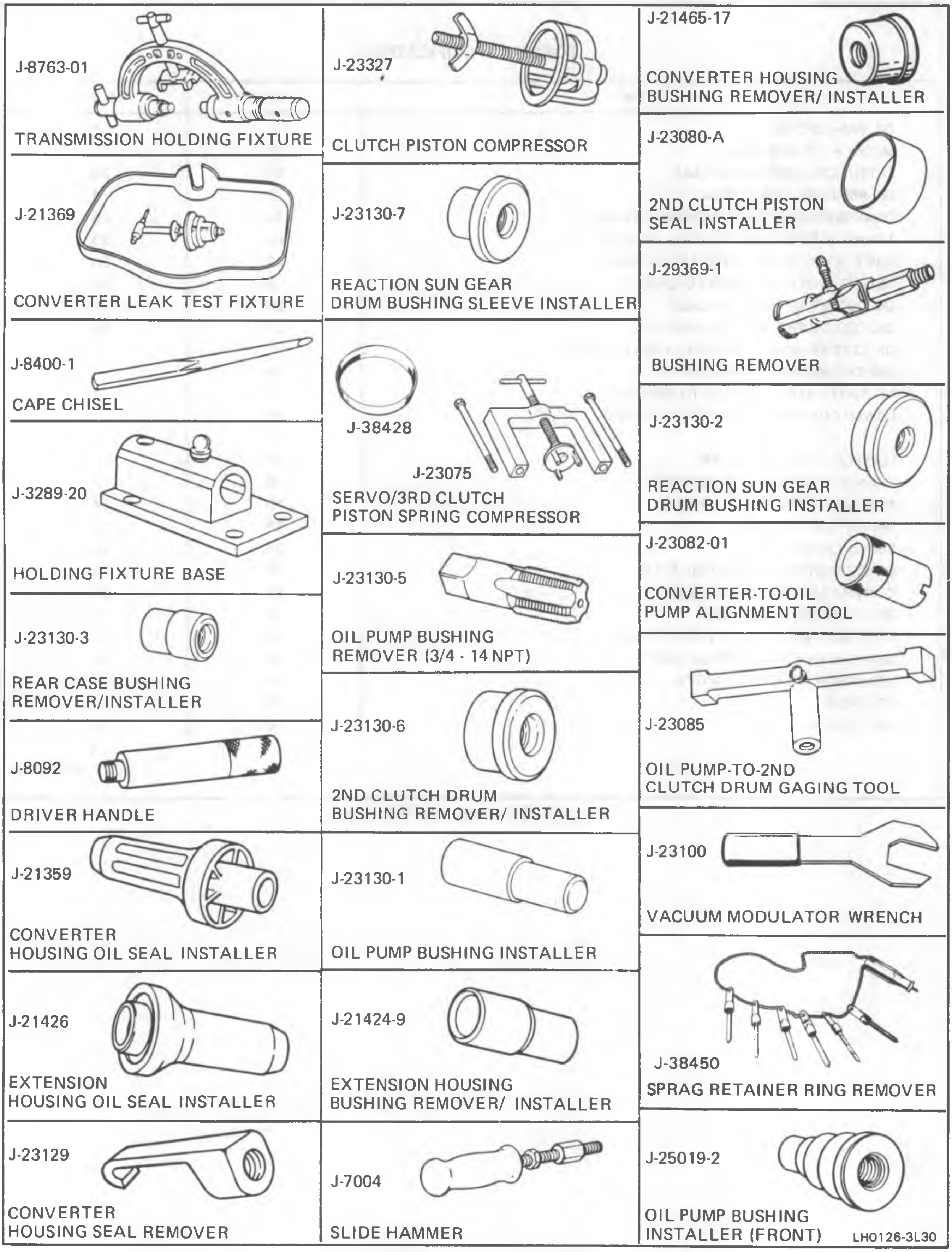


Figure 94 Special Tools

SECTION 7B1

HYDRA-MATIC 5LM60 MANUAL TRANSMISSION UNIT REPAIR (FORMERLY HM-290)

RPO MG5

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

CONTENTS

GENERAL SERVICE INFORMATION

- Lubricant

The lubricant may appear to be very dark in color, almost black. This is a normal condition. The silicon imbedded into the shift forks to reduce wear is reacting with the lubricant.

Clean

Thoroughly clean the exterior of the transmission.

UNIT DISASSEMBLY

Tools Required:

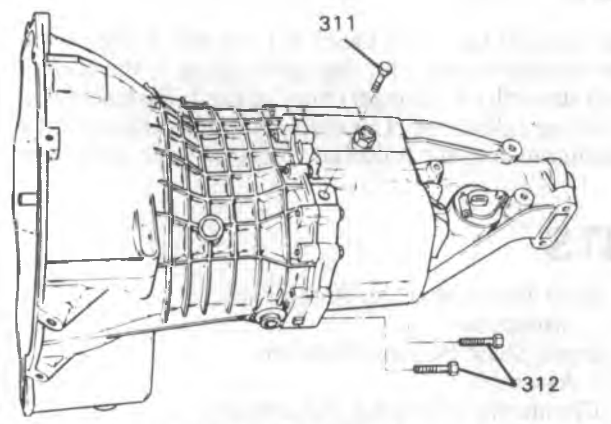
J 3289-20 Base Holding Fixture
J 8763-02 Holding Fixture C-Clamp
J 8763-21 Balance Bracket for C-Clamp
J 36824 Transmission Adapters
J 36509 Detent Spring Plug Remover
J 23907 Slide Hammer
J 36825 4WD Output Shaft Oil Seal Remover (4WD models only)
J 36515 Assembly Pallet
J 36515-12 Countershaft Adapter
J 8105 Gear Puller (2WD models only)
J 21427-01 Speedometer Gear Puller Adapter (2WD models only)
J 36516 Output Shaft Spanner Nut Wrench

2WD/4WD REAR HOUSING REMOVAL

Remove or Disconnect

Figures 1 - 13

1. Idler shaft support bolt (311) and bottom two bolts (312) (Figure 1).
   - J 8763-21 onto J 8763-02 (Figure 2)
   - J 36824 onto the transmission case.
   - J 8763-02 onto J 36824.



311 BOLT, HEX HEAD (M8 X 50 — 22 N·m)
312 BOLT, HEX HEAD (M8 X 50 — 35 N·m)

LH0001-5LM60

Figure 1 Removing Bolts for Special Tools

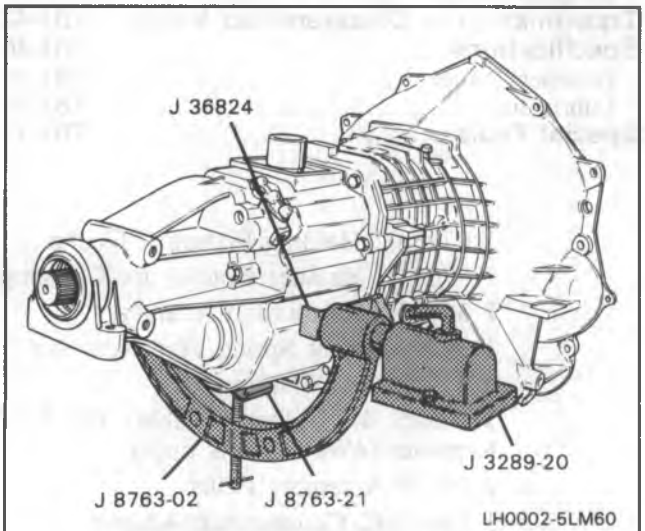
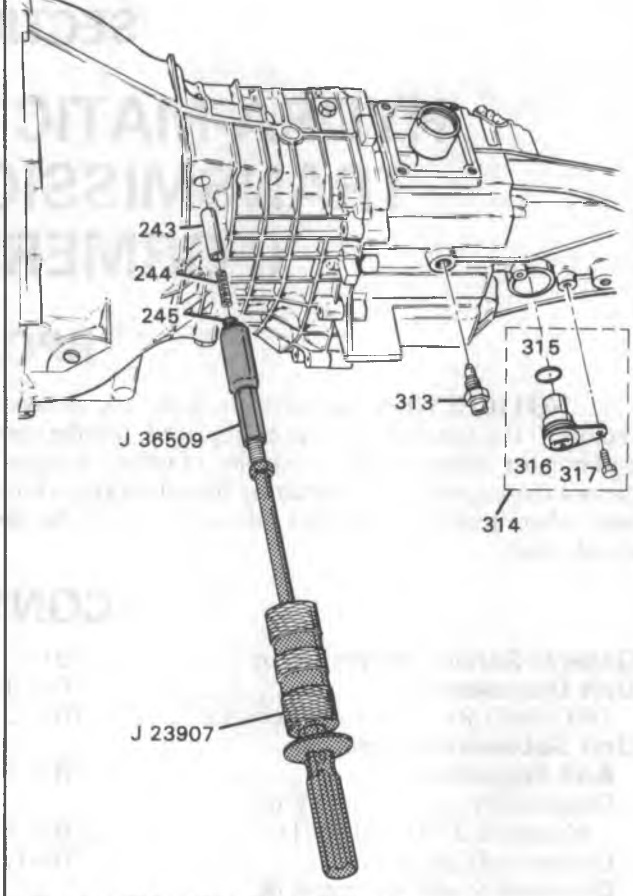


Figure 2 Holding Fixture Installed

2. Backup lamp switch assembly (313) (Figure 3).
3. Bolt (317) and electronic speed sensor assembly (314).
   - 2WD models only.
4. Detent plug (245) using J 36509 and J 23907, spring (244) and plunger (243).



243 PLUNGER, SHIFT SHAFT DETENT
244 SPRING, SHIFT SHAFT DETENT PLUNGER
245 PLUG
313 SWITCH ASSEMBLY, BACK-UP LAMP
314 SENSOR ASSEMBLY, ELECTRONIC SPEED
315 O-RING
316 SENSOR, ELECTRONIC SPEED
317 BOLT, HEX HEAD

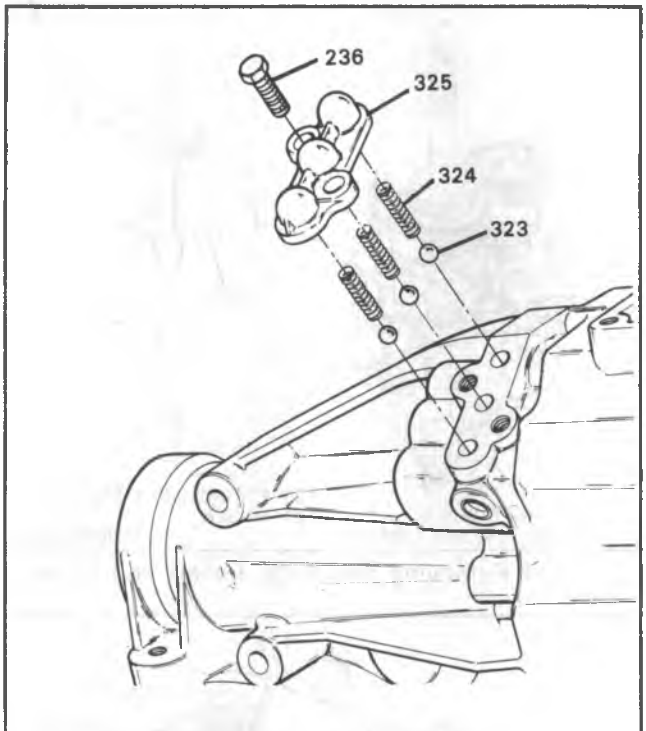
LH0003-5LM60

Figure 3 Removing External Components

5. Two bolts (236), detent spring cover (325), springs (324), and balls (323) (Figure 4).
   - It may be necessary to remove sealant from inside of holes to remove the balls (323).
6. Output shaft oil seal (320) using J 36825 and J 23907 (Figure 5).
   - 4WD models only.
     — Screw J 36825 into one of the three perforated holes in the seal.

- Position vertical.

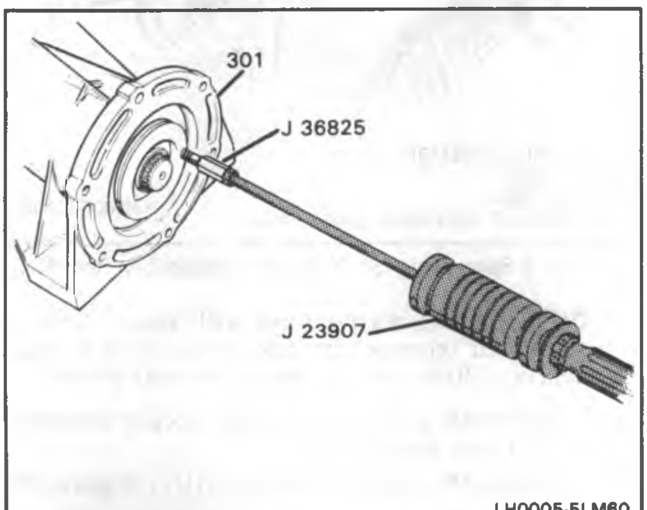
7. Six bolts (204) and input shaft bearing retainer assembly (205) (Figure 6).
   - Tap on clutch release bearing pilot with a rubber hammer.
   - Save the input bearing retainer washer (208).



236 BOLT, HEX HEAD (M6 X 16 — 8.5 N·m)
323 BALL, DETENT/INTERLOCK
324 SPRING, DETENT
325 COVER, DETENT SPRING

LH0004-5LM60

Figure 4 Removing Shift Rail Detent System



301 HOUSING, REAR (4WD)

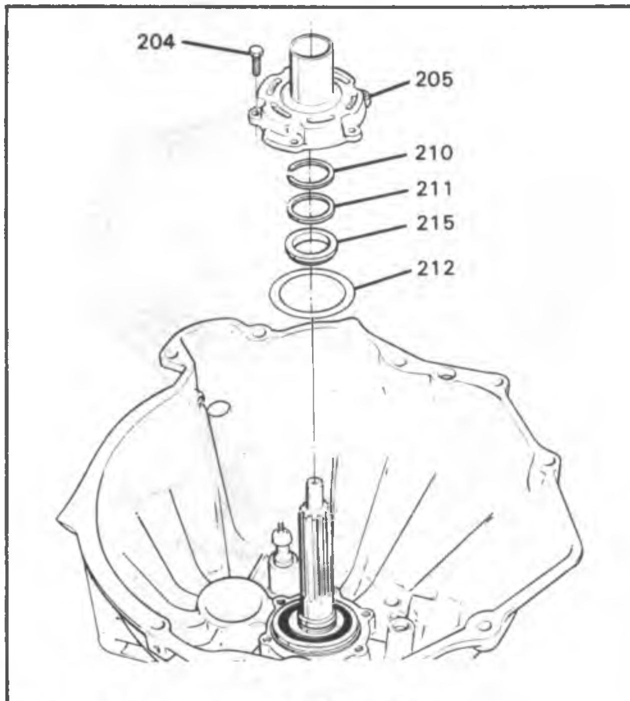
LH0005-5LM60

Figure 5 Removing 4WD Oil Seal

8. Snap ring (selective) (210), input shaft spacer (211), ball bearing inner race (215) and shim (212).

- Position horizontally.

9. Front housing to rear housing bolts (312) (Figure 7).
10. Drive dowels (321) into front housing.
11. Front housing (200).
12. Countershaft bearing (203).



204 BOLT, HEX HEAD (M6 X 25 — 8.5 N·m)
205 RETAINER ASSEMBLY, INPUT SHAFT BEARING
210 RING, SNAP (SELECTIVE)
211 SPACER, INPUT SHAFT
212 SHIM, (SELECTIVE)
215 RACE, BALL BEARING (OUTER)

LH0006-5LM60

Figure 6 Removing Input Shaft Bearing Retainer Assembly

13. Ball bearing inner race (217) and roller bearing (218).
    - Degreasing with a liquid cleaner will make it easier to remove.
    - Grab on OD edge (non-machined surface) of the inner race (217) and remove with large pliers.

Important

- Do not damage bearing cage while removing ball bearing inner race.

14. Idler shaft support (310).
    - snap out
15. Four rollers (118) (Figure 8).
    Roll Pin
    - Pull shift shaft forward.
    - Cock to detent cover side.
16. Roll pin (120)

Important

- Support the shift shaft end while driving out finger roll pin.
- Slide the shaft (116) all the way back and cocked over to the detent spring cover side.

17. Shift shaft socket assembly roll pin (122) (Figure 9).
    - Pin will fall into the case.

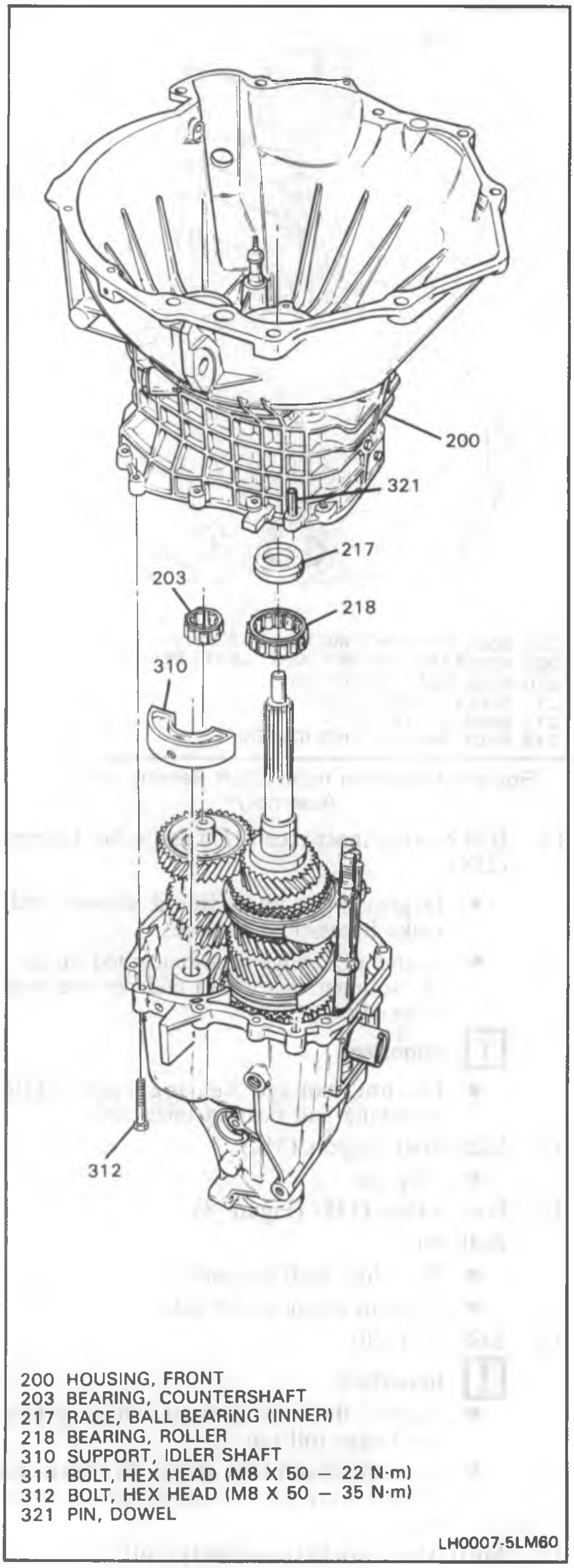


Figure 7 Removing Front Housing

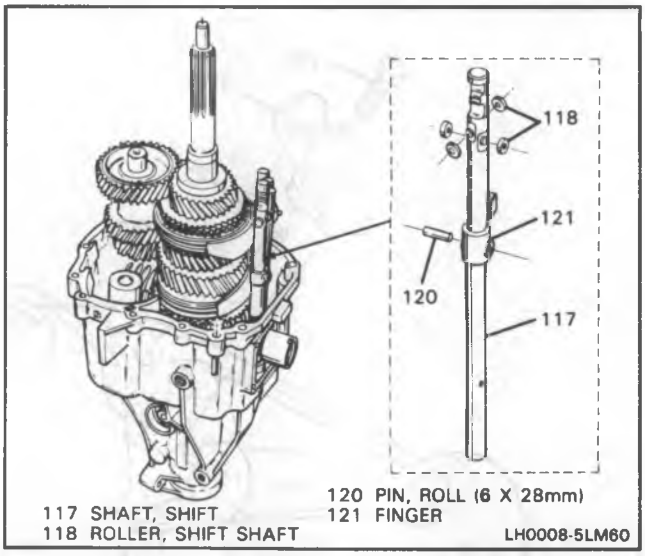


Figure 8 Removing Shift Shaft Rollers and Finger

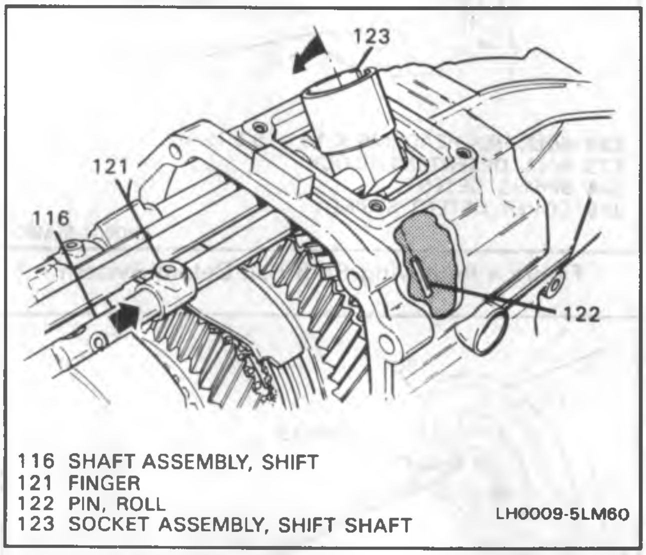


Figure 9 Removing Shift Socket Assembly Roll Pin

NOTICE: Excessive force will "peen" the shift shaft and damage the rear housing shift shaft bearing (309) causing increased shift effort.

18. Shift shaft (116), shift shaft socket assembly (123) and finger (121).
19. 3rd and 4th shift fork roll pin (107) (Figure 10).
    - With a large pair of diagonal cutters — pry out.

Important

- If roll pin (107) breaks off, put the transmission in 3rd gear and cut off remainder of roll pin then drive through, cocking roll pin so it clears the 3rd speed gear.

20. Plug (326).
    - By hitting on one side — cocking it.

21. 3rd and 4th rail (109) (Figure 11).
    - Make sure the 1-2 and 5-reverse rails are in neutral or the interlock system will not allow the 3-4 rail to move.
    - Drive through the plug hole (326) enough to expose the roll pin hole (107) then insert a 3/8 in. punch or equivalent through the roll pin hole (107) and pull (while twisting) out the shift rail.
22. Two interlock balls (323).

- Install J 36515 with J 36515-12 (Figure 12).
- Remove J 8763-02 and J 36824.

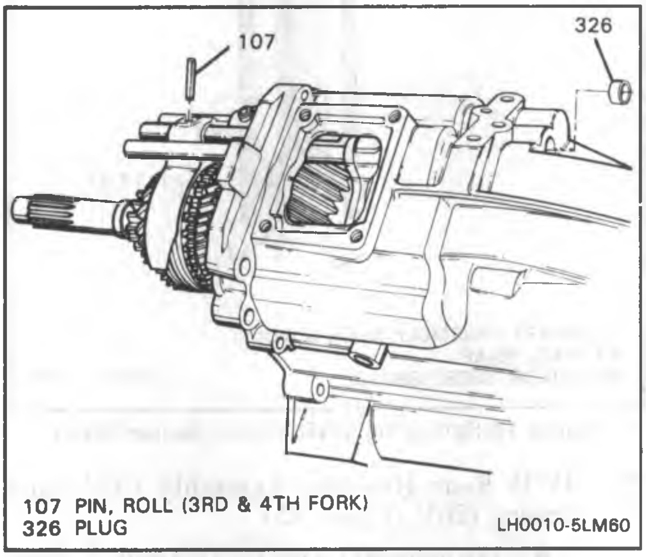


Figure 10 Removing 3-4 Rail Plug and Roll Pin

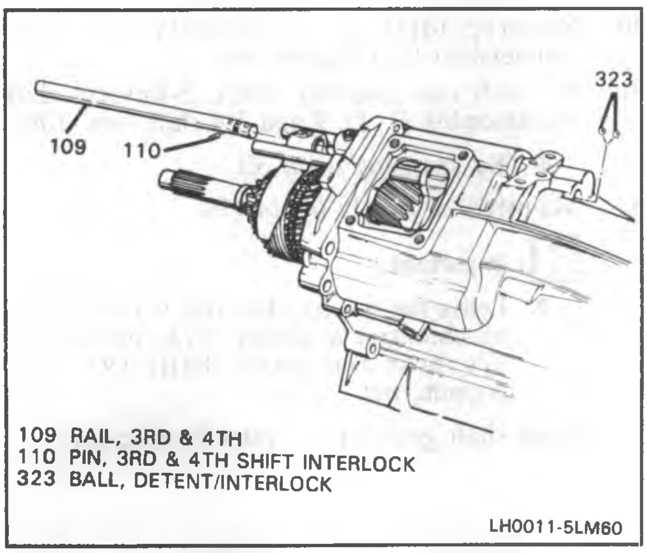


Figure 11 Removing 3-4 Rail and Interlock Balls

Important

- Steps 23 through 28 are for 2WD models only. The 4WD section starts with step 29 (Steps 30 through 33 are for both 2WD and 4WD models).

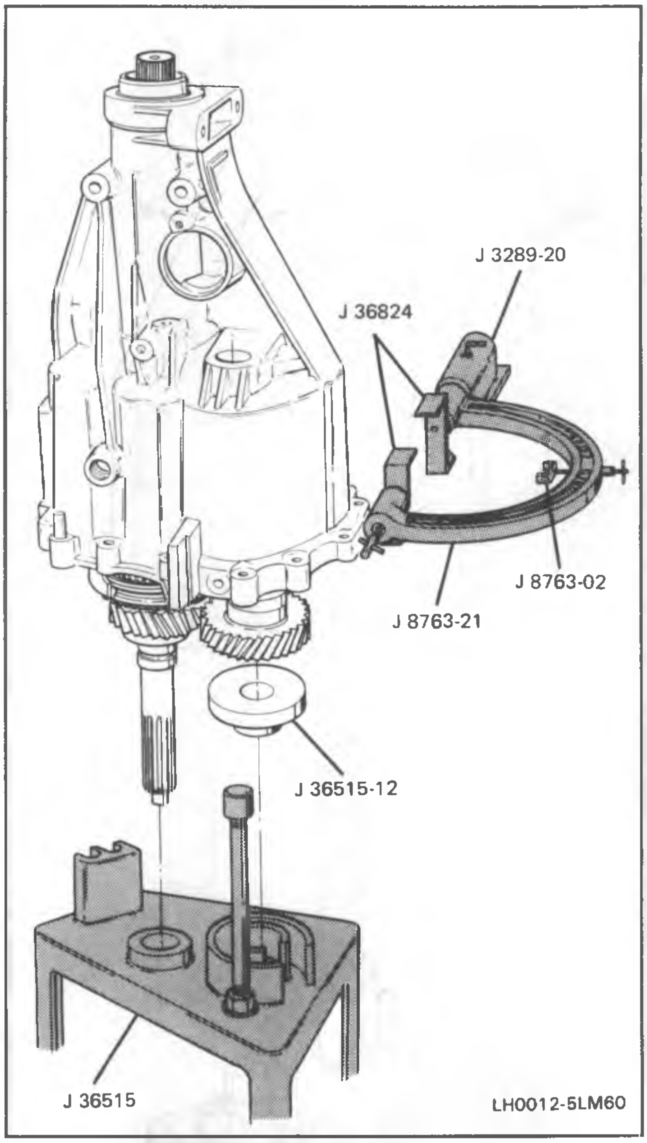
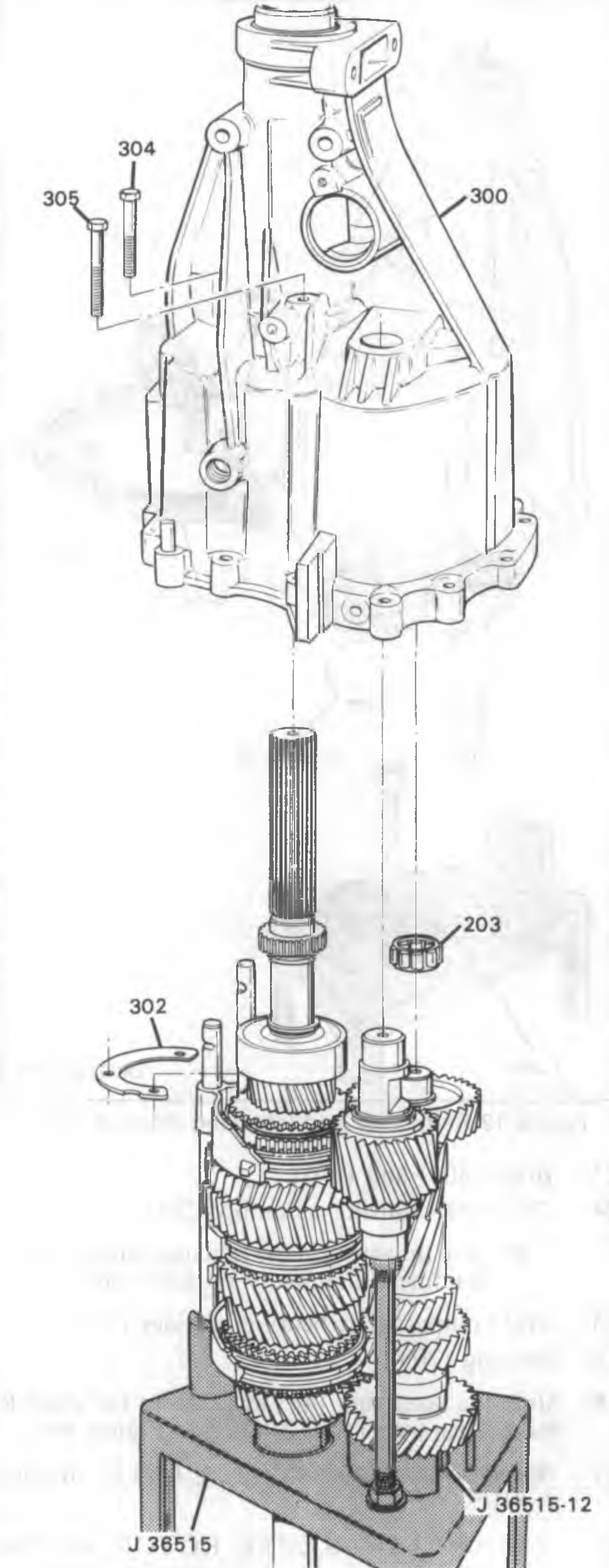


Figure 12 Removing and Installing Special Tools

23. Bolts (304) and (305).
24. 2WD rear housing assembly (300).
    - Tap upwards on the housing with a rubber hammer (alternately on each side).
25. 2WD output shaft bearing retainer (302).
26. Bearing (203).

- Slide the snap ring (43) away from the rotor to make clearance for J 21427-01 (Figure 14).

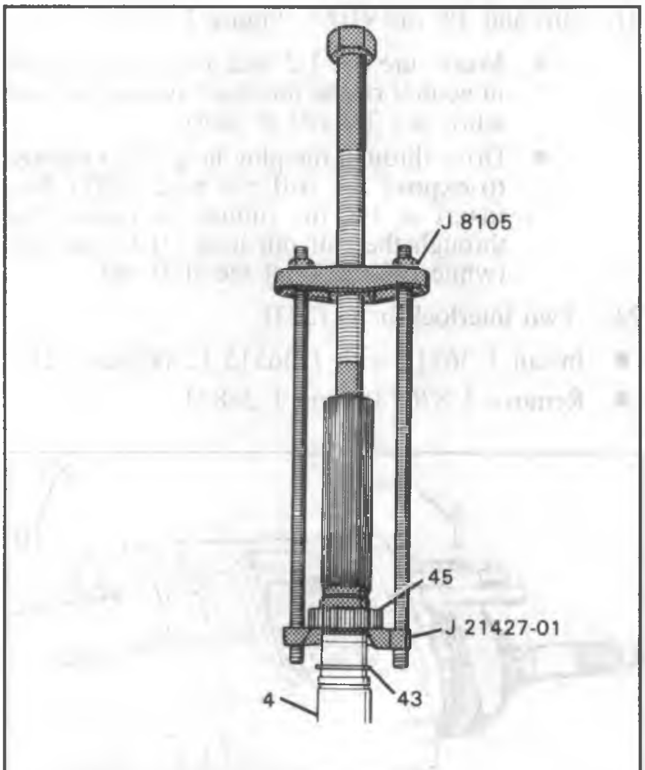
27. Speed sensor rotor (45) using J 21427-01 and J 8105
    - DO NOT REUSE ROTOR AFTER REMOVAL.
28. Snap ring (43).



203 BEARING, COUNTERSHAFT
300 HOUSING, REAR (2WD)
302 RETAINER, OUTPUT SHAFT BEARING (2WD)
304 BOLT, HEX HEAD (M8 X 50 — 22 N·m) (2WD)
305 BOLT, HEX HEAD (M8 X 60 — 22 N·m) (2WD)

LH0013-5LM60

Figure 13 Removing 2WD Rear Housing



4 SHAFT ASSEMBLY, MAIN (2WD)
43 RING, SNAP
45 ROTOR, SPEED SENSOR

LH0014-5LM60

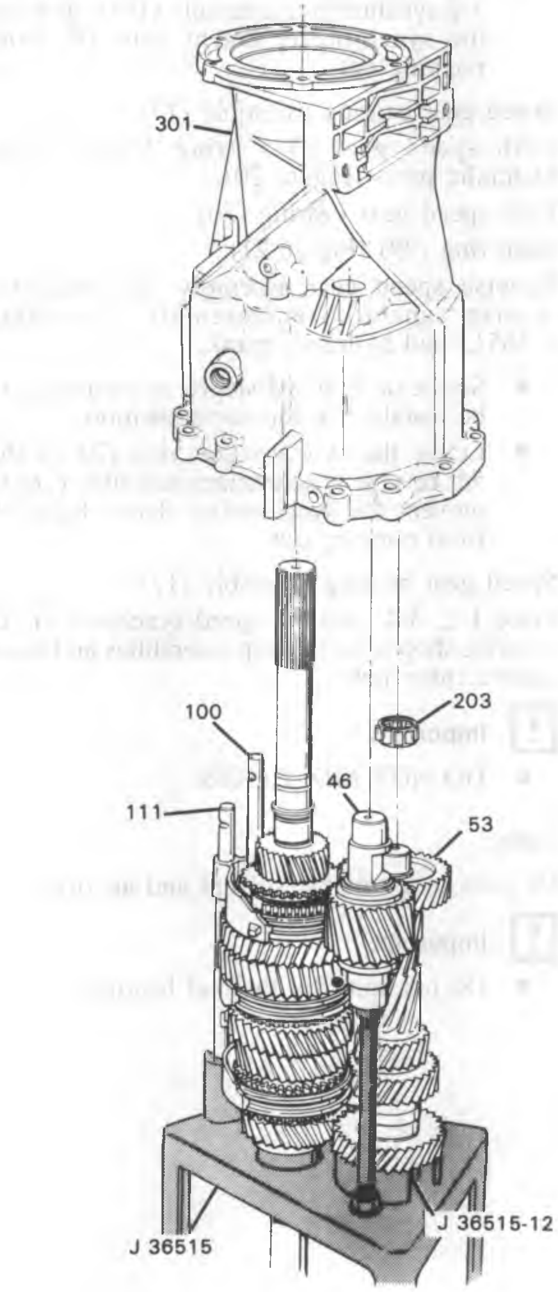
Figure 14 Removing 2WD Speed Sensor Rotor

29. 4WD Rear Housing Assembly (301) and bearing (203) (Figure 15).
    - Tap upwards on the housing with a rubber hammer (alternately on each side).
30. Reverse idler gear assembly (46) and countershaft (53) (Figure 16).
31. 1-2 shift rail assembly (100), 5-Reverse shift rail assembly (111), 2 and 3-4 shift fork (108).
    - By snapping them off
32. Mainshaft assembly (4) or (5).

Important

- Leave the synchronizer ring (2) on the 3-4 synchronizer assembly (7) to prevent the synchronizer detent balls (9) from popping out.

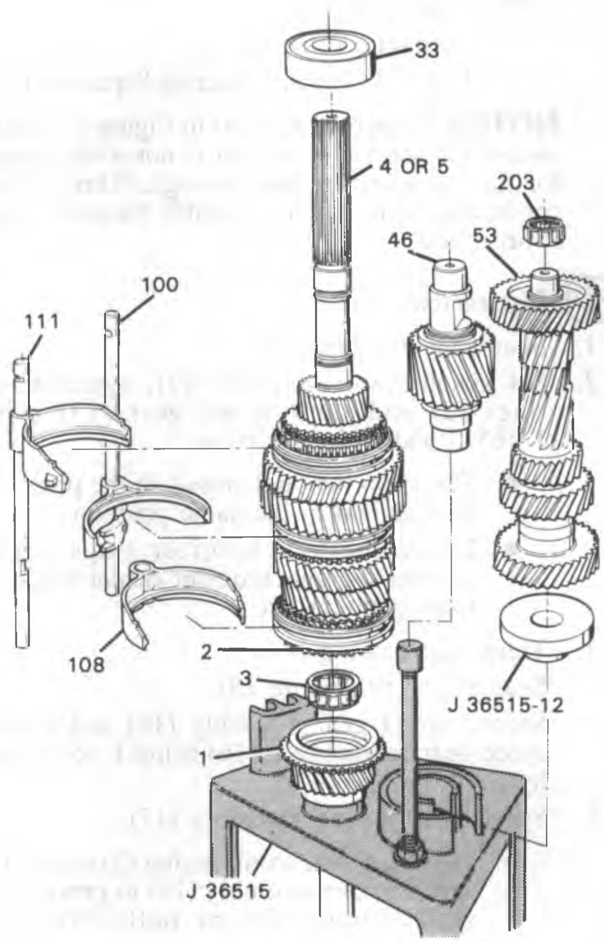
33. Input shaft gear (1) and pilot bearing (3).



46 IDLER ASSEMBLY, REVERSE
53 COUNTERSHAFT ASSEMBLY, (MG5)
100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
111 RAIL ASSEMBLY, 5TH & REVERSE SHIFT
203 BEARING, COUNTERSHAFT
301 HOUSING, REAR (4WD)

LH0016-5LM60

Figure 15 Removing 4WD Rear Housing



1 SHAFT, INPUT
2 RING, SYNCHRONIZER
3 BEARING, PILOT
4 SHAFT ASSEMBLY, MAIN (2WD)
5 SHAFT ASSEMBLY, MAIN (4WD)
33 BEARING ASSEMBLY, OUTPUT SHAFT
46 IDLER ASSEMBLY, REVERSE
53 COUNTERSHAFT ASSEMBLY, (MG5)
100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
108 FORK, 3RD & 4TH SHIFT
111 RAIL ASSEMBLY, 5TH & REVERSE SHIFT
203 BEARING, COUNTERSHAFT

LH0017-5LM60

Figure 16 Removing Gears and Shift Rails

UNIT SUBASSEMBLY REPAIR AND INSPECTION

DISASSEMBLY AND ASSEMBLY OF MAINSHAFT 2WD AND 4WD

Tools Required:

Hydraulic Press
J 36513 Gear and Bearing Separator Plate

NOTICE: Optional method in Figure 17 can be used if the service press bed is not wide enough for the 1st speed to pass through. This method can be used to totally disassemble the main shaft, if necessary.

Disassemble

1. Snap ring (6) (Figure 17).
2. 3-4 synchronizer assembly (7), synchronizer rings (2) and third speed gear (13) using J 36513 and hydraulic press.
   - Scribe on hub and sleeve so the parts can be installed in the same position.
   - Leave the synchronizer rings (2) to prevent the synchronizer detent balls (9) from popping out.
3. Third gear bearing (14).
4. Snap ring (15) (Figure 18).
5. Second speed gear assembly (18) and second speed gear bearing race (16) using J 36513 and hydraulic press.
6. Speed gear bearing assembly (17).
   - Leave the synchronizer ring (2) on the 1-2 synchronizer assembly (19) to prevent the synchronizer detent balls (9) from popping out.
7. First speed gear (22) and 1-2 synchronizer assembly (19) using J 36513 and hydraulic press.
   - Scribe on hub and sleeve so the parts can be installed in the same position.
   - Leave the synchronizer rings (2) on the 1-2 synchronizer assembly (19) to prevent the synchronizer detent balls (9) from popping out.
8. Speed gear bearing assembly (17).
9. Fifth speed gear (31) using J 36513 and hydraulic press (Figure 20).
10. Fifth speed gear bearing (30).
11. Snap ring (29) (Figure 21).
12. Reverse speed gear assembly (25) and 5th-reverse synchronizer assembly (26) using J 36513 and hydraulic press.
    - Scribe on hub and sleeve so the parts can be installed in the same position.
    - Leave the synchronizer ring (2) on the 5th-reverse synchronizer assembly (26) to prevent the synchronizer detent balls (9) from popping out.
13. Speed gear bearing assembly (17).
14. Place 1-2, 3-4, and 5th speed synchronizers in separate shop towels, wrap assemblies and press against inner hub.

Important

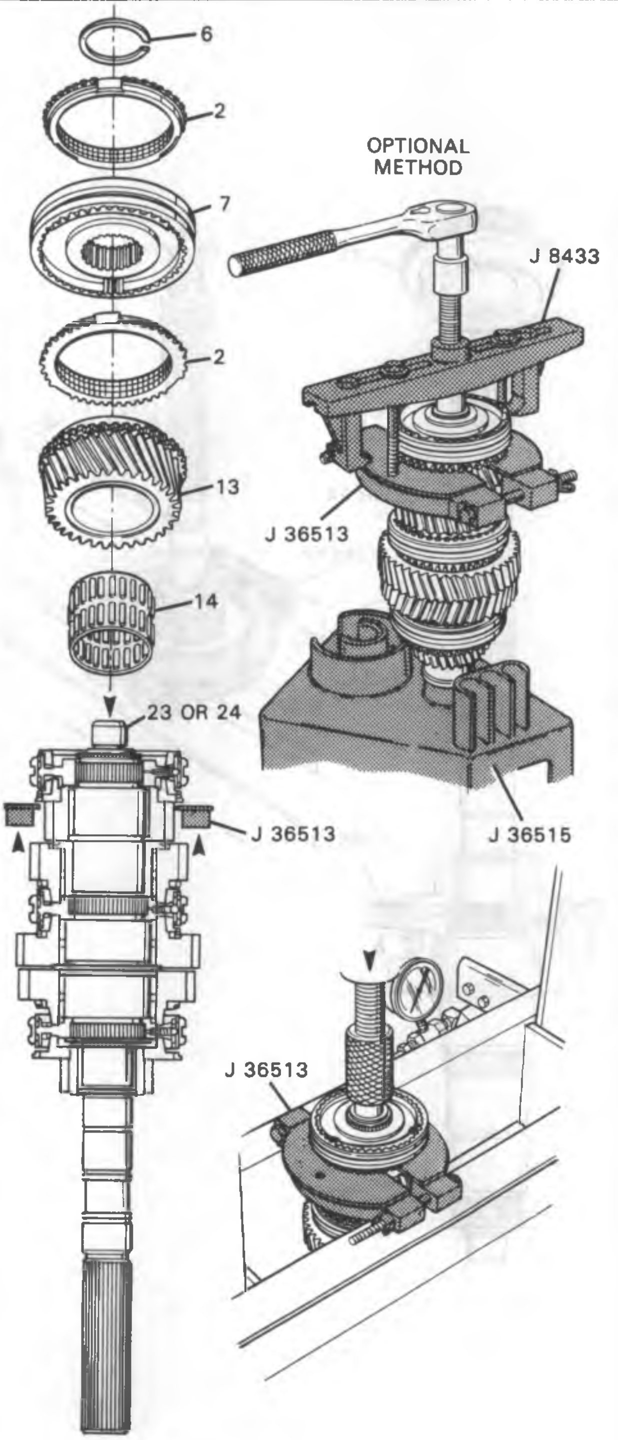
- DO NOT MIX PARTS

Clean

- All parts in a suitable solvent and air dry.

Important

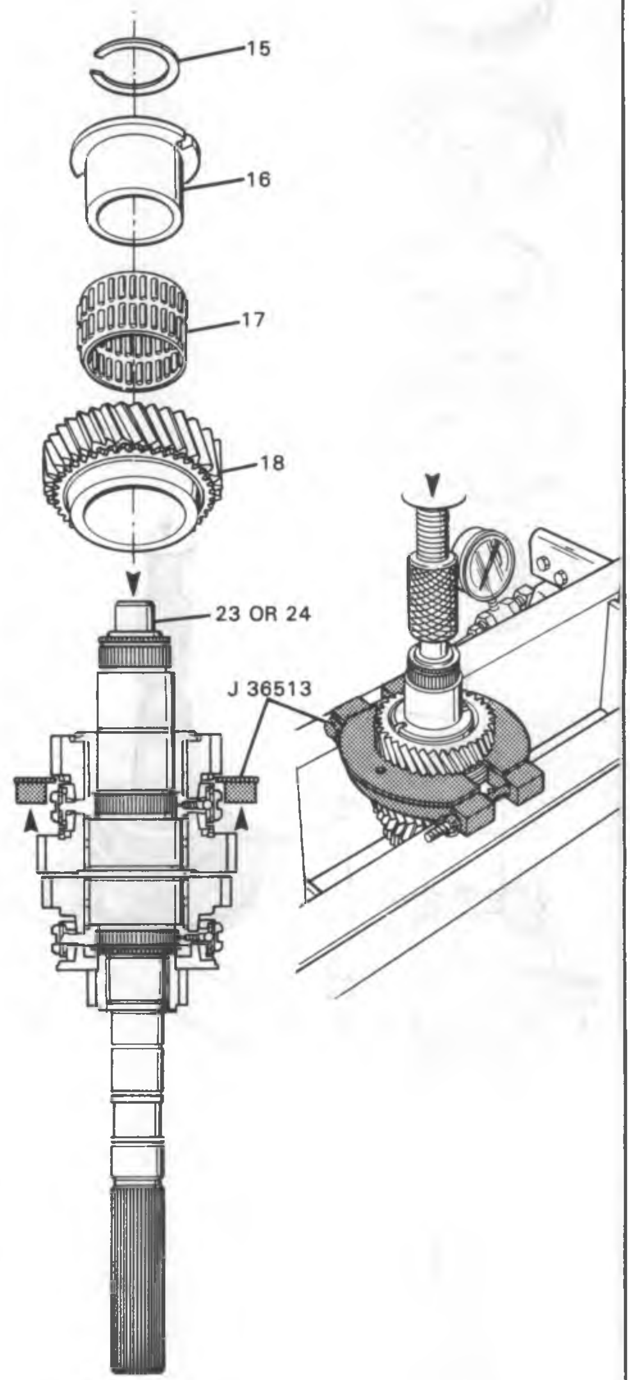
- Do not spin dry the ball bearings.



2 RING, SYNCHRONIZER
6 RING, SNAP
7 SYNCHRONIZER ASSEMBLY, 3-4
13 GEAR ASSEMBLY, 3RD SPEED
14 BEARING ASSEMBLY, 3RD SPEED GEAR NEEDLE
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0018-5LM60

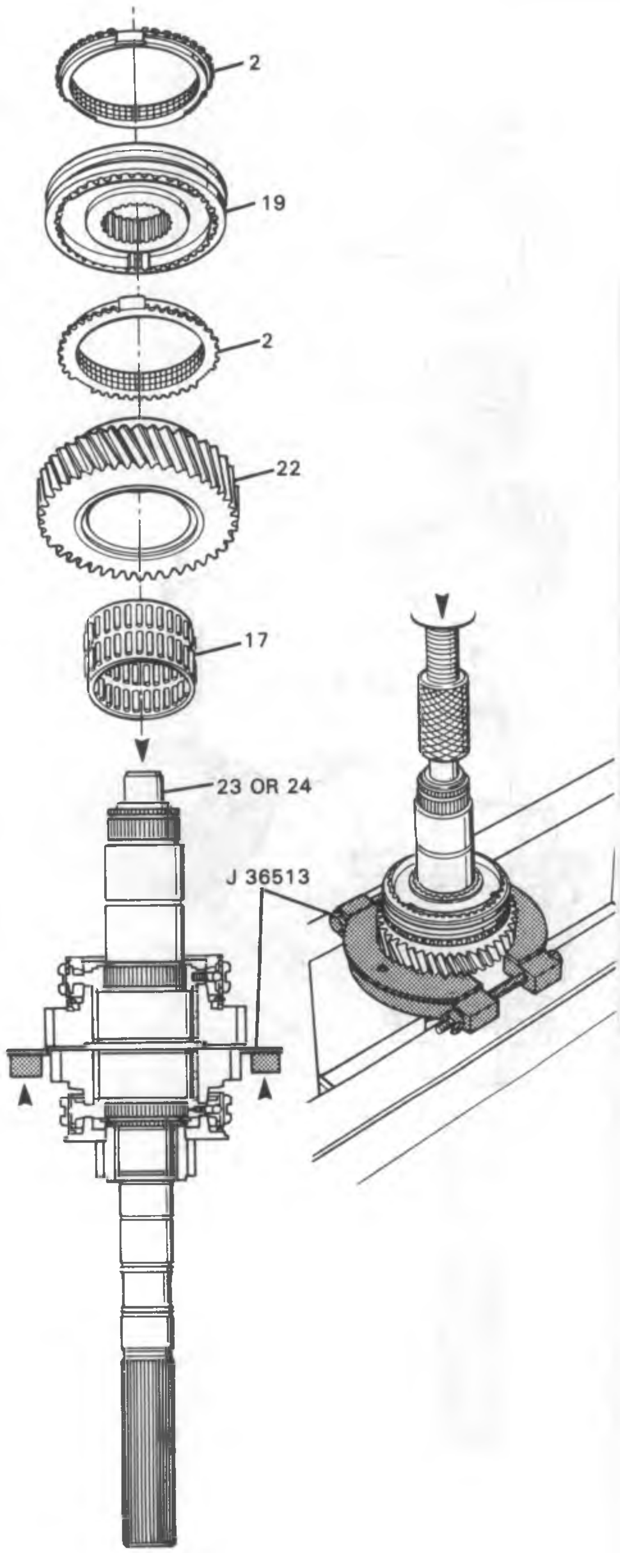
Figure 17 Removing 3-4 Gear Components



15 RING, SNAP
16 RACE, 2ND SPEED GEAR NEEDLE BEARING (INNER)
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
18 GEAR ASSEMBLY, 2ND SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0019-5LM60

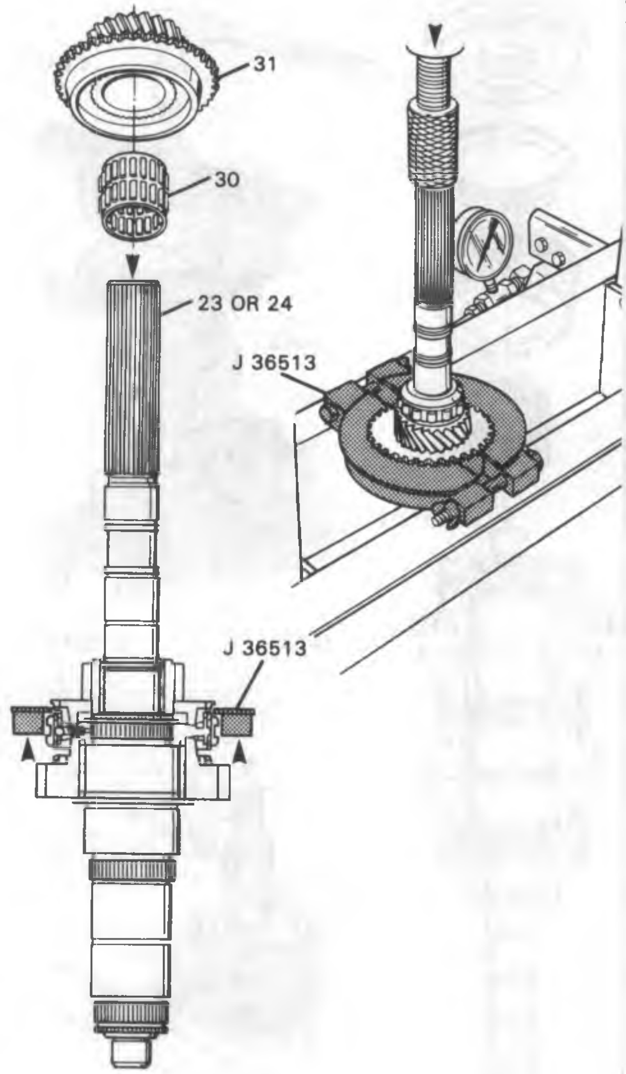
Figure 18 Removing 2nd Gear Components



2 RING, SYNCHRONIZER
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
19 SYNCHRONIZER ASSEMBLY, 1-2
22 GEAR, 1ST SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0020-5LM60

Figure 19 Removing 1st Gear Components



23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)
30 BEARING ASSEMBLY, 5TH SPEED GEAR NEEDLE (MG5)
31 GEAR ASSEMBLY, 5TH SPEED (MG5)

LH0021-5LM60

Figure 20 Removing 5th Gear Components

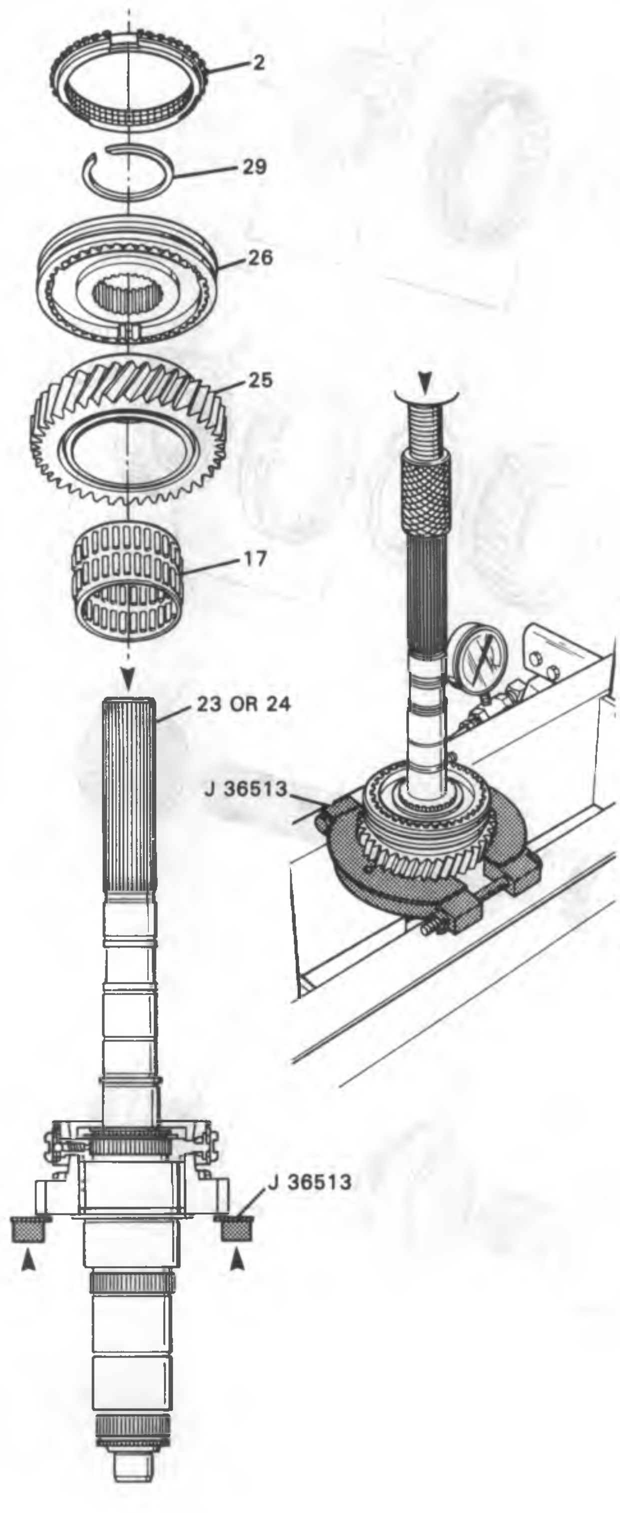


Figure 21 Removing Reverse Gear Components

Inspect

Figure 22

1. Gears for cracks, hicks/nicks, chipped gear teeth or high spots (a small shiny spot on the gear teeth mating surface) that could cause gear noise.
2. Related surfaces on the gears like thrust faces and bearing surface diameters.
3. Synchronizer sleeves for a sliding fit on the synchronizer hubs and for the hubs to have a force fit on the mainshaft splines. Replace the hub(s) if they do not require a force fit on the mainshaft.
4. Synchronizer springs and keys for damage.
5. Synchronizer rings for excess wear.
6. Synchronizer clutching teeth for wear, scuffed, nicked, burred or broken teeth.
7. Speed gear clutching cones for synchronizer ring metal transfer.
8. All gear teeth for excess wear.
   - The black phosphate coating will develop wear patterns, this is a normal condition.
9. Bearings and bearing surfaces for nicks, burrs, bent cages and wear.
10. Lubricate all bearings and check for rough rotation.
    - If scuffed, nicked, burred, scoring, or synchronizer ring metal transfer conditions cannot be removed with a soft stone or crocus cloth, replace the component and inspect mating parts.
    - Lubricate all components as assembly progresses. Use lubricant 5W-30 GM P/N 1052931 or equivalent.

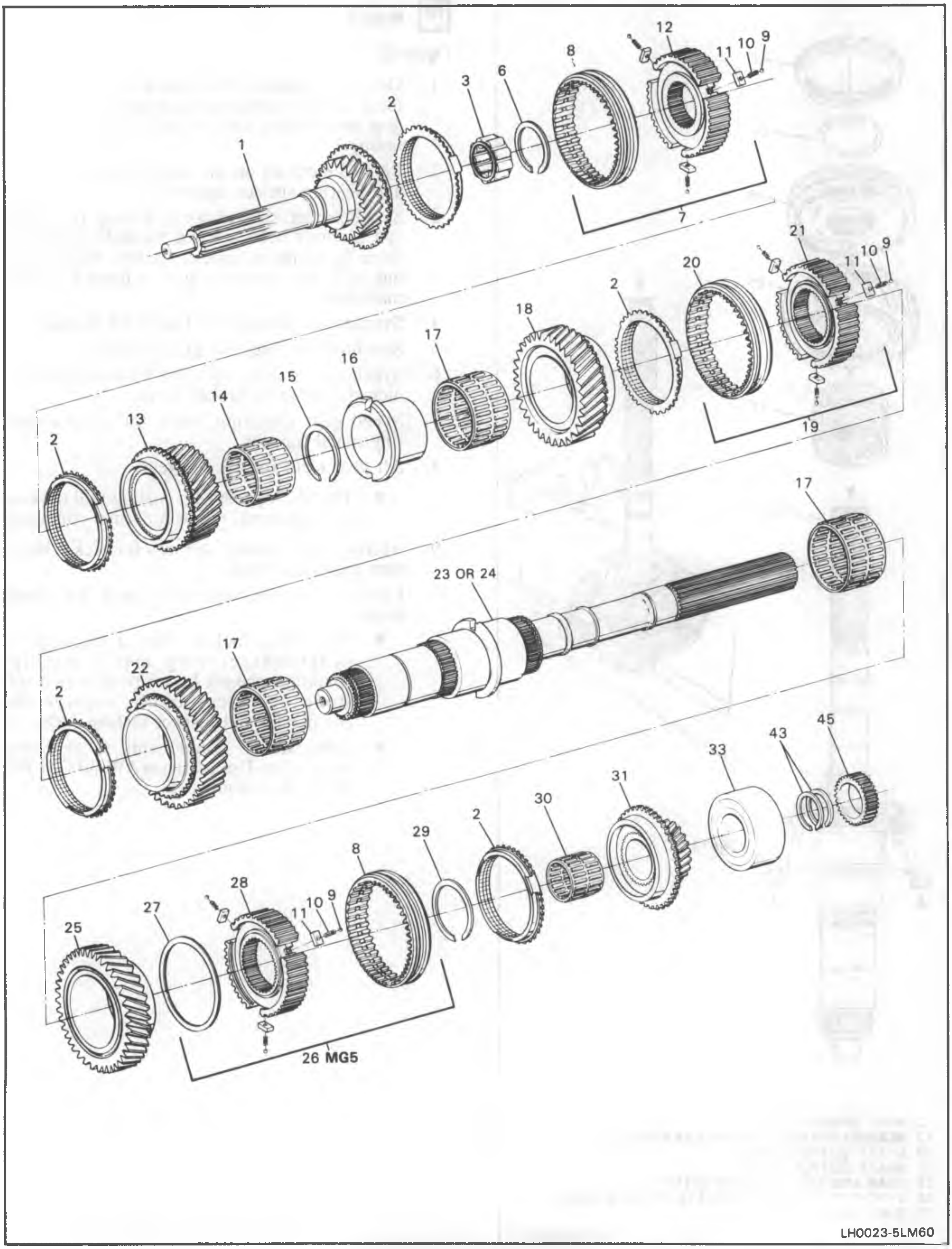


Figure 22 Main Shaft Components

1	SHAFT, INPUT
2	RING, SYNCHRONIZER
3	BEARING, PILOT
6	RING, SNAP (SELECTIVE)
7	SYNCHRONIZER ASSEMBLY, 3-4
8	SLEEVE, SYNCHRONIZER
9	BALL, SYNCHRONIZER DETENT
10	SPRING, SYNCHRONIZER DETENT
11	KEY, SYNCHRONIZER
12	HUB, 3-4 SYNCHRONIZER
13	GEAR ASSEMBLY, 3RD SPEED
14	BEARING ASSEMBLY, 3RD SPEED GEAR NEEDLE
15	RING, SNAP (SELECTIVE)
16	RACE, 2ND SPEED GEAR NEEDLE BFARING (INNER)
17	BEARING ASSEMBLY, SPEED GEAR NEEDLE
18	GEAR ASSEMBLY, 2ND SPEED
19	SYNCHRONIZER ASSEMBLY, 1-2
20	SLEEVE, 1-2 SYNCHRONIZER
21	HUB, 1-2 SYNCHRONIZER
22	GEAR, 1ST SPEED
23	SHAFT, OUTPUT (2WD)
24	SHAFT, OUTPUT (4WD)
25	GEAR ASSEMBLY, REVERSE SPEED
26	SYNCHRONIZER ASSEMBLY, 5TH-REVERSE
27	RING, SPIRAL LOCK
28	HUB, 5TH-REVERSE SYNCHRONIZER
29	RING, SNAP (SELECTIVE)
30	BEARING ASSEMBLY, 5TH SPEED GEAR NEEDLE
31	GEAR ASSEMBLY, 5TH SPEED
33	BEARING ASSEMBLY, OUTPUT SHAFT
43	RING, SNAP
45	ROTOR, SPEED SENSOR

LH0024-5LM60

Figure 23 Main Shaft Components Legend

Assemble

Important

- The assembly of some components will require use of an assembly lube. It is recommended that TRANSJEL ™ J 36850 or equivalent be used during assembly.
- The following components will require heating prior to installation during assembly procedures.
  - — 7-10 minutes, 120° C (250° F).
    - race (34) and (36)
    - 2WD speed sensor rotor (45)
  - — 20 minutes MINIMUM, 120° C (250° F)
  - 2nd speed gear race (16)

1. Synchronizer assembly procedure (7), (19) and (26), (Figure 24).
2. Bearing assembly (17), reverse speed gear (25) (Figure 25).

Important

- When pressing the 5th-reverse synchronizer assembly (26):
  - — Manually align and engage splines.
  - — Press until seated.
  - — Be sure all shavings are removed.

3. 5th-Reverse synchronizer assembly (26) with synchronizer ring (2) using J 36183, J 36184, J 36513 and hydraulic press.
   - Check scribe marks for correct positions.
   - With spiral lock ring (27) towards reverse speed gear (25).
4. NEW snap ring (29).
5. Bearing assembly (30) and 5th speed gear (31) (Figure 26).
6. Bearing assembly (17) and 1st speed gear (22) (Figure 27).

Important

- When pressing the 1st-2nd synchronizer assembly (19):
  - — Manually align and engage splines.
  - — Start press operation, STOP before tangs engage.
  - — Lift and rotate gear (22), to engage synchronizer ring (2).
  - — Continue to press until seated.
  - — Be sure all shavings are removed.

7. 1-2 synchronizer assembly (19) with both synchronizer rings (2) using J 36183, J 36184, J 22912-01 and hydraulic press.
   - Check scribe marks for correct positions.

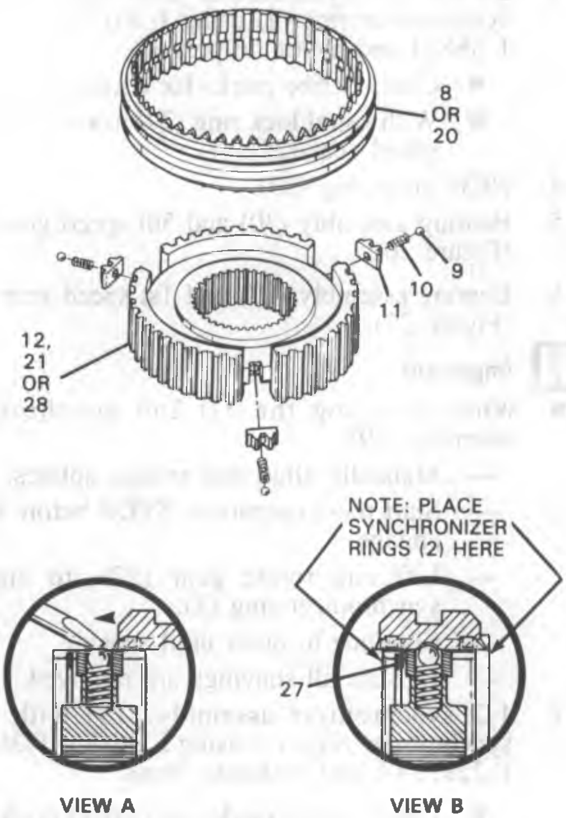
   Important

   - The groove on the outside of the sleeve MUST GO TOWARDS THE 2ND SPEED GEAR to prevent gear clash during 1st and 2nd gear shifts (the teeth on the sleeve have different angles).
8. Bearing assembly (17) and 2nd speed gear (18) (Figure 28).
   - Make sure bearing cage is together.
9. 2nd gear race (16) HEATED using J 36183, J 36184, J 22912-01 and hydraulic press.
10. NEW snap ring (15)
11. Bearing assembly (14) and 3rd speed gear (13) (Figure 29).

Important

- When pressing the 3rd-4th synchronizer assembly (7):
  - — Manually align and engage splines.
  - — Start press operation, STOP before tangs engage.
  - — Lift and rotate gear (13), to engage synchronizer ring (2).
  - — Continue to press until seated.
  - — Be sure all shavings are removed.

12. 3-4 synchronizer assembly (7) with both synchronizer rings (2) using J 36183, J 36184, J 22912-01 and hydraulic press.
13. NEW snap ring (6)



8 SLEEVE, SYNCHRONIZER
9 BALL, SYNCHRONIZER DETENT
10 SPRING, SYNCHRONIZER DETENT
11 KEY, SYNCHRONIZER
12 HUB, 3-4 SYNCHRONIZER
20 SLEEVE, 1-2 SYNCHRONIZER
21 HUB, 1-2 SYNCHRONIZER
27 RING, SPIRAL LOCK (5TH-REVERSE ONLY)
28 HUB, 5TH-REVERSE SYNCHRONIZER

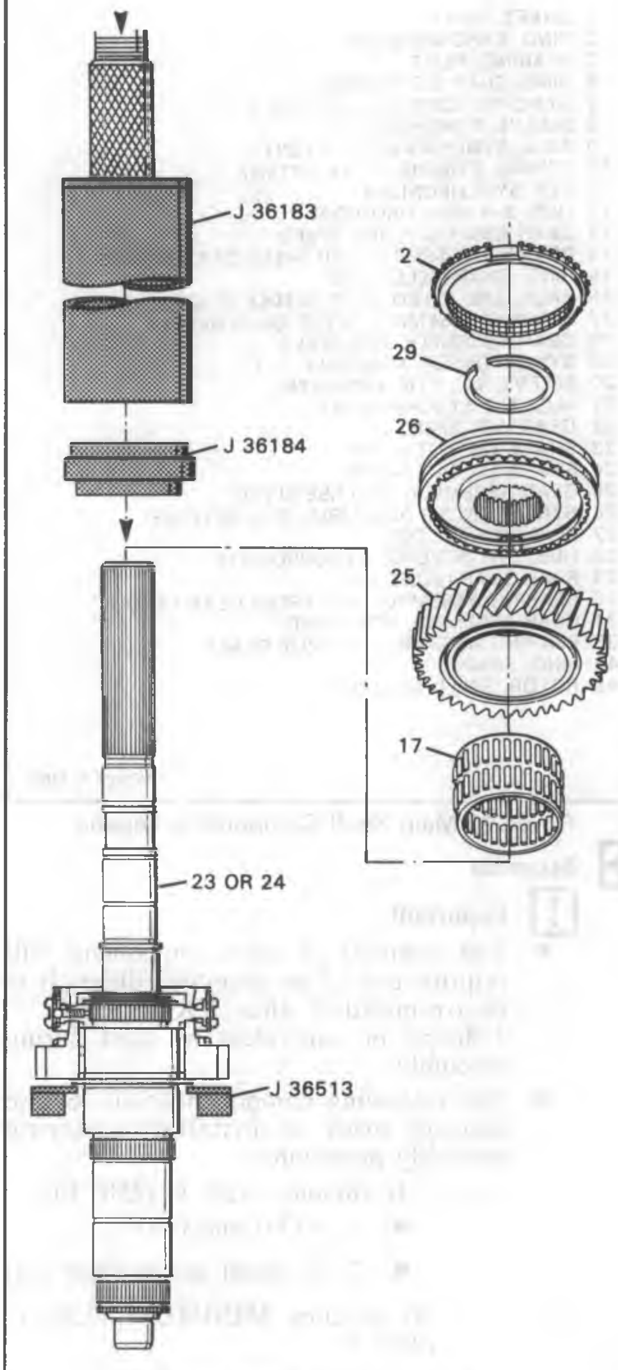
SYNCHRONIZER ASSEMBLY PROCEDURES

Install

1. Sleeve (8) (20), onto hub (12) (21) (28).
   - Check scribe marks for correct positions.
   - Remove spiral lock ring (27) for easier assembly (5th-Reverse only).
2. Spring (10) into key (11):
   - Assemble into the hub.
3. Position assembly as in View A.
4. Balls (9):
   - Push the ball into the sleeve using a screwdriver.
   - Push the sleeve (8) (20) down just enough to retain the ball (9).
   - Slide the sleeve up just enough to install each of the two remaining balls (one at a time).
5. Synchronizer rings (2):
   - Make sure synchronizer ring tangs line up with the keys.
6. Center the hub, keys and balls by pushing on the synchronizer rings, View B. Balls will "click" into position.
   - Install spiral lock ring (27) (5th-Reverse only).

LH0025-5LM60

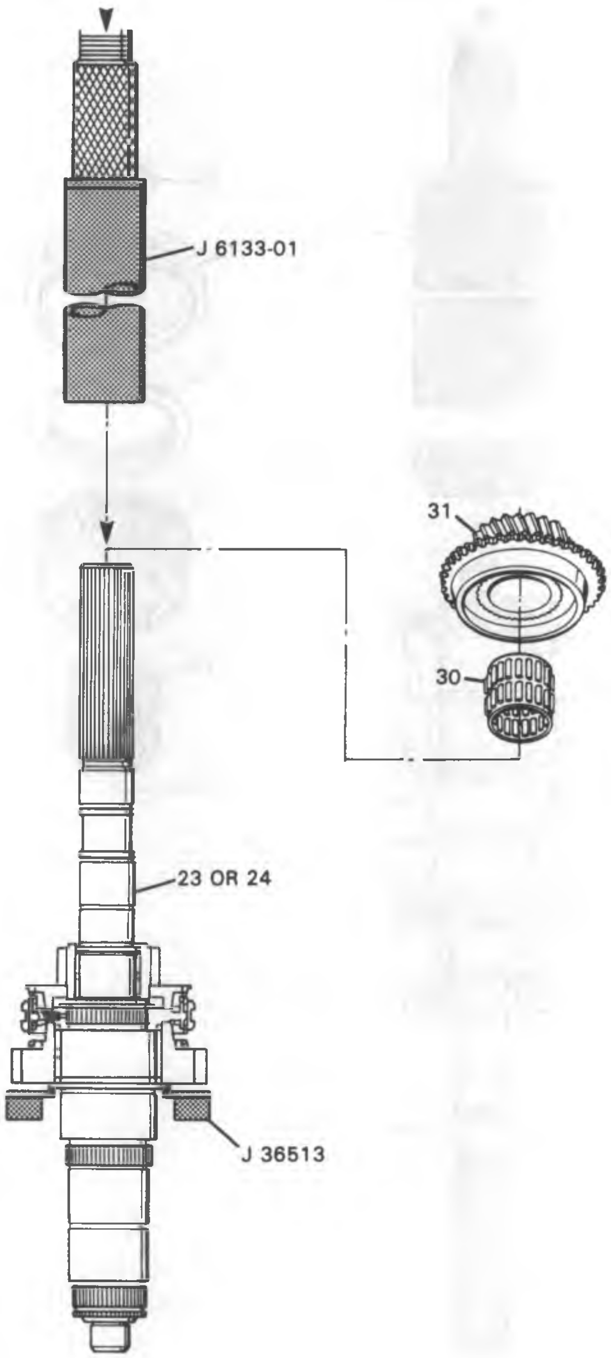
Figure 24 Synchronizer Assembly Procedure



2 RING, SYNCHRONIZER
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)
25 GEAR ASSEMBLY, REVERSE SPEED
26 SYNCHRONIZER ASSEMBLY, 5TH-REVERSE (MG5)
29 RING, SNAP

LH0026-5LM60

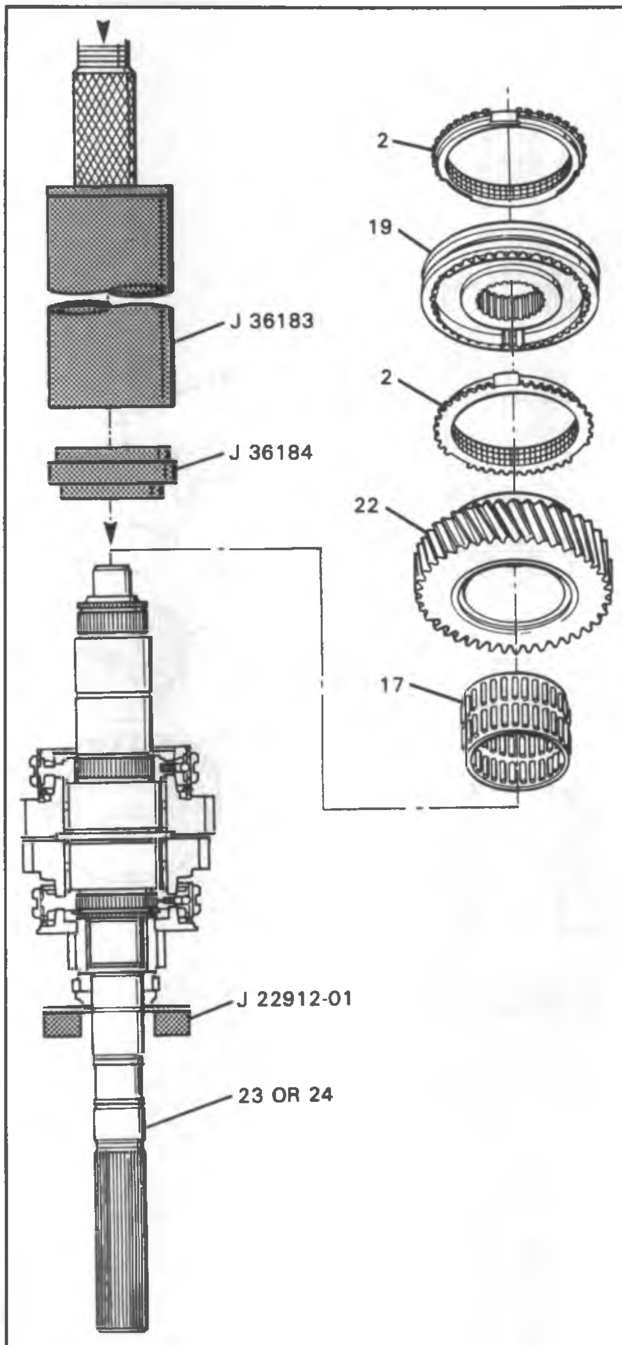
Figure 25 Reverse Gear Components Installed



23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)
30 BEARING ASSEMBLY, 5TH SPEED GEAR NEEDLE (MG5)
31 GEAR ASSEMBLY, 5TH SPEED (MG5)

LH0027-5LM60

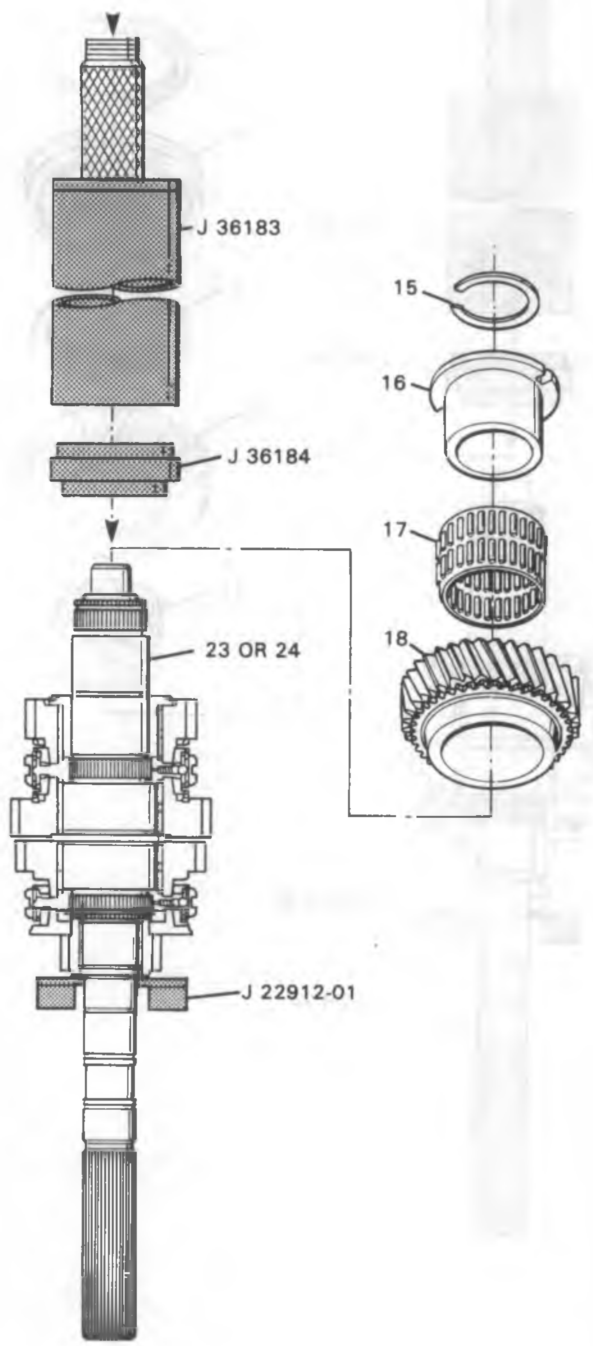
Figure 26 5th Gear Installed



2 RING, SYNCHRONIZER
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
19 SYNCHRONIZER ASSEMBLY, 1-2
22 GEAR, 1ST SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0028-5LM60

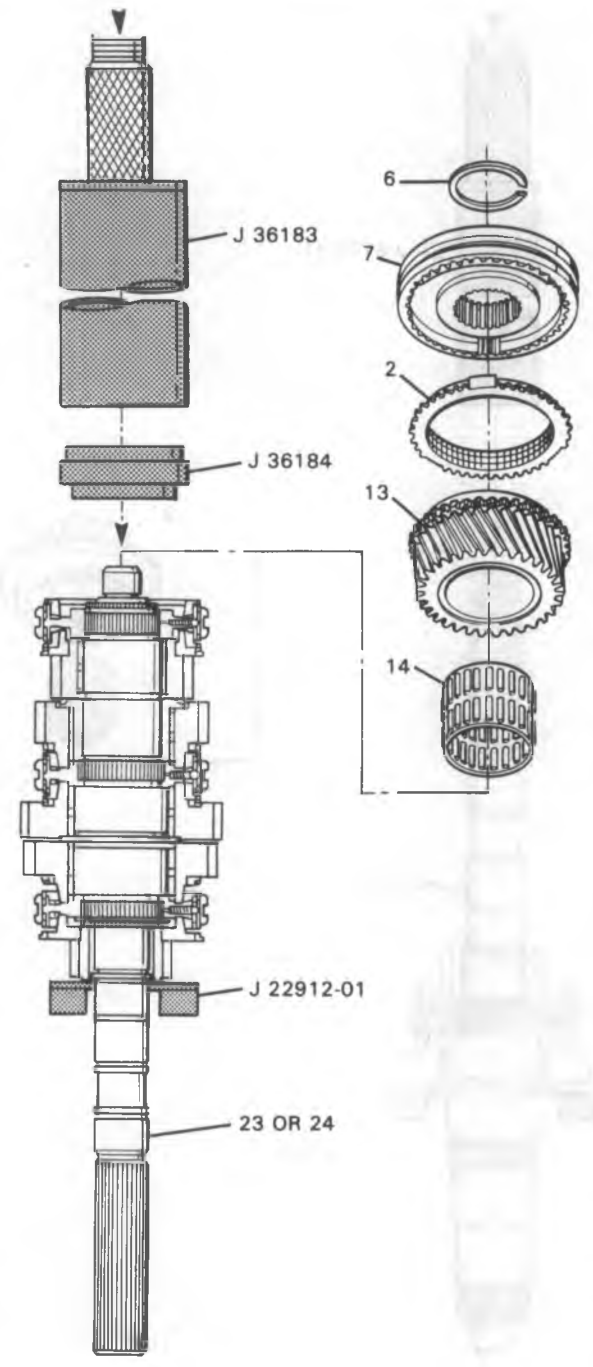
Figure 27 1st Gear and Components Installed



15 RING, SNAP
16 RACE, 2ND SPEED GEAR NEEDLE BEARING (INNER)
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
18 GEAR ASSEMBLY, 2ND SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0029-5LM60

Figure 28 2nd Gear and Components Installed



2 RING, SYNCHRONIZER
6 RING, SNAP
7 SYNCHRONIZER ASSEMBLY, 3-4
13 GEAR ASSEMBLY, 3RD SPEED
14 BEARING ASSEMBLY, 3RD SPEED GEAR NEEDLE
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

LH0030-5LM60

Figure 29 3rd Gear and Components Installed

COUNTERSHAFT INSPECTION

Clean

- All parts in a suitable solvent and air dry.

Inspect

Figure 30

1. Shaft (53), for cracks, replace if these conditions exist.
2. Gear teeth (53) for scuffed, nicked, burred, broken teeth or high spots (a small shiny spot on the gear teeth mating surface) that could cause gear noise.
3. Bearings (203) for roughness of rotation, burred or pitted condition, replace if these conditions exist (Figure 81).
4. Bearing races (202) for scoring, wear or overheating (Figure 81).

Important

- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.
- Fifth gear CANNOT be pressed off the countershaft assembly (53), replace as an assembly only.

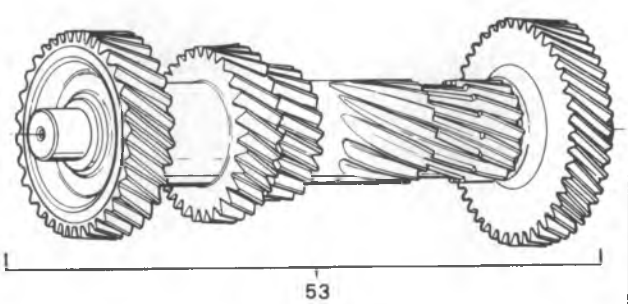


Figure 30 Countershaft

DISASSEMBLY AND ASSEMBLY OF REVERSE IDLER GEAR

Disassemble

Figure 31

1. Snap ring (47).
2. Thrust washer (48).
3. Reverse gear (49).
4. Bearing assembly (50).

Clean

- All parts in a suitable solvent and air dry.

Inspect

1. Gear teeth (49), for scuffed, nicked, burred, broken teeth or high spots (a small shiny spot on the gear teeth mating surface) that could cause gear noise.
2. Bearing assembly (50) for roughness of rotation, burred or pitted condition and cage damage, replace if these conditions exist.
3. Shaft (51), for scoring, wear or overheating.

Important

- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.

Assemble

Figure 31

- Lubricate all components as assembly progresses. Use lubricant 5W-30 GM P/N 1052931 or equivalent.

1. Bearing assembly (50).
2. Reverse gear (49).
   - Extended part of the hub faces thrust washer.
3. Thrust washer (49).
4. NEW snap ring (47).

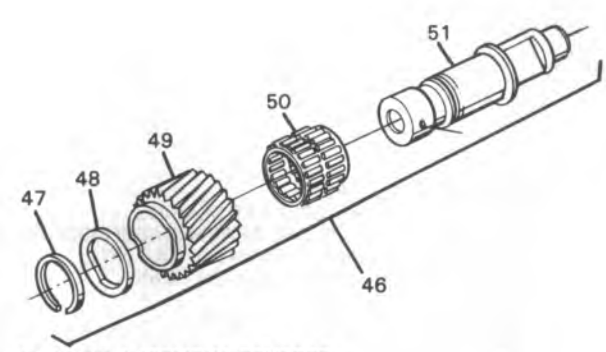


Figure 31 Reverse Idler Assembly

DISASSEMBLY AND ASSEMBLY OF FRONT HOUSING ASSEMBLY

Figure 32

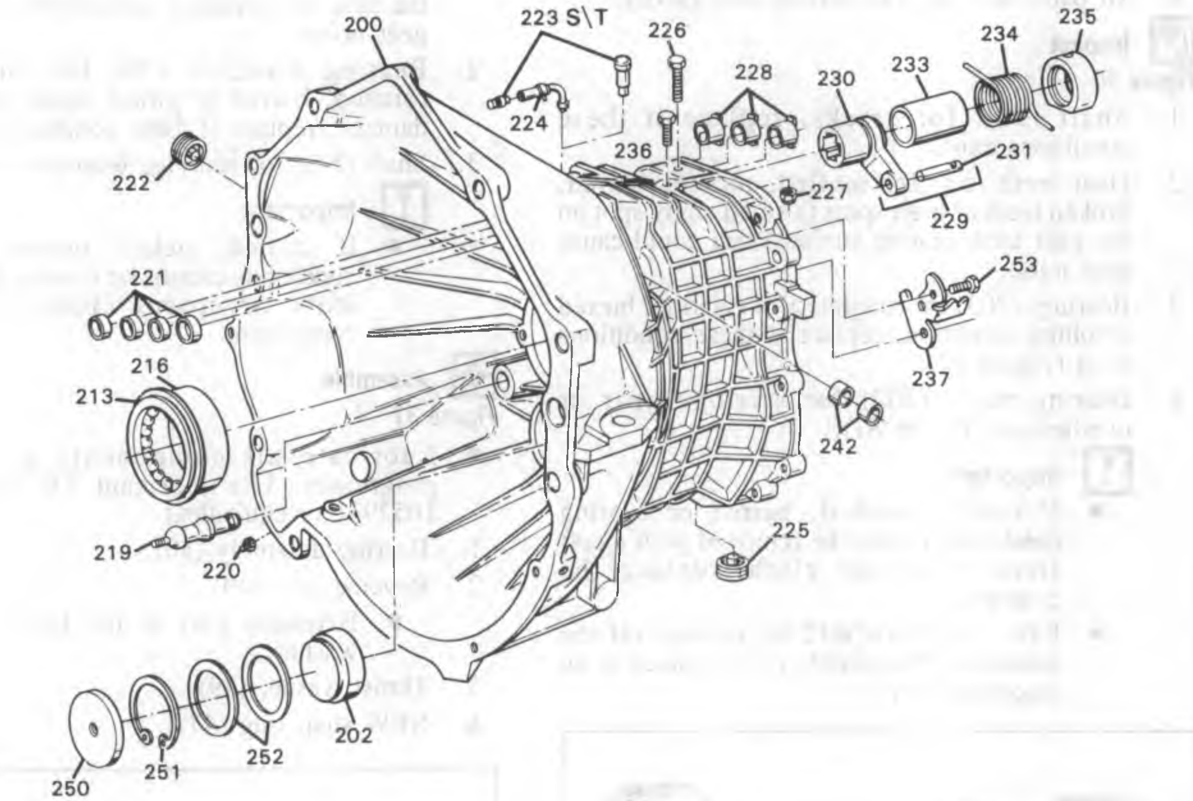
Tools Required:

J 6125-1B Slide Hammer

J 8092 Universal Drive Handle

J 36510 Clutch Fork Pivot Remover/Installer

J 36507 Detent Bushing Remover and Installer



200 HOUSING, FRONT
202 RACE, COUNTERSHAFT BEARING
213 RING, INPUT SHAFT BEARING ASSEMBLY SNAP
216 RACE, BEARING ASSEMBLY (OUTER)
219 PIVOT ASSEMBLY, CLUTCH FORK
220 FITTING, LUBE
221 PLUG, SHIFT SHAFT/RAILS
222 PLUG, OIL FILL
223 BREATHER ASSEMBLY
224 ADAPTER, BREATHER HOSE
225 PLUG, OIL DRAIN
226 BOLT, HEX HEAD (M10 X 25.4mm)
227 NUT, LOCK
228 BEARING, SHIFT RAIL FRONT HOUSING
229 LEVER ASSEMBLY, SHIFT SHAFT (230 & 231)
230 LEVER, SHIFT SHAFT
231 PIN, SHIFT SHAFT LEVER
233 SLEEVE, BIAS SPRING
234 SPRING, BIAS LOAD TORSIONAL
235 SEAT, BIAS SPRING & SLEEVE
237 SUPPORT, 5TH & REVERSE DETENT CAM
242 BUSHING, DETENT PLUNGER
250 PLUG, COUNTERSHAFT BEARING
251 RING, SNAP
252 SHIM(S)
253 BOLT, PAN HEAD (M6 X 18mm)

LH0033-5LM60

Figure 32 Front Housing Components

Drill Bit 5/16 in.
3/8-16 in. Tap
J 36800 Shift Rail Bushing Remover
J 36506 Reverse Detent Bushing Remover and Installer
J 23907 Slide Hammer
J 36511 Oil Fill Plug Hex Bit (17mm)
J 36799 Countershaft Bearing Race Shimming Tool
J 36190 Drive handle

Disassemble

1. Ball bearing outer race (216), using brass drift.
2. Three shift rail front housing bearings (228), using J 36800 and J 23907 (Figure 33).

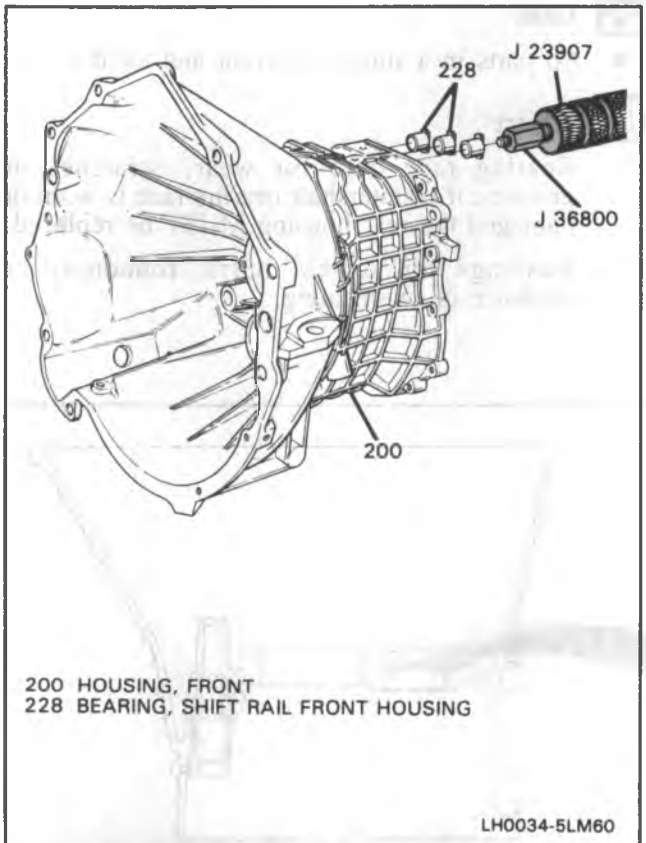


Figure 33 Removing Shift Rail Bearings

3. Clutch fork pivot assembly (219), using J 36510 and J 6125-1B (Figure 34).
   - Put an additional nut (with threads of 3/8-16 in.) into J 36510 and thread J 6125-1B into nut.
   - Tighten both nuts.
   - Slide hammer out pivot.
4. Shift shaft/rails plugs (221)
   - Use a punch to drive the plugs out.
5. Countershaft bearing plug (250) (Figure 35).
   - Remove staking.
   - Drill hole through plug (250) with 5/16 in. drill bit.
   - Tap using 3/8-16 in. tap.
   - Screw slide hammer J 6125-1B into the plug.
   - Remove the plug.

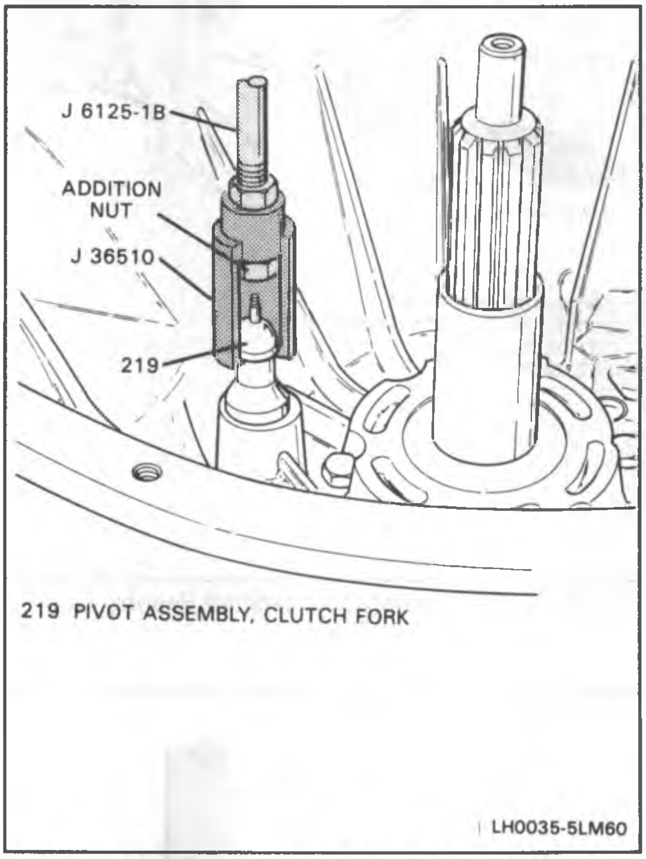


Figure 34 Removing Clutch Fork Pivot Assembly

6. Snap ring (251), shim(s) (252) and countershaft bearing race (202) using J 36799 and J 8092.

Important

- When countershaft bearing race (202) is removed refer to COUNTERSHAFT ENDPLAY ADJUSTMENT.

Measure

The countershaft bearing race bore in two places diagonally, 4mm (0.157 in.) in from the inside of the transmission housing. Replace the housing if the bore is not within 51.946 to 51.965mm (2.045 to 2.046 in.) (Figure 36).

- Release tension of bias spring (234) from the end of the shift shaft lever pin (231) using a screwdriver.

CAUTION: Spring is under high tension.

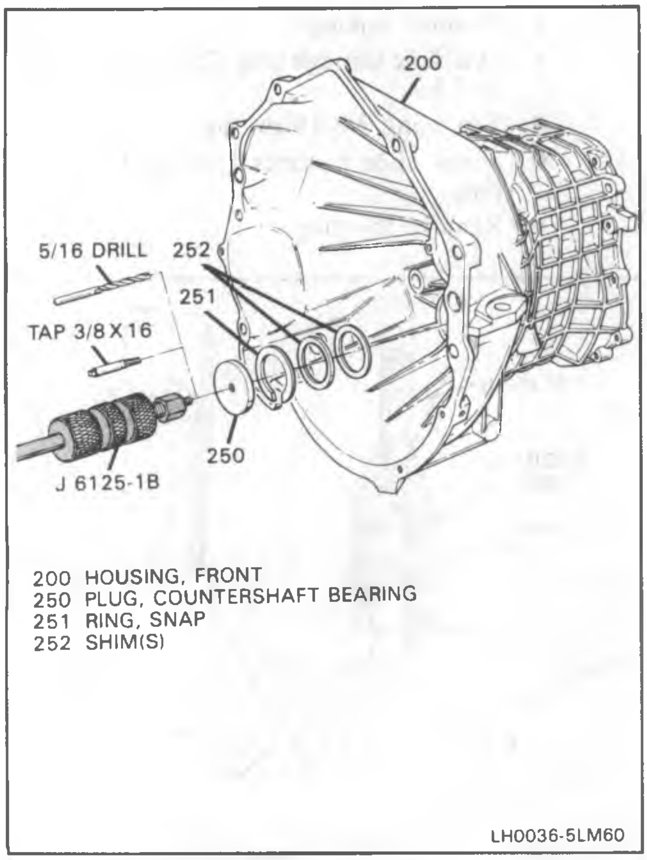


Figure 35 Removing Countershaft Bearing Plug

7. Bolt (236) bias spring and sleeve seat (235), bias load torsional spring (234), bias spring sleeve (233), and shift shaft lever assembly (229) (Figure 37).
8. Bolt (204), detent cam support (237).
9. Two detent plunger bushings (242), using J 36507 (Figure 38).
   - Remove ONE bushing at a time.
10. Breather assembly (223).
    - DO NOT REMOVE metal tube from case.
11. Oil fill plug (222) and oil drain plug (225), using J 36511 (Figure 39).
12. Gasket material from the case using liquid gasket remover.

Clean

- All parts in a suitable solvent and air dry.

Inspect

1. Bearing race bore for wear, scratches or grooves; if countershaft bearing race is worn or damaged the rear housing MUST be replaced.
2. Bushings for scores, burrs, roundness or evidence of overheating;

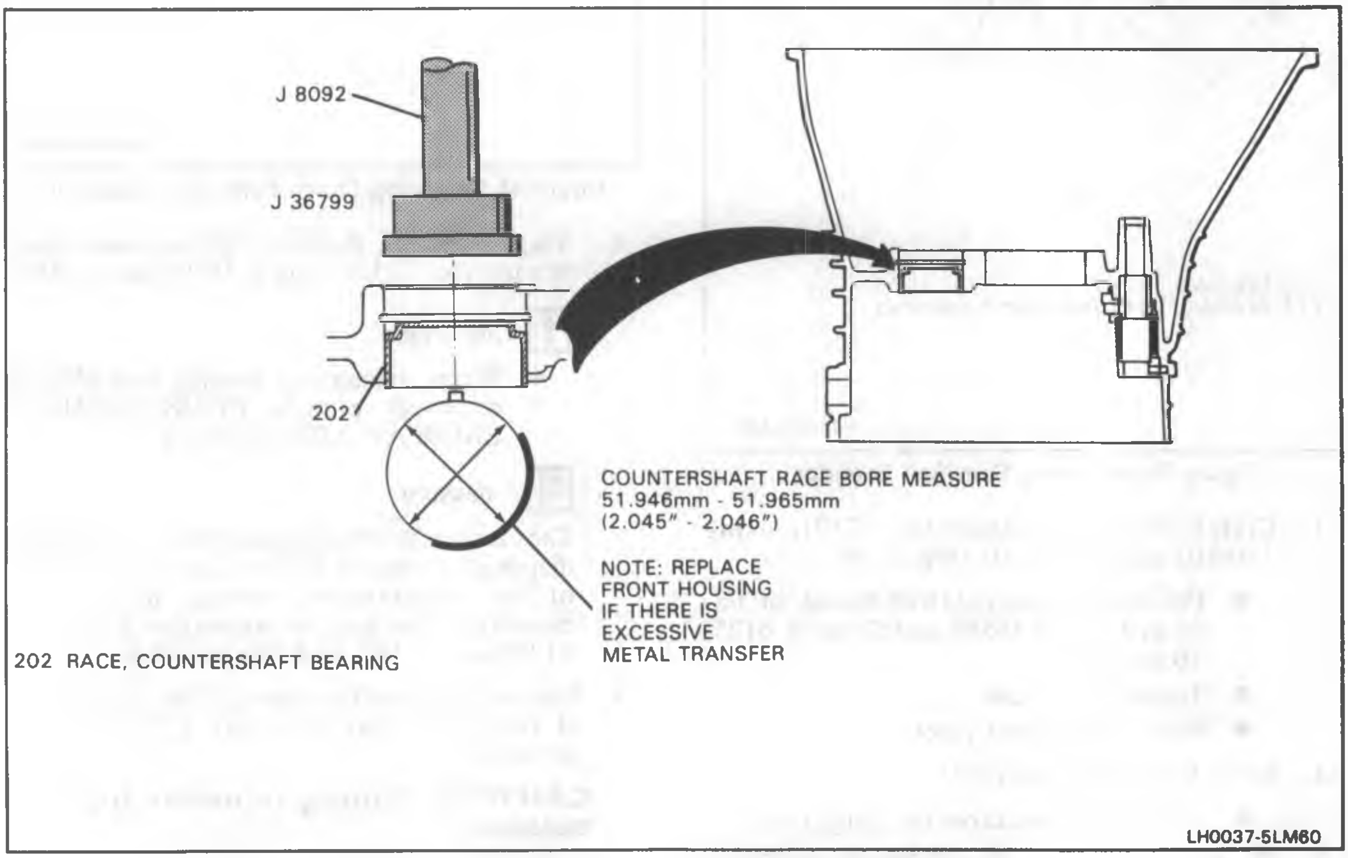


Figure 36 Countershaft Bearing Race Bore

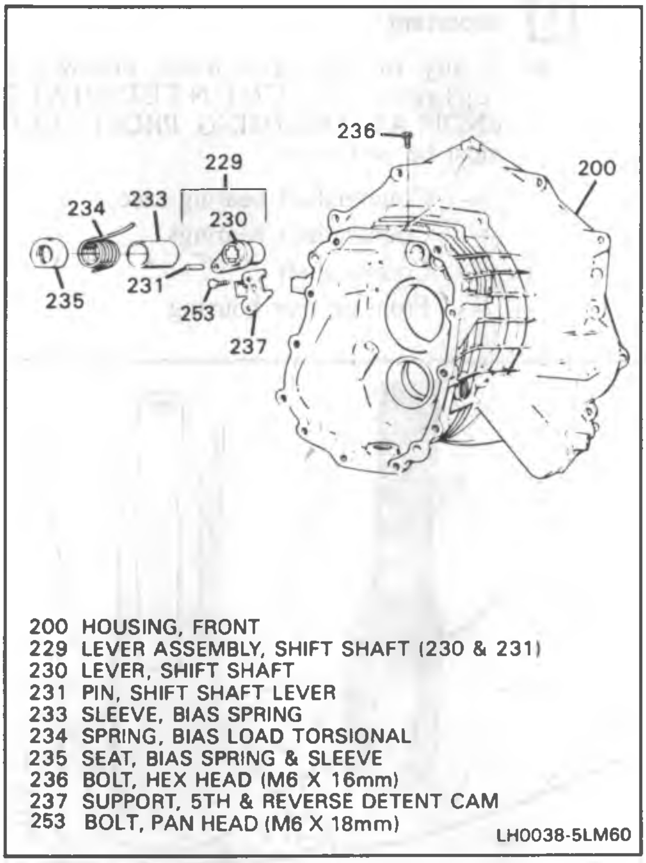


Figure 37 Removing Bias Spring Components

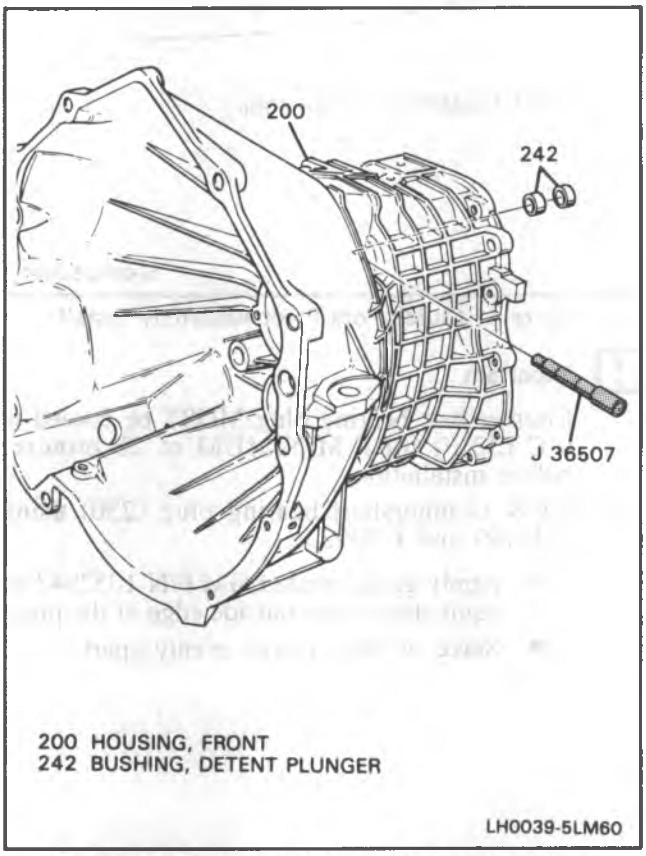


Figure 38 Removing Detent Plunger Bushings

3. Case for cracks, threaded opening for damaged threads, mounting faces for nicks, burrs, or scratches; if case is cracked, it must be replaced.
4. Machined mating surfaces for flatness, check with a straight edge.

Important

- If scratches, grooves or scoring cannot be removed with a soft stone or crocus cloth, replace the component.
- Clean-up damaged threads with correct size tap.

Assemble

Important

- The following component will require cooling prior to installation during assembly procedures.
- 20 minutes MINIMUM, 0°C (32°F).
  — countershaft bearing plug (250). (If removed)

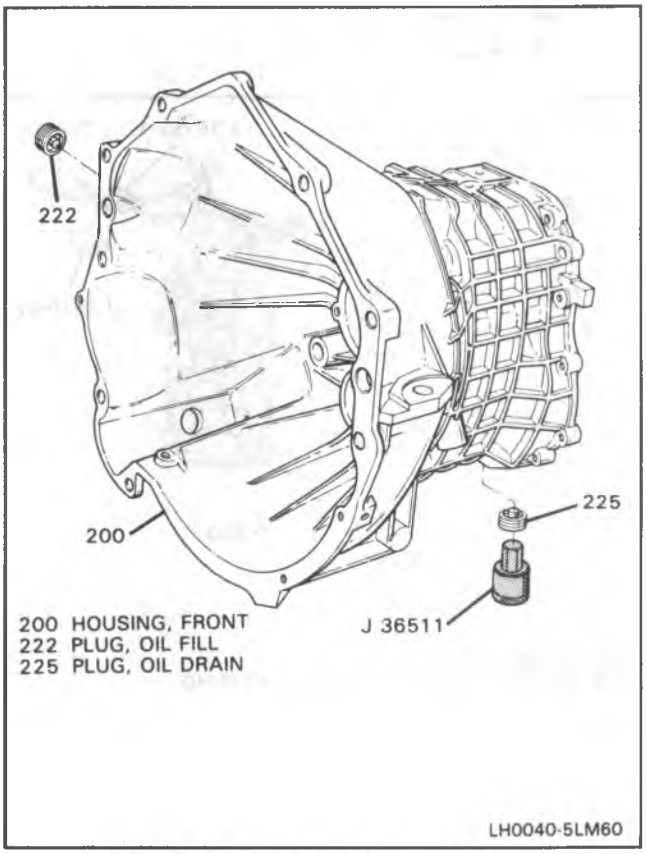


Figure 39 Removing Drain/Fill Plugs

1. Ball bearing outer race (216), using brass drift.
   - Put a shop towel over the bearing during installation.
2. Three shift rail front housing bearings (228), using J 36798-1 and J 36190 (Figure 40).

- Install flush and stake using J 36798-2, J 36798-1 and J 36190.
- DO NOT STAKE the tabs on the bushings.

3. Clutch fork pivot assembly (219), using J 36510 and J 36190 (Figure 41).
   - Grease after installation through lube fitting (220).
4. Two detent plunger bushings (242), using J 36507 (Figure 42).
   - Install one at a time.
   - Install the first bushing till the second scribe mark on the tool lines up with the housing.
   - Install the second bushing till the first scribe mark on the tool lines up with the housing.
5. Countershaft bearing race (202) using J 36799 and J 8092 (Figure 43).
   - Align lube slot in race with groove in the housing.
   - Shim(s) (252).
   - Snap ring (251).

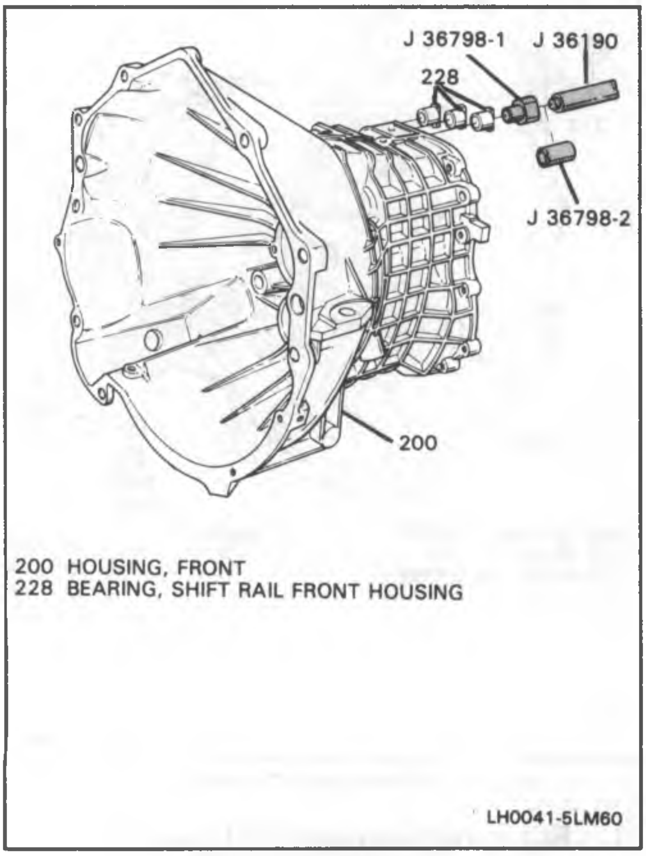


Figure 40 Shift Rail Bearings Install

Important

- If any of the parts listed below are replaced the COUNTERSHAFT ENDPLAY SHIMMING PROCEDURE must be performed:
  - — Countershaft bearing race
  - — Countershaft bearings
  - — Countershaft
  - — Front or rear housing

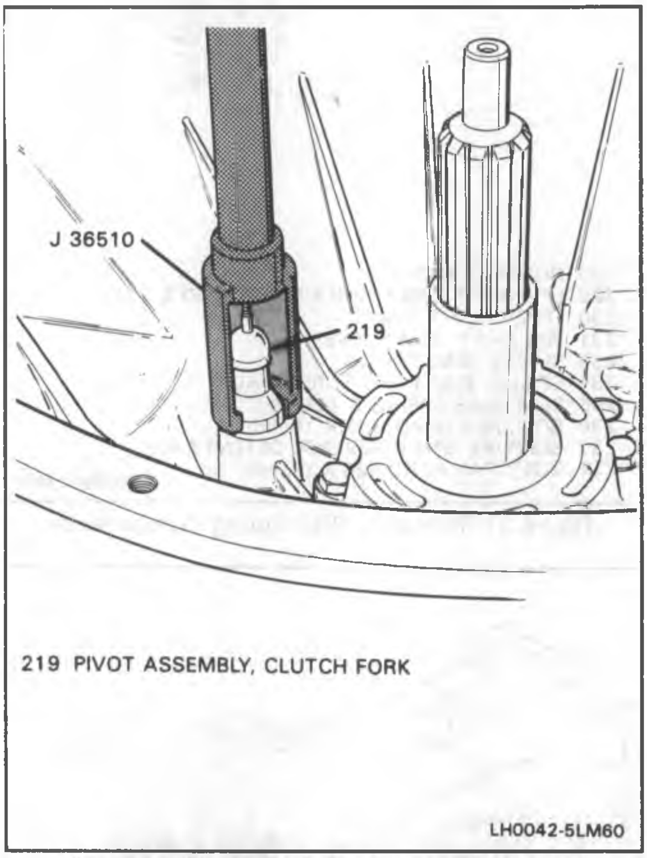


Figure 41 Clutch Fork Pivot Assembly Install

Important

Countershaft bearing plug MUST be cooled at 0°C (32°F) for a MINIMUM of 20 minutes before installation.

6. NEW Countershaft bearing plug (250) using J 36799 and J 8092.
   - Apply gasket maker GM P/N 1052943 or equivalent to the outside edge of the plug.
   - Stake in three places evenly apart.

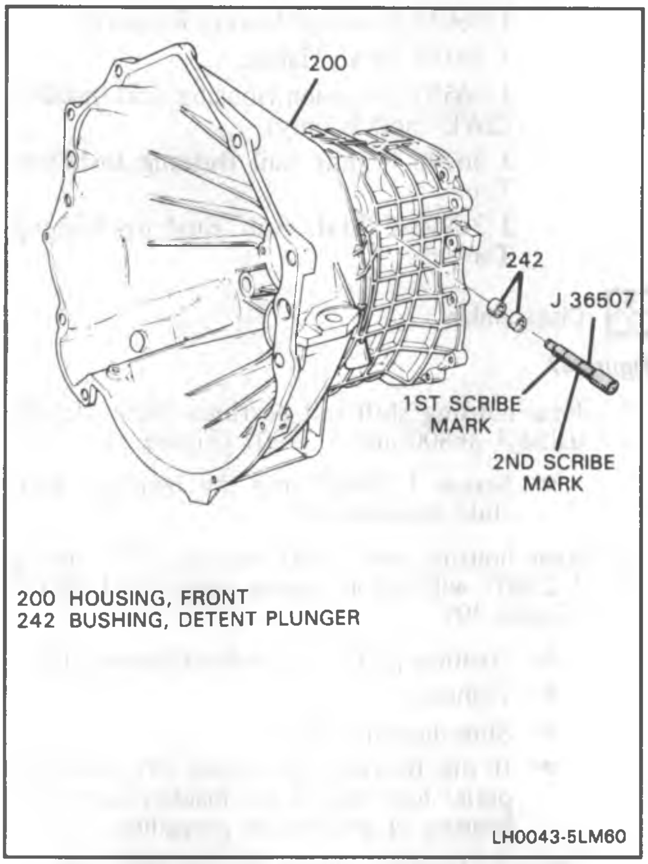


Figure 42 Detent Plunger Bushings Install

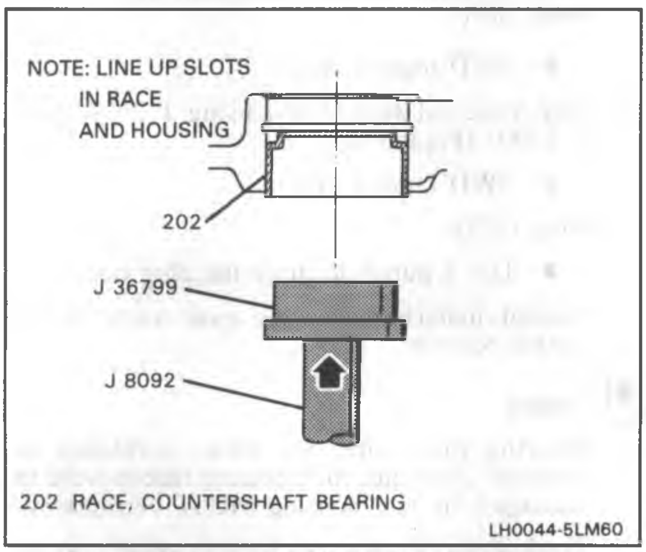


Figure 43 Countershaft Bearing Race Install

7. Detent cam support (237) and bolt (236) (Figure 44).

Tighten

- Bolt (236) to 8.5 N·m (76 lb. in.)

8. Shift shaft lever assembly (229) and into housing (Figure 45).

9. Bias spring sleeve (223), bias load torsional spring (234), bias spring and sleeve seat (235) and bolt (204).

Tighten

- Bolt (204) to 12 N·m (107 lb. in.).

10. Bias load torsional spring (235) end back onto the shift shaft lever pin (231).

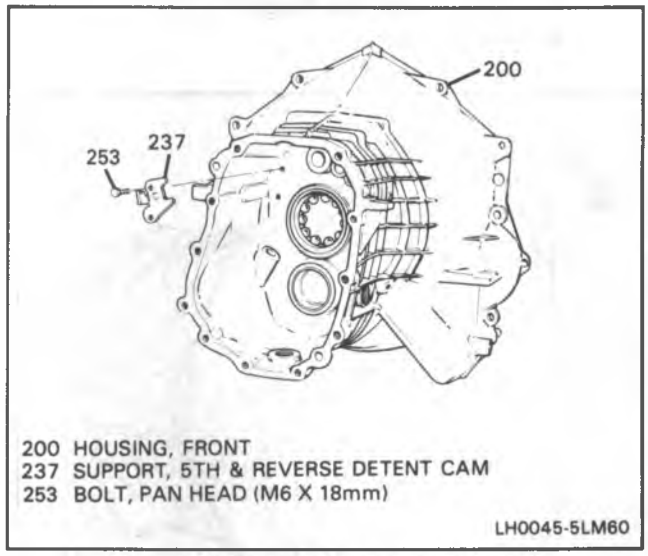


Figure 44 Detent Components Install

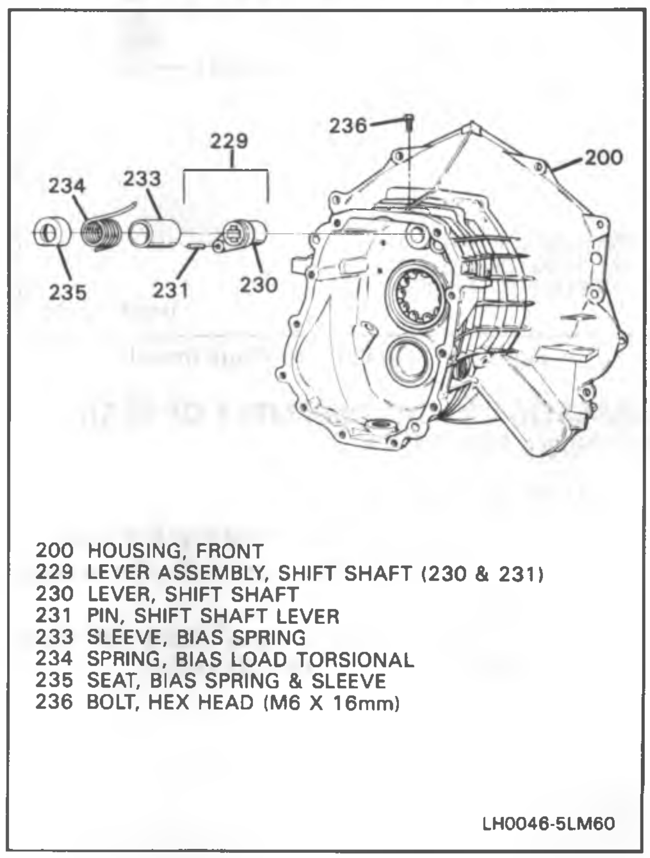


Figure 45 Bias Spring Components Install

11. Breather assembly (223).
12. Oil fill plug (222) and oil drain plug (225), using J 36511 torque drain plug to 60 N·m (44 lb. ft.) (Figure 46).
    - Apply pipe sealant with Teflon™ GM P/N 1050280 or equivalent to the threads.
13. Shift shaft/rails plugs (221)
    - Apply gasket maker GM P/N 1052943 to the edge of the plugs.
    - Install flush

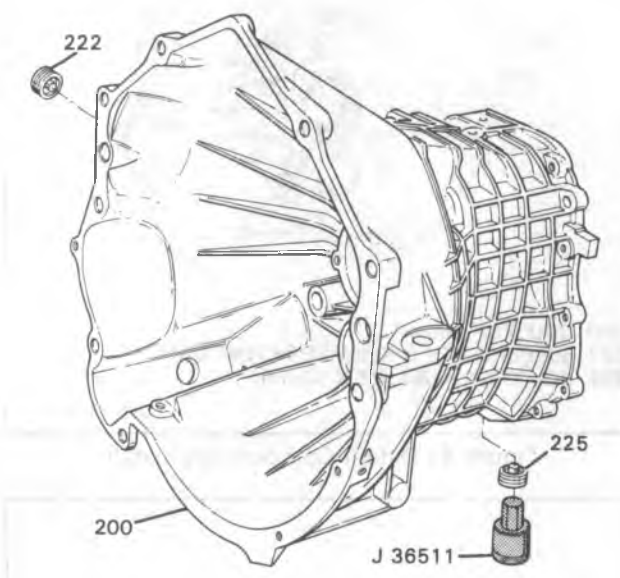


Figure 46 Oil Fill/Drain Plugs Install

DISASSEMBLY AND ASSEMBLY OF REAR HOUSING ASSEMBLY

Tools Required:

J 36800 Shift Rail Bushing Remover

J 23907 Slide Hammer with pilot bearing puller

J 26941 2WD Output Shaft Oil Seal Remover (2WD models only)

J 36032 Bushing/Bearing Remover

J 36190 Drive Handle

J 36503 Extension Housing Seal Installer (2WD models only)

J 36798-1 Shift Rail Bushing Installing Tool

J 36798-2 Shift Rail Bushing Staking Tool

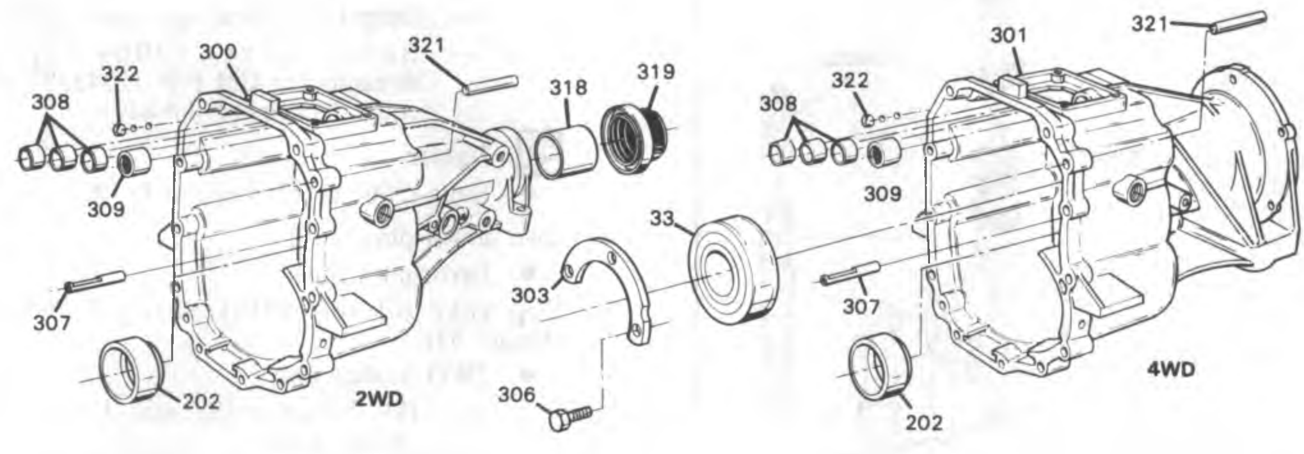
Disassemble

Figure 47

1. Rear housing shift rail bearings (308) (three), using J 36800 and J 23907 (Figure 48).
    - Screw J 36800 into the bearing, then slide hammer out.
2. Rear housing shift shaft bearing (309), using J 23907 with pilot bearing puller or J 36032 (Figure 49).
    - Position puller legs behind bearing lip.
    - Tighten.
    - Slide hammer out.
    - If the bearing lip breaks off, position puller legs behind the inside (outer end) bearing lip and repeat procedure.
3. Three bolts (306), output shaft bearing retainer (303) (4WD), bearing assembly (33), using brass drift.
    - 4WD models only.
4. Slip yoke oil seal (319), using J 26941 and J 23907 (Figure 50).
    - 2WD models only.
5. Plug (322).
    - Use a punch to drive the plug out.
6. Gasket material from the case using liquid gasket remover.

Inspect

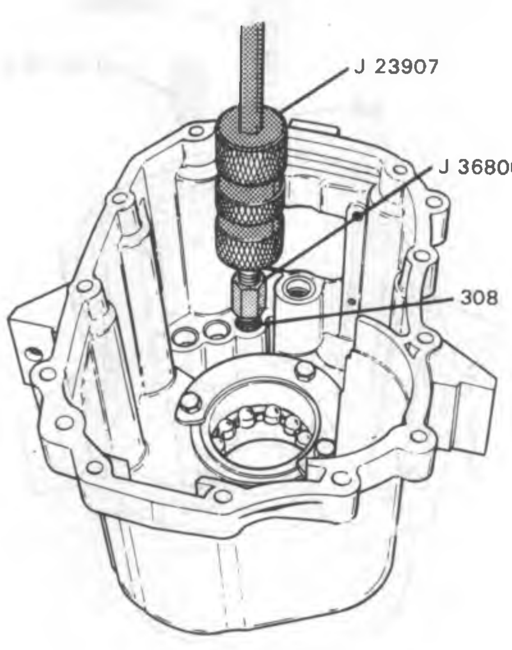
1. Bearing race bore, for wear, scratches or grooves; if counter shaft bearing race is worn or damaged the rear housing MUST be replaced.
2. Bushings, for scores, burrs, roundness or evidence of overheating; 2WD output shaft bushing (318) cannot be serviced, replace the rear housing (300) (no service for bushing).



33 BEARING ASSEMBLY, OUTPUT SHAFT
202 RACE, COUNTERSHAFT BEARING
300 HOUSING, REAR (2WD)
301 HOUSING, REAR (4WD)
303 RETAINER, OUTPUT SHAFT BEARING (4WD)
306 BOLT, HEX HEAD (M8 X 25mm) (4WD)
307 TUBE ASSEMBLY, OIL DELIVERY
308 BEARING, REAR HOUSING SHIFT RAIL
309 BEARING, REAR HOUSING SHIFT SHAFT
318 BEARING, REAR EXTENSION (2WD)
319 SEAL, SLIP YOKE OIL (2WD)
321 PIN, DOWEL
322 PLUG

LH0048-5LM60

Figure 47 Rear Housing Components



308 BEARING, REAR HOUSING SHIFT RAIL

LH0049-5LM60

Figure 48 Removing Shift Rail Bearing

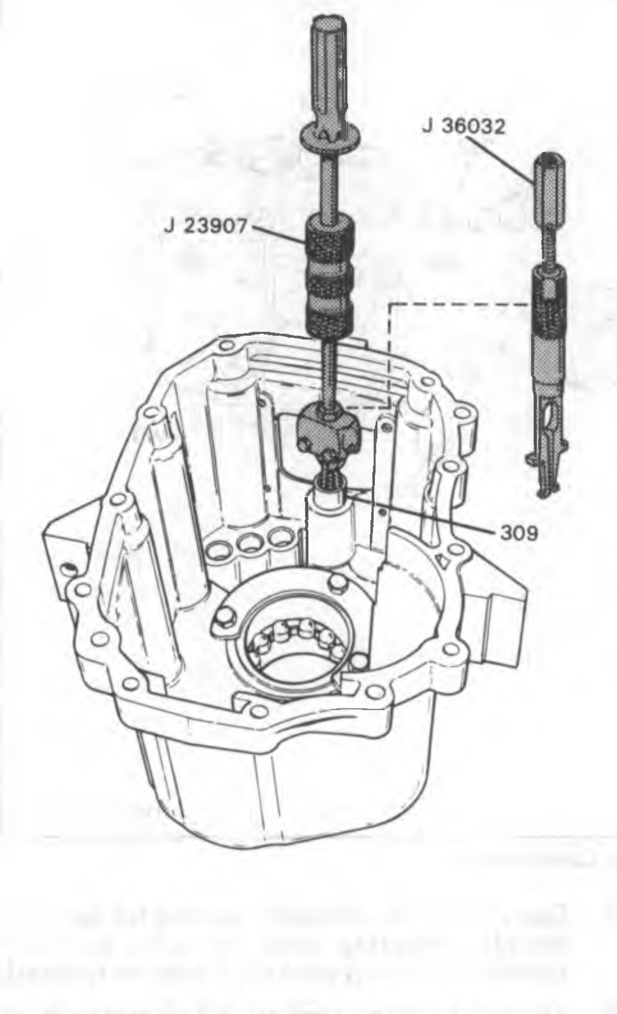
3. Case, for cracks, threaded opening for damaged threads, mounting faces for nicks, burrs, or scratches; if case is cracked, it must be replaced.
4. Machined mating surfaces for flatness, check with a straight edge.

Important

- If scratches, grooves or scoring cannot be removed with a soft stone or crocus cloth, replace the component.
- Clean-up damaged threads with correct size tap.

Assemble

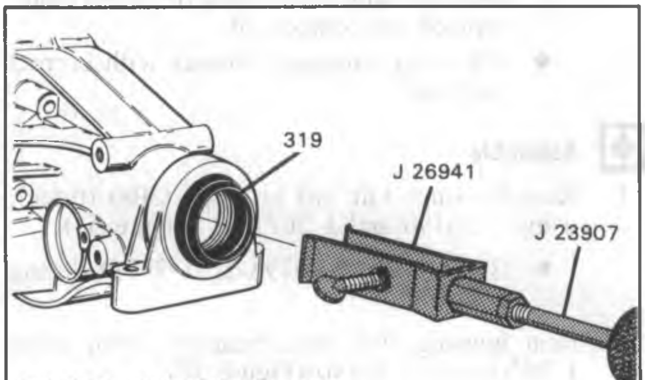
1. Rear housing shift rail bearings (308) (three), using J 36190 and J 36798-1 (Figure 51).
   - Stake with J 36798-2, J 36798-1 and J 36190.
2. Rear housing shift shaft bearing (309), using J 36505 and J 36190 (Figure 52).
   - Install bearing into bore so that the writing on bearing lip faces down.
   - Install flush.



309 BEARING, REAR HOUSING SHIFT SHAFT

LH0050-5LM60

Figure 49 Removing Shift Shaft Bearing



319 SEAL, SLIP YOKE OIL (2WD)

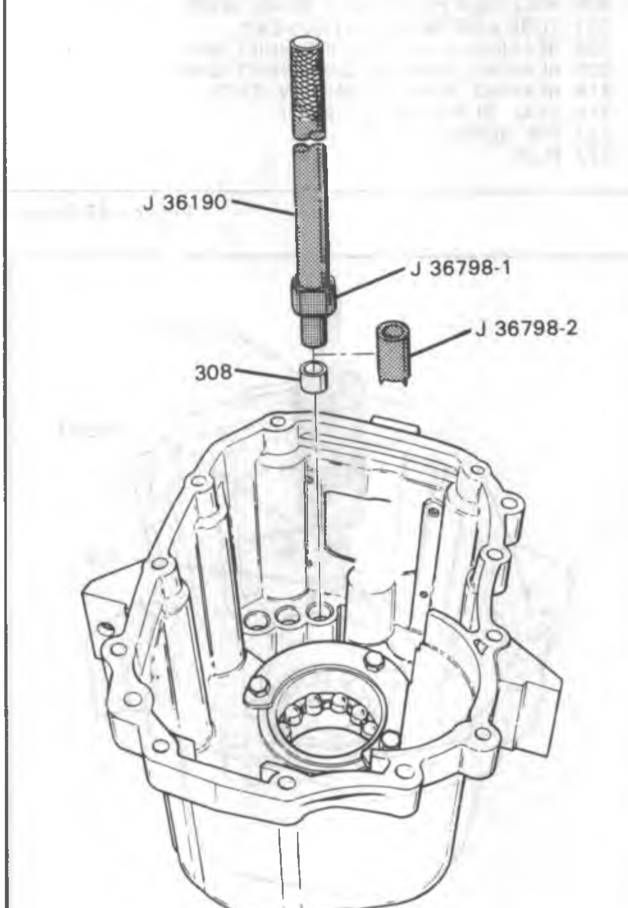
LH0051-5LM60

Figure 50 Removing 2WD Slip Yoke Oil Seal

3. Bearing assembly (33), using brass drift.
   - 4WD models only
     - — Output shaft bearing retainer (303).
     - — Bolts (three) (306) apply threadlocker GM P/N 12345382 or equivalent to the threads.

Tighten
   - Bolts (306) to 22 N·m (16 lb. ft.).

4. Two dowel pins (321).
   - Drive until flush.
5. Slip yoke oil seal (319), using J 36503 (Figure 53).
   - 2WD models only.
     - — Fill between the seal lips with chassis grease
6. Plug (322).
   - Apply gasket maker GM P/N 1052943 or equivalent around the edge of the plug.



308 BEARING, REAR HOUSING SHIFT RAIL

LH0052-5LM60

Figure 51 Shift Rail Bearings Install

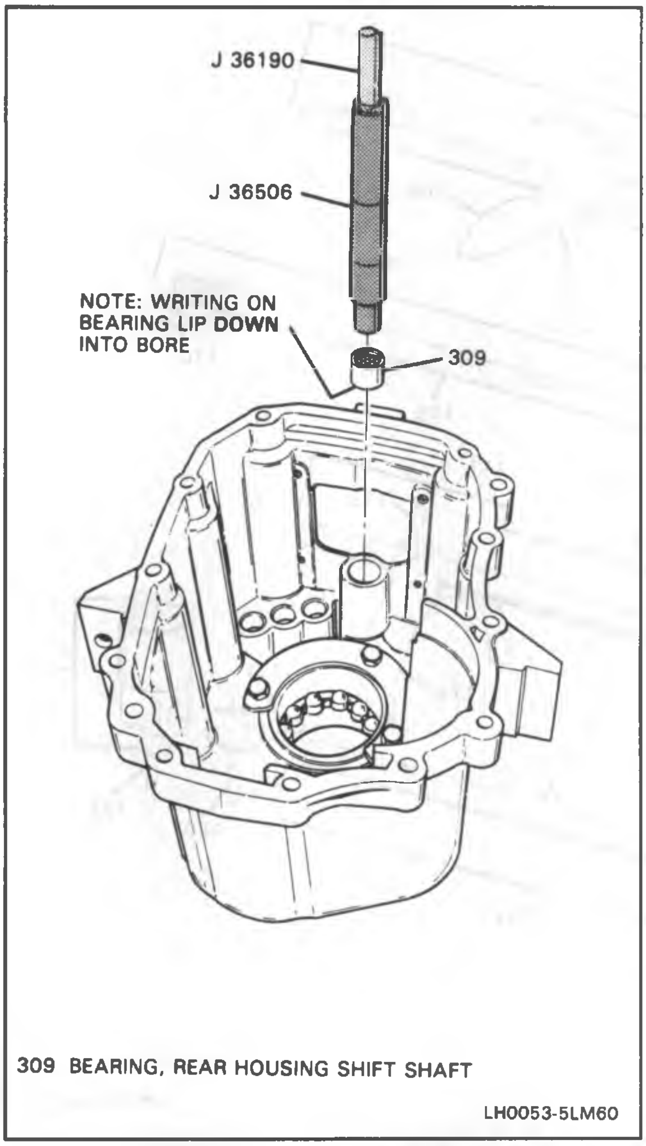


Figure 52 Shift Shaft Bearing Install

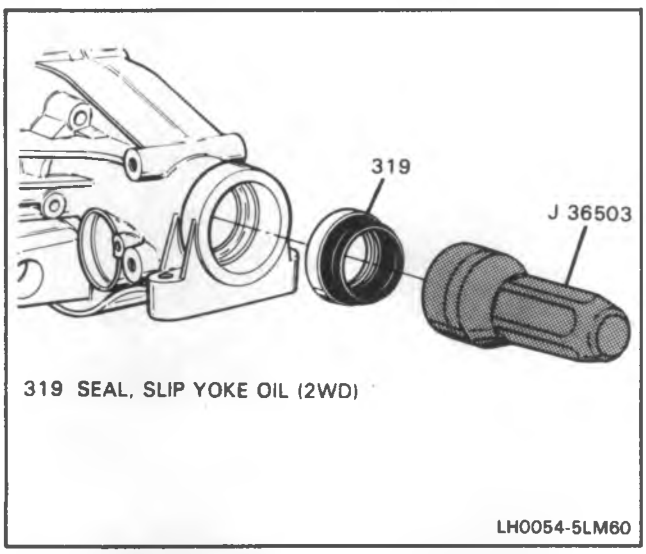


Figure 53 2WD Slip Yoke Oil Seal Install

SHIFT SHAFT/RAIL AND FORK ASSEMBLIES INSPECTION

Clean

- All parts in a suitable solvent and air dry.

Inspect

Figure 54

- The parts that compose the 1-2 (100), 5th-reverse (111) shift rail and fork assemblies are serviceable as an assembly only.

1. Shafts (101, 109, 112 and 117) for wear or scoring.
2. Forks (105, 108 and 114) for wear, scoring or distortion. The edges will turn black in color, this is a normal condition.
3. Levers (103 and 121) for wear or distortion.
4. Pins (119 and 110) for wear or distortion.
5. Shift shaft socket assembly (123) components for wear or distortion.

Important

- Wear, scoring or distortion requires replacement of assembly and close inspection of mating parts.

SHIFT LEVER HOUSING ASSEMBLY INSPECTION

Clean

- The gasket material from the machined mating surface with liquid gasket remover.

Inspect

Figure 55

- The parts that compose the shift lever housing assembly (136) are serviceable as an assembly only. Replace the assembly for any shift lever rattle/buzz.

1. Boot (130) for cracks, tears or distortion. Replace the boot if any of these conditions exist.
2. Machined mating surface for flatness, check with a straight edge.

INPUT SHAFT BEARING RETAINER ASSEMBLY

Seal Replacement

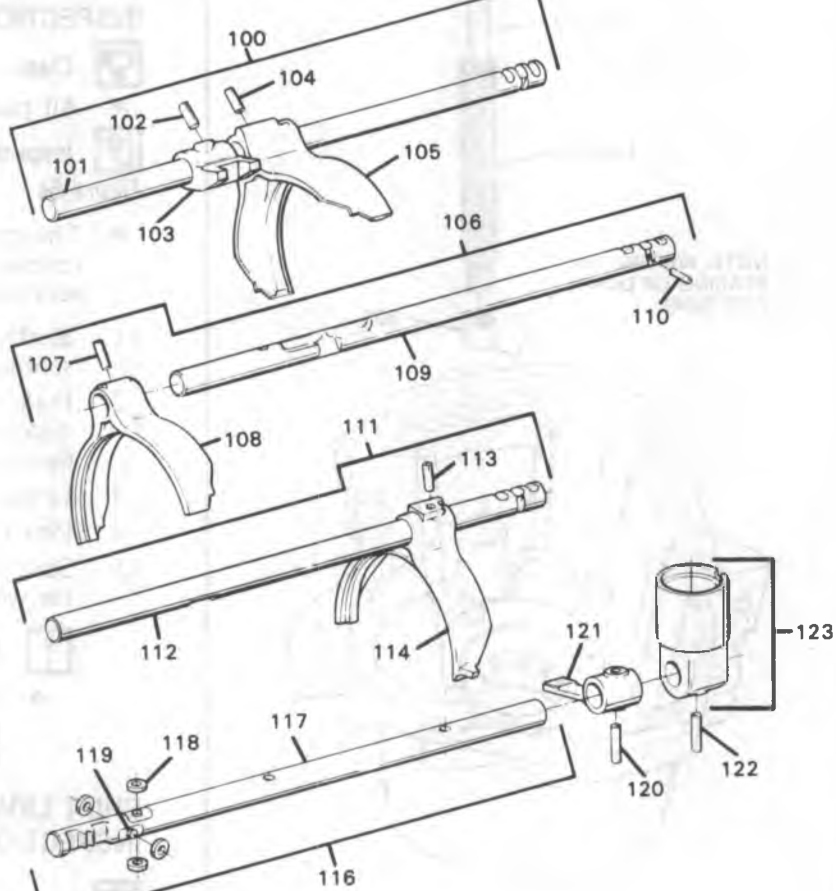
Tools Required:

J 29369-2 Input Shaft Bearing Retainer Oil Seal Remover

J 23907 Slide Hammer

J 25070 Heat Gun

J 36504 Input Shaft Bearing Oil Seal Installer



100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
101 RAIL, 1ST & 2ND SHIFT
102 PIN, ROLL
103 YOKE, 1ST & 2ND SHIFT
104 PIN, ROLL
105 FORK, 1ST-2ND SHIFT
106 RAIL ASSEMBLY, 3RD & 4TH SHIFT
107 PIN, ROLL (3RD & 4TH FORK) (6 X 36mm)
108 FORK, 3RD & 4TH SHIFT
109 RAIL, 3RD & 4TH
110 PIN, 3RD & 4TH SHIFT INTERLOCK
111 RAIL ASSEMBLY, 5TH & REVERSE SHIFT
112 RAIL, 5TH & REVERSE
113 PIN, ROLL
114 FORK, 5TH & REVERSE SHIFT
116 SHAFT ASSEMBLY, SHIFT
117 SHAFT, SHIFT
118 ROLLER, SHIFT SHAFT
119 PIN, ROLLER
120 PIN, ROLL (6 X 28mm)
121 FINGER
122 PIN, ROLL (6 X 33mm)
123 SOCKET ASSEMBLY, SHIFT SHAFT

Figure 54 Shift Shaft/Rails Assembly Components

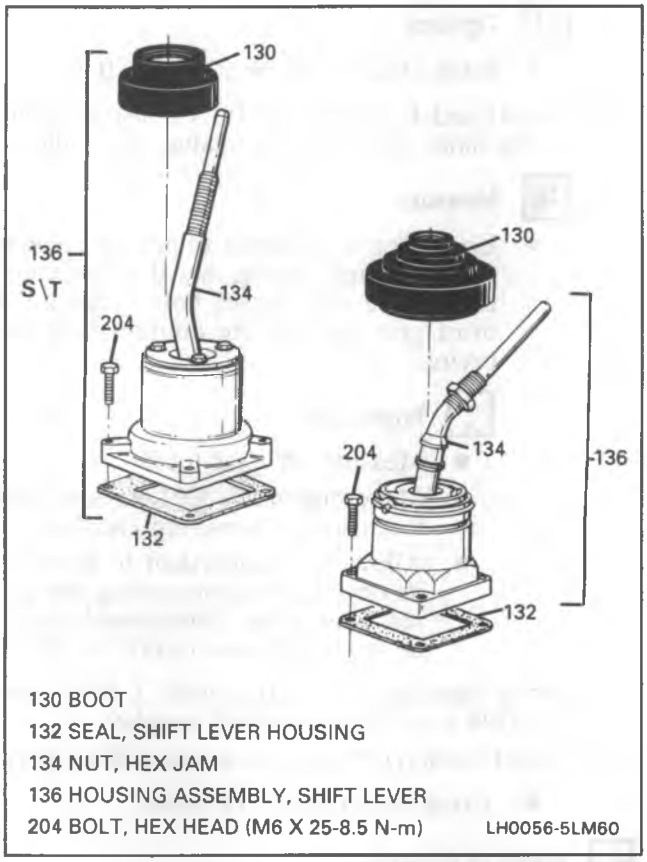


Figure 55 Shift Housing Assembly Components

Remove or Disconnect

Figure 56

1. Rubber seal lip with pliers
   - Exposing the metal lip:
     - — Save the input bearing retainer washer (208).
     - — Install J 29369-2 below metal lip of seal.
     - — Expand to finger tight.
     - — Turn five additional turns.
     - — Install J 23907 into J 29369-2.
2. Input shaft bearing retainer oil seal (209).
   - Heat oil seal with J 25070 for minimum of three minutes.
   - Hold clutch release bearing pilot with heat resisting glove or equivalent, then slide hammer out seal.
3. Gasket material from the retainer (205) using liquid gasket remover.

Inspect

1. Clutch release bearing pilot (206) for scoring, wear or cracks, especially at the flange.
2. Retainer for wear or damage.

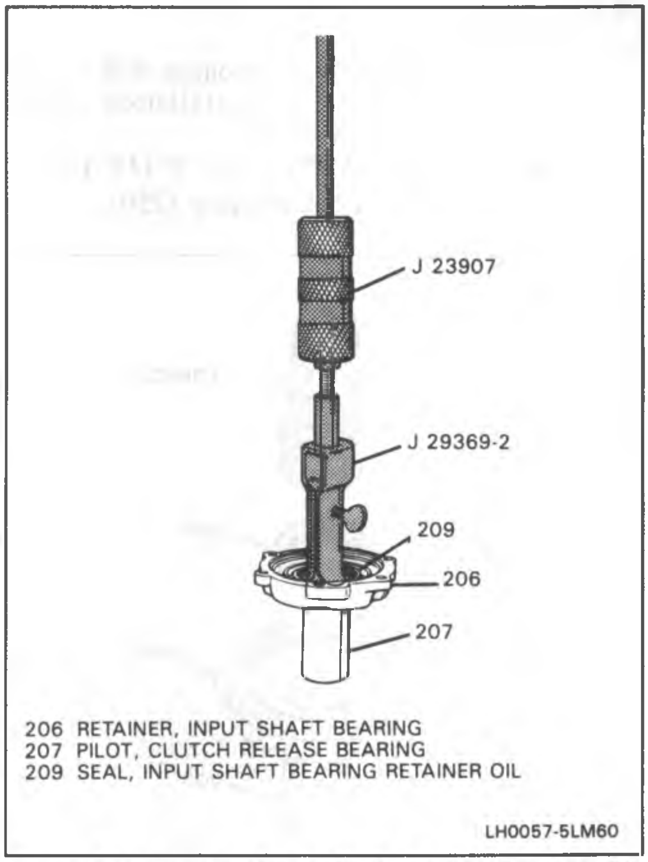


Figure 56 Removing Input Shaft Bearing Retainer Oil Seal

Install or Connect

Figure 57

1. NEW oil seal (209), using J 36504.
   - Fill between the seal lips with chassis grease.

COUNTERSHAFT ENDPLAY ADJUSTMENT

Important

- This procedure must be performed when any of the following components are replaced:
  - — Countershaft bearings (203) and/or front housing countershaft bearing race (202).
  - — Front housing (200), rear housing (300) (2WD) or (301) (4WD).
  - — Gear rattle noise complaint (not clutch disc related).

Remove or Disconnect

Figure 58

Tools Required:

J 36799 Countershaft Bearing Race Shimming Tool

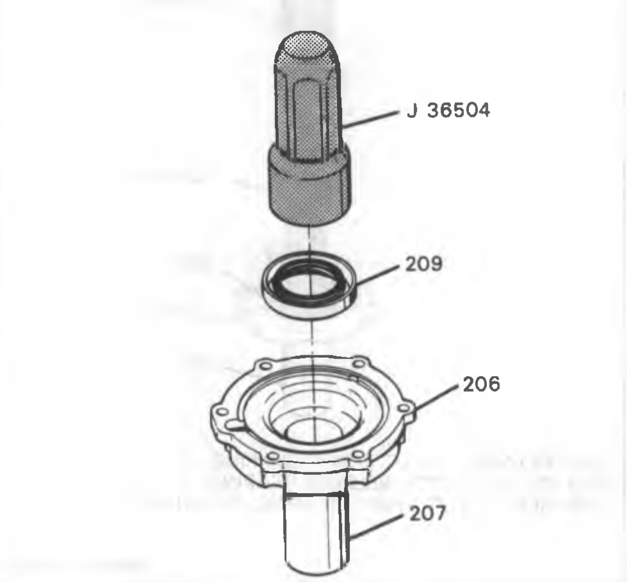
J 8092 Universal Drive Handle

J 8001 Dial Indicator Set

J 25025-A Dial Indicator Stand and Guide Pin Set

Important

- The following component will require cooling prior to installation during assembly procedures.
- 20 minutes MINIMUM, 0° (32° F).
  — countershaft bearing plug (250).



206 RETAINER, INPUT SHAFT BEARING
207 PILOT, CLUTCH RELEASE BEARING
209 SEAL, INPUT SHAFT BEARING RETAINER OIL

Figure 57 Input Shaft Bearing Retainer Oil Seal Install

1. Bearing race (216) using brass drift.
2. Countershaft bearing plug (250). Refer to page 21, step number 5 for the removal procedure.
3. Snap ring (251) and shim(s) (252).
4. Oil fill plug (222).

Inspect

1. Bearing (203) and countershaft (53).

Important

- SMALLER DIAMETER OF BEARING CAGE INTO BEARING RACE (202).
- Install bearings (203) in bearing races (202) prior to assembly.
- Retain with TRANSJEL™ J 36850 or equivalent.

2. Bolts (312).
   - Use only 4 or 5 (evenly spaced).

Tighten

- Bolts (312) to 35 N·m (26 lb. ft.).

3. J 8001 and J 25025-A to front housing in one of the input shaft bearing retainer bolt holes.

Measure

- Use a long screwdriver to pry the counter shaft upward, noting the dial indicator travel. Use the fill plug hole to reach the third gear part of the countershaft for prying.

Important

- Measure off gear tooth.
- Make sure that J 8001 stays on gear tooth while measuring endplay.
- Allow the countershaft to lower to its original position, noting the dial indicator travel. Total travel should be 0.13-0.23 mm (0.005"-0.009").

4. Move bearing race (202) with J 8092 and J 36799 to achieve specified endplay.
5. Select shim(s) (252) to retain specified endplay.
   - Using least number of shims.

Install or Connect

6. Selected shim(s) (252).
7. Snap ring (251).
8. Seat countershaft bearing race (202) using J 8092 and J 36799.
9. Repeat MEASURE procedure.
   - To make sure endplay is still correct after step 8.
10. NEW countershaft bearing plug (250). Refer to page 26, step number 6 for the installation procedure.

Remove or Disconnect

11. Front housing (200) and rear housing (300) (2WD) or (301) (4WD).
12. Countershaft (53) and bearings (203).

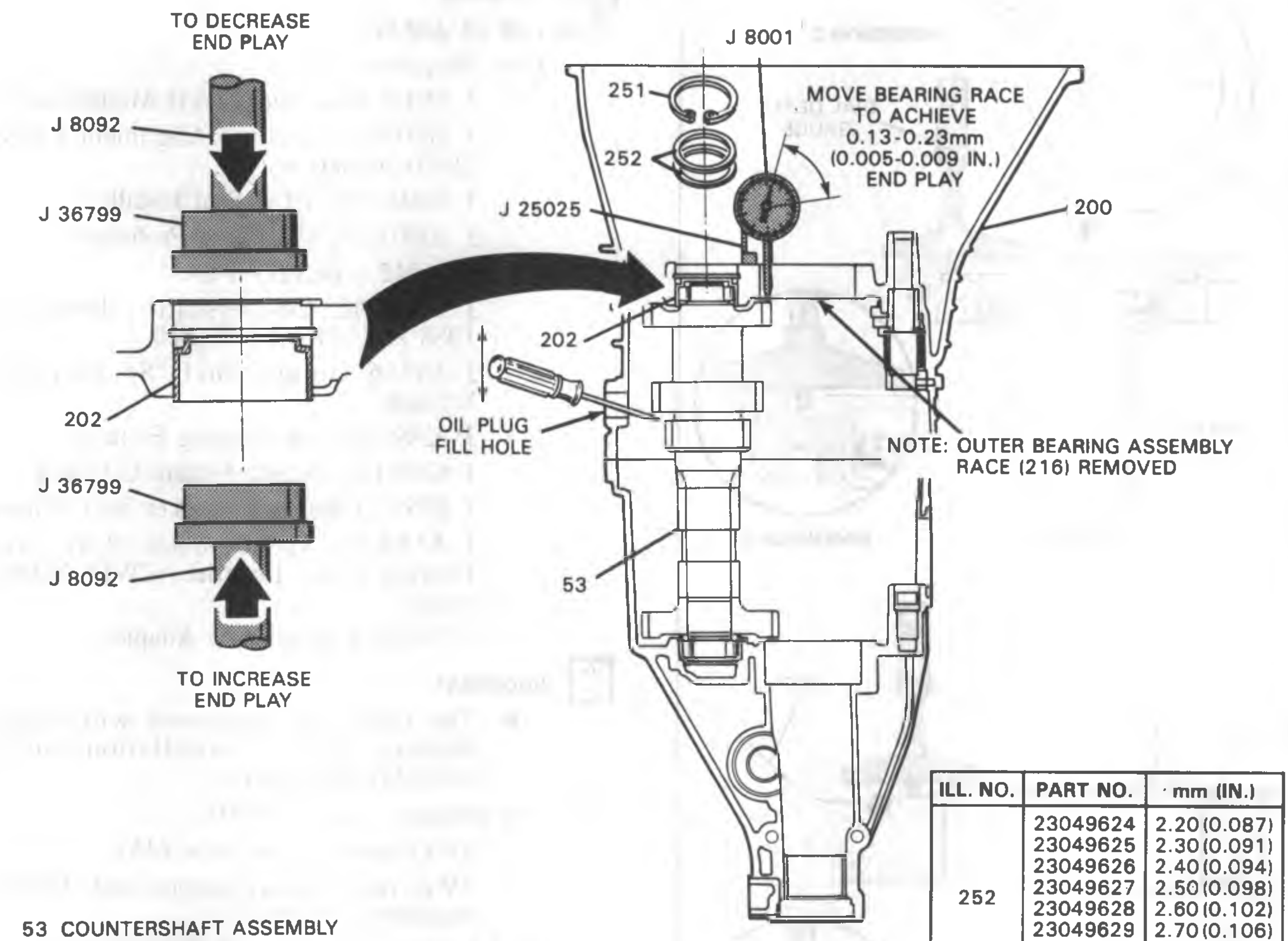
Install or Connect

13. Fill plug (222) and drain plug (225).
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the threads.
    - Do not tighten fill plug.

Tighten

- Drain plug (225) to 60 N·m (44 lb. ft.).

14. Bearing race (216) using brass drift.
    - Cover with shop towel before installing



53 COUNTERSHAFT ASSEMBLY
200 HOUSING, FRONT
202 RACE, COUNTERSHAFT BEARING
251 RING, SNAP
252 SHIMS

ILL. NO.	PART NO.	mm (IN.)
252	23049624	2.20 (0.087)
	23049625	2.30 (0.091)
	23049626	2.40 (0.094)
	23049627	2.50 (0.098)
	23049628	2.60 (0.102)
	23049629	2.70 (0.106)
	23049630	0.40 (0.016)
	23049631	0.50 (0.020)

LH0059-5LM60

Figure 58 Countershaft Endplay Adjustment

INPUT SHAFT BEARING RETAINER SELECTIVE SHIM PROCEDURE

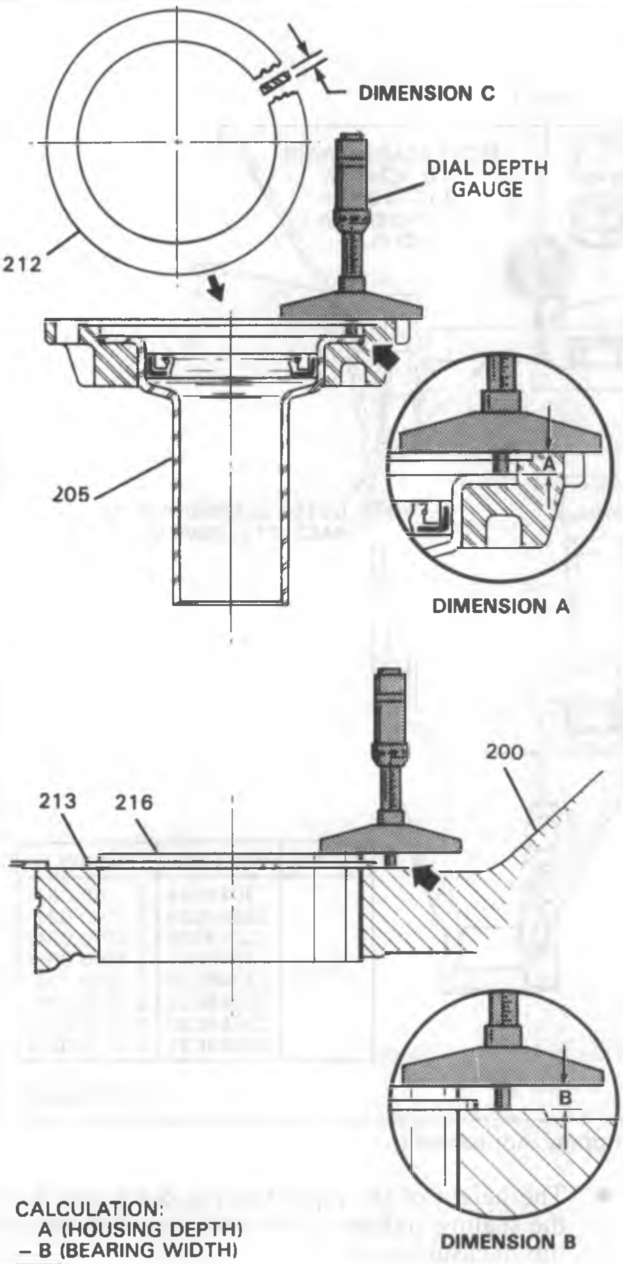
Measure

Figure 59

Tool Required:

Dial Depth Gage or Equivalent

- The distance between the sealing flange of the retainer and the flanged part of the release guide. Record this measurement.
- The height of the input bearing outer race from the sealing surface of the front housing. Record this measurement.
- Subtract the bearing race height from the retainer depth and select a shim the same (or next smaller) size as the difference in measurements.



CALCULATION:
A (HOUSING DEPTH)
– B (BEARING WIDTH)
= C (SHIM SPACE)

ILL. NO.	PART NO.	DIM. C mm (IN.)
212	23049825 23049826 23049827	0.30 (0.012) 0.40 (0.016) 0.50 (0.020)

200 HOUSING, FRONT
205 RETAINER ASSEMBLY, INPUT SHAFT BEARING
212 SHIM, (SELECTIVE)
213 RING, INPUT SHAFT BEARING ASSEMBLY SNAP
214 BEARING ASSEMBLY, INPUT SHAFT
216 RACE, BEARING ASSEMBLY (OUTER)

LH0060-5LM60

Figure 59 Input Shaft Bearing Retainer Selective Shim Procedure

UNIT ASSEMBLY

Assemble

Figures 60, 61, and 62

Tools Required:

- J 25070 Heat Gun (2WD Models only)
- J 36515-10 Retainer Alignment Cables (2WD models only)
- J 36502 4WD Oil Seal Installer
- J 36502-2A 4WD Seal Protector
- J 36515 Assembly Pallet
- J 36515-12 Countershaft Adapter for 1988 and 1989 1/2 Models
- J 36516 Output Shaft Spanner Nut Wrench
- J 3289-20 Base Holding Fixture
- J 8763-02 Holding Fixture C-Clamp
- J 8763-21 Balance Bracket for C-Clamp
- J 6133-01 Speedometer Rotor and Bearing Race Installer (2WD Models only)
- J 35824 Transmission Adapter

Important

- The following component will require heating prior to installation during assembly procedures.

- 7-10 minutes, 120°C (250°F).
  - — 2WD speed sensor rotor (45)
  - — 2WD rear housing output shaft bearing assembly (33) bore

1. Pilot bearing (3) into input shaft (1).
   - SMALLER DIAMETER OF BEARING CAGE TOWARD INPUT SHAFT.
   - Retain with TRANSJEL™ J 36850 or equivalent.
2. Input shaft (1), pilot bearing (3), synchronizer ring (2) and mainshaft assembly (4) (2WD) or (5) (4WD) into J 36515.
3. J 36515-12 onto countershaft (53).
   - Install the assembly onto J 36515.
4. Reverse idler assembly (46).
5. Bearing assembly, output shaft 33.
   - 2WD models only.
6. Install on main shaft assembly (4) or (5)
   - 3-4 shift fork (108).
   - TAPER ON FORK TOWARDS 3RD GEAR
   - 1-2 shift rail assembly (100).
   - Reverse shift rail assembly (111).

Important

Steps 7 through 13 are for 2WD models only. The 4WD section starts at step 14 (steps 17 through 47 are for both 2WD and 4WD models).

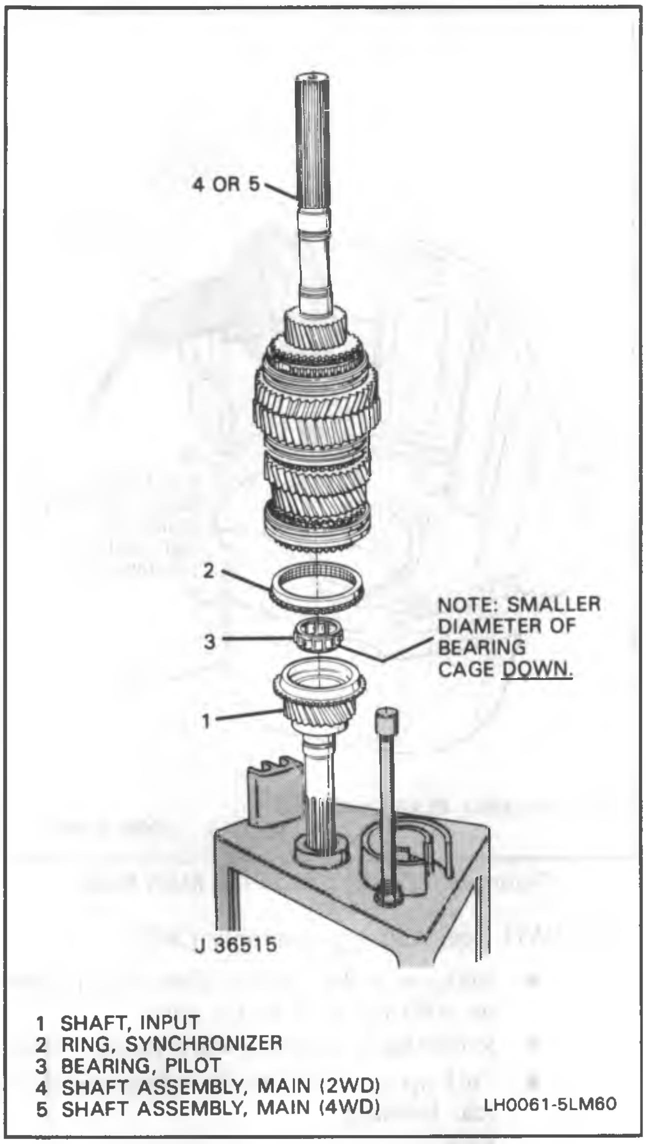


Figure 60 Mainshaft Components Install

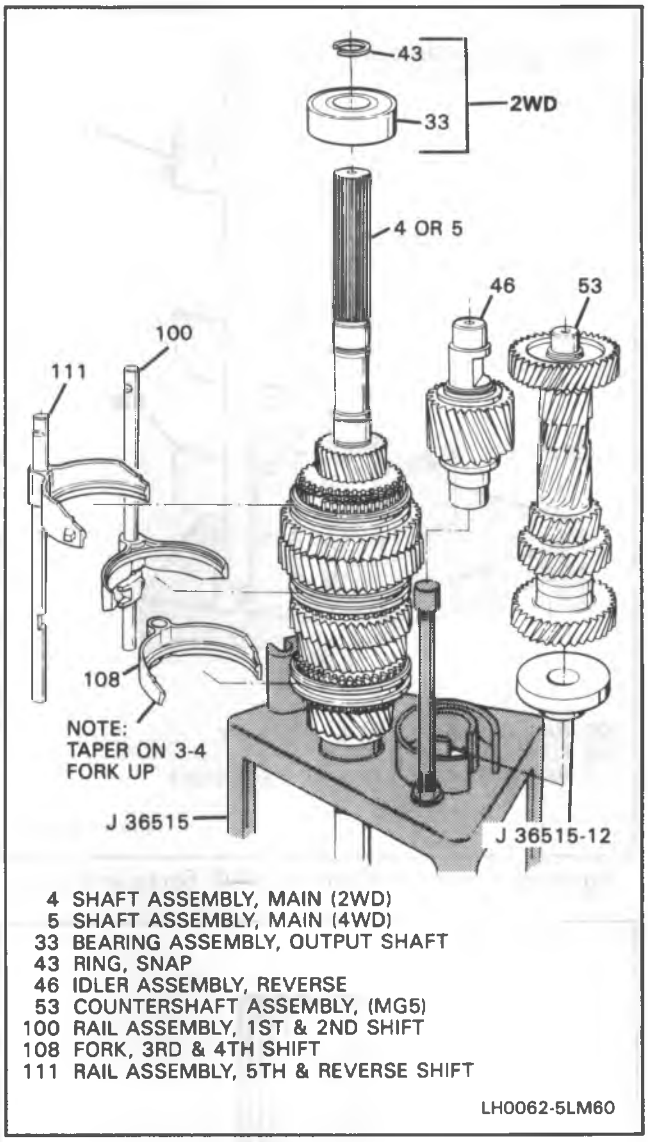


Figure 61 Countershaft and Reverse Idler Assembly Install

7. NEW snap ring (43) (2.00 mm thickness).
8. Snap-ring (43) (Figure 63).
9. 2WD Speed sensor rotor (45) HEATED.
   - If necessary seat with J 6133-01.

Important

The 2WD rear housing output shaft bearing assembly bore MUST be heated for three to five minutes with J 25070 before assembly (Figure 65).

10. 2WD J 36515-10 through bolt (304) and (305) holes in the rear housing (Figure 65).
    - Screw into the output shaft bearing retainer (302).
    - Notch in retainer towards oil delivery tube assembly (307).
11. 2WD Bearing (203).
    - Install in bearing race (202) of the housing.
      SMALLER DIAMETER OF BEARING CAGE INTO BEARING RACE.
    - Retain with TRANSJEL™ J 36850 or equivalent.

Important

- PRESS EACH ROLLER TOWARDS THE RACE TO SECURE THEM FOR EASIER ASSEMBLY.

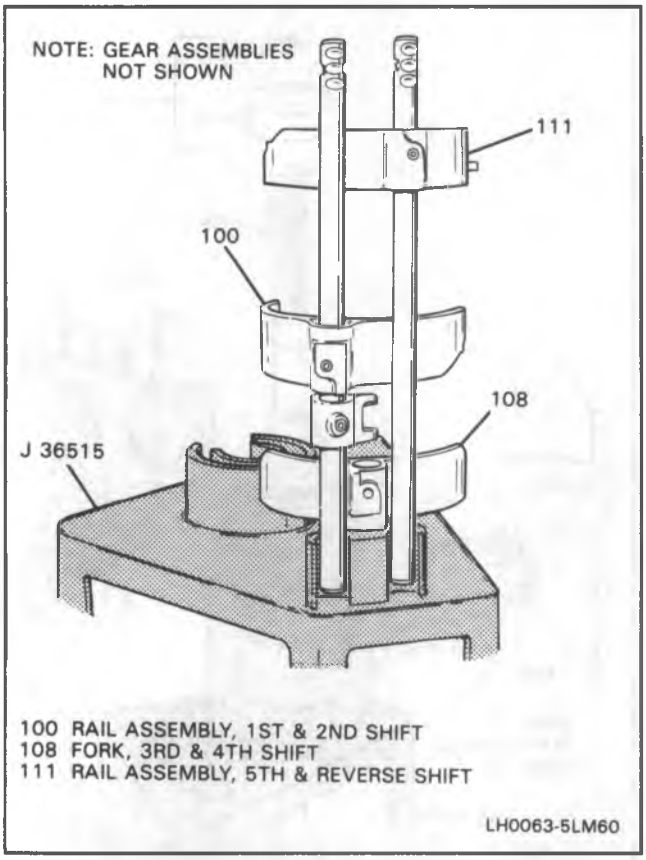


Figure 62 Proper Positions of Shift Forks and Rails

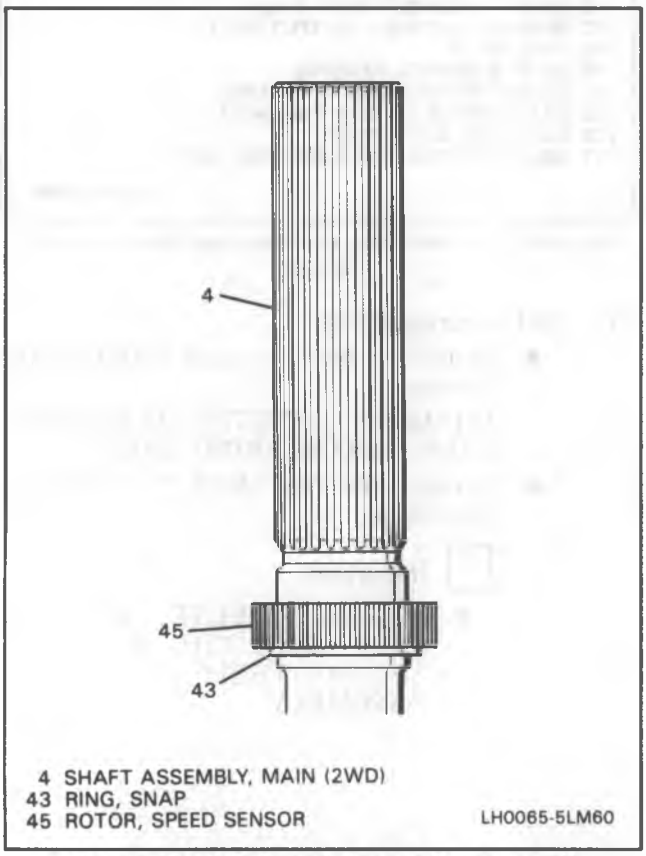


Figure 63 2WD Speed Sensor Rotor Install

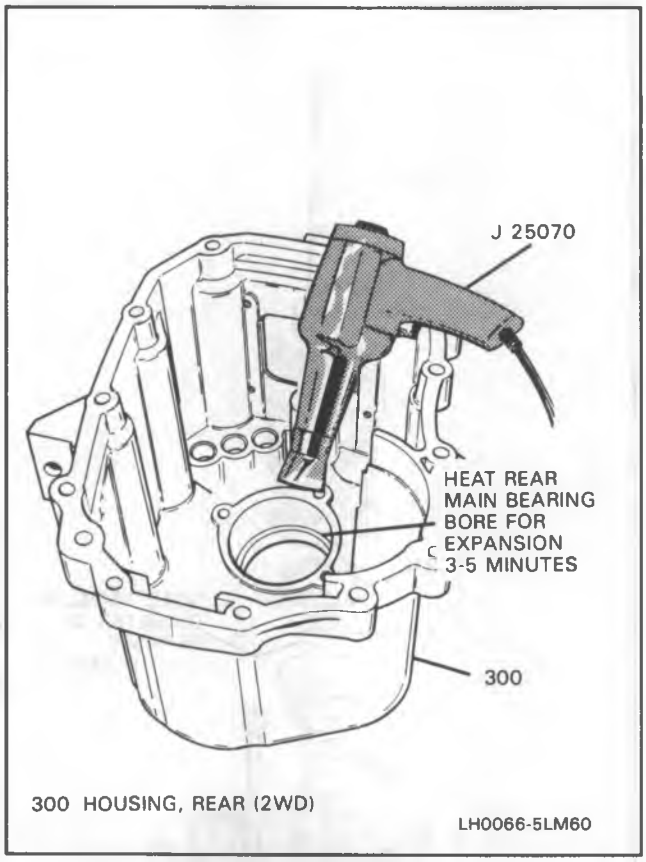


Figure 64 Heating 2WD Rear Main Bore

12. 2WD Rear housing assembly (300).
    - Make sure the reverse idler shaft is lined up with the hole in the case.
    - Rotate back and forth while pulling down.
    - Pull up on J 36515-10 while installing rear housing.

Important

- Bring housing straight down. If resistance is felt at about 7 mm (1/4 in.) then the rollers are (203) cocked. Repeat above procedures to install. DO NOT FORCE HOUSING DOWN.

13. 2WD Bolts (304) and (305) (Figure 66).
    - Apply pipe sealant with Teflon™ GM P/N 1050280 or equivalent to the bolt holes of the rear housing.
    - Apply threadlocker GM P/N 12345382 to bolt threads.
    - Remove J 36515-10.

Tighten

- Bolts (304) and (305) to 22 N·m (17 lb. ft.).

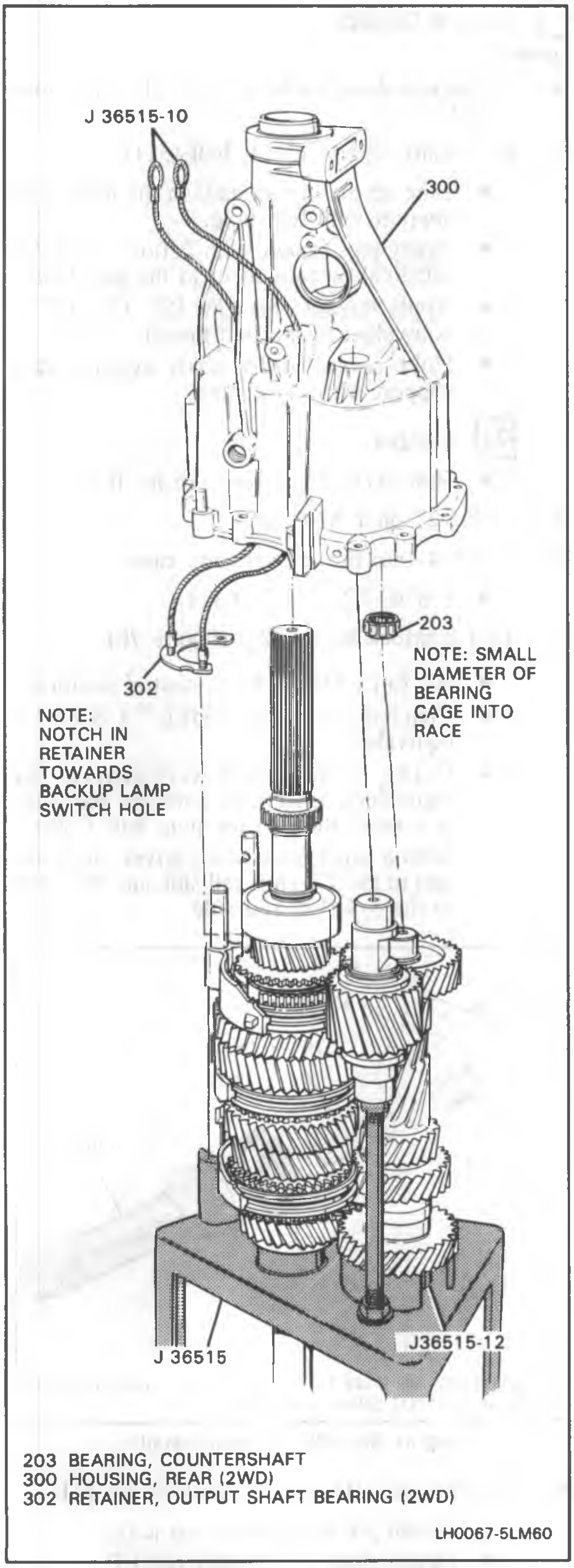


Figure 65 2WD Rear Housing Install

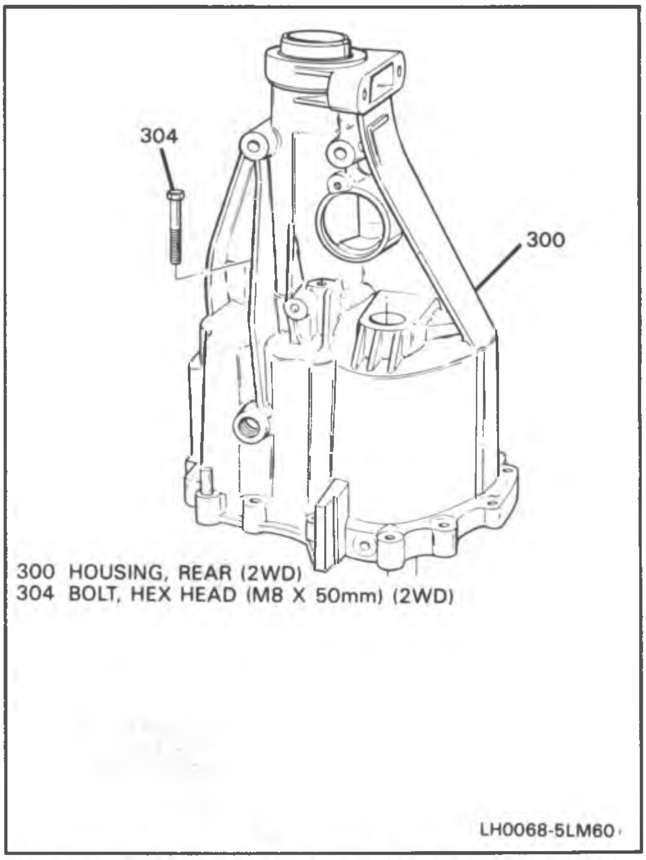


Figure 66 2WD Rear Bearing Retainer Bolts Install

14. 4WD bearing (203) (Figure 67).
    - Install in bearing race (202) of the housing.
    - SMALLER DIAMETER OF BEARING CAGE INTO BEARING RACE
    - Retain with TRANSJEL™ J 36850 or equivalent.
    - Press **Each** roller towards the race to secure them for easier assembly.
15. 4WD rear housing assembly (301).
    - Make sure the reverse idler shaft is lined up with the hole in the case.
    - Rotate back and forth while pulling down.

Important

Bring housing straight down. If resistance is felt at about 7 mm (1/4 in.) then the rollers (35) or (203) are cocked. Repeat above procedures to install. DO NOT FORCE HOUSING DOWN.

- Install seal protector J 36502-2A onto output shaft.

16. 4WD output shaft oil seal (320) using J 36502 (Figure 68).
    - Fill between the seal lips with chassis grease.
    - Remove seal protector J 36502-2A.

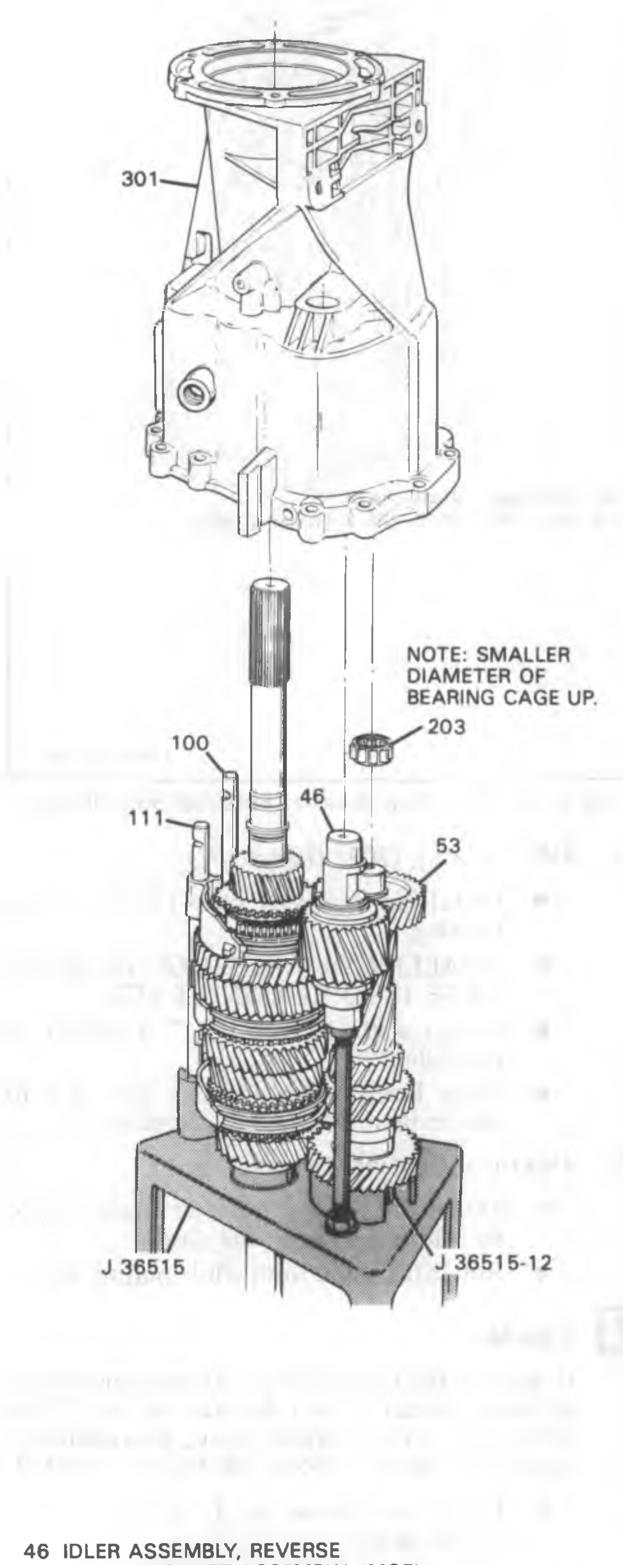


Figure 67 4WD Rear Housing Install

Install or Connect

Figure 69

- Lay the unit down on the workbench and remove J 36515.

17. Idler shaft support (310), bolt (311).
    - Line up the bolt threads in the idler shaft support with bolt hole.
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the bolt hole.
    - Apply threadlocker GM P/N 1235382 or equivalent to the bolt threads.
    - Hold reverse idler shaft against idler support while torqueing.

    Tighten

    - Bolt (311) to 22 N·m (16 lb. ft.).

- J 8763-21 on J 8763-02.

18. J 36824 onto the transmission case.
    - J 8763-02 onto J 36824.
19. Two interlock balls (323) (Figure 70).
    - All forks MUST be in neutral position.
    - Coat balls with TRANSJEL™ J 36850 or equivalent.
    - Using a magnetic screwdriver or equivalent, insert one interlock ball (one at a time) through the plug hole (326).
    - With a small blade screwdriver, push one ball to the 1-2 shift rail side and the other to the 3-4 shift rail side.

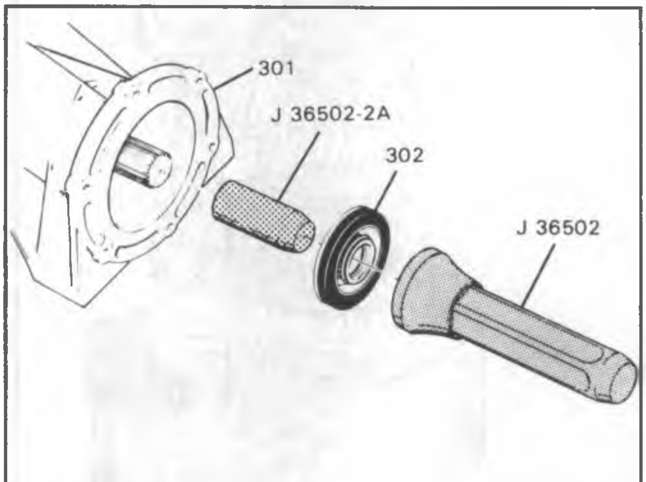
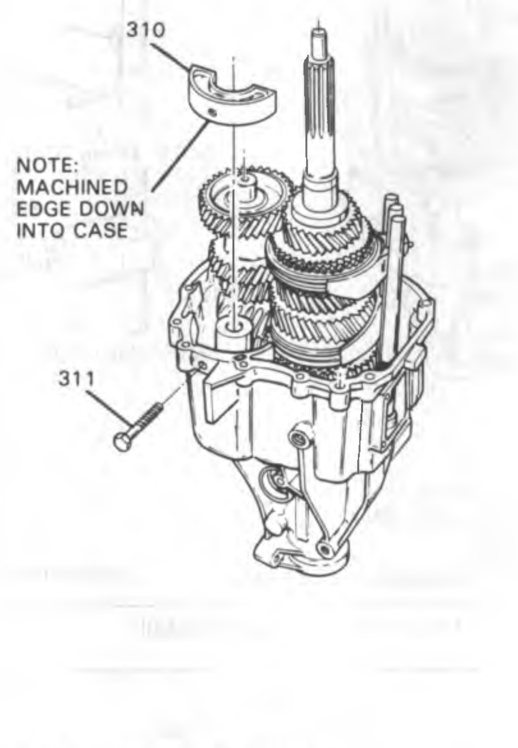


Figure 68 4WD Oil Seal Install

20. 3-4 shift rail (109), with interlock pin (110).
    - Retain pin with petroleum jelly.
    - Detent slots in 3-4 shift rail UP.
    - Install through 3-4 shift fork and into the rear housing shift rail bearing.

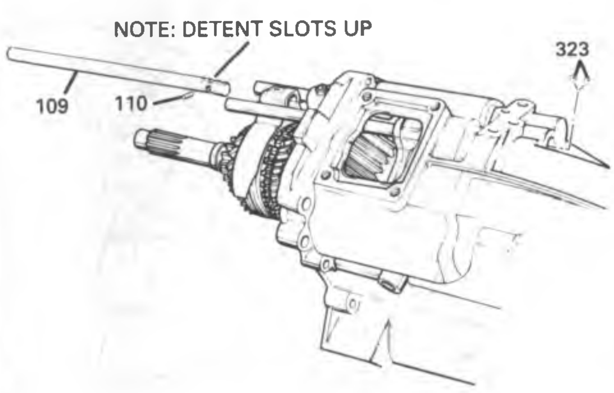
Important

- The 1-2 AND 5th-REVERSE SHIFT RAILS MUST BOTH BE IN THE NEUTRAL POSITION or the interlock system will not allow the 3-4 rail to engage.



310 SUPPORT, IDLER SHAFT
311 BOLT, HEX HEAD (M8 X 50mm) LH0071-5LM60

Figure 69 Reverse Idler Support Install



109 RAIL, 3RD & 4TH
110 PIN, 3RD & 4TH SHIFT INTERLOCK
323 BALL, DETENT/INTERLOCK LH0072-5LM60

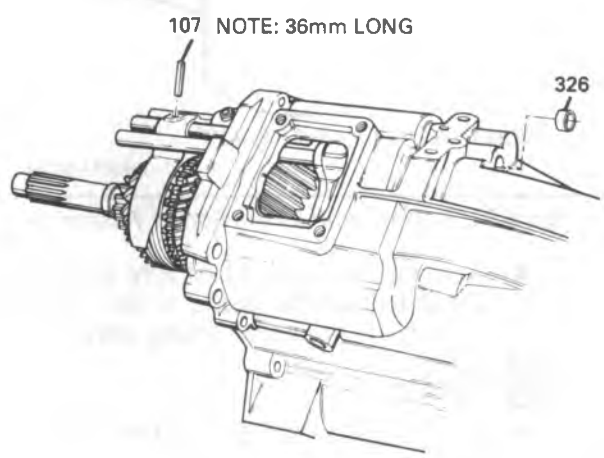
Figure 70 Interlock Balls and 3-4 Shift Rail Install

21. Roll pin (107) (36 mm) (Figure 71).
    - Install to a depth where a MAXIMUM of 5 mm (3/16 in.) of the roll pin is left remaining from the top of the fork.

NOTICE: If the roll pin is not at proper depth it may run on front housing and cause 3rd or 4th gear hop-out.

- Test interlock system to make sure interlock balls are in place by trying to move two shift rails. If two rails can be moved (selecting two gears at once). Repeat steps **19** through **20**.

22. NEW plug (326).
    - Apply gasket maker GM P/N 1052943 or equivalent to the edge of the plug.
    - Install flush.
23. Shift shaft (116), finger (121) and shift shaft socket assembly (123) (Figure 73).
    - Detent slots towards idler support side of transmission.
    - Finger extension must be on the underside of the 5-reverse shift rail.



107 PIN, ROLL (3RD & 4TH FORK)
326 PLUG

LH0073-5LM60

Figure 71 3-4 Fork Roll Pin and Plug Install

Important

Use a new shift shaft socket assembly (123) or stake the socket as shown in Figure 72. This will prevent the roll pin (122) from walking down and rubbing on the reverse speed gear (25) causing a noise in 2nd, 4th and reverse (or any combination of the three gears). DO NOT **REUSE** A STAKED SOCKET.

24. Roll pin (120) (28 mm) and roll pin (122) (33 mm).
25. Three detent balls (323) and three springs (324) (Figure 74).
26. Detent spring cover (325) and two bolts (236).

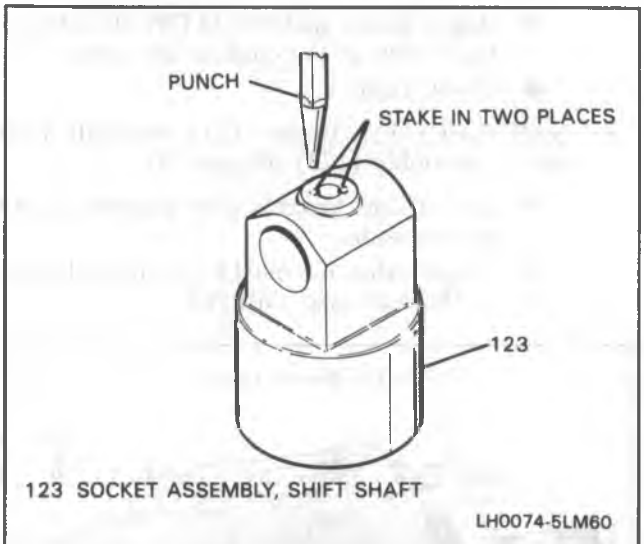


Figure 72 Staking Shift Shaft Socket Assembly

- Apply gasket maker GM P/N 1052943 or equivalent to the inside of the bolt hole pattern of the detent spring cover.

Tighten

- Bolts (236) to 8.5 N·m (76 lb. in.).

27. Four rollers (118) (Figure 75).
    - Retain with TRANSJEL™ J 36850 or equivalent.
28. Countershaft bearing (203) (Figure 76).
    - Install in bearing race (202) of the front housing.

Important

- INSTALL SMALLER DIAMETER OF BEARING CAGE INTO BEARING RACE.
- Retain with TRANSJEL™ J 36850 or equivalent and press on each roller towards the outside of the bearing race to lock it in place.
- Apply TRANSJEL™ J 36850 or equivalent to bearing race on input shaft.

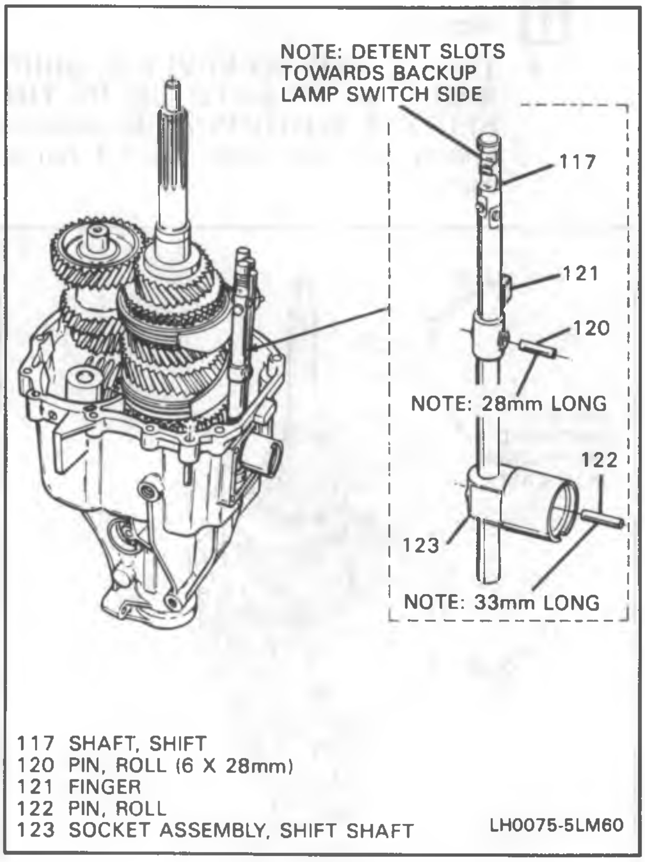


Figure 73 Shift Shaft Install

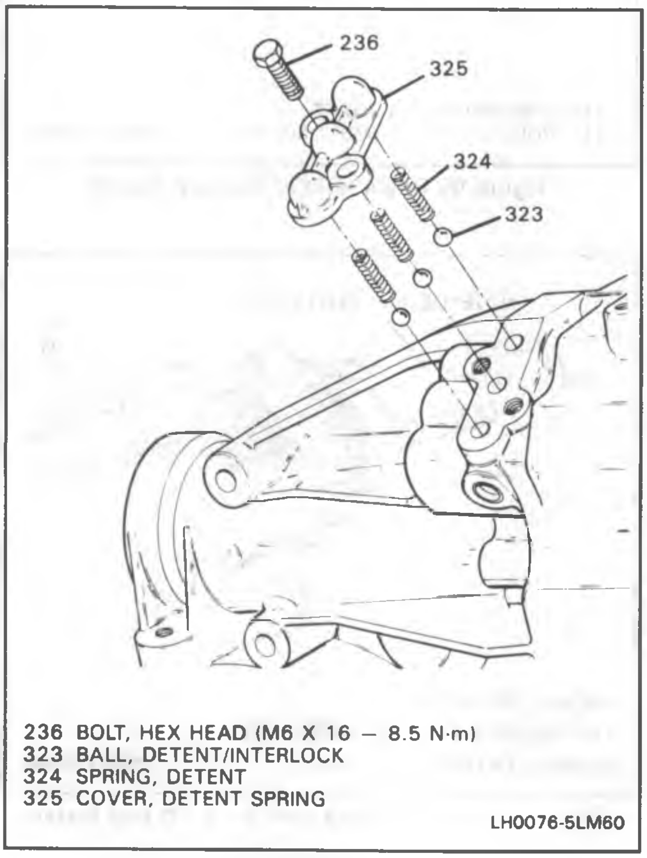


Figure 74 Detent Components Install

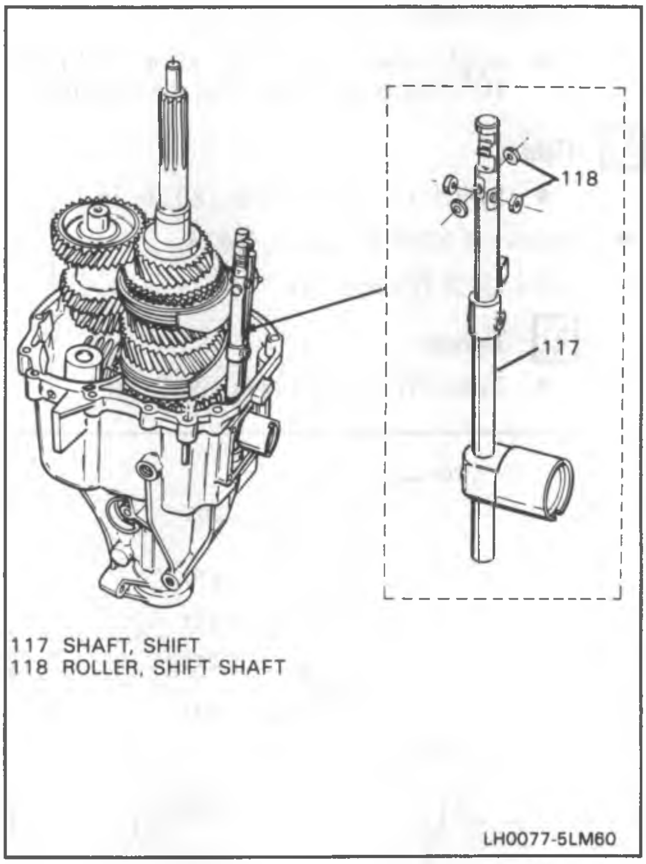


Figure 75 Rollers Install

29. Roller bearing (218) and ball bearing (outer) race (217).

Important

- INSTALL SMALLER DIAMETER OF BEARING CAGE FACING input gear splines THEN PRESS ON EACH ROLLER TO LOCK IT TO THE BEARING RACE.
- Apply gasket maker GM P/N 1052943 or equivalent to the inside of the bolt hole pattern of the rear housing.

30. Front housing (200).

Important

- Bring housing straight down. If resistance is felt at about 7 mm (1/4 in.) then the roller(s) (218) or (203) are cocked, repeat steps 28, 29 and 30. DO NOT FORCE DOWN THE HOUSING.

31. Two dowels (321).
32. Bolts (312).
    - Do not tighten.
    - Tip vertically.

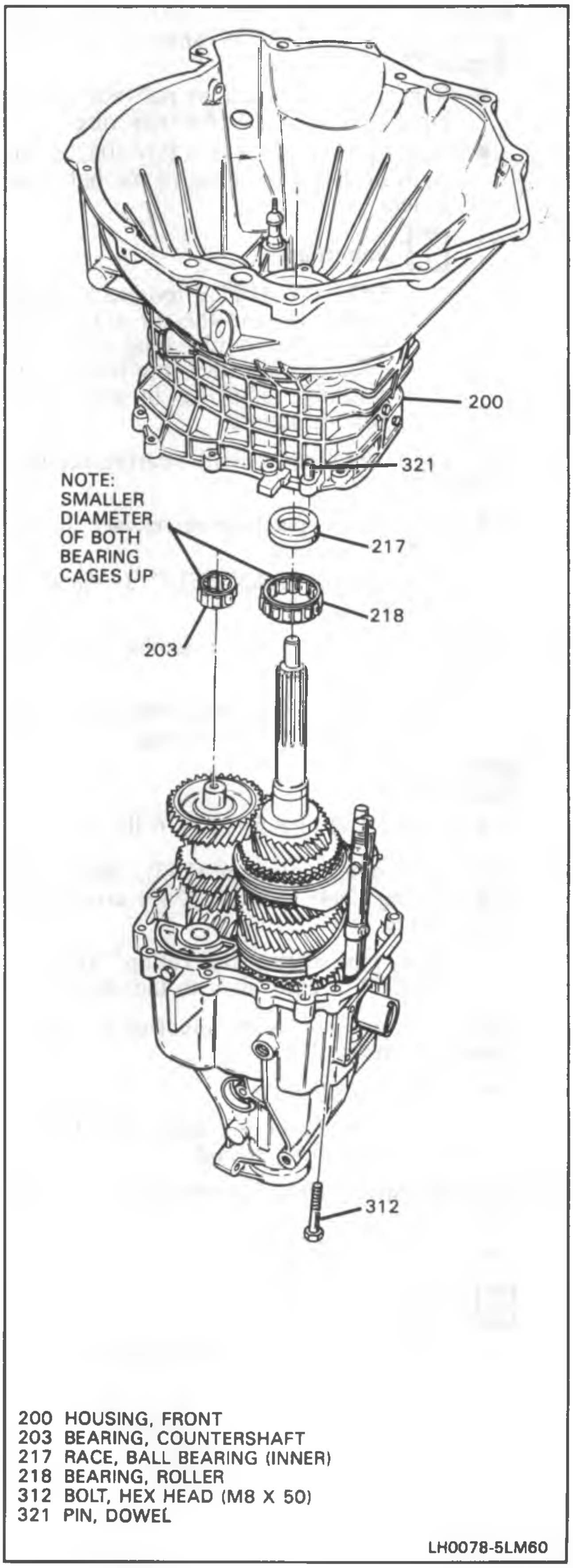


Figure 76 Front Housing Install

33. Ball bearing (outer) race (215), input shaft spacer (211) and NEW snap ring (210) (Figure 77).
    - It may be necessary to pull out on the input shaft to install the snap ring.
    - Apply gasket maker GM P/N 1052943 or equivalent to the inside of the bolt hole pattern.

    Important

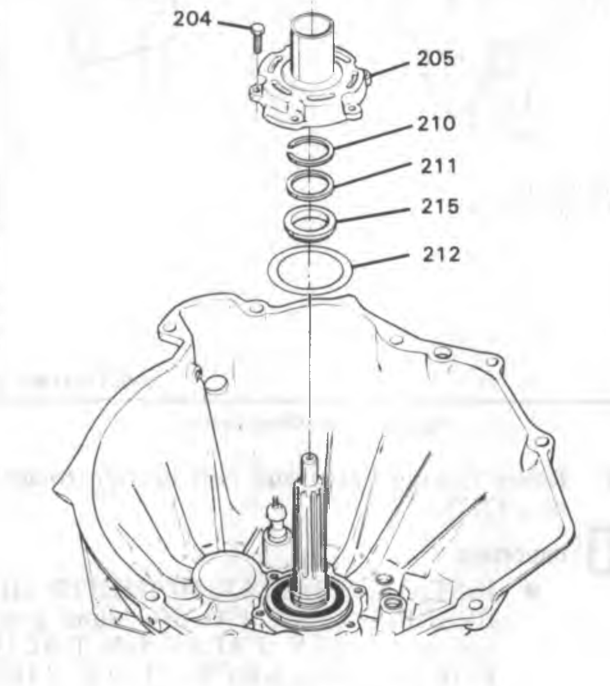
    DO NOT APPLY too much gasket maker around the oil drain back hole. this could clog the hole causing a low fluid flow through the bearing resulting in premature bearing failure.
34. Shim (212) into input shaft bearing retainer assembly (205).
    - Make sure input bearing retainer washer (208) is in place.
    - Retain with TRANSJEL™ J 36850 or equivalent.
35. Input shaft bearing retainer assembly (205) and six bolts (204).
    - Make sure oil drain back hole is lined up with the hole in the housing.

    Tighten
    - Bolts (204) to 8.5 N·m (76 lb. in.)
36. Shift shaft detent plunger (243), shift shaft detent spring (244) and plug (245) using brass drift (Figure 78).
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the plug.
37. NEW O-ring (315) onto electronic speedo sensor assembly (316).
    - 2WD models only.
      — Coat the O-ring with a thin film of transmission fluid.
38. Electronic speed sensor assembly (316) and bolt (317).
    - 2WD models only.

    Tighten
    - Bolt (317) to 9 N·m (80 lb. in.)
39. Backup lamp switch assembly (313).
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the threads.

    Tighten
    - Switch (313) to 9 N·m (80 lb. in.).
- Remove J 8763-02 and J 36824.
40. Bolts (312) (Figure 79).

    Tighten
    - Bolts (312) to 35 N·m (26 lb. ft.).

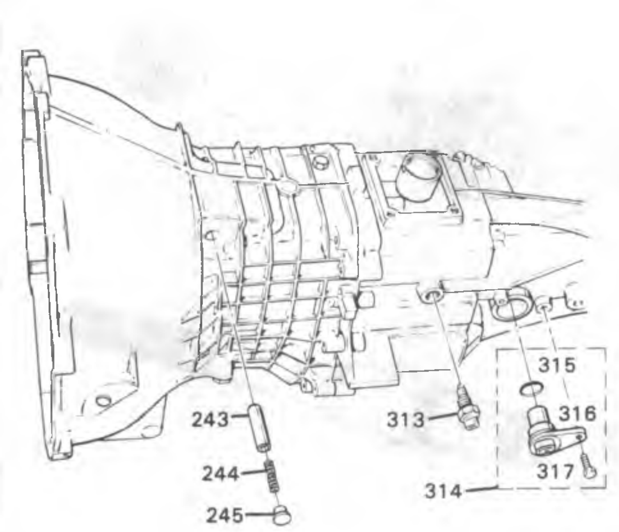


ILL. NO.	PART NO.	DIM. A mm (IN.)
210	23049935	2.00 (0.079)
	23049936	2.10 (0.083)
	23049937	2.20 (0.087)
	23049938	2.30 (0.090)

204 BOLT, HEX HEAD (M6 X 25 – 8.5 N·m)
205 RETAINER ASSEMBLY, INPUT SHAFT BEARING
210 RING, SNAP (SELECTIVE)
211 SPACER, INPUT SHAFT
212 SHIM, (SELECTIVE)
215 RACE, BALL BEARING (OUTER)

LH0079-5LM60

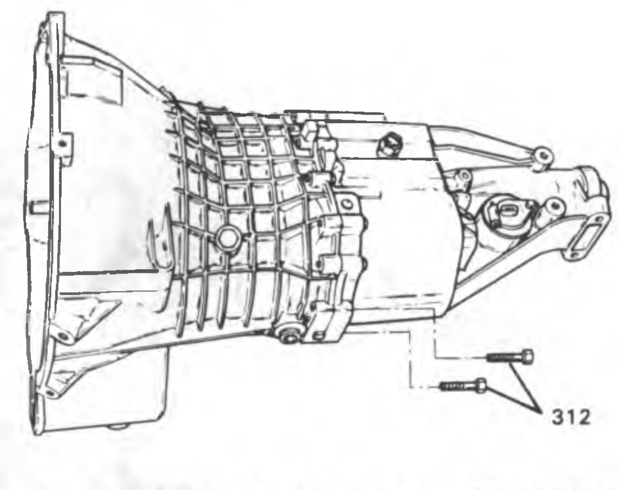
Figure 77 Install Input Shaft Bearing Retainer Assembly



243 PLUNGER, SHIFT SHAFT DETENT
244 SPRING, SHIFT SHAFT DETENT PLUNGER
245 PLUG
313 SWITCH ASSEMBLY, BACK-UP LAMP
314 SENSOR ASSEMBLY, ELECTRONIC SPEED
315 O-RING
316 SENSOR, ELECTRONIC SPEED
317 BOLT, HEX HEAD (M6 X 16)

LH0080-5LM60

Figure 78 External Components Install



312 BOLT, HEX HEAD (M8 X 50 – 35 N·m

LH0081-5LM60

Figure 79 Bolts Install

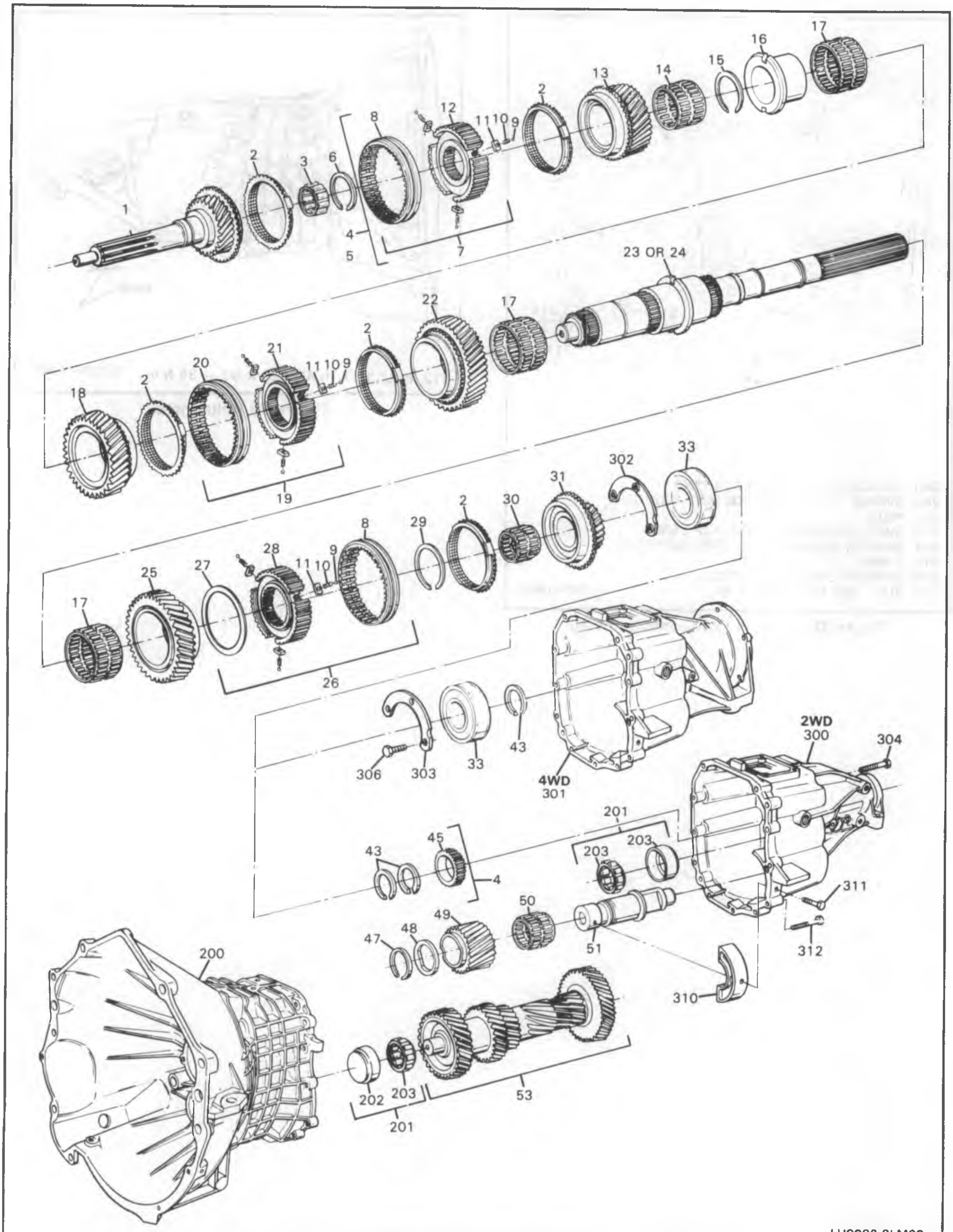


Figure 80 Transmission Gear Components

1	SHAFT, INPUT
2	RING, SYNCHRONIZER
3	BEARING, PILOT
4	SHAFT ASSEMBLY, MAIN (2WD)
5	SHAFT ASSEMBLY, MAIN (4WD)
6	RING, SNAP (SELECTIVE)
7	SYNCHRONIZER ASSEMBLY, 3-4
8	SLEEVE, SYNCHRONIZER
9	BALL, SYNCHRONIZER DETENT
10	SPRING, SYNCHRONIZER DETENT
11	KEY, SYNCHRONIZER
12	HUB, 3-4 SYNCHRONIZER
13	GEAR ASSEMBLY, 3RD SPEED
14	BEARING ASSEMBLY, 3RD SPEED GEAR NEEDLE
15	RING, SNAP (SELECTIVE)
16	RACE, 2ND SPEED GEAR NEEDLE BEARING (INNER)
17	BEARING ASSEMBLY, SPEED GEAR NEEDLE
18	GEAR ASSEMBLY, 2ND SPEED
19	SYNCHRONIZER ASSEMBLY, 1-2
20	SLEEVE, 1-2 SYNCHRONIZER
21	HUB, 1-2 SYNCHRONIZER
22	GEAR, 1ST SPEED
23	SHAFT, OUTPUT (2WD)
24	SHAFT, OUTPUT (4WD)
25	GEAR ASSEMBLY, REVERSE SPEED
26	SYNCHRONIZER ASSEMBLY, 5TH-REVERSE
27	RING, SPIRAL LOCK
28	HUB, 5TH-REVERSE SYNCHRONIZER
29	RING, SNAP (SELECTIVE)
30	BEARING ASSEMBLY, 5TH SPEED GEAR NEEDLE
31	GEAR ASSEMBLY, 5TH SPEED
33	BEARING ASSEMBLY, OUTPUT SHAFT
43	RING, SNAP
45	ROTOR, SPEED SENSOR
46	IDLER ASSEMBLY, REVERSE
47	RING, SNAP
48	WASHER, THRUST
49	GEAR, REVERSE
50	BEARING ASSEMBLY, NEEDLE
51	SHAFT, REVERSE IDLER
53	COUNTERSHAFT ASSEMBLY
200	HOUSING, FRONT
201	BEARING ASSEMBLY, COUNTERSHAFT
202	RACE, COUNTERSHAFT BEARING
203	BEARING, COUNTERSHAFT
300	HOUSING, REAR (2WD)
302	RETAINER, OUTPUT SHAFT BEARING (2WD)
303	RETAINER, OUTPUT SHAFT BEARING (4WD)
304	BOLT, HEX HEAD (M8 X 50) (2WD)
306	BOLT, HEX HEAD (M8 X 25) (4WD)
310	SUPPORT, IDLER SHAFT
311	BOLT, HEX HEAD (M8 X 50)
312	BOLT, HEX HEAD (M8 X 50)

LH0083-5LM60

Figure 81 Transmission — Gear Components Legend

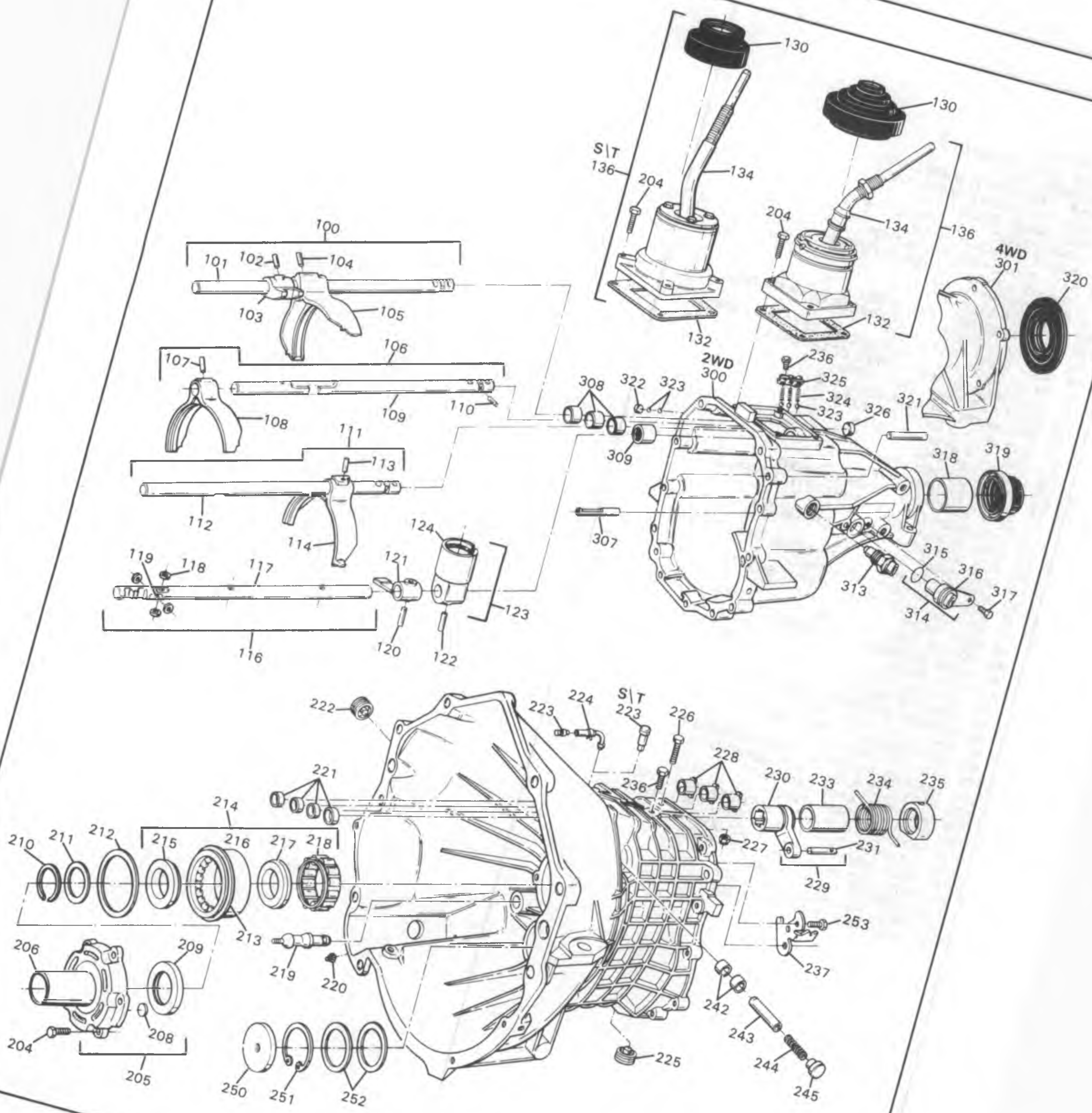


Figure 82 Transmission Shift Mechanism and Case Components

LH0084-5LM60

100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
101 RAIL, 1ST & 2ND SHIFT
102 PIN, ROLL
103 YOKE, 1ST & 2ND SHIFT
104 PIN, ROLL
105 FORK, 1ST-2ND SHIFT
106 RAIL ASSEMBLY, 3RD & 4TH SHIFT
107 PIN, ROLL (3RD & 4TH FORK)
108 FORK, 3RD & 4TH SHIFT
109 RAIL, 3RD & 4TH
110 PIN, 3RD & 4TH SHIFT INTERLOCK
111 RAIL ASSEMBLY, 5TH & REVERSE SHIFT
112 RAIL, 5TH & REVERSE
113 PIN, ROLL
114 FORK, 5TH & REVERSE SHIFT
116 SHAFT ASSEMBLY, SHIFT
117 SHAFT, SHIFT
118 ROLLER, SHIFT SHAFT
119 PIN, ROLLER
120 PIN, ROLL (6 X 28mm)
121 FINGER
122 PIN, ROLL
123 SOCKET ASSEMBLY, SHIFT SHAFT
130 BOOT
132 SEAL, SHIFT LEVER HOUSING
134 NUT, HEX JAM
136 HOUSING ASSEMBLY, SHIFT LEVER
200 HOUSING, FRONT
204 BOLT, HEX HEAD (M6 X 25mm)
205 RETAINER ASSEMBLY, INPUT SHAFT BEARING
206 RETAINER, INPUT SHAFT BEARING
208 WASHER, INPUT BEARING RETAINER
209 SEAL, INPUT SHAFT BEARING RETAINER OIL
210 RING, SNAP (SELECTIVE)
211 SPACER, INPUT SHAFT
212 SHIM, (SELECTIVE)
213 RING, INPUT SHAFT BEARING ASSEMBLY SNAP
214 BEARING ASSEMBLY, INPUT SHAFT
215 RACE, BALL BEARING (OUTER)
216 RACE, BEARING ASSEMBLY (OUTER)
217 RACE, BALL BEARING (INNER)
218 BEARING, ROLLER
219 PIVOT ASSEMBLY, CLUTCH FORK
220 FITTING, LUBE
221 PLUG, SHIFT SHAFT/RAILS
222 PLUG, OIL FILL
223 BREATHER ASSEMBLY
224 ADAPTER, BREATHER HOSE
225 PLUG, OIL DRAIN
226 BOLT, HEX HEAD (M10 X 25.4mm)
227 NUT, LOCK
228 BEARING, SHIFT RAIL FRONT HOUSING
229 LEVER ASSEMBLY, SHIFT SHAFT (230 & 231)
230 LEVER, SHIFT SHAFT
231 PIN, SHIFT SHAFT LEVER
233 SLEEVE, BIAS SPRING
234 SPRING, BIAS LOAD TORSIONAL
235 SEAT, BIAS SPRING & SLEEVE
236 BOLT, HEX HEAD (M6 X 16mm)
237 SUPPORT, 5TH & REVERSE DETENT CAM
238 CAM, 5TH & REVERSE DETENT
242 BUSHING, DETENT PLUNGER
243 PLUNGER, SHIFT SHAFT DETENT
244 SPRING, SHIFT SHAFT DETENT PLUNGER
245 PLUG
250 PLUG, COUNTERSHAFT BEARING
251 RING, SNAP
252 SHIM(S)
253 BOLT, PAN HEAD (M6 X 18mm)
300 HOUSING, REAR (2WD)
301 HOUSING, REAR (4WD)
307 TUBE ASSEMBLY, OIL DELIVERY
308 BEARING, REAR HOUSING SHIFT RAIL
309 BEARING, REAR HOUSING SHIFT SHAFT
313 SWITCH ASSEMBLY, BACK-UP LAMP
314 SENSOR ASSEMBLY, ELECTRONIC SPEED
315 O-RING
316 SENSOR, ELECTRONIC SPEED
317 BOLT, HEX HEAD (M6 X 16)
318 BEARING, REAR EXTENSION (2WD)
319 SEAL, SLIP YOKE OIL (2WD)
320 SEAL, OUTPUT SHAFT OIL (4WD)
321 PIN, DOWEL
322 PLUG
323 BALL, DETENT/INTERLOCK
324 SPRING, DETENT
325 COVER, DETENT SPRING
326 PLUG

LH0085-5LM60

Figure 83 Transmission Shift Mechanism and Case Components Legend

FASTENER TORQUE

ILLUSTRATION NUMBERS		N·m	Lbs. Ft.
204	Retainer Assembly, Input Bearing Bolts	8.5	7
222	Plug, Oil Fill	60	46
225	Plug, Oil Drain	60	46
226	5th & Reverse Rail Deflection Bolt	35	27
236	Seat, Bias Spring and Sleeve Bolt	8.5	7
249	Spring, 5th & Reverse Detent Hex Head Plug	60	46
304-306	Retainer, Output Shaft Bearing Bolts	22	17
311	Support, Idler Shaft Bolt	22	17
312	Housing Front/Rear	35	27
317	Sensor, Electronic Speed Bolt	9	7
204	Housing Assembly, Shift Lever	8.5	7

LUBRICATION

Capacity	1.98L	2.08 qts
Type Recommended:		
Manual Transmission Fluid 5W-30	GM P/N 1052931	

LH0086-5LM60

Figure 84 Specifications

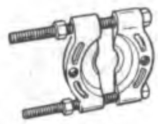
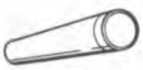
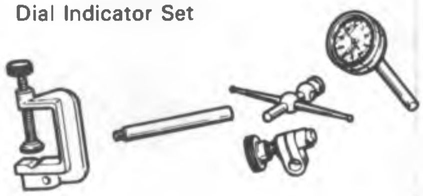
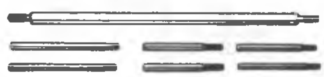
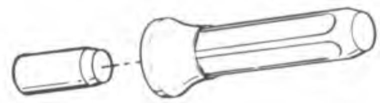
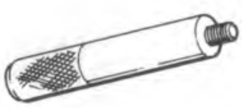
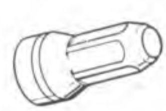
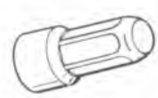
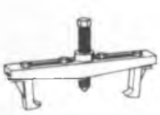
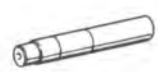
Holding Fixture  J 3289-20, J 8763-02, J 8763-21	Speedometer Gear Puller Adapter  J 21427-01	Input Shaft Remover/Installer Press Tube with Cap  J 36183
Slide Hammer With Adapter  J 6125-1B	Separator Plate or Equivalent  J 22912-01	Adapter Press Tube Reducer  J 36184
Bearing Race Installer  J 6133-01	Slide Hammer With Pilot Bearing Puller  J 23907	Universal Driver Handle  J 36190
Dial Indicator Set  J 8001	Dial Indicator Stand and Guide Pin Set  J 25025-B	4WD Output Shaft Oil Seal Installer and Seal Protector  J 36502-2A J 36502
Universal Driver Handle  J 8092	Heat Gun or Equivalent  J 25070	2WD Output Shaft Oil Seal Installer  J 36503
Gear Puller or Equivalent  J 8105	2WD Output Shaft Oil Seal Remover  J 26941	Input Shaft Bearing Retainer Oil Seal Installer  J 36504
Speedometer Gear Puller  J 8433	Input Shaft Bearing Retainer Oil Seal Remover  J 29369-2	5th and Reverse Detent Bushing Remover/Installer J 36506  LH0087-5LM60

Figure 85 Special Tools

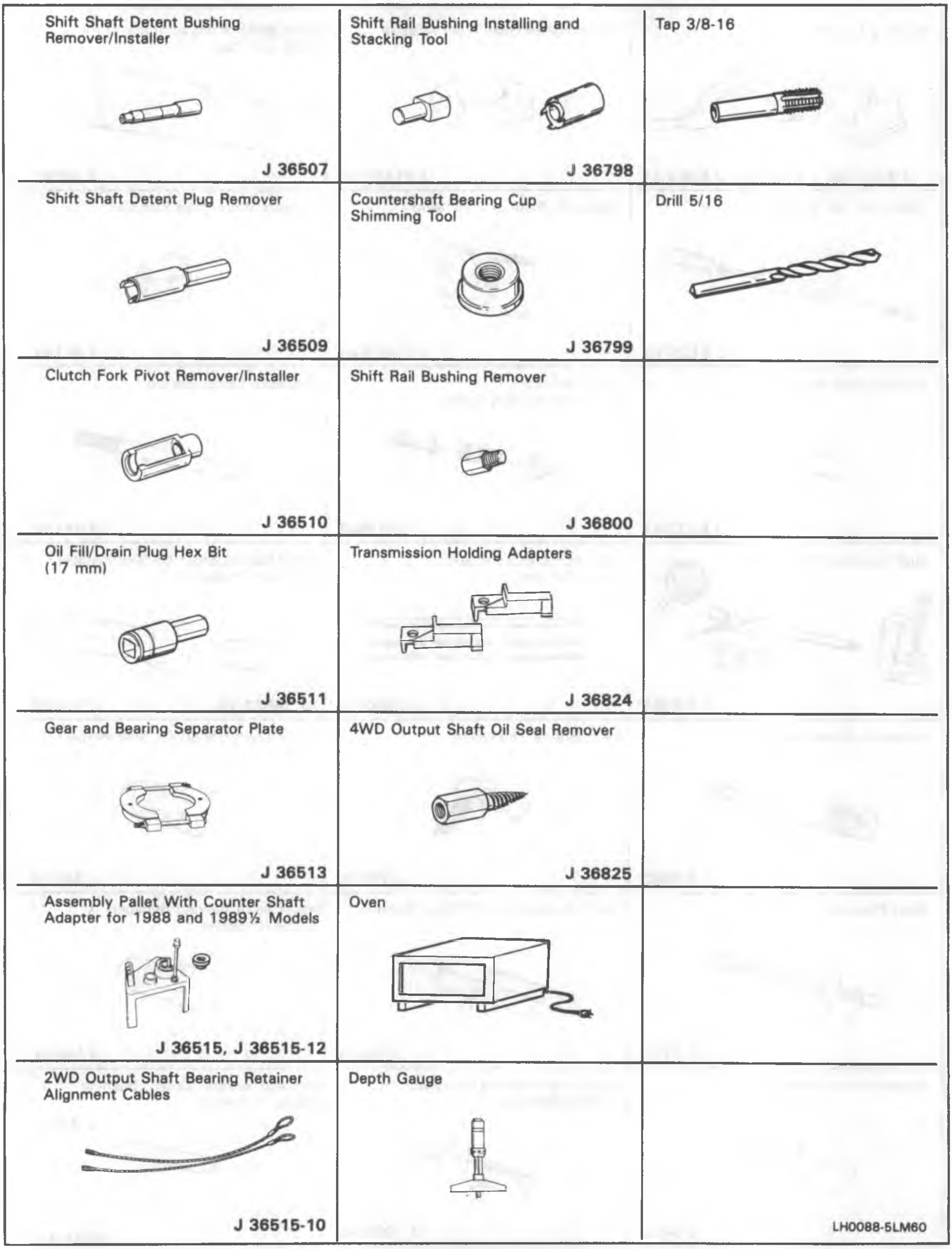


Figure 86 Special Tools

SECTION 7B2

HM-117 MANUAL TRANSMISSION UNIT REPAIR

RPO M20

CONTENTS

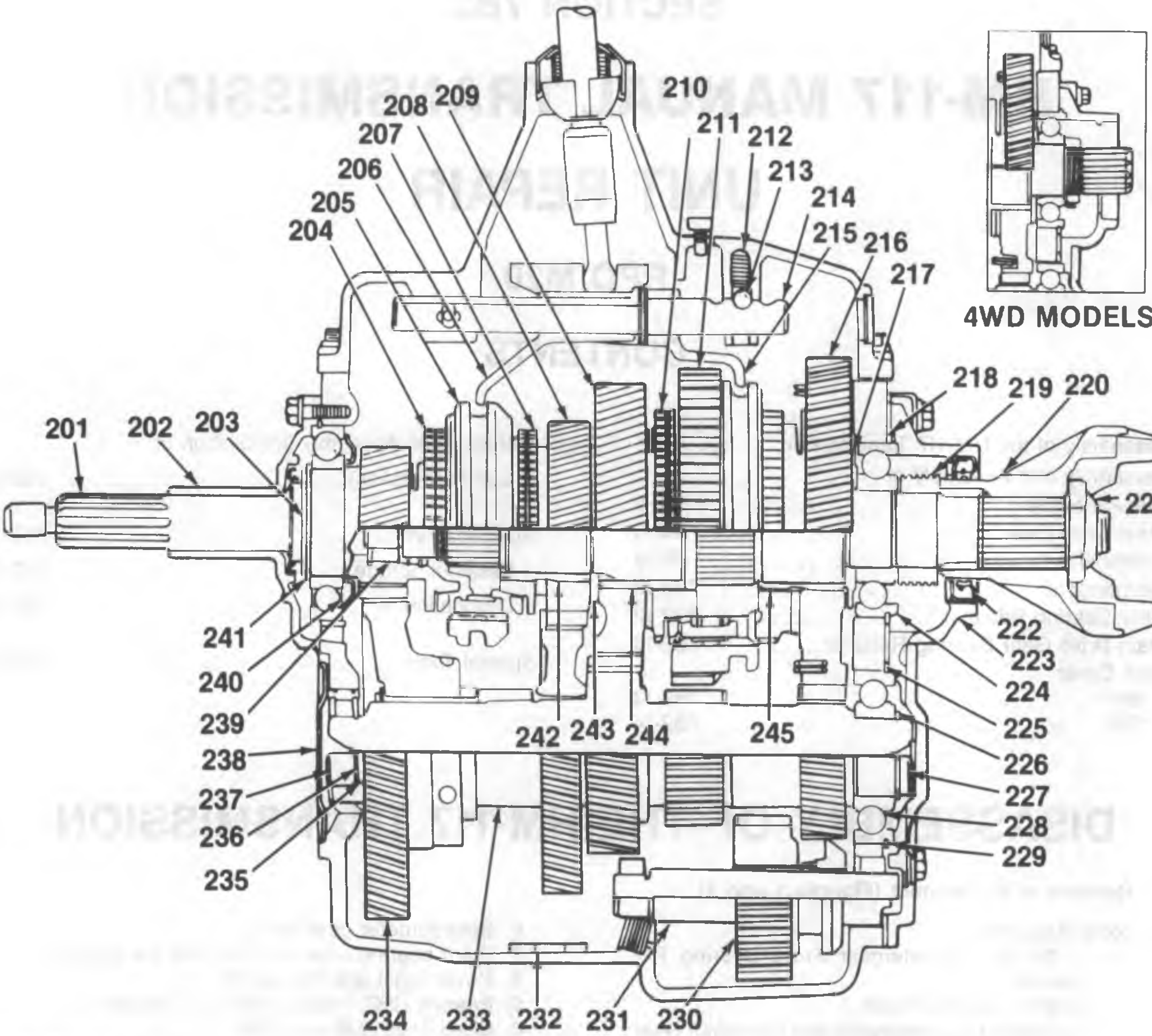
DISASSEMBLY OF THE HM-117 TRANSMISSION

Remove or Disconnect (Figures 1 and 2)

Tools Required:
- J 28509-A Countergear Front Bearing Remover
- J 8433 Bearing Puller
- J 22832-01 Countergear and Mainshaft Rear Bearing Remover
- J 35907 Mainshaft Lock Nut Wrench (4WD models only)

- Speedometer driven gear, switches and any external components.

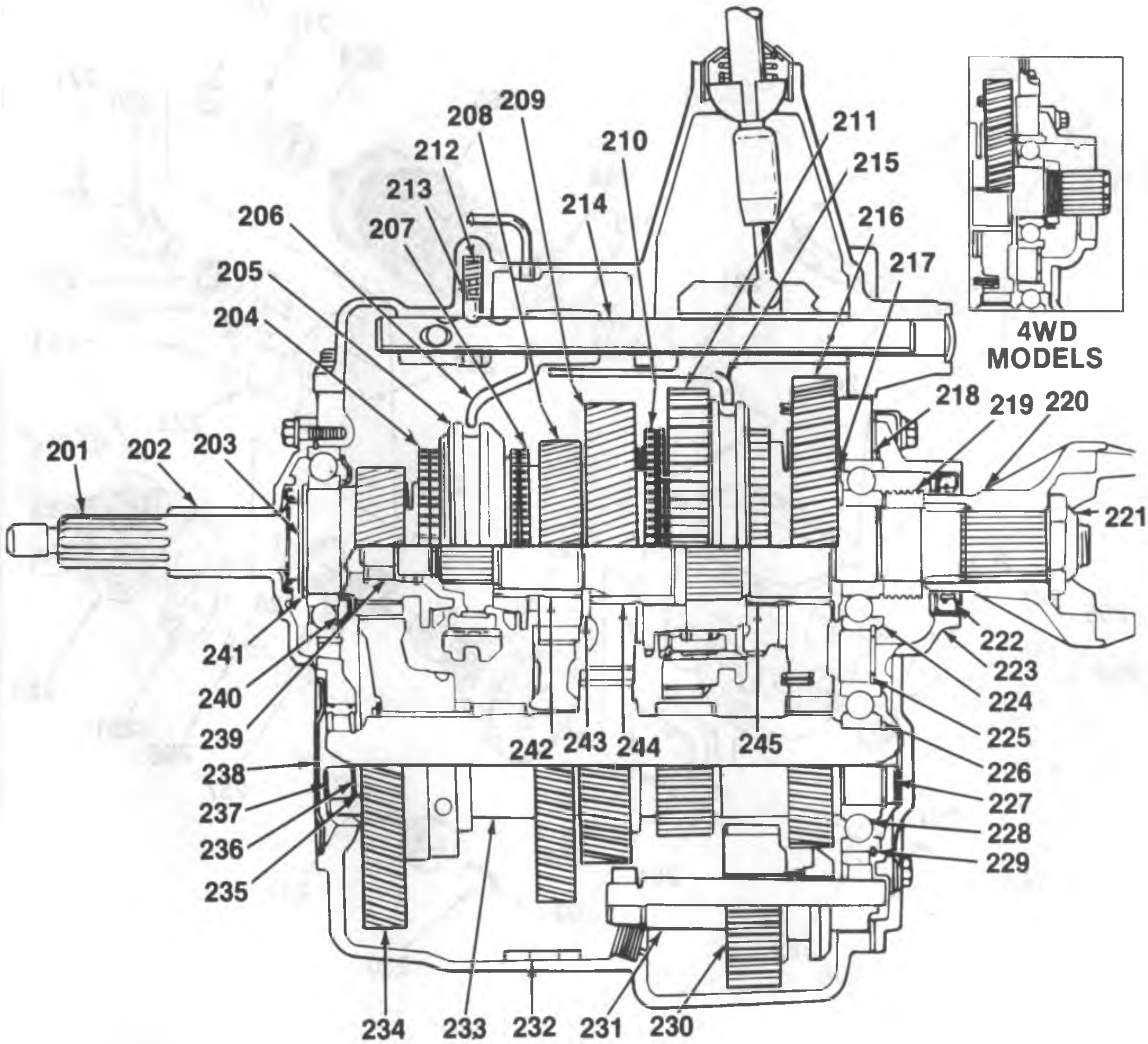
1. Shifter housing.
   - Remove shift housing bolts.
   - Move the reverse shift fork to partially engage the reverse idler gear.
   - Lift off the housing.
2. Flange nut (221).
   - Lock up transmission in two gears before removing nut.
3. Brake drum and the flange, or the yoke (220).
4. Parking brake assembly.
   - Mainshaft lock nut (256) and the washer using J 35907 (4WD models only).
5. Rear bearing retainer (223) and the gasket.
6. Speedometer gear (219).
7. Front bearing retainer (202) and the gasket.
8. Cover (238) and the gasket.
9. Bearing (237), using J 28509-A (figure 3).
10. Snap rings (225 and 226).
11. Bearing (228), using J 22832-01 and J 8433, (figure 4).
    - J 22832-01 must be seated in the groove completely.
12. Main drive gear (201).
    - Remove the bearing to case (large) snap ring.
    - Rotate the gear so the cutout portion is down to clear the countershaft, (figure 5).
    - Pull the drive gear from the case.
13. 4th speed blocker ring (204).
14. Bearing snap ring (218).
15. Bearing (224), using J 22832-01 and J 8433, (figure 6).
    - 1st speed thrust washer.
16. Mainshaft (250) from the case.
17. Countershaft (227) from the case.
18. Idler gear (230) and the shaft.
    - Drive the shaft from the case.



201. Main Drive Gear
202. Bearing Retainer
203. Snap Ring - Bearing to Case
204. 4th Speed Blocker Ring
205. 3rd and 4th Synchronizer
206. 3rd and 4th Shift Fork
207. 3rd Speed Blocker Ring
208. 3rd Speed Gear
209. 2nd Speed Gear
210. 1st and 2nd Synchronizer Hub
211. Reverse Driven Gear
212. Interlock Spring
213. Detent Ball
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
216. 1st Speed Gear
217. Thrust Washer
218. Snap Ring
219. Speedometer Drive Gear
220. Output Yoke
221. Flange Nut
222. Rear Bearing Retainer Oil Seal
223. Rear Bearing Retainer
224. Main Shaft Rear Bearing
225. Snap Ring - Bearing to Case
226. Snap Ring - Bearing to Gear
227. Counter Gear
228. Counter Gear Rear Bearing
229. Snap Ring
230. Reverse Idler Gear
231. Reverse Idler Shaft
232. Case Magnet
233. Spacer
234. Driven Gear
235. Thrust Washer
236. Snap Ring
237. Front Counter Gear Bearing
238. Counter Gear Front Cover
239. Pilot Bearing Rollers
240. Clutch Gear Oil Slinger
241. Snap Ring - Bearing to Shaft
242. 3rd Speed Gear Bushing
243. Thrust Washer
244. 2nd Speed Gear Bushing
245. 1st Speed Gear Bushing

F-04631

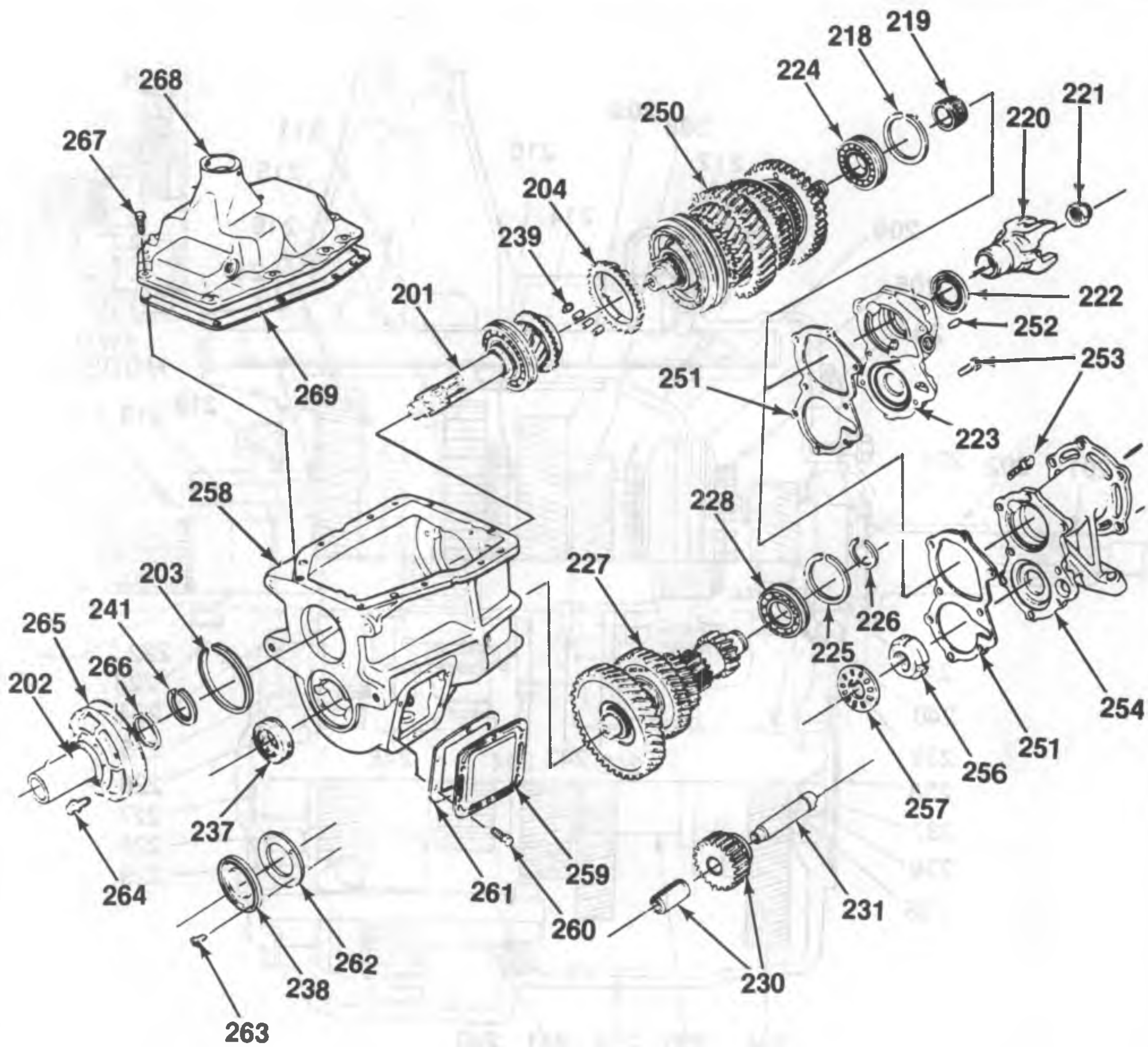
Figure 1A—R/V/P Four Speed Transmission



201. Main Drive Gear
202. Bearing Retainer
203. Snap Ring - Bearing to Case
204. 4th Speed Blocker Ring
205. 3rd and 4th Synchronizer
206. 3rd and 4th Shift Fork
207. 3rd Speed Blocker Ring
208. 3rd Speed Gear
209. 2nd Speed Gear
210. 1st and 2nd Synchronizer Hub
211. Reverse Driven Gear
212. Interlock Spring
213. Detent Pin
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
216. 1st Speed Gear
217. Thrust Washer
218. Snap Ring
219. Speedometer Drive Gear
220. Output Yoke
221. Flange Nut
222. Rear Bearing Retainer Oil Seal
223. Rear Bearing Retainer
224. Main Shaft Rear Bearing
225. Snap Ring - Bearing to Case
226. Snap Ring - Bearing to Gear
227. Counter Gear
228. Counter Gear Rear Bearing
229. Snap Ring
230. Reverse Idler Gear
231. Reverse Idler Shaft
232. Case Magnet
233. Spacer
234. Driven Gear
235. Thrust Washer
236. Snap Ring
237. Front Counter Gear Bearing
238. Counter Gear Front Cover
239. Pilot Bearing Rollers
240. Clutch Gear Oil Slinger
241. Snap Ring - Bearing to Shaft
242. 3rd Speed Gear Bushing
243. Thrust Washer
244. 2nd Speed Gear Bushing
245. 1st Speed Gear Bushing

F-04631

Figure 1B—C/K Four Speed Transmission



201. Main Drive Gear
202. Bearing Retainer
203. Snap Ring - Bearing to Case
204. 4th Speed Blocker Ring
218. Snap Ring
219. Speedometer Drive Gear
220. Output Yoke
221. Flange Nut
222. Oil Seal
223. Rear Bearing Retainer
224. Main Shaft Rear Bearing
225. Snap Ring - Bearing to Case
226. Snap Ring - Bearing to Gear
227. Counter Gear
228. Counter Gear Rear Bearing
230. Reverse Idler Gear
231. Reverse Idler Gear Shaft
237. Counter Gear Front Bearing
238. Counter Gear Front Cover
239. Pilot Bearings
241. Snap Ring - Bearing to Shaft
250. Main Shaft
251. Gasket (2WD & 4WD)
252. Dowel Pin
253. Screw
254. Transfer Case Adapter
256. Rear Lock Nut
257. Lock Washer
258. Transmission Case
259. Screw
260. Cover Plate
261. Gasket
262. Gasket
263. Screw
264. Screw
265. Gasket
266. Oil Seal
267. Screw
268. Shift Cover
269. Gasket

B-08815

Figure 2—Transmission Components

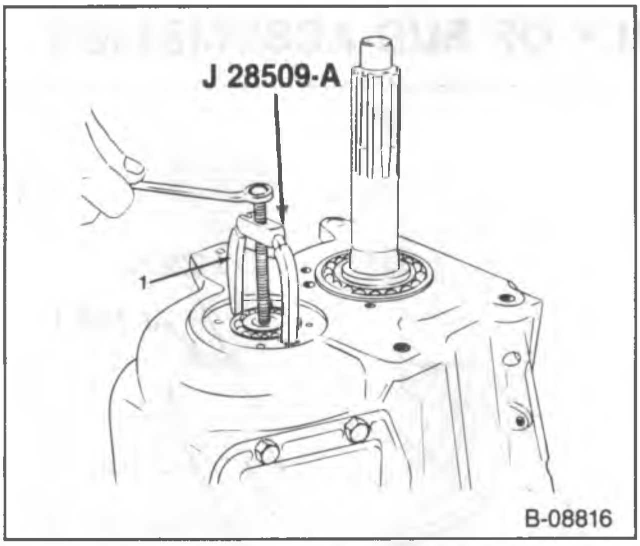


Figure 3—Removing the Countergear Front Bearing

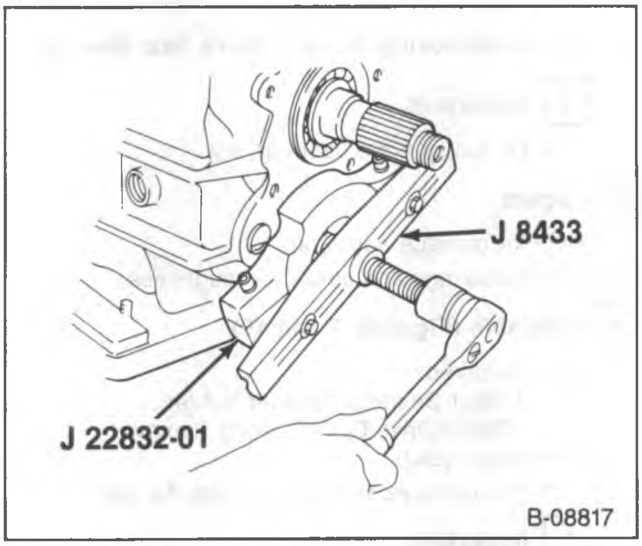


Figure 4—Removing the Countergear Rear Bearing

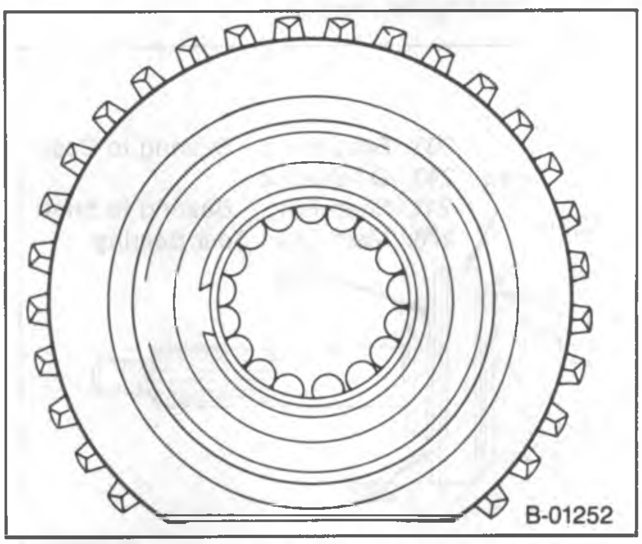


Figure 5—Main Drive Gear Cutout

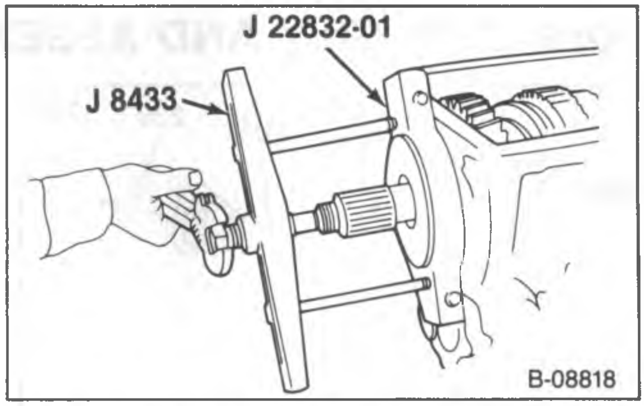


Figure 6—Removing the Mainshaft Rear Bearing

DISASSEMBLY AND ASSEMBLY OF SUB-ASSEMBLIES

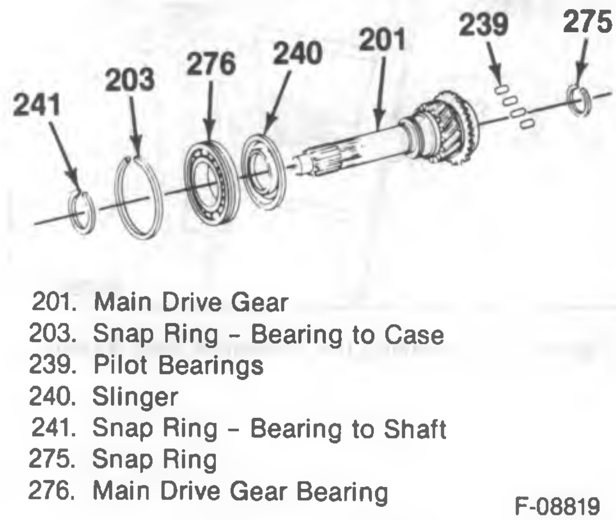


Figure 7—Main Drive Gear Components

MAIN DRIVE GEAR

Disassemble (Figure 7)

Tools Required:
J 358-1 Bearing Remover Holder
J 22872 Drive Gear Bearing Remover

1. Pilot bearings (239).
   - Do not remove the snap ring from the bore.
2. Bearing retainer (276).
3. Snap ring (241).
4. Bearing (278), using J 358-1 and J 22872, (figures 8 and 9)
5. Slinger (240).

Clean

- All parts in a suitable solvent.

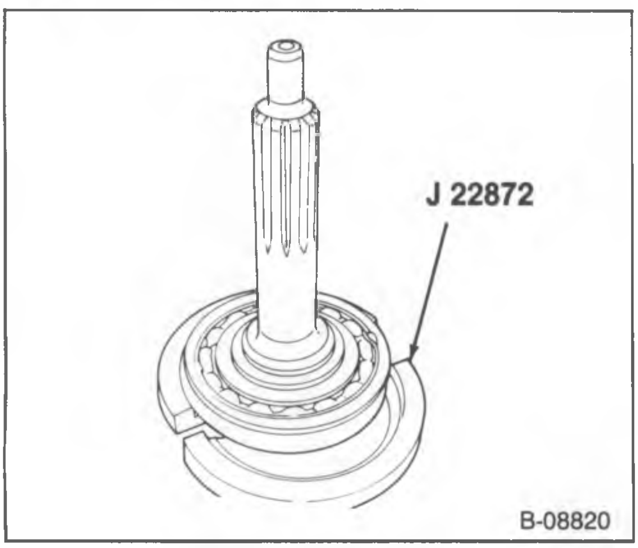


Figure 8—Installing Tool J-22872

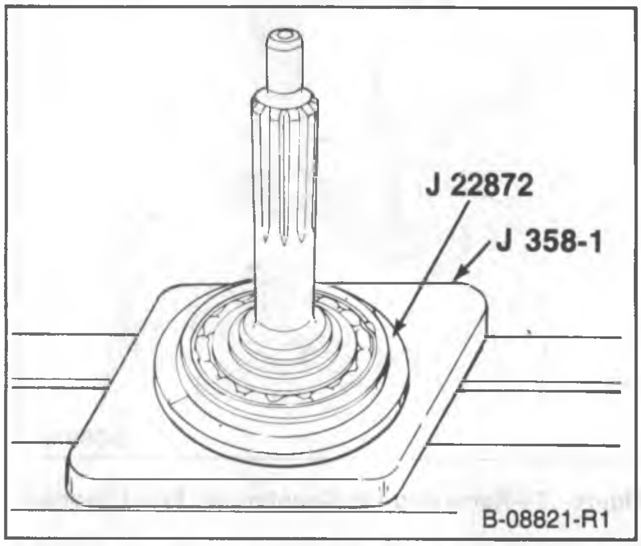


Figure 9—Removing the Main Drive Gear Bearing

Important

- Do not spin the bearings dry.

Inspect

1. Parts for damage and wear.
2. Oil the bearings and check for roughness.

Assemble (Figures 7 and 10)

Tools Required:
J 358-1 Bearing Remover Holder
J 22872 Drive Gear Bearing Remover

1. New slinger (240).
   - The concave side goes toward the gear.

Important

- Do not damage or bend the slinger when installing the bearing.

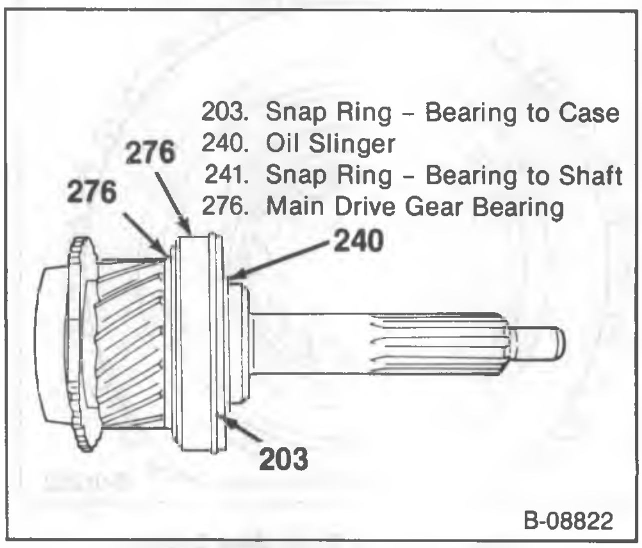
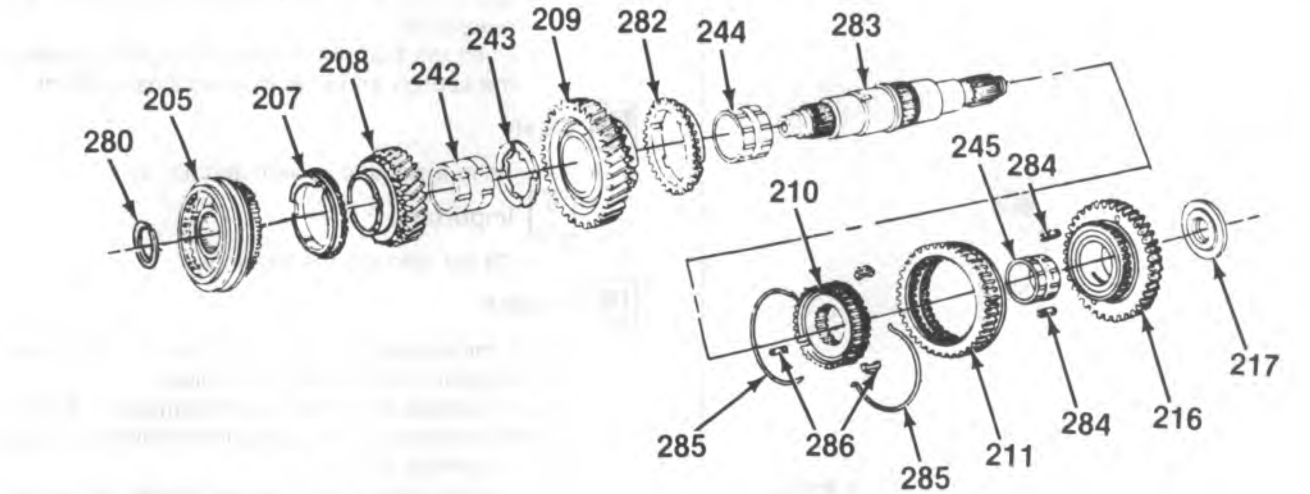


Figure 10—Main Drive Gear Assembly



205. 3rd and 4th Synchronizer
207. 3rd Speed Blocker Ring
208. 3rd Speed Gear
209. 2nd Speed Gear
210. 1st and 2nd Synchronizer Hub
211. Reverse Driven Gear
216. 1st Speed Gear
217. Thrust Washer
242. 3rd Speed Gear Bushing
243. Thrust Washer
244. 2nd Speed Gear Bushing
245. 1st Speed Gear Bushing
280. Snap Ring
282. 2nd Speed Blocker Ring
283. Shaft
284. Spring Pin
285. Synchronizer Spring
286. Synchronizer Key

B-08823

Figure 11 –Mainshaft Components

2. Bearing (277), using J 358-1 and J 22872, (figures 8 and 9).
   - The bearing snap ring groove goes away from the gear.
3. New bearing to shaft (small) snap ring (241).
4. New bearing to case (large) snap ring (203).
5. Pilot bearings (239).
   - Use chassis grease to hold the bearings in place.

MAINSHAFT

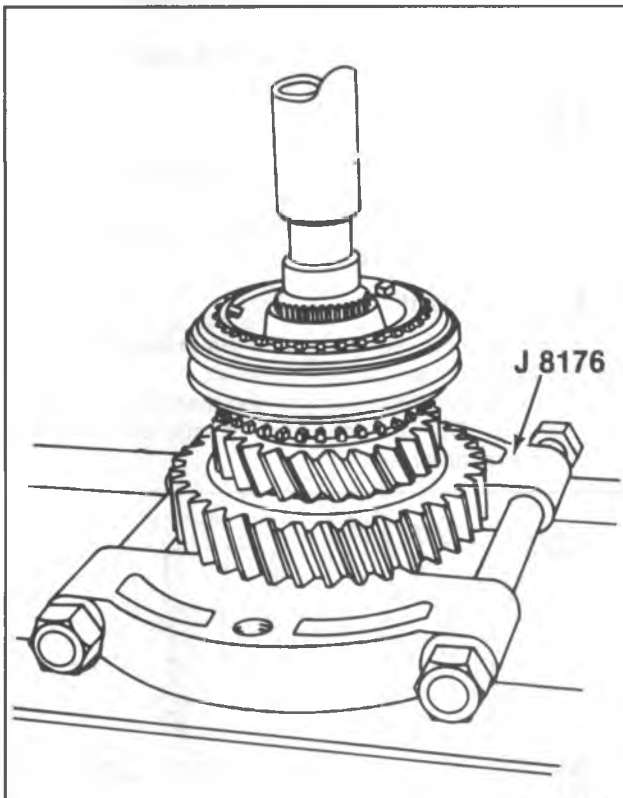
Disassemble (Figure 11)

1. Thrust washer and the 1st speed gear (216).
2. Reverse driven gear (211).
3. 3-4 synchronizer snap ring (280).
   - Do not let the synchronizer come apart.
4. 3-4 synchronizer, the 3rd speed gear (208), the 2nd speed gear (209), the bushing, and the thrust washer (243).
   - Support the second speed gear and press the mainshaft out, (figure 12).

Important

- Do not let the mainshaft fall to the floor.

5. 2nd speed blocker ring (282).
6. 1st speed gear bushing and the 1-2 synchronizer hub (210).



B-06166

Figure 12 –Removing the Mainshaft from the 2nd and 3rd Speed Gears

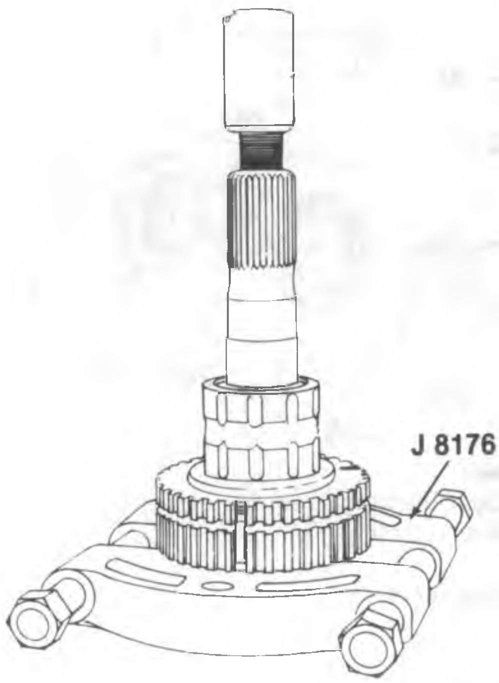


Figure 13 —Removing the Mainshaft from the 1st and 2nd Speed Synchronizer Hub

- Support the hub on J 8176 and press the mainshaft out, (figure 13).

Important

- Do not let the mainshaft fall to the floor.

7. 2nd speed gear bushing (244).
   - Use a cold chisel to split the bushing if it is worn or damaged.

Important

- Do not scratch or gouge the mainshaft.

8. 3-4 synchronizer (205), (figure 14).
   - The synchronizer hub and sleeve are a select fit. Do not mix the parts of the two synchronizers.

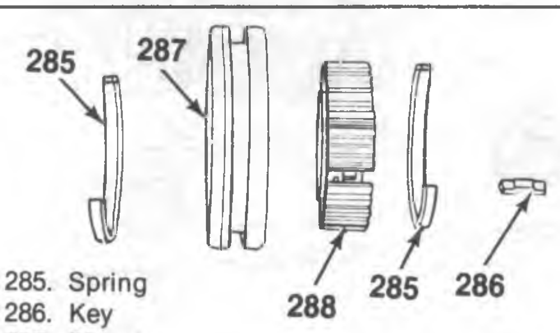


Figure 14 —Synchronizer Components

- Mark the hub and sleeve alignment for reassembly.
- Push the hub out of the sleeve while holding the springs and keys to avoid loosing them.

Clean

- All parts in a suitable solvent and air dry.

Important

- Do not spin dry the bearings.

Inspect

1. Gears for cracks, chipped gear teeth, and other damage that could cause gear noise.
2. Thrust washers and bushings for damage and wear.
3. Related surfaces on the gears like thrust faces and bearing surface diameters.
4. The reverse sliding gear for a sliding fit on the synchronizer hub without excess radial or circular play. If the sliding gear is not free on the hub, inspect it for burrs on the ends of the internal splines. Remove any burrs by honing as required.
5. Synchronizer sleeves for a sliding fit on the synchronizer hubs and for the hubs a snug fit on the mainshaft splines.
6. Synchronizer springs and keys for looseness and damage.
7. Brass synchronizer rings for excess wear and damage.
8. All gear teeth for excess wear.
9. Bearings and bearing surfaces for nicks, burrs and wear.
10. Lubricate all roller bearings with light engine oil and check for rough rotation.

Assemble (Figure 11)

Tools Required:
J 22873 Mainshaft Bushing Installer
J 22875 3rd Gear Assembly Tool

NOTICE: The mainshaft 1st, 2nd and 3rd speed gear bushings are sintered iron. The bushings MUST BE PRESSED ON SEPARATELY (NOT WITH THE HUBS) OR THE BUSHINGS WILL BE SMASHED CAUSING A PREMATURE FAILURE (OR LOCK UP) BECAUSE OF NO ENDPLAY FOR THE SPEED GEARS.

1. 3-4 synchronizer (205), (figure 15).
   - Place the keys in the hub.
   - Engage the springs in different slots in either side of the hub so they support all the keys.
   - Slide the sleeve onto the hub aligning the marks made during disassembly.
2. 2nd speed bushing, using J 22873, (figure 16).
3. 1-2 synchronizer hub (210), (figure 17).
   - A minimum press of 681 kg (1500 lbs.) is required to move the hub.
   - The annulus must be to the rear of the shaft.
4. Synchronizer keys and the springs.
5. 1st speed bushing (245), using J 22873, (figure 18).
6. 2nd speed blocker ring, the 2nd speed gear (209) and the 3rd speed thrust washer (243) (figure 19).
   - The tab on the thrust washer must be in the slot in the mainshaft.
7. 3rd speed bushing (242) using J 22875 (figure 19).

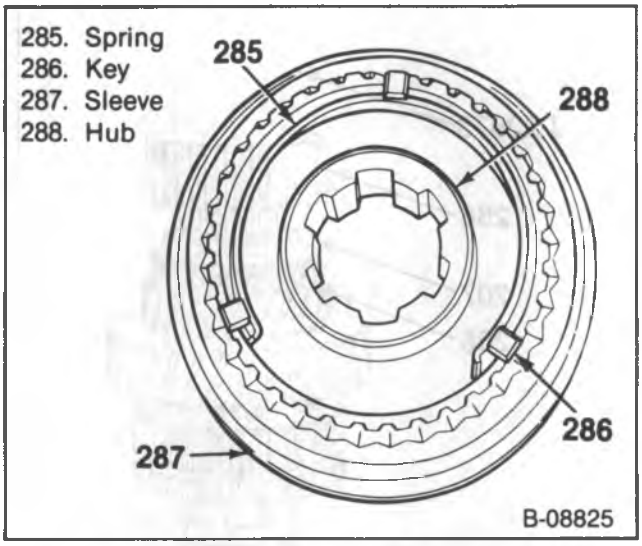


Figure 15 –Synchronizer Assembled

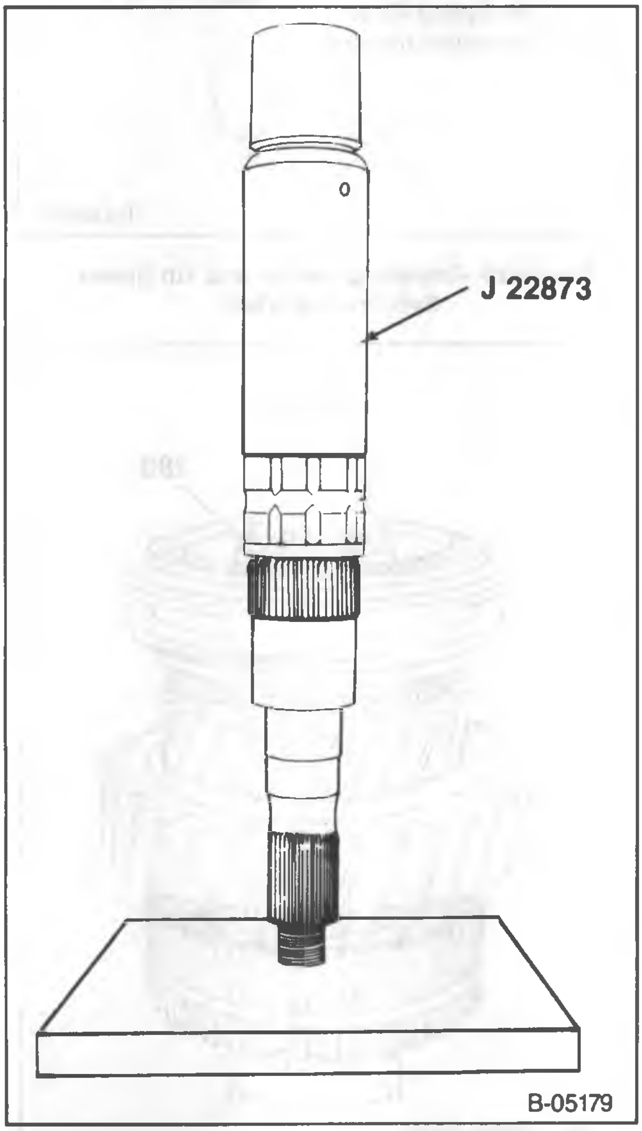


Figure 16 –Installing the 2nd Speed Bushing

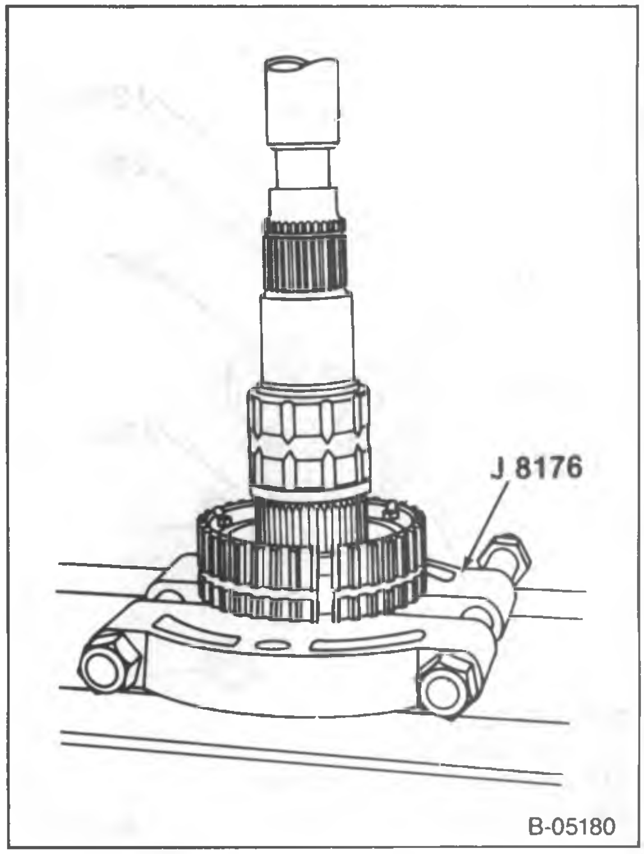


Figure 17 –Installing the 1st and 2nd Synchronizer

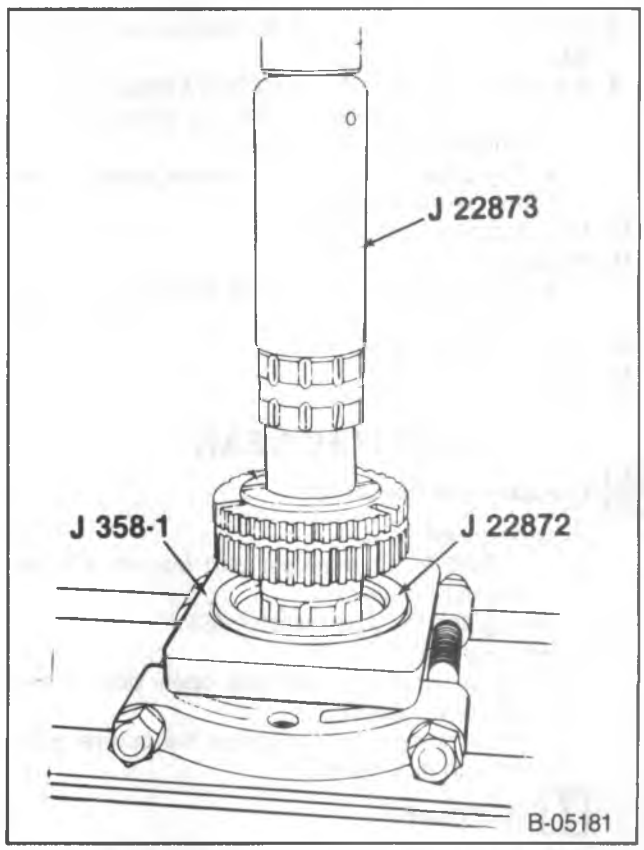


Figure 18 –Installing the 1st Speed Gear Bushing

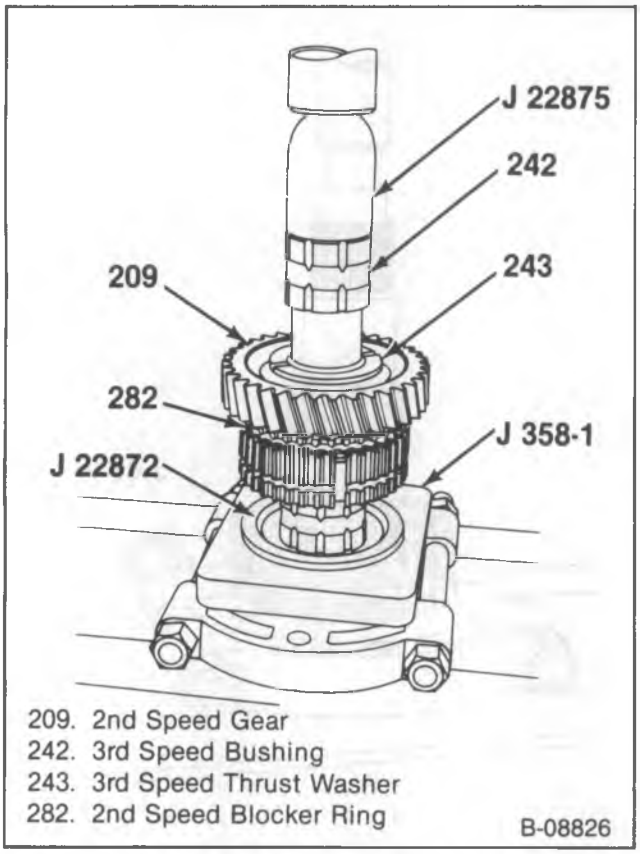


Figure 19 –Installing the 3rd Speed Gear Bushing

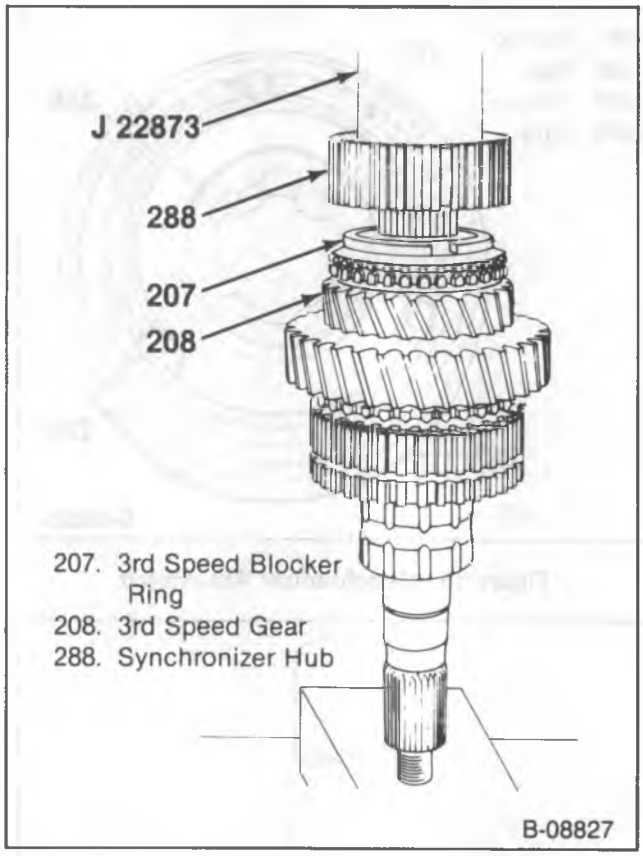


Figure 20 –Installing the 3rd and 4th Speed Synchronizer Hub

8. 3rd speed gear (208) and the blocker ring (figure 20).
9. 3-4 synchronizer (205) using J 22873 (figure 20).
   - A minimum press of 681 kg (1500 lbs.) is required to move the hub.
   - The stepped side of the sleeve goes to the front of the mainshaft.
10. New snap ring, (figure 21).
11. Reverse gear (211).
    - The shift fork groove goes to the rear of the mainshaft.
12. 1st speed gear (216).
13. Thrust washer (217).

COUNTERGEAR

Disassemble (Figure 22)

Tools Required:

J 22832-01 Countergear and Mainshaft Rear Bearing Remover

1. Snap ring and the thrust washer (235).
2. Driven gear (234).
   - Install J 22832-01 with the open side to the spacer (figure 23).
   - Support the gear and press the countergear through (figure 24).

Important

- Do not let the countergear fall to the floor.

3. Spacer (233).
4. 3rd speed gear (290).

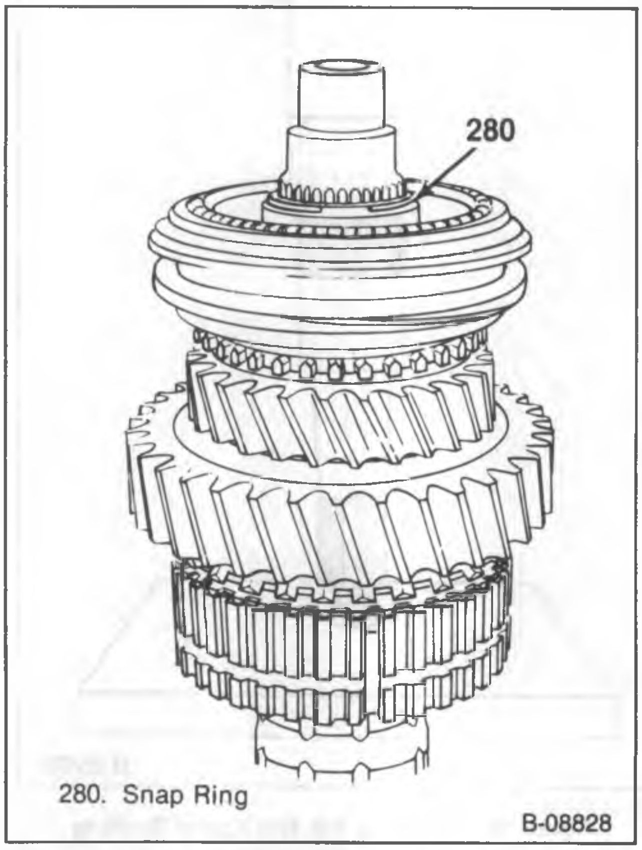


Figure 21 –3rd and 4th Synchronizer Hub Snap Ring

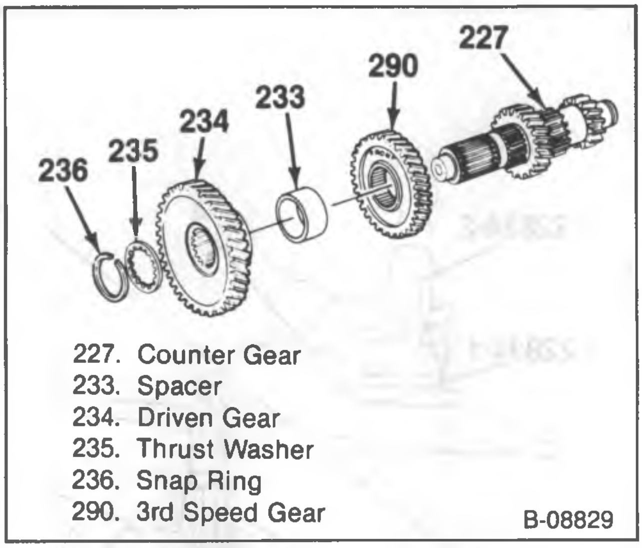


Figure 22—Countergear

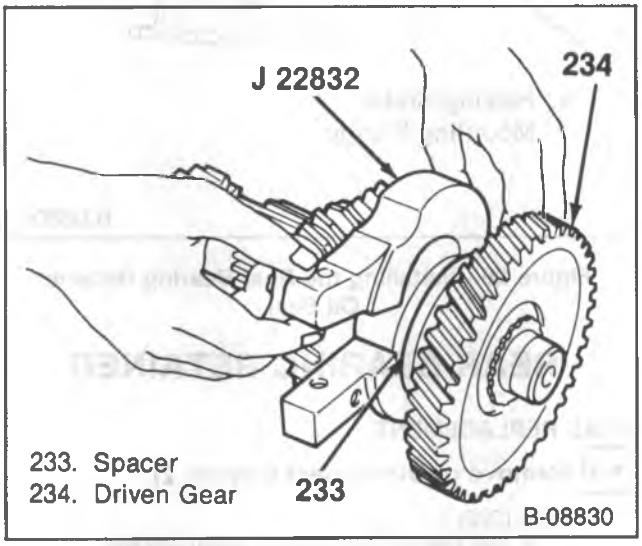


Figure 23—Installing Tool J 22832

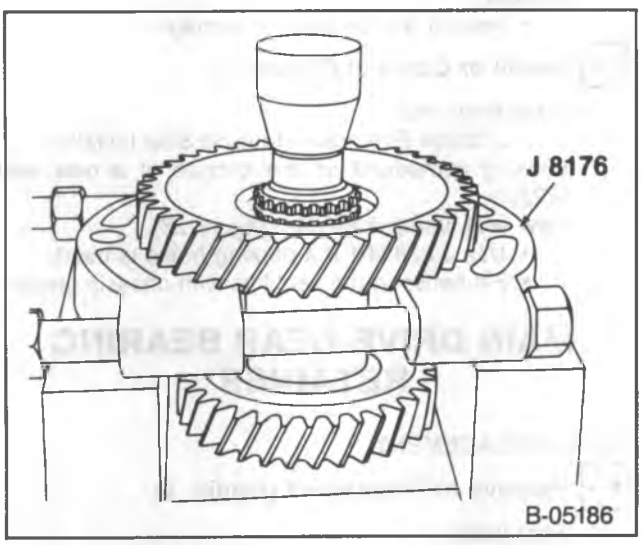


Figure 24—Removing the Driven Gear

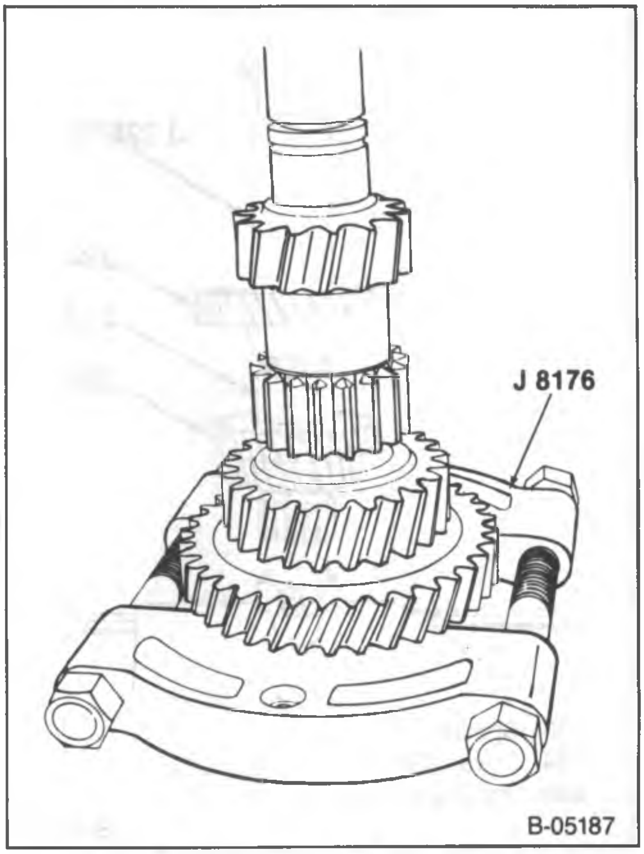


Figure 25—Installing the 3rd Speed Gear

Clean

- Countergear and the gears in suitable solvent and air dry.

Inspect

- Countergear and the gears for nicks, burrs, and broken teeth.
- The splined area on the countergear for chips and wear.

Assemble (Figure 22)

Tools Required:
J 22873 Mainshaft Bushing Installer
J 22830-A Snap Ring Installer

- A minimum press of 681 kg (1500 lbs.) is required to move each gear. If less pressure is required, replace the gear(s) or the shaft, or both.

1. 3rd speed gear (290) (figure 25).
   - The gear is marked "FRONT" in the web area, as shown in figure 22.
2. Spacer (233).
3. Driven gear (234), using J 22873 (figure 26).
4. Thrust washer (235).
5. New snap ring (236), using J 22830-A and J-22873 (figure 27).

Important

- Do not bend or damage the thrust washer.
- The snap ring should be tight in the groove with no side play.

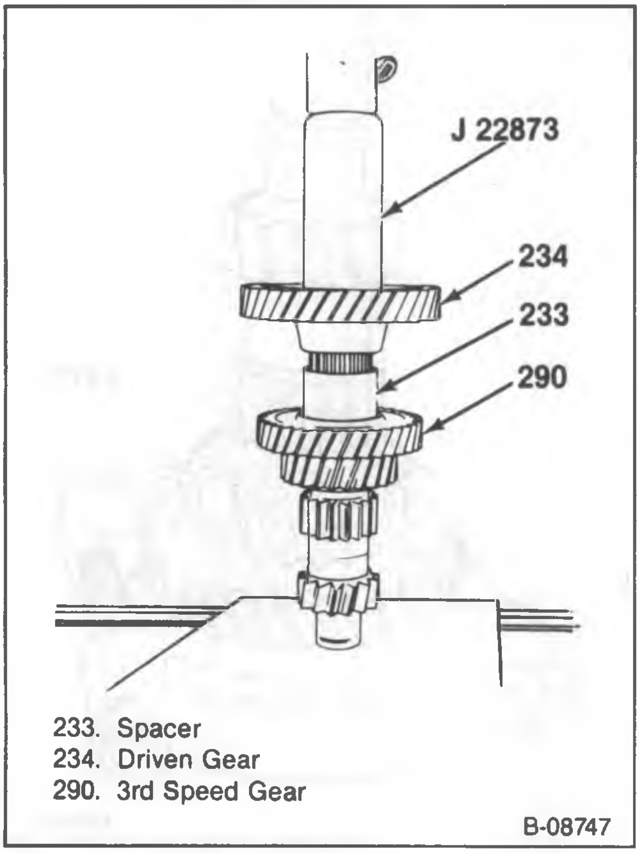


Figure 26—Installing the Driven Gear

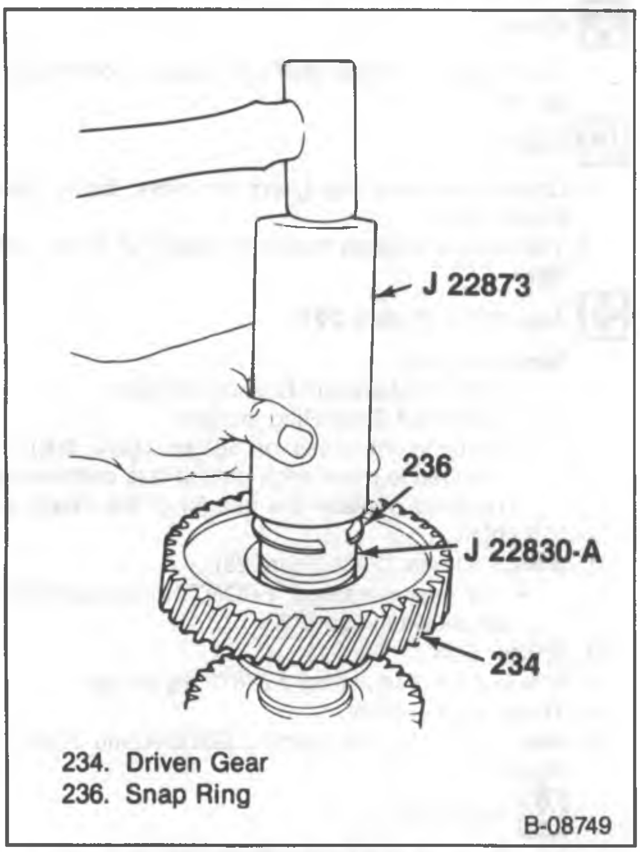


Figure 27—Installing the Driven Gear Snap Ring

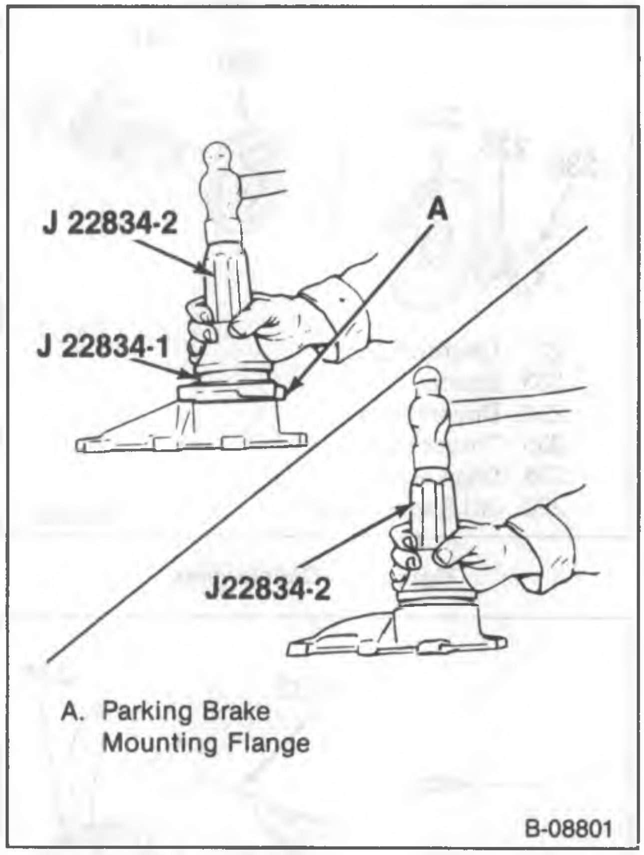


Figure 28—Installing the Rear Bearing Retainer Oil Seal

REAR BEARING RETAINER

SEAL REPLACEMENT

Remove or Disconnect (Figure 2)

1. Seal (222).
   - Pry the seal out with a small pry bar.
2. Gasket material from the retainer (223) using a scraper.
   - Inspect the retainer for damage.

Install or Connect (Figure 2)

Tools Required:
J 22834 Extension Housing Seal Installer

1. Locking compound on the outside of a new seal (222).
2. New seal, using J 22834-2 (figure 28).
   - Use J 22834-1 if a parking brake is used.
   - Fill between the seal lips with chassis grease.

MAIN DRIVE GEAR BEARING RETAINER

SEAL REPLACEMENT

Remove or Disconnect (Figure 2)

1. Seal (266).
   - Pry the seal out with a small pry bar.
2. Gasket material from the retainer (202) using a scraper.

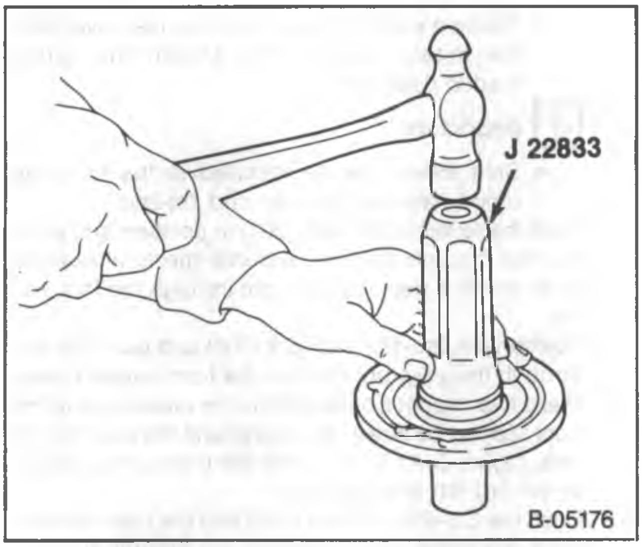


Figure 29 —Installing the Drive Gear Bearing Retainer Oil Seal

Inspect

1. Retainer nose for scoring, wear, or cracks, especially at the flange.
2. Snap ring groove for damage caused by drive gear bearing movement.
3. Retainer for wear and damage.

Install or Connect (Figure 2)

Tool Required:
J 22833 Front Housing Drive Gear Seal Installer

- Seal (266), using J 22833. The lip of the seal goes toward the installing tool, (figure 29).

R/V/P SHIFT COVER

Disassemble (Figure 30A)

1. Three plugs (297).
   - Use a punch to drive the plugs out.

   Important

   - The reverse shift fork retaining pin cannot be removed until the other shift forks have been removed.
   - Note the positions of the shift forks and the rods before removing them.
2. Fork retaining pins (303), (figure 31).
3. Shift rods and the shift forks (206, 215 and 301).
   - Shift rods must be in neutral position before any one rod can be removed.
   - Do not lose the detent balls and springs and the interlock balls and pin when removing the rods.
4. Interlock balls (306) and the pin (304).
5. Detent balls (213) and the springs (212).
6. Retainer (302) from the plunger (299).
7. Plunger (299) and spring (300) from the reverse shift fork (301).

Clean (Figure 30A)

- All parts in solvent and air dry.

Inspect (Figure 30A)

1. Shift fork
   - For damage or bends.
   - For worn finger pads.
2. Shift rods

206. 3rd and 4th Shift Fork
212. Detent Spring
213. Detent Ball
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
268. Shift Cover
295. Spring Pin
296. Vent
297. Plug
298. Dowel Pin
299. Reverse Shift Fork Plunger
300. Spring
301. Reverse Shift Fork
302. Retainer
303. Retaining Pin
304. Interlock Pin
305. 3rd and 4th Shift Rod
306. Interlock Ball
307. 1st and 2nd Shift Rod

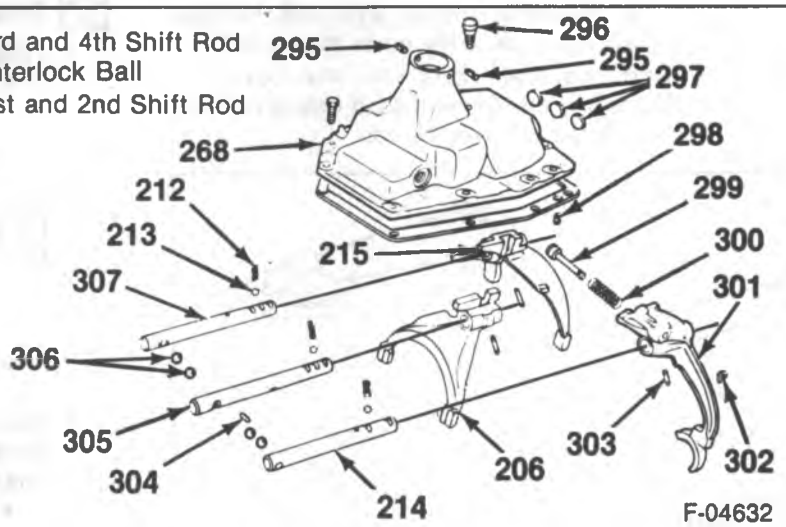


Figure 30A—R/V/P Shift Cover and Components

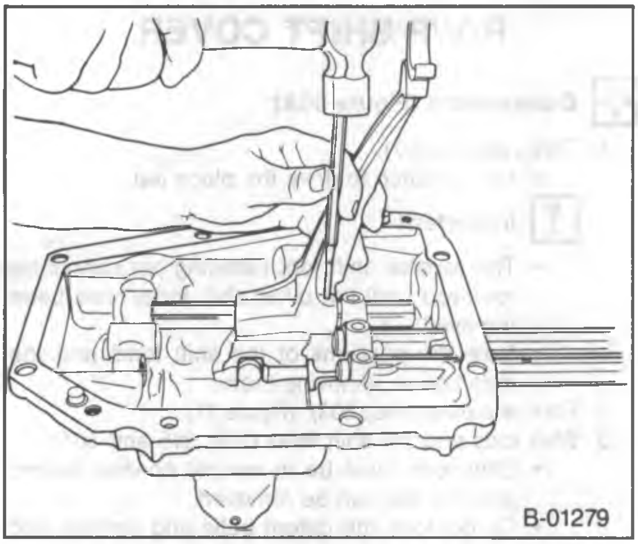


Figure 31 —Removing the Retaining Pin

- For damage and bends.
- For worn or damaged detents and detent balls.
- For broken detent springs.

3. Shift control cover
   - For cracks and warping.
   - For smooth shift rod fit.

Assemble (Figure 30A)

1. Plunger (299), spring (300) and the retainer (302) to the reverse shift fork (301), (figure 32).

Important

- The shift rods must be installed in the proper positions, (figure 33A).

2. Shift rods (307, 305 and 214).
   - Place the detent springs (212) and the balls (213) in the holes in the cover, (figure 34A).
   - Start the shift rods into the cover by depressing the spring loaded detent ball and pushing the rod over the ball.

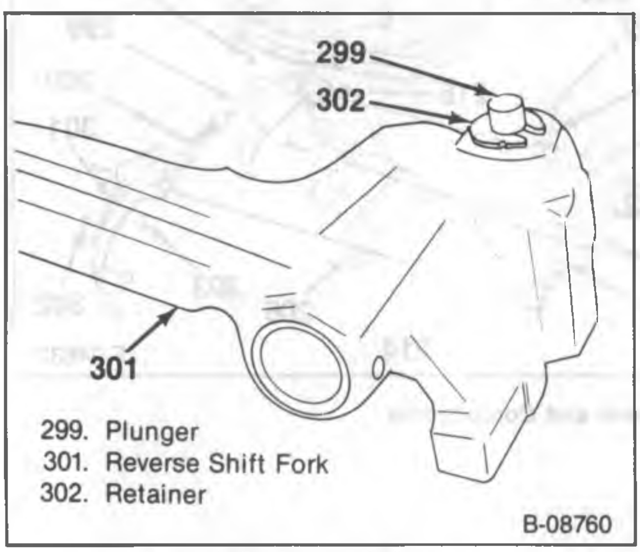


Figure 32—Plunger Retainer

- Position each rod part way into the cover with the detent groove down toward the spring loaded detent ball.

Important

- Shift forks must be installed in the following order: Reverse, 3rd-4th, and 1st-2nd.

3. Hold the reverse shift fork (301) in position and push the rod through the fork and into the front support bore. Install a new retaining pin through the fork and rod.
4. Position the 3rd-4th shift fork (206) and push the rod through the yoke but not into the front support bore.
5. Place two interlock balls (306) in the cross-bore of the front support between the reverse and the 3rd-4th shift rods,(figure 34A).Then install the interlock pin (304) in the 3rd-4th shift rod hole.
6. Push the 3rd-4th shift rod (206) into the front support bore and install a new retainer pin through the fork and rod.
7. Position the reverse and 3rd-4th shift rods in neutral position. Then place two interlock balls (306) in the cross-bore between the 1st-2nd and 3rd-4th shift rods, (figure 34B).
8. Position the 1st-2nd shift fork (215) and push the rod through the fork and into the front support bore. DO NOT force the rod into the front to see that the reverse and 3rd-4th shift rods are in neutral.
9. Install a new retainer pin through the shift fork and rod. Move the rod to neutral position.
10. Apply gasket maker GM P/N 1052942 or equivalent to the edges of three new expansion plugs (297) and install them in the housing openings. Position each plug with the convex side out and drive a flat faced 13 mm (1/2-inch) dowel pin against it to seat the plug.

C/K SHIFT COVER

Disassembly (Figure 30B)

1. Three plugs (297).
   - Pull back on shift rod then put a long thin punch through the oil passage hole that is at the back support bore (under shift tower) and drive the plug out. Return the rod to neutral position and repeat procedure for the other two rods.

Important

- The reverse shift fork retaining pin cannot be removed until the other shift forks have been removed.
- Note the positions of the shift forks, 3rd-4th stop and gate, and the rods before removing them.

2. Fork retaining pins (303), (figure 31).
3. Shift rods, 3rd-4th stop, 3rd-4th shift gate and the shift forks (206, 215, 301, 309 and 310).
   - Shift rods must be in neutral position before any one rod can be removed.
   - Do not lose the detent pins, springs interlock shuttles and the interlock pin when removing the rods.
4. Interlock shuttles (306) and the pin (304).
5. Detent pins (213) and the springs (212) and (308).
6. Retainer (302) from the plunger (299).
7. Plunger (299) and spring (300) from the reverse shift fork (301).

Clean (Figure 30B)

- All parts in solvent and air dry.

Inspect (Figure 30B)

- All parts in solvent and air dry.

1. Shift fork
   - For damage or bends.
   - For worn finger pads.
2. Shift rods
   - For damage and bends.
   - For worn or damaged detents and detent pins.
   - For broken detent springs.
3. Shift control cover
   - For cracks and warping.
   - For smooth shift rod fit.
4. 3rd-4th stop
   - For cracks and damage.

Assemble (Figure 30B)

1. Plunger (299), spring (300) and the retainer (302) to the reverse shift fork (301), (figure 32).

   Important

   - The shift rods must be installed in the proper positions, (figure 33B).
2. Shift rods (307, 305 and 214).
   - Position each rod part way into the cover with the detent grooves down.
   - Place the detent springs (212) and (308) and the pins (213) in the holes in the cover with the rounded part of the pins up, (figure 34B).

   Important

   - The 3rd-4th detent spring (308) is weaker than the 1st-2nd and reverse detent springs. The 3rd-4th spring is painted green and the two coils on the ends of the spring are coiled tight so there is no gap as compared to the other two detent springs (212).

Important

- Shift forks must be installed in the following order: Reverse, 3rd-4th, and 1st-2nd.

3. Hold the reverse shift fork (301) in position and push down on the detent pin while pushing the rod through the fork and into the front support bore. Install a new retaining pin through the fork and rod.
4. Position the 3rd-4th shift fork (206) in the middle part of the cover and partially push the rod through the back support bore. Slide the 3rd-4th shift gate (310) and then the 3rd-4th stop (309) onto the rod and push the rod through the yoke but not into the front support bore.
5. Place an interlock shuttle (306) in the cross-bore of the front support between the reverse and 3rd-4th shift rods, (figure 34B). Then install the interlock pin (304) in the 3rd-4th shift rod hole, retain with petroleum jelly.
6. Push down on the detent pin while pushing the 3rd-4th shift rod (206) into the front support bore and install a new retainer pin through the fork and rod.
7. Position the reverse and 3rd-4th shift rods in neutral position. Then place an interlock shuttle (306) in the cross-bore between the 1st-2nd and 3rd-4th shift rods, (figure 34B).
8. Position the 1st-2nd shift fork (215) and push down on the detent pin while pushing the rod through the fork and into the front support bore. DO NOT force the rod into the front support bore. Check to make sure that the reverse and 3rd-4th shift rods are in neutral or the shift interlock system will not allow the rod to engage.
9. Install a new retainer pin through the shift fork and rod. Move the rod to neutral position.
10. Apply gasket maker GM P/N 1052942 or equivalent to the edges of three new expansion plugs (297) and install them in the housing openings. Position each plug with the convex side out and drive a flat faced 13mm (1/2") dowel pin against it to seat the plug.

206. 3rd and 4th Shift Fork
212. 1st and 2nd/Reverse Detent Spring
213. Detent Pin
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
268. Shift Cover
295. Spring Pin
296. Vent
297. Plug
298. Dowel Pin
299. Reverse Shift Fork Plunger
300. Spring
301. Reverse Shift Fork
302. Retainer
303. Retaining Pin
304. Interlock Pin
305. 3rd and 4th Shift Rod
306. Interlock Shuttle
307. 1st and 2nd Shift Rod
308. 3rd and 4th Detent Spring
309. 3rd and 4th Stop
310. 3rd and 4th Shift Gate

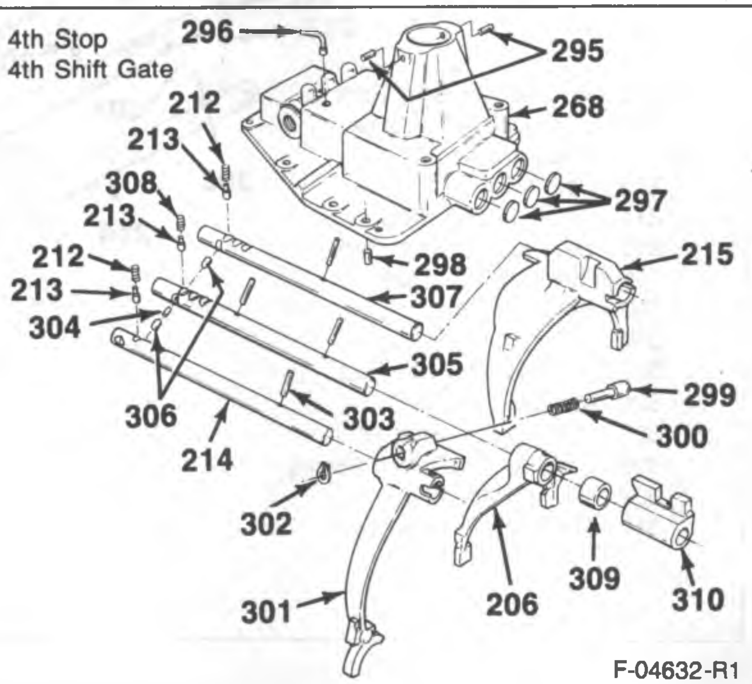
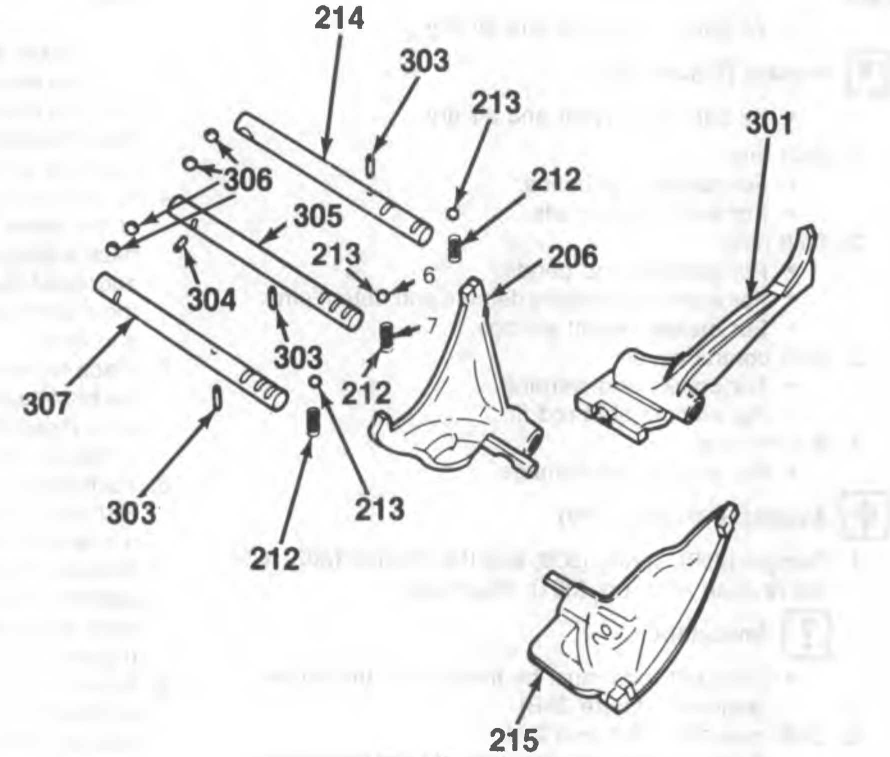


Figure 30B—C/K Shift Cover and Components

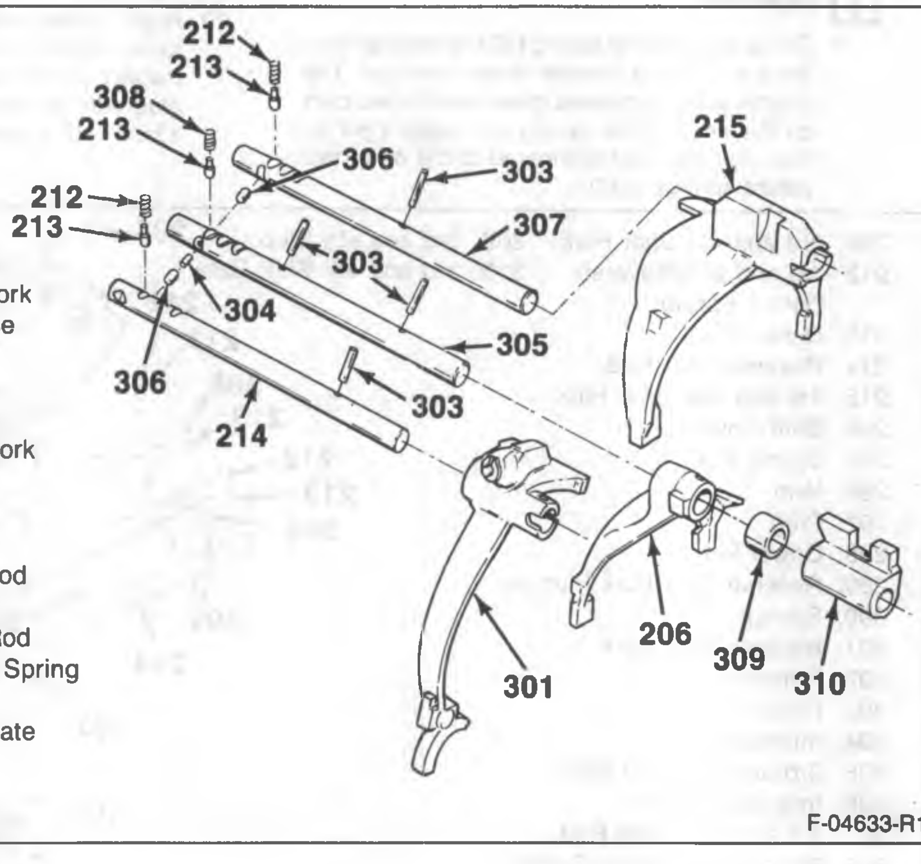
206. 3rd and 4th Shift Fork
212. Detent Spring
213. Detent Ball
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
301. Reverse Shift Fork
303. Retaining Pin
304. Interlock Pin
305. 3rd and 4th Shift Rod
306. Interlock Ball
307. 1st and 2nd Shift Rod



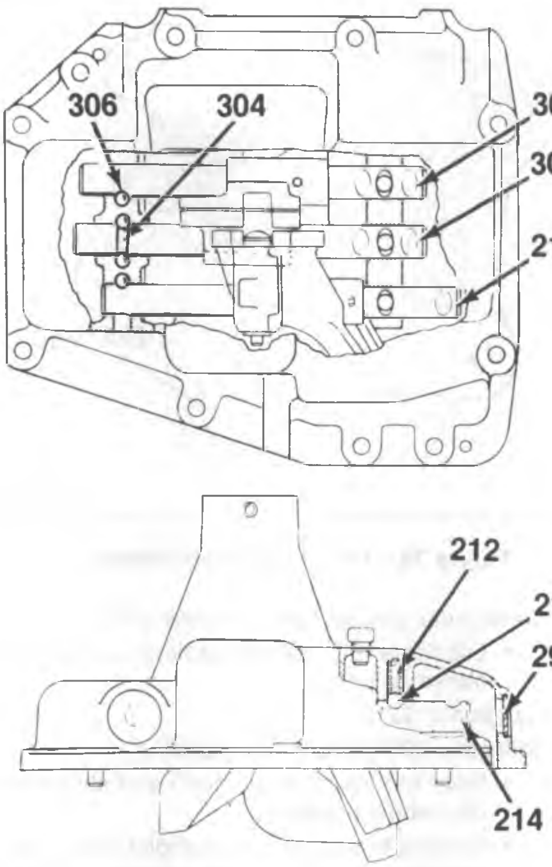
F-04633

Figure 33A—R/V/P Shift Rod and Fork Positions

206. 3rd and 4th Shift Fork
212. 1st and 2nd/Reverse Detent Spring
213. Detent Pin
214. Reverse Shift Rod
215. 1st and 2nd Shift Fork
301. Reverse Shift Fork
303. Retaining Pin
304. Interlock Pin
305. 3rd and 4th Shift Rod
306. Interlock Shuttle
307. 1st and 2nd Shift Rod
308. 3rd and 4th Detent Spring
309. 3rd and 4th Stop
310. 3rd and 4th Shift Gate



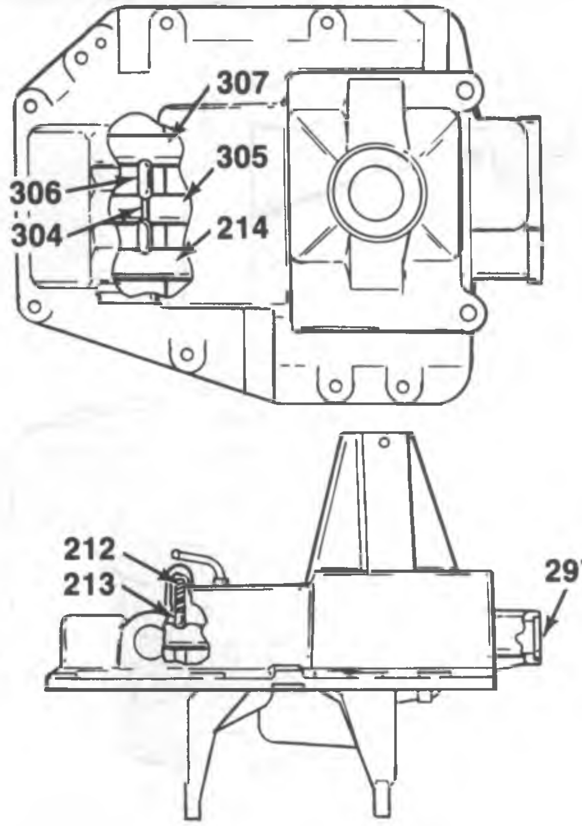
F-04633-R1



212. Detent Spring
213. Detent Ball
214. Reverse Shift Rod
297. Plug
304. Interlock Pin
305. 3rd And 4th Shift Rod
306. Interlock Ball
307. 1st And 2nd Shift Rod

F-04634

Figure 34A—R/V/P Interlock Shuttles and Pin



212. 1st and 2nd/Reverse Detent Spring
213. Detent Pin
214. Reverse Shift Rod
297. Plug
304. Interlock Pin
305. 3rd and 4th Shift Rod
306. Interlock Shuttle
307. 1st and 2nd Shift Rod

F-04634-R1

Figure 34B—C/K Interlock Shuttles and Pin

TRANSMISSION ASSEMBLY (INSTALLATION OF SUB-ASSEMBLIES)

Before assembling the transmission, check the reverse idler gear bushing for wear. Clearance between the bushing and shaft at both ends should be no more than 0.10 mm (0.004-inch). If it is more, install a new gear and bushing assembly, and/or a new shaft as required.

Use new seals, gaskets and pipe sealant with Teflon™ GM P/N 1052080 or equivalent on all bolt threads when assembling the transmission. Tighten all bolts to specified torque.

Lubricate all assemblies as they are installed in the transmission case using transmission fluid.

Install or Connect (Figure 2)

Tools Required:

J 22874, Mainshaft and Countergear Bearing Installer

J-35907 Mainshaft Lock Nut Wrench (4WD models only)

1. Countergear (227) into the case.
   - Do not install the bearings.
2. Reverse idler gear (230) and the shaft.
   - The gear teeth go forward.
   - The slot in the shaft faces down.
   - Drive the shaft flush with the case.
3. Mainshaft (250) into the case.
   - The rear of the mainshaft must be through the rear bearing hole.
   - Place J 22874-5 into the front bearing hole, engaged with the mainshaft, (figure 35).

Important

   - Be sure the 1st speed gear thrust washer is in place.
4. Mainshaft rear bearing (224).
   - Install a new snap ring (218) onto the bearing.
   - Drive the bearing until the snap ring is flush with the case using J 22874-1 (figure 35).

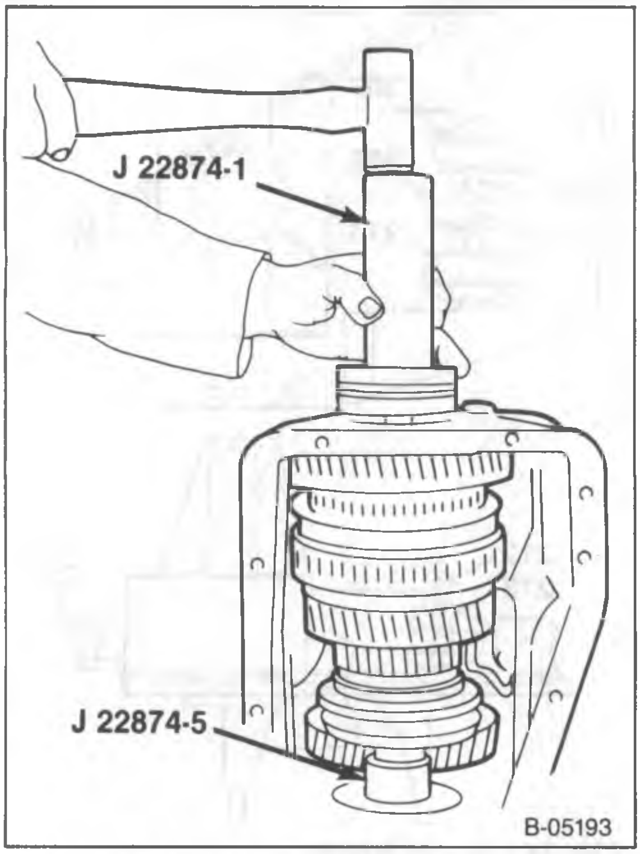


Figure 35—Installing the Mainshaft Rear Bearing

- Remove J 22874-5.

5. 4th speed blocker ring (204).
   - Be sure the cut outs align with the synchronizer keys.

Important

- Be sure the main drive gear pilot bearings are in place.

6. Main drive gear (201).
   - The drive gear cutout goes down (figure 5).
   - Tap on the outer bearing race to install the assembly.
7. Bearing retainer (202) and a new gasket.
8. Countergear rear bearing (228).
   - Support the front of the countergear using J-22874-10, (figure 36).
   - New snap ring (225) onto the bearing.
   - Drive the bearing onto the countershaft until the snap ring is flush with the case, using J-22874-1, (figure 37).
9. New bearing retainer snap ring (226).
   - Remove J 22874-10.
10. Countergear front bearing (237).
    - Tap the bearing into place.
11. Cover (238) and a new gasket.
12. Speedometer gear (219).
13. Rear bearing retainer (223) and a new gasket.
14. Parking brake assembly.
    — 4WD models only.
    - Back plate.
    - New mainshaft lock nut (256) and a new spring washer using J-35907.

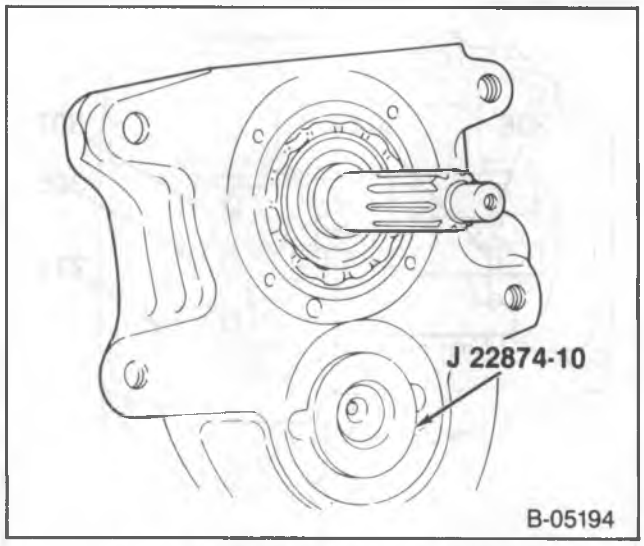


Figure 36—Tool J-22874-10 Installed

15. Brake drum and the flange or yoke (220).
    - Lubricate the flange sealing surface with transmission oil.
16. Flange nut (221).
17. Shift cover (268) and a new gasket.
    - Move the transmission gears and shift rods to the neutral position.
    - Partially engage the reverse idler gear with the countergear and move the reverse shift fork an equal distance in the shift cover.
    - Position the cover over the transmission case (not cocked or tilted) and lower the cover with the reverse shift fork entering the case first. As the cover is near its resting point on the case, observe that the 1-2 and 3-4 shift forks engage with the synchronizer collars.
    - Repeat above procedures if needed to install.
18. Shift cover screws (267).
    - Speedometer driven gear, switches and any external components that were removed.

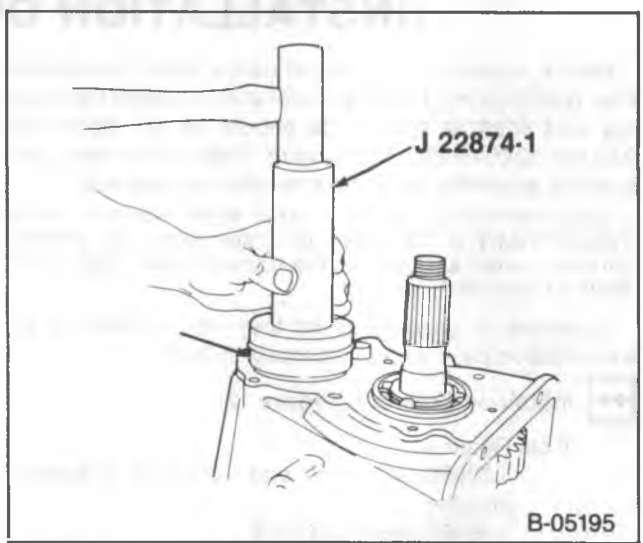


Figure 37—Installing the Countergear Rear Bearing

SPECIFICATIONS

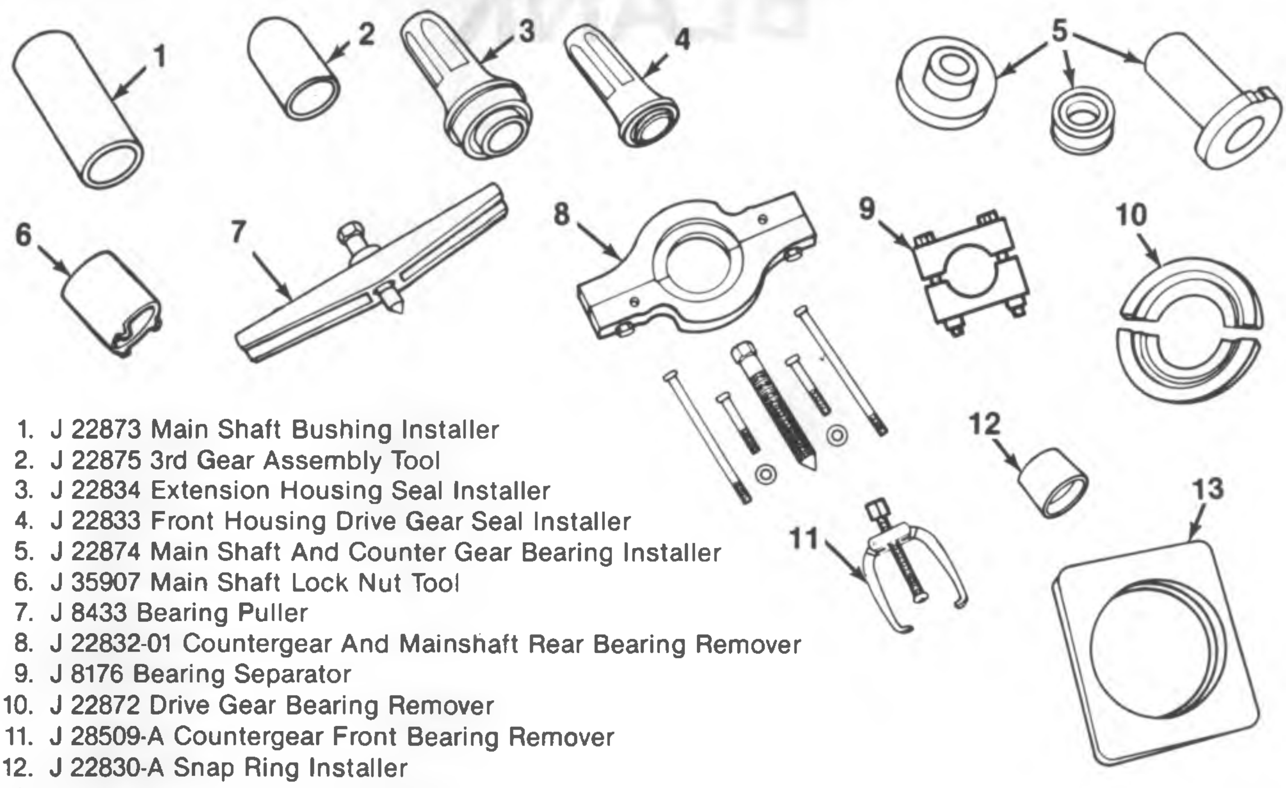
FASTENER TORQUE

	N·m	Lbs. Ft.
Rear Bearing Retainer Screws		
Top	27	20
Bottom	40	30
Plug, Drain and Fill	23	17
Drive Gear Bearing Retainer Screws	32	25
Shift Lever to Shift Shaft Nut	27	20
Cover Screws	27	20
Parking Brake Plate Screws	41	30
Mainshaft Lock Nut (K model only)	135	100
Universal Joint Flange Nut	135	100
Power Take Off Cover Bolts	23	17
Countergear Front Cover Screws	4	3
Parking Brake Flange Plate Bolts	41	30

LUBRICATION

Capacity	4.0L	4.2 qts.
Type Recommended: Manual Transmission Lubricant	GM P/N 12345577	

SPECIAL TOOLS



1. J 22873 Main Shaft Bushing Installer
2. J 22875 3rd Gear Assembly Tool
3. J 22834 Extension Housing Seal Installer
4. J 22833 Front Housing Drive Gear Seal Installer
5. J 22874 Main Shaft And Counter Gear Bearing Installer
6. J 35907 Main Shaft Lock Nut Tool
7. J 8433 Bearing Puller
8. J 22832-01 Countergear And Mainshaft Rear Bearing Remover
9. J 8176 Bearing Separator
10. J 22872 Drive Gear Bearing Remover
11. J 28509-A Countergear Front Bearing Remover
12. J 22830-A Snap Ring Installer
13. J 358-1 Bearing Remover Holder

B-08763

BLANK

SECTION 7B3

NEW PROCESS TRANSMISSION

CONTENTS

DESCRIPTION

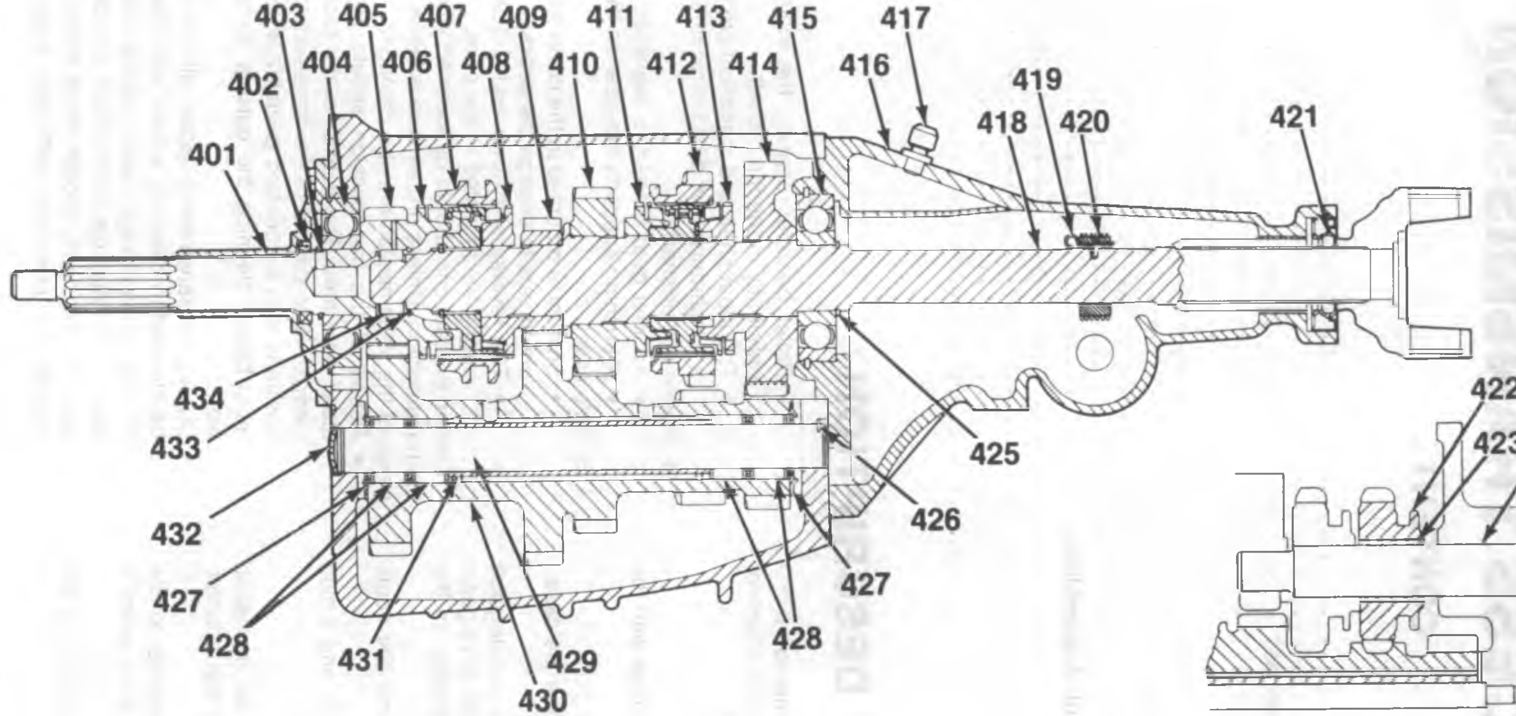
The New Process 89 mm 4 speed transmission (RPO MY6) is an overdrive transmission and is fully synchronized in all speeds except reverse (figure 1).

The main components are:

1. Main drive gear.
   - An integral shaft is splined to engage with the clutch driven plate.
   - The gear drives the countergear.
   - A ball bearing supports the shaft in the case.
2. Countershaft.
   - The countergear is keyed to the countershaft for constant rotation with the main drive gear.
   - Roller bearings align the countergear on the shaft.
   - Thrust washers and a spacer limit the countershaft end play.
   - The countershaft is not a press fit, and a plug seals the case bore.
3. Mainshaft.
   - The drive gears rotate freely on the mainshaft and are in constant mesh with the countergear.
   - Key type synchronizers are splined to the mainshaft and engage with the drive gears to turn the mainshaft.
   - A ball bearing supports the mainshaft in the extension housing.
   - Roller bearings support the mainshaft independently in the input shaft.
   - The input shaft and mainshaft are engaged by a synchronizer for direct drive in top gear.
4. Reverse idler shaft.
   - An idler gear drives the mainshaft in reverse.
   - A bushing supports the gear on the shaft.
5. Side cover.
   - Shift forks mounted in the cover move the synchronizers to engage the gears.
   - The reverse shift lever and a detent ball and spring are mounted in the case.

Certain precautions should be followed when repairing the transmission. Unless proper care is taken, the components of the transmission may be damaged.

- Repair of the transmission should be done in a clean work area. The outside of the case should be clean to keep dirt out of the transmission. On transmissions with a standard gearshift lever, install the lever before cleaning the outside of the transmission.
- During the transmission repair, all the parts should be cleaned in cleaning solvent and then air dried. Wiping cloths or rags should not be used to dry the parts as lint may get on the parts and cause trouble later. All the parts, except those being worked on, should be kept covered with clean paper.



401. Drive Gear Bearing Retainer
402. Seal
403. Snap Ring, Bearing to Shaft
404. Drive Gear Bearing
405. Main Drive Gear
406. 3rd Speed Blocker Ring
407. 3rd and Overdrive Synchronizer
408. Overdrive Blocker Ring
409. Overdrive Gear
410. 2nd Speed Gear
411. 2nd Speed Blocker Ring
412. 1st and 2nd Synchronizer (Reverse Gear)
413. 1st Speed Blocker Ring
414. 1st Speed Gear
415. Main Shaft Rear Bearing
416. Extension Housing
417. Vent Plug
418. Main Shaft
419. Retainer
420. Speedometer Gear
421. Rear Extension Seal
422. Reverse Idler Gear
423. Reverse Idler Gear Bushing
424. Reverse Idler Shaft
425. Snap Ring, Bearing to Shaft
426. Woodruff Key
427. Thrust Washer
428. Countershaft Roller Bearings
429. Countershaft
430. Counter Gear
431. Countershaft Spacer
432. Expansion Plug
433. Snap Ring
434. Pilot Bearings

B-08838

Figure 1—4 Speed 89 mm Transmission

DISASSEMBLY OF THE TRANSMISSION

Remove or Disconnect (Figure 2)

Tool Required:
J 29793 Countershaft Alignment Tool

- Speedometer driven gear, switches and any external components.
- Shift the transmission into neutral.

1. Reverse shift lever (445).
2. Side cover (450) and the gasket.
   - Detent ball and the spring.
   - Shift forks (452 and 453). Note the positions they were removed from.
3. Extension housing screws (439), (figure 3).
   - Turn the housing upside down on the mainshaft.
   - Install one screw to hold the housing, as shown.

Important

- Do not damage the countershaft or bearings when removing the plug and the countershaft.

4. Countershaft plug (432).
   - Punch or drill a hole in the center of the plug.
   - Reaching through the hole, drive the countershaft to the rear until the woodruff key can be removed.
   - Drive the countershaft to the front until it pushes the plug out of the case.
5. Countershaft (429), using J 29793.
   - Drive the countershaft out the rear of the case.
6. Extension housing screw (439).
   - Turn the housing to the normal position.
7. Bearing retainer (401) and the gasket.
8. Main drive gear (405).
   - Drive the gear out the front of the case.
9. Extension housing (416) and the mainshaft.
   - Slide the 3rd and overdrive synchronizer sleeve (407) to the front (figure 1).
   - Slide the reverse idler gear (422) to the center of the idler shaft.
   - Drive the housing to the rear.
10. Snap ring (454) and the mainshaft (418) from the extension housing (figure 4).
11. Countergear (430) and the thrust washers.
12. Reverse idler shaft (424).
    - Place a 3/8-inch x 3 1/2-in screw and nut into a 3/8-inch drive, deep 7/16-inch socket.
    - Place the screw head against the case and the socket against the shaft.
    - Turn the nut against the socket, driving the shaft out of the bore (figure 5).
    - Remove the shaft, the gaer and the key.
13. Reverse shift shaft (443) and the seal.

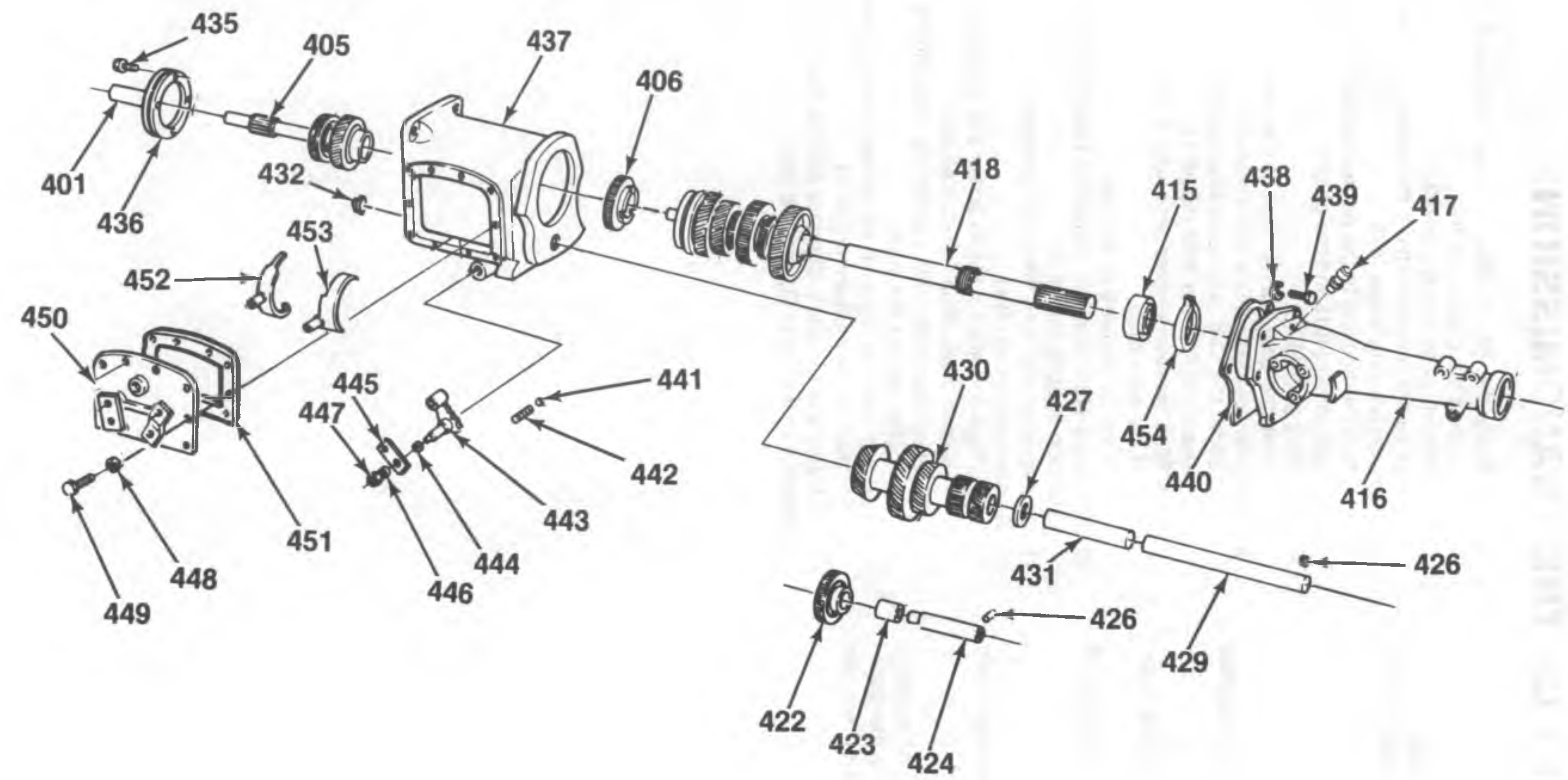


Figure 2—89 mm Transmission Components

B-08857

401. Drive Gear Bearing Retainer
405. Main Drive Gear
406. Overdrive Blocker Ring
415. Main Shaft Rear Bearing
416. Extension Housing
417. Vent Plug
418. Mainshaft
422. Reverse Idler Gear
423. Reverse Idler Gear Bushing
424. Reverse Idler Shaft
426. Woodruff Key
427. Thrust Washer
429. Countershaft
430. Countergear
431. Countershaft Spacer
432. Expansion Plug
435. Screw
436. Bearing Retainer Gasket
437. Transmission Case
438. Spring Washer
439. Screw
440. Extension Housing Gasket
441. Detent Ball
442. Detent Spring
443. Reverse Shift Shaft
444. Seal
445. Reverse Shift Lever
446. Washer
447. Nut
448. Spring Washer
449. Screw
450. Side Cover
451. Side Cover Gasket
452. 3rd and Overdrive Shift Fork
453. 1st and 2nd Shift Fork
454. Snap Ring, Bearing to Extension

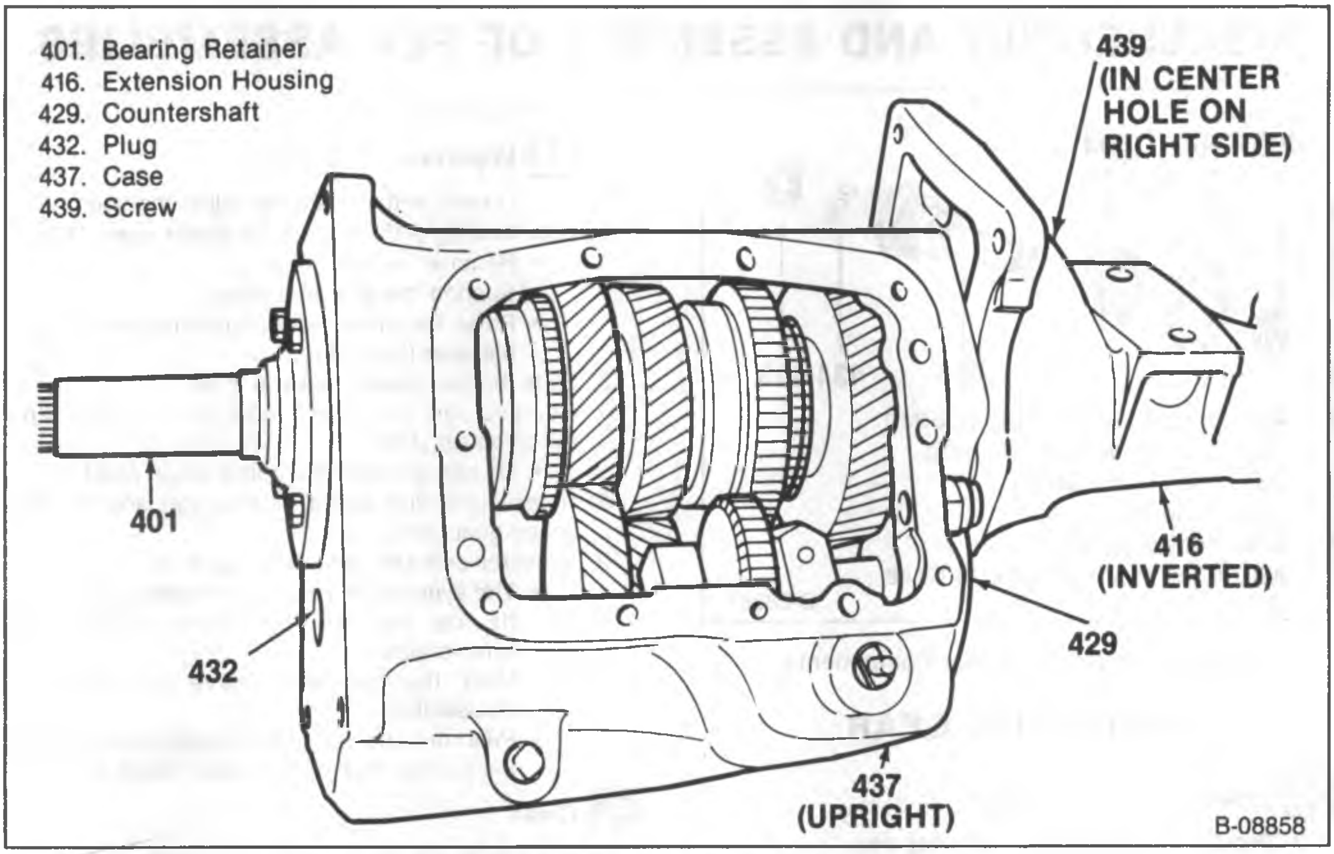


Figure 3—Turning the Extension Housing

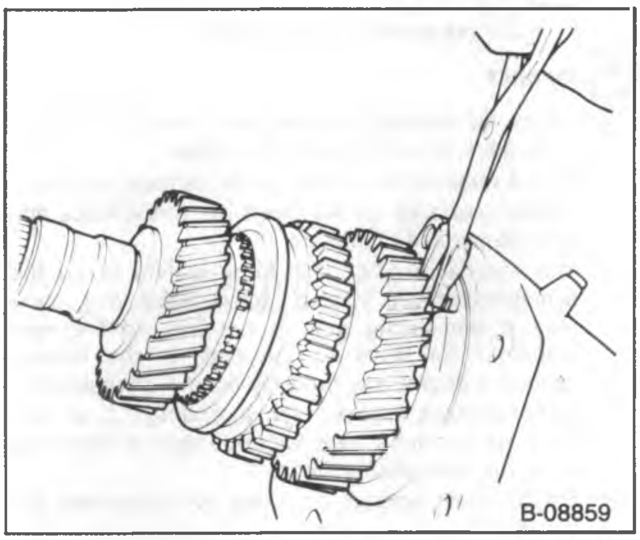


Figure 4—Removing the Mainshaft

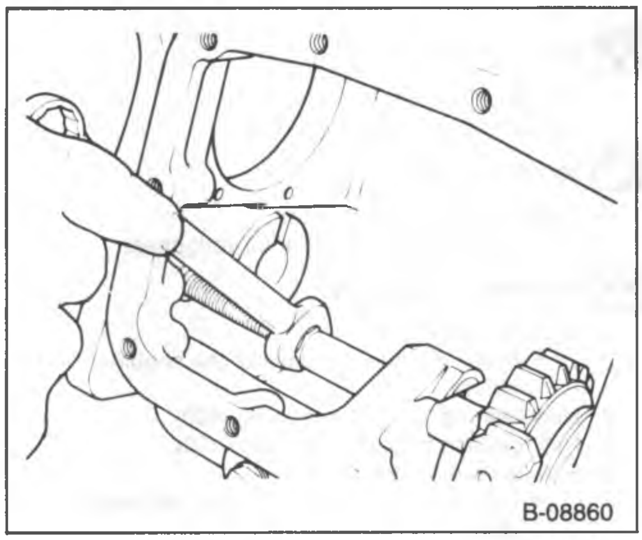
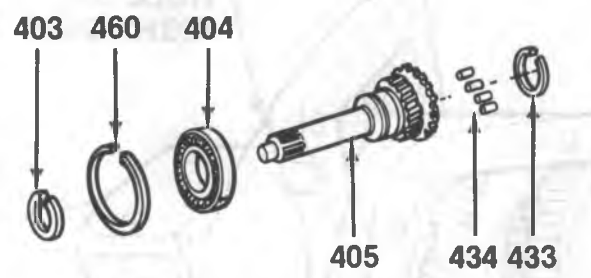


Figure 5—Removing the Reverse Idler Shaft

DISASSEMBLY AND ASSEMBLY OF SUB-ASSEMBLIES



403. Snap Ring, Bearing to Shaft
404. Main Drive Gear Bearing
405. Main Drive Gear
433. Snap Ring
434. Pilot Bearings
460. Snap Ring, Bearing to Case

B-08861

Figure 6—Main Drive Gear Components

MAIN DRIVE GEAR

Disassemble (Figure 6)

1. Pilot bearings (434) and the snap ring.
2. Bearing to case snap ring (460).
3. Bearing to shaft snap ring (403).
4. Bearing (404).

Clean (Figure 6)

- All parts in a suitable solvent. (Do not spin the bearings dry).

Inspect (Figure 6)

1. Parts for damage and wear.
2. Oil the bearings and check for roughness.

Assemble (Figure 6)

1. Bearing (404).
   - Press the bearing against the shoulder on the shaft.
2. New bearing to shaft snap ring (403).
3. New bearing to case snap ring (460).
4. Pilot bearings (434).
   - Use chassis grease to hold the bearings in place.

MAINSHAFT

Disassemble (Figure 7)

1. Slide the 3rd speed blocker ring (406) off.
2. Remove the snap ring and slide the 3rd and overdrive synchronizer (407) off.
   - Do not let the synchronizer come apart.
3. Remove the overdrive blocker ring and the overdrive gear (409).
4. Speedometer drive gear (420).
   - Press the retaining clip down.
   - Tap the gear off.

Important

- Do not let the mainshaft fall to the floor.

5. Rear bearing (415) and the 1st speed gear (414).
   - Remove the snap ring.
   - Support the gear in a press.
   - Press the mainshaft through the bearing and the gear (figure 8).
6. Slide the 1st speed blocker ring off.
7. Remove the snap ring and the 1st and 2nd synchronizer (412).
   - Do not let the synchronizer come apart.
8. Remove the 2nd speed blocker ring and the 2nd speed gear (410).
9. Synchronizers (407 and 412) (figure 9).
   - The synchronizer hub and sleeve are a select fit, do not mix the parts of the two synchronizers.
   - Mark the hub and sleeve alignment for reassembly.
   - Push the hub out of the sleeve while holding the springs and keys to avoid losing them.

Clean

- All parts in a suitable solvent and air dry.

Important

- Do not spin dry the bearings.

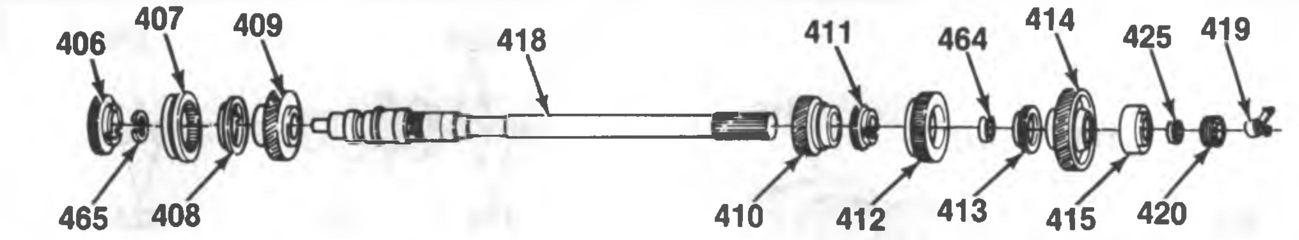
Inspect

1. Gears for cracks, chipped gear teeth, and other damage that could cause gear noise.
2. Thrust washers and bushings for damage and wear.
3. Related surfaces on the gears like thrust faecs and bearing surface diameters.
4. The reverse sliding gear for a sliding fit on the synchronizer hub without excess radial, or circular play. If the sliding gear is not free on the hub, inspect it for burrs on the ends of the internal splines. Remove any burrs by honing as required.
5. Synchronizer sleeves for a sliding fit on the synchronizer hubs, also, the hubs have to be a snug fit on the mainshaft splines.
6. Synchronizer springs and keys for looseness and damage.
7. Brass synchronizer rings for excess wear and damage.
8. All gear teeth for excess wear.
9. Bearings and bearing surface for nicks, burrs and wear.
10. Lubricate all roller bearings with light engine oil and check for rough rotation.

Assemble (Figures 7 and 10)

- Coat all parts with transmission oil before installing them onto the shaft.

1. Synchronizers (407 and 412) (figure 9).
   - Place the keys into the hub.



406. 3rd Speed Blocker Ring
407. 3rd and Overdrive Synchronizer
408. Overdrive Blocker Ring
409. Overdrive Gear
410. 2nd Speed Gear
411. 2nd Speed Blocker Ring
412. 1st and 2nd Synchronizer (Reverse Gear)
413. 1st Speed Blocker Ring
414. 1st Speed Gear
415. Mainshaft Rear Bearing
418. Mainshaft
419. Retainer
420. Speedometer Gear
425. Snap Ring, Bearing to Shaft
464. Snap Ring, 1st and 2nd Synchronizer
465. Snap Ring, 3rd and O/D Synchronizer

B-08862

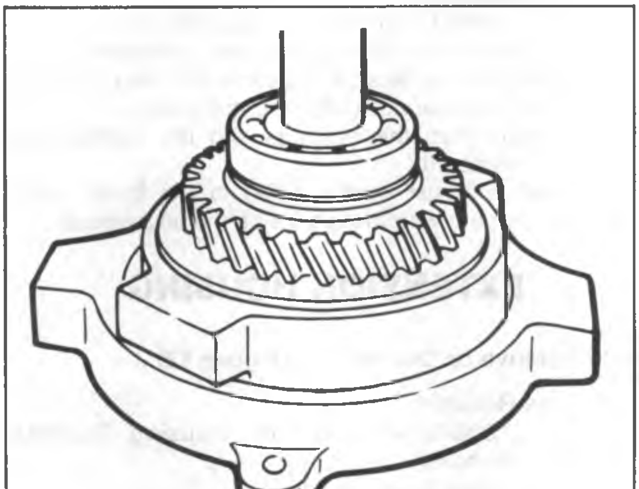
Figure 7—Mainshaft and Components

- Engage the springs in different slots in either side of the hub, so they support all the keys.
- Slide the sleeve onto the hub, aligning the marks made during disassembly.

Important

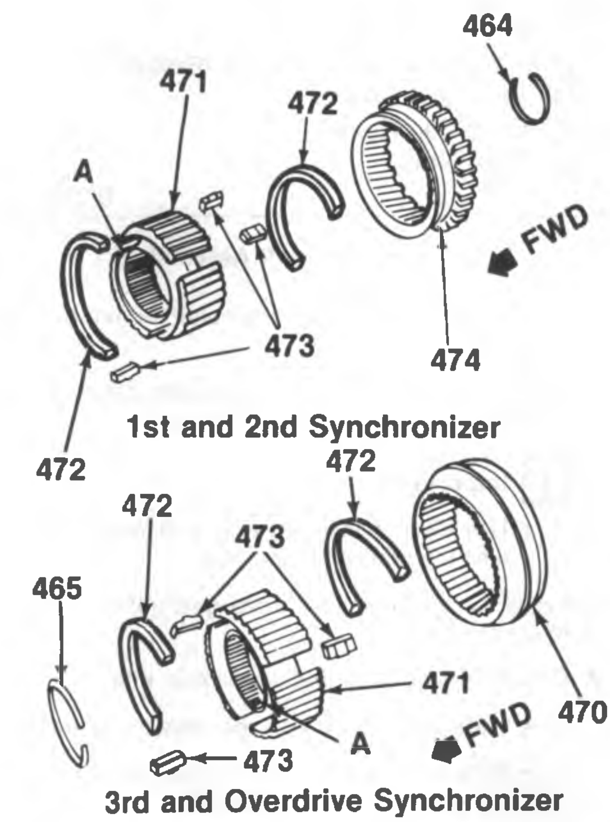
- The long side of the hub center (A) must be to the front.

2. 2nd speed gear (410) and the blocker ring.
   - Slide the gear on, with the cone to the rear.
   - Slide the blocker ring onto the gear cone with the clutching teeth to the front.
3. Install the 1st and 2nd synchronizer (412) and a new snap ring.
   - The hub slots must be engaged with the blocker ring.
4. 1st speed gear (414) and the blocker ring.
   - Slide the blocker ring on with the clutching teeth to the rear, engaged in the synchronizer hub slots.



B-08791

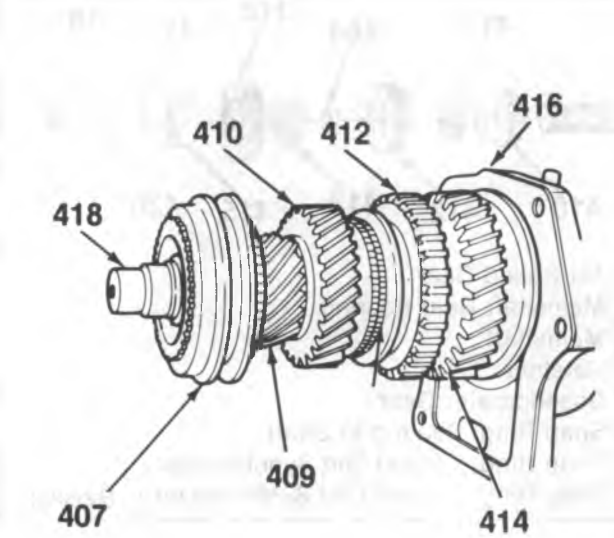
Figure 8—Pressing the Mainshaft through the Bearing



A. Forward
464. Snap Ring, 1st and 2nd Synchronizer
465. Snap Ring, 3rd and O/D Synchronizer
470. Sleeve
471. Hub
472. Spring
473. Key
474. Reverse Gear

B-08863

Figure 9—Synchronizer Components



407. 3rd and Overdrive Synchronizer
409. Overdrive Gear
410. 2nd Speed Gear
412. 1st and 2nd Synchronizer (Reverse Gear)
414. 1st Speed Gear
416. Extension Housing
418. Main Shaft

B-08864

Figure 10—Mainshaft Assembled

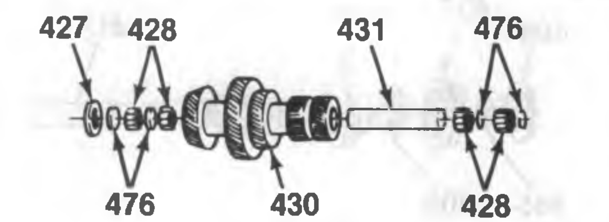
- Install the gear with the cone into the blocker ring.

5. Press the rear bearing (415) on and install a new snap ring.

Important

- Use the correct snap ring, it is a select fit to limit the mainshaft end play.

6. Install the speedometer drive gear (420) and the retaining clip.
7. Overdrive gear (409) and the blocker ring.
   - Slide the gear on with the cone to the front.
   - Slide the blocker ring onto the gear cone with the clutching teeth to the rear.
8. Install the 3rd and overdrive synchronizer (407) and a new snap ring.
   - The shift fork slot must be to the rear.
   - The hub slots must be engaged with the blocker ring.
9. Install the 3rd speed blocker ring with the clutching teeth to the front.
   - The ring must be engaged with the synchronizer hub slots.
   - Hold the ring in place with grease.



427. Thrust Washer
428. Countershaft Bearings
430. Counter Gear
431. Countershaft Spacer
476. Bearing Spacers

B-08868

Figure 11—Countergear and Components

COUNTERGEAR

Disassemble (Figure 11)

Tool Required:
J 29793 Countershaft Alignment Tool

1. Remove tool J 29793.
2. Remove the bearings (428) and the spacers.
3. Remove the countershaft spacer (431).

Clean

- All parts in suitable solvent and air dry.

Inspect

- Countergear for nicks, burrs, and broken teeth.
- Bearings for wear and rough surfaces.
- Spacers for wear and grooves.
- Countershaft for wear, nicks and burrs.

Measure

- Countershaft to case bore clearance. Clearance must be no more than 0.127 mm (0.005-in.).

Assemble (Figure 11)

Tool Required:
J 29793 Countershaft Alignment Tool

- Coat the inside of the countergear with grease.

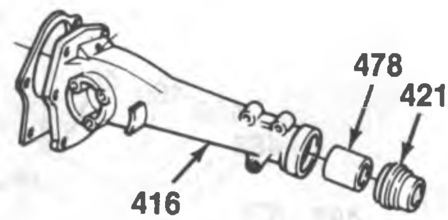
1. Install the countershaft spacer (431) using J 29793.
2. Install the bearings (428) and the spacers.
   - Be sure the bearings and the spacers are centered.
3. Install a thrust washer (427) to the front of the countergear with the tab inside the countergear.

EXTENSION HOUSING

Remove or Disconnect (Figure 12)

Tools Required:
J 23062-14 Extension Housing Bushing Remover
J 8092 Driver Handle

1. Seal (421).
2. Gasket material from flange of the extension (416).
3. Bushing (478) if it is worn or damaged, using J 23062-14.



416. Extension Housing
421. Extension Housing Seal
478. Extension Housing Bushing

B-08866

Figure 12—Extension Housing and Components

Inspect

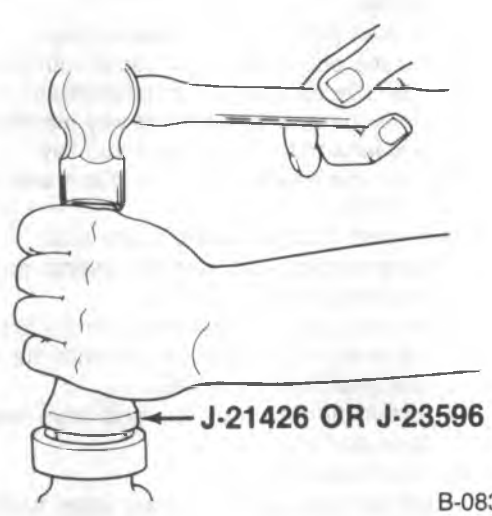
1. Extension for scoring, wear or cracks, especially at the flange.
2. Snap ring groove for wear and damage.

Install or Connect (Figure 12)

Tool Required:

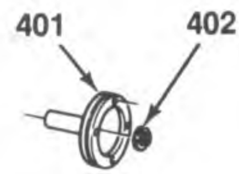
J 21426 Rear Extension Seal Installer

1. New bushing (478) if needed, using a suitable tool.
   - Coat the bushing with transmission oil.
   - Drive the bushing into the extension.
2. Locking compound on the ouside of a new seal (421).
3. New seal (421) using J 21426 (figure 13).
   - Fill between the seal lips with chassis grease.



B-08301

Figure 13—Installing the Rear Extension Bushing and Seal



401. Drive Gear Bearing Retainer
402. Seal

B-08302

Figure 14—Bearing Retainer and the Seal

MAIN DRIVE GEAR BEARING RETAINER

Remove or Disconnect (Figure 14)

1. Seal (402).
2. Gasket material from flange of retainer (401).

Inspect

1. Retainer nose for scoring, wear or cracks, especially at the flange.
2. Snap ring groove for damage caused by drive gear bearing movement.
3. Replace the retainer if it is worn or damaged.

Install or Connect (Figure 14)

Tool Required:
J 23096 Drive Gear Seal Installer

- New seal (402), using J 23096. Coat the inside of the seal with transmission oil.

SIDE COVER

Disassemble (Figure 15)

1. Remove the shift levers (484 and 487).
2. Shift shafts (480 and 481).
   - Remove any burrs from the shafts to avoid scoring the cover bores.
   - Pull the shafts out of the cover.
   - Tag the shafts so they can be installed in the positions they were removed from.
3. Remove the retaining clip, the detent cams (488) and the spring.
4. Pry the seals (482) and the retainers (483) from the cover.

Clean (Figure 15)

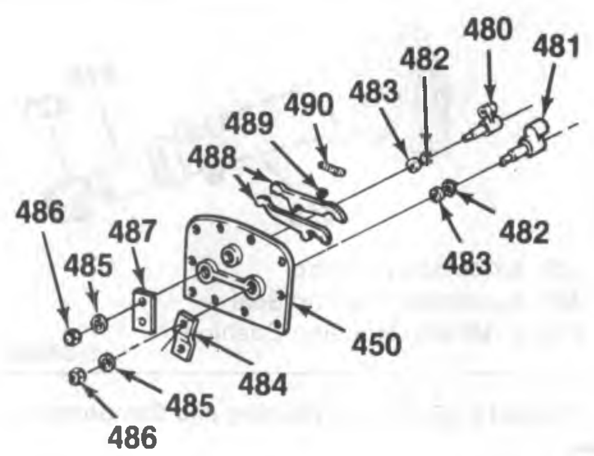
- All parts using cleaning solvent. Air dry.

Inspect (Figure 15)

- All parts for wear and damage.
- Gasket surface for nicks and scratches.
- Shift shafts and the forks for burrs and wear.
- Seal bores for cracks and damage.

Assemble (Figure 15)

1. Install the detent cams (488), a new retainer clip and the spring.
2. Shift shafts (480 and 481).
   - Coat the cover bores with grease.
   - Install the shafts in the positions they were removed from.
3. Install new seals and the retainers (483).
4. Install the shift levers (484 and 487).
   - The 3rd and overdrive lever must point down.



450. Side Cover
480. 3rd and Overdrive Shift Shaft
481. 1st and 2nd Shift Shaft
482. Shift Shaft Seal
483. Retainer
484. 1st and 2nd Shift Lever
485. Washer
486. Nut
487. 3rd and 4th Shift Lever
488. Detent Cam
489. Retaining Clip
490. Detent Spring

B-08315

Figure 15—Side Cover and Components

TRANSMISSION ASSEMBLY (INSTALLATION OF SUB-ASSEMBLIES)

Use new seals, gaskets and thread sealer on all bolt threads when assembling the transmission. Tighten all bolts to specified torque.

Lubricate all assemblies as they are installed in the transmission case using transmission oil.

Install or Connect (Figure 2)

Tool Required:

J 29793 Countershaft Alignment Tool

1. Countergear (430) and the thrust washers.
   - Lower the countergear into place with the front thrust washer tabs inthe case slots.
   - Align the rear thrust washer tabs with the case slots and slide it in.
2. Mainshaft (418) and a new snap ring (454) into the extension housing (416).
3. Extension housing (416) and a new gasket onto the case.
   - Turn the extension housing upside down and install one screw to hold it in place (figure 3).
4. Main drive gear (405).
   - Tap the gear in until the bearing snap ring bottoms against the case.

Important

- The main drive gear must fit smoothly into place, if it does not, check to see that all components of the mainshaft are in the proper positions.

5. Countershaft (429) and the woodruff key.
   - Lift the countergear into mesh with the mainshaft. Be sure the thrust washers are in place.
   - Push the countershaft half way into the countergear and install the woodruff key.
   - Push the countershaft into place and remove J 29793.
6. Reverse shift shaft (443) and a new seal.
7. Reverse idler shaft (424) and the reverse gear.
   - Push the shaft in part way.
   - Put the gear onto the shaft with the fork slot to the rear and engage the slot with the reverse shift shaft fork (figure 16).
   - Install the woodruff key and drive the shaft flush with the case.
8. Extension housing screws.
   - Do not damage the gasket when turning the housing into place.
9. Bearing retainer (401) and a new gasket.
10. New countershaft plug (432).

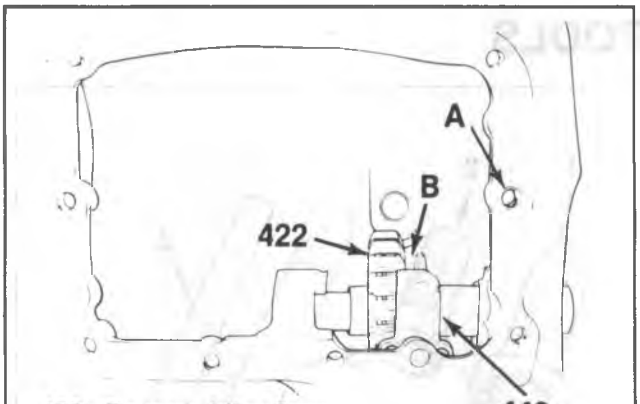


Figure 16—Reverse Idler Gear and Case

- Coat the outside of the plug with sealing compound.

11. 1st and 2nd shift fork (453) into the synchronizer slot.
12. 3rd and overdrive shift fork (452) into the side cover.
13. New side cover gsket (451) and the detent ball and spring.
14. Side cover (450).
    - Move the synchronizer sleeves and the reverse idler gear to the neutral positions.
    - Move the shift levers to neutral (straight up).
    - Hold the detent cam against the 1st and 2nd shift lever, then lift the cam over the fork to install the cover.

Important

- Be sure the detent ball and the spring are in position.

15. Side cover screws (449) and new spring washers.
    - Install the locating (long shoulder) screw finger tight in the locating hole (A), (figure 16).
    - Install the remaining screws finger tight.
    - Tighten the screws evenly.
16. Reverse shift lever (445).
    - Shift the transmission through all gears to check the operation.
    - Speedometer driven gear, switches and any external components that were removed.

SPECIFICATIONS

FASTENER TORQUE

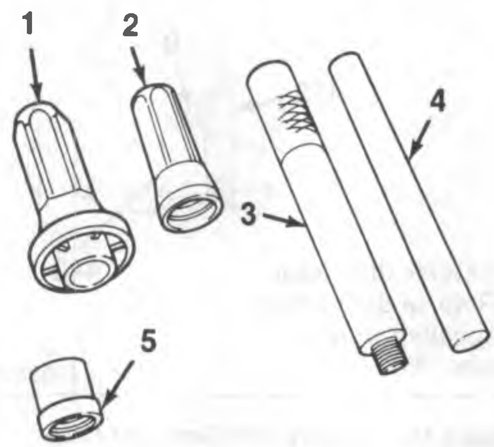
	N·m	Ft. Lbs.
Shift Lever Nut	25	18
Extension Housing Screw	68	50
Drive Gear Bearing Retainer	41	30
Side Cover Screw	20	15

LUBRICATION

Capacity	4.0 L	4.2 qts.
Type Recommended	Dexron II Automatic Transmission Fluid	

SPECIAL TOOLS

1. J 21426 Rear Extension Seal Installer
2. J 12096 Drive Gear Retainer Installer
3. J 8092 Driver Handle
4. J 29793 Countershaft Alignment Tool
5. J 23062-14 Extension Housing Bushing Remover



F-05697

SECTION 7B4

BORG WARNER TRANSMISSIONS

CONTENTS

DESCRIPTION

The 77 mm 5 speed is a constant mesh transmission, synchronized in all speeds except reverse.

The main components are:

1. Main drive gear.
   - An integral shaft is splined to engage with the clutch driven plate.
   - The gear drives the countergear.
   - A tapered bearing supports the shaft in the case.
2. Countergear.
   - The countergear is one unit for constant rotation with the main drive gear.
   - Bearings support the countergear in the case.
   - Thrust washers limit the play of the countergear.
   - An extra gear is mounted to the countergear for 5th speed.
3. Mainshaft.
   - The drive gears rotate freely on the mainshaft and are in constant mesh with the countergear.
   - Key type synchronizers engage the gears.
   - The 1st and 2nd synchronizer hub is machined in place.
   - A tapered bearing supports the mainshaft in the rear of the case.
   - Roller bearings support the mainshaft independently in the main drive gear.
   - The main drive gear and mainshaft are engaged by a synchronizer for direct drive in top gear.
   - Thrust washers limit the play of the mainshaft.
4. Reverse idler gear.
   - The idler gear drives the mainshaft in reverse.
   - The idler gear is supported on it's own shaft.
5. Shift lever.
   - The shift lever is mounted on the extension housing and holds the shift lever.
   - The shift lever moves the shafts which are mounted in the transmission top cover.
   - Shift forks mounted on shafts move the synchronizers to engage the gears.
   - A pin-type interlock blocks the other shafts when one is moved.

Certain precautions should be followed when repairing the transmission. Unless proper care is taken, the components may be damaged.

- Repair of a transmission should be done in a clean work area. The outside of the case should be clean to keep dirt out of the transmission. On transmissions with a standard gearshift lever, install the lever before cleaning the outside of the transmission.
- During transmission repair, all the parts should be cleaned in cleaning solvent and then air dried. Wiping cloths or rags should not be used to dry the parts as lint may get on the parts and cause trouble later. All the parts, except those being worked on, should be kept covered with clean paper.

DISASSEMBLY OF THE 77 mm TRANSMISSION

600. Screw
601. Shift Cover
602. Seal
603. Transmission Case
604. Mainshaft
605. Bearing Race
606. 5th Speed Gear Snap Ring
607. Retaining Clip
608. Ball
609. Speedometer Drive Gear
610. Snap Ring
611. Front Thrust Race
612. Countergear Thrust Bearing
613. Extension Housing
614. Screw
615. Funnel
616. Snap Ring
618. 5th Speed Shift Fork
619. Pin
620. Pin Roller
621. Shaft Pin
622. Fork Pin
623. 5th Speed and Reverse Shift Lever
624. Pivot Bolt
625. Retaining Ring
626. Pin Roller
627. Lock Spring
628. Reverse Shift Fork
629. 5th Speed and Reverse Shift Shaft
630. 5th Speed Synchronizer
631. 5th Speed Blocker Ring
632. 5th Speed Drive Gear
633. Snap Ring
634. Countergear Spacer, Rear
635. Countergear Ring Bearing
636. Countergear Spacer, Front
637. Reverse Idler Shaft
638. Reverse Idler Gear
639. Pin
640. Countergear
641. Countergear Thrust Washer
642. Countergear Front Bearing
643. Main Drive Gear
644. Main Drive Gear Bearing Race
645. Bearing Shim Pack
646. Main Drive Gear Bearing Retainer
647. Screw
648. Magnet
649. Nut

B-08501

Figure 1—77 mm Transmission and Components

Remove or Disconnect (Figures 1, 2 and 3)

- Speedometer driven gear, switches and any external components.

1. Control lever (653).
   - Boot and the dust cover.
2. Pin (659) from the offset lever (655), (figure 4).
3. Extension housing (613) and the offset lever.

Important

- The offset lever is engaged into the extension housing and cannot be removed when the extension housing is mounted to the transmission.

4. Detent ball and the spring from the offset lever, (figure 5).
5. Countergear rear thrust bearing (612).
   - Plastic funnel (figure 6).
   - Front thrust race.
6. Shift cover (601).

Important

- Two of the cover mounting screws are alignment screws. Note the positions they were removed from for installation.

7. 5th speed drive gear (632).
   - Support the 5th speed shift fork (618) and drive the pin out, (figure 7).
   - Snap ring and the 5th gear synchronizer (630) and shift fork together (figure 8).
   - 5th speed blocker ring (631) and the 5th speed gear (632).
8. Speedometer drive gear (609) and the clip.
9. 5th speed driven gear snap ring (606).
10. Main drive gear bearing retainer (646).
    - Mark the retainer and the case for alignment (figure 9).
11. Bearing race (644) and the shim pack (figure 10).
12. Main drive gear (643).
    - Turn the gear so the cut-out is toward the countergear (figure 11).
13. Retaining ring and the reverse shift shaft lever pivot bolt (624) (figure 12).
14. Mainshaft rear bearing race (605).
15. Mainshaft (604).
16. 5th speed and reverse shift shaft (629) (figure 13).
    - Unhook the lock spring.
    - Turn the shaft to disengage it from the reverse lever.
    - Remove the shaft from the rear of the transmission case.
17. 5th speed and reverse shift lever (623).
18. Reverse idler gear (638).
    - Drive the pin through the front of the idler shaft (637) (figure 14).
    - Idler shaft and the seal.

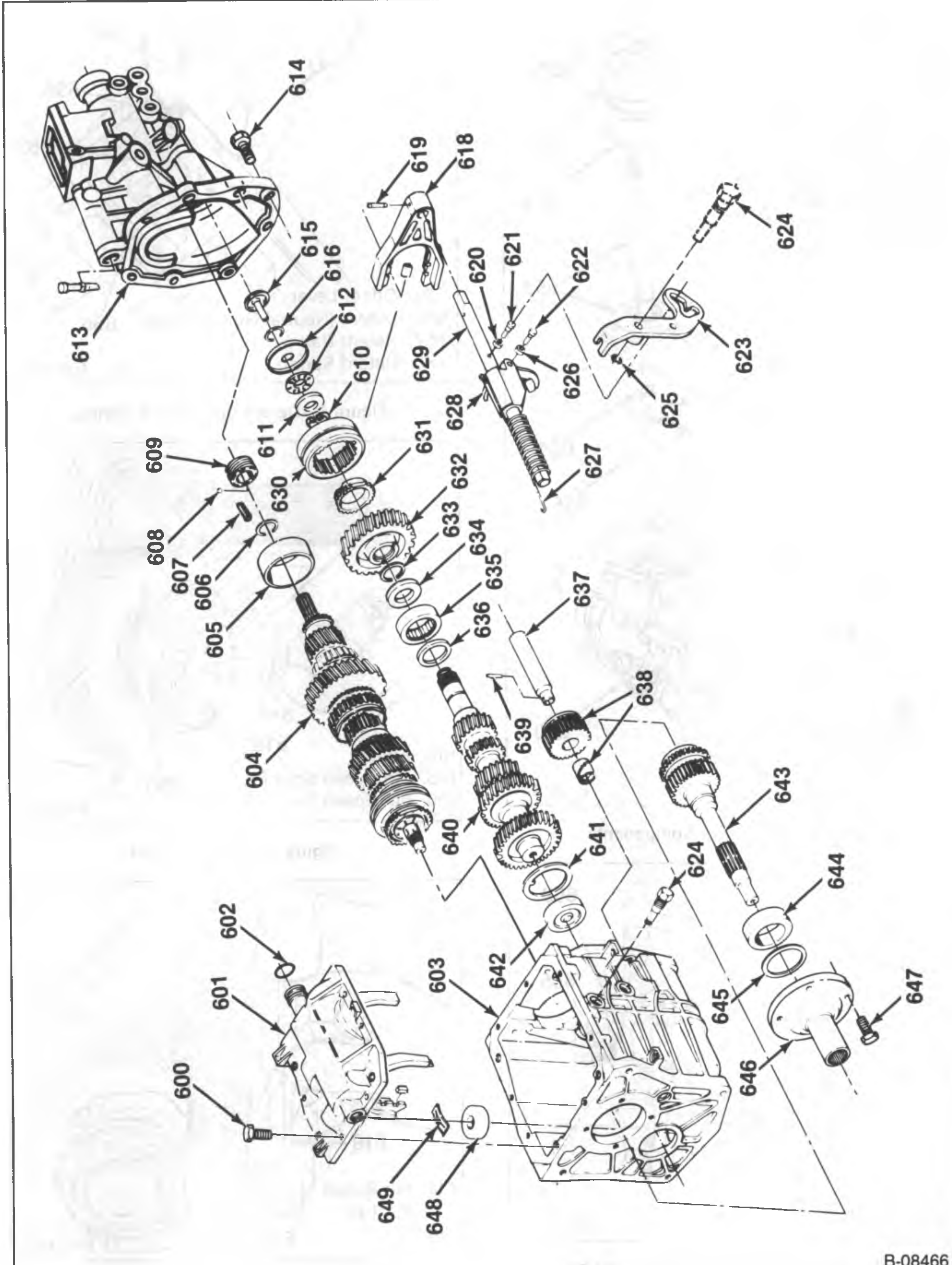


Figure 2—77 mm Transmission and Components

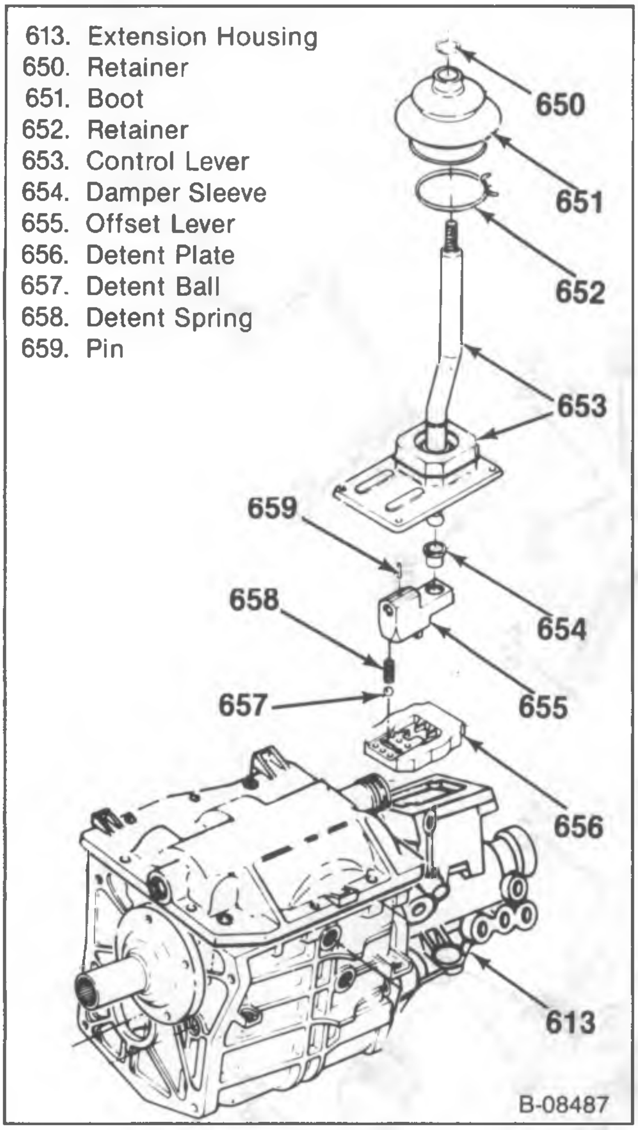


Figure 3—Shift Lever Components

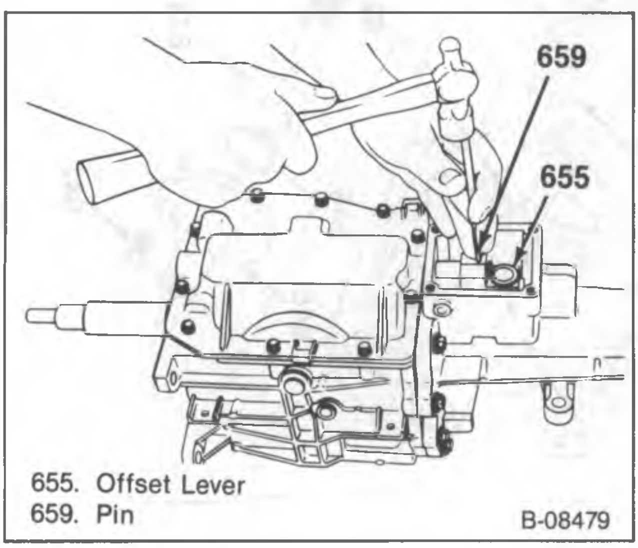


Figure 4—Removing the Offset Lever Pin

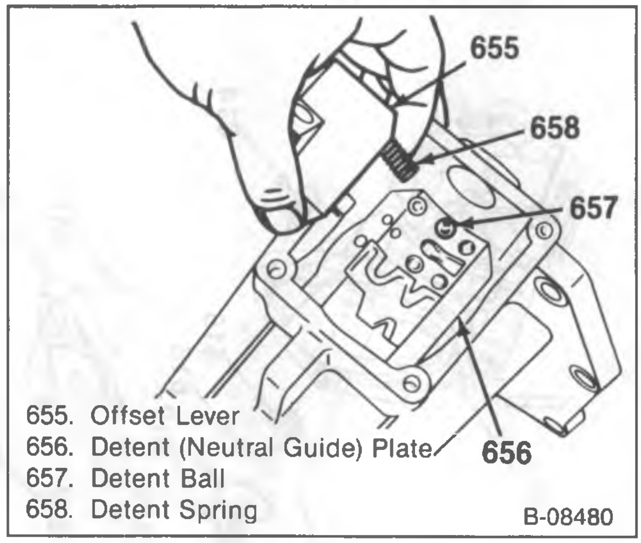


Figure 5—Detent Ball and the Spring

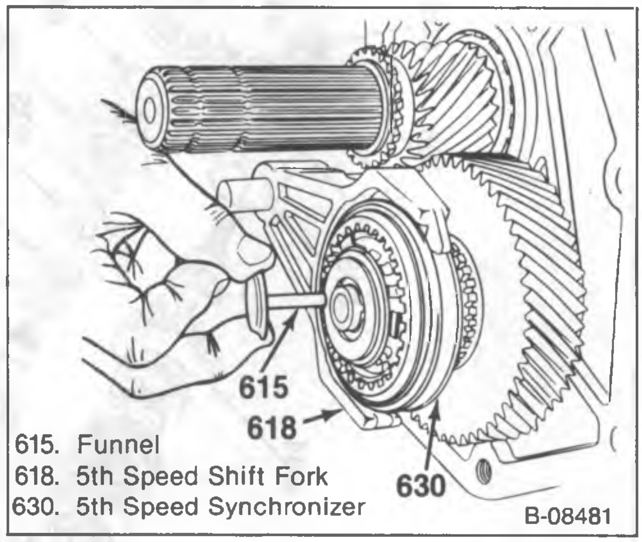


Figure 6—Plastic Funnel

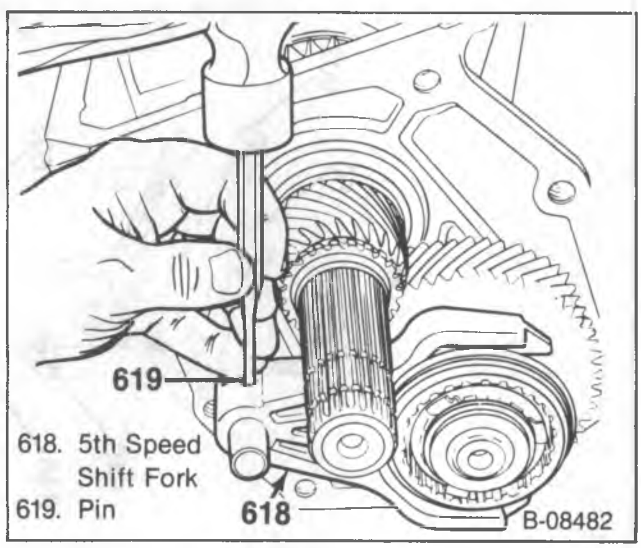


Figure 7—Removing the 5th Speed Shift Fork Pin

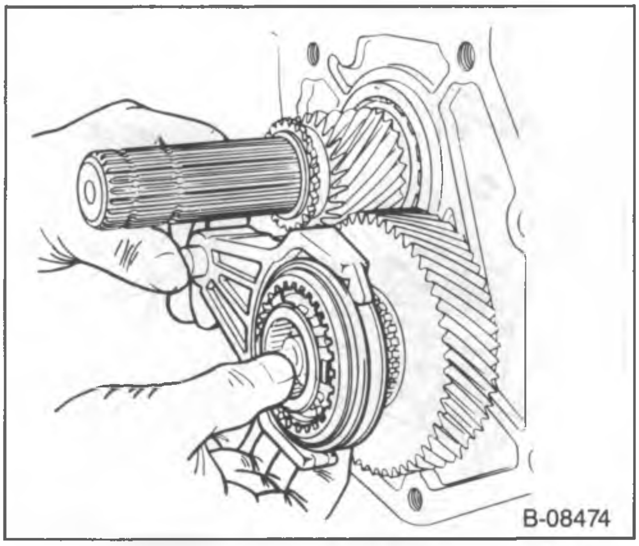


Figure 8—Removing the 5th Speed Shift Fork and the Synchronizer

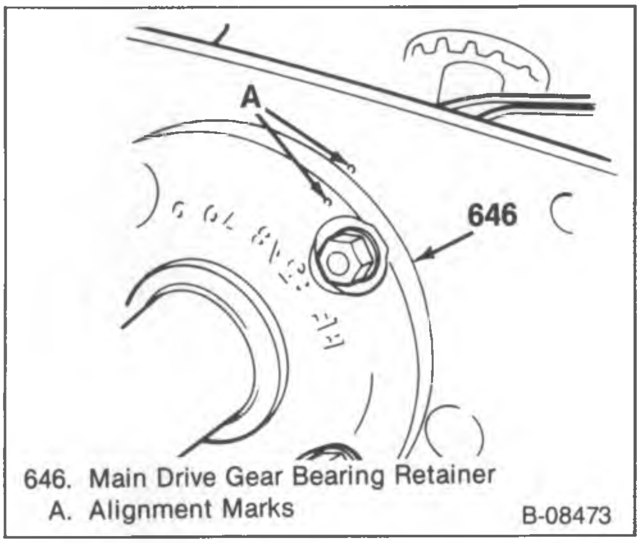


Figure 9—Bearing Cap Alignment Marks

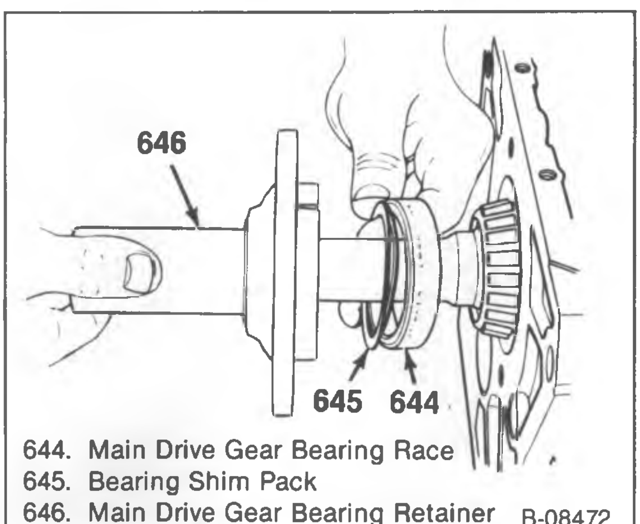


Figure 10—Main Drive Gear Shim Pack

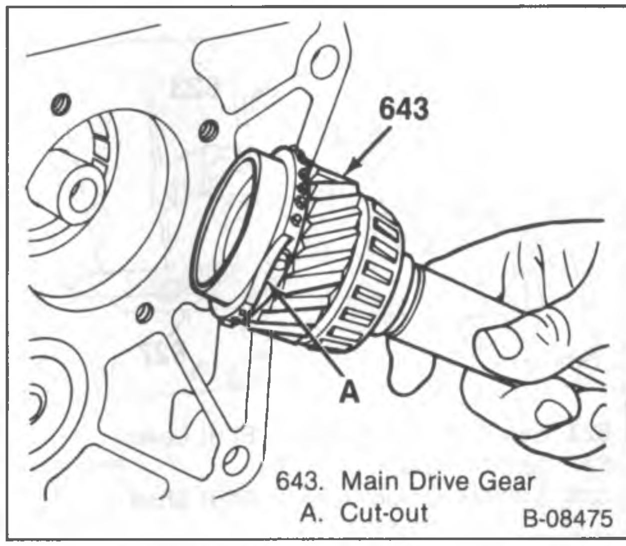


Figure 11—Main Drive Gear Cut Out

- Idler gear.

19. Snap ring and the countergear rear bearing spacer (634).
20. Countergear rear bearing (635).
    - Drive the countergear (640) to the rear to remove the bearing (figure 15).

Important

- Note the direciton the bearing faces.

21. Countergear (640) and the rear bearing spacer (636).
22. Countergear thrust washer (641).
23. Countergear front bearing (642).
    - Press the bearing from the case.

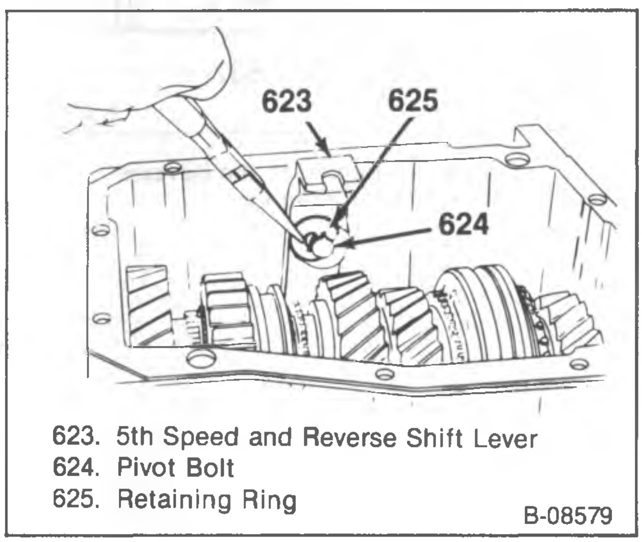


Figure 12—5th Speed and Reverse Shift Lever Retaining Ring

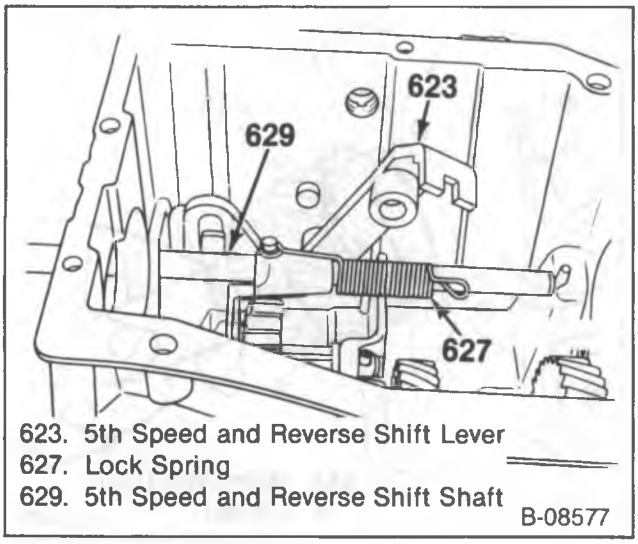


Figure 13—5th Speed and Reverse Shift Shaft

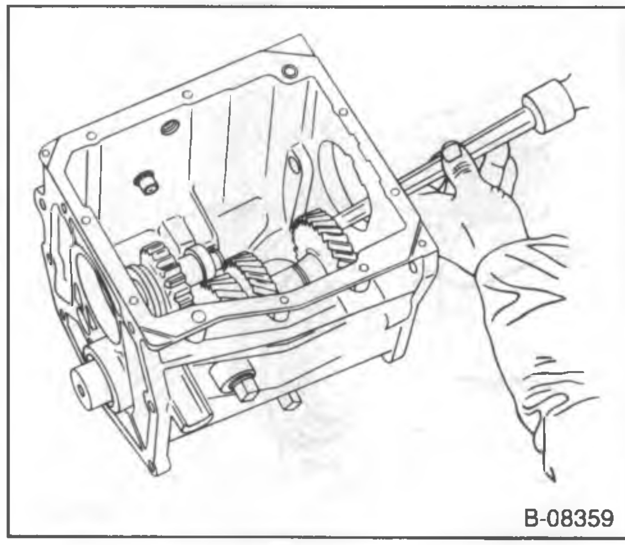


Figure 15—Removing the Countergear Rear Bearing

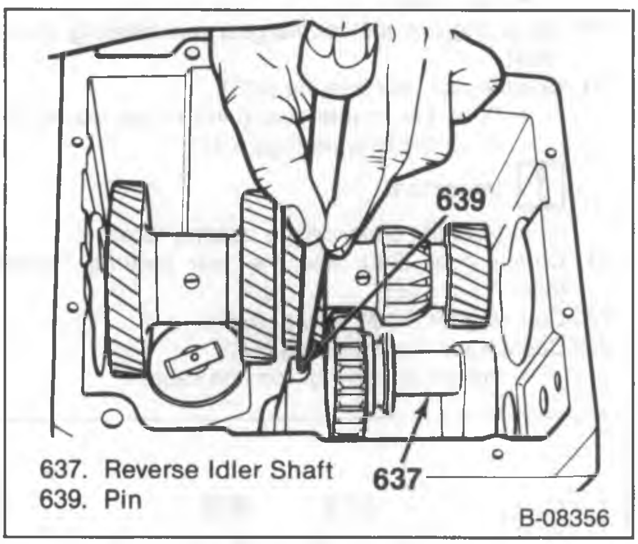
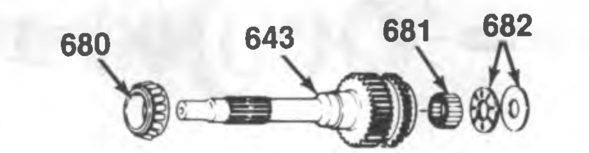


Figure 14—Removing the Reverse Idler Shaft Pin

DISASSEMBLY AND ASSEMBLY OF SUB-ASSEMBLIES



643. Main Drive Gear
680. Drive Gear Bearing
681. Pilot Bearings
682. Drive Gear Thrust Bearing

B-08485

Figure 16—Main Drive Gear Bearings

MAIN DRIVE GEAR

Disassemble (Figure 16)

Tool Required:

J 22912-01 Bearing and Gear Puller

1. Thrust bearing and the race (682).
2. Pilot bearings (681).
3. Bearing (680) using J 22912-01 (figure 17).

Clean (Figure 16)

- All parts in a suitable solvent. (Do not spin the bearings dry.)

Inspect (Figure 16)

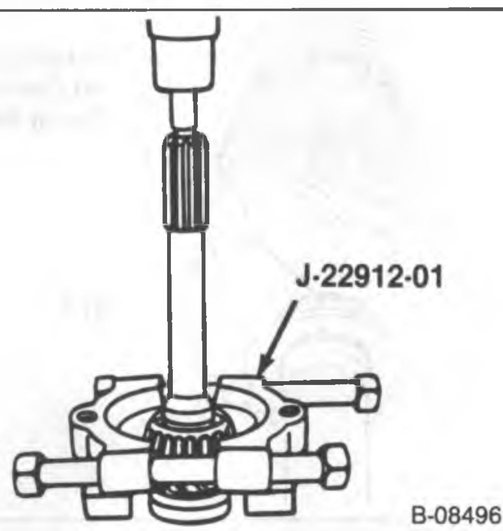
1. Parts for damage and wear.
2. Oil the bearings and check for roughness.

Assemble (Figure 16)

Tool Required:

J 22912-01 Bearing and Gear Puller

1. Bearing (680), using J 22912-01 (figure 17).
2. Pilot bearings.
   - Use chassis grease to hold the bearings in place.
3. Thrust bearing and the race (682).



B-08496

Figure 17—Removing the Main Drive Gear Bearing

MAINSHAFT

Disassemble (Figure 18)

Tool Required:

J 22912-01 Bearing and Gear Puller

1. 4th speed blocker ring (661).
2. 3rd and 4th synchronizer and the 3rd speed gear (664).
   - Press the mainshaft through the synchronizer, the blocker ring and the gear using J 22912-01 (figure 19).
   - Do not let the synchronizer come apart.

Important

- Do not let the mainshaft fall to the floor.

3. Remove the snap ring and the 2nd speed gear thrust washer (666).
4. Remove the 2nd speed gear (667) and blocker ring.
5. Press the mainshaft through the 5th speed driven gear (679) using J 22912-01 (figure 20).

Important

- Do not let the mainshaft fall to the floor.

6. Mainshaft rear bearing (678).
   - It may be necessary to press the mainshaft through the bearing using J 22912-01 (figure 20).

Important

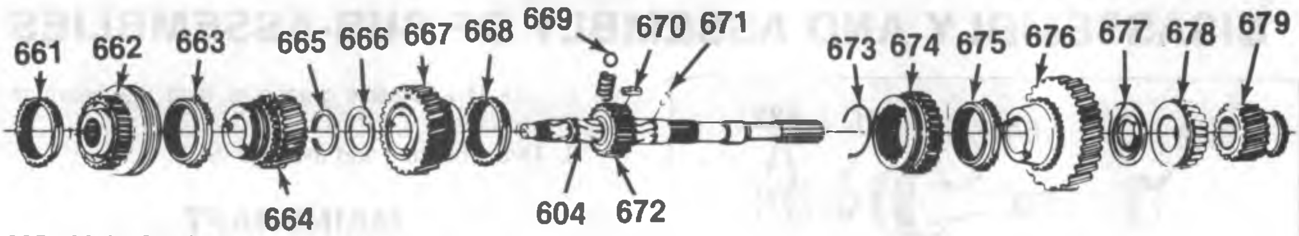
- Do not let the mainshaft fall to the floor.

7. Remove the 1st speed gear thrust washer (677).
8. Pull the retaining pin out and remove the 1st speed gear (676) (figure 21).
9. 1st and 2nd speed synchronizer sleeve (674) (figure 22).
   - Mark the hub and sleeve alignment for reassembly.
   - Push the hub out of the sleeve while holding the springs and keys to avoid losing them.
   - Do not lose the antirattle ball and spring (669) (5 speed only).

Important

- Do not remove the hub. The hub and the mainshaft are machined together as a set.

10. Synchronizers (630 and 662) (figure 22).
    - The synchronizer hub and sleeve are a select fit, do not mix the parts of the two synchronizers.
    - Mark the hub and sleeve alignment for reassembly.
    - Push the hub out of the sleeve while holding the springs and keys to avoid losing them.



605. Main Shaft
661. 4th Speed Blocker Ring
662. 3rd and 4th Synchronizer
663. 3rd Speed Blocker Ring
664. 3rd Speed Gear
665. Snap Ring
666. 2nd Speed Gear Thrust Washer
667. 2nd Speed Gear
668. 2nd Speed Blocker Ring
669. Anti Rattle Ball and Spring
670. Synchronizer Key
671. Retaining Pin
672. Synchronizer Hub
673. Synchronizer Spring
674. 1st and 2nd Synchronizer Sleeve (Reverse Gear)
675. 1st Speed Blocker Ring
676. 1st Speed Gear
677. 1st Speed Gear Thrust Washer
678. Mainshaft Rear Bearing
679. 5th Speed Driven Gear

B-08484

Figure 18—Mainshaft and Components

Clean (Figure 18)

- All parts in a suitable solvent and air dry.

Important

- Do not spin dry bearings.

Inspect (Figure 18)

1. Gears for cracks, chipped gear teeth, and other damage that could cause gear noise.
2. Thrust washers and bushings for damage and wear.
3. Related surfaces on the gears like thrust faces and bearing surface diameters.
4. The reverse sliding gear for a sliding fit on the synchronizer hub without excess radial, or circular play. If the sliding gear is not free on the hub, inspect it for burrs on the ends of the internal splines. Remove any burrs by honing as required.
5. Synchronizer sleeves for a sliding fit on the synchronizer hubs, also, the hubs have to be a snug fit on the mainshaft splines.

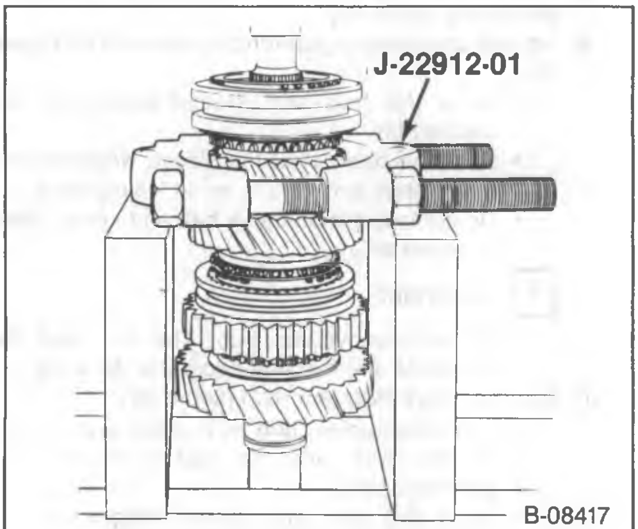


Figure 19—Removing the 3rd and 4th Synchronizer

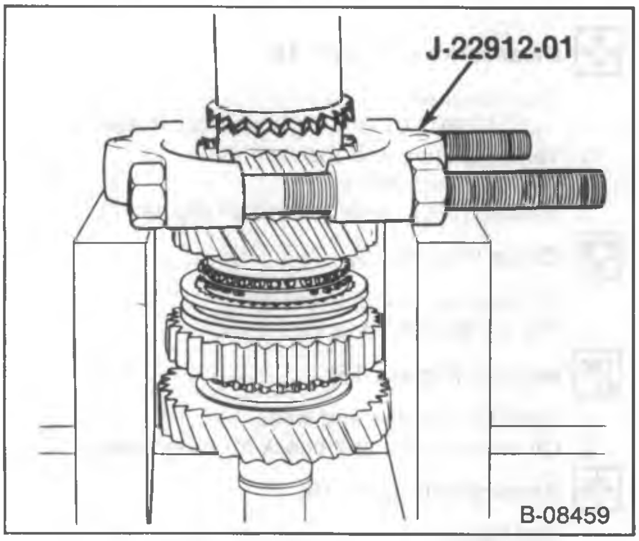


Figure 20—Removing the 5th Speed Driven Gear

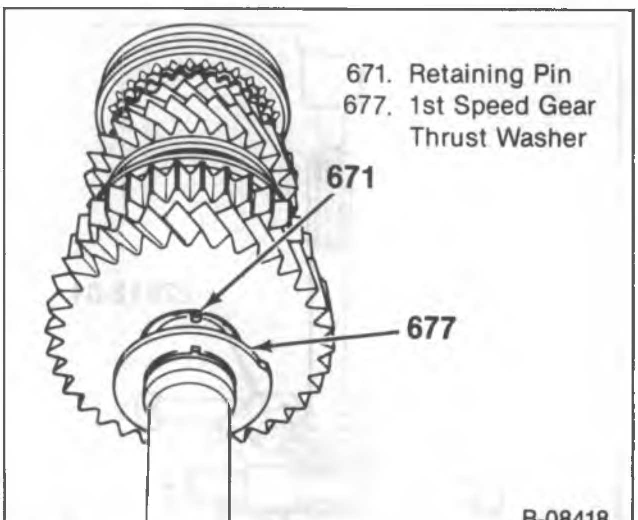
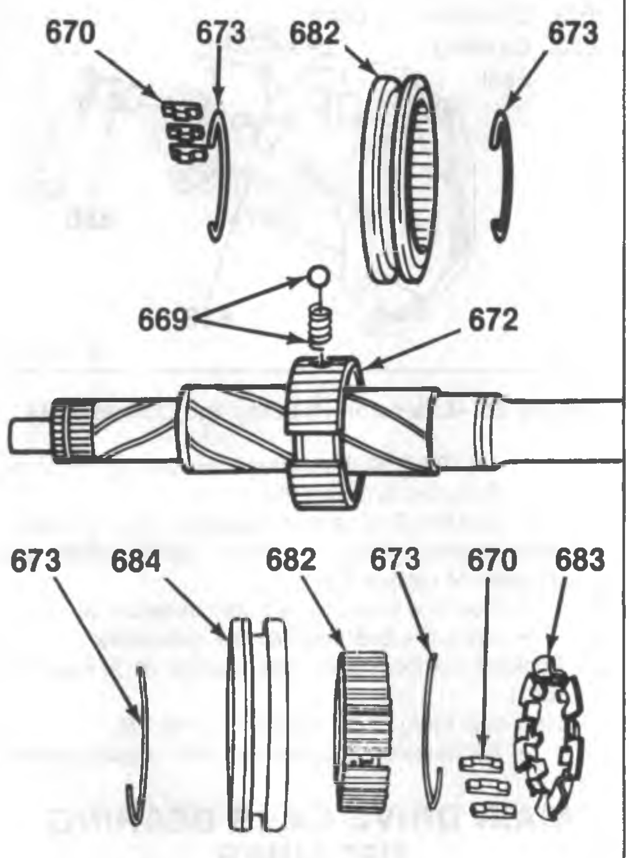


Figure 21—1st Speed Gear Retaining Ring



669. Anti Rattle Ball and Spring
670. Synchronizer Key
672. Synchronizer Hub
673. Synchronizer Spring
682. 3rd and 4th and 5th Synchronizer Hub
683. Synchronizer Key Plate (5 Speed Only)
684. Synchronizer Sleeve

B-08407

Figure 22—Synchronizer Components

6. Synchronizer springs and keys for looseness and damage.
7. Brass synchronizer rings for excess wear and damage.
8. All gear teeth for excess wear.
9. Bearings and bearing surfaces for nicks, burrs and wear.
10. Lubricate all roller bearings with light engine oil and check for rough rotation.

Assemble (Figure 18)

Tools Required:

J 22912-01 Bearing and Gear Puller
J 25234 Countergear Rear Bearing Installer

- Coat all parts with transmission oil before installing them.

1. Synchronizers (630 and 662) (figure 22).
   - Place the keys into the hub.
   - Engage the springs in the same key with the open ends away from each other (figure 23).
   - Slide the sleeve onto the hub, aligning the marks made during disassembly.

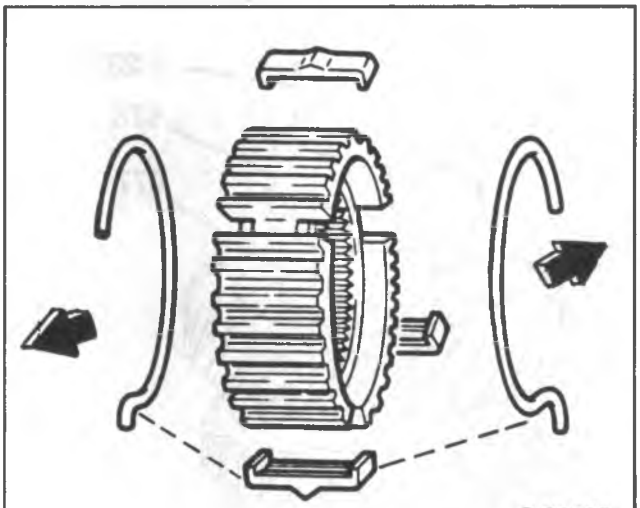
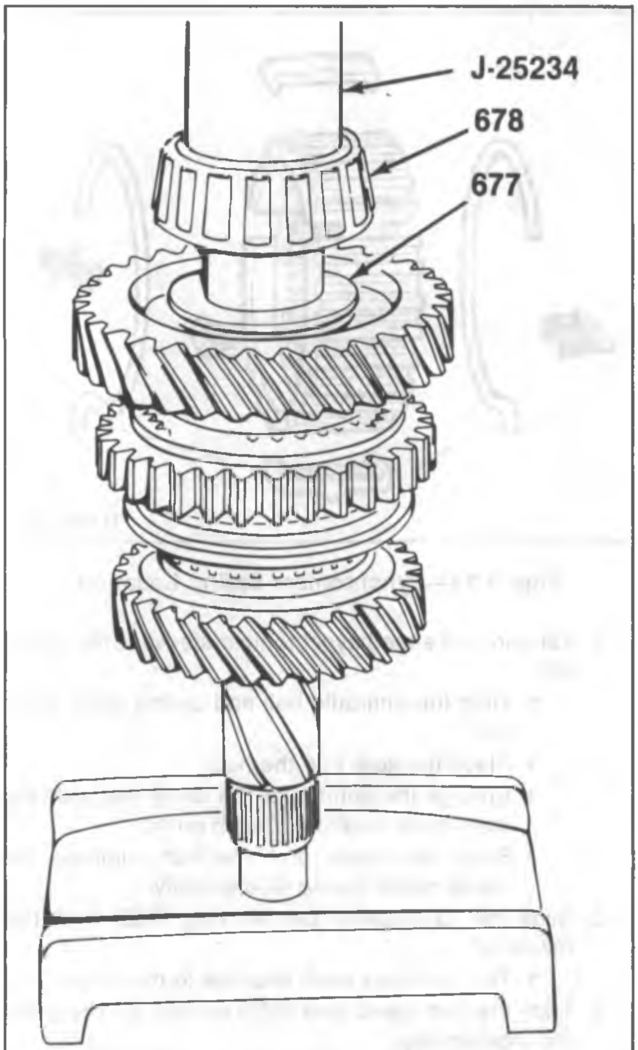


Figure 23—Synchronizer Spring Location

2. 1st and 2nd speed synchronizer sleeve (674) (figure 22).
   - Hold the antirattle ball and spring (669) in the hub.
   - Place the keys into the hub.
   - Engage the springs in the same key with the open ends away from each other.
   - Slide the sleeve onto the hub, aligning the marks made during disassembly.
3. Slide the 2nd speed blocker ring (668) onto the mainshaft.
   - The clutching teeth must be to the front.
4. Slide the 2nd speed gear (667) on with the cone into the blocker ring.
5. 2nd speed gear thrust washer (666) and a new snap ring.
   - Be sure the thrust washer tab is seated in the mainshaft groove.
6. Slide the 1st speed blocker ring (675) onto the mainshaft.
   - The clutching teeth must be to the rear.
7. Install the 1st speed gear (676) and a new retaining pin (figure 21).
8. Slide the 1st speed gear thrust washer (677) against the gear.
9. Install the mainshaft rear bearing (678).
   - The bearing may have to be pressed on using J 25234 (figure 24).
10. Install the 5th speed driven gear (679) using J 22912-01.
11. Slide the 3rd speed gear (664) on with the cone to the front.
12. Slide the 3rd speed blocker ring (663) onto the 3rd speed gear.
    - The clutching teeth must be against the gear.
13. Install the 3rd and 4th synchronizer (662) with the hub offset to the front.
14. Slide the 4th speed blocker ring (661) into the 3rd and 4th synchronizer.
    - The clutching teeth must be to the front.



677. 1st Speed Gear Thrust Washer
678. Mainshaft Rear Bearing

Figure 24—Installing the Mainshaft Rear Bearing

EXTENSION HOUSING

Remove or Disconnect (Figure 25)

Tools Required:

J 8092 Driver Handle

J 23062-14 Extension Housing Bushing Remover and Installer

1. Seal (681).
2. Sealing compound from the flange of the extension.
3. Bushing (680) if it is worn or damaged, using J 8092 and J 23062-14.

Inspect (Figure 25)

1. Extension for scoring, wear or cracks, especially at the flange.
2. Snap ring groove for wear and damage.

Install or Connect (Figure 25)

Tools Required:

J 8092 Driver Handle

613. Extension Housing
680. Bushing
681. Seal

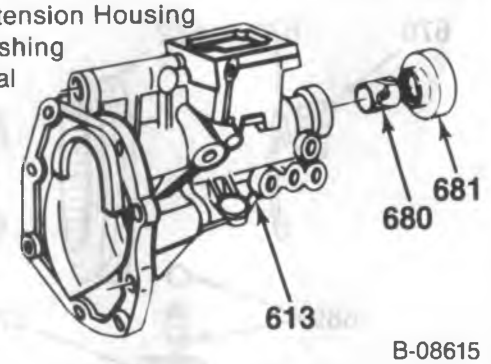


Figure 25—Extension Housing and Components

J 23062-14 Extension Housing Bushing Remover and Installer

J 21426 Extension Housing Oil Seal Installer

1. New bushing (680) if needed, using J 8092 and J 23062-14 (figure 26).
   - Coat the bushing with transmission oil.
   - Drive the bushing into the extension.
2. Locking compound on the outside of a new seal (681).
3. New seal (681) using J 21426 (figure 27).
   - Fill between the seal lips with chassis grease.

MAIN DRIVE GEAR BEARING RETAINER

Remove or Disconnect (Figure 28)

1. Seal (683).
2. Sealing compound from flange of retainer (646).

Inspect (Figure 28)

1. Retainer nose for scoring, wear or cracks, especially at the flange.
2. Snap ring groove for damage caused by drive gear bearing movement.

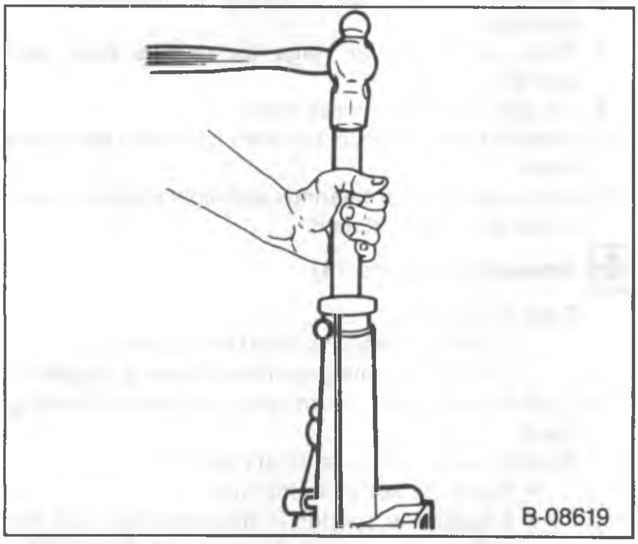


Figure 26—Installing the Extension Housing Bushing

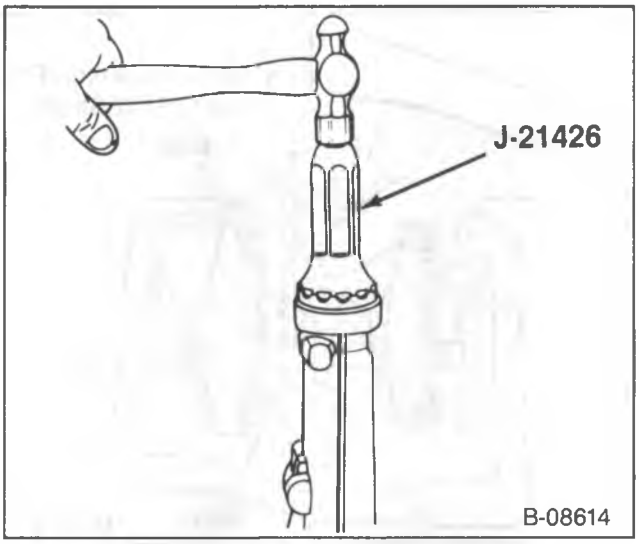


Figure 27—Installing the Extension Housing Oil Seal

3. Replace the retainer if it is worn or damaged.

Install or Connect (Figure 28)

Tool Required:
J 23096 Front Housing Drive Gear Seal Installer

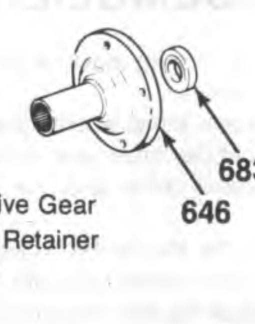
- New seal (683) using J 23096. Coat the inside of the seal with transmission oil (figure 29).

SHIFT COVER

Disassemble (Figure 30)

- The shift shaft and shift fork plates must be in the neutral position (centered).

1. Turn the shift shaft (685) until the selector arm (689) is disengaged from the fork plates (688).
2. Drive the retaining pin out of the selector arm (689) (figure 31).
3. Remove the shift shaft (685).
   - Shift forks and the plates.
   - Selector arm.
   - Interlock plate.
4. Pry the oil seal (602) out.



646. Main Drive Gear Bearing Retainer
683. Oil Seal

Figure 28—Main Drive Gear Bearing Retainer Oil Seal

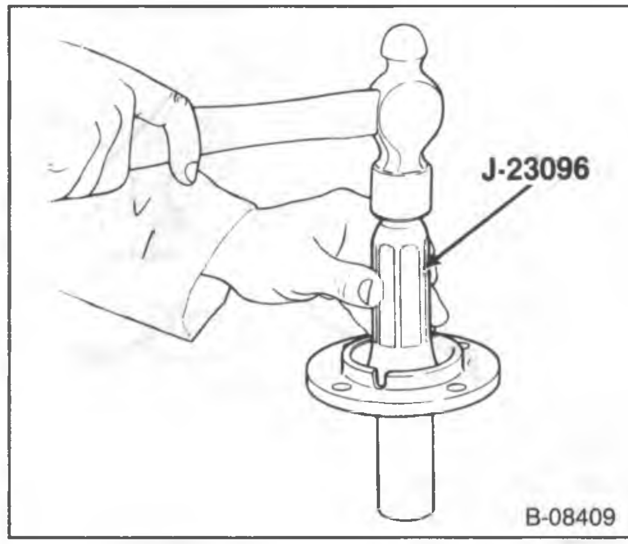


Figure 29—Installing the Bearing Retainer Oil Seal

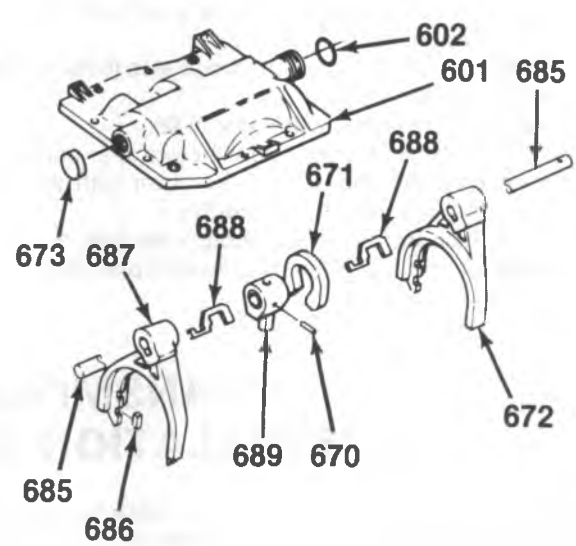
5. Remove the inserts (686) from the forks.

Clean (Figure 30)

- All metal parts in solvent and air dry.

Inspect (Figure 30)

1. Shift forks.
   - For damage or bends.
   - For worn inserts.
2. Shift shaft.



601. Shift Cover
602. Oil Seal
670. Retaining Pin
671. Interlock Plate
672. 1st and 2nd Shift Fork
673. Shaft Plug
685. Shift Shaft
686. Insert
687. 3rd and 4th Shift Fork
688. Shift Fork Plate
689. Selector Arm

B-08391

Figure 30—Shift Cover and Components

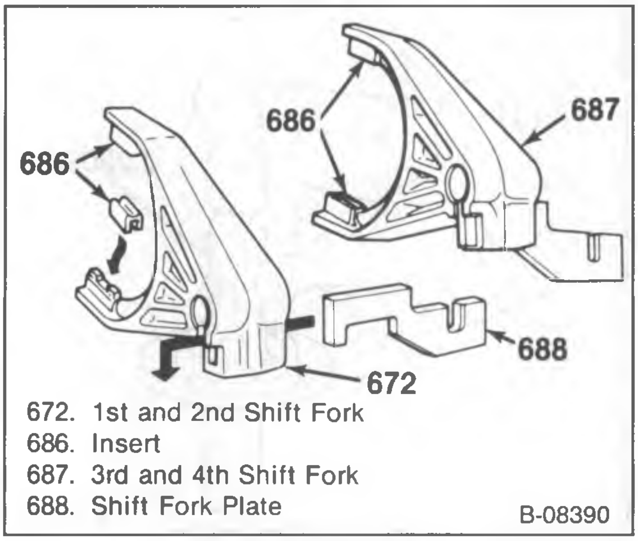


Figure 31—Shift Forks and Selector Plates

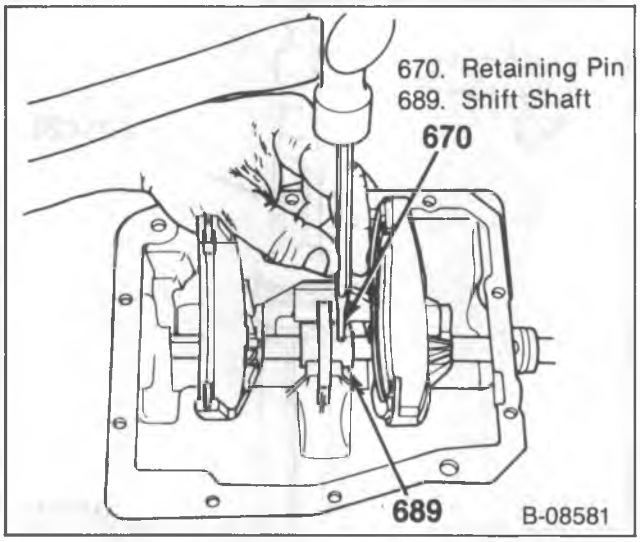


Figure 32—Removing the Shift Shaft Retaining Pin

- For damage and bends.
- For worn or damaged plates.
- For smooth fit in the cover.

3. Shift cover.
   - For cracks and warping.
   - For smooth shift shaft fit.
   - Shaft plug for damage or leaks.

Assemble (Figure 30)

- Coat the shift shaft and the cover bores lightly with grease.

1. Install a new shift shaft plug (673), if needed.
   - Coat the outside of the plug with sealing compound.
2. Fit the inserts (686) and the fork plates (688) into the shift forks (figure 31).
3. 1st and 2nd (largest) shift fork (672).
   - Fit the shift shaft into the cover rear bore.
   - Hold the shift fork in the cover with the fork offset to the rear (figure 32).
   - Push the shift shaft through the fork.
4. Selector arm (689) and the interlock plate (671).
   - Hold the selector arm and the interlock plate in the cover with the widest part of the plate away from the cover.
   - The shift arm retaining pin hole must be away from the cover and to the rear (figure 32).
   - Push the shift shaft through the arm.
5. 3rd and 4th shift fork (687).
   - Hold the shift fork in the cover with fork offset to the rear (figure 32).
   - The fork plate must be under the 1st and 2nd shift fork plate.
   - Push the shift shaft through the fork, into the cover front bore.
6. Turn the shift shaft until the front fork plate is away from the cover and parallel to it.
7. Drive a new retaining pin (670) into the selector arm and the shift shaft.
   - Be sure the arm and shaft pin holes are aligned.
   - The retaining pin must be flush with the selector arm.
8. Install a new oil seal (602).
   - Coat the seal with transmission oil.

TRANSMISSION ASSEMBLY (INSTALLATION OF SUB-ASSEMBLIES)

Use new seals, gaskets, and thread sealer on all bolt threads when assembling the transmission. Tighten all bolts to specified torque.

Lubricate all assemblies as they are installed in the transmission using transmission oil.

Install or Connect (Figures 1, 2 and 3)

Tools Required:
J 29895 Countershaft Rear Bearing Installer
J 33032 Rear Cluster Bearing Assembly Tool

1. Countergear front bearing (642) (figure 33).
   - Coat the bearing bore with Loctite #601 or equivalent.
   - The bearing must be flush with the transmission case.
2. Countergear thrust washer (641).
   - Coat the thrust washer with grease.
3. Countergear (604) and the rear bearing spacer (636).
   - Tip the transmission case up.
   - Fit the countergear into the front bearing.
   - Install the rear bearing spacer.
4. Countergear rear bearing (635) (figures 34 and 35).
   - Coat the bearing with grease.
   - Install the bearing using J 33032 and J 29895.

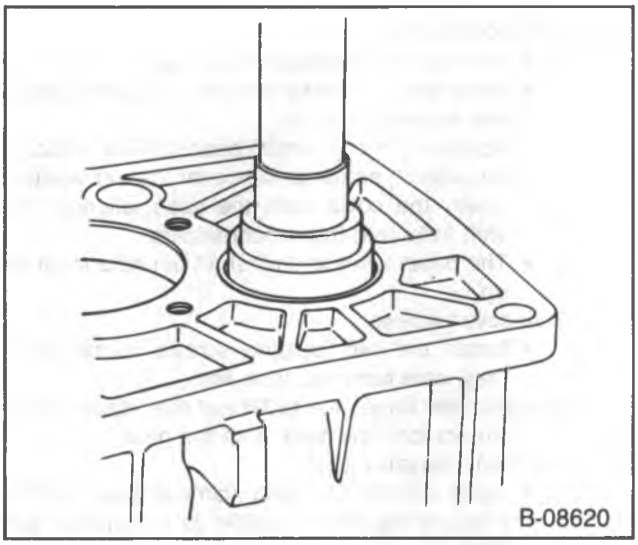


Figure 33—Installing the Countergear Front Bearing

Important

- Be sure the bearing is installed in the direction it was removed from.

Measure

- Countergear rear bearing. It must extend 3 mm (0.125-inch) past the transmission case.

5. Reverse idler gear (638) and the shaft.
   - Hold the gear in the case with the shift lever groove to the rear.
   - Install the reverse idler shaft from the rear.
   - Install a new retaining pin (figure 14).
6. Fit the mainshaft (604) into place.
7. Mainshaft rear bearing race (605).
8. Main drive gear (643).
   - Turn the gear so the cut-out is toward the countergear (figure 11).
   - Be sure the 4th speed blocker ring is engaged in the synchronizer properly.
9. Main drive gear bearing race (644).

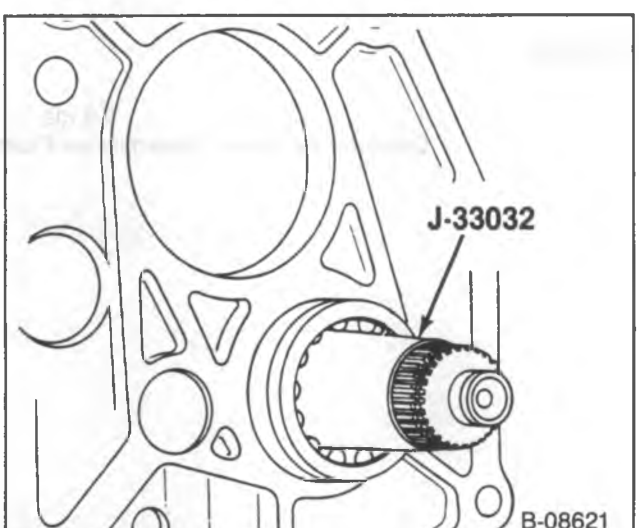


Figure 34—Installing Tool J 33032

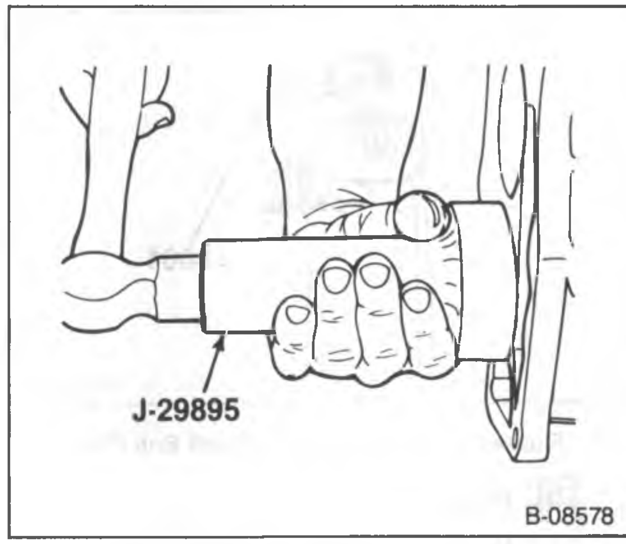


Figure 35—Installing the Countergear Ring Bearing

10. Main drive gear bearing retainer (646) and the screws.
    - Be sure to align the marks (figure 9).
11. 5th speed and reverse shift lever (623), and the pivot bolt.
    - Coat the pivot bolt threads with a non-hardening sealer.
    - Be sure the reverse lever fork is engaged in the idler gear slot.
12. New reverse shift lever retaining ring (625).
13. Countergear rear bearing spacer (634) and a new snap ring.
14. 5th speed drive gear (632).
15. 5th speed and reverse shift shaft (629) (figure 13).
    - Install the shaft from the rear of the case.
    - Turn the shaft to engage it in the reverse lever.
    - Hook the lock spring to the front of the case.
16. 5th speed shift fork (618) and the synchronizer.
    - Engage the shift fork in the synchronizer.
    - Engage the 5th speed blocker ring into the synchronizer.
    - Install the synchronizer onto the countergear and the shift fork onto the shift shaft together.
17. New pin (619).
    - Align the holes in the 5th speed shift fork and the shift shaft.
    - Support the shift fork and install the pin (figure 7).
18. Front thrust race (611) and a new snap ring.
19. Countergear thrust bearing (612).
    - Coat the bearing with petroleum jelly.
    - The bearing race lip must be over the bearing.
    - Plastic funnel (615) into the bearing.
20. Extension housing (613) and the screws.
    - Turn the transmission on end and mount a dial indicator ot the extension housing (figure 36).

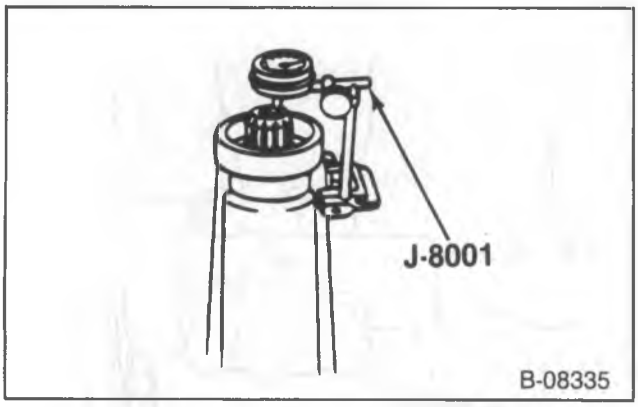


Figure 36—Measuring Mainshaft End Play

Measure

- Mainshaft end play.
- Select a shim pack 0.03-0.13 mm (0.001-0.005-inch) LARGER than the end play measured, to preload the mainshaft bearings 0.03-0.13 mm (0.001-0.005-inch).

21. Main drive gear bearing shim pack (645).
    - Remove the bearing retainer.
    - Install the correct shim pack (figure 10).
    - Apply a 3 mm (1/8-inch) diameter bead of RTV #732, or equivalent, sealer to the case mating surface.
    - Install the bearing retainer, aligning the marks (figure 9).
22. Shift cover (601).
    - Remove the extension housing.
    - Move the shift forks and the synchronizers to the neutral positions.
    - Apply a 3 mm (1/8-inch) bead of RTV #732, or equivalent, sealer to the cover mating surface.
    - Lower the cover onto the case, aligning the shift forks into the synchronizers.
    - The offset lever to shift shaft pin hole must be up.
23. Shift cover screws.
    - Install the two locating screws in the holes they were removed from first.
24. Speedometer drive gear (609) and the retaining clip.
    - Do not lose the balls from the gear.
25. Extension housing (613).
    - Apply a 3 mm (1/8-inch) diameter bead of RTV #732, or equivalent, sealer to the mating surface.
    - Hold the extension housing so the shift shaft just enters the shift cover opening.
26. Offset lever (655), the detent ball and the spring (figure 5).
    - Press the offset lever into place and seat the extension housing.
    - Install the extension housing scerws.
27. New pin (659) into the offset lever and shift shaft.
28. Control lever (653), the boot and the dust cover.
    - Silicone sealer in the groove around the dust cover.

SPECIFICATIONS

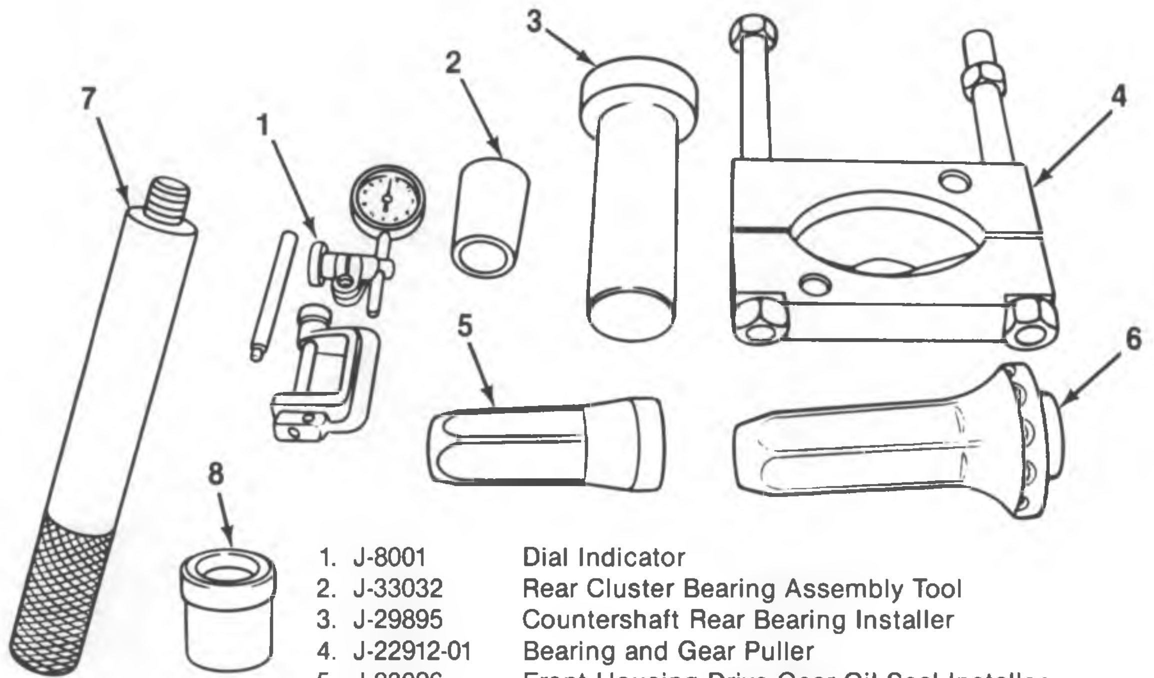
FASTENER TORQUE

	N·m	Ft. Lbs.
Drive Gear Bearing Retainer Screws	20	15
Shift Cover Screws	13	10
Rear Extension Screws	30	25
Reverse Pivot Bolt	27	20

LUBRICATION

Capacity	2.0 L	2.0 qts.
Type Recommended	Dexron II Automatic Transmission Fluid	

SPECIAL TOOLS



1.	J-8001	Dial Indicator
2.	J-33032	Rear Cluster Bearing Assembly Tool
3.	J-29895	Countershaft Rear Bearing Installer
4.	J-22912-01	Bearing and Gear Puller
5.	J-23096	Front Housing Drive Gear Oil Seal Installer
6.	J-21426	Extension Housing Oil Seal Installer
7.	J-8092	Driver Handle
8.	J-23062-14	Extension Housing Bushing Remover and Installer

B-08343

SECTION 7D

TRANSFER CASE

CONTENTS

SECTION 7D1

NEW PROCESS 205 TRANSFER CASE

CONTENTS

DESCRIPTION

A transfer case mounts behind the transmission and allows drive torque to be transmitted in a proportional split to both the front axle and the rear axle, resulting in four-wheel drive. The shift control lever for the transfer case is floor-mounted in the passenger compartment. Depending on the type of transfer case and the shift lever position, various combinations of rear wheel drive, four wheel drive, high traction (gear reduction) or direct drive may be selected.

The model 205 transfer case is a two-speed unit which can be used for either two-wheel or four-wheel drive. Direct drive (1:1 ratio) is available in two modes, 2H for two-wheel drive, or 4H for four-wheel drive. Gear reduction (1.96:1 ratio) is used in the 4L position. This unit uses constant mesh helical gears to connect the input shaft, idler gear and two out put gears, thus allowing gear selection to match driving conditions. The front input shaft gear is in constant mesh with the idler gear and, through the idler gear, with the front output gears and the rear output gear. Sliding clutches allow for selective gear engagement resulting in High or Lo range, and two-wheel or four-wheel drive. Ball bearings support the input shaft, rear output shaft and front output shaft. Tapered roller bearings are used on the idler shaft. When driving in a four-wheel mode (4L or 4H) the hubs on the front wheels must be turned to the "Locked" position.

IDENTIFICATION

An identification tag is attached to the power take-off cover transfer case. This tag provides the transfer case model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations it should be reattached.

DISASSEMBLY

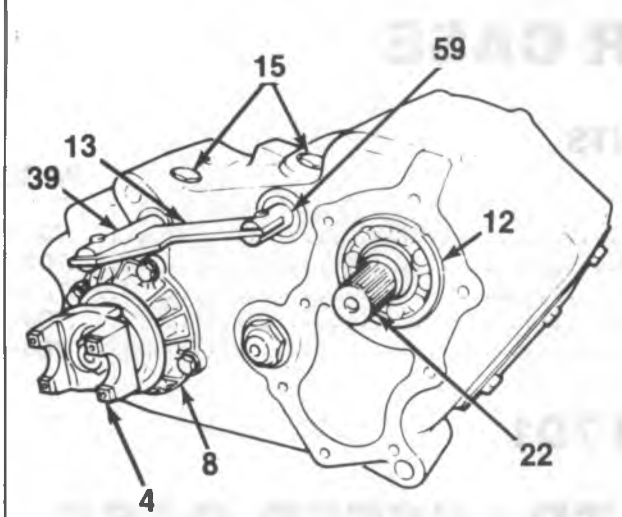


Figure 1—NP205 — Front View

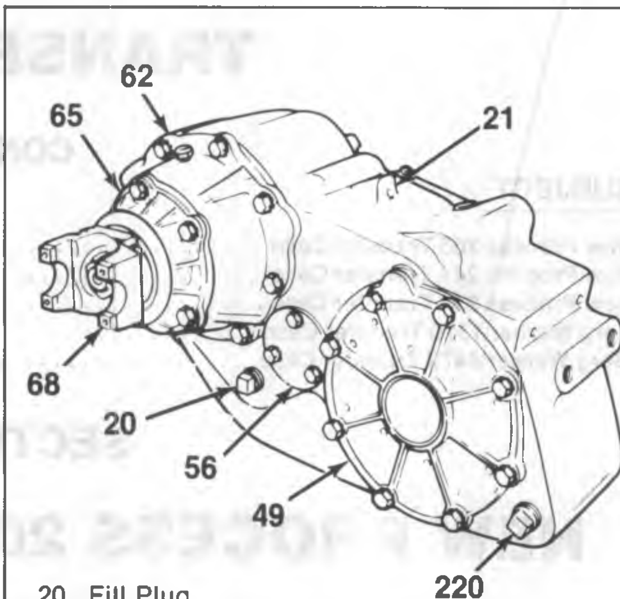


Figure 2—NP205 — Rear View

REAR OUTPUT SHAFT AND YOKE ASSEMBLY

Clean

- The transfer case exterior using a solvent and a stiff brush.

Remove or Disconnect (Figures 1, 2, 3, and 4)

Tool Required:
J 23432 Snap Ring Pliers

— Loosen the rear output shaft yoke nut (79).

1. Rear output shaft housing bolts (6).
2. Housing and retainer assembly (62) from the case (19).
3. Yoke nut (79) and washers (80 and 69).
4. Yoke (68).
5. Shaft assembly (26) from the housing (62).
6. Snap ring (46) using Tool J 23432. Discard the snap ring.
7. Thrust washer (81).
8. Washer pin (45).
9. Tanged bronze washer (60).
10. Gear roller bearings, 32 per row (41).
11. Spacer (42).
12. Gear roller bearings, 32 per row (41).
13. Tanged bronze thrust washer (60).
14. Pilot rollers (25).
15. Retainer ring (23).
16. Washer (24).
17. Oil seal retainer (65).
18. Ball bearing (9) and bearing retaining snap ring.
19. Speedometer gear (63).
20. Oil seal (67) from the retainer (65).
21. Needle bearing (61) from the rear output shaft bearing retainer (62), using a suitable tool.

FRONT OUTPUT SHAFT ASSEMBLY

Remove or Disconnect (Figures 1, 2, 3, 4 and 5)

Tools Required:
J 23432-1 Snap Ring Picks
J 23232 Snap Ring Pliers

1. Lock nut (1).
2. Washer (2 and 3).
3. Yoke (4).
4. Front bearing retainer bolts (6).
5. Retainer (8).
6. Front output shaft rear bearing retainer attaching bolts (6) and retainer (49).
7. Front output shaft (40), gear assembly, and rear bearing retainer (49) from the case (19).
   - Tap on the output shaft with a soft hammer.

8. Clutch hub (34) from the output high gear (33).
   - Output high gear, washer and bearing are still in the case.
9. Low gear retaining ring (46) from the shaft (40), using J 23432-1. Discard the ring.
10. Thrust washer (44) from the shaft.
11. Pin (45) from the shaft.
12. Low gear (43).
13. Roller bearings — 32 per row (41) — first row.
14. Spacer (42).
15. Roller bearings — 32 per row (41) — second row.
16. Front output shaft rear bearing (47).
    - Support the cover.
    - Press the bearing from the cover (figure 5).

SHIFT RAIL AND FORK ASSEMBLIES

↔ Remove or Disconnect (Figures 3, 4, 6, and 7)

1. Two poppet screws (15) on top of the case (19).
2. Two poppet springs (17).
3. Poppet balls (18).
   - Use a magnet.
4. Cup plugs.
   - Drive the cup plugs into the case, using a 6.35 mm (1/4-inch) punch (figure 6).
5. Shift fork pins (36).
   - Position both shift rails into neutral.
   - Drive the shift fork pins through the shift rails and into the case.
6. Clevis spring clips (37) and clevis pins (38).
7. Shift rail link (13).
8. Upper shift rail (39) (figure 7).
9. Lower shift rail (59).
10. Shift forks (77 and 35).
11. Sliding clutch hub (34).
12. Front output high gear (33).
13. Washer (32).
14. Bearing (9).
15. Shift rail cup plugs and shift fork pins (36) from the case.
16. Snap ring (11) in front of the main drive gear bearing (12).
17. Main drive shaft (22).
    - Tap the shaft out the rear of the case.
18. Main drive gear bearing (12).
    - Tap the bearing out the front of the case.
19. Interlock pins (21).

IDLER GEAR

↔ Remove or Disconnect (Figures 3, 4 and 8)

Tool Required:
Tool-A

1. Idler gear shaft nut (27) and washer (28).
2. Idler shaft rear cover bolts (58) and rear cover (56).
3. Idler gear shaft (54), using Tool A and a soft hammer (figure 8).
4. Idler gear (51).
   - Roll the gear to the front output shaft hole and remove it from the case.
5. Bearing cups (50), as required, from the idler gear (51).
6. Spacer (52).
7. Shims (53).

MISCELLANEOUS

↔ Remove or Disconnect

1. Lock pins (37).
2. Clevis pins (38).
3. Shift rail cross link (13).
4. Drain plugs and filler plugs.
5. PTO cover bolts (30).
6. PTO cover (31).
7. PTO cover gasket (29).

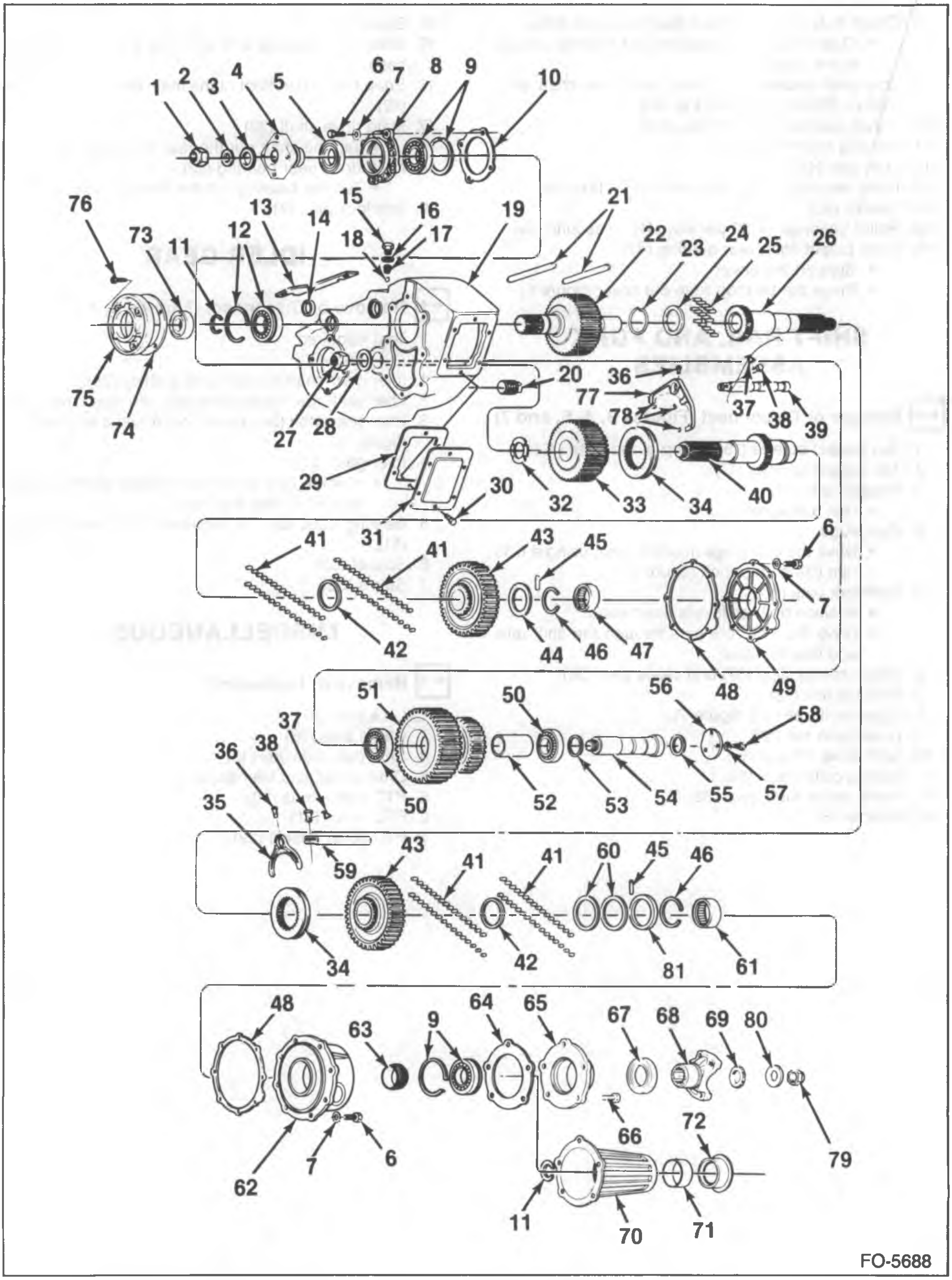
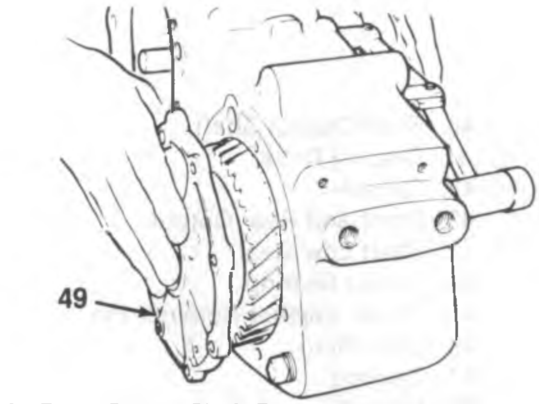


Figure 3—NP205 Transfer Case

1. Yoke Nut
2. Washer
3. Washer (Rubber)
4. Yoke
5. Seal
6. Retainer Bolt
7. Washer, Toothed
8. Retainer
9. Front and Rear Output Shaft Bearing
10. Gasket
11. Bearing Retaining Snap Ring
12. Main Drive Gear Bearing
13. Shift Shaft Link
14. Shift Shaft Oil Seal
15. Poppet Plug (on Rear Output Shift Shaft) or Four Wheel Indicator Lamp Switch (on Front Output Shift Shaft)
16. Poppet Plug Gasket
17. Poppet Plug Spring
18. Poppet Ball
19. Transfer Case
20. Fill Plug
21. Shift Rail Interlink Plunger
22. Input Main Drive Gear
23. Pilot Roller Retainer Ring
24. Rear Output Shaft Roller Bearing Thrust Washer
25. Rear Output Shaft Pilot Bearing Roller
26. Rear Output Shaft
27. Idler Shaft Yoke Nut
28. Washer
29. Power Take-Off Cover Gasket
30. Bolt
31. Power Take-Off Cover
32. Front Output Shaft Bearing Thrust Washer
33. Front Output Shaft Front Gear
34. Front Output Gear Clutch Hub
35. Front Wheel Shift Fork
36. Lock Pin
37. Shift Link Clevis Spring Clip
38. Clevis Pin
39. Two/Four Wheel Shift Shaft
40. Front Output Shaft
41. Bearing Roller
42. Spacer
43. Front and Rear Output Shaft Low Gear
44. Thrust Bearing
45. Thrust Washer Retainer Pin
46. Snap Ring
47. Bearing
48. Gasket
49. Front Output Shaft Rear Bearing Retainer
50. Idler Gear Bearing
51. Transfer Case Idler Gear
52. Idler Gear Bearing Spacer
53. Idler Gear Shim
54. Idler Gear Shaft
55. Idler Shaft Cover Gasket
56. Idler Shaft Cover
57. Washer
58. Bolt
59. Hi-Lo Range Shiaft Shaft
60. Thrust Washer
61. Rear Output Shaft Retainer Bearing
62. Rear Output Shaft Bearing Retainer
63. Speedometer Gear
64. Retainer Oil Seal Gasket
65. Retainer
66. Bolt
67. Oil Seal
68. Yoke
69. Washer (Rubber)
70. Extension
71. Bushing
72. Seal
73. Input Drive Gear Seal
74. Gasket
75. Retainer
76. Bolt
77. Front Output Shift Fork
78. Fork Insert
79. Rear Output Shaft Nut
80. Rear Output Washer
81. Thrust Washer

FO-5799

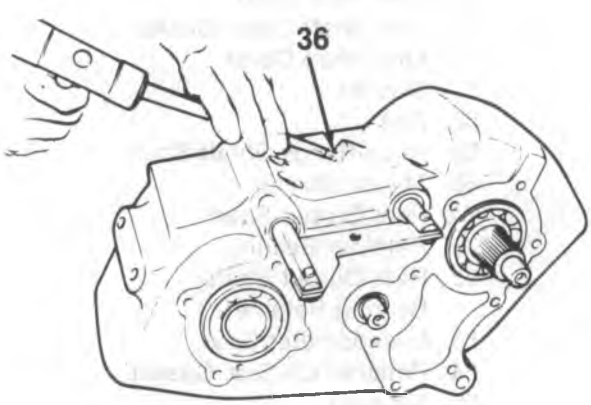
Figure 4—NP205 Transfer Case



49. Front Output Shaft Rear Bearing Retainer

FO-1979

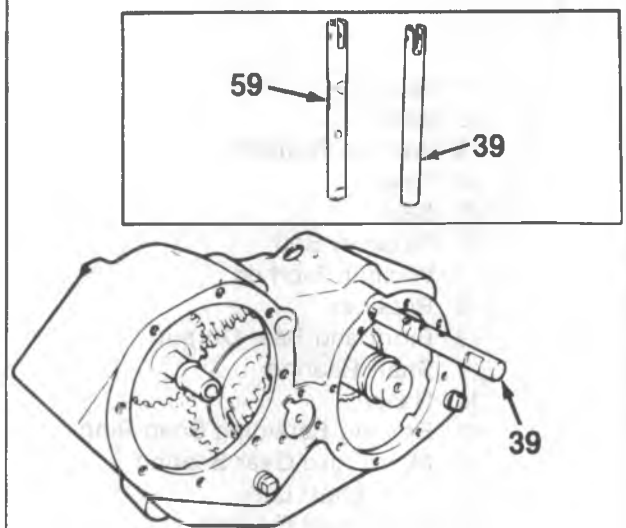
Figure 5—Removing the Front Output Shaft Bearing



36. Coiled Spring Pin

FO-2034

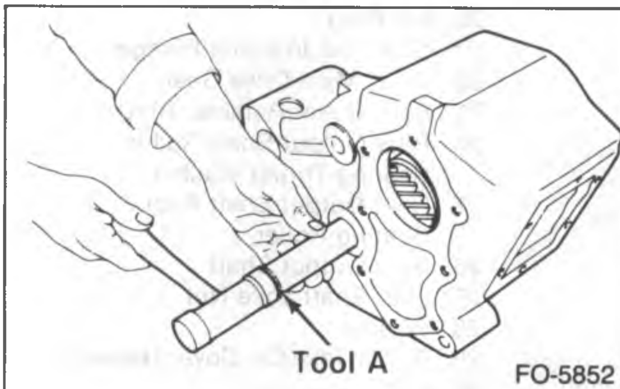
Figure 6—Removing the Shift Fork Roll Pin



39. Two/Four Wheel Shift Shaft
59. Hi/Lo Range Shift Shaft

FO-2035

Figure 7—Removing the Shift Rail



FO-5852

Figure 8—Removing the Idler Shaft

CLEANING AND INSPECTION

Clean

1. Bearings and rollers.
   - Remove all old lubricant and dirt.
2. Shafts and gears.
   - Remove all old lubricant and dirt.
3. Transfer case, cover and bearing cups.
   - Remove all old lubricant and dirt.
   - Remove all traces of gaskets.

Inspect

1. Bearings and thrust washers for wear, spalling, brinneling, or corrosion.
2. Rollers for wear, spalling or corrosion.
3. Shaft splines for excessive wear, chipped teeth, or cracks.
4. Gears for excessive wear, chipped teeth, spalling, cracks, or corrosion.
5. Housing, retainers and case for cracks, warpage or damage.
6. Shafts for wear, corrosion, cracks, and damage.
7. Bolts and threaded holes for wear, damage, stretched threads or corrosion.

ASSEMBLY

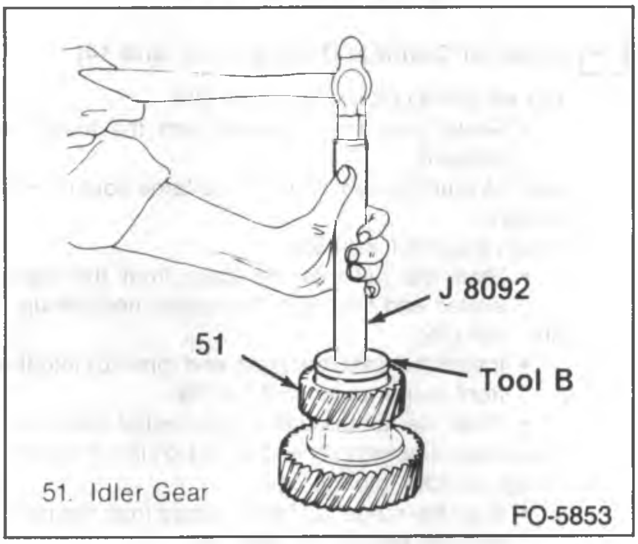


Figure 9—Installing the Bearing Cup

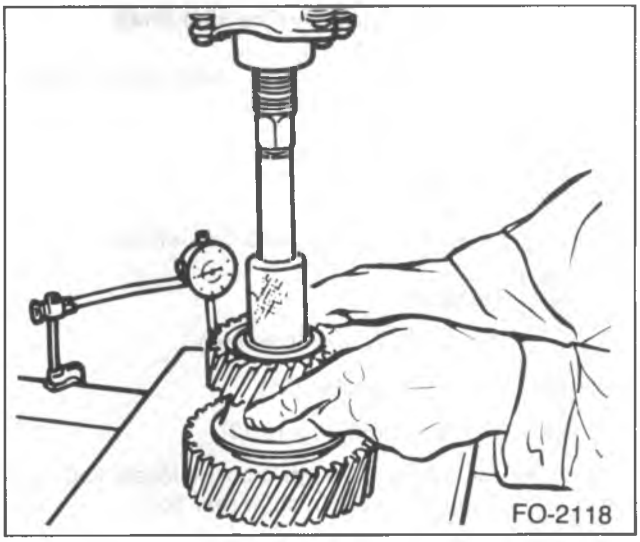


Figure 10—Idler Gear End Play Check

IDLER GEAR

Install or Connect (Figures 3, 4, 9, 10, 11, 12, and 13)

Tools Required:
- J 8092 Driver Handle
- Tool-B
- Tool-A

1. Two bearing cups (50) in the idler gear (51) using Tool-B and J 8092 (figure 9).
2. Two bearing cones (50), spacer (52), shims (53), and idler gear (51) on J 23429 with the bore up.

Measure

- End play. Limits are .025-.051 mm (0.001-0.002-inch) (figure 10).

3. Idler gear assembly with Tool-A into the case. Go through the front output bore, large end first (figure 11).
4. Idler shaft (54) from the large bore side.

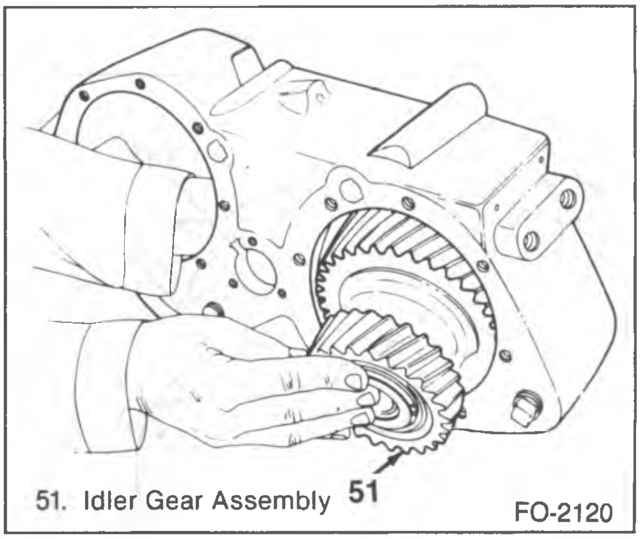


Figure 11—Installing the Idler Gear Assembly

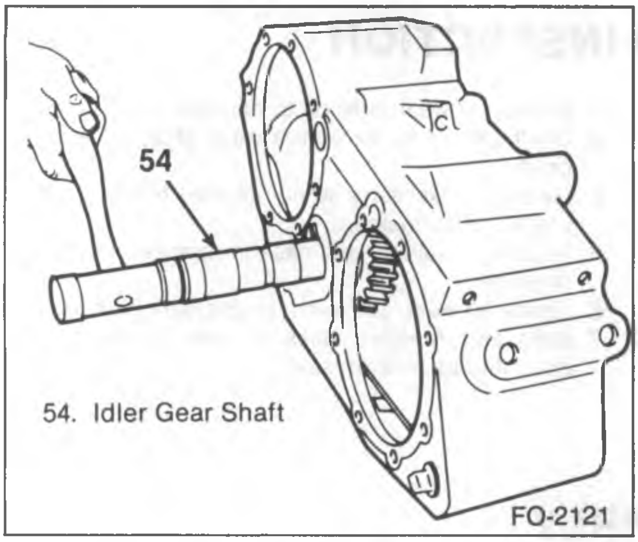


Figure 12—Installing the Idler Shaft

- Drive the shaft through, using a soft hammer (figure 12).

5. Washer (28).
6. New locknut (27).
   - Check for end play and free rotation.

Tighten

- Nut to 202 N·m (150 ft. lbs.).

7. Idler shaft cover gasket (55).
8. Idler shaft cover (56) (figure 13).
   - The flat on the cover must be located adjacent to the front output shaft rear cover.
9. Idler shaft cover bolts (58).

Tighten

- Bolts to 27 N·m (20 ft. lbs.).

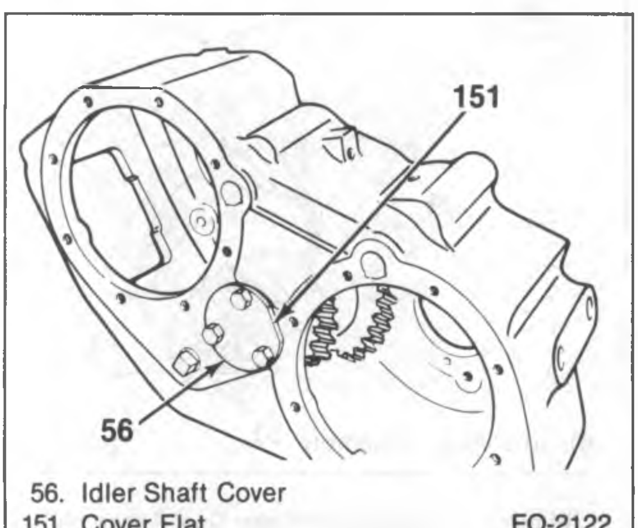


Figure 13—Idler Shaft Cover Alignment

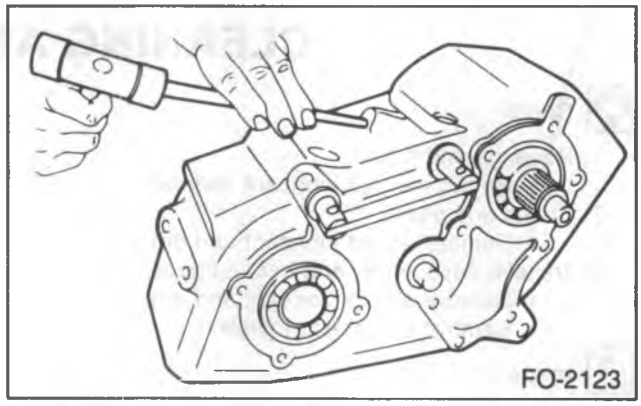


Figure 14—Installing the Shift Fork Roll Pin

SHIFT RAIL AND FORK ASSEMBLIES

Install or Connect (Figures 3, 4, and 14)

1. Two rail seals (14) into the case (19).
   - Seals should be installed with the metal lip outward.
2. Interlink plungers (21) through the large bore or PTO opening.
3. Hi-Lo range shift rail (59).
   - Start the rail into the case from the back, slotted end first, with the poppet notches up.
4. Shift fork (35).
   - Install the shift fork (long end forward) into the front output drive shift rail (59).
   - Push the rail through to the neutral position.
5. Input shaft bearing (12) and shaft (22) into the case.
6. Range rail (39) into the case.
   - Start the range rail into the case from the front, with the poppet notches up.
7. Sliding clutch (34) and fork (77).
   - Install the sliding clutch onto the fork.
   - Place the assembly over the input shaft (40) in the case.
   - Position the assembly to receive the range rail (39).
   - Push the range rail through to the neutral position.
8. Lock pins (36).
   - Install the new lock pins through the holes at the top of the case.
   - Drive the lock pins into the forks (figure 14).
   - Tip the case onto the PTO opening when installing the range rail lock pin.

FRONT OUTPUT SHAFT ASSEMBLY

Install or Connect (Figures 3, 4 and 15)

Tools Required:

J 23432 Snap Ring Pliers

J 22836 Front Output Shaft Bearing Retainer Seal Installer

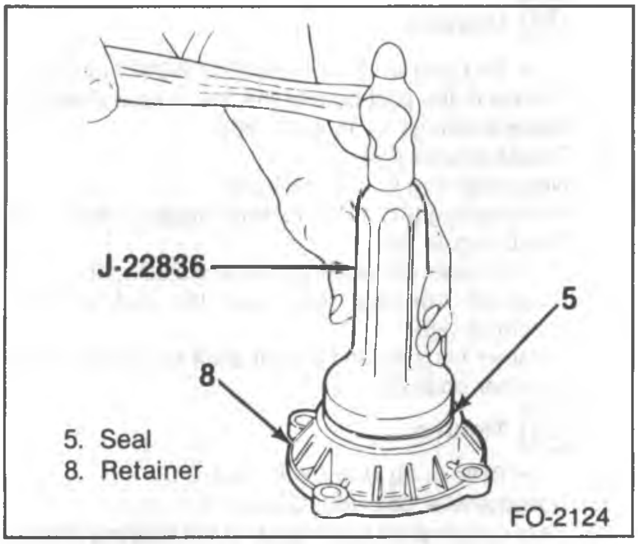


Figure 15—Installing the Front Output Bearing Retainer Seal

1. Roller bearings — 32 per row (41) in the front low gear (43).
   - Use grease to retain the roller bearings.
2. Spacer (42).
3. Roller bearings — 32 per row (41) in the front low gear (43).
4. Front low gear (43) on the front output shaft (40).
   - Place the front output shaft in a soft jawed vise, with the spline end down.
   - Install the front low gear on the shaft with the clutch gear facing down.
5. Thrust washer pin (45) in the shaft (40).
6. Thrust washer (44) on the shaft (40).
7. New snap ring (46), using tool J 23432.
   - Position the snap ring so that the opening is opposite the pin.
8. Front output shaft front bearing (9) into the case (19).
9. Front output shaft front bearing retainer seal (5), using J 22836 (figure 15).
10. Front output shaft front bearing retainer (8).
11. Retainer bolts (6).

Tighten

- Bolts to 40 N·m (30 ft. lbs.).

12. Washer (32) in the case.
13. Front output shaft high gear (33) in the case.
14. Shift fork (77) in the sliding clutch hub (34).
15. Shift fork (77) and rail (39) in the front wheel drive (4H) position with the clutch teeth in mesh with the front output high gear teeth.
16. Front output shaft and low gear assembly through the high gear assembly.
    - Line up the washer (32), high gear (33), and the clutch hub (34) with the bearing bore before installing the front output shaft (40).
17. Bearing (47) in the front output rear bearing retainer (49).
18. Front output rear bearing retainer (49) onto the case (19).
    - Use one gasket.

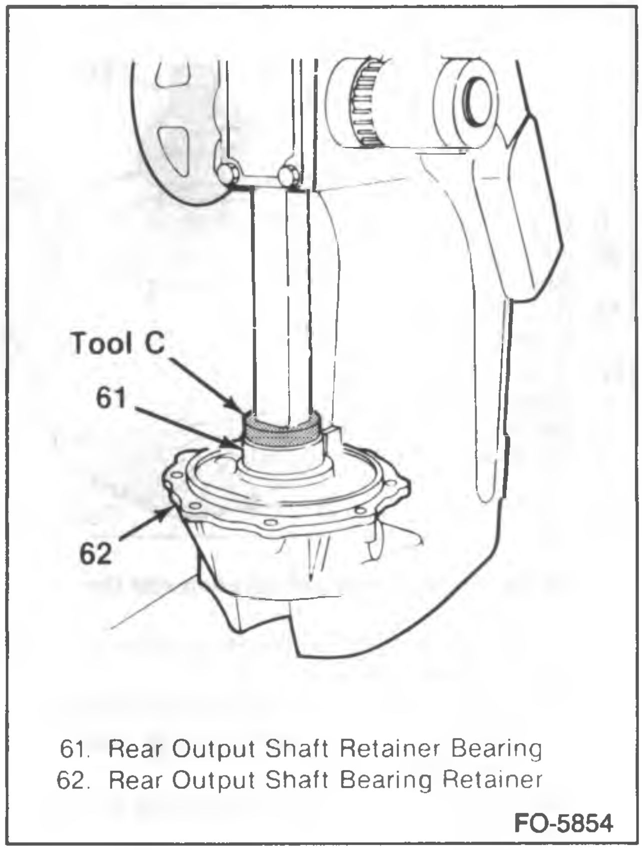


Figure 16—Installing the Rear Output Shaft Retainer Bearing

19. Retainer bolts (6).
    - Dip the bolts into sealant before installing.

Tighten

- Bolts to 40 N·m (30 ft. lbs.).

20. Front output yoke (4).
21. Washers (2 and 3).
22. Lock nut (1).

Tighten

- Nut to 202 N·m (150 ft. lbs.).

REAR OUTPUT SHAFT ASSEMBLY

Install or Connect (Figures 3, 4, 16, 17, and 18)

Tools Required:

J 22875 Rear Output Shaft Rear Bearing Installer
J 23432 Snap Ring Pliers
J 23432-1 Snap Ring Picks
Tool-C
J 21359 Rear Output Shaft Bearing Retainer Seal Installer

1. First row of roller bearings (41) — 32 each, in the rear output shaft low gear (43).
   - Use grease to retain the rollers.
2. Spacer (42) in the rear output shaft low gear (43).

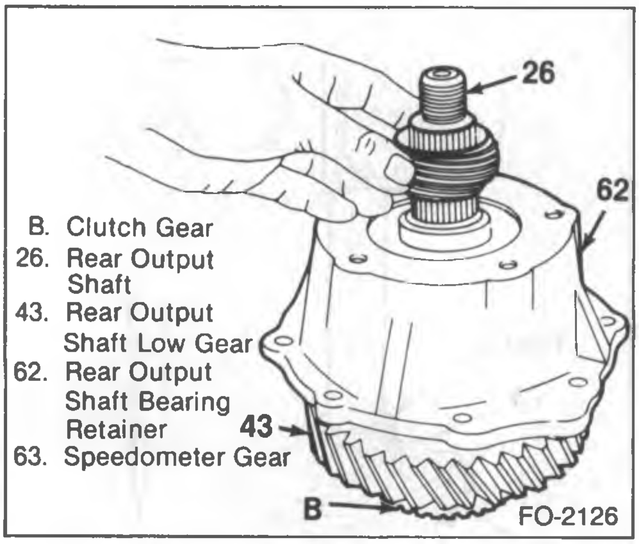


Figure 17—Installing the Speedometer Gear

3. Second row of roller bearings (41) — 32 each, in the rear output shaft low gear (43).
4. Thrust washer (60) onto the rear output shaft (26).
   - Install the washer with the tang down in the clutch gear groove.
5. Rear output shaft low gear (43) onto the rear output shaft (26).
   - Install the gear with the clutch teeth facing toward the clutch hub (34).
6. Thrust washer (60) over the gear (43).
   - Install the washer with the tab pointing up and away from the gear.
7. Washer pin (45).
8. Large thrust washer (44) over the shaft (26) and the pin (45).
   - Rotate the washer until the tab fits into the slot 90 degrees away from the pin.
9. Snap ring (46) using J 23432 and J 23432-1.

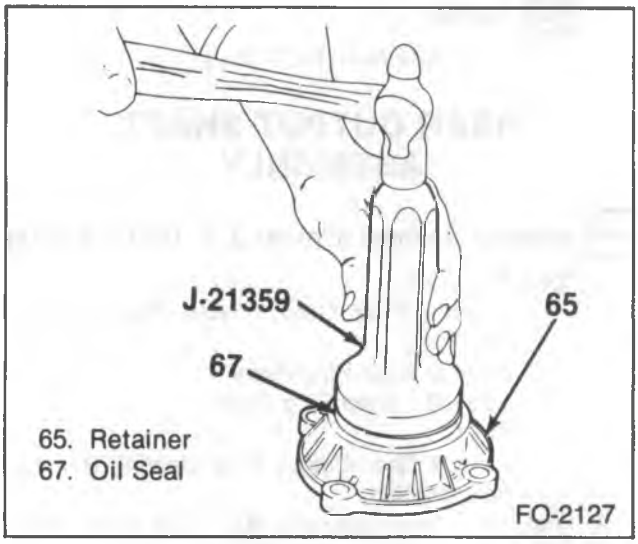


Figure 18—Installing the Rear Bearing Retainer Seal

Measure

- End play of .05-.56 mm (0.002-0.027-inch).

10. Grease in the pilot bore of the rear output shaft (26).
11. Roller bearings — 15 each (25).
12. Thrust washer (24).
13. New snap ring (23) in the bore.
14. New bearing (61) in the retainer housing (62), using Tool-C (figure 16).
    - Grease the bearing before installing it.
15. Retainer housing (62) onto the output shaft assembly (26).
16. Retainer housing and output shaft to the case (19).
17. Retainer bolts (6).

Tighten

- Bolts to 40 N·m (30 ft. lbs.)

18. Speedometer gear (63) (figure 17).
19. Rear output shaft bearing (9) in the bearing retainer housing (62), using J 22875.
20. Rear bearing seal (67) in the seal retainer (65), using J 21359 (figure 18).
21. Seal retainer (65) on the retainer housing (62).
    - Use one or two seals, depending on the needed clearance.
22. Retainer bolts (66).

Tighten

- Bolts to 40 N·m (30 ft. lbs.).

MISCELLANEOUS

Install or Connect

1. PTO cover gasket (29).
2. PTO cover (31).
3. PTO cover bolts (30).

Tighten

- Bolts to 20 N·m (15 ft. lbs.).

4. Cup plugs at the rail pin holes.
   - Apply sealant to the plugs before installing.
5. Drain plugs and filler plugs.

Tighten

- Plugs to 55 N·m (40 ft. lbs.).

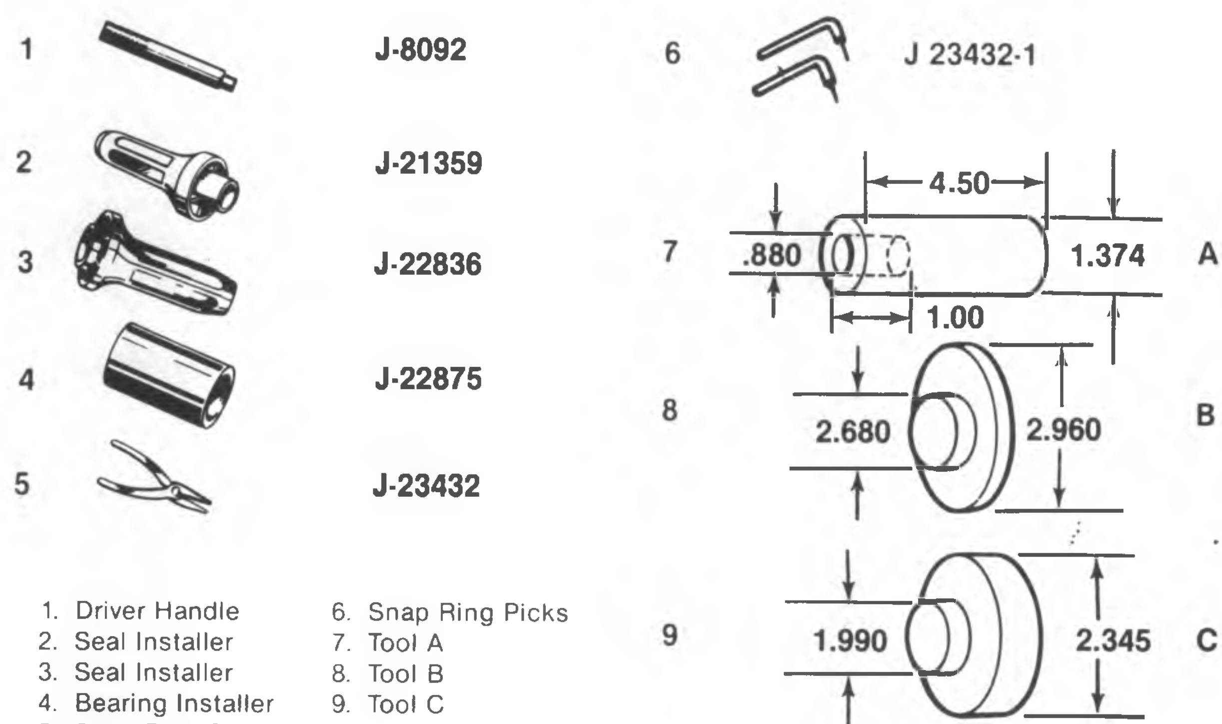
6. Shift rail cross link (13).
7. Clevis pins (38).
8. Lock pins (37).

SPECIFICATIONS

NEW PROCESS 205 TRANSFER CASE

	MM	INCH
Idler Gear End Play	0.025-0.051	0.001-0.002
Rear Output Shaft End Play	0.05-0.56	0.002-0.027
	N·m	FT. LBS.
Idler Gear Lock Nut	202	150
Idler Shaft Cover Bolts	27	20
Front Output Shaft Front Bearing Retainer Bolts	40	30
Front Output Rear Bearing Retainer Bolts	40	30
Front Output Yoke Lock Nut	202	150
Retainer Housing Bolts	40	30
Seal Retainer Bolts	40	30
Lubricant: Dexron® II	5.2 Pints	

SPECIAL TOOLS



1. Driver Handle
2. Seal Installer
3. Seal Installer
4. Bearing Installer
5. Snap Ring Pliers
6. Snap Ring Picks
7. Tool A
8. Tool B
9. Tool C

FO-5689

SECTION 7D2

NEW PROCESS 241 TRANSFER CASE

CONTENTS

SUBJECT **PAGE**

NEW PROCESS 241 TRANSFER CASE

DESCRIPTION

The Model 241 transfer case is an aluminum case, chain drive, four position unit providing four-wheel drive high and low ranges, a two-wheel high range, and a neutral position. The model 241 is a part-time four-wheel drive unit. Torque input in four-wheel high and low ranges is undifferentiated. The range positions on the Model 241 are selected by a floor mounted gearshift lever.

The case is a two-piece aluminum case containing front and rear output shafts, two drive sprockets, a shift mechanism and a planetary gear assembly. The drive sprockets are connected and operated by the drive chain. The planetary assembly which consists of a six pinion carrier and an annulus gear provide the four-wheel drive low range when engaged. Reduction ratio is 2.72:1 in this range (figures 1 and 2).

IDENTIFICATION

An identification tag is attached to the rear half of the transfer case (figure 3). This tag provides the transfer case model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive sealant such as Loctite 242, or equivalent.

POWER FLOW

In all drive range positions input torque is transmitted to the transfer case gear train through the transfer case input gear.

In 2H range, torque flows from the input gear to the range shift hub and main shaft. Torque flow continues through the slip yoke which is splined to the mainshaft, and finally to the rear propeller shaft and axle. In 2H range, the mode synchronizer remains in the neutral position and does not lock the drive sprocket to the mainshaft. As a result, torque is not transferred to the driven sprocket.

In 4H range, input torque from the input gear is transmitted to the mainshaft in exactly the same fashion as in 2H range. However, in 4H position, the mode synchronizer sleeve is shifted into engagement with the clutch teeth of the drive sprocket. This locks the drive sprocket to the mainshaft through the synchronizer. Torque is transmitted through the drive sprocket to the driven sprocket by the connecting drive chain. Since the front output shaft is splined to the driven sprocket, torque flows through the front output shaft to the front propeller shaft and axle resulting in high range four-wheel drive.

In 4L range, the path of torque through the transfer case is exactly the same as in 4H range but with one major difference. In 4L range the range shift hub is shifted into engagement with the planetary carrier. This causes the input gear to rotate the planetary pinions inside the annulus gear, causing the planetary carrier, range shift hub and mainshaft to rotate at a gear reduction ration of 2.72:1.

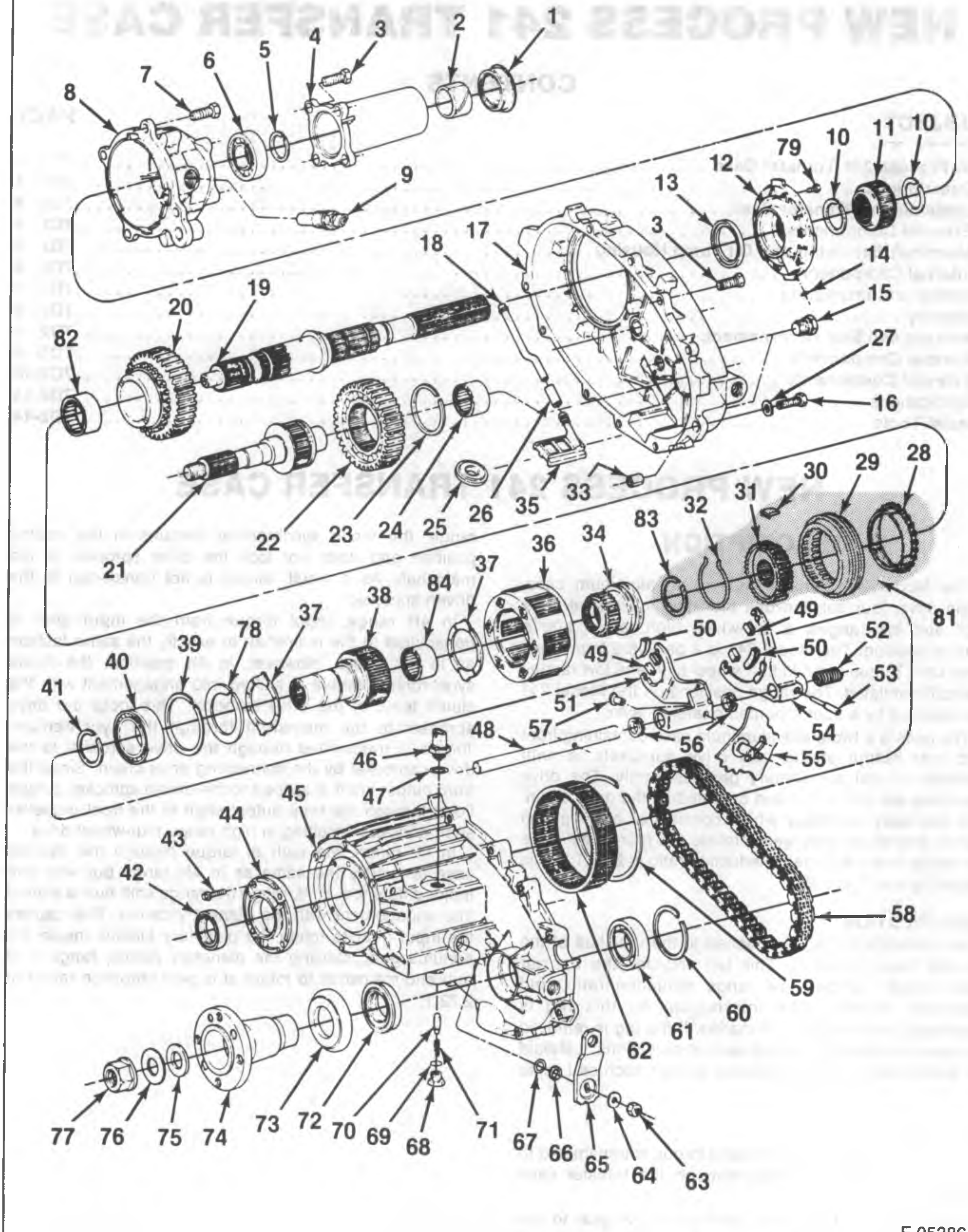
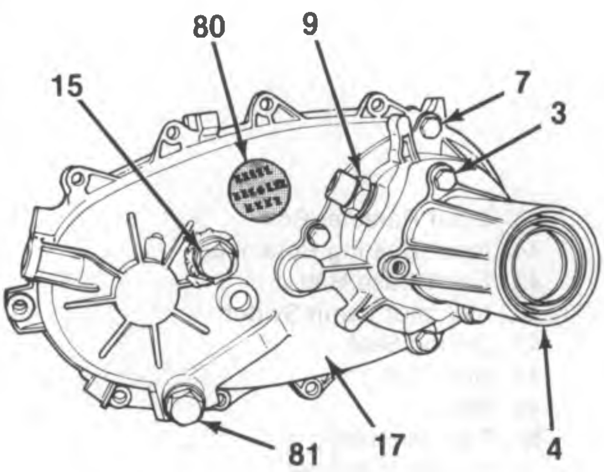


Figure 1—New Process 241 Transfer Case Components

1. Oil Seal
2. Bushing
3. Rear Extension Housing Bolts/Case Bolts
4. Rear Extension
5. Retainer Snap Ring
6. Front Output Bearing
7. Pump Retainer Housing Bolts
8. Pump Retainer Housing
9. Speedometer Sensor
10. Retainer (Snap Ring)
11. Speedometer Tone Wheel
12. Oil Pump
13. Oil Pump Seal
14. O-Ring
15. Plug
16. Bolt
17. Rear Case Half
18. Oil Pump Pick Up Tube
19. Mainshaft
20. Drive Sprocket
21. Front Output Shaft
22. Driven Sprocket
23. Retainer (Snap Ring)
24. Front Output Rear Bearing
25. Magnet
26. Oil Tube Connector
27. Washer
28. Main Drive Synchronizer Stop Ring
29. Synchronizer Sleeve
30. Strut
31. Synchronizer Hub
32. Spring Retainer
33. Dowel
34. Range Shift Hub
35. Pump Pick Up Screen
36. Planetary Carrier
37. Thrust Washer
38. Input Gear
39. Retainer Snap Ring
40. Input Bearing
41. Retainer Snap Ring
42. Input Bearing Retainer Seal
43. Input Retainer Bolt
44. Input Bearing Retainer
45. Front Case Half
46. Indicator Lamp Switch
47. O-Ring Seal
48. Shift Rail
49. Pads
50. Pads (Center)
51. Range Shift Fork
52. Fork Shift Spring
53. Pin
54. Mode Shift Fork
55. Sector With Shaft
56. Bushing
57. Range Fork Pin
58. Chain
59. Retainer Snap Ring
60. Retainer Snap Ring
61. Front Output Bearing
62. Annulus Gear
63. Shift Lever Nut, Prev. Torque
64. Washer
65. Shift Lever
66. Washer Plastic
67. O-Ring Seal
68. Poppet Screw
69. O-Ring Seal
70. Selection Plunger
71. Poppet Spring
72. Front Output Shaft Seal
73. Deflector
74. Front Output Flange
75. Rubber Sealing Washer
76. Washer
77. Nut Front Output Flange
78. Carrier Lock Ring
79. Oil Pump Screw
80. Identification Tag
81. Synchronizer Assembly
82. Drive Sprocket Bearing
83. Mode Synchronizer Hub Snap Ring
84. Mainshaft Pilot Bearing

F-05387

Figure 2—New Process 241 Transfer Case Components



3. Main Shaft Extention Bolt
4. Mainshaft Extention
7. Pump Retainer Housing Bolt
9. Speedometer Pick-up Switch
15. Plug
17. Rear Case
80. Identification Tag
81. Drain Plug

F-05385

Figure 3—Rear View — 241 Transfer Case

DISASSEMBLY OF THE TRANSFER CASE

EXTERNAL COMPONENTS

Clean

- The transfer case exterior using a solvent and a stiff brush.

Remove or Disconnect (Figures 1, 2, 3 and 4)

1. Front output flange nut (77), washer (76), rubber sealing washer (75) and front output flange (74) from the front output shaft.
2. Indicator lamp switch (46) and O-ring seal (47).
3. Speedometer sensor (9) and seal.
4. Poppet screw (68), O-ring seal (69), poppet spring (71) and poppet plunger (70).

MAINSHAFT EXTENSION AND OIL PUMP HOUSING

Remove or Disconnect (Figures 1, 2, 3 and 4))

1. Rear extension housing bolts (3) and rear extension (4).
2. Bearing retainer (snap ring) (5) from the mainshaft (19).
3. Pump retainer housing bolts (7).
   - Pump retainer housing bolts are shouldered.
4. Pump retainer housing (8) from the rear case half (17).
5. Retainer (snap ring) (10), speedometer tone wheel (11) and retainer (snap ring) (10) from the mainshaft (19).
6. Case bolts (3) from the case halves.
   - Note two longer case bolts and washers go into doweled case holes (33).

- Separate case halves. Insert screwdrivers into the slots cast in the case ends and pry apart. Do not attempt to wedge the case halves apart at any point on the mating surfaces.
  - Be careful not to damage the oil pump (12) (located in the rear case half) while removing the rear case half (17).

INTERNAL COMPONENTS

Remove or Disconnect (Figures 5, 6 and 7)

Tools Required:

J 2619-5 Slide Hammer
J 8092 Driver Handle
J 22912-1 Bearing Remover
J 29369-1 Needle Bearing Remover
J 29369-2 Needle Bearing Remover

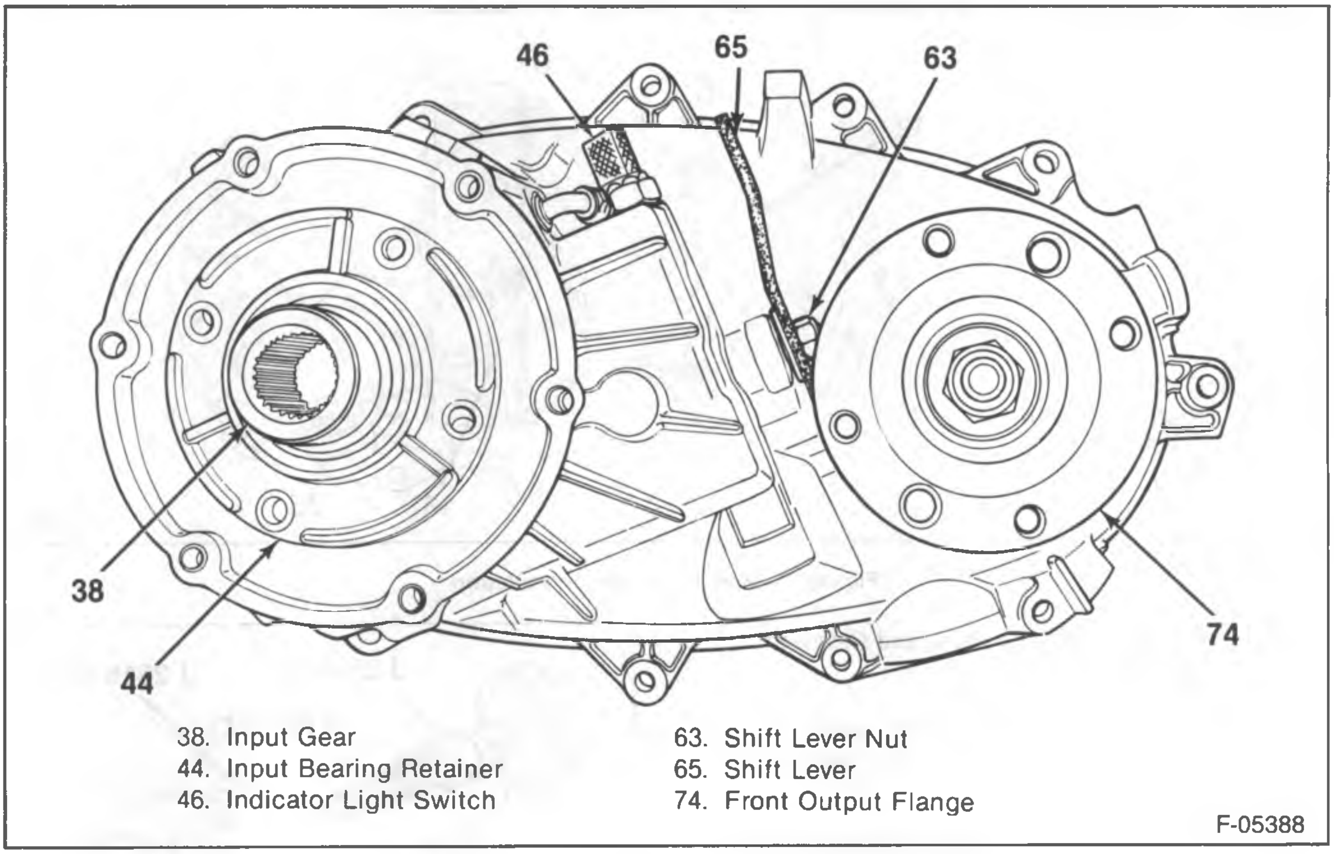


Figure 4—Front View — 241 Transfer Case

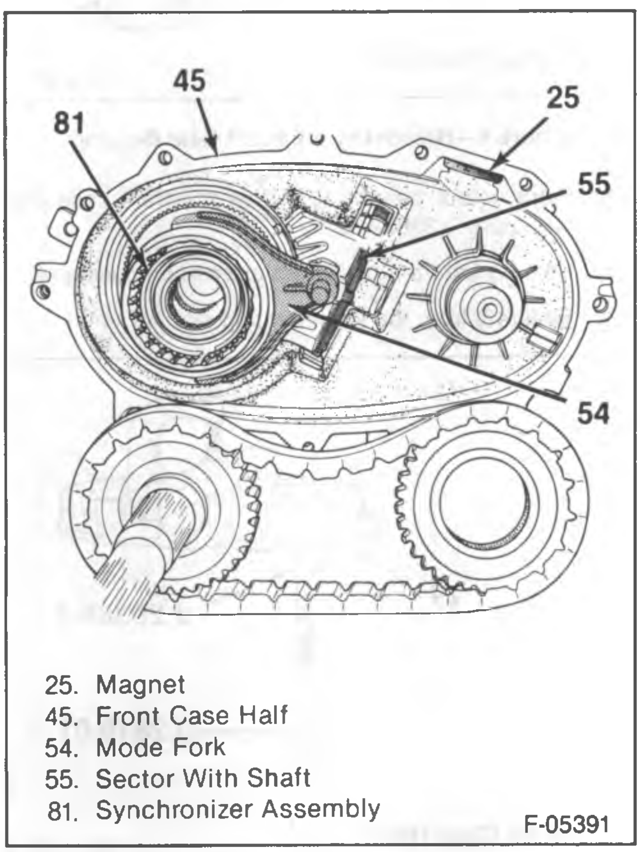


Figure 5—Mode Fork and Shaft Assembly

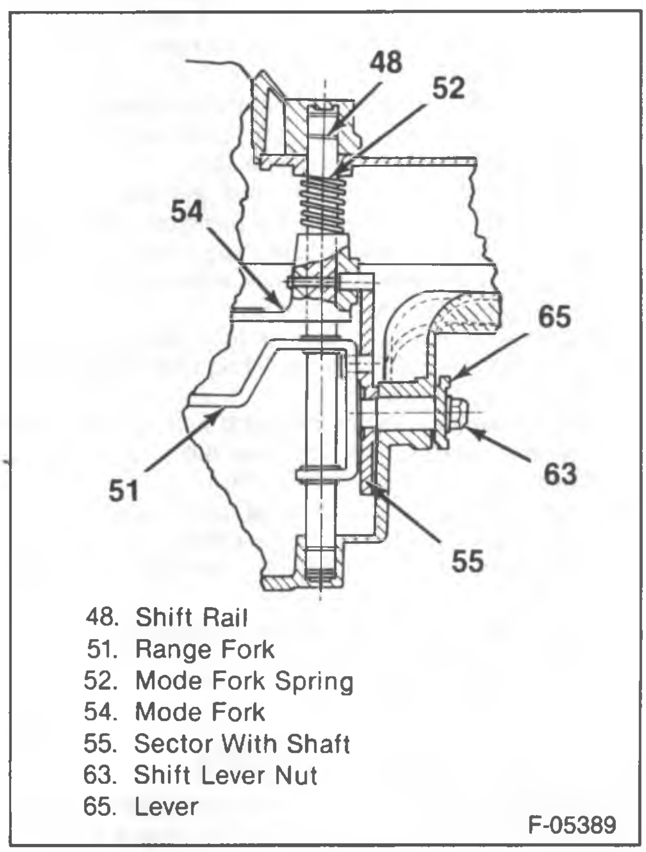
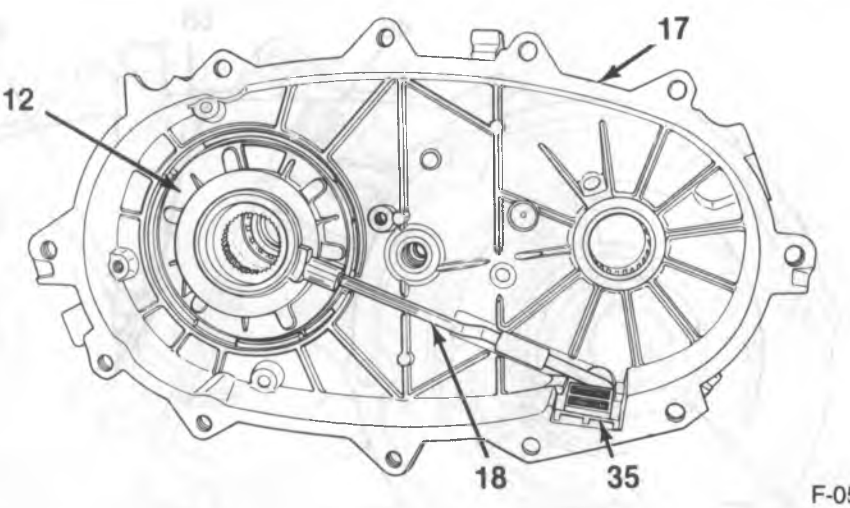


Figure 6—Shift Rail Assembly



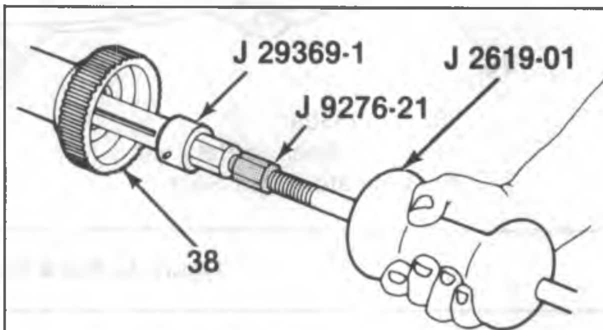
12. Oil Pump
17. Rear Case Half
18. Oil Pump Tube
35. Oil Filter

F-05390

Figure 7—Pump Housing Installation

J 33832 Bearing Installer and Remover
J 9276-21 Adapter
J 2619-01 Slide Hammer

1. Oil pump (12), pickup tube (18), O-ring (14) and pump pickup filter (35) from the rear case half (figure 7).
2. Fork shift spring (52).
3. Retainer (snap ring) (23) from the front output shaft (21).
4. Mainshaft (19), chain (58), and driven sprocket (22) from the front case half (45) as a unit. Mode shift fork (54) and shift rail (48) will be removed with the mainshaft.
5. Retainer (snap ring) (41) from the mainshaft (19).
6. Synchronizer assembly (81). Drive sprocket (20) from the mainshaft (19) (figure 5).
7. Range shift fork (51) and range shift hub (34) and sector with shaft (55) from the planetary carrier (36).
   - It is necessary to rotate the sector with shaft (55) to obtain clearance when removing the range fork (51) (figure 6).
8. Shift lever nut (63), washer (64), shift lever (65), plastic washer (66) and the O-ring seal (67) from the front case half (45).
9. Input bearing retainer bolts (43) and input bearing retainer (44) from the front case half (45).
10. Bearing retainer (snap ring) (39).
11. Planetary carrier (36) and the input gear (38) from the annulus gear (62) using a soft faced hammer.
12. Retainer ring (snap ring) (41) from the input gear (38).
13. Input bearing (40) from the input gear (38) with J 22912-1 (Bearing Remover).
   - Carrier lock ring (78).
   - Thrust washer (37).
14. Drive sprocket bearing (82) from the drive sprocket (20) using J 29369-1 and J 2619-01.
15. Needle bearings (84) from the input geart (38) using J 29369-2, J 9276-21 and J 2619-01 (figure 8).
16. Front output bearing retainer ring (snap ring) (60).
17. Front output shaft seal (72) from the front case half (45).

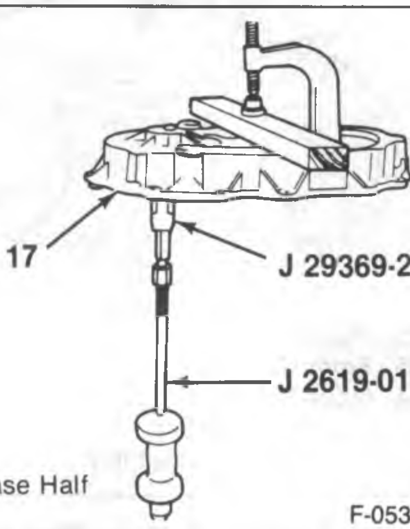


38. Input Drive Gear

F-05392

Figure 8—Removing the Input Gear Bearing

18. Front output bearing (61) from the front case half (45) using J 33832 and J 8092.
19. Seal (1) from the mainshaft extension housing (4).
20. Seal (42) from the input bearing retainer (44).



17. Rear Case Half

F-05393

Figure 9—Removing the Front Output Shaft Rear Bearing

21. Front output rear bearing (24) from the rear case half (17).
    - Insert J 29369-2 behind the needle bearings.
    - Using J 2619-5, hammer the bearing from the case (figure 9).
22. Mainshaft bearing (6) from the oil pump retainer (8).
23. Magnet (25) from the front case half (45).

Disassemble

- Scribe location of synchronizer hub and sleeve to aid in assembly.

1. Main drive synchronizer stop ring (28) from the synchronizer sleeve (29).
2. Spring retainer (32) from the synchronizer sleeve (29).
3. Synchronizer hub (31) from the synchronizer (29).
4. Oil pump screws (79) from the oil pump (12).
5. Inner gears.

CLEANING AND INSPECTION

Clean

1. Bearings.
    - Remove all old lubricant and dirt.
2. Shafts.
3. Sprockets.
4. Chain.
5. Oil feed ports and channels in each case half. Apply compressed air to each oil feed port and channel in order to remove any obstructions or cleaning solvent residue.
6. All mating and sealing surfaces.

Inspect

1. Bearings and thrust washers for wear, spalling, brinneling, or corrosion.
2. Gear teeth for excessive wear or damage, spalling, cracks, or corrosion.
3. Gear splines for excessive wear, spalling, cracks, twist or corrosion.
4. Shaft splines for excessive wear, spalling, cracks, distortion or corrosion.
5. Retainer rings for excessive wear, distortion or damage.
6. Case halves for damaged or warped mating surfaces, cracks, porosity, or damaged threaded holes.
7. Synchronizer stop ring for cracks, chips, spalling, or excessive wear.
8. Synchronizer hub and sleeve for cracks, chips, spalling, or excessive wear.
9. Pads on the mode fork and the range fork for wear, distortion.
10. Oil pump gears and case halves for wear, spalling, cracks, and damage. Replace complete assembly if there is wear.
11. Input gear, planetary carrier and range shift hub tooth chamfers for excessive wear.

ASSEMBLY

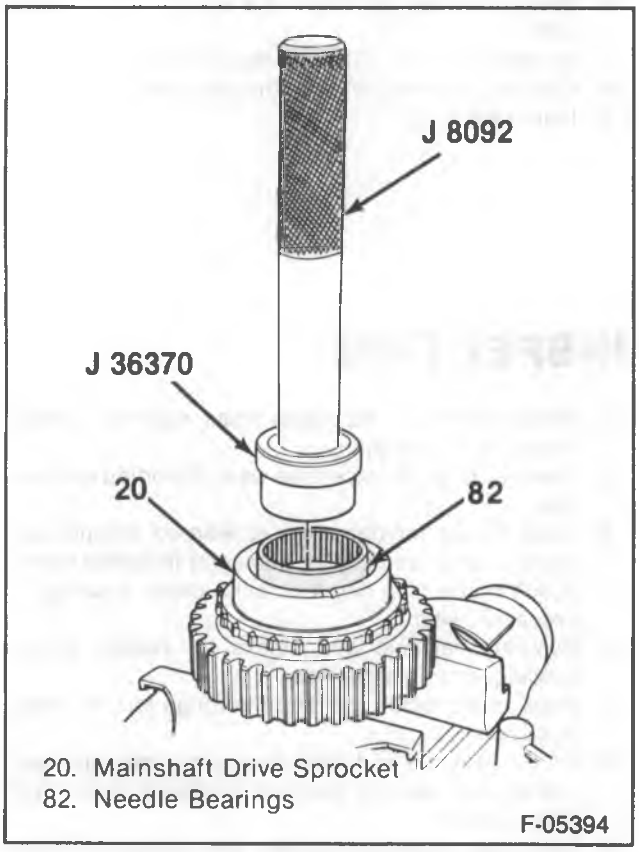


Figure 10—Installing the Needle Bearings to the Front Drive Sprocket

BEARING AND SEAL REPLACEMENT

Install or Connect)

Tools Required:
- J 8092 Driver Handle
- J 36370 Drive Gear Needle Bearing Installer
- J 36371 Front and Rear Output Shaft Bearing Installer
- J 36372 Input Gear Bearing Installer (Needle Bearing)
- J 36373 Input Gear Bearing Installer (Ball Bearing)

- Use ATF or equivalent where needed in assembly.

1. Needle bearings (82) to the drive sprocket (20) using J 36370 and J 8092 (figure 10).
   - Drive the bearings into the driven sprocket so that it is flush on the synchronizer side.
2. Needle bearing (24), to the rear case half (17) using J 36372 and J 8092.
   - Bearing must be flush with the boss on case housing.
3. Bearing (61) to the front case half (45) using J 37371.
4. Retainer (60) (figures 11 and 12).
5. Bearing (6) to the pump retainer housing (8) using J 36371 (figures 13 and 14).

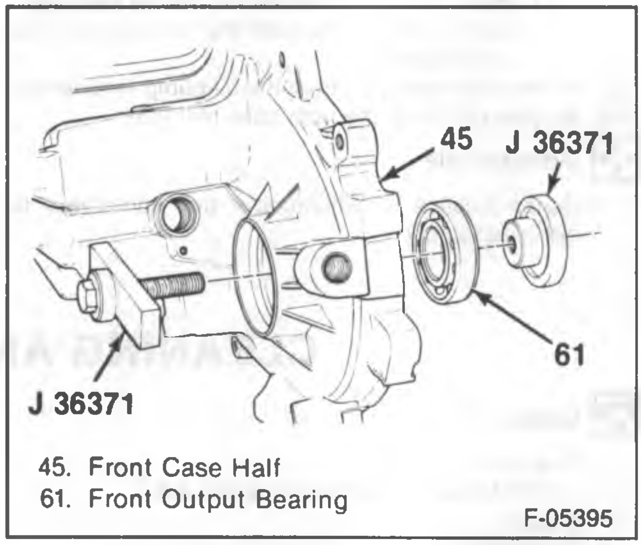


Figure 11—Installing the Front Output Bearing

6. Bearing (84) to the input gear (38) using J 36372 and J 8092.
7. Thrust washer (37).
8. Carrier lock ring (78).
9. Retainer (39).
10. Bearing (40) to the input gear (38) using J 36372.
11. Retainer ring (snap ring) (41) to the input gear (38).
12. Oil seal (1) to the rear extension (4).
13. Input bearing retainer seal (42) to the input bearing retainer (44).
14. Front output shaft seal (72) to the front case half (45).
15. Magnet (25) into front case half (45).

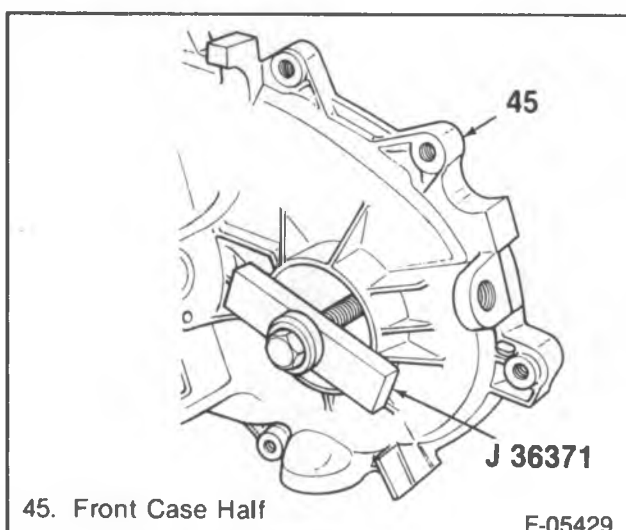


Figure 12—Installing the Front Output Bearing with J 3637

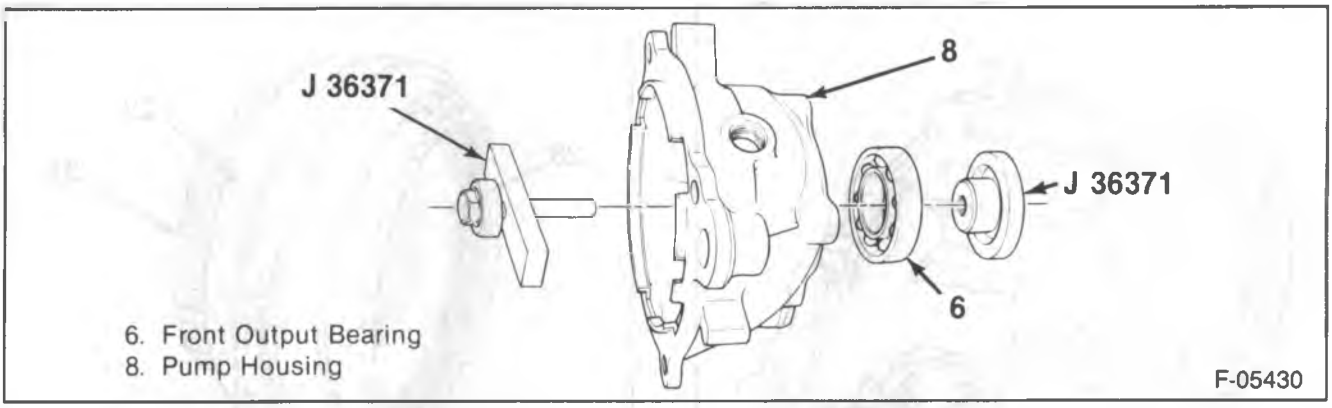


Figure 13—Installing the Pump Housing Bearing

INTERNAL COMPONENTS

Assemble

1. Synchronizer hub (31) to the synchronizer sleeve (29) along with the three struts (30).
   - Align the previously made scribe marks.
2. Spring retainer (32) to the synchronizer sleeve (29).
3. Main drive synchronizer stop ring (28) to the synchronizer sleeve (29).

Install or Connect

1. Drive sprocket (20) to the mainshaft (19).
2. Planetary input gear assembly (38) into the annulus gear (62) using a soft faced hammer.
3. Bearing retainer (snap ring) (39) to the input bearing (40).
4. Input bearing retainer bolts (43) and input bearing retainer (44) to the front case half (45).
   - Apply RTV or equivalent on bearing retainer mating surfaces.
   - Apply Loctite 242 or equivalent on bearing retainer bolts.

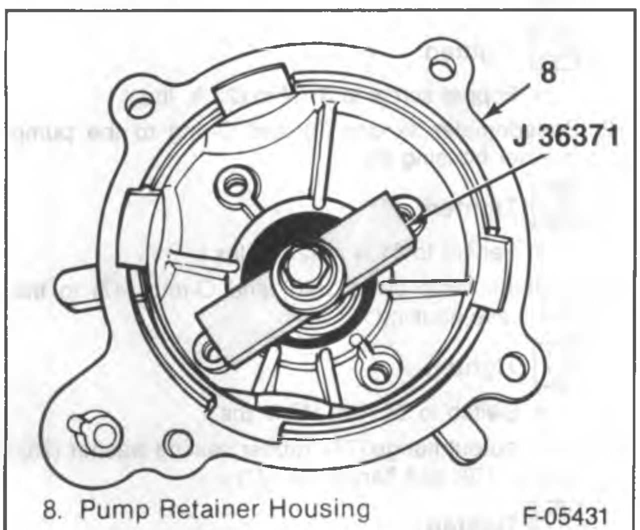


Figure 14—Installing the Pump Housing Bearing with J 36371

Tighten

- Bolts (3) to 19 N·m (14 ft. lbs.).

5. Sector with shaft (55) into the front case half (45).
6. Shift lever O-ring (67), plastic washer (66), shift lever (65), washer (64), and nut (63) to the front case half (figure 15).

Tighten

- Nut (63) to 27 N·m (20 ft. lbs.).

7. Range shift hub (34) and the range shift fork into the front case half (45).
   - It is necessary to rotate the sector to align the range shift fork.
8. Synchronizer assembly, mode shift fork (54) and rail into the front case half (45) (figure 16).
9. Front output shaft (21) to the front case half (45).
10. Driven sprocket (22) into the chain (58).
11. Drive sprocket (20) and mainshaft (19) into the chain (58).
    - Mainshaft (19), drive sprocket (20), driven sprocket (22) and chain (58) are installed as a unit.
12. Retainer (snap ring) (23) onto the front output.
13. Fork shift spring (52) onto the mode shift rail (48).,
14. Oil pump pick up tube (18), oil tube connector (26) and pump pick up screen (35) into the rear case half (17) (figuer 17).
15. Oil tube O-ring (14) onto the oil pump pick up tube (18).

NOTICE: Do not damage the O-ring during assembly as this could result in pump failure.

16. Oil pump (12) to the oil pump pick up tube (18).
    - Apply RTV sealer to the case mating surfaces.
17. Rear case (17) over mainshaft (19) and onto the front case half (45).
    - Be careful not to damage the oil pump (12) while installing the rear case half (figure 7).
18. Case bolts (3) into case halves.
    - Apply Loctite 242 or equivalent to case bolts.
    - The two longer case bolts and washers to into doweled case holes (33) (figure 17).

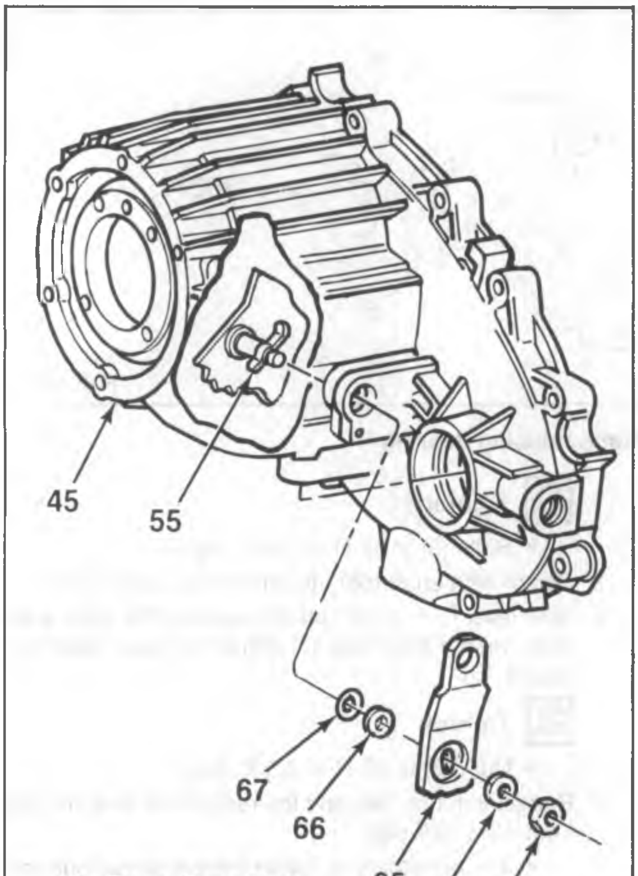


Figure 15—Sector with Shaft

Tighten

- Bolts to 31 N·m (23 ft. lbs.).

19. Pump retainer housing (8) and pump housing bolts (7) to the rear case half (17).
    - Apply Loctite 242 or equivalent on pump housing bolt threads.
    - Pump housing bolts are shouldered (7).

Tighten

- Bolts to 41 N·m (30 ft. lbs.).

20. Input bearing retainer (snap ring) (5) to the mainshaft (19).
21. Retainer (snap ring) (10), speedometer tone wheel (11) and retainer (snap ring) (10) to the mainshaft (19).
22. Rear extension housing (4) and extension housing bolts (3) to the pump retainer housing (8).
    - Apply RTV sealer to the mating surfaces.
    - Apply Loctite 242 or equivalent on the extension housing bolts.

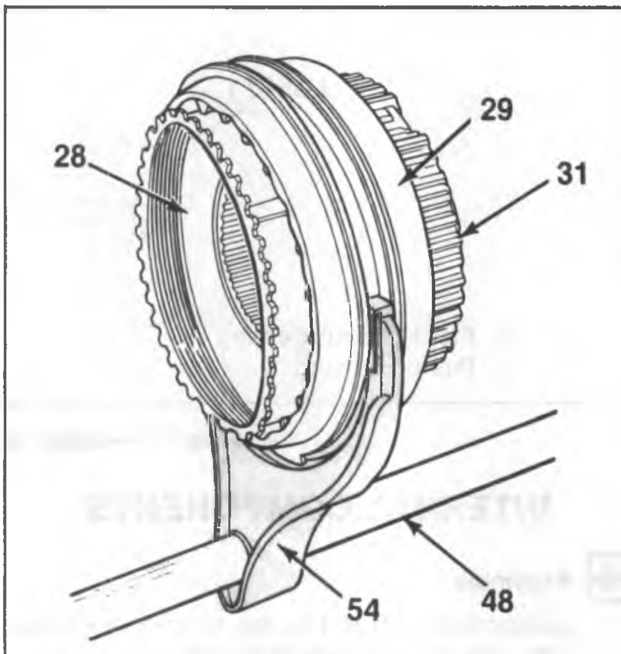


Figure 16—Synchronizer Hub Assembly and Mode Fork

Tighten

- Bolts to 31 N·m (23 ft. lbs.).

EXTERNAL COMPONENTS

Install or Connect

1. Selection plunger (70), poppot spring (71), O-ring seal (69) and poppet screw (68) to the front case half (45).

Tighten

- Poppet screw to 31 N·m (23 ft. lbs.).

2. Speedometer sensor (9) and O-ring to the pump retainer housing (8).

Tighten

- Sensor to 31 N·m (23 ft. lbs.).

3. Indicator lamp switch (46) and O-ring (47) to the front case housing.

Tighten

- Switch to 24 N·m (17 ft. lbs.).

4. Front output flange (74), rubber sealing washer (75), washer (76) and flange nut (77).

Tighten

- Nut (26) to 149 N·m (110 ft. lbs.).

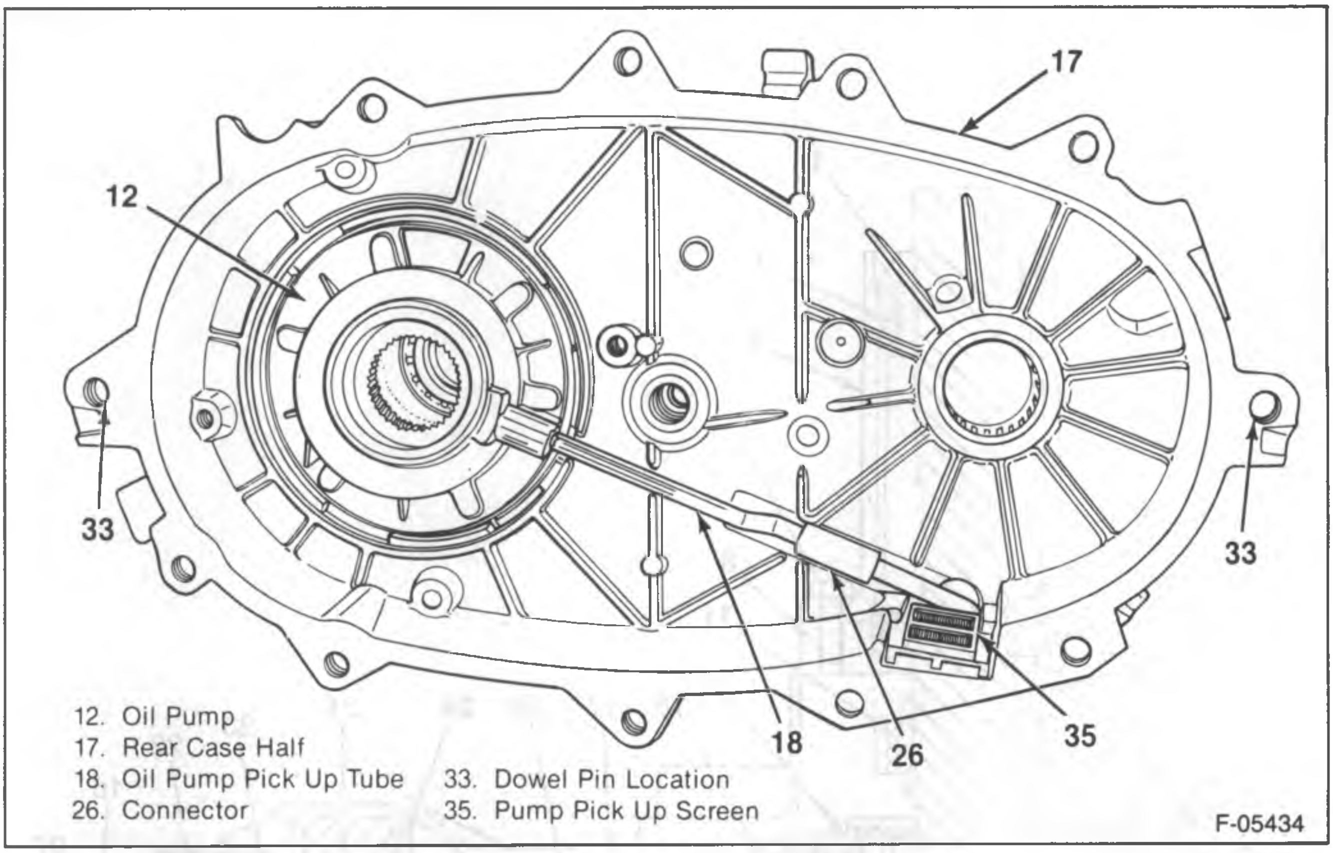


Figure 17—Oil Pump, Pickup, Screen, Doweled Case Holes

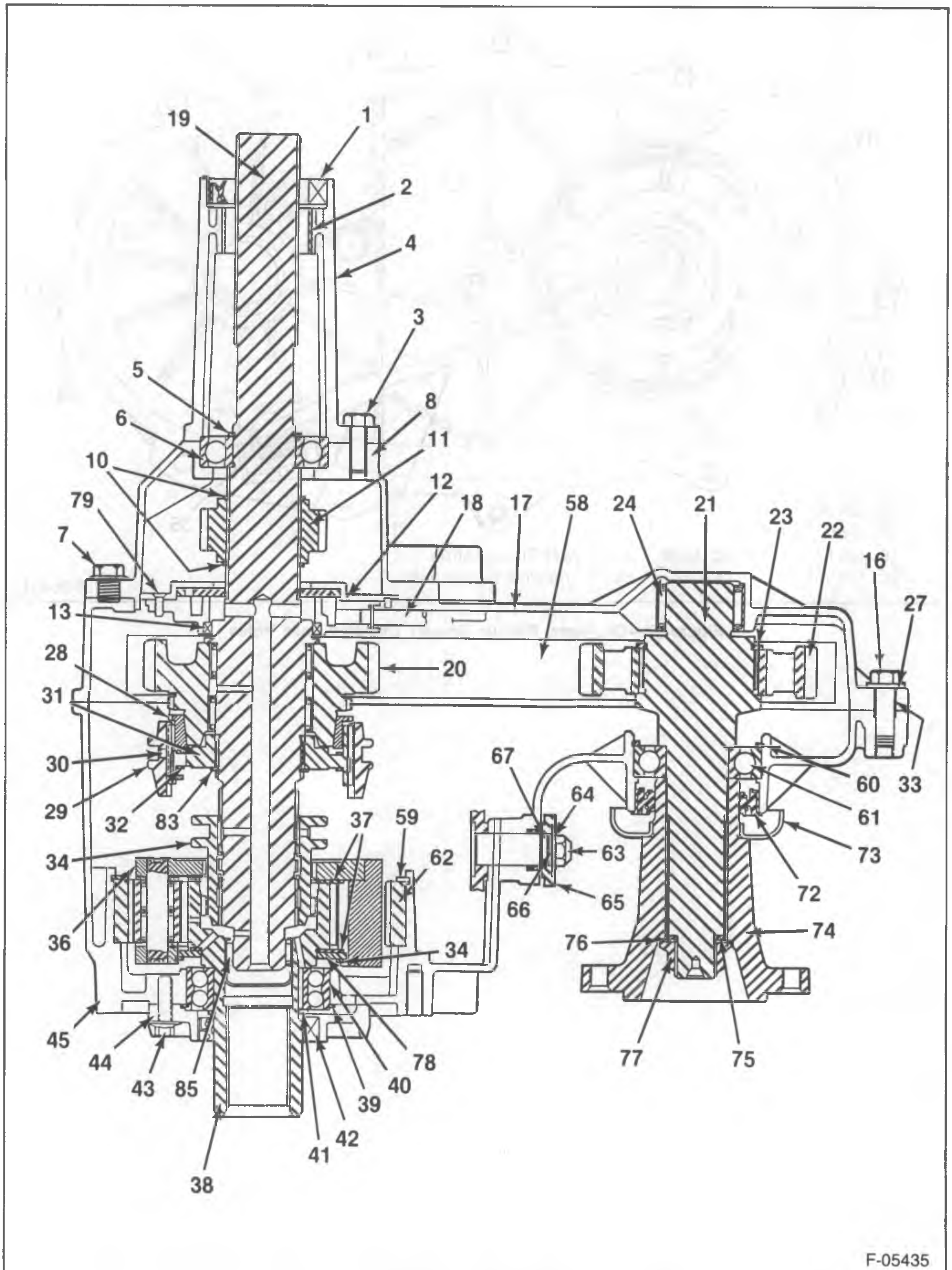


Figure 18—NP 241 Transfer Case Cut Away

1. Extension Housing Oil Seal
2. Bushing
3. Rear Extension Housing Bolts/Case Bolts
4. Rear Extension Housing
5. Retainer (Snap Ring)
6. Front Output Bearing
7. Pump Retainer Housing Bolts
8. Pump Retainer Housing
10. Retainer (Snap Ring)
11. Speedometer Tone Wheel
12. Oil Pump
13. Oil PUmp Seal
16. Bolt
17. Rear Case Half
18. Oil Pump Pick Up Tube
19. Mainshaft
20. Drive Sprocket
21. Front Output Shaft
22. Driven Sprocket
23. Retainer (Snap Ring)
24. Front Output Rear Bearing
27. Washer
28. Main Drive Synchronizer Stop Ring
29. Synchronizer Sleeve
30. Strut
31. Synchronizer Hub
32. Spring Retainer
33. Dowel
34. Range Shift Hub
36. Planetary Carrier
37. Thrust Washer
38. Input Gear
39. Retainer Snap Ring
40. Input Bearing
41. Retainer (Snap Ring)
42. Input Bearing Retainer Seal
43. Input Bearing Retainer Bolt
44. Input Bearing Reatiner
45. Front Case Half
58. Chain
59. Retainer (Snap Ring)
60. Retainer (Snap Ring)
61. Front Output Bearing
62. Annulus Gear
63. Shift Lever Nut (Prev. Torque)
64. Washer
65. Shift Lever
66. Washer (Plastic)
67. O-Ring Seal
72. Front Output Shaft Seal
73. Deflector
74. Front Out Flange
75. Rubber Sealing Washer
76. Washer
77. Front Output Flange Nut
78. Carrier Lock Ring
79. Oil Pump Screw
83. Mode Synchronizer Hub Snap Ring
85. Mainshaft Pilot Bearing

F-05436

Figure 19—NP 241 Transfer Case Cut Away

SPECIFICATIONS

NEW PROCESS 241 TRANSFER CASE

	N·m	FT. LBS.
Input Shaft Retainer Bolts	19	14
Shift Selector Lever Nut	27	20
Shift Selector Light Switch	31	23
Case Half Bolts	31	23
Pump Housing Bolts	41	30
Mainshaft Extension Housing Bolts	31	23
Speedometer Pick-up Switch	31	23
Front Propeller Shaft Flange Bolts	149	110
Drain and Fill Plugs	47	35
Lubricant: Dexron® II	4.6 Pints	

SPECIAL TOOLS

1. Slide Hammer
2. Slide Hammer
3. Driver Handle
4. Bearing Remover
5. Output Shaft Bearing Remover
6. Output Shaft Bearing Remover
7. Slide Hammer Adapter
8. Bearing Installer/Remover
9. Front and Rear Output Shaft Bearing Installer
10. Driver Sprocket Needle Bearing Installer
11. Input Gear Needle Bearing Installer
12. Input Gear Ball Bearing Installer

F-05437

SECTION 7D3

NEW PROCESS 231 TRANSFER CASE

CONTENTS

DESCRIPTION

The Model 231 transfer case is an aluminum case, chain drive, four position unit providing four-wheel drive high and low ranges, a two-wheel high range, and a neutral position. This model is a part-time four-wheel drive unit. Torque input in four-wheel high and low ranges is undifferentiated. The range positions are selected by a floor mounted gear shift lever.

The case is a two-piece aluminum case containing front and rear output shafts, two drive sprockets, a shift mechanism and a planetary gear assembly. The drive sprockets are connected and operated by the drive chain. The planetary assembly which consists of a 3-pinion planetary (6-pinion planetary 231 HD) carrier and an annulus gear provide the four-wheel drive low range when engaged. Reduction ratio is 2.72:1 in this range.

IDENTIFICATION

An identification tag is attached to the rear half of the transfer case (figure 1). This tag provides the transfer case model number, low range reduction ratio, and assembly number. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive sealant such as Loctite 242 or equivalent.

POWER FLOW

In all drive range positions input torque is transmitted to the transfer case gear train through the transfer case input gear.

In 2H range, torque flows from the input gear to the range shift hub and main shaft. Torque flow continues through the slip yoke which is splined to the mainshaft, and finally to the rear propeller shaft and axle. In 2H range, the mode synchronizer remains in the neutral position and does not lock the drive sprocket to the mainshaft. As a result, torque is not transferred to the driven sprocket.

In 4H range, input torque from the input gear is transmitted to the mainshaft in exactly the same fashion as in 2H range. However, in 4H position, the mode synchronizer sleeve is shifted into engagement with the clutch teeth of the drive sprocket. This locks the drive sprocket to the mainshaft through the synchronizer. Torque is transmitted through the drive sprocket to the driven sprocket by the connecting drive chain. Since the front output shaft is splined to the driven sprocket, torque flows through the front output shaft to the front propeller shaft and axle resulting in high range four-wheel drive.

In 4L range, the path of torque through the transfer case is exactly the same as in 4H range but with one major difference. In 4L range the range shift hub is shifted into engagement with the planetary carrier. This causes the input gear to rotate the planetary pinions inside the annulus gear, causing the planetary carrier, range shift hub and mainshaft to rotate at a gear reduction ratio of 2.72:1.

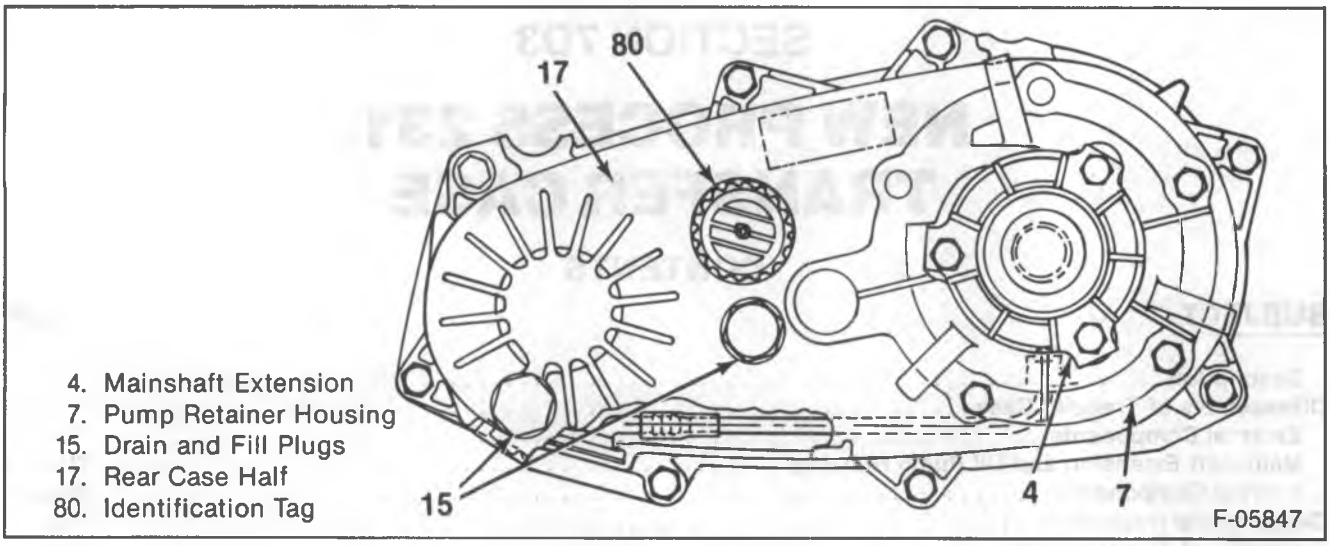


Figure 1—231 Rear Case Half

DISASSEMBLY OF THE TRANSFER CASE

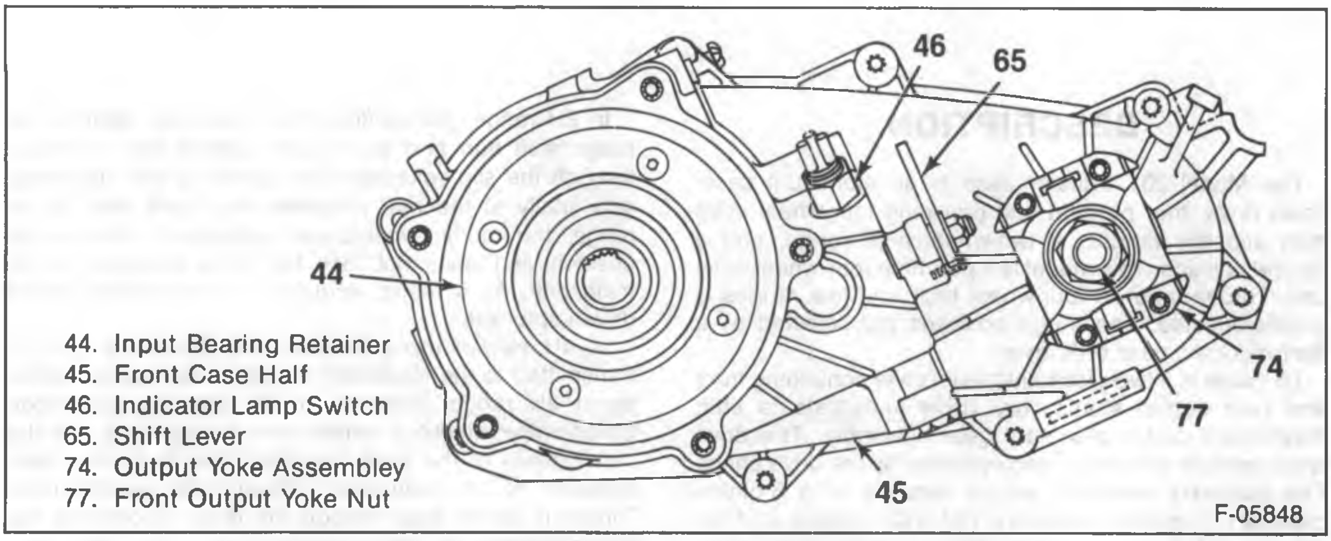


Figure 2—231 Front Case Half

EXTERNAL COMPONENTS

Clean

- The transfer case exterior using a solvent and a stiff brush.

Remove or Disconnect (Figure 2, 3, and 4)

1. Front output yoke nut (77), washer (76), rubber sealing washer (75) and front output flange (74) from the front output shaft.
2. Indicator lamp switch (46) and O-ring seal (47).
3. Poppet screw (68), O-ring seal (69), poppet spring (71) and poppet plunger (70).

MAINSHAFT EXTENSION AND OIL PUMP HOUSING

Remove or Disconnect (Figures 2, 3, and 4)

1. Rear extension housing bolts (3) and rear extension (4).
2. Bearing retainer (snap ring) (5) from the mainshaft (19).
3. Pump retainer housing bolts (7).

4. Pump retainer housing (8) from the rear case half (17).
5. Speedometer drive gear (11) from the mainshaft (19).
6. Case bolts (3) from the case halves.
    - Note two longer case bolts and washers go into doweled case holes (33).
- Separate case halves. Insert screwdrivers into the slots cast in the case ends and pry apart. Do not attempt to wedge the case halves apart at any point on the mating surfaces.
    - Be careful not to damage the oil pump (12) (located in the rear case half) while removing the rear case half (17).

INTERNAL COMPONENTS

Remove or Disconnect (Figures 3, 4, and 5 through 9)

Tools Required:

J 8092 Driver Handle
J 36370 Bearing Installer/Remover
J 29170 Bearing Remover
J 29369-1 Bearing Remover
J 9276-21 Adapter
J 2619-01 Slide Hammer
J 33790 Bearing Remover

1. Oil pump (12) pickup tube (18), O-ring (14) and pump pickup filter (35) from the rear case half (figure 5).
2. Fork shift spring (52).
3. Mainshaft (19), chain (58), and driven sprocket (22) from the front case half (45) as as unit. Mode shift fork (54) and shift rail (48) will be removed with the mainshaft.
4. Retainer (snap ring) (83) from the mainshaft (19).
5. Synchronizer assembly (81). Drive sprocket (20) from the mainshaft (19) (figure 6).
6. Range shift fork (51) and range shift hub (34) and sector with shaft (55) from the planetary carrier (36).
    - It is necessary to rotate the sector with shaft (55) to obtain clearance when removing the range fork (51) (figure 7).
7. Shift lever nut (63), washer (64), shift lever (65), plastic washer (66) and the O-ring seal (67) from the front case half (45).
8. Input bearing retainer bolts (43) and input bearing retainer (44) from the front case half (45).
9. Bearing retainer (snap ring) (39).
10. Planetary carrier (36) and the input gear (38) from the annulus gear (62) using a soft faced hammer.
11. Input bearing (40) from the front case half (45) using J 36370 and J 8092.
12. Drive sprocket bearings (82) from the drive sprocket (20) using J 29170 and J 8092.
13. Needle bearings (84) from the input gear (38) using J 29369-1, J 9276-21 and J 2619-01 (figure 8).
14. Front output shaft seal (72) from the front case half (45).
15. Front output bearing retainer ring (snap ring) (60).
16. Front output bearing (61) from the front case half (45) using J 33790 and J 8092.
17. Seal (1) from the mainshaft extension housing (4).
18. Seal (42) from the input bearing retainer (44).
19. Front output rear bearing (24) from the rear case half (17) using J 2619-01 and J 29369-2 (figure 9).
20. Mainshaft bearing (6) from the oil pump retainer (8) using J 33790.
21. Magnets (25) from the front case half (45).

Disassemble

- Mark location of synchronizer hub and sleeve to aid in assembly.

1. Main drive synchronizer stop ring (28) from the synchronizer sleeve (29).
2. Spring retainer (32) from the synchronizer sleeve (29).
3. Synchronizer hub (31) from the synchronizer (29).
4. Oil pump screws (79) from the oil pump (12).
5. Inner gear.

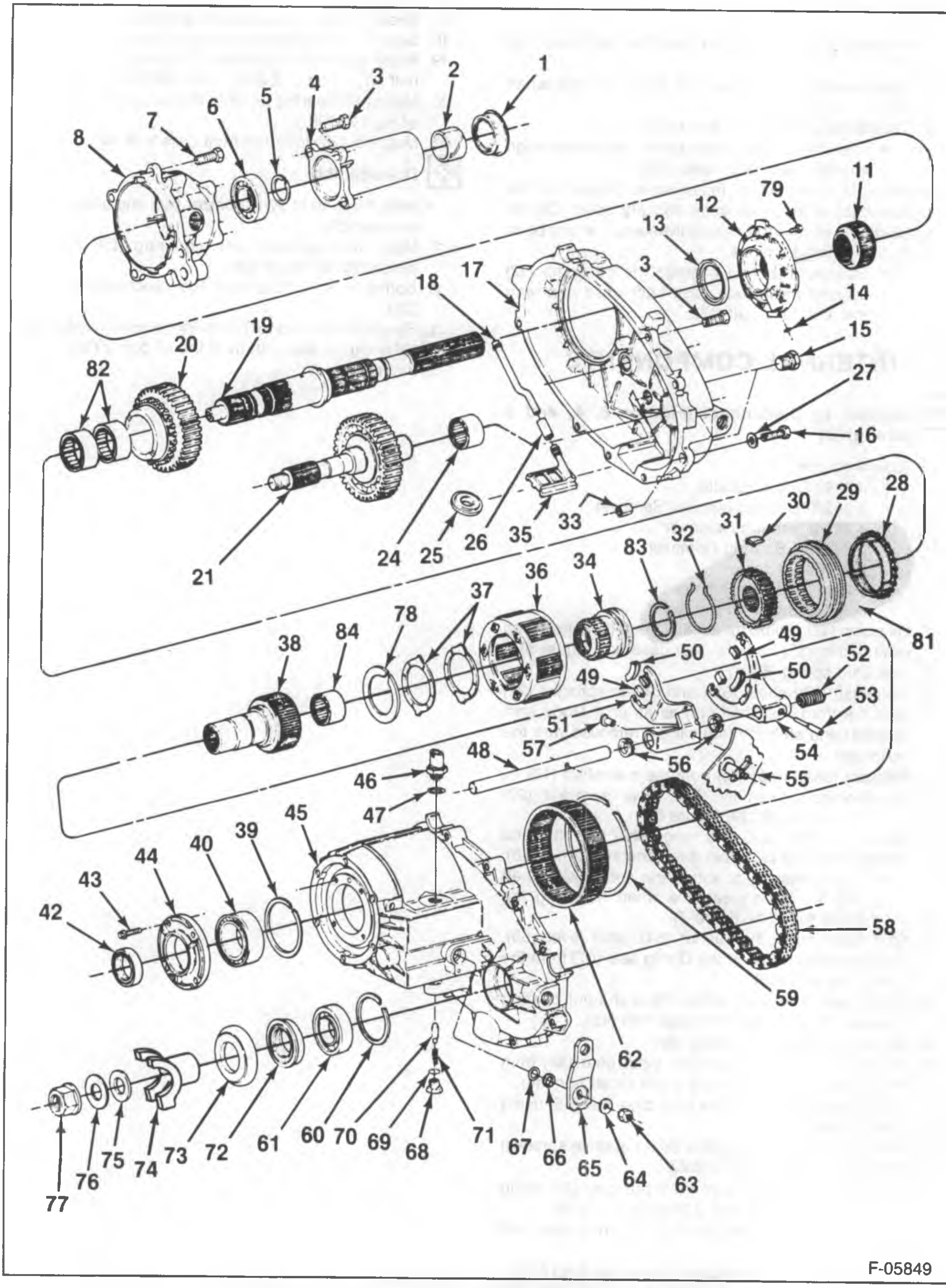


Figure 3—New Process 231 Transfer Case Components

1. Oil Seal
2. Bushing
3. Rear Extension Housing Bolts/Case Bolts
4. Rear Extension
5. Retainer Snap Ring
6. Front Output Bearing
7. Pump Retainer Housing Bolts
8. Pump Retainer Housing
11. Speedometer Drive Gear
12. Oil Pump
13. Oil Pump Seal
14. O-Ring
15. Plug
16. Bolt
17. Rear Case Half
18. Oil Pump Pick Up Tube
19. Mainshaft
20. Drive Sprocket
21. Front Output Shaft
24. Front Output Rear Bearing
25. Magnet
26. Oil Tube Connector
27. Washer
28. Main Drive Synchronizer Stop Ring
29. Synchronizer Sleeve
30. Strut
31. Synchronizer Hub
32. Spring Retainer
33. Dowel
34. Range Shift Hub
35. Pump Pick Up Screen
36. Planetary Carrier
37. Thrust Washer
38. Input Gear
39. Retainer Snap Ring
40. Input Bearing
42. Input Bearing Retainer Seal
43. Input Retainer Bolt
44. Input Bearing Retainer
45. Front Case Half
46. Indicator Lamp Switch
47. O-Ring Seal
48. Shift Rail
49. Pads
50. Pads (Center)
51. Range Shift Fork
52. Fork Shift Spring
53. Pin
54. Mode Shift Fork
55. Sector With Shaft
56. Bushing
57. Range Fork Pin
58. Chain
59. Retainer Snap Ring
60. Retainer Snap Ring
61. Front Output Bearing
62. Annulus Gear
63. Shift Lever Nut, Prev. Torque
64. Washer
65. Shift Lever
66. Washer Plastic
67. O-Ring Seal
68. Poppet Screw
69. O-Ring Seal
70. Selection Plunger
71. Poppet Spring
72. Front Output Shaft Seal
73. Deflector
74. Front Output Yoke
75. Rubber Sealing Washer
76. Washer
77. Nut Front Output Yoke
78. Carrier Lock Ring
79. Oil Pump Screw
80. Identification Tag
81. Synchronizer Assembly
82. Drive Sprocket Bearing
83. Mode Synchronizer Hub Snap Ring
84. Mainshaft Pilot Bearing

F-05850

Figure 4—New Process 231 Transfer Case

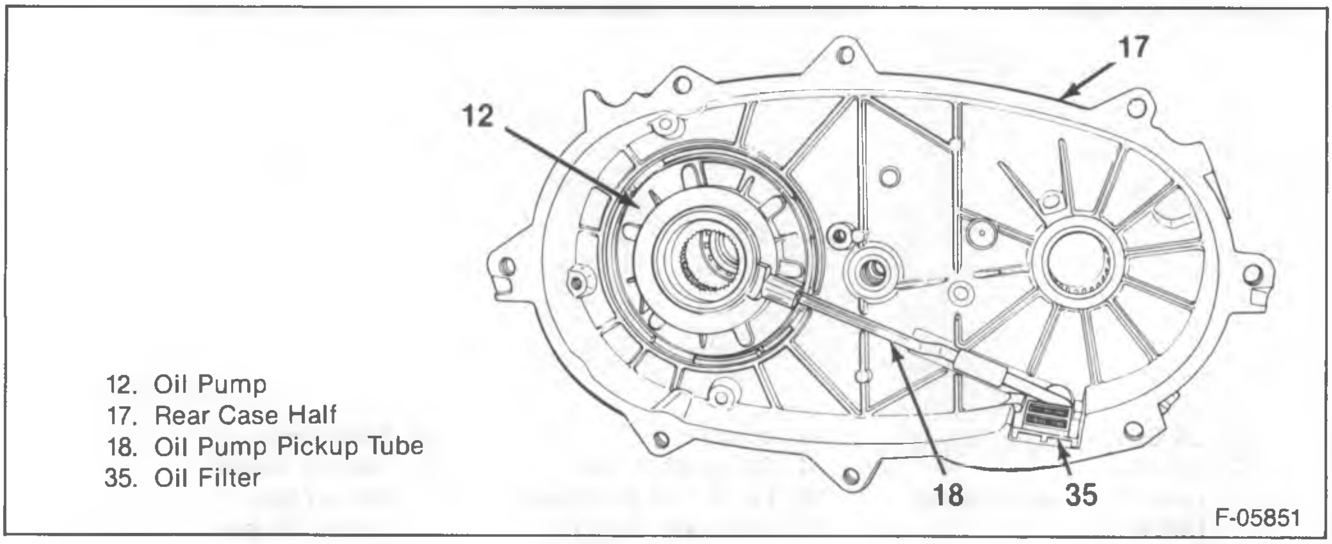


Figure 5—Oil Pump, Pickup Tube and Screen

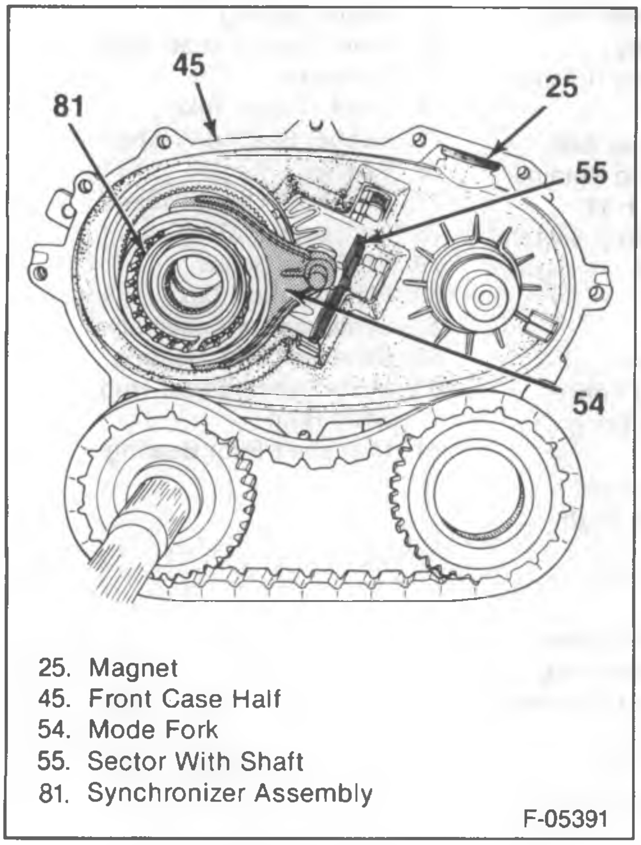


Figure 6—Mode Fork and Shaft Assembly

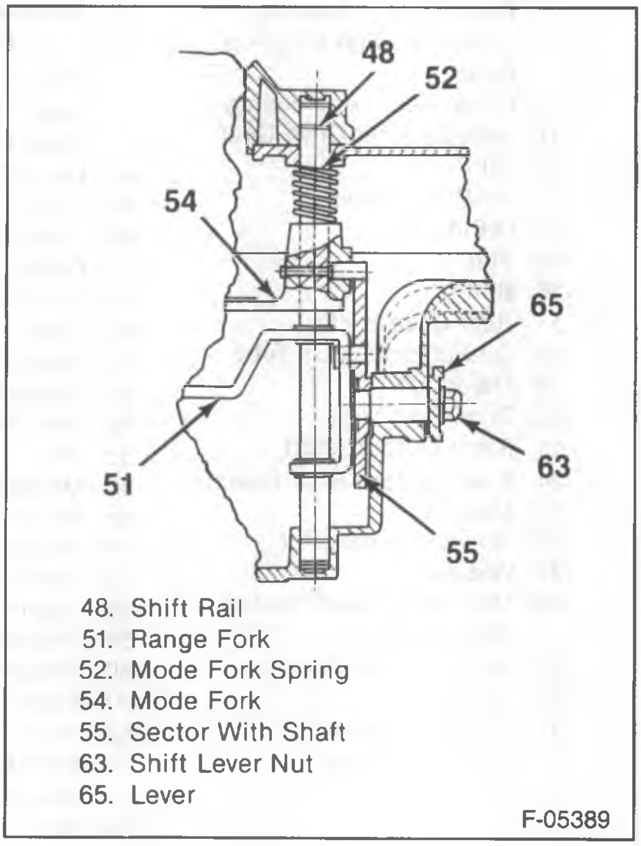


Figure 7—Shift Rail Assembly

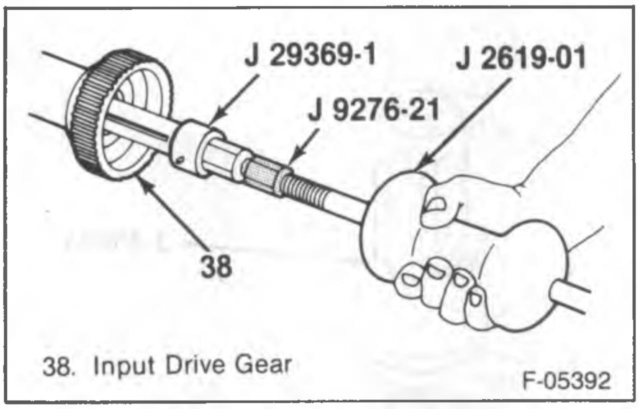


Figure 8—Removing the Input Gear Bearing

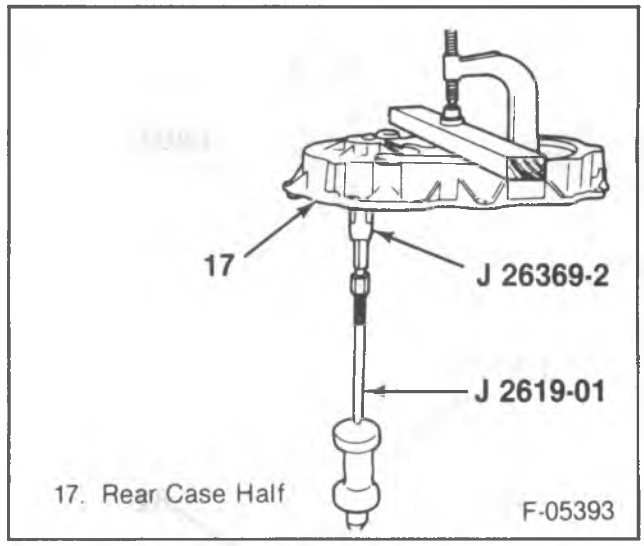


Figure 9—Front Output Shaft Rear Bearing Removal

CLEANING AND INSPECTION

Clean

1. Bearings.
   - Remove all old lubricant and dirt.
2. Shafts.
3. Sprockets.
4. Chain.
5. Oil feed ports and channels in each case half. Apply compressed air to each oil feed port and channel in order to remove any obstructions or cleaning solvent residue.
6. All mating and sealing surfaces.

Inspect

1. Bearings and thrust washers for wear, spalling, brinneling, or corrosion.
2. Gear teeth for excessive wear or damage, spalling, cracks, or corrosion.
3. Gear splines for excessive wear, spalling, cracks, twist or corrosion.
4. Shaft splines for excessive wear, spalling, cracks, distortion or corrosion.
5. Retainer rings for excessive wear, distortion or damage.
6. Case halves for damaged or warped mating surfaces, cracks, porosity, or damaged threaded holes.
7. Synchronizer stop ring for cracks, chips, spalling, or excessive wear.
8. Synchronizer hub and sleeve for cracks, chips, spalling, or excessive wear.
9. Pads on the mode fork and the range fork for wear, distortion.
10. Oil pump gears and case halves for wear, spalling, cracks, and damage. Replace complete assembly if there is wear.
11. Input gear, planetary carrier and range shift hub tooth chamfers for excessive wear.

ASSEMBLY OF TRANSFER CASE

BEARING AND SEAL REPLACEMENT

Install or Connect (Figures 10, 11, and 12)

Tools Required:

J 8092 Driver Handle
J 36370 Bearing Installer
J 33833 Bearing Installer
J 36372 Bearing Installer
J 33843 Seal Installer
J 33831 Seal Installer

- Use ATF or equivalent where needed in assembly.

1. Needle bearings (82) to the drive sprocket (20) using J 36370 and J 8092 (figure 10).
2. Needle bearing (24), to the rear case half (17) using J 36372 and J 8092.
   - Bearing must be flush with the boss on case housing.
3. Bearing (61) to the front case half (45) using J 9092 and J 33833.
4. Retainer (60).
5. Bearing (6) to the pump retainer housing (8) using J 33833 and J 8092 (figure 11).
6. Bearing (84) to the input gear (38) using J 36372 and J 8092.

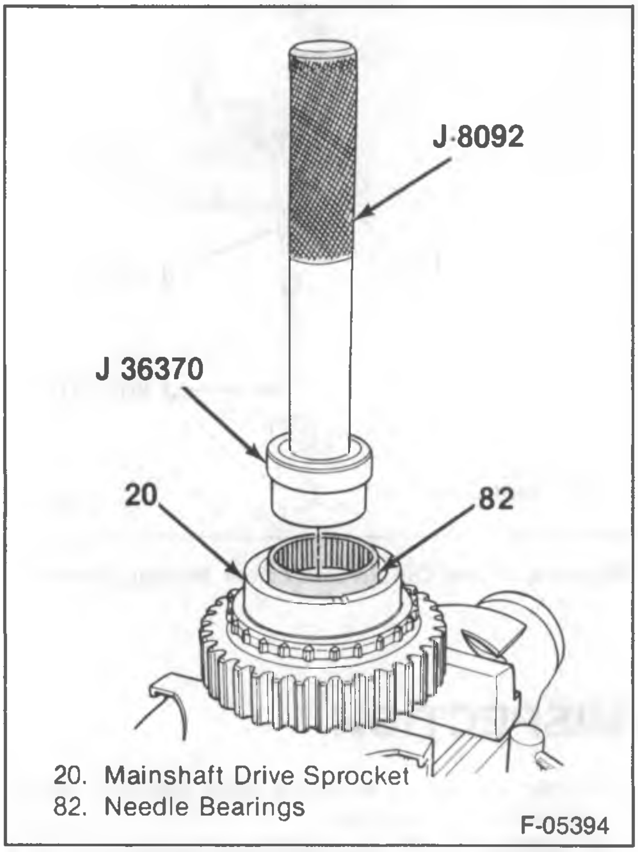


Figure 10—Installing the Needle Bearing to the Front Drive Sprocket

7. Thrust washer (37).
8. Carrier lock ring (78).
9. Retainer (39).
10. Bearing (40) to the front case half (45) using J 36372.
11. Oil seal (1) to the rear extension (4) using J 33843.
12. Input bearing retainer seal (42) to the input bearing retainer (44) using J 33831.
13. Front output shaft seal (72) to the front case half (45) using J 33834 (figure 12).
14. Magnet (25) into front case half (45).

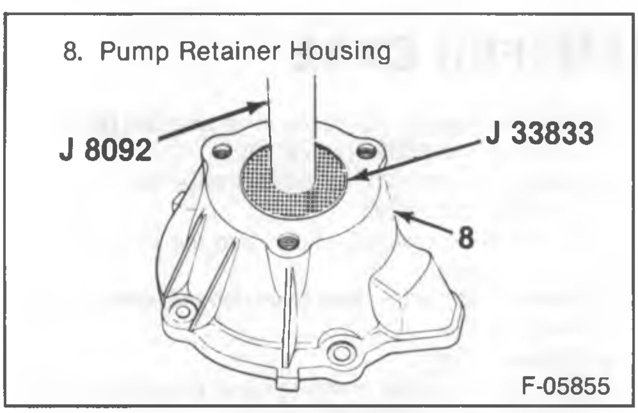


Figure 11—Pump Retainer Housing Bearing Installation

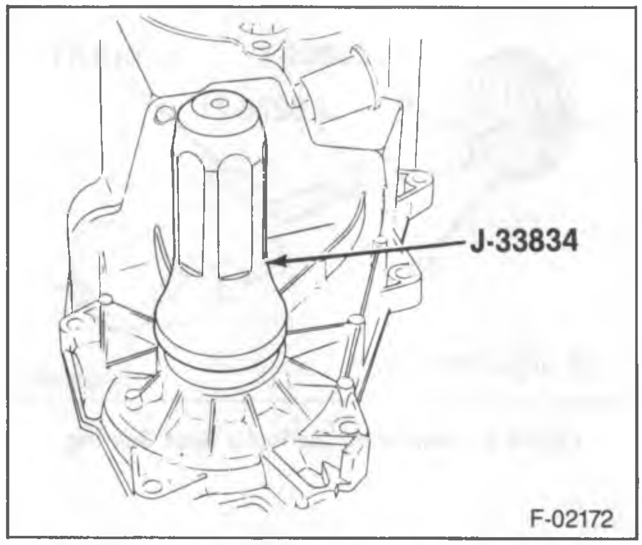


Figure 12—Front Output Shaft Seal Installation

INTERNAL COMPONENTS

Assemble (Figures 13, 14, and 15)

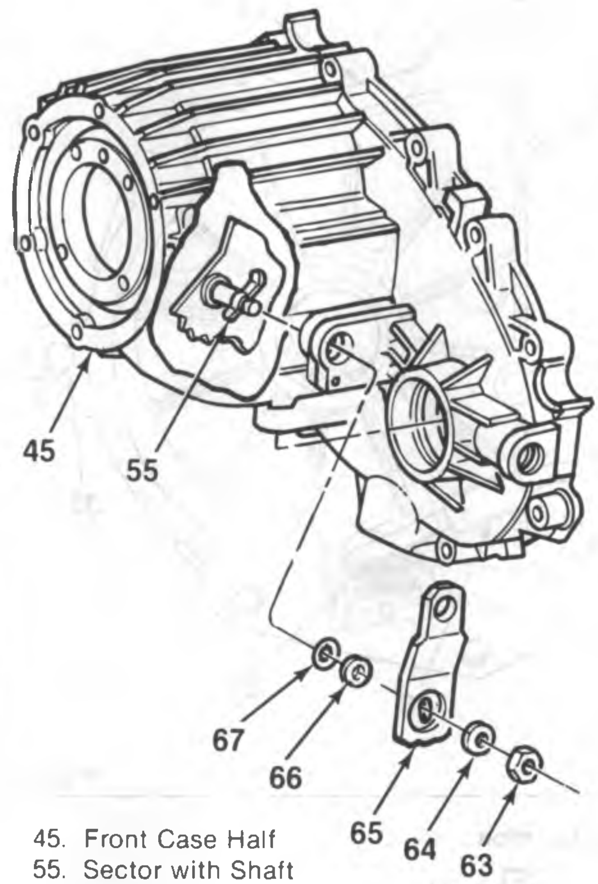
1. Synchronizer hub (31) to the synchronizer sleeve (29) along with the three struts (30).
   - Align the previously made scribe marks.
2. Spring retainer (32) to the synchronizer sleeve (29).
3. Main drive synchronizer stop ring (28) to the synchronizer sleeve (29).

Install or Connect

1. Drive sprocket (20) to the mainshaft (19).
2. Planetary input gear assembly (38) into the annulus gear (62) using a soft faced hammer.
3. Bearing retainer (snap ring) (39) to the input bearing (40).
4. Input bearing (40) to the front case half (45).
5. Input bearing retainer bolts (43) and input bearing retainer (44) to the front case half (45).
   - Apply RTV or equivalent on bearing retainer mating surfaces.
   - Apply Loctite 242 or equivalent on bearing retainer bolts.

   Tighten
   - Bolts (43) to 19 N·m (14 ft. lbs.).
6. Sector with shaft (55) into the front case half (45).
7. Shift lever O-ring (67), plastic washer (66), shift lever (65), washer (64), and nut (63) to the front case half (figure 13).

   Tighten
   - Nut (63) to 27 N·m (20 ft. lbs.).
8. Range shift hub (34) and the range shift fork into the front case half (45).
   - It is necessary to rotate the sector to align the range shift fork.
9. Synchronizer assembly, mode shift fork (54) and rail into the front case half (45) (figure 14).
10. Front output shaft (21) to the chain (58).



45. Front Case Half
55. Sector with Shaft
63. Torque Nut
64. Washer
65. Shift Lever
66. Plastic Washer
67. O-Ring Seal

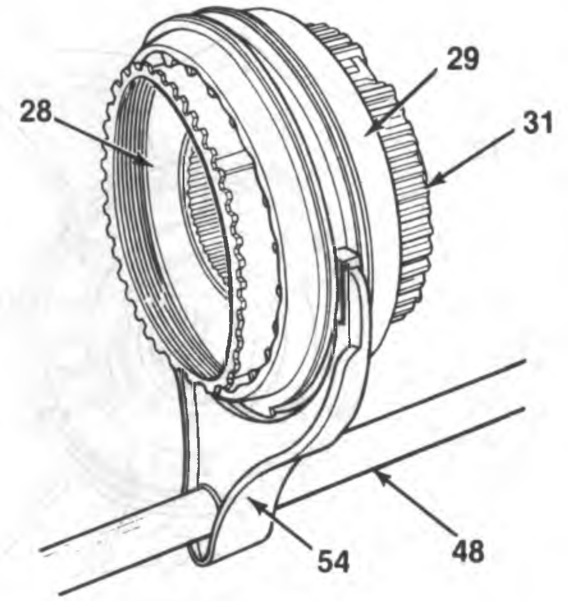
F-05433

Figure 13—Sector with Shaft

11. Drive sprocket (20) and mainshaft (19) into the chain (58).
    - Mainshaft (19), drive sprocket (20), driven sprocket (22) and chain (58) are installed as a unit.
12. Fork shift spring (52) onto the mode shift rail (48).
13. Oil pump pick up tube (18), oil tube connector (26) and pump pick up screen (35) into the rear case half (17) (figure 15).
14. Oil tube O-ring (14) onto the oil pump pick up tube (18).

NOTICE: Do not damage the O-ring during assembly as this could result in pump failure.

15. Oil pump (12) to the oil pump pick up tube (18).
    - Apply RTV sealer to the case mating surfaces.
16. Rear case (17) over mainshaft (19) and onto the front case half (45).
    - Be careful not to damage the oil pump (12) while installing the rear case half.
17. Case bolts (3) into case halves.
    - Apply Loctite 242 or equivalent to case bolts.



28. Synchronizer Stop Ring
29. Synchronizer Sleeve
31. Synchronizer Hub
48. Shift Rail
54. Mode Fork

F-05432

Figure 14—Synchronizer Hub Assembly and Mode Fork

- The two longer case bolts and washers into doweled case holes (33) (figure 16).

Tighten

- Bolts to 31 N·m (23 ft. lbs.).

18. Pump retainer housing (8) and pump housing bolts (7) to the rear case half (17).
    - Apply Loctite 242 or equivalent on pump housing bolt threads.

Tighten

- Bolts to 41 N·m (30 ft. lbs.).

19. Input bearing retainer (snap ring) (5) to the mainshaft (19).
20. Retainer (snap ring) (10), speedometer gear (11) and retainer (snap ring) (10) to the mainshaft (19).
21. Rear extension housing (4) and extension housing bolts (3) to the pump retainer housing (8).
    - Apply RTV sealer to the mating surfaces.
    - Apply Loctite 242 or equivalent on the extension housing bolts.

Tighten

- Bolts to 31 N·m (23 ft. lbs.).

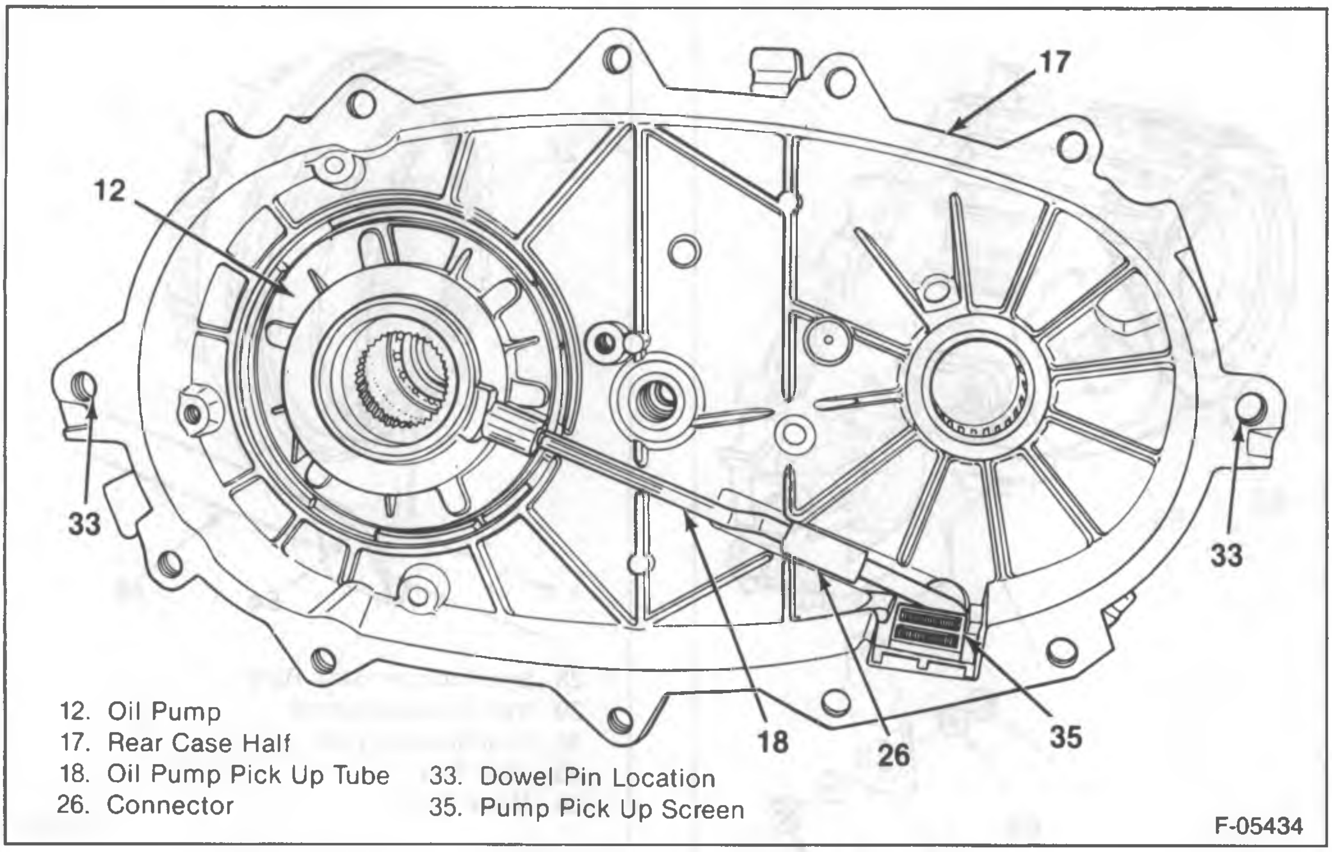


Figure 15—Oil Pump Location

EXTERNAL COMPONENTS

Install or Connect (Figures 1 and 2)

1. Selection plunger (70) poppet spring (71), O-ring seal (69) and poppet screw (68) to the front case half (45).

Tighten

- Poppet screw to 31 N·m (23 ft. lbs.).

2. Indicator lamp switch (46) and O-ring (47) to the front case housing.

Tighten

- Switch to 24 N·m (17 ft. lbs.).

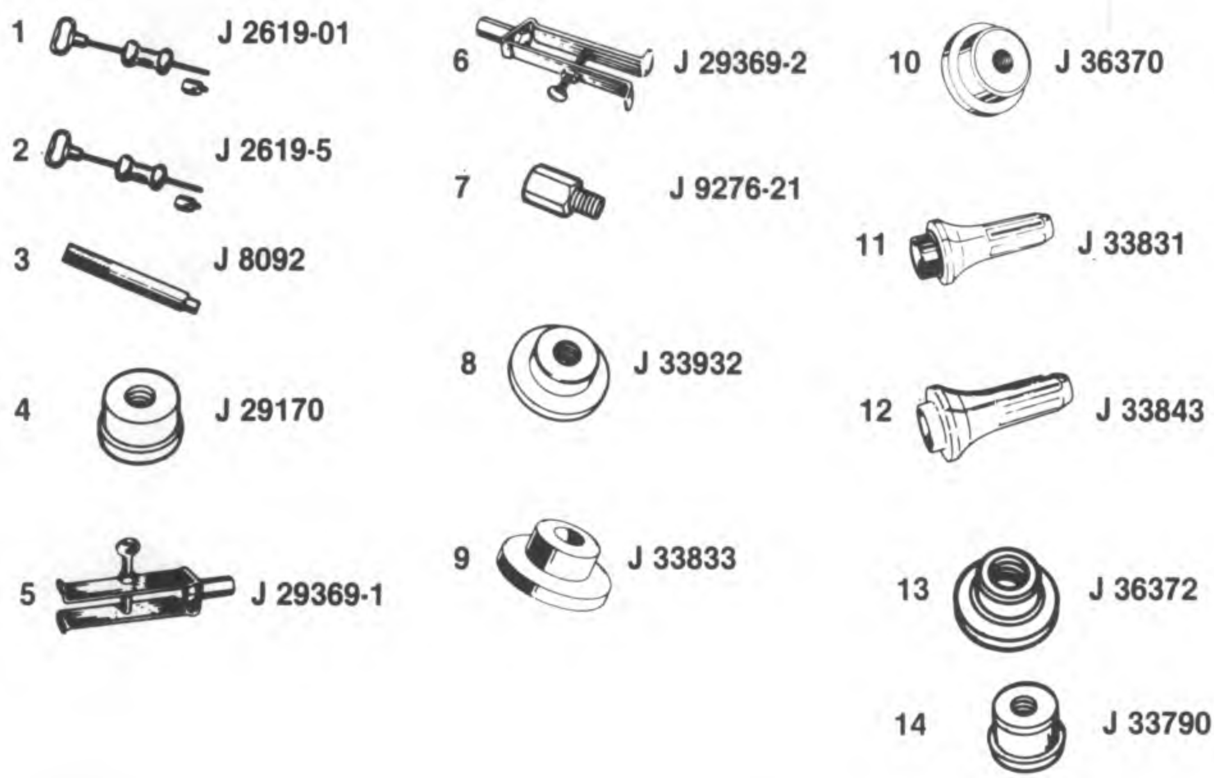
3. Front output flange (74), rubber sealing washer (75), washer (76) and flange nut (77).

SPECIFICATIONS

NEW PROCESS 231 TRANSFER CASE

	N·m	Ft. Lbs.
Input Shaft Retainer Bolts	19	14
Shift Selector Lever Nut	31	23
Shift Selector Light Switch	24	17
Case Half Bolts	31	23
Pump Housing Bolts	31	23
Mainshaft Extension Housing Bolts	31	23
Fill and Drain Plugs	47	35
Front Propeller Shaft Flange Bolts	149	110
Lubricant: Dexron II	2.5 pints	

SPECIAL TOOLS



1. Slide Hammer
2. Slide Hammer
3. Driver Handle
4. Bearing Remover
5. Bearing Remover
6. Output Shaft Bearing Remover
7. Adapter
8. Bearing Installer/Remover
9. Bearing Installer
10. Bearing Installer
11. Seal Installer
12. Extension Housing Seal Installer
13. Bearing Installer
14. Bearing Remover

F-05907

Special Tools

SECTION 7D4

BORG-WARNER 1370 TRANSFER CASE

CONTENTS

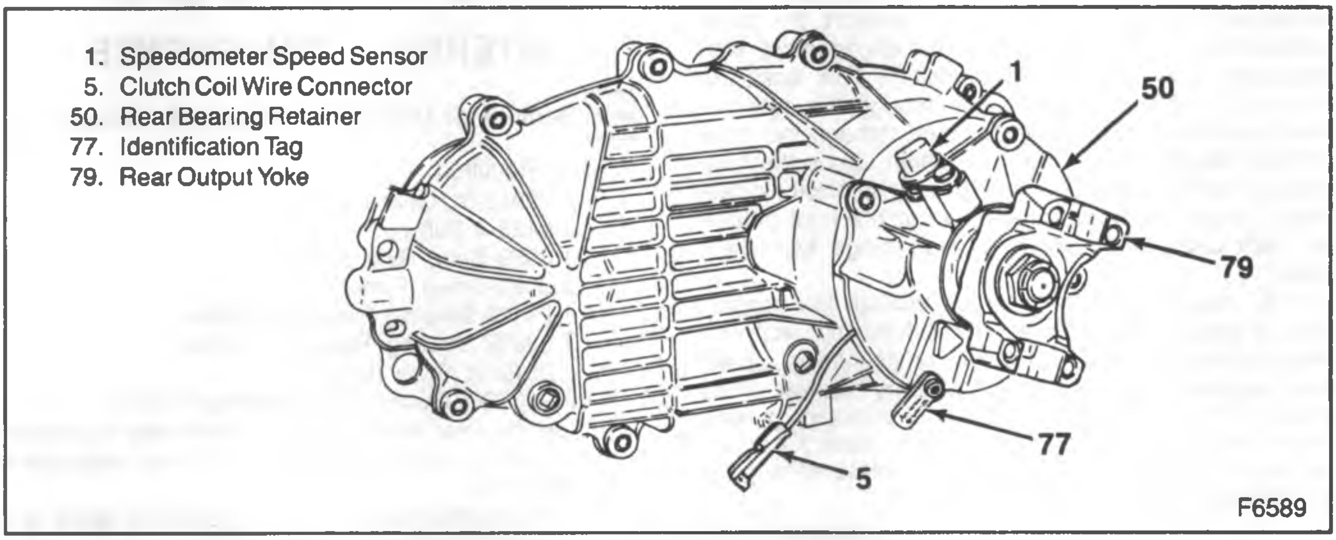


Figure 1—BW1370 Rear Case Half

DESCRIPTION

The Borg-Warner 1370 transfer case is a chain driven, four-position unit providing four-wheel drive high and low ranges, a two-wheel high range, and a neutral position. The BW1370 is a part-time four-wheel drive unit. Torque input in four-wheel drive is undifferentiated. The range positions are selected by a floor mounted gear shift lever. The unit has a gear reduction ratio of 2.69:1.

The BW1370 has a two piece aluminum case with provisions for a power take off (PTO) and uses an electric synchronizer when shifting into four-wheel drive.

IDENTIFICATION (Figures 1 and 2)

The identification tag is an aluminum tag attached under the self-tapping extension housing bolts. This tag provides the transfer case model number, serial number and the build date. The information on this tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, every attempt should be made to keep the identification tag with the unit.

POWER FLOW (Figure 3)

In all drive range positions input torque is transmitted to the transfer case gear train through the transfer case input gear.

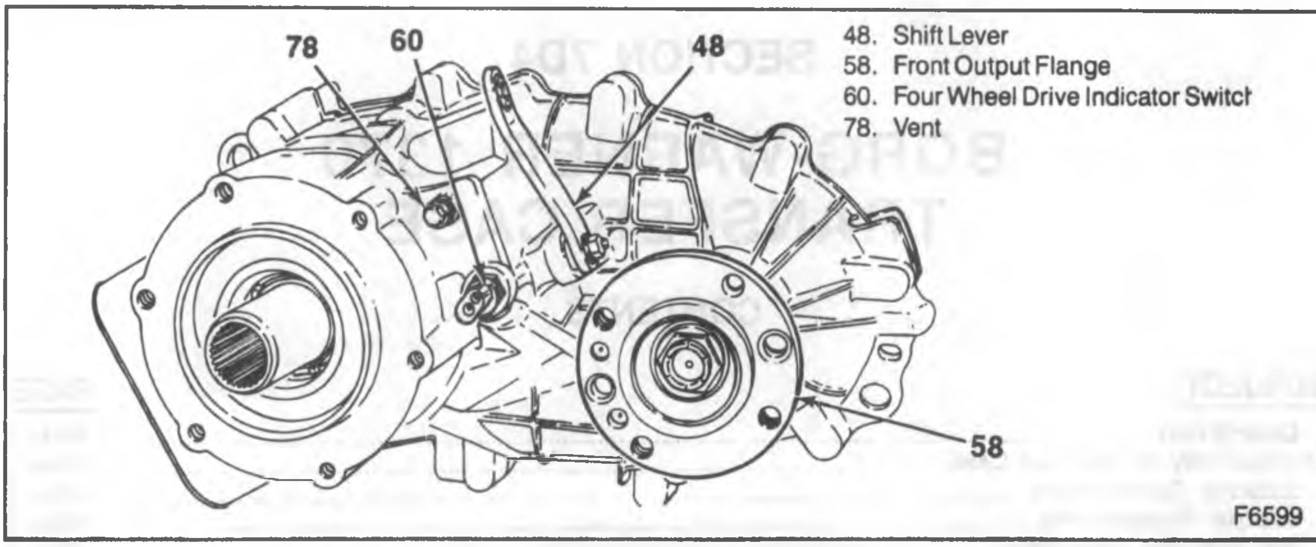


Figure 2—BW1370 Front Case Half

In 2H range, torque flows from the input gear to the range shift hub and mainshaft. Torque flow continues through the slip/fixed yoke which is splined to the mainshaft, and finally to the rear propeller shaft and axle. In 2H range, the mode synchronizer remains in the neutral position. As a result, torque is not transferred to the driven sprocket.

In 4H range, input torque from the input gear is transmitted to the mainshaft in exactly the same fashion as in 2H range. However, in 4H position, the mode synchronizer sleeve is shifted into engagement with the clutch hub teeth on the mainshaft. This locks the drive sprocket to the main shaft through the synchronizer assembly. torque is transmitted through the drive sprocket by the connecting drive chain. Since the front output shaft is splined to the driven sprocket, torque flows through the front output shaft to the front propeller shaft and axle resulting in high range four-wheel drive.

In 4L range, the path of torque through the transfer case is exactly the same as in 4H range but with one major difference. In 4L range the range hub is shifted into engagement with the planetary carrier. This causes the input gear to rotate the planetary pinions inside annulus gear, causing the planetary carrier, range shift hub and mainshaft to rotate at a gear reduction of 2.69:1.

DISASSEMBLY OF THE TRANSFER CASE

EXTERNAL COMPONENTS

Clean

- The transfer case using a solvent and a stiff brush.

Remove or Disconnect (Figures 1, 2, 3 and 4)

1. Front output flange nut (76), flat washer (56), rubber sealing washer (57) and the front output flange (58) from the front output shaft.
2. Rear output yoke nut (75), flat washer (56), rubber sealing washer (57) and the front output flange (58) from the front output shaft.
3. Speedometer pickup switch (59) from the rear bearing retainer (50).
4. Four-wheel drive indicator switch (60) from the front case half (31).
5. Rear bearing retainer bolts (61) and rear bearing retainer (50) from the rear case half (46).

INTERNAL COMPONENTS

Remove or Disconnect (Figures 4 through 21)

Tools Required:

J 22912-01 Gear Puller
J 8433-4 Puller
J 8059 Snap Ring Pliers
J 8092 Driver Handle
J 29169 Bearing Remover/Installer
J 33832 Bearing Remover/Installer
J 2619-01 Slide Hammer
J 29369-1 Output Shaft Bearing Remover

1. Speedometer tone wheel (1) from the mainshaft (23) using J 22912-01 and J 8433-4 or equivalent (figure 4).
   - Be careful not to install J 22912-01 under the speed sensor snap ring.
2. Tone wheel snap ring (3) from the mainshaft (23).
3. Rear output bearing snap ring (4) from the mainshaft (23) using J 8059 snap ring pliers (figure 5).
4. Case screws (62) from the case halves. Note these are self tapping screws and aluminum shavings are common upon removal.
5. Rear case half (46) from the front case half (31).
   - Using a suitable tool between the two pry bosses to separate the case halves.
6. Clutch coil wire connector (5) from the clutch coil wire (figure 6).
7. Clutch coil nuts (6) from the clutch coil assembly (7) (figure 6).
8. Clutch coil (7) from the rear case half (46).
9. Shift rail spring (8) from the shift rail (9).

10. Clutch coil housing snap ring (10) and the clutch coil housing (11) from the mainshaft (2) using J 8095 snap ring pliers (figure 7).
11. Synchronizer hub (55) from the synchronizer assembly (12).
12. Synchronizer assembly (12) from the mainshaft drive gear and mode shift fork (13) from the shift rail (9) (figure 8).
13. Front output shaft snap ring (15) and flat washer (17) from the front output shaft (16) (figure 9).
14. Drive gear (18), driven gear (19), and drive chain (20) as an assembly (figure 10).
15. Front output shaft (16) from the front output bearing (22).
16. Mainshaft (23) and oil pump assembly (24) from the input carrier assembly (25) (figure 11).
17. Shift rail (9), range fork (28) and shift hub (29) from the input carrier assembly (25) (figure 12).
18. Annulus gear snap ring (30) from the front case (31) (figure 13).
19. Annulus gear (32) from the front case (31) (figure 14).
20. Mainshaft front oil seal (33) from the front case (31).
21. Carrier assembly snap ring (34) from the carrier assembly input shaft (25) (figure 15).
22. Input carrier assembly (25) and power take off drive gear (35) from the front case (31) (figure 16).
23. Retaining clip (36) from the sector shaft (37) (figure 17).
24. Sector shaft (37) from the front case (31).
25. Sector (38), detent spring (39) and detent roller (49) from the front case (31).
26. Front input bearing snap ring (43) from the front case (31) (figure 18).
27. Front input bearing (44) from the front case (31) using J 8092 and J 29169 (figure 19).
28. Rear output bearing (45) from the rear case half (46) using J 8092 and J 33832.
29. Front output shaft rear bearing (85) from the rear case (46) using J2619-01 Slide Hammer and J 29369-1 Output Shaft Bearing Remover (figure 20).
30. Front output shaft seal (42) from the front case (31).
31. Front output bearing snap ring (40) from the front case (31) (figure 21).
32. Front output bearing (22) from the front case (31) using J 8092 and J 33832 (figure 22).
33. Rear output shaft seal (47) from the rear bearing retainer (50).

SYNCHRONIZER HUB ASSEMBLY

Disassemble

1. Synchronizer hub snap ring (51) from the synchronizer hub assembly (12) (figure 23).
2. Lockup hub (52) compression spring (53) from the lockup collar (54).

OIL PUMP ASSEMBLY

Disassemble

1. Oil pump retainer bolts (63) and oil pump retainer (69) from the oil pump rear cover (64) (figure 24).
2. Oil pump body (66) and pick up tube assembly from the mainshaft (23).
3. Oil pump pins (67) and oil pump spring (68) from the mainshaft (23).
4. Oil pump front cover (70) from the mainshaft (23).
5. Clamp (71) from the pick up tube (72).
6. Pick up tube (72) and oil pump pickup (26) from the oil pump body (66).
7. Oil pump pickup (26) from the pick up tube (72).

CLEANING AND INSPECTION

Clean

1. Bearings.
2. Shafts.
3. Sprockets.
4. Chain.
5. Oil feed ports and channels in each case half. Apply compressed air to each oil feed port and channel in order to remove any obstructions or cleaning solvent residue.
6. All mating surfaces.

Inspect

1. Bearings and thrust washers for wear, spalling, brinelling, or corrosion.
2. Gear teeth for excessive wear or damage, spalling, cracks, or corrosion.
3. Gear splines for excessive wear, spalling, cracks, twist or corrosion.
4. Shaft splines for excessive wear, spalling, cracks, distortion or corrosion.
5. Retainer rings for excessive wear, distortion or damage.
6. Case halves for damaged or warped mating surfaces, cracks, porosity, or damaged thread holes,
7. Synchronizer assembly for cracks chips, spalling, or excessive wear.
8. Synchronizer hub and sleeve for cracks, chips, spalling, or excessive wear.
9. Pads on the mode fork and the range fork for wear or distortion.
10. Oil pump pins and housing, mainshaft pin pump bores for wear, spalling, cracks and damage. Replace complete assembly if there is wear.
11. Input gear, planetary carrier and range shift hub tooth chamfers for excessive wear.

ASSEMBLY OF THE TRANSFER CASE

During assembly of the transfer case, lubricate all necessary parts with Dexron II automatic transmission fluid, or equivalent.

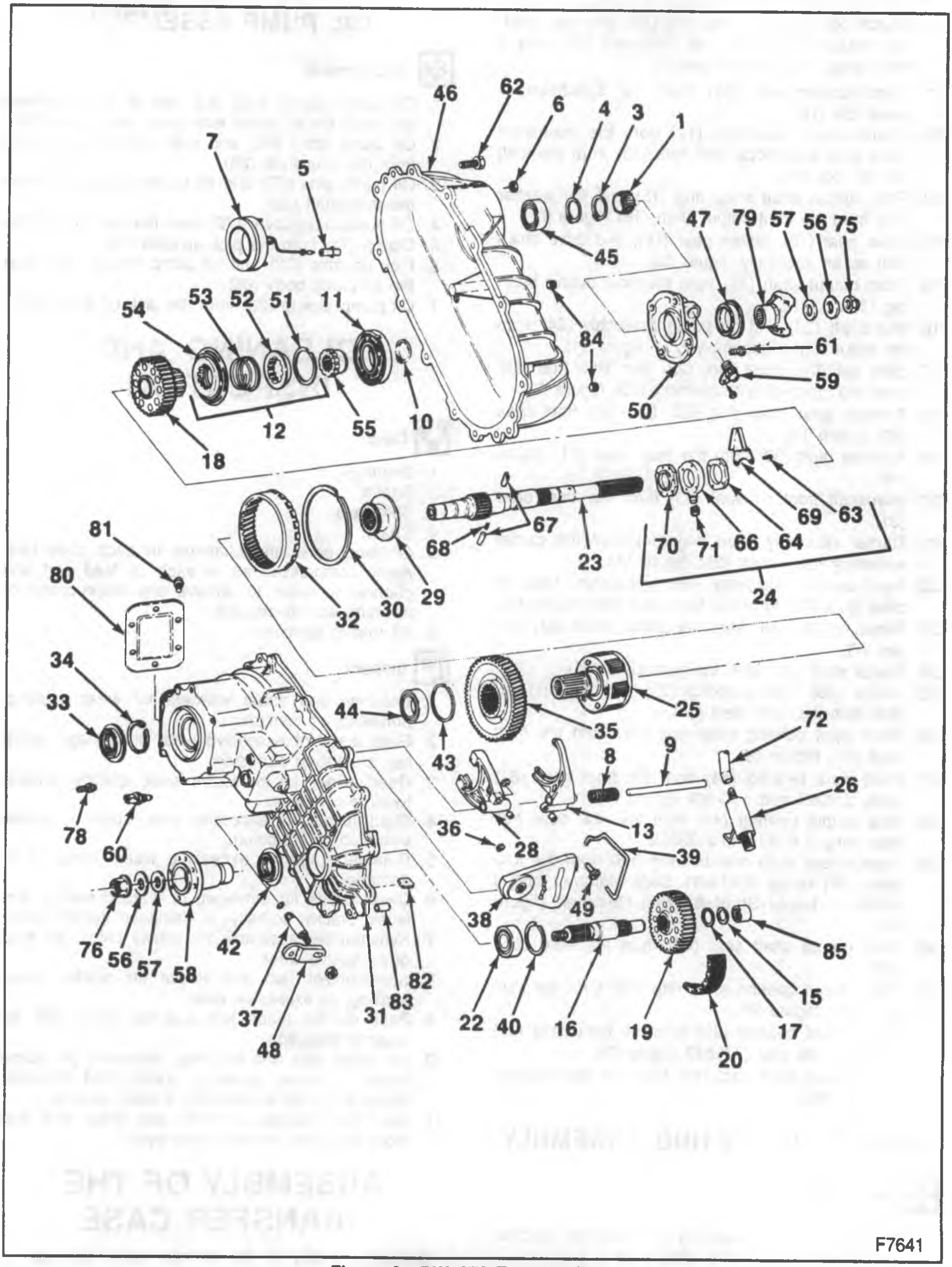
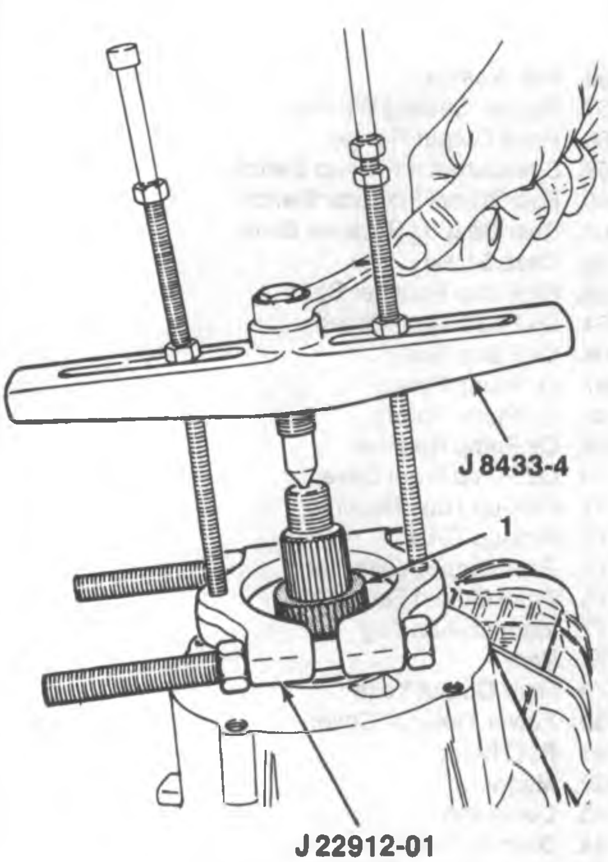


Figure 3—BW1370 Transfer Case

1. Speedometer Tone Wheel
3. Tone Wheel Snap Ring
4. Rear Output Bearing Snap Ring
5. Clutch Coil Wire Connector
6. Clutch Coil Nuts
7. Clutch Coil Assembly
8. Shift Rail Spring
9. Shift Rail
10. Clutch Coil Housing Snap Ring
11. Clutch Coil Housing
12. Synchronizer Assembly
13. Mode Shift Fork
15. Front Output Shaft Snap Ring
16. Front Output Shaft
17. Flat Washer
18. Drive Gear
19. Driven Gear
20. Drive Chain
22. Front Output Bearing
23. Mainshaft
24. Oil Pump Assembly
25. Input Carrier Assembly
26. Oil Pump Pickup
28. Range Fork
29. Shift Hub
30. Annulus Gear Snap Ring
31. Front Case
32. Annulus Gear
33. Mainshaft Front Oil Seal
34. Carrier Assembly Snap Ring
35. Power Take Off Drive Gear
36. Retainer Clip
37. Sector Shaft
38. Sector
39. Detent Spring
40. Front Output Bearing Snap Ring
42. Front Output Shaft Seal
43. Front Input Bearing Snap Ring
44. Front Input Bearing
45. Rear Output Bearing
46. Rear Case
47. Rear Output Shaft Seal
48. Shift Lever
49. Detent Roller
50. Rear Bearing Retainer
51. Synchronizer Hub and Snap Ring
52. Lockup Hub
53. Compression Spring
54. Lock Up Collar
55. Synchronizer Hub
56. Flat Washer
57. Rubber Sealing Washer
58. Front Output Flange
59. Speedometer Pick-up Switch
60. Four Wheel Indicator Switch
61. Rear Bearing Retainer Bolts
62. Case Screw
63. Oil Pump Retainer Bolts
64. Oil Pump Rear Cover
66. Oil Pump Body
67. Oil Pump Pins
68. Oil Pump Spring
69. Oil Pump Retainer
70. Oil Pump Front Cover
71. Pick-up Tube Retainer
72. Pick-up Tube
75. Rear Output Yoke Nut
76. Front Output Flange Nut
77. Identification Tag
78. Vent
79. Rear Output Yoke
80. Power Take Off Cover
81. PTO Bolt
82. Magnet
83. Dowel Pin
84. Drain/fill Plug
85. Front Output Shaft Rear Bearing

F7639

Figure 3—(Continued) BW1370 Transfer Case



1. Speedometer Tone Wheel

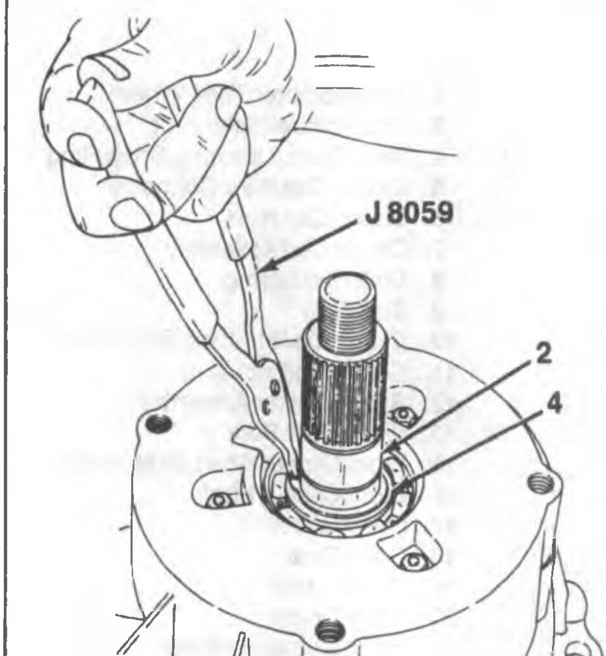
F7658

Figure 4—Removing the Speedometer Tone Wheel

OIL PUMP ASSEMBLY

Assemble (Figure 24)

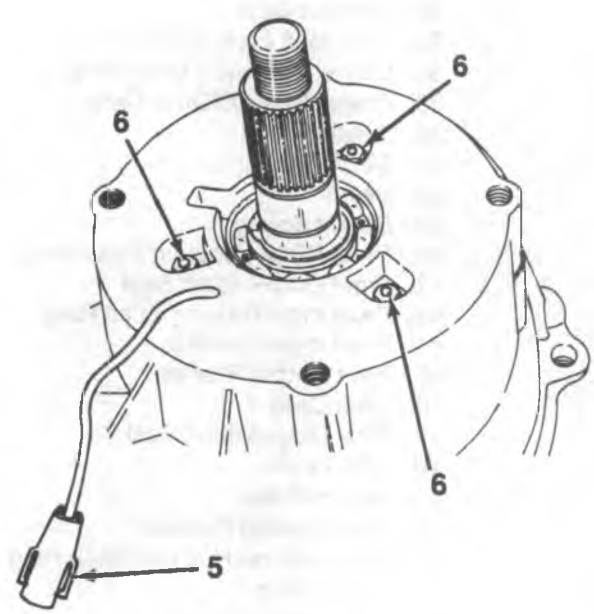
1. Oil pump pickup (26) to the pickup tube (72).
2. Pickup tube (72), oil pump pickup (26) and retainer (71) to the oil pump housing (66).
3. The oil pump front cover (70) with the word TOP facing the front of the front case.
4. Oil pump pins (67), flats facing rearward toward the output end of shaft, oil pump spring (68) between the two pins and place the assembly into the oil pump bore in the mainshaft (23).
5. Oil pump housing (66) to the mainshaft (23) making sure the oil pump pins (67) are riding against the inside of the pump housing.
   - Lubricate the assembly with automatic transmission fluid.
6. Oil pump rear cover (64) with the words TOP REAR facing the rear of the transfer case.
   - Note the word TOP on the front cover and the rear cover should be on the same side.
7. Oil pump retainer (69) with the tabs facing the front of the transfer case.



2. Mainshaft
4. Rear Output Bearing Snap Ring

F6602

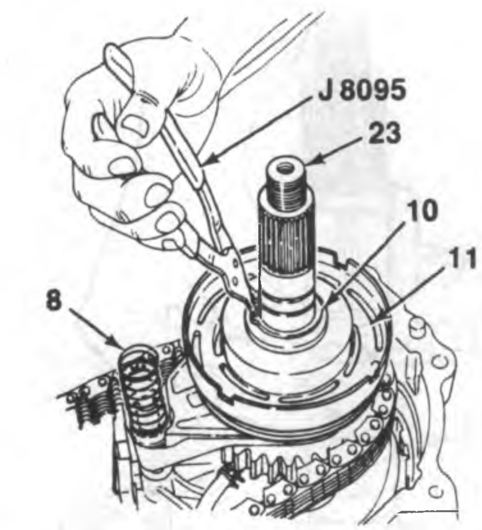
Figure 5—Removing the Output Bearing Snap Ring



5. Clutch Coil Wire Connector
6. Clutch Coil Nut

F6603

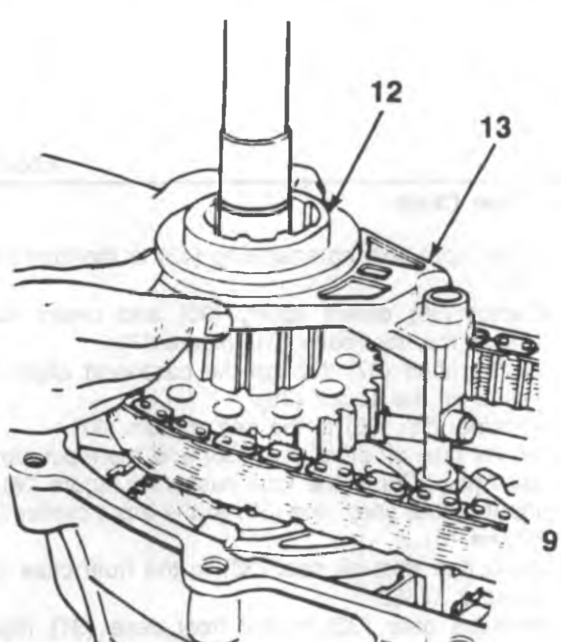
Figure 6—Removing the Clutch Coil



8. Shift Rail Spring
10. Clutch Coil Housing Snap Ring
11. Clutch Coil Housing
23. Mainshaft

F6604

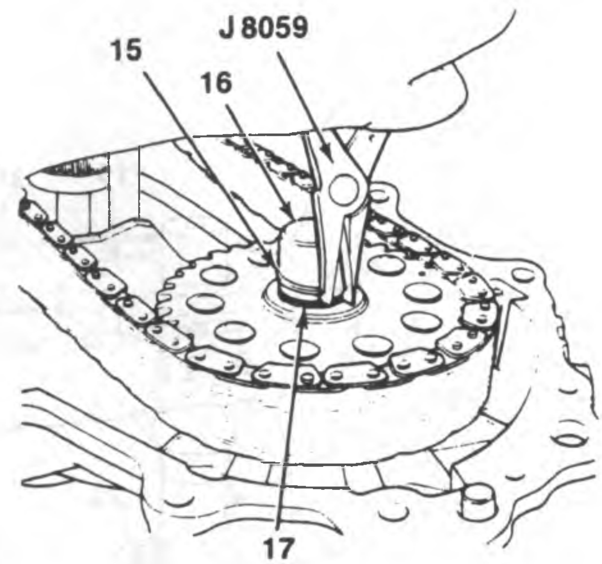
Figure 7—Removing the Clutch Coil Housing



9. Shift Rail
12. Synchronizer Assembly
13. Mode Shift Fork

F6605

Figure 8— Removing the Shift Mode Fork and the Synchronizer Assembly



15. Front Output Shaft Snap Ring
16. Front Output Shaft
17. Flat Washer

F6606

Figure 9—Removing the Front Output Shaft Snap Ring

8. Oil pump retainer bolts (63) and rotate the mainshaft while tightening the bolts to prevent the pump from binding.

Tighten

- Bolts (63) to 6.2 N.m (55 in. lbs.).

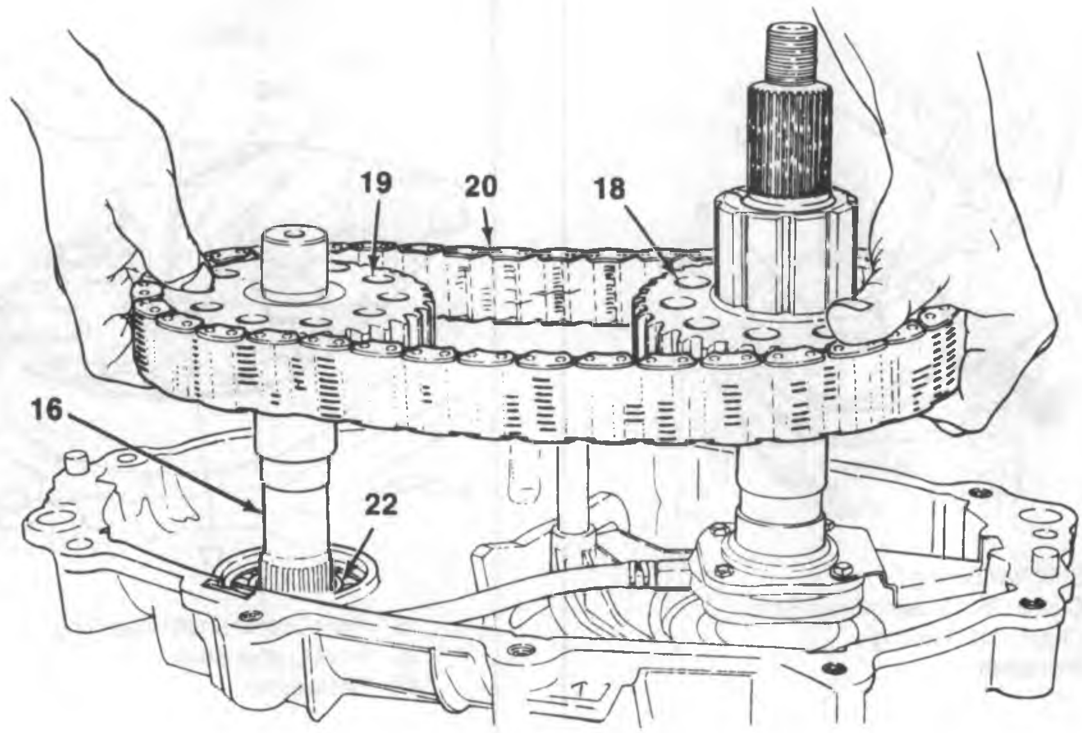
Inspect

- Oil pump operation on the mainshaft. The mainshaft must turn freely within the oil pump. If binding occurs, loosen the four bolts and retorque.

SYNCHRONIZER ASSEMBLY

Assemble (Figure 23)

1. Compression spring (53) to the lockup collar (54).
2. Lockup hub (52) compressing the compression spring (53).
3. Synchronizer hub snap ring (51).



16. Front Output Shaft
18. Drive Gear
19. Driven Gear
20. Drive Chain
22. Front Output Bearing

F6607

Figure 10—Removing the Drive Chain

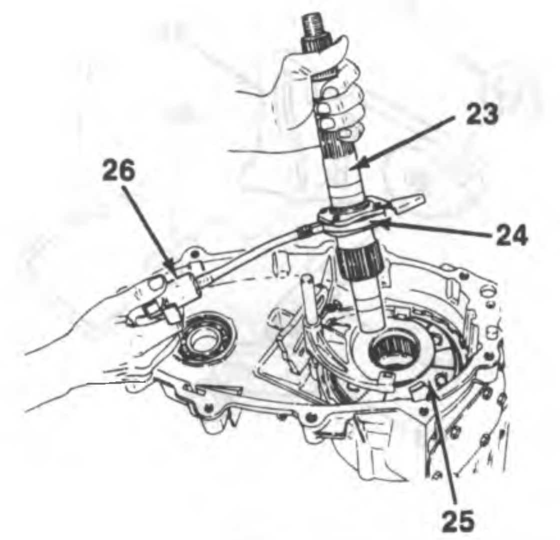
INTERNAL COMPONENTS

Install or Connect (Figures 9 through 25)

Tools Required:

J 37668 Seal Installer
J 80922 Driver Handle
J 33832 Bearing Installer/Remover
J 29169 Bearing Installer/Remover

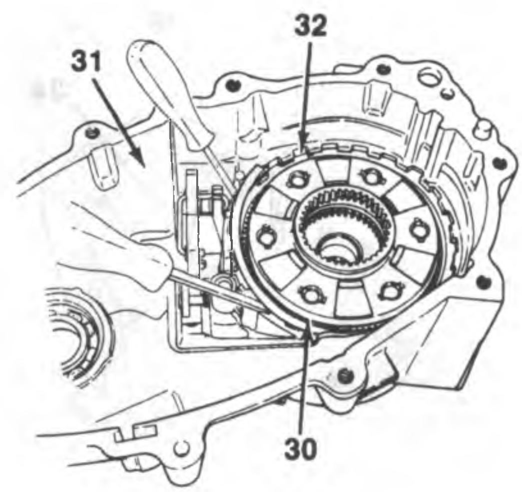
1. Rear output shaft seal (47) to the rear bearing retainer (50) using J 37668.
2. Front output bearing (22) to the front case (31) using J 8092 and J 33832 (figure 25).
3. Front output bearing snap ring (40) to the front case (31).
4. Front output shaft seal (42) to the front case (31) using J 37668.
5. Rear output bearing (45) to the rear case (46) using J 8092 and J 33832.
6. Front input bearing snap ring (44) to the front case (31) using J 8092 and J 29169 (figure 26).
7. Front input bearing snap ring (43) to the front case (31).
8. Sector (38) detent spring (39) and detent roller (49) to the front case (31) (figure 17).
9. Sector shaft (37) through the case and align with spline on the sector (38).
10. Retainer clip (36) to the sector shaft (37).
11. Power take off drive gear (35) and the input carrier assembly (25) to the front case (31) (figure 16).
12. Input carrier snap ring (32) to the input carrier (25) (figure 15).
13. Mainshaft front oil seal (33) to the front case (31) using J 37668.
14. Annulus gear (32) to the front case (31) (figure 14).
15. Annulus gear snap ring (30) to the front case (31) (figure 13).
16. Range fork (28) and shaft hub (29) aligning the shift hub to the carrier assembly and the shift fork pin to the slot in the sector (38).
17. Shift rail (9) through the range fork (28) and into the boss in the front case.



23. Mainshaft
24. Oil Pump Assembly
25. Input Carrier Assembly
26. Oil Pump Pickup

F6608

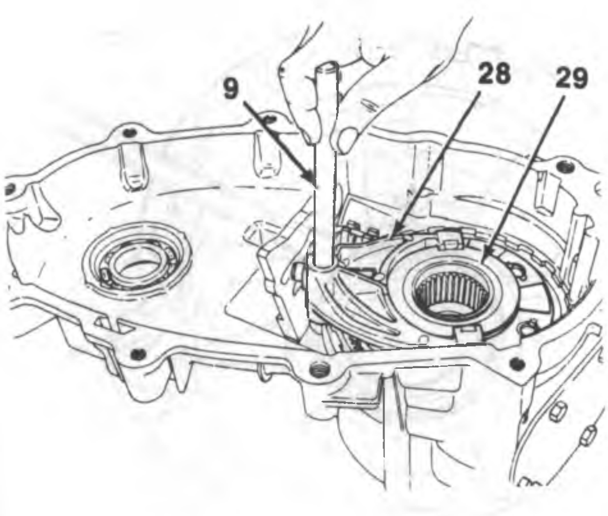
Figure 11—Removing the Mainshaft and Oil Pump



30. Annulus Gear Snap Ring
31. Front Case
32. Annulus Gear

F6610

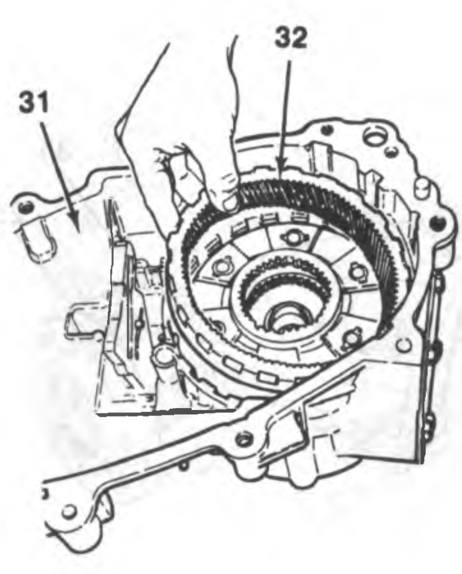
Figure 13—Removing the Annulus Gear Snap Ring



9. Shift Rail
28. Range Fork
29. Shift Hub

F6609

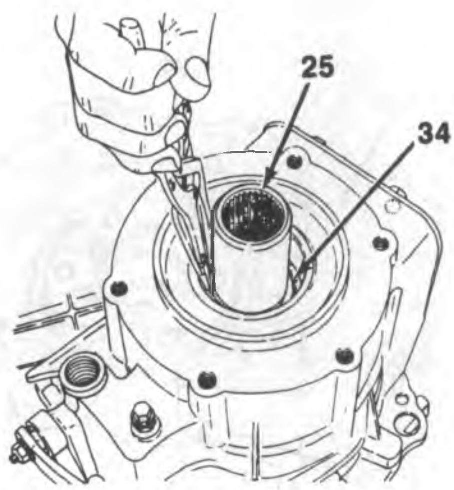
Figure 12—Removing the Shift Rail Range Fork and the Shift Hub



31. Front Case
32. Annulus Gear

F6616

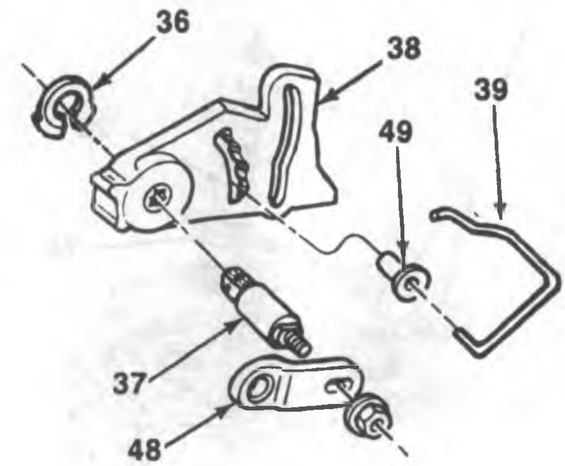
Figure 14—Removing the Annulus Gear



25. Carrier Assembly Input Shaft
34. Input Carrier Snap Ring

F6617

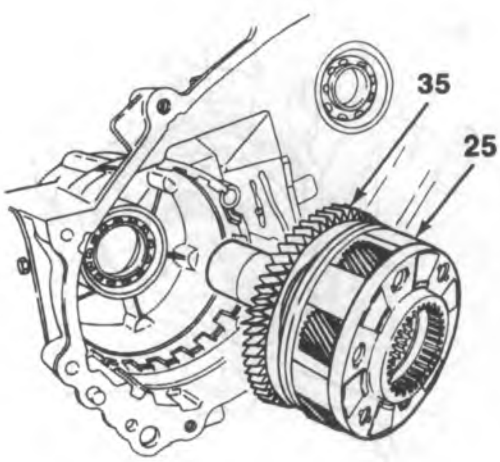
Figure 15—Removing the Carrier Assembly Snap Ring



36. Retainer Clip
37. Sector Shaft
38. Cam
39. Detent
48. Shift Lever
49. Detent Roller

F7657

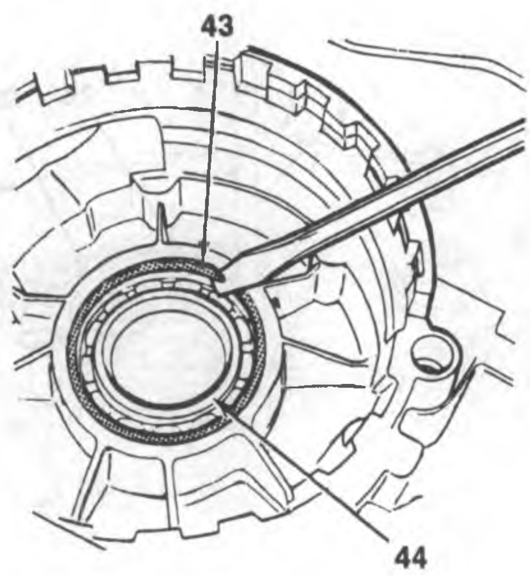
Figure 17—Sector and Shaft Assembly



25. Input Carrier Assembly
35. Power Take Off Drive Gear

F6618

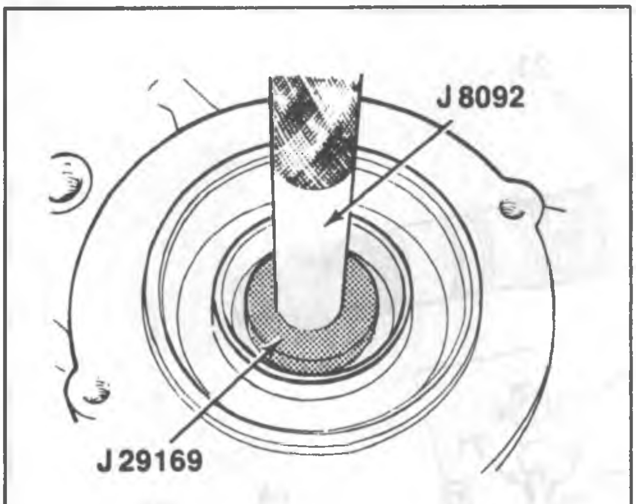
Figure 16—Input Carrier and PTO Gear



43. Front Input Bearing Snap Ring
44. Front Input Bearing

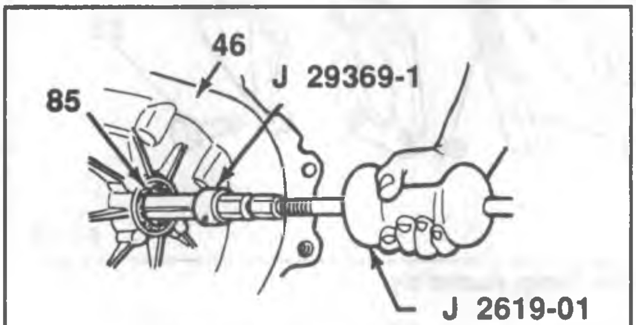
F6620

Figure 18—Removing the Front Input Bearing Snap Ring



F6621

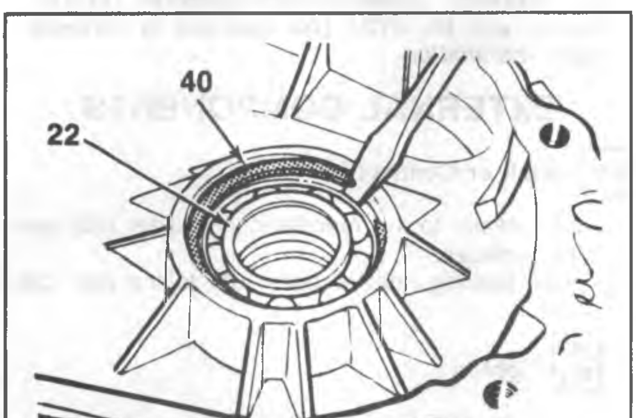
Figure 19—Removing the Front Input Bearing



46. Rear Case
85. Front Output Shaft Rear Bearing

F7659

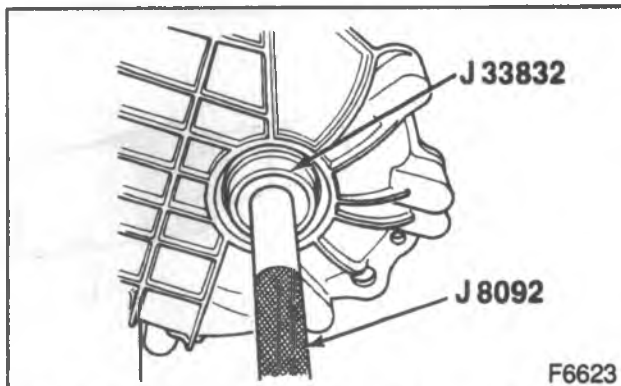
Figure 20—Removing the Front Output Shaft Rear Bearing



22. Front Output Bearing
40. Front Output Bearing Snap Ring

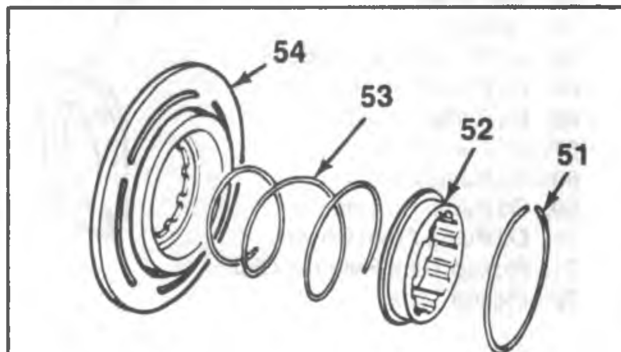
F6622

Figure 21—Removing the Front Output Bearing Snap Ring



F6623

Figure 22—Removing the Front Output Bearing



51. Synchronizer Hub Snap Ring
52. Lockup Hub Assembly
53. Compression Spring
54. Lockup Collar

F6624

Figure 23—Synchronizer Hub Assembly

18. Mainshaft (23) and oil pump assembly (24) into the carrier assembly (25) (figure 11).
19. Front output shaft (16) to the front output bearing (22).
20. Drive gear (18), driven gear (19), and drive chain (20) as an assembly to the mainshaft (23) and front output shaft (16).
21. Flat washer (17) to the front output shaft (16).
22. Front output shaft snap ring (15) to the front output shaft (16) (figure 9).
23. Synchronizer assembly (12) and mode shift fork (13) aligning the synchronizer assembly to the mainshaft drive gear (18) and the mode fork to the shift rail (9).
24. Synchronizer hub (55) to the synchronizer assembly (12).
25. Clutch coil housing (11) and clutch coil housing snap ring (10) to the mainshaft (23).
26. Shift rail spring (8) to the shift rail (9).
27. Clutch coil (7) to the rear case (46).
28. Clutch coil nuts (6) to the clutch coil (7).

Tighten

- Clutch coil nuts (6) to 10 N.m (84 inch lbs.).

29. clutch coil wire through the rear case and clutch coil wire connector (5) to the clutch coil wire.
30. RTV sealer to the case sealing surfaces and the rear case half (46) to the front case half (31).

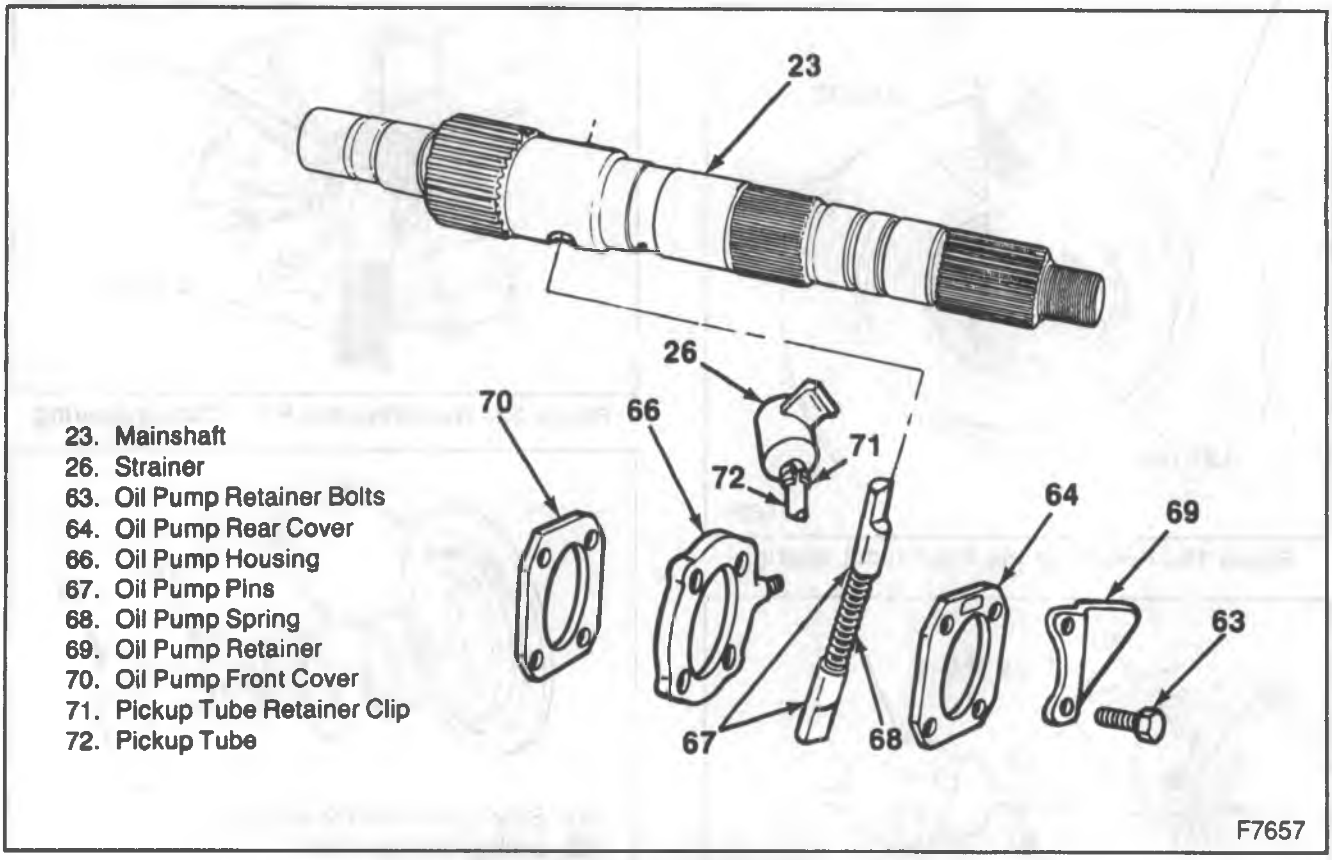


Figure 24—Mainshaft and Oil Pump Assembly

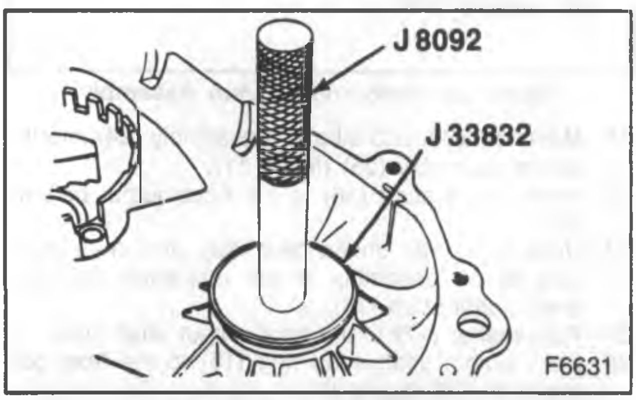


Figure 25—Installing the Front Output Bearing

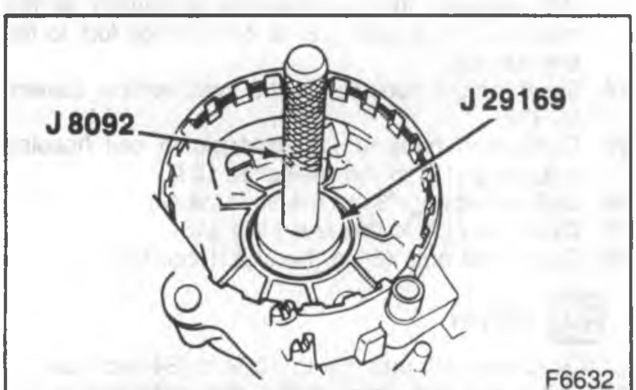


Figure 26—Installing the Front Input Bearing

31. Case screws (61) to the case halves.

Tighten

- Case screws (62) to 31 N.m (23 ft. lbs.).

32. A new speedometer tone wheel (1) to the mainshaft (23) using J 5590.

NOTE: The speedometer tone wheel is important to the proper operation of the RWAL braking system, speedometer/odometer, cruise control and the ECM. Use care not to damage upon installation.

EXTERNAL COMPONENTS

Install or Connect

1. RTV sealer to the rear bearing retainer (50) sealing surfaces.
2. Rear bearing retainer bolts (61) to the rear case (46).

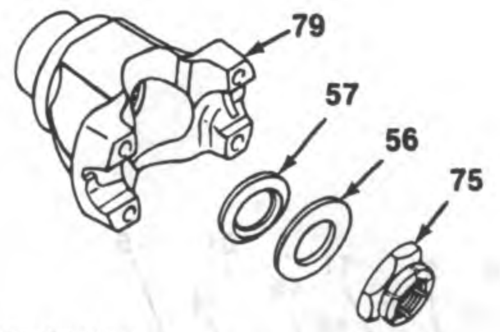
Tighten

- Bolts to 31 N.m (23 ft. lbs.).

3. Four-wheel drive indicator switch (60) to the front case half (31).

Tighten

- Switch to 41 .nm (30 ft. lbs.).



56. Flat Washer
57. Rubber Sealing Washer
75. Rear Output Yoke Nut
79. Rear Output Yoke

F6633

Figure 27—Installing the Rear Output Yoke

4. Speedometer pickup switch (59) and bolt to the rear bearing retainer (50).

Tighten

- Bolt to 16 N.m (12 ft. lbs.).

5. Rear output yoke (79), rubber sealing washer (57), flat washer (56) and the rear output yoke nut (75) to the rear output shaft (figure 27).

Tighten

- Nut (75) to 170 N.m (125 ft. lbs.).

6. Front output flange (58), rubber sealing washer (57), flat washer (56) and the front output flange nut (76) to the front output shaft.

Tighten

- Nut (76) to 224 N.m (165 ft. lbs.).

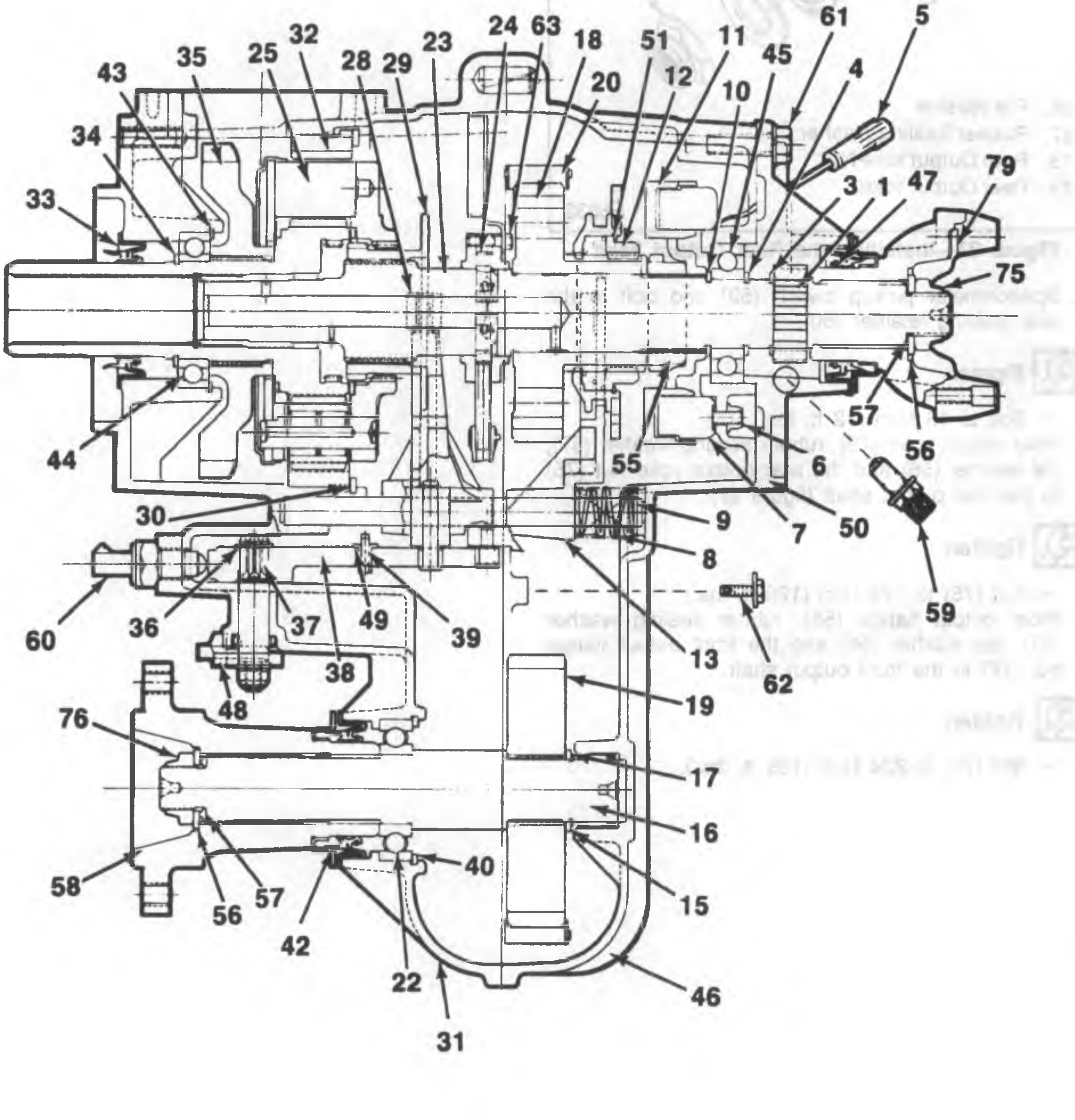


Figure 28—BW1370 Transfer Case

1. Speedometer Tone Wheel
3. Tone Wheel Snap Ring
4. Rear Output Bearing Snap Ring
5. Clutch Coil Wire Connector
6. Clutch Coil Nuts
7. Clutch Coil Assembly
8. Shift Rail Spring
9. Shift Rail
10. Clutch Coil Housing Snap Ring
11. Clutch Coil Housing
12. Synchronizer Assembly
13. Mode Shift Fork
15. Front Output Shaft Snap Ring
16. Front Output Shaft
17. Flat Washer
18. Drive Gear
19. Driven Gear
20. Drive Chain
22. Front Output Bearing
23. Mainshaft
24. Oil Pump Assembly
25. Input Carrier Assembly
28. Range Fork
29. Shift Hub
30. Annulus Gear Snap Ring
31. Front Case
32. Annulus Gear
33. Mainshaft Front Oil Seal
34. Carrier Assembly Snap Ring
35. Power Take Off Drive Gear
36. Retainer Clip
37. Sector Shaft
38. Sector
39. Detent Spring
40. Front Output Bearing Snap Ring
42. Front Output Shaft Seal
43. Front Input Bering Snap Ring
44. Front Input Bearing
45. Rear Output Bearing
46. Rear Case
47. Rear Output Shaft Seal
48. Shift Lever
49. Detent Roller
50. Rear Bearing Retainer
51. Synchronizer Hub Snap Ring
55. Synchronizer Hub
56. Flat Washer
57. Rubber Sealing Washer
58. Front Output Flange
59. Speedometer Pick-up Switch
60. Four Wheel Indicator Switch
61. Rear Bearing Retainer Bolts
62. Case Screw
63. Oil Pump Retainer Bolts
75. Rear Output Yoke Nut
76. Front Output Flange Nut
79. Rear Output Yoke

F6637

Figure 28—(Continued) BW1370 Transfer Case

SPECIFICATIONS

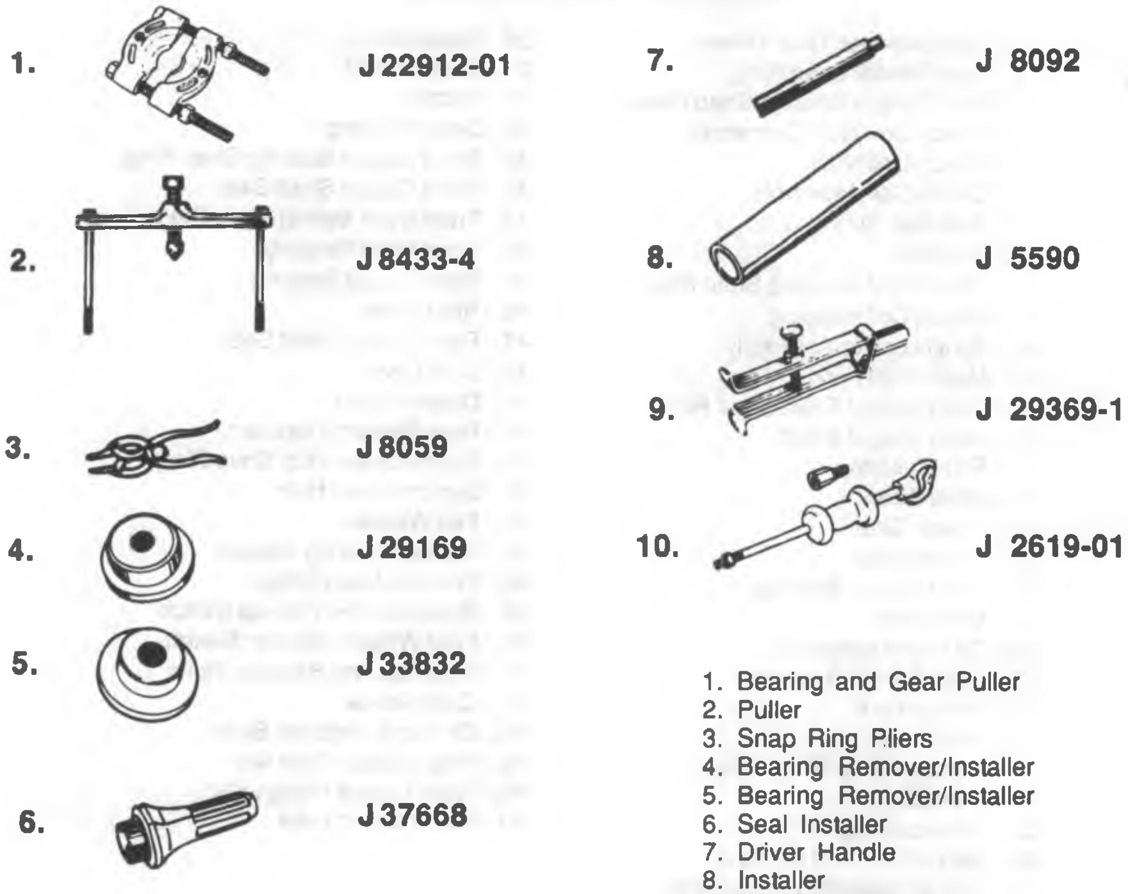
BW1370 TRANSFER CASE

	N·m	Ft. Lbs.	In. Lbs.
Drain/Fill Plugs	25	18	—
Case and Rear Bearing Retainer Screws	31	23	—
Four Wheel Drive Indicator Switch	41	30	—
Vent	14	10	—
Clutch Coil Nuts	10	—	84
P.T.O. Cover Bolts	27	20	—
Flange Nut (Front Output)	224	165	—
Yoke Nut (Rear Output)	170	125	—
Speedometer Pickup Switch	16	12	—
Oil Pump Retainer Bolts	6.2	—	54.8

Lubricant: Dextron II 1.4 Liters (1.5 Quarts)

T2542

SPECIAL TOOLS



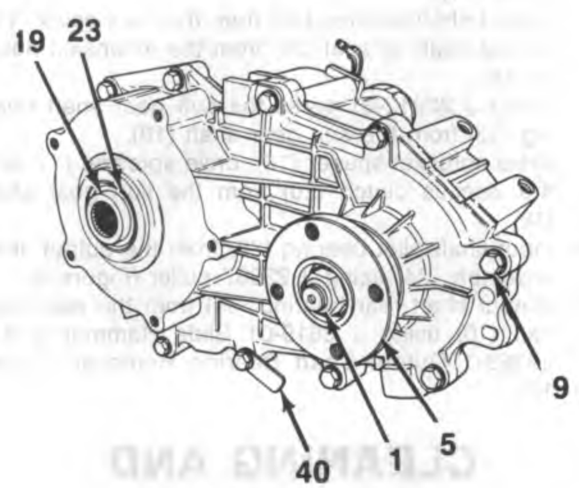
1. Bearing and Gear Puller
2. Puller
3. Snap Ring Pliers
4. Bearing Remover/Installer
5. Bearing Remover/Installer
6. Seal Installer
7. Driver Handle
8. Installer
9. Output Shaft Bearing Remover
10. Slide Hammer

F7663

SECTION 7D5

BORG-WARNER 4472 TRANSFER CASE

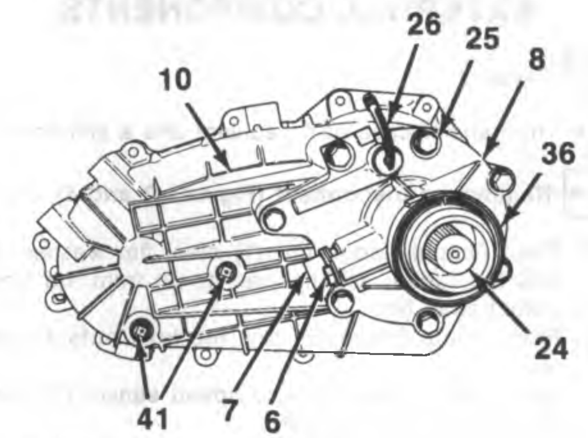
CONTENTS



1. Front Output Flange Nut
5. Front Output Flange
9. Front Cover Bolts
19. Input Shaft
23. Input Shaft Oil Seal
40. Identification Tag

F7561

Figure 1—BW4472 Front View



6. Speed Sensor Bolt
7. Speed Sensor
8. Extension Housing
10. Rear Case Half
24. Output Shaft Assembly
25. Extension Housing Bolt
26. Breather Assembly
36. Output Shaft Oil Seal
41. Drain/Fill Plugs

F7562

Figure 2—BW4472 Rear View

DESCRIPTION

The BW4472 is a two piece aluminum case, chain driven, viscous clutch type transfer case. This produces a system which engages all wheel drive every time it is needed. All wheel drive is automatic and has no external controls.

The viscous clutch used in the BW4472 is a torque distribution device and is nonserviceable. The internal construction of the viscous clutch consists of alternating plates that are connected to the front and rear outputs of the transfer case. The viscous clutch is filled with a high viscosity fluid which flows through slots in the plates. The resistance to sheer causes the plates to transmit torque at the needed ratio. The ratio that torque is transmitted is approximately 1/3 front, 2/3 rear.

IDENTIFICATION (Figures 1 and 2)

The identification tag is an aluminum tag attached under one of the self tapping case bolts. The tag provides the Borg-Warner part number, the General Motors part number, serial number and the build date. The information on the tag is necessary for servicing information. If the tag is removed or becomes dislodged during service operations, every attempt should be made to keep the identification tag with the unit.

POWER FLOW

Torque is transmitted through the input shaft to the planet carrier assembly. The viscous clutch provides the connection between the gear ring and the sun gear shaft. Torque flow continues through the gear ring to the rear output shaft. Torque also flows from the planet carrier assembly to the sun gear shaft which is splined to the drive gear. The drive gear is connected to the driven sprocket by the drive chain. Torque continues through the driven sprocket to the front output shaft flange.

DISASSEMBLY OF THE TRANSFER CASE

EXTERNAL COMPONENTS

Clean

- The transfer case using solvent and a stiff brush.

Remove or Disconnect (Figures 3 and 4)

1. Front Output flange nut (1) steel flat washer (2) and the rubber sealing washer (3) from the front output shaft (4).
2. Front output flange (5) from the front output shaft (4).
3. Speed sensor bolt (6) and speed sensor (7) from the extension housing (8).
4. Front cover bolts (9) from the rear case half (10).
5. Front cover (11) by prying on the tabs provided (Figure 5).

INTERNAL COMPONENT

1. Front output shaft spacer (12) from the front output shaft (4).
2. Front output shaft (4), drive chain (13) and the driven sprocket (14) from the rear case half (10) (Figure 6).
3. Magnet (15) from the rear case half (10).
4. Input shaft (19) from the sun gear shaft (18) (Figure 7).
5. Sun gear shaft (18), sun gear shaft bearing (33), drive sprocket spacer (16), drive sprocket (17), viscous clutch (20) and the sun gear shaft thrust washer (21) as an assembly from the planet carrier assembly (22).
6. Planet carrier assembly (22) and the planet carrier assembly thrust washer (23) from the output shaft assembly (24).
7. Extension housing bolts (25) from the extension housing (8).
8. Breather assembly (26) from the extension housing (8).
9. Extension housing (8) from the rear case half (10).
   - Turn the rear case half (10) over and support the output shaft assembly (24) from the inside of the rear case half (10).
10. Output shaft bearing snap ring (27) from the output shaft bearing (28) (Figure 8).
11. Gear ring snap ring (29) from the gear ring (30).
12. Output shaft assembly (24) from the gear ring (30).

BEARINGS AND SEALS

Remove or Disconnect

Tools Required:
J 22912-01 Bearing Remover
J 23907 Puller
J 2619-01 Slide Hammer
J 29369-1 Output Shaft Bearing Remover

1. Front output shaft oil seal (31) from the front cover (11).
2. Input shaft oil seal (32) from the front cover (11).
3. Output shaft bearing snap ring (34) from the front cover (11).
4. Output shaft bearing (35) from the front cover (11).
5. Output shaft oil seal (36) from the extension housing (8).
6. Using J 22912-01 press the sun gear shaft bearing (33) from the sun gear shaft (18).
7. Drive sprocket spacer (16), drive sprocket (17) and the viscous clutch (20) from the sun gear shaft (18).
8. Input shaft pilot bearing (38) from the output shaft assembly (24) using J 23907 puller (Figure 9).
9. Output shaft rear bearing (39) from the rear case half (10) using J 2619-01 Slide Hammer and J 29369-1 Output Shaft Bearing Remover (Figure 10).

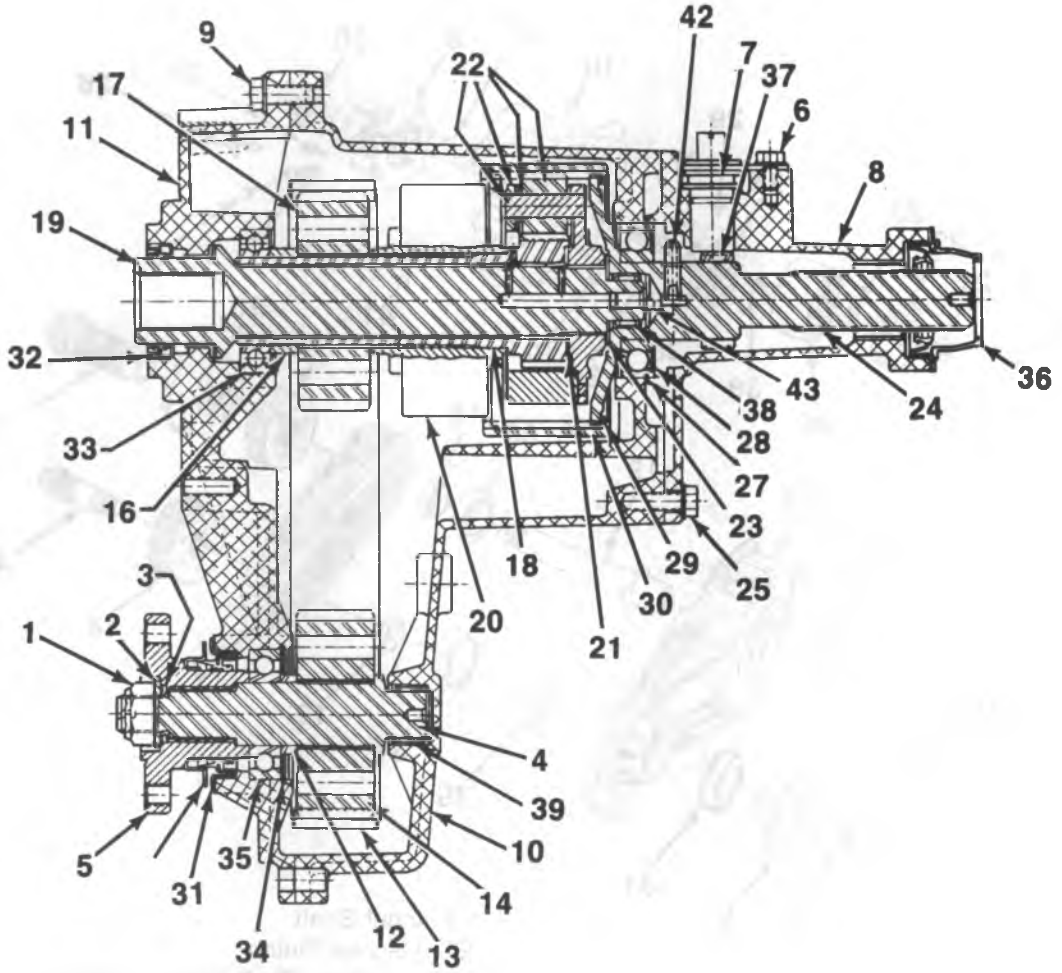
CLEANING AND INSPECTION

Clean

1. Bearings.
2. Shafts.
3. Sprockets.
4. Chain.
5. Oil feed ports and channels. Apply compressed air to each oil feed port and channel in order to remove any obstructions or cleaning solvent residue.

Inspect

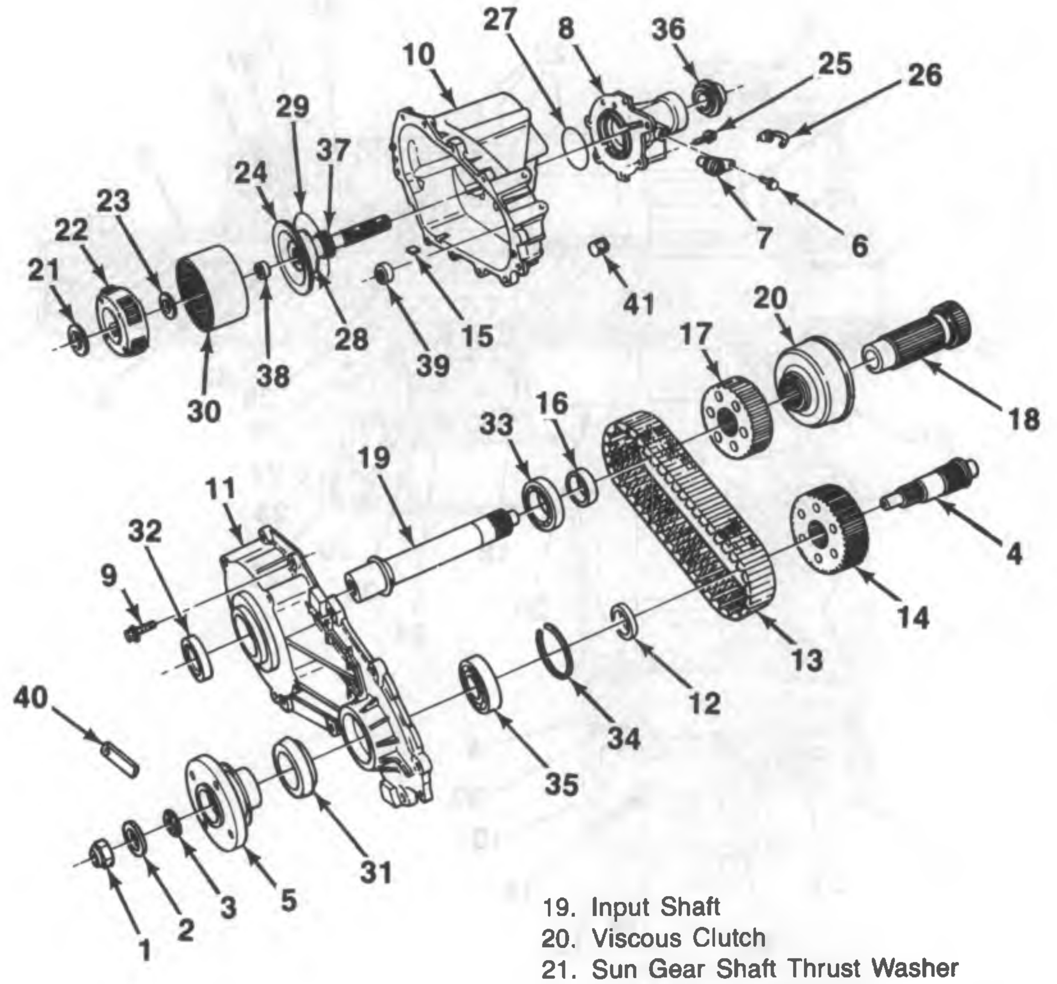
1. Bearings and thrust washers for wear, spalling, brinelling, or corrosion.
2. Gear teeth for excessive wear or damage, spalling cracks or corrosion.
3. Gear splines for excessive wear, spalling, cracks, twist or corrosion.
4. Shaft splines for excessive wear, spalling cracks, distortion or corrosion.



1. Front Output Flange Nut
2. Steel Flat Washer
3. Rubber Sealing Washer
4. Output Shaft
5. Front Output Flange
6. Speed Sensor Bolt
7. Speed Sensor
8. Extension Housing
9. Front Cover Bolts
10. Rear Case Half
11. Front Cover
12. Front Output Shaft Spacer
13. Drive Chain
14. Driven Sprocket
16. Drive Sprocket Spacer
17. Drive Sprocket
18. Sun Gear Shaft
19. Input Shaft
20. Viscous Clutch
21. Sun Gear Shaft Thrust Washer
22. Planet Carrier Assembly
23. Planet Carrier Assembly Thrust Washer
24. Output Shaft Assembly
25. Extension Housing Bolts
27. Output Shaft Bearing Snap Ring
28. Output Shaft Bearing
29. Gear Ring Snap Ring
30. Gear Ring
31. Front Output Shaft Oil Seal
32. Input Shaft Oil Seal
33. Sun Gear Shaft Bearing
34. Output Shaft Bearing Snap Ring
35. Output Shaft Bearing
36. Output Shaft Oil Seal
37. Speedometer Tone Wheel
38. Input Shaft Pilot Bearing
39. Output Shaft Rear Bearing
42. Oil Scoop
43. Lubrication Tube

F7563

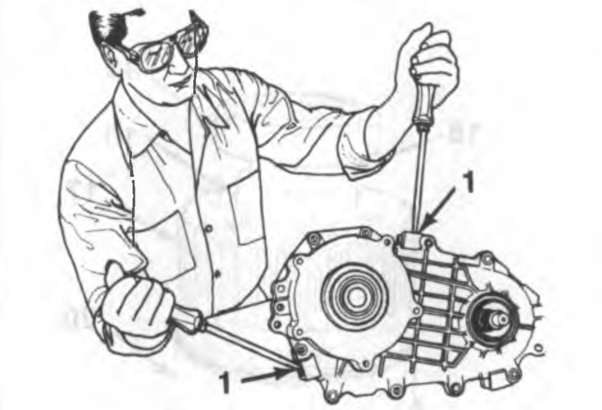
Figure 3—BW4472 Cross Section



1. Front Output Flange Nut
2. Steel Flat Washer
3. Rubber Sealing Washer
4. Output Shaft
5. Front Output Flange
6. Speed Sensor Bolt
7. Speed Sensor
8. Extension Housing
9. Front Cover Bolts
10. Rear Case Half
11. Front Cover
12. Front Output Shaft Spacer
13. Drive Chain
14. Driven Sprocket
15. Magnet
16. Drive Sprocket Spacer
17. Drive Sprocket
18. Sun Gear Shaft
19. Input Shaft
20. Viscous Clutch
21. Sun Gear Shaft Thrust Washer
22. Planet Carrier Assembly
23. Planet Carrier Assembly Thrust Washer
24. Output Shaft Assembly
25. Extension Housing Bolts
26. Breather Assembly
27. Output Shaft Bearing Snap Ring
28. Output Shaft Bearing
29. Gear Ring Snap Ring
30. Gear Ring
31. Front Output Shaft Oil Seal
32. Input Shaft Oil Seal
33. Sun Gear Shaft Bearing
34. Output Shaft Bearing Snap Ring
35. Output Shaft Bearing
36. Output Shaft Oil Seal
37. Speedometer Tone Wheel
38. Input Shaft Pilot Bearing
39. Output Shaft Rear Bearing
40. Identification Tag
41. Drain/Fill Plug

F7565

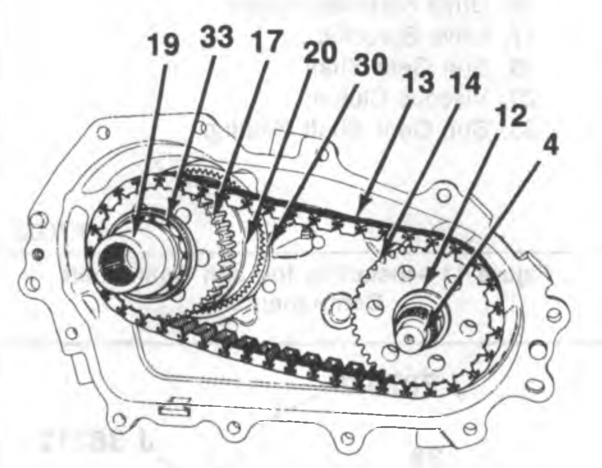
Figure 4—BW4472 Transfer Case



1. Tab Locations

F7564

Figure 5—Tab Locations

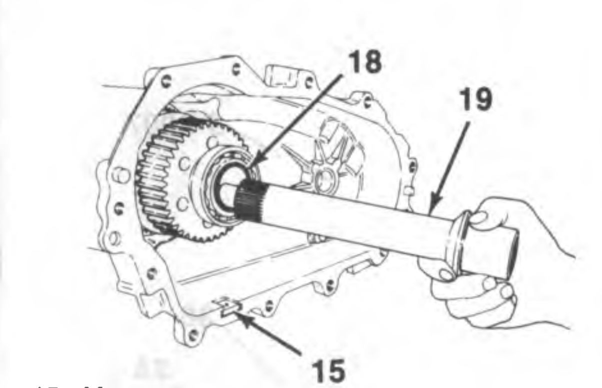


4. Front Output Shaft
12. Front Output Shaft Spacer
13. Drive Chain
14. Driven Sprocket
17. Drive Sprocket
19. Input Shaft
20. Viscous Clutch
30. Gear Ring
33. Sun Gear Shaft Bearing

F7566

Figure 6—Inside The rear Case Half

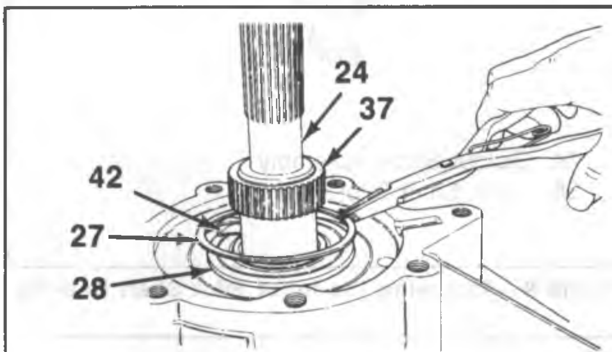
5. Case half for damaged or warped mating surfaces, cracks, porosity, or damaged thread holes.
6. Oil scoop on the output shaft assembly for cracks, wear or damage.
7. Speedometer tone wheel (37) for wear, spalling, cracks, twist and corrosion.
8. Speed sensor and the breather assembly O-ring seals for cuts, tears, cracks or damage.



15. Magnet
18. Sun Gear Shaft
19. Input Shaft

F7567

Figure 7—Removing the Input Shaft



24. Output Shaft Assembly
27. Output Shaft Bearing Snap Ring
28. Output Shaft Bearing
37. Speedometer Tone Wheel
42. Oil Scoop

F7568

Figure 8—Removing the Output Shaft Rear Bearing

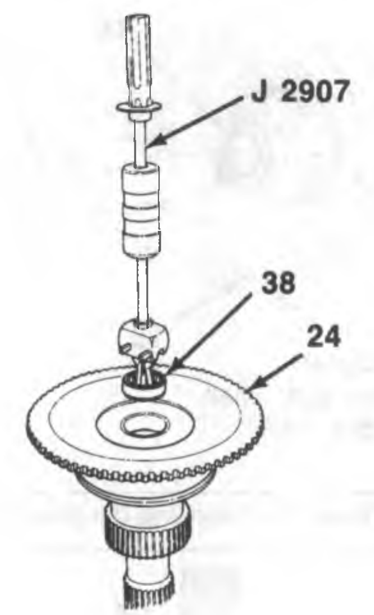
ASSEMBLY OF THE TRANSFER CASE

Tools Required:
J 7079-2 Driver Handle
J 38212 Needle Bearing Installer

During assembly of the transfer case, lube all necessary parts with dexron II automatic transmission fluid, or equivalent.

Assemble

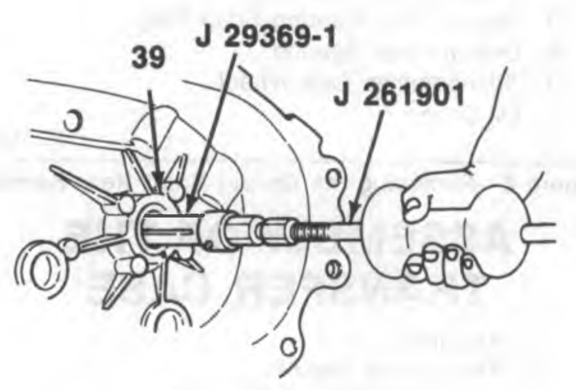
1. Viscous clutch (20), drive sprocket (17), drive sprocket spacer (16), and the sun gear shaft bearing (33) onto the sun gear shaft (18) (Figure 11).
2. Input shaft pilot bearing (38) into the output shaft assembly (24) using J 7079-2 Driver Handle and J 38212 Needle Bearing Installer (Figure 12).
3. Output shaft assembly (24) to the gear ring (30).



24. Output Shaft Assembly
38. Input Shaft Pilot Bearing

F7601

Figure 9—Removing the Input Pilot Shaft Bearing

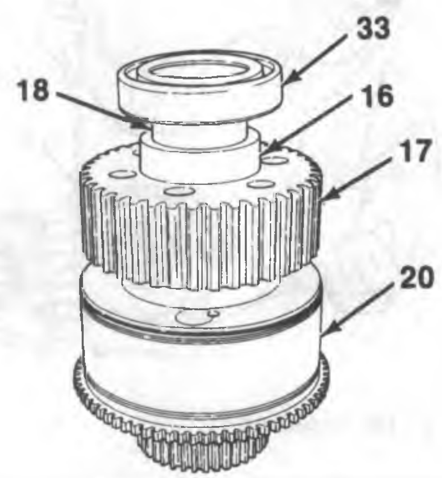


39. Output Shaft Rear Bearing

F7602

Figure 10—Removing the Output Shaft Rear Bearing

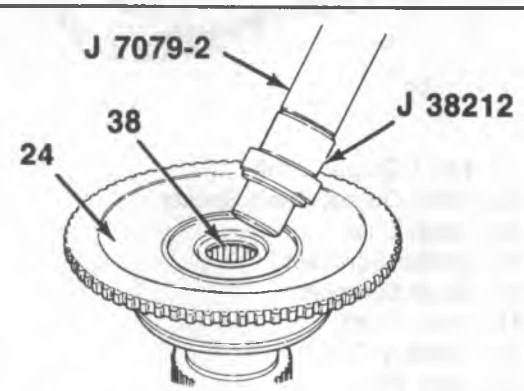
4. Gear ring snap ring (29) to the gear ring (30) (Figure 13).
5. Output shaft bearing (35) to the front cover (11).
6. Output shaft bearing snap ring (34) to the front cover (11) (Figure 14).
7. Output shaft rear bearing (39) to the rear case half (10) using J 7079-2 Driver Handle and J 38212 Needle Bearing Installer (Figure 15).



16. Drive Sprocket Spacer
17. Drive Sprocket
18. Sun Gear Shaft
20. Viscous Clutch
33. Sun Gear Shaft Bearing

F7603

Figure 11—Installing the sun Gear Shaft Components



24. Output Shaft Assembly
38. Input Shaft Pilot Bearing

F7604

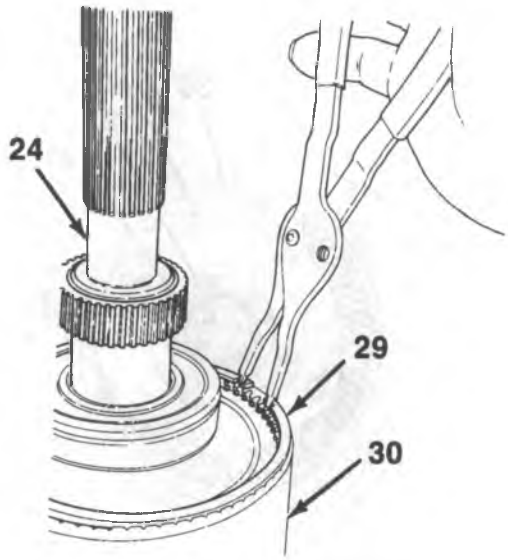
Figure 12—Installing the Input Shaft Pilot Bearing

Install or Connect

Tools Required:

J 37668 Seal Installer
J 38216 Seal Installer
PT-7276 Kent Moore Gasket Eliminator

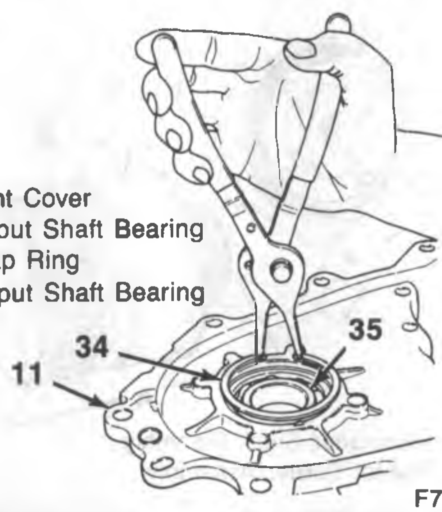
1. Output shaft assembly (24) and gear ring (30) through the rear case half (10).



24. Output Shaft Assembly
29. Gear Ring Snap Ring
30. Gear Ring

F7605

Figure 13—Installing the Gear Ring Snap Ring

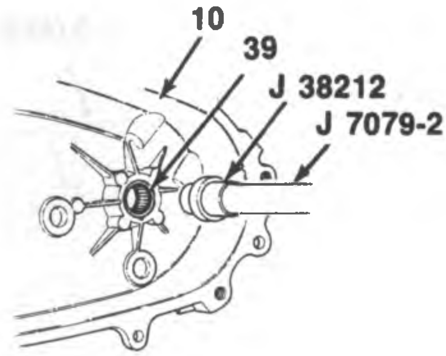


11. Front Cover
34. Output Shaft Bearing Snap Ring
35. Output Shaft Bearing

F7606

Figure 14—Installing the Output Shaft Bearing Snap Ring

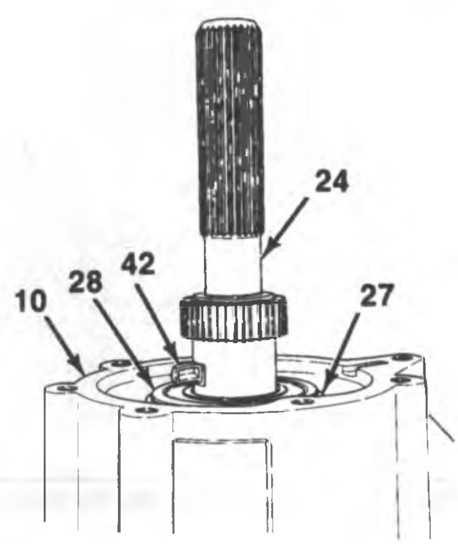
2. Output shaft bearing snap ring (27) to the Output shaft bearing (28) (Figure 16).
3. Apply an 1/8 inch bead of Gasket Eliminator PT-7276 (Loctite 51580) or equivalent to the rear case half (10) extension housing sealing surface.
   - If Gasket Eliminator 51580 is used you must allow one half hour cure time before adding fluid.
4. Extension housing (8) and the extension housing bolts (25) to the rear case half (10).



10. Rear Case Half
39. Output Shaft Rear Bearing

F7607

Figure 15—Installing the Output Shaft Rear Bearing



10. Rear Case Half
24. Output Shaft Assembly
27. Output Shaft Bearing Snap Ring
28. Output Shaft Bearing
42. Oil Scoop

F7608

Figure 16—Installing the Output Shaft Bearing Snap Ring

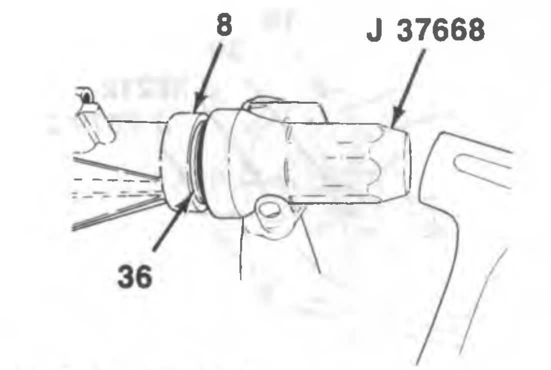
Tighten

- Extension housing bolts (25) to 47 N·m (35 ft.lbs.).

5. Speed sensor (7) and speed sensor bolt (6) into the extension housing (8).

Tighten

- Speed sensor bolt (6) to 1 N·m (10 Inch lbs.)

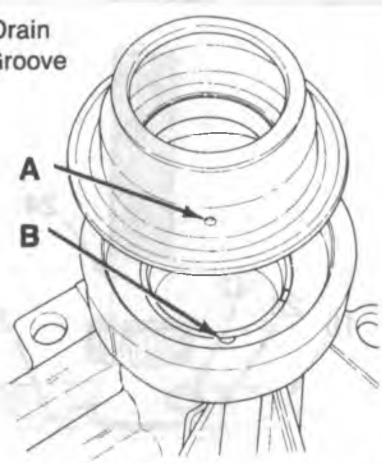


8. Extension Housing
36. Output Shaft Oil Seal

F7609

Figure 17—Installing the Output Shaft Oil Seal

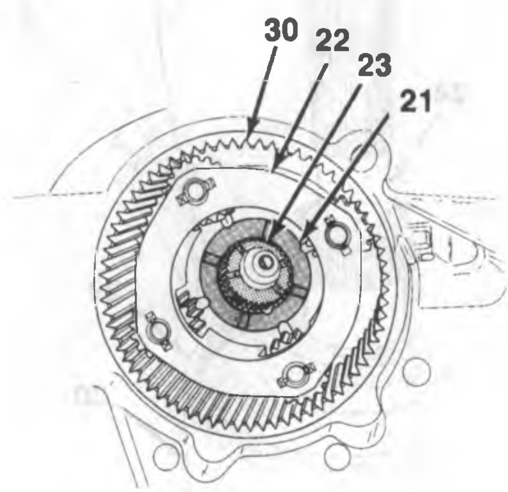
A. Water Drain
B. Drain Groove



F7610

Figure 18—Alignment of the Oil Seal

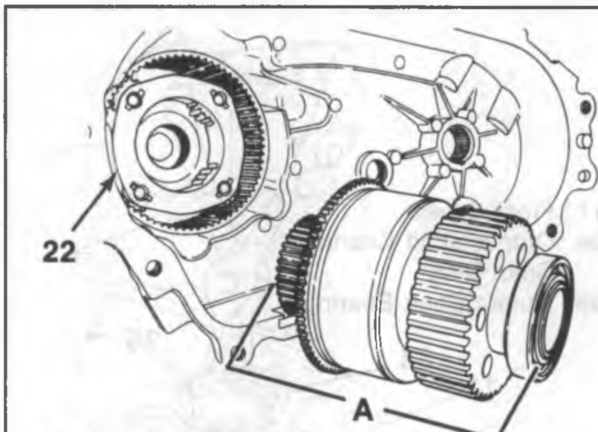
6. Output shaft oil seal (36) to the extension housing (8) using J 37668 Seal Installer. Align the water drain hole in the output shaft oil seal (36) with the drain groove in the extension housing (figures 17 and 18).
7. Planet carrier assembly thrust washer (23) to the output shaft assembly (24) using a petroleum jelly and align with the input shaft pilot bearing (38)
8. Planet carrier assembly (22) into the gear ring (30).
9. Sun gear shaft thrust washer (21) to the planet carrier assembly (22) using a petroleum jelly (Figure 19).
10. Sun gear shaft assembly into the planet carrier assembly planet gears (22) and align the viscous clutch teeth (20) to the gear ring spline (30) (figure 20).
11. Input shaft (19) into the input shaft pilot bearing (38) aligning the input shaft with the sun gear shaft thrust washer (21) and the planet carrier assembly thrust washer (23).
12. Driven sprocket (14) onto the front output shaft (4).
13. Drive chain (13) onto the driven sprocket (14).



21. Sun Gear Shaft Thust Washer
22. Planet Carrier Assembly
23. Planet Carrier Assembly Thrust Washer
30. Gear Ring

F7611

Figure 19—Installing the Planet Carrier Assembly

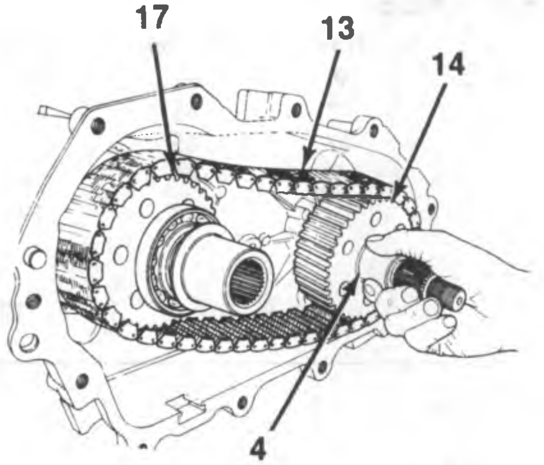


A. Sun Gear Shaft Assembly
22. Planet Carrier Assembly

F7612

Figure 20—Installing the Sun Gear Shaft Assembly

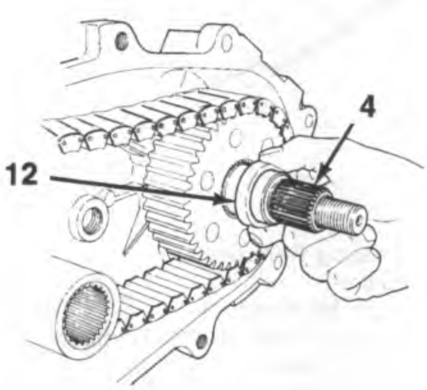
14. Drive chain (13) over the drive sprocket (17) and the front output shaft (4) into the output shaft rear bearing (39) (figure 21).
15. Front output shaft spacer (12) onto the front output shaft (4) (Figure 22).
16. Magnet (15) to the rear case half (10).
17. Apply an 1/8 inch bead of Gasket Eliminator PT-7276 (Loctite 51580) or equivalent to the rear case half (10) front cover sealing surface.
   - If Gasket Eliminator 51580 is used you must allow one half hour cure time before adding fluid.



4. Output Shaft
13. Drive Chain
14. Driven Spocket
17. Drive Sprocket

F7613

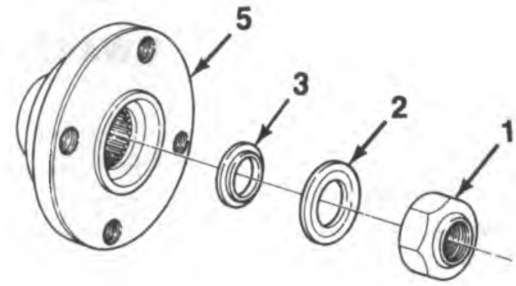
Figure 21—Installing the Drive Chain Assembly



4. Output Shaft
12. Front Output Shaft Spacer

F7636

Figure 22—Installing the Front Output Shaft Spacer



1. Front Output Flange Nut
2. Steel Flat Washer
3. Rubber Sealing Washer
5. Front Output Flange

F7637

Figure 23—Installing the Output Flange Assembly

18. Front cover (11) and front cover bolts (9) to the rear case half (10).

Tighten

- Front cover bolts (9) to 47 N·m (35 ft.lbs.).

19. Front output shaft oil seal (31) to the front cover (11) using J 37668 Seal Installer.
20. Input shaft oil seal (32) using J 38216 Seal Installer.
21. Front output flange (5) to the front output shaft (4) (Figure 23).
22. Rubber sealing washer (3), steel flat washer (2) and a new front output flange nut (1).

Tighten

- Front output flange nut (1) to 108 N·m (80 ft.lbs.).

SPECIFICATIONS

BW4472 TRANSFER CASE

	N·m	Ft. Lbs.	In. Lbs.
Drain/Fill Plugs	9	—	80
Front Cover Bolts	47	35	—
Extension Housing Bolts	47	35	—
Front Output Flange Nut	108	80	—
Speed Sensor Bolts	1	—	10

Lubricant: Dexron II 1.4 Liters 52 Ounces (1.5 Quarts)

T2380

SPECIAL TOOLS

1.  J 22912-01

2.  J 23907

3.  J 2619-01

4.  J 29369-1

5.  J 7079-2

6.  J 38212

7.  J 37668

8.  J 38216

9.  PT 7276

1. Bearing Remover
2. Puller
3. Slide Hammer
4. Output Shaft Bearing Remover
5. Driver Handle
6. Needle Bearing Installer
7. Seal Installer
8. Seal Installer
9. 515 Gasket Eliminator

F7638

GM

Automotive Service Educational Program

TT

Transportation Technician

ASE CERTIFIED®

We employ technicians certified by the National Institute for

AUTOMOTIVE SERVICE EXCELLENCE

Let us show you their credentials

GMC TRUCK

MEDIUM TRUCK

PROFESSIONAL TRUCK ADVISORS GUILD