1991

CHEVROLET

TRUCKS

LIGHT DUTY TRUCK UNIT REPAIR MANUAL

ST 333-91

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.

CHEVROLET MOTOR DIVISION
. General Motors Corporation
Warren, 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.

1991 LIGHT TRUCK UNIT REPAIR MANUAL

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.

ST 333-91

Printed in U.S.A.

June, 1990

TABLE OF CONTENTS

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.

SECTION 0A

GENERAL INFORMATION

CONTENTS

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 instrument panel compartment (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

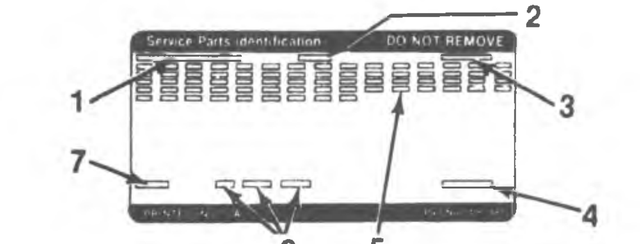
The VIN is the legal identifier of the vehicle. On all models except the Forward Control, it is located on a plate which is attached to the left top of the instrument panel and can be seen through the windshield from the outside of the vehicle (figure 2). On Forward Control models, the plate is mounted to the top of the radiator support. 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, the front and rear GAWRs, and the payload rating for the 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.

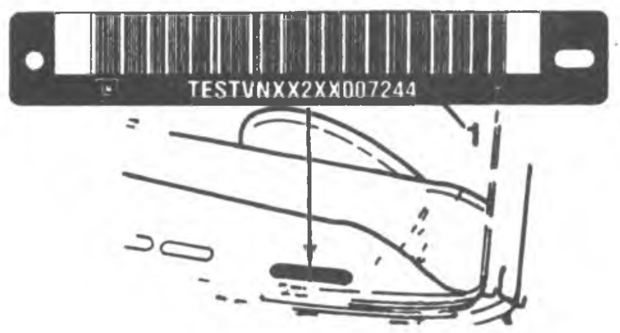
The payload rating shown on the label is the maximum allowable cargo load (including the weight of the driver and all occupants) that the vehicle can carry



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

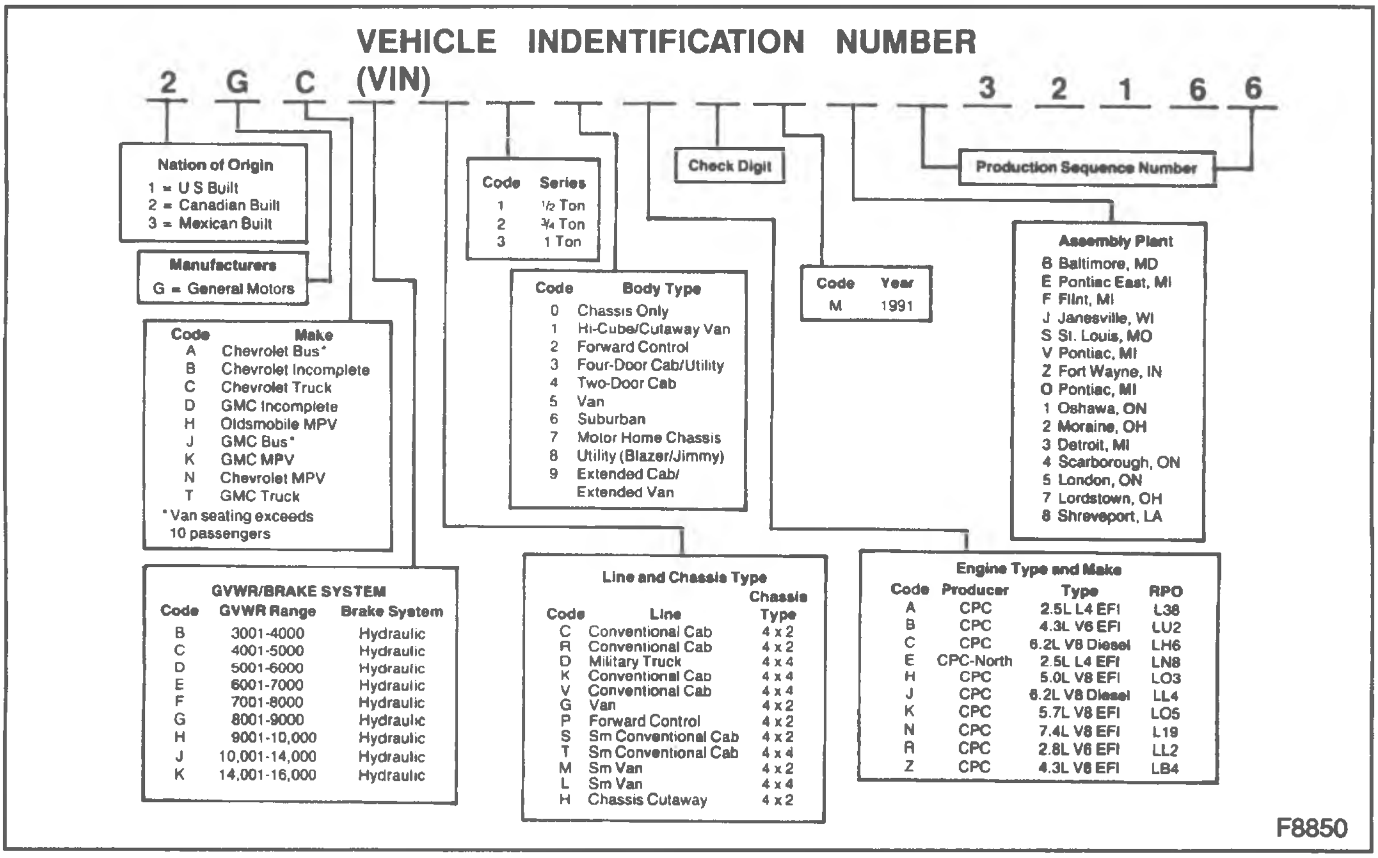


Figure 3—Vehicle Identification Number

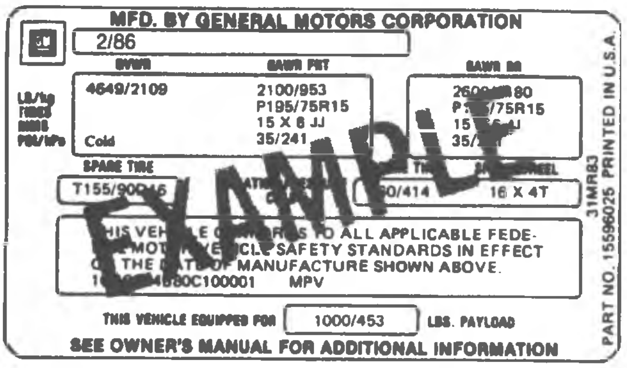


Figure 4—Certification Label

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.

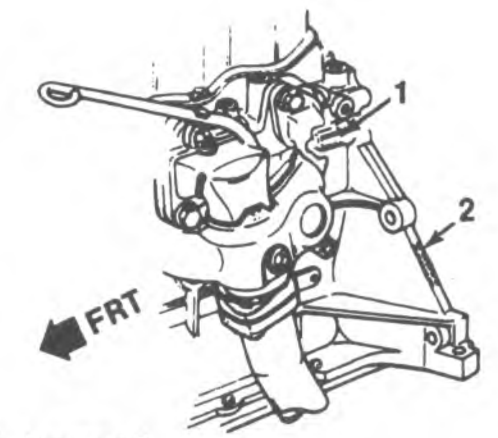
The vehicle may also have a GCWR (Gross Combination Weight Rating). The GCW (Gross Combination Weight) is the total weight of the loaded tow vehicle (including passengers) and a loaded trailer.

The tires on the vehicle must be the proper size and properly inflated for the load being carried. The vehicle certification label shows the originally equipped tire size and recommended inflation pressures.

On C/K and R/V trucks, M vans and G vans, the certification label is located on the trailing edge of the driver's door. On S/T trucks, it is located on the door lock pillar on the driver's side. The label for Forward Control models is shipped separately and installed by the body manufacturer.

ENGINE IDENTIFICATION NUMBER

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



1. Engine I.D.
2. Engine I.D. (Optional Location)

F0689

Figure 5—2.5L Engine I.D. Locations

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 the 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

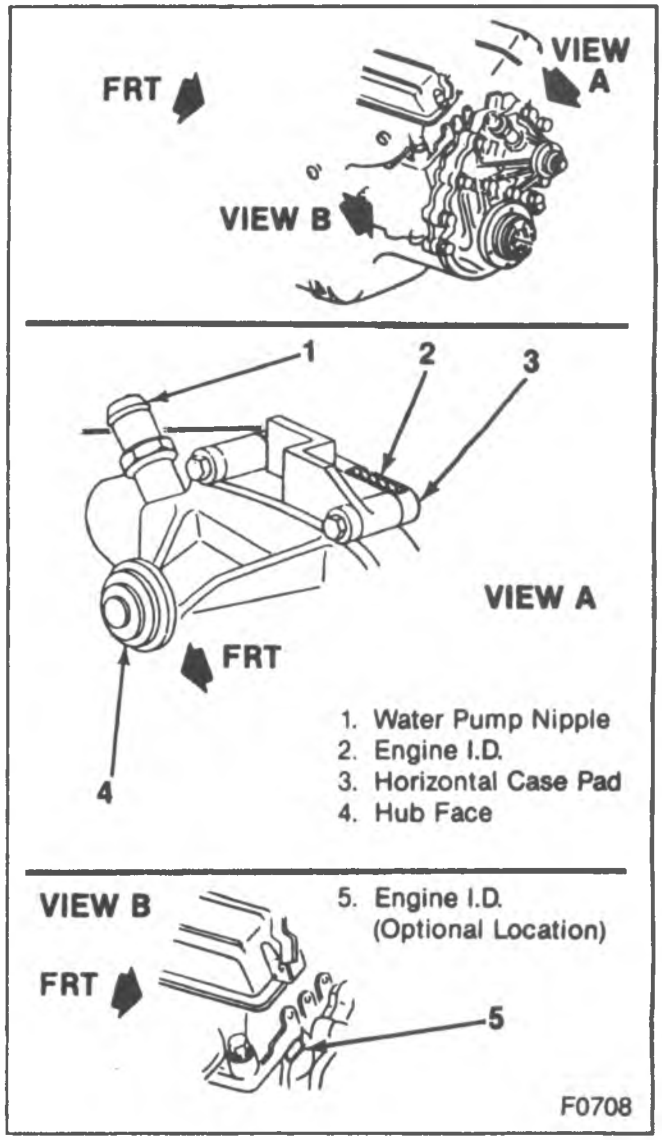


Figure 6—2.8L Engine I.D. Location

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

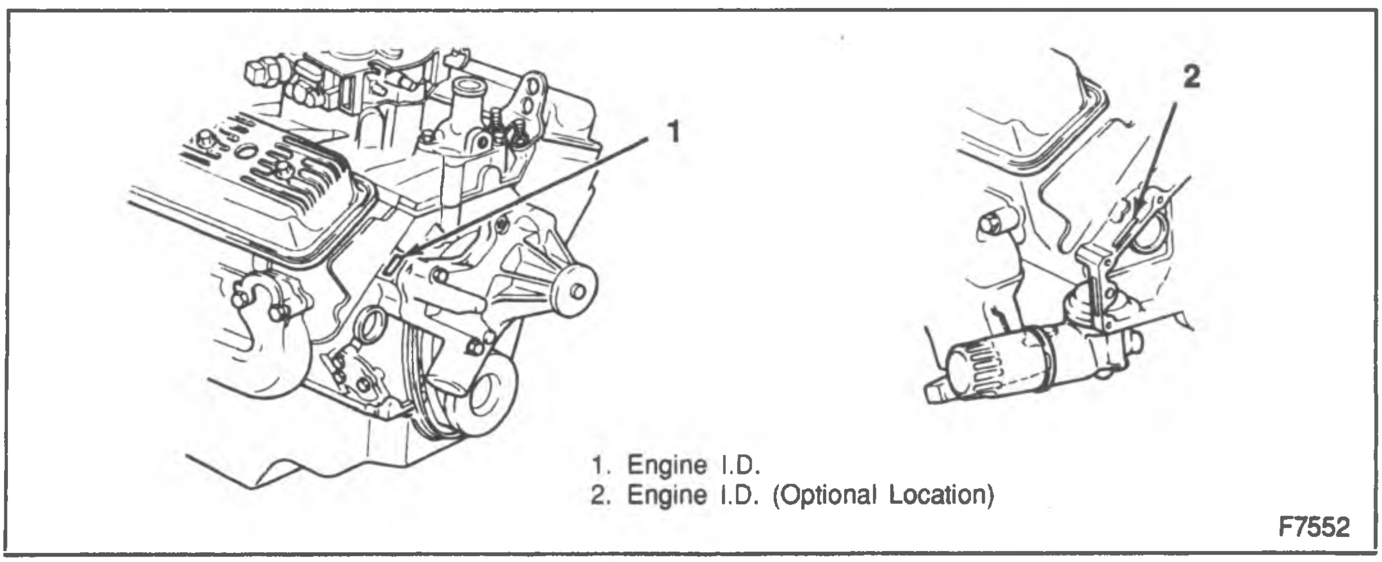


Figure 7—4.3L Engine I.D. Location

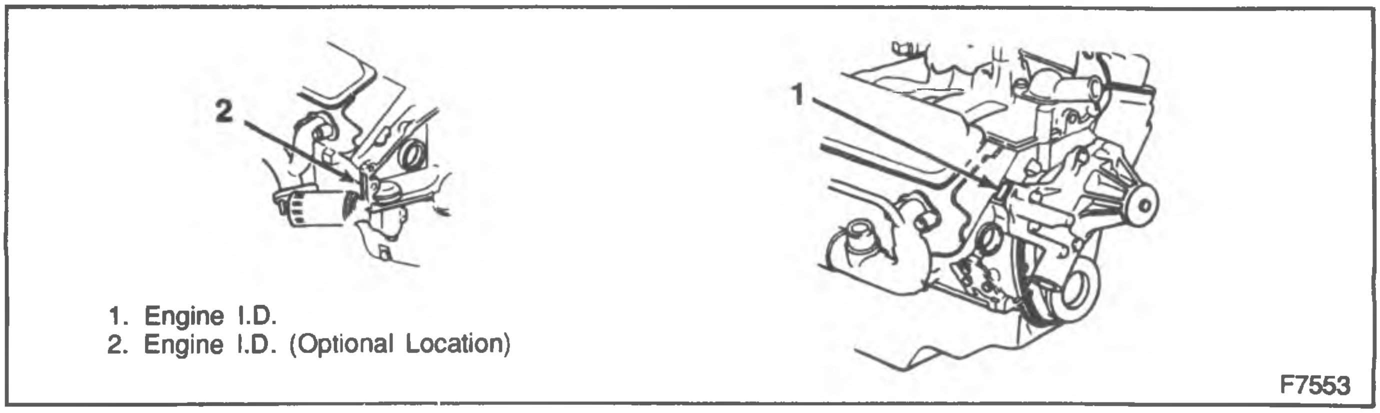


Figure 8—5.0L, 5.7L, 7.4L Engine I.D. Location

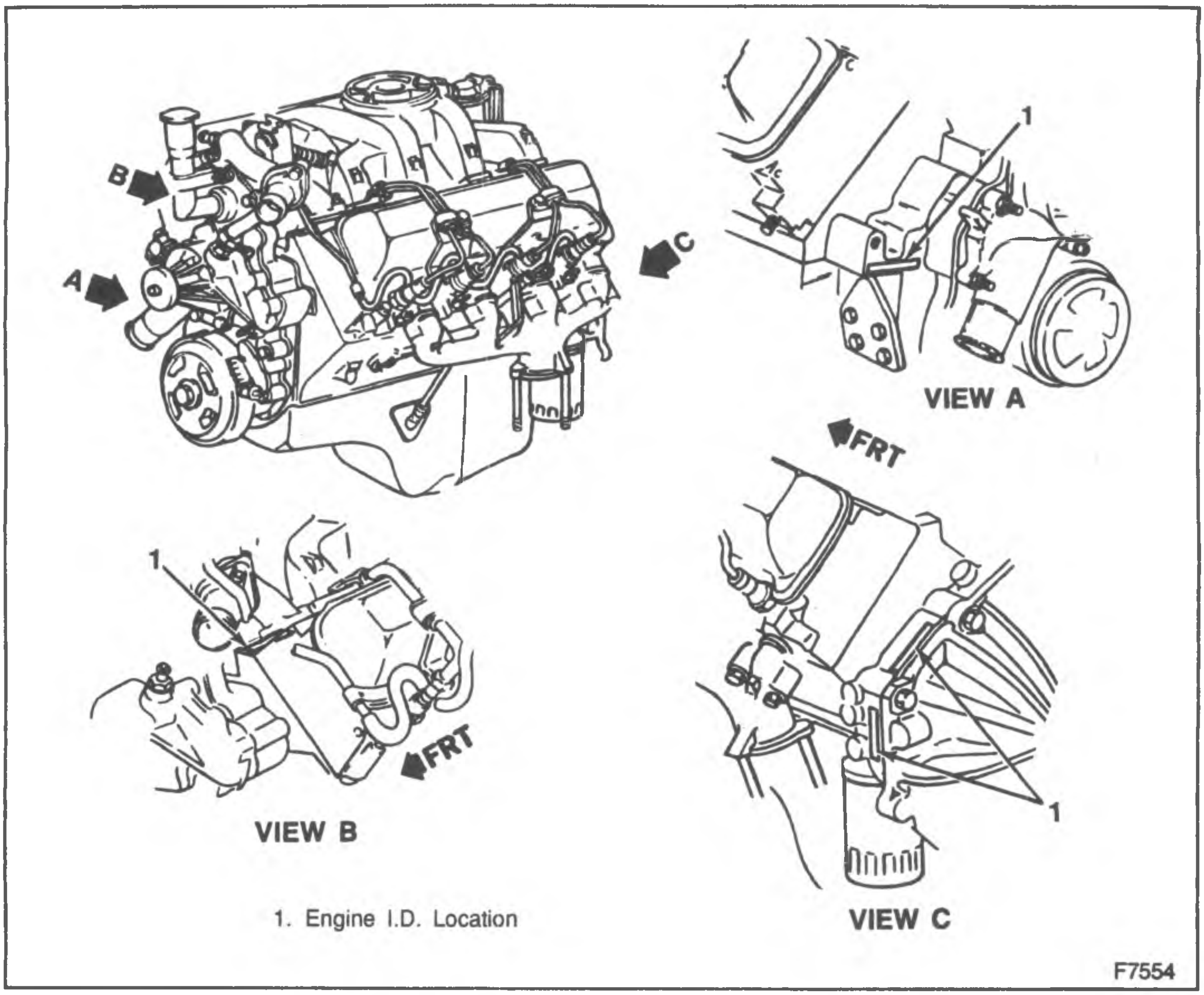


Figure 9—6.2L Diesel Engine I.D. Location

per inch. The thread pitch is in between the customary coarse and fine thread pitches.

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

FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property 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. Mark-

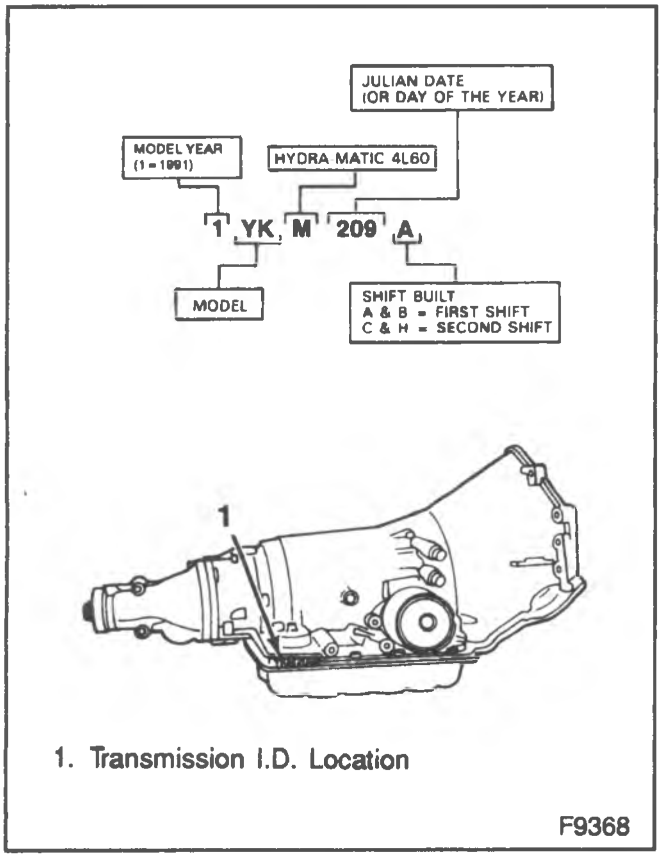


Figure 10—Hydra-matic 4L60 Transmission I.D.Location

ings 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.

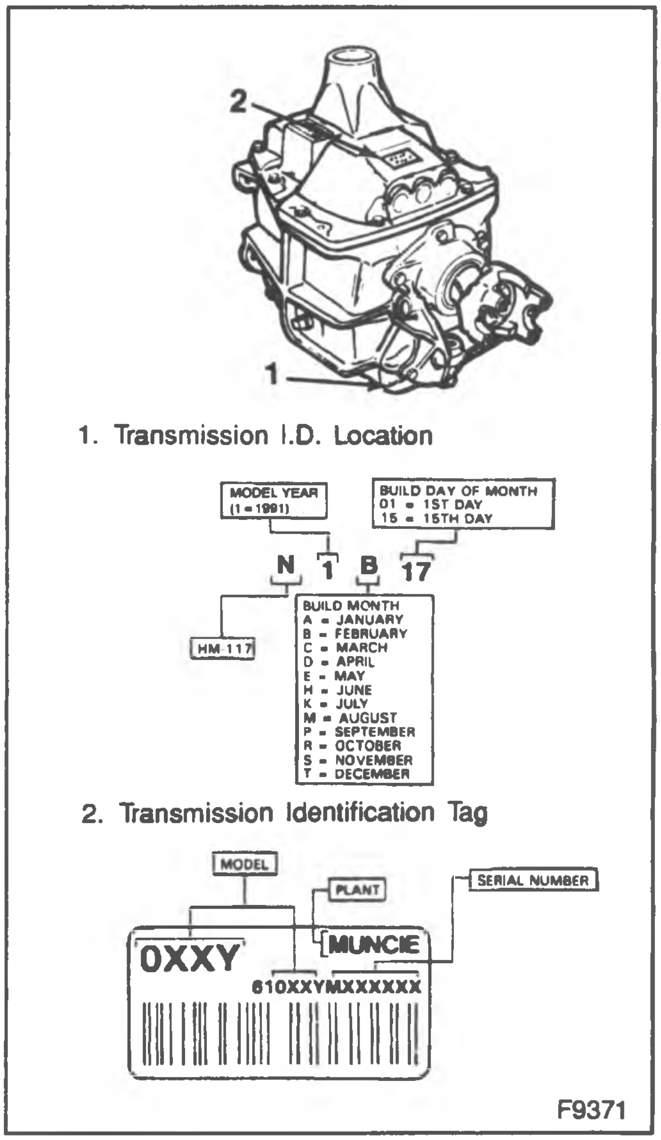


Figure 11—Hydra-matic HM-117 Transmission I.D.Location

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 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.

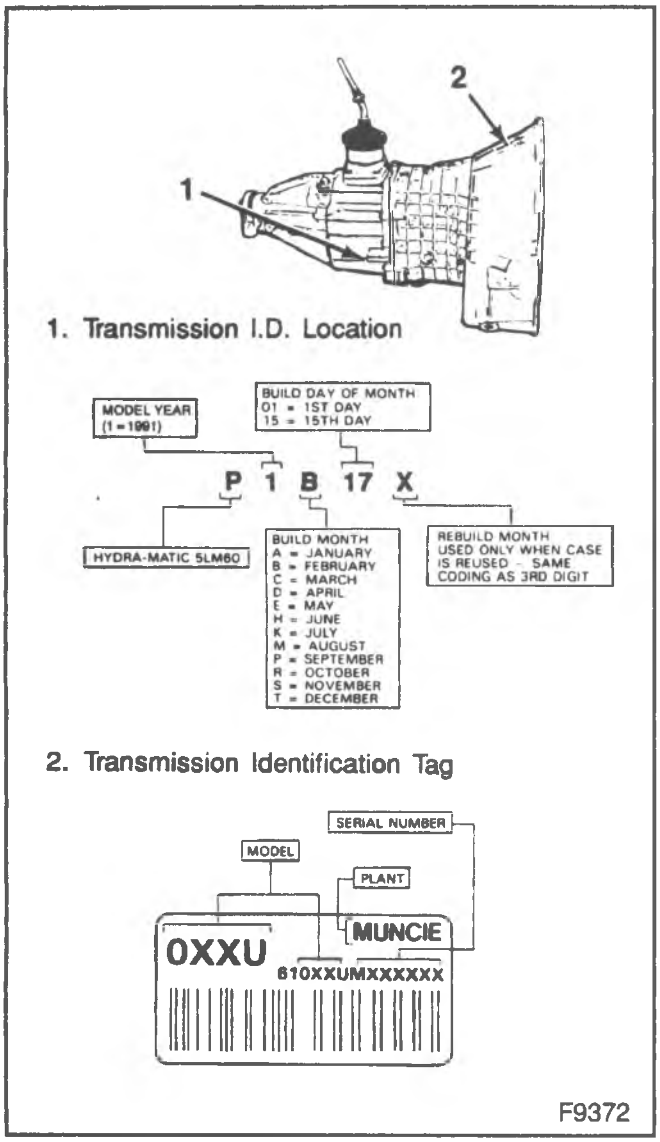


Figure 12—Hydra-matic 5LM60 Transmission I.D.Location

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 of equal or greater strength.)
c. Assemble the parts and hand start the nut or bolt.
d. Observe that, before the 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.

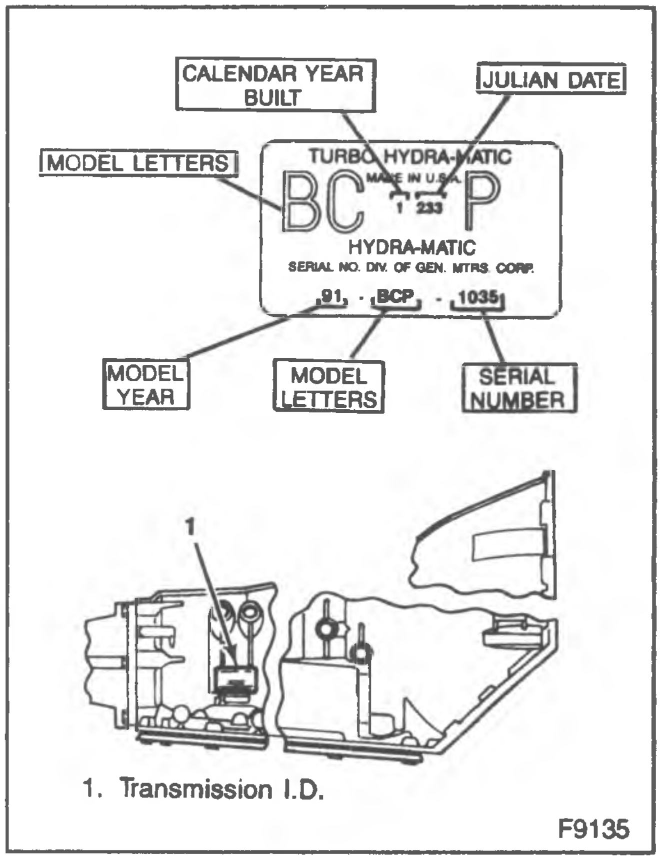


Figure 13—Hydra-Matic 4L80E Transmission I.D.Location

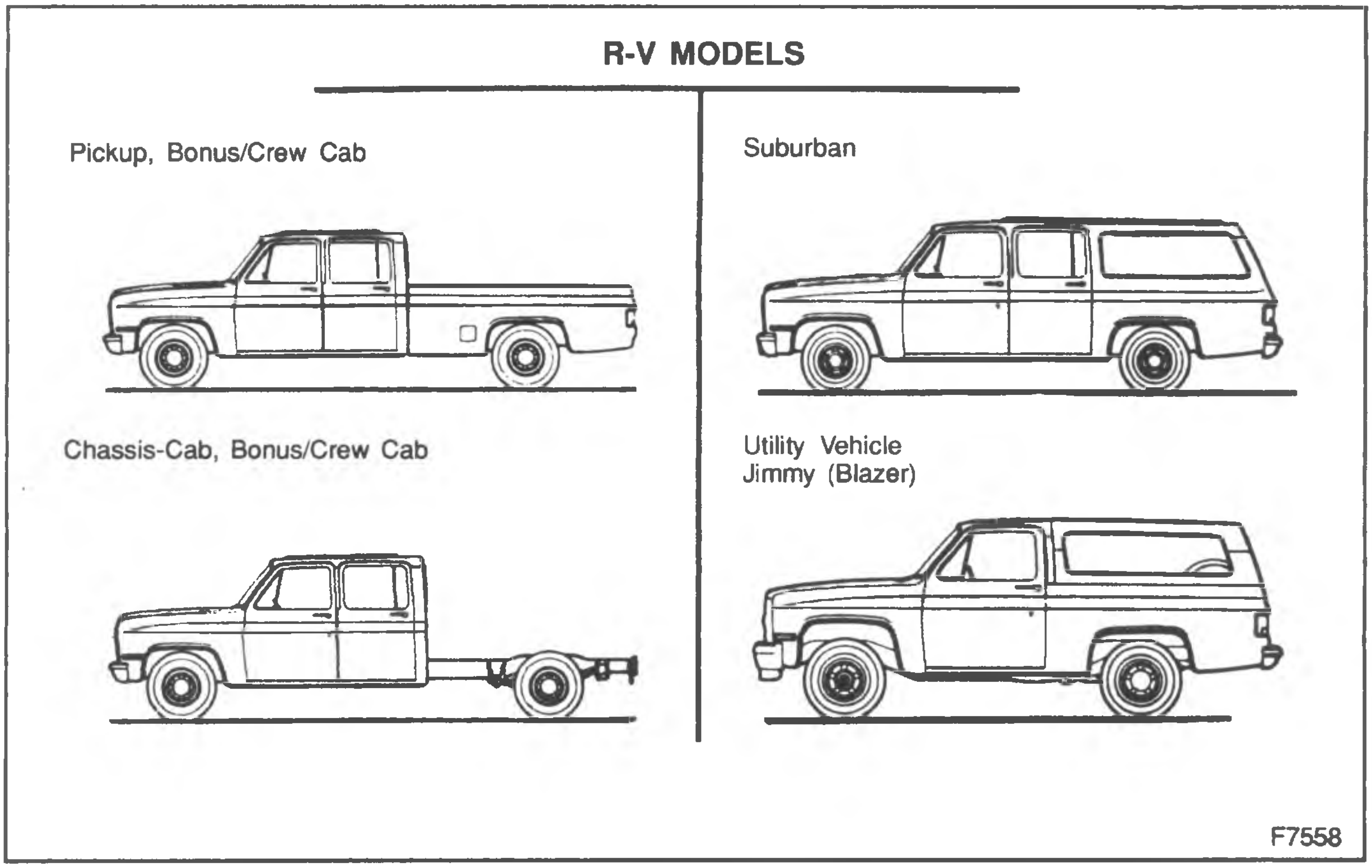


Figure 14—R/V Models

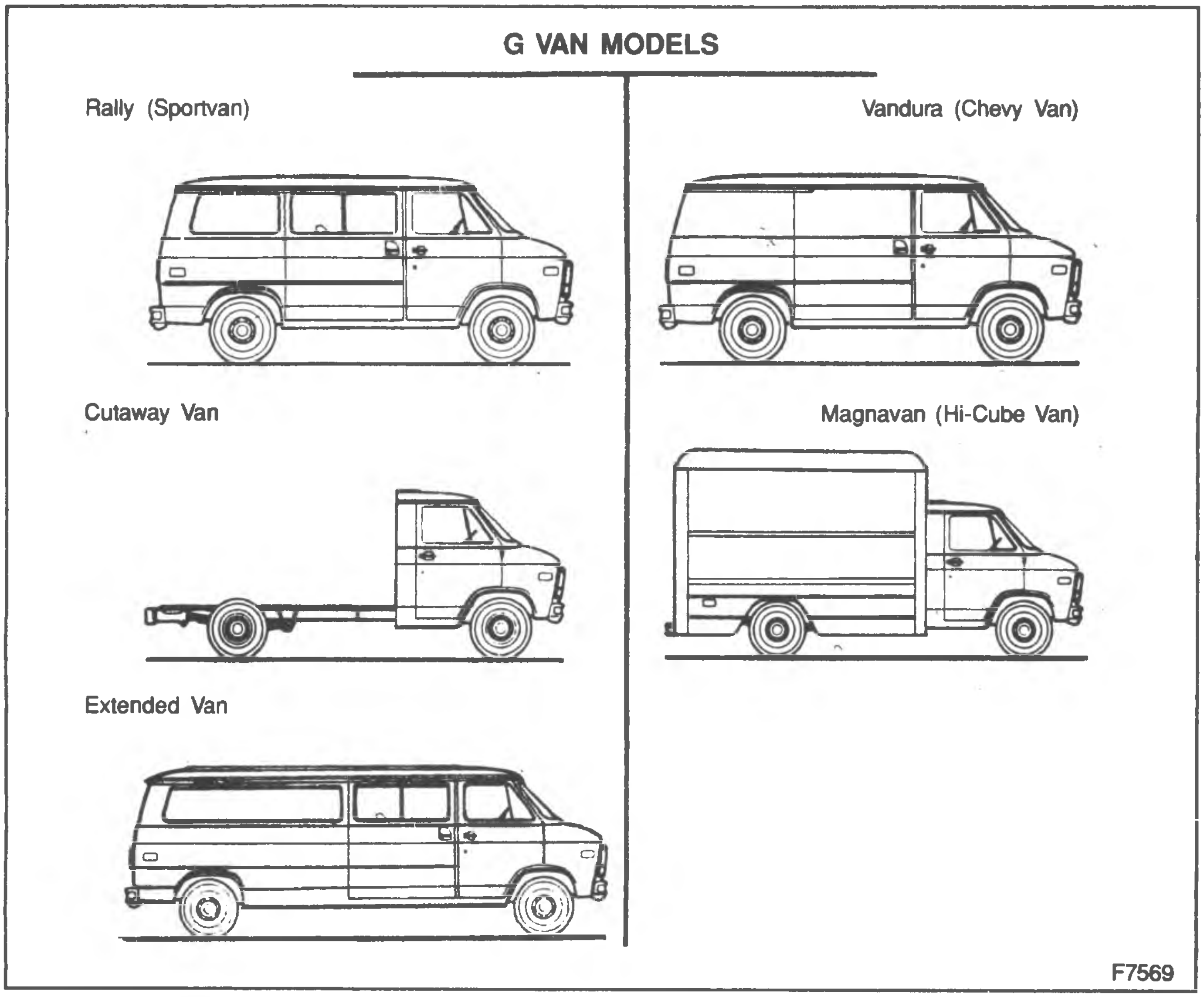


Figure 15—G Models

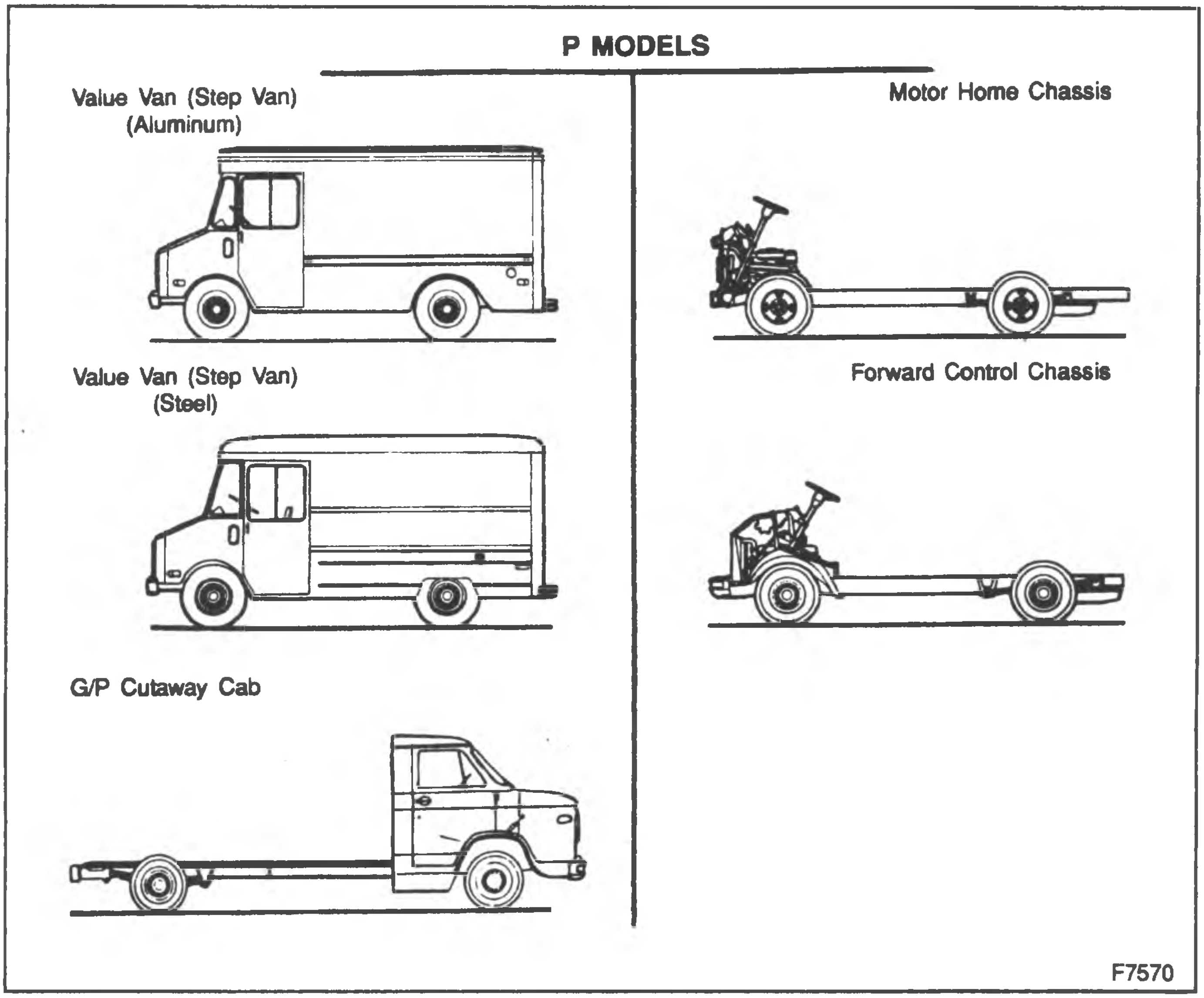


Figure 16—P Models

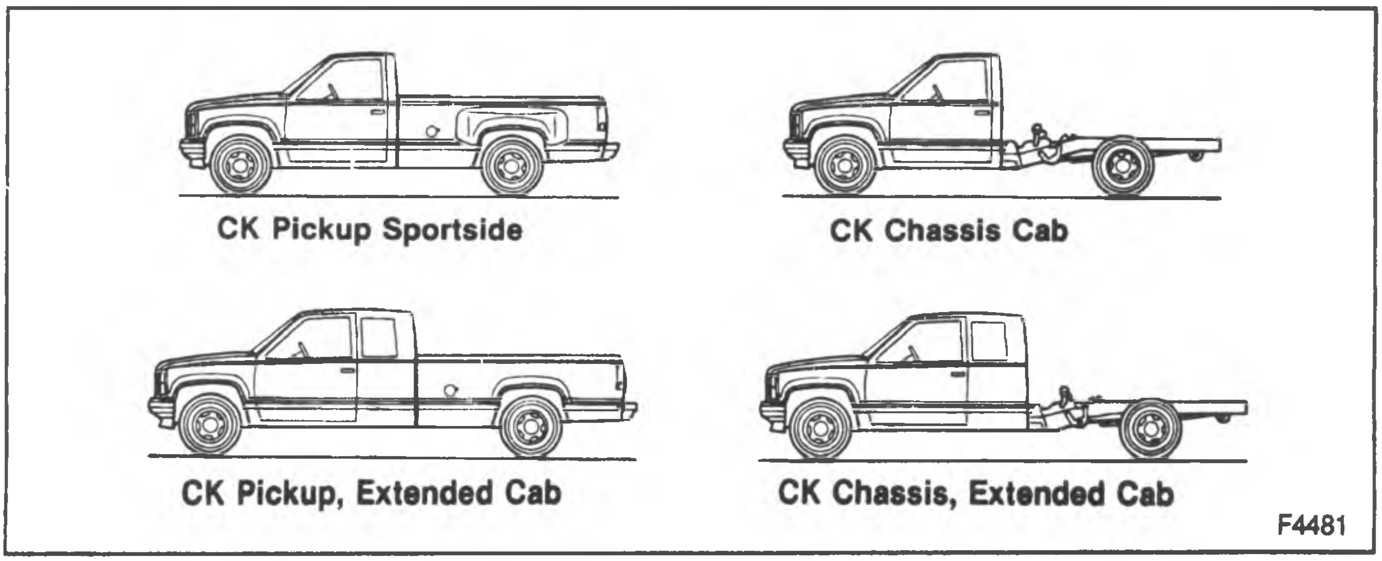


Figure 17—C/K Models

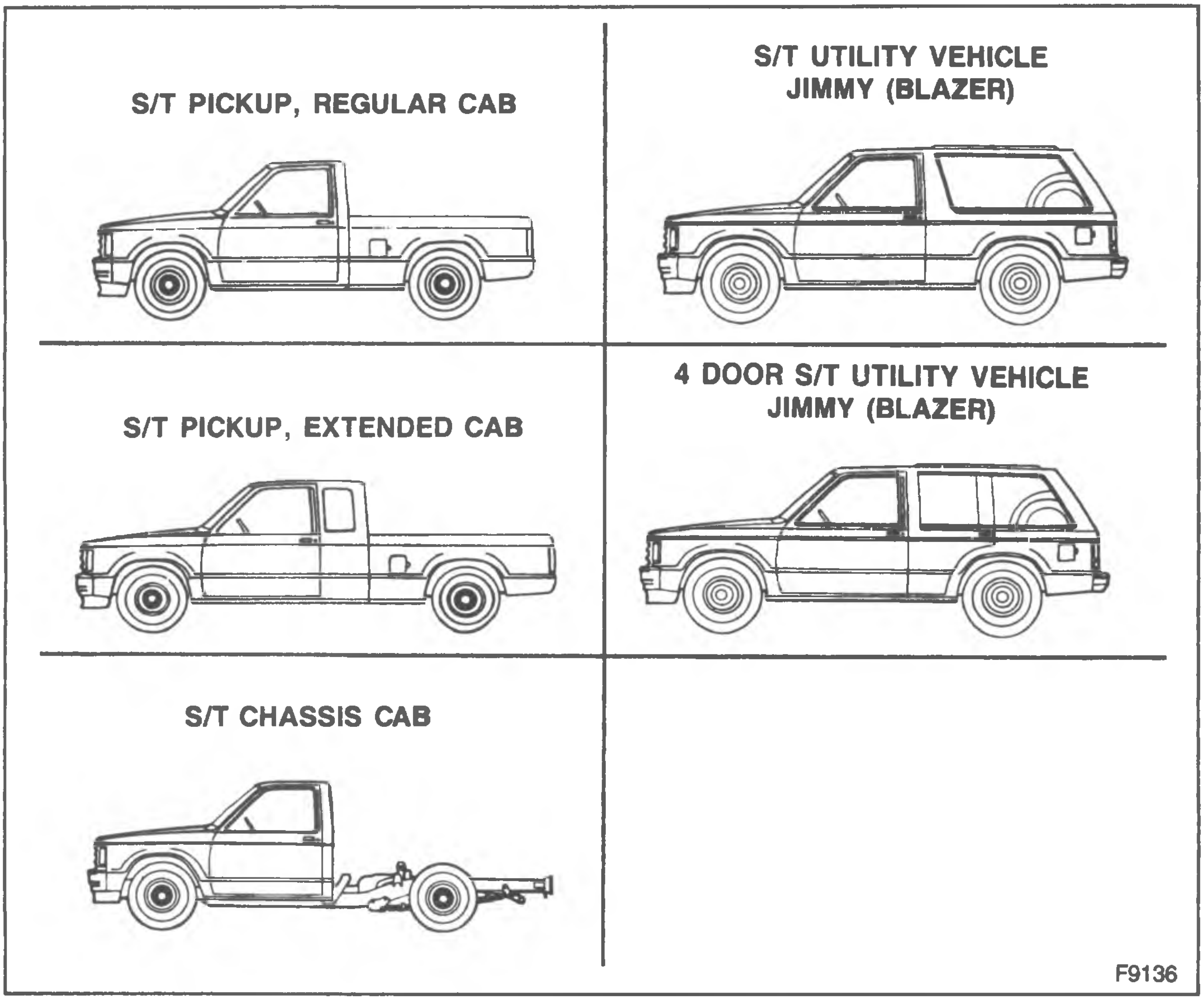


Figure 18—ST Models

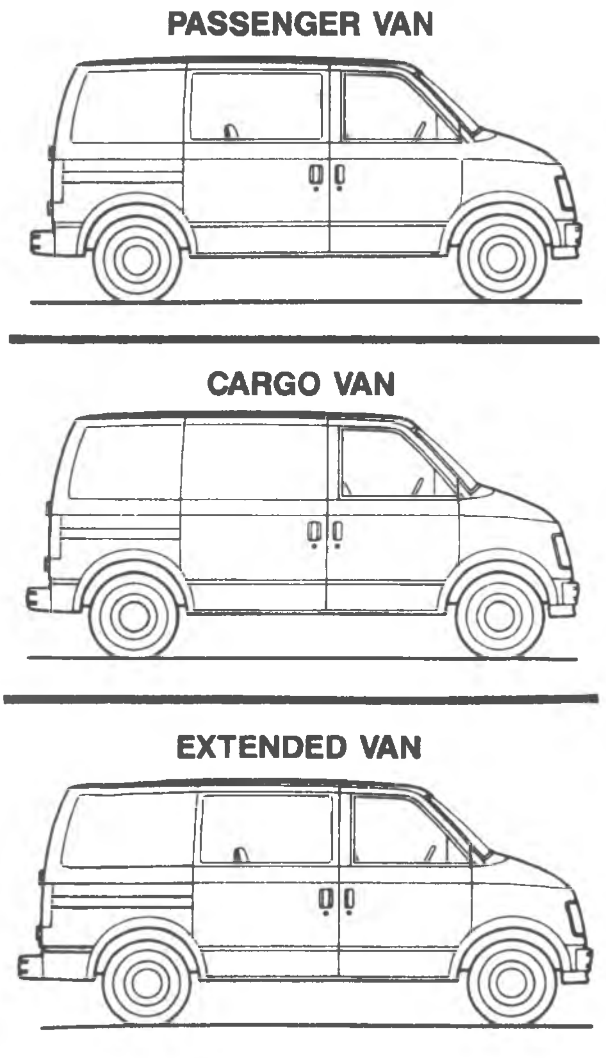
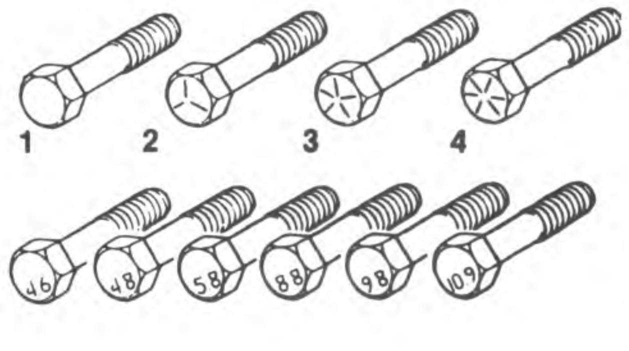
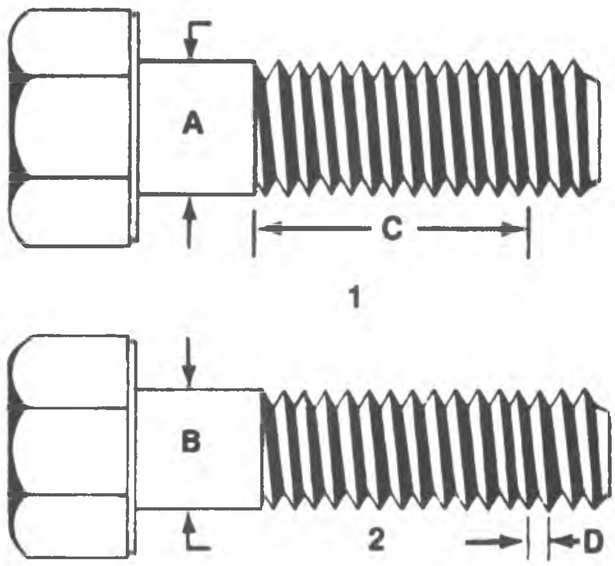


Figure 19—M Models



1. Grade 2 (GM 200-M)
2. Grade 5 (GM 280-M)
3. Grade 7 (GM 290-M)
4. Grade 8 (GM 300-M)
5. Manufacturer's Identification
6. Nut Strength Identification
7. Identification Marks (Posidriv Screw Head)

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

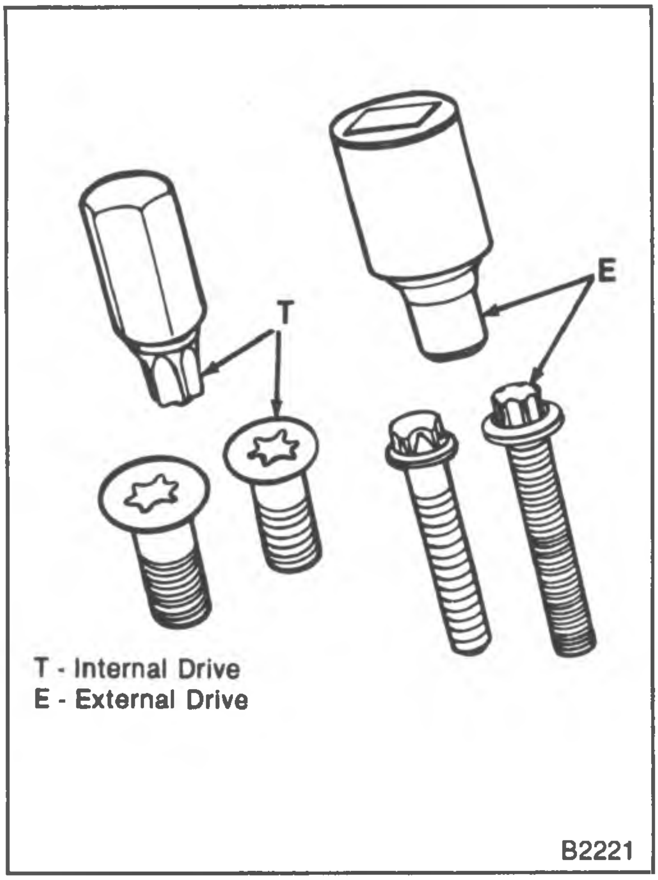
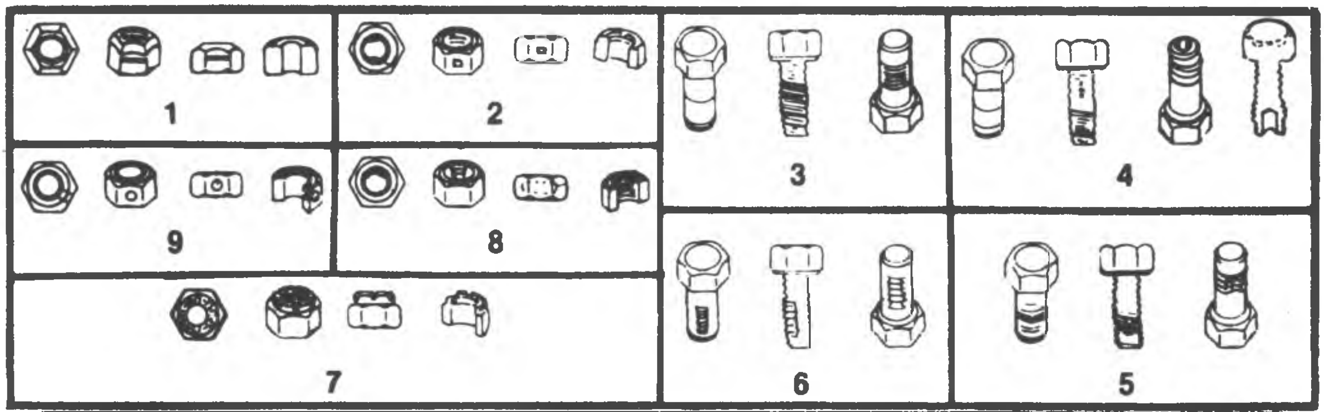


Figure 22—Six Lobed Socket Head Fasteners



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

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 DESCRIPTION

When servicing the 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 trichlorethane, naptha or Stoddard solvent, kerosene or equivalent.

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.

MINOR REPAIR 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-A Compressor Shaft Nut Socket
- J 9401-B Hub Drive Plate Remover
- J 25030-A 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-A.
   - Hold the clutch plate and hub assembly (2) with J 25030-A (figure 2).
2. Clutch plate and hub assembly (2).
   - Thread J 9401-B into the clutch plate and hub (2) (figure 3).
   - Hold the body of J 9401-B with a wrench 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-A Compressor Shaft Nut Socket
- J 9401-A Hub and Drive Plate Assembly Installer
- J 25030-A 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.
   - Install J 9401-A on the threaded end of the shaft (figure 5).
   - Back off J 9401-A 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 9401-A body while pressing the hub onto the shaft (39). After tightening the body several turns, remove J 9401-A 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 9401-A.

Inspect

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

3. Shaft nut (1).
   - Use J 25030-A to hold the clutch plate and hub assembly (2).

Tighten

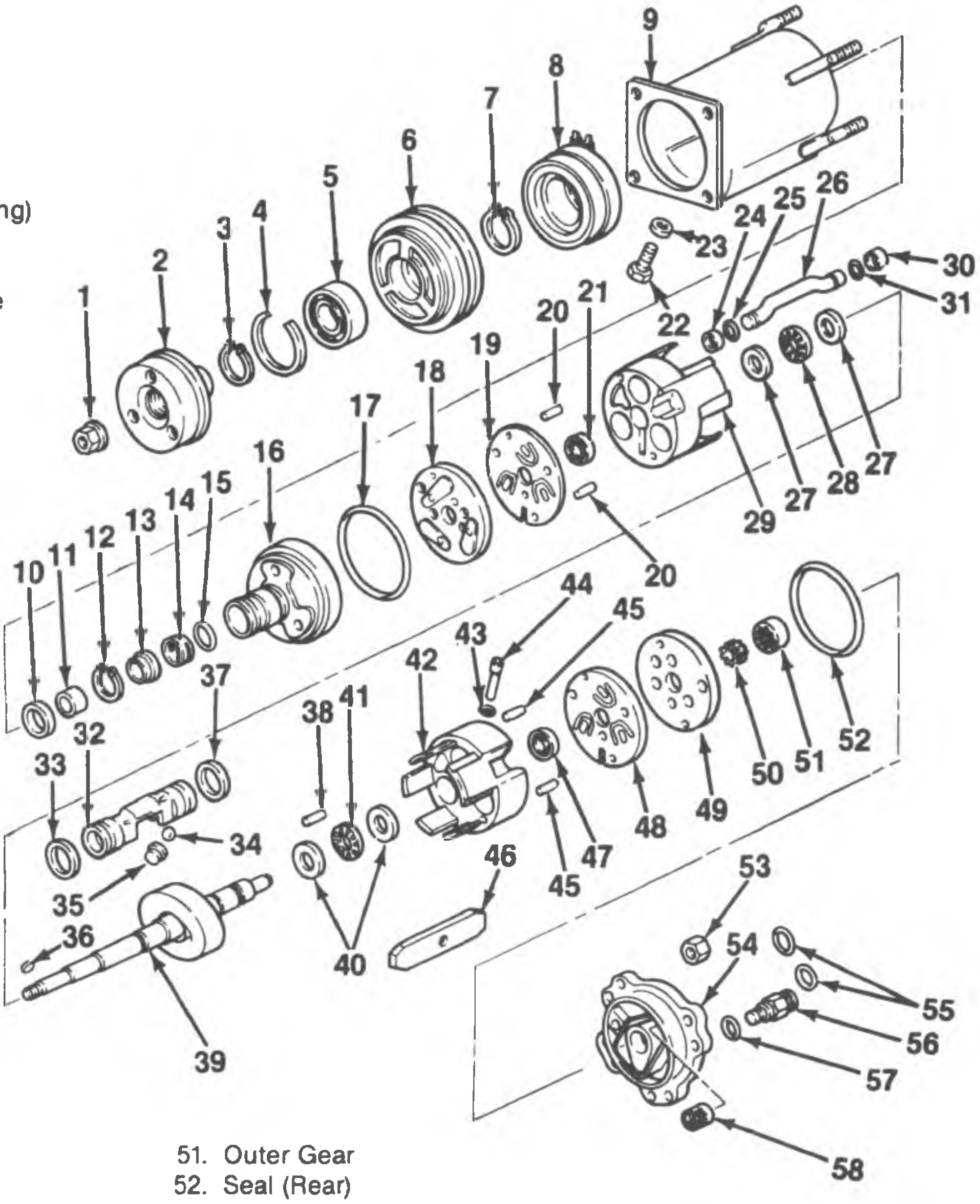
- Shaft nut (1) to 27 N.m (20 ft.lbs.) with J 9399-A.
- Hand spin the pulley (6) to check for free rotation.

CLUTCH ROTOR AND BEARING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 1, 6 through 9)

Tools Required:
- J 6435 External 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. 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

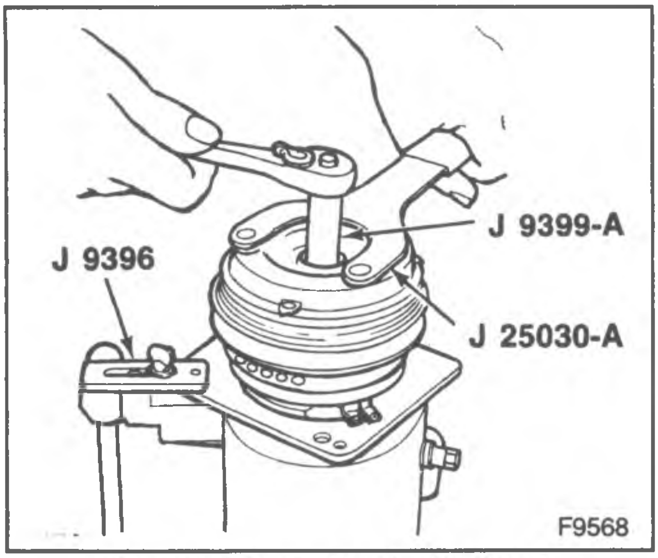


Figure 2—Removing the Shaft Nut

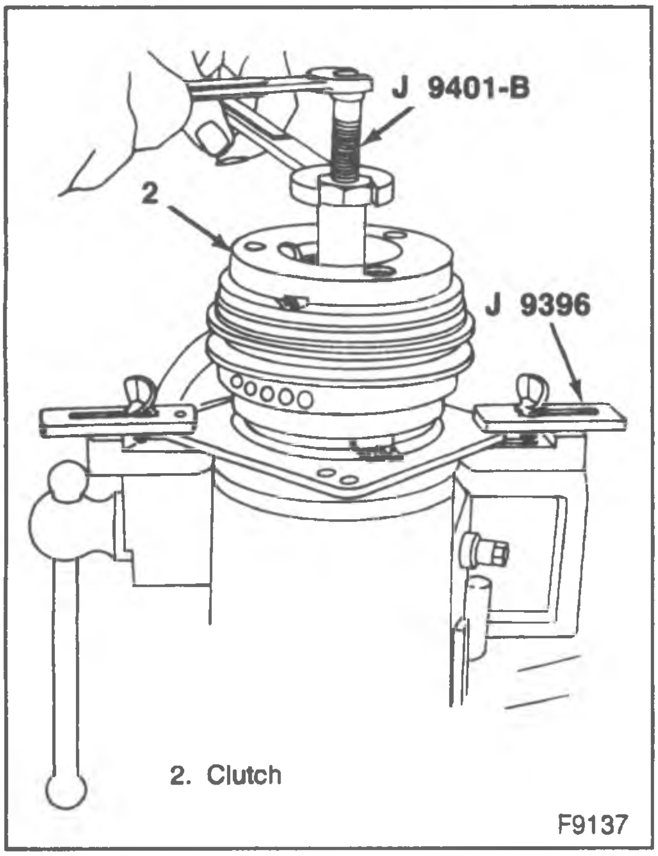


Figure 3—Removing the Clutch Plate and Hub Assembly

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

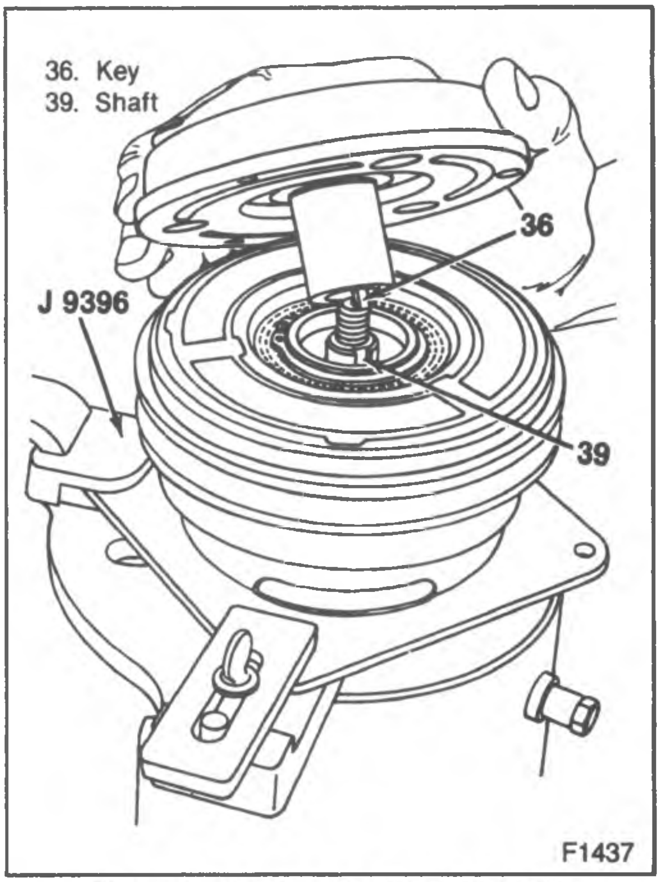


Figure 4—Aligning the Drive Plate Key

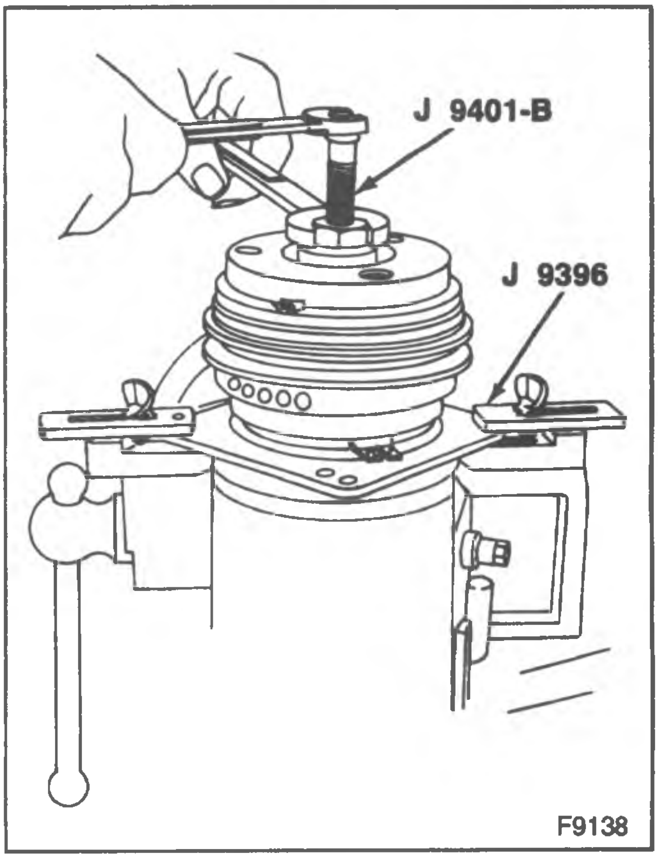


Figure 5—Installing the Drive Plate

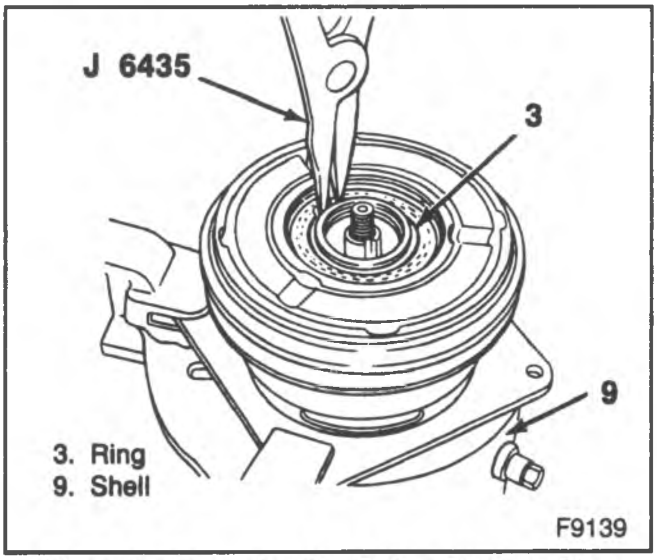


Figure 6—Removing the Pulley Retainer Ring

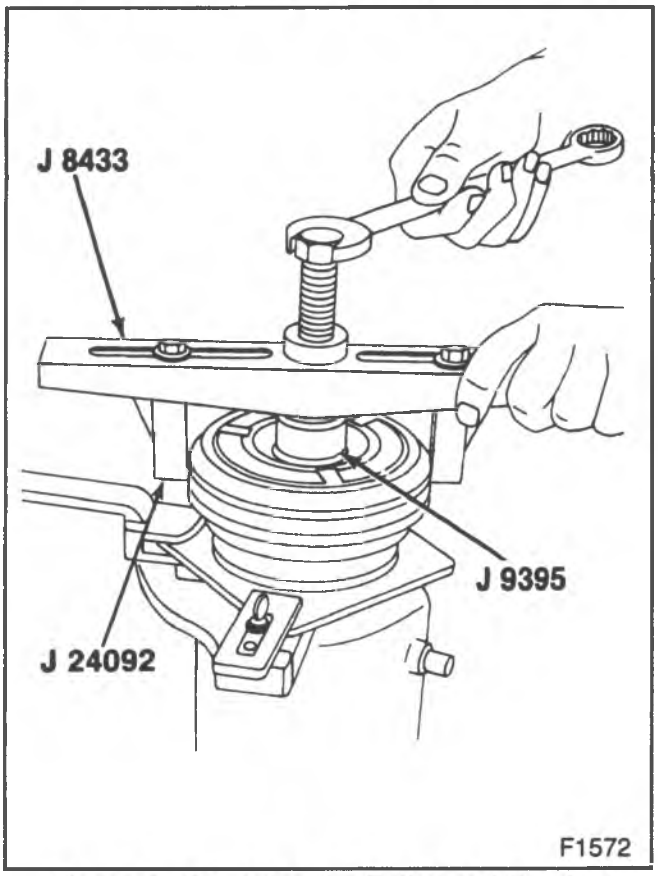


Figure 7—Removing the Pulley and Bearing

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.
- 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-A (figure 9).
   - Drive the bearing (5) from the pulley (6) with J 9398-A and J 8092.

Install or Connect (Figures 1 and 10)

Tools Required:
J 6435 External 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).

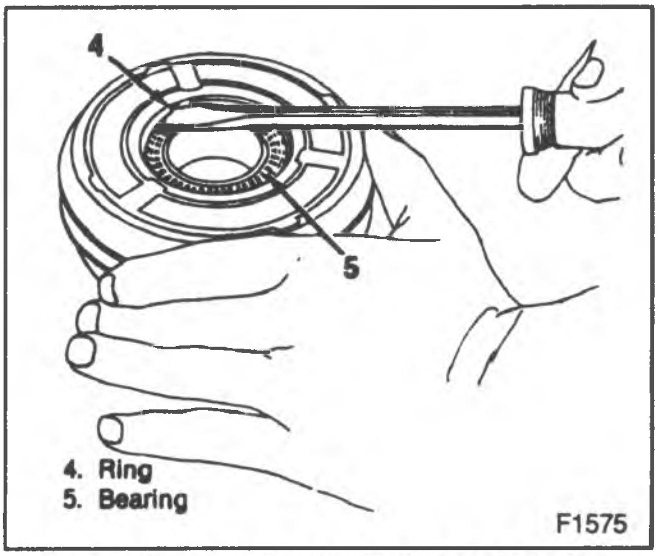


Figure 8—Removing the Pulley and Bearing Retainer Ring

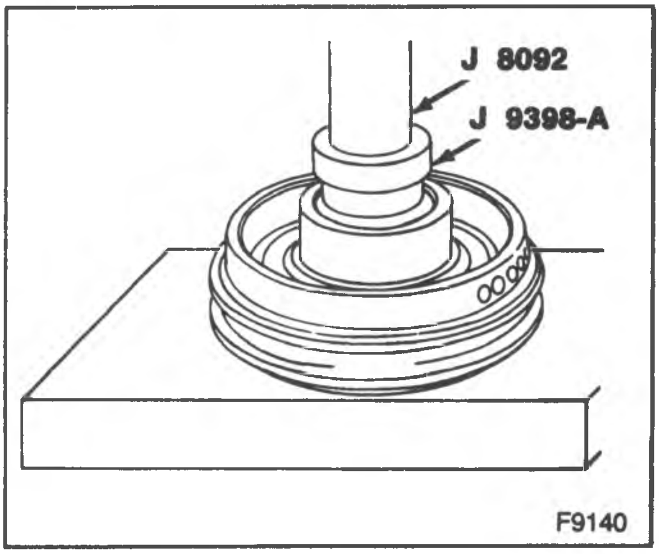


Figure 9—Removing the Bearing from the Pulley

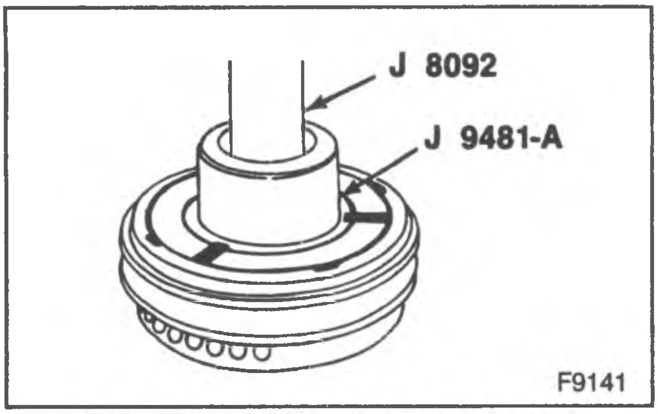


Figure 10—Installing the Pulley Bearing

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 6435.
6. Clutch plate and hub assembly (2).
   - Refer to "Clutch Rotor and Hub Assembly Replacement."

CLUTCH COIL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 1)

Tool Required:
J 6435 External 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.
- 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 External Snap Ring Pliers

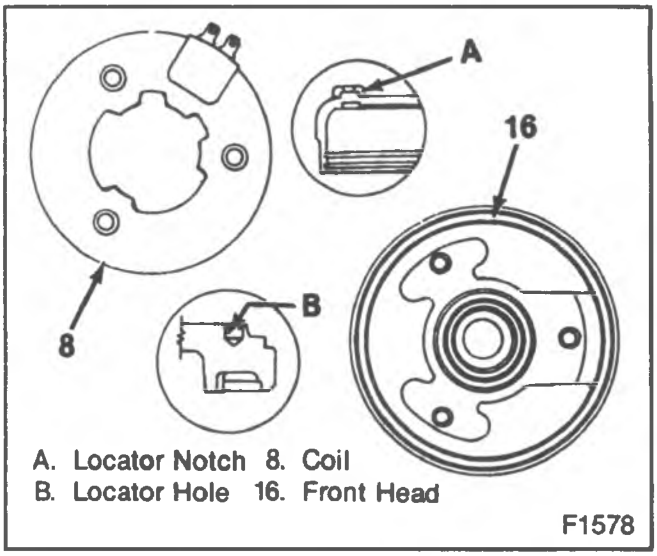


Figure 11—Adhesive Fill Guide

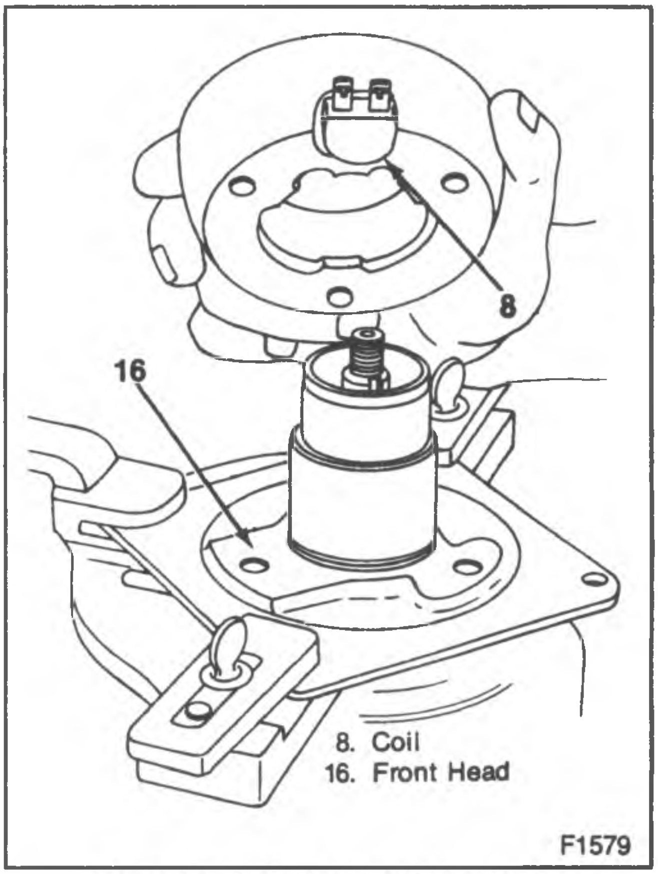


Figure 12—Installing the Coil Housing

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.

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

MAJOR REPAIR TO THE COMPRESSOR

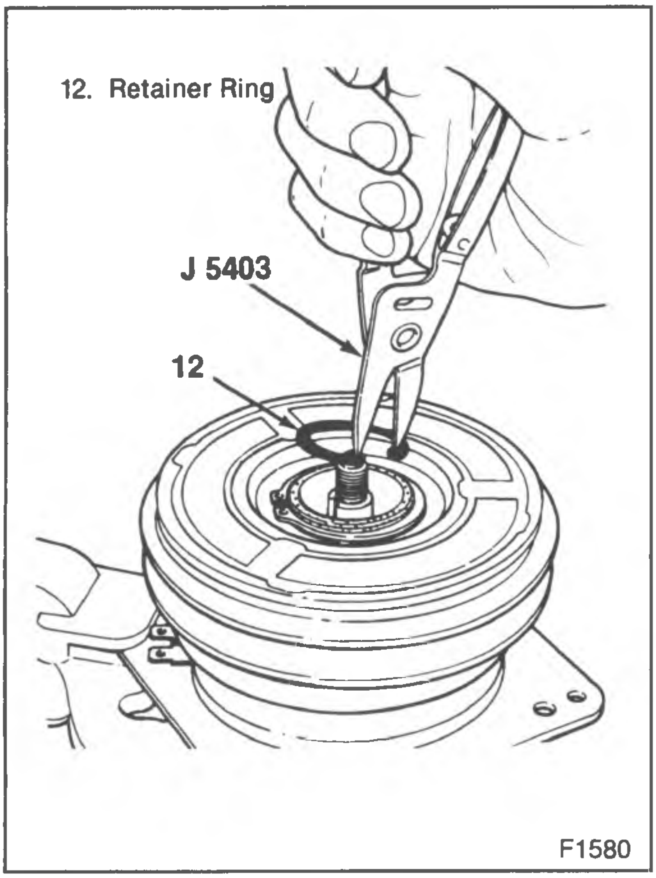


Figure 13—Removing/Installing the Shaft Seal Seat Retaining Ring

SHAFT SEAL REPLACEMENT

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

Tools Required:
J 5403 External Snap Ring Pliers
J 9392-01 Shaft Seal Remover and Installer
J 9553-01 O-Ring 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).

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 seal seat retaining ring (12) with J 5403 (figure 13).
5. Shaft seal seat (13) (figure 14).
   - Engage J 23128-A into the recessed portion of the seat by turning to the right (clockwise).
   - Lift the seat (13) from the compressor with a rotary motion.
6. Shaft seal (figure 15).
   - Place J 22974-A over the end of the shaft (38) to prevent cutting the O-ring (13).

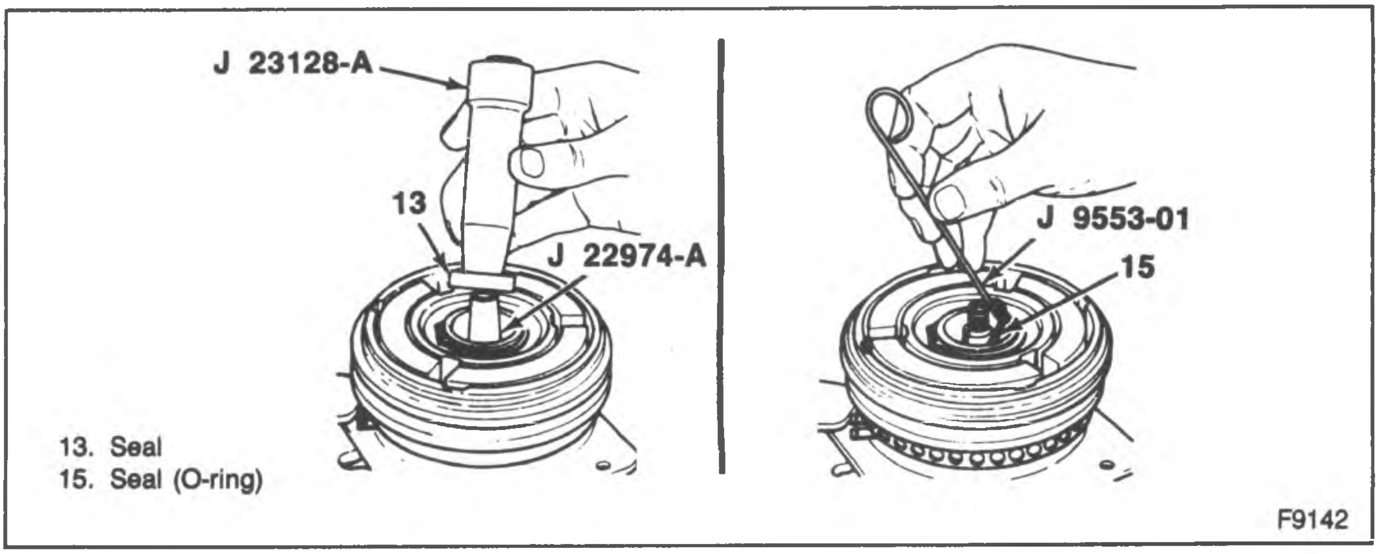


Figure 14—Removing/Installing the Shaft Seal Seat and O-Ring

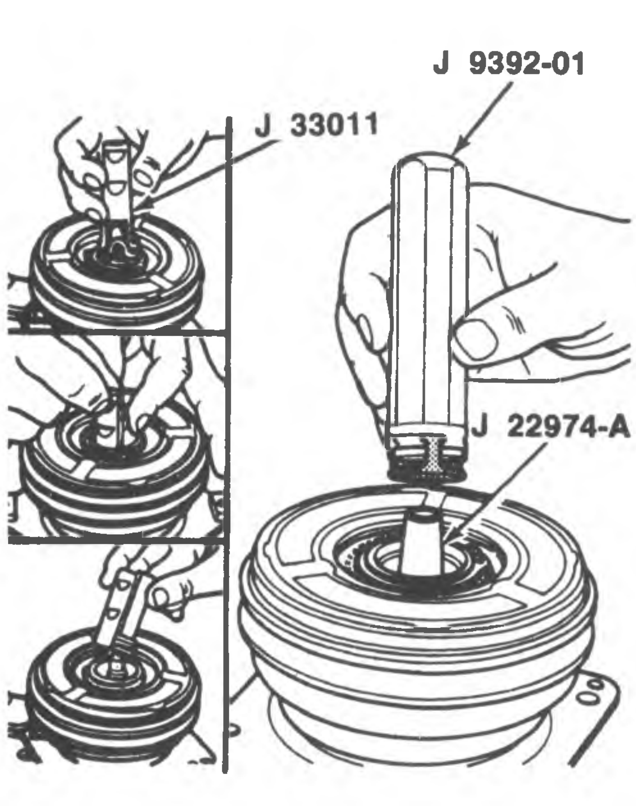


Figure 15—Removing/Installing Shaft Seal and O-Ring

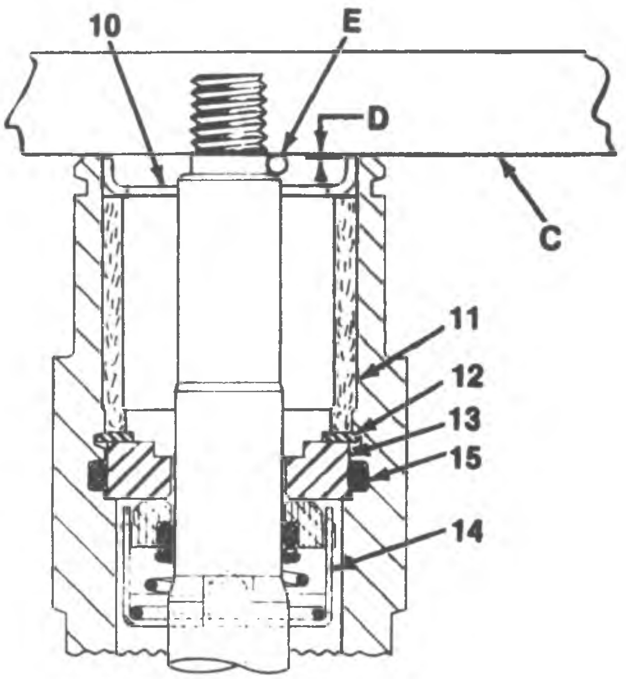
- Insert J 9392-01 over the compressor shaft (39).
- Engage the tabs on the seal (14) by twisting the J 9392-01 to the right.
- Engage the tabs and lift the seal (14) out of the shaft (39) cavity. Hold J 22974-A in place while removing the seal.

7. O-ring (15) with J 9553-01.

Install or Connect (Figures 1, 13 through 16)

Tools Required:
J 5403 External 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 33011 O-Ring Installer

1. O-ring (15) with J 33011.
   - 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.



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

2. Shaft seal (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-A over the end of the compressor shaft (39).
   - Slide the seal (14) and J 22974-A 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. Shaft seal seat (13) (figure 14).
   - Seal (13) to J 23128-A.
   - Dip the seal (13) into clean 525 viscosity refrigerant oil.
   - Install J 23128-A 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. Shaft seal seat retaining 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-A 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.
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 screwdriver spread the sleeve ends of the sleeve butt at the top vertical centerline.
7. Sleeve retainer (10) with J 9393-A.
   - 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-A.
   - Place the compressor in a horizontal position with the oil sump down.
   - Rotate the compressor shaft by hand.
   - Replace shaft nut (1) with a new one.

PRESSURE RELIEF VALVE REPLACEMENT

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.

Install or Connect (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.).

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-A 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 38505, 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-A 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-A to keep air, dirt and moisture out of the compressor until installed.

SPECIFICATIONS

A-6 COMPRESSOR

COMPRESSOR

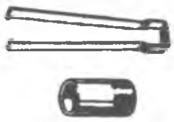
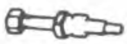
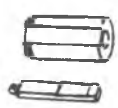
Type—Harrison A-6	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise
Belt Tension	(Refer to applicable service manual)
Oil Capacity	295 ml. (10 fl. oz.)
Clutch Plate Air Gap	0.56-1.34 mm (0.022-0.057 inch)

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

1.		J 5403
2.		J 9392-01
3.		J 9393-A
4.		J 9396
5.		J 9398-A
6.		J 9399-A
7.		J 9401-B
8.		J 9459
9.		J 9553-01
10.		J 9625-A
11.		J 21352-A
12.		J 22974-A
13.		J 23138-A
14.		J 24092
15.		J 25030-A
16.		J 38505
17.		J 33011

1. Snap Ring Pliers
2. Shaft Seal Remover and Installer
3. Seal Seat Remover and Installer
4. Compressor Holding Fixture
5. Pulley Bearing Remover
6. 9/16" Nut Socket (Thin Walled)
7. Hub and Clutch Drive Plate Remover
8. 9° Elbow Adapter
9. O-Ring Remover
10. Compressor Test Set
11. Compressor Support Block
12. Oil Seal Protector
13. Compressor Shaft Seal Remover and Installer
14. Pulley Hub Puller Set
15. Clutch Hub Holding Tool
16. Battery Powered Leak Detector
17. O-Ring Installer

F9152

SECTION 1B2

V-5 AIR CONDITIONING COMPRESSOR

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 DESCRIPTION

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. This 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.

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 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 Trichlorethane, naptha, stoddard solvent, kerosene or equivalent solvent and dried with dry air. Use only lint free cloths to wipe parts.

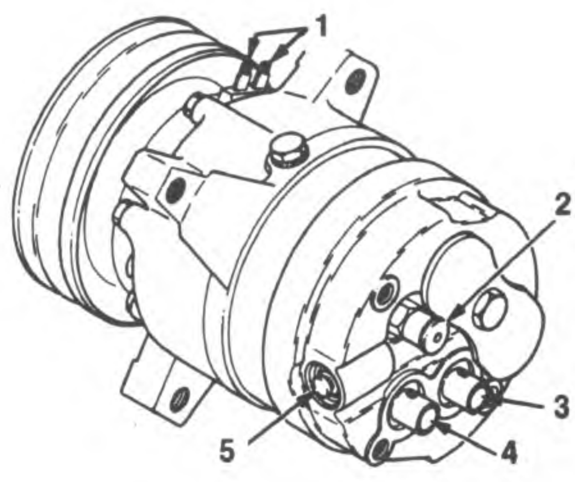
Up to 118 ml (4 fl.oz.) of oil can collect in the crankcase. Therefore, it is important when replacing a compressor that the oil in the old compressor crankcase be drained through the drain plug and measured (discard after recording amount) (figure 2).

All replacement compressors will be shipped with 236 ml (8 fl.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."

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 3).

IDENTIFICATION

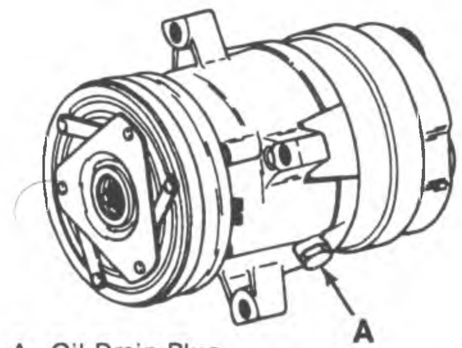
An identification label attached to the compressor provides the name of the manufacturer, model number and build code. If the label is removed or becomes dislodged during service operation, reattach it using an adhesive sealant such as Loctite 312 or equivalent.



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

F4535

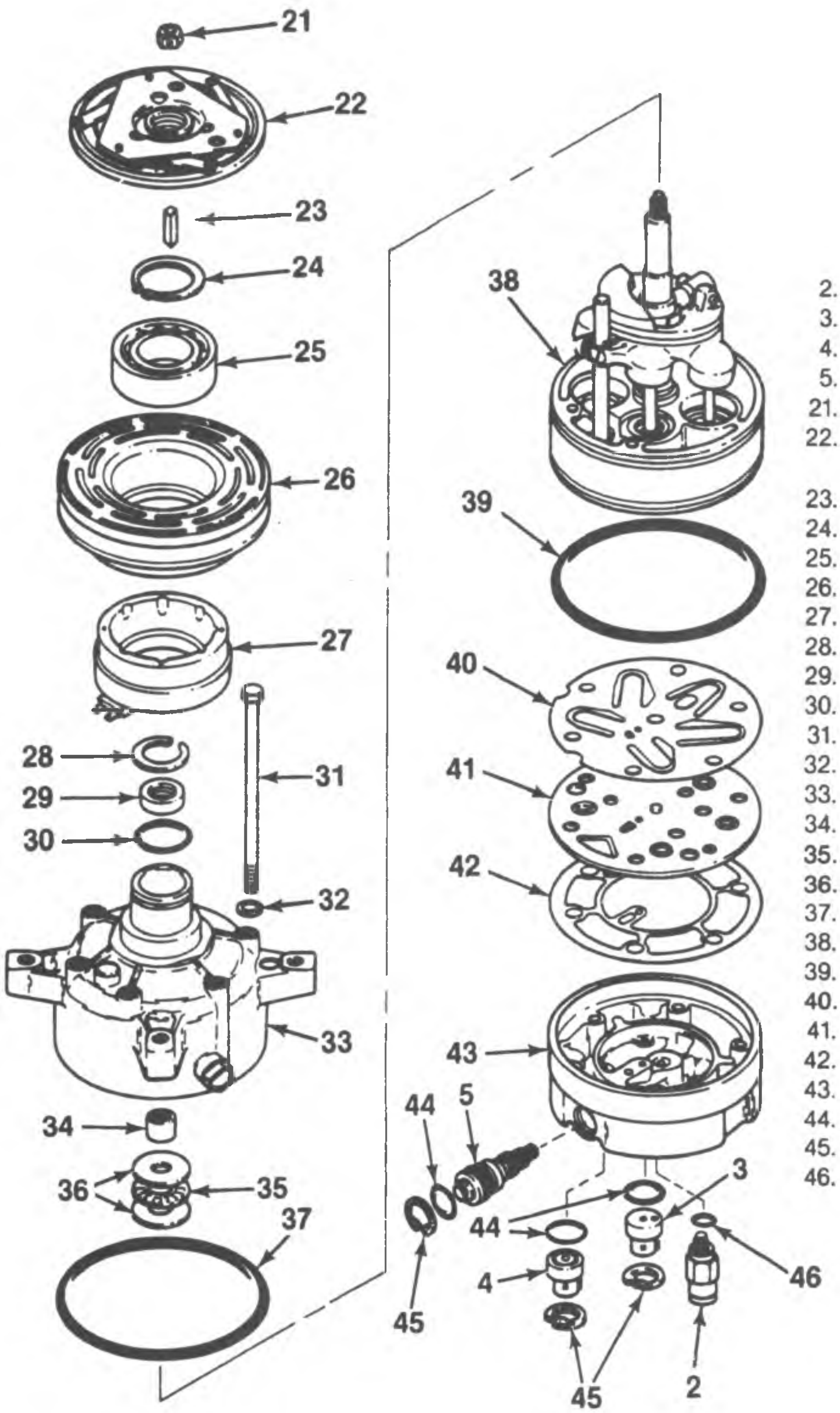
Figure 1—Rear Head Details



A. Oil Drain Plug

F4533

Figure 2—Mounting View



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

F6447

Figure 3—Compressor Components

MINOR REPAIR TO THE COMPRESSOR

CLUTCH PLATE AND HUB ASSEMBLY REPLACEMENT

Clean

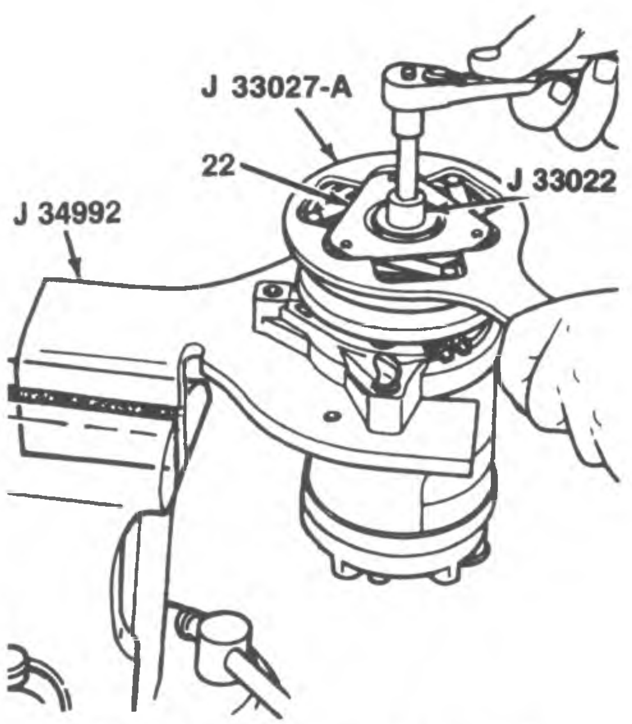
- The compressor assembly with solvent and blow dry with dry air.

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-A 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) steady using J 33027-A.
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).



22. Clutch Plate and Hub Assembly

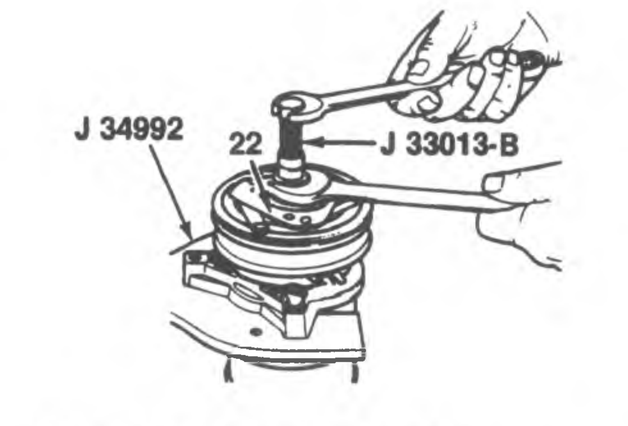
F9153

Figure 4—Removing the Shaft Nut

3. Shaft key (23).
   - Retain shaft key (21) if usable.

Inspect

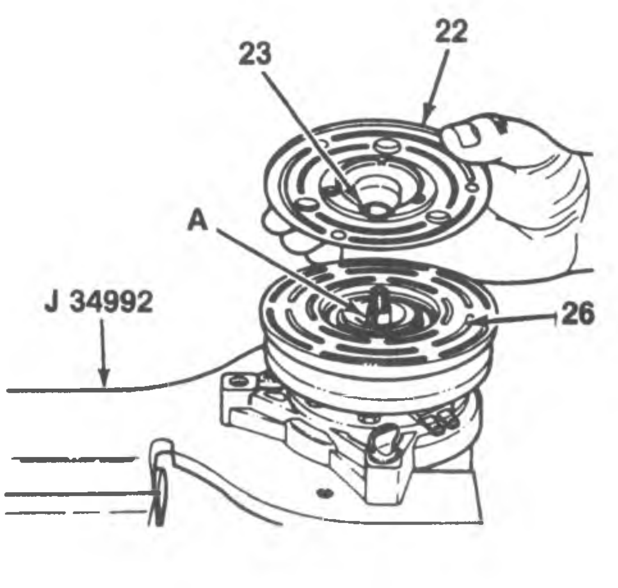
- All parts and replace as necessary.



22. Clutch Plate and Hub Assembly

F6449

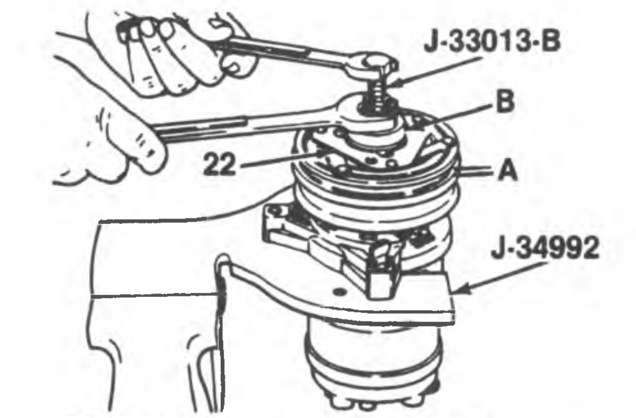
Figure 5—Removing the Clutch Plate and Hub Assembly



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

F6450

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
F4540

Figure 7—Installing the Clutch Plate and Hub Assembly

Install or Connect (Figures 3, 6 and 7)

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

1. Shaft key (23) into the hub key groove.
   - 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 hub key groove.

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 (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).
   - 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 to press 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).
- Use J 33027-A to hold the clutch plate and hub assembly (2).

Tighten

- Shaft nut (21) to 17 N.m (12 ft.lbs.) with J 33022.
  — Use J 33027-A 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.

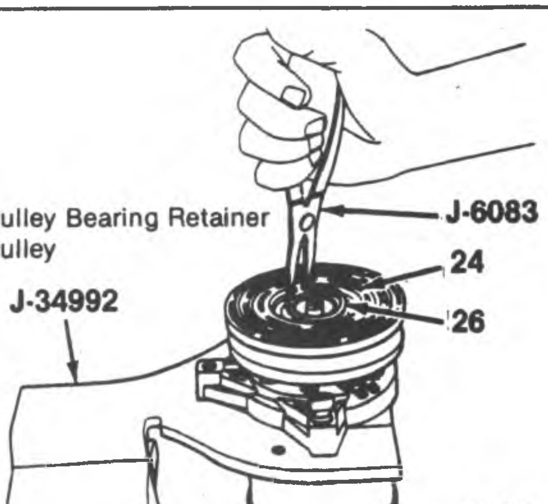
CLUTCH ROTOR AND/OR BEARING ASSEMBLY REPLACEMENT

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

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

24. Pulley Bearing Retainer
26. Pulley



F4562

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

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 (5) in the pulley bore.

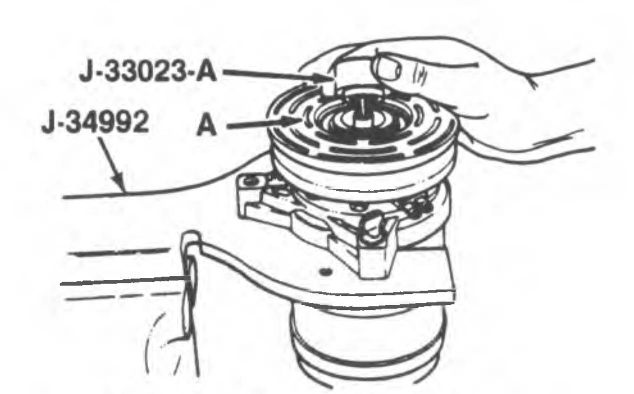
Install or Connect (Figures 4, 12, 13, 14 and 15)

Tools Required:
J 6083 External Snap Ring Pliers
J 9481-A Pulley Bearing Installer
J 21352-A Support Block
J 29886 Threaded Driver Handle
J 33017 Pulley and Bearing Assembly Installer
J 33019 Bearing Staking Tool (with staking pin and retaining band)
J 33023-A Puller Pilot
J 34992 Compressor Holding Fixture

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.

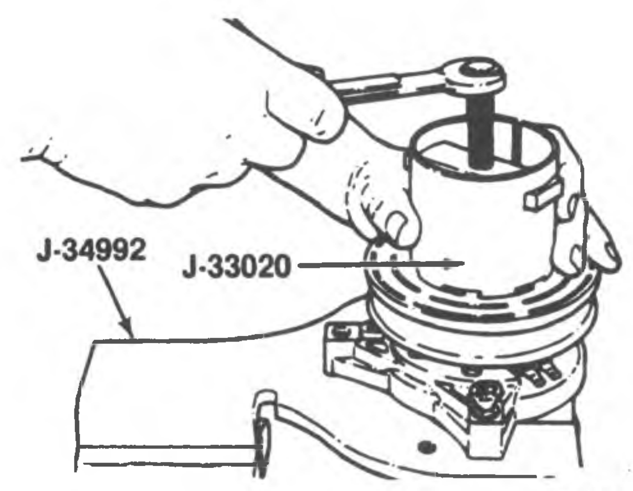
2. Pulley bearing (25) into the hub using J 29886, J 9481-A and J. th21352-A (figure 12).
   - J 33019 into the pulley bore (figure 12).
   - Seat the pulley and bearing assembly on J 21352-A to support to the hub under the staking pin location (figure 13).



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

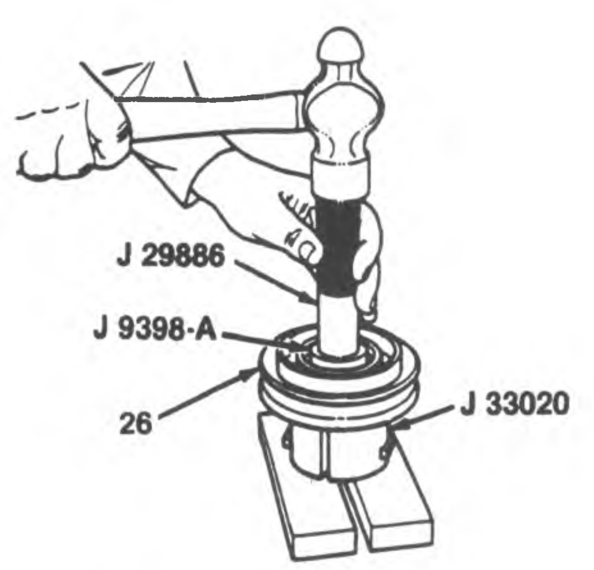
F4563

Figure 9—Installing the Pulley Rotor and Bearing Puller Guide



F4564

Figure 10—Removing the Pulley Rotor and Bearing Assembly



26. Pulley Rotor "Face Down"

F6451

Figure 11—Removing the Bearing from the Pulley Rotor Assembly

- 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).

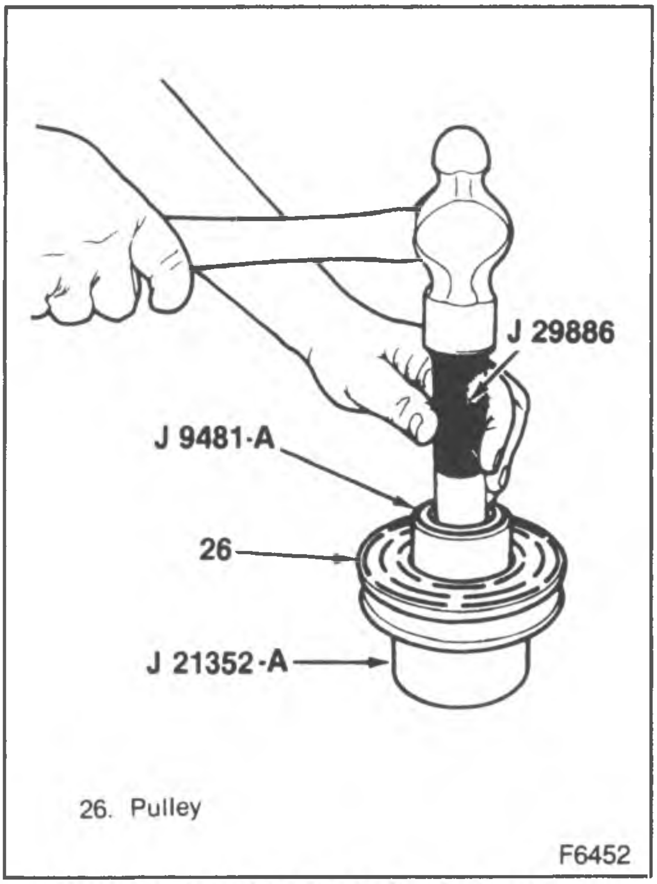


Figure 12—Installing the Pulley Rotor Bearing

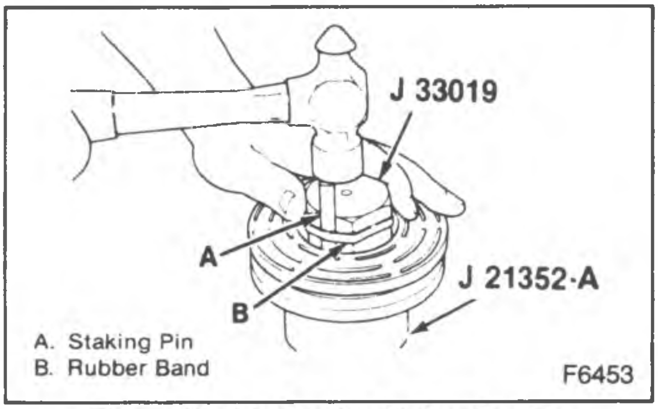


Figure 13—Staking the Pulley Bearing in the Pulley Bore

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 8433-1 on J 33023-A and assemble the through bolts and washers through the puller bar slots and thread them into J 34992 (figure 15).
     - The thread of the through bolts should engage the full thickness of the compressor holding fixture.
   - Tighten the center screw in J 8433-1 to force the pulley and bearing assembly onto the compressor front head (33).

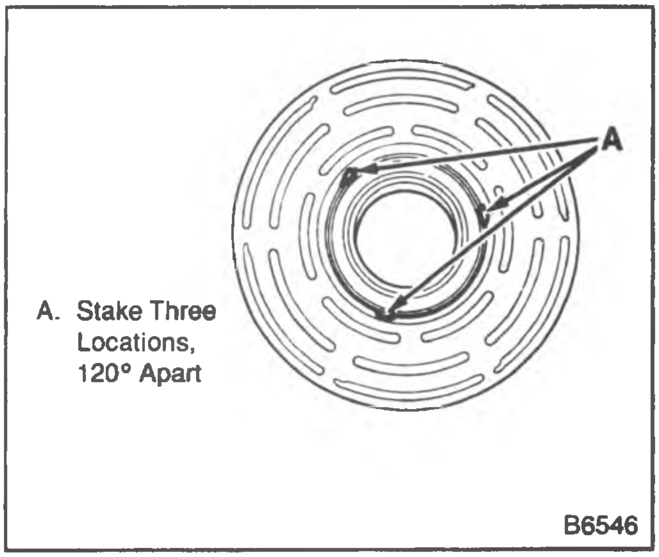


Figure 14—Bearing Stake Locations

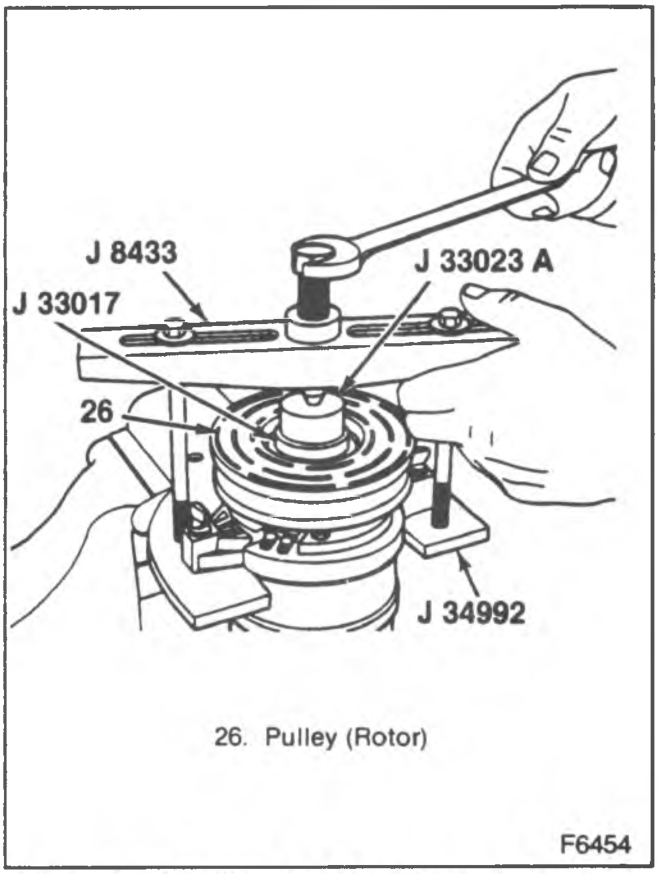


Figure 15—Installing the Pulley Bearing Assembly

— If 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 (24) using J 6083 (figure 8).
5. Clutch plate and hub assembly (22).

CLUTCH COIL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 3 and 16)

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

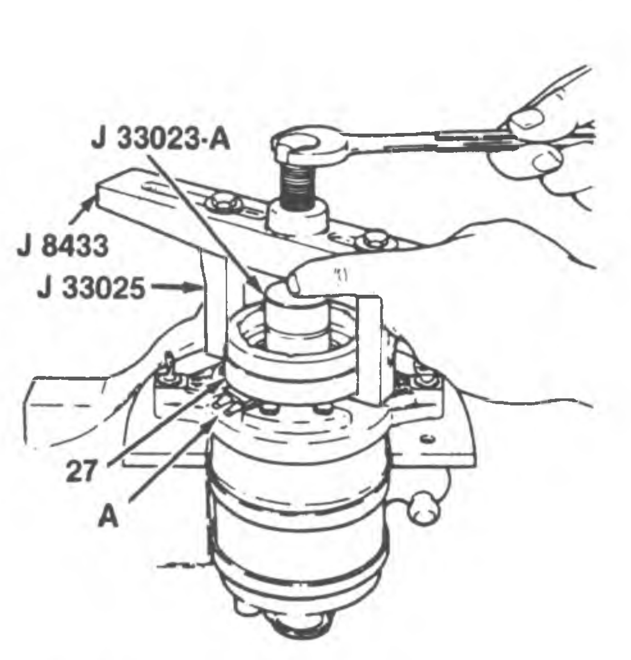
1. Clutch plate and hub assembly (22).
2. Pulley (26).
   - Mark or scribe the location of the clutch coil (27) to terminal on the compressor front head (33).
3. Clutch coil assembly (27).
   - Install J 33023-A on the head (33) of the compressor.
   - Install J 8433-1 with J 33025 (figure 16).
   -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

Inspect

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

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

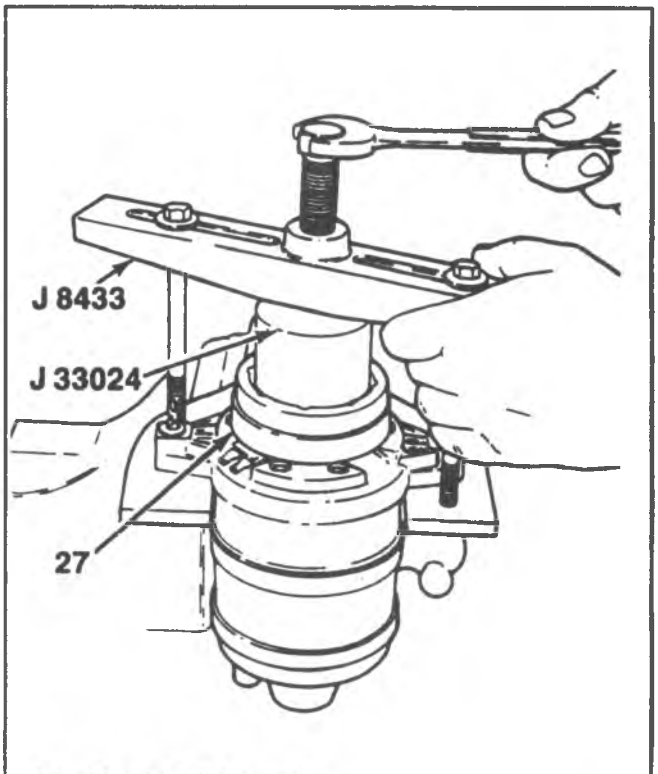
Tools Required:
- J 8433-1 Puller Bar
- J 33024 Clutch Coil Installer Adapter.



A. Mark
27. Clutch Coil Assembly

F6455

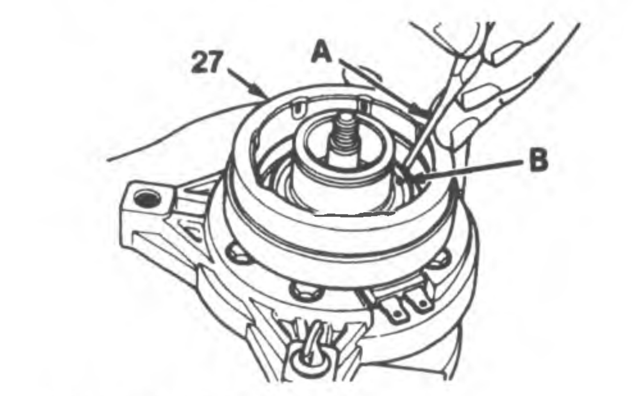
Figure 16—Removing the Clutch Coil Assembly



27. Clutch Coil Assembly

F6456

Figure 17—Installing the Clutch Coil Assembly



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

F4570

Figure 18—Staking the Clutch Coil to the Front Head

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 8433-1 with through bolts, washers and forcing screw over J 33024.
   - Be sure J 8433-1 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 ensure 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).

MAJOR REPAIR TO THE COMPRESSOR

SHAFT SEAL REPLACEMENT

Replacement of the shaft seal assembly or the pressure relief valve will require the discharge of the vehicle's refrigeration 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.

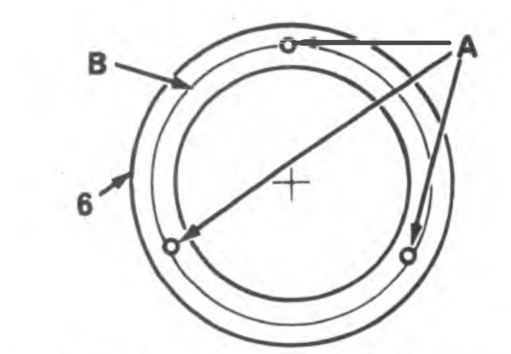
Keep the workbench and work area clean when servicing the compressor, and use proper, clean service tools.

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 just as they are removed from the service package.

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

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



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

B6552

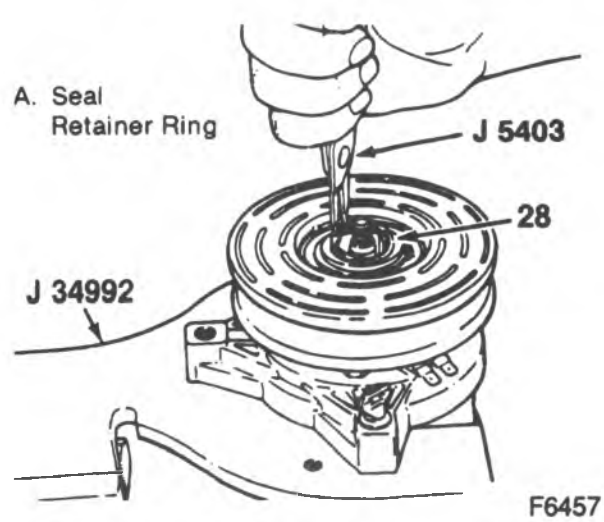
Figure 19—Clutch Coil Staking Locations

1. Clutch plate and hub assembly (22).
2. Shaft seal retainer ring using J 5403 (figure 21).
   - Clean the compressor neck area around the shaft (38), the exposed part of the shaft seal (29) and the O-ring seal groove. Any dirt or foreign material getting into the compressor may cause damage.
3. Shaft lip seal using J 23128-A (figure 22).
   - Install J 34614 over the threaded end of the shaft (20).
   - Insert J 23128-A into the shaft lip seal, tighten and remove lip seal.
4. O-Ring seal using J 9553-01 (figure 23).

A. Steel Shell
B. Lip Seal

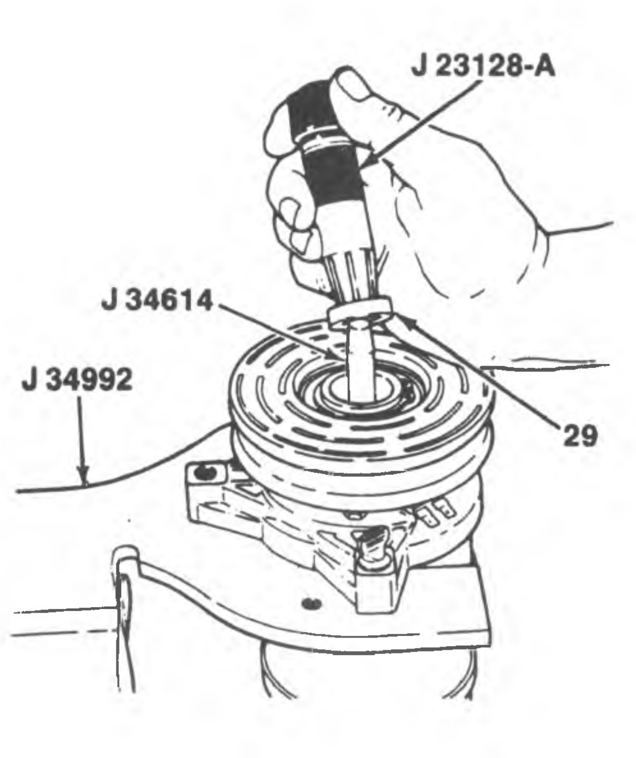
B6551

Figure 20—Compressor Shaft Seal



F6457

Figure 21—Removing or Installing the Shaft Seal Retainer



29. Shaft Lip Seal

F6458

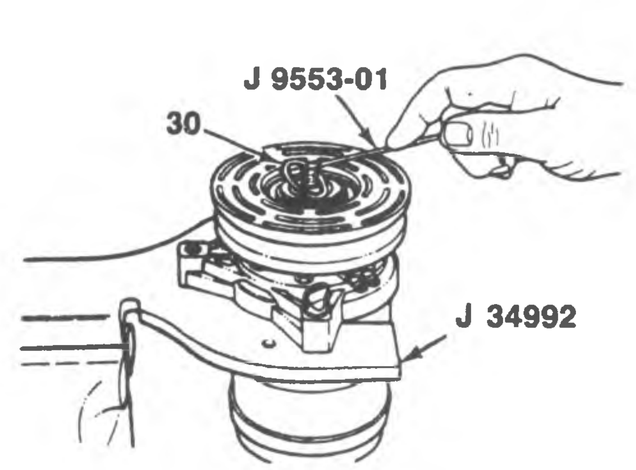
Figure 22—Removing or Installing the Shaft Seal

Inspect

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

Install or Connect (Figures 3, 20, 21, 22 and 24)

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



30. O-Ring.

F9154

Figure 23—Removing the Shaft Seal Seat O-Ring

- 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 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 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 and inside the compressor neck area.

5. Clutch plate and hub assembly (22).

PRESSURE RELIEF VALVE REPLACEMENT

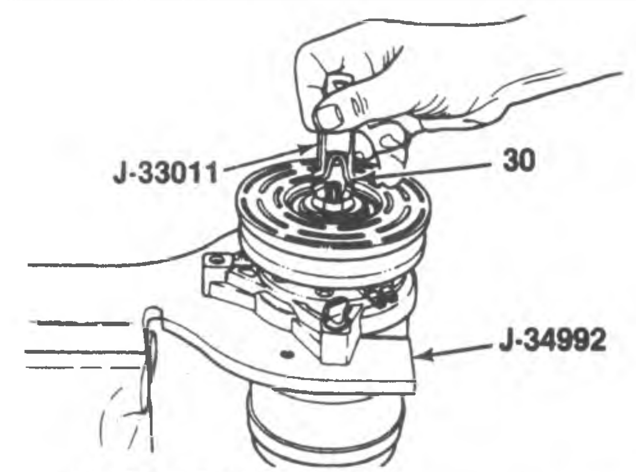
Remove or Disconnect (Figures 1 and 3)

- Be sure the compressor has no change.

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



30. Shaft Seal Seat O-Ring

F4573

Figure 24—Installing the Shaft Seal Seat O-Ring

1. New O-ring.
2. Pressure relief valve (2).

Tighten

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

Important

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

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

Remove or Disconnect (Figures 1 and 3)

Tool Required:
J 5403 Internal 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 groove.

Install or Connect (Figures 1 and 3)

Tools Required:
J 5403 Internal 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).

CONTROL VALVE REPLACEMENT

Remove or Disconnect (Figures 1 and 3)

Tools Required:
J 5403 Internal 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 Internal 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.

LEAK TESTING

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

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 88.5 ml (3 fl.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 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 (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

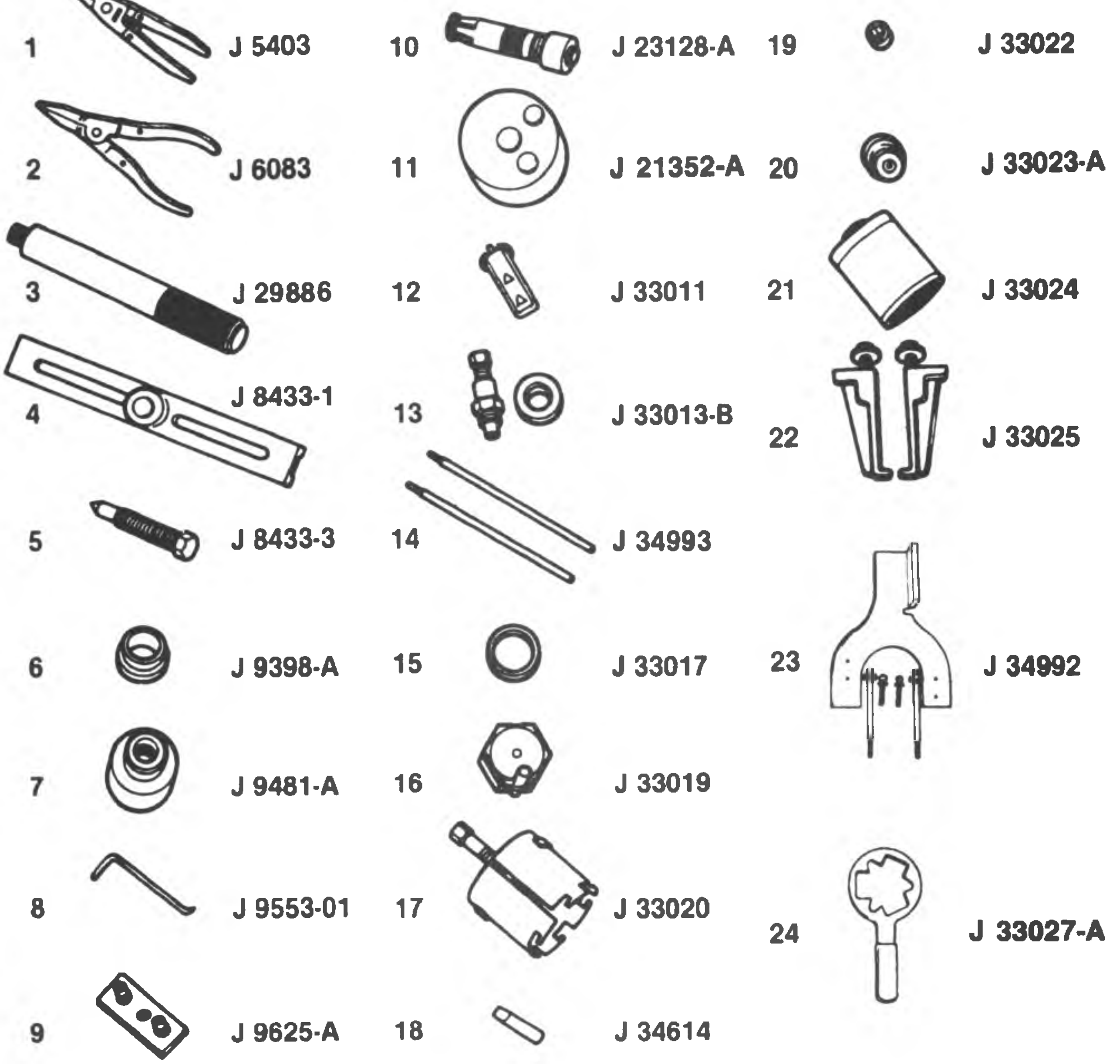
V-5 COMPRESSOR

COMPRESSOR	
Type—Harrison V5	5 Cylinder Axial
Displacement	9.2 Cu. In.
Rotation	Clockwise
Oil Capacity	236 ml. (8 fl. oz.)
Clutch Plate Air Gap	0.38-0.64 mm (0.015-0.025 inch

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.)

T2502

SPECIAL TOOLS



1. J 5403 Snap Ring Pliers
2. J 6083 Snap Ring Pliers
3. J 29886 Driver Handle
4. J 84331-1 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-A Clutch Hub Holding Tool

F9155

SECTION 1B3

R-4 AIR CONDITIONING COMPRESSOR

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 DESCRIPTION

The Harrison R-4 compressor is a four cylinder, radial opposed with 10.0 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 trichlorethane, 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.

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 3).

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 29.5 ml (1 fl. oz.) is drained from the compressor add 59 ml (2 fl. oz.) of new 525 viscosity oil to the assembly after overhaul. If more than 29.5 ml (1 fl. oz.) is drained from the compressor, add the same amount of new 525 viscosity oil to the overhauled assembly.

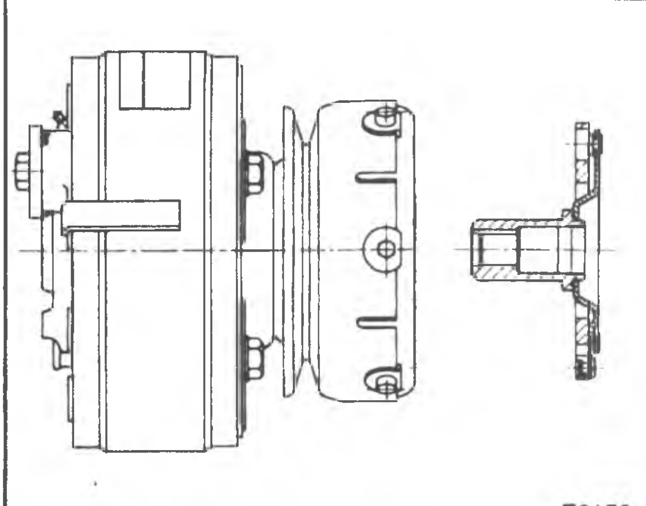


Figure 1—R-4 Compressor, V-Groove Pulley Type with 4 Pole Clutch and Driver Shown

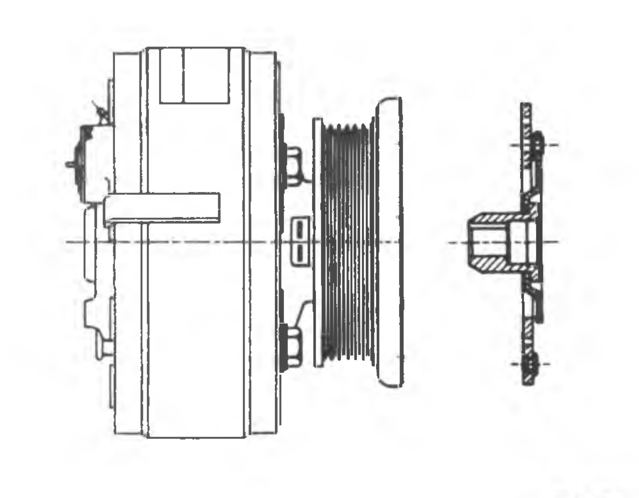
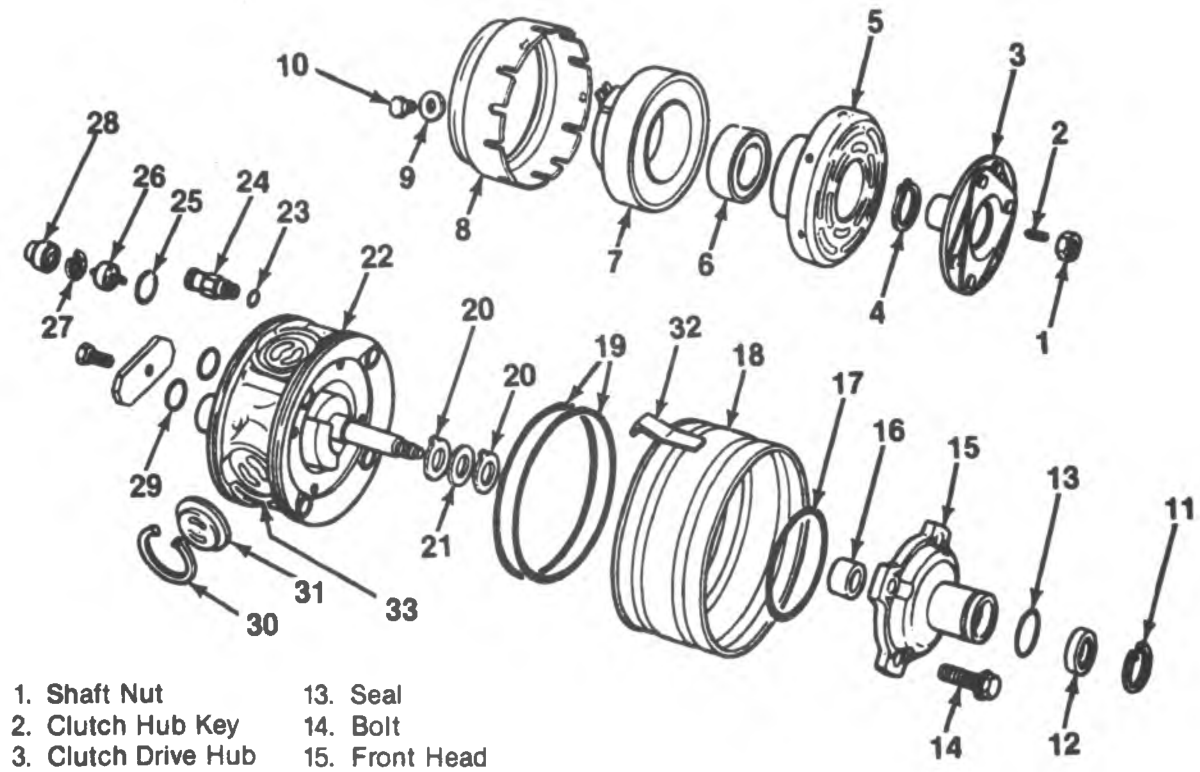


Figure 2—R-4 Compressor, Poly-Groove Pulley Type with a 6 Pole Clutch and Driver Shown



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

B8291

Figure 3—Compressor Component View

MINOR REPAIR TO THE COMPRESSOR

CLUTCH PLATE AND HUB REPLACEMENT

Remove or Disconnect (Figures 3, 4, 5 and 6)

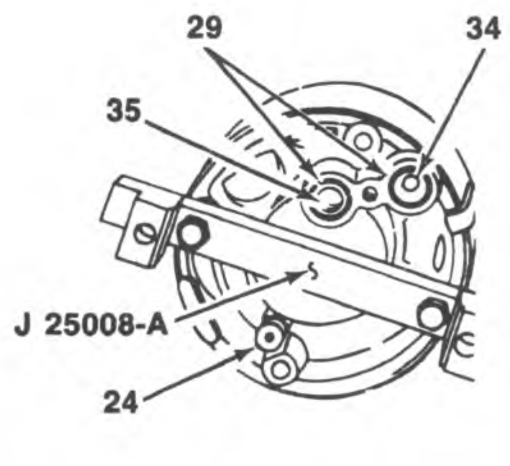
Tools Required:
- J 9399-A Thin Wall Socket
- J 33027-A Clutch Hub Holding Tool
- J 33013-B Hub and Drive Plate Remover
- J 25008-A Compressor Holding Fixture

- Loosen compressor mounting brackets.

1. Belt.
2. Compressor from vehicle.
- Attach J 25008-A to the compressor (figure 4).
- Mount J 25008-A in a vise.
- Hold clutch hub with J 33027-A (figure 5).
3. Shaft nut using J 9399-A and discard.
4. Clutch plate and hub assembly using J 33013-B (figure 6).
5. Shaft key.

Install or Connect (Figures 4, 5, 7 and 8)

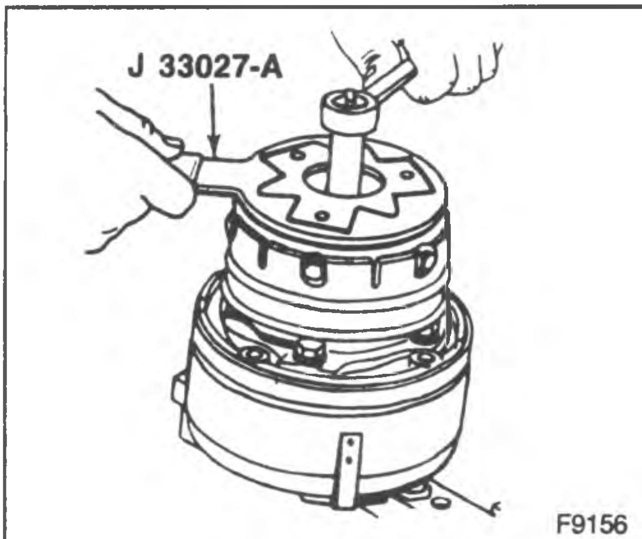
Tools Required:
- J 9399-A Thin Wall Socket
- J 9401-B Hub and Drive Plate Installer
- J 33027-A Clutch Hub Holding Tool
- J 25008-A Compressor Holding Fixture



24. High Pressure Relief Valve
29. Seals
34. Discharge
35. Suction Port

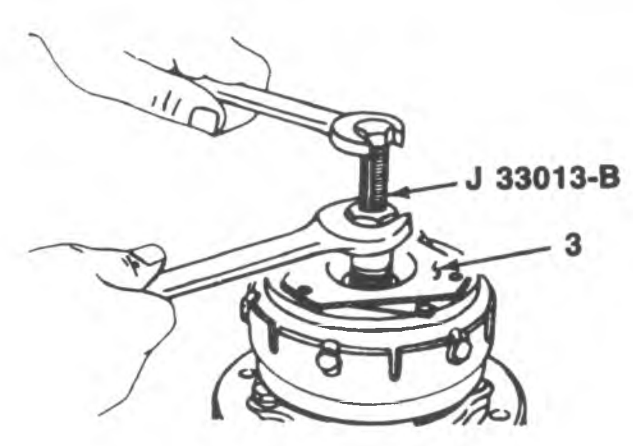
F9175

Figure 4—Compressor in Holding Fixture



F9156

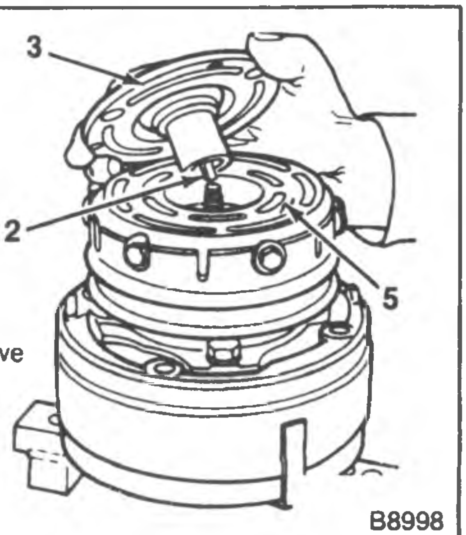
Figure 5—Replacing the Shaft Nut



3. Clutch Drive Assembly

F9176

Figure 6—Clutch Plate and Hub Removal



2. Key
3. Clutch Drive Hub
5. Rotor

B8998

Figure 7—Installing the Shaft Key

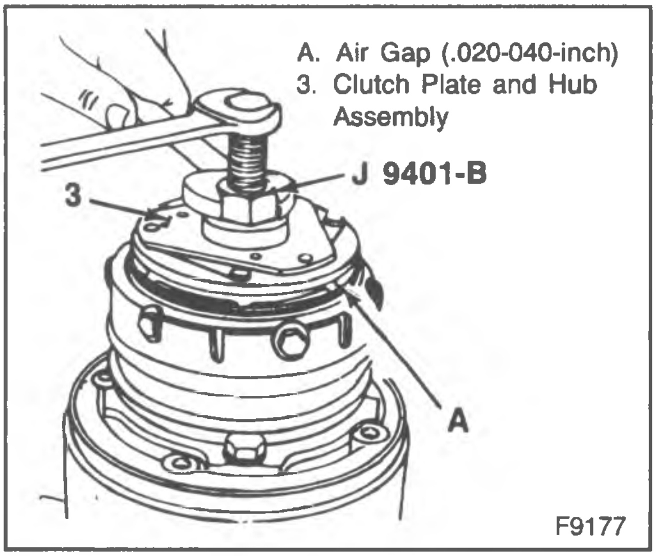


Figure 8—Installing the Clutch Plate and Hub

1. Shaft key into hub key groove (figure 7).
   - Allow the shaft key to extend 4.8 mm (3/16-inch) out of the key way.
   - The shaft key is curved slightly to give an interference fit in the groove.
2. Clutch plate and hub assembly (figure 8).

Important

- Do not drive or pound on the clutch hub or the shaft. This may cause internal damage.
- Make sure the contact surfaces of the clutch plate and hub are clean.
- Install J 9401-B.
- Hold the hex portion of J 9401-B with a wrench and tighten the center screw to press the hub onto the shaft until there is a 0.5-1.0 mm (0.20-0.40-inch) air gap between the frictional surfaces of the clutch plate and the clutch rotor.
- Remove J 9401-B.

3. New shaft nut with J 9399-A (figure 5).
   - Use J 33027-A to hold the clutch plate and hub assembly.

Tighten

- Shaft nut to 14 N·m (124 in. lbs.).

4. Compressor to the vehicle.
5. Belt.

Adjust

- Belts and brackets as necessary.

CLUTCH ROTOR AND/OR BEARING REPLACEMENT V-GROOVE TYPE

Remove or Disconnect (Figures 3, 4, 9, 10, 11 and 12)

Tools Required:
J 6083 External Snap Ring Pliers
J 25031 Rotor and Bearing Puller
J 9398-A Rotor Bearing Remover

1. Clutch plate and hub assembly (3).
2. Snap ring (4) with J 6083 (figure 9).

- Mark the location of the clutch coil terminals.

Important

- If only the clutch rotor and/or rotor bearing are to be replaced, bend the washers (9) away from the pulley rim and remove the six mounting screws (10). Remove the six mounting screws (10) and special lock washers (9).

3. Rotor (6) and bearing (5) assembly using J 25031.
   - Place J 25031 down into the rotor until the puller legs engage the recessed edge of the rotor hub (figures 10 and 11).
   - Tighten the puller screw against the puller guide and remove the clutch rotor and bearing.

Important

- If the pulley rim mounting screws (10) and washers (9) were removed, only the clutch rotor and bearing assembly will be removed for replacement. The clutch coil and housing assembly is pressed into the compressor and will not be removed unless the pulley rim mounting screws are left in place and the pulley rim pulls the coil and housing assembly off with the clutch rotor and pulley rim assembly.

- Place the clutch assembly face on wood blocks to remove the bearing.

4. Bearing (6) from the clutch rotor hub (5) with J 9398-A (figure 12).

Important

- It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing. However, file away the old staked metal to provide the proper clearance for the new bearing being installed into the rotor bore.

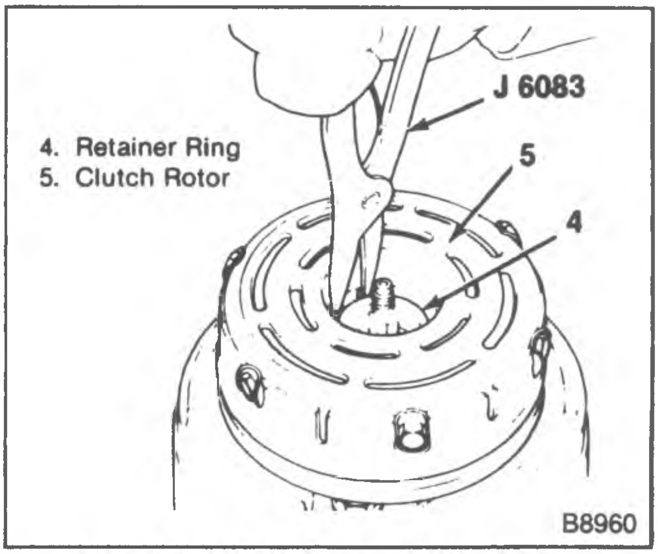


Figure 9—Removing the Retaining Ring

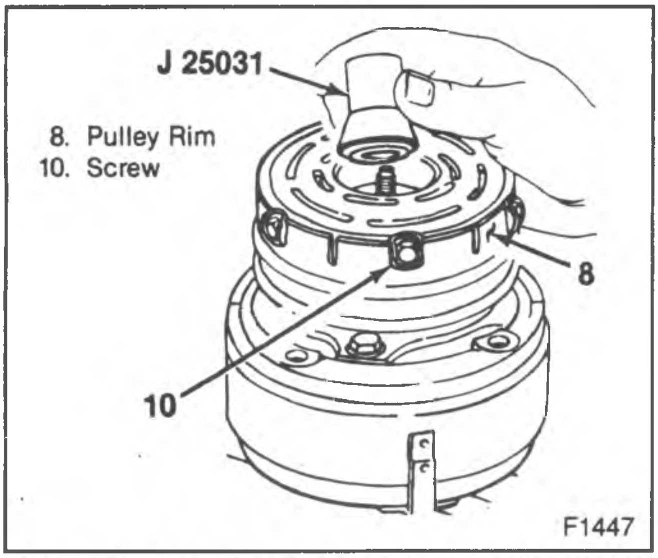


Figure 10—Installing the Rotor and Bearing Guide

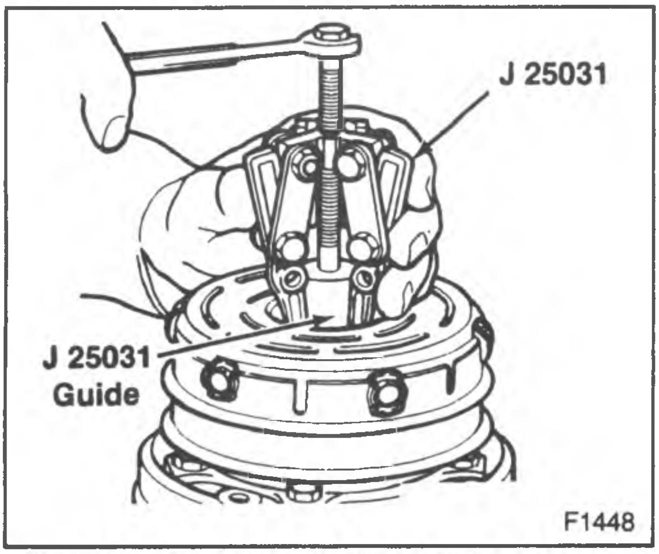


Figure 11—Removing the Clutch Rotor Assembly

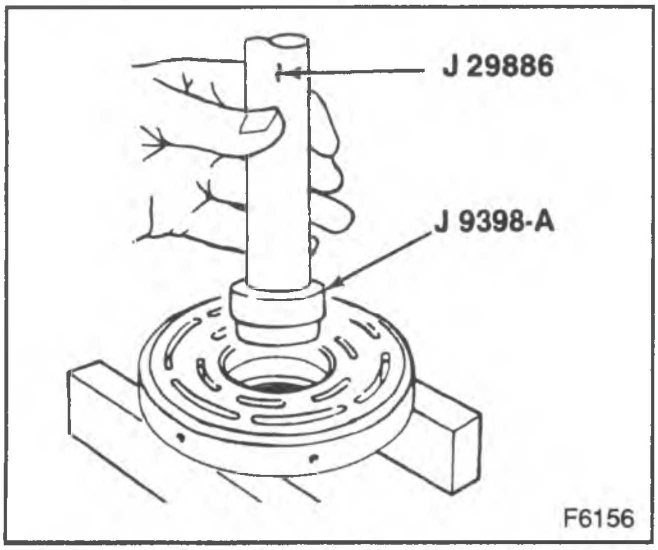


Figure 12—Removing the Clutch Rotor Bearing

Install or Connect (Figures 3, 13, 14 and 15)

Tools Required:
- J 6083 External Snap Ring Pliers
- J 29886 Universal Drive Handle
- J 9481-A Pulley and Bearing Installer
- J 26271-A Rotor and Bearing Installer

- Place the rotor and hub assembly face down on a clean, flat surface.
- Align the bearing with the hub bore.

1. Bearing (6) to the rotor hub with J 29886 and J 9481-A (figure 13).
   - Using a center punch with a 45° angle point, stake 1.1-1.4 mm (0.045-0.055-inch) deep the bearing in three places 120° apart (figure 14).
2. Rotor (6) and bearing (5) assembly to the compressor with J 29886 and J 26271-A (figure 15).

- With Rotor and Bearing Installer J 26271-A assembled to Universal Handle J 29886, force will be applied to the inner race of the bearing and the face of the rotor when installing the assembly onto the front head of the compressor.

3. Retainer ring (4) with J 6083.
   - Apply Loctite 601 or equivalent to the threads of the pulley rim mounting screws.
4. Pulley rim mounting screws (10) and new special lock washers (9).
   - Hand spin the pulley to check for free rotation.

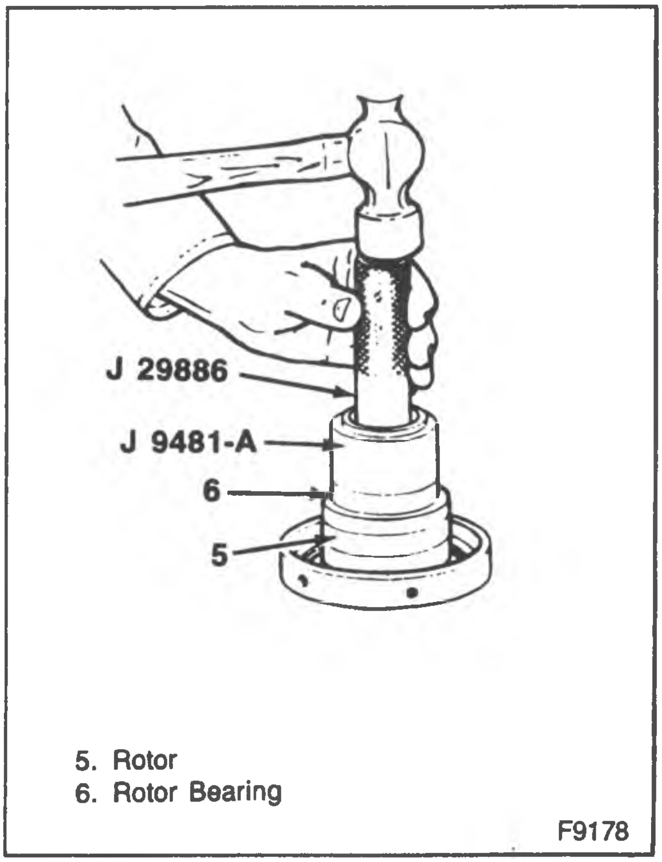


Figure 13—Installing the Clutch Rotor Bearing

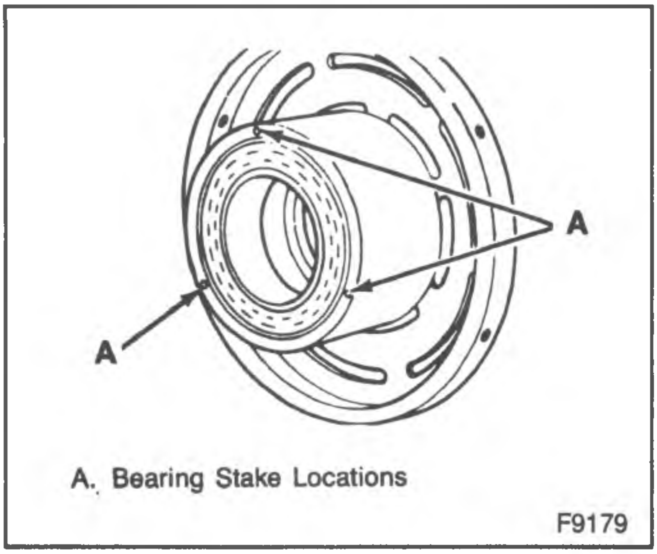


Figure 14—Staking the Bearing

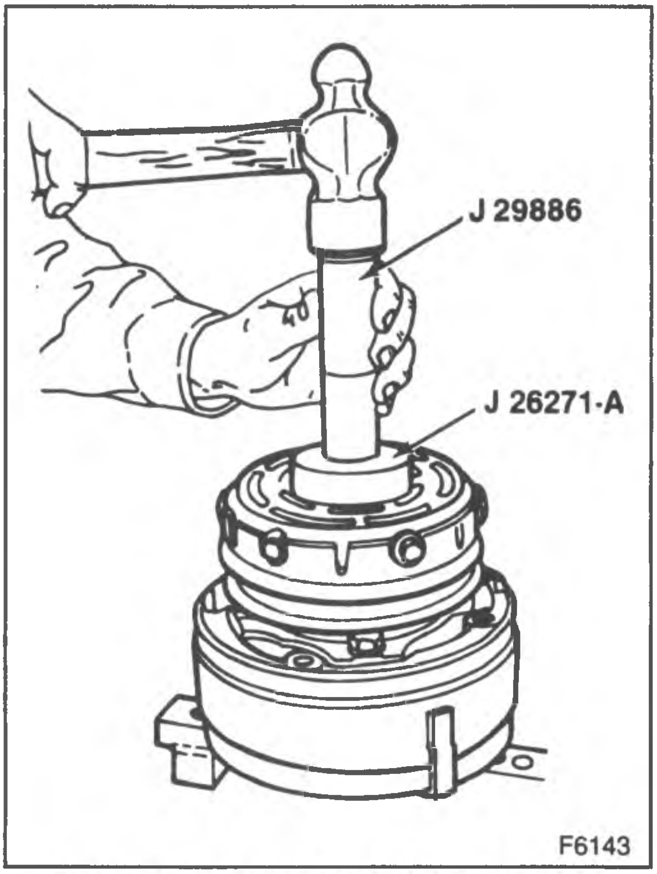


Figure 15—Installing the Rotor and Bearing (V-Groove Type)

Tighten

- Screws (10) to 11 N·m (100 in. lbs.).
- Bend the washers to lock the rim in place.

5. Clutch rotor (5) and hub (3) assembly.

CLUTCH ROTOR AND/OR BEARING REPLACEMENT POLY-GROOVE TYPE

Remove or Disconnect (Figures 3, 6, 9 and 16)

Tools Required:
- J 6083 External Snap Rings Pliers
- J 29886 Universal Driver Handle
- J 9398-A Rotor Bearing Remover
- J 25031 Rotor and Bearing Puller
- J 33020 Pulley Puller

1. Clutch plate (5) and hub (3) assembly (figure 6).
2. Retaining ring (4) with J 6083 (figure 9).
   - Install J 25031 guide over the shaft (39) end.
   - Install J 33020 down into the inner circle of slots in the rotor. Turn the J 33020 Puller clockwise in the slots to engage the puller tangs with the segments between the slots in the rotor.
   - Hold the J 33020 Puller in place and tighten the puller screw against the Puller Guide to remove the pulley rotor and bearing assembly (figure 16).

Important

- To prevent damage to the pulley rotor during bearing removal, the rotor hub must be properly supported.

3. Pulley rotor and bearing assembly.
   - Remove the forcing screw from J 33020 Puller and with the puller tangs still engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks.
4. Bearing from rotor hub.
   - Drive the bearing out of the rotor hub with Rotor Bearing Remover J 9398-A and J 29886 Universal Handle (figure 17).

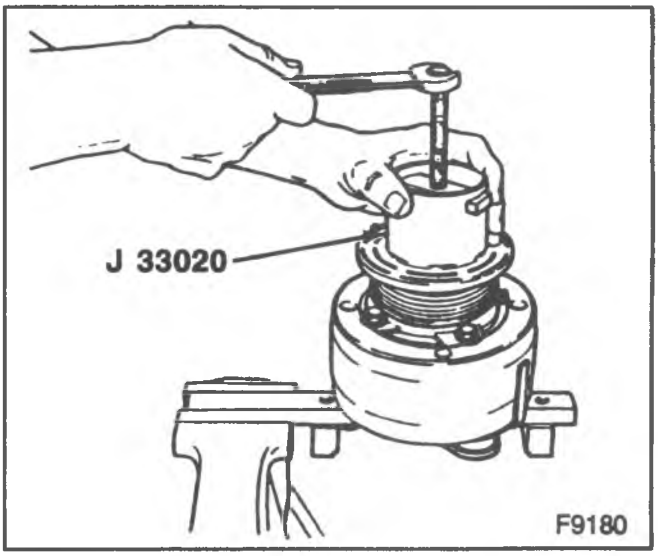


Figure 16—Clutch Rotor and Bearing Removal

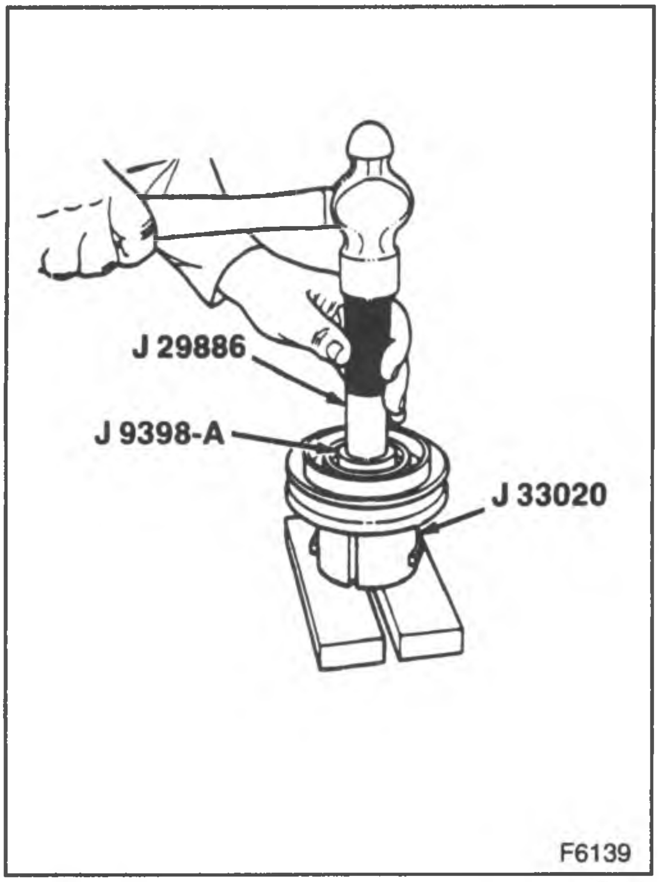


Figure 17—Bearing Removal

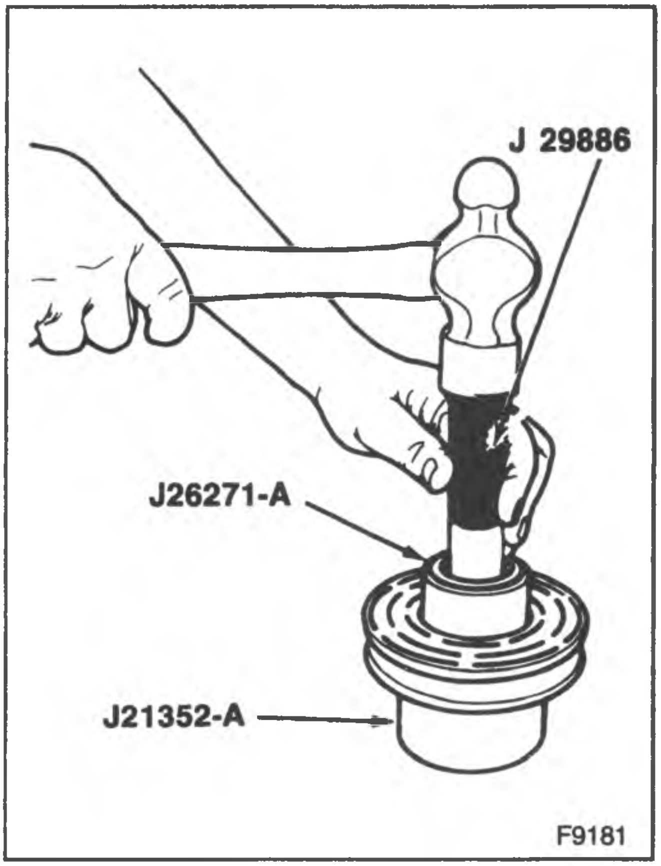


Figure 18—Bearing Installation

Important

- It is not necessary to remove the staking in front of the bearing. However, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore or the bearing may be damaged.

Install or Connect (Figures 18 and 19)

Tools Required:
- J 6083 External Snap Ring Pliers
- J 29886 Universal Driver Handle
- J 26271-A Rotor and Bearing Installer
- J 21352-A Support Block
- J 33019 Bearing Staking Tool and Pulley Installer
- J 25008-A Compressor Holding Fixture

1. Pulley rotor onto the J 21352-A Support Block to fully support the rotor hub during bearing installation. Do not support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent (figure 18).
2. Align the new bearing squarely with the hub bore and using Rotor and Bearing Installer J 26271-A with Universal Handle J 29886, drive the bearing fully into the hub.
3. Insert Bearing Staking Guide J 33019-1 and Bearing Staking Pin J 33019-2 into the hub bore. Shift the rotor and bearing assembly on the J 21352-A Support Block to give full support of the hub under

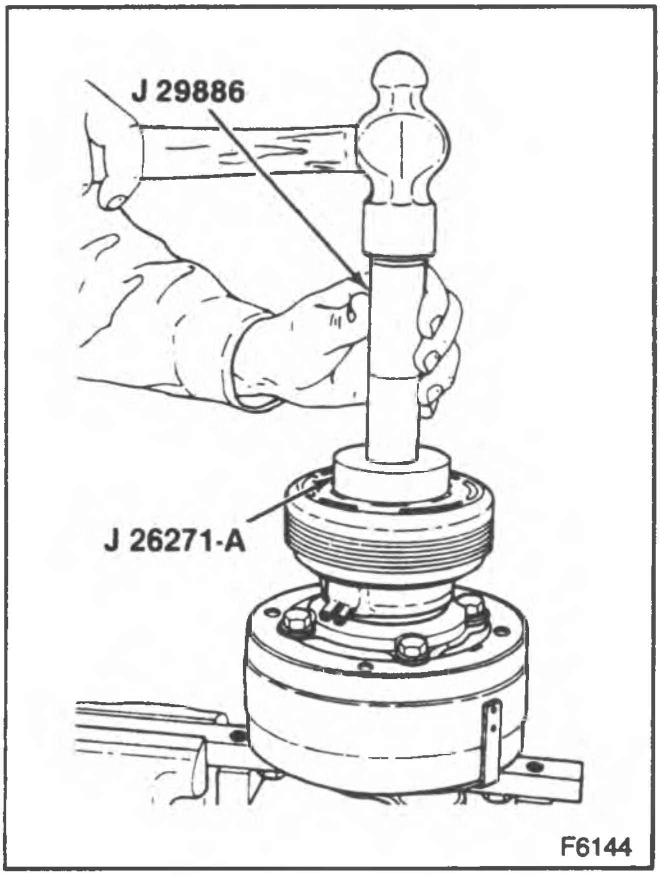


Figure 19—Installing the Rotor and Bearing (Poly-Groove Type)

the staking pin location. A heavy duty rubber band may be used to hold the stake pin in the guide, and the stake pin should be properly positioned in the guide after each impact of the pin.

4. Using care to prevent personal injury, strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching, the bearing. Stake three places 120° apart.

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

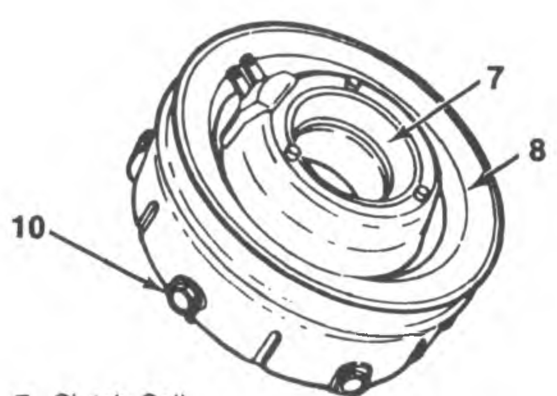
5. With the compressor mounted to the J 25008-A Holding Fixture, position the Rotor and Bearing Assembly on the front head. Using Rotor and Bearing Installer J 26271-A and Universal Handle J 29886 drive the rotor and bearing assembly onto the front head. With J 26271-A attached to J 29886 the force will be applied to the inner race of the bearing when installing the assembly onto the front head of the compressor (figure 19).
6. Retainer ring (4) with J 6083.
7. Clutch plate and hub assembly (3).

CLUTCH COIL AND/OR PULLEY RIM REPLACEMENT (V-GROOVE TYPE)

Remove or Disconnect (Figure 3)

Tool Required:
J 25008-A Compressor Holding Fixture
J 25031 Rotor and Bearing Puller

1. Perform steps 1 through 4 of "Clutch Rotor and Bearing Replacement" but do not loosen or remove the pulley rim mounting screws until the clutch rotor, coil and pulley rim assembly have been removed from the front head. Be careful not to drop the Puller Guide J 25031 when removing the assembly.



7. Clutch Coil
8. Pulley Rim
10. Screw

F9182

Figure 20—Assembling Clutch Coil, Pulley Rim, Rotor and Bearing Assembly

2. Pulley rim mounting screws and discard.
3. Slide the pulley rim off the rotor and hub assembly. The pulley rim and clutch coil are replaceable at this point.

Install or Connect (Figures 3 and 20)

Tool Required:
J 26271-A Rotor and Bearing Installer

1. Clutch coil, pulley rim, clutch rotor and bearing assembly (figure 20).

Important

- Use new screws and apply Loctite 601 or equivalent to the screw threads, but do not tighten.

2. Place the assembly on the neck of the front head and seat into place using J 26271-A.
   - Before fully seating the assembly, place the clutch coil terminals in relation to the compressor. Align the three protrusions on the rear of the clutch coil with the locator holes in the front head.
3. Rotor and bearing retainer ring (4) and reassemble the clutch plate and hub assembly as described in "Clutch Plate and Hub Assembly Replacement."
4. Rotate the pulley rim (8) and rotor (5) to be sure the pulley rim (8) is rotating "in-line" and adjust as required.

Inspect

- Clutch plate to clutch rotor gap is 0.5 to 1.0 mm (0.020 to 0.040-inches).

Tighten

- Pulley rim mounting screws (10) to 11 N·m (100 in. lbs.).

5. Bend the lock washers (9) to secure the screws (10).

CLUTCH COIL AND/OR PULLEY RIM REPLACEMENT (POLY-GROOVE TYPE)

Remove or Disconnect (Figures 3 and 21)

Tools Required:
J 25008-A Compressor Holding Fixture
J 25287 Clutch Coil Puller
J 25031 Rotor and Bearing Puller Guide

1. Clutch plate and hub assembly (3).
2. Rotor (5) and bearing (6) assembly.

- Mark the location of the clutch coil terminals on the compressor.

3. Install Rotor and Bearing Puller Guide J 25031 to the front head and install J 25287 and remove the clutch coil from the front head (figure 21).

Install or Connect (Figures 3 and 19)

Tool Required:
J 26271-A Rotor and Bearing Installer

1. Clutch coil (7) onto the neck of the front head (15).
   - Position the coil terminals as marked during removal.
2. Pulley rotor (5) and bearing (6) to the compressor with J 26271-A (figure 19).

Important

- Before seating the assembly, position the clutch coil terminals in the proper location to the compressor.
- Align the three protrusions on the rear of the clutch coil housing with the locator holes in the front head.

3. Retainer ring (4).
4. Clutch plate and hub assembly (3).

Inspect

- Clutch plate to clutch rotor air gap to 0.5-1.0 mm (0.020-0.040-inch).

MAJOR REPAIR TO THE COMPRESSOR

SHAFT SEAL REPLACEMENT

Remove or Disconnect (Figures 22 and 23)

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

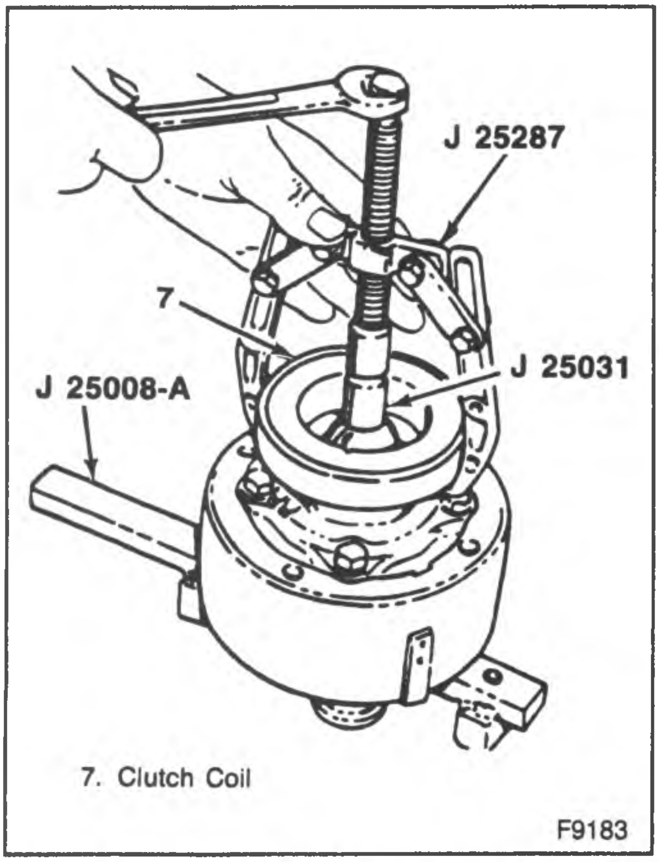


Figure 21—Removing the Poly-Groove Clutch Coil

1. Clutch plate and hub assembly. Refer to " Clutch Plate and Hub Replacement" earlier in this section.
2. Shaft seal seat retainer ring using J 5403.

Clean

- Inside of compressor neck area and O-ring groove surrounding the shaft, the exposed portion of the seal seat and the shaft itself. Any dirt or foreign material getting the compressor may cause damage.

3. Shaft seal (12).
   - Fully engage the knurled tangs of Seal Remover-Installer J 23128-A into the recessed portion of the seal by turning the handle clockwise. Remove the seal from the compressor with a rotary-pulling motion. Discard the seal. The handle must be hand-tightened securely. Do not use a wrench or pliers (figure 22).
4. Seal seat O-ring from the compressor neck using J 9553-01 (figure 23).

Inspect

- Shaft and inside of the compressor neck and O-ring groove for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

Seals should not be reused. Always use a new specification service seal kit on rebuild. Care should be taken to prevent damage to the lip of the one piece seal. Make sure that the seal seat and seal lip are free of lint and dirt that could damage the seal surface or prevent sealing.

Install or Connect (Figures 22, 24 and 25)

Tools Required:
- J 33011 O-Ring Installer
- J 23128-A Seal Seat Remover and Installer
- J 34614 Shaft Seal Protector
- J 5403 External Snap Ring Pliers
- J 9625-A Pressure Test Fixture

1. New O-ring seal, dipped in 525 refrigerant oil, onto J 33011 (figure 24).
2. Insert J 33011 completely down into the compressor neck until it bottoms. Lower the moveable slide of J 33011 to release the O-ring into the seal seat O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate J 33011 to seat the O-ring and remove.
3. New shaft seal to J 23128-A (figure 22).
   - Insert by turning handle clockwise, and then push J 34614, into seal lip. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so that flared-out side of lip seal is facing and installed towards the compressor.
4. Shaft seal.
   - Place J 34614 over end of compressor shaft and slide new seal onto the shaft until it stops. Disengage installer from seal and remove J 34614 from compressor shaft.

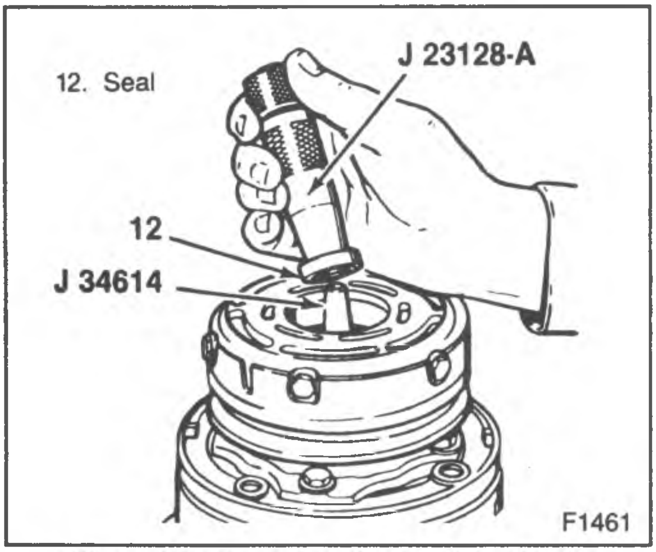


Figure 22—Removing the Shaft Seal with J 23128-A

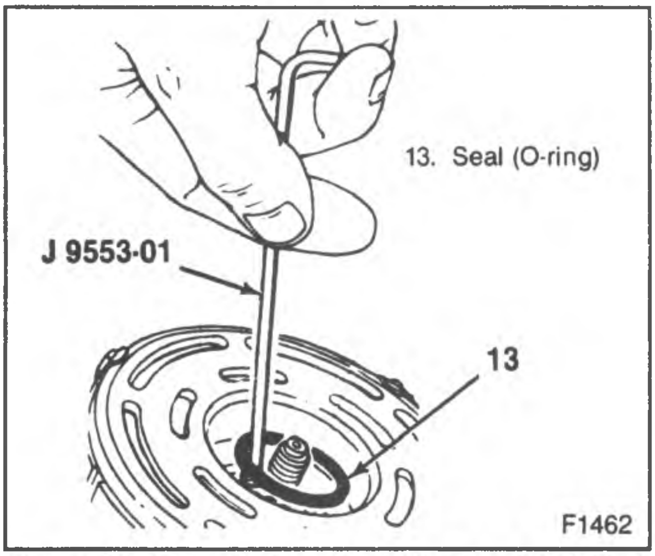


Figure 23—Removing and Installing the Shaft Seal

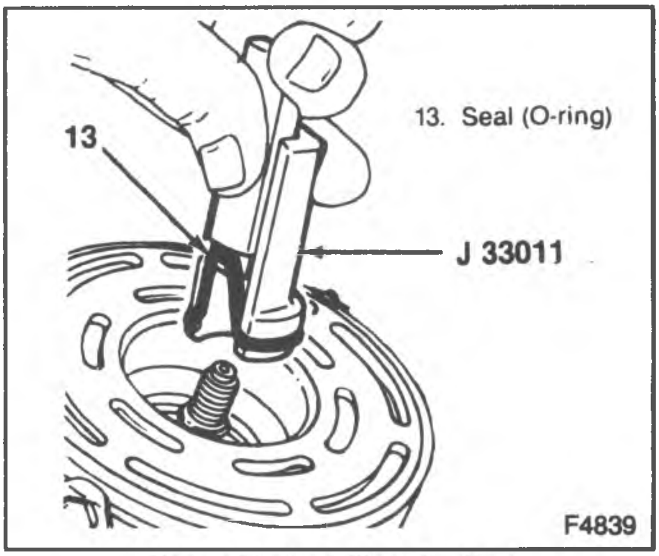


Figure 24—Installing the Seal

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

5. New seal seat retainer ring using J 5403.
   - Insert new seal seat retainer ring with its flat side against the seal seat, using J 5403. Use the sleeve from J 33011 to press in on the seal seat retainer ring so that it snaps into its groove.
6. Leak test as necessary (figure 25).
   - Install J 9625-A onto the rear head of the compressor and connect gage charging lines, or pressurize suction side (low pressure side) of compressor on vehicle with Refrigerant-12

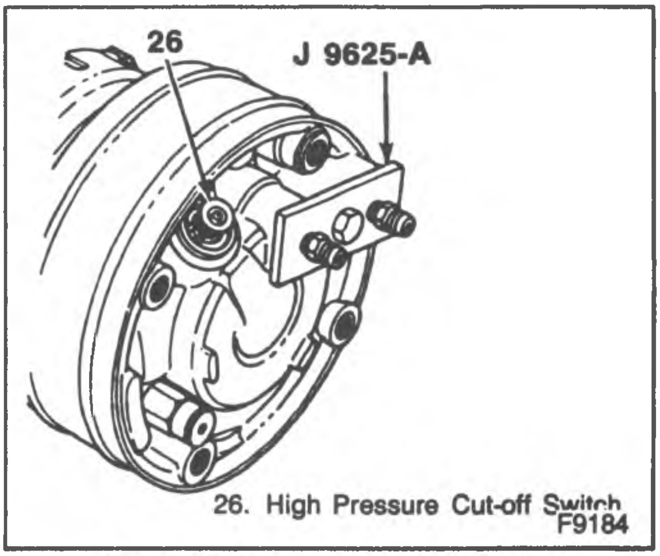


Figure 25—Compressor Leak Testing

vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and with the compressor in a horizontal position and using a wrench, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal and correct any leak found. Remove, discard and later replace with a new shaft nut.

7. Excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.
8. Clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly" earlier in this section.

PRESSURE RELIEF VALVE REPLACEMENT

Remove or Disconnect (Figure 3)

1. Valve (24).
2. O-ring (23).

Install or Connect (Figure 3)

1. New O-ring (25).
   - New O-ring should be coated with 525 viscosity refrigerant oil.
2. Valve (24).

HIGH SIDE HIGH PRESSURE CUTOFF SWITCH REPLACEMENT

Remove or Disconnect (Figure 3)

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

1. Electrical connector at switch.
2. Switch retaining ring using J 5403.
3. Switch from compressor by pulling on terminal housing.
4. Old O-ring seal from the switch cavity using J 9553-01.
   - If the high pressure cut-off switch is reinstalled in the compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used.

Inspect

- Switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary.

Install or Connect (Figure 3)

Tool Required:
J 5403 Internal Snap Ring Pliers

1. New O-ring seal coated with 525 refrigerant oil.
- Lubricate the high pressure cut-off switch housing with clean 525 refrigerant oil.
2. Switch into switch cavity until switch bottoms in cavity.
3. Switch retaining ring using J 5403.
4. Electrical connector into the switch.

FRONT HEAD AND O-RING REPLACEMENT

Remove or Disconnect (Figures 26 and 27)

Tool Required:
J 25031 Rotor and Bearing Puller

1. Clutch rotor and bearing assembly. Refer to "Clutch Rotor and Bearing Replacement" earlier in this section.
   - Perform steps 1 through 4 of the removal procedure, but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly.
2. Shaft seal. Refer to "Shaft Seal Replacement" earlier in this section.
   - Before removing the front head, mark the cylinder next to the narrow front head leg position.
3. Four front head mounting screws (figure 26).
4. Front head assembly (figure 27).
5. Front head O-ring.

Install or Connect (Figures 26 and 27)

Tool Required:
J 26271-A Rotor and Bearing Installer

Inspect

- Front head and compressor cylinder area for any dirt, lint, etc. and clean if necessary.

1. New front head O-ring coated with 525 viscosity refrigerant oil into the seal groove on the front head.
2. Front head assembly (figure 27).
   - Position the front head narrow leg to the marking previously made on the cylinder.
3. Four front head mounting screws (figure 26).

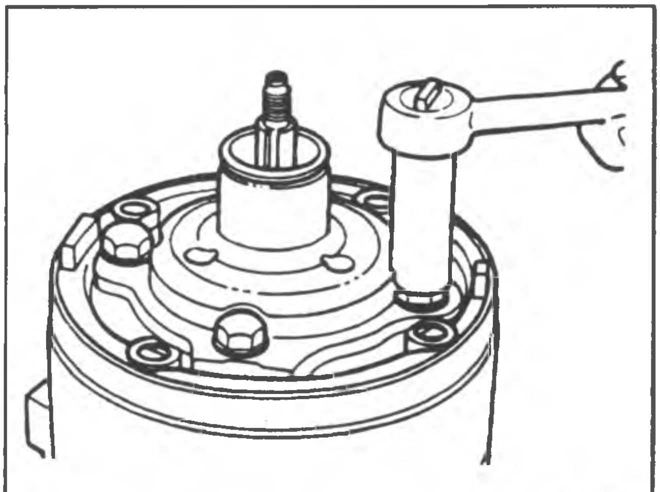

F6140

Figure 26—Removing the Front Head Mounting Screws

Tighten

- Front head mounting screws to 27 N·m (20 ft.lbs.).

4. New shaft seal.
5. Clutch Rotor and Bearing, Clutch Coil and Pulley Rim assembly to the front head using J 26271-A.
   - Before fully seating the assembly onto the front head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the front head.
6. Clutch plate and hub assembly. Refer to "Clutch Plate and Hub Assembly Replacement"earlier in this section. Check to see that the clutch plate to clutch rotor gap is 0.5-1.0mm (0.020-0.040 inches).

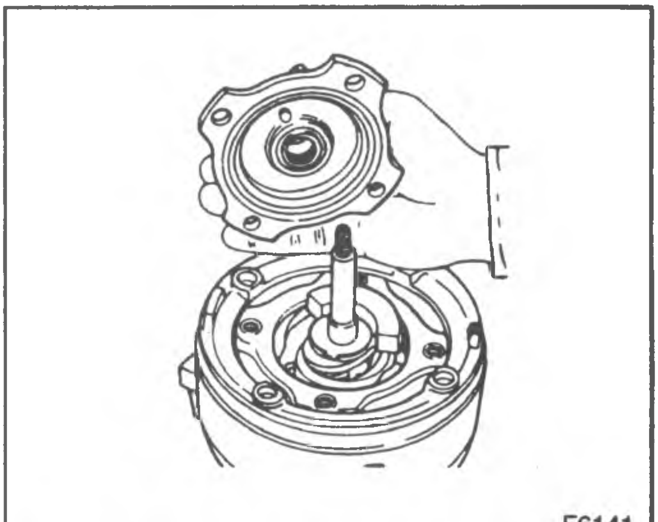


Figure 27—Removing the Front Head Assembly

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-A 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 in to 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 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, reassembly 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.

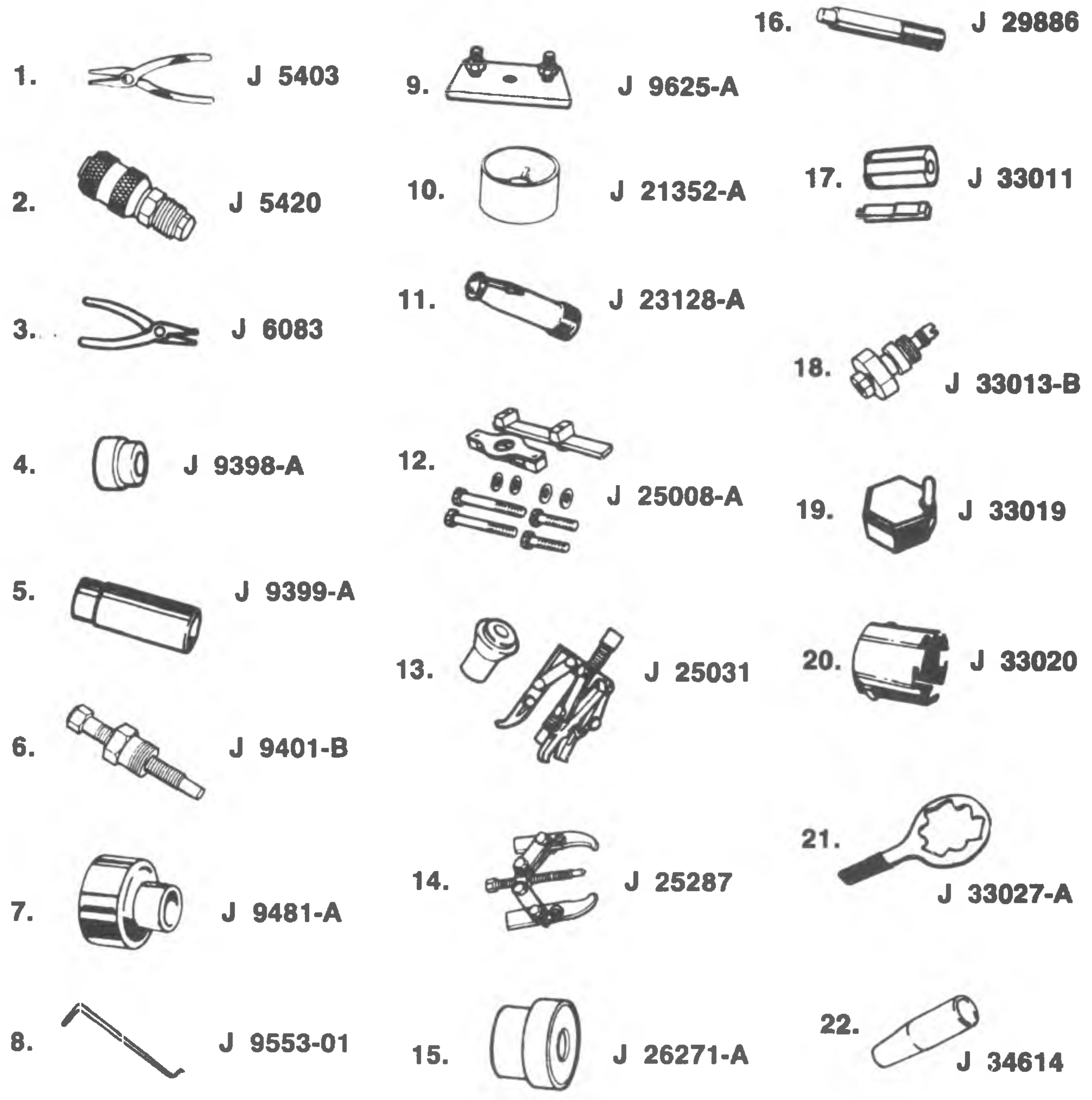
SPECIFICATIONS

R-4 COMPRESSOR

COMPRESSOR	
Type-Harrison R-4	4 Cylinder Radial
Displacement	10 cu. in.
Rotation	Clockwise
Oil Capacity	177 ml (6 fl. oz.)
Clutch Plate to Rotor Gap	0.5-1.0 mm (0.02-0.04 in.)
TORQUE SPECIFICATIONS	
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.)

T2503

SPECIAL TOOLS



1. Snap Ring Pliers (Internal)
2. Straight Connector
3. Snap Ring Pliers (#24 Internal)
4. Rotor Bearing Remover
5. 9/16 Inch Thin Wall Socket
6. Hub and Drive Plate Remover and Installer
7. Pulley Bearing and Pulley Installer
8. O-Ring Remover
9. Pressure Plate Connector
10. Compressor Support Block
11. Seal Seat Remover and Installer
12. Compressor Holding Fixure
13. Rotor and Bearing Puller
14. Clutch Coil Puller
15. Rotor and Bearing Installer
16. Driver Handle
17. O-Ring Installer
18. Hub and Driver Plate Remover and Installer
19. Bearing Staking Tool
20. Pully Puller
21. Clutch Hub Holding Tool
22. Shaft Seal Protector

F9194

SECTION 1B4

HR-6 HE AIR CONDITIONING COMPRESSOR

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 DESCRIPTION

The Harrison HR-6 HE 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.

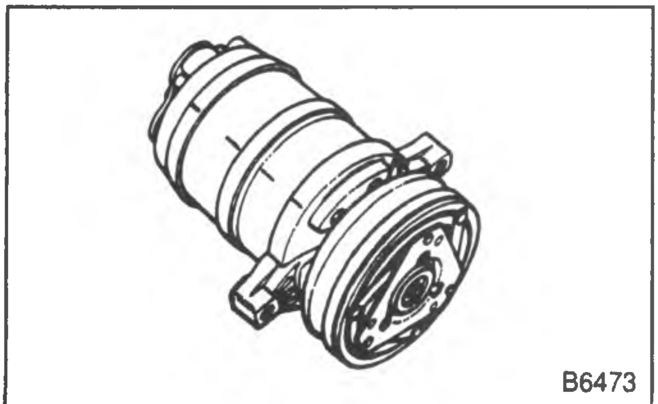


Figure 1—HR-6 HE Compressor, V-Groove Pulley

The piston group of the compressor is not serviceable. If piston, bearing, ball shoe, shaft and axial plate,

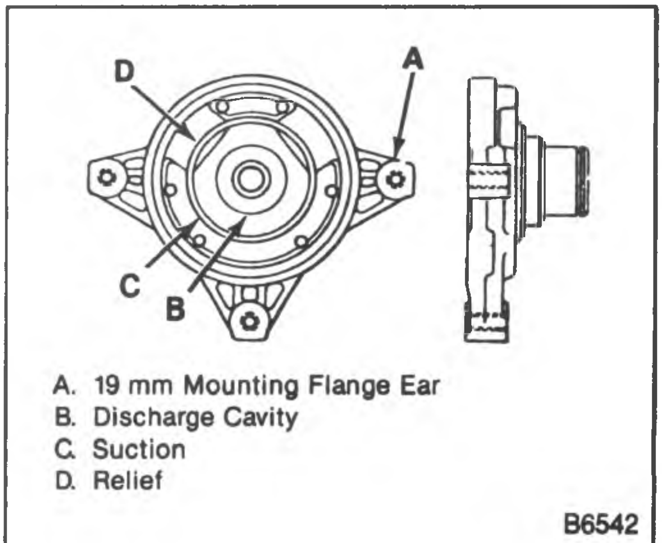


Figure 2—HR-6 HE Front Head Assembly

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.

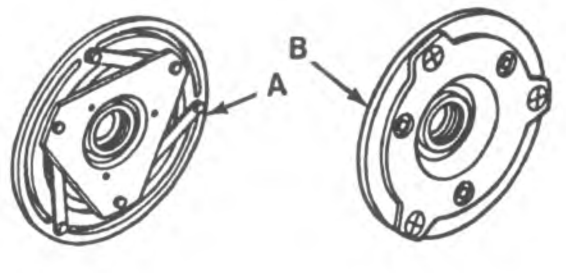
The front head is shown with three integral mounting flange ears (figure 2). These ears have 19 mm flats cast to provide for a wrench to be used as a prying means when tensioning the compressor drive belt.

There are two clutch driver designs for the HR-6 HE 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-A is used in place of J 33027-A.

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 Trichlorethane, naptha, Stoddard solvent, kerosene, or equivalent solvent and dry. Use only lint free cloths to wipe parts.



A. Without Torque Cushion
B. Thin Torque Cushion

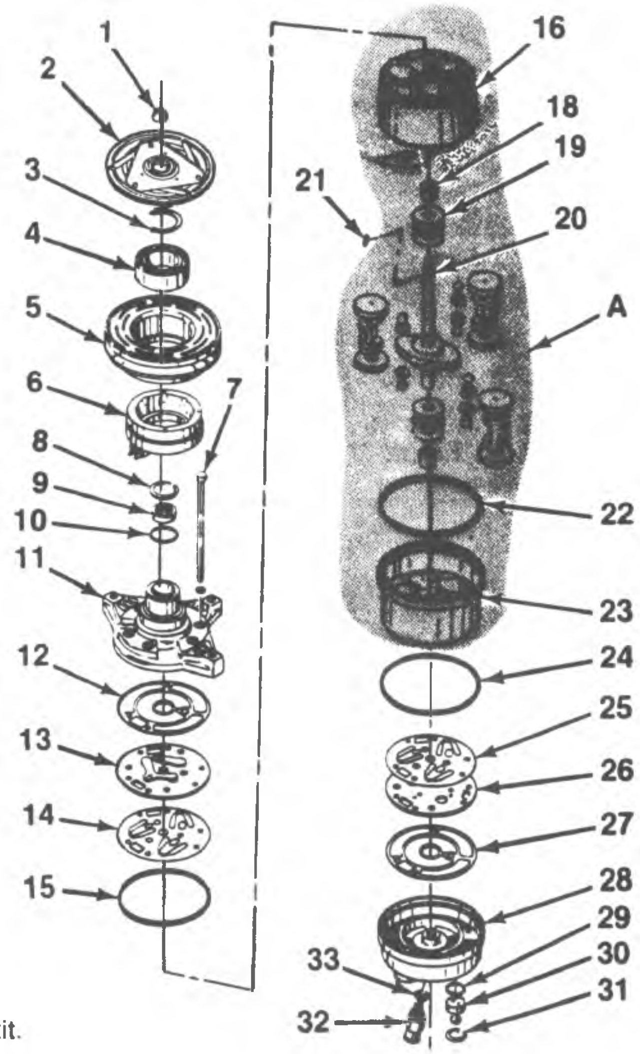
F5646

Figure 3—HR-6 HE Clutch Driver Designs

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

1. Shaft Nut
2. Clutch Plate and Hub Assembly
3. Pulley 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.



F6508

Figure 4—HR-6 HE Component View

and an equal amount of new 525 viscosity refrigerant oil added to the compressor.

Note: The service compressor is shipped with 236 ml (8 fl.oz.) of 525 viscosity refrigerant oil. This oil should be drained and retained for replacement oil when service procedures required 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.

MINOR REPAIR TO THE COMPRESSOR

CLUTCH PLATE AND HUB ASSEMBLY REPLACEMENT

Clean

- The compressor assembly with solvent and blow dry.

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

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

- 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-A.
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 shaft key (21) if usable.

Inspect

- All parts and replace as necessary.

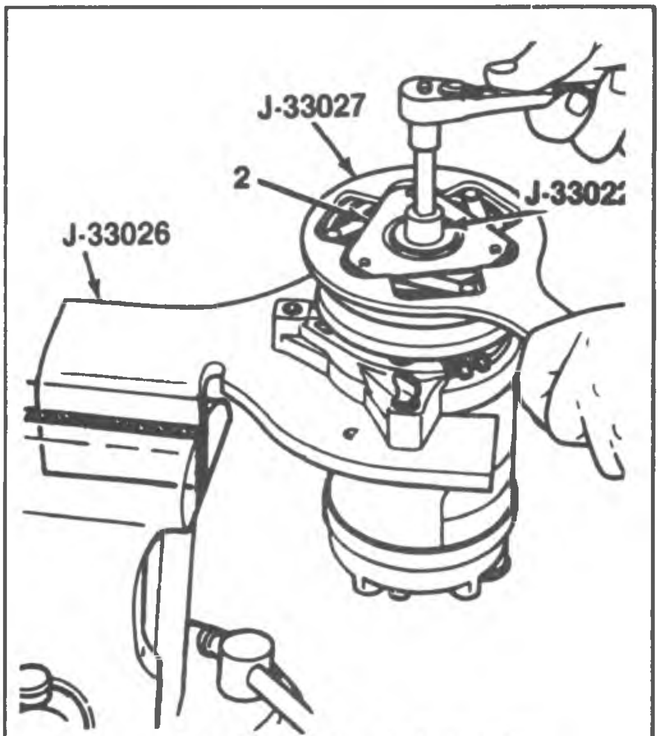
Install or Connect (Figures 4, 7 and 8)

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

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.

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

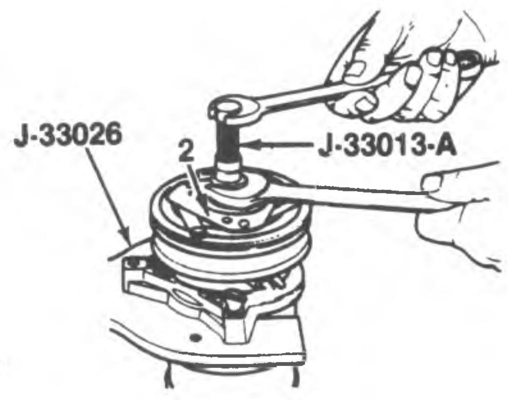
2. Clutch plate and hub assembly (2) (figure 8).
   - Make sure the contact surfaces of the clutch plate (2) and the pulley (5) are clean.
   - Remove the forcing screw tip from J 33013-B and reverse the body direction on the center screw.
   - Install J 33013-B with bearing (B) (figure 8).
   - Back off J 33013-B body enough to allow the center screw to be threaded against the end of the compressor shaft (38).
   - 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



2. Clutch Plate And Hub Assembly

F4458

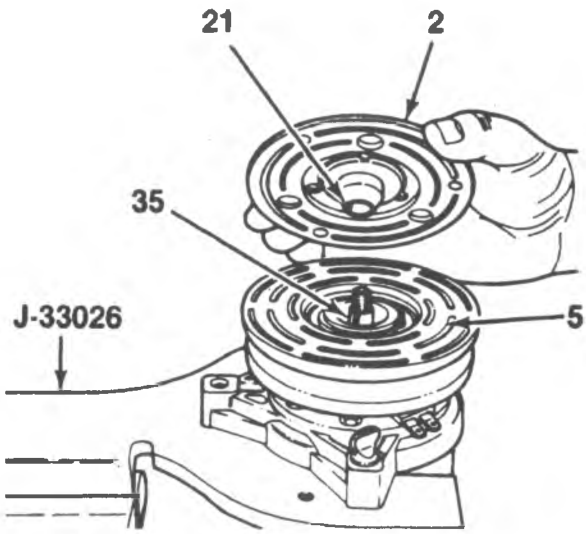
Figure 5—Removing the Shaft Nut



2. Clutch Plate And Hub Assembly

B6574

Figure 6—Removing the Clutch Plate and Hub Assembly



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

F4459

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

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.

3. Shaft nut (1).

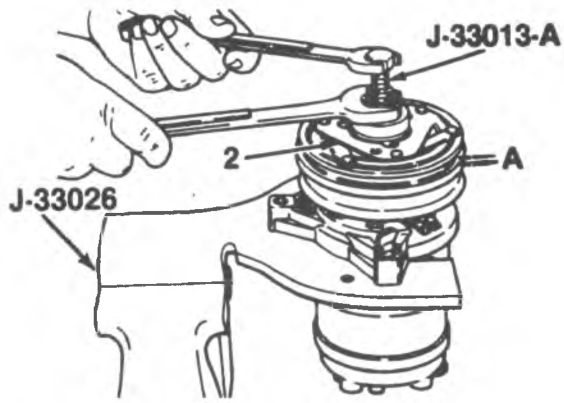
Inspect

- Position of the shaft (20) (even with or slightly above the clutch hub).
- Use J 33027-A 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
A. Air Gap 0.38-0.64 mm (.015-.025 inch)

F4460

Figure 8—Installing the Clutch Plate and Hub Assembly

ROTOR AND/OR BEARING ASSEMBLY REPLACEMENT

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

Tools Required:
J 6083 External 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. Rotor and bearing assembly retaining ring (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 6083 Snap Ring Pliers
J 8433-1 Puller Bar
J 9481-A Pulley Bearing Installer
J 33017 Pulley and Bearing Assembly Installer

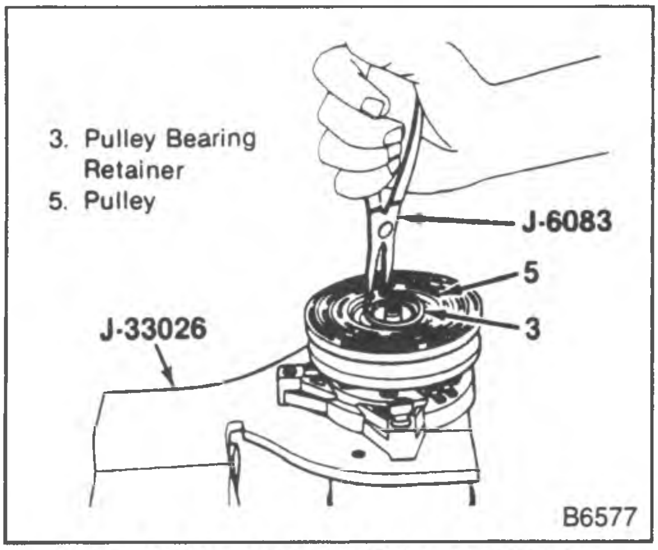


Figure 9—Removing the Rotor and Bearing Retaining Ring

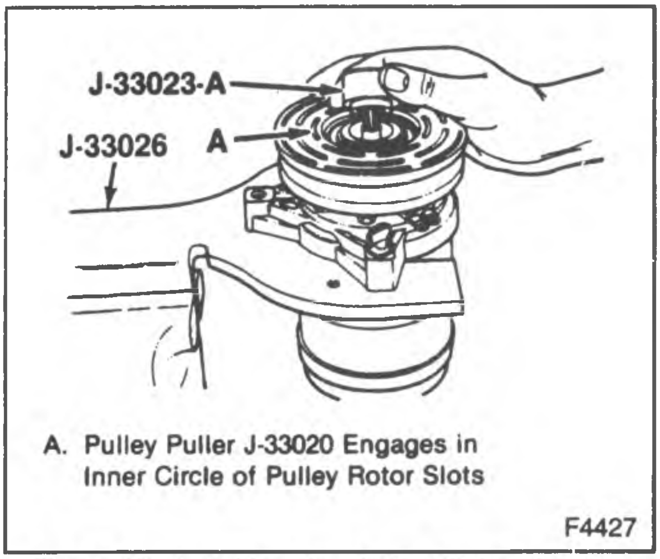


Figure 10—Installing the Puller Pilot and Pulley Rotor Slot Location

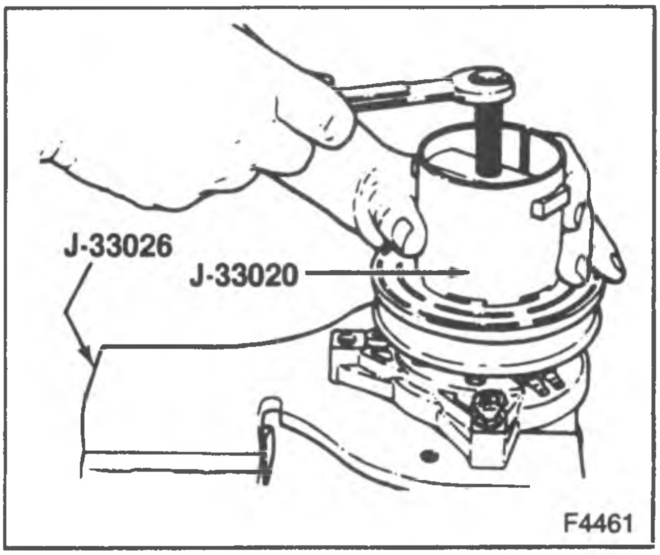


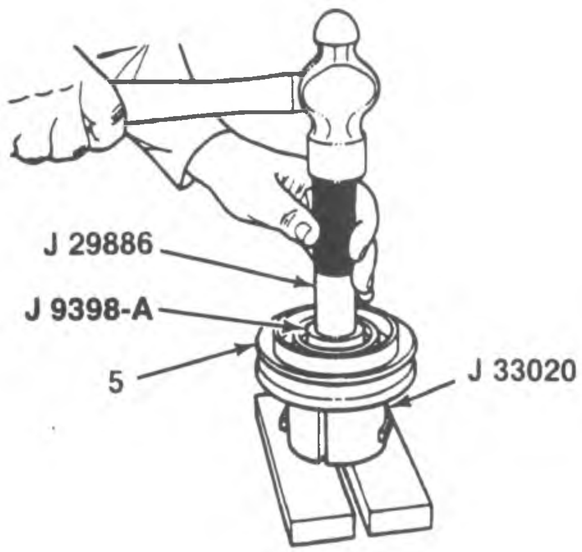
Figure 11—Installing J 33020 In the Pulley Rotor Slots

J 33019 Bearing Staking Tool (with staking pin and retaining band)
J 33023-A Puller Pilot
J 33026 Compressor Holding Fixture
J 21352-A Compressor Support Block

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.

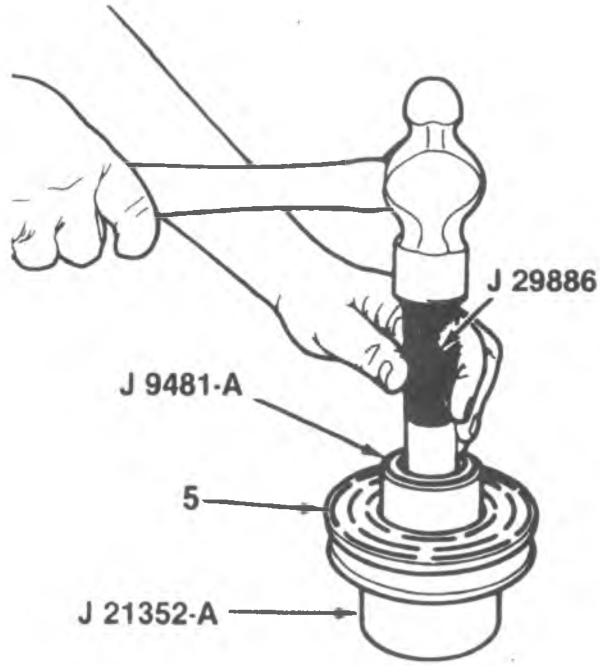
2. Pulley bearing (4) into the hub using J 29886, J 9481-A and J 21352-A (figure 13).
   - J 33019 in the pulley bore (figure 14).
   - Seat the pulley and bearing assembly on J 21352-A to support to the hub under the staking pin location (figure 14).
   - Strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching the bearing.
     — Position the stake pin after striking.



5. Pulley Rotor "Face Down"

F7096

Figure 12—Removing the Pulley Bearing



5. Pulley (Rotor)

F5648

Figure 13—Installing the Pulley Rotor Bearing

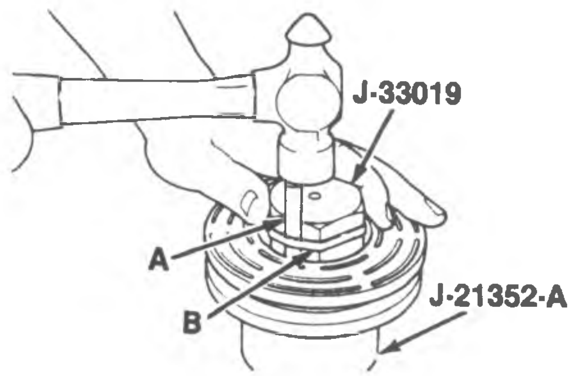
- — The staked metal should not contact the outer race of the bearing to prevent the possibility of bending the outer race.
- — Stake 3 places 120 degrees apart (figure 15).

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).
     - — The thread of the through bolts should engage the full thickness of the compressor holding fixture.

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).



A. Staking Pin
B. Rubber Band

B6544

Figure 14—Staking the Pulley Bearing in the Rotor Bore

CLUTCH COIL 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

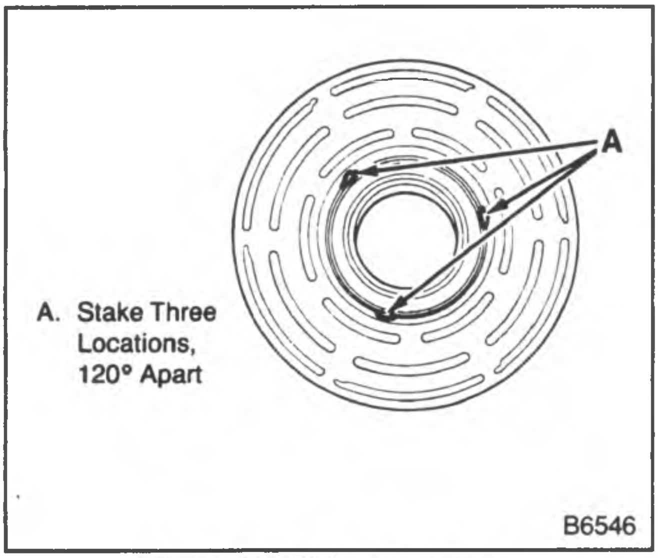


Figure 15—Staking Locations

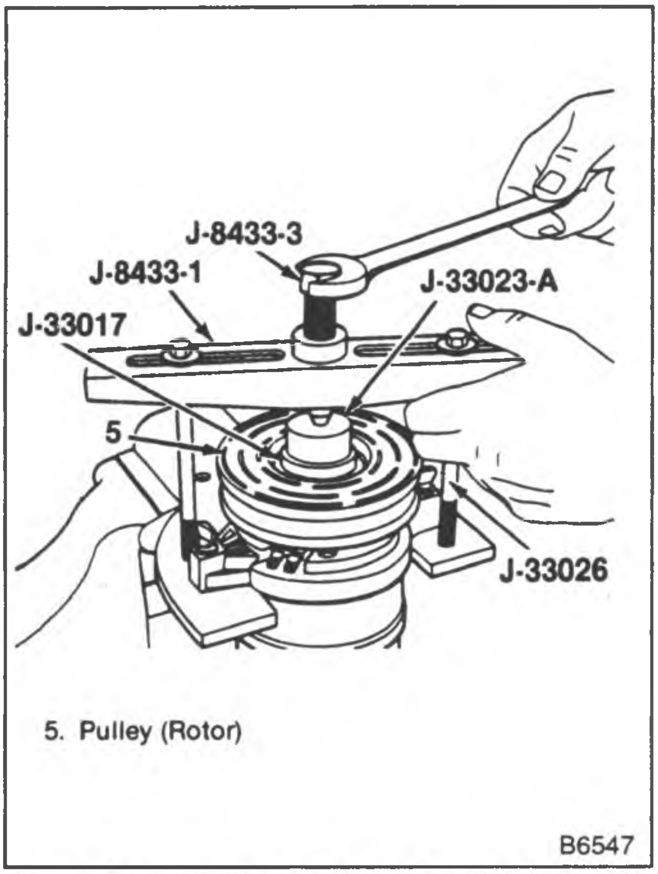


Figure 16—Installing the Pulley Bearing Assembly

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.

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.

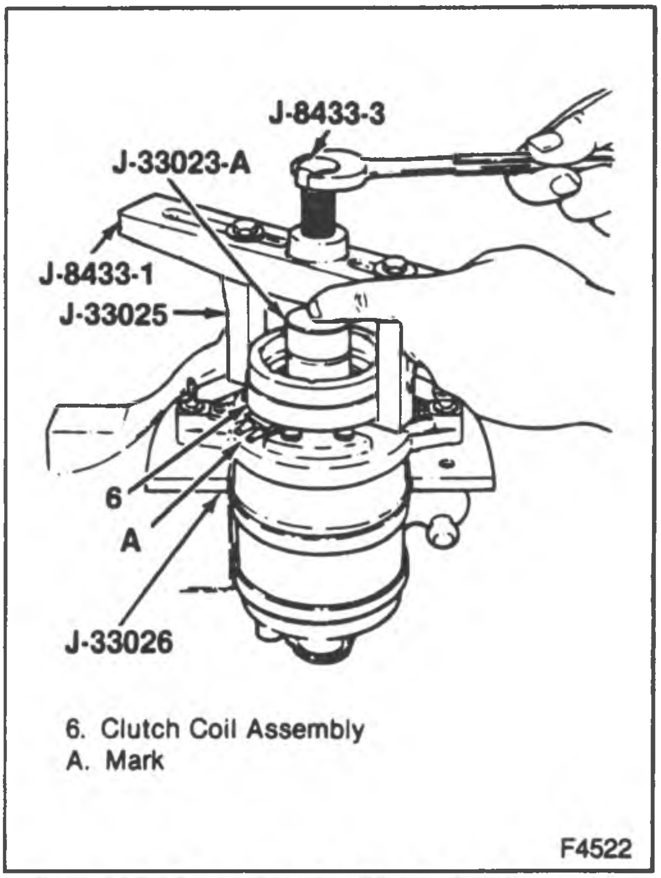
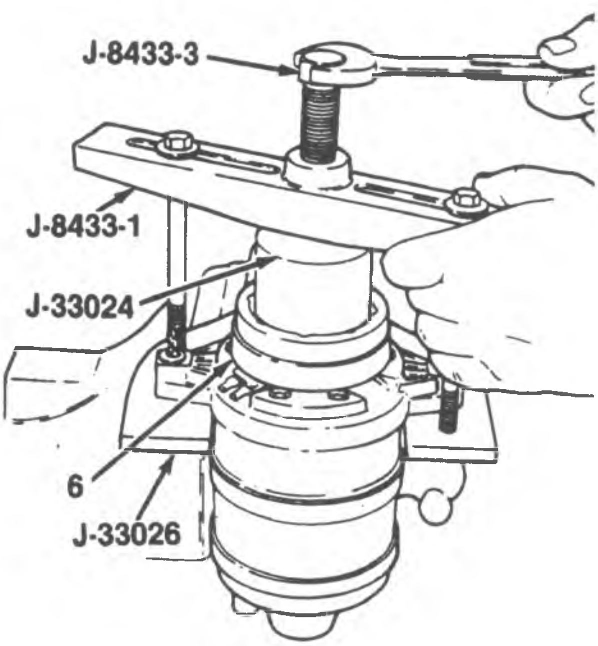


Figure 17—Removing the Clutch Coil Assembly



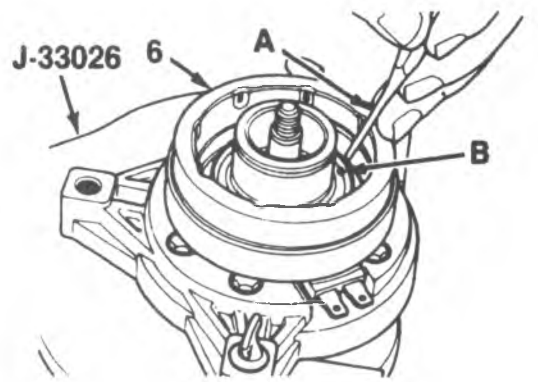
6. Clutch Coil Assembly

F4462

Figure 18—Installing the Clutch Coil Assembly

- When the clutch coil assembly (27) is seated on the front head (11), 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 (6) remains in position (figure 19).

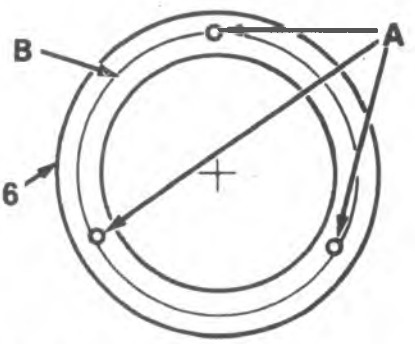
— Stake size should be one half the area of the punch tip and 0.28-0.35 mm (0.010-0.015-inch) deep (figure 20).



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

F4523

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



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

B6552

Figure 20—Staking Locations on the Front Head

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

MAJOR REPAIR TO THE COMPRESSOR

SHAFT SEAL REPLACEMENT

Remove or Disconnect (Figures 4, 21, 22, 23 and 24)

Tools Required:
J 5403 External 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, 21, 22, 23 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 External 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).

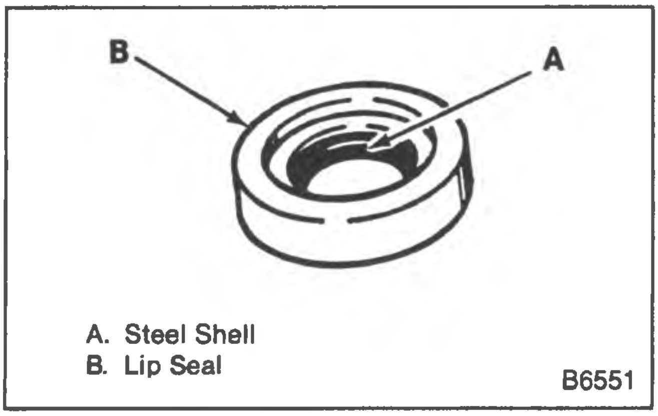


Figure 21—Compressor Shaft Seal

- 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.
- Release and remove J 23128-A.

3. Shaft seal retaining using J 5403 (figure 22).
   - 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 (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 O-ring seal with 525 viscosity refrigerant oil.

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

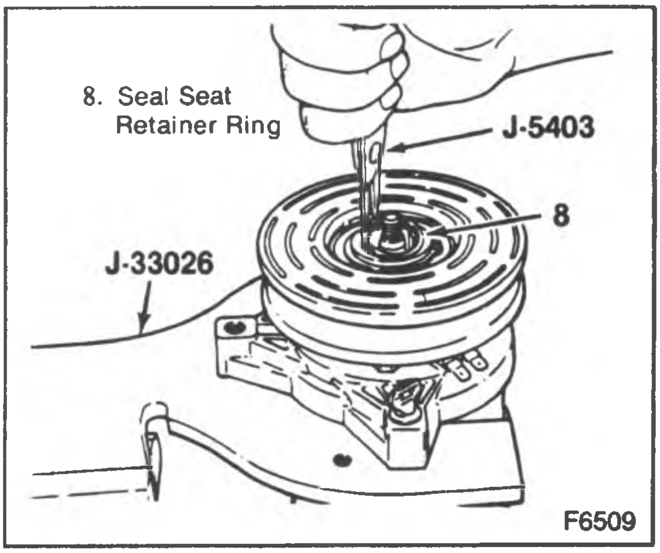
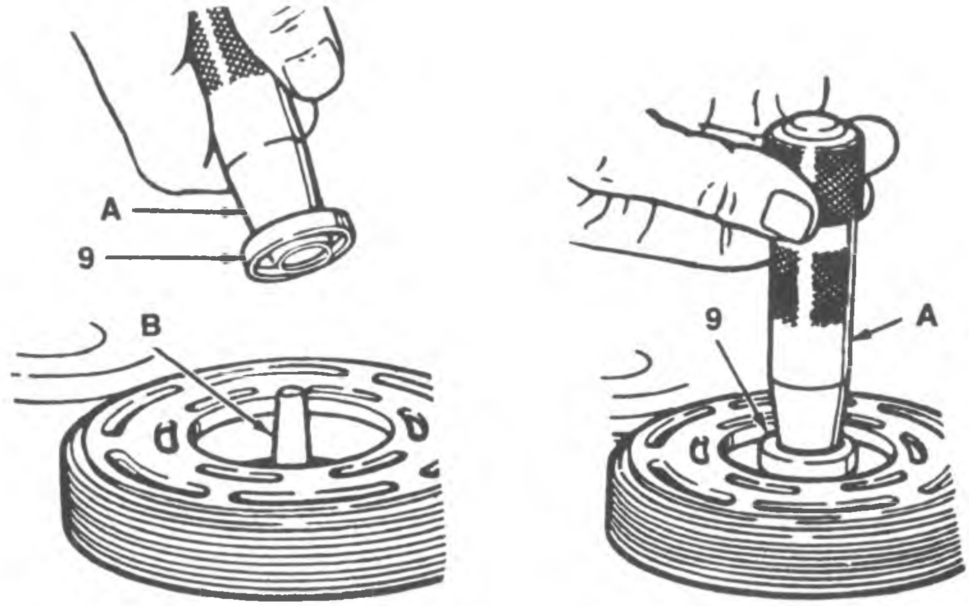


Figure 22—Removing or Installing the Shaft Lip Seal Retaining Ring



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

F6507

Figure 23—Removing or Installing Shaft Lip Seal

Tighten

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

Important

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

CONTROL SWITCH REPLACEMENT

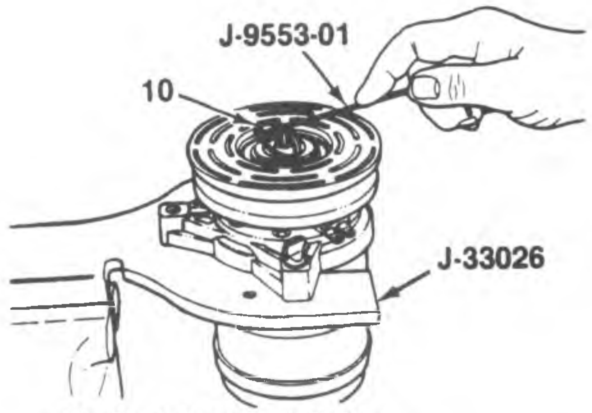
Remove or Disconnect (Figure 4)

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

1. Electrical connector from the switch in the rear head of the compressor.
2. Switch retaining ring (31) with J 5403.
3. Switch (30).
4. O-ring seal (29) from the switch cavity with J 9553-01.

Important

- If existing control switch is reinstalled in the compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used.



10. Shaft Seal Seat O-Ring

F6510

Figure 24—Removing the Shaft Seal Seat O-Ring

Install or Connect (Figure 4)

Tools Required:
J 5403 External Snap Ring Pliers
J 33011 O-Ring Seal Installer

1. O-ring seal (29) with J 33011.
   - Dip the seals into new clean 525 refrigerant oil.
2. Switch (30).
3. Switch retaining ring (31) with J 5403.
4. Electrical connector to the switch in the rear head of the compressor.

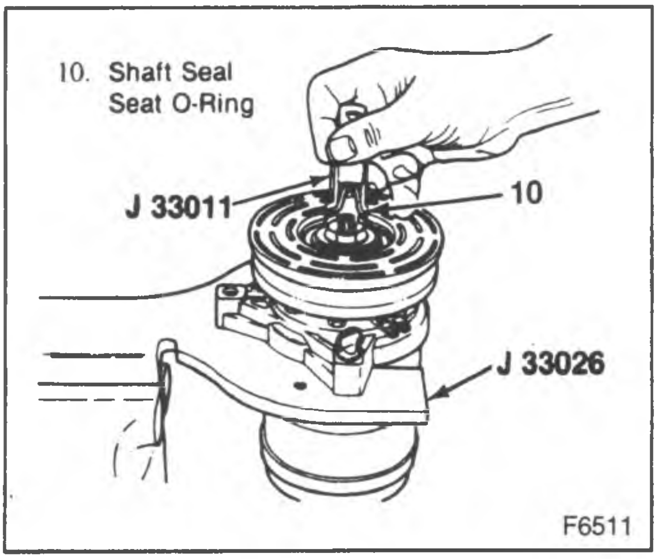


Figure 25—Installing the Seal Seat O-Ring

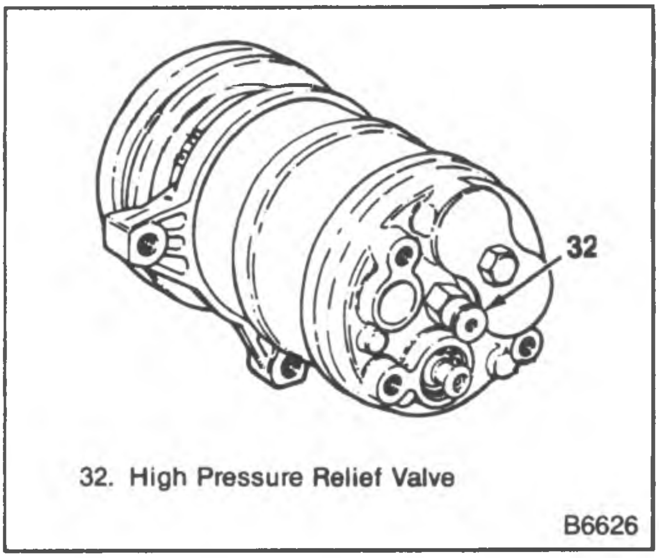


Figure 26—HR-6 HE Compressor Rear Head Detail

LEAK TESTING

Tools Required:
J 9625-A Pressure Test Plate
J 23500-01 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 the compressor (figure 4).
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 the corresponding fittings on J 9625-A using gage adapters or hoses equipped with valve depressors. Suction port (low side) of the compressor has a 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 the refrigerant vapor to flow into the compressor.

Important

- Check for leaks at the 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 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 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 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 indic-ate 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.

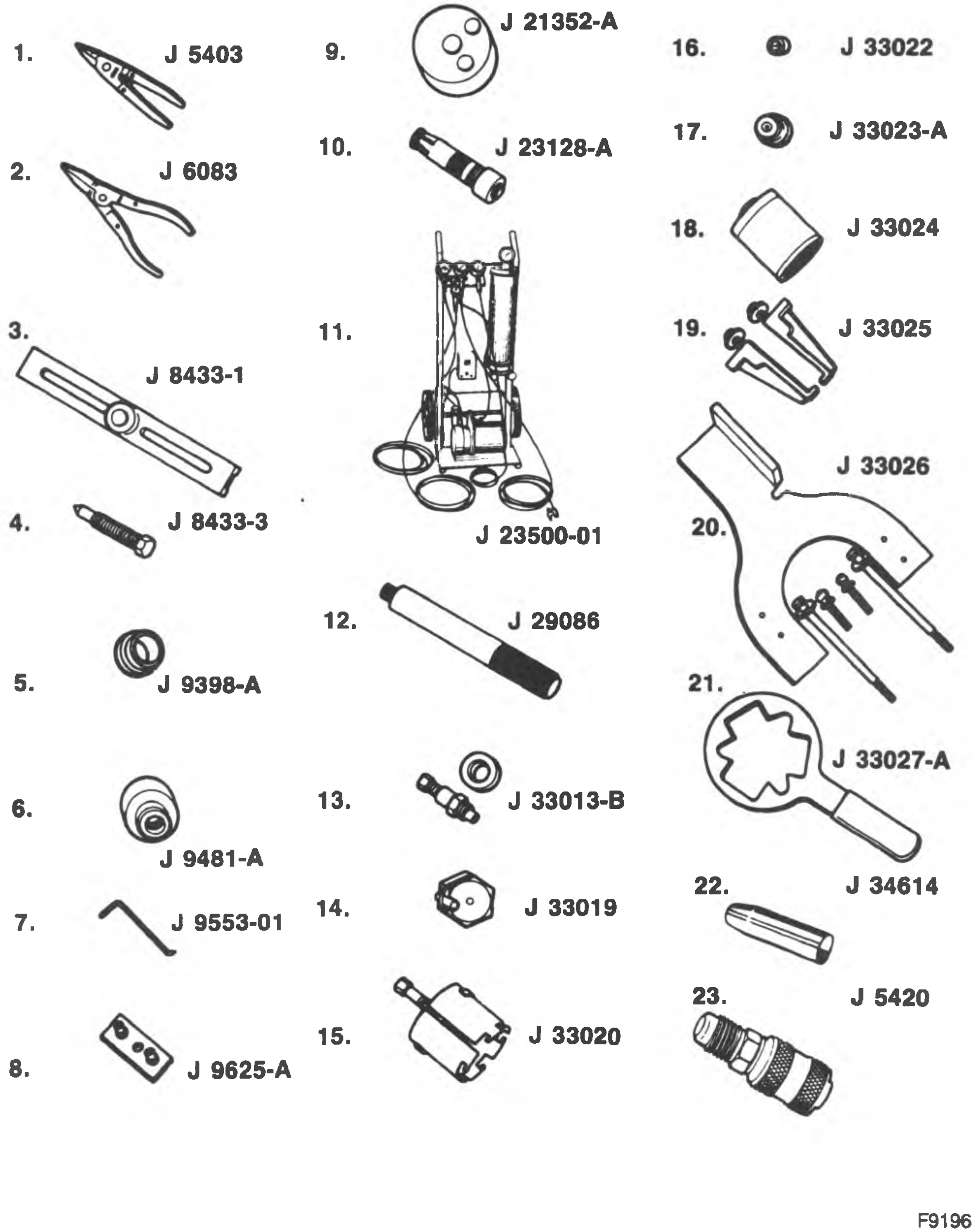
SPECIFICATIONS

HR-6 HE COMPRESSOR

COMPRESSOR	
Type—Harrison HR-6 HE	6 Cylinder Axial
Displacement	10.0 Cu. In.
Rotation	Clockwise
Oil Capacity	236 ml (8 fl. oz.)
Clutch Plate Air Gap	0.38-0.64 mm (0.015-0.025 inch)
TORQUE SPECIFICATIONS	
Compresor 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.)

T2504

SPECIAL TOOLS



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

F9197

SECTION 1B5

SD-709 AIR CONDITIONING COMPRESSOR

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 DESCRIPTION

The Sanden 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.

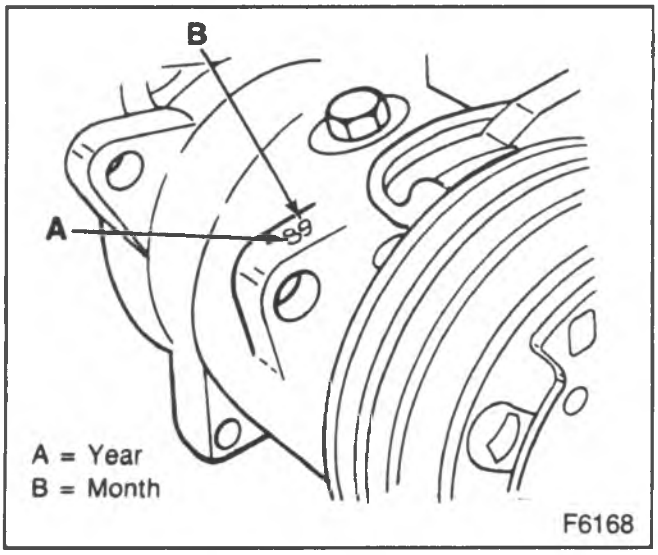


Figure 1—Date Code

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 accessability to the components (figure 2).

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.

DISASSEMBLY OF THE CLUTCH AND SHAFT SEAL

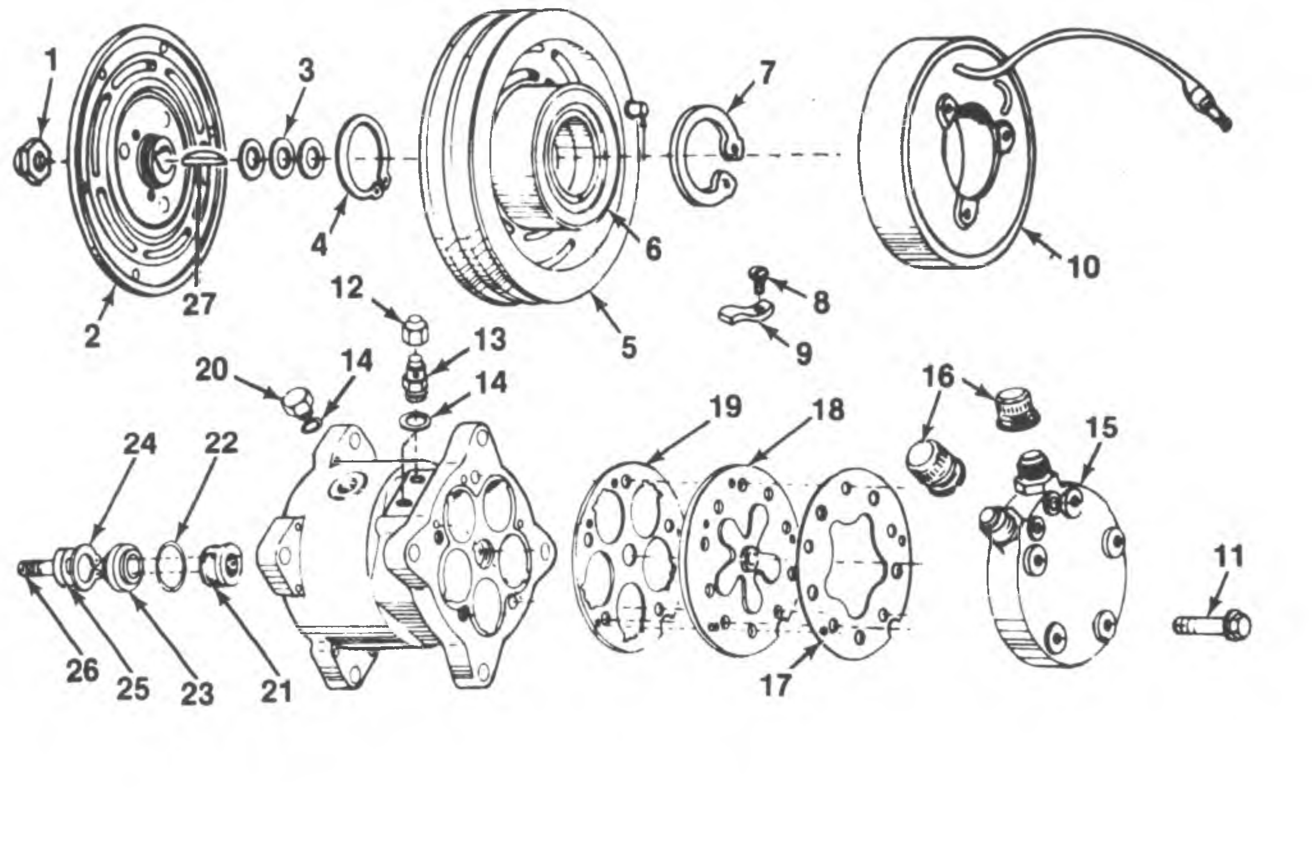
CLUTCH

Remove or Disconnect (Figures 2 through 9)

Tools Required:
- J 4245 Internal Snap Ring Pliers
- J 6435 External Snap Ring Pliers
- J 8433 Puller Set
- J 37825 Puller Plate Assembly
- J 37827 Puller Pilot
- J 37828 Puller Fingers
- J 37872 Spanner Wrench

- Insert the two pins of the J 37872 into any two threaded holes of the clutch front plate (2). Hold the clutch plate stationary (figure 3).

1. Hex nut using a 19 mm socket.
2. Clutch front plate using J 37825 (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 J 4245 (figure 6).
5. External front housing snap ring with J 6435.
6. Rotor pulley assembly.
   - Insert J 37828 into the snap ring groove.
   - Insert J 37827 over the exposed shaft (figure 7).
   - Align the thumb head bolts of J 8433 to the puller fingers and tighten.
   - Turn the puller center bolt to the right with a socket wrench until the rotor pulley is free (figure 8).



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

F6169

Figure 2—Compressor Components

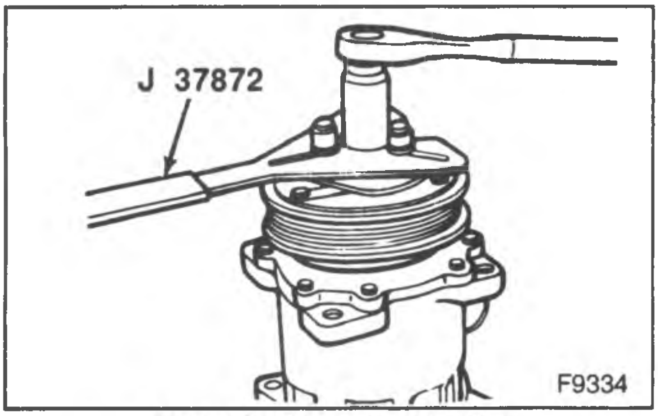


Figure 3—Removing the Nut

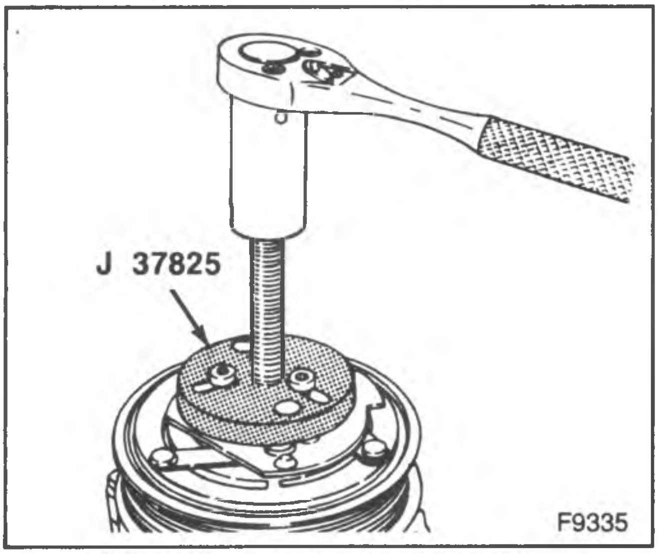


Figure 4—Removing the Clutch Plate

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.

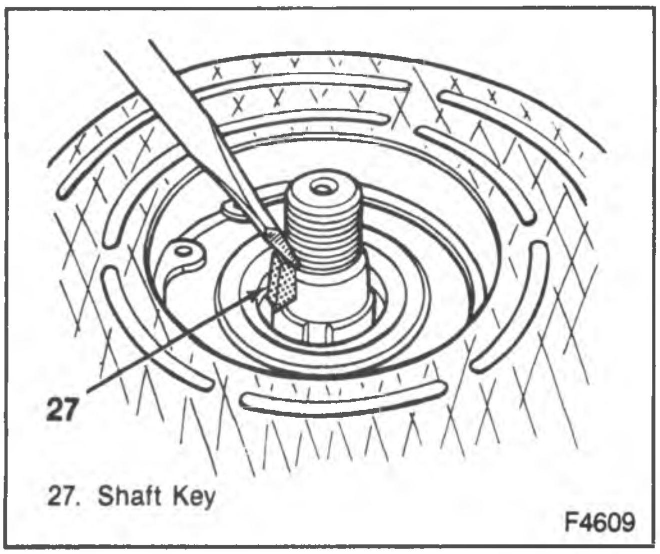


Figure 5—Removing the Shaft Key

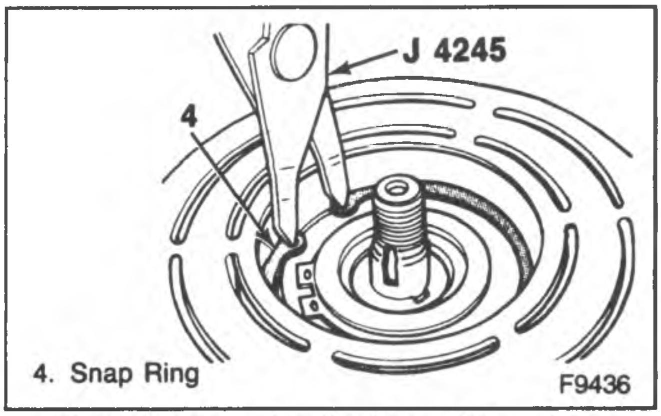


Figure 6—Removing the Internal Snap Ring

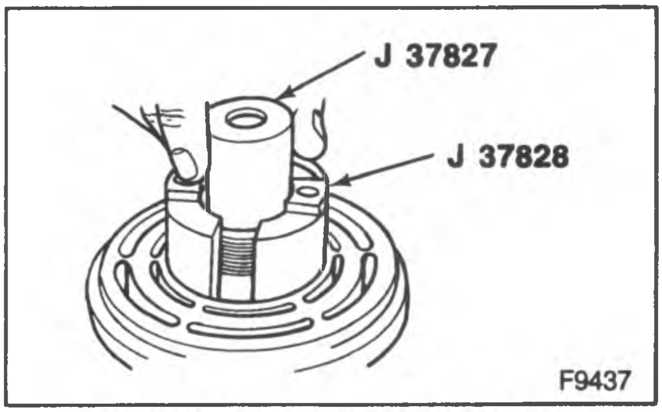


Figure 7—Removing the Rotor Pulley

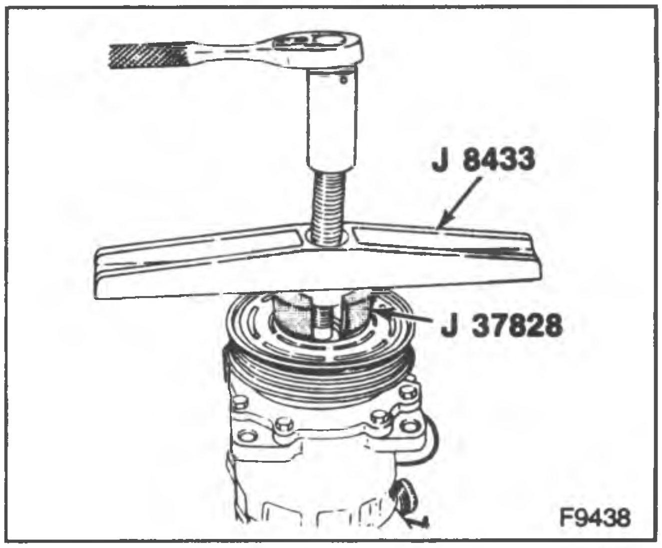


Figure 8—Removing the Rotor Pulley (Cont.)

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.

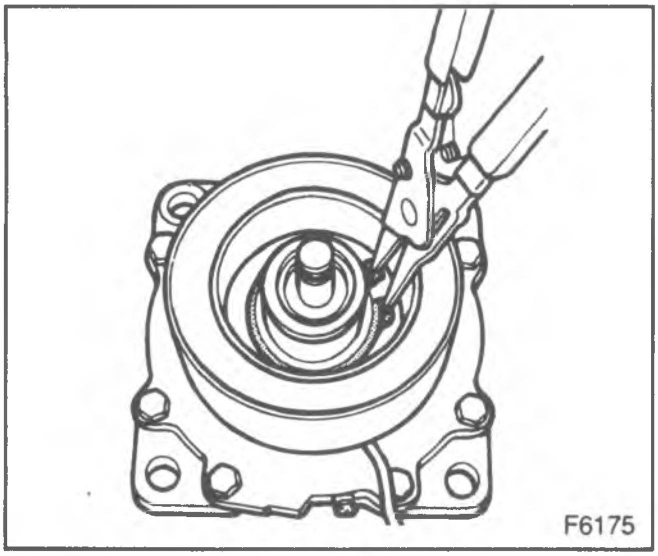


Figure 9—Removing the Coil Snap Ring

Remove or Disconnect (Figures 2 and 10 through 12)

Tools Required:
- J 4245 Internal Snap Ring Pliers
- J 9553-01 O-Ring Remover
- J 38468 Shaft Seal Remover and Installer
- J 38479 Seal Seat Remover and Installer

1. Clutch shims (3) using J 9553-01 and a small screwdriver.
2. Felt ring metal retainer (25).

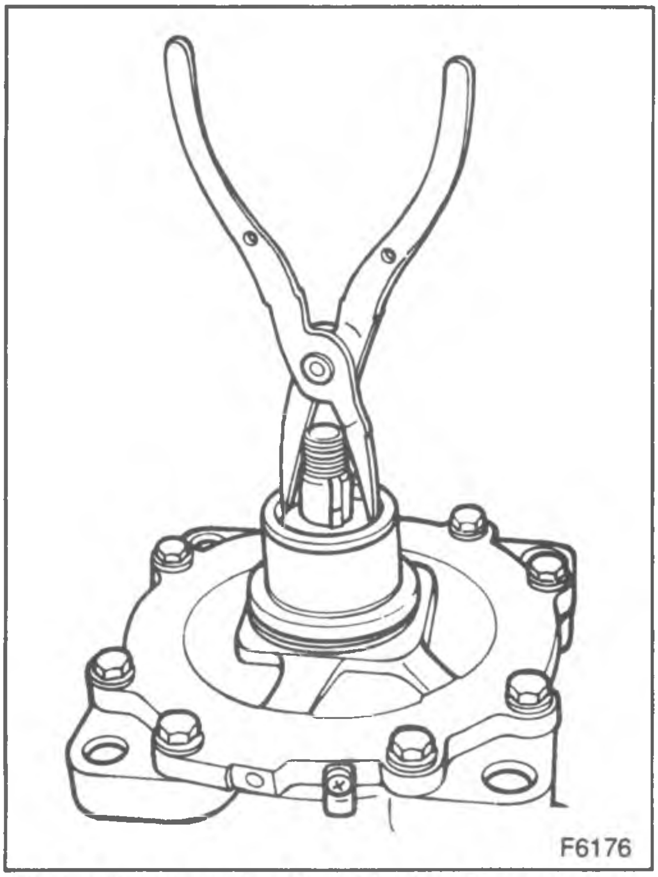


Figure 10—Removing the Felt Ring Metal Retainer

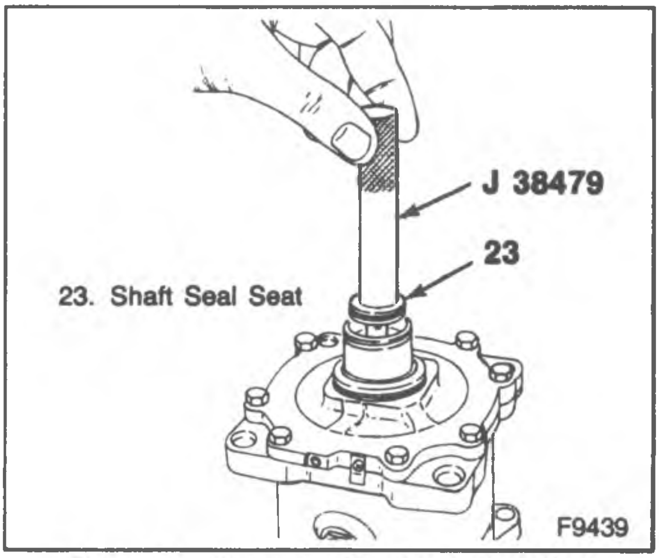


Figure 11—Removing the Shaft Seal Seat

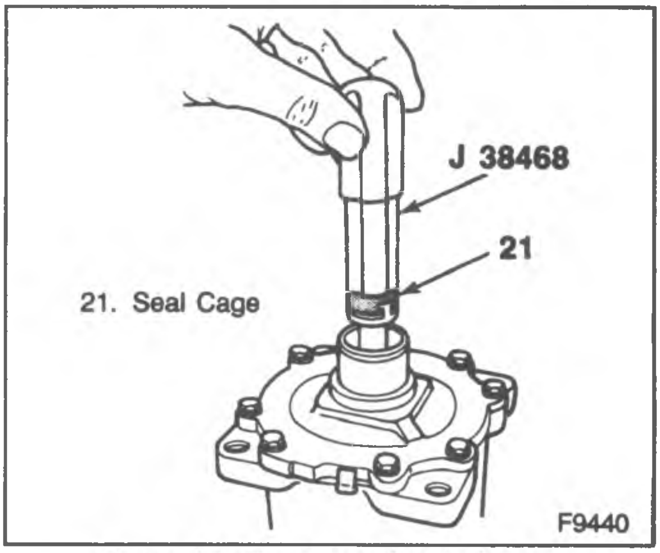


Figure 12—Removing the Seal Cage

- Insert the points J 4245 into the holes in the retainer and lift out (figure 10).

3. Shaft seal seat snap ring.
4. Shaft seal seat (23) with J 38479 (figure 11).
5. Seal assembly

- Press J 38468 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 38468 Shaft Seal Remover and Installer
- J 38479 Seal Seat Remover and 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 cage (21).
2. Slots of J 38468 to the new seal cage (21).
3. Seal assembly into place in the compressor seal cavity (figure 13).
   - Twist J 38468 to disengage it from the cage.
4. Clean refrigerant oil to the shaft seal seat.
5. Shaft seal seat (23) with J 38479 (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 and 14)

Tools Required:
J 4245 Internal Snap Ring Pliers
J 6435 External Snap Ring Pliers
J 29640 Shaft Protector
J 29886 Driver Handle
J 37872 Spanner Wrench
J 38467 Bearing Remover and Installer

1. Field coil and snap ring retainer.
   - The coil flange protrusions must match the hole in the front housing to prevent coil movement and to correctly place the lead wire.
2. Rotor pulley (5) to the front housing hub and align.
   - Place J 38467 into the bearing cavity with the outer edge on the rotor bearing outer race.
   - Place J 29886 into the ring (figure 14).
   - 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.
3. Internal bearing snap ring with J 4245.
4. External front housing snap ring with J 6435.
5. Shaft key (27).
6. Front plate assembly.
   - Align the front plate keyway to the compressor shaft key.
7. J 29640 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 37872 (figure 3).

Tighten

- Nut to 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 remover shims from the shim stack.

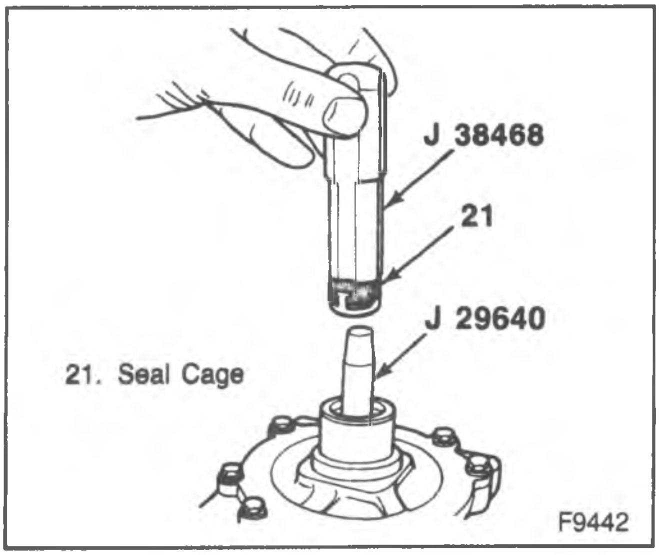


Figure 13—Installing the Seal Cage

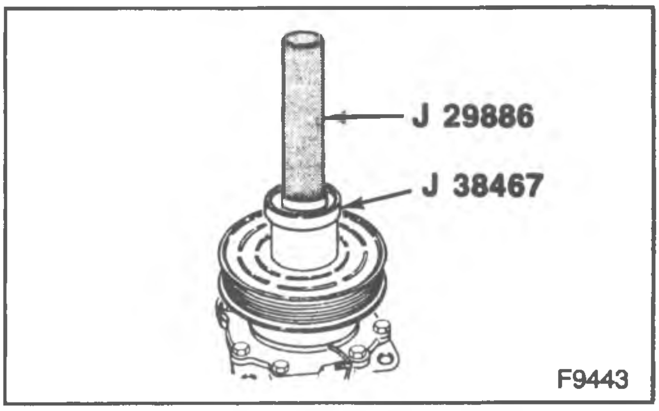


Figure 14—Installing the Rotor Pulley

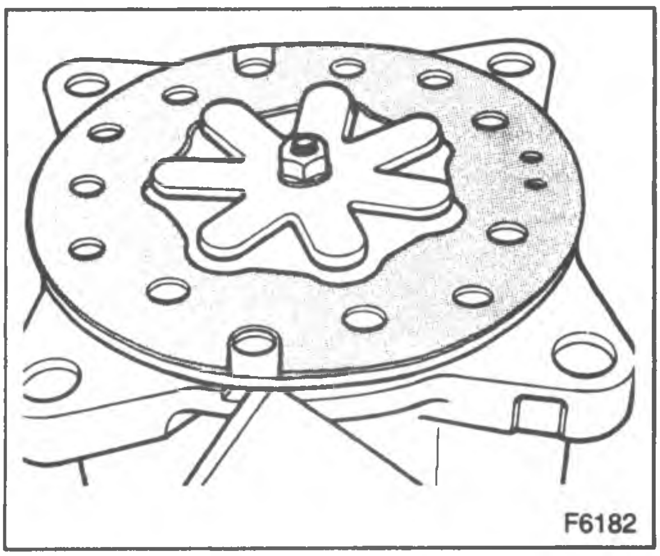


Figure 15—Loosening the Valve Plate

DISASSEMBLY OF THE CYLINDER HEAD AND VALVE PLATE

Remove or Disconnect (Figures 2 and 15)

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 it worn.
4. Gasket material carefully from the valve plate and cylinder head with the gasket scraper.

ASSEMBLY OF THE CYLINDER HEAD AND VALVE PLATE

Important

- Use new gaskets for reassembly.

Install or Connect (Figures 2 and 16)

1. Clean refrigerant oil to the valve plate gasket (17).
2. Gasket to the locating pin holes and oil orifice in the cylinder block.

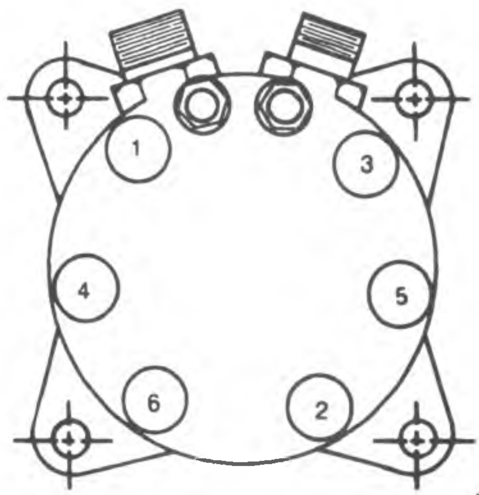


Figure 16—Torque Sequence

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. Cylinder head (15) and cap screws (11).

Tighten

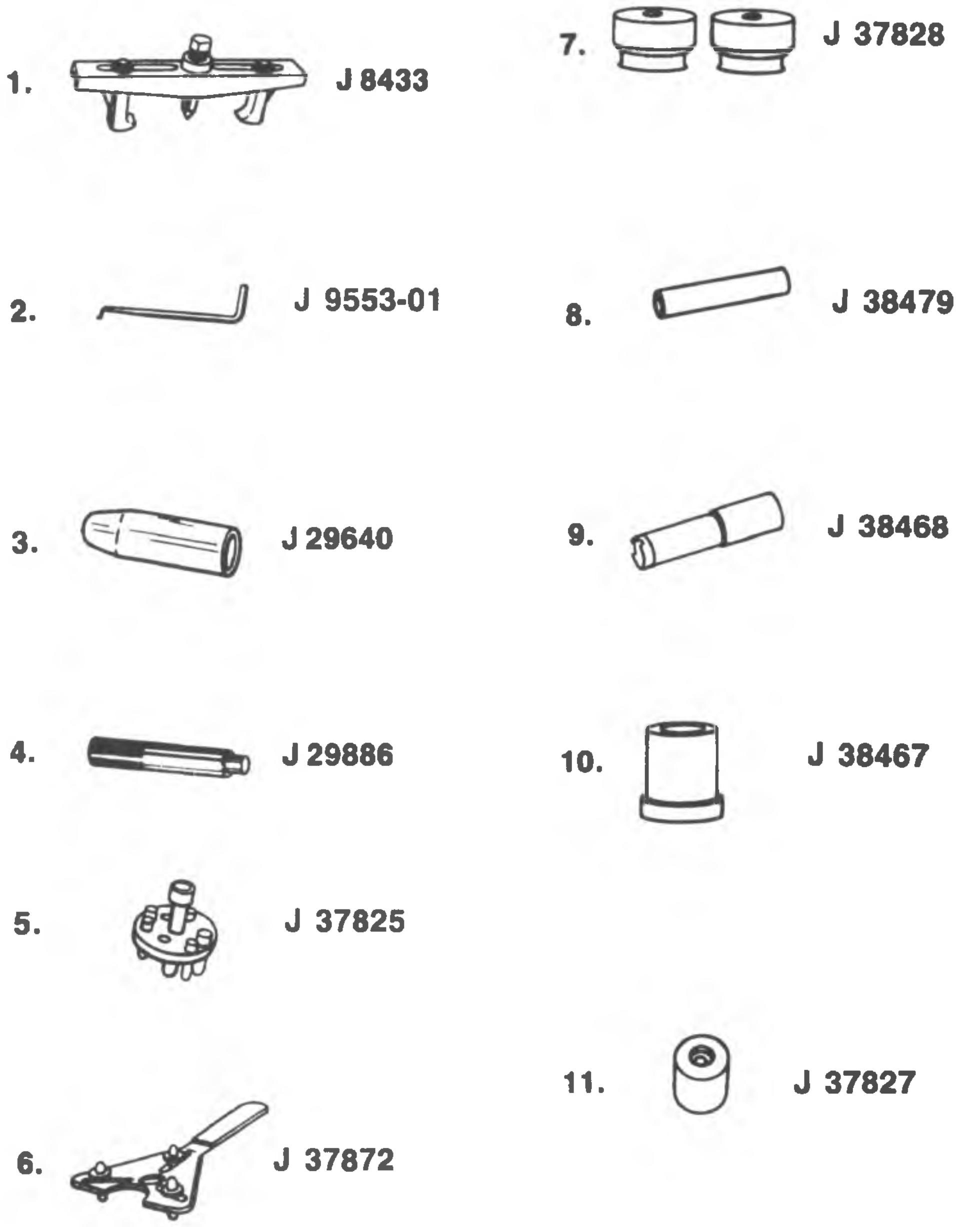
- Screws to 32 N·m (24 ft. lbs.) using the star configuration as shown in figure 16.

SPECIFICATIONS

COMPRESSOR	
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 oz.)
Clutch Hub Air Gap	0.49 to 0.79 mm (0.016 to 0.031 in.)
TORQUE SPECIFICATIONS	
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.)

T2505

SPECIAL TOOLS



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

F9567

SECTION 3B2

MANUAL STEERING GEAR

NOTICE: When fasteners 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

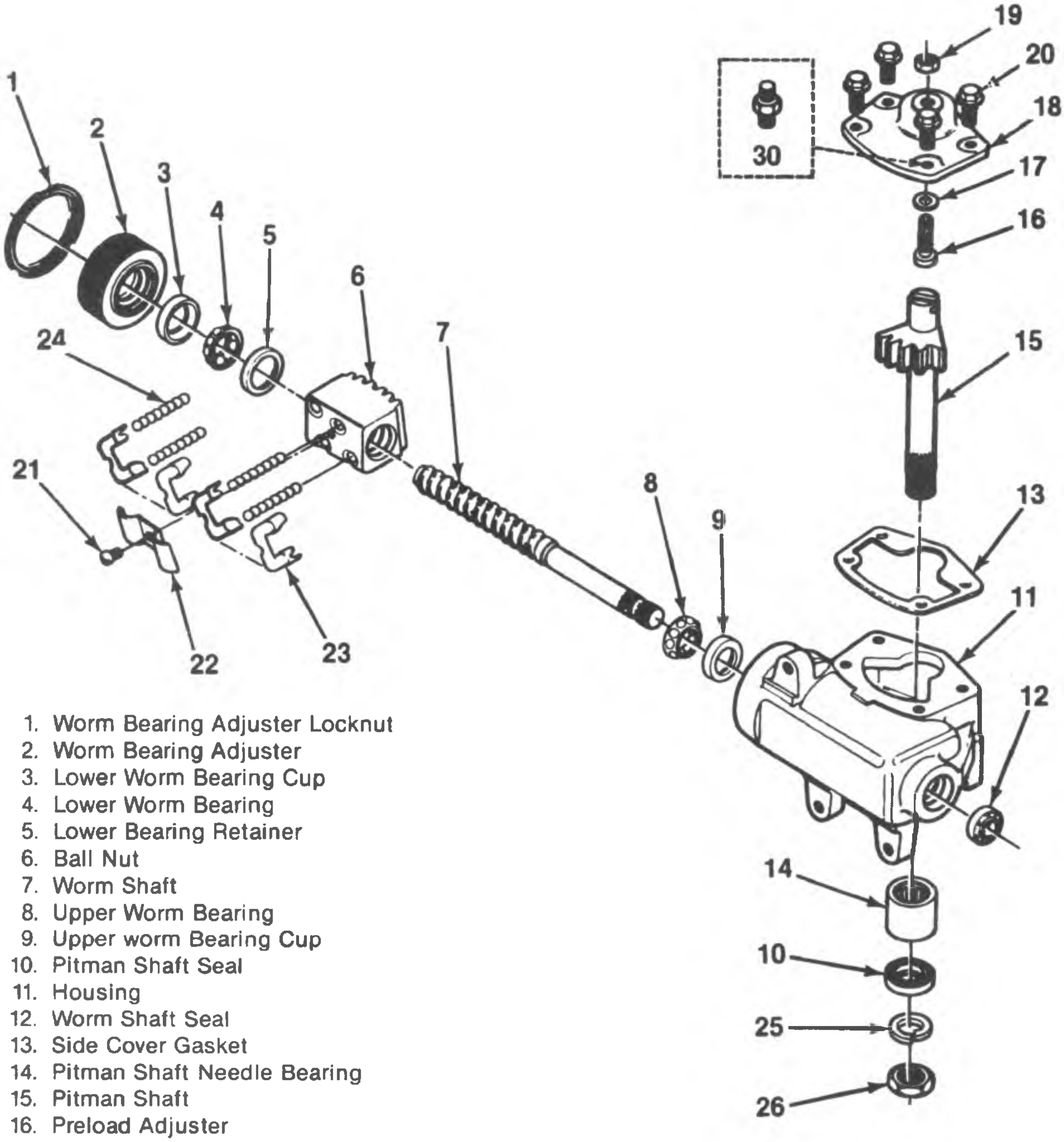
DESCRIPTION

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 535 steering gear is used on the S, T and M model vehicles, (figure 1).

The visual identification of the 535 gear is a four bolt side cover The (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.



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 1—Steering Gear Components—Model 535

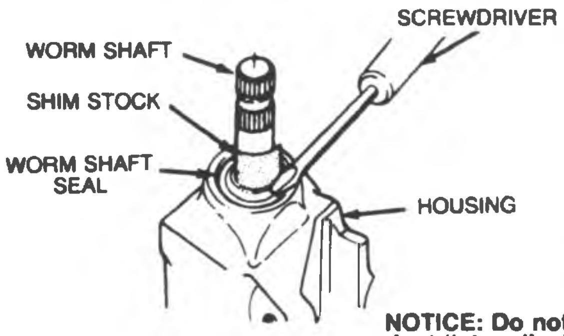
1. REMOVE AND INSTALL WORM SHAFT SEAL GEAR ASSEMBLED

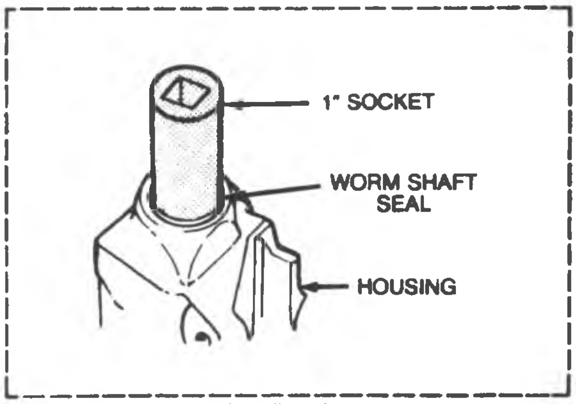
REMOVE

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

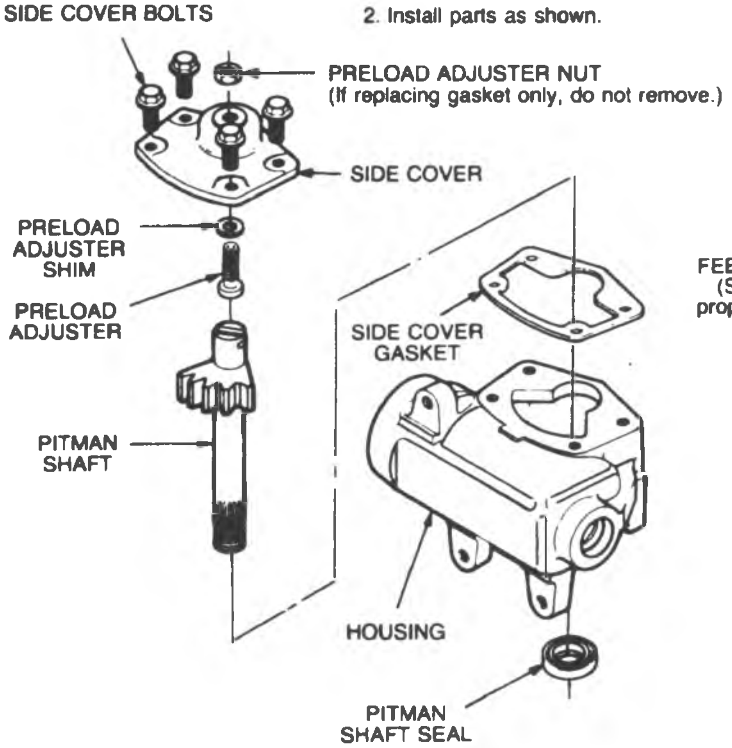
1. Center steering gear.
2. Remove parts as shown.

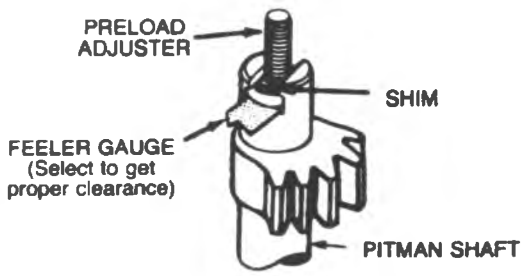
INSTALL

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 2—Model 535—Chart A

3. REMOVE AND INSTALL WORMSHAFT AND BALL NUT

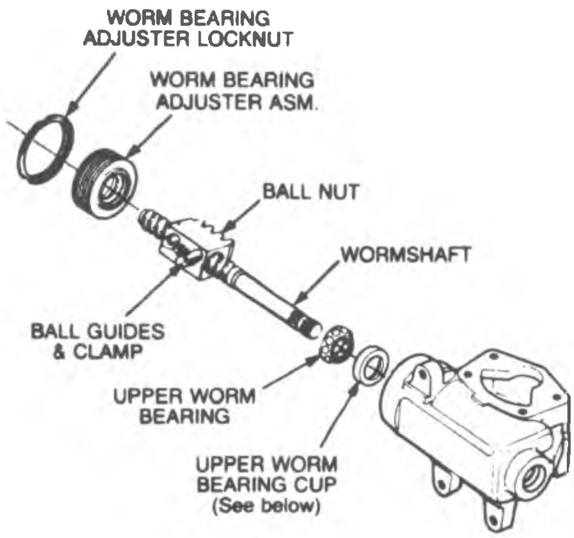
REMOVE

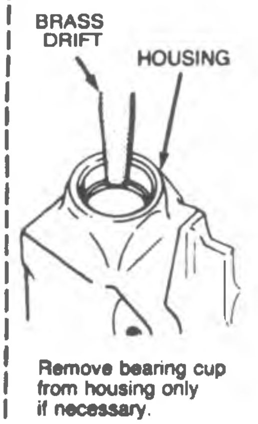
1. Loosen lock nut. Use punch against edge of slot.
2. Remove parts as shown.

INSTALL

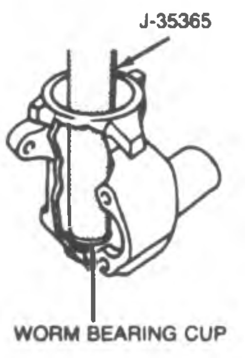
1. Install parts as shown.

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

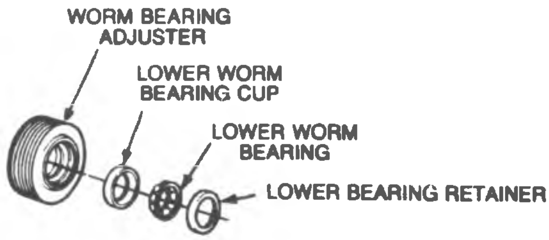
4. DISASSEMBLE AND ASSEMBLE WORM BEARING ADJUSTER

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.



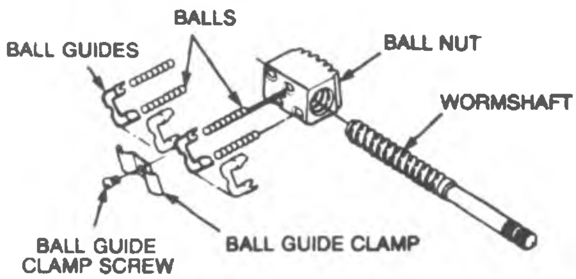
5. DISASSEMBLE AND ASSEMBLE WORMSHAFT AND BALL NUT

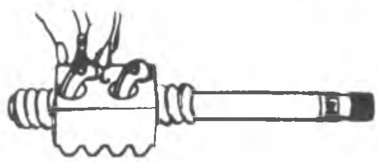
DISASSEMBLE

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

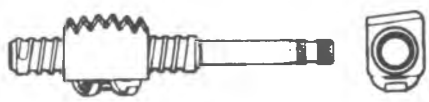
ASSEMBLE

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





Installing Balls



Viewed From Splined End of Wormshaft

F5904

Figure 3—Model 535—Chart B

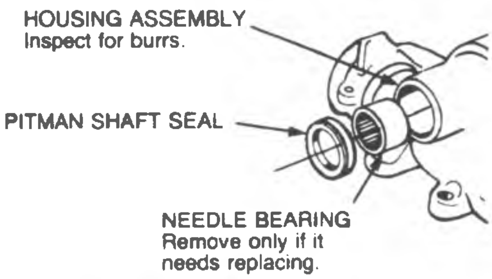
6. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

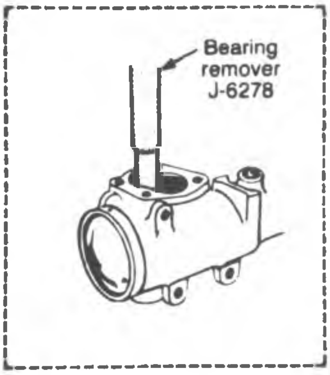
REMOVE

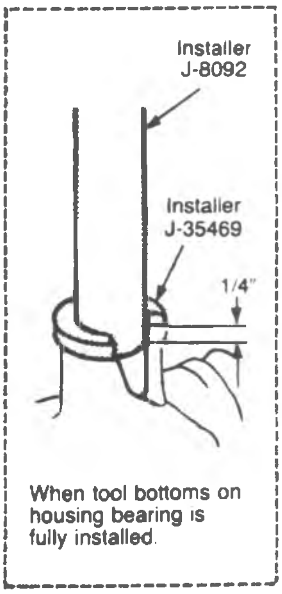
1. Clean end of housing thoroughly to prevent dirt from entering and be extremely careful not to score the housing bore.
2. Usine screwdriver, pry seal from bore.

INSTALL

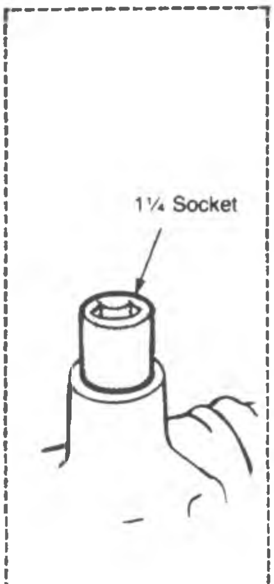
1. Install parts as shown.







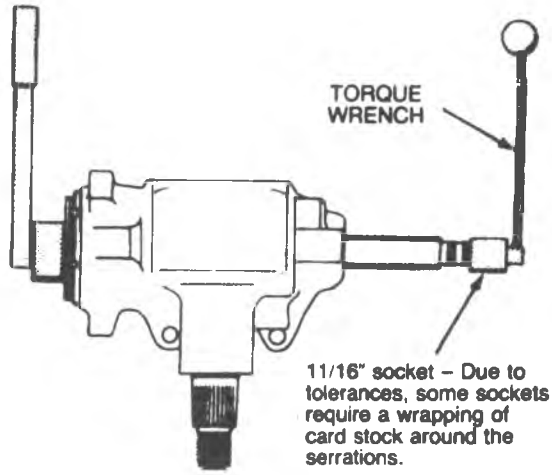
Install Pitman shaft bearing.



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 4—Model 535—Chart C—Adjustment

SPECIFICATIONS

ADJUSTMENT

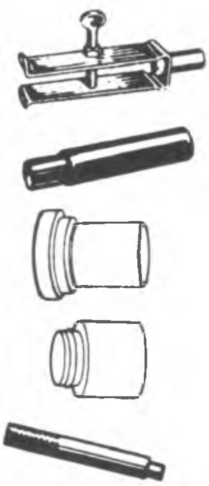
Adjustment	Torque to Turn Worm Shaft N·m	Torque to Turn Worm Shaft In. Lbs.
Worm Bearing	0.6-1.0	5-8
Over Center Preload	0.5-1.2	4-10
	In Excess of Worm Bearing Preload	
Total Steering Gear Preload	1.8	16 max.

FASTENER TORQUE
SAGINAW MODEL 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	49 in. lbs.

T2506

SPECIAL TOOLS

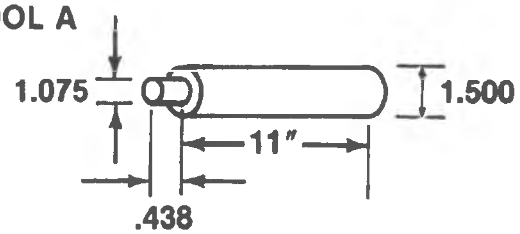


1. J 29369-1
2. J 6278
3. J 35469
4. J 35365
5. J 8092

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

TOOL A



A. Worm Bearing Cup Installer

F5905

SECTION 3B3

POWER STEERING

NOTICE: When fasteners 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

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 build date is stamped in the cover. The build 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 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.

A. RV, G, P, ST, M
B. CK, L
202. Nut
203. Spring Washer
204. Retaining Ring
205. Washer
206. Double Lip Seal
207. Single Lip Seal
208. Bearing
209. Screw
210. Clamp
211. Ball Guide
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. Pitman Shaft Dust Seal (CK, L)
254. Seal (CK, L)
255. Pin

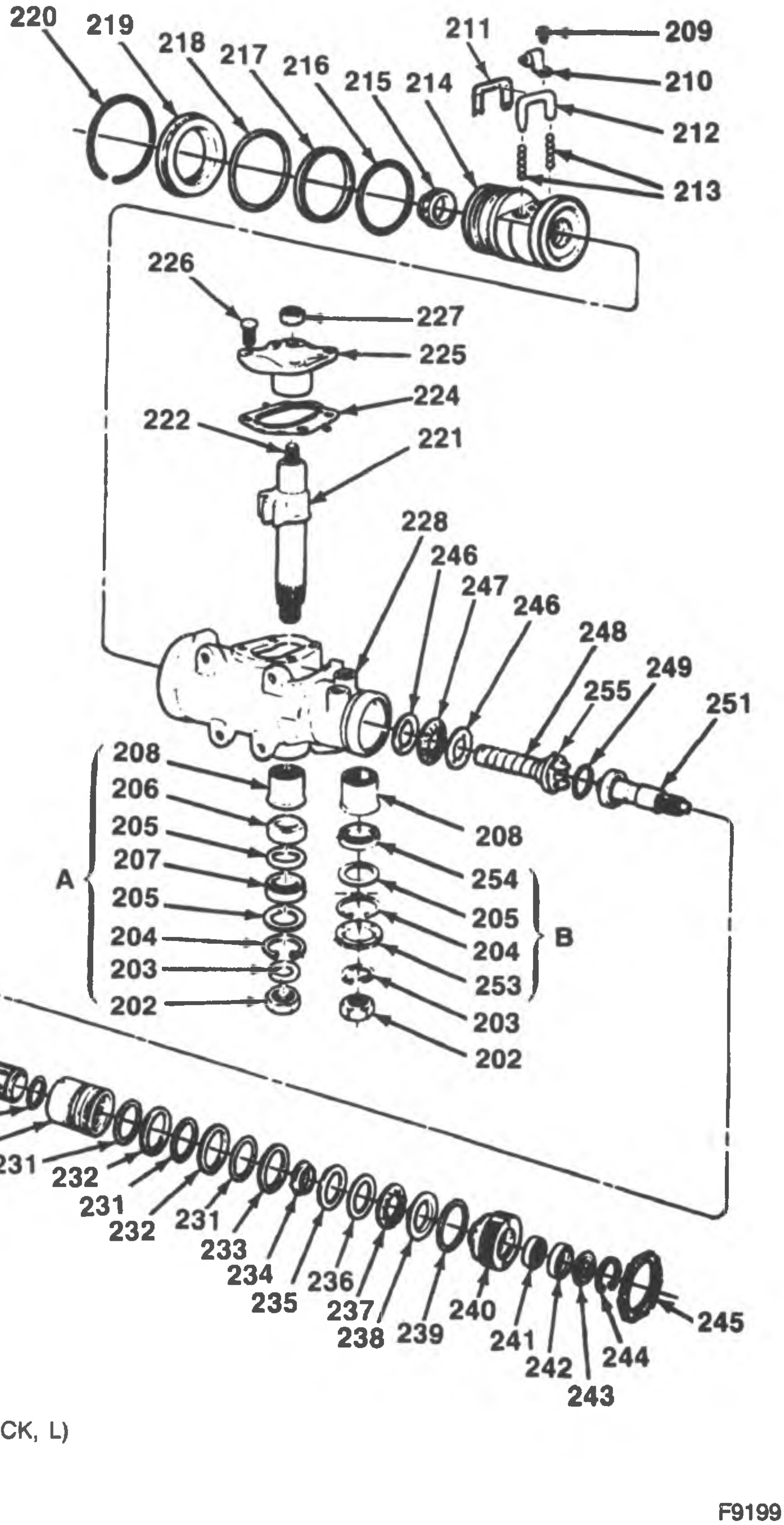


Figure 1—Integral Steering Gear Components

SAGINAW INTEGRAL POWER STEERING GEAR

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

NOTICE: When adding fluid or making a complete fluid change, always use GM Part No. 10500179 (or equivalent meeting GM Spec. No. 9985010) power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

In some instances, "power steering fluid" will be specified to lubricate parts upon assembly.

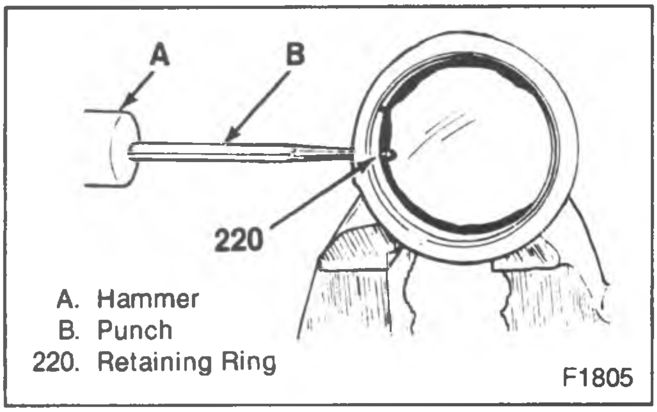


Figure 2—Unseating the Retaining Ring

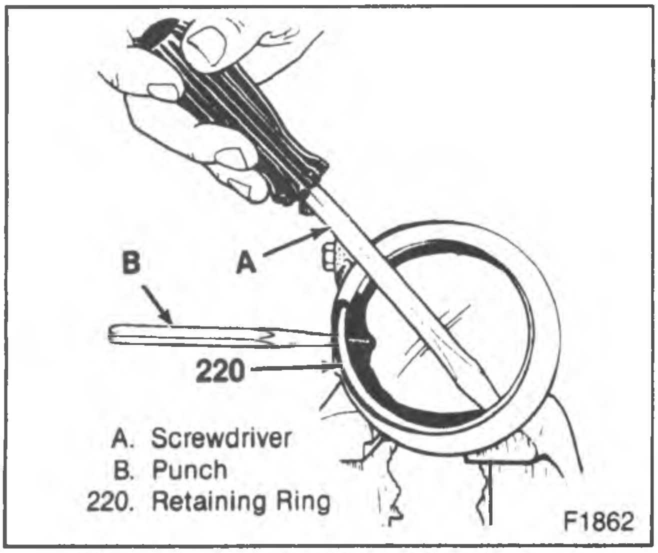


Figure 3—Removing the Retaining Ring

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
- 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).
   - Insert punch through access hole to unseat retaining ring.
   - Pry retaining ring out of the housing groove with a screwdriver (figure 3).
2. End plug (219).
   - Turn stud shaft (251) to the left (only until the plug is forced out of the cylinder).
3. Seal (218).
4. Rack piston plug (215) from the rack piston (214) (figure 4).
5. Bolts (226).

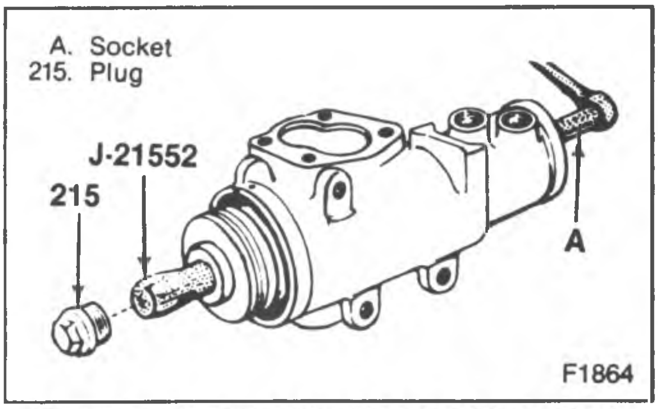


Figure 4—Removing the Plug and Piston Rack

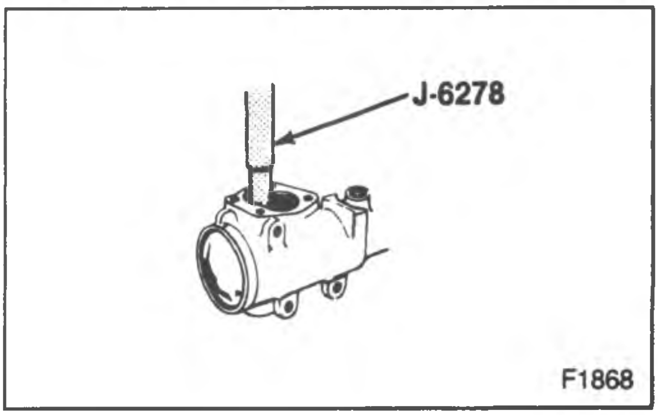


Figure 5—Removing the Pitman Shaft Bearing

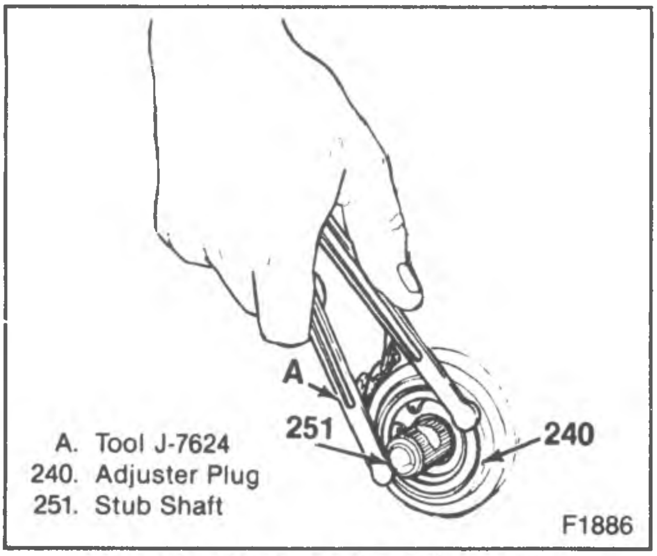


Figure 6—Removing the Adjuster Plug

6. Sector shaft assembly (221, 222, 224, 225, 227).
7. Nut (202), spring washer (203). (Retains pitman arm.)
8. Retaining ring (204) with tool J 4245.
9. Washers (205) and seals (206, 207, 253, 254) (figure 1).
   A. Retaining ring (204), washer (205), single lip seal (207), washer (205), double lip seal (206).
   B. Pitman shaft dust seal (253), retaining ring (204), washer (205), seal (254).
10. Bearing (209) with 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 4).
    - 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).

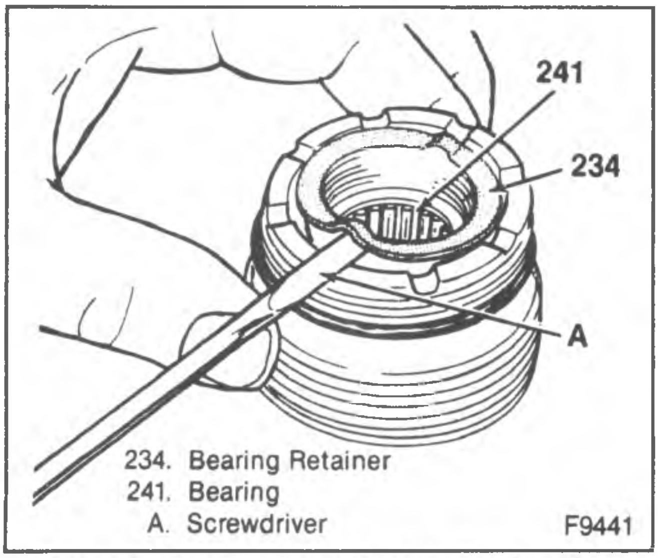


Figure 7—Removing the Bearing Retainer from Adjuster Plug

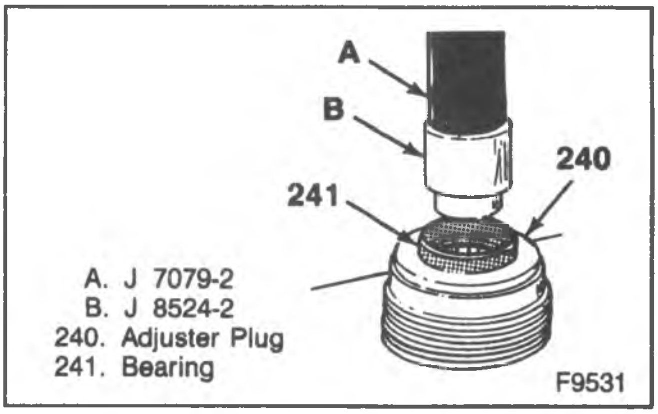


Figure 8—Removing the Needle Bearing from Adjuster Plug

12. Adjuster plug locknut (245).
13. Adjuster plug valve assembly (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. Remove seal. (figure 7).
    - Needle bearing (241). Use J 8524-1 and J 7079-2 (figure 8).
14. Valve (250), seal (249) and wormshaft (248) as an assembly, with both races (246) and bearing (247).

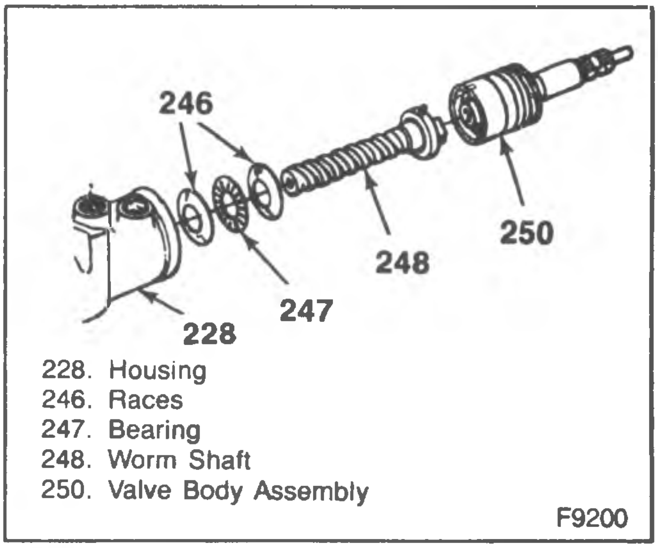


Figure 9—Bearing, Worm and Valve Assembly

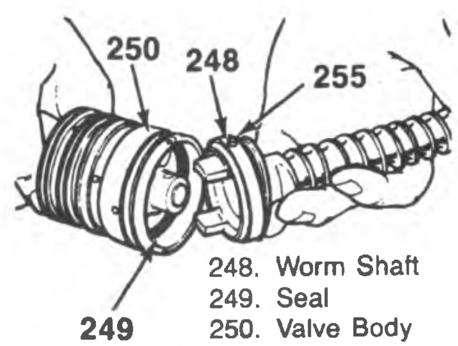
Important (Figure 9)

- Angle of thrust washers and bearing is critical. Note the position on wormshaft before disassembly.
- Wormshaft assembly fits in notch in valve assembly. Note position before disassembly.

Disassemble

- Wormshaft (248) from valve assembly (figure 10).
- Seal (249) from inside valve body.
- Races (246) and bearing (247) from the wormshaft (248).

15. Stub shaft (251) from valve body (250) (figure 11).
    - 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 6mm (1/4-inch).
    - Locate pin on shaft (251) and hole in spool (252). Disengage pin and pull shaft out of spool.
    - Rotate spool (252) to remove from valve body (250) (figure 12).
    - Remove spool to valve body seal (230).
    - Remove teflon valve body rings (232) and seals (231).
16. Screws (209), clamp (210) and ball guides (211, 212).
17. Balls (213).



248. Worm Shaft
249. Seal
250. Valve Body
255. Pin

F9210

Figure 10—Separating the Wormshaft from the Valve Assembly

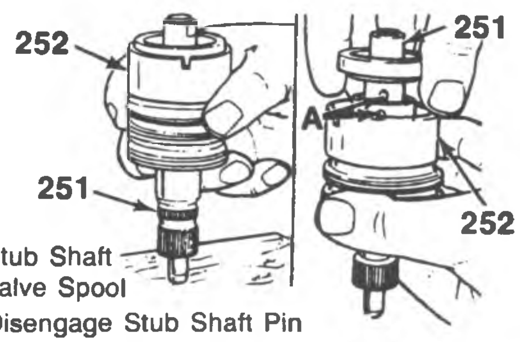
CLEANING AND INSPECTION

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 damage. The adjuster screw must turn freely.
2. Rack piston.
    - Worm (248) and rack piston (214) grooves and all balls (213) for scoring. (MUST BE REPLACED as a matched assembly).
    - Seal (216) and ring (217) for wear.
    - Ball return guide halves (212) and (211) for cracks and damage.
    - Bearing (247) and races (246) for scoring and excessive wear.
    - Rack piston (214) teeth and external machined surfaces for scoring or excessive wear. If either condition exists, replace the rack piston (214) and worm (248).

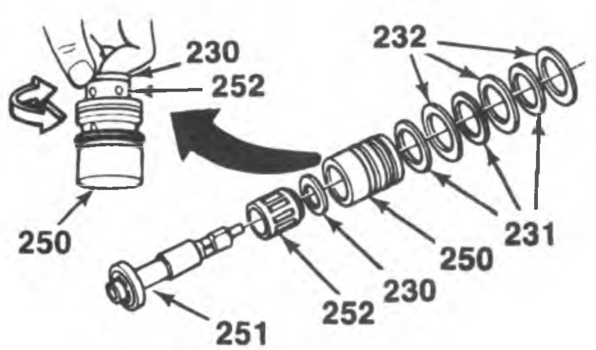


251. Stub Shaft
252. Valve Spool
A. Disengage Stub Shaft Pin From Hole in Spool Valve

F9268

Figure 11—Removing or Installing the Stub Shaft Assembly

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) (Replace with new parts).
    - Shaft pin for wear or cracks. If excessively worn or broken, replace the complete valve and shaft assembly.
    - Machined surfaces of 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 crocus cloth cannot clean the nicks or burrs, replace the entire shaft and valve assembly.



230. Valve Spool Seal	250. Valve Body
231. Valve Body Seal	251. Stub Shaft
232. Teflon Rings	252. Valve Spool

F9269

Figure 12—Removing or Installing Valve Spool Assembly

- Valve spool inside the valve body (250). The valve spool, when lubricated with steering fluid, must rotate without binding. If binding occurs, replace the complete valve and shaft assembly.

ASSEMBLY

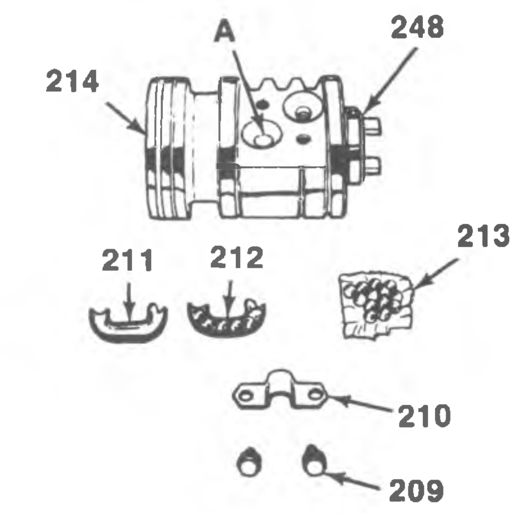
Install or Connect (Figures 1, 4, and 10 through 16)

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

NOTICE: When installing balls in rack piston, the black balls are smaller than the silver and MUST BE INSTALLED ALTERNATELY WITH SILVER BALLS to maintain rack piston to worm gear preload. If balls have worn to one color replace them.

NOTICE: For steps 4, 16 see "Notice" on page 3B3-1 of this section.

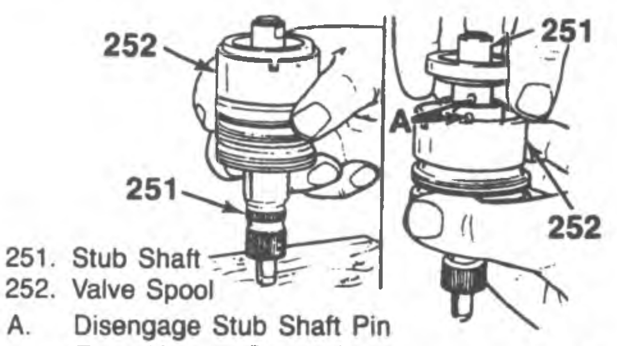
1. Balls (213), alternately by color, in the rack piston (214) (figure 13). Use J 21552 in the rack piston.
   - Lubricate the 24 balls with power steering fluid.



A. Install Balls in This Hole Slowly Rotating Worm Counterclockwise
210. Screw
211. Clamp
212. Ball Guides (Left Half)
213. Ball Guides (Right Half)
213. Balls
214. Rack Piston
248. Worm Shaft

F9270

Figure 13—Installing the Balls into the Rack Piston

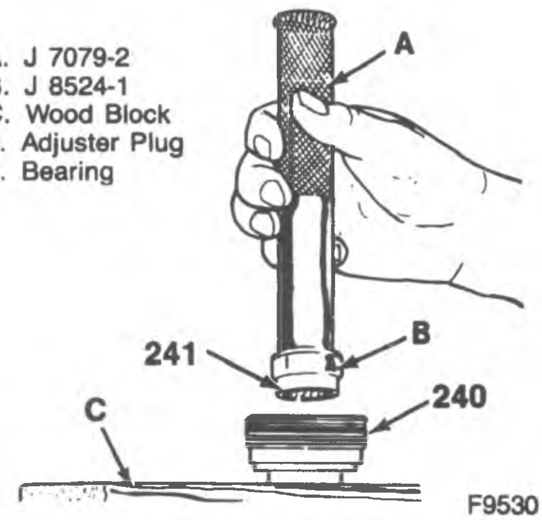


251. Stub Shaft
252. Valve Spool
A. Disengage Stub Shaft Pin From Hole in Spool Valve

F9268

Figure 14—Retaining the Balls in the Ball Guide

A. J 7079-2
B. J 8524-1
C. Wood Block
240. Adjuster Plug
241. Bearing



F9530

Figure 15—Installing the Needle Bearing in Adjuster Plug

2. Balls (213), alternating by color, in the ball guide (212) (figure 14).
   - Retain the balls in the guide with petroleum jelly.
3. Place second half of ball guide over balls. Check that halves are mated properly to insure free movement of balls once installed.
4. Ball guide assembly (211, 212), clamp (210) and screws (209) to the rack piston (214).
5. Stub shaft (251) into the valve body (250) (figure 11).
6. 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.

Important

- When assembling gear make sure angle of thrust bearing races are correct in relation to the worm shaft assembly.

7. Valve assembly (250), seal (249), wormshaft (248), thrust bearing races (246) with roller bearing (247) between races (Figure 9).
   - Lubricate seals with power steering fliud.

Assemble (Figure 15)

- Adjuster plug assembly.
- Lubricate seal (239) before installing on adjuster plug.
- Seat needle bearing (241) in the adjuster plug using J 8524-1 and J 7079-2.
- Seal (242), washer (243), and retaining ring (244), into the adjuster plug.

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.

8. Wormshaft, valve assembly into the steering gear housing.
9. Adjuster plug assembly into the steering gear housing. Use spanner wrench J 7624.

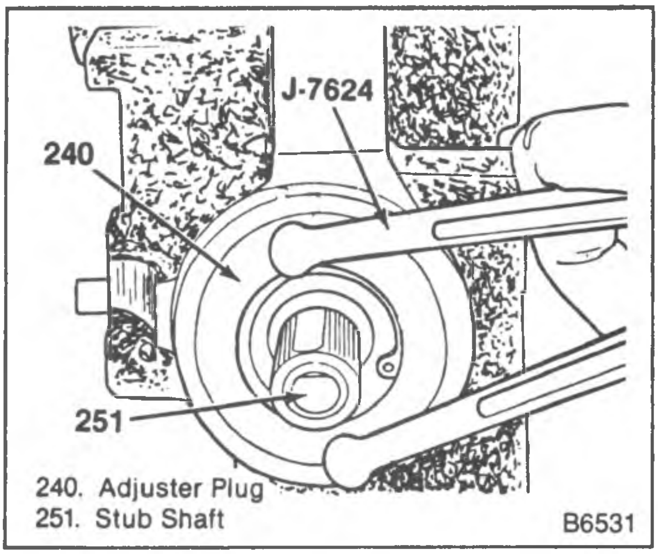


Figure 16—Bottoming the Adjuster Plug

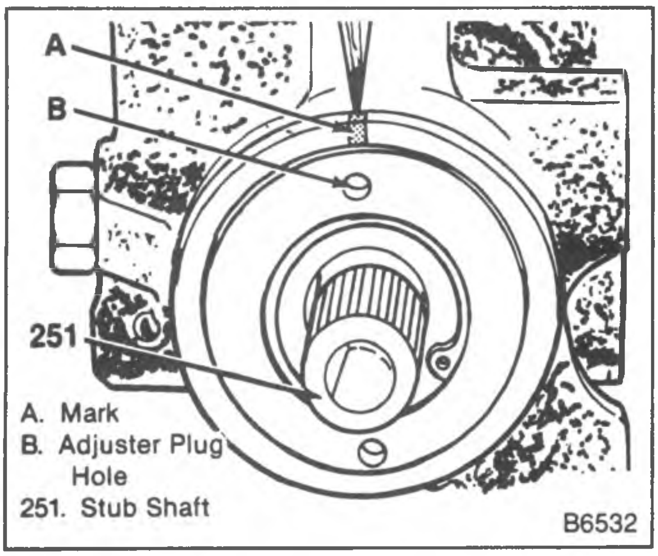


Figure 17—Marking the Housing

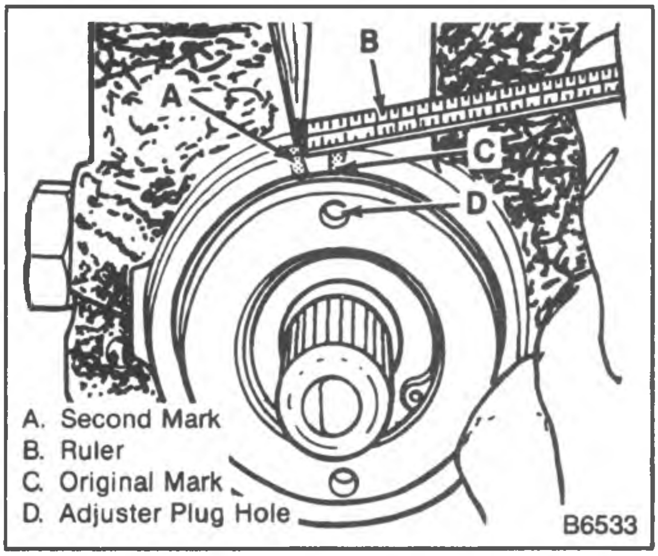


Figure 18—Remarking the Housing

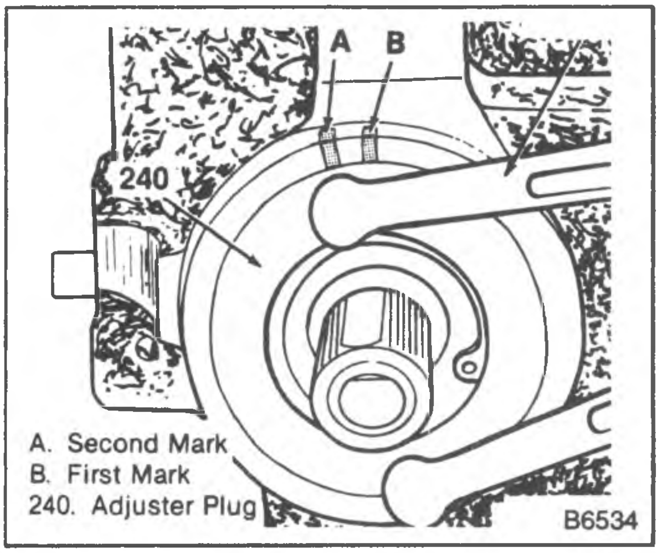


Figure 19—Aligning the Adjuster Hole with the Second Mark

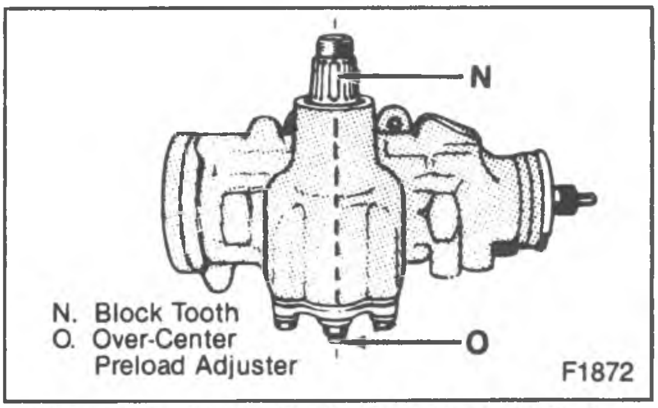


Figure 20—Pitman Shaft "Over-Center" Sector Adjustment

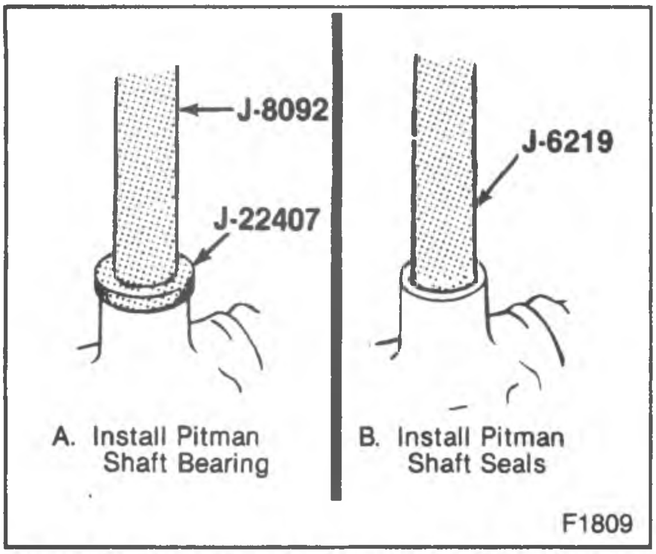


Figure 21—Installing the Pitman Shaft Bearing and Seals

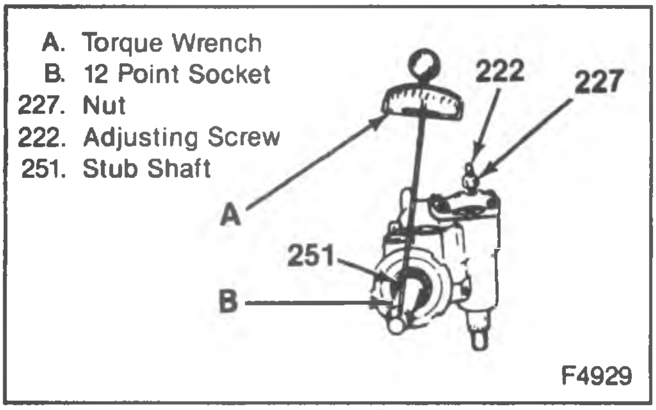


Figure 22—Aligning the Over-Center Preload

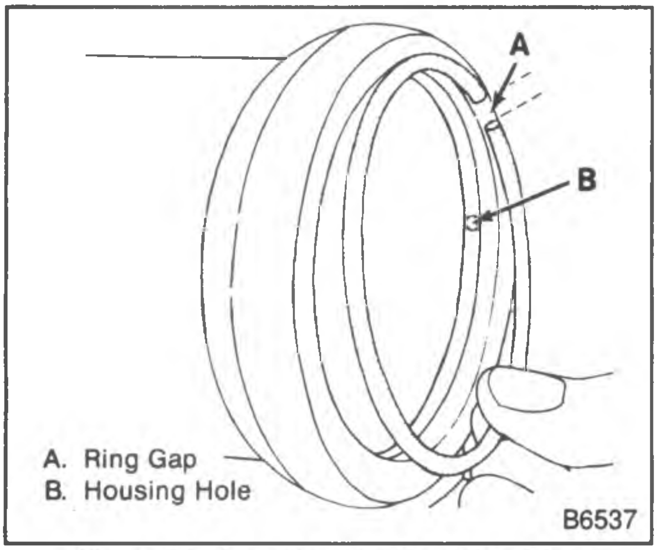


Figure 23—Installing the Retaining Ring

Adjust (Figures 15 through 23)

Tools Required:
J 7624 Spanner Wrench
J 7754-01 Torque Wrench

- Bearing preload:
  - Use tool J 7624. Turn the adjuster plug (240) to the left until the plug assembly is firmly bottomed (30 N.m (22 ft. lbs.) (figure 16).
  - Mark the housing in line with one of the holes in the adjuster plug (figure 17).
  - Measure back (to the left) 13mm (1/2-inch) and re-mark the housing (figure 18).
  - Rotate the adjuster to the left until the hole in the adjuster is in line with the second mark (figure 19).
  - Install the adjuster locknut (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 20). If the reading is less than 0.60 N.m (5 in. lbs.) or more than 1.13 N.m (10 in. lbs.), repeat the adjustment procedure.
  - Coat the stub shaft (251) area just outside the dust seal (206) with chassis lubricant or an all purpose grease.

10. Bearing (209) using J 22407 and J 8092.
11. Washers (207) and seal (254), using J 6219 (figure 1).
12. Retaining ring (205).
13. Rack piston (214) using J 21552 (figure 4).
14. Gasket (224) to side cover (225) and bend tangs.
15. Pitman shaft (221), side cover (225), nut (227) assembly.
16. Bolts (226).
17. Plug (215) into rack piston (214).

Tighten

- Bolt (226) to 18 N.m (13 ft. lbs.)
- Plug (215) to 150 N.m (110 ft. lbs.)

18. Seal (218), plug (219) and retaining ring (220) to housing (figure 23).

Adjust (Figure 22)

Tool Required:
J 7754-01 Torque Wrench

- Pitman shaft preload.
  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. Adjuster nut (227) loose, back out adjuster screw (222) fully, then turn in, one full turn.
  4. Check the combined ball and bearing preload by turning the torque wrench through the center of travel. Note the highest reading.
  5. Tighten the adjusting screw (222) until the torque wrench reads 0.6-1.3 N.m (6-10 in. lbs.) higher than the reading noted in step 3.

Tighten

- Nut (227) to 27 N·m (20 ft.lbs.).

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

SAGINAW (TC SERIES) POWER STEERING PUMP

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.

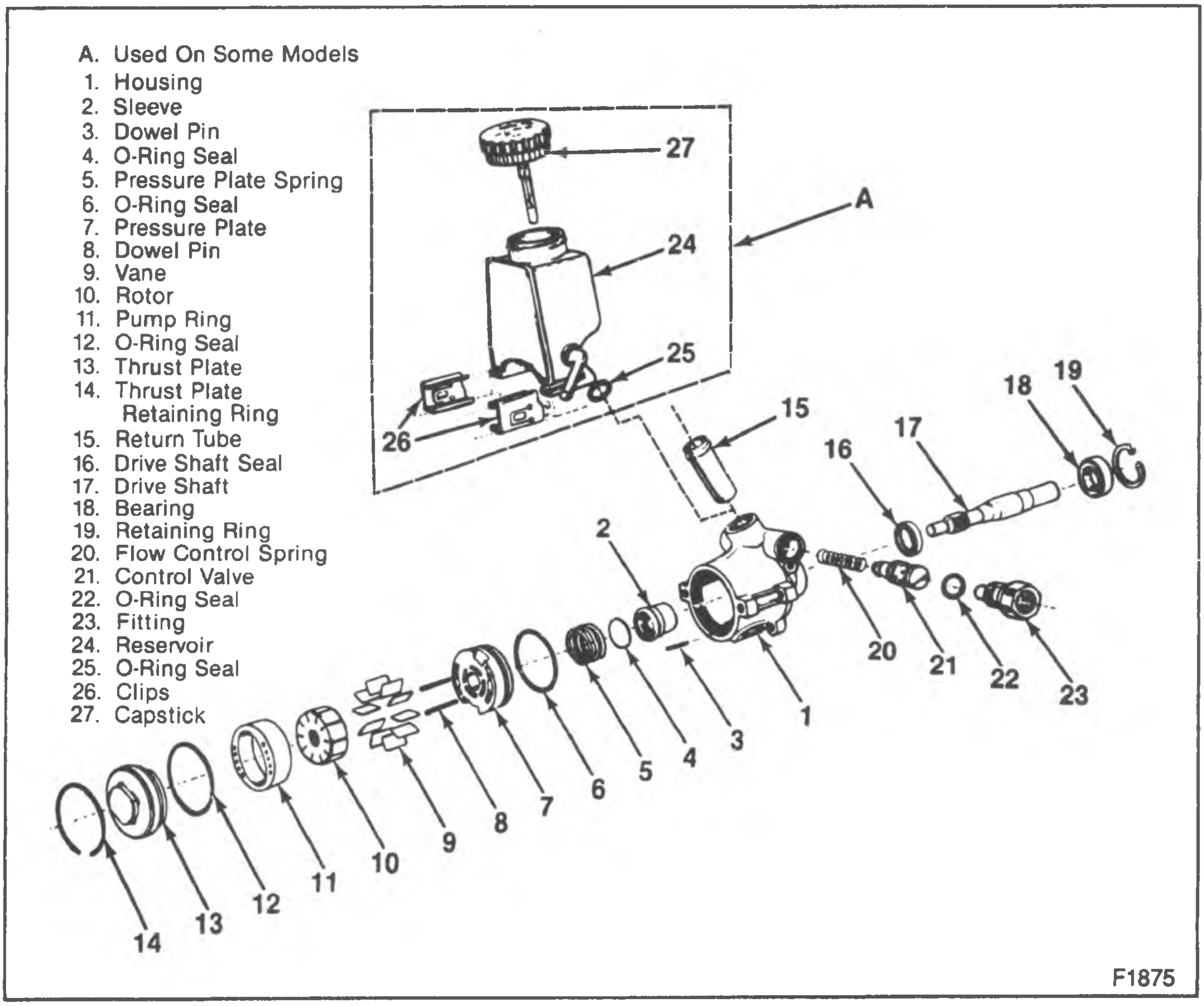


Figure 24—Power Steering (TC SERIES) Pump Components

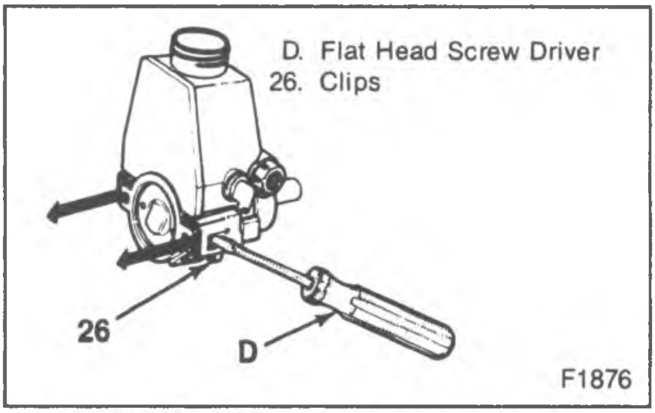


Figure 25—Removing the Reservoir Clips

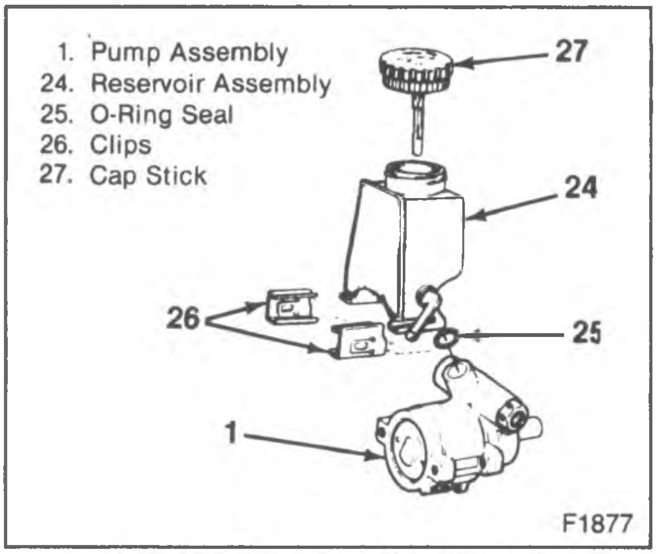


Figure 26—Removing the Reservoir

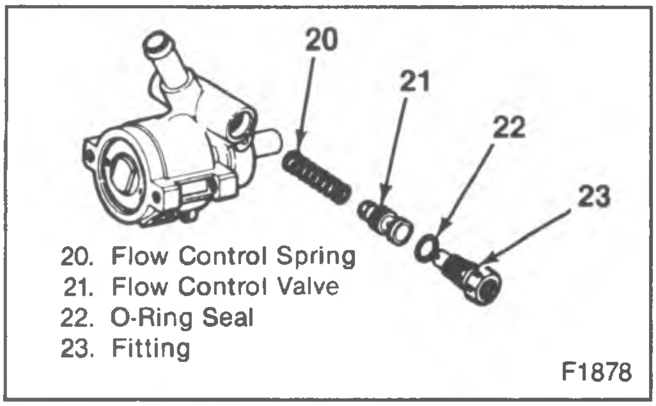


Figure 27—Removing the Fitting, Control Valve, Spring and Seal

DISASSEMBLY

Clean

- Exterior of the pump with solvent.

Remove or Disconnect (Figures 24 through 36)

- Clamp the front hub of the pump in a soft jaw vise.

1. Clips (26), if equipped.
   - Pry the tab and slide the retaining clip off (figure 25).

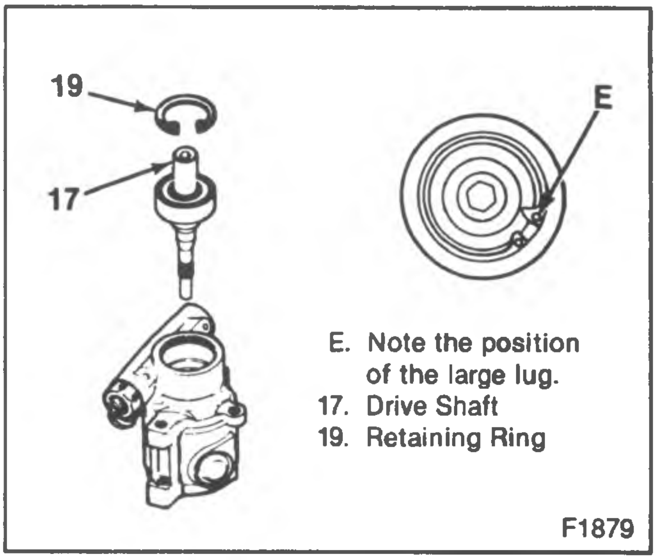


Figure 28—Removing and Installing Retaining Ring

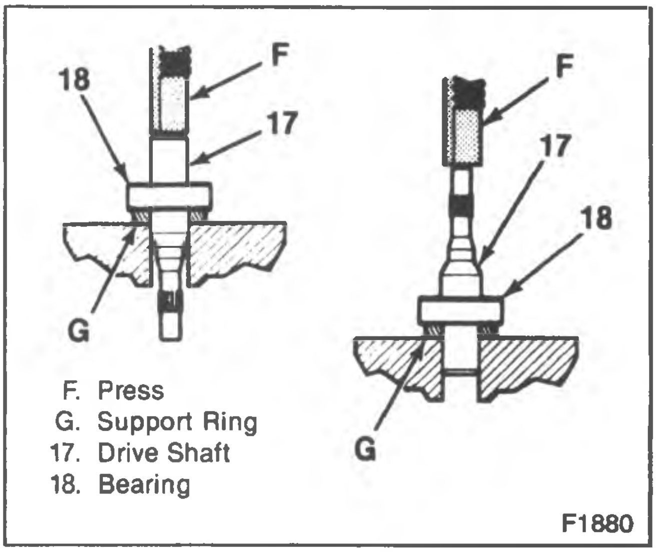
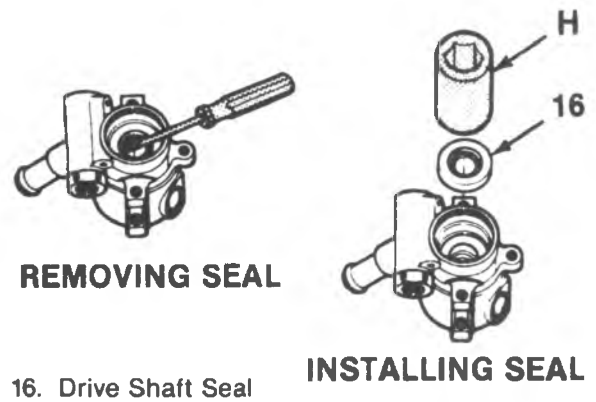


Figure 29—Removing and Installing Driveshaft Bearing

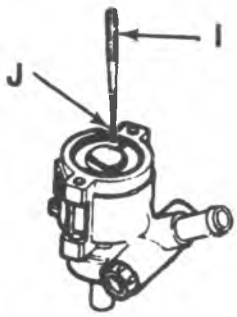
2. Reservoir (24) (figure 26) or return tube (15) (figure 36)
   - Assemble five - 5/8" washers (A) and one 1-9/16"-12 nut (B) outside tube (15).
   - Plug tube to prevent chips from entering pump.
   - Insert one - 9/16"-12 tap (C) into return tube and turn until tube is pulled out of housing or use other suitable means of removal.
3. O-ring (25).
4. Fitting (23) (figure 27).
5. O-ring seal (22).
6. Flow control valve (21).
7. Flow control spring (20).
8. Retaining ring (19) (figure 28).
   - Use suitable snap ring pliers.
   - Note the position of the large lug of the retainer ring in housing before removal (E).
9. Driveshaft (17).
10. Bearing (18) (figure 29).
   - Note and measure any clearance between collar and shaft (if applicable).



16. Drive Shaft Seal
H. Suitable Socket and a Press

F1881

Figure 31—Removing and Installing Driveshaft Seal



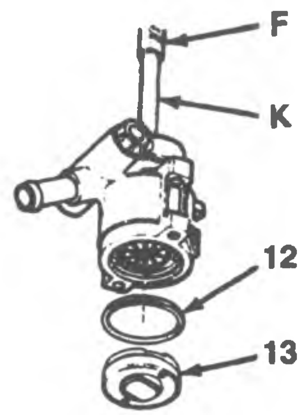
I. Punch
J. Access Hole in Housing

F2101

Figure 32—Removing the Retaining Ring

- Press bearing from shaft using a support ring under bearing.

11. Driveshaft seal (16).
    - Pry the seal loose with a flat head screwdriver (figure 31).
12. Retaining ring (14).
    - Insert a punch into the access hole and pry the ring loose (figure 32) with a flat blade screwdriver.
13. Thrust plate (13) (figure 33).
    - Use a 16mm (5/8-inch) piece of bar stock or suitable brass drift.



F. Press
K. Bar Stock
12. O-Ring Seal
13. Thust Plate

F2151

Figure 33—Removing the Thrust Plate

14. O-ring seal (12).
15. Pump ring (11) (figure 34).
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 35).

CLEANING AND INSPECTION

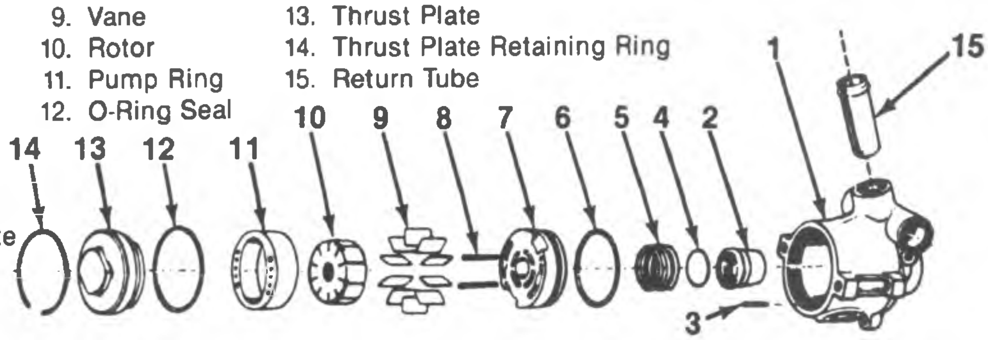
Clean

- All parts with solvent and blow dry.

Inspect (Figure 34)

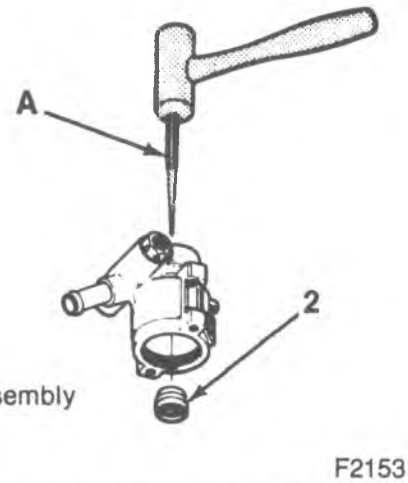
1. Rotating group components.
   - — Vane (9) tips for scoring or wear.
   - — Fit of vanes (9) in the rotor (10). The vanes must fit properly in the rotor slots, without sticking or excessive play.
   - — Rotor slots for burrs and excessive wear at the thrust faces.

1. Housing
2. Sleeve
3. Dowel Pin
4. O-Ring Seal
5. Pressure Plate Spring
6. O-Ring Seal
7. Pressure Plate
8. Dowel Pin
9. Vane
10. Rotor
11. Pump Ring
12. O-Ring Seal
13. Thrust Plate
14. Thrust Plate Retaining Ring
15. Return Tube



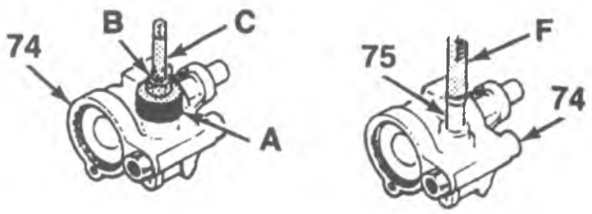
F2152

Figure 34—Pump Housing Components



A. Punch
2. Sleeve Assembly

Figure 35—Removing the Sleeve Assembly



Remove return tube.

Install return tube.

A. Five 5/8 Washers
B. One 9/16-12 Nut
C. One 9/16-12 Tap

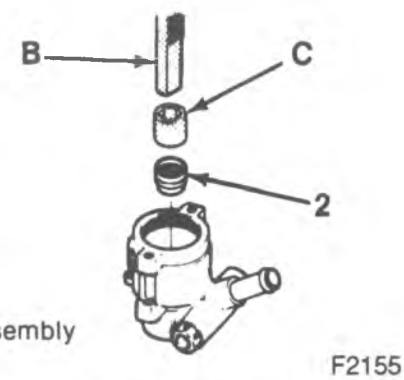
74. Housing
75. Return Tube

F9276

Figure 36—Removing and Installing Return Tube

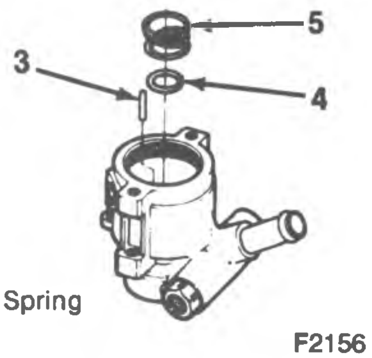
— Inner surface of the pump ring (11) for scoring or wear.
— Thrust plate (13) and pressure plate (7) for wear on the plate surfaces.
— If heavy wear is present, or parts are faulty, replace the entire rotating group.

2. Bearing (18). If the bearing is rough or loose, replace it.
   — Seal (16) for leakage, cracking, or swelling. If so replace.
3. Driveshaft (17) for excessive burning or scoring.
   — Bearing bore for excessive scoring or burning.



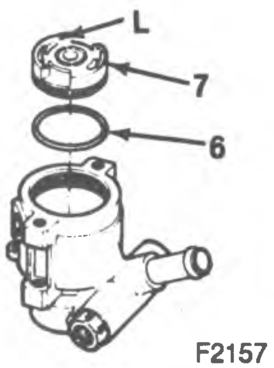
2. Press
C. Socket
2. Sleeve Assembly

Figure 37—Install Sleeve Assembly



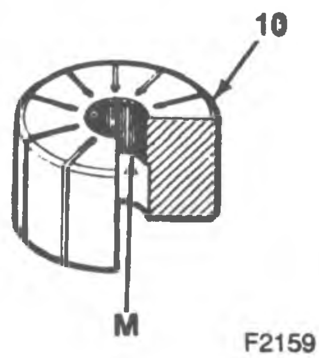
3. Dowel Pin
4. O-Ring Seal
5. Pressure Plate Spring

Figure 38—Installation of the Pin, Seal and Pressure Plate Spring



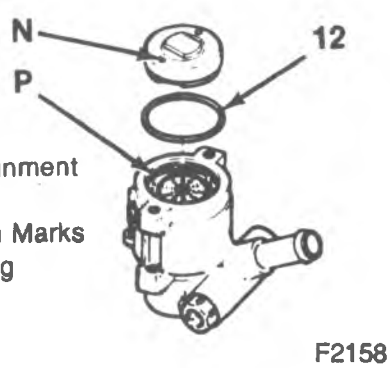
L. Mark Top of Pressure Plate
6. O-Ring Seal
7. Pressure Plate

Figure 39—Installing of the Pressure Plate



10. Rotor
M. The Counterbore Faces Drive Shaft End of Housing

Figure 40—Installing the Rotor



N. Housing Alignment Indentations
P. Identification Marks on Pump Ring
12. O-Ring Seal

Figure 41—Aligning and Installing the Pump Ring

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

ASSEMBLY

Install or Connect (Figures 24, 36 through 42)

1. Sleeve (2) (figure 37).
   - Press sleeve into housing using a suitable socket.
2. Dowel pin (3) (figure 38).
3. O-ring seal (4).
4. Pressure plate spring (5).
5. O-ring seal (6) (figure 39).
6. Pressure plate (7).
   - Mark the top of pressure plate where the pin enters from underneath (see hole in bottom of plate) to ease alignment with dowel pin during assembly (L).
7. Dowel pins (8) through pressure plate.

Important

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

8. Vanes (9).
   - The rounded edge of the vanes face away from the rotor.
9. Rotor (10) (figure 40).
   - Make sure the counterbore faces the driveshaft end of the housing.
10. Pump ring (11) (figure 41).
    - Make sure the identification marks face up.
11. O-ring seal (12).
12. Thrust plate (13).

Important

- The thrust plate dimples must line up with the bolt holes in the housing and plate must engage the pump ring dowel pins (N).

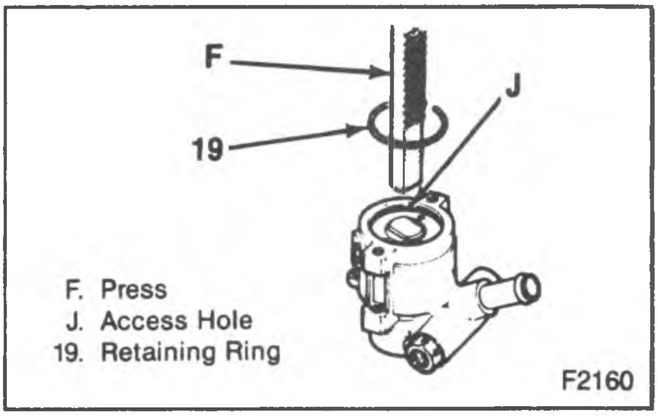


Figure 42—Installing the Retaining Ring.

13. Retaining ring (14).
    - Use a press to compress the thrust plate (figure 42).
    - Opening of ring (14) centered with bolt hole nearest to access hole.
14. Driveshaft seal (16).
    - Use a suitable socket to press seal into housing until it bottoms (figure 31).
15. Bearing (18) onto the driveshaft (17) (figure 29).
    - Slide the assembly into the housing while rotating the driveshaft so that the shaft serrations engage with the rotor.
16. Retaining ring (19). Use suitable snap ring pliers.
    - Make sure the large tab of retaining ring (19) is properly located (figure 28).
17. Flow control spring (20).
18. Flow control valve (21).
19. O-ring seal (22).
20. O-ring (25).
21. Reservoir (24) (figure 26) or return tube (15) (figure 36).
22. Clips (26) (figure 25) (if applicable).

SAGINAW (Model P and N) POWER STEERING PUMP

DISASSEMBLY

Remove or Disconnect (Figure 43)

- Drain fluid from unit.
- Clean the exterior of the pump with solvent and blow dry.

Model P Power Steering Pump

1. Bolt (71) and fitting (73).
2. Reservoir (70) and seals (69).

Model P and N Power Steering Pump

1. End plate retaining ring (68) (figure 45) using a screwdriver and punch.
2. End plate (67) and pressure plate spring (66).
3. O-ring (60).
4. Control valve (58).
5. Control valve spring (59).
6. Pressure plate (65). Tap lightly on the driveshaft with a rubber mallet.
7. Pump ring (64) and vanes (63).
8. Shaft retaining ring (62).
9. Pump rotor (61).
10. Thrust plate (56).
11. Driveshaft (50).
12. Seal (51) from the housing (53).
13. Dowel pins (55).
14. O-rings (54).
15. Seal (52).

CLEANING AND INSPECTION

Clean

- All parts with solvent and blow dry.

Inspect (Figure 43, 44, 46)

1. Rotating group components (figure 46).
   - 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 43, 44, 46)

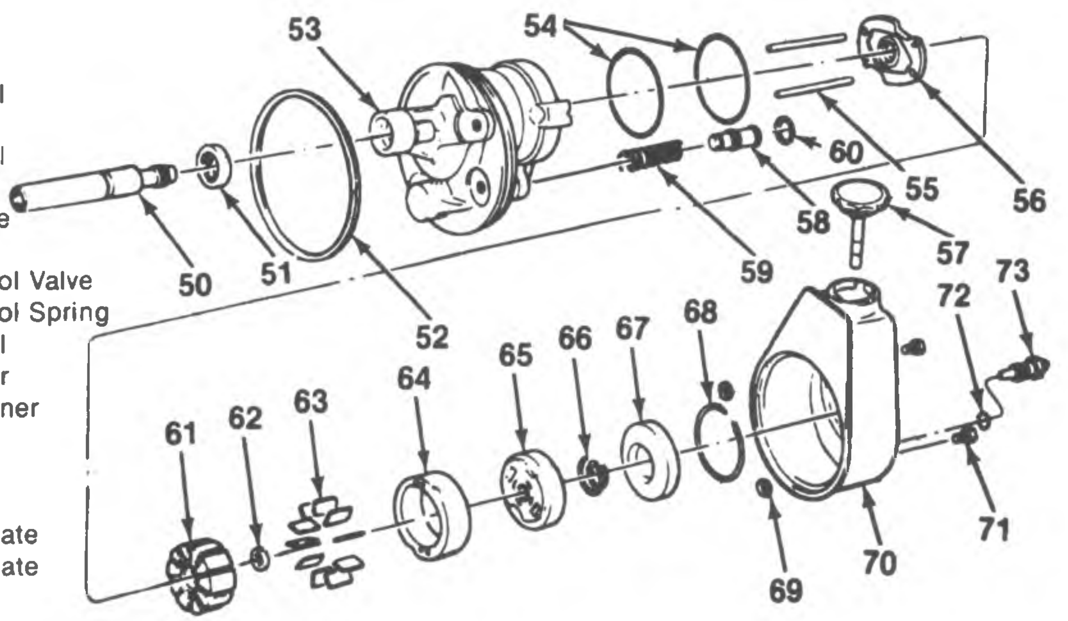
Tool Required:
J 7728 Seal Installer

Important

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

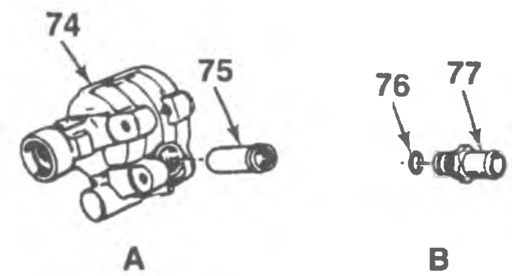
1. Dowel pins (55) and O-rings (54).
2. Seal (51) using J 7728.
3. O-ring (52).
4. Driveshaft (50)
5. Thrust plate (56).
6. Rotor (61).
   - Make sure the counterbore faces the driveshaft end of the housing.
7. Vanes (63), the rounded edge faces away from the rotor.
8. Shaft retaining ring (62).
9. Pump ring (64).
10. Pressure plate (65) (figure 46).
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).

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

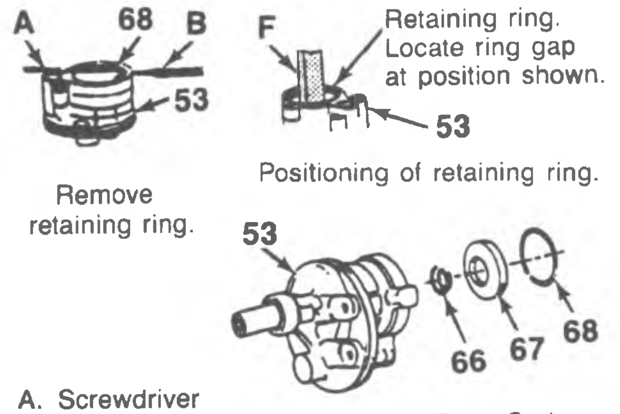
Figure 43—Power Steering Pump—Model P



A. Pressed In Return Tube
B. Treaded Return Tube
74. Housing
75. Return Tube
76. O-Ring Seal
77. Return Tube

F9272

Figure 44—Power Steering Pump—Model N (Remote Reservoir)

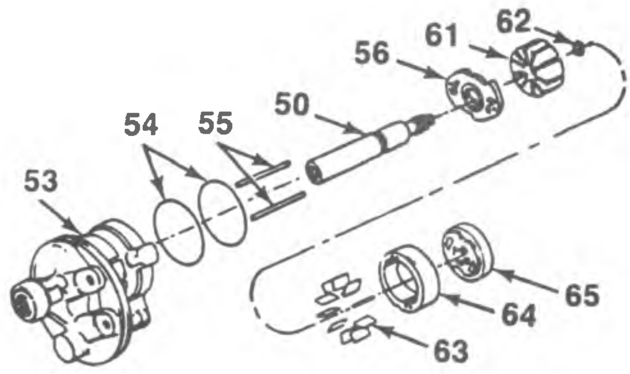


A. Screwdriver
B. Punch
F. Press
53. Housing

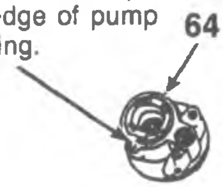
66. Pressure Plate Spring
67. Housing End Plate
68. Retaining Ring

F9274

Figure 45—End Plate Removal and Installation



Identification arrow on top edge of pump ring.

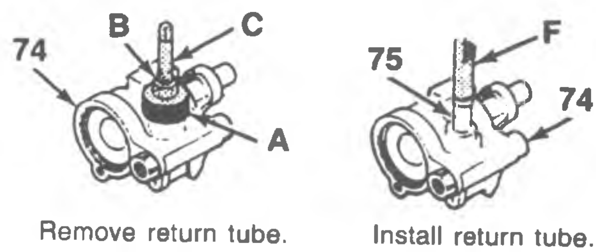


Install pump ring.

50. Drive Shaft
53. Housing
54. O-Ring Seal
55. Pin
56. Thrust Plate
61. Pump Rotor
62. Shaft Retainer Ring
63. Vane
64. Pump Ring
65. Pressure Plate

F9275

Figure 46—Rotating Group Removal and Installation



Remove return tube.

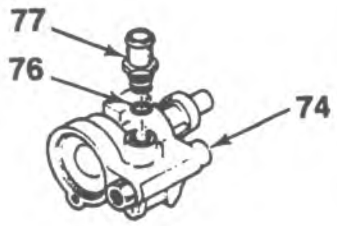
Install return tube.

A. Five 5/8 Washers
B. One 9/16-12 Nut
C. One 9/16-12 Tap

74. Housing
75. Return Tube

F9276

Figure 47—Pressed Return Tube Removal and Installation—Model N



74. Housing
76. O-Ring Seal
77. Return Tube

F9311

Figure 48—Threaded Return Removal and Installation—Model N

Model P Power Steering Pump

1. Seal (69).
2. Reservoir (70).
3. Bolt (71).
4. Fitting (73).

Model N Power Steering Pump

1. Pressed return tube (75) (figure 47).
2. O-ring seal (76) (figure 48).
3. Threaded return tube (77).

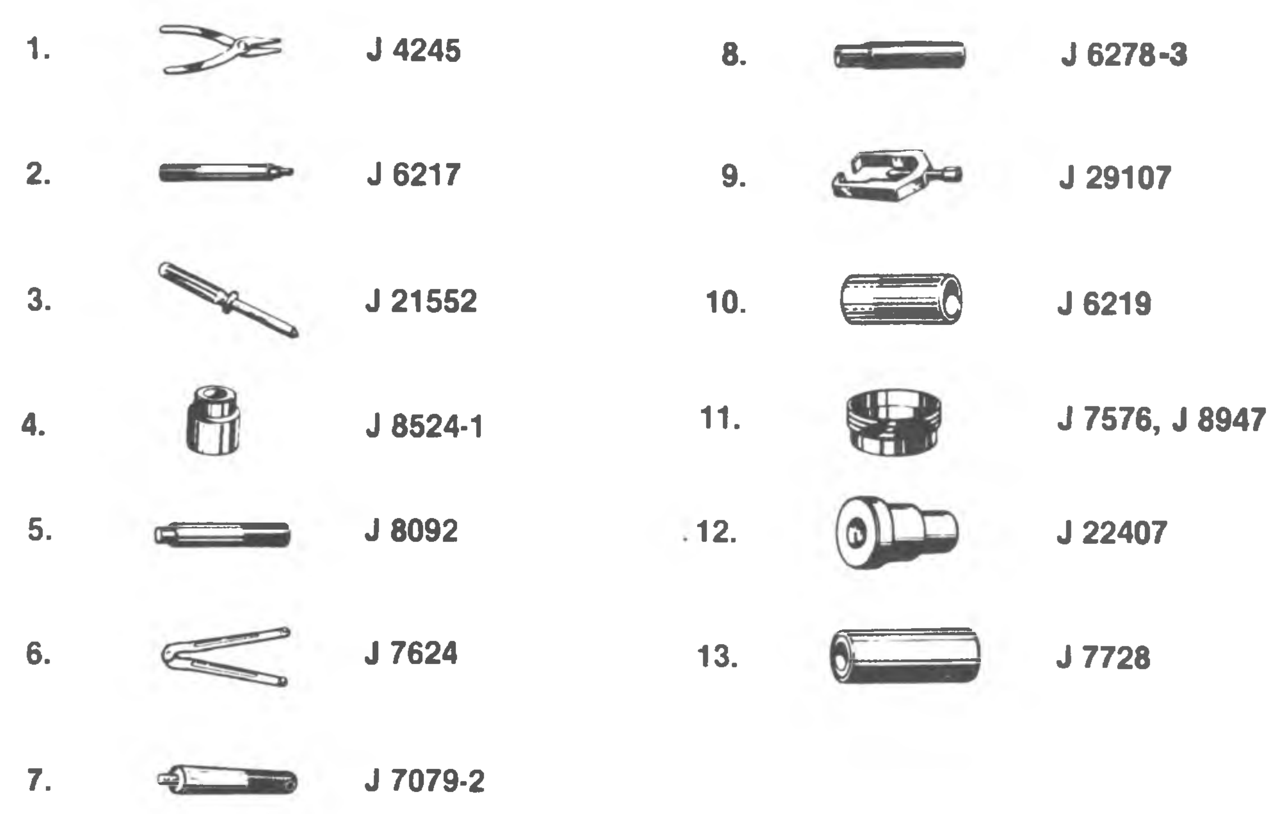
SPECIFICATIONS

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	
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

F9204

SECTION 4B

REAR AXLE

CONTENTS

SECTION 4B1

7 1/2 AND 7 5/8-INCH RING GEAR AXLES

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

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 axle 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 collapsible 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 bearings 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 an alphabetic broadcast code 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 Adjustments 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.

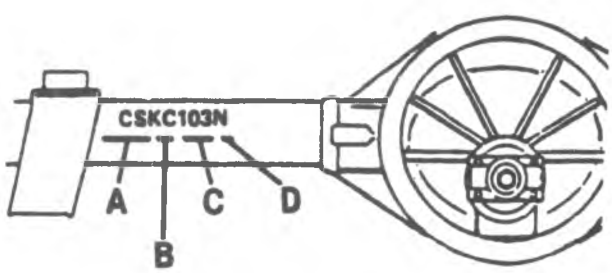
- Determine the cause of the axle problem before disassembly if possible.

DISASSEMBLY OF THE REAR AXLE

Remove or Disconnect (Figure 2)

Tools Required:
- J 2619-01 Slide Hammer
- J 22813-01 Axle Bearing Puller
- J 8107-2 Differential Side Bearing Remover Plug
- J 22888 Side Bearing Remover
- J 8614-01 Pinion Flange Holder
- J 8614-02 Pinion Flange Remover
- J 25320 Rear Pinion Bearing Remover

- Place the rear axle in a suitable support.



A. Axle Code
B. 7½" (190 mm) Chevrolet St. Catherines
C. Day Built
D. Shift (D = Day, N = Night)

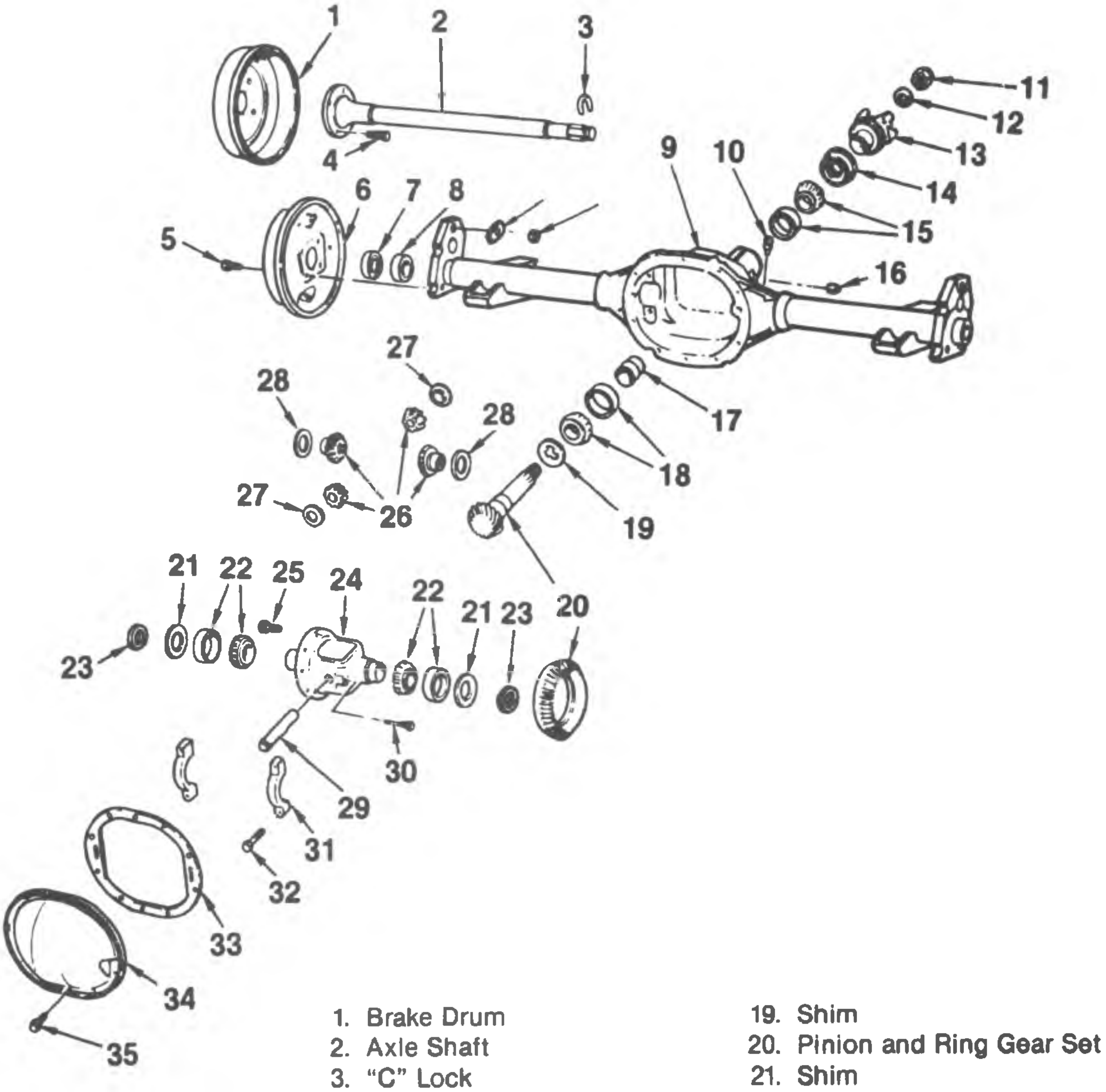
B8110

Figure 1—Rear Axle Identification

1. The differential cover bolts (35) and the differential cover (34).
   - Drain the gear lubricant into a suitable container.
2. Pinion shaft lock bolt (30) (Figure 3).
3. Pinion shaft (29).
4. 'C' lock (3) from the button end of the axle shaft (2).
   - Push the axle shaft (2) in towards the center of the differential case (24).
5. Axle shaft (2) from the axle housing.
6. Oil seal (7) using an oil seal removal tool.
   - Be careful not to damage the housing.
7. Bearing (8) using J 2619-01 and J 22813-01 (Figure 4).
   - The tangs of the tool should engage the bearing outer race.
8. 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.
9. Differential bearing cap bolts (32).
10. 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.

11. Differential case (24).
    - Pry the case from the axle housing at the differential "window" (Figure 7).
12. 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.



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

F4673

Figure 2—Rear Axle Components

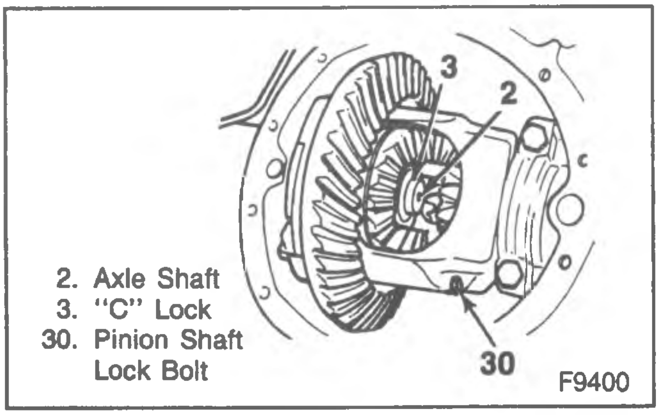


Figure 3—Pinion Shaft Lock Bolt

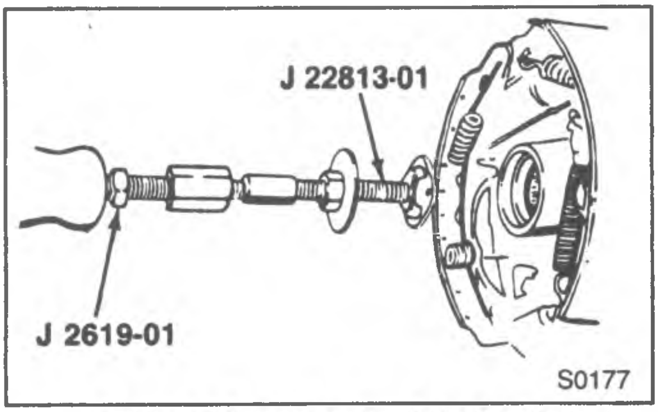


Figure 4—Removing the Axle Bearing

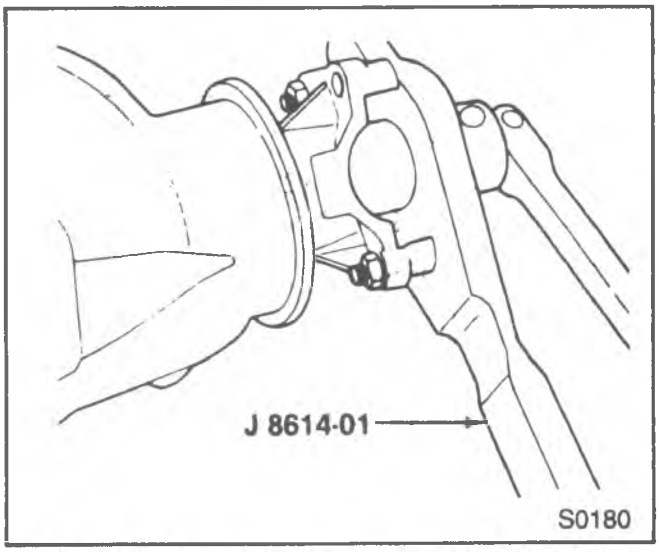


Figure 5—Removing/Installing the Pinion Nut.

13. Differential side bearings using J 8107-2 and J 22888 (figure 8).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage.
14. 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.

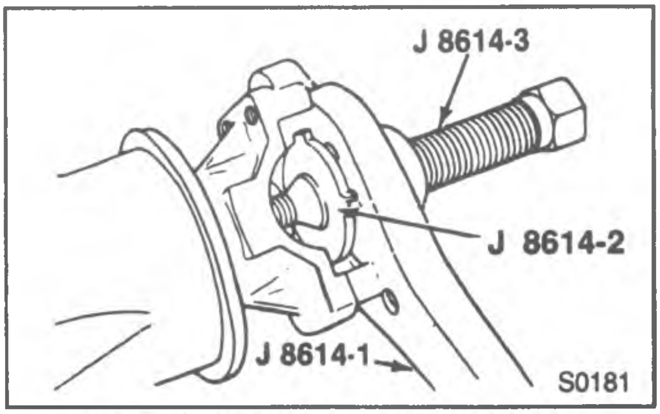


Figure 6—Removing the Pinion Flange

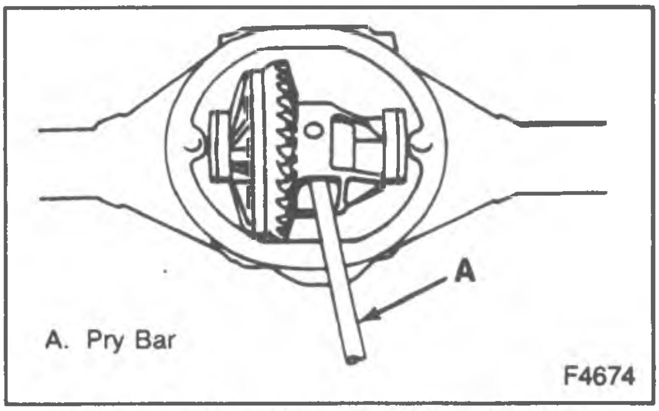


Figure 7—Removing the Differential Case

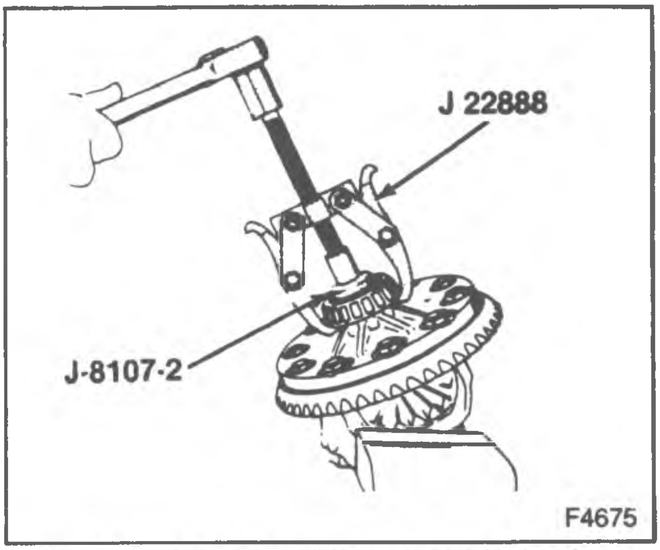


Figure 8—Removing Differential Side Bearings

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

Inspect

- Drive pinion bearing preload (figure 9).
- The pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear).

16. Pinion flange nut (11) and washer (12) using J 8614-01 to hold the pinion flange (figure 5).
17. Pinion flange using J 8614-02 (figure 6).

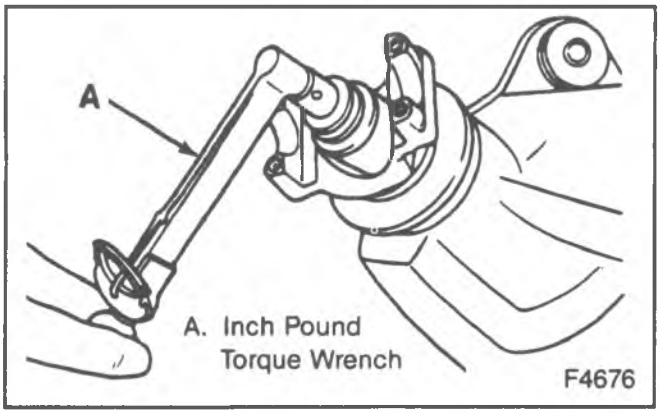


Figure 9—Checking Pinion Preload

18. 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).
19. Collapsible spacer (17) from the pinion (figure 10).
20. Outer seal (14) and outer pinion bearing (15).
21. Inner bearing (18) and shim (19) from the pinion.
    - Press the bearing off the pinion using J 25320 (figure 11).
    - Remove the shim.
22. 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, lint free 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.

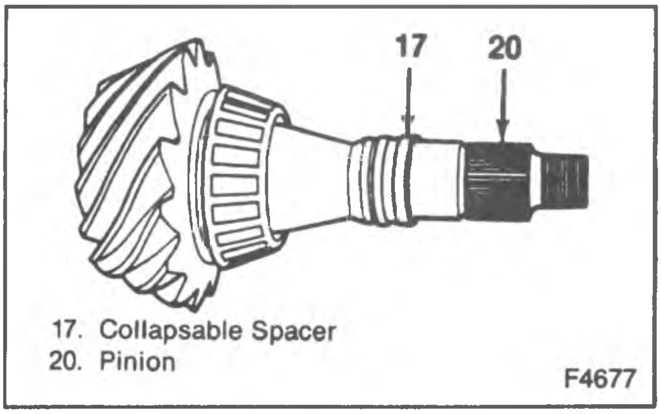


Figure 10—Pinion Collapsible Spacer

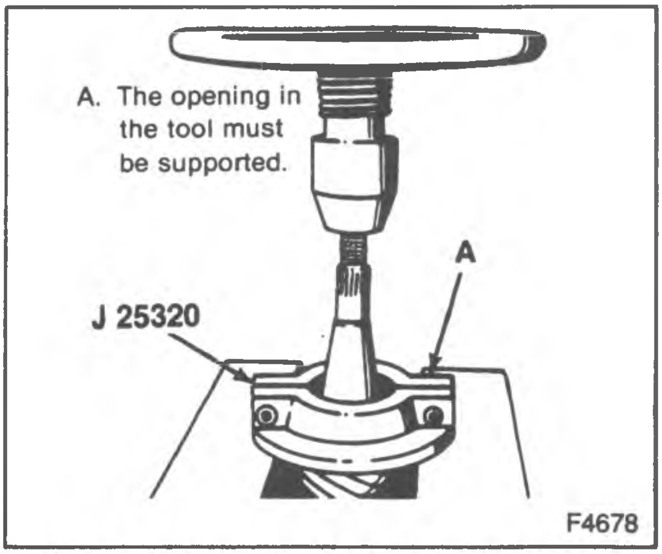


Figure 11—Removing the Pinion Rear Bearing

- 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 gear splines for wear.

- Pinion flange splines for wear.
- The fit of the pinion gear splines 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 very small 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.

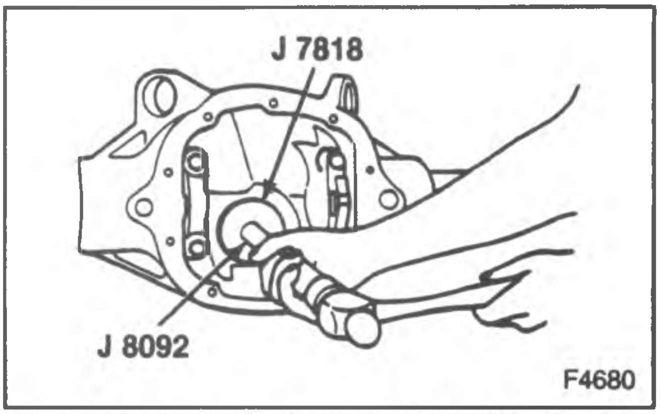


Figure 13—Installing the Rear Pinion Bearing Cup

ASSEMBLY OF THE REAR AXLE

Install or Connect (Figures 2, 12 and 13)

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 14)

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

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 14).
5. Hold the stud stationary at the flats of the stud.

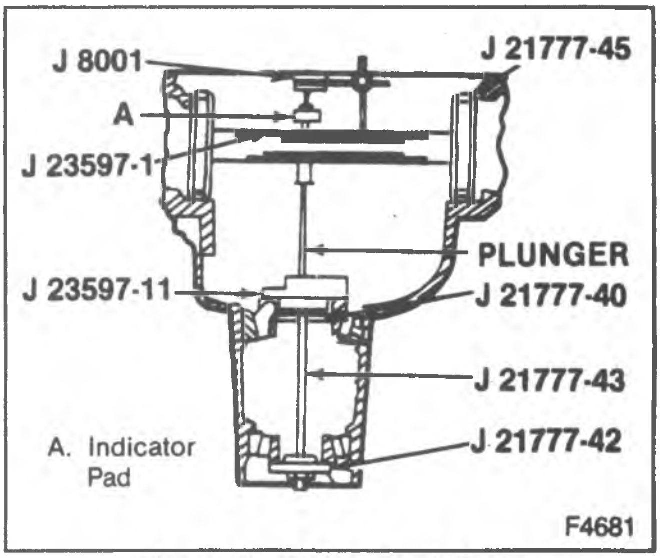


Figure 14—Pinion Depth Tools

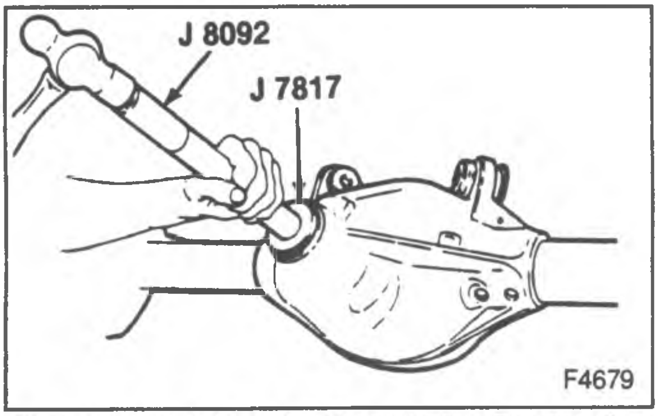


Figure 12—Installing the Front Pinion Bearing Cup

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 21777-45, J 23597-11, and J 8001 to the differential bearing bores as shown in figure 14.
   - 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 3/4 of a turn to the right. Tighten the dial indicator in this position.
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 1.70mm (0.067-inch) to a dial reading of 0.84 mh (0.033-inch) as shown in figure 15, record the dial reading of 0.84mm (0.033-inch) not 1.70 mh (0.067-inch). The dial indicator should be in the 0.50 to the 1.27mm (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.
18. Remove bearing caps (31) and depth gaging tools.
19. Install the correct pinion shim (19) according to this procedure to the pinion.

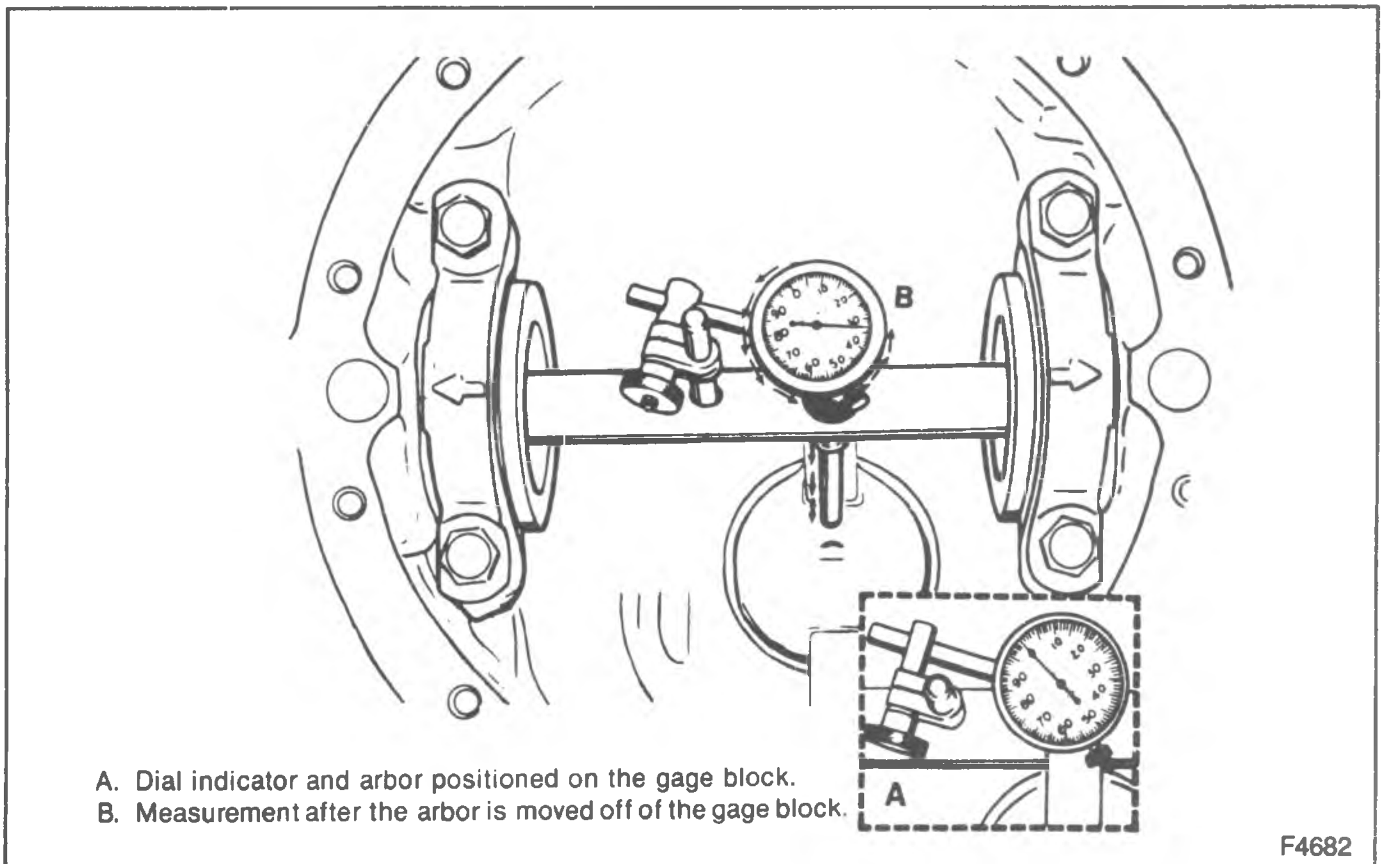
DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 2)

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).



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

Figure 15—Checking Pinion Depth

- 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 verify 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 16).
   - 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 17).
   - 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 Adjustments" in this section.

SIDE BEARING PRE-LOAD ADJUSTMENT

Tool Required:
J 22779 Side Bearing Backlash Gage

- The differential side bearing pre-load adjustment must be made before installing the pinion.
- The differential 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.
- 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 spacer thickness is nominal at 4.32mm (0.170-inch).
- Service shims are available from 1.02mm to 2.54mm (0.040 to 0.100-inch) in increments of 0.101mm (0.004-inch).
- Be sure that the side bearing surfaces are clean and free of burrs.

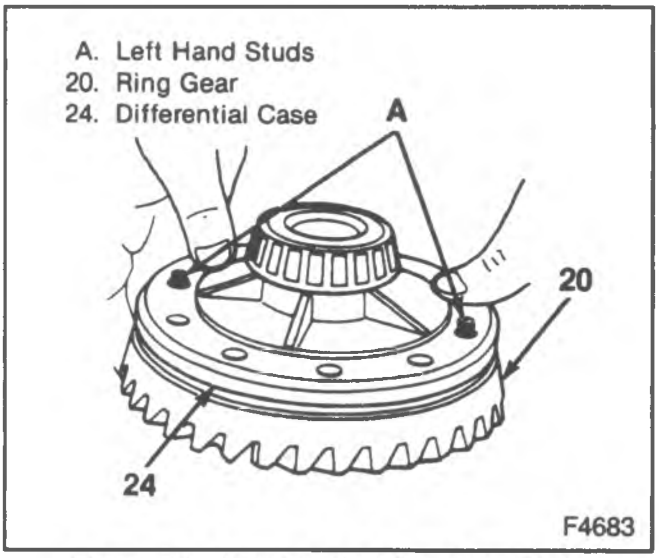


Figure 16—Aligning the Ring Gear Studs

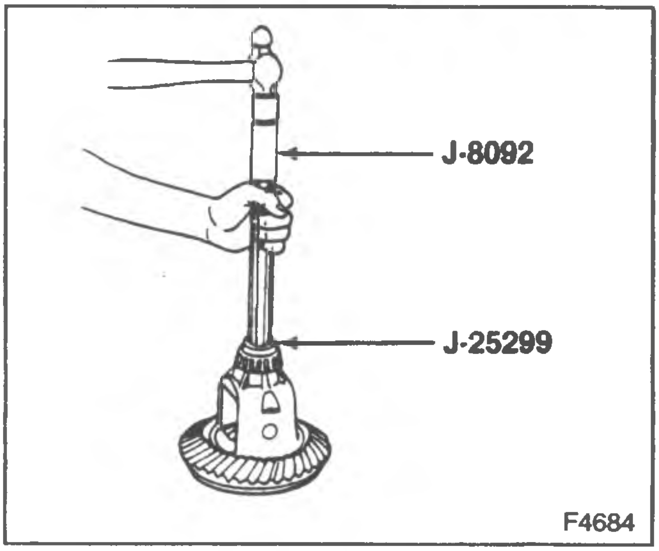


Figure 17—Installing the Side Bearing

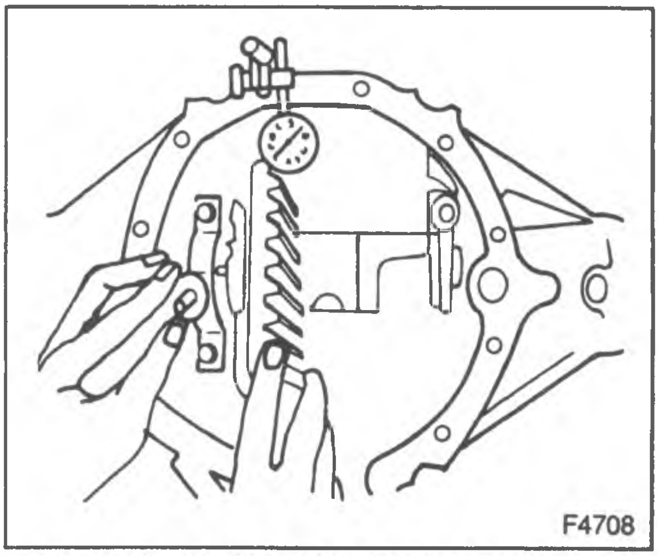


Figure 18—Installing Side Bearing Gaging Tool

1. Place the case with the bearing cups installed into the axle housing (figure 2).
   - Lubricate the axle bearings with axle lubricant.
   - Support the case to keep it from falling into the axle housing.
2. Insert J 22779 between the axle housing and the left bearing cup (figure 18).
3. Move the tool back and forth in the bore while turning the adjusting nut to the right until a noticeable drag is produced (figure 19).
   - Tighten the lock bolt on the side of the tool.
   - Leave the tool in place.
4. Install a service spacer (9) and a service shim (9) between the right bearing cup and the axle housing.
5. 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.
6. Remove the strap, J 22779, the service spacer, service shim, feeler gage, and differential case from the axle housing.
7. Measure J 22779 in three places using a micrometer. Average the readings (figure 20).
8. Add the dimensions of the right side service spacer, service shim, and the feeler gage.
9. 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.
10. To obtain the proper preload on the side bearings add 0.10mm (0.004-inch) to the measurement of each shim pack.
11. Install the differential. Refer to "Backlash Adjustment" in this section.

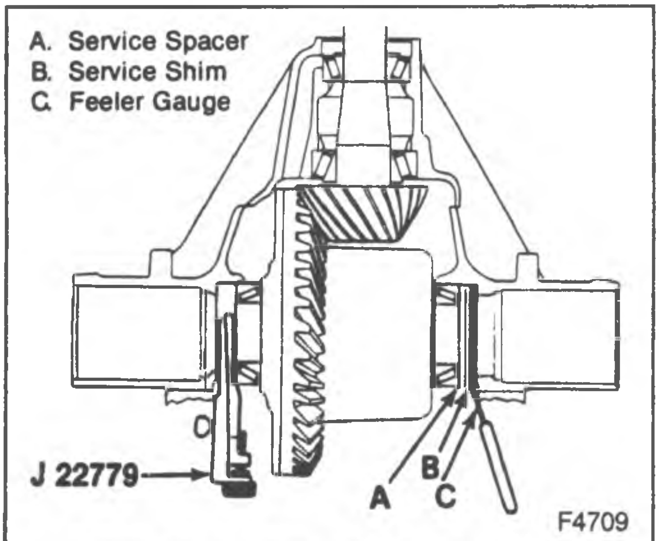


Figure 19—Measuring Side Bearing Shim Requirements

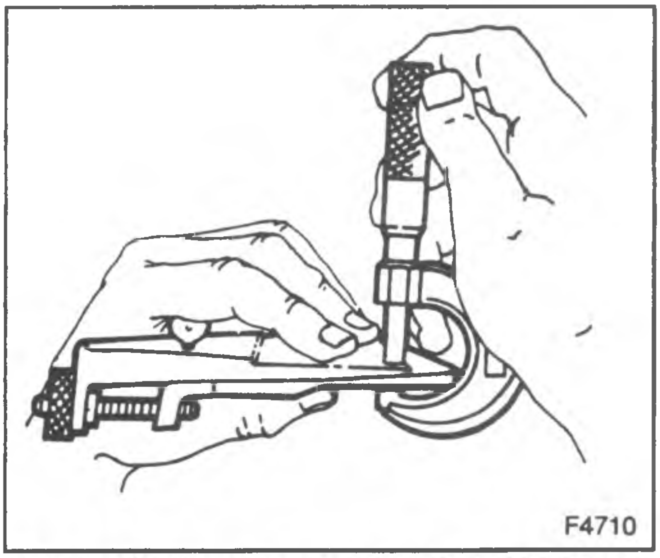


Figure 20—Measuring the Gage Plate Thickness

Figure 21—Shim Thickness Chart

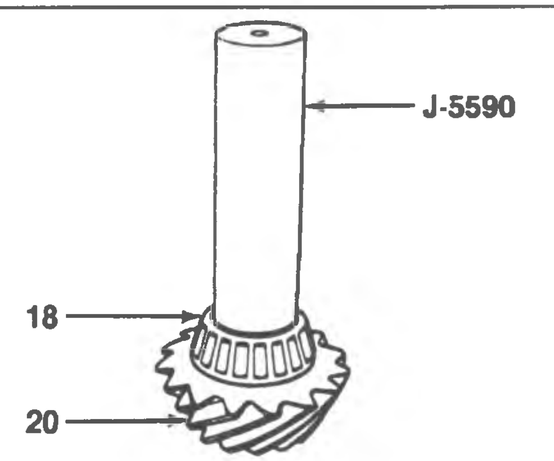
PINION INSTALLATION

Install or Connect

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

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

1. The pinion inner bearing (18) using J 5590 (figure 22).
   - 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.



18. Pinion Rear Bearing
20. Pinion

Figure 22—Installing the Pinion Inner Bearing

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 23). 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 collapsible 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 24).
   - 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 0.05mm (0.002-inch). If the backlash varies more than 0.05mm (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 0.23mm (0.005 and 0.009-inch) for all new gear sets.

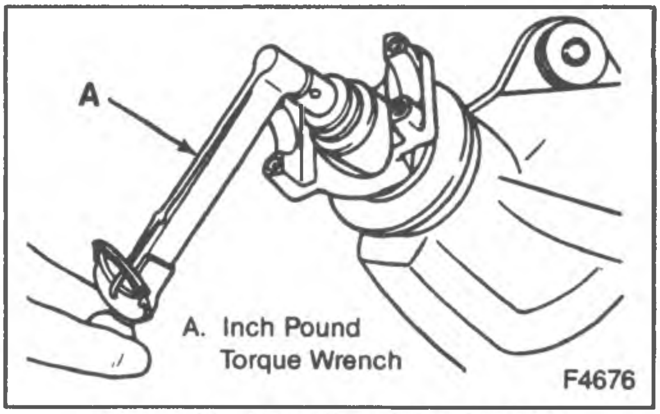


Figure 23—Checking Pinion Preload

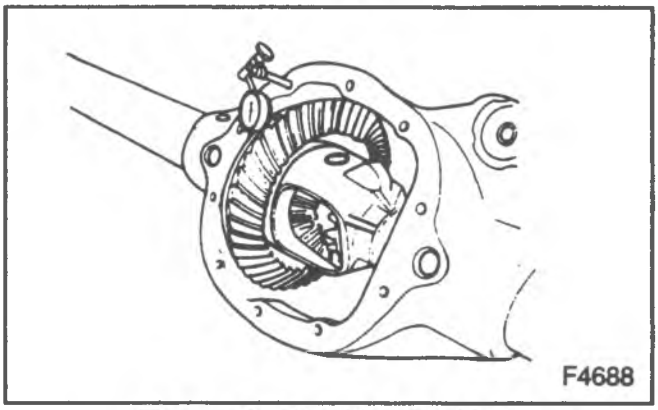


Figure 24—Checking Backlash

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 0.05mm (0.002-inch) worth of shim from one side of the differential to the other will change the backlash adjustment by 0.03mm (0.001-inch).
9. When the backlash is correctly adjusted, remove the bearing caps and the shim packs.
10. Select a shim 0.10mm (0.004-inch) thicker than the one removed from the left side. Insert this shim between the spacer and the left bearing race (figure 25).

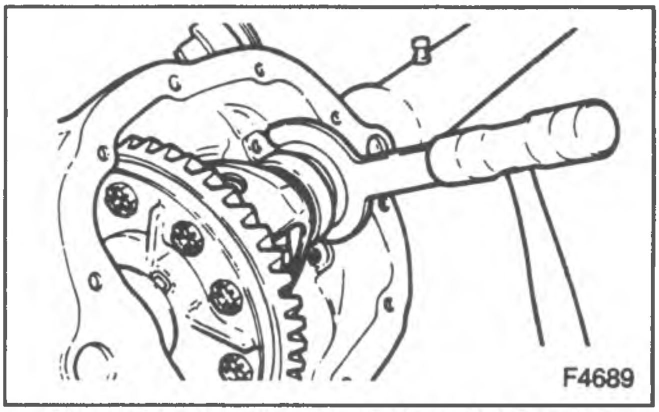


Figure 25—Installing the Differential Bearing Preload Shim

11. Install the left bearing cap and bolts.
    - Do not tighten.
12. Select a shim 0.10mm (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

Tools Required:
J 8092 Driver Handle
J 23765 Axle Shaft Bearing Installer
J 23771 Axle Shaft Seal Installer
J 23911 Pinion Oil Seal Installer

Install or Connect

1. Bearing (8) with J 23765 and J 8092 until the tool bottoms against the housing shoulder (figure 26).
    - Lubricate the bearing with gear lubricant.
2. Oil Seal using J 23771 untill the oil seal is flush with the axle tube (figure 27).
    - Lubricate the seal lips with gear lubricant.

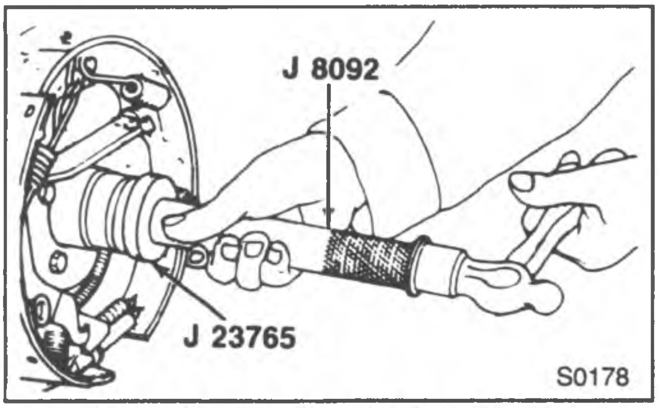


Figure 26—Installing the Axle Bearing

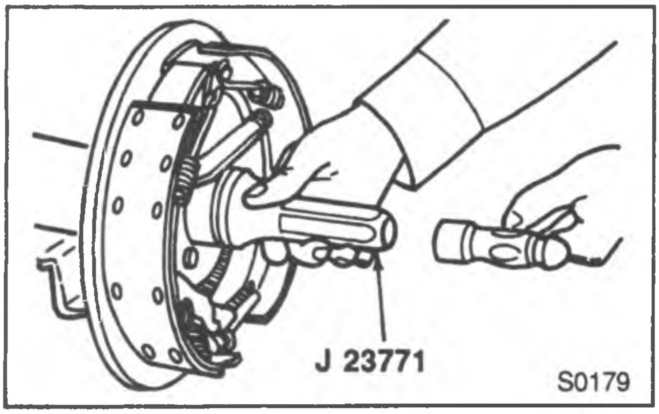


Figure 27—Installing the Axle Seal

3. Axle shafts (2) into the axle housing (9).
    - Be careful not to damage the oil seal.
    - The splines at the end of the axle shaft must engage with the splines of the rear axle side gear.
4. The "C" locks (3) on the axle shaft (2).
    - Pull the axle shaft (2) outward so the "C" lock (3) seats in the counterbore of the rear axle side gear (Figure 28).
5. Pinion shaft (29) through the case (24) and the differential gears (26).
    - Align the hole in the pinion shaft (29) with the lock bolt hole.

NOTICE: See "notice" on page 4B1-1 of this section.

6. New pinion shaft lock bolt (30).

Tighten

- Lock bolt (30) to 34 N.m (25 ft. lbs.).

7. A new cover gasket (33) and the cover (34).

Tighten

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

8. Lubricant to the rear axle.
    - Lubricant to a level within 9.5mm (3/8 inch) of the filler plug hole.
9. Fill plug (16) to 35 N.m (26 ft. lbs.).

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.

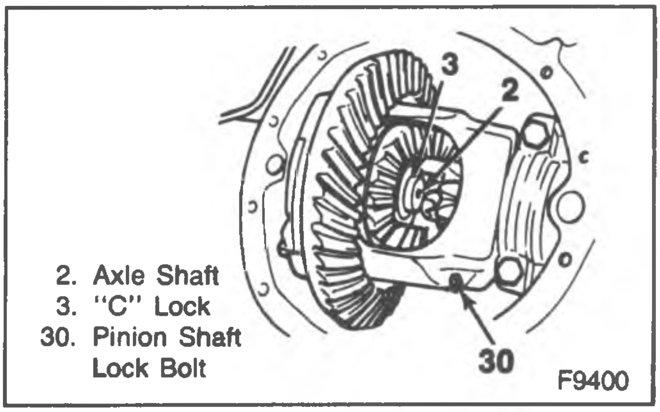


Figure 28—"C" Lock and Axle Shaft Seated in the Side Gear

1. Wipe all oil out of the carrier, and carefully clean each tooth of the ring gear (figure 29).
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 30.

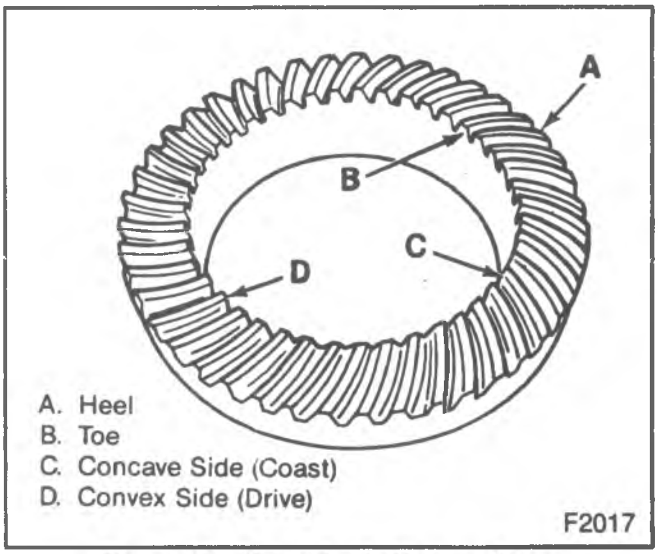


Figure 29—Gear Tooth Nomenclature

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.

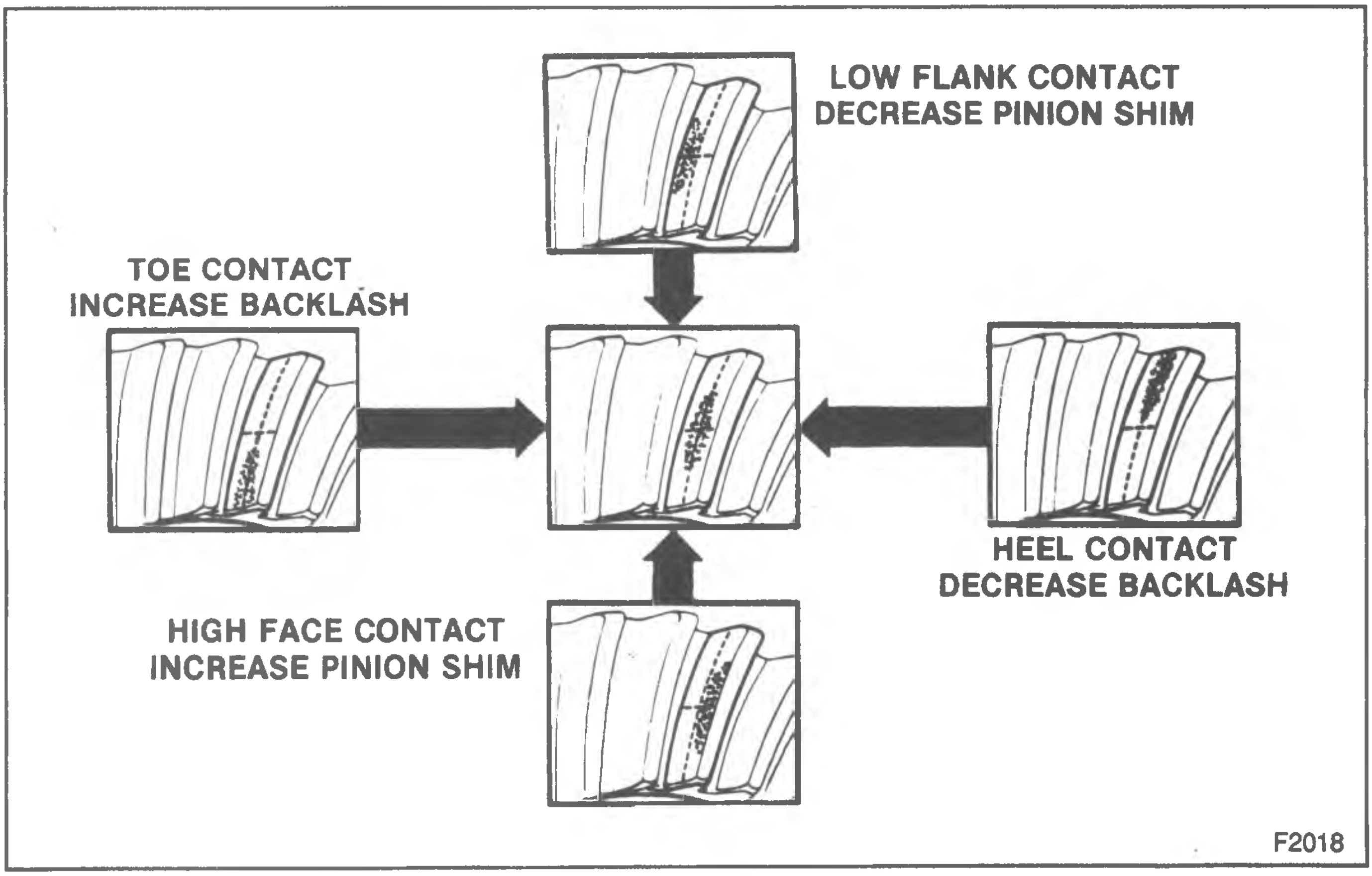


Figure 30—Gear Tooth Pattern

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

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
Filler Plug	35	26

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 0.058-0.063-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

T2508

SPECIAL TOOLS

1.  J 7817

2.  J 7818

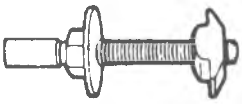
3.  J 8107-2

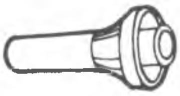
4.  J 8614-02

5.  J 8614-02

6.  J 22888

7.  J 5590

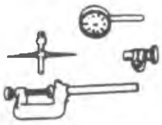
8.  J 22813-01

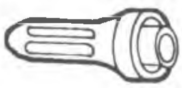
9.  J 23911

10.  J 25299

11.  J 25320

12. 

13.  J 8001

14.  J 23771

15.  J 2619-01

16.  J 23765

1. Front Pinion Bearing Cup Installer
2. Rear Pinion Bearing Cup Installer
3. Differential Side Bearing Remover Plug
4. Pinion Flange Holder
5. Pinion Flange Remover
6. Side Bearing Remover
7. Rear Pinion Bearing Cone Installer
8. Axle Bearing Puller
9. Pinion Oil Seal Installer
10. Differential Side Bearing Installer
11. Rear Pinion Bearing Remover
12. Driver Handle
13. Dial Indicator
14. Axle Seal Installer
15. Slide Hammer
16. Axle Bearing Installer

F9399

SECTION 4B2

8 1/2-INCH RING GEAR

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

DESCRIPTION

The corporate 8 1/2-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 axle 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 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 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 alphabetic broadcast code 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.
   - Refer to "Checking the Axle Before Disassembly" in this section.
2. Pinion shaft lock bolt (15) Figure 2.
3. Pinion shaft (17).
4. "C" lock (34) from the button end of the axle shaft (33).
   - Push the axle shaft (33) in towards the center of the differential case (24).
5. Axle shaft (33) from the axle housing (1).
6. Oil seal (28) using an oil seal removeing tool.
   - Be careful not to damage the housing.
7. Bearing (27) using J 2619-01 and J 22813-01.
   - The tangs of the tool should engage the bearing outer race.
8. 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.
9. Differential bearing cap bolts (18).
10. 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.

11. Differential case (24).
    - Pry the case from the axle housing at the differential "window" (Figure 3).
12. Bearing outer races (8) and shims (9).
    - Mark the races and the shims as left and right, and place them with the bearing caps.
13. Differential side bearings (8) using J 8107-4 and J 22888 (figure 4).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage. Use the slots provided for the puller.
14. 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.

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

Inspect

- Drive pinion bearing preload (Figure 5).
- For looseness of pinion assembly by moving it back and forth. (This indicates excessive bearing wear).

16. Pinion flange nut (35) and washer (36) using J 8614-01 to hold the pinion flange (Figure 6).
17. Pinion flange using J 8614-01 (Figure 7).
18. 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 8).
19. Collapsible spacer (4) from the pinion.
20. Outer pinion seal (38) and bearing (39).
21. Inner bearing (5) and shim (6) from the pinion.
    - Press the bearing off the pinion using J 8612-B (Figure 9).
    - Remove the shim.
22. 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.

CLEANING

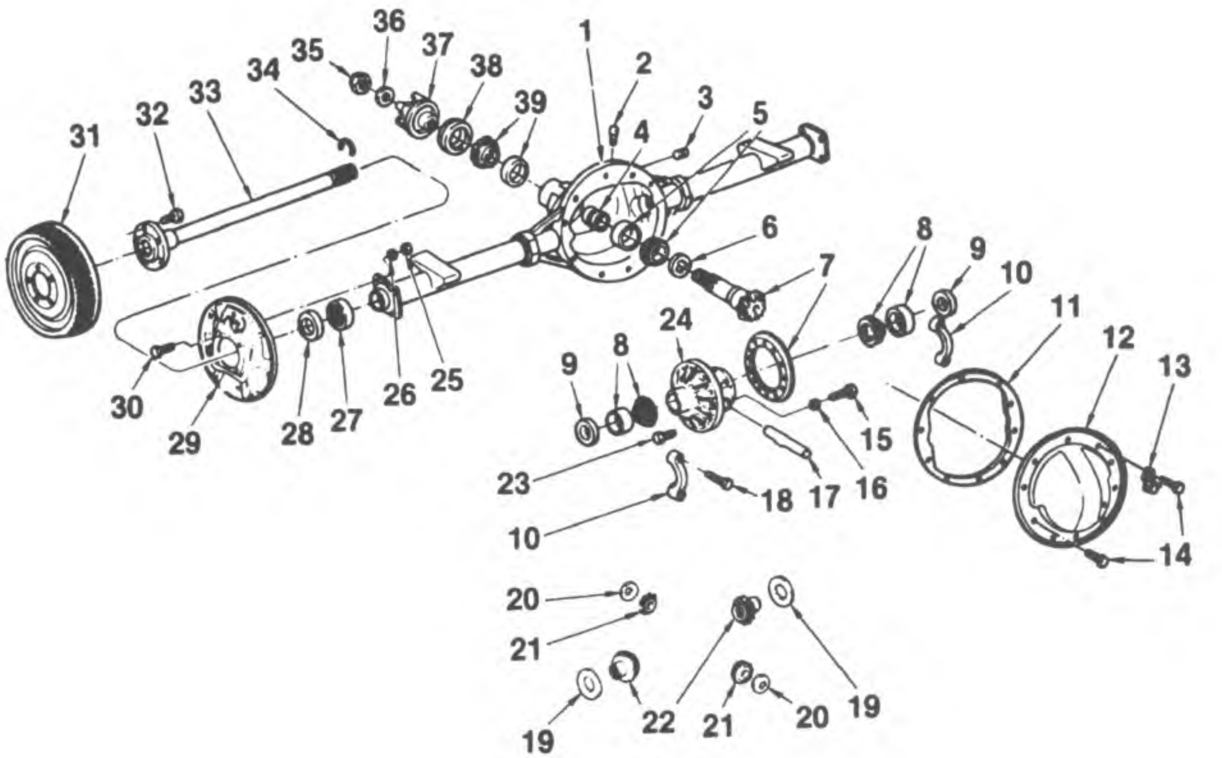
Do not steam clean drive parts having ground and polished surfaces such as gears, bearings, and shafts. These parts should be cleaned in a suitable solvent. All parts should be disassembled before cleaning.

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. 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

F4687

Figure 1—Rear Axle Components

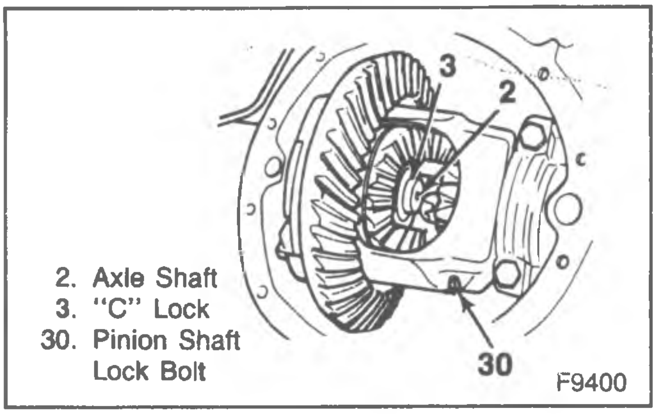


Figure 2—Pinion Shaft Lock Bolt

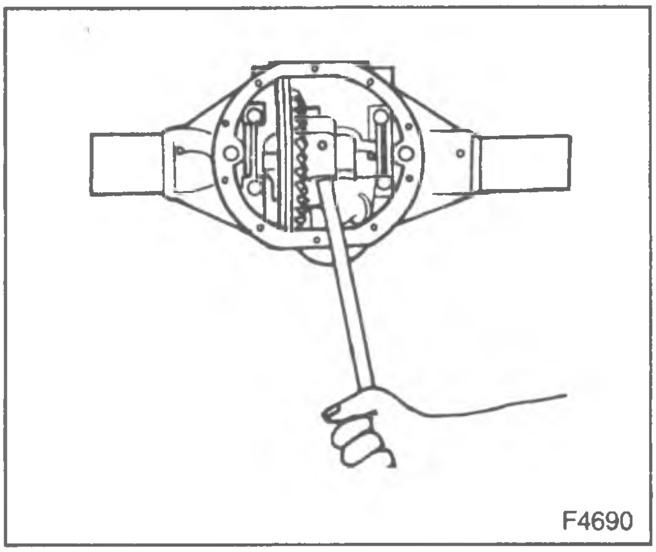


Figure 3—Prying the Differential Case

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.

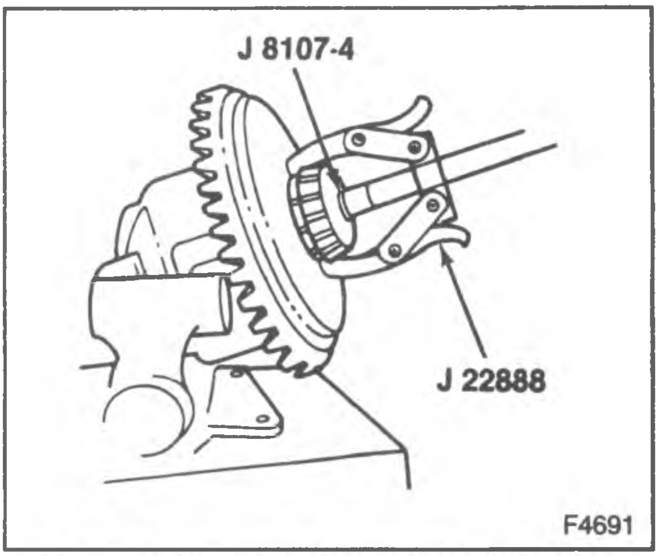


Figure 4—Removing Differential Side Bearing

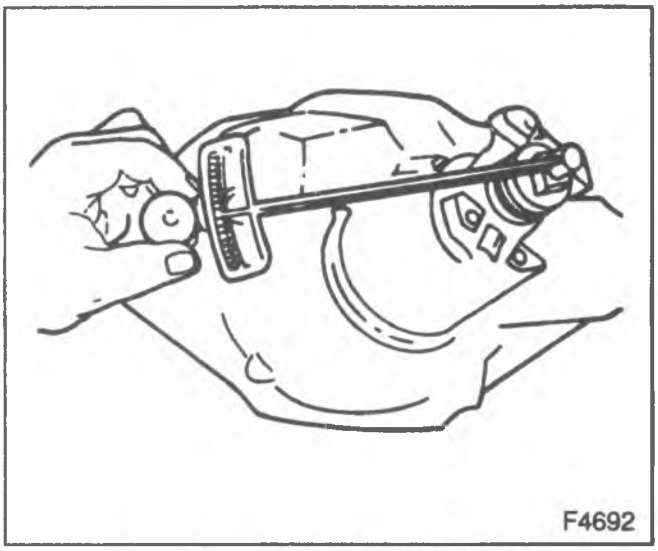


Figure 5—Checking Pinion Preload

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion gear splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion gear on the pinion flange.
- The 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.

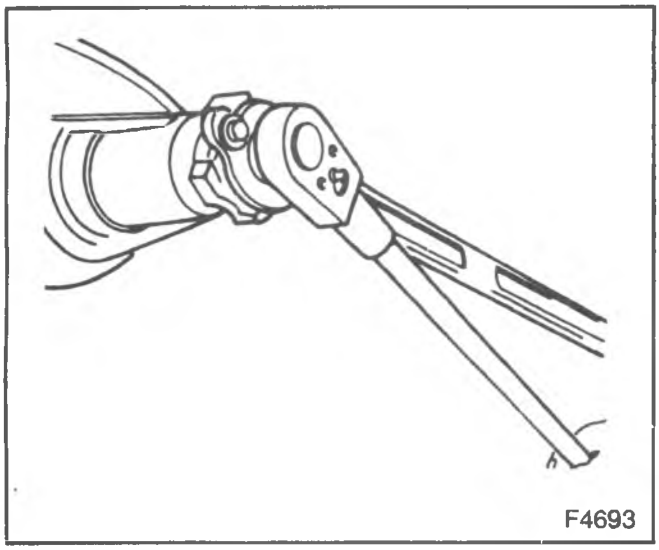


Figure 6—Removing the Drive Pinion Nut

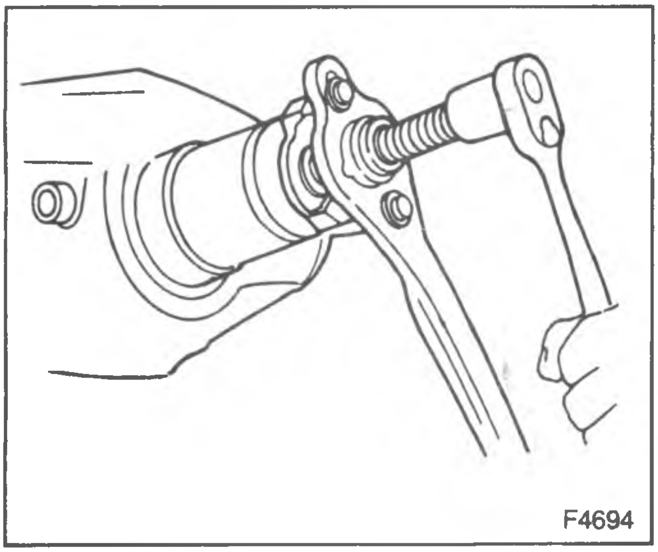


Figure 7—Removing the Pinion Flange

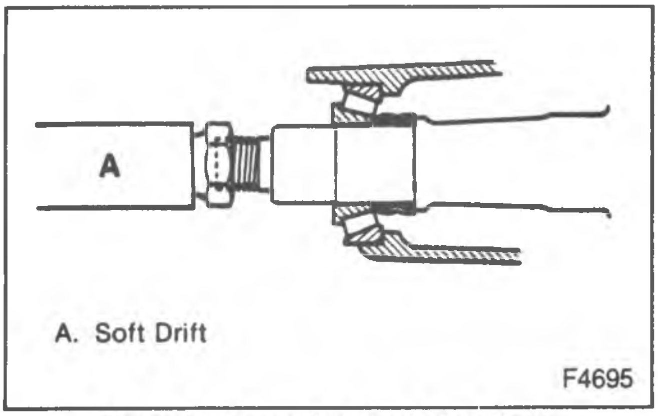


Figure 8—Removing the Drive Pinion

- 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.

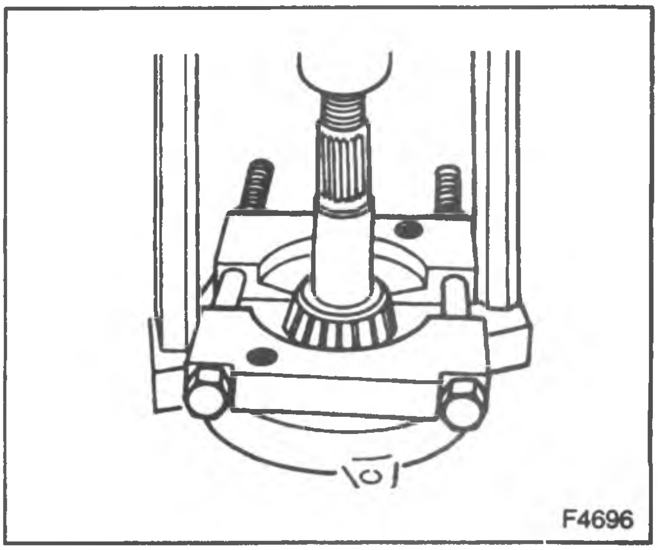


Figure 9—Removing the Pinion Rear Bearing

- 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 very small 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 10) .
2. Rear pinion bearing cup (5) using J 8608 and J 8092 (Figure 11).

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.

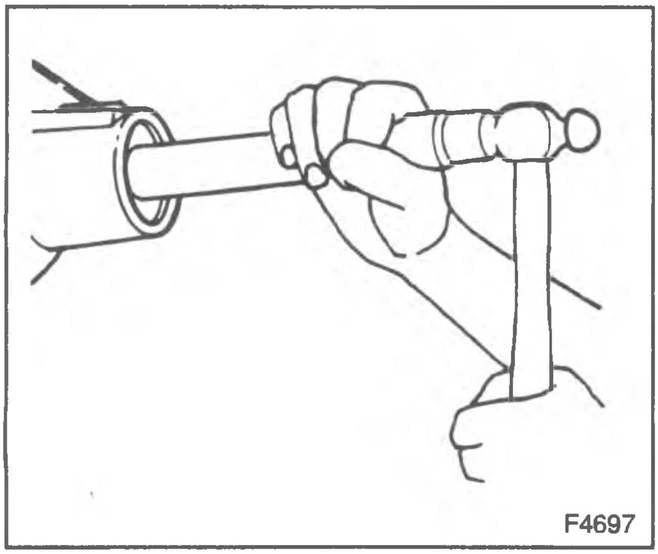


Figure 10—Installing the Front Pinion Bearing Cup

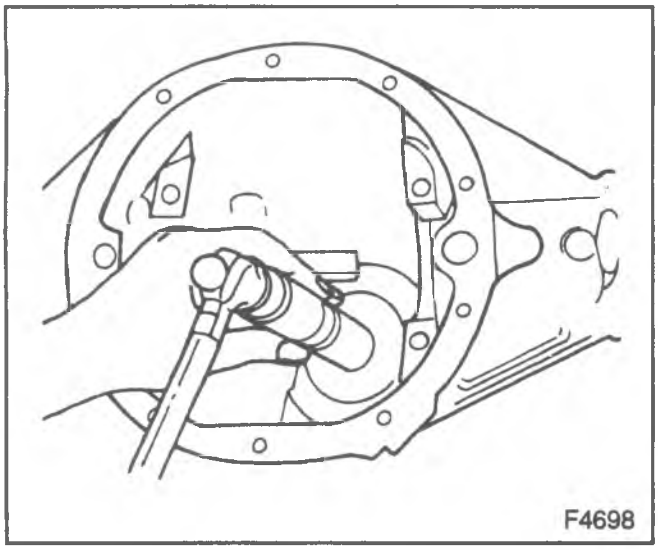


Figure 11—Installing the Rear Pinion Bearing Cup

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 12).
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 21777-45, J 21777-1 Arbor, and J 8001 to the differential bearing bore as shown in (Figure 13).
   - The bearing bores must be clean and burr free.
9. Install the side bearing caps, and tighten the bolts finger tight.

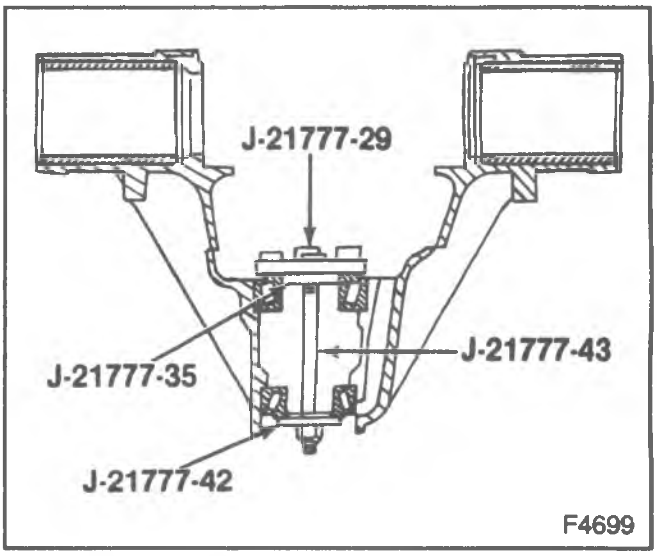


Figure 12—Gage Plate Tools

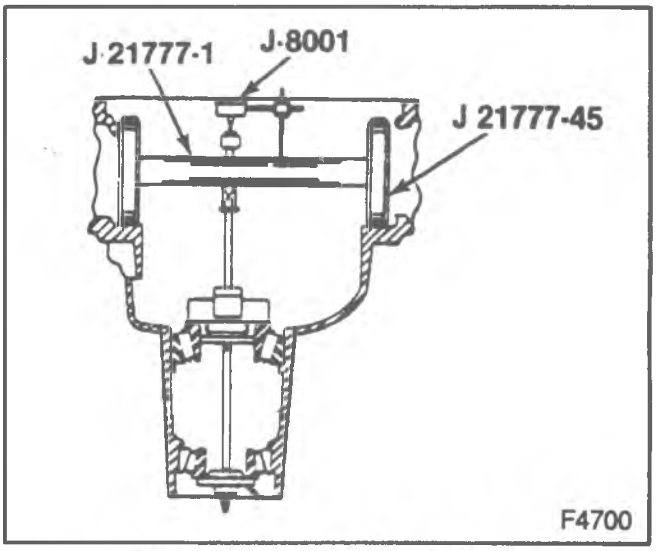


Figure 13—Pinion Depth Tools

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 3/4 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).
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 14). 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

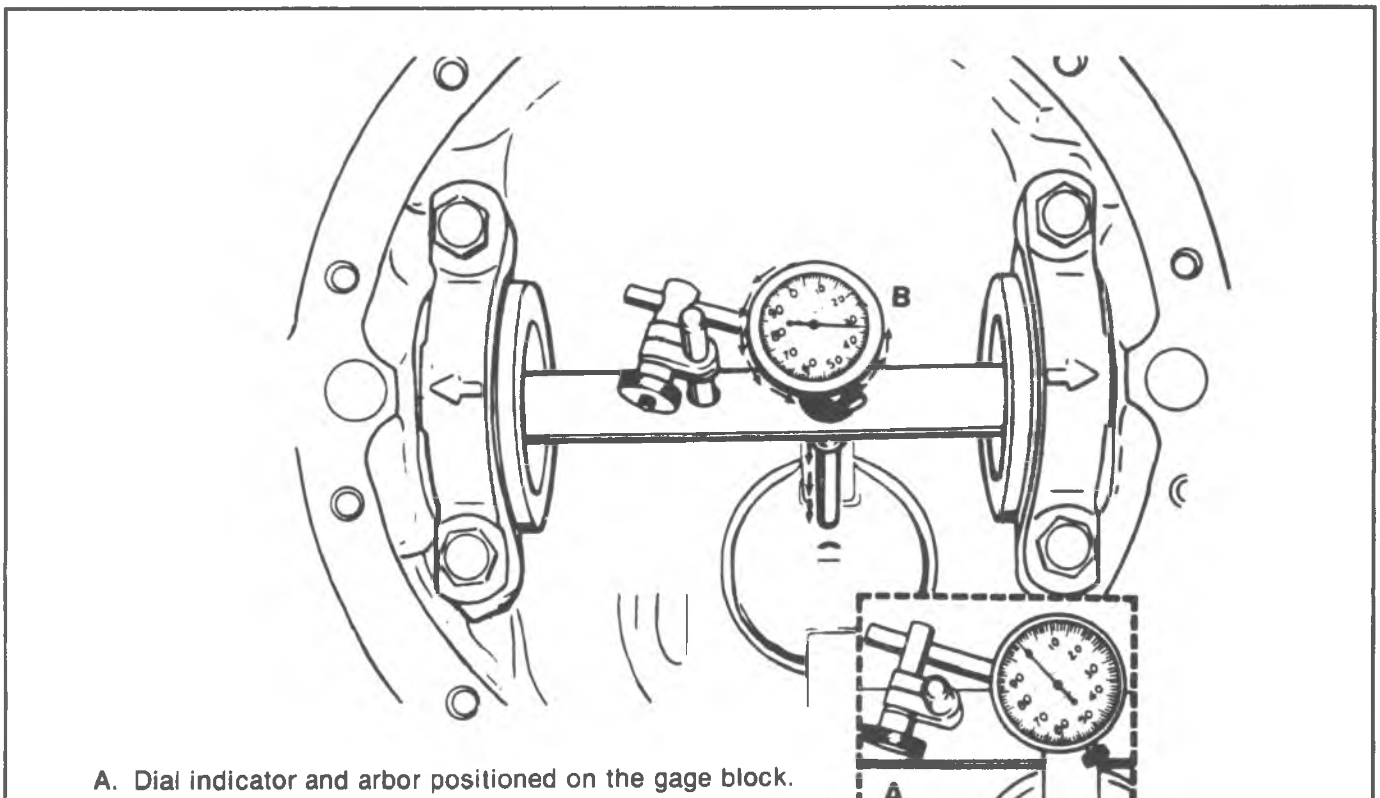
Tools Required:
J 8809-01 Rear Pinion Bearing Cone Installer
J 22388 Pinion Oil Seal Installer
J 8614-01 Pinion Flange Remover
J 5590 Rear Pinion Bearing Cone Installer

- 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 collapsible 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 15).
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 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).



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

F4682

Figure 14—Checking Pinion Depth

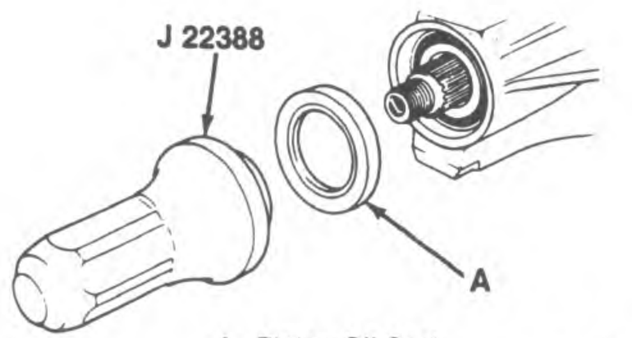


Figure 15—Installing the Pinion Oil Seal

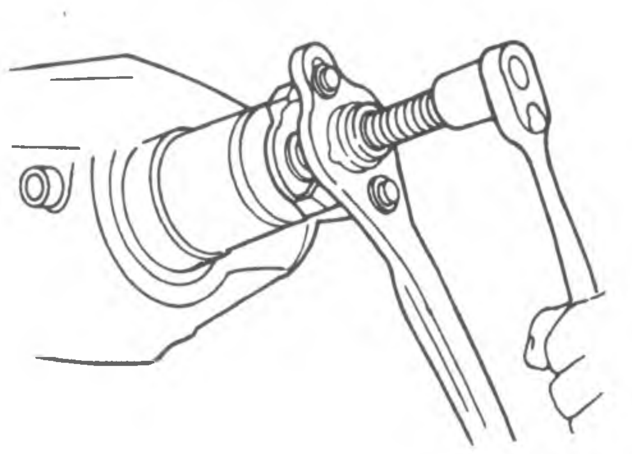


Figure 16—Installing the Pinion Flange

- 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.

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 18).
   - Place the ring gear onto the case, and align the holes in the case with the studs.

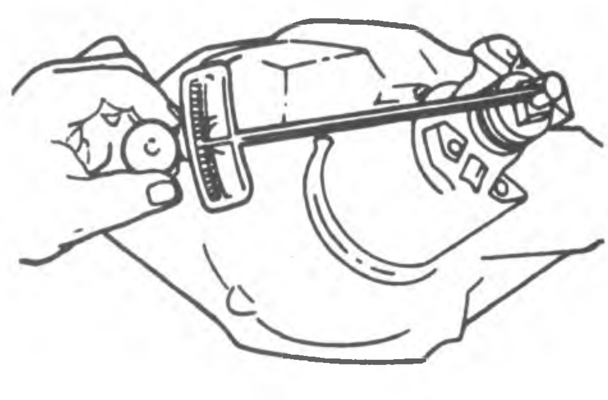


Figure 17—Checking Pinion Bearing Preload

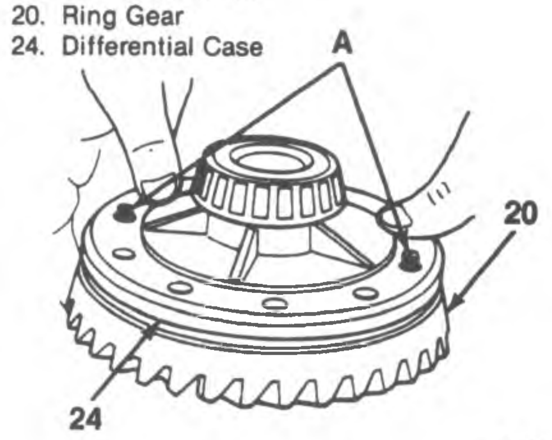


Figure 18—Aligning the Ring Gear Studs

- 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 19).

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 120 N.m (60 ft. lbs.).

7. Differential side bearings (8) using J 22761, J 8107-4 and J 8092 (Figure 20).
   - 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.

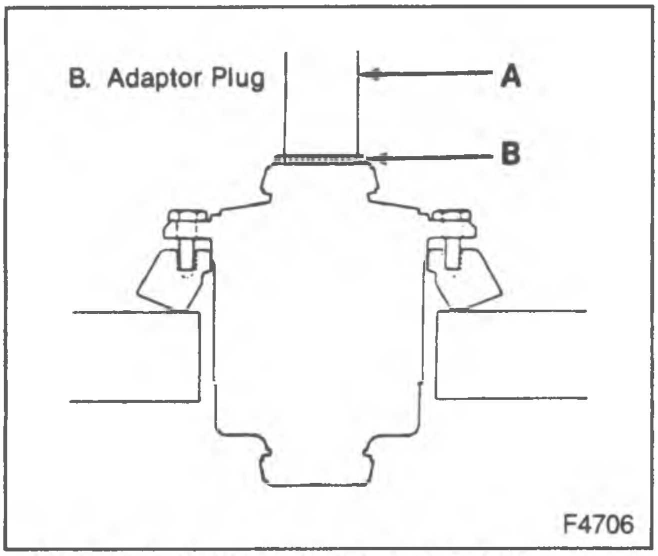


Figure 19—Installing the Ring Gear to the Case

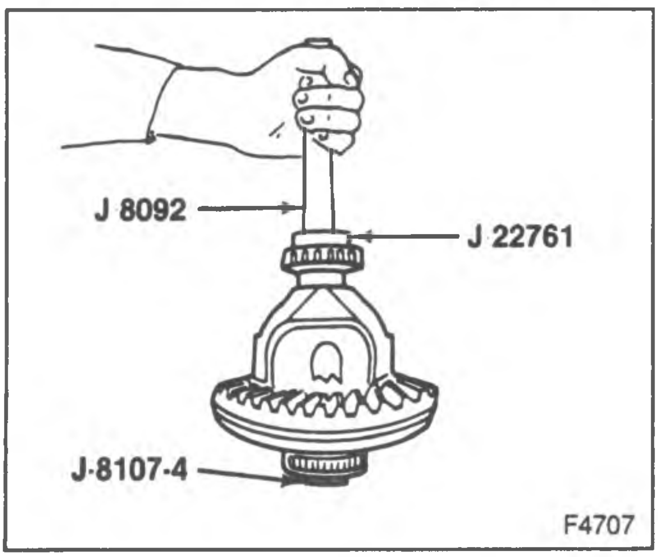


Figure 20—Installing the Side Bearing

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 spacer thickness is nominal at 4.32 mm (0.170-inch).
- 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.

  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 21).
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 22).
   - Tighten the lock bolt 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 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.

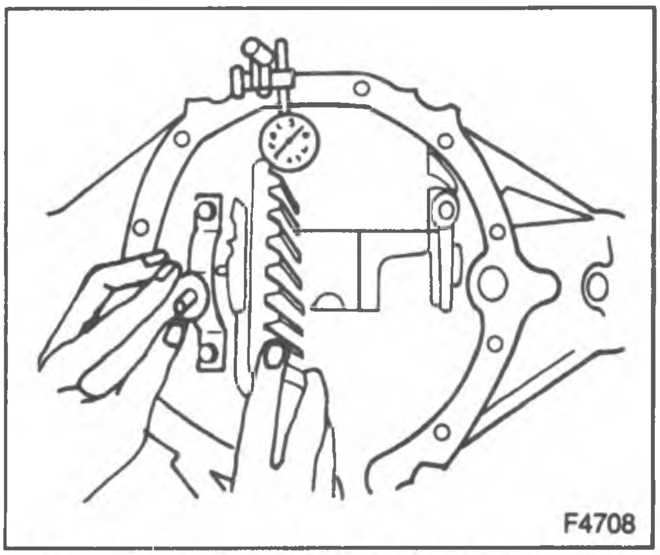


Figure 21—Installing Side Bearing Gaging Tool

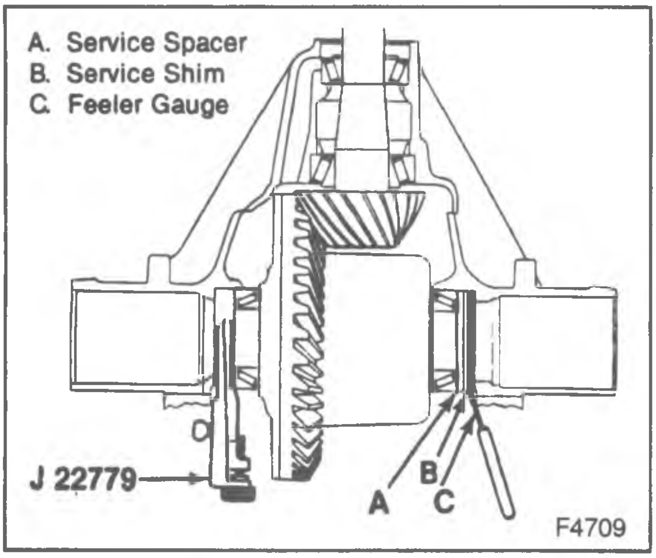


Figure 22—Measuring Side Bearing Shim Requirements

- 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 23).
10. Add the dimensions of the right side 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 24).
   - 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 25).

NOTICE: See notice on page 3B2-1 of this section.

5. Install the differential caps (10) and bolts (18).

Tighten

- The bolts to 80 N·m (60 ft. lbs.).

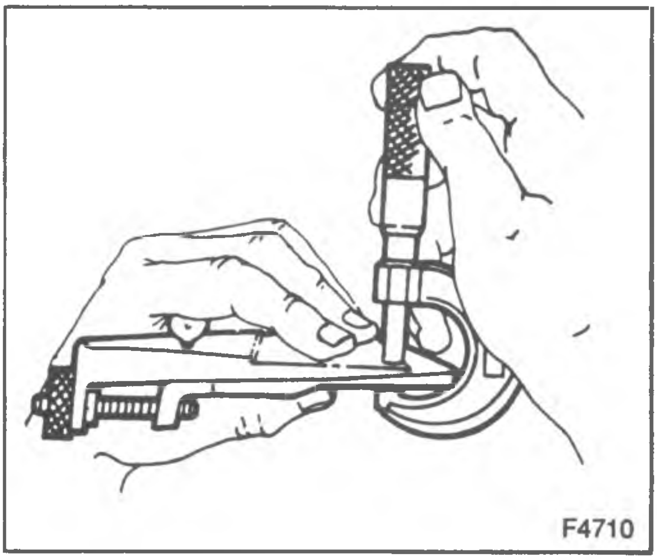


Figure 23—Measuring the Gage Plate Thickness

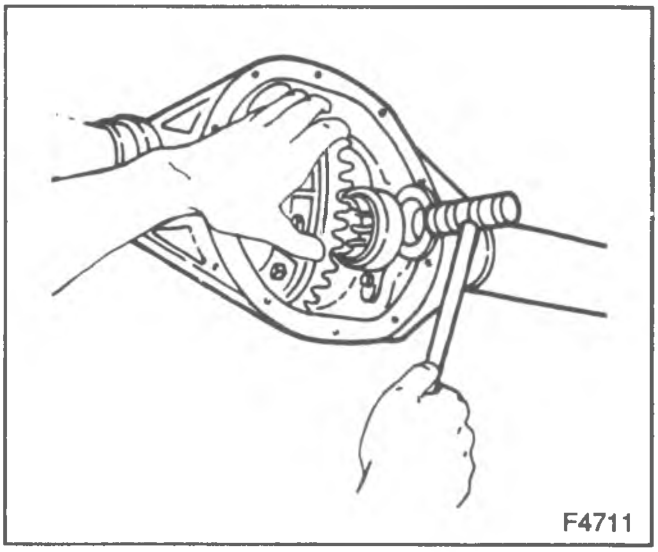


Figure 24—Installing the Final Preload Shim

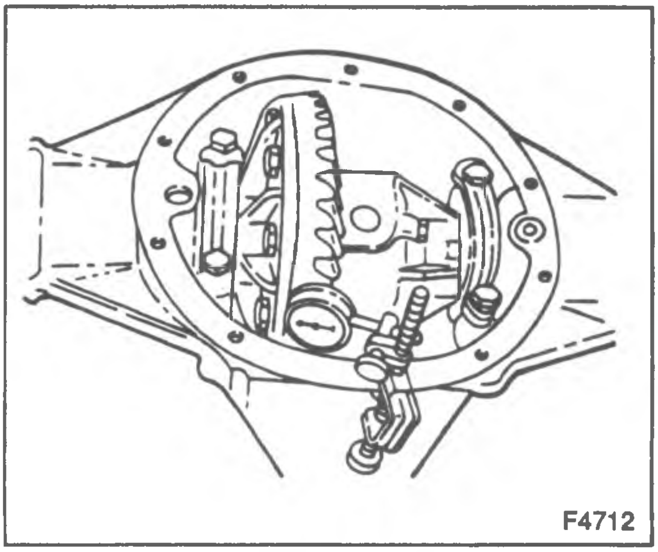


Figure 25—Checking Ring Gear Backlash

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.
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

Tools Required:
J 8092 Driver Handle
J 23765 Axle Shaft Bearing Installer
J 23771 Axle Shaft Seal Installer
J 23911 Pinion Oil Seal Installer

Install or Connect

1. Bearing (27) with J 23765 and J 8092 untill the tool bottoms against the housing shoulder.(figure 26)
   - Lubricate the bearing with gear lubricant.
2. Oil Seal using J 23771 until the oil seal is flush with the axle tube.(figure 27)
   - Lubricate the seal lips with gear lubricant.
3. Axle shafts (33) into the axle housing (1).
   - Be careful not to damage the oil seal.
   - The splines at the end of the axle shaft must engage with the splines of the rear axle side gear.
4. "C" locks (34) on the axle shaft (33).
   - Pull the axle shaft (33) outward so the "C" lock (34) seats in the counterbore of the rear axle side gear (figure 2).
5. Pinion shaft (17) through the case (24) and the differential gears (22).

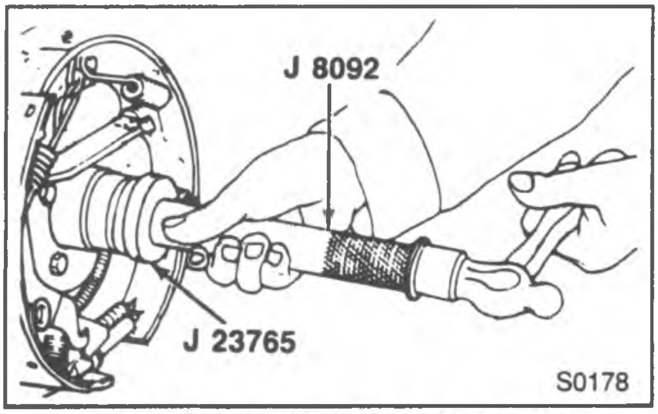


Figure 26—Installing the Axle Bearing

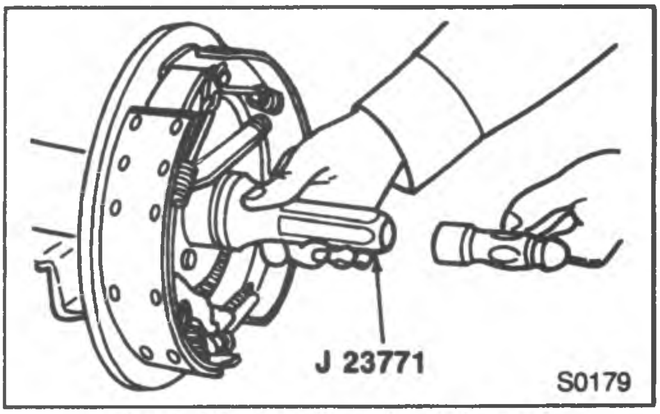


Figure 27—Installing the Axle Seal

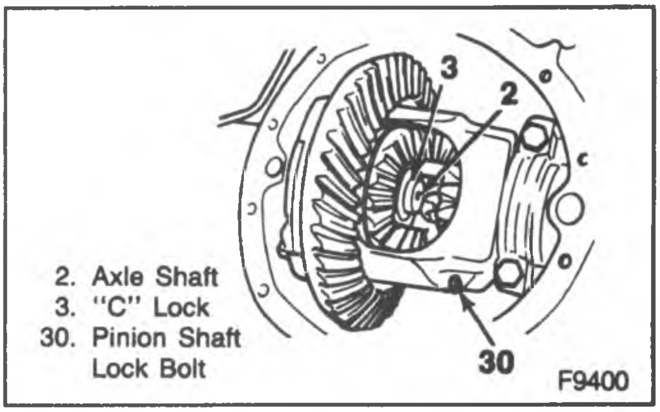


Figure 28—"C" Lock and Axle Shaft seated in the Side Gear

   - Align the hole in the pinion shaft (17) with the lock bolt hole.

NOTICE: See "notice" on page 4B2-1 of this section.

6. New pinion shaft lock bolt (15).

Tighten

   - Lock bolt (15) to 34 N·m (25 ft.lbs.).

7. A new cover gasket (11) and the cover (12).

Tighten

   - The cover bolts (14) to 27 N·m (20 ft. lbs.).

8. Lubricant to the rear axle.
   - Lubricant to a level within 9.5 mm (3/8 inch) of the filler plug hole.
9. Fill plug (3) to 35 N·m (ft. lbs.).

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 29).
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 30.

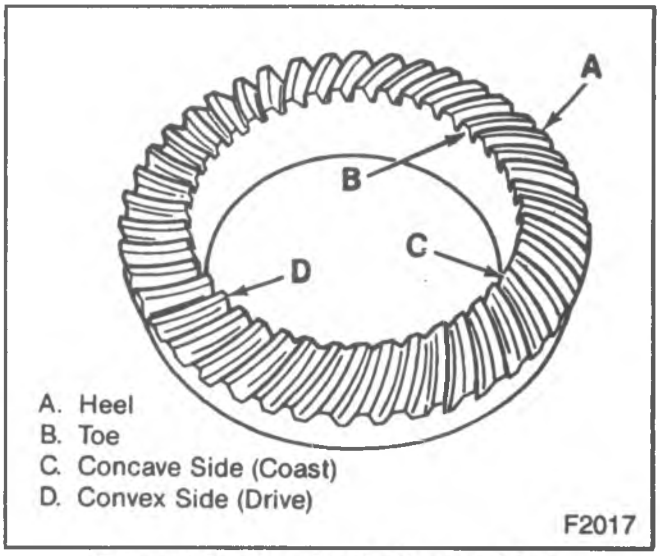


Figure 29—Gear Tooth Nomenclature

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).

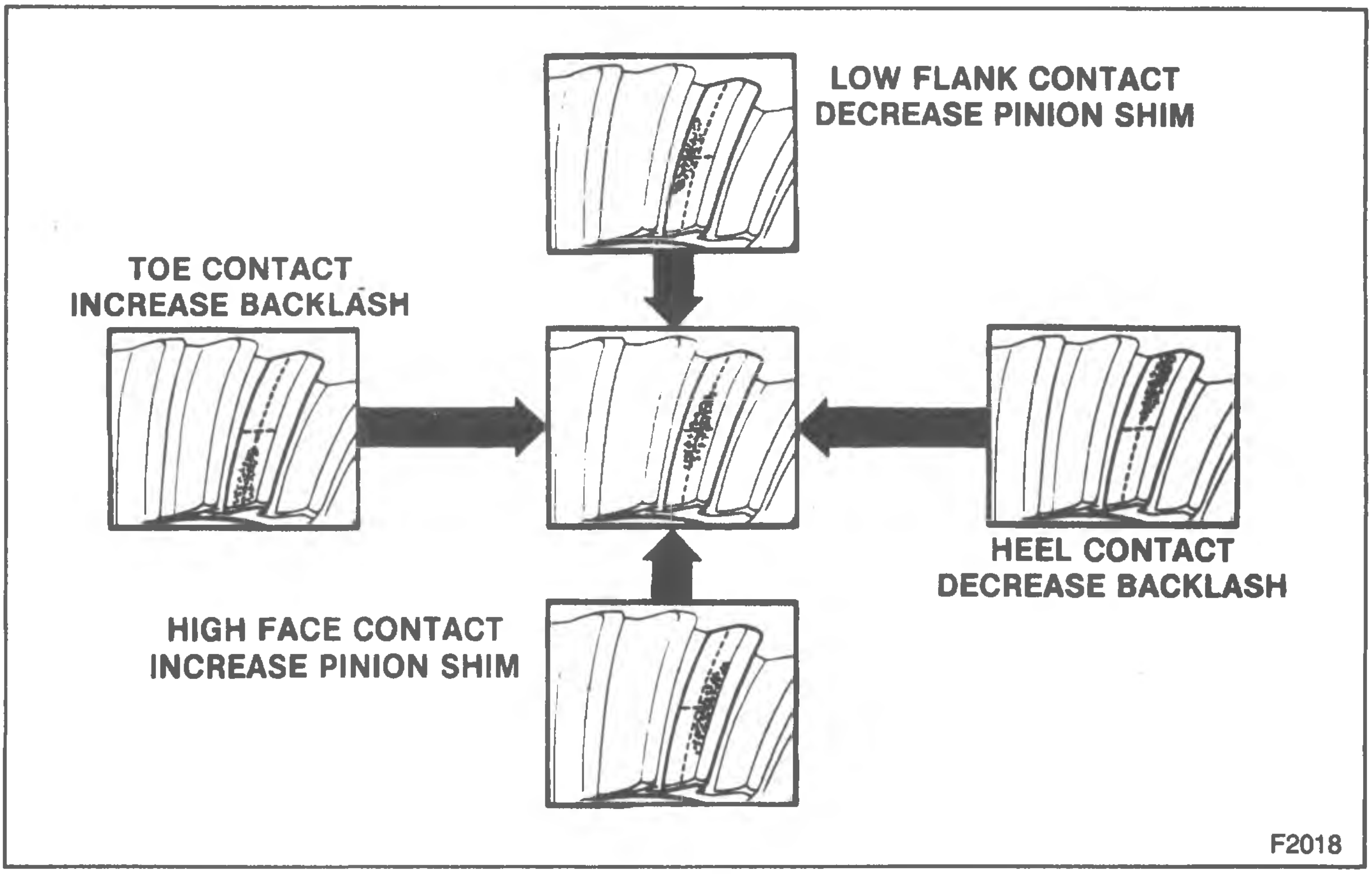


Figure 30—Gear Tooth Pattern

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)

SPECIFICATIONS

8 1/2-INCH RING GEAR AXLE

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	120	90
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	0.040-0.044-inch 0.046-0.050-inch 0.052-0.056-inch 0.058-0.063-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	0.020-0.024-inch 0.025-0.029-inch 0.030-0.034-inch 0.035-0.039-inch
Lubricant	80W-90 GL-5

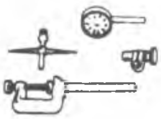
T2509

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

F4660

SECTION 4B3

9 1/2-INCH RING GEAR

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

DESCRIPTION

The corporate 9 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. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the axle 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 an alphabetic broadcast code 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.

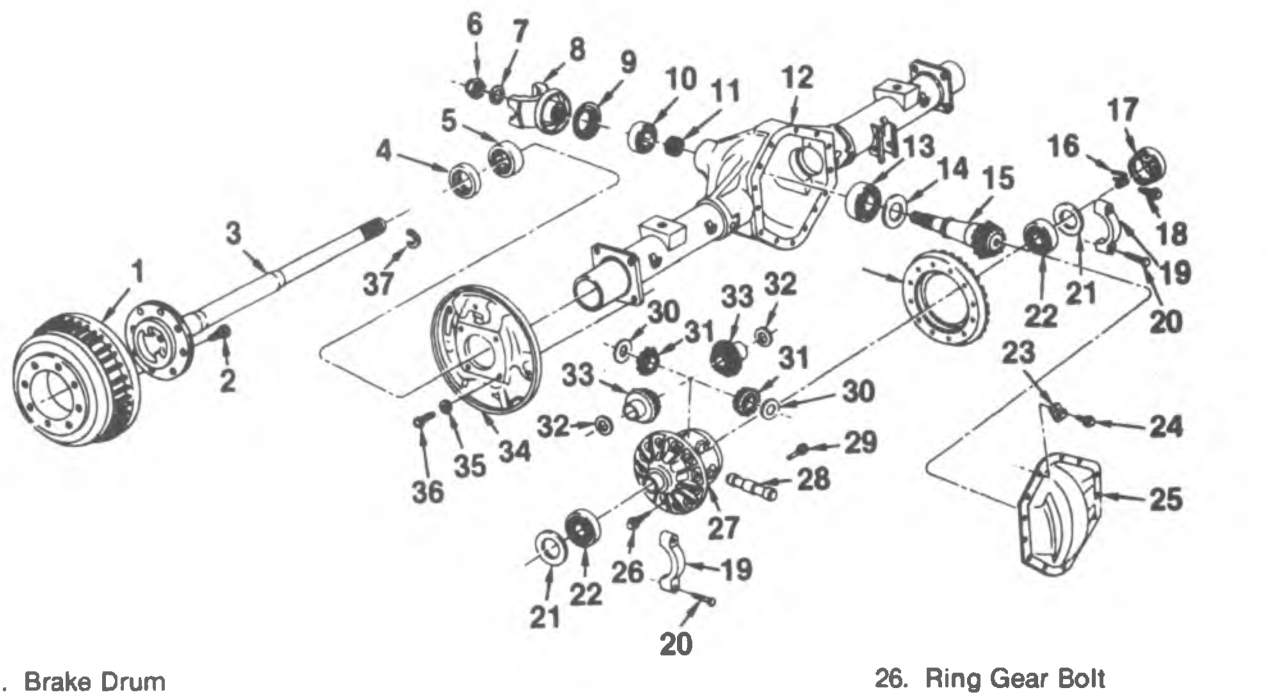
2. The case for metal chips and shavings. Determine where these chips and shavings come from, such as a broken gear or bearing cage.
- Determine the cause of the axle problem before disassembly if possible.

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 (14) and the differential cover (12).
   - Drain the gear lubricant into a proper container.
   - Refer to "Checking the Axle Before Disassembly" in this section.
2. Pinion shaft lock bolt (29)(Figure 2).
3. Pinion shaft (28).
4. "C" lock (37) from the button end of the axle shaft (3).
   - Push the axle shaft (3) in towards the center of the differential case (27).
5. Axle shaft (3) from the axle housing (12).
6. Oil seal (4) using a seal removal tool behind the seal lip.
   - Be careful not to damage the housing.
7. Bearing (5) using J 2619-01 and J 22813-01.
   - The tangs of the tool should engage the bearing outer race.
8. 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.
9. Adjusting nut lock bolt (18).
10. Adjusting nut lock (16).
    - Loosen the adjusting nut (17).
11. Differential bearing cap bolts (20).



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

F4713

Figure 1—Rear Axle Components

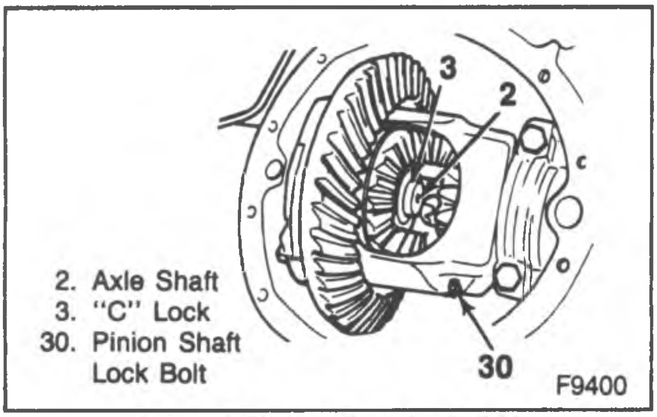


Figure 2-Pinion Shaft Lock Bolt

12. 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.

13. Differential case (27).
    - Pry the case from the axle housing at the differential "window" (Figure 3).
14. 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.
15. Differential side bearings using J 8107-3 and J 22888 (Figure 4).
    - The jaws of J 22888 must pull from beneath the bearing cone and not the cage. Use the slots provided for this purpose.

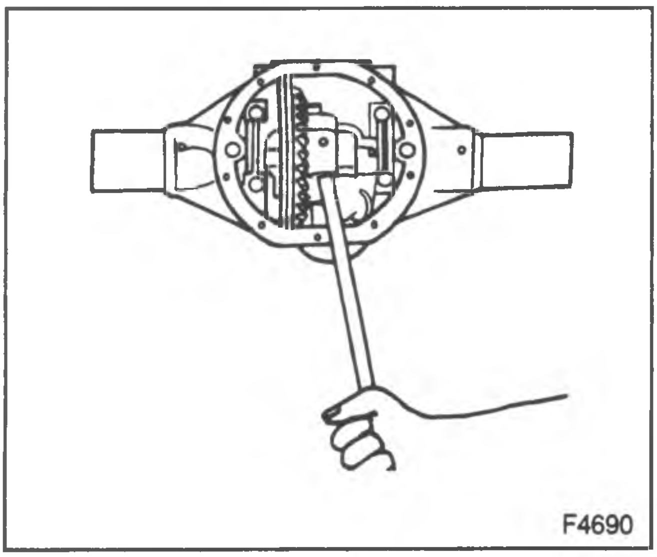


Figure 3-Removing the Differential Case

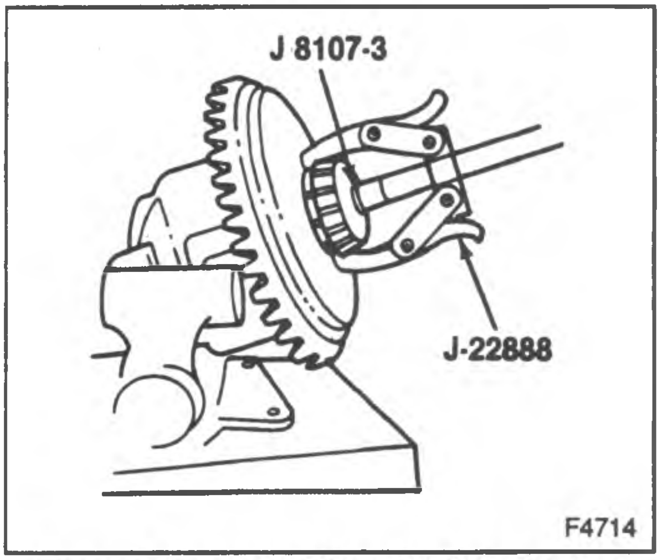


Figure 4—Removing Differential Side Bearings

16. Ring gear bolts (26).
    - 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.

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

Inspect

- Drive pinion bearing preload (figure 5).
- Pinion assembly for looseness by moving it back and forth. (Looseness indicates excessive bearing wear).

18. Pinion flange nut (6) and washer (7) using J 8614-01 to hold the pinion flange (Figure 6).

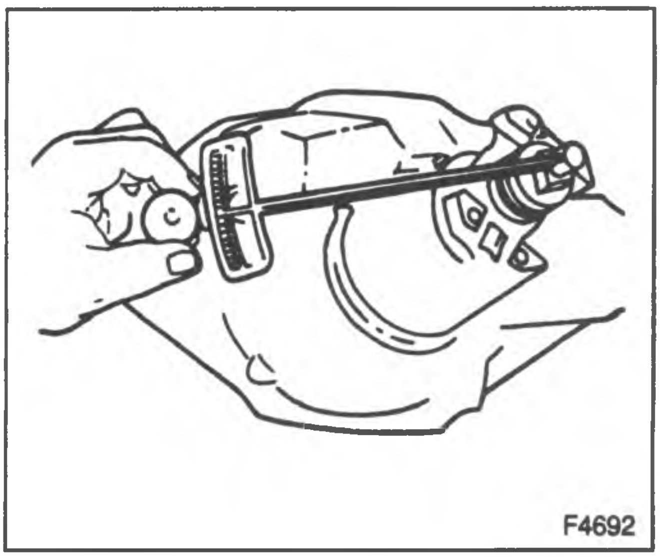


Figure 5—Checking Pinion Preload

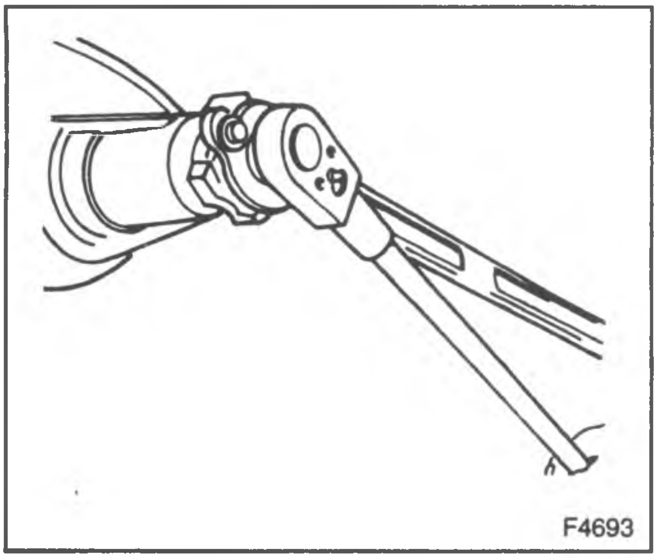


Figure 6—Removing the Drive Pinion Nut

19. Pinion flange using J 8614-01 (Figure 7).
20. 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.
    - Drive the pinion out of the housing with a hammer and a soft drift (Figure 8) .
    - Remove the cover (25) and the pinion (15).
21. Collapsible spacer (11) from the pinion.
22. Outer seal (9) and outer pinion bearing (10).
23. Inner bearing (13) and shim (14) from the pinion.
    - Press the bearing off the pinion using J 22912-01 (figure 9).
    - Remove the shim.
24. 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.

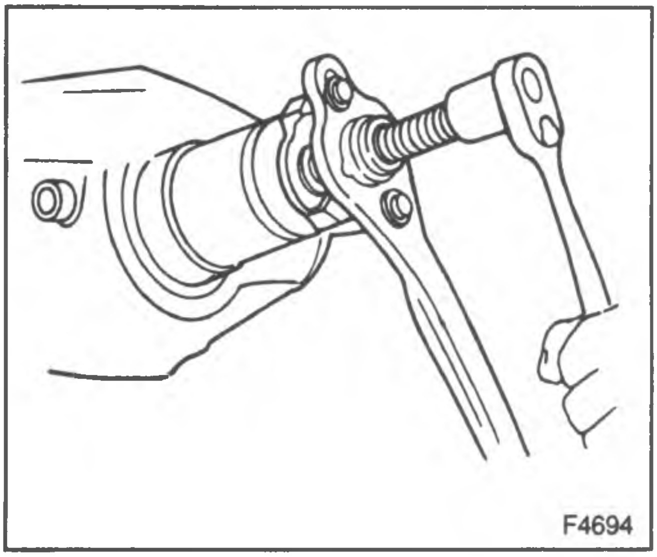


Figure 7—Removing the Pinion Flange

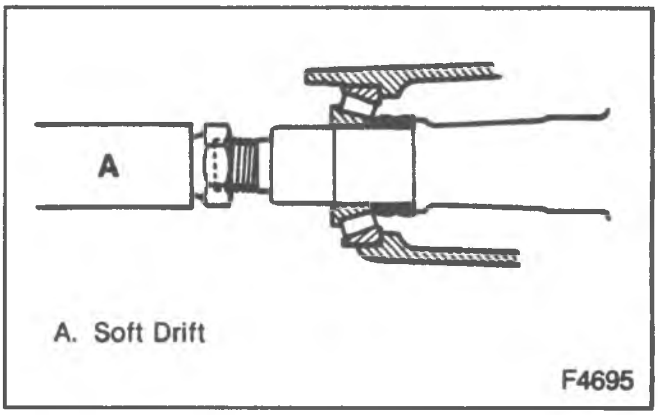


Figure 8—Removing the Drive Pinion

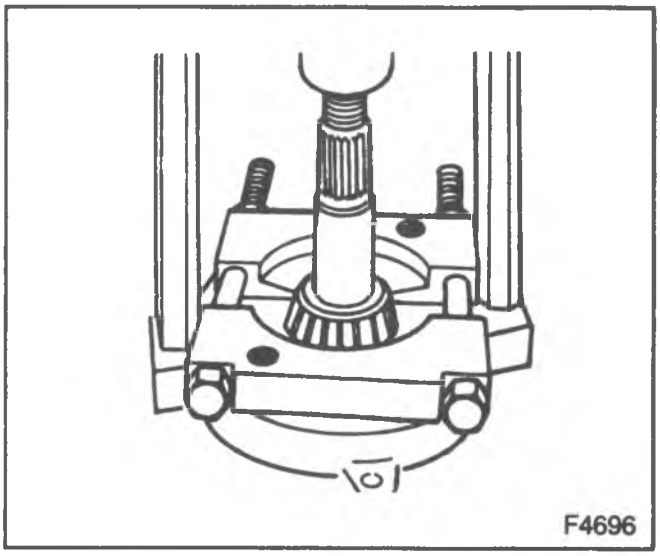


Figure 9—Removing the Pinion Rear Bearing

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 flange on the pinion gear.
- The 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 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 very small 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 10 and 11)

Tools Required:
J 7817 Front Pinion Bearing Cup Installer
J 22306 Rear Pinion Bearing Cup Installer
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

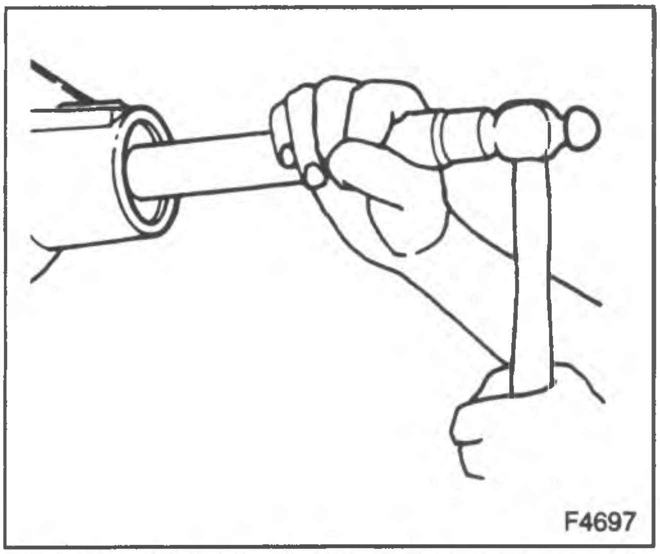


Figure 10—Installing the Front Pinion Bearing Cup

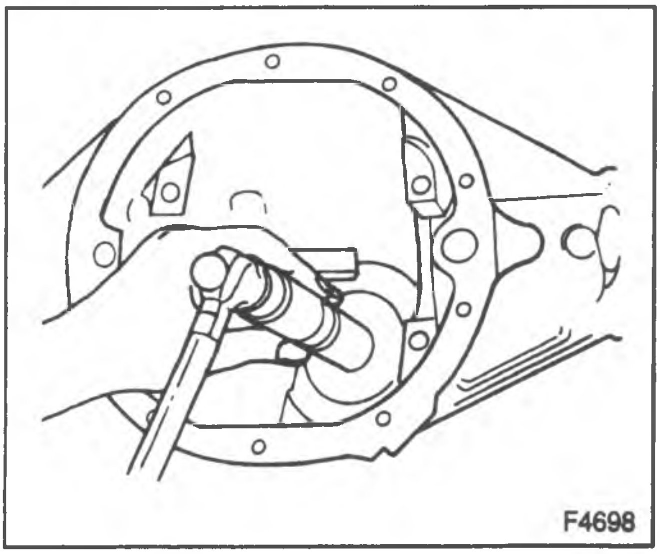


Figure 11—Installing the Rear Pinion Bearing Cup

1. Clean all the gage parts.
2. Lubricate the front and rear pinion bearings with axle lubricant.
3. Place the bearings (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 12).
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 13.
   - 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 approximately 3/4 of a turn to the right. Tighten the dial indicator in this postion (figure 14).
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.

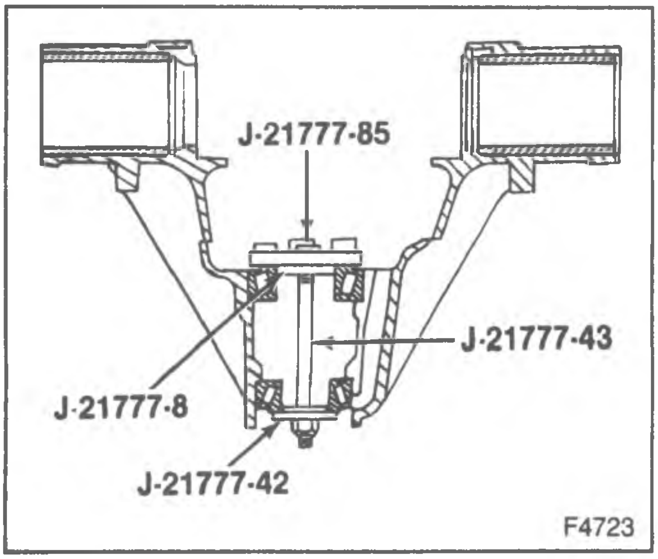


Figure 12—Gage Plate Tools

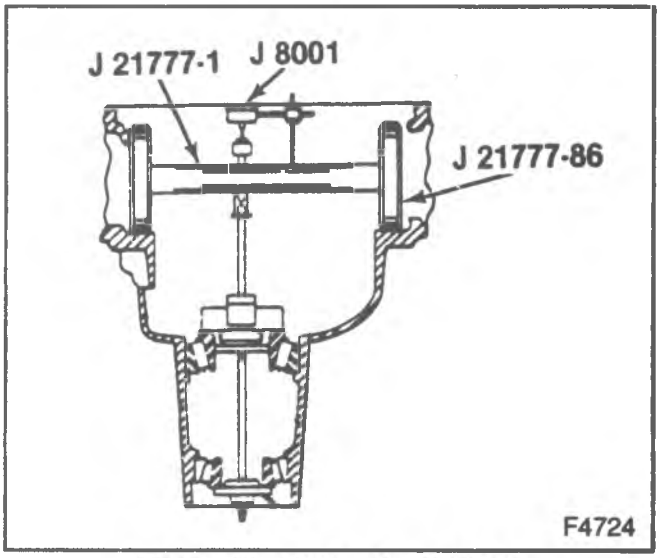


Figure 13—Pinion Depth Tools

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 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.

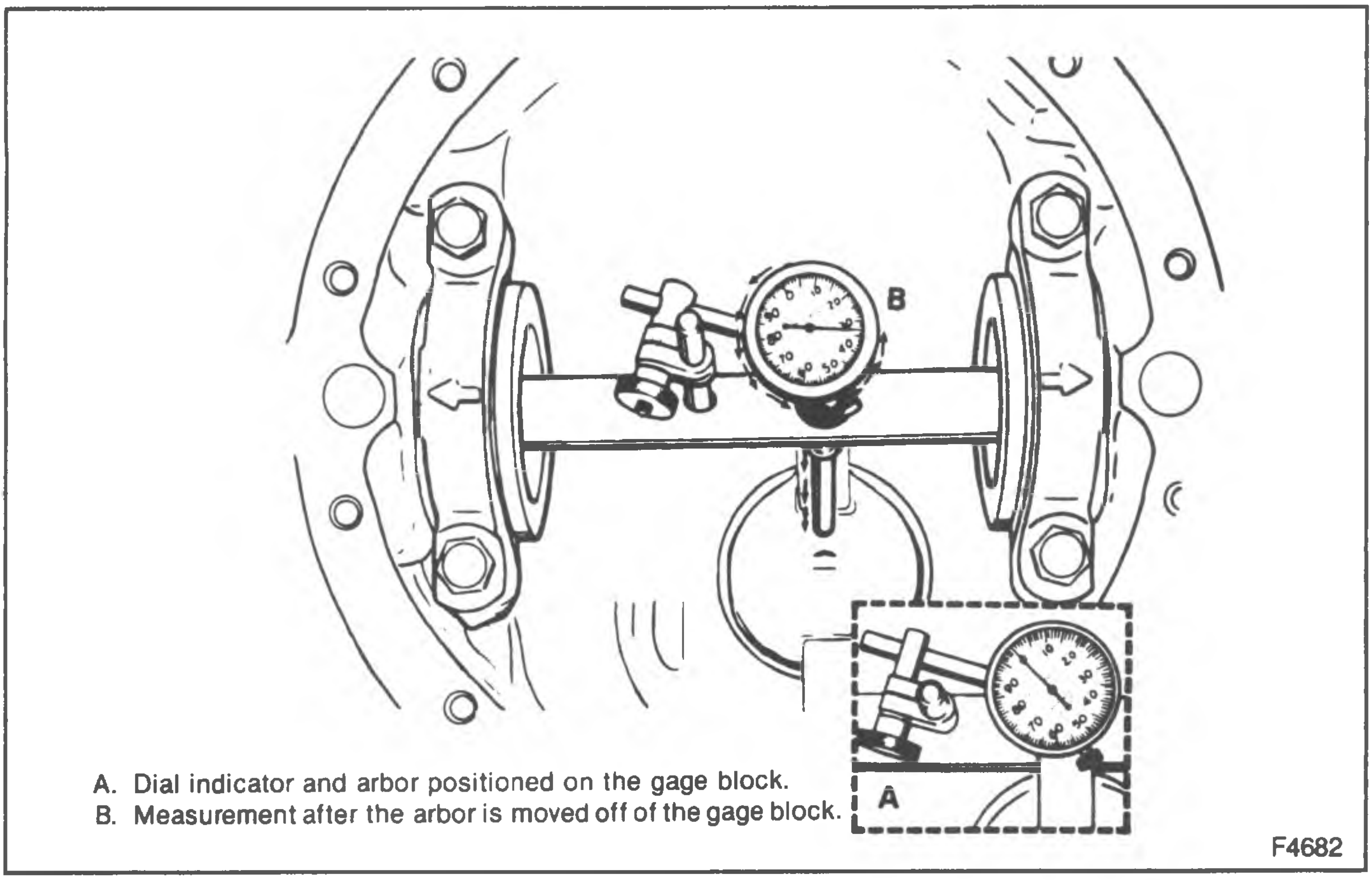


Figure 14—Checking Pinion Depth

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 15).
2. A new collapsible 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 16).
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 17).

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

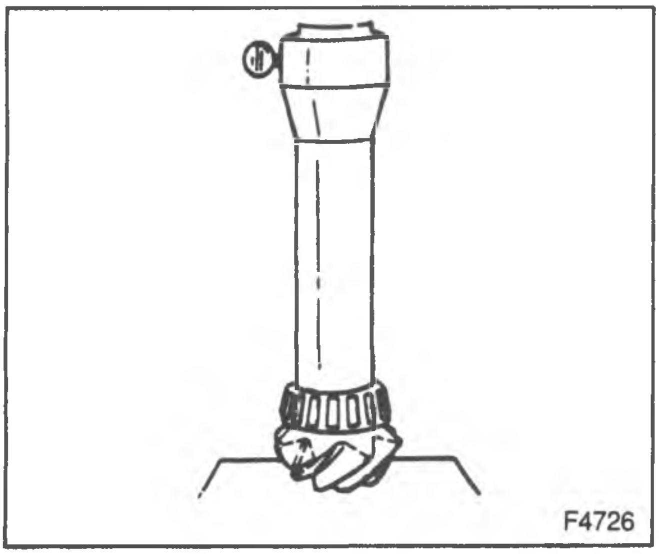


Figure 15—Installing the Pinion Inner Bearing

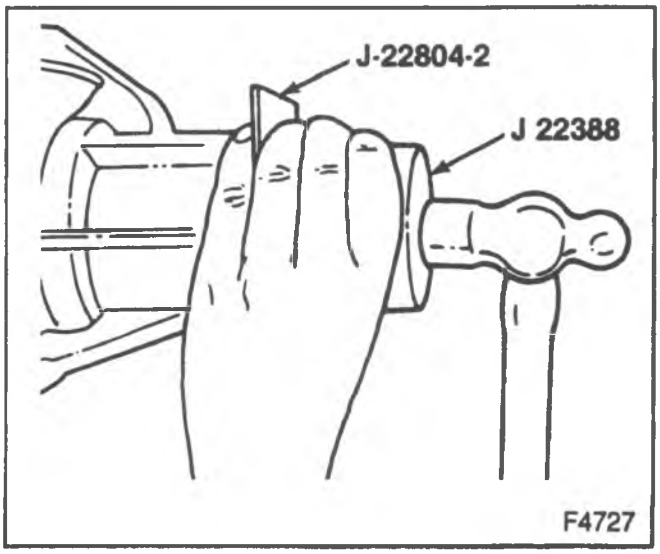


Figure 16—Installing the Pinion Oil Seal

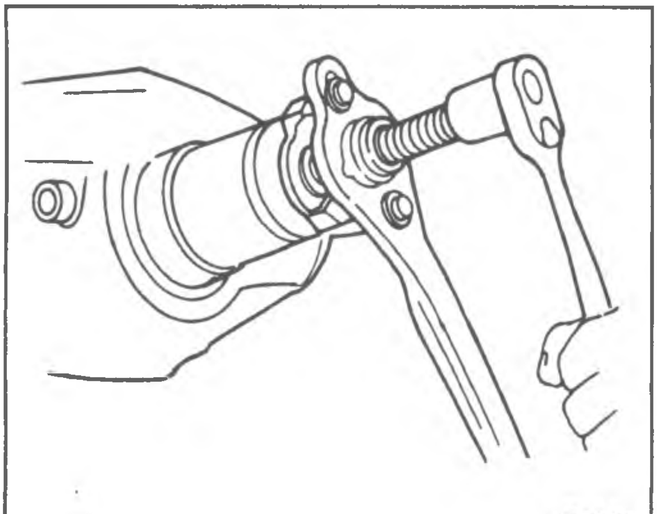

F4694

Figure 17—Installing the Pinion Flange

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 18).
- 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.

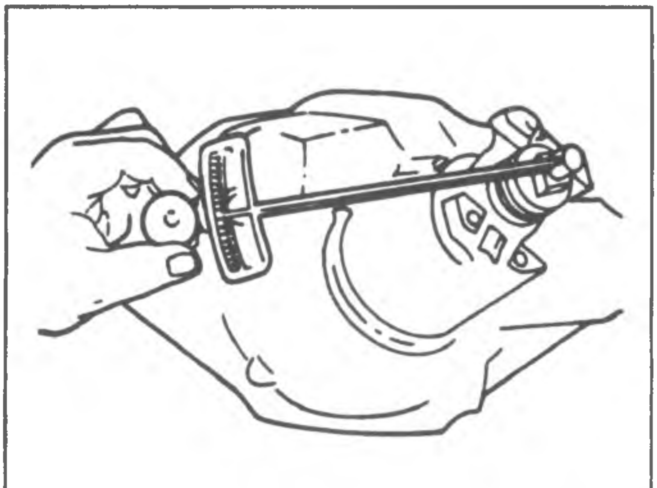

F4692

Figure 18—Checking Pinion Bearing Preload

DIFFERENTIAL CASE ASSEMBLY

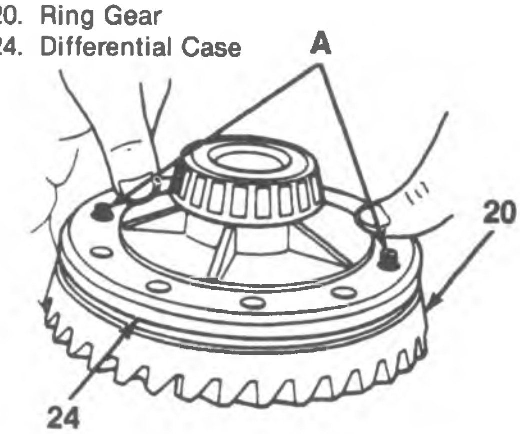
Install or Connect (Figure 1)

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 19).

A. Left Hand Studs
20. Ring Gear
24. Differential Case



F4683

Figure 19—Aligning the Ring Gear Studs

- 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 20).

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 21).
   - 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.
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.

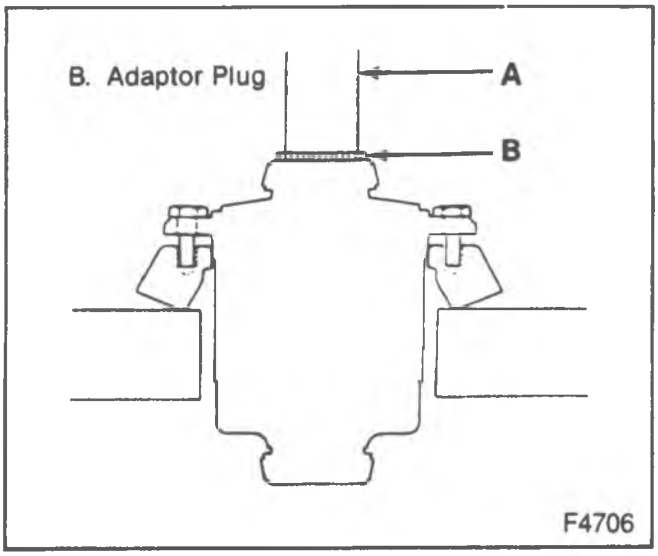


Figure 20—Installing the Ring Gear to the Case

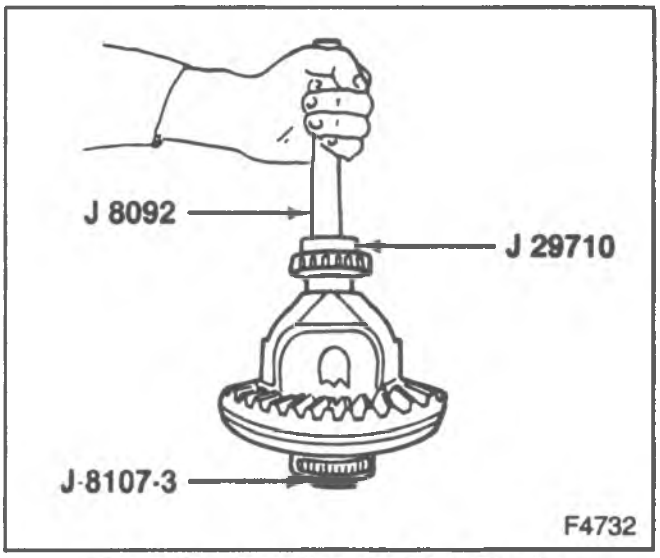


Figure 21—Installing the Side Bearing

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 22).

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.

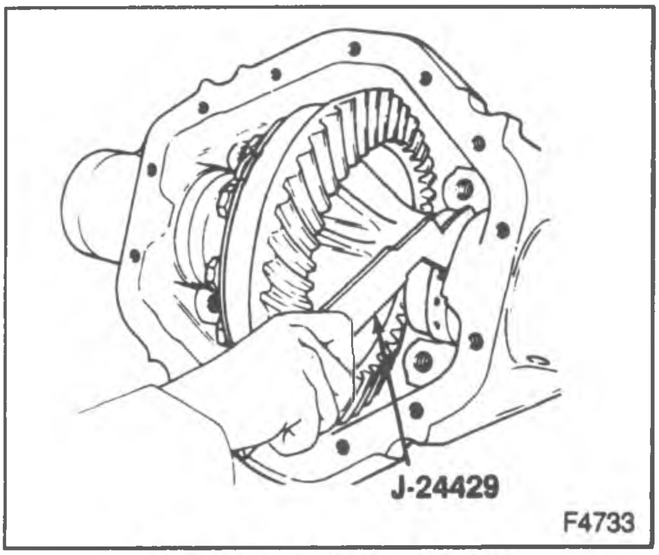


Figure 22—Adjusting the Nut

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 23).
   - 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

Tools Required:
J 8092 Driver Handle
J 23765 Axle Shaft Bearing Installer
J 23771 Axle Shaft Seal Installer
J 23911 Pinion Oil Seal Installer

Install or Connect (Figure 1)

1. Bearing (5) with J 23765 and J 8092 untill the tool bottoms against the housing shoulder (figure 24).
   - Lubricate the bearing with gear lubricant.

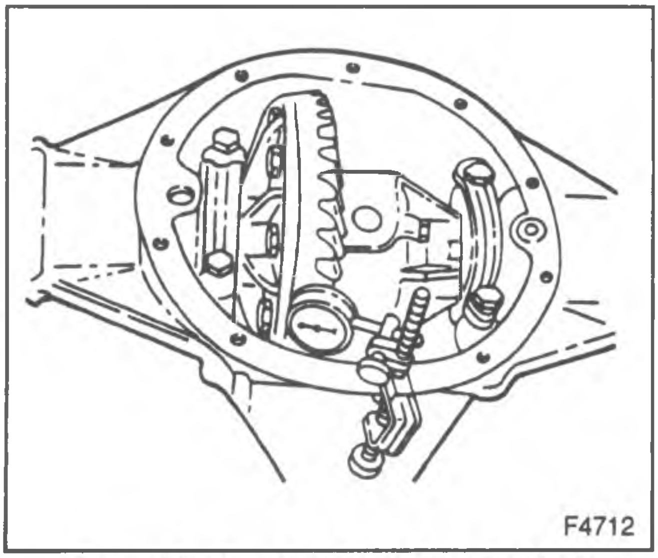


Figure 23—Checking Ring Gear Backlash

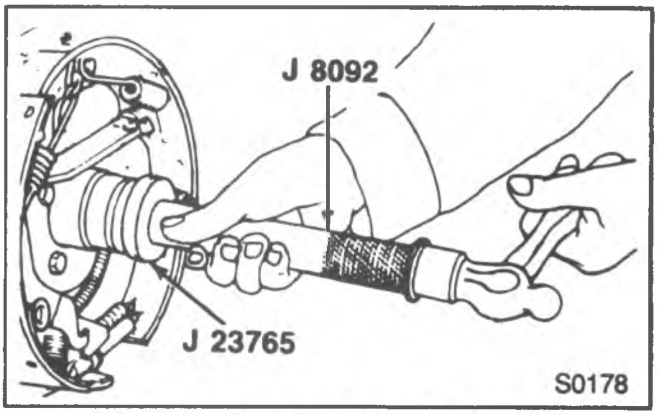


Figure 24—Installing the Axle Bearing

2. Oil Seal using J 23771 until the oil seal is flush with the axle tube (figure 25).
   - Lubricate the seal lips with gear lubricant.
3. Axle shafts (3) into the axle housing (12).
   - Be careful not to damage the oil seal.
   - The splines at the end of the axle shaft must engage with the splines of the rear axle side gear.
4. "C" locks (37) on the axle shaft (3).
   - Pull the axle shaft (3) outward so the "C" lock (37) seats in the counterbore of the rear axle side gear (figure 2).
5. Pinion shaft (28) through the case (27) and the differential gears (33).
   - Align the hole in the pinion shaft (28) with the lock bolt hole.

NOTICE: See "notice" on page 4B3-1 of this section.

6. New pinion shaft lock bolt (29).

Tighten

   - Lock bolt (29) to 34 N.m (25 ft.lbs.).
7. A new cover gasket and the cover (25).

Tighten

   - The cover bolts (24) to 27 N.m (20 ft. lbs.).
8. Lubricant to the rear axle.
   - Lubricant to a level within 9.5 mm (3/8 inch) of the filler plug hole.
9. Fill plug to 35 N.m (ft.lbs.).

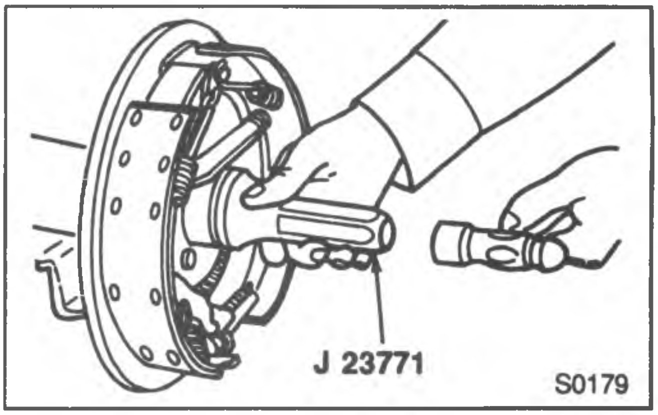
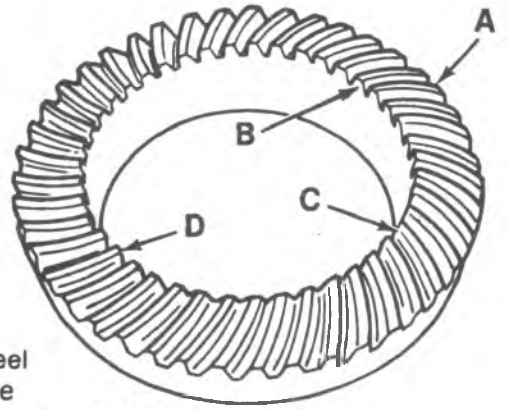


Figure 25—Installing the Axle Seal

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 26).



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

F2017

Figure 26—Gear Tooth Nomenclature

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 27).

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 pin-

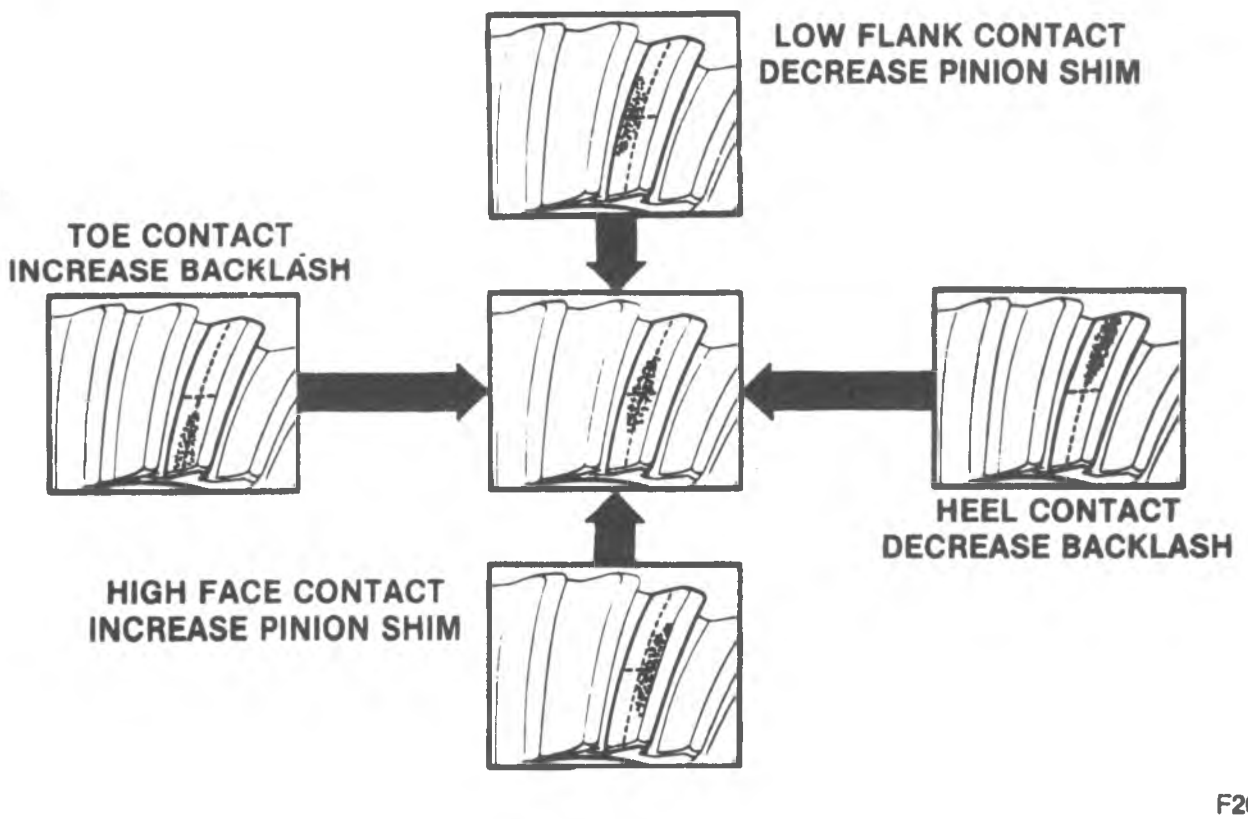


Figure 27—Gear Tooth Pattern

ion 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).

SPECIFICATIONS

SPECIFICATIONS

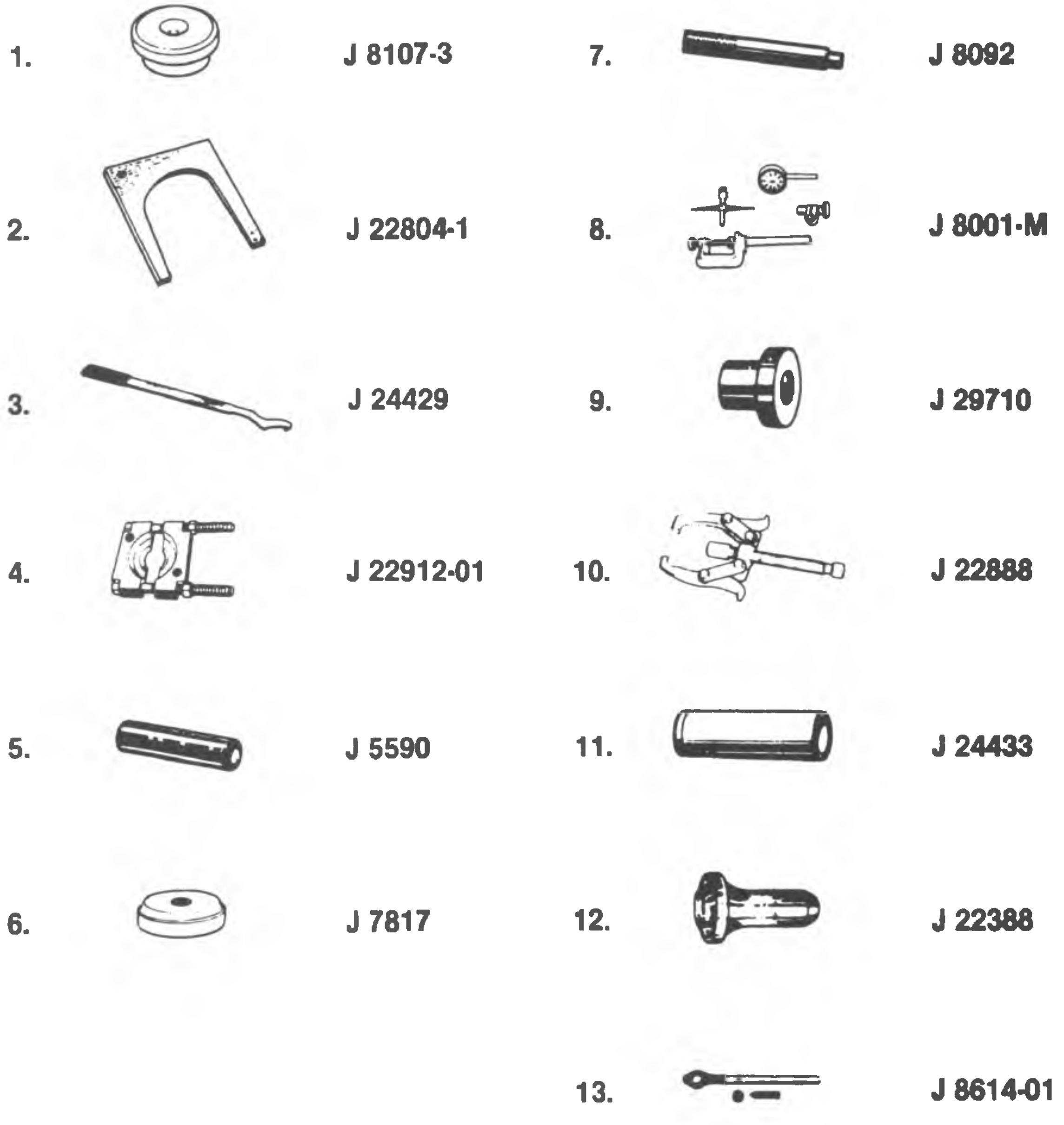
9 1/2-INCH RING GEAR AXLE

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
Filler Plug	35	26

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 Kits	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

T2510

SPECIAL TOOLS



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

F4661

SECTION 4B4

10 1/2-INCH RING GEAR

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

DESCRIPTION

The corporate 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. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the axle 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 carrier housing 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 alphabetic broadcast code 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 suitable container.
2. Outer axle shaft bolts (46).
3. Axle shafts (47).
4. Adjusting nut lock bolts (22).
5. Adjusting nut lock (21).

- Loosen the adjusting nuts (19).

6. Differential bearing cap bolts (28) and washers (27).
7. Differential bearing caps (20).
   - Mark the caps and the housing as left and right.
8. Adjusting nuts (19) and bearing cups (18).
   - Mark the nuts and cups as left and right.
9. Differential carrier (34).
10. 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.

11. 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.

12. Ring gear (14) from the differential.
    - Drive the ring gear off with a brass drift if necessary.
13. Case halves.
14. Differential side gears (29) and thrust washers (30).
    - Mark the gears and the case halves as left and right.
15. Differential pinion spider (33).
16. 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).

17. Pinion assembly cage bolts (7) and washers (8) (figure 4).
18. Pinion assembly cage (10).
    - Tap on the pilot end of the pinion with a hammer and a brass drift if necessary.
19. Pinion cage shims (11).
    - Keep the shims together for measurement later in the procedure.

- Place the pinion cage in a soft-jawed vise.

20. Pinion flange nut (1) and washer (2) using J 8614-01 to hold the flange (figure 5).
21. Pinion flange using J 8614-01 (figure 6).
22. 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.
23. Collapsible spacer (12) from the pinion.
24. Inner bearing (13) from the pinicn (14).
    - Press the bearing from the pinion using J 22912-01 (figure 8).
25. Pinion seal (5) from the pinion cage.
    - Drive the seal from the cage with a hammer and punch.
26. Front bearing (6) from the cage.
27. Bearing cups from the pinion cage.
28. 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

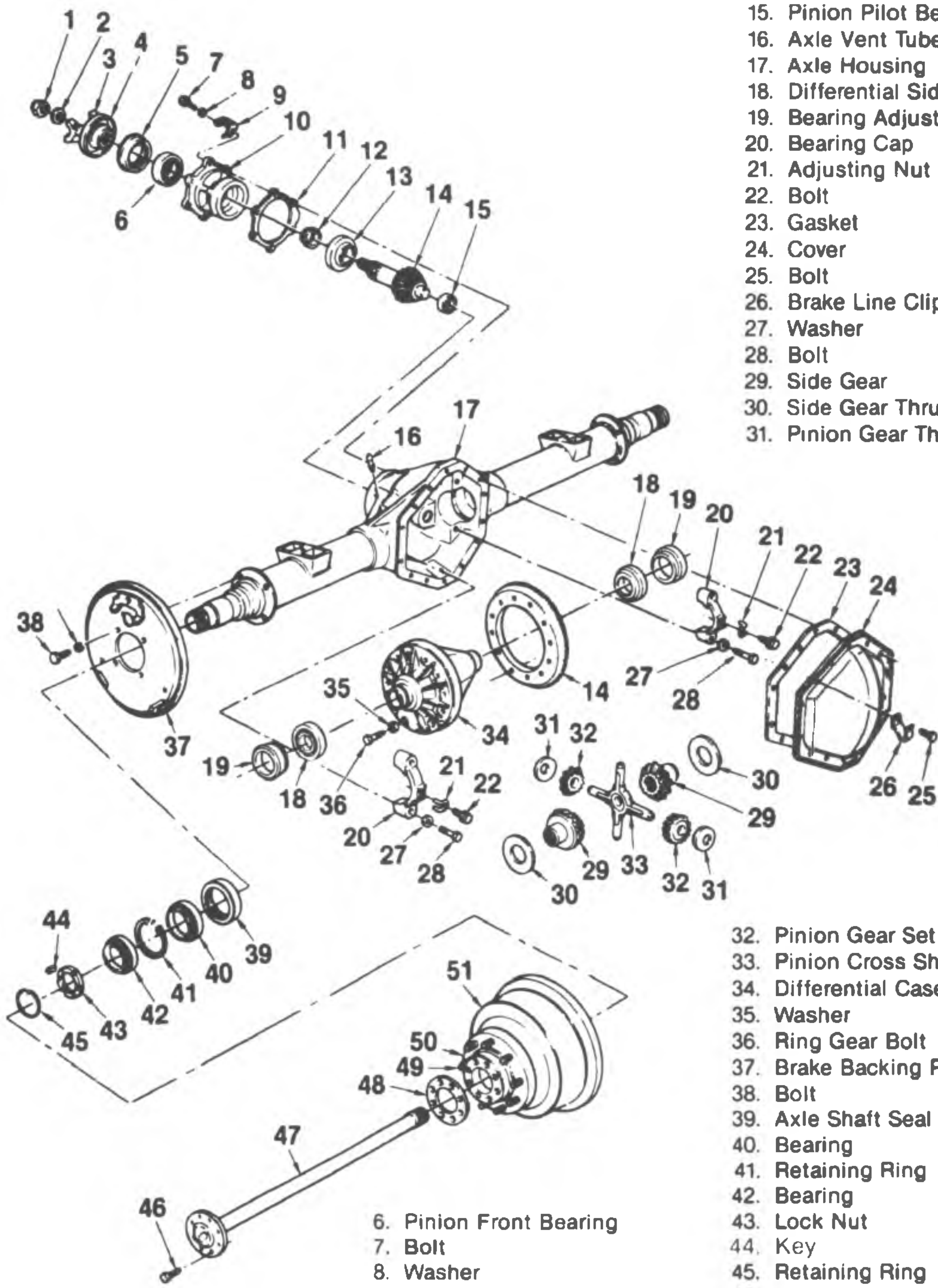
It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

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 ofthe 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.



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

F5900

Figure 1—Rear Axle Components

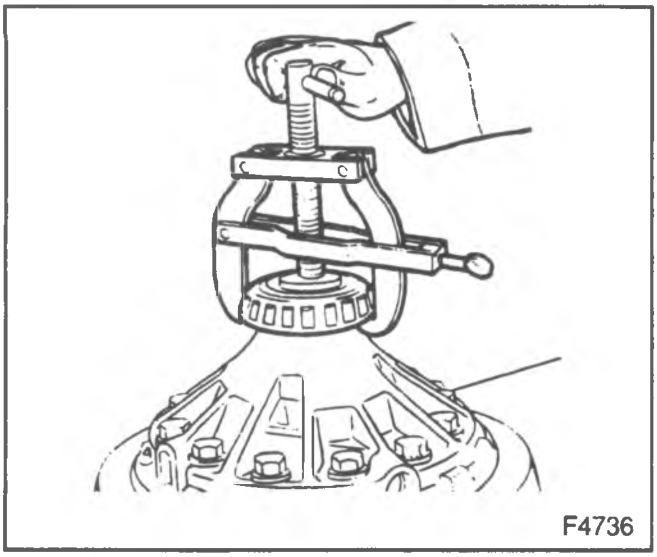


Figure 2—Removing the Differential Side Bearings

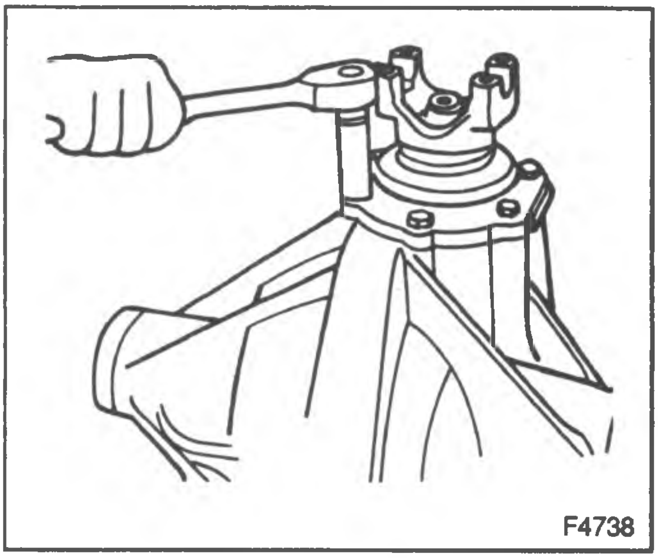


Figure 4—Removing the Pinion Cage

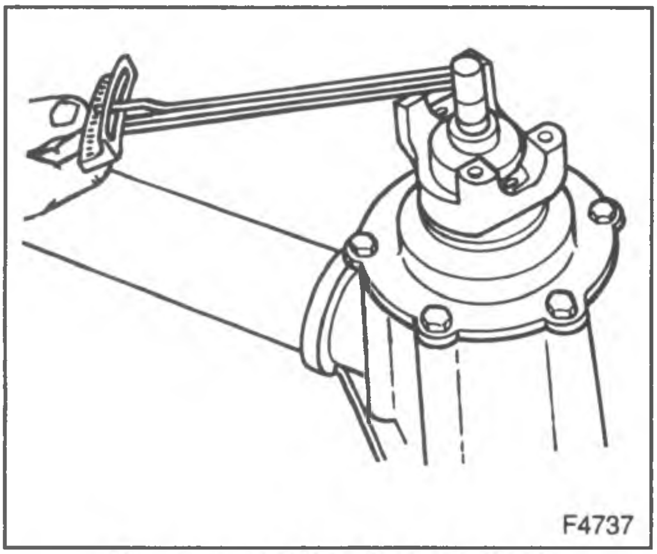


Figure 3—Checking Pinion Preload

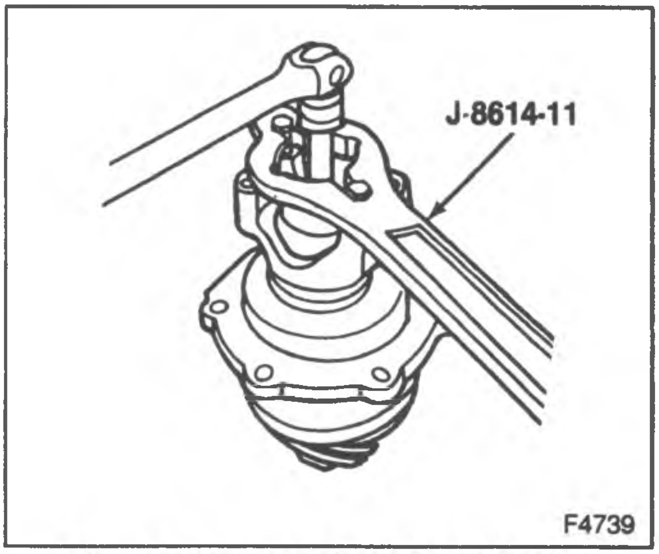


Figure 5—Removing the Drive Pinion Nut

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 flange on the pinion gear.
- 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.

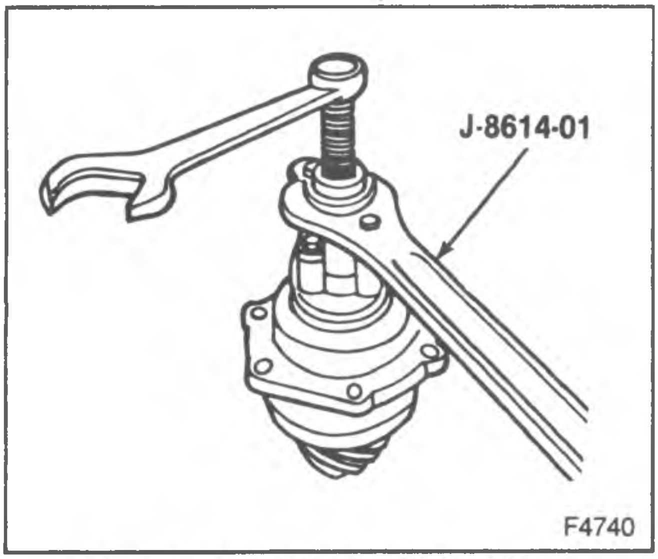


Figure 6—Removing the Pinion Flange

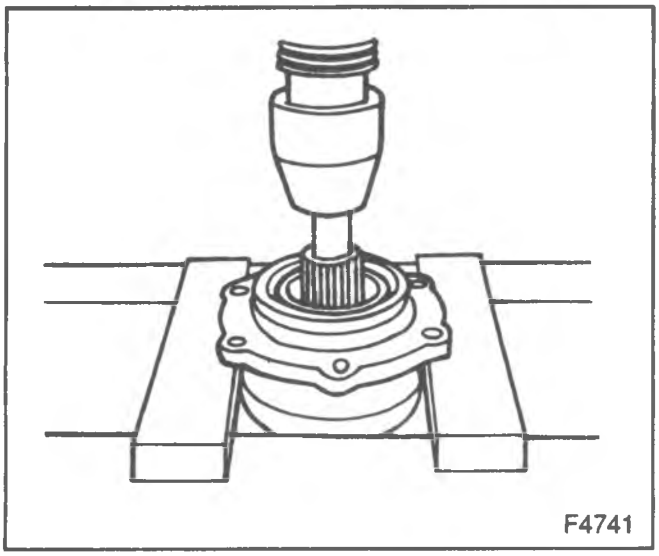


Figure 7—Pressing the Drive Pinion from the Cage

- 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 very small 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.

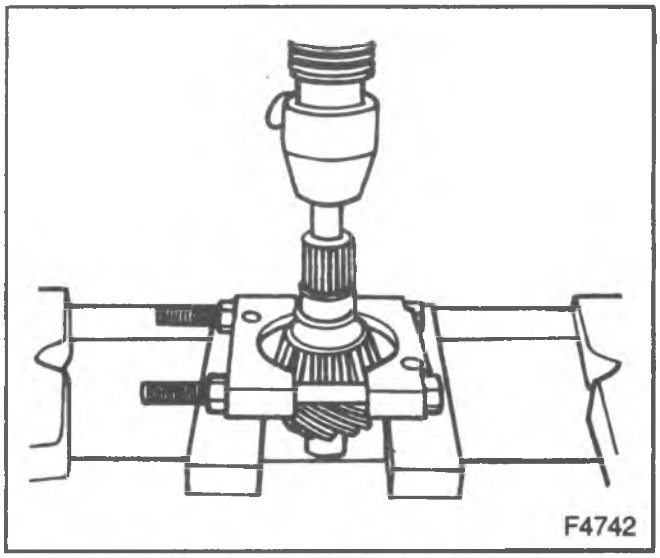


Figure 8—Removing the Pinion Inner Bearing

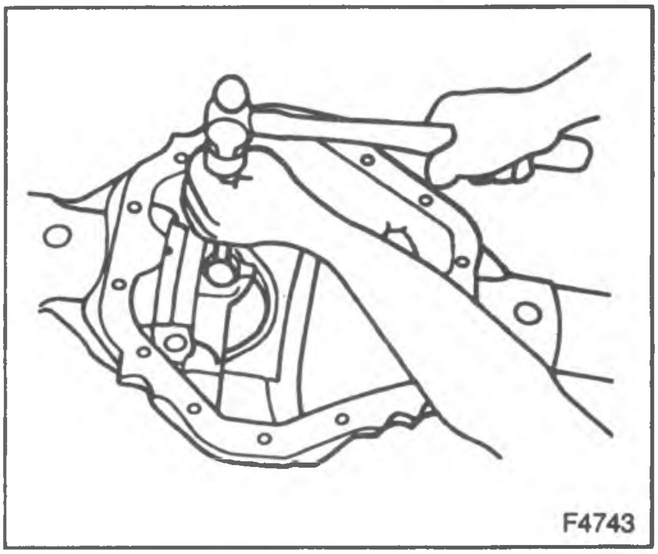


Figure 9—Removing the Pilot Bearing

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).

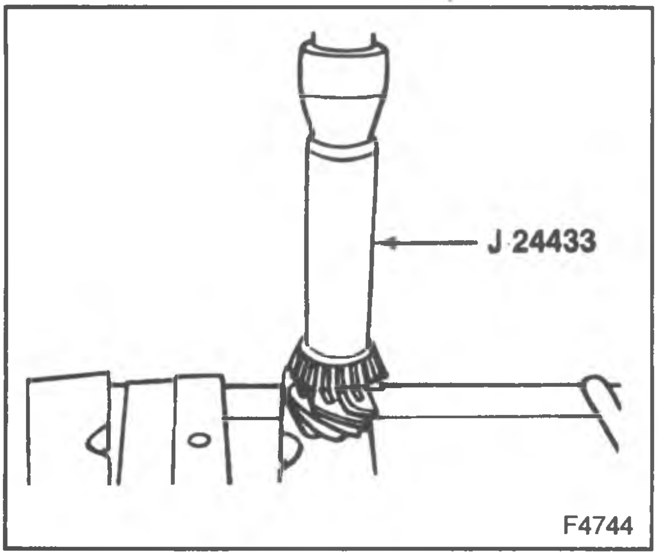


Figure 10—Installing the Inner Pinion Bearing

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 vise.
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.

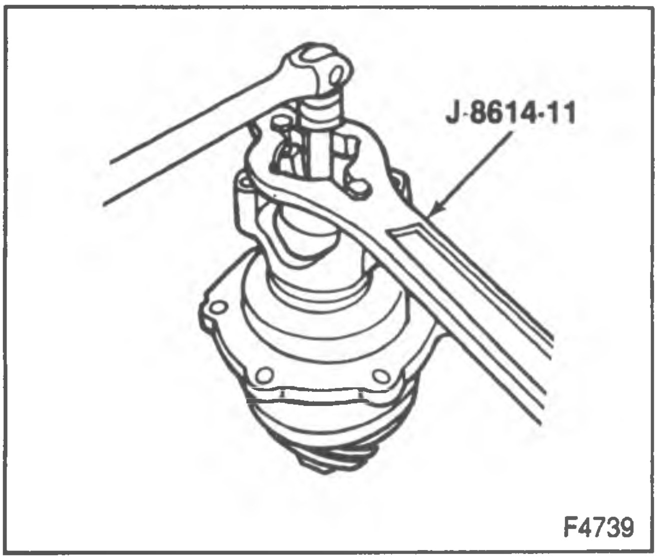


Figure 11—Installing the Pinion Nut

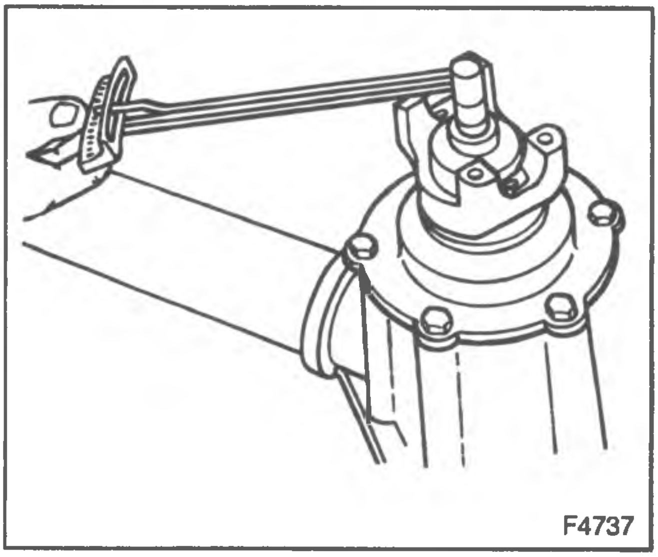


Figure 12—Checking Pinion Preload

- 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.

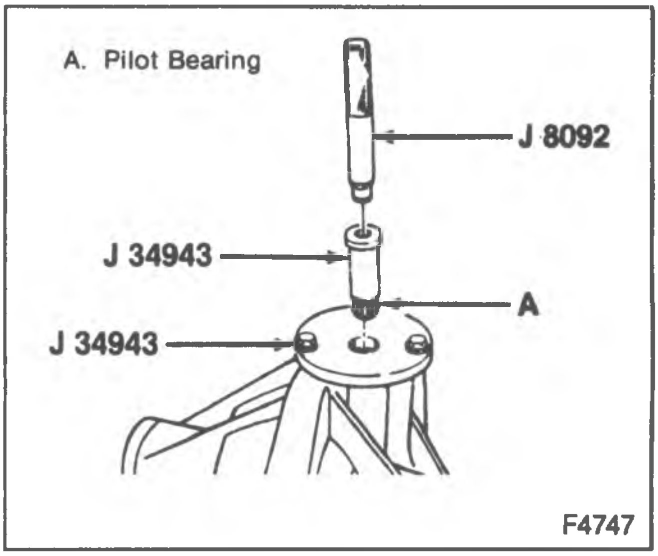


Figure 13—Installing the Pilot Bearing

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.

		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.	—

F4748

Figure 14—Pinion Depth Codes

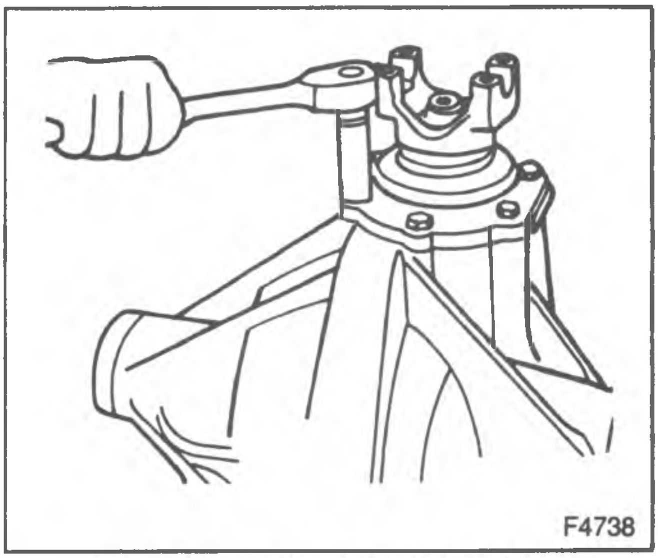


Figure 15—Installing the Pinion Cage

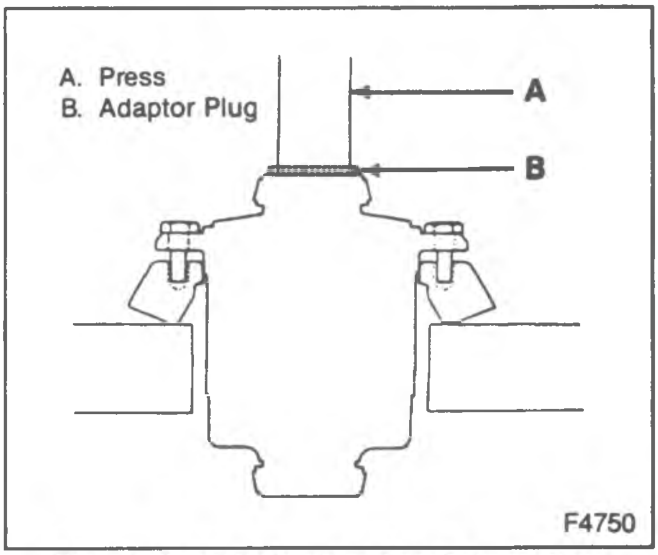


Figure 16—Installing the Ring Gear to Case

1. Differential pinion gears (32) and thrust washers (31) to the spider (33).
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).

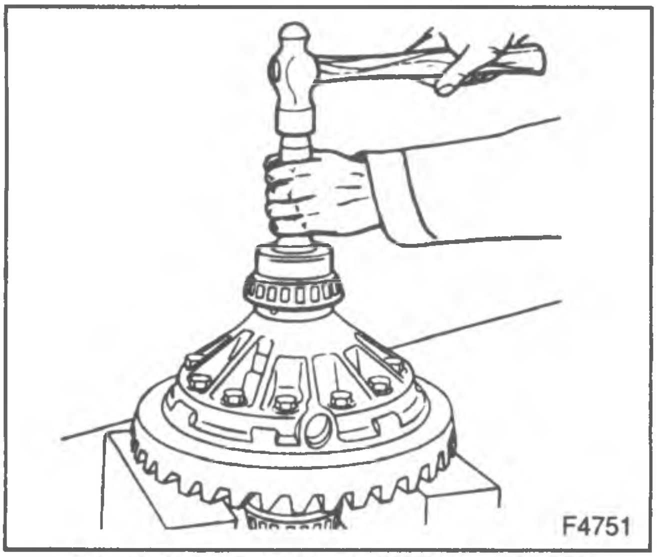


Figure 17—Installing Differential Bearings

Tighten

- The ring gear bolts alternately in stages gradually pulling the ring gear onto the differential case.
- 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.

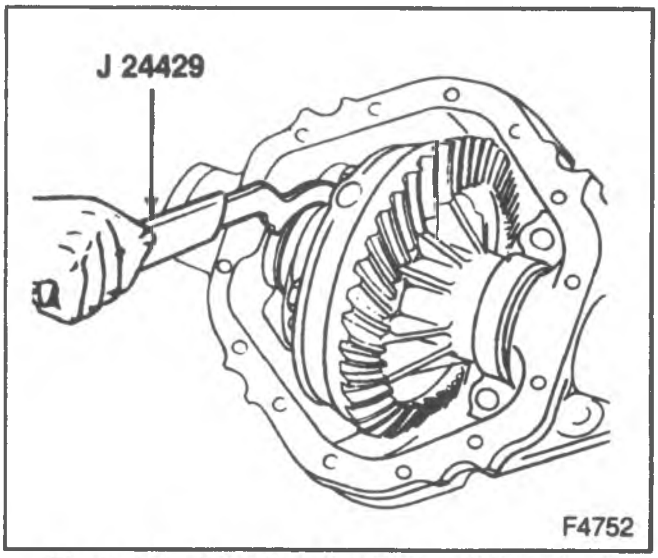


Figure 18—Adjusting the Differential Preload

5. Adjusting nut lock (21) and lock bolt (22) to the left nut.
   - 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.

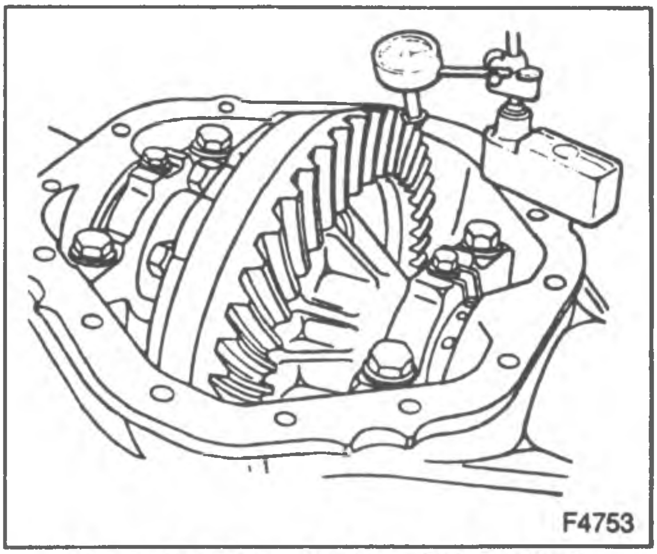


Figure 19—Measuring Gear Set Backlash

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).
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.
2. Cover gasket (23) and cover (24) to the housing.
3. Cover bolts (25).

Tighten

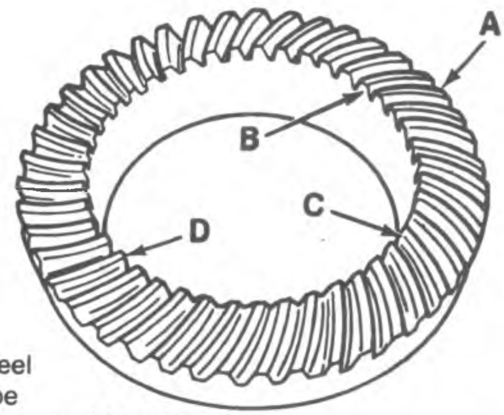
- The cover bolts (25) to 27 N·m (20 ft. lbs.).

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

F2017

Figure 20—Gear Tooth Nomenclature

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).

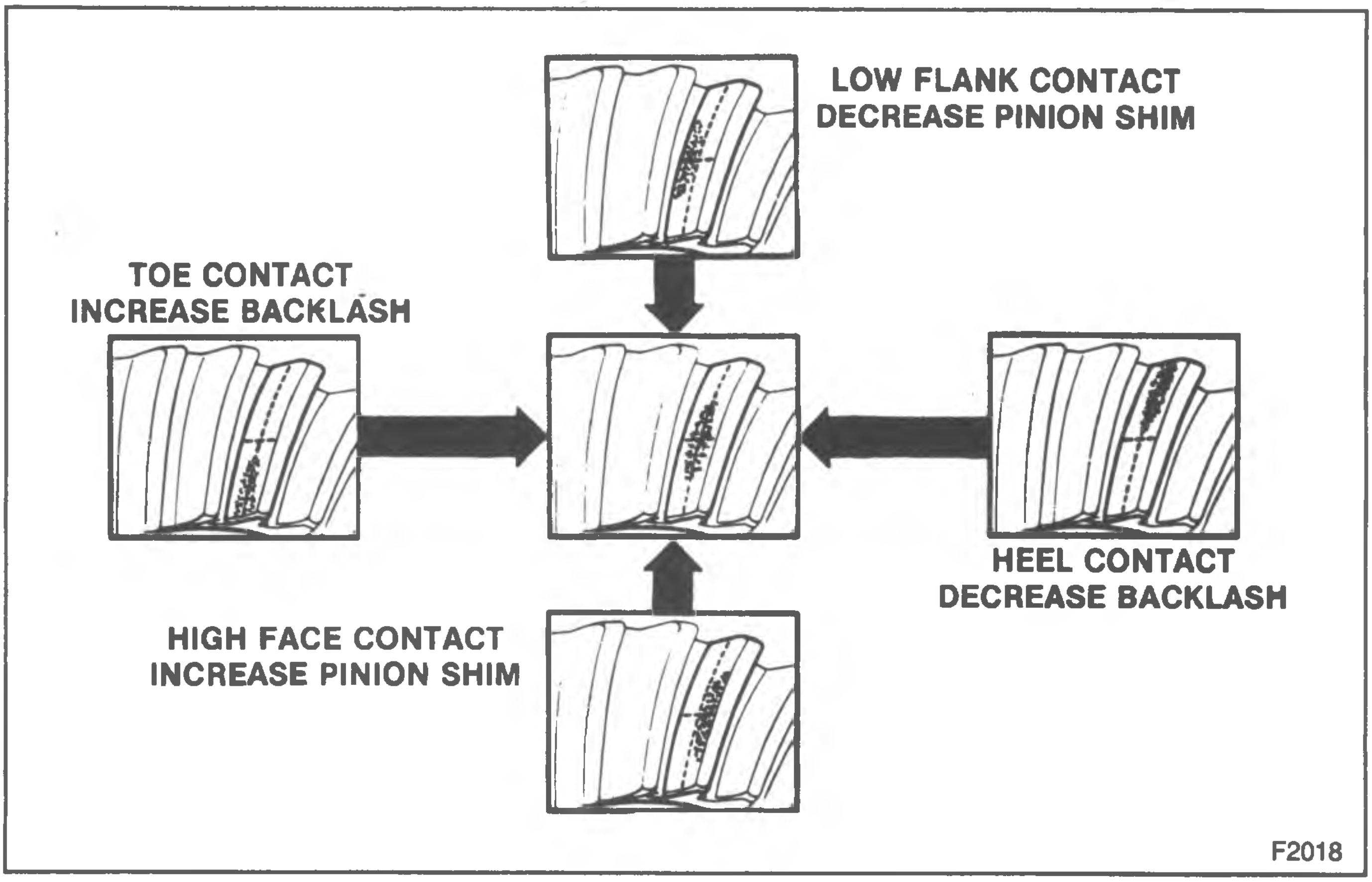


Figure 21—Gear Tooth Pattern

SPECIFICATIONS

10 1/2-INCH RING GEAR AXLE (CORPORATE)

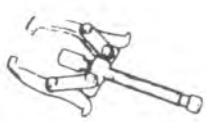
Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	163	120
Bearing Cap Bolts	183	135
Axle Cover Bolts	27	20
Adjusting Nut Lock Bolts	30	22

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

T2511

SPECIAL TOOLS

1.  J 8614-01

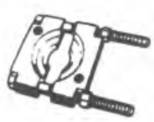
2.  J 22888

3.  J 8608

4.  J 8092

5.  J 24433

6.  J 24429

7.  J 22912-01

1. Pinion Flange Remover
2. Side Bearing Remover
3. Rear Pinion Bearing Cup Installer
4. Driver Handle
5. Rear Pinion Bearing Cone Installer
6. Side Bearing Adjustment Spanner
7. Rear Pinion Bearing Cone Remover
8. Pinion Pilot Bearing Installer (Not Illustrated)

F4662

SECTION 4B5

DANA REAR AXLES

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

9 3/4-INCH RING GEAR

DESCRIPTION

The Dana 9 3/4-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 axle shafts.

This axle is full-floating. The axle shafts are 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 housing 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.

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 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 suitable container.
2. Axle shafts (38).
3. Bearing cap bolts (19) (figure 3).
4. Bearing caps (18).
   - Corresponding 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 0.38mm (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 0.38mm (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 their corresponding 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 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.

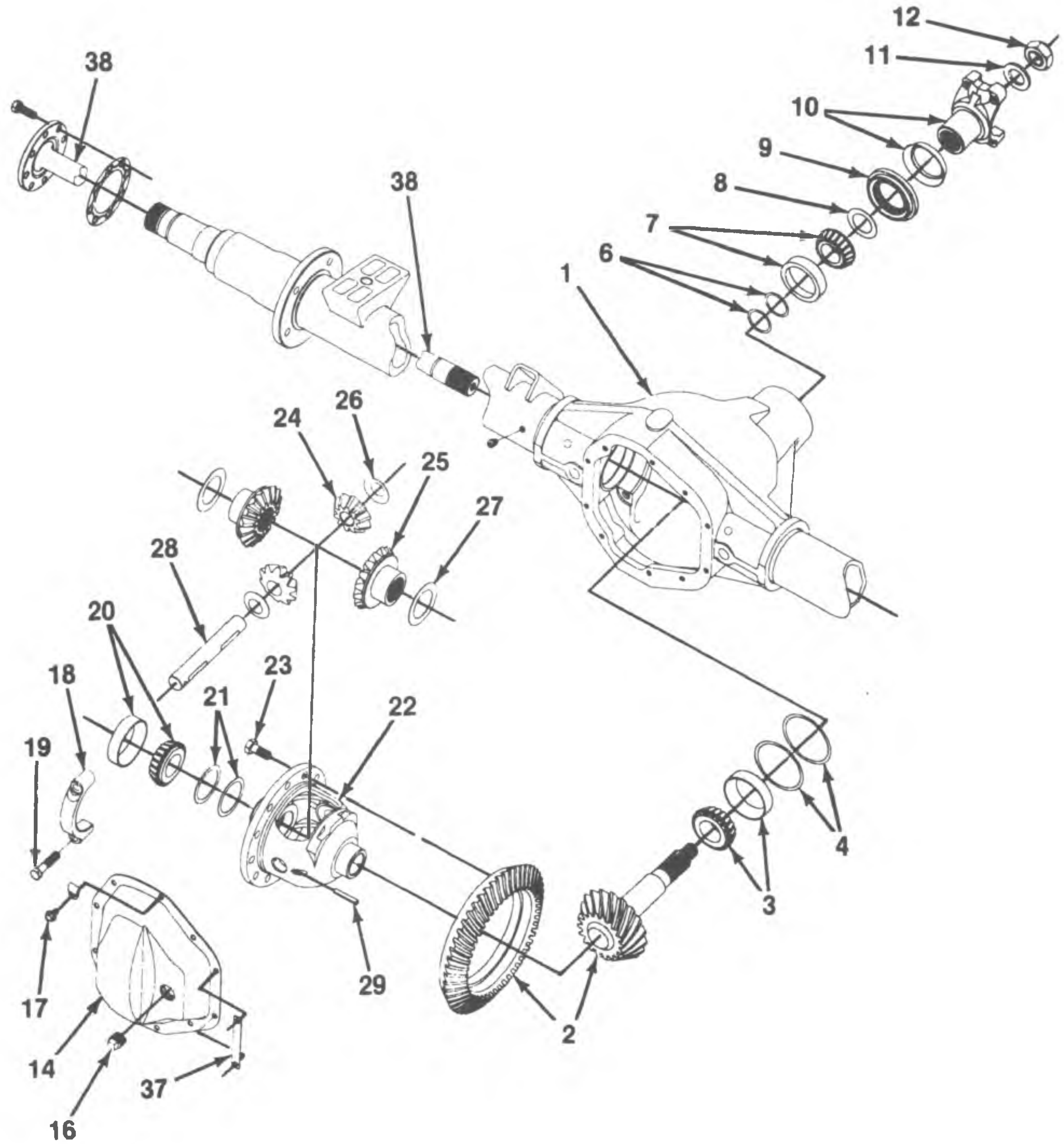
12. Lock pin (29) from the differential using a hammer and a punch (figure 8).
13. Pinion shaft (28) using a hammer and a brass drift (figure 9).
14. Differential pinion gears (24) and thrust washers (26).
    - Rotate the side gears until the pinion gears are in the opening of the differential (figure 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).



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

F5909

Figure 1—Rear Axle Components

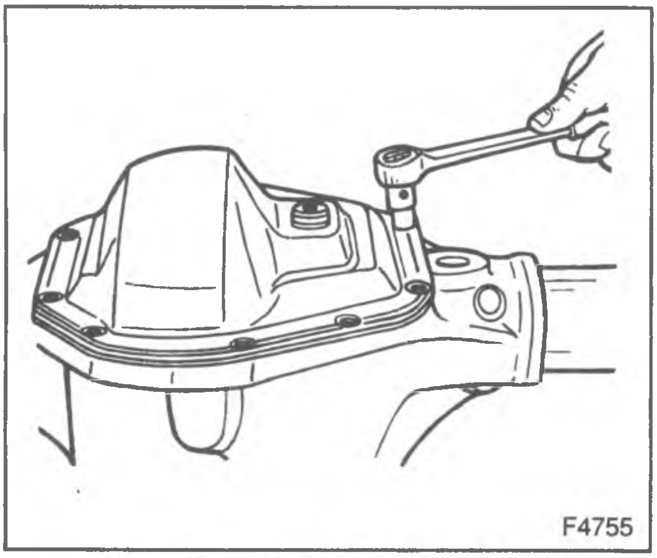


Figure 2—Removing the Axle Cover

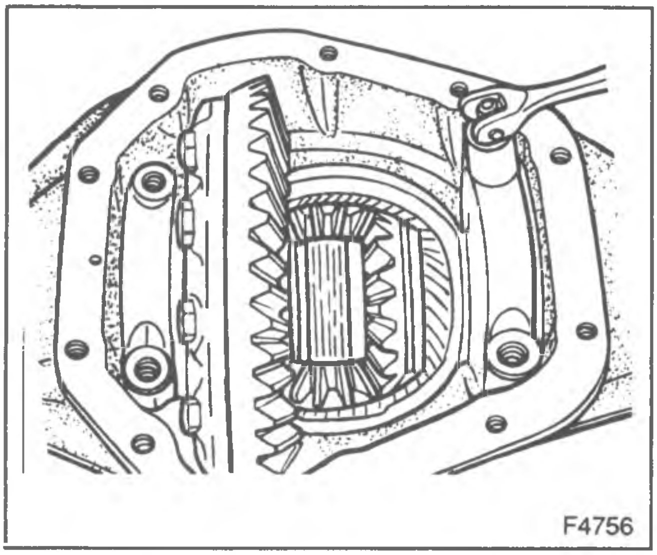


Figure 3—Removing the Bearing Cap

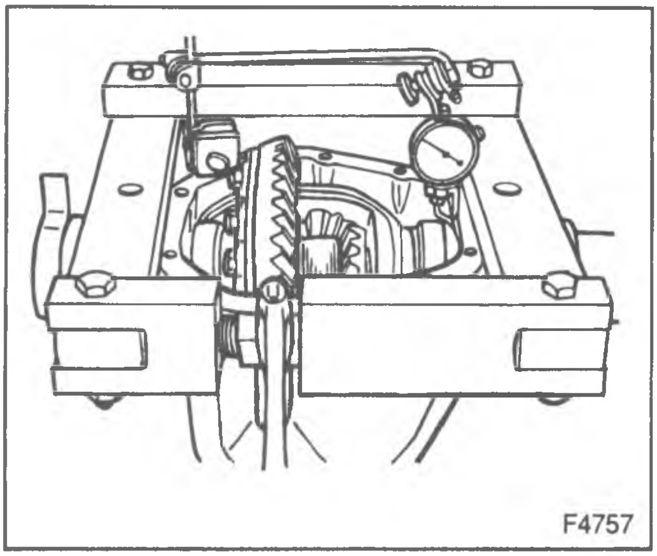


Figure 4—Spreading the Differential Case

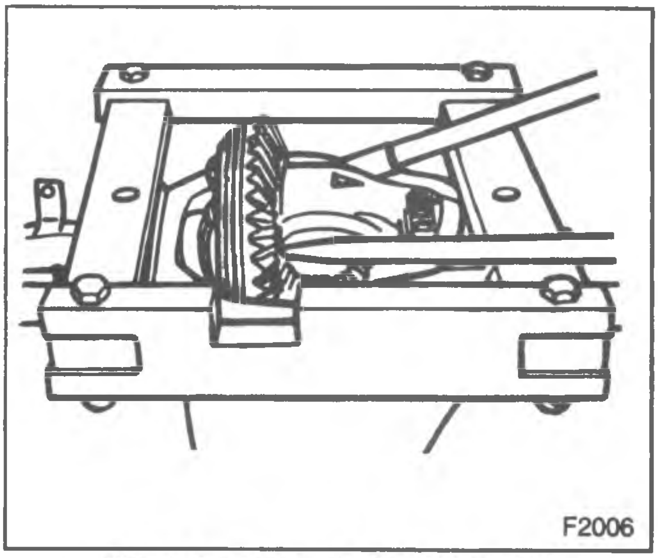


Figure 5—Removing the Differential

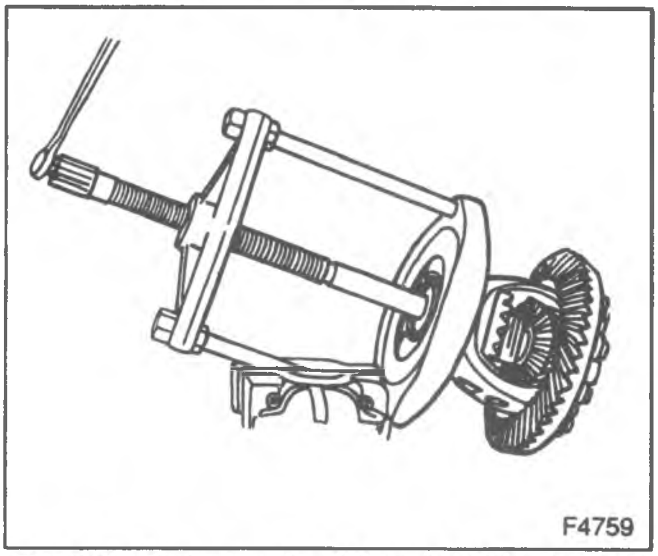


Figure 6—Removing the Differential Side Bearings

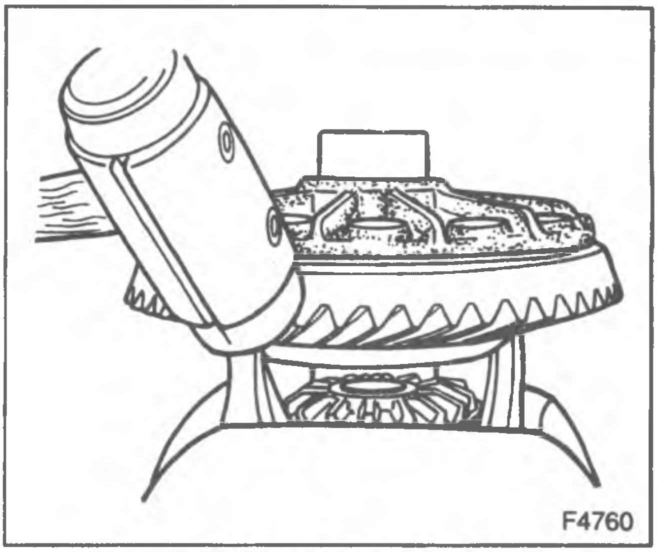


Figure 7—Removing the Ring Gear

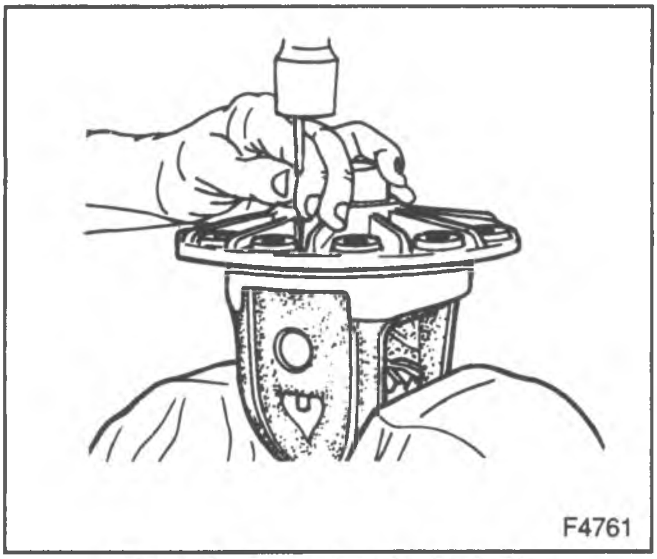


Figure 8—Removing the Lock Pin

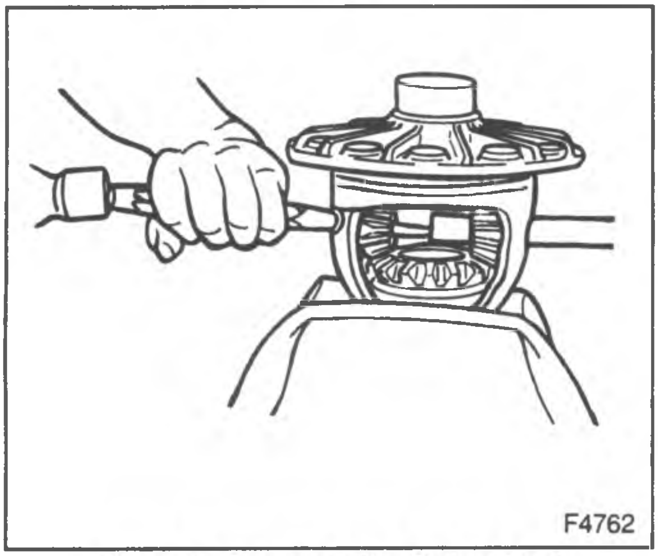


Figure 9—Removing the Pinion Shaft

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.

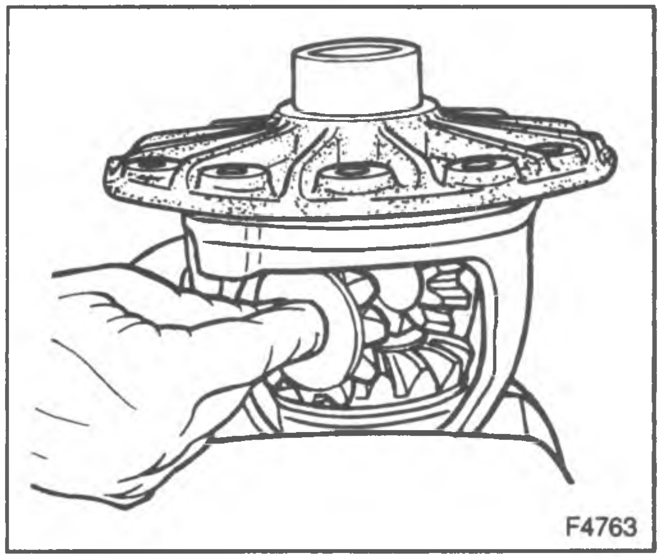


Figure 10—Removing the Pinion Gears

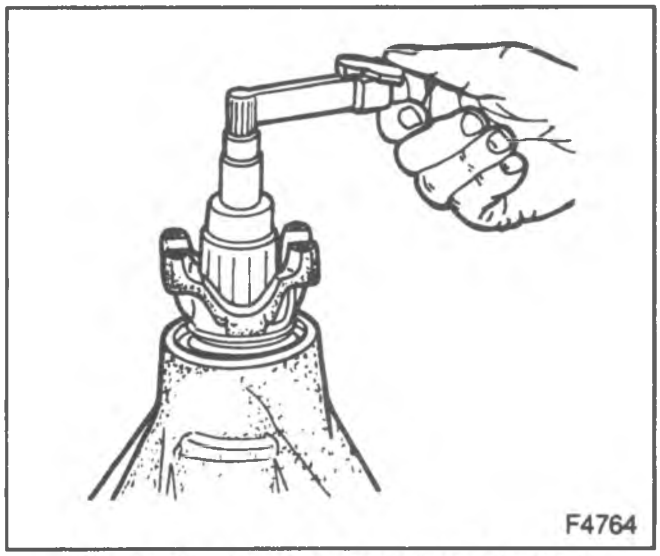


Figure 11—Checking the Pinion Preload

INSPECTION

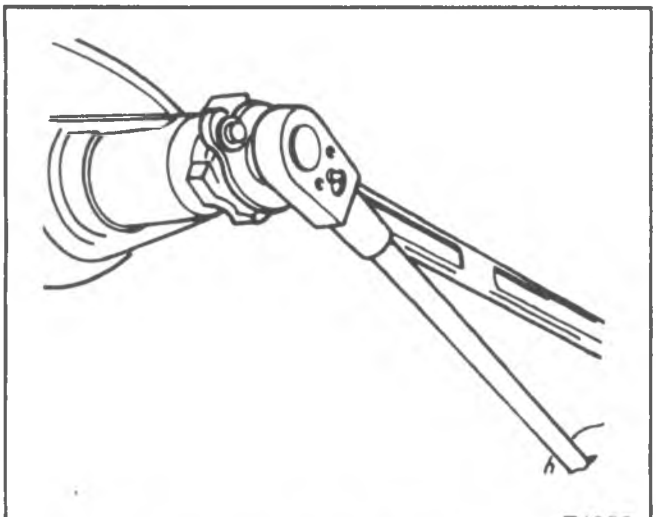
It is very important to carefully and thoroughly inspect all drive unit parts before reassembly.

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

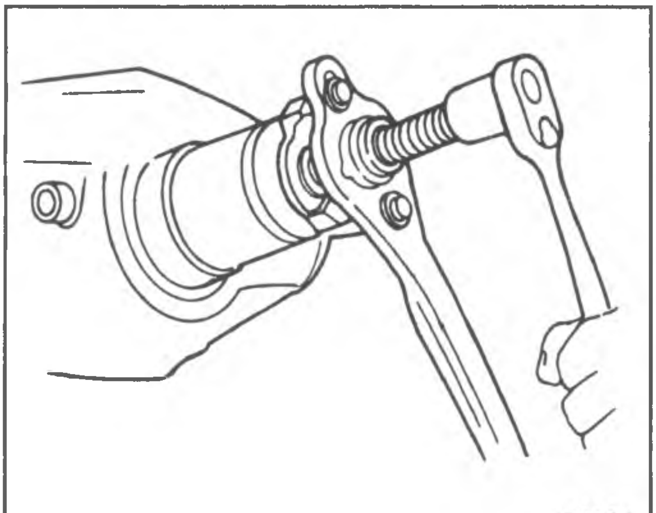
Inspect

- 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.



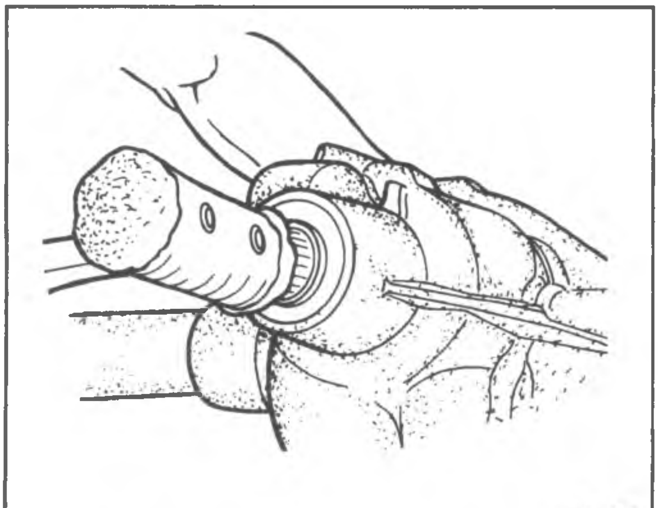
F4693

Figure 12—Removing the Drive Pinion Nut



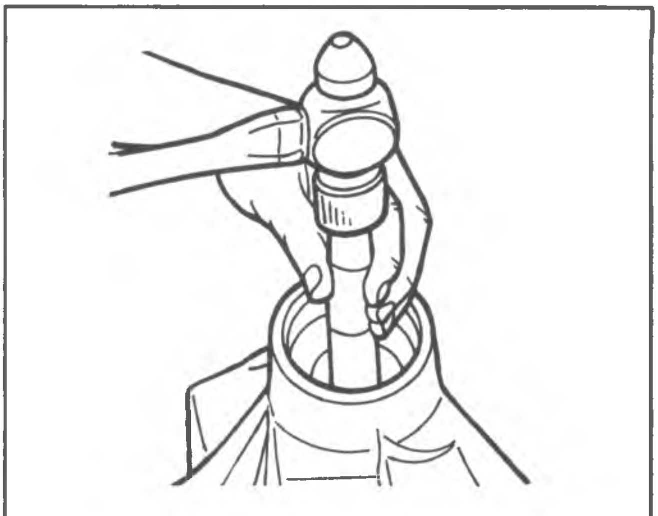
F4694

Figure 13—Removing the Pinion Flange



F4767

Figure 14—Removing the Pinion



F4768

Figure 15—Removing the Bearing Cups

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 gear splines for wear.
- Pinion flange splines for wear.
- The fit of the pinion flange on the pinion gear.
- 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.

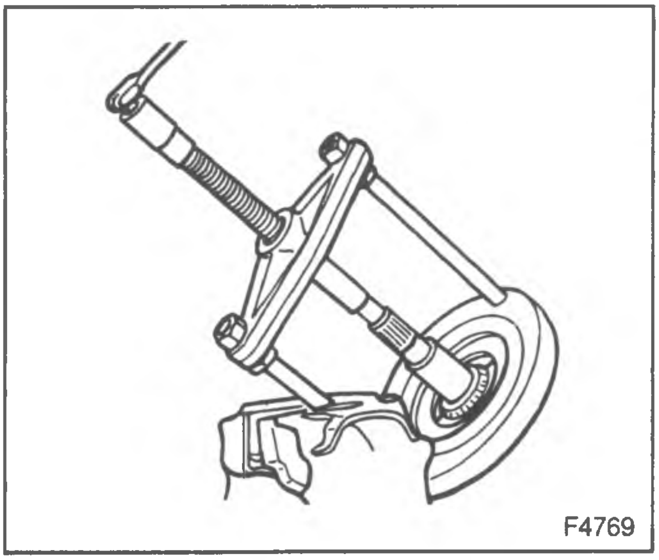


Figure 16—Removing the Pinion Inner Bearing

- 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 small 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.

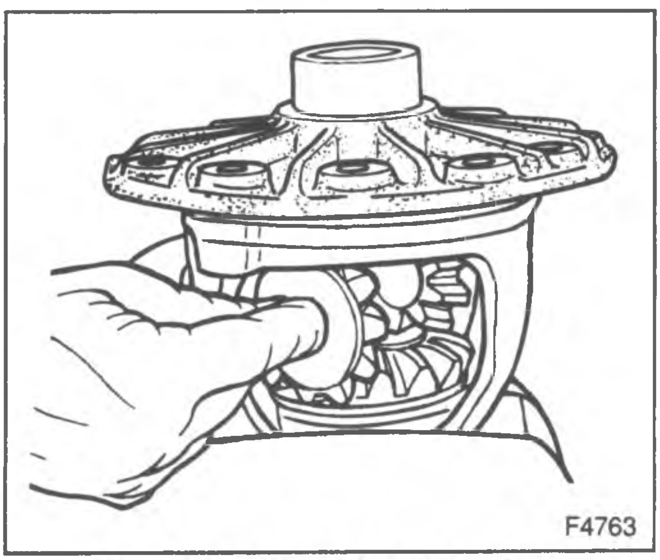


Figure 17—Installing the Pinion Gears

ASSEMBLY OF THE REAR AXLE

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.

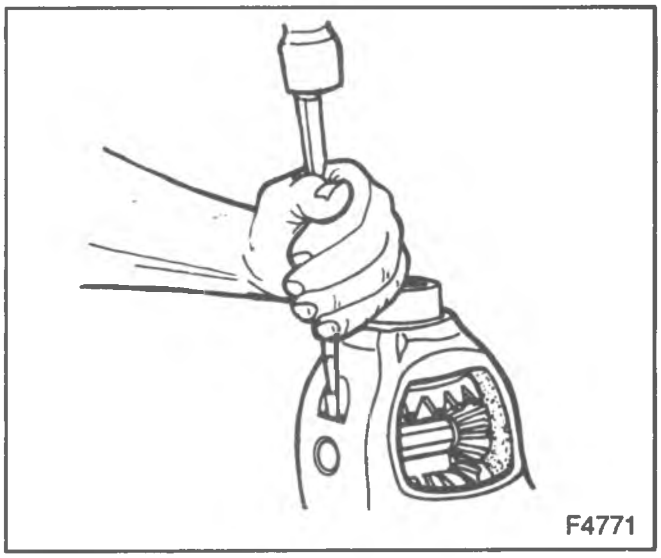


Figure 18—Installing the Lock Pin

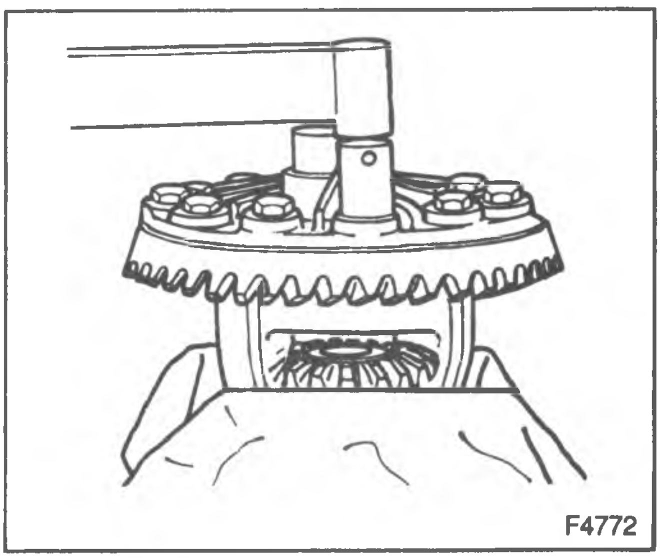


Figure 19—Installing the Ring Gear Bolts

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.
   - 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.

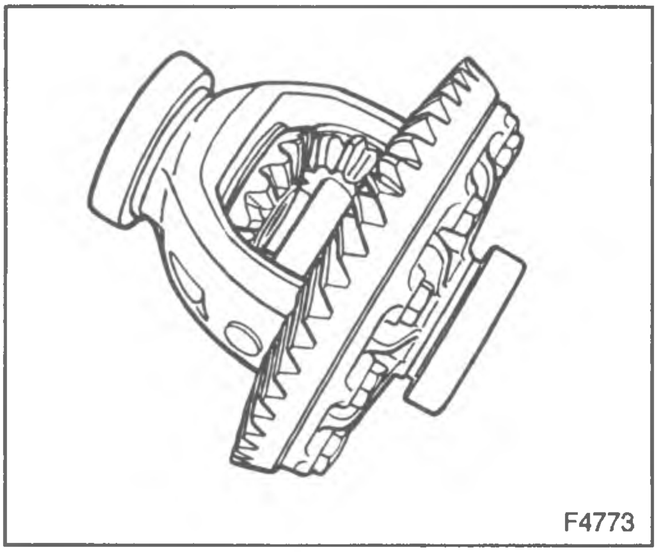


Figure 20—Differential with the Master Bearings

- The new ring gear bolts in sequence to 150 N·m (110 ft. lbs.). Refer to "Specifications" for bolt information.
9. Master differential bearings using D-117 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.
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.

PINION DEPTH ADJUSTMENT

Tools Required:
D-120 Master Pinion Block
D-116-1 Pinion Height Block
D-116-2 Master Discs
D-115-3 Arbor
D-115 Scooter Gage

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).

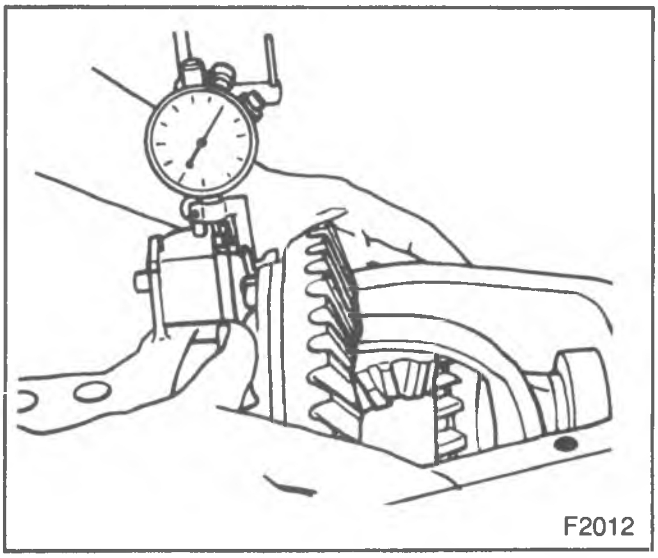


Figure 21—Determining Differential Shim Pack

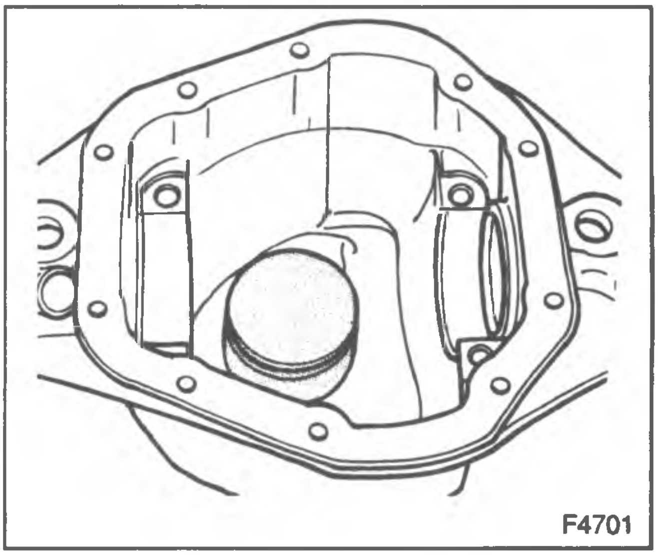


Figure 22—Master Pinion Block

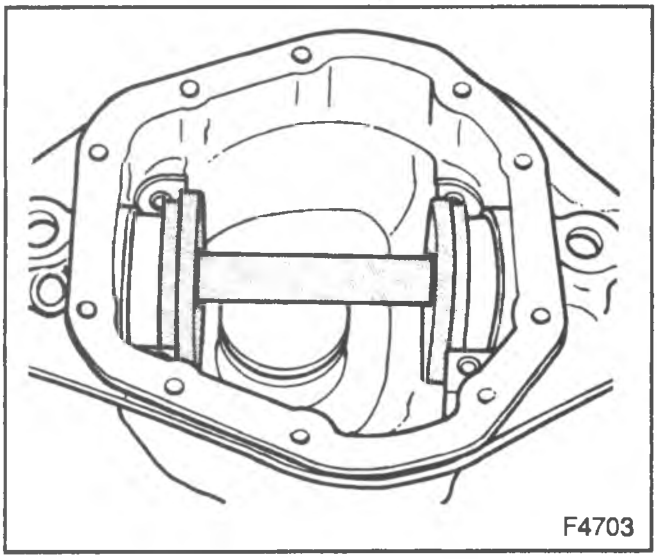


Figure 23—Arbor and Discs

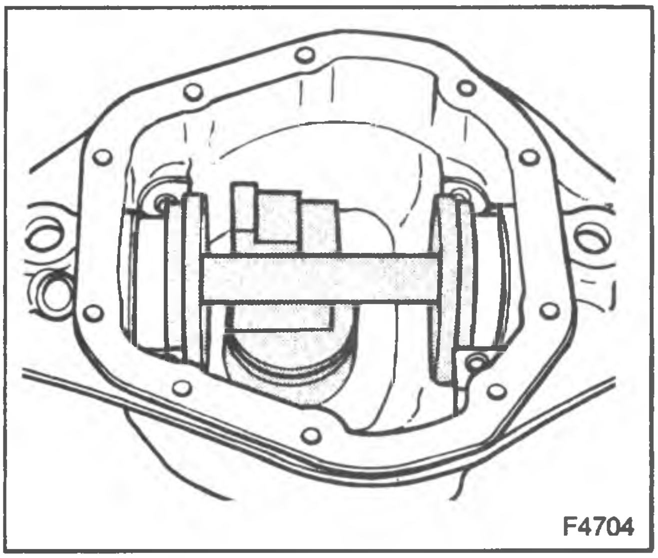


Figure 24—Pinion Height Block

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).
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).

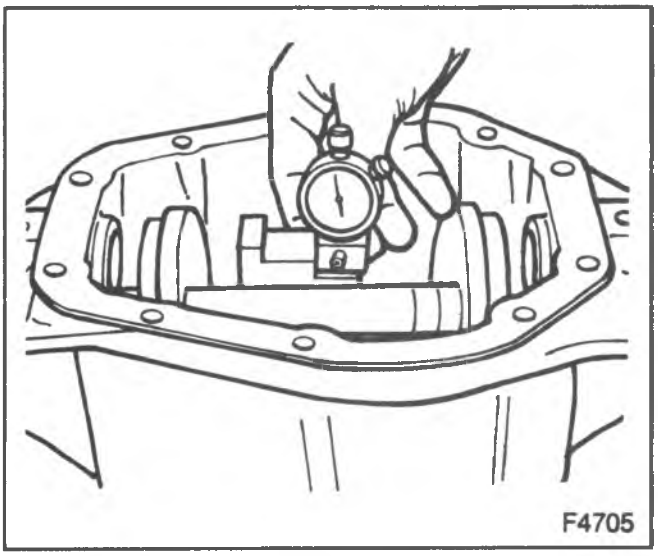


Figure 25—Scooter Gage on the Height Block

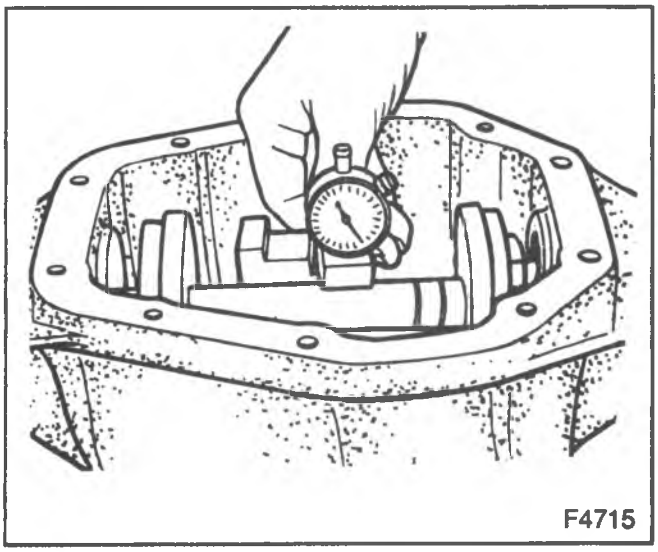


Figure 26—Scooter Gage on the Arbor

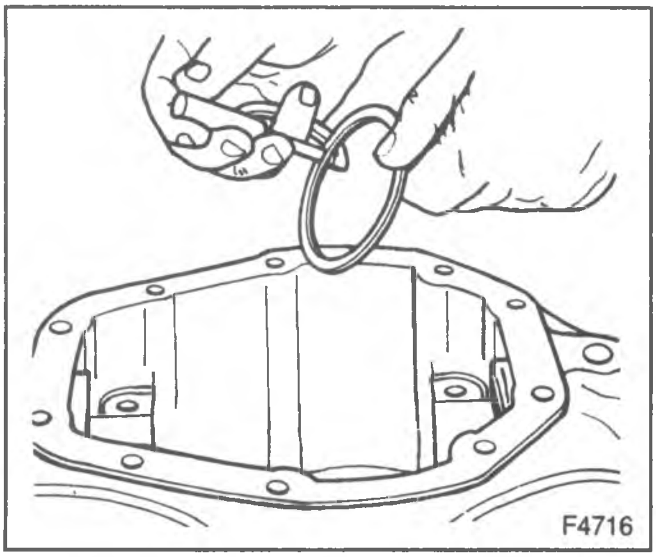


Figure 27—Measuring the Shims

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
- C-4171 Handle
- 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.
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.

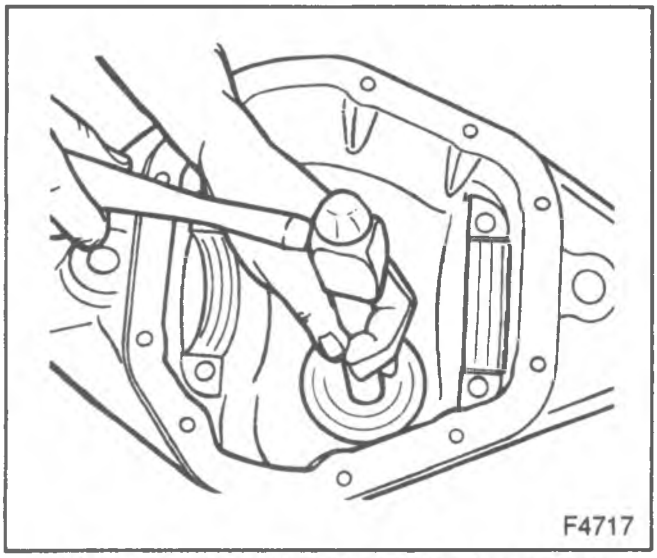


Figure 28—Installing the Pinion Inner Cup

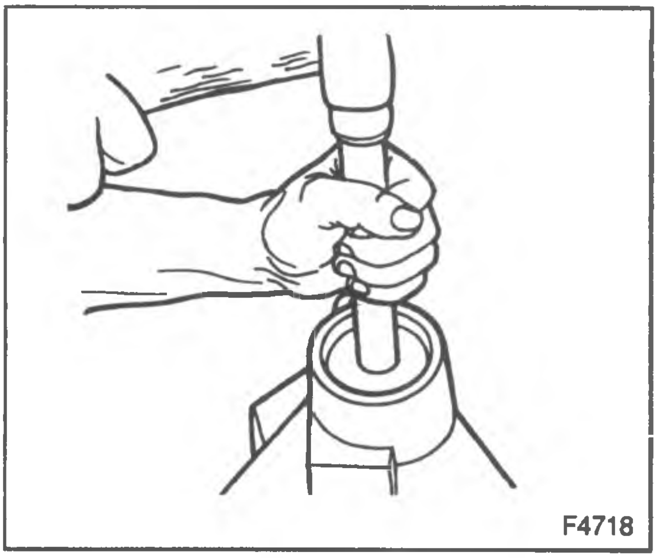


Figure 29—Installing the Pinion Front Cup

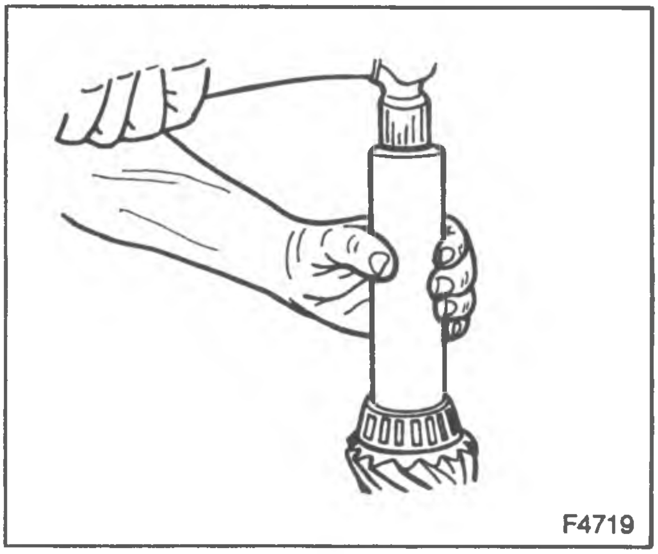


Figure 30—Installing the Inner Bearing

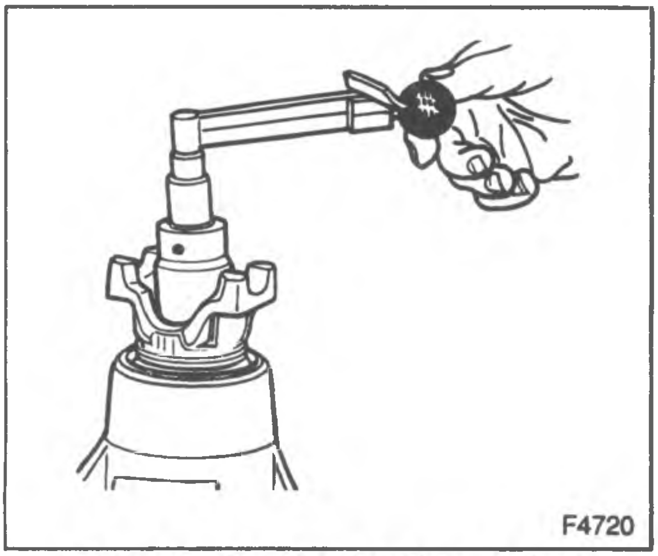


Figure 31—Checking the Pinion Preload

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 enut 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.

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 0.05mm (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.

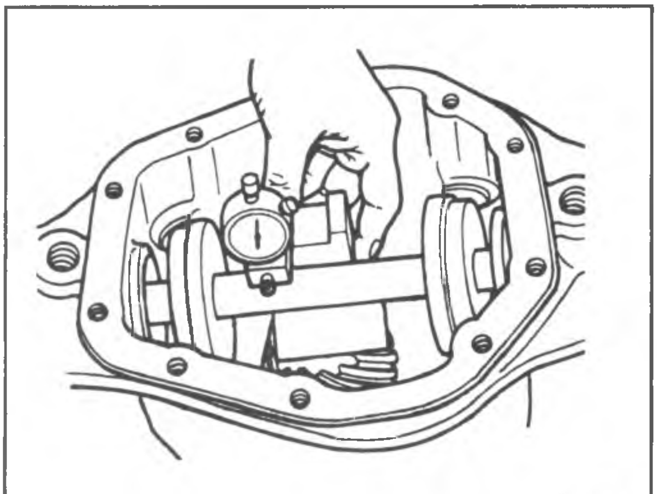

F4721

Figure 32—Checking the Pinion Depth Setting

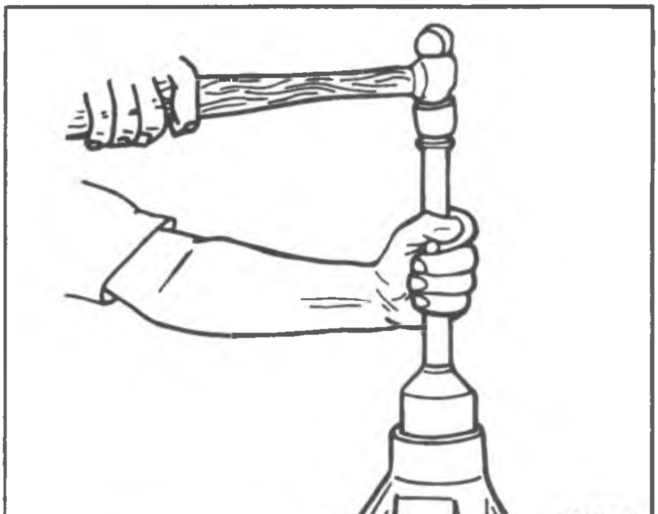

F4722

Figure 33—Installing the Pinion Seal

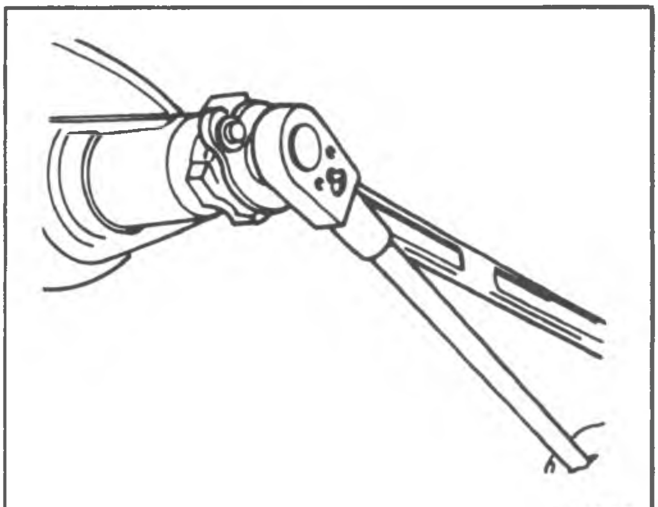

F4693

Figure 34—Tightening the Pinion Nut

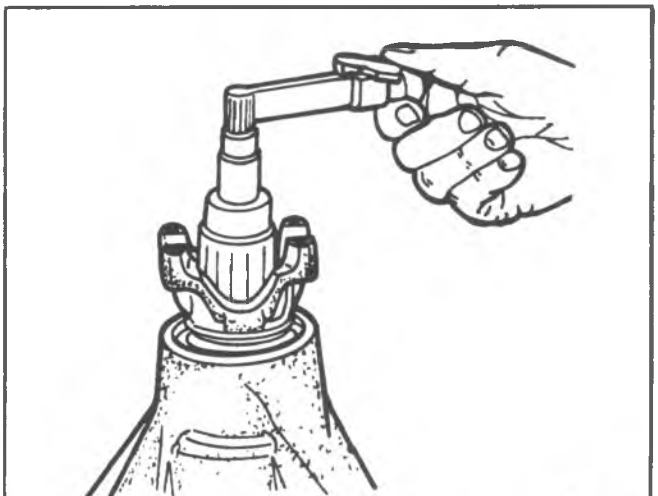

F4764

Figure 35—Checking Pinion Preload

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 enut 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.

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 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.

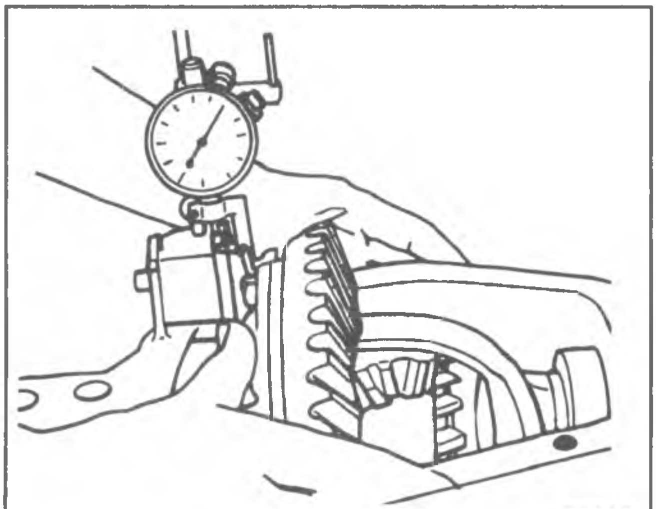

F2012

Figure 36—Measuring Differential Movement


F4725

Figure 37—Installing the Differential Bearings

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 0.38mm (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 e 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.
12. Assemble J 24385-01 to the axle housing as shown in figure 38.

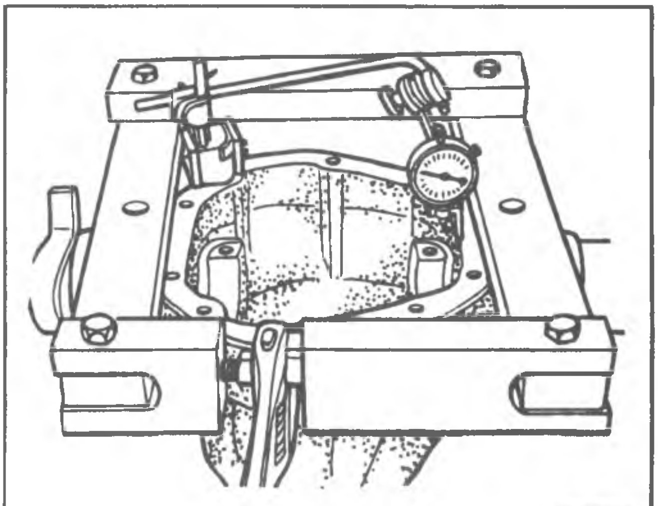

F4728

Figure 38—Mounting the Carrier Spreader

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 0.38mm (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).

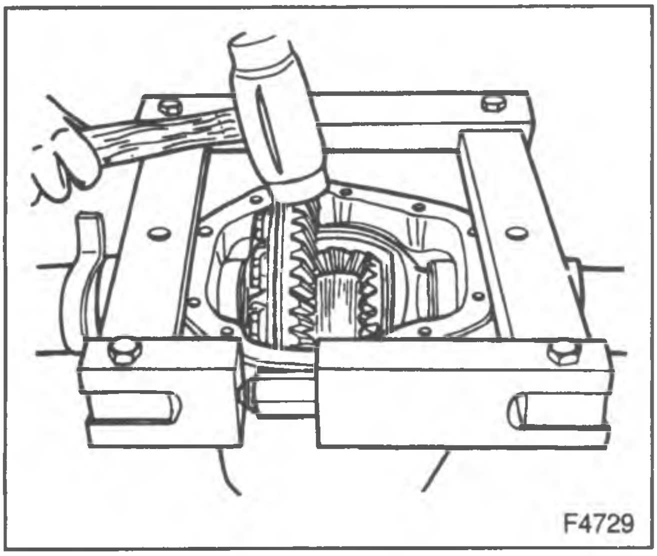


Figure 39—Installing the Differential Case

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 0.13-0.23mm (0.005-0.009-inch). The measurement must not vary more than 0.05mm (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.
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. Lubricant to the rear axle (after the RTV has cured).

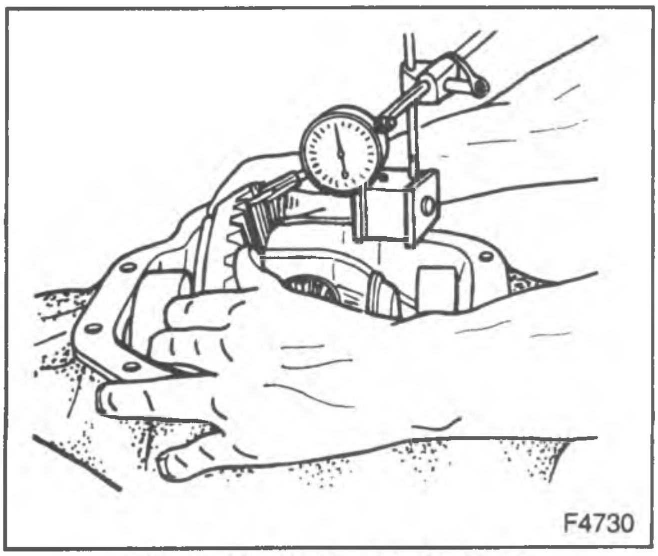


Figure 40—Measuring Backlash

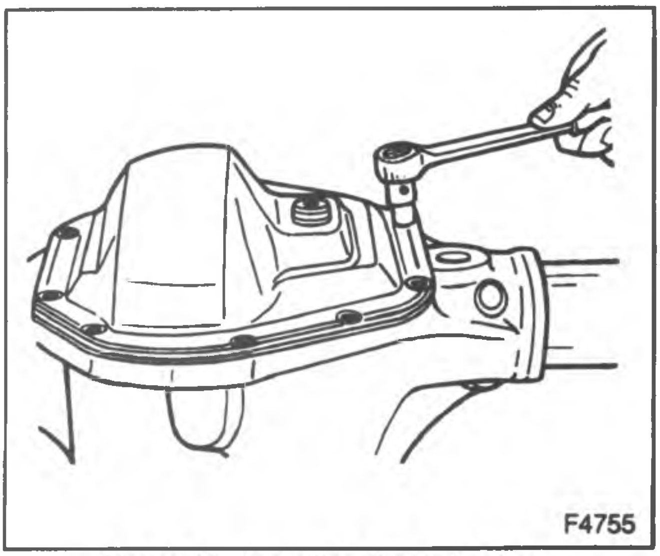


Figure 41—Installing the Axle Cover

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 axle 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.

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.

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 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.

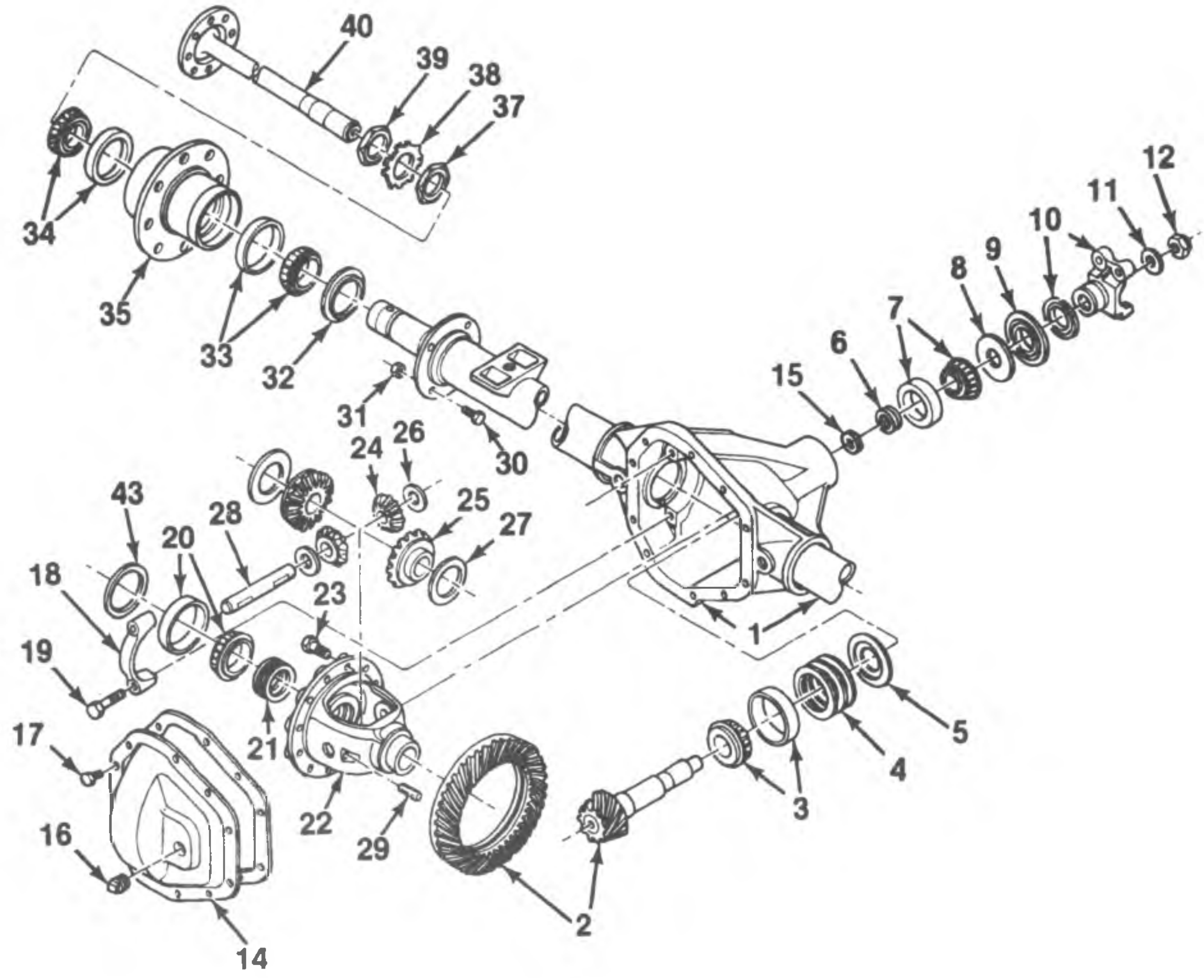
1. The differential cover bolts (17) and the differential cover (14) (figure 43).
   - Drain the gear lubricant into a proper container.
2. Axle shafts (40).
3. Bearing cap bolts (19) (figure 44).
4. Bearing caps (18).
   - The mating letters are stamped on the caps and the axle housing. The caps are 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 0.38mm (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 0.38mm (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).
7. Bearing cups (20).
   - Mark the cups as left and right, and place them with their corrosponding 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 their corrosponding bearing caps and cups.
9. Differential shims (21).
   - Mark the shims as left or right.



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

F5910

Figure 42—Rear Axle Components

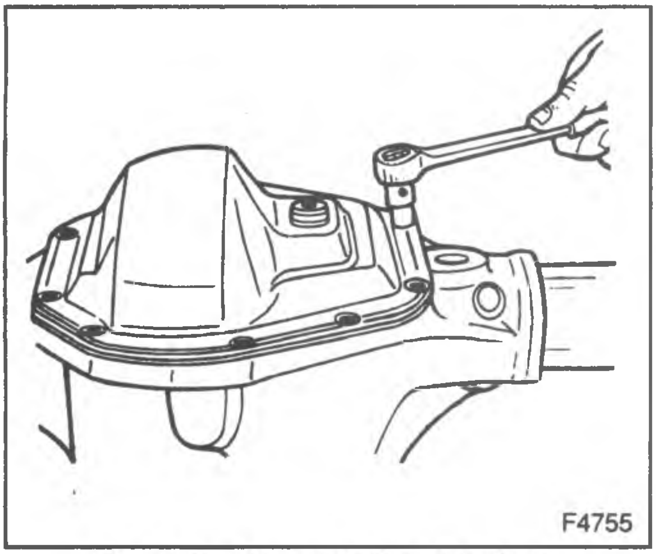


Figure 43—Removing the Axle Cover

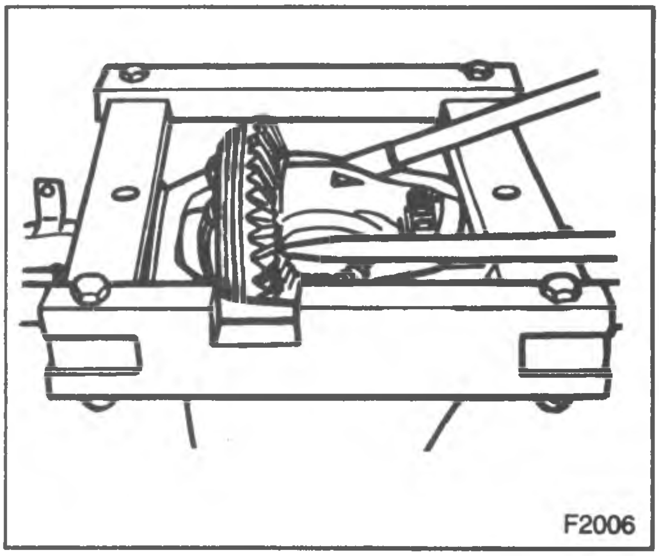


Figure 46—Removing the Differential

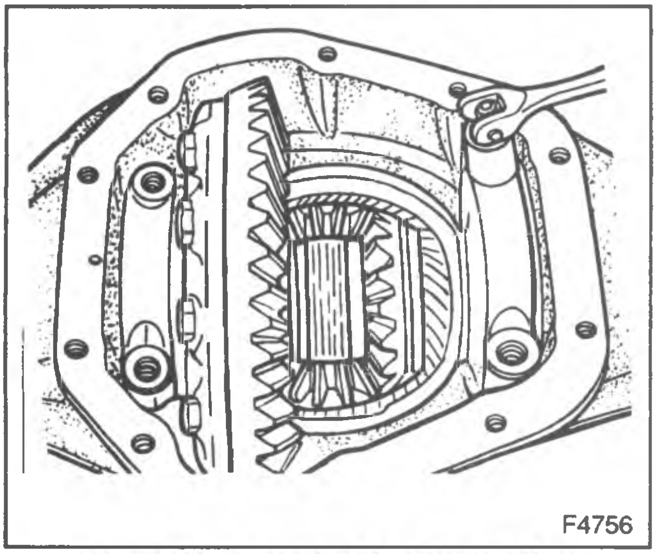


Figure 44—Removing the Bearing Cap

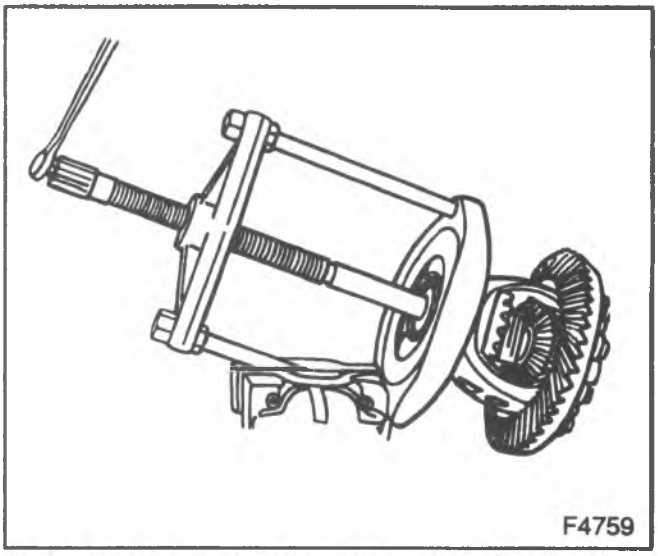


Figure 47—Removing the Differential Side Bearings

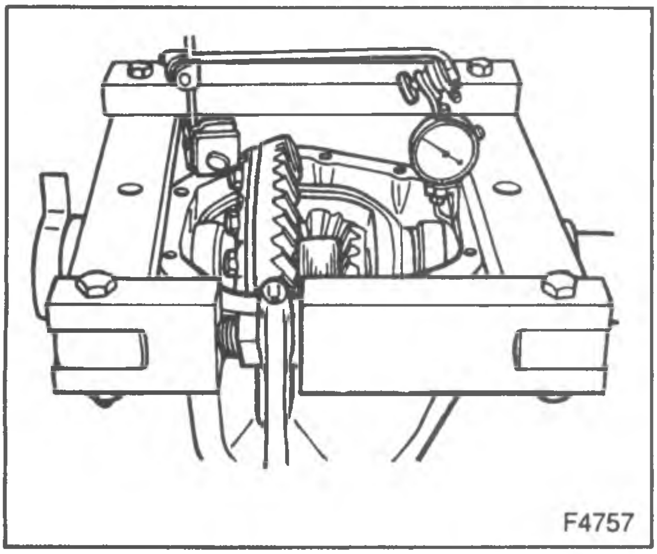


Figure 45—Spreading the Differential Case

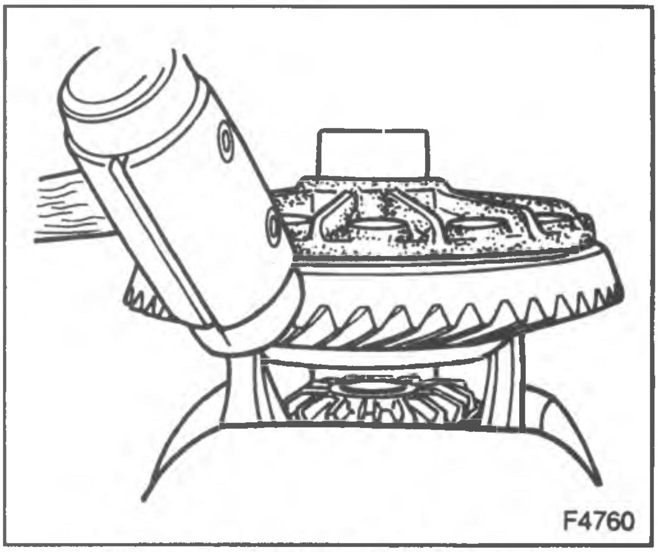


Figure 48—Removing the Ring Gear

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).
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 together on the bench.
21. Pinion seal (9).

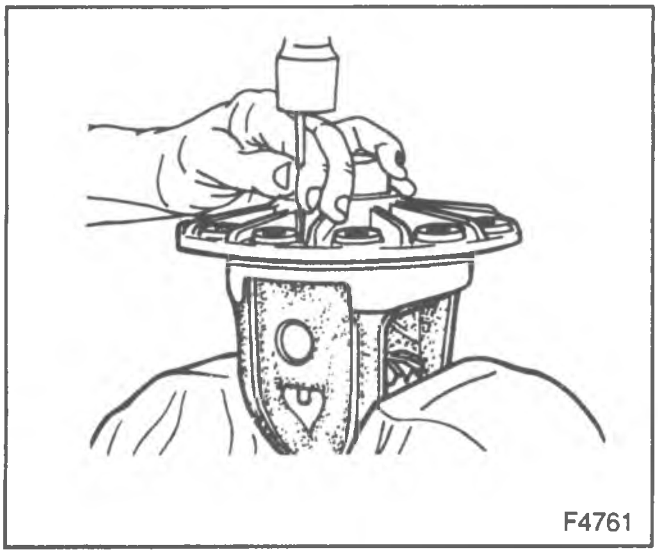


Figure 49—Removing the Lock Pin

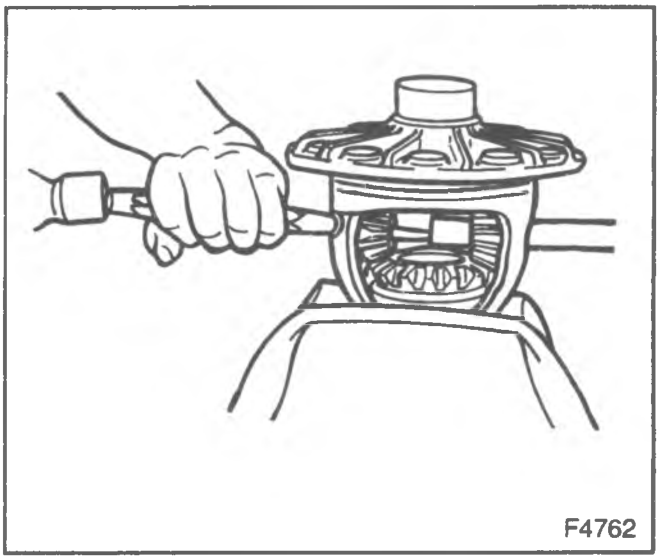


Figure 50—Removing the Pinion Shaft

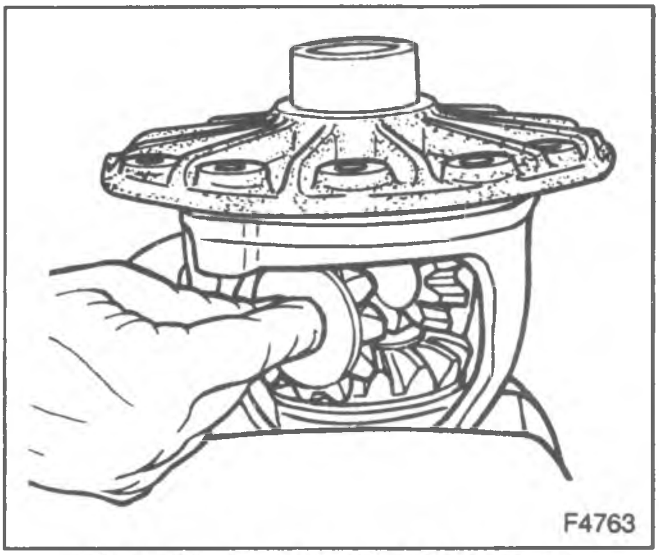


Figure 51—Removing the Pinion Gears

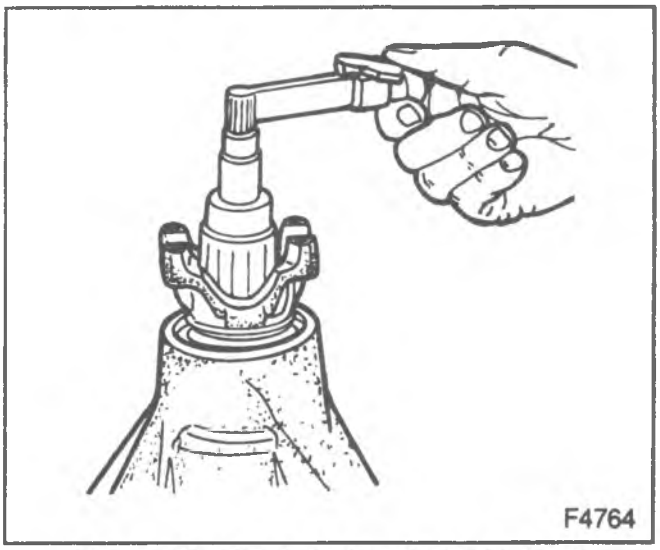


Figure 52—Checking the Pinion Preload

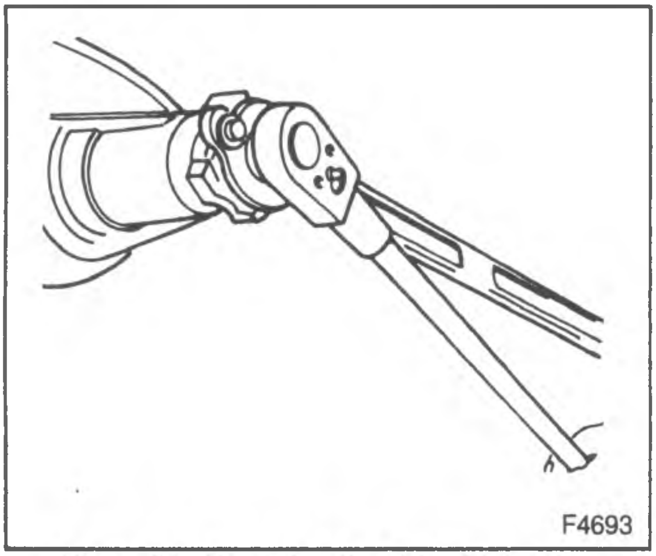


Figure 53—Removing the Drive Pinion Nut

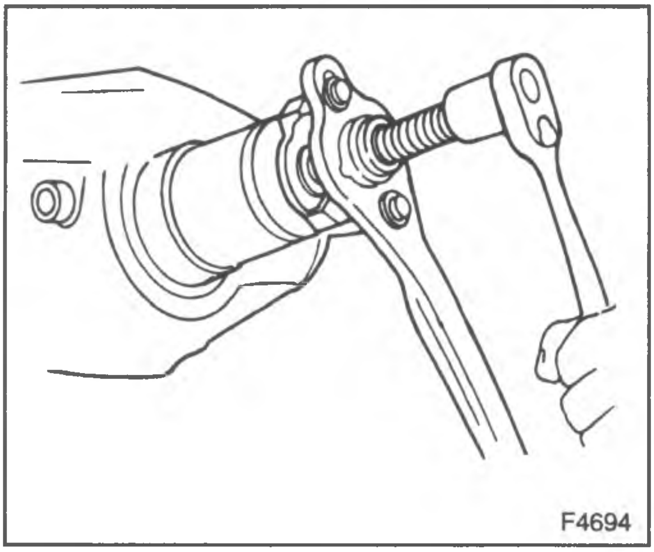


Figure 54—Removing the Pinion Flange

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).

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.

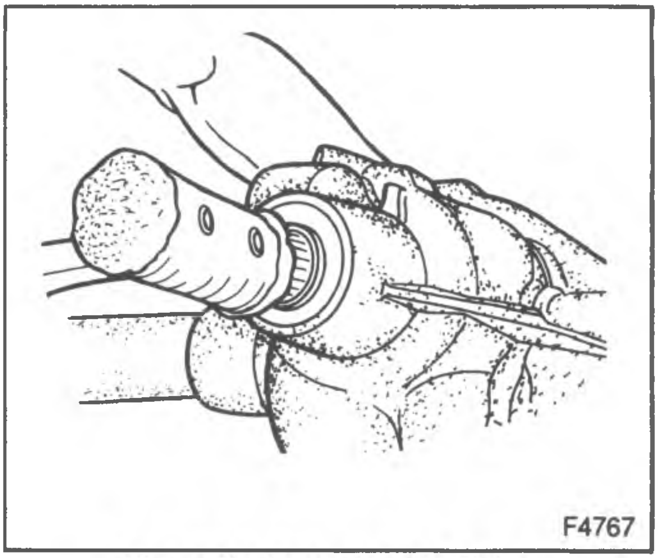


Figure 55—Removing the Pinion

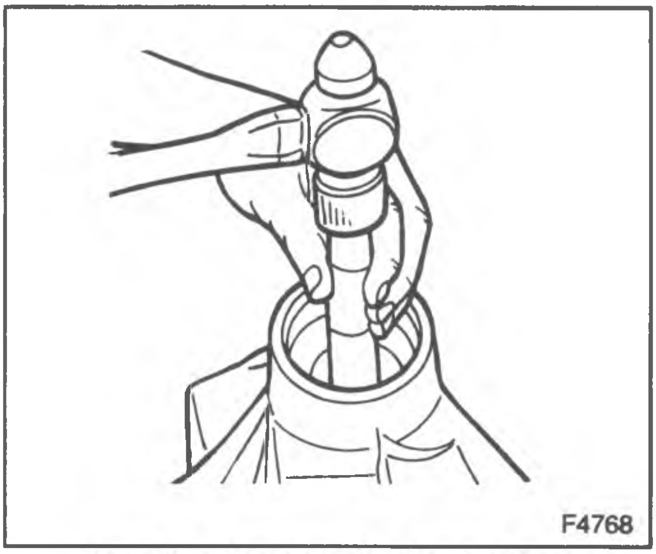


Figure 56—Removing the Bearing Cups

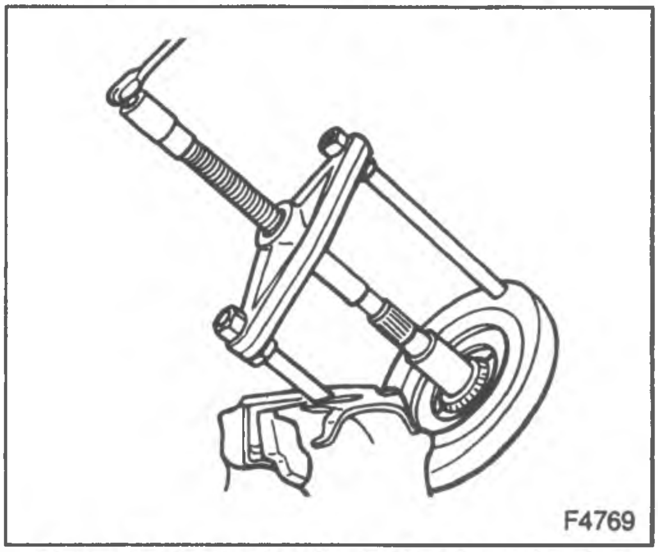


Figure 57—Removing the Pinion Inner Bearing

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 ofthe 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 areplacement 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

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 42)

Tools Required:
D-136 Master Differential Bearings H.D.
D-117 Master Differential Bearings

- 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.

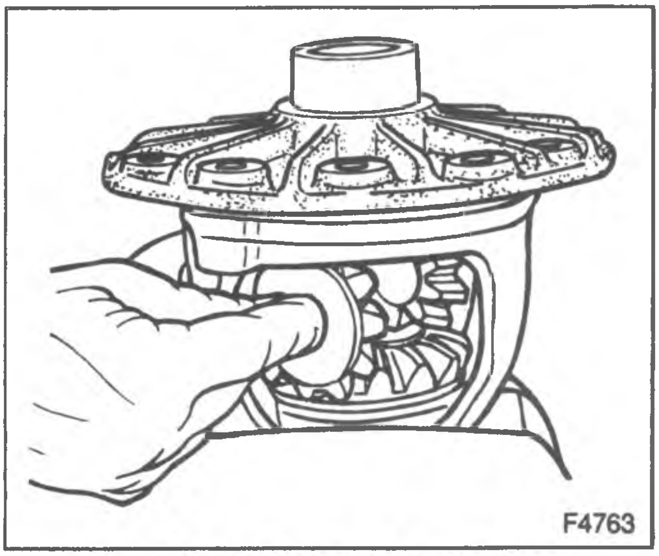


Figure 58—Installing the Pinion Gears

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.

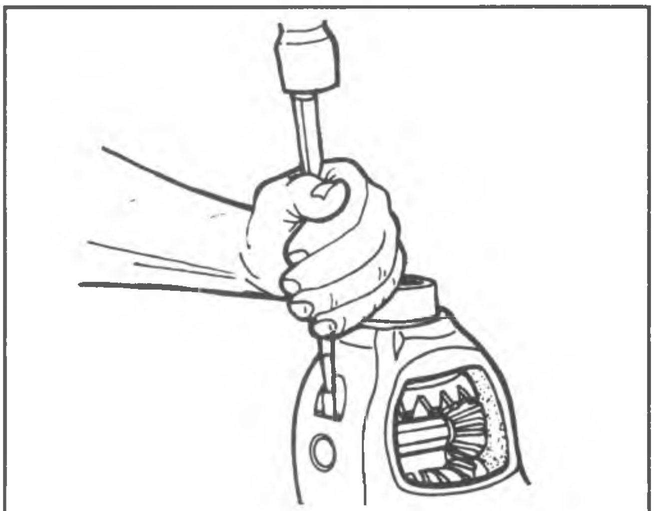

F4771

Figure 59—Installing the Lock Pin

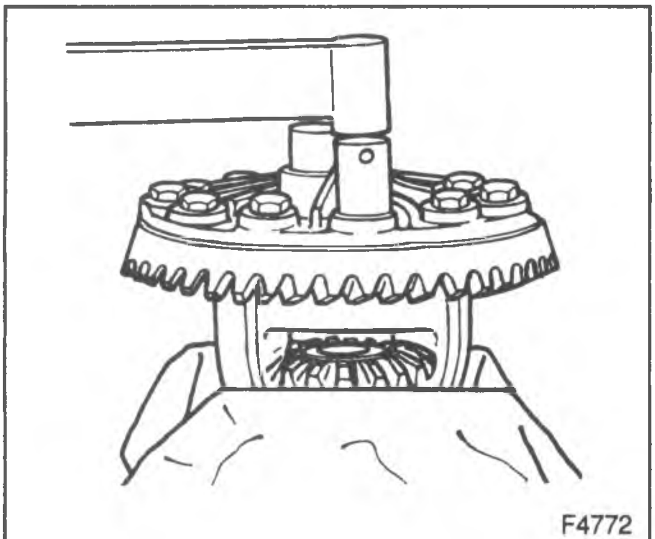

F4772

Figure 60—Installing the Ring Gear Bolts

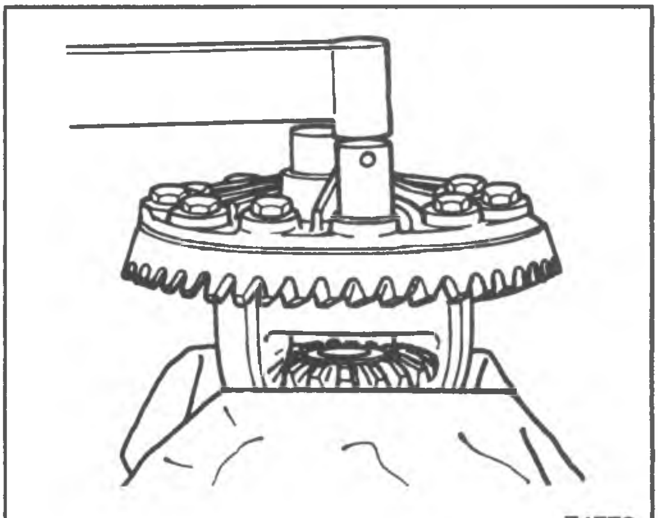

F4772

Figure 61—Differential with the Master Bearings

- 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 for H.D. Axles.
- Refer to "Determining Total Shim Pack Size" in this section.

DETERMINING TOTAL DIFFERENTIAL SHIMPACK 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.

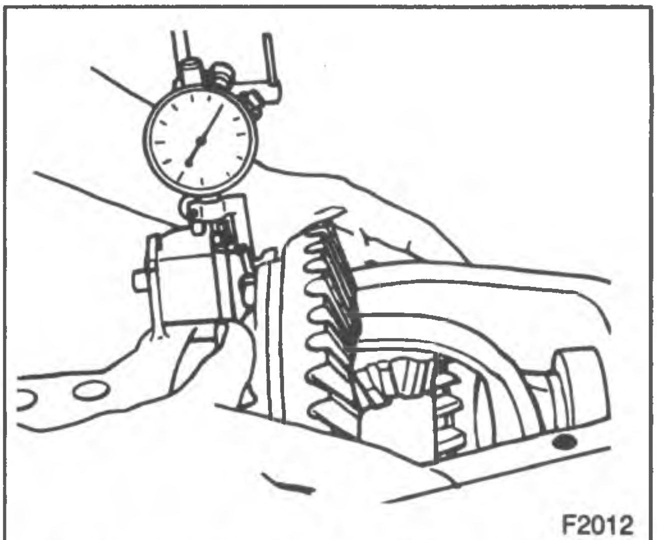

F2012

Figure 62—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 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.

DETERMINING TOTAL DIFFERENTIAL SHIMPACK 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 (60 and 70U)
D-137 Master Pinion Block (70B and 70 H.D.)
D-116-1 Pinion Height Block
D-116-2 Master Discs
D-115-3 Arbor
D-115 Scooter Gage

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.

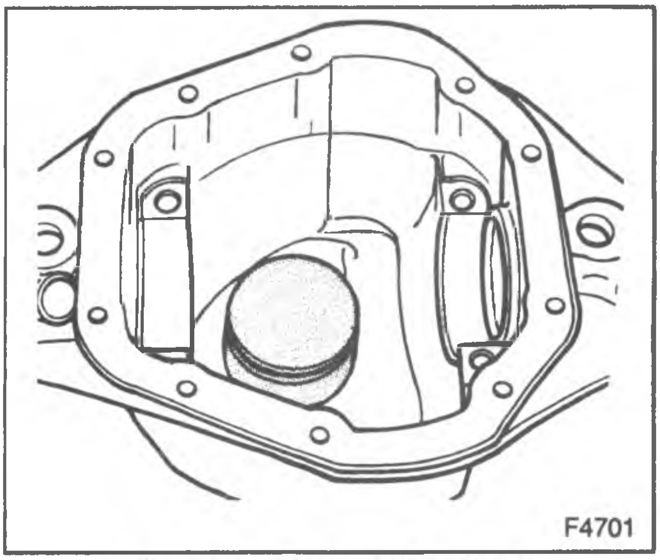


Figure 63—Master Pinion Block

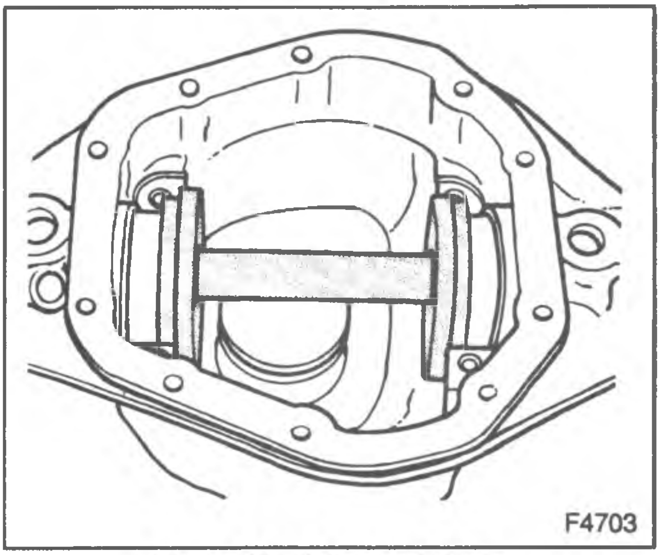


Figure 64—Arbor and Discs

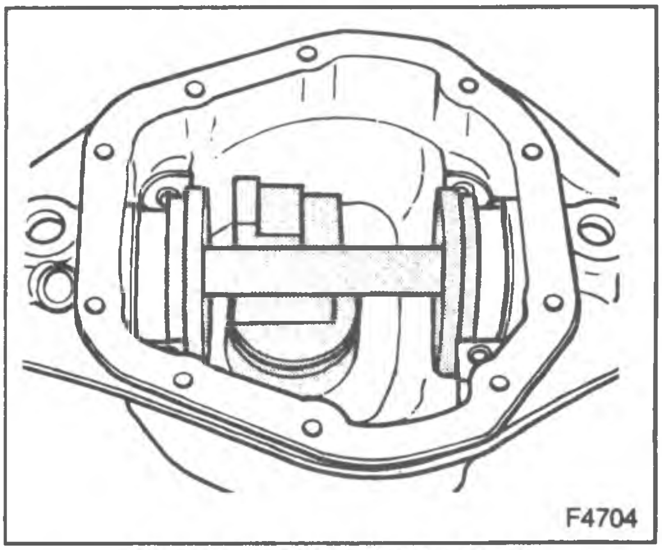


Figure 65—Pinion Height Block

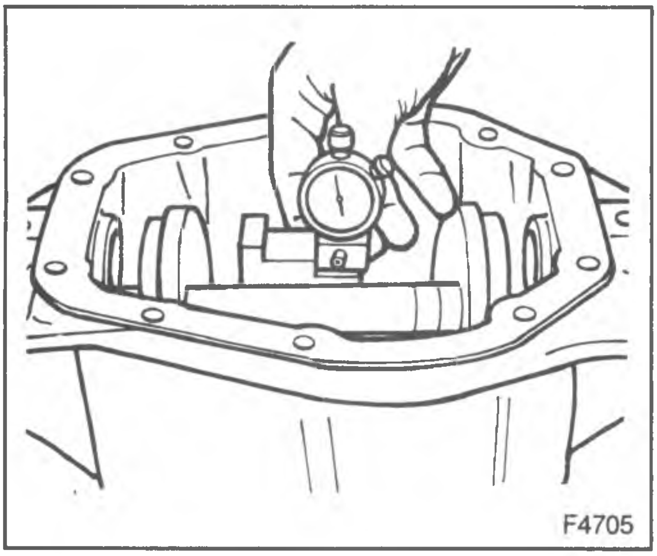


Figure 66—Scooter Gage on the Height Block

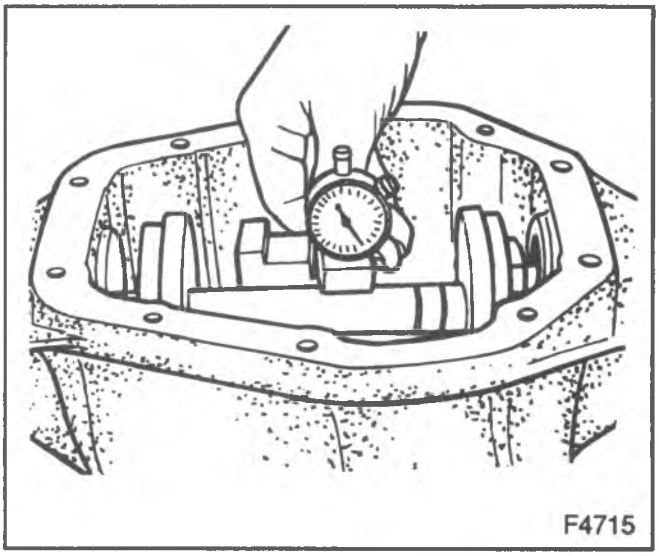


Figure 67—Scooter Gage on the Arbor

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).
   - 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).

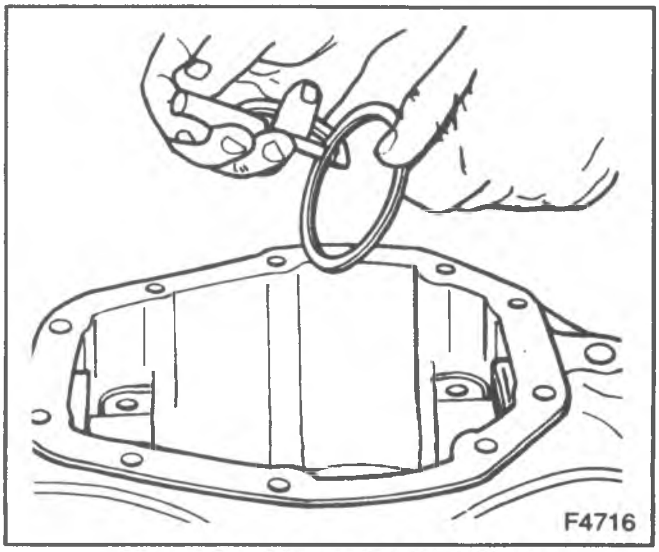


Figure 68—Measuring the Shims

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
- C-4171 Handle
- 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

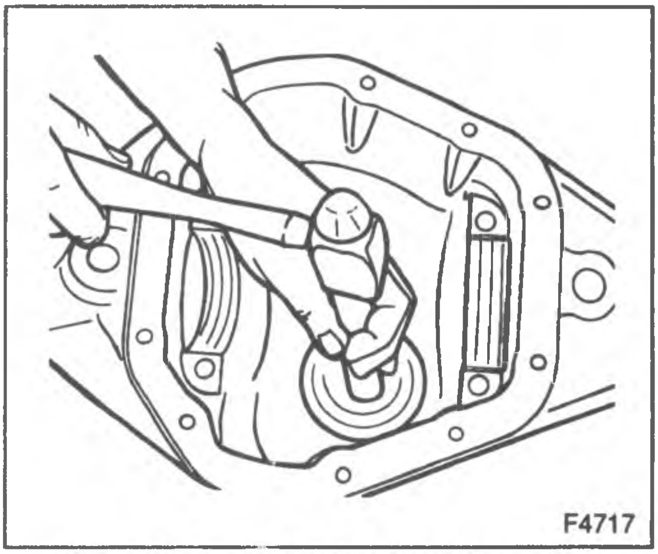


Figure 69—Installing the Pinion Inner Cup

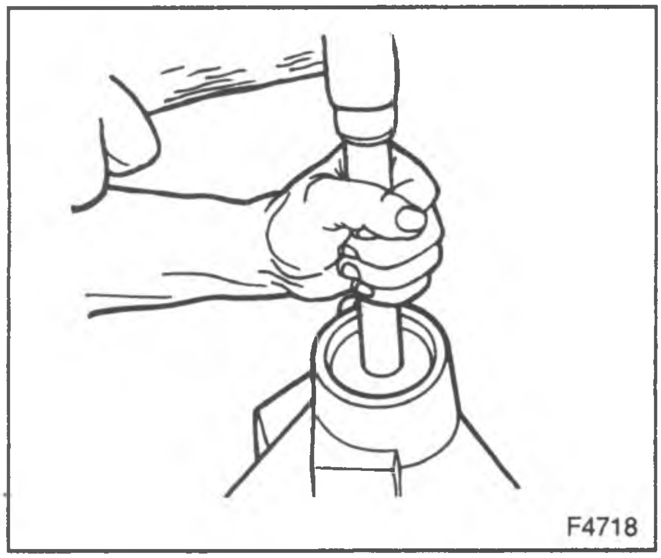


Figure 70—Installing the Pinion Front Cup

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 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 nut until it requires a torque of 1.13 N.m (10 in. lbs.) to rotate the pinion (figure 72). Rotate the pinion several times to seat the bearings and assure a more accurate reading pinion depth setting.

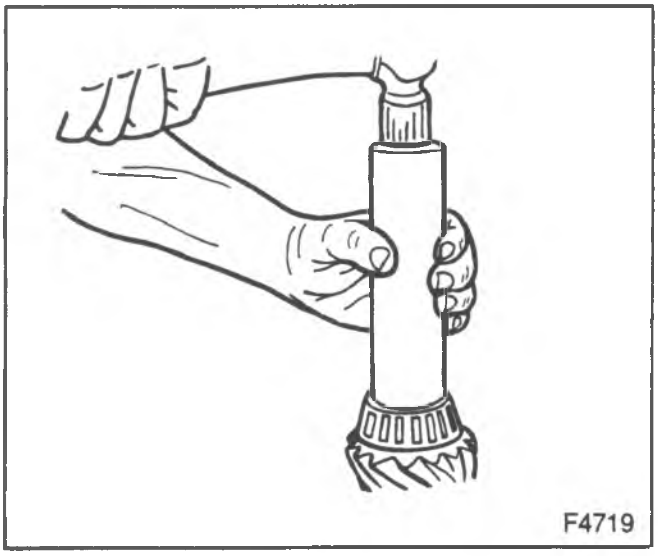


Figure 71—Installing the Inner Bearing

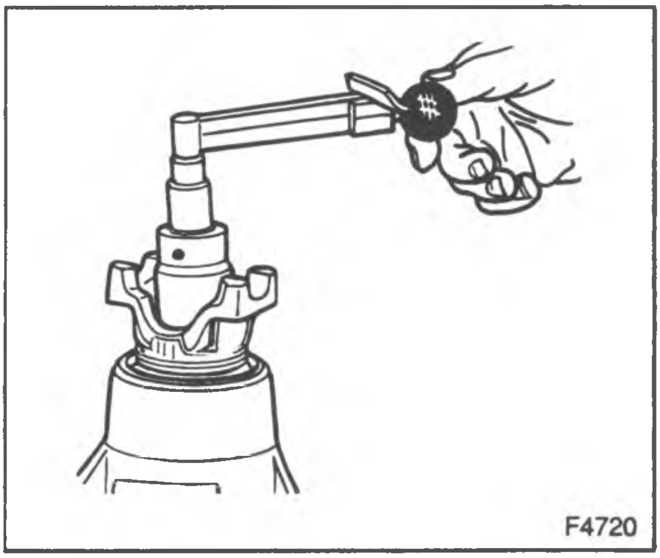


Figure 72—Checking the Pinion Preload

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 0.05mm (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

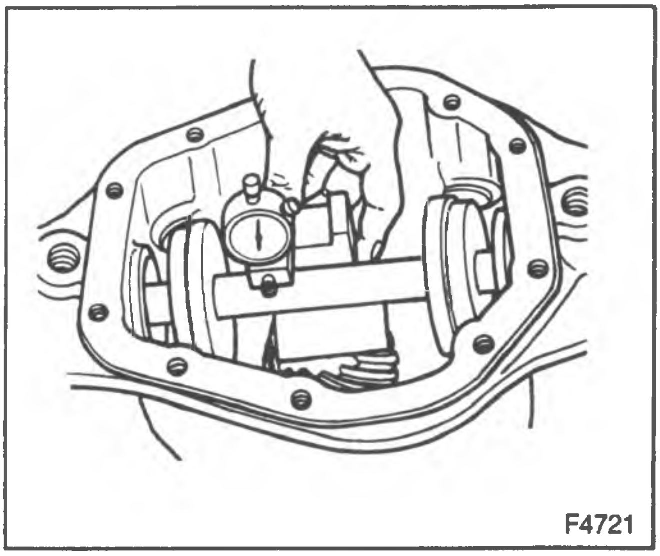


Figure 73—Checking the Pinion Depth Setting

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 seal 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 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.

ASSEMBLING THE DIFFERENTIAL TO THE AXLEHOUSING—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.

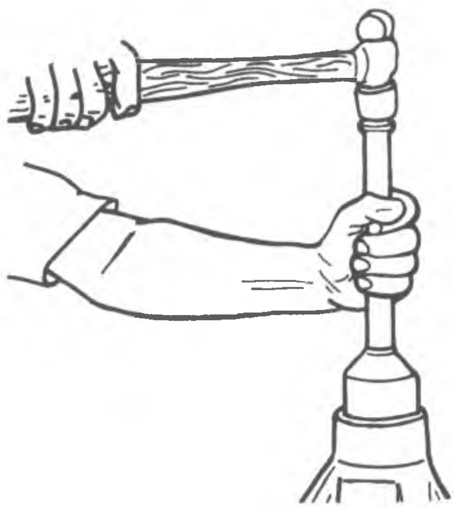


Figure 74—Installing the Pinion Seal

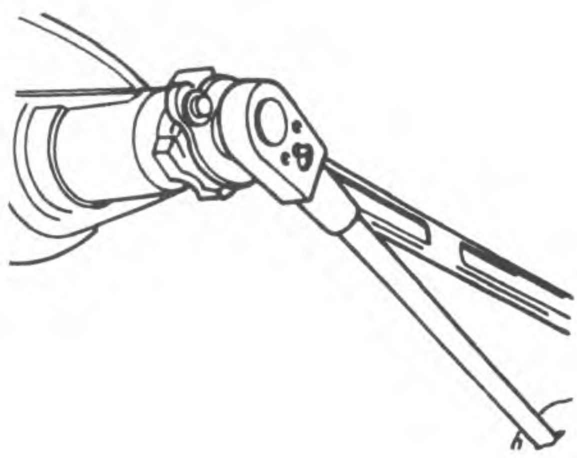


Figure 75—Tightening the Pinion Nut

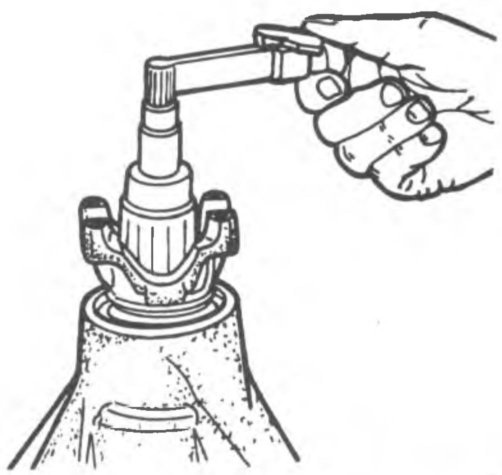


Figure 76—Checking Pinion Preload

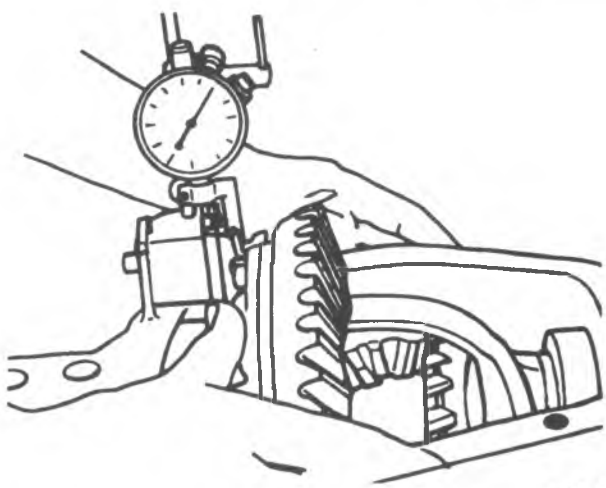


Figure 77—Measuring Differential Movement

6. Force the differential case away from the pinion gear to obtain an indicator reading. Repeat this action until a consistent 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 0.38mm (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.
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 0.38mm (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.

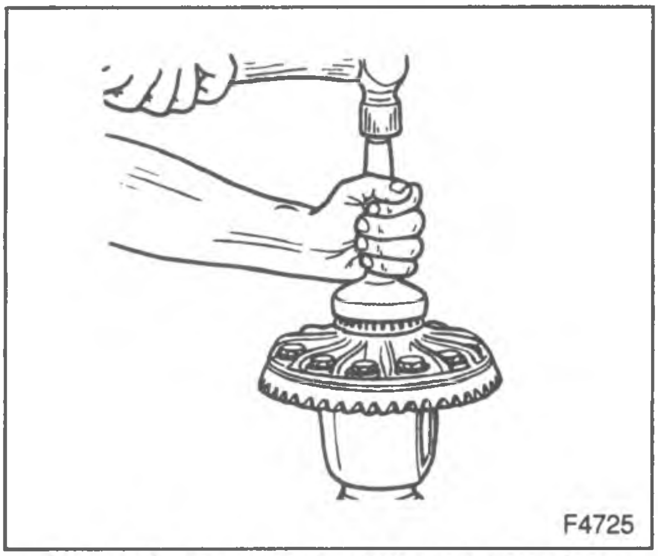


Figure 78—Installing the Differential Bearings

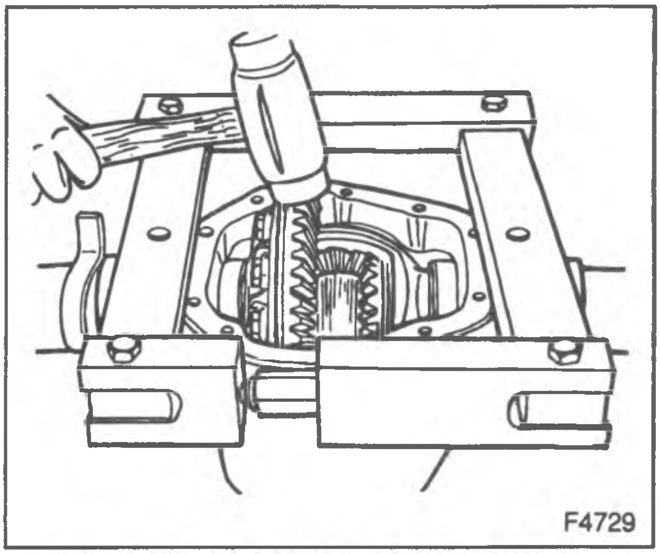


Figure 80—Installing the Differential Case

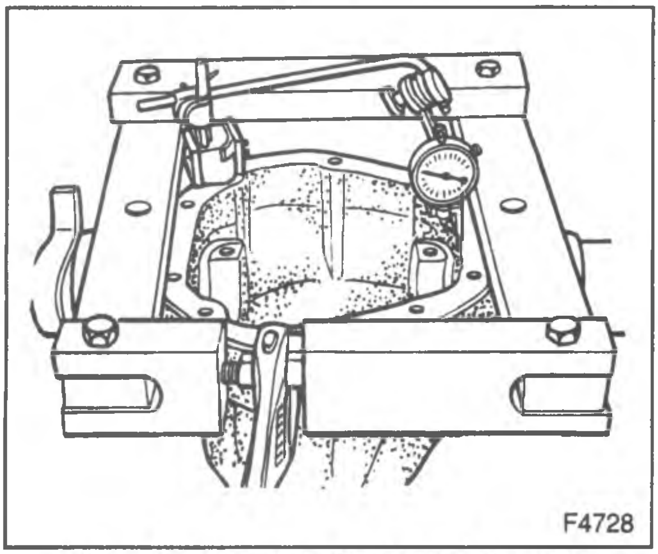


Figure 79—Mounting the Carrier Spreader

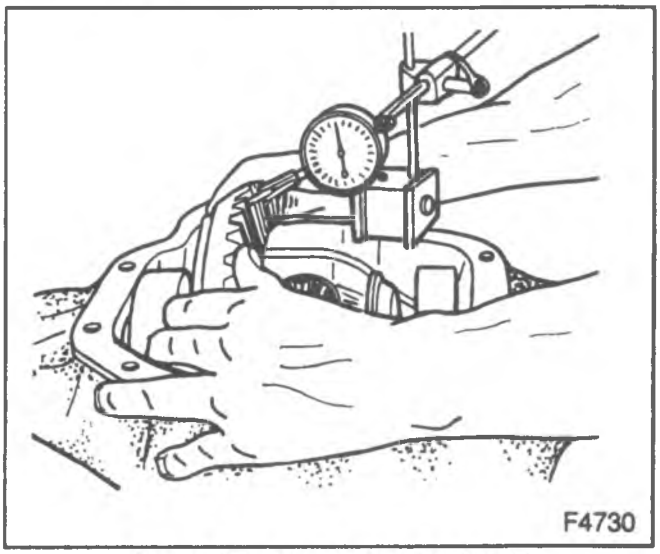


Figure 81—Measuring Backlash

- 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

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.

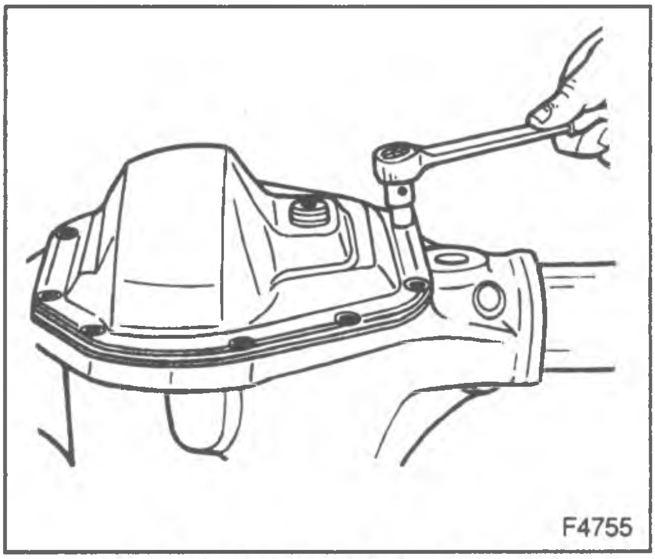


Figure 82—Installing the Axle Cover

11. Place the correct 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 size of the shim pack by subtracting the spacer size from the remaining amount of shims necessary (determined in step 10).
13. Place the necessary 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 0.38mm (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. 13-0.23mm (0.005-0.009-inch). The measurement must not vary more than 0.05mm (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.
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. Lubricant to the rear axle. (After the RTV has cured.)

SPECIFICATIONS

9 3/4-INCH RING GEAR AXLE

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	150	110
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35

Available 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
Lubricant	80W-90 GL-5

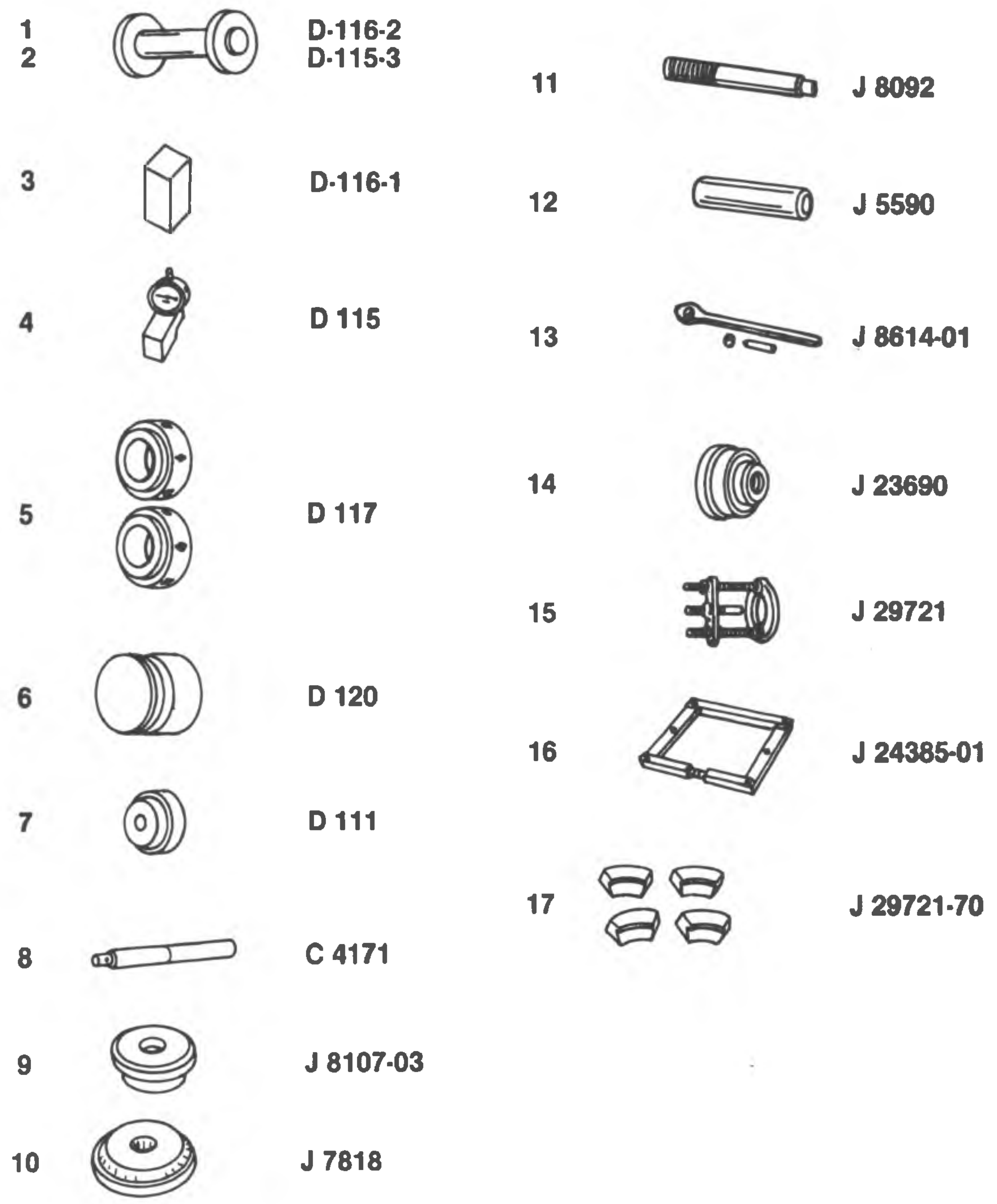
10 1/2-INCH RING GEAR AXLE

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	142	105
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35

Available 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
Lubricant	80W-90 GL-5

T2512

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

F4663

SPECIAL TOOLS

1. 2.		D 116-2 D 115-3	10.		J 8107-3
			11.		J 8092
3.		D 116-1	12.		J 7817
4.		D 115	13.		J 5590
5.		D 136 or D 117 (Heavy Duty Axles)	14.		J 8614-01
6.		D 120	15.		J 23690
7.		C 4204	16.		J 29721
8.		C 4171	17.		J 24385-01
9.		4205	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

F4664

SECTION 4B6

12-INCH RING GEAR (ROCKWELL)

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

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 axle 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.
- Bolts (1) and washers (2).
- Hubcap (3).
- Thread J 2619-01 into the tapped hole on the axle shaft flange.

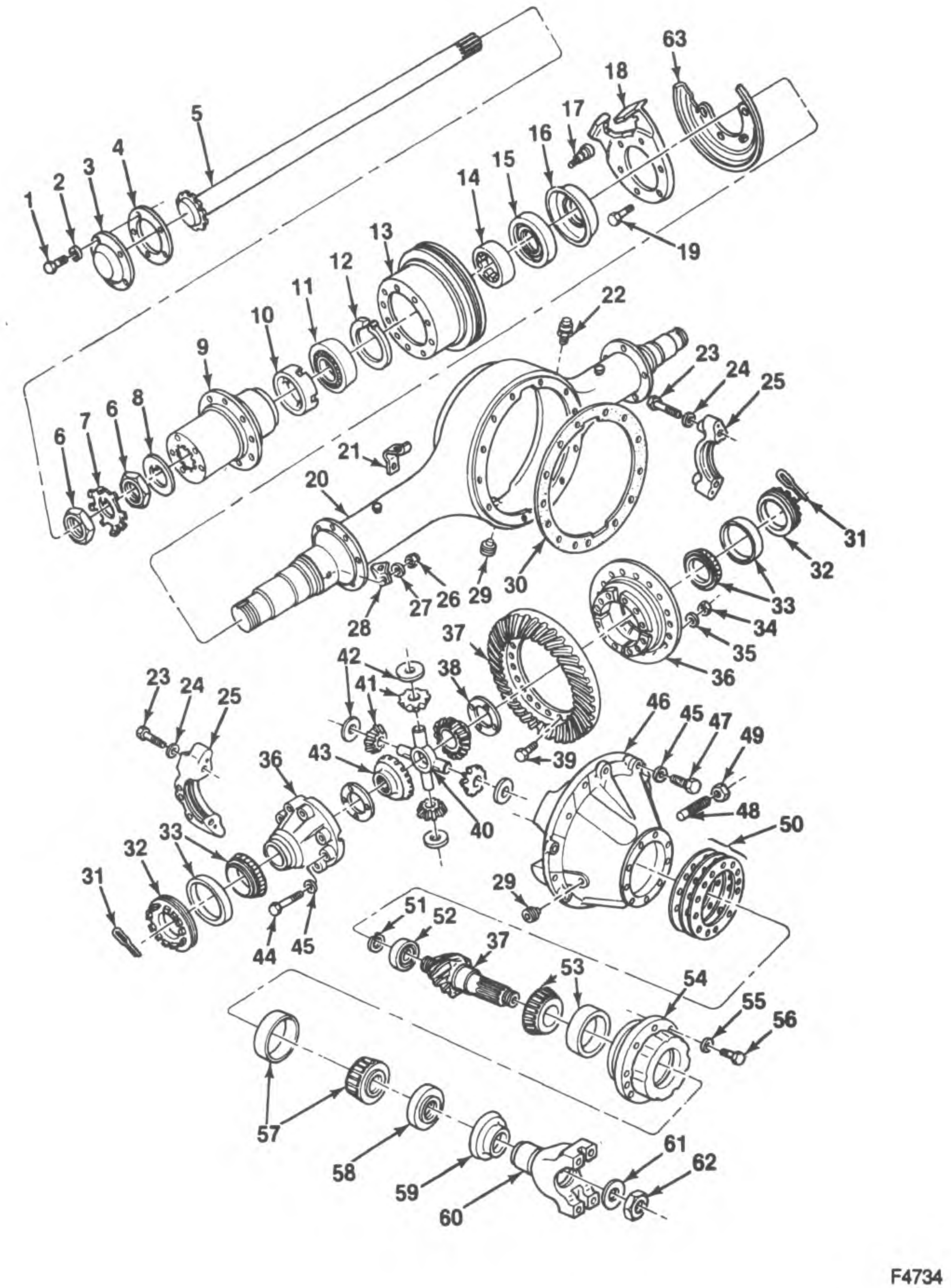


Figure 1—Rear Axle Components

1. Bolt	22. Axle Vent	43. Side Gears
2. Washer	23. Bolt	44. Bolt
3. Hub Cap	24. Washer	45. Washer
4. Gasket	25. Bearing Cap	46. Carrier
5. Axle Shaft	26. Nut	47. Bolt
6. Adjusting Nut	27. Washer	48. Thrust Block Screw
7. Lock Ring	28. Bracket	49. Nut
8. Thrust Washer	29. Plug	50. Pinion Depth Shims
9. Wheel Hub	30. Gasket	51. Retaining Ring
10. Thrust Spacer	31. Pin	52. Bearing
11. Bearing	32. Adjusting Nut	53. Bearing
12. Retaining Ring	33. Bearing	54. Pinion Cage
13. Rotor	34. Nut	55. Washer
14. Bearing	35. Washer	56. Bolt
15. Hub Oil Seal	36. Differential Case	57. Bearing
16. Deflector	37. Pinion and Ring Gear Set	58. Pinion Oil Seal
17. Bolt	38. Side Gear Thrust Washer	59. Deflector
18. Brake Caliper Bracket	39. Ring Gear Bolt	60. Pinion Flange
19. Bolt	40. Pinion Spider	61. Washer
20. Axle Housing	41. Pinion Gears	62. Nut
21. Bracket	42. Pinion Thrust Washers	63. Backing Plate

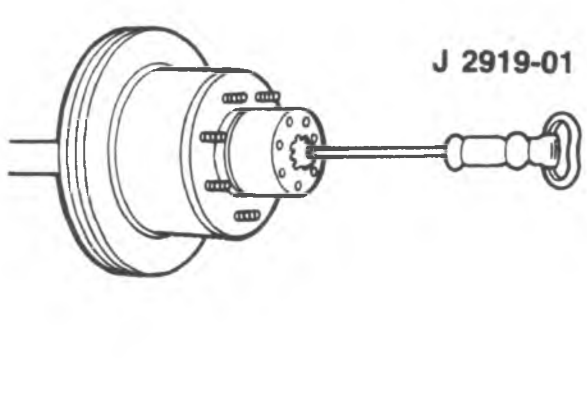
F9580

Figure 2—Rear Axle Components

1. Axle shaft. (figure 3).
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 loosen the carrier from the housing.
   - Remove the two upper bolts (47).

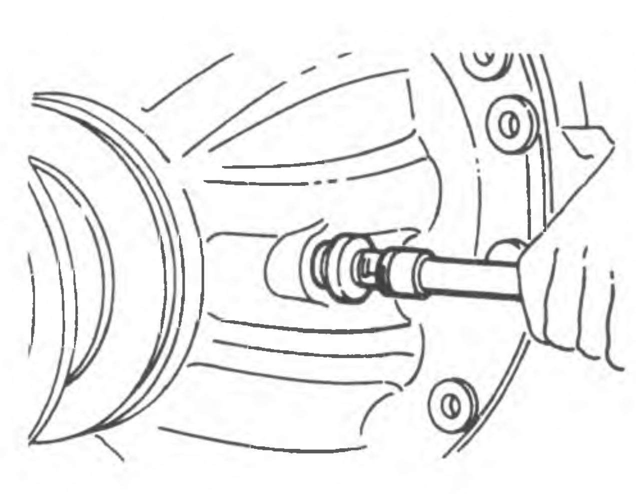
- Place the carrier in a suitable holding fixture.
- Loosen the jam nut (49) and back off the thrust block adjusting screw (48) (figure 4).
- Center punch one differential carrier leg and bearing cap to identify the cap for reassembly (figure 5).

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.



L0369

Figure 3 - Removing/Installing the Axle Shaft.



F4746

Figure 4—Loosening the Thrust Adjusting Screw

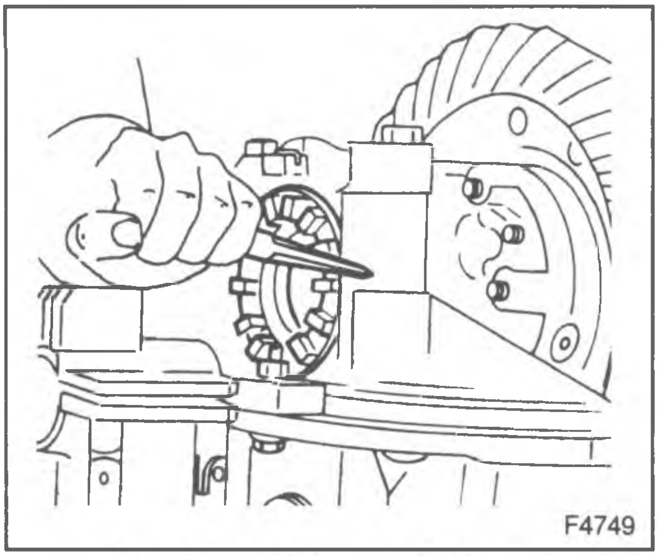


Figure 5—Punching the Carrier Leg

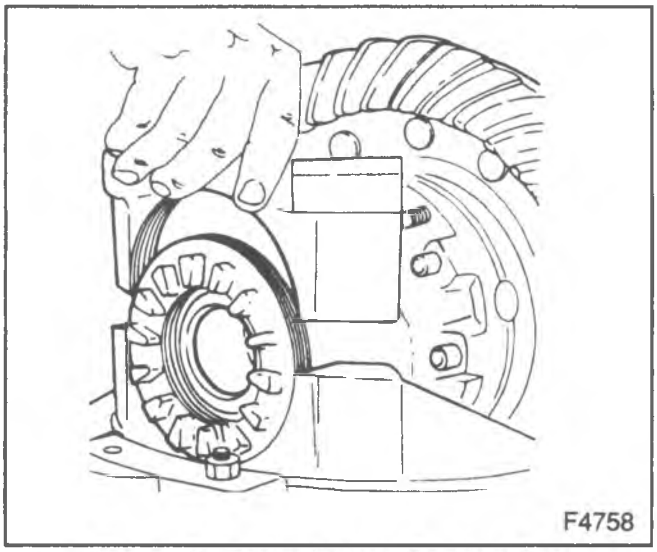


Figure 6—Removing the Bearing Cap

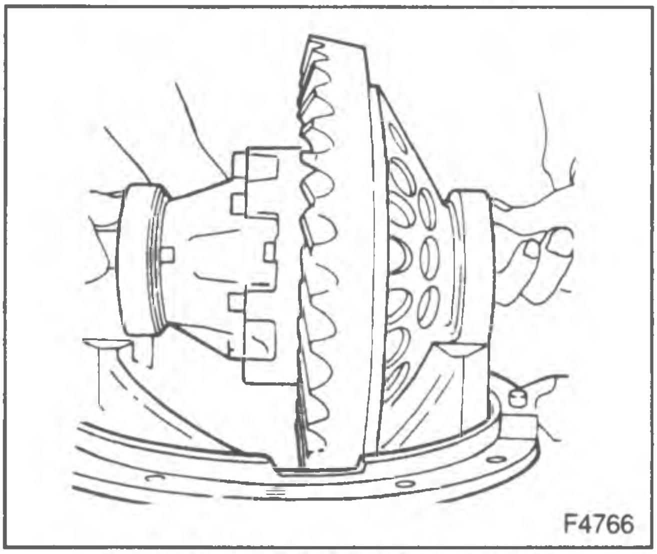


Figure 7—Removing the Differential

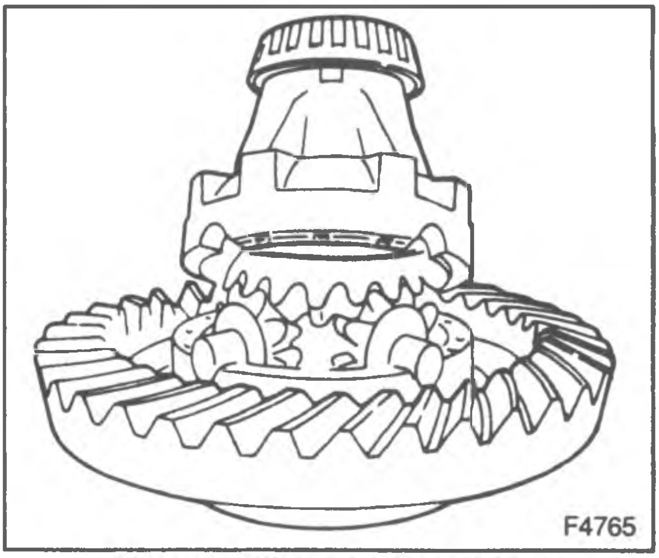


Figure 8—Differential Case Halves

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.
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.

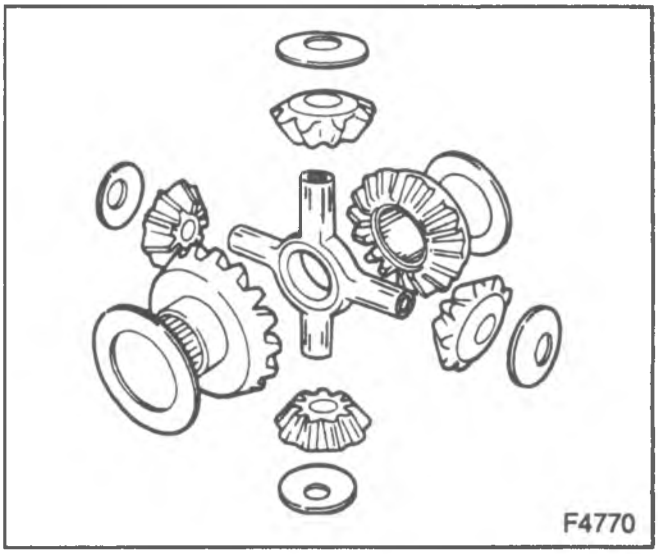


Figure 9—Differential Components

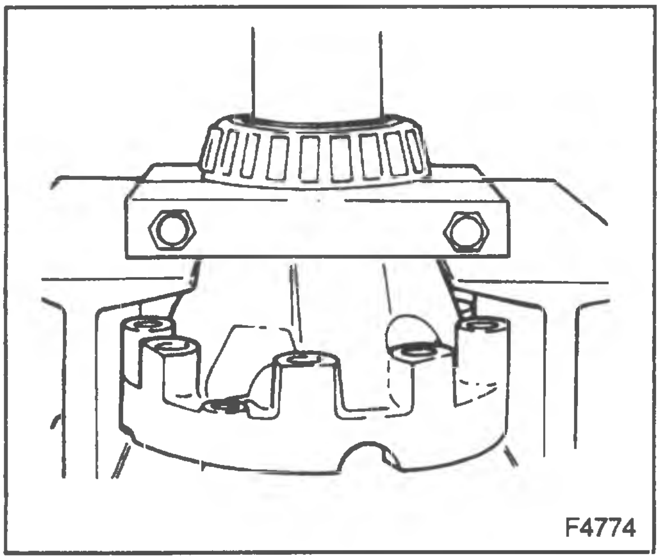


Figure 10—Removing the Differential Side Bearing

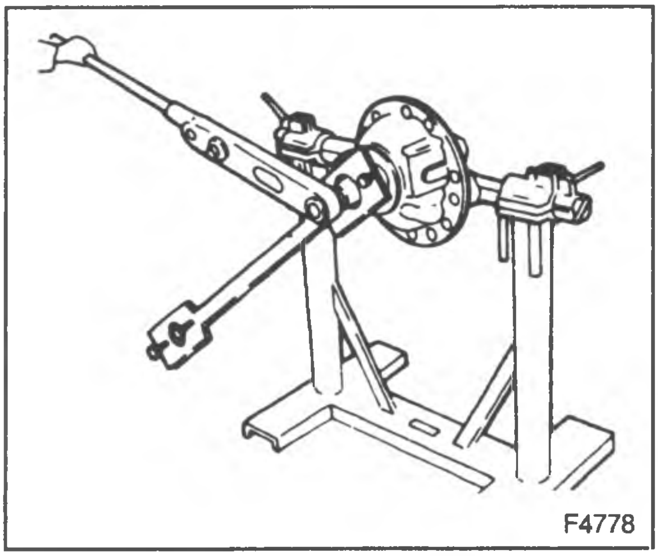


Figure 11—Removing the Pinion Nut

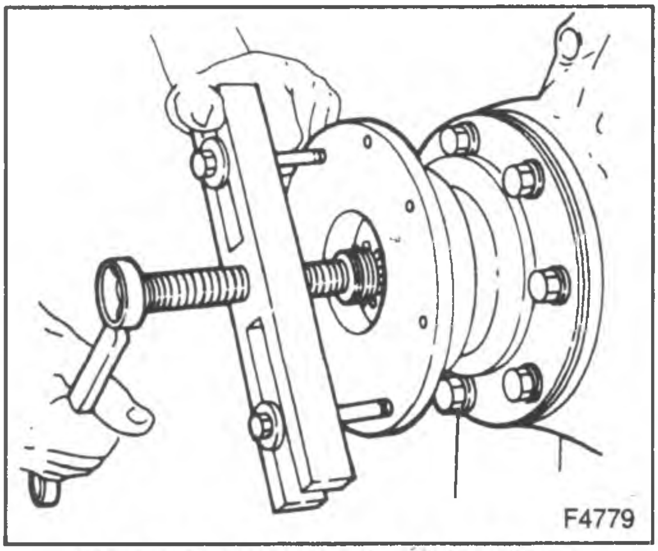


Figure 12—Removing the Pinion Flange

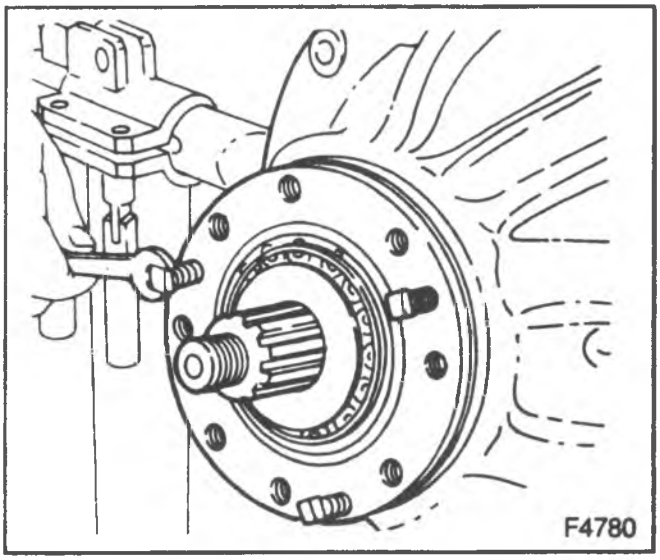


Figure 13—Removing the Pinion Cage

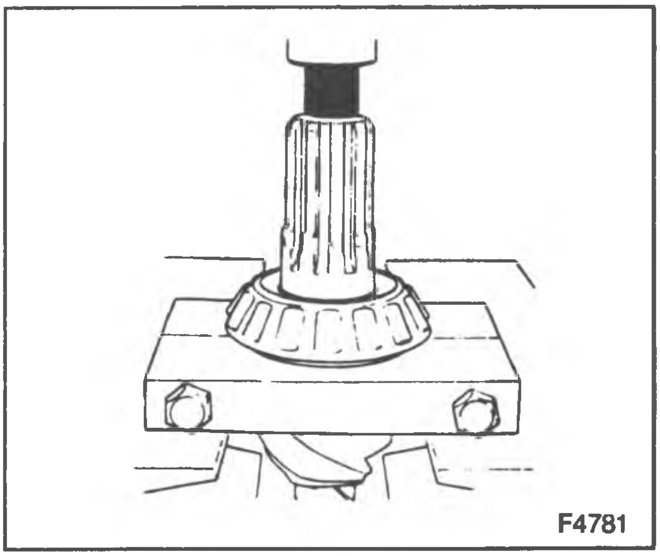


Figure 14—Removing the Pinion Inner Bearing

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.

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.

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, 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 seal's 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 very small 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

NOTICE: See Notice on page 4B6-1 of this section.

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.

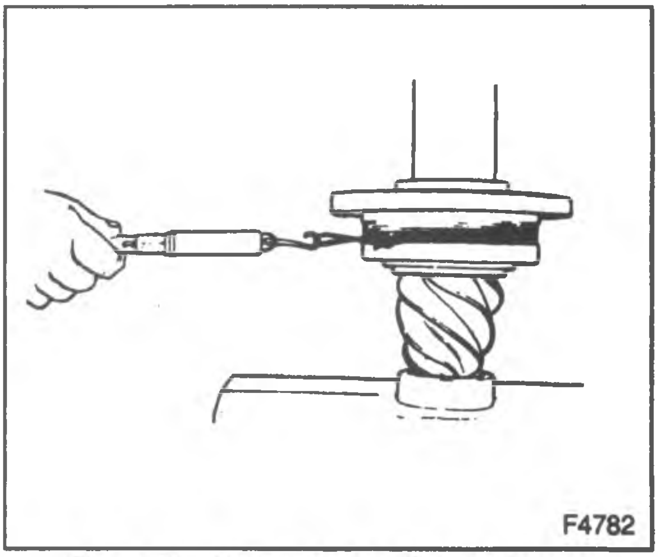


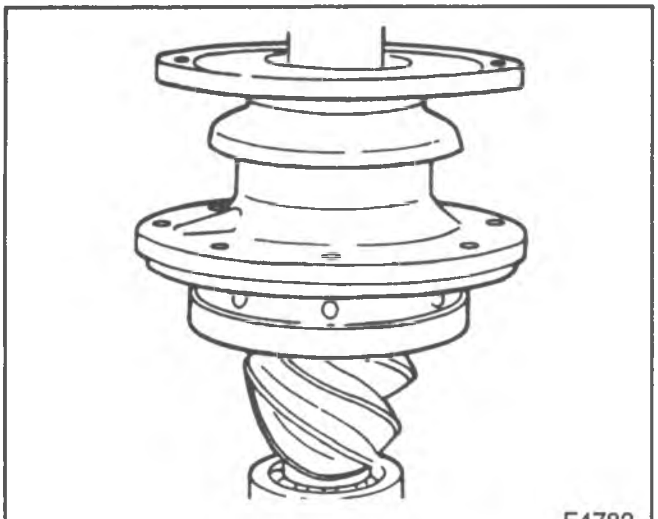
Figure 15—Measuring the Preload Torque

- 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.
  - — 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).

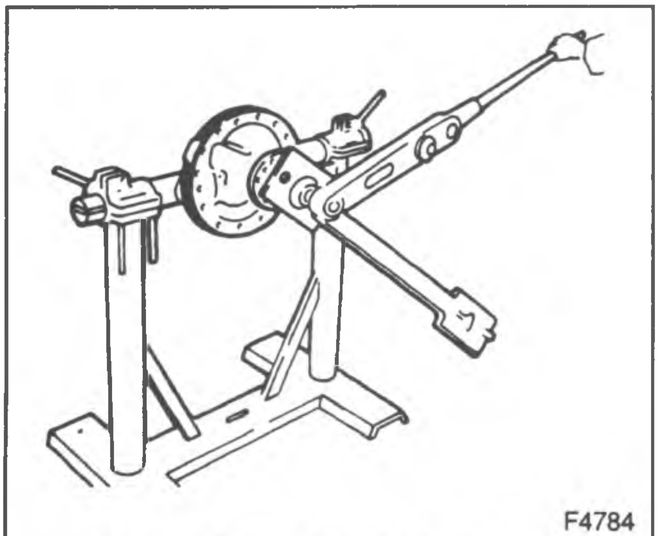
Tighten

- Nut (62) to 325 N·m (240 ft. lbs.).



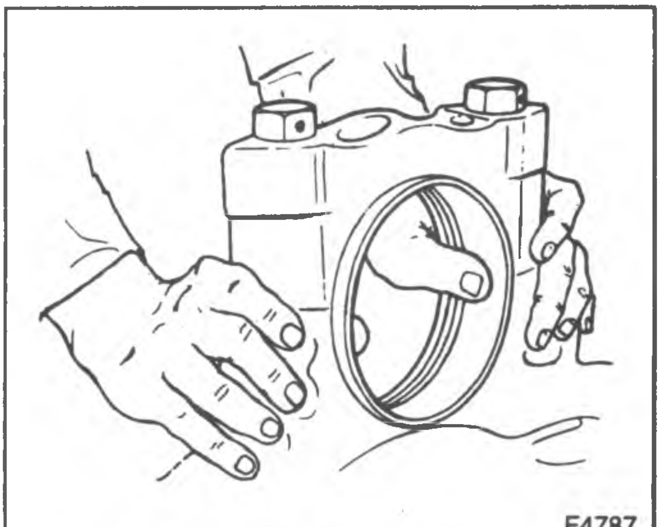
F4783

Figure 16—Installing the Pinion Flange



F4784

Figure 17—Installing the Pinion Nut



F4787

Figure 18—Removing the Pinion Nut

- 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).

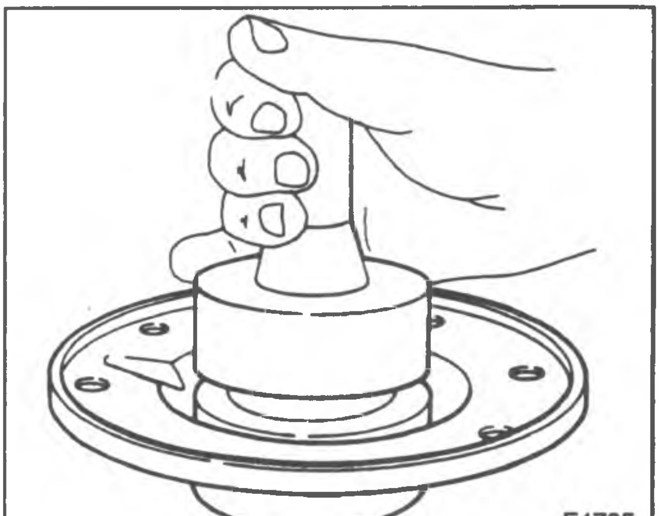
9. Pinion oil seal (58) using J 3154-04 (figure 19).
10. Pinion flange deflector (59).
11. Pinion flange (60) to the pinion (figure 16).
    - Press the flange onto the pinion.
12. Pinion washer (61) and a new nut (62) using J 3453 to hold the pinion (figure 17).

Tighten

- Nut (62) to 400-540 N·m (300-400 ft. lbs.).

PINION INSTALLATION

NOTICE: See Notice on page 4b6-1 of this section



F4785

Figure 19—Installing the Seal

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.
- 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.
3. Cage bolts (56).

Tighten

- Bolts to 48 N.m (35 ft. lbs.).

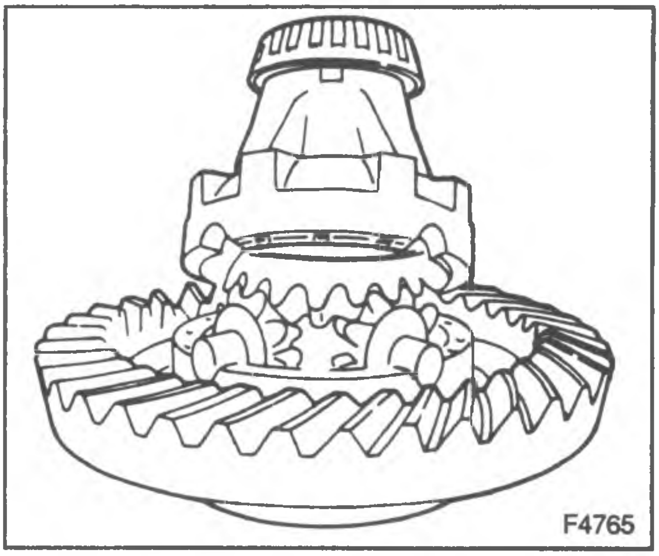


Figure 21—Installing the Case Halves

DIFFERENTIAL CASE ASSEMBLY

See Notice on page 4B6-1 of this section.

Install or Connect

- Lubricate all parts with rear axle lubricant.

1. Differential pinion gears (41) and thrust washers (42) to the spider (40) (figure 1).
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 21).
   - Align the scribe marks on the case halves.
5. Case bolts (44).

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.

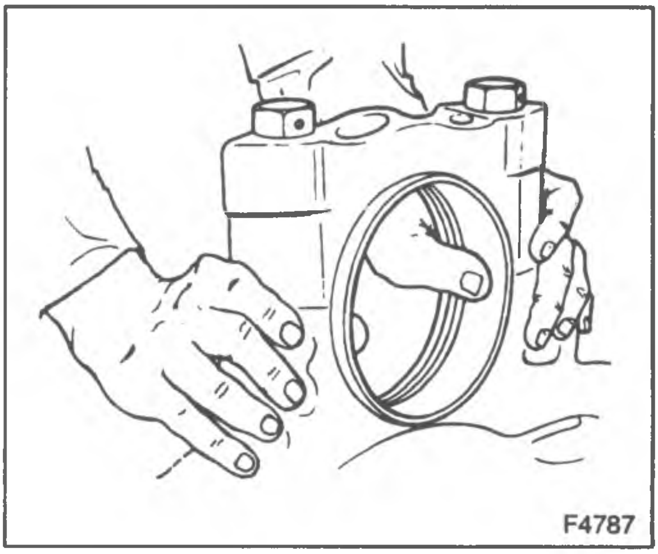


Figure 22—Checking the Bearing Cup Fit

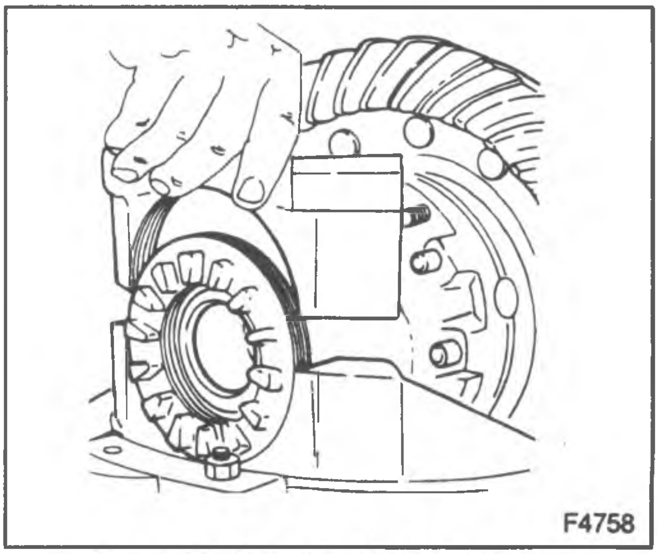


Figure 23—Installing the Bearing Cup

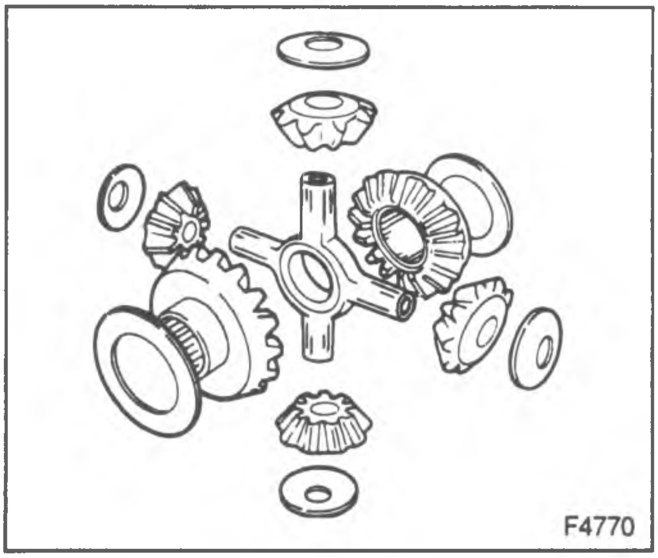


Figure 20—Differential Components

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 case 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.
- The ring gear bolts in sequence to 136 N·m (100 ft. lbs.).

8. Differential side bearings (33).
   - Press the bearings on using a suitable tool.

DIFFERENTIAL INSTALLATION

NOTICE: See Notice on page 4B6-1 of this section.

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 22).

Remove or Disconnect

NOTICE: See Notice on page 4B6-1 of this section.

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 22).
   - 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.

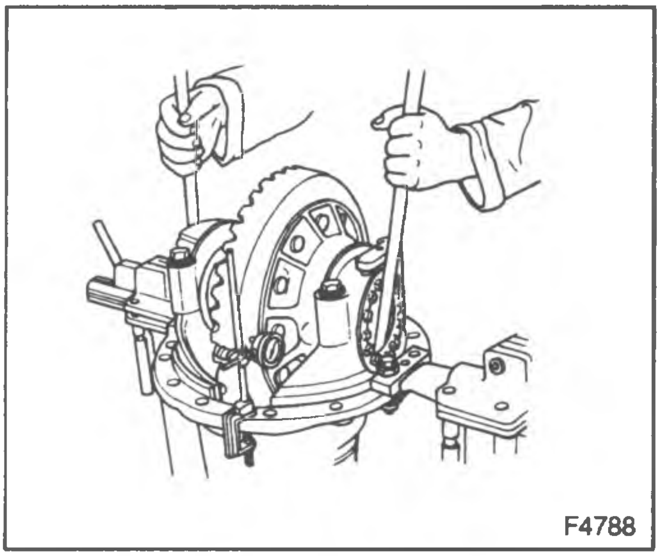


Figure 24—Adjusting Side Bearing Preload

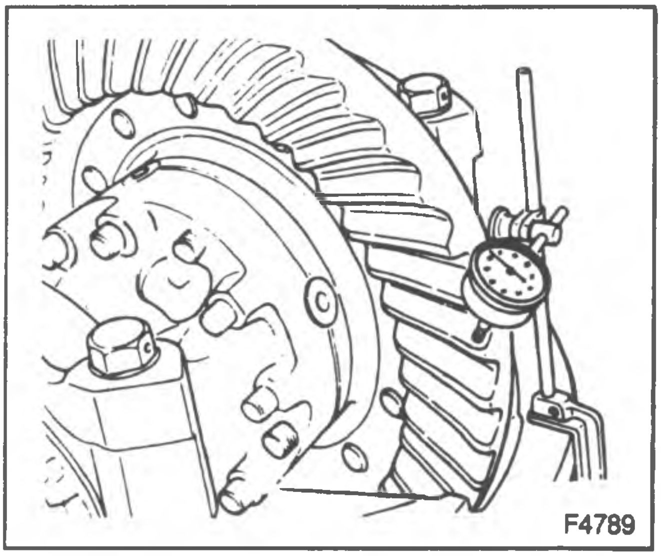


Figure 25—Checking Backlash

- 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.

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 24).

- Mount a dial indicator to the carrier (46). Place the stem of the indicator onto the toe end of a tooth (figure 25).

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 0.008 - 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.

FINAL ASSEMBLY

Install or Connect

1. Carrier (46) to the axle housing.
2. Drive axles.
3. Lubricant to the rear axle. Refer to specifications

SPECIFICATIONS

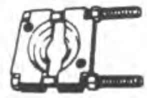
12-INCH RING GEAR AXLE (ROCKWELL)

FASTENER	N·m	Ft. Lbs.
Pinion 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 Shims	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

T2513

SPECIAL TOOLS

1.		J 3154-04	4.		J 7804-01
2.		J 3453	5.		J 22912-01
3.		J 23723-7			

1. Seal Installer Set
2. Flange Holding Bar
3. Differential Side Bearing Installer
4. Yoke Remover
5. Rear Pinion Bearing Cone Remover

SECTION 4B7

LOCKING DIFFERENTIAL

***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

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, 7 5/8 AND 8 1/2-INCH

Install or Connect (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).

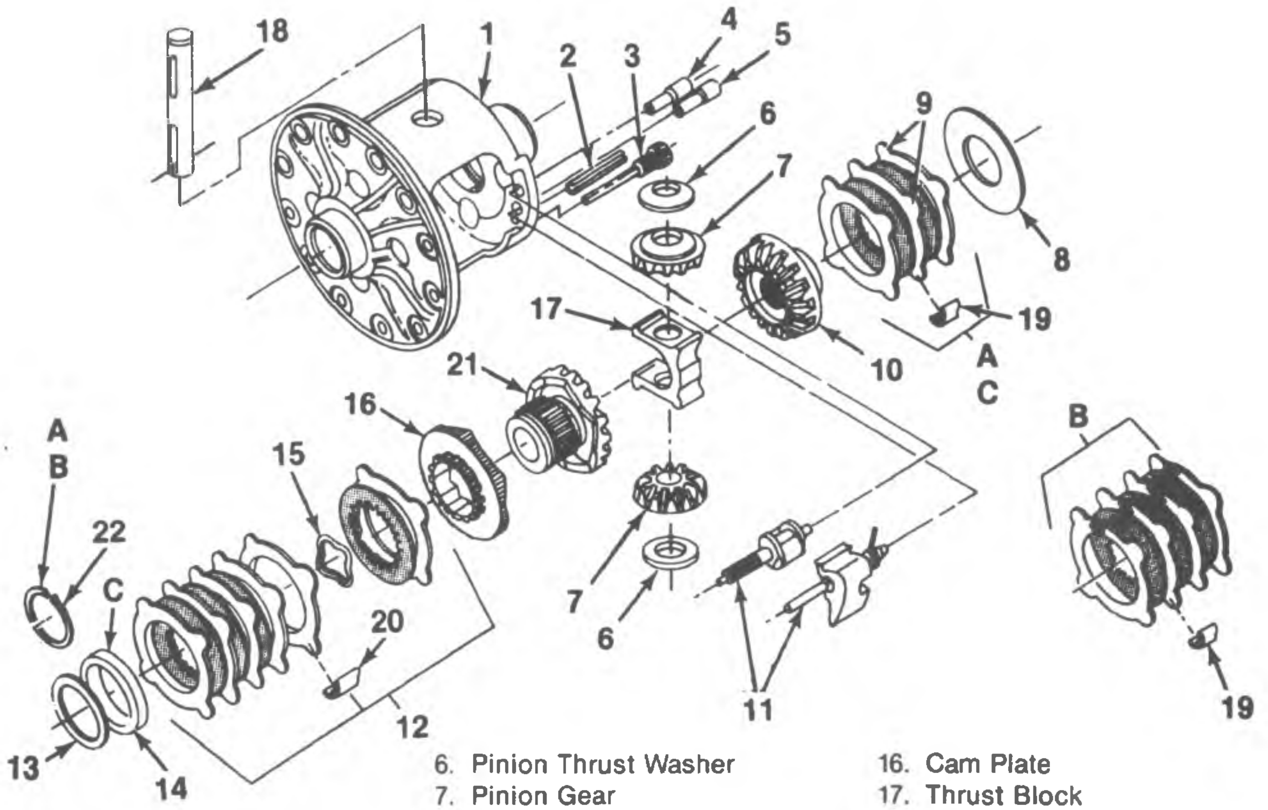
CAM UNIT DISASSEMBLY — 9 1/2-INCH

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).



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

F5914

Figure 1—Differential Components

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, scoring, and spalling.
- Thrust washer for wear.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Thrust sleeve for excessive wear. Do not replace the thrust sleeve unless necessary. Inspect the side gear bore for scoring. If scoring is present, replace the entire differential.
- Replace parts as necessary.

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 ASSEMBLY - 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.

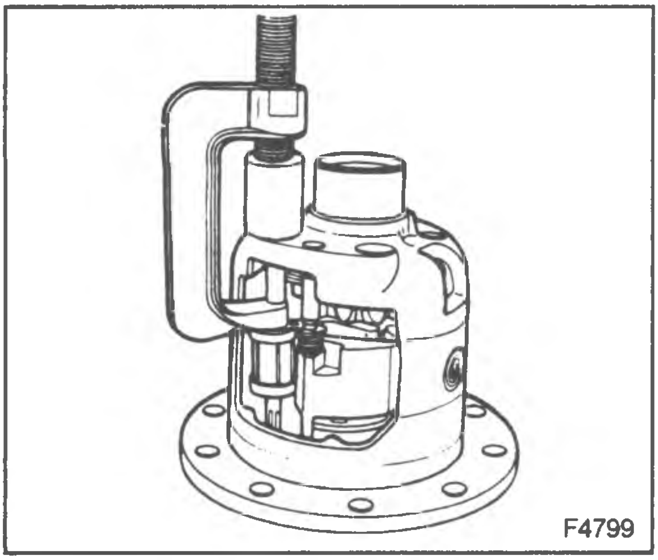


Figure 2—Removing the Governor Bushings

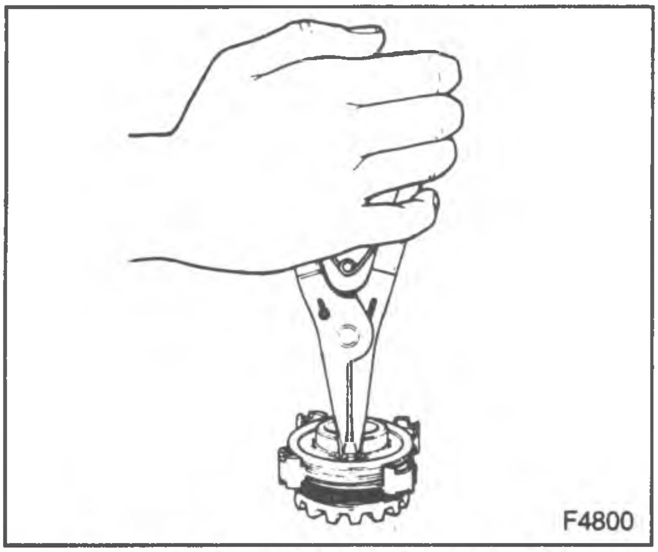


Figure 3—Removing the Retaining Ring

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 selective thickness thrust washers between the reaction blocks.

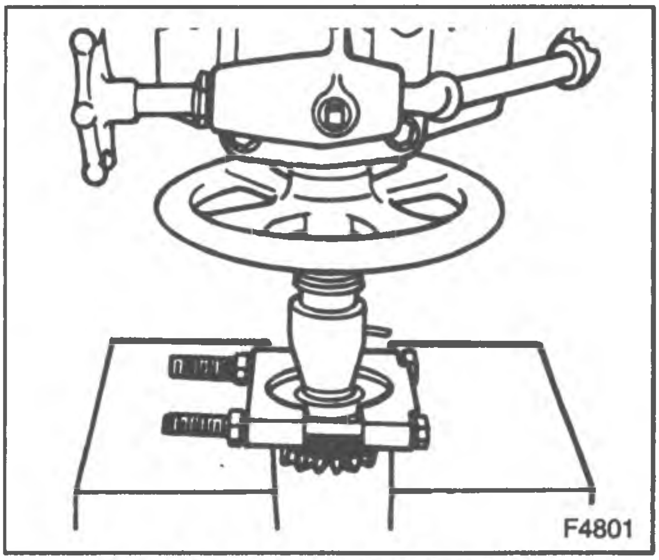


Figure 4—Removing the Thrust Ring

- 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 (perpendicular 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 0.457mm (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.

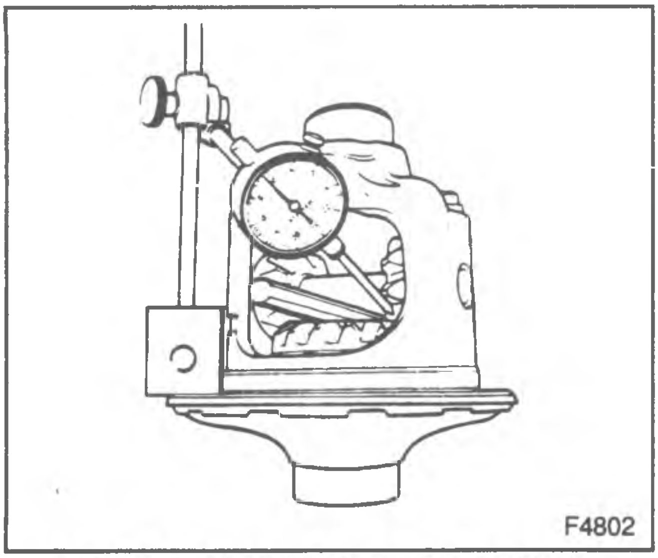


Figure 5—Checking Cam Gear Backlash

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 (perpendicular 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:
  - — Selecting a new thrust block the correct size to obtain 0.000 to 0.006-inch clearance.
  - — Reshimming the right and/or left clutch disk pack. The backlash must remain 0.002 - 0.010-inch.

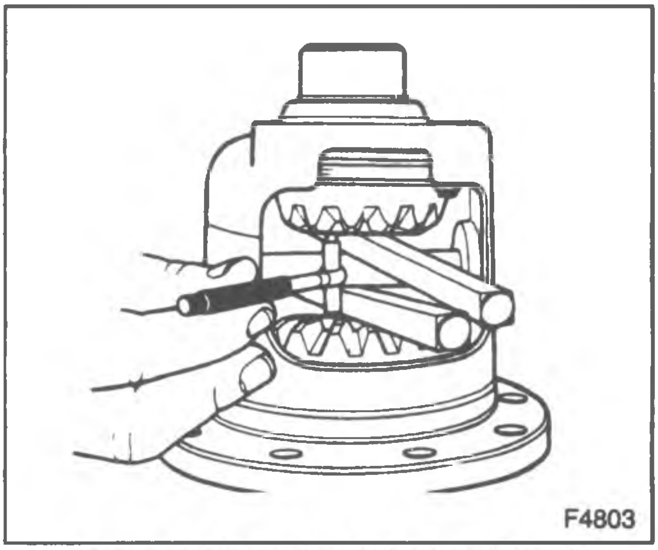


Figure 6—Measuring Side Gear Spread

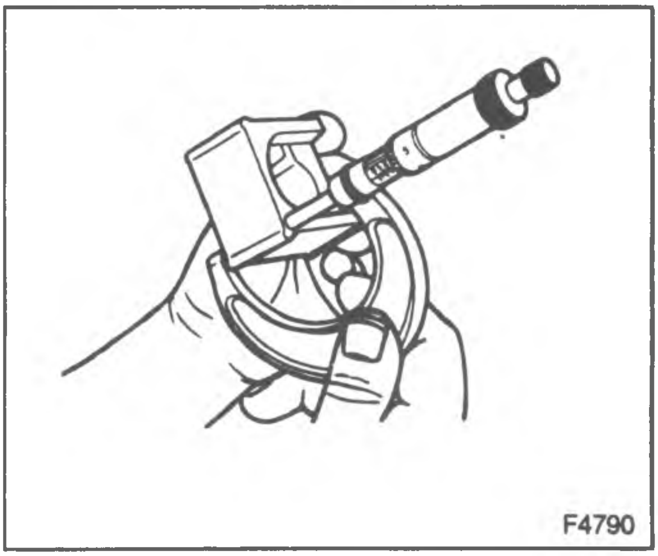


Figure 7—Measuring the Thrust Block

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).
   - Assemble alternately 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.
- 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 installed 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) (9 1/2-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.

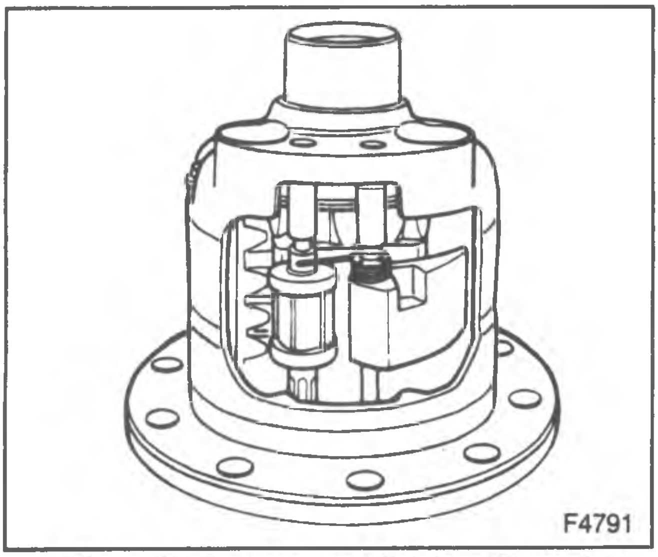


Figure 8—Governor and Latching Bracket

10 1/2-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 "Disassembly of the Rear Axle" under the "10 1/2-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, scoring, and spalling.
- Thrust washers for wear.
- The fit of the side gears on the axle shafts.
- Differential case for cracks and scoring.
- Thrust sleeve for excessive wear. Do not replace the thrust sleeve unless necessary. Inspect the side gear bore for scoring. If scoring is present, replace the entire differential.
- If any damage to the differential case is found, the entire differential must be replaced.
- Replace parts as necessary.

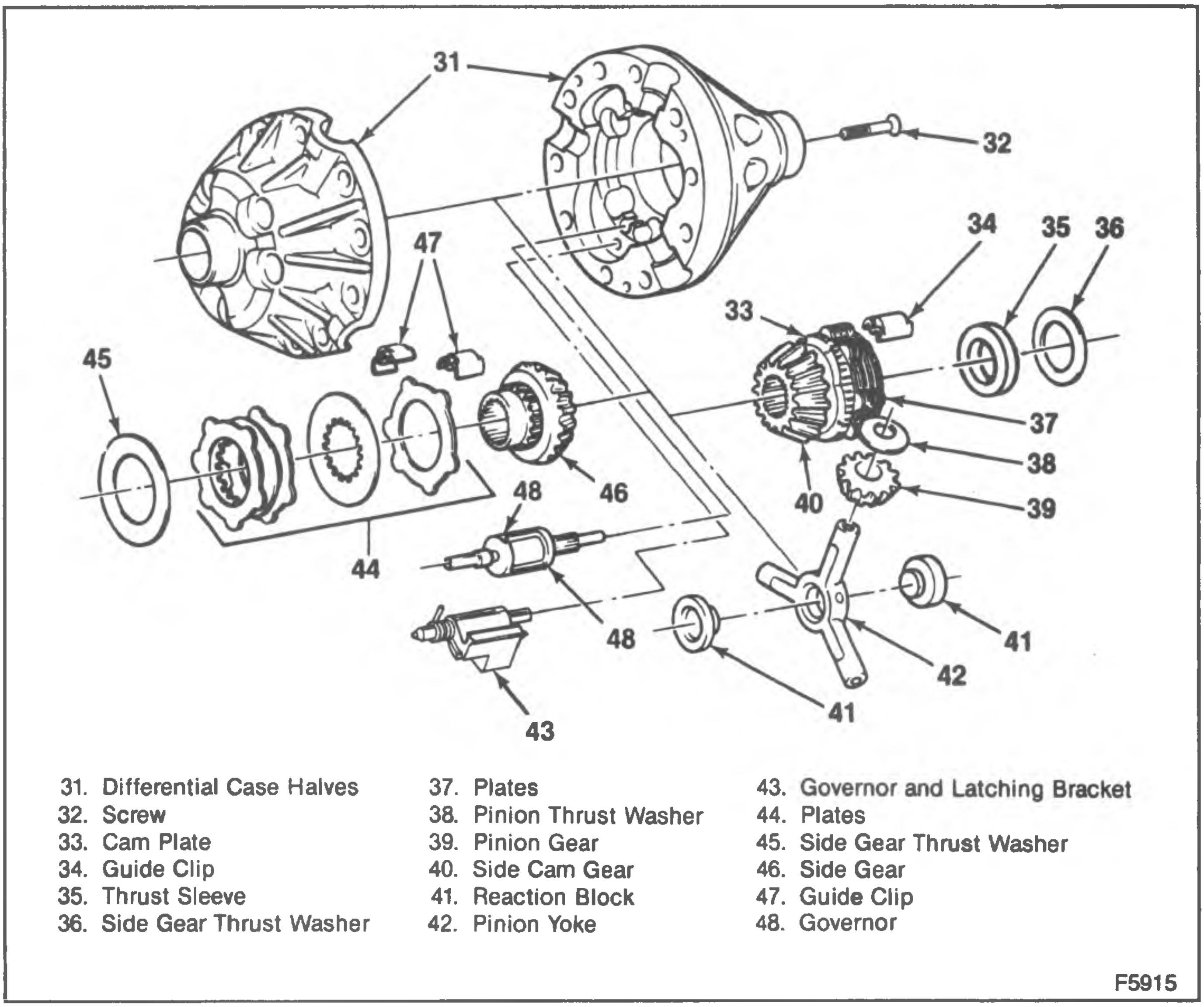


Figure 9—Differential Components

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.

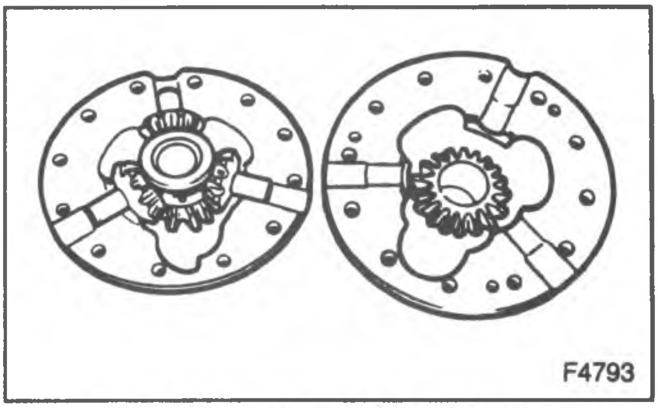


Figure 10—Differential Case Halves

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 wash-

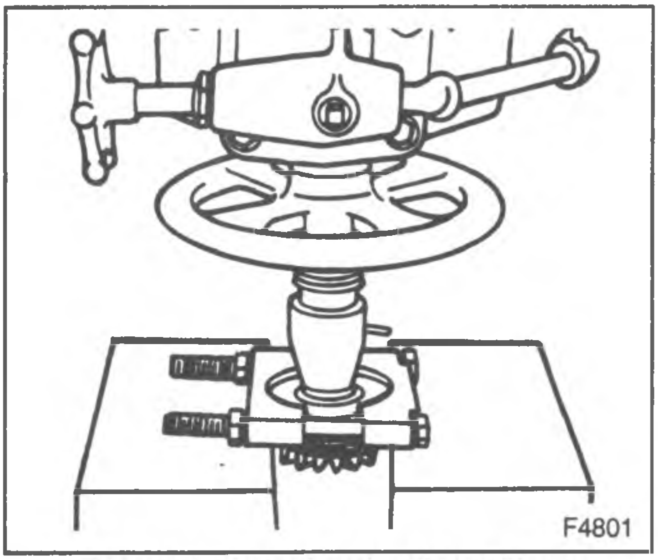


Figure 11—Removing the Thrust Sleeve

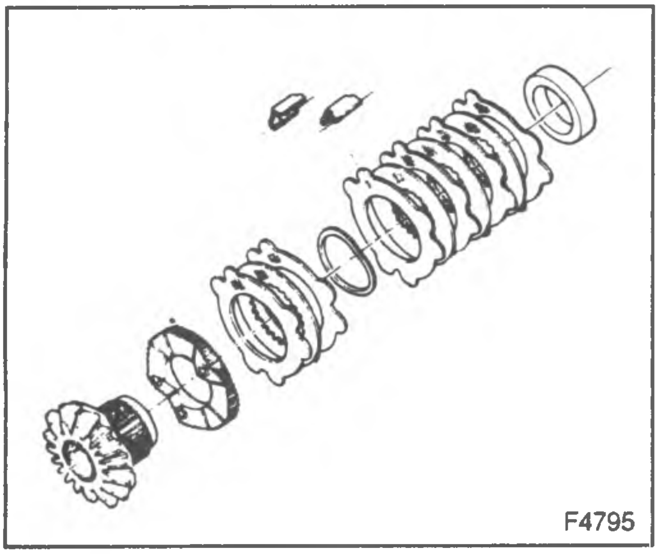


Figure 12—Cam Unit Components

ers behind each side gear, and selective thickness thrust washers between the reaction blocks.

- It is important to build up the differential properly. The proper clearance between parts is necessary for the proper operation of the unit.
- There are three adjustments to be made:
  - (1) Left side gear backlash.
  - (2) Right side gear backlash.
  - (3) Thrust block clearance.

Right Side Gear Backlash 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 (perpendicular to the case half face). Tighten the nut to specifications.

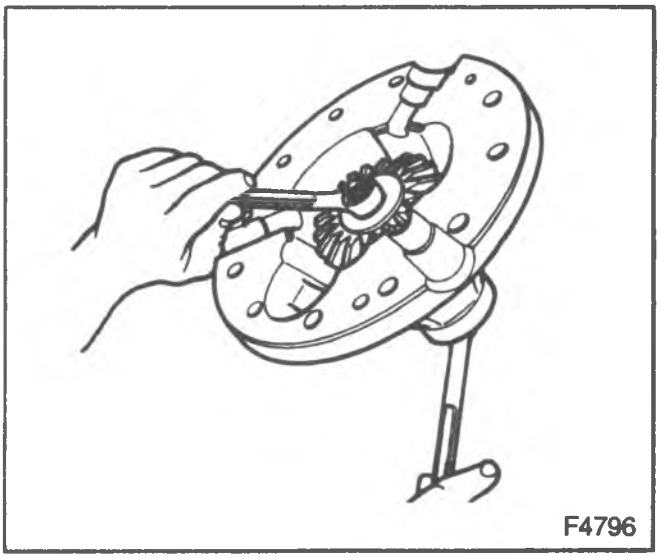


Figure 13—Clamping the Cam Unit in Place

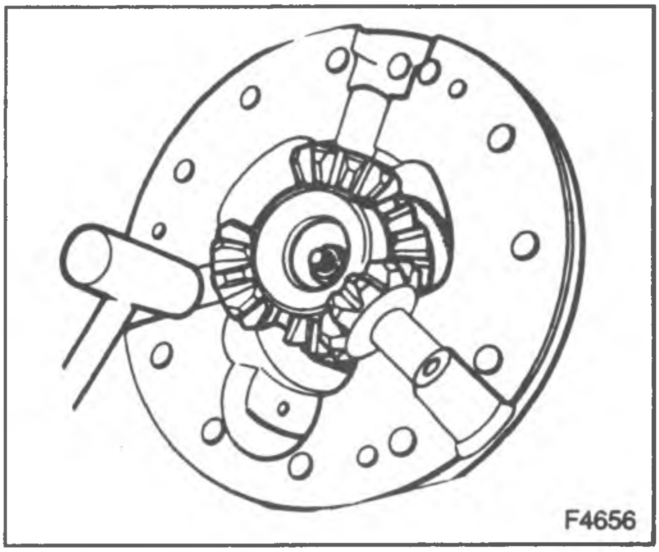


Figure 14—Installing the Pinion Yoke

6. Mount a dial indicator on the case half face using a magnetic base (figure 15).

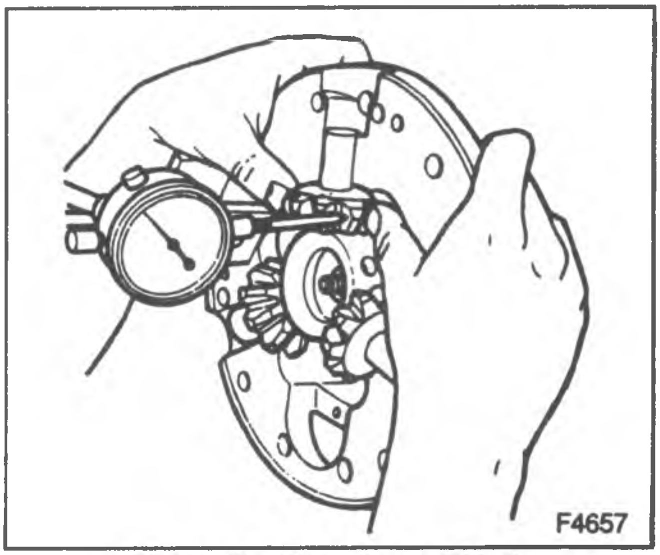


Figure 15—Measuring Backlash

7. Place the stem of the dial indicator on the pinion gear tooth.
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 remaining 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 (perpendicular 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.

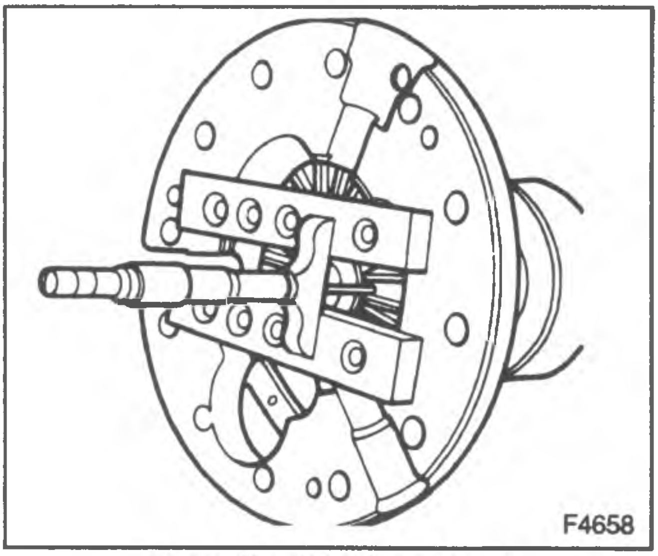

F4658

Figure 16—Side Gear Spread

- Measure the thickness of the original reaction blocks and reaction block thrust washers together (figure 17).
- If the combined reaction block and thrust washer thickness is not 0.000 to 0.006-inch less than the side gear spread, adjust the clearance by:
  - — Selecting new reaction block thrust washer of the correct thickness to obtain 0.000 to 0.006-inch clearance.
  - — Reshimming the left and/or right clutch disc pack. The side gear backlash must be maintained. Refer to "Right Side" and/or "Left Side Gear Backlash Adjustment" in this section.

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), reaction block thrust washer, pinion yoke (42), pinion gears (39), and pinion thrust washers (38).

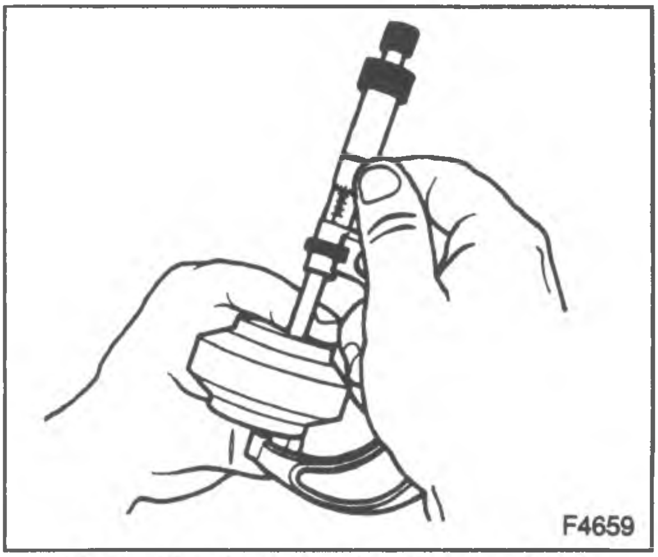

F4659

Figure 17—Measuring the Reaction Block

4. Left thrust washer (45).
   - Assemble the plates as shown in figures 9 and 12.
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 SIZE — 10 1/2-INCH

0.787-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	0.022-inch
0.15-inch	0.027-inch
0.20-inch	0.032-inch
0.25-inch	0.036-inch
0.30-inch	0.040-inch
0.35-inch	0.042-inch
0.40-inch	0.044-inch
0.45-inch	0.048-inch
	0.052-inch

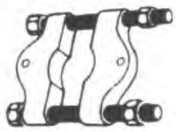
LEFT HAND SIDE GEAR THRUST WASHER

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	0.10-inch
0.027-inch	0.027-inch	0.027-inch	0.15-inch
0.032-inch	0.032-inch	0.032-inch	0.20-inch
0.036-inch	0.036-inch	0.036-inch	0.25-inch
0.040-inch	0.040-inch	0.040-inch	0.30-inch
—	—	0.042-inch	0.35-inch
0.044-inch	0.044-inch	0.044-inch	0.40-inch
0.048-inch	0.048-inch	0.048-inch	0.45-inch
0.052-inch	0.052-inch	0.052-inch	

Lubricant 80W90 GL-5
(Do not use limited slip additive)

T2514

SPECIAL TOOLS

1.  J 22912-01

2.  J 26252

1. Rear Pinion Bearing Cone Remover
2. Locking Differential Governor Remover

SECTION 4C

FRONT AXLE

CONTENTS

SECTION 4C1

8 1/2-INCH RING GEAR FRONT AXLE

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

DESCRIPTION

The GM 8 1/2-inch ring gear front axle uses a coventional ring 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 axle shafts.

This axle is full-floating. The shafts are retained in the housing by the spindle bearings.

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 bearings 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 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 alphabetic broadcast code 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.

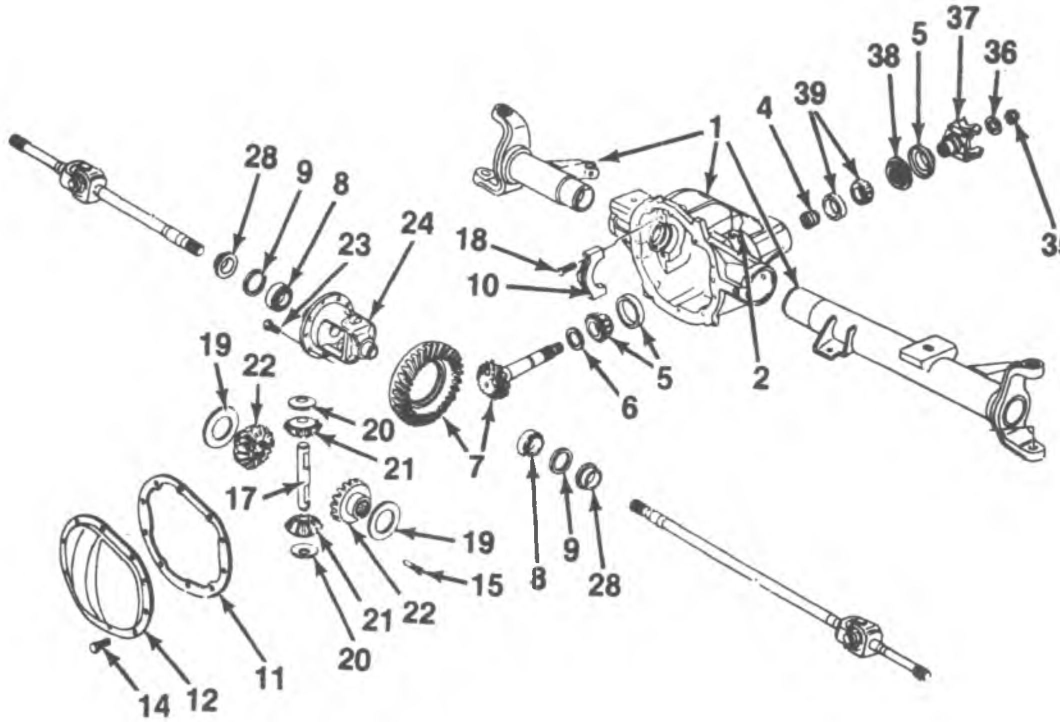
1. Differential cover bolts (14) and differential cover (12).
   - Drain the gear lubricant into a proper container.
2. Pinion shaft lock screw (15).
3. Pinion shaft (17).
4. Differential pinion (21) and side gears (22).
   - Roll the pinion gears out of the case with the pinion thrust washers (20).
   - Remove the side gears and the side gear thrust washers (19). Mark the gears and the differential case as left and right.
5. Differential bearing cap bolts (18).
6. 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.

7. Differential carrier (24)
   - Pry the case from the axle housing at the differential "window" (figure 2).
8. Bearing outer races (8) and shims (9).
   - Mark the races and the shims as left and right, and place them with the bearing caps.
9. 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.
10. 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.

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



1. Axle Housing	11. Gasket	22. Side Gear
2. Air Vent	12. Cover	23. Ring Gear Bolt
4. Collapsable Spacer	14. Bolt	24. Differential Case
5. Inner Pinion Bearing	15. Pinion Shaft Lock Screw	28. Axle Shaft Seal
6. Shim	17. Pinion Shaft	35. Pinion Nut
7. Ring and Pinion Gear Set	18. Bolt	36. Washer
8. Differential Side Bearing	19. Side Gear Thrust Washer	37. Pinion Flange
9. Shim Pack (including spacer)	20. Pinion Thrust Washer	38. Pinion Seal
10. Bearing Cap	21. Pinion Gear	39. Outer Pinion Bearing

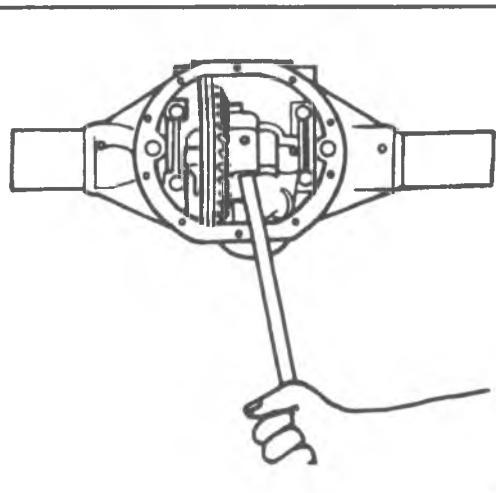
F4548

Figure 1—Front Axle Components

Inspect

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

12. Pinion flange nut (35) and washer (36) using J 8614-01 to hold the pinion flange (figure 5).
13. Pinion flange using J 8614-01 (figure 6).
14. 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) .
15. Collapsible spacer (4) from the pinion.
16. Outer pinion seal (38) and bearing (39).
17. Inner bearing (5) and shim (6) from the pinion.
    - Press the bearing off the pinion using J 8612-B (figure 8).
    - Remove the shim.



F4690

Figure 2—Prying the Differential Case from the Axle Housing

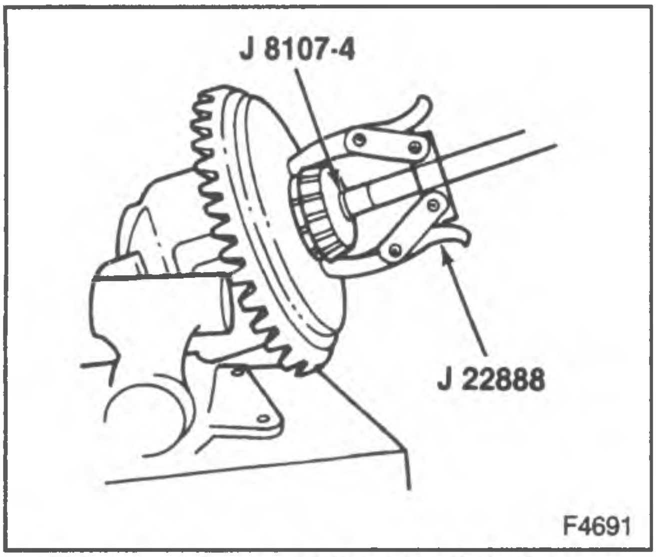


Figure 3—Removing Differential Side Bearing

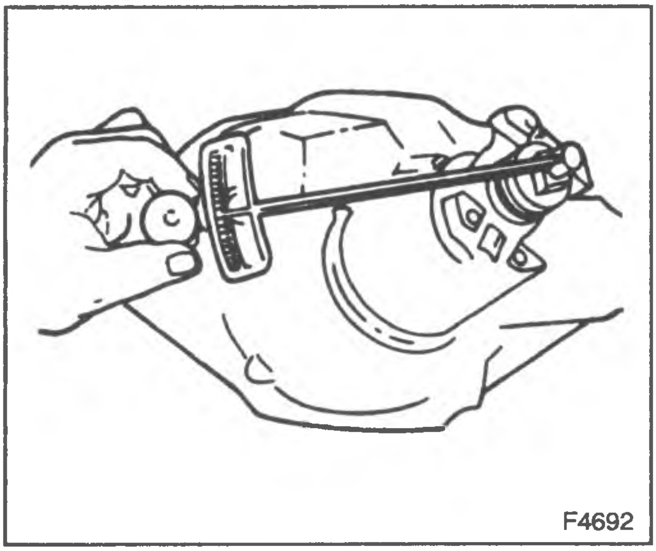


Figure 4—Checking Pinion Bearing Preload

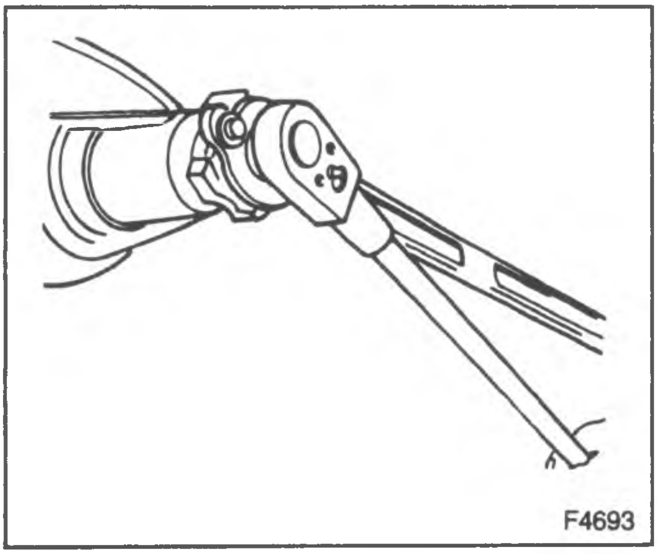


Figure 5—Pinion Flange Nut Removal

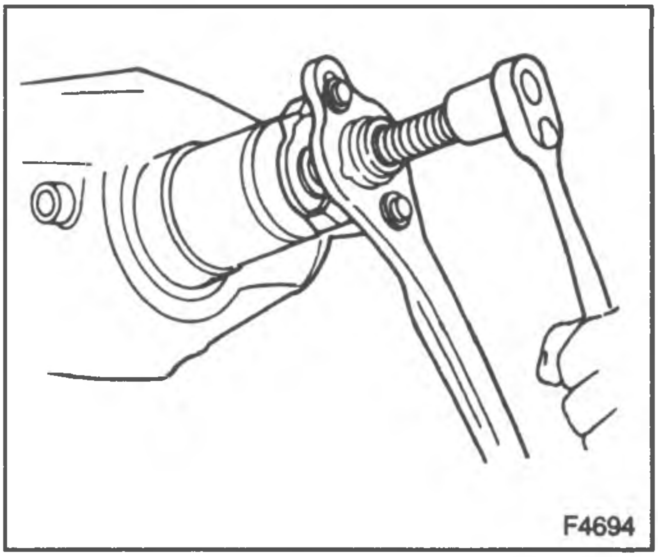


Figure 6—Pinion Flange Removal

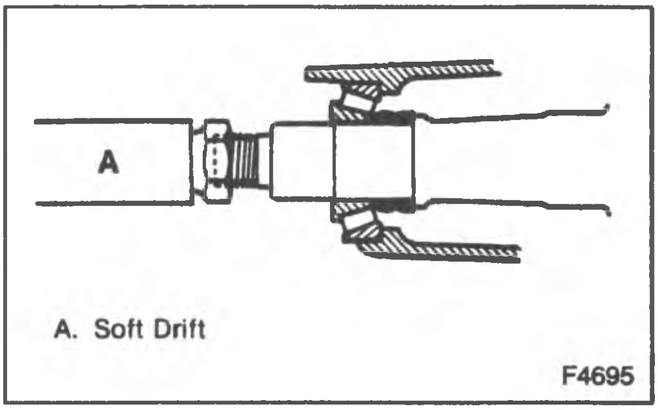


Figure 7—Removing the Drive Pinion

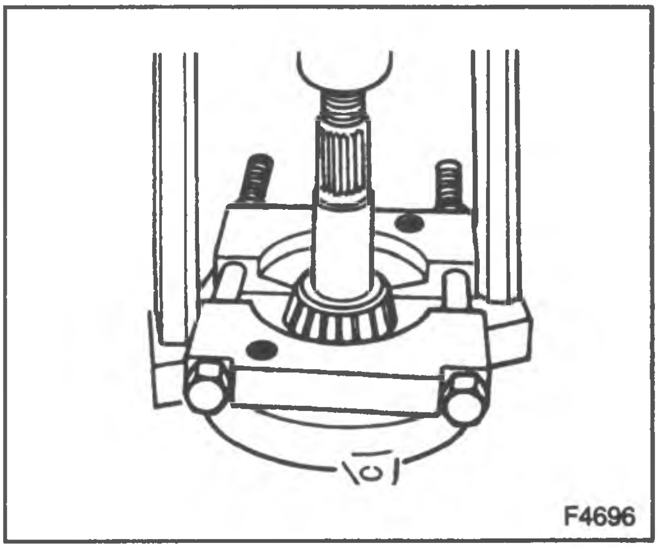


Figure 8—Removing Drive Pinion Rear Bearing

18. 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.
19. Axle seals.

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 flange on the pinion gear.
- 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 small 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 and spacer combination.

Important

- Lubricate all seal lips, gears, and bearing surfaces with axle lubricant prior to assembly.

ASSEMBLY OF AXLE

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).

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 and 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.

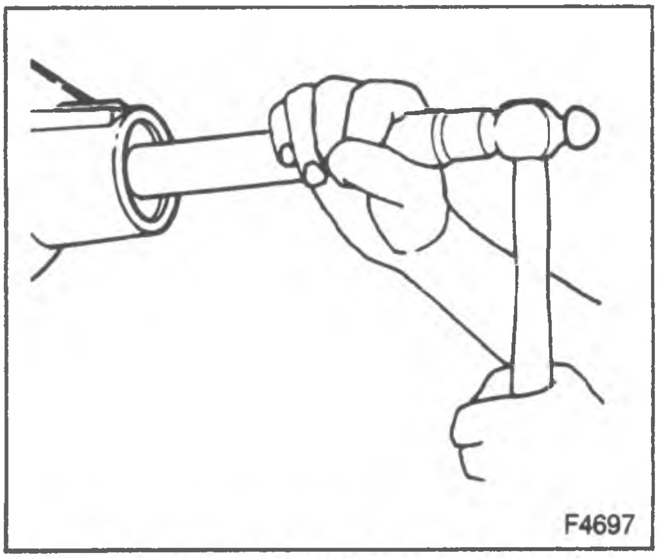


Figure 9—Installing Front Pinion Bearing Cup

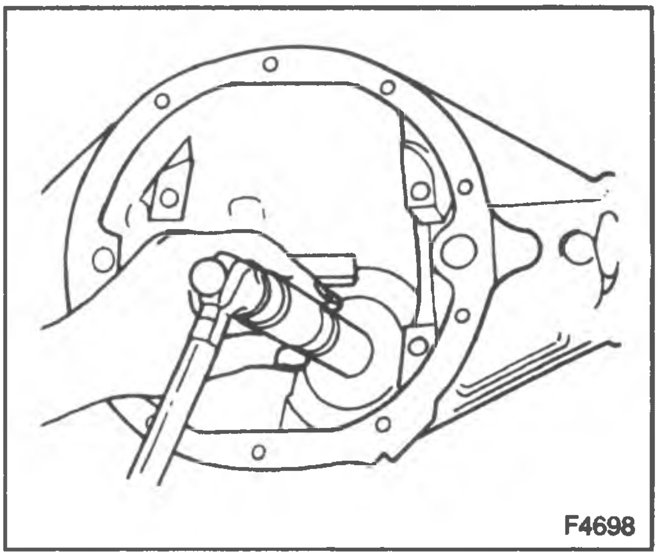


Figure 10—Installing Rear Pinion Bearing Cup

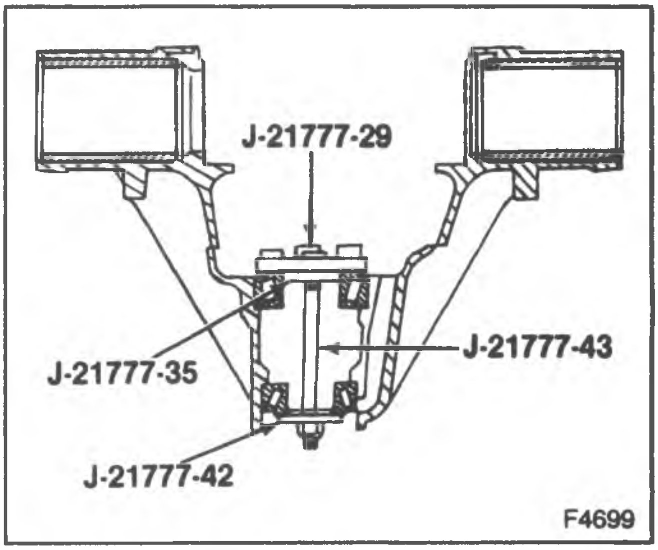


Figure 11—Gage Plate Components

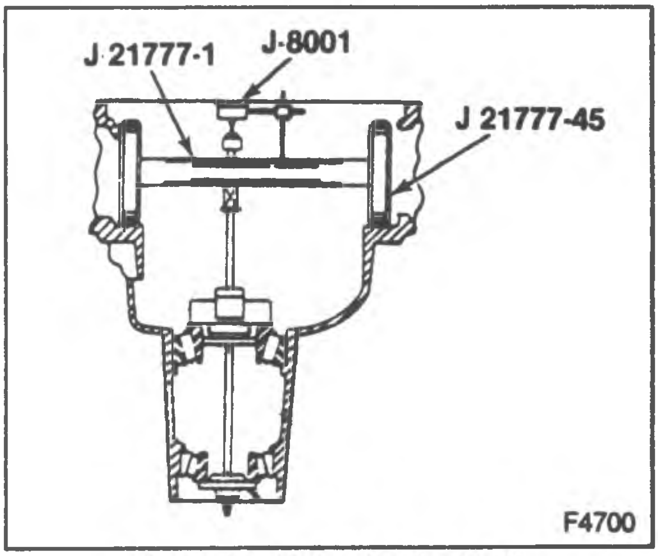


Figure 12—Pinion Gaging Tools

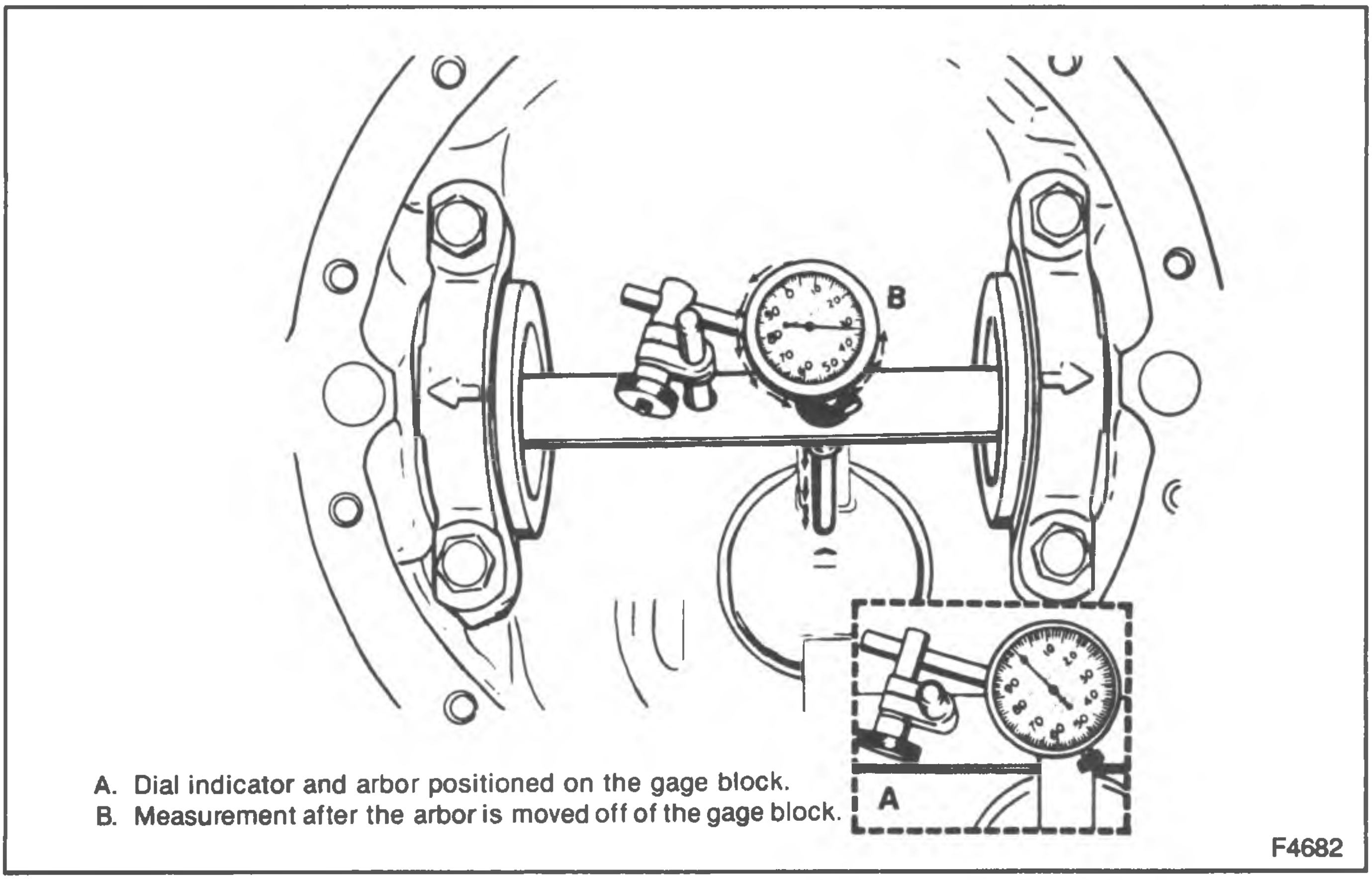


Figure 13—Checking Pinion Depth

- 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 3/4 of a turn to the right. Tighten the dial indicator in this position.
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.

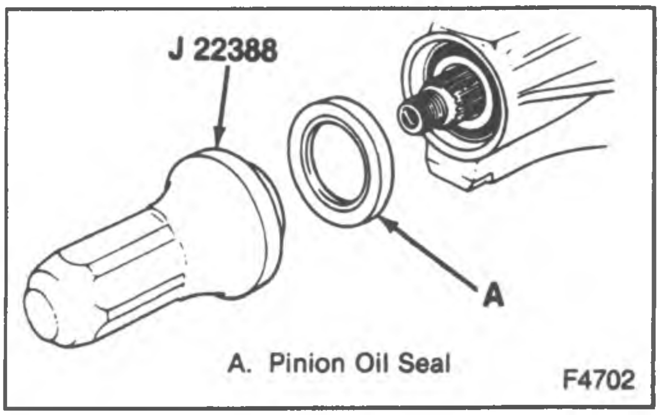


Figure 14—Installing the Pinion Oil Seal

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 collapsible 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.

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 15).
- 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.

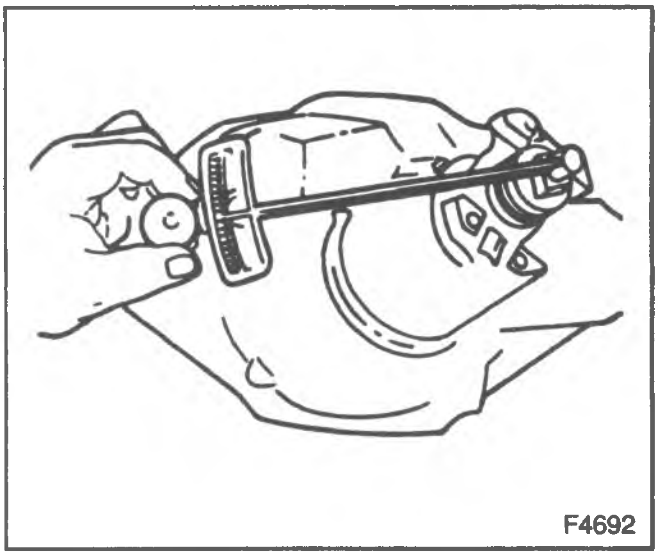


Figure 15—Checking Pinion Bearing Preload

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. 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

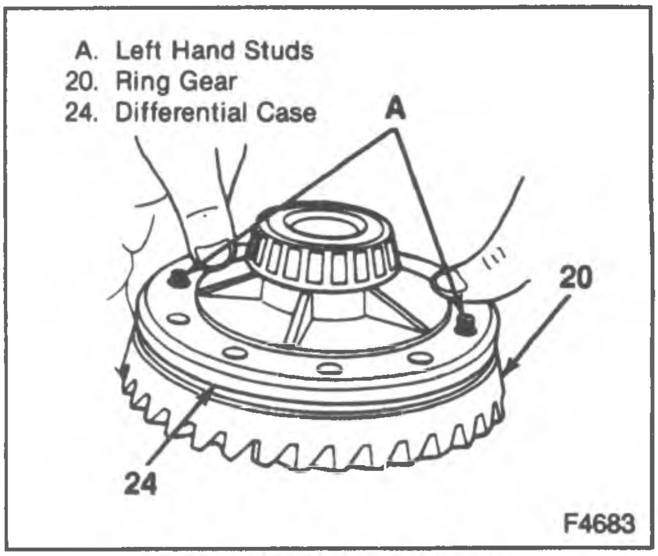


Figure 16—Ring Gear Studs

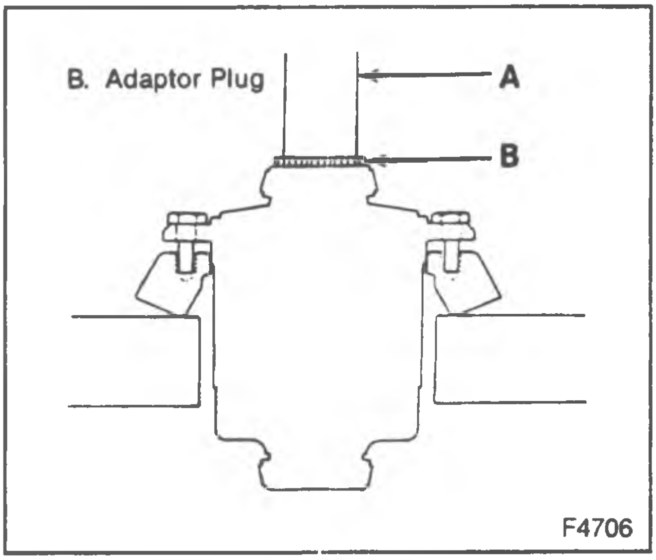


Figure 17—Installing the Ring Gear

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 16).
   - 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 17).
7. New ring gear bolts (23).
   - Tighten the ring gear bolts alternately in stages gradually and evenly pulling the ring gear onto the differential case.

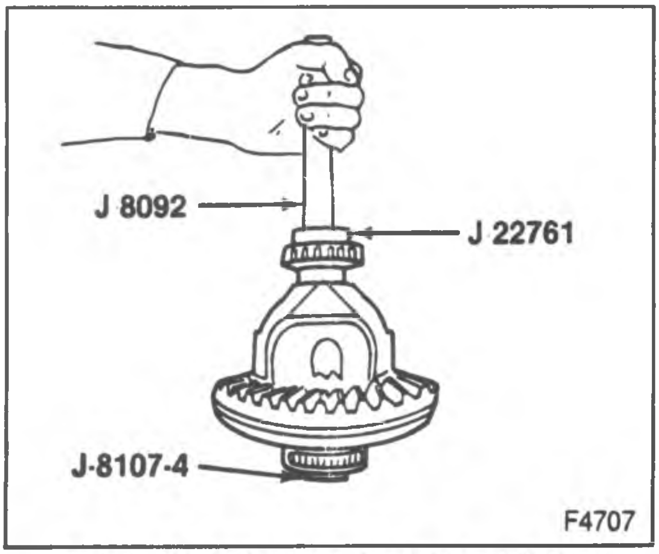


Figure 18—Differential Bearing Installation

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 18).
   - 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.

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.

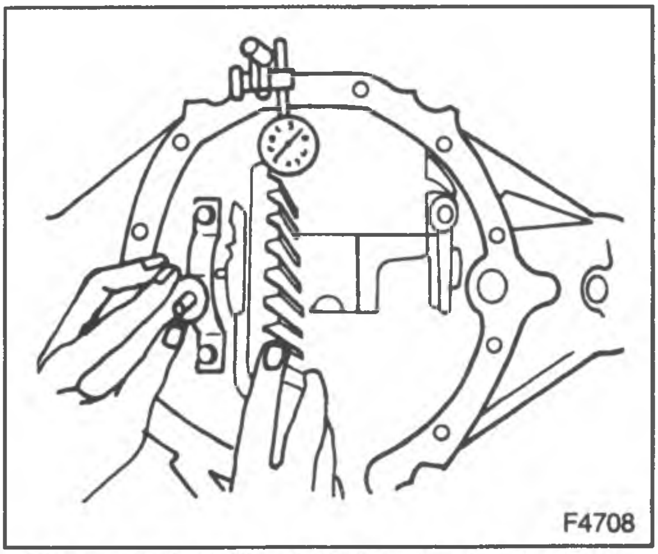


Figure 19—Installing Side Bearing Gaging Tools

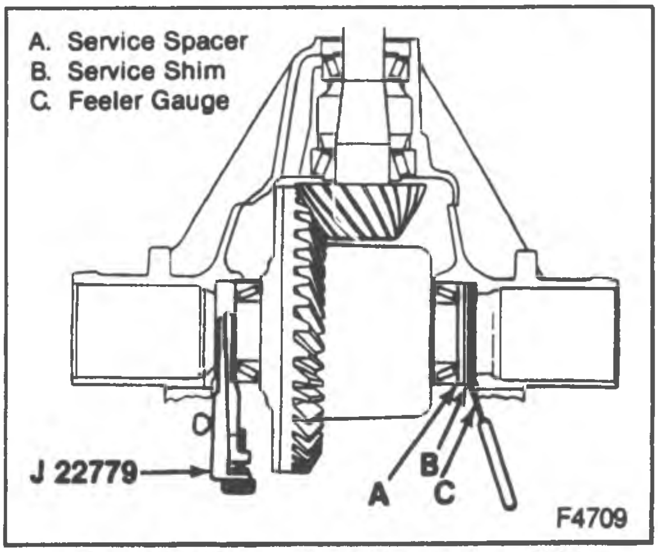


Figure 20—Measuring side Bearing Shim Requirements

- 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.
   - Support the case to keep it from falling into the axie housing.
2. Install the strap from J 22779 on the left bearing with the cap bolts. Tighten the bolts snug.
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 19).
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 20).
   - 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 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 21).
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.

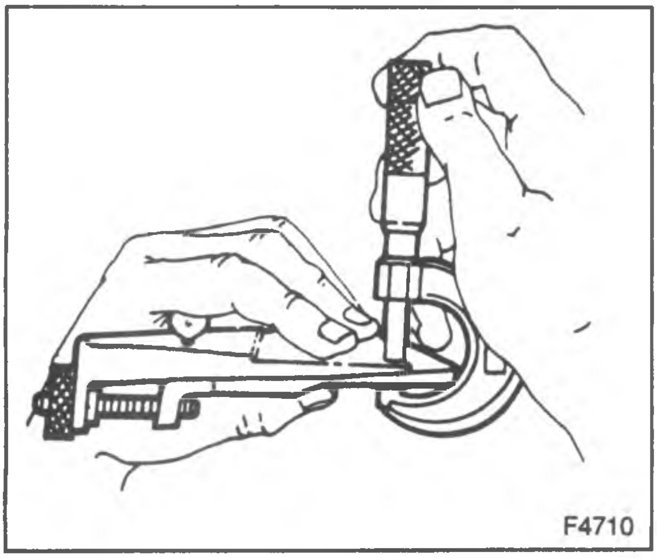


Figure 21—Measuring the Gage Plate Thickness

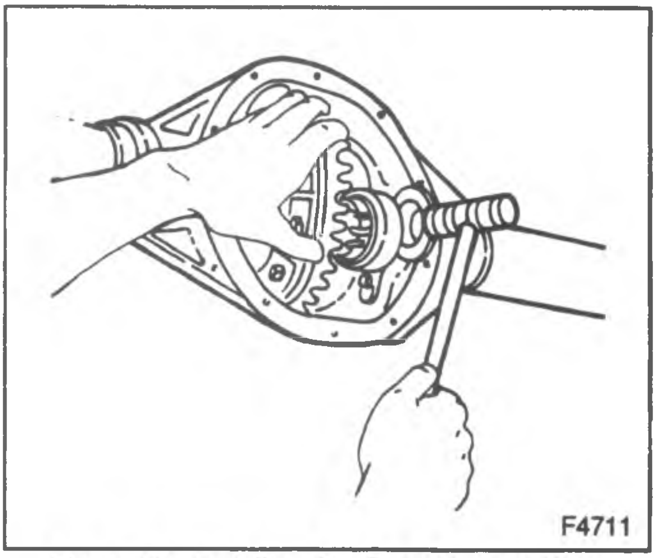


Figure 22—Installing the Final Preload Shim

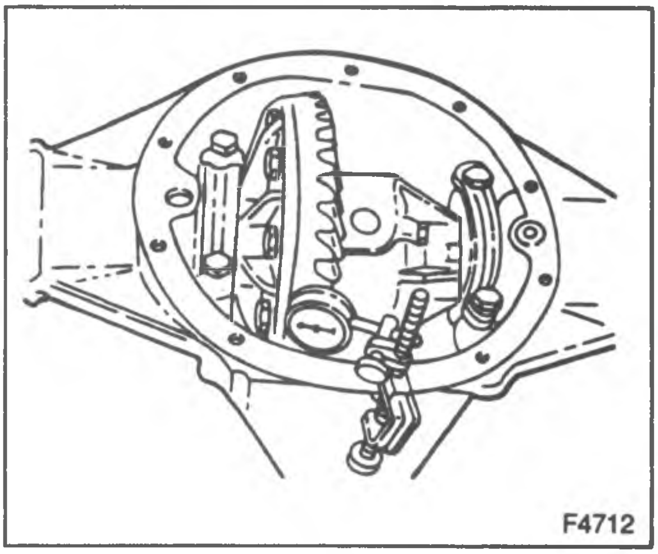


Figure 23—Checking Ring Gear Backlash

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 22).
   - 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 23).

NOTICE: See Notice on page 4C1-1 of this section.

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. The 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, 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.

GEAR TOOTH CONTACT PATTERN CHECK

Before final assembly of the differential, a gear tooth contact pattern check should be performed.

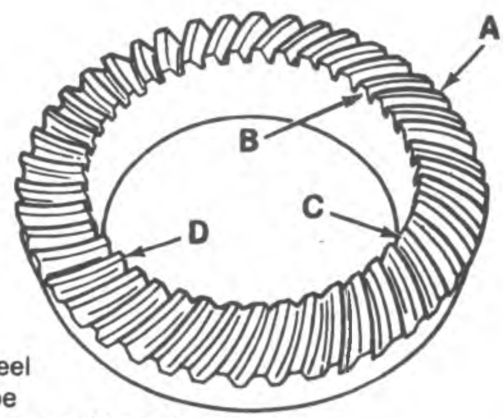
It should be noted that a gear tooth contact pattern check is NOT a substitute for adjusting pinion depth and backlash as previously outlined. It is a final check to veryify the correct running position of the ring gear and the drive pinion. Gear sets which are not positioned properly may be noisy, or 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 24).

TEST

1. Wipe oil out of carrier and carefully clean each tooth of the ring gear.



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

F2017

Figure 24—Gear Tooth Terms

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.
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 25.

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.

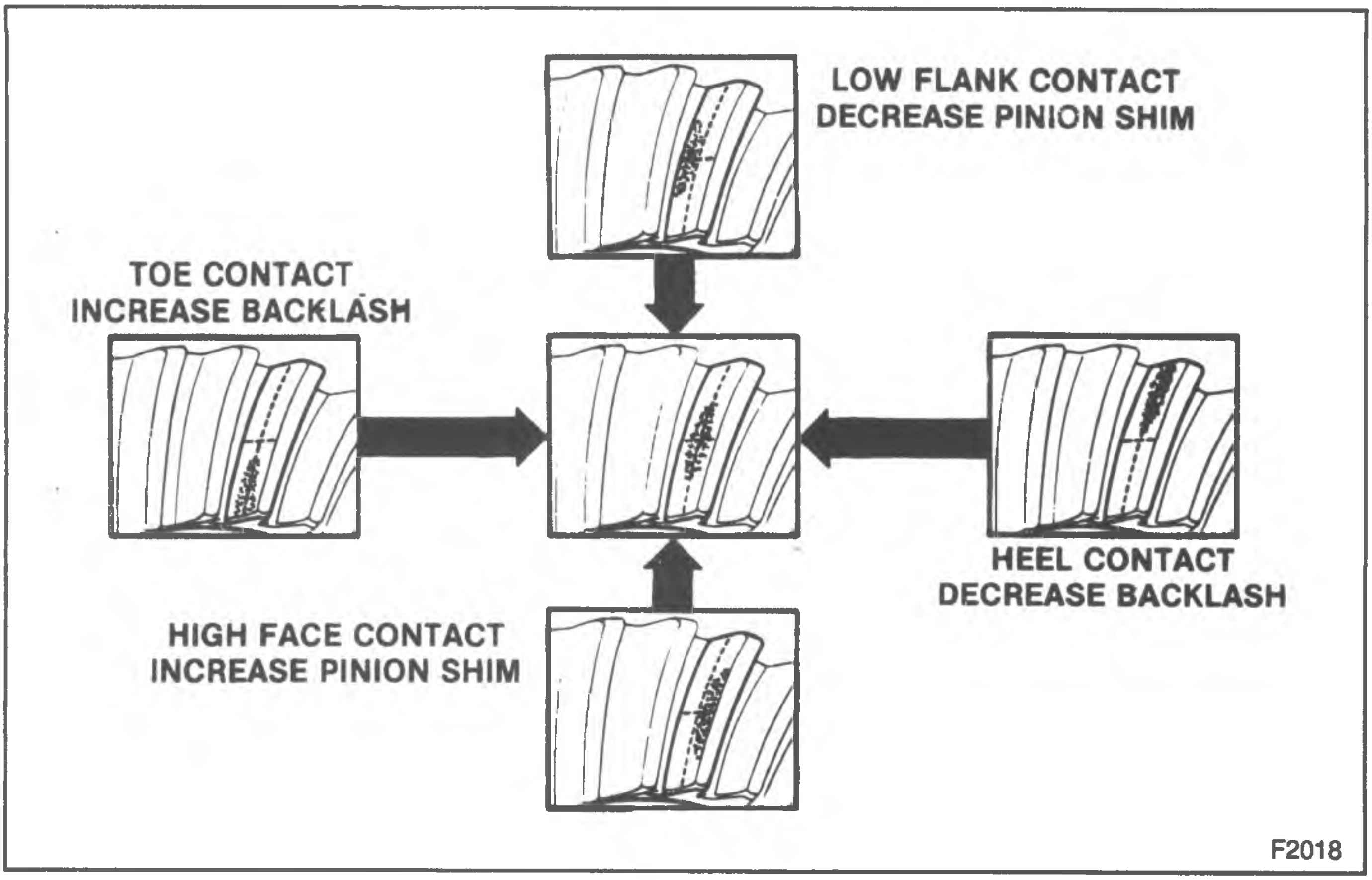


Figure 25—Gear Tooth Contact Pattern

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. Axle shafts

NOTICE: See Notice on page 4C1-1 of this section.

2. New cover gaskets and the cover (12).
   - Fill with lubricant to specs.

Tighten

- Cover bolts (14) to 27 N.m (20 ft. lbs.).

SPECIFICATIONS

8 1/2-INCH RING GEAR FRONT AXLE

TORQUE SPECIFICATIONS

Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	120	90
Bearing Cap Bolts	80	60
Axle Cover Bolts	27	20

AVAILABLE SHIM AND SPACER SIZES

Differential Side Bearing Spacer	Nominal
Differential Side Bearing Shim 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

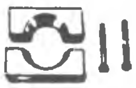
PINION PRELOAD AND BACKLASH

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.)

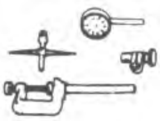
T2515

SPECIAL TOOLS

1.  J 8611-01

2.  J 8612-B

3.  J 8092

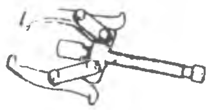
4.  J 8001

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

F4660

SECTION 4C2

9 3/4-INCH RING GEAR FRONT AXLE

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

DESCRIPTION

The Dana 9 3/4-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 axle 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, axle seals, 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).
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 0.50mm (0.020-inch), and then rotate the gage housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38mm (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 0.38mm (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.

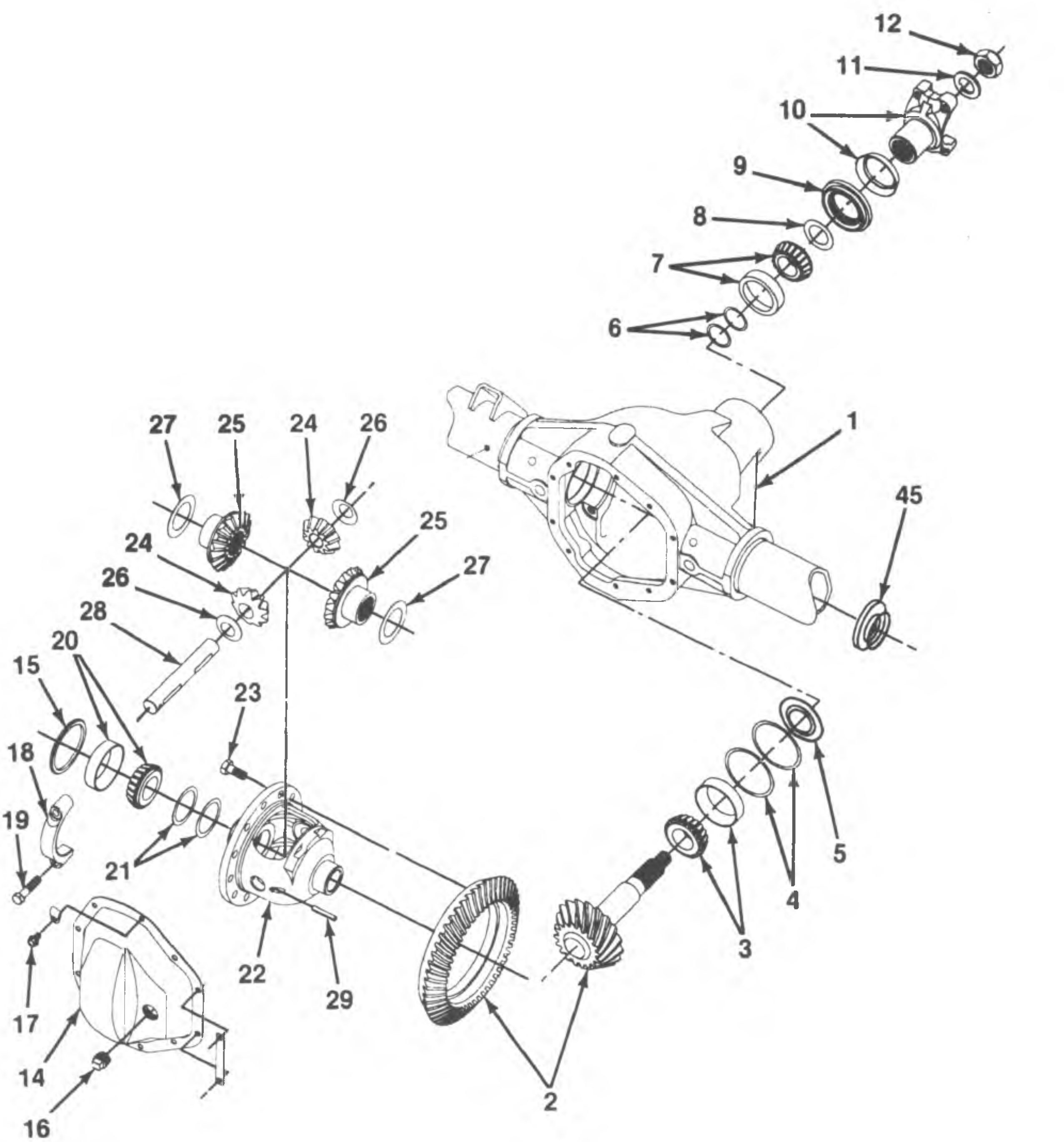
Measure

- Drive pinion bearing preload (figure 11).

Inspect

- 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).



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

F5784

Figure 1—Front Axle Components

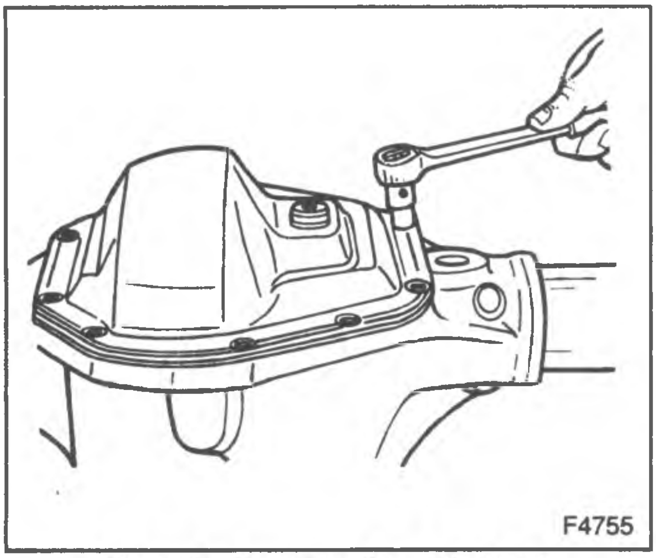


Figure 2—Removing the Axle Cover

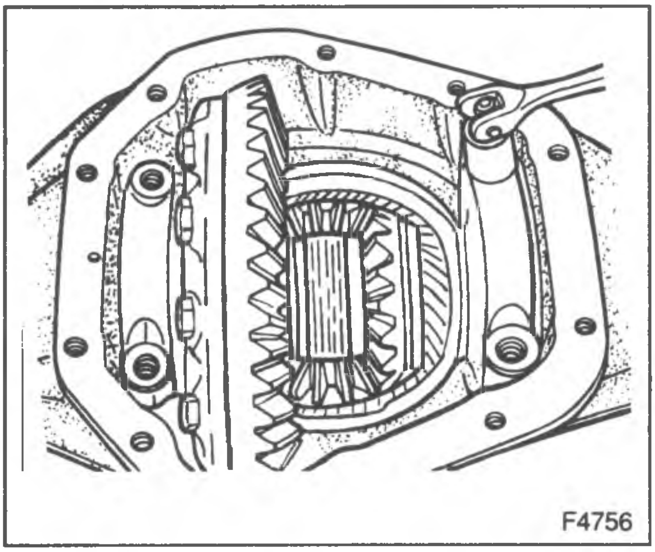


Figure 3—Removing the Bearing Cap

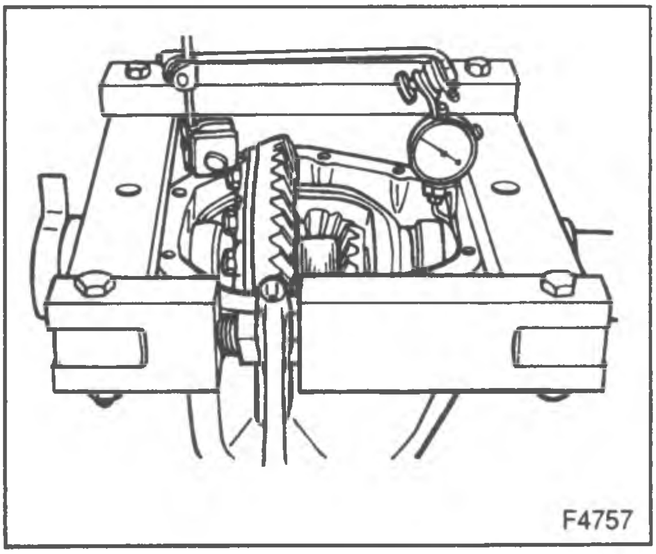


Figure 4—Spreading the Differential Case

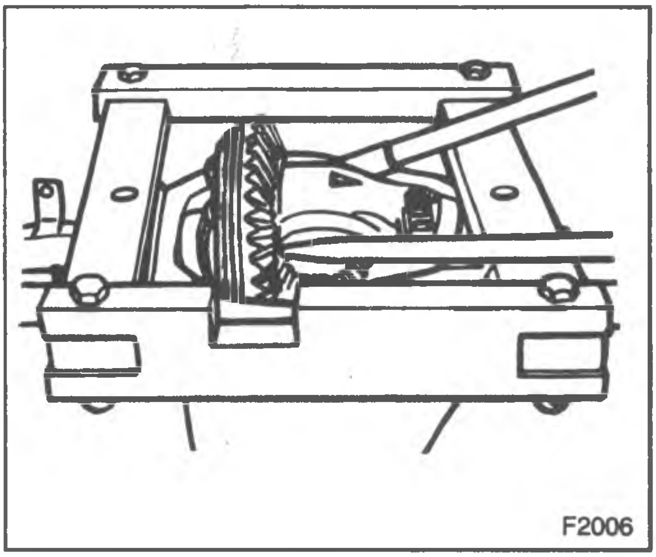


Figure 5—Removing the Differential

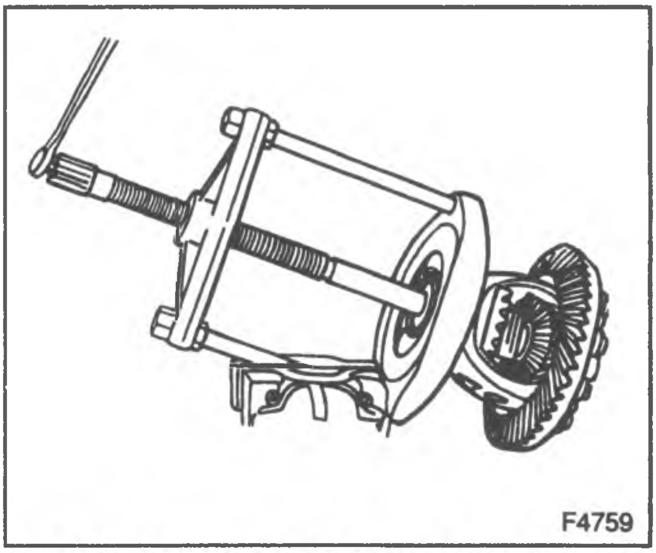


Figure 6—Removing the Differential Side Bearings

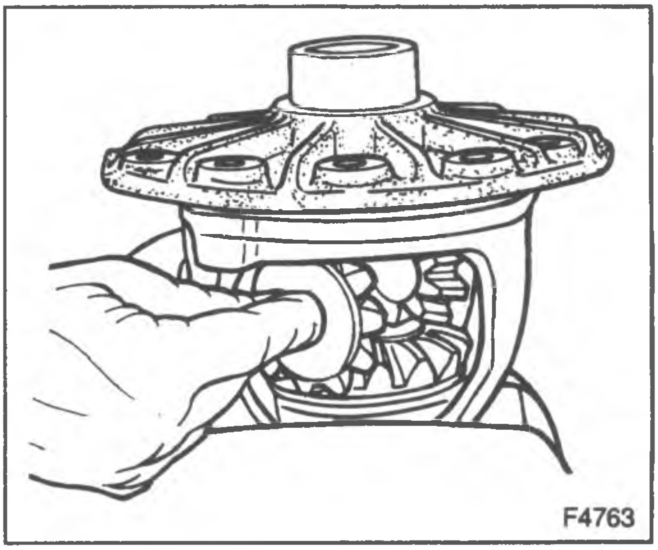


Figure 7—Removing the Ring Gear

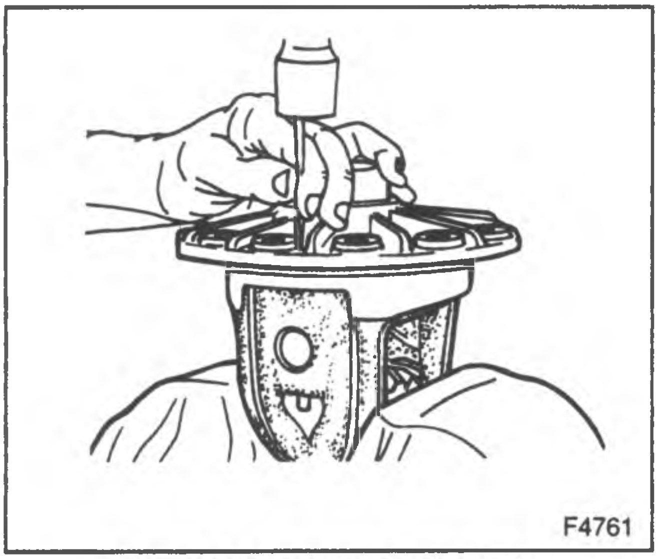


Figure 8—Removing the Lock Pin

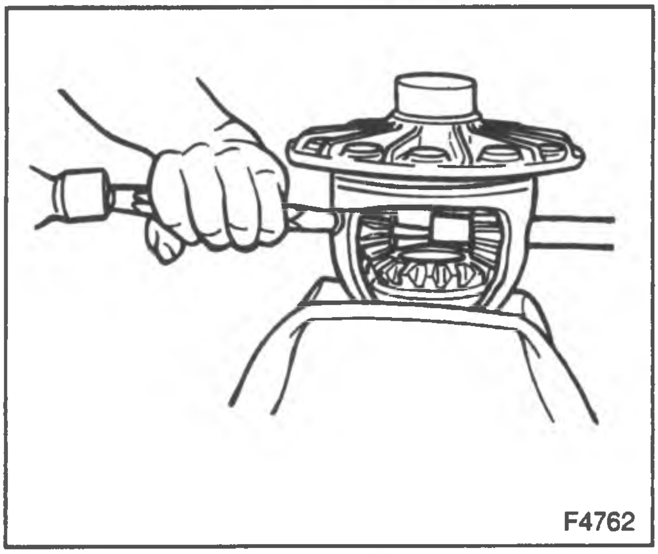


Figure 9—Removing the Pinion Shaft

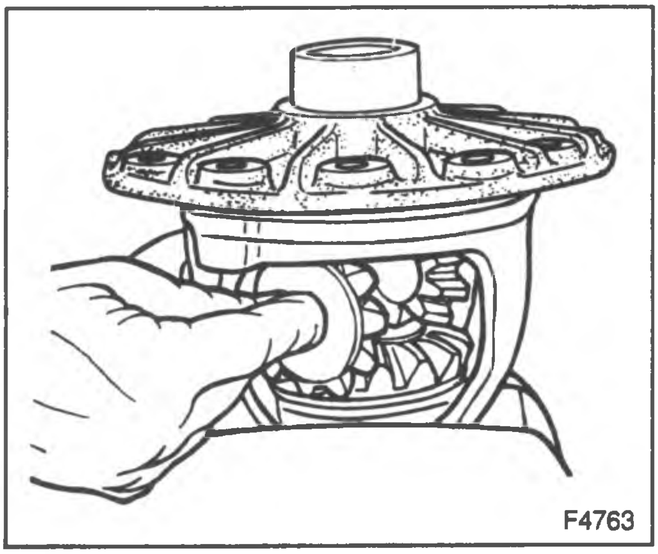


Figure 10—Removing the Pinion Gears

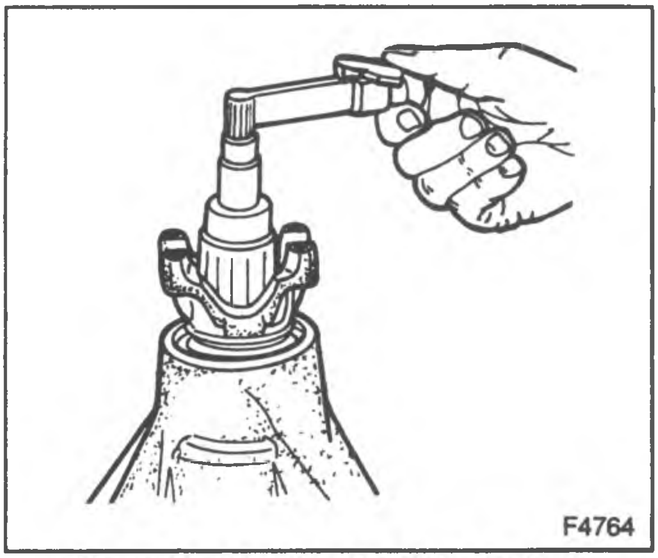


Figure 11—Checking the Pinion Preload

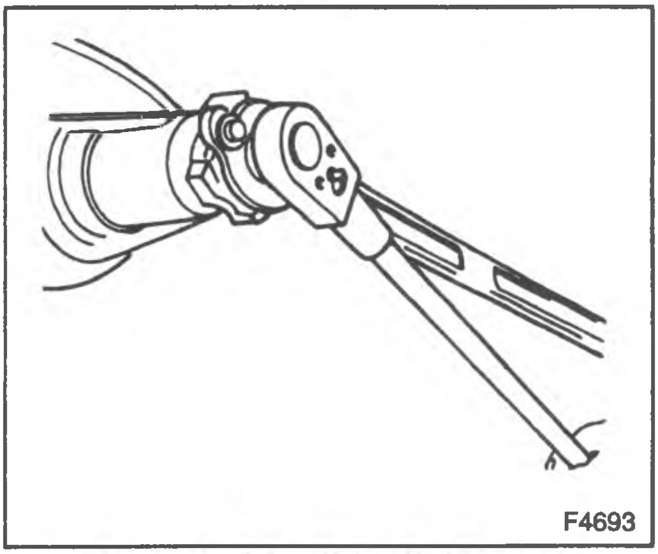


Figure 12—Drive Pinion Nut Removal

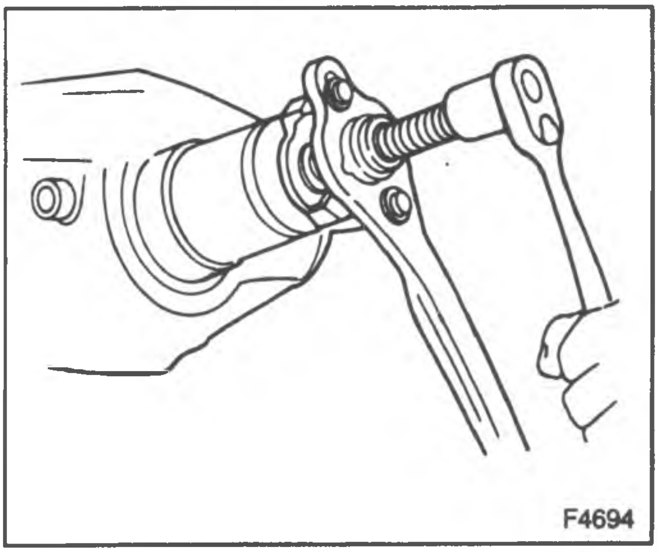


Figure 13—Pinion Flange Removal

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.

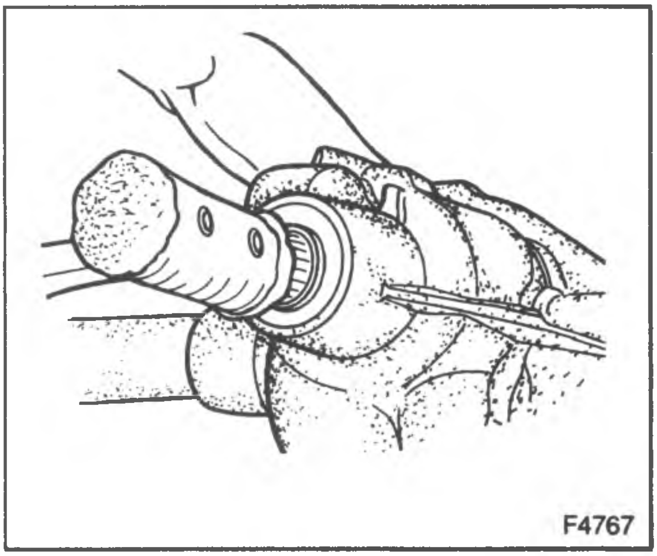


Figure 14—Removing the Pinion

CLEANING AND INSPECTION

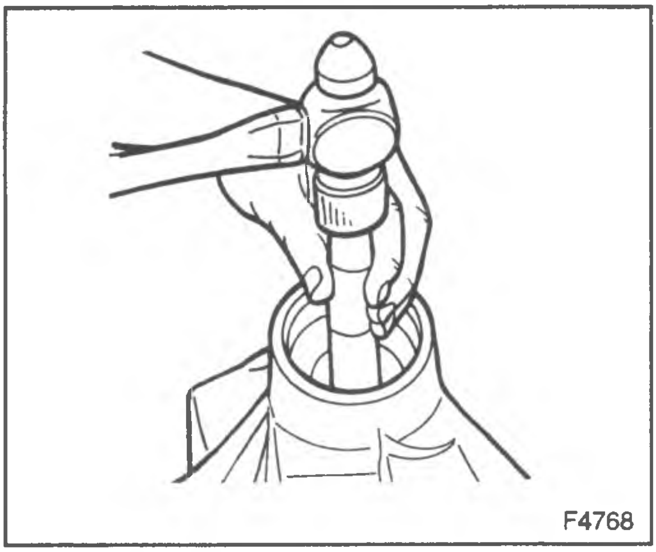


Figure 15—Removing the Bearing Cups

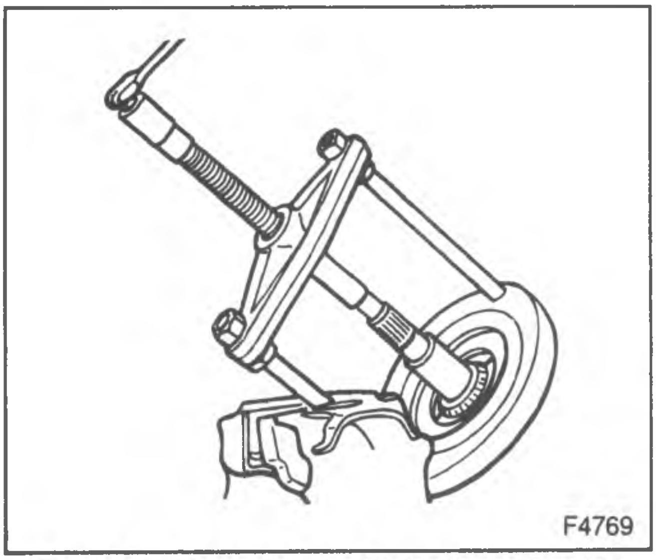


Figure 16—Removing the Pinion Inner Bearing

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.

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, 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 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 seal's inside diameter and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and must both be 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 very small 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 service shim.

Important

- Lubricate all seal lips, bearings, gears, and bearing surfaces with axle lubricant prior to assembly.

ASSEMBLY OF AXLE

DIFFERENTIAL CASE ASSEMBLY

Install or Connect (Figure 1)

Tool Required:
D 160, Axle Shaft Seal Installer

- 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).
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.

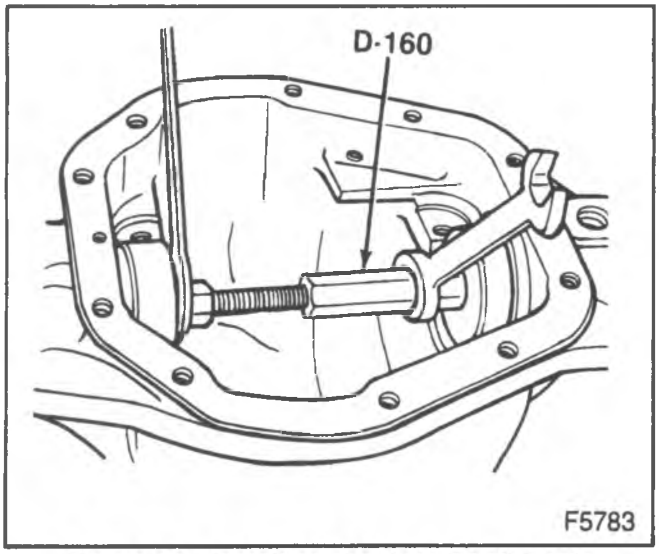


Figure 17—Installing the Axle Shaft Seals

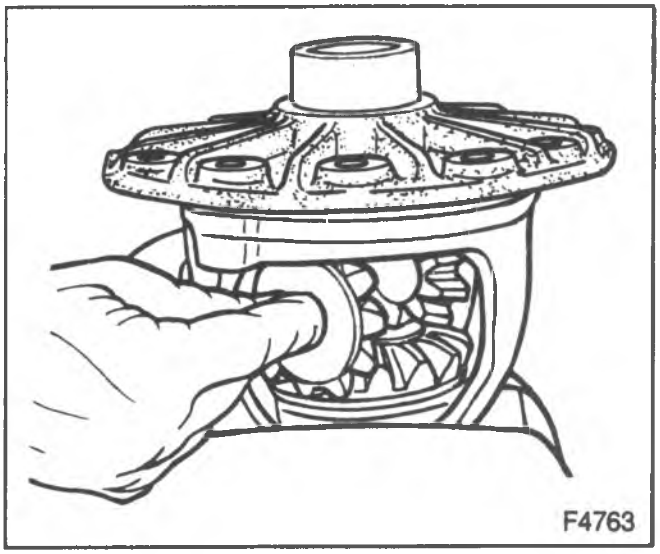


Figure 18—Installing the Pinion Gears

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.

NOTICE: See Notice on page 4C2-1 of this section.

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 and evenly 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).
    - 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 5mm (0.200-inch) with a magnetic base on the ring gear bolt side of the housing (figure 22).

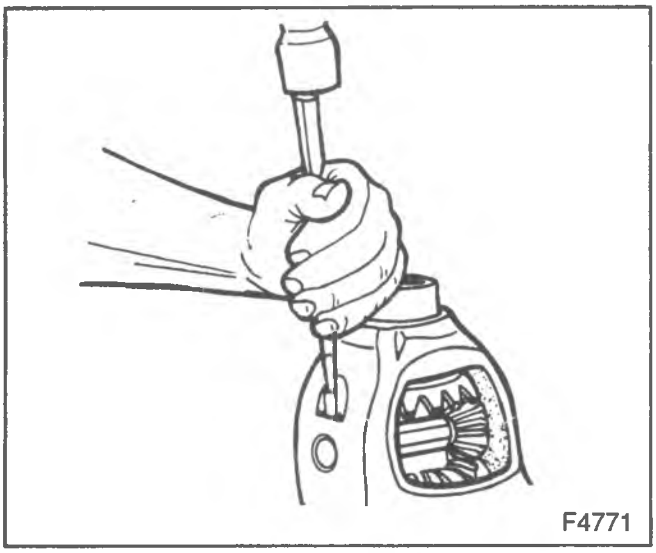


Figure 19—Installing the Lock Pin

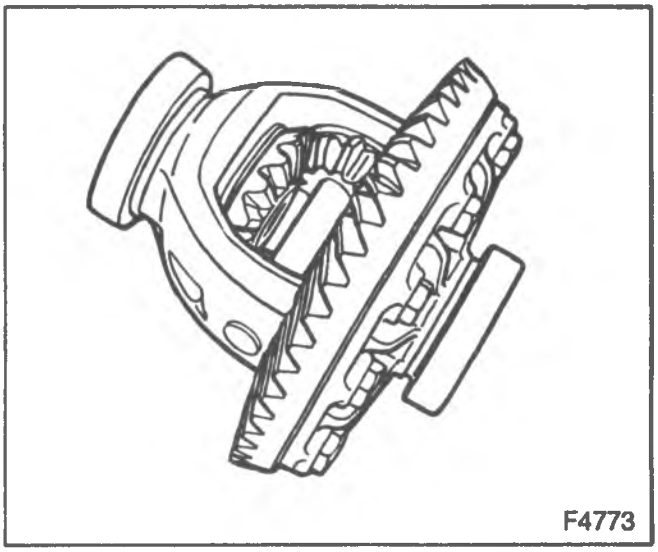


Figure 21—Differential with Master Bearings

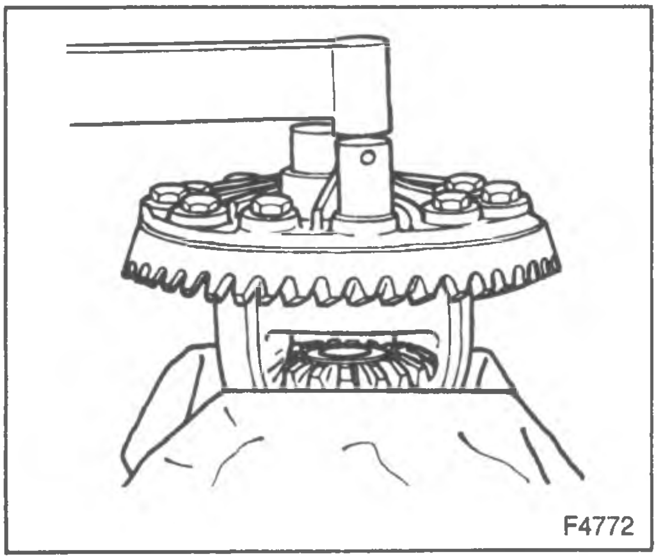


Figure 20—Installing the Ring Gear Bolts

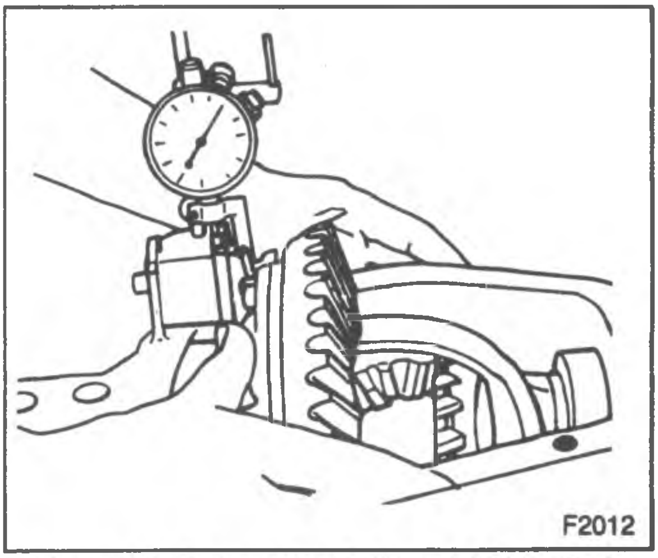


Figure 22—Determining Differential Shim Pack

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.
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
D 116-1 Pinon Height Block
D 116-2 Master Discs
D 115-3 Arbor
D 115 Scooter Gage

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).

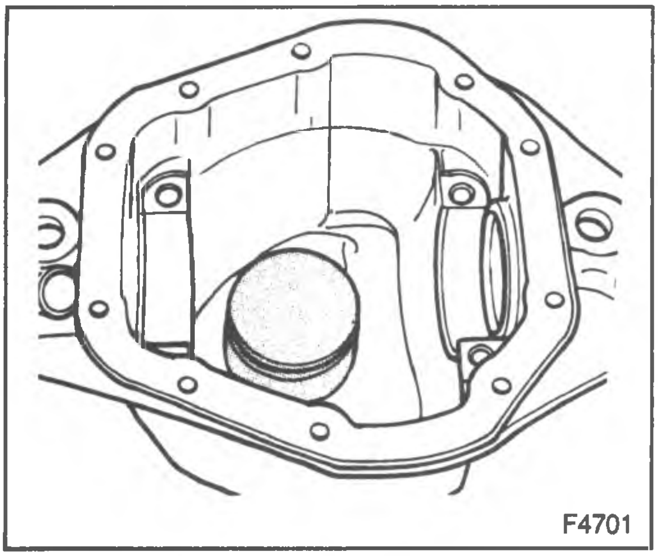


Figure 23—Master Pinion Block

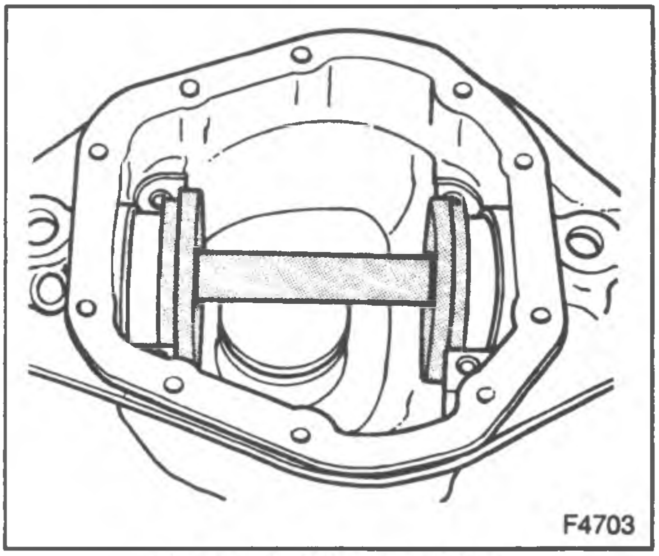


Figure 24—Arbor and Discs

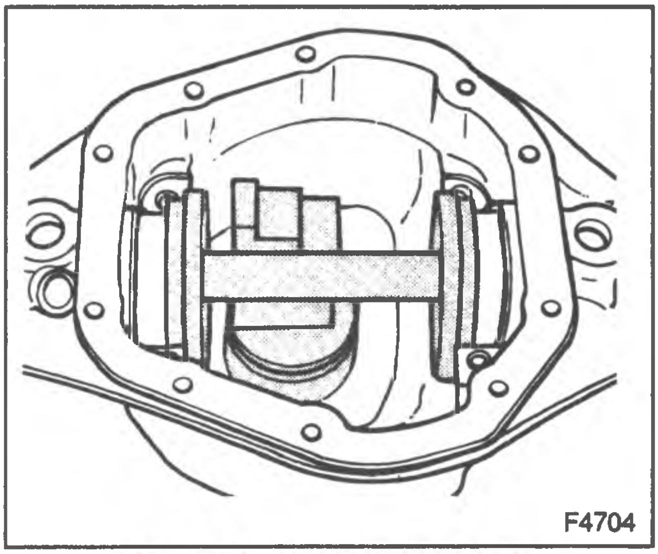


Figure 25—Pinion Height Block

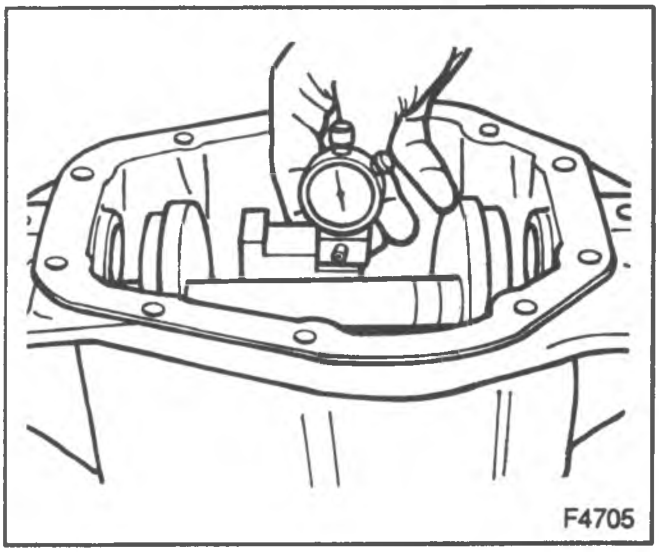


Figure 26—Scooter Gage on the Height Block

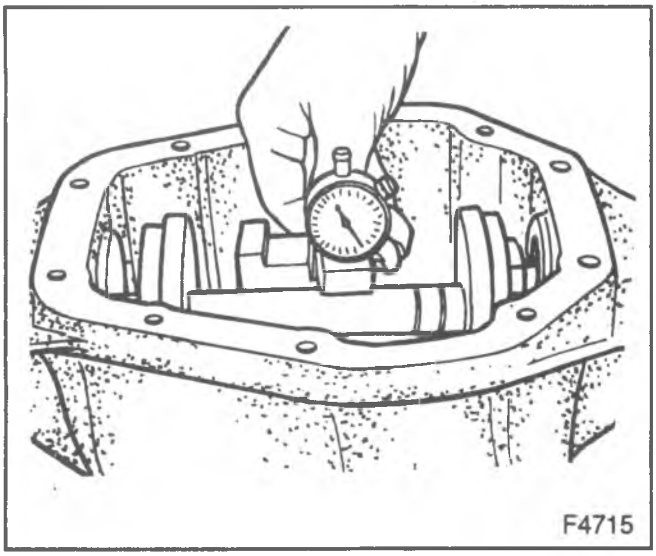


Figure 27—Scooter Gage on the Arbor

- 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 28).

PINION INSTALLATION

Install or Connect

Tools Required:
- J 7818 Front Pinion Bearing Cup Installer
- J 5590 Rear Pinion Bearing Cone Installer
- D 111
- J 8092 Handle
- J 8614-01 Pinion Flange Remover
- D 116-1 Pinion Height Block
- D 116-2 Master Disc
- D 115-3 Master Disc
- D 115 Scooter Gage
- D 163 Seal Installer

1. Place the required amount of shims (and baffle if used) in the inner bearing bore.

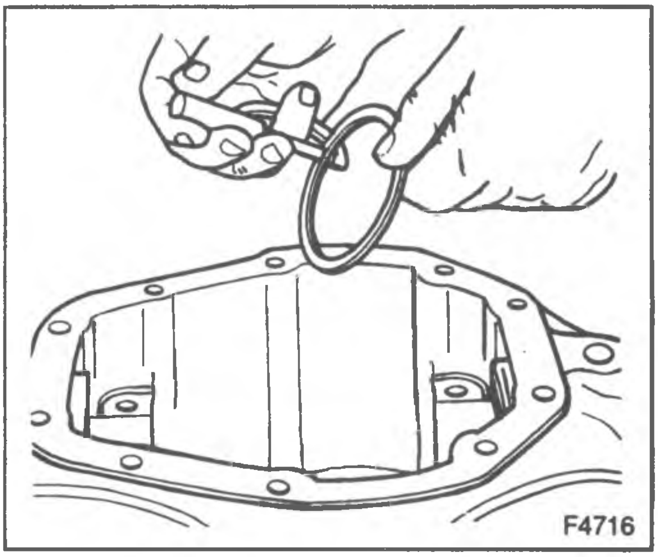


Figure 28—Measuring the Shims

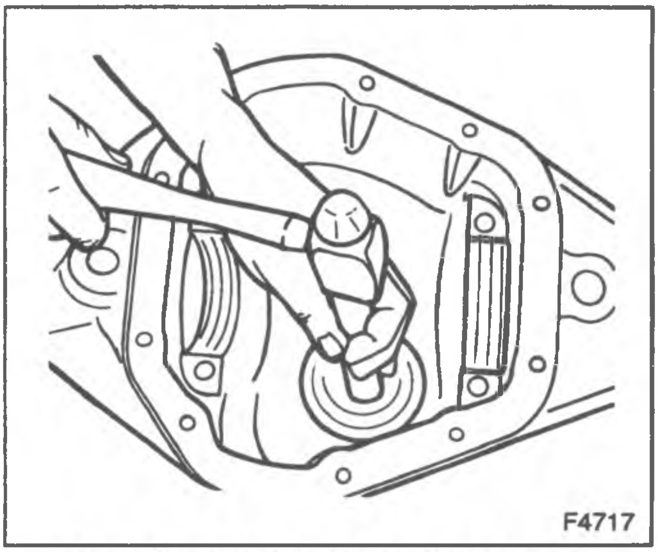


Figure 29—Installing the Pinion Inner Cup

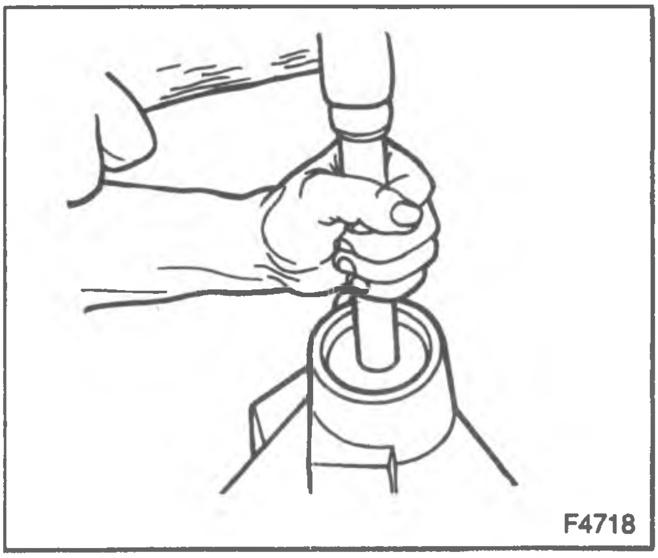


Figure 30—Installing the Pinion Front Cup

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 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 enut until it requires a 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.

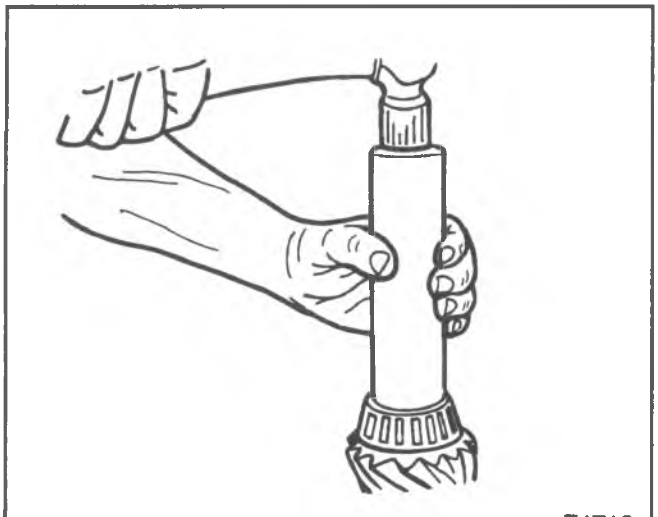

F4719

Figure 31—Installing the Inner Bearing

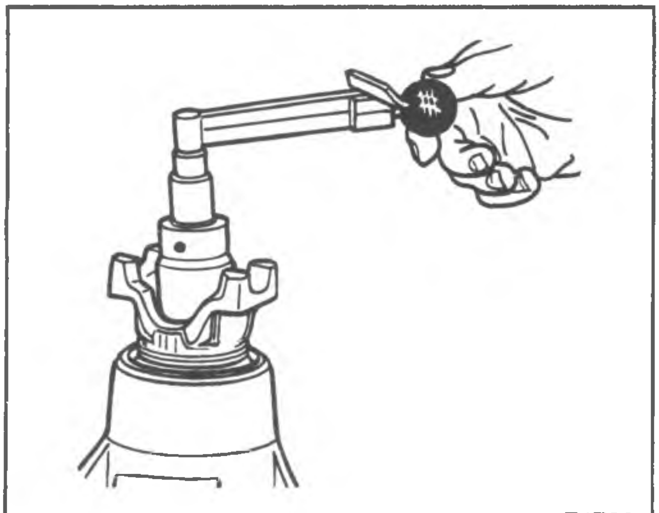

F4720

Figure 32—Checking the Pinion Preload

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 0.05mm (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 enut 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.
- Add shims to increase the preload.

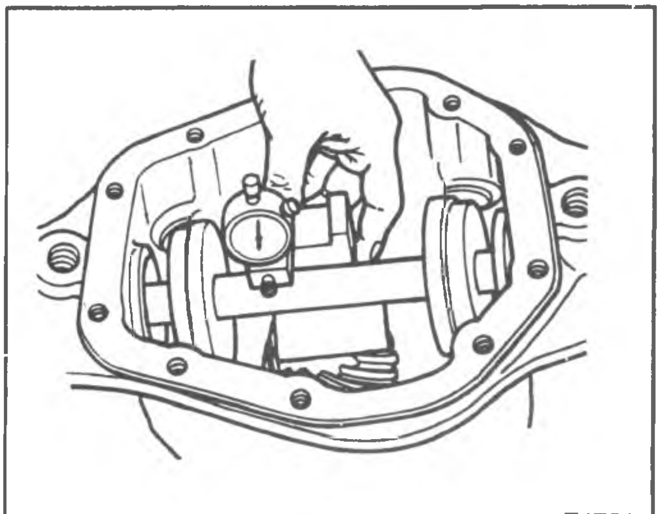

F4721

Figure 33—Checking the Pinion Depth Setting

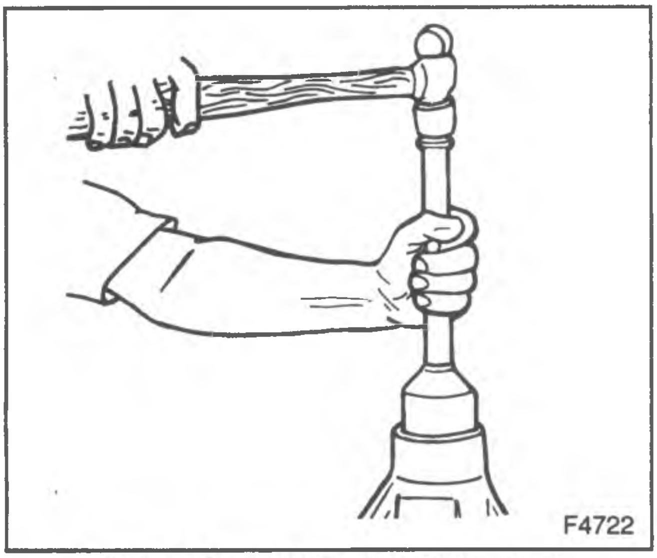


Figure 34—Installing the Pinion Seal

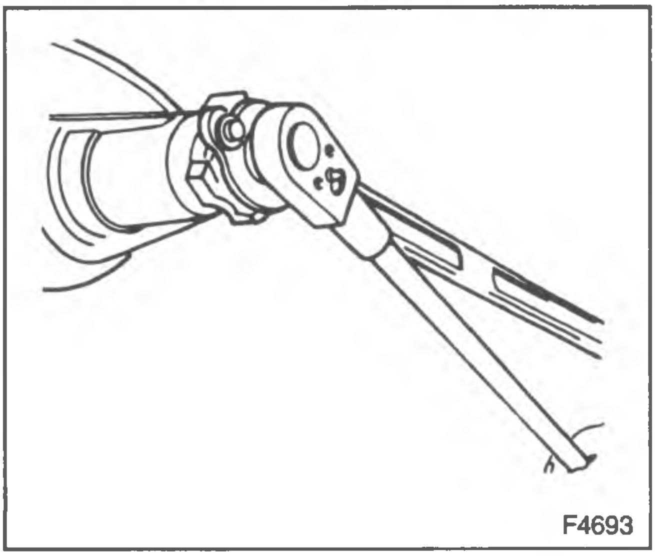


Figure 35—Tightening the Pinion Nut

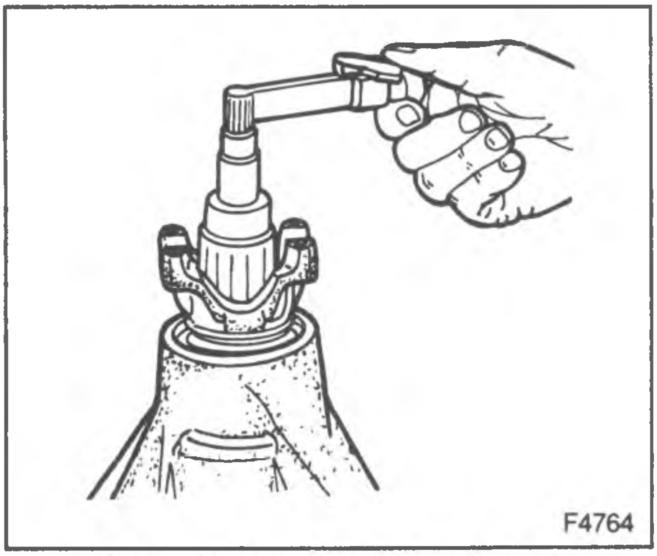


Figure 36—Checking Pinion Preload

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 5mm (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.
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 0.38mm (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).

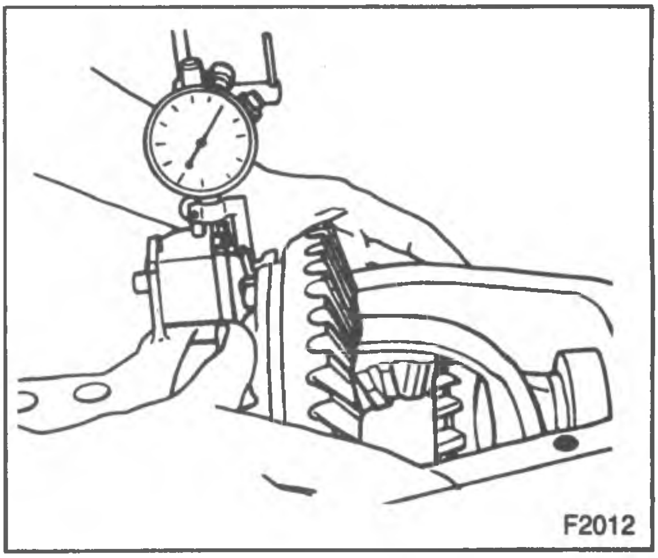


Figure 37—Measuring Differential Movement

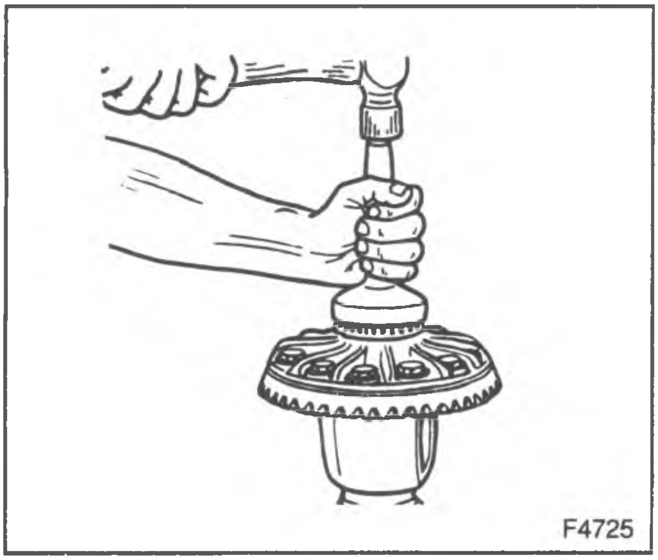


Figure 38—Installing the Differential Bearings

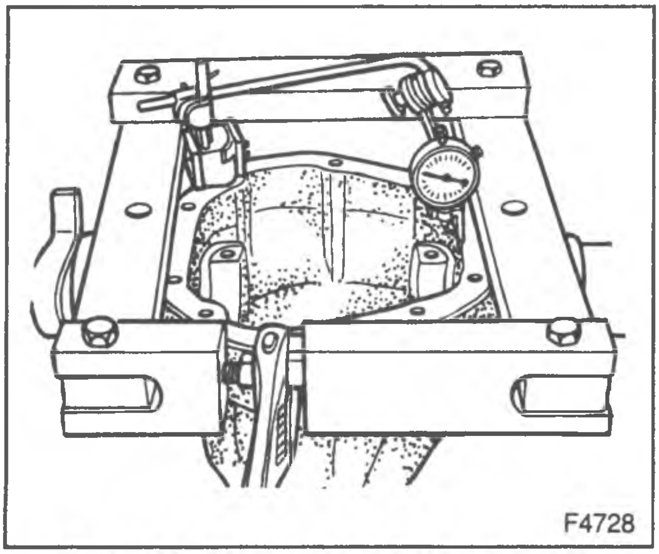


Figure 39—Mounting the Carrier Spreader

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 (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 5mm (0.020-inch), and then rotate the indicator housing to zero the dial.

NOTICE: Do not spread the differential carrier more than 0.38mm (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 40).

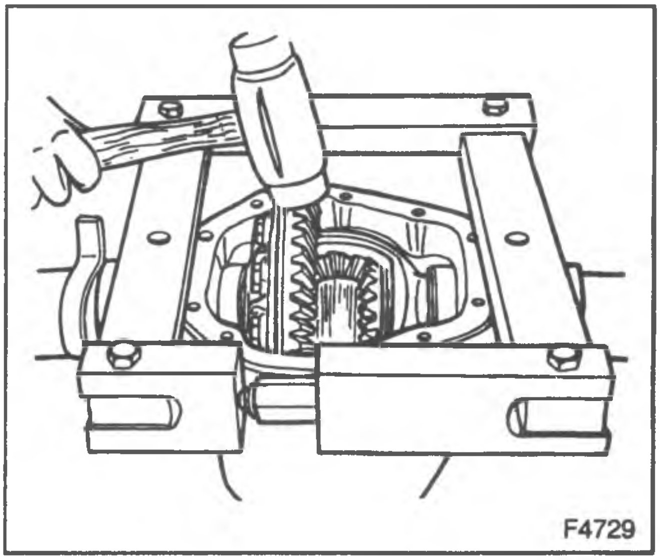


Figure 40—Installing the Differential Case

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 - 0.23mm (0.005 - 0.009-inch). The measurement must not vary more than 0.05mm (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.

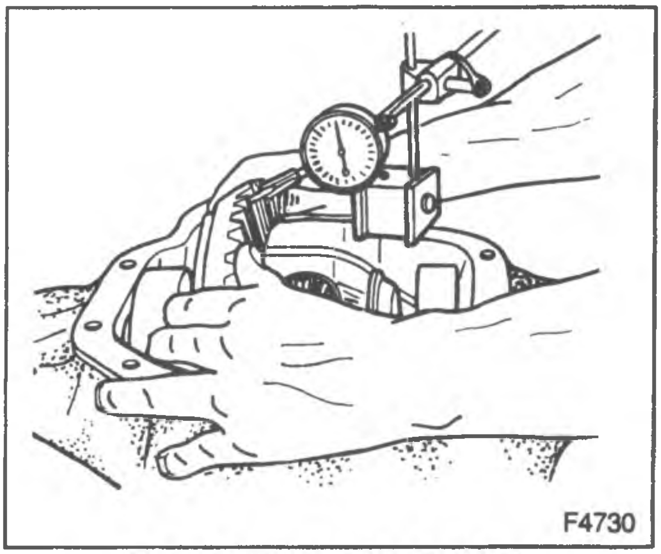


Figure 41—Measuring Backlash

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.
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.

NOTICE: See Notice on page 4C2-1 of this section.

3. Cover bolts (17).

Tighten

- Bolts to 47 N.m (35 ft. lbs.).

SPECIFICATIONS

9 3/4-INCH RING GEAR FRONT AXLE

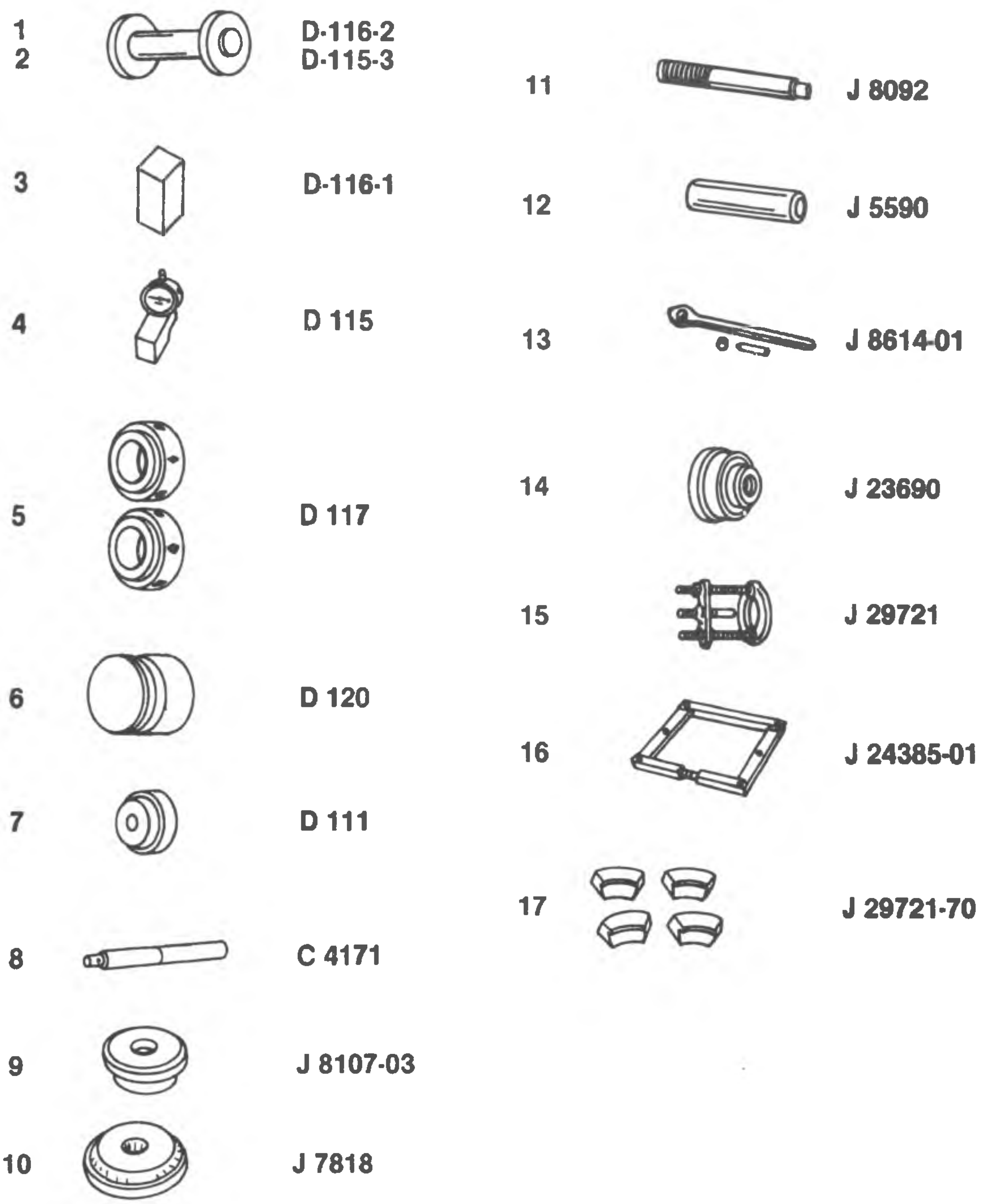
Fastener	N·m	Ft. Lbs.
Ring Gear Bolts	150	110
Bearing Cap Bolts	115	85
Axle Cover Bolts	47	35

Available 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

	N·m	In. Lbs.
Pinion Preload	2.26-4.53	20-40
	MM	**Inches**
Backlash	0.13-0.23	0.005-0.009

T2516

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

F4663

SECTION 4C3

7 1/4-INCH RING GEAR

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

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 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 axle 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 differential 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 code is located on a tag attached to the right axle tube.

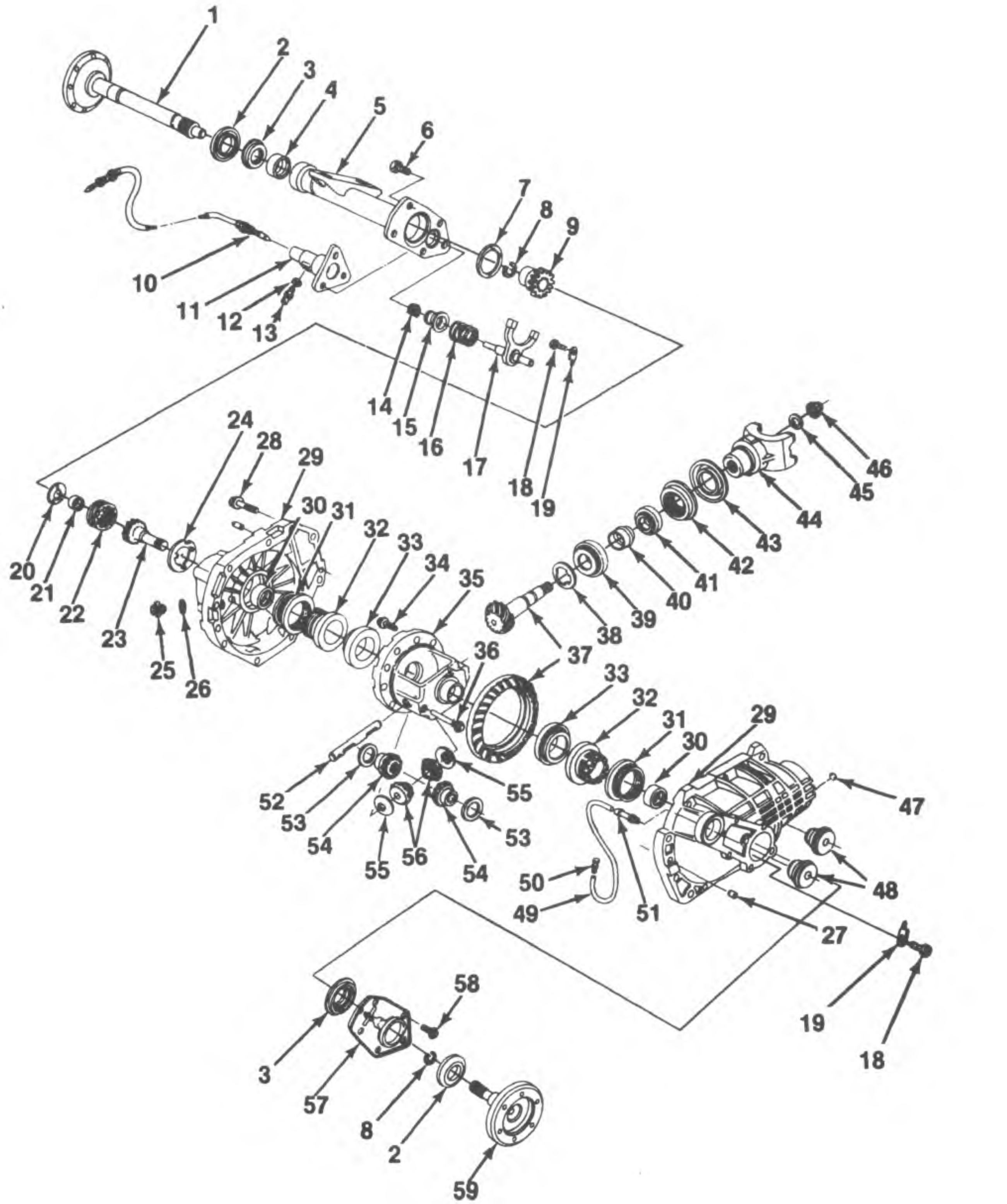


Figure 1—Axle Components

1. Shaft	16. Spring	31. Insert	46. Nut
2. Deflector	17. Shift Shaft and Fork	32. Sleeve	47. Plug
3. Seal	18. Bolt	33. Side Bearing	48. Bushing
4. Bearing	19. Lock Tab	34. Bolt	49. Vent Hose
5. Tube	20. Thrust Washer	35. Differential Case	50. Vent
6. Bolt	21. Differential Pilot Bearing	36. Bolt	51. Fitting
7. Thrust Washer	22. Sleeve	37. Ring and Pinion Gears	52. Shaft
8. Retaining Ring	23. Output Shaft	38. Shim	53. Thrust Washer
9. Carrier Connector	24. Washer	39. Bearing	54. Side Gear
10. Shift Cable	25. Plug	40. Spacer	55. Thrust Washer
11. Shift Cable Housing	26. Washer	41. Bearing	56. Differential Pinion Gear
12. Gasket	27. Pin	42. Seal	57. Cover
13. Indicator Switch	28. Bolt	43. Deflector	58. Bolt
14. Spring	29. Carrier Case	44. Flange	59. Shaft
15. Seal	30. Bearing	45. Washer	

F1388

Figure 2—Axle Components

DISASSEMBLY OF AXLE

INSPECTION

Perform the following checks before disassembling the axle.

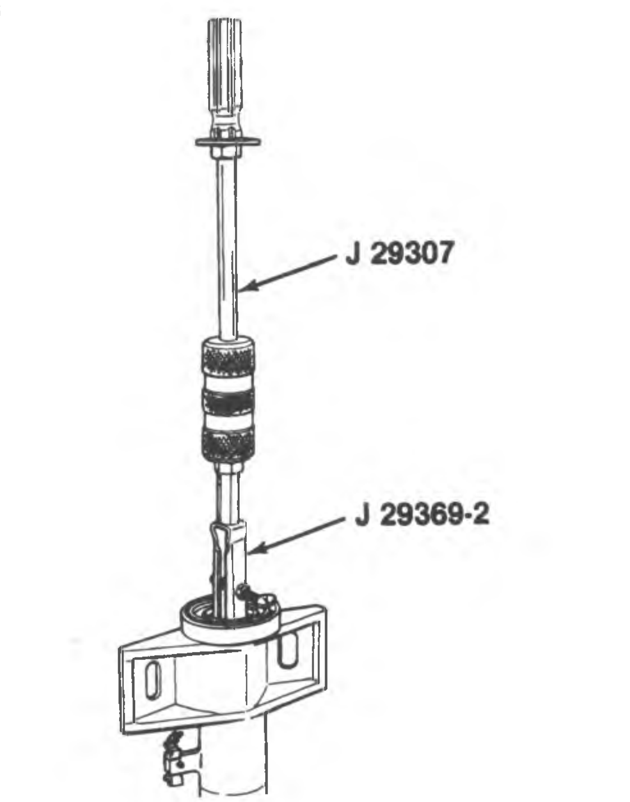
1. Remove the fill plug from the axle and drain the axle lubricant into a suitable container.
2. Check the ring gear backlash. Refer to "Backlash Adjustment." This information can be used to determine the cause of the axle problem. It will also help when setting up the shim packs for locating and preloading 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 (Figure 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).



F5786

Figure 3—Removing the Axle Tube Bearing and Seal

10. Differential pilot bearing (21) from the output shaft, using J 34011 (figure 4).
11. Washer (24).
12. Shaft (59), and deflector (2).
    - Using J 2619-01, pull the output shaft out of the case (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).

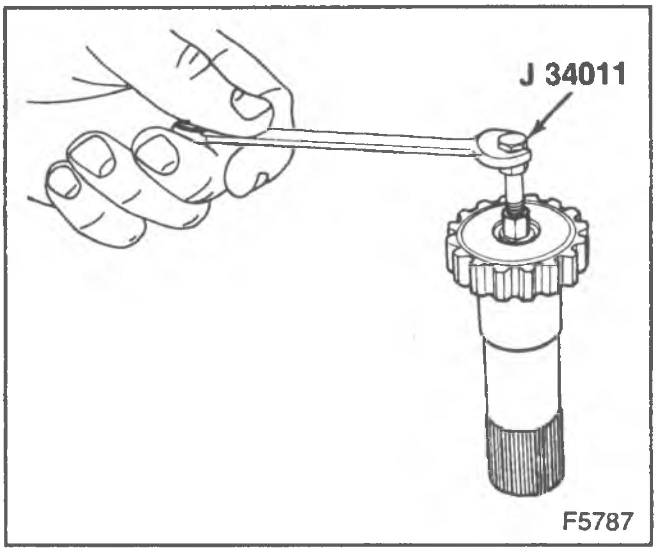


Figure 4—Removing the Output Shaft Pilot Bearing

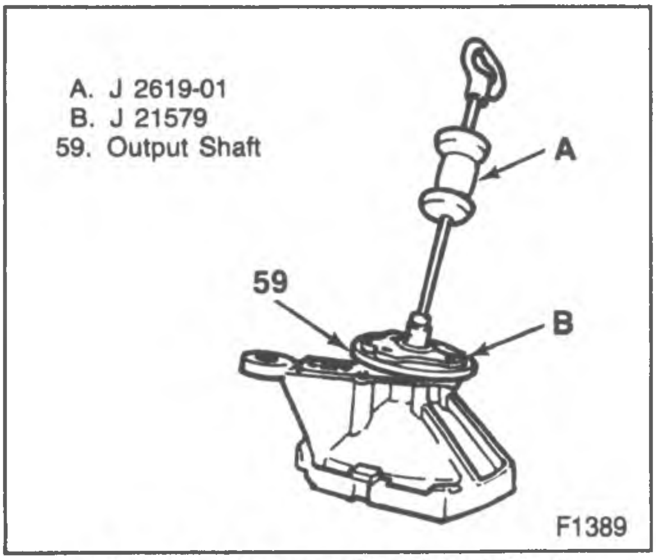


Figure 5—Removing the Output Shaft

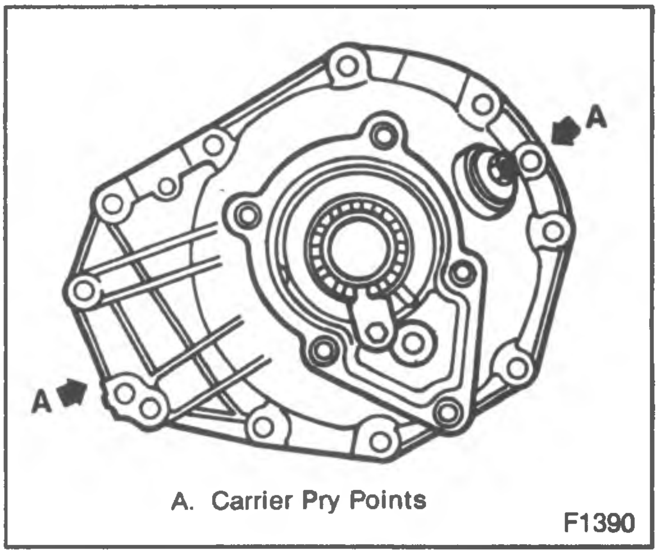


Figure 6—Separating the Carrier Case Halves

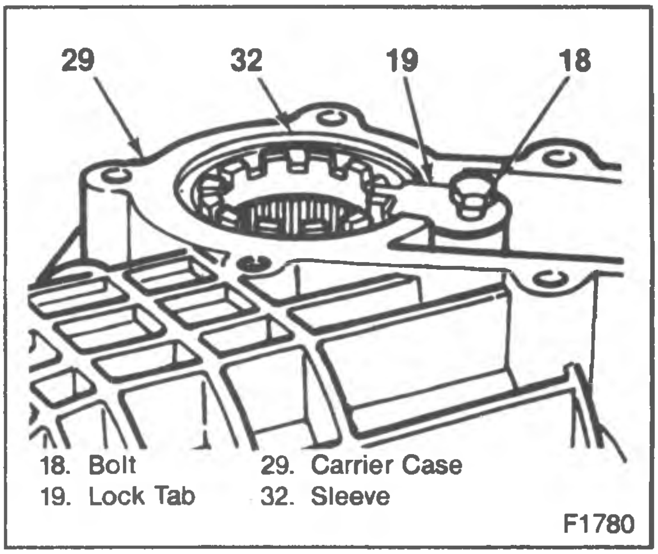


Figure 7—Removing the Lock Tabs

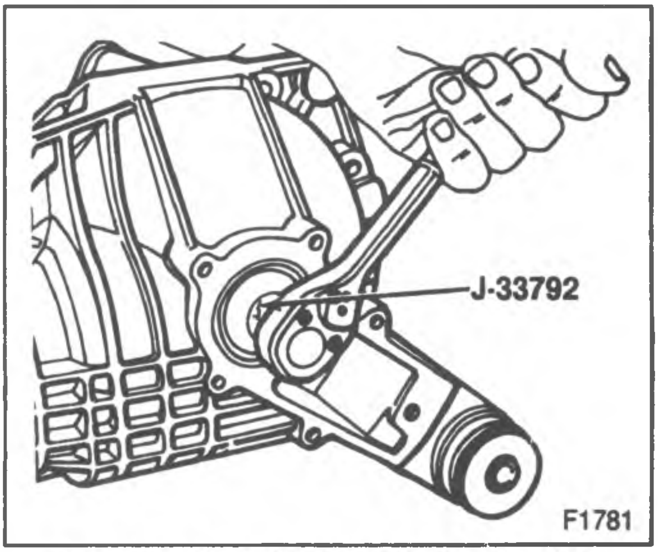


Figure 8—Removing the Side Bearing Cup

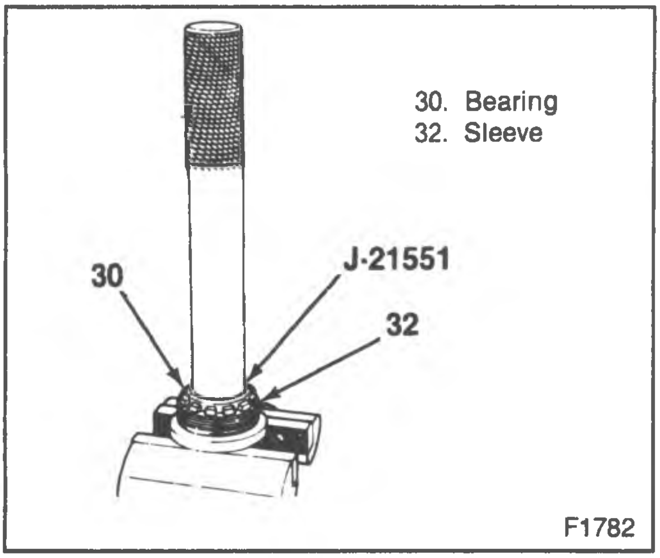


Figure 9—Remove the Sleeve Bearing

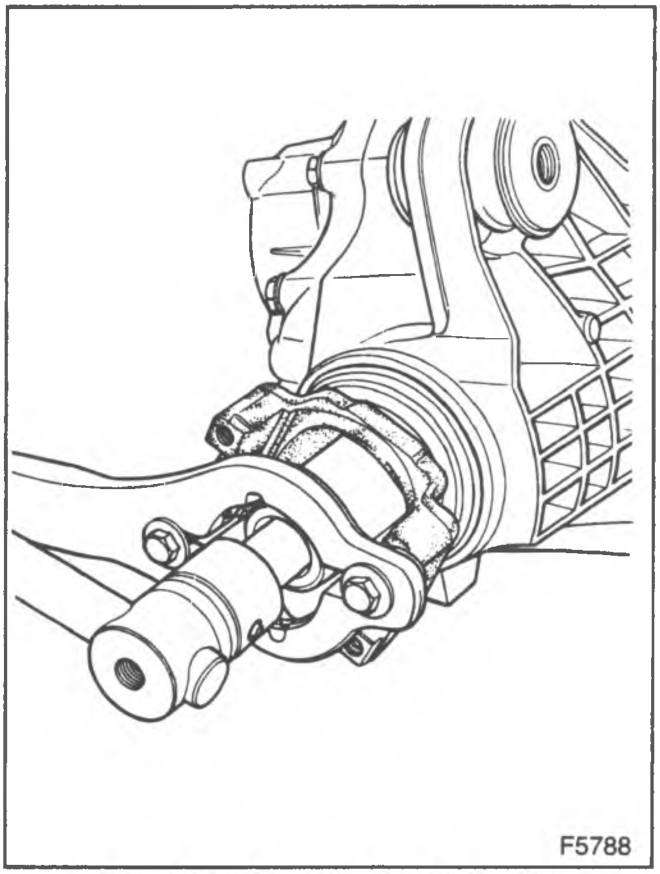


Figure 10—Removing the Pinion Nut

- 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.

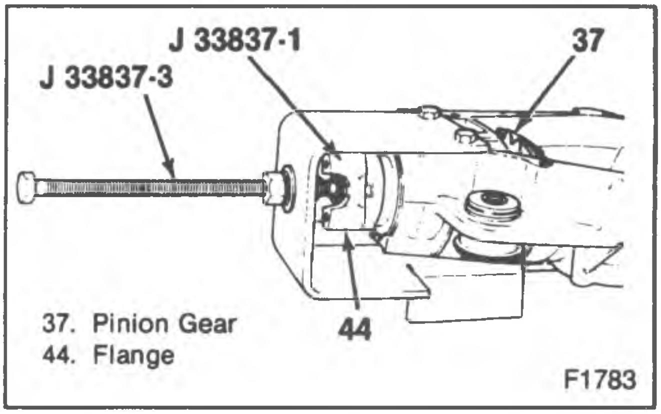


Figure 11—Remove the Pinion Flange

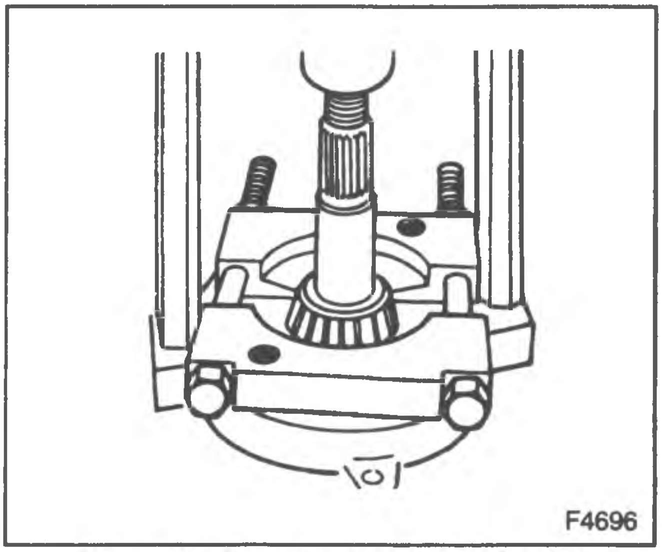


Figure 12—Removing the Pinion Bearing

- 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).

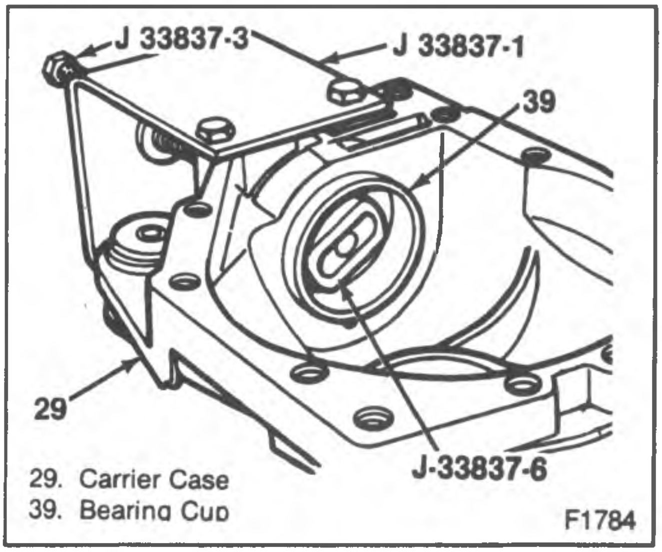


Figure 13—Removing the Inner Pinion Bearing Cup

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).

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.

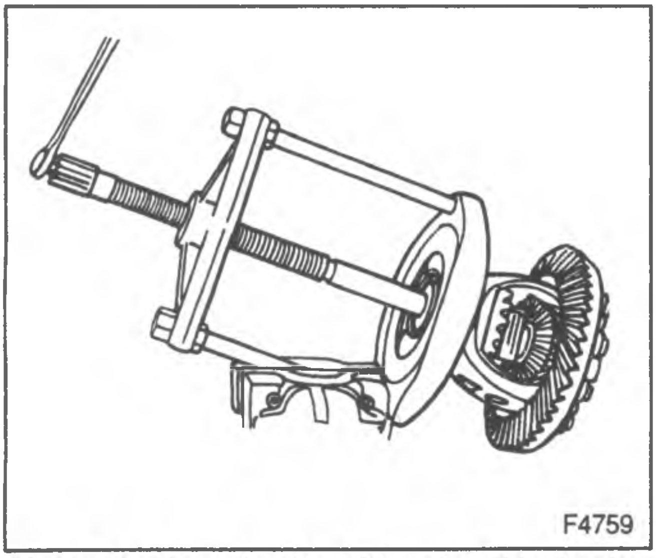


Figure 14—Removing the Differential Side Bearing

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.

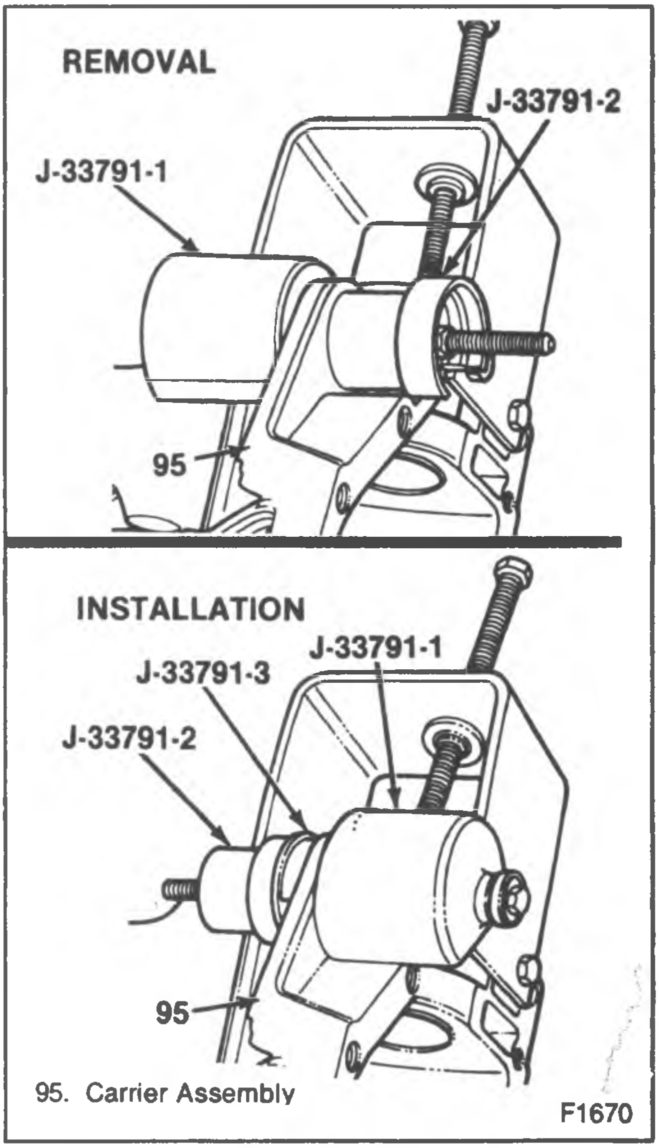


Figure 15—Replacing the Case Bushings

- 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 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.

Important

- Lubricate all the seal lips, bearings, gears, and bearing surfaces with axle lubricant prior to assembly.

ASSEMBLY OF AXLE

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).

NOTICE: See Notice on page 4C3-1 of this section.

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).

PINION DEPTH ADJUSTMENT

Tools Required:
J 33838 Pinion Depth Setting Gage
J 29763 Dial Indicator

- Refer to figure 1.

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 19).
   - Set the dial indicator at ZERO, then position it in J 33838. Push the dial indicator downward until the needle rotates approximately 3/4 turns to the right.

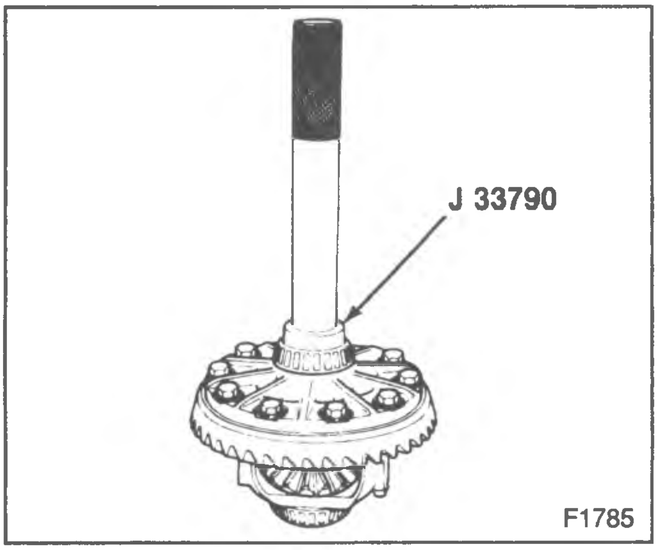


Figure 16—Installing the Differential Side Bearings

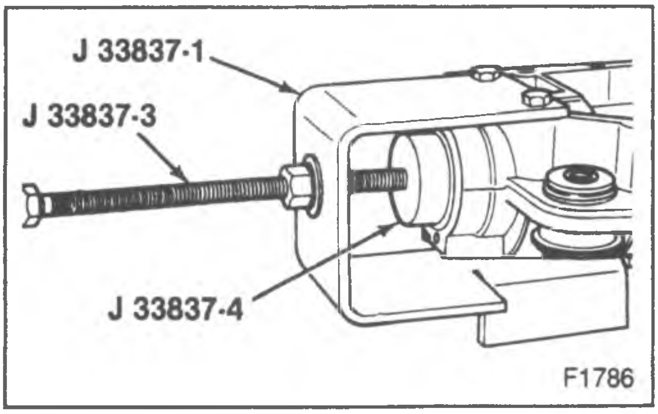


Figure 17—Installing the Outer Pinion Bearing Cup

4. Tighten the dial indicator in this position.
5. Set the button of J 33838 on the differential bearing bore (figure 19).
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 19). 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.

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 (figure 10).

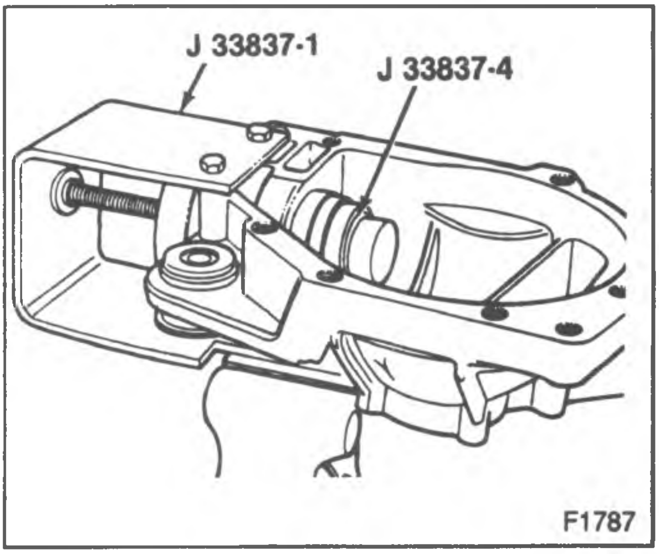
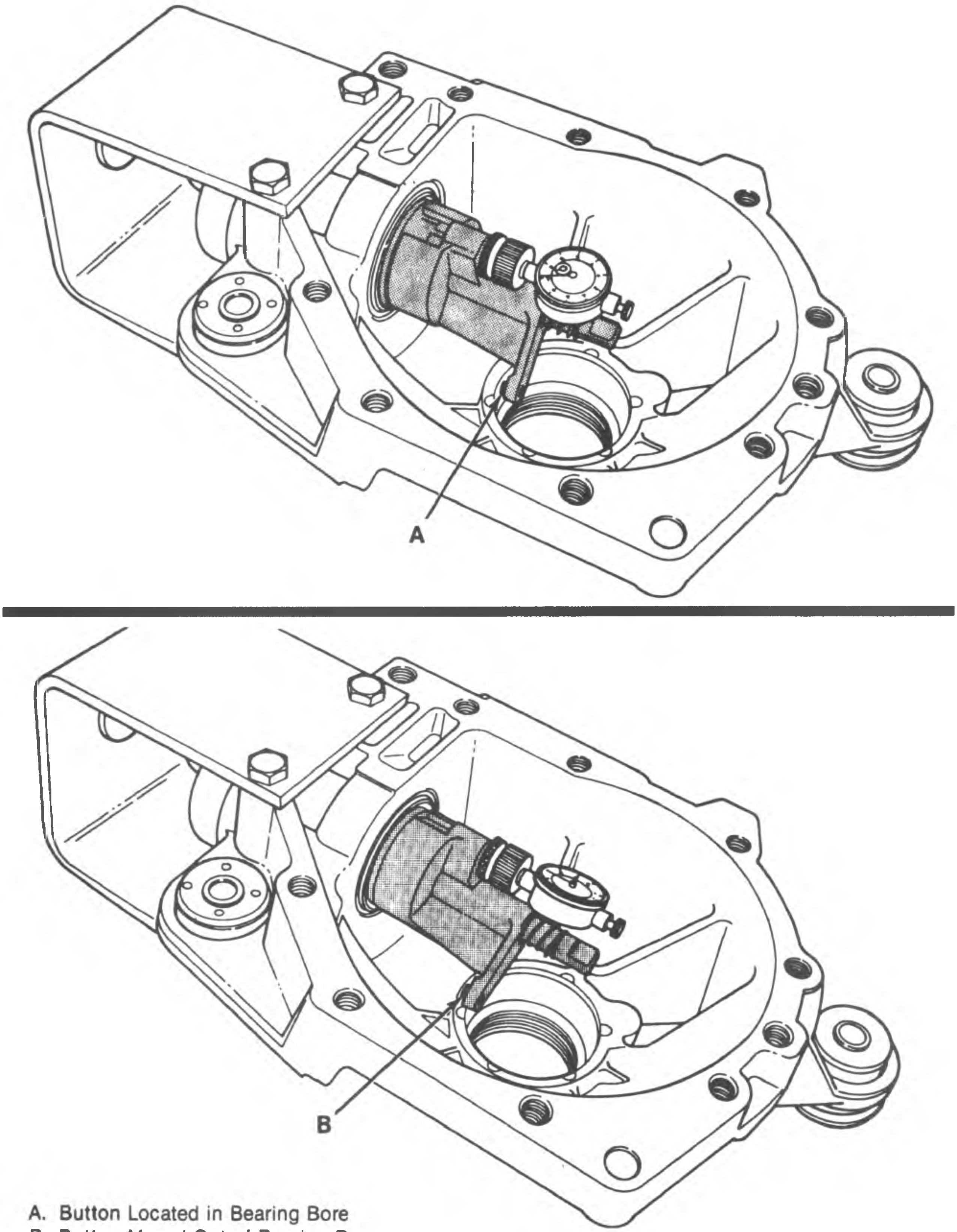


Figure 18—Installing the Inner Pinion Bearing Cup



A. Button Located in Bearing Bore
B. Button Moved Out of Bearing Bore

F5791

Figure 19—Measuring Pinion Depth

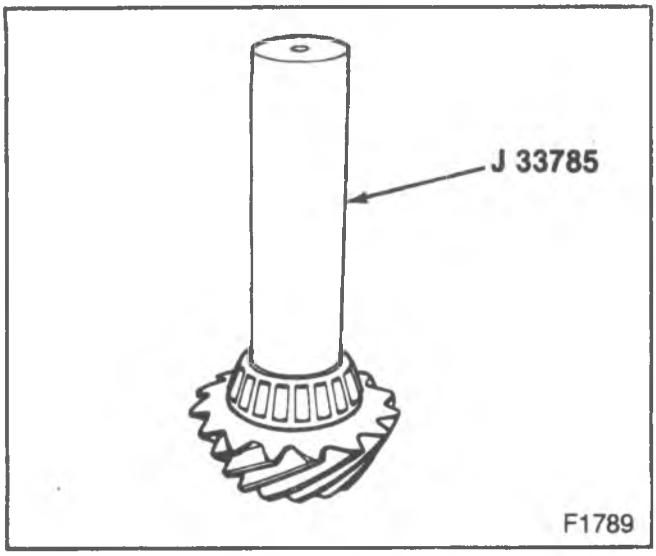


Figure 20—Installing the Pinion Bearing

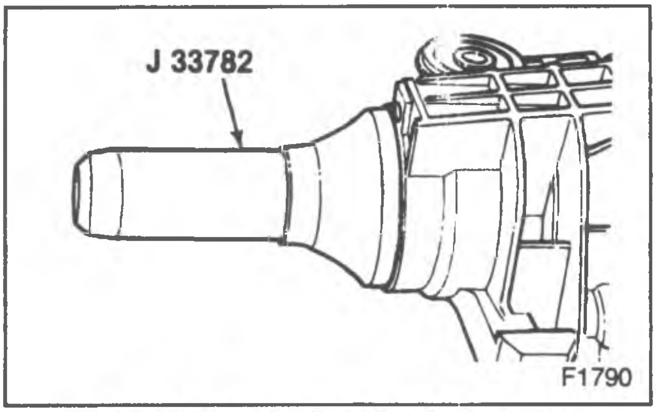


Figure 21—Installing the Pinion Seal

- No further tightening should be attempted until bearing preload has been checked.

Measure

- Pinion bearing preload. Use an inch pound torque wrench (figure 22).

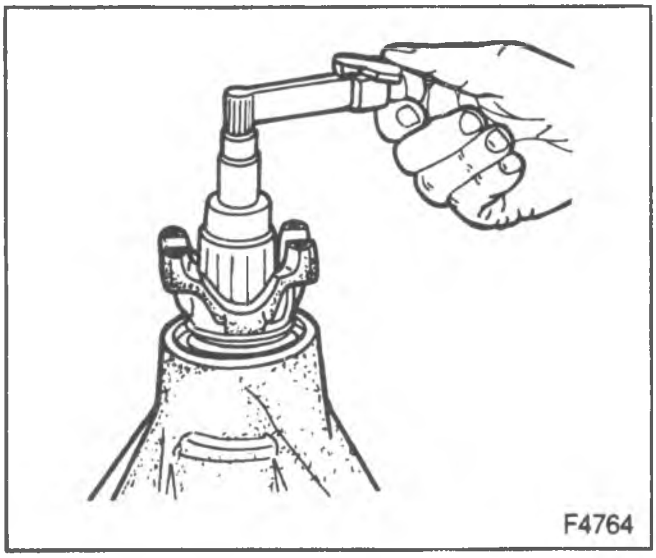


Figure 22—Measuring Pinion Bearing Preload

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.

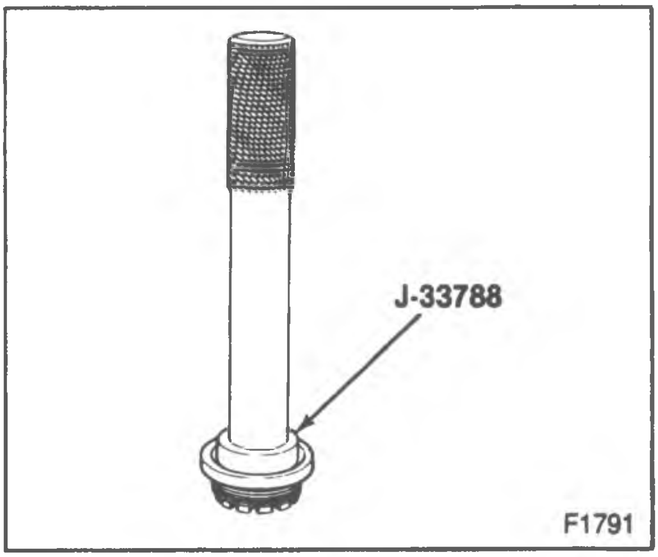


Figure 23—Installing the Sleeve Bearing

- If the carrier halves do not make complete contact, back out the right hand adjusting sleeve (32). Use J 33792 (figure 24).

NOTICE: See Notice on page 4C3-1 of this section.

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. Tighten the right sleeve (32) to 140 N.m (100 ft. lbs.) using J 33792 (figure 24).
3. Tighten the left sleeve (32) to 140 N.m (100 ft. lbs.) using 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.
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.
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

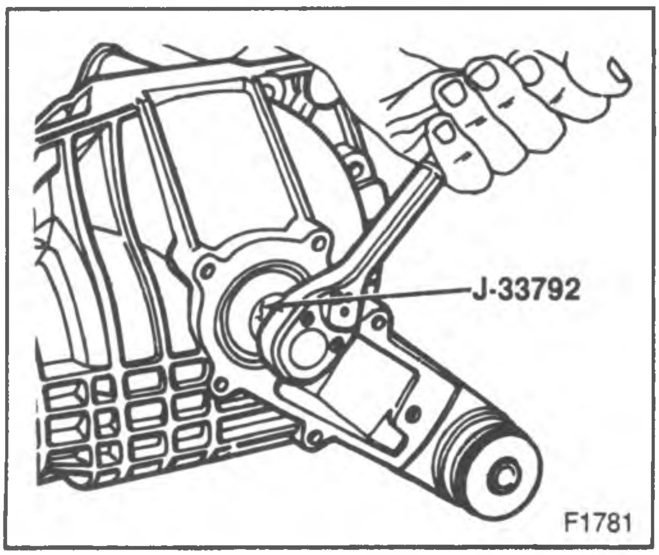


Figure 24—Adjusting the Sleeve

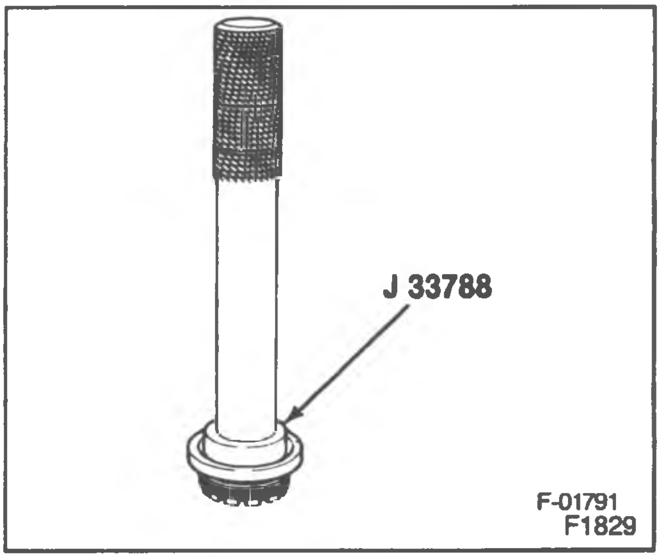


Figure 25—Carrier Case Bolts Installed

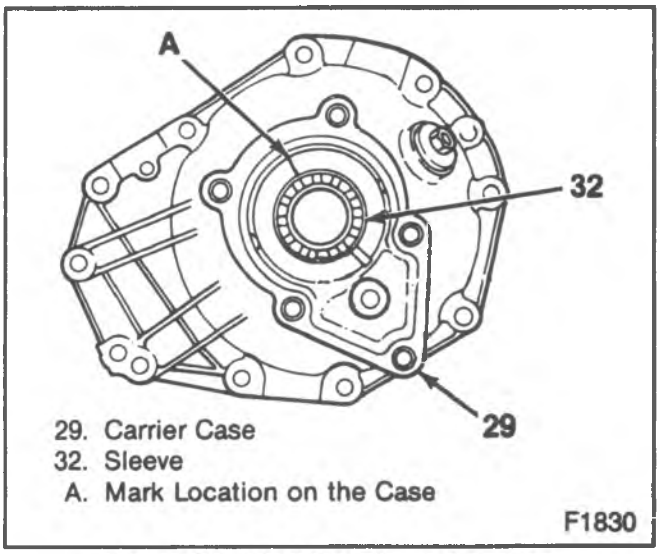


Figure 26—Marking Sleeve Location

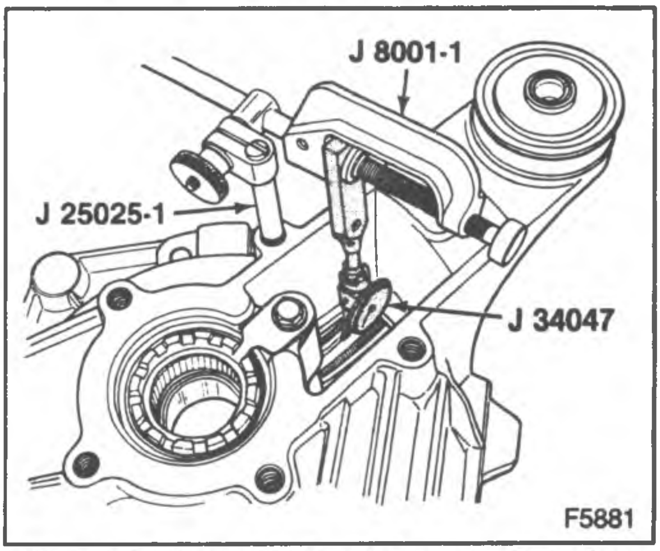


Figure 27—Measuring Backlash at the Ring Gear

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 identical amount. To decrease backlash, turn the right sleeve in and turn the left sleeve out an identical amount.

11. When the backlash is correct, mark the position of the sleeves so they can be kept in the same location.

MEASURING BACKLASH (ALTERNATE METHOD)

- If the specified tools are not available, it is possible to read backlash at the pinion flange as follows:

1. 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).
2. Move the pinion flange through its free play while holding the differential carrier. Record the dial indicator reading.

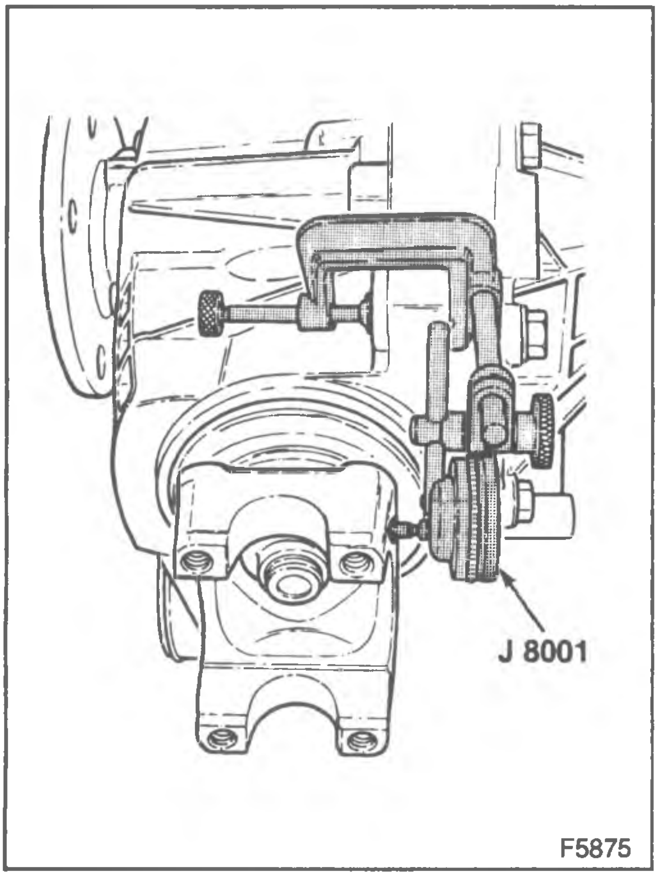


Figure 28—Measuring Backlash at the Pinion Flange

3. 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.
4. 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 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

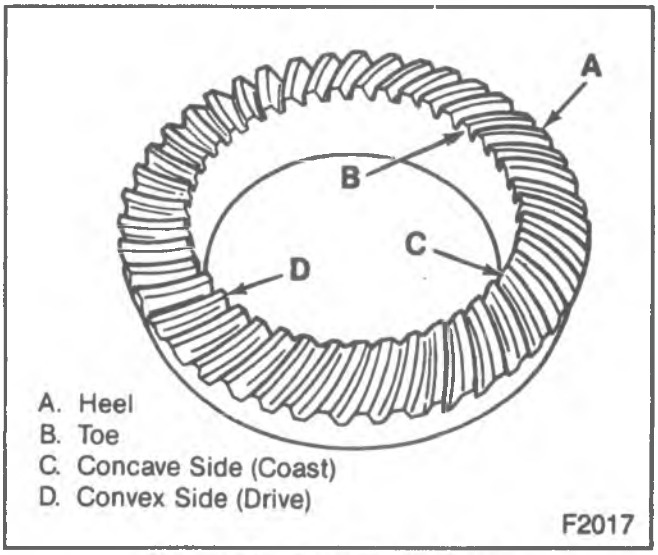


Figure 29—Gear Tooth Terms

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 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.

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)

NOTICE: For steps 2, 3, 5 and 21 see Notice on page 4C3-1 of this section.

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.

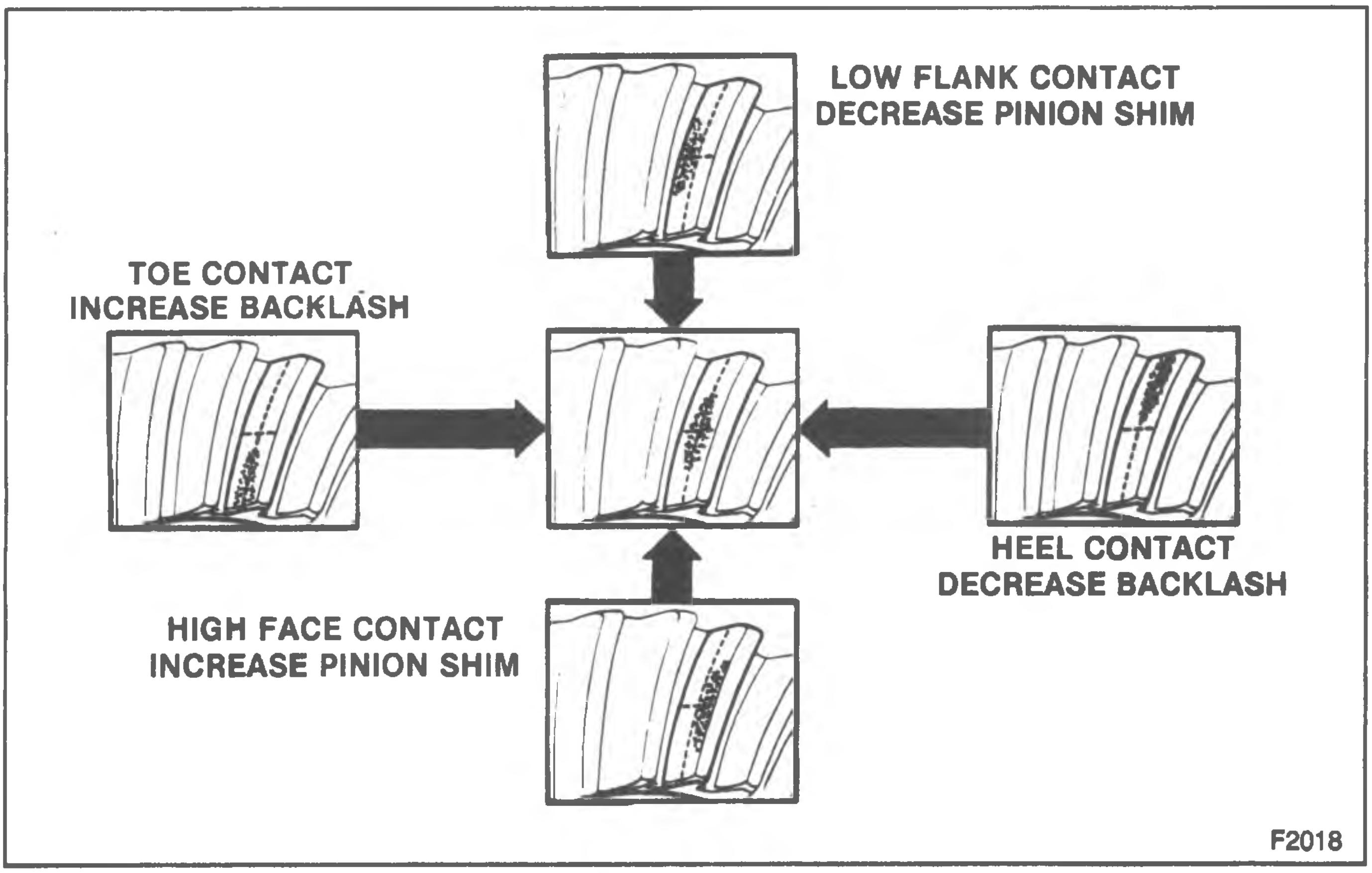


Figure 30—Gear Tooth Contact Pattern

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 31).
9. Seal (15). Use J 33799 (figure 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).
14. Thrust washer (20). Use grease to hold it in place.
15. Spring (16) and shift shaft and fork (17).

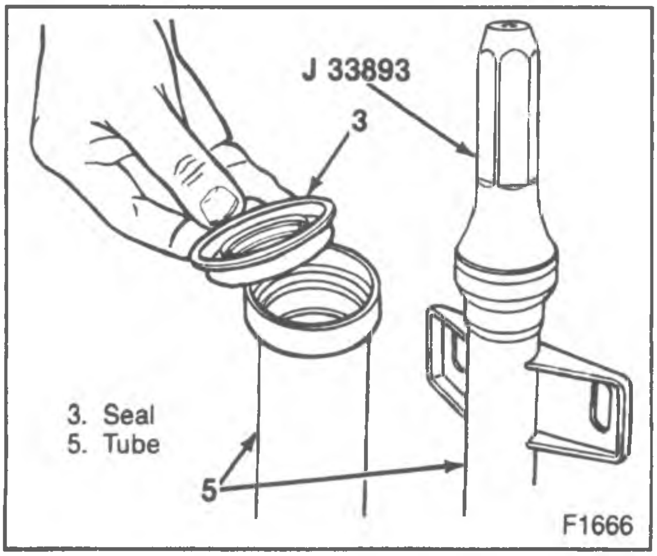


Figure 31—Installing the Shaft Seal

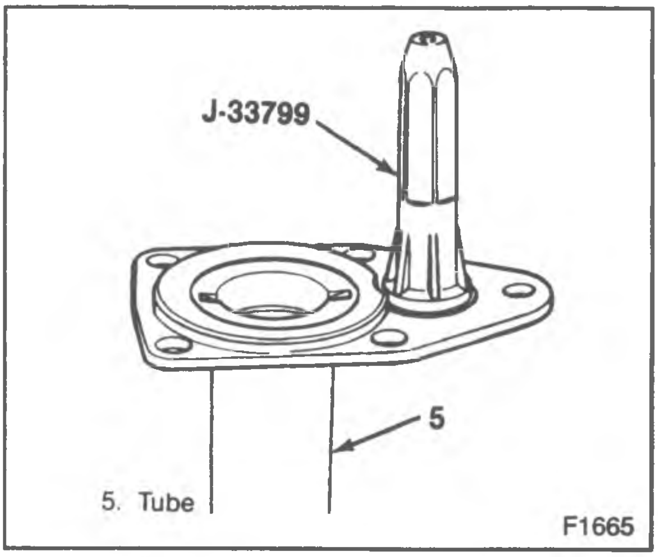


Figure 32—Installing the Shift Housing Seal

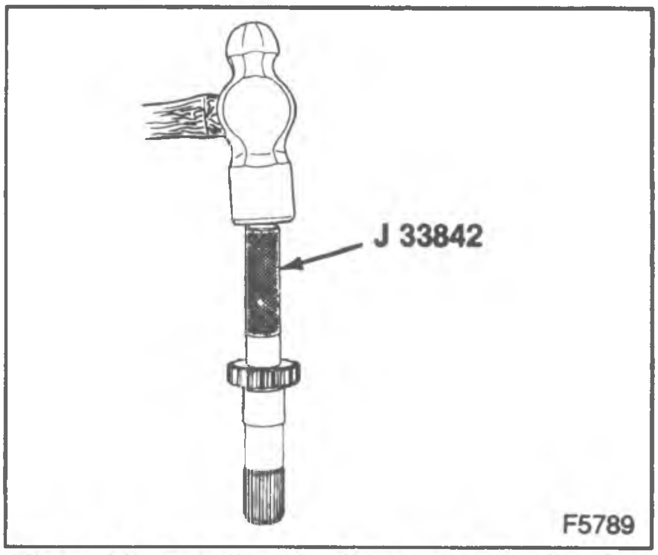


Figure 33—Installing the Differential Pilot Bearing

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).

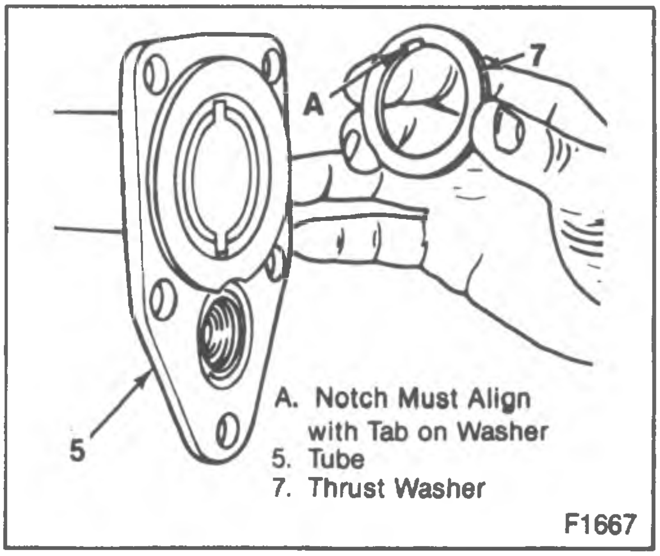


Figure 34—Installing the Thrust Washer

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 not 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 47 N.m (35 ft. lbs.).

22. Bushings (48). Use J 33791 (figure 15).

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.

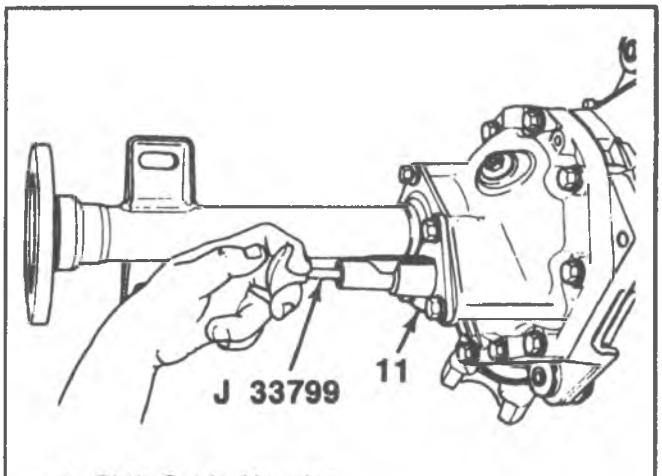


Figure 35—Checking the Shift Mechanism

DRIVE AXLE ASSEMBLY

OUTER DEFLECTOR RING

Remove or Disconnect (Figures 30 through 32)

1. Clamp the axle shaft (13) in a vise.
    - Use soft metal or wood to protect the shaft.
2. Deflector 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 deflector ring (21) at press diameter of C/V outer race (20).
2. Using a 3-inch pipe coupling, M24 x 2.0 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 36 and 39 through 42)

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 a chisel, and discard.

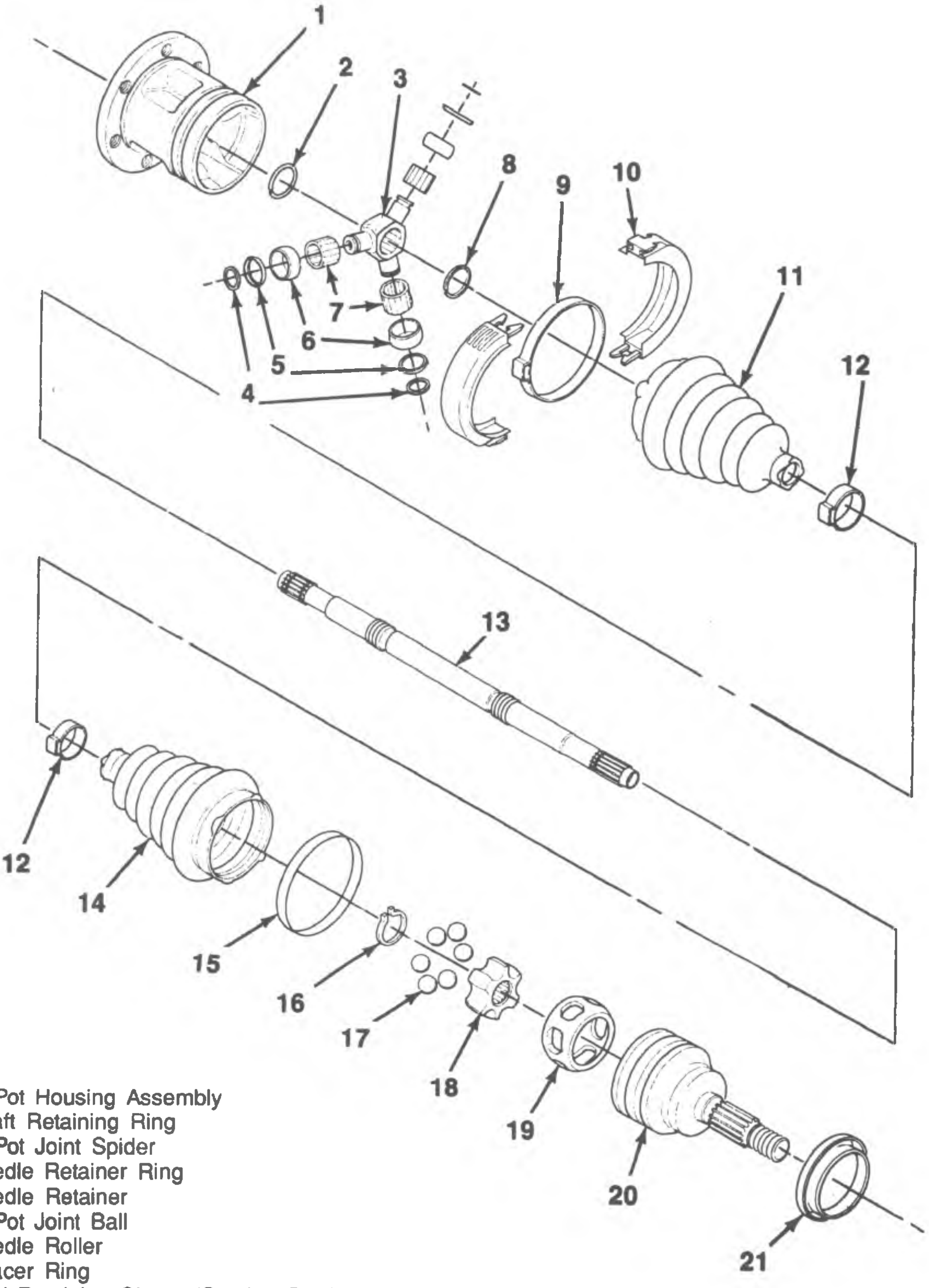
Important

- Do not cut through seal (14) and damage sealing surface of C/V outer housing (20) with the 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 before 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 the seal (14) onto axle shaft (13) and position neck of seal in seal groove on axle shaft.



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 36—Front Drive Axle

3. Crimp seal-retaining clamp (12) with J 35910 to 136 N·m (100 ft. lbs.). Refer to figure 41.
4. Place approximately half of the grease provided inside the seal (14) and pack 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 seal lip 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 let air escape. 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 (figure 42).
— Insert bolts and tighten by hand until snug.

Important

- Make sure that seal (14), housing (20) and swage ring (15) all remain in alignment (figure 42).

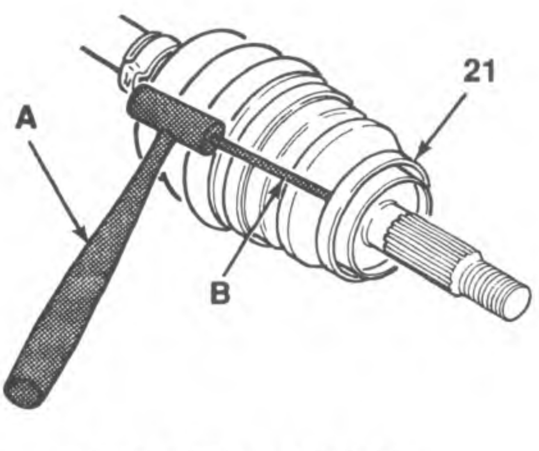
— Continue to tighten each bolt 180°at a time, alternating until both sides are bottomed.

9. Remove axle assembly from tool.

OUTER JOINT ASSEMBLY

Disassemble (Figures 36, and 43 through 45)

1. Remove outer joint seal. Refer to "Outer Joint Seal" in this section.
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) (figure 43).
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. Refer to figure 44.
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. Refer to figure 45.
8. Pivot inner race (18) into cage (19) window and remove inner race.

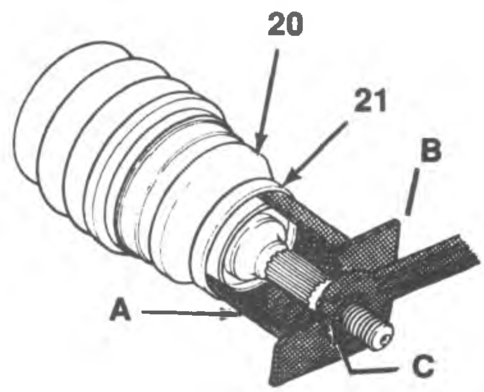


TAP DEFLECTOR RING OFF OUTER RING AND DISCARD

21. Deflector Ring
A. Hammer
B. Brass Drift

F7483

Figure 37—Removing Outer Deflector Ring



SQUARE UP DEFLECTOR RING AND TIGHTEN NUT UNTIL RING BOTTOMS AGAINST SHOULDER OF OUTER RACE

20. C/V Joint Outer Race
21. Deflector Ring
A. 3" Pipe Coupling
B. Sheet Steer (3 mm Min. Thickness) With 28 mm Drilled Hole
C. M24 x 2.0 Nut

F7484

Figure 38—Installing Outer Deflector Ring

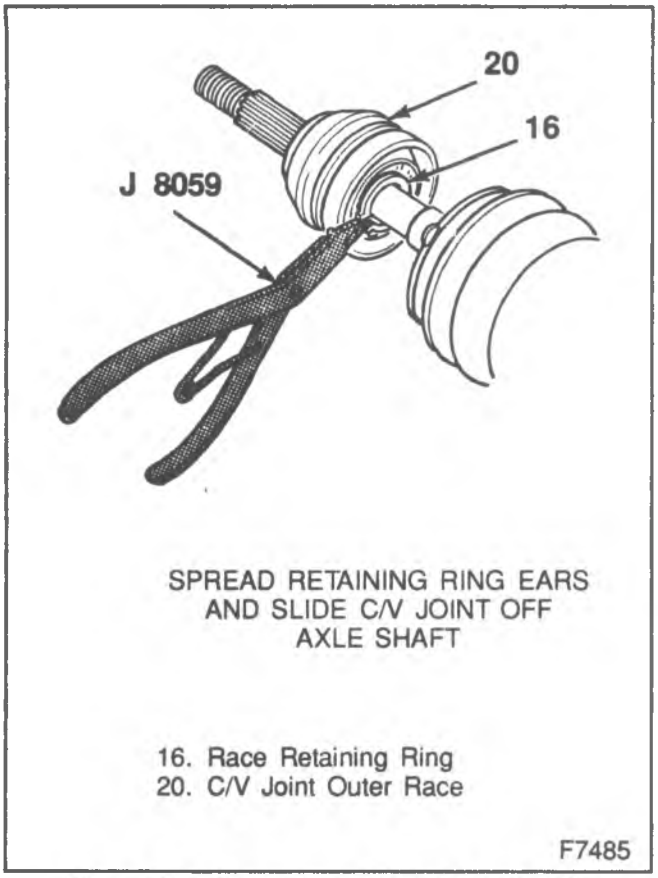


Figure 39—Separating C/V Joint and Axle

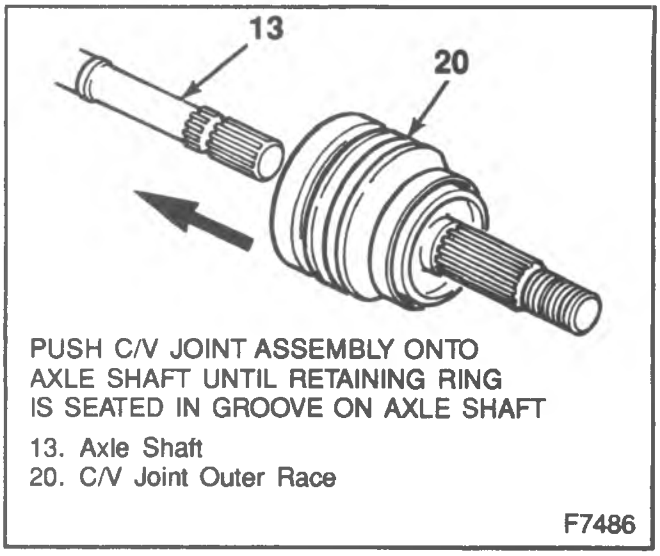


Figure 40—Installing C/V Joint to Axle

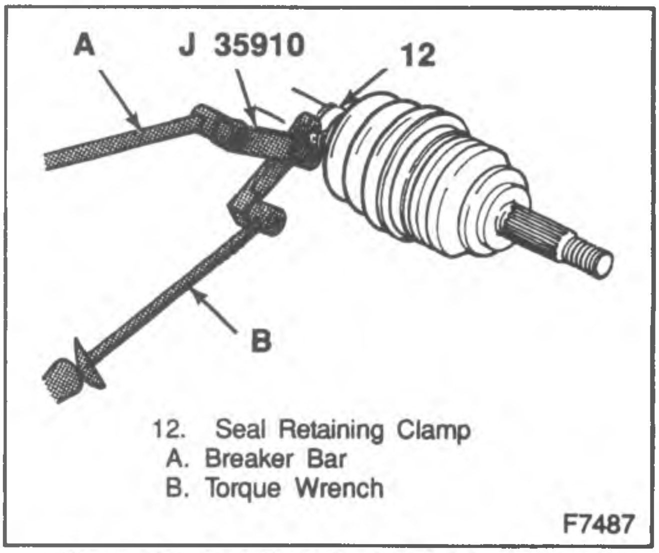


Figure 41—Installing Seal Retaining Clamp

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.

Important

- Be sure that retaining ring side of inner race (18) faces axle shaft (13).

3. Install outer joint seal. Refer to "Outer Joint Seal" in this section.

INNER TRI-POT SEAL

Remove or Disconnect (Figures 36, 41, and 46 and 47)

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).
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.

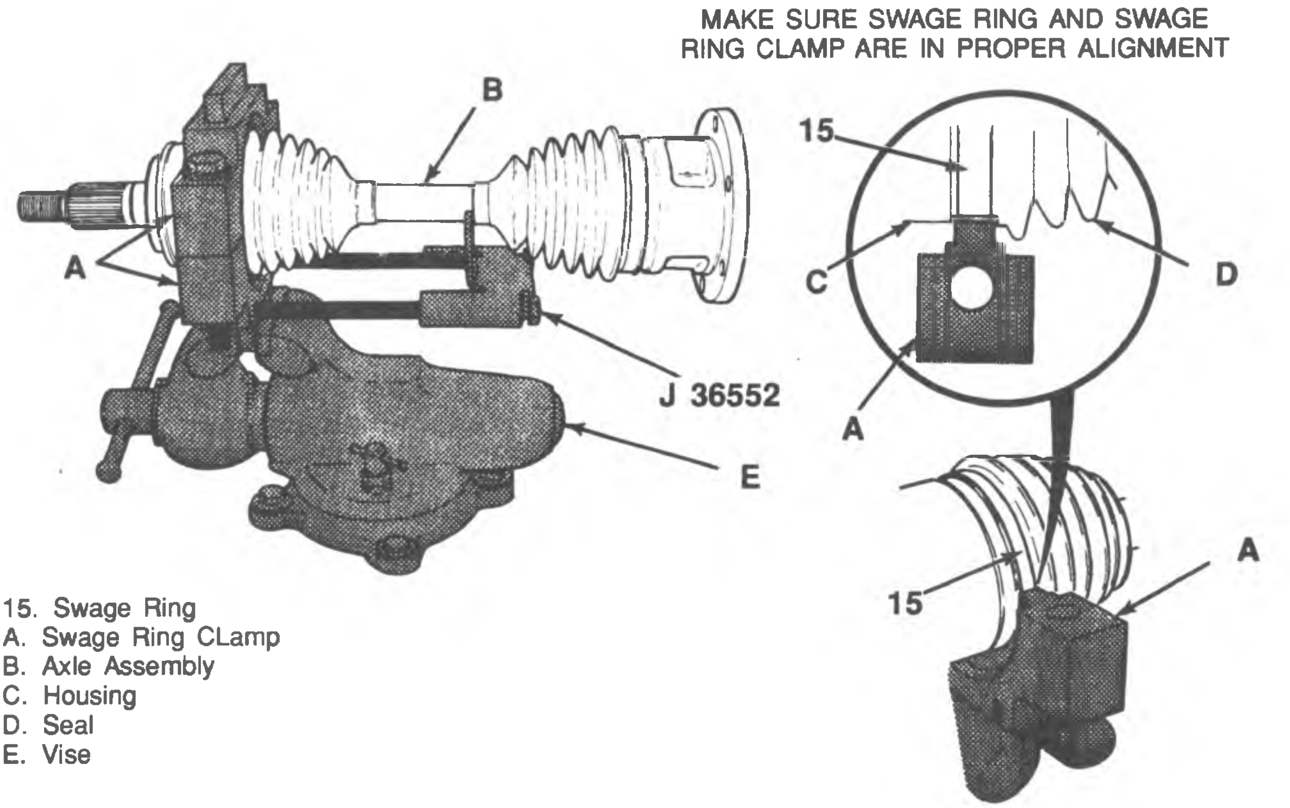
3. Small seal-retaining clamp (12) from axle shaft (13) with side cutter, and discard.
4. Seal (11) from tri-pot housing by separating (1) at large diameter and sliding seal away from joint along axle shaft (13).
5. Tri-pot housing (1) from spider (3) and shaft (13).
6. Spread spacer ring (8) with J 8059 and slide spacer ring and tri-pot spider (3) back on axle shaft (13) as shown in figure 47.
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.



15. Swage Ring
A. Swage Ring CLamp
B. Axle Assembly
C. Housing
D. Seal
E. Vise

F7488

Figure 42—Installing Swage Ring

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

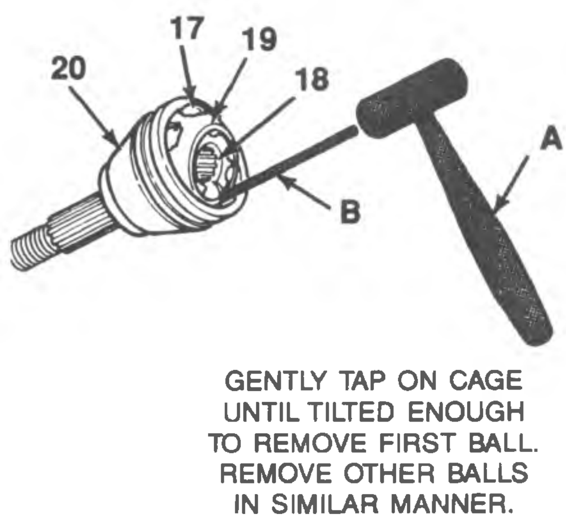
Install or Connect

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 in figure 41.
4. Spacer ring (8) on axle shaft (13) and beyond second 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).

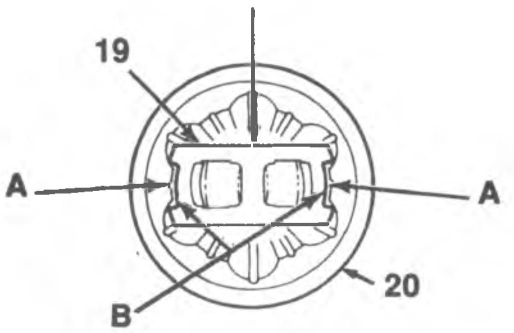
6. Install shaft retaining ring (2) in groove of axle shaft (13) with J 8059.



17. Ball
18. C/V Joint Inner Race
19. C/V Joint Cage
20. C/V Joint Outer Race
A. Hammer
B. Brass Drift

F7489

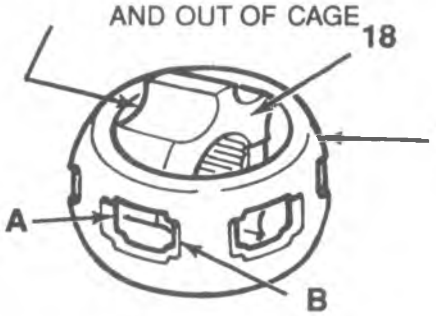
Figure 43—Removing C/V Joint Ball



19. C/V Joint Cage
20. C/V Joint Outer Race
A. Land
B. Window

F7490

Figure 44—Separating Outer Race and Cage

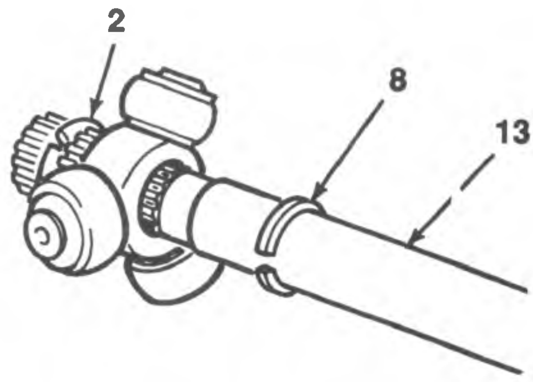


18. C/V Joint Inner Race
19. C/V Joint Cage
A. Inner Race Land
B. Cage Window

F7491

Figure 45—Separating Inner Race and Cage

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 pack 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 seal lip in housing groove.
12. Position the tri-pot assembly at the proper vehicle dimension as shown in figure 49.



2. Shaft Retaining Ring
8. Spacer Ring
13. Axle Shaft
A. Spider Assembly

F7492

Figure 46—Removing Spider Assembly

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 let air escape. 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 41.

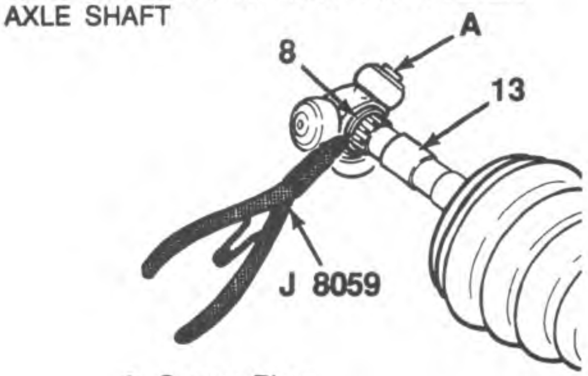
Important

- 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

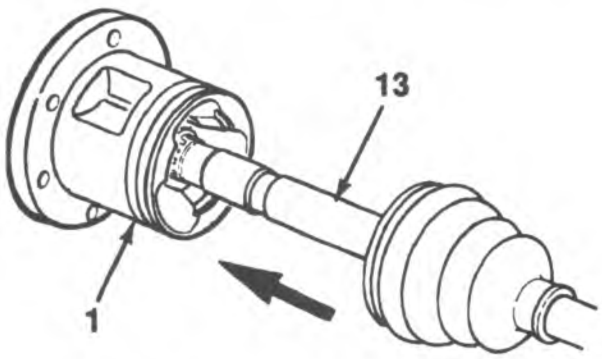
- Due to possible road hazards, a retaining clamp protector (10) must be installed when inboard seal or clamp is serviced.



8. Spacer Ring
13. Axle Shaft
A. Spider Assembly

F7493

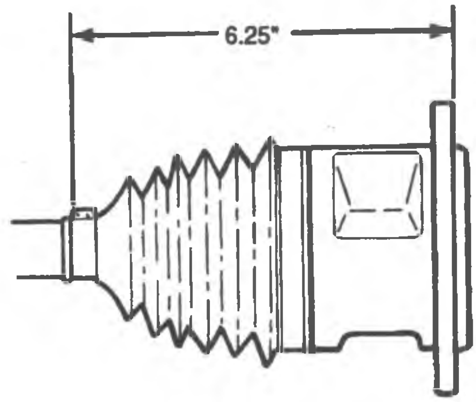
Figure 47—Installing Spider Assembly



1. Tri-Pot Housing Assembly
13. Axle Shaft

F7494

Figure 48—Installing Tri-pot to Housing



F7495

Figure 49—Tri-pot Seal Installation Measurement

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

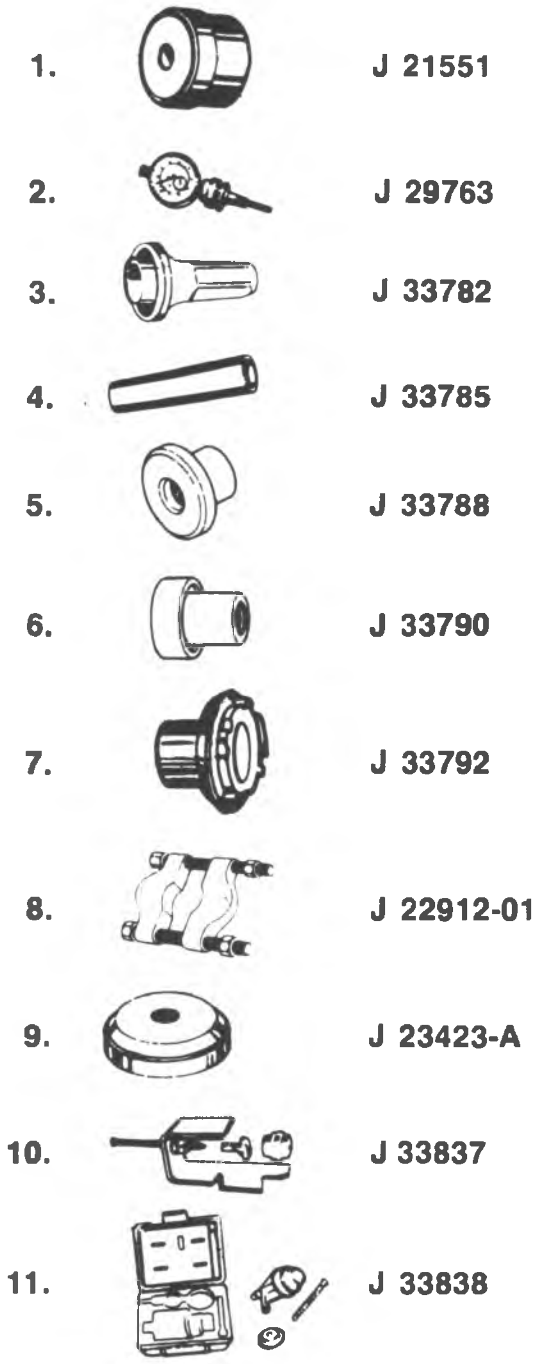
Pinion Shim Kits	0.53-0.64 mm 0.66-0.79 mm 0.81-0.94 mm

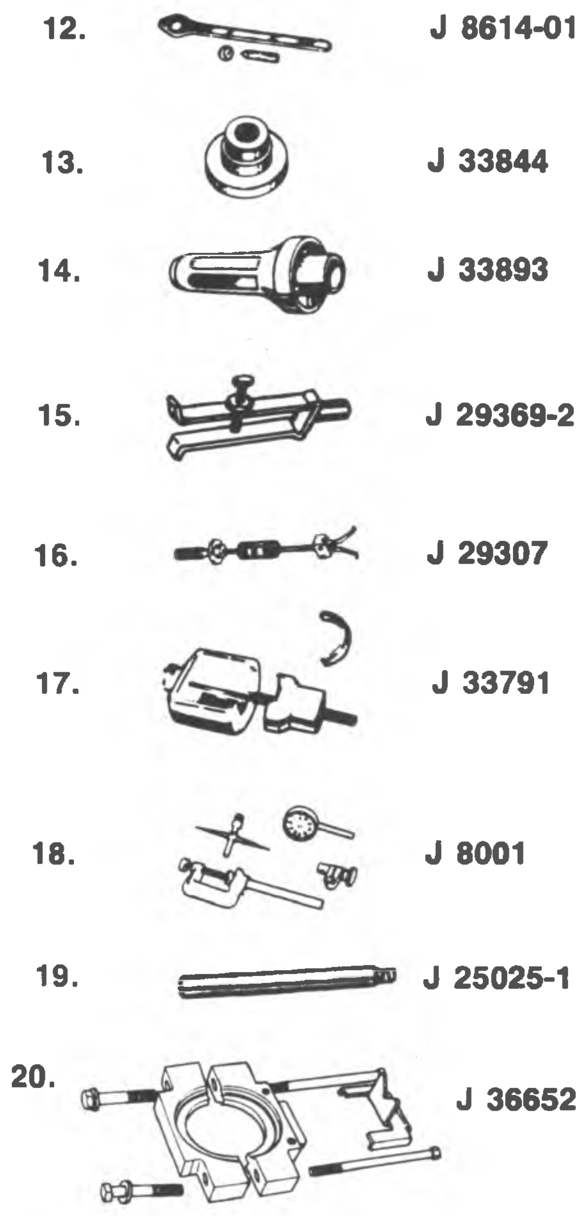
PINION PRELOAD AND BACKLASH

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. 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 4C4

8 1/4 AND 9 1/4-INCH RING GEAR

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

DESCRIPTION

The front axle used 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. The axle is shifted by a thermally actuated solenoid.

The axle uses a conventional ring and pinion gear set to transmit the driving force of the engines 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 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 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 gear are located in relationship to the pinion by using threaded adjusters.

The axle identification is an alphabetic broadcast code located on a tag attached to the right axle tube.

The axle is produced with 8 1/4-inch and 9 1/4-inch ring gears. The 8 1/4-inch ring gear is used on K1,2 models; the 9 1/4-inch ring gear is used on K3 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. 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 18)

Tools Required:

J 29369-1 Bearing Remover (K1, 2 Models)
J 29369-2 Bearing Remover (K3 Models)
J 29307 Slide Hammer
J 34011 Pilot Bearing Remover
J 36599 Adjusting Sleeve Wrench
J 36615 Adjuster Plug Wrench (K3 Models)
J 8614-01 Pinion Remover
J 36598 Holding Fixture and Pinion Service Tool
J 8612-B Pinion Bearing Remover (K1, 2 Models)
J 36606 Pinion Bearing Remover (K3 Models)
J 22888-D Side Bearing Puller
J 8107-2 Side Bearing Puller Pilot (K1, 2 Models)
J 36597 Side Bearing Puller Pilot (K3 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) (K1, 2 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) (K3 models) (figure 4).
11. Shaft (1) with deflector (2).
12. Seal (3) and bearing (4). Use J 29369-1 (K1, 2 models) or J 29369-2 (K3 models) with J 29307 (figure 5).
13. Output shaft (23).
14. Differential pilot bearing (21). Use J 34011 (figure 6).
15. Shaft (59) with deflector (2) using tool J 2619-1 (figure 7).
16. Seal (3). Pry out with seal removal tool.
17. Bearings (30). Use the tools listed in step 12.
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 K3).
21. Bolt (64) and lock (63) (K3 models).
22. Sleeve(s) (32) and side bearing (33) cups (right side only on K3).
   - Turn the sleeve(s) to push the bearing cup(s) out of the bore(s). Use J 36599 (figure 8).
23. Adjuster plug (61) with side bearing cup (33) and O-ring (62) (K3 models). Use J 36615 (figure 9).
24. Nut (46). Use J 8614-01 to hold the pinion flange (figure 10).
25. Flat washer (45).
26. Flange (44) with deflector (43). Use J 8614-01 (figure 11).
   - Mount the left carrier case in J 36598. Be sure to use the adapter plate (J 36598-6) for K1, 2 models.
27. Pinion (37) with shim (38), bearing cone (39), and spacer (40). Use J 36598 (figure 12).
28. Spacer (40) from the pinion.
29. Pinion bearing (39). Use J 8612-B (K1, 2 models) or J 36606 (K3 models) and a press (figure 13).
30. Shim (38).
31. Seal (42), and bearing cup and cone (41). Use J 36598 (figure 14).
32. Bearing cup (39). Use J 36598 (figure 15).
33. Side bearings (33). Use J 22888-D and J 8107-2 (K1, 2 models) or J 36597 (K3 models) (figure 16).
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) (K1, 2 models). Drive out with a drift and hammer (figure 17).
37. Bolt (24) (K3 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) (K3 models only).
40. Vent plug (60). Use a 6-point deep socket.
41. Bushings (48). Use J 36616 (figure 18).

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 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 scoring.

PINION AND RING GEAR

Inspect

- Pinion and ring gear teeth for cracking, chipping, scoring, or excessive wear.
- Pinion gear splines for wear.
- Pinion flange splines for wear.
- Fit of the pinion flange on the pinion gear.
- Sealing surface of the pinion flange for nicks, burrs, or rough tool marks which would cause damage to the inside diameter of the pinion seal and result in an oil leak.
- Replace all worn or broken parts.
- Ring and pinion gears are matched sets and must both be 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 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 very small 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

- 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.

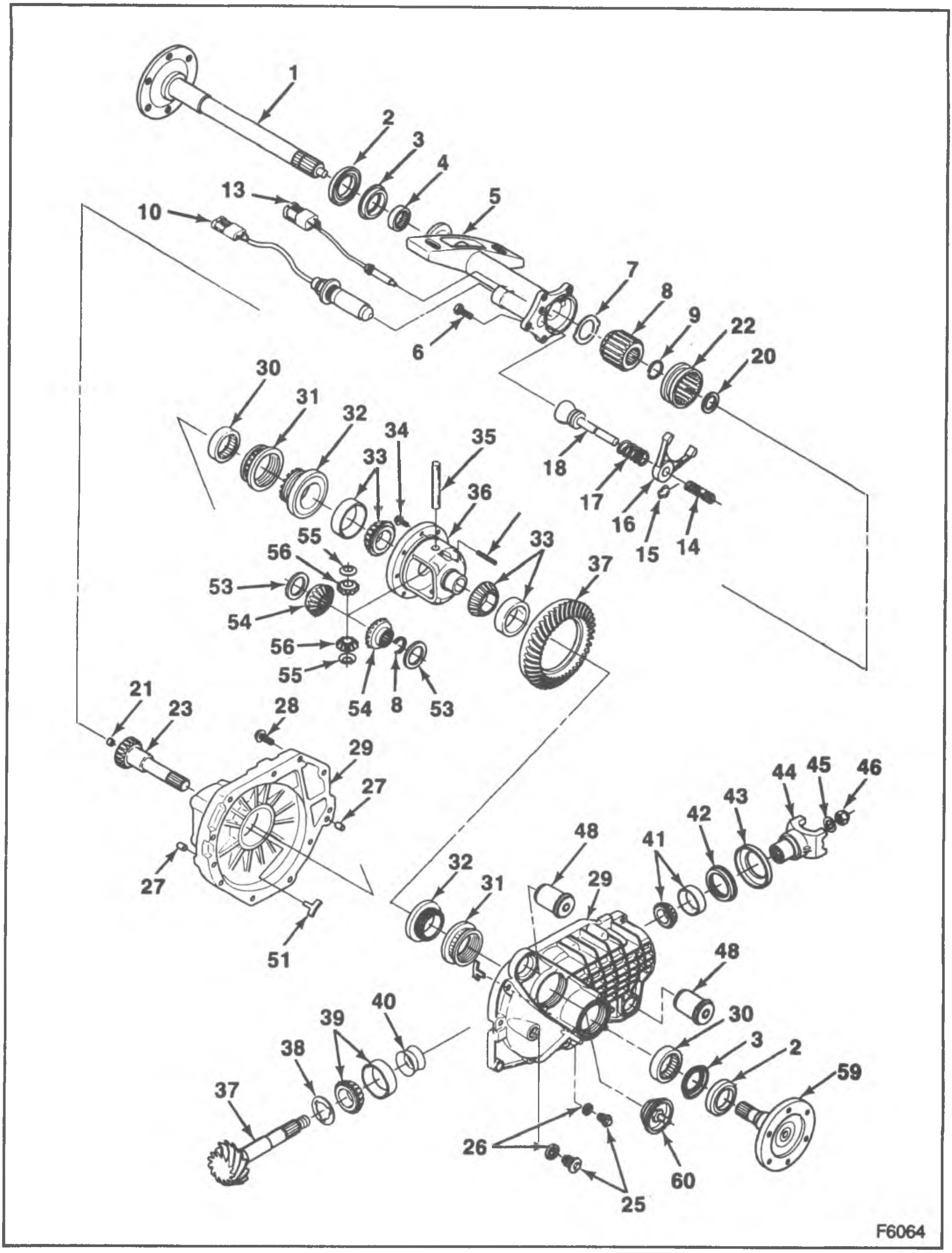


Figure 1—Front Axle Components (K1, 2 Models)

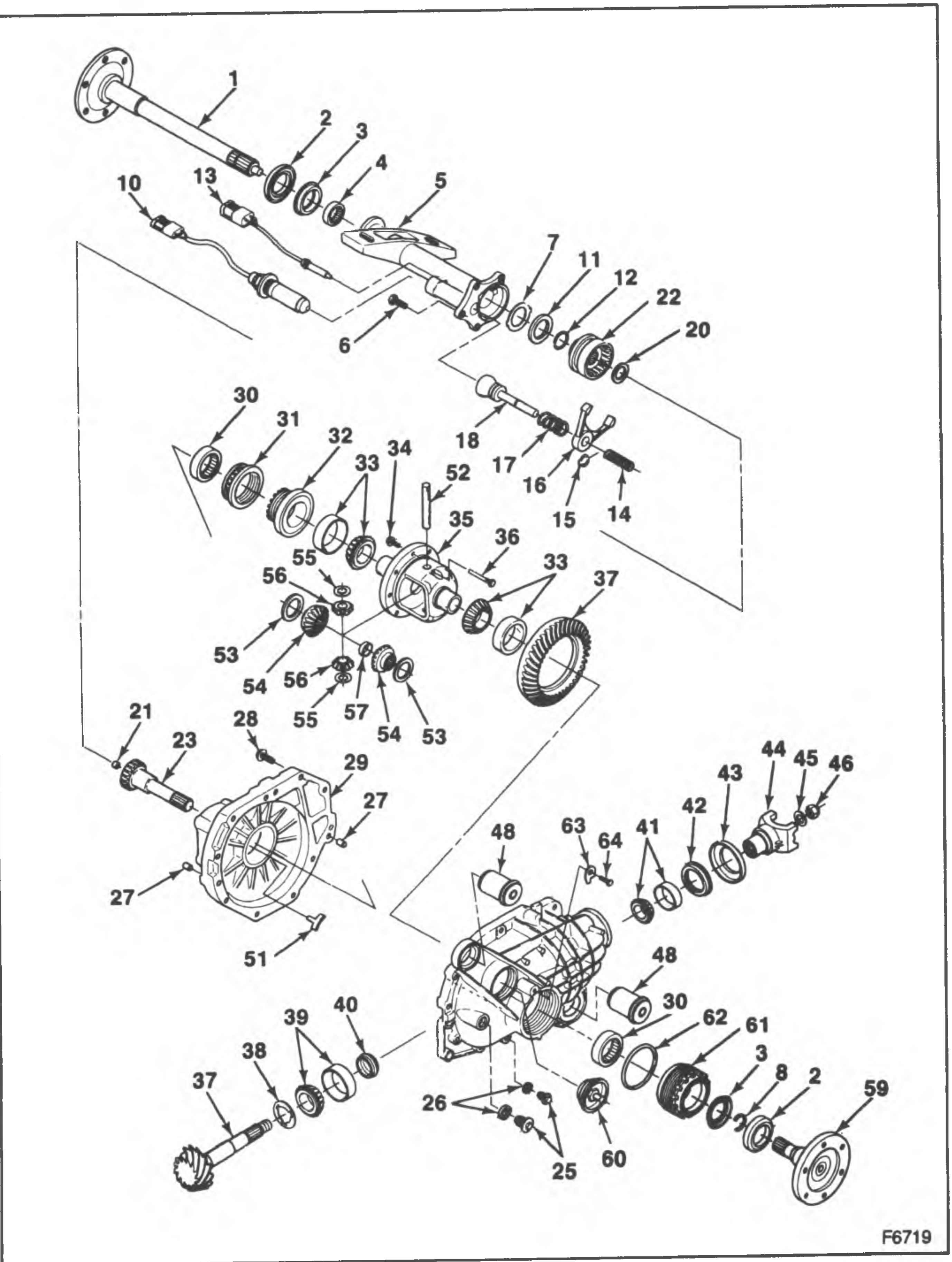


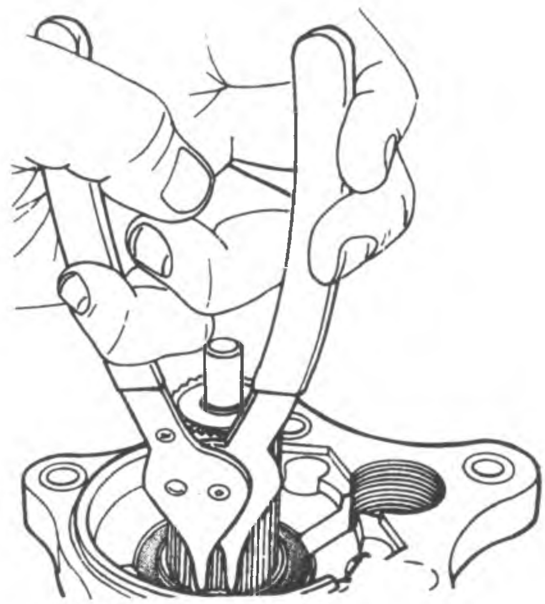
Figure 2—Front Axle Components (K3 Models)

1. Right Output Shaft
2. Deflector
3. Seal
4. Output Shaft Bearing
5. Axle Tube
6. Bolt
7. Thrust Washer
8. Retaining Ring
9. Connector
10. Differential Actuator
11. *Washer
12. *Retaining Ring
13. Engagement Switch
14. Shifter Fork Spring
15. Shifter Shaft Ring
16. Shift Fork
17. Damper Spring
18. Shifter Shaft
20. Shim
21. Pilot Bearing
22. Differential Sleeve
23. *Inner Output Shaft
25. Fill/Drain Plug
26. Washer
27. Pin
28. Bolt
29. Carrier Case
30. Differential Case Bearing
31. Insert
32. Sleeve
33. Side Bearing
34. Ring Gear Bolt
35. Differential Case
36. Pin
37. Ring and Pinion Gears
38. Pinion Shim
39. Pinion bearing
40. Spacer
41. Pinion Bearing
42. Seal
43. Deflector
44. Pinion Flange
45. Washer
46. Nut
48. Mounting Bushing
51. Lock
52. Pinion Shaft
53. Thrust Washer
54. Side Gear
55. Thrust Washer
56. Differential Pinion Gear
57. *Spacer
59. Left Output Shaft
60. Vent Plug
61. *Adjuster
62. *O-Ring
63. *Retainer Tab
64. *Bolt

*Components Unique to K3

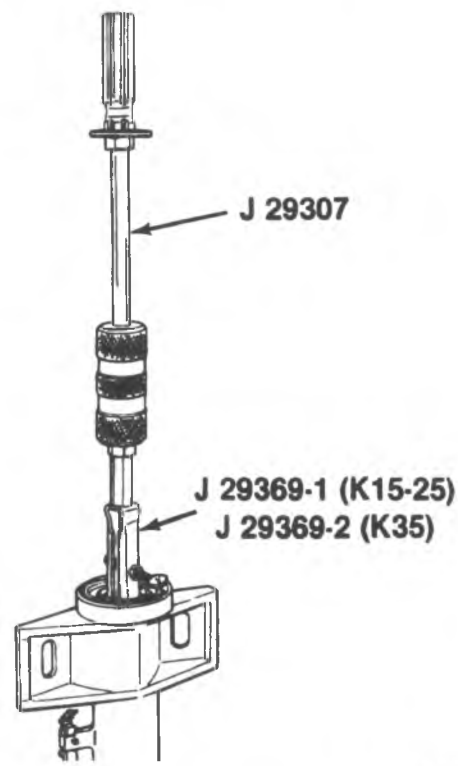
F9575

Figure 3—Front Axle Components (K1, 2,3 Models)



F5797

Figure 4—Removing the Snap Ring (K3 Models)



F5856

Figure 5—Removing the Axle Bearing

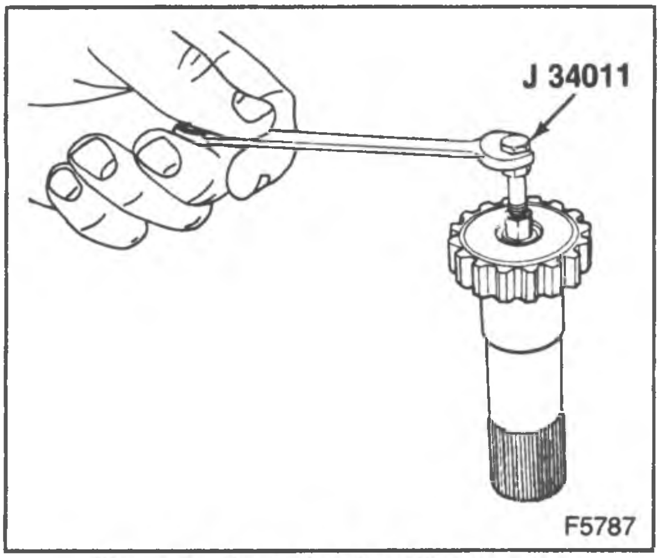


Figure 6—Removing the Pilot Bearing

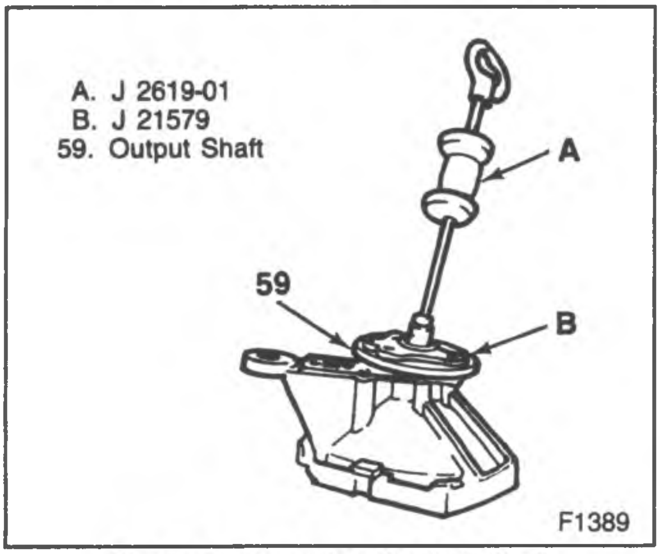


Figure 7—Removing the Left Shaft

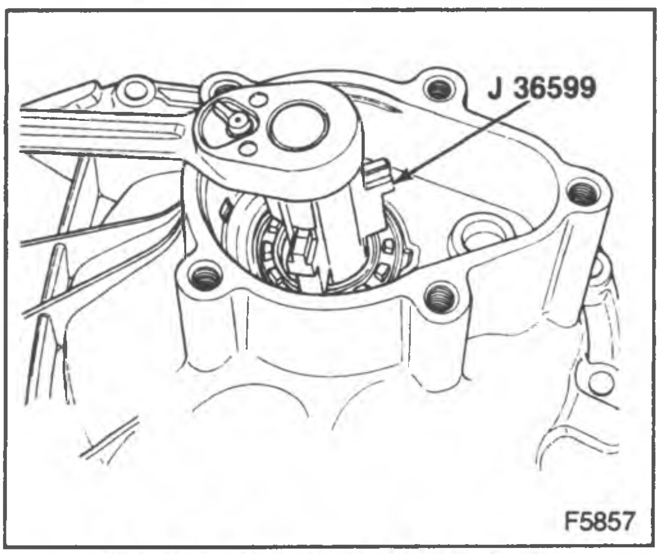


Figure 8—Turning the Adjuster Sleeve

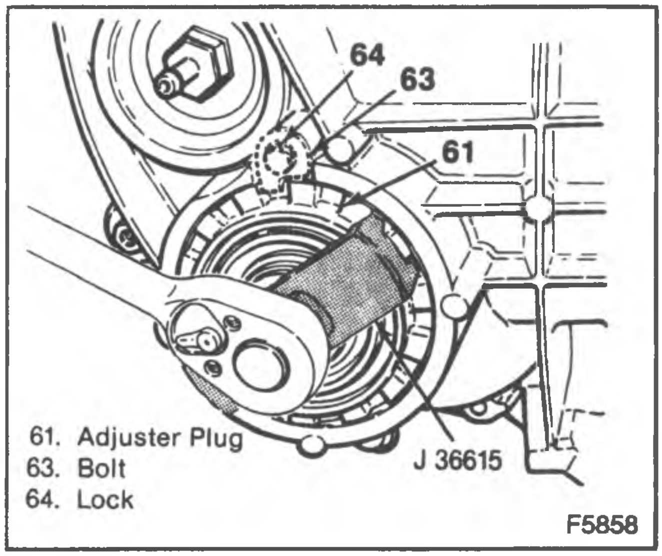


Figure 9—Turning the Adjuster Plug (K3 Models)

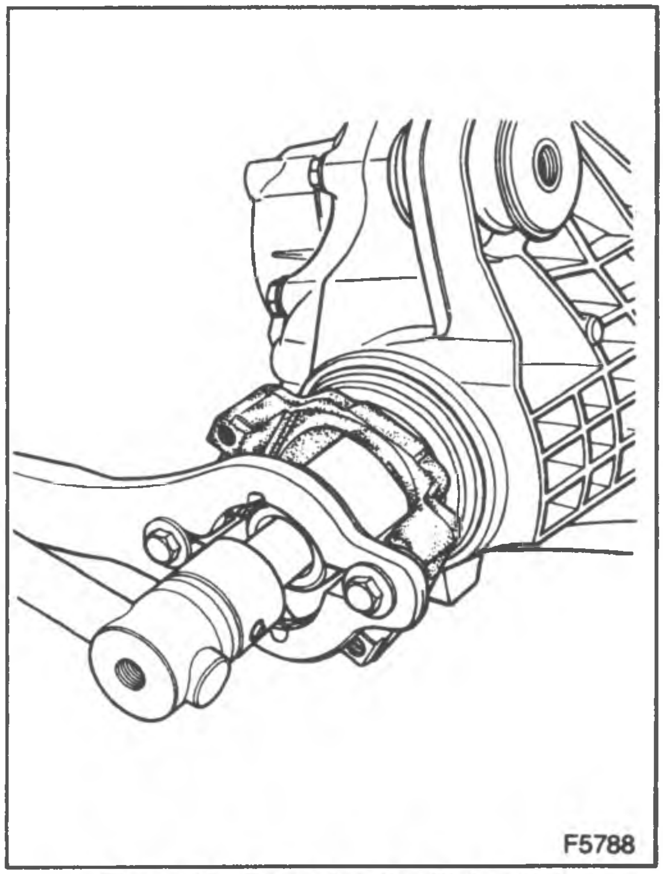


Figure 10—Removing the Pinion Nut

- Spring (16) for breakage.
- Actuator (10) and engagement 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.

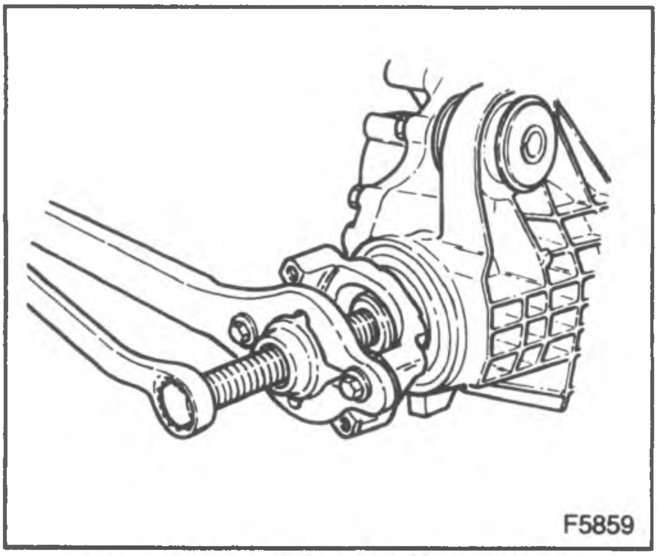


Figure 11—Removing the Pinion Flange

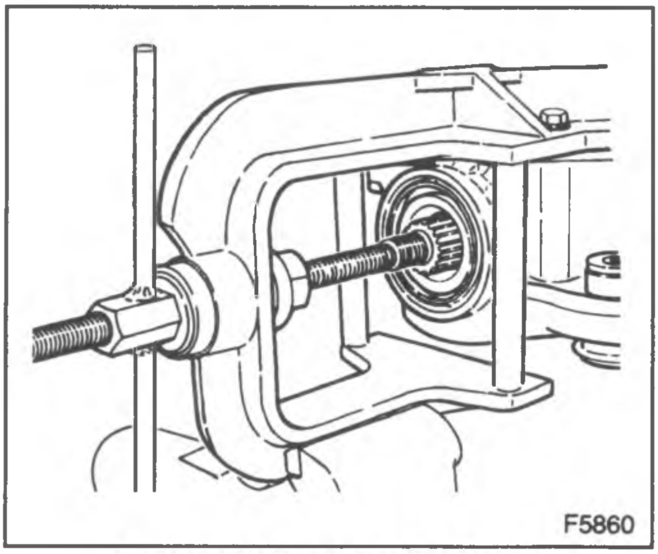


Figure 12—Removing the Pinion

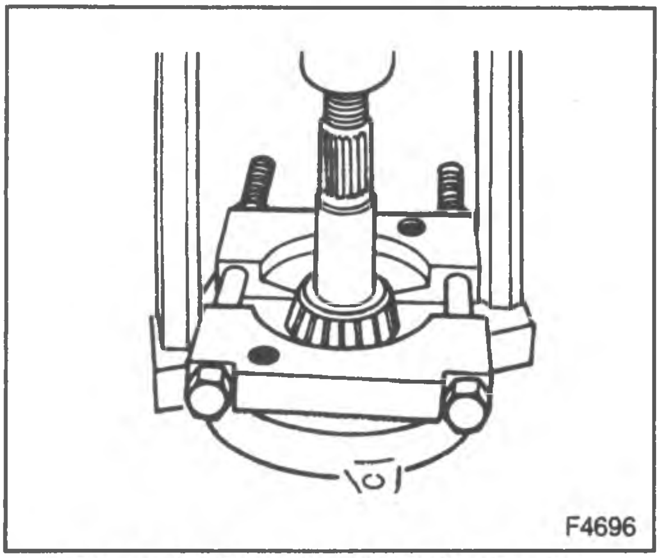


Figure 13—Removing the Pinion Bearing

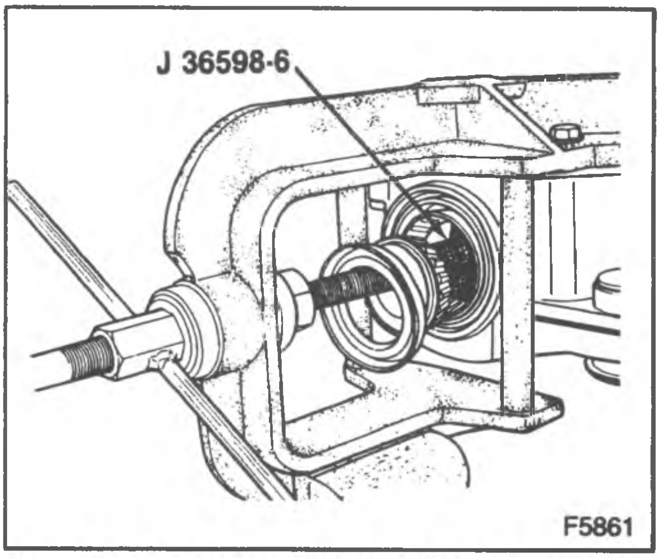


Figure 14—Removing the Outer Pinion Bearing and Seal

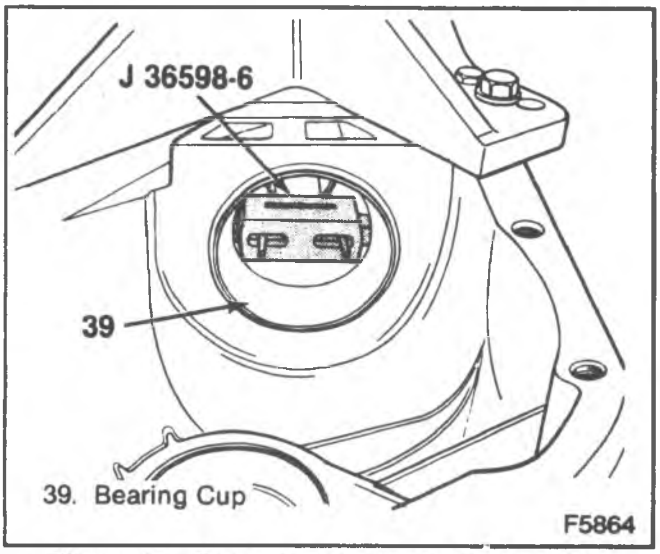


Figure 15—Removing the Inner Bearing Cap

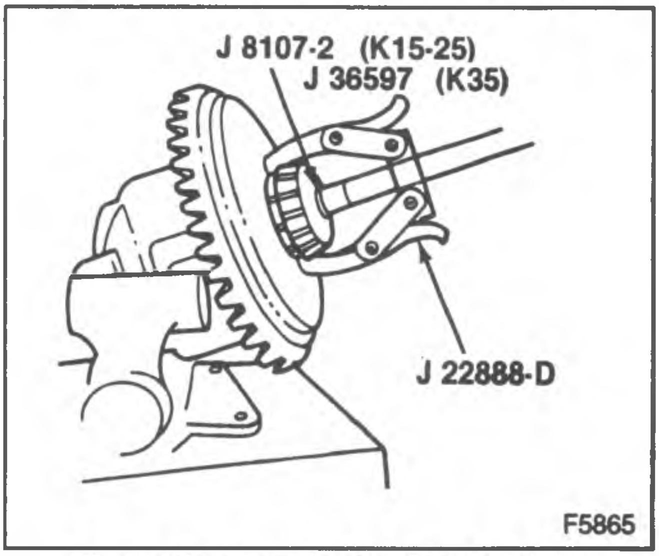


Figure 16—Removing the Side Bearings

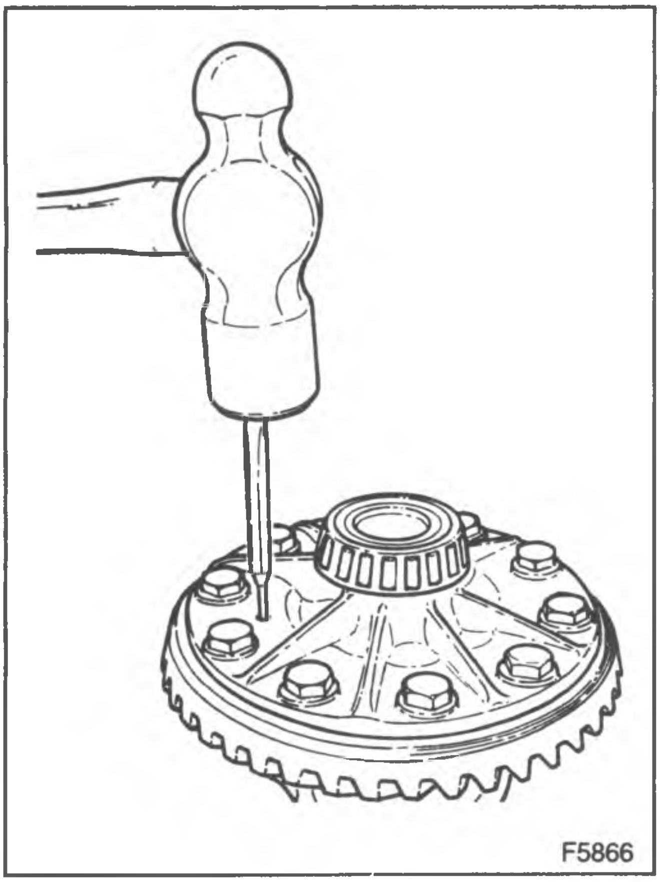


Figure 17—Removing the Pin (K1, 2 Models)

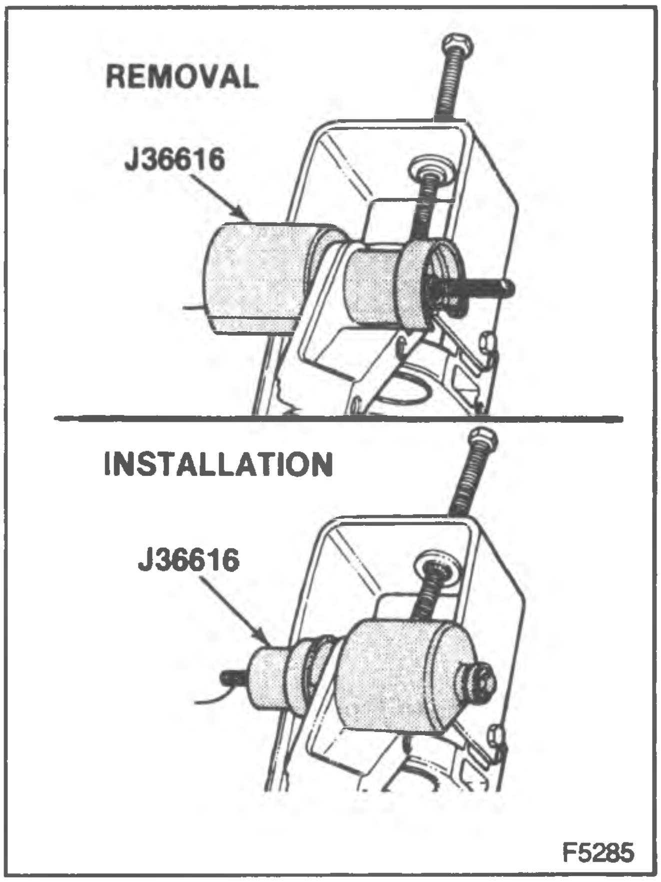


Figure 18—Replacing the Carrier Bushings

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 3, 19, and 20)

Tool Required:
J 36598 Holding Fixture and Pinion Service Tool

- Mount the left carrier case in J 36598. Use the J 36598-6 adapter late for K1, K2 models. Tighten the attaching bolts securely.

1. Outer bearing cup (40). Use the forcing screw and J 36598-3 (K1, 2) or J 36598-4 (K3) (figure 19).
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 (K1, 2 models) or J 36598-4 (K3 models) on the forcing screw (figure 20).
   - 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 20).

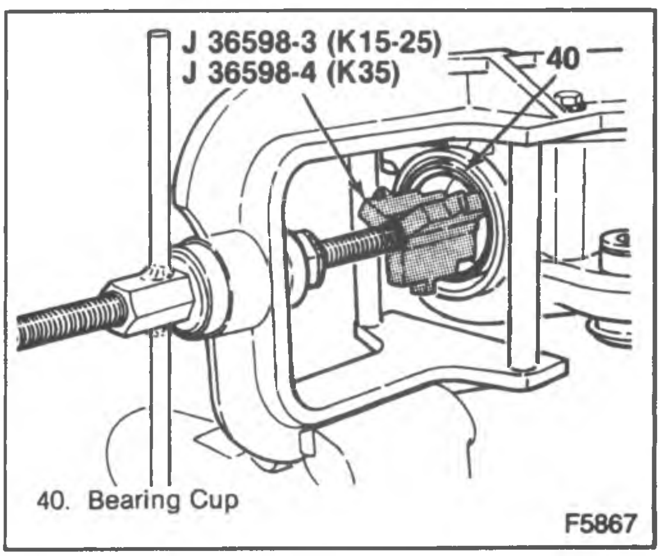


Figure 19—Installing the Outer Pinion Bearing Cup

PINION DEPTH ADJUSTMENT

Tools Required:
J 36601 Pinion Depth Setting Gage
J 29763 Dial Indicator

1. Refer to figures 1 through 3 and 21.
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 K1, 2 models, J 36601-3 for K3 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, 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.) 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 3/4 turns.
10. Tighten the dial indicator in this position.
11. Set the button of J 36601 on the differential bearing bore (figure 21).
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 21). 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 3 and 11, 22 and 23)

Tools Required:
J 35512 Bearing Installer (K1, 2 Models)
J 36614 Bearing Installer (K3 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 (K1, 2 models) or J 36614 (K3 models) (figure 22).
3. New spacer (40) onto the pinion gear.
4. Bearing (41) into the case.
5. Seal (42) into the case using J 36366 (figure 23).
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 10).
   - No further tightening should be attempted until the bearing preload has been checked.

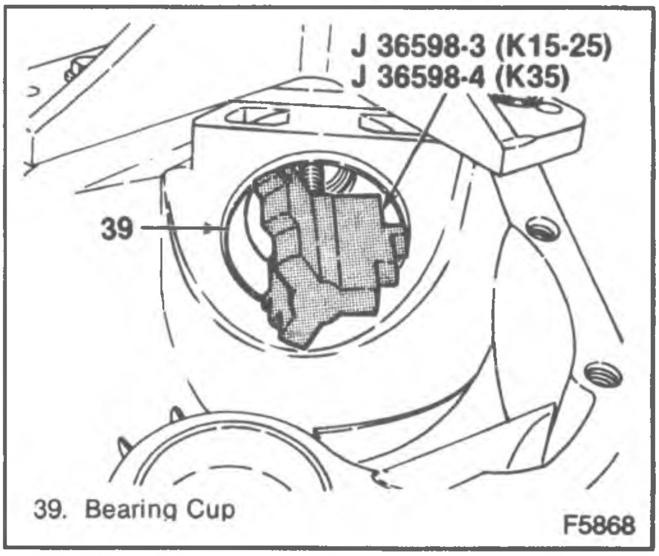


Figure 20—Installing the Inner Pinion Bearing Cup

Measure (Figure 24)

- Pinion bearing preload. Use an inch pound torque wrench (figure 24). 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 will increase 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 3, and 25)

Tools Required:
J 22761 Side Bearing Installer (K1, 2 Models)
J 29710 Side Bearing Installer (K3 Models)
J 8092 Driver Handle

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 they were removed from.
2. Pinion gears (56).

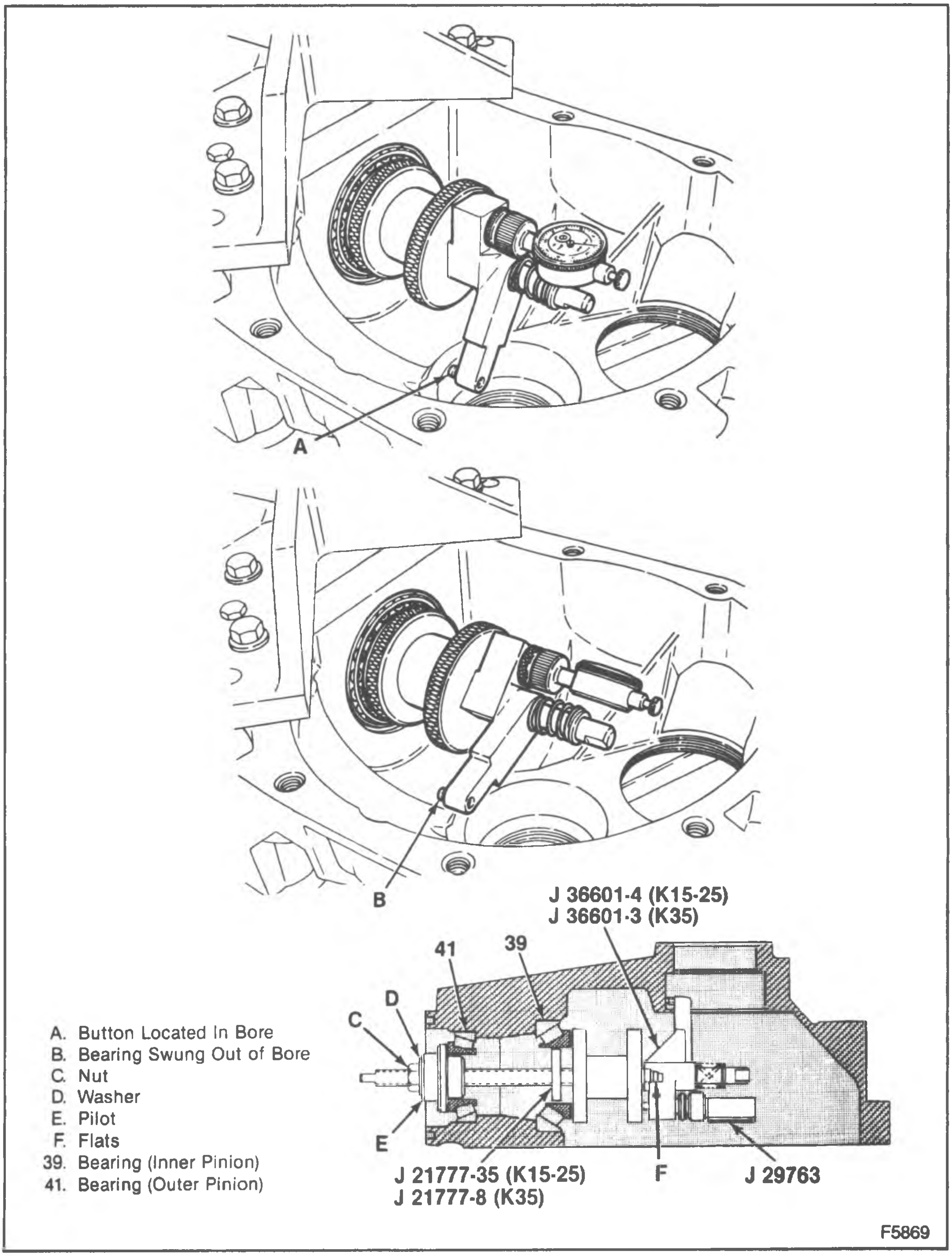


Figure 21—Measuring Pinion depth

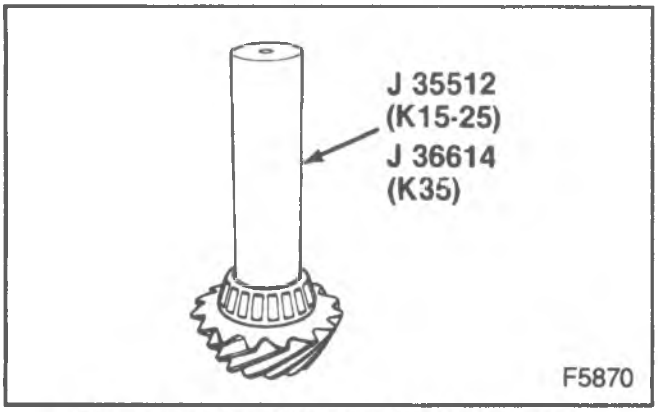


Figure 22—Installing the Pinion Bearing

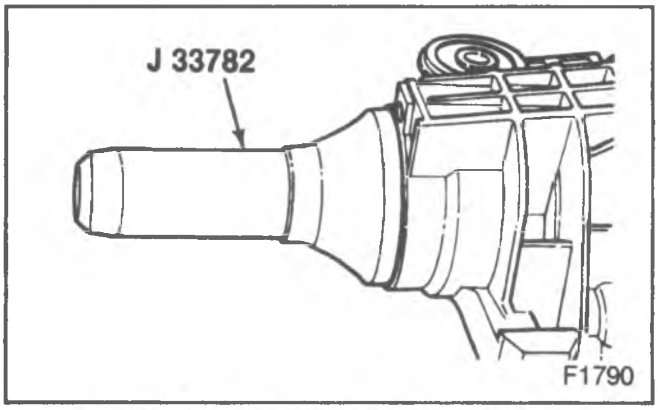


Figure 23—Installing the Pinion Seal

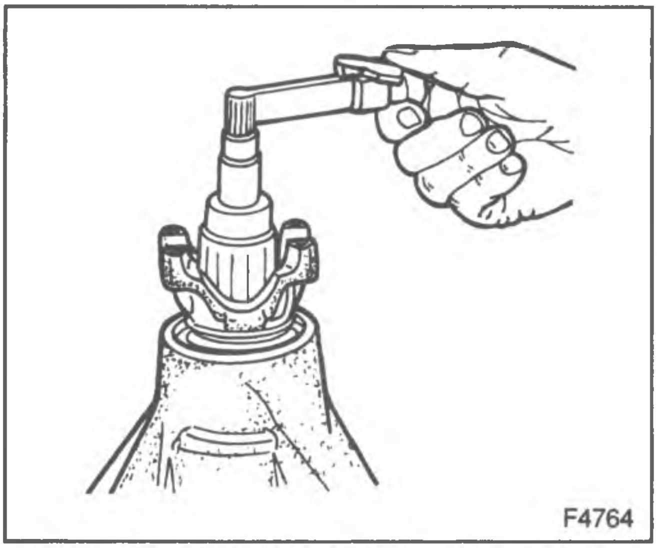


Figure 24—Measuring Pinion Bearing Preload

- 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) (K1, 2 models) or bolt (24) (K3 models).

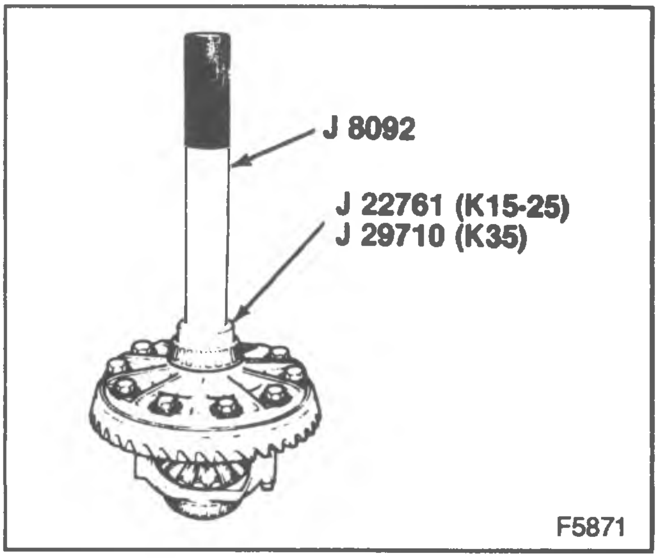


Figure 25—Installing the Differential Side Bearing

5. Ring gear (37) onto the differential case (35).

NOTICE: See "NOTICE" on page 4C4-1 of this section.

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 (K1, 2 models) or J 29710 (K3 models) and J 8092 (figure 25).

DIFFERENTIAL ASSEMBLY INSTALLATION

Install or Connect (Figures 1 through 3 and 26 through 29)

Tools Required:
- J 36612 Bearing Installer (K1, 2 Models)
- J 36613 Bearing Installer (K3 Models)
- J 8092 Driver Handle
- J 36599 Sleeve Adjusting Wrench
- J 36615 Adjuster Plug Wrench (K3 Models)
- J 36603 Side Bearing Cup Installer

1. Bearings (30) to the sleeves (32) and/or adjuster plug (61) (K3 models). Use J 8092 and J 36612 (K1, 2 models) or J 36613 (K3 models) (figure 26).
2. New O-ring (62) to the adjuster plug (61) (K3 models).
3. Sleeves (32) and/or adjuster plug (61) to the carrier case (29).
   - K1, 2 models: Use J 36599 (figure 27).
   - K3 models: Use J 36599 for the right sleeve (figure 27). Use J 36615 for the adjuster plug (figure 28).

4. Side bearing cups (33). Use J 36603 with J 8092 (figure 29).
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) (K1, 2 models) or adjuster plug (61) (K3 models) in until backlash is felt between the ring and pinion.
     - K1, 2 models: Use J 36599 (figure 27).
     - K3 models: Use J 36615 (figure 28).
- 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 27).
7. Bolts (28).

Tighten

- Bolts (28) 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

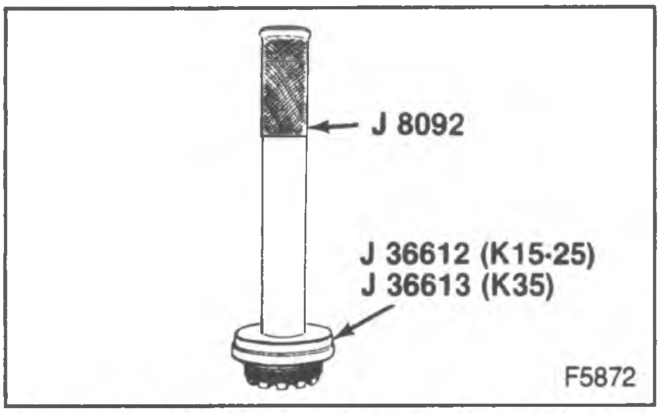


Figure 26—Installing the Adjuster Sleeve Bearing

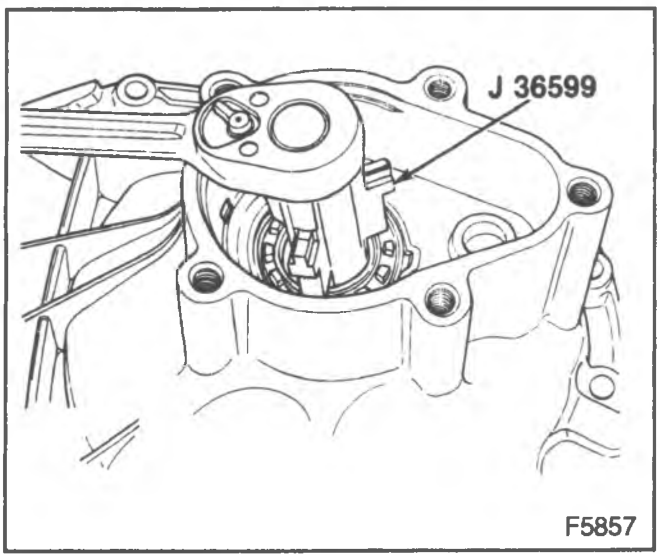


Figure 27—Turning the Adjuster Sleeve

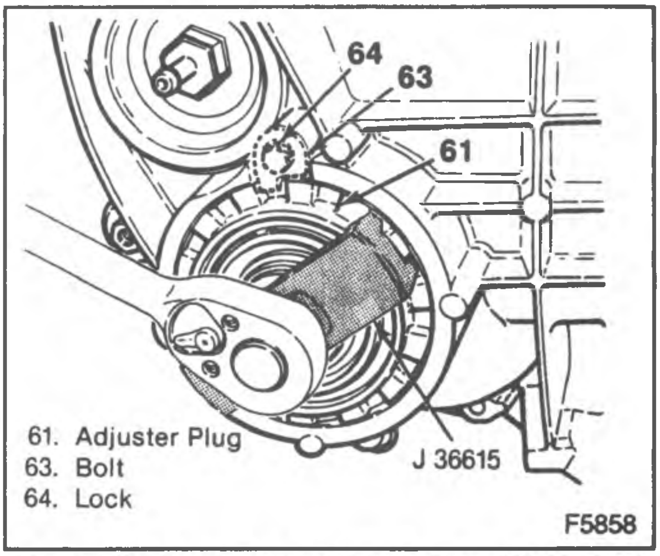


Figure 28—Turning the Adjuster Plug (K3 Models)

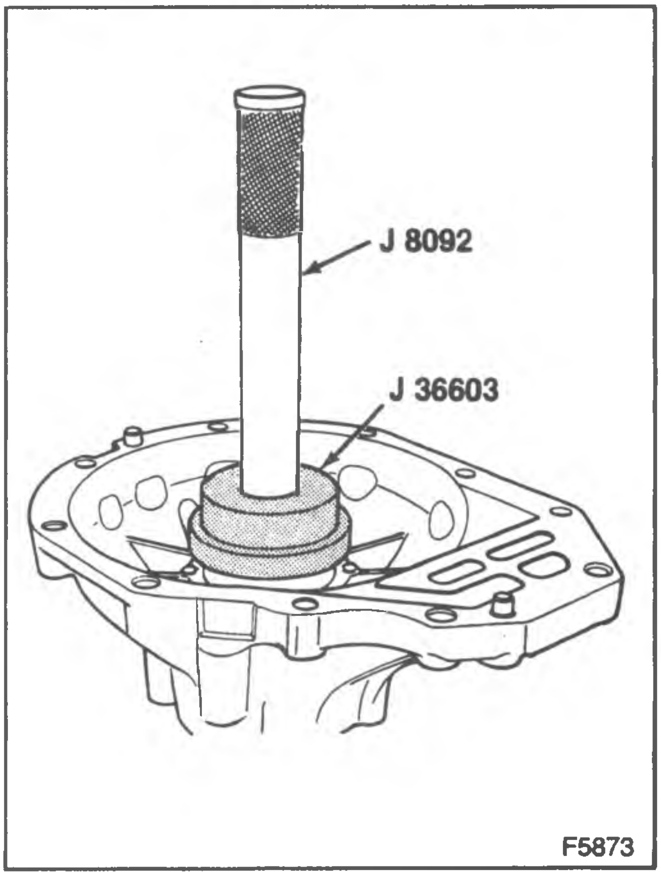


Figure 29—Installing the Side Bearing Cups

1. Refer to figures 1 through 3
2. Tighten the right sleeve (32) to 140 N·m (100 ft. lbs.). Use J 36599 (figure 27).
3. Tighten the left sleeve (32) (K1, 2 models) or adjuster plug (61) (K3 models) to 140 N·m (100 ft. lbs.).
   - Use J 36599 (K1, 2 models) (figure 27).
   - Use J 36615 (K3 models) (figure 28).
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 (K1, 2 models) or adjuster plug (K3 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 30.
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 identical 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).

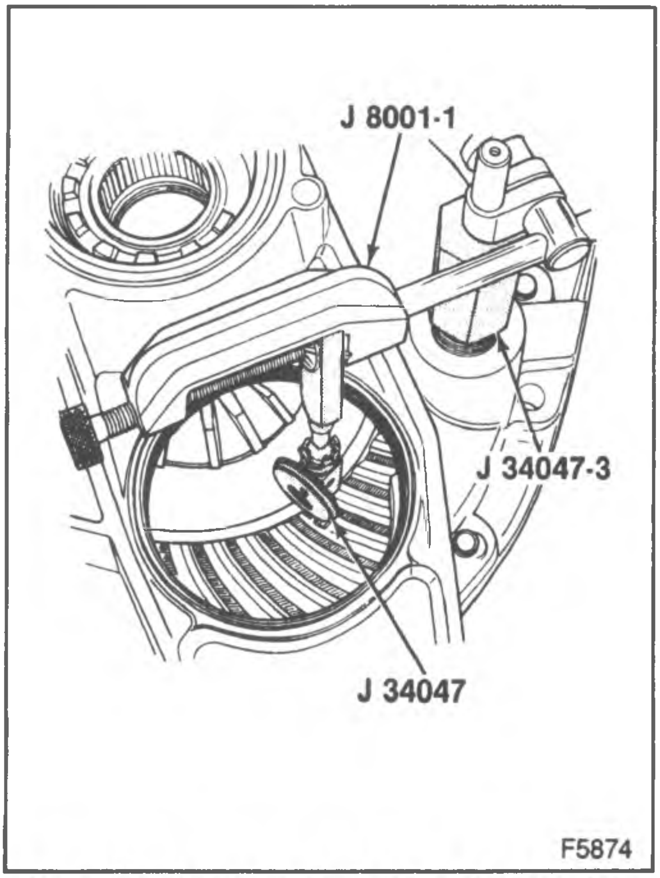


Figure 30—Measuring Backlash at the Ring Gear

MEASURING BACKLASH (ALTERNATE METHOD)

1. If the specified tools are not available, it is possible to read backlash at the pinion flange, as follows:
2. 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 31).
3. Move the pinion flange through its free play while holding the differential carrier. Record the dial indicator reading.
4. 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.
5. 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

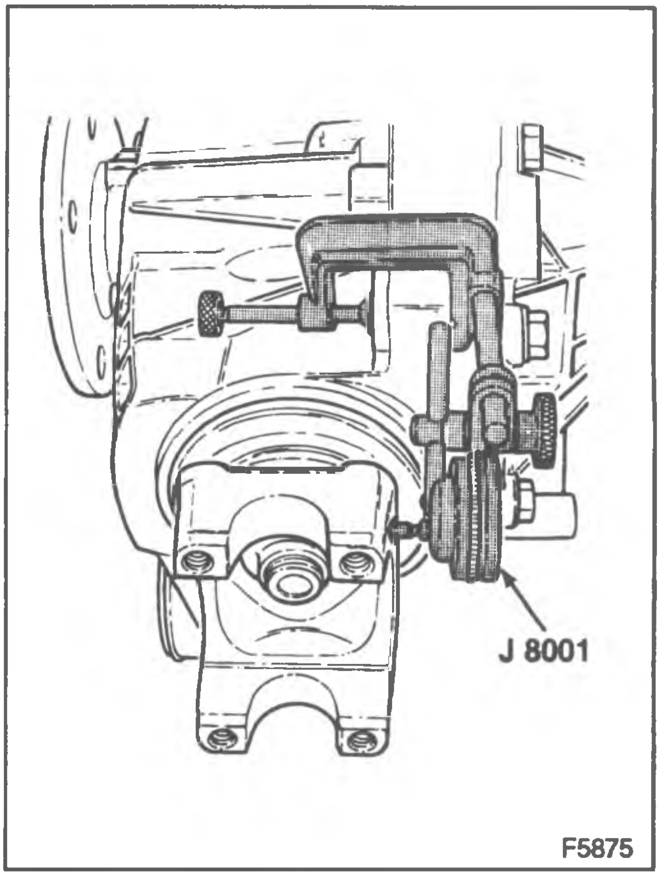


Figure 31—Measuring Backlash at the Pinion Flange

the ring gear and the drive pinion for low noise level and long life can be assured.

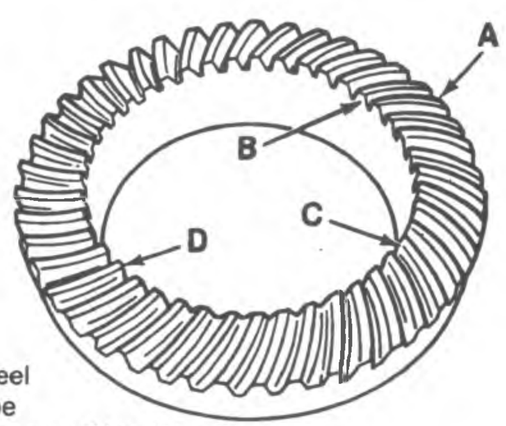
GEAR TOOTH TERMS

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 32).

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. Using a torque wrench, 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 33.



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

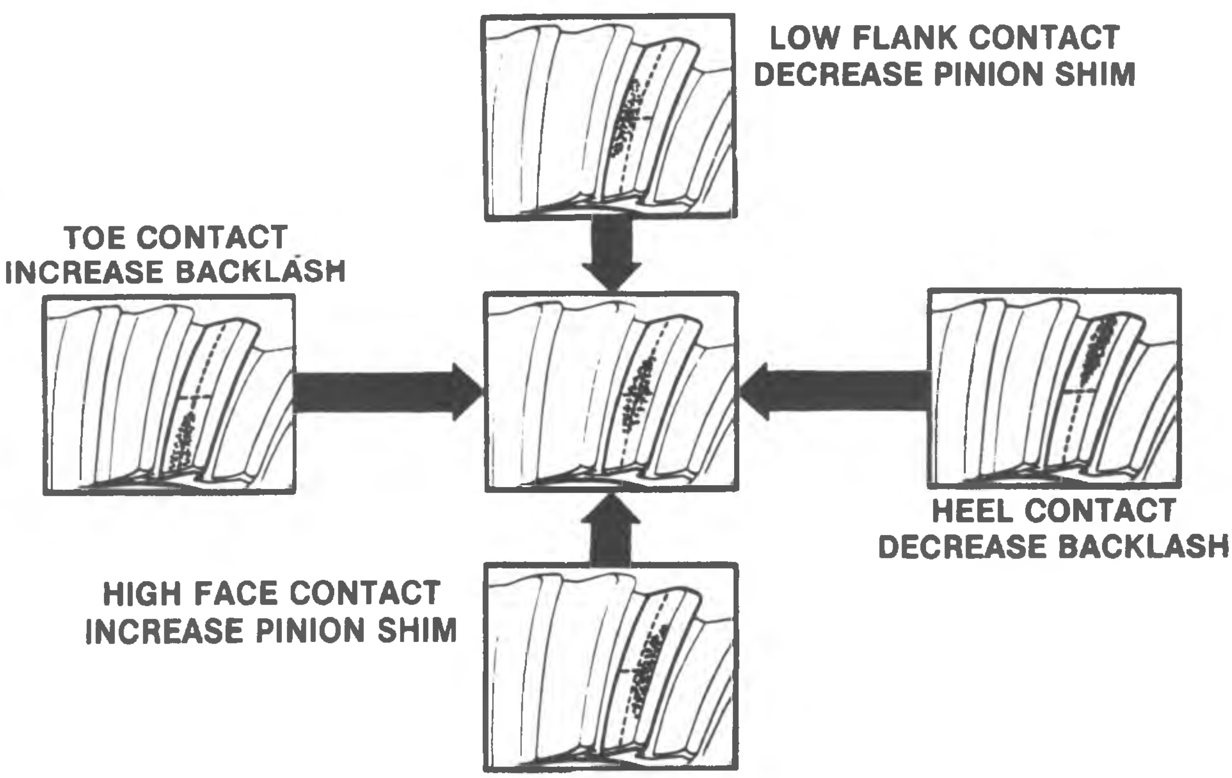
F2017

Figure 32—Gear Tooth Terms

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.



F2018

Figure 33—Gear Tooth Contact 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 3)

- Bend the lock (51) over the sleeves (32). (Right side only on K3 models).
- Bolt (64) and lock (63) (K3 models).

Remove or Disconnect (Figures 1 through 3)

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 3, 18, and 33)

Tools Required:
J 36600 Output Shaft Seal Installer (K1, 2)
J 22833 Output-Shaft Seal Installer (K3).
J 33842 Pilot Bearing Installer
J 36616 Bushing Replacer Set

- 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).

NOTICE: See "NOTICE" on page 4C4-1 of this section.

2. Bolts (28).

Tighten

- Bolts (28) to 47 N.m (35 ft. lbs.).

3. Left seal (3). Use J 36600 (K1, 2 models) or J 22833 (K3 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 34).

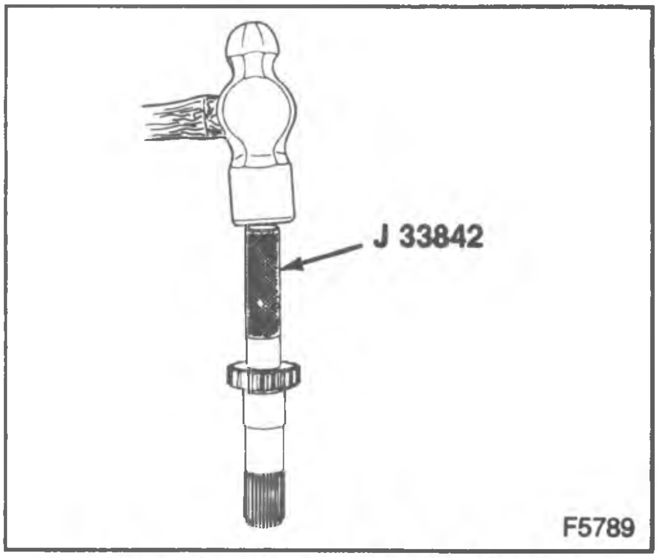


Figure 34—Installing the Pilot Bearing

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 18).

AXLE TUBE ASSEMBLY

ASSEMBLY

Install or Connect (Figures 1 through 3 and 35)

Tools Required:
J 36609 Bearing Installer
J 36600 Seal Installer (K1, 2 Models)
J 22833 Seal Installer (K3 Models)

1. Bearing (4). Use J 36609. Drive into place with a hammer.
2. Seal (3). Use J 36600 (K1, 2 models) or J 22833 (K3 models) (figure 35).
3. Shaft (1) with deflector (2) to the axle tube.
4. Washer (7). Align the tabs with the slots in the tube.
5. Gear (9) with retaining ring (8) (K1, 2 models). Drive gear into place with a plastic hammer.
6. Washer (11) and new snap ring (12) (K3 models). Make sure the snap ring seats properly in the groove.

OUTPUT SHAFT SHIM SELECTION

- Refer to figures 1 through 3.
- 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) (K1, 2 models).

Preferred Method:

Tool Required:

J 34672 Depth Gage (or equivalent)

- Refer to figures 36 and 37

1. 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".
2. Measure dimension "A". Use J 34672 or equivalent (figure 37).
   - K1, 2: Tube flange machined surface to inner surface of connector (9).
   - K3: Tube flange machined surface to inner surface of axle shaft shoulder.
3. Measure dimension "B."
   - Carrier machined surface to outer surface of output shaft (23).
4. Subtract dimension "A" from dimension "B."
5. 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 (K1, 2 models) or 2.80 mm shim (K3 models).
6. Shims are available in the following sizes:
   - K1, 2 models: 1.27 mm 1.78 mm, 2.29 mm, 2.70 mm, 3.30 mm, 3.81 mm.
   - K3 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 3)

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

- Bolts (6) to 40 N.m (30 ft. lbs.).

Measure (Figure 36)

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 38).
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 3)

1. Bolts (6).
2. Axle tube assembly.

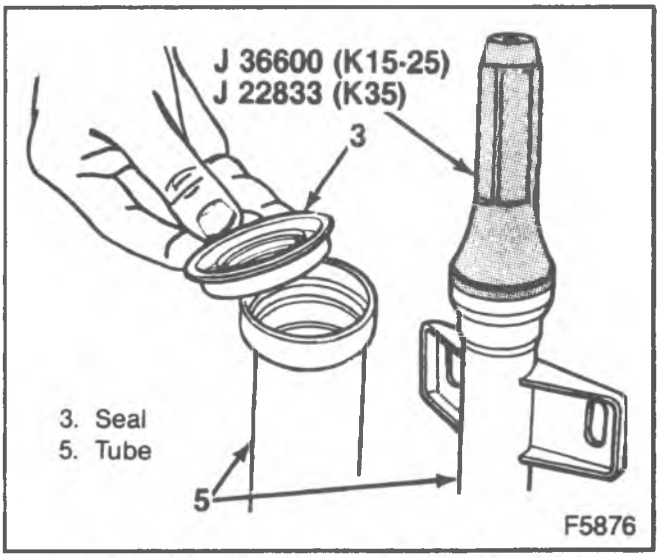


Figure 35—Installing the Axle Tube Seal

FINAL ASSEMBLY

Clean (Figures 1 through 3)

- 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 3)

NOTICE: For steps 6, 7, 8 and 10 see "NOTICE" on page 4C4-1 of this section.

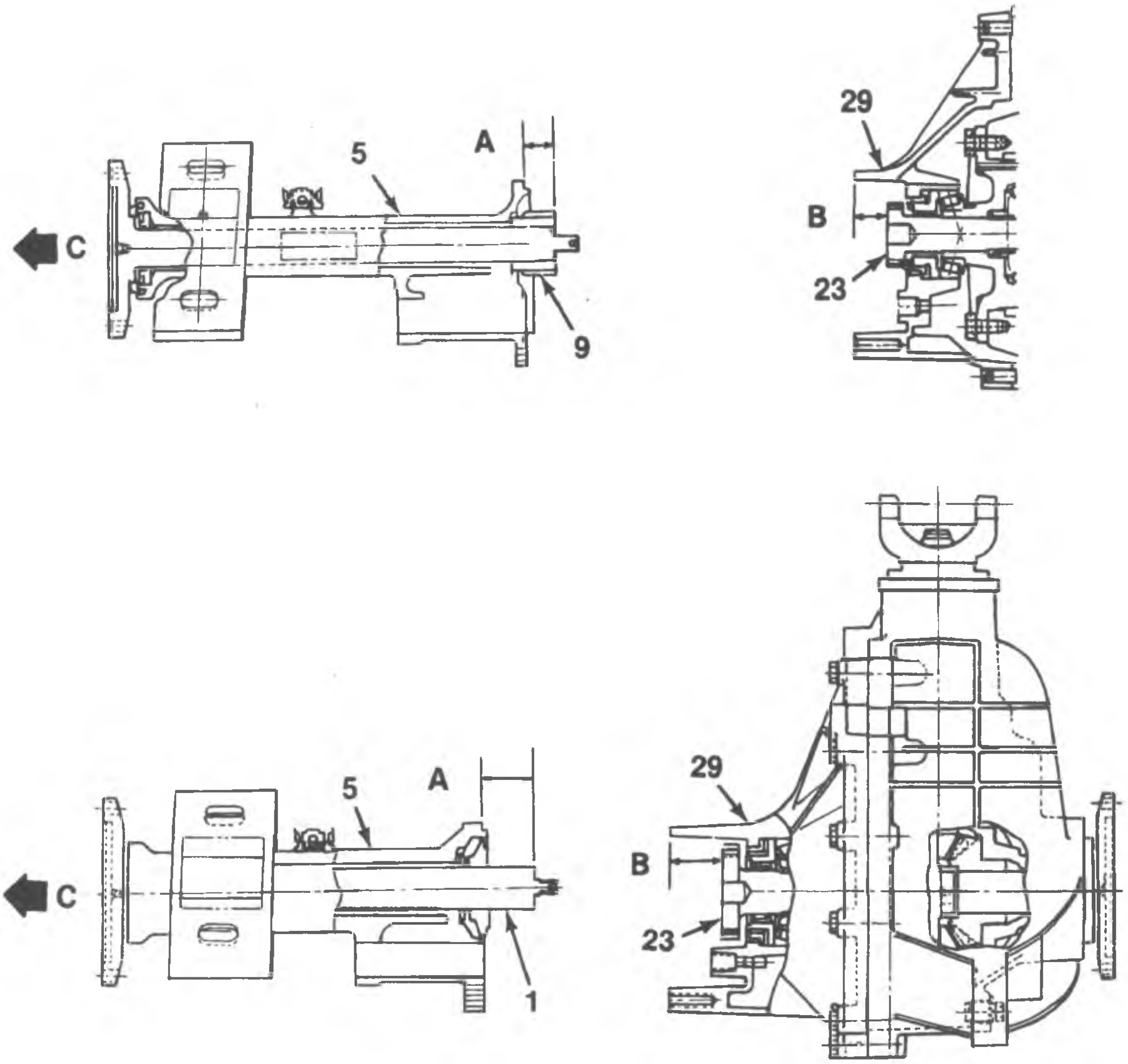
1. Shim (20), as selected previously, to the output shaft (23). Use grease to hold it in place.
2. Sleeve (22).
3. Spring (14).
4. Shift shaft (18), spring (17), shift fork (16), and clip (15) assembly to the carrier case.
   - Damper spring fits into shift fork indentation.
   - Make sure clip is seated in groove of shift shaft.
   - Apply a bead of sealer (GM part no. 1052942 [Loctite 518] or equivalent) to the tube (5) sealing surface.
5. Assembled tube (5) to the carrier assembly.
6. Bolts (6).

Tighten

- Bolts (6) to 40 N.m (30 ft. lbs.).

Inspect (Figure 39)

- 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 binding.



C. Measure with Axle Shaft Forced Outboard
1. Shaft
5. Tube
9. Carrier Connector
23. Output Shaft
29. Carrier Case

F5877

Figure 36—Measuring to Calculate Shim Size

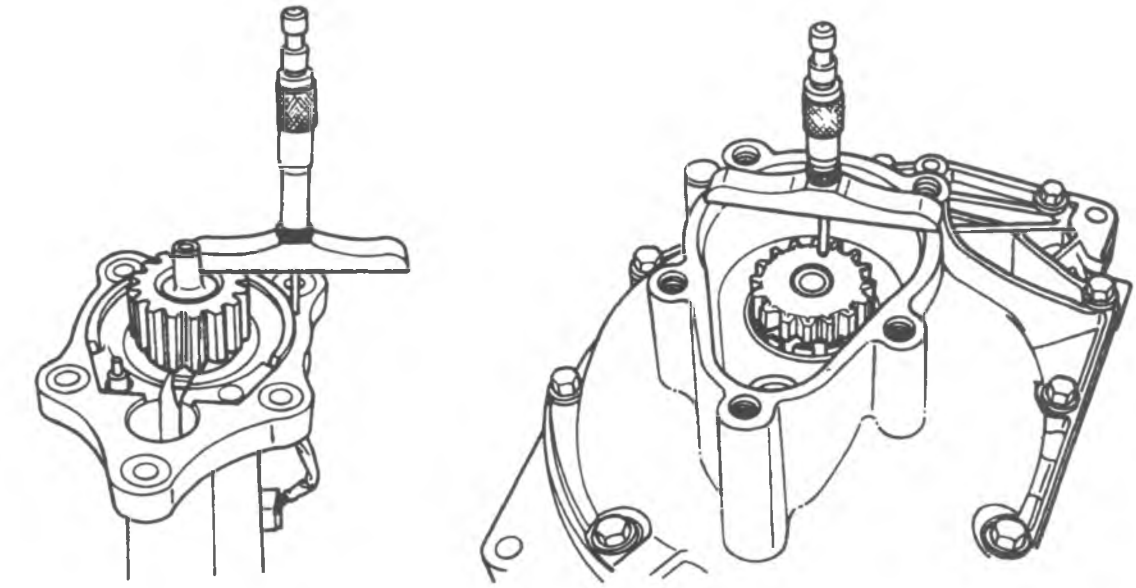


Figure 37—Measuring to Calculate Shim Size

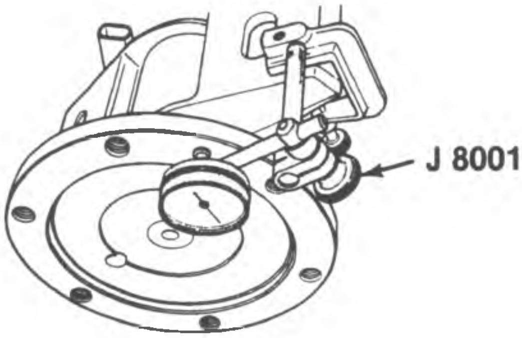


Figure 38—Measuring Axle Shaft End Play

7. Actuator (10). Apply sealer (GM part no. 1052942 {Loctite 518} or equivalent) to the threads.
8. Switch (13). Apply sealer (GM part no. 1052942 {Loctite 518} or equivalent) to the threads.
9. Axle lubricant, as specified.
10. Drain and fill plugs (25) with sealing washers (26)

Tighten

- Actuator bolts to 22 N·m (16 ft. lbs.)
- Switch bolts to 5 N·m (45 in. lbs.)
- Drain and fill plug to 33 N·m (24 ft. lbs.)

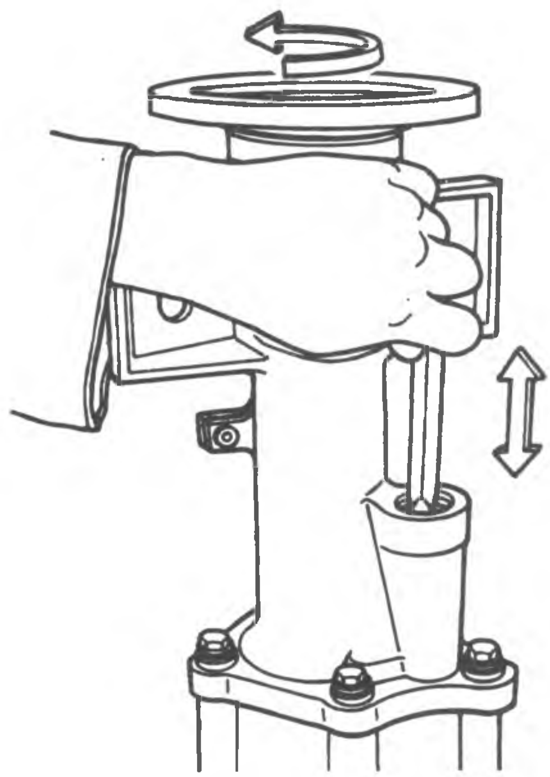


Figure 39—Checking the Shift Mechanism

DRIVE AXLE ASSEMBLY

OUTER DEFLECTOR RING REPLACEMENT

Remove or Disconnect (Figures 40, 41 and 42)

- Clamp the axle shaft (12) in a vise.
- Use soft metal or wood to protect the shaft.

1. Deflector ring (19) from C/V outer race (18) with a brass drift and a hammer as shown and discard (figure 41).

Install or Connect

- Position and square up the deflector ring (19) at the press diameter of C/V outer race (18).
- Using a 3" pipe coupling (K10/20) or 4" pipe coupling (K3), M24 x 2.0 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 40 and 43 through 46)

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."

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 self retaining clamp (11) with J 35910 to 136 N·m (100 ft. lbs.) (figure 45).
- 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 seal lip in the housing groove.

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 release the air. Shape the seal by hand and remove the tool.
- Refer to the chart in figure 46 and select the correct size swage clamp tool J 36652.
- Mount the proper size swage clamp tool in the vise 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 46).
— Insert the bolts and tighten by hand until snug.

Important

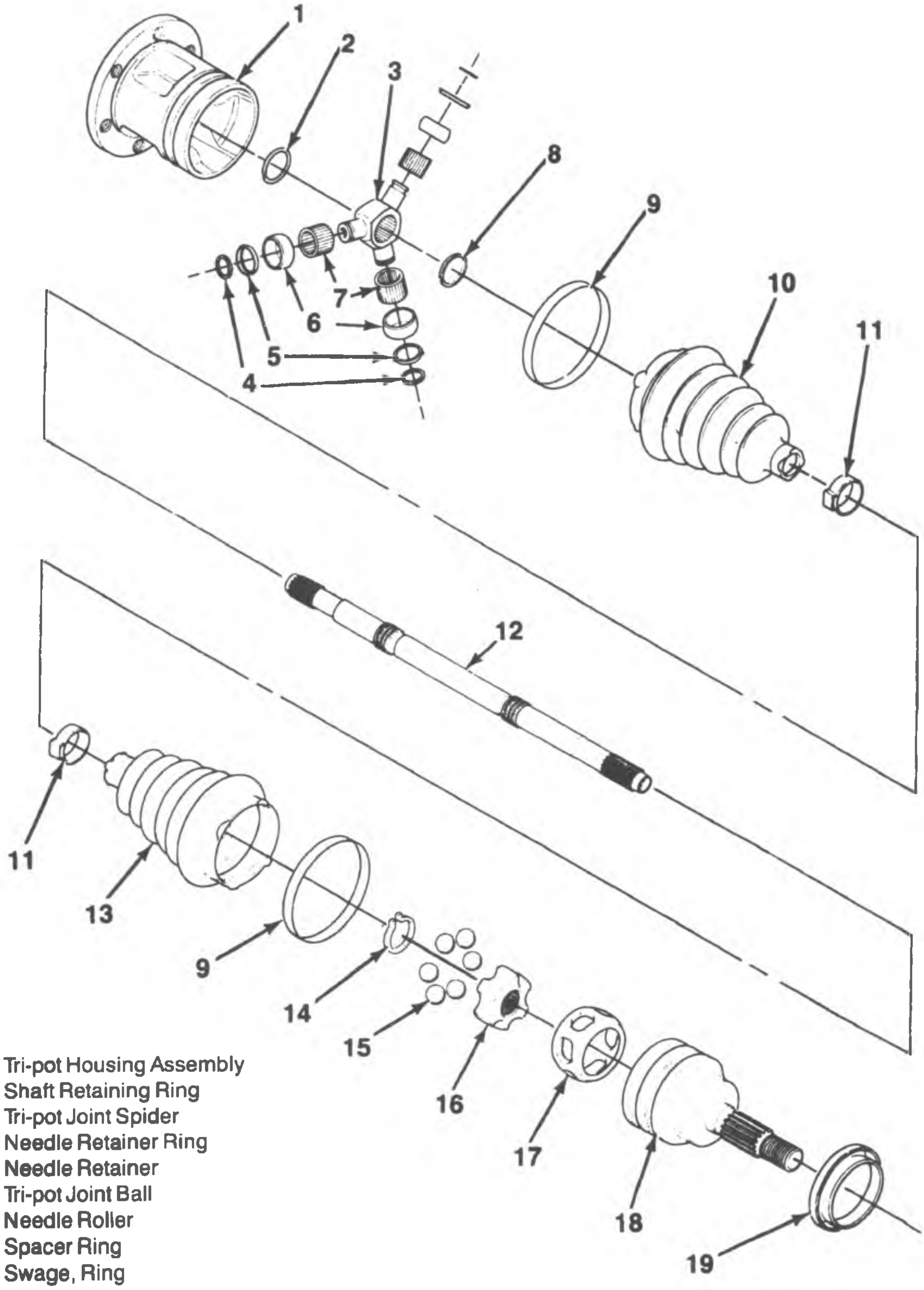
- Make sure the seal (13), housing (18) and swage ring (9) all remain in alignment (figure 46).

— Continue to tighten each bolt 180°at a time alternately until both sides are bottomed.
- Remove the axle assembly from the tool.

OUTER JOINT ASSEMBLY REPLACEMENT

Disassemble (Figures 40, and 47 through 49)

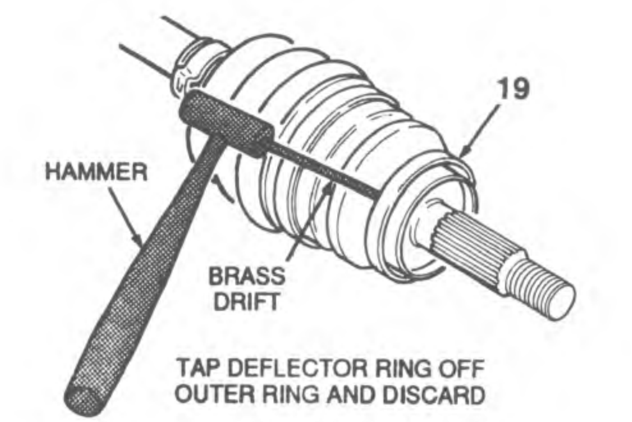
- Perform steps 1 through 3 in "Outer Joint Seal Replacement" in this section.
- Use a brass drift and a hammer to gently tap on the C/V joint cage (17) until it is tilted enough to remove the first chrome alloy ball (15) (see figure 47).
- Tilt the cage (17) in opposite direction to remove opposing ball (15).
- Repeat this process until all six balls (15) are removed.



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

F6721

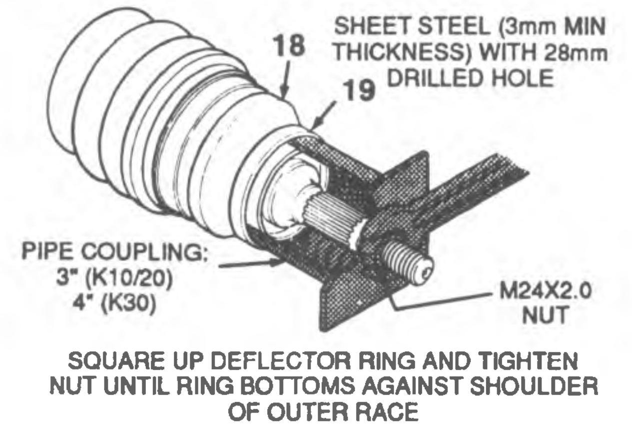
Figure 40—Front Drive Axle Components



19. Deflector Ring

F6722

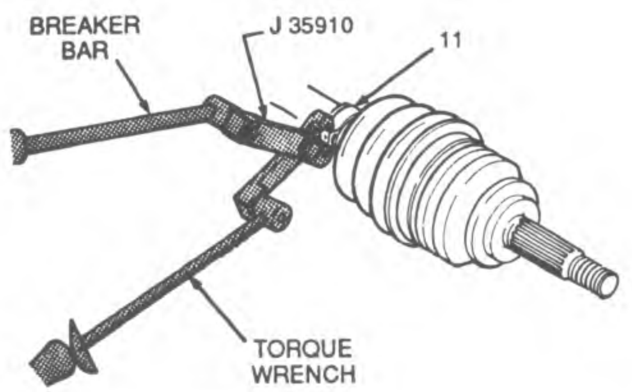
Figure 41—Removing Outer Deflector Ring



18. C/V Joint Outer Race
19. Deflector Ring

F6723

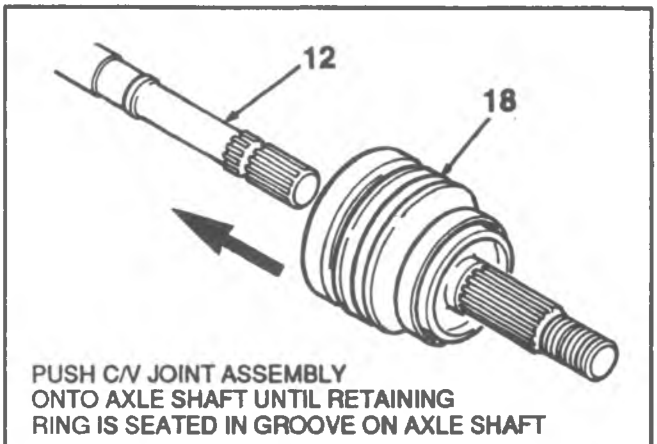
Figure 42—Installing Outer Deflector Ring



11. Seal Retaining Clamp

F6724

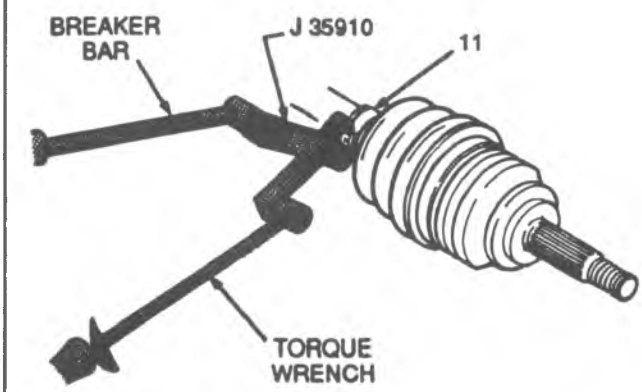
Figure 43—Removing C/V Joint



12. Axle Shaft
18. C/V Joint Outer Race

F6725

Figure 44—Installing C/V Joint



11. Seal Retaining Clamp

F6726

Figure 45—Installing Seal Retaining Clamp

- 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 48).
- 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 49).
- 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.

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)

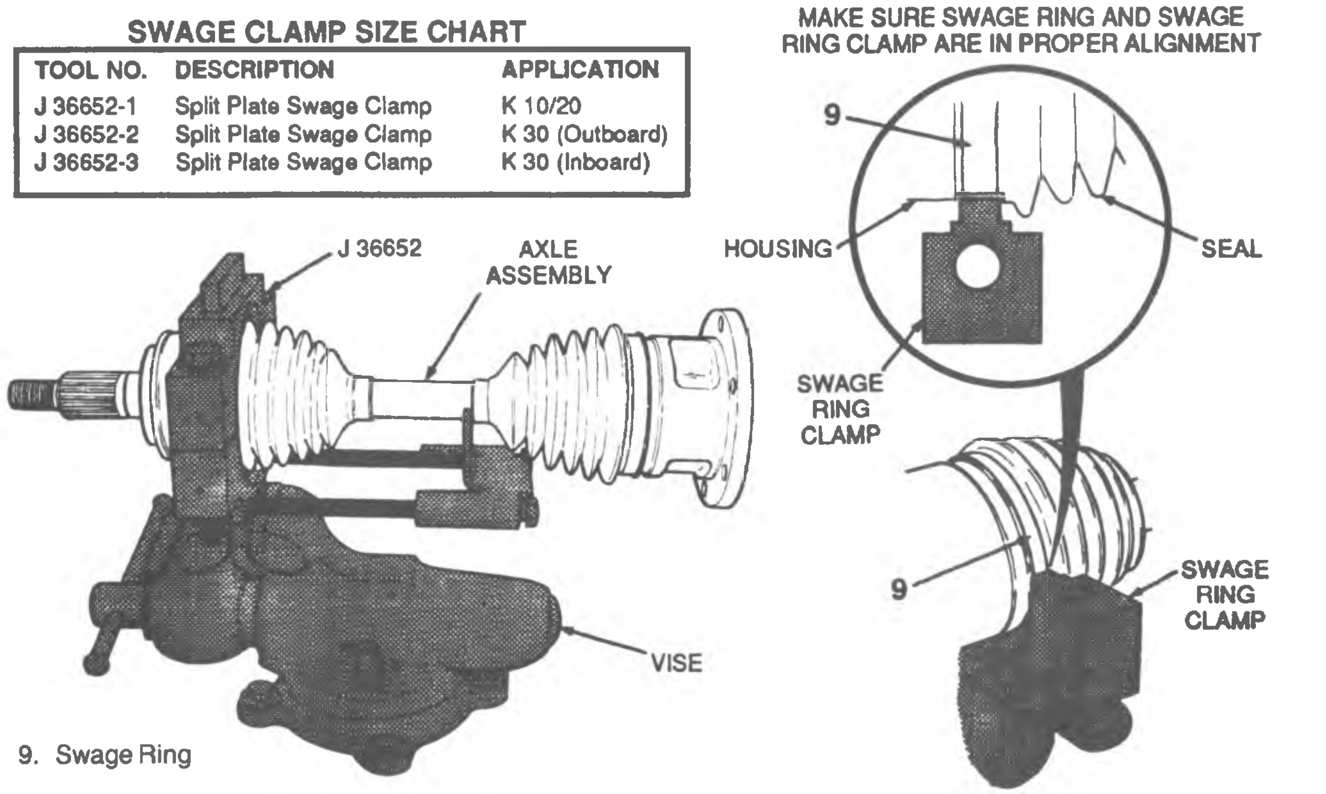


Figure 46—Installing Swage Ring

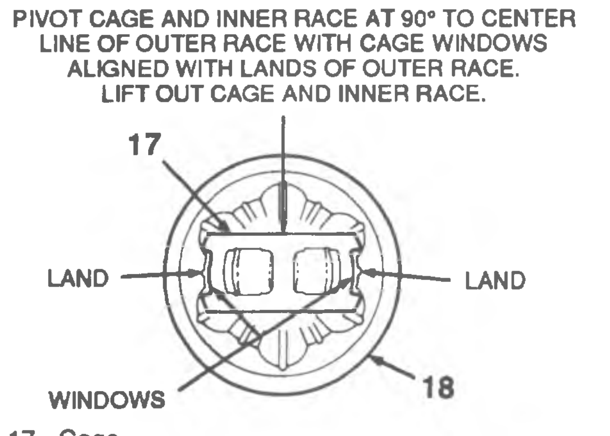
Important

- Be sure that the retaining ring side of the inner race (16) faces the axle shaft (12).
- Perform steps 1 through 3 in "Outer Joint Seal Replacement" Install or Connect.

15. Ball
16. Inner Race
17. Cage
18. Outer Race

F6728

Figure 47—Removing C/V Joint Balls



17. Cage
18. Outer Race

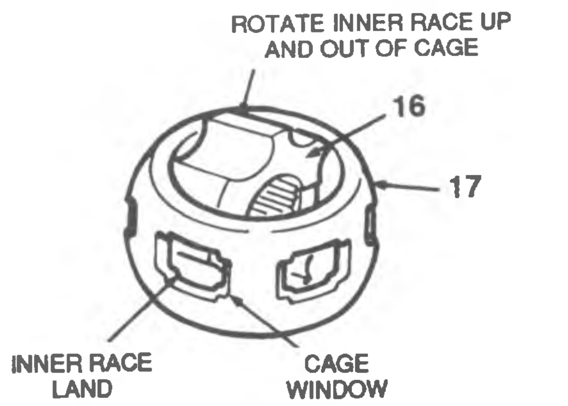
F6729

Figure 48—Separating Outer Race and Cage

INNER TRI-POT SEAL REPLACEMENT

Remove or Disconnect (Figures 40, 46, and 50 through 53)

Tools Required:
- J 8059 Snap Ring Pliers
- J 35910 Seal Clamp Tool
- J 36652 Swage Clamp Tool



16. Inner Race
17. Cage

F6730

Figure 49—Separating Inner Race and Cage

1. Large swage ring (9) from the in-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 side 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 50).
4. Shaft retaining ring (2) from the groove on the axle shaft (12) and slide the spider assembly off the shaft.

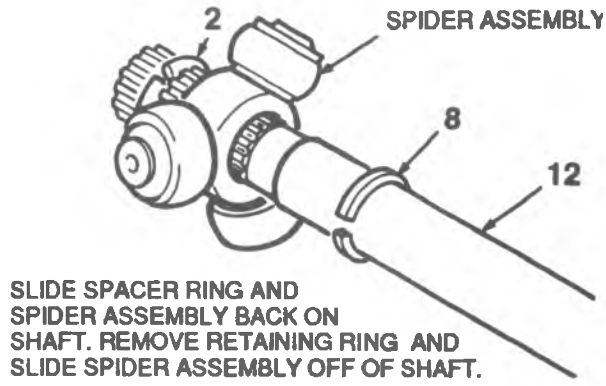
Important

- 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

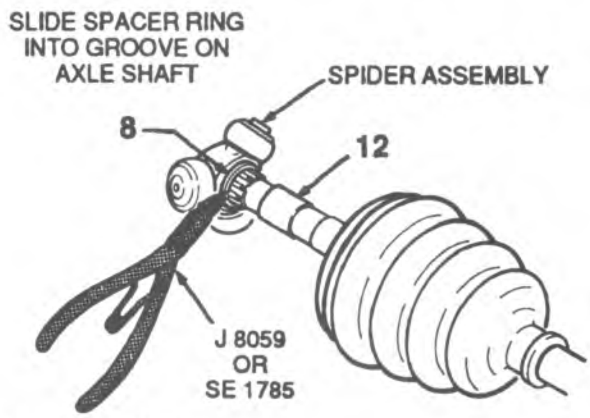
1. Small seal-retaining clamp (11) on the neck of the seal (10).
   - Do not crimp.
2. Slide the seal (10) onto the shaft (12) and position the neck of the seal in the seal groove on the axle shaft (12).
- Crimp seal retaining clamp (11) with J 35910 to 136 N.m (100 ft. lbs.)
3. Spacer ring (8) on the front axle shaft (12) and beyond the secor 1 groove as shown (figure 51).
- Slide the tri-pot spider assembly against the spacer ring (8) and the shaft (12).



2. Shaft Retaining Ring
8. Spacer
12. Axle Shaft

F6731

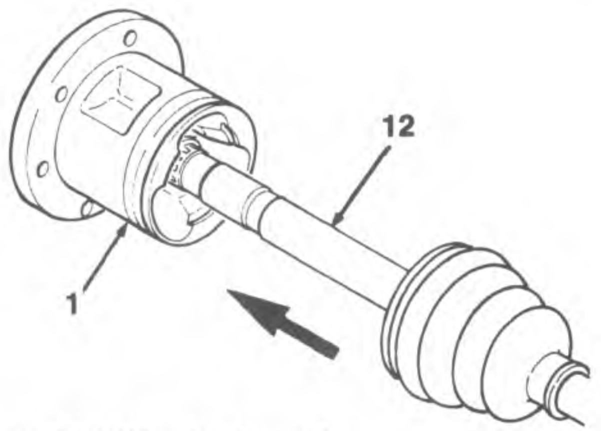
Figure 50—Removing Spider Assembly



8. Spacer Ring
12. Axle Shaft

F6732

Figure 51—Installing Spider Assembly



1. Tri-Pot Housing Assembly
12. Axle Shaft

F6733

Figure 52—Installing Tri-pot to Housing

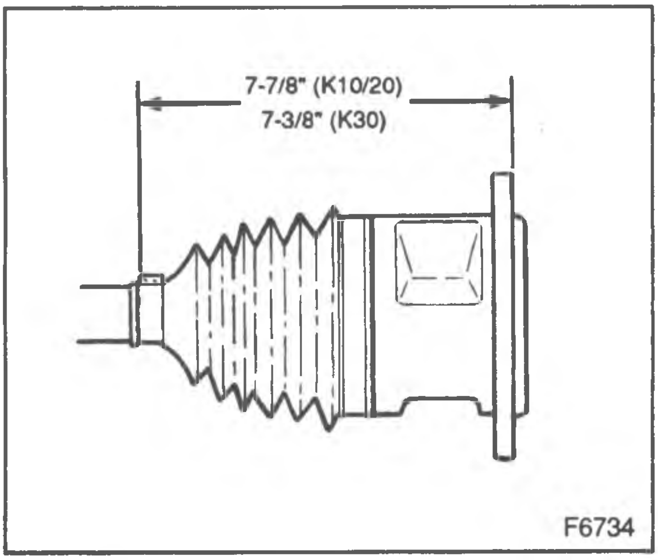


Figure 53—Tri-pot Seal Installation Measurements

Important

- Be sure that the counterbored face of the tri-pot spider (3) faces the end of the shaft (12).

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 52).
- 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 seal lip in the housing groove.
- Position the tri-pot assembly at the proper vehicle dimension as shown in figure 53.

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 release the air. 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 46 and select the proper size swage clamp tool J 36652.
- Mount the swage clamp tool in the vise 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 46 and 53).

— Insert the bolts and tighten by hand until snug.

Important

- Make sure that the seal (10), housing (1) and swage ring (9) all remain in alignment (figure 46).

— 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, 4.80mm

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)

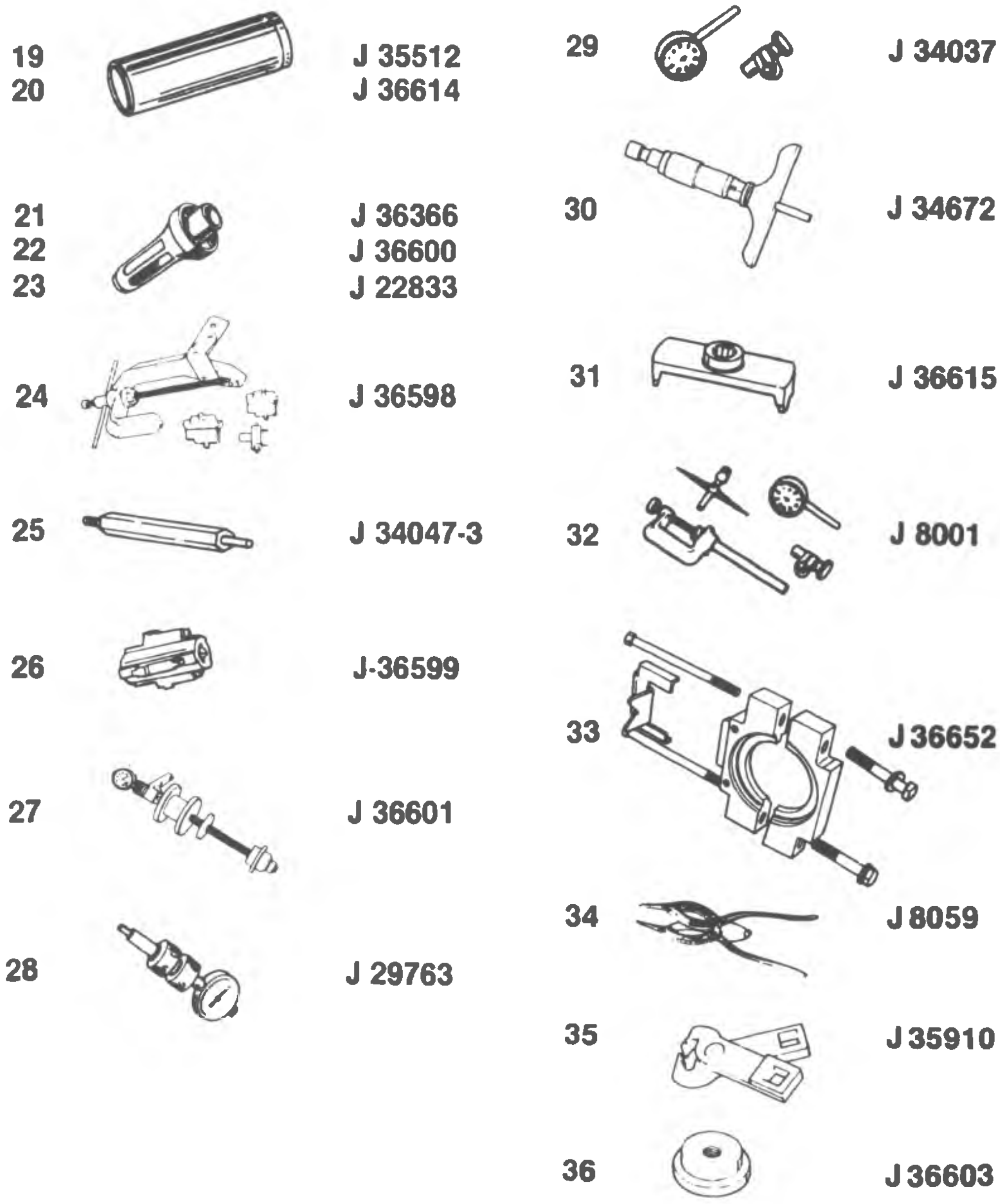
T2518

SPECIAL TOOLS

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

F6761

SPECIAL TOOLS



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

F6762

SECTION 4C5

ALL WHEEL DRIVE FRONT AXLE 7 1/4-INCH RING GEAR

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

DESCRIPTION

The front axle on the All Wheel Drive model uses 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 axle 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 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 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.

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).
   - Use J 2619-01 and J 21579 to pull the output shaft from the carrier (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, 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.

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, 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 gear splines for wear.
- Pinion flange splines for wear.
- Fit of the pinion flange on the pinion gear.
- 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 very small 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.
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).

NOTICE: See Notice on page 4C5-1 of this section.

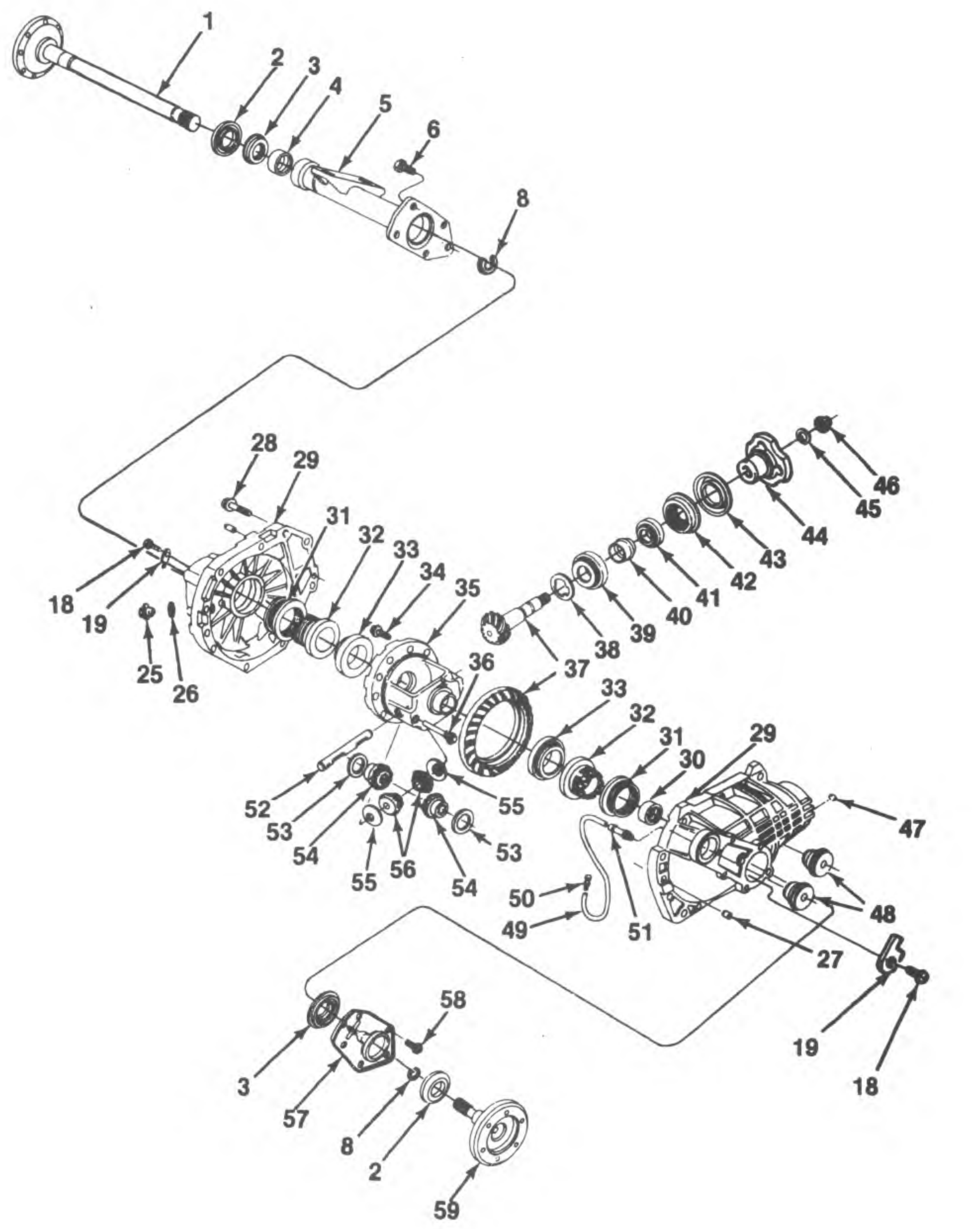


Figure 1—All Wheel Drive Front Axle

1. Shaft
2. Deflector
3. Seal
4. Bearing
5. Tube
6. Bolt
8. Retaining Ring
18. Bolt
19. Lock
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. Buching
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—All Wheel Drive Front Axle

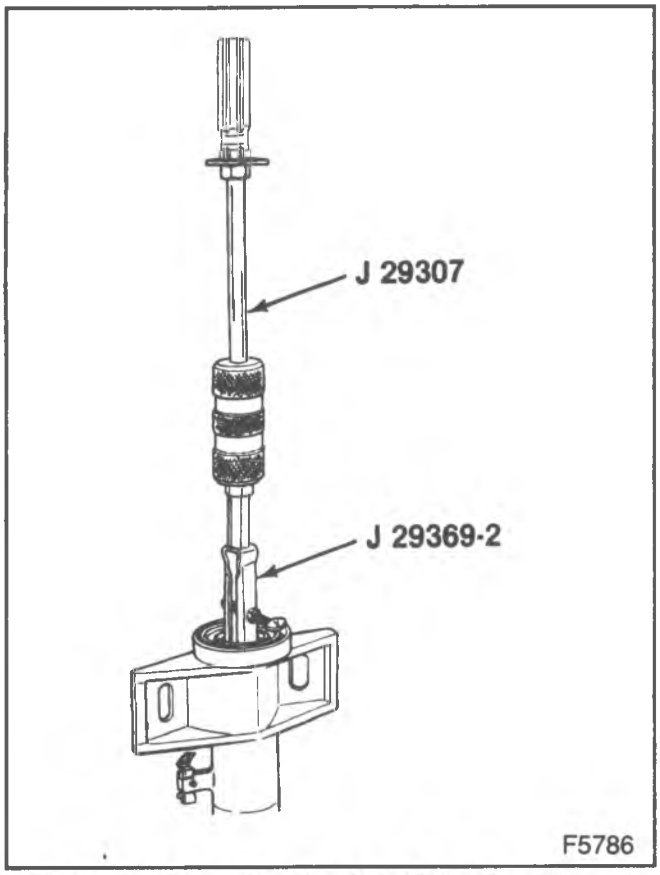


Figure 3—Removing the Axle Tube Bearing and Seal

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).

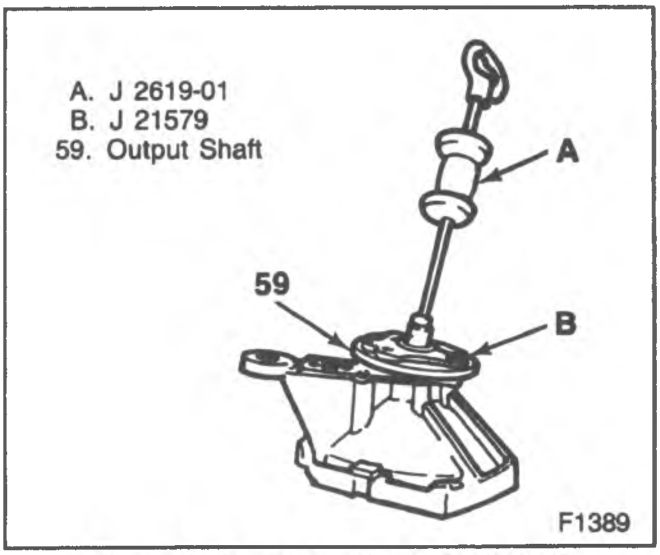


Figure 4—Removing the Output Shaft

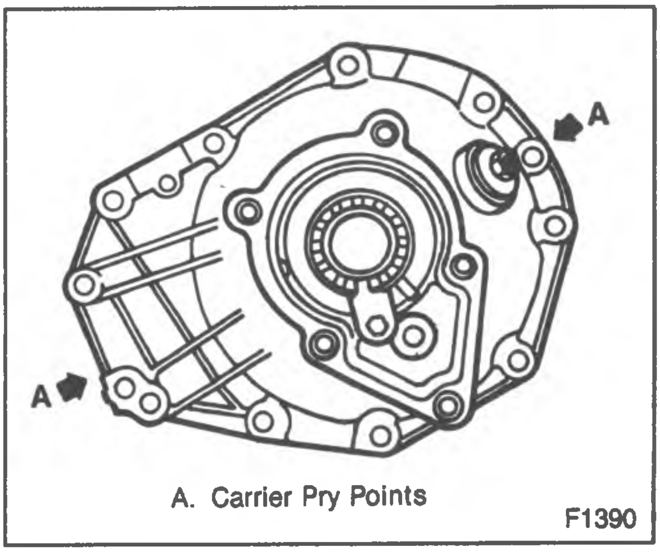


Figure 5—Separating the Carrier Case Halves

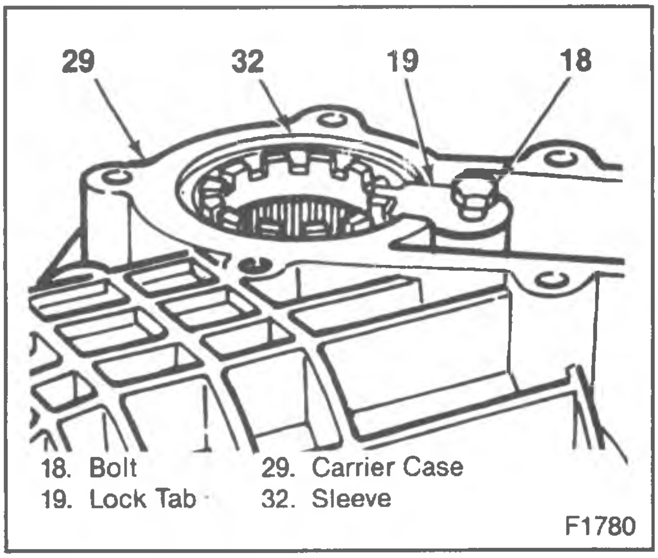


Figure 6—Removing the Lock Tabs

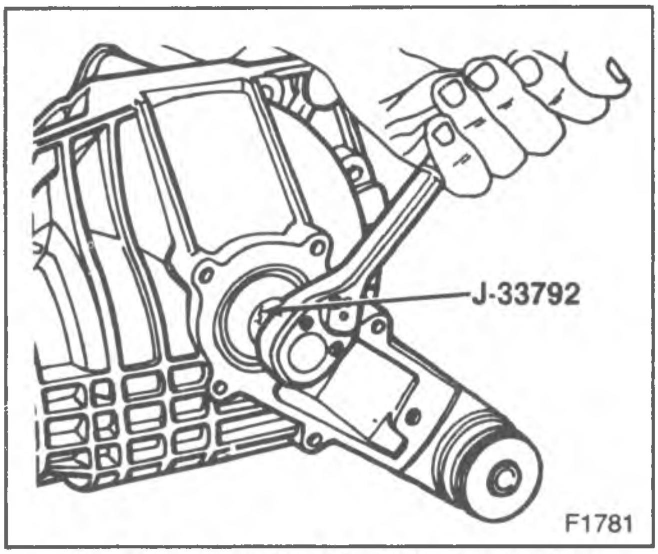


Figure 7—Removing the Side Bearing Cup

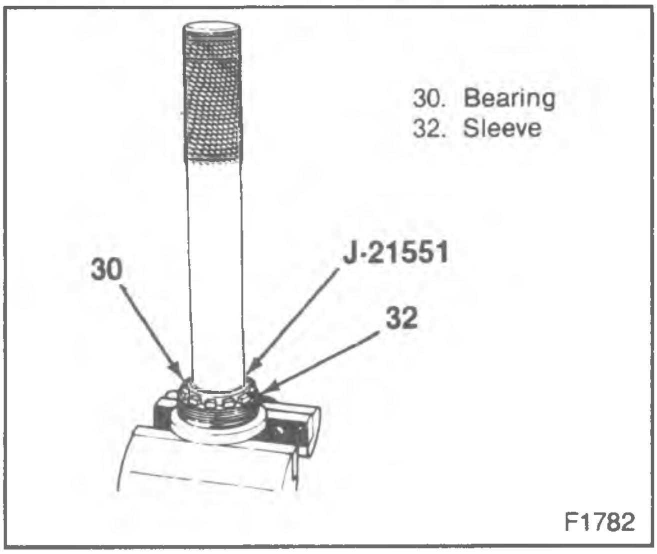


Figure 8—Removing the Sleeve Bearing

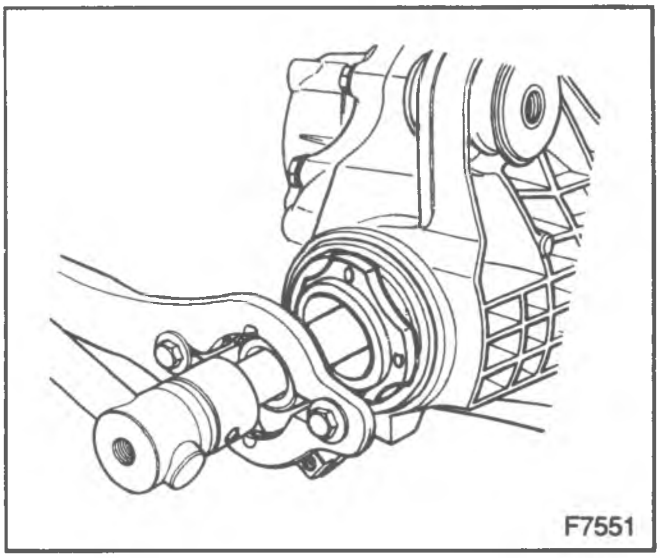


Figure 9—Removing the Pinion Nut

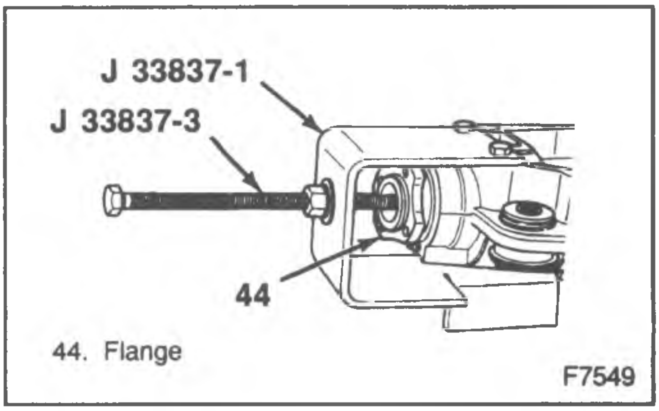


Figure 10—Removing the Pinion Flange

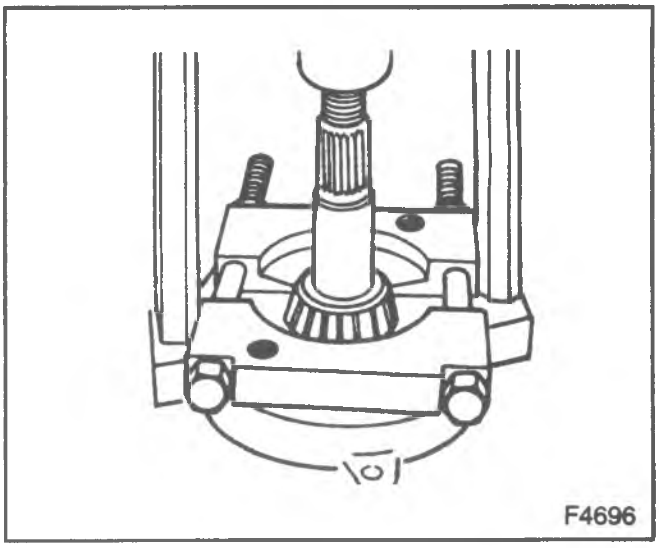


Figure 11—Removing the Pinion Bearing

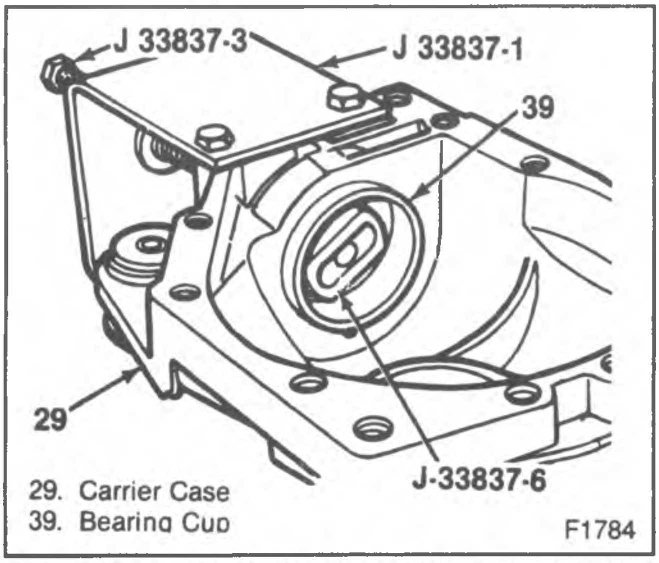


Figure 12—Removing the Inner Pinion Bearing Cup

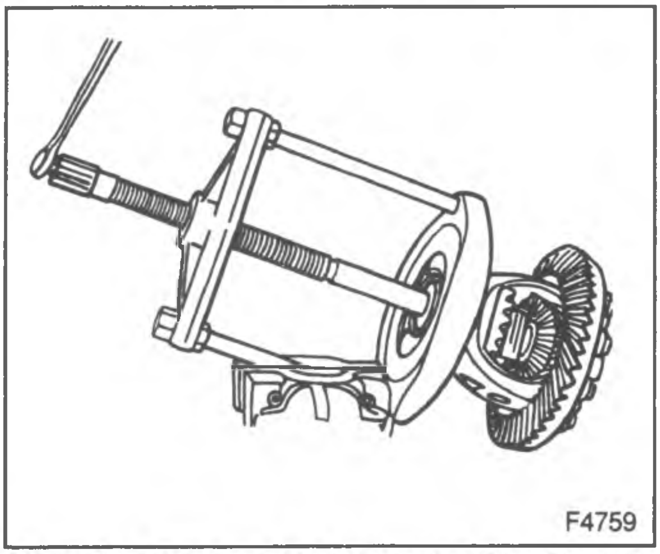


Figure 13—Removing the Differential Side Bearings

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

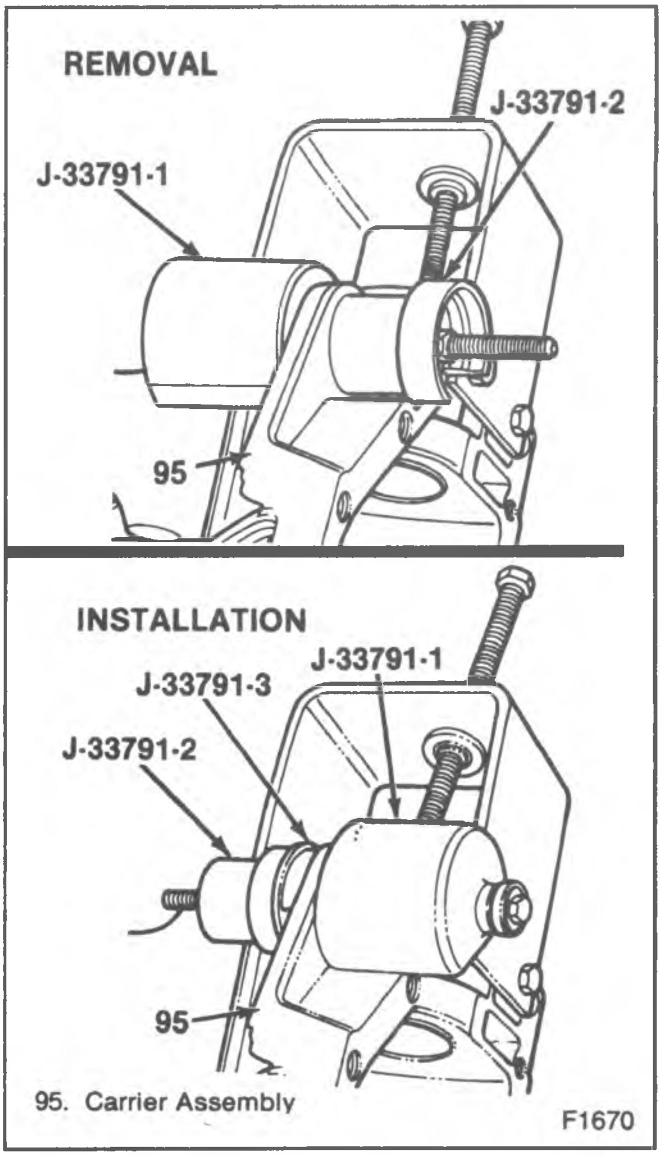


Figure 14—Replacing the Case Bushings

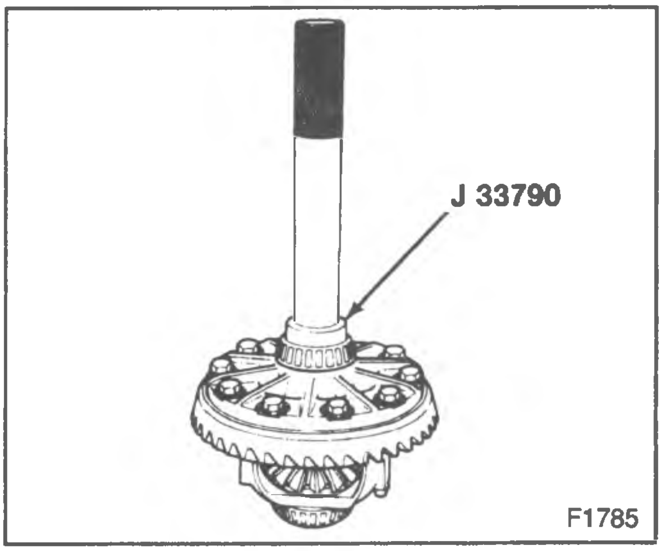


Figure 15—Installing the Differential Side Bearings

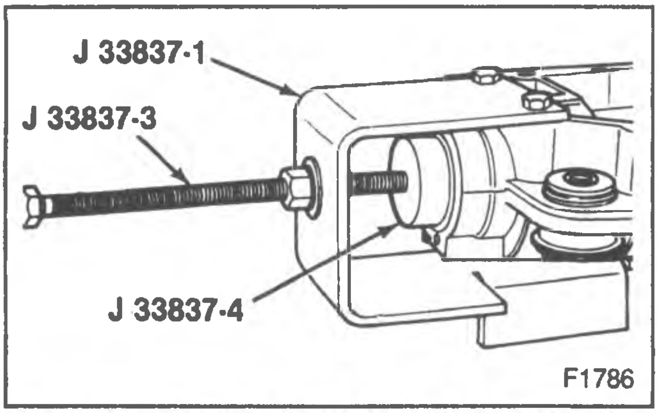


Figure 16—Installing the Outer Pinion Bearing Cup

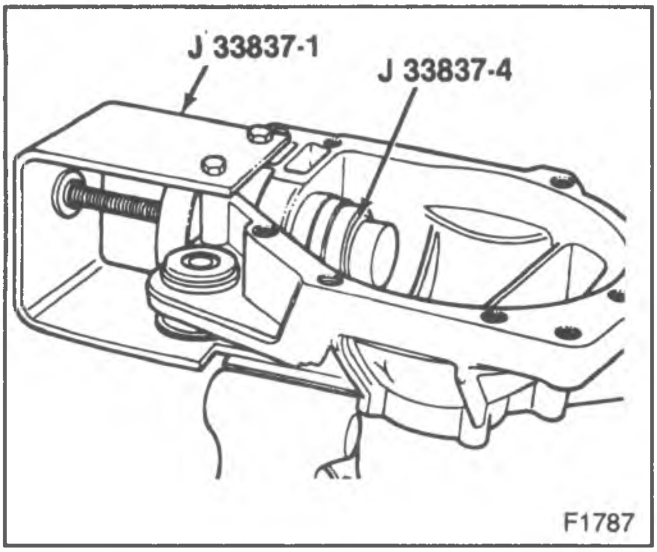


Figure 17—Installing the Inner Pinion Bearing Cup

approximately 3/4 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.

PINION INSTALLATION

Install or Connect (Figures 19 through 21)

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.).

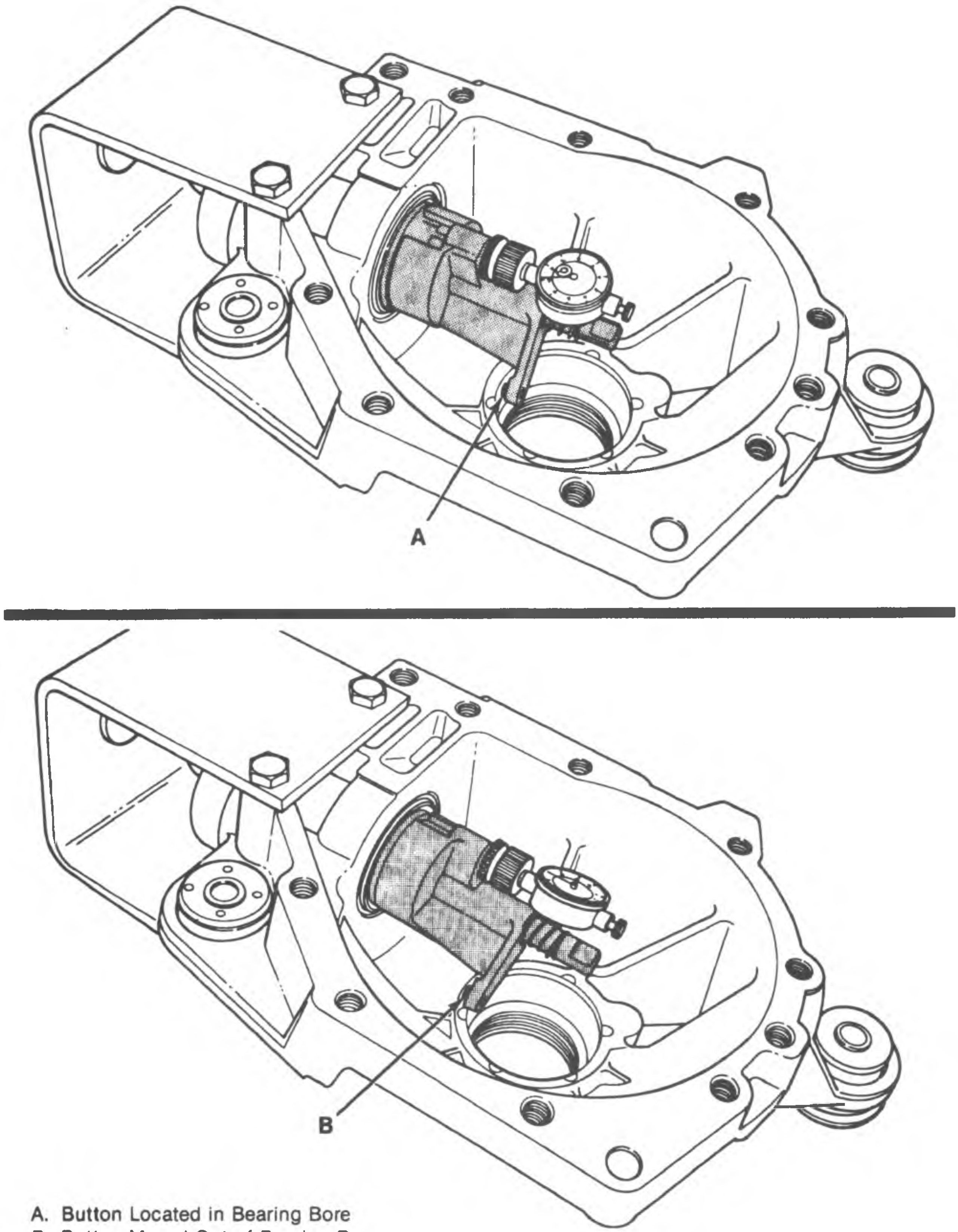
1. Rotate the pinion with the torque wrench and observe the reading.
2. If the preload torque is below specifications, continue torquing the pinion nut in small increments. Check the preload after each tightening. Each tightening increases the bearing preload by several inch pounds. If the bearing preload 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.



A. Button Located in Bearing Bore
B. Button Moved Out of Bearing Bore

F5791

Figure 18—Measuring Pinion Depth

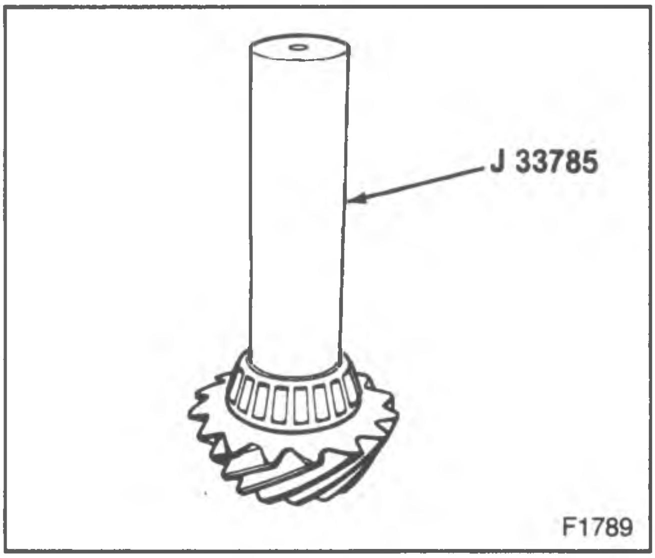


Figure 19—Installing the Pinion Bearing

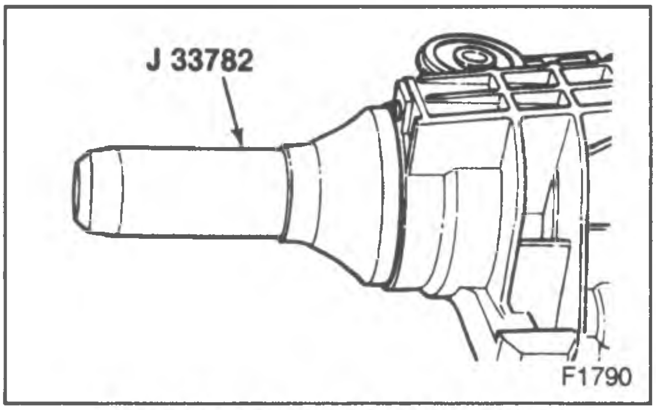


Figure 20—Installing the Pinion Seal

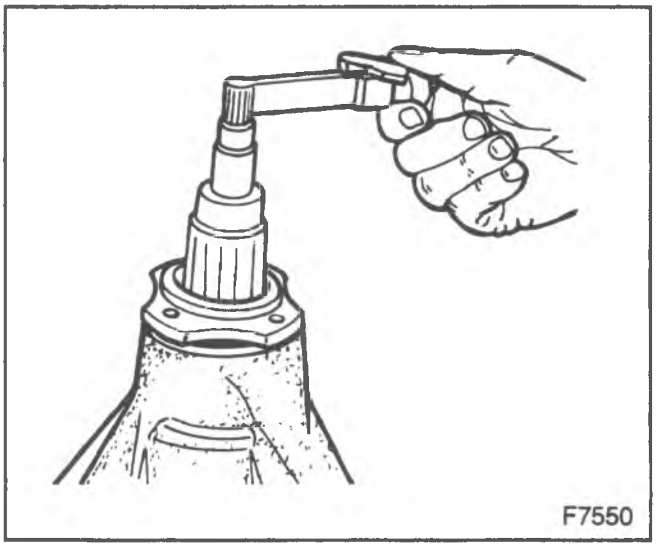


Figure 21—Measuring Pinion Bearing Preload

- If the carrier halves do not make complete contact, back out the right hand adjusting sleeve (32). Use J 33792 (figure 23).

NOTICE: See Notice on page 4C5-1 of this section.

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).
   - 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

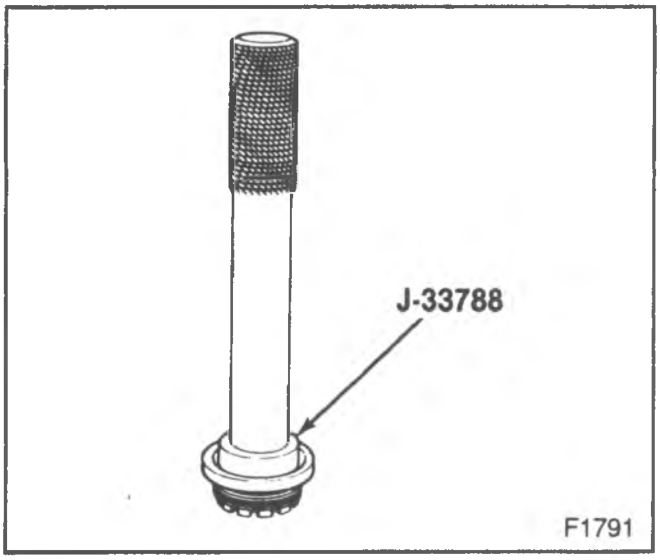


Figure 22—Installing the Sleeve Bearing

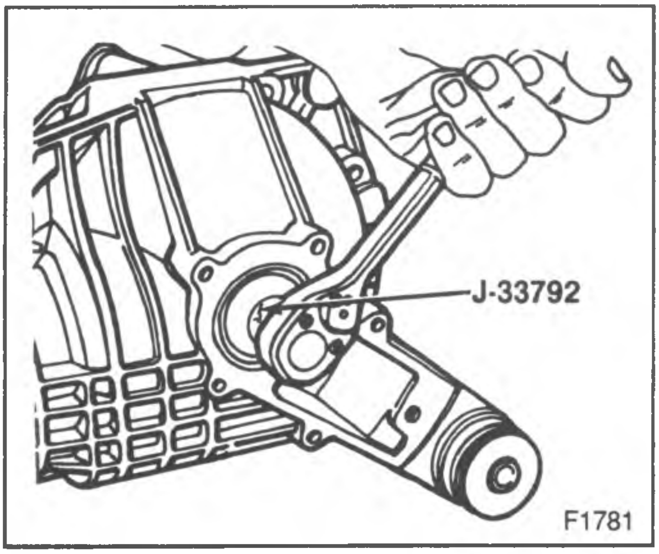


Figure 23—Adjusting the Sleeve

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 27).

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.

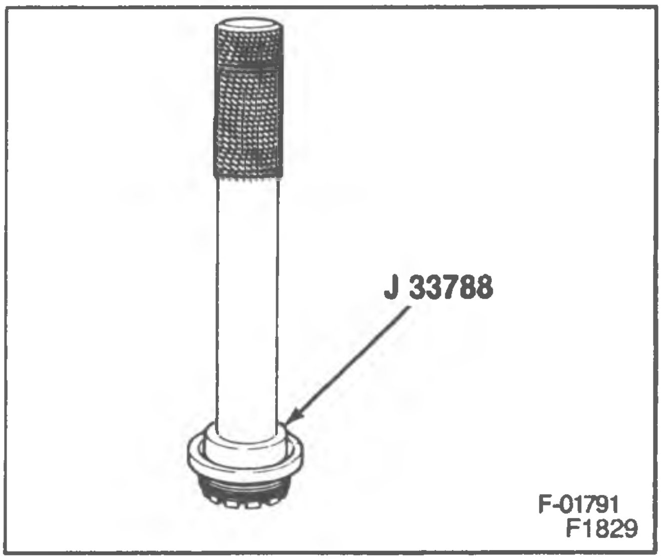


Figure 24—Carrier Case Bolts Installed

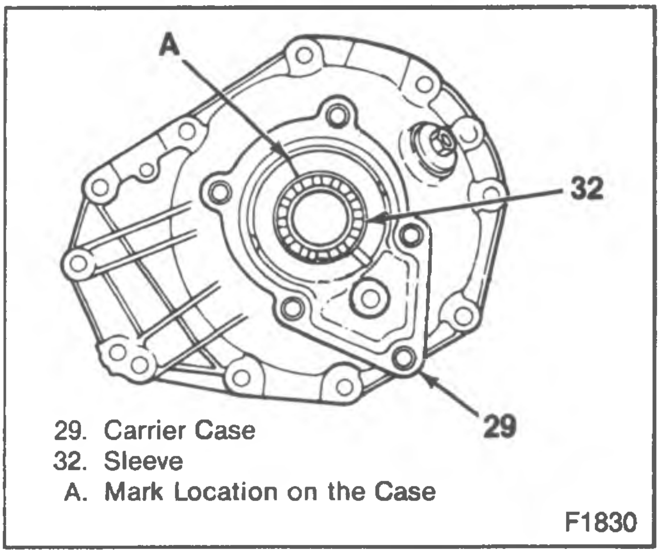


Figure 25—Marking Sleeve Location

3. Apply a load until a torque of 54-70 N·m (40-50 ft. lbs.) is required to turn the pinion.

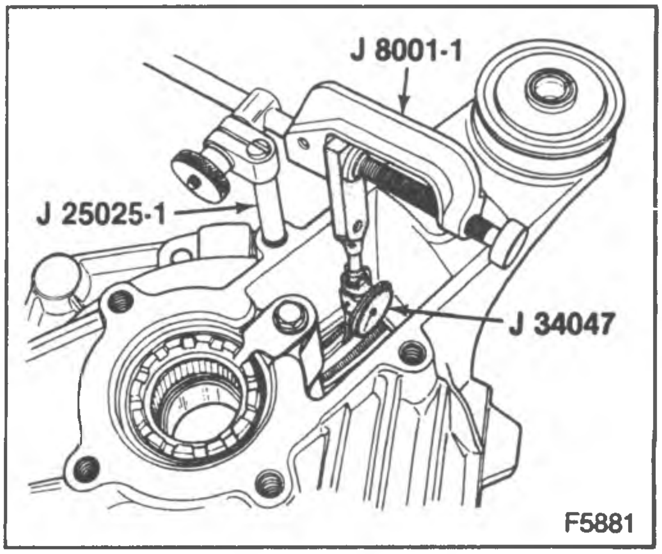


Figure 26—Measuring Backlash at the Ring Gear

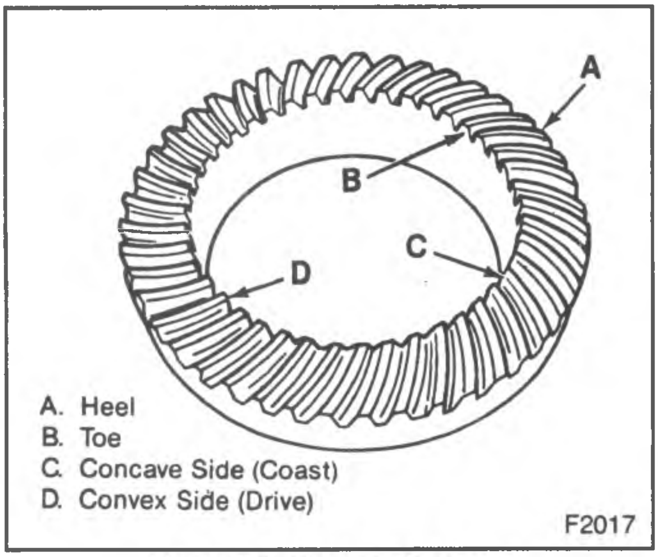


Figure 27—Gear Tooth Terms

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 28.

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.

Important

- The contact pattern should be located in the middle of the ring gear teeth face (figure 28).

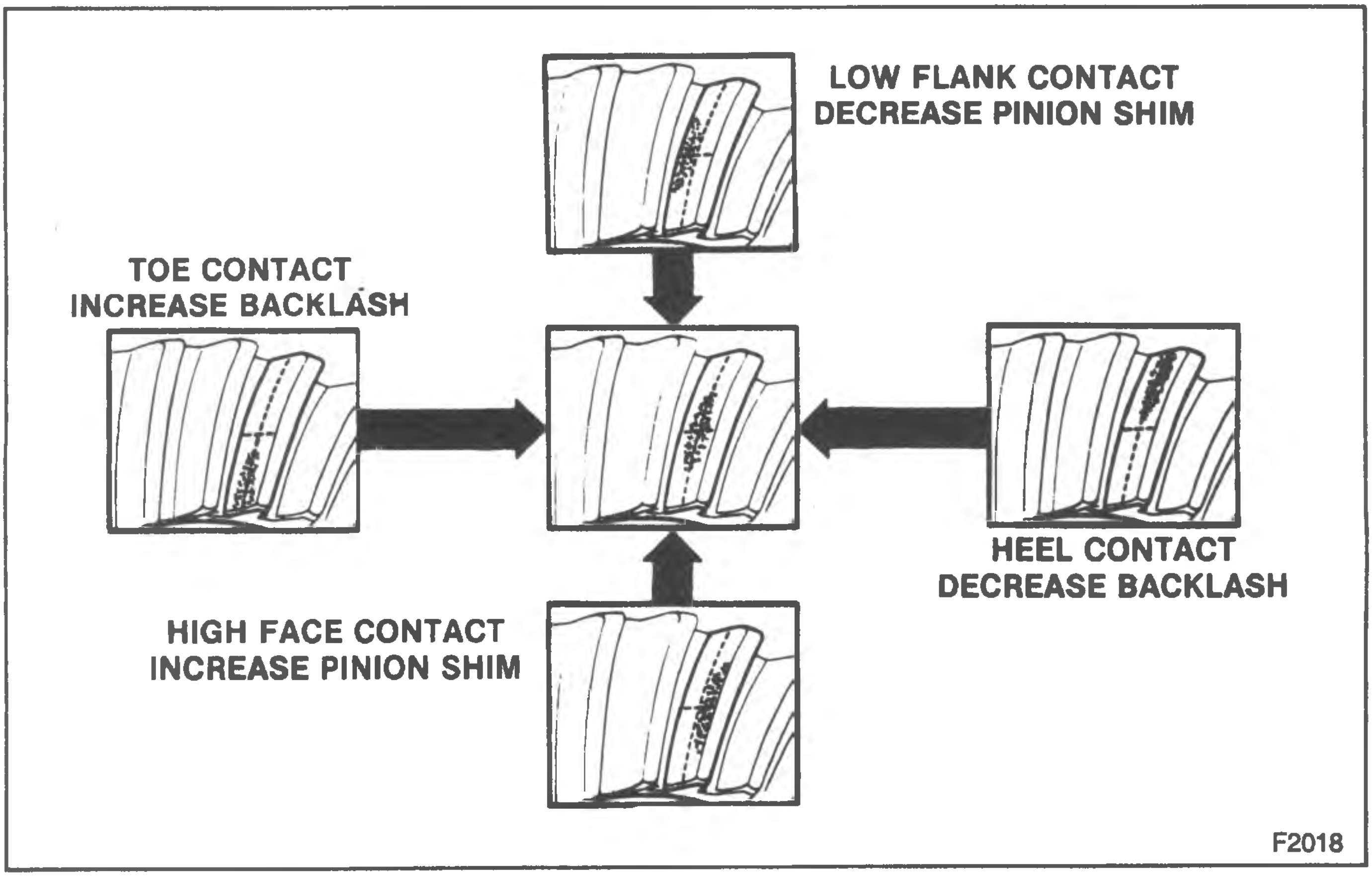


Figure 28—Gear Tooth Contact Pattern

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)

NOTICE: For steps 2, 3, 5, and 10 see "Notice" on page 4C5-1 of this section.

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.

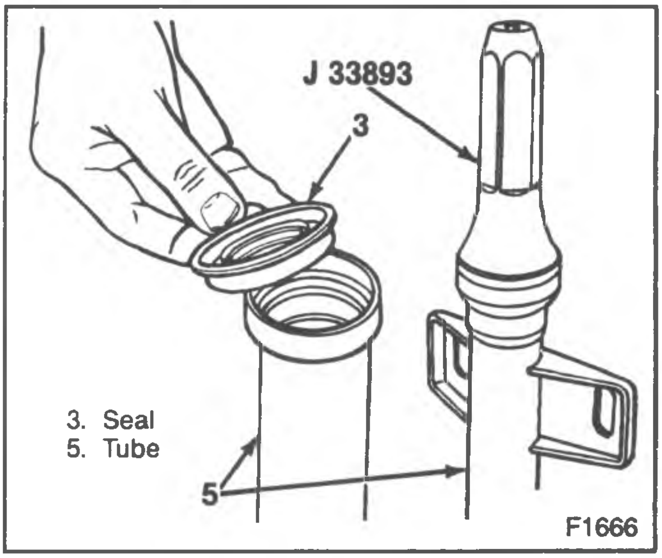


Figure 29—Installing the Shaft Seal

- 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.
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

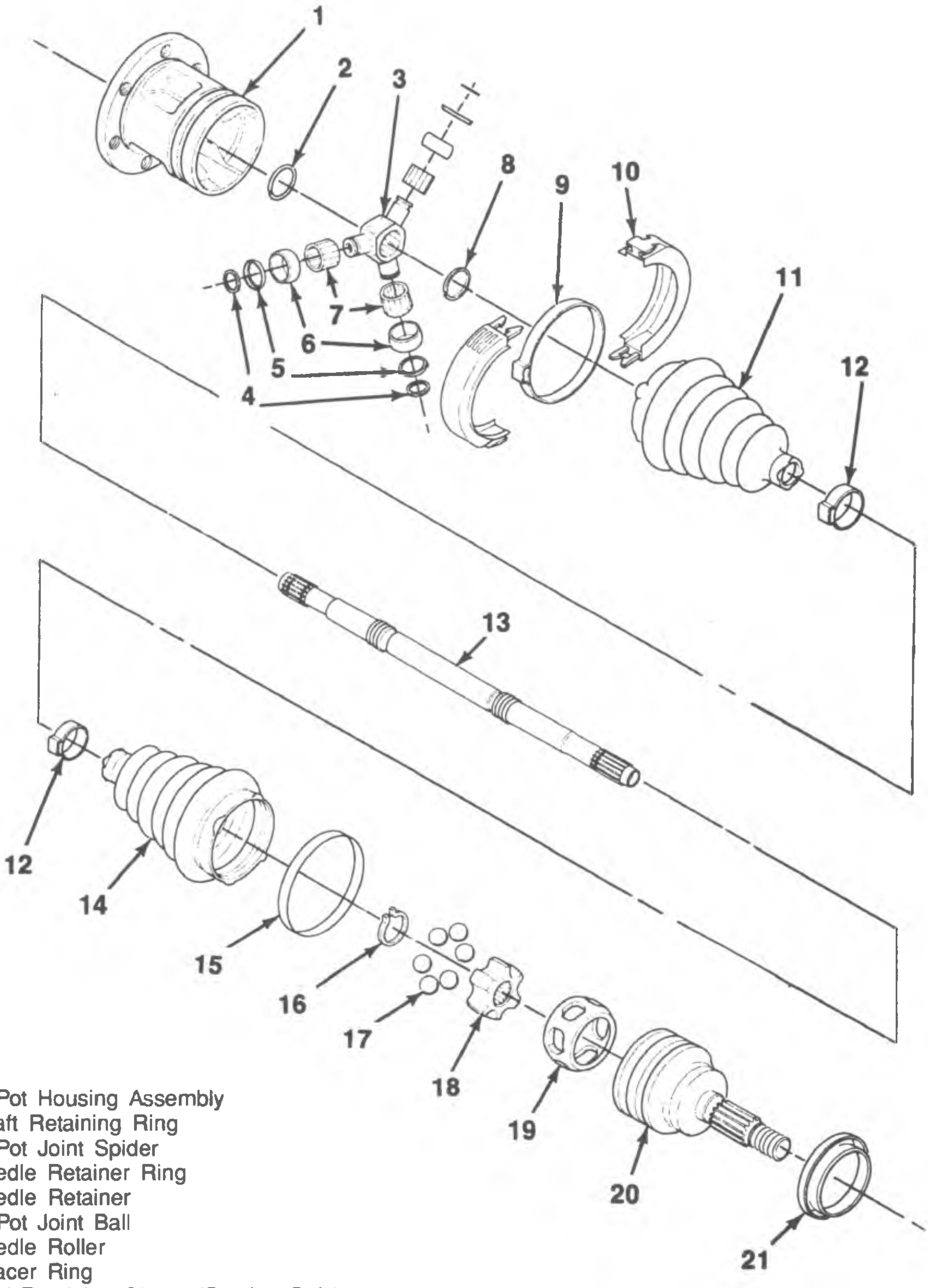
OUTER DEFLECTOR RING

Remove or Disconnect (Figures 30, 31 and 32)

1. Clamp the axle shaft (13) in a vise.
   - Use soft metal or wood to protect the shaft.
2. Deflector 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 deflector ring (21) at press diameter of C/V outer race (20).
2. Using a 3-inch pipe coupling, M24 x 2.0 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).



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

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 a chisel, and discard.

Important

- Do not cut through seal (14) and damage sealing surface of C/V outer housing (20) with the chisel.

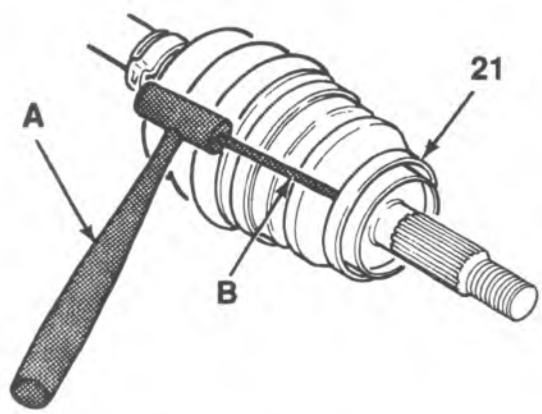
2. Small seal-retaining clamp (12) on axle shaft with side cutter, and discard.
3. Separate joint seal (14) from C/V joint race (20) at large diameter, and slide seal away from joint along axle shaft (13).
4. Wipe excess grease from face of C/V inner race (18).
5. Spread ears on race retaining ring (16) 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 before installing new seal. See "Outer Joint Assembly" in this section.

Install or Connect

1. Small the seal-retaining clamp (12) on neck of new seal (14). Do not crimp.
2. Slide the 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.). Refer to figure 35.
4. Place approximately half of the grease provided inside the seal (14) and pack 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 seal lip 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 let air escape. Shape seal properly by hand and remove tool.

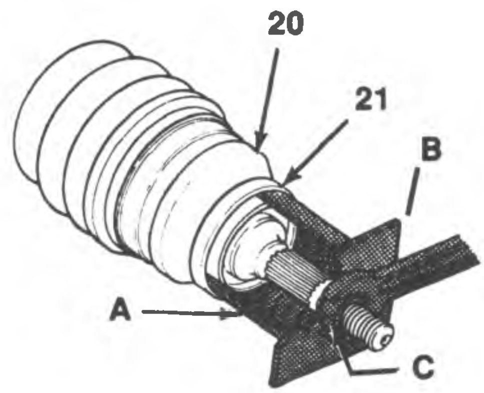


TAP DEFLECTOR RING OFF OUTER RING AND DISCARD

21. Deflector Ring
A. Hammer
B. Brass Drift

F7483

Figure 31—Removing Outer Deflector Ring

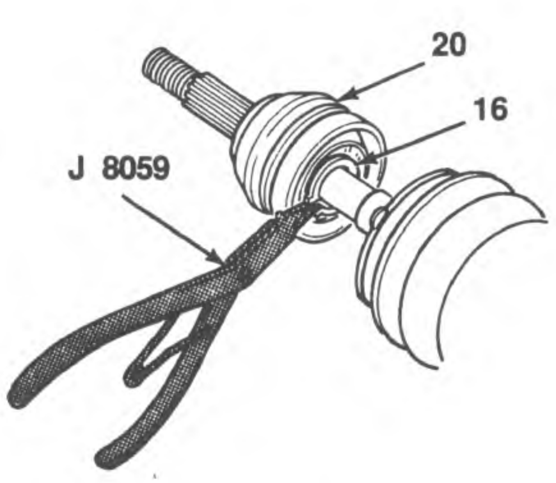


SQUARE UP DEFLECTOR RING AND TIGHTEN NUT UNTIL RING BOTTOMS AGAINST SHOULDER OF OUTER RACE

20. C/V Joint Outer Race
21. Deflector Ring
A. 3" Pipe Coupling
B. Sheet Steer (3 mm Min. Thickness) With 28 mm Drilled Hole
C. M24 x 2.0 Nut

F7484

Figure 32—Installing Outer Deflector Ring



SPREAD RETAINING RING EARS AND SLIDE C/V JOINT OFF AXLE SHAFT

16. Race Retaining Ring
20. C/V Joint Outer Race

F7485

Figure 33—Separating C/V Joint and Axle

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 (figure 36).
   - — Insert bolts and tighten by hand until snug.

Important

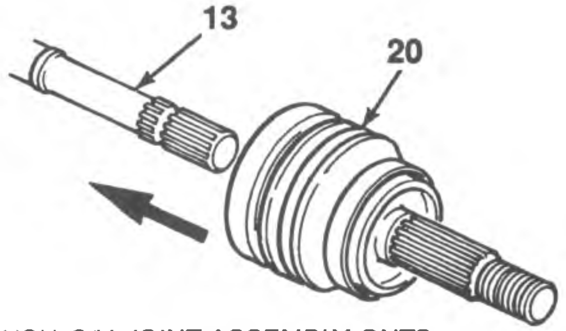
- Make sure that seal (14), housing (20) and swage ring (15) all remain in alignment (figure 36).

   - — 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. Remove outer joint seal. Refer to "Outer Joint Seal" in this section.
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)(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. Refer to figure 38.
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. Refer to figure 39.
8. Pivot inner race (18) into cage (19) window and remove inner race.

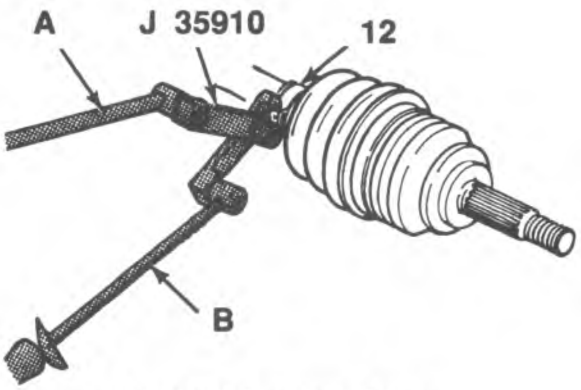


PUSH C/V JOINT ASSEMBLY ONTO AXLE SHAFT UNTIL RETAINING RING IS SEATED IN GROOVE ON AXLE SHAFT

13. Axle Shaft
20. C/V Joint Outer Race

F7486

Figure 34—Installing C/V Joint to Axle



12. Seal Retaining Clamp
A. Breaker Bar
B. Torque Wrench

F7487

Figure 35—Installing Seal Retaining Clamp

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.

Important

- Be sure that retaining ring side of inner race (18) faces axle shaft (13).

3. Install outer joint seal. Refer to "Outer Joint Seal" in this section.

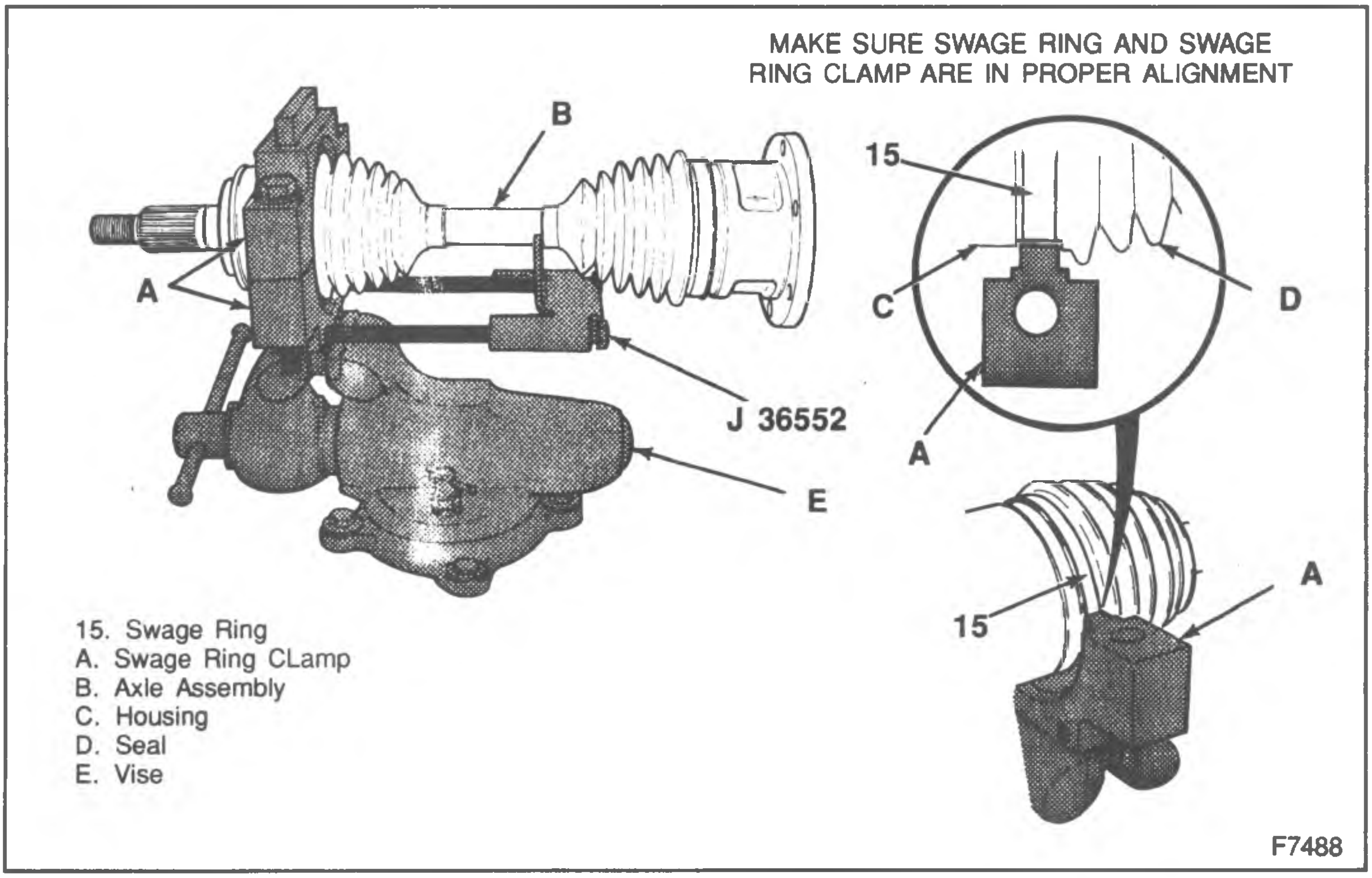


Figure 36—Installing Swage Ring

INNER TRI-POT SEAL

Remove or Disconnect (Figures 30, 35, and 40 through 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).
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 in figure 41.
7. Shaft retaining ring (2) from groove on axle shaft (13) and slide spider assembly off of shaft.

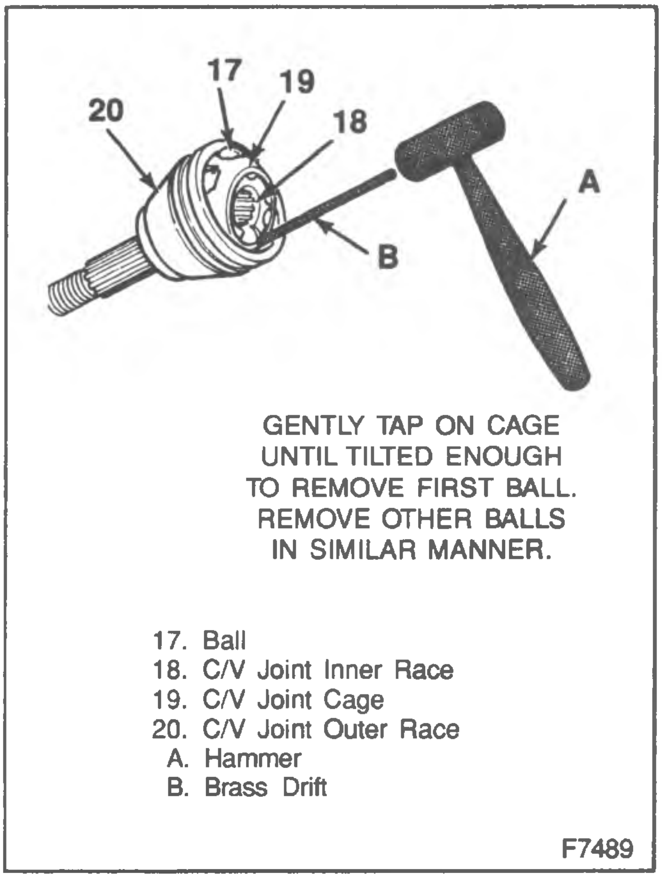


Figure 37—Removing C/V Joint Ball

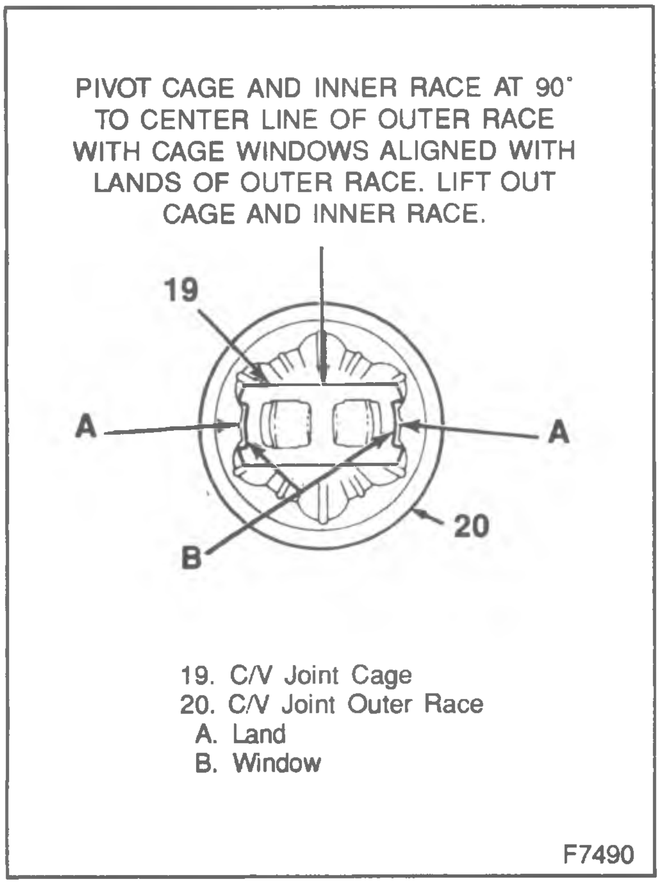


Figure 38—Separating Outer Race and Cage

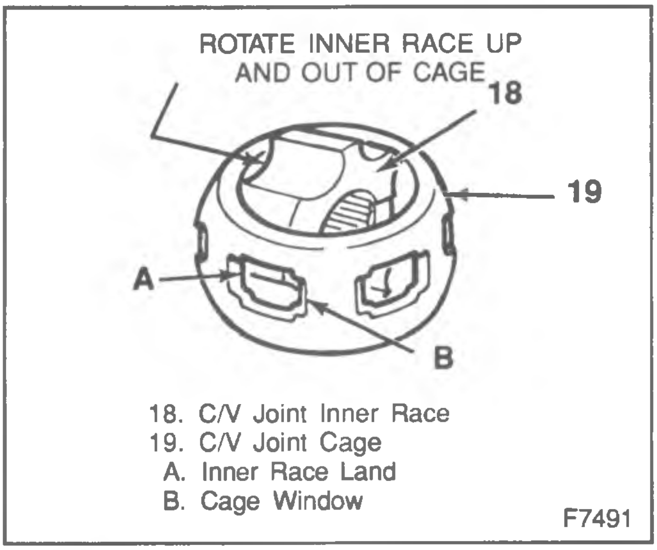


Figure 39—Separating Inner Race and Cage

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.

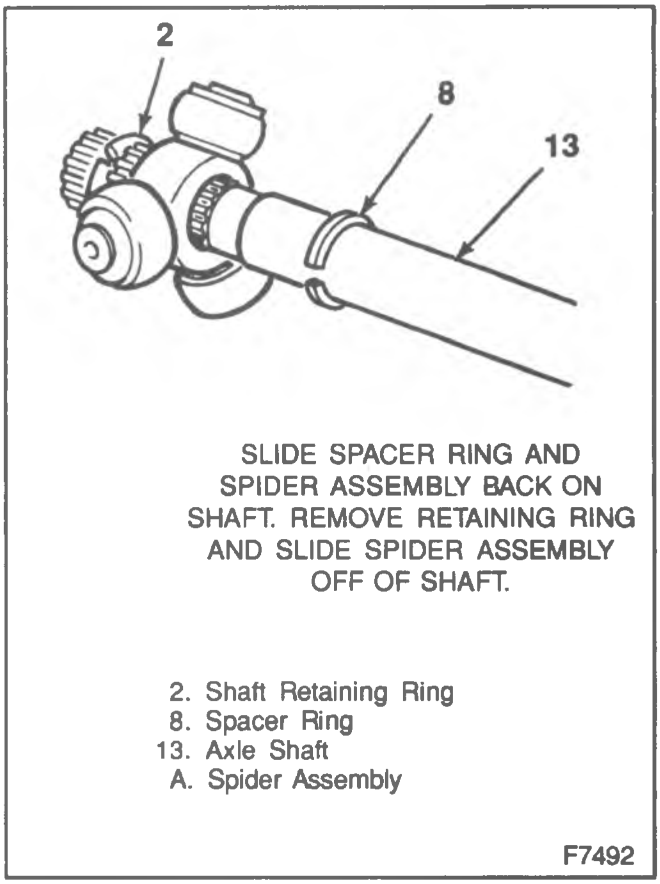


Figure 40—Removing Spider Assembly

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 in figure 35.
4. Spacer ring (8) on axle shaft (13) and beyond second 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.

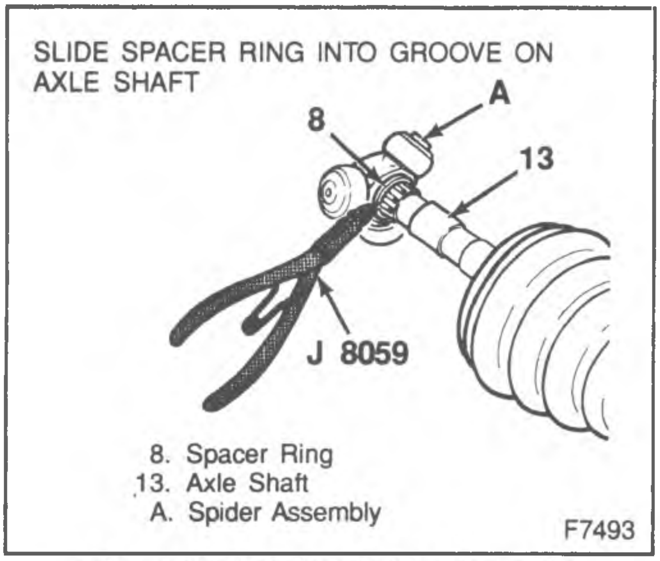


Figure 41—Installing Spider Assembly

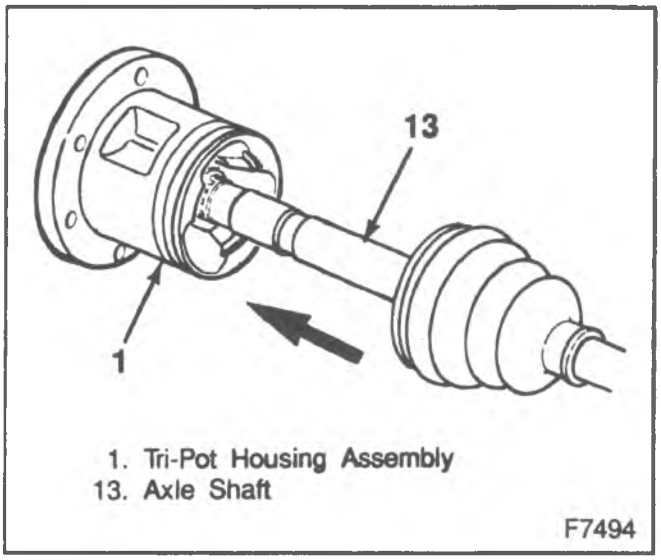


Figure 42—Installing Tri-pot to Housing

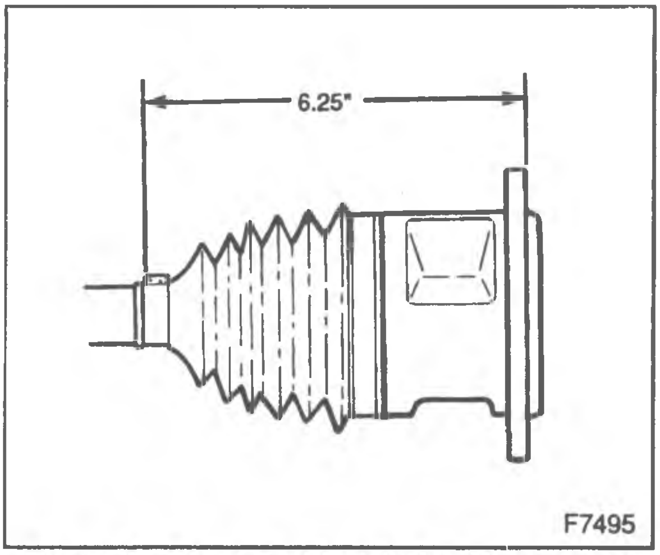


Figure 43—Tri-pot Seal Installation Measurement

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 pack 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 seal lip 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 let air escape. 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

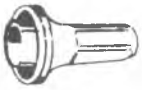
Pinion Preload	1.7-2.8 N·m (15-25 in. lbs.)
Backlash	0.08-0.25 mm (0.003-0.010-inch)
(Preferred)	0.13-0.18 mm (0.005-0.007-inch)

T2378

SPECIAL TOOLS

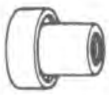
1.  J 21551

2.  J 29763

3.  J 33782

4.  J 33785

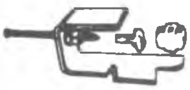
5.  J 33788

6.  J 33790

7.  J 33792

8.  J 22912-01

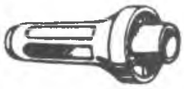
9.  J 23423-A

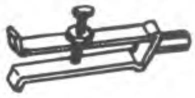
10.  J 33837

11.  J 33838

12.  J 8614-01

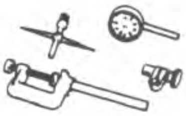
13.  J 33844

14.  J 33893

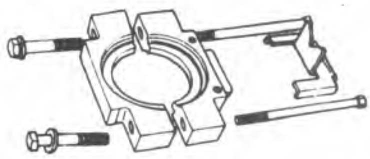
15.  J 29369-2

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

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

HYDRAULIC BOOSTER

BENDIX HYDRO-BOOST

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 an inoperative accumulator 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.

Install or Connect (Figures 1 and 2)

Tool Required:
J 26889 Accumulator Piston 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.

Remove or Disconnect (Figures 1 through 4)

1. Retainer (1).
   - Release the C-clamp.
   - Nut from stud.
   - Special tool J 26889.
2. Accumulator (2) and O-ring (3).
3. Retainer (4) (figure 3).
4. Plug (5) and O-ring (6).
5. Spring (7).
6. Retainer (26).
7. Output pushrod (28) and baffle (27).
8. Piston return spring (25) and retainer (24).
   - Saw off the eyelet of the pedal rod (20).
9. Boot (19).
10. Nut (18) and bracket (17).
11. Bolts (9).
    - Separate the cover (16) from the housing (8).
12. Seals (14 and 15).
13. Piston assembly (22) and seal (23).
14. Spool valve (13).
15. Accumulator valve (11).
    - Make a wire hook as in figure 4 to aid in the removal.
16. Return line fitting (12) and seal (10).

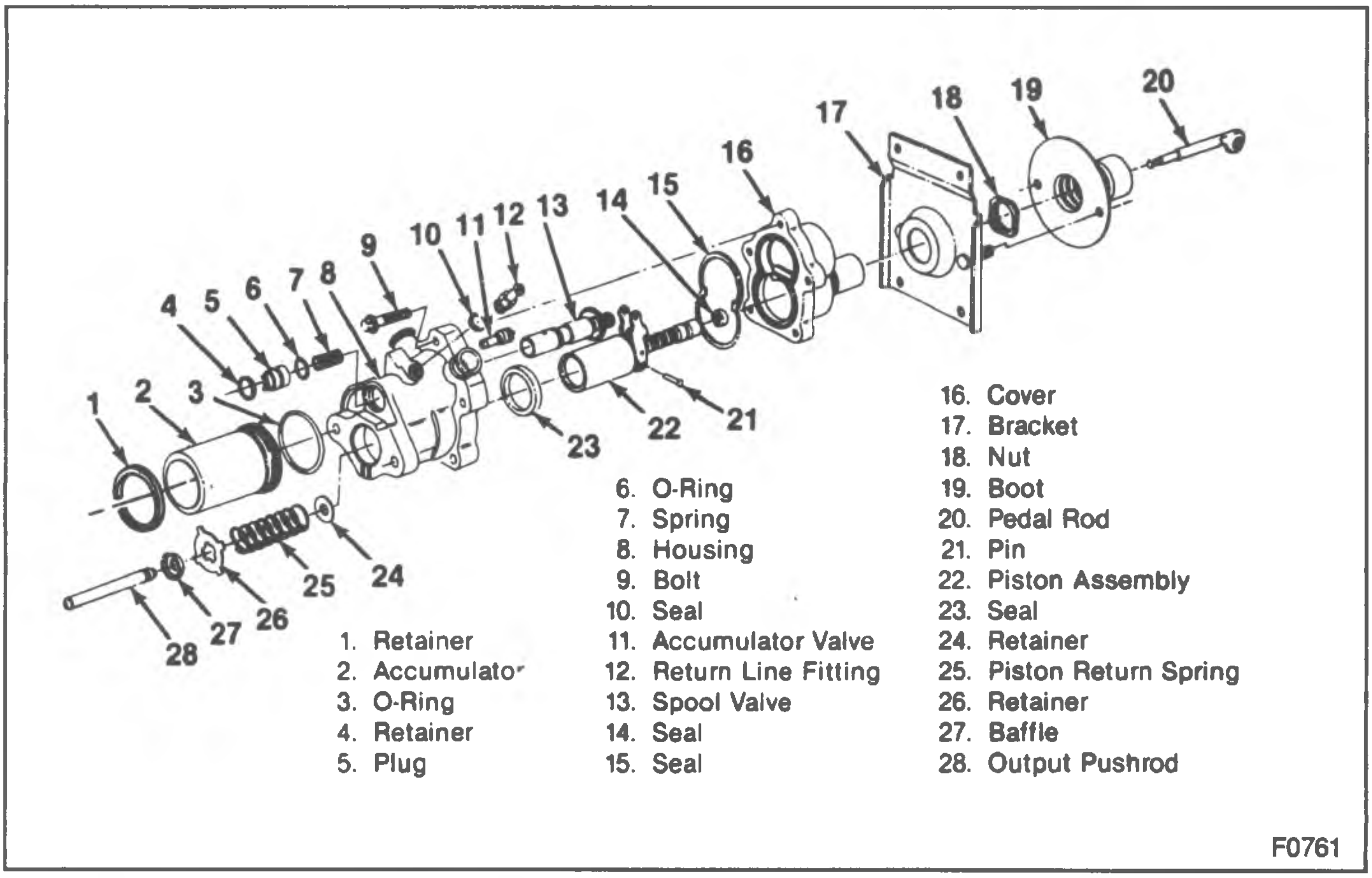


Figure 1—Hydro-Boost Components

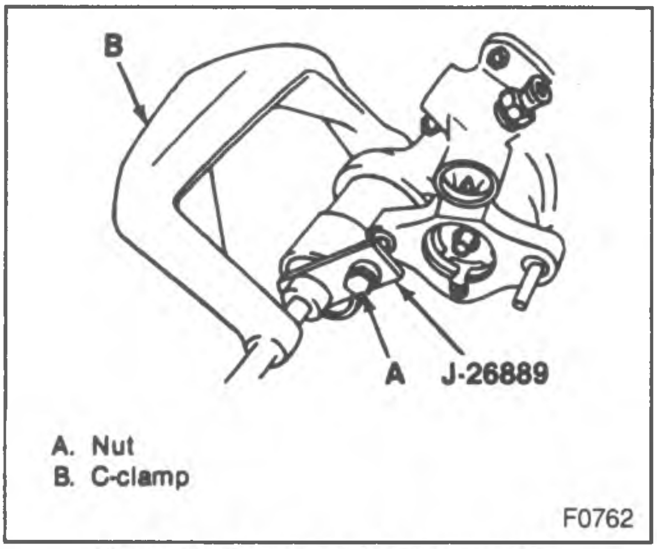


Figure 2—Removing the Accumulator

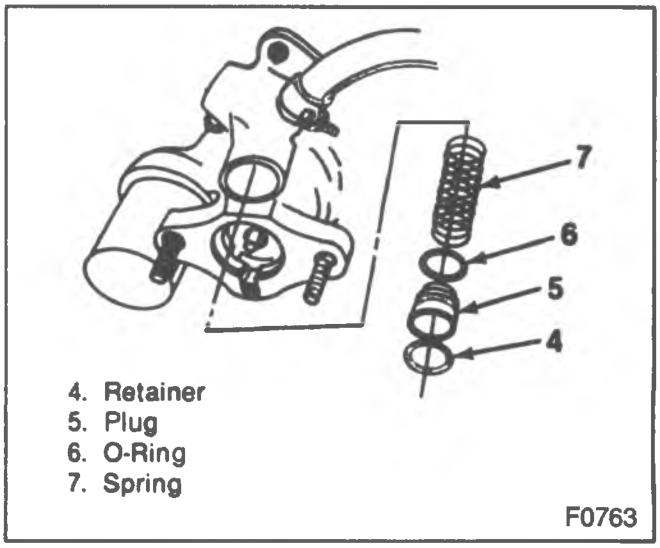


Figure 3—Removing the Plug and Spring

Clean

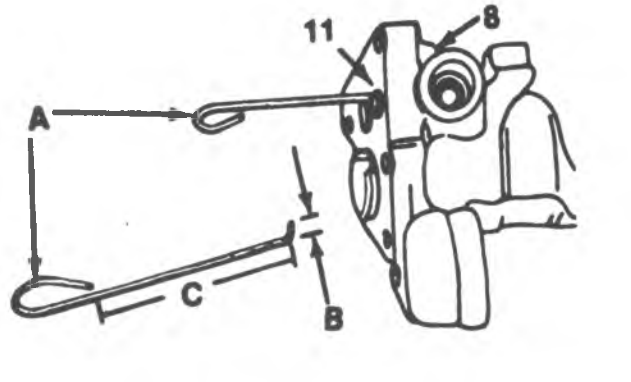
- All the parts with power steering fluid.

Inspect

- Spool valve and spool valve bore for corrosion, nicks and scoring.
- 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).
- If damage to the booster is found, replace the complete booster.

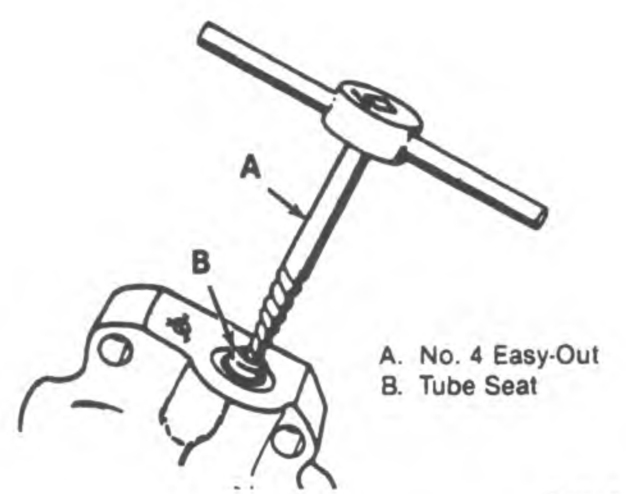
Install or Connect (Figure 1)

Tools Required:
J 26889 Accumulator Piston Compressor
J 24551-A Seal Protector
J 25083 Seal Protector



8. Housing
11. Accumulator Valve
A. Wire Hook
B. 3.0 mm (0.125-inch)
C. 57 mm (2.25-inches)
F0768

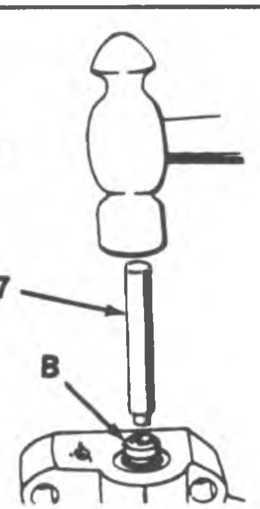
Figure 4—Removing the Accumulator Valve



A. No. 4 Easy-Out
B. Tube Seat
F0765

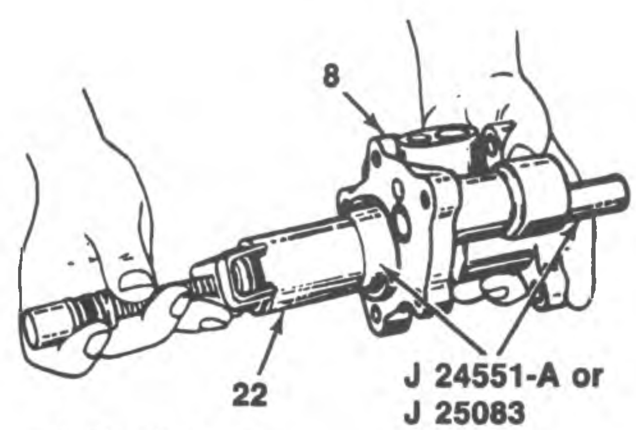
Figure 5—Removing the Tube Seat

B. Tube Seat



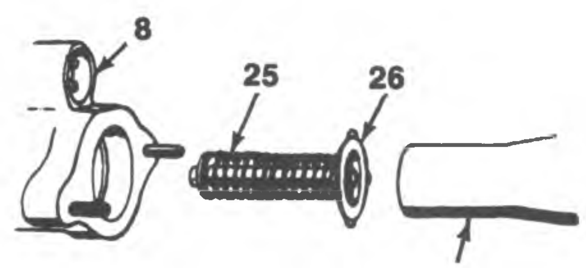
F0764

Figure 6—Installing the Tube Seat



8. Housing
22. Piston Assembly
F9318

Figure 7—Installing the Piston Assembly



8. Housing
25. Piston Return Spring
26. Retainer
J 24551 or
J 25083
F9319

Figure 8—Installing the Output Rod Retainer

- 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) (figure 7).
   - Lubricate J 24551-A or J 25083 with clean power steering fluid.
   - Use the proper tool to install the piston assembly.
5. Seal (14) onto the piston assembly (22).
6. Seal (15) onto the housing (8).
7. Cover (16) onto the housing (8).

NOTICE: For steps 8 and 9 see "Notice" on page 5-1 of this section.

8. Bolts (9).

Tighten

- Bolts (9) to 30 N.m (22 ft. lbs.).

9. Bracket (17) and nut (18).

Tighten

- Nut (18) to 149 N.m (110 ft. lbs.).

10. Boot (19).

11. Output pushrod assembly (figure 8).
    - Retainer (24), piston return spring (25), baffle (27) and output pushrod(28) by using J 24551-A or J 25083.
12. Retainer (26).
13. Plug and spring assembly (figure 3).
    - O-ring (6) onto the plug (5).
    - Spring (7), O-ring (6) and plug (5).
14. Retainer (4).
15. Accumulator assembly.
    - O-ring (3) onto the accumulator (2).
    - 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 (20).
18. Eyelet onto the pedal rod (20).

MASTER CYLINDERS

The master cylinder has identifying information stamped into the unit.

On the Delco Moraine NDH cylinders (composite or cast iron), the information is located on the front outlet tube or on the front surface of the body The first and second digits are the build code. The third digit indicates the year it was built. (An 0 means 1990 or a 1 means 1991.) The last digits indicate the day it was built. (Example: 271 means it was the 271st day of the production year.)

On the Bendix master cylinder, the information is 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. (An 0 means 1990 or a 1 means 1991). The last digits indicate the day it was built. (Example: 271 would mean 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 hard smooth surface and will cause rapid wear of the rubber cups.

NOTICE: Do not use unapproved solvents when cleaning or flushing the master cylinder and related components. The use of these liquids as cleaning solvents, will damage the rubber parts in the system if they have any trace of mineral oil.

COMPOSITE MASTER CYLINDER

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).

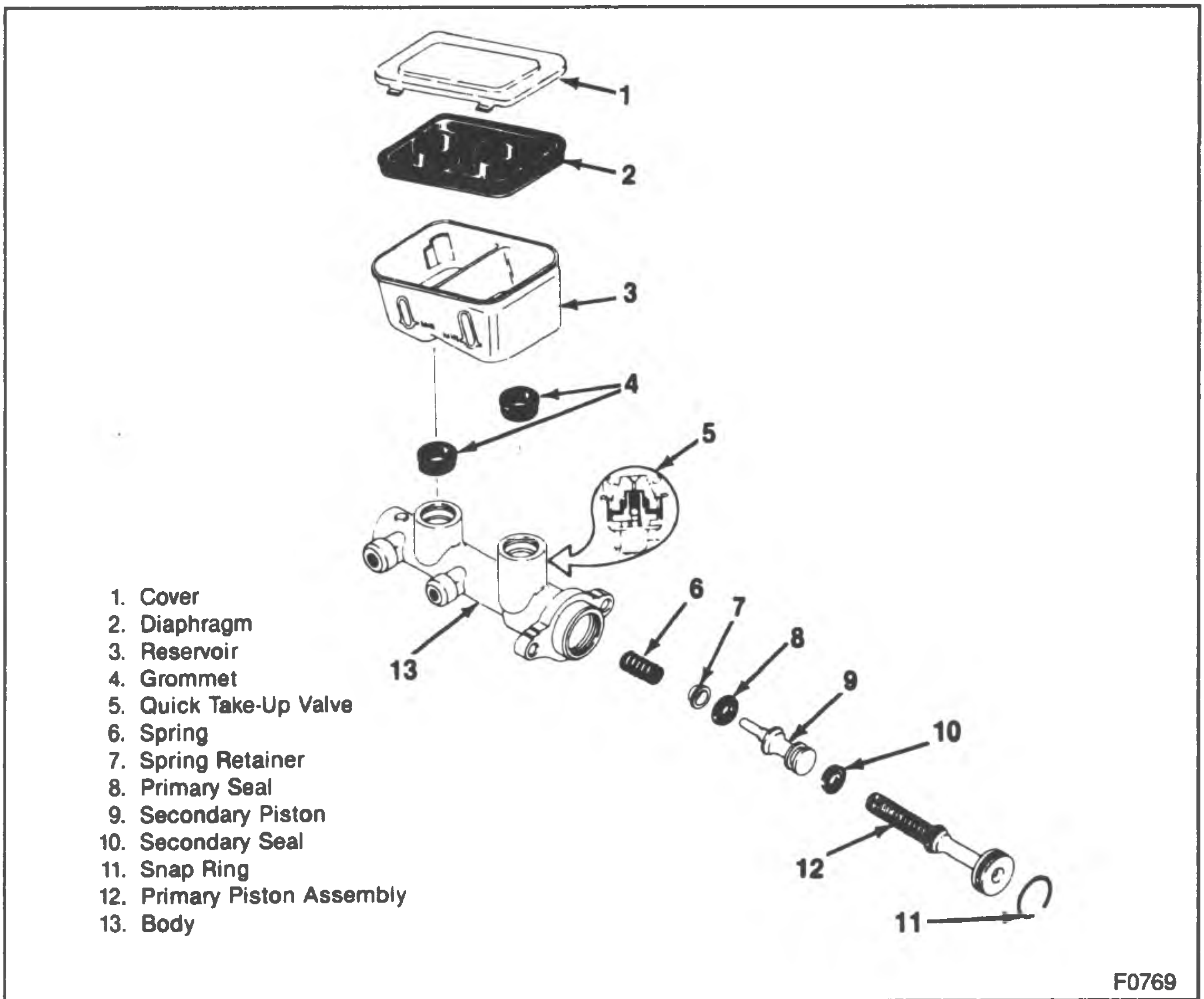


Figure 9—Composite Master Cylinder Components

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

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).

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.

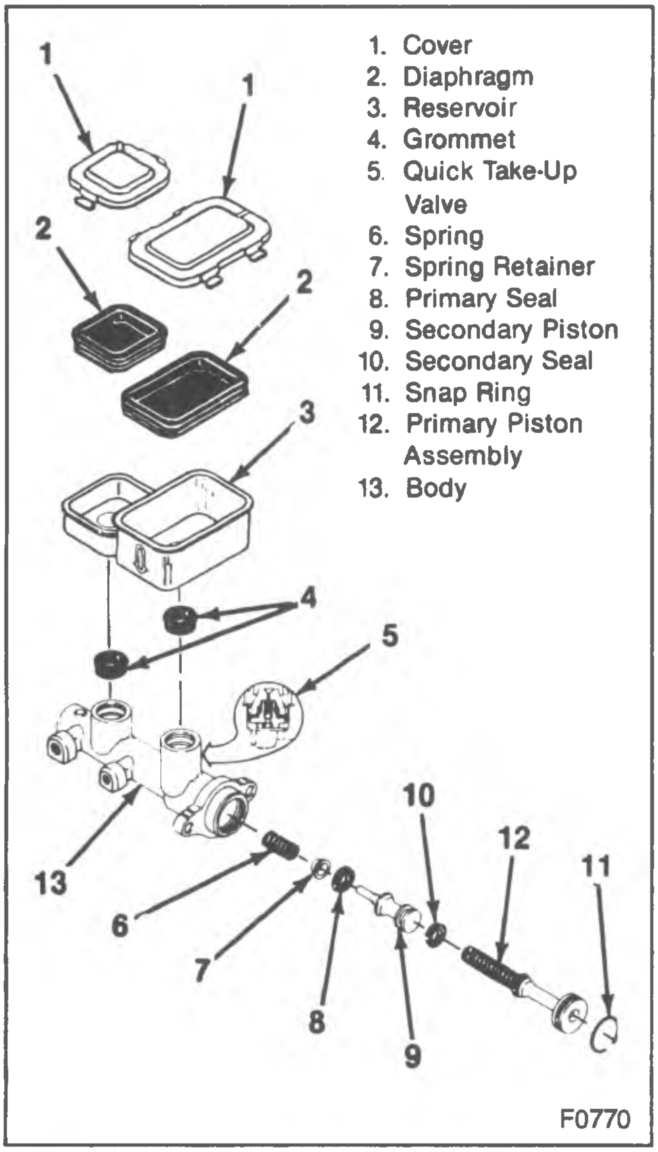


Figure 10—Composite Master Cylinder Components

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).

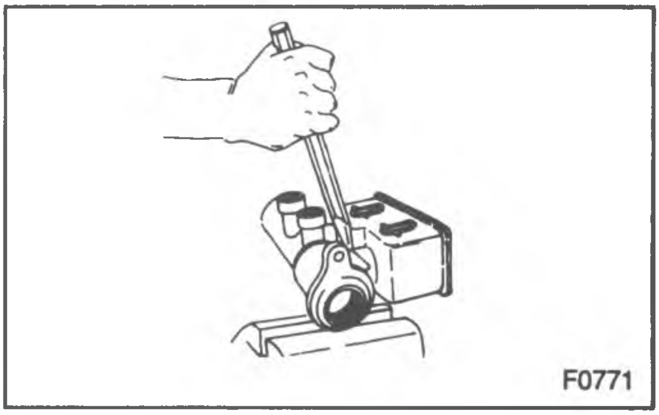


Figure 11—Removing The Reservoir

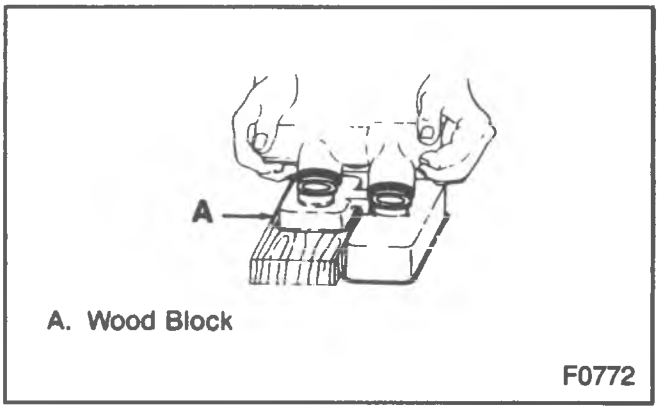


Figure 12—Installing The Reservoir

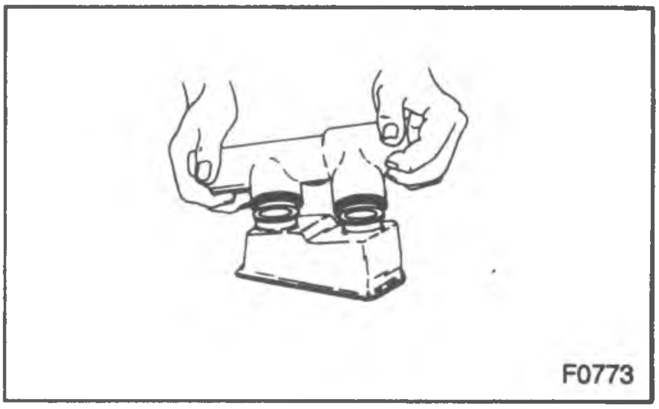
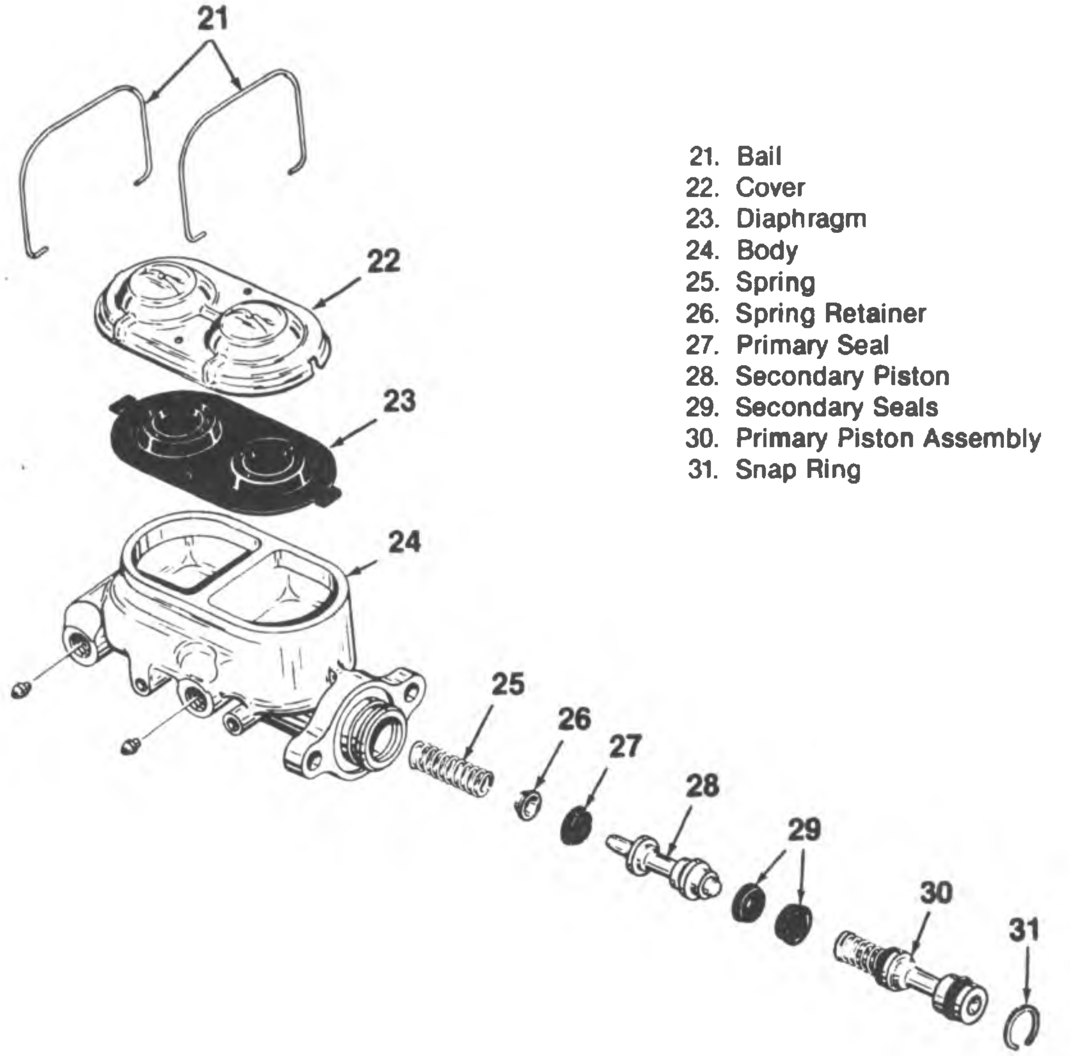


Figure 13—Installing The Reservoir

4. Secondary piston (28).
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).
9. Tube seats (if removed).
   - Seat the tube seats with a spare brake tube nut (figure 18).



21. Bail
22. Cover
23. Diaphragm
24. Body
25. Spring
26. Spring Retainer
27. Primary Seal
28. Secondary Piston
29. Secondary Seals
30. Primary Piston Assembly
31. Snap Ring

F0774

Figure 14—Cast Iron Master Cylinder Components

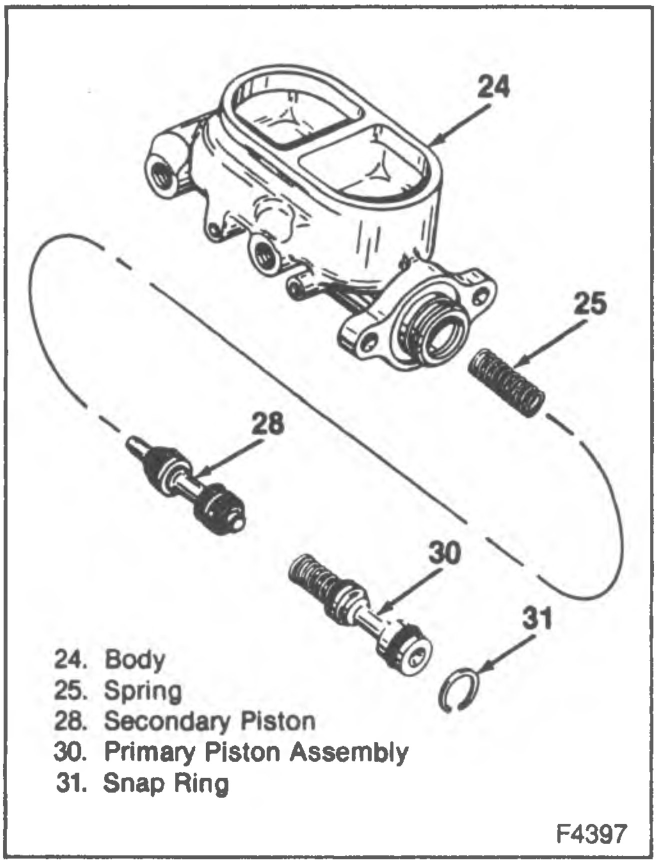


Figure 15—Cast Iron Master Cylinder Components

BENDIX MASTER CYLINDER

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.

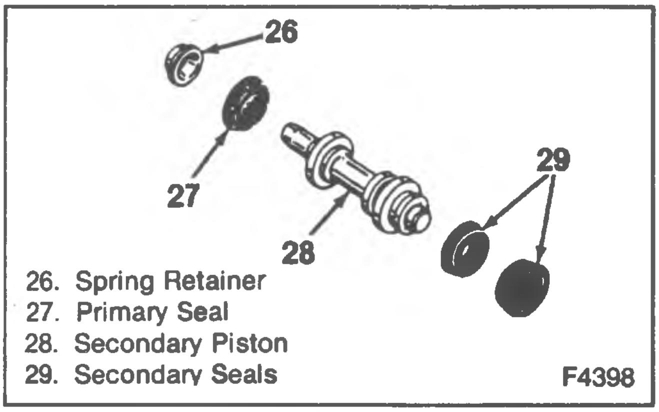


Figure 16—Secondary Piston Assembly

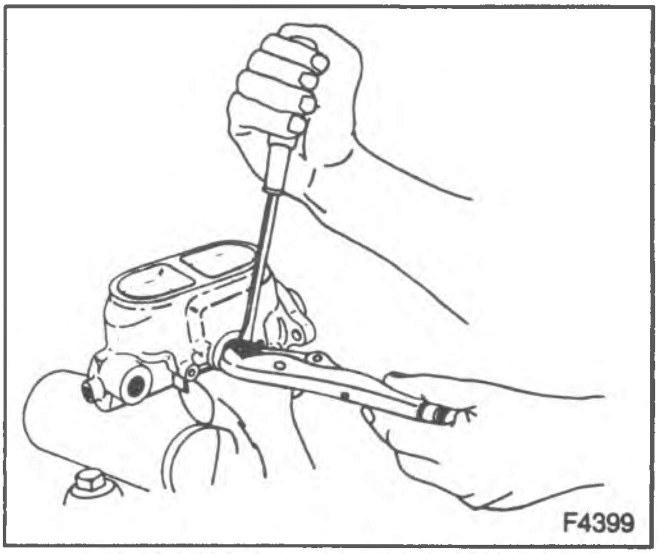


Figure 17—Removing the Tube Seats

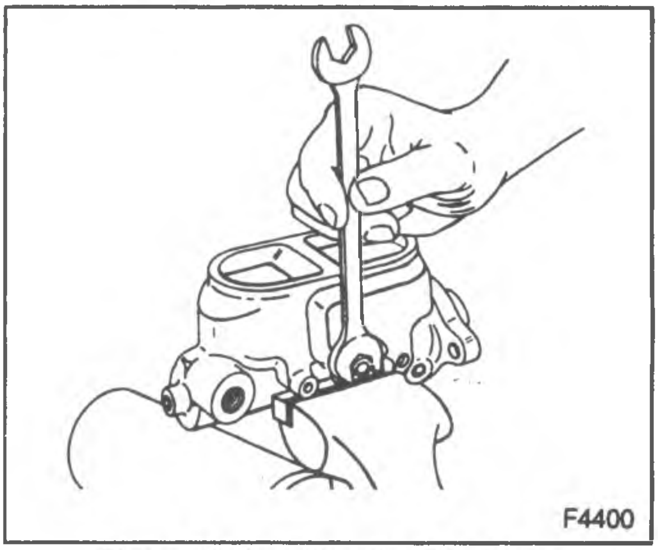


Figure 18—Installing the Tube Seats

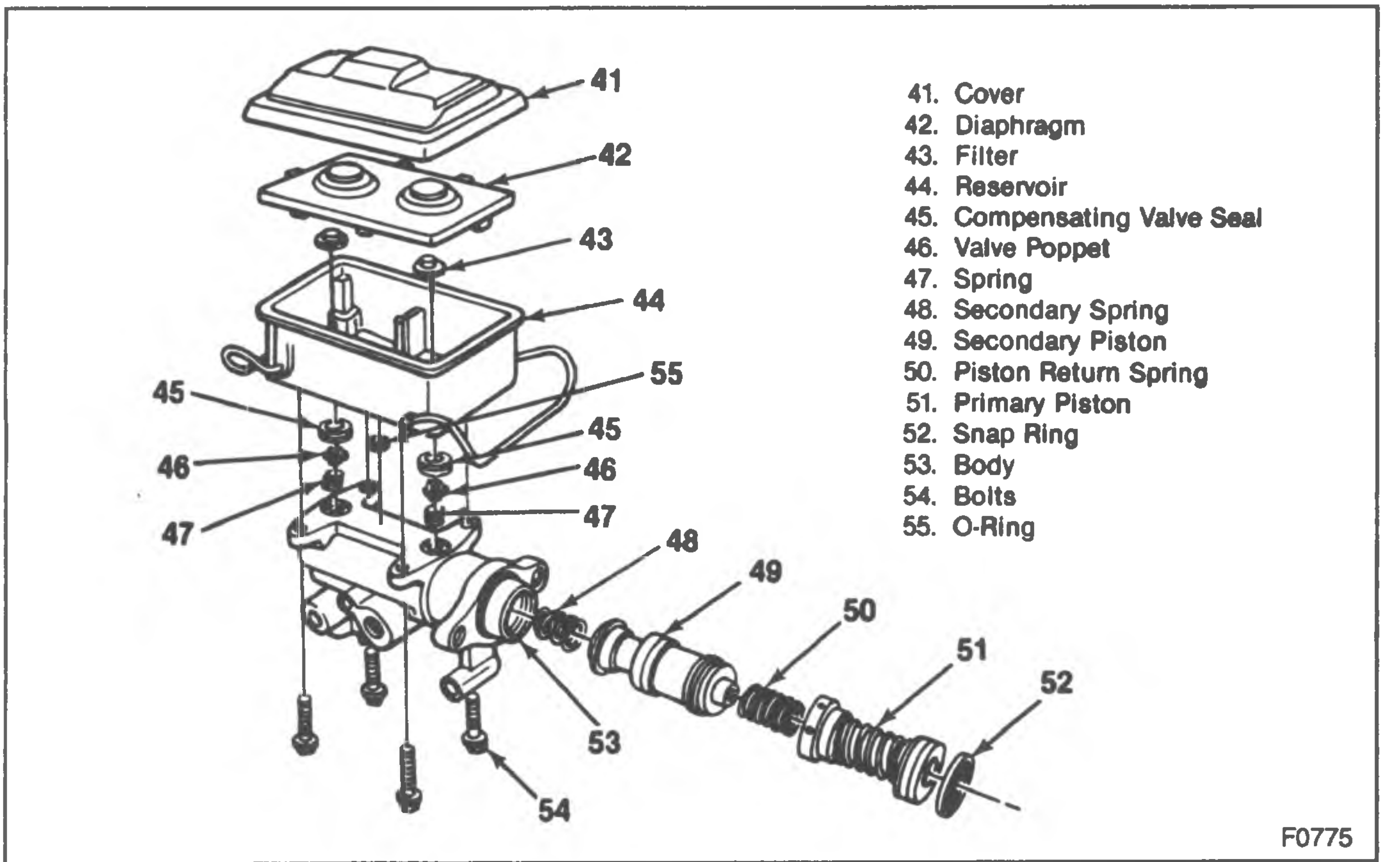


Figure 19—Bendix Master Cylinder Components

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.
- 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).
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: For step 8 "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).

VACUUM BOOSTERS

Delco Moraine NDH vacuum boosters have a build date on a small paper label glued onto the front housing. The first digit indicates the Delco Moraine NDH assembly line where it was built. The second digit indicates the year it was built (a 0 means 1990 or a 1 means 1991). The last digits indicate the day it was built. (Example: 271 would mean the 271st day of production year.)

SINGLE DIAPHRAGM VACUUM BOOSTER

Remove or Disconnect (Figures 20 and 21)

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 reassembly.
   - 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, **except the power piston and pushrod assembly** in clean denatured alcohol.
- Dry all parts cleaned with dry, filtered and unlubricated compressed air.

Install or Connect (Figures 20 through 23)

Tools Required:
J 23456 Power Brake Booster Disassembly and Reassembly Tool
J 28458 Power Piston Seal Protector

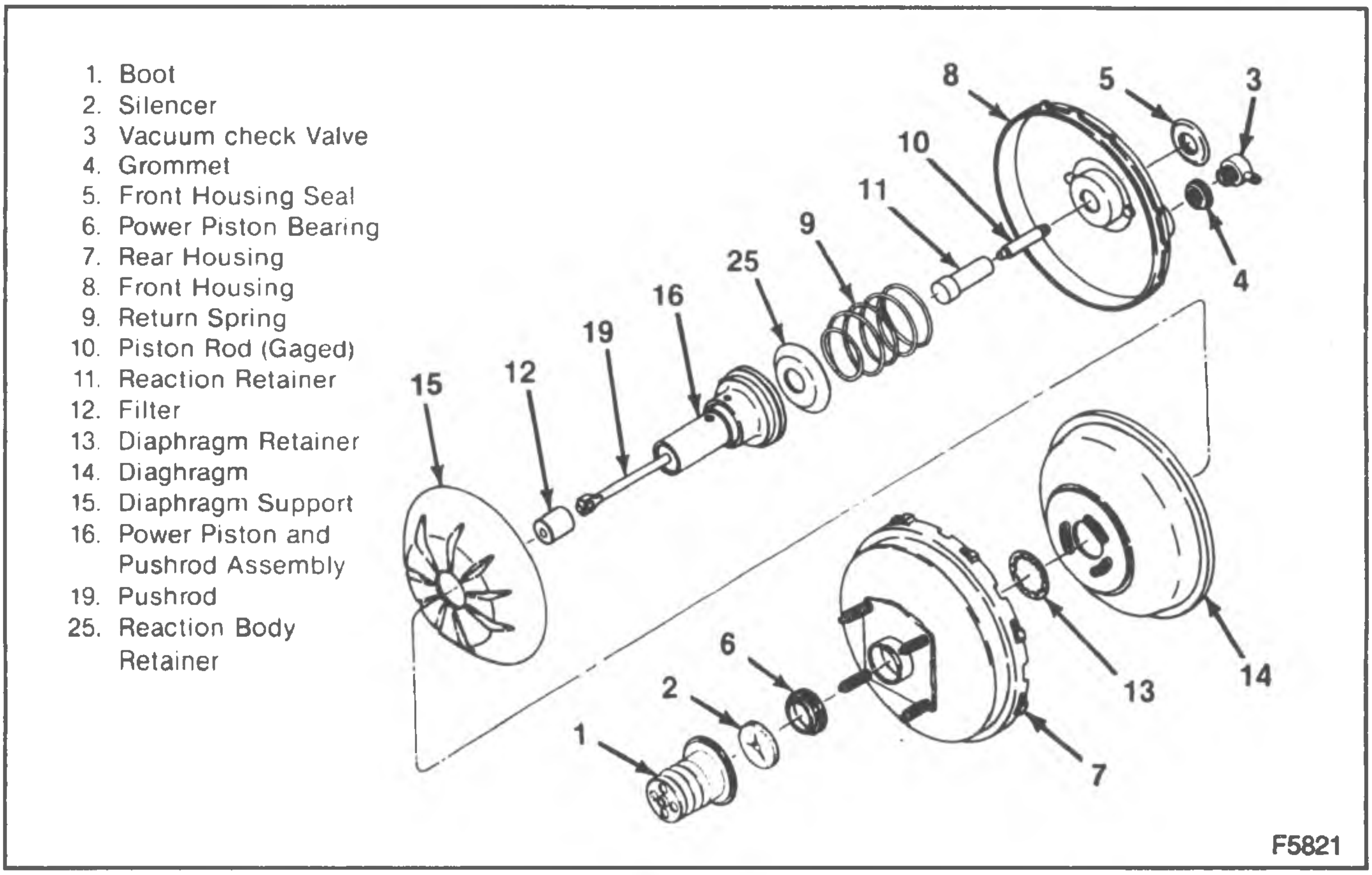


Figure 20—Single Diaphragm Vacuum Booster Components

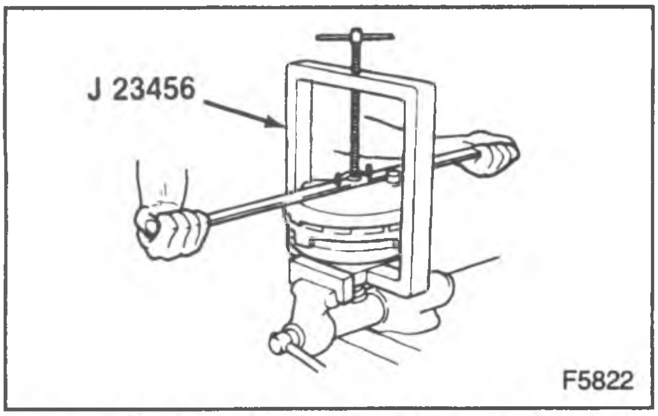


Figure 21—Unlocking and Locking the Booster

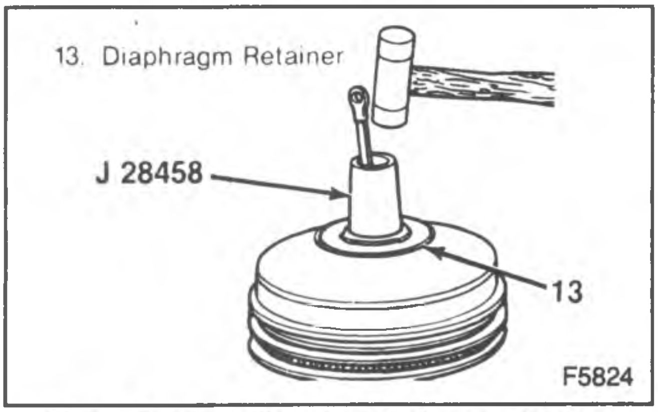


Figure 22—Installing the Diaphragm Retainer

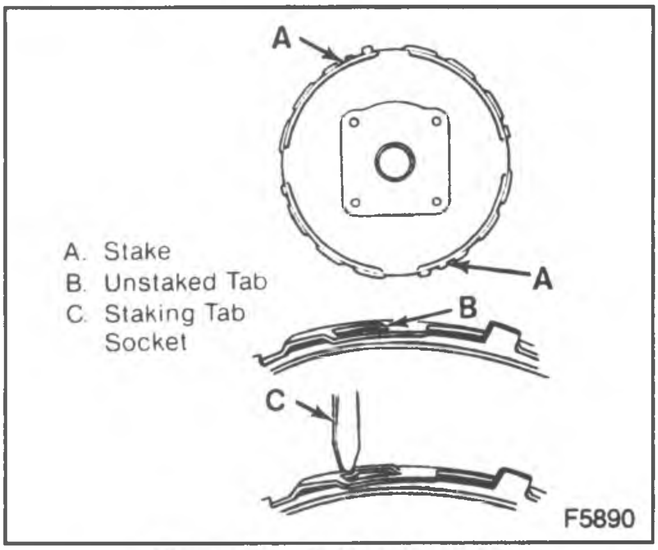


Figure 23—Staking the Tabs

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).

Notice: Do not stake a tab that has previously been staked. The tab may break at a later time and system failure may occur.

   - Assembly can be aided by connecting a vacuum source to the booster.
10. Grommet (4) and vacuum check valve (3).
   - Lubricate the inside and outside diameters of the grommet and front housing seal with a thin layer of silicone grease.
11. Front housing seal (5).
12. Silencer (2) and boot (1).

Measure (Figure 24)

Tool Required:
J 37839 Pushrod Height Gage

- Gage the piston rod using J 37839 (figure 24).
  - Gage the booster with 85.0 kPa (25 In. Hg) vacuum or at maximum engine vacuum.
  - Check both maximum and minimum rod length.
- If the piston rod is not within limits, obtain a service adjustable piston rod and adjust the rod to the correct measurement.

TANDEM DIAPHRAGM VACUUM BOOSTER

Remove or Disconnect (Figures 21 and 25 through 27)

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).

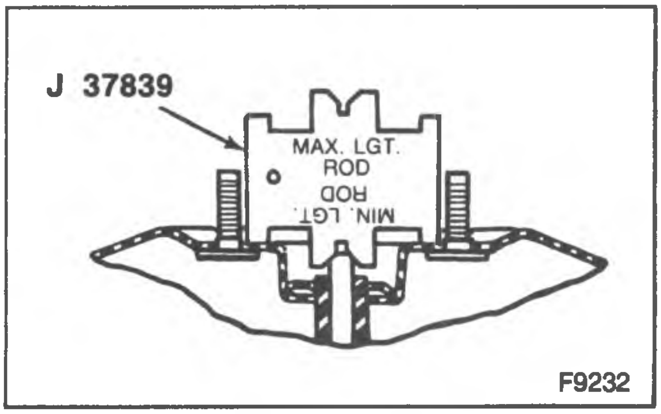


Figure 24—Gaging the Piston Rod

- Scribe a mark on the front and rear housings to aid in reassembly.
- 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) (figures 25 and 27).
   - Grasp the assembly at the outside edge of the housing divider (19) and the 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 pull the assembly straight out.
    - Considerable force will be required.
19. Filter (29), retainer (30) and O-ring (31) from the air valve pushrod assembly (32).

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
41. Power Piston Assembly

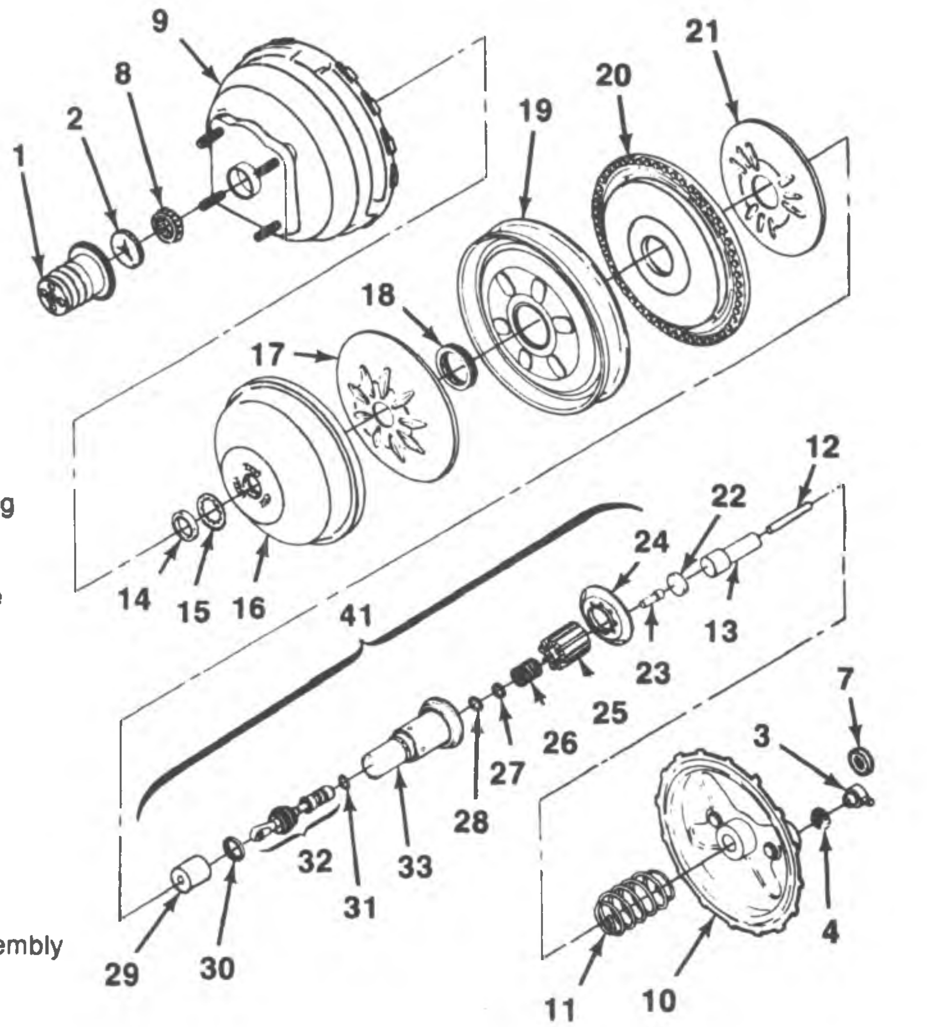


Figure 25—Tandem Diaphragm Vacuum Booster Components

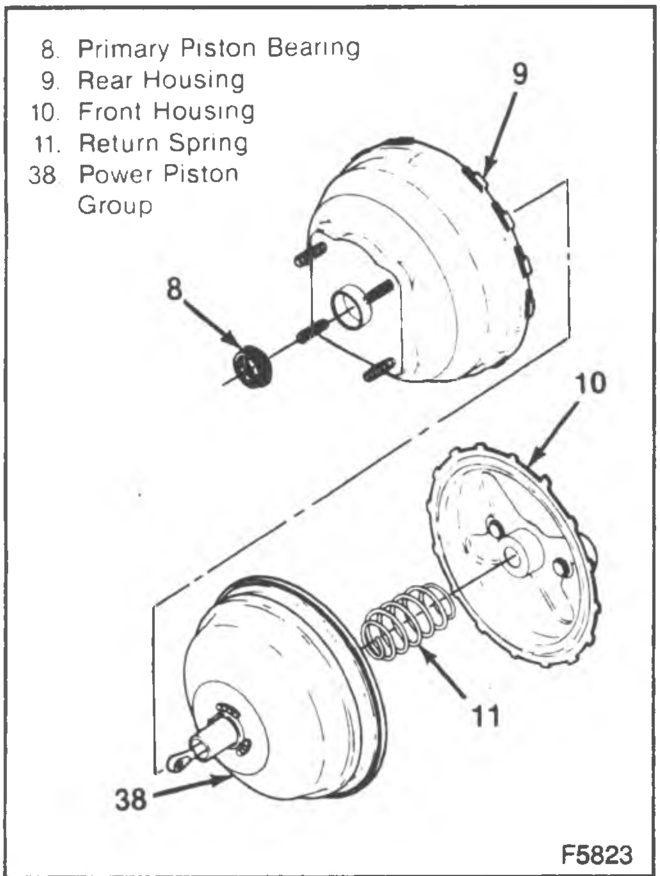


Figure 26—Booster Inner Components

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, **except the power piston and pushrod assembly** in clean denatured alcohol.
- Dry all parts cleaned with dry, filtered and unlubricated compressed air.

Install or Connect (Figures 25 through 29)

Tools Required:
J 23456 Power Brake Booster Disassembly and Reassembly Fixture
J 28458 Power Piston Seal Protector

1. Lubricated O-ring (31) with a thin layer of silicone grease and install onto the air valve pushrod assembly (32).
2. Air valve pushrod assembly (32) into the power piston (33).
3. Retainer (30) and seat.
4. Filter (29) over the pushrod eyelet and into the power piston (33).
5. Retaining ring (28) onto the air valve pushrod assembly (32).
6. Reaction bumper (27) and air valve spring (26).

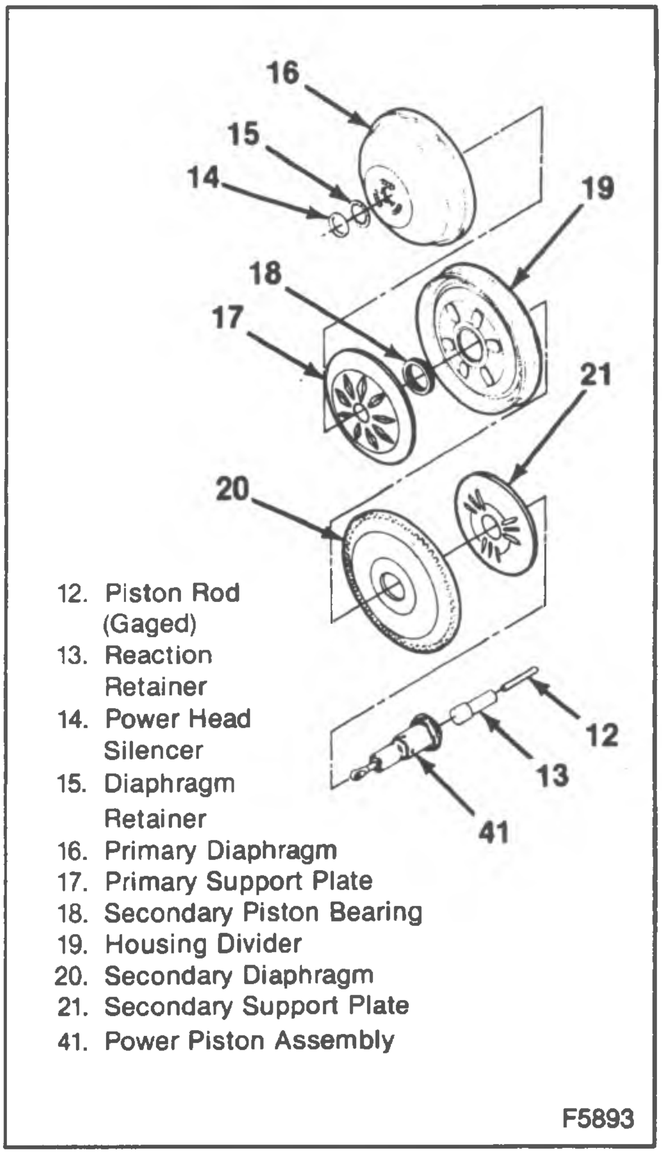
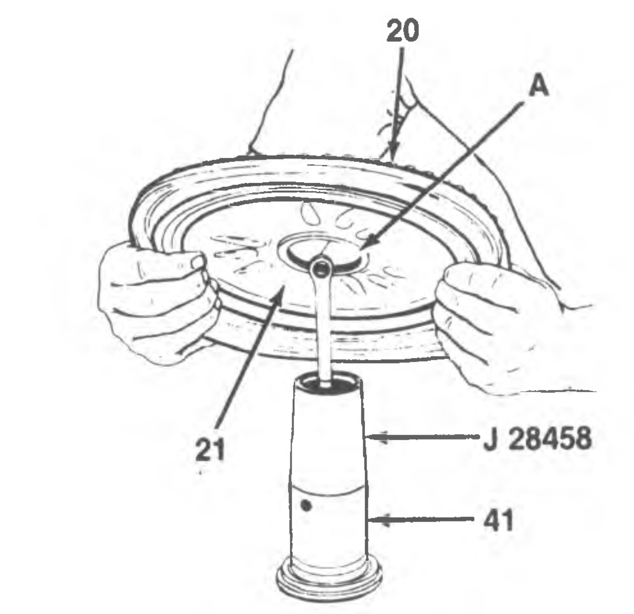


Figure 27—Power Piston Group

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) (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). Use J 28458 as a guide (figure 29).
14. Primary diaphragm (16) into the primary support plate (17).



A. Diaphragm Lip
20. Secondary Diaphragm
21. Secondary Support Plate
41. Power Piston Assembly

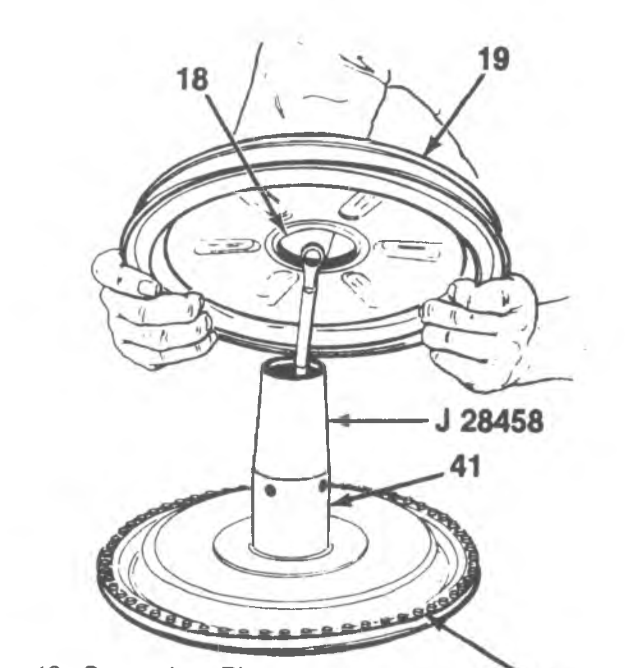
F5894

Figure 28—Assembling the Secondary Diaphragm and Support

- Fold the primary diaphragm (16) up and away from the primary support plate (17).

15. Primary diaphragm (16) and support plate (17) over the power piston assembly (41).
    - 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).
        - 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 at two tabs 180 degrees apart (figure 23).

Notice: Do not stake a tab that has previously been staked. The tab may break at a later time and system failure may occur.



18. Secondary Piston Bearing
19. Housing Divider
20. Secondary Diaphragm
41. Power Piston Assembly

F5895

Figure 29—Assembling the Housing Divider

- 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).

Measure (Figure 24)

Tool Required:
J 37839 Pushrod Height Gage

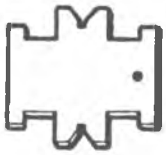
- Gage the piston rod using J 37839 (figure 24).
    - Gage the booster with 85.0 kPa (25 In. Hg) vacuum or at maximum engine vacuum.
    - Check both maximum and minimum rod length.
- If the piston rod is not within limits, obtain a service adjustable piston rod and adjust the rod to the correct measurement.

SPECIFICATIONS

	N·m	Ft. Lbs.
Hydro-Boost Housing to Cover Bolts	30	22
Hydro-Boost Nut	149	110
Reservoir Bolts	18	13

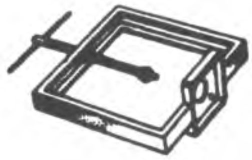
T2519

SPECIAL TOOLS

1.  J 37839

2.  J 24551-A

3.  J 25083

4.  J 23456

5.  J 26889

6.  J 6217

7.  J 28458

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 Compressor
6. Valve Connector Seal Installer
7. Power Piston Seal Protector

SECTION 6

ENGINE

CONTENTS

SECTION 6A

GENERAL ENGINE MECHANICAL

CONTENTS

CONTENTS (cont'd)

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 or TBI unit is removed, the intake opening must be covered. 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.

NOTICE: 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 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 continuous 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.

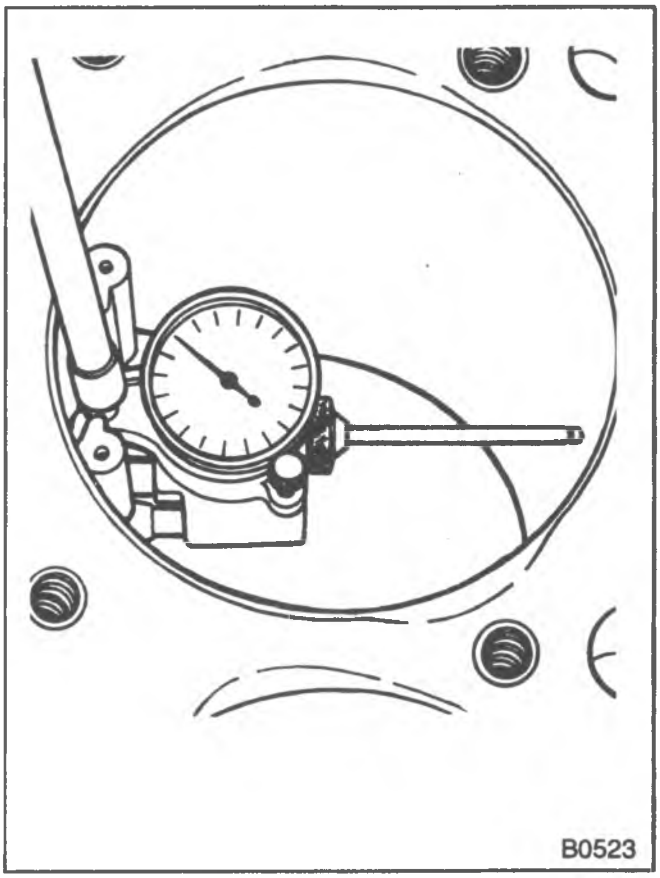


Figure 1—Checking the Cylinder Bore

CYLINDER BORE RECONDITIONING (2.5L 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

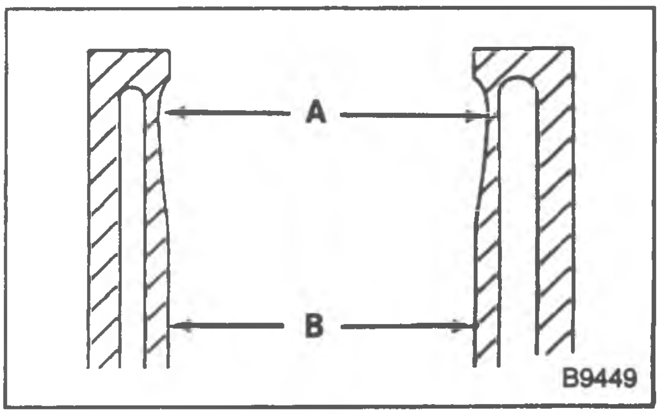


Figure 2—Typical Wear Pattern

an 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.
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 (2.8L 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 trueing 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 ebore 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.

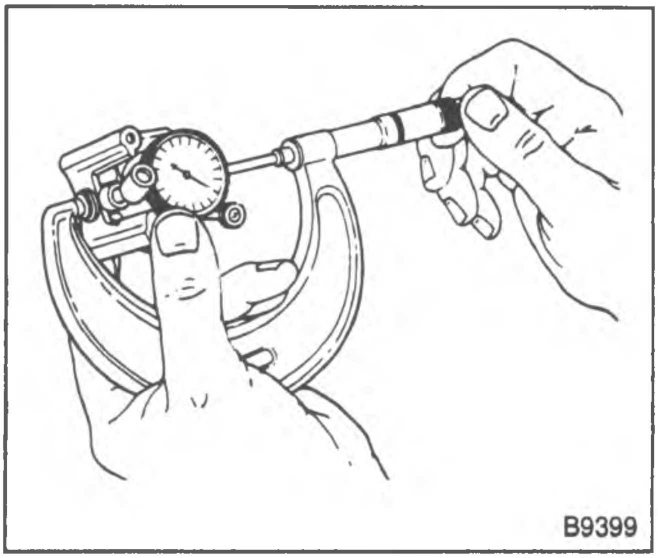


Figure 3—Measuring the Cylinder Bore Gage

CYLINDER BORE RECONDITIONING (ALL EXCEPT 2.5L AND 2.8L 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 ebore 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.
   - 2.5L: 45 degrees
   - 2.8L: 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 6.2L ENGINES)

Disassemble (Figures 4, 5 and 6)

Tools Required:
J 24086-B Piston Pin Remover and Installer

1. Piston rings. 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 2.8L pistons.

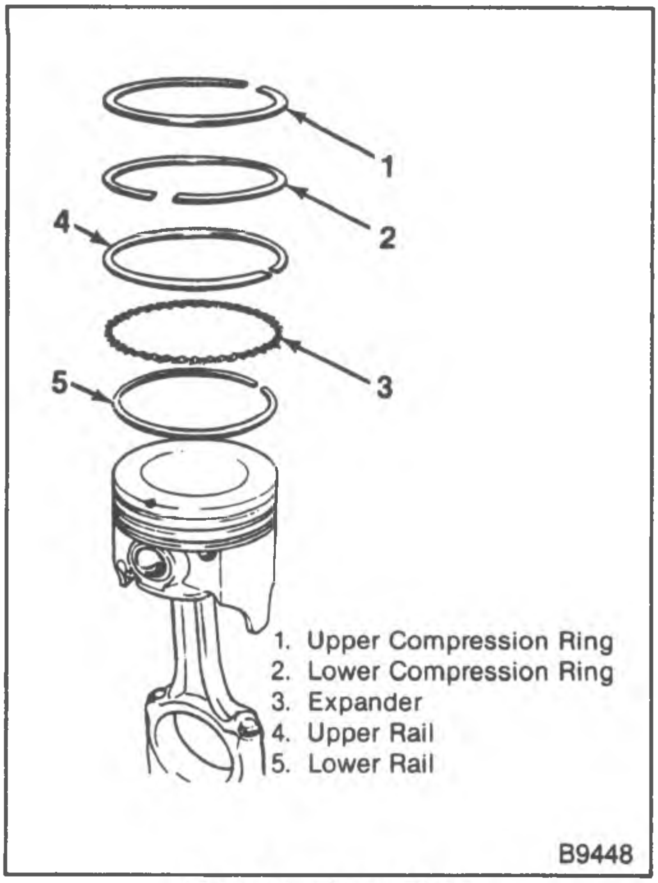


Figure 4—Piston Rings

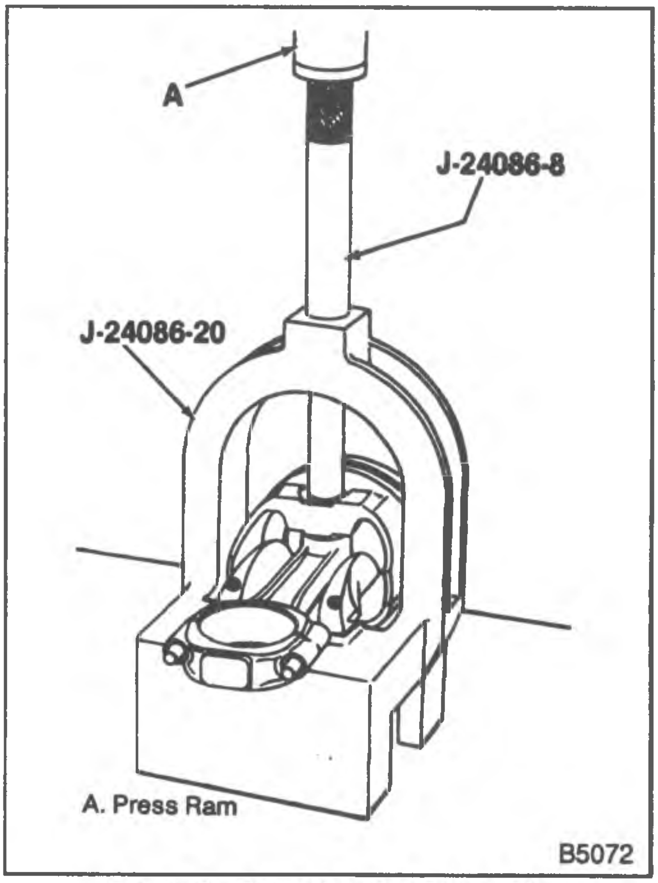


Figure 6—Removing the Piston Pin

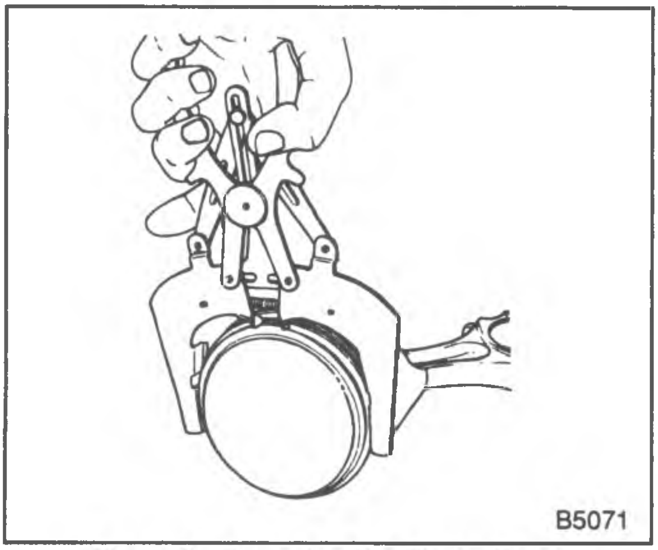


Figure 5—Removing the Piston Rings

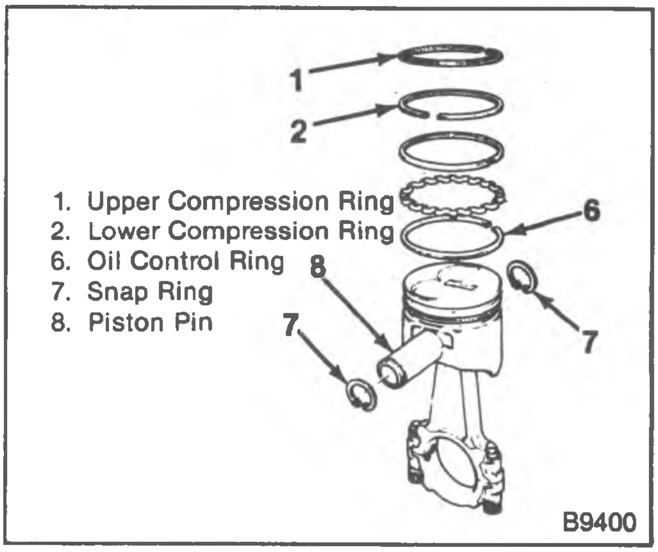


Figure 7—Piston and Components—6.2L Engine

- Place remover J 24086-8 (J 24086-88A for 2.8L pistons) on the support fixture.
- Press out the piston pin.

DISASSEMBLY (6.2L ENGINES)

Disassemble (Figures 5 and 7)

1. Piston rings.
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.

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 6.2L)

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 (6.2L ENGINES)

Clean

- Piston pin and bushing. The parts must be free of oil and dirt.

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).

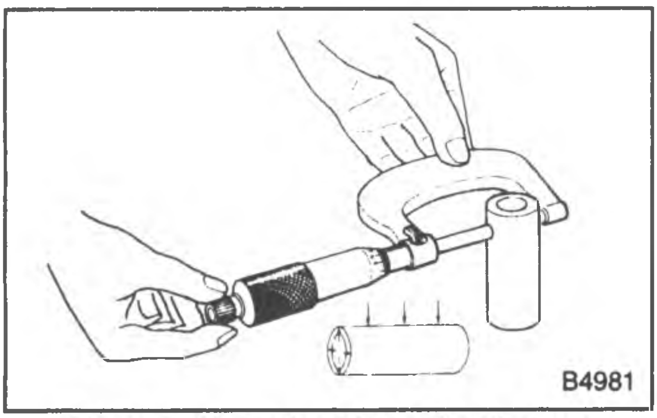


Figure 8—Measuring Piston Pin Diameter

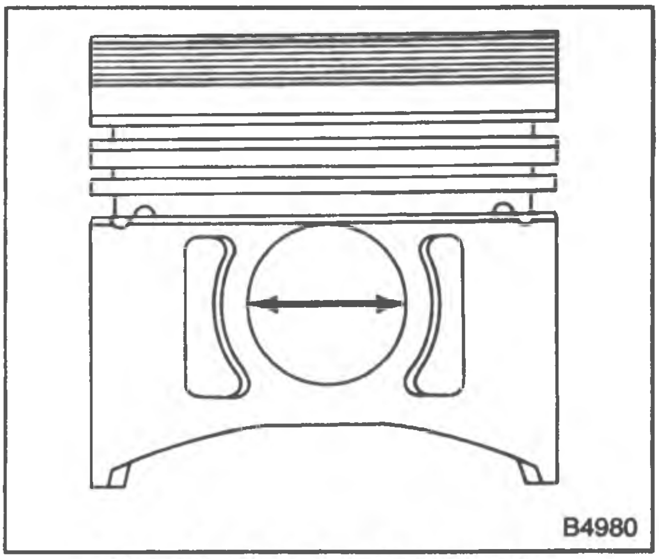


Figure 9—Piston Pin Hole Diameter

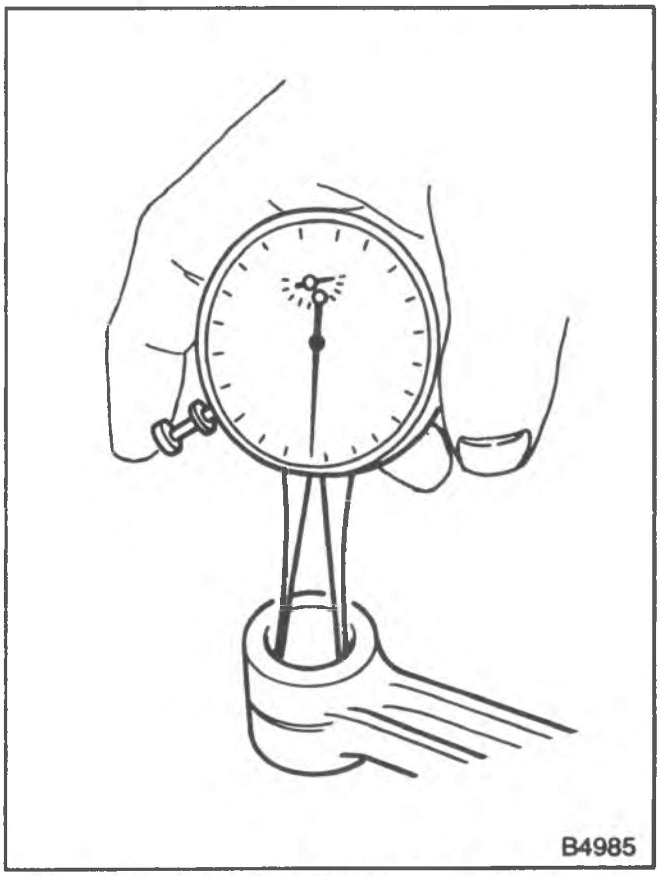


Figure 10—Measuring Piston Pin Bushing Inside Diameter

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 excessive with a new piston pin, the connecting rod must be replaced. Replacement bushings are not available.

PISTON SELECTION (2.5L AND 2.8L ENGINES)

Refer to the proper section.

PISTON SELECTION (ALL EXCEPT 2.5L AND 2.8L 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 1/2-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.
- 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.

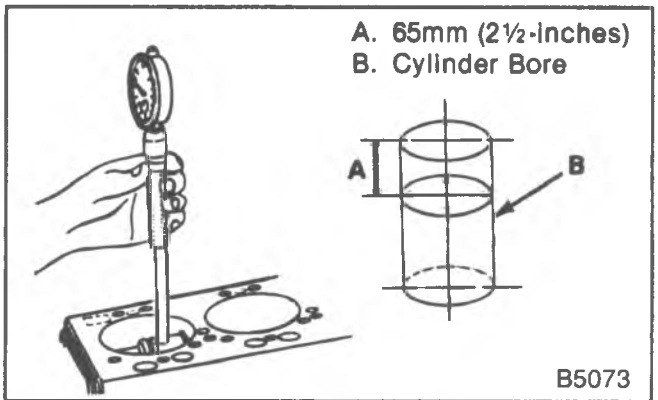


Figure 11—Measuring Cylinder Bore Diameter

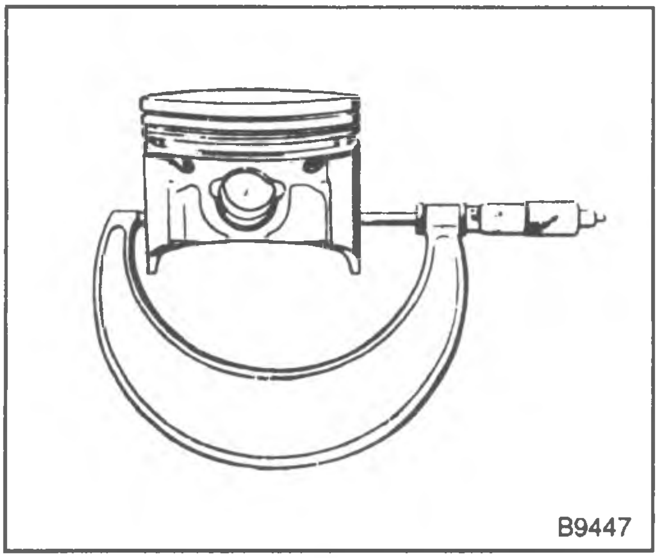


Figure 12—Measuring the Piston Skirt

ASSEMBLY

Assembling the Piston and Connecting Rod (All except 6.2L Engines)

Assemble (Figure 13)

Tool Required:
J 24086-B Piston Pin Remover and Installer Set

1. Piston and connecting rod.
   - The piston and connecting rod must be installed in the proper position.
     - 2.5L Engines: The raised notch side of the connecting rod must be opposite the notch in the piston crown.
     - 2.8L Engines: The bevel on the connecting rod should face the outside of the engine.
     - 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).

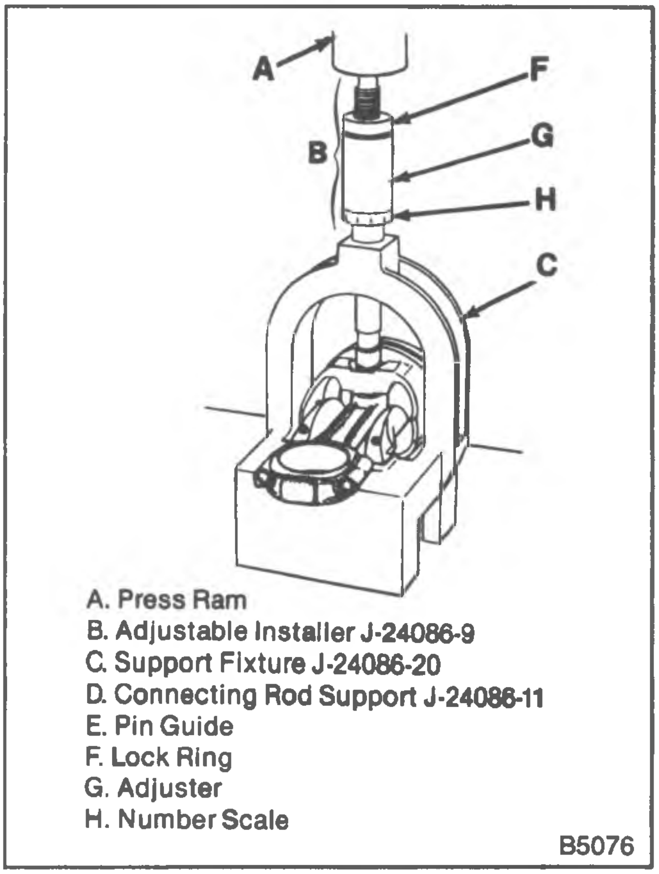


Figure 13—Installing the Piston Pin

- 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).
- 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 (6.2L Engines)

Assemble (Figures 7, 14, and 15)

Tool Required:
J 29134-B Piston Pin Clip Installer

1. Piston to the 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-B (figure 15).

Inspect

- Snap rings for proper assembly. Rotate the snap rings to make sure that they are seated in their grooves.

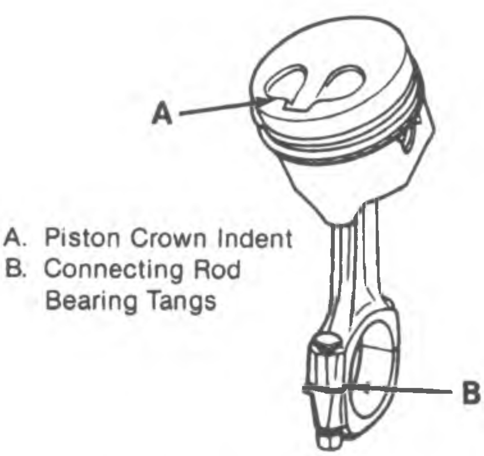


Figure 14—Aligning the Piston and Connecting Rod

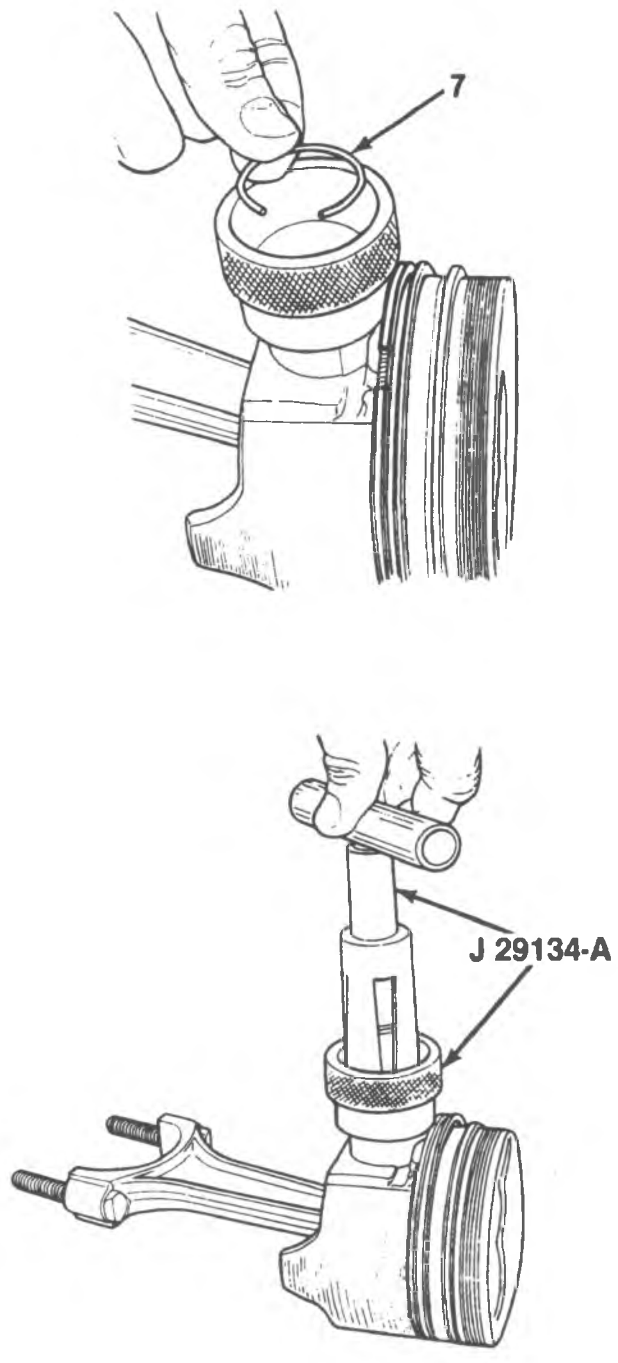


Figure 15—Installing the Piston Pin Snap Ring (6.2L Engines)

Installing the Piston Rings (All Except 6.2L)

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.

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 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)

- 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 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.

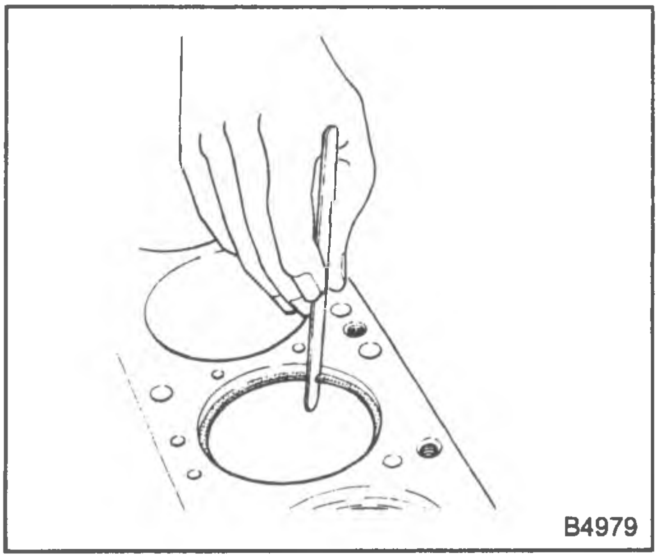


Figure 16—Measuring the Ring End Gap

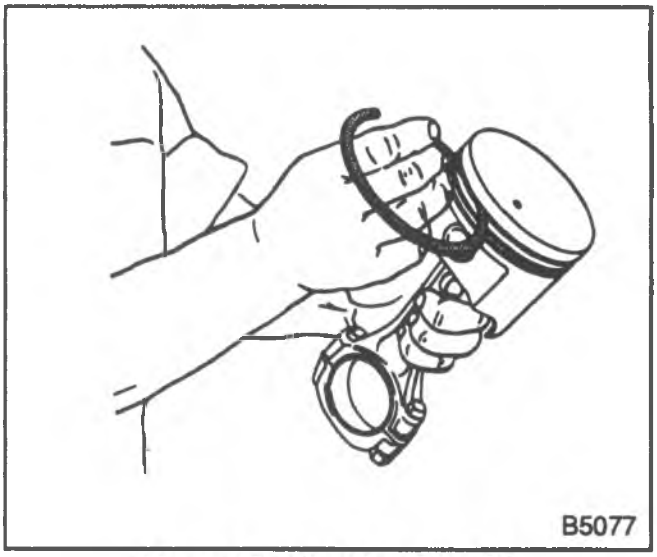


Figure 17—Checking Ring Fit

5. Lower compression ring. 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 (6.2L 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.

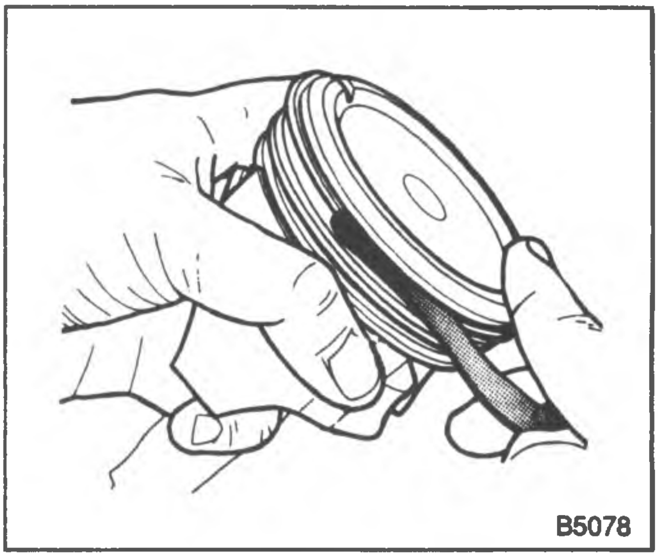


Figure 18—Measuring Ring Clearance

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 BEARING REPLACEMENT (2.5L AND 6.2L ENGINES)

Refer to the proper section.

CAMSHAFT BEARING REPLACEMENT (ALL EXCEPT 2.5L AND 6.2L 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

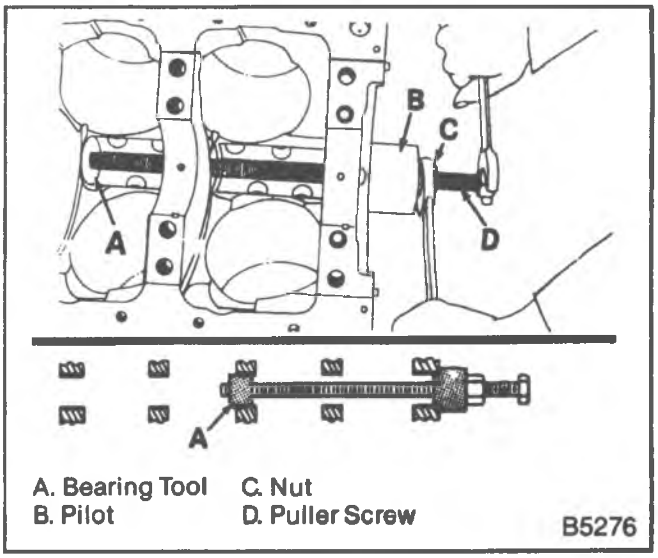


Figure 19—Removing or Installing the Inner Camshaft Bearings

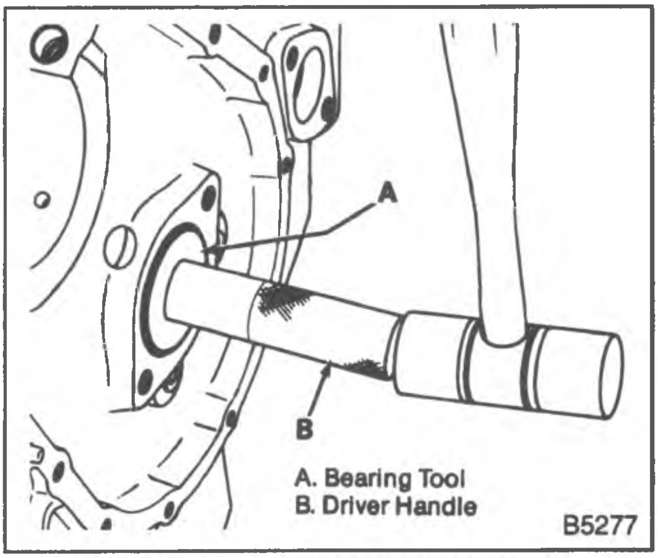


Figure 20—Removing or Installing the Outer Camshaft Bearings

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).
   - 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.

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 to check alignment (figure 21).

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.

A. Checking oil hole alignment with brass rod. Make rod as shown using 3/32" rod about 762 mm (30") long.

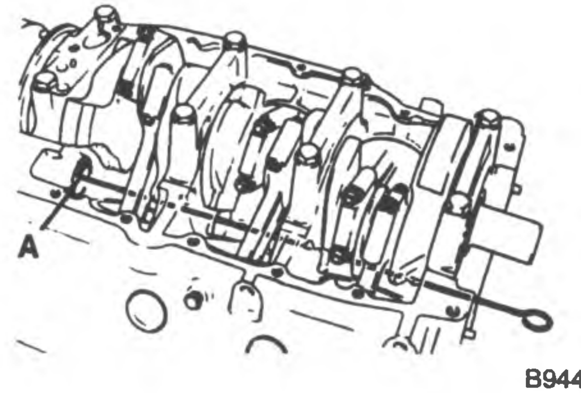


Figure 21—Checking Camshaft Bearing Oil Hole Alignment (Typical)

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 2.8L engines:
   - Coat a new camshaft plug with sealer (Loctite #592 or equivalent).
   - Install the plug flush to 0.80 mm (1/32-inch) deep.

   — 2.8L 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 2.5L 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.

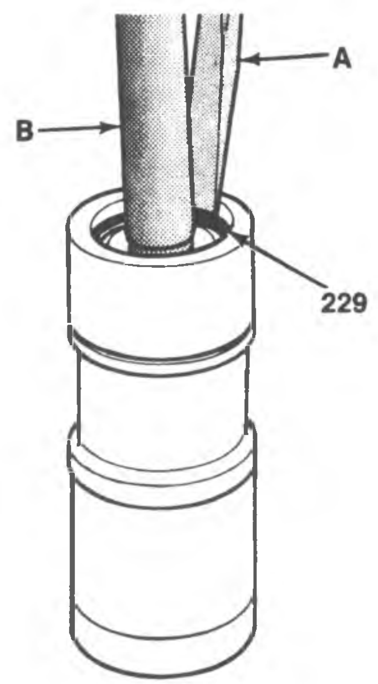
— Lifter foot (flat type lifters). The lifter foot must be smooth and slightly convex. If worn, pitted, or damaged the mating camshaft lobe should also be checked.
— Roller (roller type lifters) for:

- — 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)

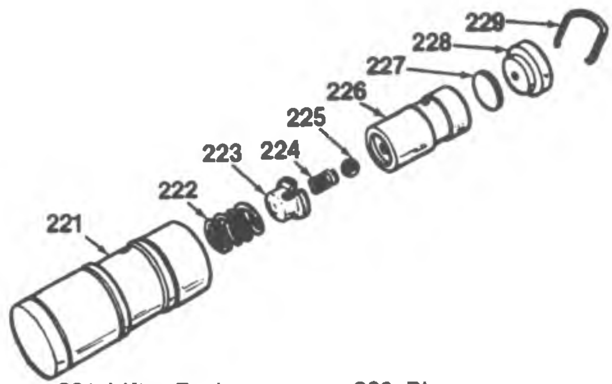
1. Retainer (figure 25).
   - Push the pushrod seat (228) down, using a pushrod.
   - Pry out the retainer with a screwdriver.
2. Pushrod seat (228).
3. Metering valve (227).
4. Plunger (226) and plunger spring (222).
   - If the plunger is stuck, turn the lifter body upside down and tap it on a flat 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

B5237

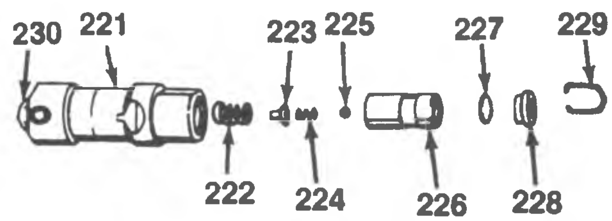
Figure 22—Flat Type Hydraulic Lifter Assembly



221. Lifter Body
222. Plunger Spring
223. Check Ball Retainer
224. Check Ball Spring
225. Check Ball
226. Plunger
227. Metering Valve
228. Pushrod Seat
229. Retainer

B5236

Figure 23—Flat Type Hydraulic Lifter Components



221. Lifter Body
222. Plunger Spring
223. Check Ball Retainer
224. Check Ball Spring
225. Check Ball
226. Plunger
227. Metering Valve
228. Pushrod Seat
229. Retainer
230. Roller

B9402

Figure 24—Roller Type Hydraulic Lifter Components

Clean

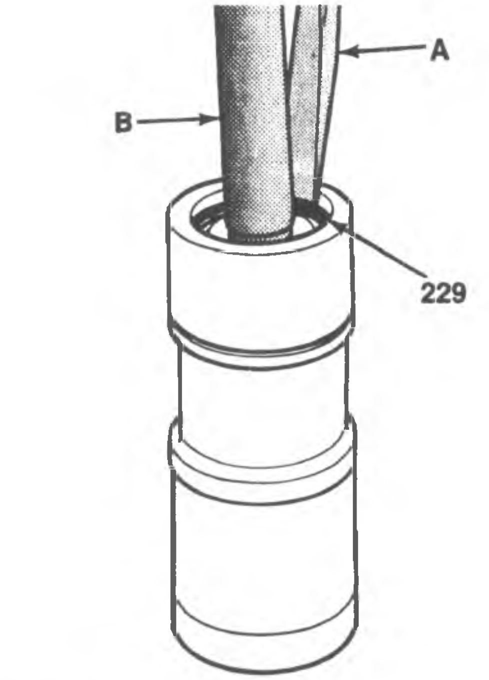
- All parts in CLEAN solvent. Remove all gum and varnish deposits.

Inspect (Figures 22, 23, and 24)

— Plunger (226) for scoring and wear.
— Pushrod seat (228). If worn or rough, also check the mating pushrod.

Important

- Do not attempt re-conditioning by taking parts from other unserviceable lifters.



A. Screwdriver
B. Pushrod
229. Retainer

B5238

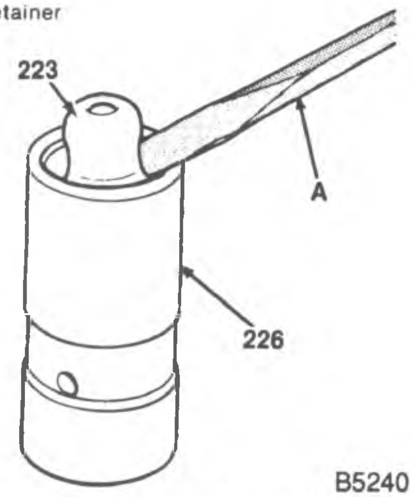
Figure 25—Removing the Retainer (Typical)

Assemble (Figures 22, 23, 24, 27, and 28)

Important

- Absolute cleanliness is necessary when assembling the hydraulic lifters. Use only clean, lint-free shop rags. Work with clean hands, on a clean work surface.

A. Screwdriver
223. Check Ball Retainer
226. Plunger



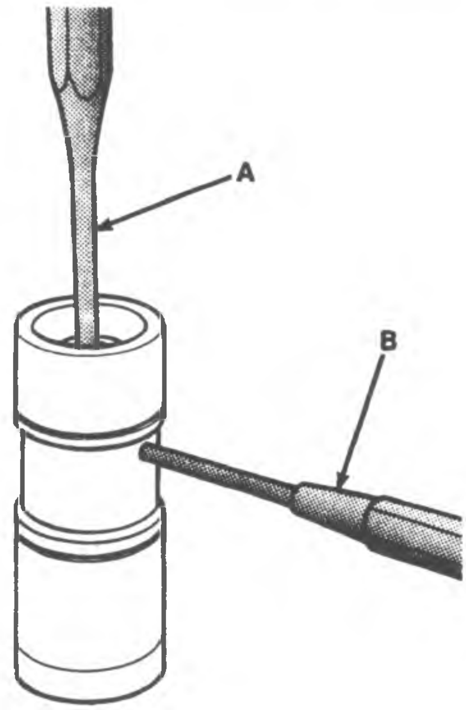
B5240

Figure 26—Removing the Check Ball Retainer (Typical)

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.

B5241

Figure 27—Installing the Check Ball Retainer (Typical)



A. 3 mm (1/8-inch) drift
B. 1.5 mm (1/16-inch) drift inserted in oil feed hole

B5242

Figure 28—Assembling the Hydraulic Lifter (Typical)

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.
   - 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-B Hydraulic Lifter Leakdown Tester

The hydraulic lifter leakdown tester will very accurately check the leakdown rate of the overhauled valve lifters (figure 29). 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.
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.

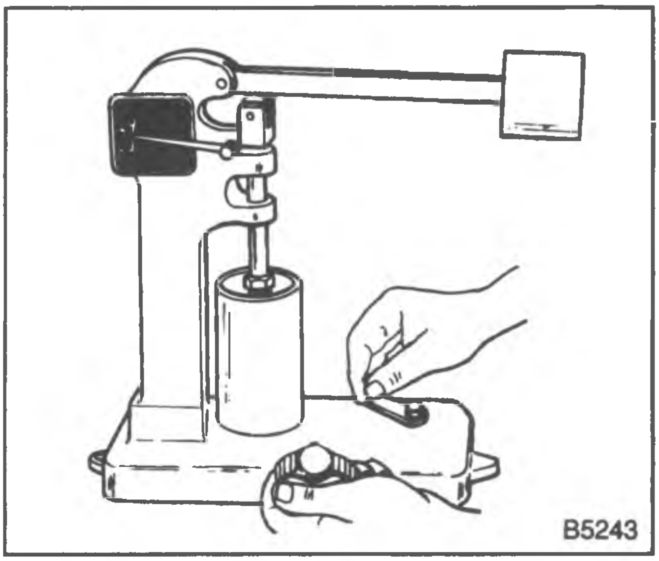


Figure 29—Testing the Hydraulic Lifter—Flat Type Only

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 9666 Valve Spring Tester
— Valve stem to guide bore clearance.

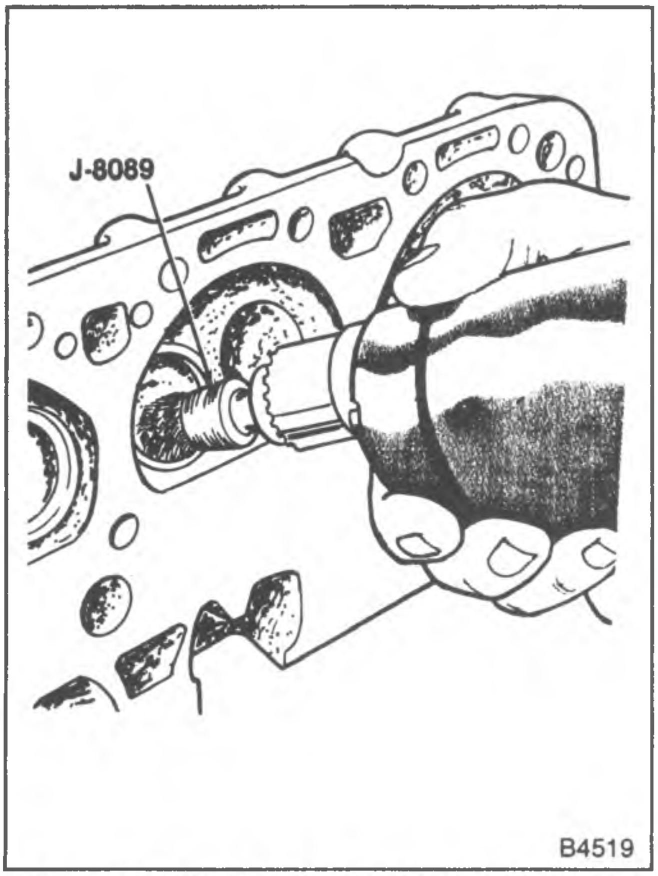


Figure 30—Cleaning the Combustion Chambers (Typical)

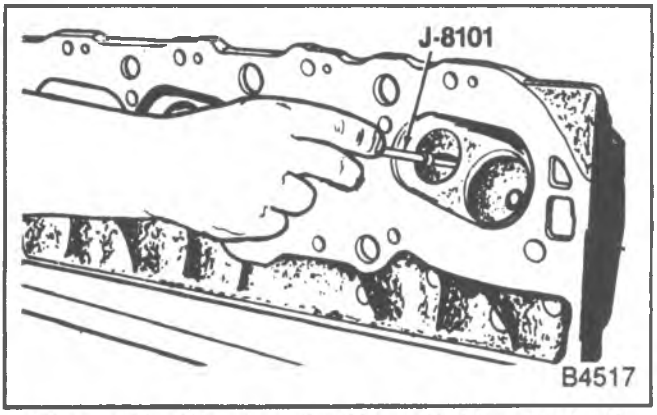


Figure 31—Cleaning the Valve Guides (Typical)

- 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.
- 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 9666 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.

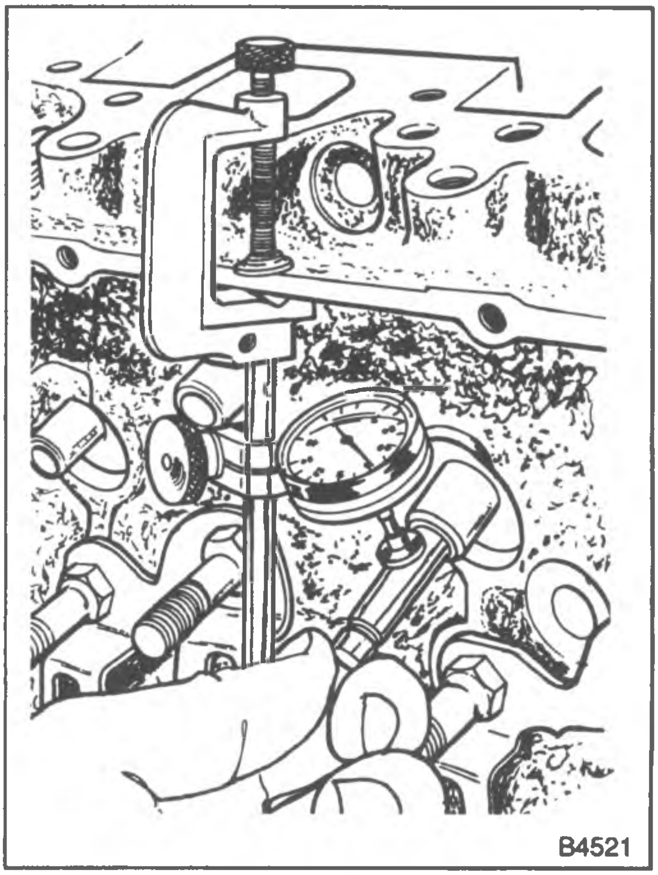


Figure 32—Measuring Stem to Bore Clearance (Typical)

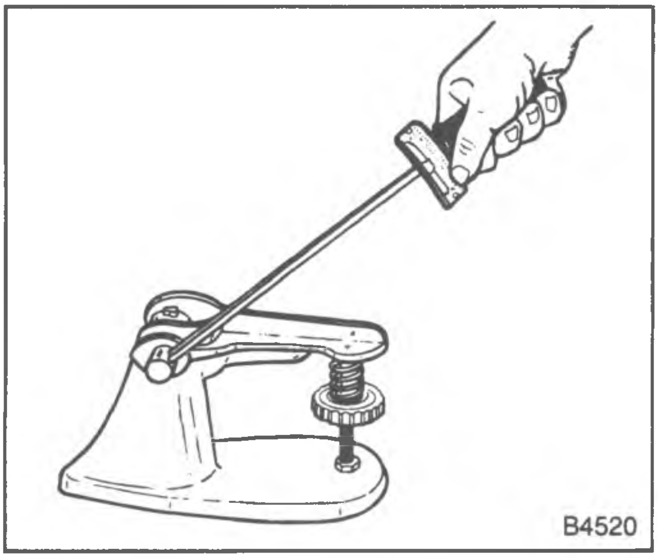


Figure 33—Measuring Valve Spring Tension

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 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, replace the valve (figure 35).

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 important 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.

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 2.5L and 6.2L engines are induction hardened. Excessive removal of stock may result in damage to the valve seats.

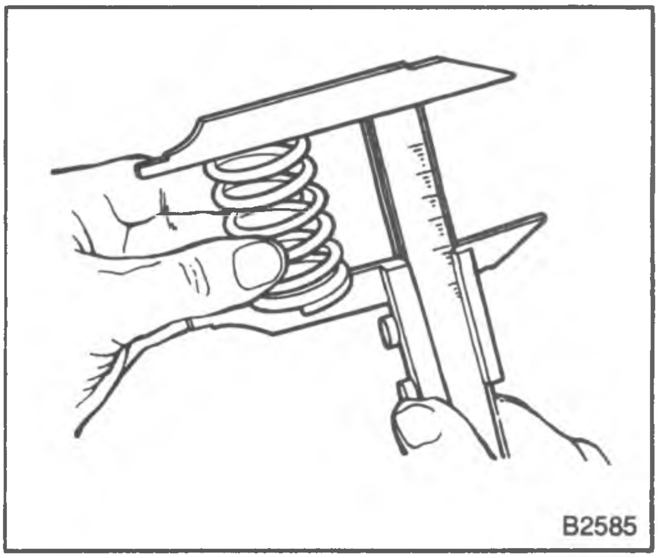


Figure 34—Measuring Valve Spring Length

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.

- 2.5L:
  - Intake: 0.08 mm (0.003-inch), 0.13 mm (0.005-inch).
  - Exhaust: 0.08 mm (0.003-inch).
- 2.8L, 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).

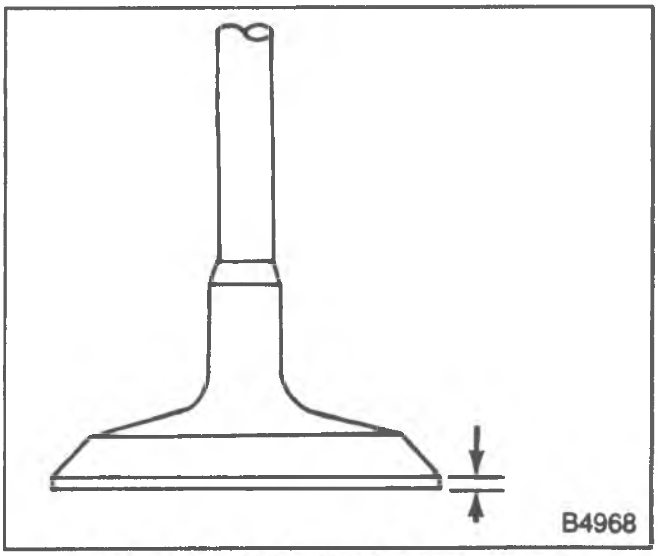


Figure 35—Valve Head Measurement

— 6.2L:
— 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 6.2L 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.
- 6.2L 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.

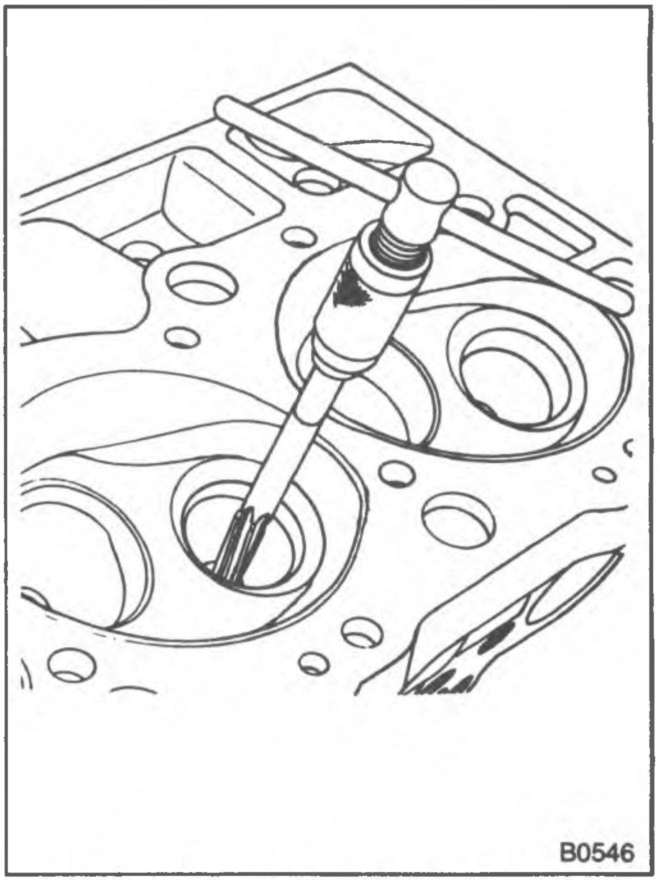


Figure 36—Reaming the Valve Guides (Typical)

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.
   - 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 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.

5L 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 2.5L, 2.8L, and 6.2L engines. After selecting the new bearing, recheck the clearance.
7. Remove the flattened gaging plastic.
8. Perform the preceding steps on the remaining main bearings.

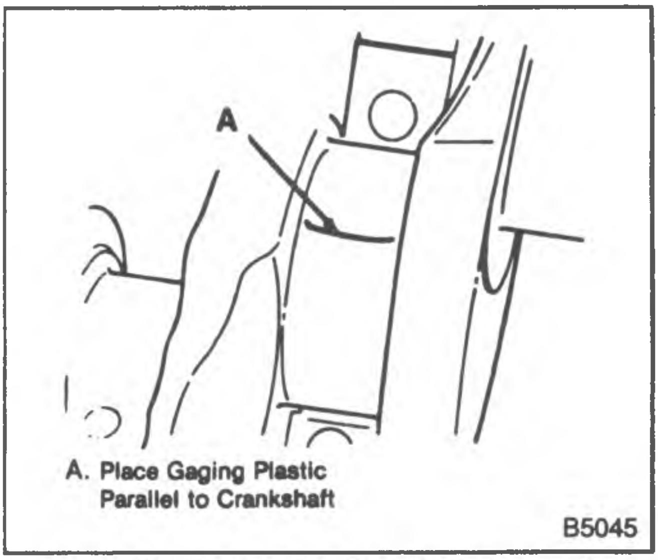


Figure 37—Placing the Gaging Plastic on the Bearing Journal

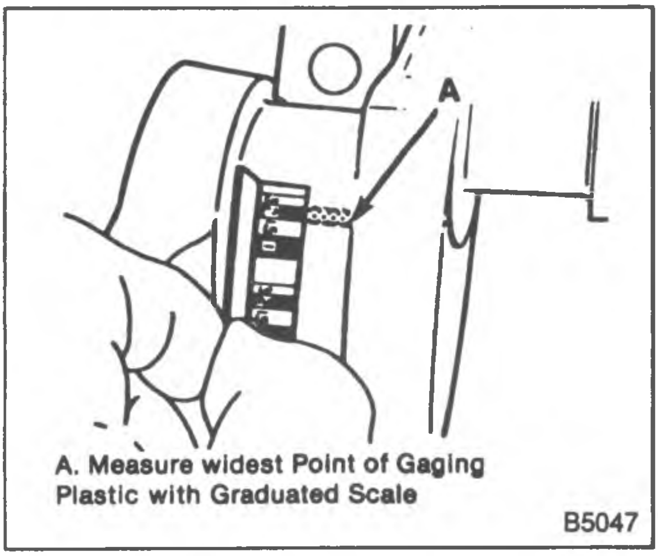


Figure 38—Measuring the Gaging Plastic

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 clearance 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 excessively 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.

Clean (Figure 40)

- Gaging plastic at its widest point, using the scale at the gaging plastic envelope (figure 40).
- If the clearance exceeds specifications, 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 2.5L, 2.8L, and 6.2L engines.)

Remove or Disconnect

- Gaging plastic.

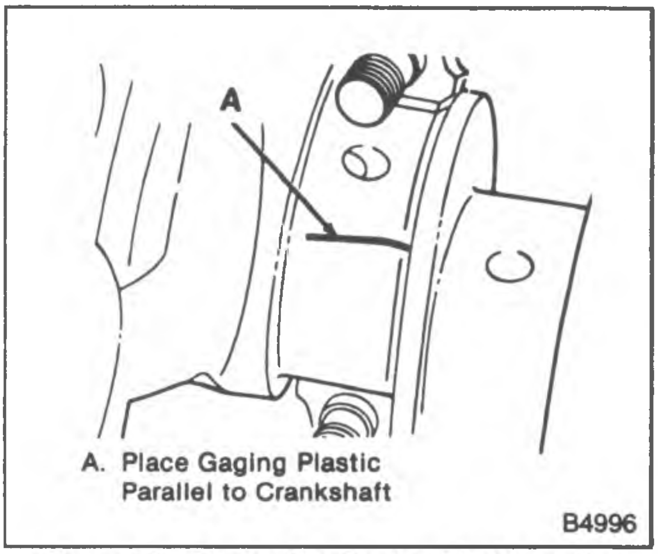


Figure 39—Placing the Gaging Plastic on the Connecting Rod Journal

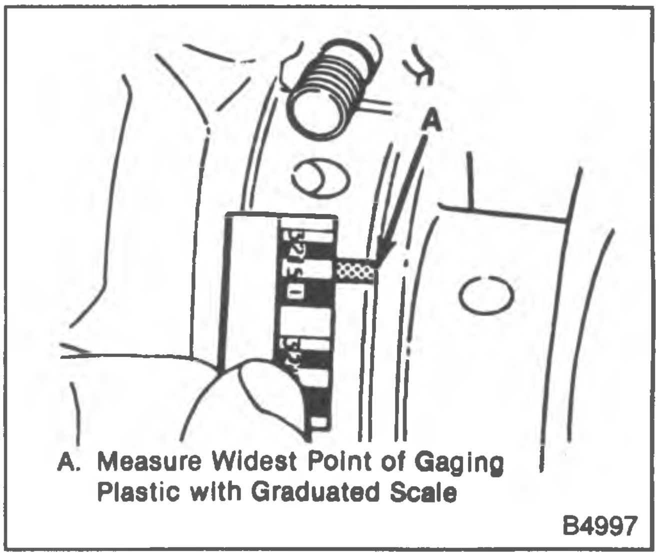


Figure 40—Measuring the Gaging Plastic

SPECIAL TOOLS

1.  J 8087

2.  J 24086-B

3.  J 29134-B

4.  J 6098-01

5.  J 5790-B

6.  J 8089

7.  J 8101

8.  J 8001

9.  J 9666

10. 11.  J 5830-02 J 7049

1. Cylinder Bore Gage
2. Piston Pin Replacer Set
3. Piston Pin Clip Installer
4. Camshaft Bearing Replacer
5. Hydraulic Lifter Leakdown Tester
6. Wire Brush
7. Valve Guide Cleaning Tool
8. Dial Indicator
9. Valve Spring Tester
10. Valve Guide Reamer Set (All Engines Except 6.2L and 7.4L) Consists of:
    —J 5830-1: 0.08mm (0.003-inch) oversize
    —J 5830-2: 0.38mm (0.015-inch) oversize
    —J 5830-3: 0.76mm (0.030-inch) oversize
11. Valve Guide Reamer Set (6.2L and 7.4L Engines) Consists of:
    —J 7049-1: 0.08mm (0.003-inch) oversize
    —J 7049-2: 0.30mm (0.015-inch) oversize
    —J 7049-3: 0.76mm (0.030-inch) oversize

F9534

SECTION 6A1

2.5L (151 CID) ENGINE

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 for the 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

CONTENTS (cont'd)

DESCRIPTION

The GM 2.5 Liter 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 pistons.

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. 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.

DISASSEMBLY OF THE ENGINE

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, cooling fan, generator, TBI unit, distributor.

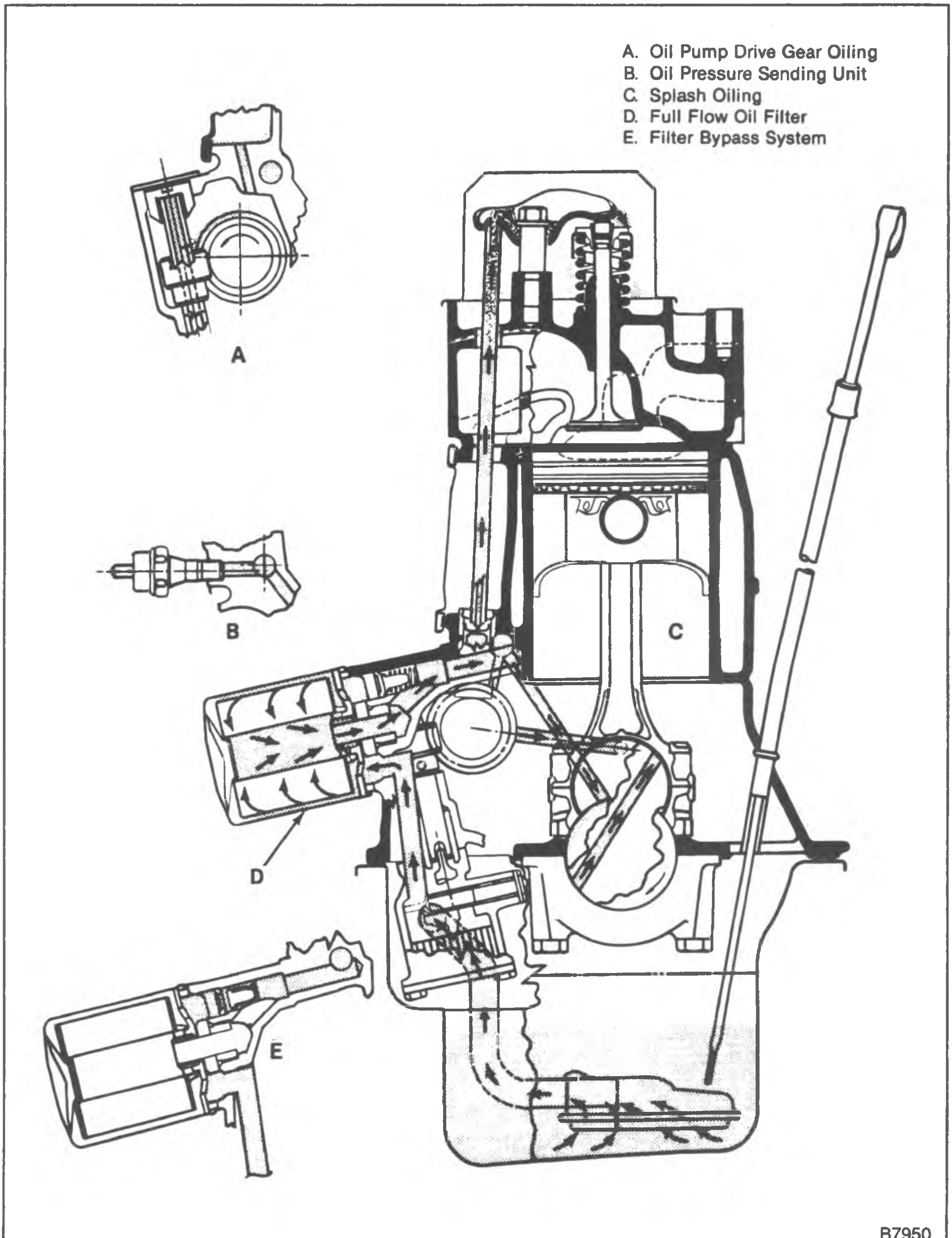
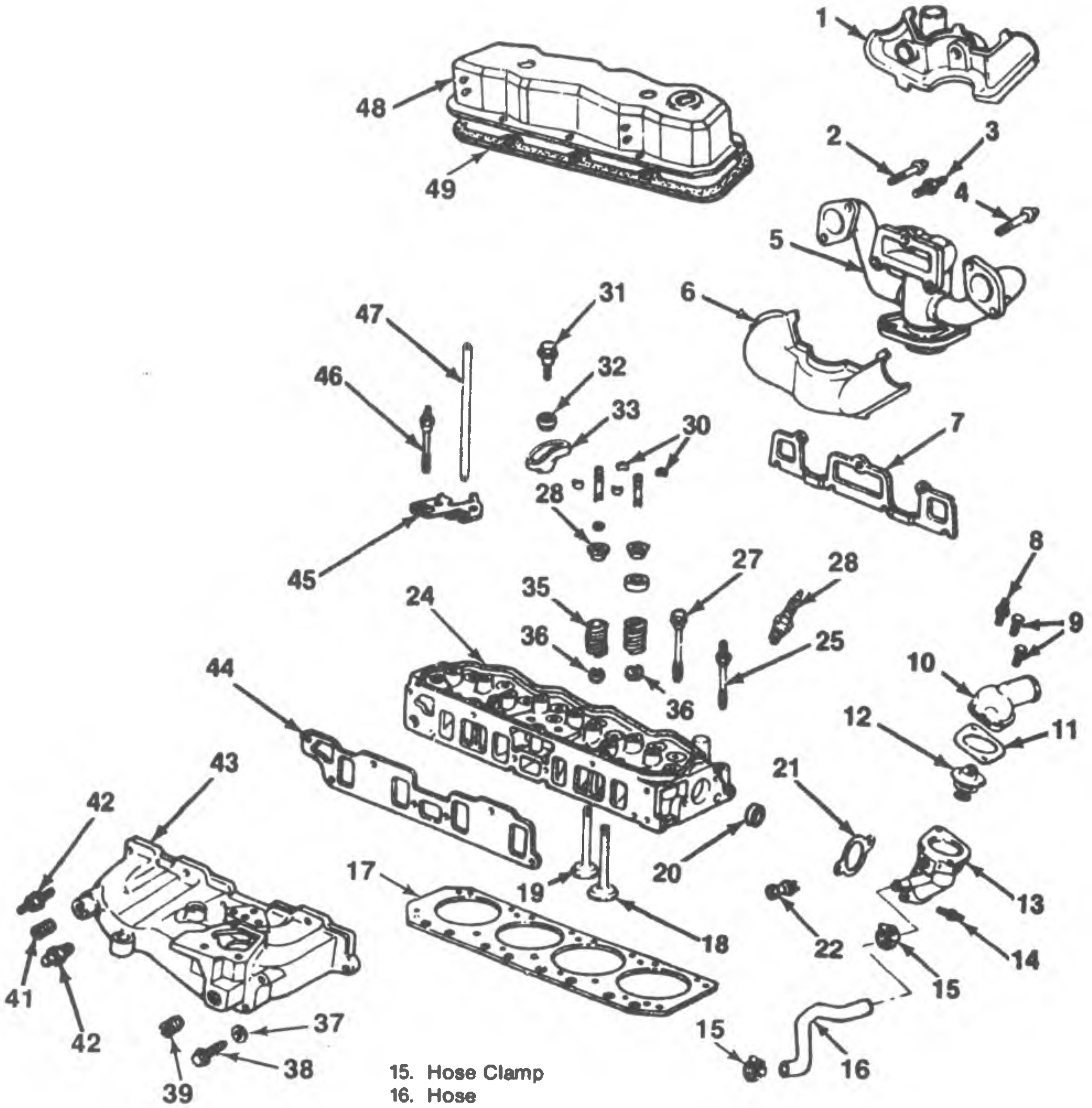


Figure 1—Engine Lubrication Diagram



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
30. Valve Keys
31. Rocker Arm Ball Bolt
32. Rocker Arm Ball
33. Valve Rocker Arm
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
49. Rocker Cover Gasket

F9389

Figure 2—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
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

F9390

Figure 3—Block and Components

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 coolant, 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 4.

DRAINING THE ENGINE

Remove or Disconnect (Figure 4)

- Oil drain plug (73). Allow the oil to drain.
- Oil filter.

Install or Connect (Figure 4)

1. Oil drain plug (73).

Tighten

- Oil pan drain plug to 34 N.m (25 ft. lbs.).

INTAKE MANIFOLD REMOVAL

Remove or Disconnect (Figure 5)

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 6)

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.

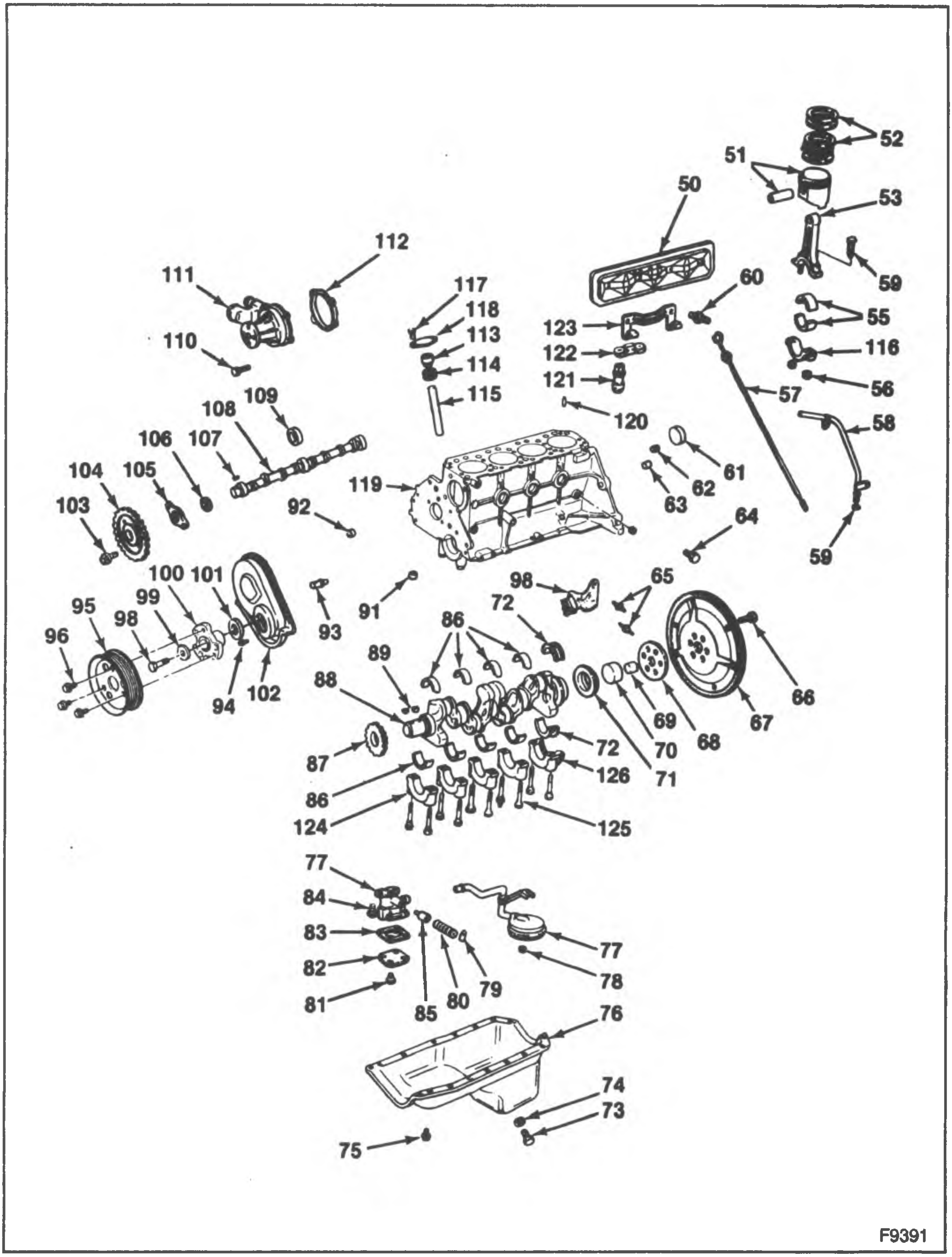


Figure 4—Block and Components

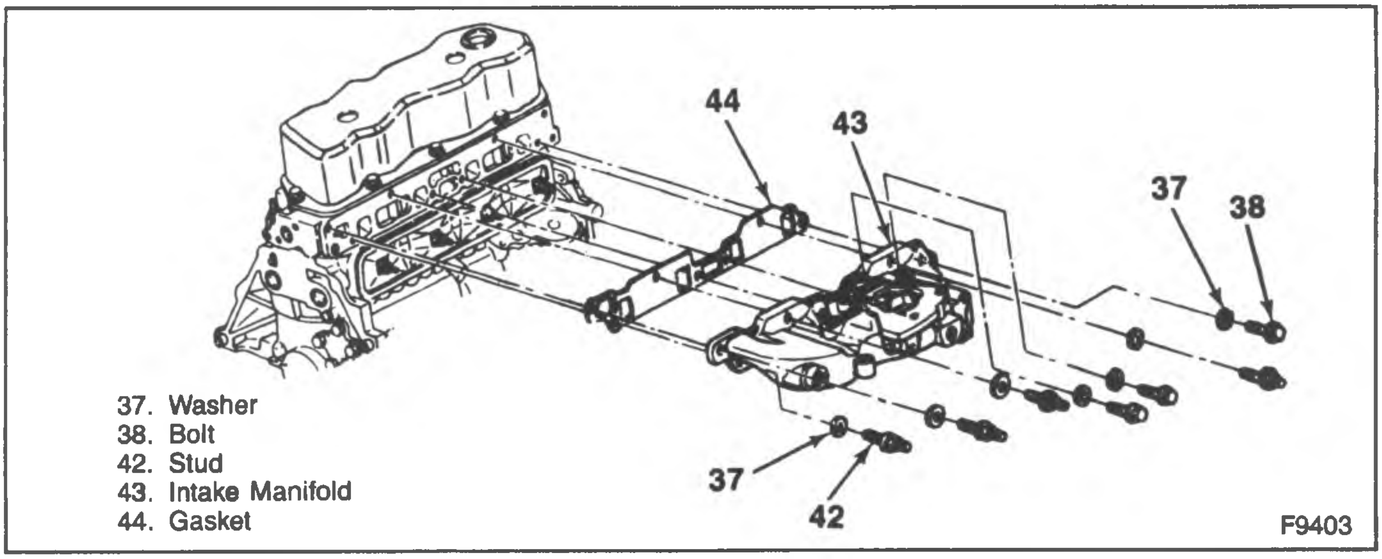


Figure 5—Intake Manifold Components

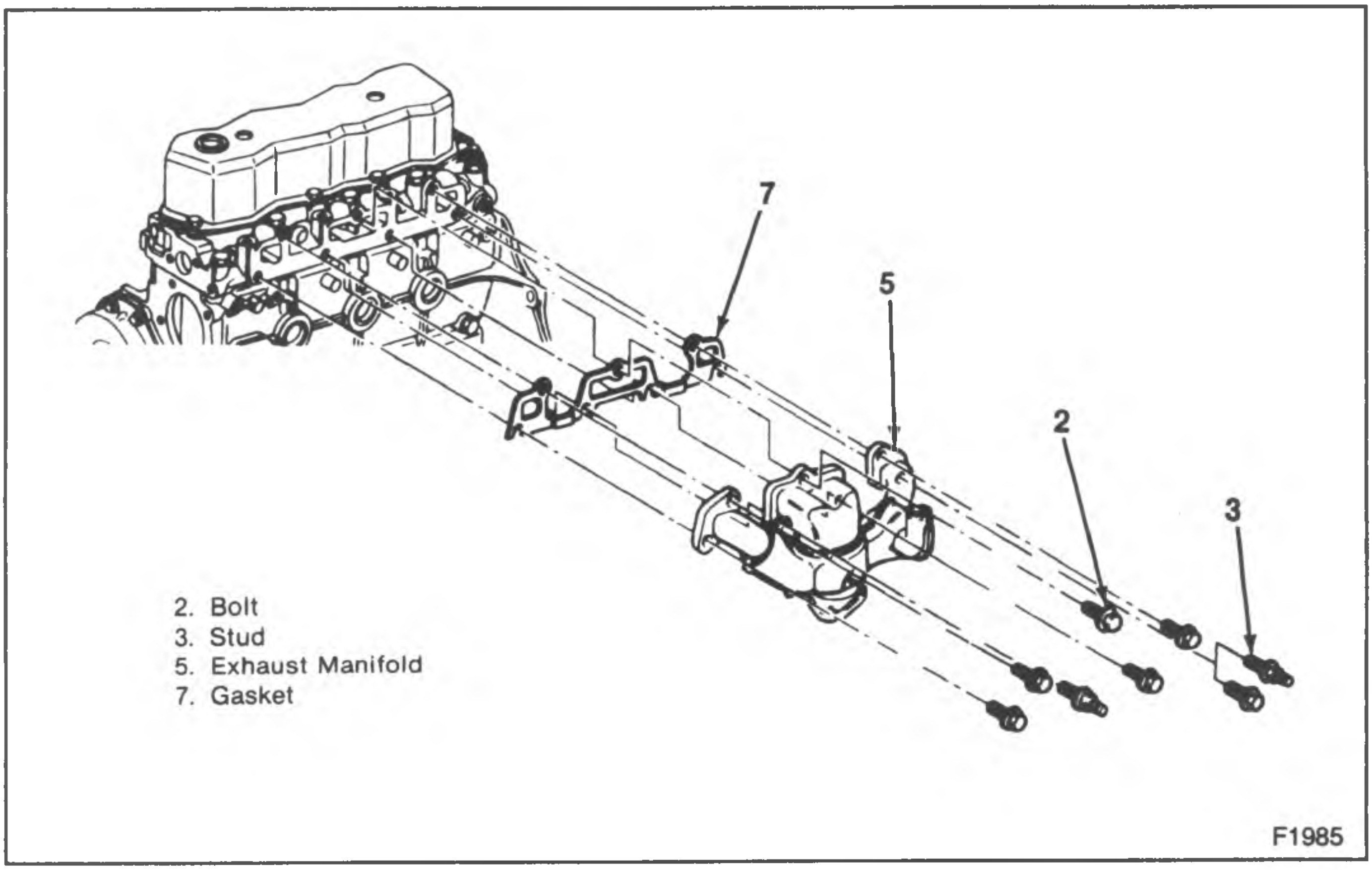


Figure 6—Exhaust Manifold Components

THERMOSTAT HOUSING REMOVAL

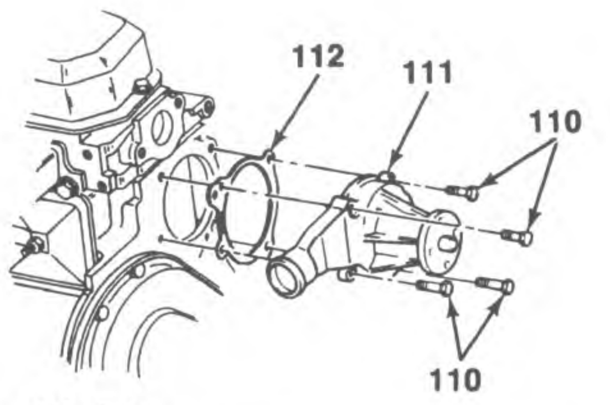
Remove or Disconnect (Figure 4)

1. Thermostat bypass hose.
2. Thermostat housing bolts.
3. Thermostat housing and gasket.

COOLANT PUMP REMOVAL

Remove or Disconnect (Figure 7)

1. Fan and fan clutch.
2. Coolant pump pulley.
3. Bolts.
4. Coolant pump.
5. Gasket.



110. Bolt
111. Coolant Pump
112. Gasket

F9392

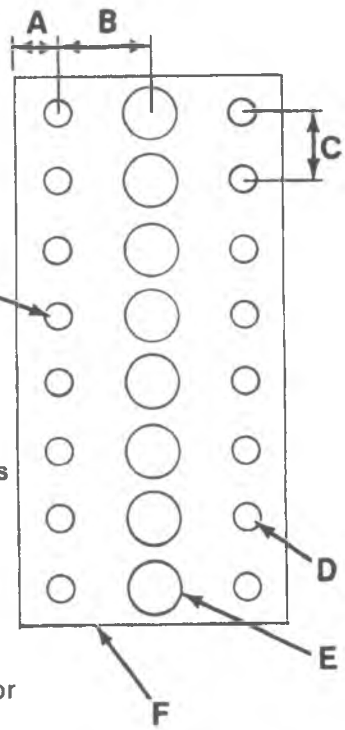
Figure 7—Coolant Pump

VALVE TRAIN COMPONENT REMOVAL

Tools Required:
J 3049A Valve Lifter Remover (Plier Type)

Remove or Disconnect (Figures 2, 8, 9, and 10)

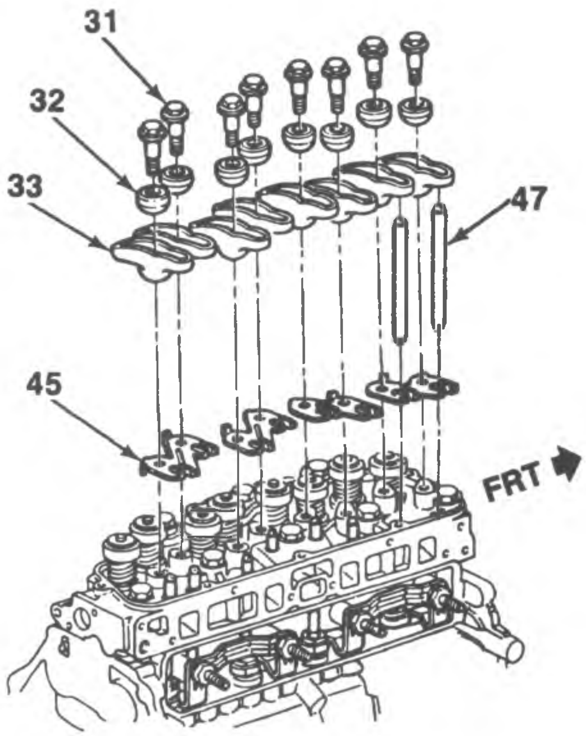
1. Rocker arm cover bolts.
2. Rocker arm cover.



A. 22 mm (7/8")
B. 55 mm (2 1/8")
C. 40 mm (1 1/2")
D. 10 mm (3/8")
25 mm (1") Deep
Holes for Pushrods
E. 22 mm (7/8") Drill
25 mm (1") Deep
Holes for Valve
Lifters
F. 50 mm x 155 mm
(2" x 6") Lumber
G. 50 mm (2") Pegs for
Rocker Arms
and Balls

F1988

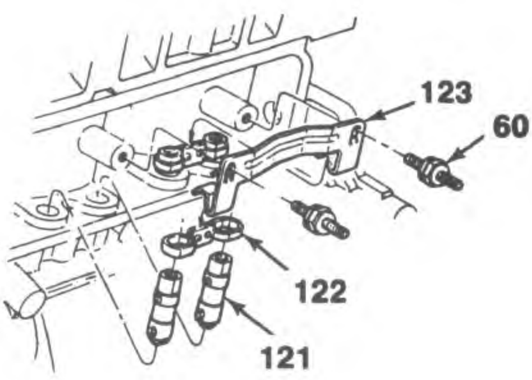
Figure 8—Valve Train Component Rack



31. Bolt
32. Rocker Arm Ball
33. Rocker Arm
45. Push Rod Guide
47. Push Rod

F9396

Figure 9—Valve Train Components



60. Stud
121. Hydraulic Roller Lifter
122. Valve Lifter Guide
123. Lifter Guide Retainer

F9395

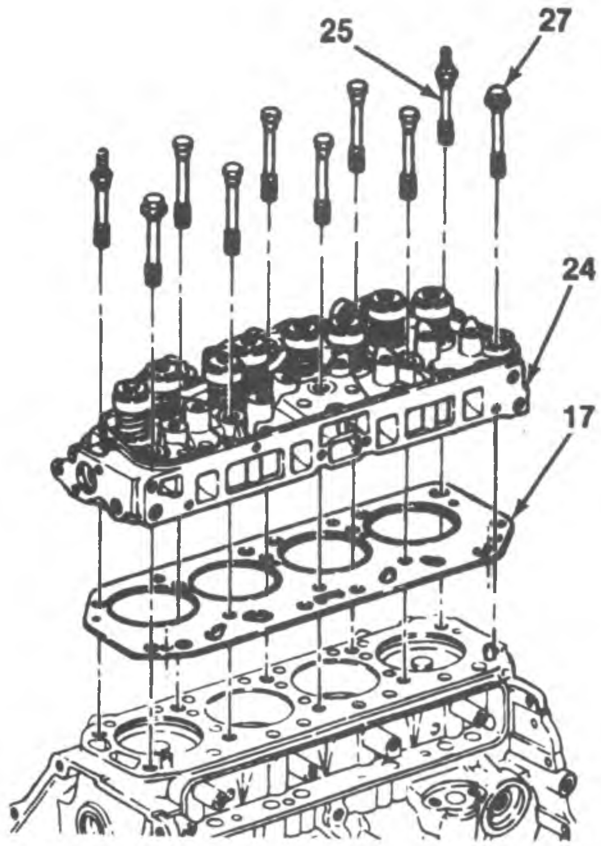
Figure 10—Hydraulic Lifters and Components

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 9.
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 (121).
   - 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 3049A.

CYLINDER HEAD REMOVAL

Remove or Disconnect (Figure 11)

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).

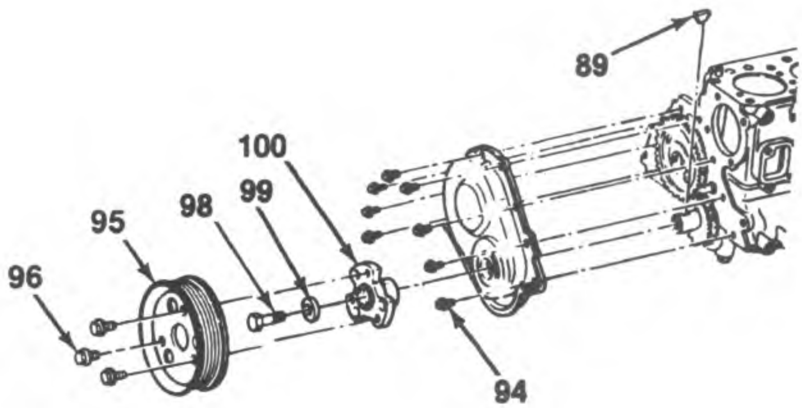


17. Head Gasket
24. Cylinder Head
25. Head Bolt (Stud)
27. Head Bolt

F1991

Figure 11—Cylinder Head Components

89. Key
94. Bolt
95. Crankshaft Pulley
96. Bolt
98. Bolt
99. Washer
100. Crankshaft Pulley Hub



F9393

Figure 12—Timing Gear Cover and Components

CRANKSHAFT PULLEY HUB REMOVAL

Remove or Disconnect (Figure 4 and 12)

1. Bolt (98) and washer (99).
2. Pulleys (96 and 97) and hub (100).

OIL PAN REMOVAL

Remove or Disconnect (Figure 4)

1. Bolts (75).
2. Oil pan (76).
   - If the oil pan 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 4 and 13)

1. Bolts (117).
2. Plate (118).
3. Bearing (113).
4. Shaft and gear assembly (115 and 114).

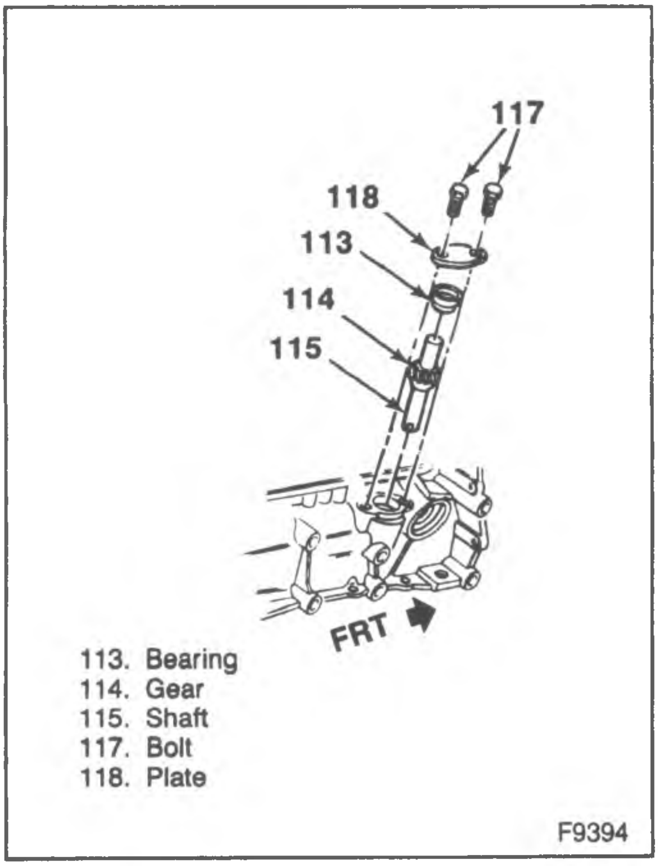


Figure 13—Oil Pump Drive Shaft

OIL PUMP REMOVAL

Remove or Disconnect (Figure 4)

1. Bolts (84) and nut (78) at oil screen bracket.
2. Oil pump (77).

FRONT COVER REMOVAL

Remove or Disconnect (Figures 4 and 12)

1. Timing gear cover bolts (94).

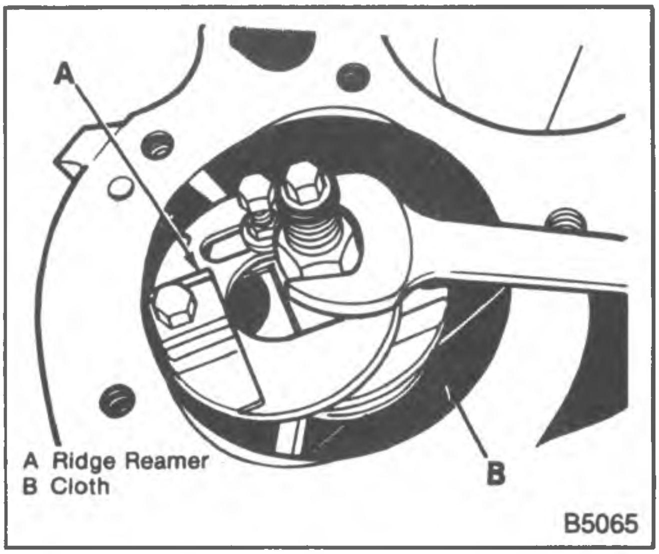


Figure 14—Removing the Cylinder Ridge

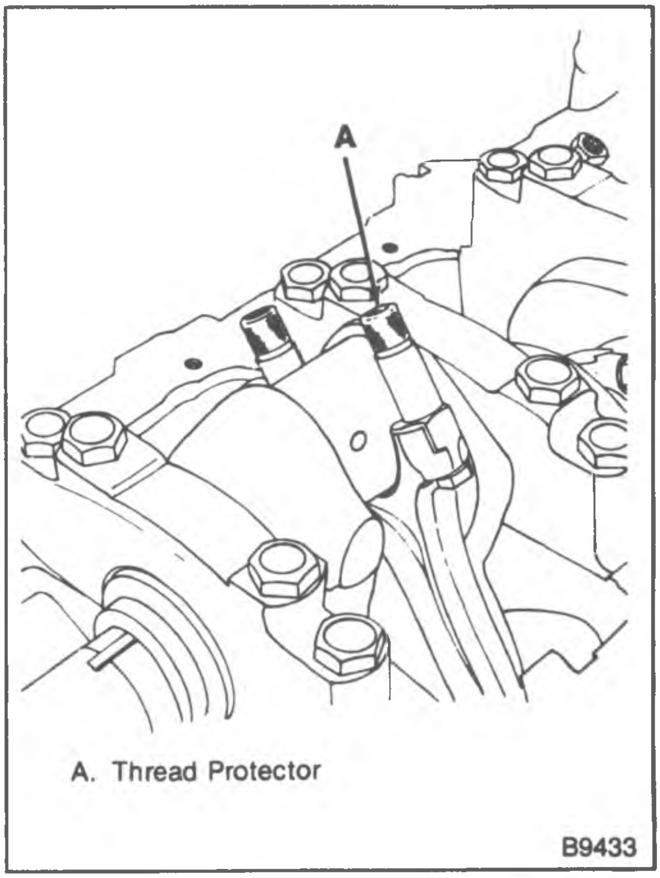


Figure 15—Connecting Rod Thread Protectors

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 4, 14 and 15)

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.
   - 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.

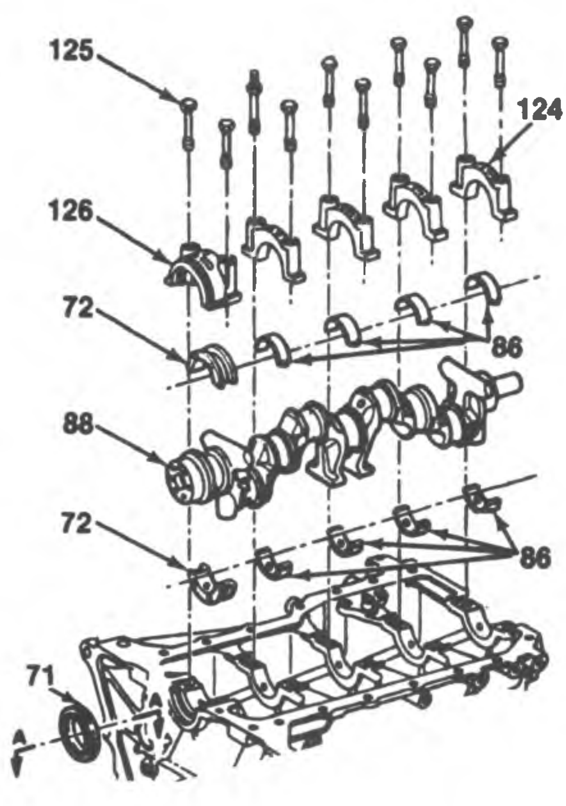
FLYWHEEL REMOVAL

Remove or Disconnect (Figure 4)

1. Flywheel bolts (66).
2. Flywheel (67).
3. Spacer (68).

CRANKSHAFT REMOVAL

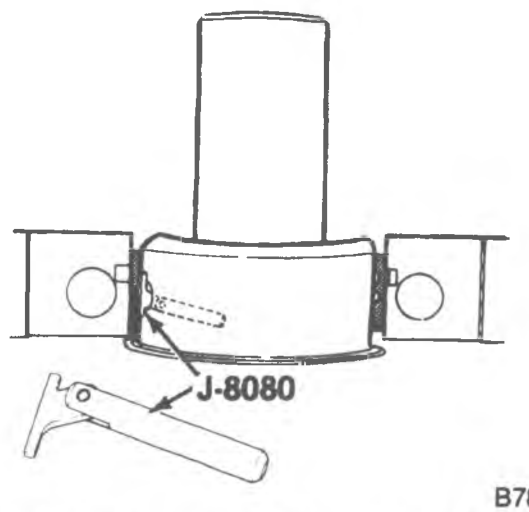
The main bearings and rear oil seal can be replaced without removing the crankshaft, as outlined later in this section.



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

F9397

Figure 16—Crankshaft and Bearing Components



B7879

Figure 17—Removing the Upper Main Bearing Insert

Remove or Disconnect (Figures 4, 16 and 17)

- 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 18).
   - If the main bearing inserts are to be reused, mark them to insure they are installed in their original positions before removal.

CRANKSHAFT REAR OIL SEAL REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect (Figure 4)

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 4, 18 and 19)

- Turn the camshaft (108) until the bolts (103) are visible through the holes in the camshaft gear (104).

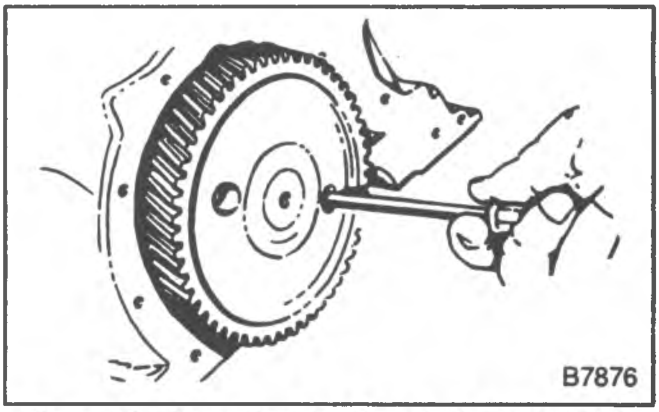


Figure 18—Removing the Camshaft Thrust Plate Bolts

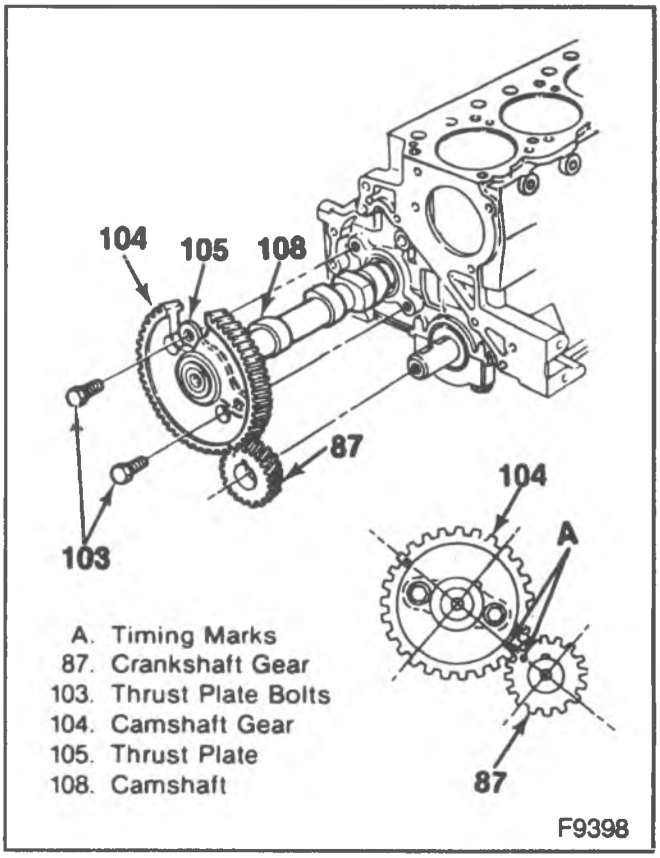


Figure 19—Camshaft and Timing Gears

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.**

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 4)

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 20)

- Head gasket surface distortion. Use a straight edge and a feeler gage to check for flatness of the deck 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 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 21 and 22)

- 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, which is at the centerline of the piston pin,

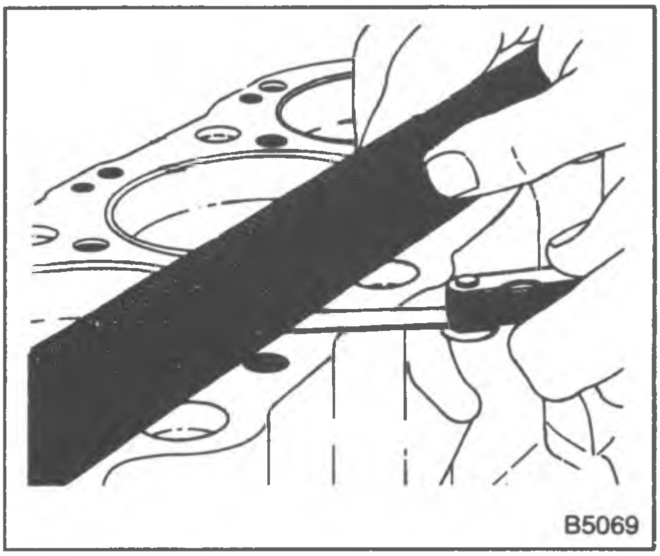


Figure 20—Checking the Block Gasket Surface

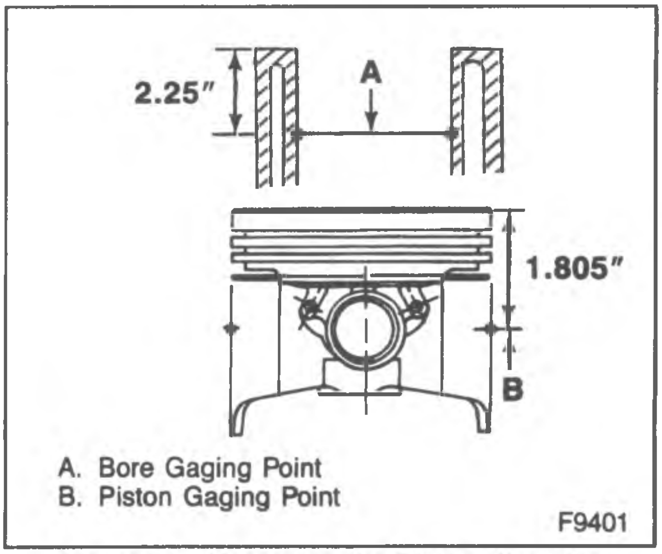


Figure 21—Measuring the Piston Diameter

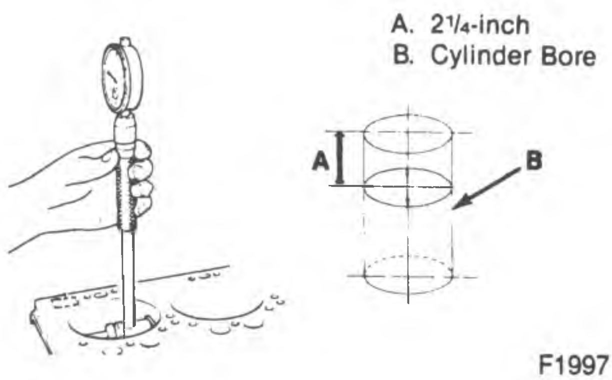


Figure 22—Measuring Cylinder Bore Diameter

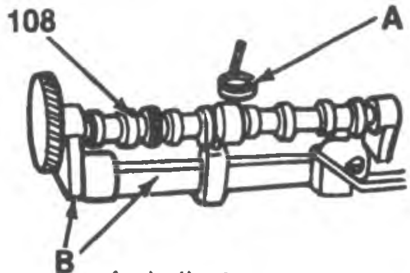


Figure 23—Measuring Camshaft Journal Runout

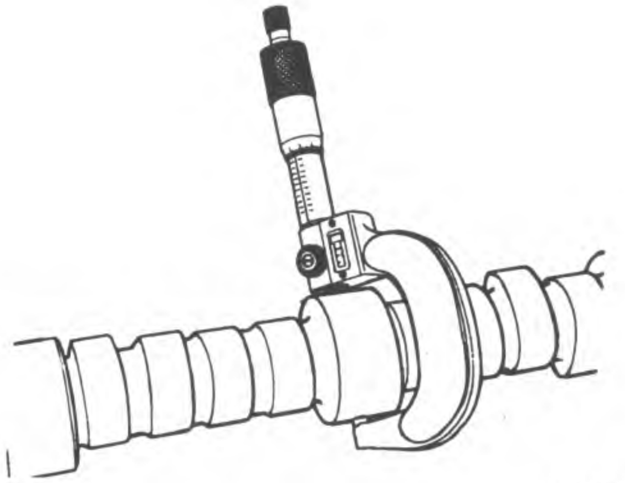


Figure 24—Checking the Camshaft Journals

Figure 25—Measuring Camshaft Thrust Plate Clearance (Camshaft End Play)

which is 45.84 mm (1.805 inch) from the piston crown. By measuring at this point, the largest piston diameter will be obtained.

- 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.

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 4)

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.
- Timing gear for damaged, worn, or missing teeth.

Measure (Figures 23 through 25)

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.
- 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 26)

1. Gear (104) from the camshaft.
   - Place the camshaft gear in a press. Support the camshaft gear. DO NOT support the thrust plate.

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 27)

- 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).

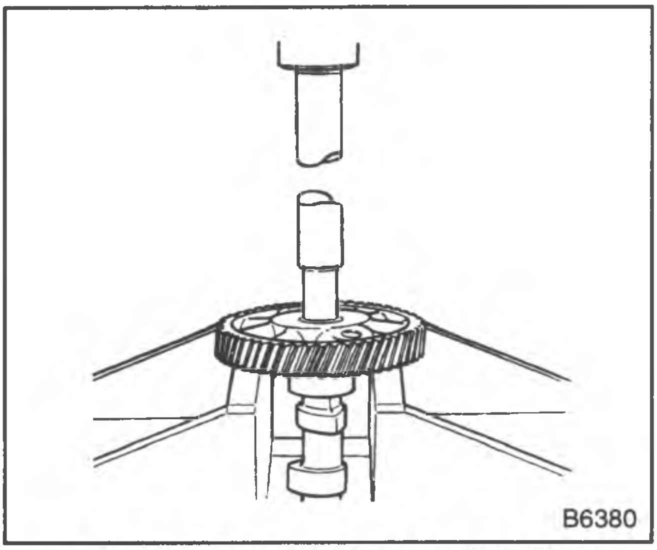


Figure 26—Removing the Camshaft Gear

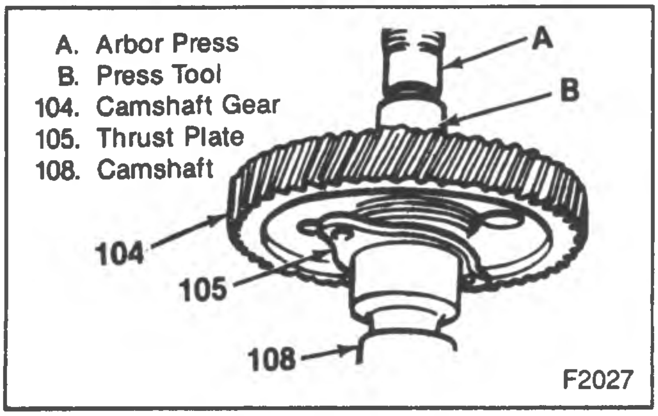


Figure 27—Installing the Camshaft Gear

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 25)

- 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 28)

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.

Install or Connect (Figure 28)

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.

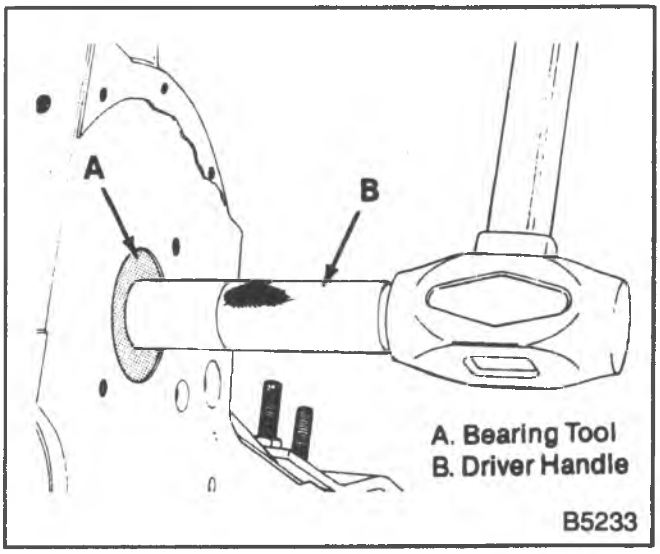


Figure 28—Removing or Installing Camshaft Bearings

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 4)

- Seal (101). Pry the seal out with a screwdriver.

Assemble (Figure 29)

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.
  — Press the seal into place. The open end of the seal faces inside the front cover.
- Lubricate the seal lips with grease.

COOLANT 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

— Coolant pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the coolant pump.
— Coolant pump body at the drain hole. If there is evidence of coolant leakage, the coolant pump shaft seal is leaking, and the coolant pump should be replaced.

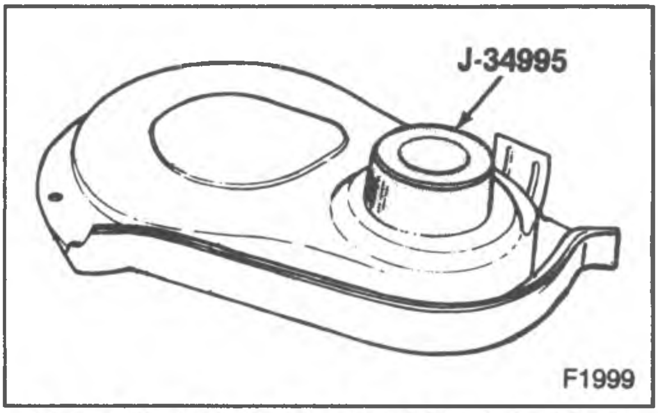


Figure 29—Installing the Front Crankshaft Seal

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.

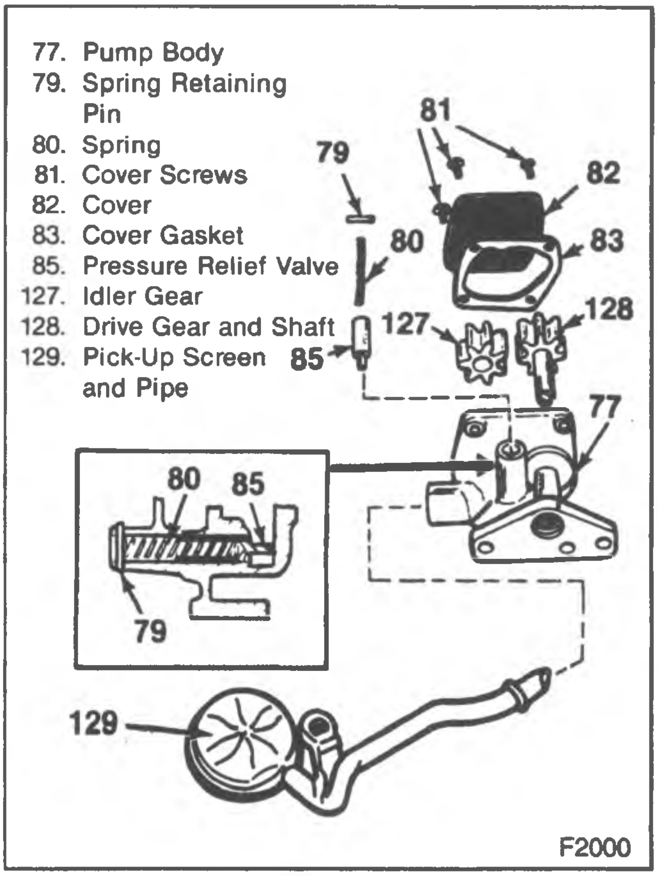


Figure 30—Oil Pump Components

OIL PUMP

Disassemble (Figure 30)

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.
— 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 30 and 31)

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.

Important

- **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.

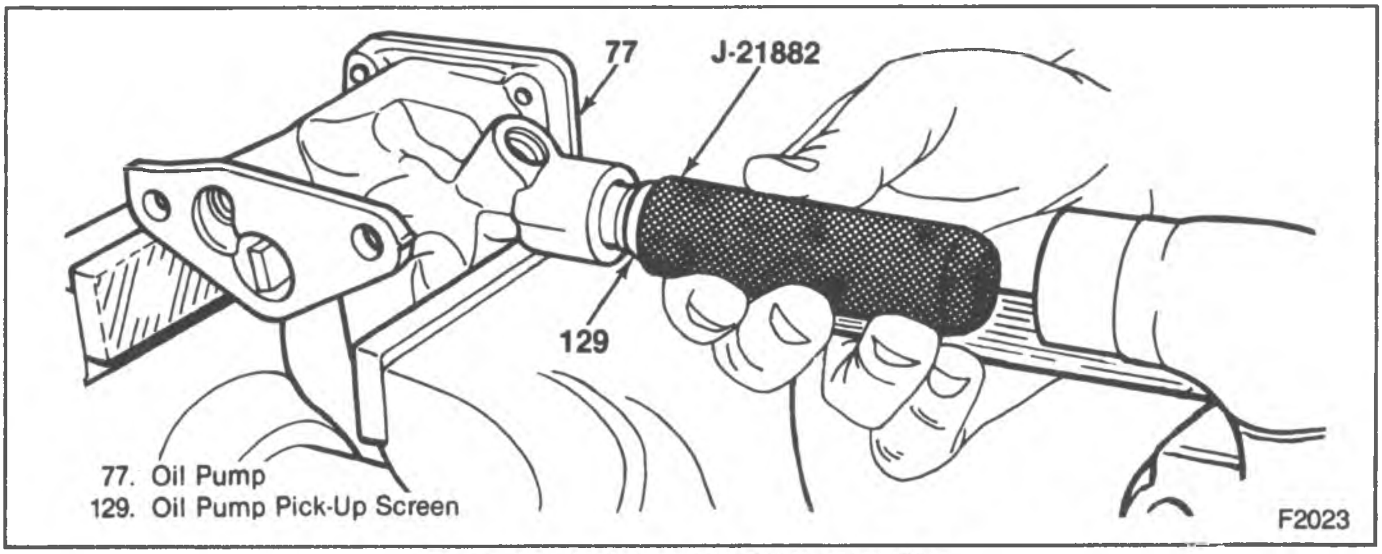


Figure 31—Installing the Oil Suction Pipe

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 2 and 8)

— 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

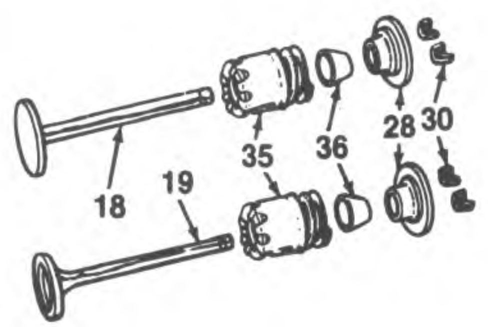
For information regarding valve lifters refer to GENERAL ENGINE MECHANICAL (SEC. 6A) of this manual.

CYLINDER HEAD

Information regarding cylinder head disassembly 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.

Disassemble (Figures 32 and 33)

Tool Required:
J 8062 Valve Spring Compressor



18. Intake Valve
19. Exhaust Valve
28. Valve Spring Cap
30. Valve Keepers
35. Valve Spring (with Damper)
36. Valve Stem Seal

F9402

Figure 32—Valves and Components

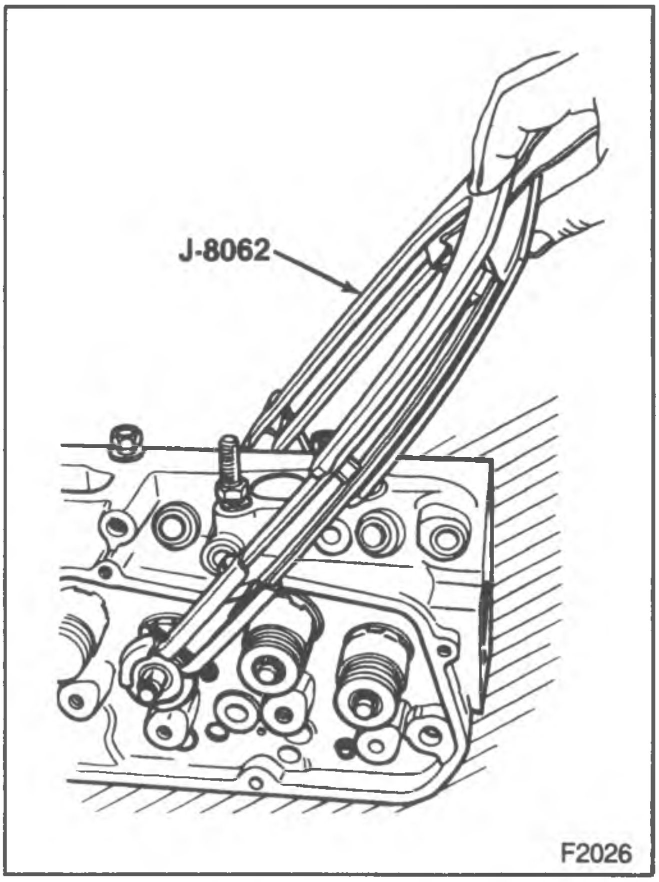


Figure 33—Compressing the valve Springs

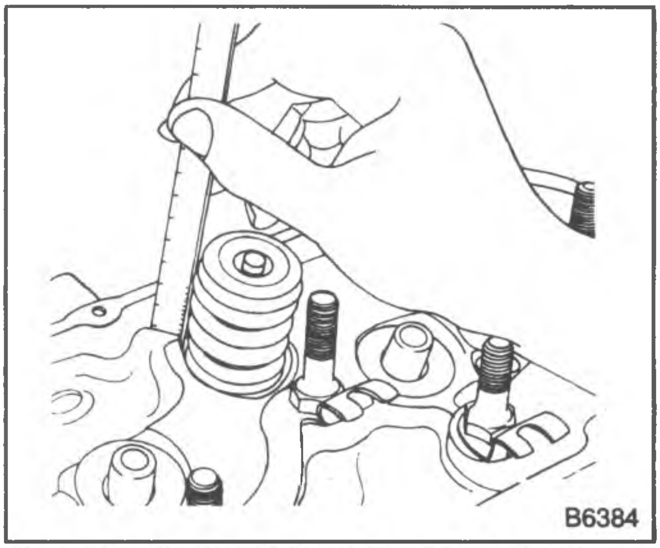


Figure 34—Measuring Valve Spring Installed height

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).
4. Valves (18 and 19). Place them in a rack so they can be returned to their original position at assembly.
5. Valve stem seal (36).

For information on cylinder head measuring and reconditioning, refer to GENERAL ENGINE MECHANICAL (SEC. 6A) in this manual.

Assemble (Figures 32, 33 and 34)

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).
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.
   - Apply grease to the area of the valve stem groove. Assemble the two valve keepers, using the grease to hold the keepers in place. Make sure that the keepers seat properly in the groove.
   - Repeat the preceding steps on the remaining valves.

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 bottom 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 2)

1. Bolts (8 and 9).
2. Coolant outlet (10).
3. Thermostat (12).
4. Gasket (11).

Inspect (Figure 2)

- Coolant outlet (10) and housing (13) for cracks or damage.

Assemble (Figure 2)

1. Thermostat (12).
2. Gasket (11).
3. Coolant outlet (10).
4. Bolts (8 and 9).

Tighten

- Bolts (8 and 9) to 23 N.m (17 ft. lbs.).

CRANKSHAFT AND BEARINGS

Clean (Figure 4)

— 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 4)

— 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.

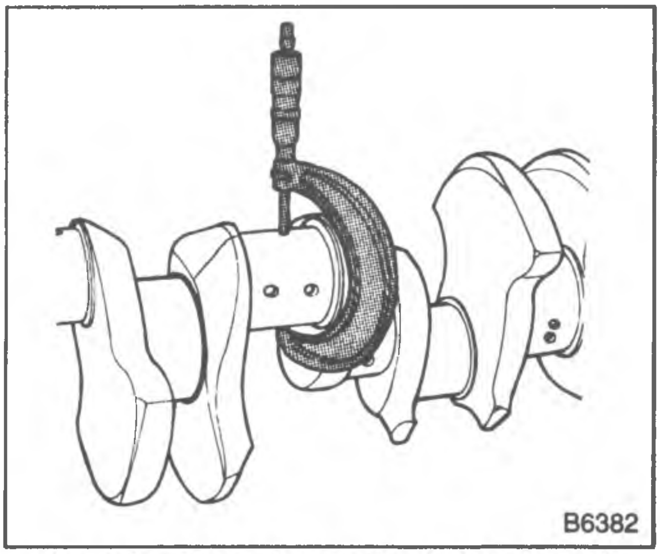


Figure 35—Measuring the Crankshaft Journals

Measure (Figures 35 and 36)

— Main bearing and connecting rod journal diameters. Compare with "Specifications" at the end of this section.

Because the 2.5L 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.

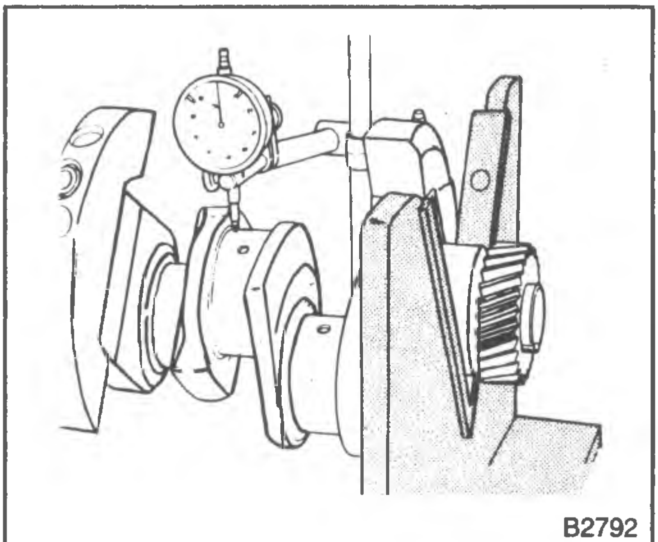


Figure 36—Checking Crankshaft Runout

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

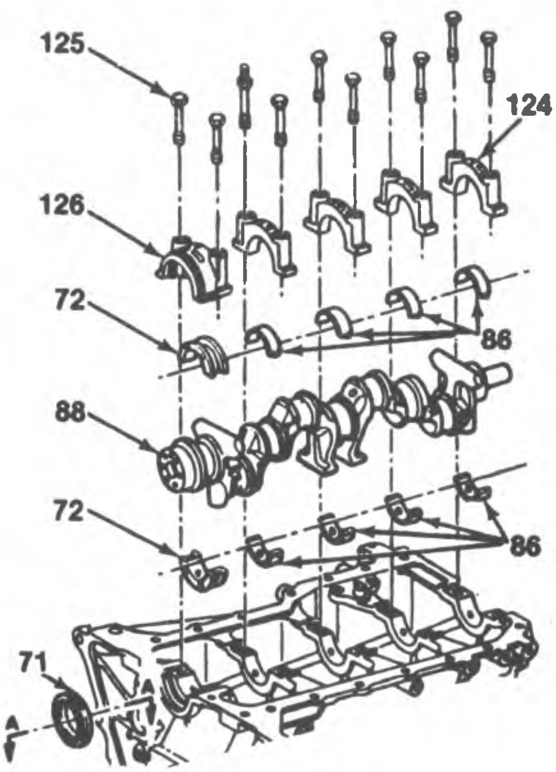
Service bearing inserts are available in standard size and 0.001-inch undersize.

Install or Connect (Figures 4 and 37)

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.
4. Engine oil to the lower main bearing inserts.
5. Main bearing caps (except the rear cap) with the selected lower main bearing 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.



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

F9397

Figure 37—Crankshaft and Bearing Components

6. 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 95 N.m (70 ft. lbs.).

7. Rear main bearing cap to the block.
8. Rear main bearing cap bolts. Tighten the bolts temporarily to 14 N.m (124 in. lbs.).

Measure (Figure 38)

- 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.
- the rear main bearing cap bolts to 95 N.m (70 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).

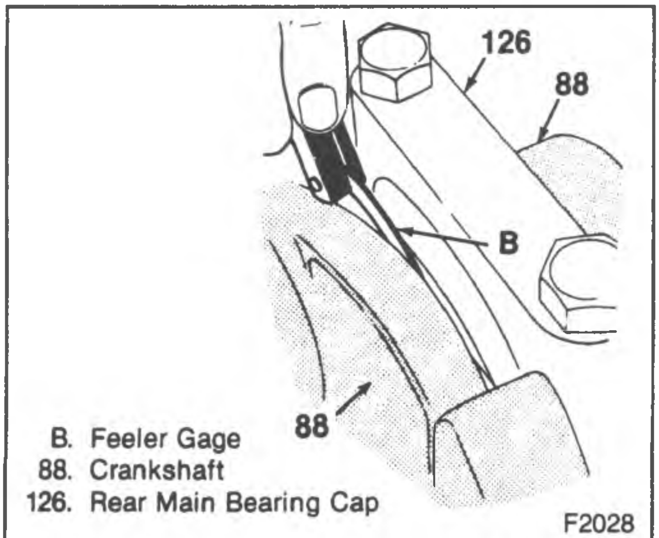
Inspect

- 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 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 4 and 39)

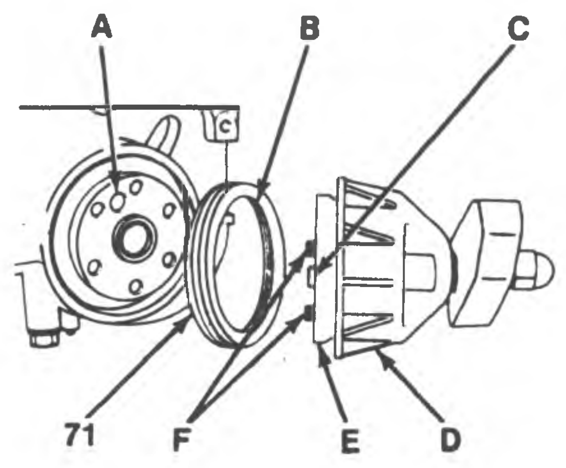
Tool Required:
J 34924-A Seal Installer.



B. Feeler Gage
88. Crankshaft
126. Rear Main Bearing Cap

F2028

Figure 38—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

F2029

Figure 39—Installing the Rear Crankshaft Oil Seal

- Crankshaft rear oil seal using J 34924-A.
  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.

MAIN BEARING INSTALLATION (WITHOUT REMOVING THE CRANKSHAFT)

Install or Connect (Figures 4 and 40)

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.

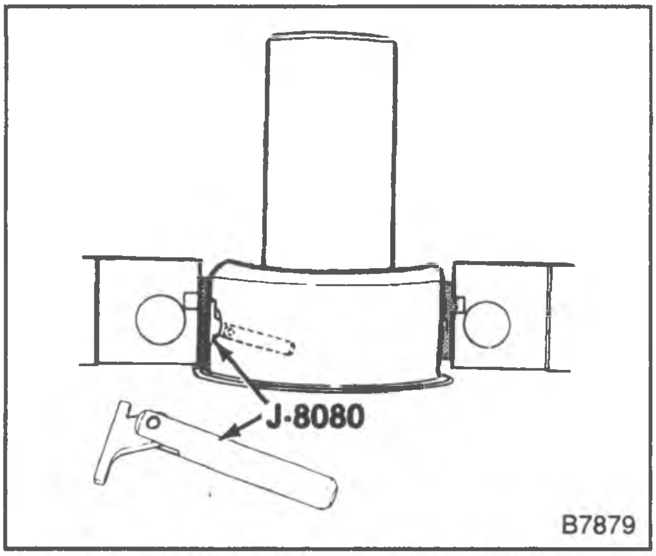


Figure 40—Installing the Upper Main Bearing Insert

- 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 2, 41, and 42)

- 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).

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 4, 43 and 44)

Tool Required:
J 34995 Crankshaft Front Cover Oil Seal Installer

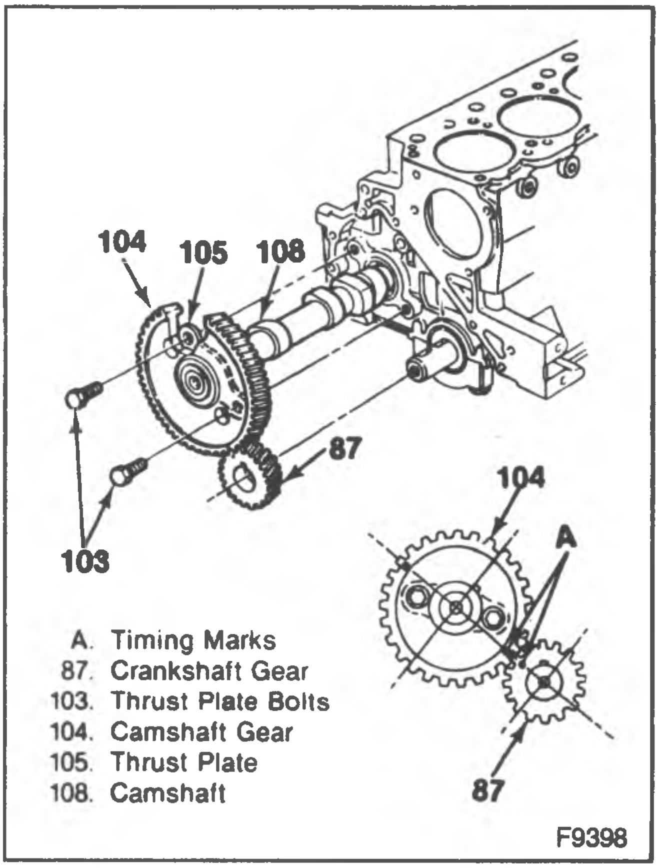


Figure 41—Camshaft and Timing Gears

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 43.

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.

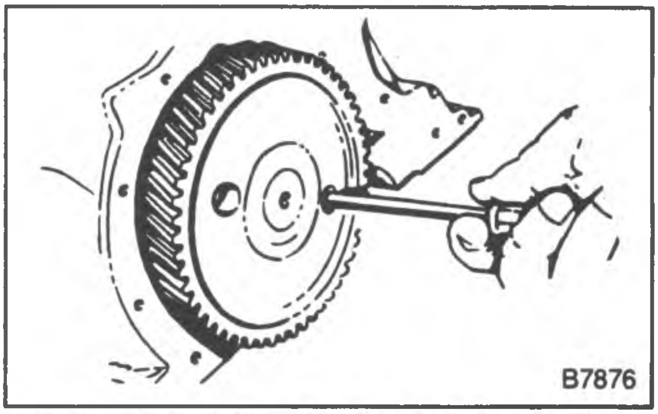


Figure 42—Installing the Camshaft Thrust Plate Bolts

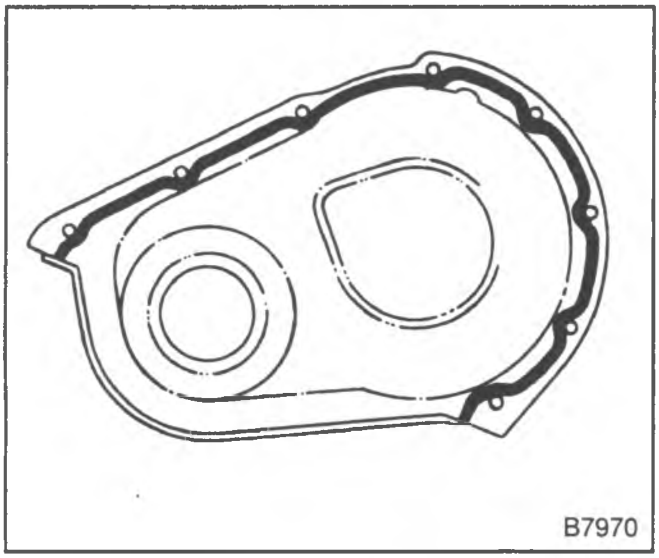


Figure 43—Applying RTV to the Timing Gear Cover

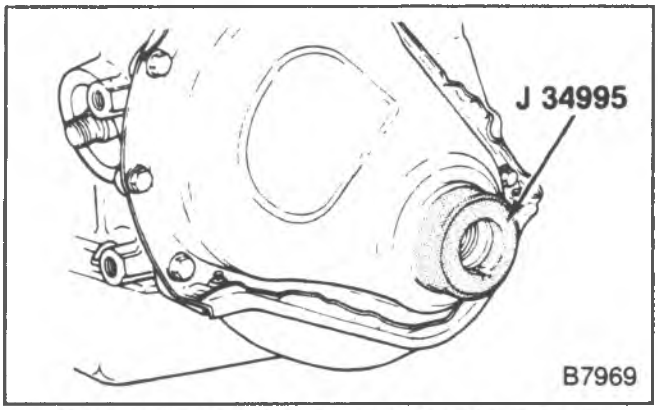


Figure 44—Installing the Timing Gear Cover

2. Timing gear cover, with J 34995 in place, to the block.
3. Bolts (94) (Figure 45).

Tighten

- Bolts to 10.0 N·m (90 in. lbs.).
- Remove J 34995 from the timing gear cover.

CRANKSHAFT PULLEY HUB INSTALLATION

Install or Connect (Figures 4 and 45)

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 4, 46 and 47)

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.

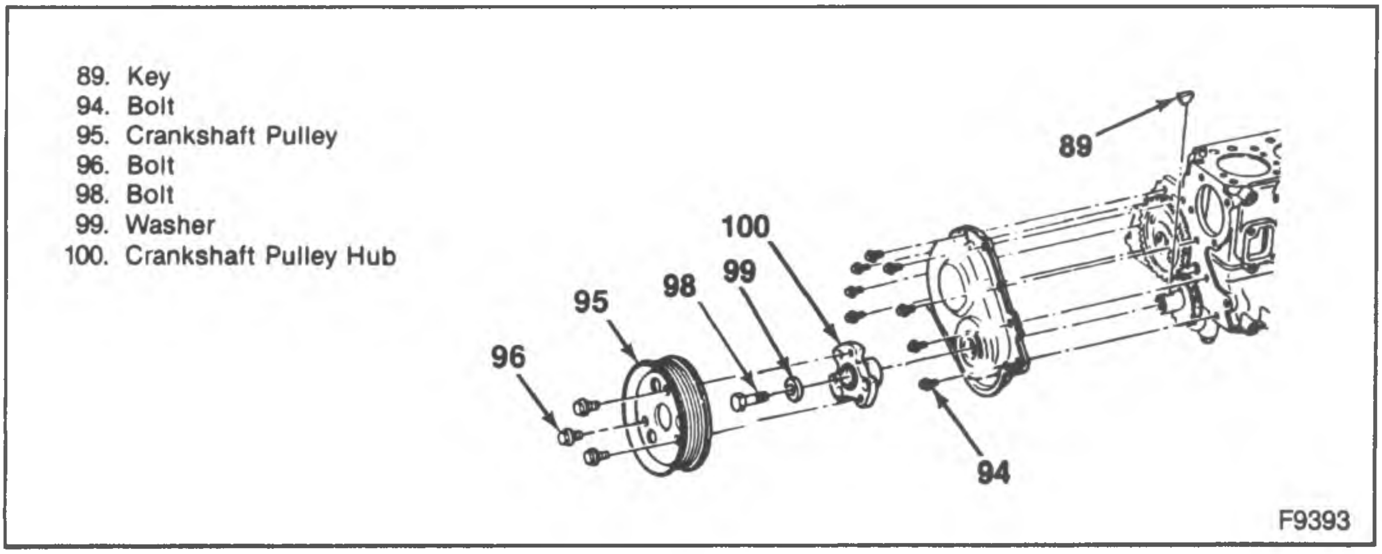
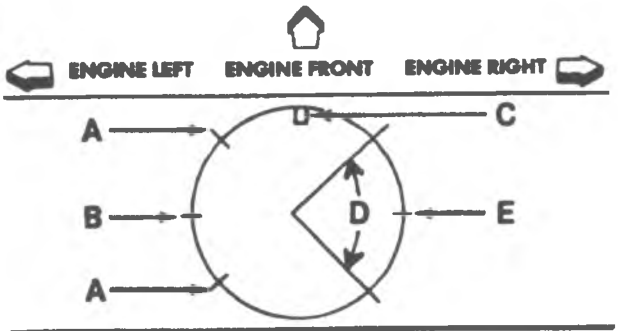


Figure 45—Timing Gear Cover and Components



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

B7895

Figure 46—Piston Ring Gap Location

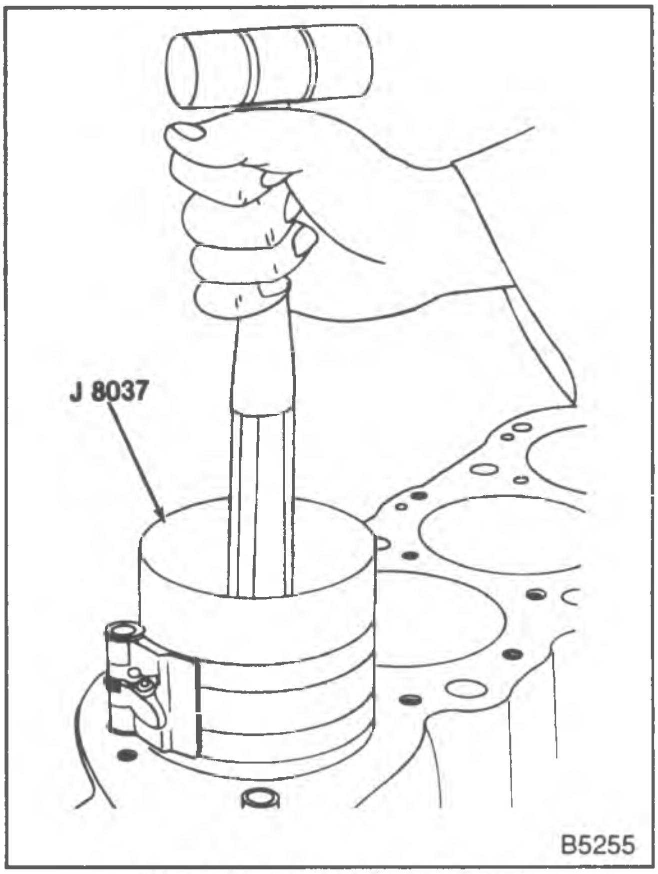


Figure 47—Installing the Piston

- 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 2.5L 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).

FINAL ASSEMBLY

Install or Connect (Figure 4)

- 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 44 N·m (32 ft. lbs.).

Measure (Figure 48)

- 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).

OIL PUMP INSTALLATION

Install or Connect (Figure 4)

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.
2. Oil pump bolts (84) and nut (78).

Tighten

- Bolts (84) to 25 N·m (18 ft. lbs.).
- Nut (78) to 42 N·m (31 ft. lbs.).

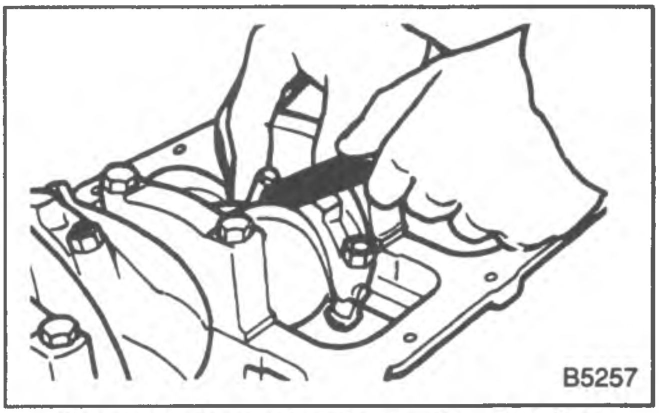


Figure 48—Measuring Connecting Rod Side Clearance

OIL PAN INSTALLATION

Install or Connect (Figures 4 and 49)

- Apply RTV sealant to the oil pan flange and block. Refer to figure 49.

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 4 and 50)

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 50.
4. Bolts (117).

Tighten

- Bolts to 14 N·m (124 in. lbs.).

CYLINDER HEAD INSTALLATION

Install or Connect (Figures 2 and 51)

- 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 51.
   - 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 51).
2. All head bolts except number 9 to 35 N·m (26 ft. lbs.). Number 9 bolt should only be tightened to 25 N·m (18 ft. lbs.). Tighten the bolts in the specified sequence.

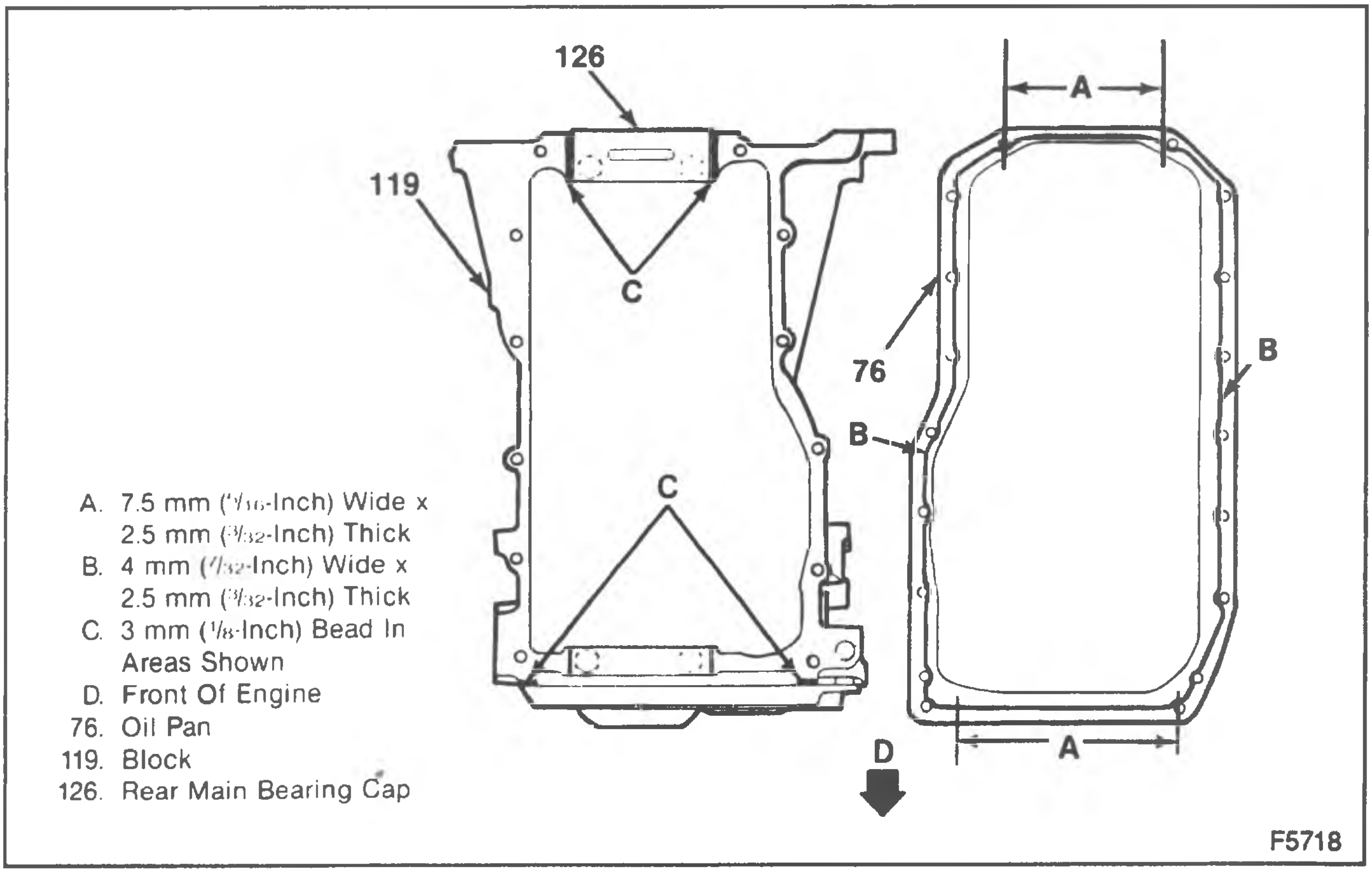


Figure 49—Applying RTV to the Oil Pan and Block

- 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.

VALVE TRAIN COMPONENT INSTALLATION

Install or Connect (Figures 2, 4, 52, and 53)

- 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 53.
5. 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.
6. Rocker arms (33).

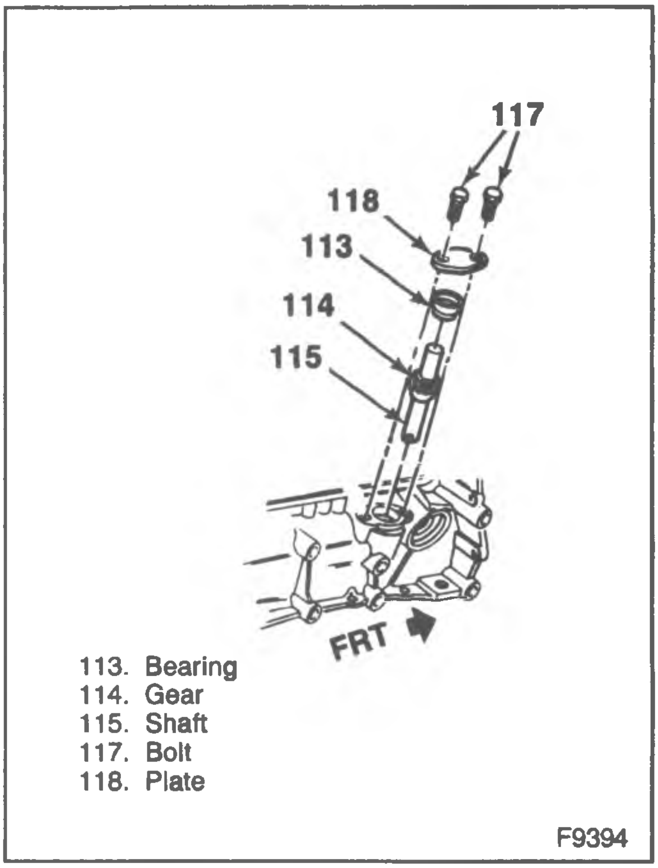


Figure 50—Oil Pump Drive Shaft

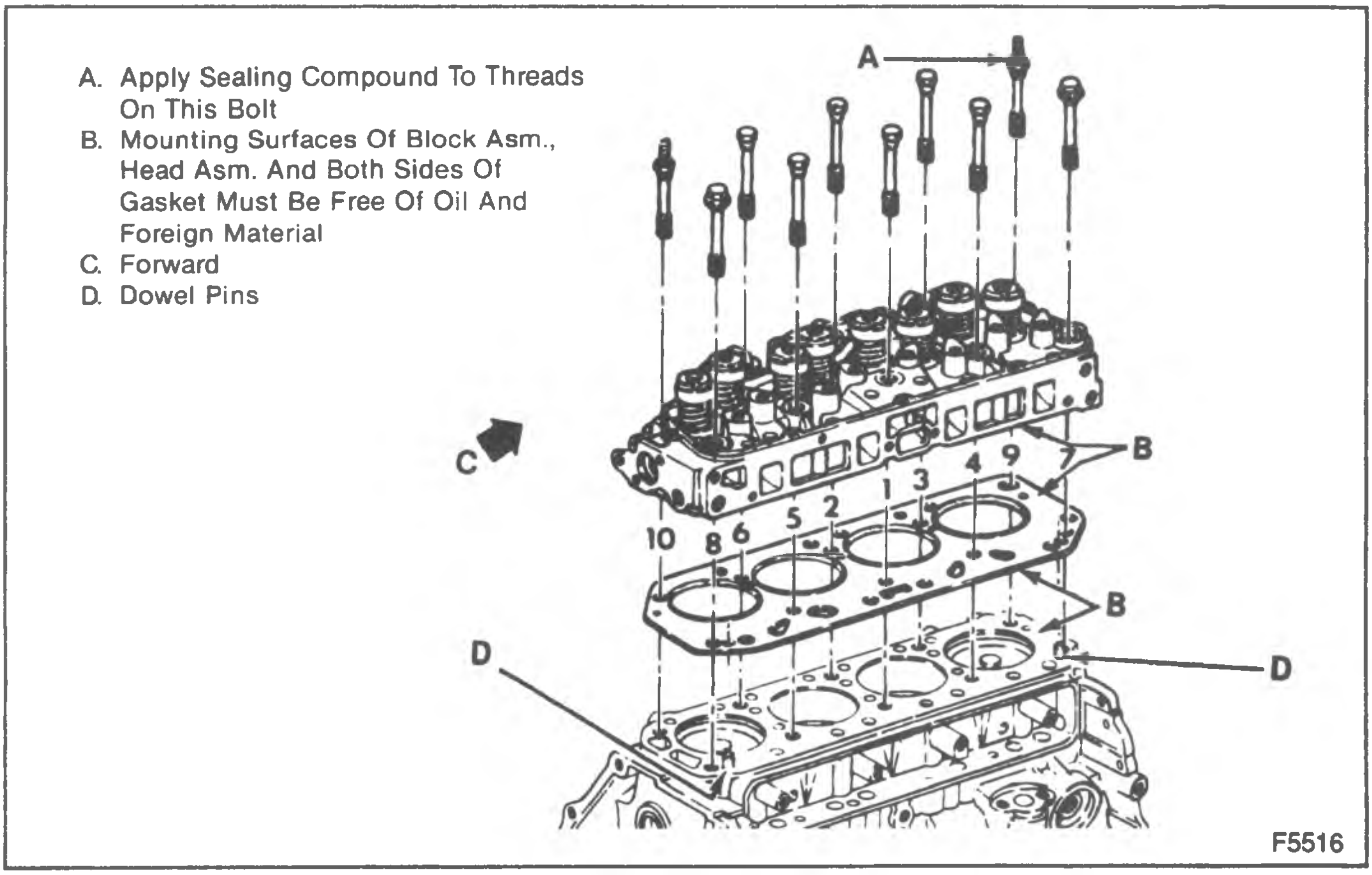
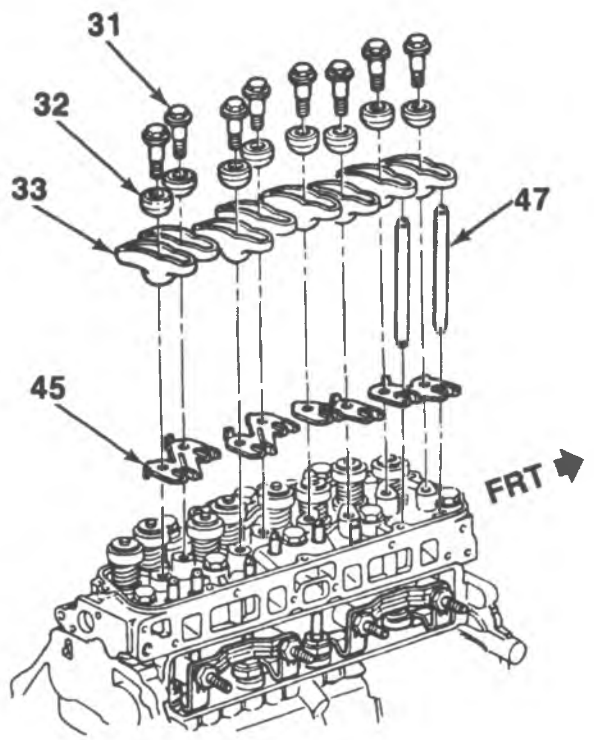


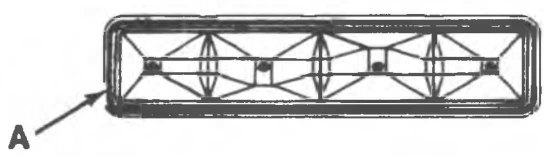
Figure 51—Cylinder Head Installation



31. Bolt
32. Rocker Arm Ball
33. Rocker Arm
45. Push Rod Guide
47. Push Rod

F9396

Figure 52—Valve Train Components



A. Apply A Continuous (5 mm 3/16-Inch) Diameter Bead Of RTV As Shown

B7963

Figure 53—Applying RTV to the Pushrod Cover

7. Balls (32).
8. Bolts (31).

Install or Connect

- Bolts to 30 N·m (22 ft. lbs.). DO NOT OVER-TIGHTEN.

9. Rocker arm cover (48) and gasket (49).
10. Rocker arm cover bolts.

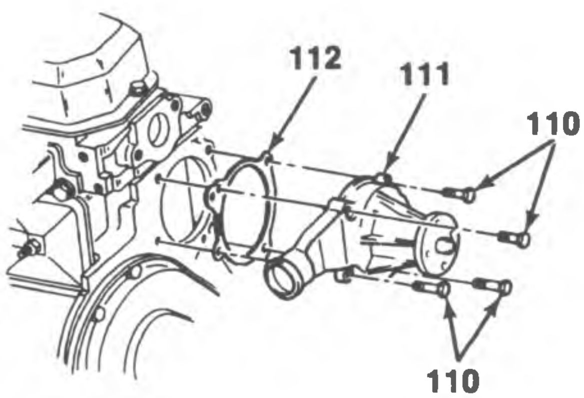
Tighten

- Bolts to 8.5 N·m (75 in. lbs.).

COOLANT PUMP INSTALLATION

Install or Connect (Figure 54 and 55)

1. Gasket.

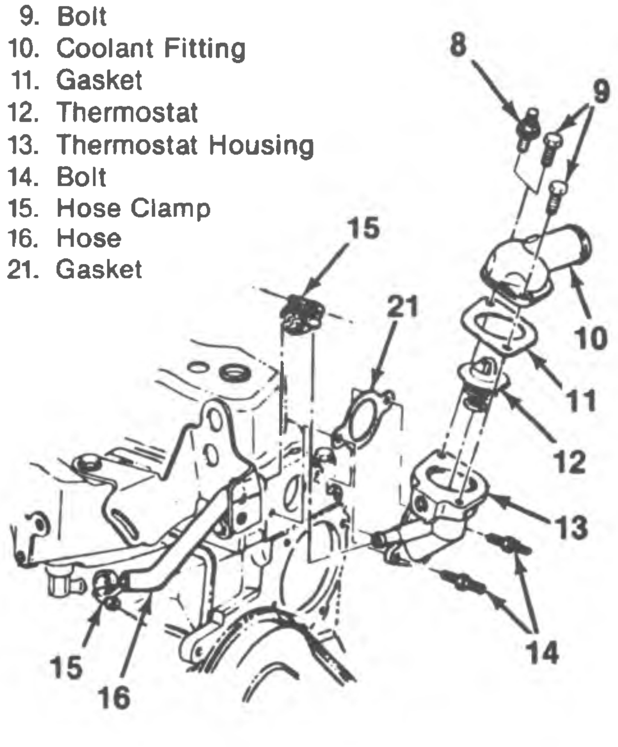


110. Bolt
111. Coolant Pump
112. Gasket

F9392

Figure 54—Coolant Pump Components

8. Stud
9. Bolt
10. Coolant Fitting
11. Gasket
12. Thermostat
13. Thermostat Housing
14. Bolt
15. Hose Clamp
16. Hose
21. Gasket



F1986

Figure 55—Thermostat Housing Components

2. Coolant pump.
3. Bolts.
4. Coolant pump pulley.
5. Fan and fan clutch.

THERMOSTAT HOUSING INSTALLATION

Install or Connect (Figure 55)

1. Thermostat housing and new gasket.
2. Thermostat housing bolts.
3. Thermostat bypass hose.

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figure 56)

1. Gasket.
   - Apply sealant to the bolts indicated in figure 56.
2. Intake manifold.
3. Intake manifold bolts and washers.

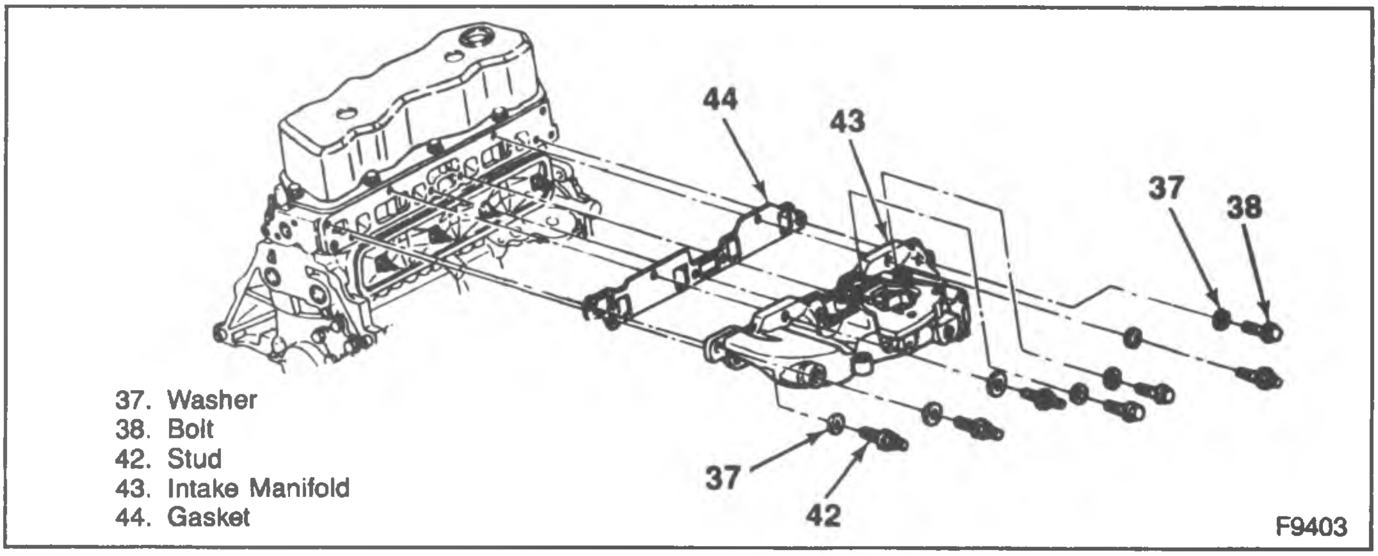


Figure 56—Intake Manifold Installation

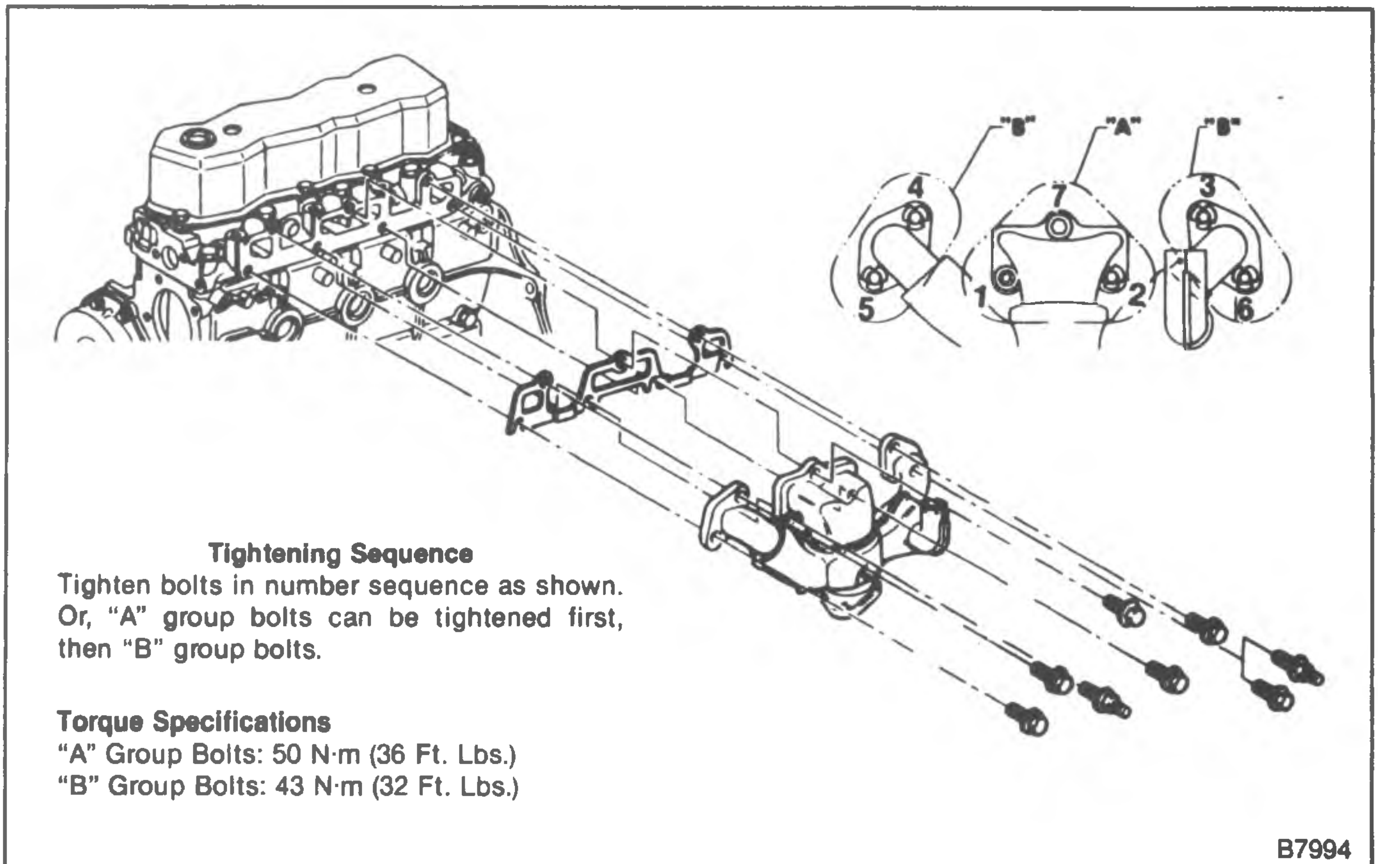


Figure 57—Exhaust Manifold Installation

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 57)

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 57.

3. Oxygen sensor wire.
4. Thermac heat stove pipe.

FLYWHEEL INSTALLATION

Install or Connect (Figure 4)

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.
2. Fill the crankcase with the proper quantity and grade of oil. The crankcase takes 3 quarts (2.8 liters) of oil. With filter it takes 3.5 quarts (3.3 liters) of oil.
3. Fill the cooling system with the proper coolant 11.5 quarts (11 liters).
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. Run the engine at about 1000 rpm until the engine is at operating temperature.
6. Listen for improperly adjusted valves or sticking lifters, or other unusual noises.
7. Check for oil and coolant leaks while the engine is running.
8. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing and idle rpm.

SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:			
Type			L-4
Displacement			2.5L (151 CID)
RPO			L38
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			0.0015-0.0035
PISTON RING:			
COMPRESSION	Groove Clearance	Top	0.0015-0.0035
		Second	0.0015-0.0035
	Gap	Top	0.010-0.015
		Second	0.010-0.020
OIL	Groove Clearance		0.0015-0.0075
	Gap		0.015-0.055
PISTON PIN:			
Diameter			0.9271-0.9275
Clearance In Piston			0.0004-0.0006
Fit In Rod			Production: 0.0002-0.0007 Service: 0.0002-0.0023
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

T2360

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)			0.251
End Play			0.015-0.0050
Journal Diameter			1.869
Journal Clearance			0.0007-0.0027
VALVE SYSTEM:			
Lifter Type			Roller 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	0.058-0.112
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		2.00
	Pressure N @ mm	Closed	71-78 lbs. @ 1.679
		Open	170-178 lbs. @ 1.239
	Installed Height		1.679

T2361

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

T2520

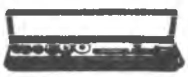
SPECIAL TOOLS

1.  J 8037

2.  J 34995

3.  J 8080

4.  J 8062

5.  J 33049

6.  J 21882

7.  J 34924-A

8.  J 22330

9.  J 3049

10.  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. Rear Crankshaft Oil Seal Installer
8. Valve Seal Checker
9. Hydraulic Lifter Remover
10. Dial Indicator

F4487

SECTION 6A2

V6 ENGINE
2.8L (173 CID)

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

CONTENTS (cont'd)

DESCRIPTION

GM 2.8L engines are 60-degree V6 type, overhead valve, coolant 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.

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.

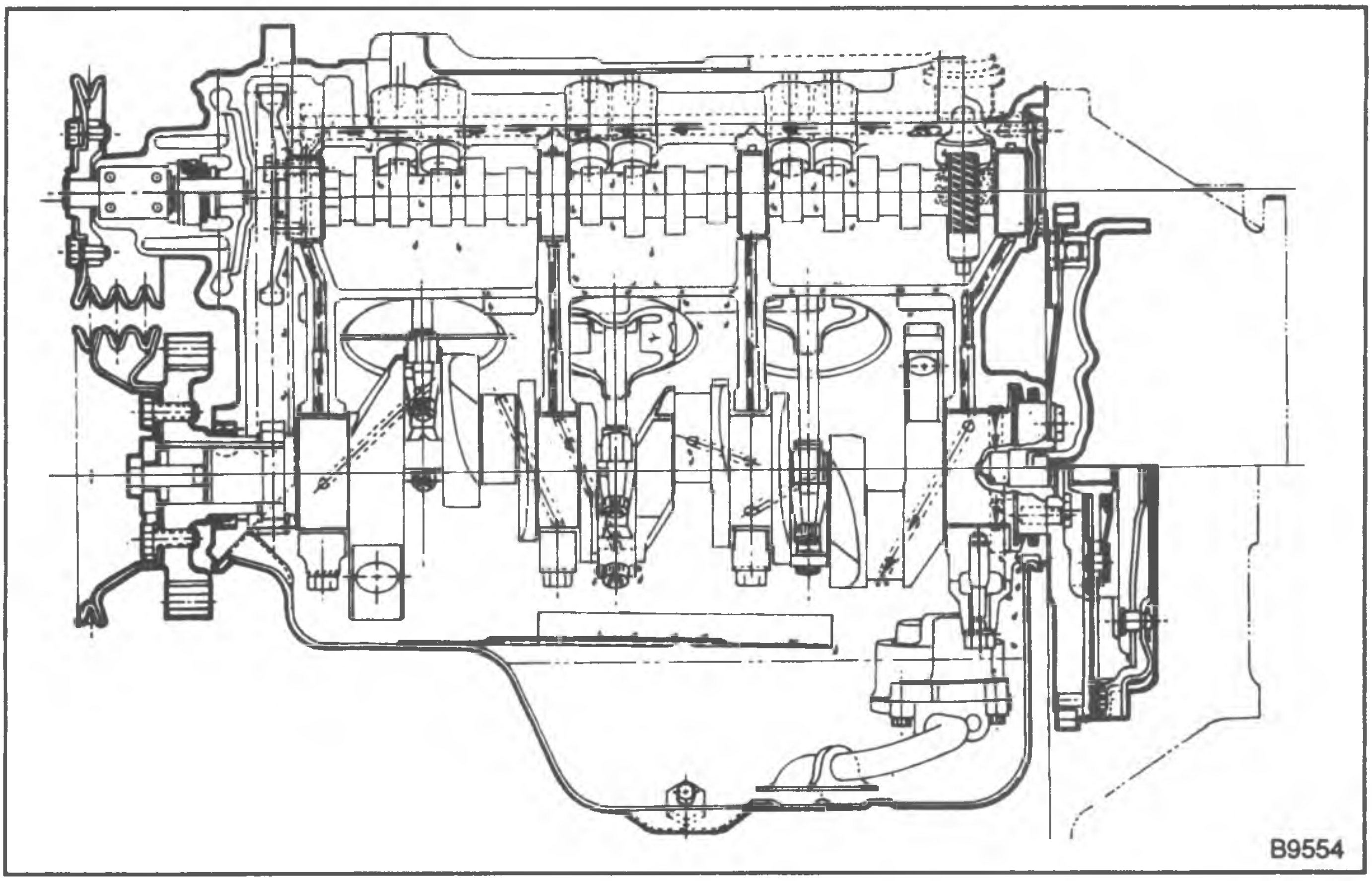


Figure 1—Engine Lubrication Diagram

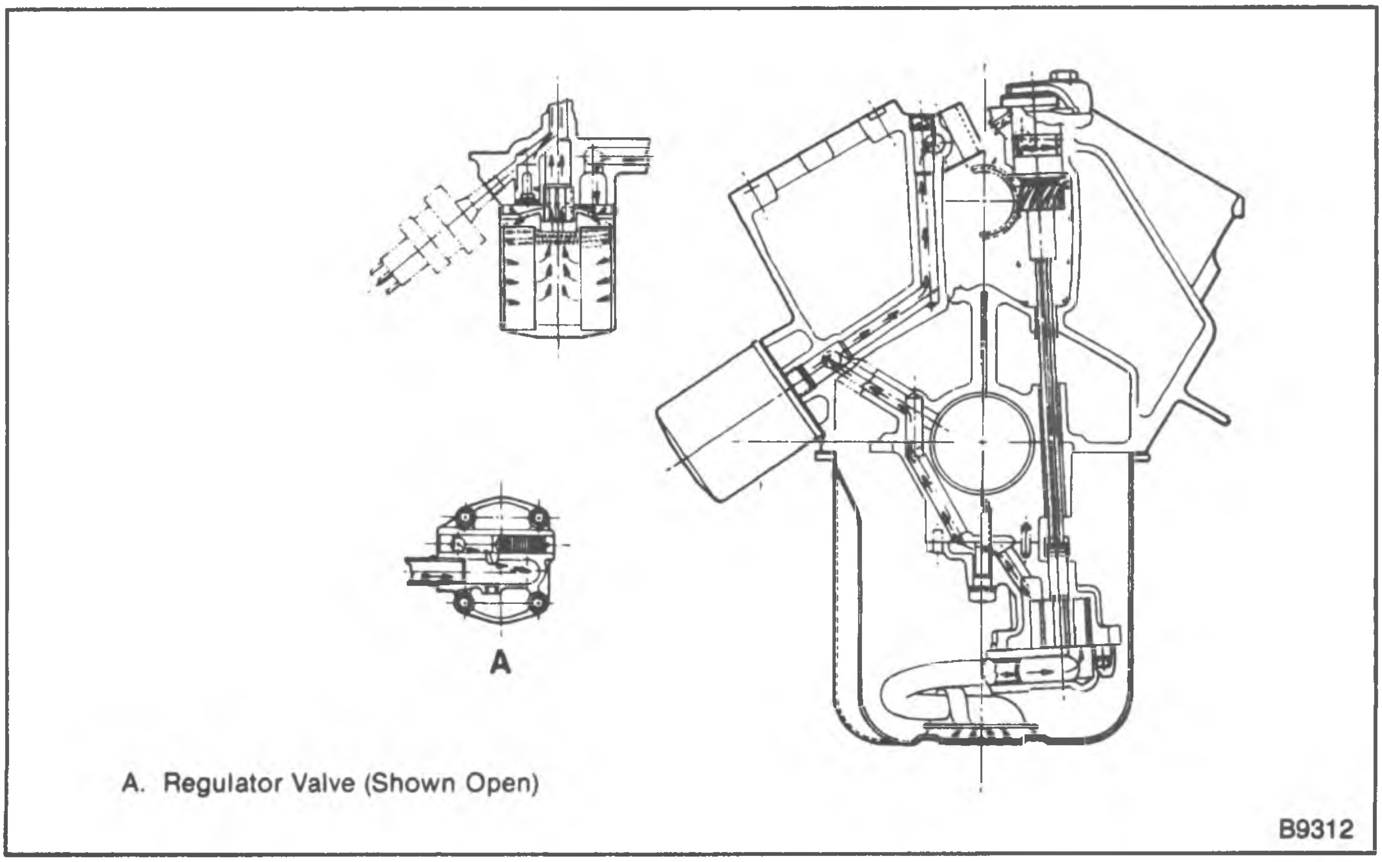
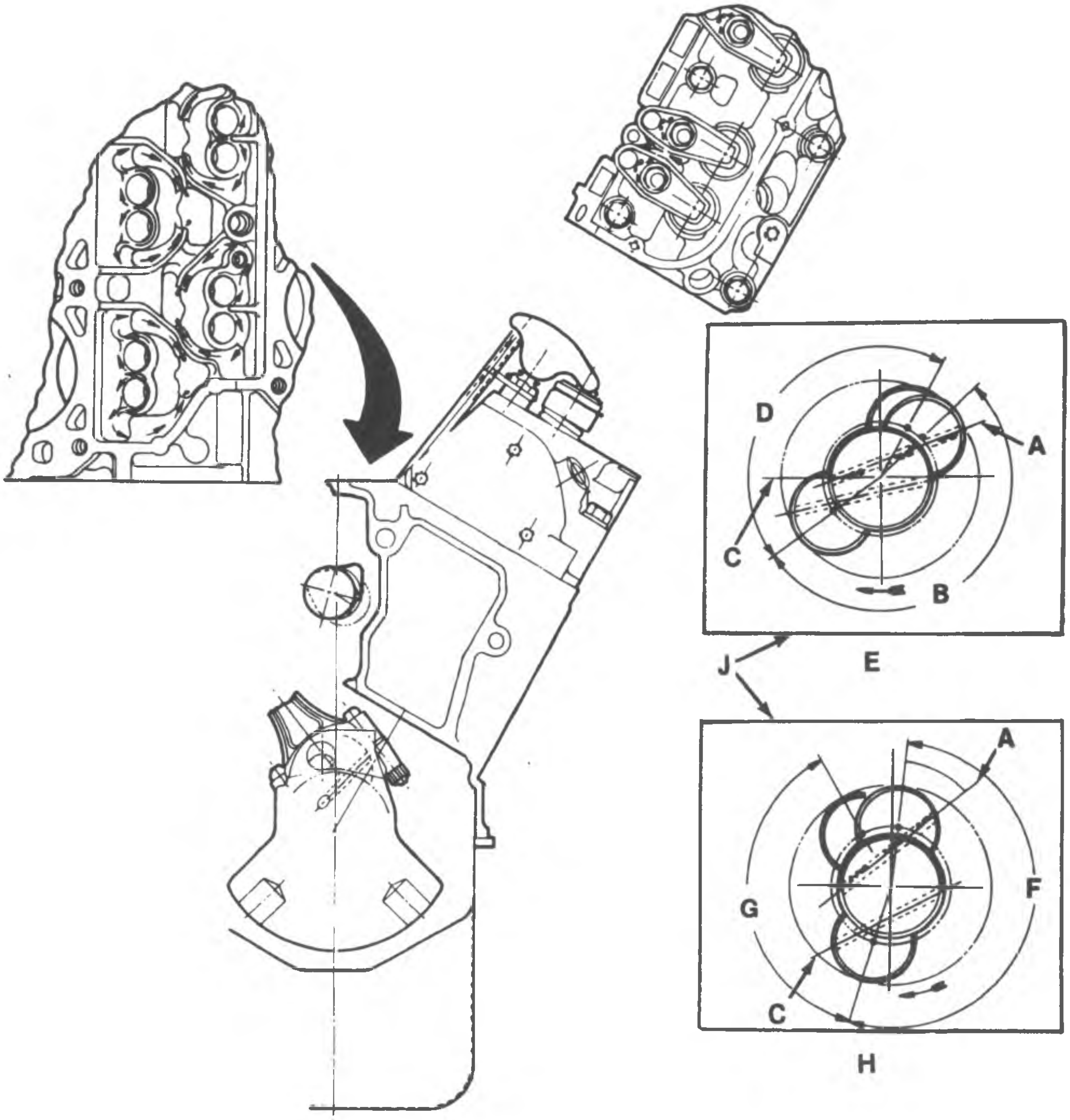


Figure 2—Engine Lubrication Diagram



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

B9548

Figure 3—Engine Lubrication Diagram

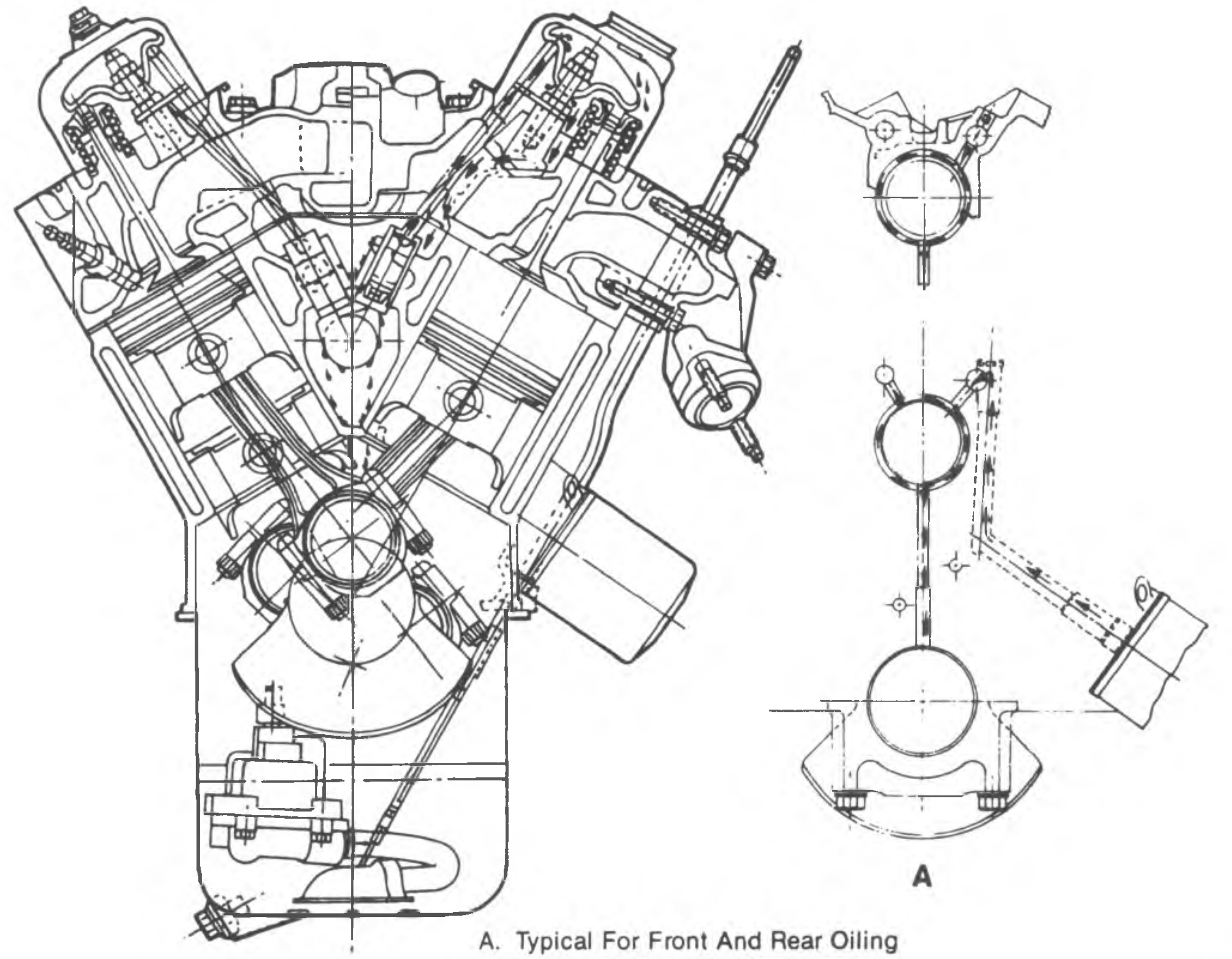


Figure 4—Engine Lubrication Diagram

ACCESSORY REMOVAL

This manual assumes that the engine accessories have been removed. These accessories may include one or more of the following:

Hydraulic Pump	Cooling Fan
AIR Pump	Distributor
Generator	TBI Unit
Air Conditioning Compressor	

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 the engines 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 (106 in. lbs.).

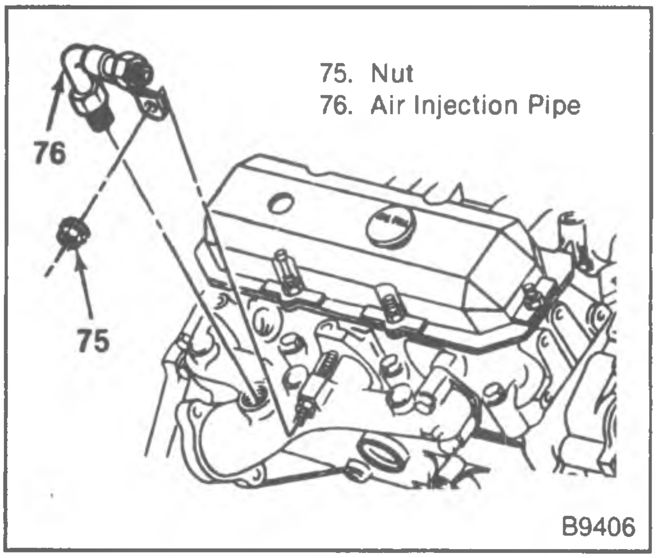


Figure 5—Air Injection Tube

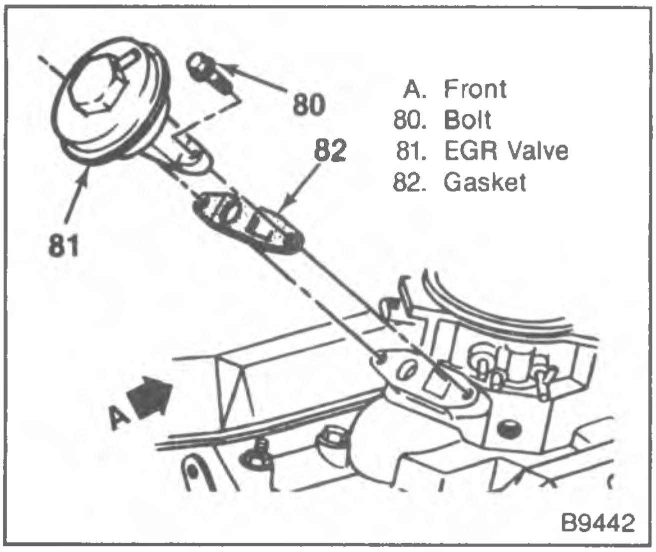


Figure 6—EGR Valve

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 (3) and gasket (4).
   - 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.
2. Intake manifold.
   - Lift the intake manifold straight up.

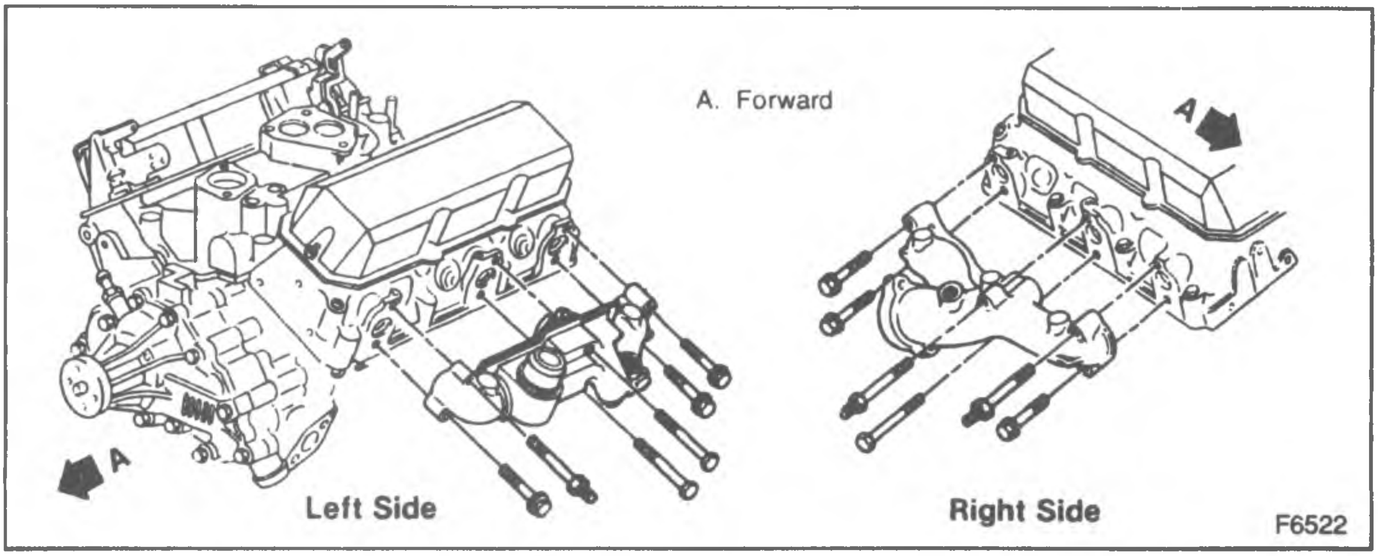


Figure 7—Exhaust Manifolds

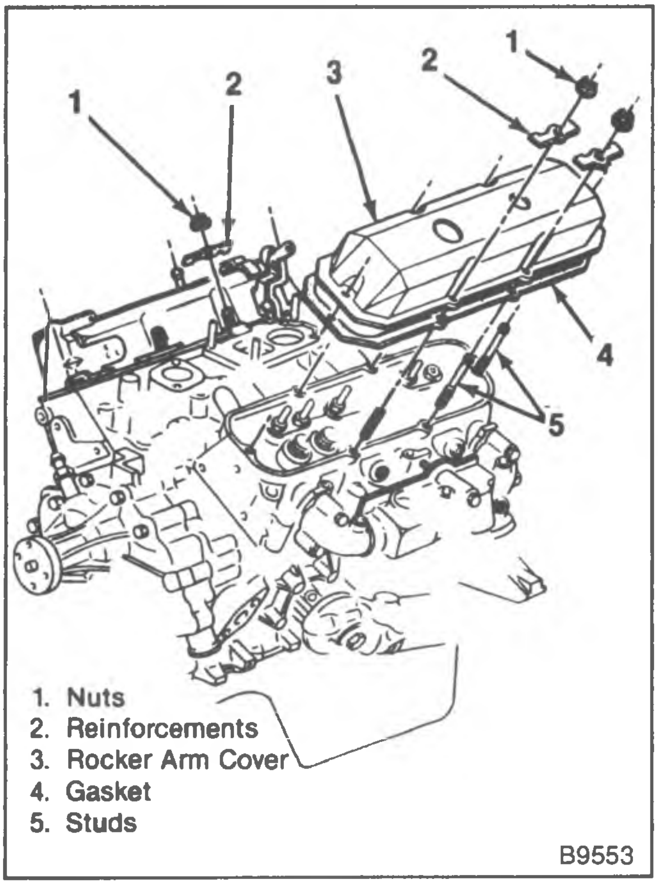


Figure 8—Rocker Arm Cover Removal

- Do not attempt to loosen the manifold by prying under the gasket surface with any tool.

3. Gaskets.

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)

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 9290-1 (figure 11).

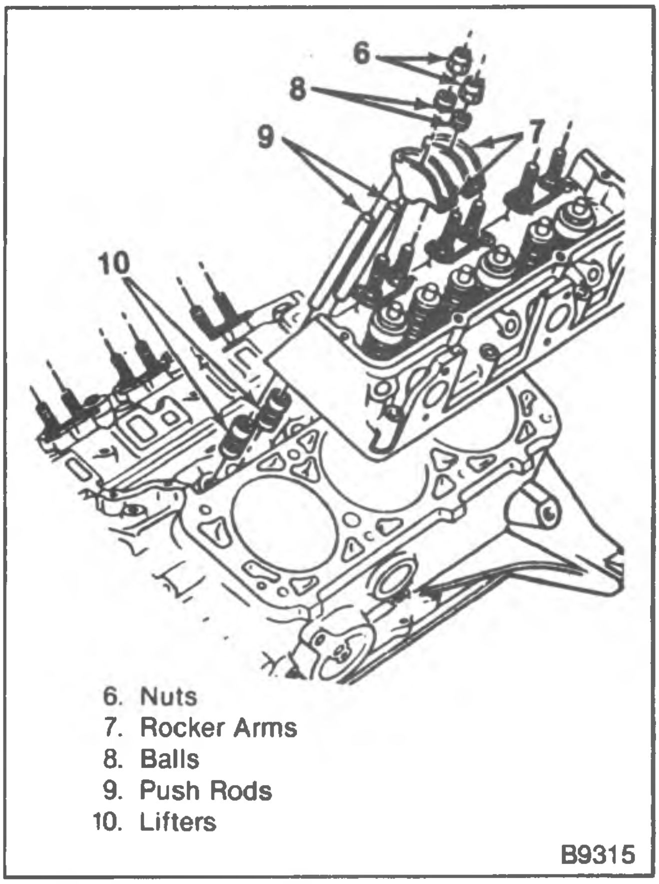


Figure 9—Valve Train Components

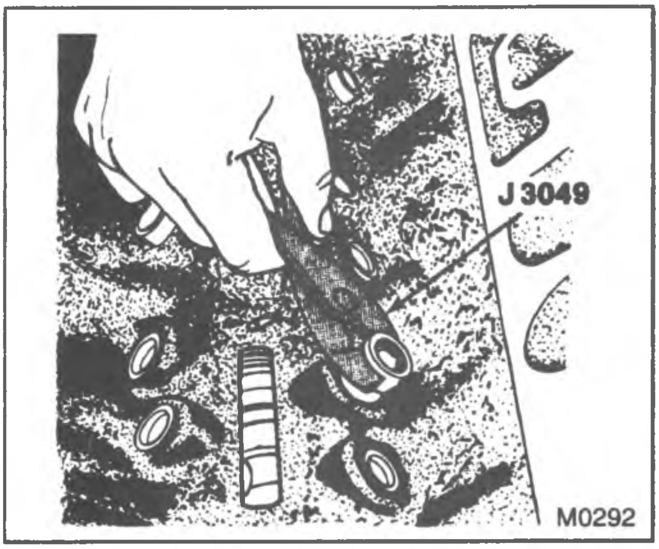


Figure 10—Removing the Hydraulic Lifters with J 3049

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.

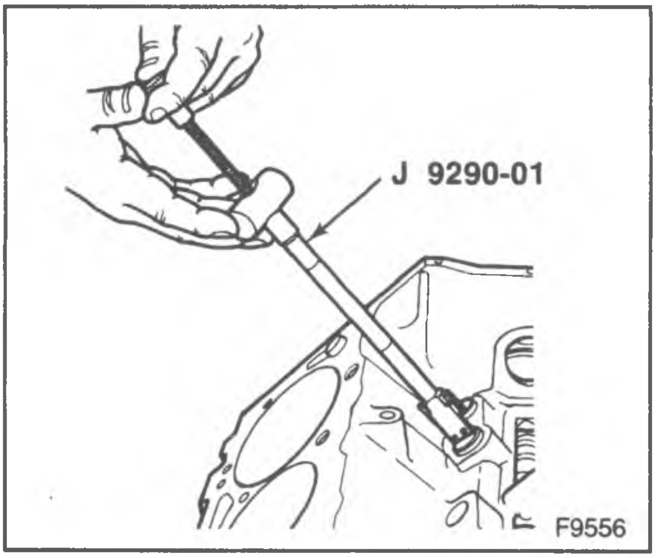


Figure 11—Removing the Hydraulic Lifters (Typical)

TORSIONAL DAMPER REMOVAL

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The removal 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 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 Puller 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.

FRONT COVER AND COOLANT PUMP REMOVAL

Remove or Disconnect

1. Coolant pump and gaskets.
2. Front cover bolts.
3. Front cover.
4. Front cover gasket.

OIL PAN REMOVAL

Remove or Disconnect

1. Bolts, nuts and studs from the oil pan.

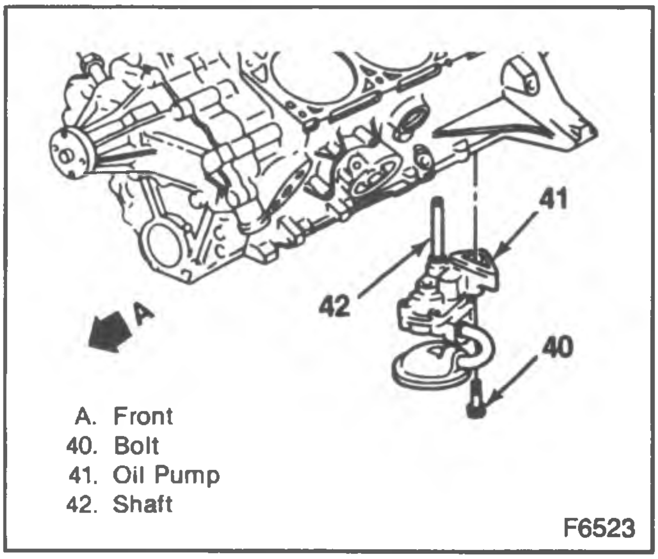


Figure 12—Oil Pump Removal

2. Oil pan.
3. Gasket.

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.

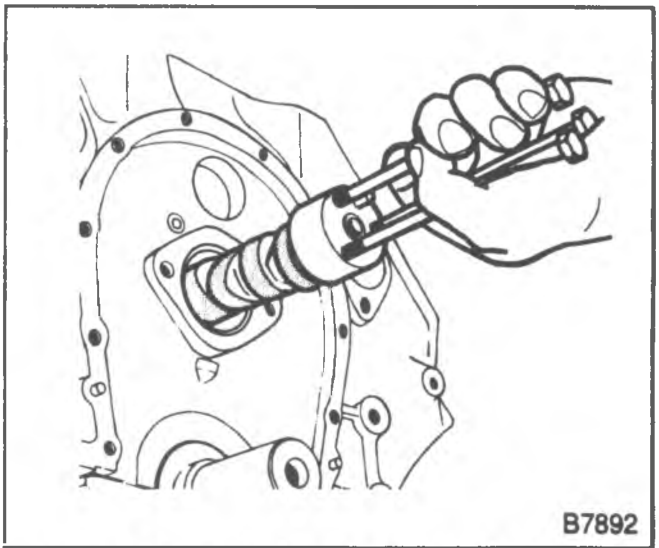


Figure 13—Replacing the Camshaft (Typical)

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.

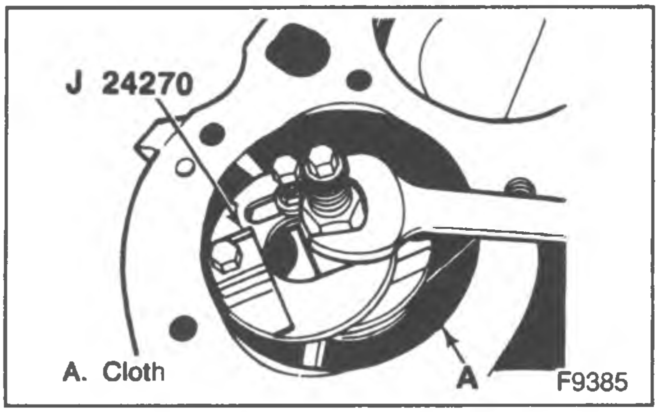


Figure 14—Removing the Cylinder Ridge

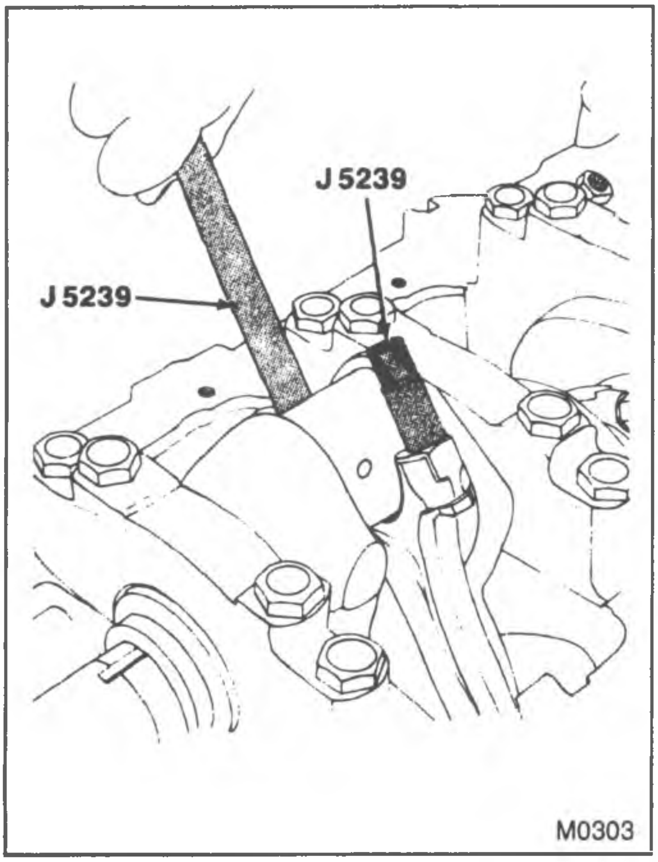


Figure 15—Replacing the Piston and Connecting Rod (Typical)

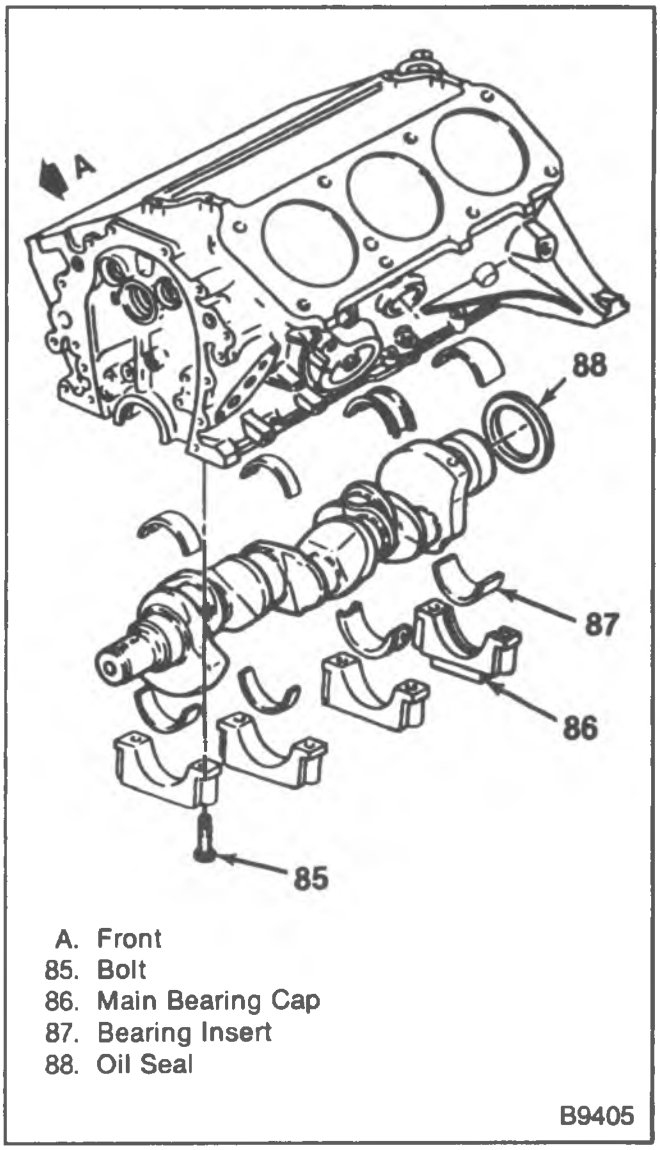


Figure 16—Crankshaft Installation

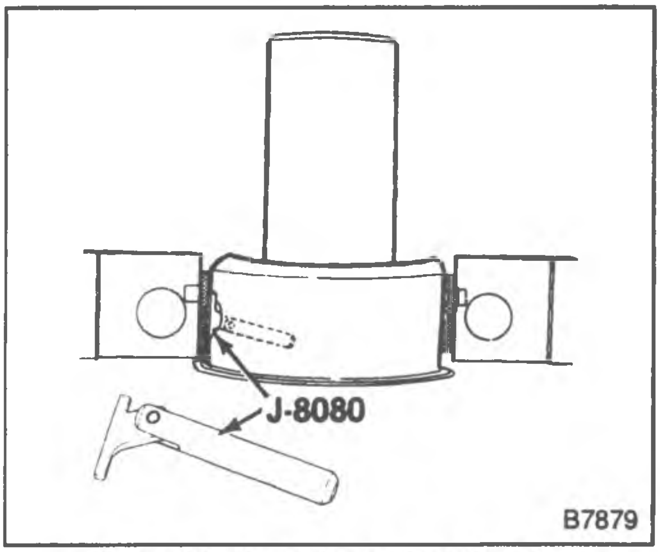


Figure 17—Removing or Installing the Main Bearing Insert

PISTON AND CONNECTING ROD REMOVAL

Ridge Reaming Cylinder

Remove or Disconnect

- 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.

1. 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.
3. Connecting rod and piston (figure 15).
   - Install thread protector over the threads of the rod studs to prevent damage to the bearing journal and rod studs.
4. Connecting rod bearings.

FLYWHEEL REMOVAL

Remove or Disconnect

1. Bolts.
2. Retainer (automatic transmission only).
3. Flywheel.

CRANKSHAFT REMOVAL

Remove or Disconnect (Figure 16)

- 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.

MAIN BEARING REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Remove or Disconnect

Tool Required:
J 8080 Main Bearing Remover/Installer

1. Bolts (85).
2. Main bearing caps (86).
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during reassembly.
3. Lower main bearing inserts (87) from the main bearing caps.
4. 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.

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 can 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 of 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 with a ridge reamer.
2. Wipe the bores and pistons clean.
3. Select a piston and rod assembly for the bore to be fitted.
   - Position the piston down into the selected bore with the top facing down.
   - The piston should slide freely through the bore by its own weight when the piston skirt is 12 to 25mm from the top of the block. Use care not to damaged the piston as it slides through the bore.
     — If the piston is not able to slide freely through the bore, another piston must be selected.
   - Position the selected piston in the bore (top down) with the skirt 12 to 25mm from the top of the block.
   - Place a feeler gage, (0.060 mm for used pistons, 0.050 mm for new pistons, at least 150 mm long and not over 12mm wide) into the bore at a 90 degree angle from the piston pin with the selected piston.
   - 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, with the feeler gage between the piston and cylinder wall, another piston must be selected.
   - When checking more than one bore, a piston that does not fit one bore may fit another bore. Care must be taken to retain connecting rod alignment
4. Mark the proper piston and bore for reassembly.

Assemble

- Components as outlined.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine (with the engine upright). Cylinders 2, 4 and 6 are the left bank and 1, 3 and 5 are the right bank. The numbers on the connecting rod and bearing cap, must remain on the same bank when reinstalled into the cylinder bore. If a connecting rod is ever moved to another block or cylinder, new connecting rod bearings should be fitted and the connecting rod should be renumbered to correspond with the new cylinder number.

Measure

- Ring end gap and ring clearance.

Inspect

- Ring fit.

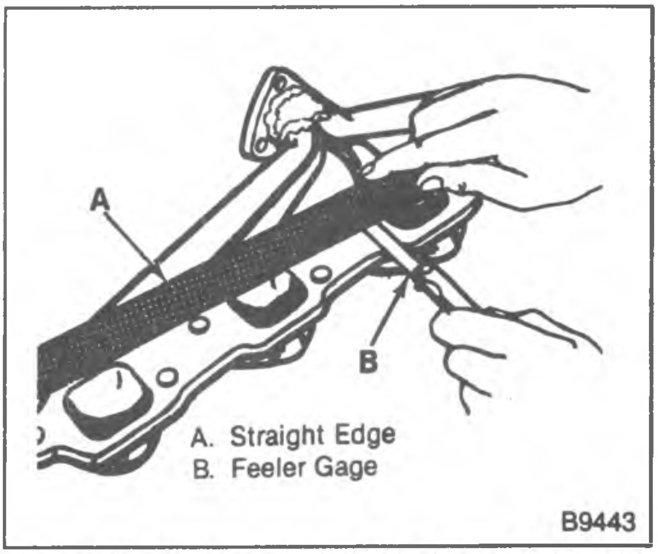


Figure 18—Inspecting Manifold Flange Alignment

INTAKE AND EXHAUST MANIFOLDS

Clean

- Old pieces of gasket from 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 or gasket surface damage.
- Alignment of manifold flanges.
  - — Use a straight edge and feeler gage.
  - — If the flanges are out of alignment by more than 0.1mm (0.005-inch), the manifold needs to be replaced.

CAMSHAFT

Important

- When replacing the camshaft, always install a new set of lifters.

Inspect

- Camshaft lobes and journals for scratches, pitting, scoring and wear.

Measure

- Camshaft journal diameter (figure 19).
- The proper diameters are listed in "Specifications".

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) for replacement procedures.

TIMING CHAIN AND SPROCKETS

Inspect

- Chipped teeth or wear on the sprockets.
  - — Excessively worn sprockets will rapidly wear a new chain.
- Timing chain for damage.
- Timing chain for wear.
  - — Excessively worn chain will rapidly wear a new set of sprockets.
  - — If the chain can be pulled out more than 6.3mm (1/4-inch) from the damper, the chain must be replaced.

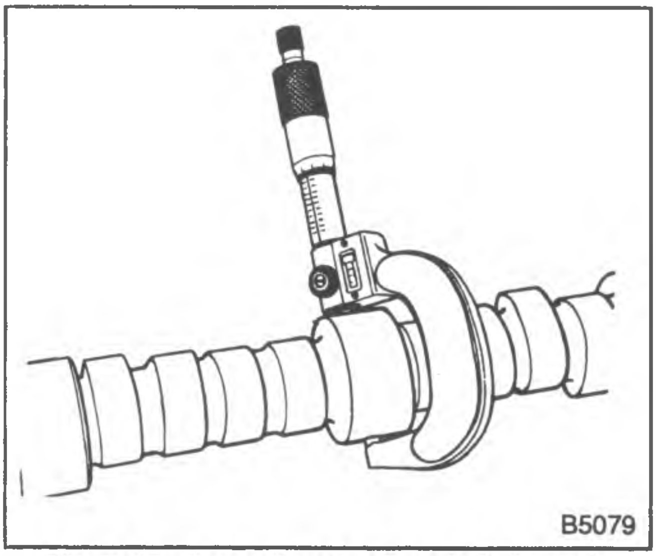


Figure 19—Inspecting the Camshaft Journals

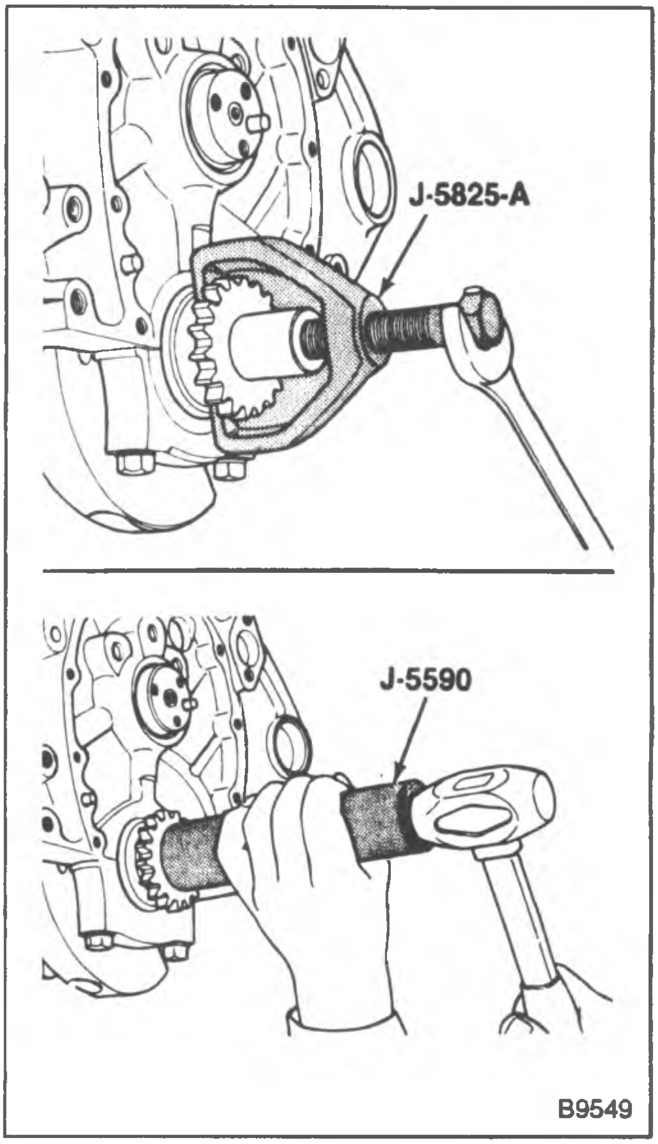


Figure 20—Replacing and Installing the Camshaft Sprocket

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).

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 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.

  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.

COOLANT 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 lubricant supply and cause premature bearing failure.

Inspect

- Coolant pump shaft for roughness, leakage and play.
  - The shaft should turn smoothly.
  - There should not be excessive end play.
  - Coolant pump body at the drain hole for evidence of coolant leakage.
- Replace the coolant pump if any faults are found.

OIL PAN AND ROCKER ARM COVERS

Clean

- Parts in solvent. Remove all sludge and varnish.
- Old gaskets from gasket surfaces.

Inspect

- Gasket flanges for bending or damage.
- Rocker arm cover parts for deterioration.
- Oil pan for rock damage, tears or cracks.
- Oil pan baffle for lack of fit.
- Stripped drain plug threads.

OIL PUMP

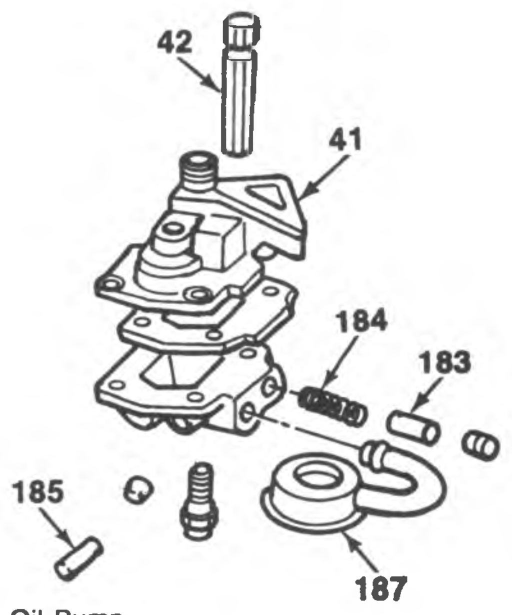
- Do not remove the pick-up screen and pipe unless replacement is required.
- The pick-up pipe is a press fit in the pump body (41).
- Do not try to remove the screen from the pipe. The pick-up screen and pipe are serviced as a complete assembly.

Clean

- All parts in clean solvent and blow dry with compressed air.

Inspect (Figure 21)

- Pump and cover for cracks or other damage.



41. Oil Pump
42. Shaft
183. Pressure Relief Valve
184. Spring
185. Spring Retaining Pin
187. Pick-up Screen and Pipe

B9404

Figure 21—Oil Pump Components

- 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 22)

Tool Required:
J 21882 Pick-Up Tube and Screen Installer

NOTICE: When installing the pipe into the pump, take care not to twist, shear or collapse the pipe. An improperly installed pipe will not allow proper oil flow and may cause system failure.

1. Pick-up screen and pipe (if removed).
   - If the pick-up screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition, can 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.
2. Oil pump drive shaft (42) and connector.
3. Bolt (figure 12).

VALVE TRAIN COMPONENTS

PUSHRODS, ROCKER ARMS, BALLS AND NUTS

Clean

- Parts in solvent and blow dry with compressed air.
- Oil passages in the pushrods.

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.
- Bent pushrods.
  - — Roll the pushrod on a flat surface to determine if it is bent.
- Pushrod ends for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

Cylinder head disassembly is covered in this procedure. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A) for information regarding the following:

- Cleaning
- Inspection
- Measuring clearances
- Valve grinding
- Valve guide reconditioning

Disassemble (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 valve keepers (22).
   - 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 reassembly.

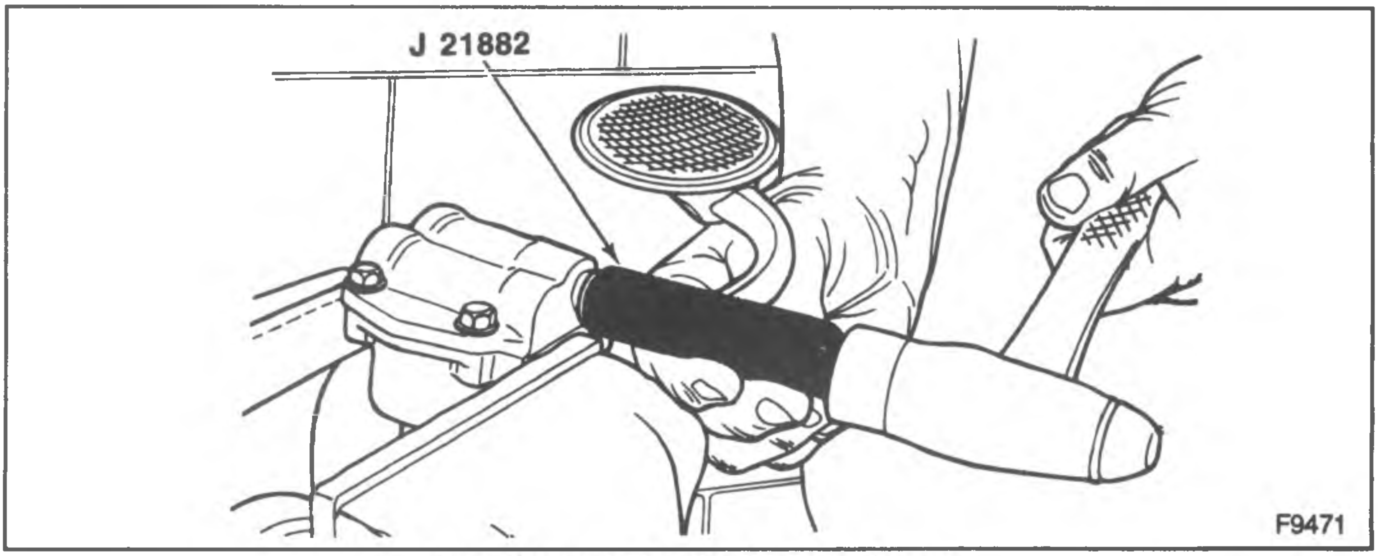
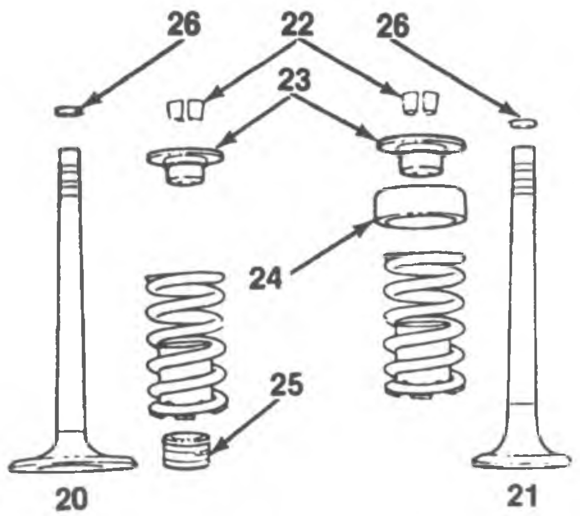


Figure 22—Installing the Oil Pump Screen



20. Intake Valve
21. Exhaust Valve
22. Valve Keepers
23. Valve Cap
24. Oil Shedder
25. Seal
26. O-Ring

B9551

Figure 23—Valves and Components

ROCKER ARM STUD AND PUSHROD GUIDE REPLACEMENT

The rocker arm studs are threaded into the cylinder heads.

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.

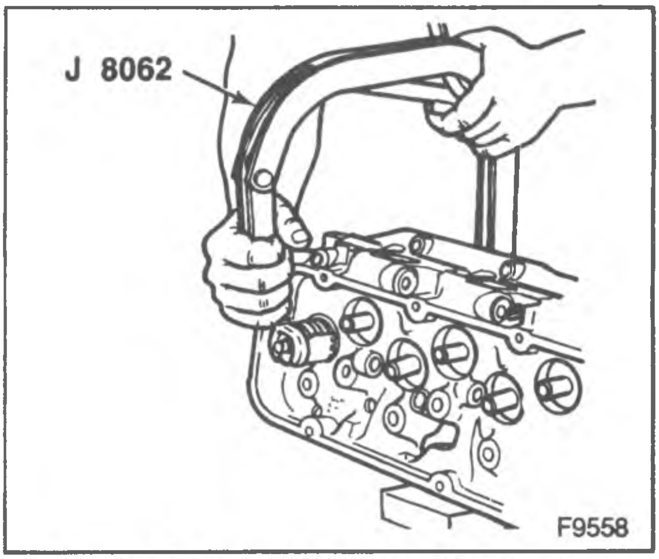
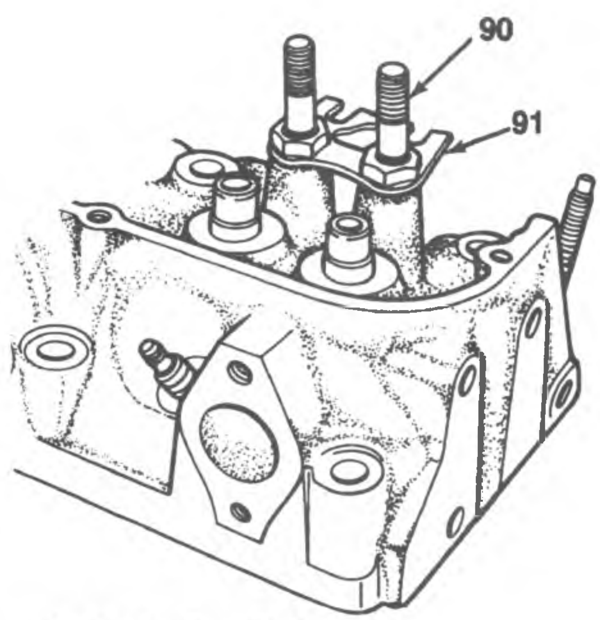


Figure 24—Compressing the Valve Springs



90. Rocker Arm Stud
91. Pushrod Guide

B9444

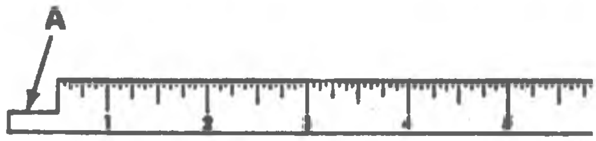
Figure 25—Rocker Arm Studs

4. Oil shedder (24).
5. Caps (23).
6. O-ring seals (26) and valve keepers (22).
   - 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 0.75mm (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.



A. Grind out this portion.

B5248

Figure 26—Scale for Checking Valve Spring Installed Height

THERMOSTAT AND COOLANT OUTLET

Remove or Disconnect (Figure 27)

1. Bolts.
2. Coolant outlet.
3. Thermostat (including the gasket).

Inspect

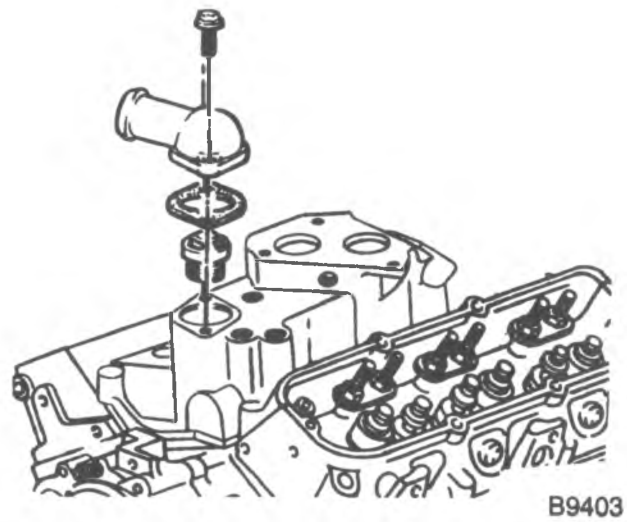
- Coolant outlet for cracks.
- Gasket for cracks or tears.

Install or Connect (Figure 27)

1. Thermostat (including the gasket).
2. Coolant outlet.
3. Bolts.

Tighten

- Bolts to 21 N.m (15 ft. lbs.).



B9403

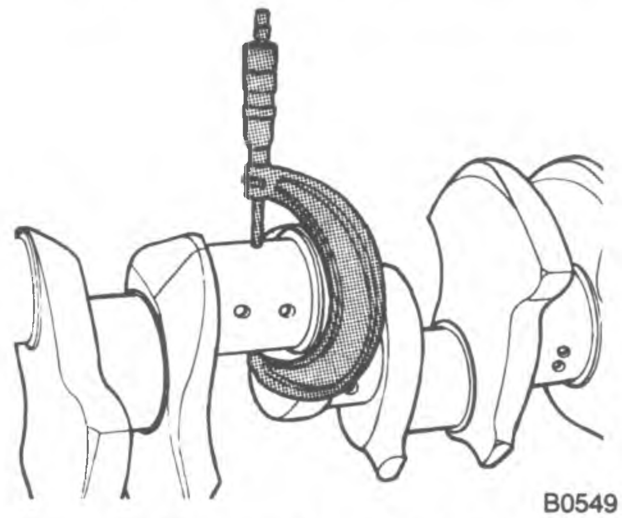
Figure 27—Thermostat and Coolant Outlet

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.



B0549

Figure 28—Measuring the Crankshaft Journals (Typical)

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 0.005mm, 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 0.025mm, the crankshaft is bent and must be replaced, along with the main bearing.

ASSEMBLY

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 0.032mm 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 0.032mm undersize insert which will decrease the clearance 0.016mm from using a full standard bearing.

Install or Connect

1. Upper main bearing inserts into 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.

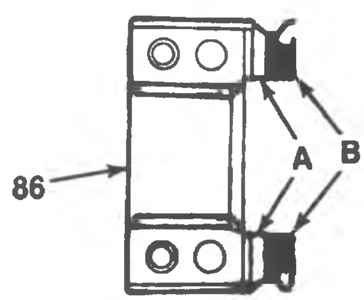
   Measure

   - Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).
- Apply engine oil to the main bearing inserts.
4. 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.
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.).
   - 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.).

A. Anaerobic Sealant (GM Part No. 1052756 or Equivalent)
B. RTV Sealant (GM Part No. 1052942 or Equivalent)



86. Main Bearing Cap

F5901

Figure 29—Applying Sealer to the Rear Main Bearing Cap

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 0.21mm.

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 even a faulty insert can cause a lack of clearance at the bearing.

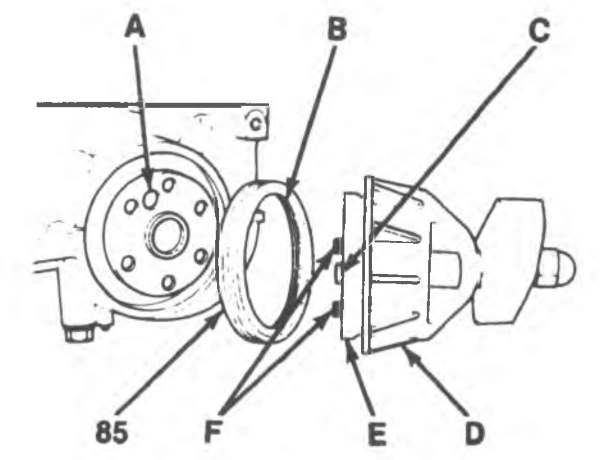
REAR CRANKSHAFT OIL SEAL INSTALLATION

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 mandrel 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 (35 in. 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.

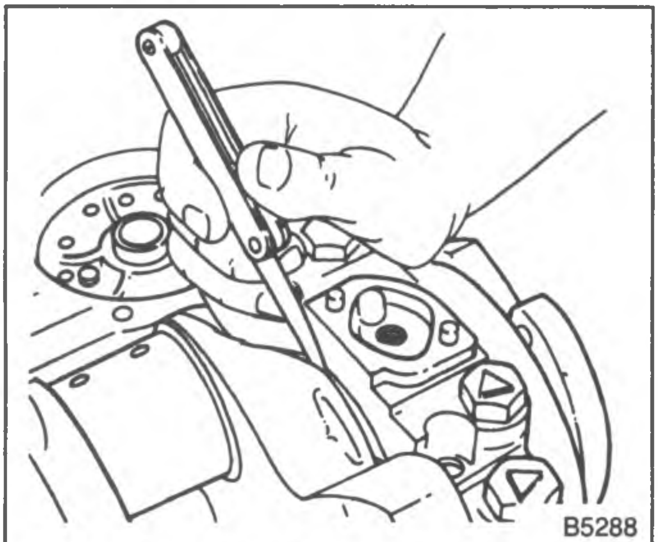
- Loosen the "T" handle until it comes to a stop.
- Remove the attaching screws.



A. Alignment Hole In Crankshaft
B. Dust Lip
C. Dowel Pin
D. Collar
E. Mandrel
F. Screws
85 Crankshaft Rear Oil Seal

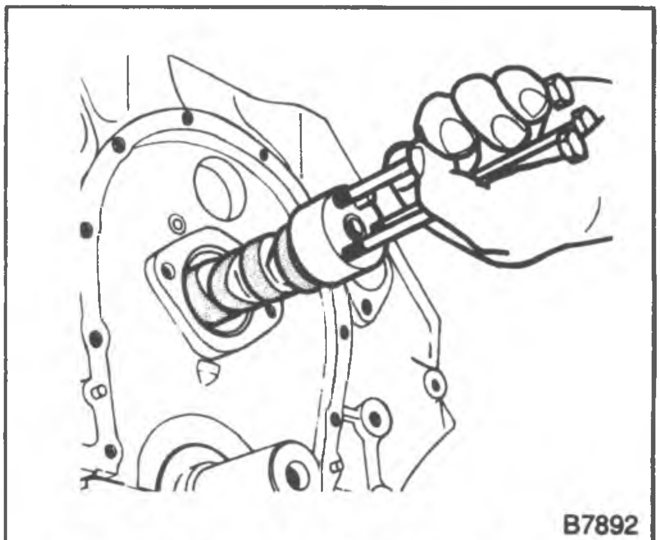
B7973

Figure 31—Installing the Crankshaft Oil Seal



B5288

Figure 30—Measuring Crankshaft End Play (Typical)



B7892

Figure 32—Replacing the Camshaft (Typical)

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 32 and 33)

NOTICE: All camshaft bearing journals are the same diameter. Care must be exercised in installing the camshaft to avoid bearing damage.

- 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 lifters, engine oil and filter.

1. Camshaft.
2. Timing chain onto the sprocket.
   - Lubricate the cam lobes or lifter feet 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 dowel 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 COOLANT PUMP INSTALLATION

Install or Connect

- Lubricate the lips of the front crankshaft oil seal with engine oil.

1. New gasket.
   - All sealing surfaces must be clean.
   - Take care not to damage the sealing surfaces.
   - Lightly coat both sides of the lower 5mm of the gasket with anaerobic sealant (GM Part No. 1052080 or equivalent).
2. Front cover.
3. Coolant pump.
4. Bolts and stud.

Tighten

- Bolts and stud to specifications. Refer to "Specifications" at the end of this section.

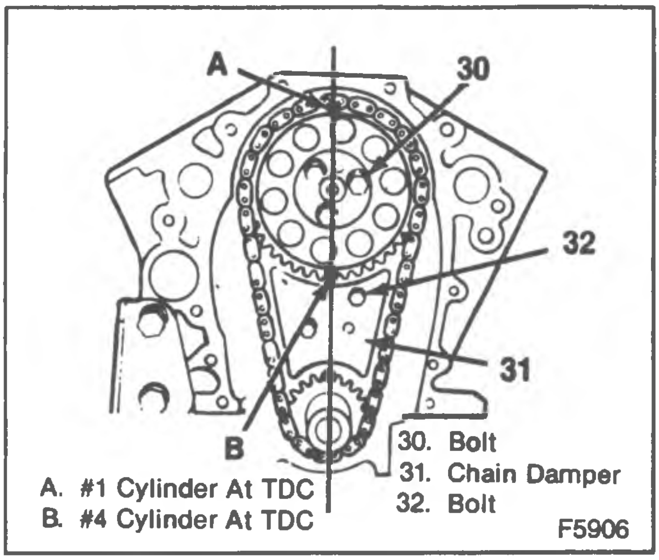


Figure 33—Camshaft Timing Marks

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 6mm (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 0.013mm and 0.026mm undersize for use with new and used standard size crankshafts.

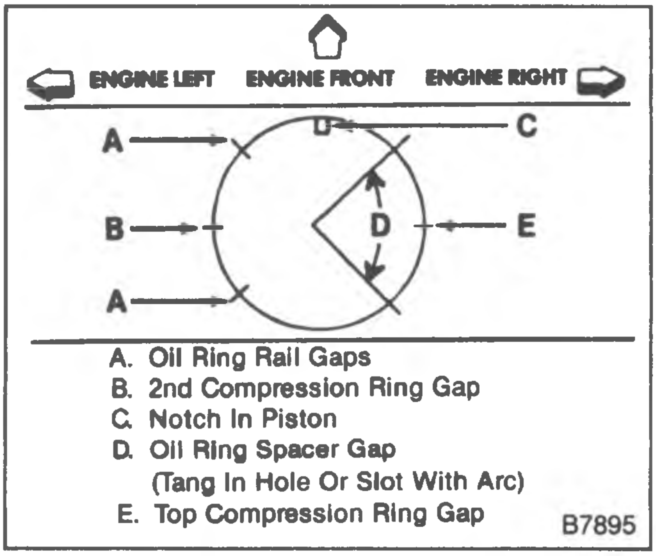


Figure 34—Piston Ring End Gap Locations

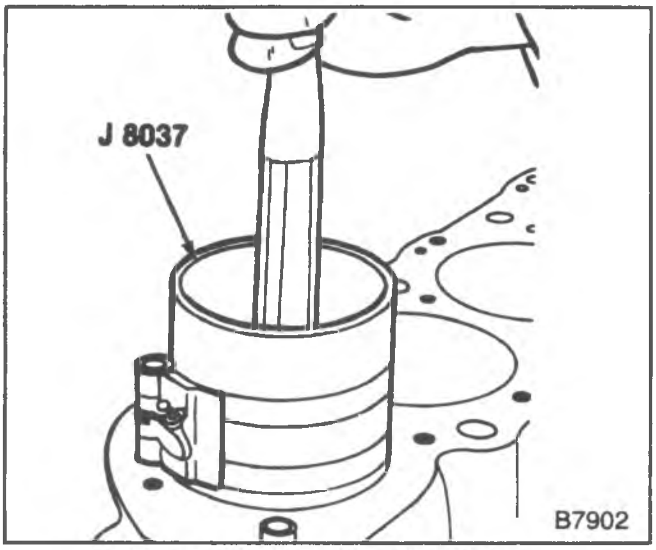


Figure 35—Installing the Piston

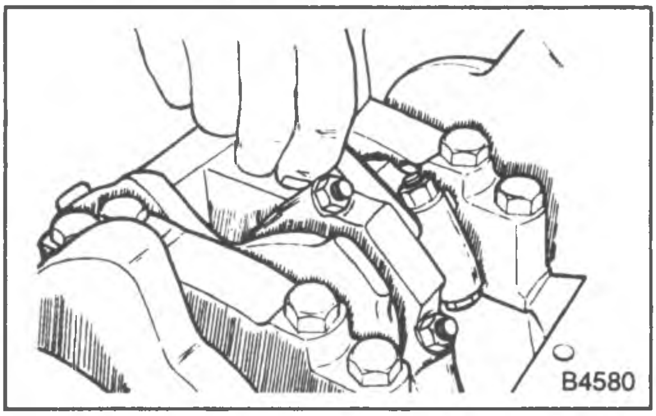


Figure 36—Measuring the Connecting Rod Side Clearance (Typical)

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 into the proper bore.
   - Install thread protectors 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.
   - 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 numbers on the connecting rod and bearing cap must be on the same bank when reinstalling them into the cylinder bore. If a connecting rod is ever moved 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). Clearance is 0.16 to 0.64mm.

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 (40) to 41 N.m (30 ft. lbs.).

OIL PAN INSTALLATION

Clean

- Sealing surfaces on the engine and oil pan.

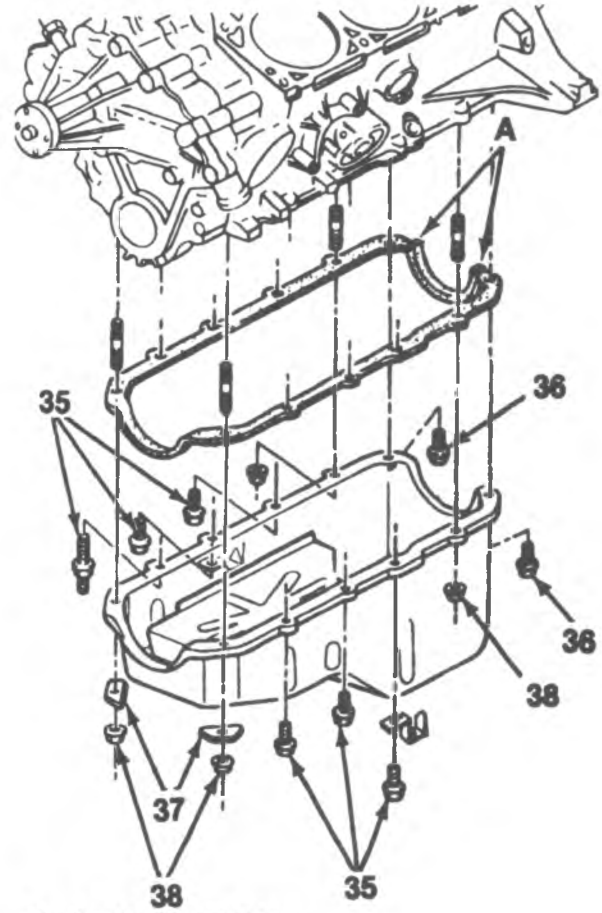
Install or Connect (Figure 38)

NOTICE: Before installing the oil pan, check to see that all 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

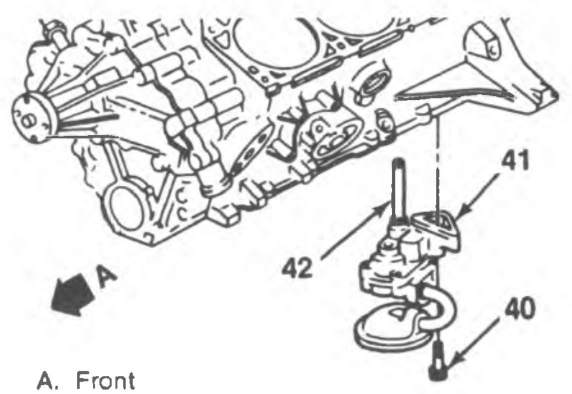
- Bolts (36) to 25 N.m (18 ft. lbs.).
- Bolts and studs (35) and nuts (38) to 10 N.m (7 ft. lbs.).



A. Apply Sealer Here
35. Bolts
36. Bolts
37. Reinforcements
38. Nuts

F5902

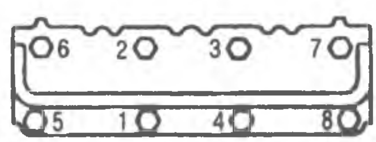
Figure 38—Oil Pan Installation



A. Front
40. Bolt
41. Oil Pump
42. Shaft

F6523

Figure 37—Oil Pump Installation



B9419

Figure 39—Cylinder Head Bolt Tightening Sequence

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.
   - Seat the gasket fully on the block before installing the cylinder head.
2. Cylinder head.
3. Head bolts.
   - Coat the bolt threads with sealing compound (GM part no. 1052080 or equivalent).
   - Install all bolts finger tight.

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).

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 when a new camshaft is installed.

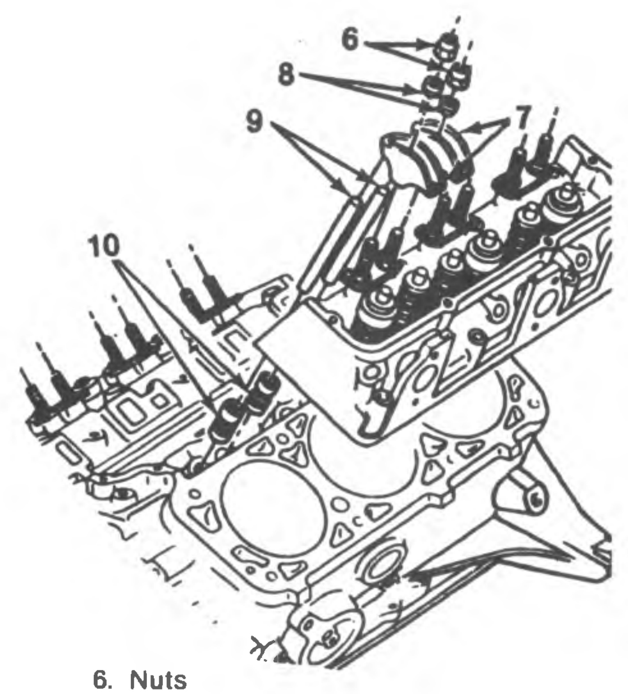
Install or Connect (Figure 40)

- Lubricate the hydraulic lifter bodies and lifter feet or camshaft lobes with Engine Oil Supplement (GM Part No. 1051396 or equivalent) or "Molykote".

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.

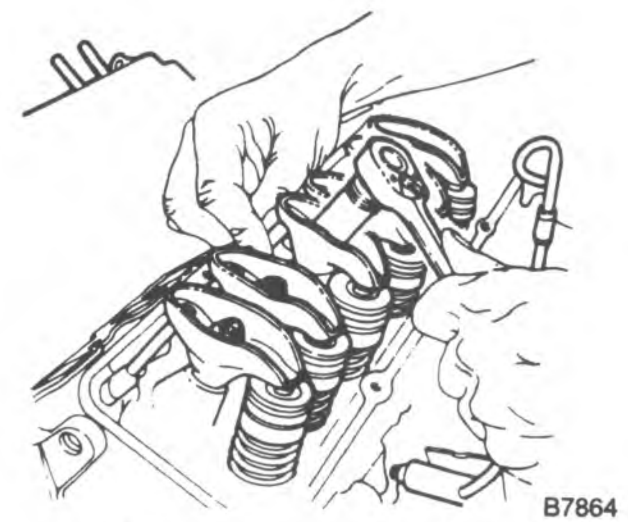
3. Rocker arms (7).
4. Balls (8).
5. Nuts (6).



6. Nuts
7. Rocker Arms
8. Balls
9. Push Rods
10. Lifters

B9315

Figure 40—Rocker Arms and Pushrods



B7864

Figure 41—Adjusting the Valves

VALVE ADJUSTMENT

1. Crank the engine until the mark on the torsional damper lines up with the "0" 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 "0" 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 "0" mark and vibration damper mark are again in alignment. This is the number four firing position and the following valves may be adjusted:

— Exhaust: 4, 5, 6
— Intake: 2, 3, 4

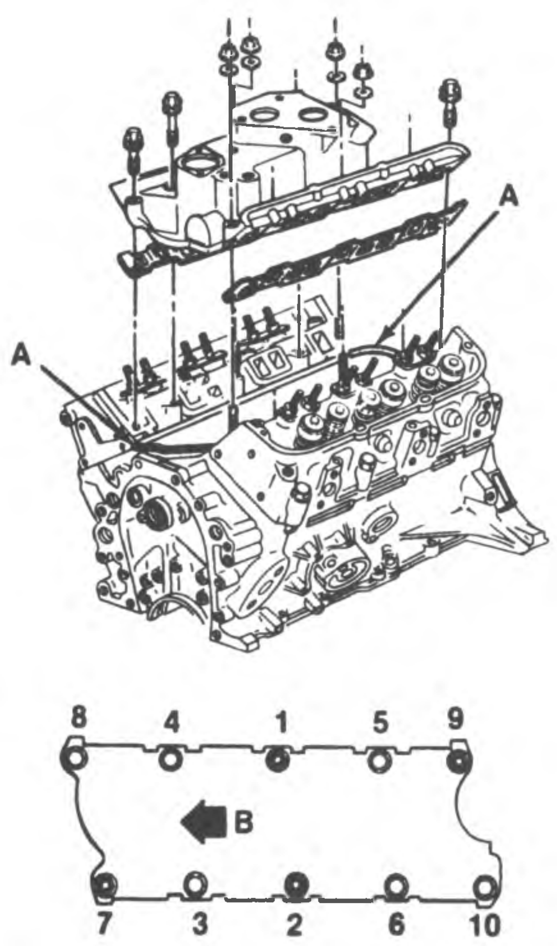


Figure 42—Intake Manifold Installation

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figure 42)

1. RTV to the front and rear sealing surfaces on the block. Apply a 5mm (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. Use them only as indicated to maintain design efficiency of the engine.
   • Hold the gaskets in place by extending the bead of RTV 6mm (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 31 N·m (23 ft. lbs.) in the sequence shown in figure 42.
   • Re-torque to 31 N·m (23 ft. lbs.) in the same sequence.

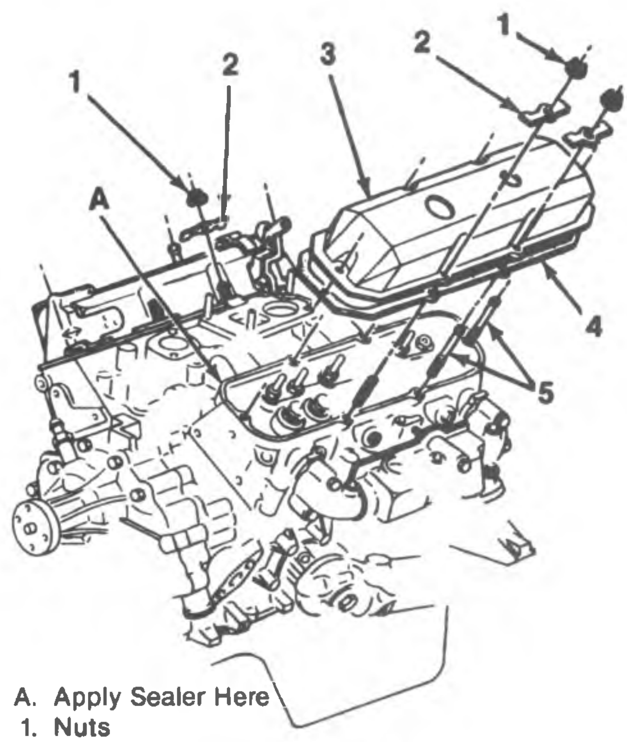


Figure 43—Rocker Arm Cover Installation

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 (3) and gasket (4).
   - 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 (1) and reinforcements (2).

Tighten

- Nuts to 8 N·m (70 in. lbs.).

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.).

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.

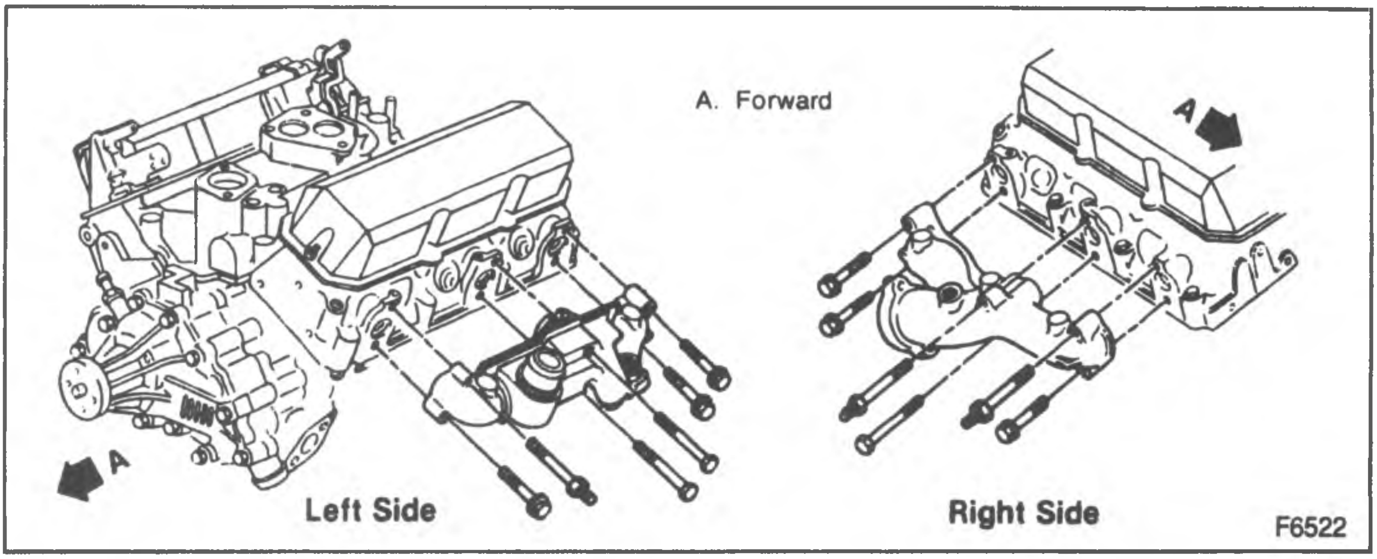


Figure 44—Exhaust Manifold Installation

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.
3. Install proper oil filter.

Important

- If a new camshaft or hydraulic lifters were installed, add Engine Oil Supplement (GM Part No. 1051396) or equivalent to the engine oil.

4. Fill the cooling system with the proper coolant conforming to GM-6038-M.
5. With the ignition "OFF" or disconnected, crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
6. Start the engine and listen for unusual noises.
7. Run the engine at about 1000 RPM until the engine is at operating temperature.
8. Listen for improperly adjusted valves or sticking lifters and other unusual noises.
9. Check for oil and coolant leaks while the engine is running.
10. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing.

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		0.27-1.25
PISTON PIN:			
Diameter			22.9937-23.0015
Clearance			0.0065-0.0091
Fit in Rod			0.0187-0.0515 (Press)

T2362

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in MILLIMETERS unless others 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			0.032-0.069
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			0.028-0.083
Rod Side Clearance			0.36-0.60
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		1-1/2 Turns Down from Zero Lash
	Exhaust		
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

T2363

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 Bolts		
10mm Bolt (4)	50	37
8mm Bolts (6)	30	22
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
Coolant Outlet Bolts	21	15
Coolant Pump Nut	10	7
Coolant Pump Bolt (M6 x 1.0)	10	7
Coolant 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

T2521

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

F4357

SECTION 6A3

4.3L V6 ENGINE (262 CID)

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

CONTENTS (cont'd)

DESCRIPTION

4.3L engines are 90-degree V6 type, overhead valves, coolant cooled, with cast iron block and cylinder heads.

There are also heavy duty (HD) and high output (HO) versions of this engine. The differences are internal and are covered in this section.

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 within the cylinder head on the light duty version and are a non serviceable press fit on the heavy duty version.

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 with a lower compression ratio on the heavy duty version. The piston pins are a floating fit in the piston.

For Engine Identification, refer to GENERAL INFORMATION (SECTION. 0A).

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 by-pass 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.

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 help aid with the work and help prevent personal injury or component damage.

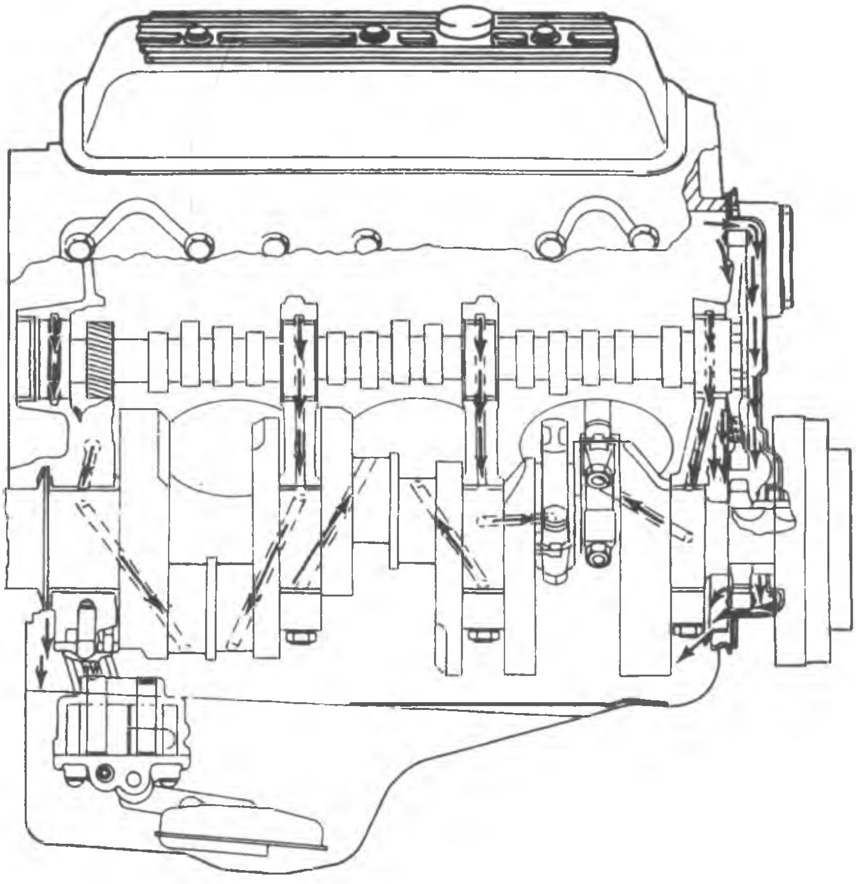


Figure 1—Engine Lubrication Diagram

Special tools are listed and illustrated throughout this section, with a complete listing at the end of the section. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special 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

The various procedures in this manual assume 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 cover in detail the many different accessory installations. Refer to the proper Truck Service Manual for this information.

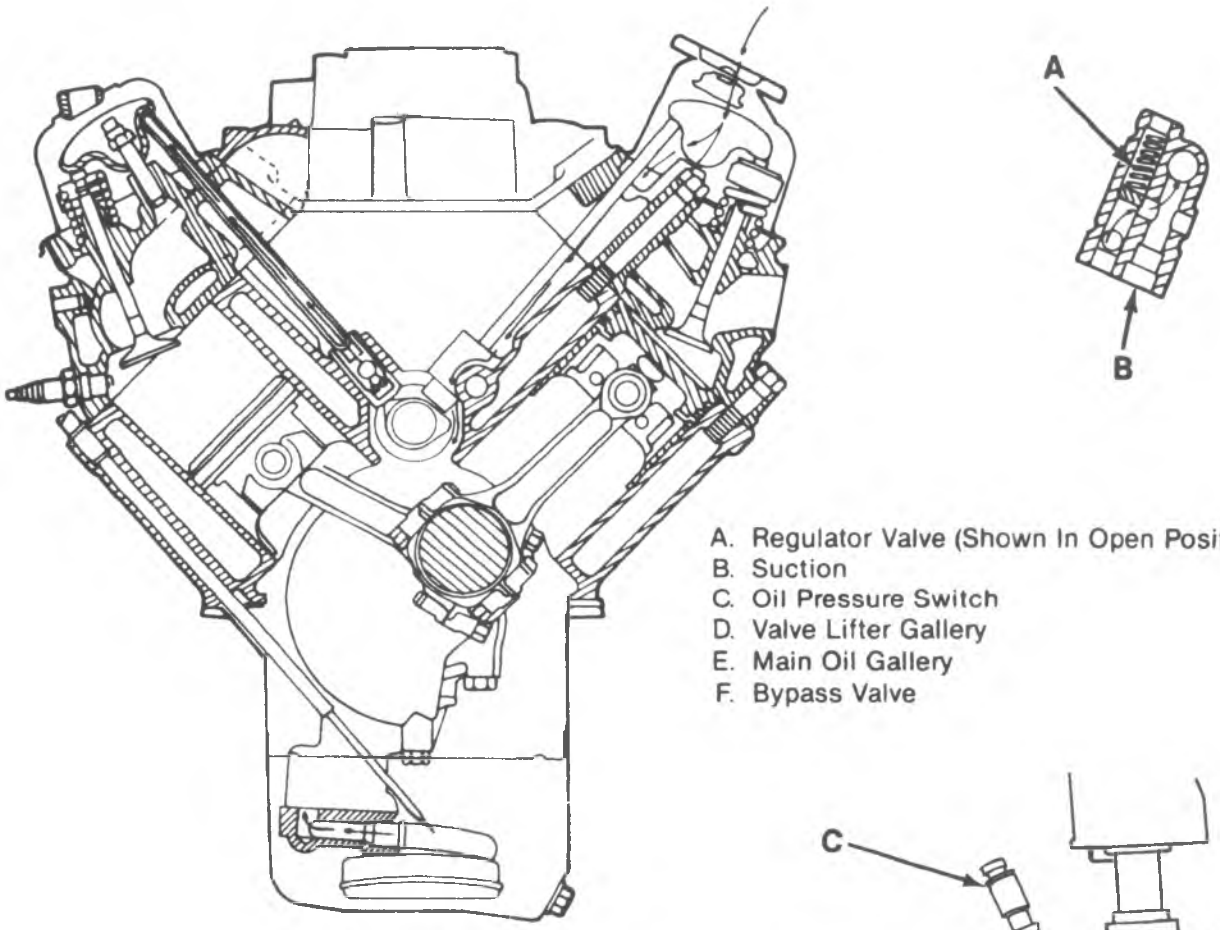
Diagrams of emissions and vacuum hose routings, wiring harness routing, accessory drive belt layout, etc. should be found before removing accessories.

CLEANING

Remove the engine accessories before cleaning, to provide better access to the engines exterior surfaces. After removing the TBI unit, distributor, etc., cover the openings with tape to prevent the entry of contaminants.

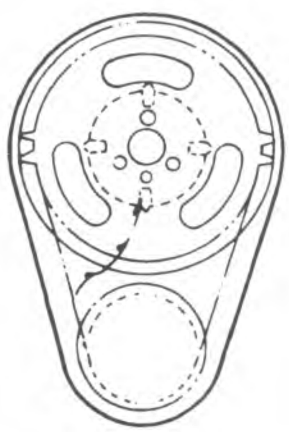
Methods used to clean the engine will depend on the means which are available. Steam cleaning, pressure washing or solvent cleaning are some of the acceptable methods. Allow the engine to dry thoroughly before beginning any work.

It is important that the engine be as clean as possible to prevent dirt, water or any other contaminants from entering critical areas during disassembly.

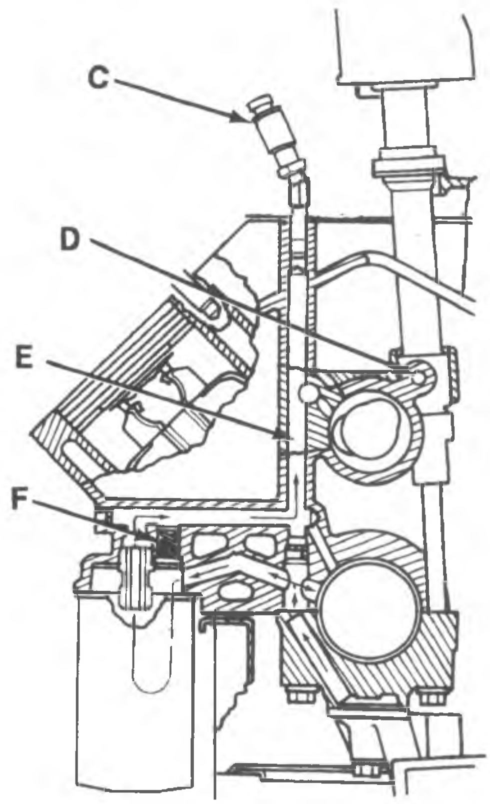


A. Regulator Valve (Shown In Open Position)
B. Suction
C. Oil Pressure Switch
D. Valve Lifter Gallery
E. Main Oil Gallery
F. Bypass Valve

Front View



Front View
Showing Path Of Oil To Timing Chain.



Rear View
Showing Main Gallery, Oil Filter And Crankshaft Oil Feed.

V0575

Figure 2—Engine Lubrication Diagram

DRAINING THE ENGINE

Remove or Disconnect

1. Oil pan drain plug and washer
   - Allow the oil to drain into a proper container.
2. Oil filter.
3. Coolant drain plug and or ESC Knock sensor from the block.
   - Allow the coolant to drain from the block into a proper container.

Install or Connect

1. Oil pan drain plug and washer.
2. Coolant drain plug and or ESC Knock sensor into the block.

Tighten

- Coolant drain plugs or ESC Knock sensor to 14 N·m (124 in. lbs.).

EGR VALVE REMOVAL

Remove or Disconnect

1. Bolts or nuts.
2. EGR valve
3. Gasket

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect

1. Exhaust manifold bolts, washers and tab washers.
2. Heat shields.
3. Exhaust manifold.

ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figure 3)

1. Rocker arm cover bolts (700).
2. Rocker arm covers (701).
3. Gaskets (702).

INTAKE MANIFOLD REMOVAL

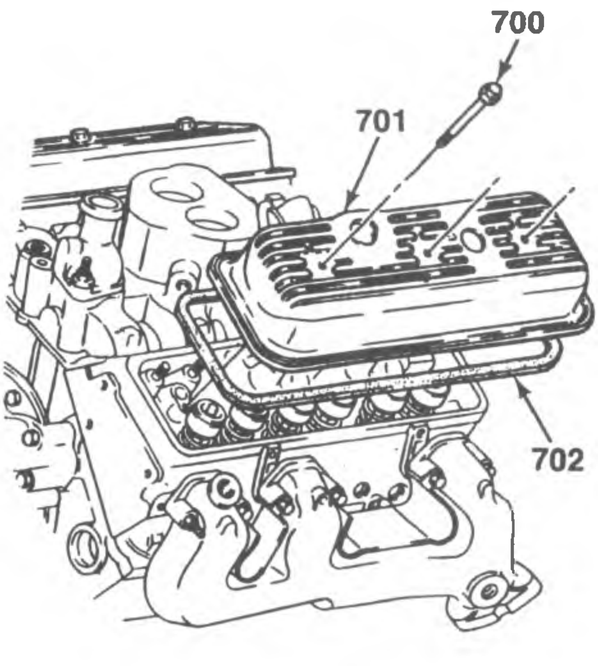
Remove or Disconnect

1. Intake manifold bolts.
2. Intake manifold.
3. Gaskets.

VALVE TRAIN COMPONENT REMOVAL

Important

- Store all reusable components in an exact order, so they can be reassembled in the same position from which they were removed.



700. Bolt
701. Rocker Arm Cover
702. Gasket

F5520

Figure 3—Rocker Arm Cover Removal

Remove or Disconnect (Figure 4)

1. Rocker arm nuts (42), balls (43) and rocker arms (44).
2. Push rods (45)
3. Bolts (40).
4. Retainer (41) with restrictors (46).
5. Hydraulic lifters (47).
   - Remove the lifters one at a time and place them in an organizer rack.

CYLINDER HEAD REMOVAL

Remove or Disconnect

1. Spark plugs.
2. Cylinder head bolts.
3. Cylinder heads.
4. Head gaskets.

TORSIONAL DAMPER REMOVAL

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The removal procedures must be followed (with the 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.

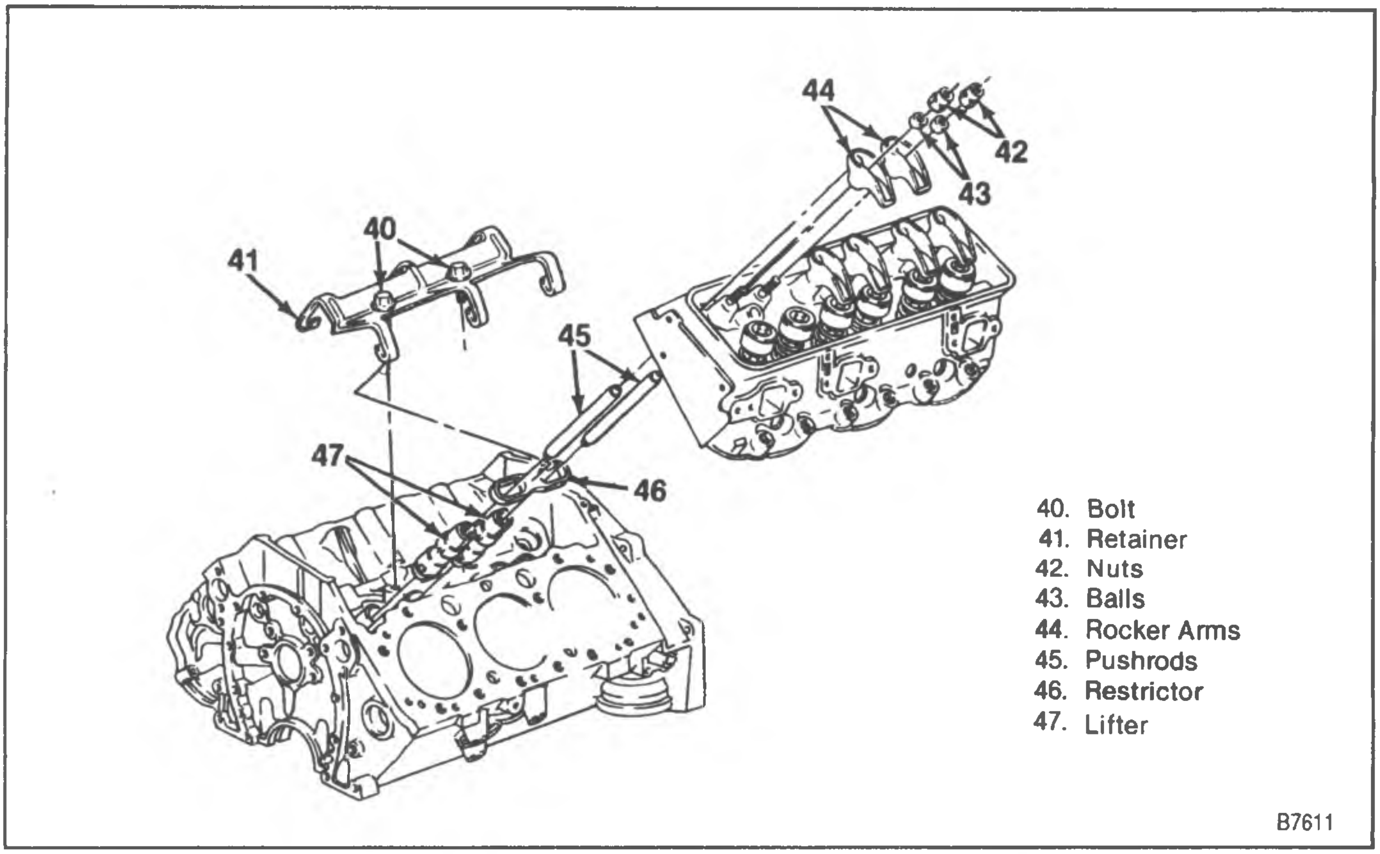


Figure 4—Valve Train Components

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 (figure 5).
3. Crankshaft key.

OIL PAN REMOVAL

Remove or Disconnect

1. Oil pan bolts and nuts.
2. Clips and reinforcements (71).
3. Oil pan.
4. Gasket (70).

OIL PUMP REMOVAL

Remove or Disconnect

1. Oil pump to main bearing cap bolt.
2. Complete oil pump assembly.
3. Shaft extension.

FRONT COVER REMOVAL

Remove or Disconnect

1. Front cover bolts.
2. Front cover.
3. Front cover gasket.

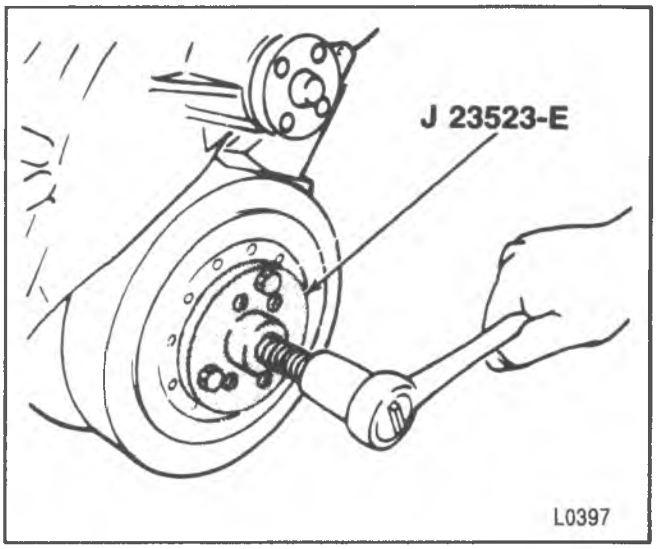


Figure 5—Removing the Torsional Damper

CAMSHAFT REMOVAL

Remove or Disconnect (Figures 7 through 9)

Tools Required:
J 5825-A Crankshaft Gear Puller

1. Camshaft sprocket bolts.
2. Camshaft sprocket and timing chain.
   - The sprocket has a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.

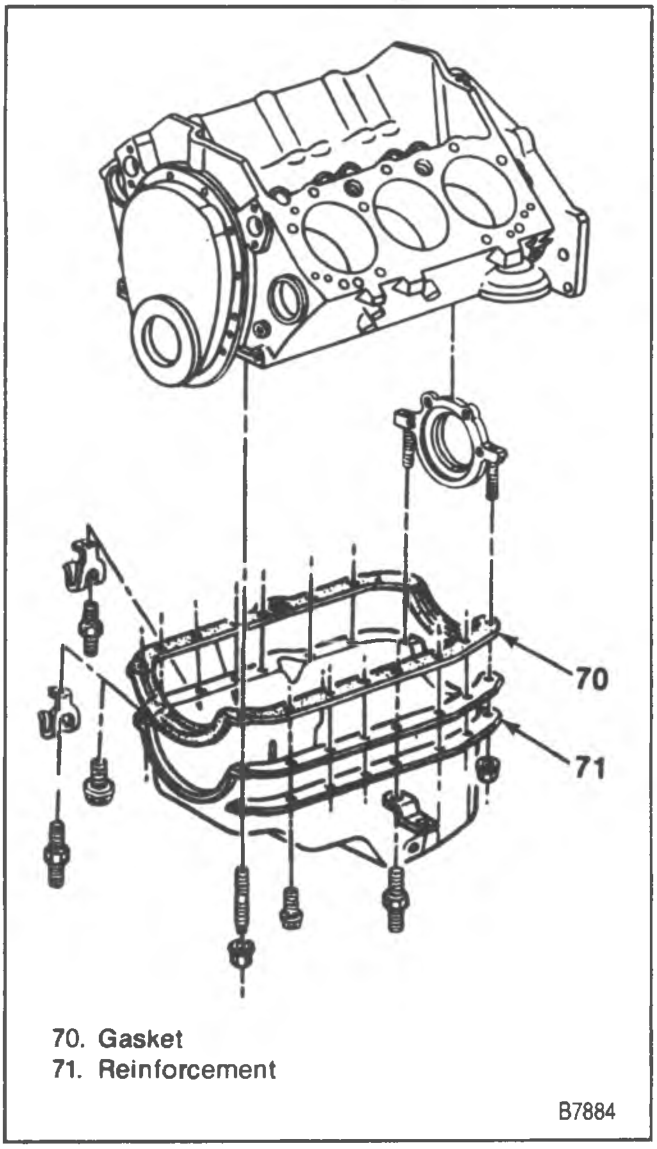


Figure 6—Oil Pan Removal

3. Crankshaft sprocket, if necessary. Use J 5825 (figure 9).
4. Screws (88) and thrust plate (87).
5. Camshaft.
   - Install three 5/16-18 inch bolts 100-125 mm (4-5 inches) long into the camshaft's threaded holes. Use these bolts to handle the camshaft (figure 8).
   - Use care to prevent damage to the camshaft bearings.
   - Pull the camshaft out from the block.

RIDGE REAMING

Clean (Figure 10)

Tool Required:
J 24270 Ridge Reamer

- Ridge or deposits from the upper end of the cylinder bores.
  a. Rotate the crankshaft until the piston is at BDC.
  b. Place a cloth on top of the piston.
  c. Perform the cutting operation with a J 24270 Ridge Reamer.
  d. Rotate the crankshaft until the piston is at TDC.
  e. Remove the cloth and cuttings.

PISTON AND CONNECTING ROD REMOVAL

Inspect

- The top of the cylinder for carbon build-up. Refer to "Ridge Reaming" if necessary.

Remove or Disconnect (Figure 11)

Tools Required:
J 5239 Guide Set

1. Mark the cylinder numbers on the tops of each piston.
   - Marking them from the front to the rear, with the engine in an upright position:
     — The left bank is numbered 1-3-5.
     — The right bank is numbered 2-4-6.

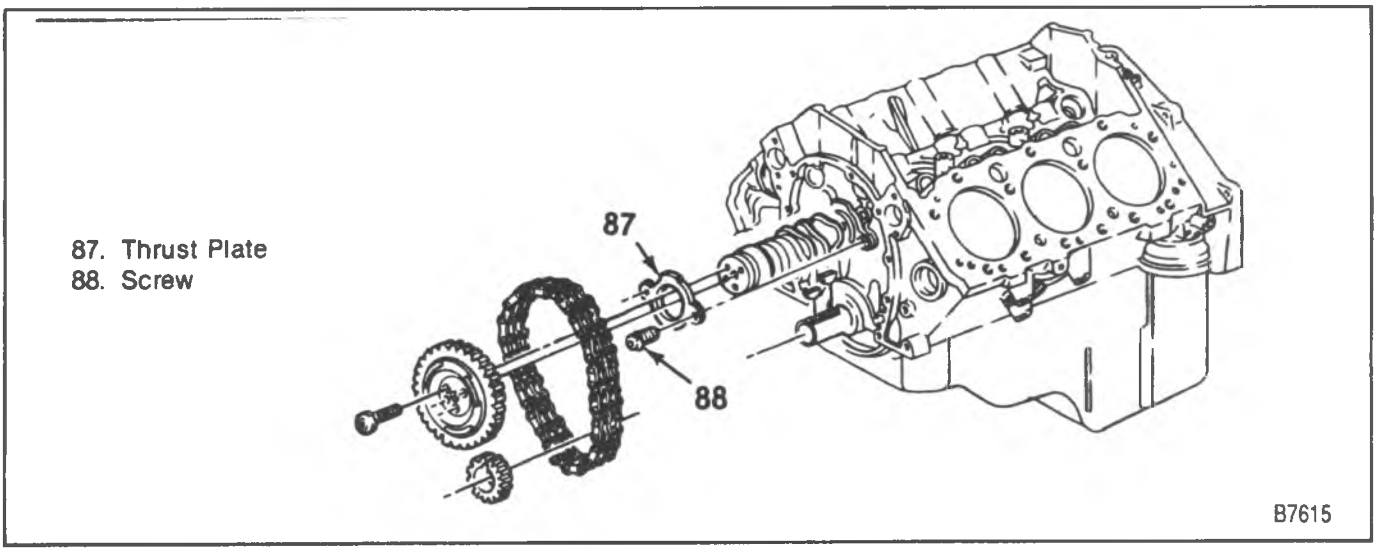


Figure 7—Camshaft and Components

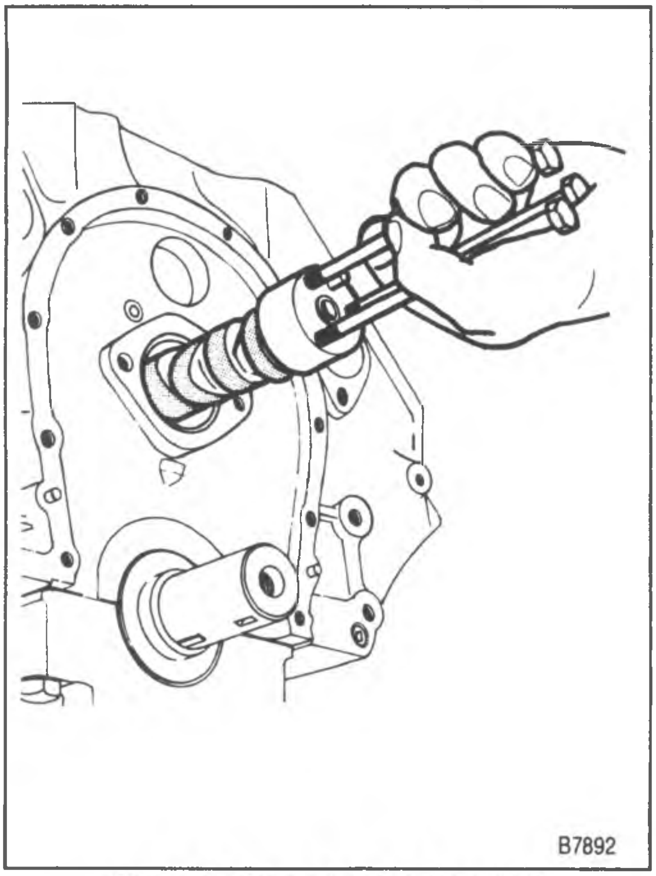


Figure 8—Removing the Camshaft

2. Check the connecting rod and cap for identification marks.
   - Mark the parts if required.
   - Marking them from the front to the rear, with the engine in an upright position:
     - —The left bank is numbered 1-3-5.
     - —The right bank is numbered 2-4-6.

Important

- Store the connecting rod and cap together as mating parts, so they may be reassembled in the same position from which they were removed.

3. Connecting rod cap.
4. Connecting rod and piston.
   - Attach J 5239 to the connecting rod bolts (figure 11).
   - Use the long guide rod of J 5239 to push the connecting rod and piston out of the bore through the top of the engine.
5. Connecting rod bearings.

FLYWHEEL REMOVAL

Remove or Disconnect

1. Flywheel bolts.
2. Flywheel.

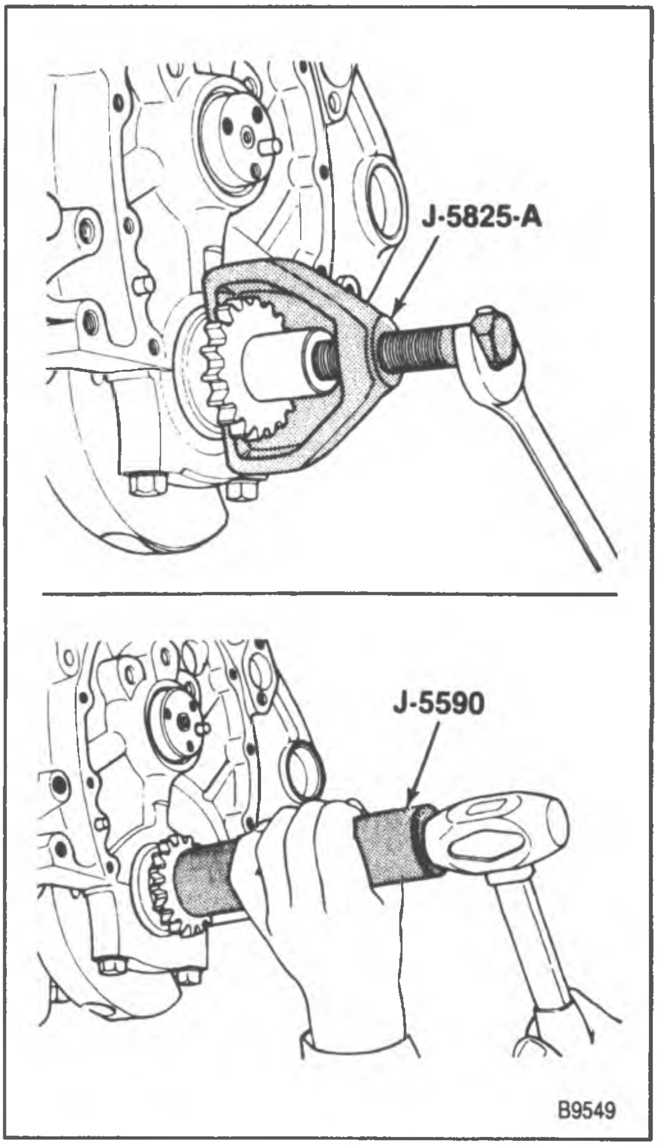


Figure 9—Removing the Crankshaft Sprocket

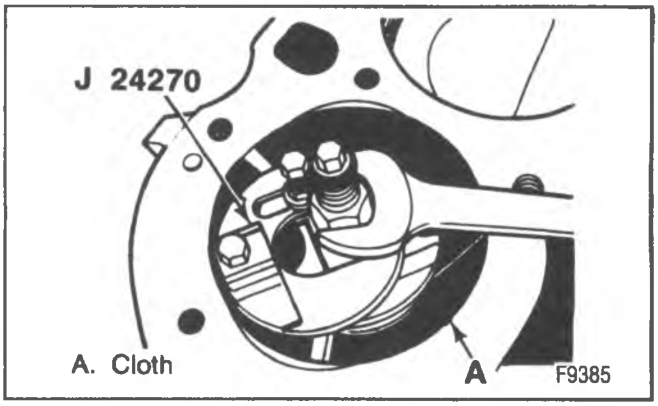


Figure 10—Removing the Cylinder Ridge

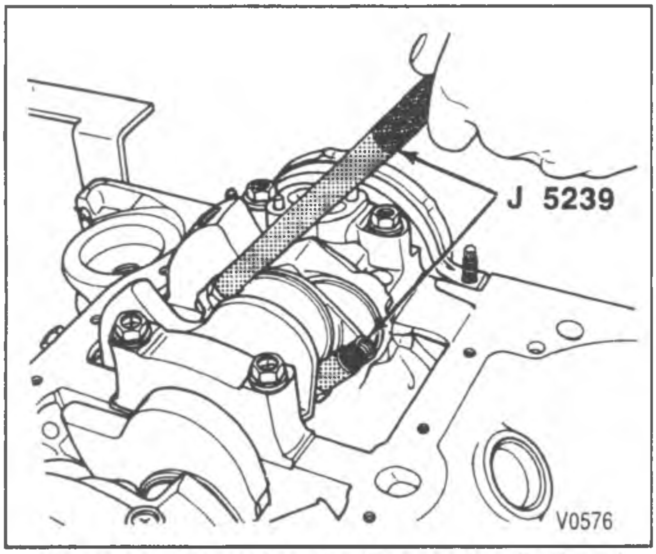


Figure 11—Removing the Connecting Rod and Piston

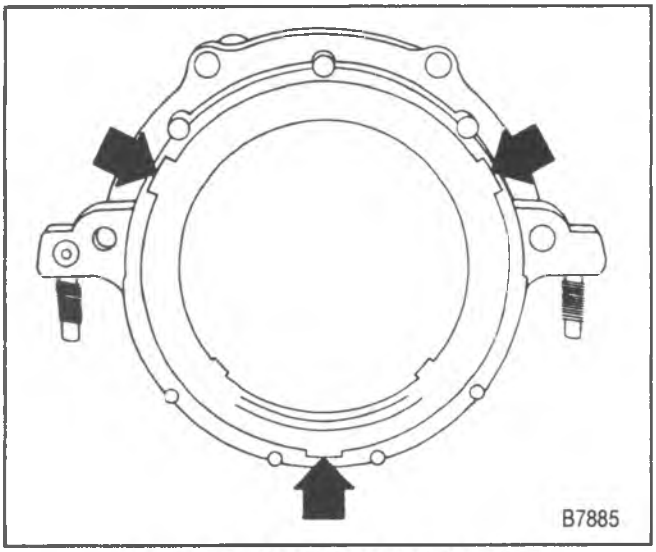


Figure 12—Seal Removal Notches

REAR CRANKSHAFT OIL SEAL REMOVAL

Remove or Disconnect (Figure 12)

NOTICE: Care should be taken when removing the rear crankshaft oil seal so as not to damage the crankshaft sealing surface. A minor scratch can cause a mojor oil leak.

Remove or Disconnect

- Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 12).

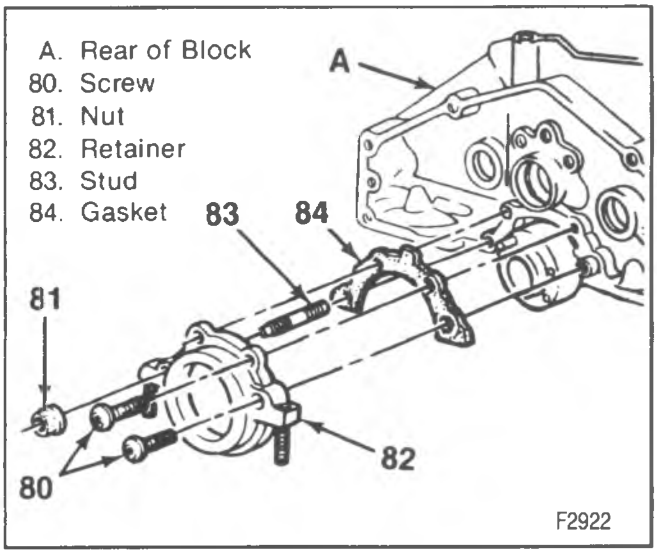


Figure 13—Rear Crankshaft Oil Seal Retainer

REAR CRANKSHAFT OIL SEAL RETAINER REMOVAL

Remove or Disconnect

1. Screws (80) and nuts (81).
2. Seal retainer (82).
3. Gasket (84).

CRANKSHAFT REMOVAL

Important

- Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.

Remove or Disconnect

1. Main bearing cap bolts
2. Main bearing caps and lower main bearing inserts.
3. Crankshaft from the cylinder block with extreme care, taking care to avoid damage to crankshaft journals and thrust flange surfaces.
4. Upper main bearing inserts.

MAIN BEARING REMOVAL (WITHOUT REMOVING CRANKSHAFT)

Important

- Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.

Remove or Disconnect (Figure 14)

Tool required:
J 8080 Main Bearing Remover/Installer

1. Main bearing cap bolts.
2. Main bearing caps.
3. Lower main bearing inserts from the main bearing caps.
4. Upper main bearing inserts.
   - Insert J 8080 into the crankshaft oil hole (figure 14).
   - Rotate the crankshaft to turn the upper main bearing insert out of the block.

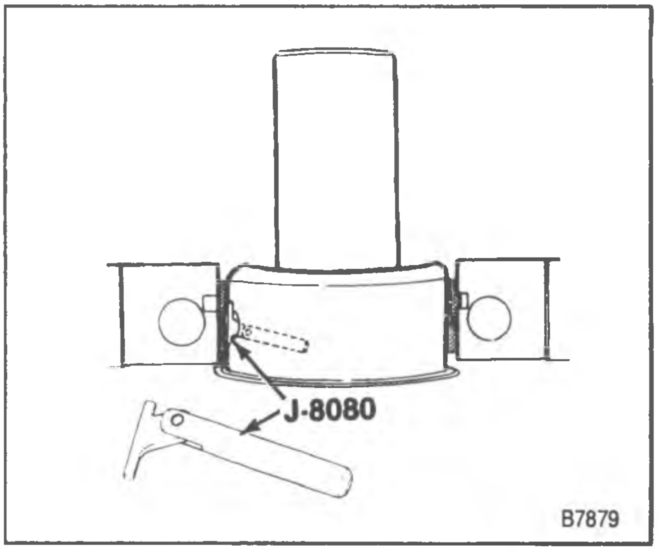


Figure 14—Removing the Main Bearing Insert

CLEANING, INSPECTION AND REPAIR

A solvent tank large enough to hold the larger engine parts will be needed, as well as various bristle brushes and gasket scrapers. A source of compressed air will also be helpful in the cleaning operations.

Special tools are listed and illustrated throughout this section, with a complete listing at the end of the section. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. They should not be used in operations for which they are not designed. These special tools when they are properly used, will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components. These include micrometers, torque wrenches, feeler gages, dial indicator set, etc. The inspection work, when performed with the proper methods and tools, is most important. The rebuilt engine cannot be expected to perform properly if the parts are worn beyond acceptable limits are reused.

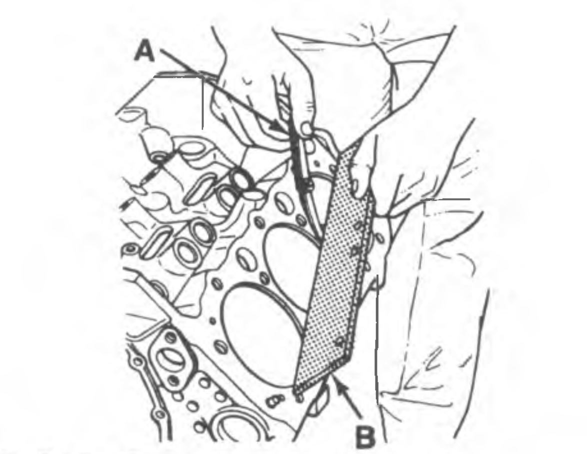
BLOCK

Clean

1. Block with solvent.
2. All traces of old gaskets.
3. Cylinder bores.
4. Threaded holes.
5. Oil galleries and passages.
6. Scale deposits from coolant passages.

Inspect

1. All expansion plugs for lack of fit or leakage.
2. Valve lifter bores for deep scratches and deposits.
3. Cracks in the block.
   — Cylinder walls.
   — Coolant jackets.
   — Engine mount bosses.
   — Main bearing webs.
4. Main bearing bores and caps.
   — All main bearing bores should be rounded and uniform in ID at all of the bearing supports.
   — The area were the main bearing inserts contact the main bearing bore should be smooth.
   — If a main bearing cap is found to be damaged, replace the cap and line bore the block.
5. Cylinder head mounting surface for flatness, using a precision straight edge and feeler gage.
   - Set the straight edge on the sealing surface to be inspected.
   - Take the feeler gage and at various locations, check the gap between the straight edge and the sealing surface.
   - If the gap is found to be greater than 0.25 mm (0.010-inch) at any sealing location, the block must be replaced.



A. Feeler Gage
B. Straight Edge
V0578

Figure 15—Inspecting The Block

- If the gap is found to be less than 0.25 mm (0.010-inch) at any sealing location and a cause for leakage is suspected, then the minor irregularities may be carefully machined from the block.

6. Oil pan, timing cover and intake manifold mounting surfaces 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 (SECTION 6A).

Cylinder Bore Reconditioning

Refer to GENERAL ENGINE MECHANICAL (SECTION 6A).

PISTON AND CONNECTING ROD ASSEMBLY

Notice: The connecting rod and cap need to be stored together as mating parts, so they may be reassembled in the same position from which they were removed.

Refer to GENERAL ENGINE MECHANICAL (SECTION 6A) and perform the following:

- Disassembly.
- Cleaning.
- Inspection.
- Measuring.
  - — Piston pin diameter and clearance.
  - — Piston to bore clearance and fit of pistons.
  - — Ring end gap and ring clearances.
  - — Ring fit.

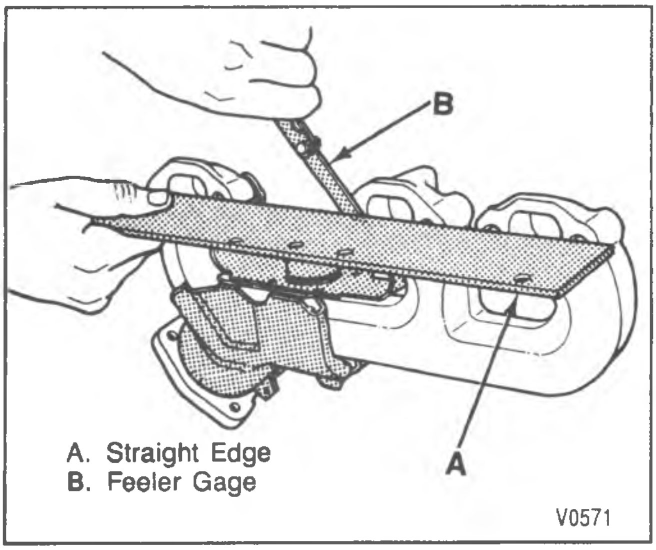


Figure 16—Checking Alignment of Manifold Flanges

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 16)

- Manifolds for cracks, broken flanges and gasket surface damage.
- 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 diameters (figure 17). Refer to "Specifications" in the back of this section for proper diameters.

CAMSHAFT BEARINGS

Refer to GENERAL ENGINE MECHANICAL (SECTION 6A) for replacement procedures.

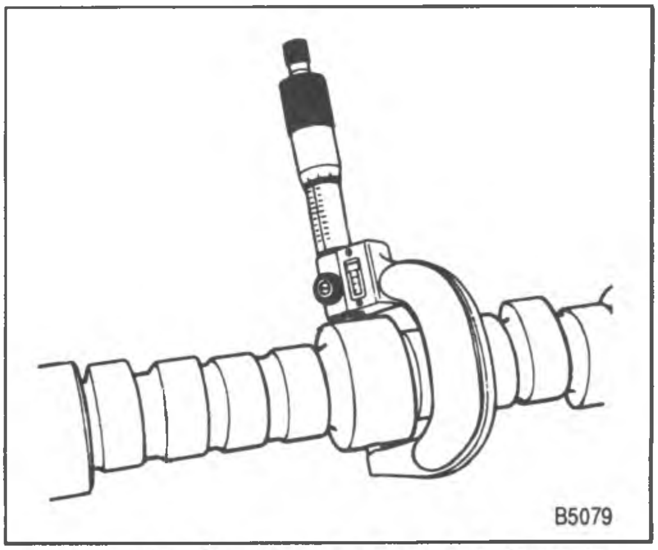


Figure 17—Checking the Camshaft Journals

TIMING CHAIN AND SPROCKETS

Inspect

- Sprockets for chipped teeth and wear.
- Timing chain for damage.
- Excessively worn sprockets will rapidly wear a new chain.
- An excessively worn chain will rapidly wear a new set of sprockets.

CRANKSHAFT SPROCKET REPLACEMENT

Remove or Disconnect (Figure 18)

Tool Required:
J 5825-A Crankshaft Sprocket Puller

1. Crankshaft sprocket using J 5825-A.
2. Key (if necessary).

Install or Connect (Figure 18)

Tool Required:
J 5590 Crankshaft Sprocket Installer

1. Key (if removed).
2. Crankshaft sprocket using J 5590.

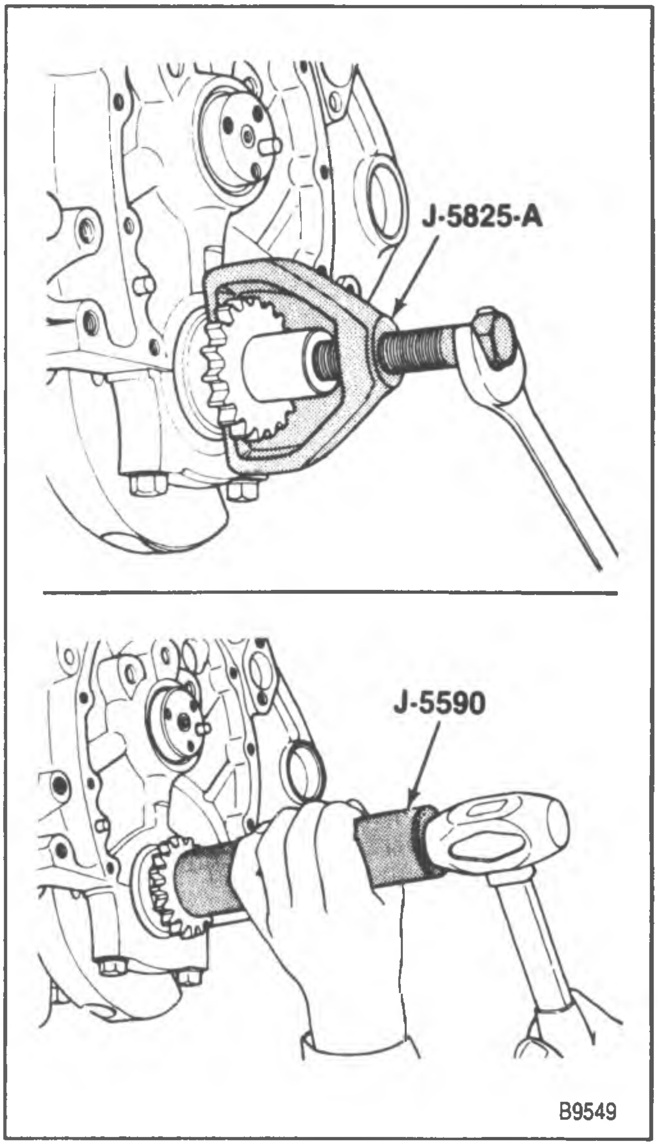


Figure 18—Replacing the Crankshaft Sprocket

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 screwdriver.
  - — 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.
  - — Support the cover at the seal area.
  - — Drive the seal into position with J 35468.
- Lubricate the seal with engine oil before installing the torsional damper.

COOLANT PUMP

Clean

- Old gasket from the gasket surface.

Notice: Do not immerse the pump in solvent. The solvent may enter the pump's permanently lubricated bearings and cause premature bearing failure.

Inspect

- Coolant pump shaft for roughness and end play. If the shaft does not turn smoothly or if there is excessive end play, replace the coolant pump.
- Coolant pump body at the weep hole. If there is evidence of coolant leakage, the coolant pump shaft seal is leaking and the coolant 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.

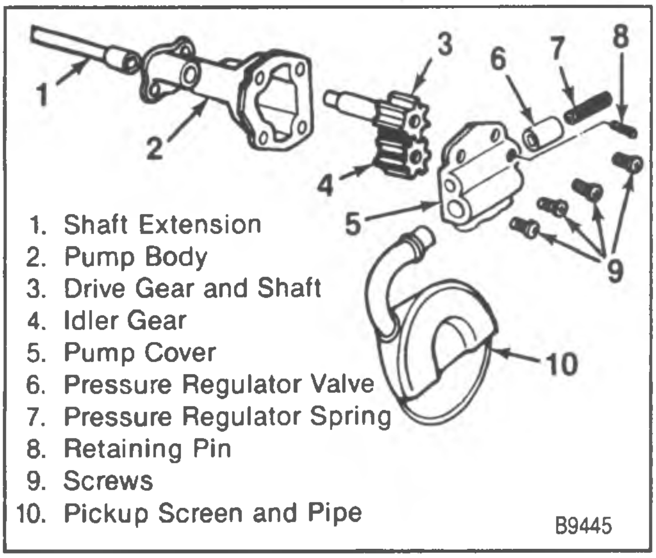


Figure 19—Oil Pump Components

- 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 19)

1. Shaft extension (1).
   - Do not remove the pickup pipe and screen unless replacement is required.
   - The pickup pipe has a press fit in to the pump cover.
   - Do not remove the screen from the pipe. The pick-up screen and pipe are serviced as a complete assembly only.
2. Pickup pipe and screen.
3. Screws (9).
4. Pump cover (5).
   - Mark where the idler gear (4) and drive gear (3) mesh together, so they can be reinstalled with the same gear teeth indexed.
5. Idler gear (4) and drive gear (3).
6. Retaining pin (8).
7. Pressure regulator spring (7)
8. Pressure regulator valve (6).

Clean

- All parts in clean solvent and dry them with compressed air.

Inspect (Figure 19)

- Pump body (2) for cracks, wear or other damage.
- Inside of the cover (5) for cracks and wear that would permit oil to leak past the ends of the gears.
- Gears (3 and 4) for wear.
- Drive gear and shaft (3) for lack of fit in the pump body (2).
- The pump gears, cover and body are not serviced separately. If any of the parts are damaged or worn, the entire oil pump assembly must be replaced.
- Pickup screen and pipe (10) for damage to the screen or loose fit of the pipe.
- Pressure regulator valve (6) for fit. The regulator valve should slide freely in its bore without sticking or binding.

Install or Connect (Figures 19 and 20)

Tool Required:
J 21882 Pickup Tube and Screen Installer

1. Pressure regulator valve (6) into the pump cover.
2. Pressure regulator spring (7) into the pump cover.
3. Retaining pin (8) into the pump cover.
4. Drive gear and shaft (3) into the pump body.
5. Idler gear (4) into the pump body.
   - Match together the index marks on the two gears made during disassembly.
6. Pump cover (5).
7. Screws (9).

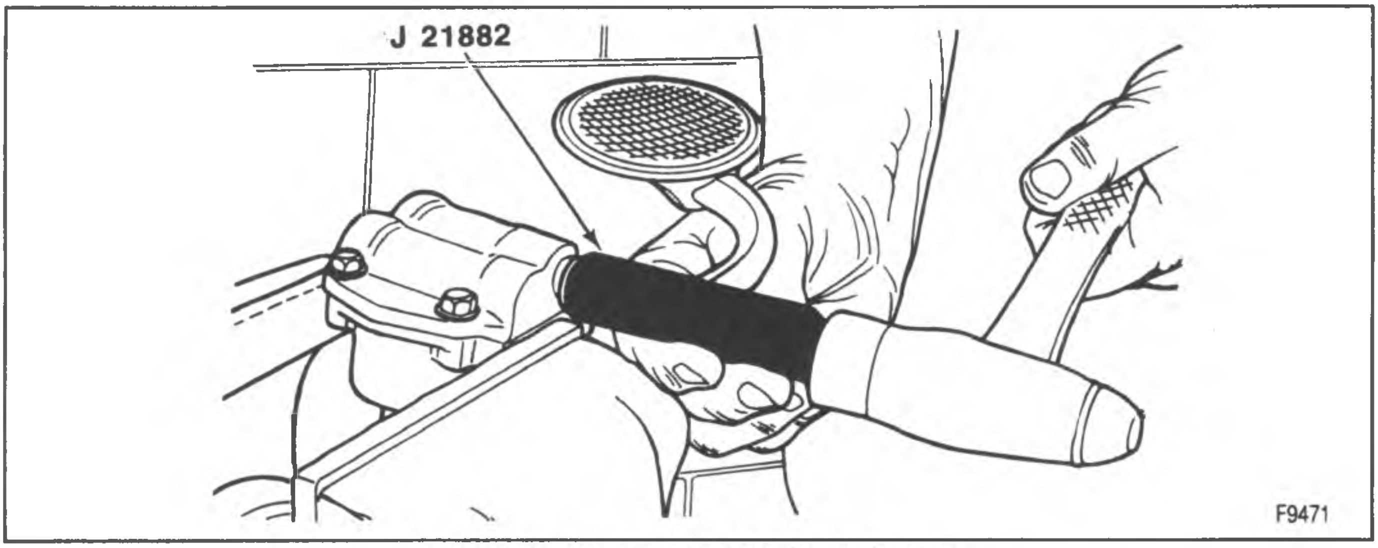


Figure 20—Installing the Oil Pump Screen

Tighten

— Screws (9) to 5.0 N·m (84 in. lbs.).
- With the shaft extension (1) installed on the pump, turn the drive shaft by hand to check for smooth operation.

NOTICE: Be careful of twisting, shearing or collapsing the pipe when installing it to the pump. A damaged pipe can cause lack of lubrication and engine failure.

8. Pickup screen and pipe.
   - 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.
9. Oil pump drive shaft and connector (1).

VALVE TRAIN COMPONENTS

Important

- Store all reusable components in an exact order, so they may be reassembled in the same position from which they were removed.

PUSHRODS, ROCKER ARMS, BALLS AND NUTS

Clean

- All parts in clean solvent and dry them with compressed air.
- Make sure the oil passages through the pushrods are clear.

Inspect

- Rocker arms and balls at their mating surfaces. These surfaces should be free from wear or damage.
- Rocker arm areas that contact the valve stems and the socket areas that contact the ends of the pushrods. These areas should be free of wear or damage.
- Rocker arm nuts.
- Pushrod ends for scoring, roughness or bends.
  — Roll the pushrod on a flat surface to determine its straightness. If the rod is bent, the rod will not roll freely. Replace if necessary.

HYDRAULIC LIFTERS

The type of hydraulic lifters used in this engine are the roller type.

Hydraulic lifters are serviced only as an assembly. **No internal parts are available.** Service is limited to a disassembly and cleaning. It is understood that most technicians discard any suspicious valve lifters. The

20. Valve Keeper
21. Cap
22. Shield
23. O-Ring Seal
24. Seal
25. Damper
26. Spring
27. Intake Valve
28. Rotator
29. Exhaust Valve

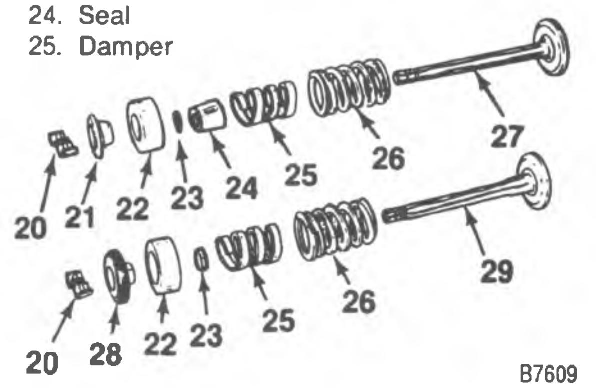


Figure 21—Valve and Components

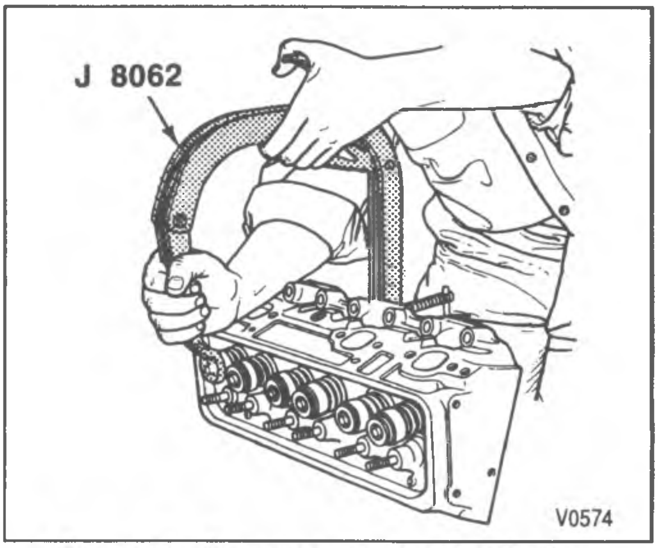


Figure 22—Compressing the Valve Springs

information in GENERAL ENGINE MECHANICAL (SECTION 6A), is offered for those who may wish to clean and inspect the valve lifters.

Important

- Whenever the camshaft needs to be replaced, a new set of hydraulic lifters must also be installed.

CYLINDER HEAD

Cylinder head disassembly is covered in this procedure. Refer to GENERAL ENGINE MECHANICAL (SECTION 6A) for information regarding the following:
- Cleaning
- Inspection
- Measuring clearances
- Valve grinding
- Valve guide reconditioning

Remove or Disconnect (Figures 21 and 22)

Tool Required:
J 8062 Valve Spring Compressor

1. Valve keepers (20).
   - Compress the springs with J 8062 (figure 22).
   - Remove the keepers.
   - Remove J 8062.
2. Intake valve components (figure 21).
   - Cap (21)
   - Shield (22)
   - Seal (24)
   - Damper (25)
   - Spring (26)
3. Exhaust valve components (figure 21).
   - Rotator (28)

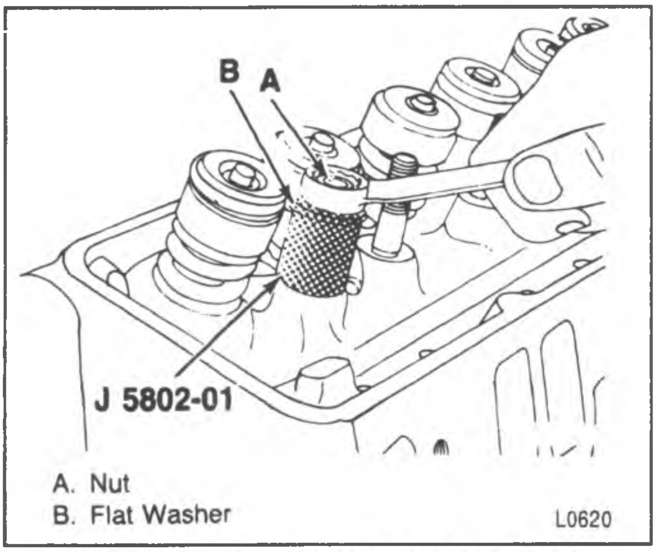


Figure 23—Removing Rocker Arm Stud

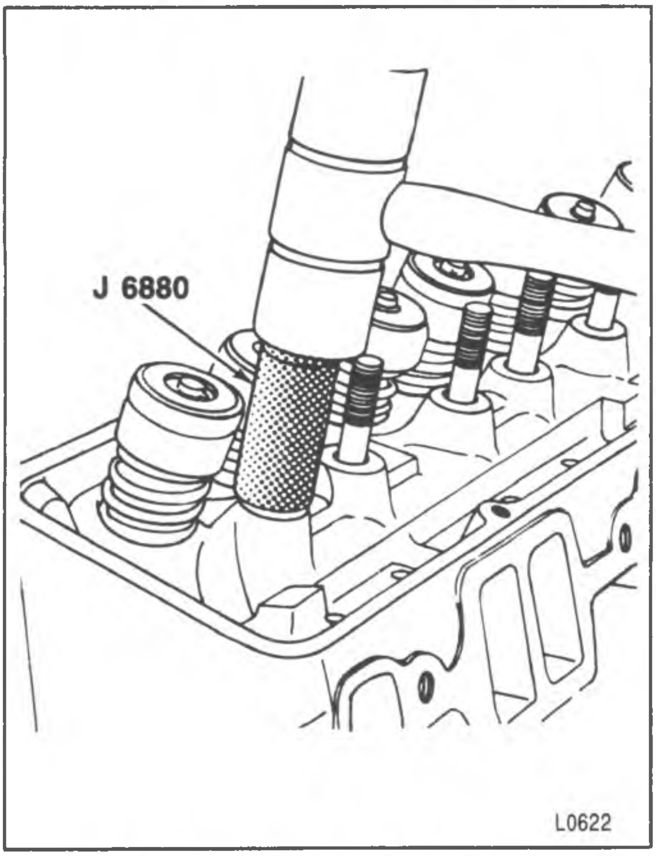


Figure 24—Installing the Rocker Arm Stud

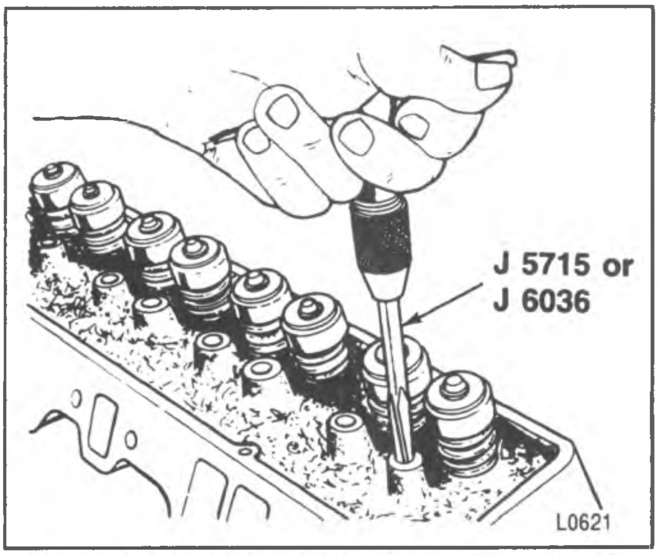


Figure 25—Reaming the Rocker Arm Stud Bore

   - Shield (22)
   - Seal (24)
   - Damper (25)
   - Spring (26)
4. O-ring seals (23).
5. Valves (27 and 29).
   - Place the valves in an organizer rack so they can be replaced in their original position at reassembly.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect (Figure 23)

Tool Required:
J 5802-01 Rocker Arm Stud Remover

- 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 24)

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 (figure 25).
  - — J 5715 for 0.003-inch oversize studs.
  - — J 6036 for 0.013-inch oversize studs.
- Lightly lubricate lower end (press-fit area) of rocker arm stud with hypoid axle lubricant.
- Rocker arm stud.
  - — Use J 6880 (figure 24).
  - — Stud is installed to proper depth when the tool bottoms on the cylinder head.

ASSEMBLY

Install or Connect (Figures 21, 22 and 26)

Tools Required:
J 8062 Valve Spring Compressor
J 23738-A Vacuum Pump

1. Valves (27 and 29).
   - Lubricate the valve stems with engine oil.
   - Insert the valves into the proper valve guides until the face of the valve contacts the valve seat.
2. Seal (24) (intake valves only).
   - Install the seal (24) over the valve stem (27).
   - Hold the valve (27) against The valve seat.
   - Push the seal (24) down the valve stem (27) until it bottoms out against the head.
3. Springs (26) and dampers (25).
4. Shields (22).
5. Cap (21) or rotator (28).
   - Compress the valve spring using J 8062 (figure 22), enough so the lower valve stem groove can be seen clearly.
6. O-ring seal (23) onto the valve stem's lower groove, making sure the seal is flat and not twisted.
7. Apply a small amount of grease to the area of the upper valve stem groove.
8. Assemble the two valve keepers into the upper groove using the grease to hold them in place.
   - Release the compressor tool J 8062, making sure the valve keepers stay in place.
9. Repeat the preceding steps on the remaining valves.

Inspect

- O-ring seals 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.
  - Repeat the preceding steps on the remaining valves.

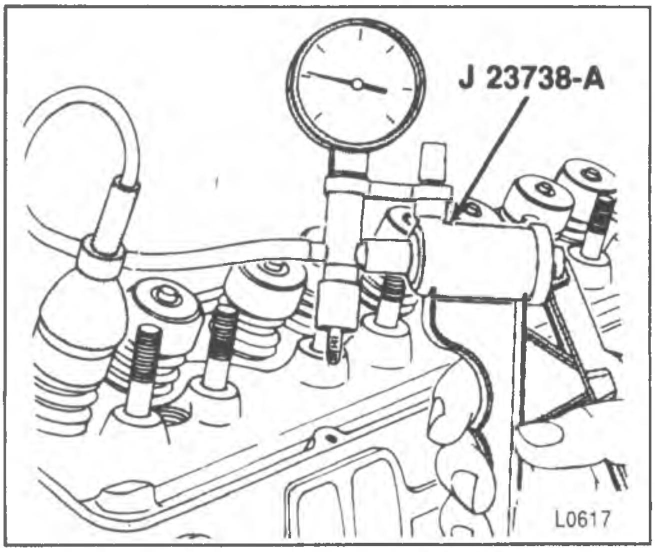


Figure 26—Checking the Valve Seals

Measure

- Valve spring installed height of each spring as follows.

1. Use a narrow thin scale. A cutaway scale may be helpful.
2. 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 COOLANT OUTLET

Remove or Disconnect

1. Bolts.
2. Coolant outlet.
3. Gasket.
4. Thermostat.

Inspect

- Coolant outlet for cracks.

Install or Connect

1. Thermostat.
2. New gasket.
3. Coolant outlet.
4. Bolts.

Tighten

- Bolts to 28 N·m (21 ft. lbs.).

CRANKSHAFT AND BEARINGS

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.

Clean

- Crankshaft with solvent.
  —Do not scratch the bearing journals.
  —Remove all sludge from the oil passages with compressed air.
- Main bearing inserts.
  —Wipe free of oil with a soft cloth.

Inspect

In general, the lower inserts (except the #1 bearing), shows the greatest wear and distress from fatigue. Upon inspection, if the lower insert is suitable for reuse, 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.

- Main bearing inserts for scoring or other damage.
- 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.

Measure

- Main bearing and connecting rod journal diameters (figure 27). Compare with "Specifications."
- Main bearing and connecting rod journals for taper and out-of-round.
  - — Maximum journal taper is 0.001-inch.
  - — Maximum out-of-round is 0.002-inch.
- 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. The main bearings must also be replaced at the same time.
- Grind or replace the crankshaft if necessary.

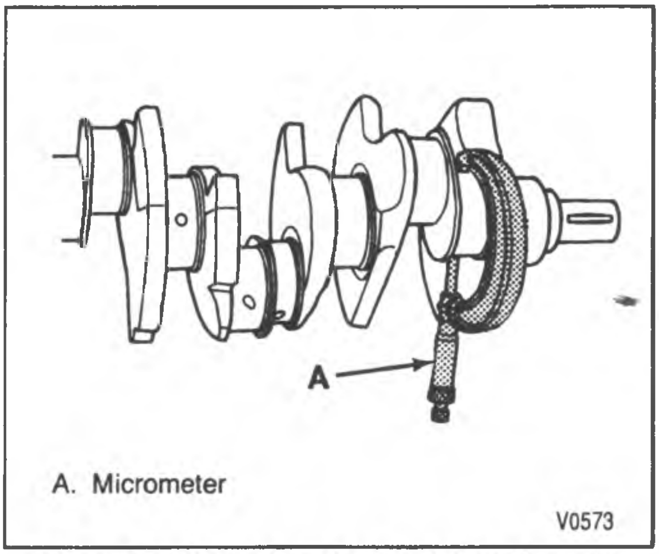


Figure 27—Measuring the Crankshaft Journals

ASSEMBLY

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 otherwise specified) 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, both upper and lower bearing 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.

INSPECTING CRANKSHAFT END PLAY

Remove or Disconnect

1. Upper main bearing inserts to the block.

   Important

   - If any undersized bearings are used, they must be 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 (SECTION 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 (except rear cap) to 100 N·m (75 ft. lbs.).
5. Rear main bearing cap.
6. Rear main bearing cap bolts.

   Tighten

   - Rear main bearing cap bolts to 14 N·m (124 in. lbs.).

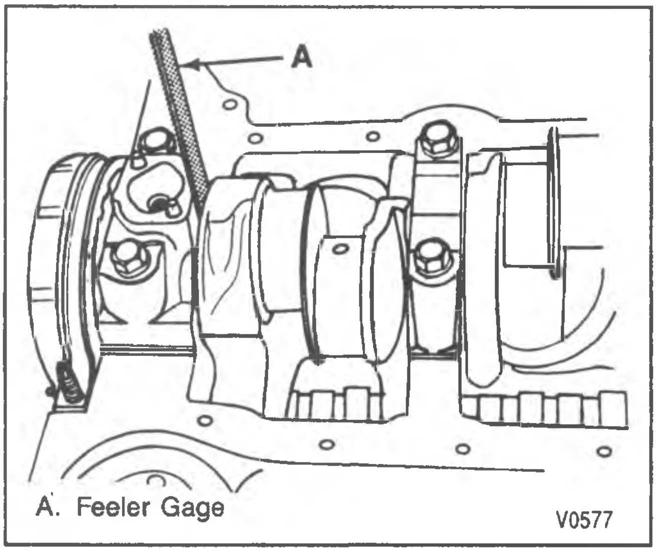


Figure 28—Measuring Crankshaft End Play

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 100 N·m (75 ft. lbs.).

Measure

- — With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 28). The proper clearance is 0.002 to 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.

Tighten

- All main bearing cap bolts to 100 N·m (75 ft.lbs.).

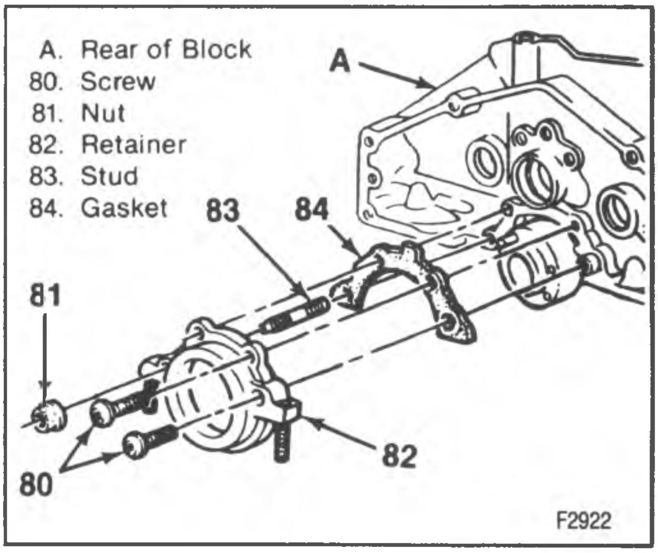


Figure 29—Rear Crankshaft Oil Seal Retainer Installation

REAR CRANKSHAFT OIL SEAL RETAINER INSTALLATION

Clean

- Gasket surfaces on the block and seal retainer.

Install or Connect (Figure 29)

1. New gasket (84) to the block.
   - It is not necessary to use sealant to hold the gasket in place.
2. Seal retainer (82).
3. Screws (80) and nuts (81).

Tighten

- — Screws and nuts to 15 N·m (135 in. lbs.).

REAR CRANKSHAFT OIL SEAL INSTALLATION

Install or Connect (Figure 30)

Tool Required:
J 35621 Seal Installer

- Rear crankshaft oil seal.

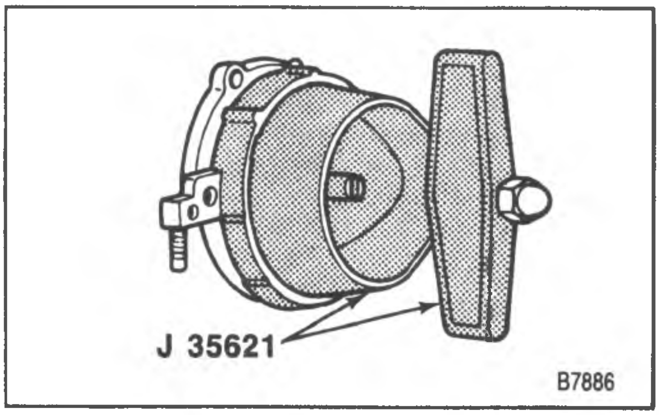


Figure 30—Installing the Rear Crankshaft Oil Seal

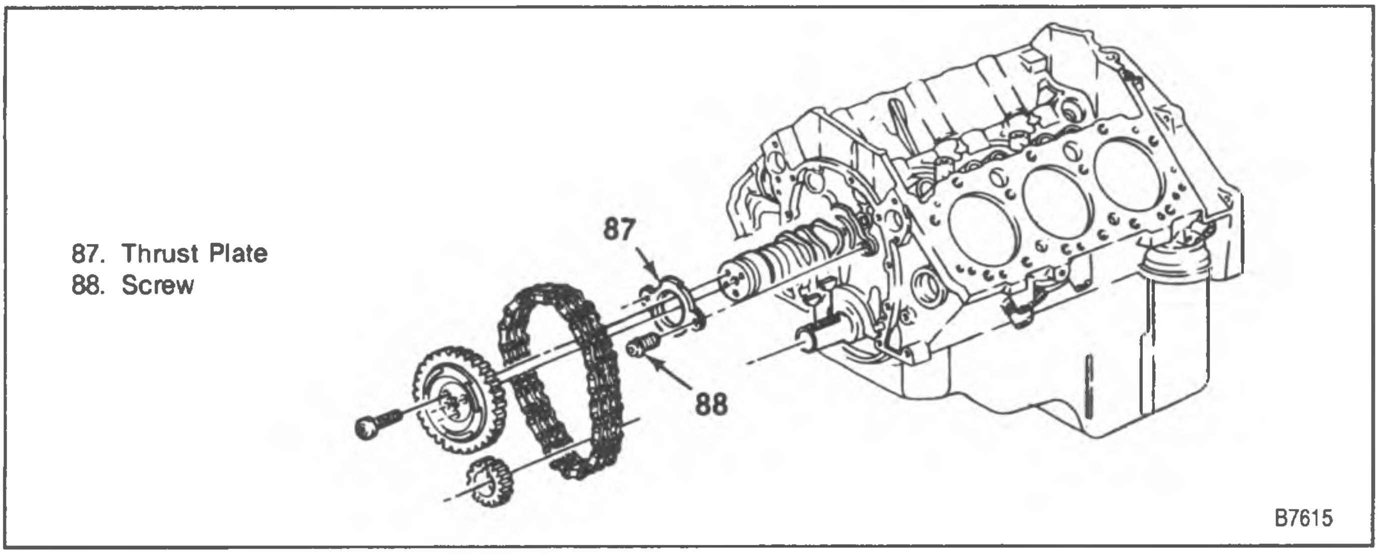


Figure 31—Camshaft and Components

a. Lubricate the inner and outer diameter of the seal with engine oil.
b. Install the seal on J 35621.
c. Position J 35621 against the crankshaft. Thread the attaching screws into the tapped holes in the crankshaft.
d. Tighten the screws securely with a screwdriver. This will ensure that the seai is installed squarely over the crankshaft.
e. Turn the handle until it bottoms.
f. Remove J 35621.

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 31, 32 and 33)

NOTICE: For steps 3 and 5, see "NOTICE" on page 6A3-1.

- Coat the camshaft lobes and journals with a high viscosity oil with zinc (GM part number 12345501 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 32). Handle the camshaft carefully to prevent damage to the camshaft bearings.
3. Thrust plate (87) and screws (88).

Tighten

- Screws (88) to 12 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 33).

5. Camshaft sprocket bolts.

Tighten

- Camshaft sprocket bolts to 28 N·m (21 ft. lbs.).

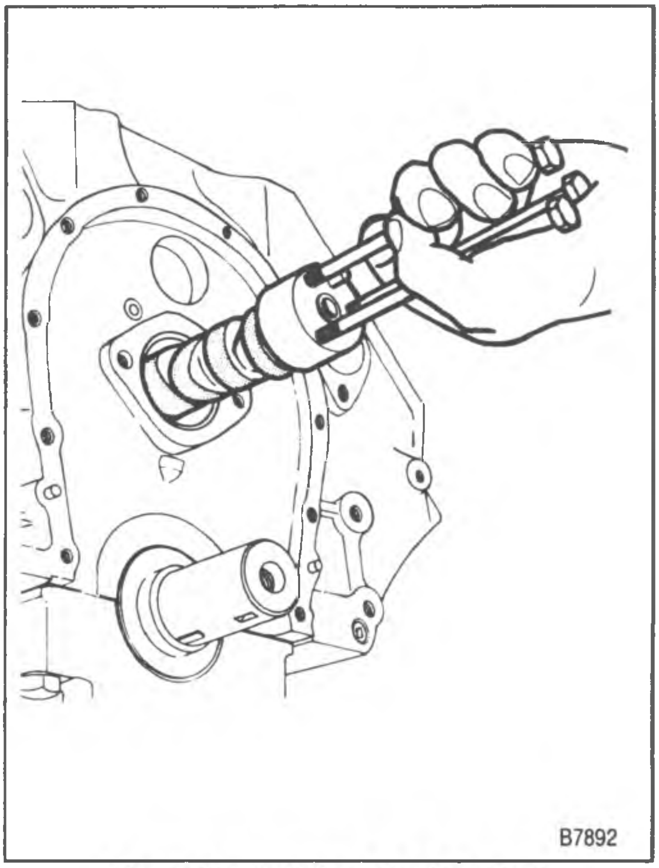


Figure 32—Installing the Camshaft

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.

NOTICE: See "NOTICE" on page 6A1-1.

3. Front cover bolts.

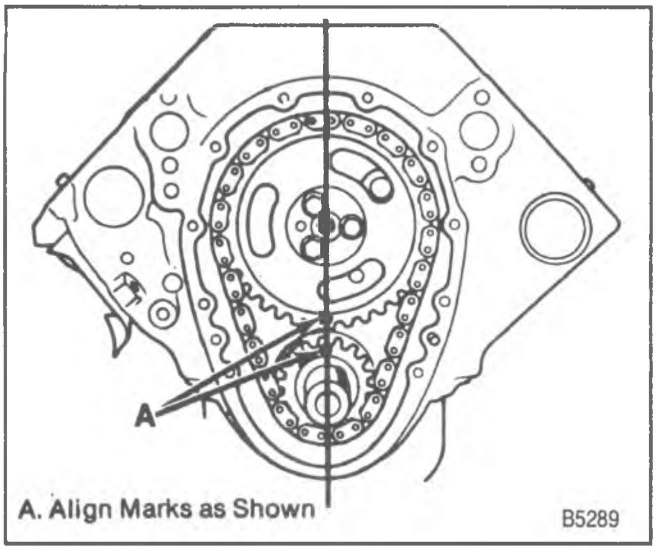


Figure 33—Timing Mark Alignment

Tighten

- Front cover to block bolts to 14 N·m (120 in. lbs.).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figures 30, 32 and 34)

Tool Required:
J 23523-E Torsional Damper Puller and Installer

1. Crankshaft key (if removed).

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 34) 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 30).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.

NOTICE: See "NOTICE" on page 6A3-1.

5. Torsional damper bolt and washer.

Tighten

- Bolt to 95 N·m (70 ft. lbs.).

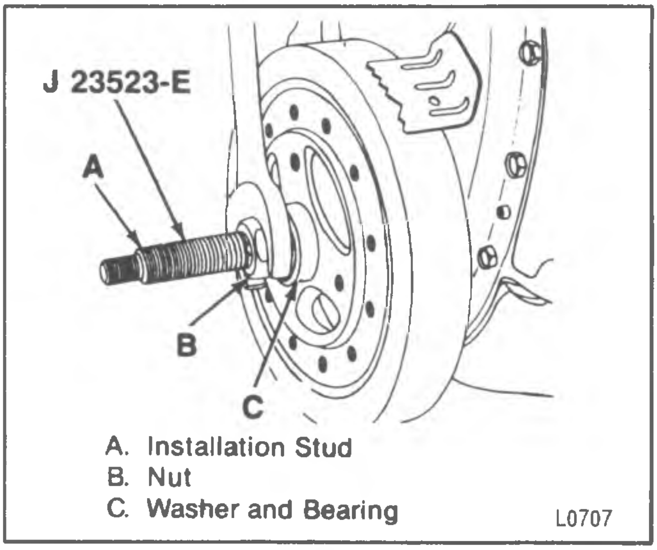


Figure 34—Installing the Torsional Damper

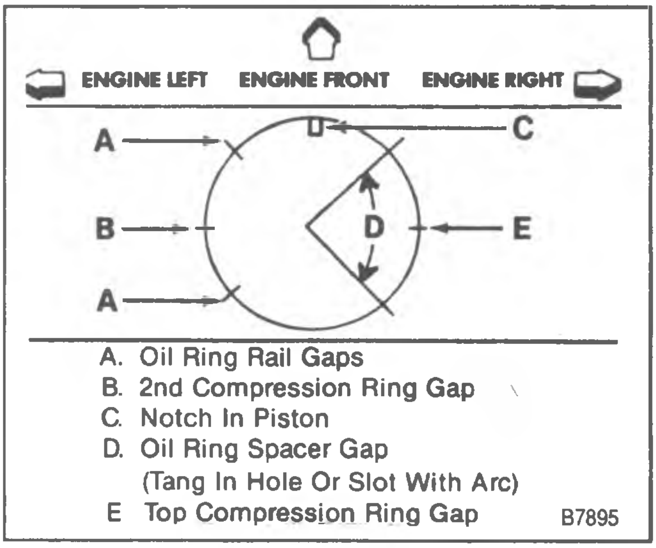


Figure 35—Piston Ring End Gap Locations

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 35 through 37)

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.
   - Make sure 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 into the proper bore.
   - With the connecting rod cap removed, install J 5239 onto the connecting rod studs (figure 37).
   - Locate the piston ring end gaps (figure 35). Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston (figure 36).
   - The piston must be installed so that the notch in the piston faces the front of the engine (figure 35).
   - Place the piston in its matching bore. The connecting rod bearing tang slots must be on the side opposite the camshaft. Using light taps with a hammer handle, tap the piston down into its bore (figure 36). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J 5239 (figure 37). 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 (SECTION 6A).

Tighten

- Connecting rod cap nuts to 27 N·m (20 ft. lbs.).
- Connecting rod cap nuts an additional 60 degrees.

Measure

- Connecting rod side clearance (figure 38). 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.

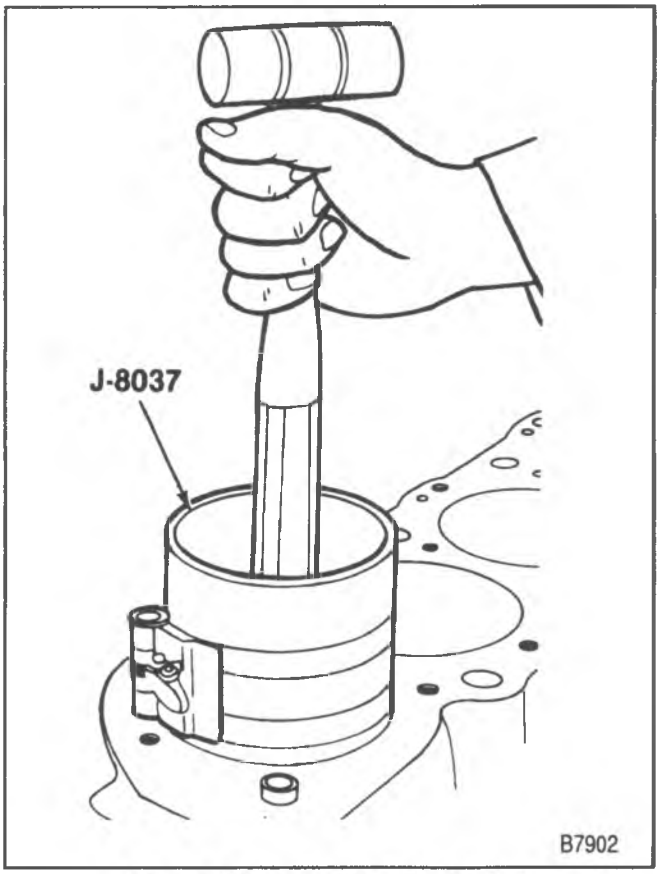


Figure 36—Installing the Piston

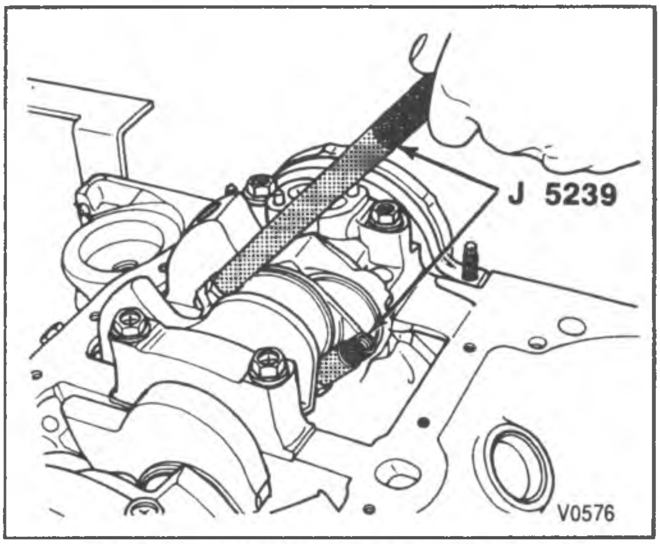


Figure 37—Guiding the Connecting Rod

- The oil pump should slide easily into place.
- No gasket is used.

NOTICE: See "NOTICE" on page 6A3-1.

2. Oil pump to main bearing cap bolt.

Tighten

- Oil pump to main bearing cap bolt to 90 N·m (65 ft. lbs.).

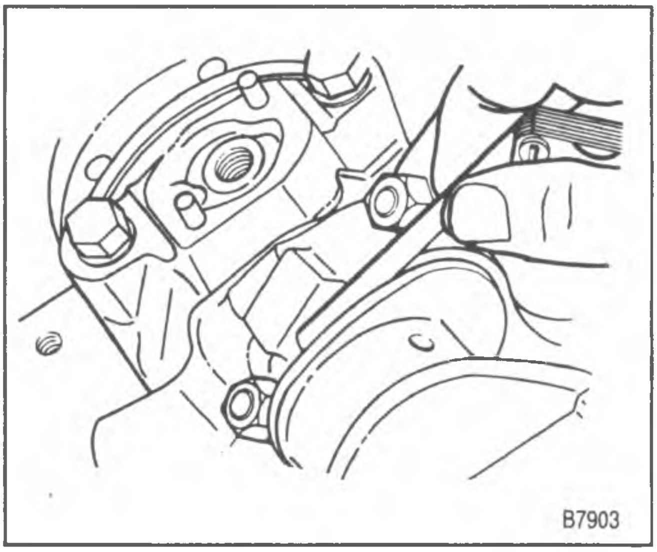


Figure 38—Measuring Connecting Rod Side Clearance

OIL PAN INSTALLATION

Install or Connect (Figure 39)

- 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 39).

1. Oil pan gasket to the oil pan.
2. Oil pan to the engine.
3. Oil pan bolts and nuts.

Tighten

- Bolts to 11 N·m (100 in. lbs.).
- Nuts to 23 N·m (17 ft. lbs.).

CYLINDER HEAD INSTALLATION

Clean

- Gasket surfaces on the block and cylinder head.

Install or Connect (Figure 40)

1. Head gasket.
   - Do not use sealer on composition gaskets.
   - Place the gasket over the block dowel pins.
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 in three steps, using the sequence shown in figure 40.
  - — The first sequence should go to 34 N·m (25 ft.lbs).
  - — The second sequence should go to 61 N·m (45 ft.lbs).
  - — Final torque sequence should be 90 N·m (65 ft. lbs.).

VALVE TRAIN COMPONENT INSTALLATION

Important

- Replace all hydraulic lifters, change the engine oil and filter and add GM Engine Oil Supplement (GM part number 1052367 or equivalent) to the engine oil whenever a new camshaft is installed.

Install or Connect (Figure 41)

1. Hydraulic lifters to the block. Lubricate the lifter roller and body with high viscosity oil with zinc (GM part number 12345501 or equivalent).
2. Restrictors (46) and retainer (41) with bolts (40).

Tighten

- Bolts (40) to 16 N·m (145 in. lbs.).

3. Pushrods.
   - Seat the pushrods into the socket of the hydraulic lifters.

Important

- When new rocker arms and/or balls are installed, coat their bearing surfaces with high viscosity oil with zinc (GM part number 12345501 or equivalent).

4. Rocker arms (44) with balls (43) on to the proper stud.
5. Rocker arm nuts (42) on to the studs.
   - Align the push rod into the rocker arm while tightening rocker arm nut (42).

Adjust

- Valves. Refer to "Valve Adjustment."

VALVE ADJUSTMENT

1. Crank the engine until the mark on the torsional damper lines up with the "0" 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 "0" 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 valves 1, 5, 6.

   Intake valves 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).

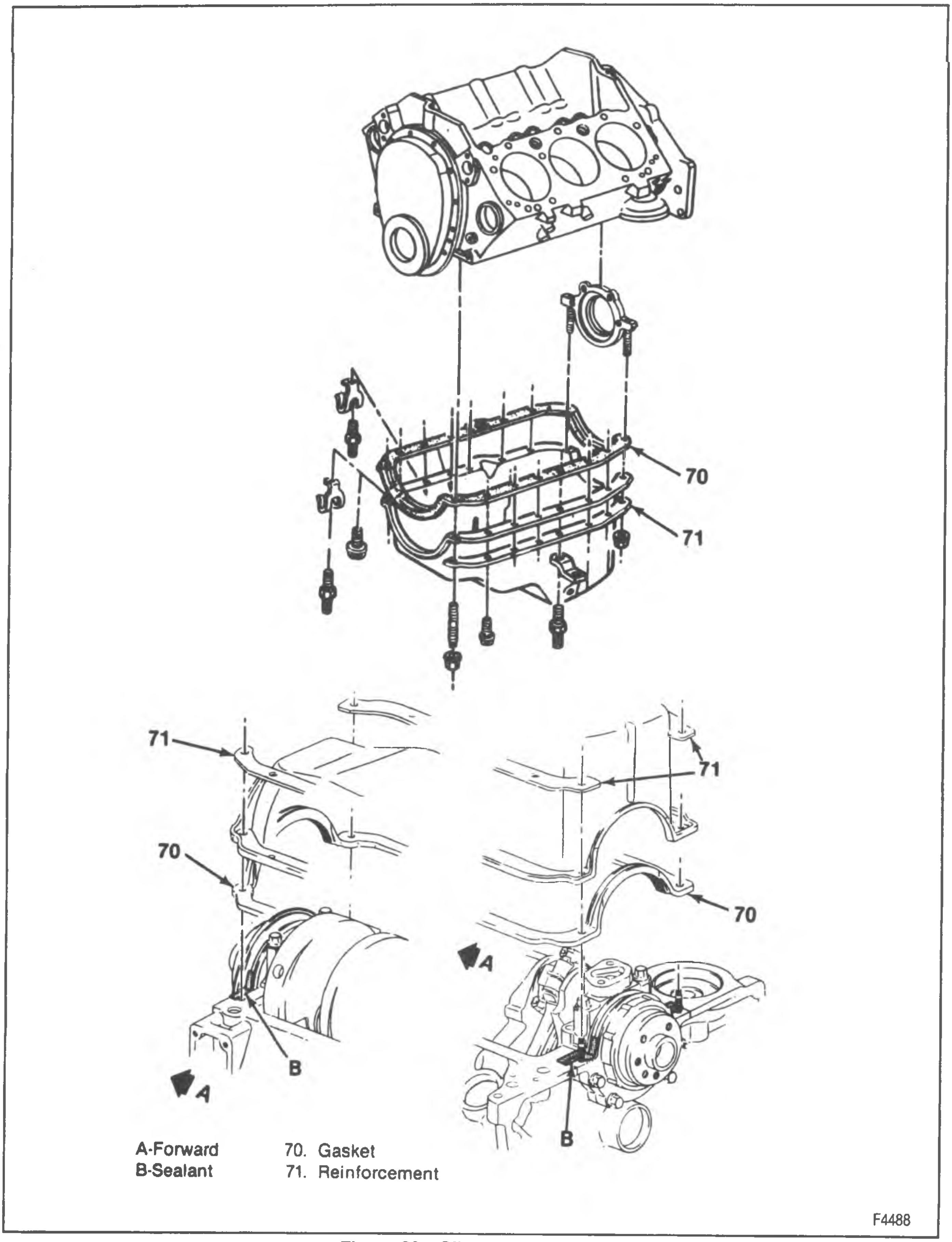


Figure 39—Oil Pan Installation

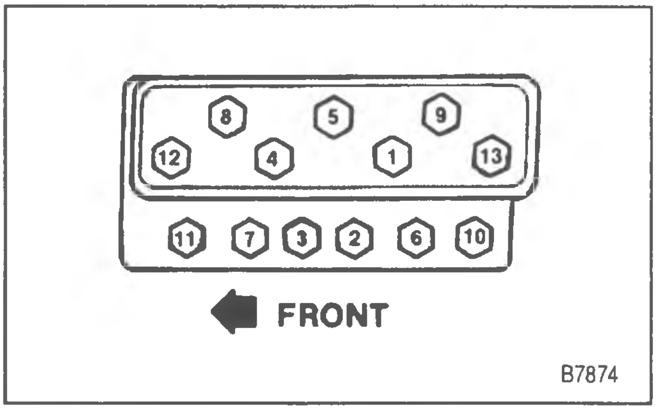


Figure 40—Cylinder Head Bolt Tightening Sequence

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 "0" mark and torsional damper mark are again in alignment. This is the number four firing position. The following valves may be adjusted:
   Exhaust valves 2, 3, 4.
   Intake valves 4, 5, 6.

INTAKE MANIFOLD INSTALLATION

Install or Connect (Figures 42 and 43)

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 number 1052366 or equivalent) to the front and rear of the block as shown in figure 42. Extend the bead 13 mm (1/2-inch) up each cylinder head to seal and retain the gaskets.
3. Intake manifold to the engine.

NOTICE: See "Notice" on page 6A3-1.

4. Intake manifold bolts.

Tighten

- Intake manifold bolts using the tightening sequence shown in figure 43.
- Retorque, intake manifold bolts to using the tightening sequence shown in figure 43.
- Bolt 9 (A in figure 9) to 56 N·m (41 ft. lbs.)

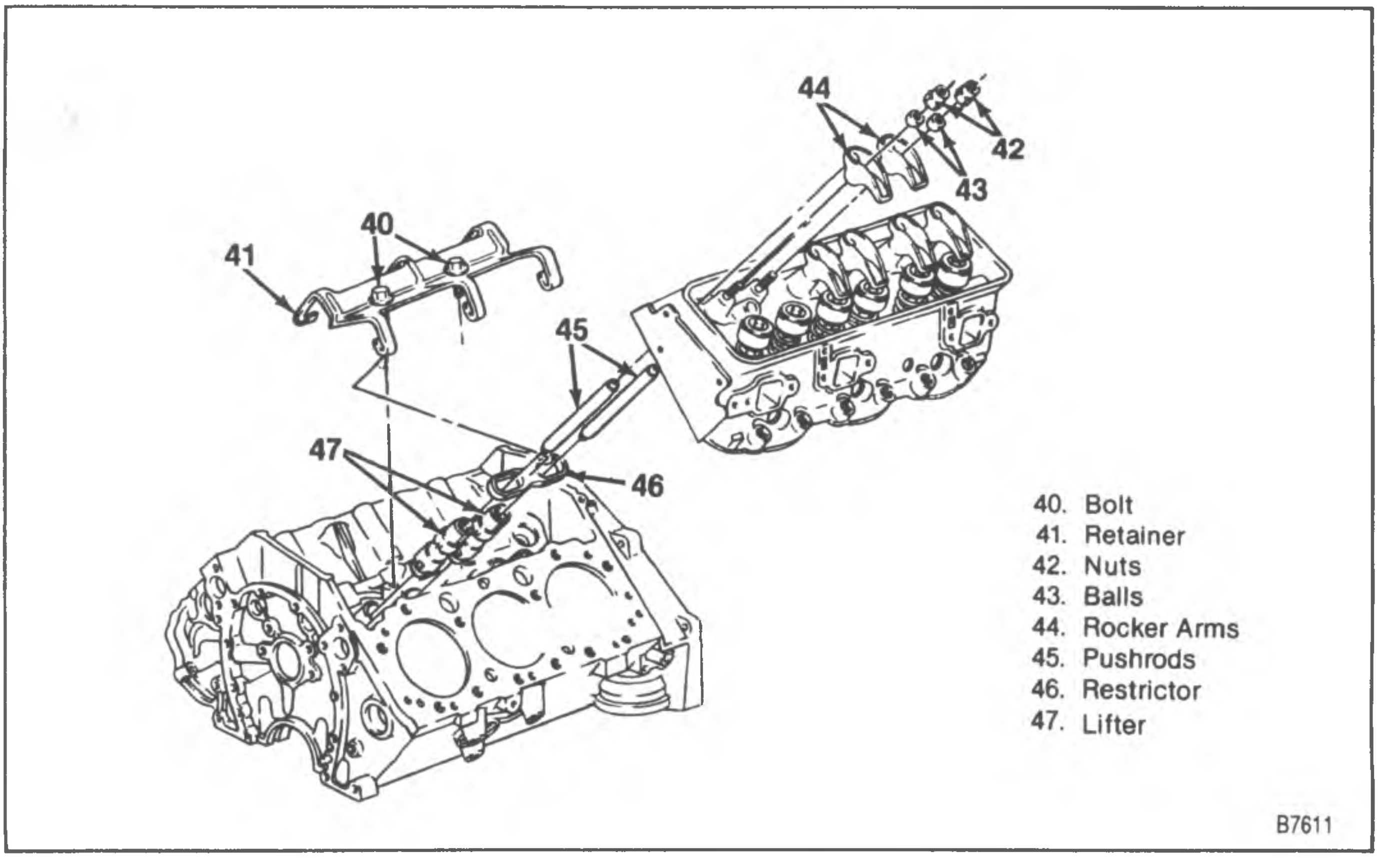


Figure 41—Valve Train Components

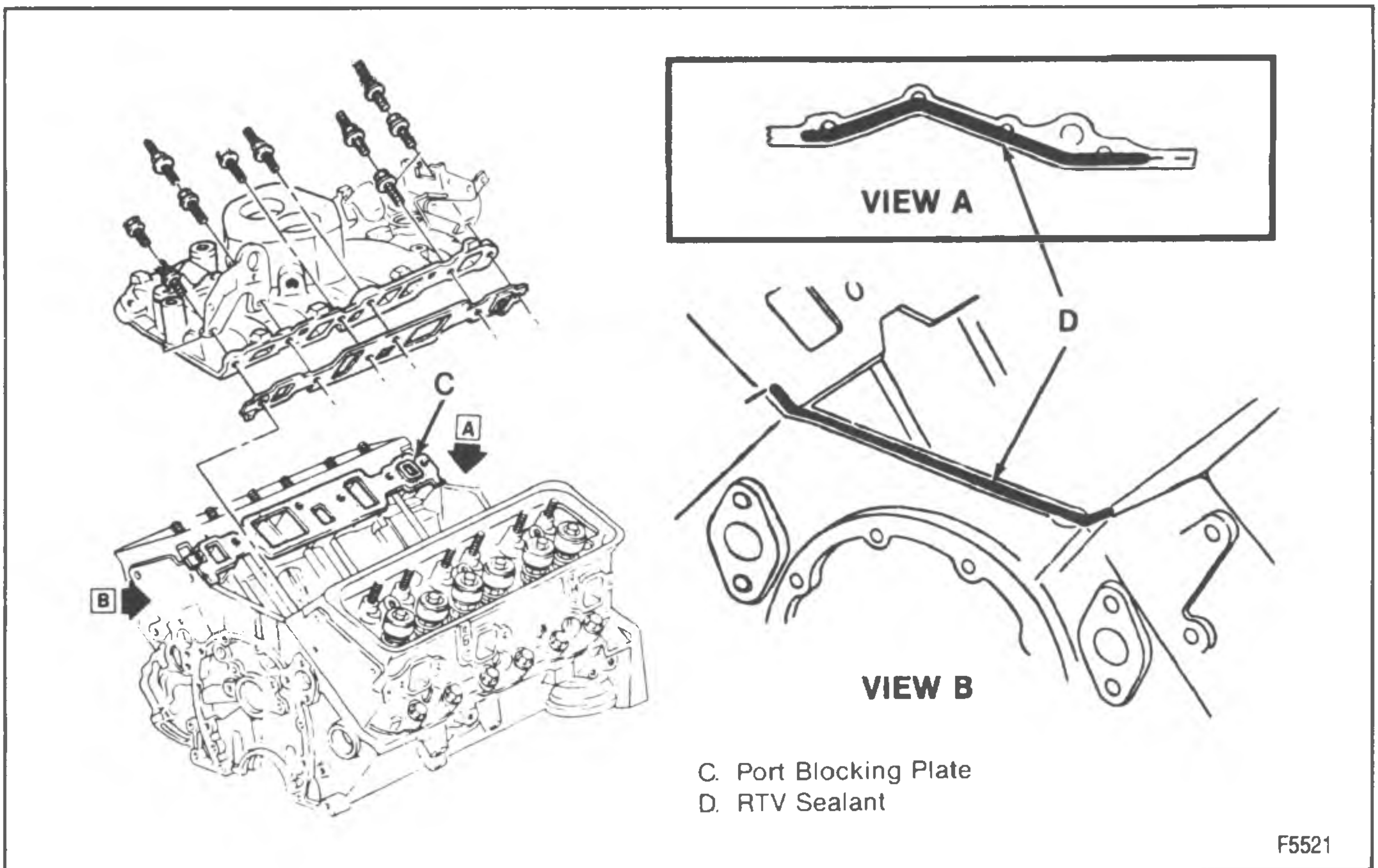


Figure 42—Intake Manifold Installation

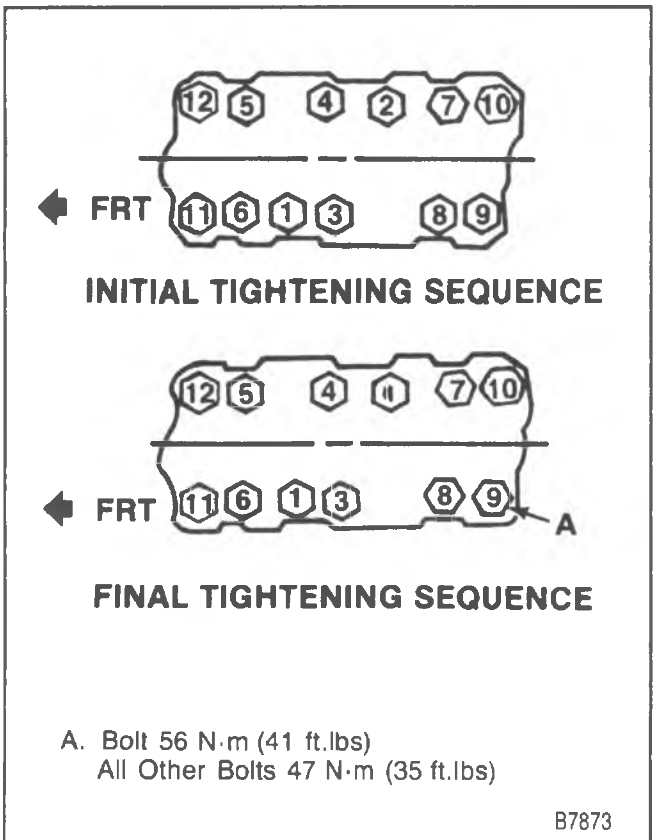


Figure 43—Intake Manifold Bolt Tightening Sequence

ROCKER ARM COVER INSTALLATION

Install or Connect (Figure 44)

1. Rocker arm cover (701).
2. New gasket (702).
3. Rocker arm cover bolts (700) and washers.

Tighten

- Rocker arm cover bolts (700) to 10 N.m (90 in. lbs.).

EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figure 45)

1. Exhaust manifold.
2. Heat shield.
3. Exhaust manifold bolts, washers and tab washers.

Tighten

- Bolts on center exhaust tube to 36 N.m (26 ft. lbs.).
- 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 or studs and nuts.

Tighten

- Refer to specifications for proper torques.

FLYWHEEL INSTALLATION

Install or Connect

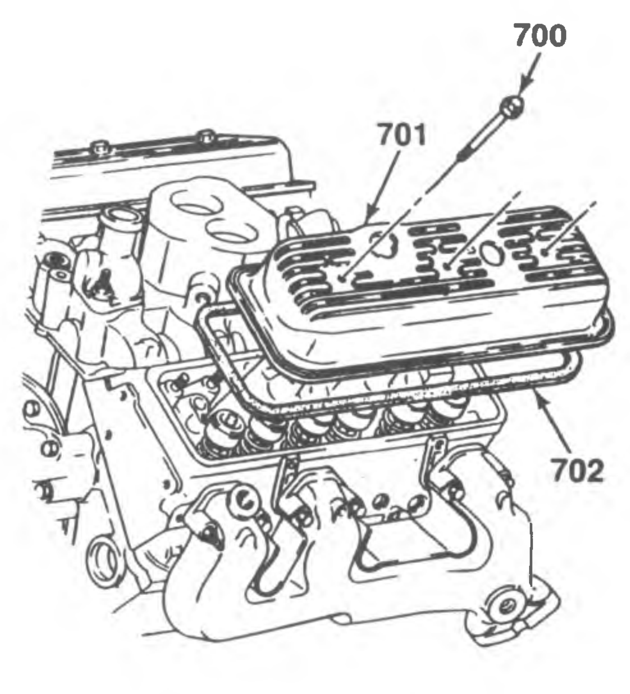
1. Flywheel.
2. Flywheel bolts.

Tighten

- Bolts to 100 N·m (75 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

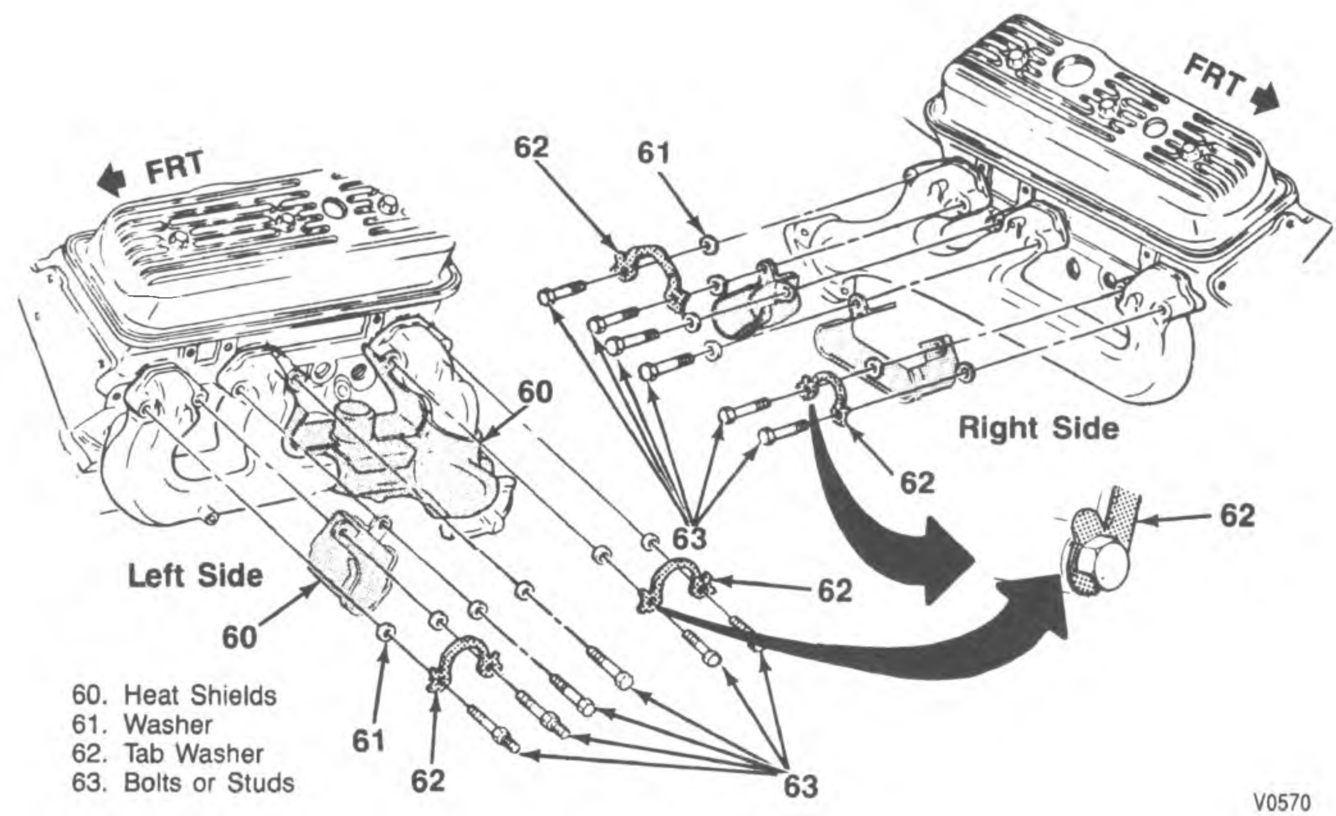
Install the engine accessories (distributor, oil filter, generator, etc.) as directed in the proper Truck Service Manual. Connect all vacuum hoses and electrical equipment the same way as removed.



700. Bolt
701. Rocker Arm Cover
702. Gasket

F5520

Figure 44—Rocker Arm Cover Installation



60. Heat Shields
61. Washer
62. Tab Washer
63. Bolts or Studs

V0570

Figure 45—Exhaust Manifold Installation

ENGINE SET-UP AND TESTING

After overhaul, the engine should be tested before installing it in the vehicle.

1. Install oil filter.
2. Fill the crankcase with the proper quantity and grade of engine oil.

Important

- If a new camshaft or hydraulic lifters were installed, add Engine Oil Supplement (GM part number 1052367 or equivalent) to the engine oil.

3. Fill the cooling system with the proper quantity and grade of coolant.
4. Crank the engine several times. Listen for any unusual noises or evidence that any parts are binding.
5. Using the proper Truck Service Manual or Emission Control Label for specifications, adjust the ignition timing.
6. Start the engine and listen for unusual noises.
7. Run the engine at about 1000 rpm until the engine is at operating temperature.
8. Listen for improperly adjusted valves or sticking lifters and other unusual noises.
9. Check for oil and coolant leaks while the engine is running.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:			
Type			V6
Displacement			4.3L (262 CID)
RPO			LB4/LU2
Bore			4.00
Stroke			3.48
Compression Ratio			(LB4 & LU2 9.3:1) (LB4 HD 8.6:1)
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			4.0007/4.0017
Out Of Round			0.001 (Maximum)
Taper		Thrust Side	0.0005 (Maximum)
		Relief Side	0.001 (Maximum)
PISTON:			
Clearance	Production		0.0007-0.0017
PISTON RING:			
COMPRESSION	Groove Clearance	Top	0.0012-0.0032
		2nd	
	Gap	Top	0.010-0.020
		2nd	0.010-0.025
OIL	Groove Clearance		0.002-0.007
	Gap		0.015-0.055
PISTON PIN:			
Diameter			0.9270-0.09273
Clearance In Piston			0.0002-0.0007
Fit In Rod			0.0008-0.0016 Interference

T2364

SPECIFICATIONS (CONT.)

ENGINE SPECIFICATIONS (CONT.)

All Specifications are in INCHES unless otherwise noted.

DISPLACEMENT:			4.3L (262 CID)
CRANKSHAFT:			
Main Journal	Diameter	#1	2.4484-2.4493
		#2, #3	2.4481-2.4490
		#4	2.4479-2.4488
	Taper		0.0002 (Maximum)
	Out Of Round		0.0002 (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		0.0005
	Out of Round		0.0005
Rod Bearing Clearance			0.0013-0.0035
Rod Side Clearance			0.006-0.014
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		LB4/.234 LU2/.269
	Exhaust		.257 .276
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
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

T2365

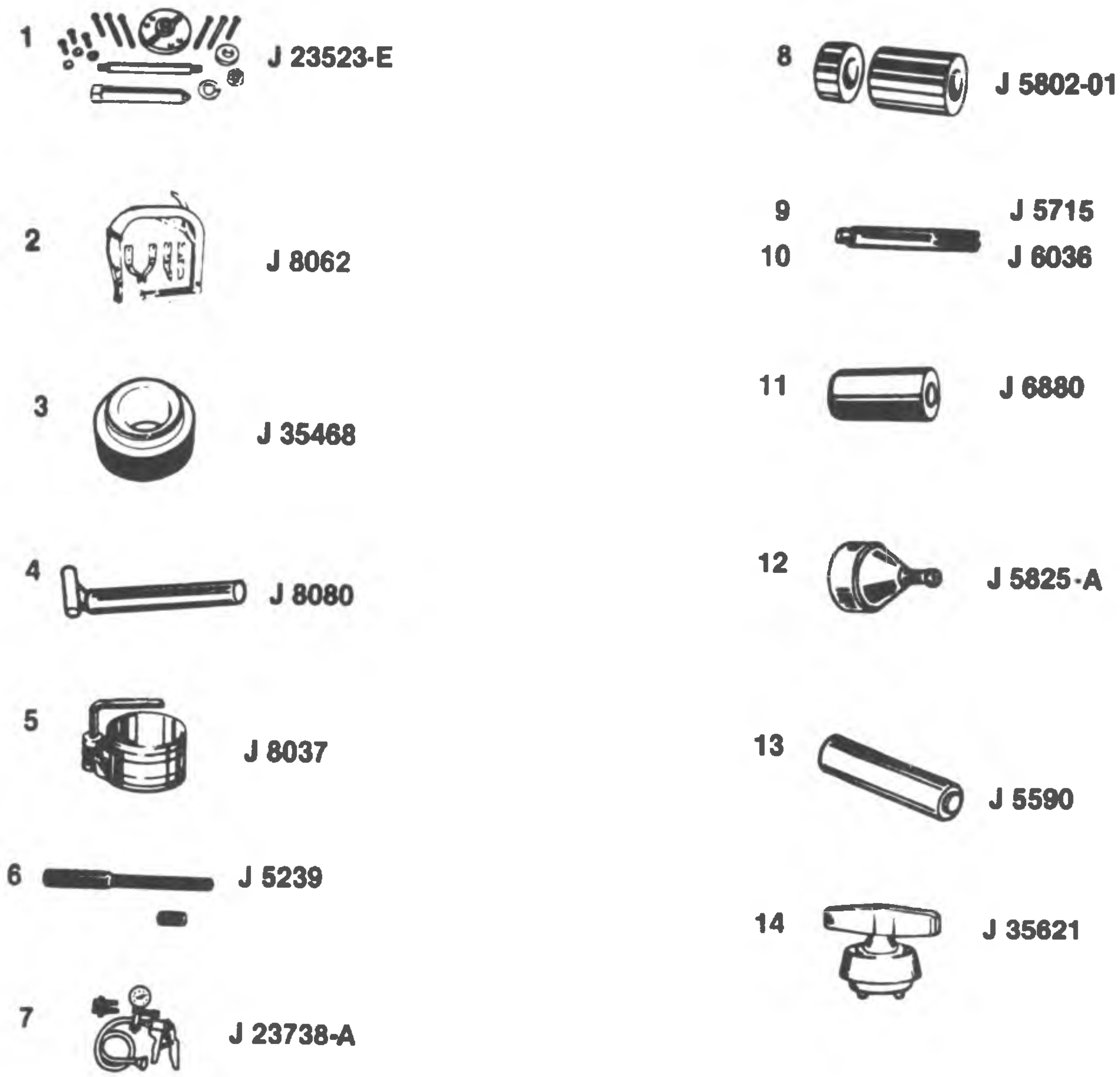
SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Bolts	10	—	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	14	—	124
Oil Pan Nuts	23	17	—
Oil Pan Bolts	11	—	97
Oil Pump Bolt	90	65	—
Rear Crankshaft Oil Seal Retainer Screws and Nuts	15	—	133
Camshaft Sprocket Bolts	28	21	—
Connecting Rod Cap Nuts (Torque Plus 60°)	60	20	—
Oil Filter Adapter Bolts	20	15	—
Main Bearing Cap Bolts	110	75	—
Oil Pump Cover Bolts	9	—	80
Flywheel Bolts	100	75	—
Spark Plugs	30	22	—
Coolant Outlet Bolts	28	21	—
Coolant Pump Bolts	40	30	—
Flywheel Housing Bolts	44	32	—
Hydraulic Lifter Restrictor Retainer Bolts	16	12	—
Oil Pan Studs to Oil Seal Retainer or Crankcase	2	—	18
Camshaft Thrust Plate	12	—	106
EGR Valve Stud	15	11	—
EGR Valve Nut	23	17	—
EGR Valve Bolt	23	17	—

T2522

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

F4490

SECTION 6A5

V8 ENGINES
5.0L (305 CID)
5.7L (350 CID)
7.4L (454 CID)

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

CONTENTS (cont'd)

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. Heavy Duty 5.7L exhaust and all 7.4L valve guides are pressed in.

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 figures 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 5.0L (305 CID) and 5.7L (350 CID) displacements.

The second type is the 7.4L (454 CID) engine, which is sometimes referred to as the "Mark V" 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.

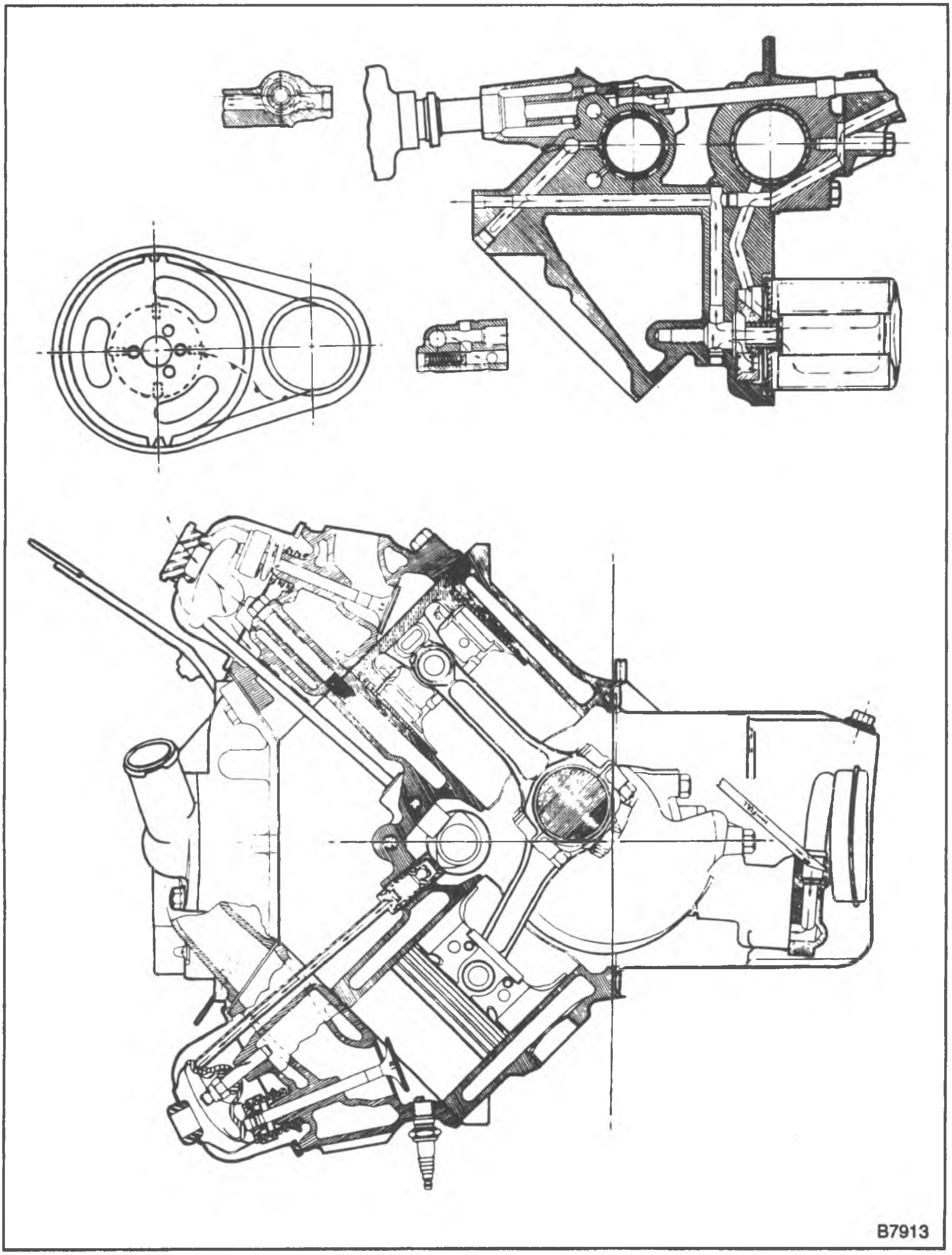
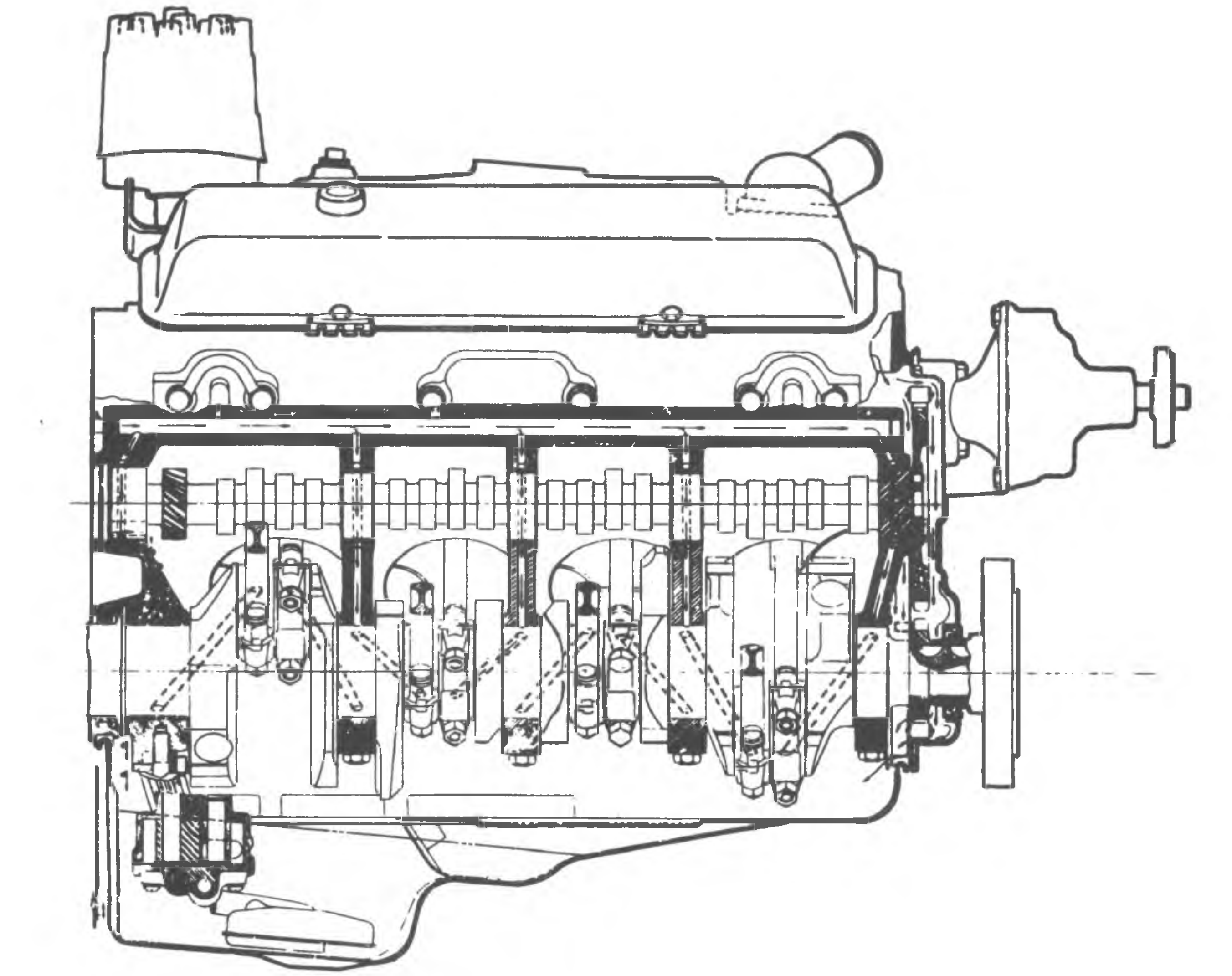


Figure 1—Lubrication Diagram (5.0L and 5.7L Engines)



F9474

Figure 2—Lubrication Diagram (5.0L and 5.7L Engines)

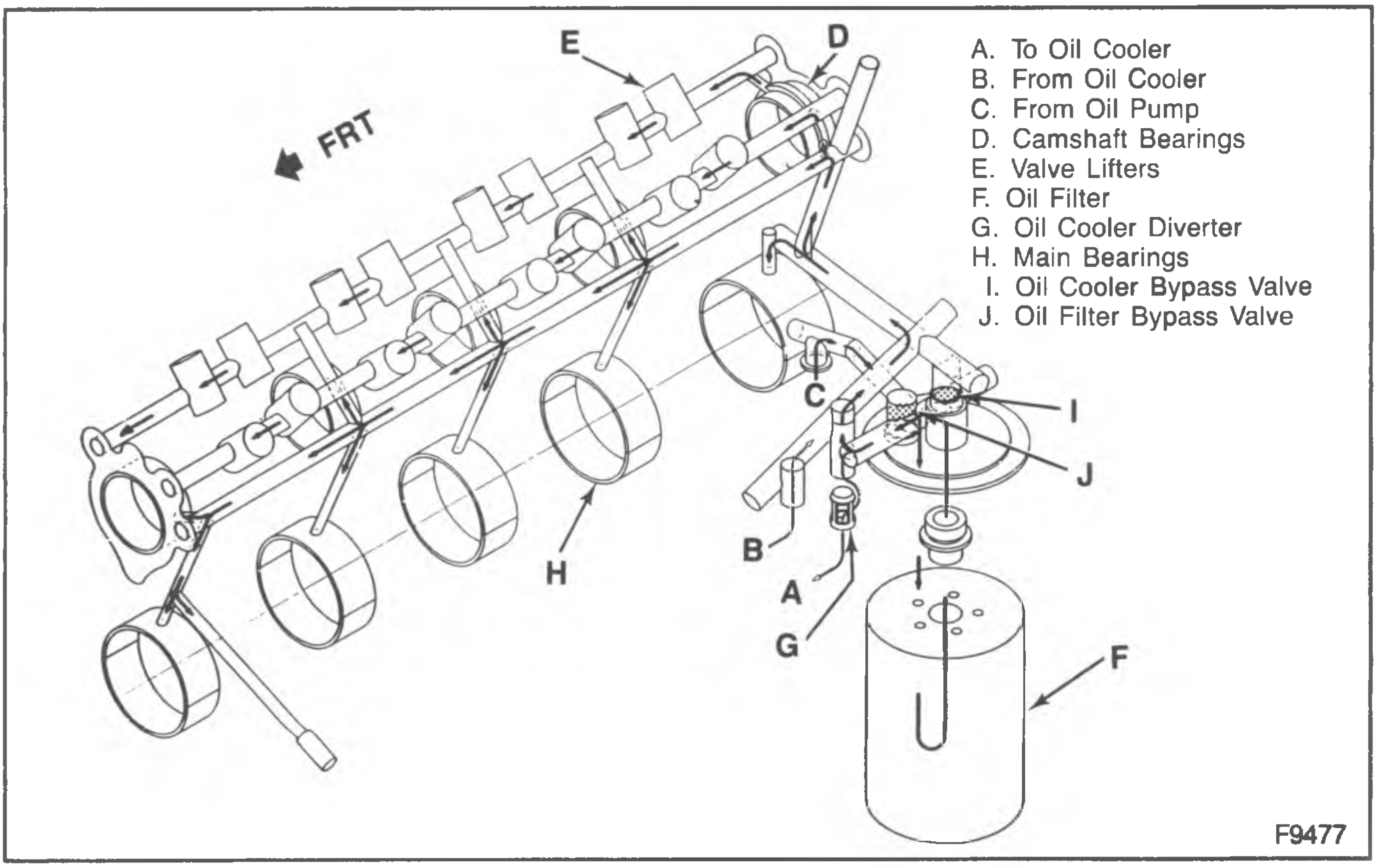


Figure 3—Lubrication Diagram (7.4L Engines)

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
Generator
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 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 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.

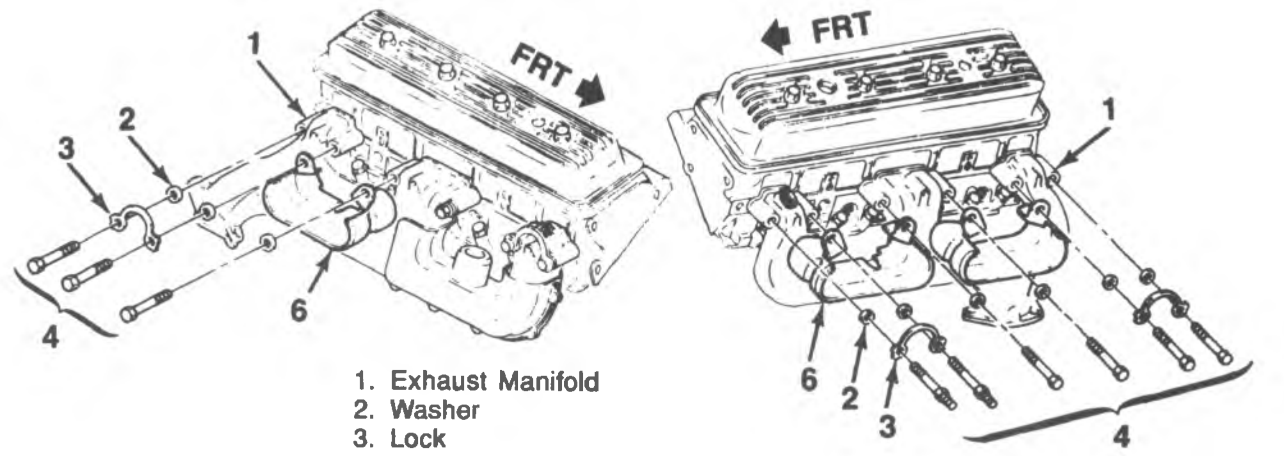
Tighten

- Block drain plugs to 12 N·m (112 in. lbs.).

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect (Figures 4 and 5)

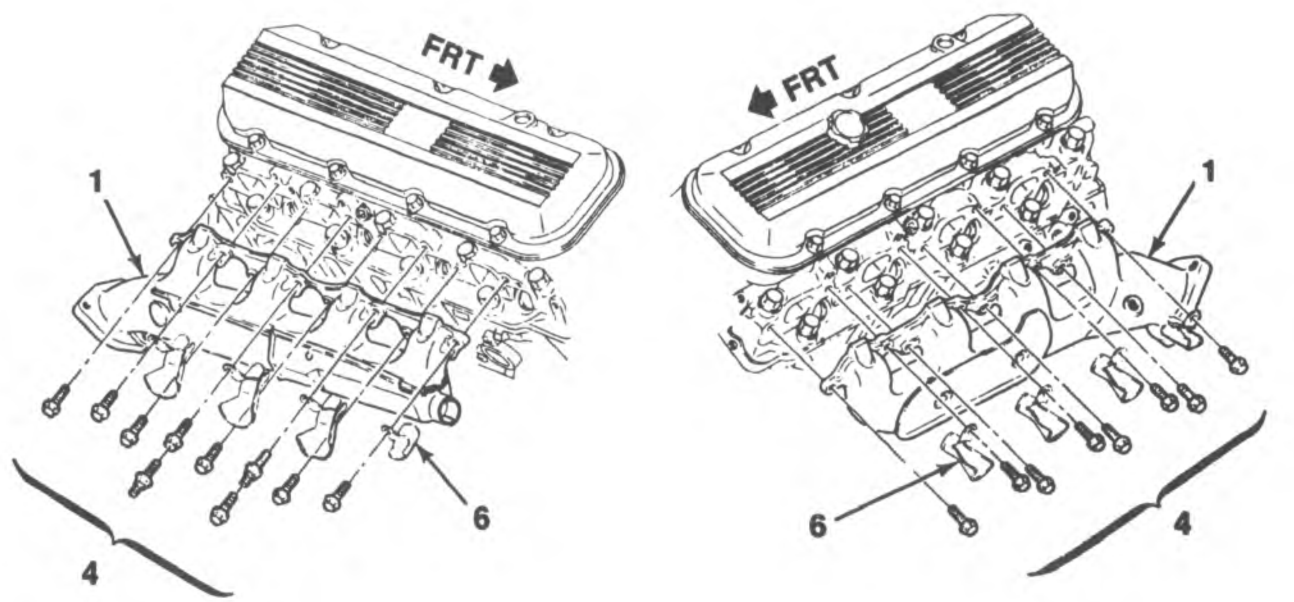
1. Oil dipstick tube.



1. Exhaust Manifold
2. Washer
3. Lock
4. Bolt/Stud
6. Spark Plug Wire Heat Shield

F9367

Figure 4—Exhaust Manifold (5.0L and 5.7L Engines)



1. Exhaust Manifold
4. Bolt/Stud
6. Spark Plug Heat Shield

F9328

Figure 5—Exhaust Manifold (7.4L Engines)

- On 5.0L and 5.7L engines, bend back the tab washers (3).

2. Bolts and studs (4).
3. Tab washers (3) and washers (2).
4. Heat shields (6).
5. Exhaust manifold (1). Take care not to damage the AIR injection tubes (if used).

COOLANT PUMP REMOVAL

Remove or Disconnect (Figures 6 and 7)

1. Bolts (12).

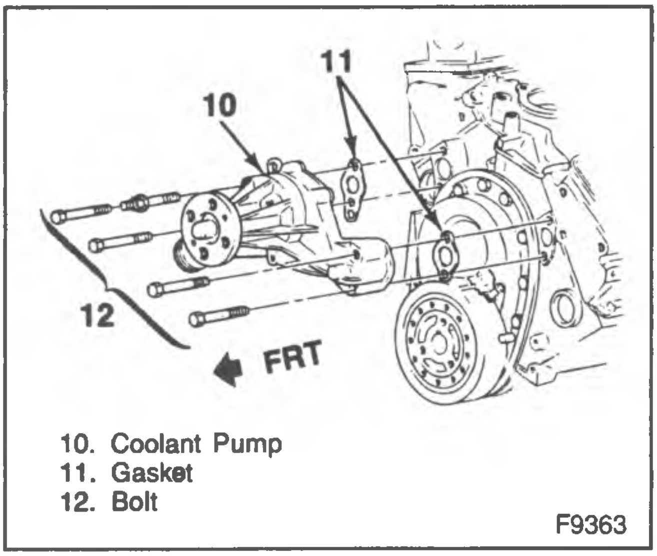


Figure 6—Coolant Pump (5.0L and 5.7L Engines)

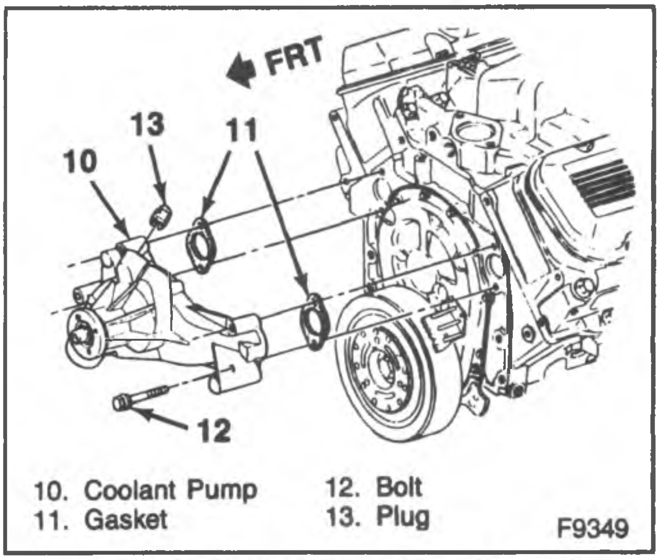


Figure 7—Coolant Pump (7.4L Engines)

2. Coolant pump (10).
3. Gaskets (11).

INTAKE MANIFOLD REMOVAL

Remove or Disconnect (Figure 8)

1. Bolts.
2. Intake manifold (21).
   — Pull the intake manifold up.

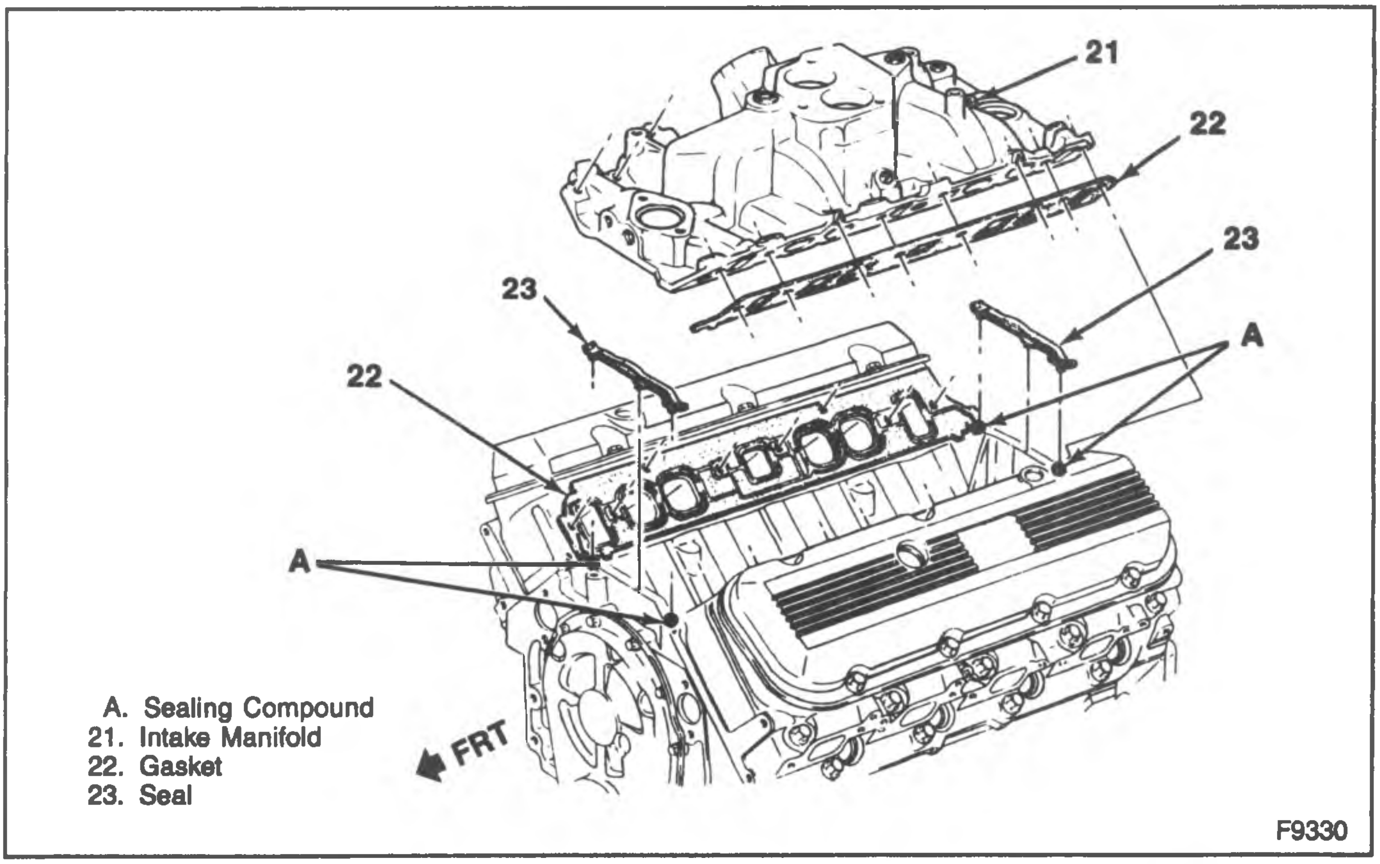


Figure 8—Intake Manifold (7.4L Engines)

— **Do not attempt to loosen the manifold by prying under the gasket surface with any tool.**

3. Gasket (22).
4. Seals (23) (7.4L engines).

ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figures 9 and 10)

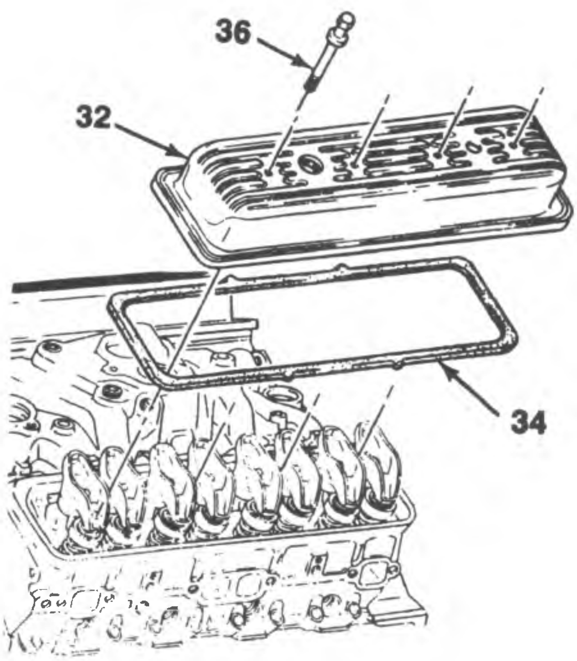
1. Bolts.
2. Rocker arm covers (32). If the rocker arm cover adheres to the cylinder head, try to shear the gasket by bumping the end of the cover with a rubber mallet. If the cover will not come loose, carefully pry until loose. DO NOT DISTORT THE SEALING FLANGE.
3. Gaskets (34).

VALVE TRAIN COMPONENT REMOVAL

Remove or Disconnect (Figures 11 through 15)

Tools Required:
J 3049-A Valve Lifter Remover (Plier Type)
J 9290-01 Valve Lifter Remover (Slide Hammer Type)

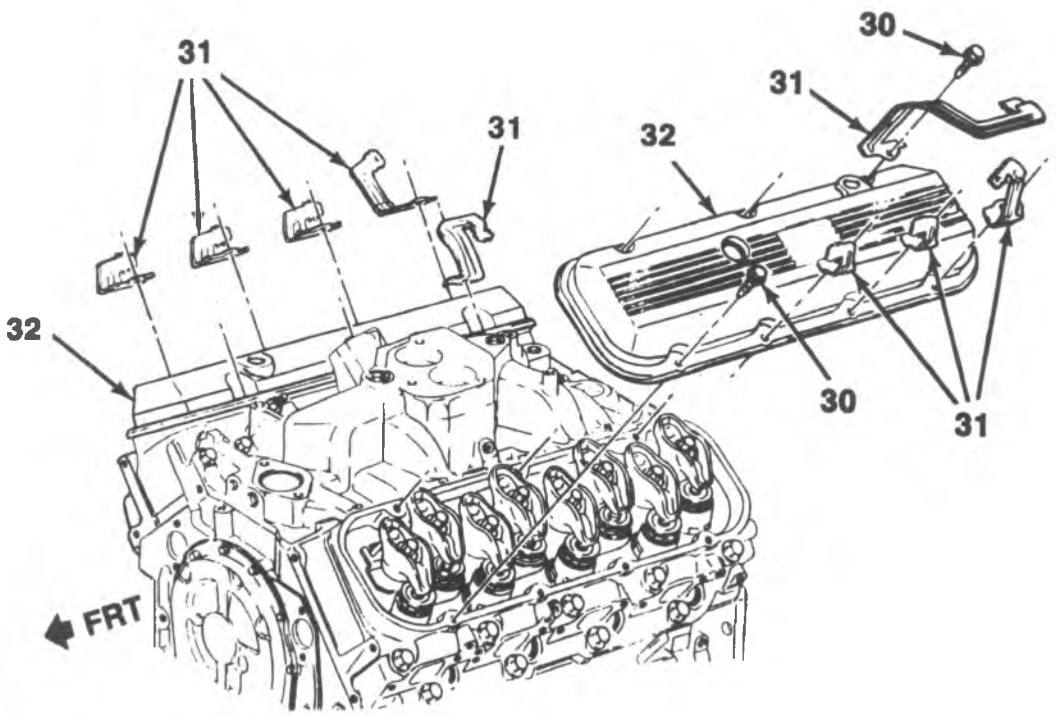
1. Nuts (40), balls (41), rocker arms (42) and pushrods (43).



32. Rocker Arm Cover
34. Gasket
36. Bolt

F9362

Figure 9—Rocker Arm Cover (5.0L and 5.7L Engines)



30. Bolt
31. Support
32. Rocker Arm Cover

F9326

Figure 10—Rocker Arm Cover (7.4L Engines)

— Note that on 7.4L 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 13.

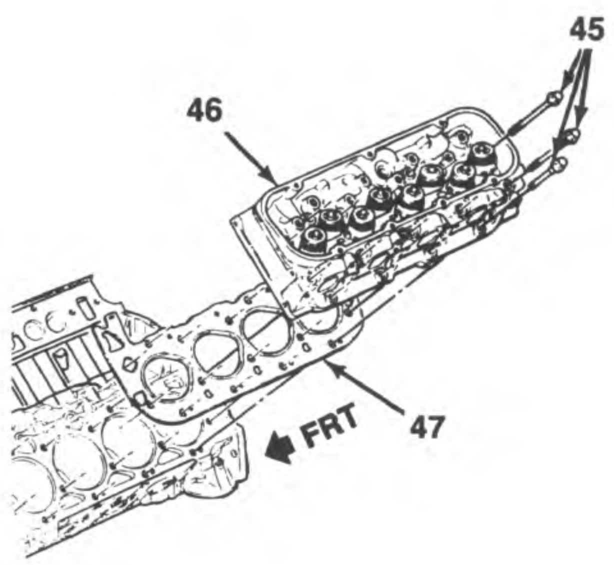
2. Hydraulic lifters (44).

— 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.
— Some lifters may be stuck in their bores due to gum or varnish deposits. These lifters can be removed using either J 3049-A (figure 14) or J 9290-01 (figure 15).

CYLINDER HEAD REMOVAL

Remove or Disconnect (Figures 11 and 12)

1. Bolts (45).
2. Cylinder heads (46). Use care when handling the cylinder heads, to prevent damage to the gasket sealing surfaces.
3. Gaskets (47).

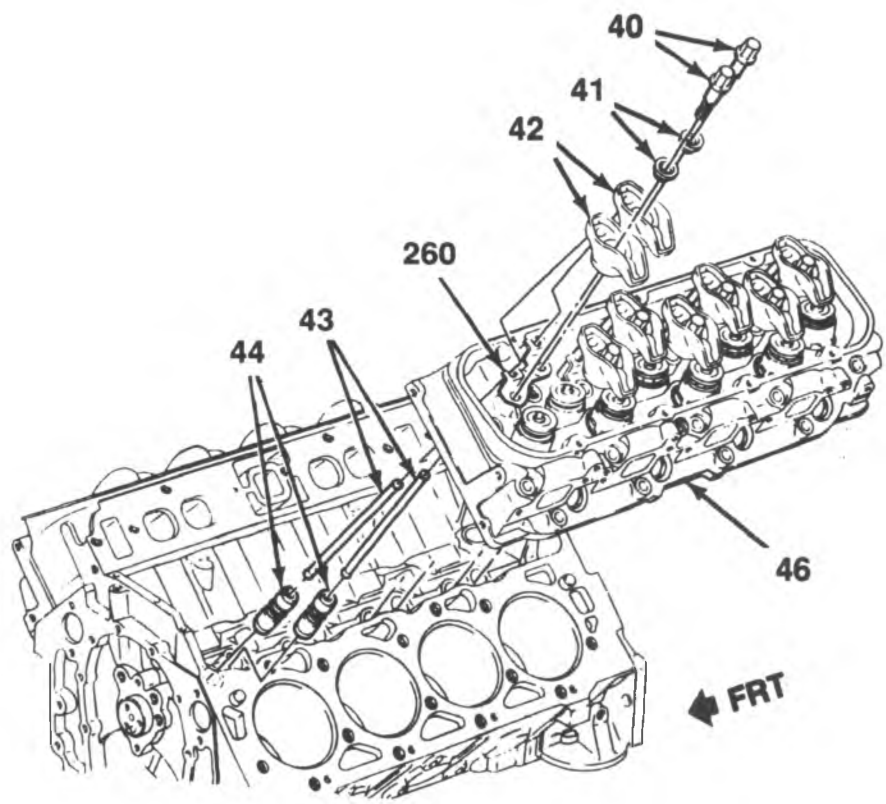


45. Bolt
46. Cylinder Head
47. Gasket

F9327

Figure 11—Cylinder Head (7.4L Engines)

40. Bolt
41. Ball
42. Rocker Arm
43. Pushrod
44. Hydraulic Lifter
46. Cylinder Head
260. Pushrod Guide



F9325

Figure 12—Cylinder Head Components (7.4L Engines)

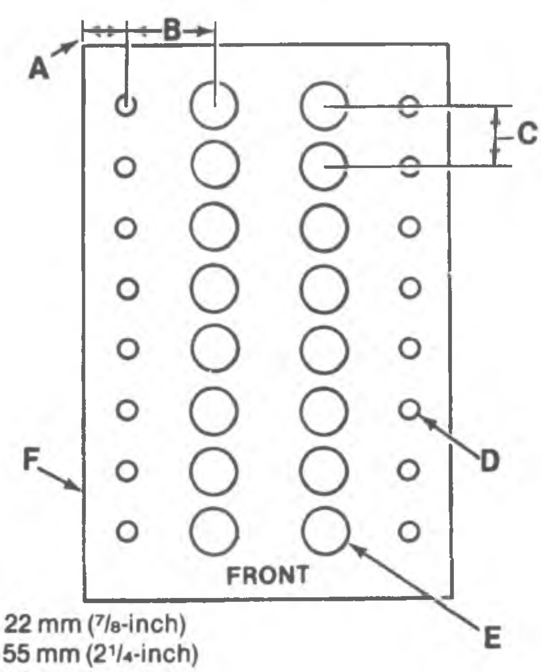


Figure 13—Valve Train Component Organizer

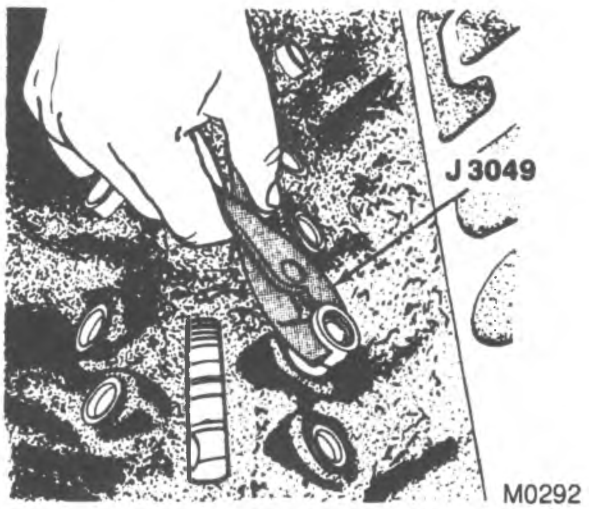


Figure 14—Removing the Hydraulic Lifter

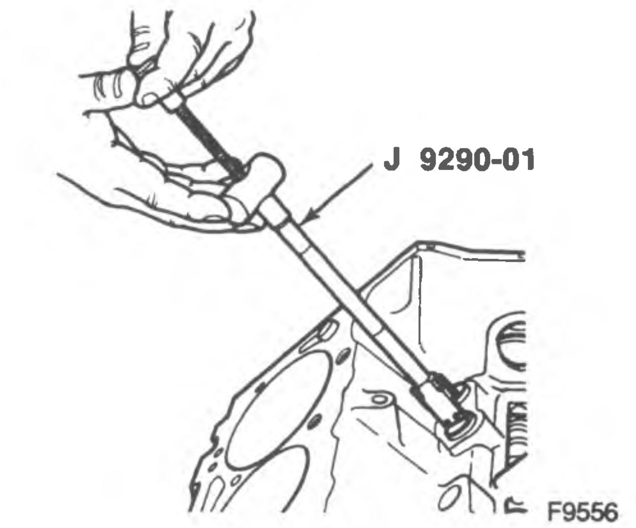


Figure 15—Removing the Hydraulic Lifter

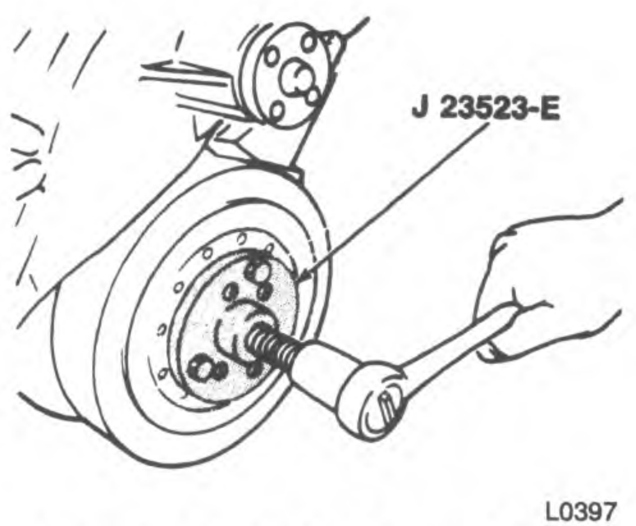


Figure 16—Removing the Torsional Damper

TORSIONAL DAMPER REMOVAL

Remove or Disconnect (Figure 16)

Tool Required:
J 23523-E Torsional Damper Puller and Installer

1. Crankshaft pulley.
2. Torsional damper retaining bolt and washer.
3. Torsional damper. Use J 23523-E (figure 16).

OIL PAN REMOVAL

Remove or Disconnect (Figures 17, 18 and 19)

1. Oil pan bolts, clips and reinforcements.
2. Oil pan.
3. Gasket.

OIL PUMP REMOVAL

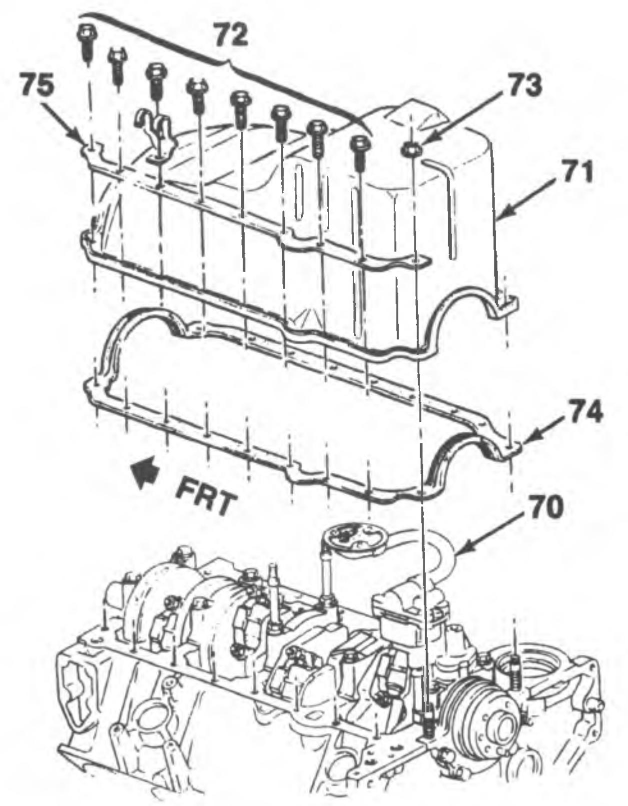
Remove or Disconnect (Figures 17 and 19)

1. Bolt.
2. Oil pump, with drive shaft and connector.

FRONT COVER REMOVAL

Remove or Disconnect (Figure 20)

1. Bolts (93).
2. Front cover (91).
3. Gasket (90).



70. Oil Pump
71. Oil Pan
72. Bolt
73. Nut
74. Gasket
75. Reinforcement

F9364

Figure 17—Oil Pan (5.0L and 5.7L Engines)

TIMING CHAIN AND CAMSHAFT SPROCKET REMOVAL

Remove or Disconnect (Figure 21)

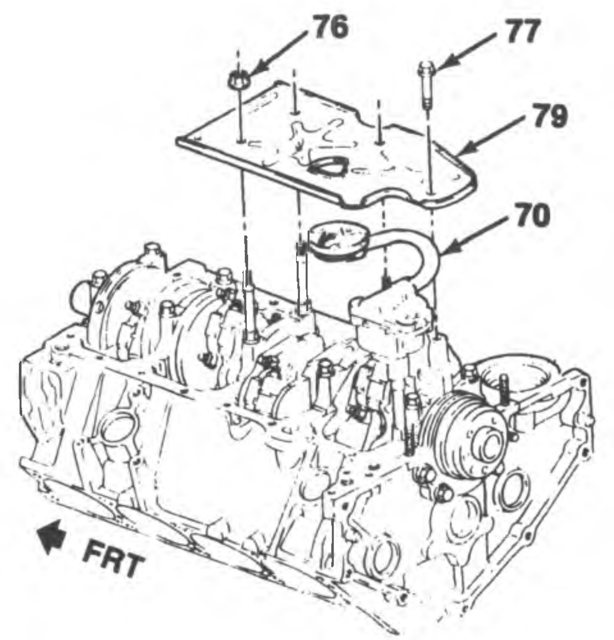
- Timing chain free play. If the chain can be moved back and forth in excess of 16 mm (5/8-inch), make a note that the timing chain should be replaced during assembly (Figure 21).

1. Bolts (100).
2. Camshaft sprocket (101) and timing chain (102) together.

CAMSHAFT REMOVAL

Remove or Disconnect (Figure 22)

- 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.



70. Oil Pump
76. Nut
77. Bolt
79. Oil Pan Baffle (H.D. 5.7L)

F9365

Figure 18—Oil Pan Baffle

- Use care to prevent damage to the camshaft and bearings.

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 23 and 24)

Tool Required:
J 5239 Connecting Rod Guide Set

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.
   - Using the manufacturer's directions, install a ridge reamer into the top of the cylinder (figure 23). 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 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 connect-

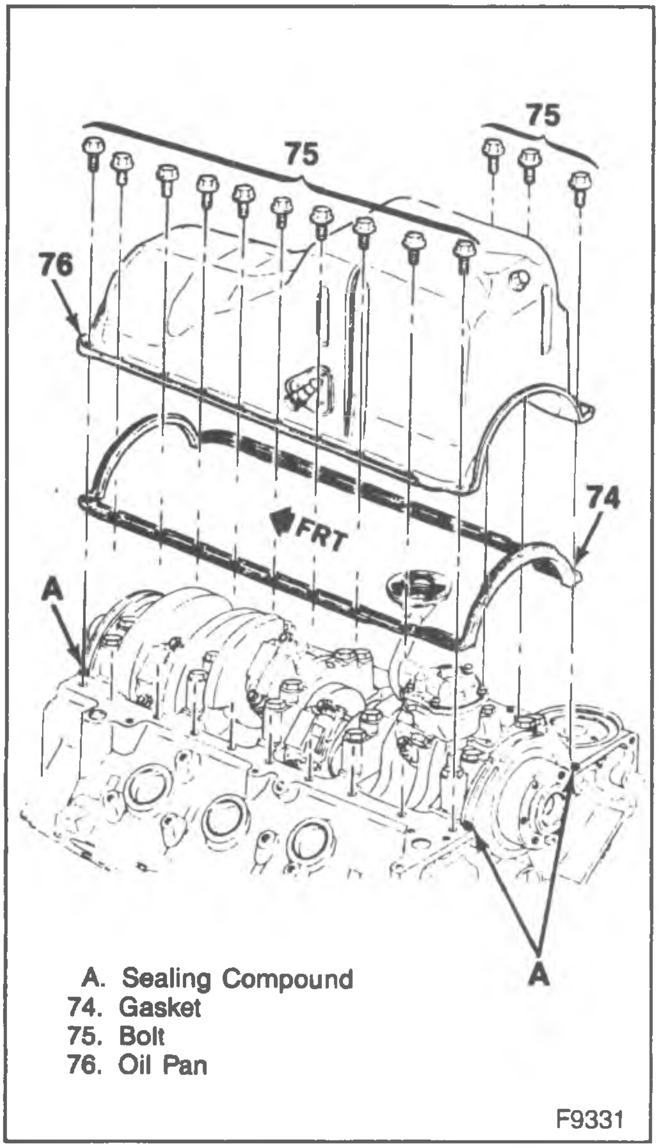


Figure 19—Oil Pan (7.4L Engines)

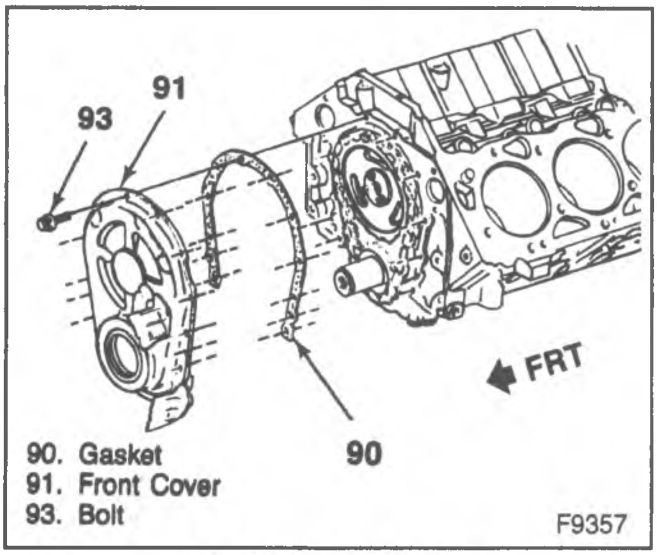


Figure 20—Front Cover

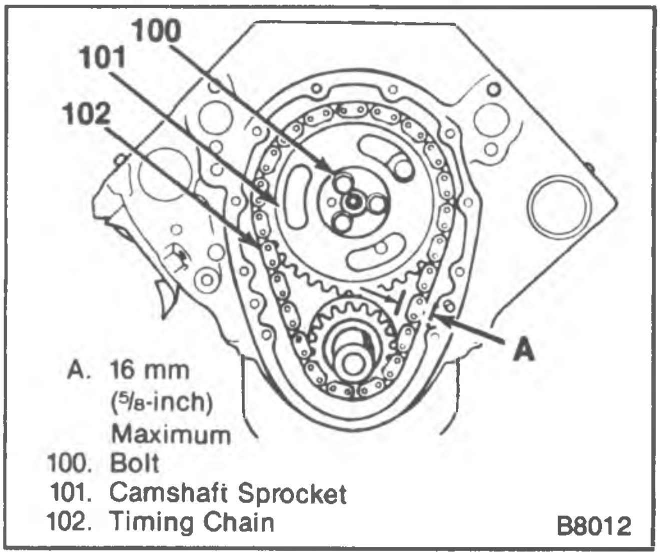


Figure 21—Timing Chain and Sprockets

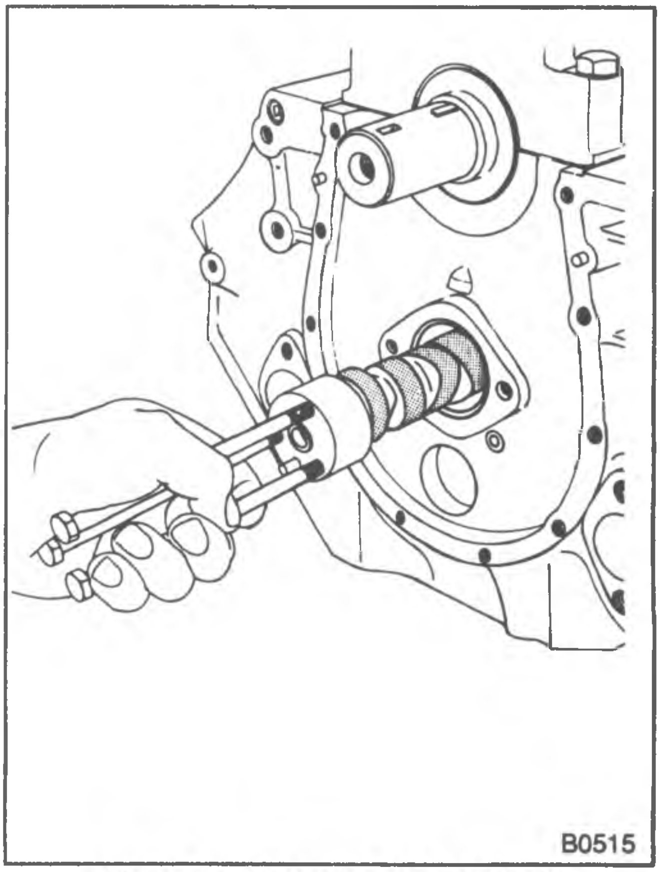


Figure 22—Removing the Camshaft

ing 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.

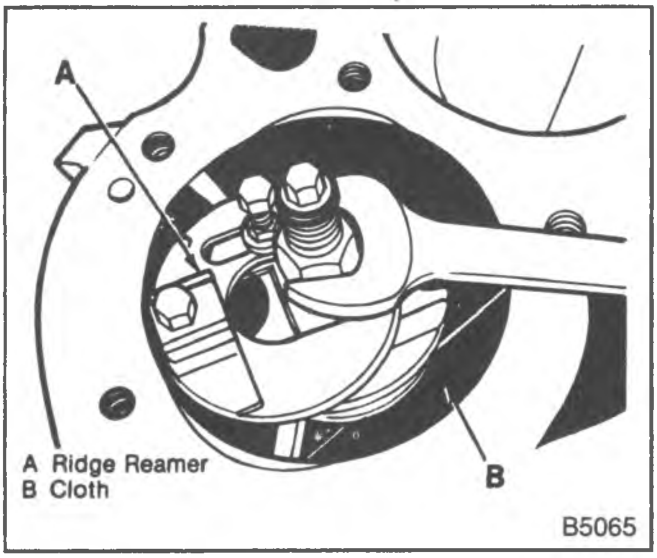


Figure 23—Removing the Cylinder Ridge

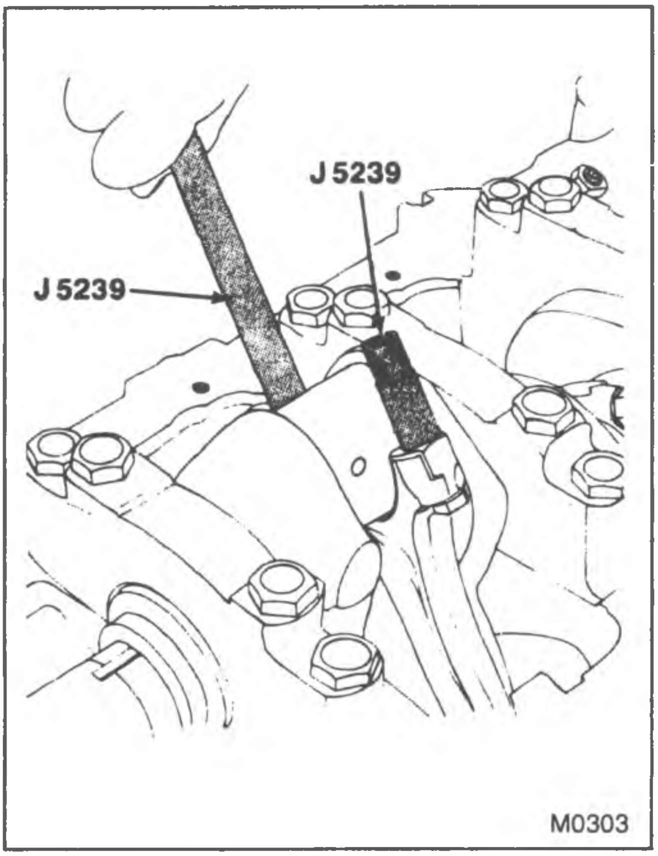


Figure 24—Removing the Piston and Connecting Rod

3. Connecting rod and piston from the block.
   - Push on the guide rod (item A, figure 24) to push the piston and connecting rod out.
   - Use the guide rod to prevent the connecting rod from scoring the cylinder bore.
   - Install the connecting rod cap onto the connecting rod. Do not tighten.
   - Repeat this procedure on the remaining piston and connecting rod assemblies.

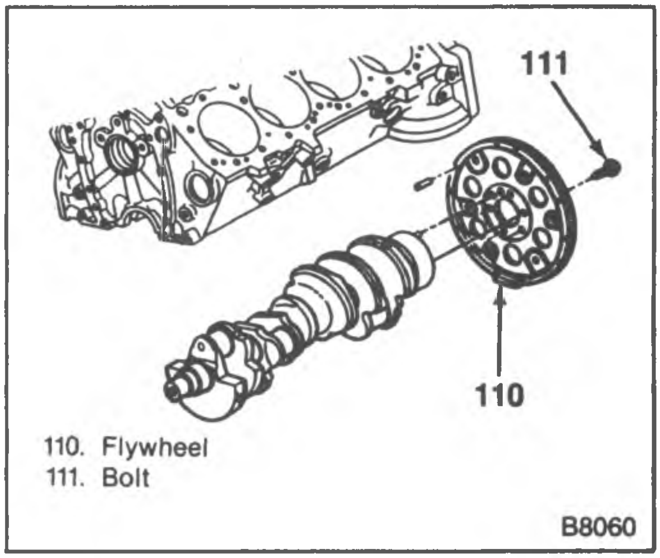


Figure 25—Flywheel (5.0L and 5.7L Engines)

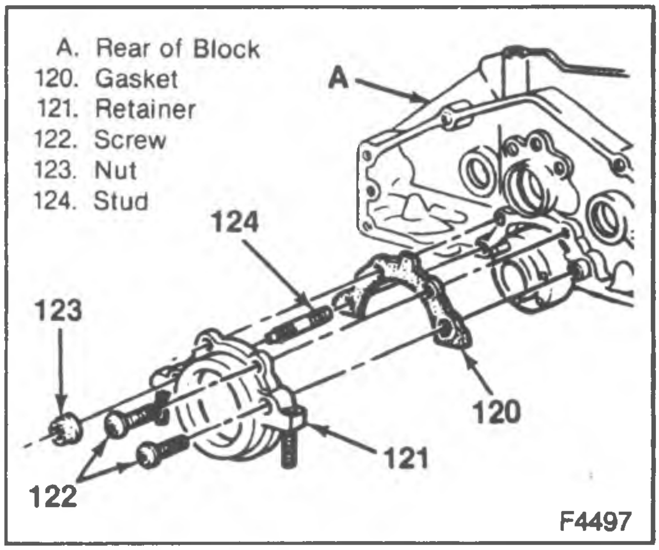


Figure 26—Rear Crankshaft Oil Seal Retainer (5.0L and 5.7L Engines)

FLYWHEEL REMOVAL

Remove or Disconnect (Figure 25)

1. Bolts (111).
2. Flywheel (110).

REAR CRANKSHAFT OIL SEAL RETAINER REMOVAL (5.0L and 5.7L ENGINES)

Remove or Disconnect (Figure 26)

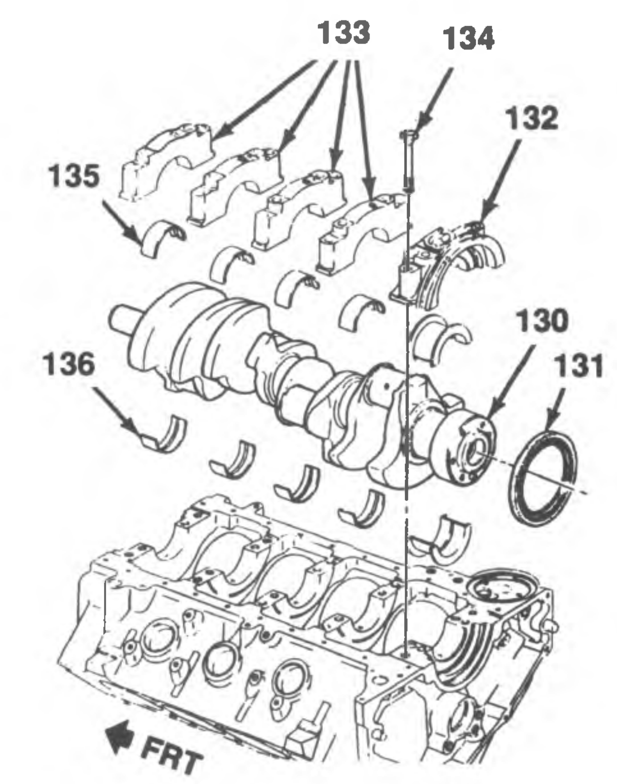
1. Screws and nuts.
2. Seal retainer (121).
3. Gasket (120).

CRANKSHAFT REMOVAL

Remove or Disconnect (Figure 27)

- 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).
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. Rear seal (131).
5. Main bearing inserts (135 and 136). If the main bearings are to be reused, mark them to insure they are installed in their original positions before removal.



130. Crankshaft
131. Rear Seal
132. Rear Main Bearing Cap
133. Main Bearing Cap
134. Bolt
135. Lower Main Bearing Insert
136. Upper Main Bearing Insert

F9332

Figure 27—Crankshaft and Components (7.4L Engines)

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 inside diameter (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 28)

- 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

- Main bearing vertical ID (inside diameter). Use an inside micrometer.
- This dimension should be the same as the other main bearing bore vertical diameters.

CYLINDER BORES

Inspect

- Cylinder bores for scoring and other damage.

Measure

- Cylinder out of round and taper. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

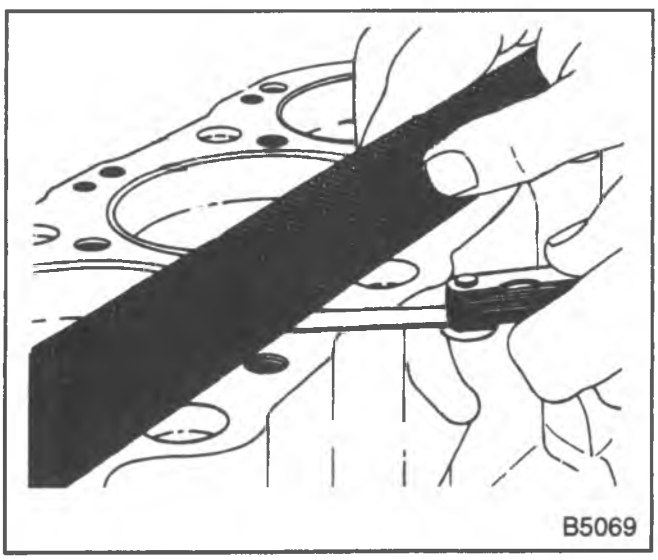


Figure 28—Checking the Block Gasket Surface

Cylinder Bore Reconditioning

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

For disassembly, cleaning, inspection, and assembly of these components, refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

Measure

- Piston pin diameter and pin to piston clearance.
- Piston to bore clearance, and fit pistons 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.

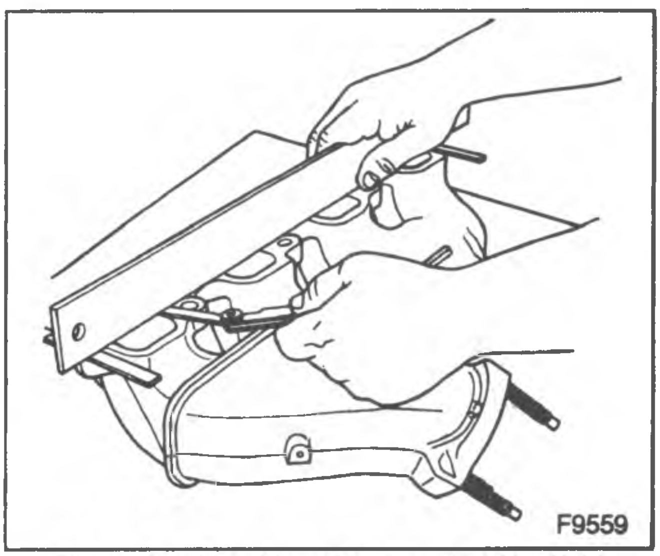


Figure 29—Checking Alignment of Manifold Flanges

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 29)

— Manifolds for cracks, broken flanges, and gasket surface damage.
— Alignment of exhaust manifold flanges. Use a straight edge and feeler gage (figure 29). If the flanges do not align, the manifold is warped and should be replaced.
— 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 30 and 31)

Tool Required:
J 7872 Dial Indicator (or equivalent)

— Camshaft runout (figure 30). Mount the camshaft in V-blocks or between centers. Using J 7872, check the intermediate camshaft journal. If runout exceeds (.002-inch), the camshaft is excessively bent and should be replaced along with the camshaft bearings.
— Camshaft journal out-of-round. Use a micrometer (figure 31). If the journals are more than 0.001-inch out-of-round, replace the camshaft.
— Camshaft journal diameter. Use a micrometer (figure 31). The proper diameter is listed in "Specifications."

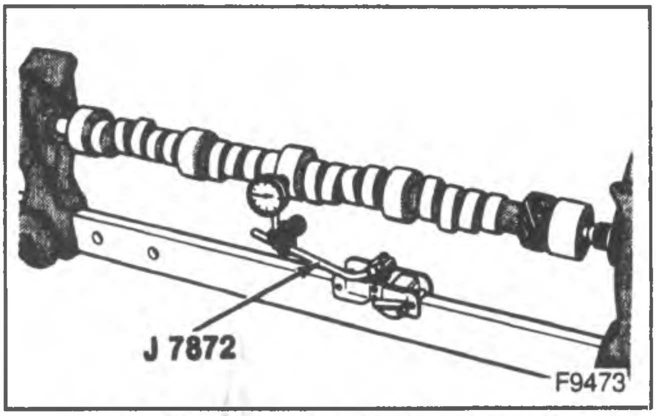


Figure 30—Measuring Camshaft Run-Out

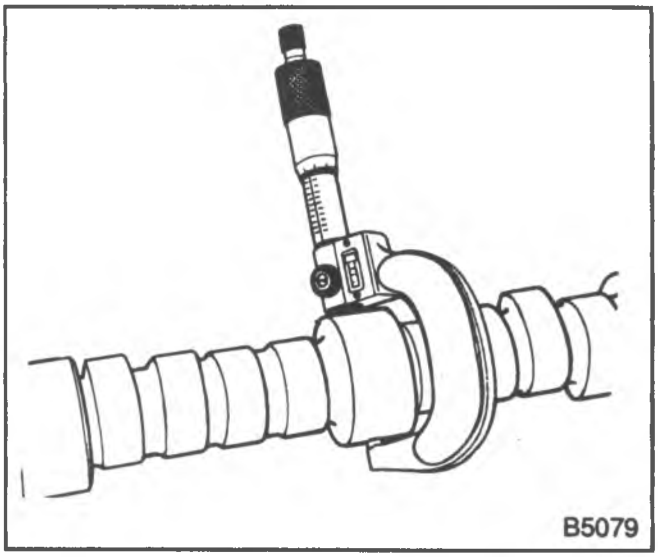


Figure 31—Checking the Camshaft Journals

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 32 and 33)

Tools Required:
J 5825 Crankshaft Sprocket Puller
J 1619 Crankshaft Sprocket Puller

1. Crankshaft sprocket. On 5.0L and 5.7L engines, use J 5825 (figure 32). On 7.4L engines, use J 1619 (figure 33).
2. Key, if necessary.

Assemble (Figures 32 and 33)

Tools Required:
J 5590 Crankshaft Sprocket Installer
J 22102 Crankshaft Sprocket Installer

1. Key, if removed.
2. Crankshaft sprocket. Use J 5590 (5.0L and 5.7L engines) or J 22102 (7.4L 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.

Assemble

- Front crankshaft seal. Use J 35468 (5.0L and 5.7L engines) or J 22102 (7.4L engines) (figure 34). The open end of the seal must be facing the inside of the front cover.
- Lightly coat the seal lips with grease.

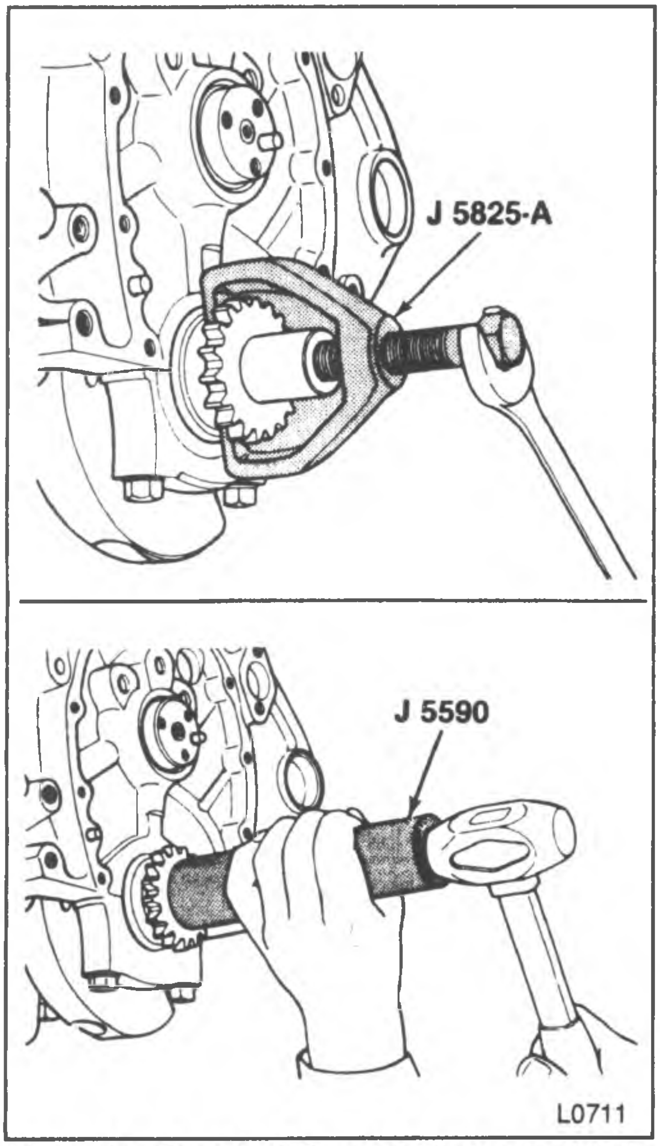


Figure 32—Crankshaft Sprocket Replacement (5.0L and 5.7L Engines)

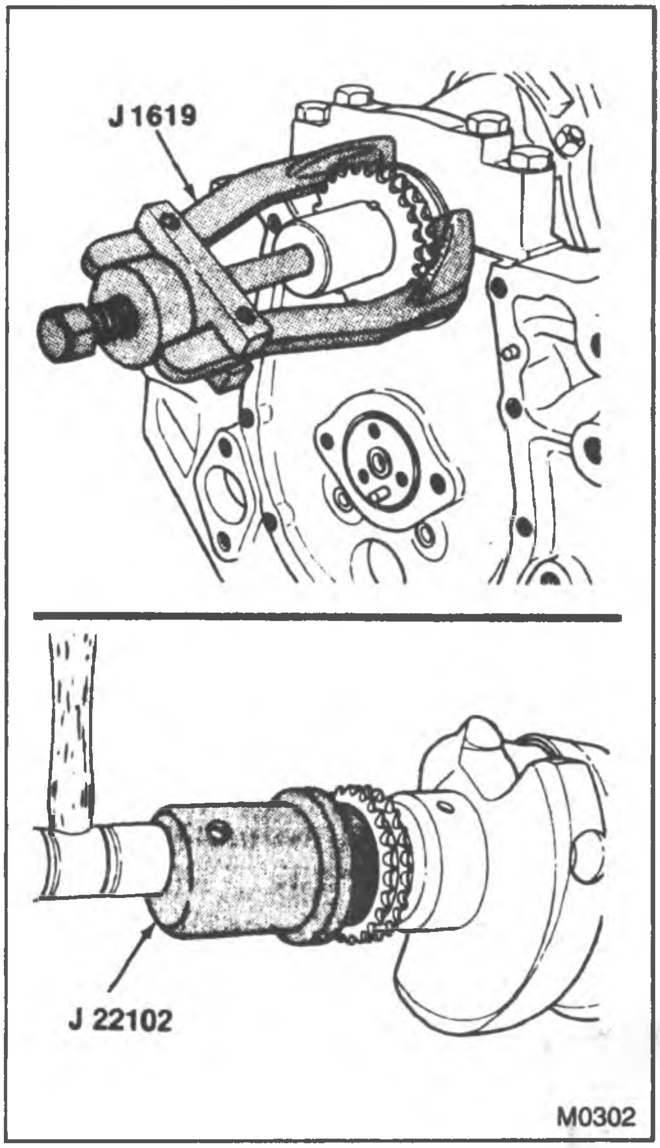


Figure 33—Crankshaft Sprocket Replacement (7.4L Engines)

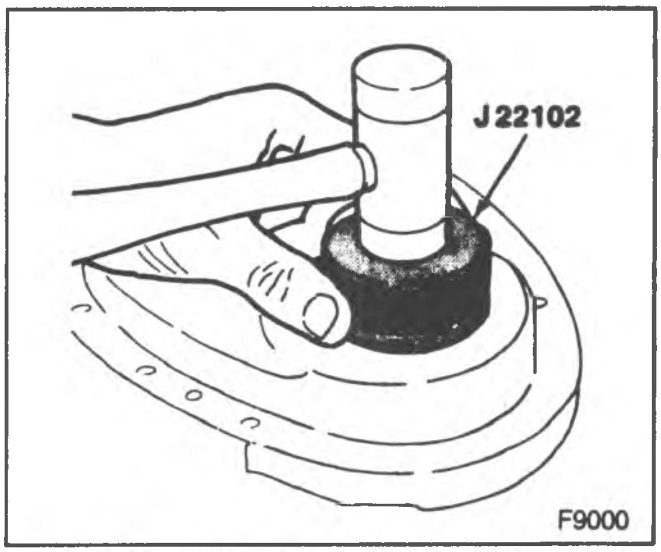


Figure 34—Installing the Front Crankshaft Seal

COOLANT 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

- Coolant pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the coolant pump.
- Coolant pump body at the drain hole. If there is evidence of coolant leakage, the coolant pump shaft seal is leaking and the coolant 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.

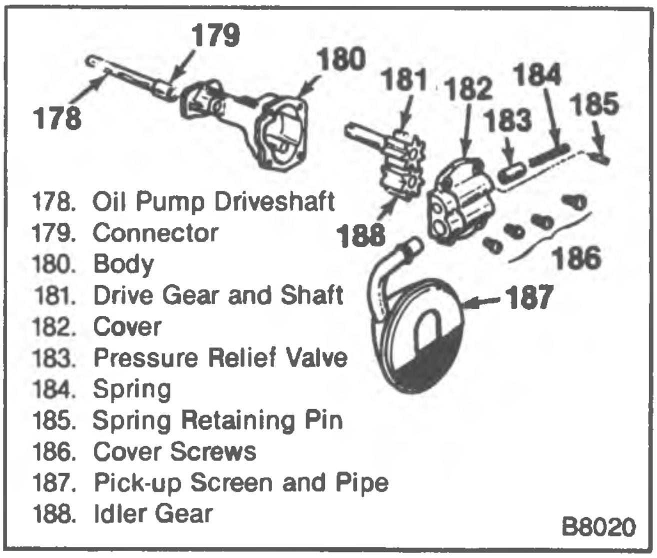
Inspect

— 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

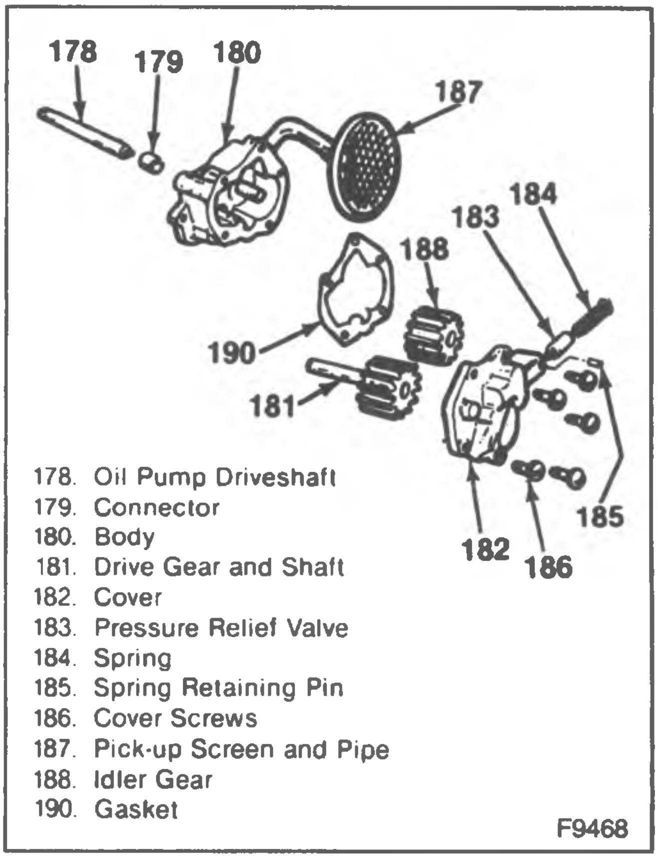
Disassemble (Figures 35 and 36)

1. Oil pump driveshaft (178) and connector (179).
2. Cover screws (186).
3. Cover (182) and gasket (190) (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. Spring (184).
8. Pressure relief valve (183).
9. Pickup screen and pipe (187).
   - Do not remove the pickup screen and pipe unless replacement is required. The 7.4L engine uses a pickup pipe and screen that are not serviceable, the oil pump assembly must be replaced if the pickup pipe or screen need replacement.
   - The pickup pipe is press fit in the pump body to seal it and welded to retain it.



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

Figure 35—Oil Pump Components (5.0L and 5.7L Engines)



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
190. Gasket

Figure 36—Oil Pump Components (7.4L Engines)

- 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.

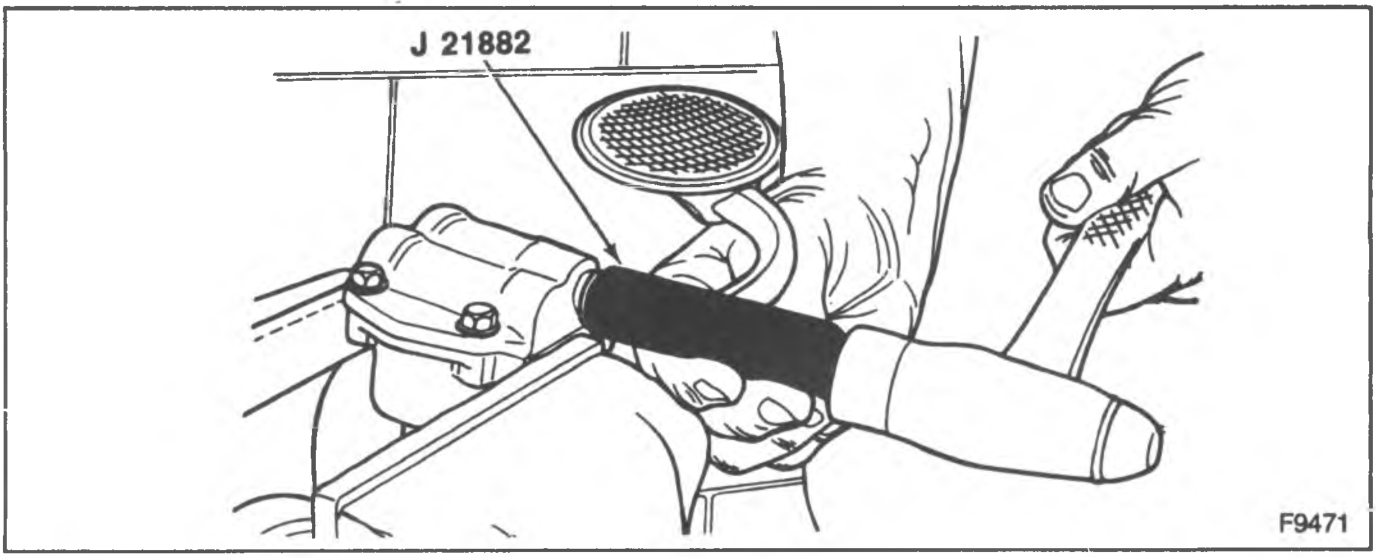


Figure 37—Installing the Oil Pump Pickup Tube and Screen (5.0L and 5.7L Engines)

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. (Figures 35, and 36)

Assemble (Figures 35, 36 and 37)

Tool Required:
J 21882 Pickup Tube and Screen Installer (5.0L and 5.7L engines)

1. Pressure relief valve (183).
2. Spring (184).
3. Spring retaining pin (185).
4. Drive gear and shaft (181).
5. 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.
6. Cover (182), gasket (190) (7.4L engines) and screws (186).

Tighten

- Screws (186) to 9 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.

7. Pickup screen and pipe (187) (if removed) (figure 37).
   - 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 (5.0L and 5.7L engines), and a hammer.
   - The pump screen must be parallel with the bottom of the oil pan when installed.
8. 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.

— 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 or bolts.
  - The 5.7L engine uses 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.
  - The 7.4L engine uses a bolt to retain the rocker arm, ball and pushrod guide to the cylinder head.

— Check pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

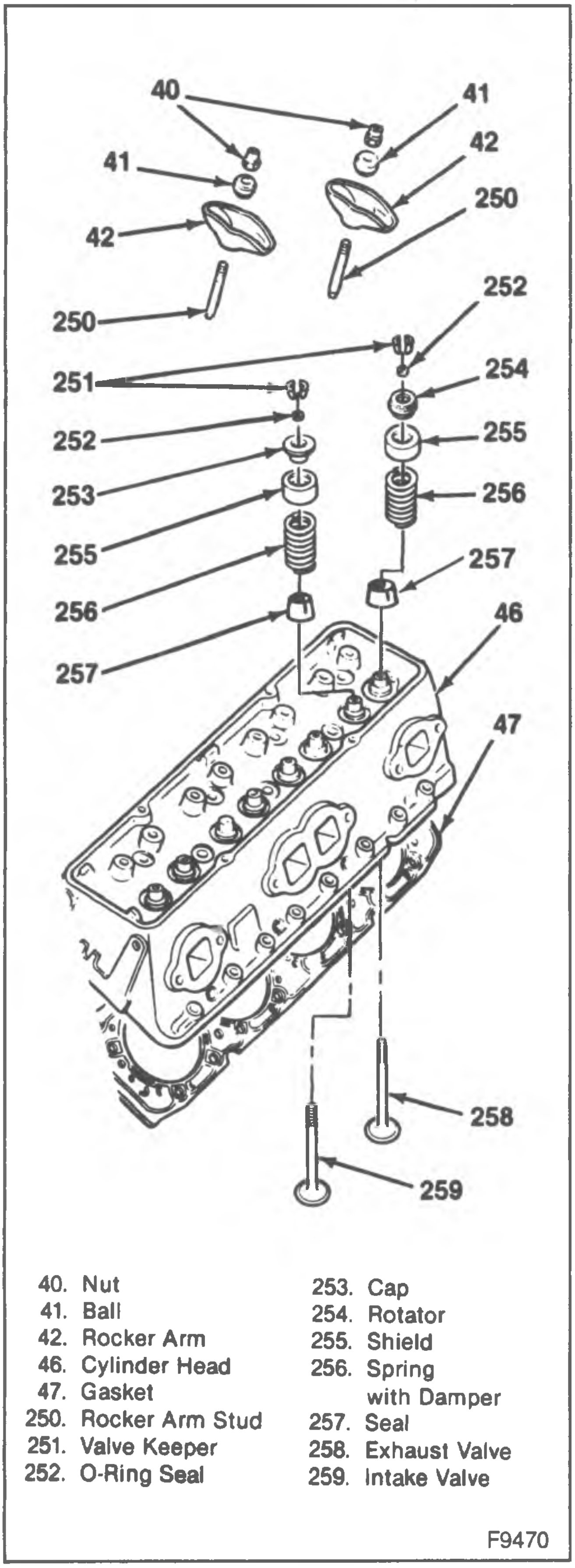


Figure 38—Cylinder Head and Components (5.0L and 5.7L Engines)

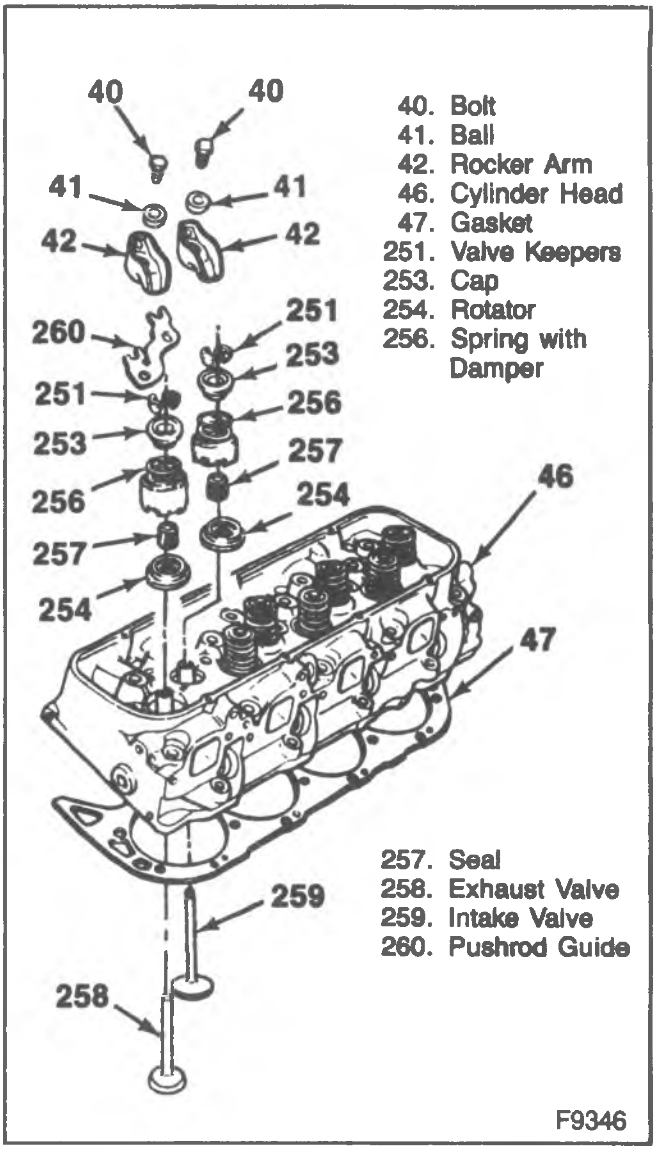


Figure 39—Cylinder Head and Components (7.4L Engines)

— Ends of the pushrods for scoring or roughness.

HYDRAULIC LIFTERS

Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

CYLINDER HEAD

Disassemble (Figures 38, 39 and 40)

Tool Required:
J 8062 Valve Spring Compressor

1. Valve keepers (251).
   - Compress the springs (256) with J 8062 (figure 40).
   - Remove the valve keepers.
   - Remove J 8062.
2. Caps (253), shields (255), springs with dampers (256) and rotators (254).

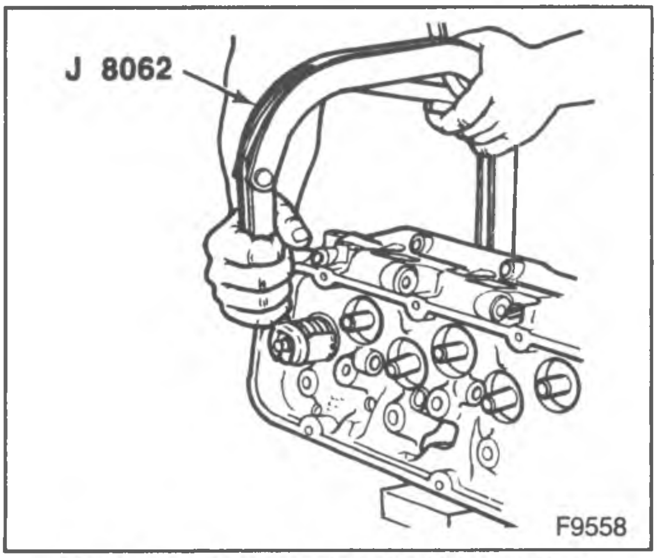


Figure 40—Compressing the Valve Springs

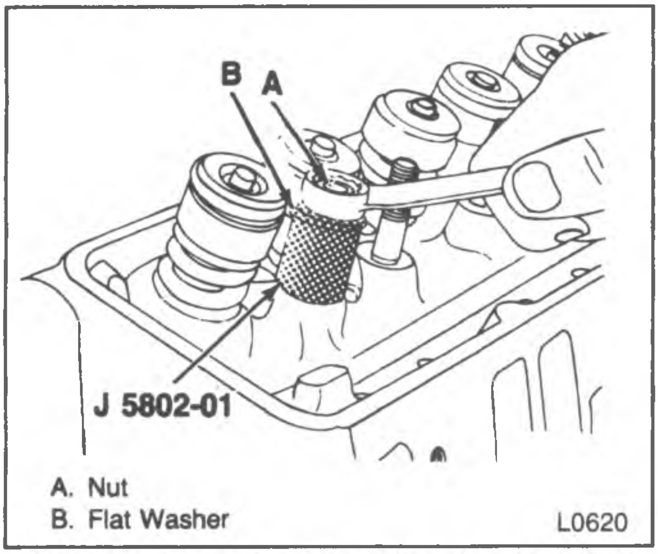


Figure 41—Removing the Rocker Arm Stud (5.0L and 5.7L Engines)

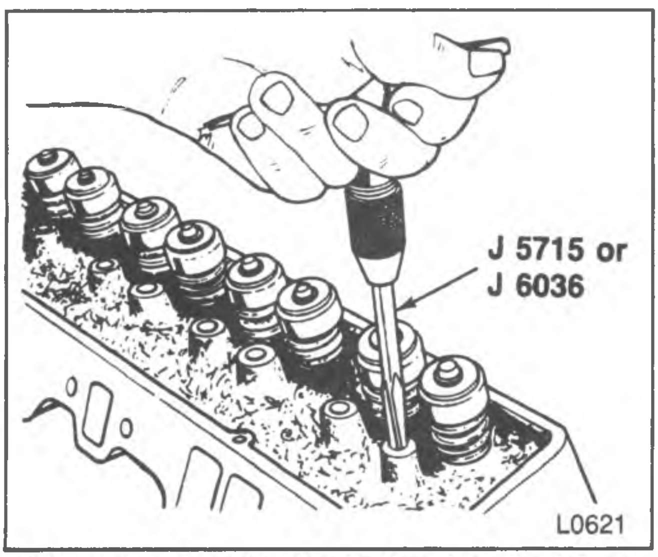


Figure 42—Reaming the Rocker Arm Stud Bore (5.0L and 5.7L Engines)

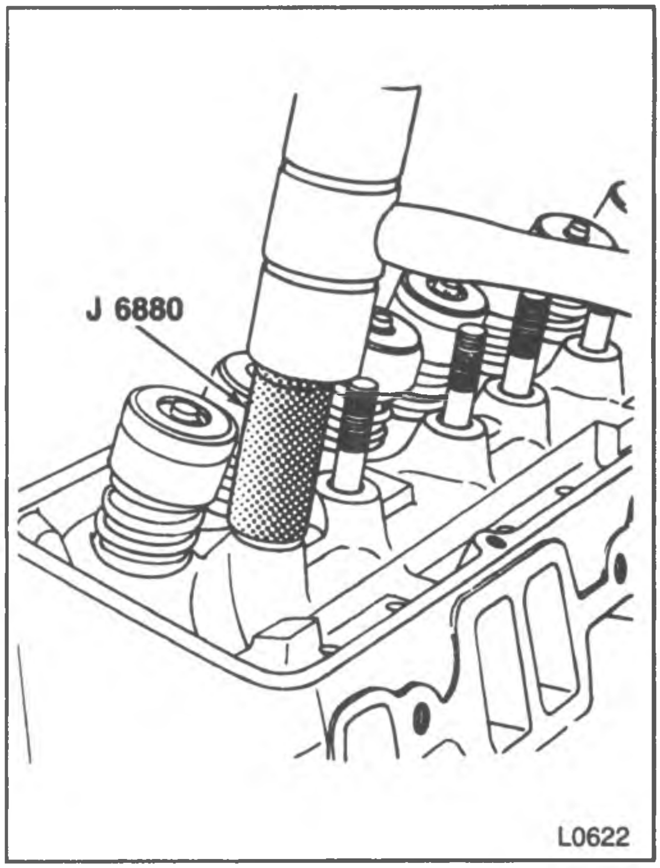


Figure 43—Installing the Rocker Arm Stud (5.0L and 5.7L Engines)

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:

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 (5.0L AND 5.7L 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 41).
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 42).

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 43).

ASSEMBLY (5.0L AND 5.7L ENGINES)

Assemble (Figures 38, 40, and 44)

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.
2. Seals (257). 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).

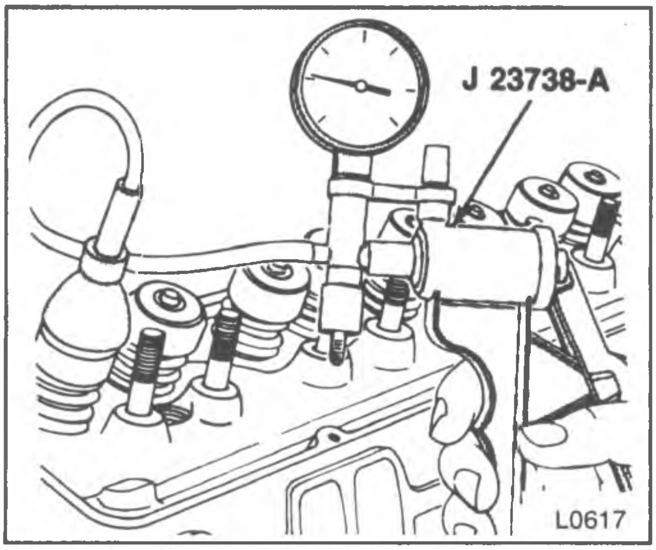


Figure 44—Checking the Valve Seal (5.0L and 5.7L Engines)

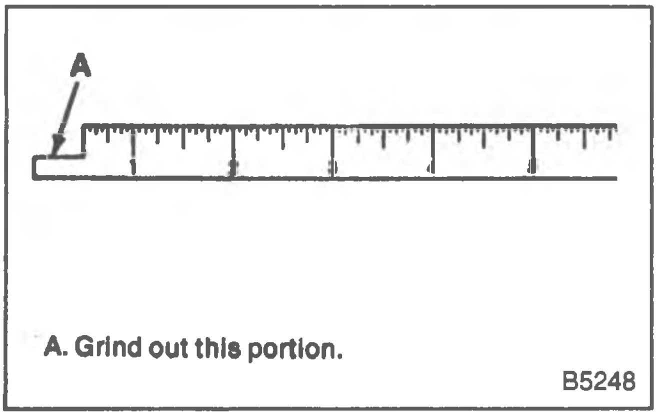


Figure 45—Cutaway Scale

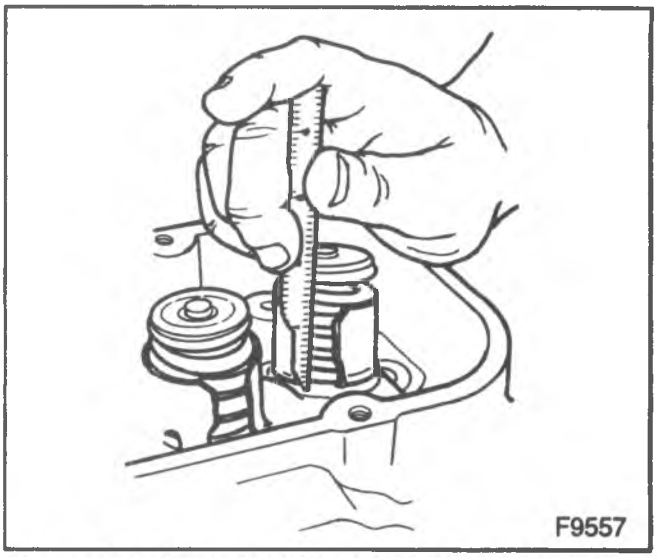


Figure 46—Measuring Valve Spring Installed Height (7.4L Engine)

7. O-ring seals (252) and valve keepers (251).
   - Compress the valve spring, using J 8062 (figure 40). 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 44). 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 45 and 46)

- Valve spring installed height of each valve spring as follows:
  1. Use a narrow, thin scale. A cutaway scale (figure 45) may be helpful.
  2. Measure from the valve shim or spring seat to the top of the shield (255) (figure 46).
  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 (7.4L ENGINES)

Assemble (Figures 39 and 40)

Tool Required:
J 8062 Valve Spring Compressor

1. Valves (258 and 259).
   - Lubricate the valve stems with engine oil.
   - 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 40). 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 45 and 46)

- Valve spring installed height of each valve spring.

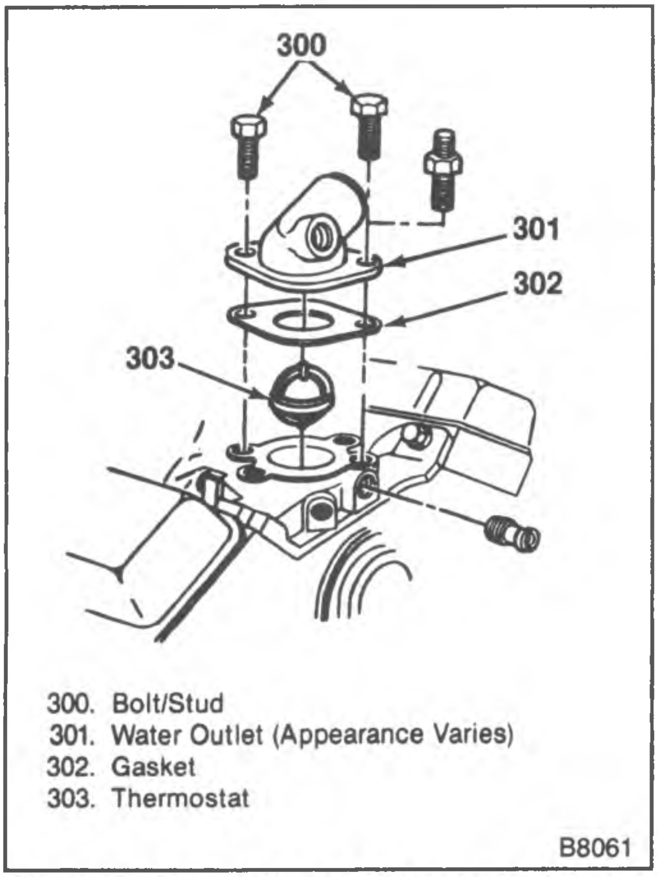


Figure 47—Thermostat and Components (5.0L and 5.7L Engines)

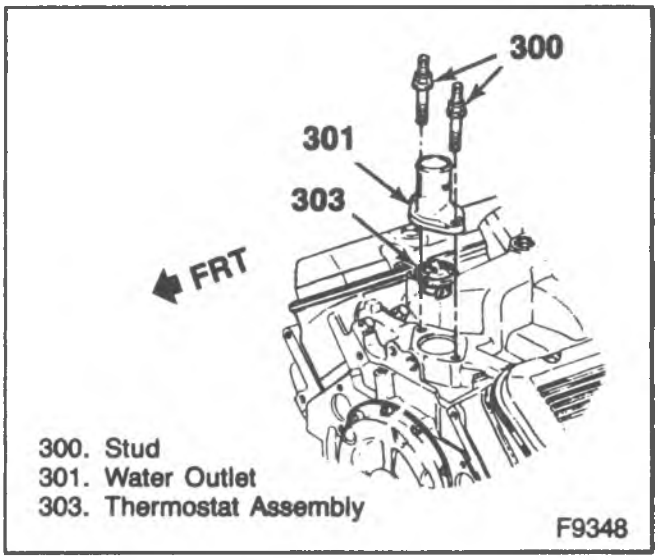


Figure 48—Thermostat and Components (7.4L Engines)

1. Use a narrow, thin scale. A cutaway scale (figure 45) may be helpful.
2. Measure from the spring seat to the top of the valve spring (figure 46).
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 (Figures 47 and 48)

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.

Install or Connect (Figures 47 and 48)

1. Thermostat (303).
2. Gasket (302).
3. Water outlet (301).
4. Bolts or studs (300).

Tighten

- Bolts or studs to specifications.
  - — 5.0L and 5.7L engines: 28 N·m (21 ft. lbs.).
  - — 7.4L 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.
— Seal running surfaces with a non-abrasive cleaner.
— 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.

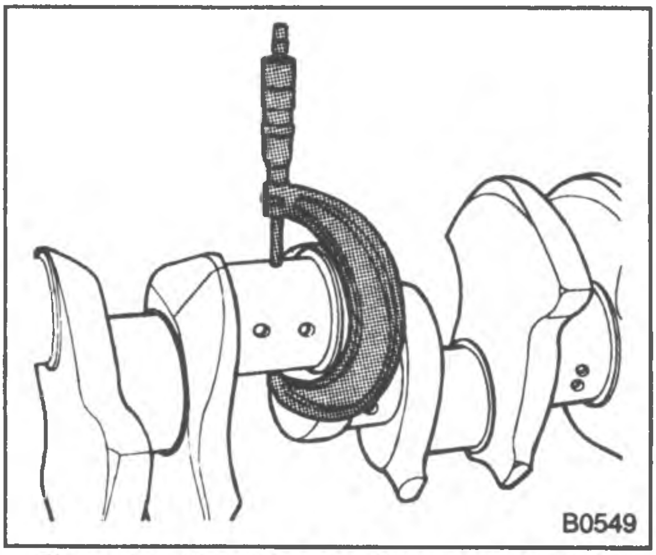


Figure 49—Measuring the Crankshaft Journals

Measure (Figures 49 and 50)

— Main bearing and connecting rod journal diameters (figure 49). Compare with "Specifications." Grind or replace the crankshaft if necessary.
— Main bearing and connecting rod journals for taper and out-of-round (figure 49). If the journals are tapered or out-of-round more than 0.001-inch, grind or replace the crankshaft.
— Crankshaft run-out (figure 50).

- 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.

Crankshaft Bearing Availability

Crankshaft main and connecting rod bearings are available in 0.001, 0.002, 0. 010, and 0.020-inch undersizes.

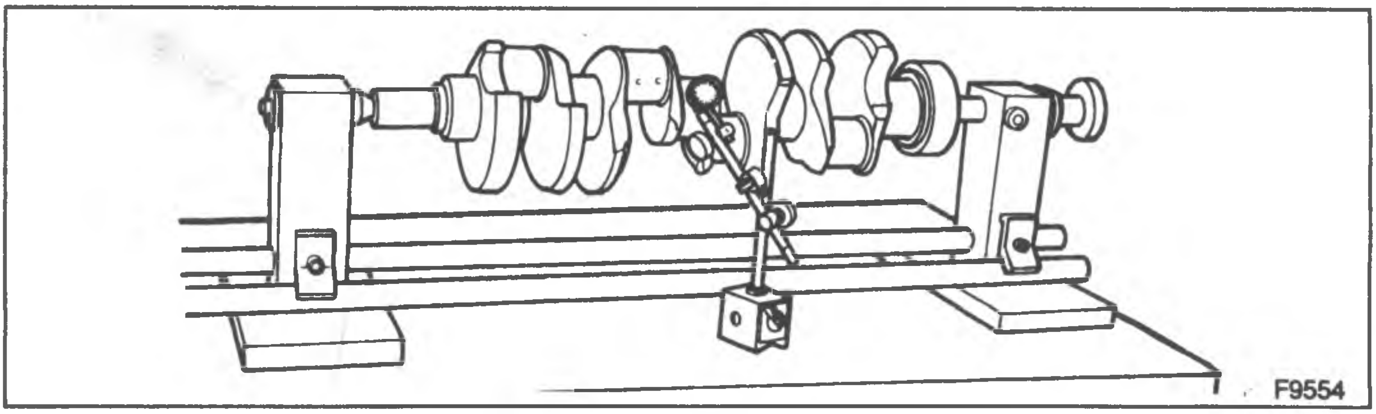


Figure 50—Checking the Crankshaft Run-Out

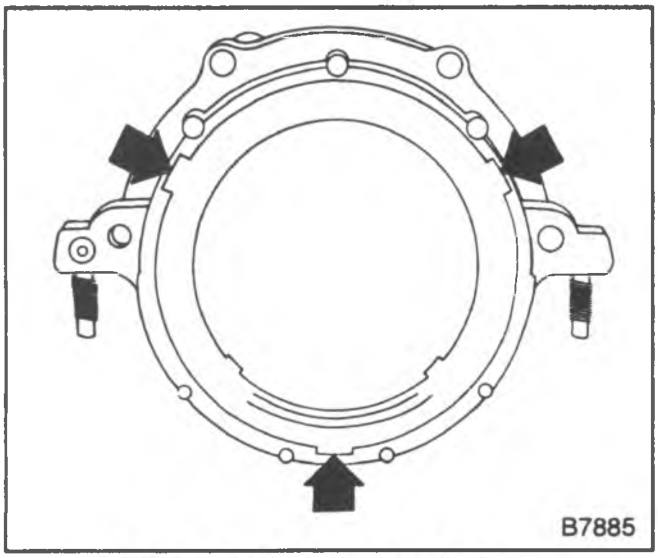


Figure 51—Seal Removal Notches (5.0 and 5.7L Engines)

REAR CRANKSHAFT OIL SEAL RETAINER (5.0L AND 5.7L ENGINES)

Disassemble (Figure 51)

- Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 51).

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

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 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 to 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 (5.0L AND 5.7L ENGINES)

- On 5.0L and 5.7L 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 (5.0L AND 5.7L ENGINES)

- Some 5.0L and 5.7L 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 52, 53, and 54)

1. Upper main bearing inserts to the block.

   Important

   - If any undersized bearings are used, make sure they are fitted to the proper journals.

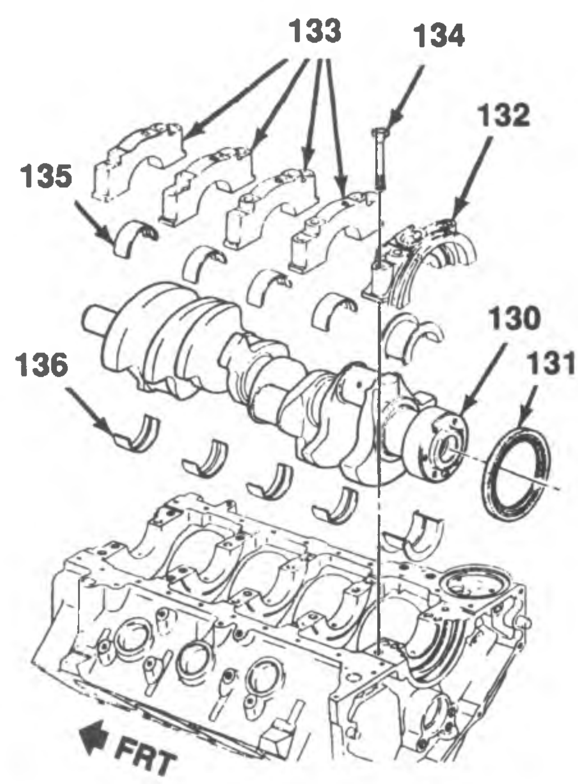
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps.

   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.



130. Crankshaft
131. Rear Seal
132. Rear Main Bearing Cap
133. Main Bearing Cap
134. Bolt
135. Lower Main Bearing Insert
136. Upper Main Bearing Insert

F9332

Figure 52—Crankshaft and Components (7.4L Engines)

Tighten

- Main bearing cap bolts to specifications.
  - 5.0L and 5.7L 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.).
  - 7.4L engines: 150 N·m (110 ft. lbs.).

5. Rear main bearing cap and bolts to the block.

- On 7.4L engines, apply anaerobic sealing compound to the rear bearing cap sealing face or to the rear bearing cap channel of the engine block, from the corner of the rear thrust bearing pocket to the edge of the channel as shown in figure 53. Do not allow any sealant on either crankshaft or rear oil seal.

Tighten

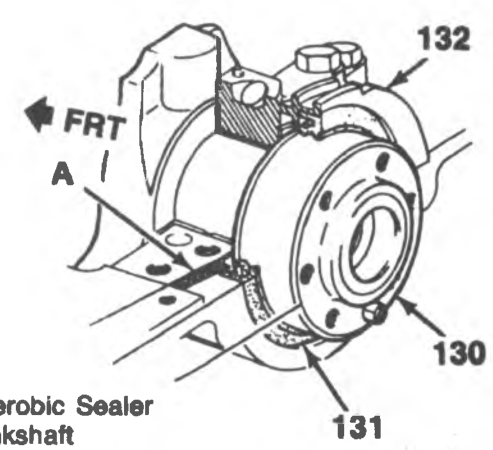
- Rear main bearing cap bolts temporarily to 14 N·m (124 in. lbs.).

Measure (Figure 54)

- 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

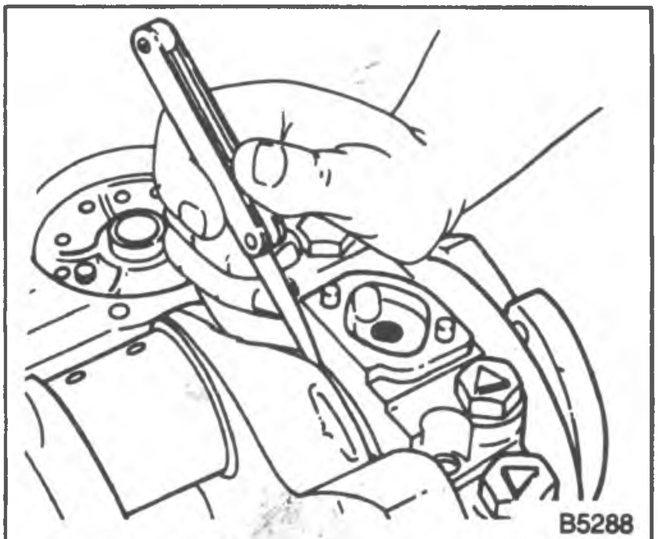
- Rear main bearing cap bolts to specifications:
  — 5.0L and 5.7L engines: 110 N·m (80 ft. lbs.).
  — 7.4L engines: 150 N·m (110 ft. lbs.).
- With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 54). The proper clearance is 0.002-0.006-inch (5.0L and 5.7L engines), 0.002-0.010-inch (7.4L engines).



A. Anaerobic Sealer
130. Crankshaft
131. Rear Seal
132. Rear Main Bearing Cap

F9350

Figure 53—Applying Sealant to the Block (7.4L Engines)



B5288

Figure 54—Measuring Crankshaft End Play

- On 5.0L and 5.7L 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 INSTALLATION (7.4L ENGINES)

Install or Connect

Tool Required:
J 38841 Seal Installer

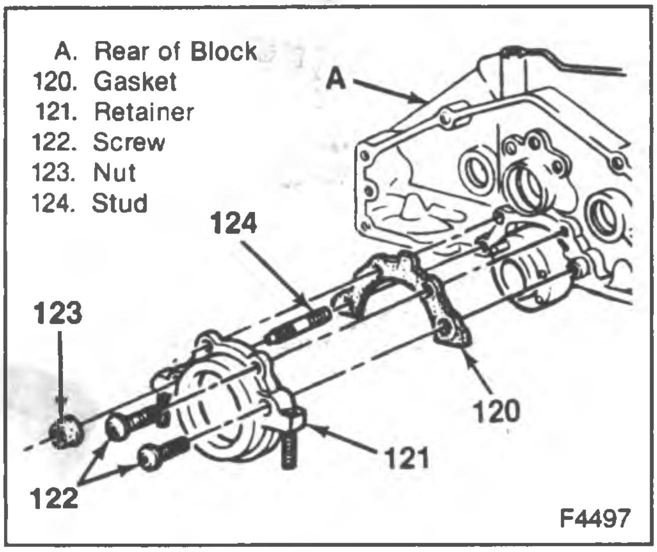


Figure 55—Rear Crankshaft Oil Seal Retainer (5.0L and 5.7L Engines)

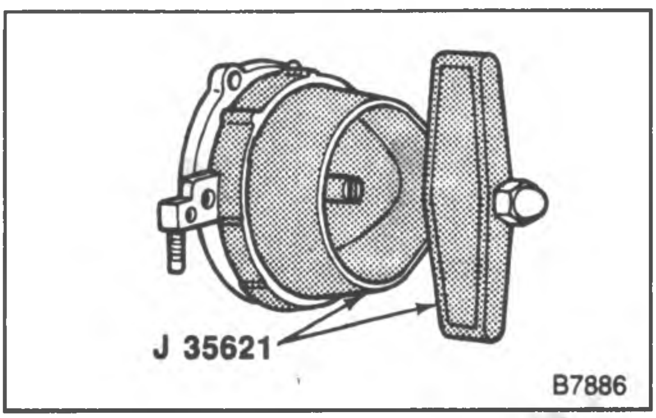


Figure 56—Installing the Rear Crankshaft Oil Seal (5.0L and 5.7L Engines)

— Rear crankshaft oil seal.

- 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 38841.
- Position J 38841 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 38841.

REAR CRANKSHAFT OIL SEAL AND RETAINER INSTALLATION (5.0L AND 5.7L ENGINES)

Install or Connect (Figures 55 and 56)

Tool Required:
J 35621 Seal Installer

- Whenever the seal retainer is removed, a new retainer gasket and rear crankshaft oil seal must be installed.

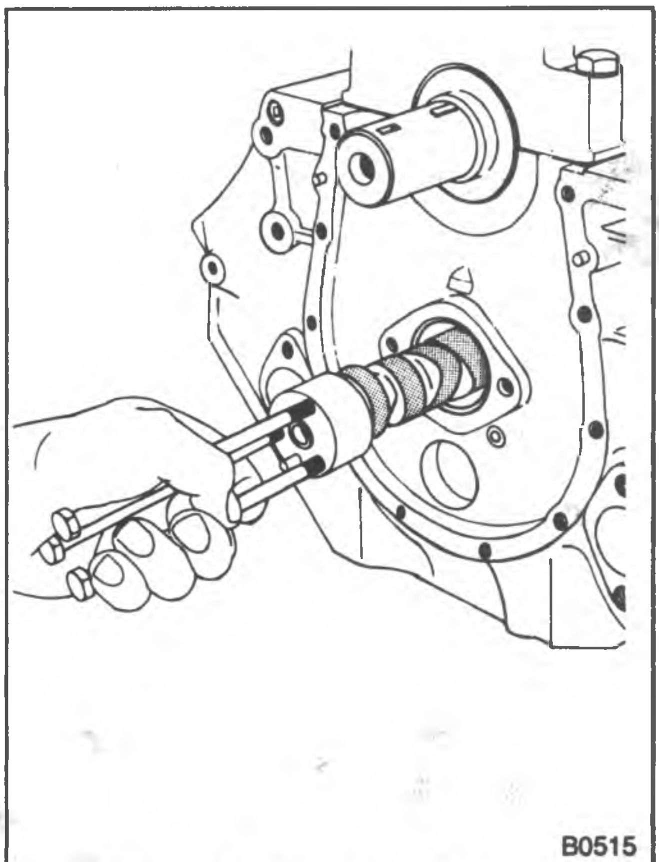


Figure 57—Installing the Camshaft

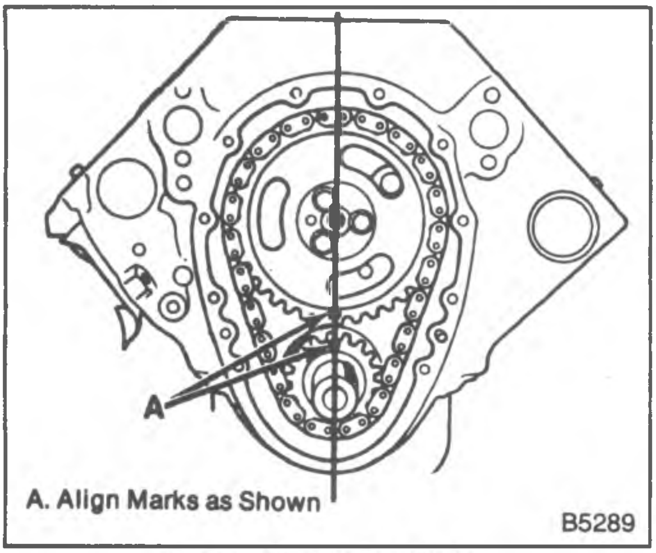


Figure 58—Timing Marks

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.

Tighten

- Screws and nuts to 15 N·m (11 ft. lbs.).

4. Rear crankshaft oil seal (figure 56).
   - 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.

CAMSHAFT, TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figures 57 and 58)

- Coat the camshaft lobes and journals with Engine Oil Supplement (GM part number 1051396) or equivalent.

1. Camshaft (figure 57).
   - 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.

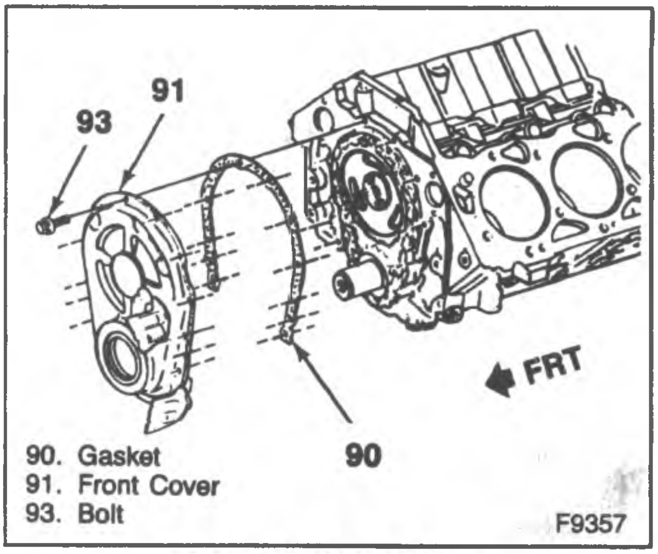


Figure 59—Front Cover

Important

- Align the timing marks on the camshaft sprocket and crankshaft sprocket (figure 58).

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.
  - — 5.0L and 5.7L engines: 28 N·m (21 ft. lbs.).
  - — 7.4L 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 59)

- Lubricate the lips of the front crankshaft oil seal with engine oil.

1. Gasket (90).
2. Front cover (91).
3. Bolts (93).

Tighten

- Bolts (93) to specifications:
  - — 5.0L and 5.7L engines: 10 N·m (96 in. lbs.).
  - — 7.4L engines: 11 N·m (100 in. lbs.).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figure 60)

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 60) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.

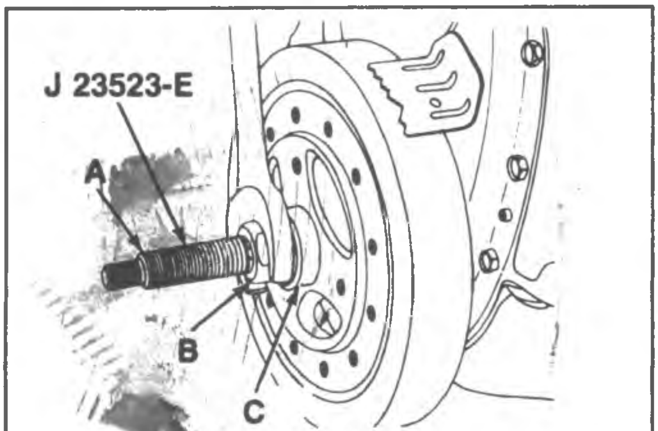


Figure 60—Installing the Torsional Damper

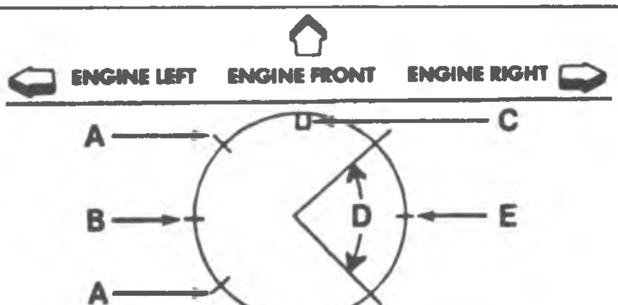


Figure 61—Piston Ring End Gap Location (5.0L and 5.7L Engines)

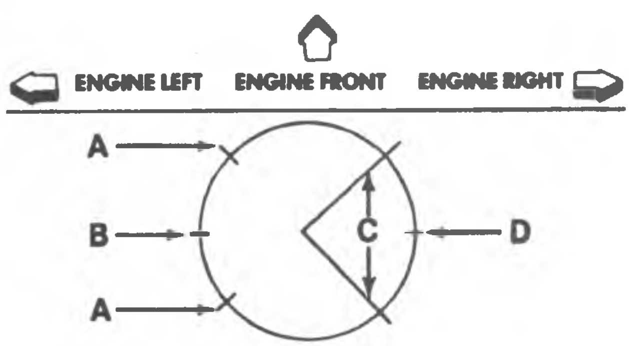


Figure 62—Piston Ring End Gap Location (7.4L Engines)

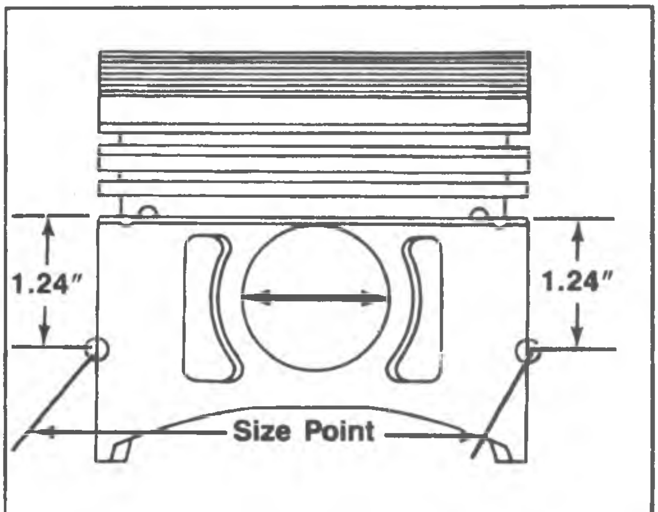


Figure 63—Piston Pin Hole Diameter

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 60).
   - 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.
  - — 5.0L and 5.7L engines: 95 N·m (70 ft. lbs.).
  - — 7.4L engines: 115 N·m (85 ft. lbs.).

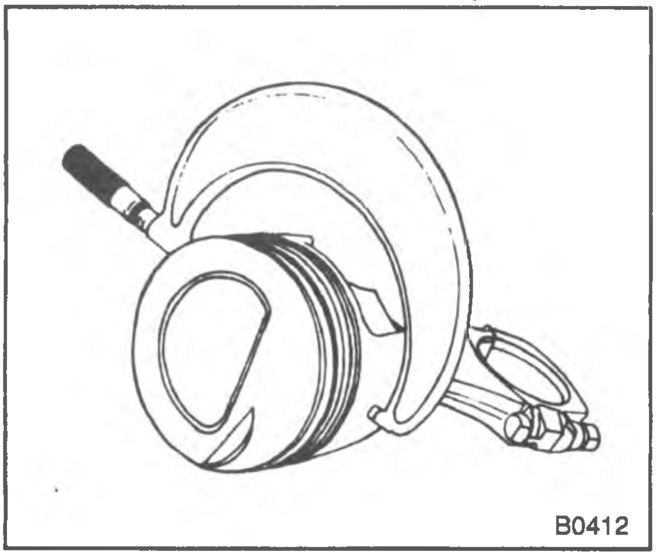


Figure 64—Measuring Piston Diameter

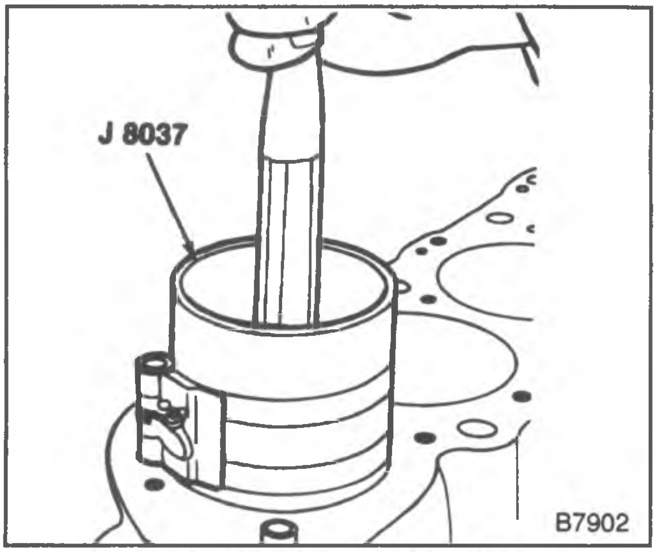


Figure 65—Installing the Piston

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 5.0L and 5.7L 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.

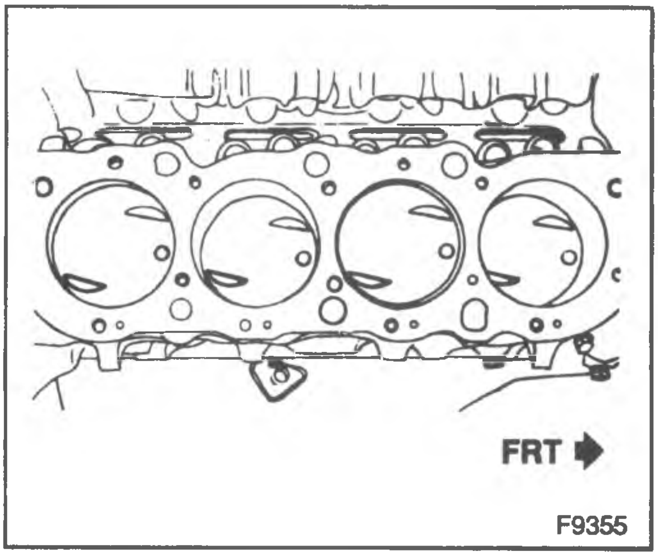


Figure 66—Piston Installed (7.4L Engines)

INSTALLATION

Install or Connect (Figures 61 through 66)

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 61 (5.0L and 5.7L engines) or figure 62 (7.4L engines).
   - Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston (figure 65).
   - Use a hammer handle to tap the piston down into its matching bore.
     - —On 5.0L and 5.7L engines, the notch in the piston crown (figure 61) must face the front of the engine.
     - —On 7.4L engines, the dimple must face the front of the block (figure 66).
   - 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

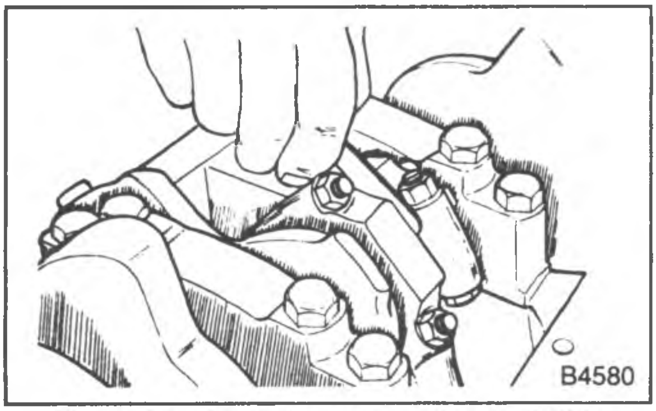
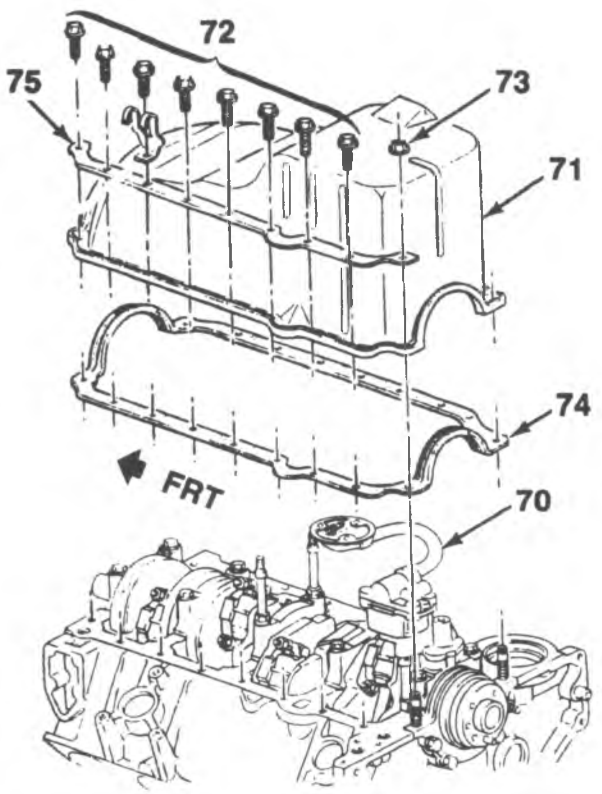


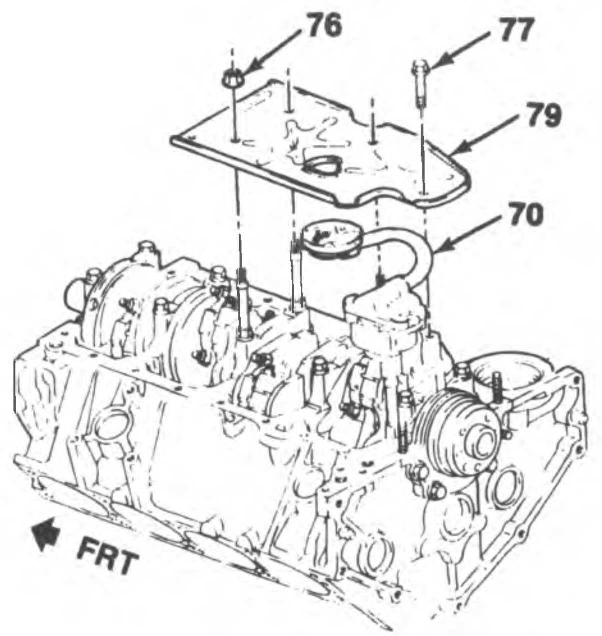
Figure 67—Measuring Connecting Rod Side Clearance



70. Oil Pump
71. Oil Pan
72. Bolt
73. Nut
74. Gasket
75. Reinforcement

F9364

Figure 68—Oil Pan (5.0L and 5.7L Engines)



70. Oil Pump
76. Nut
77. Bolt
79. Oil Pan Baffle (H.D. 5.7L)

F9365

Figure 69—Oil Pan Baffle

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.
  - — 5.0L and 5.7L engines: 60 N·m (45 ft. lbs.).
  - — 7.0L engines: 66 N·m (48 ft. lbs.).

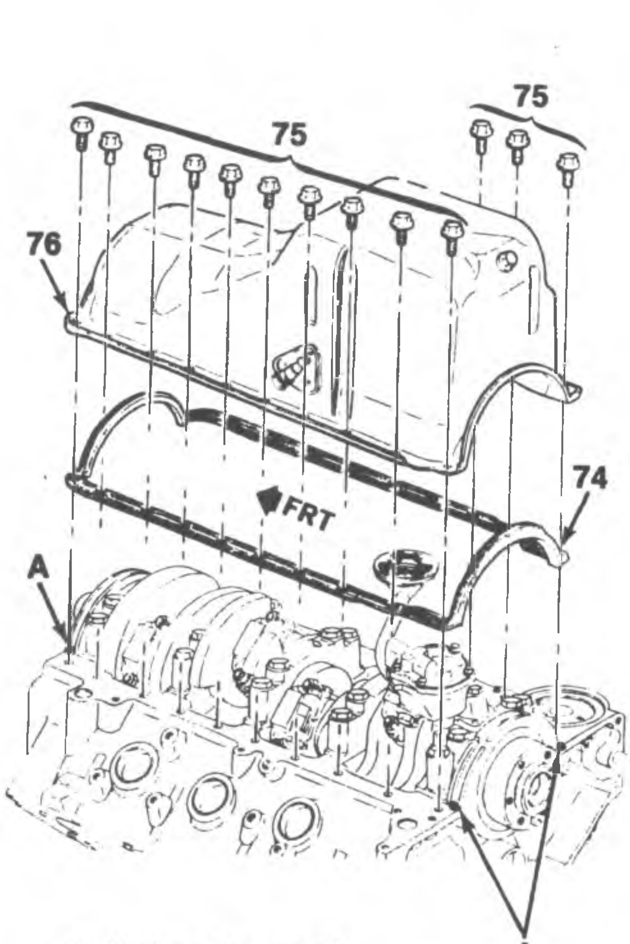
Measure (Figure 67)

- Connecting rod side clearance. Use a feeler gage between the connecting rods (figure 67). The proper clearance is as follows:
  - — 5.0L and 5.7L engines: 0.006-0.014-inch.
  - — 7.4L 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.



A. Sealing Compound
74. Gasket
75. Bolt
76. Oil Pan

F9331

Figure 70—Oil Pan (7.4L Engines)

Tighten

- Bolt to 90 N·m (65 ft. lbs.).

OIL PAN INSTALLATION

5.0L AND 5.7L ENGINES

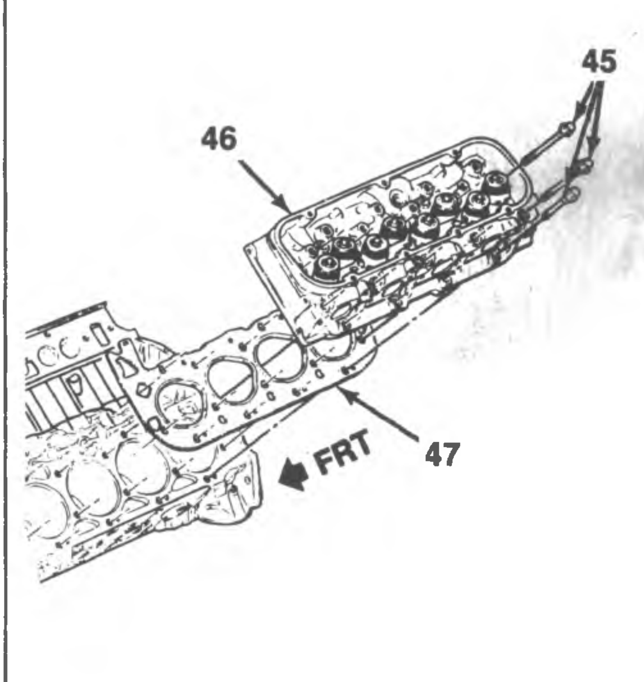
Install or Connect (Figures 68 and 69)

- Apply PST sealer (GM part no. 1052080 or equivalent) to the front cover to block joint and rear crankshaft seal retainer to block joint.

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 N·m (100 in. lbs.).
— Oil pan nuts to 22 N·m (200 in. lbs.).



45. Bolt
46. Cylinder Head
47. Gasket

F9327

Figure 71—Cylinder Head (7.4L Engines)

7.4L ENGINES

Install or Connect (Figure 70)

- Apply PST sealer (GM part no. 1052080 or equivalent) in four places where the front and rear main bearing caps meet the engine block as shown in figure 70.

1. Gasket (74) to the block.
2. Oil pan (76). Make sure the gasket stays in place.
3. Bolts (75).

Tighten

- Bolts to 18 N·m (160 in. lbs.).

CYLINDER HEAD INSTALLATION

Clean

— Gasket surfaces on block and cylinder head.

Install or Connect (Figures 71, 72, 73 and 74)

1. Head gasket.
   - On engines using a STEEL gasket, coat both sides of the new gasket with an anaerobic sealer. Spread the sealer thin and even. Too much sealer may hold the gasket away from the head or block.
   - Use no sealer on engines using a composition gasket.

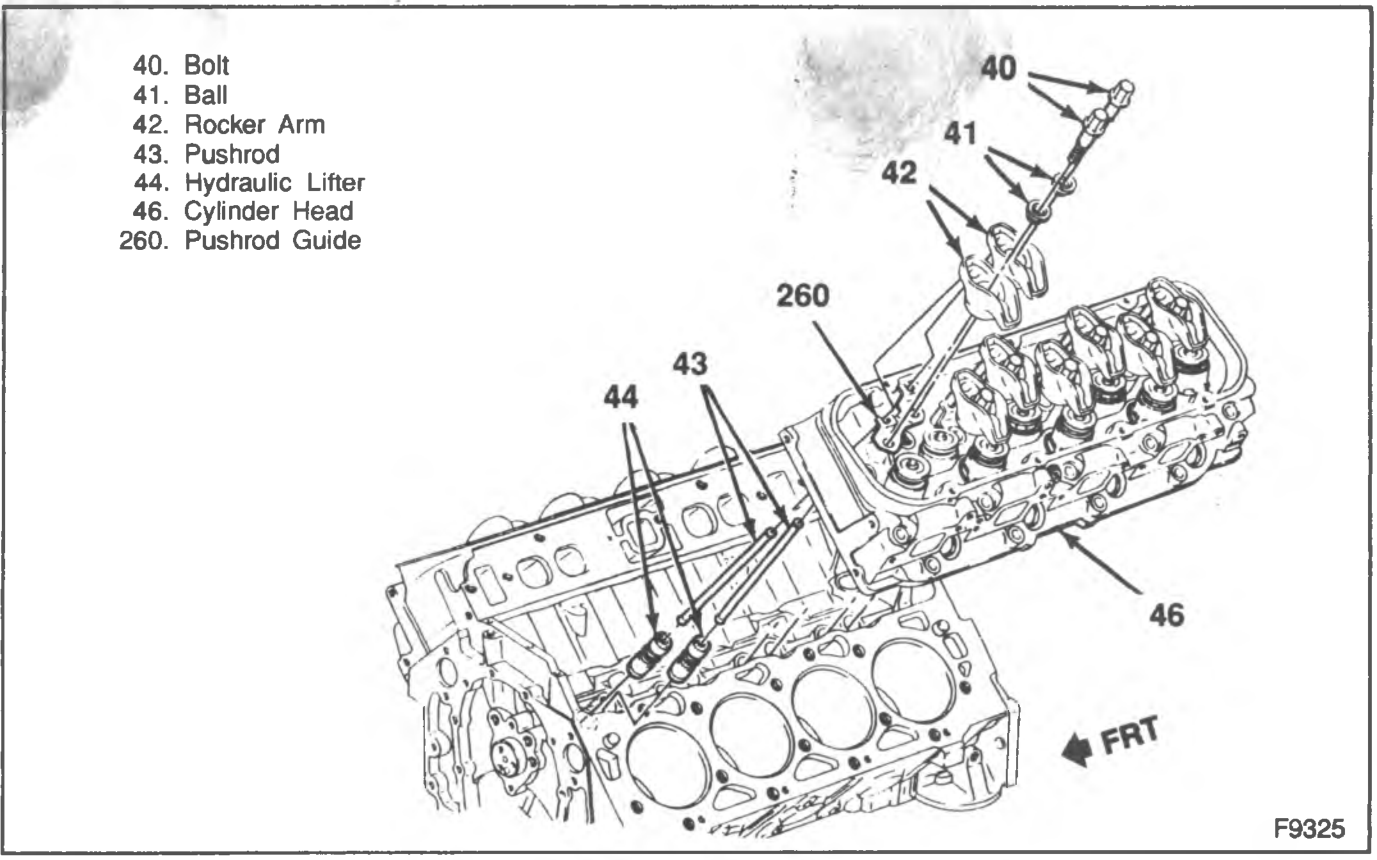


Figure 72—Cylinder Head and Components (7.4L Engines)

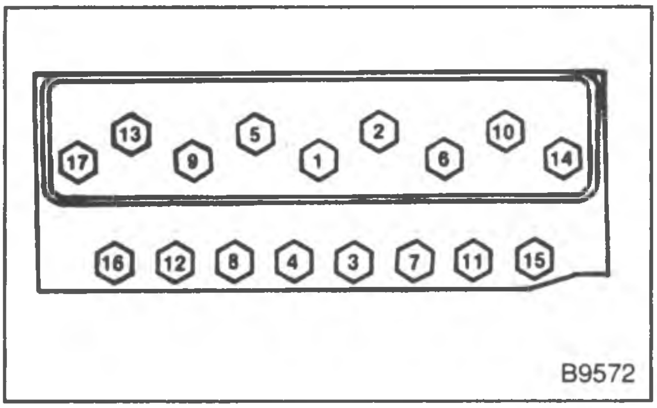


Figure 73—Cylinder Head Bolt Tightening Sequence (5.0L and 5.7L Engines)

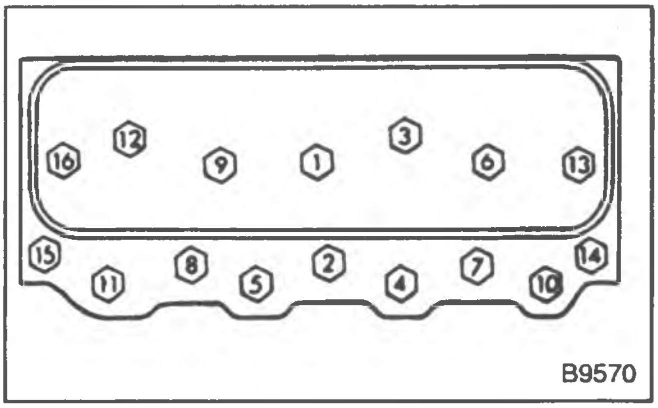


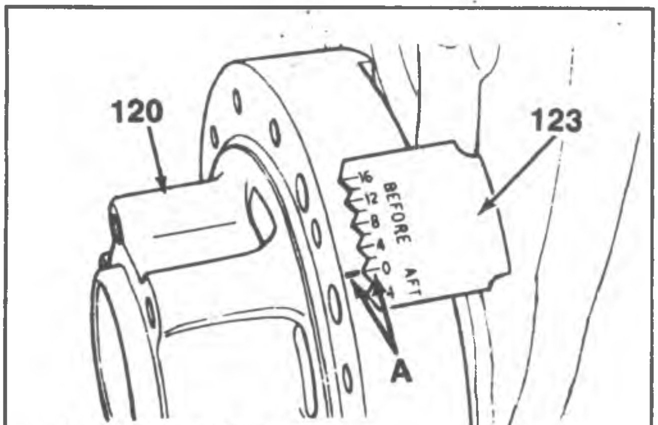
Figure 74—Cylinder Head Bolt Tightening Sequence (7.4L Engines)

- 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.

Tighten

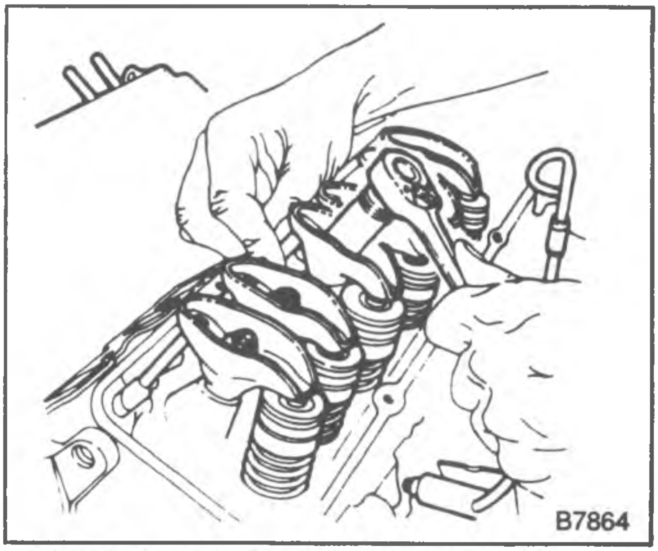
- Bolts in three steps using the sequence shown in figures 73 or 74 until the proper torque is reached:
  - 5.0L and 5.7L engines:
    - The first sequence should go to 35 N.m (25 ft. lbs.).
    - The second sequence should go to 60 N.m (45 ft. lbs).
    - The final torque sequence should be 90 N.m (65 ft. lbs.).
  - 7.4L engines:
    - The first sequence should go to 40 N.m (30 ft. lbs.).
    - The second sequence should go to 80 N.m (60 ft. lbs).
    - The final torque sequence should be 110 N.m (80 ft. lbs.).



A. Timing Marks
120. Torsional Damper
123. Timing Tab

F9358

Figure 75—Timing Marks



B7864

Figure 76—Adjusting the Valves (5.0L and 5.7L Engines)

VALVE TRAIN COMPONENT INSTALLATION

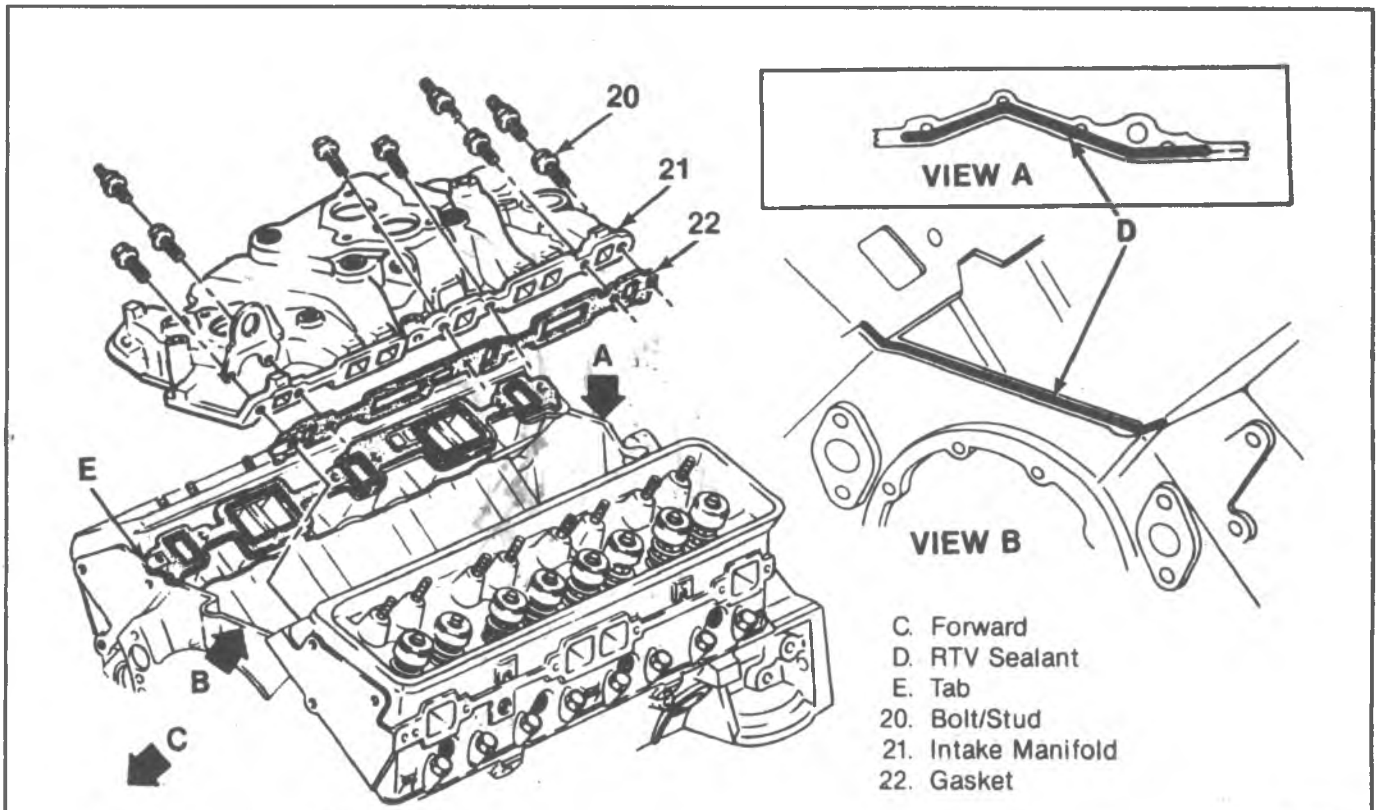
Important

- Replace all hydraulic lifters if a new camshaft was installed.

Install or Connect (Figure 72)

- 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.
   - The 7.4L engine uses different length intake and exhaust pushrods. The exhaust valve



C. Forward
D. RTV Sealant
E. Tab
20. Bolt/Stud
21. Intake Manifold
22. Gasket

F5723

Figure 77—Intake Manifold (5.0L and 5.7L Engines)

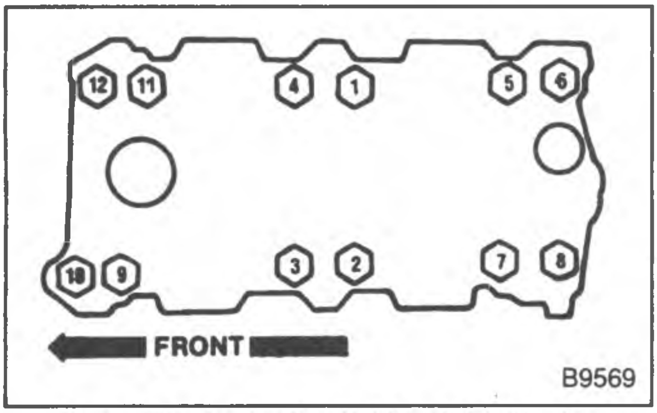


Figure 78—Intake Manifold Bolt Tightening Sequence (5.0L and 5.7L Engines)

pushrods are longer than the intake valve pushrods.

- Coat the mating surfaces of the rocker arms (42) and balls (41) with "Moly Kote" or equivalent.

3. Pushrod guides (260), 7.4L engines only.
4. Rocker arms.
5. Balls.
6. Nuts, on 5.0L and 5.7L engines or bolts on 7.4L engines.

Tighten

- Bolts to 54 N.m (40 ft. lbs.), 7.4L Engines only.

VALVE ADJUSTMENT

5.0L and 5.7L ENGINES

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 75). 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.
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 76). When the play has been removed, turn the adjusting nut in as follows:
   - — 5.0L and 5.7L engines: One full turn.

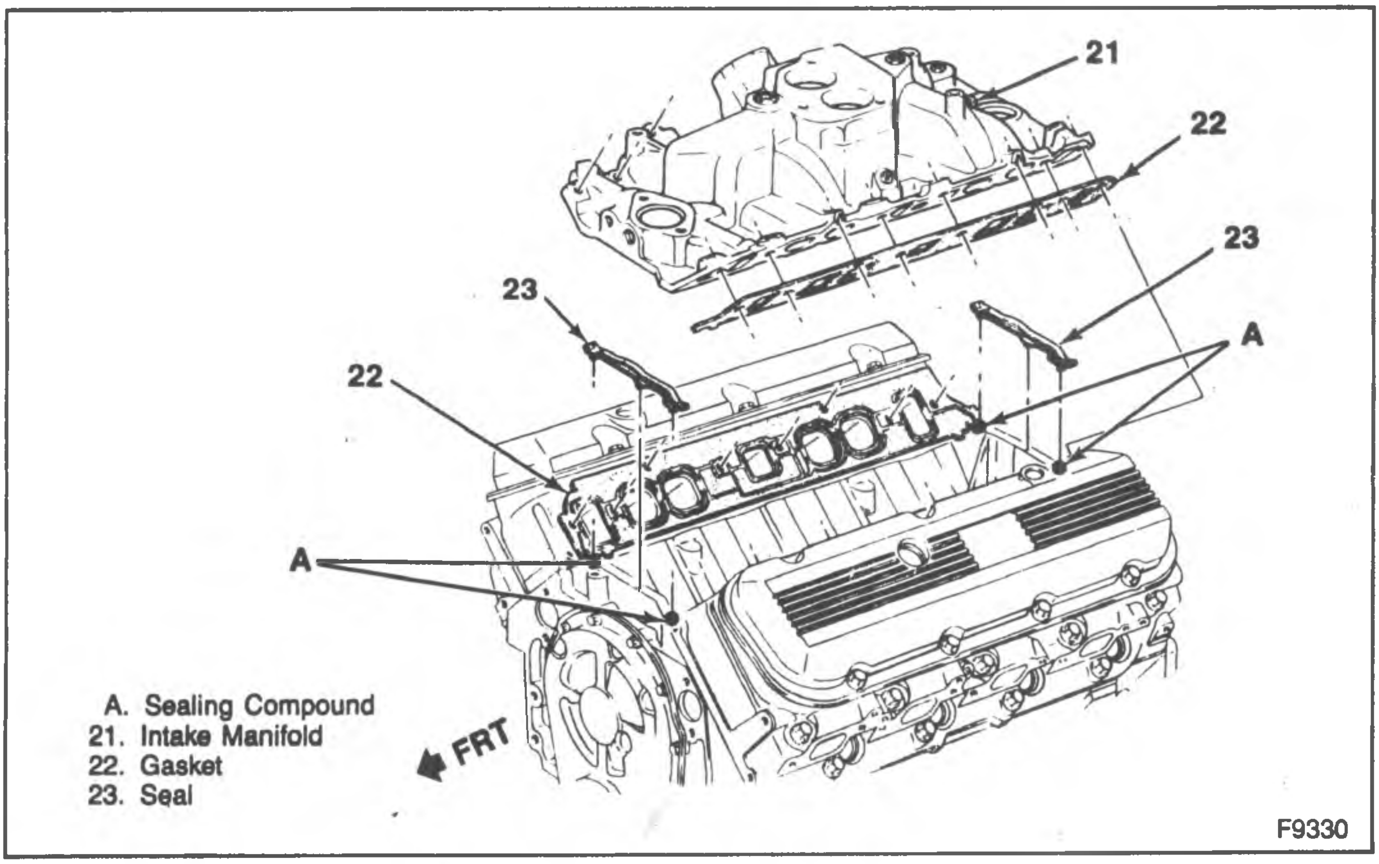


Figure 79—Intake Manifold (7.4L Engines)

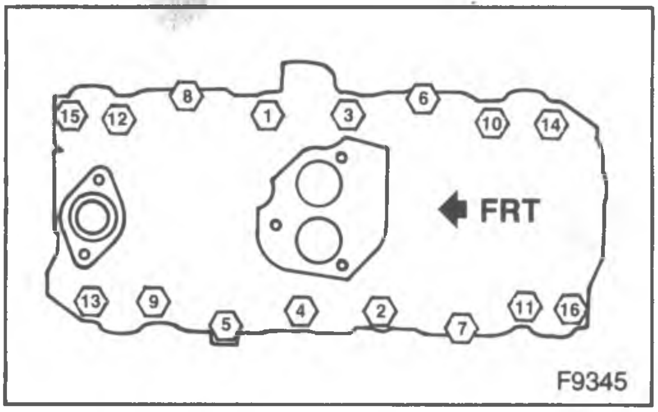


Figure 80—Intake Manifold Tightening Sequence (7.4L Engines)

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

5.0L AND 5.7L ENGINES

Install or Connect (Figures 77 and 78)

1. Gaskets to the cylinder heads.
   • Make sure the tab and/or arrow faces the front

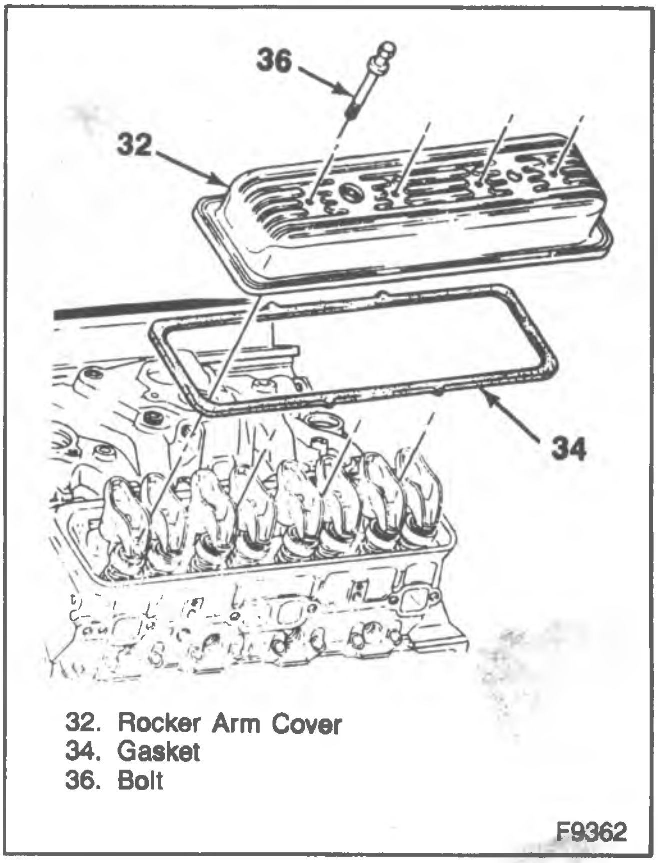


Figure 81—Rocker Arm Cover Installation (5.0L and 5.7L Engines)

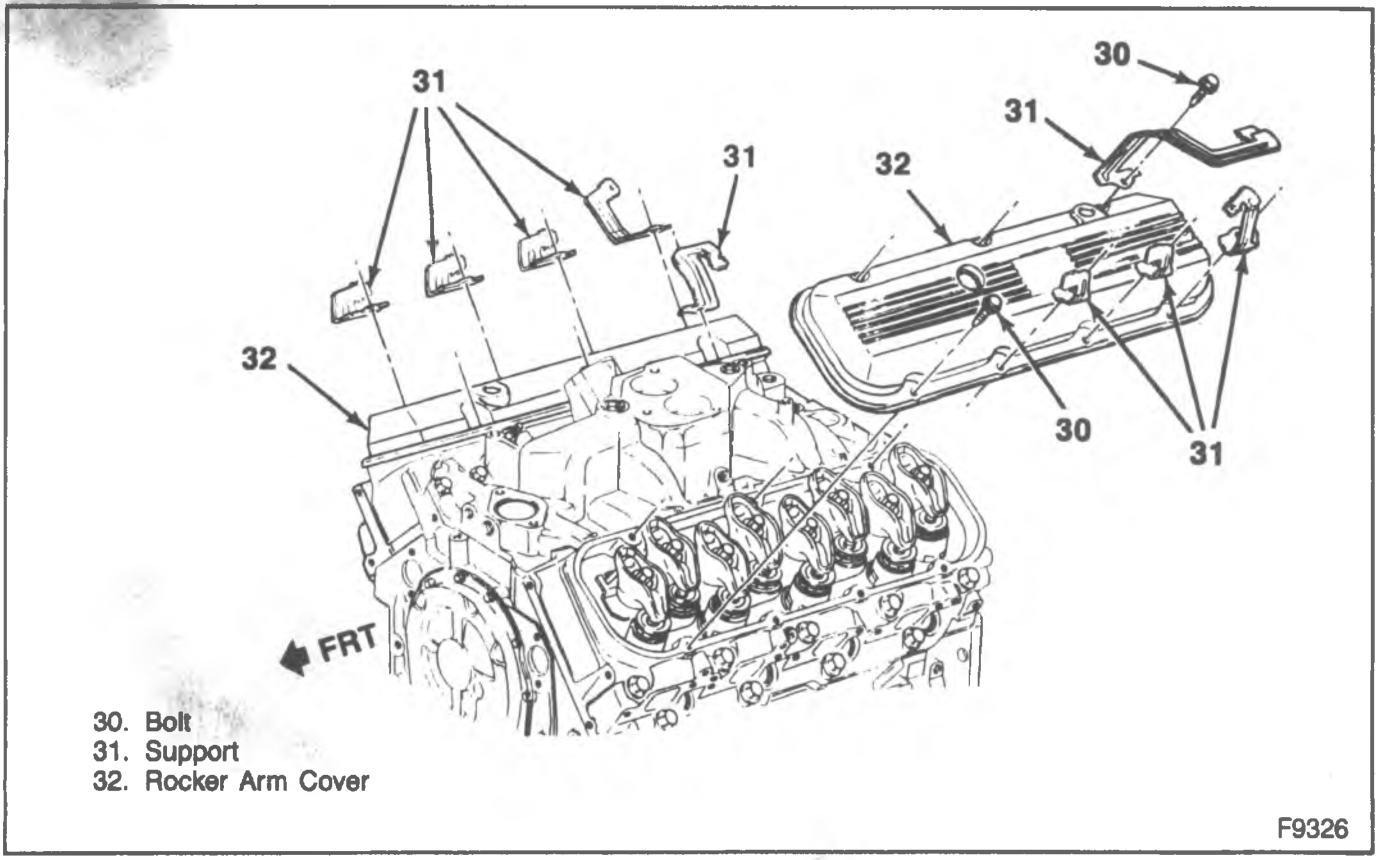


Figure 82—Rocker Arm Cover Installation (7.4L Engines)

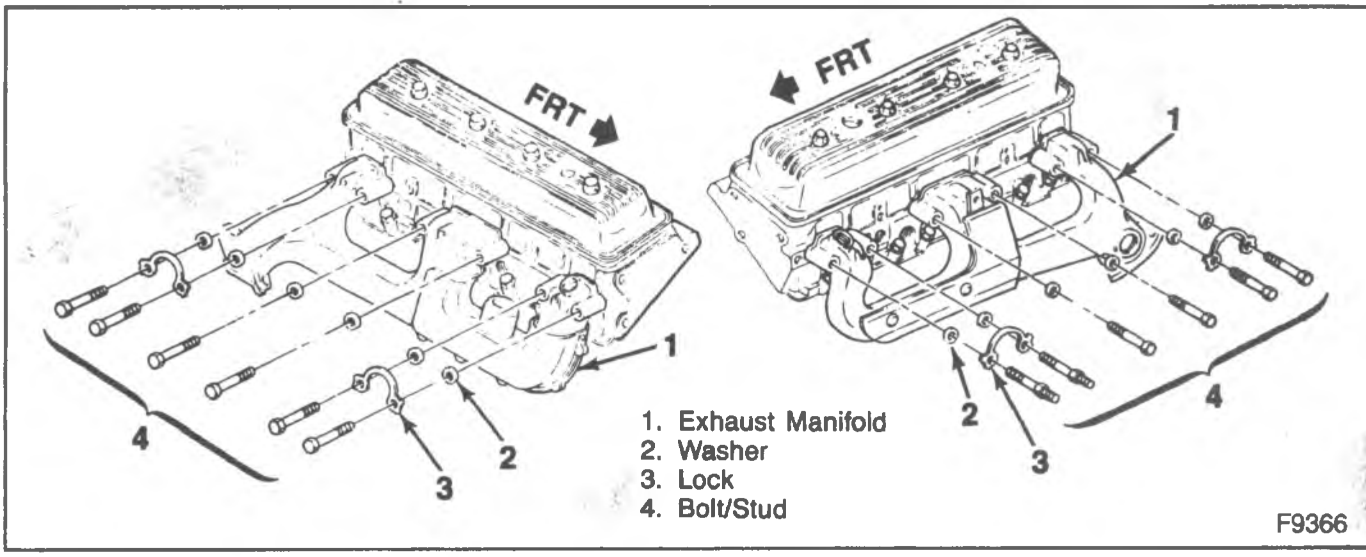


Figure 83—Exhaust Manifold (5.0L and 5.7L Engines)

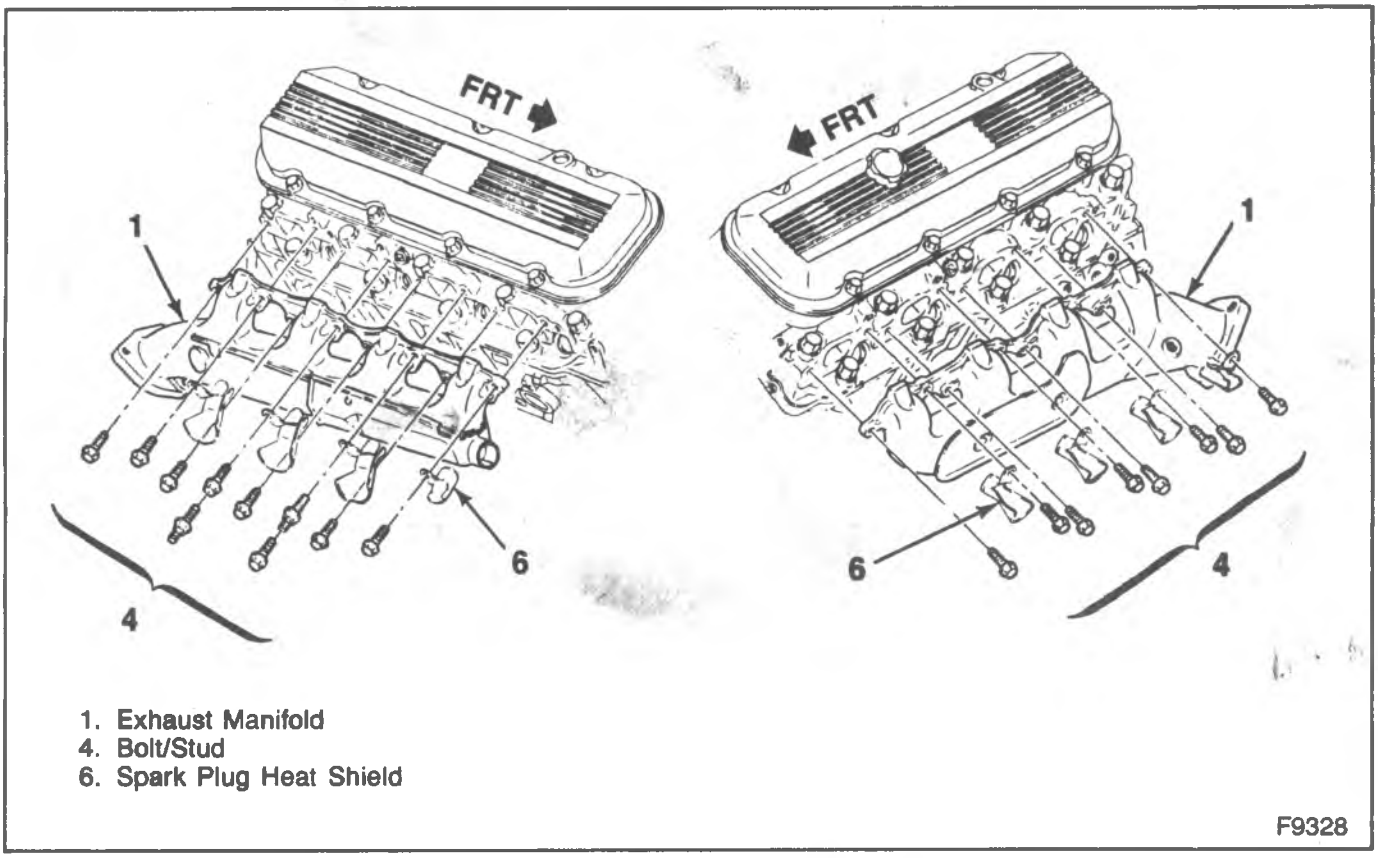


Figure 84—Exhaust Manifold (7.4L Engines)

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 77.
   - 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 78.

7.4L ENGINES

Install or Connect (Figures 79 and 80)

1. Gaskets (22) to the cylinder heads.
   - Apply a 5 mm (3/16-inch) spot of RTV sealer (part number 1052289 or equivalent) on the

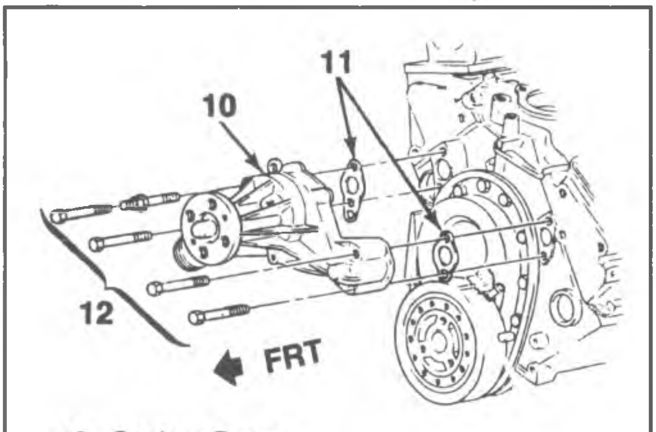


Figure 85—Coolant Pump (5.0L and 5.7L Engines)

front and rear of the block in four places as shown in figure 79.
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 80.

ROCKER ARM COVER INSTALLATION

Install or Connect (Figures 81 and 82)

1. Gaskets (34).
2. Rocker arm covers (32).
3. Bolts.

Tighten

- Bolts to specification:
  - — 5.0L and 5.7L engines: 10 N·m (90 in. lbs.).
  - — 7.4L engines: 13 N·m (115 in. lbs.).

EXHAUST MANIFOLD INSTALLATION

Install or Connect (Figures 83 and 84)

1. Exhaust manifold (1).
2. Spark plug wire heat shields (6), if used.
3. Washers (2), tab washers (3) (5.0L and 5.7L engines) and bolts or studs (4).

Tighten

- Bolts or studs to specifications:
  - — 5.0L and 5.7L engines:
    - Two center bolts: 36 N·m (26 ft. lbs.).

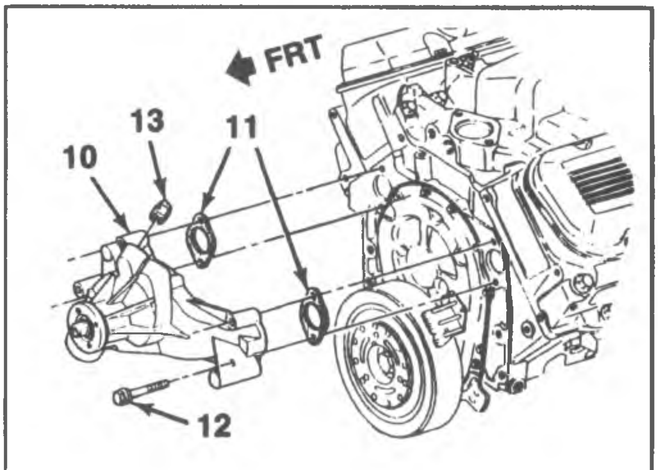


Figure 86—Coolant Pump (7.4L Engines)

    - Outside bolts: 28 N·m (20 ft. lbs.).
    - Bend the tab washers against the bolt heads.
  - — 7.4L engines: 54 N·m (40 ft. lbs.).

COOLANT PUMP INSTALLATION

Install or Connect (Figures 85 and 86)

1. Gaskets (11).
2. Coolant pump (10).
3. Bolts (12).

Tighten

- Bolts (12) to 40 N·m (30 ft. lbs.).

ENGINE ACCESSORY INSTALLATION

Install the engine accessories (TBI unit, distributor, oil filter, generator, etc.) as directed in the proper Service Manual Section. 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 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 governor settings, if so equipped.

SPECIFICATIONS

ENGINE SPECIFICATIONS (5.0L/5.7L)

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:					
Type				V8	
Displacement				5.0L (305 CID)	5.7L (350 CID)
RPO (VIN Code)				L03 (H)	L05 (K)
Bore				3.736	4.00
Stroke				3.480	
Compression Ratio				*	*
Firing Order				1-8-4-3-6-5-7-2	
Oil Pressure (Minimum)				6 PSI @ 1000 RPM; 18 PSI @ 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)	
	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 Limit Production ± 0.010	
PISTON PIN:					
Diameter				0.9269-0.09271	
Clearance In Piston	Production			0.0002-0.0007	
	Service Lmit			0.001 (Maximum)	
Fit In Rod				0.0008-0.0016 Interference	

*8.3:1 (Over 8500-lb. GVW)
9.1:1 (Under 8500-lb. GVW)

T2368

SPECIFICATIONS

ENGINE SPECIFICATIONS (5.0L/5.7L) (Cont.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT:			5.0L (305 Cu. In.)	5.7L (350 Cu. In.)
CRANKSHAFT:				
Main Journal	Diameter	#1	2.4484-2.4493	
		#2, #3, #4	2.4481-2.4490	
		#5	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, #4	0.0011-0.0023	
		#5	0.0017-0.0032	
	Service Limit	#1	0.0010-0.0015	
		#2, #3, #4	0.0010-0.0025	
		#5	0.0025-0.0035	
Crankshaft End Play			0.002-0.006	
Crankpin	Diameter		2.0988-2.0998	
	Taper	Production	0.0005 (Maximum)	
		Service Limit	0.001 (Maximum)	
	Out Of Round	Production	0.0005 (Maximum)	
		Service Limit	0.001 (Maximum)	
Rod Bearing Clearance	Production		0.0013-0.0035	
	Service Limit		0.003 (Maximum)	
Rod Side Clearance			0.006-0.014	
CAMSHAFT:				
Lobe Lift ±0.002	Intake		0.2336	0.2565
	Exhaust		0.2565	0.2690
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"	
		Open	194-206 lbs. @ 1.25"	
	Installed Height ±1/32"		1 23/32	
Valve Spring Damper	Free Length		1.86	
	Approx. # of Coils		4	

T2369

SPECIFICATIONS

ENGINE SPECIFICATIONS (7.4L)

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				V8
Displacement				7.4L (454 Cu. In.)
RPO				L19
Bore				4.25
Stroke				4.00
Compression Ratio				7.9:1
Firing Order				1-8-4-3-6-5-7-2
Oil Pressure (Minimum)				10 psi @ 500 RPM Minimum; 40-60 psi @ 2000 RPM
CYLINDER BORE:				
Diameter				4.2500-4.2507
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			0.0025-0.0037
	Service Limit			0.0045 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0012-0.0029
			2nd	0.0012-0.0029
		Service Limit		Hi Limit Production +0.001
	Gap	Production	Top	0.010-0.018
			2nd	0.016-0.024
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.0050-0.0065
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.010-0.030
		Service Limit		Hi Limit Production + 0.010
PISTON PIN:				
Diameter				0.98945-0.98965
Clearance In Piston	Production			0.0002-0.0007
	Service Lmit			0.001 (Maximum)
Fit In Rod				0.0012-0.0024 Interference

T2370

SPECIFICATIONS

ENGINE SPECIFICATIONS (7.4 L) (CONT.)

All Specifications are in INCHES unless otherwise noted.

<table>
<tr><td colspan="3">DISPLACEMENT:</td><td>7.4L</td></tr>
<tr><td colspan="4">CRANKSHAFT:</td></tr>
<tr><td rowspan="5">Main Journal</td><td>Diameter</td><td>#1, #2, #3, #4, #5</td><td>2.7482-2.7489</td></tr>
<tr><td rowspan="2">Taper</td><td>Production</td><td>0.0002 (Maximum)</td></tr>
<tr><td>Service Limit</td><td>0.001 (Maximum)</td></tr>
<tr><td rowspan="2">Out Of Round</td><td>Production</td><td>0.0002 (Maximum)</td></tr>
<tr><td>Service Limit</td><td>0.001 (Maximum)</td></tr>
<tr><td rowspan="4">Main Bearing Clearance</td><td rowspan="2">Production</td><td>#1, #2, #3, #4</td><td>0.0017-0.0030</td></tr>
<tr><td>#5</td><td>0.0025-0.0038</td></tr>
<tr><td rowspan="2">Service Limit</td><td>#1, #2, #3, #4</td><td>0.0010-0.0030</td></tr>
<tr><td>#5</td><td>0.0025-0.0040</td></tr>
<tr><td colspan="3">Crankshaft End Play</td><td>0.006-0.010</td></tr>
<tr><td rowspan="5">Crankpin</td><td colspan="2">Diameter</td><td>2.1990-2.1996</td></tr>
<tr><td rowspan="2">Taper</td><td>Production</td><td>0.0005</td></tr>
<tr><td>Service Limit</td><td>0.001</td></tr>
<tr><td rowspan="2">Out Of Round</td><td>Production</td><td>0.0005</td></tr>
<tr><td>Service Limit</td><td>0.001</td></tr>
<tr><td rowspan="2">Rod Bearing Clearance</td><td colspan="2">Production</td><td>0.0011-0.0029</td></tr>
<tr><td colspan="2">Service Limit</td><td>0.003 (Maximum)</td></tr>
<tr><td colspan="3">Rod Side Clearance</td><td>0.0013-0.023</td></tr>
<tr><td colspan="4">CAMSHAFT:</td></tr>
<tr><td rowspan="2">Lobe Lift ± 0.002</td><td colspan="2">Intake</td><td>0.2343</td></tr>
<tr><td colspan="2">Exhaust</td><td>0.2530</td></tr>
<tr><td colspan="3">Journal Diameter</td><td>1.9482-1.9492</td></tr>
<tr><td colspan="4">VALVE SYSTEM:</td></tr>
<tr><td colspan="3">Lifter</td><td>Hydraulic</td></tr>
<tr><td colspan="3">Rocker Arm Ratio</td><td>1.70:1</td></tr>
<tr><td colspan="2" rowspan="2">Valve Lash</td><td>Intake</td><td rowspan="2">Net Lash</td></tr>
<tr><td>Exhaust</td></tr>
<tr><td colspan="3">Face Angle (Intake & Exhaust)</td><td>45°</td></tr>
<tr><td colspan="3">Seat Angle (Intake & Exhaust)</td><td>46°</td></tr>
<tr><td colspan="3">Seat Runout (Intake & Exhaust)</td><td>0.002 (Maximum)</td></tr>
<tr><td colspan="2" rowspan="2">Seat Width</td><td>Intake</td><td>1/32-1/16</td></tr>
<tr><td>Exhaust</td><td>1/16-3/32</td></tr>
<tr><td rowspan="4">Stem Clearance</td><td rowspan="2">Production</td><td>Intake</td><td>0.0010-0.0027</td></tr>
<tr><td>Exhaust</td><td>0.0012-0.0029</td></tr>
<tr><td rowspan="2">Service</td><td>Intake</td><td>High Limit Production +0.001</td></tr>
<tr><td>Exhaust</td><td>High Limit Production +0.002</td></tr>
<tr><td rowspan="5">Valve Spring</td><td colspan="2">Free Length</td><td>2.12</td></tr>
<tr><td rowspan="2">Pressure lbs. @ in.</td><td>Closed</td><td>74-86 lbs. @ 1.80-in.</td></tr>
<tr><td>Open</td><td>195-215 lbs. @ 1.40-in.</td></tr>
<tr><td colspan="2">Installed Height ± 1/32"</td><td>1 51/64 (1.80 in.)</td></tr>
<tr><td colspan="2">Valve Spring Fit In Damper</td><td>0.042-0.094 Interference</td></tr>
</table>

T2371

SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS
(5.0L AND 5.7L ENGINES)

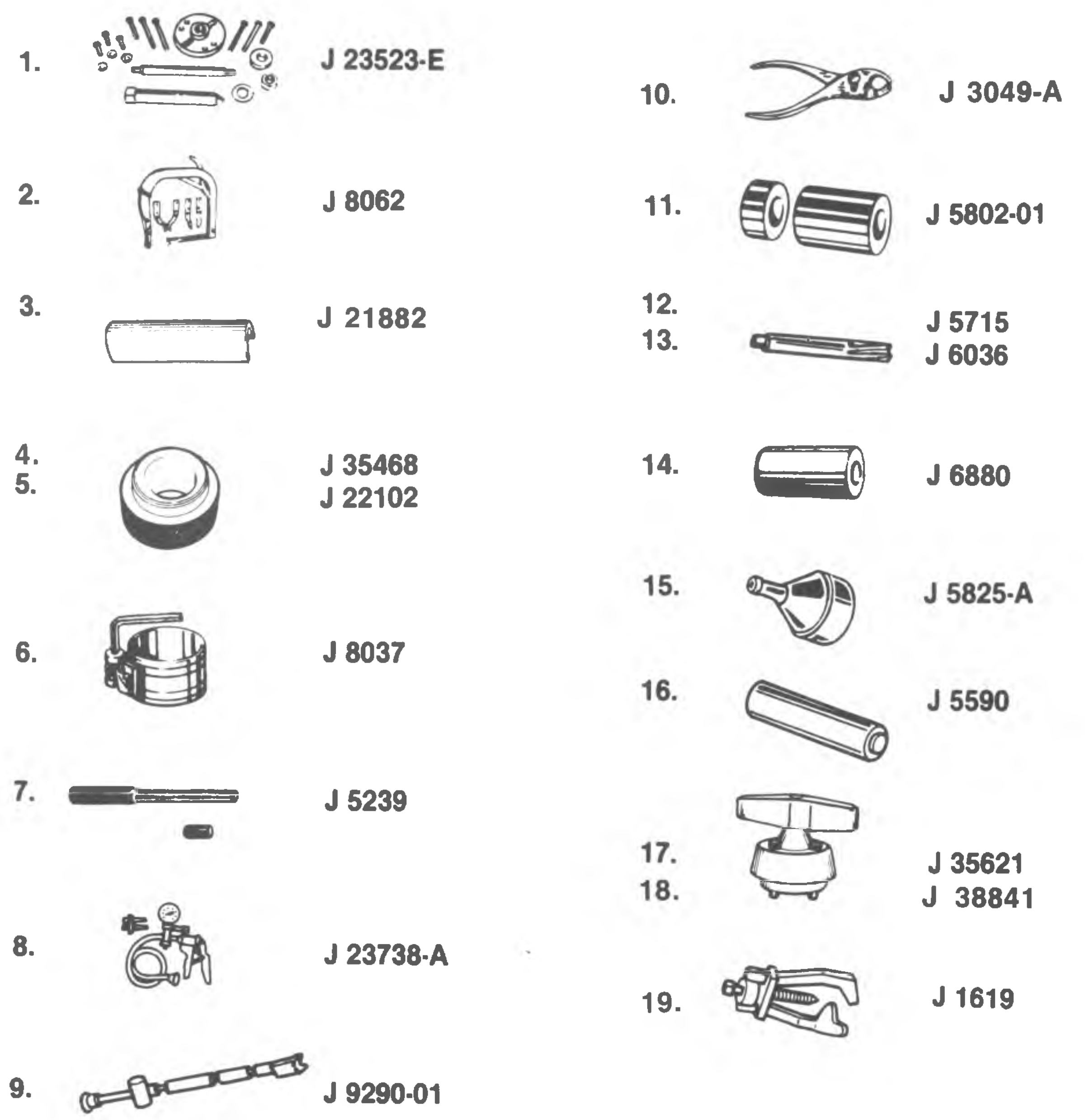
Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Bolt	10.2	—	90
Intake Manifold Bolts	48	35	—
Exhaust Manifold Bolts			
Center Two Bolts	36	26	—
All Others	28	20	—
Cylinder Head Bolts	90	65	—
Torsional Damper Bolt	95	70	—
Front Cover Bolts	11	—	100
Oil Pan Nuts at Corners	22	—	200
Oil Pan Bolts	11	—	100
Oil Pump Bolt	90	65	—
Oil Pan Baffle Nuts (Some 5.7L Engines)	36	26	—
Rear Crankshaft Oil Seal Retainer Screws and Nuts	15	—	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	—	80
Flywheel Bolts	100	75	—
Spark Plugs	20	15	—
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	—	112

(7.4L ENGINES)

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Bolts	7	—	60
Intake Manifold Bolts	40	30	—
Rocker Arm Bolts	54	40	—
Exhaust Manifold Bolts	54	40	—
Cylinder Head Bolts	110	80	—
Torsional Damper Bolts	115	85	—
Front Cover to Block Bolts	10	—	96
Oil Pan to Block Bolts	18	—	160
Oil Pump Bolt	90	65	—
Main Bearing Caps	150	110	—
Camshaft Sprocket Bolts	26	20	—
Connecting Rod Cap Nuts	66	48	—
Flywheel Bolts	90	65	—
Oil Pump Cover Bolts	9	—	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	—	112
TBI Adapter to Intake Manifold Bolts	23	17	—

T2525

SPECIAL TOOLS



1. Torsional Damper Remover and Installer
2. Valve Spring Compressor
3. Oil Pump Pick-Up Tube Installer
4. Crankshaft Seal Installer (Small Block Engines)
5. Crankshaft Seal Installer (Mark V Engines)
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 (Small Block Engines)
12. Reamer (0.003-inch oversize)
13. Reamer (0.013-inch oversize)
14. Stud Installer (Small Block Engines)
15. Crankshaft Sprocket Puller (Small Block Engines)
16. Crankshaft Sprocket Installer (Small Block Engines)
17. Rear Oil Seal Installer (5.0L and 5.7L Engines)
18. Rear Oil Seal Installer (Mark V Engines)
19. Crankshaft Sprocket Puller

F9528

SECTION 6A7

6.2L DIESEL ENGINE

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

CONTENTS (cont'd)

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.

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, piston rings, cylinder walls, and connecting rod small end bearings are lubricated by oil splash.

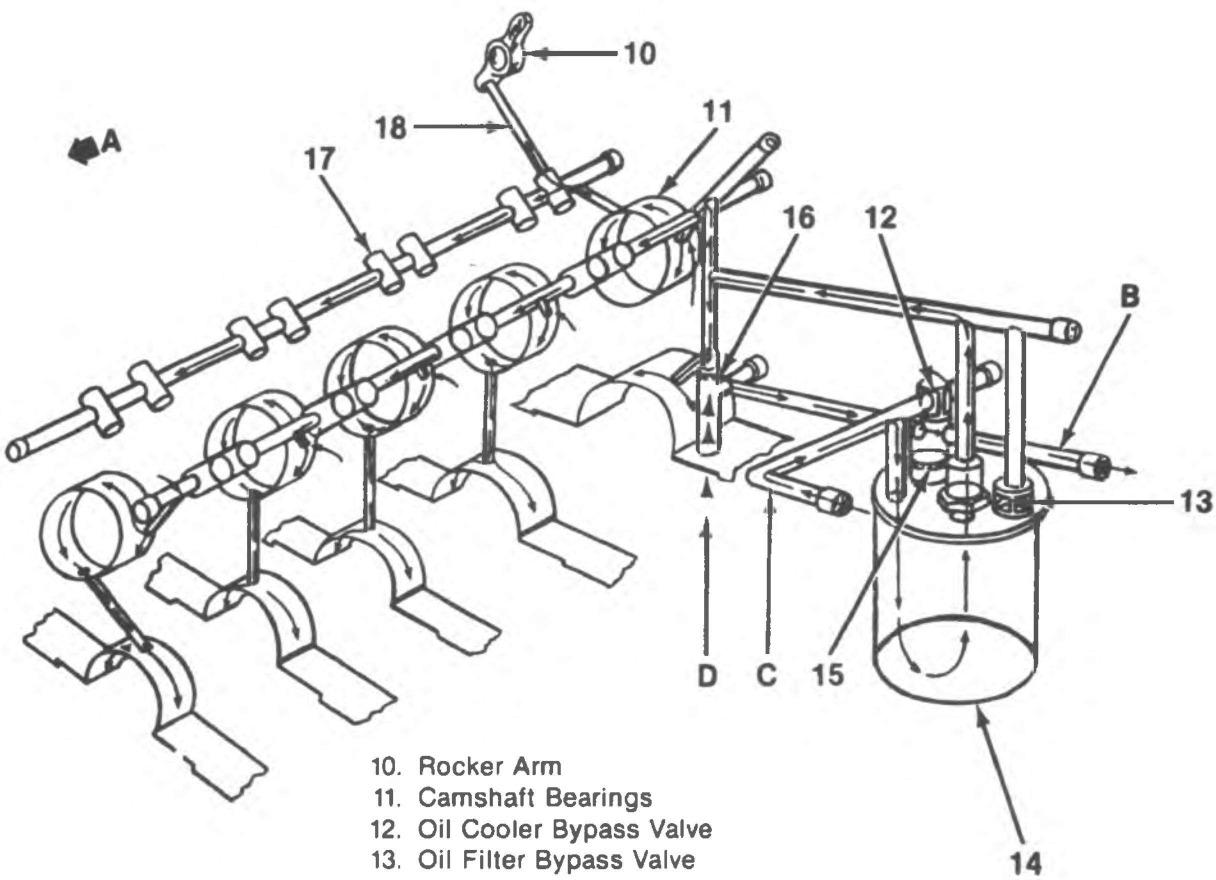
DISASSEMBLY

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 intend-



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

F8022

Figure 1—Lubrication Diagram

ed. 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 emissions 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.

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.).

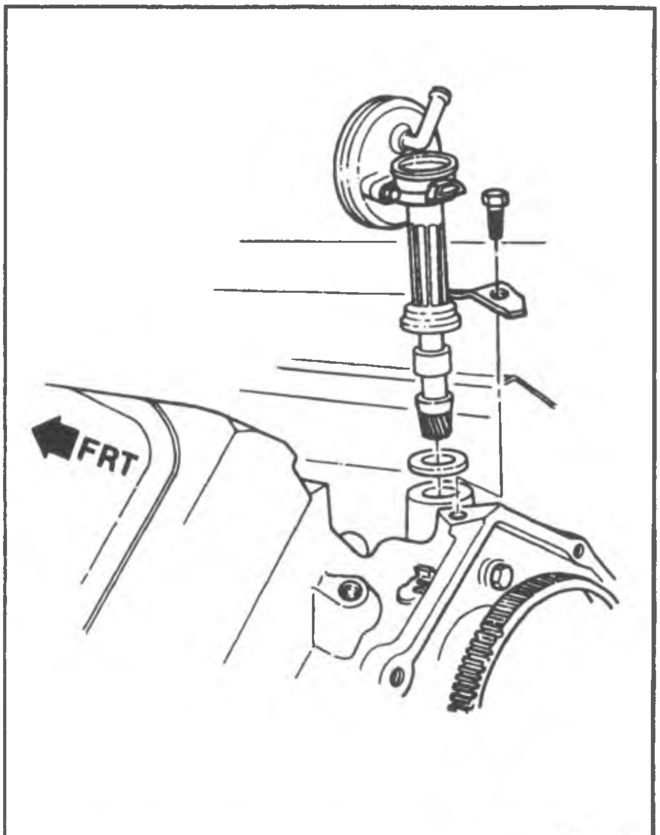
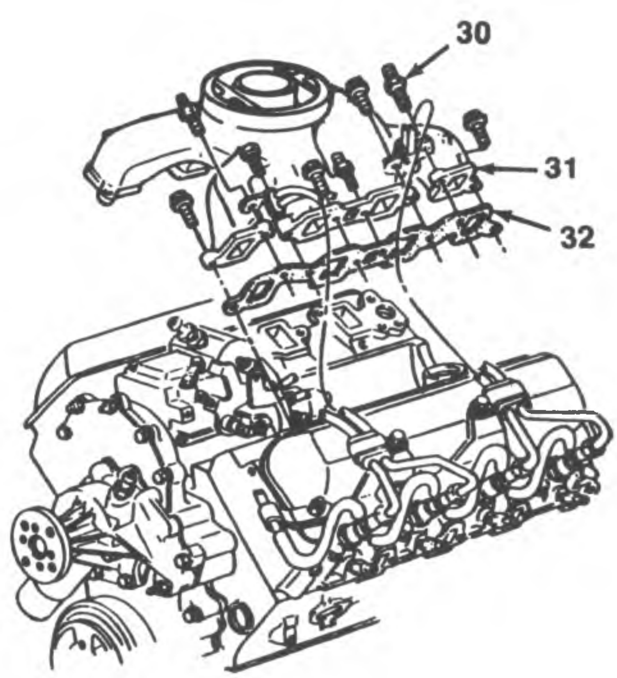


Figure 2—Vacuum Pump (R-V Models)



30. Bolt/Stud
31. Intake Manifold
32. Gasket

F9262

Figure 3—Single Plane Intake Manifold

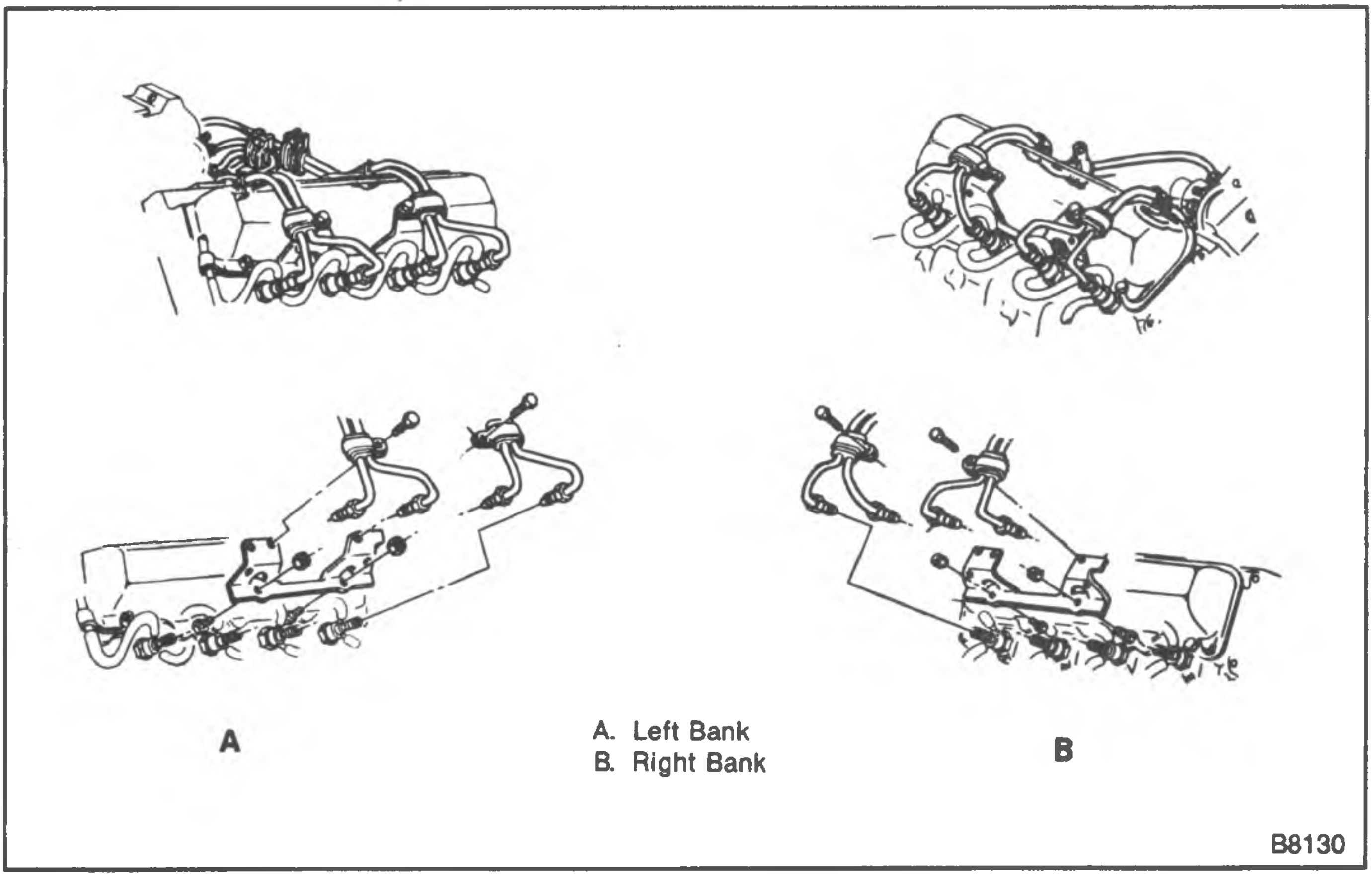


Figure 4—Injection Lines

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.

INTAKE MANIFOLD REMOVAL

Remove or Disconnect (Figure 3)

Tool Required:
J 29664 Manifold Cover Set

1. Intake manifold bolts and fuel line clips.
2. Intake manifold.
3. Gaskets.
- Install 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.

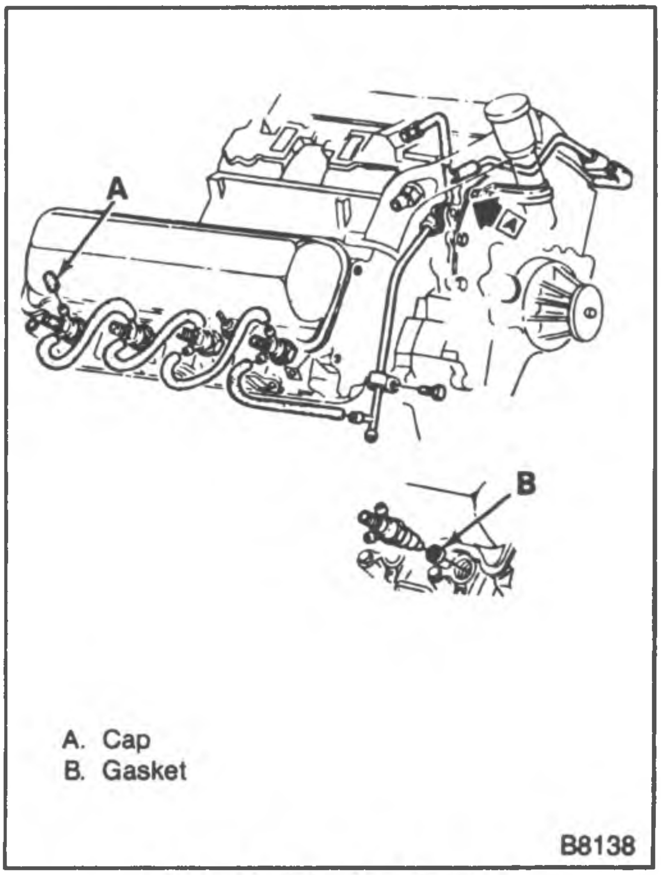


Figure 5—Injection Nozzles

- 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.

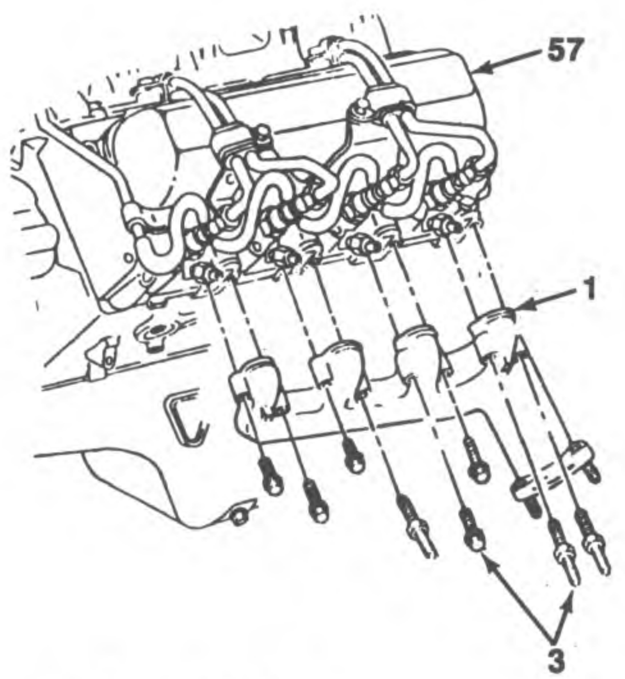
NOTICE: When removing an injection nozzle, use J 29873. Remove the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

3. Injection nozzle using J 29873. Store the nozzles in a clean place.
4. Gaskets.

GLOW PLUG REMOVAL

Remove or Disconnect

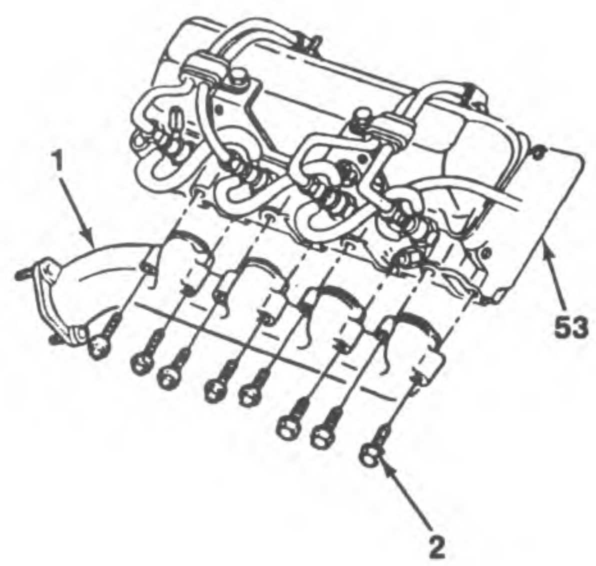
- Glow plugs. Use a 3/8 inch, deep socket.



1. Exhaust Manifold
3. Bolt/Stud
57. Valve Cover

F9535

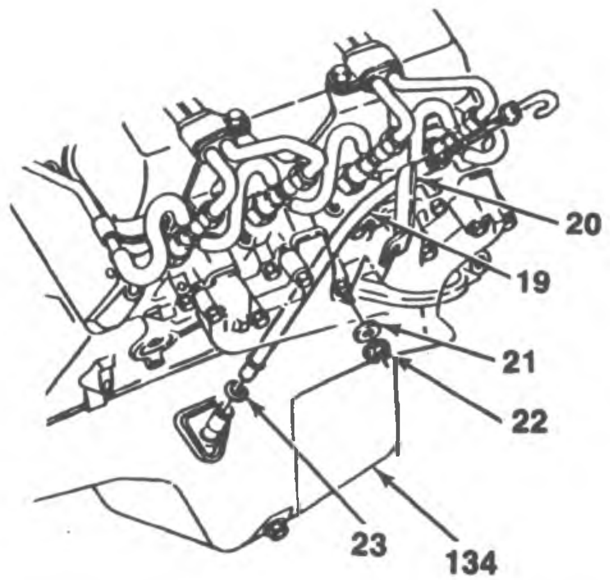
Figure 7—Exhaust Manifold Left Side



1. Exhaust Manifold
2. Bolt
53. Cylinder Head

F9529

Figure 6—Exhaust Manifold Right Side



19. Dipstick Tube
20. Dipstick Bracket
21. Washer
22. Nut
23. O-Ring
134. Oil Pan

F9546

Figure 8—Dipstick Tube Assembly

EXHAUST MANIFOLD REMOVAL

Remove or Disconnect (Figures 6 and 7)

1. Exhaust manifold bolts.
2. Exhaust manifolds.

DIPSTICK TUBE REMOVAL

Remove or Disconnect (Figure 8)

1. Dipstick bracket bolt.
2. Dipstick tube. Pull out to remove.
3. O-ring from the dipstick tube.

COOLANT CROSSOVER REMOVAL

Remove or Disconnect (Figure 9)

1. Glow plug inhibit switch wire.
2. Clamps (47).
3. Bolts or studs (44).
4. Coolant crossover (45).
5. Gaskets (46).
6. Hose (48).

ROCKER ARM COVER REMOVAL

Remove or Disconnect (Figure 10)

1. Bolts (58).

NOTICE: Do not pry on the rocker arm cover. Damage to sealing surfaces may result.

2. Rocker arm covers (57).

ROCKER ARM AND PUSHROD REMOVAL

Remove or Disconnect (Figure 10)

1. Bolts (54).
2. Rocker arm assemblies (55). Mark the assemblies

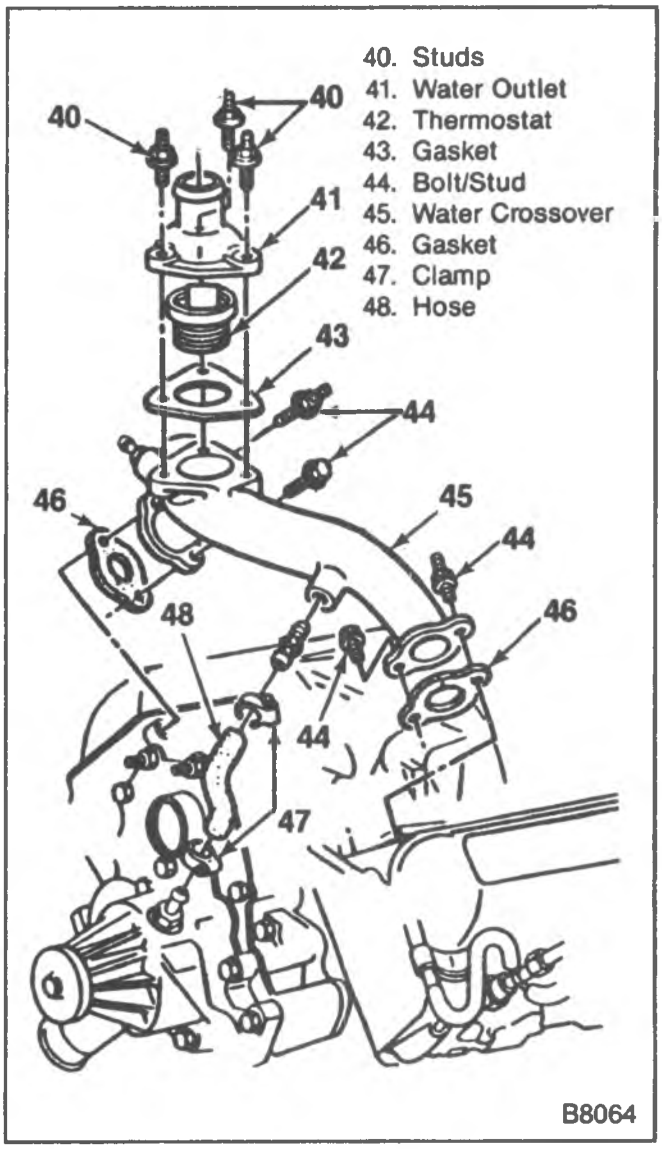


Figure 9—Thermostat and Coolant Crossover

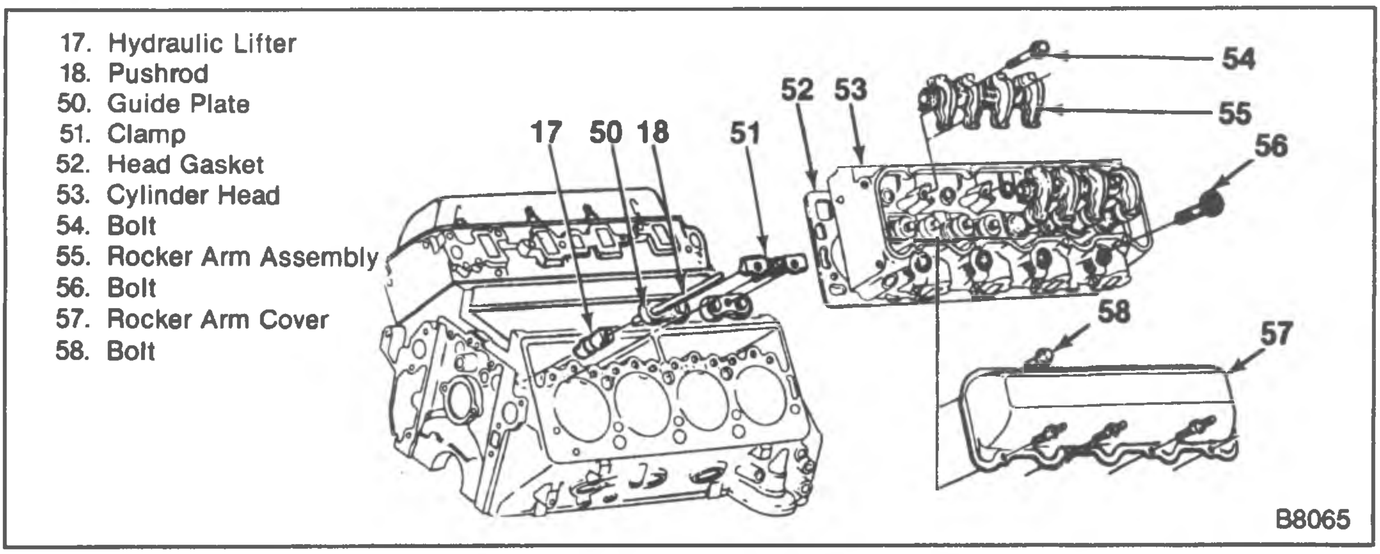
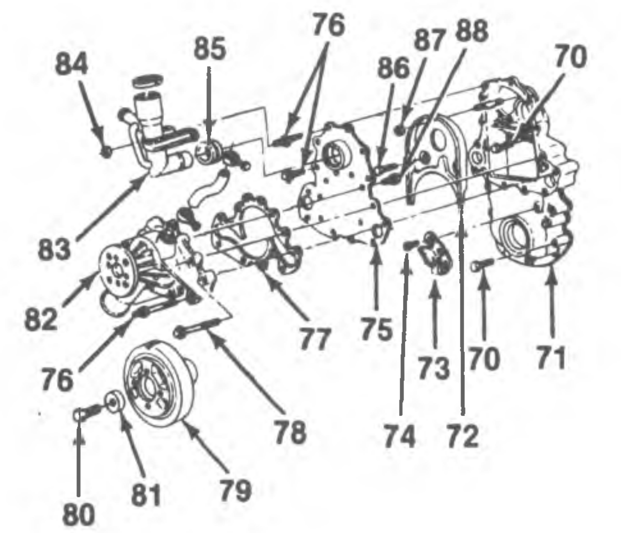


Figure 10—Cylinder Head and Components



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

F5726

Figure 11—Front Cover and Components

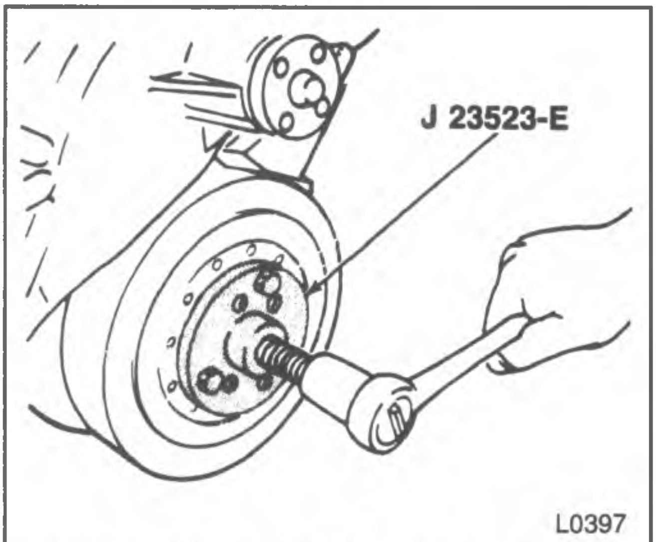


Figure 12—Removing the Torsional Damper

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.

CYLINDER HEAD REMOVAL

Remove or Disconnect (Figure 10)

1. Fuel return line bolts.
2. Bolts (56).
3. Cylinder heads (53).
4. Head gaskets (52).

HYDRAULIC LIFTER REMOVAL

Remove or Disconnect (Figure 10)

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.

COOLANT PUMP REMOVAL

Remove or Disconnect (Figure 11)

1. Nuts (84).
2. Oil filler neck (83).
3. Bolts and studs (76).
4. Coolant pump (82) with coolant pump plate (75).
5. Bolts (88).
6. Coolant pump from the coolant pump plate.
7. Gasket (77).

TORSIONAL DAMPER REMOVAL

Remove or Disconnect (Figures 11 and 12)

Tool Required:
J 23523-E Torsional Damper Puller

1. Bolt (80) and washer (81).
2. Torsional damper (79). Use J 23523-E (figure 12).

INJECTION PUMP REMOVAL

Remove or Disconnect (Figure 13)

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).

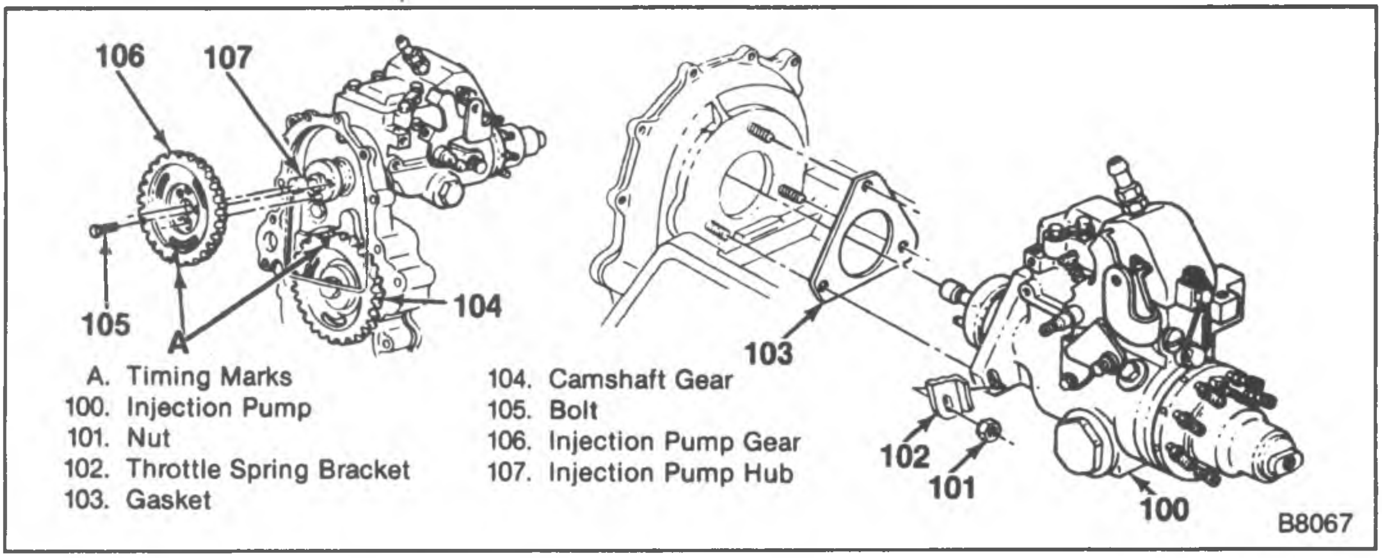


Figure 13—Injection Pump

FRONT COVER REMOVAL

Remove or Disconnect (Figure 11)

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 14)

1. Bolt (119) and washer (118).
2. Camshaft gear (104).
3. Camshaft sprocket (115) with timing chain (116).
4. Crankshaft sprocket (117).

CAMSHAFT REMOVAL

Remove or Disconnect (Figure 14)

1. Bolts (114) and thrust plate (113).
2. Camshaft (110).
   - The fuel pump (lift pump) and pushrod must be removed to remove the camshaft.

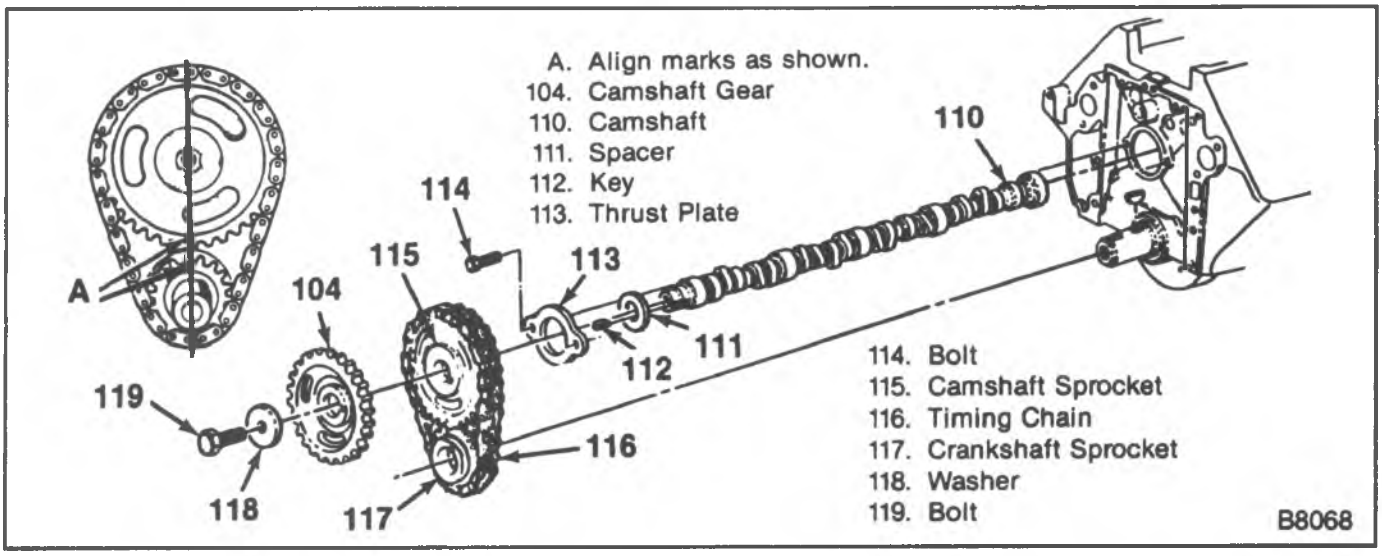


Figure 14—Camshaft and Components

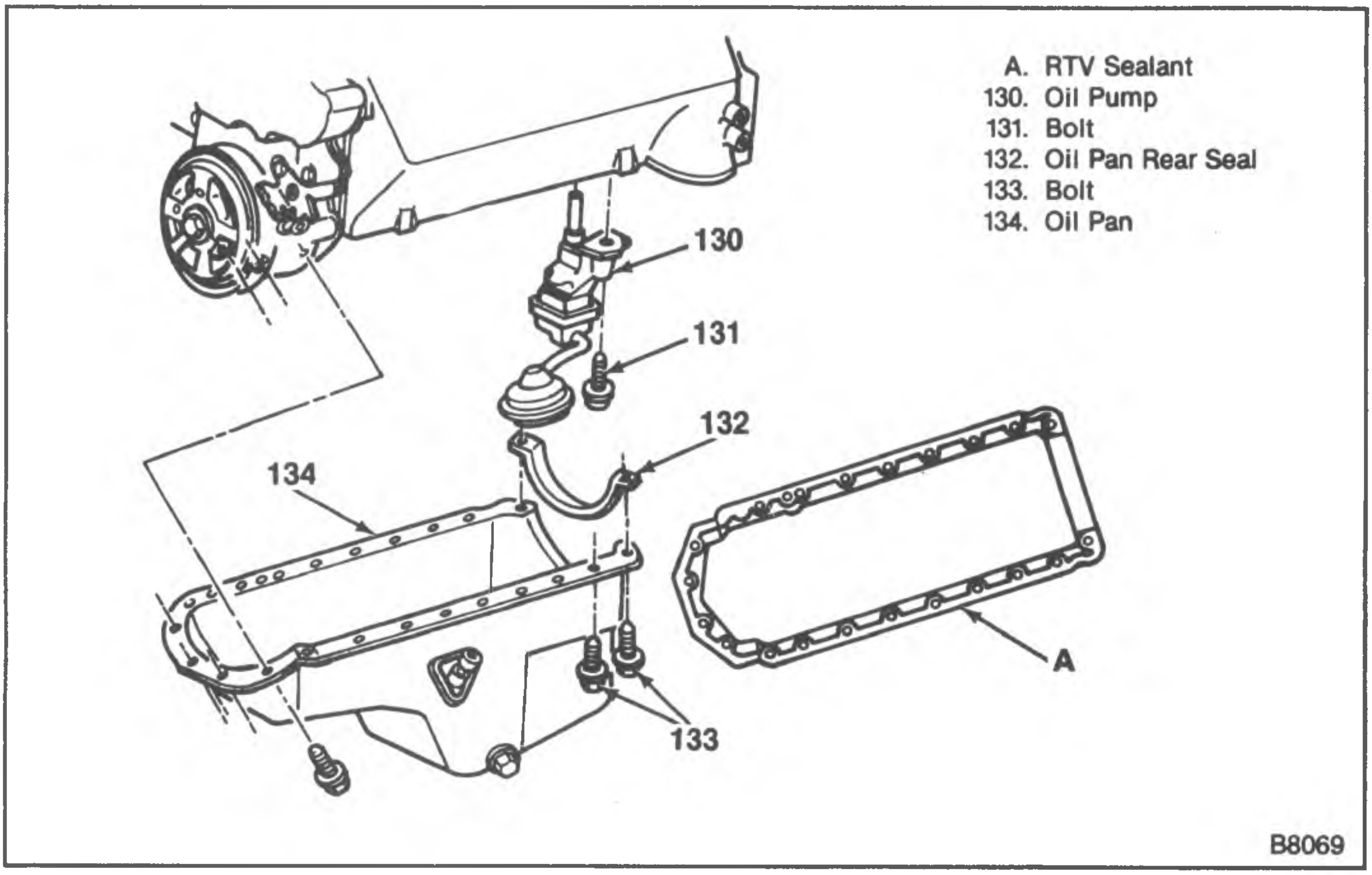


Figure 15—Oil Pan and Oil Pump

- Pull the camshaft from the block carefully to avoid damage to the camshaft bearings.

OIL PAN REMOVAL

Remove or Disconnect (Figure 15)

1. Bolts (133).
2. Oil Pan (134).
3. Oil pan rear seal (132).

OIL PUMP REMOVAL

Remove or Disconnect (Figure 15)

1. Bolt (131).
2. Oil pump (130).

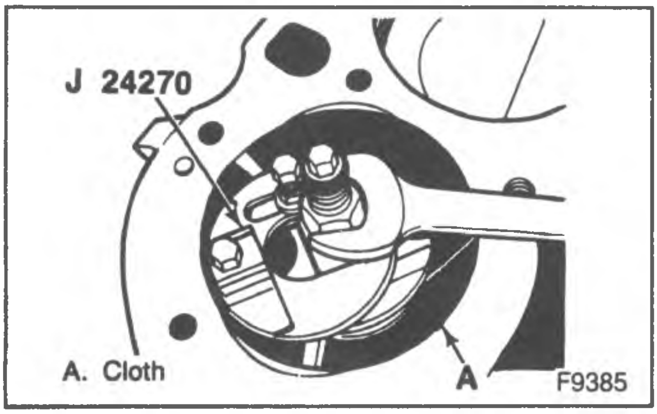


Figure 16—Removing the Cylinder Ridge

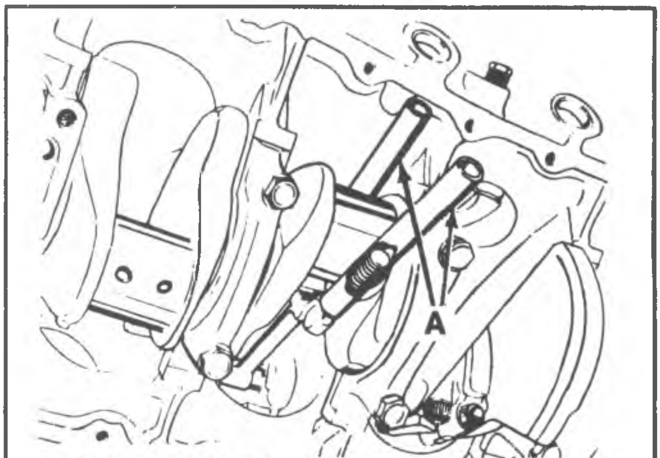


Figure 17—Removing the Piston and Connecting Rod

PISTON AND CONNECTING ROD REMOVAL

Remove or Disconnect (Figures 16 and 17)

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 16).
- 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 17). 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 18)

1. Bolts (141).
2. Flywheel (140).

CRANKSHAFT REMOVAL

Remove or Disconnect (Figure 18)

- 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 surfaces.
4. Rear crankshaft seal halves (142 and 145).
5. Main bearing inserts (143 and 144).

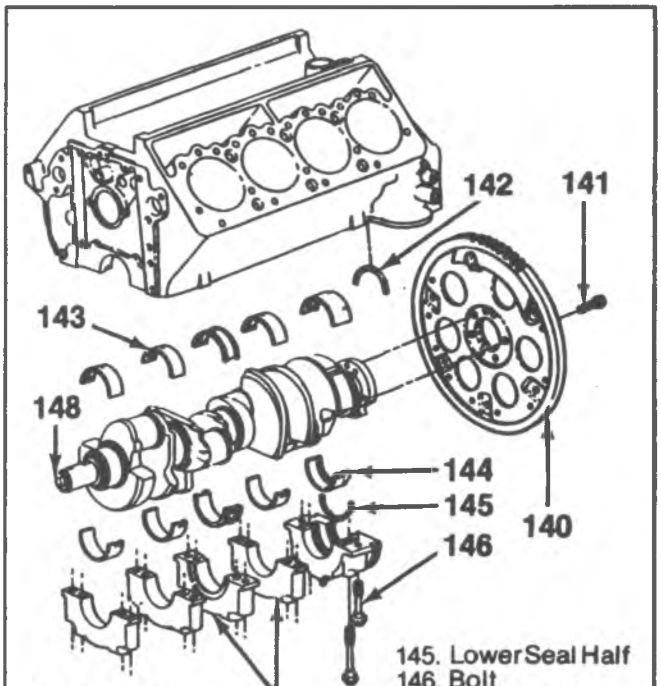


Figure 18—Crankshaft and Components

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 Reconditioning

- Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

PISTON AND CONNECTING ROD ASSEMBLIES

For information regarding disassembly, cleaning, inspecting, measurement, assembly and selection of the piston and connecting rod assemblies, refer to GENERAL ENGINE MECHANICAL (SEC.6A).

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.

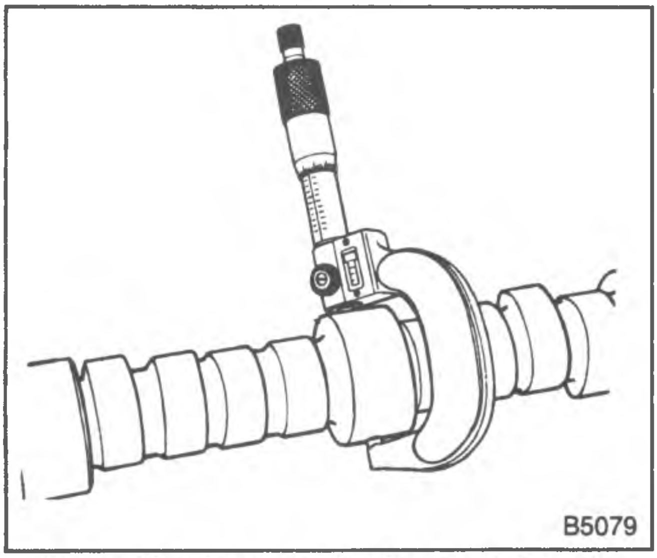


Figure 19—Measuring the Camshaft Journals

CAMSHAFT

Important

- Whenever the camshaft needs to be replaced, a new set of hydraulic lifters must also be installed.

Inspect (Figure 14)

- Camshaft lobes and journals for scratches, pitting, scoring, and wear.
- Thrust plate (113) for wear and scoring.

Measure (Figure 19)

- Camshaft journals. Use a micrometer (figure 19). 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 20 and 21)

Tools Required:
J 6098-01 Camshaft Bearing Remover and Installer
J 6098-10 Adapter Set

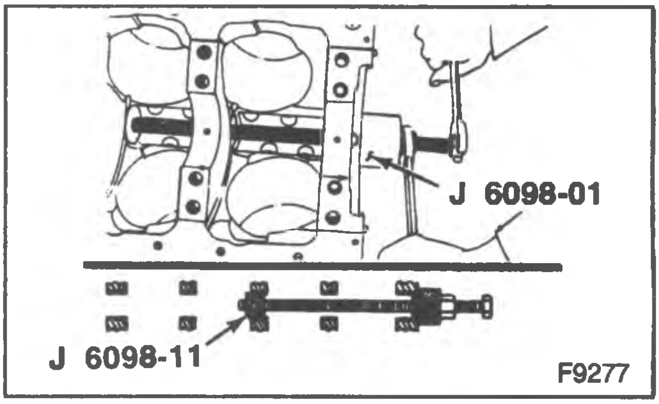


Figure 20—Replacing the Inner Camshaft Bearings

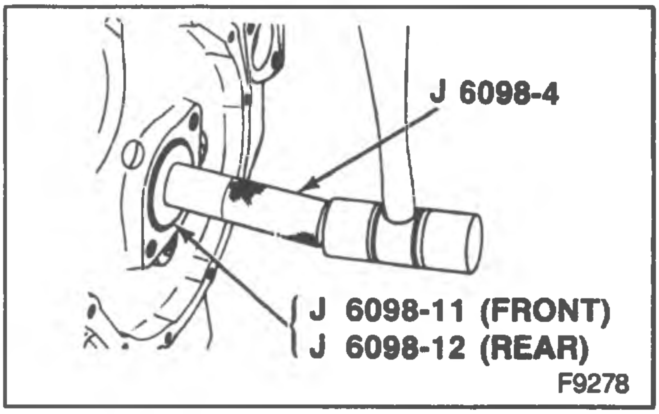


Figure 21—Replacing the Outer Camshaft Bearings

1. Rear camshaft plug.
2. Inner camshaft bearings. Use J 6098-01 and J 6098-11 (figure 20).
   - 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 6098-11 (figure 21).
   - Assemble the bearing tool (J 29764-11) and driver handle (J 6098-4).
   - Drive the outer camshaft bearings out of the block.
4. Rear camshaft bearing, as described in step 3. Use the driver handle J 6098-4 and bearing tool bearing tool J 6098-12 (figure 18).

Clean

- Camshaft bearing bores in the block.

Assemble (Figures 20 and 21)

Tools Required:
J 6098-01 Camshaft Bearing Remover and Installer Set
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 inner 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 J 6098-4 and bearing tool J 6098-12 (figure 21).

   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 J 6098-4 and camshaft bearing installer J 6098-11 (figure 21).

   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 6098-11 (figure 20).
   - 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 6098-11). 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, refer to "Front Cover Installation."

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, refer to "Front Cover Installation."

COOLANT PUMP

Clean

- Old gasket from the gasket surfaces on the coolant pump and coolant 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

- Coolant pump shaft for roughness and end play. If the shaft does not turn smoothly, or if there is excessive end play, replace the coolant pump.
- Coolant pump body at the drain hole. If there is evidence of coolant leakage, the coolant pump shaft seal is leaking and the coolant pump should be replaced.
- Coolant 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

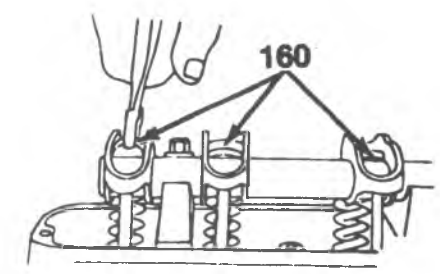
— Pump body and cover for cracks or other damage.
— Gears for wear.
— Drive gear and shaft for improper fit in the pump body.
— Inside of the cover for wear that would permit oil to leak past the ends of the gears. The pump gears, cover, and body are not serviced separately. If the parts are damaged 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.



160. Rocker Arm Retainers

B8071

Figure 22—Removing the Rocker Arm Retainers

VALVE TRAIN COMPONENTS

Clean

- Parts in solvent. Blow dry with compressed air.
- Make sure the oil passages in the pushrods are clear.

Disassemble (Figure 22)

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 22).
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.
— 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.

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

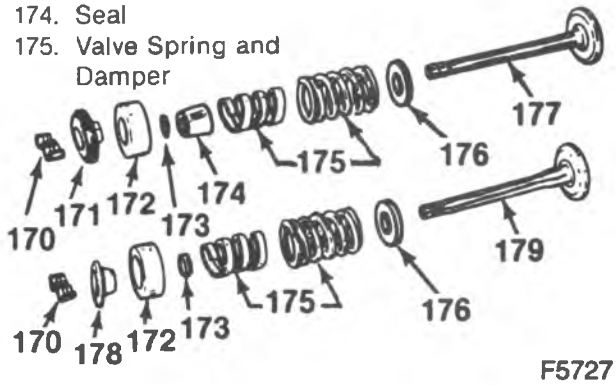


Figure 23—Valves and Components

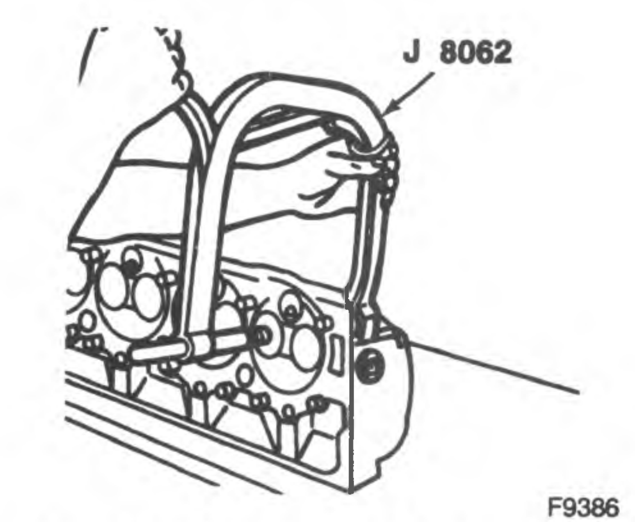
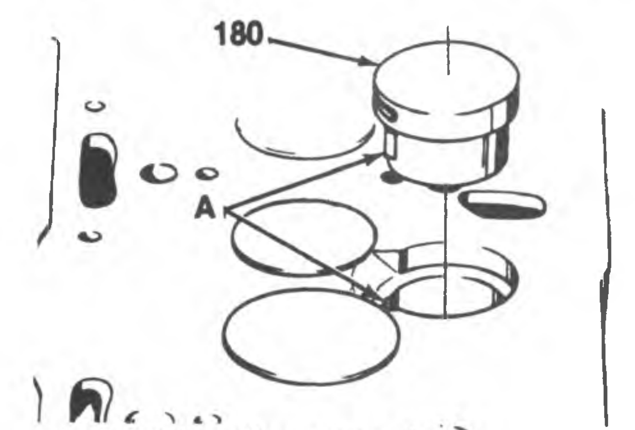


Figure 24—Compressing the Valve Springs



A. Notch (Location may vary.)
180. Prechamber

B8413

Figure 25—Prechamber

CYLINDER HEAD

Disassemble (Figures 23, 24, and 25)

Tool Required:
J 8062 Valve Spring Compressor

1. Valve keepers (170).
   - Compress the valve springs with J 8062 (figure 24).
   - Remove the valve keepers.
   - Remove J 8062.
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 26). 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 26)

1. Components outlined in GENERAL ENGINE MECHANICAL (SEC. 6A). Replace all valve springs at overhaul.
2. Pre-chambers for cracks. Replace any pre-chambers with facial cracks longer than 5 mm (3/16-inch) (figure 26). Service pre-chambers are available in standard and 0.254 mm oversize.

Measure (Figure 27)

1. Valve stem clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).
2. Cylinder head warpage. Use a straightedge and a feeler gage (figure 27). 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).

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 23, 24 and 25)

Tool Required:
J 8062 Valve Spring Compressor

1. Pre-chambers (180) (if removed) (figure 25).
   - 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.

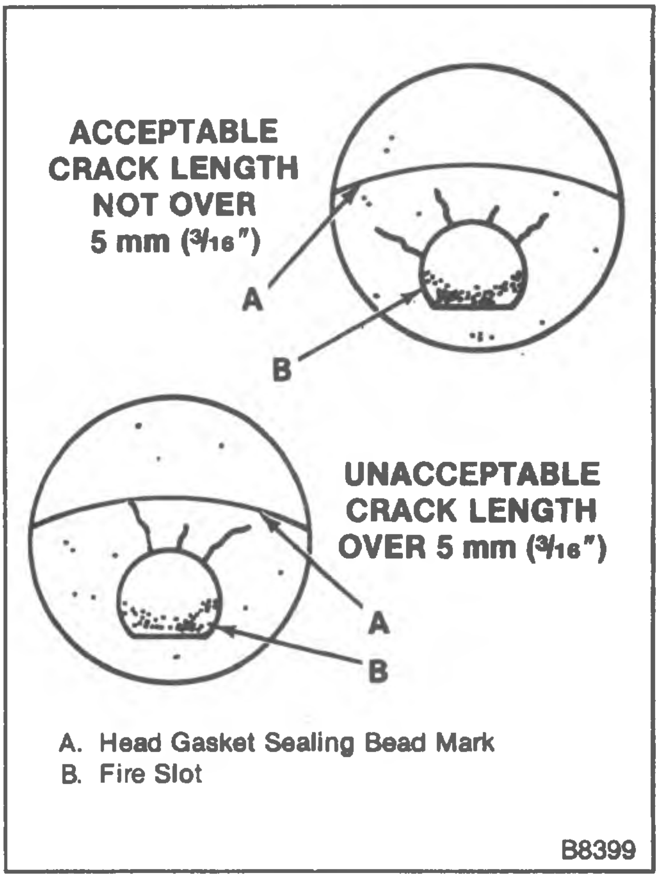


Figure 26—Prechamber Inspection

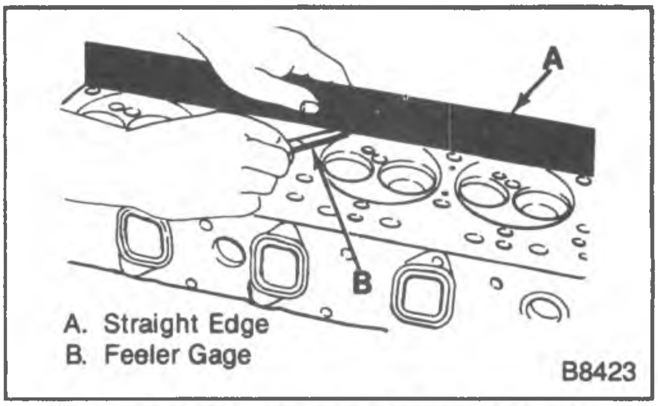


Figure 27—Checking the Cylinder Head for Warpage

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 pre-chamber 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 valve 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 24). 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 28 and 29)

- Valve spring installed height of each valve spring, as follows:
  1. Use a narrow, thin scale. A cutaway scale may be helpful. Refer to figure 28.
  2. Measure from the valve shim or spring seat to the top of the shield (figure 29).
  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.

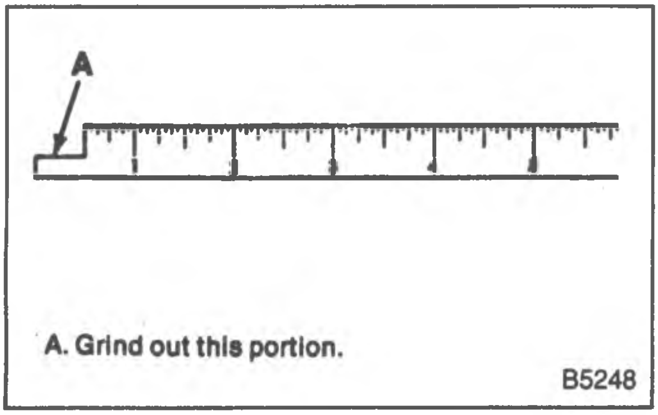


Figure 28—Cutaway Scale

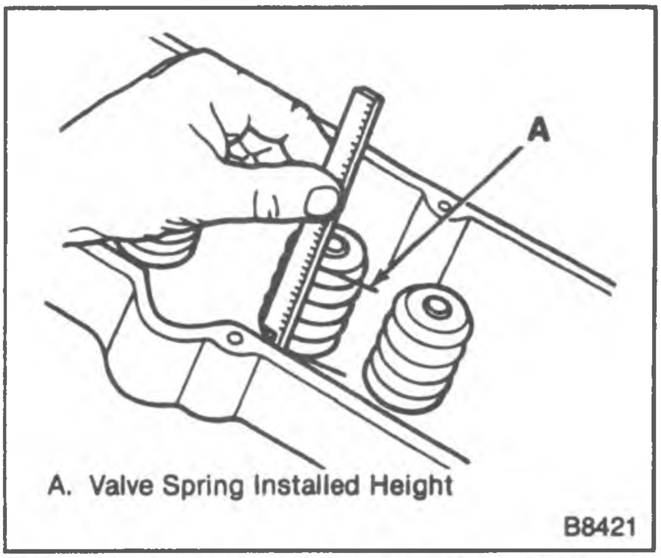


Figure 29—Measuring Valve Spring Installed Height

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.

THERMOSTAT AND COOLANT CROSSOVER

Disassemble (Figure 9)

1. Bolts or studs (40).
2. Coolant outlet (41).
3. Thermostat (42).
4. Gasket (43).

Inspect

- Coolant outlet and coolant 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 thoroughly agitated while heating. Apply heat to the coolant and record both the temperature at which the thermostat begins to open and the temperature at which the thermostat is fully open. The thermostat should open at 25°C(4°F) above the temperature stamped on the thermostat.
2. 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 9)

1. Gasket (43).
2. Thermostat (42).
3. Coolant outlet (41).
4. Bolts or studs (40).

Tighten

- Bolts or studs to 47 N.m (35 ft. lbs.).

INJECTION NOZZLE TESTS

Tool Required:
J 29075-B Diesel Nozzle Tester

Nozzle testing is comprised of the following checks:

- Nozzle opening pressure
- Leakage
- Chatter
- Spray pattern

Each test should be considered independent of the others (for example, when checking opening pressure, do not check for leakage).

If all of the above tests are satisfied, the nozzle holder assembly can be re-used. If any one of the tests is not satisfied, the complete nozzle holder assembly must be replaced. The nozzle holder will then be checked and repaired at a centralized location.

When performing the injection nozzle tests, refer to the instructions provided with the nozzle tester J 29075-B

- Test Lines - 6x2x400 mm (1.5 mm bore).
- Test Fluid - per ISO 4113 (Example: Shell V 1399, Viscosity 1487C or equivalent).
- Kinetic Viscosity at 40°- per ISO 3104: 2,45 - 2.75 mm /second.
- Test oil temperature during test: 20 - 25°C (68°F - 77°F).

1. Connect the nozzle holder assembly to the test line.
2. Place clear plastic tubes on overflow connections to prevent leakoff from being confused with actual leak.
3. Close the shutoff valve to the pressure gage.

CAUTION: When testing nozzles, do not place your hands or arms near the tip of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle, preferably transparent, to contain the spray.

4. Fill and flush the nozzle holder assembly with test oil by activating the lever briskly and repeatedly. This will apply test oil to all functionally important areas of the nozzle and purge it of air.

OPENING PRESSURE TEST

1. Open the shutoff valve at the pressure gage one-quarter turn.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

2. Depress the tester lever slowly. Note at what pressure the needle of the pressure gage stopped. The maximum observed pressure is the opening pressure.
   - Some nozzles may pop while other nozzles may drip down. This is not leakage.
3. The opening pressure should not fall below the lower limit of 105 bar (1500 psi) on used nozzles.
4. Replace nozzles which fall below the lower limit.

LEAKAGE TEST

1. Further open the shutoff valve at the pressure gage 1/2 to 1 1/2 turns).
2. Blow-dry the nozzle tip.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

3. Depress the lever of the manual test stand slowly until the gage reads a pressure of 95 bar (1400 psi). Observe the nozzle tip. A drop may form on the end of the nozzle but should not drop off within a period of 10 seconds.
4. Replace the nozzle assembly if a drop falls during the 10 seconds.

CHATTER TEST

When testing for chatter, it should be noted that the sound (chatter) for new and used nozzles may vary. This is due to carbonized fuel deposits on the pintle and nozzle tip of used nozzles. With some used nozzles, chatter is difficult to detect during slow actuation of the hand lever.

Some nozzles may chatter louder than others. As long as there is chatter, the nozzle is acceptable.

1. Close the shutoff lever at the pressure gage.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

2. Depress the lever of the test stand slowly and note whether chatter noise can be heard.
3. If no chatter is heard, move the lever faster until it chatters. At fast lever movement, the nozzle may make a "hissing" or "squealing" sound rather than the normal chatter. This is acceptable.

4. These sounds indicate that the nozzle needle moves freely and that the nozzle seat, guide, and pintle are OK.
5. Replace nozzles that do not chatter.

SPRAY PATTERN

This nozzle features a longer nozzle overlap, greater pintle to body clearance, and an internal wave washer between the nozzle nut and the nozzle. These features make objective spray pattern testing difficult.

A pop tester will not deliver fuel fast enough for proper spray pattern analysis. Based on this, this type of nozzle should not be rejected for spray pattern.

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.

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 DIESEL FUEL INJECTION (SEC.6C2) in the proper 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,

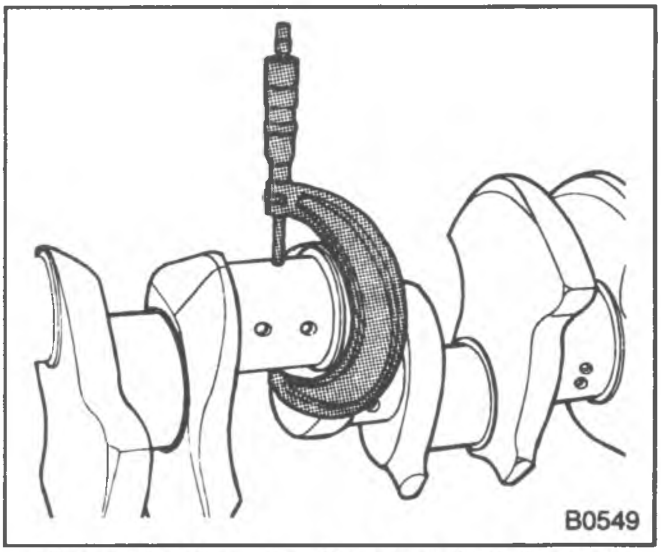


Figure 30—Measuring the Crankshaft Journals

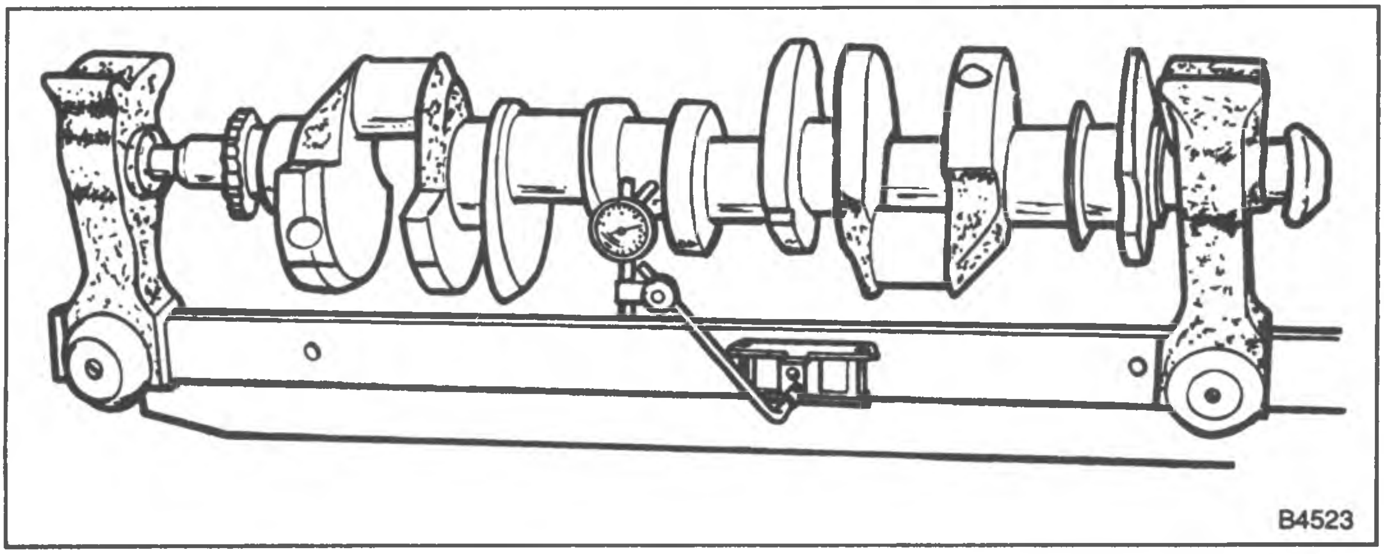


Figure 31—Checking the Crankshaft Run-Out

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 30 and 31)

- — Main bearing and connecting rod journal diameters (figure 30). Compare with "Specifications." Grind or replace the crankshaft if necessary.
- — Main bearing and connecting rod journals for taper and out-of-round (figure 30). If the journals are tapered or out-of-round more than 0.001-inch, replace the crankshaft.
- — Crankshaft runout (figure 31).
  - 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.

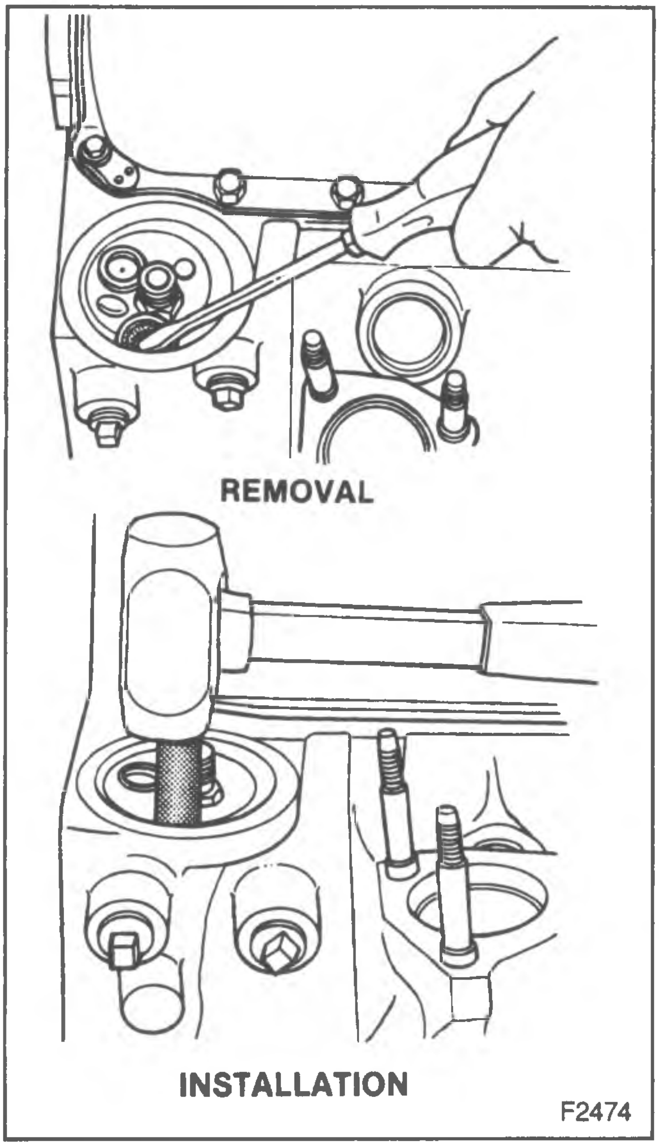


Figure 32—Oil Filter Bypass Valve Replacement

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 32)

1. Oil filter.
2. Oil filter bypass valve. Pry out with a screwdriver.

Clean

- Recess in the block.

Install or Connect (Figure 32)

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 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 33 through 36)

1. Upper main bearing inserts to the block.
2. Crankshaft.

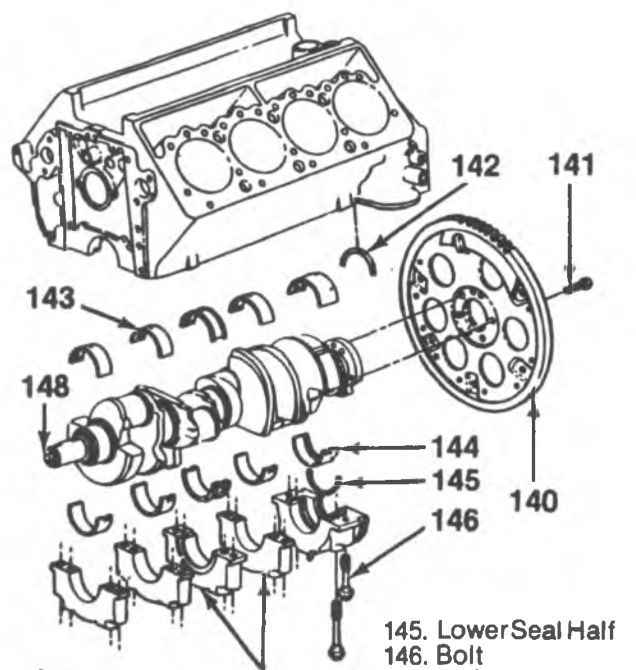


Figure 33—Crankshaft and Components

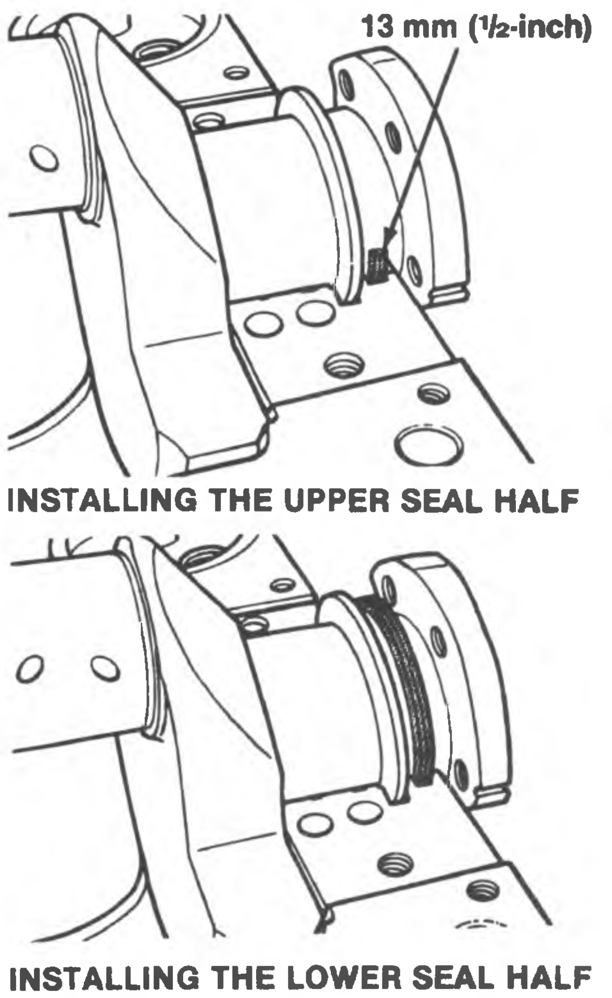


Figure 34—Installing the Two-Piece Rear Oil Seal

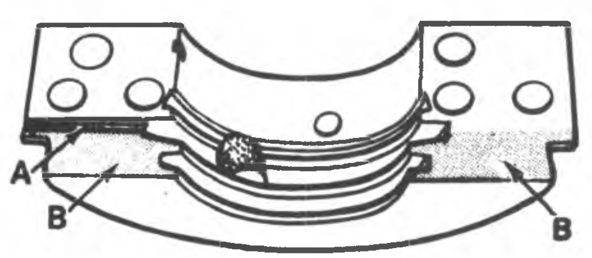


Figure 35—Applying Sealant to the Main Bearing Cap

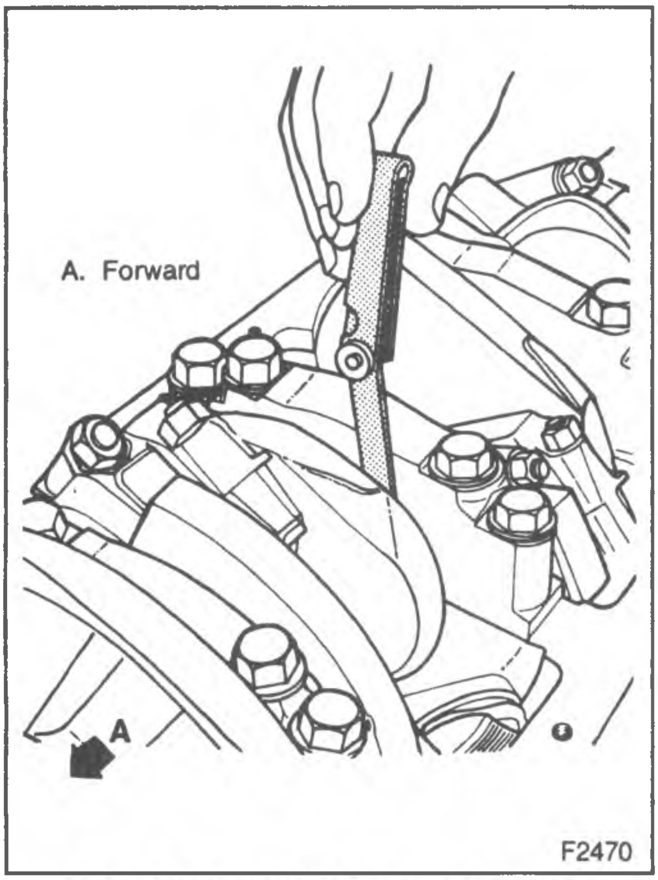


Figure 36—Measuring Crankshaft End Play

3. Lower main bearing inserts to the main bearing caps.

Measure

- Main bearing clearance. Refer to GENERAL ENGINE MECHANICAL (SEC. 6A).

4. Apply engine oil to the main bearings.
5. Rear crankshaft oil seal halves to the block.
   - Apply a light coat of engine oil to the seal lips where they contact the crankshaft.
   - "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 34).
   - Insert the other seal half into the opposite side of the seal groove in the block (figure 34).

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.

6. Number 5 (rear) main bearing cap.
   - When installing the two piece seal, 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 35. 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.
7. Numbers 1, 2, and 4 main bearing caps and bolts.

   Tighten

   - Bolts to specifications. Refer to step 5.
8. Number 3 (center) main bearing cap and bolts. Tighten the bolts temporarily to 14 N.m (10 ft. lbs.).

Measure (Figure 36)

- 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 36). 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 33)

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.

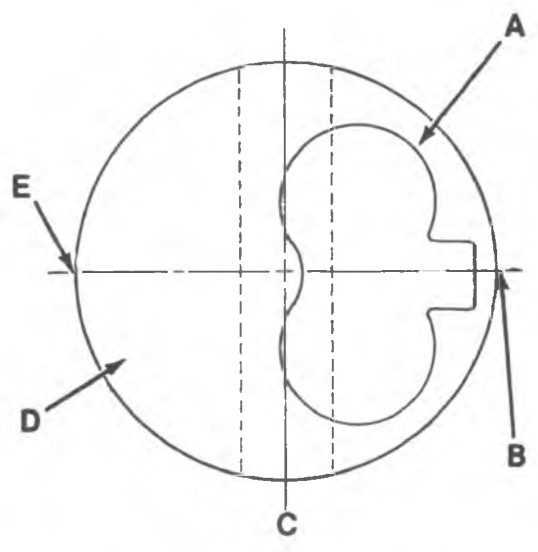
Some VIN Code C (RPO LH6) (light duty emissions) engines may have both standard and 0.08 mm (0.003-inch) oversize connecting rod bearings. The oversize connecting rods are stamped "O.S." on the cap's lower end.

INSTALLATION

Install or Connect (Figures 37, 38, and 39)

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.



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

B8046

Figure 37—Ring Gap Location

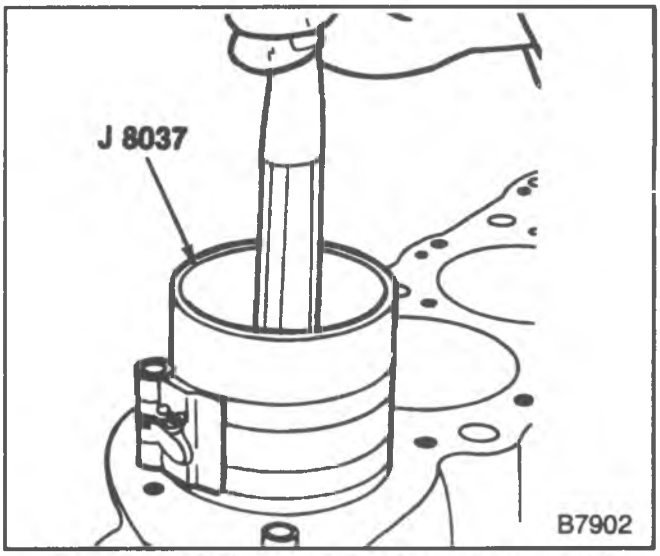
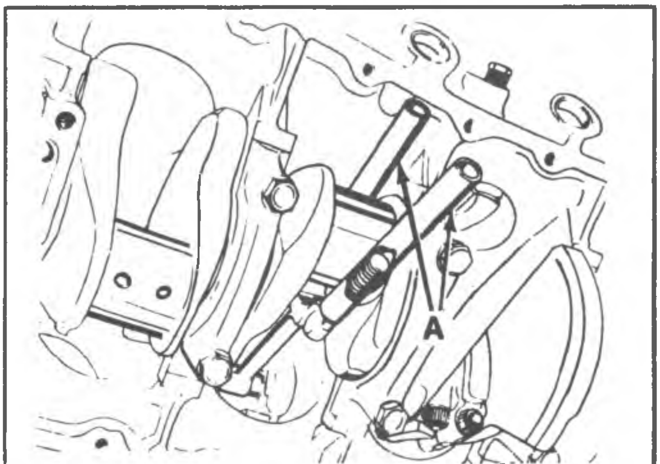


Figure 38—Installing the Piston and Connecting Rod



A. Use short pieces of 10 mm (3/8-inch) hose to protect the crankshaft journal.

B8045

Figure 39—Installing the Connecting Rod and Piston

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 removed, 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 37. Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J 8037 over the piston (figure 38).
   - 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 38). At the same time, from beneath the engine, guide the connecting rod to the journal with the pieces of hose (figure 39). Hold the ring compressor against the block until all rings have entered the cylinder bore.
- 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 34)

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 40). The correct clearance is 0.17-0.63 mm.

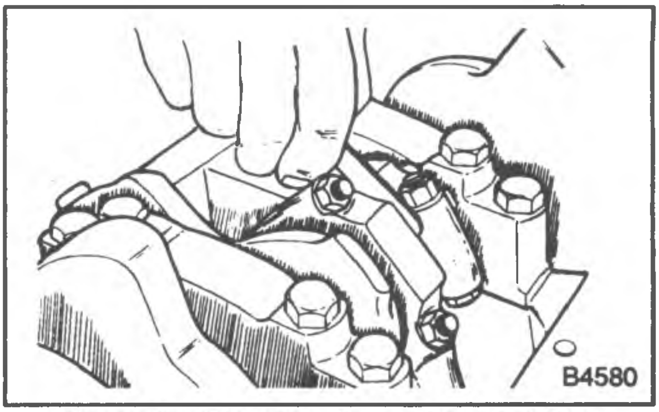


Figure 40—Checking Connecting Rod Side Clearance

CAMSHAFT INSTALLATION

Install or Connect (Figure 41)

- 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).
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.).

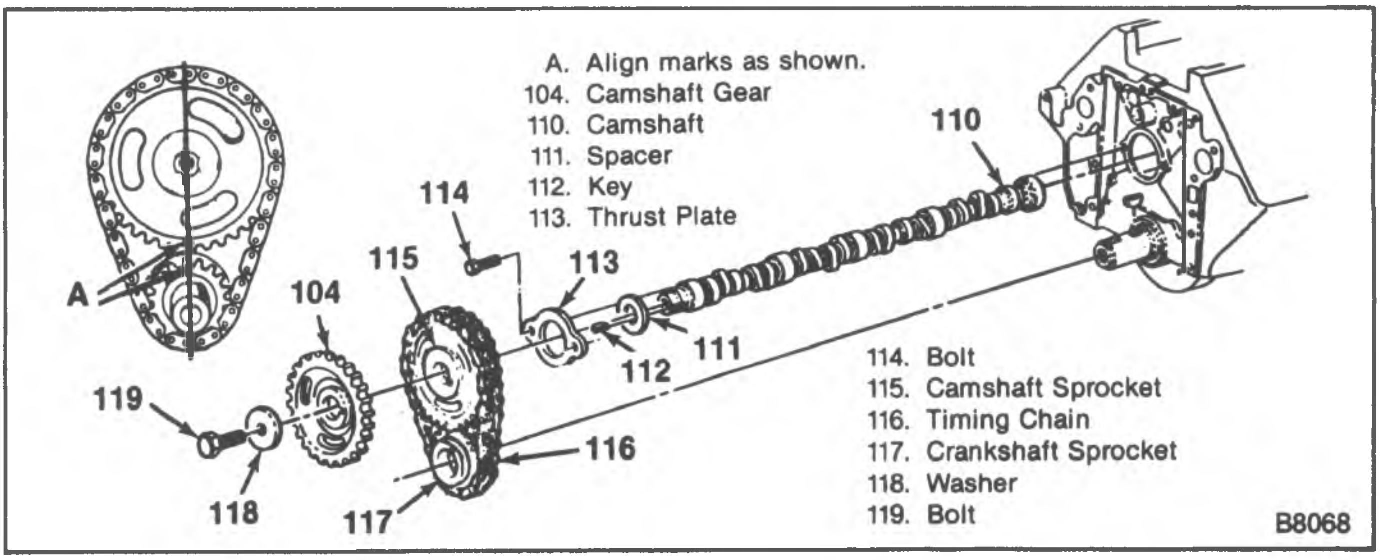


Figure 41—Camshaft and Components

TIMING CHAIN AND SPROCKET INSTALLATION

Install or Connect (Figure 41)

1. Crankshaft sprocket (117).
2. Camshaft sprocket (115) with timing chain (116).

Important

- Align the timing marks (figure 41).

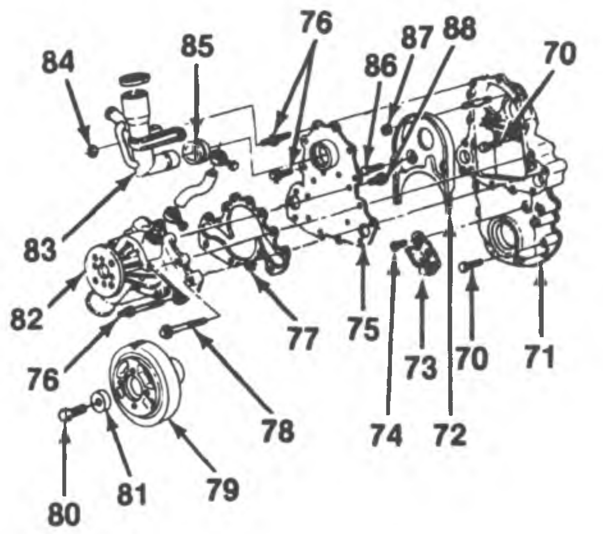
3. Camshaft gear (104), washer (118) and bolts (119).

Tighten

- Bolt (119) to 100 N·m (75 ft. lbs.).

Measure

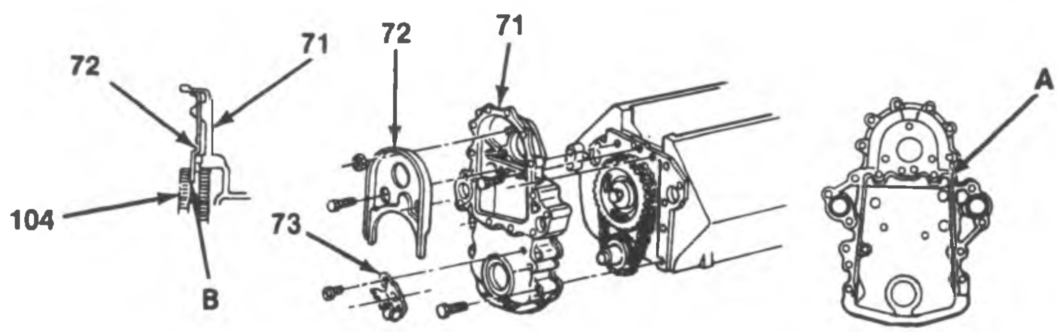
- Timing chain free play as follows:
  1. Mount a dial indicator to the front of the block.
  2. Position the dial indicator so that the plunger contacts the timing chain between the two sprockets.
  3. Pull the chain outward (parallel to the front face of the block) the maximum amount with finger pressure 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).



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

F5726

Figure 42—Front Cover and Components



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

F5728

Figure 43—Front Cover Installation

FRONT COVER INSTALLATION

Clean

- Sealing surfaces on the block and front cover with carburetor cleaner or equivalent.

Install or Connect (Figures 42 and 43)

- 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 43.

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 43). 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.

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).

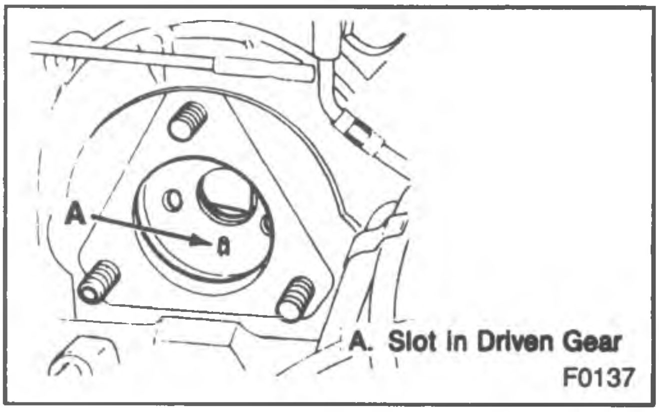


Figure 44—Slot in Injection Pump Gear

2. Install J 33042 in the injection pump location.
   - Do not use the gasket.
3. Set the injection pump gear (106) (figure 47) 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 44). If not, remove J 333042 and rotate the engine crankshaft 360 degrees.
4. Fasten J 33042 to the injection pump gear and tighten (figure 45).
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.

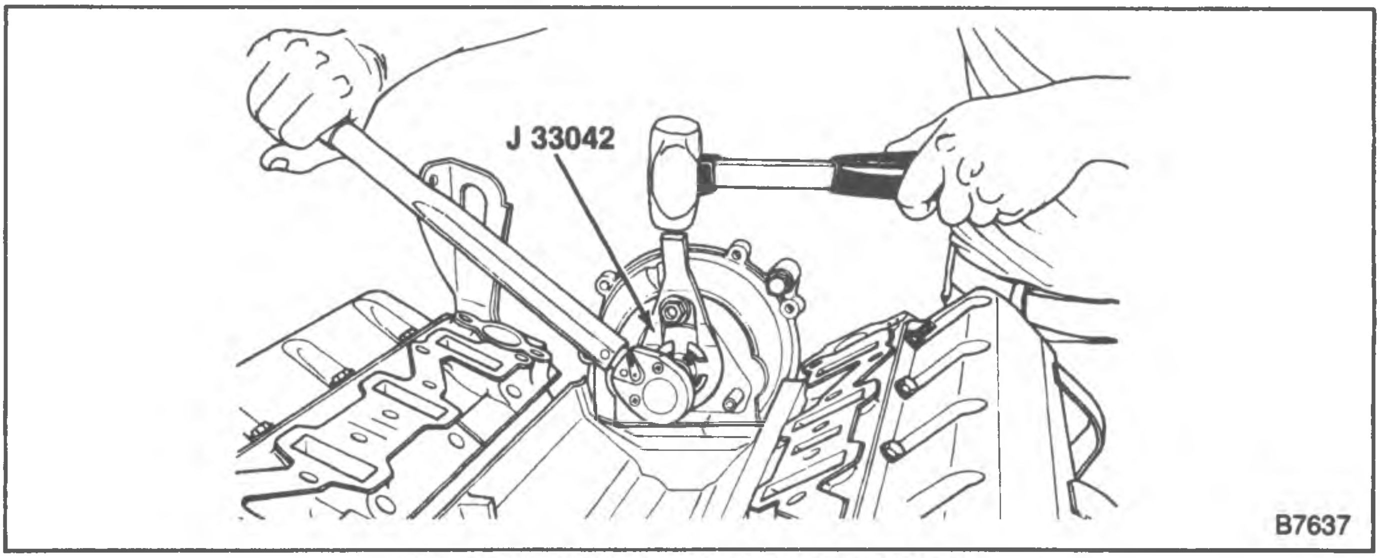


Figure 45—Marking TDC on the Front Cover

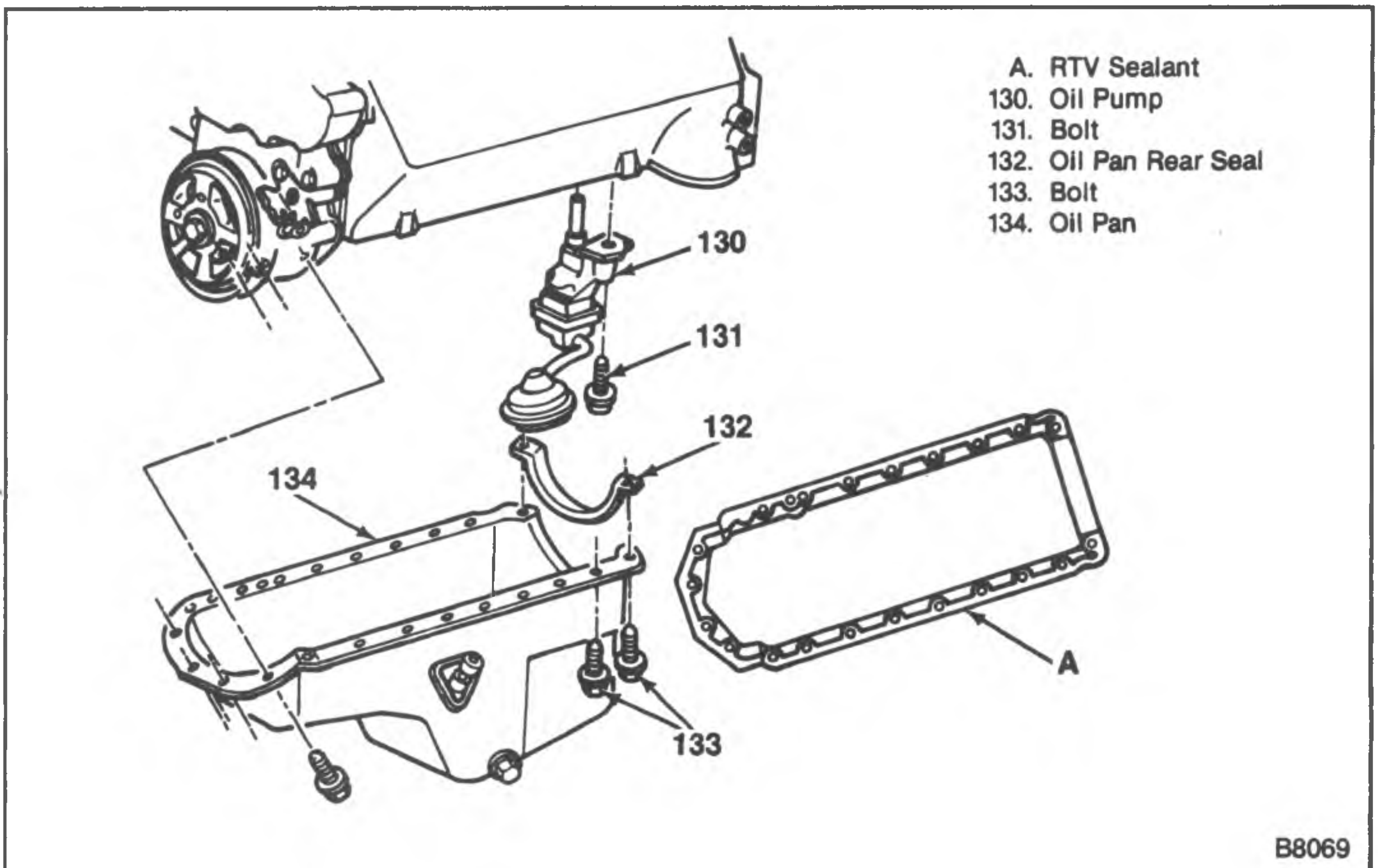


Figure 46—Oil Pan and Oil Pump

OIL PUMP INSTALLATION

Install or Connect (Figure 46)

1. Oil pump with extension.
2. Bolt (131).

Tighten

- Bolt (131) to 90 N·m (65 ft. lbs.).

OIL PAN INSTALLATION

Install or Connect (Figure 46)

- 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 43). 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 47)

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 47).

6. Bolts (105).

Tighten

- Bolts (105) to 25 N·m (20 ft. lbs.).

7. Wires and hoses at the injection pump.

Adjust (Figure 48)

- 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 48). The engine must be off when the timing is reset.

Tighten

- Nuts (101) to 40 N.m (30 ft. lbs.) (figure 47).

TORSIONAL DAMPER INSTALLATION

Install or Connect (Figure 42)

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).

Tighten

- Bolt (80) to 270 N.m (200 ft. lbs.).

COOLANT PUMP INSTALLATION

Clean

- Sealing surfaces on the coolant pump plate and block. Use carburetor cleaner or equivalent.

Install or Connect (Figures 42 and 49)

1. Coolant pump (82) and gasket (77) to the coolant 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 coolant pump plate as shown in figure 49.

3. Coolant 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

— Coolant pump to front cover bolts to 42 N.m (32 ft. lbs.).
— Coolant 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.

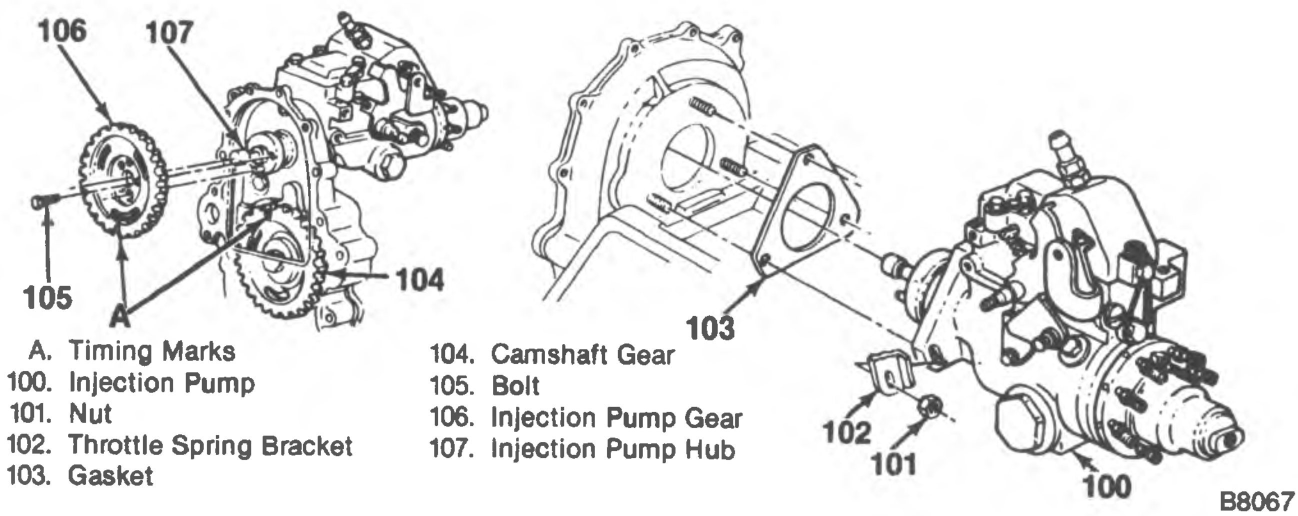
Install or Connect (Figure 50)

NOTICE: New hydraulic lifters must be primed before installation. Damage to the lifters may result if they are 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).

Tighten

- Clamp bolts to 26 N.m (18 ft. lbs.).



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 47—Injection Pump

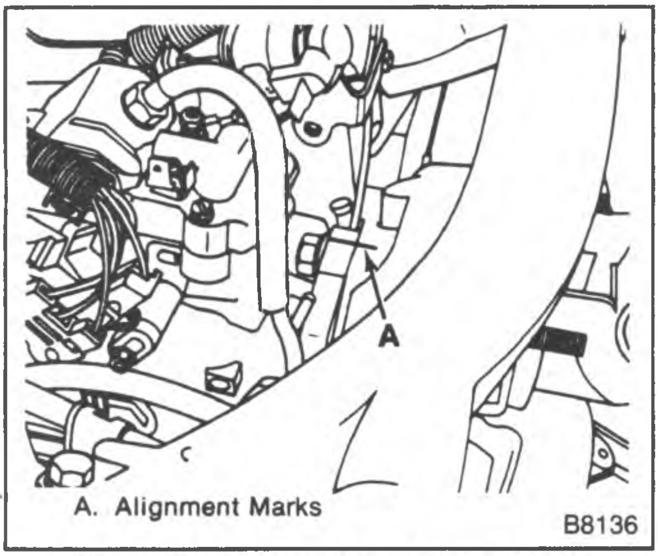


Figure 48—Injection Pump Timing Marks

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 50 and 51)

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.

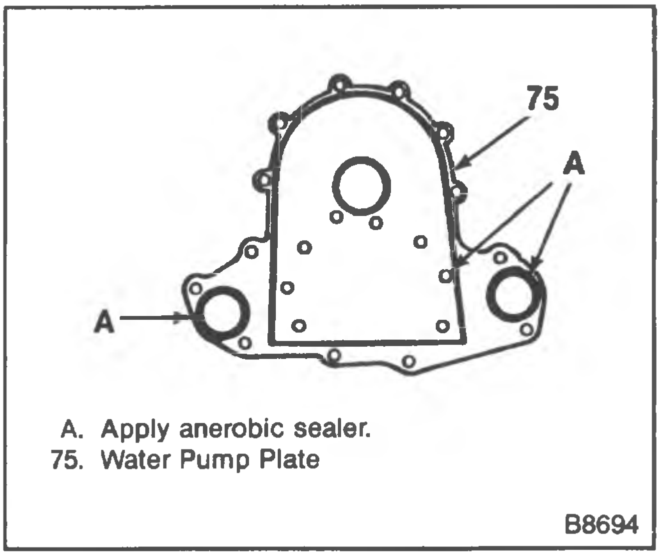


Figure 49—Applying Sealer to the Coolant Pump Plate

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 51, tighten all bolts to 25 N·m (20 ft. lbs.).
- 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.

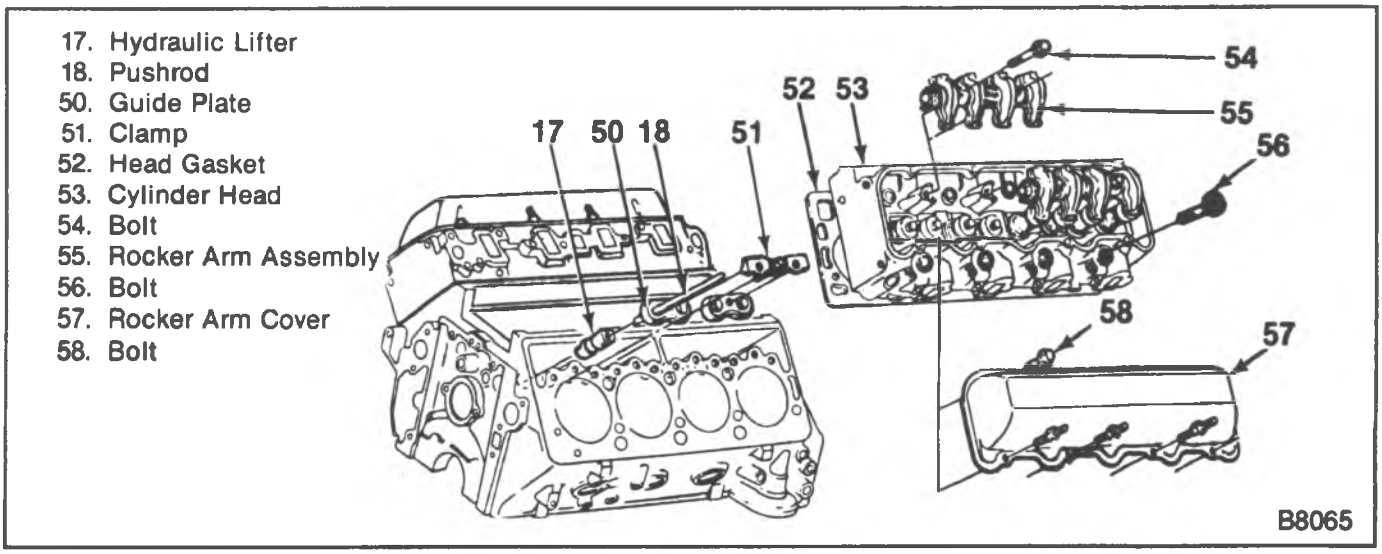


Figure 50—Cylinder Head and Components

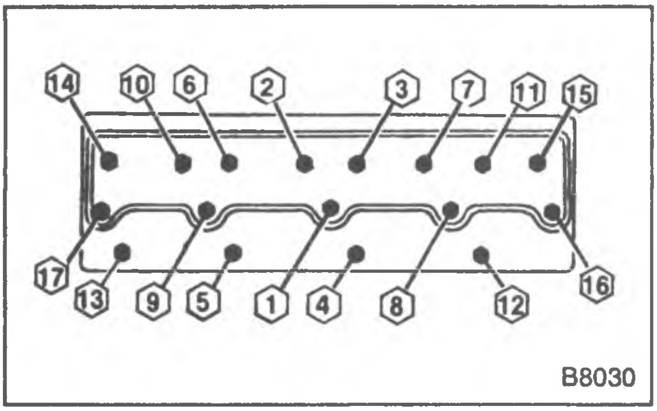


Figure 51—Head Bolt Tightening Sequence

PUSHROD AND ROCKER ARM INSTALLATION

Install or Connect (Figures 50 and 52)

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).
   - Rotate the engine until the mark on the torsional 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 coolant pump bolt (figure 52). 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.

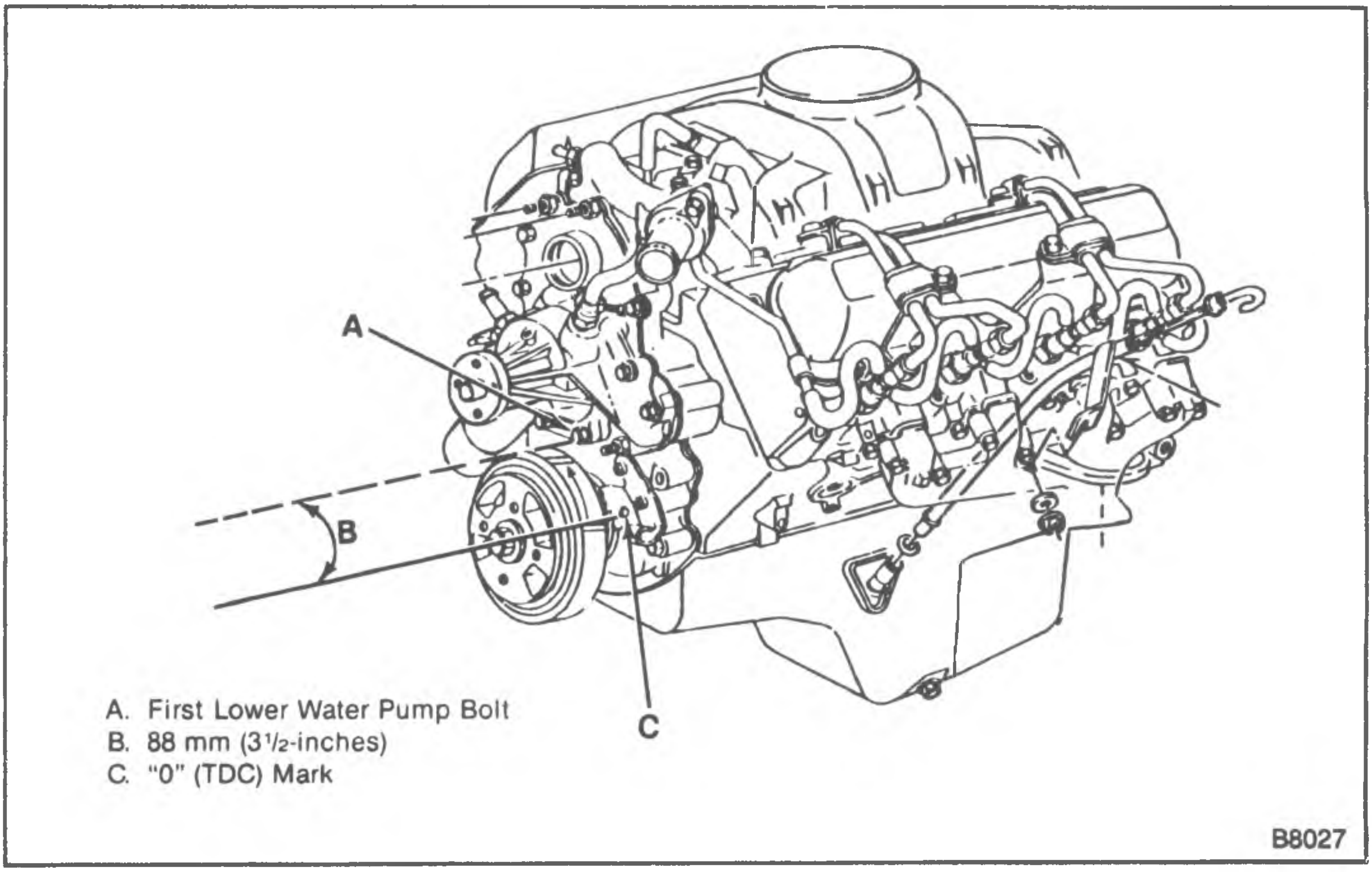


Figure 52—Aligning the Timing Mark

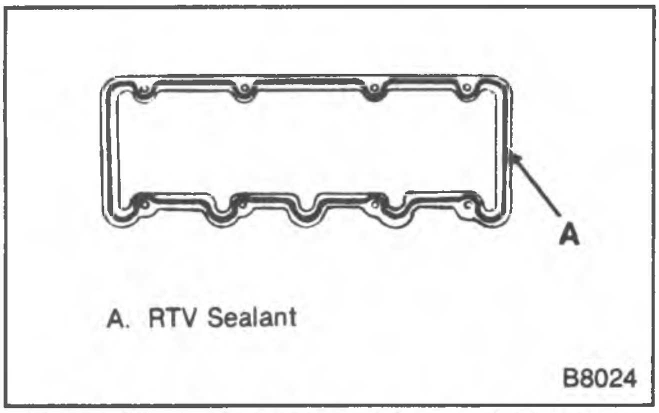


Figure 53—Applying Sealant to the Rocker Arm Cover

Install or Connect (Figure 53)

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 53. The sealer must be wet to the touch when the bolts are tightened.

1. Rocker arm covers.
2. Bolts (58).

Tighten

- Bolts (58) to 22 N.m (16 ft. lbs.).

COOLANT CROSSOVER INSTALLATION

Install or Connect (Figure 54)

1. Gaskets (46).
2. Coolant 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.

DIPSTICK TUBE INSTALLATION

Install or Connect

1. New O-ring to the dipstick.
2. Dipstick to the engine.
3. Dipstick bracket bolt.

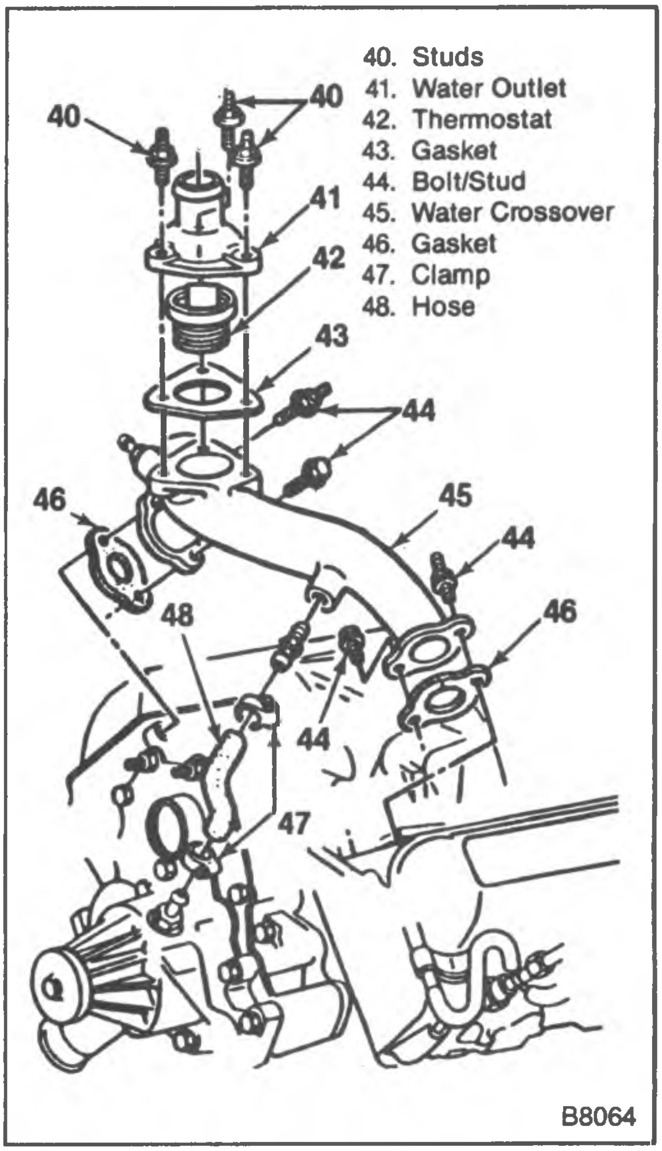


Figure 54—Thermostat and Coolant Crossover

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 (124 ft. lbs.).

INJECTION NOZZLE INSTALLATION

Install or Connect (Figure 55)

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 install 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.

Tighten

- Nozzle to 70 N.m (50 ft. lbs.).

2. Fuel return hose.
3. Fuel line clip.

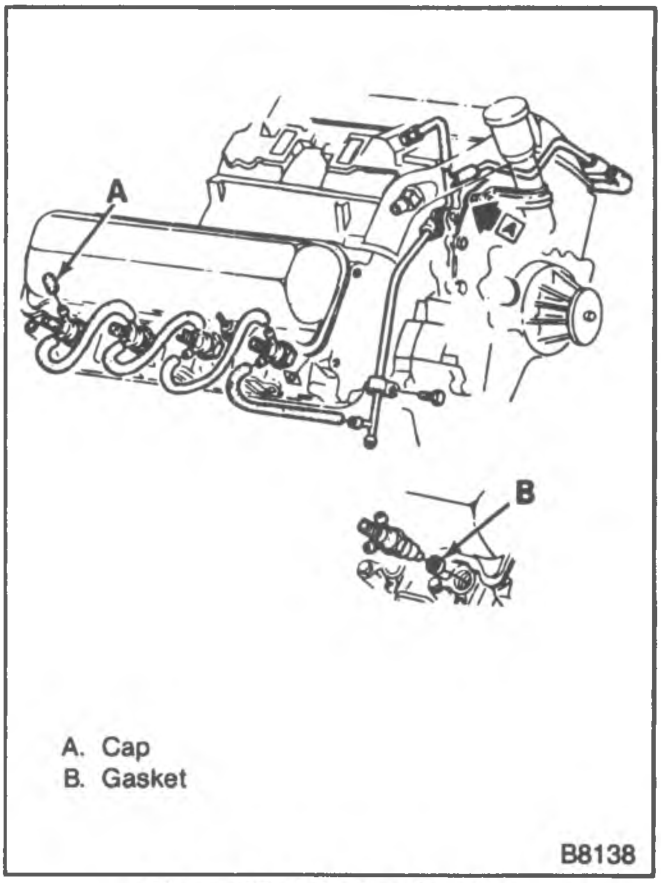


Figure 55—Injection Nozzles

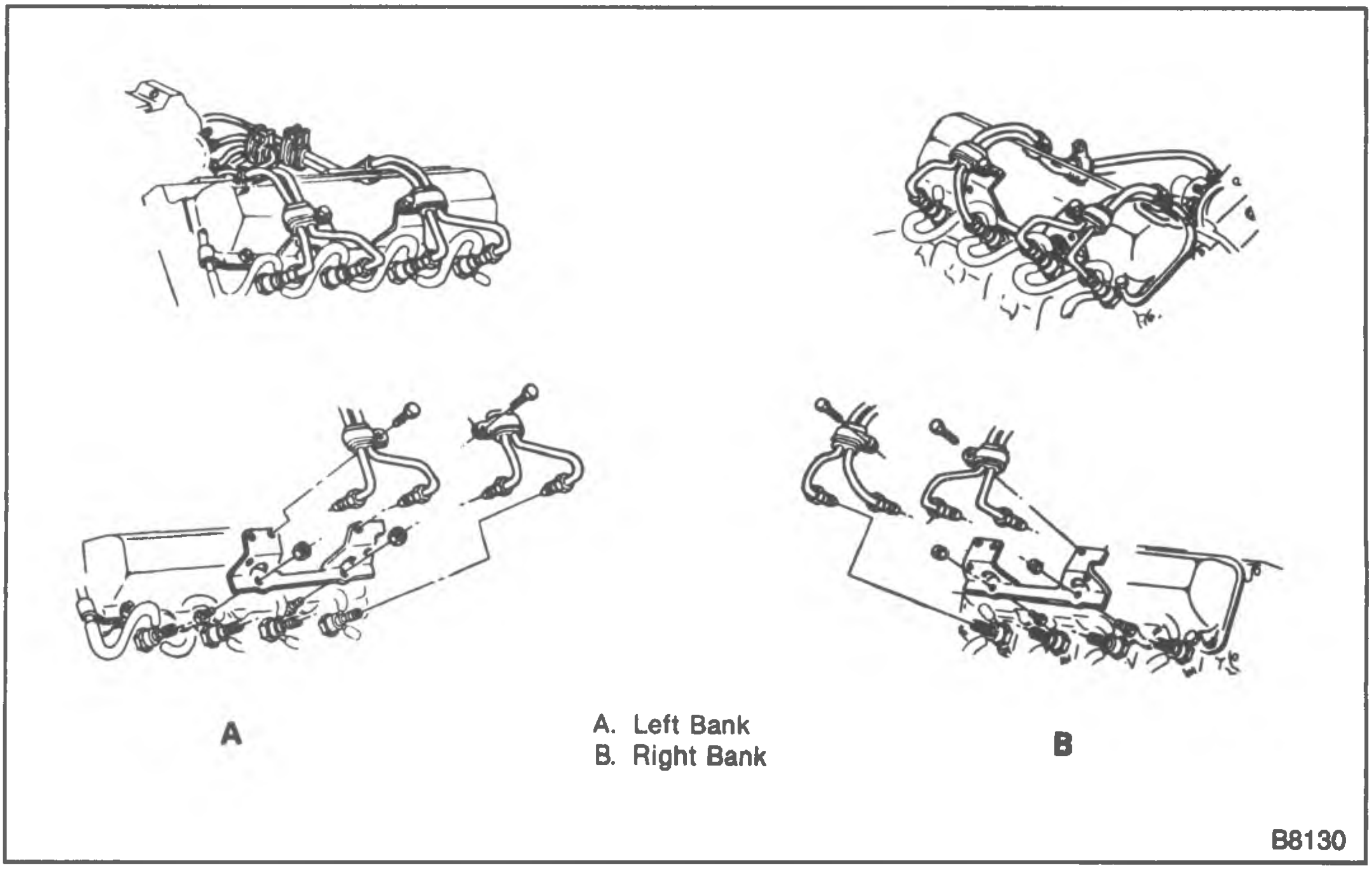


Figure 56—Injection Lines

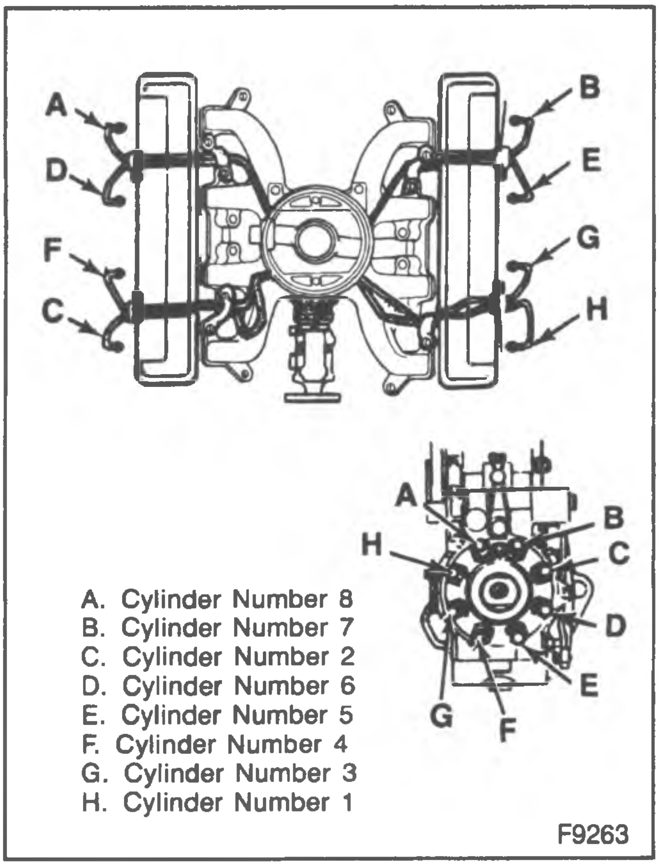


Figure 57—Injection Line Routing

INJECTION LINE INSTALLATION

Install or Connect (Figures 56 and 57)

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 58)

Tool Required:
J 29664 Manifold Cover Set

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 58.

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 59, 60, and 61)

1. New gasket to the oil pump drive or vacuum pump.

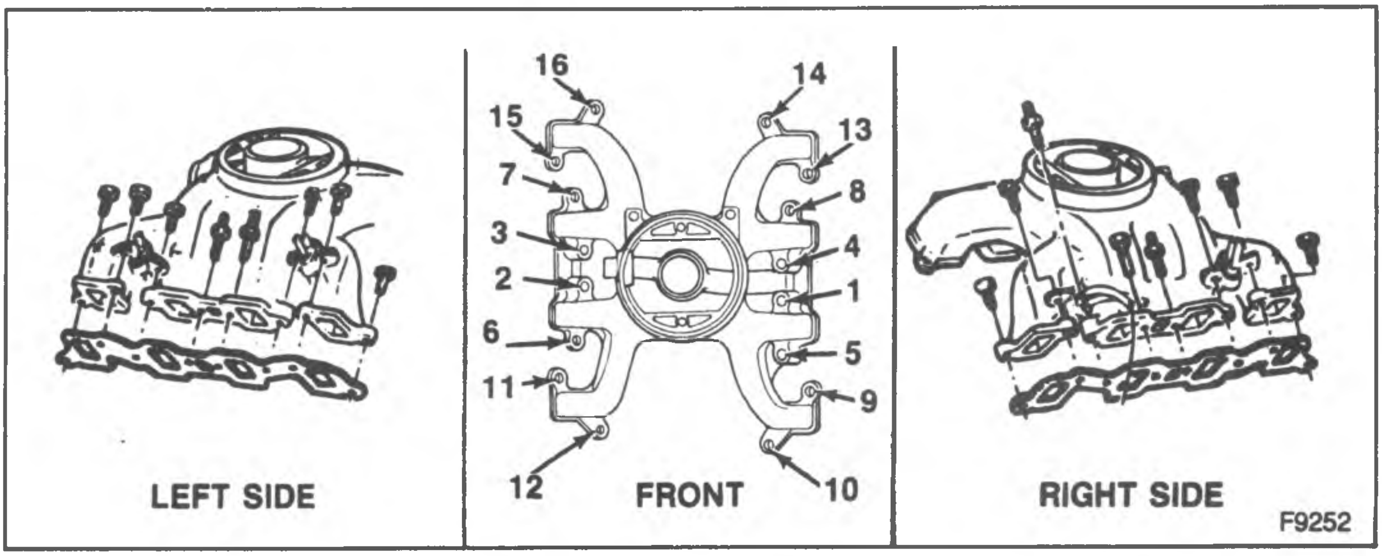


Figure 58—Intake Manifold Installation

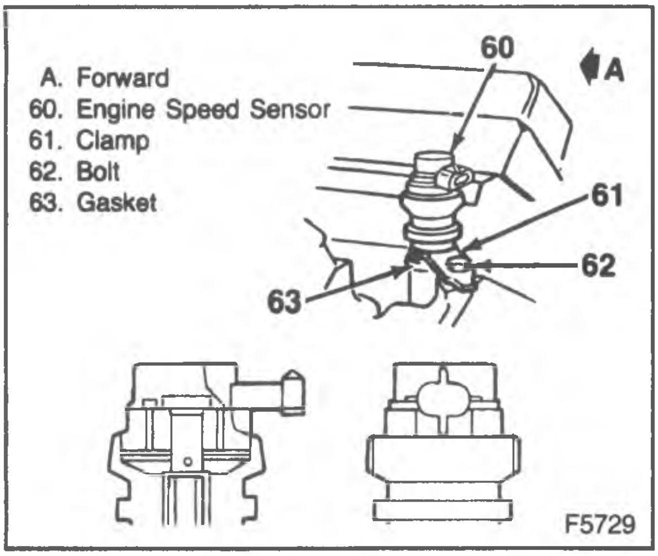


Figure 59—Oil Pump Drive Installed

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 61).
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 Owner'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.

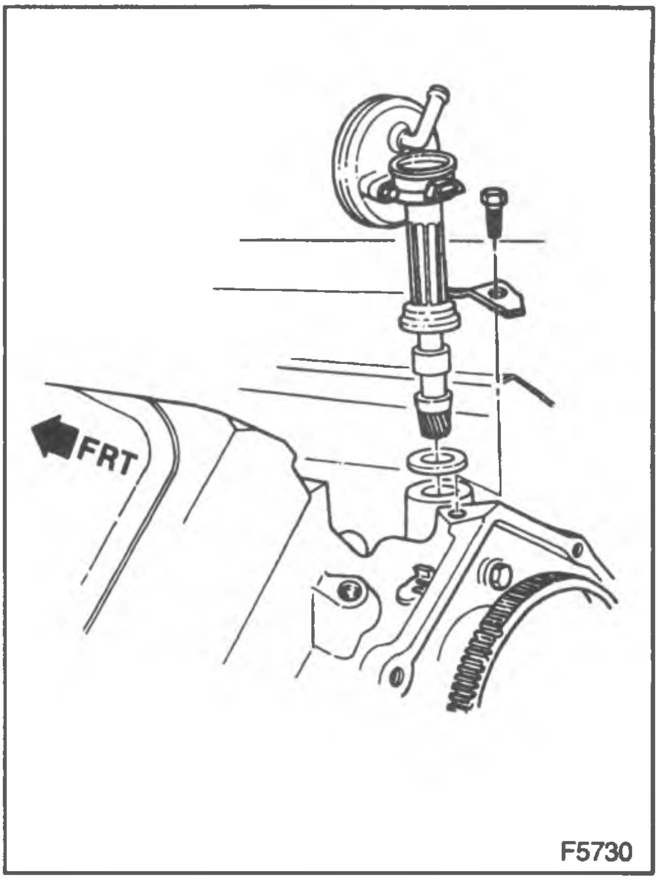


Figure 60—Vacuum Pump

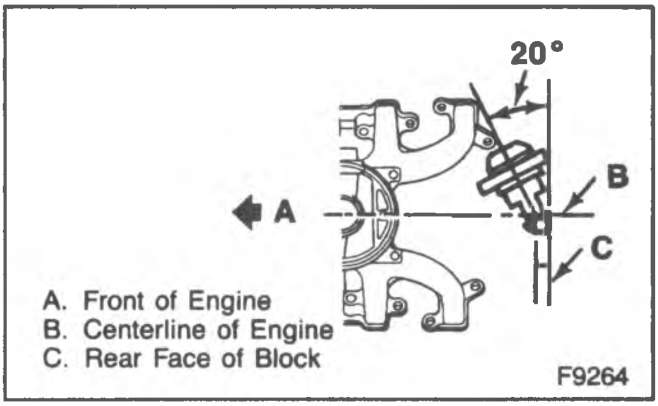


Figure 61—Vacuum Pump Installed

Listen for sticking lifters, and other unusual noises. Check for oil and coolant leaks while the engine is running.

Using the Emission Control Label for specifications, adjust idle speed, fast idle speed, etc. as required.

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">Out of Round</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 colspan="2" rowspan="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">Crankpin</td><td colspan="2">Diameter</td><td>60.913-60.939</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 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>

T2474

ENGINE SPECIFICATIONS (CONT.)

All Specifications are in millimeters (mm) unless otherwise noted.

DISPLACEMENT			6.2 L
CAMSHAFT:			
Lobe Lift ±0.05		Intake	7.133
		Exhaust	7.133
Journal Diameter		#1 2, 3, 4	54.970-55.025
		#5	50.970-51.025
Journal Clearance		#1, 2, 3, 4	0.025-0.118
		#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
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.05
Seat Width		Intake	0.89-1.53
		Exhaust	1.57-2.36
Stem Clearance		Intake	0.026-0.069
		Exhaust	0.026-0.069
Valve Spring	Pressure Newtons @ mm	Closed	356 N @ 46.0 mm
		Open	1025 N @ 35.3 mm
	Installed Height		46
Timing Chain Free Play	New Chain		12.7 mm (0.0500-inch)
	Used Chain		20.3 mm (0.800-inch)
Hydraulic Lifter Diameter	Standard		23.39-23.41
	0.010-inch Oversize		23.64-23.66
Lifter Bore Diameter	Standard		23.45-23.47
	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.

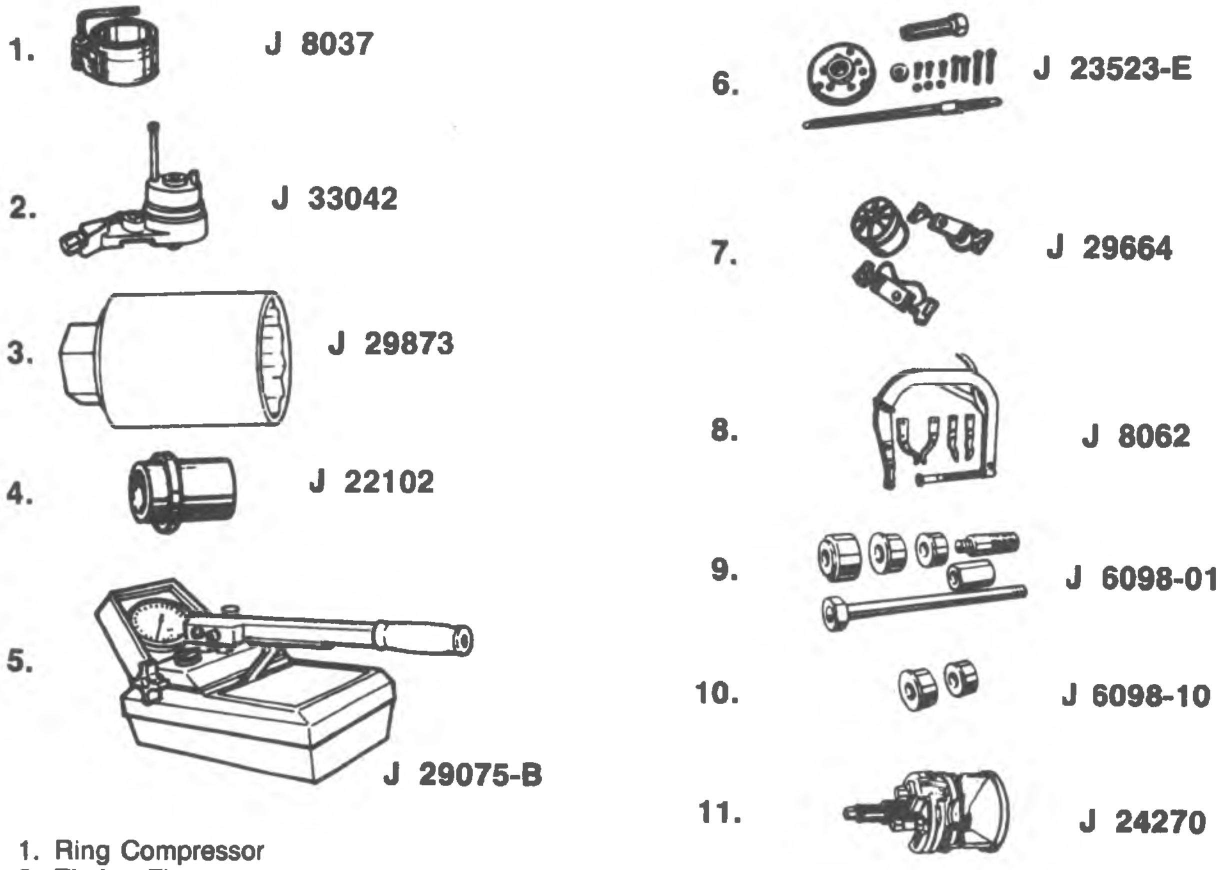
T2475

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Coolant Outlet Bolts/Studs	47	35	—
Coolant 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	—
Coolant Pump Plate to Water Pump Bolts	22	16	—
Coolant Pump to Front Cover Bolts	42	32	—
Coolant 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	—

T2526

SPECIAL TOOLS



1. Ring Compressor
2. Timing Fixture
3. Nozzle Socket
4. Seal Installer
5. Nozzle Tester
6. Torsional Damper Remover
7. Manifold Cover Set
8. Valve Spring Compressor
9. Camshaft Bearing Remover and Installer
10. Camshaft Bearing Remover and Installer Adapter
11. Ridge Reamer

F9279

SECTION 6C1

MODEL 220 THROTTLE BODY

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

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 you are replacing the throttle body, transfer the identification number to the new throttle body.

Throttle body parts are shown in the disassembled view (figure 2).

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 an 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 90 kPa (9 and 13 psi). Fuel in excess of injector needs is returned to the fuel tank by a separate line.

The ECM monitors information from several sensors to determine fuel requirements based on engine operating conditions. The fuel is delivered under one of several conditions called "modes." All the modes are controlled by the ECM.

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)

THROTTLE BODY DISASSEMBLY

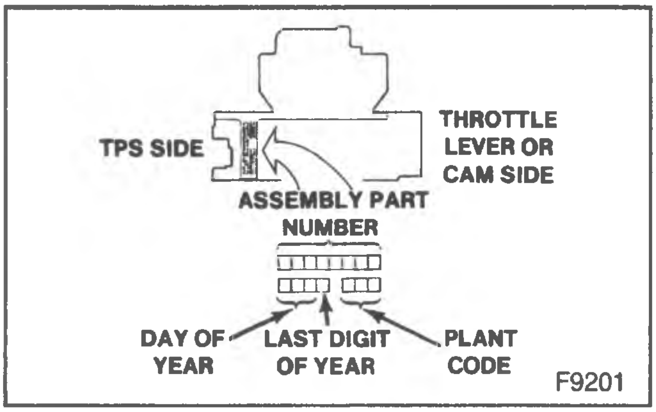


Figure 1—TBI Identification

IDLE AIR CONTROL (IAC) VALVE

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may 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

1. Fuel Meter Cover Attaching Long Screw Assembly
2. Fuel Meter Cover Attaching Short Screw Assembly
3. Fuel Meter Cover Assembly
4. Fuel Meter Cover Gasket
5. Fuel Meter Outlet Gasket
6. Pressure Regulator Seal
7. Pressure Regulator
10. TBI Fuel Injector Assembly
11. Fuel Injector Inlet Filter
12. Fuel Injector O-Ring (Lower)
13. Fuel Injector O-Ring (Upper)
19. Fuel Meter Body/Throttle Body Attaching Screw
21. Fuel Meter Body Assembly
22. Throttle Body to Fuel Meter Body Gasket
23. Air Cleaner Gasket
30. Fuel Return Line O-Ring
31. Fuel Outlet Nut
37. Fuel Inlet Nut O-Ring
38. Fuel Inlet Nut
40. Fuel Outlet Nut Gasket
41. Fuel Inlet Nut Gasket
52. TPS Attaching Screw Assembly
53. Throttle Position Sensor Seal
58. Throttle Position (TPS) Sensor
65. Throttle Body Assembly
70. Flange Gasket
75. Idle Air Control (IAC) Valve (Thread Mounted)
76. Idle Air Control (IAC) Valve (Flange Mounted)
77. Idle Air Control Valve Assembly Gasket
78. Idle Air Control Valve O-Ring
79. Idle Air Control Valve Attaching Screw Assembly

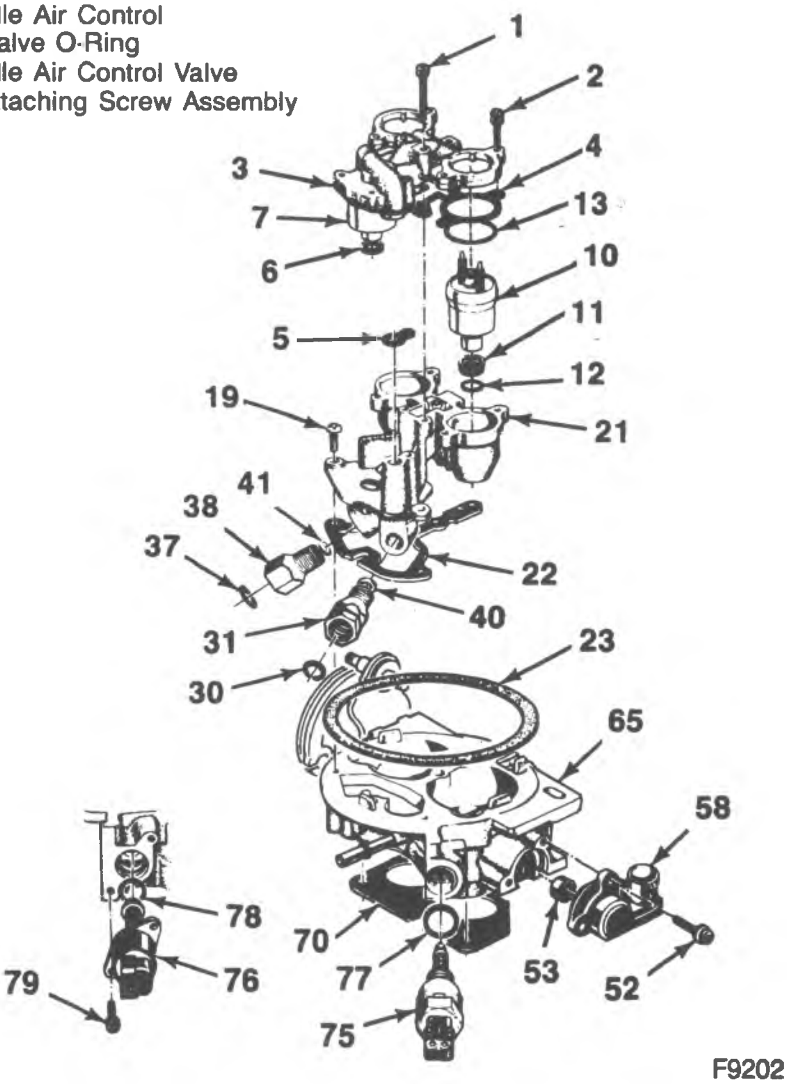


Figure 2—Model 220 TBI Parts Identification

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 (1 1/4-inch) 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)

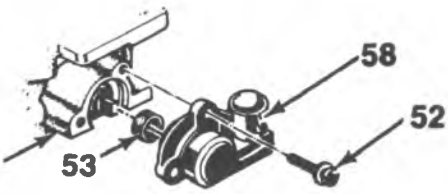
NOTICE: The TPS is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may result.

Important

On the Model 220 TBI Unit, the TPS is throttle shaft driven and non-adjustable. Be sure to order the correct one for your engine with the identical part number, if being replaced.

Remove or Disconnect (Figure 5)

1. Two TPS attaching screw assemblies.
2. TPS from throttle body assembly.
3. TPS seal.



52. TPS Attaching Screw Assembly
53. Throttle Position Sensor Seal
58. Throttle Position Sensor (TPS)
65. Throttle Body Assembly

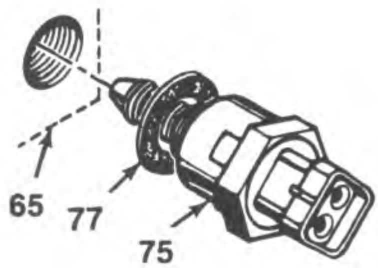
F9206

Figure 5—TBI Model 220 TPS

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.

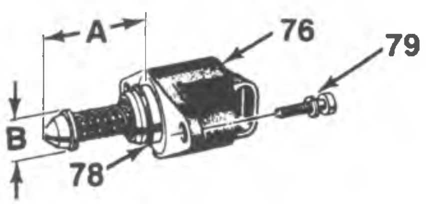
CAUTION: DO NOT remove the four screws securing the pressure regulator to the fuel meter cover. The fuel pressure regulator includes a large spring under heavy compression which, if accidentally released, could cause personal injury. Diassembly might also result in a fuel leak between the diaphragm and the regulator container.



65. Throttle Body Assembly
75. Idle Air Control (IAC) Valve
77. IAC Valve Gasket

F9249

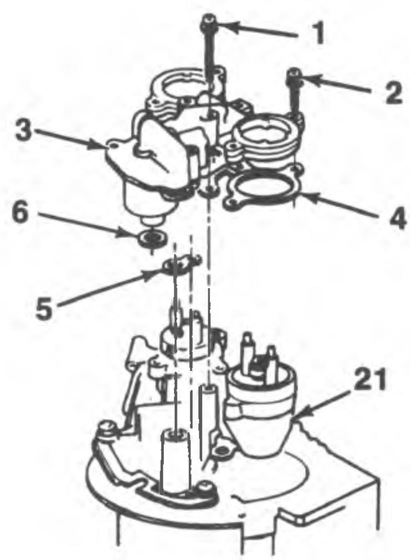
Figure 3—Thread Mounted Type IAC Valve



A. Distance of Pintle Extension
B. Diameter of Pintle
76. Idle Air Control (IAC) Valve
78. IAC Valve O-Ring
79. IAC Valve Attaching Screw Assembly

F9203

Figure 4—Flange Mounted Type IAC Valve



1. Long Attaching Screw
2. Short Attaching Screw
3. Fuel Meter Cover Assembly
4. Cover Gasket
5. Outlet Gasket
6. Dust Seal
21. Fuel Meter Body Assembly

F9248

Figure 6—Replacing Model 220 Fuel Meter Cover

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.

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)

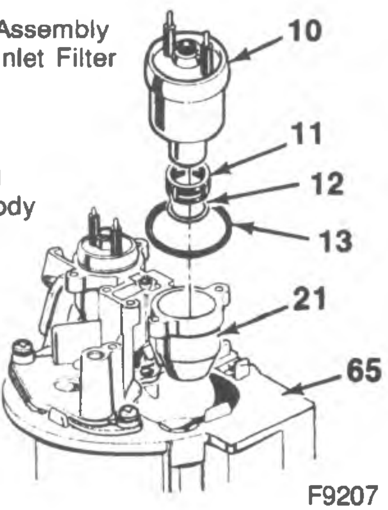
- With fuel meter cover gasket in place to prevent damage to casting, use a screwdriver and fulcrum to carefully lift out each injector (figure 8).

1. Lower (small) O-ring from nozzle of injectors and discard.
2. Fuel meter cover gasket and discard.
3. Upper (large) O-ring from top of fuel injector cavity and discard.

Inspect

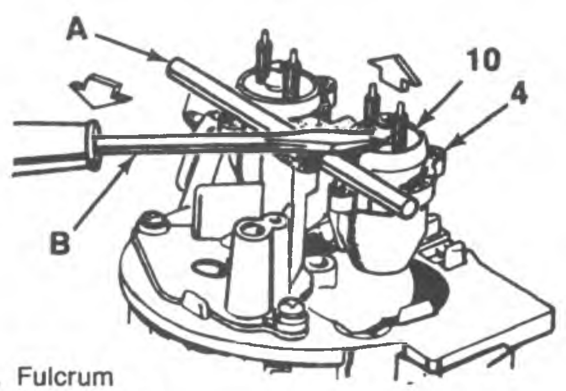
- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

10. Fuel Injector Assembly
11. Fuel Injector Inlet Filter
12. Fuel Injector Lower O-Ring
13. Fuel Injector Upper O-Ring
21. Fuel Meter Body Assembly
65. Throttle Body Assembly



F9207

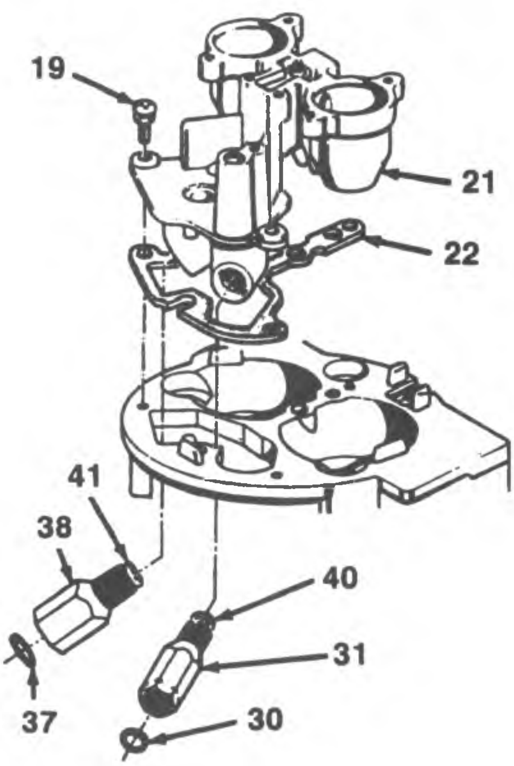
Figure 7—Model 220 Fuel Injection Parts



A. Fulcrum
B. Screwdriver
4. Fuel Meter Cover Gasket
10. Fuel Injector

F9251

Figure 8—Removing TBI 220 Fuel Injector



19. Attaching Screw Assembly
21. Fuel Meter Body Assembly
22. Gasket
30. Outlet O-Ring
31. Outlet Nut
37. Inlet O-Ring
38. Inlet Nut
40. Outlet Nut Gasket
41. Inlet Nut Gasket

F9250

Figure 9—Fuel Meter Body Assembly

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.

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.

Tighten

- Inlet nut to 40.0 N·m (30.0 ft. lbs.)
- Outlet nut to 29.0 N·m (21.0 ft. lbs.)

FUEL INJECTORS

Install or Connect (Figure 10)

- Lubricate new lower (small) O-rings with clean engine oil and push on nozzle end of injector until it presses against injector fuel filter.
- Lubricate new upper (large) O-ring with clean engine oil and install on injector cavity upper ledge. Be sure O-ring is seated properly and is flush with top of fuel meter body surface.

NOTICE: Upper and lower O-rings must be installed before injectors, or improper seating of large O-ring could cause fuel to leak.

- 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 (Figures 2 and 3)

1. New pressure regulator seal, fuel meter outlet passage gasket, and cover gasket.
2. Fuel meter cover assembly.
3. Attaching screw assemblies, precoated with appropriate locking compound to threads (Short screws are next to injectors).

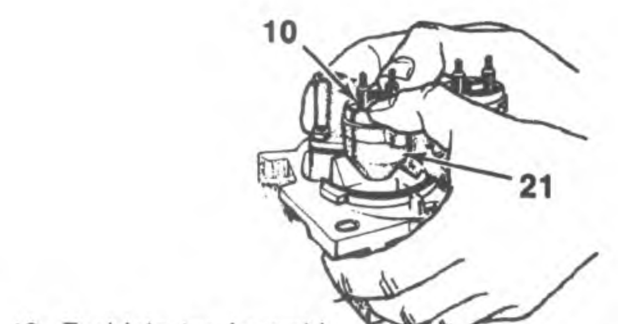
Tighten

- Screw assemblies to 3.0 N·m (28.0 in. lbs.).

THROTTLE POSITION SENSOR

Install or Connect

1. TPS seal over throttle shaft as shown in figure 5.
2. With throttle valve in normally closed position, install TPS on throttle shaft and rotate counterclockwise to align mounting hole.



10. Fuel Injector Assembly
21. Fuel Meter Body Assembly

F9208

Figure 10—Installing Fuel Injector—TBI 220

3. TPS attaching screw assemblies, precoated with appropriate thread-locking compound.

Tighten

- Screw assemblies to 2.0 N·m (18.0 lb. in.).

4. Electrical connector.

IDLE AIR CONTROL VALVE

NOTICE: Since the IAC valve was removed during service, its 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 an IAC valve, measure the distance between the tip of the valve pintle and the mounting surface. If the dimension is greater than 28 mm (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 with a slight side-to-side movement on valve pintle to retract it (figures 11 or 12).

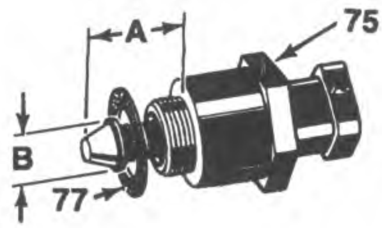
Important

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)

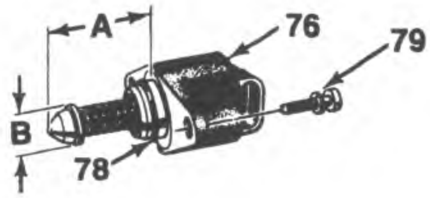
— IAC valve into throttle body as follows:

- Thread-mounted valve—install with new gasket.
- Flange-mounted valve—install with new lubricated O-ring, using attaching screw assemblies.



A. Distance of Pintle Extension
B. Diameter and Shape of Pintle
75. Idle Air Control (IAC) Valve
77. IAC Valve Gasket
F9209

Figure 11—Adjusting Valve Pintle—Thread Type



A. Distance of Pintle Extension
B. Diameter of Pintle
76. Idle Air Control (IAC) Valve
78. IAC Valve O-Ring
79. IAC Valve Attaching Screw Assembly
F9203

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 inch) wrench.
- Flange-mounted attaching screw assemblies to 3.0 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	3.0	—	28

T2528

SECTION 6C2

MODEL 700 THROTTLE BODY

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

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 you are 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 the disassembled view (figure 2).

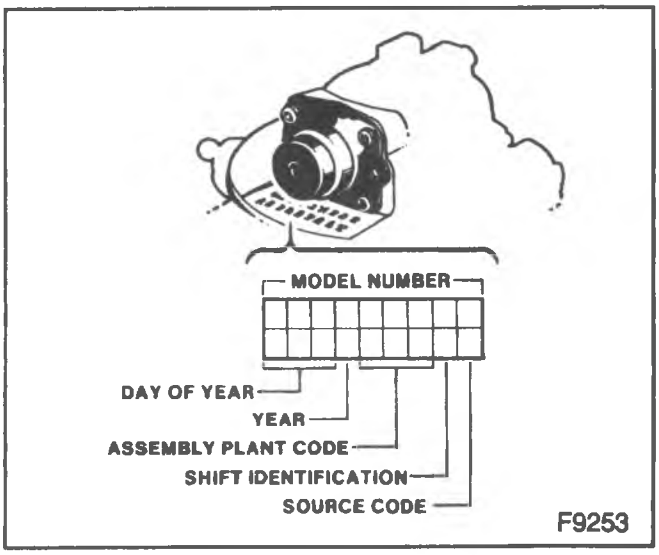
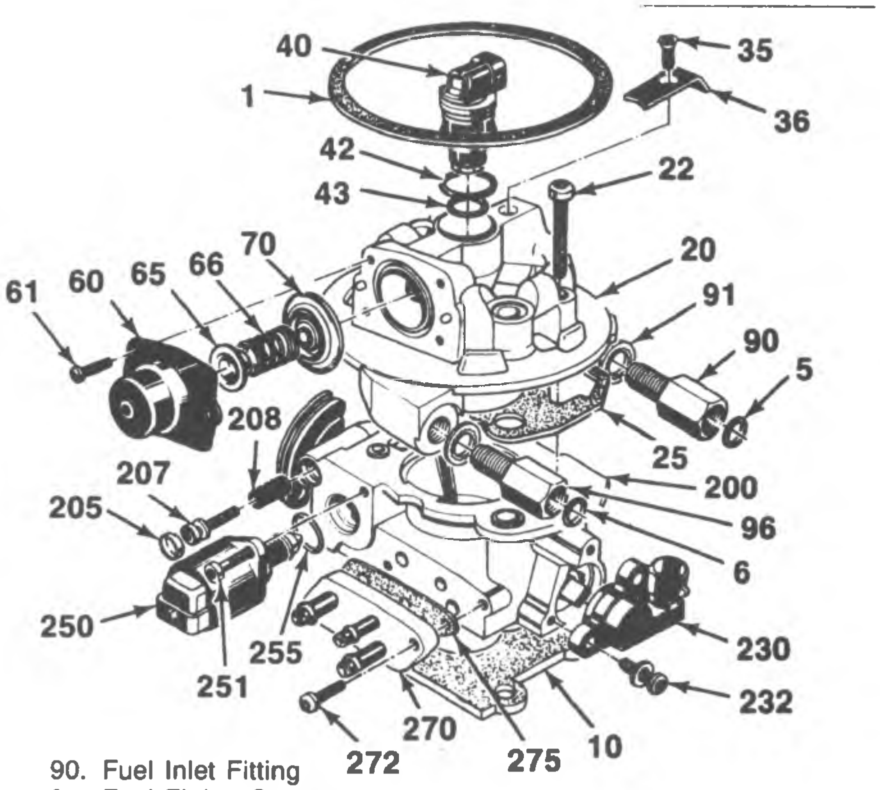


Figure 1—TBI Identification



1. Air Cleaner Gasket
5. Fuel Line Inlet Nut O-Ring
6. Fuel Line Outlet Nut O-Ring
10. Flange Gasket
20. Fuel Meter Body Assembly
22. Fuel Meter Body/Throttle Body Attaching Screw
25. Fuel Meter Body to Throttle Body Gasket
35. Injector Retainer Attaching Screw
36. Injector Retainer
40. TBI Injector Assembly
42. Fuel Injector O-Ring (Upper)
43. Fuel Injector O-Ring (Lower)
60. Pressure Regulator Cover Assembly
61. Pressure Regulator Attaching Screw
65. Pressure Regulator Spring Seat
66. Pressure Regulator Spring
70. Pressure Regulator Diaphragm Assembly
90. Fuel Inlet Fitting
91. Fuel Fitting Seal
96. Fuel Outlet Fitting
200. Throttle Body Assembly
205. Idle Stop Screw Plug
207. Idle Stop Screw Assembly
208. Idle Stop Screw Spring
230. Throttle Position (TPS) Sensor
232. TPS Attaching Screw Assembly
250. Idle Air Control (IAC) Valve Assembly
251. IAC Valve Attaching Screw
255. IAC Valve O-Ring
270. Tube Module Assembly
272. Tube Module Assembly Attaching Screw
275. Tube Module Assembly Gasket

F9254

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 monitors information from several sensors to determine fuel requirements based on engine operating conditions. The fuel is delivered under one of several conditions called "modes." All the modes are controlled by the ECM.

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 2.5L engine, consists 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 is serviced only as a complete assembly (Figure 3).

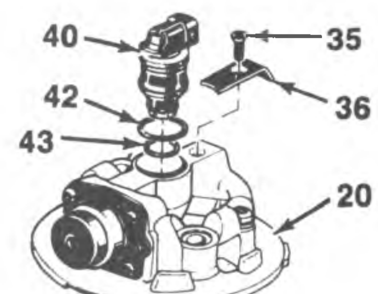
NOTICE: Use care in removing the injector to prevent damage to the electrical connector on top of the injector, and nozzle. Also, because the fuel injector is an electrical component, it should not be immersed in any type of liquid solvent or cleaner, as damage may occur.

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 (figure 4).
3. Upper and lower O-rings from injector and in fuel injector cavity and discard.

Inspect

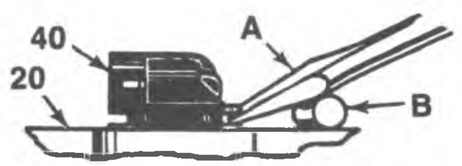
- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.



20. Fuel Meter Assembly
35. Injector Retainer Screw
36. Injector Retainer
40. Fuel Injector Assembly
42. Fuel Injector O-Ring (Upper)
43. Fuel Injector O-Ring (Lower)

F9255

Figure 3—Model 700 Fuel Injection Parts



20. Fuel Meter Body
40. Fuel Injector
A. Screwdriver
B. Fulcrum

F9256

Figure 4—Removing TBI 700 Fuel Injector

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

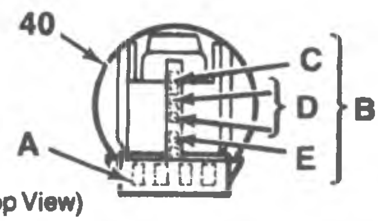
NOTICE: To prevent leaks, the pressure regulator diaphragm assembly must be replaced whenever the cover is removed.

Remove or Disconnect

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.

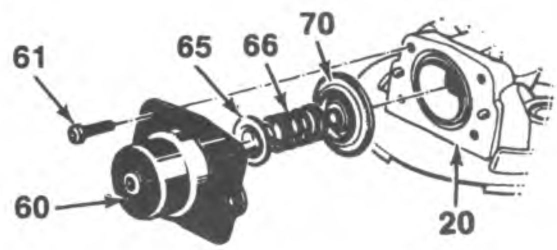
2. Pressure regulator cover assembly.
3. Pressure regulator spring.



40. 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

F9257

Figure 5—Fuel Injector Part Number Location



20. Fuel Meter Assembly
60. Pressure Regulator Cover Assembly
61. Pressure Regulator Attaching Screw
65. Spring Seat
66. Pressure Regulator Spring
70. Diaphragm Assembly

F9258

Figure 6—TBI 700 Pressure Regulator

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)

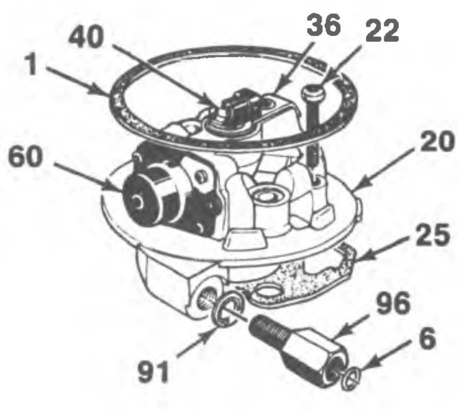
1. Two fuel meter body attaching screw and washer assemblies.
2. Fuel meter assembly from throttle body assembly.
3. Fuel meter body to throttle body gasket and discard.

THROTTLE POSITION SENSOR

Remove or Disconnect (Figure 8)

1. Screw assemblies.
2. Throttle position sensor.

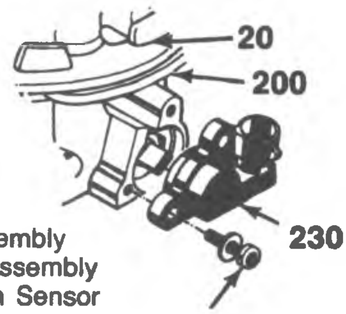
NOTICE: The throttle position sensor is an electrical component, and should not be immersed in any type of liquid solvent or cleaner, as damage may result.



1. Air Cleaner Gasket
6. Fuel Line Outlet Nut O-Ring
20. Fuel Meter Assembly
22. Fuel Meter Body-Throttle Body Attaching Screw
25. Fuel Meter Body to Throttle Body Gasket
36. Injector Retainer
40. Fuel Injector
60. Pressure Regulator Cover Assembly
91. Fuel Nut Seal
96. Fuel Outlet Nut

F9259

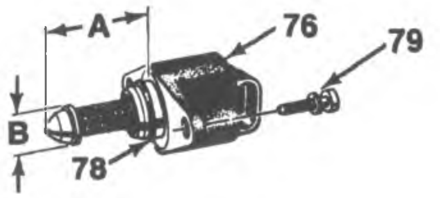
Figure 7—Fuel Meter Assembly—TBI 700



20. Fuel Meter Assembly
200. Throttle Body Assembly
230. Throttle Position Sensor
232. TPS Attaching Screw and Washer Assembly

F9260

Figure 8—Throttle Position Sensor (TPS) TBI 700



A. Distance of Pintle Extension
B. Diameter of Pintle
76. Idle Air Control (IAC) Valve
78. IAC Valve O-Ring
79. IAC Valve Attaching Screw Assembly

F9203

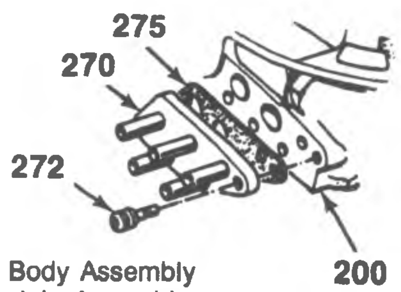
Figure 9—Flange Mounted IAC Valve—TBI 700

IDLE AIR CONTROL (IAC) VALVE

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may 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.



200. Throttle Body Assembly
270. Tube Module Assembly
272. Tube Module Screw Assembly
275. Tube Module Assembly Gasket

F9261

Figure 10—Tube Module Assembly—TBI 700

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.

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 Meter Cover Assembly, or Fuel Injector Assemblies 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.
   - Coat attaching screws with thread locking compound.

Tighten

- Screw assemblies to 3.0 N·m (28 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 28 mm (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 with a slight side-to-side movement on valve pintle to retract it (figure 11).

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 clean engine oil and install on IAC valve.
2. IAC valve to throttle body.

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.

3. IAC valve attaching screw assemblies.
   - Coat attaching screws with thread locking compound.

Tighten

- Screw assemblies to 3.0 N·m (28.0 lbs. in.).

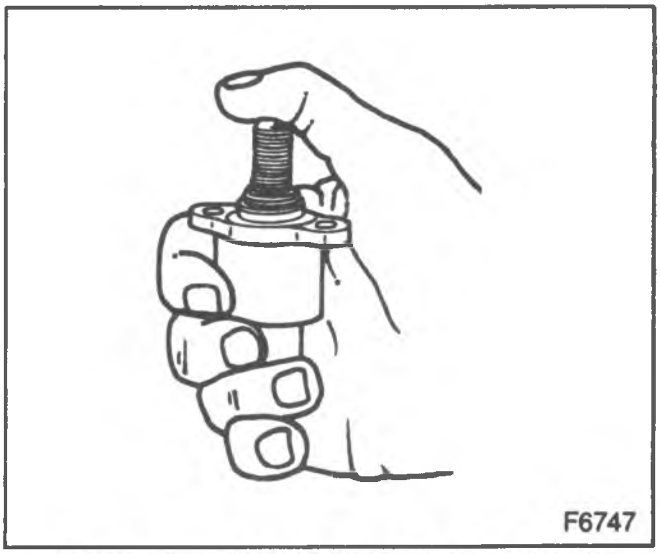


Figure 11—Adjusting Valve Pintle—TBI 700

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.
   - Coat attaching screws with thread locking compound.

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.
   - Coat attaching screws with thread locking compound.

Tighten

- Attaching screws to 6.0 N·m (53 lb. in.).

PRESSURE REGULATOR ASSEMBLY

Install or Connect

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 clean engine oil 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.

Remove or Disconnect

- Be sure the electrical connector end on the injector is facing in the general direction of the cut-out in the meter body for the wire grommet.

2. Injector retainer.
   - Coat retainer attaching screws with thread locking compound.

Tighten

- Injector retainer attaching screw to 3.0 N·m (27.0 lb. in.).

SPECIFICATIONS

TORQUE SPECIFICATIONS

Fastener	N·m	In. Lbs.
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 Screws	2.5	22.0
Injector Retainer to Fuel Meter Body Screw	3.0	28.0

T2530

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

SUBJECT **PAGE**

SECTION 6D1

SI SERIES GENERATORS

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

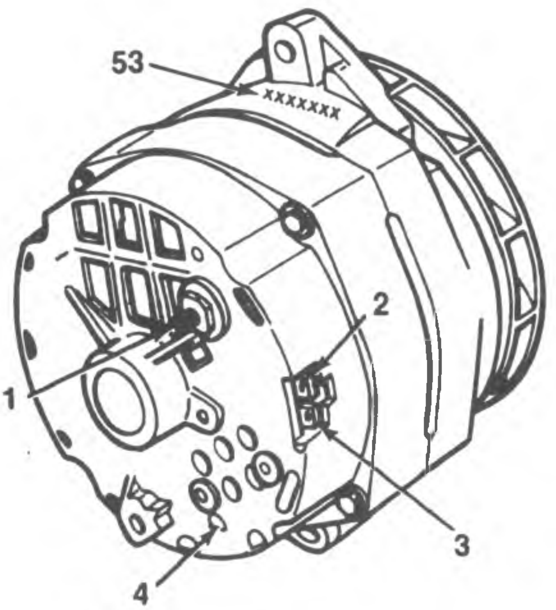
SUBJECT **PAGE**

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.

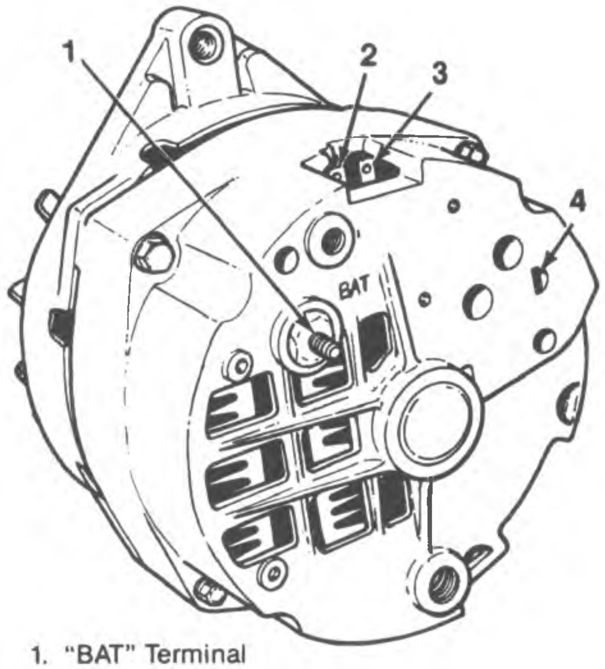
The generator rotor bearings contain enough grease to eliminate periodic lubrication. Two brushes carry current through two slip rings to the field coil.



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Test Hole
53. Part Number

F4478

Figure 1—12-SI Series 100 Generator



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Field Ground Hole

F4193

Figure 2—17-SI Series 100 Generator

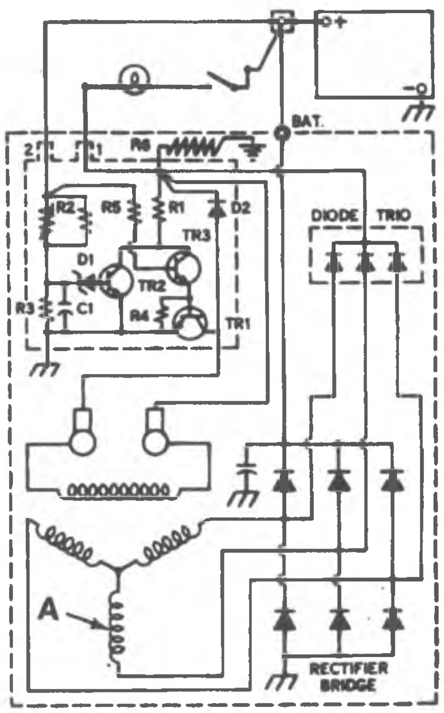
The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator AC voltages to a DC voltage which appears at the generator output "BAT" terminal. Generator 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).

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



A. "Y" Stator. (Stator is Delta Wound on the 17-SI 100.)

F4194

Figure 3—Generator Schematic

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.

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 certain 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.

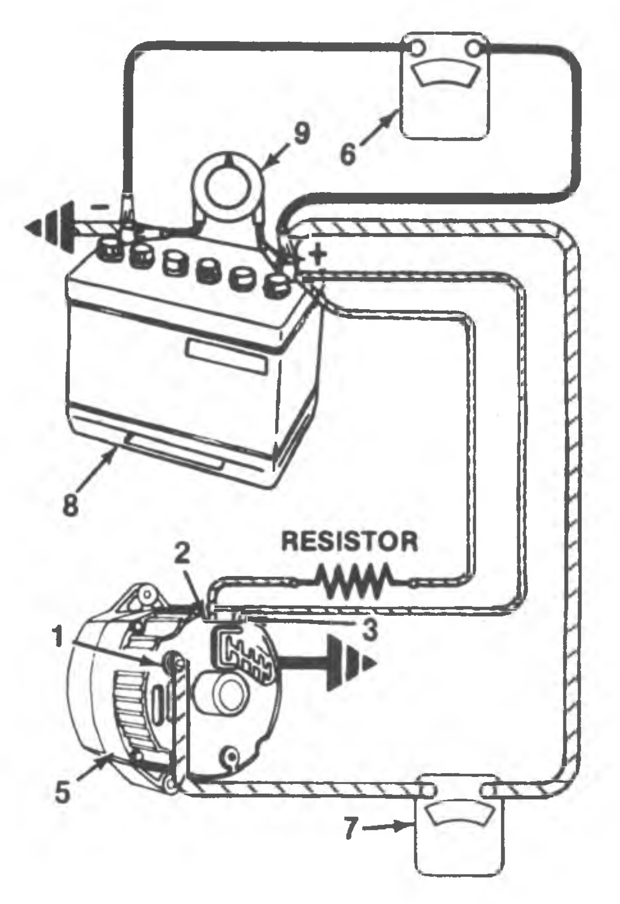
If an open should occur in the No. 2 terminal circuit, TR3 and TR1 will turn off, field current will stop and the indicator lamp current will flow through R6 to ground, causing the indicator lamp to come on. Also, an open in the field circuit will cause the indicator lamp to turn on because indicator 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.

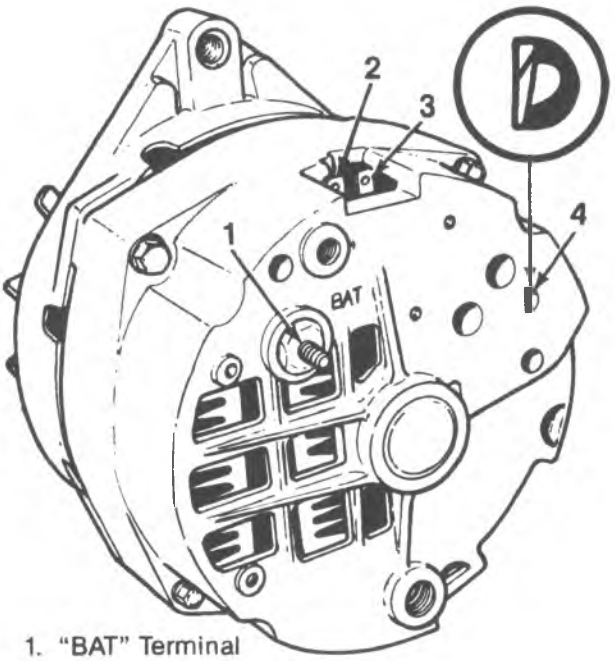


1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
5. Generator
6. Voltmeter
7. Ammeter
8. Battery
9. Carbon Pile

F4195

Figure 4—Generator Bench Check

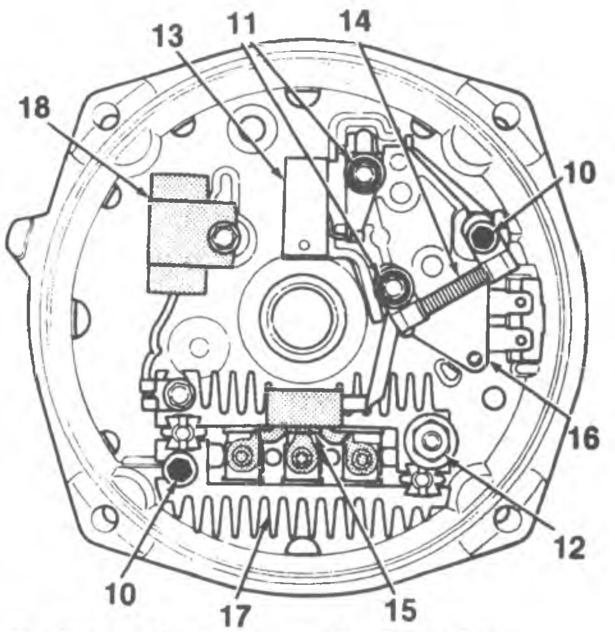
5. Operate the generator at moderate speed as required and adjust the carbon pile as required to obtain maximum current output.
6. If the output is within 10 amperes of the rated output as stamped on the generator frame, the generator is good.
7. If the output is not within 10 amperes of the rated output, 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.
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".



1. "BAT" Terminal
2. No. 1 Terminal
3. No. 2 Terminal
4. Field Ground Hole

F4196

Figure 5—Field Ground Tab



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

F4197

Figure 6—Slip Ring End Frame: 12-SI 100

DISASSEMBLY

SLIP RING END FRAME

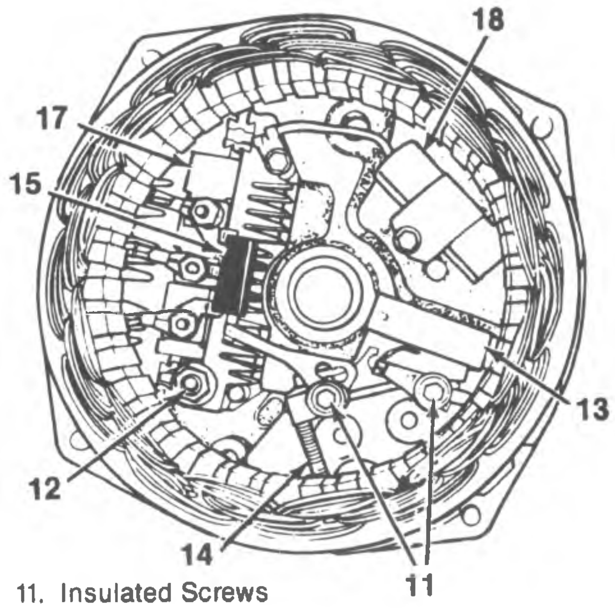
Disassemble (Figures 6, 7, 8, and 9)

- 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).
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.



11. Insulated Screws
12. "BAT" Terminal Stud
13. Brush Holder
14. Resistor
15. Diode Trio
17. Rectifier Bridge
18. Capacitor

F4198

Figure 7—Slip Ring End Frame: 17-SI 100

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

Important (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.

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.

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.

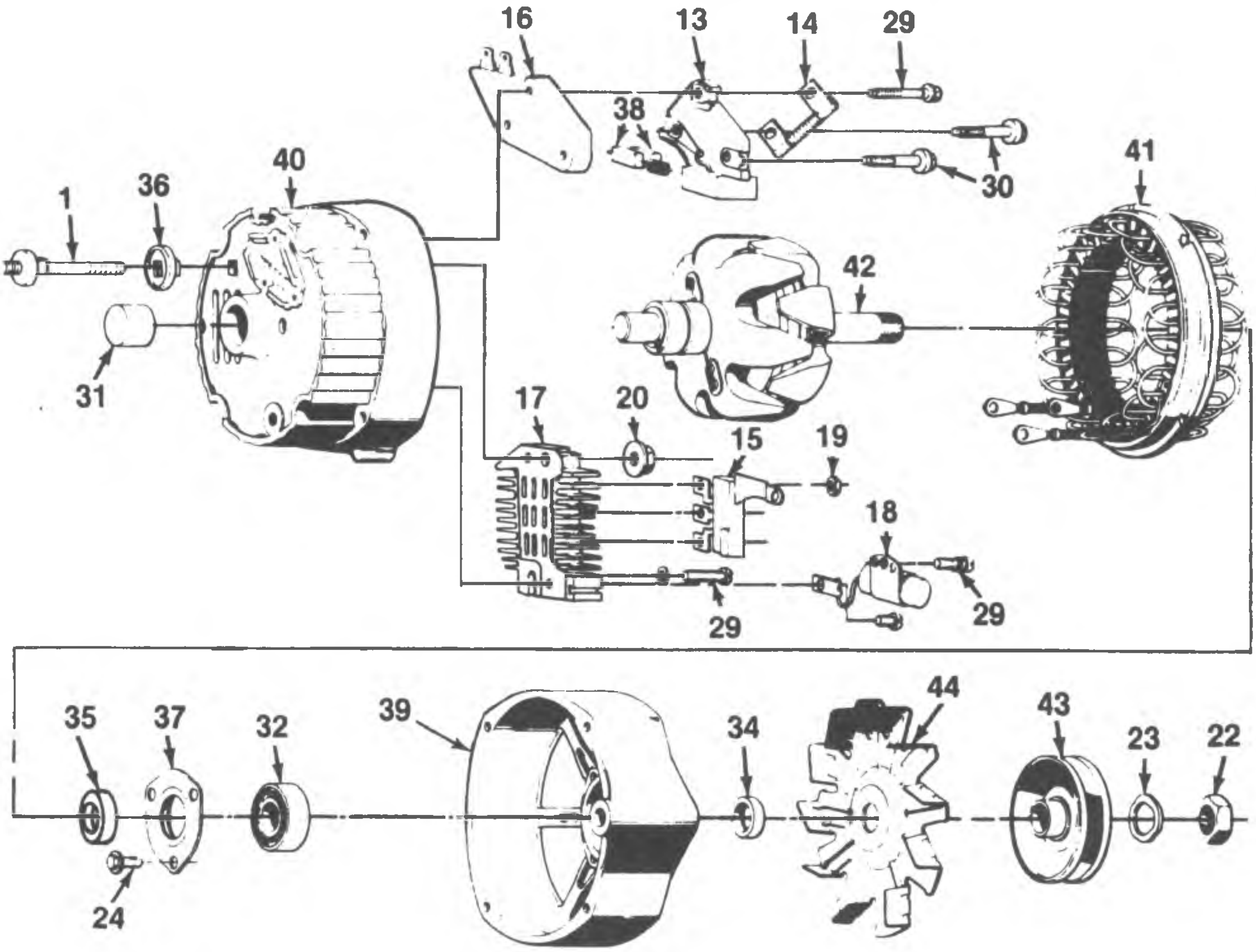
Ground Winding

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.

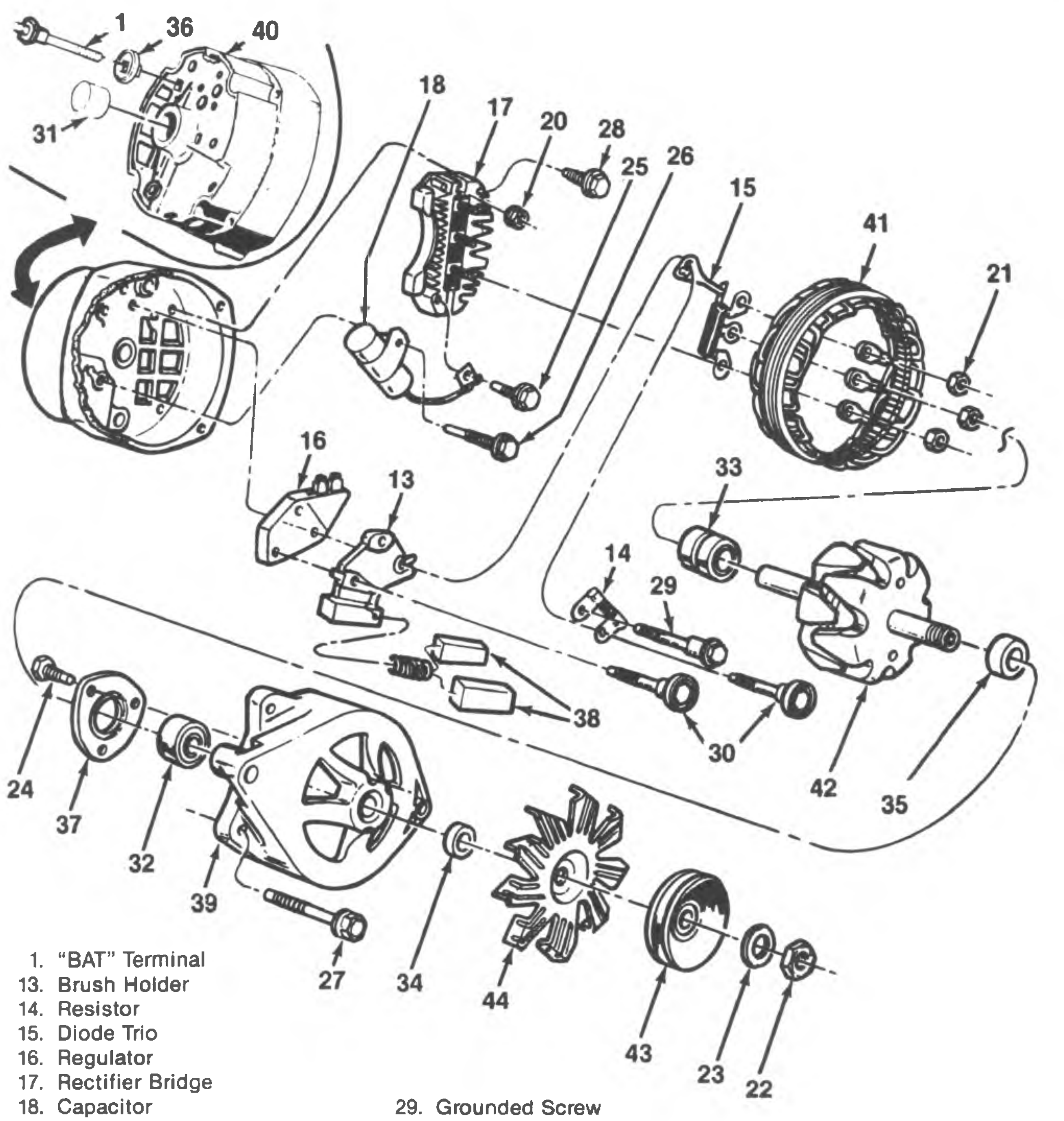
An ammeter reading above the specified value indicates shorted windings; a reading below the specified value indicates excessive resistance. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. If the resistance reading is above the specified value the winding



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

F4199

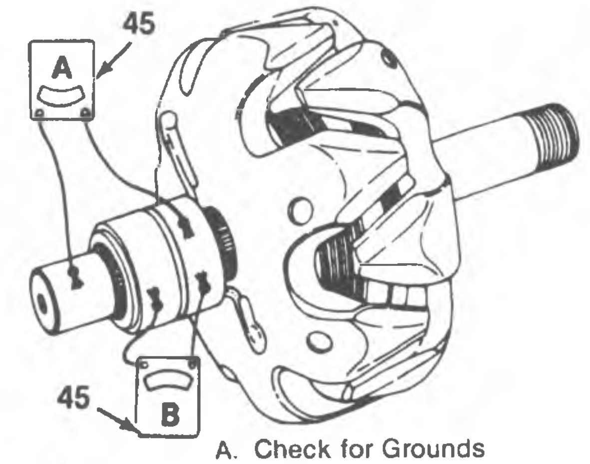
Figure 8—12-SI Series 100 Components



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

F4200

Figure 9—17-SI Series 100 Components



A. Check for Grounds
45. Ohmmeter B. Check for Opens

F4201

Figure 10—Checking Rotor Field Windings

has excessive resistance. Note the reading and refer to "Specifications" at the end of this section.

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)

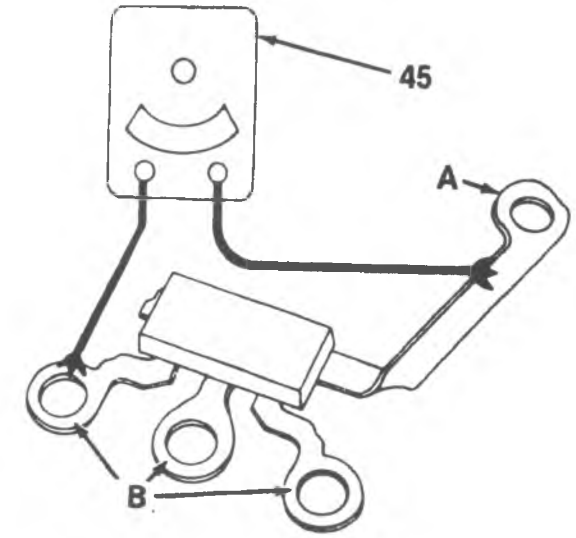
Connect an ohmmeter having a 1.5-volt cell, and using the lowest range scale, to the single connector and to one of the three connectors (figure 11). Observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio 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 grounded 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 the three terminals or connectors. This makes a total of six checks, with two readings taken for each check.

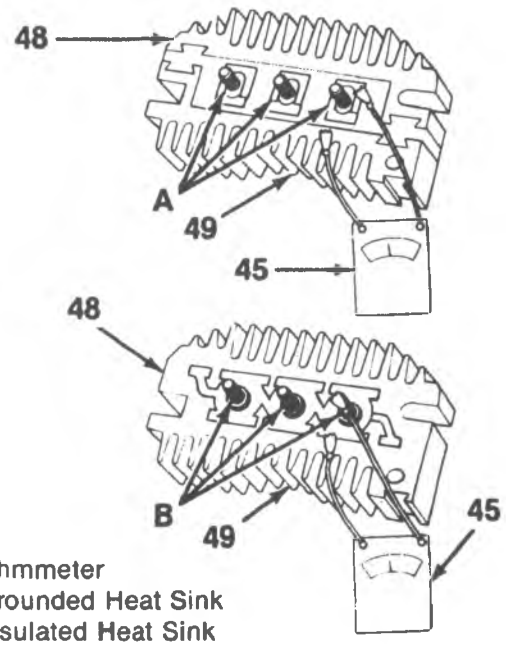
The ohmmeter check of the rectifier bridge, and of the diode trio as previously covered, is a valid and accurate check. Do not replace either unit unless at least one pair of readings is the same.



A. Single Connector
B. Three Connectors
45. Ohmmeter

F4202

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.

F4203

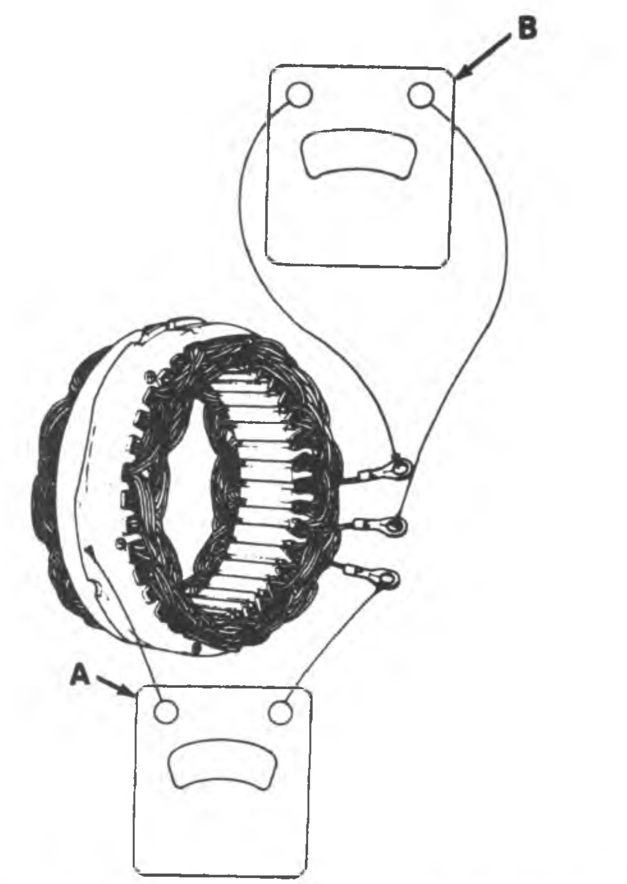
Figure 12—Rectifier Bridge Check

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.

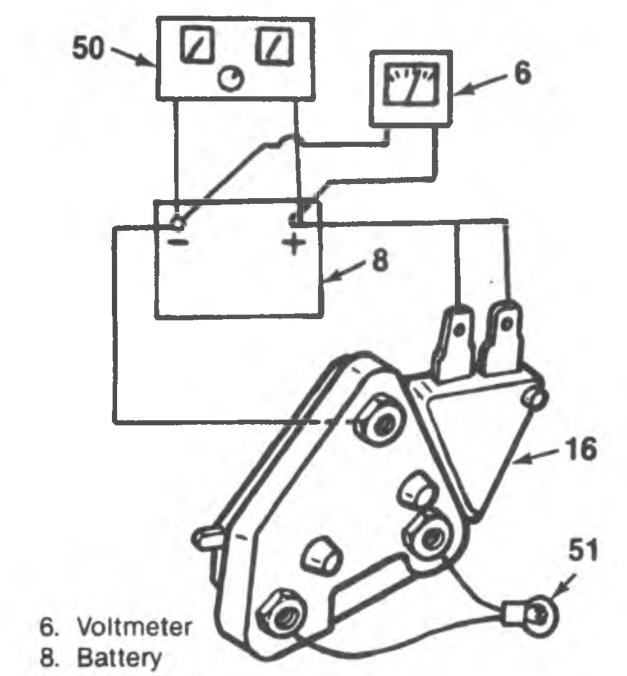
A short circuit in the delta stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings or an open delta winding is indicated. 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.



A. Ohmmeter Connections Checking for Grounds
B. Ohmmeter Connections Checking for Opens

F7074

Figure 13—Checking the Stator



6. Voltmeter
8. Battery
16. Regulator
50. Fast Charger
51. Test Lamp

F4204

Figure 14—Testing the Voltage Regulator

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.
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.
   - 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 enuts 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.
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).

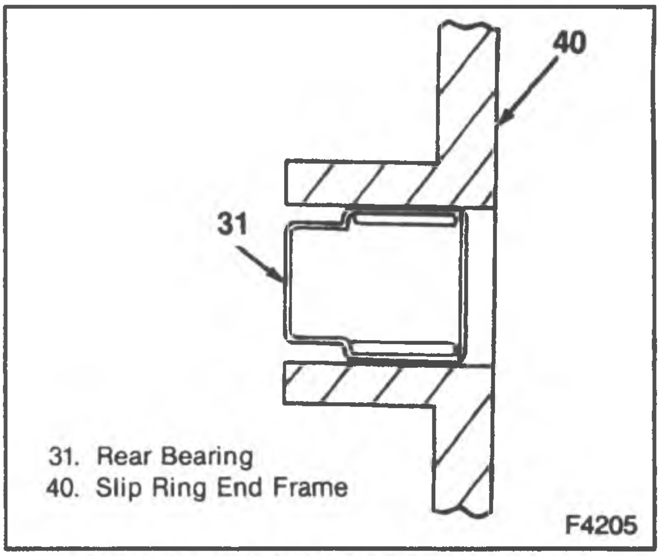


Figure 15—Slip Ring End Frame Bearing

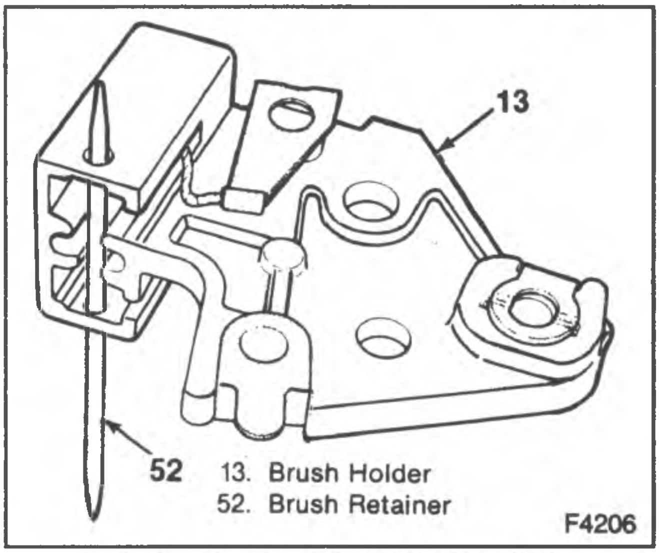


Figure 16—Brush Retainer Installed

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

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

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

DELCO REMY CS-144 GENERATOR

DESCRIPTION

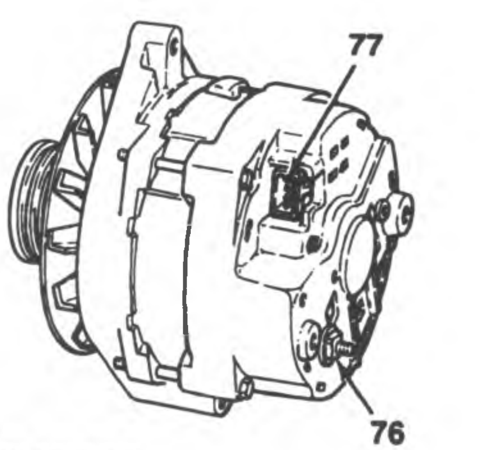
The generator with integral regulator shown in figure 1 features a high ampere output per pound of weight. It does not use a diode trio. The delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to other generators. The CS stands for Charging System, and 144 indicates 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 sends 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

F7079

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.
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.

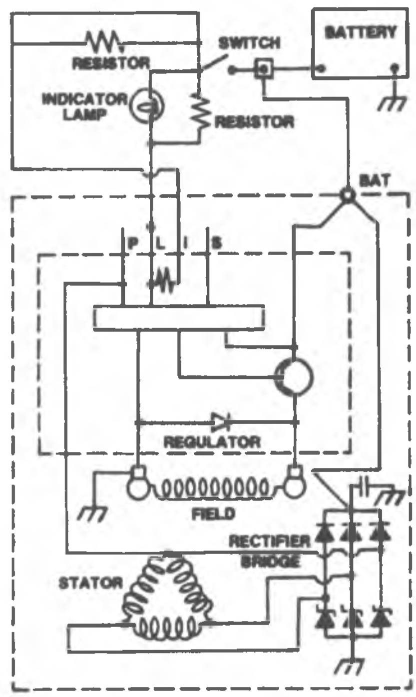
NOTICE: The rotor may be distorted if the vise is overtightened.

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 (1298) 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

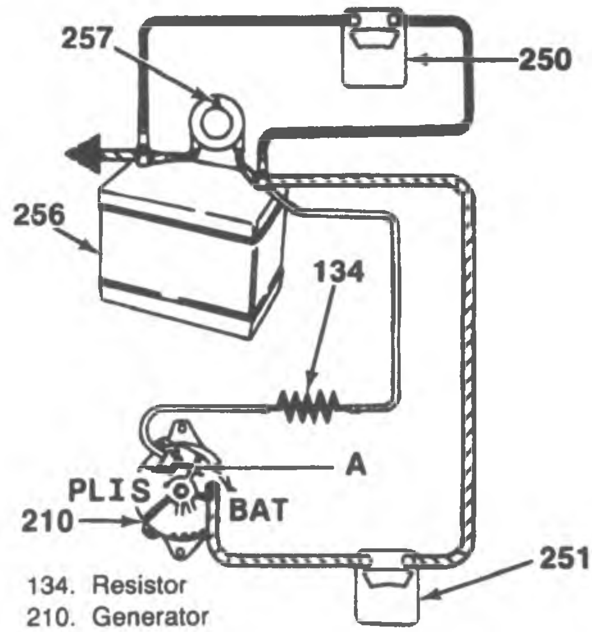
Tool Required:
J 28509-A Bearing Remover

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).



F7080

Figure 2—Generator Schematic



134. Resistor
210. Generator
250. Voltmeter
251. Ammeter
256. Battery
257. Carbon Pile
A. Connect Resistor to "L" Terminal

F7081

Figure 3—Connections for Generator Output Test

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.

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.

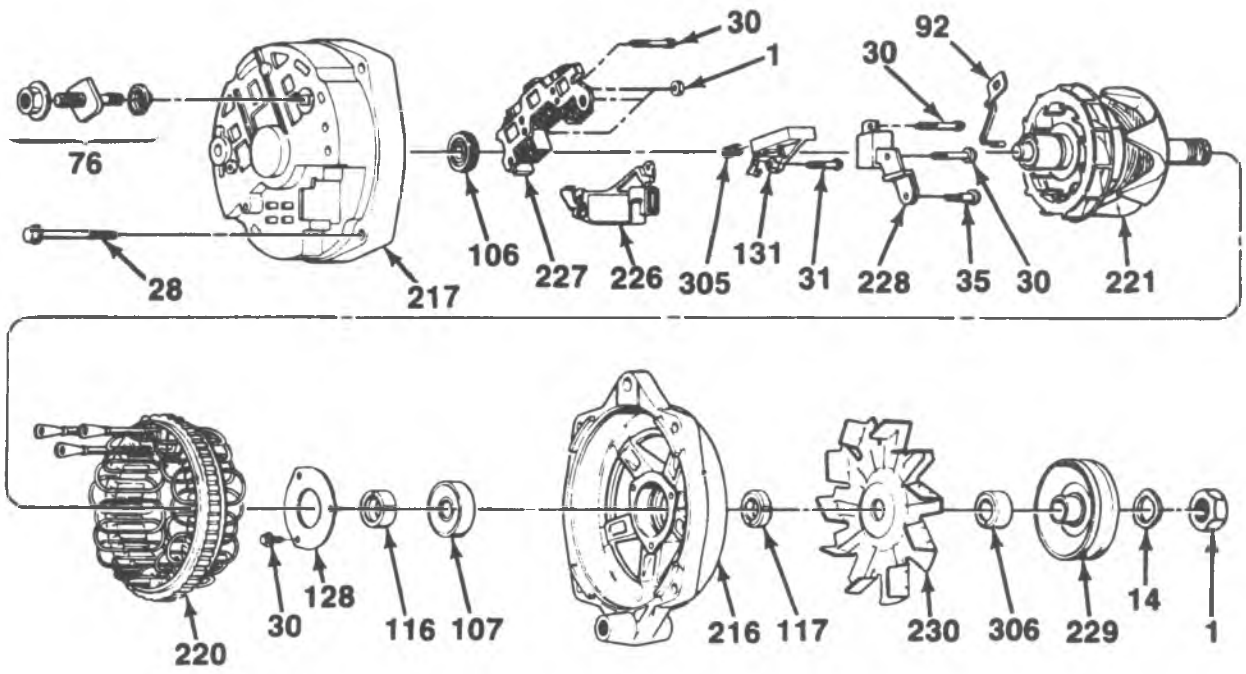
Inspect

1. Brush holder for damage.

Clean

— Brush holder. Make sure the brush pockets are clean.
— Brushes with a soft dry cloth.

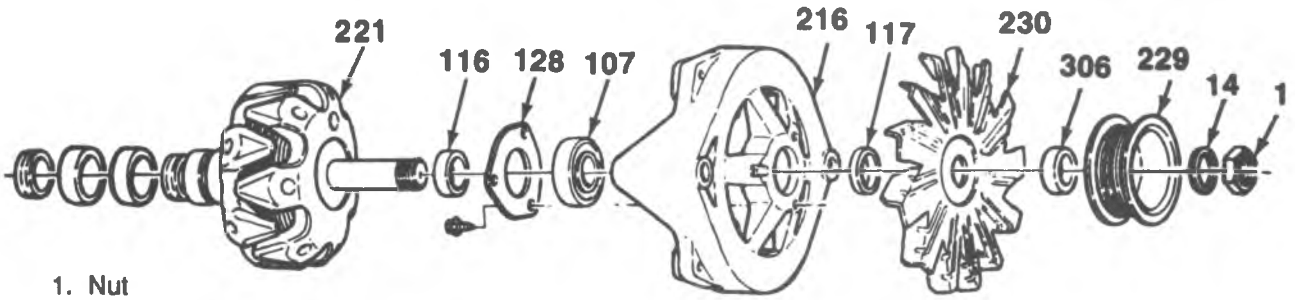
2. Brushes for wear. If the brushes are worn to one half or less of their original length, replace the brush holder assembly. Use a retainer pin to hold the brushes in the holders.
3. Brush springs for broken wire or corrosion.
4. Slip ring end of the rotor shaft for overheating or scoring. If signs 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.
   - 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.



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

F7091

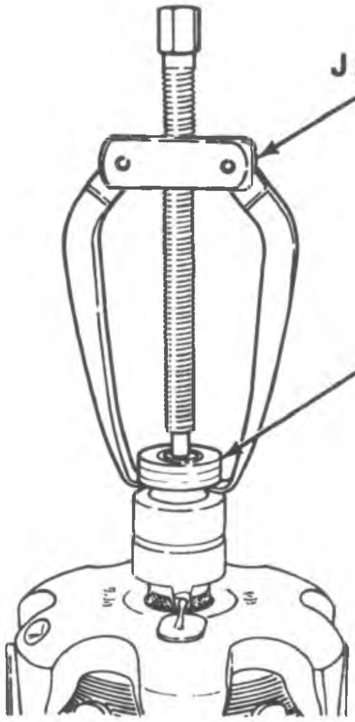
Figure 4—CS-144 Components



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

F7082

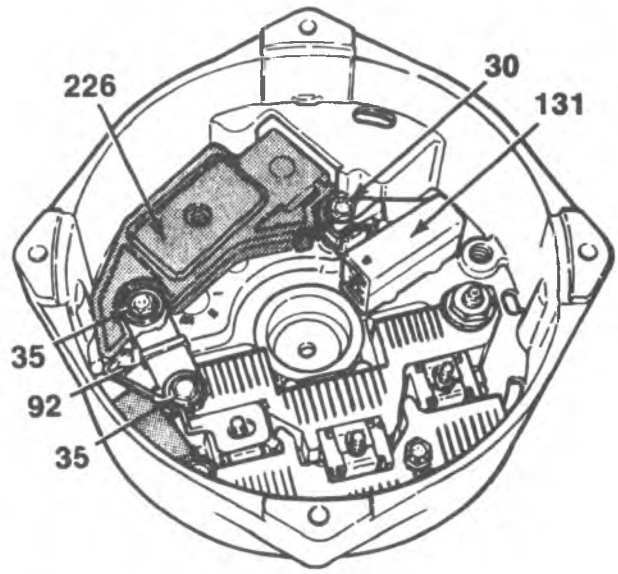
Figure 5—Drive End Frame Components



106. Slip Ring End Bearing

F7083

Figure 6—Removing the Slip Ring End Bearing



30. Screw
35. Insulated Screw
92. Regulator Connector
131. Brush Holder
226. Regulator

F7084

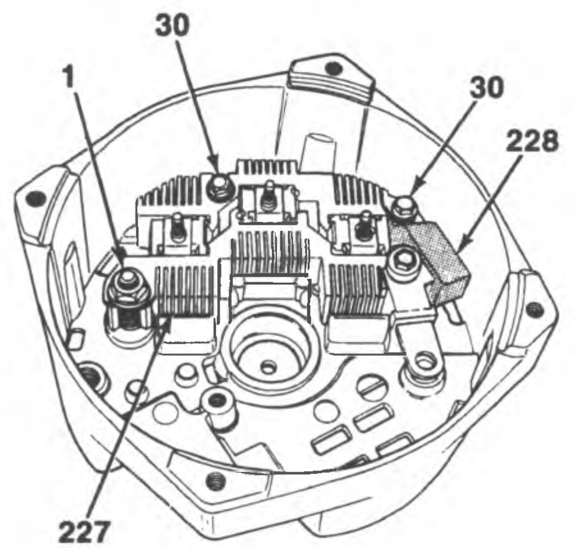
Figure 7—Slip Ring End Frame with Stator Removed

- If the rings are dirty, clean with a 400 grain, or liner, 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

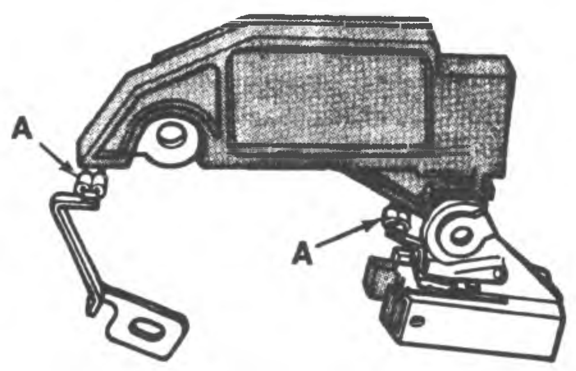
Except as stated, make the following tests with an ohmmeter on the low range scale.



1. Nut
30. Screw
227. Rectifier Bridge
228. Capacitor

F7085

Figure 8—Rectifier Bridge in End Frame



A. Connections crimped and soldered.

F7086

Figure 9—Regulator Connections

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.

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.

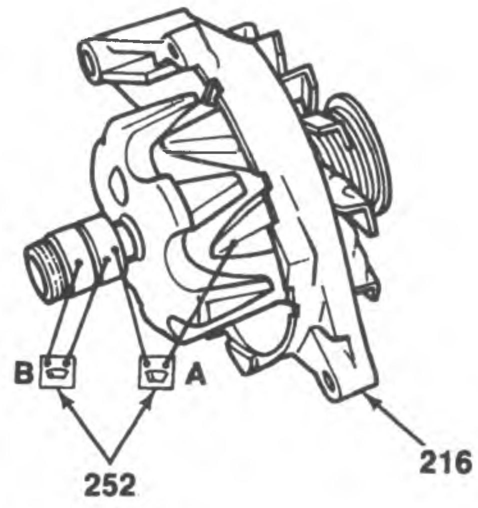
Short Circuit or Resistance Check

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.



216. Drive End Frame
252. Ohmmeter
A. Check for Grounds
B. Check for Opens

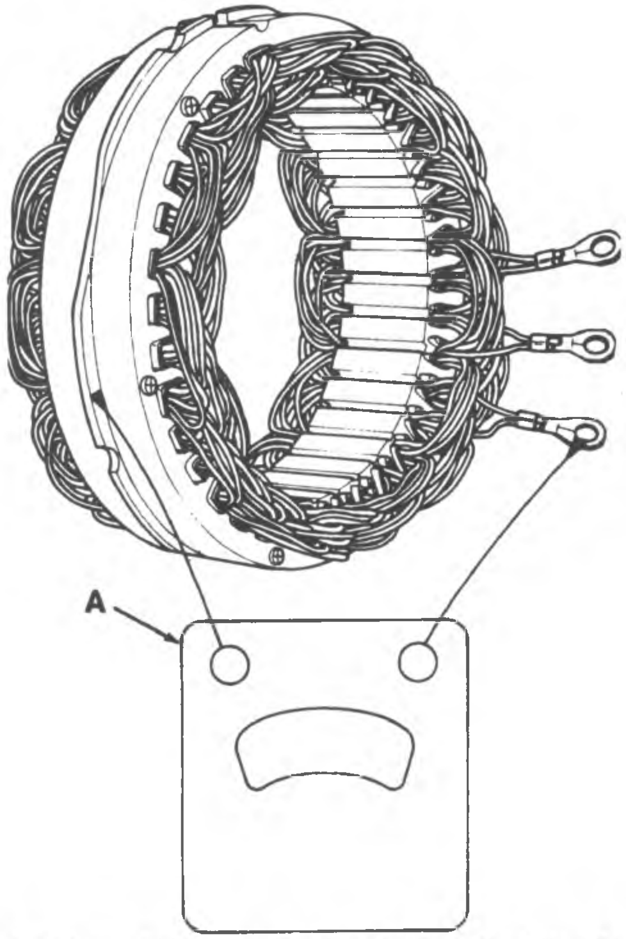
F7087

Figure 10—Checking the Rotor Field Windings

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.

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.



A. Ohmmeter Connections Checking For Grounds

F6292

Figure 11—Checking the Stator

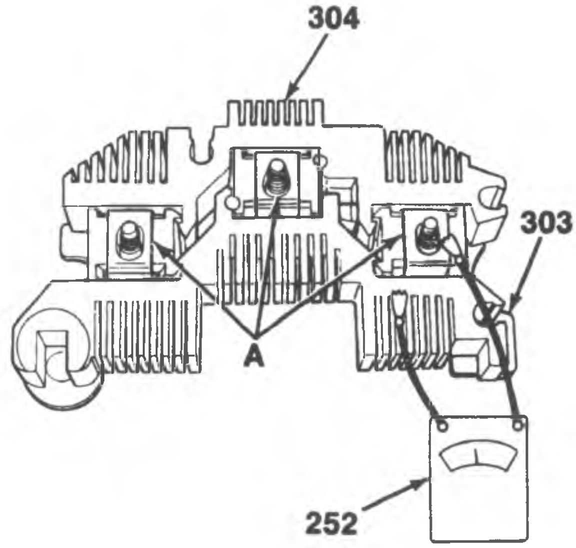
RECTIFIER BRIDGE CHECK (Figure 12)

To check the rectifier bridge, connect the ohmmeter to the grounded heal 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.

REGULATOR

The regulator cannot be checked. If the rotor, stator and rectifier bridge are OK, but the generator still produces more than 16 volts or does not produce within 15 amperes of the rated output during a generator output test, replace the regulator.



252. Ohmmeter
303. Insulated Heat Sink
304. Grounded Heat Sink
A. Connect to Metal Clip, Not to Threaded Stud

F7088

Figure 12—Rectifier Bridge Check

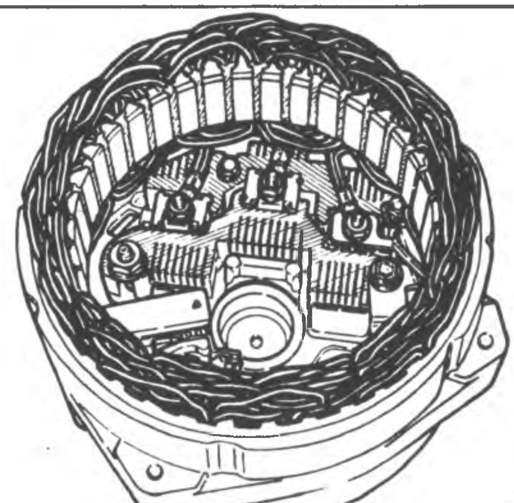
ASSEMBLY

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.



F7089

Figure 13—Stator in the Slip Ring End Frame

- 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

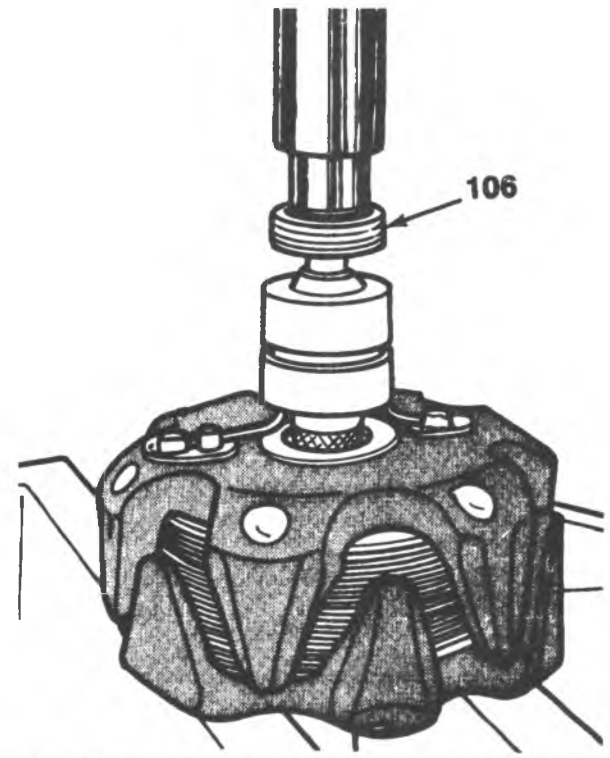
Install or Connect (Figures 4, 7, 8, 9 and 13)

1. "BAT" terminal (76) into the end frame.
2. Rectifier bridge (227).
3. Capacitor.
   - 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 13).
11. Three terminal nuts. Tighten the nuts securely.

DRIVE END FRAME

Install or Connect (Figures 4, 5 and 14)

1. Drive end bearing (107) into the frame (figure 5).
   - Press against the outer race to press the bearing into place.
2. Retainer (128) with three screws.



106. Slip Ring End Bearing

F7090

Figure 14—Installing the Slip Ring End Bearing

3. Slip ring end bearing (106) onto the rotor (figure 14).
   - 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 (24) 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
1101491	CS-144	1.7-2.1	5.7-7.1	120
1101493	CS-144	1.7-2.1	5.7-7.1	120

FASTENERS

	N·m	Ft. Lbs.
Pulley Nut	80	60

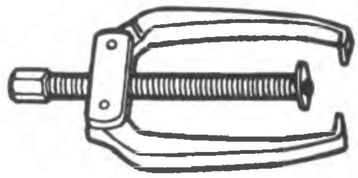
LUBRICATION

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

F7092

SECTION 6D3

STARTING MOTORS

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

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 starting motor has the drive and housing extended to enclose the shift lever and solenoid plunger. The solenoid flange is mounted on the drive end housing with sealing compound between the flange and the field frame.

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. 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

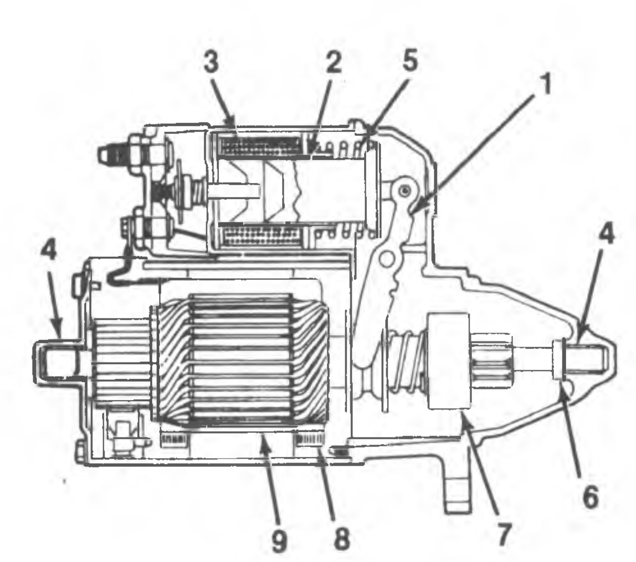


Figure 1—SD-200 and SD-260 Starting Motor

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.
   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.

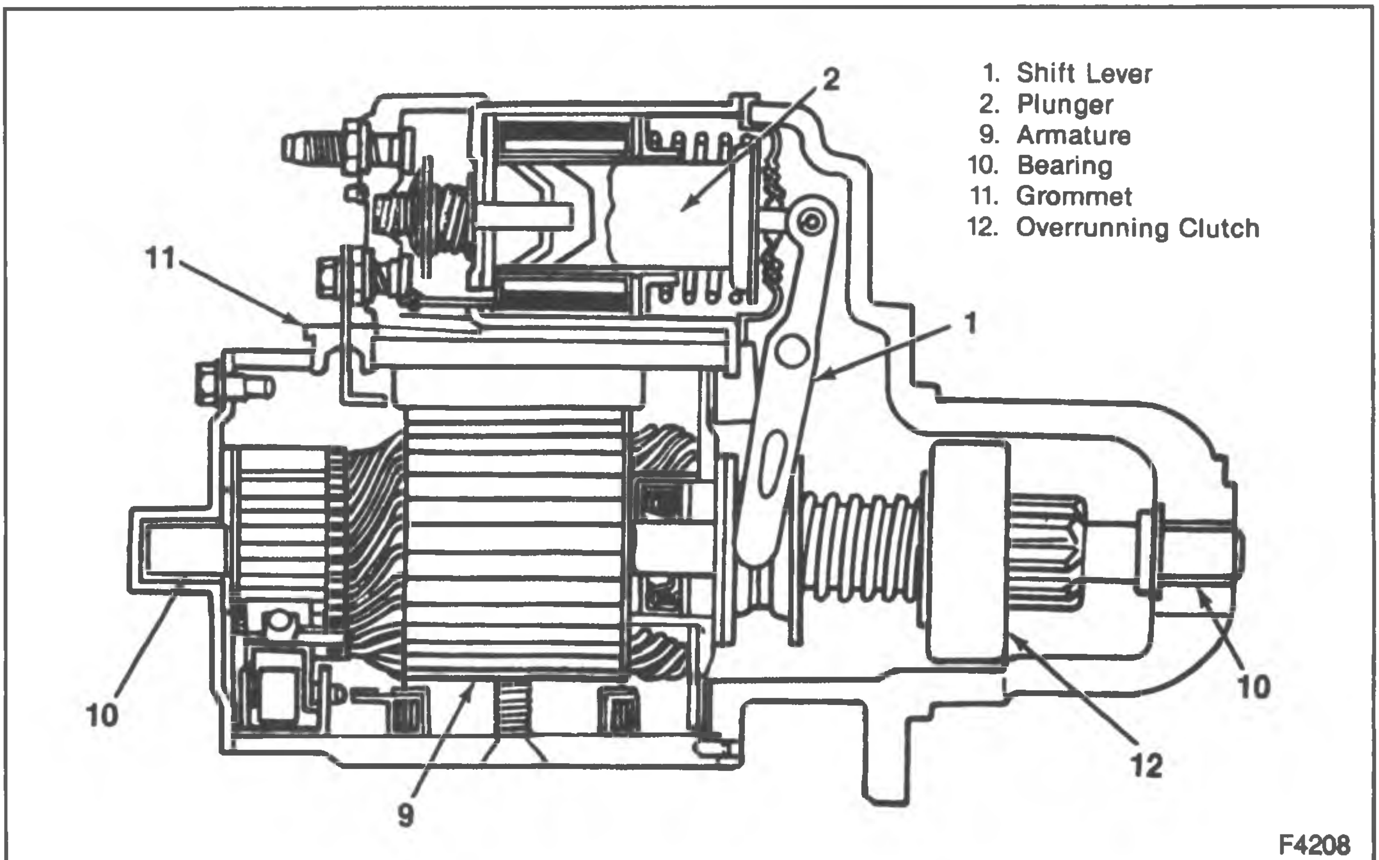
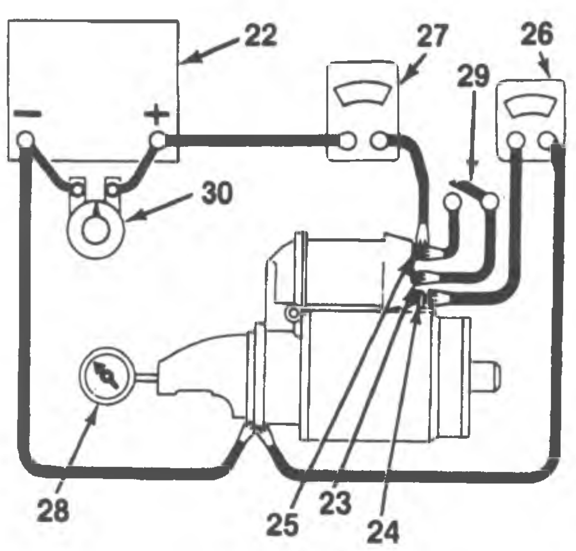


Figure 2—SD-300 Starting Motor



22. Battery
23. "S" Terminal
24. "M" Terminal
25. "BAT" Terminal
26. Voltmeter
27. Ammeter
28. Tachometer
29. Load Switch
30. Carbon Pile

F4210

Figure 3—No-Load Test Hookup

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 OF THE SD-200 AND SD-300 STARTING MOTORS

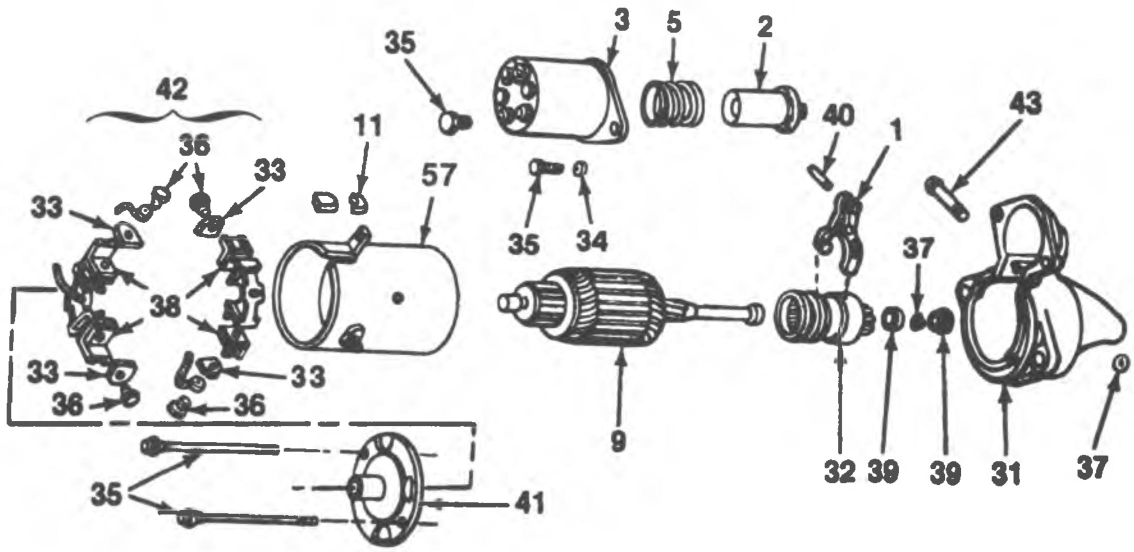
If the motor does not perform to specifications, it may need to be disassembled for further testing of the components. Normally the starting motor should be disassembled only so far as is necessary to make repair or replacement of parts. As a precaution, it is suggested that safety glasses be worn when 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 (57) from the drive housing (31) and the armature assembly (9).



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
57. Field Frame

F9320

Figure 4—SD-200 Components

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
57. Field Frame

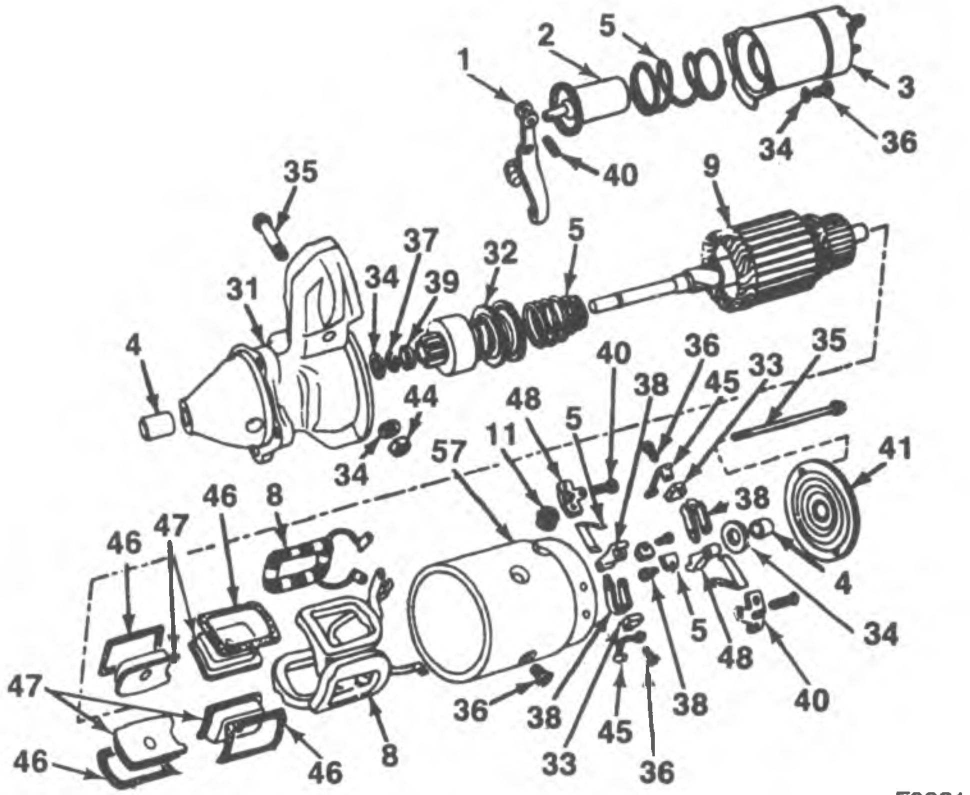


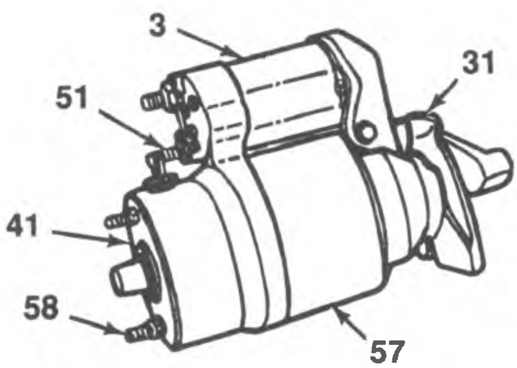
Figure 5—SD-300 Components

6. Armature from the drive housing by tilting the armature to disengage the shift lever fingers (1) from the drive collar (figure 7).

LEVER HOUSING

Disassemble

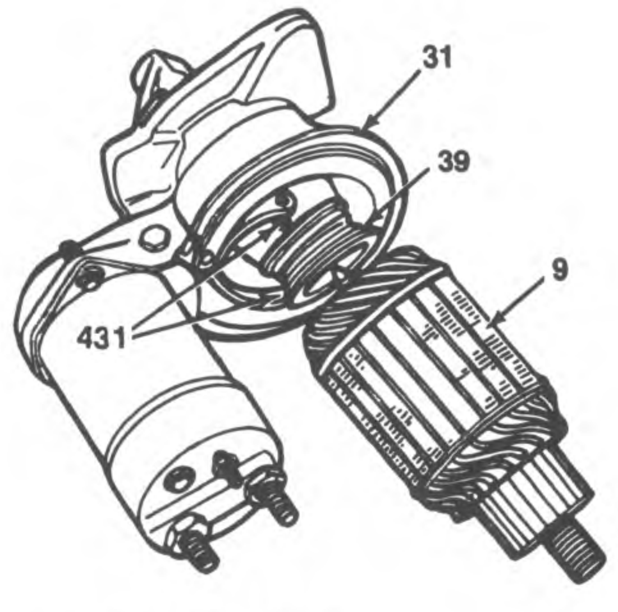
1. Drive assembly (32) from the armature shaft (9) as follows:
   - Remove the pinion stop washer (34) or thrust collar (39) from the armature shaft.



3. Solenoid
31. Drive Housing
41. End Frame
51. Field Coil Construction
57. Field Frame
58. Through Bolts

F9322

Figure 6—Light Duty Starting Motor



1. Shift Lever Finger
9. Armature
31. Drive Housing
39. Drive Collar

F4215

Figure 7—Disengaging the Drive Collar from the Shift Lever Fingers

- 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 from 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.
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.
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 (Figure 10)

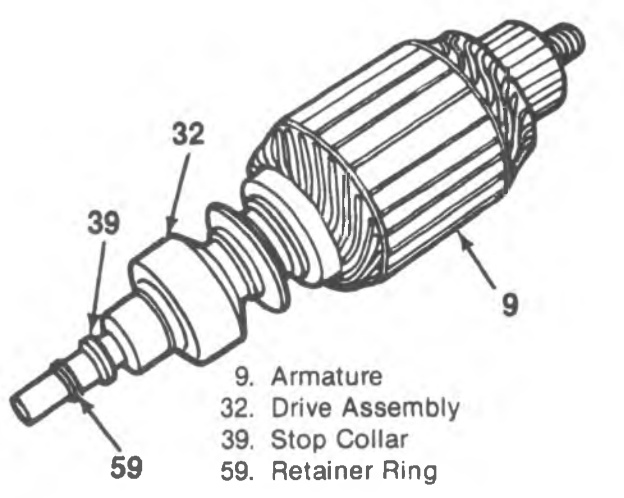
1. Brush holders (38) from the brush supports (62).
2. Screws from the brush holders.
3. Brushes (33) from the holders.

SD-300 (Figure 11)

1. Brush holder pivot pins (63).
2. Brush springs (64).
3. Brushes (33) from the brush holders.

SOLENOID

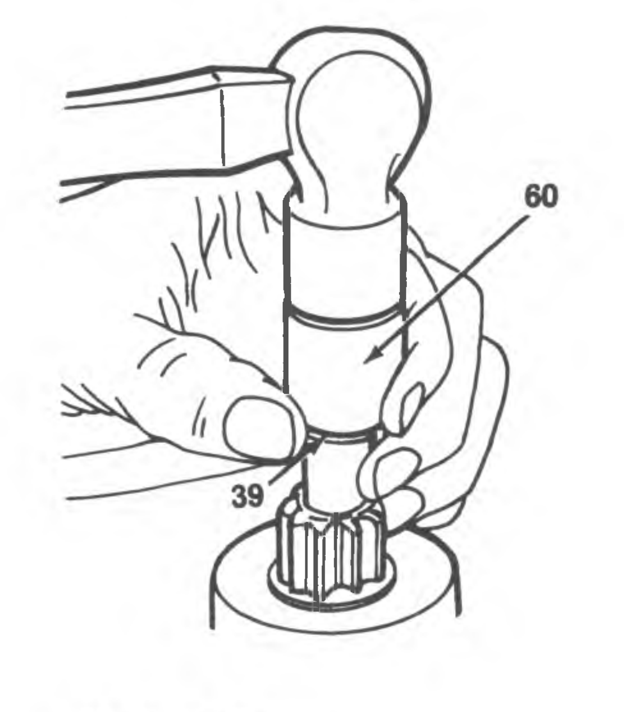
First perform the electrical tests on the solenoid described under "Inspection and Repair" later in this section. Then disassemble the solenoid to inspect the contact disc and terminals.



9. Armature
32. Drive Assembly
39. Stop Collar
59. Retainer Ring

F4216

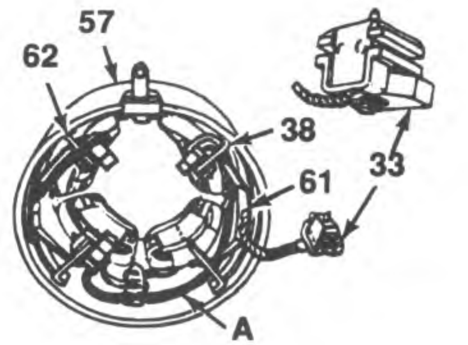
Figure 8—Retaining Ring on Armature



39. Stop Collar
60. Metal Cylinder

F4217

Figure 9—Driving the Stop Collar Off the Retaining Ring



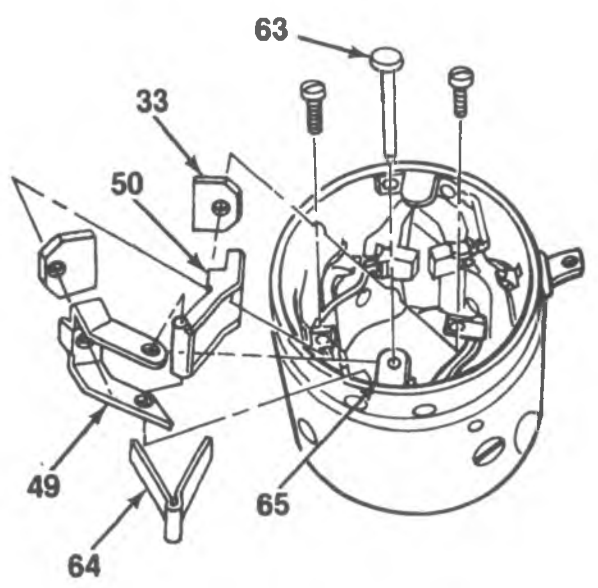
33. Brush
38. Brush Holder
57. Field Frame Assembly
61. Rivet
62. Brush Support
A. Route Wire as Shown

F9323

Figure 10—Replacing Brushes on the SD-200

Remove or Disconnect (Figure 12)

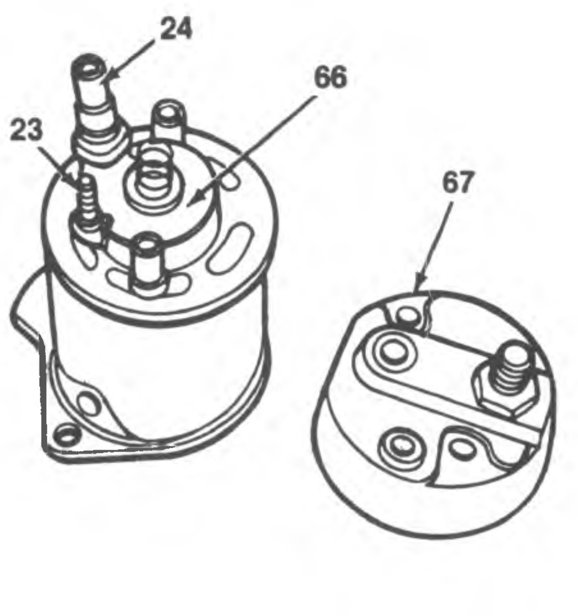
1. Nuts from the "S" terminal (23) and the motor terminal (24).
2. Screws attaching the end cover (67).
3. End cover from the solenoid body.



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

Inspect

1. Contact disc for wear.
   - Replace if worn.

DISASSEMBLY OF THE SD-260 STARTING MOTOR

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.

Before disassembly, perform the electrical tests on the solenoid described under "Inspection and Repair" later in this section.

SOLENOID

Disassemble (Figure 13)

- Clean the outside of the starter housing, removing grease, oil, mud, etc.
- Make scribe marks to show the relationship of the drive end frame, frame and field assembly, and the end frame to aid in assembly.

Models with Solenoid Shield:

1. Solenoid shield nuts (20) from the solenoid clamp screws (54).
2. Shield (21) from the solenoid.
3. Motor lead attaching nut (52) and lead from the solenoid.
4. Solenoid clamp attaching screws (54) and solenoid (3) from the frame assembly (57).

FRAME AND FIELD ASSEMBLY

Disassemble (Figure 13)

1. Through bolts (58) from the end frame (41).
2. End frame (41).
3. Brake washer (14) from the armature assembly (9).
4. Frame and field (57) assembly from the armature/drive end frame assembly.

DRIVE END FRAME ASSEMBLY

Disassemble (Figure 13)

1. Plug (15) from the drive end frame assembly.
2. Armature (9) with the drive assembly (32), shift lever (1), plunger (2) and return spring (5) from the drive end frame.
3. Return spring from the plunger.
4. Plunger from the shift lever.
5. Shift lever (1) from the drive assembly by spreading the lever arms slightly to snap them off the mating buttons on the drive collar.
6. Drive assembly (32) from the armature shaft (9) as follows:
   - Remove the thrust collar (17) from the armature shaft.
   - Drive the pinion stop collar (39) away from the pinion stop retainer ring (37) by sliding a metal cylinder onto the armature shaft and with a

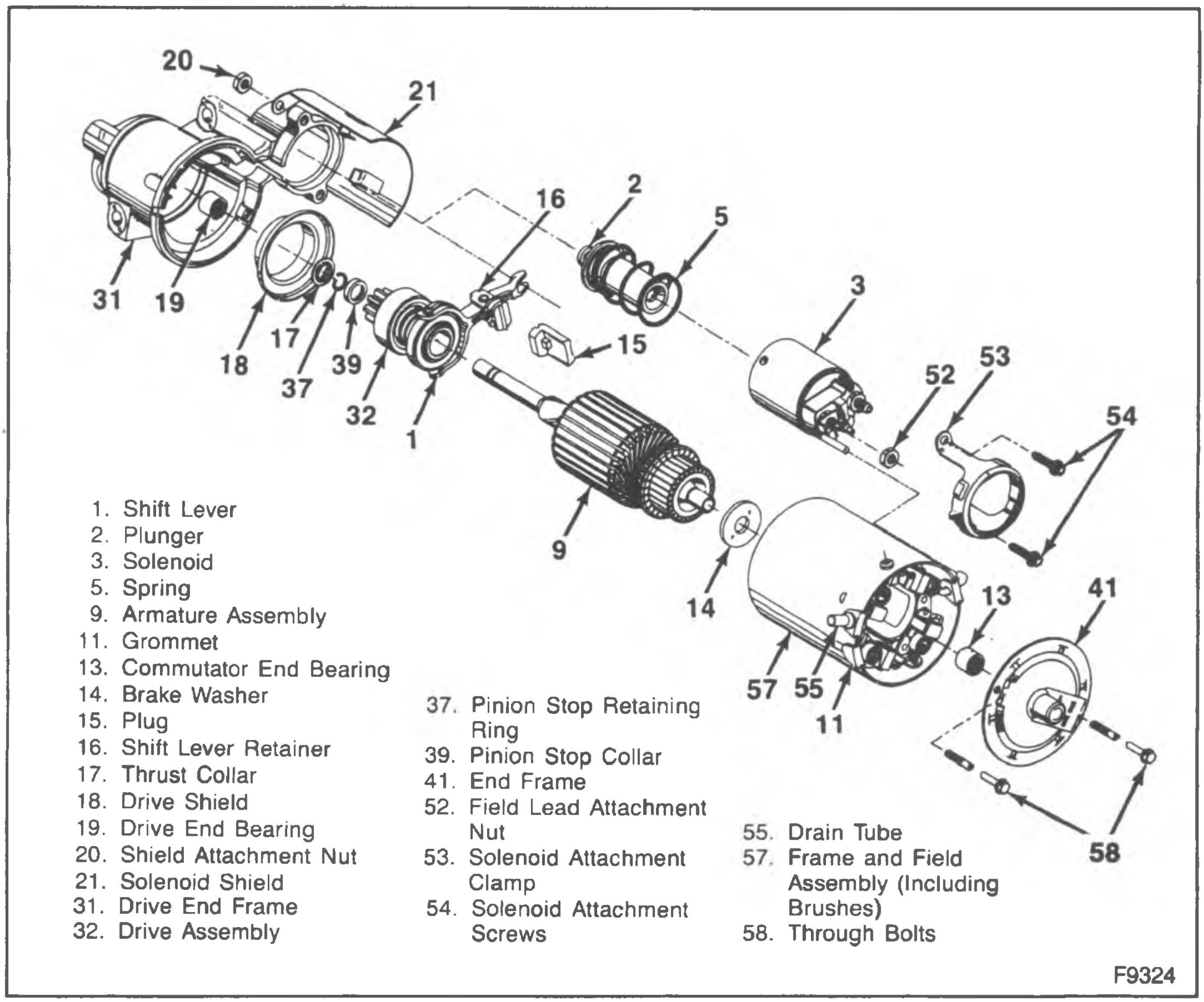


Figure 13—SD-260 Components

hammer, striking the metal cylinder against the stop collar (figure 9).

- Spread the pinion stop retainer ring to remove it from the groove in the armature shaft. Discard the old ring. If the retainer ring is distorted during removal, it must be replaced.
- Slide the drive assembly and the stop collar off the armature shaft.

INSPECTION AND REPAIR

Clean

Do not clean the starting motor parts in a degreasing tank. Immersing parts in a cleaning solution will dissolve permanent lubrication and may damage electrical insulation, causing shortened motor life.

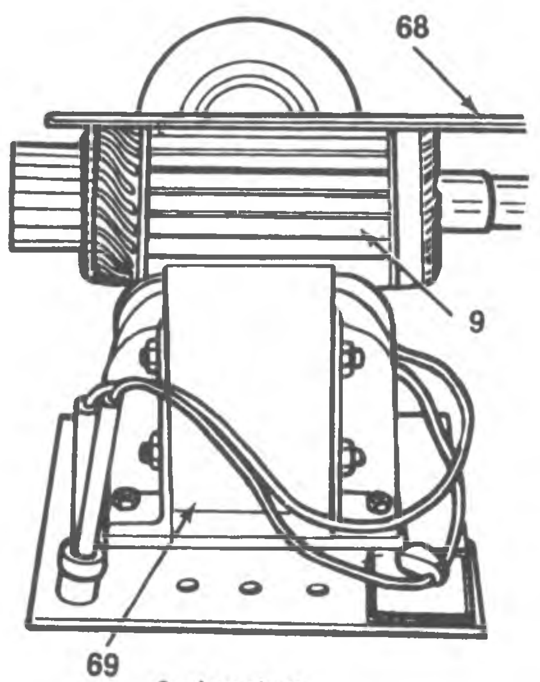
- All parts, except the drive, with mineral spirits.
  — Dry by wiping with a clean cloth.

Inspect

1. Armature bearing fit in the end frame, lever housing, and nose housing. On models with bushings, 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.
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 14).
   - 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.

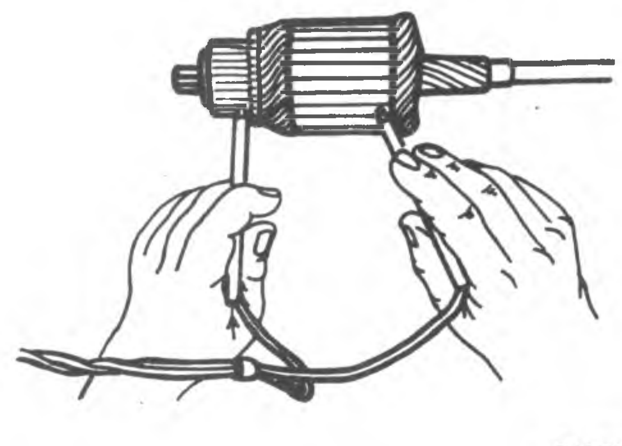
6. Armature for opens.
   - Look for loose connections where the conductors join the commutator bars. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, the leads can be resoldered.
7. Armature for grounds by using a test lamp (figure 15).
   - If the test 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.
   - 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. On the SD-260, the brushes and brush holders are an integral part of the frame and field assembly, so the assembly must be replaced.
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.



9. Armature
68. Saw Blade
69. Growler

F4221

Figure 14—Testing the Armature for Short Circuits



F1970

Figure 15—Testing the Armature for Grounds

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 over-running 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 16.

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.
  - The coil resistance can be determined by dividing the voltage by the current (amperes) listed in "Specifications" at the end of this section.

ASSEMBLY OF THE SD-200 AND SD-300 STARTING MOTORS

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 (Figure 10)

1. Brushes (33) into the holders (38).
2. Screws into the brush holders.
3. Brush holders into the brush supports (62).

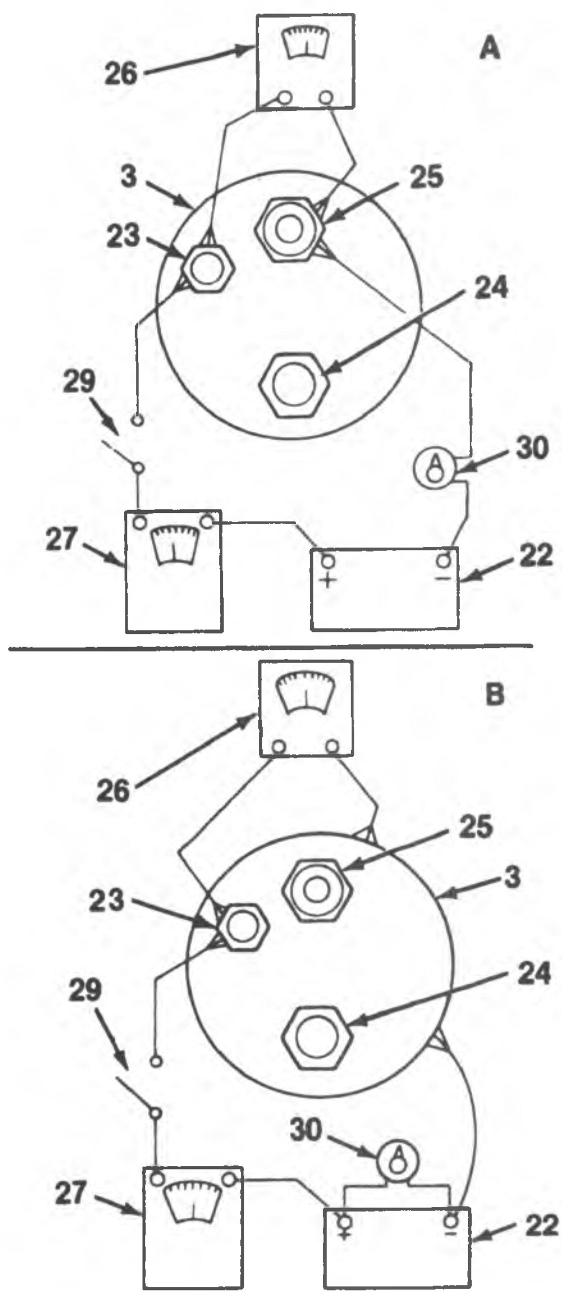
SD-300 (Figure 11)

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.



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 16—Solenoid Test Connections

- 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 Corning 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.
4. Stop collar (39) on the shaft with the cupped end away from the pinion gear.
5. Retainer ring (37) on the shaft (figure 17).
   - 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 18).
   - 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.

ASSEMBLY OF THE SD-260 STARTING MOTOR

DRIVE END FRAME

Assemble (Figure 13)

- Wipe the armature shaft (9) clean and lubricate the area that will be under the drive assembly . Refer to "Specifications" at the end of this section.

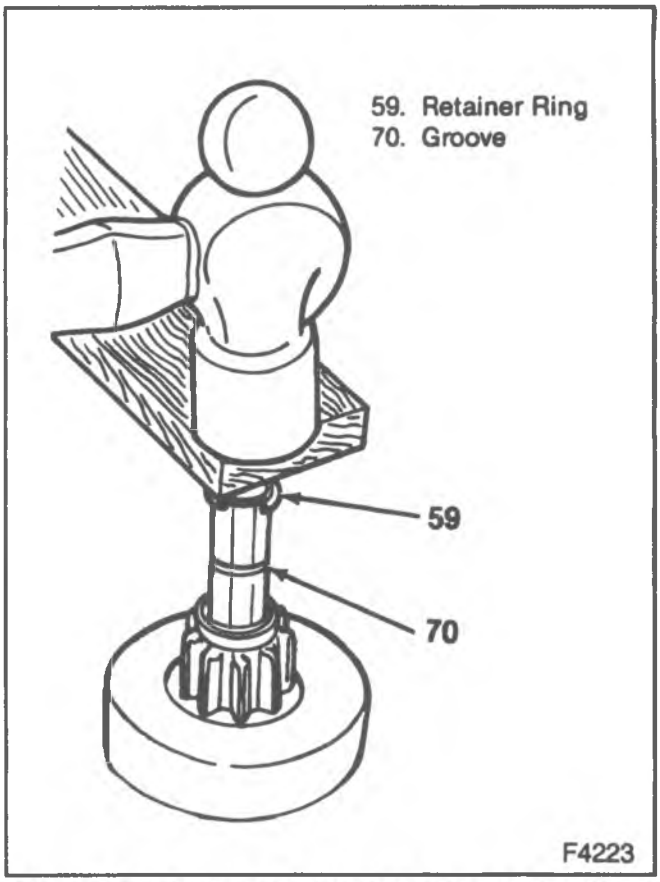


Figure 17—Forcing the Retainer Ring on the Shaft

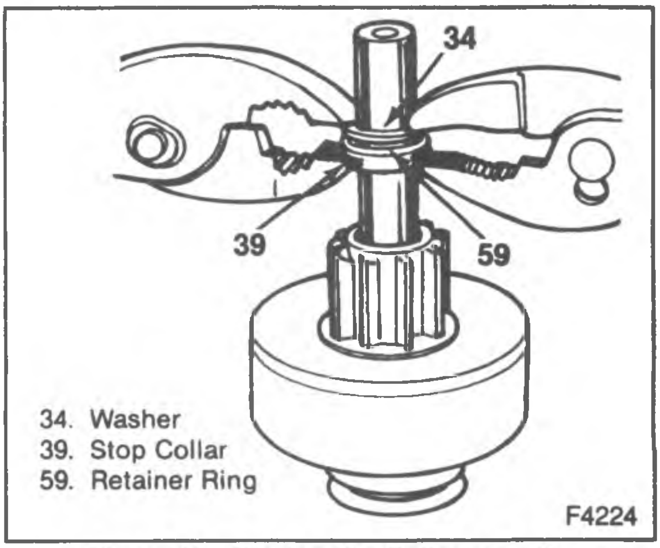


Figure 18—Forcing the Collar over the Retainer Ring

- Wipe the drive assembly (32) clean.

1. Drive assembly onto the armature shaft.
2. Pinion stop collar (39) with the flat side of the collar toward the drive pinion.
3. New retaining ring (37) onto the armature shaft.
   - Slide the ring down the shaft until it seats in the shaft groove.
4. Thrust collar (17) onto the shaft with the flange toward the retaining ring.

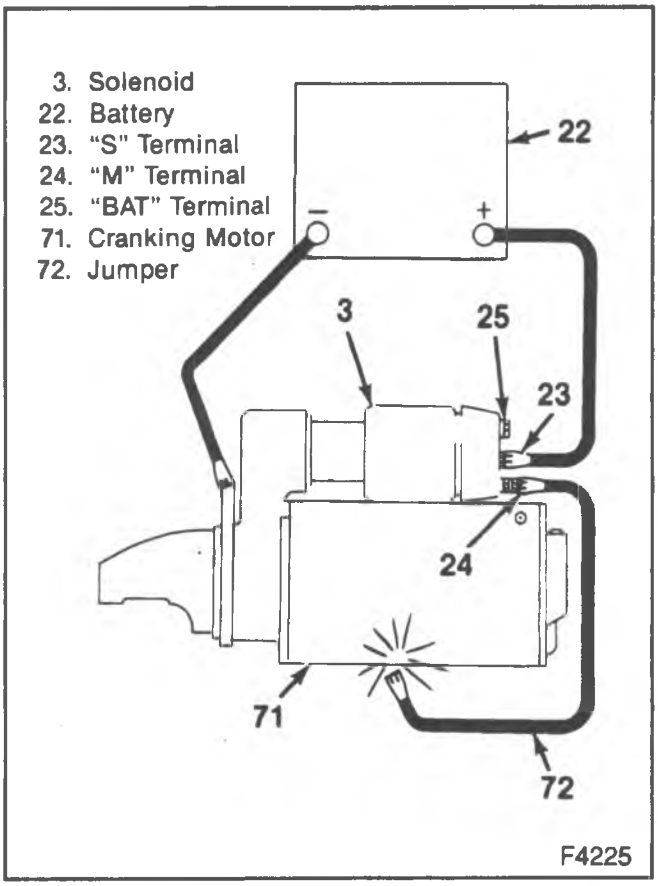


Figure 19—Pinion Clearance Circuit

- Using two sets of pliers, push the pinion stop collar and thrust collar together to snap the thrust collar onto the retaining ring.

Inspect

- Drive end bearing. If no lubrication is visible or the bearing appears damaged, remove it by pressing it out.

5. New drive end bearing by pressing it in until it is recessed 1.6 mm (0.06-inch) into the casting. It is pre-lubricated, so do not add lubricant.
6. Shift lever (1) to the drive assembly by spreading the arms slightly to snap it onto the buttons on the drive collar.
7. Plunger (2) to the lever (1) by snapping into place.
8. Armature shaft into the drive end bearing while sliding the shift lever retainer (16) into the slot on the drive end housing.
9. Spring (5) onto the plunger (2).
10. Solenoid (3) and clamp (53) onto the drive end frame.
    - The locating button on the solenoid must be in the slot on the housing.
11. Clamp retaining screws (54).

Tighten

- Screws to 11 N·m (95 in. lbs.).

FRAME AND FIELD ASSEMBLY

Assemble

1. Frame and field assembly onto the armature.
    - Clean the contact faces of the brushes and the commutator with a soft cloth.
    - Push the brushes into the brush holders and hold them in place while installing the frame.
    - Align the notch in the frame with the locator on the drive end frame.
    - Release the brushes onto the commutator, making sure all four brushes move freely and contact the commutator.
2. Brake washer to the armature assembly.
3. End frame (41) to the field frame.
    - If the end frame bearing shows no lubrication or looks damaged, replace it.
    - Recess the new bearing 2 mm (0.08-inch) into the housing.
    - The bearing is pre-lubricated, so do not add lubricant.
4. Identification tag over the hole in the end frame with the fluted end around the bearing well.
5. Through bolts (58).

Tighten

- Bolts to 8.5 N·m (75 in. lbs.).

6. Motor field lead over the motor terminal on the solenoid.
7. Field lead attaching nut.

Tighten

- Nut to 11 N·m (95 in. lbs.).

8. Solenoid shield (21) onto the protruding end s of the solenoid bracket screws.
9. Shield attaching nuts (20).

Tighten

- Nuts to 8 N·m (70 in. lbs.).

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 19 and 20).

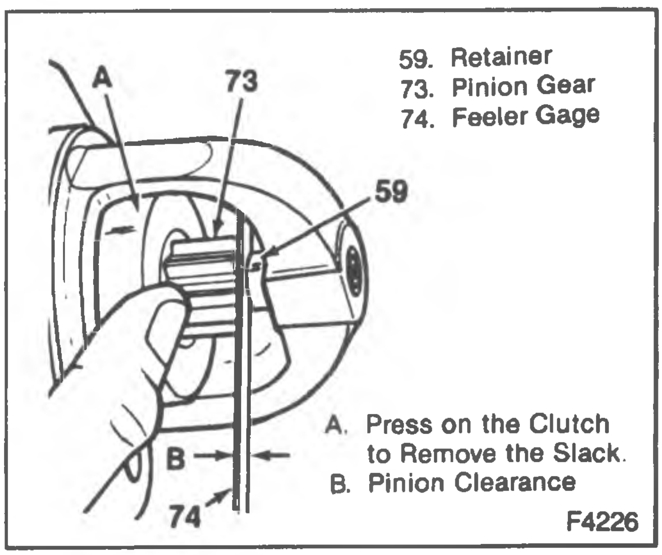


Figure 20—Measuring Pinion Clearance

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).

SPECIFICATIONS

STARTER

No Load Test @ 10 Volts						
Starter		AMPS		RPM		Solenoid
Part No.	Series	Minimum	Maximum	Minimum	Maximum	Part No.
10455013	SD-260	50	62	8500	10700	10469039
10455016	SD-200	50	75	6000	11900	1114530
10455018	SD-200	50	75	6500	11900	1114530
10455042	SD-260	50	70	7000	11000	10469039
10455305	SD-300	70	110	6500	10700	1114520
10455306	SD-300	70	110	6500	10700	1114563
10355307	SD-300	70	110	6500	10700	1114520

SOLENOID SWITCHES

Switch		Pull-In Winding		Hold-In Winding	
Part No.	Volts	Amps	Volts	Amps	Volts
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

DISTRIBUTORS

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

DELCO-REMY DISTRIBUTORS

DESCRIPTION

Distributors with separate coils are used on the light truck engines (figures 1 2, and 3). The coil connects to the rotor through a high tension wire.

The distributor uses a magnetic pickup assembly located inside the distributor which 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. There is a capacitor in the distributor for radio noise suppression. It may be mounted separately in the distributor housing or be integral with the terminal block.

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.

These distributors are used on engines with TBI, and the ignition system is controlled by the vehicle's computer (ECM). The computer provides voltage output signals to the distributor module to control spark timing and dwell. 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.

The part number (seven digits) is located on a label on the distributor cap (figure 1).

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 is connected to the distributor by a high tension wire.

ELECTRONIC MODULE

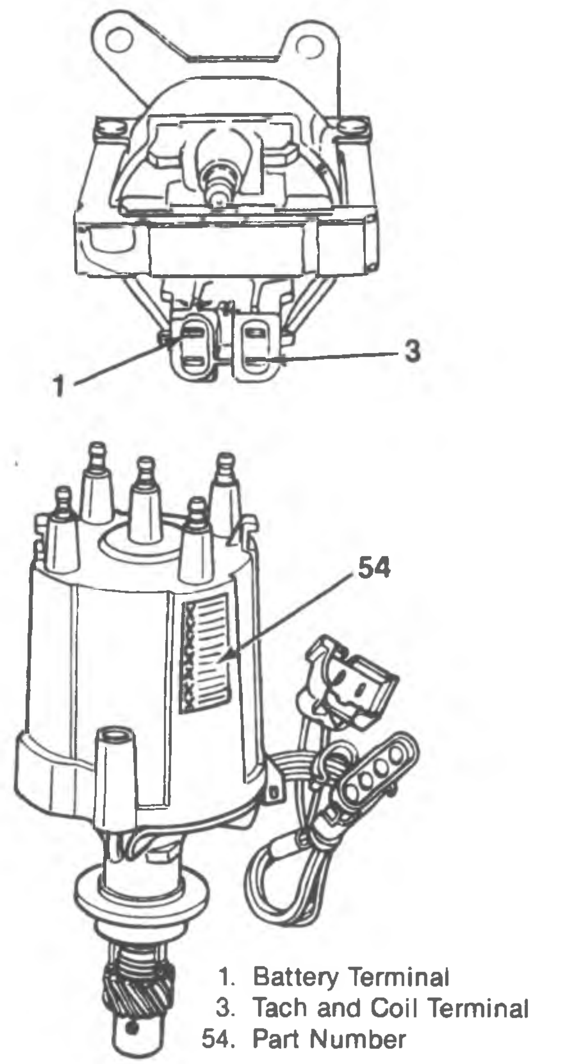
The electronic module is a solid state unit containing many complete circuits. The circuits control spark triggering, switching, current limiting, dwell control and distributor pickup. The vehicle's computer sends signals to the module to control dwell and spark timing. The module may have seven or eight terminals, depending on the ignition system.

POLE PIECE AND COIL ASSEMBLY (Figure 4)

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.

HALL EFFECT SWITCH

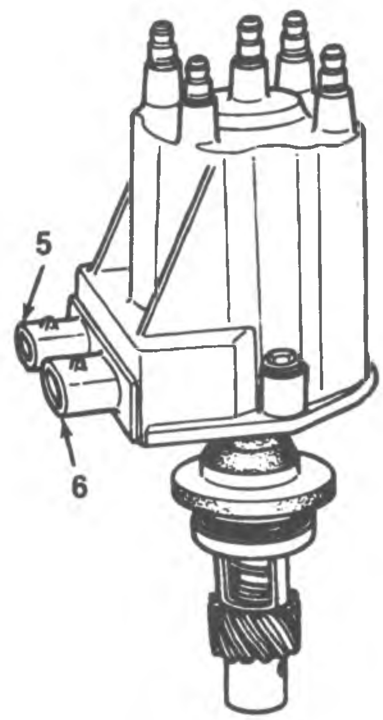
This switch, used on some distributors in the EST system, signals the vehicle's computer which cylinder will fire next.



1. Battery Terminal
3. Tach and Coil Terminal
54. Part Number

F4480

Figure 1—Distributor with Separate Coil



5. Ignition Coil Connector Terminals
6. Four Terminal Connector

F4229

Figure 2—Distributor with Separate Coil and Sealed Connectors

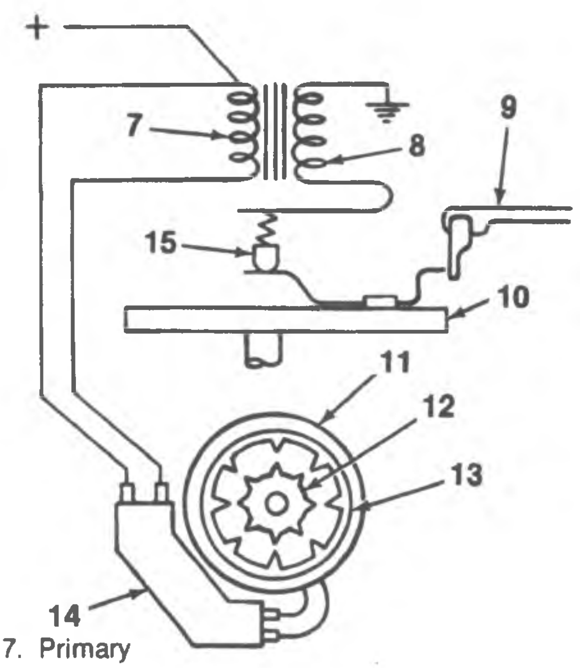
DISASSEMBLY

DISTRIBUTORS WITH SEALED MODULE CONNECTORS (Figure 2)

Remove or Disconnect (Figures 5 and 6)

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 7).
5. Driven gear (29), washer or spring, and spring retainer (52) or tan washer (33).



7. Primary
8. Secondary
9. Spark Plug Wire
10. Rotor
11. Pickup Coil
12. Timer Core
13. Pole Piece
14. Module
15. Contact Button

F4230

Figure 3—Basic Wiring Schematic

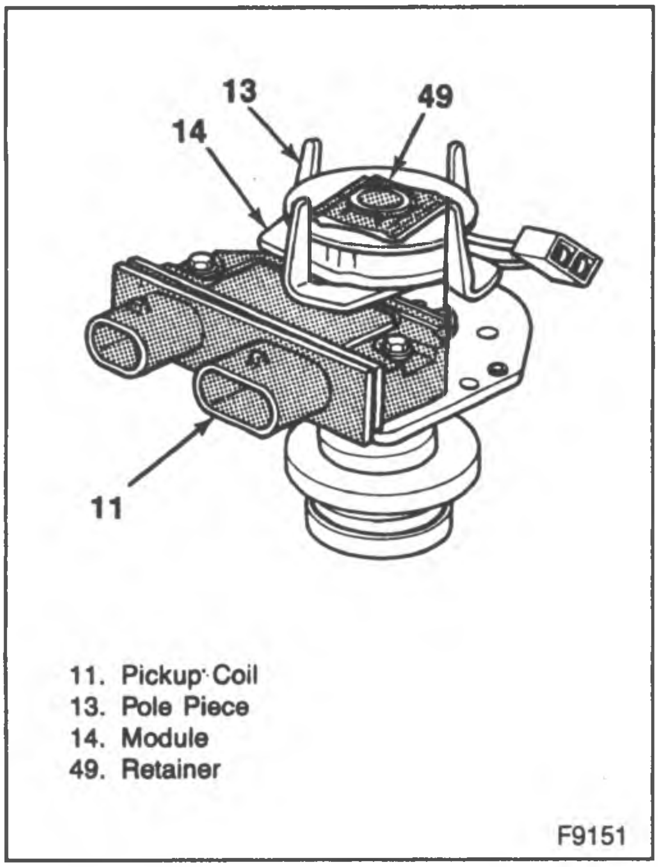


Figure 4—Distributor with Sealed Module Connector

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 (Figure 1)

Remove or Disconnect (Figure 8)

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 7).
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.
2. Metal terminals in the cap for corrosion. Scrape them clean with a knife or replace the cap.

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

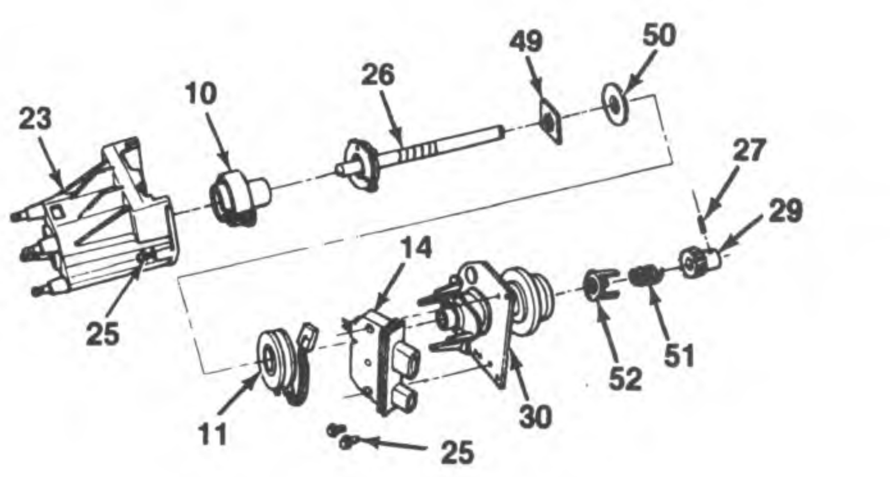


Figure 5—Distributor Components (Separate Coil and Sealed Connector)

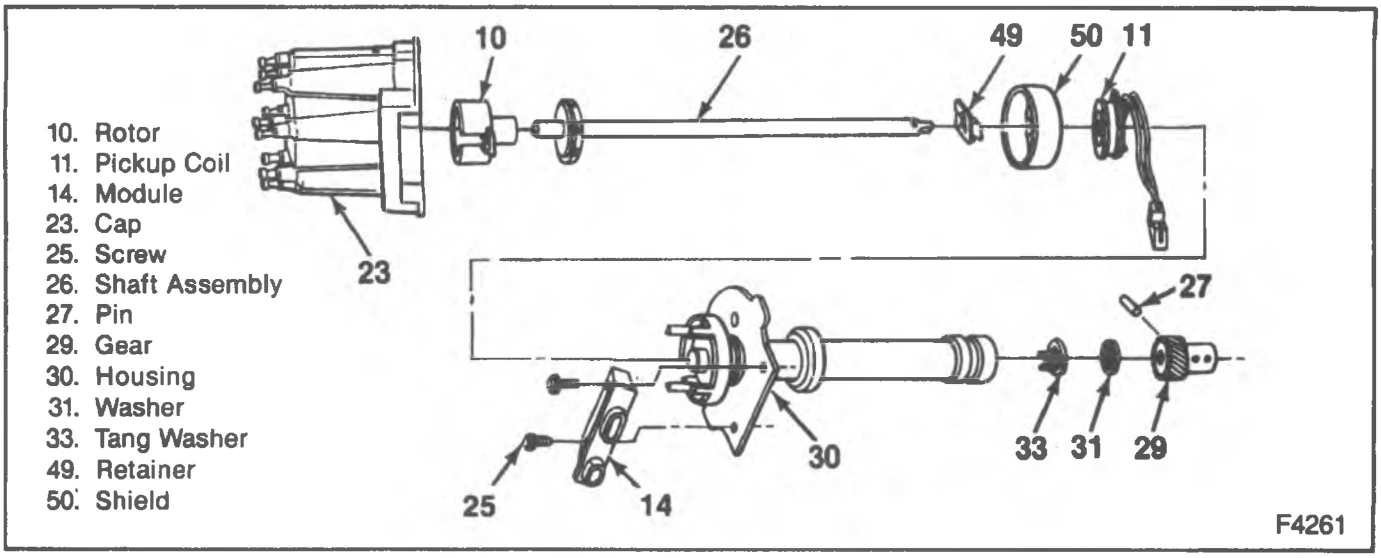


Figure 6—Distributor Components (Separate Coil and Sealed Connector) for an 8-Cylinder Engine

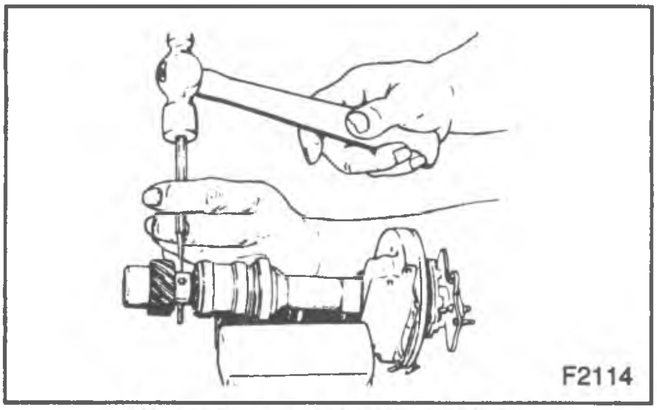


Figure 7—Removing the Roll Pin

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 9.
   - 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 10, step 1. The reading should be infinite. If not, replace the coil.
   - Connect an ohmmeter to both pickup coil leads as shown in figure 10, 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 11, 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

DISTRIBUTORS WITH SEALED MODULE CONNECTORS

Install or Connect (Figures 5 and 6)

- 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.

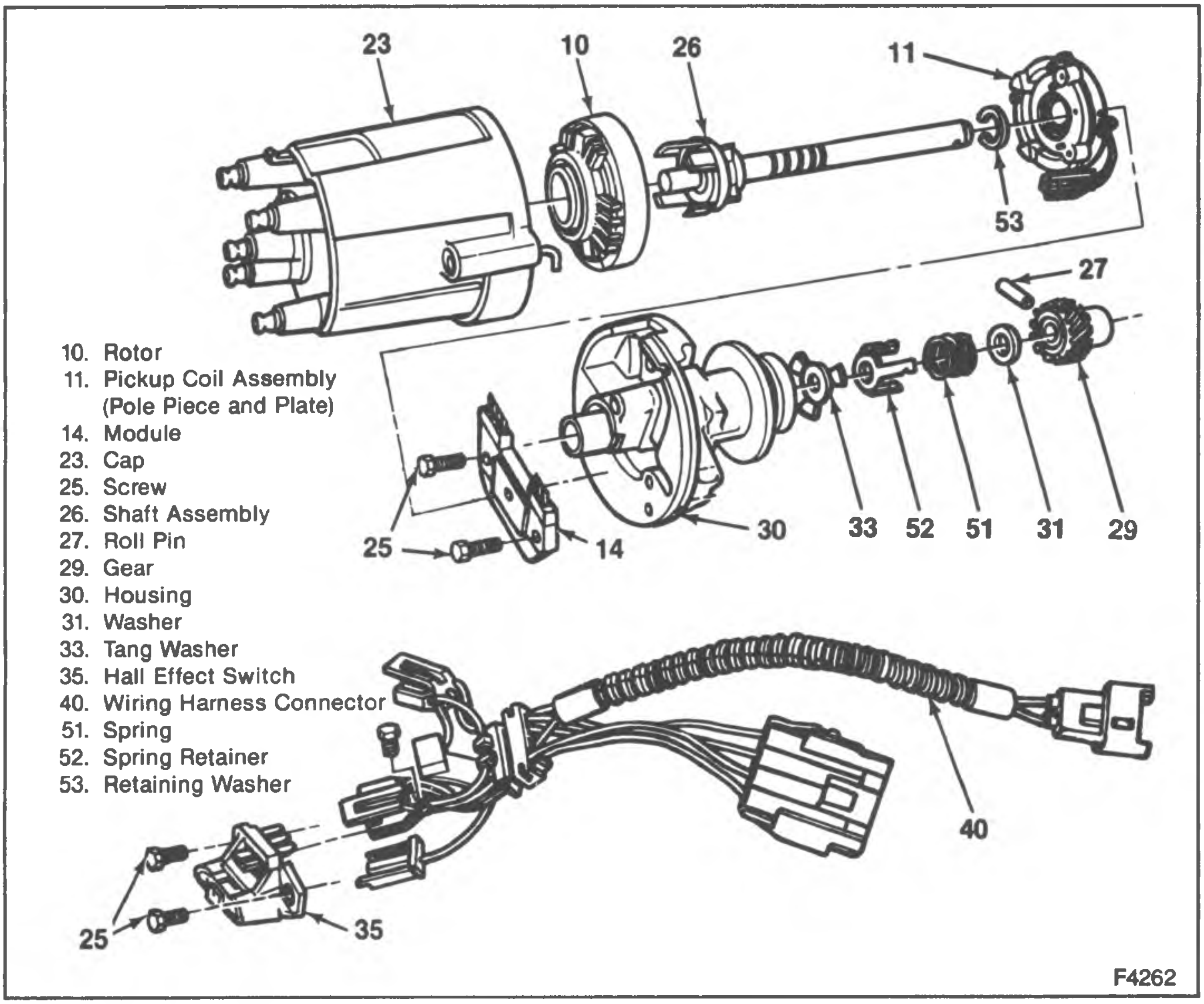


Figure 8—Distributor Components

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.

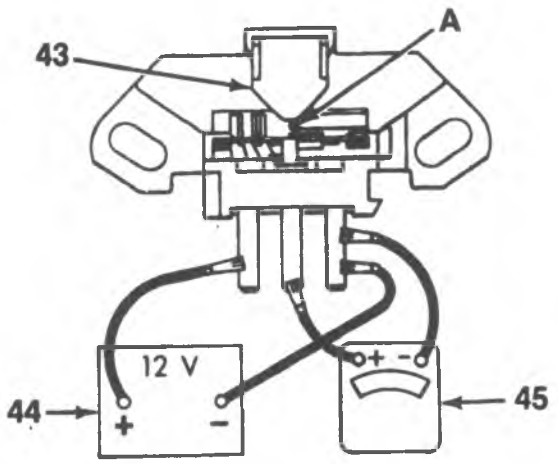
DISTRIBUTORS WITHOUT SEALED CONNECTORS

Install or Connect (Figure 8)

- 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.

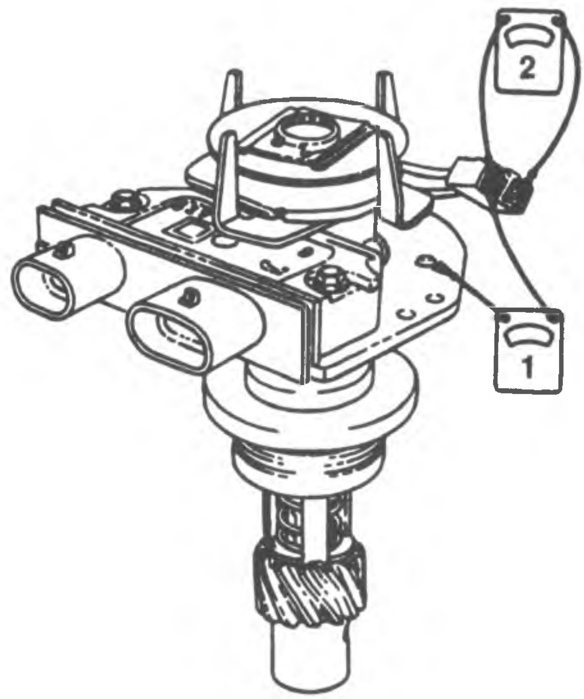
1. Module (14) to the housing (30) with two screws.
2. Wiring harness into the housing.
3. Two harness mounting tabs to the housing with one bolt.
4. Two wiring connectors to the module.
   - Be sure the locking tabs are in place.
5. Pickup coil (11) to the housing.
   - Fit the tab on the bottom of 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.



43. Magnet
44. Battery
45. Voltmeter
A. Insert a knife blade straight down and against the magnet.

F4240

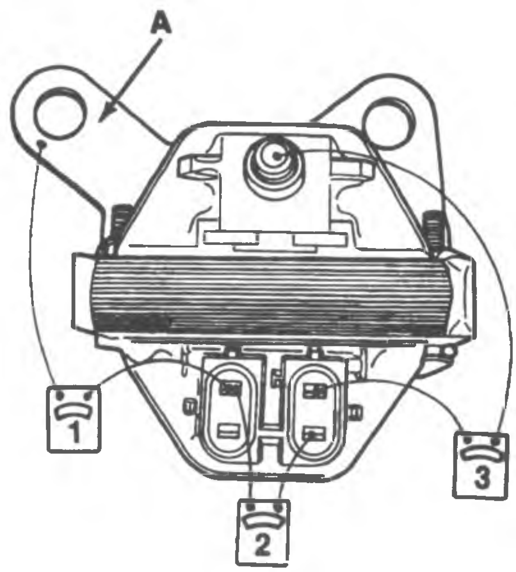
Figure 9—Testing the Hall Effect Switch



F2116

Figure 10—Testing the Pickup Coil

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.



A. Scrape clean metal ground.

F2117

Figure 11—Testing the Ignition Coil

SECTION 7

TRANSMISSION

CONTENTS

SECTION/HYDRA-MATIC 4L60

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 1990 Service Manual.**

TRANSMISSION DISASSEMBLY

General Service Information

Figure 1

Tool Required:

J 8763-02 Holding Fixture and Base

NOTICE: It is not recommended to use air powered tools to disassemble or assemble transmissions/transaxles. Improper bolt torques can contribute to transmission repair conditions and this information, vital to diagnosis, can only be detected when using hand tools.

- 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

1. J 8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid out case extension by rotating transmission so bell housing is up.

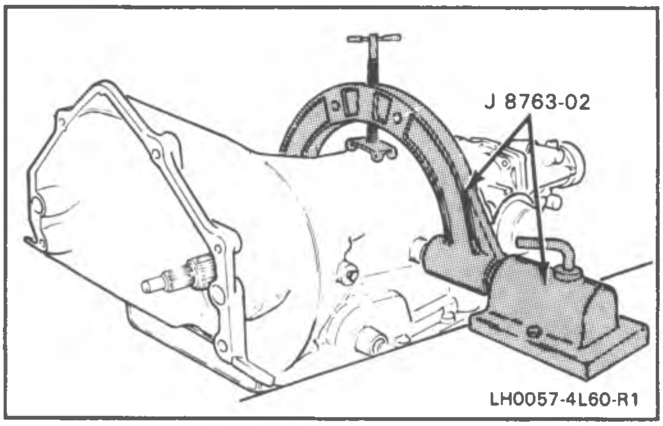


Figure 1 Holding Fixture

2-4 Servo Assembly

Figures 2 and 3

Tool Required:

J 29714 Servo Cover Compressor

Remove or Disconnect

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).

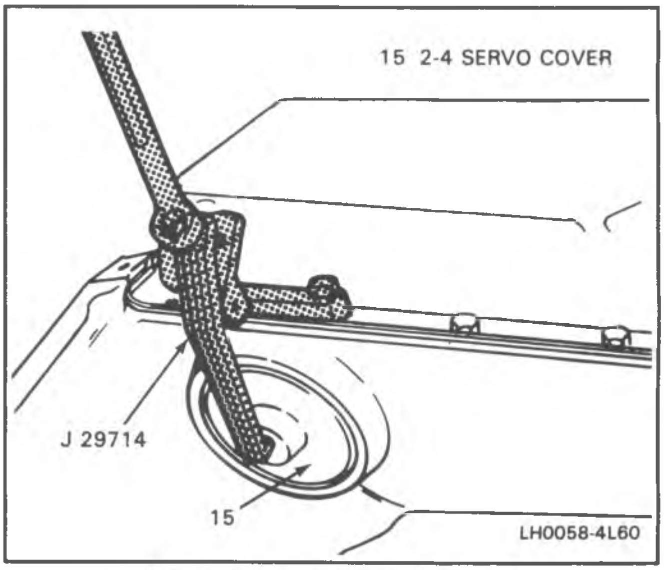


Figure 2 Servo Cover Removal

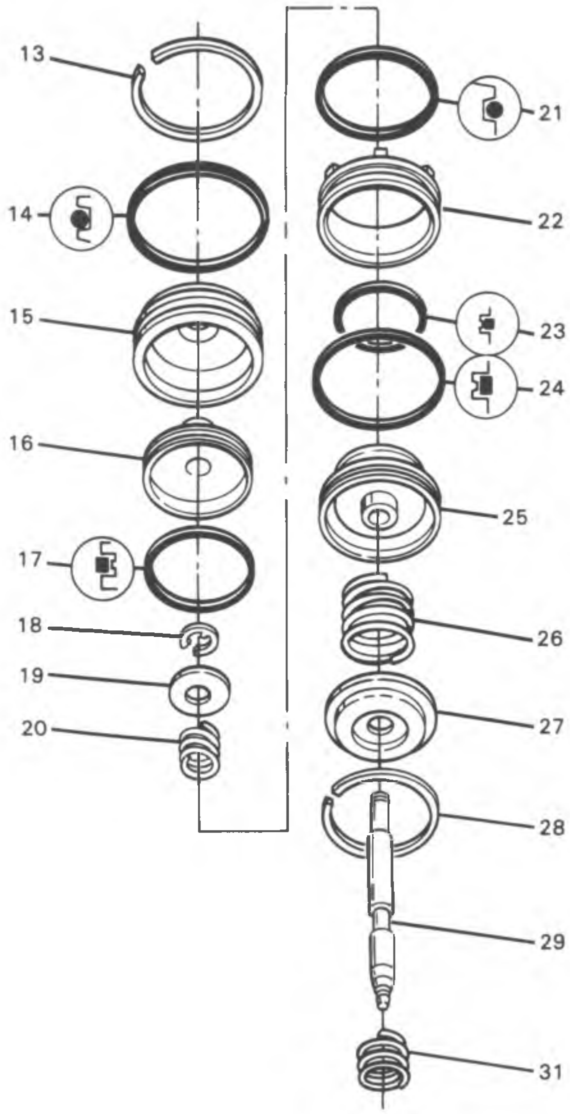
Servo Pin Length

Figures 3, 4 and 5

Tools Required:

J 33037 Band Apply Pin Tool
J 22269-01 Piston Compressor

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.



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

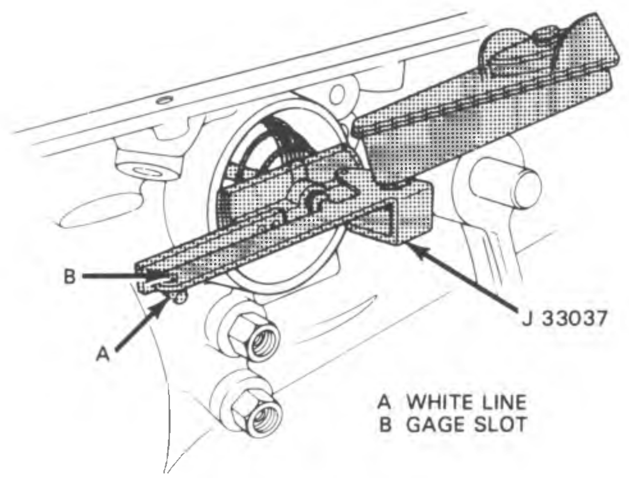
LH0059-4L60

Figure 3 Servo Assembly

Measure

Figure 4

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		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

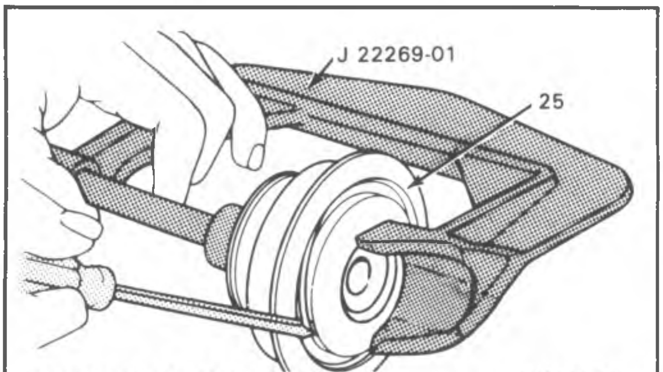
LH0060-4L60

Figure 4 Servo Pin Length

Remove or Disconnect

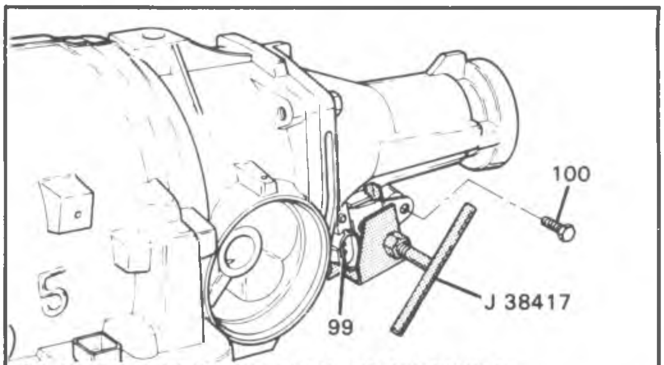
Figures 3 and 5

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)



25 SECOND APPLY PISTON ASM. LH0061-4L60

Figure 5 Second Servo Piston Retaining Ring Removal



99 SPEED SENSOR, INTERNAL TRANSMISSION
100 BOLT, SPEEDO SENSOR RETAINING LH0062-4L60

Figure 6 Speed Sensor Removal

Governor and Extension

Figures 6 and 7

Tool Required:

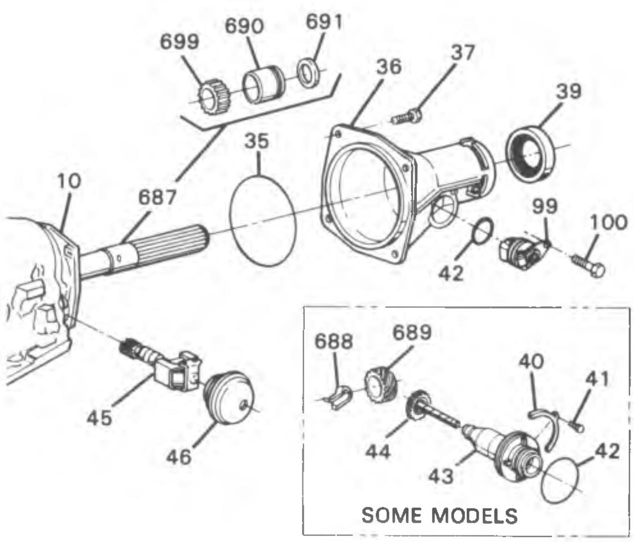
J 38417 Speed Sensor Remover and Installer

Remove or Disconnect

Figures 6 and 7

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.



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-R1

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

Figure 8

Clean

- Exposed ends of bottom pan screws and spray with penetrating oil

Remove or Disconnect

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.

   Inspect

   - Filter (71), open filter by prying the metal crimping away from the top of the filter (black) and pull apart. The filter may contain evidence for root cause diagnosis.
     - clutch material
     - bronze slivers indicating bushing wear
     - steel particles
3. Outside electrical connector (33) and o-ring seal (34)

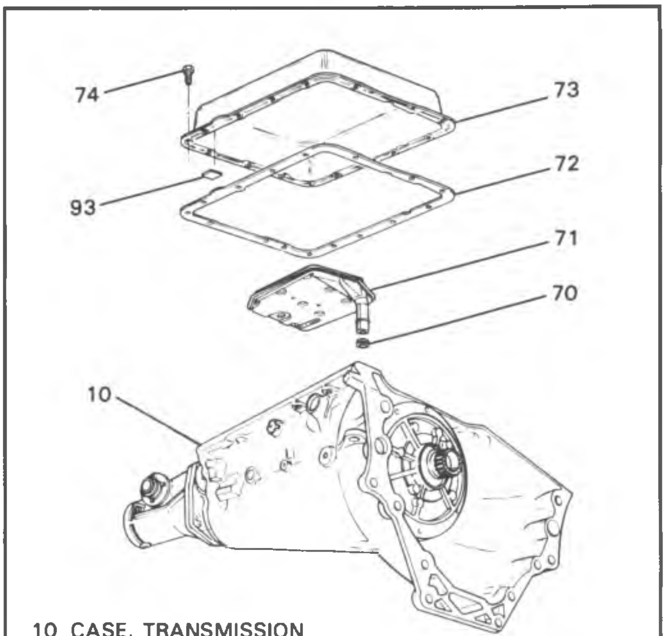
Valve Body And Wiring Harness

Figures 9 through 16

Remove or Disconnect

Figures 9 and 10

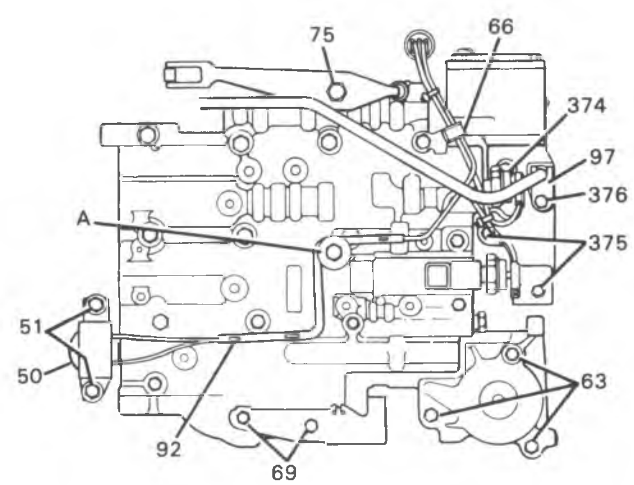
1. Electrical connections from switches
   - Refer to wiring diagrams in the Diagnosis Section for specific model applications.
2. Solenoid bolts (51) and solenoid assembly (50) with o-ring seal (49) and wiring harness
3. Accumulator cover bolts (63) and 1-2 accumulator cover and pin assembly (62)
4. 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-R1

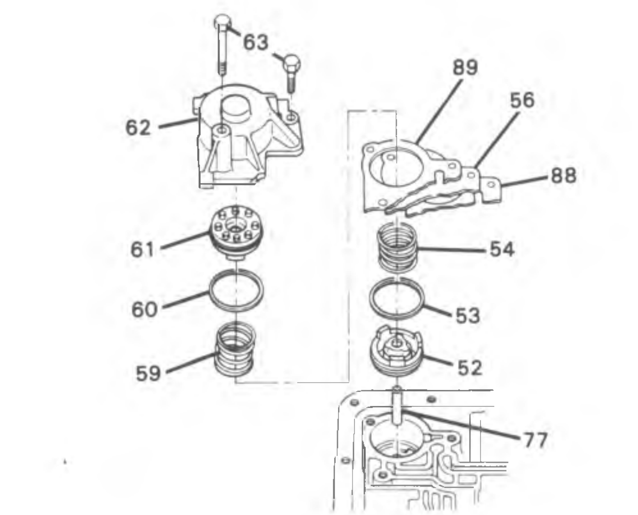
Figure 8 Pan, Filter & Seal Remove



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

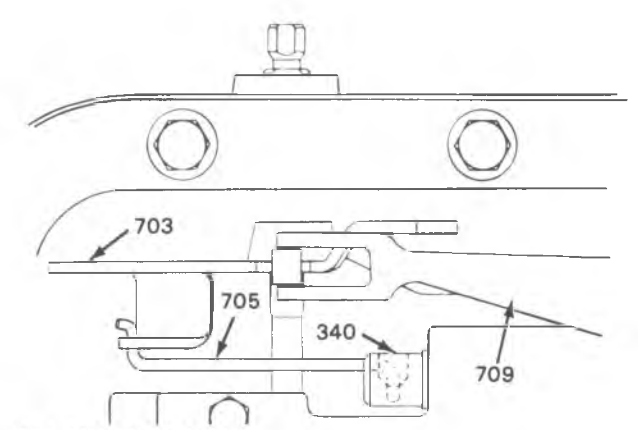
Figures 9, 11, 12 and 13

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)

Remove or Disconnect

Figures 11 and 13 through 16

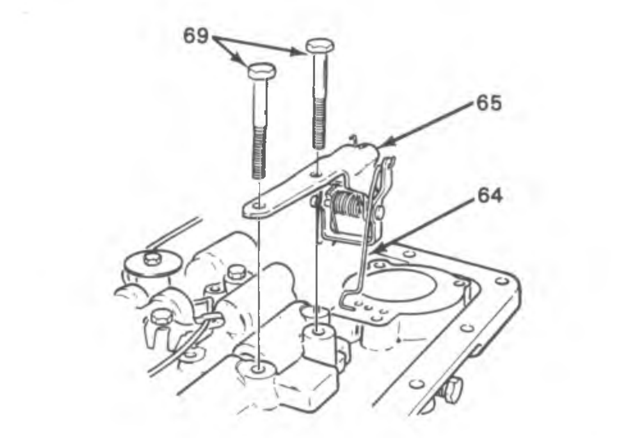
1. Remaining valve body bolts (69)
2. Manual valve link (705)
3. Control valve assembly (67)
4. Bolts (374-375), auxiliary valve body (377), and checkball (55B)
5. Spacer plate (56) and spacer plate gaskets (88 and 89)
6. Checkballs (55A, 55C and 91) spring (54), piston (52), seal (53) and pin
   - Three checkballs are located under the valve body: one is in the auxiliary valve body and four are located in the case. The large copper flash colored ball is #10 checkball (91).



340 VALVE, MANUAL
703 LEVER, DETENT (INNER)
705 LINK, MANUAL VALVE
709 SPRING ASSEMBLY, MANUAL DETENT

LH0067-4L60

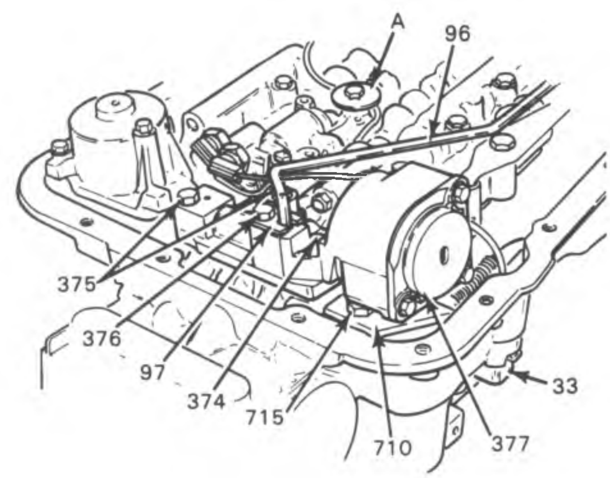
Figure 11 Manual Valve Link



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

LH0068-4L60

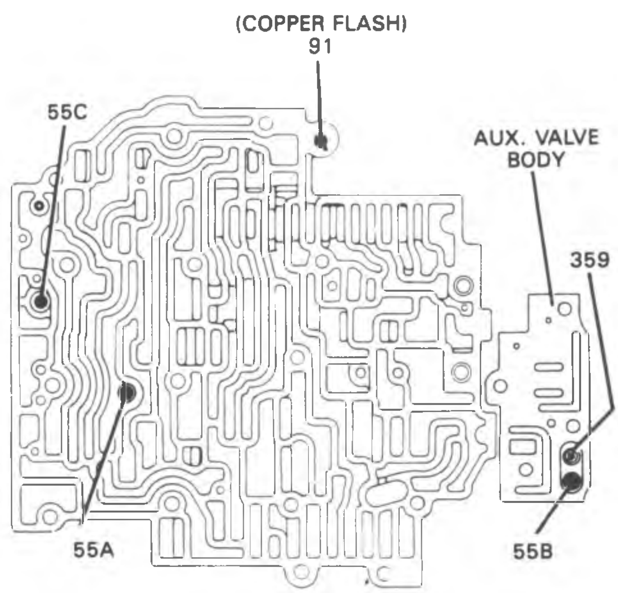
Figure 12 T.V. Lever and Bracket



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

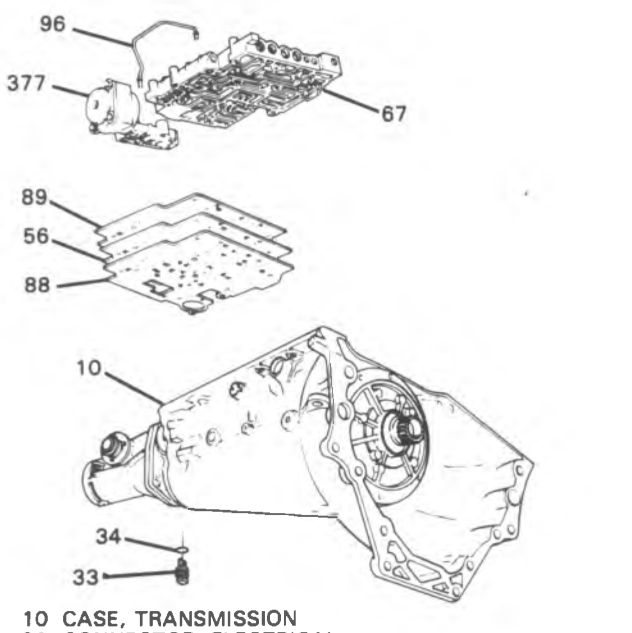
Figure 13 Removing Auxiliary Valve Body Assembly



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

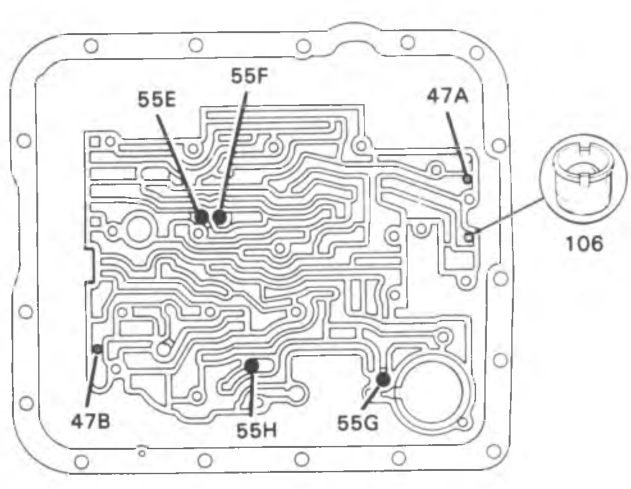
Figure 15 Valve Body Checkballs



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



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

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

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

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").

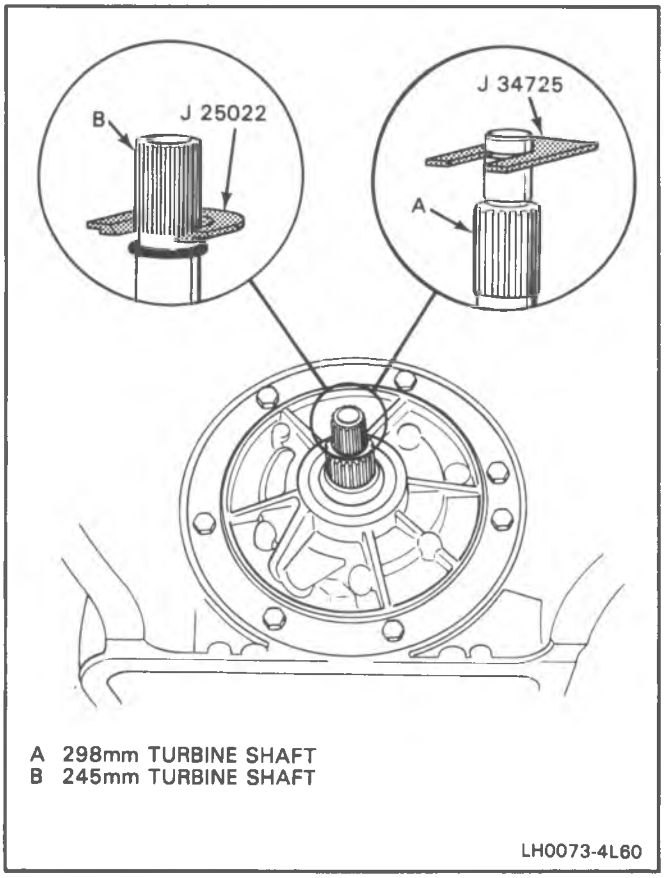


Figure 17 End Play Tool

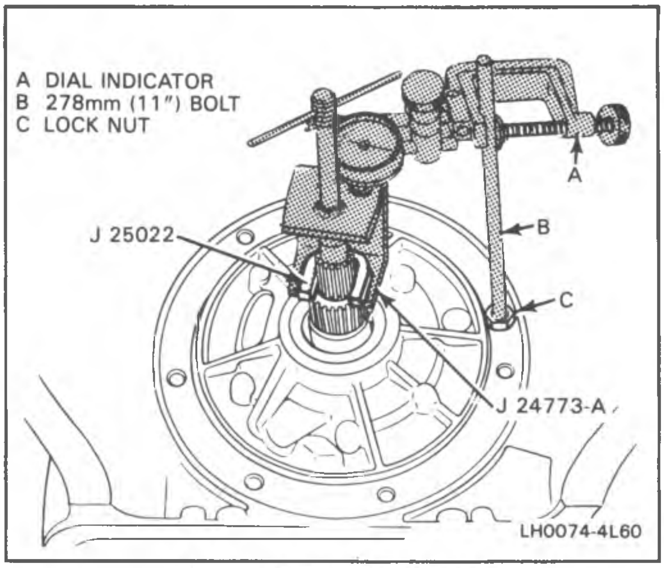


Figure 18 End Play Check

Oil Pump Assembly

Figures 19 and 20

Tool Required:

J 24773-A Oil Pump Remover

Remove or Disconnect

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)

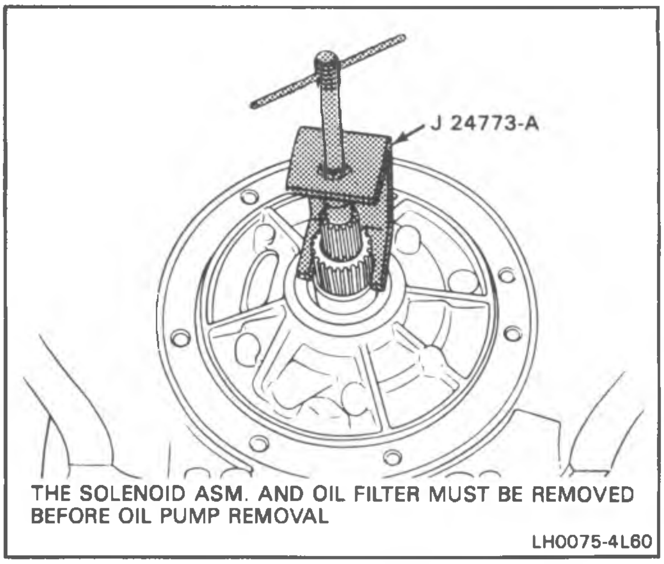
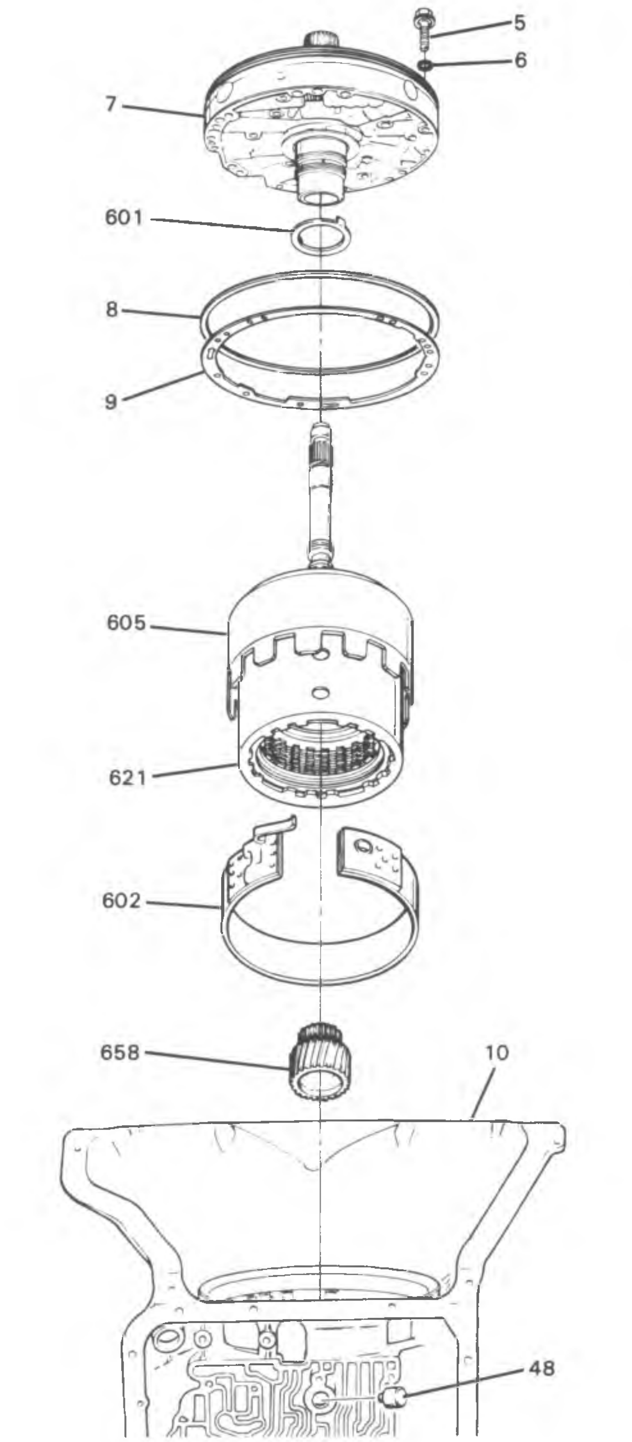


Figure 19 Oil Pump Removal



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 through 22

Tools Required:

J 29837 Output Shaft Support Fixture
J 34627 Snap Ring Pliers

Remove or Disconnect

Figures 20 and 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)

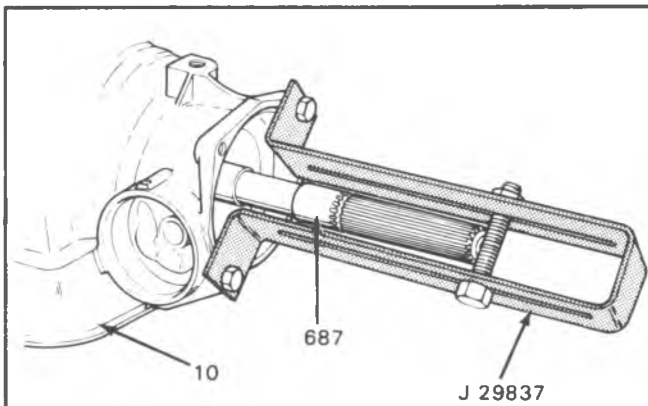
Install or Connect

Figures 21 and 22

- 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

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)

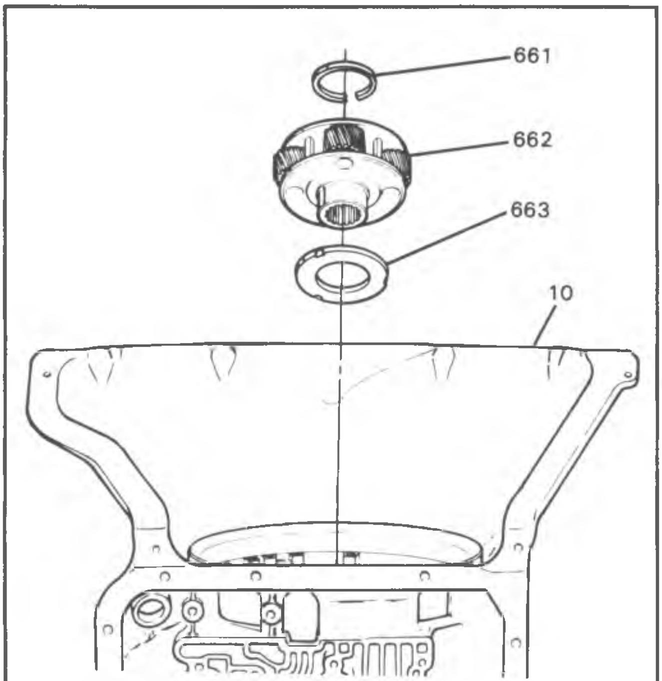


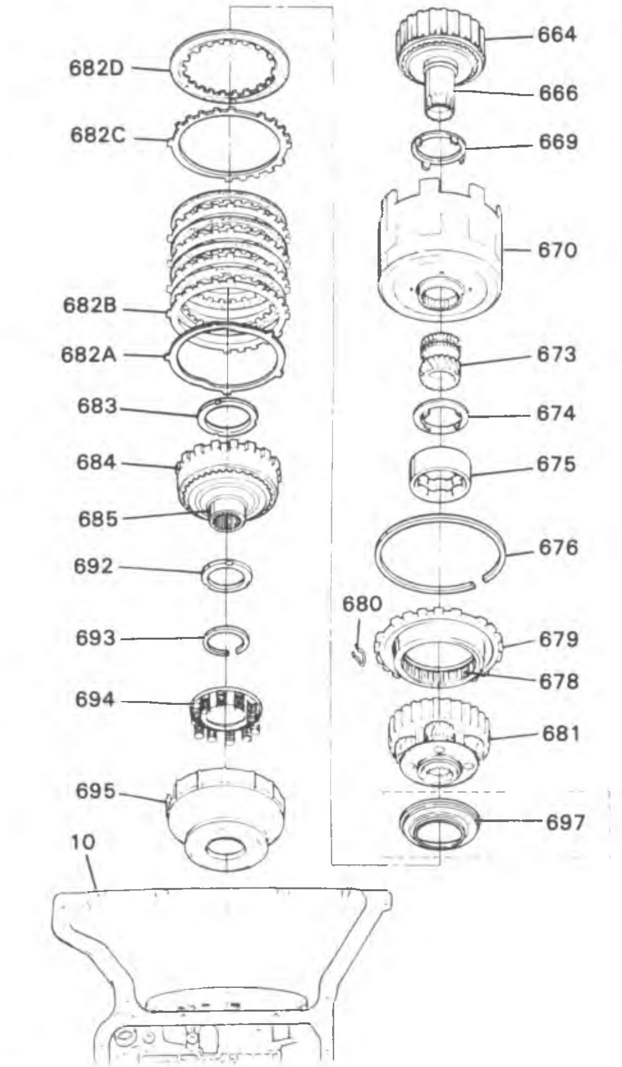
Figure 22 Input Carrier Removal

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

Tools Required:

J 34627 Snap Ring Remover/Installer
J 23327 Clutch Spring Compressor

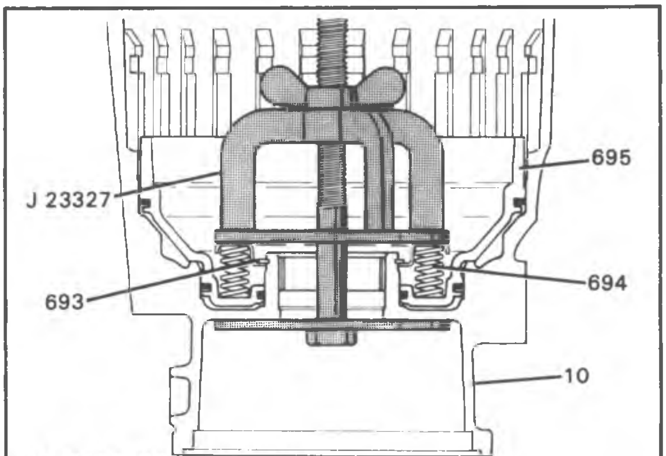
Remove or Disconnect

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.

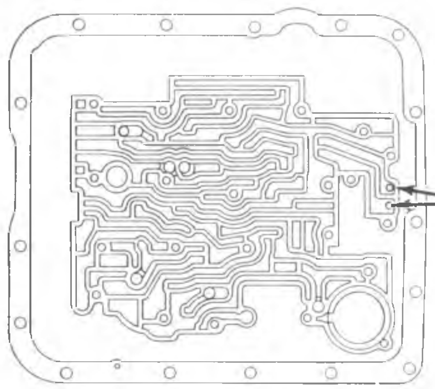
2. Parking pawl shaft plug (713) with a #4 screw extractor
3. Parking pawl pivot shaft (712) with a magnet
4. Parking pawl (711) and return spring (714)
5. Install tool J 23327.
6. Lo and reverse clutch retainer ring (693) with J 34627
7. Lo and reverse clutch spring assembly (694)
8. Lo and reverse clutch piston (695)
   - Apply air prèssure 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

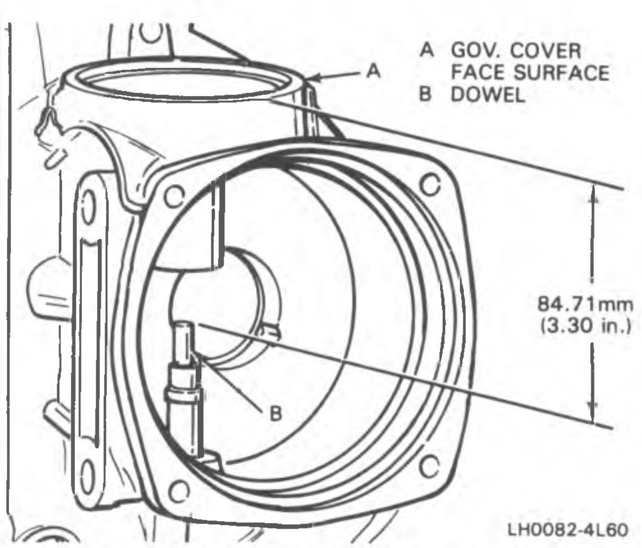
Figure 24 Lo and Reverse Snap Ring Removal



(A) APPLY AIR PRESSURE HERE TO REMOVE LO & REVERSE PISTON FROM THE CASE

LH0081-4L60

Figure 25 Lo and Reverse Piston Removal



A GOV. COVER FACE SURFACE
B DOWEL

LH0082-4L60

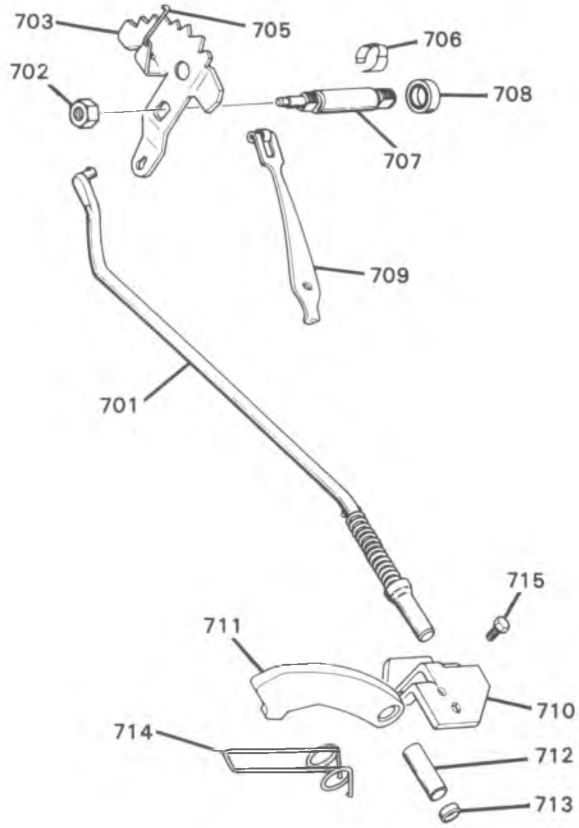
Figure 26 Governor Bore Pin Location

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)



701 ACTUATOR ASSEMBLY, PARKING LOCK
702 NUT, HEX HEAD
703 LEVER, INSIDE DETENT
705 LINK, MANUAL VALVE
706 RETAINER, MANUAL SHAFT
707 SHAFT, MANUAL
708 SEAL, MANUAL SHAFT
709 MANUAL DETENT ROLLER & SPRING ASM.
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

LH0083-4L60

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.

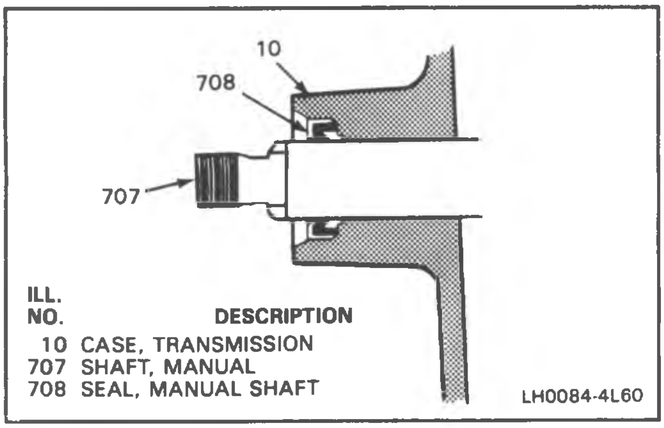


Figure 28 Manual Shaft Seal

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.

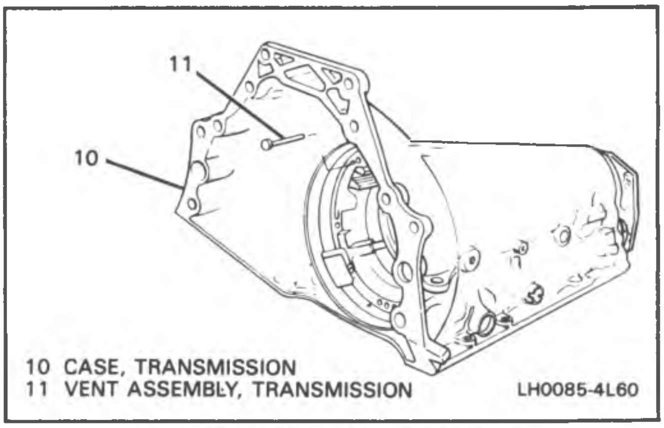


Figure 29 Case Vent Assembly

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.)

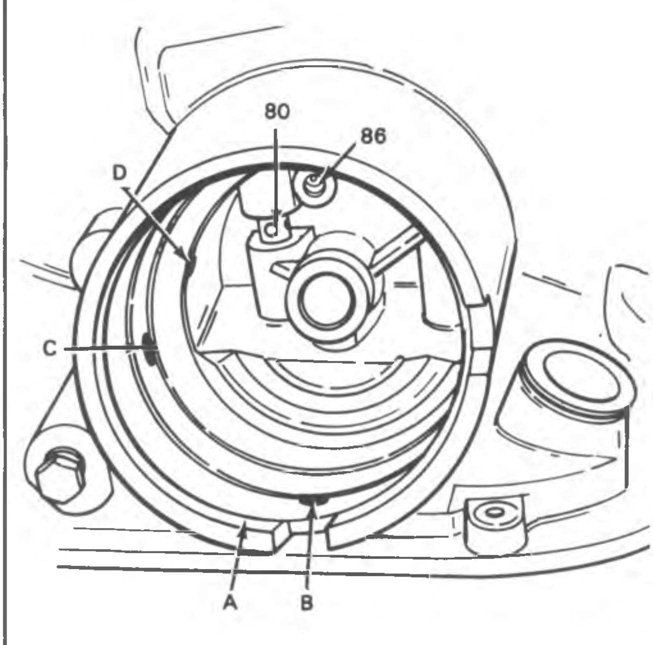


Figure 30 2-4 Servo Bore

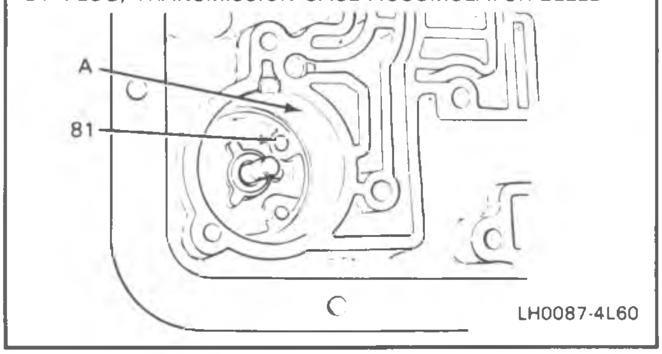


Figure 31 Third Accumulator Bore

Third Accumulator Retainer and Ball Assembly

Figure 32

Inspect

- Ball for:
  - Presence
  - Sticking or leaking
- Retainer for:
  - Presence
  - Loose
  - Incorrect seating
  - Restricted feed slots

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

Tools Required:

6.3 mm (#4) Screw Extractor
9.5 mm (3/8 in.) diameter metal rod

Remove or Disconnect

- Third accumulator retainer and ball assembly (80)
  - Use 6.3 mm (#4) screw extractor.

Install or Connect

Figures 32 and 33

- 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.

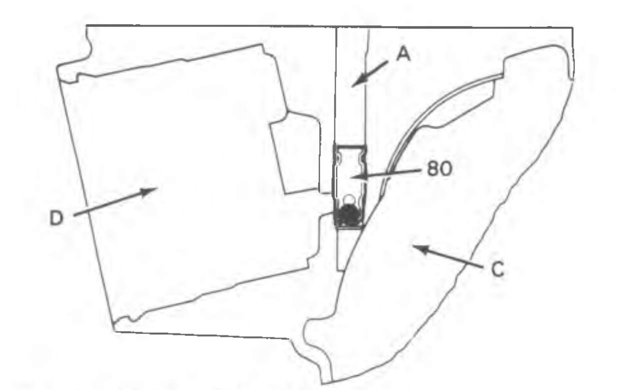


Figure 32 Leak Check — 3rd Accumulator

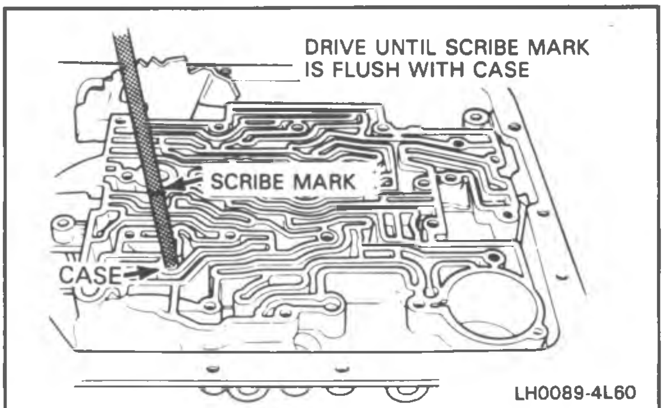


Figure 33 Third Accumulator Retainer and Ball Asm.— Installation

Lo and Reverse Clutch Piston

Figures 34 and 35

Tools Required:

J 34627 Snap Ring Remover/Installer
J 23327 Clutch Spring Compressor

Inspect

Figure 34

- 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

1. Piston seals (696) onto the piston (695)
   - Lubricate with TRANSJEL™ J 36850 or equivalent.
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

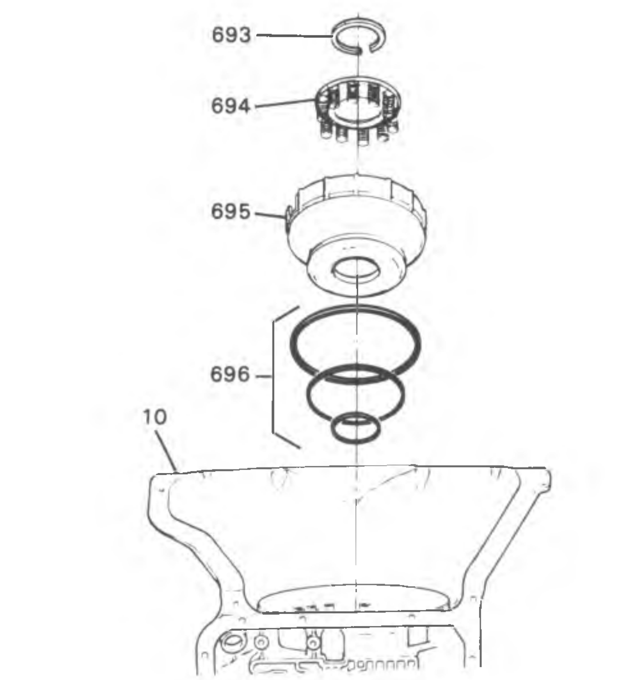
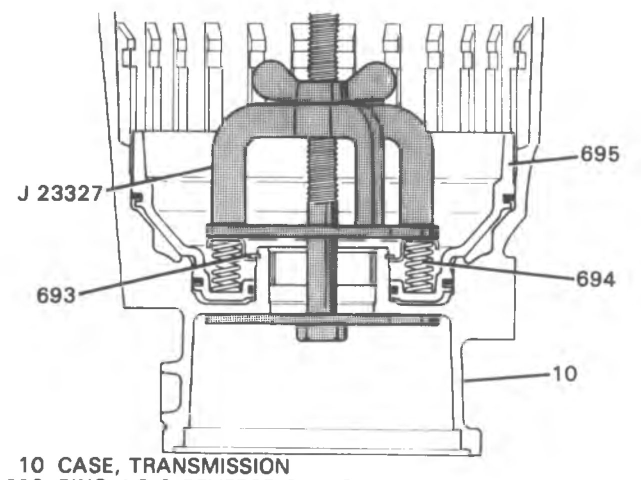


Figure 34 Lo and Reverse Piston



10 CASE, TRANSMISSION
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
LH0080-4L60

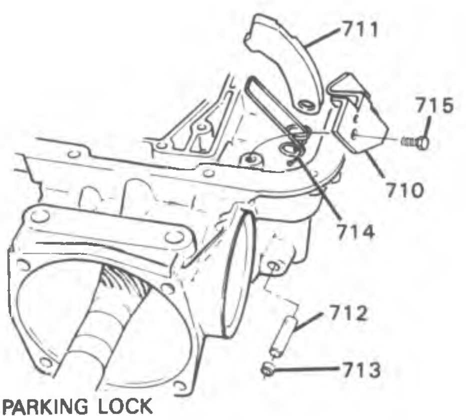
Figure 35 Installing Lo and Reverse Snap Ring

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



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

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.

Reaction Internal Gear and Carrier Assembly

Figures 37, 38 and 39

Inspect

- 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.

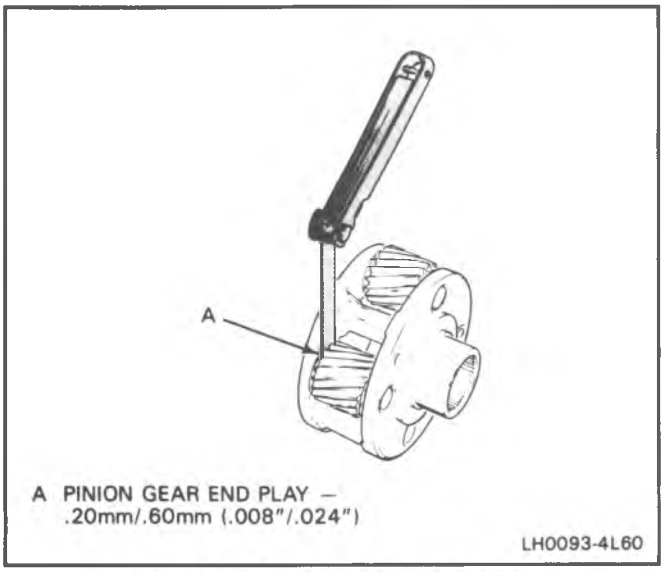


Figure 37 Pinion End Play Check

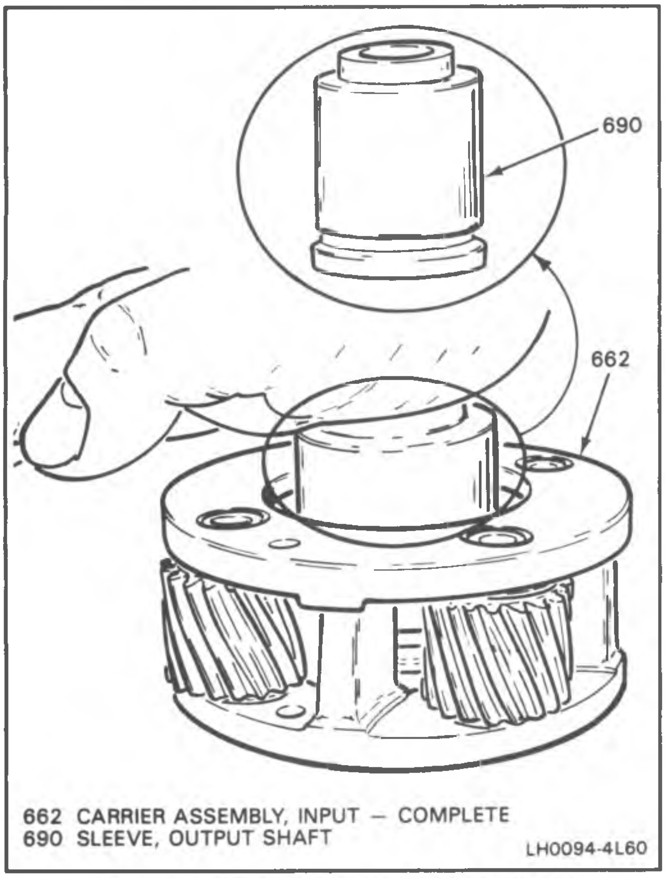


Figure 38 Captive Thrust Bearing Check

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

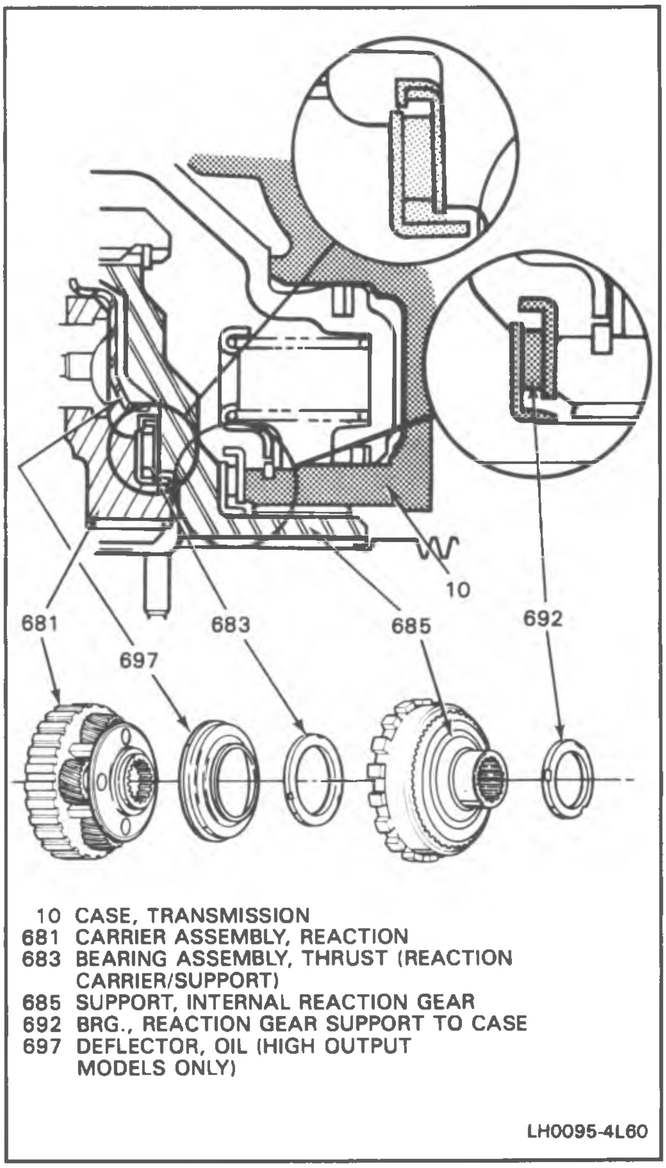


Figure 39 Reaction Internal Gear and Carrier Bearing Locations

Lo and Reverse Clutch Spacer Plate Selection

Figures 40 through 43

Tools Required:

Scale

Straight edge

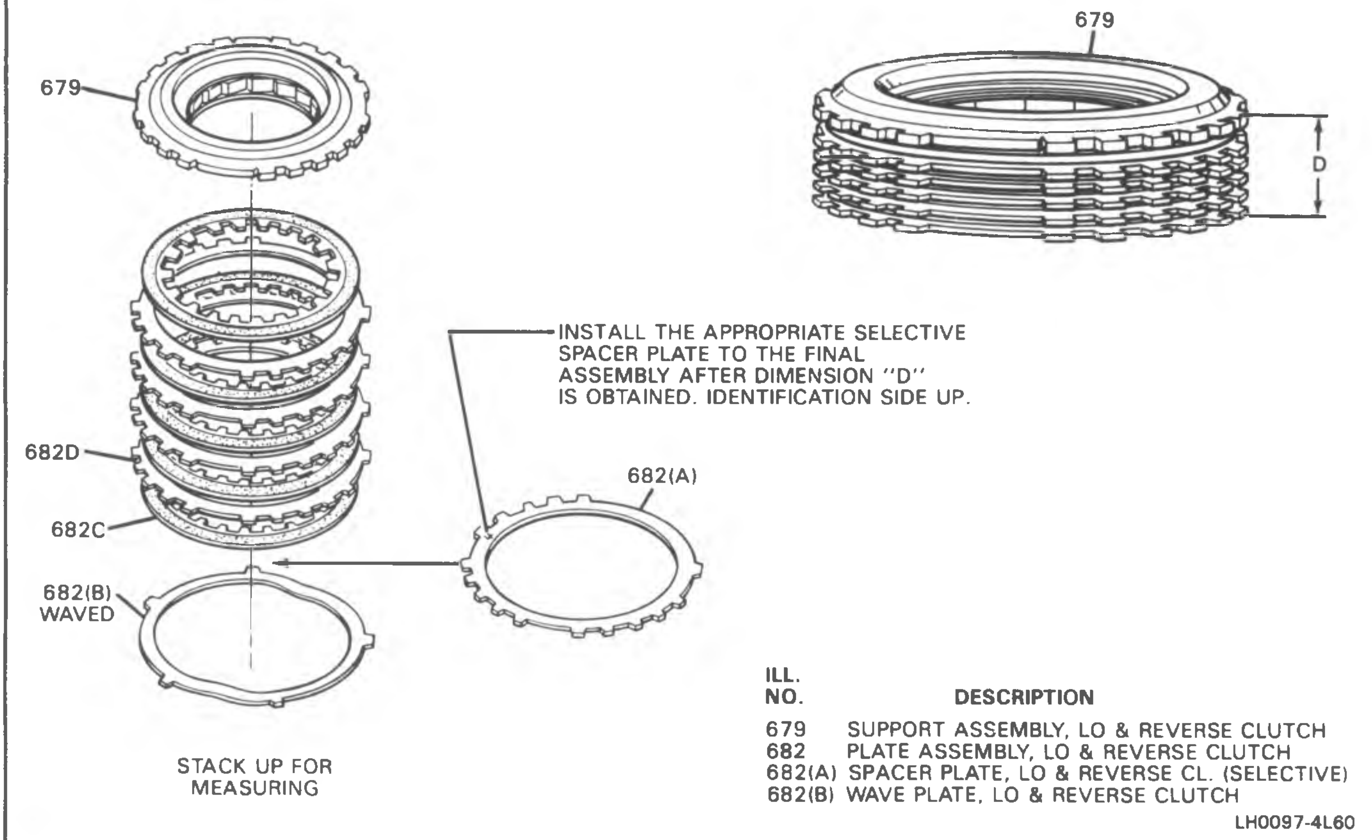


Figure 40 Measuring For Spacer Plate Selection

Measure

Figures 40, 41 and 42

1. To measure for proper selective spacer plate, stack the lo and reverse assembly on a flat surface in the following order:
   - One waved plate (682B)
   - Five composition and four 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.

   NOTICE: 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").

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

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.

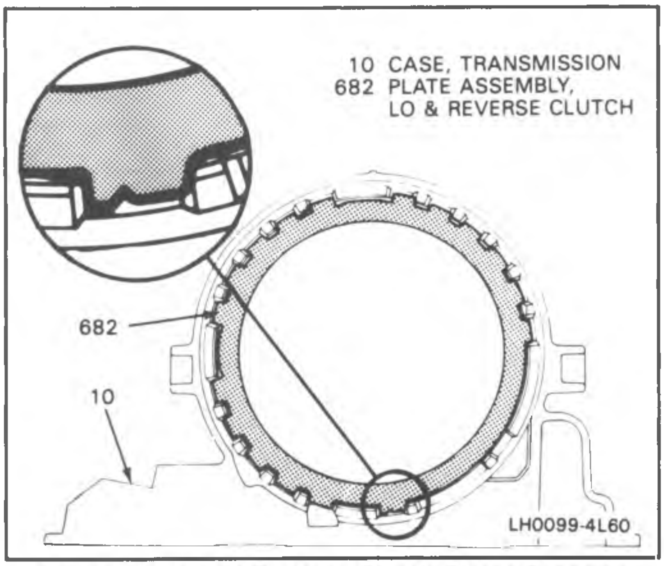
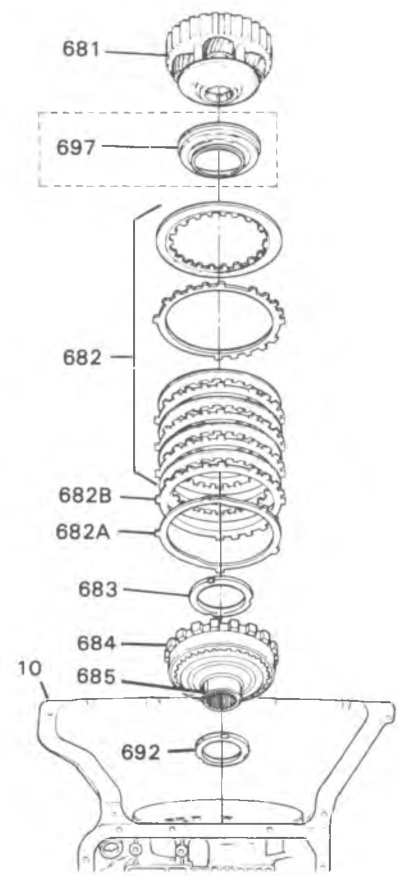


Figure 43 Lo and Reverse Clutch Plates Properly Installed



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

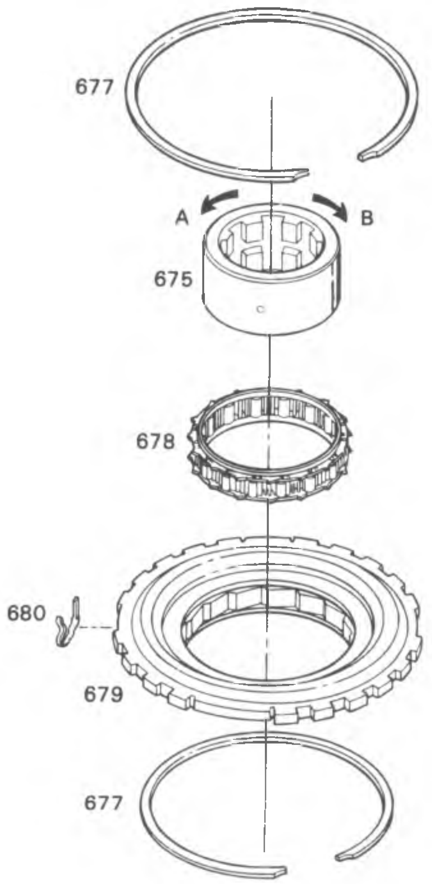
Lo and Reverse Clutch Support Assembly

Figures 45, 46 and 47

Remove or Disconnect

Figure 45

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

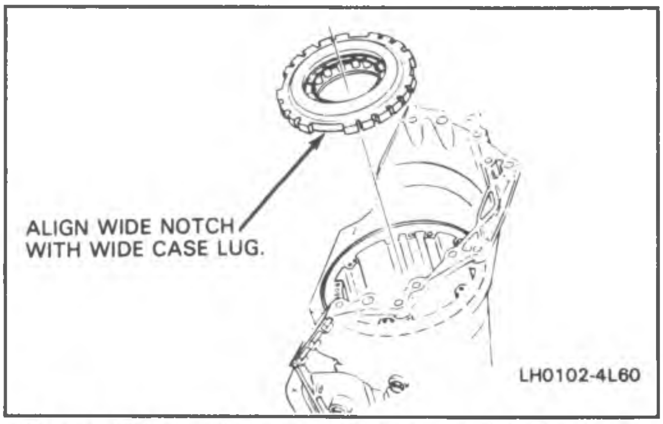
Figure 45

- 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

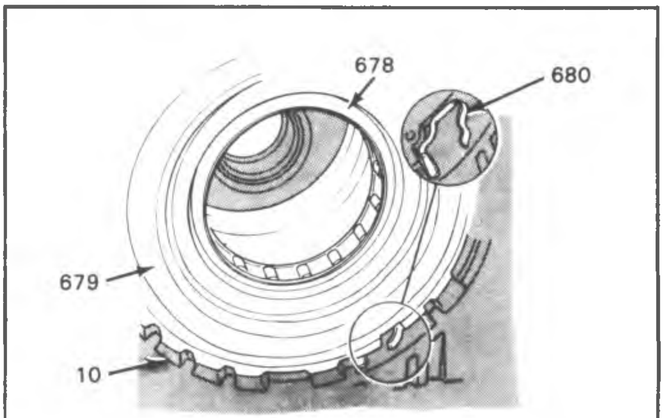
Figures 45, 46 and 47

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

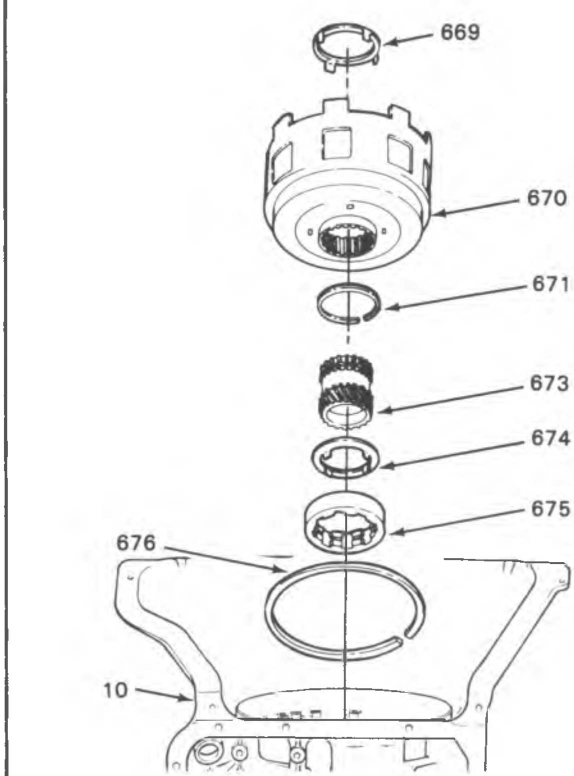
Inspect

- 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.



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

Input Internal Gear and Reaction Shaft

Figures 49 and 50

Remove or Disconnect

Figure 49

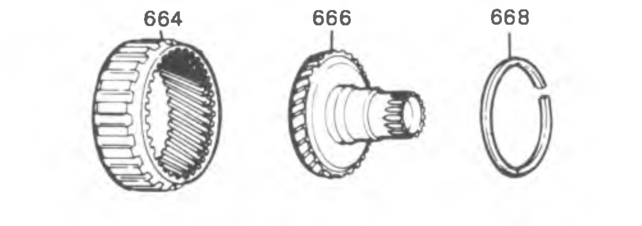
1. Retainer ring (668) from input internal gear (664)
2. Reaction carrier shaft (666) from the input internal gear

Inspect

Figures 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

Figure 50

Tools Required:

J 21427-01 Speedometer Gear Puller Adapter
J 8433 Speedometer Gear Puller
J 36352-6 "C" Washer
J 36352-4 Rotor Installer
Mechanical press

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

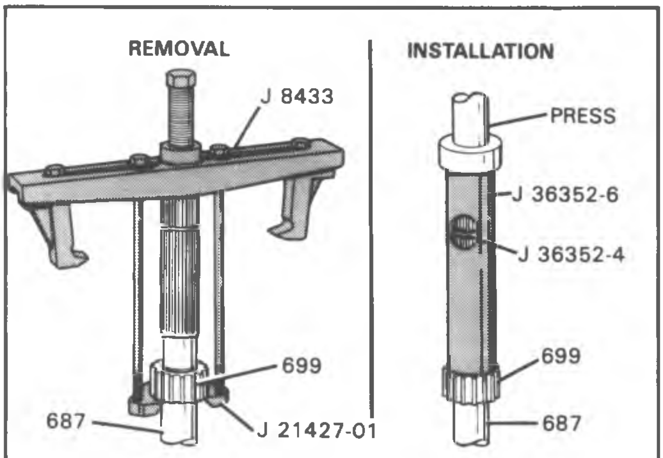
Figure 50

- Install J 21427 with J 8433 and remove rotor.

Install or Connect

Figure 50

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

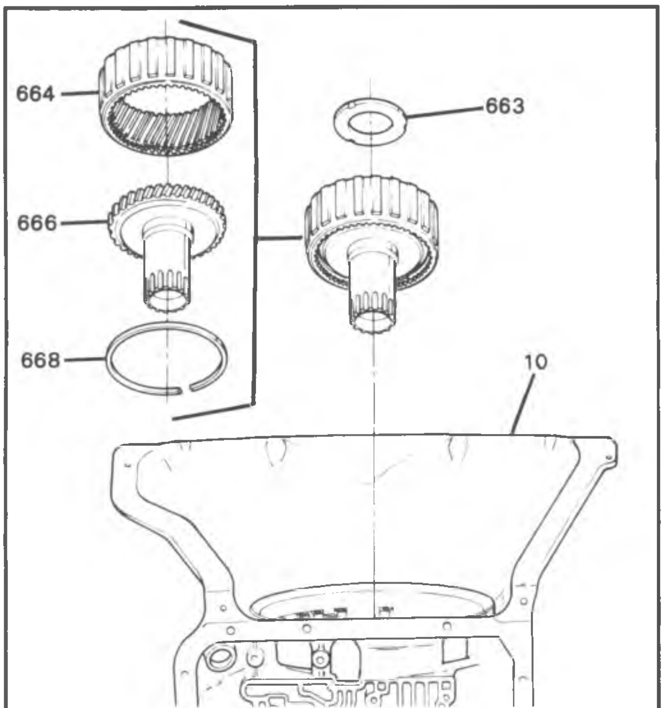
Figures 51 and 52

Tool Required:

J 29837 Output Shaft Support Fixture

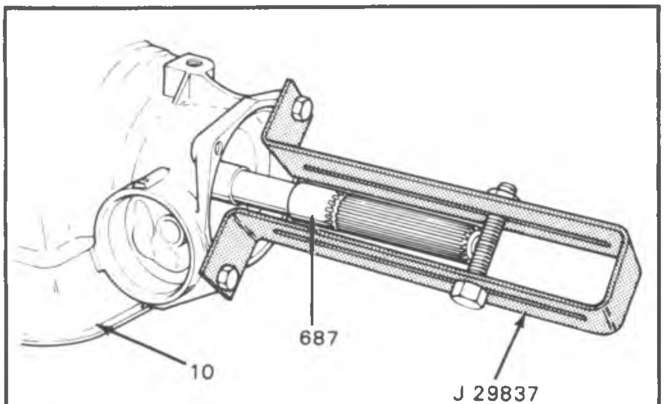
Install or Connect

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

Tool Required:

J 34627 Snap Ring Pliers

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

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

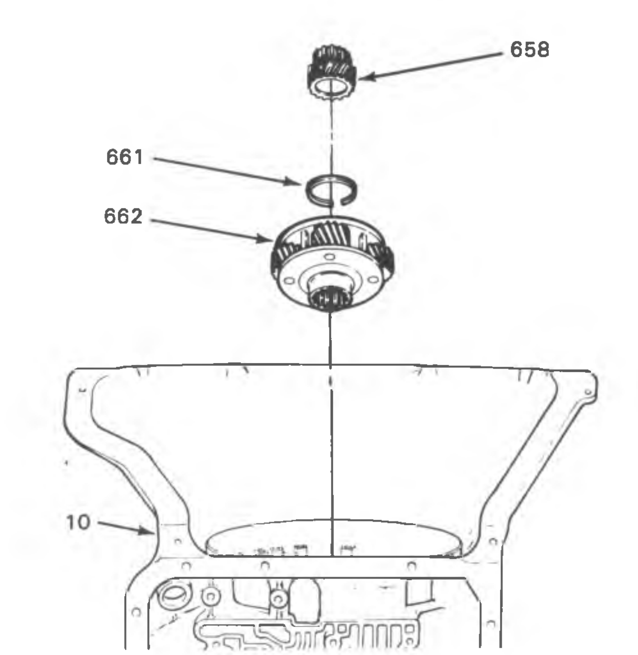


Figure 53 Input Carrier and Sun Gear — Installation

Input Clutch Assembly

Figures 54 through 58

Tools Required:

J 23456 Clutch Spring Compressor Press
J 23327-1 Clutch Spring Compressor
J 25018-A Clutch Spring Compressor Adaptor

Remove or Disconnect

Figures 54 and 56

- 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.

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)

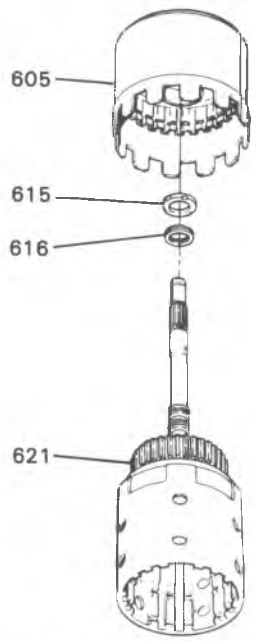


Figure 54 Reverse Input and Input Clutches

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)

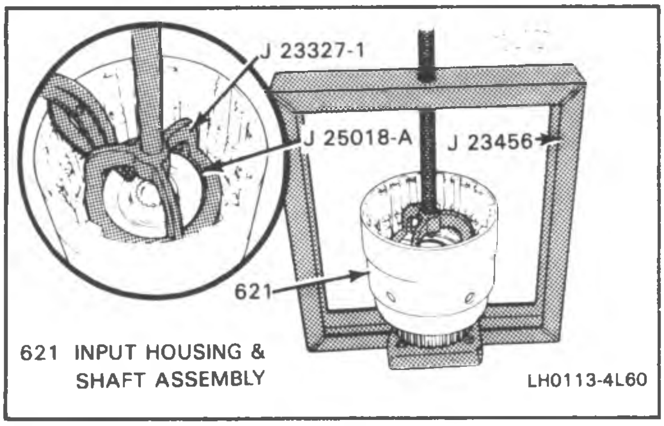


Figure 55 Overrun Clutch Retainer Ring — Removal

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

Figures 56 through 67

Tools Required:

6.3 mm (#4) Screw extractor
9.5 mm (3/8 in.) diameter metal rod
6.35 mm (1/4 in.) diameter rod or drift hammer
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

Remove or Disconnect

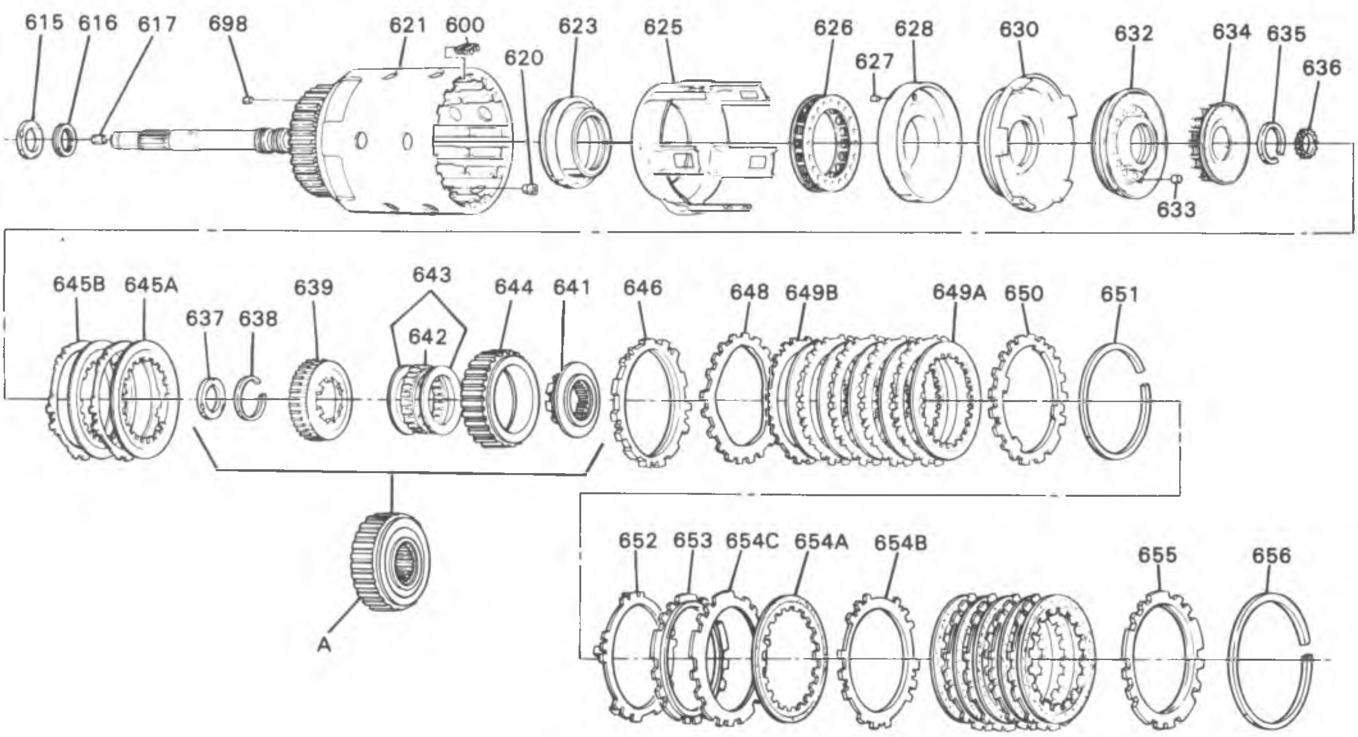
Figure 58

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

- 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.

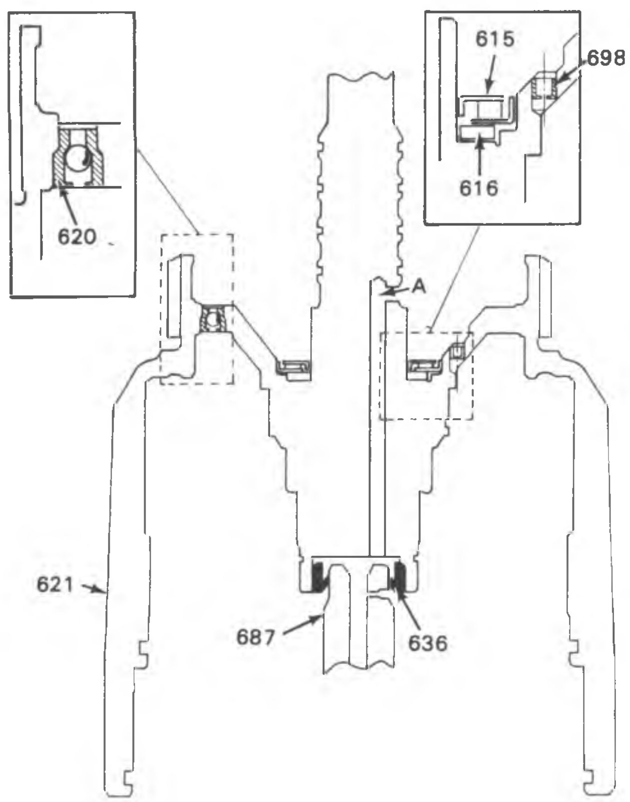


ILL. NO.	DESCRIPTION
600	SPRING ASM., 3-4 CLUTCH BOOST (5)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASSEMBLY, CHECK VALVE
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 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

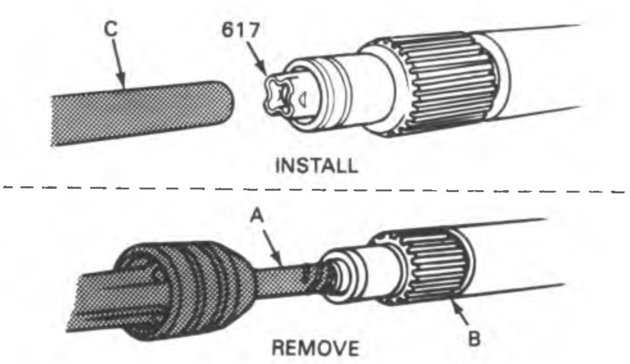
Figure 56 Input Clutch Assembly



A LUBE PASSAGE
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
687 SHAFT, OUTPUT
698 PLUG, ORIFICED CUP

LH0115-4L60

Figure 57 Input Housing Check Valve Ball



A #4 EASY OUT
B TURBINE SHAFT
C 9.5mm (3/8") METAL ROD
617 CHECK VALVE RETAINER & BALL ASSEMBLY

LH0116-4L60

Figure 58 Retainer and Ball Assembly — Replacement

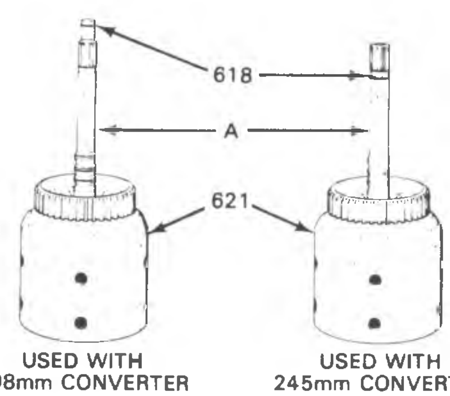
Inspect

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).



A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT

LH0117-4L60

Figure 59 Views of the Input Housing

Remove or Disconnect

Figure 60

- 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.

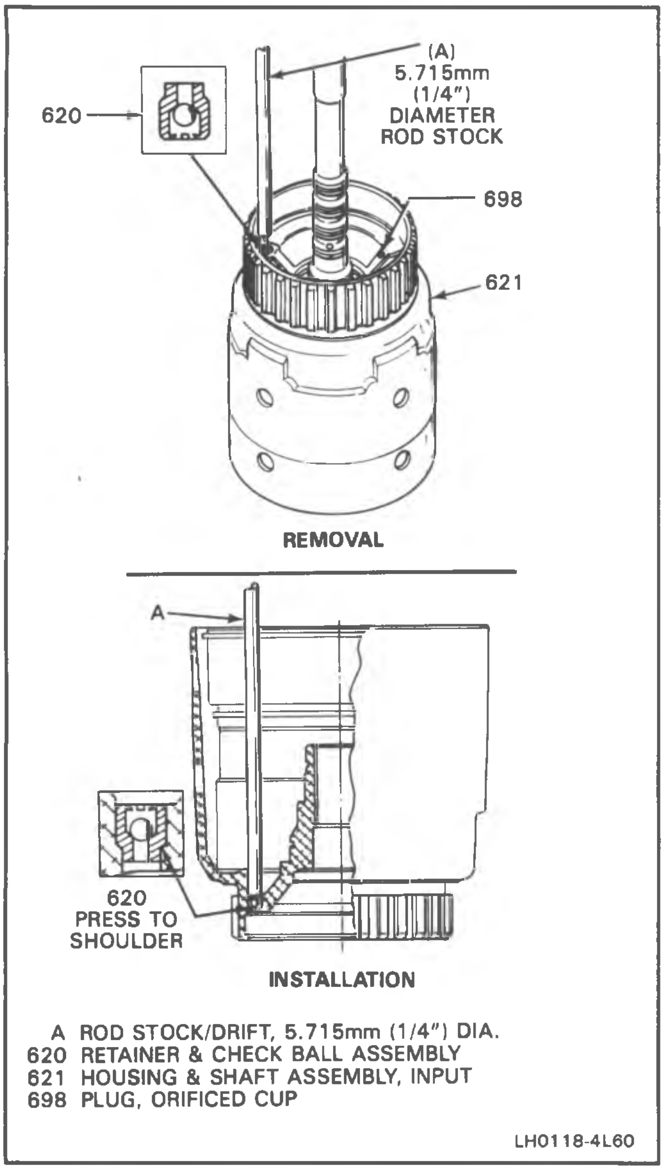


Figure 60 Retainer and Check Ball Removal/Installation

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 TRANSJEL™ J 36850 or equivalent.
2. The 3-4 clutch piston (623) into the input housing as shown
   - Use care not to damage the seals.

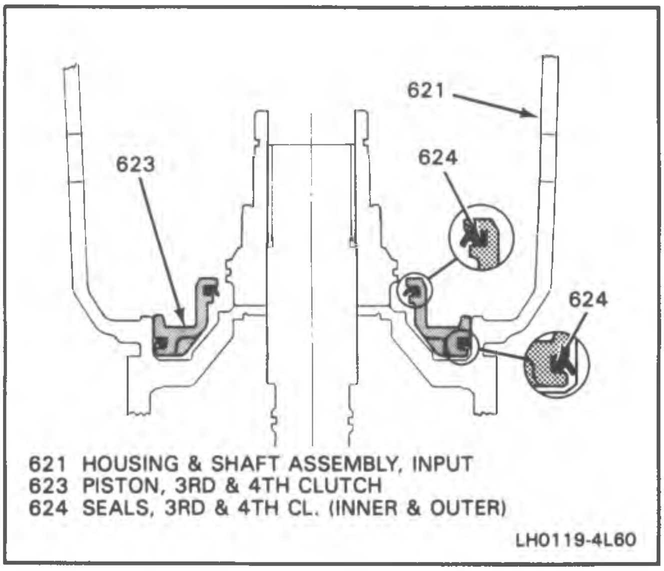


Figure 61 Input Housing and 3-4 Piston

Inspect

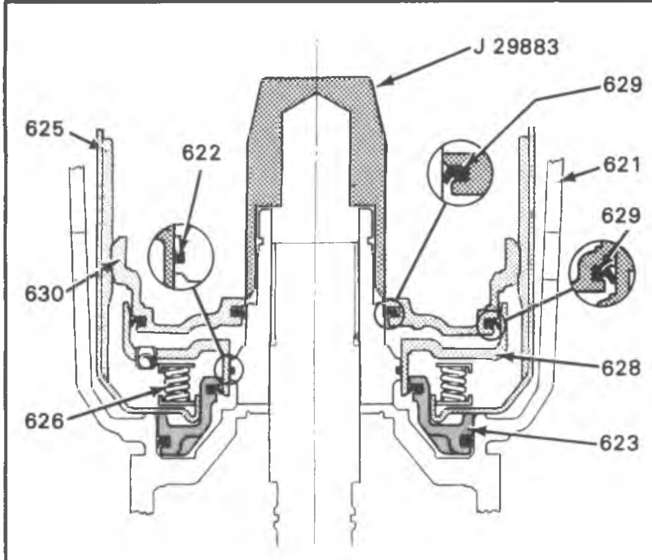
Figures 62 and 63

- 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

1. Forward clutch housing to input clutch housing O-ring seal (622) as shown
   - Lubricate with TRANSJEL™ J 36850 or equivalent.

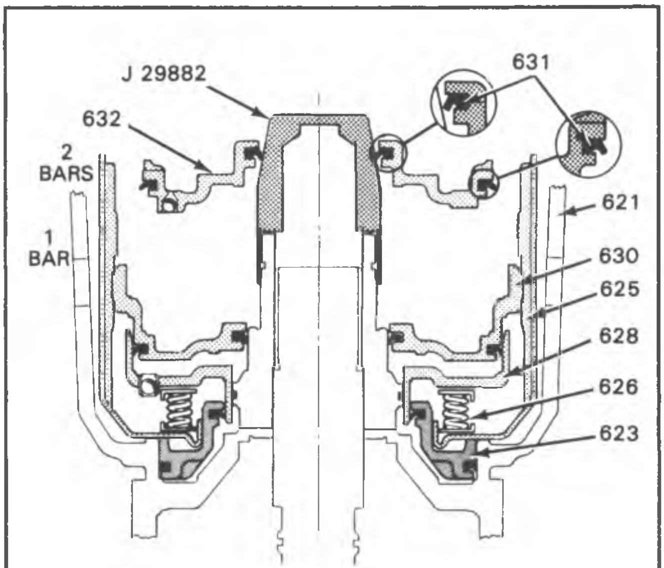


621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, "O" RING INPUT TO FORWARD HSG.
623 PISTON, 3RD & 4TH CLUTCH
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEALS, FORWARD CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH

LH0120-4L60

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™ J 36850 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.



621 HOUSING & SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD & 4TH CLUTCH
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER & OUTER)
632 PISTON, OVERRUN CLUTCH

LH0121-4L60

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

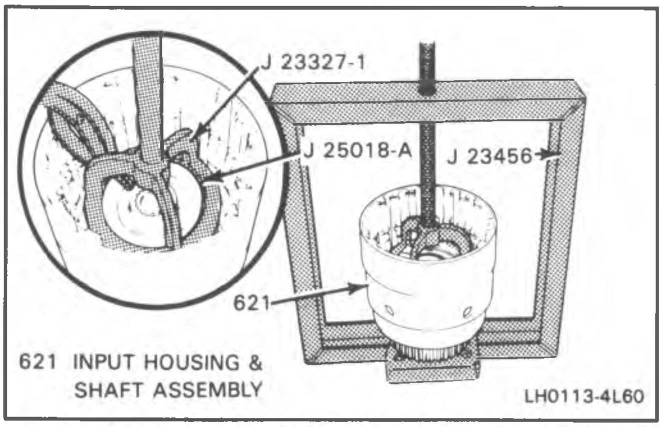
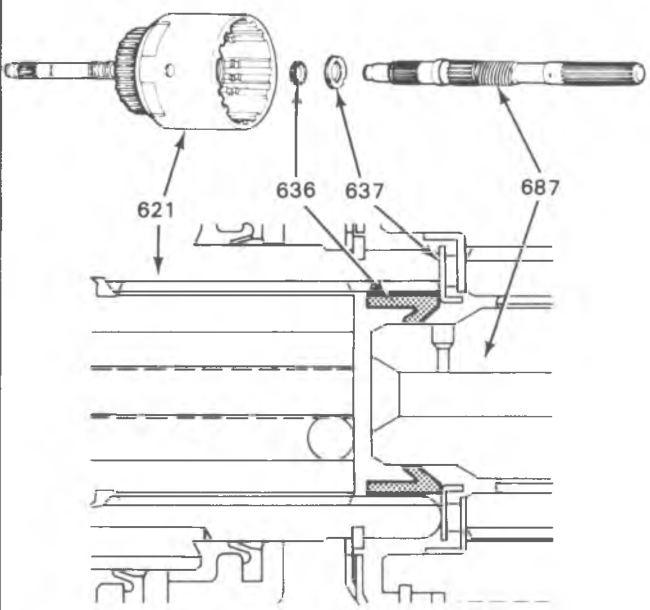


Figure 64 Overrun Clutch Retaining Ring — Installed



621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
687 SHAFT, OUTPUT

LH0123-4L60

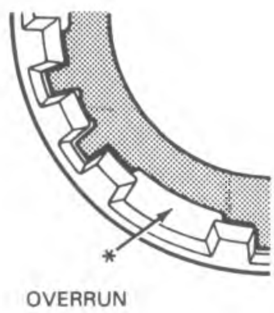
Figure 65 Input Hsg. to Output Shaft Lip Seal

- Input sun gear bearing assembly (637) for:
  - Wear
  - Flatness
  - Damaged

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

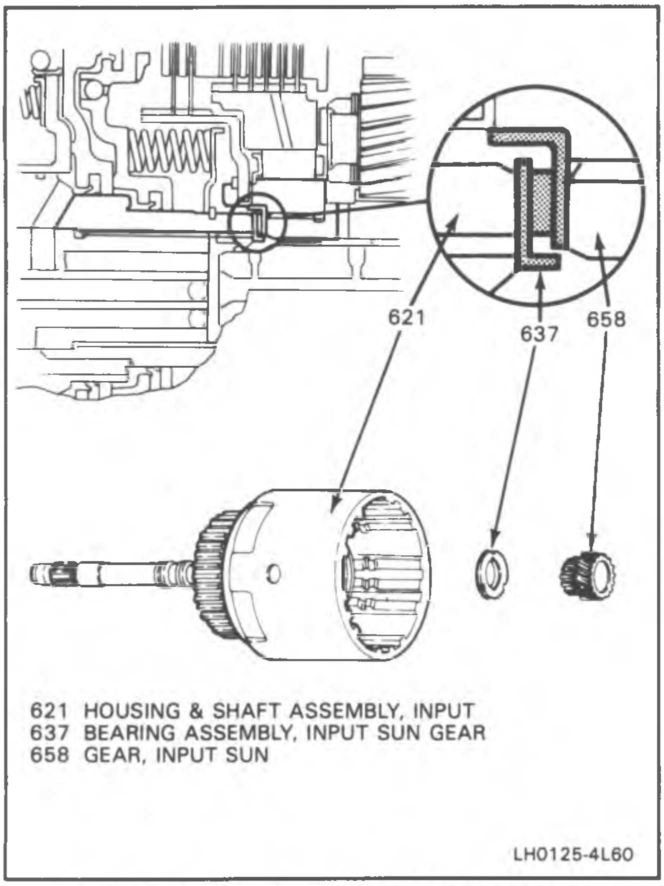


Figure 67 Input Sun Gear Thrust Bearing

Forward Clutch Sprag Assembly

Figures 68 through 75

Disassemble

Figure 68

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

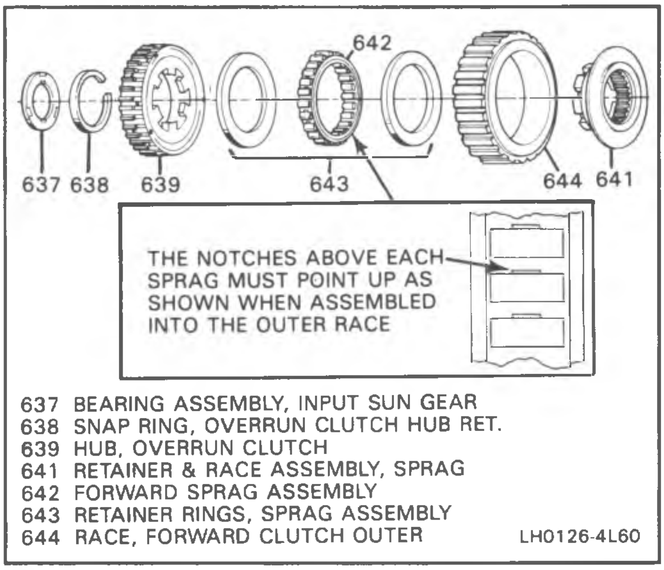


Figure 68 Forward Clutch Sprag Assembly

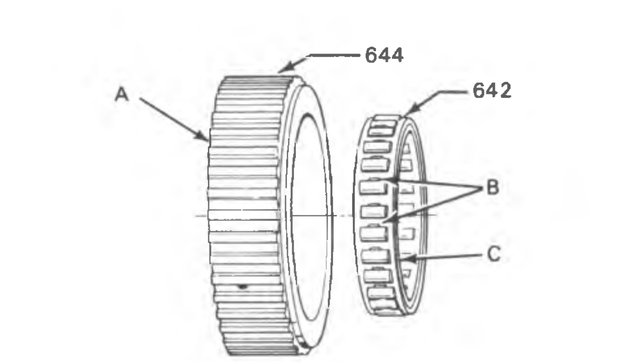
Assemble

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

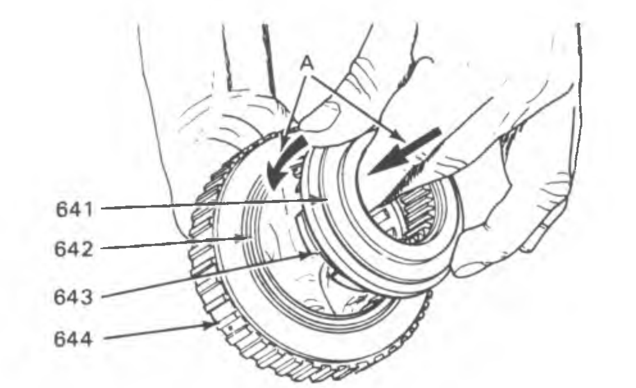
- If the assembly operates backwards, you have installed the sprag backwards. Reassemble correctly.



A RECESSED FACE
B NOTCHES POINT UPWARD AS SHOWN
C LIPPED EDGE
642 FORWARD SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)

LH0127-4L60

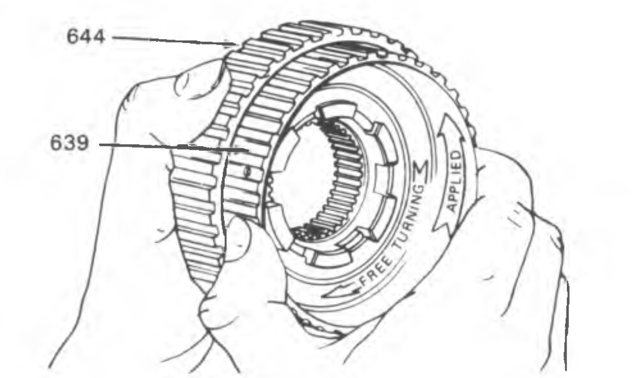
Figure 69 Sprag Assembly Procedure



A PUSH IN AND TURN COUNTERCLOCKWISE TO INSTALL
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)

LH0128-4L60

Figure 70 Sprag Race and Retainer Assembly Procedure



THE OVERRUN CLUTCH HUB MUST TURN CLOCKWISE, BUT NOT COUNTERCLOCKWISE

639 HUB, OVERRUN CLUTCH
644 RACE, FORWARD CLUTCH (OUTER)

LH0129-4L60

Figure 71 Sprag Operation Check

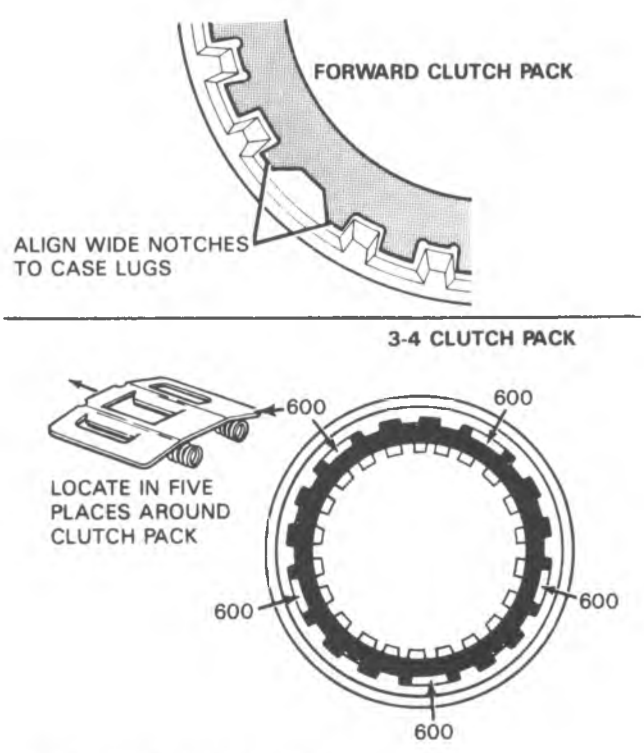
Assemble

- Forward clutch sprag assembly into the input clutch housing
  - Index the overrun clutch hub into the overrun clutch plates.

Inspect

Figures 72 and 73

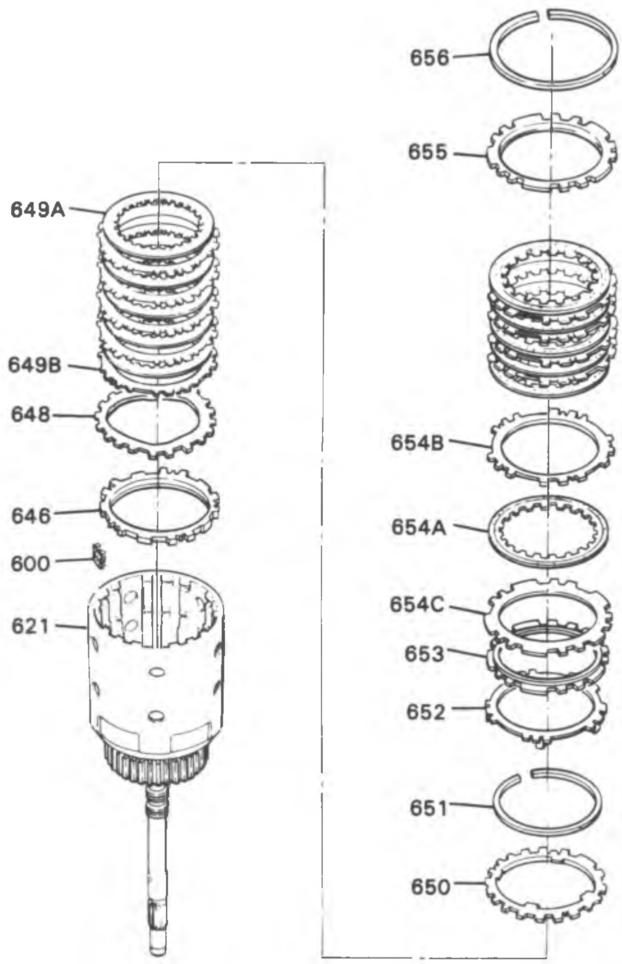
- Forward (649) and 3-4 clutch plates (654) for:
  - Composition plate damaged tangs, delamination, or wear
  - Steel plate damaged tangs, wear, or heat damage
- Forward (650) and 3-4 clutch backing plates (655) for:
  - Flatness
  - Surface finish damage
  - Burrs or nicks
- Forward clutch apply plate (646) and spacer plate (647) for:
  - Flatness
  - Surface finish damage
  - Burrs or nicks



600 SPRING ASM., BOOST 3-4 CLUTCH

LH0130-4L60

Figure 72 Forward and 3-4 Clutch Plates — Installed



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

- The 3-4 clutch apply plate (653) for:
  - Flatness
  - Surface finish damage
- The 3-4 clutch ring retainer plate (652) for:
  - Bent tangs
  - Flatness

Assemble

Figures 72 through 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.

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

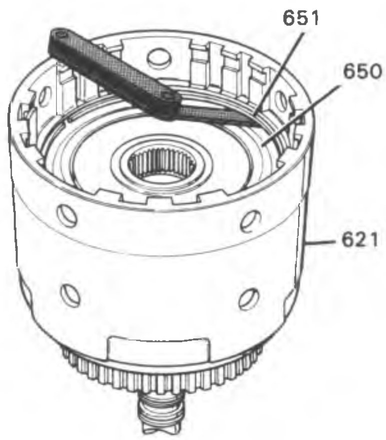
Figure 74 Forward Clutch Plate Chart

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 Assembly

Figures 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)

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

5. The 3-4 clutch backing plate (655) and retainer ring (656)
   - Chamfered side up

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.

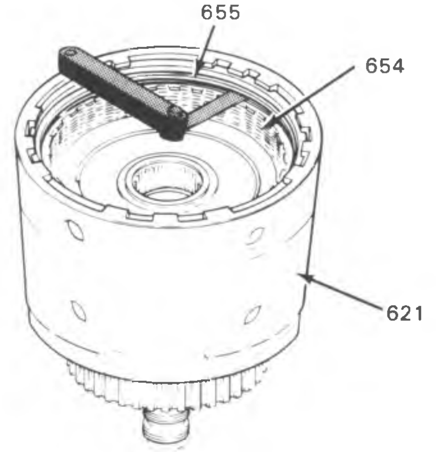
Clutch Air Check

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.)

3-4 BACKING PLATE SELECTION

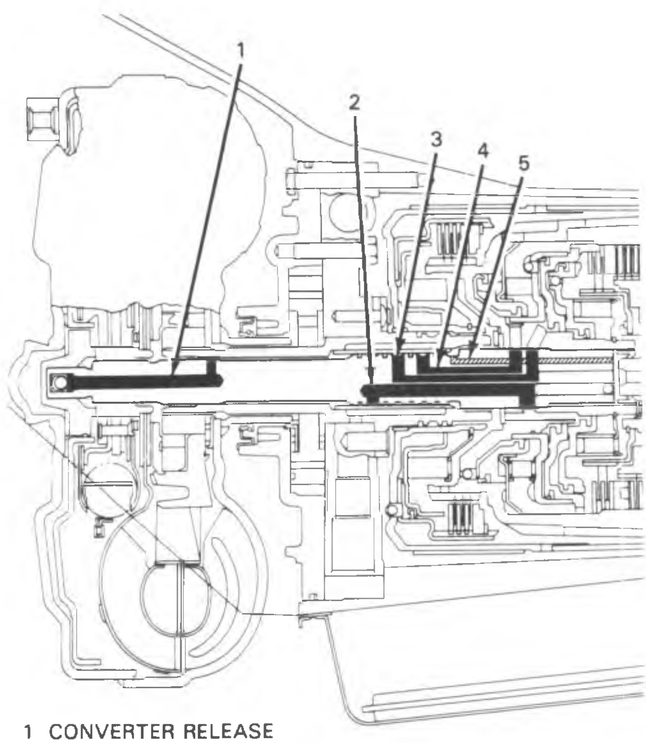
MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM.	I.D.
FBM, MBM, SAM	2.42mm - 1.61mm (.095" - .063")	6.58mm-6.38mm (.259"-.251")	5
		5.75mm-5.55mm (.226"-.218")	6
ALL OTHERS	2.40mm - 1.52mm (.094" - .060")	4.92mm-4.72mm (.194"-.186")	7
		4.09mm-3.89mm (.161"-.153")	8



621 HOUSING & SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING

LH0135-4L60

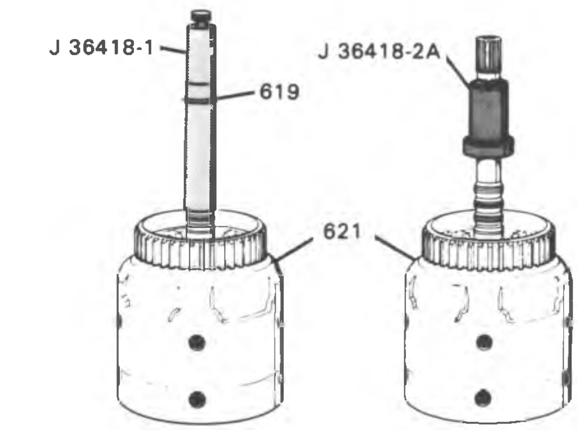
Figure 77 3-4 Backing Plate Selection Chart



1 CONVERTER RELEASE
2 OVERRUN CLUTCH
3 FORWARD CLUTCH
4 3-4 CLUTCH
5 LUBE

LH0136-4L60

Figure 78 Turbine Shaft Fluid Passages



619 RING, OIL SEAL (TURBINE SHAFT)
621 HOUSING & SHAFT ASSEMBLY, INPUT

LH0137-4L60

Figure 79 Turbine Shaft Oil Seal Rings

Turbine Shaft Seals

Figure 79

Tools Required:

J 36418-1 Seal Installer
J 36418-2A Seal Sizer

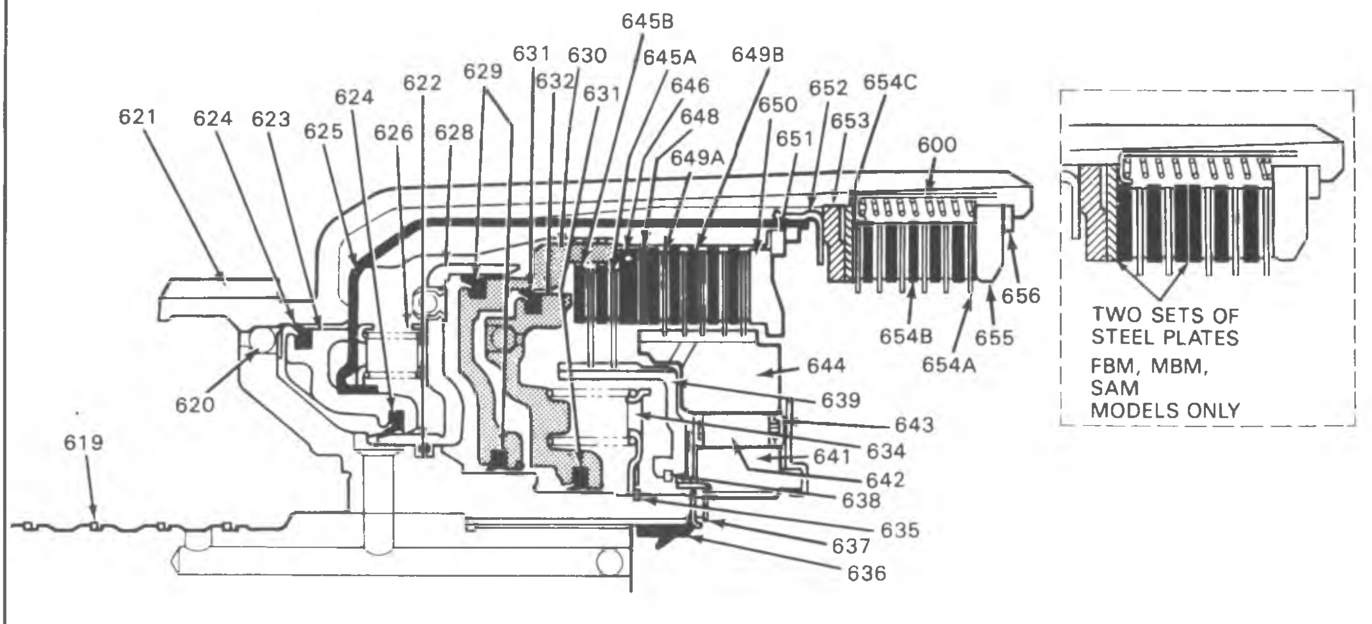
Assemble

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.



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

Reverse Input Clutch Assembly

Figures 81 through 86

Tools Required:

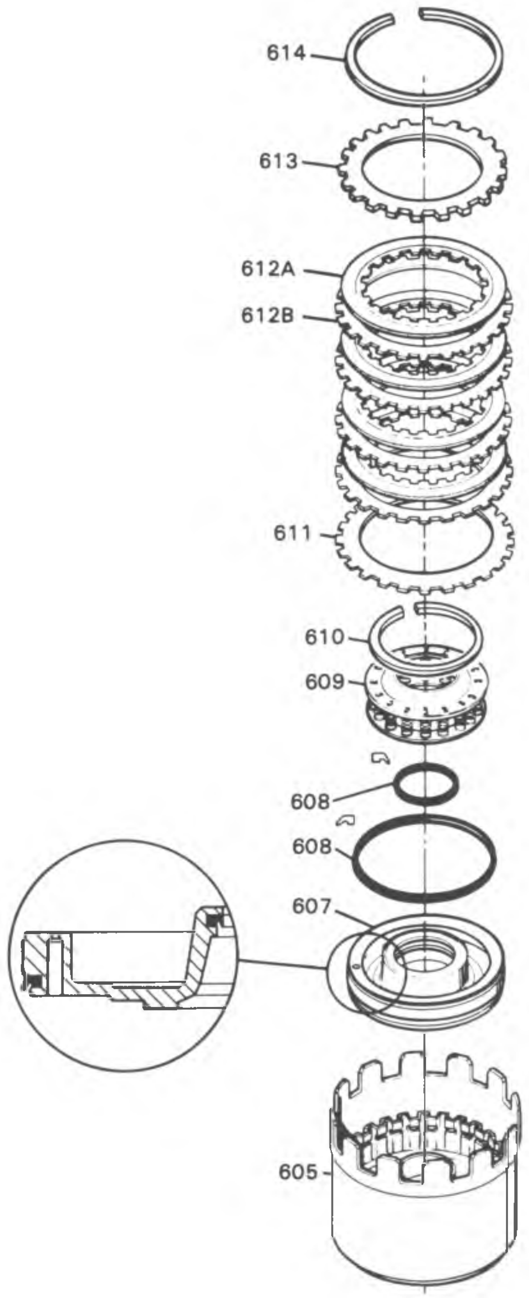
J 23327-1 Clutch Spring Compressor

J 25018-A Clutch Spring Compressor Adaptor

Disassemble

Figures 81 and 82

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)



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

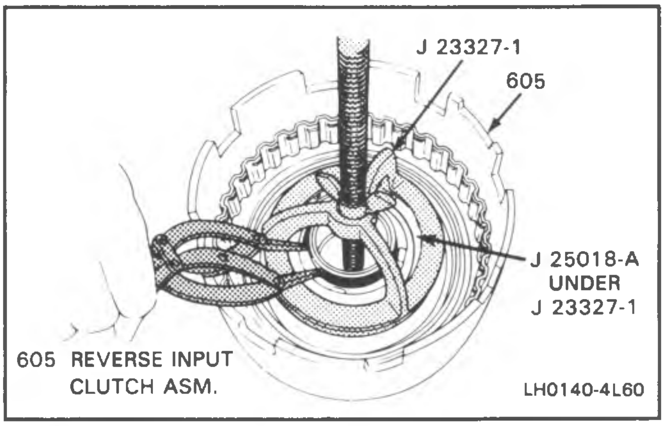
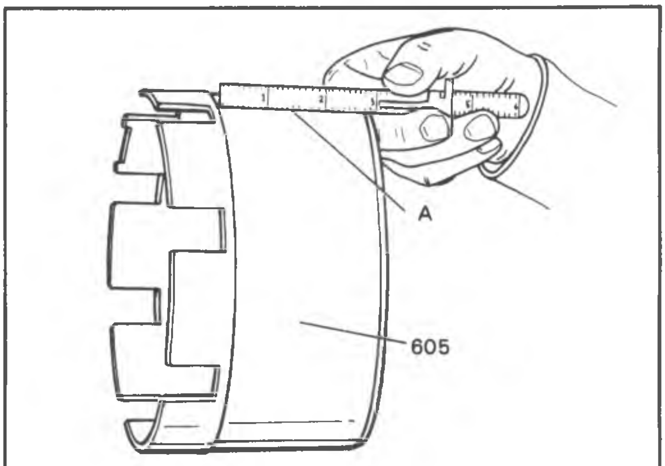


Figure 82 Reverse Input Retainer Ring — Removal

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

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.

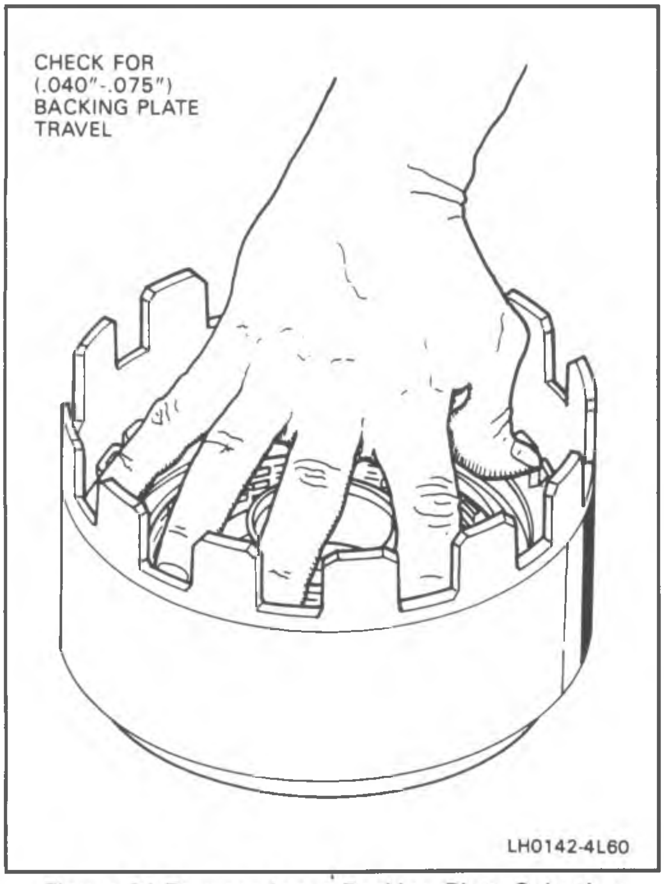


Figure 84 Reverse Input Backing Plate Selection

7. Backing plate (613)
   - Chamfered side up
8. Retaining ring (614)

Reverse Input Clutch Backing Plate Selection

Figures 84, 85 and 86

Measure

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.

NOTICE: 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.

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

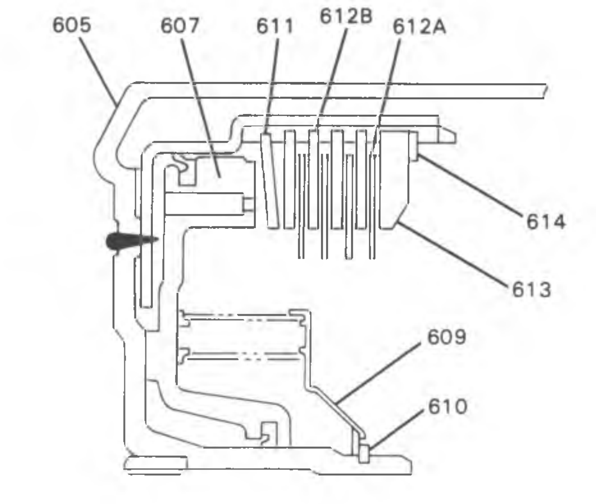
ALL MODELS

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

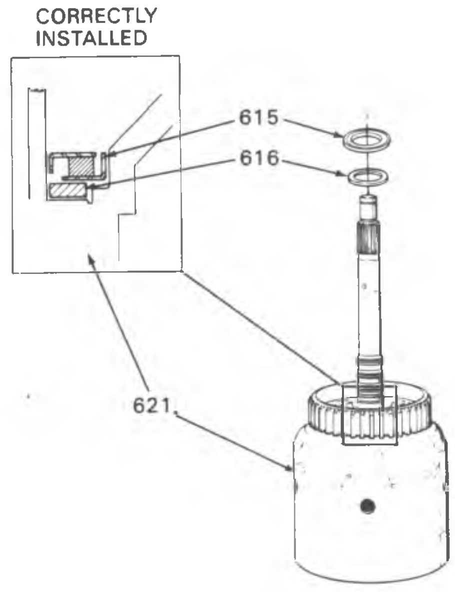
Figure 86 Reverse Input Backing Plate Selection Chart



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



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

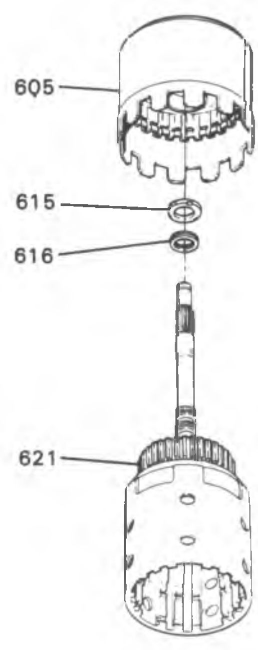
Reverse Input and Input Clutches

Figures 88, 89 and 90

Assemble

Figures 88 and 89

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.



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.

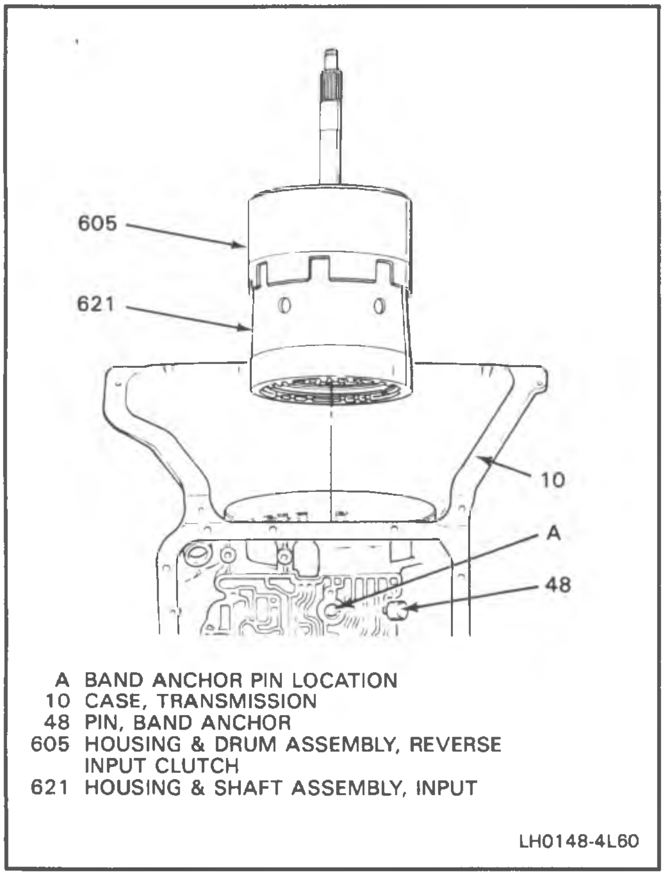


Figure 90 Installing Input Clutch

2-4 Band Assembly

Figures 90 and 91

Inspect

- 2-4 band assembly (602) for damage or wear

Assemble

Figures 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.

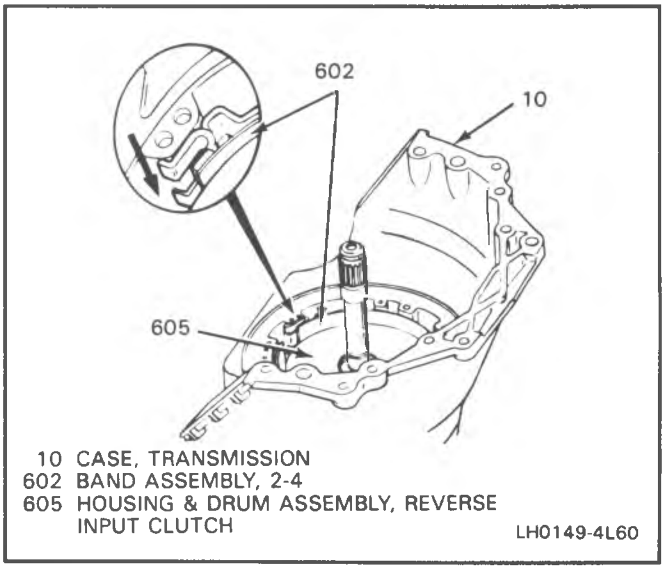


Figure 91 2-4 Band Assembly — Installed

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)

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.

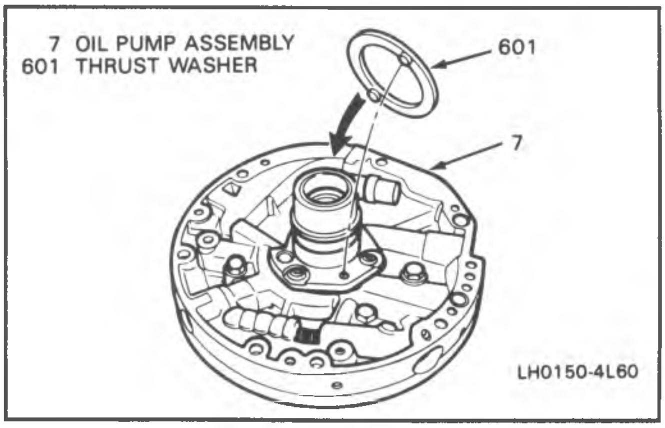


Figure 92 Oil Pump Thrust Washer Location

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

Figures 93, 94 and 97

Tool Required:

One inch micrometer

Disassemble

Figures 94 and 97

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

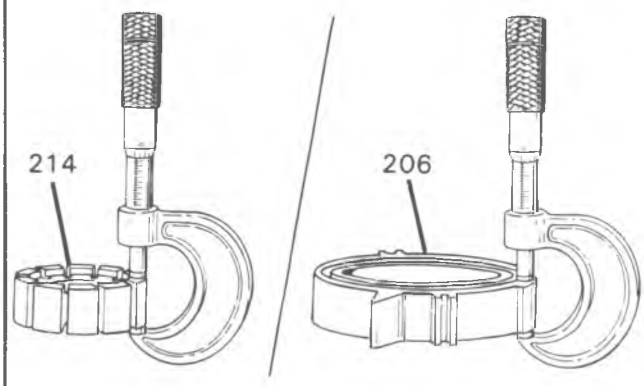
- Do not wipe dry with a cloth.

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

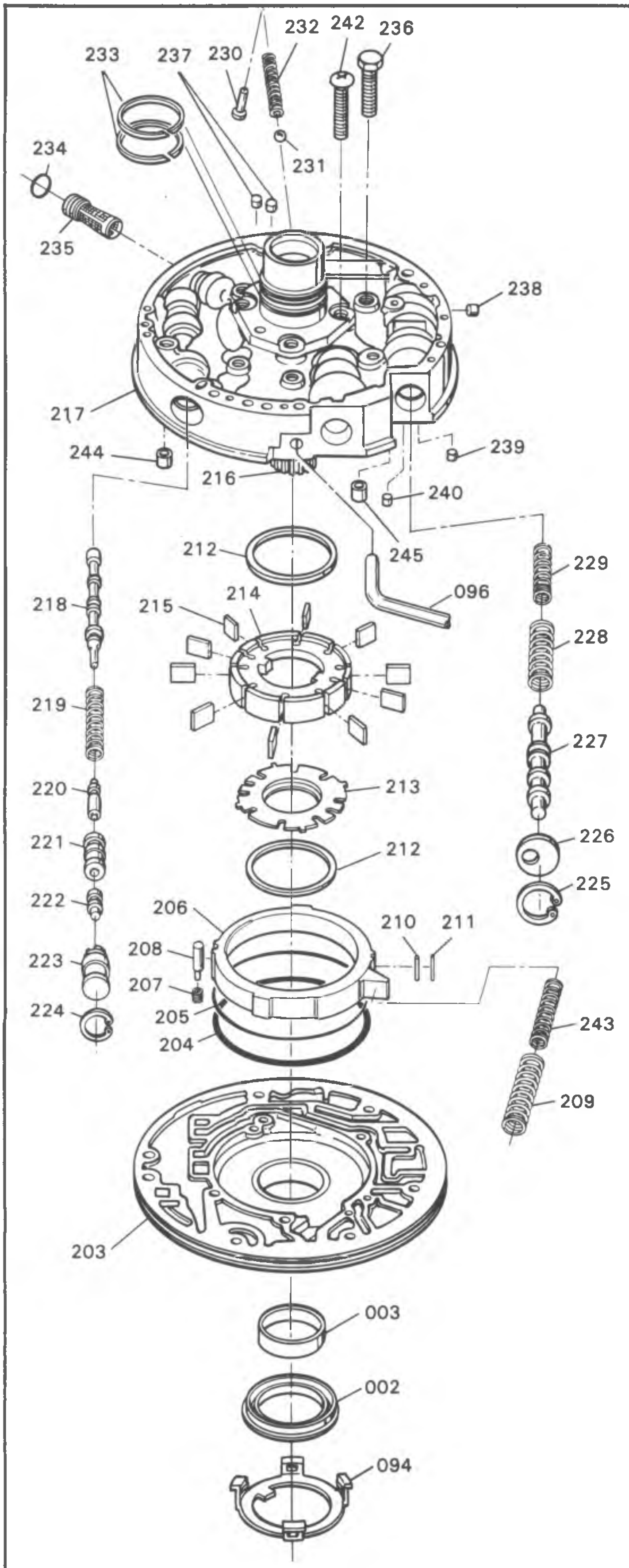
THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091



206 SLIDE, PUMP
214 ROTOR, OIL PUMP

LH0151-4L60

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

Measure

Figure 93

- 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

Figures 94, 95 and 96

Tool Required:

Assemble

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

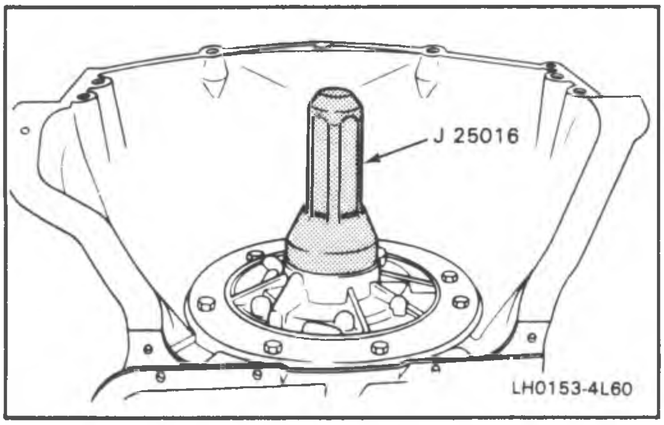
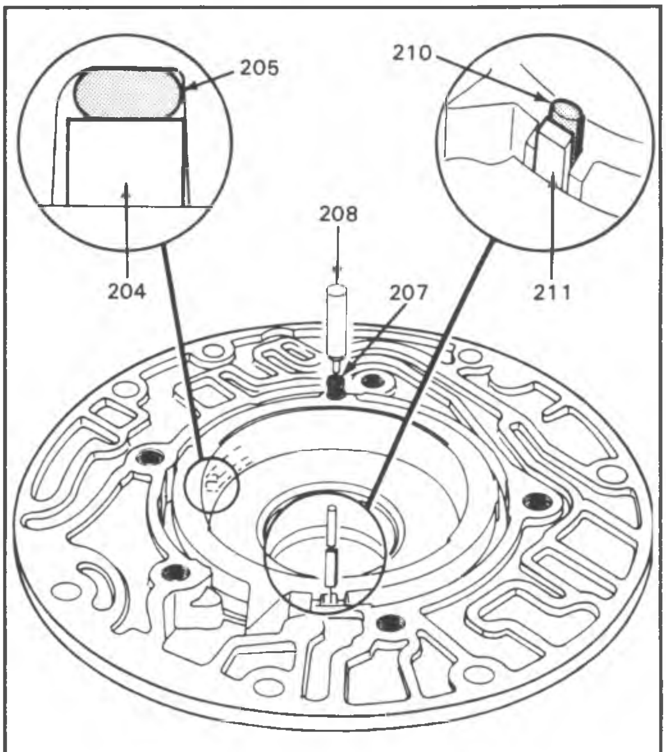


Figure 95 Oil Pump Seal

8. Vanes (215)
9. Vane guide ring (212)
10. Pump slide spring (209)
11. Oil seal assembly (2), retainer (94)
    - Use J 25016.



204 SLIDE BACK UP
205 SEAL AND RING
207 SPRING
208 PIVOT PIN
210 SUPPORT
211 SLIDE SEAL

LH0154-4L60

Figure 96 Slide Back Up and Slide Seal

Oil Pump Cover

Figure 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 and 98 through 101

Tools Required:

J 21368 Oil Pump Body and Cover Alignment Band
J 25025-1 Alignment Pins

Assemble

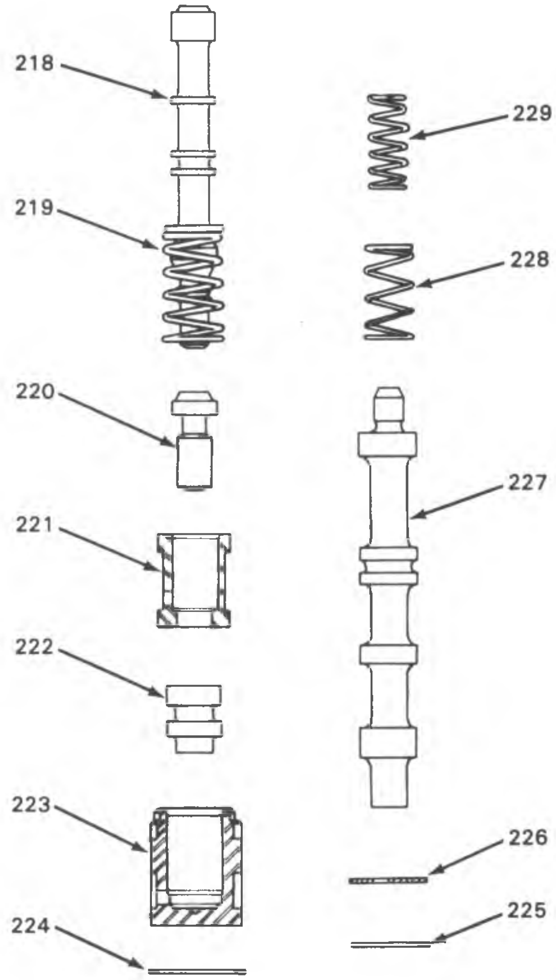
Figures 94, 98, 99 and 100

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.

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 TRANSJEL™ J 36850 or equivalent.
7. Thrust washer (601)



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

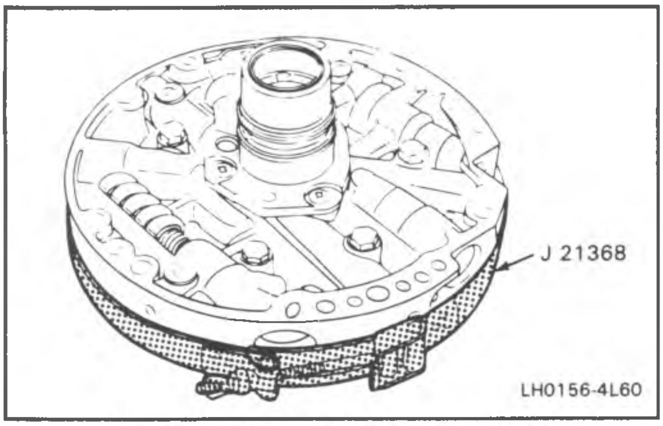


Figure 98 Oil Pump Alignment Band

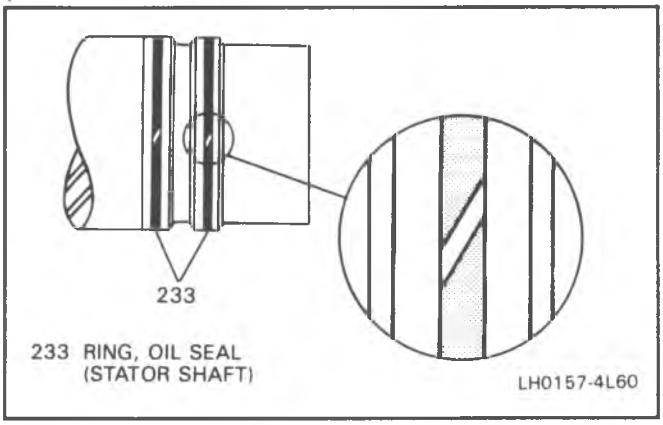


Figure 99 Oil Pump Hub Seal Rings

Install or Connect

Figure 101

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.)

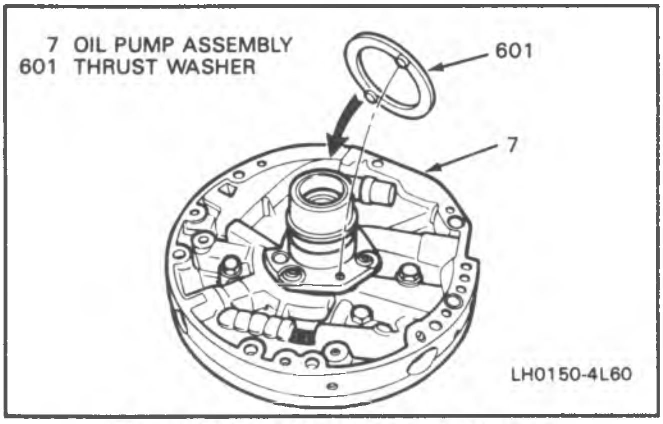


Figure 100 Oil Pump Thrust Washer

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.

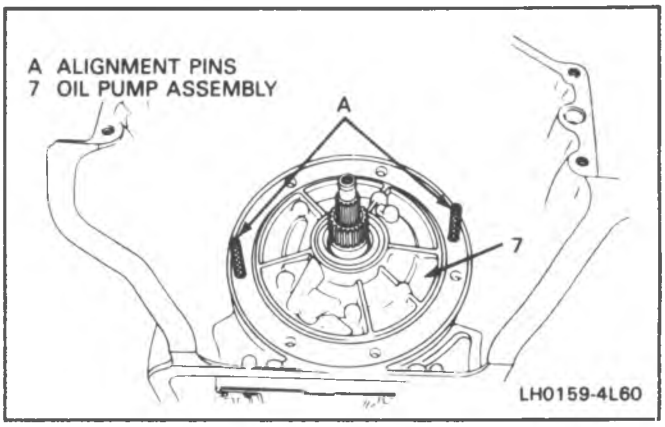


Figure 101 Oil Pump and Case

Transmission End Play Check

Figures 102 through 106 and 109, 110 and 111

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

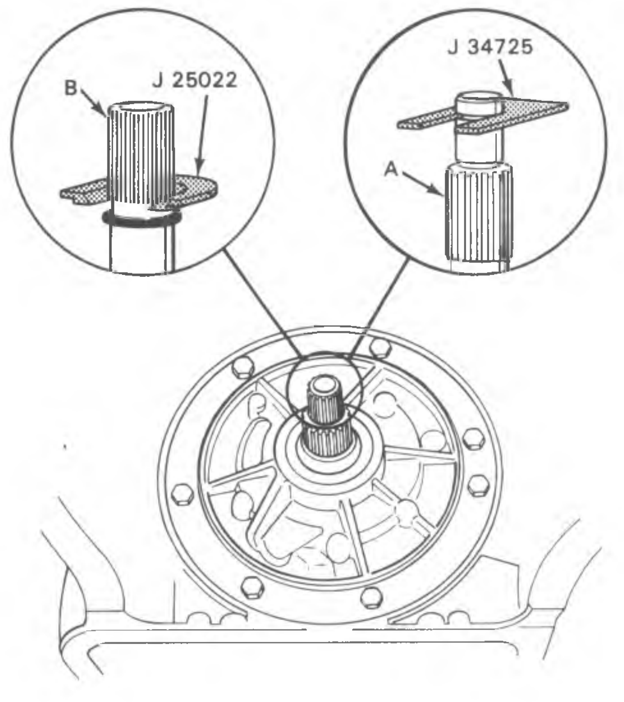
Dial indicator

Measure

Figures 102 through 105

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.



A 298mm TURBINE SHAFT
B 245mm TURBINE SHAFT

LH0073-4L60

Figure 102 End Play Tool

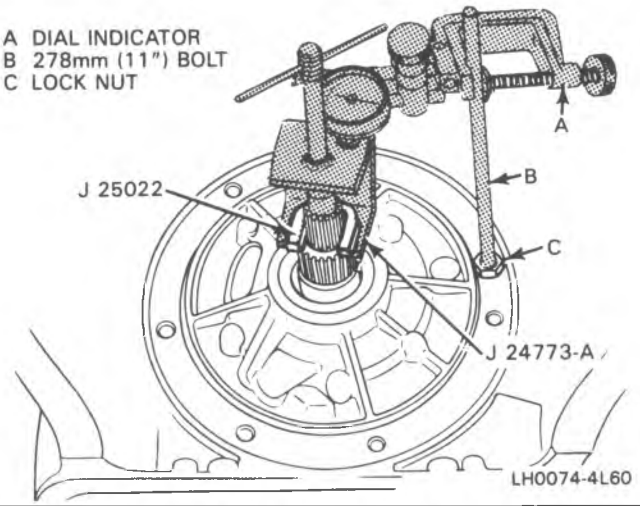


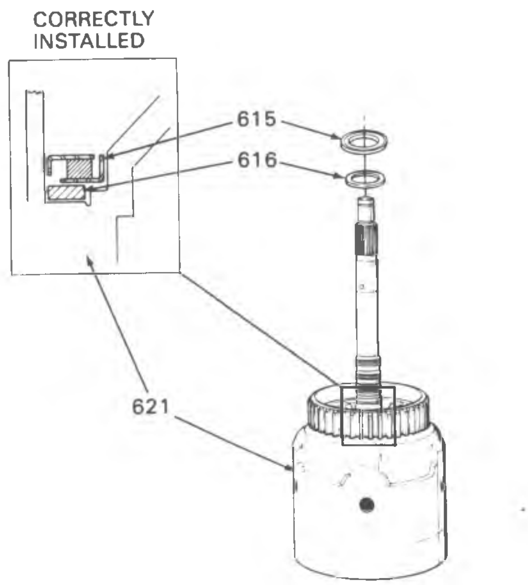
Figure 103 J 25022-A Installed

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



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

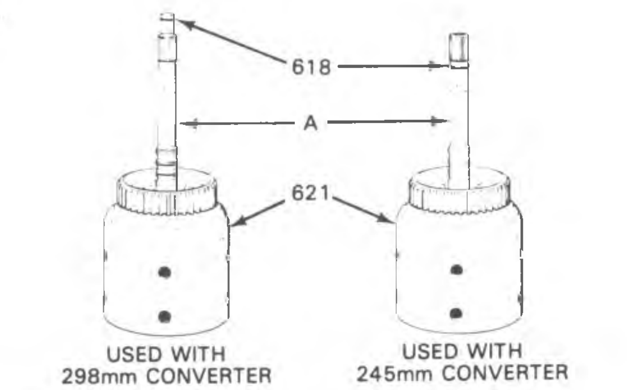
Assemble

Figure 106

- O-ring seal (618) into the groove in the end of the turbine shaft.

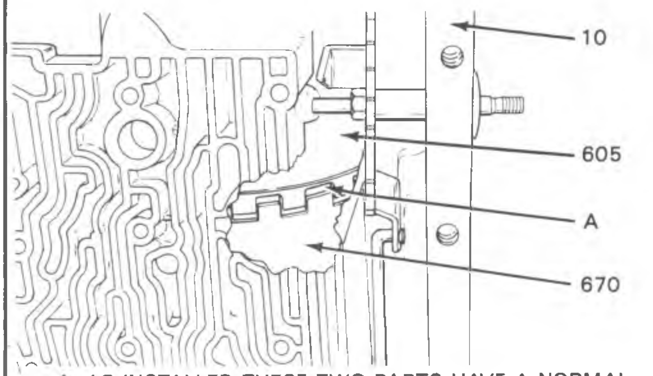
Important

- 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).



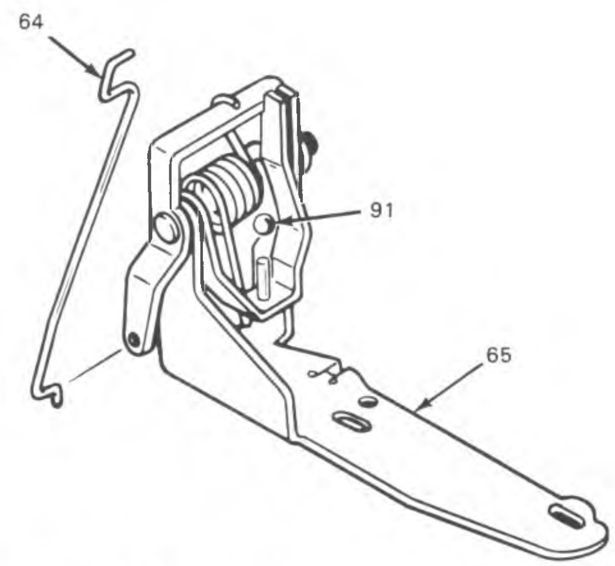
A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT
LH0117-4L60

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

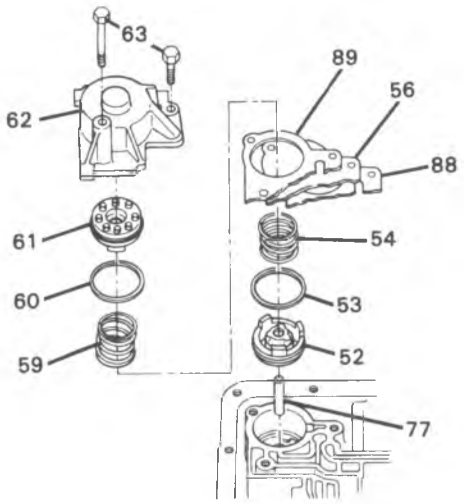
Figure 108 Throttle Lever and Bracket Assembly

Inspect

Figures 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 Accumulator Assembly

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.

Figures 109 and 111

Tool Required:

J 25025-5 Guide Pins

1991 MODELS	1-2 ACCUMULATOR SPRING COLOR	3-4 ACCUMULATOR SPRING COLOR
CHM, CJM, KCM, RAM, WCM	ORANGE, LT. GREEN, WHITE OR PLAIN	VIOLET
CAM, CBM, KAM, MJM, MNM, WAM	ORANGE, LT. GREEN, WHITE OR PLAIN	DK. GREEN
CCM, CFM, FTM, KBM, LAM, LBM, LCM, LDM, LFM, WBM	ORANGE, LT. GREEN, WHITE OR PLAIN	RED
FUM	YELLOW	YELLOW
HCM, MBM, SAM, SFM	YELLOW	RED
SHM, TLM	DK. GREEN	LT. BLUE
FZM	YELLOW	VIOLET
HBM, HFM, HHM	DK. GREEN	YELLOW
FBM, HDM	DK. GREEN	RED
AAM, ABM	ORANGE, LT. GREEN, WHITE OR PLAIN	ORANGE, LT. GREEN, WHITE OR PLAIN
YDM	YELLOW	ORANGE, LT. GREEN, WHITE OR PLAIN
MSM	ORANGE, LT. GREEN, WHITE OR PLAIN	YELLOW
BBM, BCM, BFM, CWM	DK. GREEN	ORANGE, LT. GREEN, WHITE OR PLAIN

MH0168-4L60

Figure 110 1-2 and 3-4 Accumulator Spring Chart

Install or Connect

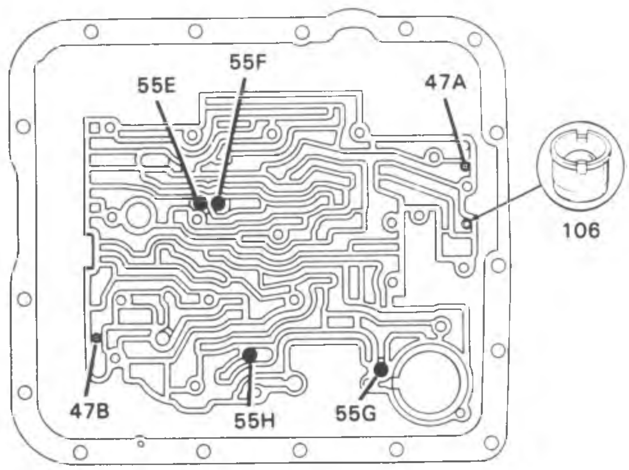
Figure 109

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

1. Governor and converter clutch oil screens (47)



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

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

Figures 112, 113 and 115

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

Figure 112

Position as shown on a clean surface.

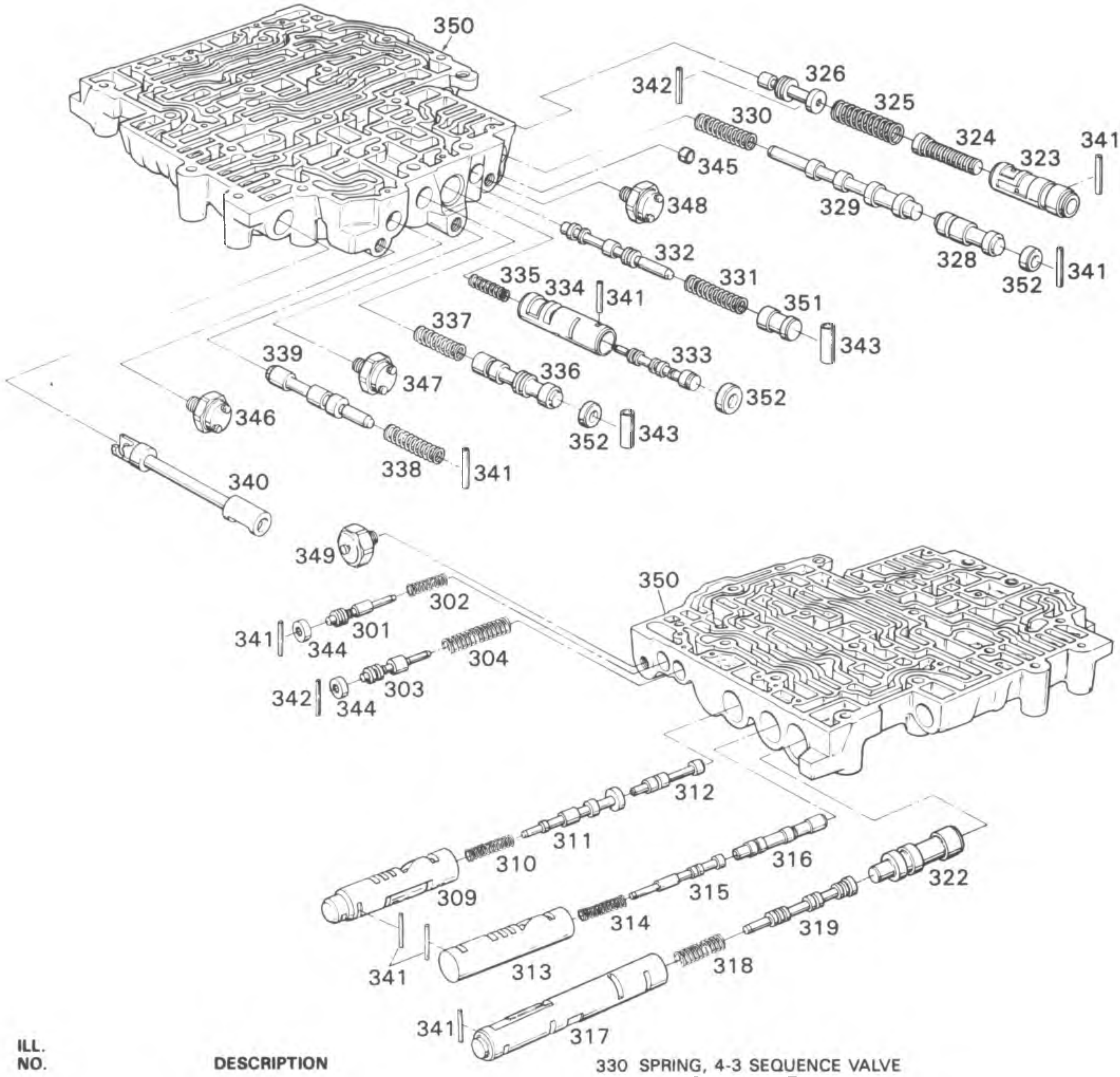
- Valve trains beginning with the upper left hand corner

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

Clean

- All valves, springs, bushings and control valve body in clean solvent
- Dry using compressed air.



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 112 Control Valve Assembly

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

Figure 112

- Control valve assembly (67) exactly as shown.
  - Notice the position of the valve lands and bushing passages.

Install or Connect

Figures 113 and 115

1. Three checkballs (55A), (55C), and (91) into the valve body assembly. Checkball (91) is the larger copper colored ball.
   - Retain with TRANSJEL ™ J 36850 or equivalent.
2. Valve body assembly (67)
   - Connect the manual valve link (705) to the inside detent lever (703).

Auxiliary Accumulator Valve Body Assembly

Figures 108, 108, 114, 117, 118 and 119

Tools Required:

#3 Screw Extractor
9.5 mm (3/8 in.) rod

Clean

Figure 114

- 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.

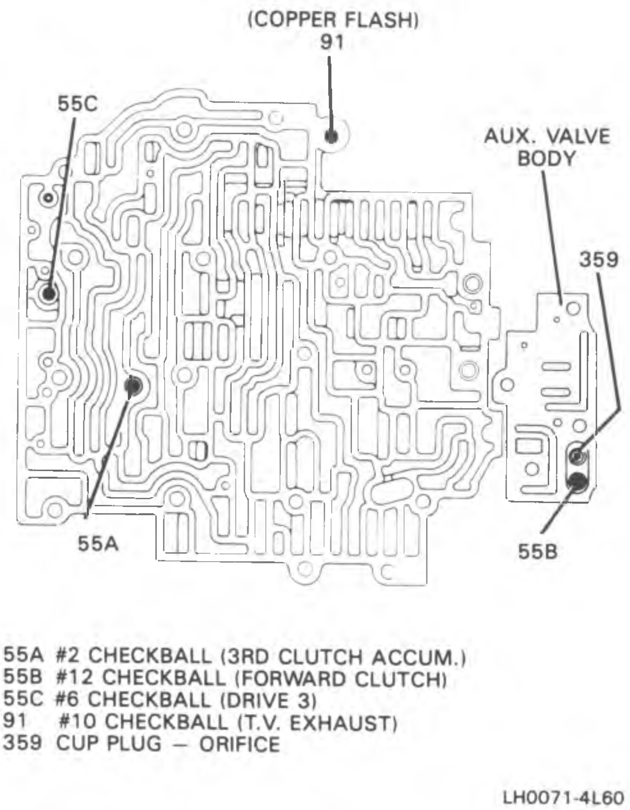


Figure 113 Valve Body Checkball Locations

Disassemble

Figure 114

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 114

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.

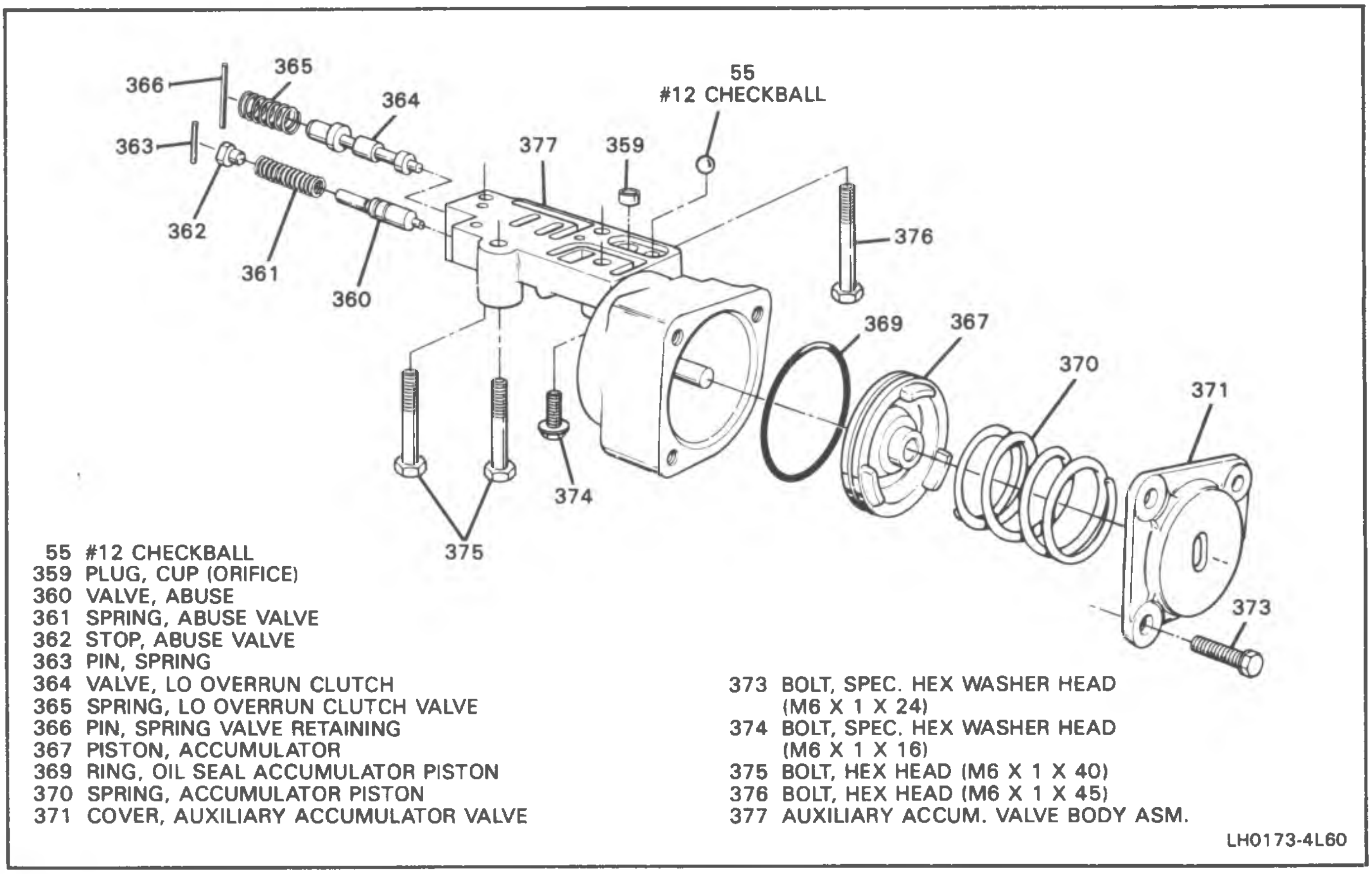


Figure 114 Auxiliary Valve Body Assembly

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

- Orifice cup plug (359). Use modified #3 screw extractor.

Install or Connect

- Orifice cup plug (359). Use 9.5 mm (3/8 in.) rod.
  - Seat flush

Assemble

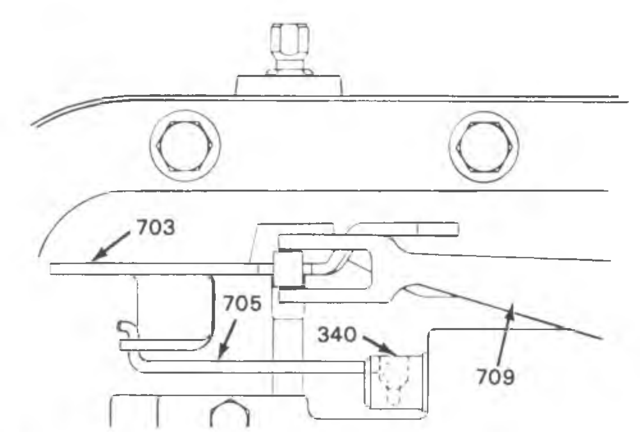
Figure 114

- Auxiliary accumulator valve train exactly as shown. Notice the valve lands.

Assemble

Figure 114

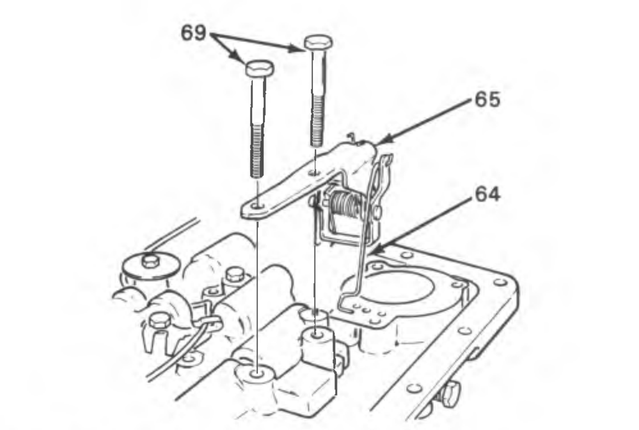
1. Piston oil seal ring (369) onto piston (367)
   - Lubricate with TRANSJEL™ J 36850 or equivalent.
2. Piston (367)
3. Accumulator spring (370)
4. Cover (371) and (3) bolts (373)



340 VALVE, MANUAL
703 LEVER, DETENT (INNER)
705 LINK, MANUAL VALVE
709 SPRING ASSEMBLY, MANUAL DETENT

LH0067-4L60

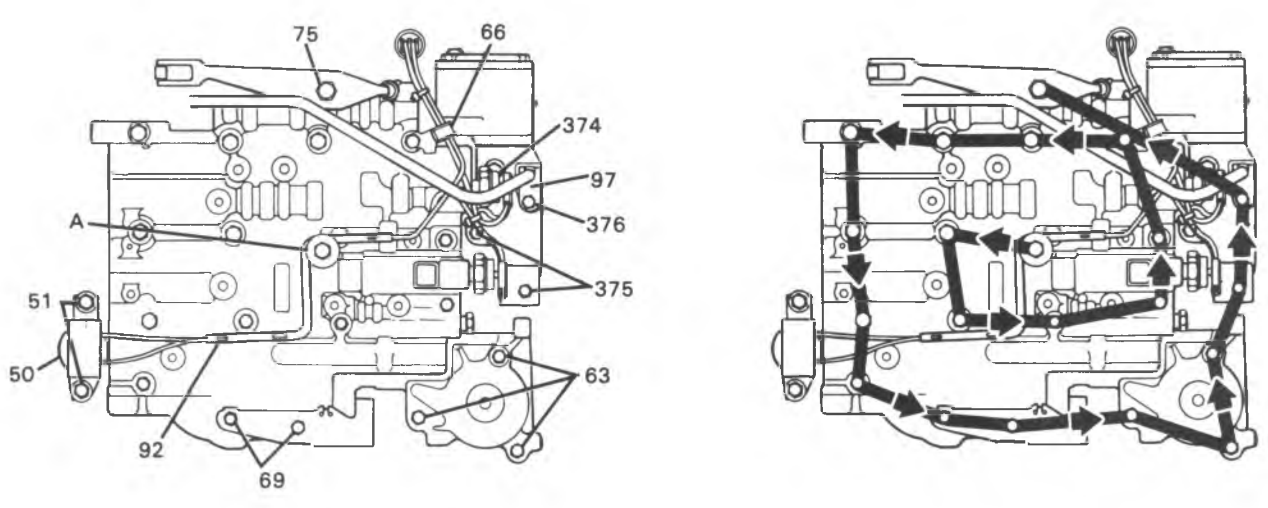
Figure 115 Manual Valve Link



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

LH0068-4L60

Figure 116 T.V. Lever and Bracket



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)

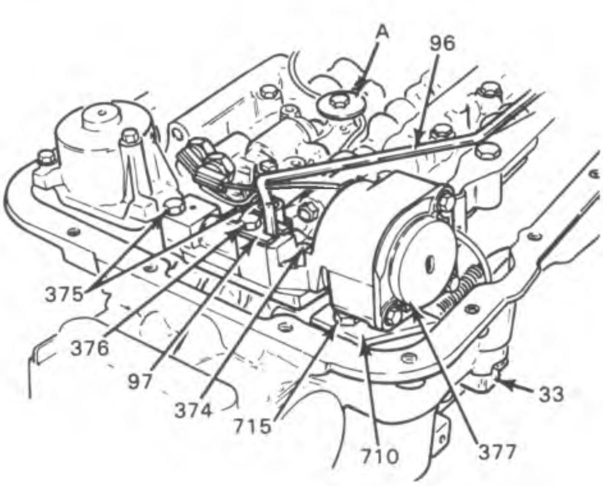
MH0211-4L60

Figure 117 Valve Body Bolt Locations

Install or Connect

Figures 114, 117 and 118

1. Check ball (55B) into auxiliary accumulator valve body (377) as shown in Figure 114.
   - 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) finger tight



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 118 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 116, 117 and 118

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)

NOTICE: Torque valve body bolts in a spiral pattern starting from the center. If bolts are torqued at random, valve bores may be distorted and inhibit valve operation.

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, 116 and 117

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 119

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.)

2-4 Servo Assembly

Figures 120 through 125

Tools Required:

J 33037 Band Apply Pin Tool
Vernier calipers
Scale
J 22269-01 Piston Compressor
J 29714 Servo Cover Compressor

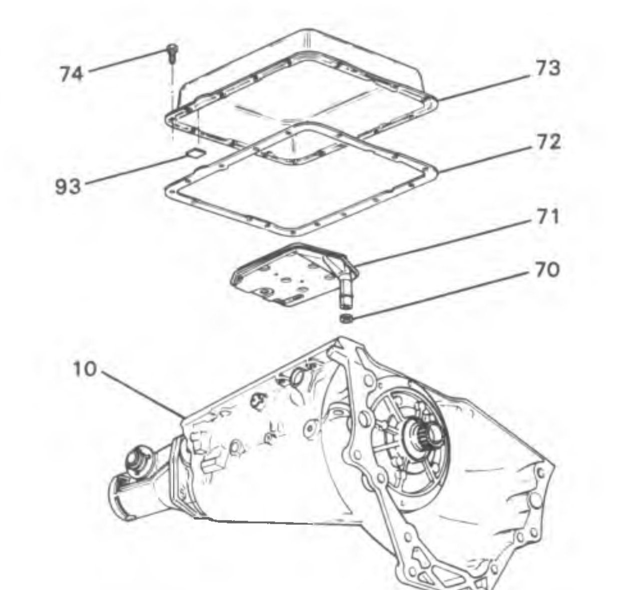
Measure

Figure 120

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

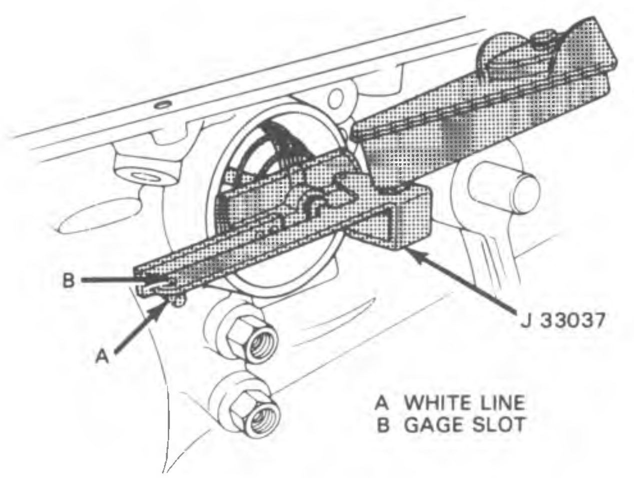
- Pistons for:
  - Porosity or damage
  - Ring groove damage



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-R1

Figure 119 Case, Pan and Filter Assembly



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 120 Servo Pin Length

- 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.

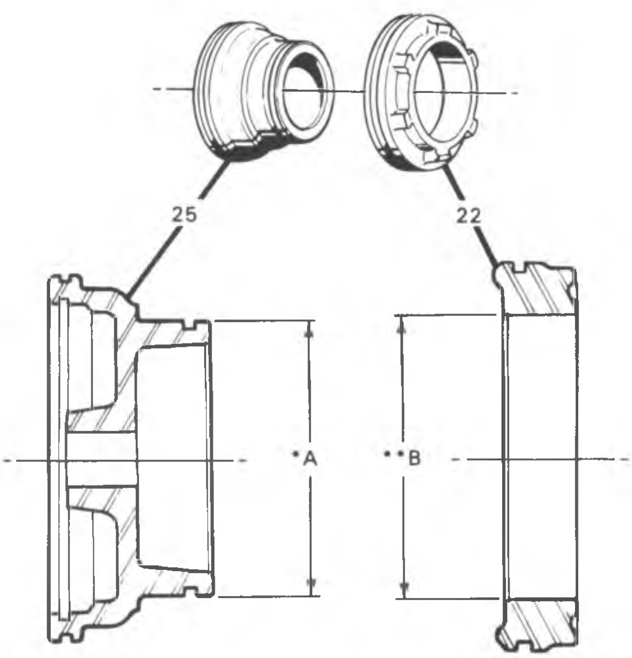
Measure

Figure 121

1. Measure piston (25) dimension *A.
2. Measure housing (22) dimension **B.
3. Check model application.

2ND APPLY PISTON & HOUSING APPLICATION

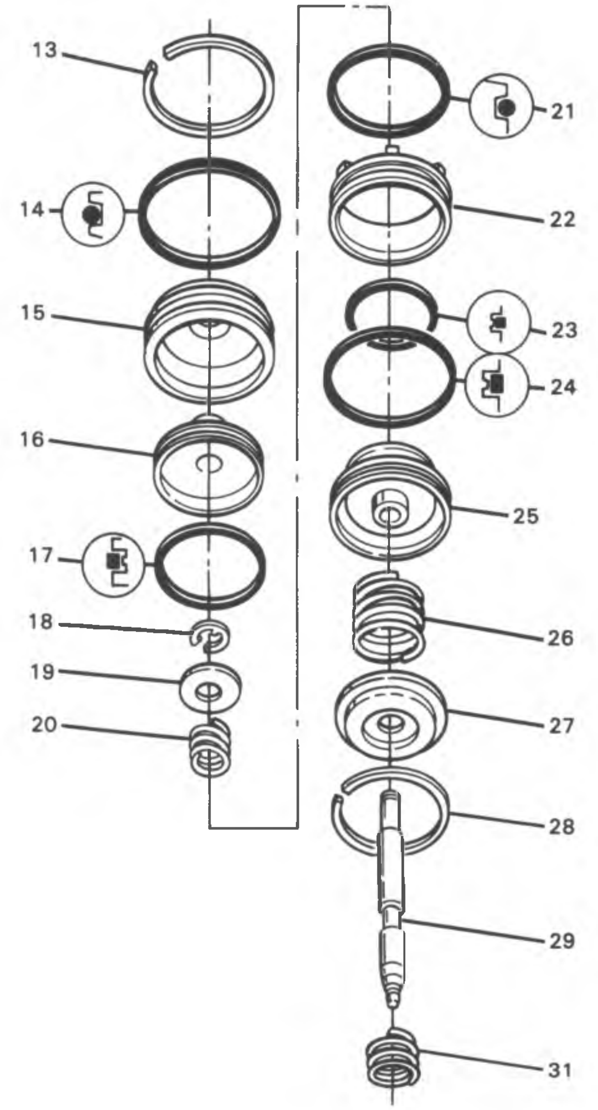
MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
YDM	44.64 mm (1.78")	45.54 mm (1.79")
CHM, CJM, DBM, FUM, FZM, HBM, HFM, HHM, KCM, LAM, LBM, LCM, LDM, LFM, RAM, WCM	57.85 mm (2.28")	58.74 mm (2.31")
BAM, BPM, CAM, CBM, CCM, CFM, FBM, FTM, HCM, HDM, KAM, KBM, MBM, MJM, MNM, MSM, SAM, SHM, TLM, WAM, WBM	63.10 mm (2.48")	64.00 mm (2.52")



22 HOUSING, SERVO PISTON (INNER)
25 PISTON, 2ND APPLY

LH0180-4L60

Figure 121 2nd Apply Piston and Housing Measurement



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 122 2-4 Servo Assembly

Assemble

Figures 122 through 125

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 TRANSJEL™ J 36850 or equivalent.
15. Servo cover (15) into the servo bore
16. Install J 29714.
    - Compress the servo cover.
    - Install the retainer ring (13).

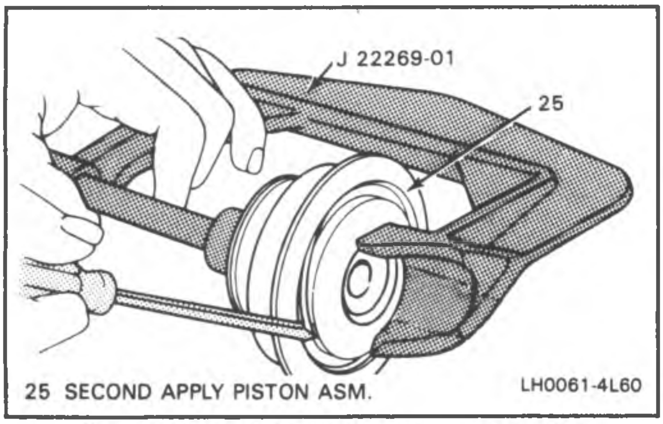


Figure 123 2nd Servo Piston — Assembly

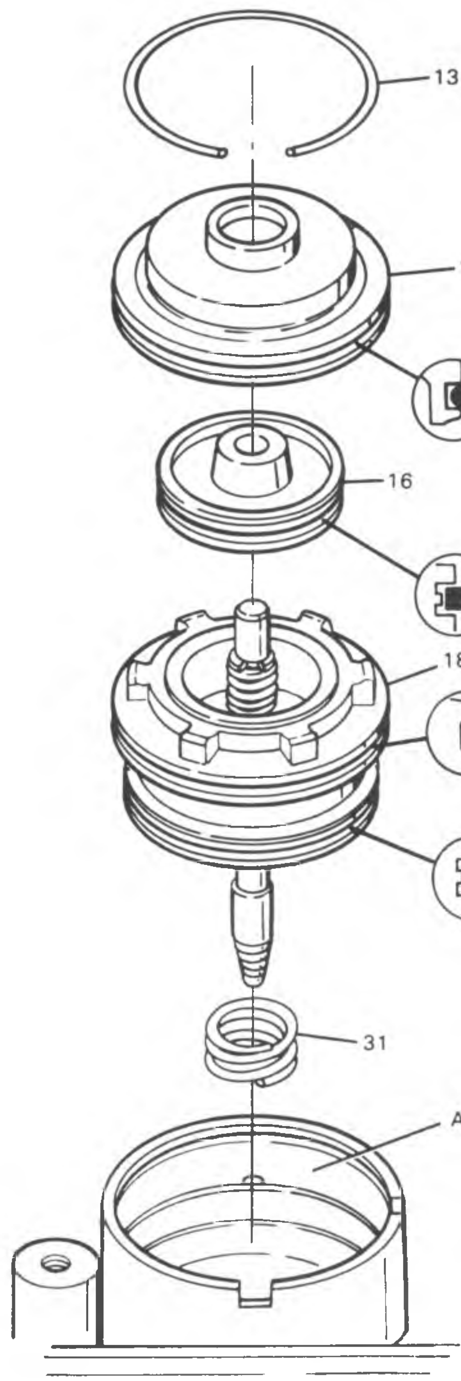


Figure 124 2-4 Servo Bore

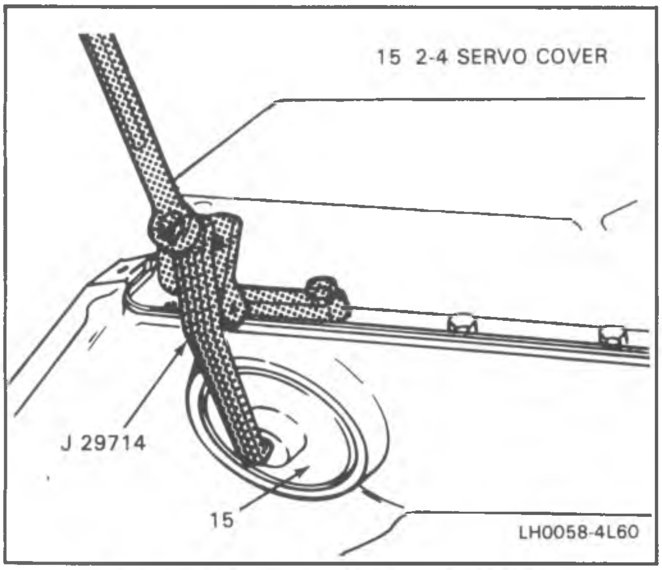


Figure 125 Servo Cover — Installed

Governor Assembly

Figures 126 and 127

Inspect

Figure 126

- 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.

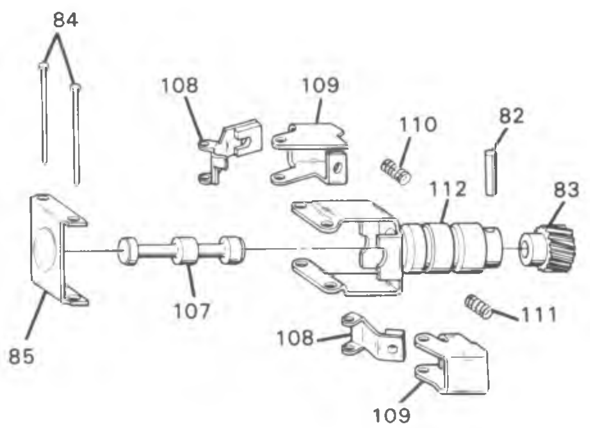
1. Cut off one end of each governor weight pin.
2. Pins (84)
3. Weights
4. Valve
5. Driven gear (83)
   - Drive out the retainer pin (82) with a small punch.
   - Support the governor assembly sleeve on plates installed in the exhaust slots. Push out the gear with an arbor press and a long punch.

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.



GOVERNOR ASSEMBLY

82 PIN, GOVERNOR GEAR RETAINER
83 GEAR, GOVERNOR DRIVEN
84 PIN, GOVERNOR WEIGHT
85 CAP, GOVERNOR THRUST
107 VALVE, GOVERNOR
108 WEIGHT, GOVERNOR SECONDARY
109 WEIGHT, GOVERNOR PRIMARY
110 SPRING, GOVERNOR WEIGHT PRIMARY
111 SPRING, GOVERNOR WEIGHT SECONDARY
112 SLEEVE & CARRIER ASSEMBLY

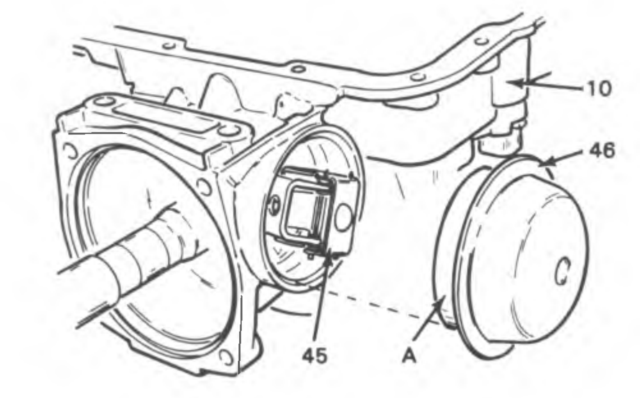
LH0185-4L60

Figure 126 Governor Assembly

Install or Connect

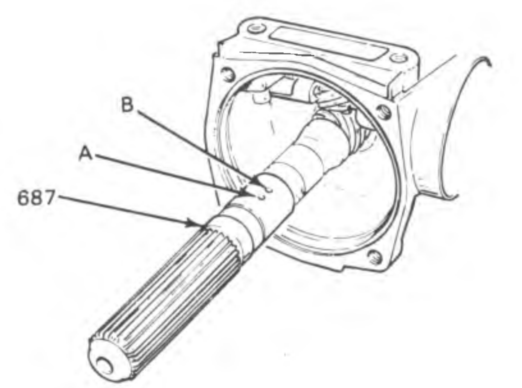
Figures 126 and 127

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.



A APPLY SEALANT ON THIS FLANGE BEFORE INSTALLATION
10 CASE, TRANSMISSION
45 GOVERNOR, ASSEMBLY
46 COVER, GOVERNOR
LH0186-4L60

Figure 127 Governor Cover



A SPEEDO CLIP HOLE FOR CORVETTE ONLY
B SPEEDO CLIP HOLE FOR ALL OTHER VEHICLES
687 SHAFT, OUTPUT
LH0187-4L60

Figure 128 Speedometer Clip Holes

Mechanical Speedometer

Figures 128 and 133

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

Torque Converter Assembly

Figure 136

Tool Required:

J 35138 Torque Converter End Play Checking Tool

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 136

- 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

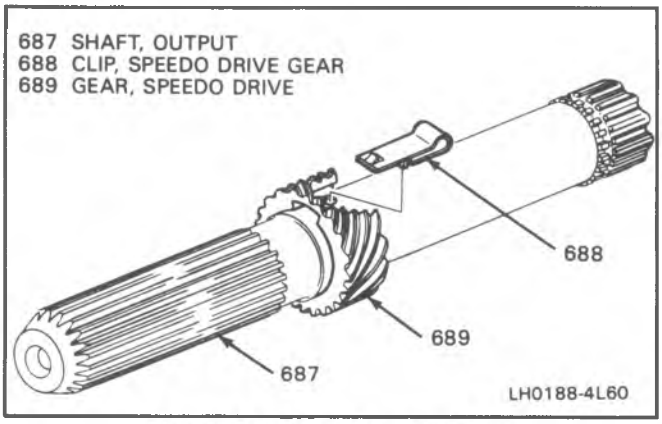


Figure 129 Speedometer Gear

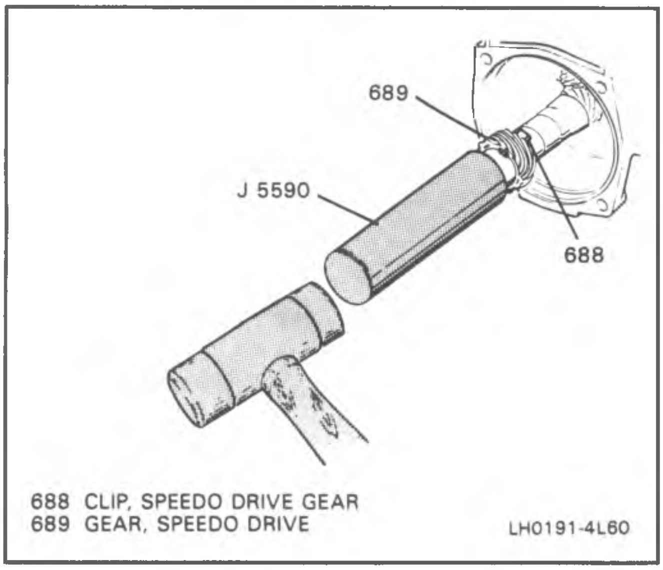


Figure 130 Speedometer Gear — Installation

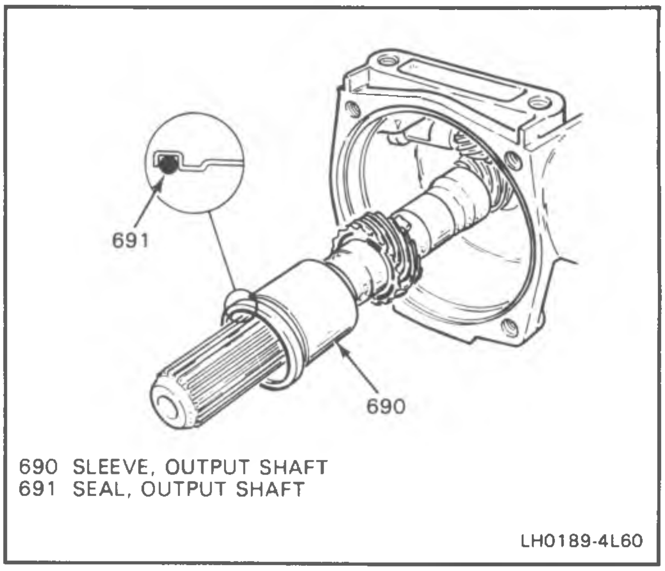


Figure 131 Output Shaft Sleeve and Seal

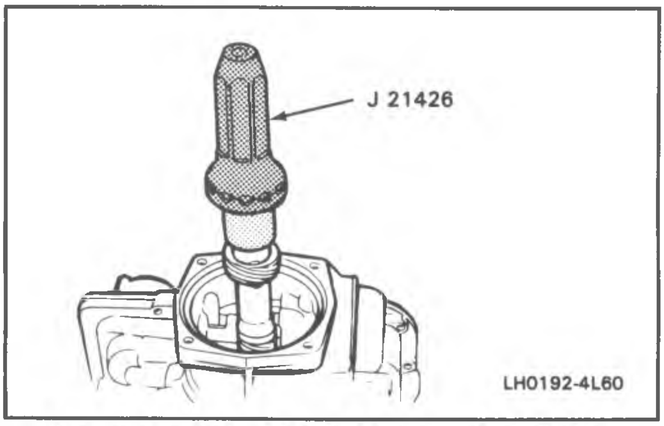


Figure 132 Output Shaft Sleeve — Installation

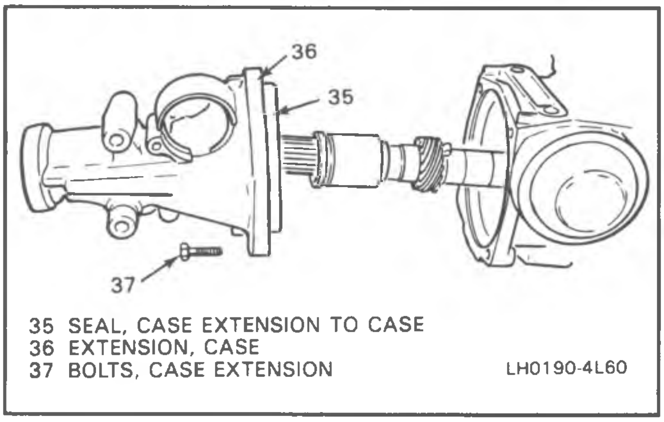
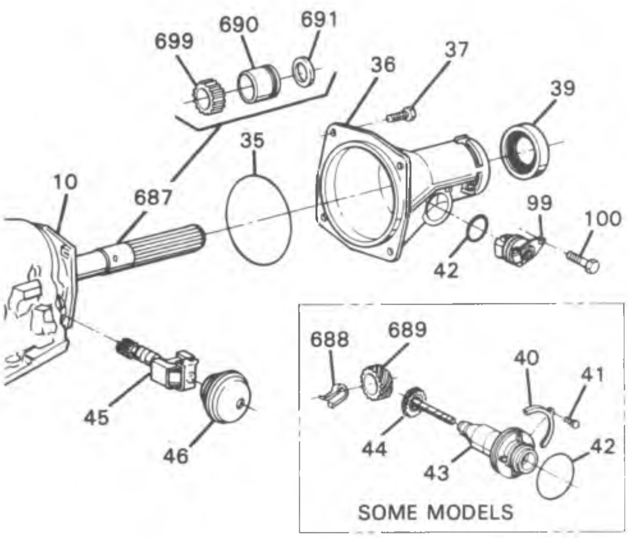


Figure 133 Case Extension and Seal



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-R1

Figure 134 Case Extension and Associated Parts

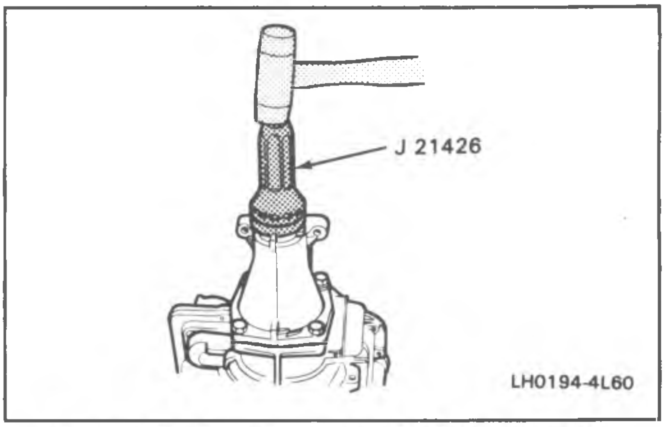


Figure 135 Case Extension Oil Seal Assembly

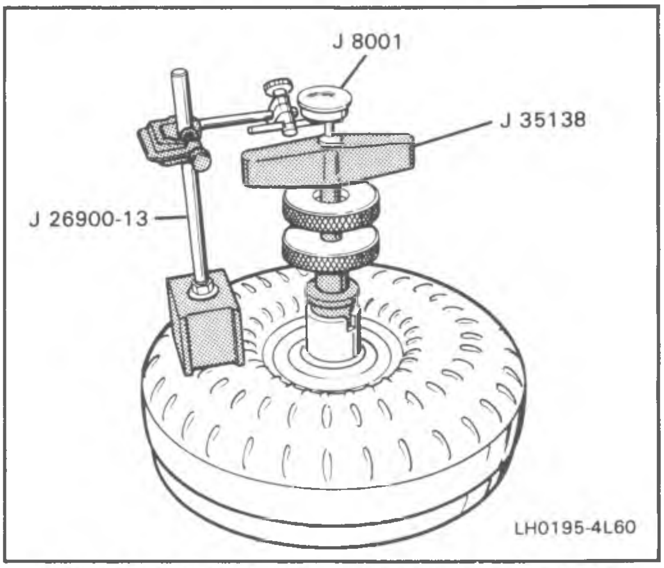


Figure 136 Checking Torque Converter End Play

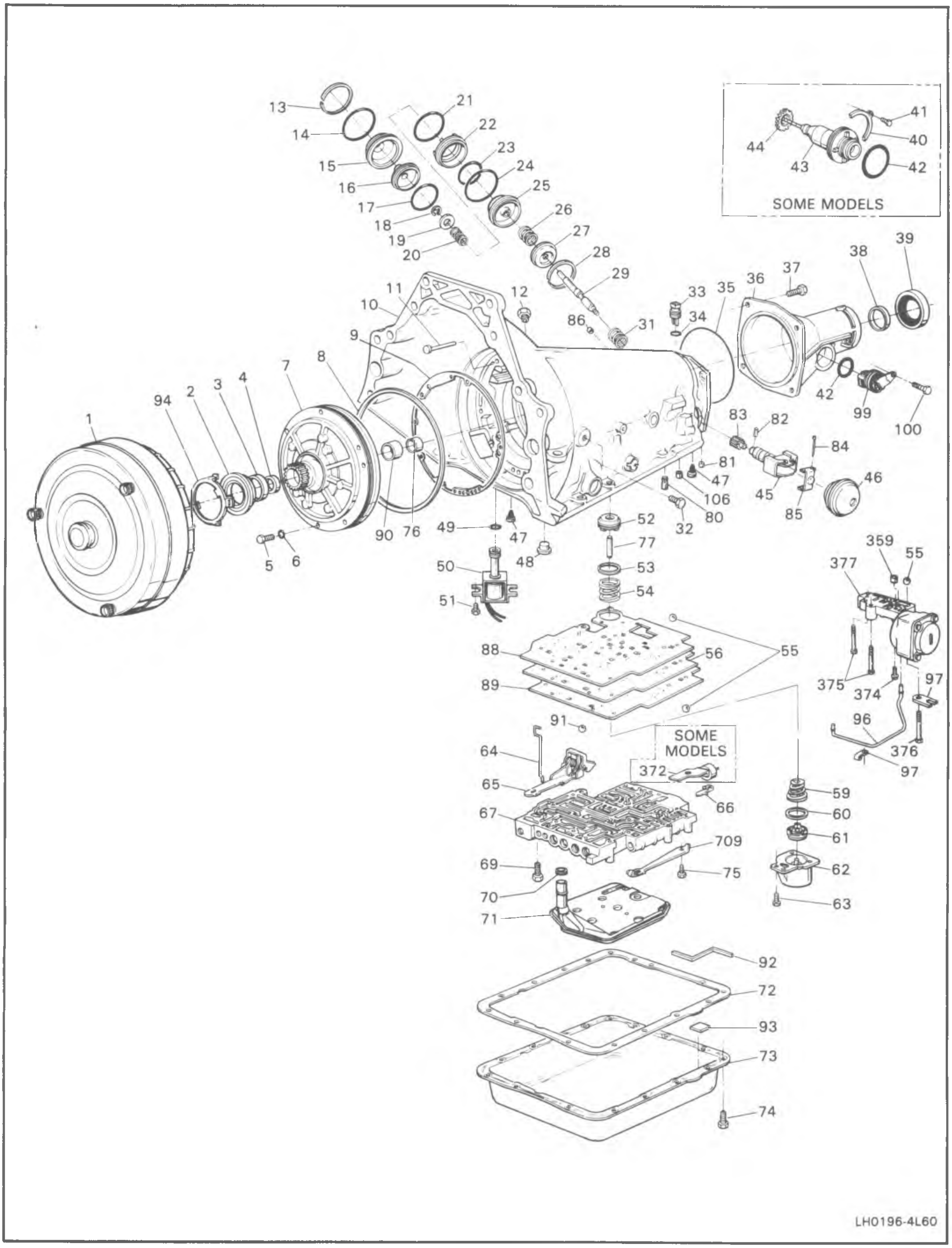


Figure 137 Case and External Parts

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 138 Case and External Parts — Legend

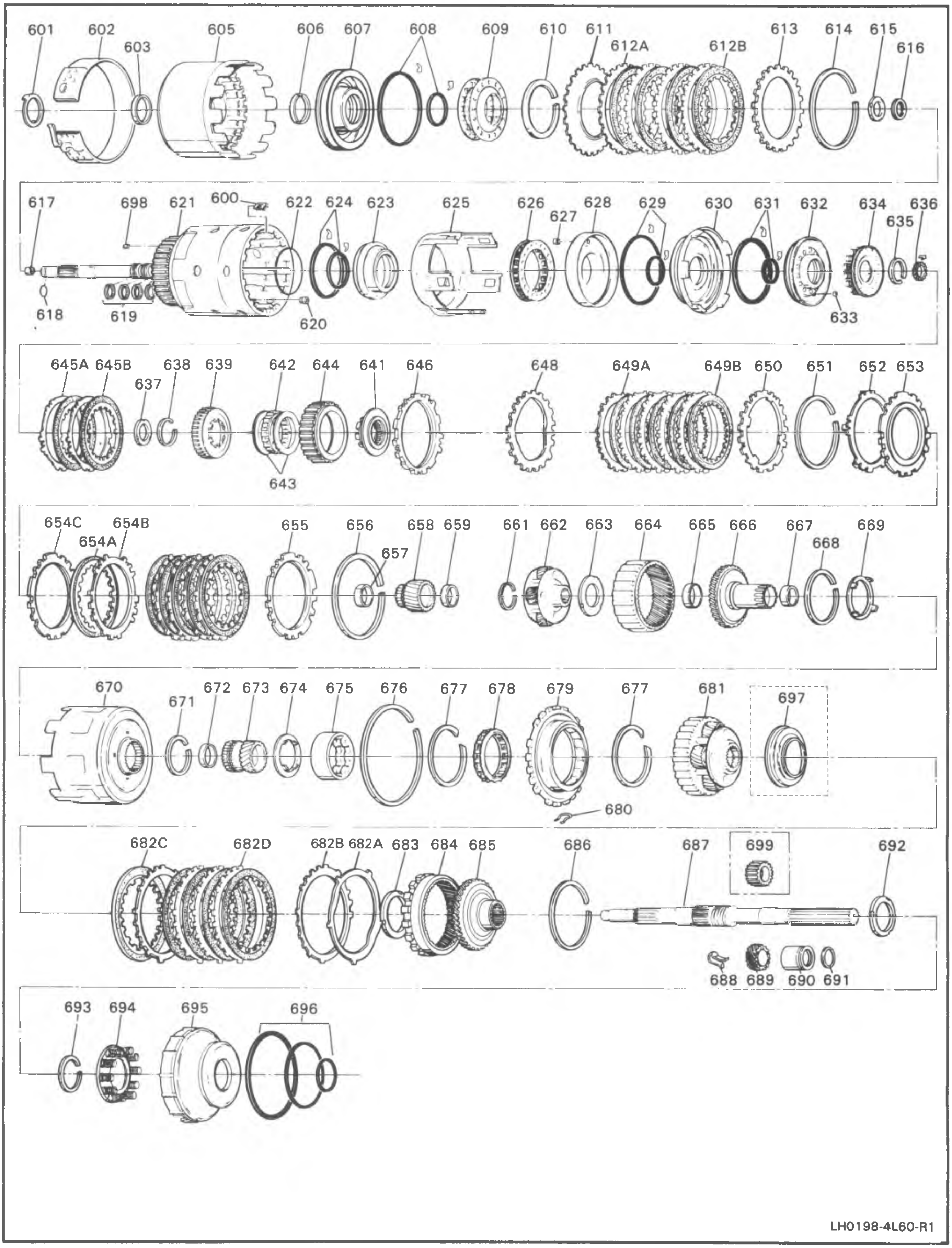
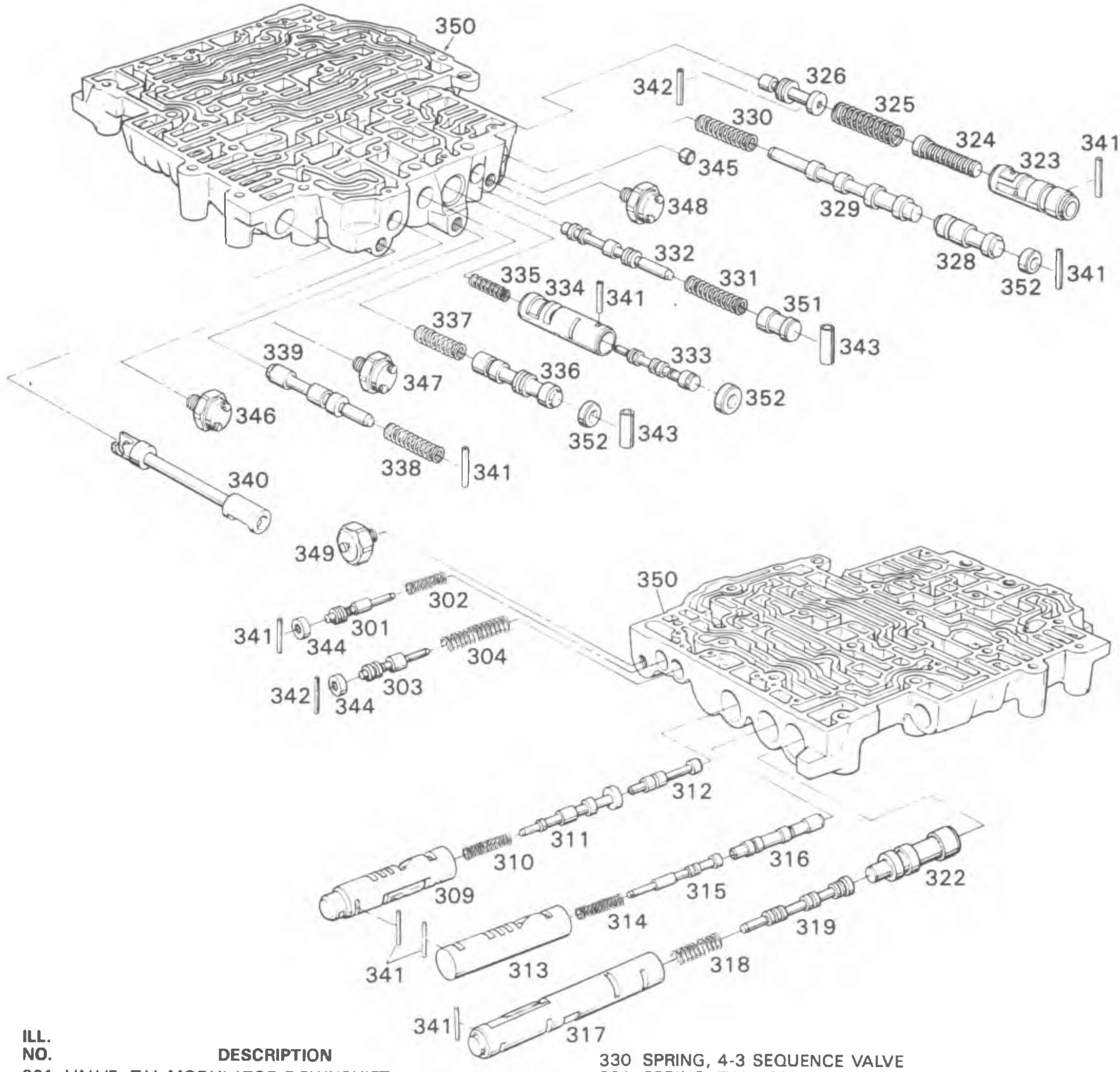


Figure 139 Transmission Internal Parts

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)
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

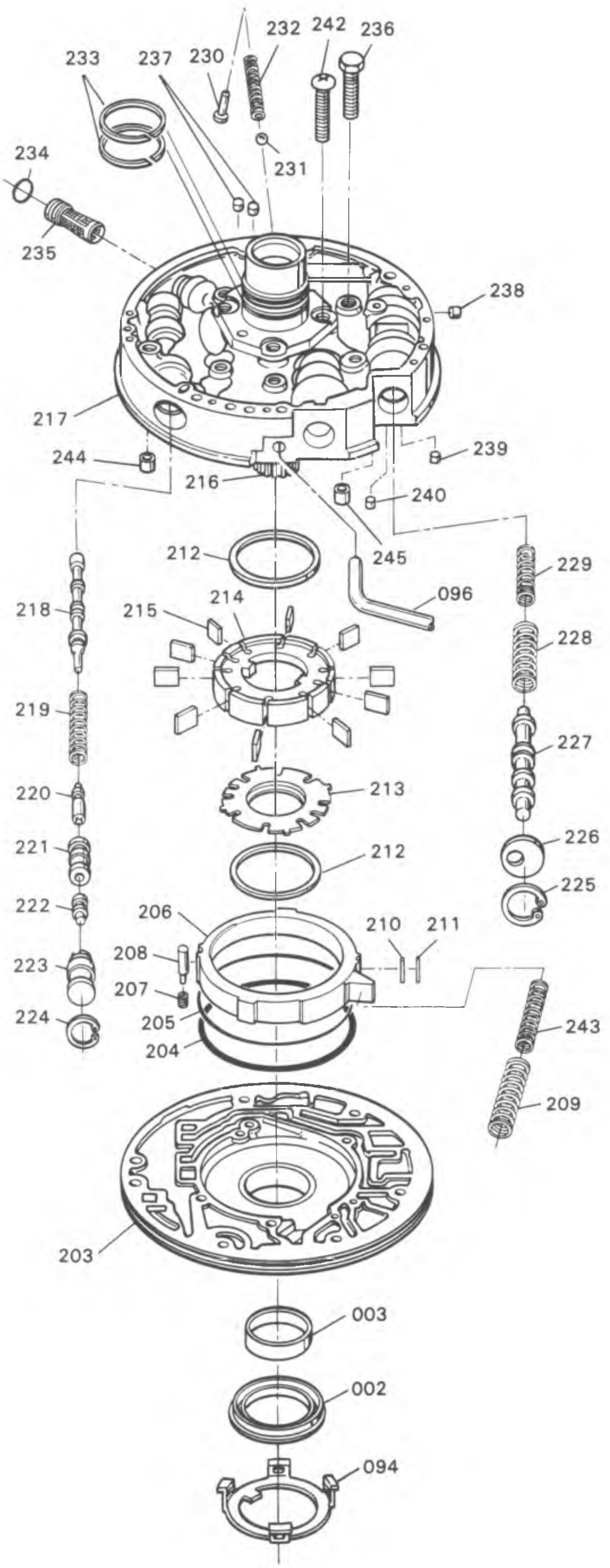
Figure 140 Transmission Internal Parts— Legend



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

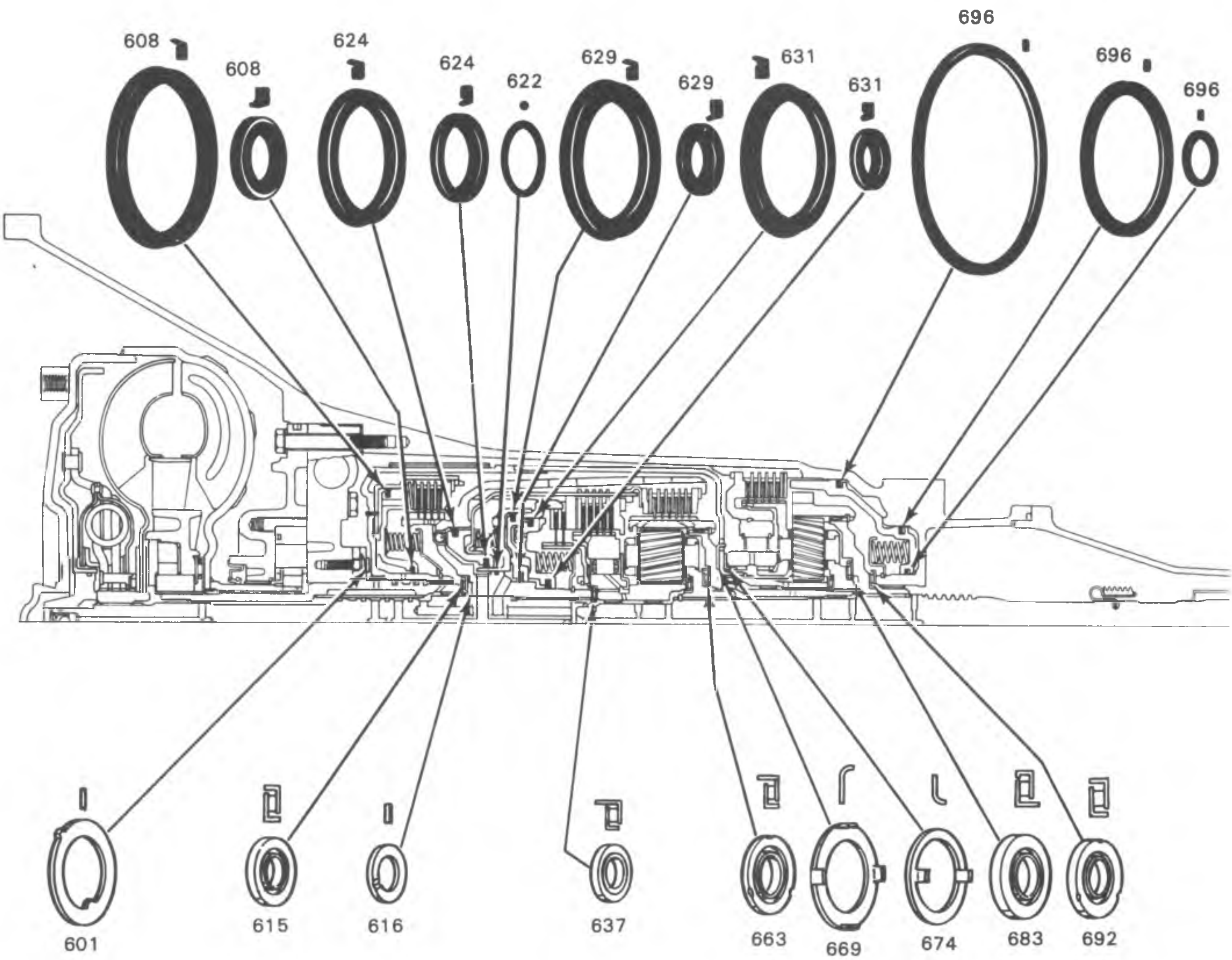
Figure 141 Control Valve Assembly



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 142 Oil Pump Assembly

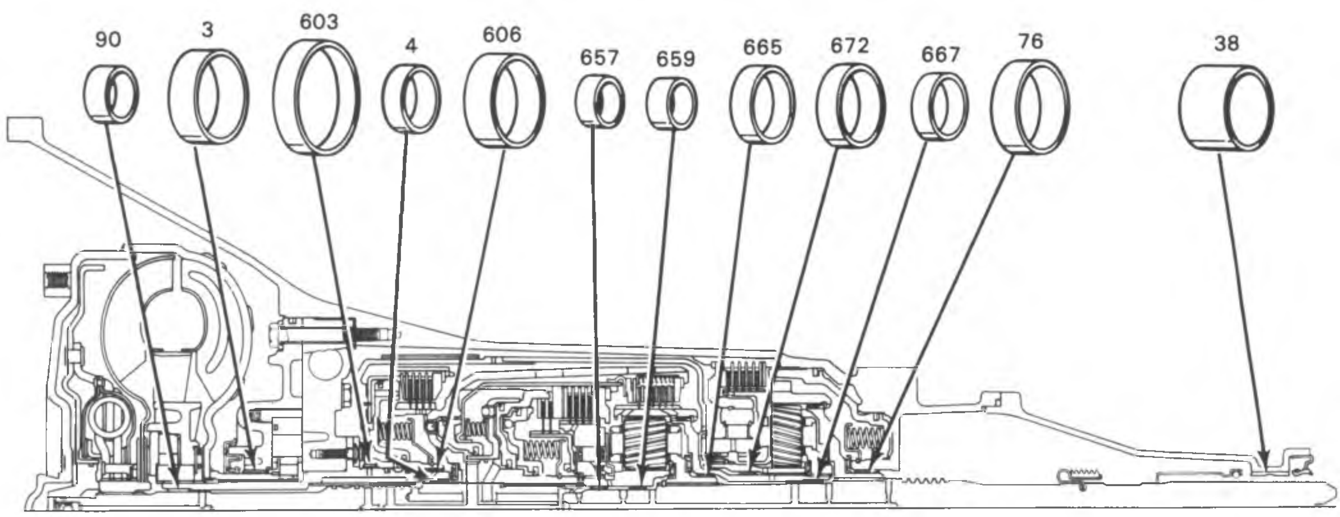


ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
622	SEAL, "O" RING INPUT TO FORWARD HSG.
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
629	SEAL, FORWARD CLUTCH (INNER & 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 143 Seal 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)

ILL. NO.	DESCRIPTION
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

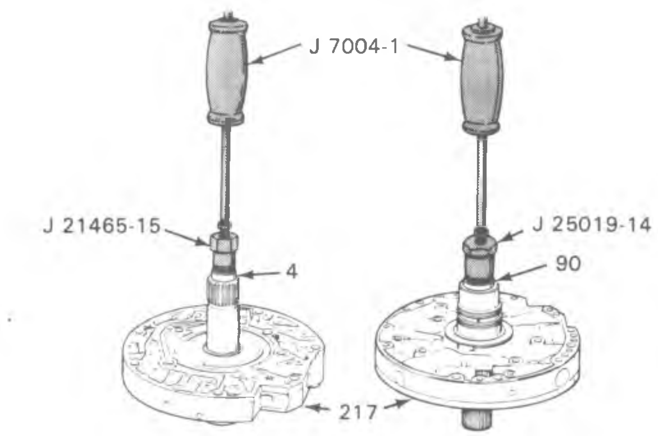
LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	M6 1.0 x 35.0	11 N·m (8 LB.-FT.)	PARK BRAKE BRACKET TO CASE	2	M8 1.25 x 20.0	22 N·m (18 LB.-FT.)
ACCUMULATOR COVER TO CASE	1	M6 1.0 x 65.0	11 N·m (8 LB.-FT.)	PUMP COVER TO BODY	5	M8 1.25 x 40.0	22 N·m (18 LB.-FT.)
DETENT 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 AUX. VALVE BODY	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.)	CONNECTOR COOLER PIPE	2	¼ - 18	38 N·m (28 LB.-FT.)
PRESSURE SWITCHES	1-3	⅛ - 27	11 N·m (8 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-R1

Figure 144 Torque Specifications and Bushing Locations

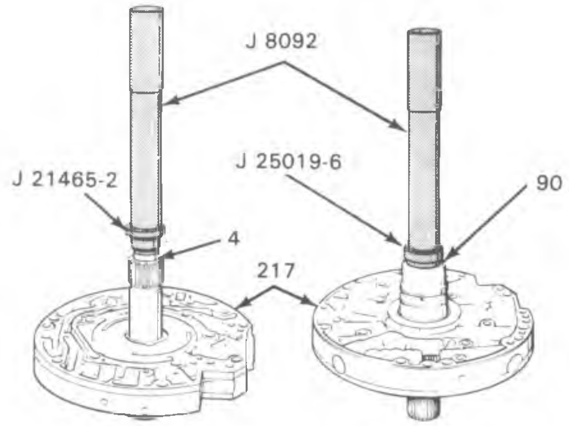
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

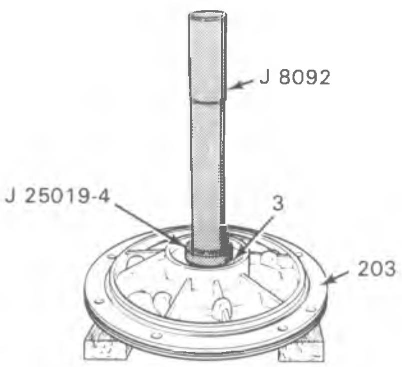


4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP

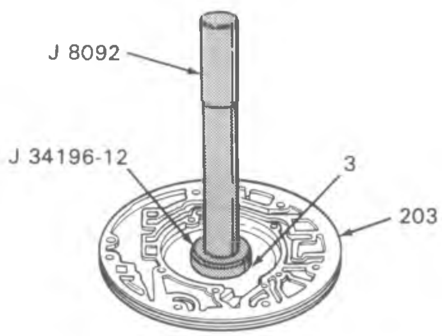
INSTALL AS SHOWN



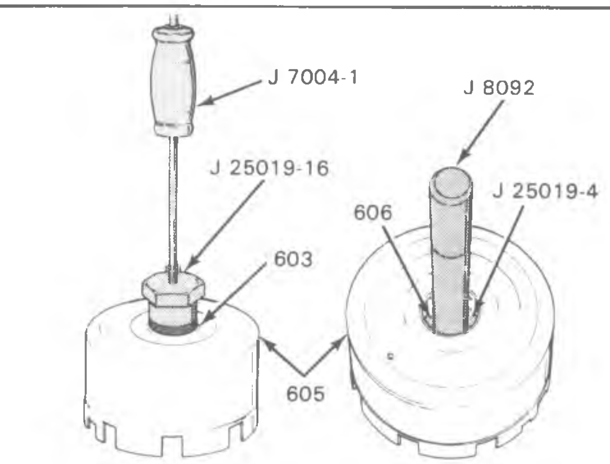
4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP



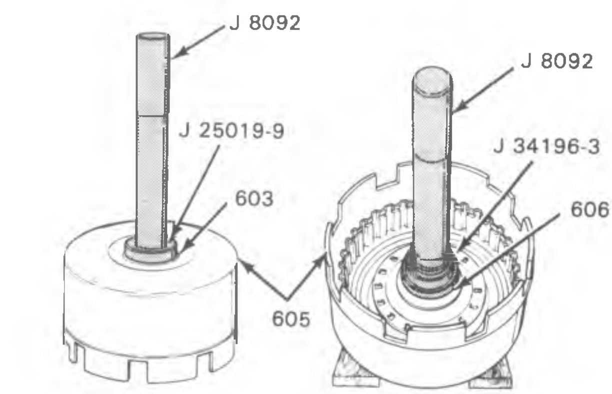
3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



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



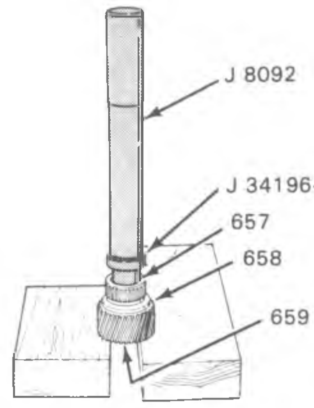
603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASM., REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

LH0205-4L60

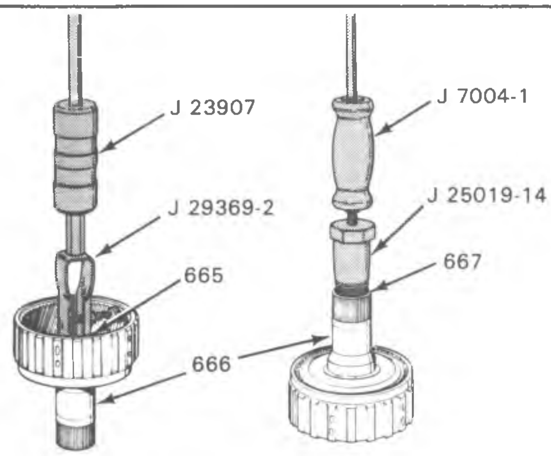
Figure 145 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

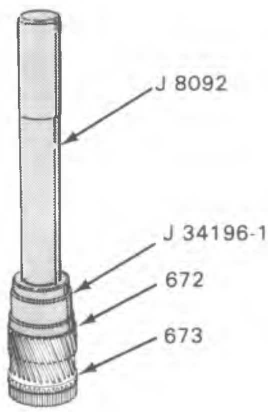
REMOVE AS SHOWN



657 BUSHING, INPUT SUN GEAR — FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR — REAR

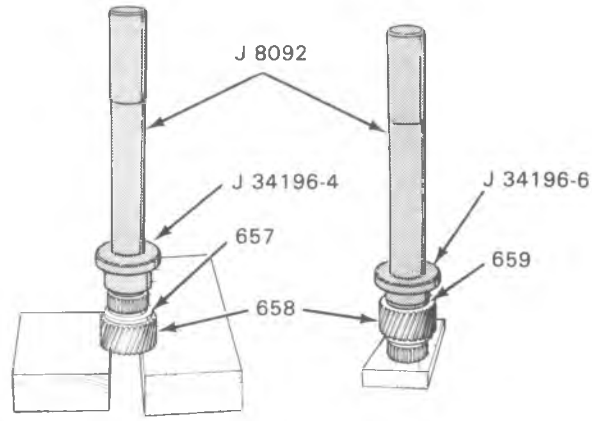


665 BUSHING, REACTION CARRIER SHAFT — FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT — REAR

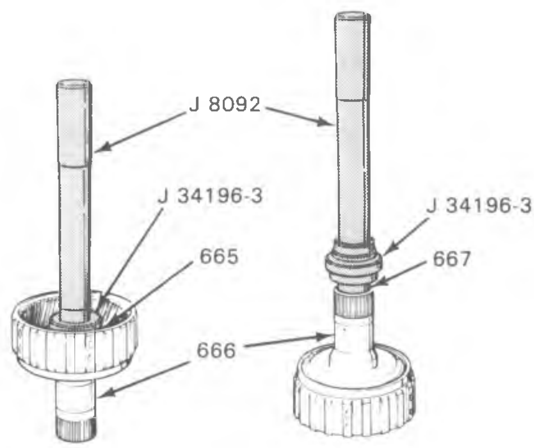


672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

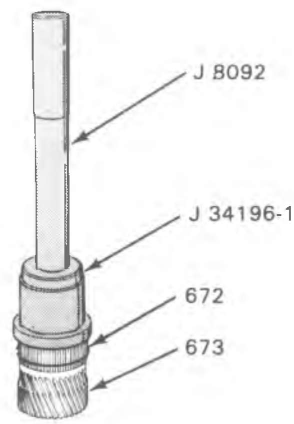
INSTALL AS SHOWN



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



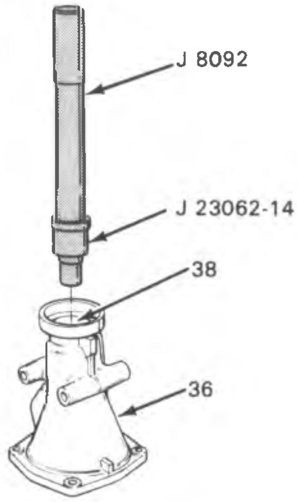
672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

LH0206-4L60

Figure 146 Bushing Replacement Procedure

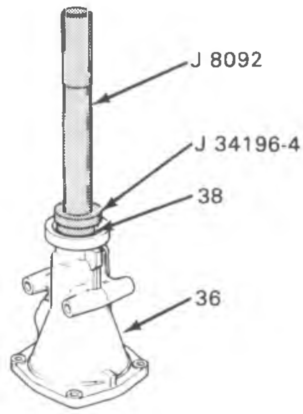
BUSHING REPLACEMENT PROCEDURE
PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

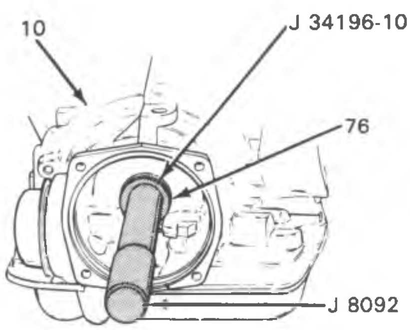


36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION

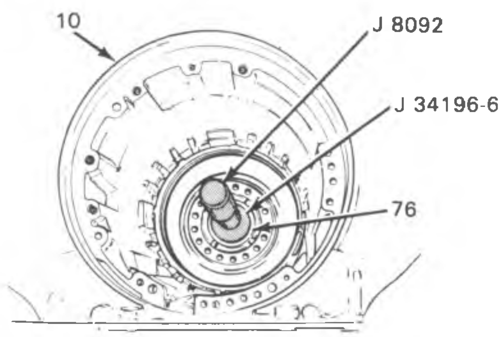
INSTALL AS SHOWN



36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION



10 CASE, TRANSMISSION
76 BUSHING, CASE



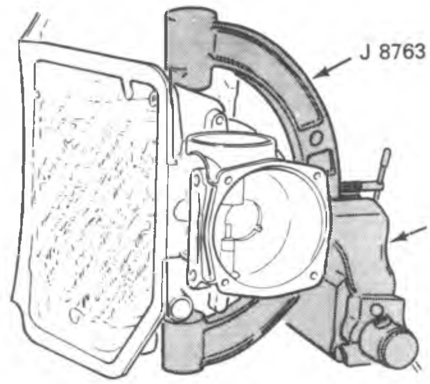
10 CASE, TRANSMISSION
76 BUSHING, CASE

LH0207-4L60

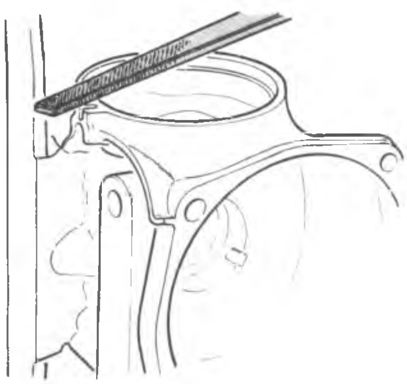
Figure 147 Bushing Replacement Procedure

GOVERNOR BORE REPAIR PROCEDURE

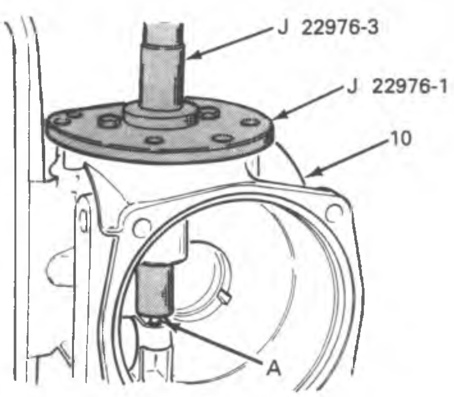
FOLLOW STEPS 1-6 TO REPAIR THE GOVERNOR BORE



STEP 1 Install holding fixture J 8763 and mount in vise.

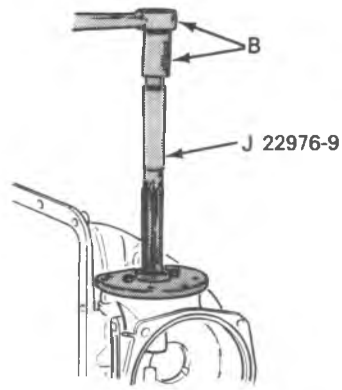


STEP 2 Remove (file) any excess material from the governor face.



A PIN, GOVERNOR SUPPORT
10 CASE, TRANSMISSION

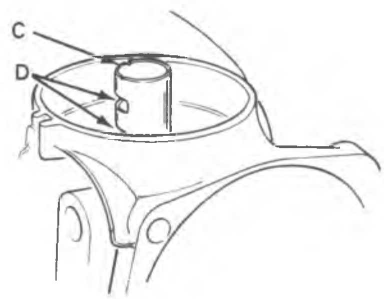
STEP 3 Install J 22976-3 and J 22976-1. Torque bolts to 13 N·m (10 ft.-lbs.). Make sure J 22976-3 rotates freely and then remove it.



B RATCHET & SOCKET

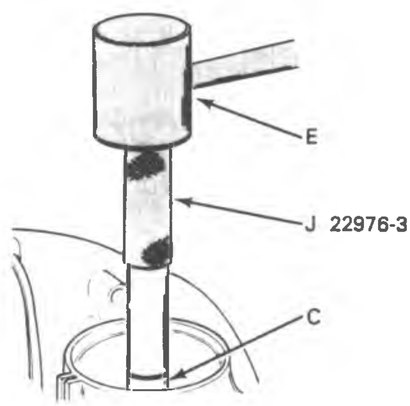
STEP 4 Ream the governor bore as follows:

- 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 148 Governor Bore Repair Procedure

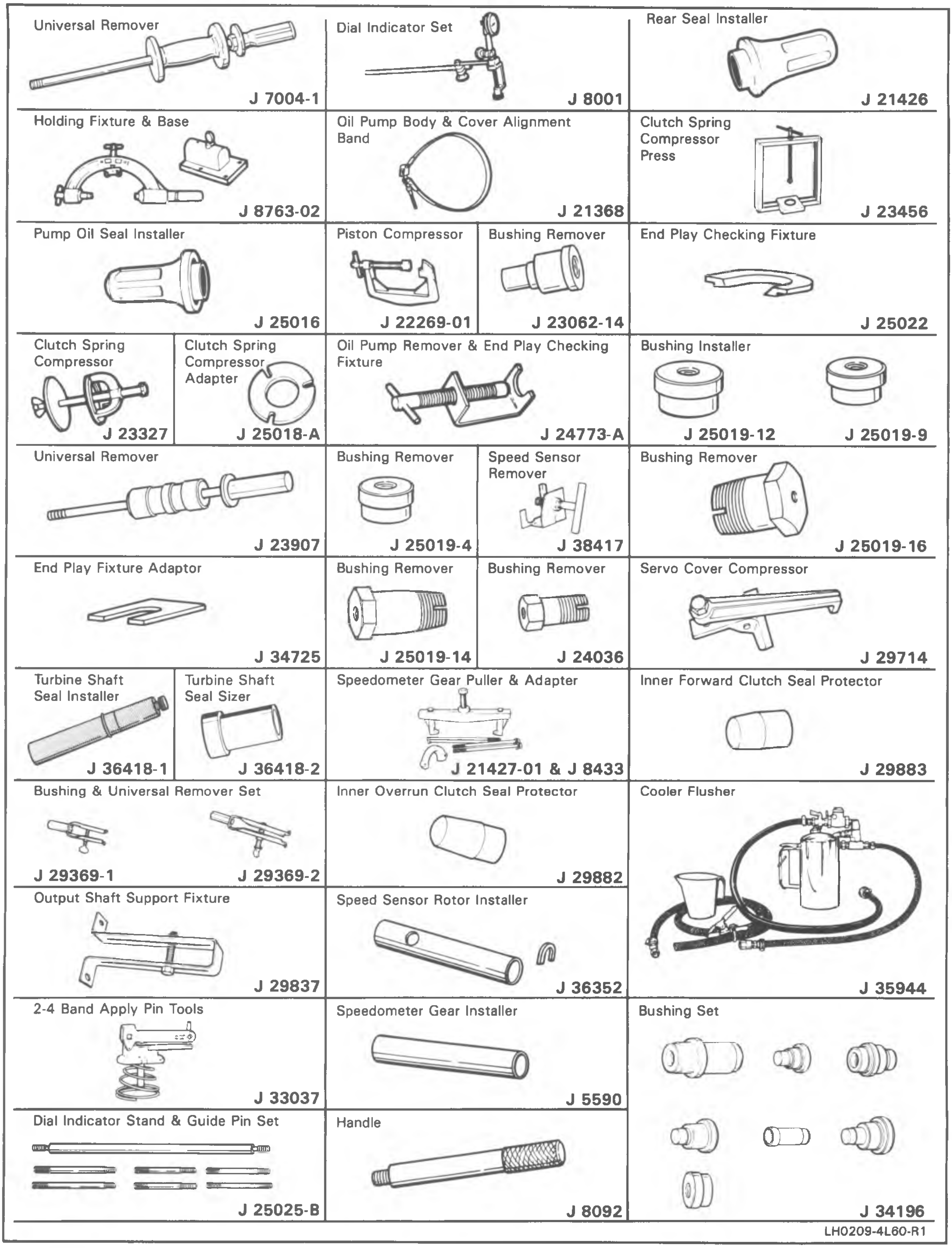


Figure 149 Special Tools

SECTION/HYDRA-MATIC 4L80-E

AUTOMATIC TRANSMISSION UNIT REPAIR

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 the 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

CONVERTER ASSEMBLY/SPEED SENSORS

Figure 1

Tools Required:

J 3289-20 Base
J 8763-02 Holding Fixture
J 38655 Adapter
J 23129 Seal Remover
J 6125-1B Slide Hammer

Remove or Disconnect

- Torque Converter (1).
  - Install cap on converter hub to hold oil.
- Two Speed Sensor Assemblies (22) and two 8 mm bolts (23) (See Figure 10)
- Pump Body Seal Assembly (201)

Install or Connect

1. Holding fixture J 8763-02 and J 38655 onto transmission.

NOTICE: Overtightening of tool could cause case damage and inhibit disassembly.

2. Transmission and holding fixture into J 3289-20.
3. Lock in place with fixture pin.

- Drain transmission fluid.

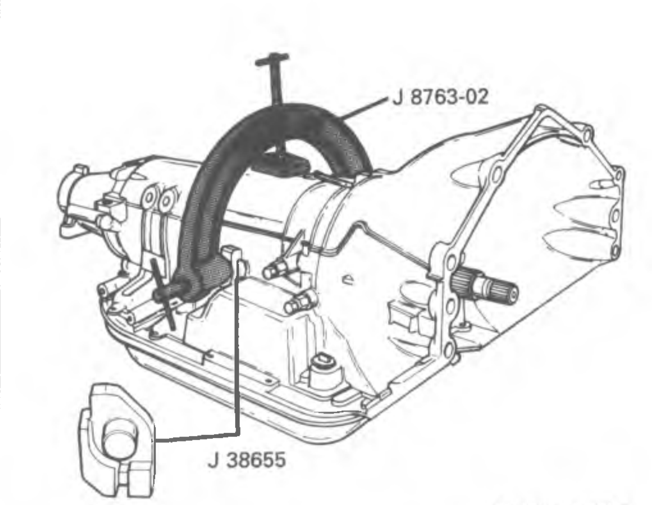


Figure 1 Transmission Holding Fixture, Base and Adapter

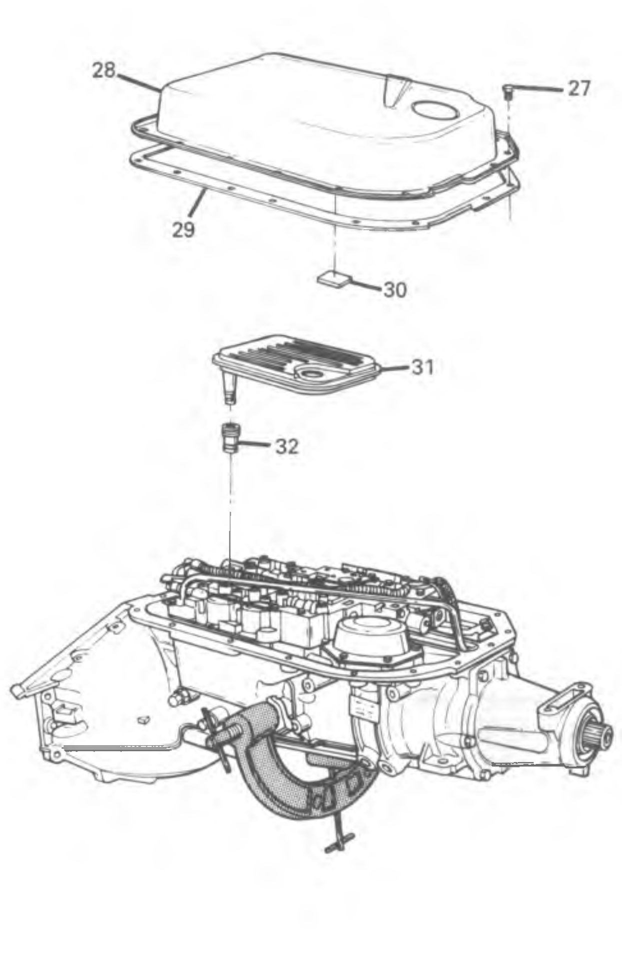
PAN AND FILTER ASSEMBLY

Figure 2

Remove or Disconnect

- Rotate transmission bottom pan up and lock in place with base pin.

1. Seventeen, 10 mm screws (27).
2. Pan (28), gasket (29) and magnet (30).
3. Filter assembly (31) and multilip seal (32).



27 BOLT, HEX FLANGE HD (PAN TO CASE)
28 PAN, TRANSMISSION OIL
29 SEAL, TRANS. OIL PAN
30 MAGNET, CHIP COLLECTOR
31 FILTER ASSEMBLY, TRANSMISSION OIL
32 SEAL ASSEMBLY, FILTER NECK
MH0002-4L80-E

Figure 2 Removing Pan and Filter Assembly

CONTROL VALVE ASSEMBLY

Figure 3

Remove or Disconnect

- Connector wire harness assembly (34) from case and six connectors.

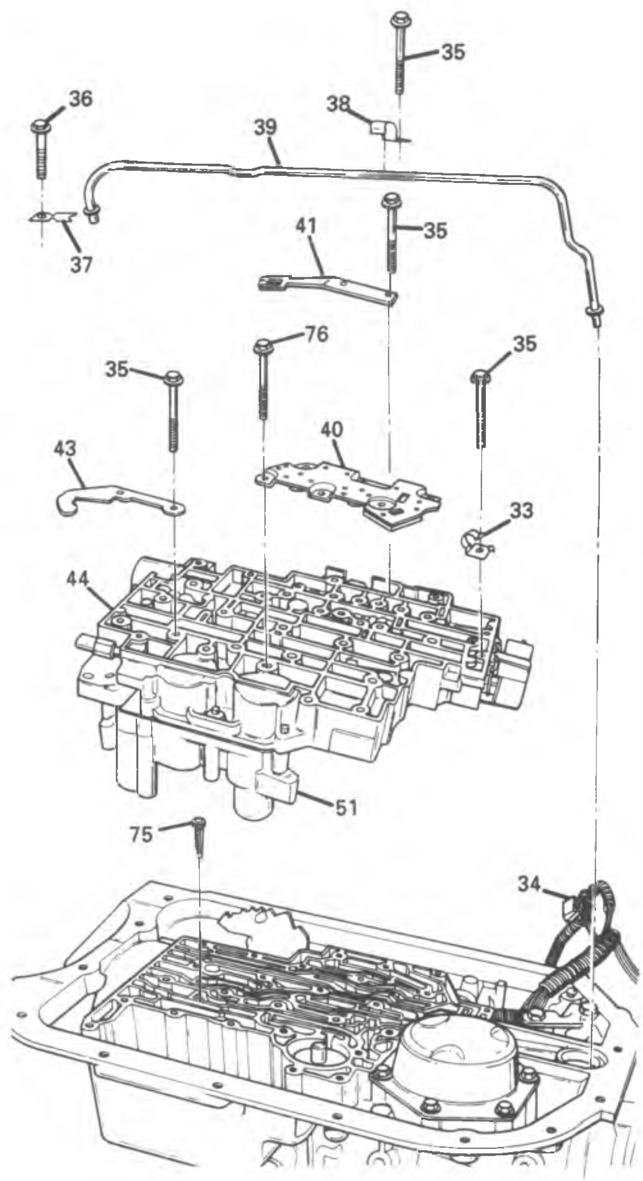
1. Six 8mm bolts (76) and pressure switch manifold assembly (40).

   NOTICE: Be sure five O-rings are attached to pressure switch manifold assembly.

2. Twenty-one, 10 mm bolts (35) from valve body assembly, manual detent spring and roller assembly (41).
3. Three wiring clips (33), fluid level indicator stop (43), one 10mm bolt (36), lube pipe (39), lube pipe retainer (37) and clamp (38).
4. Control valve assembly (44) including the accumulator housing assembly (51), valve body gaskets (45 and 48), spacer plate (46) and accumulator gasket (47).
5. Manual Valve (319) from Control Valve Assembly (301) to prevent any damage.
6. Eight check balls (54) from case passages.

   CAUTION: Do not use magnet. It could cause check ball to be magnetized causing metal chips to stick to the ball.

7. Pulse Width Modulated (PWM) solenoid screen (75).



33 CLAMP, ELECTRICAL CABLE
34 HARNESS ASSEMBLY, ELECTRICAL WIRING
35 BOLT, HEX HD. (M6 X 1.0 X 55.0)
36 BOLT, HEX HD (M6 X 1.0 X 35.0)
37 RETAINER, LUBE PIPE
38 CLAMP, LUBE PIPE
39 PIPE, LUBE
40 MANIFOLD, PRESSURE SWITCH
41 SPRING ASSEMBLY, MANUAL DETENT
43 STOP, OIL (DIPSTICK)
44 BODY ASSEMBLY, CONTROL VALVE
51 HOUSING, ACCUMULATOR
75 SCREEN, PWM SOLENOID
76 BOLT, SPECIAL M6 X 1.0

MH0003-4L80-E

Figure 3 Removing Control Valve Assembly

FRONT AND REAR SERVO

Figures 4 and 5

Remove or Disconnect

1. Front servo piston assembly (55 through 60).
2. Six, 10 mm rear servo bolts (61), cover (62) and gasket (63).
3. Rear servo/accumulator assembly (64 through 74).

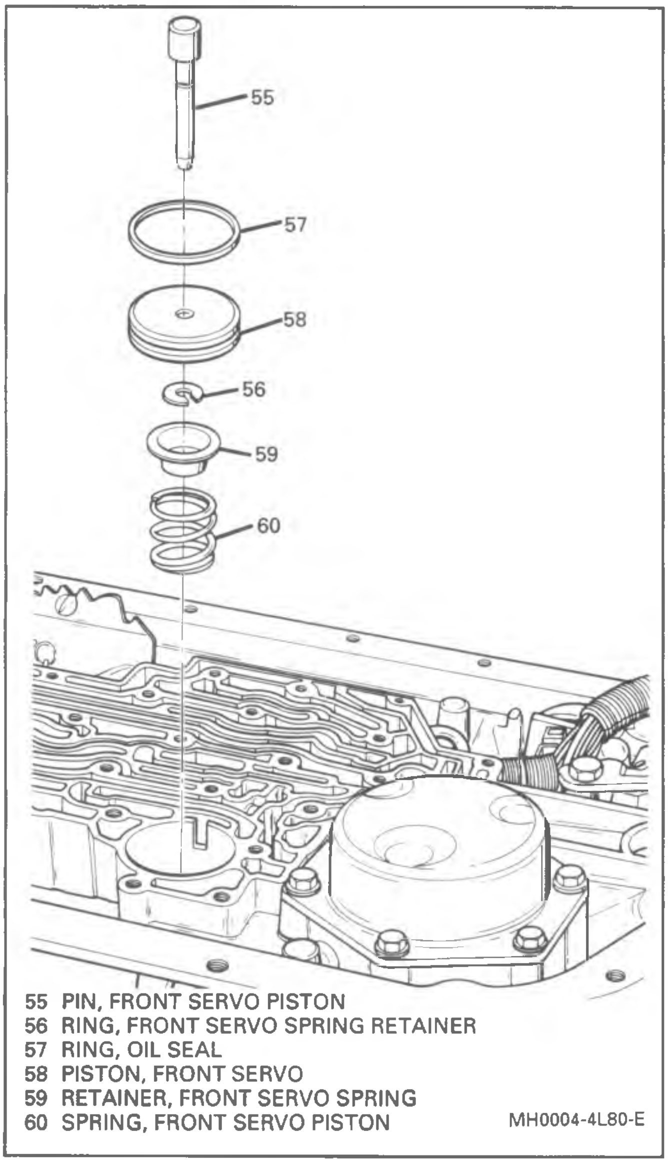


Figure 4 Front Servo Assembly

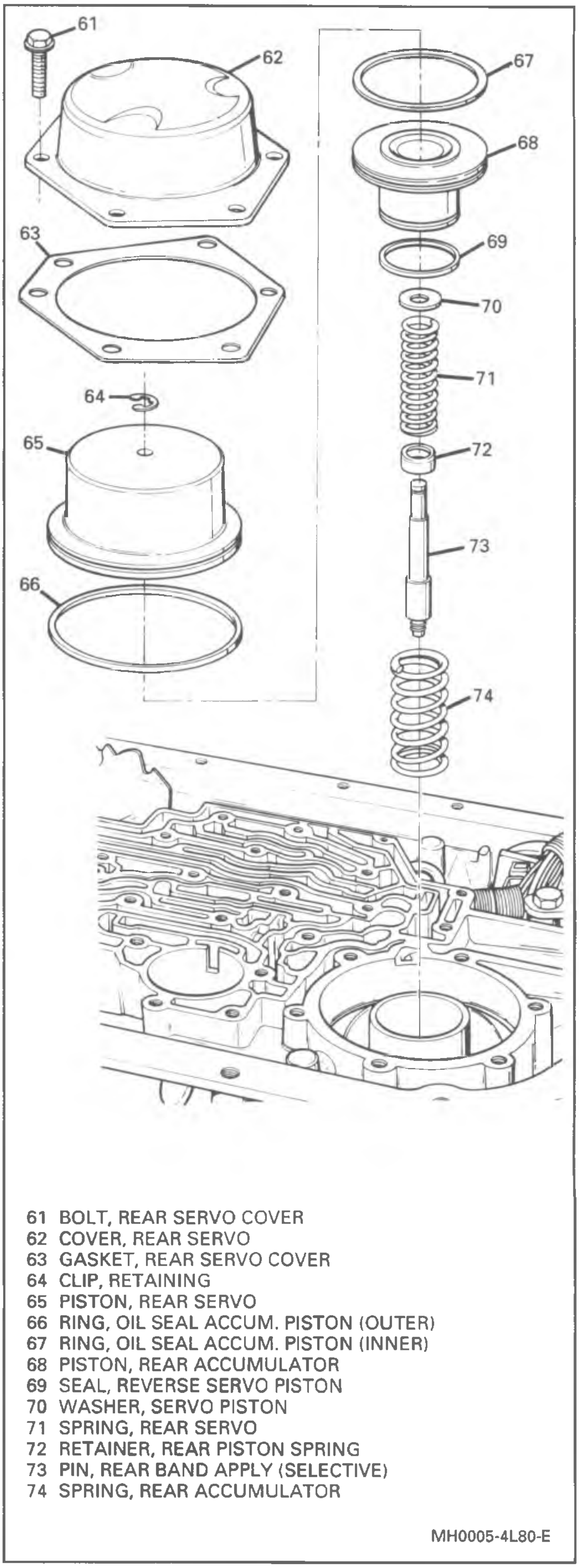


Figure 5 Rear Servo Assembly

BAND APPLY PIN CHECK

Figures 6, 7, and 8

Tools Required:

J 21370-10 Gage Pin
J 38737 Band Apply Pin Checking Tool

Measure

1. Place J 21370-10 in the servo bore.
2. Position J 38737 over the bore with the hex nut facing the parking pawl linkage.
3. Fasten with two rear servo cover bolts (61) 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 8.

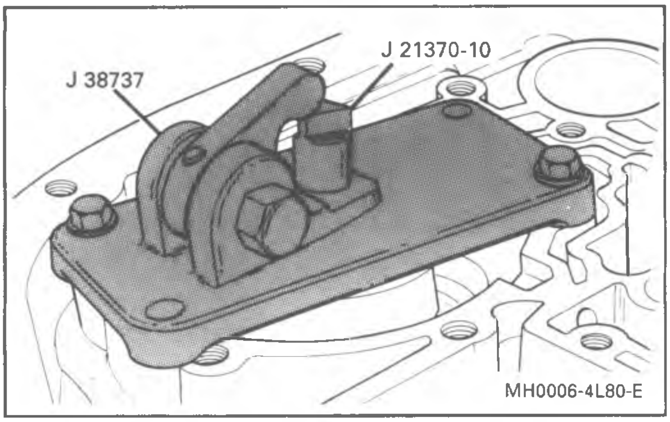


Figure 6 Installing Servo Pin Gage

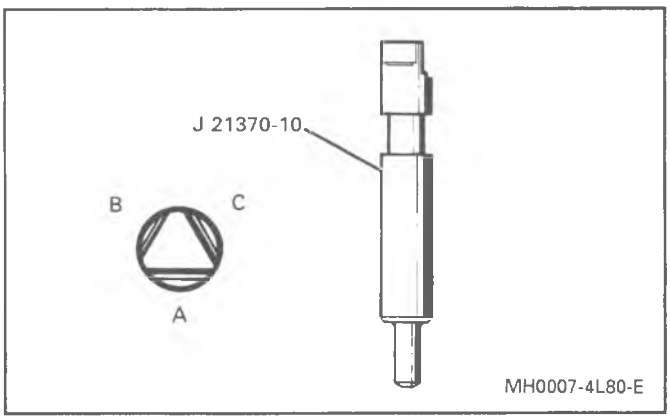


Figure 7 Gage Pin

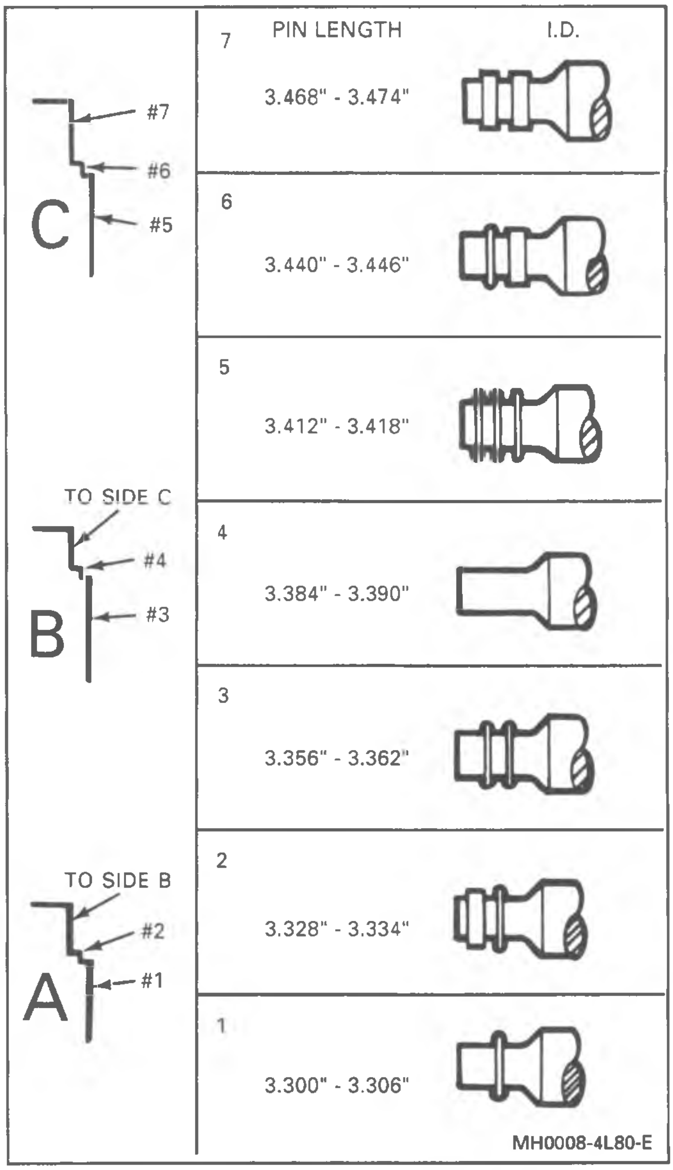


Figure 8 Band Apply Pin Selection Chart

CASE EXTENSION ASSEMBLY

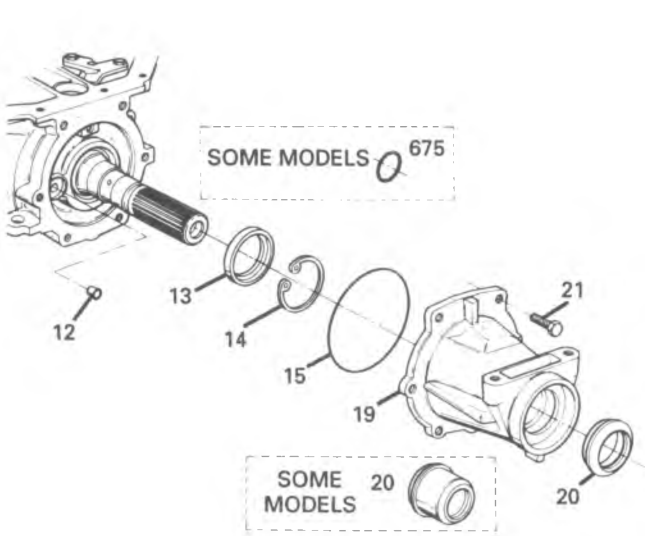
Figure 9

Remove or Disconnect

1. Six, 15 mm bolts (21) and extension assembly (19).
2. O-ring (15).

Inspect

- Output shaft O-ring seal (675) (some models) for damage.



12 CUP, ORIFICE W/SEAL/PLUG-REAR LUBE (4WD)
13 SEAL ASSEMBLY, REAR LUBE
14 RING, SNAP CASE BUSHING
15 RING, SEAL EXTENSION TO CASE
19 EXTENSION ASSEMBLY, CASE
20 HELIXSEAL ASSEMBLY, CASE EXTENSION
21 BOLT, HEX HD (M10 X 1.5 X 30.0)
675 SEAL, O-RING (OUTPUT SHAFT)

MH0009-4L80-E

Figure 9 Removing Case Extension Assembly

PARKING LOCK PAWL AND ACTUATOR ASSEMBLY

Figures 10 and 11

NOTICE: Do not apply excessive force, prying, or hammering to any parking mechanism parts, doing so could cause parking system failure.

Remove or Disconnect

1. Nut (712) and pin (709).
2. Detent lever (711) and actuator assembly (710).
3. Bolts (714) and parking pawl bracket (713).
4. Spring (705).
5. Plug (701) using screw extractor.
6. Parking pawl shaft retainer (704), shaft (702) and pawl (703).
7. Seal (707) and manual shaft (708).

FRONT END PLAY CHECK

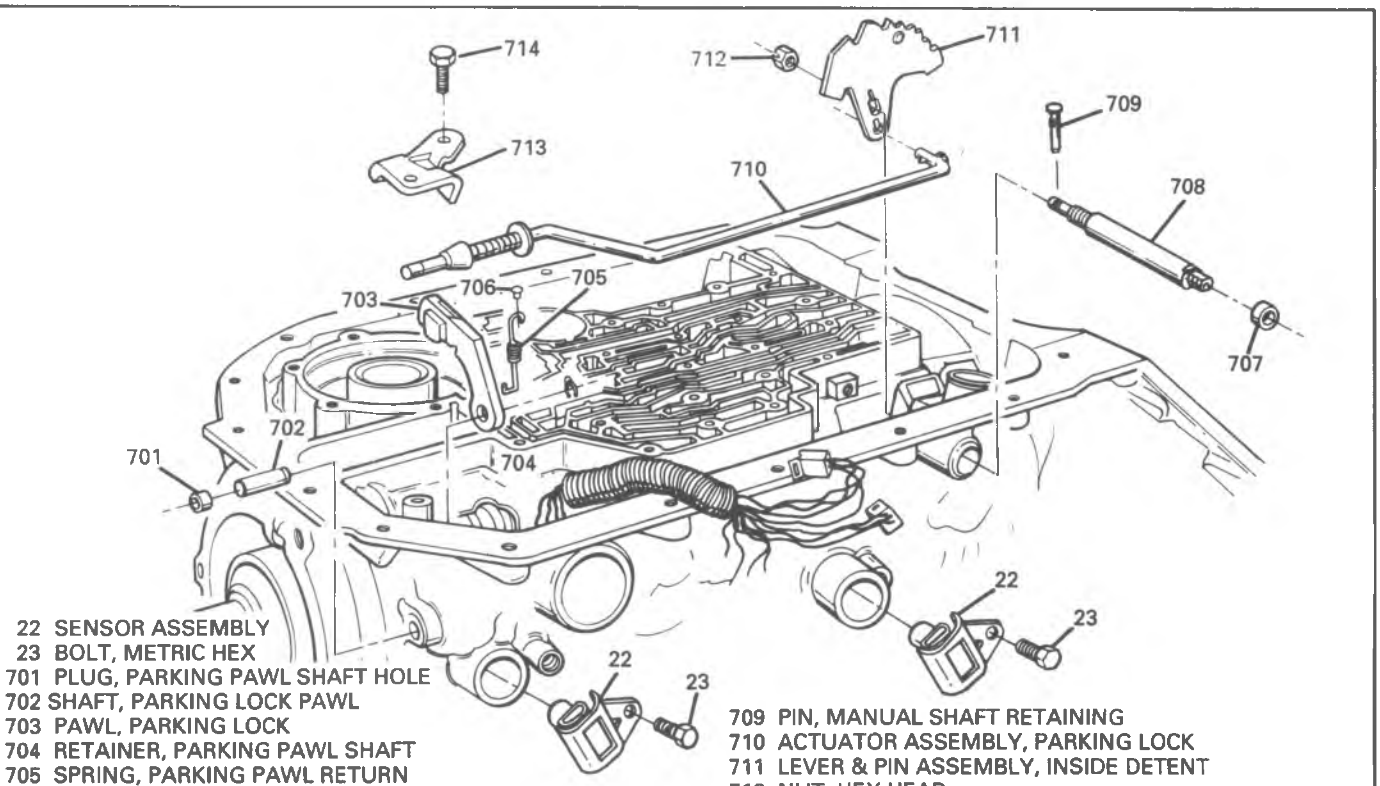
Figures 12 and 13

Tool Required:

J 8001 Dial Indicator Set

Measure

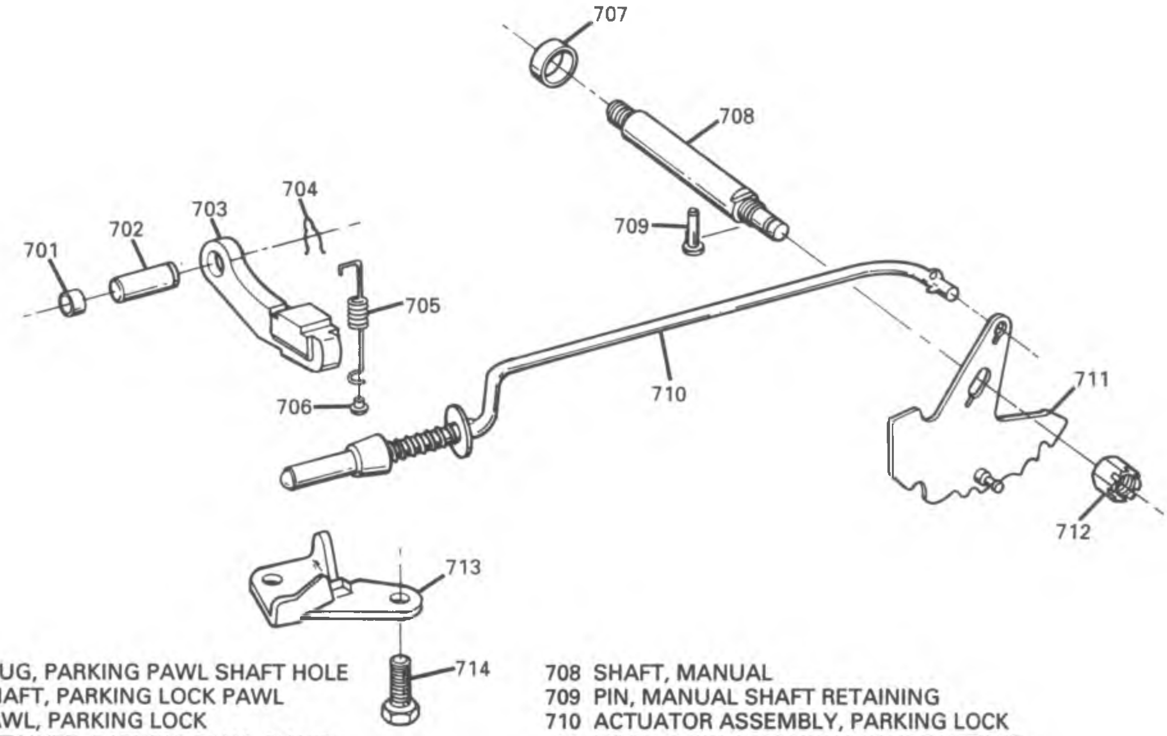
1. Attach J 8001 rod through bell housing hole and secure.



22 SENSOR ASSEMBLY
23 BOLT, METRIC HEX
701 PLUG, PARKING PAWL SHAFT HOLE
702 SHAFT, PARKING LOCK PAWL
703 PAWL, PARKING LOCK
704 RETAINER, PARKING PAWL SHAFT
705 SPRING, PARKING PAWL RETURN
706 STUD, PARKING PAWL RETURN SPRING
707 SEAL ASSEMBLY, MANUAL SHIFT SHAFT
708 SHAFT, MANUAL
709 PIN, MANUAL SHAFT RETAINING
710 ACTUATOR ASSEMBLY, PARKING LOCK
711 LEVER & PIN ASSEMBLY, INSIDE DETENT
712 NUT, HEX HEAD
713 BRACKET, PARKING LOCK
714 BOLT, HEX HD (M8 X 1.25 X 20.0)

MH0010-4L80-E

Figure 10 Removing Parking Lock and Actuator Assembly/Speed Sensors



701 PLUG, PARKING PAWL SHAFT HOLE
702 SHAFT, PARKING LOCK PAWL
703 PAWL, PARKING LOCK
704 RETAINER, PARKING PAWL SHAFT
705 SPRING, PARKING PAWL RETURN
706 STUD, PARKING PAWL RETURN SPRING
707 SEAL ASSEMBLY, MANUAL SHIFT SHAFT
708 SHAFT, MANUAL
709 PIN, MANUAL SHAFT RETAINING
710 ACTUATOR ASSEMBLY, PARKING LOCK
711 LEVER & PIN ASSEMBLY, INSIDE DETENT
712 NUT, HEX HEAD
713 BRACKET, PARKING LOCK
714 BOLT, HEX HD (M8 X 1.25 X 20.0)

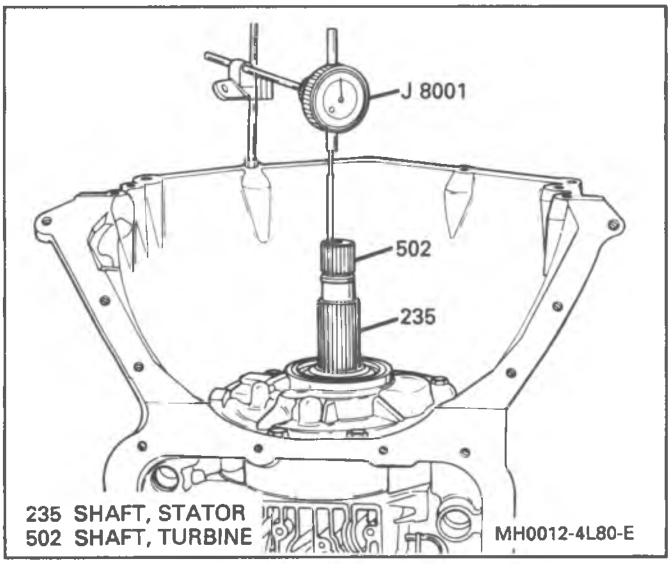
MH0011-4L80-E

Figure 11 Parking Lock and Actuator Assembly

2. Attach J 8001 indicator.
   - Maintain approximately 3 lbs. of lifting force to take up any slack from snap ring to overdrive carrier
   - Index J 8001 dial to "0."
   - Increase lifting force to approximately 20 lbs.
   - End play should be between 0.102 to 0.559 mm (0.004 to 0.022 inch).
3. Select correct washer from chart (Figure 13). Hold until reassembly.
4. Remove tools.

Important

- During reassembly Front End Play Check must be repeated to verify accuracy of selective washer.



235 SHAFT, STATOR
502 SHAFT, TURBINE

MH0012-4L80-E

Figure 12 Front Unit End Play Check

THICKNESS (INCH)	STRIPE
.057 - .061	BLUE
.073 - .077	RED
.089 - .093	BROWN
.105 - .109	GREEN
.121 - .125	PLAIN

MH0013-4L80-E

Figure 13 Selective Thrust Washer Chart

REAR UNIT END PLAY CHECK

Figures 14 and 15

Tool Required:

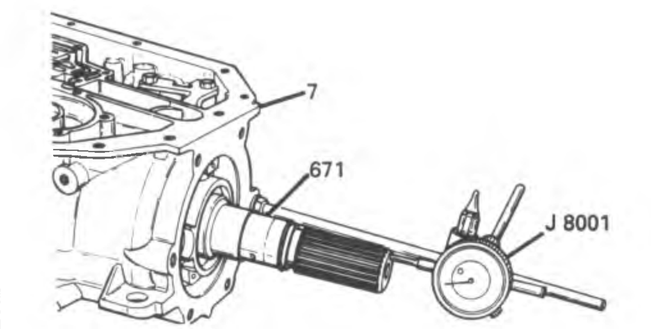
J 8001 Dial Indicator Set

Measure

1. Attach J 8001 rod to one of the bolt holes at the end of the transmission case (7).
2. Push in on output shaft (671) to take up any slack.
3. Attach J 8001 on the rod. Set indicator to "0."
4. Move the output shaft in and out noting the amount of end play. Correct end play is between 0.127 to 0.635 mm (0.005 to 0.025 inch).

Important

- During reassembly, Rear End Play Check must be repeated.



7 CASE ASSEMBLY, COMPLETE
671 SHAFT & BUSHING ASSEMBLY, OUTPUT MH0014-4L80-E

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	ON END OF 1 TAB	4
.106 - .110	ON END OF 2 TABS	5
.114 - .118	ON END OF 3 TABS	6

MH0015-4L80-E

Figure 15 Output/Case Selective Thrust Washer

PUMP ASSEMBLY

Figures 16 and 17

Tool Required:

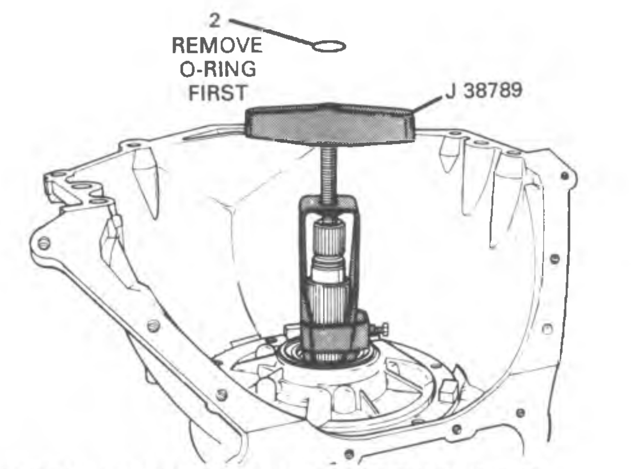
J 38789 Pump Remover

Remove or Disconnect

1. O-ring turbine shaft (2).

NOTICE: Pump assembly can not be removed without damage to the O-ring.

2. Seven 13 mm bolt and O-ring assemblies (3).
3. Attach tool J 38789.
4. Pump assembly (4).
5. Tool J 38789.
6. Gasket (6).
7. Selective thrust washer (218).



2 SEAL, "O" RING (TURBINE SHAFT/TURBINE HUB)
MH0016-4L80-E

Figure 16 Removing Pump Assembly

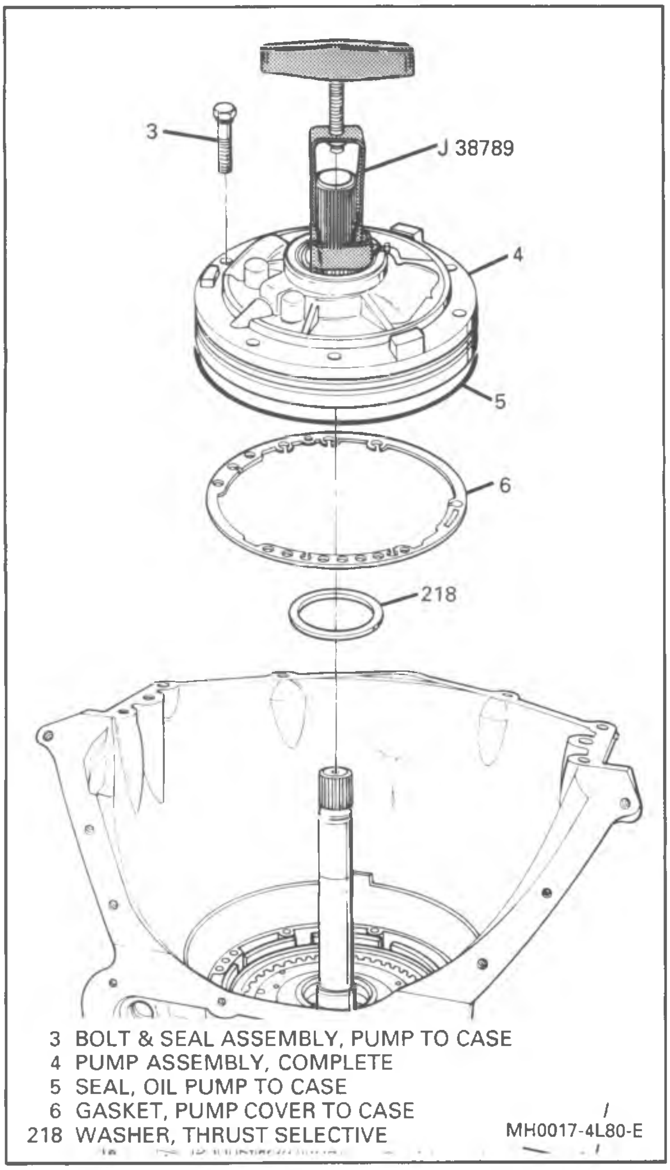


Figure 17 Pump Assembly and Selective Thrust Washer

OVERDRIVE UNIT AND FOURTH CLUTCH ASSEMBLY

Figures 18, 19 and 20

Remove or Disconnect

1. Overdrive unit assembly (504) and turbine shaft (502).
2. Recheck Fourth Clutch Bolt (26). Torque should be 15 N·m minimum (133 in. lb. minimum).
3. Fourth clutch bolt (26) using 40T torx head socket.

NOTICE: Discard bolt, do not reuse! Damage could result to the Fourth Clutch Housing.

4. Fourth clutch assembly complete (529).

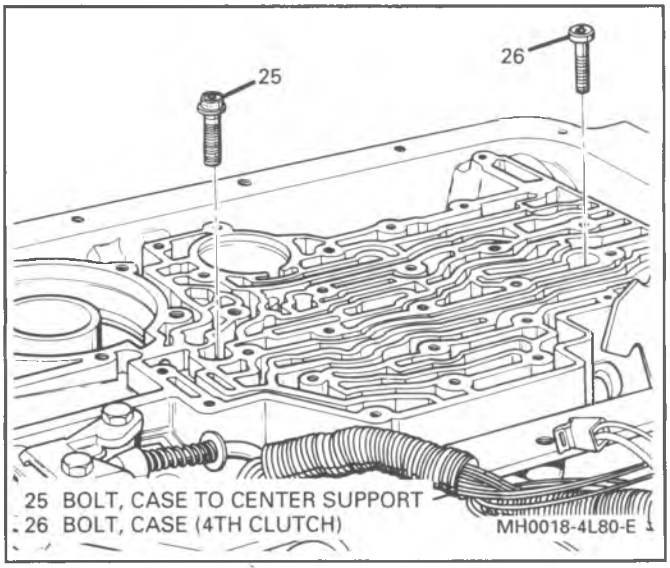


Figure 18 4th Clutch Bolt and Center Support Bolt Location

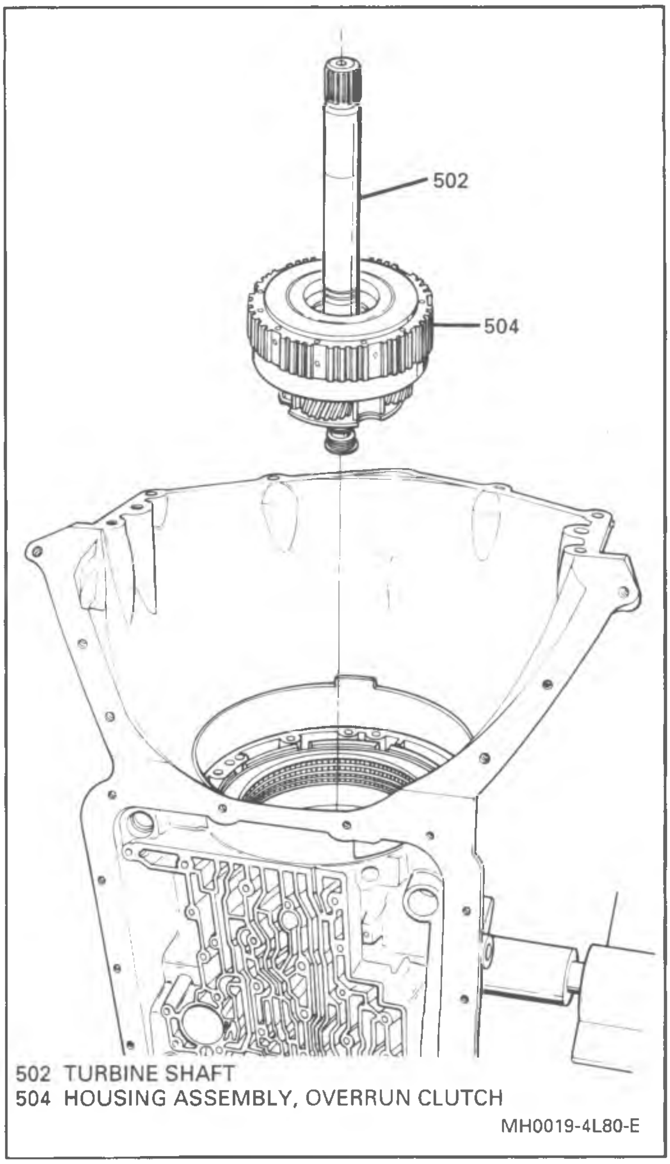


Figure 19 Removing Overdrive Clutch Assembly

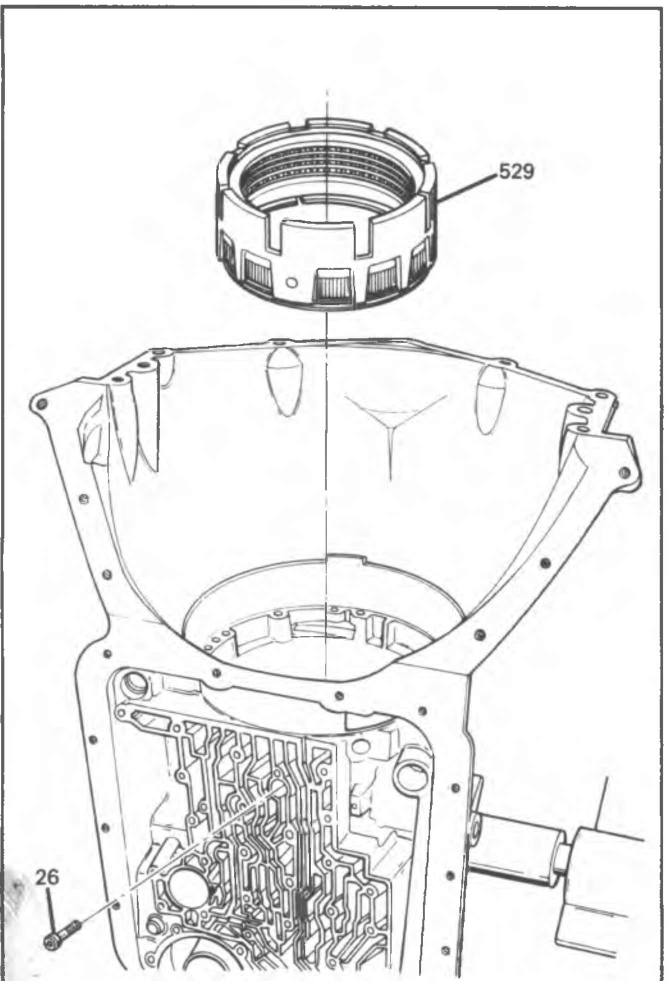


Figure 20 Removing 4th Clutch Assembly

FORWARD CLUTCH ASSEMBLY

Figure 21

Tool Required:

J 38358-A Forward Clutch Assembly Remover and Installer

Remove or Disconnect

1. Bearing assembly (601). From top of forward clutch housing.

Important

- Notice the position of the bearing during removal, to insure proper installation during reassembly.

2. Forward clutch assembly complete (602).
3. Thrust washer (612). This washer may be stuck to the bottom of the forward clutch assembly or top of direct clutch housing.

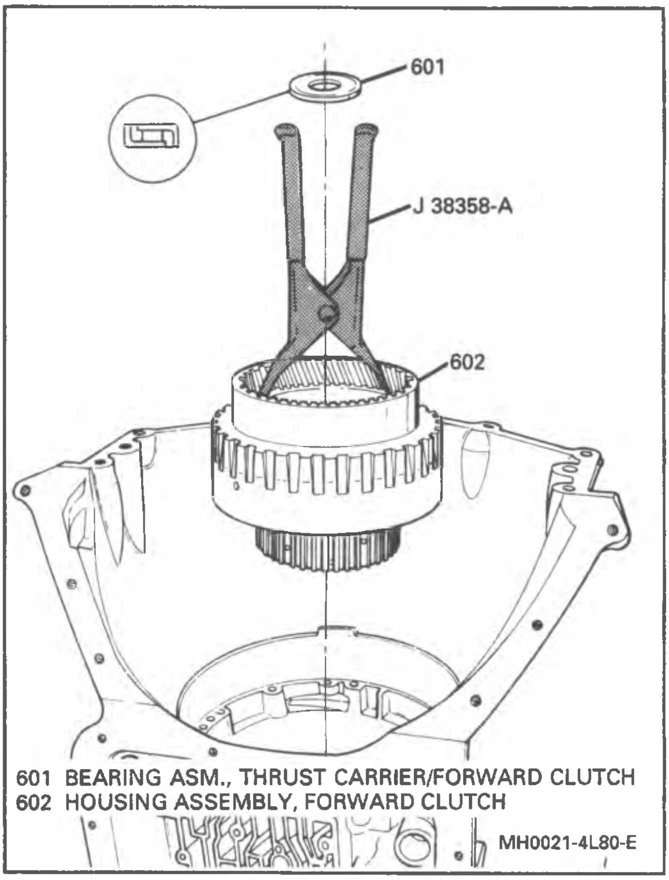


Figure 21 Removing Forward Clutch Assembly

DIRECT CLUTCH ASSEMBLY

Figure 22

Tool Required:

J 38733 Direct Clutch Assembly Remover

Remove or Disconnect

1. Direct clutch housing assembly (623).
2. Front band (628).

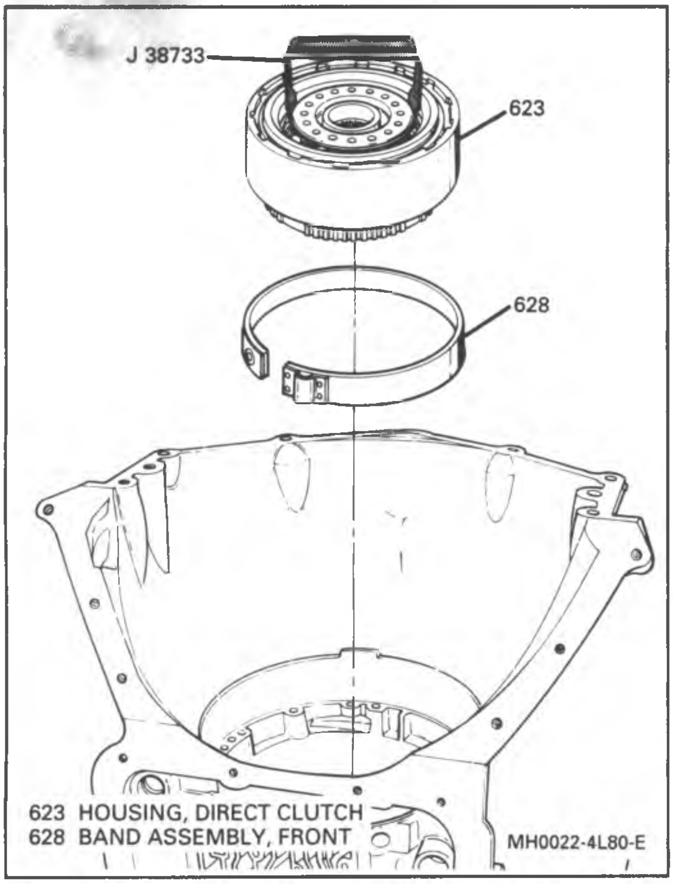


Figure 22 Removing Direct Clutch Housing Assembly

INTERMEDIATE CLUTCH ASSEMBLY

Figure 23

Remove or Disconnect

1. Snap ring (629).
2. Intermediate clutch backing plate (630).
3. Clutch plates (631 and 632), four each.

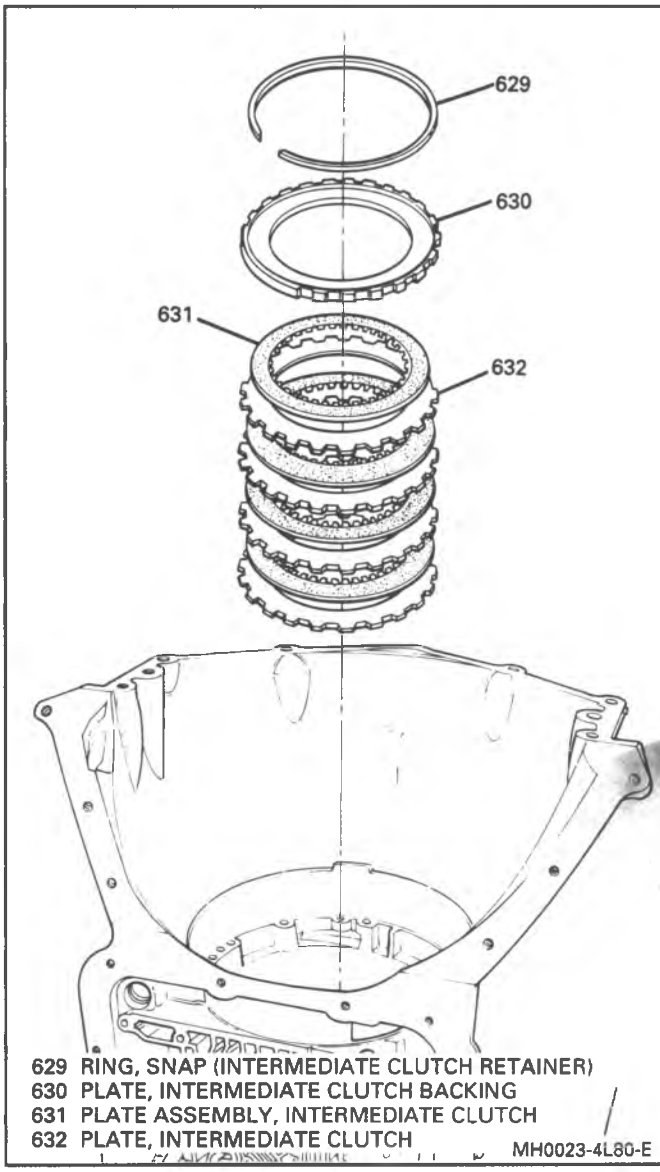


Figure 23 Removing Intermediate Clutch

CENTER SUPPORT AND GEAR UNIT ASSEMBLY

Figures 24, 25 and 26

Tools Required:

J 6116-01 Gear Holding Fixture
J 21364-A Adapter
J 38868 Gear Assembly Remover and Installer

NOTICE: If Center Support Bolt (25) is removed, a new center support (640) and bolt (25) should be installed during reassembly to avoid component damage.

Remove or Disconnect

- Check torque of bolt (25).

1. Center support bolt (25). **Discard bolt do not reuse!**
2. Snap ring (633).

- Attach tool J 38868 to main shaft (662).

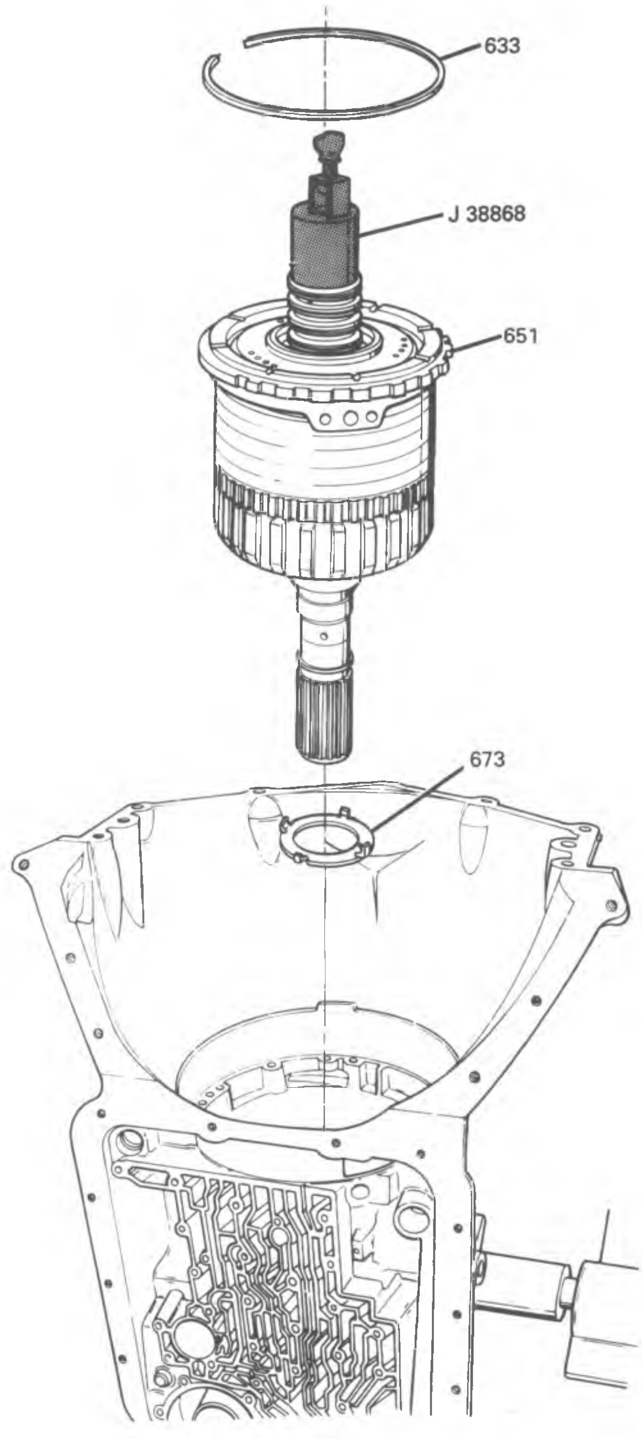
3. Center support assembly (634-641) and gear unit assembly (642-672) using tool J 38868.

- Place center support assembly and gear unit assembly into J 6116-01 fixture.

4. Tool J 38868.
5. Spacer (643).
   - Location of thin spacer (643) located at bottom of case splines.
6. Rear band (657), thrust washer (673) and selective thrust washer (674).

Important

- Thrust washer (674) may be attached to the output shaft and gear unit assembly.



633 RING, SNAP CENTER SUPPORT/CASE
651 DRUM & CARRIER ASSEMBLY, REACTION
673 WASHER, THRUST

MH0024-4L80-E

Figure 24 Removing Center Support and Gear Unit Assembly

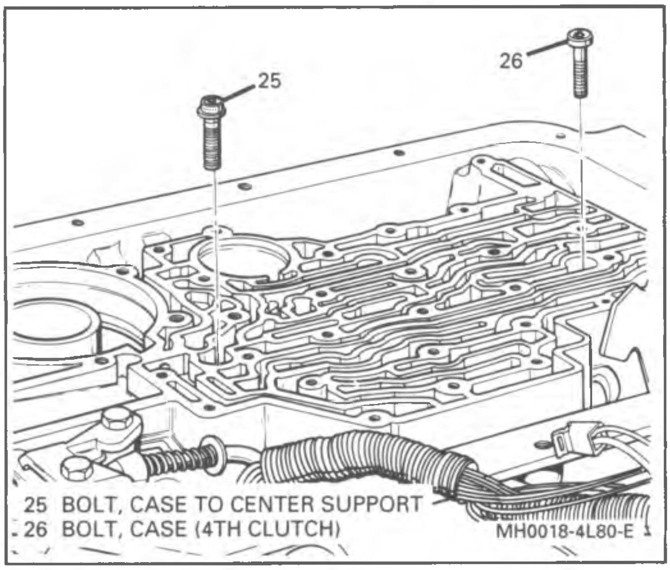


Figure 25 4th Clutch Bolt and Center Support Bolt Location

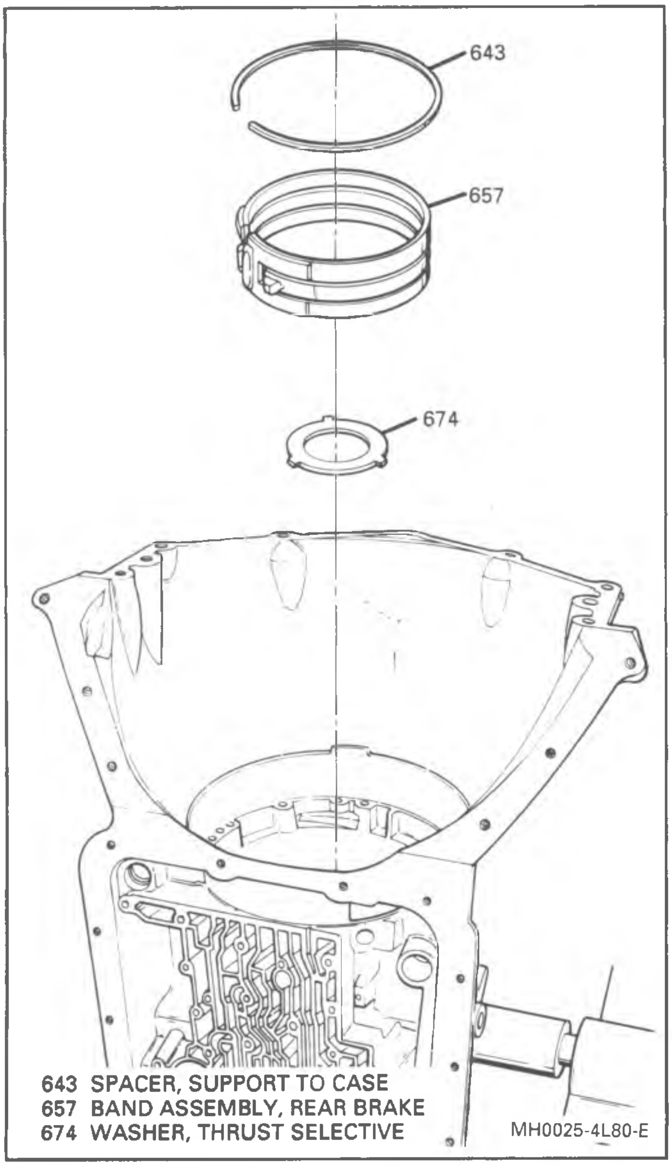


Figure 26 Removing Rear Band and Selective Thrust Washer

TRANSMISSION CASE

Figure 27

Inspect

1. Case (7) for:
   - cracks
   - porosity
   - connected passages
   - scored bushing (78)
   - excess gasket material left on surfaces
2. Case extension (19) for:
   - cracks
   - porosity
   - scored bushing (77)
3. All threaded holes for:
   - damage
     - Heli-coil to repair damage
4. Air check all fluid passages.
   - See Diagnosis Section for fluid passage identification
5. Front and rear servo bores for:
   - porosity
   - burrs
   - damage
6. Two cooler connectors (8) for:
   - damage
   - proper torque 35 N·m (26 lb. ft.)
7. Intermediate clutch plate lugs for:
   - damage or hardening
8. Snap ring grooves for:
   - damage.
9. Case center support bolt hole for:
   - damage.
10. Speed sensors and brackets.
11. Pipe vent (9).
12. 2-3 Drive passage filter.
13. Rear case seal and snap ring.
14. Manual shaft seal.

Clean

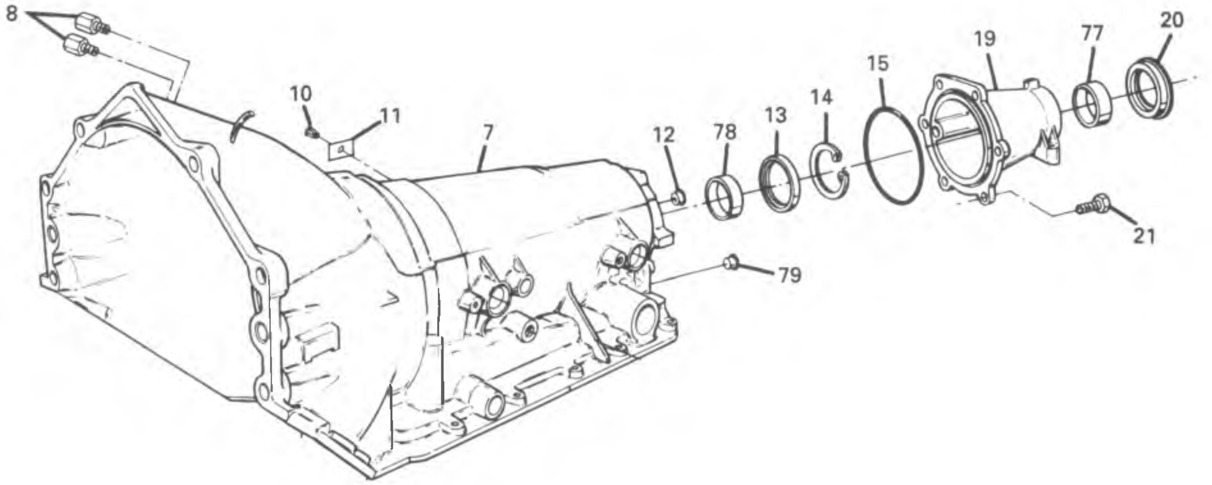
- All components

TRANSMISSION ASSEMBLY

Figures 28, 29 and 30

The assembly of some components will require use of an assembly lube. It is recommended that TRANSJEL™ J 36850 or the equivalent of petroleum jelly be used during assembly.

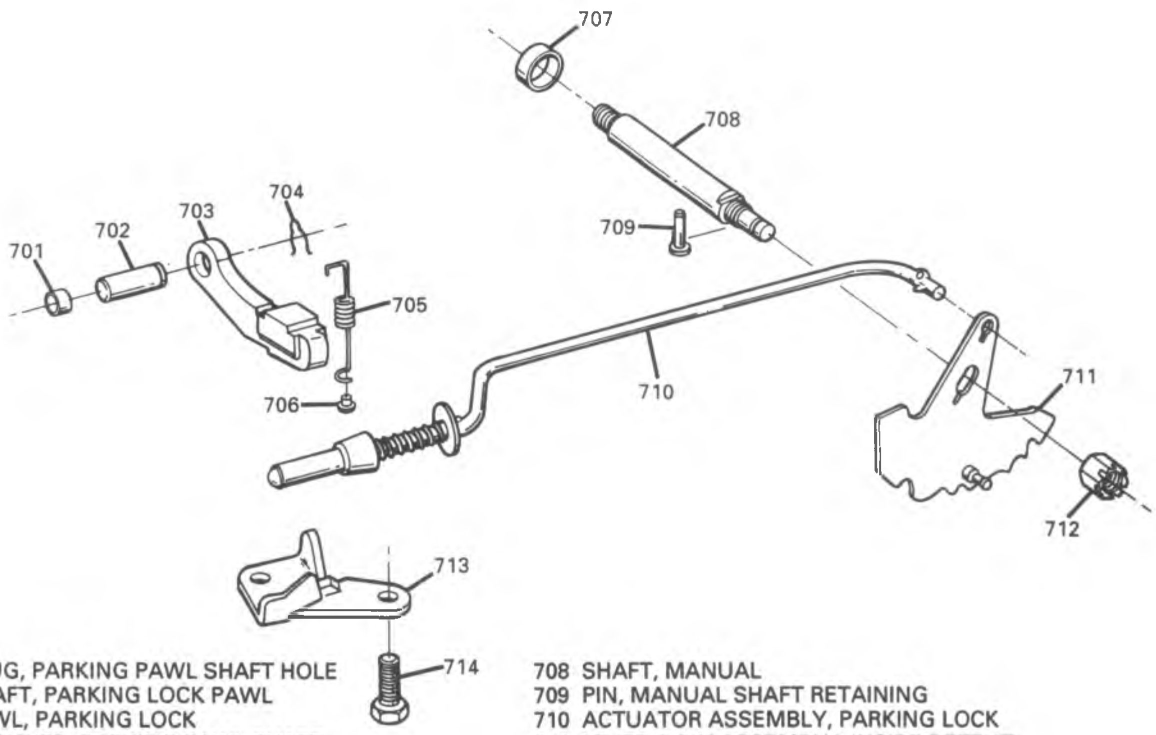
NOTICE: Do not use any type of grease to retain parts during assembly of this unit. Greases other than the recommended assembly lube will change transmission fluid characteristics and cause undesirable shift conditions and/or filter clogging.



7 CASE ASSEMBLY, COMPLETE
8 FITTING, COOLER PIPE
10 SCREW, NAMEPLATE
11 NAMEPLATE
12 CUP, ORIFICE W/SEAL
13 SEAL ASSEMBLY, REAR LUBE
14 RING, SNAP CASE BUSHING
15 RING, SEAL EXTENSION TO CASE
19 EXTENSION ASSEMBLY, CASE
20 HELIXSEAL ASSEMBLY, CASE EXTENSION
21 BOLT, HEX HD (M10 X 1.5 X 30.0)
77 BUSHING, CASE EXTENSION
78 BUSHING, CASE TRANS.
79 PLUG, DIRECT OIL

MH0026-4L80-E

Figure 27 Transmission Case and Extension Assembly



701 PLUG, PARKING PAWL SHAFT HOLE
702 SHAFT, PARKING LOCK PAWL
703 PAWL, PARKING LOCK
704 RETAINER, PARKING PAWL SHAFT
705 SPRING, PARKING PAWL RETURN
706 STUD, PARKING PAWL RETURN SPRING
707 SEAL ASSEMBLY, MANUAL SHIFT SHAFT
708 SHAFT, MANUAL
709 PIN, MANUAL SHAFT RETAINING
710 ACTUATOR ASSEMBLY, PARKING LOCK
711 LEVER & PIN ASSEMBLY, INSIDE DETENT
712 NUT, HEX HEAD
713 BRACKET, PARKING LOCK
714 BOLT, HEX HD (M8 X 1.25 X 20.0)

MH0011-4L80-E

Figure 28 Parking Lock and Actuator Assembly

PARKING LOCK PAWL AND ACTUATOR ASSEMBLY

Figure 28

Inspect

1. Parking pawl (703) for:
   - cracks
   - burrs
   - damage
2. Parking pawl shaft (702) for:
   - damage
   - freeness of fit
3. Parking pawl return spring (705) for:
   - distortion
   - damage
4. Parking pawl return spring stud (706) for:
   - tightness
5. Detent lever (711) and actuator (710) for:
   - cracks
   - damage
6. Manual shaft (708) for:
   - damaged flats or threads

Install or Connect

Figures 29 and 30

NOTICE: Do not apply excessive force, prying, or hammering to any parking mechanism parts, doing so could cause parking system failure.

1. Pawl shaft (702).
2. Parking pawl (703).
3. Plug (701) (using 5/16 rod) with loctite.
4. Retainer (704).
5. Pawl return spring (705).
6. Detent lever (711) to actuator assembly (710).
7. Actuator assembly (710) over parking pawl (703).
8. Seal (707) and manual shaft (708).
9. 15 mm nut (712) on shaft (708).

   Tighten
   - Nut (712) to 24 N·m (18 lb. ft.)
10. Roll pin (709).
11. Parking lock bracket (713) with two bolts (714).

    Tighten
    - Bolts (714) to 24 N·m (18 lb. ft.)

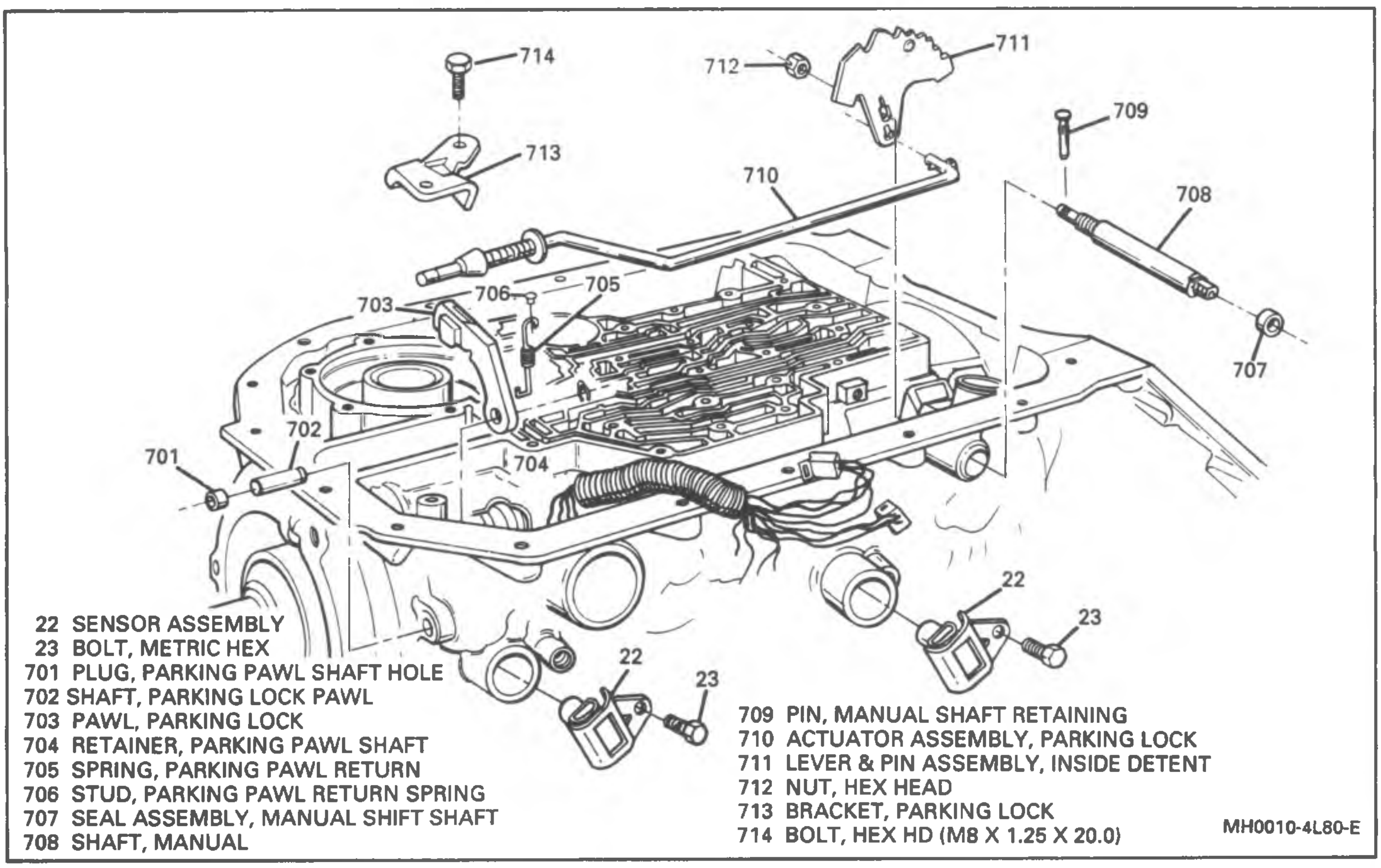
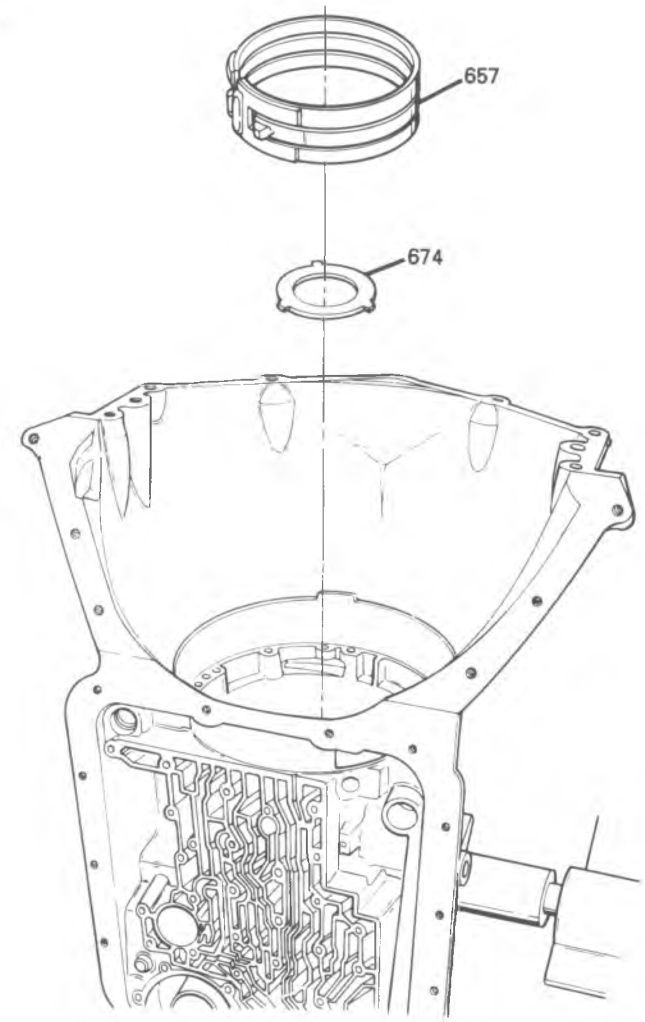


Figure 29 Removing Parking Lock and Actuator Assembly/Speed Sensors



657 BAND ASSEMBLY, REAR BRAKE
674 WASHER, THRUST SELECTIVE OUTPUT/CASE

MH0027-4L80-E

Figure 30 Installing Rear Band and Selective Thrust Washer

REAR BAND AND SELECTIVE THRUST WASHER

Figure 30

Inspect

- Rear band (657) and selective thrust washer (674) for:
  - wear
  - damage

Install or Connect

1. Selective thrust washer (674) determined by Rear End Play Measurement. Smooth side facing up. Retain with Transjel ™ J 36850 or equivalent.
2. Rear band (657).
   - Make sure band tab lines up with servo pin hole.

GEAR UNIT AND OUTPUT ASSEMBLIES

Figures 31 and 32

Disassemble

Figure 31

1. Center support (640).
2. Sun gear shaft (649).
3. Reaction drum and carrier assembly (651).
4. Output carrier assembly (661).
5. Thrust bearing (647) and races (646 and 648).
6. Sun gear (650), front internal reaction carrier washer (659) and front internal gear ring (658).
7. Snap ring (670), output shaft (671).
8. Thrust bearing (647) and races (648 and 669).
9. Rear internal gear (666) and main shaft (662).
10. Snap ring (670) from main shaft (662).
11. Main shaft (662).
12. Thrust bearing (664) and races (663 and 665).

Clean

- All Components

Inspect

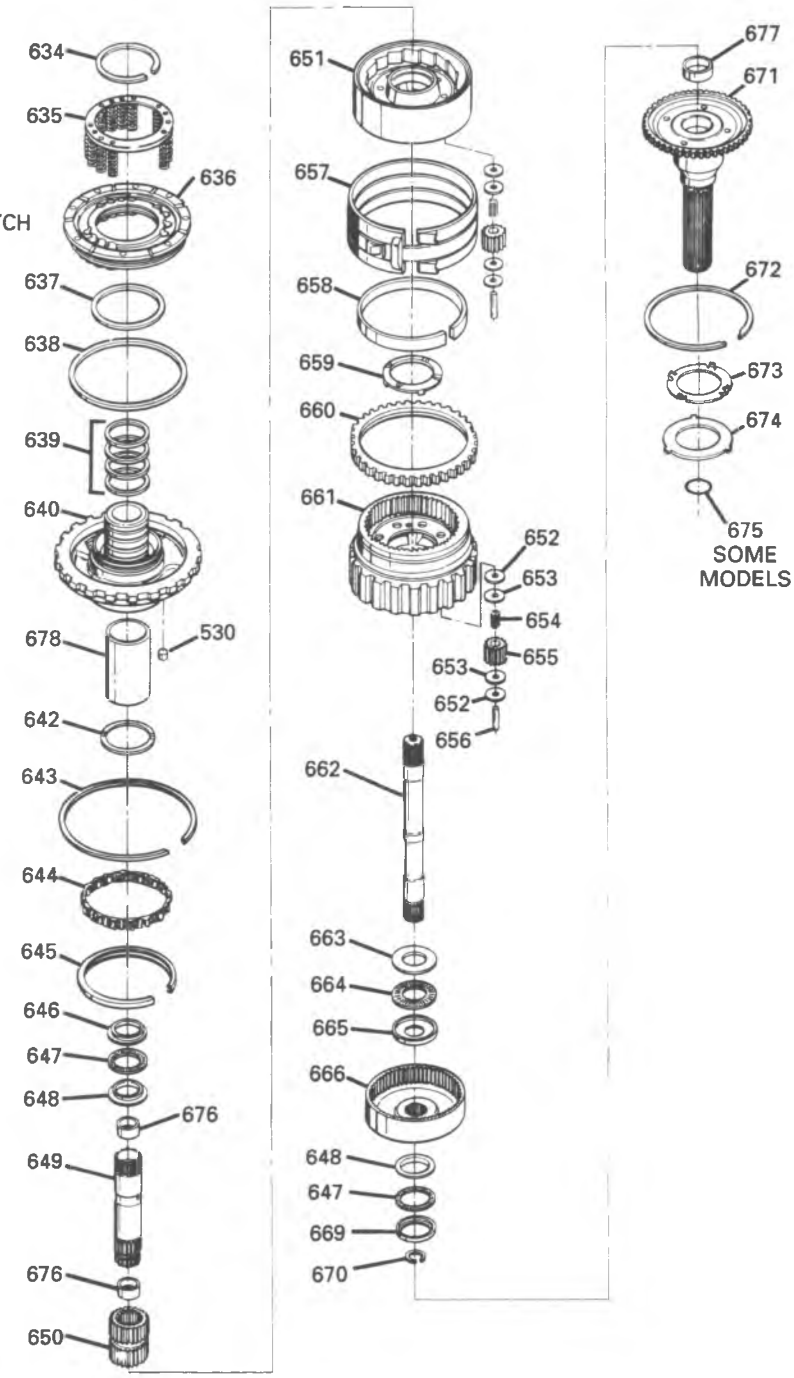
Figures 31 and 32

1. Main shaft (662) for:
   - damaged splines
   - wear
2. Rear internal gear (666) for:
   - stripped splines
   - damaged teeth
   - wear
3. Output shaft (671) for:
   - stripped splines
   - damaged teeth
   - cracks
   - damaged bushing
4. Output carrier assembly (661) for:
   - wear
   - damaged lugs
   - pinion gear damage
   - washer wear
   - pinion gear and pocket thrust surfaces damage

Inspect

- Excess pinion washer wear (end play should be 0.228 to 0.610 mm (0.009 to 0.024 inch) using feeler gage

530 PLUG, ORIFICE CENTER SUPPORT
634 RING, SNAP INTERMEDIATE CLUTCH
635 SPRING & RETAINER ASM., INTERMEDIATE CLUTCH
636 PISTON, INTERMEDIATE CLUTCH
637 SEAL, INTERMEDIATE CLUTCH (INNER)
638 SEAL, INTERMEDIATE CLUTCH (OUTER)
639 RING, OIL SEAL
640 SUPPORT & RACE ASSEMBLY, CENTER
641 PLUG, ORIFICE CENTER SUPPORT
642 WASHER, THRUST SUPPORT/REACTION DRUM
643 SPACER, SUPPORT TO CASE
644 ROLLER CLUTCH ASSEMBLY
645 RING, REACTION DRUM SPACER
646 RACE, THRUST BEARING TO CENTER SUPPORT
647 BEARING, NEEDLE THRUST
648 RACE, THRUST BEARING
649 SHAFT ASSEMBLY, SUN GEAR
650 GEAR, SUN
651 DRUM & CARRIER ASSEMBLY, REACTION
652 WASHER, PINION THRUST
653 WASHER, PINION THRUST
654 ROLLER, NEEDLE BEARING
655 PINION, PLANET
656 PIN, PLANET PINION
657 BAND ASSEMBLY, REAR BRAKE
658 RING, FRONT INTERNAL GEAR
659 WASHER, FRONT INTERNAL/REACTION CARRIER
660 RING, OUTPUT SPEED SENSOR
661 CARRIER ASSEMBLY, OUTPUT
662 SHAFT, TRANSMISSION MAIN
663 RACE, THRUST BEARING TO SUN GEAR
664 BEARING, NEEDLE THRUST RR INTERNAL GEAR
665 RACE, THRUST BEARING TO RR INTERNAL GEAR
666 GEAR, REAR INTERNAL
669 RACE, THRUST BEARING TO OUTPUT SHAFT
670 RING, SNAP MAINSHAFT INTERNAL GEAR
671 SHAFT & BUSHING ASSEMBLY, OUTPUT
672 RING, SNAP (OUTPUT SHAFT/ FRONT INTERNAL GEAR)
673 WASHER, THRUST (INPUT DRUM/HSG.) OUTPUT
674 WASHER, THRUST SELECTIVE OUTPUT/CASE
675 SEAL, O-RING OUTPUT SHAFT
676 BUSHING, SUN GEAR SHAFT
677 BUSHING, OUTPUT SHAFT
678 BUSHING, CENTER SUPPORT



MH0028-4L80-E

Figure 31 Center Support and Gear Unit Assembly

5. Front internal gear ring (658) for:
   - damage
   - cracks
6. Thrust washers (659, 673, and 674), bearings (647 and 664) and races (646, 648, 663, 665, and 669) for:
   - damage
7. Ring output speed sensor (22) for:
   - tightness

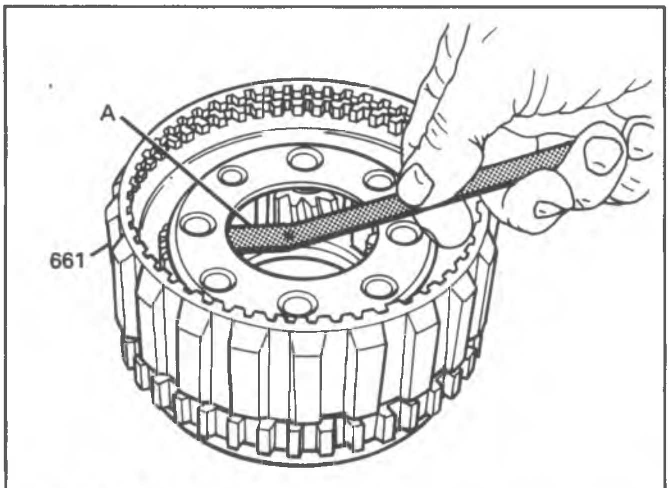


Figure 32 Measuring Pinion End Play

REACTION DRUM AND CARRIER ASSEMBLY

Figures 31 and 33

Inspect

1. Reaction drum and carrier assembly (651) for:
   - pinion gear and pocket thrust surfaces for damage
   - cracks or damage to band apply surface
   - pinion gear damage

   Measure

   - excess pinion washer wear using feeler gauge (end play should be 0.228 to 0.610 mm (0.009 to 0.024 inch)
2. Roller clutch assembly (644) for:
   - damage to rollers, springs and cage surfaces
3. Reaction drum spacer ring (645) for:
   - damage

Assemble

1. Reaction drum spacer ring (645) into reaction drum (651).
2. Roller clutch assembly (644) into reaction drum (651).

Inspect

- Sun gear (650) and sun gear shaft (649) for:
  - nicked, scored or worn bushings (676).
  - damaged splines or teeth
  - cracks

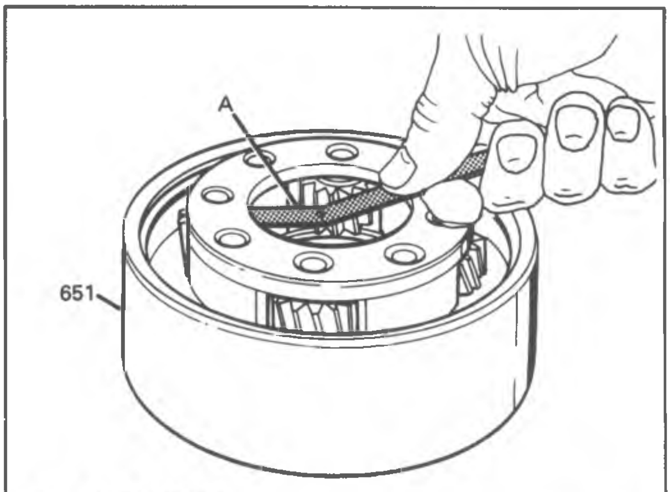


Figure 33 Measuring Reaction Carrier Pinion End Play

CENTER SUPPORT ASSEMBLY

Figures 34 through 37

Tools Required:

J 6116-01 Rear Gear Assembly Holding Fixture
J 21363 Intermediate Clutch Inner Seal Protector
J 23327 Clutch Spring Compressor
J 38734 Intermediate Clutch Piston Compressor Adapter
J 38735-1 Solid Seal Installer
J 38735-2 Seal Sizer
J 38735-3 Seal Pusher

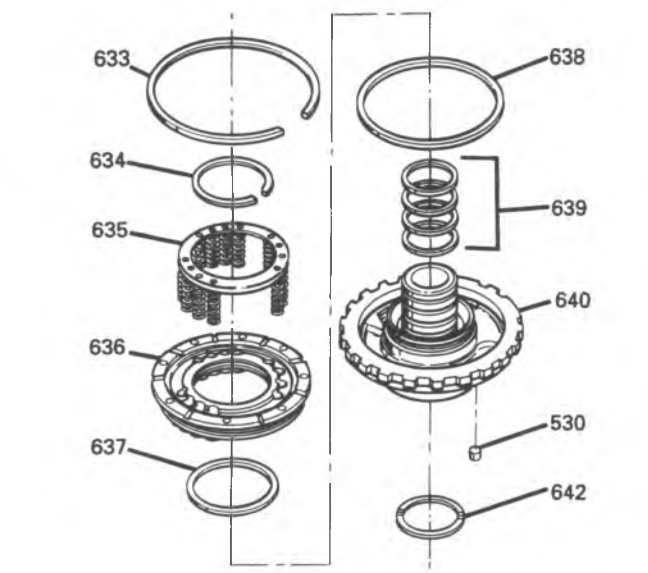
Remove or Disconnect

Figure 34

1. Press in on spring retainer (635) and remove snap ring (634). Using J 38734 Adapter.
2. Spring and retainer assembly (635).
3. Clutch piston (636).
4. Inner seal (637) and outer seal (638) from clutch piston (636).

Important

- Do not remove three bolts holding roller clutch race to center support (640). A new center support assembly (640) and bolt (25) should be used for any overhaul.



530 PLUG, ORIFICE CENTER SUPPORT
633 RING, SNAP CENTER SUPPORT/CASE
634 RING, SNAP INTERMEDIATE CLUTCH
635 SPRING & RETAINER ASM., INTERMEDIATE CLUTCH
636 PISTON, INTERMEDIATE CLUTCH
637 SEAL, INTERMEDIATE CLUTCH (INNER)
638 SEAL, INTERMEDIATE CLUTCH (OUTER)
639 RING, OIL SEAL
640 SUPPORT & RACE ASSEMBLY, CENTER
642 WASHER, THRUST SUPPORT/REACTION DRUM

MH0031-4L80-E

Figure 34 Center Support and Intermediate Clutch Piston

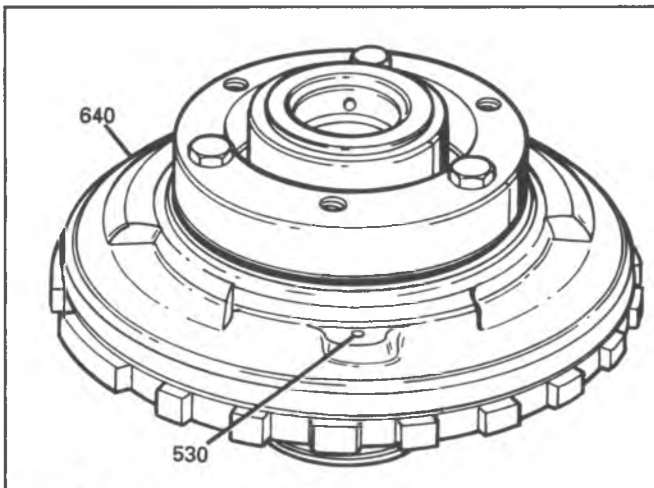
Clean

- All components

Inspect

Figures 34, 35 and 37

1. Roller clutch race on *new* center support (640) for:
   - scratches
   - wear
   - damage
2. New center support (640) for:
   - cracks
   - damaged lugs
   - damaged center support bolt threads
3. Ring grooves on *new* center support (640) for:
   - damage
   - burrs
   - cuts
4. Intermediate clutch piston (636) for:
   - cracks
   - damage
5. Sealing surfaces and seal grooves for:
   - scratches
   - damage
6. Springs (635) for:
   - collapsed coils
   - distortion
7. Cup plug (530), orifice is open approximately 0.51 mm (0. 020 inch).
8. Bushing (678) for:
   - scores
   - damage



530 PLUG, ORIFICE CENTER SUPPORT
640 SUPPORT & RACE ASSEMBLY, CENTER MH0032-4L80-E

Figure 35 Constant Bleed Orifice

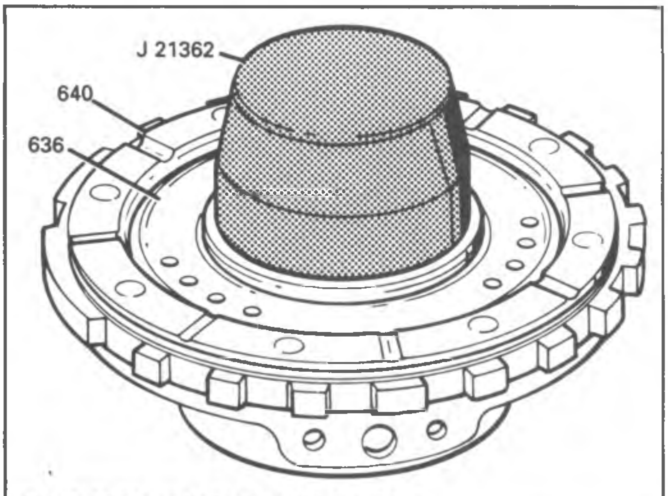
Assemble

Figures 34, 36 and 37

1. Lubricate new inner and outer clutch piston seals (637 and 638) and seal pockets in housing with DEXRON®-II transmission fluid.
2. Seals (637 and 638) on piston (636) with lips facing away from spring pockets.
3. Clutch piston (636) on center support (640) with J 21363.
4. Spring and retainer assembly (635) and snap ring (634). Using J 38734 Compressor Adapter. Align springs with pockets in housing.
5. New seal rings (639) on new center support hub (640) using seal tools J 38735.
   - Use TRANSJEL™ J 36850 or equivalent to keep rings (639) tightly sealed.

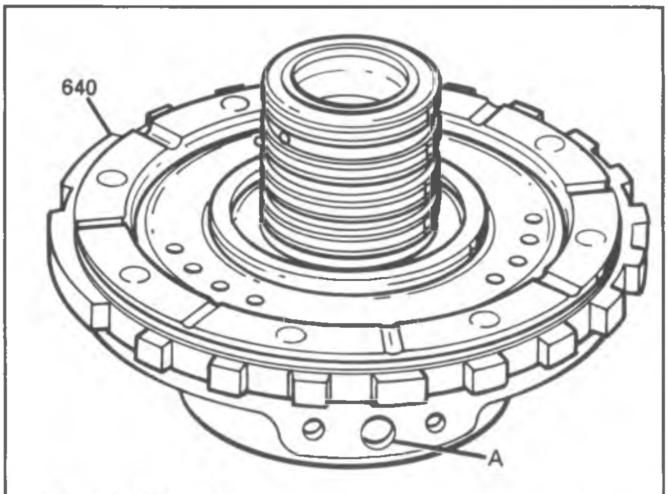
Important

- Be sure to use small chamfered end of sizer J 38735-2 to do the lower ring. Then use larger chamfered end to size all other seals. Start with lower ring, then work towards top.
- Pre heat seals (639) prior to installation in hot tap water



636 PISTON, INTERMEDIATE CLUTCH
640 SUPPORT & RACE ASSEMBLY, CENTER MH0033-4L80-E

Figure 36 Installing Intermediate Piston Seals



A PISTON APPLY
640 SUPPORT & RACE ASSEMBLY, CENTER MH0034-4L80-E

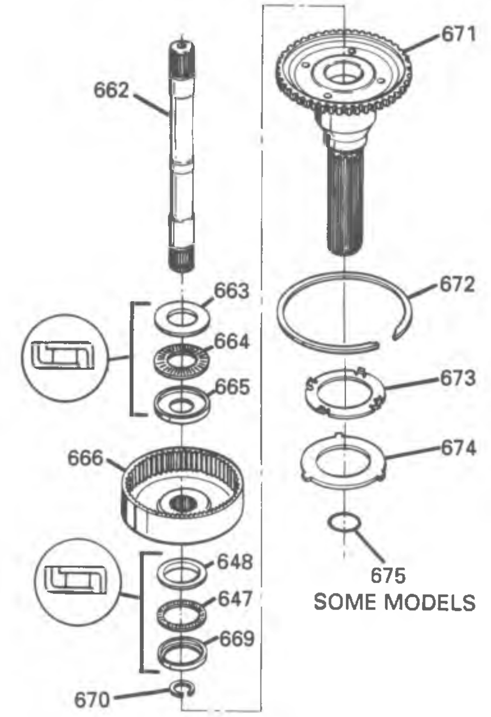
Figure 37 Checking Intermediate Clutch

GEAR UNIT ASSEMBLY

Figures 38 through 41

Assemble

1. Main shaft (662) into rear internal gear (666).
2. Snap ring (670) onto main shaft (662).
3. Inner race (648), lip up, thrust bearing (647) and outer race (669), lip down, onto rear internal gear hub (666), retain with TRANSJEL™ J 36850 or equivalent.
4. Outer race (665), lip up, thrust bearing (664) and inner race (663), lip down onto main shaft (662).
5. Main shaft (662) and rear internal gear (666) assembly into output carrier assembly (661).
   - Lubricate pinion gears (665) with DEXRON®-II transmission fluid.



647 BEARING, NEEDLE THRUST
648 RACE, THRUST BEARING
662 SHAFT, TRANSMISSION MAIN
663 RACE, THRUST BEARING TO SUN GEAR
664 BEARING, NEEDLE THRUST RR INTERNAL GEAR
665 RACE, THRUST BEARING TO RR INTERNAL GEAR
666 GEAR, REAR INTERNAL
669 RACE, THRUST BEARING TO OUTPUT SHAFT
670 RING, SNAP MAINSHAFT INTERNAL GEAR
671 SHAFT & BUSHING ASSEMBLY, OUTPUT
672 RING, SNAP (OUTPUT SHAFT/ FRONT INTERNAL GEAR)
673 WASHER, THRUST (INPUT DRUM/HSG.) OUTPUT
674 WASHER, THRUST SELECTIVE OUTPUT/CASE
675 SEAL, O-RING OUTPUT SHAFT MH0035-4L80-E

Figure 38 Assembling Output Shaft and Rear Internal Gear

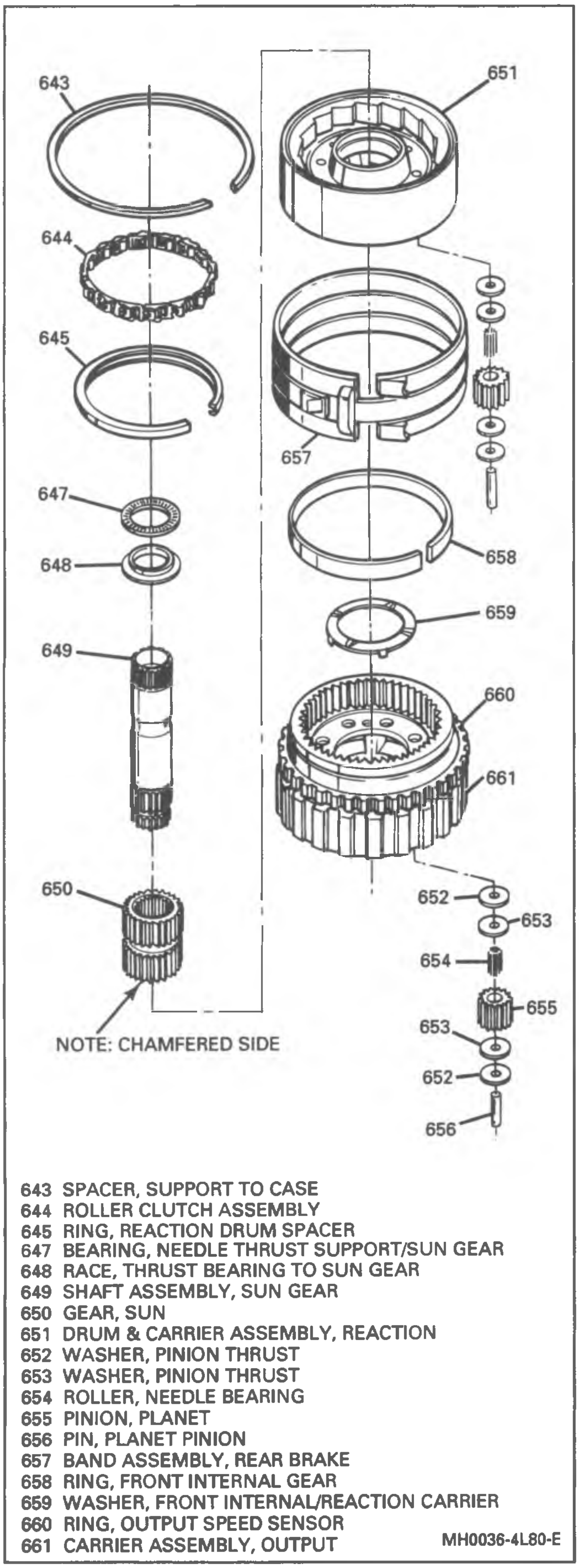


Figure 39 Assembling Output and Reaction Carriers

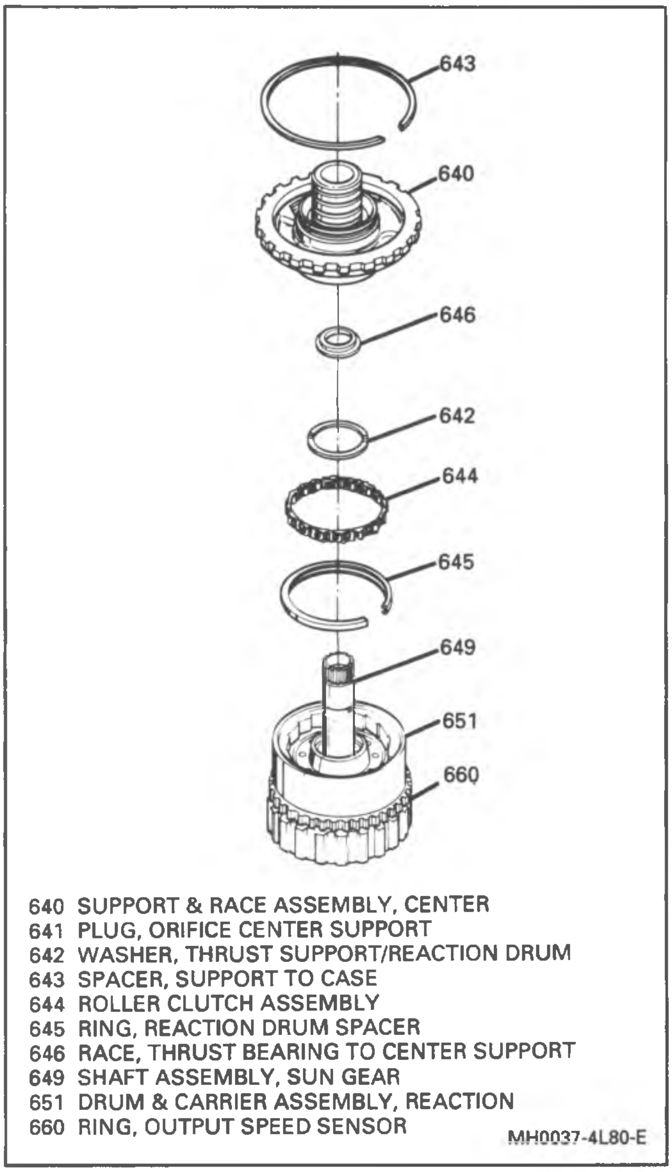


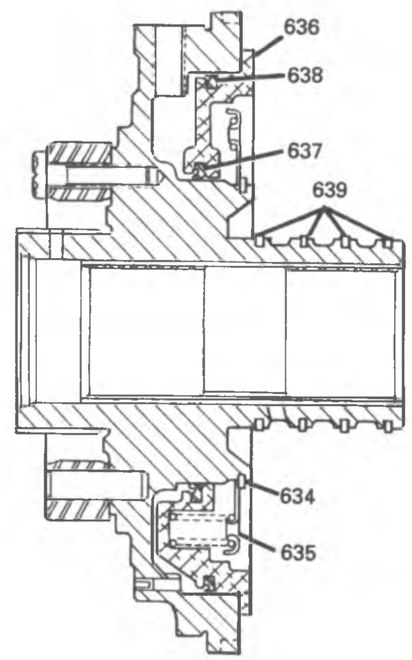
Figure 40 Installing Spacer Ring and Roller Clutch Assembly

6. Output shaft (671) into output carrier assembly (661).
7. Snap ring (672) in groove of output carrier assembly (661) .
8. Thrust washer (673) onto output shaft (671).
9. Thrust washer (659) onto output carrier assembly (661) with tabs in pockets. Retain with TRANSJEL™ J 36850 or equivalent.
10. O-ring seal (675). (Some models.)
11. Front internal gear ring (658) onto carrier assembly (661).
12. Reaction drum and carrier assembly (651) into output carrier (661)
    - Lubricate pinion gears (655) with DEXRON®-II transmission fluid.
13. Sun gear (650) (chamfered inner diameter first) into reaction drum and carrier assembly (651).
14. Sun gear shaft (649), long splined end first.

15. Longer lipped race (648) on sun gear shaft (649) with lip up.
16. Needle thrust bearing assembly (647), on long lipped race (648).
17. With center support assembly (640) on bench, attach race (646) onto rear hub with Transjel™ J 36850 or equivalent.
18. Thrust washer (642) in recess of center support (640).
19. New center support (640) into reaction carrier (651).

Important

- To verify correct assembly, hold reaction carrier (651) stationary. Center support (640) should turn counterclockwise only.



634 RING, SNAP INTERMEDIATE CLUTCH
635 SPRING & RETAINER ASM., INTERMEDIATE CLUTCH
636 PISTON, INTERMEDIATE CLUTCH
637 SEAL, INTERMEDIATE CLUTCH (INNER)
638 SEAL, INTERMEDIATE CLUTCH (OUTER)
639 RING, OIL SEAL
MH0038-4L80-E

Figure 41 Center Support and Reaction Carrier Assembly

DIRECT CLUTCH ASSEMBLY

Figures 42 and 43

Tools Required:

J 23327 Spring Compressor
J 25018-A Adapter Mechanical Press

Important

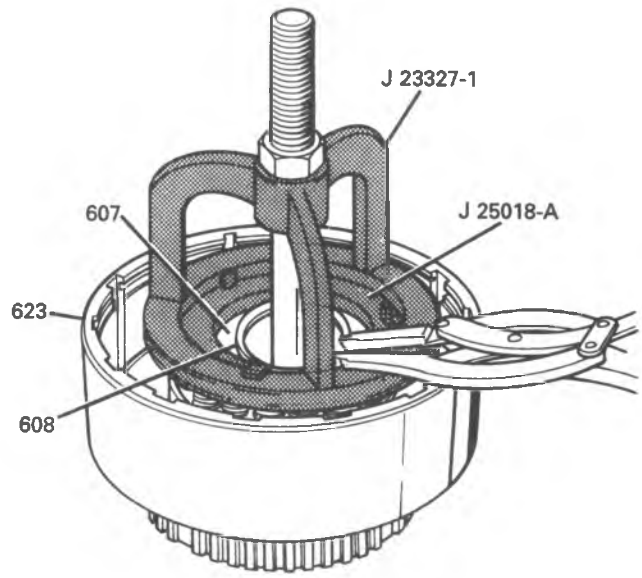
- If spiral snap ring (627) is removed, a *new* snap ring (627) must be used.

Disassemble

1. Spiral snap ring (627).
2. Clutch retainer (626) and race (625).
3. Race and sprag assembly (624).
4. Snap ring (616).
5. Direct clutch backing plate (617) and clutch plates (611 and 618).
6. Dish plate (609).
7. Snap ring (608) with J 23327 and J 25018-A.
8. Spring and retainer assembly (607).
9. Piston (619).
10. Inner seal (605) and outer seal (604) from piston (619).
11. Center seal (622) from housing (623).

Clean

- All components



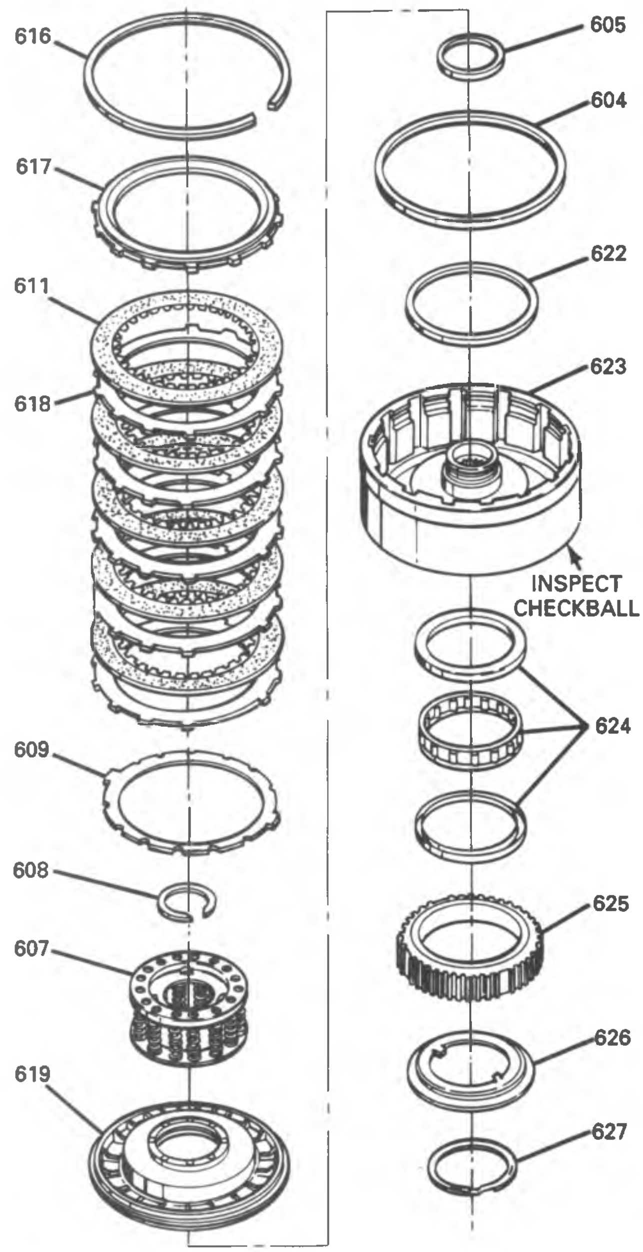
607 SPRING & RETAINER ASM.
608 RING, SNAP
623 HOUSING, DIRECT CLUTCH
MH0039-4L80-E

Figure 42 Removing Piston Release Spring Retainer

Inspect

Figure 43

1. Sprag assembly (624) for:
   - damaged sprags or cage
   - distorted springs
2. Race intermediate clutch outer (625) for:
   - smoothness of inside diameter
   - spline damage



604 SEAL, CLUTCH (OUTER)
605 SEAL, CLUTCH (INNER)
607 SPRING & RETAINER ASM., FORWARD CLUTCH
608 RING, SNAP
609 PLATE, CLUTCH (.054 DISHED)
611 PLATE ASSEMBLY, CLUTCH
616 RING, SNAP (6.24 O.D. X .062)
617 PLATE, DIRECT CLUTCH BACKING
618 PLATE, CLUTCH (.0915 FLAT)
619 PISTON, DIRECT CLUTCH
622 SEAL, CLUTCH (CENTER)
623 HOUSING, DIRECT CLUTCH
624 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
625 RACE, INTERMEDIATE CLUTCH (OUTER)
626 RETAINER, INTERMEDIATE CLUTCH
627 RING, EXTERNAL LOCKING

MH0040-4L80-E

Figure 43 Direct Clutch Assembly and Intermediate Sprag Assembly

3. Clutch housing (623) for:
   - cracks
   - wear
   - proper opening of oil passages
4. Clutch plates (611 and 618) for:
   - wear
   - burned
   - flaking
5. Backing plate (617) and piston (619) for:
   - damage
   - cracks
6. Clutch springs (607) for:
   - collapsed coils

Assemble

Figure 43

1. Lubricate clutch piston seals (605, 604 and 622) and grooves with DEXRON®-II transmission fluid.
2. Inner seal (605) and outer seal (604) with lips facing down towards housing onto piston (619).
3. Center housing seal (622). Lip seal facing up, onto housing (623).

DIRECT CLUTCH PISTON

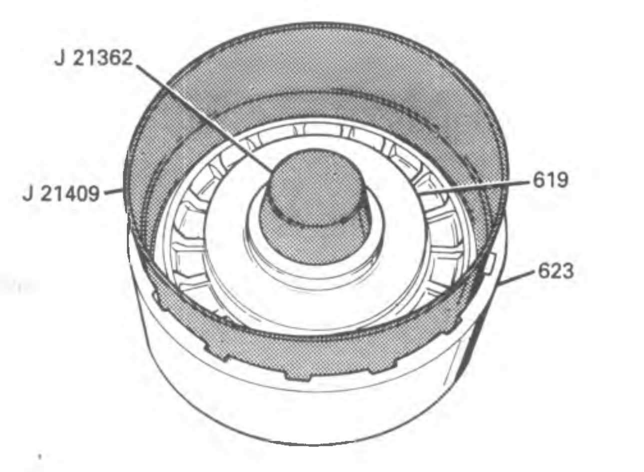
Figures 44 and 45

Tools Required:

J 21362 Seal Protector (inner)
J 21409 Seal Protector (outer)
J 23327 Spring Compressor
J 25018-A Adapter

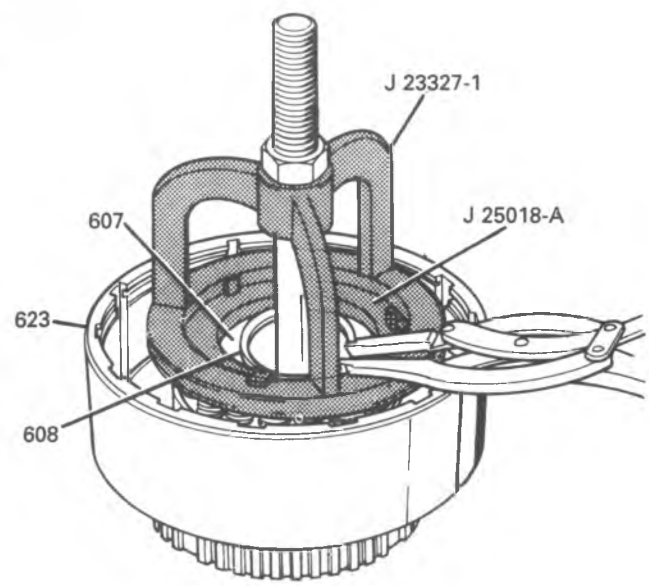
Install or Connect

1. J 21362 and J 21409 on housing (623).
2. Lubricate tools with Dexron®-II fluid.
3. Piston (619) into housing (623) with rotating movement until seated.
4. Spring and retainer assembly (607) with J 23327 and J 25018-A.
5. Snap ring (608).



619 PISTON, DIRECT CLUTCH
623 HOUSING, DIRECT CLUTCH
MH0041-4L80-E

Figure 44 Installing Direct Clutch Piston



607 SPRING & RETAINER ASM.
608 RING, SNAP
623 HOUSING, DIRECT CLUTCH
MH0039-4L80-E

Figure 45 Installing Piston Release Spring Retainer

SPRAG ASSEMBLY

Figures 46 through 49

Tool Required:

J-38695 Spiral Snap Ring Installer

Install or Connect

Figures 46, 47 and 48

IMPORTANT: Dip all clutch plates in DEXRON®-II transmission fluid prior to assembling, to aid lubrication during start up.

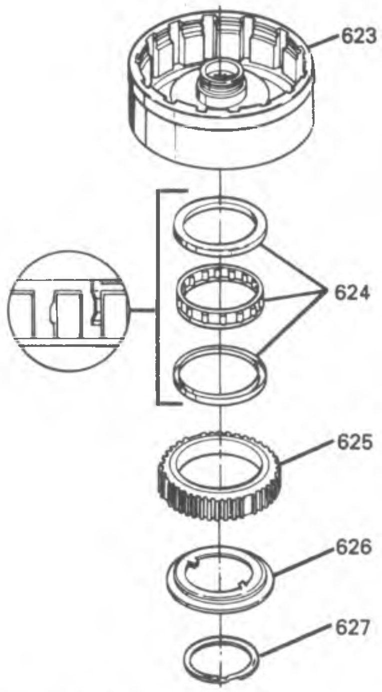
1. Sprag assembly (624).
2. Intermediate clutch race (625), grooves up, with clockwise motion. When properly installed, it should not rotate counterclockwise with sprag end facing down.
3. Intermediate clutch retainer (626).
4. Place snap ring (627) over direct clutch hub, install tool J 38695 in hub hole, rotate clockwise while pressing down until snap ring is in place.
5. Dished plate (609) into direct clutch housing (623). Inner diameter down.
6. Plate assemblies (611) and steel plates (618).
   - alternate clutch plate, starting with steel plate first
7. Direct clutch backing plate (617) and snap ring (616).

1991 HYDRA-MATIC 4L80-E
CLUTCH PLATE APPLICATION CHART
DIRECT CLUTCH

MODELS		NO. OF FLAT STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK
	THICKNESS	2.32MM (.0915")		2.03MM (.080")	3.07-6.00MM (0.121"-0.236")
ALL MODELS		5	1	5	

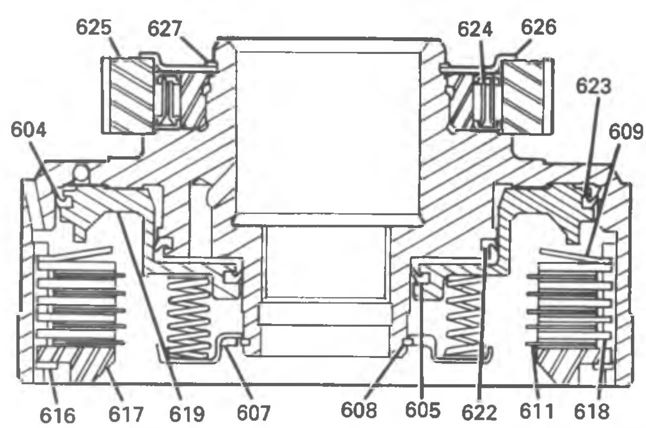
MH0043-4L80-E

Figure 46 Direct Clutch Plate Chart



623 HOUSING, DIRECT CLUTCH
624 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
625 RACE, INTERMEDIATE CLUTCH (OUTER)
626 RETAINER, INTERMEDIATE CLUTCH
627 RING, EXTERNAL LOCKING
MH0044-4L80-E

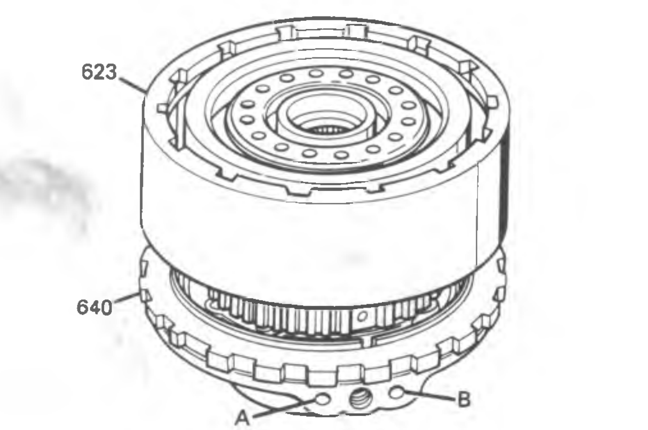
Figure 47 Installing Sprag Assembly



604 SEAL, CLUTCH (OUTER)
605 SEAL, CLUTCH (INNER)
607 SPRING & RETAINER ASM.
608 RING, SNAP
609 PLATE, CLUTCH (.054 DISHED)
611 PLATE ASSEMBLY, CLUTCH
616 RING, SNAP (6.24 O.D. X .062)
617 PLATE, DIRECT CLUTCH BACKING
618 PLATE, CLUTCH (.0915 FLAT)
619 PISTON, DIRECT CLUTCH
622 SEAL, CLUTCH (CENTER)
623 HOUSING, DIRECT CLUTCH
624 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
625 RACE, INTERMEDIATE CLUTCH (OUTER)
626 RETAINER, INTERMEDIATE CLUTCH
627 RING, EXTERNAL LOCKING

MH0045-4L80-E

Figure 48 Direct and Intermediate Sprag Clutch Assembly



A DIRECT CLUTCH FLUID PASSAGE
B REVERSE CLUTCH FLUID PASSAGE
623 HOUSING, DIRECT CLUTCH
640 SUPPORT & RACE ASSEMBLY, CENTER

MH0046-4L80-E

Figure 49 Air Checking Direct Clutch

Measure

Figure 49

1. Place direct clutch assembly (623) on center support (640) for air check operation.
2. Place indicator onto piston (619).
3. Air applied to reverse passage will escape from direct passage. This condition is normal. Apply 80 P.S.I. of air pressure to direct passage to actuate piston and move clutch plates.
4. Piston travel should be 3.07 to 6.00 mm (0.121 to 0.236 inch)
5. Remove direct clutch assembly (623).

CENTER SUPPORT AND GEAR UNIT ASSEMBLY

Figures 50, 51 and 52

Tools Required:

J 38868 Gear Unit Assembly Remover and Installer

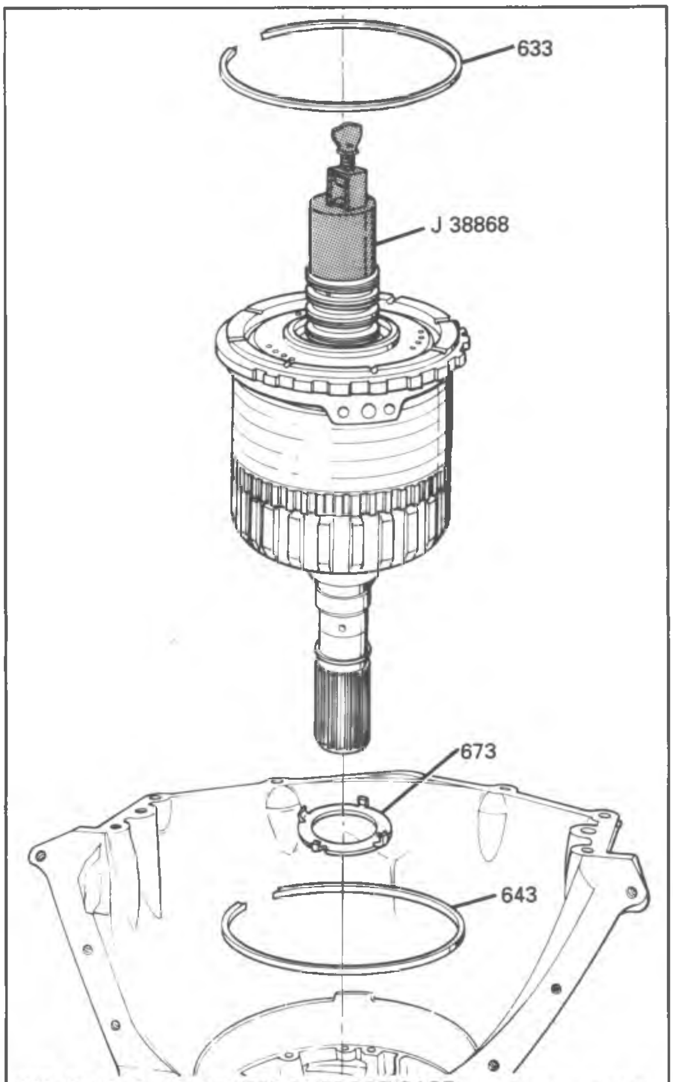
J 23093 Center Support Locating Tool

J 8001 Dial Indicator Set

J 6125-1B Slide Hammer

Install or Connect

1. Spacer (643) to the bottom of case splines. Leave opening of snap ring at 9 o'clock position.
   - Third snap ring groove down



633 RING, SNAP CENTER SUPPORT/CASE
643 SPACER, SUPPORT TO CASE
673 WASHER, THRUST (INPUT DRUM/HSG.) OUTPUT

MH0047-4L80-E

Figure 50 Installing Center Support and Gear Unit Assembly

2. J 38868 to main shaft (662).
3. With transmission in a vertical position, align bolt hole in center support (640) with hole in case (7) and carefully lower gear unit/center support assembly into case using J 38868.
4. Beveled snap ring (633). Flat side down.
   - Leave open span in snap ring (633) below #9 pin. (Front band anchor pin.)
5. Check rear end play before installing center support bolt. Locate indicator onto main shaft. End play should be 0.127 to 0.635 mm (0.005 to 0.025 inch), using J 8001 Dial Indicator, while prying up on output carrier.
6. Locate J 23093 into the center support (640) direct clutch passage through case (7). Apply pressure on J 23093, in direction of arrow (Figure 52), seating the center support splines counterclockwise against the case splines.
7. New case to center support bolt (25).
   - Assure the bolt head (25) is seated to the bottom of the case (7).

Tighten

- New center support bolt (25) to 43 N·m (32 lb. ft.).

Important

- DO NOT OVER TORQUE!

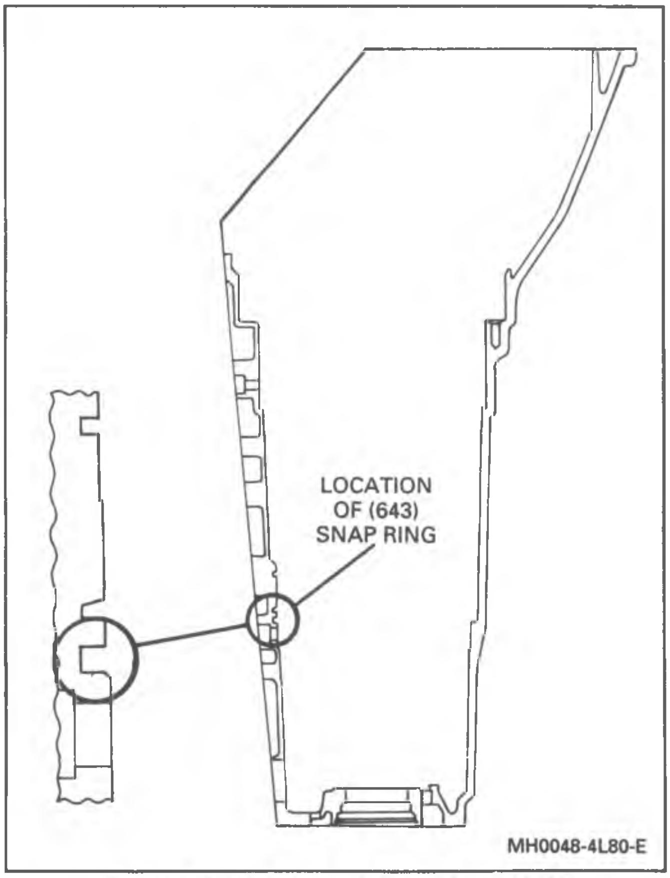


Figure 51 Location of Snap Ring (643)

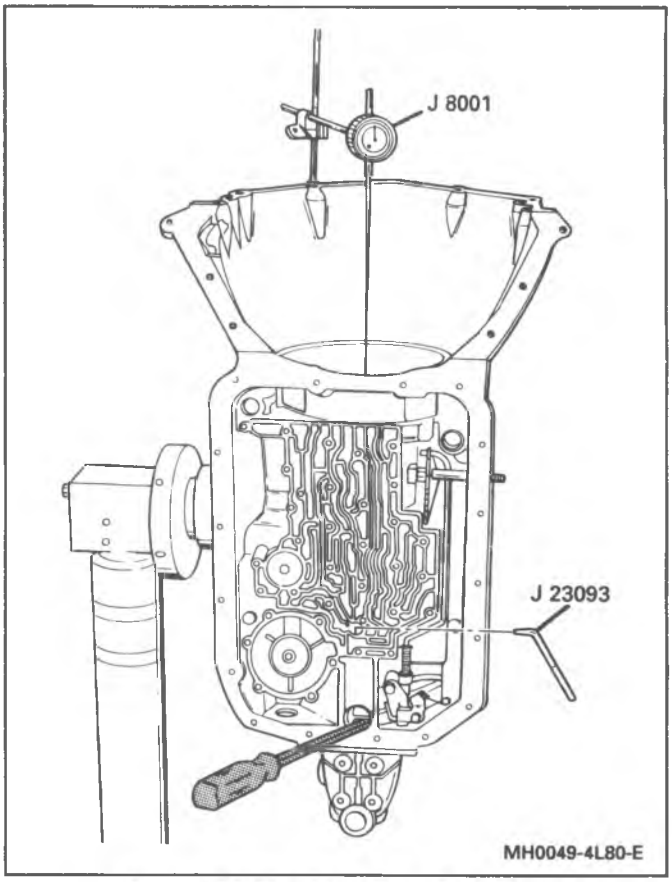


Figure 52 Checking Rear End Play

INTERMEDIATE CLUTCH ASSEMBLY

Figures 53 through 57

Tool Required:

J 24396 Intermediate Clutch Pack Alignment Tool

Inspect

Figure 53

1. Clutch plates (631 and 632) for:
   - wear, pitting, flaking or cracks in lining
   - discoloration, scoring or cracks
2. Backing plate (630) for:
   - burrs and dirt
3. Front band (628) for:
   - wear, pitting, flaking or cracks in lining

Assemble

Figures 53 through 55

NOTICE: Dip all clutch plates in DEXRON®-II transmission fluid.

1. Steel plates (632) and composition plates (631) alternately, starting with a steel plate. Refer to Figure 53.

2. Intermediate clutch backing plate (630). Flat side down.
3. Snap ring (629), medium size.
4. End play check for intermediate clutch piston travel. 1.02 to 2.72 mm (0.040 to 0.107 inch). Using feeler gage between backing plate & snap ring.
5. Align clutch plates (631 and 632) with J 24396. Leave tool in place.
6. Apply air through center support bolt hole to engage intermediate clutch.
7. Remove tool J 24396.
8. Continue applying air to hold clutch plates in place and install direct clutch assembly (623).
9. Front band (628).
   - check for proper position and freedom of movement.

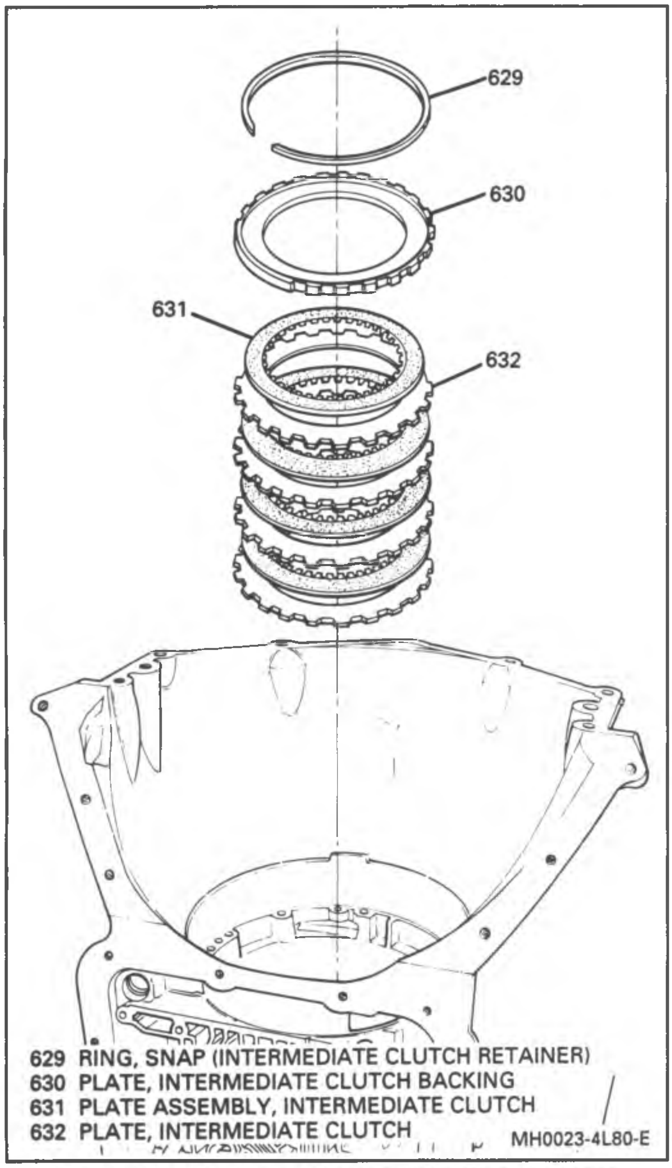


Figure 53 Installing Intermediate Clutch Plates

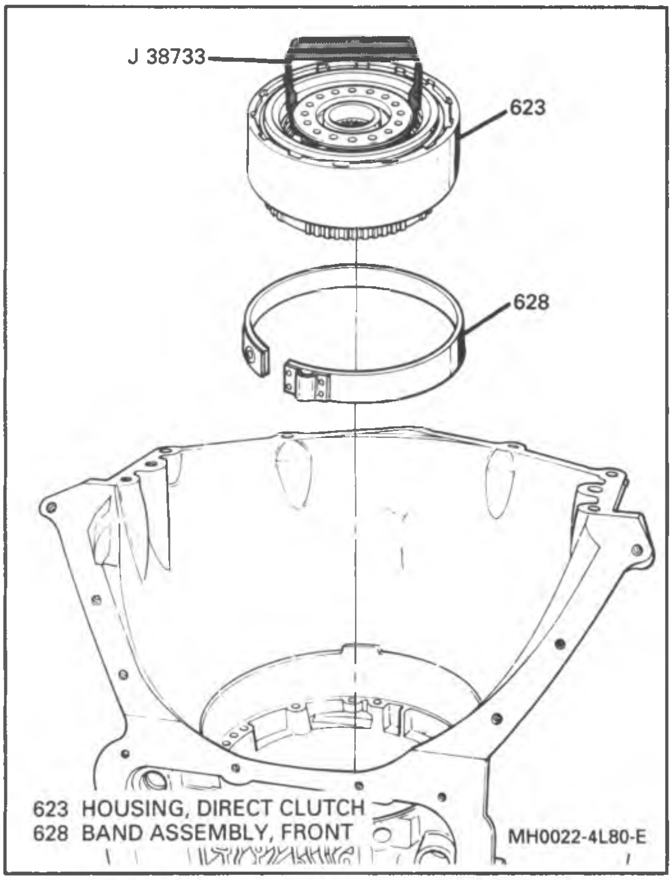


Figure 54 Installing Direct Clutch Assembly

**1991 HYDRA-MATIC 4L80-E
CLUTCH PLATE APPLICATION CHART
INTERMEDIATE CLUTCH**

MODELS		NO. OF FLAT STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK
	THICKNESS	1.97MM (.077")			1.02-2.54MM (0.040"-0.107")
ALL MODELS		4		4	

MH0050-4L80-E

Figure 55 Intermediate Clutch Plate Chart

FORWARD CLUTCH ASSEMBLY

Figures 56 through 63

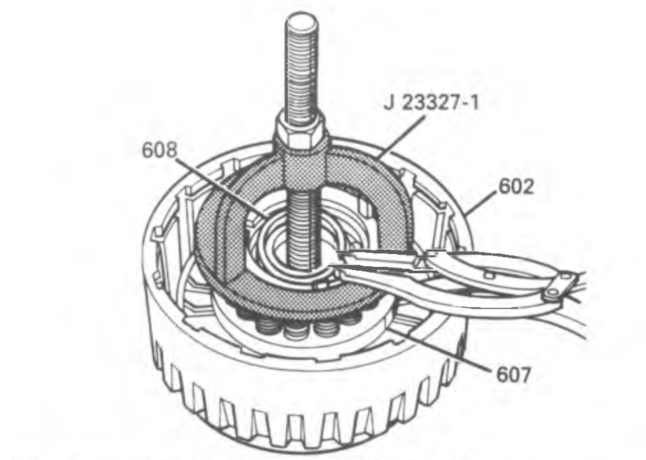
Tools Required:

- J 23327 Spring Compressor
- J 21664 Adapter
- J 38732 Seal Protector (outer)
- J 21362 Seal Protector (inner)
- J 8001 Dial Indicator Set
- J 38358-A Forward Clutch Installation

Disassemble

Figures 56 and 57

1. Snap ring (616) and direct clutch driving hub (615) from forward clutch housing (602).
2. Forward clutch hub (613).
3. Thrust washers (614 and 612).
4. Clutch plates (610 and 611).
5. Dished plate (609).
6. Snap ring (608), spring and retainer assembly (607) using J 23327.
7. Piston (606), and seals (604 & 605).
8. Seal (603) from forward clutch housing (602).



602 HOUSING ASSEMBLY, FORWARD CLUTCH
607 SPRING & RETAINER ASM.
608 RING, SNAP
MH0051-4L80-E

Figure 56 Removing Forward Clutch Piston Release Springs

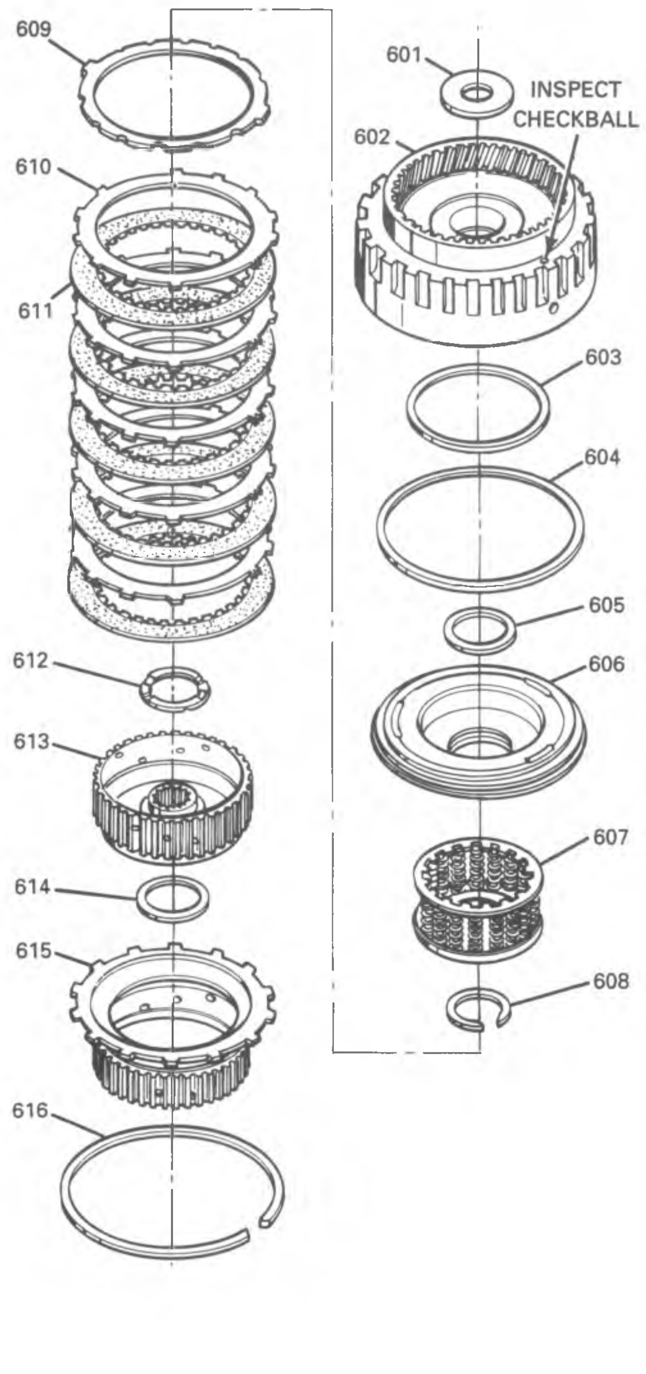
Clean

- All components.

Inspect

Figure 57

1. Clutch plates (610 and 611) for:
   - burning
   - scoring
   - flaking
   - pitting
   - wear
2. Spring and retainer assembly (607) for:
   - collapsed coils
   - distortion
3. Clutch hubs (613 and 615) for:
   - spline wear
   - open lubrication holes
   - damaged thrust faces



601 BEARING ASM., THRUST CARRIER/FORWARD CLUTCH
602 HOUSING ASSEMBLY, FORWARD CLUTCH
603 SEAL, CLUTCH (CENTER)
604 SEAL, CLUTCH (OUTER)
605 SEAL, CLUTCH (INNER)
606 PISTON, FORWARD CLUTCH
607 SPRING & RETAINER ASM.
608 RING, SNAP
609 PLATE, CLUTCH (.054 DISHED)
610 PLATE, CLUTCH (.0775 FLAT)
611 PLATE ASSEMBLY, CLUTCH
612 WASHER, THRUST CLUTCH HUB HOUSING
613 HUB, FORWARD CLUTCH DRIVEN
614 WASHER, THRUST FORWARD CLUTCH
615 HUB, DIRECT CLUTCH DRIVING
616 RING, SNAP (6.24 O.D. X .062)
MH0052-4L80-E

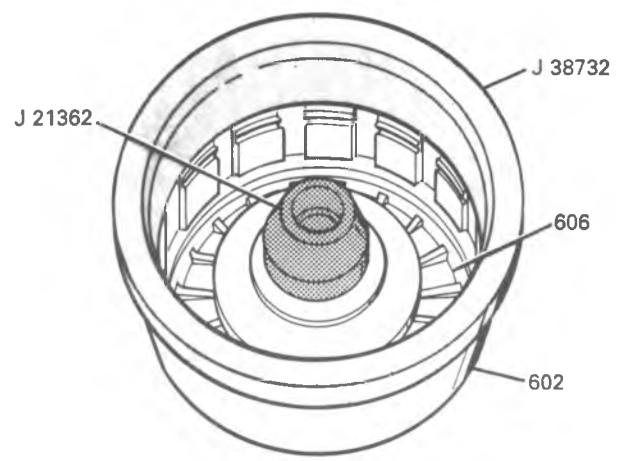
Figure 57 Forward Clutch Assembly

4. Piston (606) for:
   - cracks
5. Seals (603, 604 & 605) for:
   - cuts
   - tears
   - nicks
6. Forward clutch housing (602) for:
   - wear
   - open lubrication holes
   - damaged thrust faces
7. Free operation of check ball.

Assemble

Figures 56, 57 and 58

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 down towards housing.
3. Lubricate center housing seal (603) and groove.
4. Center housing seal (603) onto forward 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 until seated.



602 HOUSING ASSEMBLY, FORWARD CLUTCH
606 PISTON, FORWARD CLUTCH
MH0053-4L80-E

Figure 58 Installing Forward Clutch Piston

Assemble

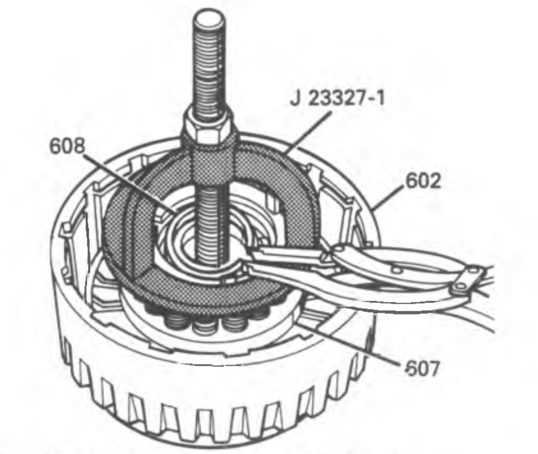
Figures 57, 59, 60 and 61

1. Retainer and spring assembly (607) with J 23327.
2. Snap ring (608).
3. Bronze thrust washer (612) on inside of hub (613). Retain with TRANSJEL™ J 36850 or equivalent.
4. Thrust washer (614) on outside of forward clutch hub (613).
5. Forward clutch hub (613) in clutch housing (602).

Important

- Dip clutch plates in DEXRON®-II transmission fluid.

6. Dished clutch plate (609). Inside diameter first.
7. Clutch plates (610 and 611) alternately. Starting with steel plate first.
8. Direct clutch hub (615) in forward clutch housing (602).
9. Snap ring (616).



602 HOUSING ASSEMBLY, FORWARD CLUTCH
607 SPRING & RETAINER ASM.
608 RING, SNAP
MH0051-4L80-E

Figure 59 Installing Forward Clutch Piston Release Springs

1991 HYDRA-MATIC 4L80-E
CLUTCH PLATE APPLICATION CHART
FORWARD CLUTCH

MODELS		NO. OF FLAT STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES	PISTON TRAVEL CHECK
	THICKNESS	1.97MM (.0775")	1.37MM (.054")	2.03MM (.080")	3.07-6.00MM (0.121"-0.236")
ALL MODELS		5	1	5	

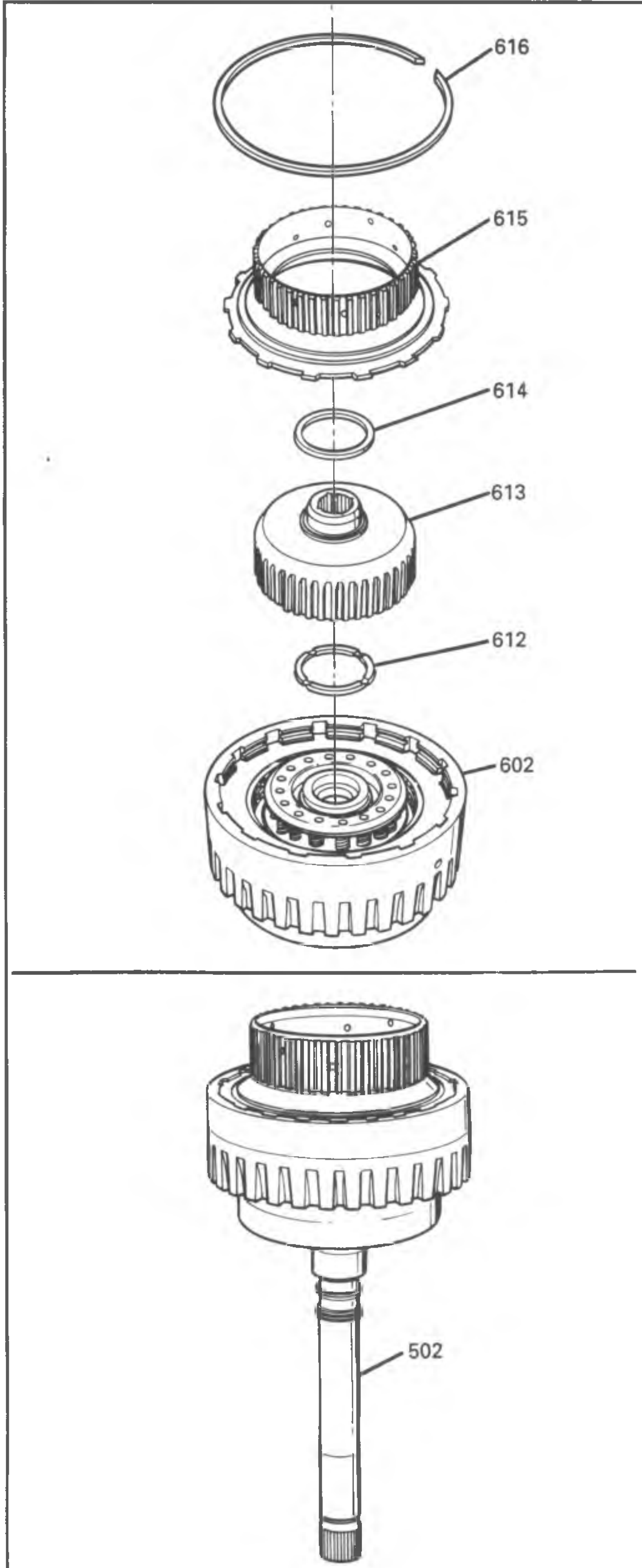
MH0054-4L80-E

Figure 60 Forward Clutch Plate Chart

Inspect

Figure 61

- install forward clutch on a reconditioned turbine shaft
- check piston and clutch operation by applying air to forward clutch passage



502 SHAFT, TURBINE
602 HOUSING ASSEMBLY, FORWARD CLUTCH
612 WASHER, THRUST CLUTCH HUB HOUSING
613 HUB, FORWARD CLUTCH DRIVEN
614 WASHER, THRUST FORWARD CLUTCH
615 HUB, DIRECT CLUTCH DRIVING
616 RING, SNAP (6.24 O.D. X .062)

MH0055-4L80-E

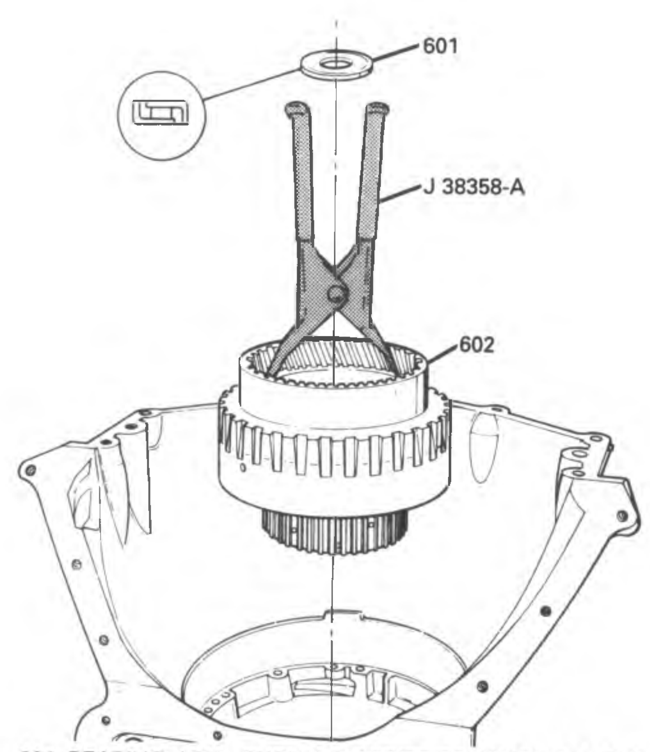
Figure 61 Checking Forward Clutch Piston Travel

Install or Connect

Figure 62

- Forward clutch assembly (602) using J 38358-A.

  NOTICE: Top of speed sensor ring to the pump gasket surface is approximately 98-99 mm or 3.85-3.89 inches.



601 BEARING ASM., THRUST CARRIER/FORWARD CLUTCH
602 HOUSING ASSEMBLY, FORWARD CLUTCH

MH0021-4L80-E

Figure 62 Installing Forward Clutch Assembly

FOURTH CLUTCH ASSEMBLY

Figures 63 and 64

Tools Required:

J 38731 Fourth Clutch Seal Protectors, and Base

J 38882 Adapter Fourth Clutch Spring Compressor

J 23327 Base, Bolt and Nut

Disassemble

Figure 63

1. Snap ring (523).
2. Backing plate (524) and clutch plates (525 and 526). Four of each.
3. Install tools J 38882 and J 23327, and compress spring retainer assembly.
4. Snap ring (533) and spring retainer assembly (532).

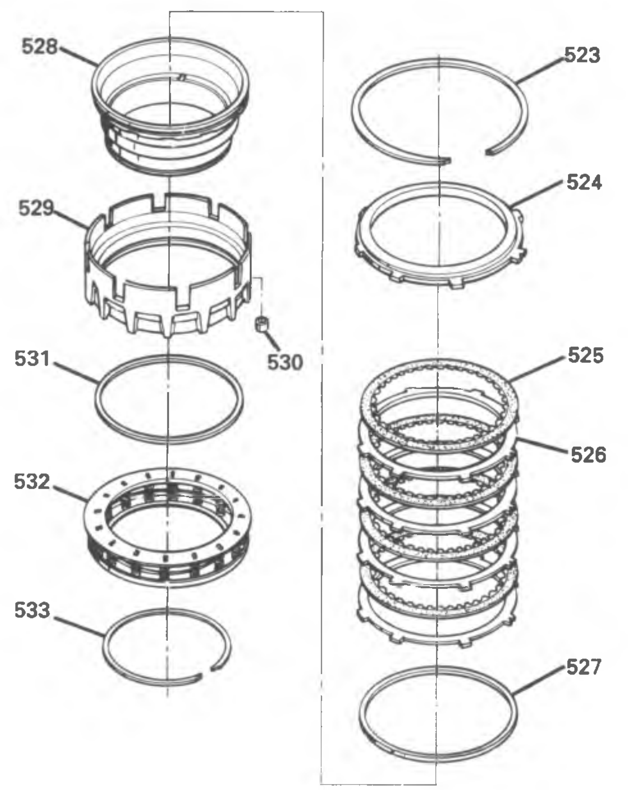
5. Fourth clutch piston (528) with outer seal (527).
6. Housing (529) with inner seal (531).

Clean

- All components

Inspect

1. Replace 4th clutch piston seal (527).
2. Replace 4th clutch housing seal (531).
3. 4th clutch housing orifice cup plug (530).



523 RING, SNAP (4TH CLUTCH)
524 PLATE, 4TH CLUTCH BACKING
525 PLATE ASSEMBLY, 4TH CLUTCH
526 PLATE, 4TH CLUTCH
527 SEAL, 4TH CLUTCH (OUTER)
528 PISTON, 4TH CLUTCH
529 HOUSING, 4TH CLUTCH
530 PLUG, ORIFICE CENTER SUPPORT
531 SEAL, 4TH CLUTCH (INNER)
532 SPRING & RETAINER ASSEMBLY, 4TH CLUTCH
533 RING, SNAP (SPRING & RETAINER ASSEMBLY 4TH CLUTCH PISTON)

MH0056-4L80-E

Figure 63 Fourth Clutch Assembly

Assemble

Figure 64

1. Place seal protector J 38731-1 onto housing (529) through small end.
2. Place seal protector J 38731-2 onto piston (528) through large end.
3. Place spacer J 38731-3 inside of piston (528).
4. Place housing (529) on bench resting on piston (528) and piston spacer.
5. Push down on housing until piston is through housing, exposing snap ring groove.
6. Remove housing seal protector J 38731-1.
7. Place snap ring (533), spring and retainer assembly (532) onto piston (528).
8. Compress spring and retainer assembly using J 38882 Adapter and J 23327.
9. Install snap ring (533).
10. Remove tools.
11. Turn assembly over and install 4 of each clutch plates (525 and 526) alternating steel and fiber plates. Starting with steel first. Locate steel plate index notch opposite 4th clutch bolt hole.
12. Backing plate (524) flat side down, notch location same as steel plates and snap ring (523).

Important

- Insure snap ring (523) is properly seated in groove

4TH CLUTCH TRAVEL CHECK

Inspect

Figure 65

1. Place 4th clutch assembly (529) with the spring and retainer assembly (532) facing up.
2. Apply 80 psi air pressure to fourth clutch bolt hole to cycle piston and remove excess oil on plates for accurate clutch travel reading.
3. Place feeler gage between backing plate (524) and snap ring (523). Measurement should be 1.016-2.540 mm (0.040-0.100 inch).

Install or Connect

Figure 66

1. 4th clutch assembly (529) into case (7).

NOTICE: Backing plate (524) tang extending out of 4th clutch housing (529) must assemble into slot space in case and housing, with transmission in the vertical position.

2. New 4th clutch bolt (25) through case fluid passages into 4th clutch housing (529) and rotate transmission to horizontal position.

Tighten

- Bolt (25) to 15-17 N·m (11-13 lb. ft.)

Important

- DO NOT OVER TORQUE!

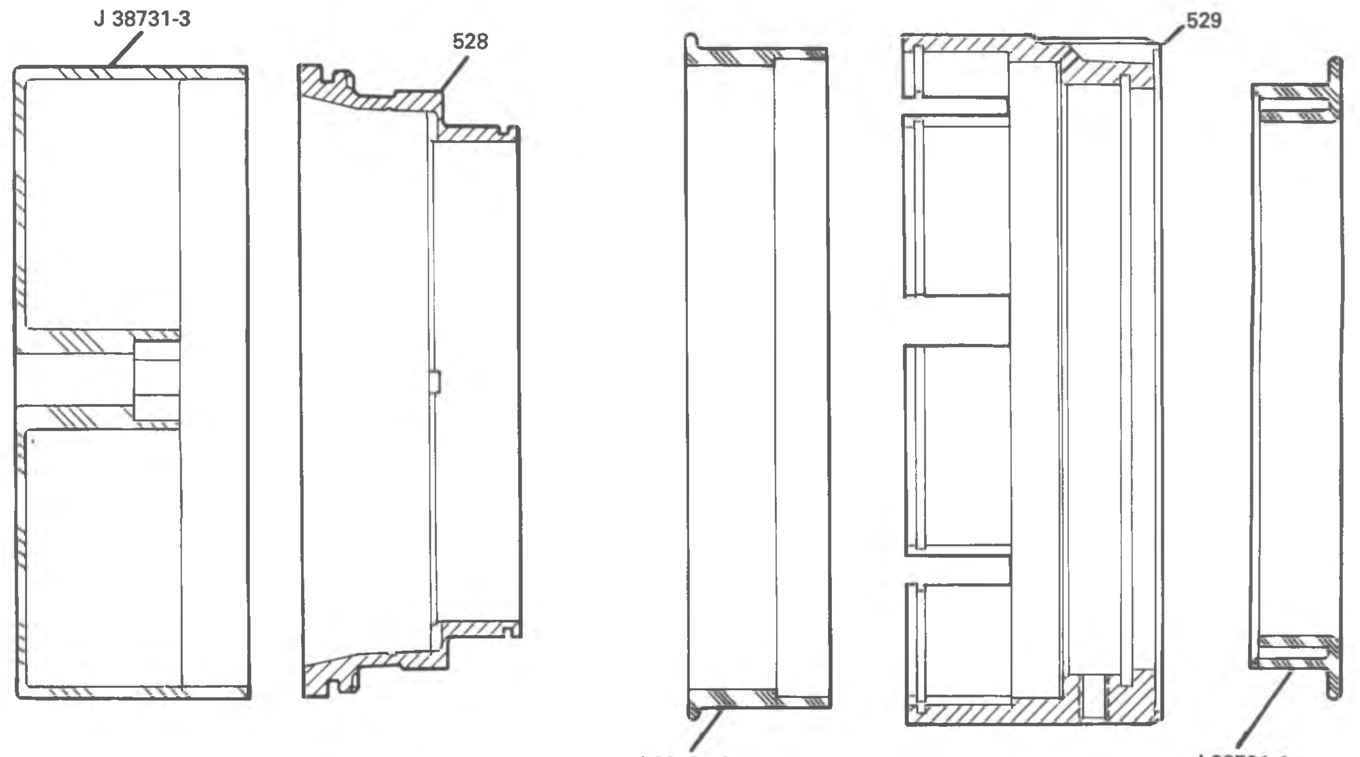
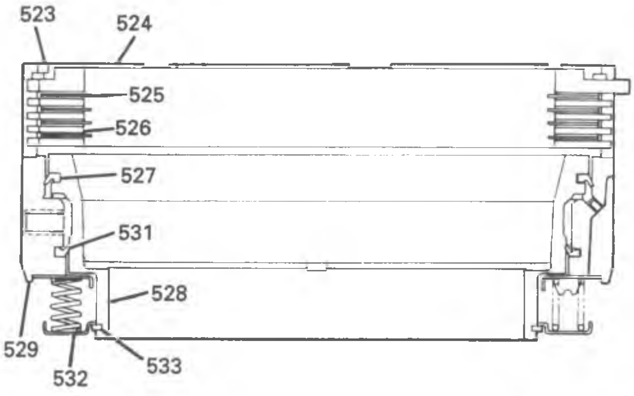
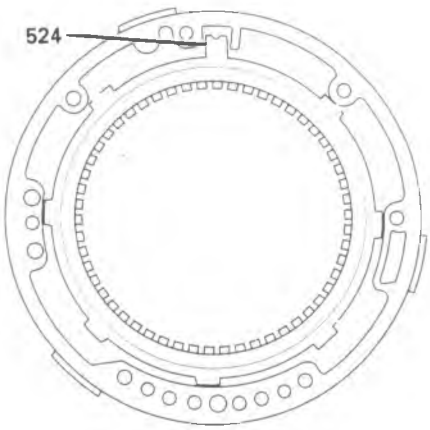


Figure 64 Assembling Fourth Clutch Assembly



523 RING, SNAP (4TH CLUTCH)
524 PLATE, 4TH CLUTCH BACKING
525 PLATE ASSEMBLY, 4TH CLUTCH
526 PLATE, 4TH CLUTCH
527 SEAL, 4TH CLUTCH (OUTER)
528 PISTON, 4TH CLUTCH
529 HOUSING, 4TH CLUTCH
531 SEAL, 4TH CLUTCH (INNER)
532 SPRING & RETAINER ASSEMBLY, 4TH CLUTCH
533 RING, SNAP (SPRING & RETAINER ASSEMBLY 4TH CLUTCH PISTON)
MH0058-4L80-E

Figure 65 Fourth Clutch Assembly



524 PLATE, 4TH CLUTCH BACKING
MH0059-4L80-E

Figure 66 Installing Backing Plate (524)

OVERDRIVE UNIT ASSEMBLY

Figure 67

Disassemble

1. Snap ring (522).
2. Turbine shaft (502).
3. Overrun carrier assembly (514) from housing (504).

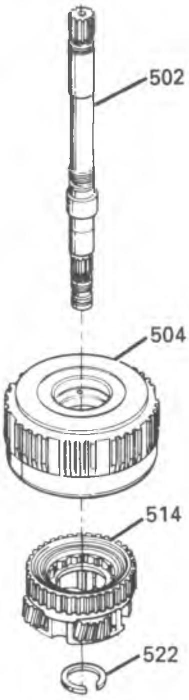


Figure 67 Overdrive Unit Assembly

OVERRUN CLUTCH ASSEMBLY

Figures 68 through 71

Tools Required:
- J 38729 Piston Seal Protector
- J 8001 Dial Indicator Set
- J 23327 Clutch Piston Compressor
- J 38734 Adapter
- J 38729 Piston Seal Protector

Disassemble

Figure 68

1. Snap ring (511).
2. Clutch plates (508 and 509) (three steel and three fiber).
3. Backing plate (510).
4. Compress spring and retainer assembly (506) using J 23327 and J 38734 adapter.
5. Snap ring (507).
6. Remove tools.
7. Spring and retainer assembly (506).
8. Piston (505).

Clean

- All components
- Piston (505) should not be cleaned with solvent.

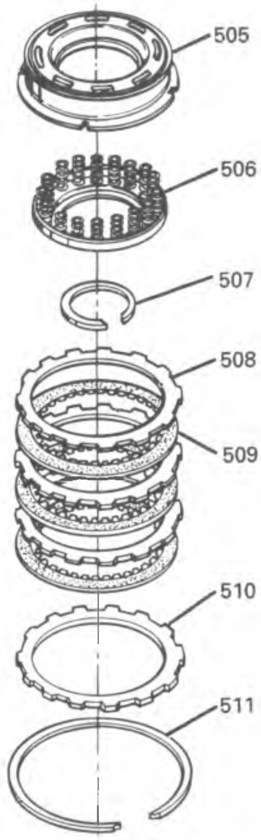


Figure 68 Overrun Clutch Assembly

Inspect

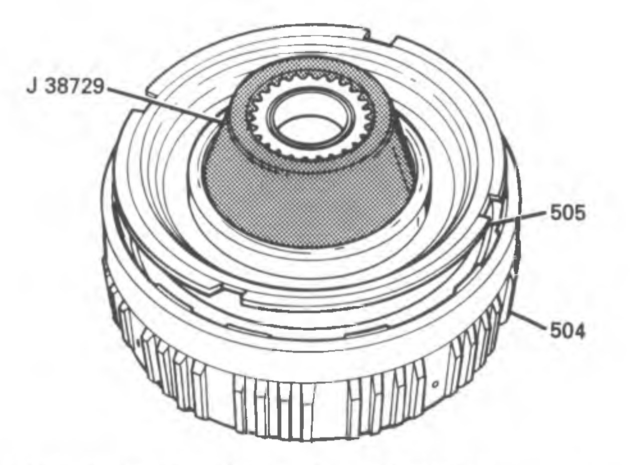
1. Clutch plates (508 and 509) for:
   - burning
   - scoring
   - flaking
   - pitting
   - wear
2. Spring and retainer assembly (506) for:
   - collapsed coils
   - distortion
3. Piston (505) for:
   - cracks
   - cut seal
4. Housing (504) for:
   - wear
   - open lube holes
   - damaged thrust faces

Assemble

Figure 69

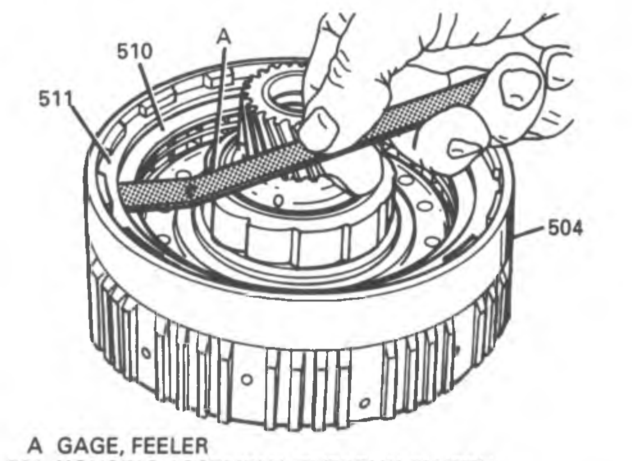
1. Piston seal protector J 38729 into housing (504).
2. Piston and seal assembly (505) into housing (504) while rotating.

   NOTE: Piston must be kept level while rotating.
3. Spring and retainer assembly (506) (springs facing down) using J 23327 and J 38734.
4. Place snap ring tools on housing (504) and press snap ring (507) into position using tool.
5. Clutch plates (508 and 509), 3 of each, backing plate (510).
6. Snap ring (511).



504 HOUSING ASSEMBLY, OVERRUN CLUTCH
505 PISTON ASSEMBLY, OVERRUN CLUTCH MH0062-4L80-E

Figure 69 Installing Overrun Clutch Piston

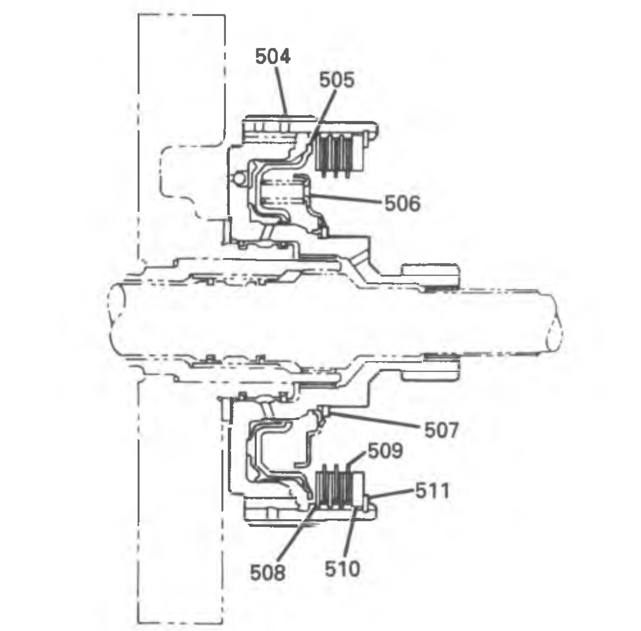


A GAGE, FEELER
504 HOUSING ASSEMBLY, OVERRUN CLUTCH
510 PLATE, OVERRUN CLUTCH BACKING
511 RING, SNAP MH0063-4L80-E

Figure 70 Measuring Overrun Clutch Piston Travel

Measure

1. Place overrun clutch assembly (504) on a reconditioned pump assembly (4) to check clutch apply.
2. Feeler gage between backing plate and snap ring.
3. Clearance should be between 0.838 to 2.38 mm (0.033 to 0. 094 inch.)



504 HOUSING ASSEMBLY, OVERRUN CLUTCH
505 PISTON ASSEMBLY, OVERRUN CLUTCH
506 SPRING & RETAINER ASSEMBLY
507 RING, SNAP RETAINER
508 PLATE, OVERRUN CLUTCH
509 PLATE ASSEMBLY, OVERRUN CLUTCH
510 PLATE, OVERRUN CLUTCH BACKING
511 RING, SNAP MH0064-4L80-E

Figure 71 Overrun Clutch Assembly

OVERDRIVE CARRIER ASSEMBLY

Figure 72

Measure

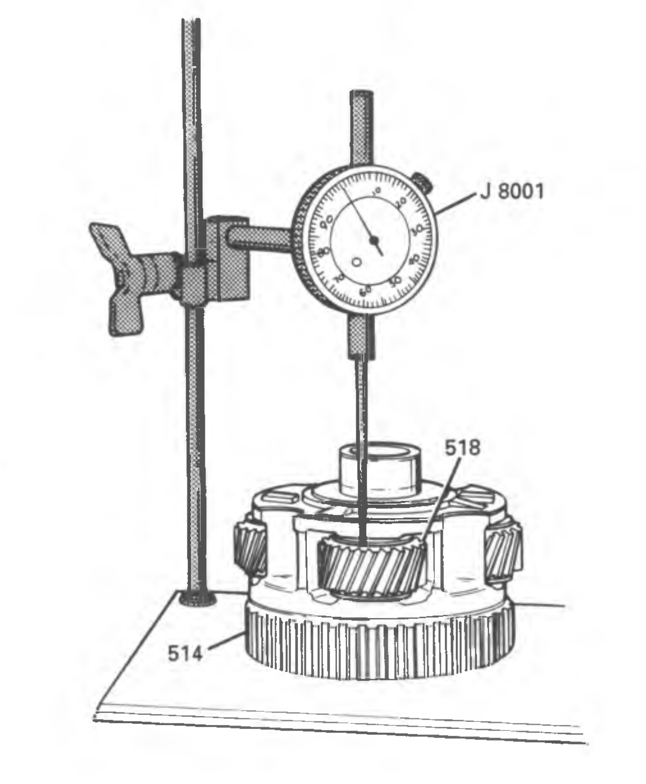
1. Set dial indicator on pinion (518) to zero. Manually raise pinion.
2. End play is 0.229 to 0.610 mm (0.009 to 0.024 inch).

Disassemble

Figures 73 and 74

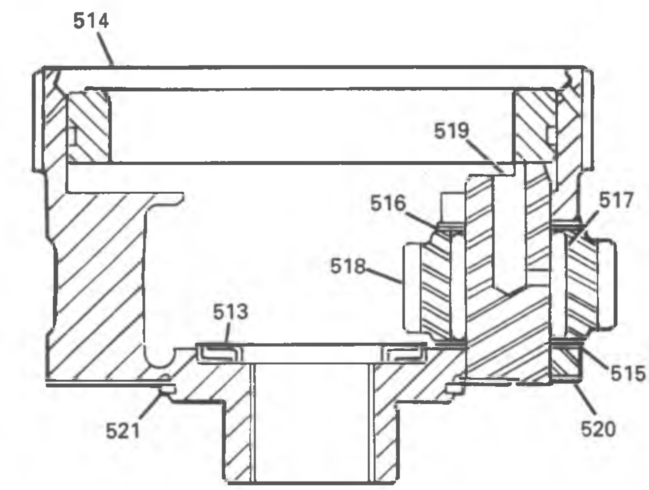
1. Snap ring (521) and retainer pinion pin (520).

   NOTE: Mark top of pinion gears and location on carrier of pins to be reinstalled in original locations.
2. Four pinion pins (519) from carrier (514).
3. Pinions (518), thrust washers (515 and 516) and roller needle bearings (517).



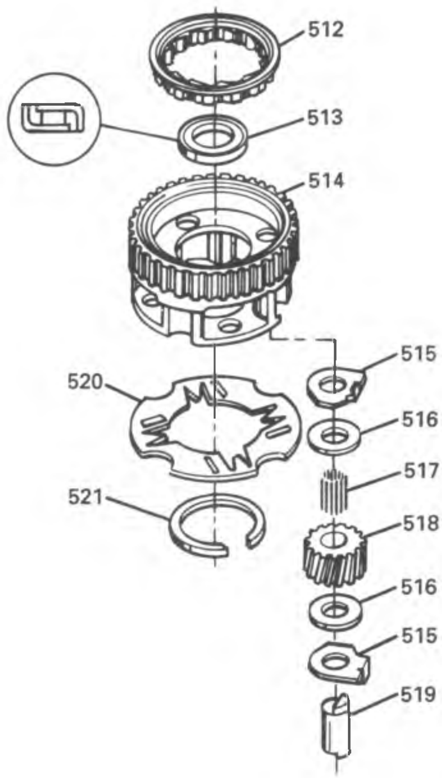
514 CARRIER ASSEMBLY, OVERDRIVE
518 PINION, OVERDRIVE PLANET
MH0065-4L80-E

Figure 72 Measuring Overdrive Carrier Pinion Travel



513 BEARING ASSEMBLY, (THRUST CARRIER/ OVERRUN CLUTCH)
514 CARRIER ASSEMBLY, OVERDRIVE
515 WASHER, PINION THRUST
516 WASHER, PINION THRUST (STEEL)
517 ROLLER, NEEDLE BEARING
518 PINION, OVERDRIVE PLANET
519 PIN, OVERDRIVE PINION
520 RETAINER, PINION PIN
521 RING, SNAP
MH0066-4L80-E

Figure 73 Overdrive Carrier Assembly



512 ROLLER CLUTCH ASSEMBLY, OVERDRIVE
513 BEARING ASSEMBLY, (THRUST CARRIER/ OVERRUN CLUTCH)
514 CARRIER ASSEMBLY, OVERDRIVE
515 WASHER, PINION THRUST
516 WASHER, PINION THRUST (STEEL)
517 ROLLER, NEEDLE BEARING
518 PINION, OVERDRIVE PLANET
519 PIN, OVERDRIVE PINION
520 RETAINER, PINION PIN
521 RING, SNAP
MH0067-4L80-E

Figure 74 Overdrive Carrier Assembly

Inspect

1. Pinion pocket thrust surfaces for:
   - burrs
2. Roller clutch assembly (512).
3. Pinion assembly (518).
4. Thrust bearing assembly (513).
5. Carrier (514) for:
   - cracks
   - damage
   - wear

Assemble

1. Needle bearing (517) and pinions (518).
2. Washers (515 and 516) on pinion (518).

Important

- Thrust bearing (513) must be installed before pinions.

3. Thrust bearing (513).
4. Pinion gear assemblies into carrier (514).
5. Pinion pins (519) through pinion gear (518) and carrier (514).
6. Retainer (520) and snap ring (521).

TURBINE SHAFT

Figures 75, 76 and 77

Tools Required:

J 38736 Seal Sizer (2 different sizes)
Seal Installer (2 different sizes)
Seal Pusher (2 different sizes)

Inspect

Figure 75

1. Seals (501 and 503).
2. Check ball (534) on end of shaft (502).
3. Splines on shaft (502).

Disassemble

- Turbine shaft seals (501 and 503).

Assemble

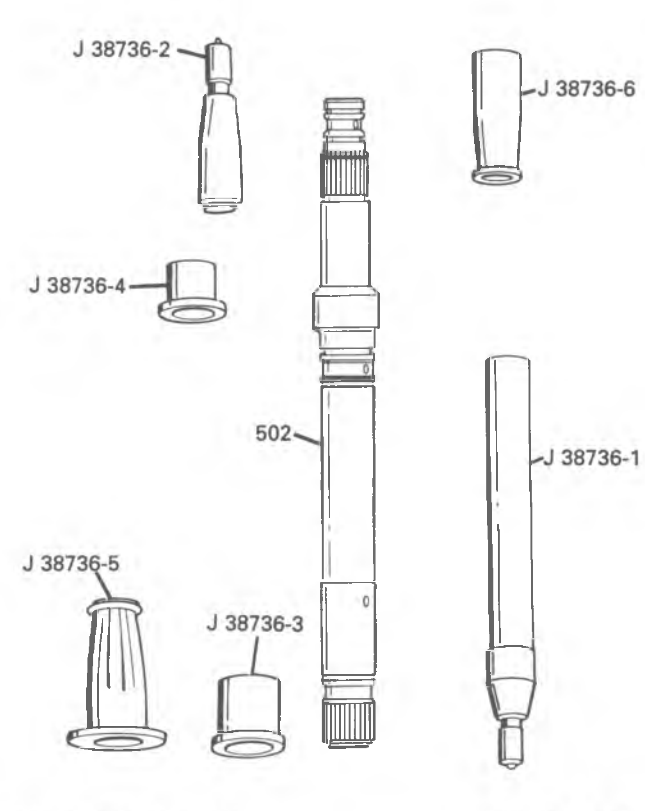
Figures 76 and 77

1. Place seal installer J 38736 onto shaft.
2. Push seals (501 and 503) over and down the installer until they are in place, using pusher tool.
3. Remove installer.
4. Place sizer over shaft to size seals in place.

Important

- Be sure to use small chamfer end of sizer to do the lower ring. Then use larger chamfered end to size all other seals.

5. Remove sizer.
6. Always start with lower seal first and work towards top.
7. Repeat procedure with different size set of tools for opposite end.



502 SHAFT, TURBINE MH0068-4L80-E

Figure 75 Turbine Shaft Seal Installation

8. Turbine shaft (502) through housing (504) until splines show through.
9. Overdrive carrier assembly (514) into housing assembly (504).
   - DO NOT DAMAGE SEALS.
10. Snap ring (522).
11. Bearing assembly (601) with TRANSJEL™ J 36850 or equivalent, onto forward clutch housing (602). Silver side up.
12. Complete assembly into case.

Important

- Be sure assembly is fully engaged in clutch plates and is at the level of the 4th clutch housing. Using selective thrust washer (218) onto top of overrun housing and straight edge to pump to cage surface. The two surfaces should be flush.

501 RING, OIL SEAL (TURBINE SHAFT/STATOR HSG.)
502 SHAFT, TURBINE
503 RING, OIL SEAL (TURBINE SHAFT/FORWARD HSG.)
504 HOUSING ASSEMBLY, OVERRUN CLUTCH
505 PISTON ASSEMBLY, OVERRUN CLUTCH
506 SPRING & RETAINER ASSEMBLY
507 RING, SNAP RETAINER
508 PLATE, OVERRUN CLUTCH
509 PLATE ASSEMBLY, OVERRUN CLUTCH
510 PLATE, OVERRUN CLUTCH BACKING
511 RING, SNAP
512 ROLLER CLUTCH ASSEMBLY, OVERDRIVE
513 BEARING ASSEMBLY, (THRUST CARRIER/ OVERRUN CLUTCH)
514 CARRIER ASSEMBLY, OVERDRIVE
515 WASHER, PINION THRUST
516 WASHER, PINION THRUST (STEEL)
517 ROLLER, NEEDLE BEARING
518 PINION, OVERDRIVE PLANET
519 PIN, OVERDRIVE PINION
520 RETAINER, PINION PIN
521 RING, SNAP
522 RING, SNAP (TURBINE SHAFT/CARRIER)

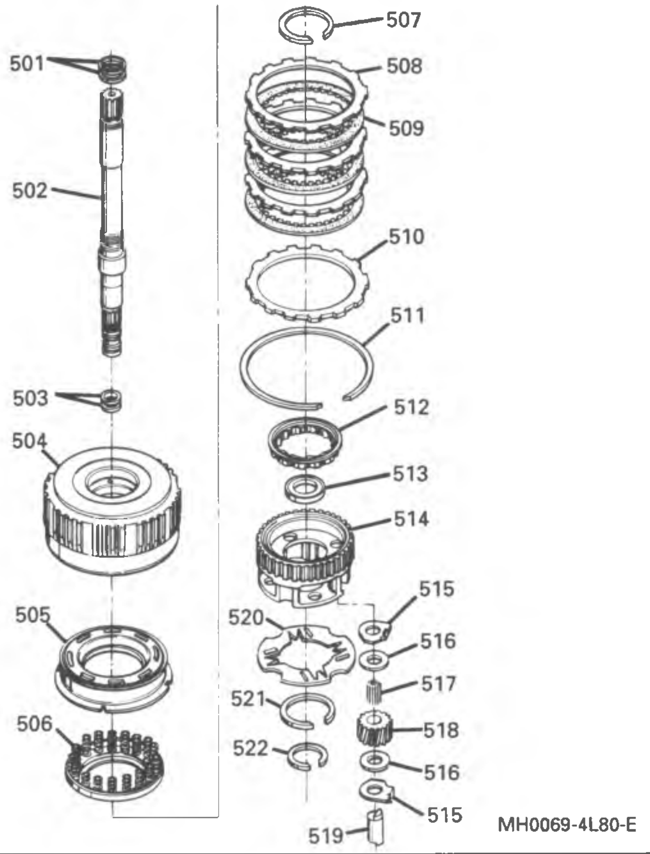
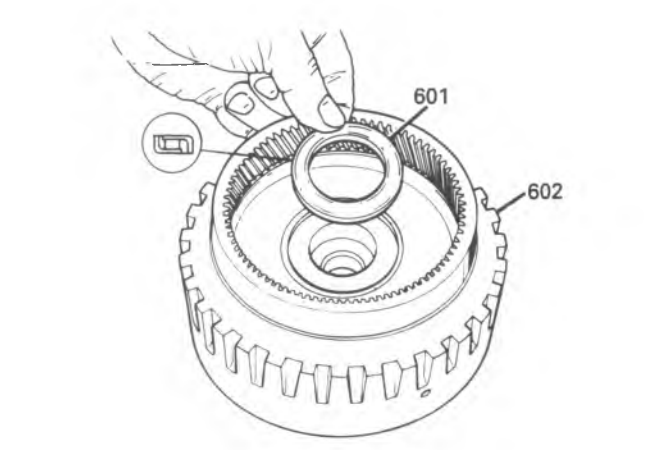


Figure 76 Overdrive/Overrun Clutch Assembly



601 BEARING ASM., THRUST CARRIER/FORWARD CLUTCH
602 HOUSING ASSEMBLY, FORWARD CLUTCH
MH0070-4L80-E

Figure 77 Installing Bearing Assembly

PUMP ASSEMBLY

Figure 78

Tools Required:

J 23129 Seal Remover
J 6125-1B Slide Hammer

Disassemble

1. Five bolts (220).

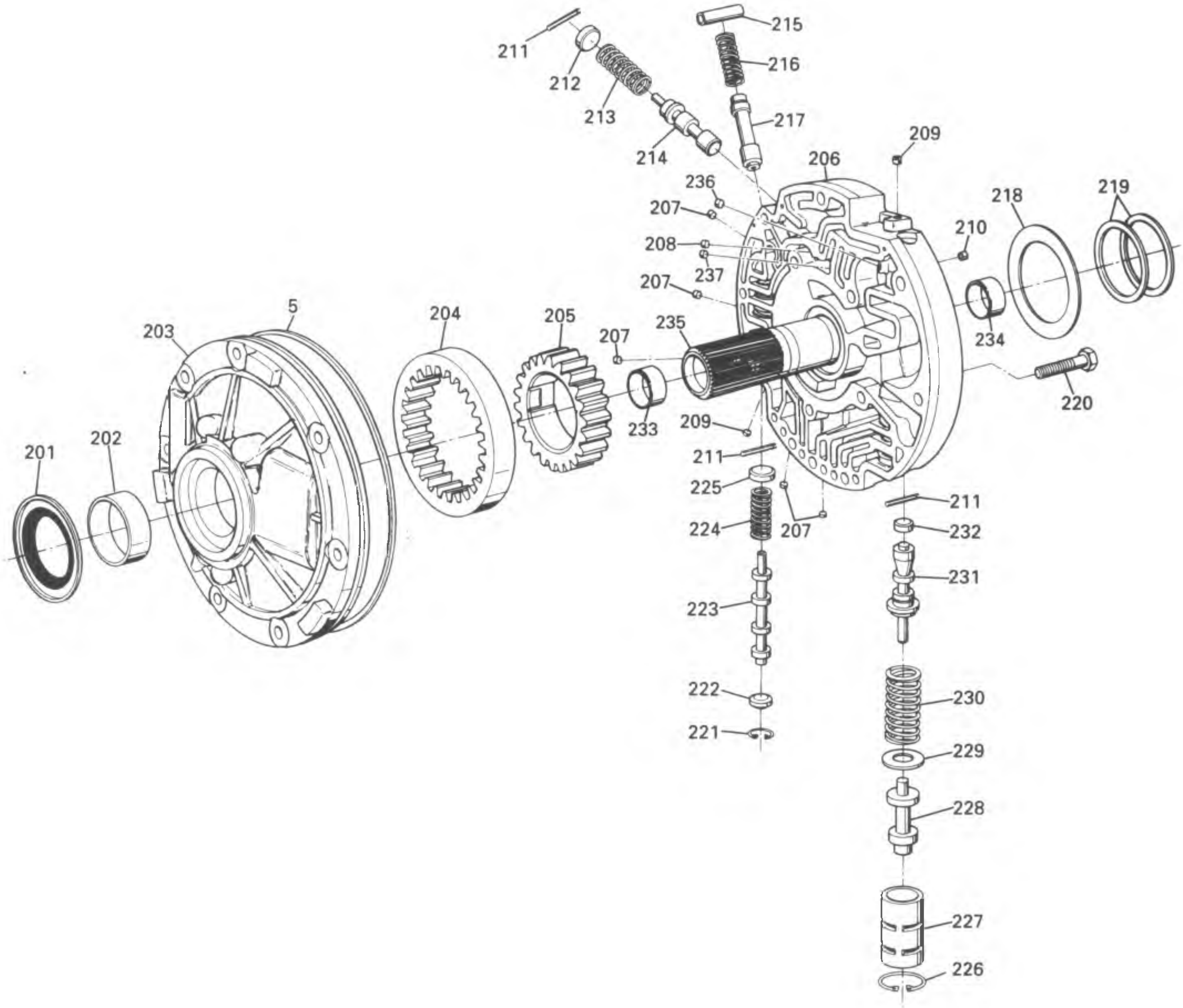
CAUTION: Regulator spring (230) is tightly compressed. Use care when removing retaining ring (226). Personal injury could result.

2. Retaining ring (226).
3. Pressure regulator and boost valve assemblies (227-232).
4. Converter limit valve assembly, pin (211), plug (212), spring (213) and valve (214).
5. Torque converter clutch enable valve assembly, sleeve (215), spring (216) and valve (217).
6. Torque converter clutch valve assembly, snap ring (221), plug (222), valve (223), spring (224), plug (225) and pin (211).

Important

- Before removing gears (204) and (205) from pump body, inspect markings on gear faces and chamfer of gear teeth to ensure reassembly to same position.

7. Pump drive gear (205) and driven gear (204).
8. Seal rings (219) and selective thrust washer (218).
9. Seal ring (5) pump to case.



5 SEAL, OIL PUMP TO CASE
201 HELIX SEAL ASSEMBLY, PUMP BODY
202 BUSHING, PUMP BODY
203 BODY, OIL PUMP
204 GEAR, PUMP DRIVEN
205 GEAR, PUMP DRIVE
206 COVER, PUMP
207 PLUG, CUP (5)
208 PLUG, CUP (1)
209 PLUG, CUP (2)
210 PLUG, ORIFICE CUP (1)
211 PIN, COILED SPRING (3)
212 PLUG, CONVERTER LIMIT VALVE BORE
213 SPRING, CONVERTER LIMIT VALVE
214 VALVE, CONVERTER LIMIT
215 SLEEVE, SPRING RETAINER
216 SPRING, TCC ENABLE VALVE
217 VALVE, TCC ENABLE
218 WASHER, THRUST SELECTIVE
219 RING, OIL SEAL (2)
220 BOLT, M8 X 1.25 X 40 (5)
221 RING, SNAP
222 PLUG, TCC VALVE BORE
223 VALVE, TCC
224 SPRING, TCC VALVE
225 PLUG, TCC VALVE BORE
226 RING, RETAINER (REV. BOOST VALVE BUSHING)
227 BUSHING, REVERSE BOOST VALVE
228 VALVE, REVERSE BOOST
229 RETAINER, PRESSURE REGULATOR SPRING
230 SPRING, PRESSURE REGULATOR
231 VALVE, PRESSURE REGULATOR
232 PLUG, PRESSURE REGULATOR
233 BUSHING, STATOR SHAFT (FRONT)
234 BUSHING, STATOR SHAFT (REAR)
235 SHAFT, STATOR
236 PLUG, CUP (1)
237 PLUG, CUP (1)

MH0071-4L80-E

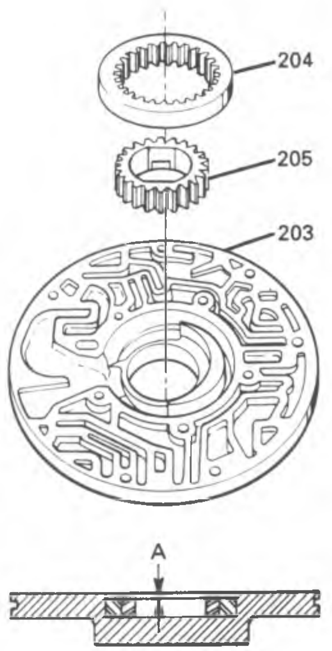
Figure 78 Pump Assembly

Pump Body

Figure 78

Inspect

1. Gear pockets, crescent, pump body face, and bushing for:
   - scoring
   - nicks
   - wear
2. Oil passages for:
   - foreign material or debris
   - porosity
   - scored or irregular mating surfaces
   - cross channel leaks
3. Pump body bolt threads for:
   - damage
4. Oil seal (201), bushing (202) for:
   - wear
   - damage



A 0.0007"-0.0028" (0.017mm-0.071mm)
203 BODY, OIL PUMP
204 GEAR, PUMP DRIVEN
205 GEAR, PUMP DRIVE
MH0072-4L80-E

Figure 79 Measuring Pump Body Face To Gear Face Clearance

Pump Cover

Figure 81

Inspect

1. Pump gear face for:
   - wear
   - scoring
2. Stator shaft splines for:
   - damage or stripped splines
3. Stator shaft bushings (233) and (234) for:
   - wear
   - galling
4. Oil ring grooves for:
   - nicks
   - burrs
   - debris
5. Pressure regulator.
6. Converter limit valve assembly.
7. TCC enable valve assembly.
8. TCC valve assembly for:
   - free movement of valves in bores.
   - chips
   - burrs
   - distortion
   - plugged oil passages
9. Breather hole in pump cover blocked.

Clean

- All components.

Pump Assembly

Figures 78, 79 and 80

Measure

- For proper gear clearance install pump gears (204 and 205) in body (203) as marked. Chamfer side down.
- Measure clearance between gears and body with straight edge and feeler gauge.
  - maximum clearance 0.017-0.071 mm (0.0007 to 0.0028 inch.)
- Pump body with straight edge to insure flatness.

Assemble

1. Drive gear (205) and driven gear (204) with identification marks facing up. Outside diameter chamfer side down on gear teeth.
   - install drive gear into pump body (203) with flats facing up.
   - lubricate drive gear (205) and driven gear (204) with DEXRON®-II automatic transmission fluid.
2. Pressure regulator valve (231) into bore.
3. Bore plug (232) and valve straight pin (211).
4. Spring (230) and retainer (229) in pressure regulator bore.
5. Regulator boost valve (228) into boost valve bushing (227), stem out against spring (230).
6. Snap ring (226).
7. Converter limit valve (214), spring (213), plug (212) and pin (211).
8. TCC enable valve (217), spring (216), compress spring down and insert a small rod into hole A (see figure 80) to hold down spring until sleeve (215) is installed. Pull out rod when sleeve is installed.
9. TCC valve plug (225), pin (211), load from other end of bore, spring (224), valve (223), plug (222) and snap ring (221).
10. Cover (206) on body (203).
11. Five bolts (220).
    - do not fully torque

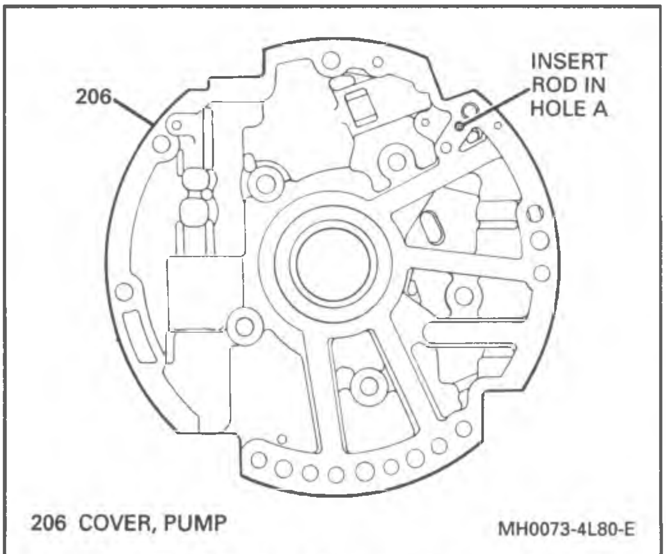


Figure 80 TCC Enable Valve Spring Rod Location

Assemble

Figures 81 and 82

Tools Required:

J 21368 Alignment Band
J 38693 Oil Seal Installer
J 38739 Oil Pump Installer, Sizer and Pusher
J 25025-1 Guide Pin
J 38789 Pump — Install/Remove

1. J 21368 on pump assembly. J 25025-1 Guide pin in bolt hole.
2. Five bolts (220).

Tighten

- Five bolts (220) to 24 N·m (18 lb. ft.)

3. Oil seal (5).
4. Correct selective thrust washer (218) as determined by Front End Play Check during disassembly. Use TRANSJEL™ J 36850 or equivalent to hold in place.
5. Two solid oil seals (219). Using J 38739 installer pusher and sizing tool onto pump hub.

Important

- Be sure to use small chamfer end of sizer J 38739 to do the lower ring. Then use larger chamfered end to size other seal.

Install or Connect

1. Gasket (6) on transmission case (7) using guide pin J 25025-1.
2. Oil pump assembly (4) in transmission case (7) using J 38789, bolt holes closest together are towards channel face.
3. Six bolts (3)

Tighten

- Bolts (3) to 24 N·m (18 lb. ft.)

Important

- If turbine shaft cannot be rotated as pump assembly is being pulled into place, the overrun, 4th, 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.

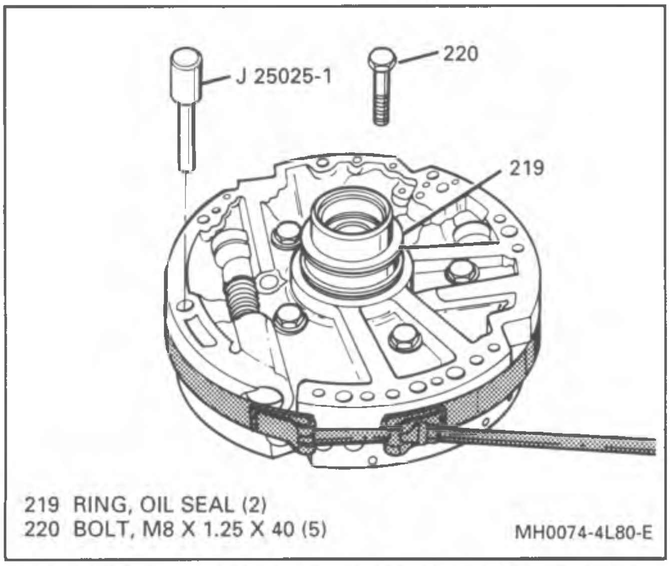


Figure 81 Assembling Pump Body and Pump Cover

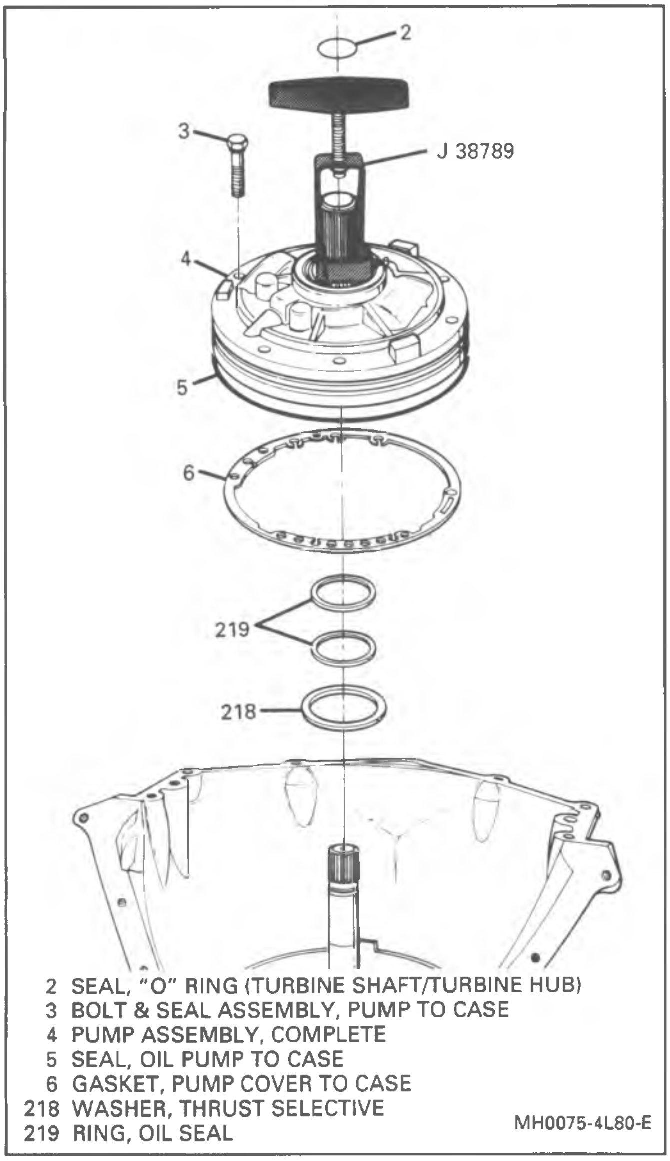


Figure 82 Gasket and Pump Assembly

FRONT UNIT END PLAY CHECK

Figures 83, 84 and 85

Tool Required:

J 8001 Dial Indicator

Measure

1. Install J 8001.
2. Eliminate slack by pressing turbine shaft (502) to the rear and output shaft (671) forward.
3. Index J 8001 against end of turbine shaft.
   - set dial to "0"
4. Pull out turbine shaft.
   - proper end play is 0.102 to 0.559 mm (0.004 to 0.022 inch)
5. Remove tools and correct end play if necessary.
6. Pump bolt (3).

Tighten

- Pump bolt (3) to 24 N·m (18 lb. ft.)

7. O-Ring (2) on turbine shaft.
8. Seal assembly (201) using J 38693

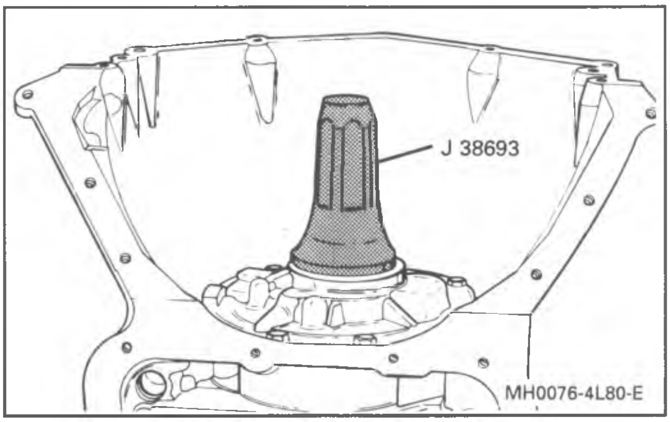


Figure 83 Installing Pump Seal

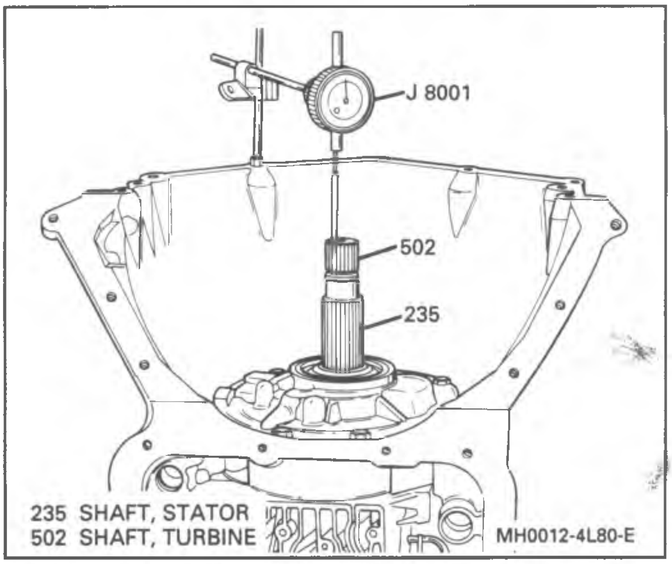


Figure 84 Front End Play Check

THICKNESS (INCH)	STRIPE
.057 - .061	BLUE
.073 - .077	RED
.089 - .093	BROWN
.105 - .109	GREEN
.121 - .125	PLAIN

MH0013-4L80-E

Figure 85 Selective Washer (218)

REAR UNIT END PLAY CHECK

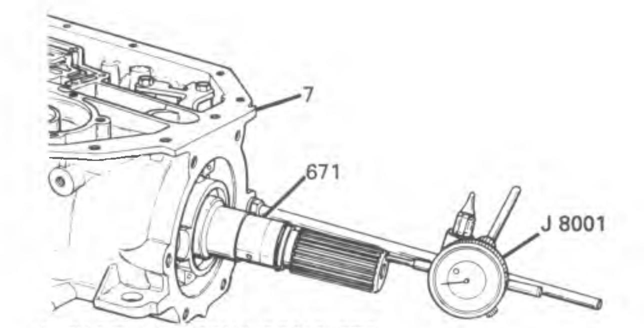
Figures 86 and 87

Measure

Tool Required:

J 8001 Dial Indicator Set

1. Attach J 8001 rod to one of the bolt holes at the end of the transmission case (7).
2. Mount J 8001 on the bolt and index it to end of the output shaft (671). Set indicator to "0."
3. Move the output shaft in and out noting the amount of end play. Correct end play is between 0.127 to 0.635 mm (0.005 to 0.025 inch).



7 CASE ASSEMBLY, COMPLETE
671 SHAFT & BUSHING ASSEMBLY, OUTPUT MH0014-4L80-E

Figure 86 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	ON END OF 1 TAB	4
.106 - .110	ON END OF 2 TABS	5
.114 - .118	ON END OF 3 TABS	6

MH0015-4L80-E

Figure 87 Output/Case Selective Thrust Washer (674)

FRONT SERVO ASSEMBLY

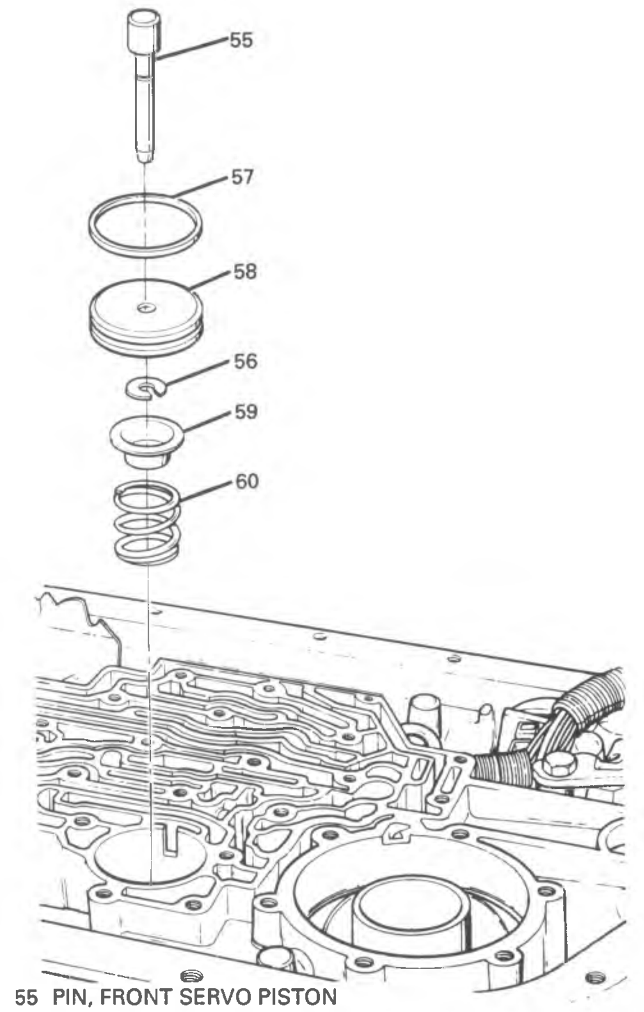
Figure 88

Clean

- All components

Inspect

1. Front servo piston (58) for:
   - porosity or damage
   - seal and seal ring groove for damage
2. Piston pin (55) for:
   - wear
3. Spring (60) for:
   - distortion
4. Servo bore for:
   - wear or scoring



55 PIN, FRONT SERVO PISTON
56 RING, FRONT SERVO PISTON RETAINER
57 RING, OIL SEAL
58 PISTON, FRONT SERVO
59 RETAINER, FRONT SERVO SPRING
60 SPRING, FRONT SERVO PISTON MH0077-4L80-E

Figure 88 Front Servo Assembly

Install or Connect

1. New seal (57) onto piston (58).
2. Front servo piston spring (60) and retainer (59).
3. Ring (56), piston pin (55) and piston (57).
   - make certain tapered end of piston pin (55) contacts band
4. Front servo assembly into case.

BAND APPLY PIN CHECK

Figures 89, 90 and 91

Tools Required:

J 21370-10 Gage Pin
J 38737 Band Apply Pin Checking Tool

Measure

1. Place J 21370-10 in the servo pin bore.
2. Position J 38737 over the bore with the hex nut facing the parking pawl linkage.
3. Fasten with two servo cover bolts (61).

Tighten

- Bolts (61) to 24 N·m (18 lb. ft.).

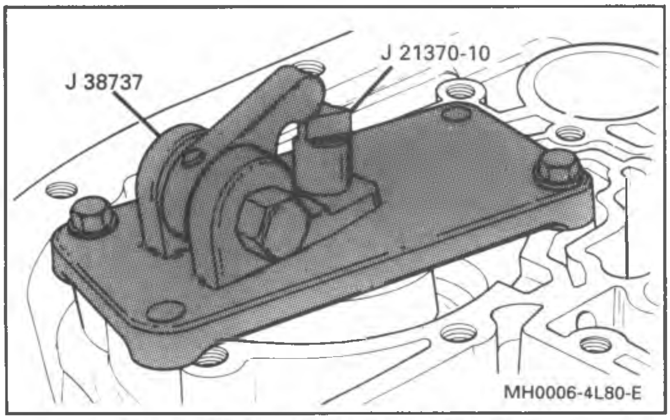


Figure 89 Installing Servo Pin Gage

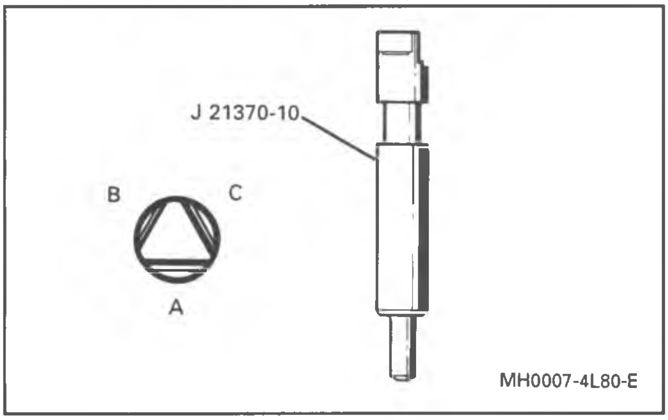


Figure 90 Gage Pin

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 91.

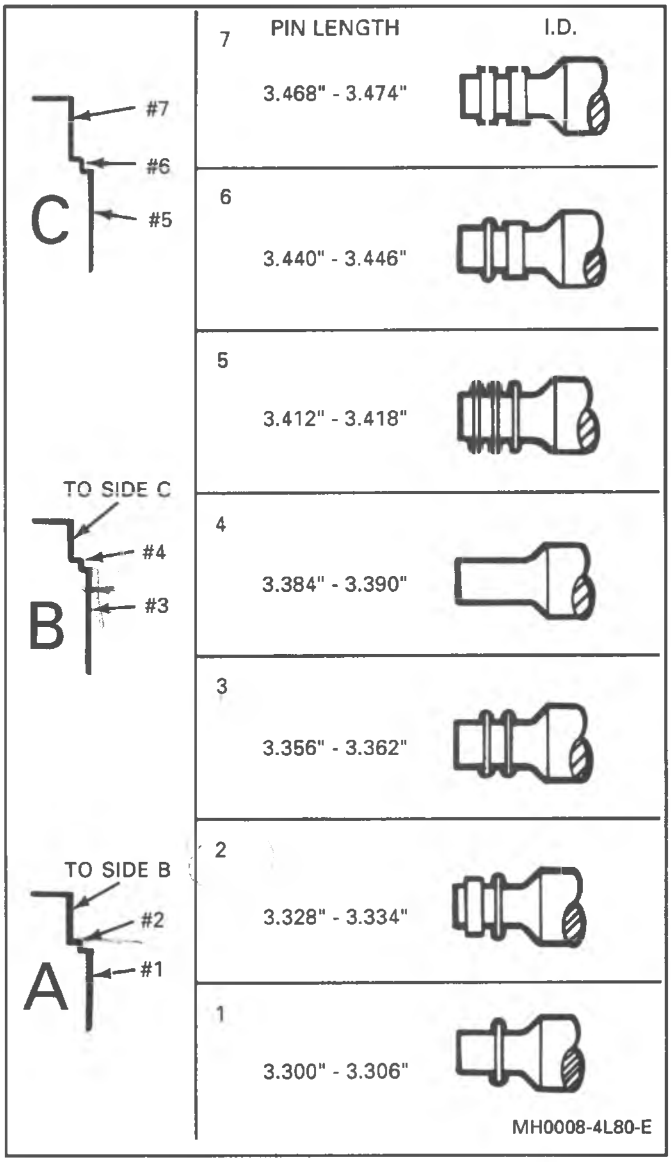


Figure 91 Servo Pin Selection

REAR SERVO ACCUMULATOR

Figure 92

Disassemble

- Retaining clip (64) from rear band apply pin (73) and inspect.

Inspect

1. Rear Accumulator piston (68) and Rear Servo piston (65) for:
   - porosity or damage
   - ring groove damage
2. Seals (66, 67 and 68) for:
   - nicks or cuts
3. Cover (62) for:
   - porosity
   - scored or damaged
4. Springs (71 and 74) for distortion.
5.. Pin (73) for wear.
6. Servo bore for wear or scoring.

Clean

- All components.

Assemble

1. Rear servo spring retainer (72), rear servo spring (71) and servo washer (70) on rear band apply pin (73).
2. Reverse servo piston seal (66) on rear servo piston (65) and press onto rear band apply pin (73).
3. Retaining ring (64).
4. Lube seals, inner (69) and outer (67) before installing accumulator piston seals on accumulator piston (68). Place in rear servo piston.

Install or Connect

1. Rear accumulator spring (74) in case bore.
2. New gasket (63), cover (62) and six 10 mm bolts (61).

Tighten

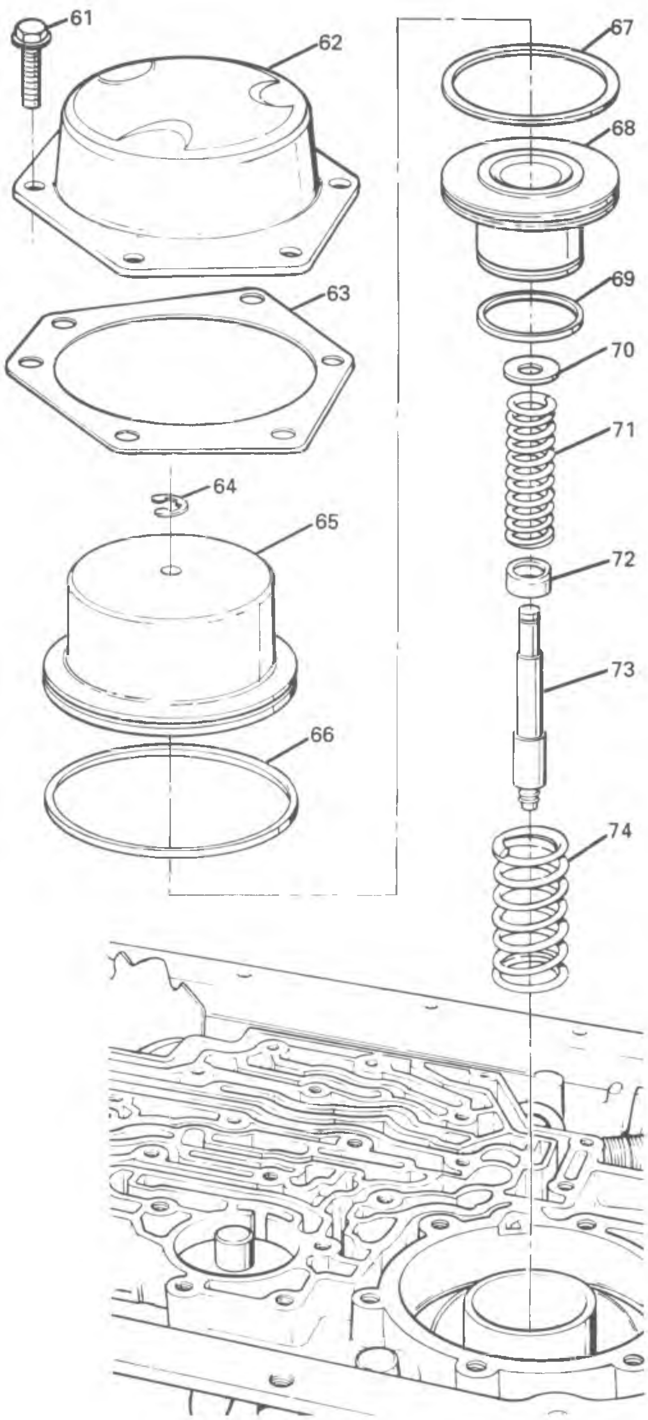
- Bolts (61) to 24 N·m (18 lb. ft.).

CONTROL VALVE ASSEMBLY/ACCUMULATOR HOUSING

Figure 93

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 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.



61 BOLT, REAR SERVO COVER
62 COVER, REAR SERVO
63 GASKET, REAR SERVO COVER
64 CLIP, RETAINING
65 PISTON, REAR SERVO
66 RING, OIL SEAL ACCUM. PISTON (OUTER)
67 RING, OIL SEAL ACCUM. PISTON (INNER)
68 PISTON, REAR ACCUMULATOR
69 SEAL, REVERSE SERVO PISTON
70 WASHER, SERVO PISTON
71 SPRING, REAR SERVO
72 RETAINER, REAR PISTON SPRING
73 PIN, REAR BAND APPLY (SELECTIVE)
74 SPRING, REAR ACCUMULATOR

MH0078-4L80-E

Figure 92 Installing Rear Servo

Clean

- Control valve assembly and accumulator housing (51) thoroughly in clean solvent.
- Air dry.

Disassemble

Figure 93

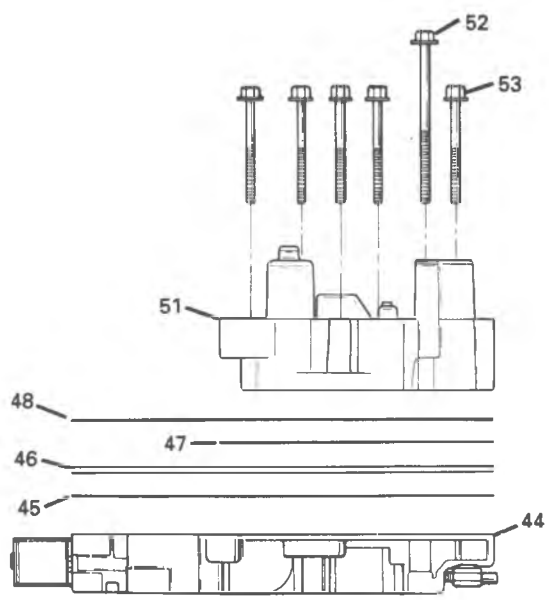
- Control valve assembly/accumulator housing assembly.
  - Position as shown on a clean surface.
  - Remove valve trains and accumulator pistons.

CAUTION: Some valves are under pressure – cover the bores while removing the roll pins or personal injury could result.

  - Remove blind hole roll pins with a modified drill bit.
  - Valves, springs, bushings and pistons must be laid out on a clean surface in the exact sequence they are removed.

Clean

- All valves, springs, bushings, pistons, control valve body and accumulator housing in clean solvent.
- Dry using compressed air.



44 BODY ASSEMBLY, CONTROL VALVE
45 GASKET, VALVE BODY TO SPACER PLATE
46 PLATE, VALVE BODY SPACER
47 GASKET, ACCUMULATOR HSG. TO SPACER PLATE
48 GASKET, SPACER PLATE TO CASE
51 HOUSING, ACCUMULATOR
52 BOLT, ACCUM. HOUSING TO VALVE BODY (LONG)
53 BOLT, ACCUM. HOUSING TO VALVE BODY (SHORT)

MH0079-4L80-E

Figure 93 Control Valve Assembly/Accumulator Housing

Inspect

1. All valves, pistons and bushings for:
   - porosity
   - scoring
   - nicks
   - scratches
2. Pistons for:
   - seal damage
3. Springs for:
   - damaged or distorted coils
4. Valve body casting and accumulator housing for:
   - porosity
   - cracks
   - interconnected passages
   - damaged machined surfaces
5. Solenoid, connectors and switches.

ACCUMULATOR HOUSING ASSEMBLY

Figures 93 and 94

Disassemble

Figure 93

1. Five 8 mm bolts (53).
2. One 8 mm bolt (52).
3. Accumulator housing assembly.
4. Gasket accumulator housing (47).
5. Spacer plate (46).
6. Gasket (45) valve body spacer.
7. Gasket (48) accumulator housing to spacer plate.

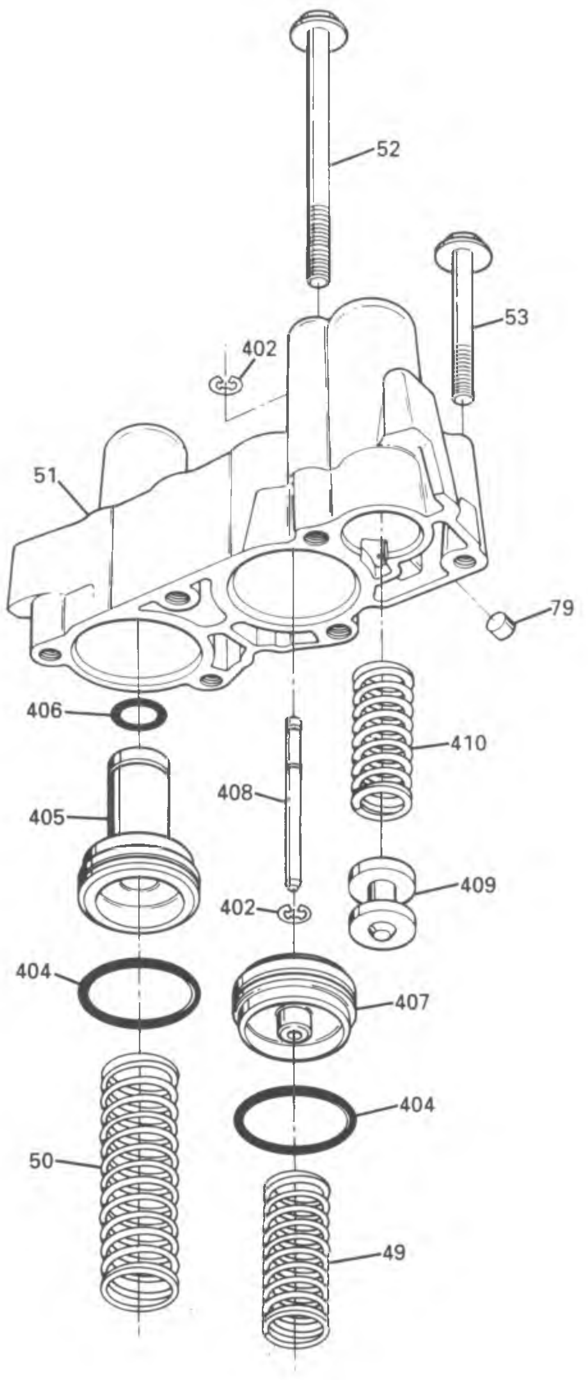
Disassemble

Figure 94

1. Torque signal compensator valve (409) and spring (410).
2. Snap ring (402) from outside housing, pin (408), snap ring (402), piston (407) and spring (49).
3. 3rd clutch piston (405) and spring (50).
4. Seals (404 and 406).

Assemble

- Accumulator housing assembly components exactly as shown. Notice the positions of the valve and pistons.



49 SPRING, 4TH CLUTCH ACCUM. PISTON
50 SPRING, 3RD CLUTCH ACCUM. PISTON
51 HOUSING, ACCUMULATOR
52 BOLT, ACCUM. HOUSING TO VALVE BODY (LONG)
53 BOLT, ACCUM. HOUSING TO VALVE BODY (SHORT)
79 PLUG, DIRECT OIL GAL (.25 DIA. CUP)
402 RING, SNAP
404 SEAL, (1.615) SQUARE CUT
405 PISTON, 3RD CLUTCH ACCUMULATOR
406 SEAL, (.859) SQUARE CUT
407 PISTON, 4TH CLUTCH ACCUMULATOR
408 PIN, 4TH CLUTCH ACCUMULATOR PISTON
409 VALVE, TORQUE SIGNAL COMPENSATOR
410 SPRING, T.S. COMPENSATOR

MH0080-4L80-E

Figure 94 Accumulator Housing Assembly Tightening Sequence

CONTROL VALVE ASSEMBLY

Figure 95

Assemble

- Control valve assembly components exactly as shown. Notice the position of the valve lands and bushing passages.

Installing Control Valve Assembly and Accumulator Housing

Figures 96 through 98

Tool Required:

Guide Pin J 25025-5

Assemble

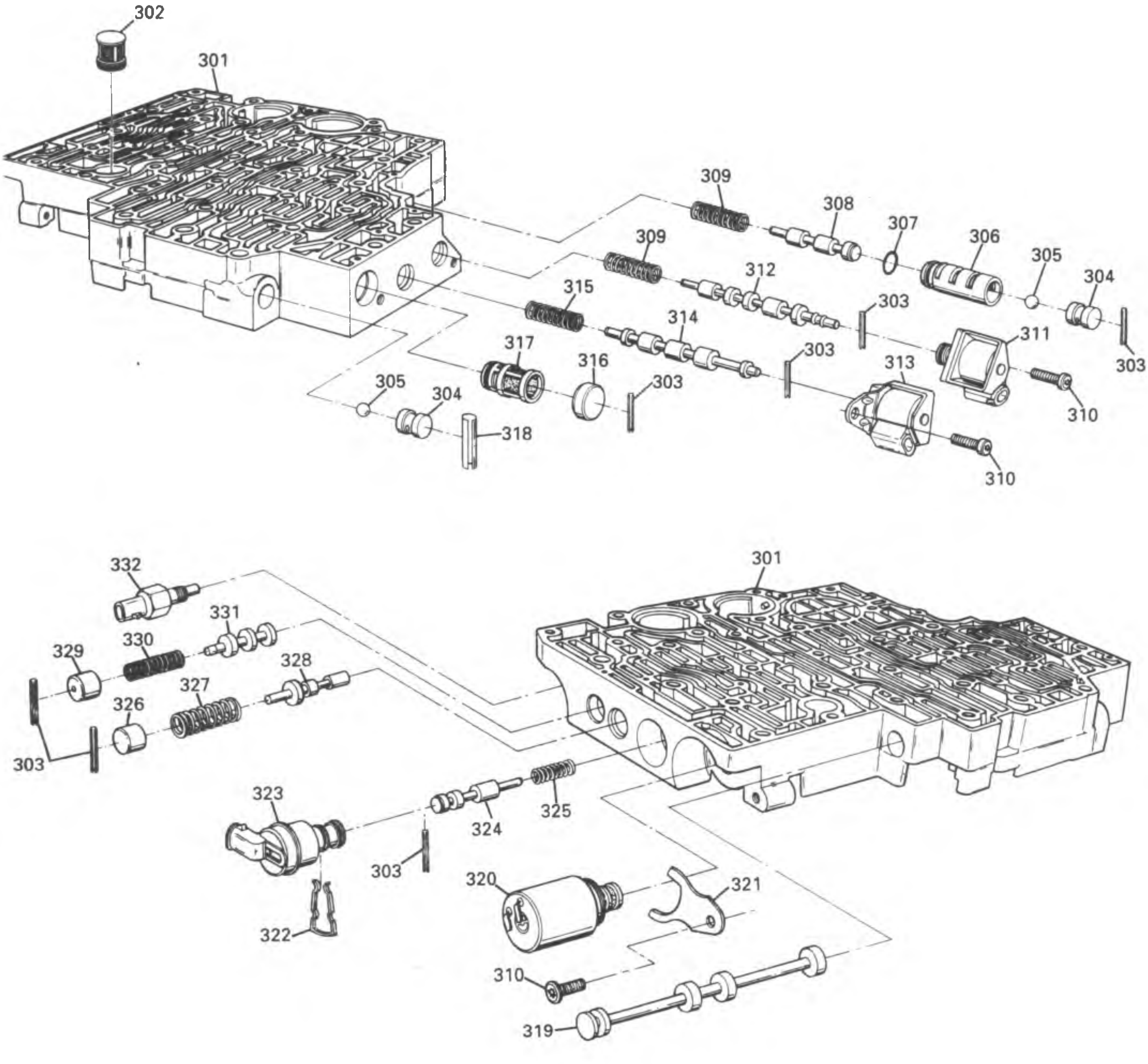
1. Gasket (45) valve body to spacer plate (46).
2. Spacer plate (46).
3. Gasket (47) accumulator housing to spacer plate (46).
4. Accumulator housing assembly (51) onto valve body assembly (44).
5. Guide pin J 25025-5 into valve body. Located at back bolt hole of detent spring and roller assembly bolt hole.
6. Five 8 mm bolts (53) and one long bolt (52) through accumulator housing into valve body assembly.

NOTE: Start accumulator housing bolts finger tight starting with bolt (52) and work towards opposite end. Tighten sequence Figure 96.

Tighten

- Bolts (52 and 53) to 11 N·m (97 lb. in.)

7. Remove guide pin J 25025-5.



301 BODY, CONTROL VALVE
302 SCREEN FILTER, FORCE MOTOR FEED
303 PIN, COILED SPRING
304 PLUG, CHECKBALL
305 BALL (.375 DIA.)
306 BUSHING, 3RD/REVERSE CHECKBALL
307 SEAL, OIL PUMP CVR SCREEN
308 VALVE, 3/4 SHIFT
309 SPRING, SHIFT VALVE RETURN (2/3 & 3/4)
310 BOLT, SOLENOID (1/2 & 2/3 SHIFT, FORCE MOTOR)
311 SOLENOID & O-RING ASSEMBLY, B
312 VALVE, 2/3 SHIFT
313 SOLENOID & O-RING ASSEMBLY, A
314 VALVE, 1/2 SHIFT
315 SPRING, 1/2 SHIFT VALVE RETURN
316 PLUG, SHIFT SOLENOID FEED FILTER
317 FILTER, SHIFT SOLENOID FEED
318 SLEEVE, LO/REVERSE CHECKBALL
319 VALVE, MANUAL
320 VARIABLE FORCE MOTOR
321 CLAMP, FORCE MOTOR RETAINING
322 CLIP, PWM SOLENOID RETAINING
323 SOLENOID ASSEMBLY, PWM
324 VALVE, TCC REGULATOR APPLY
325 SPRING, TCC REGULATOR APPLY VALVE
326 PLUG, VALVE BORE (ACTUATOR FEED)
327 SPRING, ACTUATOR FEED LIMIT VALVE
328 VALVE, ACTUATOR FEED LIMIT
329 PLUG, ACCUMULATOR VALVE BORE
330 SPRING, ACCUMULATOR VALVE
331 VALVE, ACCUMULATOR
332 SENSOR, TEMPERATURE

MH0081-4L80-E

Figure 95 Control Valve Assembly

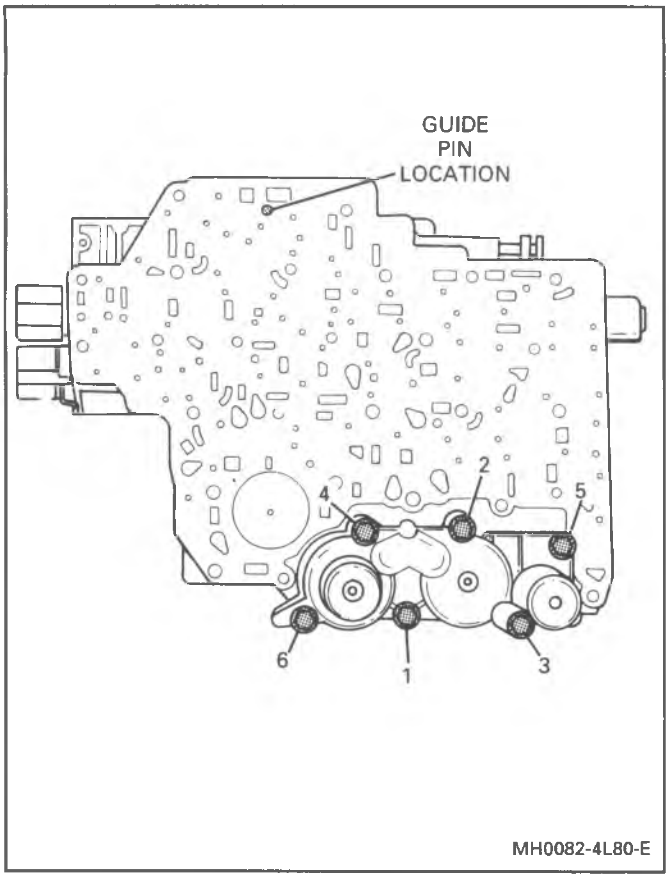


Figure 96 Torque Sequence & Guide Pin Location

Install or Connect

Figures 96 through 99

1. Install eight check balls (54) in proper location into case fluid passages.
2. Gasket (48) spacer plate to case.
3. Complete valve body assembly (44) onto case (7). Use J 25025-B guide pin set.
4. Pressure manifold (40) onto valve body assembly (44). Spring and roller assembly (41) into place.
5. Three wiring clips (33) and fluid indicator stop (43).
6. Twenty-one 10mm bolts (35).

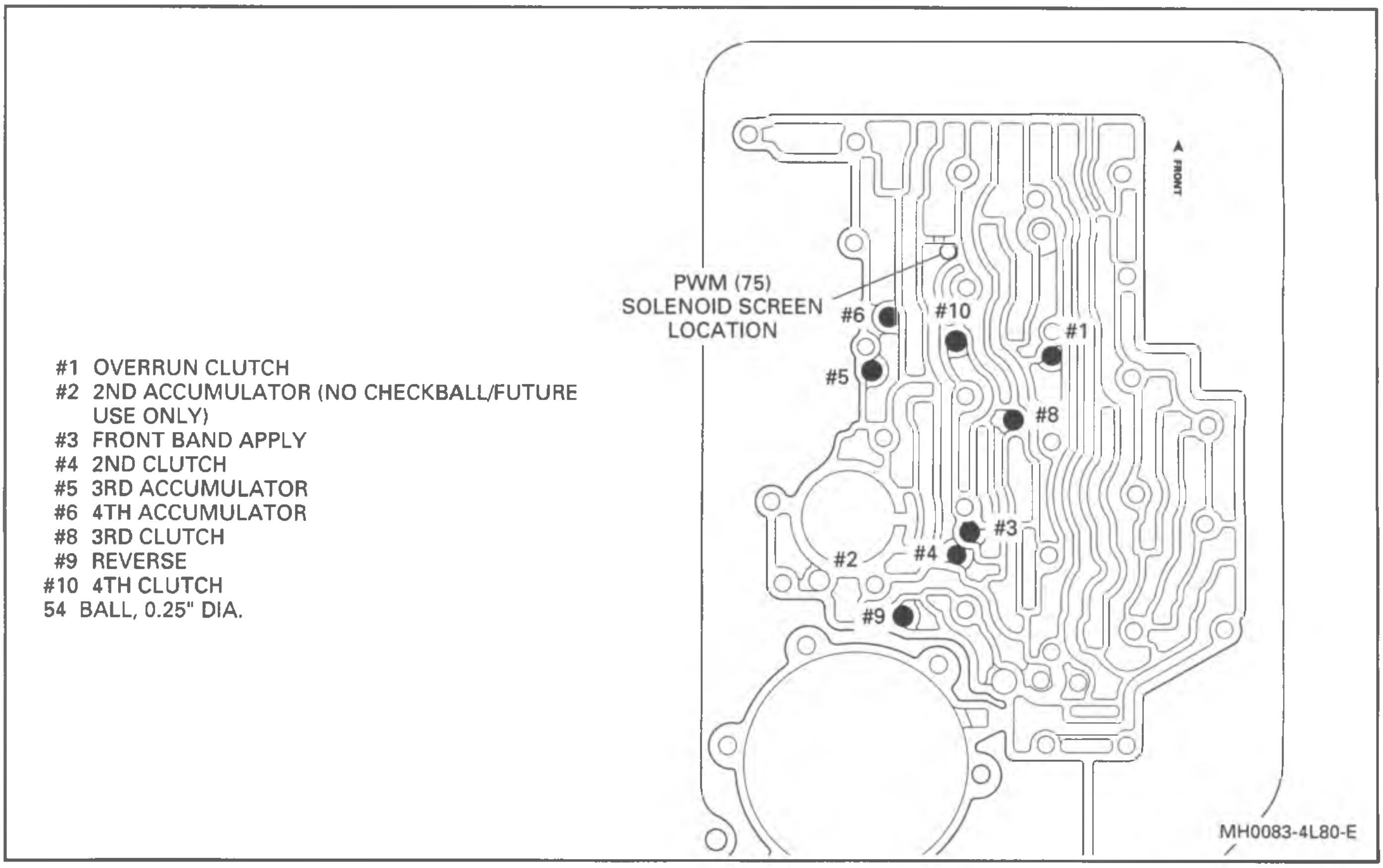


Figure 97 Checkball Location

7. Six 8 mm bolts (76) into PSM (Pressure Switch Manifold) (40).

Tighten

- Bolts (76) to 11 N·m (97 lb. in.).

8. Lube pipe (39) long end into case.
9. Lube pipe clip (37) with short bolt (36).
10. Attach wiring harness (34) to six connectors.
    - Put large end into case first, pressure switch hook up, solenoid A (blue) and B (red), temperature sensor, PWM (Pulse Width Modulated) solenoid and force motor.

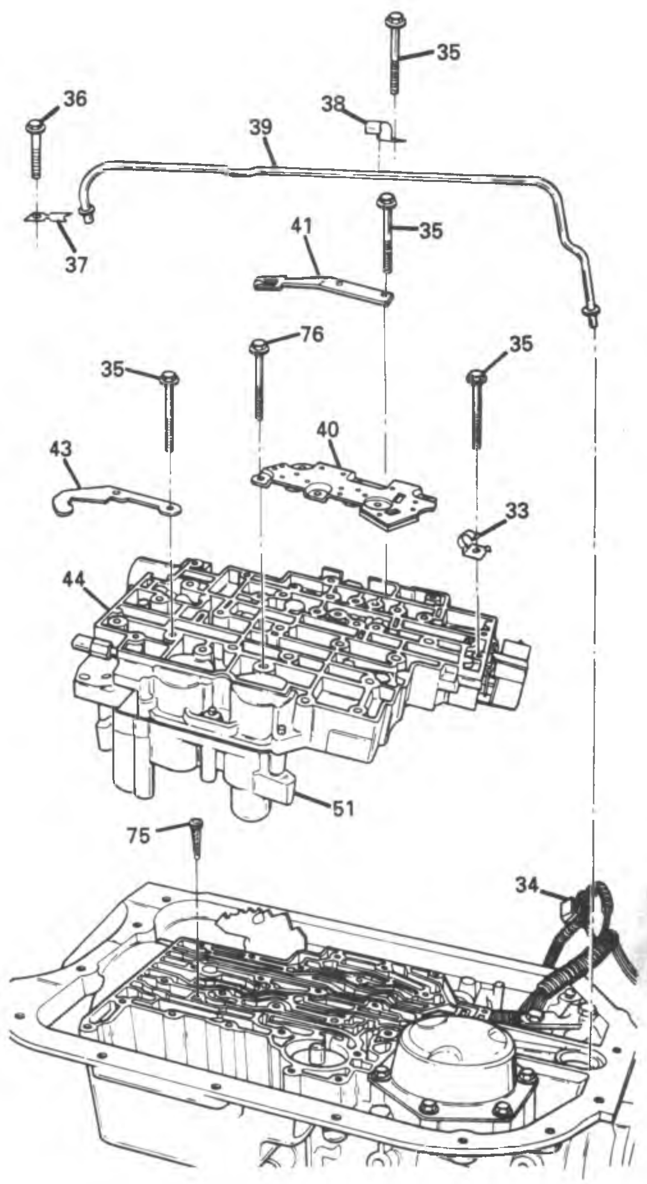
Tighten

- Bolts (36) to 13 N·m (116 lb. in.).

11. Twenty-one 10 mm bolts (35) and one bolt (36), attaching valve body to case.

Tighten

- Bolts (35) to 11 N·m (97 lb. in.).



33 CLAMP, ELECTRICAL CABLE
34 HARNESS ASSEMBLY, ELECTRICAL WIRING
35 BOLT, HEX HD. (M6 X 1.0 X 55.0)
36 BOLT, HEX HD (M6 X 1.0 X 35.0)
37 RETAINER, LUBE PIPE
38 CLAMP, LUBE PIPE
39 PIPE, LUBE
40 MANIFOLD, PRESSURE SWITCH
41 SPRING ASSEMBLY, MANUAL DETENT
43 STOP, OIL (DIPSTICK)
44 BODY ASSEMBLY, CONTROL VALVE
51 HOUSING, ACCUMULATOR
75 SCREEN, PWM SOLENOID
76 BOLT, SPECIAL M6 X 1.0

MH0003-4L80-E

Figure 98 Installing Control Valve Assembly

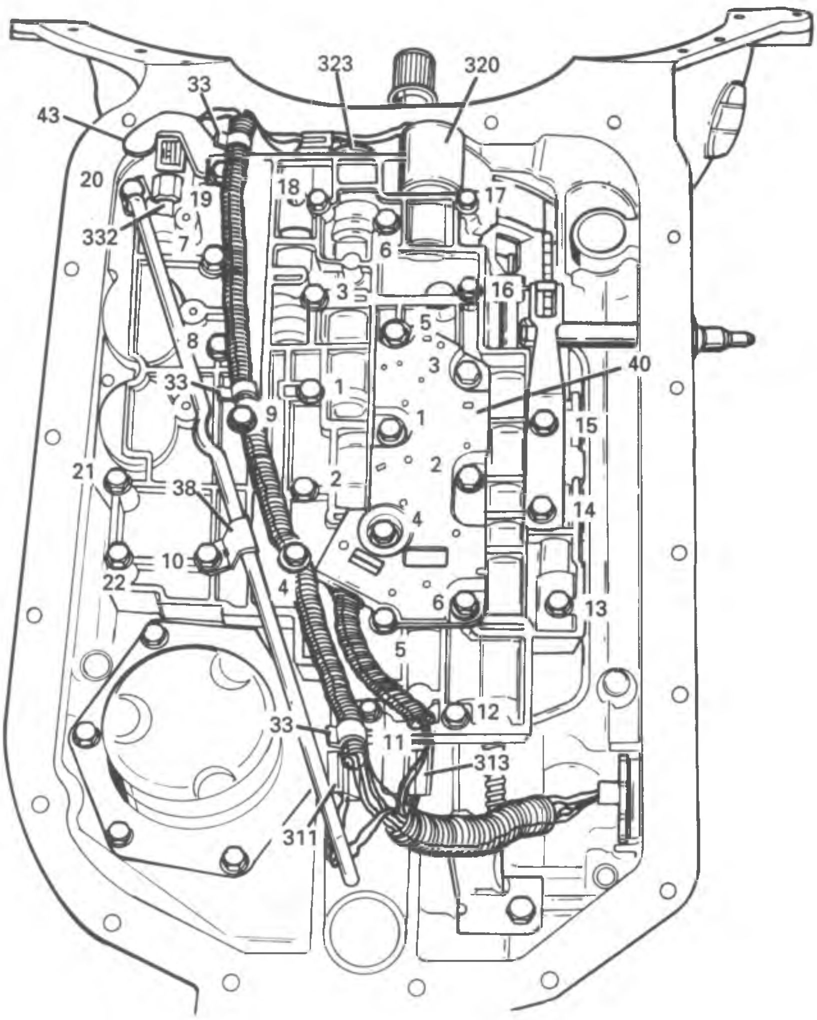


Figure 99 Control Valve Assembly, Bolt Tighten Sequence/Clips and Retainer

PAN AND FILTER ASSEMBLY

Figure 100

Install or Connect

1. Seal (32) inside of case (7).
2. Filter assembly (31).
3. Bottom pan gasket (29).
4. Magnet (30) into bottom pan.
5. Pan (29).
6. Seventeen 10 mm bolts (27).

Tighten

- Bolts (27) to 24 N·m (18 lb. ft.)

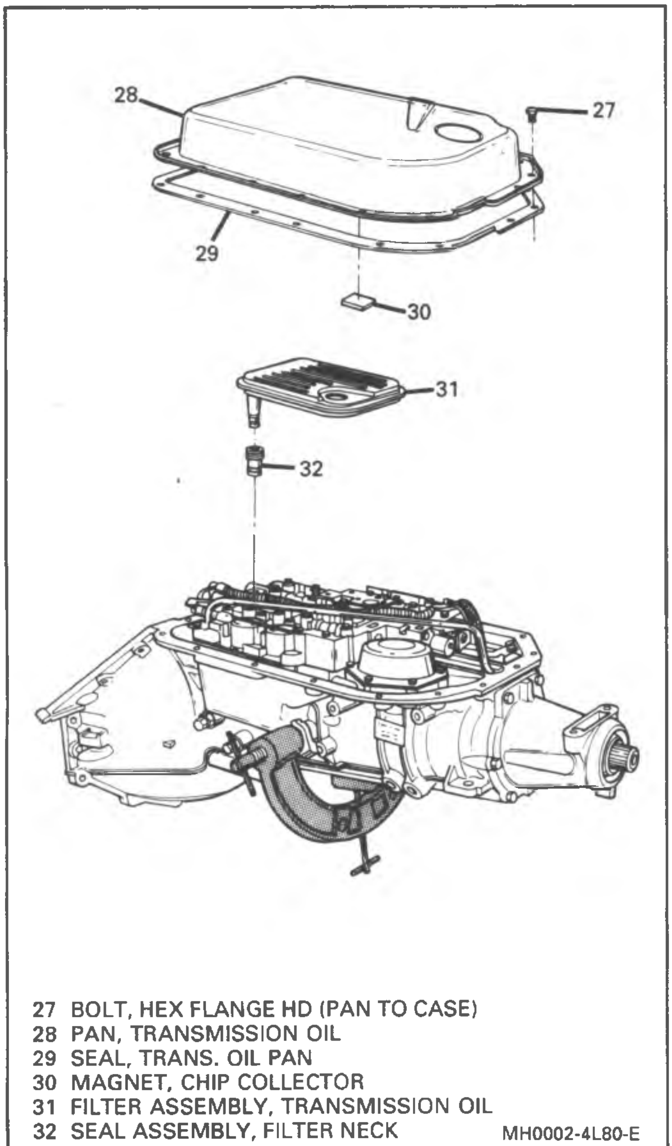


Figure 100 Pan and Filter

CASE EXTENSION ASSEMBLY

Figure 101

Tools Required:

J 38694 Rear Seal Installer (Fixed Yoke)
J 38869 Rear Seal Installer (Slip Yoke)

Inspect

1. Bearings (17), bushing (13) and O-ring (15) for:
   - wear
   - damage

Install or Connect

1. O-ring and orifice assembly (12) to rear end of case.
2. O-ring (15) onto extension assembly.
3. Six 15 mm bolts (21).

Tighten

- Bolts (21) to 34 N·m (25 lb. ft.)

4. New rear seal (20) with J 38694 or J 38869.
   - Apply TRANSJEL™ J 36850 or equivalent to spring pocket.

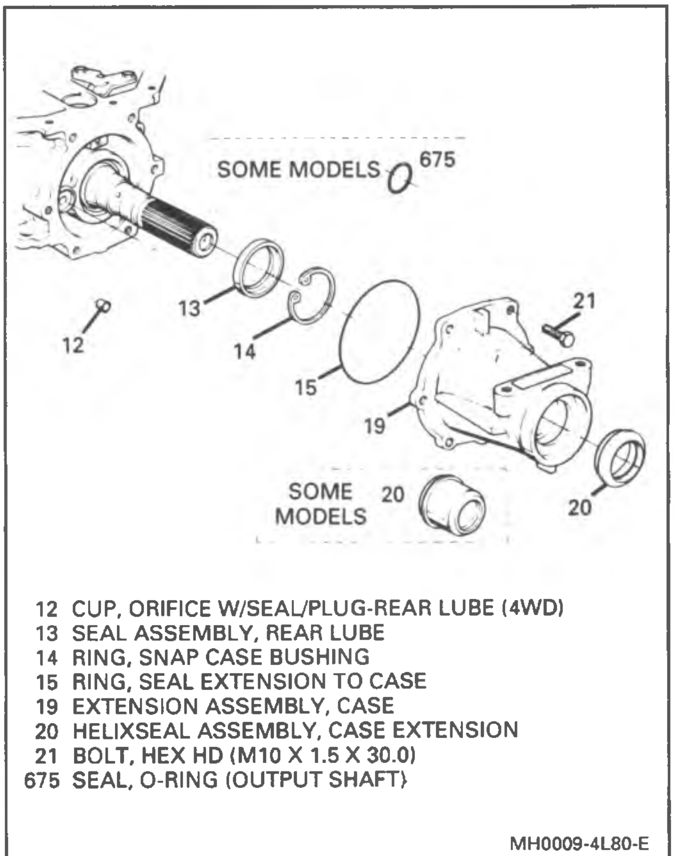


Figure 101 Extension Assembly

SPEED SENSOR ASSEMBLIES

Figure 102

Inspect

- Speed Sensor Assemblies (22) for:
   - Evidence of damage.

Install or Connect

1. Two speed sensor and bracket assemblies (22) onto case.
2. Two 8 mm bolts (23).

Tighten

- Bolts (23) and (24) to 11 N·m (97 lb. in.)

3. Case oil test plug (24) (if removed).

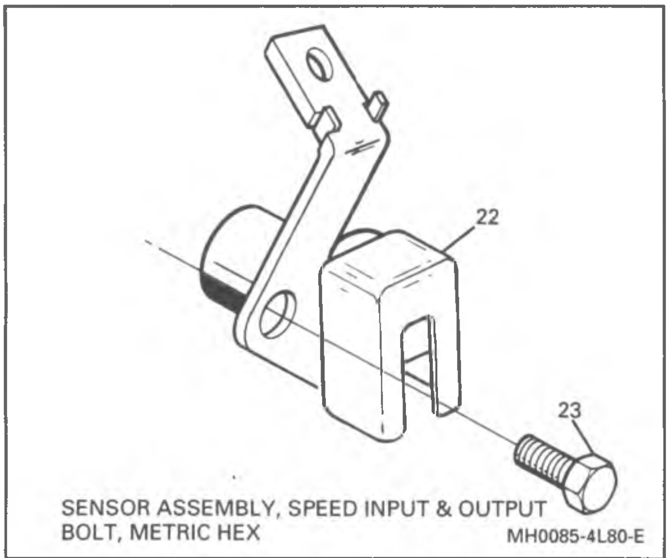


Figure 102 Speed Sensor Assembly

TORQUE CONVERTER ASSEMBLY

Figure 103

Tools Required:

J 35138 Torque Converter End Play Checking Tool

J 26900-13 Magnetic Base

J 8001 or J 8001-M Dial Indicator Set

J 21369-E Converter Leak Test 1.625 Plug

J 21366 Converter Holding Strap

Inspect

- The torque converter assembly (1) must be replaced for any of the following conditions:

1. Evidence of damage to the pump assembly.
2. Metal particles are found after flushing the cooler and cooler lines.
3. External leaks in hub weld area.
4. Converter pilot is broken, damaged or poor fit into crankshaft.
5. Converter hub is scored or damaged.
6. Internal failure to stator.
7. Contamination from engine coolant.
8. Excess end play.

Measure

Figure 103

- 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 knob 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:
   - 0.0 to 6 mm (0 to 0.024 inch)
8. Remove tool by turning wing nut counterclockwise 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:

1. 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)
2. The converter bolt hole threads are damaged.
   - Correct with thread insert

Flushing the torque converter is not recommended.

Install or Connect

- Torque converter (1) with J 21366.

NOTICE: Transmission must be in the vertical position.

- Engage turbine shaft, stator shaft and lugs on pump driven gear. Three clicks will be felt as each engages flats in converter.

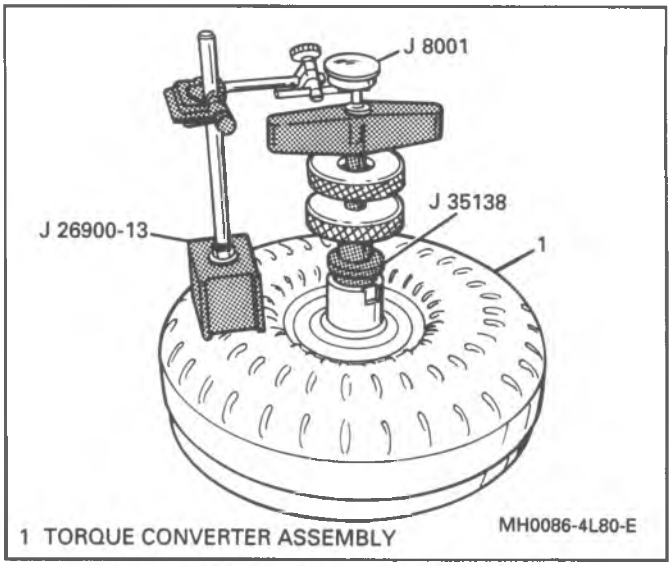


Figure 103 Converter End Play Check

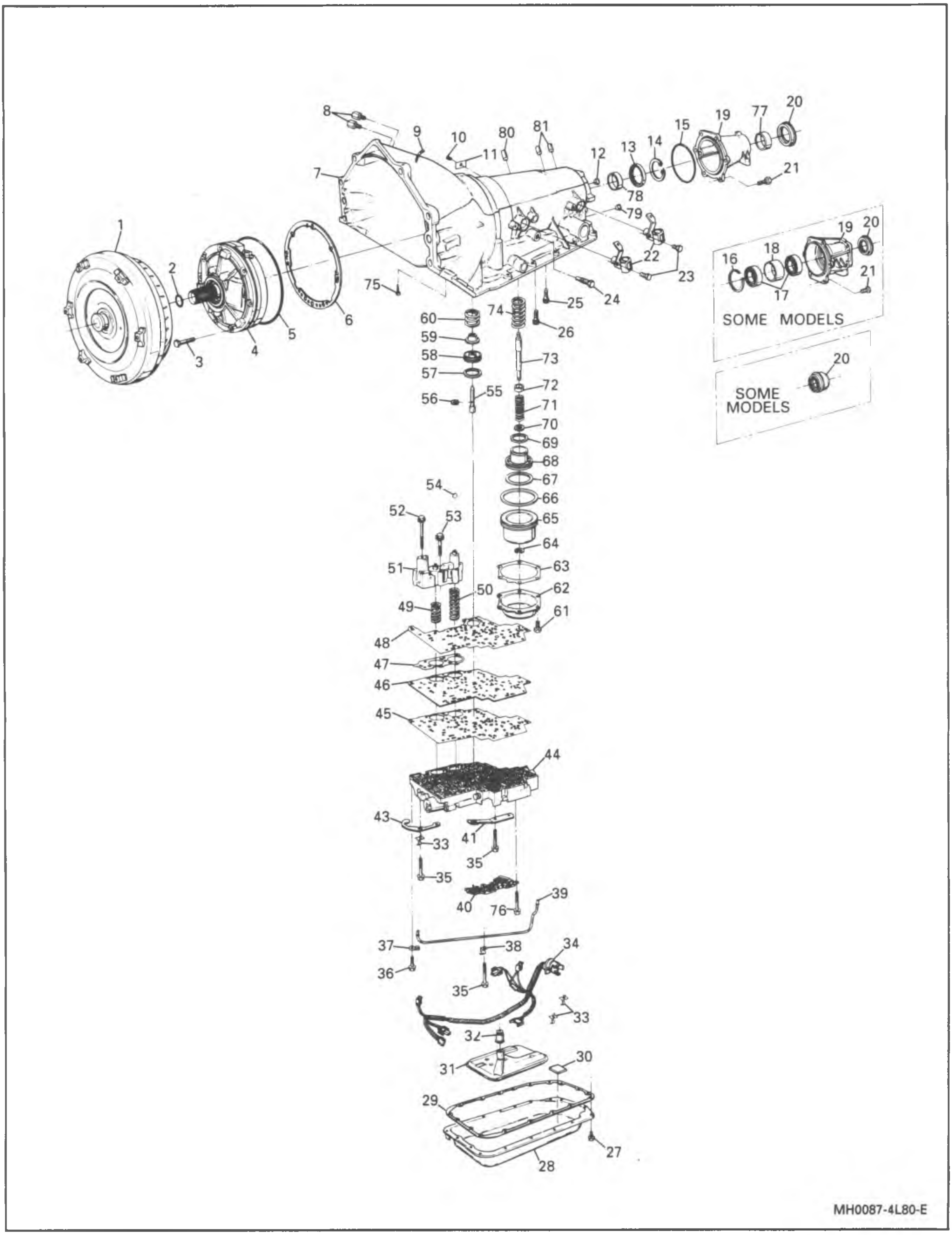
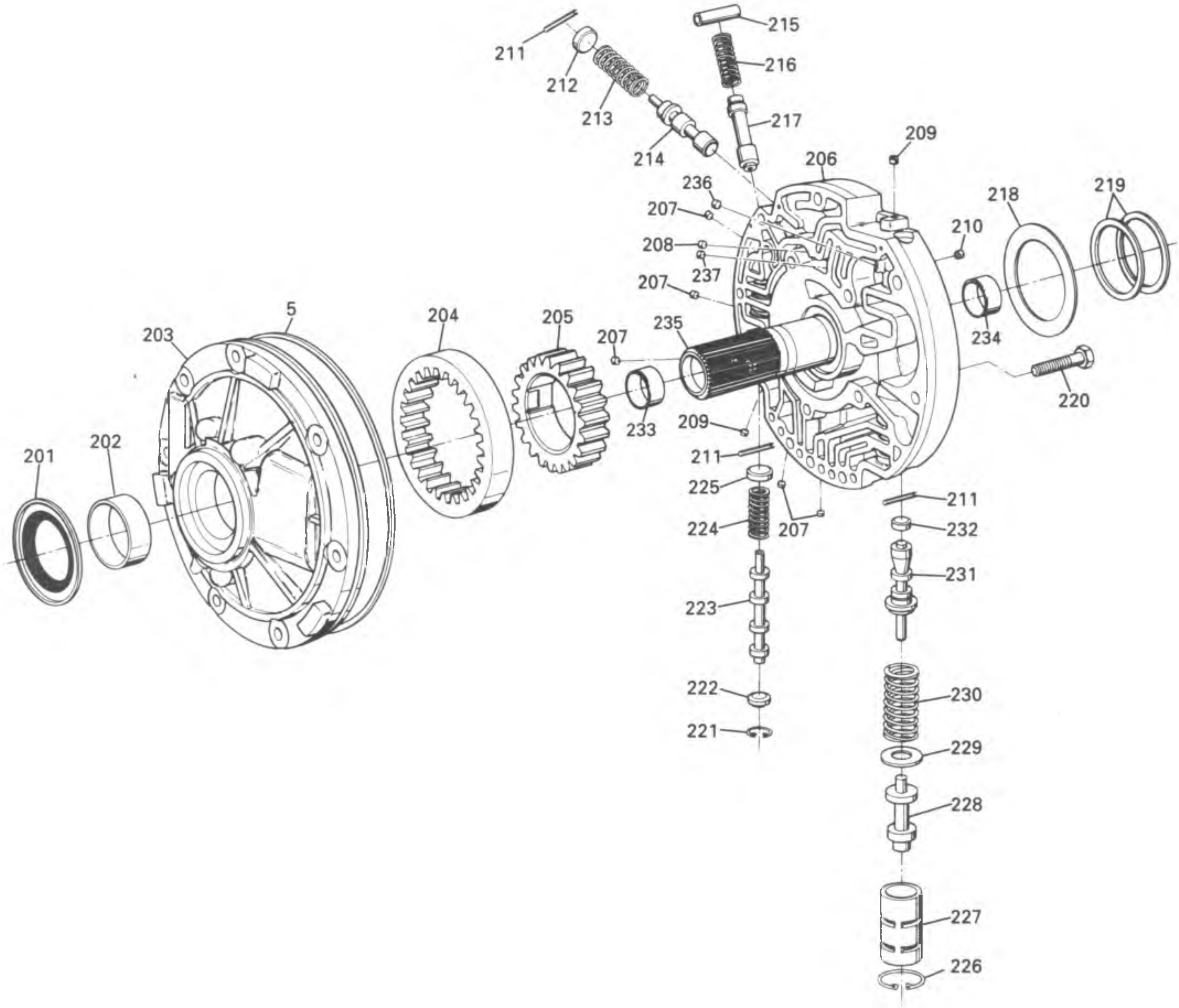


Figure 104 Case and Associated Parts

1 TORQUE CONVERTER ASSEMBLY
2 SEAL, O-RING (TURBINE SHAFT/TURBINE HUB)
3 BOLT & SEAL ASSEMBLY, PUMP TO CASE
4 PUMP ASSEMBLY, COMPLETE
5 SEAL, OIL PUMP TO CASE
6 GASKET, PUMP COVER TO CASE
7 CASE ASSEMBLY, COMPLETE
8 CONNECTOR, INVERTED FLARED TUBE
9 PIPE, VENT
10 SCREW, NAMEPLATE
11 NAMEPLATE
12 CUP, ORIFICE W/SEAL/PLUG-REAR LUBE (4WD)
13 SEAL ASSEMBLY, REAR LUBE
14 RING, SNAP SEAL RETAINER
15 RING, SEAL EXTENSION TO CASE
16 RING, SNAP INTERNAL
17 BEARING ASSEMBLY, BALL
18 SPACER, BEARING
19 EXTENSION ASSEMBLY, CASE
20 HELIXSEAL ASSEMBLY, CASE EXTENSION
21 BOLT, HEX HD (M10 X 1.5 X 30.0)
22 SENSOR ASSEMBLY, SPEED INPUT & OUTPUT
23 BOLT, METRIC HEX
24 PLUG, OIL TEST HOLE (HEX HD 1/8 PIPE)
25 BOLT, CASE TO CENTER SUPPORT
26 BOLT, CASE (4TH CLUTCH)
27 BOLT, HEX FLANGE HD (PAN TO CASE)
28 PAN, TRANSMISSION OIL
29 SEAL, TRANS. OIL PAN
30 MAGNET, CHIP COLLECTOR
31 FILTER ASSEMBLY, TRANSMISSION OIL
32 SEAL ASSEMBLY, FILTER NECK
33 CLAMP, ELECTRICAL CABLE
34 HARNESS ASSEMBLY, ELECTRICAL WIRING
35 BOLT, HEX HD. (M6 X 1.0 X 55.0)
36 BOLT, M6 X 1.0 X 35.0 LG V/B TO C/P
37 RETAINER, LUBE PIPE
38 CLAMP, LUBE PIPE
39 PIPE, LUBE
40 MANIFOLD, PRESSURE SWITCH
41 SPRING ASSEMBLY, MANUAL DETENT
43 STOP, DIPSTICK (FLUID LEVEL INDICATOR)
44 BODY ASSEMBLY, CONTROL VALVE
45 GASKET, VALVE BODY TO SPACER PLATE
46 PLATE, VALVE BODY SPACER
47 GASKET, ACCUMULATOR HSG. TO SPACER PLATE
48 GASKET, SPACER PLATE TO CASE
49 SPRING, 4TH CLUTCH ACCUM. PISTON
50 SPRING, 3RD CLUTCH ACCUM. PISTON
51 HOUSING, ACCUMULATOR
52 BOLT, ACCUM. HOUSING TO VALVE BODY (LONG)
53 BOLT, ACCUM. HOUSING TO VALVE BODY (SHORT)
54 BALL, .25 DIAMETER
55 PIN, FRONT SERVO PISTON
56 RING, FRONT SERVO SPRING RETAINER
57 RING, OIL SEAL
58 PISTON, FRONT SERVO
59 RETAINER, FRONT SERVO SPRING
60 SPRING, FRONT SERVO PISTON
61 BOLT, REAR SERVO COVER
62 COVER, REAR SERVO
63 GASKET, REAR SERVO COVER
64 CLIP, RETAINING (BOTTOM)
65 PISTON, REAR SERVO
66 RING, OIL SEAL ACCUM. PISTON (OUTER)
67 RING, OIL SEAL ACCUM. PISTON (INNER)
68 PISTON, REAR ACCUMULATOR
69 SEAL, REVERSE SERVO PISTON
70 WASHER, SERVO PISTON
71 SPRING, REAR SERVO
72 RETAINER, REAR PISTON SPRING
73 PIN, REAR BAND APPLY (SELECTIVE)
74 SPRING, REAR ACCUMULATOR
75 SCREEN, PWM SOLENOID
76 BOLT, SPECIAL
77 BUSHING, CASE EXTENSION
78 BUSHING, TRANSMISSION CASE
79 PLUG, DIRECT OIL GAL (.25 DIA. CUP)
80 PIN, ANCHOR FRONT BAND
81 PIN, ANCHOR REAR BAND

MH0088-4L80-E

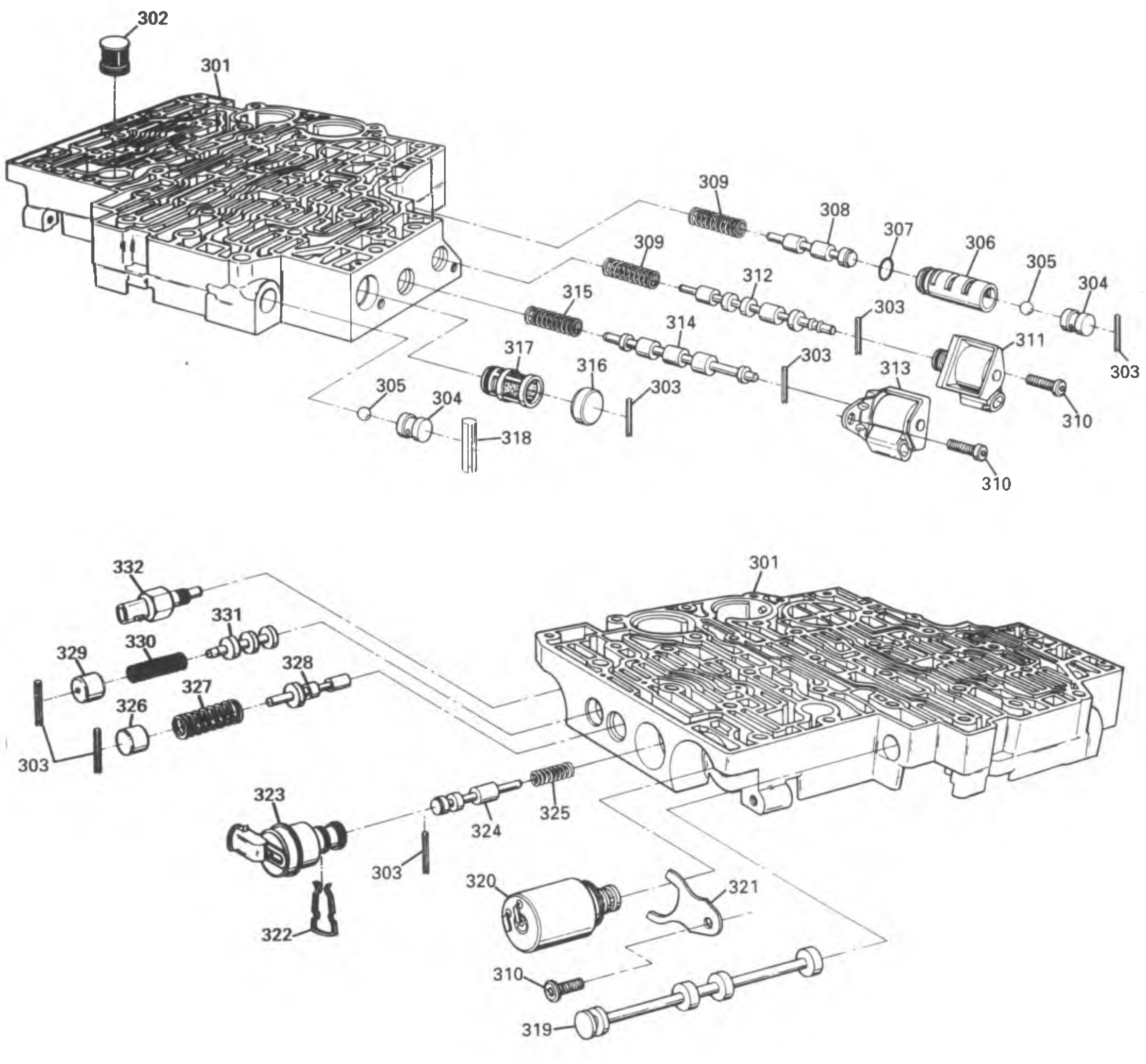
Figure 105 Case and Associated Parts — Legend



5 SEAL, OIL PUMP TO CASE
201 HELIX SEAL ASSEMBLY, PUMP BODY
202 BUSHING, PUMP BODY
203 BODY, OIL PUMP
204 GEAR, PUMP DRIVEN
205 GEAR, PUMP DRIVE
206 COVER, PUMP
207 PLUG, CUP (5)
208 PLUG, CUP (1)
209 PLUG, CUP (2)
210 PLUG, ORIFICE CUP (1)
211 PIN, COILED SPRING (3)
212 PLUG, CONVERTER LIMIT VALVE BORE
213 SPRING, CONVERTER LIMIT VALVE
214 VALVE, CONVERTER LIMIT
215 SLEEVE, SPRING RETAINER
216 SPRING, TCC ENABLE VALVE
217 VALVE, TCC ENABLE
218 WASHER, THRUST SELECTIVE
219 RING, OIL SEAL (2)
220 BOLT, M8 X 1.25 X 40 (5)
221 RING, SNAP
222 PLUG, TCC VALVE BORE
223 VALVE, TCC
224 SPRING, TCC VALVE
225 PLUG, TCC VALVE BORE
226 RING, RETAINER (REV. BOOST VALVE BUSHING)
227 BUSHING, REVERSE BOOST VALVE
228 VALVE, REVERSE BOOST
229 RETAINER, PRESSURE REGULATOR SPRING
230 SPRING, PRESSURE REGULATOR
231 VALVE, PRESSURE REGULATOR
232 PLUG, PRESSURE REGULATOR
233 BUSHING, STATOR SHAFT (FRONT)
234 BUSHING, STATOR SHAFT (REAR)
235 SHAFT, STATOR
236 PLUG, CUP (1)
237 PLUG, CUP (1)

MH0071-4L80-E

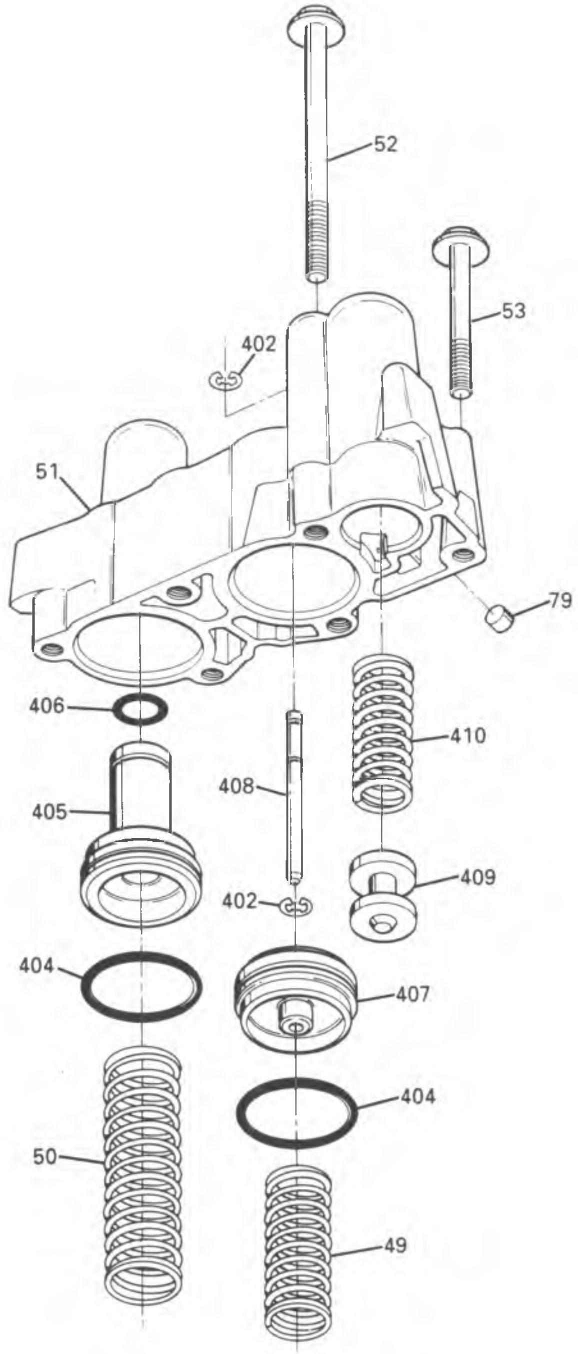
Figure 106 Pump Assembly



301 BODY, CONTROL VALVE
302 SCREEN FILTER, FORCE MOTOR FEED
303 PIN, COILED SPRING
304 PLUG, CHECKBALL
305 BALL (.375 DIA.)
306 BUSHING, 3RD/REVERSE CHECKBALL
307 SEAL, OIL PUMP CVR SCREEN
308 VALVE, 3/4 SHIFT
309 SPRING, SHIFT VALVE RETURN (2/3 & 3/4)
310 BOLT, SOLENOID (1/2 & 2/3 SHIFT, FORCE MOTOR)
311 SOLENOID & O-RING ASSEMBLY, B
312 VALVE, 2/3 SHIFT
313 SOLENOID & O-RING ASSEMBLY, A
314 VALVE, 1/2 SHIFT
315 SPRING, 1/2 SHIFT VALVE RETURN
316 PLUG, SHIFT SOLENOID FEED FILTER
317 FILTER, SHIFT SOLENOID FEED
318 SLEEVE, LO/REVERSE CHECKBALL
319 VALVE, MANUAL
320 VARIABLE FORCE MOTOR
321 CLAMP, FORCE MOTOR RETAINING
322 CLIP, PWM SOLENOID RETAINING
323 SOLENOID ASSEMBLY, PWM
324 VALVE, TCC REGULATOR APPLY
325 SPRING, TCC REGULATOR APPLY VALVE
326 PLUG, VALVE BORE (ACTUATOR FEED)
327 SPRING, ACTUATOR FEED LIMIT VALVE
328 VALVE, ACTUATOR FEED LIMIT
329 PLUG, ACCUMULATOR VALVE BORE
330 SPRING, ACCUMULATOR VALVE
331 VALVE, ACCUMULATOR
332 SENSOR, TEMPERATURE

MH0081-4L80-E

Figure 107 Valve Body Assembly

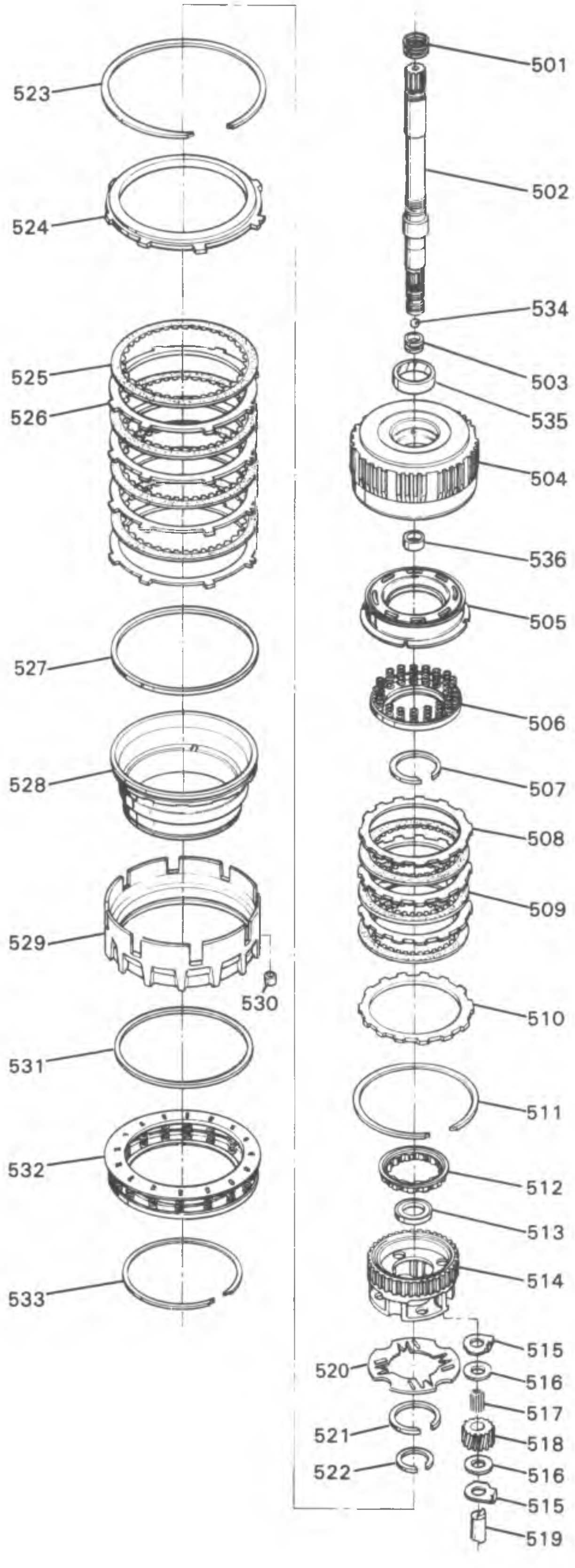


49	SPRING, 4TH CLUTCH ACCUM. PISTON	404	SEAL, (1.615) SQUARE CUT
50	SPRING, 3RD CLUTCH ACCUM. PISTON	405	PISTON, 3RD CLUTCH ACCUMULATOR
51	HOUSING, ACCUMULATOR	406	SEAL, (.859) SQUARE CUT
52	BOLT, ACCUM. HOUSING TO VALVE BODY (LONG)	407	PISTON, 4TH CLUTCH ACCUMULATOR
53	BOLT, ACCUM. HOUSING TO VALVE BODY (SHORT)	408	PIN, 4TH CLUTCH ACCUMULATOR PISTON
79	PLUG, DIRECT OIL GAL (.25 DIA. CUP)	409	VALVE, TORQUE SIGNAL COMPENSATOR
402	RING, SNAP	410	SPRING, T.S. COMPENSATOR

MH0080-4L80-E

Figure 108 Accumulator Assembly

501 RING, OIL SEAL (TURBINE SHAFT/STATOR HSG.)
502 SHAFT, TURBINE
503 RING, OIL SEAL (TURBINE SHAFT/FORWARD HSG.)
504 HOUSING ASSEMBLY, OVERRUN CLUTCH
505 PISTON ASSEMBLY, OVERRUN CLUTCH
506 SPRING & RETAINER ASSEMBLY
507 RING, SNAP RETAINER
508 PLATE, OVERRUN CLUTCH
509 PLATE ASSEMBLY, OVERRUN CLUTCH
510 PLATE, OVERRUN CLUTCH BACKING
511 RING, SNAP
512 ROLLER CLUTCH ASSEMBLY, OVERDRIVE
513 BEARING ASSEMBLY, THRUST CARRIER/ OVERRUN CLUTCH
514 CARRIER ASSEMBLY, OVERDRIVE
515 WASHER, PINION THRUST
516 WASHER, PINION THRUST (STEEL)
517 ROLLER, NEEDLE BEARING
518 PINION, OVERDRIVE PLANET
519 PIN, OVERDRIVE PINION
520 RETAINER, PINION PIN
521 RING, SNAP
522 RING, SNAP (TURBINE SHAFT/CARRIER)
523 RING, SNAP (4TH CLUTCH)
524 PLATE, 4TH CLUTCH BACKING
525 PLATE ASSEMBLY, 4TH CLUTCH
526 PLATE, 4TH CLUTCH
527 SEAL, 4TH CLUTCH (INNER)
528 PISTON, 4TH CLUTCH
529 HOUSING, 4TH CLUTCH
530 PLUG, ORIFICE CENTER SUPPORT
531 SEAL, 4TH CLUTCH (OUTER)
532 SPRING GUIDE & RETAINER ASSEMBLY, 4TH CLUTCH
533 RING, SNAP (SPRING & RETAINER ASSEMBLY 4TH CLUTCH PISTON)
534 BALL, 0.28' DIA.
535 BUSHING, OVERRUN CLU. HSG.
536 BUSHING, 1.12' O.D. X 0.50'



MH0089-4L80-E

Figure 109 Overrun, Overdrive and 4th Clutch Assembly

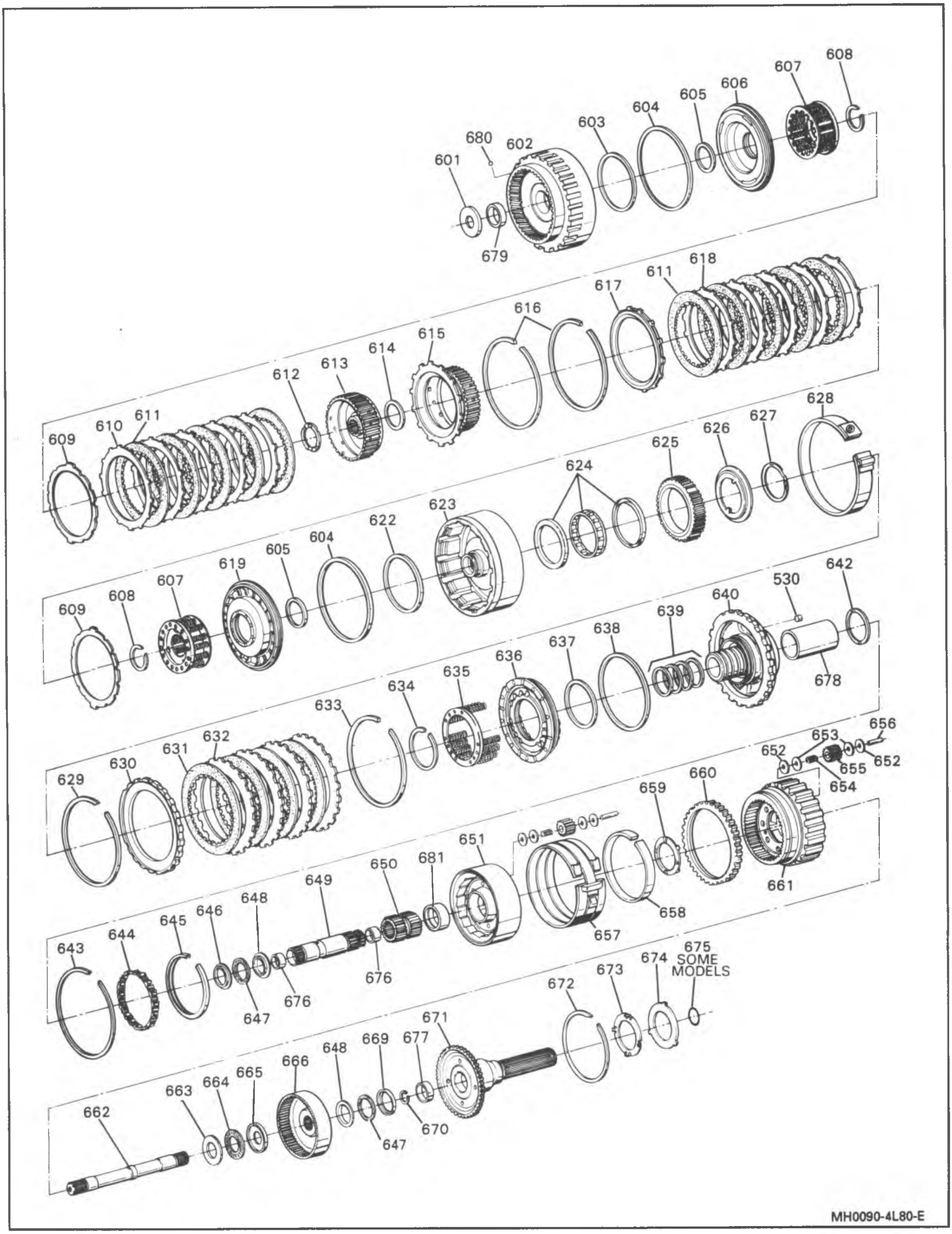
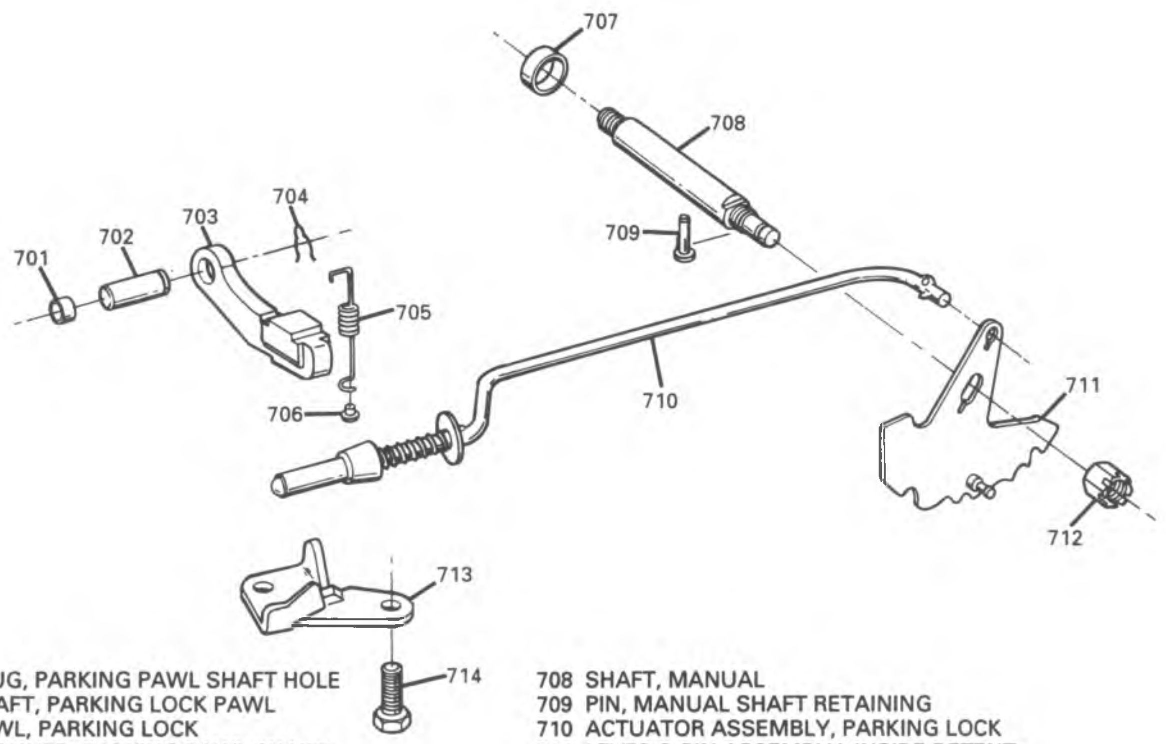


Figure 110 Internal Components

530 PLUG, ORIFICE CENTER SUPPORT
601 BEARING ASM., THRUST CARRIER/FORWARD CLUTCH
602 HOUSING ASSEMBLY, FORWARD CLUTCH
603 SEAL, CLUTCH (CENTER)
604 SEAL, CLUTCH (OUTER)
605 SEAL, CLUTCH (INNER)
606 PISTON, FORWARD CLUTCH
607 SPRING & RETAINER ASSEMBLY
608 RING, SNAP
609 PLATE, CLUTCH (.054 DISHED)
610 PLATE, CLUTCH (.0775 FLAT)
611 PLATE ASSEMBLY, CLUTCH
612 WASHER, THRUST CLUTCH HUB HOUSING
613 HUB, FORWARD CLUTCH DRIVEN
614 WASHER, THRUST FORWARD CLUTCH
615 HUB, DIRECT CLUTCH DRIVING
616 RING, SNAP (6.24 O.D. X .062)
617 PLATE, DIRECT CLUTCH BACKING
618 PLATE, CLUTCH (.0915 FLAT)
619 PISTON, DIRECT CLUTCH
622 SEAL, CLUTCH (CENTER)
623 HOUSING, DIRECT CLUTCH
624 SPRAG ASSEMBLY, INTERMEDIATE CLUTCH
625 RACE, INTERMEDIATE CLUTCH (OUTER)
626 RETAINER, INTERMEDIATE CLUTCH
627 RING, EXTERNAL LOCKING
628 BAND ASSEMBLY, FRONT
629 RING, SNAP (INTERMEDIATE CLUTCH RETAINER)
630 PLATE, INTERMEDIATE CLUTCH BACKING
631 PLATE ASSEMBLY, INTERMEDIATE CLUTCH
632 PLATE, INTERMEDIATE CLUTCH
633 RING, SNAP CENTER SUPPORT/CASE
634 RING, SNAP INTERMEDIATE CLUTCH
635 SPRING & RETAINER ASM., INTERMEDIATE CLUTCH
636 PISTON, INTERMEDIATE CLUTCH
637 SEAL, INTERMEDIATE CLUTCH (INNER)
638 SEAL, INTERMEDIATE CLUTCH (OUTER)
639 RING, OIL SEAL
640 SUPPORT & RACE ASSEMBLY, CENTER
641 PLUG, ORIFICE CENTER SUPPORT
642 WASHER, THRUST SUPPORT/REACTION DRUM
643 SPACER, SUPPORT TO CASE
644 ROLLER CLUTCH ASSEMBLY
645 RING, REACTION DRUM SPACER
646 RACE, THRUST BEARING TO CENTER SUPPORT
647 BEARING, NEEDLE THRUST
648 RACE, THRUST BEARING
649 SHAFT ASSEMBLY, SUN GEAR
650 GEAR, SUN
651 DRUM & CARRIER ASSEMBLY, REACTION
652 WASHER, PINION THRUST
653 WASHER, PINION THRUST
654 ROLLER, NEEDLE BEARING
655 PINION, PLANET
656 PIN, PLANET PINION
657 BAND ASSEMBLY, REAR BRAKE
658 RING, FRONT INTERNAL GEAR
659 WASHER, FRONT INTERNAL/REACTION CARRIER
660 RING, OUTPUT SPEED SENSOR
661 CARRIER ASSEMBLY, OUTPUT
662 SHAFT, TRANSMISSION MAIN
663 RACE, THRUST BEARING TO SUN GEAR
664 BEARING, NEEDLE THRUST RR INTERNAL GEAR
665 RACE, THRUST BEARING TO RR INTERNAL GEAR
666 GEAR, REAR INTERNAL
669 RACE, THRUST BEARING TO OUTPUT SHAFT
670 RING, SNAP MAINSHAFT INTERNAL GEAR
671 SHAFT & BUSHING ASSEMBLY, OUTPUT
672 RING, SNAP (OUTPUT SHAFT/
FRONT INTERNAL GEAR)
673 WASHER, THRUST
674 WASHER, THRUST SELECTIVE
675 SEAL, O-RING OUTPUT SHAFT
676 BUSHING, SUN GEAR SHAFT
677 BUSHING, OUTPUT SHAFT
678 BUSHING
679 BUSHING, 1.536" DIA. X 3.52"
680 BALL, CHECK
681 BUSHING, REACTION DRUM

MH0091-4L80-E

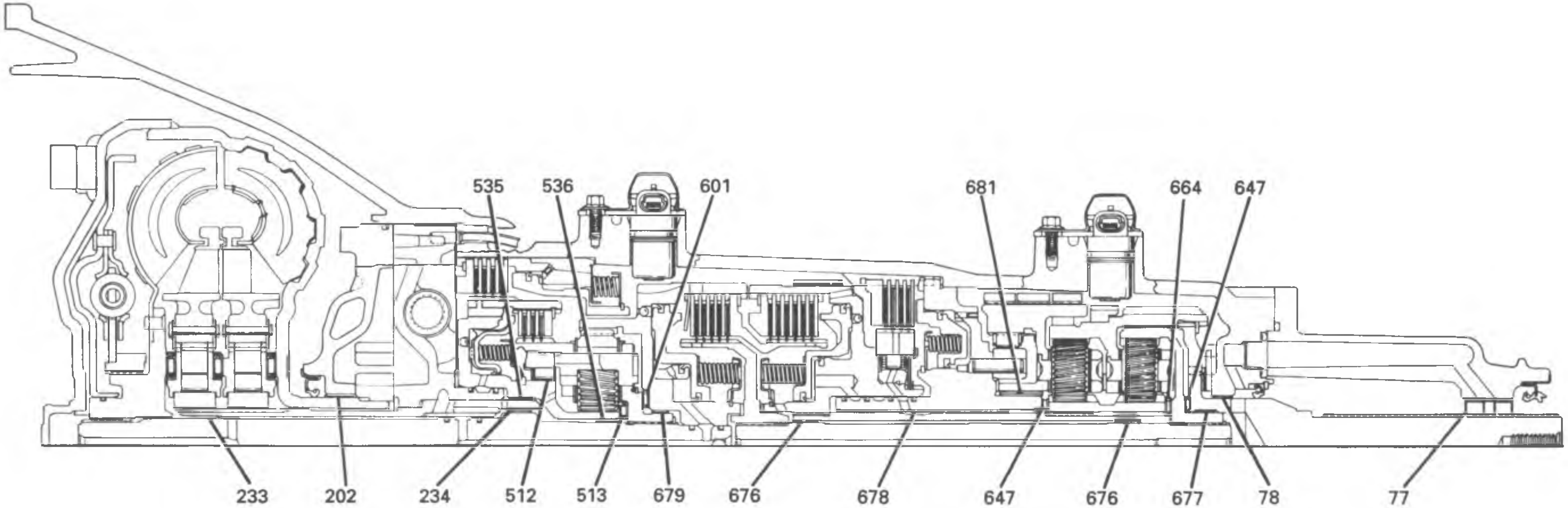
Figure 111 Internal Components — Legend



701 PLUG, PARKING PAWL SHAFT HOLE
702 SHAFT, PARKING LOCK PAWL
703 PAWL, PARKING LOCK
704 RETAINER, PARKING PAWL SHAFT
705 SPRING, PARKING PAWL RETURN
706 STUD, PARKING PAWL RETURN SPRING
707 SEAL ASSEMBLY, MANUAL SHIFT SHAFT
708 SHAFT, MANUAL
709 PIN, MANUAL SHAFT RETAINING
710 ACTUATOR ASSEMBLY, PARKING LOCK
711 LEVER & PIN ASSEMBLY, INSIDE DETENT
712 NUT, HEX HEAD
713 BRACKET, PARKING LOCK
714 BOLT, HEX HD (M8 X 1.25 X 20.0)

MH0011-4L80-E

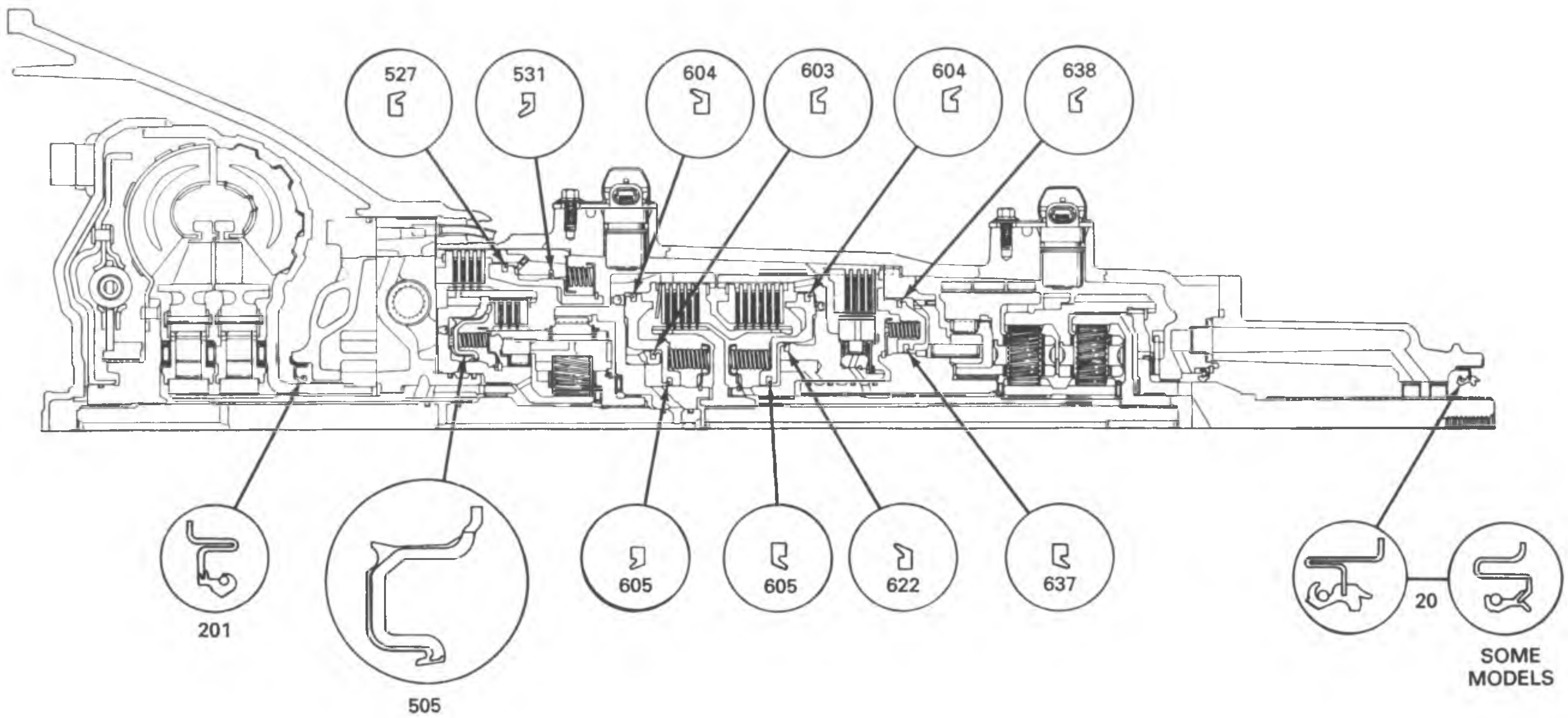
Figure 112 Parking Lock and Actuator Assembly



77 BUSHING, CASE EXTENSION
78 BUSHING, CASE TRANS
202 BUSHING, PUMP BODY
233 BUSHING, STATOR SHAFT (FRONT)
234 BUSHING, STATOR SHAFT (REAR)
512 ROLLER CLUTCH ASSEMBLY, OVERDRIVE
513 BEARING ASM., THRUST CARRIER/OVERRUN CLU.
535 BUSHING, OVERRUN CLU. HSG.
536 BUSHING, 1.12" O.D. X 0.50"
601 BEARING ASM., THRUST CARRIER/FORWARD CLU
647 BEARING, NEEDLE THRUST
664 BEARING, NEEDLE THRUST RR INTERNAL GEAR
676 BUSHING, SUN GEAR SHAFT
677 BUSHING, OUTPUT SHAFT
678 BUSHING
679 BUSHING, 1.536" DIA. X 3.52"
681 BUSHING, REACTION DRUM

MH0092-4L80-E

Figure 113 Bushing and Bearing Locations



20 HELIX SEAL ASSEMBLY, CASE EXTENSION
201 HELIX SEAL ASSEMBLY, PUMP BODY
505 PISTON ASSEMBLY, OVERRUN CLUTCH
527 SEAL, 4TH CLUTCH (INNER)
531 SEAL, 4TH CLUTCH (OUTER)
603 SEAL, CLUTCH (CENTER)
604 SEAL, CLUTCH (OUTER)
605 SEAL, CLUTCH (INNER)
622 SEAL, CLUTCH (CENTER)
637 SEAL, INTERMEDIATE CLUTCH (INNER)
638 SEAL, INTERMEDIATE CLUTCH (OUTER)

MH0093-4L80-E

Figure 114 Lip Seal Locations

SPECIFICATIONS

FASTENER APPLICATION	ASSEMBLY TORQUE			RECHECK TORQUE		
	N.M	LB.-FT.	LB.-IN.	N.M	LB.-FT	LB.-IN.
TEMPERATURE SENSOR TO VALVE BODY	4	—	35	4 MIN.	—	35 MIN.
SOLENOID TO VALVE BODY SCREW	8	—	71	5 MIN.	—	44 MIN.
CONTROL VALVE ASSEMBLY TO CASE SCREW	11	—	97	8 MIN.	—	71 MIN.
OIL TEST HOLE PLUG	11	—	97	8 MIN.	—	71 MIN.
FLYWHEEL HOUSING COVER TO TRANSMISSION SCREW	7	—	62	7 MIN.	—	62 MIN.
PUMP BODY TO COVER SCREW	24	18	—	20 MIN.	15 MIN.	—
PUMP ASSEMBLY TO CASE SCREW	24	18	—	20 MIN.	15 MIN.	—
REAR SERVO COVER TO CASE SCREW	24	18	—	20 MIN.	15 MIN.	—
FORCE MOTOR BRACKET TO VALVE BODY SCREW	8	—	71	5 MIN.	—	44 MIN.
PARKING PAWL BRACKET TO CASE SCREW	24	18	—	20 MIN.	15 MIN.	—
ACCUMULATOR HOUSING TO VALVE BODY SCREW	11	—	97	8 MIN.	—	71 MIN.
FOURTH CLUTCH SCREW	16	12	—	15 MIN.	—	133 MIN.
PAN TO CASE SCREW	24	18	—	15 MIN.	—	133 MIN.
EXTENSION HOUSING TO CASE SCREW	34	25	—	27 MIN.	20 MIN.	—
MANUAL SHAFT TO DETENT LEVER NUT	24	18	—	20 MIN.	15 MIN.	—
SPEED SENSOR TO CASE SCREW	11	—	97	8 MIN.	—	71 MIN.
CASE CENTER SUPPORT SCREW	39	29	—	34 MIN.	25 MIN.	—
FLYWHEEL TO CONVERTER SCREW	44	32	—	44 MIN.	32 MIN.	—
TRANSMISSION CASE TO ENGINE SCREW	44	32	—	44 MIN.	32 MIN.	—
COOLER PIPE CONNECTOR NUT AT CASE &RADIATOR	38	28	—	35 MIN.	26 MIN.	—
VALVE BODY TO CASE/LUBE PIPE	11	—	97	8 MIN.	—	71 MIN.
ENGINE REAR MOUNT TO TRANSMISSION BOLT	44	32	—	44 MIN.	32 MIN.	—
ENGINE REAR SUPPORT BRACKET TO FRAME NUT	44	32	—	44 MIN.	32 MIN.	—
VALVE BODY TO CASE/PSM	11	—	97	8 MIN.	—	71 MIN.

MH0094-4L80-E

SPECIAL TOOLS

Overrun Clutch Piston Seal Protector

J 38729

Forward and Direct Clutch
Inner Seal Protector

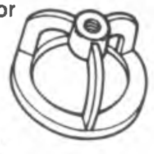
J 21362

Compressor Adapter
(Used with J 23327-1 & J 6129)

J 25018-A

Clutch Spring Compressor
(Use with J 25018-A)

J 6129



J 23327-1

Second Clutch Inner Seal Protector

J 21363

Gear Unit Assembly Installer/Remover

J 38868

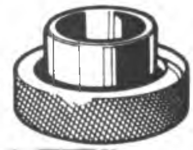
Clutch Unit Holding Fixture

J 6116-01

Support Adapter
(Used with J 6116-01)

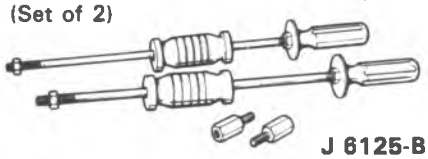
J 21364-A

Direct Clutch Spiral Snap Ring Placer



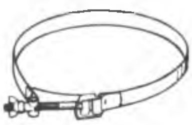
J 38695

5/16-18 Thread with 3/8-16 Adapter
(Set of 2)



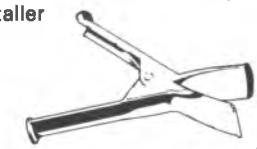
J 6125-B

Pump Body and Cover Alignment Band



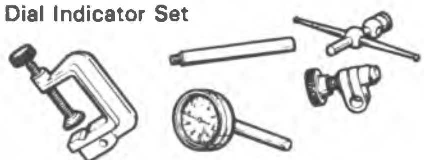
J 21368

Forward Clutch Assembly Remover & Installer



J 38358-A

Dial Indicator Set

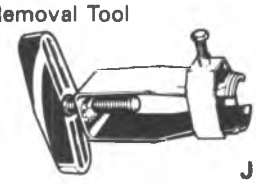


J 8001

Band to Apply Pin Gauge
(Used with J 21370-6)

J 21370-10

Pump Removal Tool

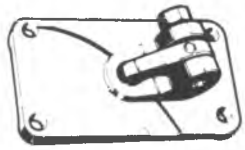


J 37789

Driver Handle—3/4"-10 Thread
(Use with J 21465-01
Bushing Service Set)

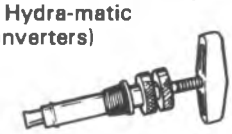
J 8092

Band Apply Pin Checking Tool



J 38737

Universal Converter End-Play Tool
(All Turbo Hydra-matic
Torque Converters)

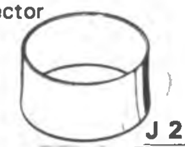


J 35138

Oil Pump Seal Installer

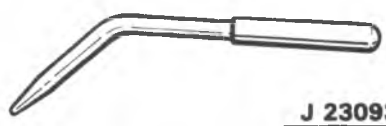
J 38693

Forward and Direct Clutch
Outer Seal Protector



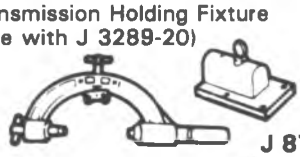
J 21409

Center Support Tool



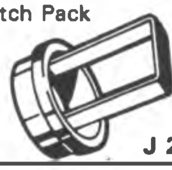
J 23093

Transmission Holding Fixture
(Use with J 3289-20)



J 8763-02

Intermediate Clutch Pack
Alignment Tool

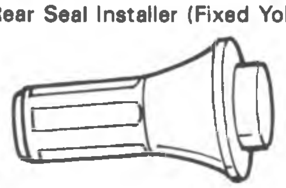


J 24396

Transmission Holding Fixture Adapter

J 38655

Rear Seal Installer (Fixed Yoke)



J 38694

Rear Seal Installer (Slip Yoke)

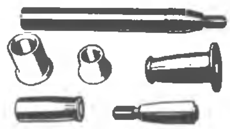
J 38869

Axle Seal Remover
(Use with J 6125-1B)

J 23129

MH0095-4L80-E

SPECIAL TOOLS (CONT)

Fourth Clutch Piston & Housing Seal Protectors/Spacer  J 38731	Intermediate Clutch Piston Compressor Adapter  J 38734	Oil Pump Assembly Seal Ring Installer/Sizer/Pusher  J 38739
Forward Clutch Piston & Seal Protectors (Outer & Inner)  J 38732  J 21362	Center Support Seal Installer/Sizer/Pusher  J 38735	Fourth Clutch Spring & Retainer Assembly Adapter  J 38882
Direct Clutch Assembly Remover/Installer  J 38733	Turbine Shaft Seal Installer/Sizer/Pusher  J 38736	

MH0096-4L80-E

SECTION 7B1

NEW VENTURE GEAR 5LM60 MANUAL TRANSMISSION UNIT REPAIR

RPO MG5 AND MY2

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 36516-15 Mainshaft Adapter
J 36516-16 Countershaft Adapter
J 8105 Gear Puller (2WD models only)
J 21427-01 Speedometer Gear Puller Adapter (2WD models only)
J 26941 Output Shaft Oil Seal Remover (2 WD only)

2WD/4WD REAR HOUSING REMOVAL

Figures 1 - 13

Remove or Disconnect

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.

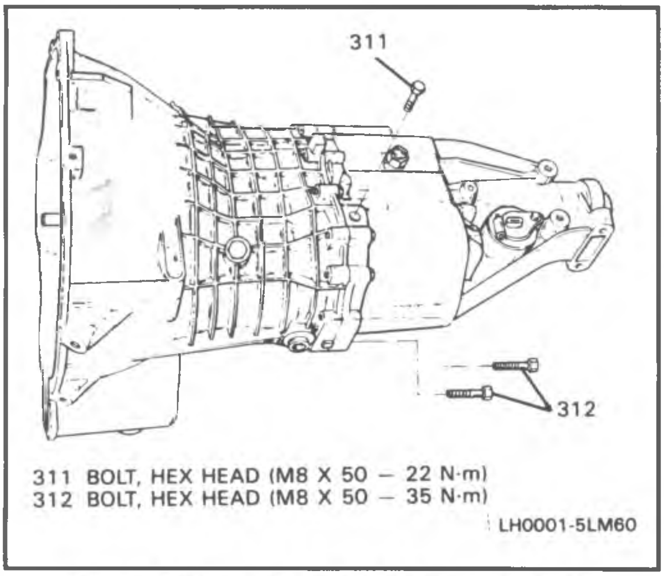


Figure 1 Removing Bolts for Special Tools

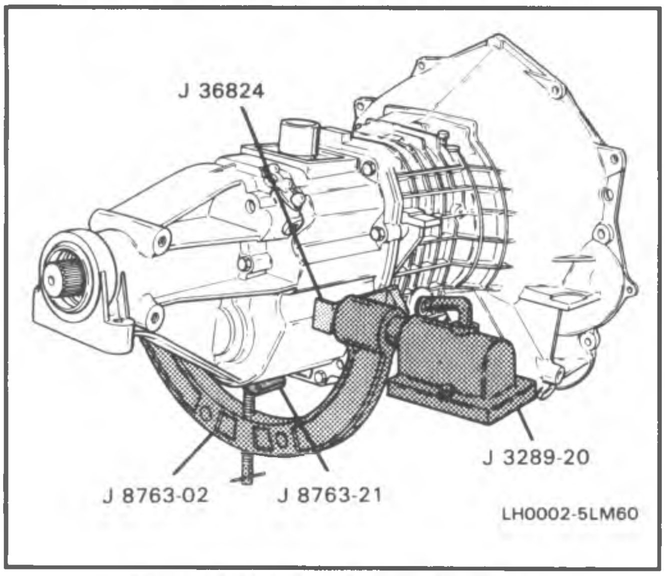


Figure 2 Holding Fixture Installed

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).
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 26941 and J 23907 (Figure 5). (2WD models only).
   - Use J 36825 by screwing into one of the three perforated holes in the seal. (4WD models only).

- Position transmission vertically.

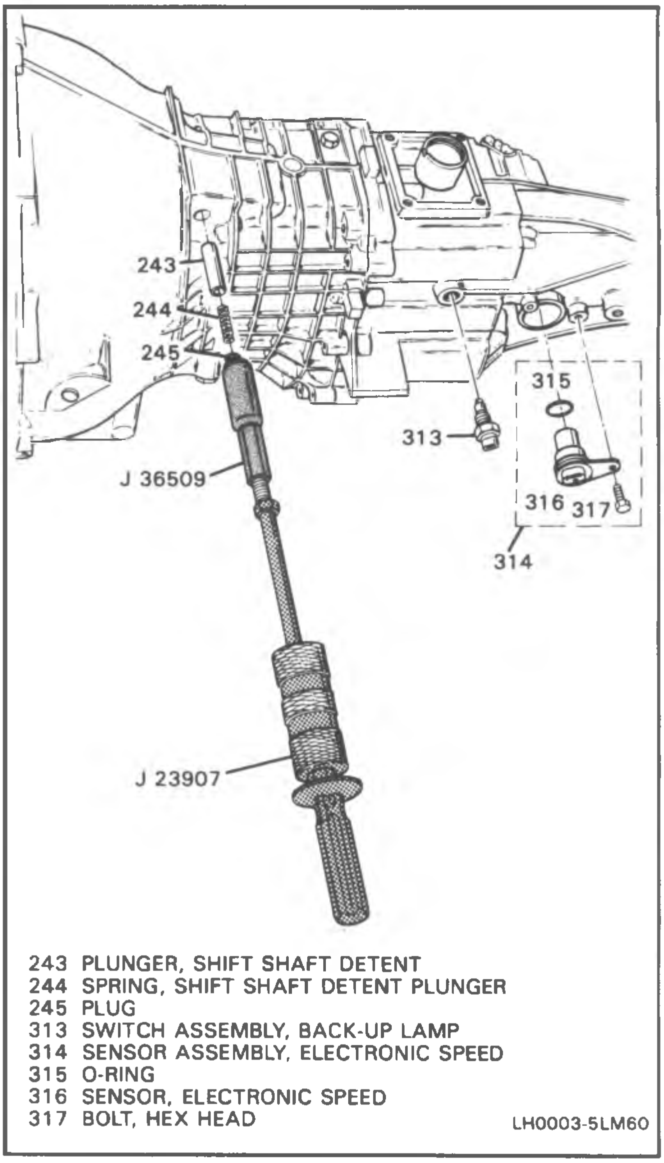


Figure 3 Removing External Components

7. Six bolts (204) and input shaft bearing retainer assembly (205) (Figure 6).
   - Tap clutch release bearing pilot with a rubber mallet.
   - Save the input bearing retainer washer (208).
8. Snap ring (210) and shim (212).

- Position transmission 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).
13. Idler shaft support (310).
    - snap out

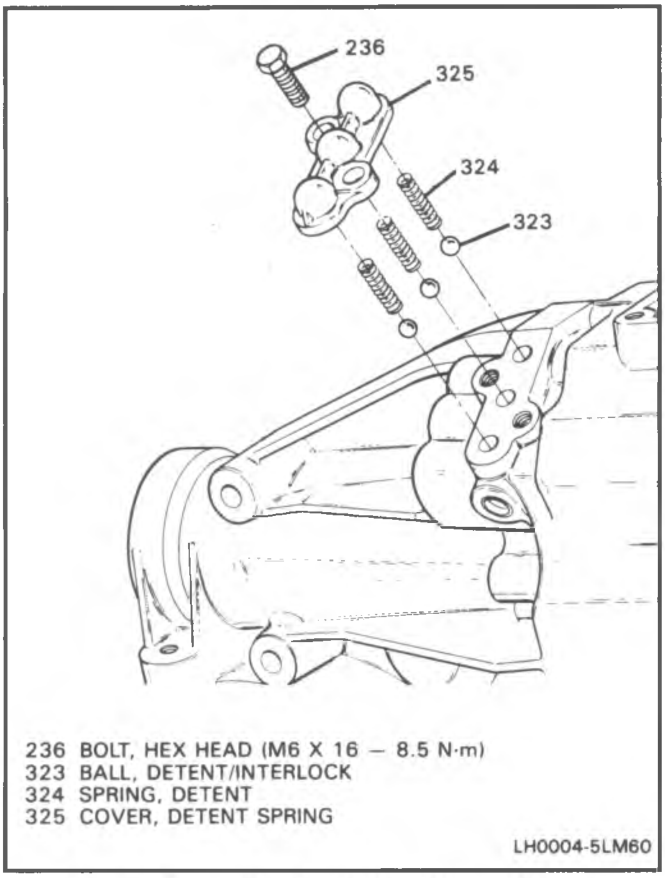


Figure 4 Removing Shift Rail Detent System

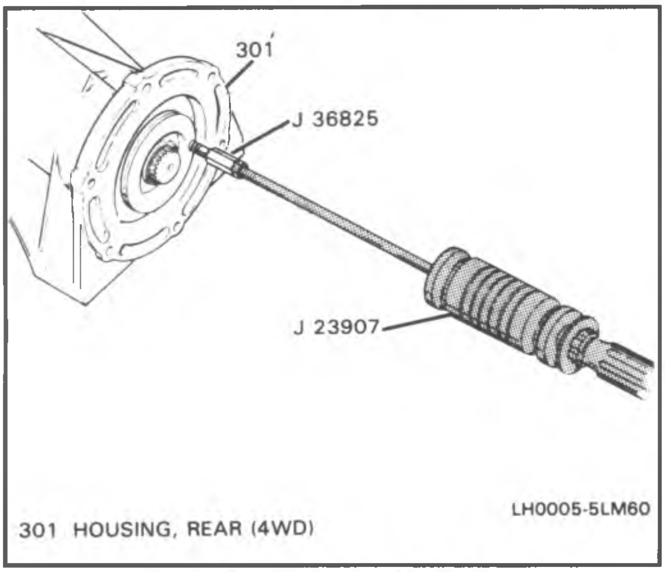


Figure 5 Removing 4WD Oil Seal

14. Four rollers (118) (Figure 8).
    Roll Pin
    - Pull shift shaft forward.
    - Cock to detent cover side.
15. Roll pin (120)

Important

- Support the shift shaft end while driving out finger roll pin.

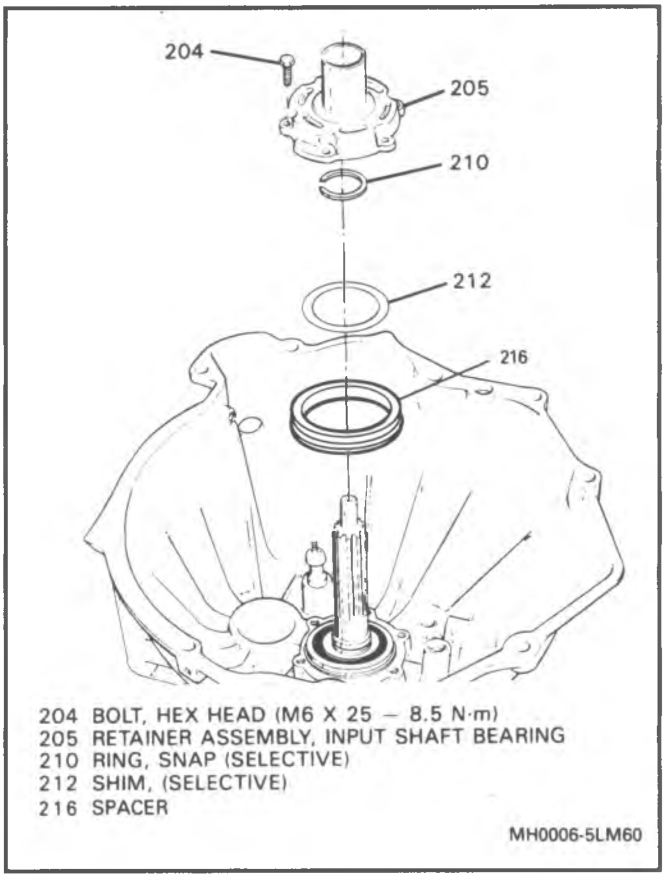


Figure 6 Removing Input Shaft Bearing Retainer Assembly

- Slide the shaft (116) all the way back and cocked over to the detent spring cover side.

16. Shift shaft socket assembly roll pin (122) (Figure 9).
    - Pin will fall into the case.

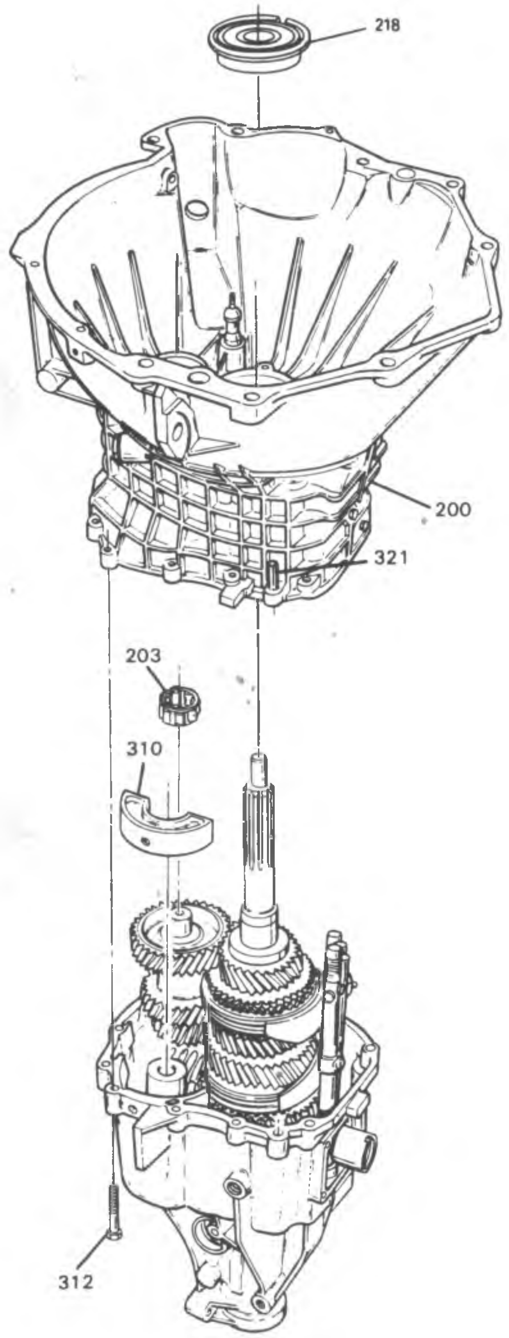
NOTICE: Excessive force will "peen" the shift shaft and damage the rear housing shift shaft bearing (309) causing increased shift effort.

17. Shift shaft (116), shift shaft socket assembly (123) and finger (121).
18. 3-4 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.

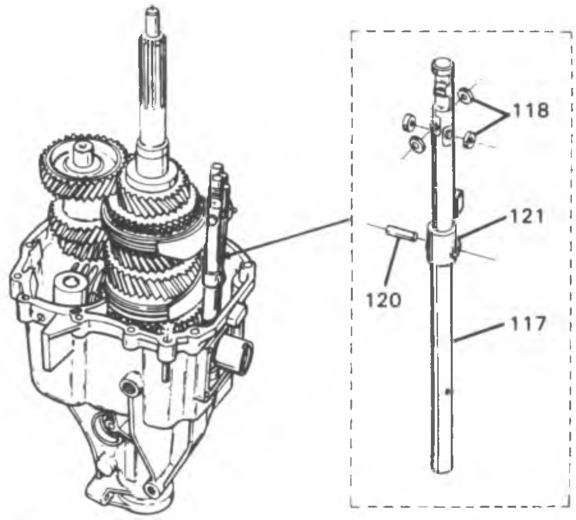
19. Plug (326).
    - By hitting on one side — cocking it.



200 HOUSING, FRONT
203 BEARING, COUNTERSHAFT
218 BEARING ASM, INPUT SHAFT (WITH SNAP RING)
310 SUPPORT, IDLER SHAFT
311 BOLT, HEX HEAD (M8 X 50 – 22 N·m)
312 BOLT, HEX HEAD (M8 X 50 – 35 N·m)
321 PIN, DOWEL

MH0007-5LM60

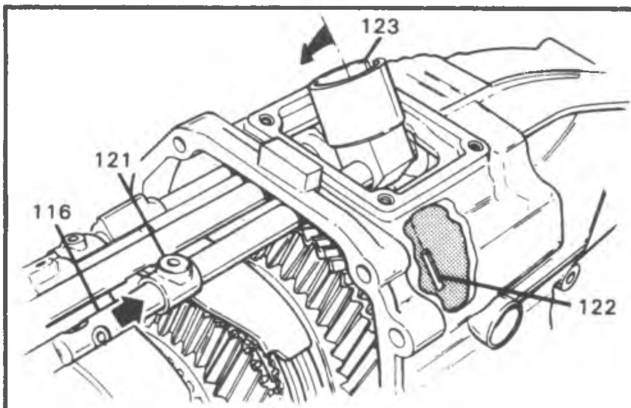
Figure 7 Removing Front Housing



117 SHAFT, SHIFT
118 ROLLER, SHIFT SHAFT
120 PIN, ROLL (6 X 28mm)
121 FINGER

LH0008-5LM60

Figure 8 Removing Shift Shaft Rollers and Finger



116 SHAFT ASSEMBLY, SHIFT
121 FINGER
122 PIN, ROLL
123 SOCKET ASSEMBLY, SHIFT SHAFT

LH0009-5LM60

Figure 9 Removing Shift Socket Assembly Roll Pin

20. 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.

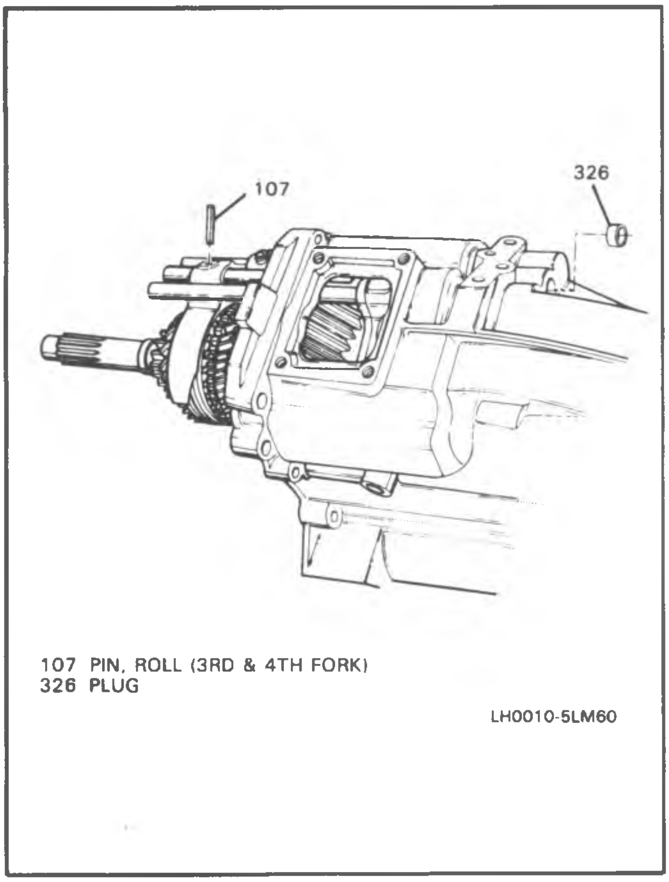


Figure 10 Removing 3-4 Rail Plug and Roll Pin

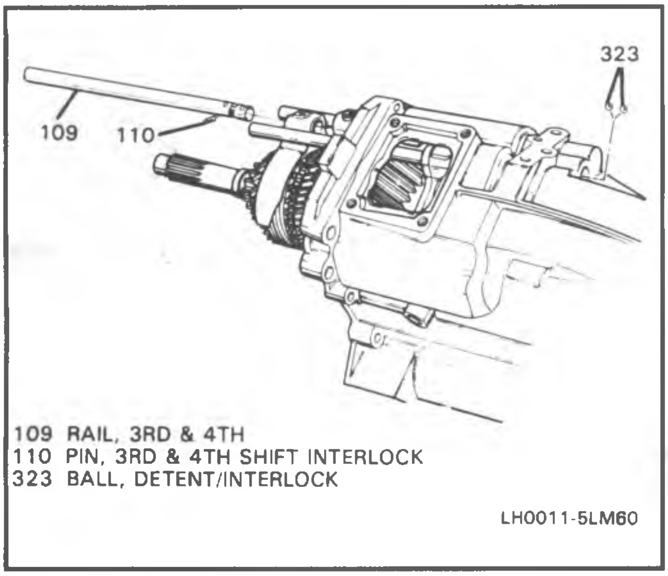


Figure 11 Removing 3-4 Rail and Interlock Balls

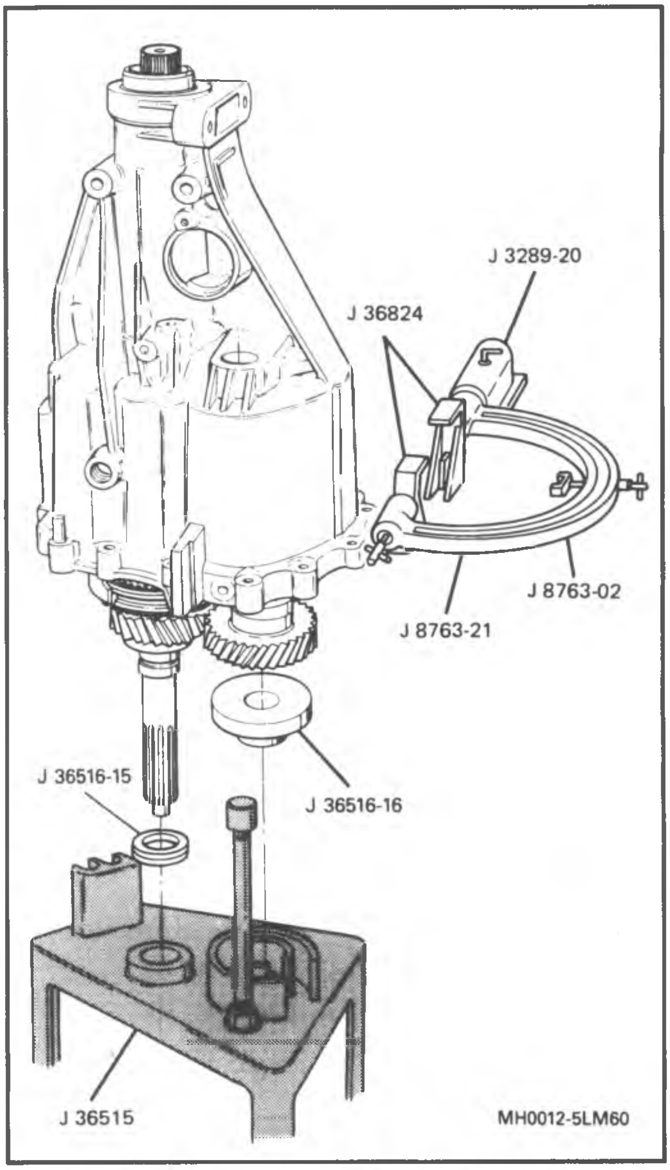


Figure 12 Removing and Installing Special Tools

21. Two interlock balls (323).
   - Install J 36516-15 and J 36516-16 with J 36515 (Figure 12).
   - Remove J 8763-02 and J 36824.

Important

Steps 22 through 29 are for 2WD models only. The 4WD section starts with step 30 (Steps 31 through 34 are for both 2WD and 4WD models).

22. Bolts (304).
23. 2WD rear housing assembly (300).
   - Tap upwards on the housing with a rubber mallet (alternately on each side).
24. 2WD output shaft bearing retainer (302).
25. Bearing (203).
   - Slide the snap ring (43) away from the rotor to make clearance for J 21427-01 (Figure 14).

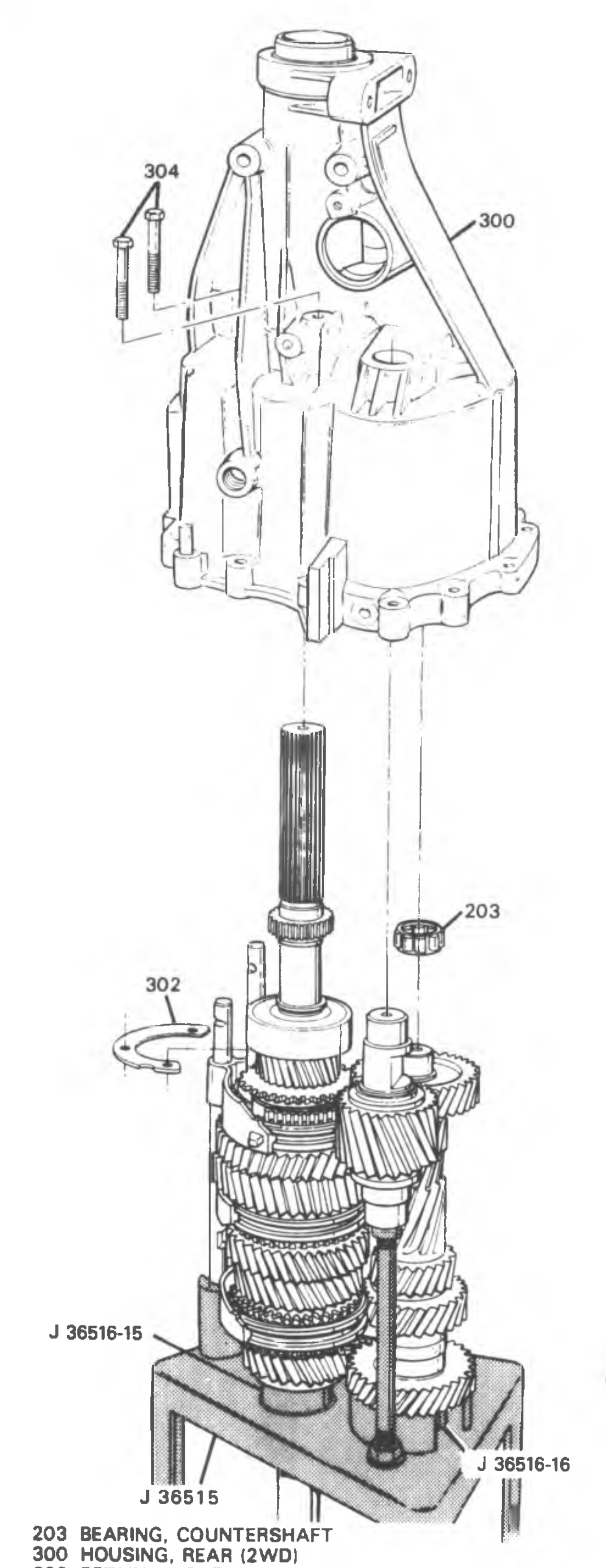


Figure 13 Removing 2WD Rear Housing

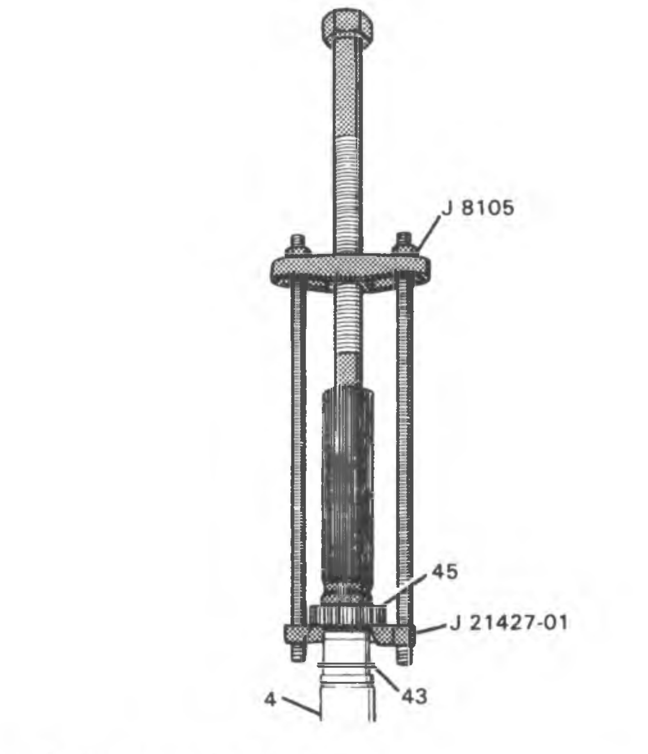


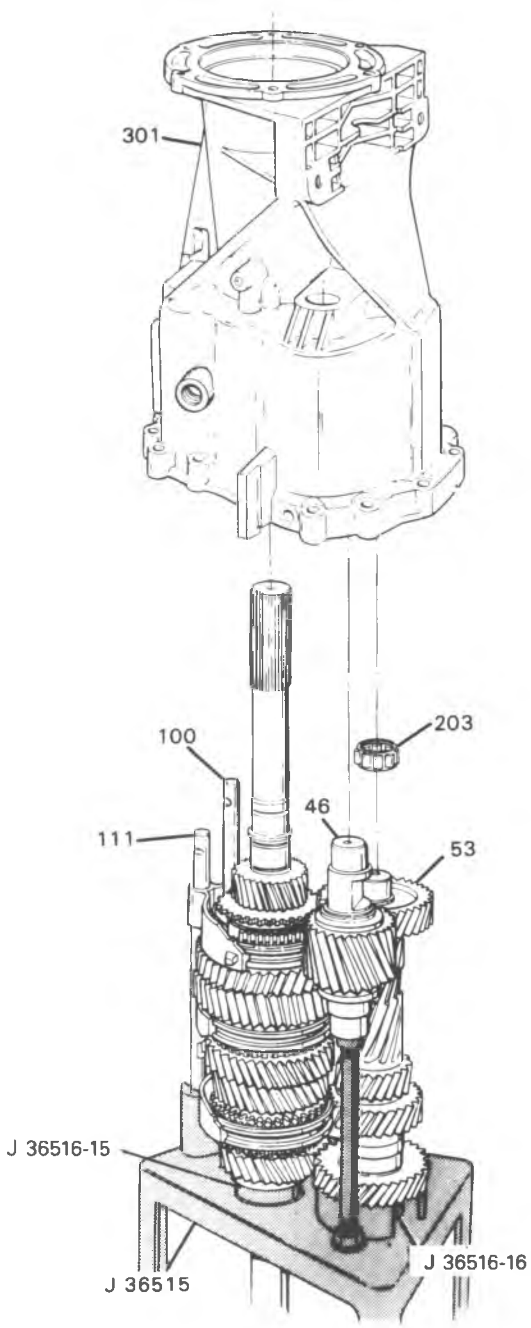
Figure 14 Removing 2WD Speed Sensor Rotor

26. Speed sensor rotor (45) using J 21427-01 and J 8105
    - DO NOT REUSE ROTOR AFTER REMOVAL.
27. Snap ring (43).
28. Snap ring (44).
29. Bearing assembly, output shaft (33).
30. 4WD Rear Housing Assembly (301) and bearing (203) (Figure 15).
    - Tap upwards on the housing with a rubber mallet (alternately on each side).
31. Reverse idler gear assembly (46) and countershaft (53) (Figure 16).
32. 1-2 shift rail assembly (100), 5-Reverse shift rail assembly (111), 2 and 3-4 shift fork (108).
    - By snapping them off
33. 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.

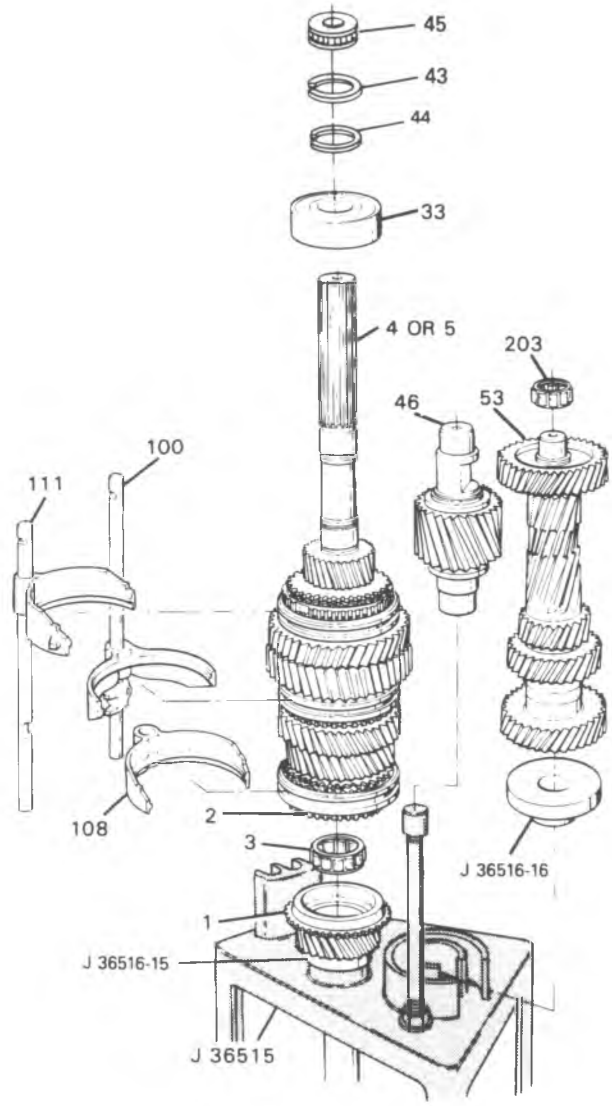
34. Input shaft gear (1) and pilot bearing (3).



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)

MH0016-5LM60

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
43 RING, SNAP
44 SNAP RING
45 ROTOR, SPEED SENSOR
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

MH0017-5LM60

Figure 16 Removing Gears and Shift Rails

UNIT SUBASSEMBLY REPAIR AND INSPECTION

DISASSEMBLY AND ASSEMBLY OF MAINSHAFT 2WD AND 4WD

Figures 17 through 31

Tools Required:

Hydraulic Press
J 36183 Input Shaft Press Tube with Cap
J 36184 Adapter Press Tube Reducer
J 36513 Gear and Bearing Separator Plate
J 22912-01 Separator Plate or Equivalent

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

Figures 17 through 23

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 reinstalled 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. Collar (15) and spacers (16) (Figure 18).
5. Second speed gear assembly (18).
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 reinstalled 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. First speed gear bearing assembly (17).
9. Fifth speed gear (31) (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 reinstalled 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. Third 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

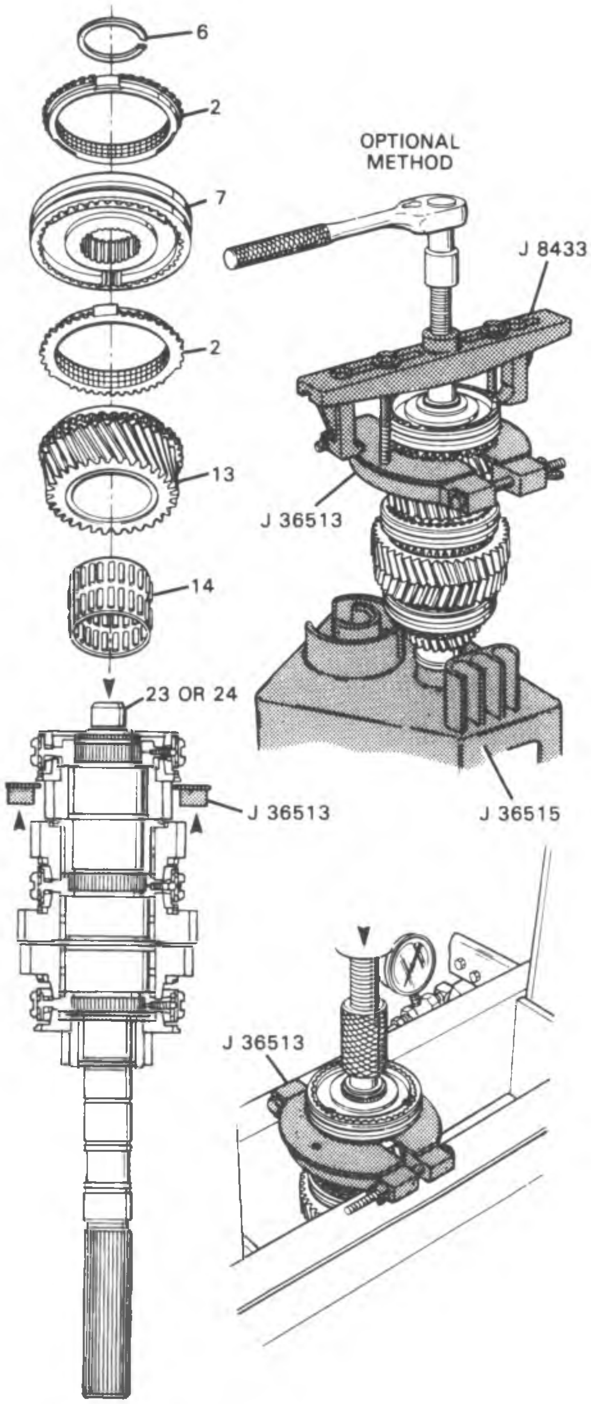
- DO NOT MIX PARTS

Clean

- All parts in a suitable solvent and air dry.

Important

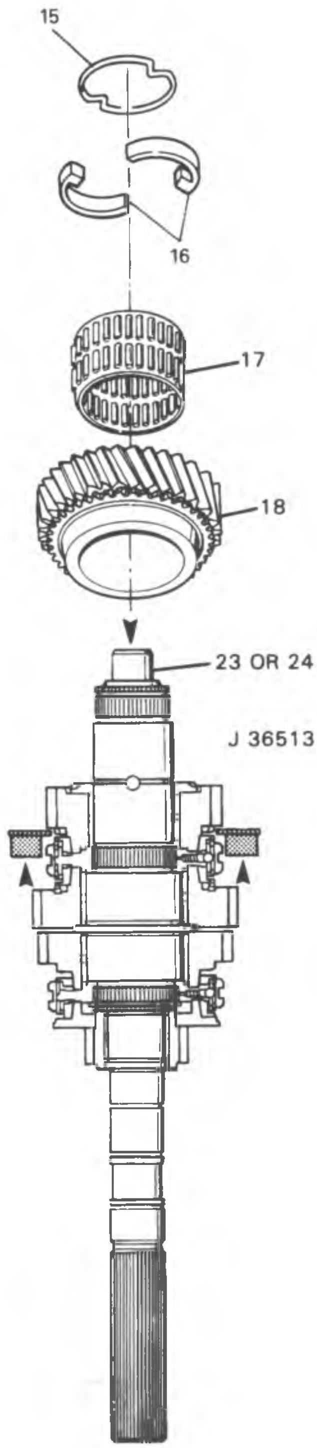
- Do not spin dry the ball bearings.



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

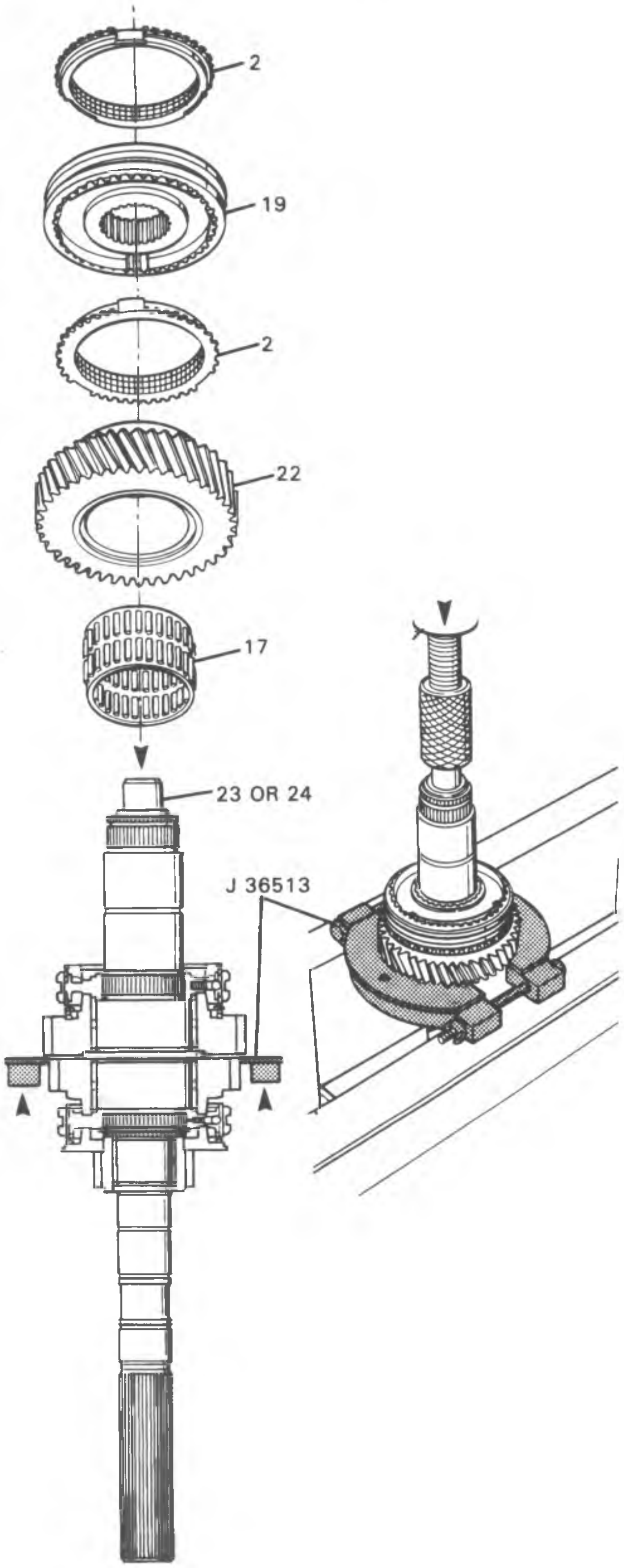
Figure 17 Removing 3-4 Gear Components



15 COLLAR
16 SPACERS
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
18 GEAR ASSEMBLY, 2ND SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

MH0019-5LM60

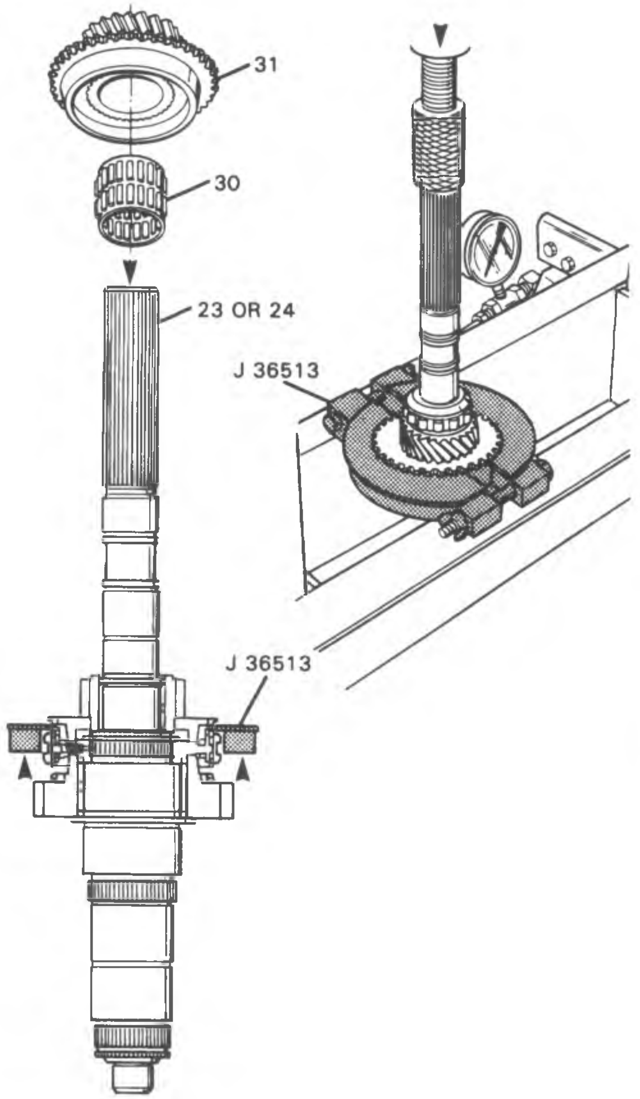
Figure 18 Removing 2nd Gear Components



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

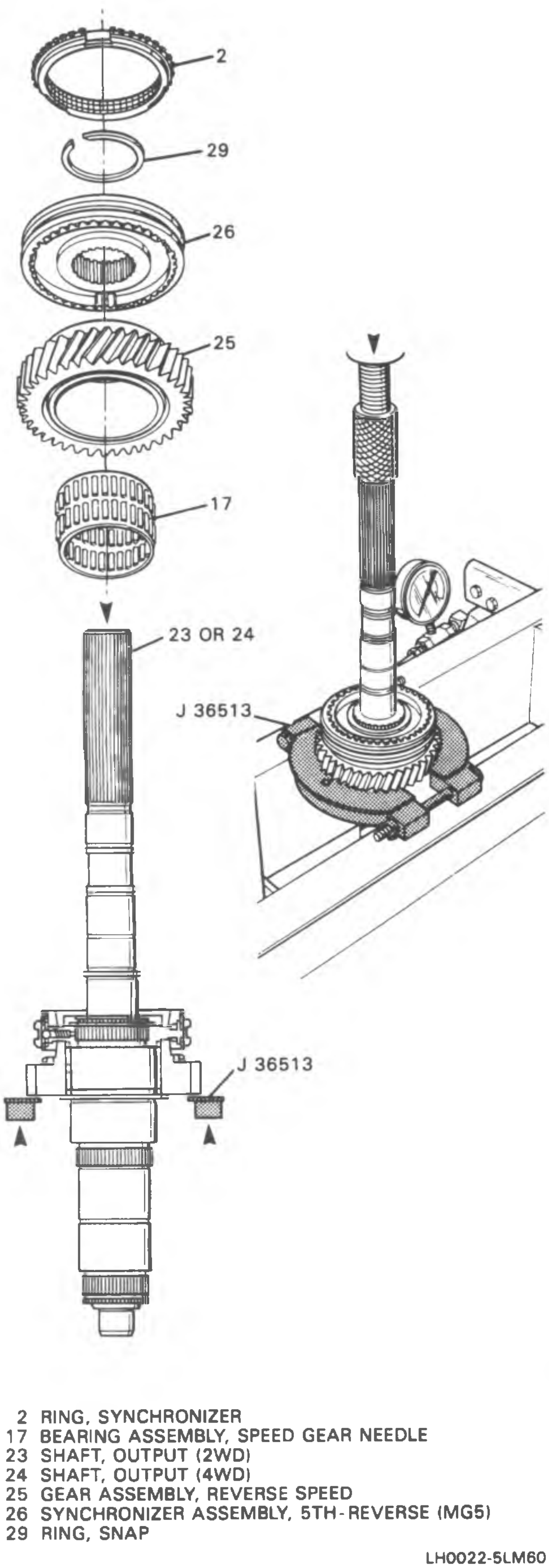


Figure 21 Removing Reverse Gear Components

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
   - 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.

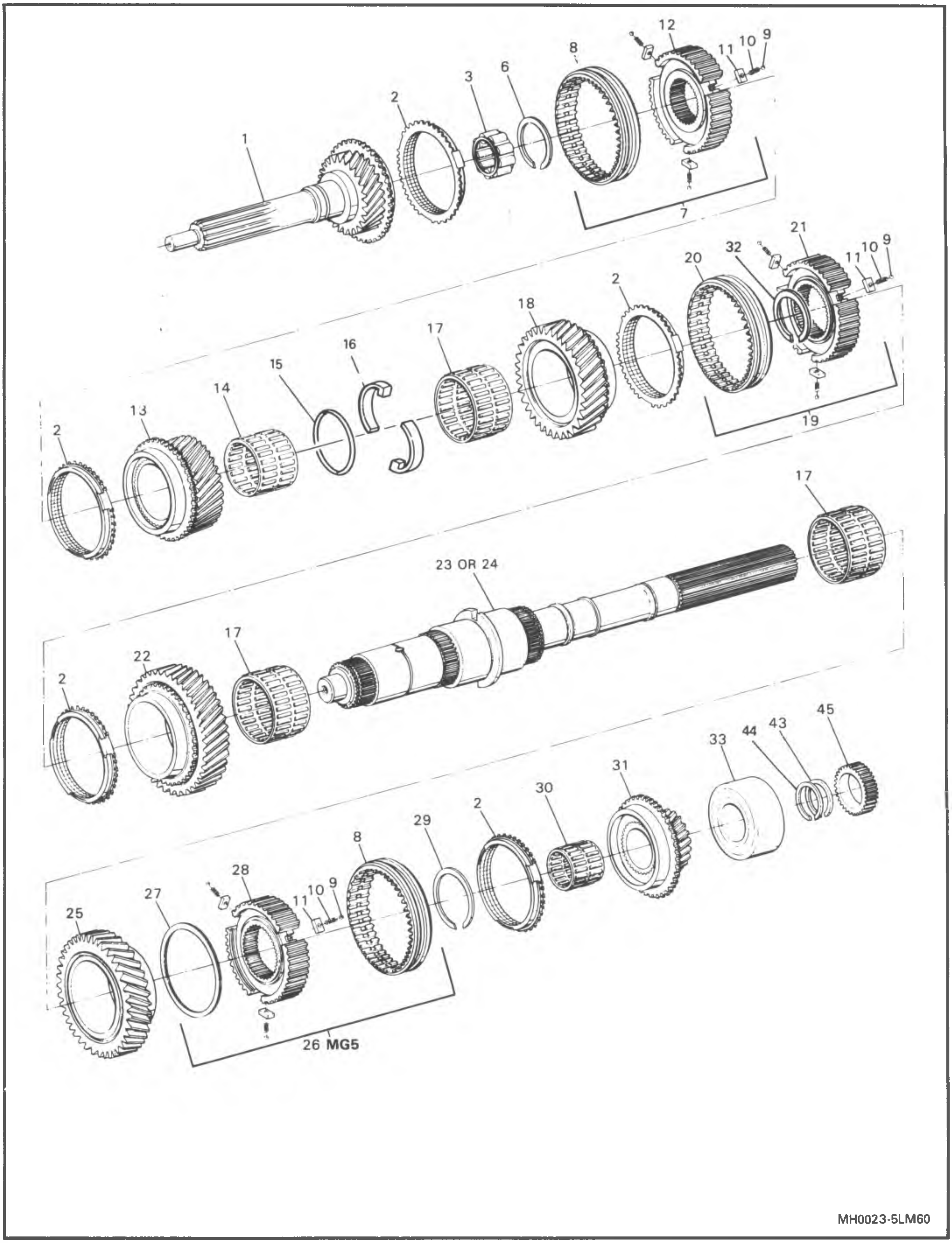


Figure 22 Main Shaft Components

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 RETAINER RING
15 THRUST WASHER
16 SPACERS
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
32 RING, SNAP
33 BEARING ASSEMBLY, OUTPUT SHAFT
43 RING, SNAP
44 RING, SNAP
45 ROTOR, SPEED SENSOR

MH0024-5LM60

Figure 23 Main Shaft Components Legend

Assemble

Figures 24 through 31

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).
    - 2WD speed sensor rotor (45)

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 1-2 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.

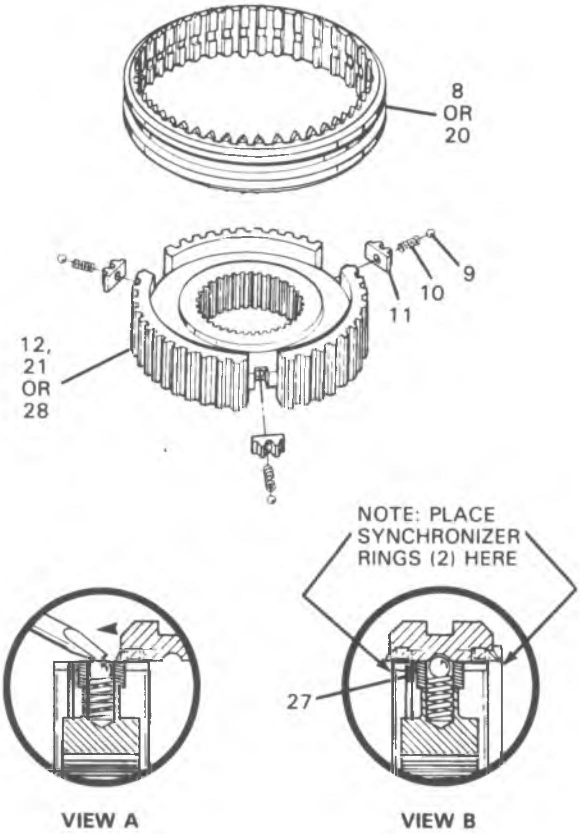
   Important

   - 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. Spacers (16) and collar (15).
10. NEW snap ring (15)
11. Bearing assembly (14) and 3rd speed gear (13) (Figure 29).

Important

- When pressing the 3-4 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

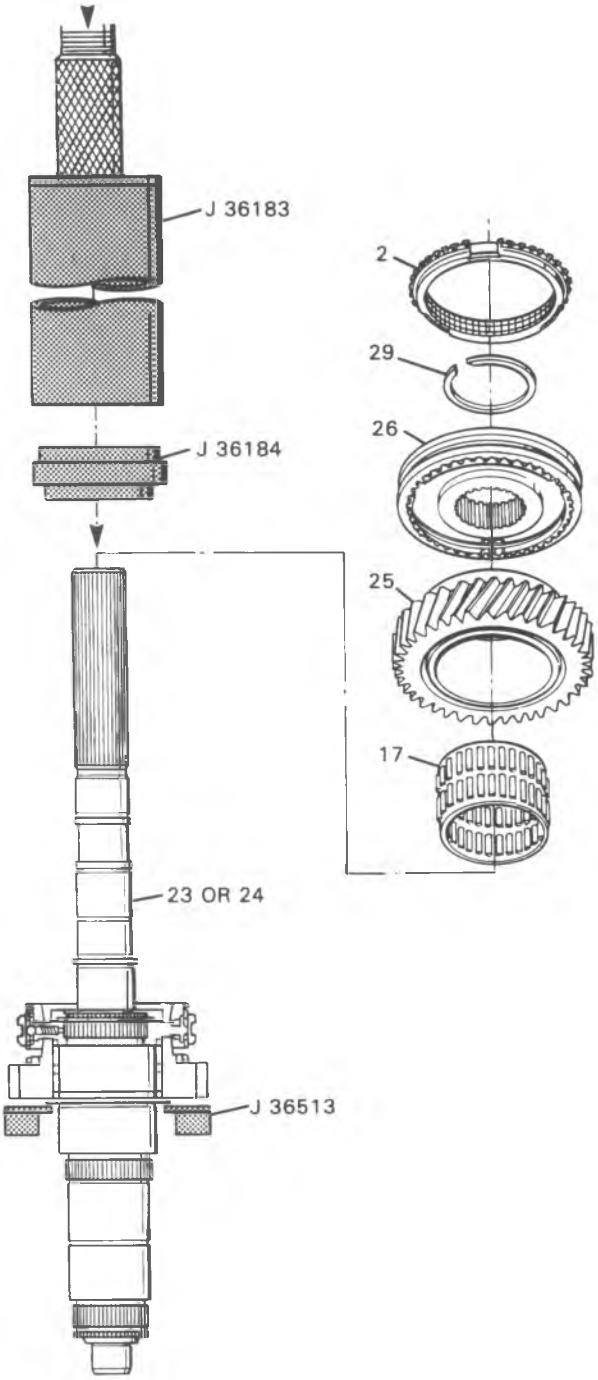
SYNCHRONIZER ASSEMBLY PROCEDURES

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

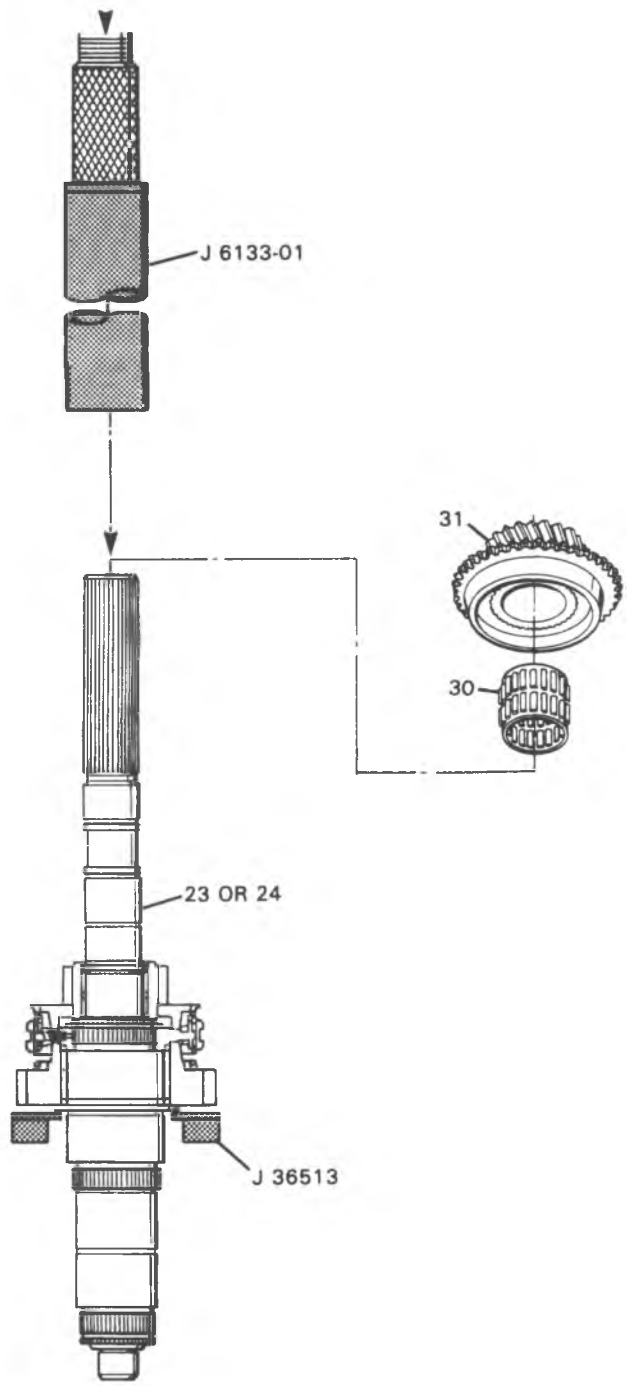
Figure 24 Synchronizer Assembly Procedure



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

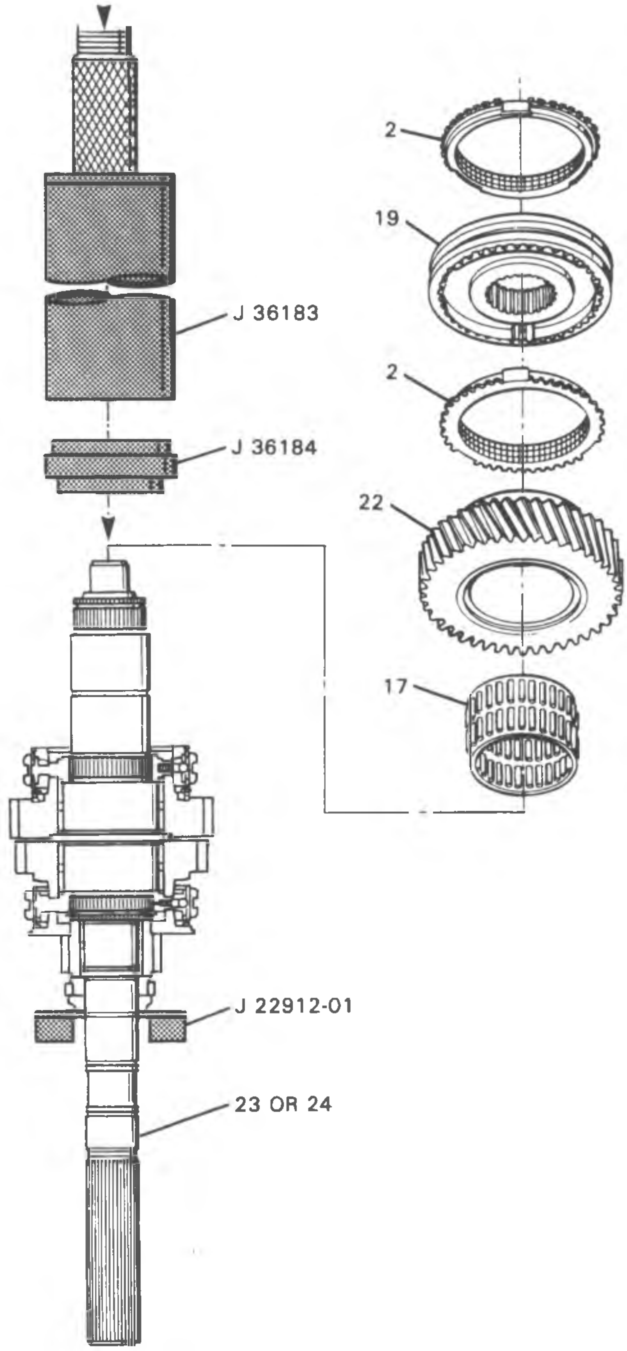
Figure 25 Reverse Gear Components Installed



23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)
30 BEARING ASSEMBLY, 5TH SPEED GEAR NEEDLE (MG5)
31 GEAR ASSEMBLY, 5TH SPEED (MG5)

LH0027-5LM60

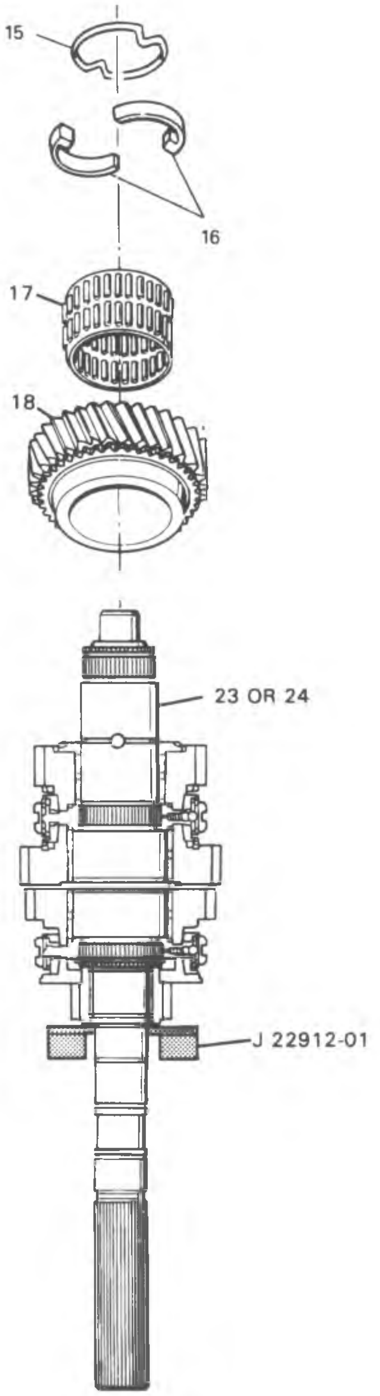
Figure 26 5th Gear Installed



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

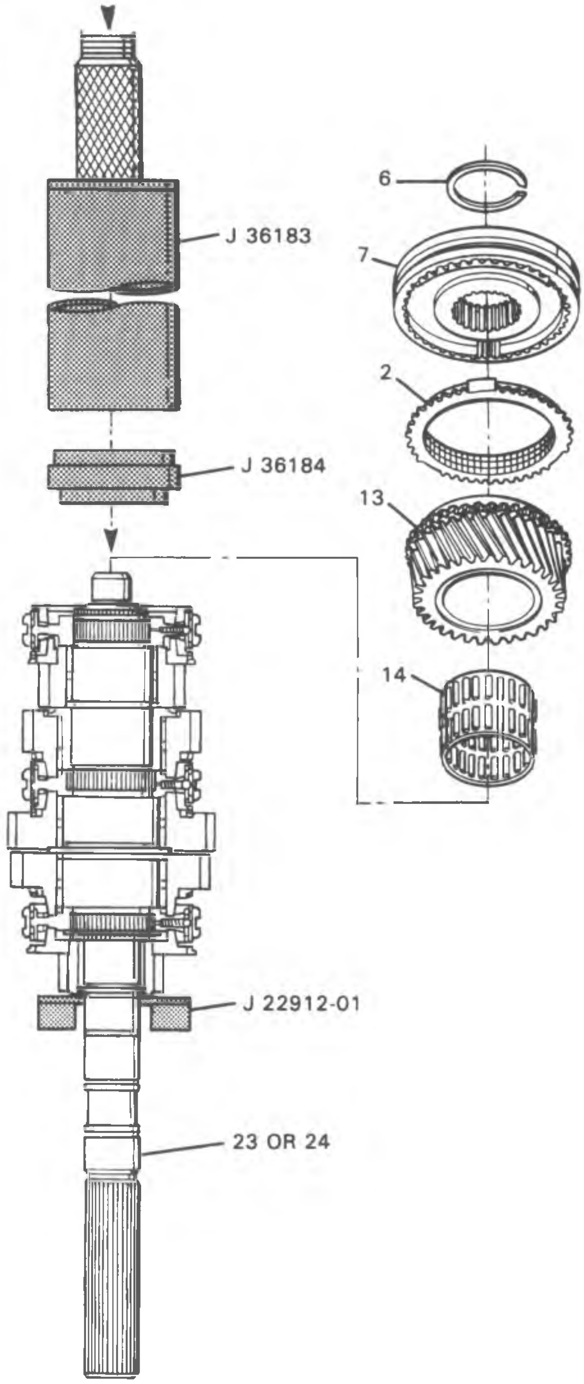
Figure 27 1st Gear and Components Installed



15 COLLAR
16 SPACERS
17 BEARING ASSEMBLY, SPEED GEAR NEEDLE
18 GEAR ASSEMBLY, 2ND SPEED
23 SHAFT, OUTPUT (2WD)
24 SHAFT, OUTPUT (4WD)

MH0029-5LM60

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

Figure 30

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 (See Figure 79).
4. Bearing races (202) for scoring, wear or overheating (See Figure 79).

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.

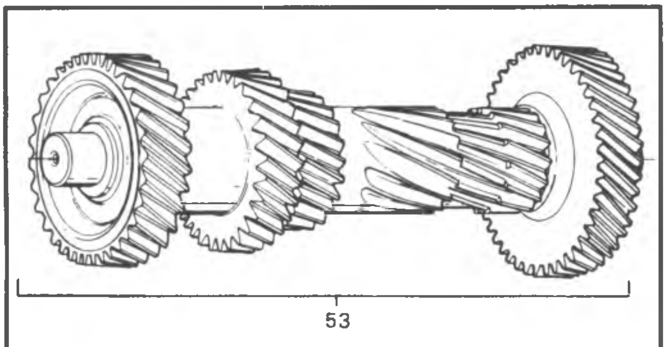


Figure 30 Countershaft

DISASSEMBLY AND ASSEMBLY OF REVERSE IDLER GEAR

Figure 31

Disassemble

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)

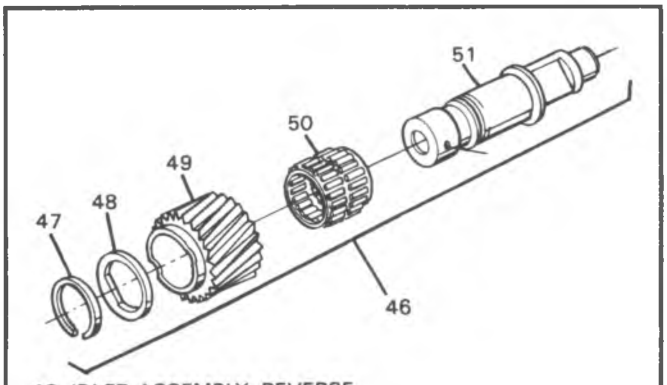
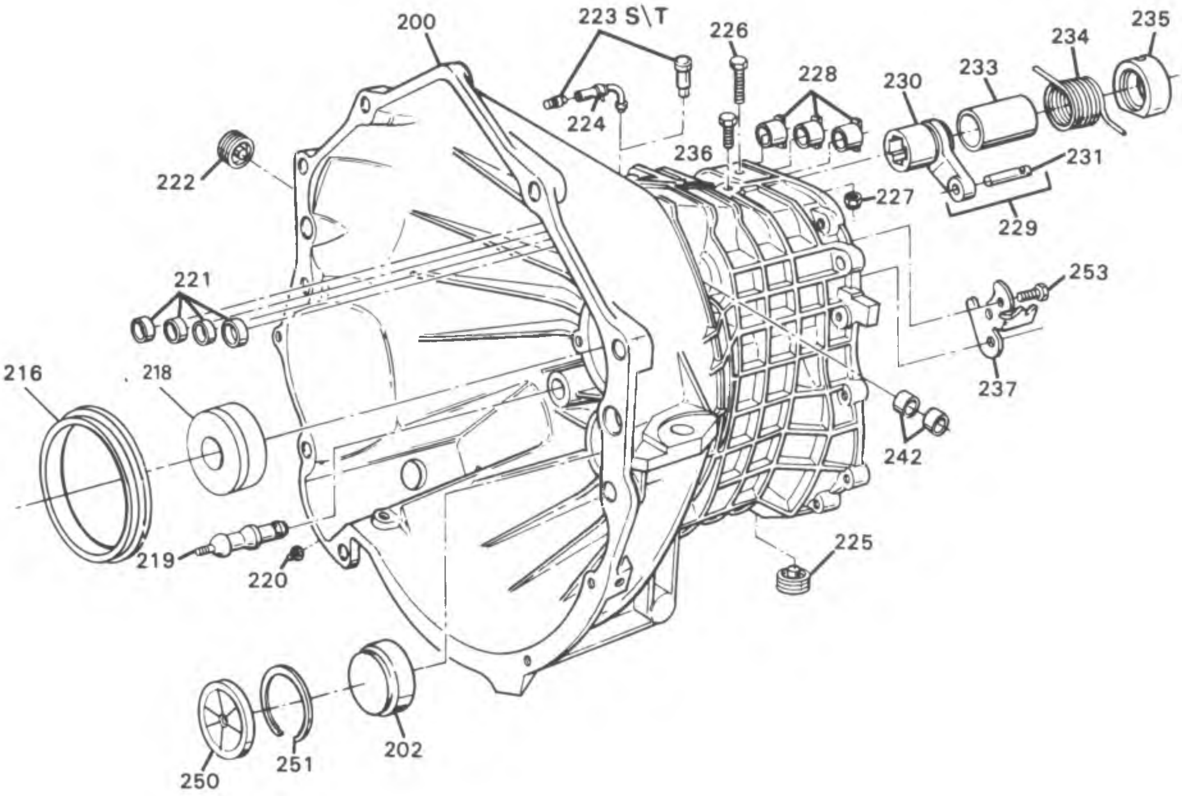


Figure 31 Reverse Idler Assembly



200 HOUSING, FRONT
202 RACE, COUNTERSHAFT BEARING
213 RING, INPUT SHAFT BEARING ASSEMBLY SNAP
216 SPACER
218 INPUT SHAFT BEARING ASSEMBLY
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 BUSHING, 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
253 BOLT, PAN HEAD (M6 X 18mm)

MH0033-5LM60

Figure 32 Front Housing Components

DISASSEMBLY AND ASSEMBLY OF FRONT HOUSING ASSEMBLY

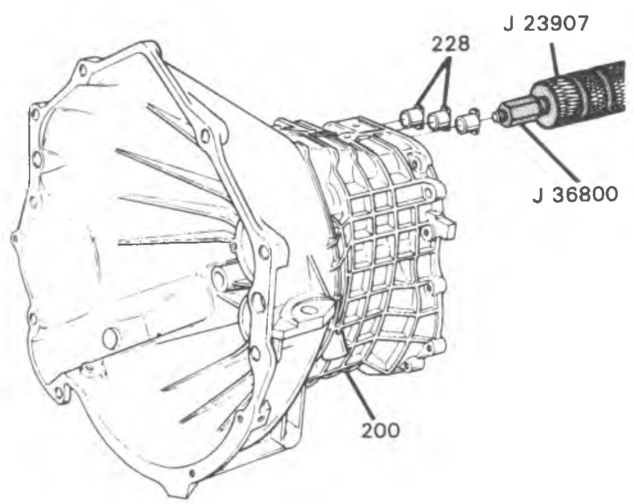
Figures 32 through 46

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
- J 36798 Shift Rail Bushing Installing and Stacking Tool
- J 38884 Countershaft Race Installer
- J 33367 Bridge
- J 35280 Bearing Race Puller
- 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 (17 mm)
- J 36190 Drive handle

Disassemble

1. Spacer (16)
2. Press out input shaft bearing (213) using J 36183, J 36184 and Hydraulic Press.
3. Three shift rail front housing bearings (228), using J 36800 and J 23907 (Figure 33).

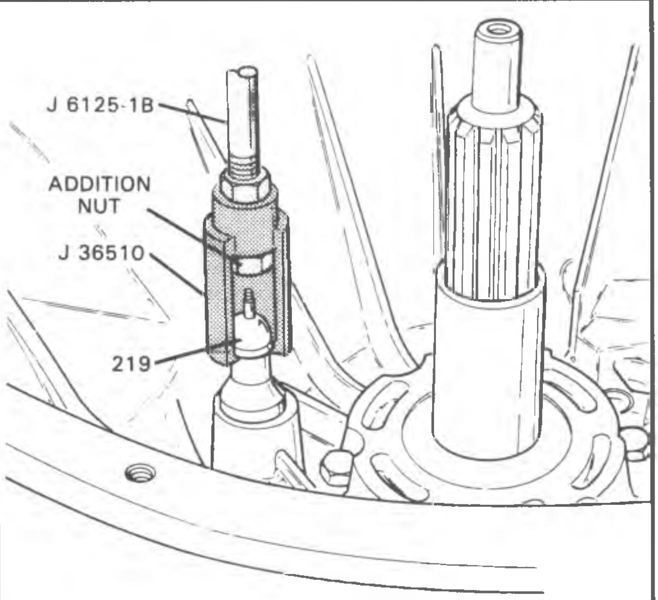


200 HOUSING, FRONT
228 BUSHING, SHIFT RAIL FRONT HOUSING

MH0034-5LM60

Figure 33 Removing Shift Rail Bushings

4. 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 onto nut.
   - Tighten both nuts.
   - Slide hammer out pivot.
5. Shift shaft/rails plugs (221)
   - Use a punch to drive the plugs out.
6. Countershaft bearing plug (250).
   - Drive out from rear.



219 PIVOT ASSEMBLY, CLUTCH FORK

LH0035-5LM60

Figure 34 Removing Clutch Fork Pivot Assembly

7. Snap ring (251), and countershaft bearing race (202) using J 8961 and J 35280 (Figure 35).

Measure

The countershaft bearing race bore in two places diagonally, 4 mm (0.157 in.) in from the inside of the transmission housing. Replace the housing if the bore is not within 58.006 to 58.024 mm (2.283 to 2.284 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.

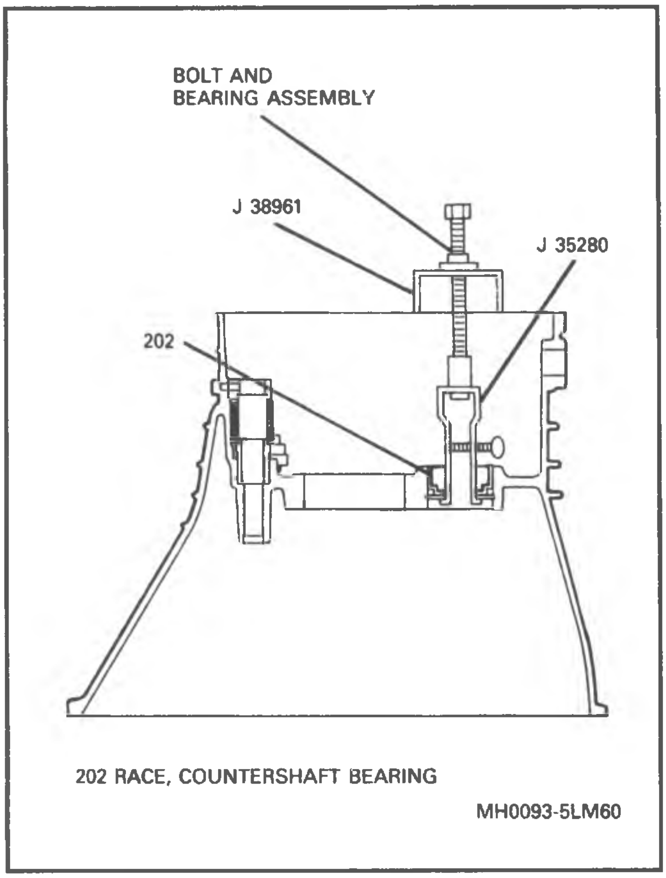


Figure 35 Removing Countershaft Bearing Race

8. 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).
9. Bolt (204), detent cam support (237).
10. Two detent plunger bushings (242), using J 36507 (Figure 38).
    - Remove ONE bushing at a time.
11. Breather assembly (223).
    - DO NOT REMOVE metal tube from case.
12. Oil fill plug (222) and oil drain plug (225), using J 36511 (Figure 39).
13. 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 bore is worn or damaged the rear housing MUST be replaced.
2. Bushings for scores, burrs, roundness or evidence of overheating;

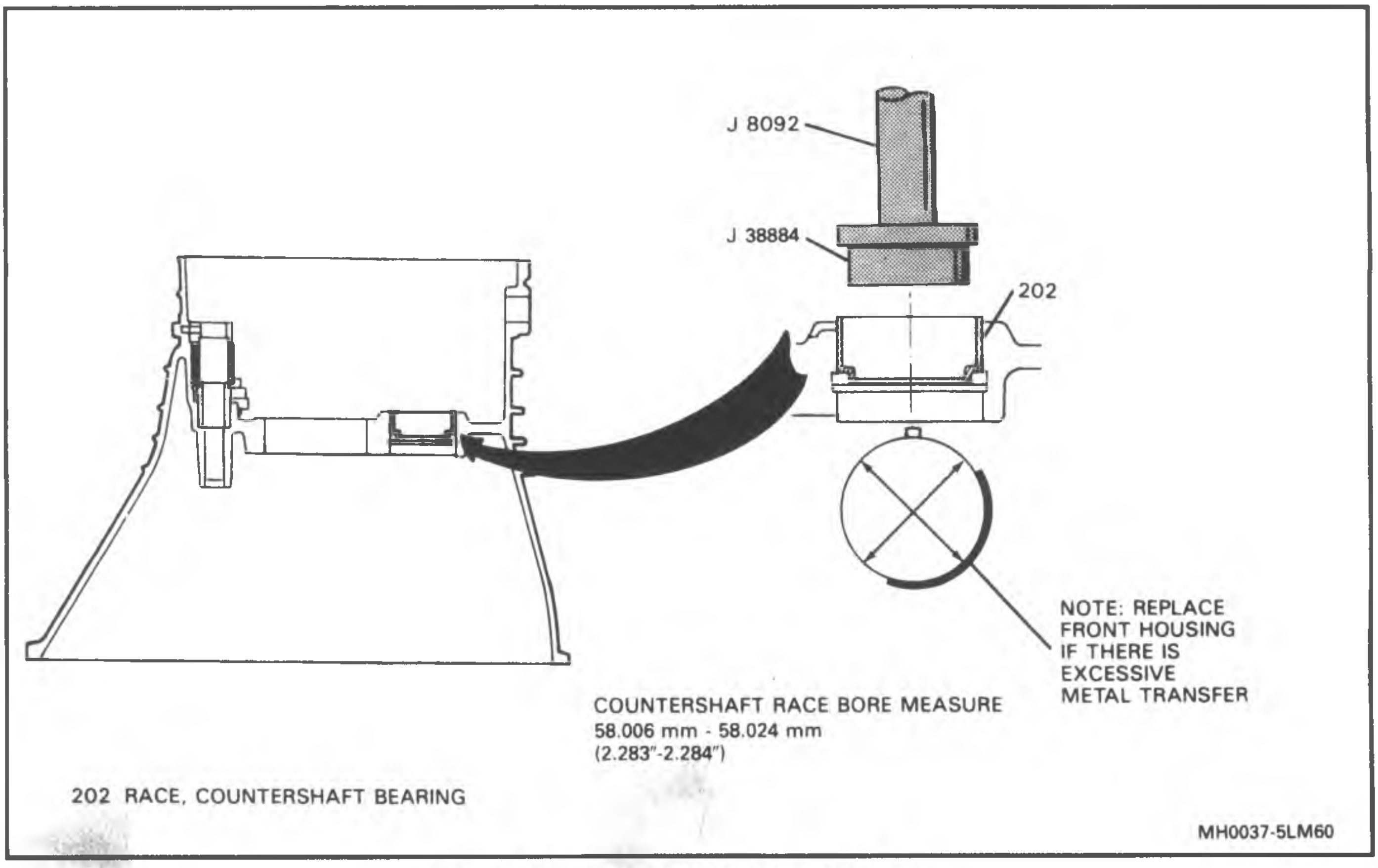
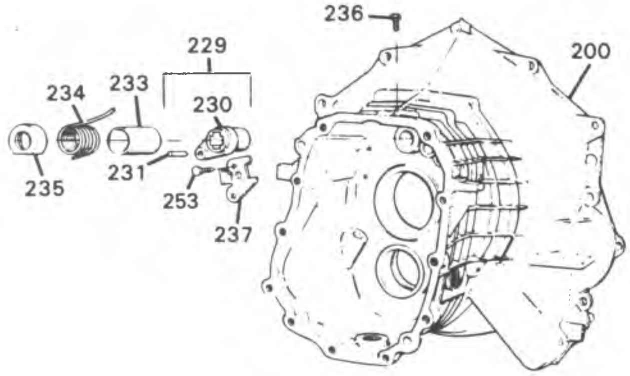


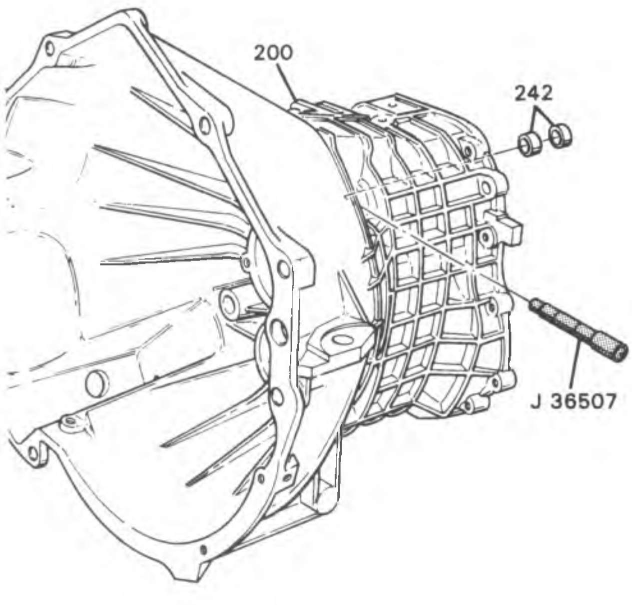
Figure 36 Countershaft Bearing Race Bore



200 HOUSING, FRONT
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
253 BOLT, PAN HEAD (M6 X 18mm)

LH0038-5LM60

Figure 37 Removing Bias Spring Components



200 HOUSING, FRONT
242 BUSHING, DETENT PLUNGER

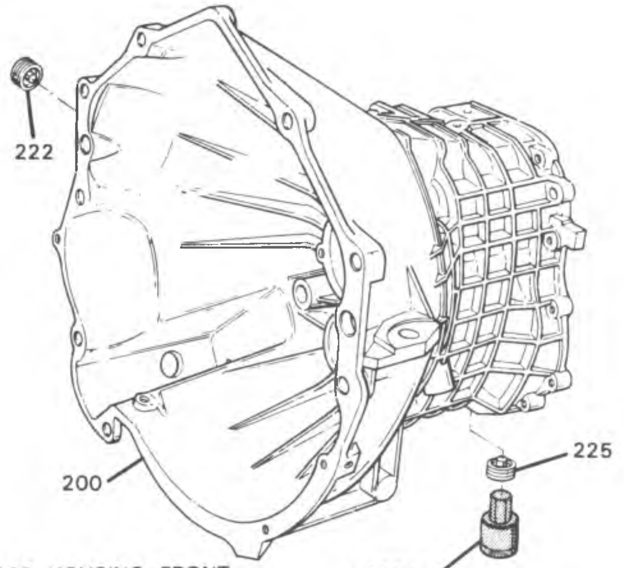
LH0039-5LM60

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.



200 HOUSING, FRONT
222 PLUG, OIL FILL
225 PLUG, OIL DRAIN

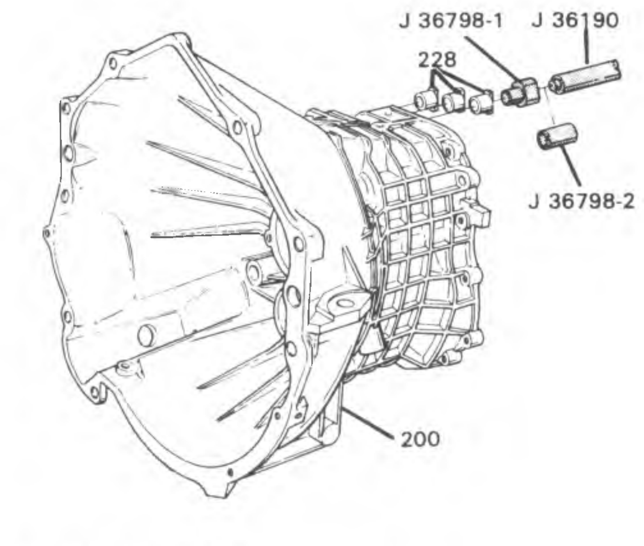
LH0040-5LM60

Figure 39 Removing Drain/Fill Plugs

Assemble

1. Press in bearing until snap ring is seated using J 36183, J 36184 and hydraulic press.
2. Spacer.
3. Three shift rail front housing bushings (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.
4. Clutch fork pivot assembly (219), using J 36510 and J 36190 (Figure 41).
   - Grease after installation through lube fitting (220).

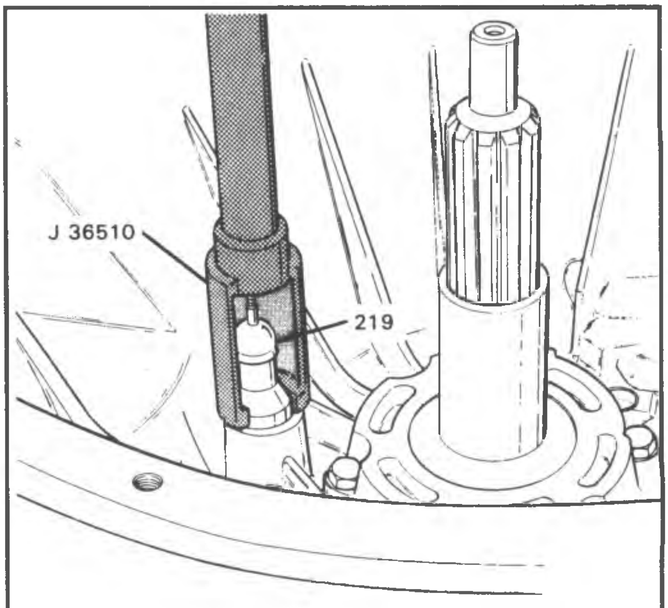
5. Two detent plunger bushings (242), using J 36507 (Figure 42).
   - Install one at a time.
   - Install the first bushing until the second scribe mark on the tool is aligned with the housing.
   - Install the second bushing until the first scribe mark on the tool is aligned with the housing.
6. Countershaft bearing race (202) using J 38884 and J 8092 (Figure 43).
   - Align lube slot in race with groove in the housing.
   - Snap ring (251).



200 HOUSING, FRONT
228 BUSHING, SHIFT RAIL FRONT HOUSING

MH0041-5LM60

Figure 40 Shift Rail Bushings Installation

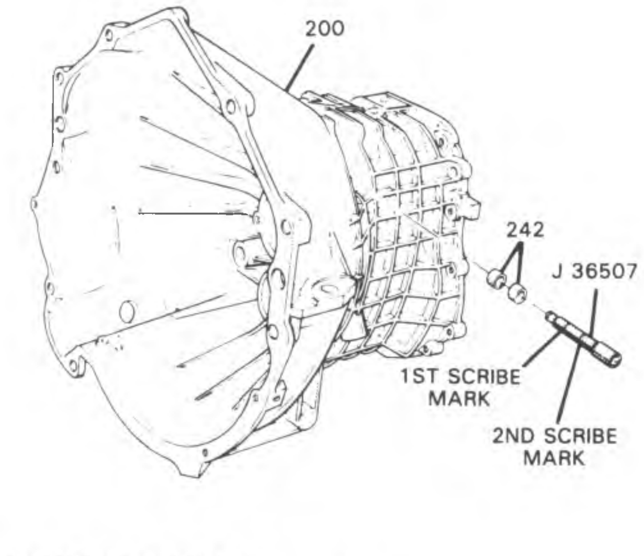


219 PIVOT ASSEMBLY, CLUTCH FORK

LH0042-5LM60

Figure 41 Clutch Fork Pivot Assembly Installation

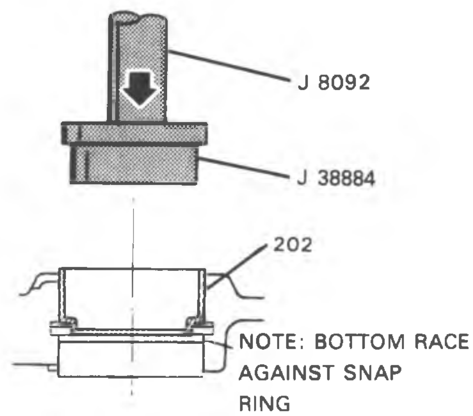
7. NEW Countershaft bearing plug (250) using J 38884 and J 8092.
   - Apply gasket maker GM P/N 1052943 or equivalent to the outside edge of the plug.
   - Stake in three places evenly apart.



200 HOUSING, FRONT
242 BUSHING, DETENT PLUNGER

LH0043-5LM60

Figure 42 Detent Plunger Bushing Installation



202 RACE, COUNTERSHAFT BEARING

MH0044-5LM60

Figure 43 Countershaft Bearing Race Installation

8. Detent cam support (237) and bolt (236) (Figure 44).

Tighten

- Bolt (236) to 8.5 N·m (76 lb. in.)

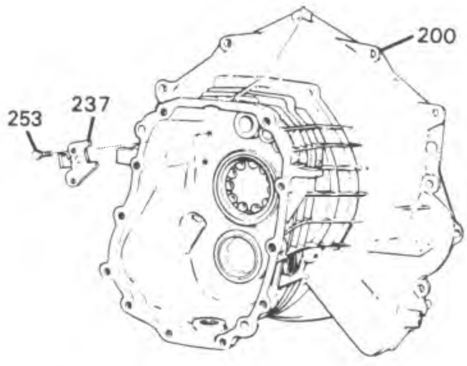
9. Shift shaft lever assembly (229) into housing (Figure 45).

10. 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.).

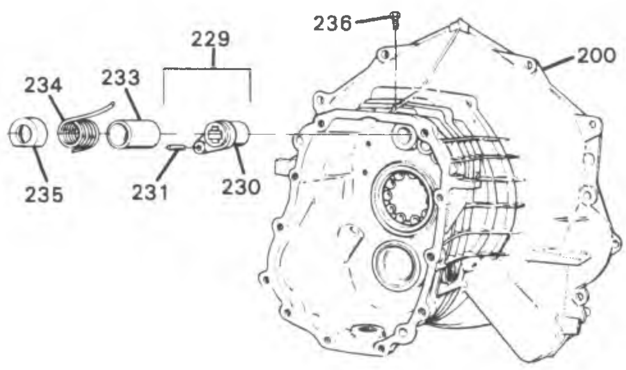
11. Bias load torsional spring (235) end back onto the shift shaft lever pin (231).



200 HOUSING, FRONT
237 SUPPORT, 5TH & REVERSE DETENT CAM
253 BOLT, PAN HEAD (M6 X 18mm)

LH0045-5LM60

Figure 44 Detent Component Installation



200 HOUSING, FRONT
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)

LH0046-5LM60

Figure 45 Bias Spring Component Installation

12. Breather assembly (223).
13. Oil fill plug (222) and oil drain plug (225), using J 36511 torque drain plug to 60 N·m (44 lb. ft.) (Figure 45).
    - Apply pipe sealant with Teflon™ GM P/N 1050280 or equivalent to the threads.
14. Shift shaft/rails plugs (221)
    - Apply gasket maker GM P/N 1052943 to the edge of the plugs.
    - Install flush

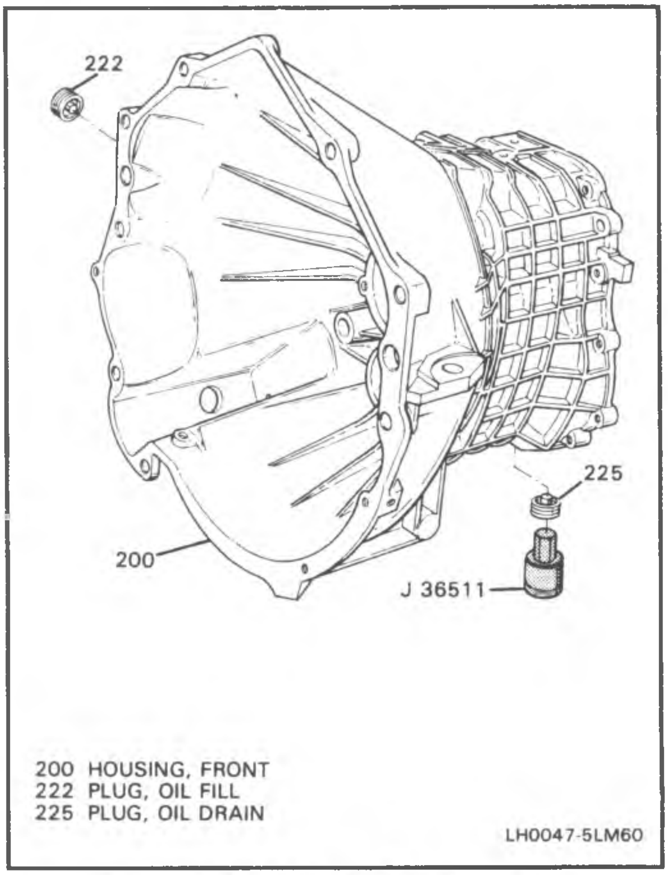


Figure 46 Oil Fill/Drain Plug Installation

DISASSEMBLY AND ASSEMBLY OF REAR HOUSING ASSEMBLY

Figures 47 through 54

Tools Required:

Hydraulic Press
J 33367 Bridge
J 35280 Bearing Race Puller
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 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
J 38884 Countershaft Bearing Race Installer

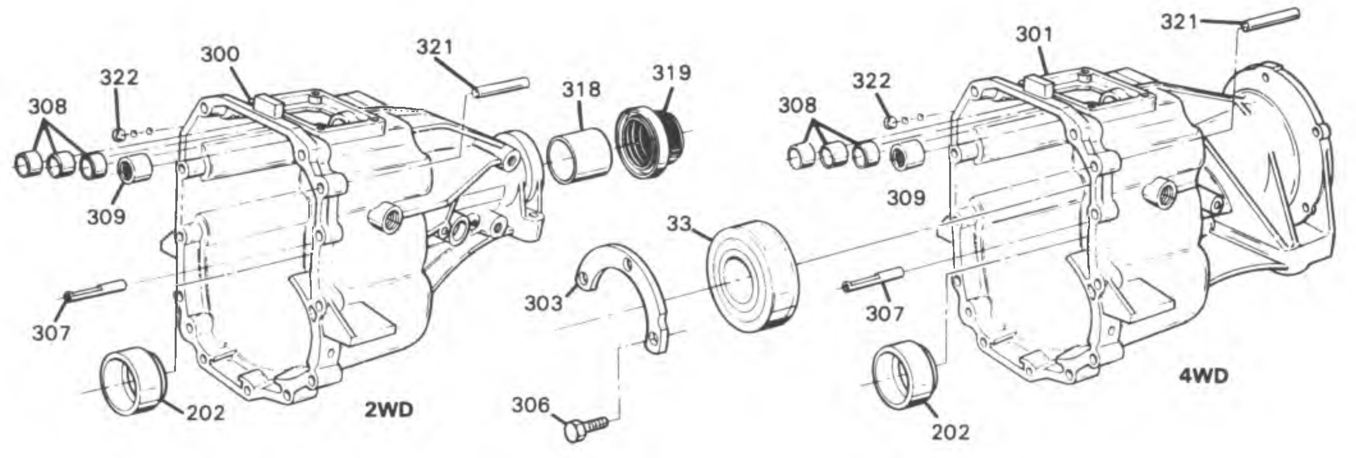
Disassemble

Figure 47

1. Rear housing shift rail bushings (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 (Figure 50).
    - 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. Drive out dowel pins.
4. Three bolts (306), output shaft bearing retainer (303) (4WD), bearing assembly (33), using brass drift.
    - 4WD models only.
5. Slip yoke oil seal (319), using J 26941 and J 23907 (Figure 51).
    - 2WD models only.
6. Plug (322).
    - Use a punch to drive the plug out.
7. Countershaft bearing race using J 8961 and J 35280 (Figure 52).
8. Gasket material from the case using liquid gasket remover.

Inspect

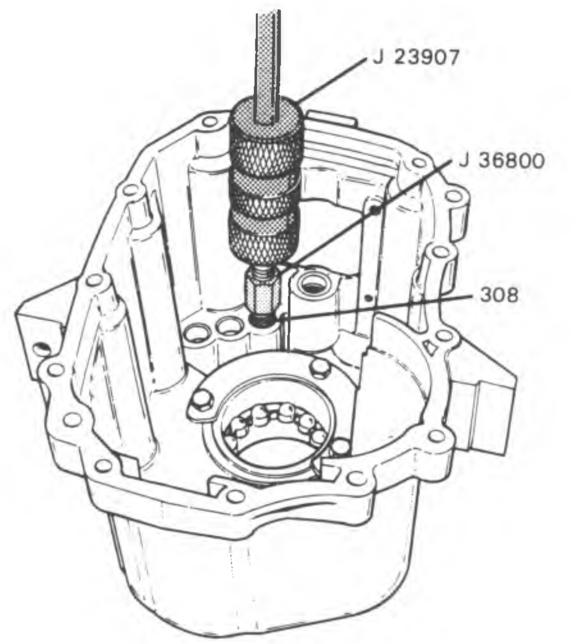
1. Bearing race bore, for wear, scratches or grooves; if counter shaft bearing race bore is worn or damaged the rear housing MUST be replaced.
2. Bushings, for scores, burrs, roundness or evidence of overheating; 2WD output shaft bushing (318) cannot be serviced, replace the rear housing (300) (no service 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 BUSHING, 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

MH0048-5LM60

Figure 47 Rear Housing Components



308 BEARING, REAR HOUSING SHIFT RAIL

LH0049-5LM60

Figure 48 Removing Shift Rail Bushing

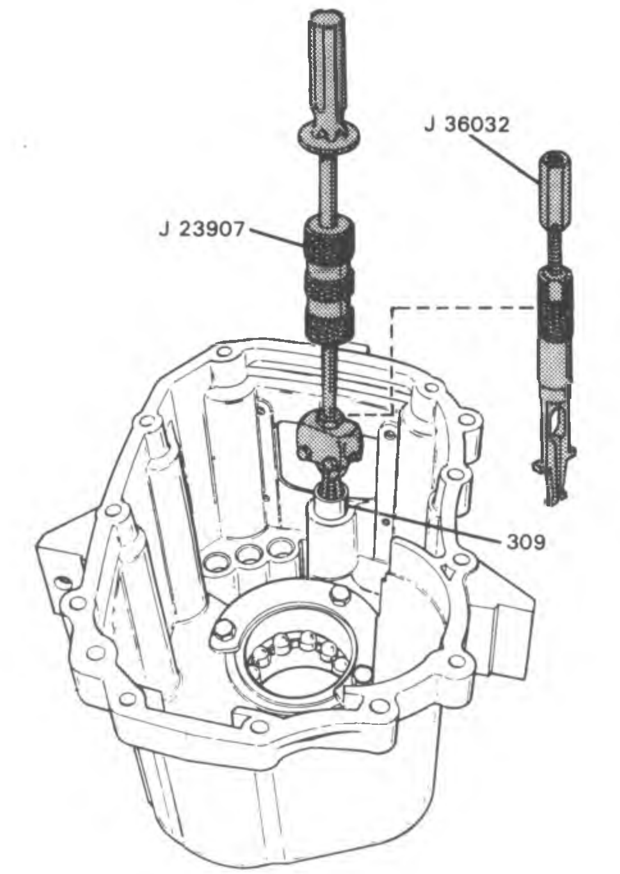
3. Case, for cracks, threaded opening for damaged threads, mounting faces for nicks, burrs, or scratches; if case is cracked, it must be replaced.
4. Machined mating surfaces for flatness, check with a straight edge.

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

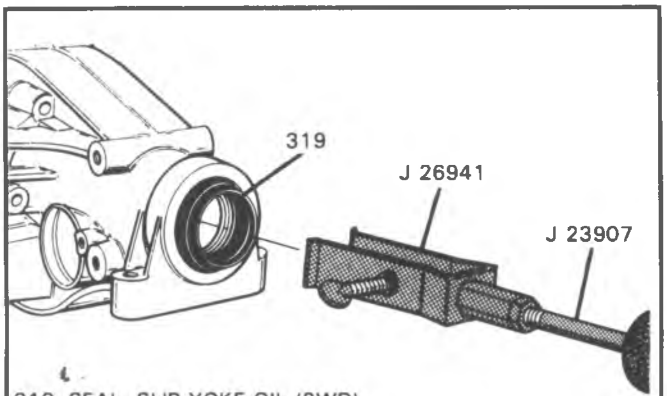
1. Rear housing shift rail bushings (308) (three), using J 36190 and J 36798-1 (Figure 52).
   - Stake with J 36798-2, J 36798-1 and J 36190.
2. Rear housing shift shaft bearing (309), using J 36506 and J 36190 (Figure 53).
   - Install bearing into bore so that the writing on bearing lip faces down.
   - Install flush.



309 BEARING, REAR HOUSING SHIFT SHAFT

LH0050-5LM60

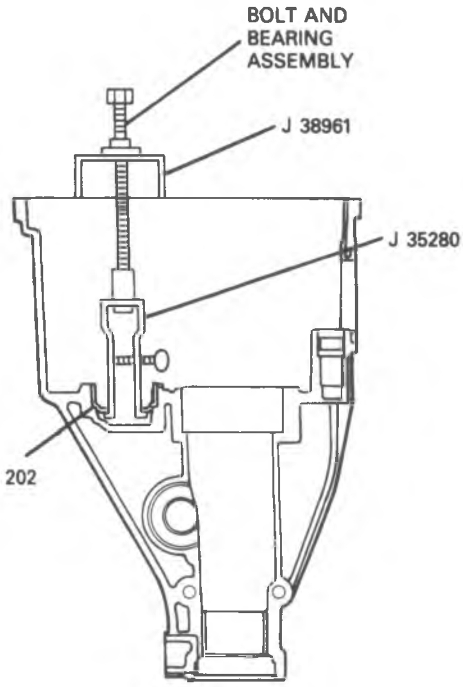
Figure 49 Removing Shift Shaft Bushing



319 SEAL, SLIP YOKE OIL (2WD)

LH0051-5LM60

Figure 50 Removing 2WD Slip Yoke Oil Seal



202 RACE, COUNTERSHAFT BEARING

MH0094-5LM60

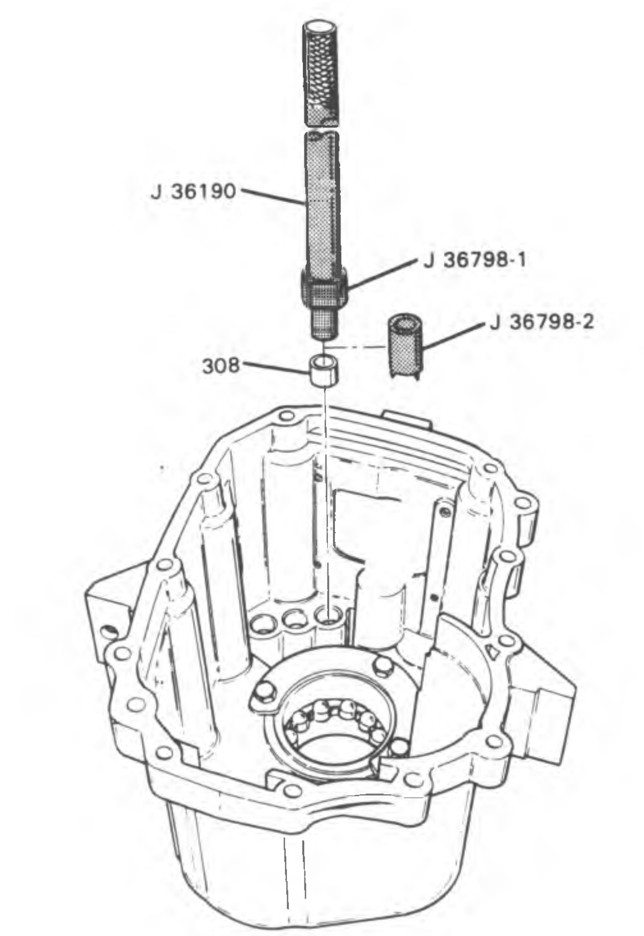
Figure 51 Removing Countershaft Bearing Race

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.).

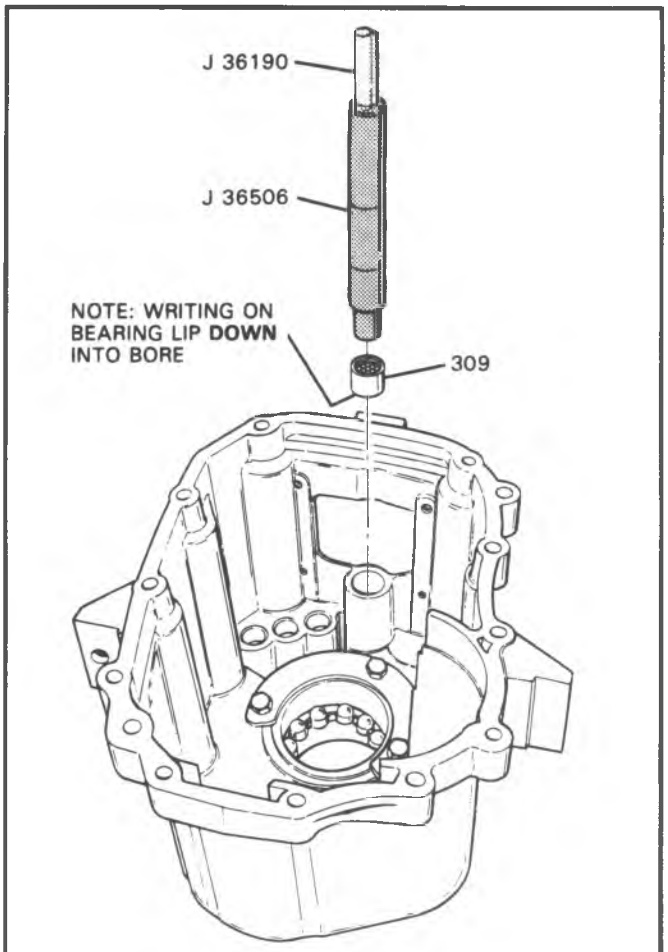
4. Two dowel pins (321).
   - Drive until flush.
5. Slip yoke oil seal (319), using J 36503 (Figure 54).
   - 2WD models only.
     - Fill between the seal lips with chassis grease



308 BUSHING, REAR HOUSING SHIFT RAIL MH0052-5LM60

Figure 52 Shift Rail Bushings Installation

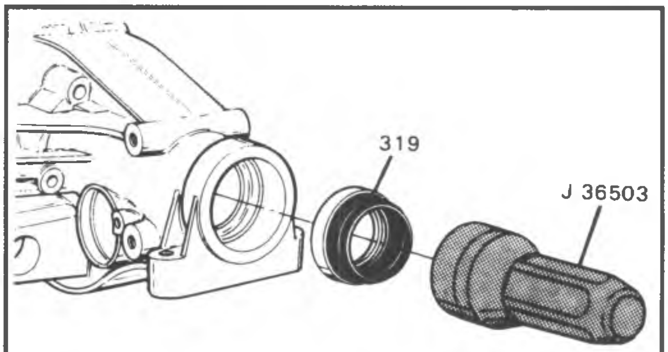
6. Plug (322).
   - Apply gasket maker GM P/N 1052943 or equivalent around the edge of the plug.
7. Countershaft bearing race using J 38884 and hydraulic press.



309 BEARING, REAR HOUSING SHIFT SHAFT

LH0053-5LM60

Figure 53 Shift Shaft Bearing Installation



319 SEAL, SLIP YOKE OIL (2WD)

LH0054-5LM60

Figure 54 2WD Slip Yoke Oil Seal Installation

SHIFT SHAFT/RAIL AND FORK ASSEMBLIES INSPECTION

Figure 55

Clean

- All parts in a suitable solvent and air dry.

Inspect

- 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

Figure 56 and 57

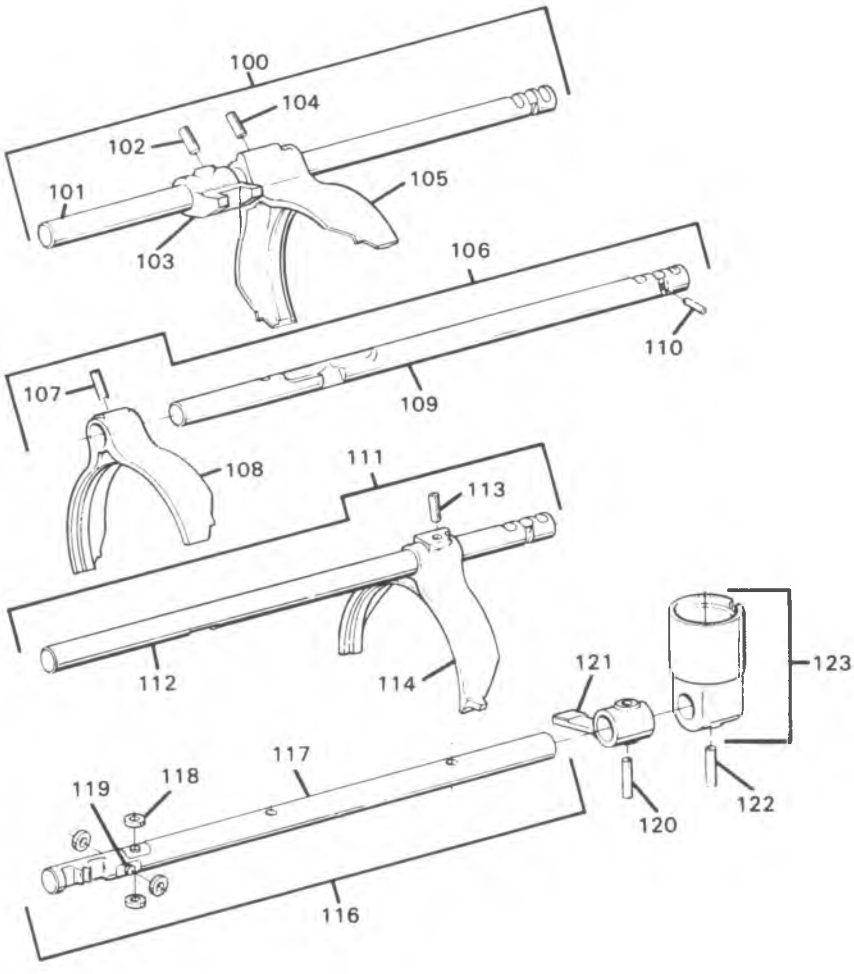
Clean

- The gasket material from the machined mating surface with liquid gasket remover.

Inspect

Figure 57

- 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.

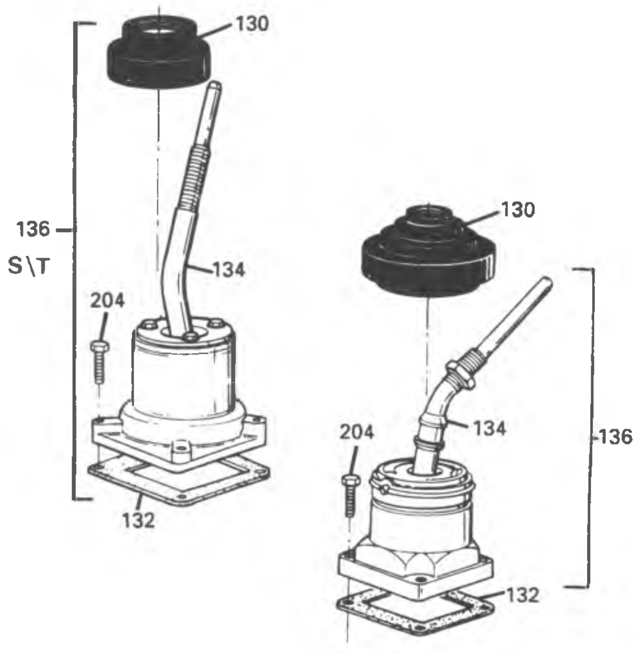


100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
101 RAIL, 1ST & 2ND SHIFT
102 PIN, ROLL
103 YOKE, 1ST & 2ND SHIFT
104 PIN, ROLL
105 FORK, 1ST-2ND SHIFT
106 RAIL ASSEMBLY, 3RD & 4TH SHIFT
107 PIN, ROLL (3RD & 4TH FORK) (6 X 36mm)
108 FORK, 3RD & 4TH SHIFT
109 RAIL, 3RD & 4TH
110 PIN, 3RD & 4TH SHIFT INTERLOCK
111 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

LH0055-5LM60

Figure 55 Shift Shaft/Rails Assembly Components

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.



130 BOOT
132 SEAL, SHIFT LEVER HOUSING
134 NUT, HEX JAM
136 HOUSING ASSEMBLY, SHIFT LEVER
204 BOLT, HEX HEAD (M6 X 25-8.5 N-m) LH0056-5LM60

Figure 56 Shift Housing Assembly Components

INPUT SHAFT BEARING RETAINER ASSEMBLY

Figures 57 and 58

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

Seal Replacement

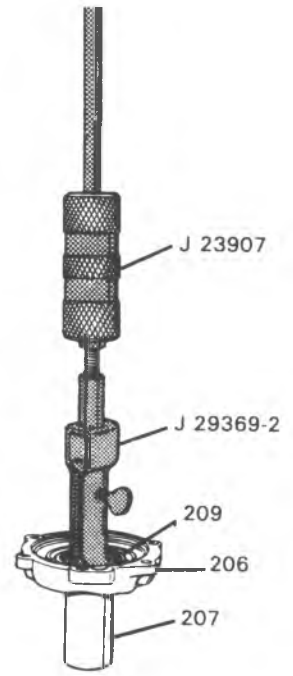
Remove or Disconnect

Figure 55

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. Remove seal with slide hammer.
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.



206 RETAINER, INPUT SHAFT BEARING
207 PILOT, CLUTCH RELEASE BEARING
209 SEAL, INPUT SHAFT BEARING RETAINER OIL

LH0057-5LM60

Figure 57 Removing Input Shaft Bearing Retainer Oil Seal

Install or Connect

Figure 56

1. NEW oil seal (209), using J 36504.
   - Fill between the seal lip with chassis grease.

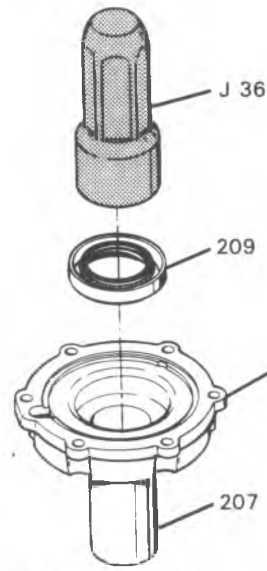


Figure 58 Input Shaft Bearing Retainer Oil Seal Installation

UNIT ASSEMBLY

Figures 59 through 82

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 36516-16 Countershaft Adapter

J 36516-15 Mainshaft Adapter

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 Installer (2WD Models only)

Assemble

Figures 59, 60, and 61

Important

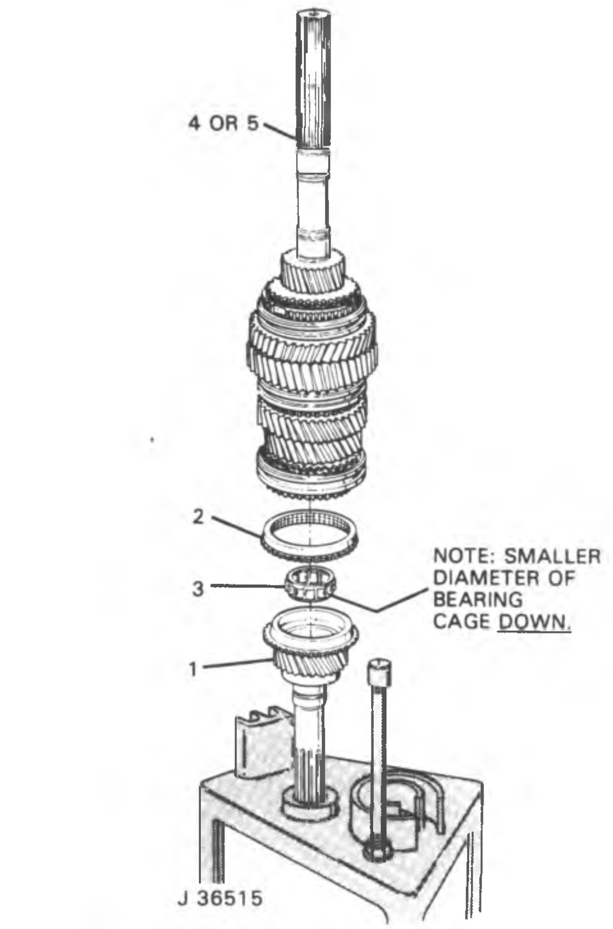
- The following component will require heating prior to installation during assembly procedures.

- 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 36516-15 and J 36515.
3. J 36516-16 onto countershaft (53).
   - Install the assembly onto J 36515.
4. Reverse idler assembly (46).
5. Bearing assembly, output shaft 33.
   - 2WD models only.
6. Snap ring
7. 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 8 through 14 are for 2WD models only. The 4WD section starts at step 15 (steps 18 through 39 are for both 2WD and 4WD models).



1 SHAFT, INPUT
2 RING, SYNCHRONIZER
3 BEARING, PILOT
4 SHAFT ASSEMBLY, MAIN (2WD)
5 SHAFT ASSEMBLY, MAIN (4WD)

LH0061-5LM60

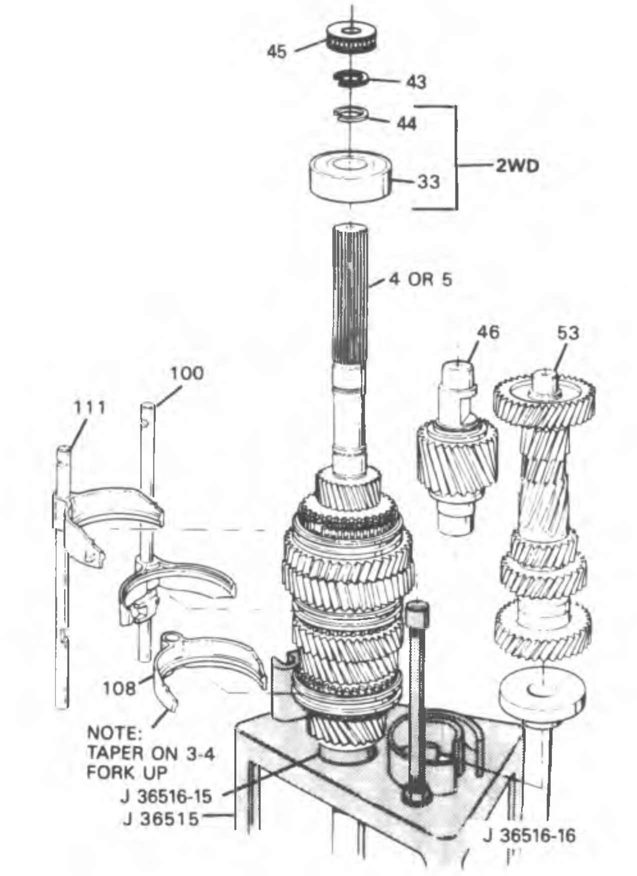
Figure 59 Mainshaft Components Installation

8. NEW snap ring (44).
9. Snap-ring (43) (Figure 60).
10. 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 64).

11. 2WD J 36515-10 through bolt (304) and (305) holes in the rear housing (Figure 62).
    - Screw into the output shaft bearing retainer (302).
    - Notch in retainer towards oil delivery tube assembly (307).



4 SHAFT ASSEMBLY, MAIN (2WD)
5 SHAFT ASSEMBLY, MAIN (4WD)
33 BEARING ASSEMBLY, OUTPUT SHAFT
43 SNAP RING
44 SNAP RING
45 SPEED SENSOR
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

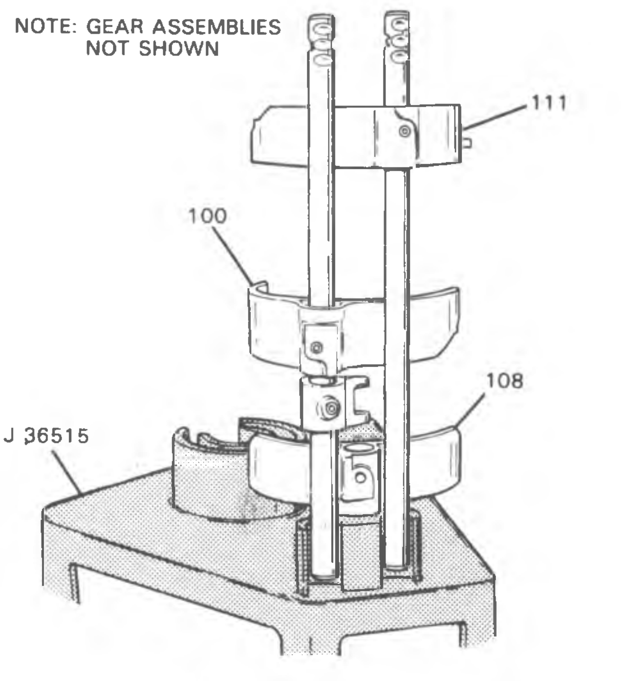
MH0062-5LM60

Figure 60 Countershaft and Reverse Idler Assembly Installation

12. 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

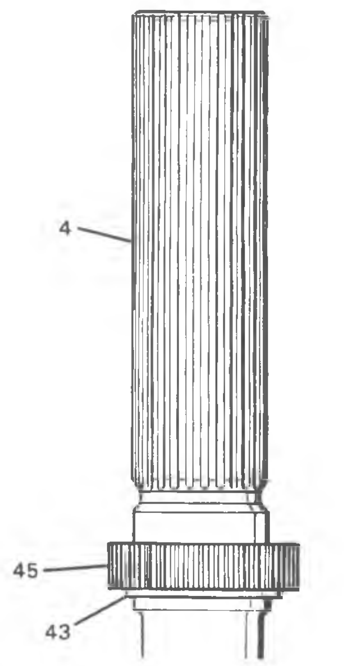
- PRESS **EACH** ROLLER TOWARDS THE RACE TO SECURE THEM FOR EASIER ASSEMBLY.



100 RAIL ASSEMBLY, 1ST & 2ND SHIFT
108 FORK, 3RD & 4TH SHIFT
111 RAIL ASSEMBLY, 5TH & REVERSE SHIFT

LH0063-5LM60

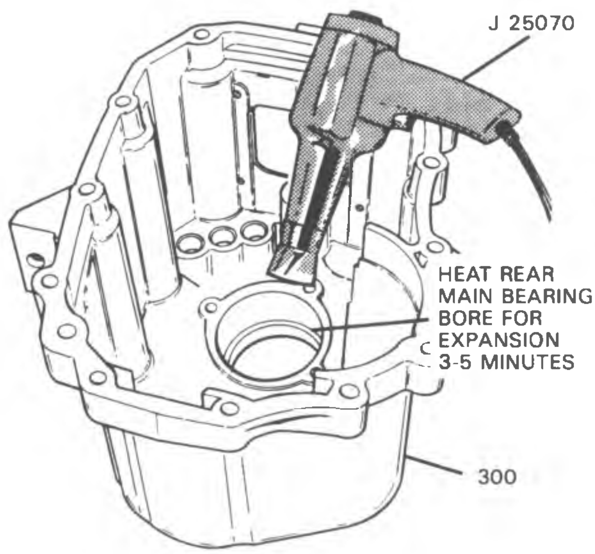
Figure 61 Proper Positions of Shift Forks and Rails



4 SHAFT ASSEMBLY, MAIN (2WD)
43 RING, SNAP
45 ROTOR, SPEED SENSOR

LH0065-5LM60

Figure 62 2WD Speed Sensor Rotor Installation



300 HOUSING, REAR (2WD)

LH0066-5LM60

Figure 63 Heating 2WD Rear Main Bore

13. 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.

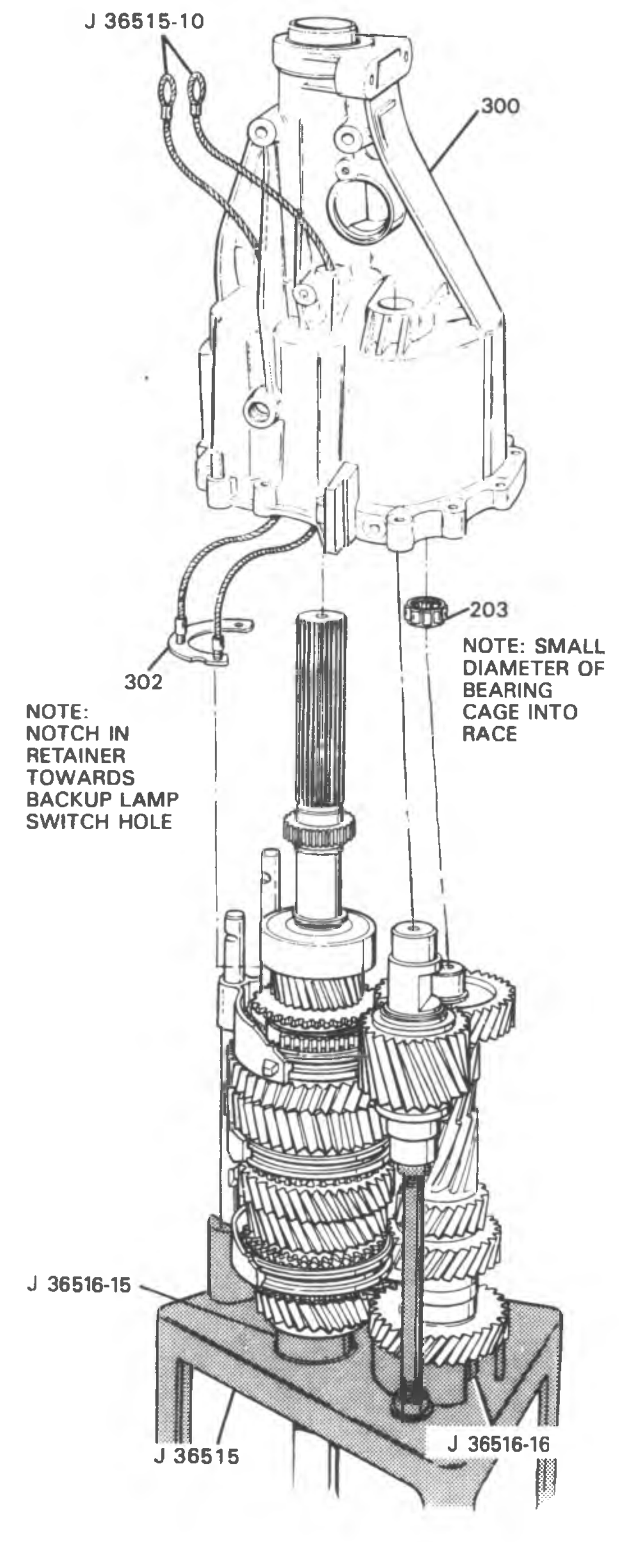
Important

   - 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.

14. 2WD Bolts (304) and (305) (Figure 65).
   - 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

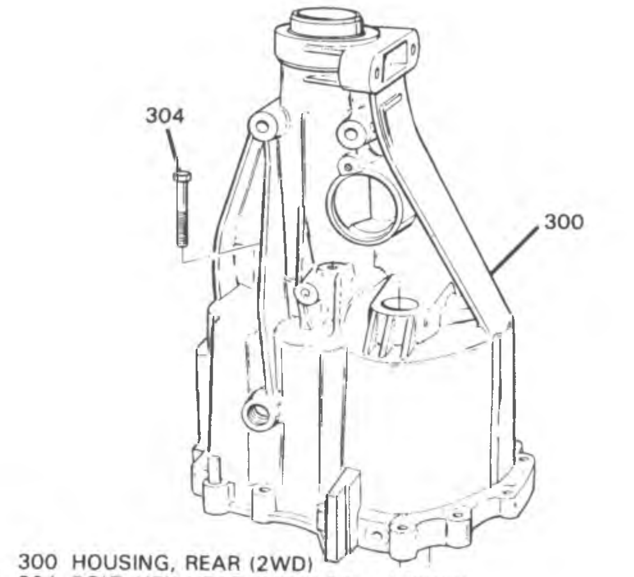
   - Bolts (304) and (305) to 22 N·m (17 lb. ft.).



203 BEARING, COUNTERSHAFT
300 HOUSING, REAR (2WD)
302 RETAINER, OUTPUT SHAFT BEARING (2WD)

MH0067-5LM60

Figure 64 2WD Rear Housing Installation



300 HOUSING, REAR (2WD)
304 BOLT, HEX HEAD (M8 X 50mm) (2WD)

LH0068-5LM60

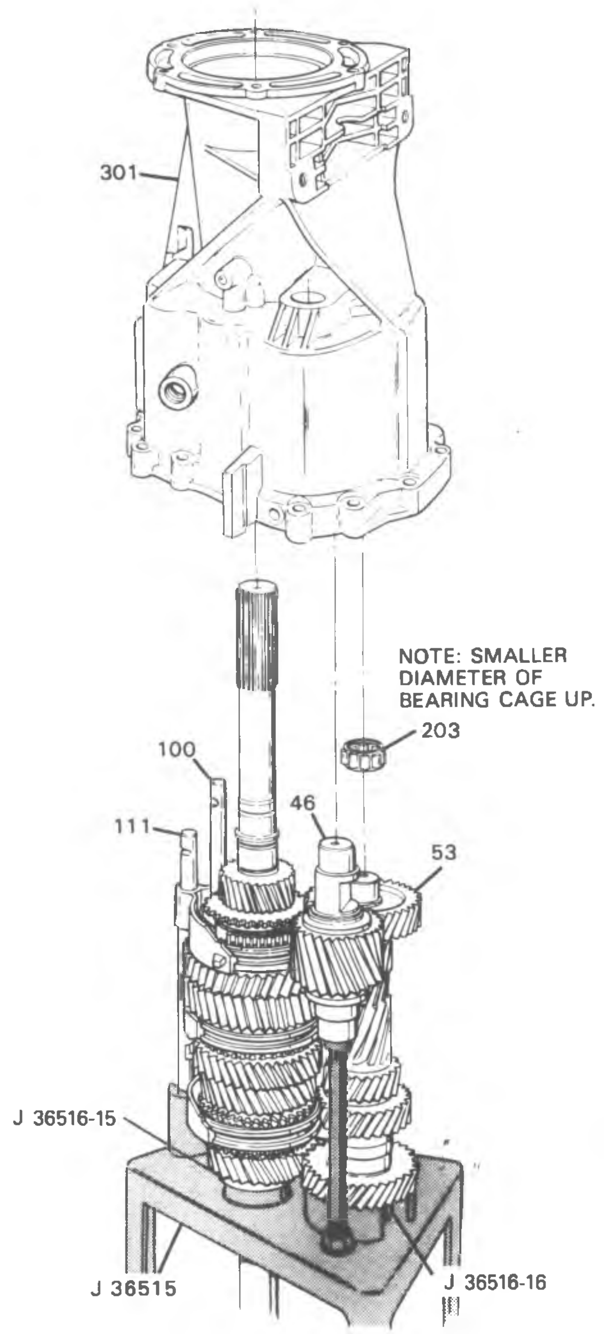
Figure 65 2WD Rear Bearing Retainer Bolts Installation

15. 4WD bearing (203) (Figure 69).
    - 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.
16. 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.

17. 4WD output shaft oil seal (320) using J 36502 (Figure 67).
    - Fill between the seal lip with chassis grease.
    - Remove seal protector J 36502-2A.



46 IDLER ASSEMBLY, REVERSE
53 COUNTERSHAFT ASSEMBLY, (MG5)
00 RAIL ASSEMBLY, 1ST & 2ND SHIFT
11 RAIL ASSEMBLY, 5TH & REVERSE SHIFT
203 BEARING, COUNTERSHAFT
301 HOUSING, REAR (4WD)

MH0069-5LM60

Figure 66 4WD Rear Housing Installation

Important

- The remaining assembly procedures apply to both 2WD and 4WD models.

Install or Connect

Figure 66

- Lay the unit down on the workbench and remove J 36515, J 36516-15 and J 36516-16.

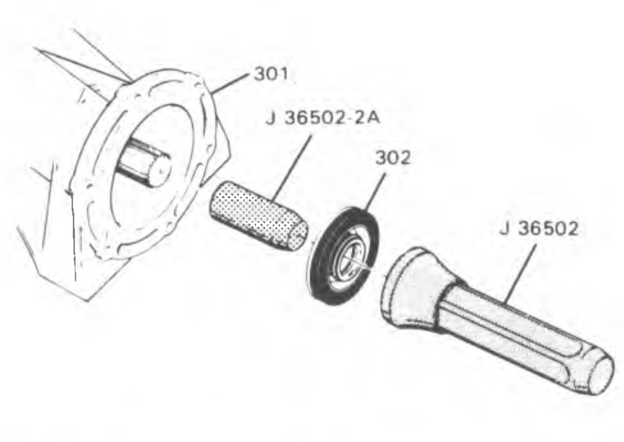
18. Idler shaft support (310), bolt (311).
    - Line up the bolt threads in the idler shaft support with bolt hole.
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the bolt hole.
    - Apply threadlocker GM P/N 1235382 or equivalent to the bolt threads.
    - Hold reverse idler shaft against idler support while torqueing.

    Tighten

    - Bolt (311) to 22 N·m (16 lb. ft.).

- J 8763-21 on J 8763-02.

19. J 36824 onto the transmission case.
    - J 8763-02 onto J 36824.
20. Two interlock balls (323) (Figure 69).
    - 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.



301 HOUSING, REAR (4WD)
320 SEAL, OUTPUT SHAFT OIL (4WD)

LH0070-5LM60

Figure 67 4WD Oil Seal Installation

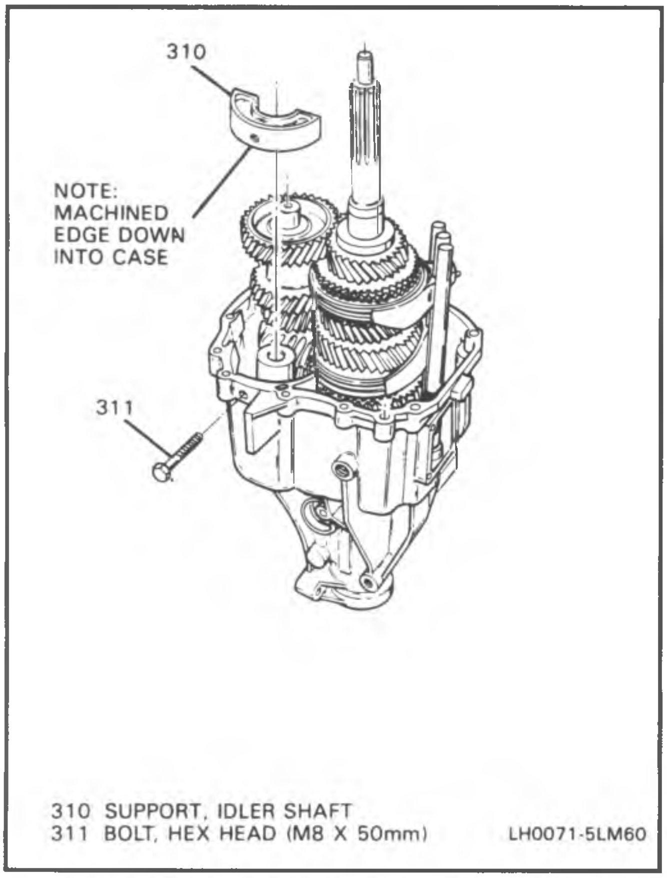


Figure 68 Reverse Idler Support Installation

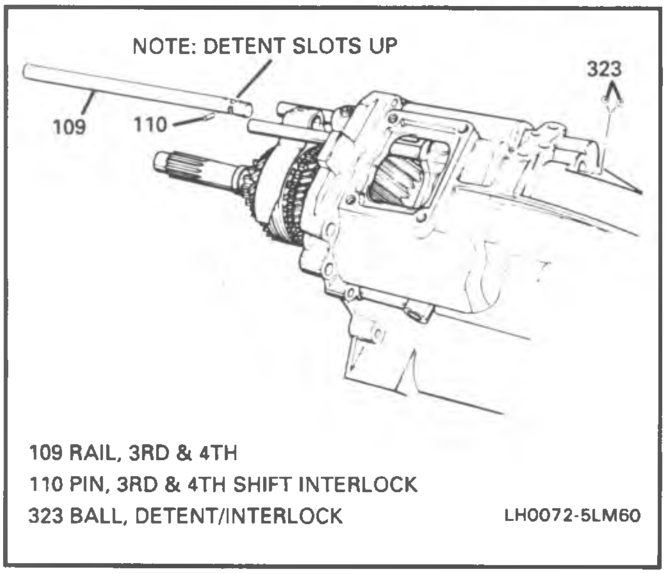


Figure 69 Interlock Balls and 3-4 Shift Rail Installation

21. 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.

22. Roll pin (107) (36 mm) (Figure 70).
    - 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 20 through 21.

23. NEW plug (326).
    - Apply gasket maker GM P/N 1052943 or equivalent to the edge of the plug.
    - Install flush.

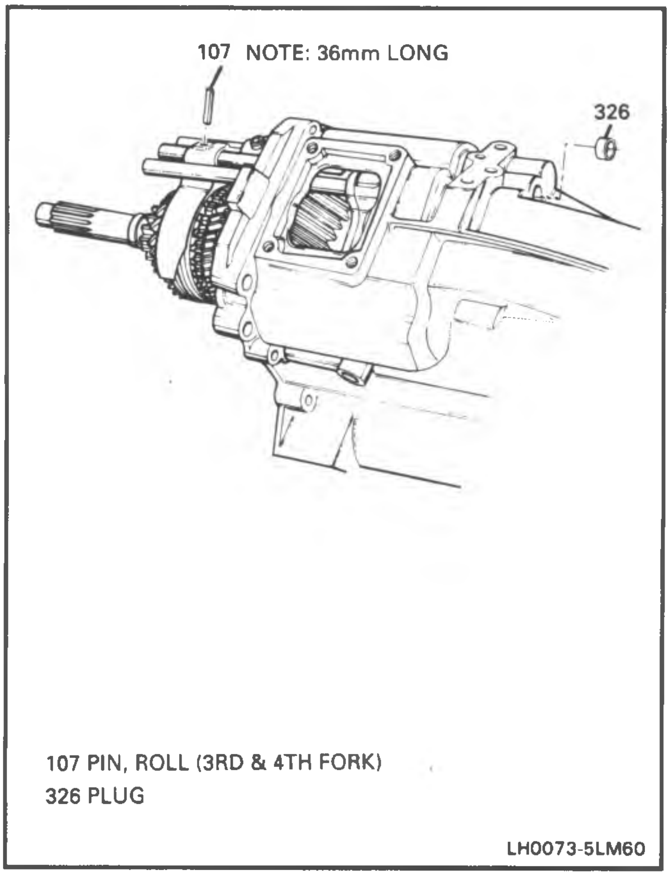


Figure 70 3-4 Fork Roll Pin and Plug Installation

24. Shift shaft (116), finger (121) and shift shaft socket assembly (123) (Figure 72).
    - Detent slots towards idler support side of transmission.
    - Finger extension must be on the underside of the 5-reverse shift rail.

Important

- Use a new shift shaft socket assembly (123) or stake the socket as shown in Figure 69. 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.

25. Roll pin (120) (28 mm) and roll pin (122) (33 mm).
26. Three detent balls (323) and three springs (324) (Figure 73).
27. Detent spring cover (325) and two bolts (236).

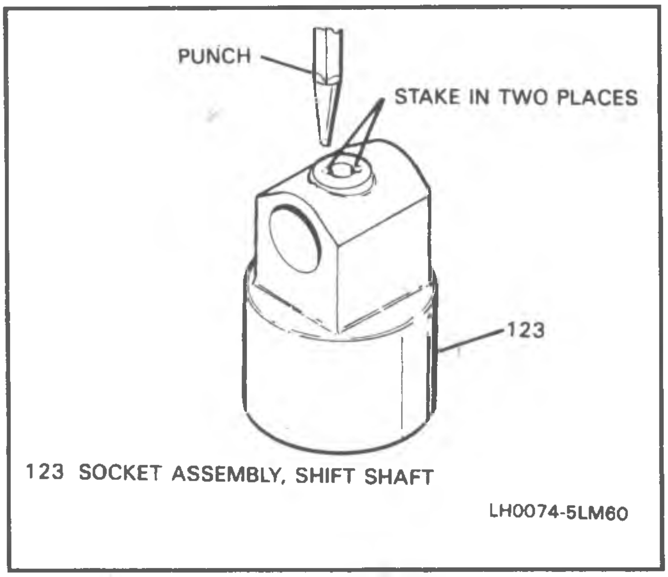


Figure 71 Staking Shift Shaft Socket Assembly

- 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.).

28. Four rollers (118) (Figure 74).
    - Retain with TRANSJEL™ J 36850 or equivalent.
29. Countershaft bearing (203) (Figure 75).
    - 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.

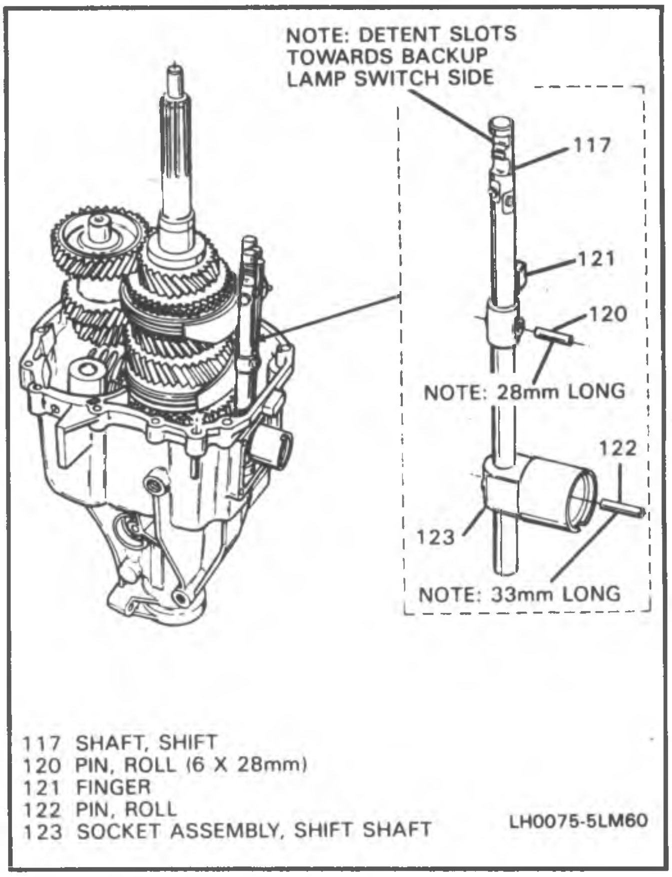


Figure 72 Shift Shaft Installation

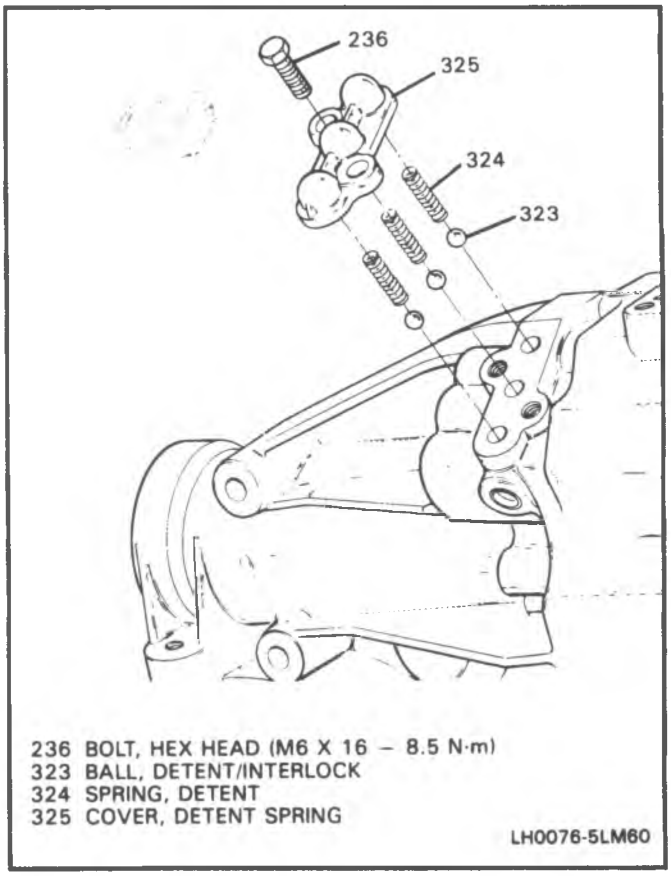


Figure 73 Detent Components Installation

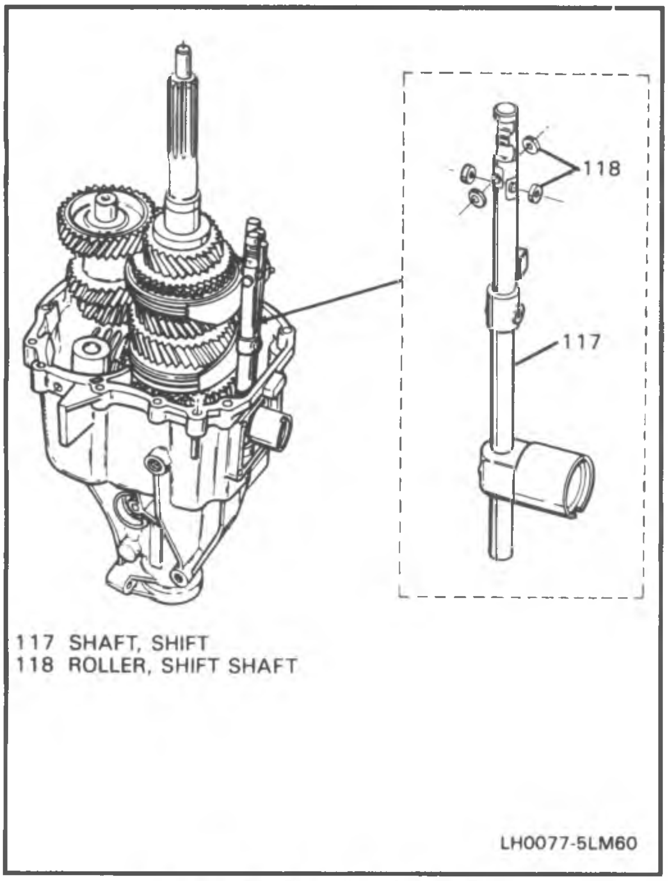


Figure 74 Rollers Installation

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.
33. NEW snap ring (210) (Figure 76).
    - 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.

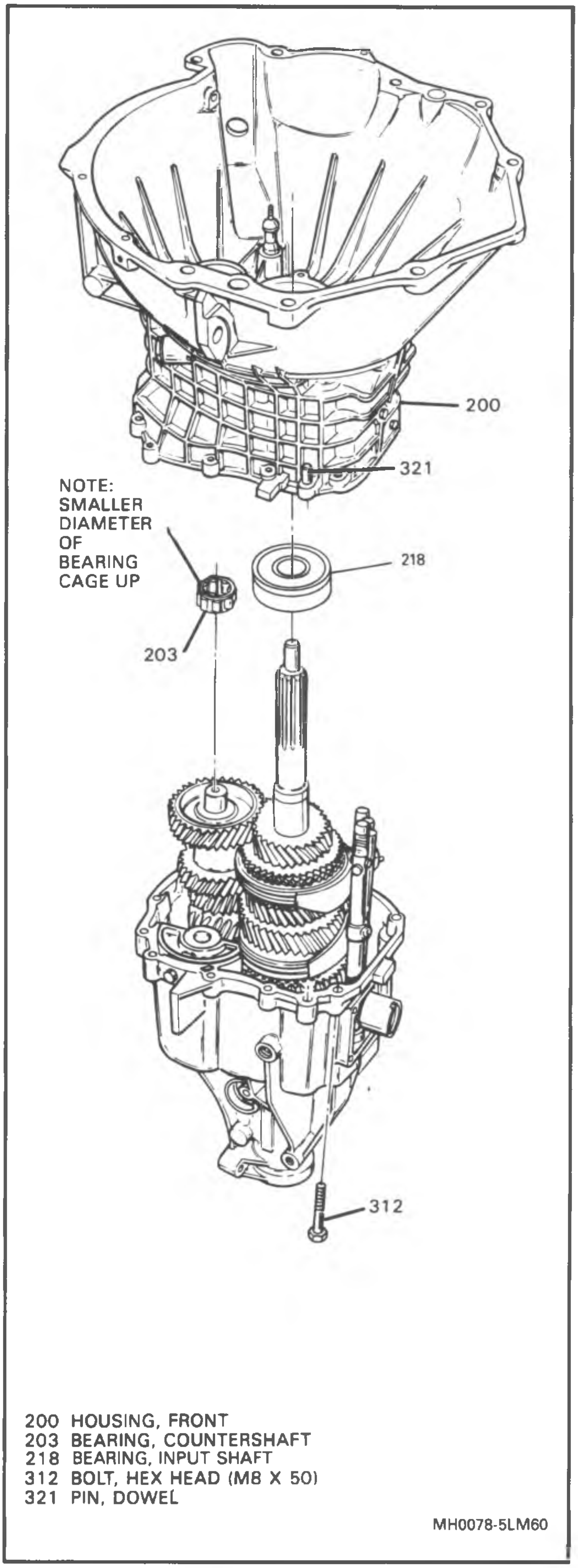


Figure 75 Front Housing Installation

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.)

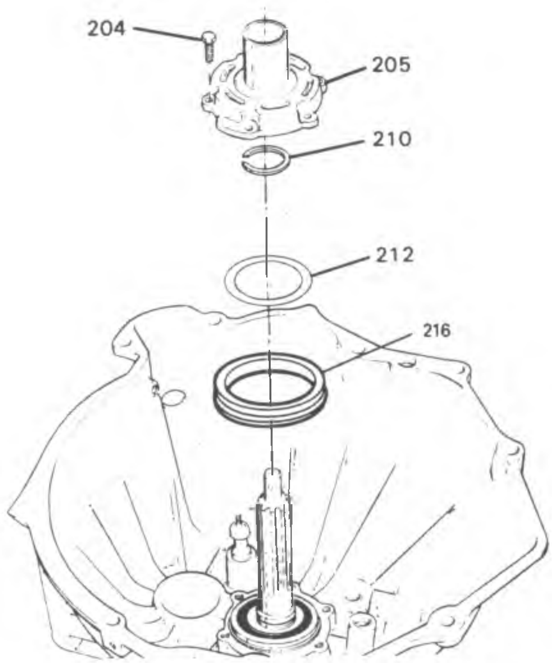
36. Shift shaft detent plunger (243), shift shaft detent spring (244) and plug (245) using brass drift (Figure 77).
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the plug.

- Install new O-ring (315) onto electronic speed sensor assembly (316) (2WD models only).
    - Coat the O-ring with a thin film of transmission fluid.

37. Electronic speed sensor assembly (316) and bolt (317).
    - 2WD models only.
    - Bolt (317) to 9 N·m (80 lb. in.)

38. Backup lamp switch assembly (313).
    - Apply pipe sealant with Teflon™ GM P/N 1052080 or equivalent to the threads.
    - Switch (313) to 9 N·m (80 lb. in.).

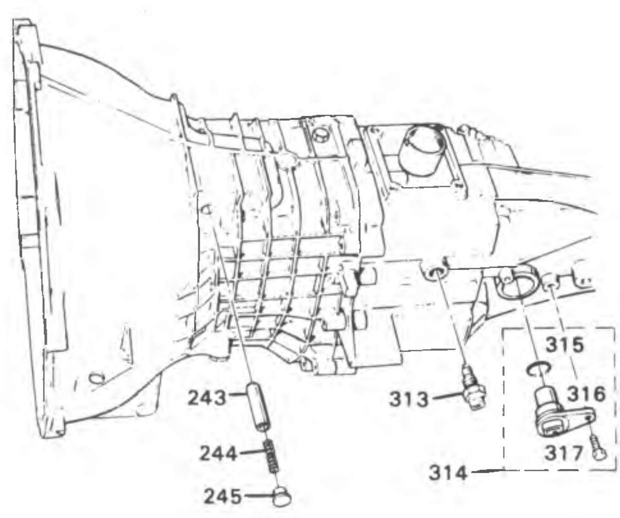
39. Remove J 8763-02 and J 36824.
    - Bolts (312) (Figure 76) to 35 N·m (26 lb. ft.).



204 BOLT, HEX HEAD (M6 X 25 – 8.5 N·m)
205 RETAINER ASSEMBLY, INPUT SHAFT BEARING
210 RING, SNAP (SELECTIVE)
212 SHIM, (SELECTIVE)
216 SPACER

MH0006-5LM60

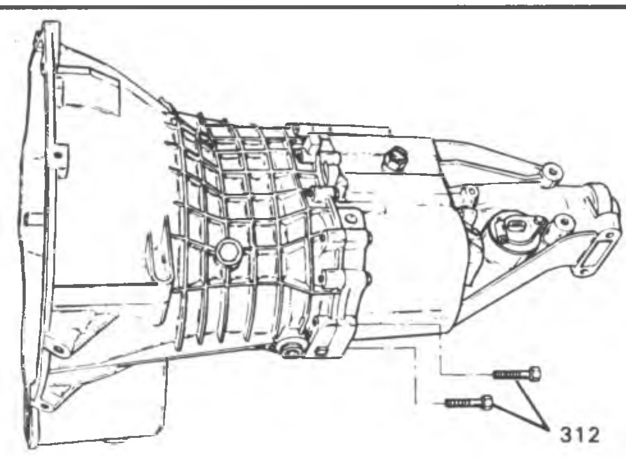
Figure 76 Install Input Shaft Bearing Retainer Assembly



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 77 External Components Installation



312 BOLT, HEX HEAD (M8 X 50 – 35 N·m

LH0081-5LM60

Figure 78 Bolts Installation

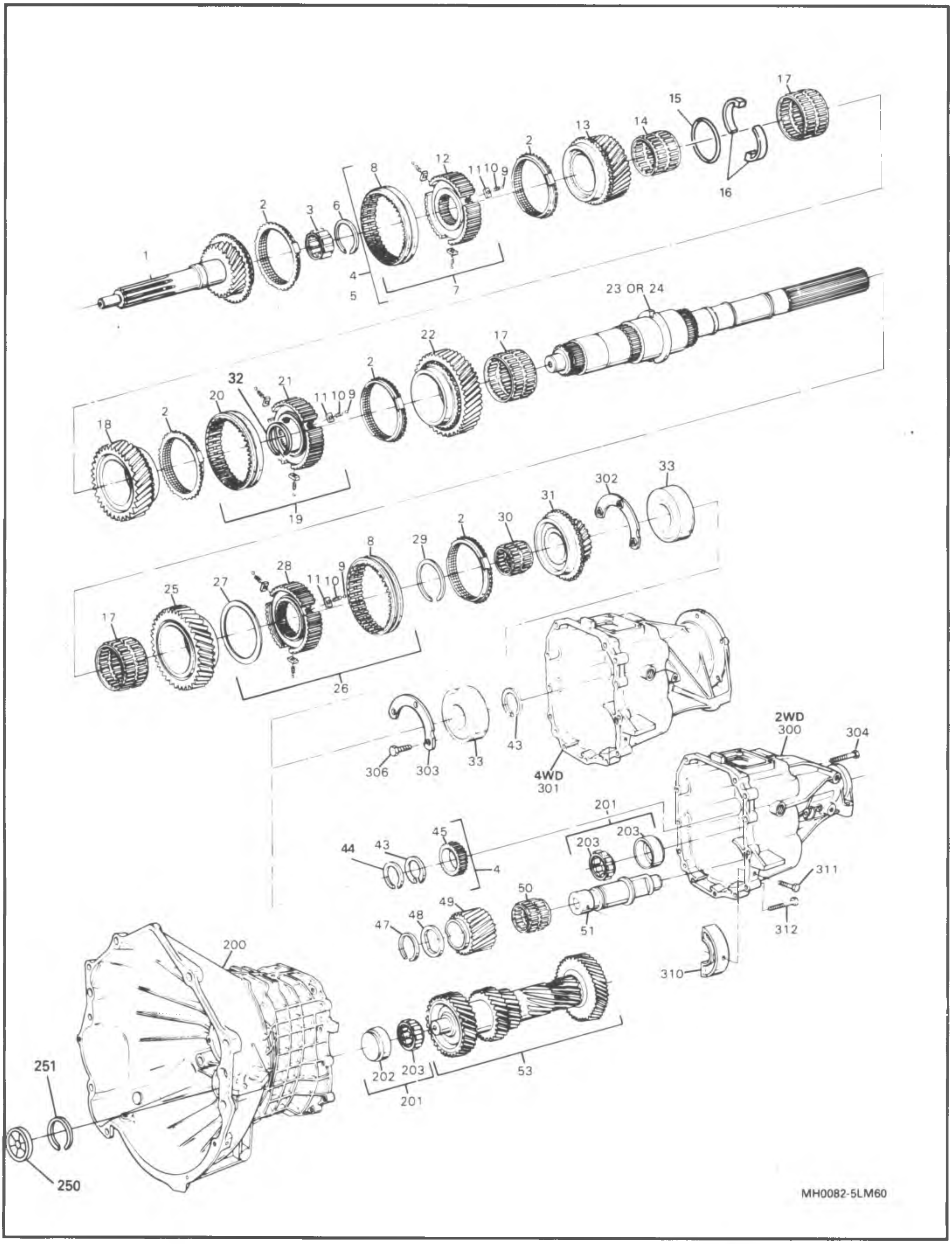


Figure 79 Transmission Gear Components

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 RETAINER RING
16 THRUST WASHER 2-PIECE
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
32 SNAP RING
33 BEARING ASSEMBLY, OUTPUT SHAFT
43 RING, SNAP
44 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)

MH0083-5LM60

Figure 80 Transmission — Gear Components Legend

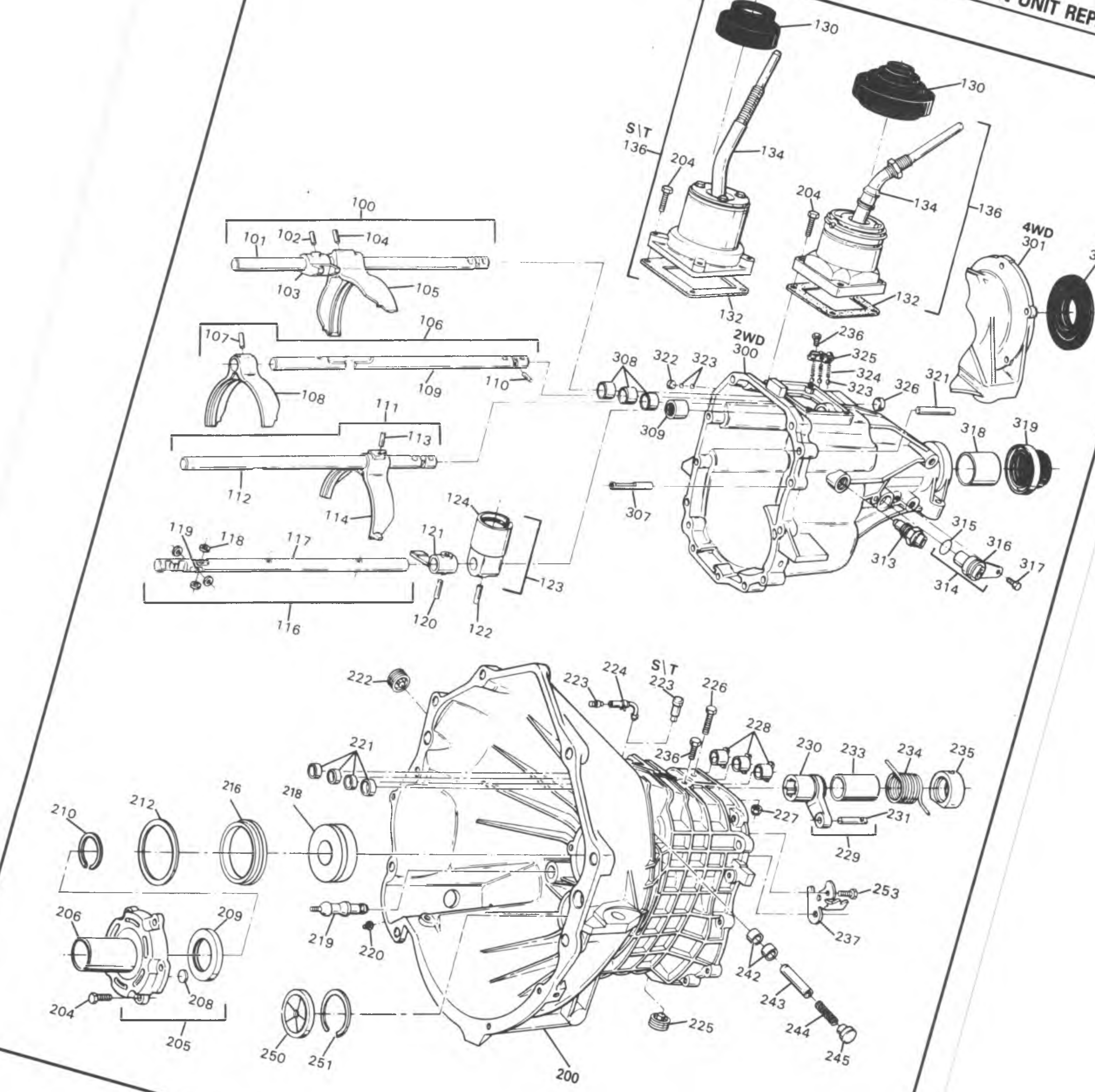


Figure 81 Transmission Shift Mechanism and Case Components

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)
212 SHIM, (SELECTIVE)
213 RING, INPUT SHAFT BEARING ASSEMBLY SNAP
215 RACE, BALL BEARING (OUTER)
216 SPACER
218 BEARING ASSEMBLY, INPUT SHAFT
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 BUSHING, 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
253 BOLT, PAN HEAD (M6 X 18mm)
300 HOUSING, REAR (2WD)
301 HOUSING, REAR (4WD)
307 TUBE ASSEMBLY, OIL DELIVERY
308 BUSHING, 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 BUSHING, 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

MH0085-5LM60

Figure 82 Transmission Shift Mechanism and Case Components Legend

SPECIFICATIONS

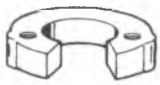
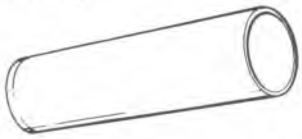
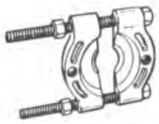
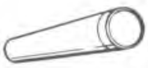
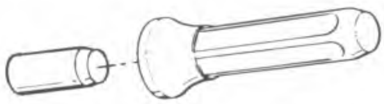
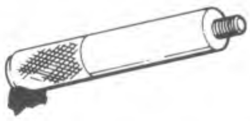
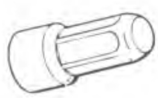
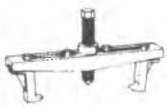
FASTENER TORQUE SPECIFICATIONS

Retainer Assembly, Input Bearing Bolts .... 8.5 N·m (75 lb. in.)
Plug, Oil Fill .... 60 N·m (46 lb. ft.)
Plug, Oil Drain .... 60 N·m (46 lb. ft.)
5th & Reverse Rail Deflection Bolt .... 35 N·m (27 lb. ft.)
Seat, Bias Spring and Sleeve Bolt .... 8.5 N·m (75 lb. in.)
Spring, 5th & Reverse Detent Hex Head Plug .... 60 N·m (46 lb. ft.)
Retainer, Output Shaft Bearing Bolts .... 22 N·m (17 lb. ft.)
Support, Idler Shaft Bolt .... 22 N·m (17 lb. ft.)
Housing Front/Rear .... 35 N·m (27 lb. ft.)
Sensor, Electronic Speed Bolt .... 9 N·m (80 lb. in.)
Housing Assembly, Shift Lever .... 8.5 N·m (75 lb. in.)

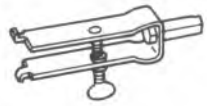
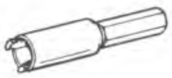
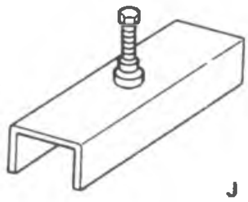
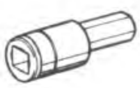
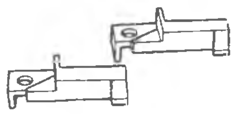
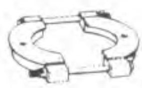
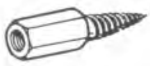
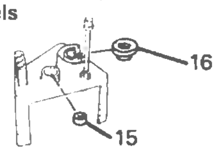
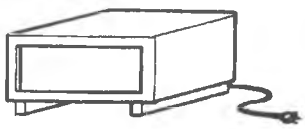
LUBRICATION

Capacity .... 1.98L (2.08 qts)
Type Recommended:
Manual Transmission Fluid 5W-30 .... GM P/N 1052931

SPECIAL TOOLS

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**
		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**  MH0087-5LM60

SPECIAL TOOLS (CONT.)

Shift Shaft Detent Bushing Remover/Installer  J 36507	Shift Rail Bushing Installing and Stacking Tool  J 36798	Bearing Cup Remover  J 35280
Shift Shaft Detent Plug Remover  J 36509	Bearing Cup Puller Bridge  J 38961	Countershaft Race Installer  J 38884
Clutch Fork Pivot Remover/Installer  J 36510	Shift Rail Bushing Remover  J 36800	
Oil Fill/Drain Plug Hex Bit (17 mm)  J 36511	Transmission Holding Adapters  J 36824	
Gear and Bearing Separator Plate  J 36513	4WD Output Shaft Oil Seal Remover  J 36825	
Assembly Pallet With Counter Shaft and Input Shaft Adapters for 1991 Models  J36515, J36515-15, J36515-16	Oven 	
2WD Output Shaft Bearing Retainer Alignment Cables  J 36515-10		

MH0088-5LM60

SECTION 7B2

NEW VENTURE GEAR-117 MANUAL TRANSMISSION UNIT REPAIR

RPO M20

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

UNIT DISASSEMBLY

Figures 1 through 7

Tools Required:

J 28509-A Countergear Front Bearing Remover

J 8433 Bearing Puller

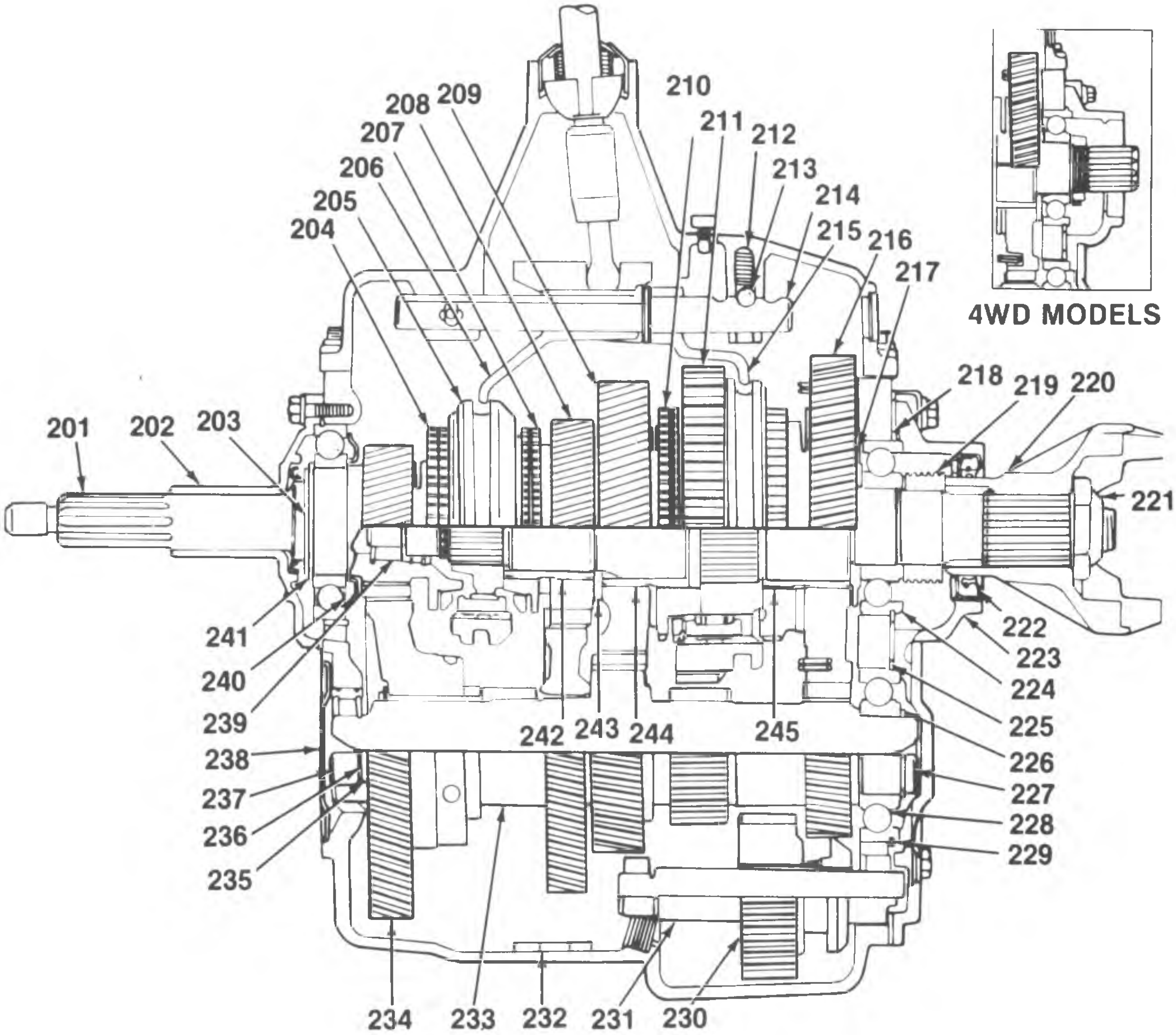
J 22832-01 Countergear and Mainshaft Rear Bearing Remover

J 35907 Mainshaft Lock Nut Wrench (4WD models only)

Remove or Disconnect

Figures 1 through 3

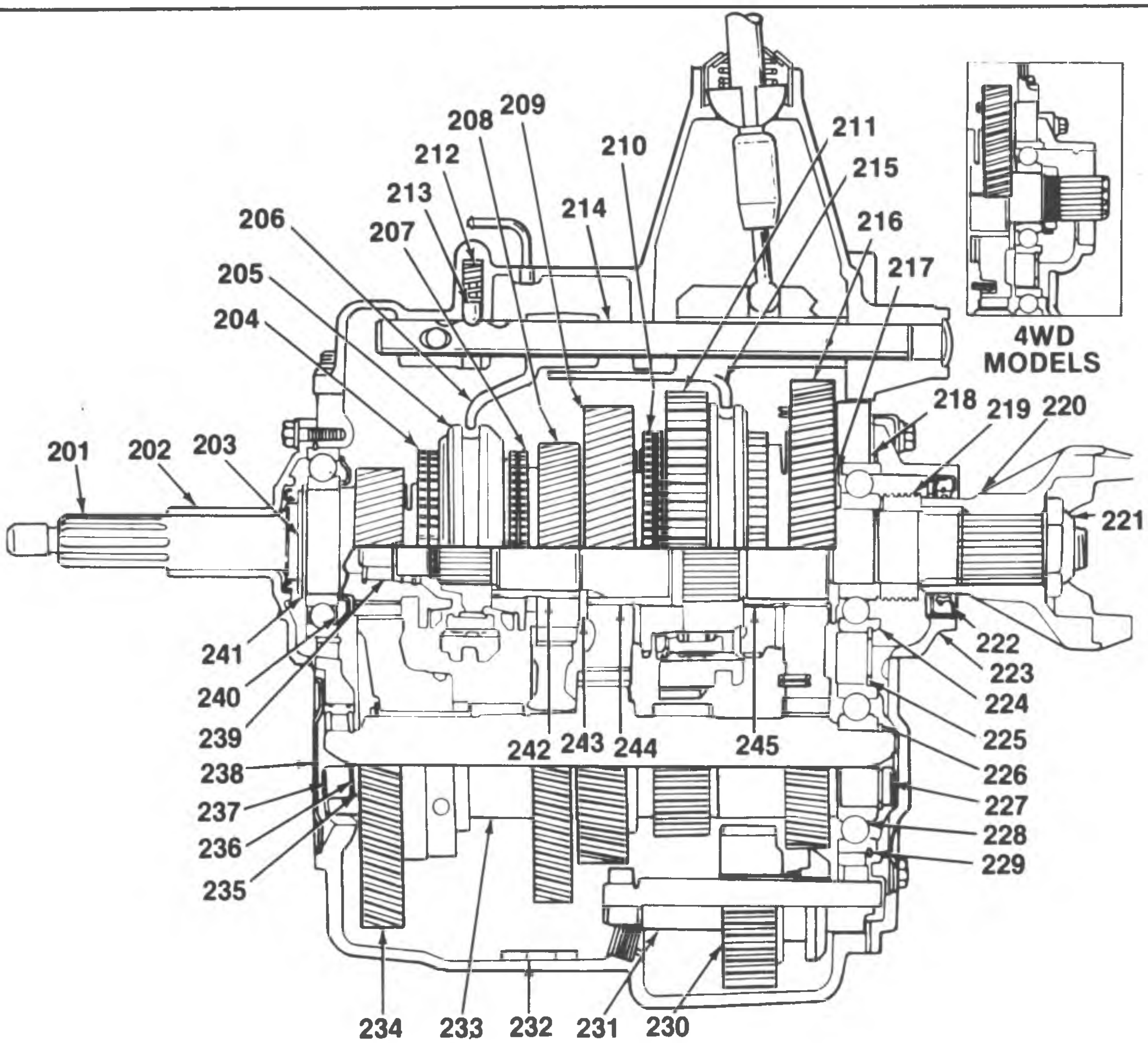
1. Speedometer driven gear, switches and any external components.
2. Shifter housing.
   - Bolts
   - Move the reverse shift fork to partially engage the reverse idler gear.
   - Lift off the housing.
3. Flange nut (221).
   - Lock up transmission in two gears before removing nut.
4. Brake drum and the flange, or the yoke (220).
5. Parking brake assembly as applicable.
   - Mainshaft lock nut (256) and the washer using J 35907 (4WD models only).
6. Rear bearing retainer (223) and the gasket.
7. Speedometer gear (219).
8. Front bearing retainer (202) and the gasket.
9. Cover (238) and the gasket.
10. Bearing (237), using J 28509-A (Figure 4).
11. Snap rings (225 and 226).
12. Bearing (228), using J 22832-01 and J 8433, (Figure 5).
    - J 22832-01 must be seated in the groove completely.
13. 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 6).
    - Pull the drive gear from the case.
14. 4th speed blocker ring (204).
15. Bearing snap ring (218).
16. Bearing (224), using J 22832-01 and J 8433, (Figure 7).
    - 1st speed thrust washer.
17. Mainshaft (250) from the case.
18. Countershaft (227) from the case.
19. 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

MH0001-117

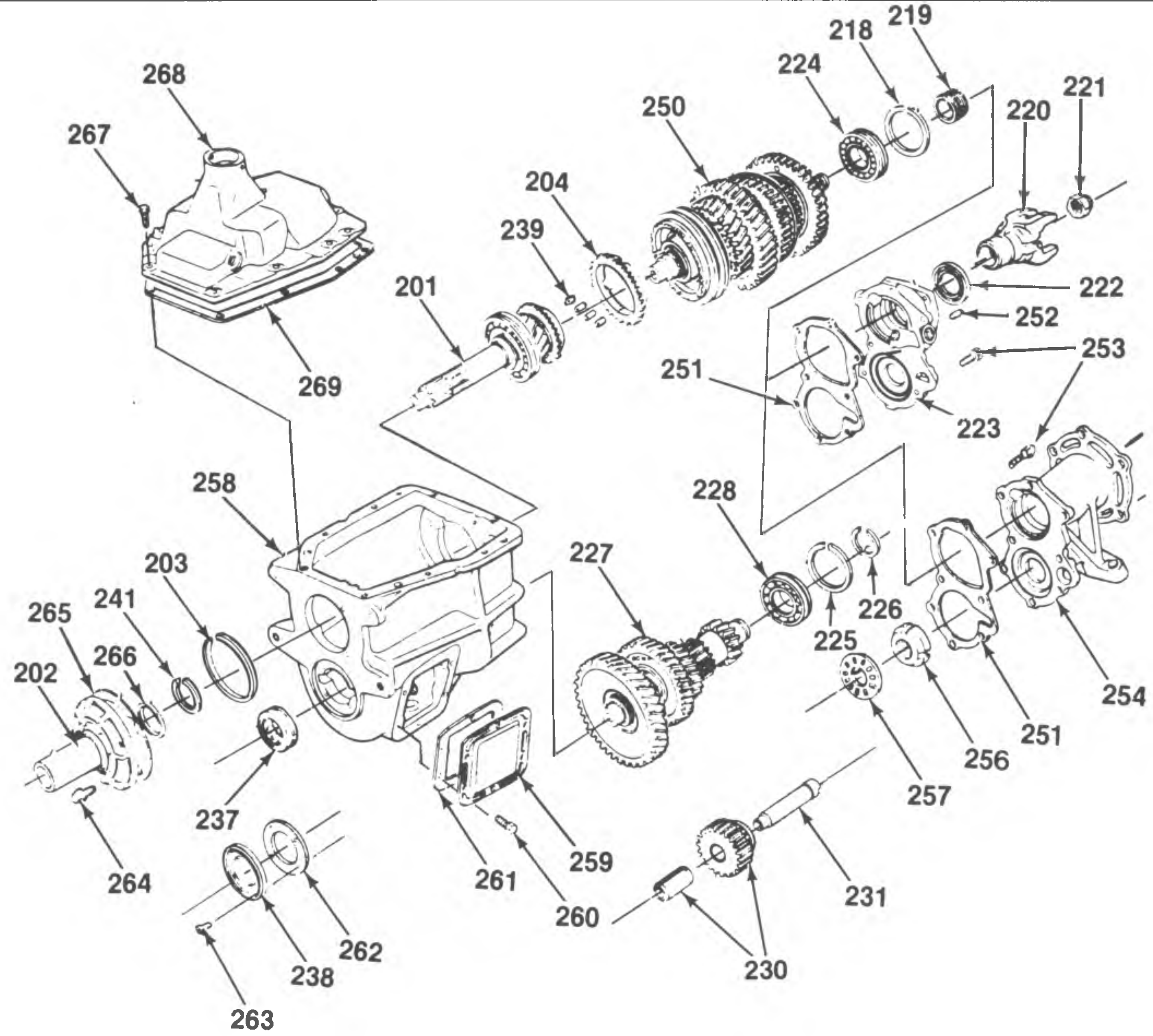
Figure 1 R/V/P Four Speed Transmission



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 2 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 3 Transmission Components

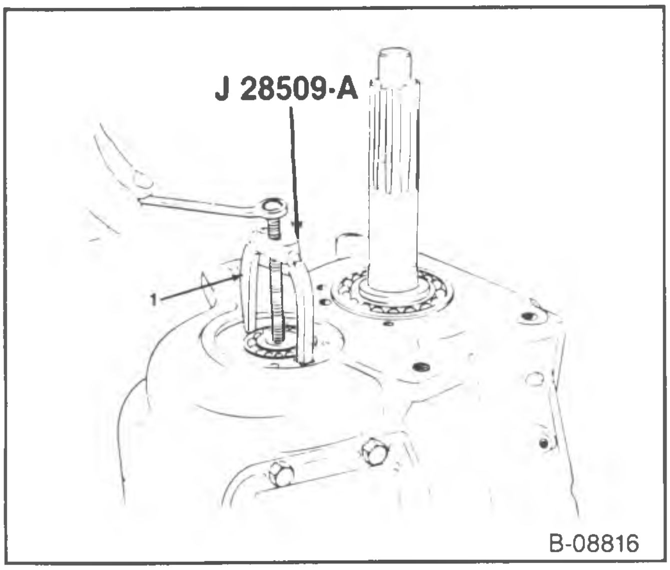


Figure 4 Removing the Countergear Front Bearing

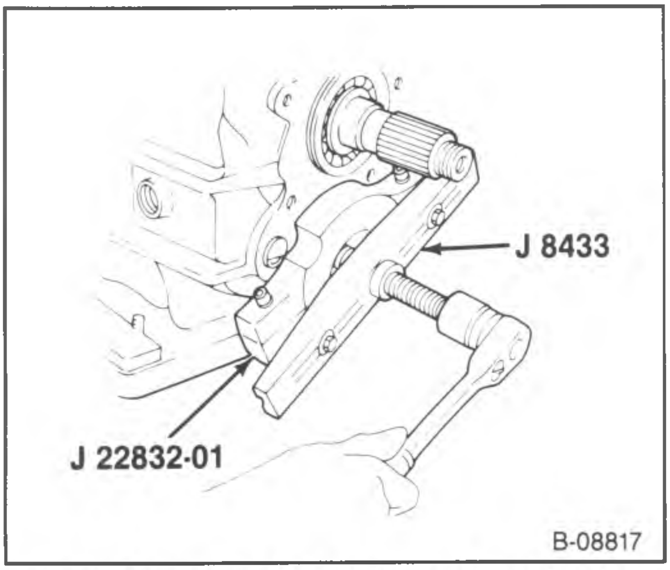


Figure 5 Removing the Countergear Rear Bearing

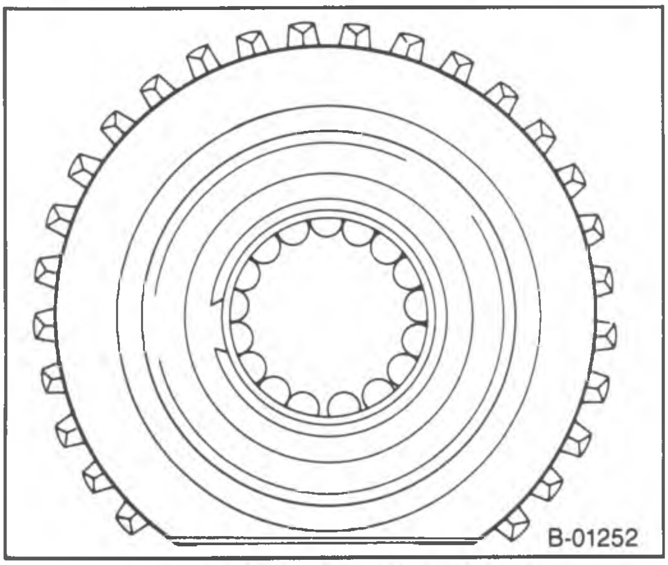


Figure 6 Main Drive Gear Cutout

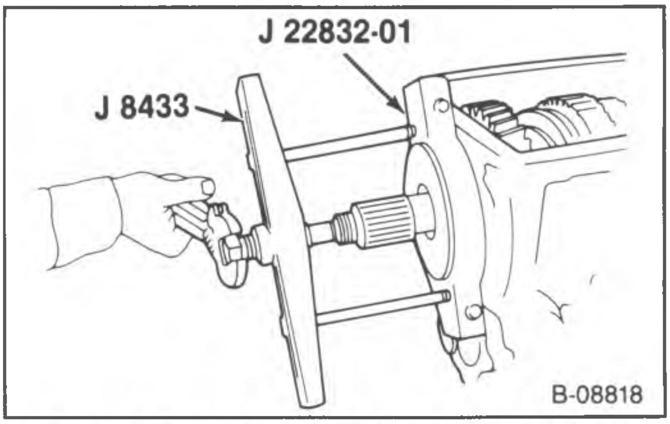


Figure 7 Removing the Mainshaft Rear Bearing

UNIT SUB ASSEMBLY REPAIR AND INSPECTION

MAIN DRIVE GEAR

Figures 8 through 11

Tools Required:
J 358-1 Bearing Remover Holder
J 22872 Drive Gear Bearing Remover

Disassemble

Figure 8

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 9 and 10)
5. Slinger (240).

Clean

- All parts in a suitable solvent.

Important
- Do not spin dry the bearings.

Inspect

- Parts for damage and wear.
- Oil the bearings and check for roughness.

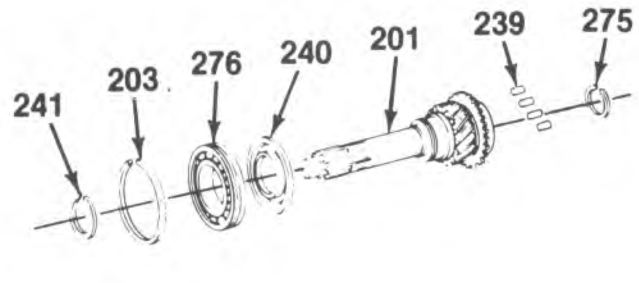
Assemble

Figures 8 and 11

1. New slinger (240).

Important
- The concave side goes toward the gear.
- Do not damage or bend the slinger when installing the bearing.

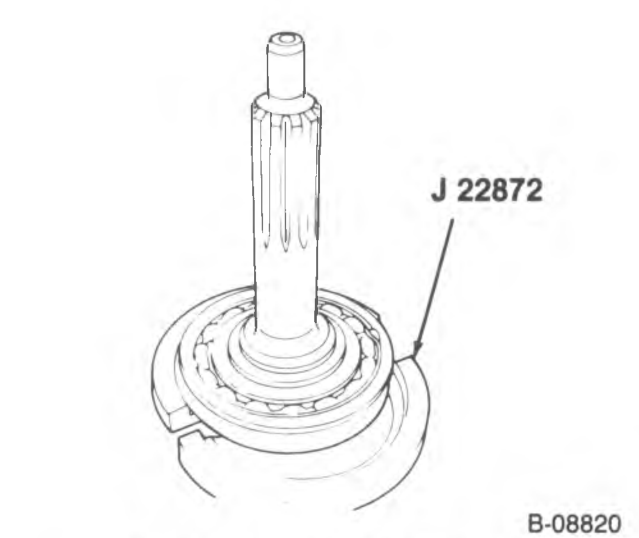
2. Bearing (277), using J 358-1 and J 22872, (Figures 9 and 10).
   - The bearing snap ring groove goes away from the gear.
3. New bearing to shaft (small) snap ring (241).
4. New bearing to case (large) snap ring (203).
5. Pilot bearings (239).
   - Use chassis grease to hold the bearings in place.



201. Main Drive Gear
203. Snap Ring - Bearing to Case
239. Pilot Bearings
240. Slinger
241. Snap Ring - Bearing to Shaft
275. Snap Ring
276. Main Drive Gear Bearing

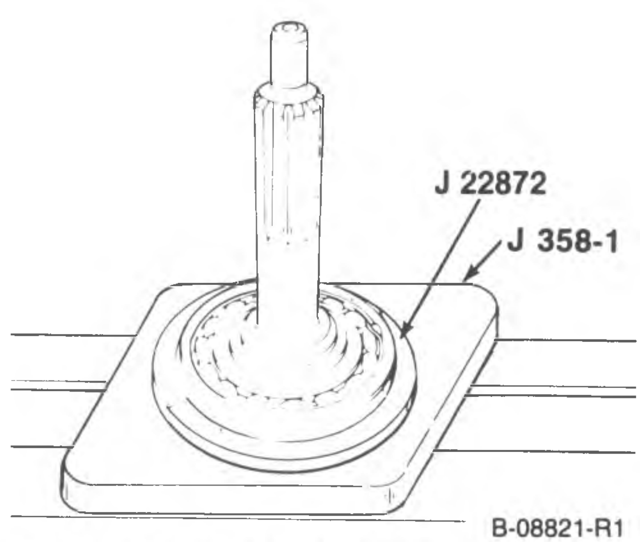
F-08819

Figure 8 Main Drive Gear Components



B-08820

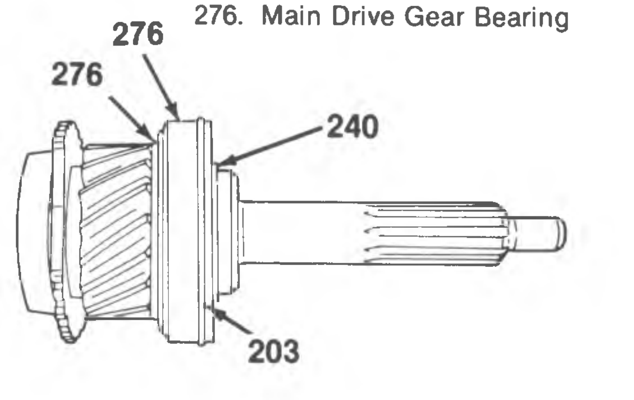
Figure 9 Installing Tool J-22872



B-08821-R1

Figure 10 Removing the Main Drive Gear Bearing

203. Snap Ring - Bearing to Case
240. Oil Slinger
241. Snap Ring - Bearing to Shaft
276. Main Drive Gear Bearing



B-08822

Figure 11 Main Drive Gear Assembly

MAINSHAFT

Figures 12 through 22

Tools Required:

J 22873 Mainshaft Bushing Installer

J 22875 3rd Gear Assembly Tool

Disassemble

Figure 12

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), and 2nd speed gear (209), the bushing, and the thrust washer (243).
   - Support the second speed gear and press the mainshaft out (Figure 13).

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).
   - Support the hub on J 8176 and press the mainshaft out, (Figure 14).

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 15).
   - 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

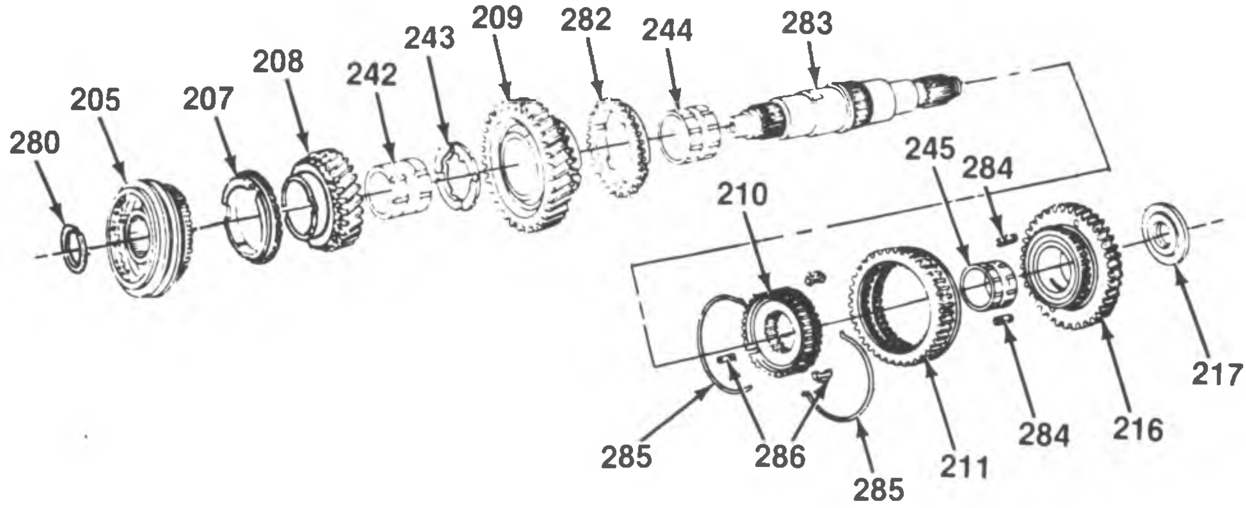
- Gears for cracks, chipped gear teeth, and other damage that could cause gear noise.
- Thrust washers and bushings for damage and wear.
- Related surfaces on the gears like thrust faces and bearing surface diameters.
- The reverse sliding gear for a sliding fit on the synchronizer hub without excess 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.
- Synchronizer sleeves for a sliding fit on the synchronizer hubs and for the hubs a snug fit on the mainshaft splines.
- Synchronizer springs and keys for looseness and damage.
- Brass synchronizer rings for excess wear and damage.
- All gear teeth for excess wear.
- Bearings and bearing surfaces for nicks, burrs and wear.
- Lubricate all roller bearings with light engine oil and check for rough rotation.

Assemble

Figure 12

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 16).
   - 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 17).
3. 1-2 synchronizer hub (210), (Figure 18).
   - 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 19).
6. 2nd speed blocker ring, the 2nd speed gear (209) and the 3rd speed thrust washer (243) (Figure 20).
   - The tab on the thrust washer must be in the slot in the mainshaft.
7. 3rd speed bushing (242) using J 22875 (Figure 20).
8. 3rd speed gear (208) and the blocker ring (Figure 21).
9. 3-4 synchronizer (205) using J 22873 (Figure 21).
   - 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 22).
11. Reverse gear (211).
    - The shift fork groove goes to the rear of the mainshaft.
12. 1st speed gear (216).
13. Thrust washer (217).



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 12 Mainshaft Components

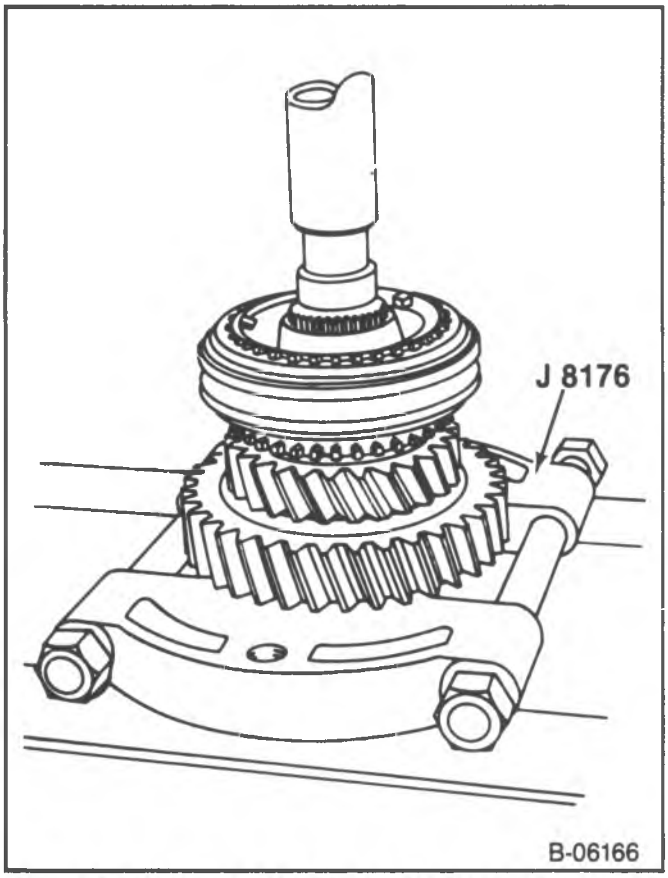


Figure 13 Removing the Mainshaft from the 2nd and 3rd Speed Gears

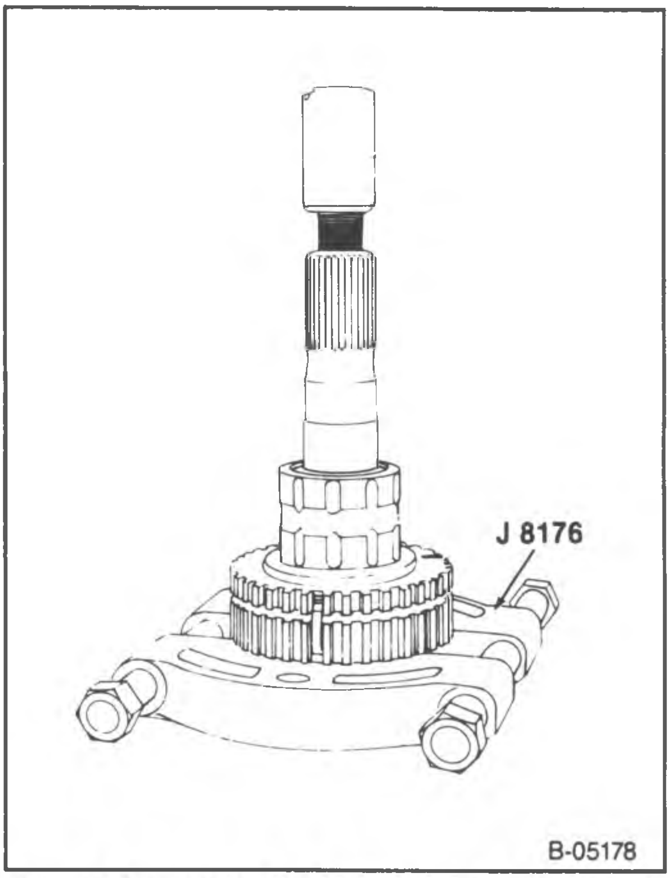


Figure 14 Removing the Mainshaft from the 1st and 2nd Speed Synchronizer Hub

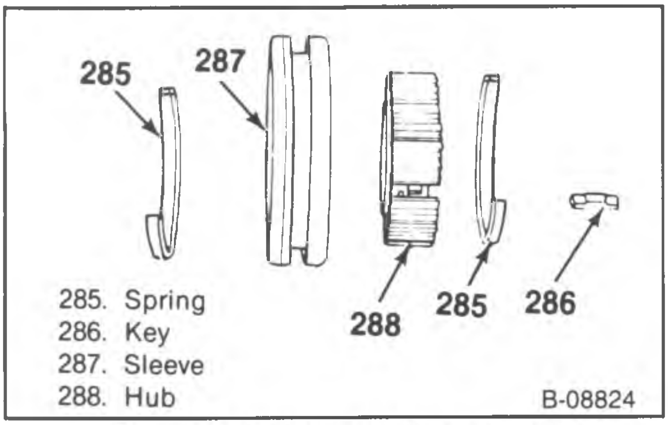


Figure 15 Synchronizer Components

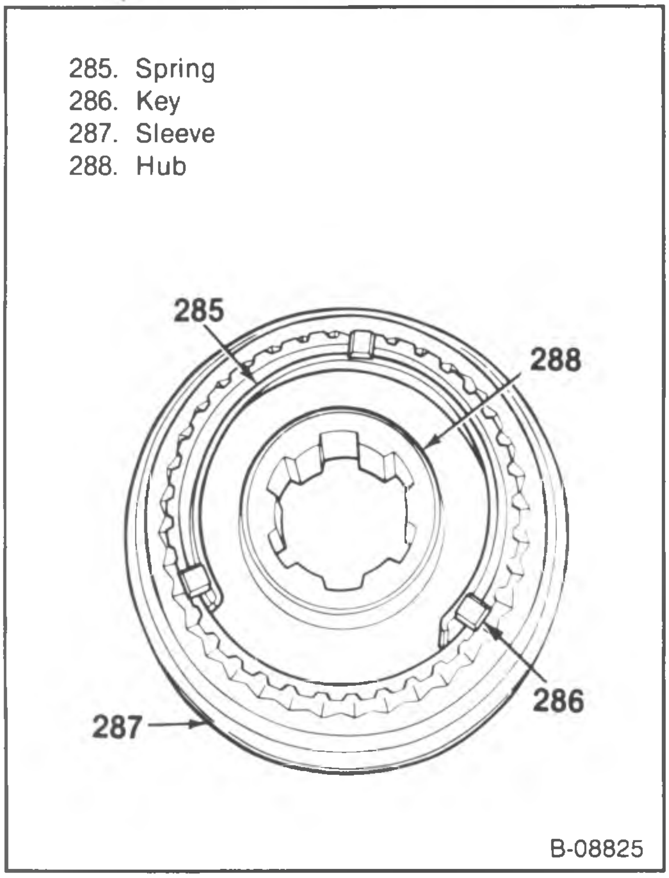


Figure 16 Synchronizer Assembled

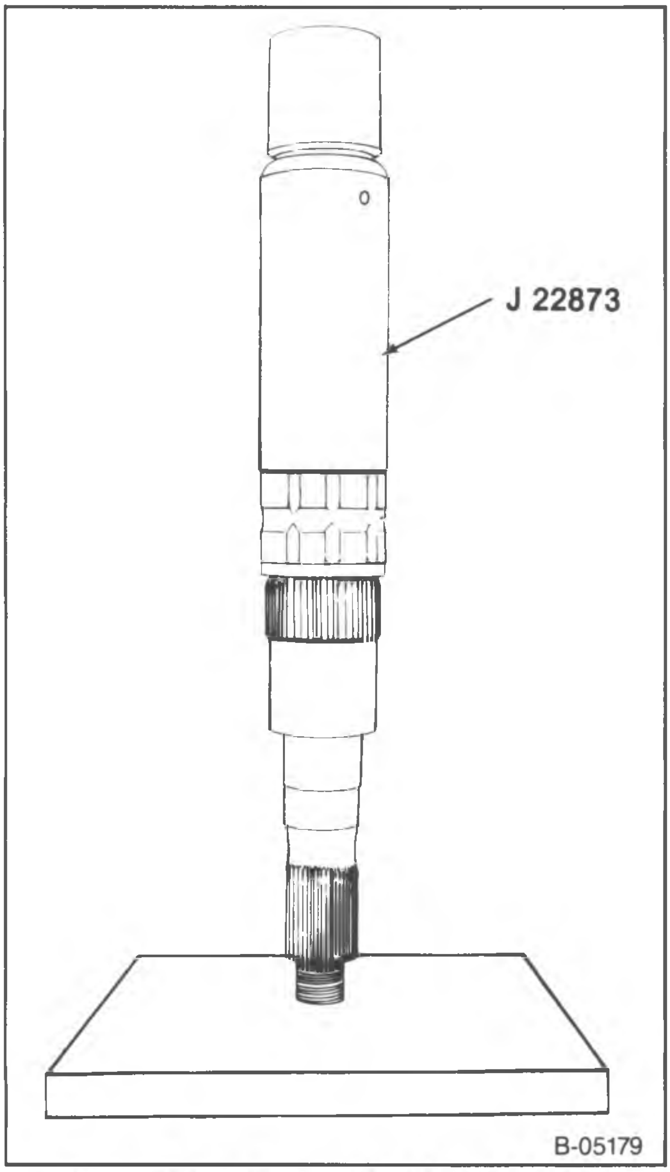


Figure 17 Installing and 2nd Speed Bushing

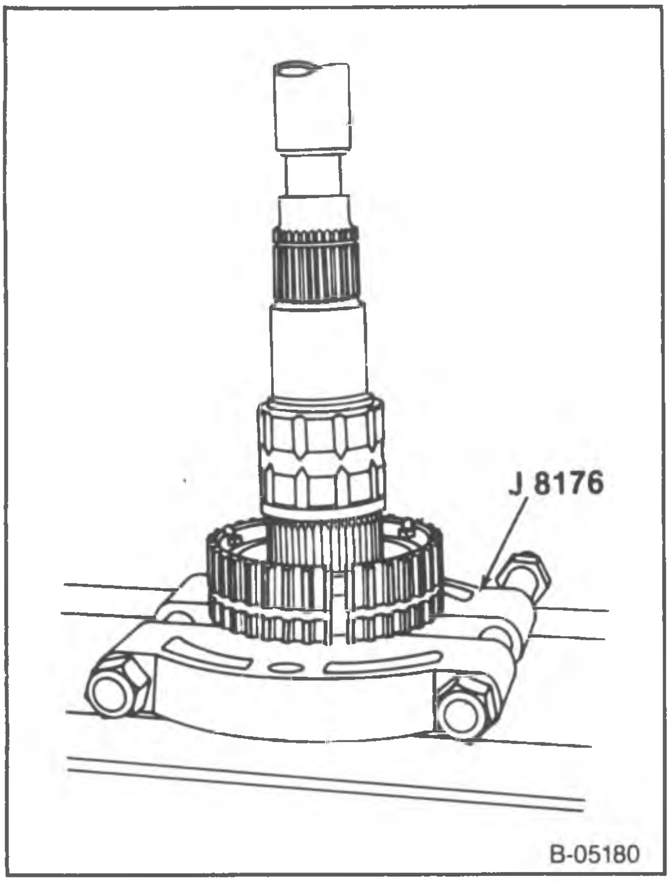


Figure 18 Installing the 1st and 2nd Synchronizer

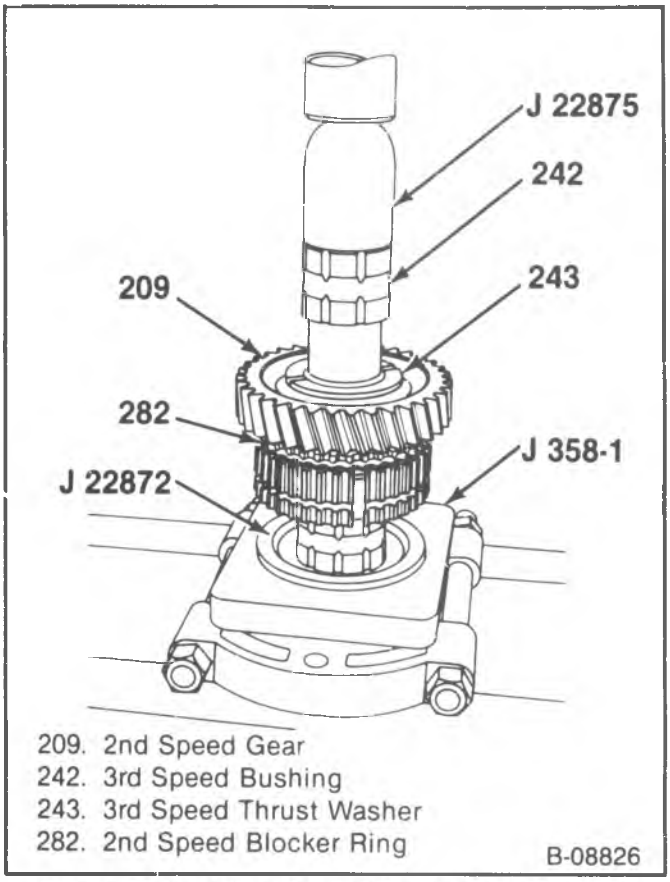


Figure 20 Installing the 3rd Speed Gear Bushing

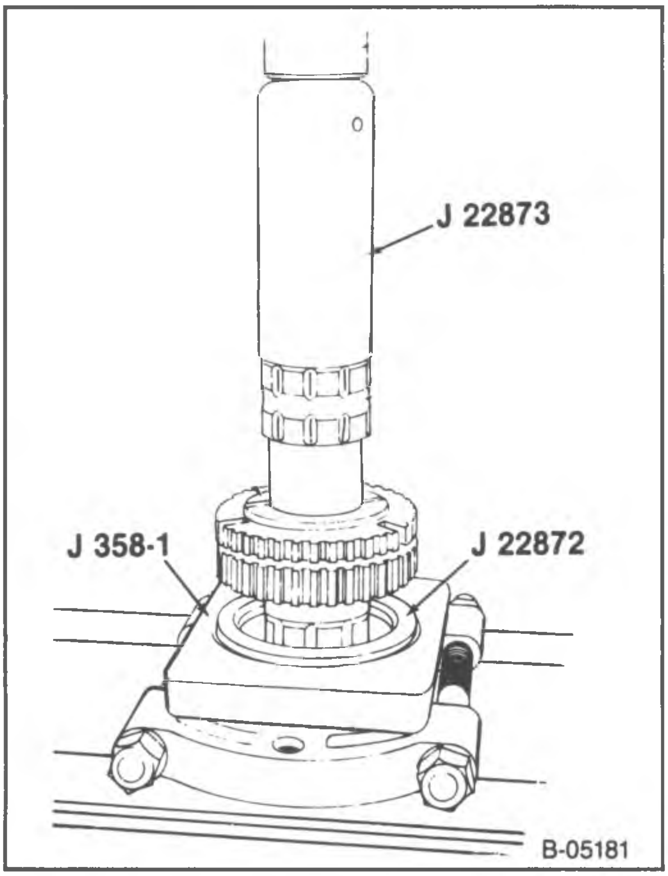


Figure 19 Installing the 1st Speed Gear Bushing

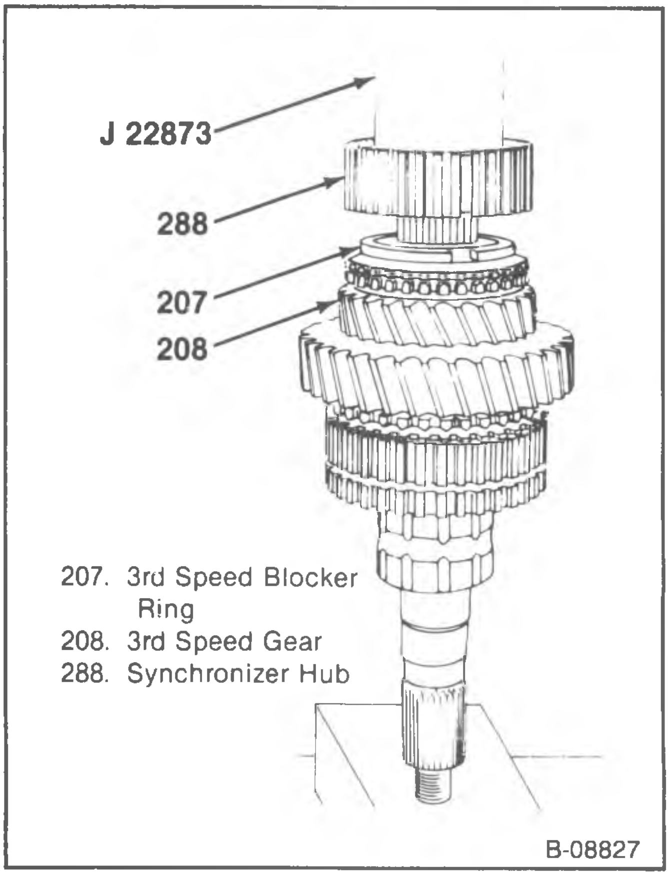


Figure 21 Installing the 3rd and 4th Speed Synchronizer Hub

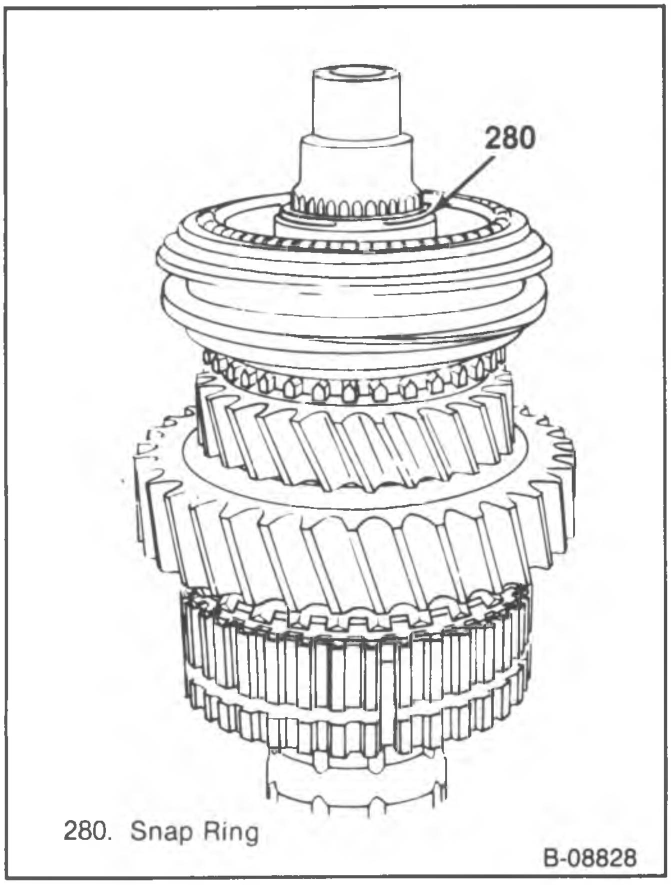


Figure 22 3rd and 4th Synchronizer Hub Snap Ring

COUNTERGEAR

Figures 23 through 28

Tools Required:

J 22832-01 Countergear and Mainshaft Rear Bearing Remover

J 22873 Mainshaft Bushing Installer

J 22830-A Snap Ring Installer

Disassemble

Figure 23

1. Snap ring and the thrust washer (235).
2. Driven gear (234).
   - Install J 22832-01 with the open side to the spacer (Figure 24).
   - Support the gear and press the countergear through (Figure 25).

   Important

   - Do not let the countergear fall to the floor.
3. Spacer (233).
4. 3rd speed gear (290).

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 23

- 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 26).
   - The gear is marked "FRONT" in the web area, as shown in Figure 23.
2. Spacer (233).
3. Driven gear (234), using J 22873 (Figure 27).
4. Thrust washer (235).
5. New snap ring (236), using J 22830-A and J-22873 (Figure 28).

   Important

   - Do not bend or damage the thrust washer.
   - The snap ring should be tight in the groove with no side play.

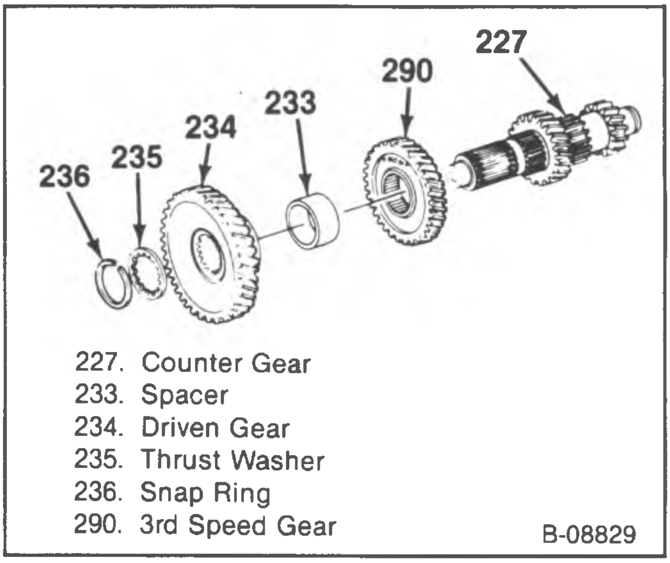


Figure 23 Countergear

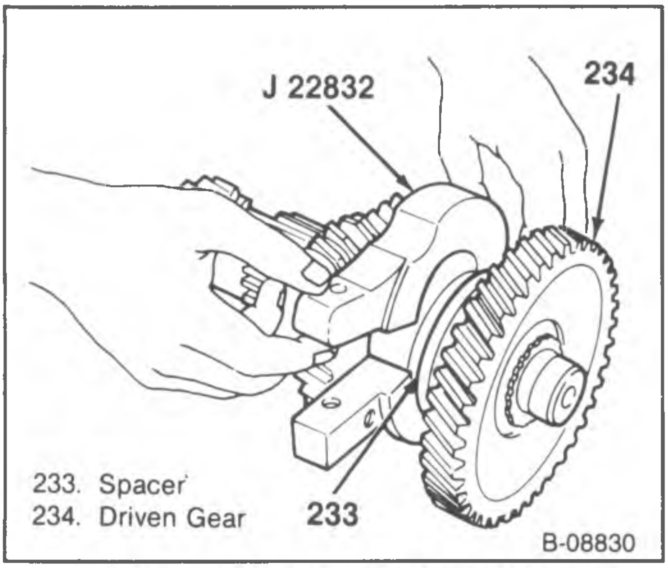


Figure 24 Installing Tool J 22832

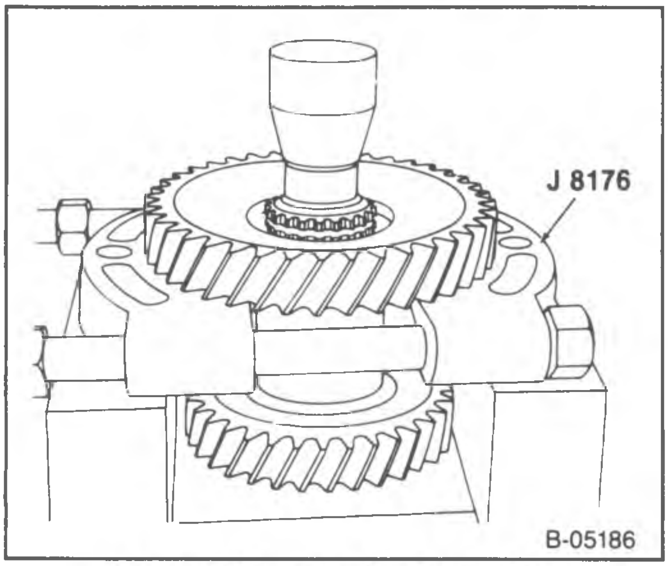


Figure 25 Removing the Driven Gear

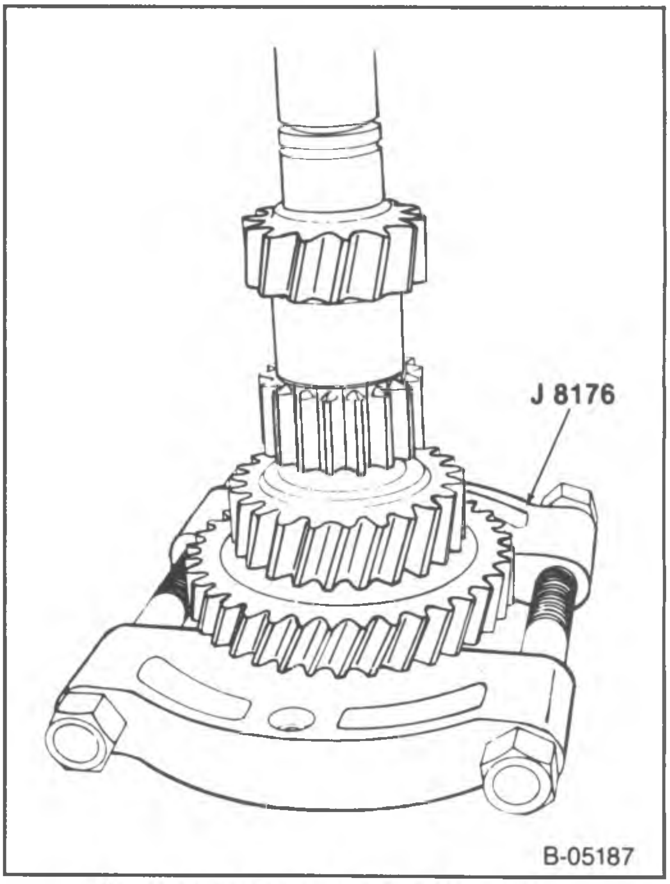


Figure 26 Installing the 3rd Speed Gear

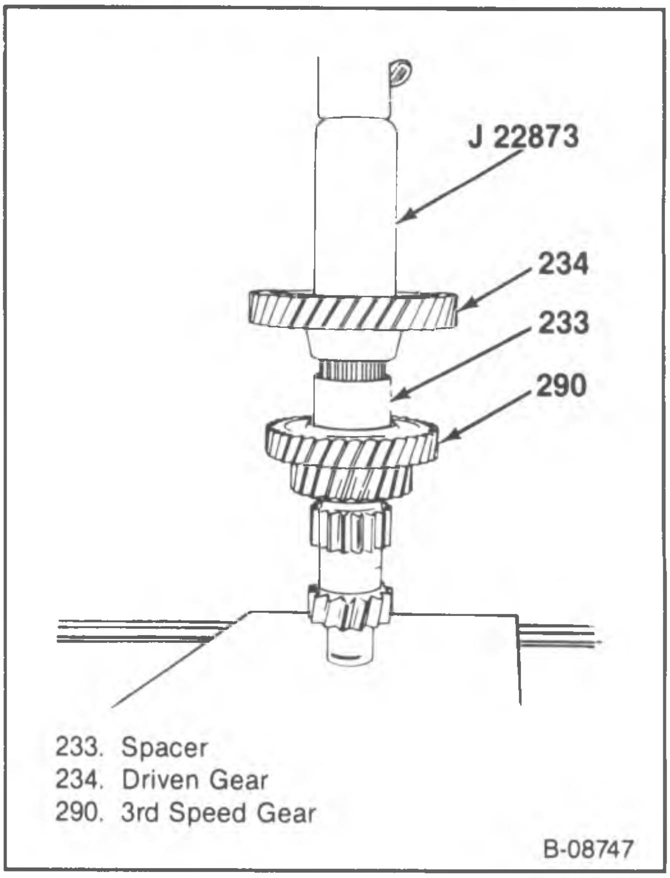


Figure 27 Installing the Driven Gear

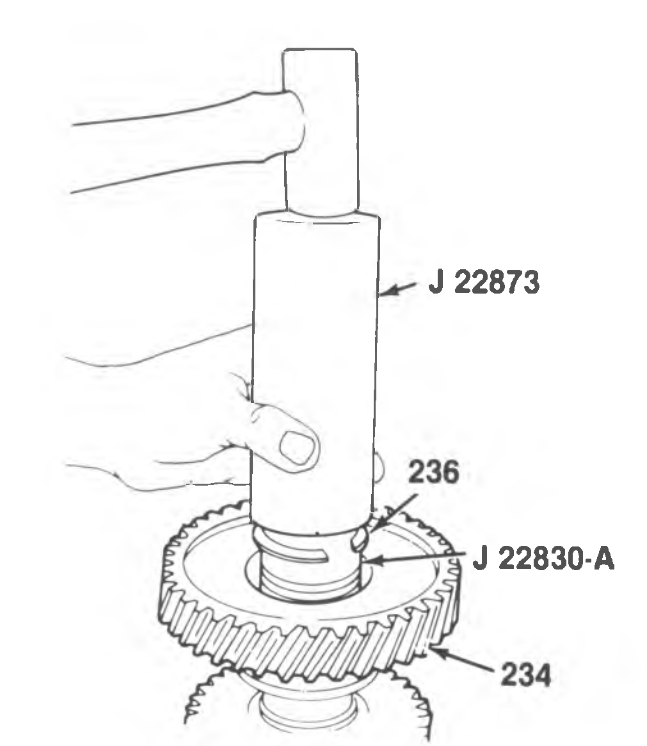


Figure 28 Installing the Driven Gear Snap Ring

REAR BEARING RETAINER

Seal Replacement

Figures 3 and 29

Tools Required:

J 22834 Extension Housing Seal Installer

Remove or Disconnect

Figure 3

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 3

1. Locking compound on the outside of a new seal (222).
2. New seal, using J 22834-2 (Figure 29).
   - Use J 22834-1 if a parking brake is used.
   - Fill between the seal lips with chassis grease.

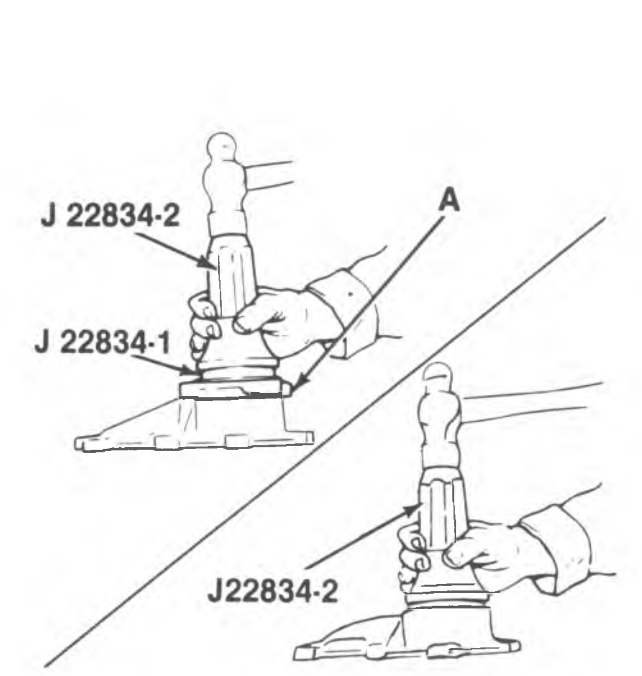


Figure 29 Installing the Rear Bearing Retainer Oil Seal

MAIN DRIVE GEAR BEARING RETAINER

Seal Replacement

Figures 3 and 30

Tool Required:

J 22833 Front Housing Drive Gear Seal Installer

Remove or Disconnect

Figure 3

1. Seal (266).
   - Pry the seal out with a small pry bar.
2. Gasket material from the retainer (202) using a scraper.

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 3

- Seal (266), using J 22833. The lip of the seal goes toward the installing tool, (Figure 30).

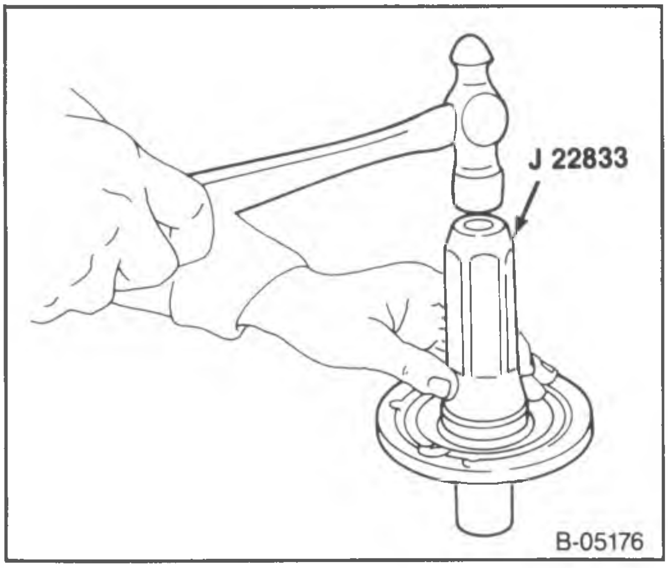


Figure 30 Installing the Drive Gear Bearing Retainer Oil Seal

R/V/P SHIFT COVER

Figures 31, 32, 33, 35, 37 and 38

Disassemble

Figure 31

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 32).
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 31

- All parts in solvent and air dry.

Inspect

Figure 31

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 balls.
   - For broken detent springs.
3. Shift control cover
   - For cracks and warping.
   - For smooth shift rod fit.

Assemble

Figure 31

1. Plunger (299), spring (300) and the retainer (302) to the reverse shift fork (301), (Figure 33).

   Important
   - The shift rods must be installed in the proper positions, (Figure 35).
2. Shift rods (307, 305 and 214).
   - Place the detent spring (212) and the balls (213) in the holes in the cover, (Figure 37).
   - Start the shift rods into the cover by depressing the spring loaded detent ball and pushing the rod over the ball.
   - 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 37). 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 38).

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

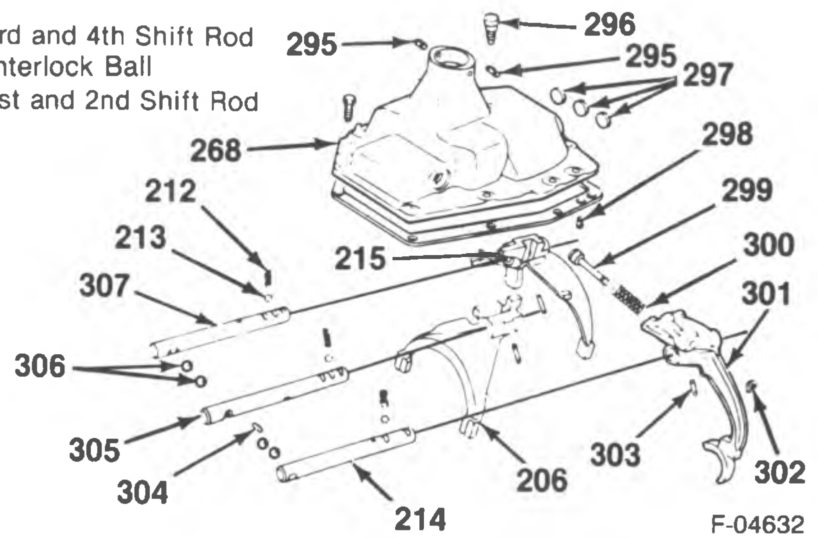


Figure 31 R/V/P Shift Cover and Components

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 to seat with a flat-faced 13 mm (1/2 inch) dowel pin.

C/K SHIFT COVER

Figures 32, 33, 34, 36 and 38

Disassemble

Figure 34

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 32).
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.

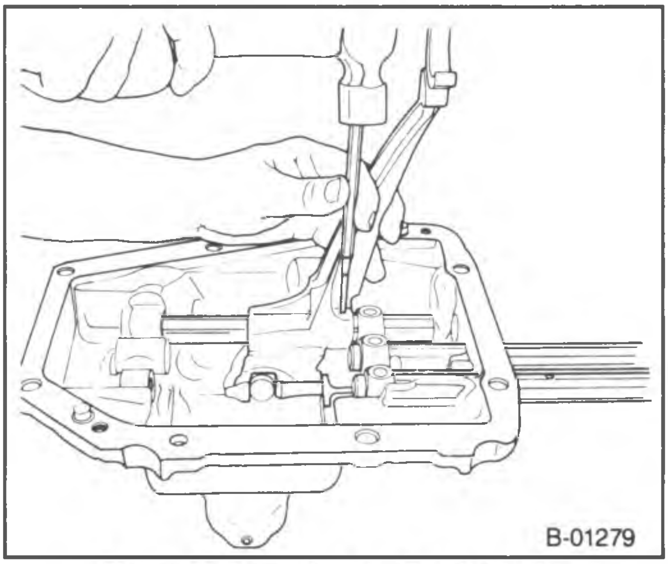


Figure 32 Removing the Retaining Pin

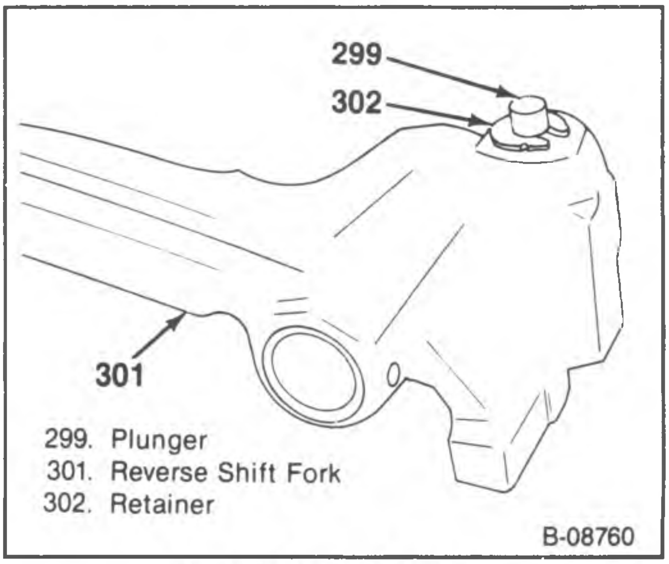


Figure 33 Plunger Retainer

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

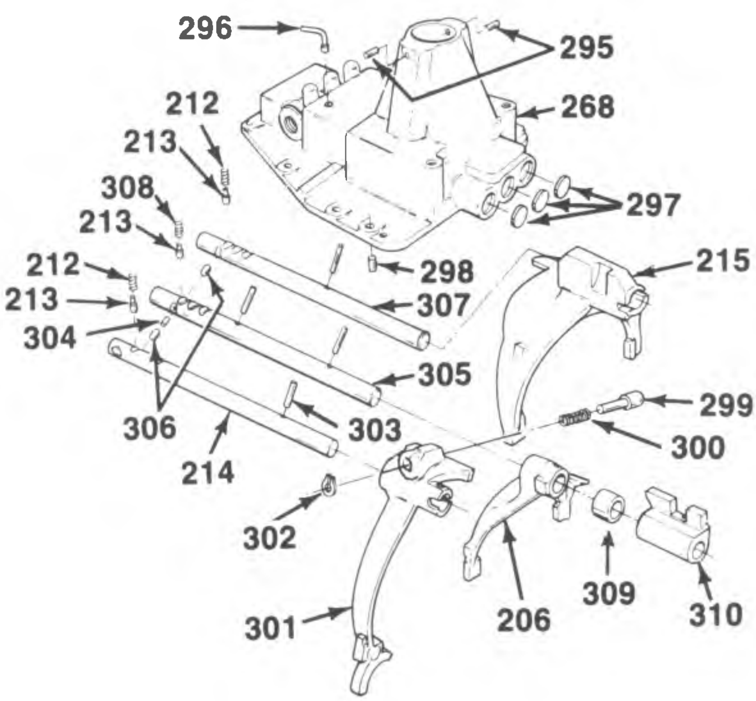


Figure 34 C/K Shift Cover and Components

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 34

- All parts in solvent and air dry.

Inspect

Figure 34

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

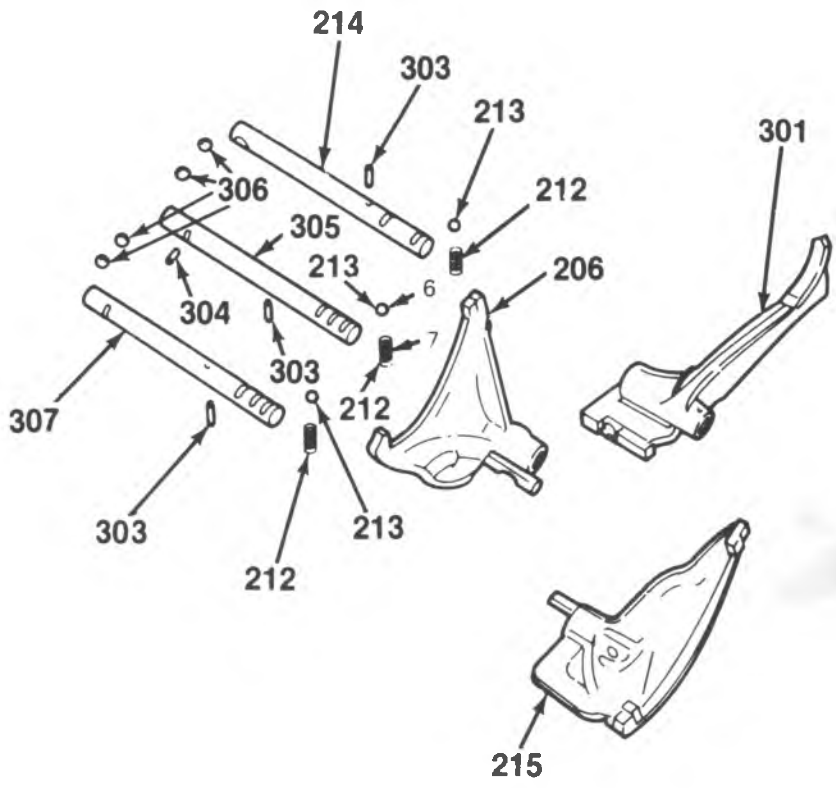
Figure 34

1. Plunger (299), spring (300) and the retainer (302) to the reverse shift fork (301), (Figure 33).

   Important
   - The shift rods must be installed in the proper positions, (Figure 36).
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 38).

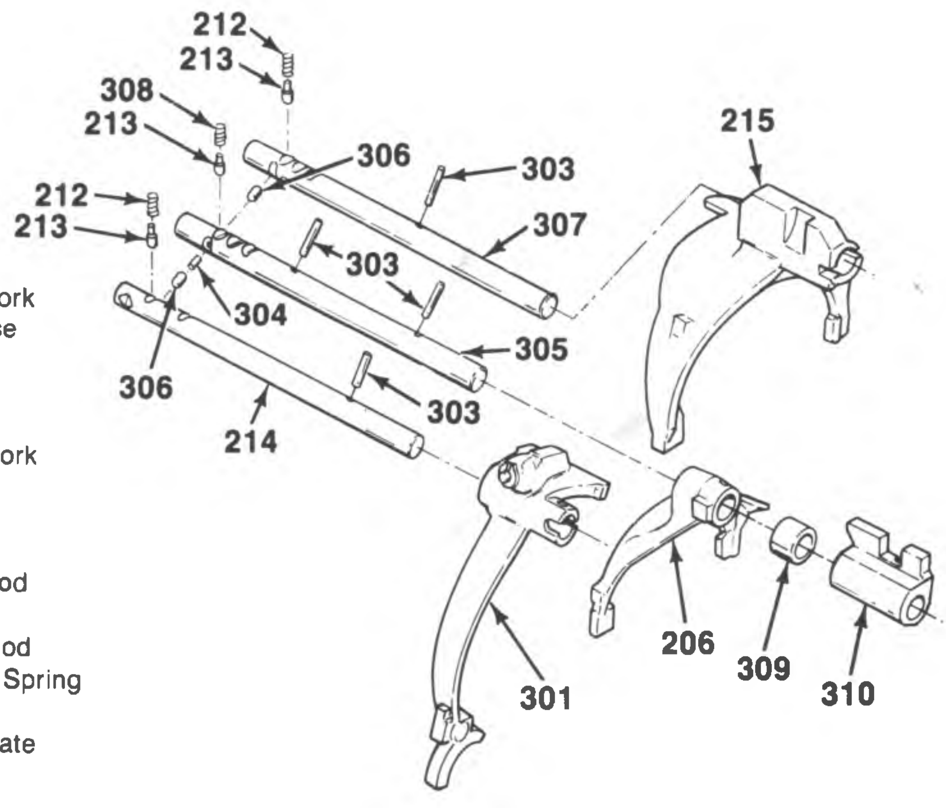
   Important
   - The 3rd-4th detent spring (308) is weaker than the 1st-2nd and reverse detent springs. The 3rd-4th spring is painted green and the two coils on the ends of the spring are coiled tight so there is no gap as compared to the other two detent springs (212).

   Important
   - Shift forks must be installed in the following order: Reverse, 3rd-4th, and 1st-2nd.



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

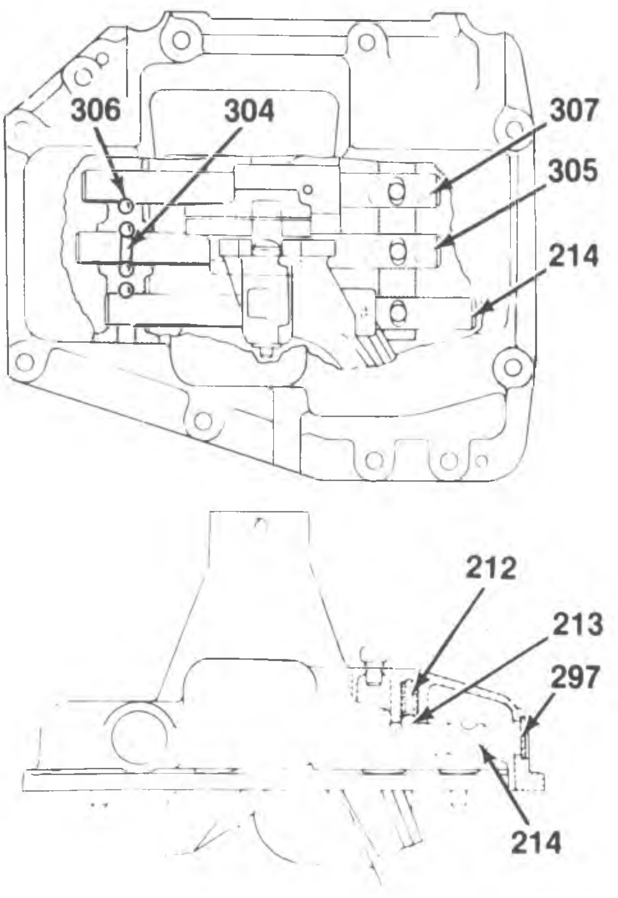
Figure 35 R/V/P Shift Rod and Fork Positions



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

Figure 36 C/K Shift Rod and Fork Positions

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.

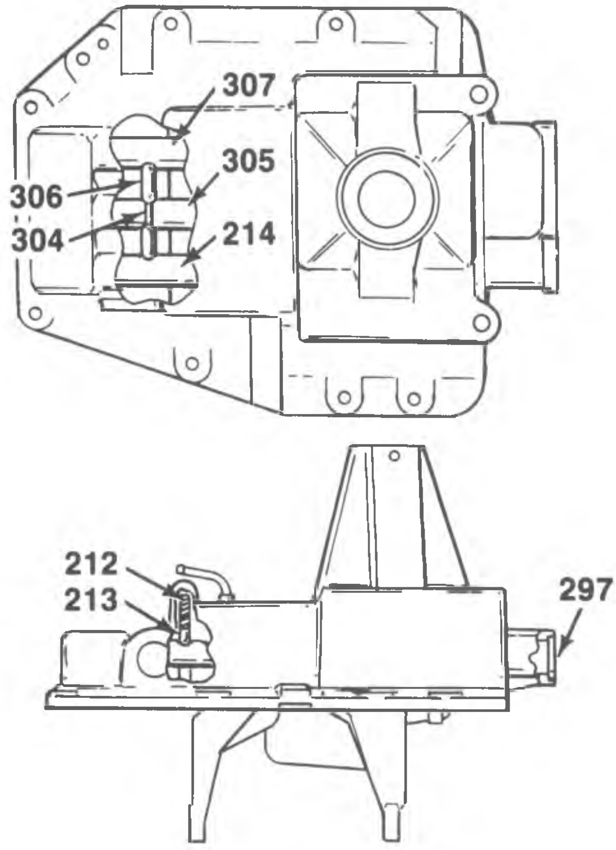


212. Detent Spring
213. Detent Ball
214. Reverse Shift Rod
297. Plug
304. Interlock Pin
305. 3rd And 4th Shift Rod
306. Interlock Ball
307. 1st And 2nd Shift Rod

F-04634

Figure 37 R/V/P Interlock Shuttles and Pin

5. Place an interlock shuttle (306) in the cross-bore of the front support between the reverse and 3rd-4th shift rods, (Figure 38). 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 38).



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 38 C/K Interlock Shuttles and Pin

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 to seat with a flat-faced 13 mm (1/2 inch) dowel pin.

UNIT ASSEMBLY AND SUB-ASSEMBLY

Figures 3, 6, 39, 40 and 41

Tools Required:

J 22874, Mainshaft and Countergear Bearing Installer

J-35907 Mainshaft Lock Nut Wrench (4WD models only)

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 lubricant.

Install or Connect

Figure 3

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 39).

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 39).
   - 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 cut-out goes down (Figure 6).
   - 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 40).
   - 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 41).
9. New bearing retainer snap ring (226).
   - Remove J 22874-10.

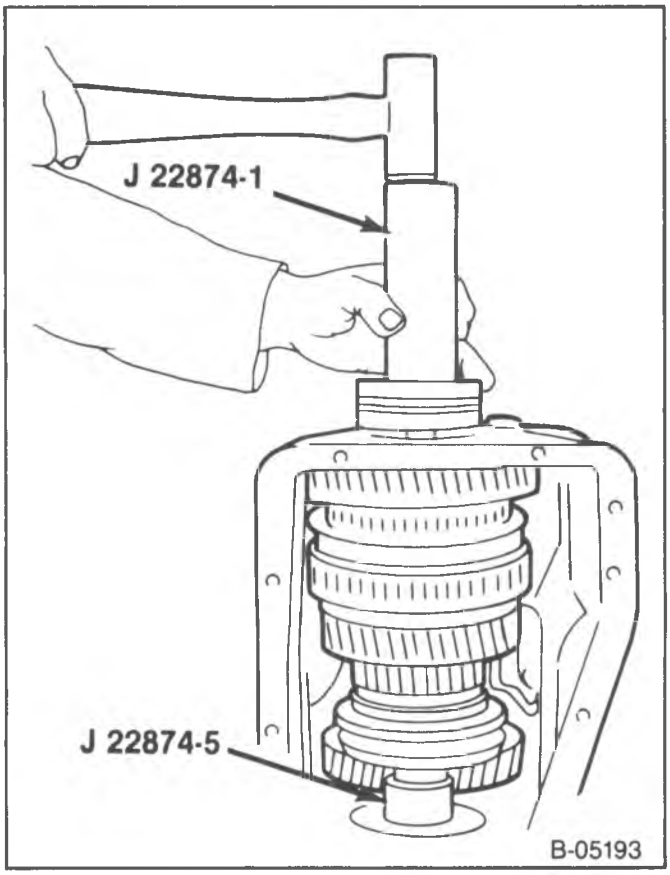


Figure 39 Installing the Mainshaft Rear Bearing

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.
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.

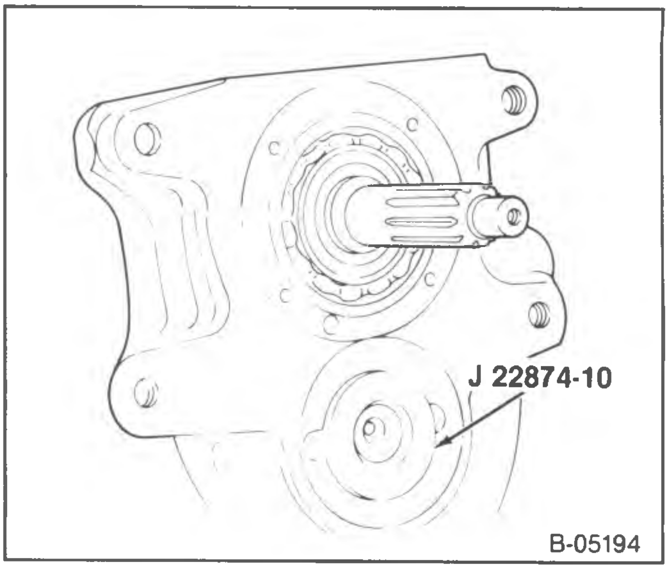


Figure 40 Tool J-22874-10 Installed

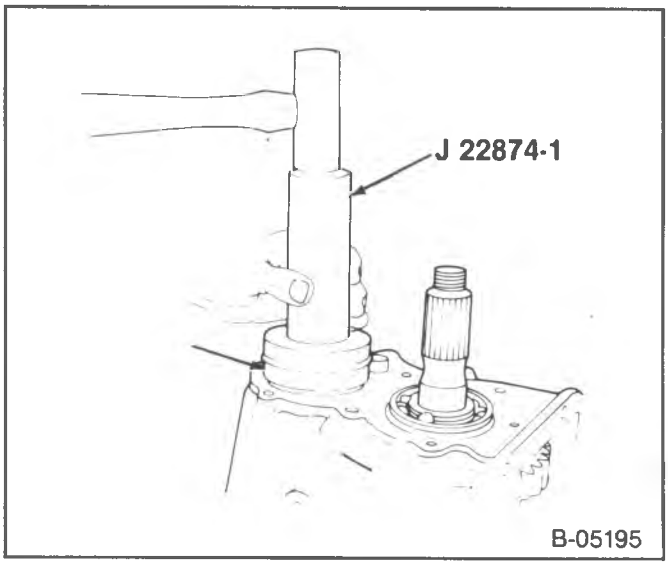


Figure 41 Installing the Countergear Rear Bearing

SPECIFICATIONS

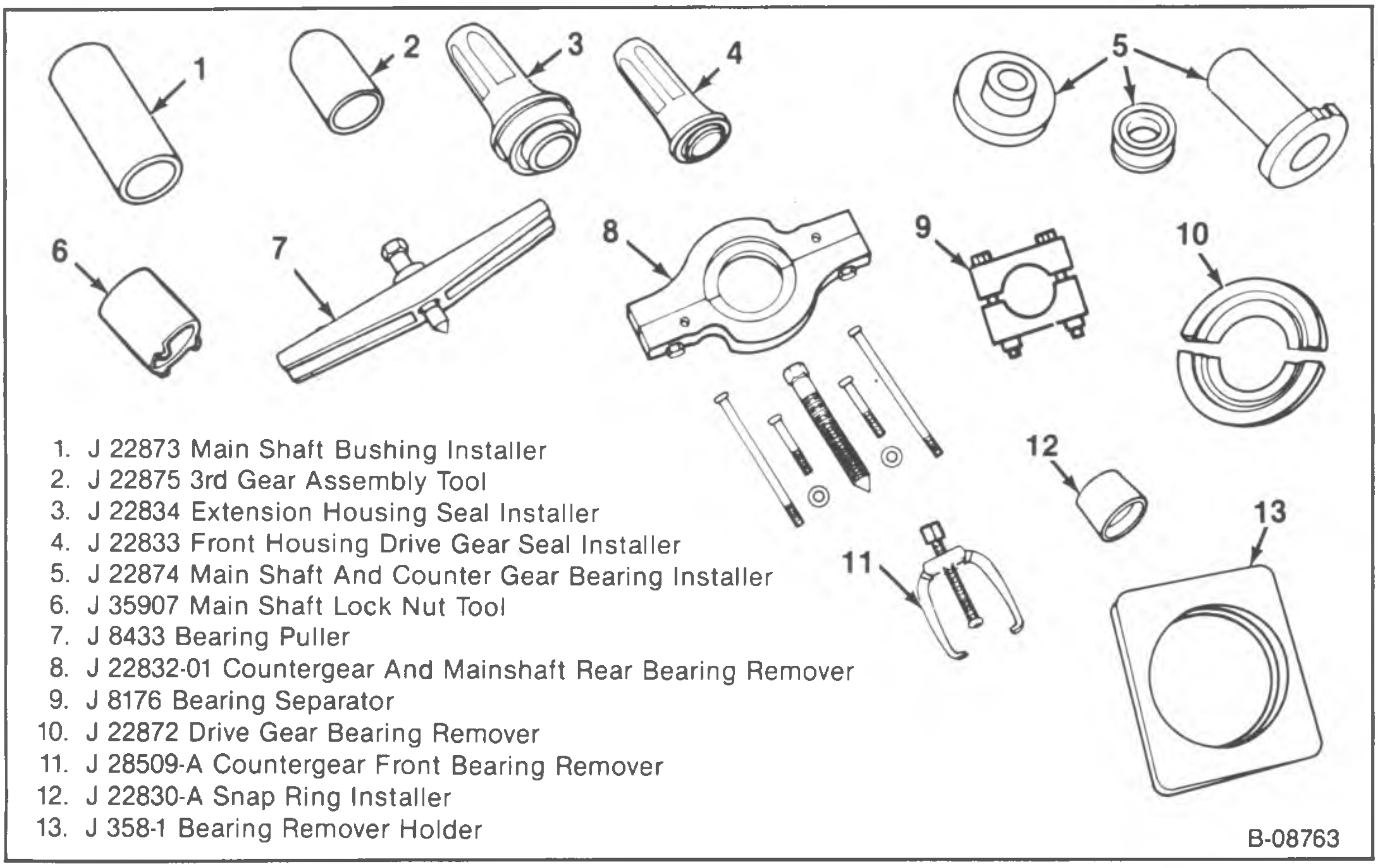
FASTENER TORQUE SPECIFICATIONS

Rear Bearing Retainer Screws	
Top	27 Nm (20 lb. ft.)
Bottom	40 Nm (30 lb. ft.)
Plug, Drain and Fill	23 Nm (17 lb. ft.)
Drive Gear Bearing Retaining Screws	32 Nm (25 lb. ft.)
Shift Lever to Shift Shaft Nut	27 Nm (20 lb. ft.)
Cover Screws	27 Nm (20 lb. ft.)
Parking Brake Plate Screws	41 Nm (30 lb. ft.)
Mainshaft Lock Nut (K model only)	135 Nm (100 lb. ft.)
Universal Joint Flange Nut	135 Nm (100 lb. ft.)
Power Take Off Cover Bolts	23 Nm (17 lb. ft.)
Countergear Front Cover Screws	4 Nm (35 lb. in.)
Parking Brake Flange Plate Bolts	41 Nm (30 lb. ft.)

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

SECTION 7B3

BORG WARNER T5 MANUAL TRANSMISSION

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

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 its 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

Remove or Disconnect (Figures 1, 2 and 3)

- Speedometer driven gear, switches and any external components.

1. Control lever (657) (figure 3).
   - Boot and the dust cover.
2. Pin (663) from the offset lever (659) (figure 4).
3. Extension housing (610) 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 (613).
   - Plastic funnel (figure 6).
   - Front thrust race.
6. Shift cover (602).

Important

- Two of the cover mounting screws are alignment screws. Note the positions that they were removed from for installation.

7. 5th speed drive gear (622).
   - Support the 5th speed shift fork (649) and drive the pin out (figure 7).
   - Snap ring and the 5th gear synchronizer and shift fork together (figure 8).
   - 5th speed blocker ring (621) and the 5th speed gear (622).
8. Speedometer drive gear (609) and the clip.
9. 5th speed driven gear snap ring (606).
10. Main drive gear bearing retainer (634).
    - Mark the retainer and the case for alignment (figure 9).
11. Bearing race (637) and the shim pack (figure 10).
12. Main drive gear (639).
    - Turn the gear so the cut-out is toward the countergear (figure 11).
13. Retaining ring and the reverse shift shaft lever pivot bolt (638) (figure 12).
14. Mainshaft rear bearing race (605).
15. Mainshaft (604).
16. 5th speed and reverse shift rail (646) (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 (654).
18. Reverse idler gear (641).
    - Drive the pin through the front of the idler shaft (642) (figure 14).
    - Idler shaft and the seal.
    - Idler gear.
19. Snap ring and the countergear rear bearing spacer (624).
20. Countergear rear bearing (625).
    - Drive the countergear (628) to the rear to remove the bearing (figure 15).

Important

- Note the direction the bearing faces.

21. Countergear (628) and the rear bearing spacer (626).
22. Countergear thrust washer (629).
23. Countergear front bearing (630).
    - Press the bearing from the case.

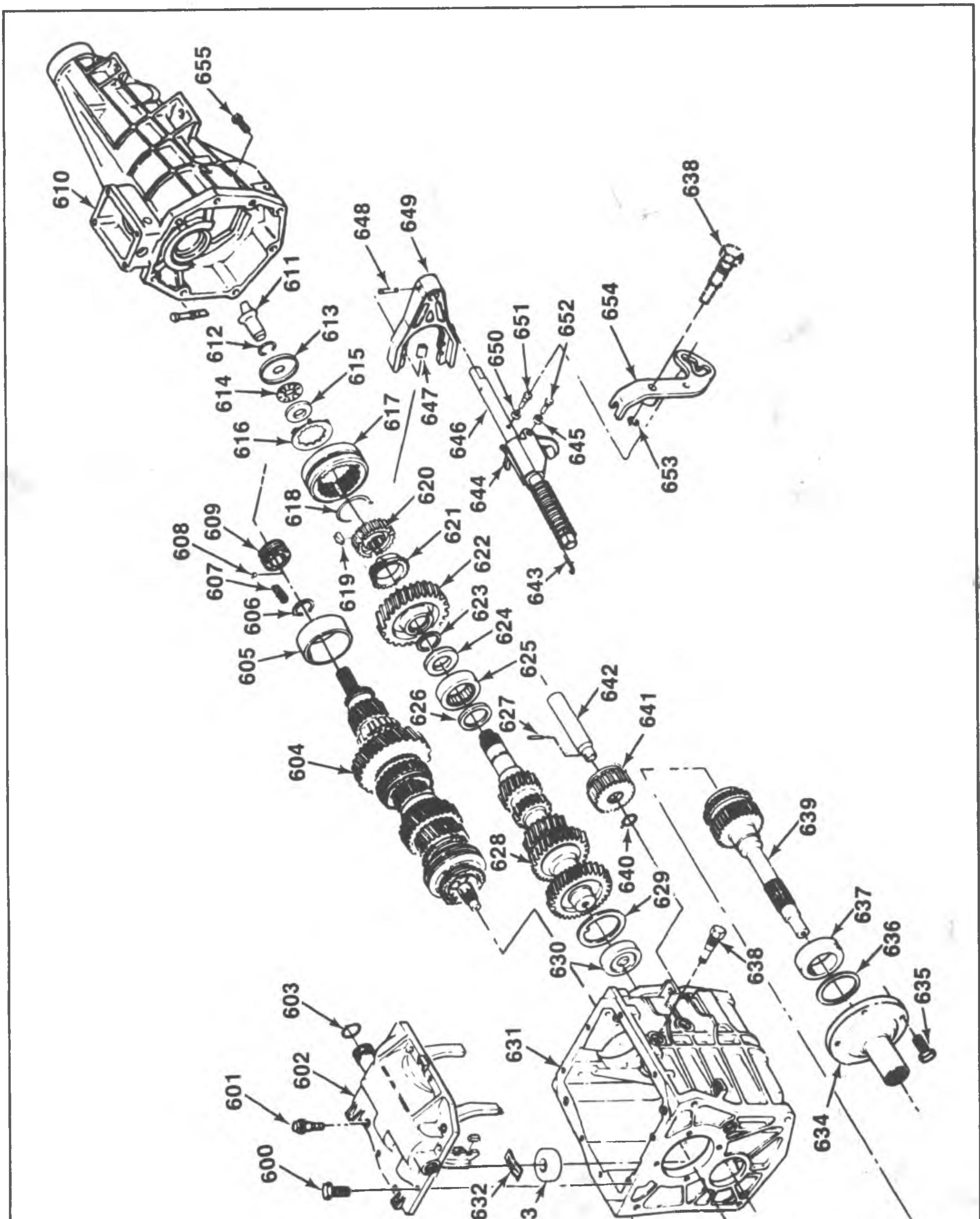


Figure 1—77 mm Transmission and Components

600. Cover Bolt
601. Cover Alignment Bolt
602. Cover
603. O-Ring
604. Mainshaft
605. Bearing Race
606. Fifth Speed Gear Retaining Ring
607. Retaining Clip
608. Ball
609. Speedometer Drive Gear
610. Extension Housing
611. Oiling Funnel
612. Fifth Synchronizer Retaining Ring
613. Fifth Synchronizer Thrust Bearing Race
614. Fifth Synchronizer Thrust Bearing
615. Fifth Synchronizer Front Thrust Bearing Race
616. Fifth Synchronizer Key Retainer
617. Fifth Synchronizer Sleeve
618. Fifth Synchronizer Spring
619. Synchronizer Key
620. Fifth Synchronizer Hub
621. Fifth Speed Blocker Ring
622. Fifth Speed Drive Gear
623. Retaing Ring
624. Countergear Rear Spacer
625. Countergear Ring Bearing
626. Countergear Front Spacer
627. Pin
628. Countergear
629. Countergear Thrust Washe
630. Countergear Front Bearing
631. Transmission Case
632. Nut
633. Magnet
634. Main Drive Gear Bearing Retainer
635. Bolt
636. Main Drive Gear Bearing Shim
637. Main Drive Gear Bearing
638. Fifth Speed Shift Lever Pivot Pin
639. Mian Drive Gear
640. Reverse Idler O-Ring
641. Reverse Idler Gear
642. Reverse Idler Shaft
643. Reverse Lock Spring
644. Reverse Shift Fork
645. Fork Roller
646. Fifth Speed and Reverse Shift Rail
647. Shift Fork Insert
648. Pin
649. Fifth Speed Shift Fork
650. Rail Pin Roller
651. Shift Rail Pin
652. Reverse Fork Pin
653. Retaining Ring
654. Fifth Speed and Reverse Shift Lever
655. Bolt

F9281

Figure 2—77 mm Transmission and Components

DISASSEMBLY AND ASSEMBLY OF SUB-ASSEMBLIES

MAIN DRIVE GEAR

Disassemble (Figure 16)

Tool Required:
J 22912-01 Bearing and Gear Puller

1. Thrust bearing and the race (667).
2. Pilot bearings (666).
3. Bearing (665) 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 (665), using J 22912-01 (figure 17).
2. Pilot bearings (666).
   - Use chassis grease to hold the bearings in place.
3. Thrust bearing and the race (667).

MAINSHAFT

Disassemble (Figure 18)

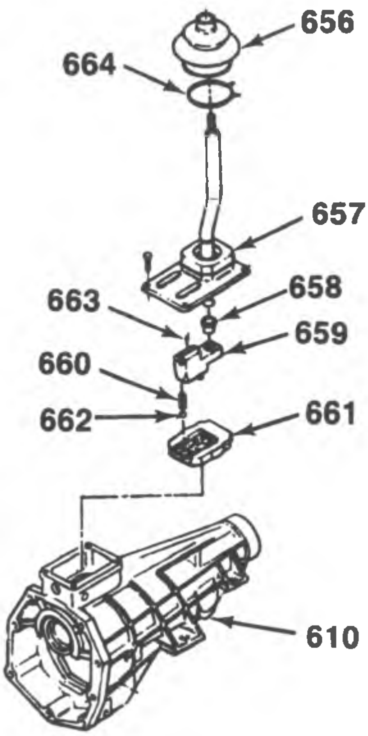
Tool Required:
J 22912-01 Bearing and Gear Puller

1. 4th speed blocker ring (668).
2. 3rd and 4th synchronizer and the 3rd speed gear (671).
   - 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.

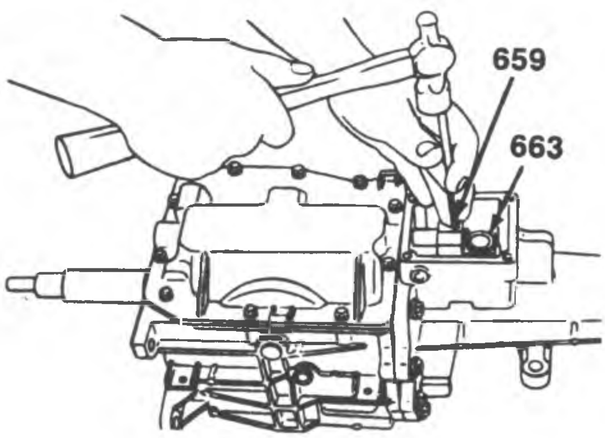
3. Remove the snap ring and the 2nd speed gear thrust washer (673).
4. Remove the 2nd speed gear (674) and blocker ring.



610. Extension Housing
656. Boot
657. Control Lever
658. Damper Sleeve
659. Offset Lever
660. Detent Spring
661. Detent Plate
662. Detent Ball
663. Pin
664. Retainer

F9282

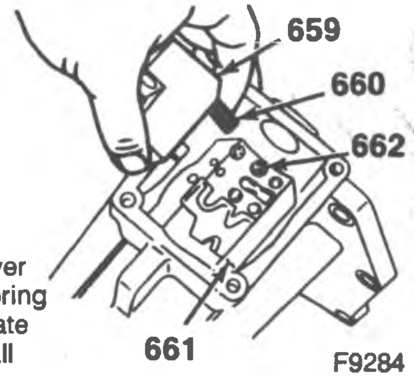
Figure 3—Shift Lever Components



659. Offset Lever
663. Pin

F9283

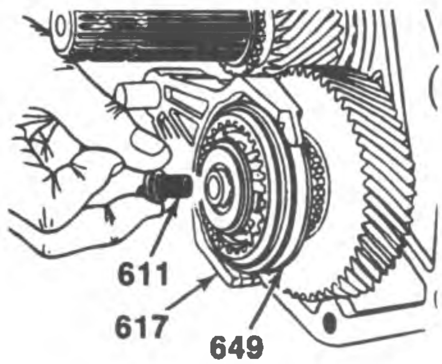
Figure 4—Removing the Offset Lever Pin



659. Offset Lever
660. Detent Spring
661. Detent Plate
662. Detent Ball

F9284

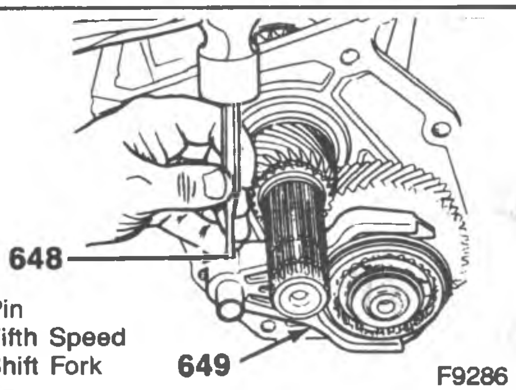
Figure 5—Detent Ball and the Spring



611. Oiling Funnel
617. Fifth Speed Shift Fork
649. Fifth Speed Synchronizer

F9285

Figure 6—Plastic Funnel



648. Pin
649. Fifth Speed Shift Fork

F9286

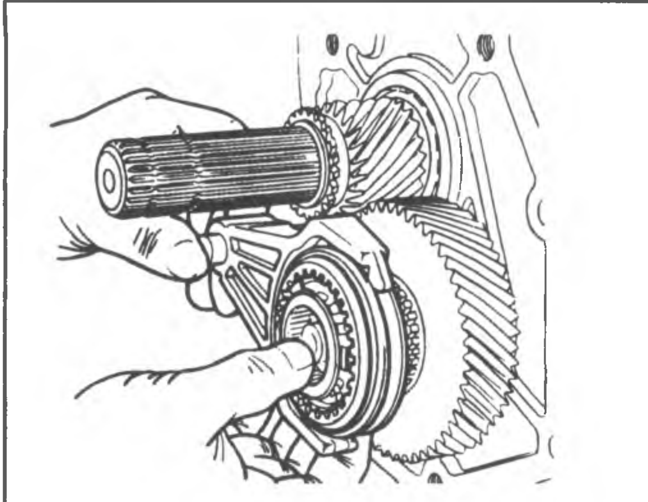
Figure 7—Removing the 5th Speed Shift Fork Pin

5. Press the mainshaft through the 5th speed driven gear (686) using J 22912-01 (figure 20).

Important

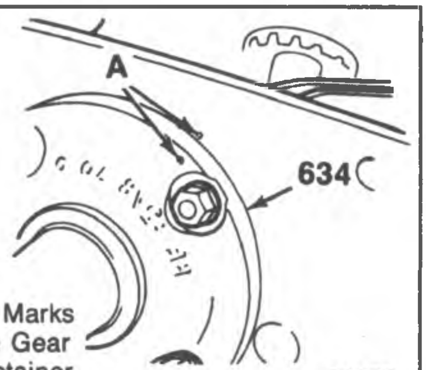
- Do not let the mainshaft fall to the floor.

6. Mainshaft rear bearing (685).
   - It may be necessary to press the mainshaft through the bearing using J 22912-01 (figure 20).



B8474

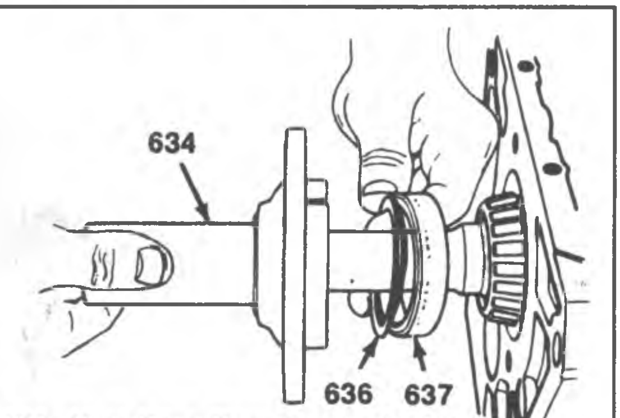
Figure 8—Removing the 5th Speed Shift Fork and the Synchronizer



A. Alignment Marks
634. Main Drive Gear Bearing Retainer

F9287

Figure 9—Bearing Cap Alignment Marks



634. Main Drive Gear Bearing Retainer
636. Main Drive Gear Bearing Shim
637. Main Drive Gear Bearing Race

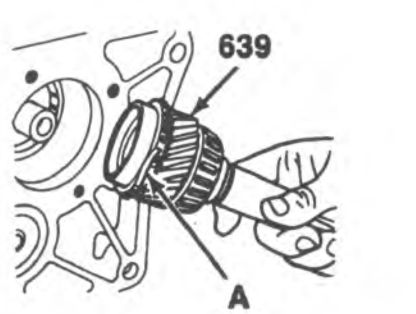
F9288

Figure 10—Main Drive Gear Shim Pack

Important

- Do not let the mainshaft fall to the floor.

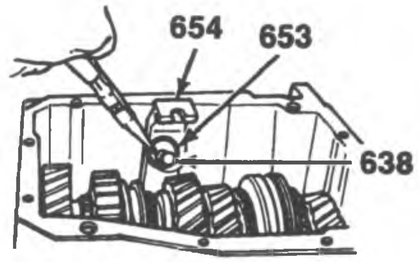
7. Remove the 1st speed gear thrust washer (684).
8. Pull the retaining pin out and remove the 1st speed gear (683) (figure 21).



A. Cut-out
639. Main Drive Gear

F9289

Figure 11—Main Drive Cut Out



638. Pivot Pin
653. Retaining Ring
654. Fifth Speed and Reverse Shift Lever

F9290

Figure 12—5th Speed and Reverse Shift Lever Retaining Ring

9. 1st and 2nd speed synchronizer sleeve (681).
   - 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 anti-rattle ball and spring (676) (figure 22).

Important

- Do not remove the hub. The hub and the mainshaft are machined together as a set.

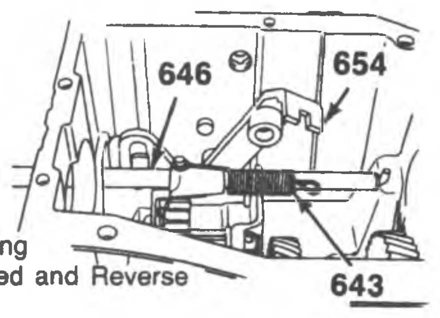
10. Synchronizers (617 and 669) (figures 1 and 18).
    - The synchronizer hub and sleeve are a select fit. Do not mix the parts of the two synchronizers (figure 22).
    - Mark the hub and sleeve alignment for reassembly.
    - Push the hub out of the sleeve while holding the springs and keys to avoid losing them.

Clean (Figure 18)

- All parts in a suitable solvent and air dry.

Important

- Do not spin dry bearings.



643. Reverse Lock Spring
646. Fifth Speed and Reverse Shift Rail
654. Fifth Speed and Reverse Shift Lever

F9291

Figure 13—5th Speed and Reverse Shift Shaft

Inspect (Figure 18)

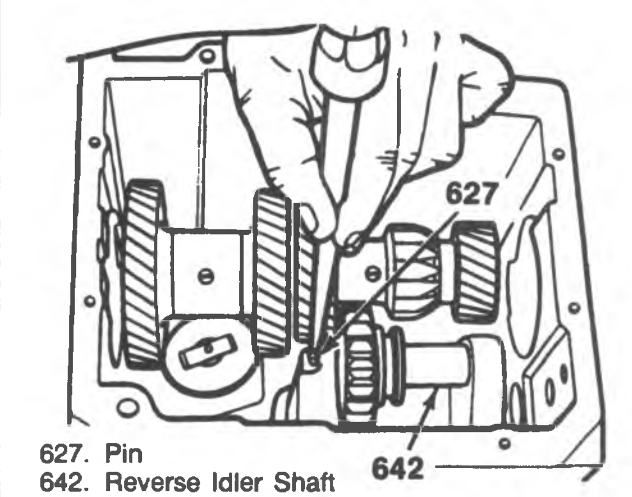
1. Gears for cracks, chipped gear teeth, and other damage that could cause gear noise.
2. Thrust washers and bushings for damage and wear.
3. Related surfaces on the gears like thrust faces and bearing surface diameters.
4. The reverse sliding gear for a sliding fit on the synchronizer hub without excess 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.
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.

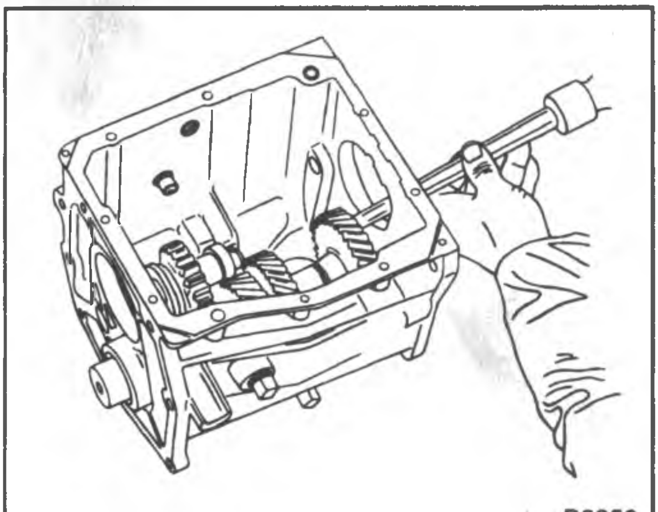
1. Synchronizers (617 and 669) (figures 1 and 18).
   - Place the keys into the hub.
   - Engage the springs in the same way with the open ends away from each other (figure 23).
   - Slide the sleeve onto the hub, aligning the marks made during reassembly.
2. 1st and 2nd speed synchronizer sleeve (681) (figure 18).
   - Hold the antirattle ball and spring (676) 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.



627. Pin
642. Reverse Idler Shaft

F9292

Figure 14—Removing the Reverse Idler Shaft Pin



B8359

Figure 15—Removing the Countergear Rear Bearing

639. Main Drive Gear
665. Drive Gear Bearing
666. Pilot Bearings
667. Drive Gear Thrust Bearing

F9293

Figure 16—Main Drive Gear Bearing

3. Slide the 2nd speed blocker ring (675) onto the mainshaft.
   - The clutching teeth must be to the front.
4. Slide the 2nd speed gear (674) on with the cone onto the blocker ring.
5. 2nd speed thrust washer (673) and a new snap ring.

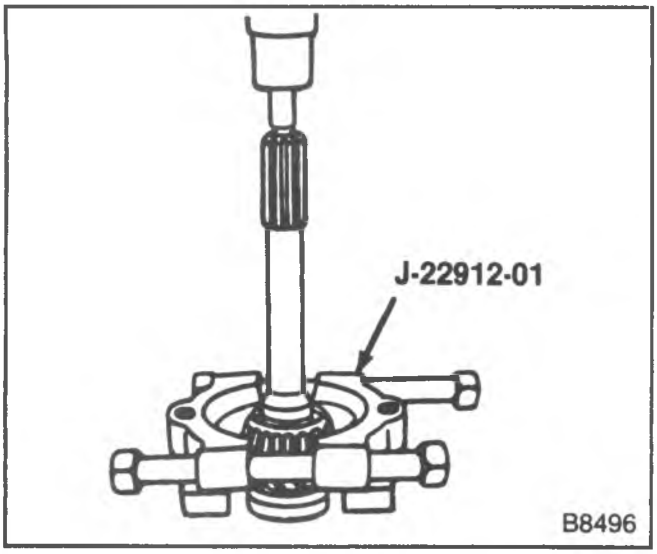


Figure 17—Removing the Main Drive Gear Bearing

- Be sure the thrust washer tab is seated in the mainshaft groove.

6. Slide the 1st speed blocker ring (682) onto the mainshaft.
   - The clutching teeth must be to the rear.
7. Install the 1st speed gear (683) and a new retaining pin (figure 21).
8. Slide the 1st speed gear thrust washer (684) against the gear.
9. Install the mainshaft rear bearing (685).
   - The bearing may have to be pressed on using J 25234 (figure 24).
10. Install the 5th speed driven gear (686) using J 22912-01.
11. Slide the 3rd speed gear (671) on with the cone to the front.
12. Slide the 3rd speed blocker ring (670) onto the 3rd speed gear.
    - The clutching teeth must be against the gear.
13. Install the 3rd and 4th synchronizer (669) with the hub offset to the front.
14. Slide the 4th speed blocker ring (668) into the 3rd and 4th synchronizer.
    - The clutching teeth must be to the front.

EXTENSION HOUSING

Remove or Disconnect (Figure 25)

Tool Required:
J 8092 Driver Handle
J 23062-14 Extension Housing Bushing Remover and Installer

1. Seal (691).
2. Sealing compound from the flange of the extension.
3. Bushing (690) if it is worn or damaged, using J 8092 and J 23062-14.

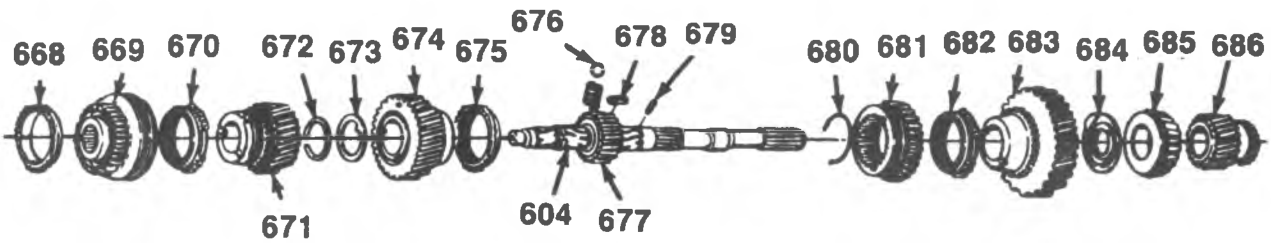
Inspect (Figure 25)

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
J 21426 Extension Housing Oil Seal Installer
J 23062-14 Extension Housing Bushing Remover and Installer

1. New bushing (690) 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 (691).
3. New seal (691) using J 21426 (figure 27).
   - Fill between the seal lips with chassis grease.



604. Main Shaft
668. Fourth Speed Blocker Ring
669. Third and Fourth Synchronizer
670. Third Speed Blocker Ring
671. Third Speed Gear
672. Retaining Ring
673. Second Speed Gear Thrust Washer
674. Second Speed Gear
675. Second Speed Blocker Ring
676. Anti Rattle Ball and Spring
677. Synchronizer Hub
678. Synchronizer Key
679. Retaining Pin
680. Synchronizer Spring
681. First and Second Synchronizer Sleeve (Reverse Gear)
682. First Speed Blocker Ring
683. First Speed Gear
684. First Speed Gear Thrust Washer
685. Mainshaft Rear Bearing
686. Fifth Speed Driven Gear

F9294

Figure 18—Mainshaft and Components

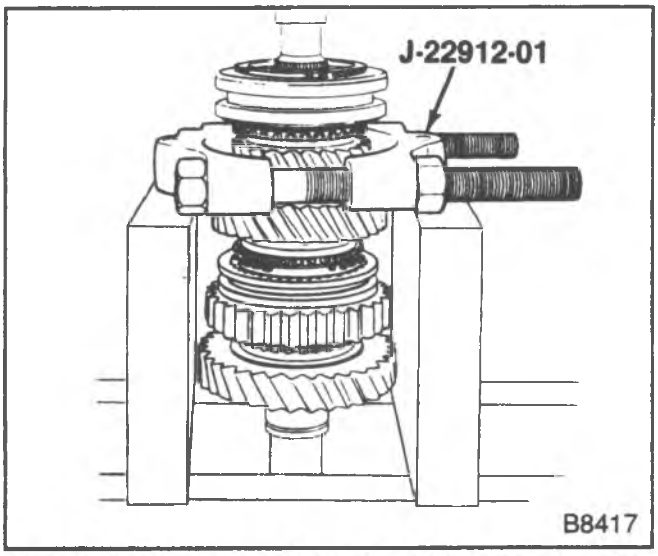


Figure 19—Removing the 3rd and 4th Synchronizer

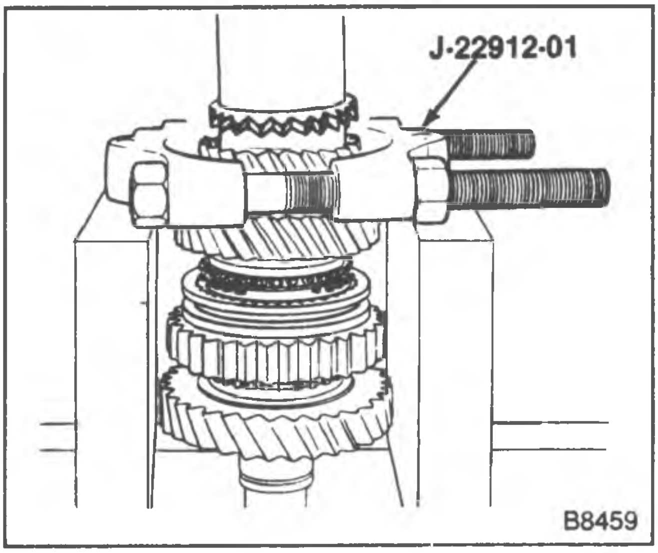


Figure 20—Removing the 5th Speed Driven Gear

MAIN DRIVE GEAR BEARING RETAINER

Remove or Disconnect (Figure 28)

1. Seal (692).
2. Sealing compound from flange of retainer (634).

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 28)

Tool Required:
J 23096 Front Housing Drive Gear Seal Installer

- New seal (692) using J 23096. Coat the inside of the seal with transmission oil (figure 29).

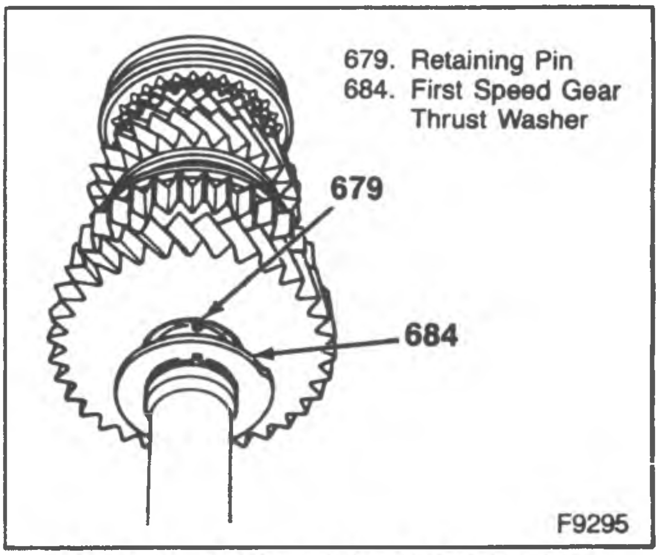


Figure 21—1st Speed Gear Retaining Ring

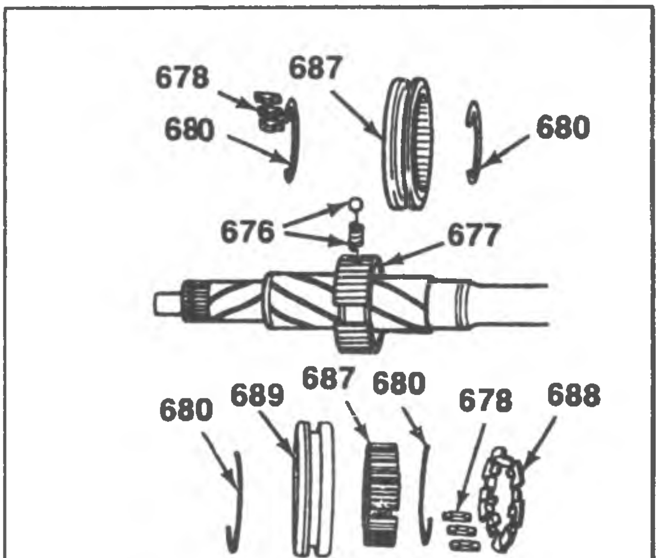


Figure 22—Synchronizer Components

SHIFT COVER

Disassemble (Figure 30)

- The shift shaft and shift fork plates must be in the neutral position (centered).

1. Turn the shift shaft (697) until the selector arm (699) is disengaged from the fork plates (695).
2. Drive the retaining pin out of the selector arm (699) (figure 31).

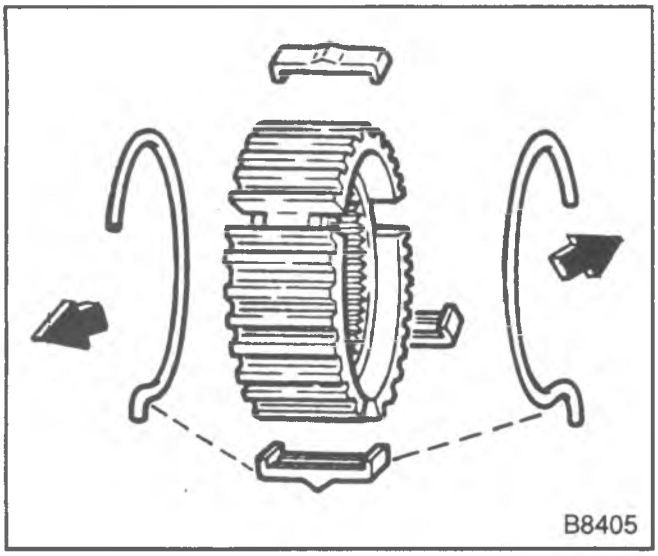


Figure 23—Synchronizer Spring Location

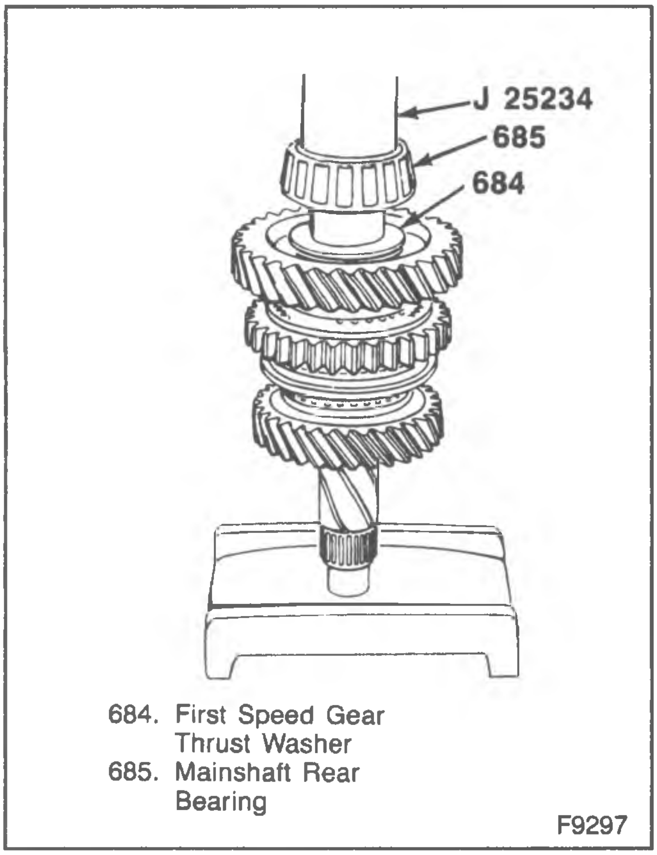


Figure 24—Installing the Mainshaft Rear Bearing

3. Remove the shift shaft (697).
   - Shift forks and the plates.
   - Selector arm.
   - Interlock plate.
4. Pry the oil seal (603) out.
5. Remove the inserts (698) from the forks.

Clean (Figure 30)

- All metal parts in solvent and air dry.

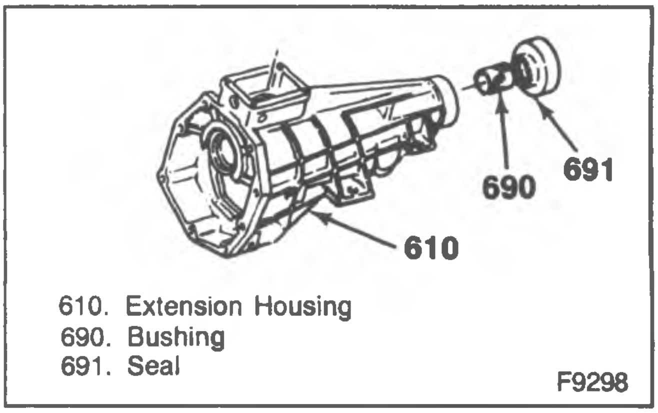


Figure 25—Extension Housing and Components

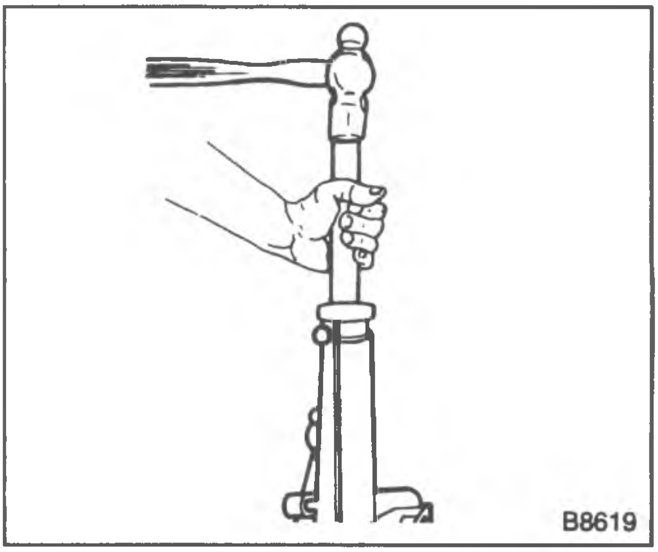


Figure 26—Installing the Extension Housing Bushing

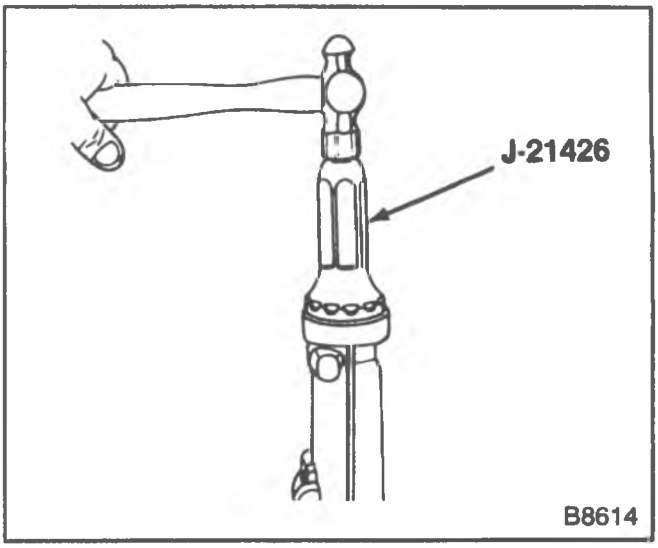
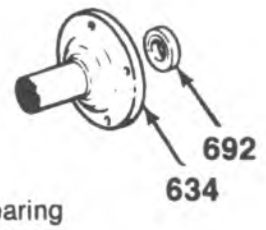


Figure 27—Installing the Extension Housing Oil Seal

Inspect (Figure 30)

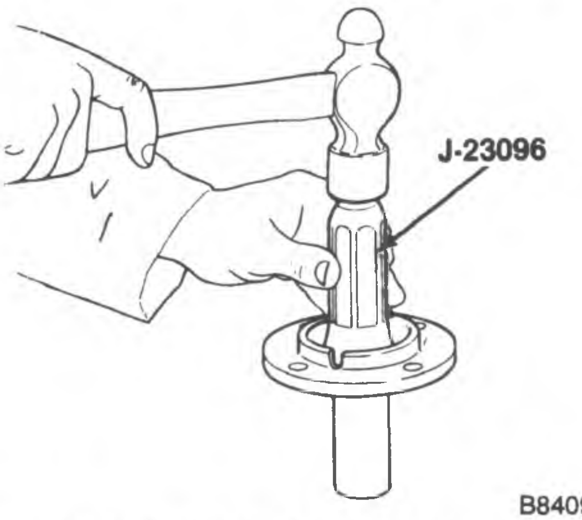
1. Shift forks.
   - For damage or bends.



634. Main Drive Gearing Bearing Retainer
692. Oil Seal

F9299

Figure 28—Main Drive Gear Bearing Retainer



B8409

Figure 29—Installing the Bearing Retainer Oil Seal

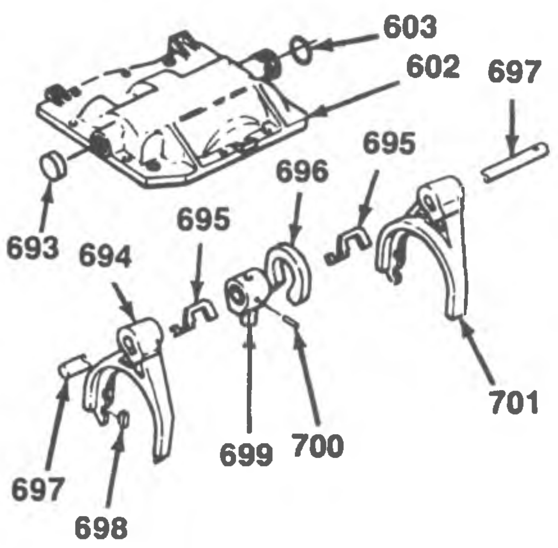
- For worn inserts.

2. Shift shaft.
   - 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.

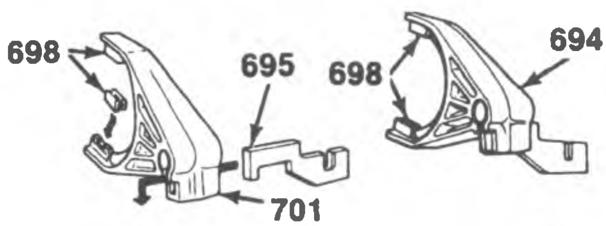
1. Install a new shift shaft plug (693), if needed.
   - Coat the outside of the plug with sealing compound.
2. Fit the inserts (698) and the fork plates (695) into the shift forks (figure 31).
3. 1st and 2nd (largest) shift fork (701).
   - Fit the shift shaft into the cover rear bore.
   - Hold the shift fork in the cover with the fork offset to the rear (figure 32).
   - Push the shift shaft through the fork.
4. Selector arm (699) and the interlock plate (696).
   - Hold the selector arm and the interlock plate in the cover with the widest part of the plate away from the cover.



602. Shift Cover
603. O-Ring
693. Shaft Plug
694. Third and Fourth Shift Fork
695. Shift Fork Plate
696. Interlock Plate
697. Shift Shaft
698. Insert
699. Selector Arm
700. Retaining Pin
701. First and Second Shift Fork

F9300

Figure 30—Shift Cover and Components



694. Third and Fourth Shift Fork
695. Shift Fork Plate
698. Insert
701. First and Second Shift Fork

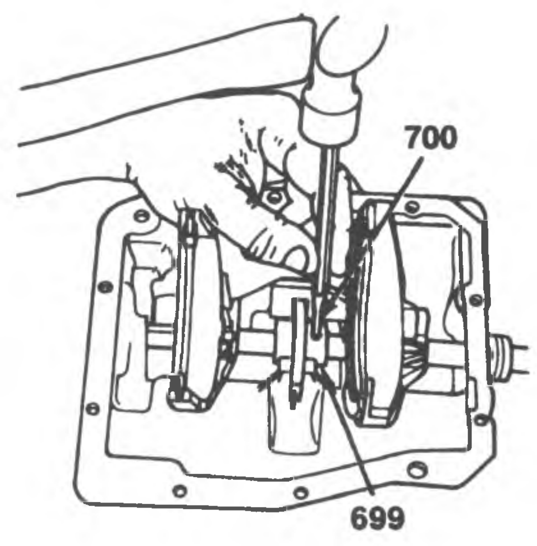
F9301

Figure 31—Shift Forks and Selector Plates

   - The shift arm retaining pin hole must be away from the cover and to the rear (figure 32).
   - Push the shift fork through the arm.
5. 3rd and 4th shift fork (694).
   - 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 (700) 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 (603).
   - Coat the seal with transmission oil.



699. Selector Arm
700. Retaining Pin

F9302

Figure 32—Removing the Shift Shaft Retaining Pin

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.

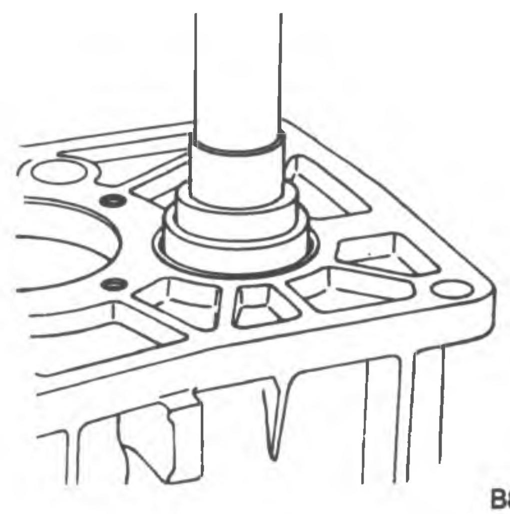
Install or Connect (Figures 1, 2 and 3)

Tools Required:
J 29895 Countershaft Rear Bearing
J 33032 Rear Cluster Bearing Assembly Tool

1. Countergear front bearing (630) (figure 33).
   - Coat the bearing bore with Loctite #601 or equivalent.
   - The bearing must be flush with the transmission case.
2. Countergear thrust washer (629).
   - Coat the thrust washer with grease.
3. Countergear (628) and the rear bearing spacer (626).
   - Tip the transmission case up.
   - Fit the countergear into the front bearing.
   - Install the rear bearing spacer.
4. Countergear rear bearing (625) (figures 34 and 35).
   - Coat the bearing with grease.
   - Install the bearing using J 33032 and J 29895.

Important

- Be sure the bearing is installed in the direction it was removed from.



B8620

Figure 33—Installing the Countergear Front Bearing

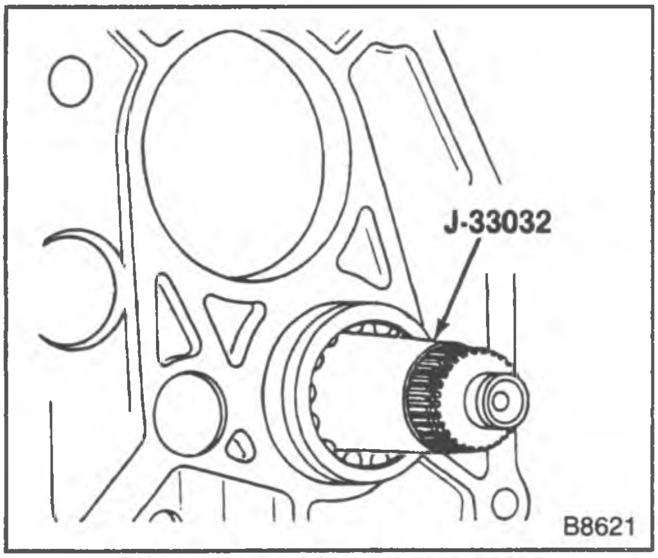


Figure 34—Installing Tool J 33032

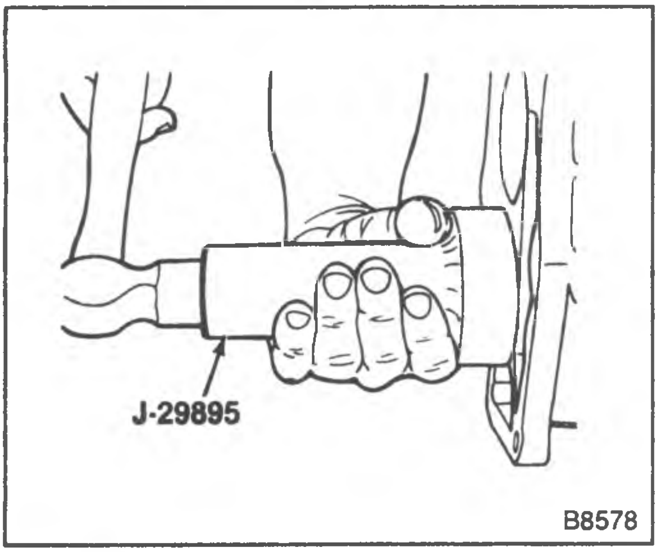


Figure 35—Installing the Countergear Ring Bearing

Measure

- Countergear rear bearing. It must extend 3 mm (0.125-inch) past the transmission case.

5. Reverse idler gear (641) 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 (639).
   - 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 (637).
10. Main drive gear bearing retainer (634) and the screws.
    - Be sure to align the marks (figure 9).
11. 5th speed and reverse shift lever (654), and the pivot bolt.
    - Coat the pivot bolt threads with a non-hardening sealer.
    - Be sure the reverse idler fork is engaged in the idler gear slot.
12. New reverse shift lever retaining ring (653).
13. Countergear rear bearing spacer (624) and a new snap ring.
14. 5th speed drive gear (622).
15. 5th speed and reverse shift shaft (646) (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 (649) 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 (648).
    - 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 (615) and a new snap ring.
19. Countergear thrust bearing (614).
    - Coat the bearing with petroleum jelly.
    - The bearing race lip must be over the bearing.
    - Plastic funnel (611) into the bearing.
20. Extension housing (610) and the screws.
    - Turn the transmission on end and mount a dial indicator on the extension housing (figure 36).

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 (636).
    - Remove the bearing retainer.
    - Install the correct shim pack (figure 10).
    - Apply a 3 mm (1/8-inch) diameter bead of RTV #372, or equivalent, sealer to the case mating surface.
    - Install the bearing retainer, aligning the marks (figure 9).
22. Shift cover (602).

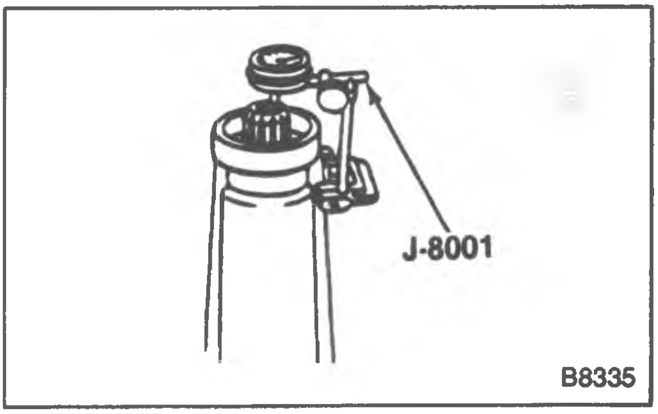


Figure 36—Measuring Mainshaft End Play

- 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 (610).
    - 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 (659), detent ball, and the spring (figure 5).
    - Press the offset lever into place and seat the extension housing.
    - Install the extension housing screws.
27. New pin (663) into the offset lever and shift shaft.
28. Control lever (657), the boot and the dust cover.
    - Silicone sealer in the groove around the dust cover.

SPECIFICATIONS

FASTENER TORQUE

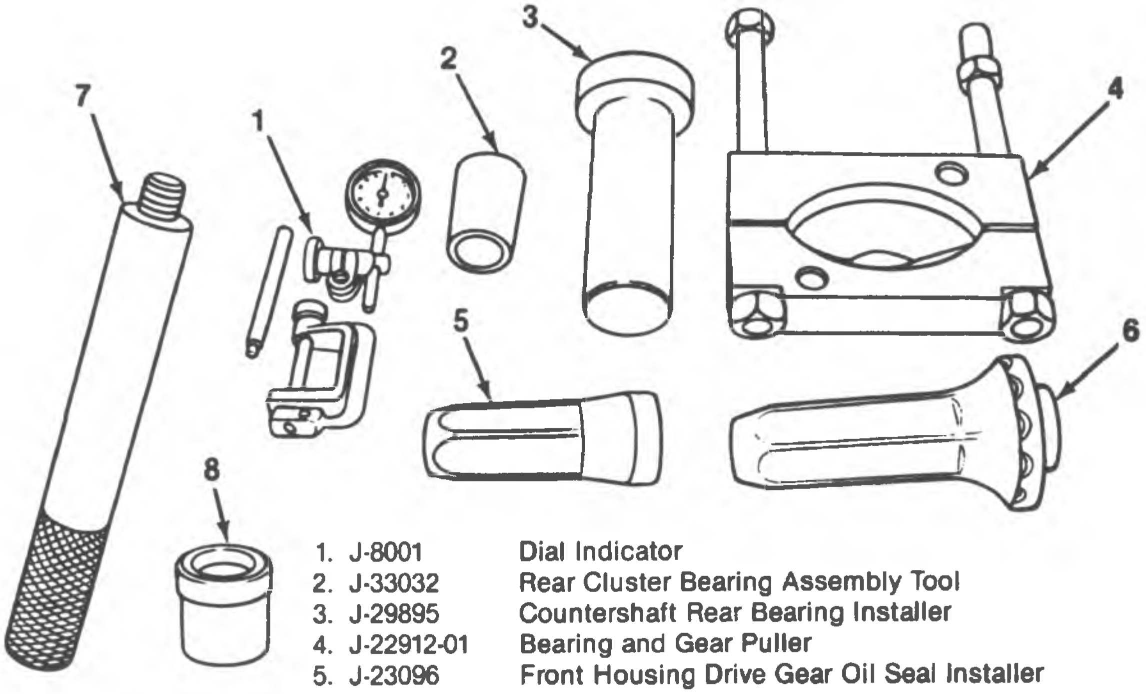
	N·m	Ft. Lbs.
Drive Gear Bearing Retainer Screws	20	15
Shift Cover Screws	13	10
Rear Extension Screws	30	25
Reverse Pivot Bolt	27	20

LUBRICATION

Capacity	2.0L	2.2 qts
Type Recommended	Dexron II Automatic Transmission Fluid	

T2538

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

SECTION 7D

TRANSFER CASE

CONTENTS

SECTION 7D1

NEW PROCESS 205 TRANSFER CASE

CONTENTS

DESCRIPTION

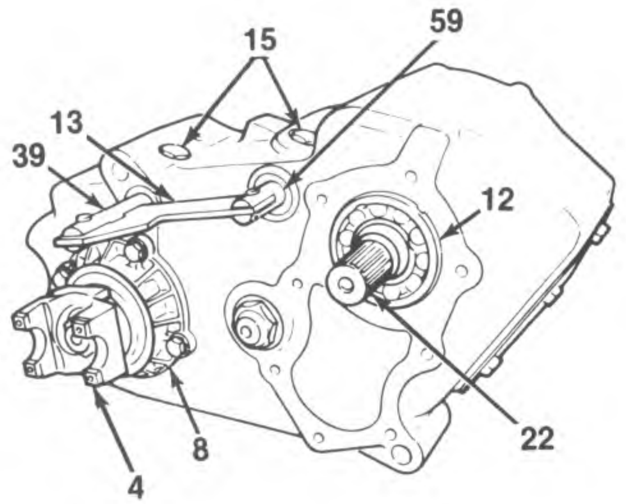
A transfer case mounts behind the transmission and allows drive torque to be transmitted in a proportional split to both the front axle and the rear axle, resulting in four-wheel drive. The shift control lever for the transfer case is floor-mounted in the passenger compartment. Depending on the type 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.

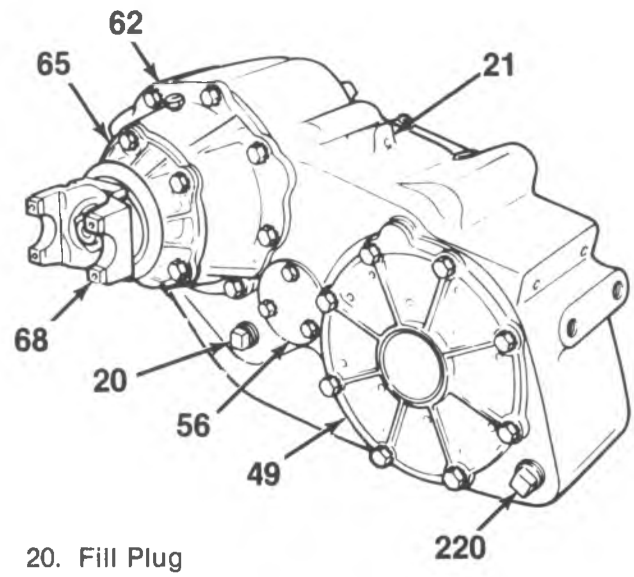
DISASSEMBLY



4. Yoke
8. Retainer
12. Main Drive Gear Bearing
13. Shift Rail Link
15. Poppets
22. Input Main Drive Gear
27. Idler Shaft Retaining Nut
39. Front Output Shift Rail
59. Rear Output Shift Rail

FO-1977

Figure 1—NP205 — Front View



20. Fill Plug
21. Shift Rail Interlink Plunger
49. Front Output Shaft Rear Bearing Retainer
56. Idler Shaft Cover
62. Rear Output Shaft Bearing Retainer
65. Retainer
68. Yoke
220. Drain Plug

FO-1978

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).

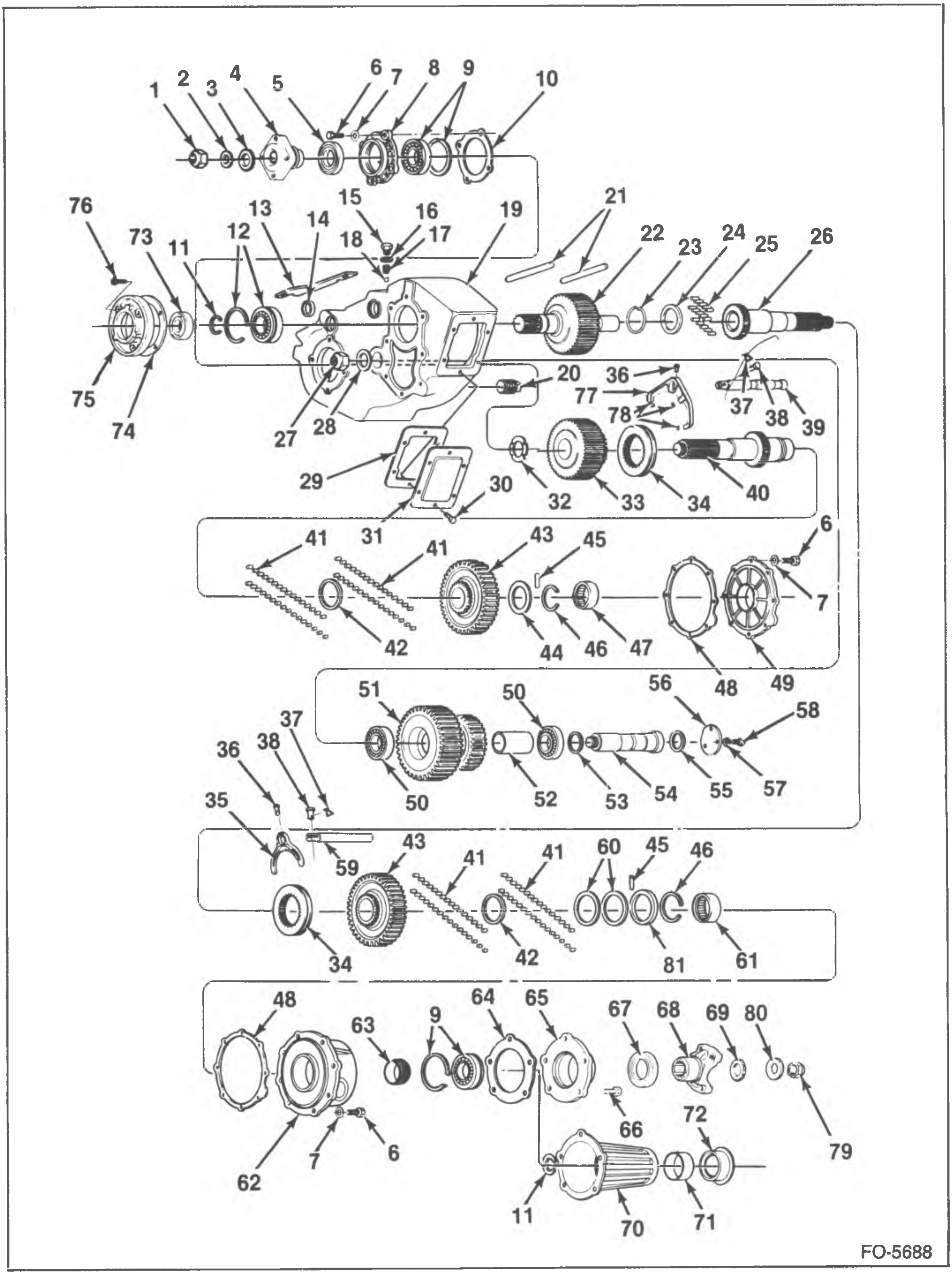
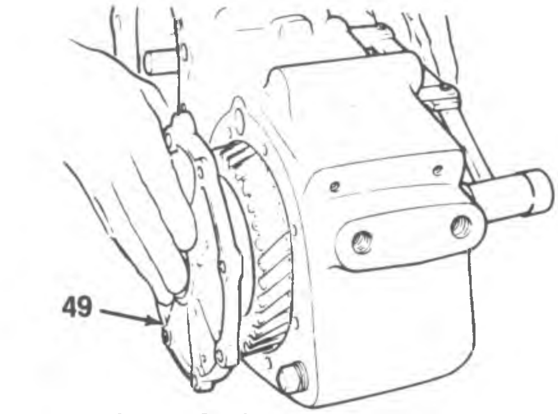


Figure 3—NP205 Transfer Case

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

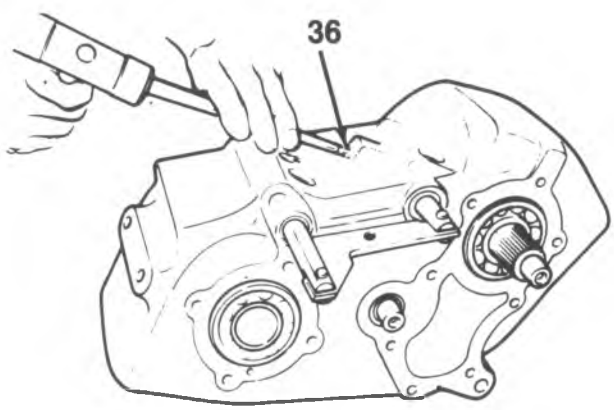
Figure 4—NP205 Transfer Case



49. Front Output Shaft Rear Bearing Retainer

FO-1979

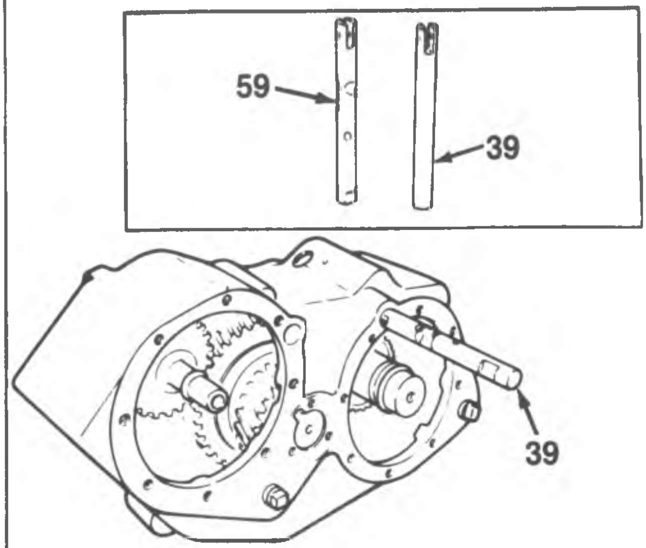
Figure 5—Removing the Front Output Shaft Bearing



36. Coiled Spring Pin

FO-2034

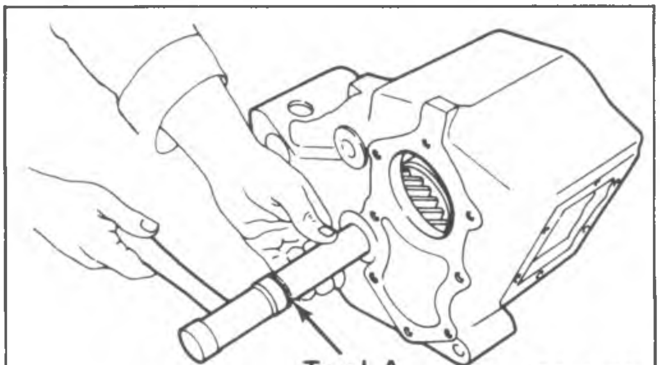
Figure 6—Removing the Shift Fork Roll Pin



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

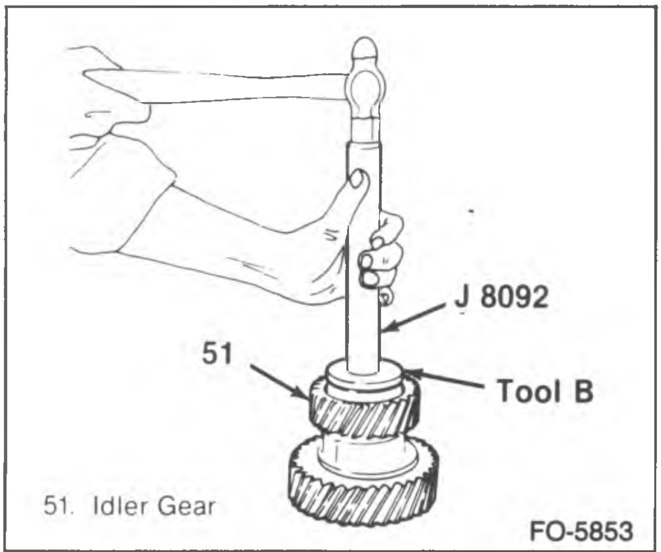


Figure 9—Installing the Bearing Cup

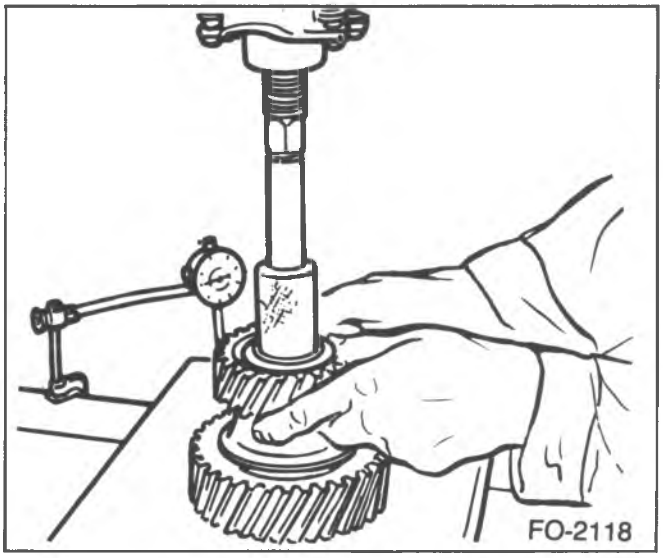


Figure 10—Idler Gear End Play Check

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.

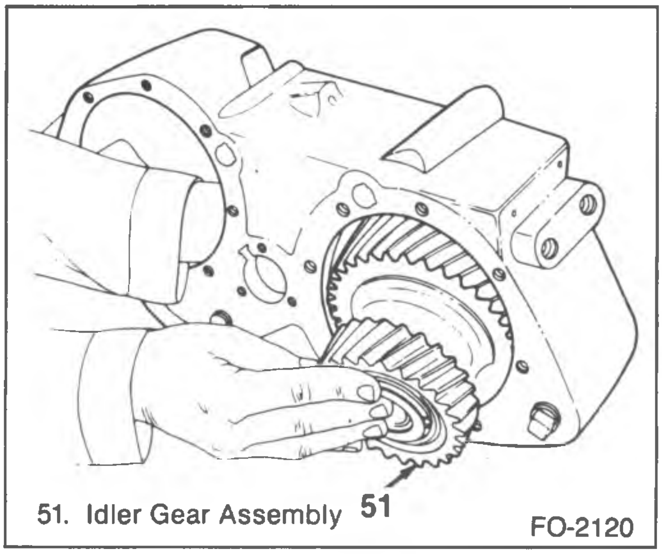


Figure 11—Installing the Idler Gear Assembly

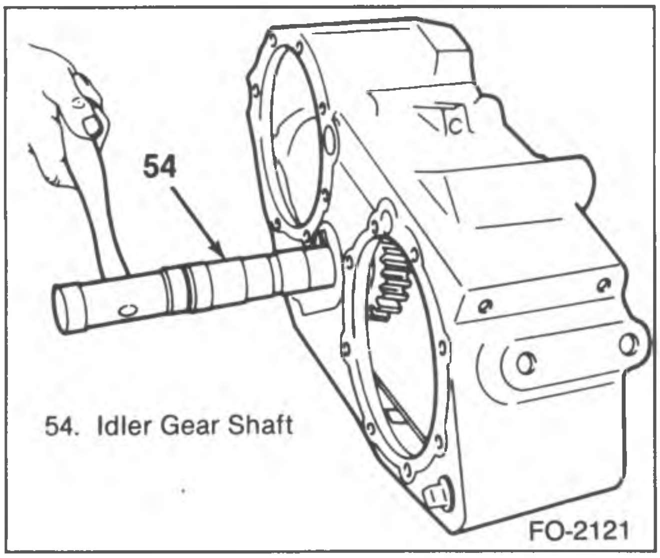


Figure 12—Installing the Idler Shaft

- 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.).

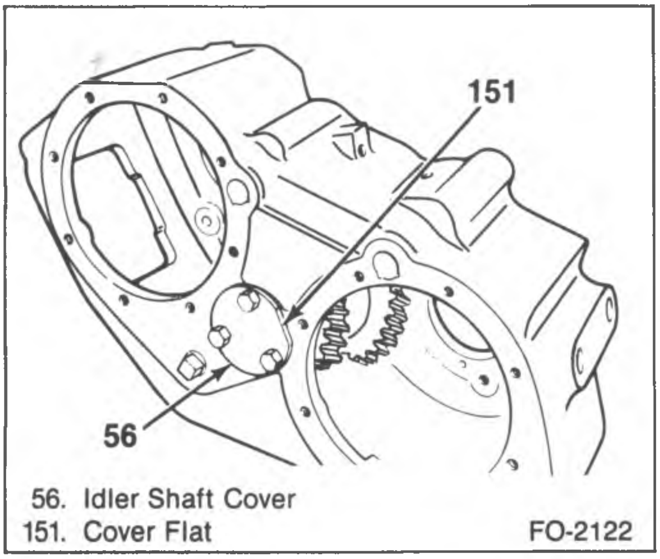


Figure 13—Idler Shaft Cover Alignment

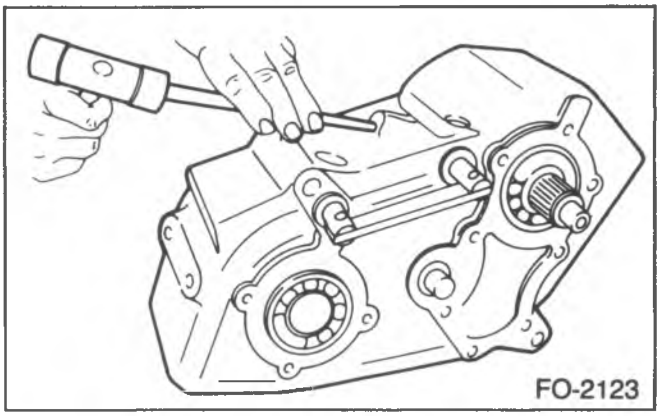


Figure 14—Installing the Shift Fork Roll Pin

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

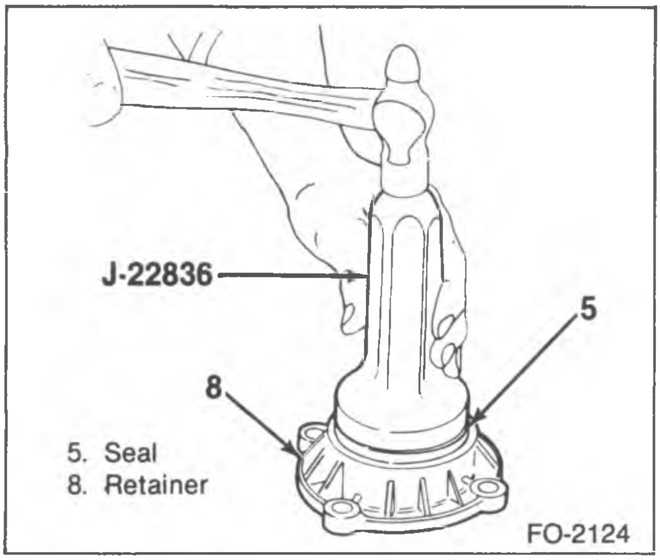


Figure 15—Installing the Front Output Bearing Retainer Seal

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.

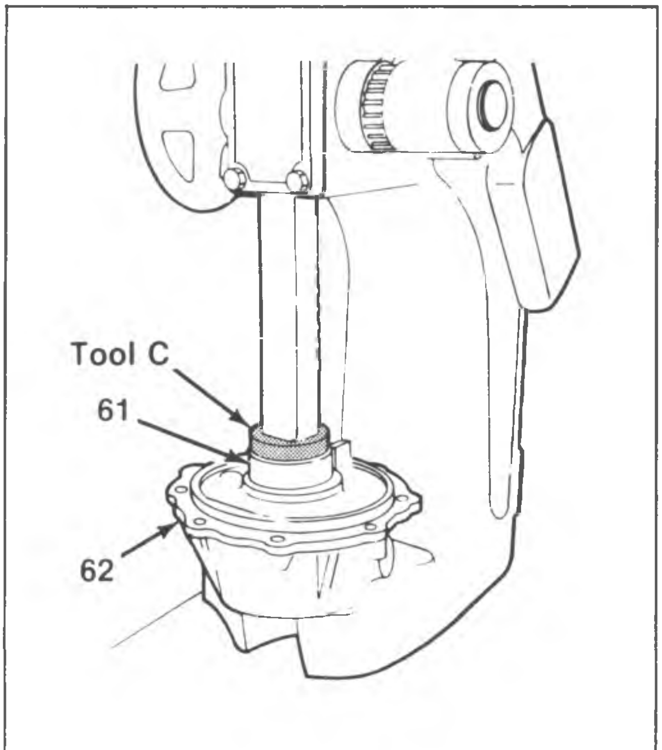


Figure 16—Installing the Rear Output Shaft Retainer Bearing

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).

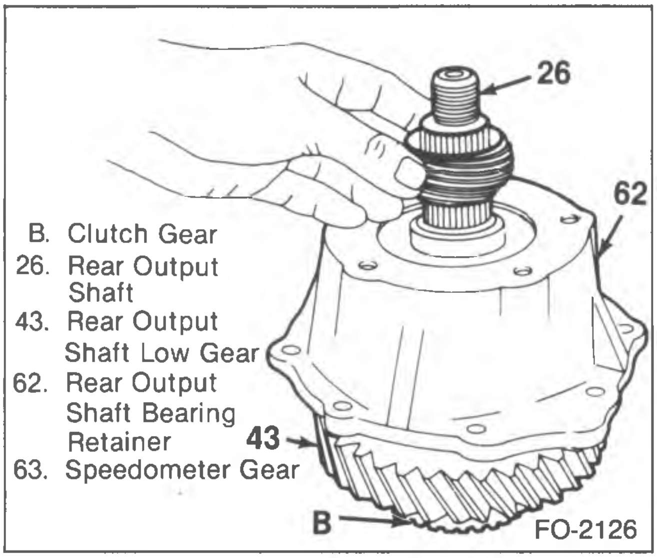


Figure 17—Installing the Speedometer Gear

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.

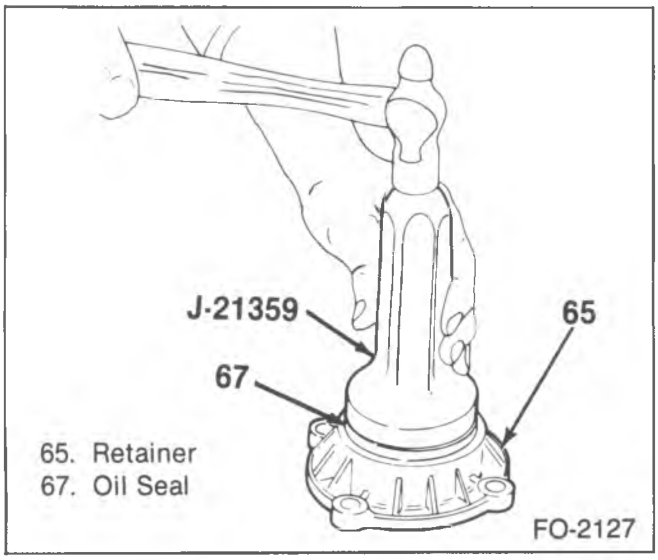


Figure 18—Installing the Rear Bearing Retainer Seal

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.).

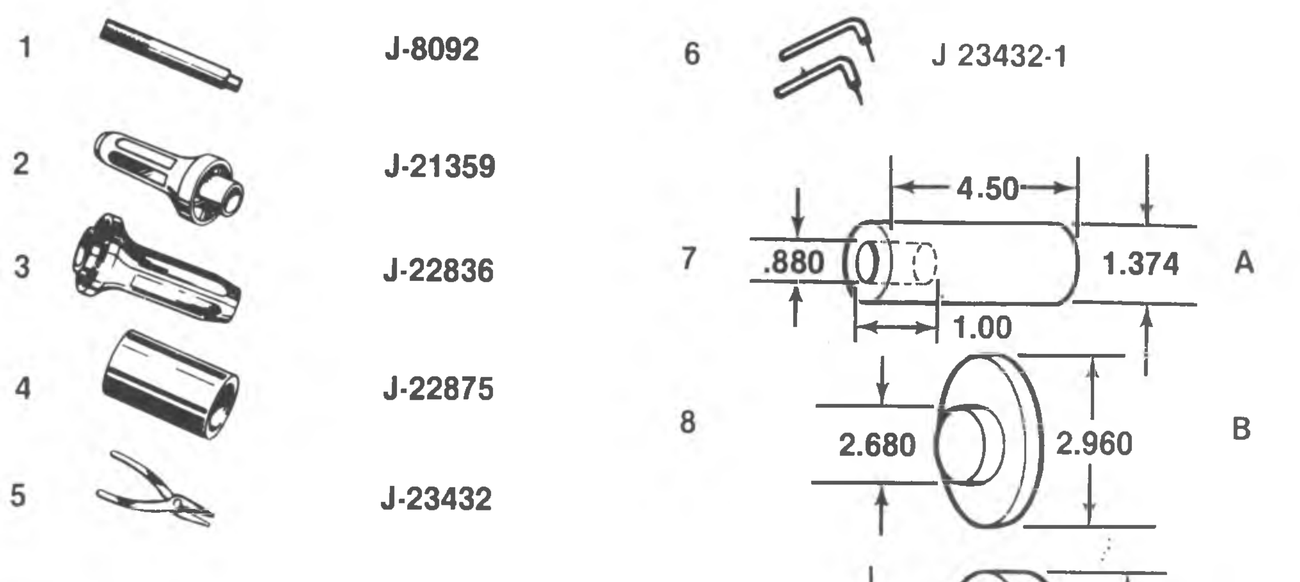
6. Shift rail cross link (13).
7. Clevis pins (38).
8. Lock pins (37).

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

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

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 Model 241 transfer case are selected by a floor mounted gearshift lever.

The Model 241 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 provides, the four-wheel drive low range when engaged.The gear 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 2). This tag provides the transfer case model number, low range reduction ratio, and an assembly number. The information on this tag is necessary for servicing this transfer case. 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 mainshaft. 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 sychronizer 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 the 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 now 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 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

DISASSEMBLY

EXTERNAL COMPONENTS

Clean

- The transfer case exterior using a solvent and a stiff brush.

Remove or Disconnect (Figures 1 through 4)

1. Front output flange nut (77), washer (76), rubber sealing washer (75) and front output flange (74) from the front output shaft.
2. Four-wheel drive actuator switch (46) and O-ring seal (47).
3. Speedometer sensor (9) and O-ring seal (85).
4. Poppet screw (68), O-ring seal (47), poppet spring (71) and poppet plunger (70).

MAINSHAFT EXTENSION AND OIL PUMP HOUSING

Remove or Disconnect (Figures 3, 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 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 mainshaft (19).
6. Case bolts (3) from case halves.
   - Note two longer case bolts and washers go into the doweled case holes (33).

- Separate the case halves. Insert two screwdrivers into the slots cast into 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) (17).

INTERNAL COMPONENTS

Remove or Disconnect (Figures 3 through 9)

Tools Required:
- J 2619-01 Slide Hammer
- J 8092 Driver Handle
- J 22912-1 Bearing Remover
- J 29369-1 Output Shaft Bearing Remover
- J 29369-2 Output Shaft Bearing Remover
- J 9276-21 Slide Hammer Adapter
- J 33832 Bearing Installer/Remover

NOTICE:The annulus gear found in this transfer case is not serviceable or removable, and should only be replaced as a unit with the front case half. If the annulus gear is removed, damage will result to the case.

38. Input Gear
44. Input Bearing Retainer
46. 4WD Actuator Switch
63. Shift Lever Nut
65. Shift Lever
74. Front Output Flange

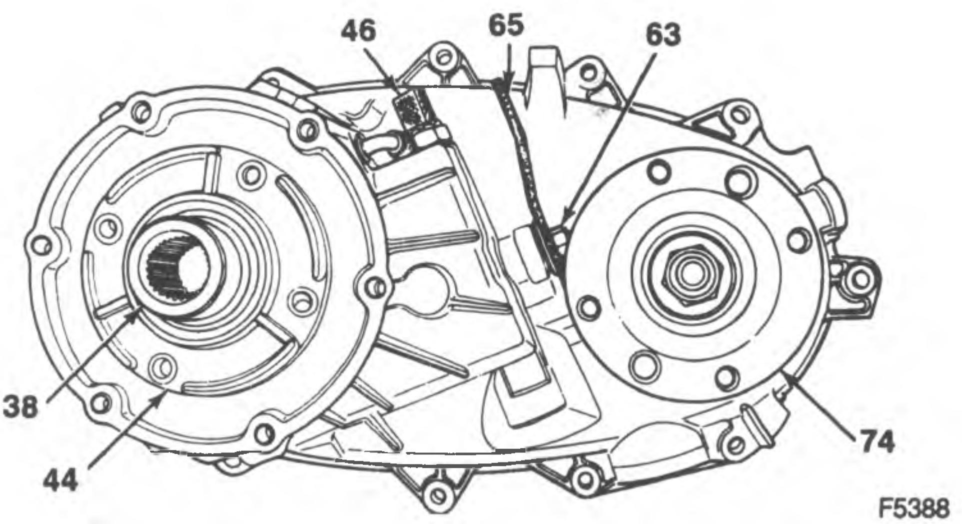
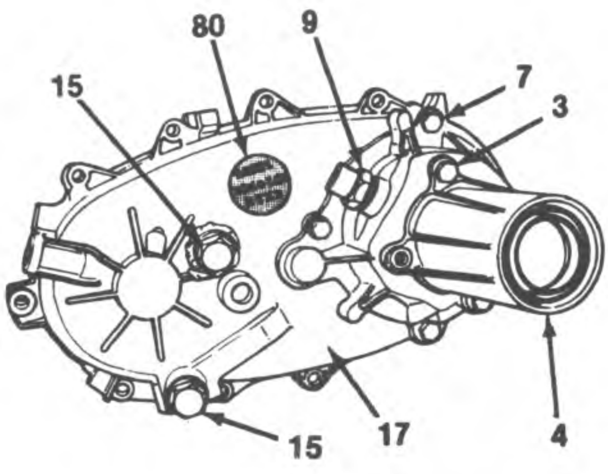


Figure 1—Front View 241—Transfer Case

1. Oil pump (12), pickup tube (18), O-ring (14) and pump pickup filter (35) from the rear case half (17) (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) (83) from the mainshaft (19).
6. Synchronizer assembly (81) and drive sprocket (20) from the mainshaft (19) (figure 5).
7. Range shift fork (51), range shift hub (34) and sector with shaft (55) from 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 O-ring (67) from the front case half (45).
9. Input bearing retainer bolts (43) and input bearing retainer (44) from front case half (45).
10. Bearing retainer (snap ring) (39).
11. Planetary carrier (36) and input gear (38) from the annulus gear using a soft faced hammer.
12. Retainer ring (snap ring) (41) from input gear (38).
13. Input bearing (40) from the input gear (38) using J 22912-01 (Bearing Remover).
    - Carrier lock ring (78).
    - Thrust washer (37).
14. Drive sprocket bearings (82) from drive sprocket (20) using J 29369-1 and J 2619-01 (figure 8).
15. Mainshaft pilot bearing (84) from the input gear (38) using J 29369-2, J 9276-21 and J 2619-01 (figure 8).
16. Front output bearing retainer (snap ring) (60).
17. Front output shaft seal (72) from front case half (45).
18. Front output bearing (61) from front case half (45) using J 33832 and J 8092.
19. Seal (1) from the mainshaft extension housing (4).
20. Seal (42) from input bearing retainer (44).
21. Front output bearing (24) from rear case half (17).
    - Insert J 29369-2 behind the needle bearings.
    - Using J 2619-01, hammer the bearing from the case (figure 9).
22. Mainshaft bearing (6) from the oil pump retainer (8).



3. Mainshaft Extension Bolt
4. Mainshaft Extension
7. Pump Retainer Housing Bolt
9. Speedometer Pick-up Switch
15. Fill/Drain Plug
17. Rear Case
80. Identification Tag

F5385

Figure 2—Rear View 241—Transfer Case

23. Magnet (25) from the front case half (45).

Disassemble

- Scribe the location of the synchronizer sleeve and hub to aid in assembly.

1. Main drive synchronizer stop ring (28) from the synchronizer sleeve (29).
2. Spring retainers (32) from the synchronizer hub (31).
3. Synchronizer hub (31) from the synchronizer sleeve (29).

- Be careful not to damage the synchronizer struts (30) when removing the sleeve (29) from the hub (31).
- The oil pump (12) is not serviceable and should be replaced as a unit only.

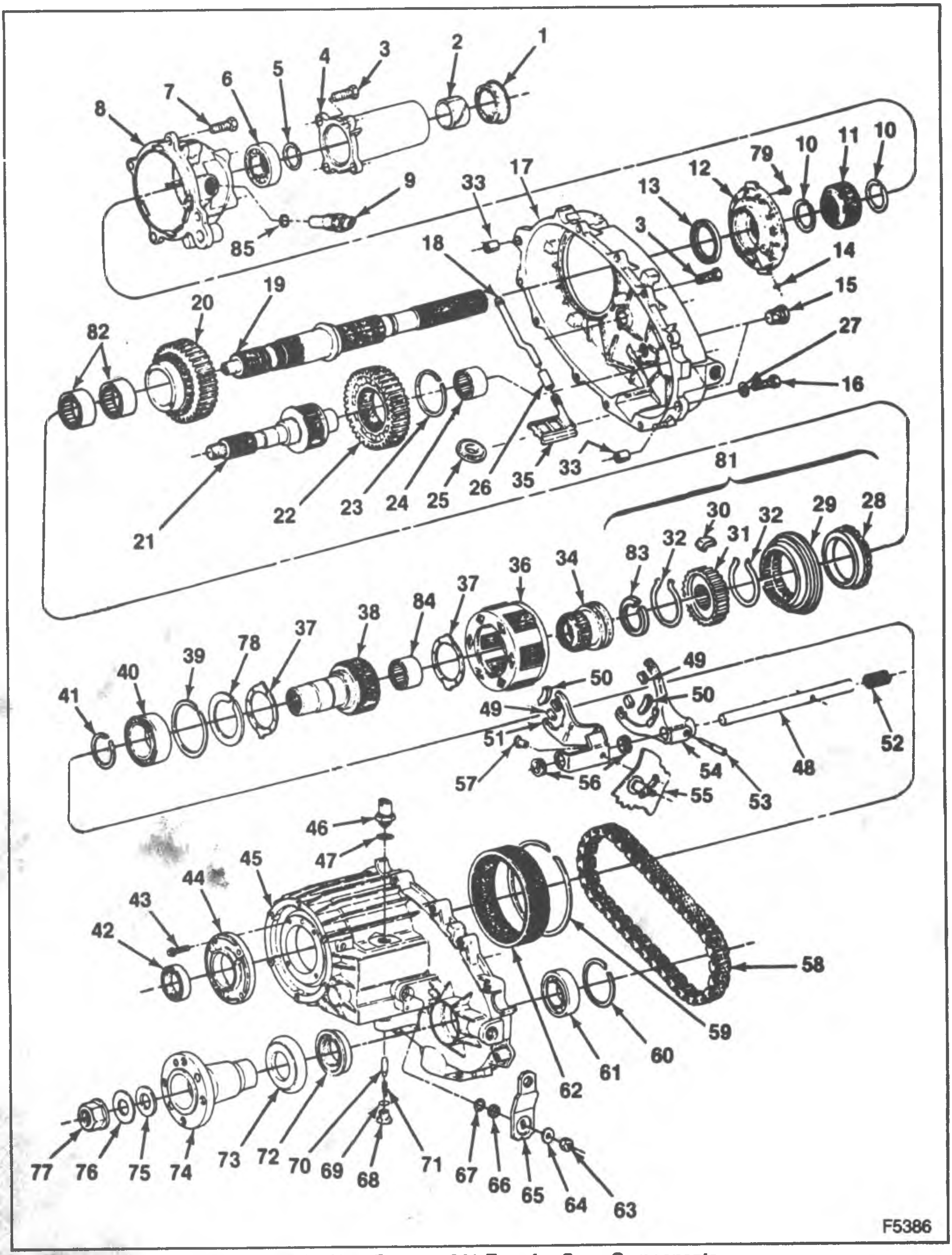
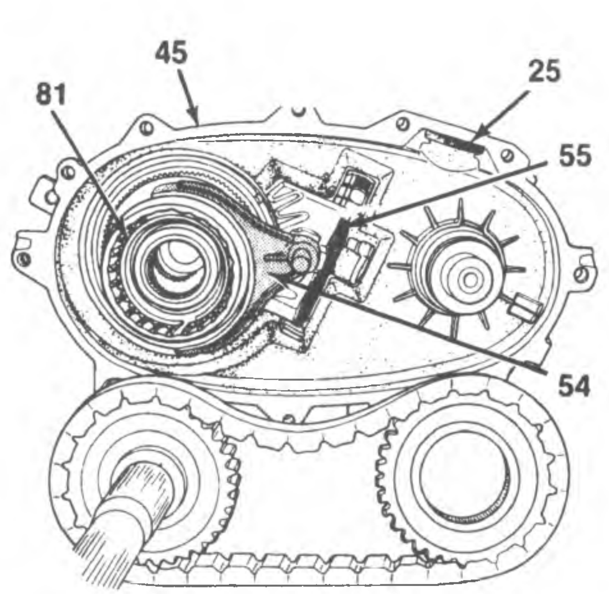


Figure 3—New Process 241 Transfer Case Components

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 (4)
9. Speedometer Sensor
10. Retainer (Snap Rings) (2)
11. Speedometer tone Wheel
12. Oil Pump
13. Oil Pump Seal
14. Oil Pump Pickup Tube O-Ring Seal
15. Fill/Drain Plugs
16. Long Case Bolts (2)
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 (3)
31. Synchronizer Hub
32. Spring Retainers (2)
33. Dowels (2)
34. Range Shift Hub
35. Pump Pick Up Screen
37. Thrust Washers (2)
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. 4WD Actuator Switch
47. O-Ring Seal
48. Shift Rail
49. Pads (4)
50. Pads (Center) (2)
51. Range Shift Fork
52. Fork Shift Spring
53. Mode Shift Fork Pin
54. Mode Shift Fork
55. Sector With Shaft
56. Bushings (2)
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
85. Speedometer Sensor O-Ring Seal

F5387

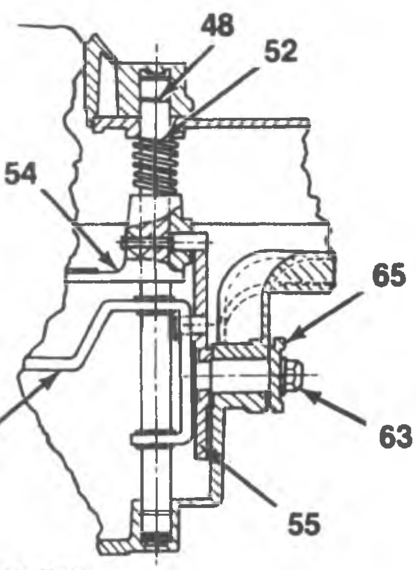
Figure 4—New Process 241 Transfer Case Legend



25. Magnet
45. Front Case Half
54. Mode Fork
55. Sector With Shaft
81. Synchronizer Assembly

F5391

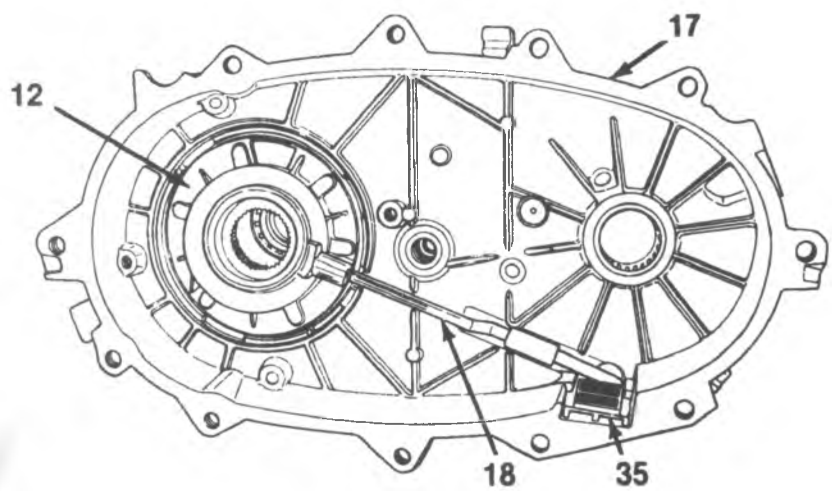
Figure 5—Mode Fork and Shaft Assembly



48. Shift Rail
51. Range Fork
52. Mode Fork Spring
54. Mode Fork
55. Sector With Shaft
63. Shift Lever Nut
65. Lever

F5389

Figure 6—Shift Rail Assembly



12. Oil Pump
17. Rear Case Half
18. Oil Pump Tube
35. Oil Filter

F5390

Figure 7—Oil Pump Assembly

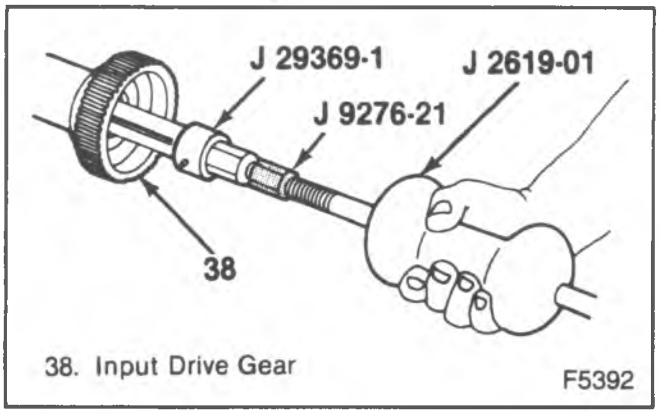


Figure 8—Removing the Input Gear Bearing

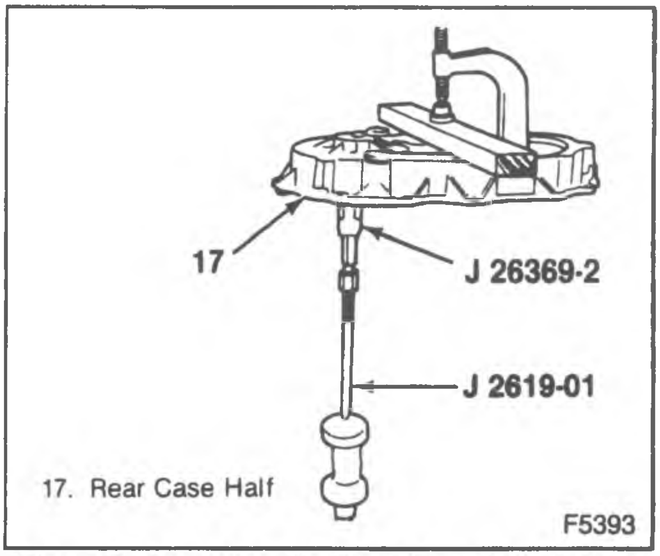


Figure 9—Removing the Front Output Shaft Rear Bearing

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 to remove any obstructions, or cleaning solvent residue.
6. All mating and sealing surfaces

Inspect

1. Bearings and thrust washers for 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 thread holes.
7. Synchronizer stop rings for cracks, chips, spalling, or excessive wear.
8. Synchronizer hub and sleeve for cracks, chips, spalling, or excessive wear.
9. Pads on mode fork and range fork for wear and 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

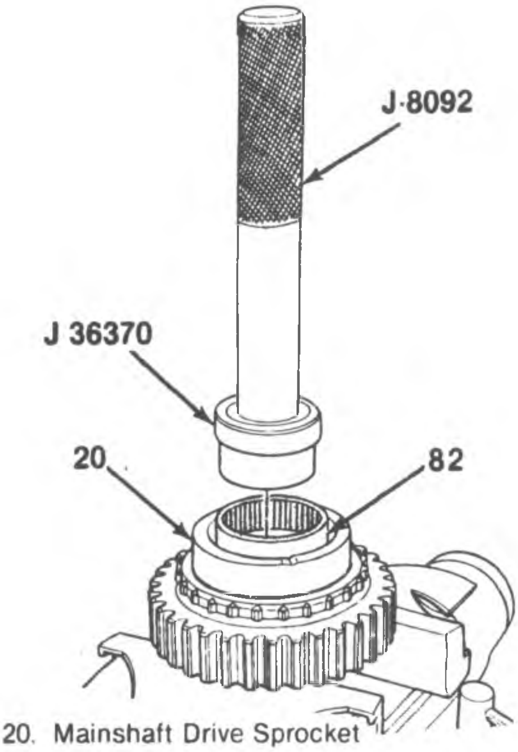
BEARING AND SEAL REPLACEMENT

Install or Connect (Figures 10 through 14)

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 automatic transmission fluid where needed in assembly.

1. Needle bearings (82) into the drive sprocket (20) using J 36370 and J 8092 (figure 10).
   - Drive the bearings (82) into the drive sprocket so that they are flush on the synchronizer side.
2. Needle bearing (24), into the rear case half (17) using J 36372 and J 8092.
   - Bearing must be flush with boss on the case housing.

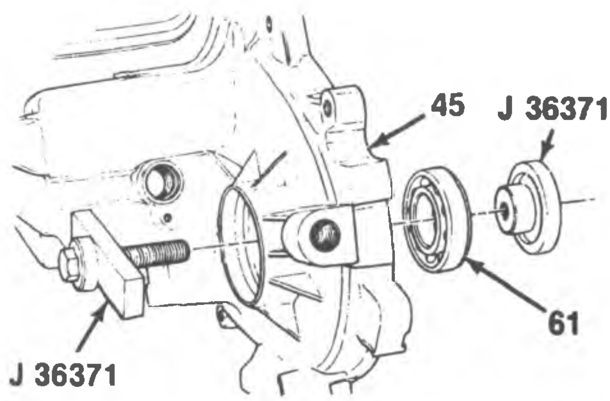


20. Mainshaft Drive Sprocket
82. Needle Bearings

F5394

Figure 10—Installing the Needle Bearings to the Front Drive Sprocket

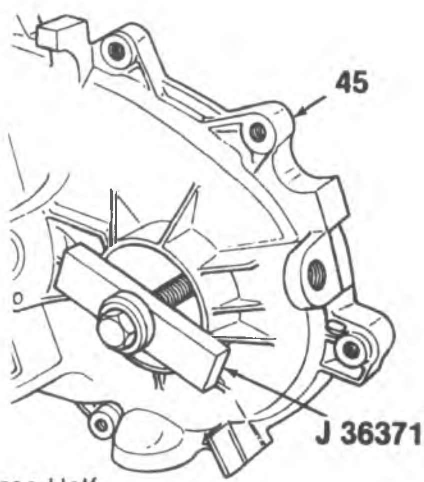
3. Bearing (61) into front case half (45) using J 37371 (figures 11 and 12).
4. Bearing retainer (60) into front case half (45).
5. Bearing (6) into pump retainer housing (8) using J 36371 (figures 13 and 14).
6. Bearing (84) to the input gear (38) using J 36372 and J 8092.
7. Thrust washer (37).
8. Carrier lock ring (78).
9. Retainer (39).
10. Bearing (40) to the input gear (38) using J 36373.
11. Retainer ring (snap ring) (41) to the input gear (38).
12. Oil seal (1) to rear extension (4).
13. Input bearing retainer seal (42) to the input bearing retainer (44).



45. Front Case Half
61. Front Output Bearing

F5395

Figure 11—Installing the Front Output Bearing

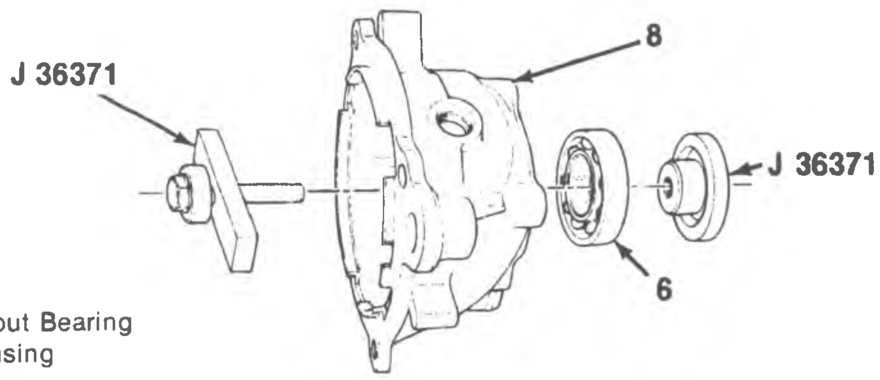


45. Front Case Half

F5429

Figure 12—Installing the Front Output Bearing with J 36371

14. Front output shaft seal (72) to the front case half (45).
15. Magnet (25) to front case half (45).



6. Front Output Bearing
8. Pump Housing

F5430

Figure 13—Installing the Pump Housing Bearing

INTERNAL COMPONENTS

Assemble (Figures 15 through 19)

NOTICE: For steps 6, 8, 23, 25 see "Notice" on page 7D2-1 of this section.

1. Spring retainers (32) to the synchronizer hub (31).
2. Synchronizer hub (31) to the synchronizer sleeve (29) along with the three struts (30).
   - Align the previously scribed marks.
3. Main drive synchronizer stop ring (28) to the synchronizer sleeve (29).

Install or Connect

1. Drive sprocket (20) to the mainshaft (19).
2. Synchronizer assembly (81) to the mainshaft (19).
3. Synchronizer retainer snap ring (83) to the mainshaft (19).
4. Planetary input gear assembly (38) into the annulus gear (62) using a soft faced hammer.
5. Bearing retainer (snap ring) (39) to the input bearing (40).
6. Input bearing retainer (44) and input bearing retainer bolts (43) to the front case half (45).
   - Apply RTV or equivalent to bearing retainer mating surfaces.
   - Apply Loctite 242 or equivalent on bearing retainer bolts.

Tighten

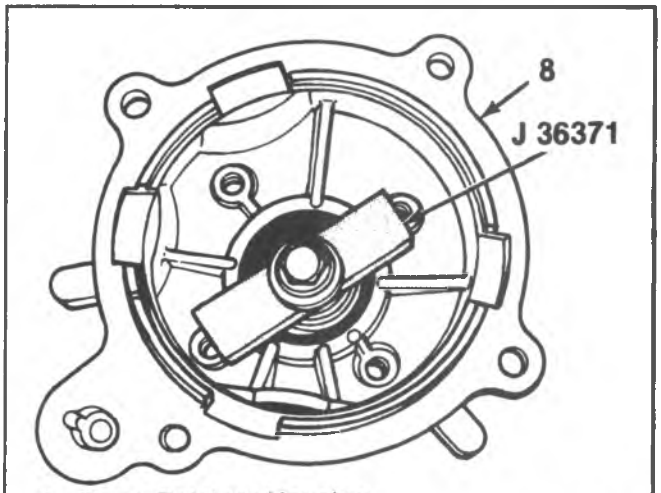
- Bolts (43) to 19 N·m (14 ft.lbs.).

7. Sector with shaft (55) into the front case half (45).
8. Shift lever O-ring (67), plastic washer (66), shift lever (65), washer (64), and nut (63) to the front case half (45) (figure 15).

Tighten

- Nut (63) to 27 N·m (20 ft. lbs.).

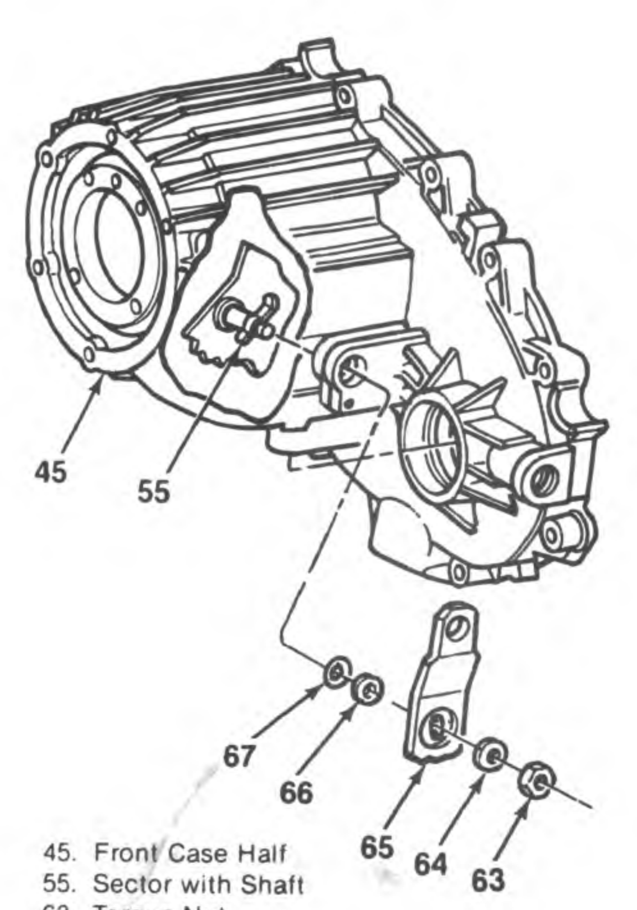
9. Range shift hub (34) and the range fork into the front case half (45).
   - It is necessary to rotate the sector to align the range shift fork.
10. Front output shaft (21) to the front case half (45).
11. Driven sprocket (22) to the chain (58).
12. Chain (58) onto the drive sprocket (20) located on the mainshaft (19).
    - Mainshaft assembly (19), driven sprocket (22), and chain (58) are installed into the front case half as a unit.
13. Driven gear retainer, (snap ring) (23) to front output shaft (21).
14. Mode shift fork (54) onto shift rail (48).
15. Mode shift fork pin (53).
    - Mode shift fork (54), shift rail (48), and the mode shift fork pin should be assembled as a unit before they are installed into the case.
16. Mode shift fork assembly (54) through the range shift fork (51), onto the synchronizer sleeve and into the front case half (45).



8. Pump Retainer Housing

F5431

Figure 14—Installing the Pump Housing Bearing with J 36371



45. Front Case Half
55. Sector with Shaft
63. Torque Nut
64. Washer
65. Shift Lever
66. Plastic Washer
67. O-Ring Seal

F5433

Figure 15—Sector with Shaft

17. Fork shift spring (52) to the shift rail (48).
18. Oil pump pick up tube (18), oil tube connector (26) and pump pick up screen (35) into rear case half (17) (figure 17).
19. Oil tube O-ring (14) into oil pump (12).
20. Oil pump (12) to the oil pick up tube (18).
    - Lubricate oil pump pick tube with automatic transmission fluid before installing into pump.
21. Dowels (33) into front case half.
    - Wipe case mating surfaces clean.
    - Apply RTV sealer case mating surfaces.
22. Rear case half (17) over mainshaft (19) and onto front case half (45).
    - Be careful not to damage the oil pump (12) while installing the rear case half (figure 7).
23. Case bolts (3) into case halves.
    - Apply Loctite 242 or equivalent to the case bolts (3).
    - The two longer case bolts and washers into the doweled case holes (33) (figure 17).

Tighten

- Bolts (3) to 31 N.m (23 ft. lbs.).

24. Retainer (snap ring) (10), speedometer tone wheel (11) and retainer (snap ring) (10) to the mainshaft (19).
25. Pump retainer housing (8) and pump retainer bolts (7) to the rear case half (17).
    - Apply Loctite 242 or equivalent to pump housing bolts.
    - Pump bolts (7) are shouldered.
26. Output bearing retainer (snap ring) (5) to the mainshaft (19).
27. Rear extension housing (4) and extension bolts (3) to the pump retainer housing (8).
    - Apply RTV or equivalent to the mating surfaces.
    - Apply Loctite 242 or equivalent to the extension housing bolts.

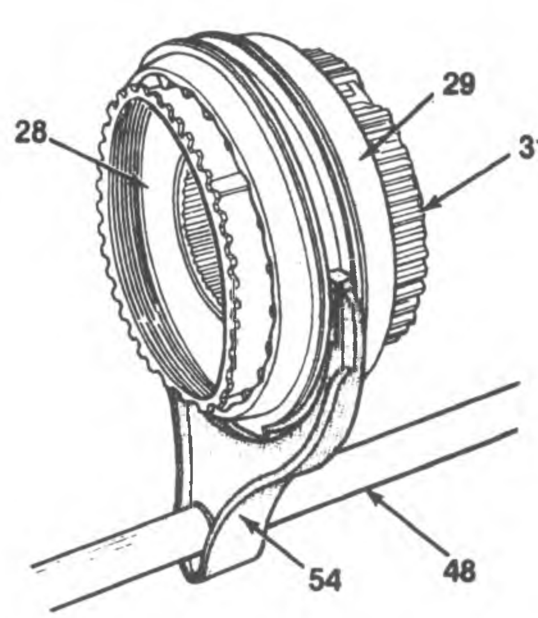
Tighten

- Bolts to 31 N.m (23 ft. lbs.).

EXTERNAL COMPONENTS

Install or Connect

NOTICE: For steps 1 through 4 see "Notice" on page 7D2-1 of this section.



28. Synchronizer Stop Ring
29. Synchronizer Sleeve
31. Synchronizer Hub
48. Shift Rail
54. Mode Fork

F5432

Figure 16—Synchronizer Hub Assembly and Mode Fork

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 15 N.m (11 ft. lbs.).

2. Speedometer sensor (9) and O-ring (85) to the pump retainer housing (8).

Tighten

- Sensor to 31 N.m (23 ft. lbs.).

3. Four wheel drive actuator switch (46) and O-ring (47) to front case half (45).

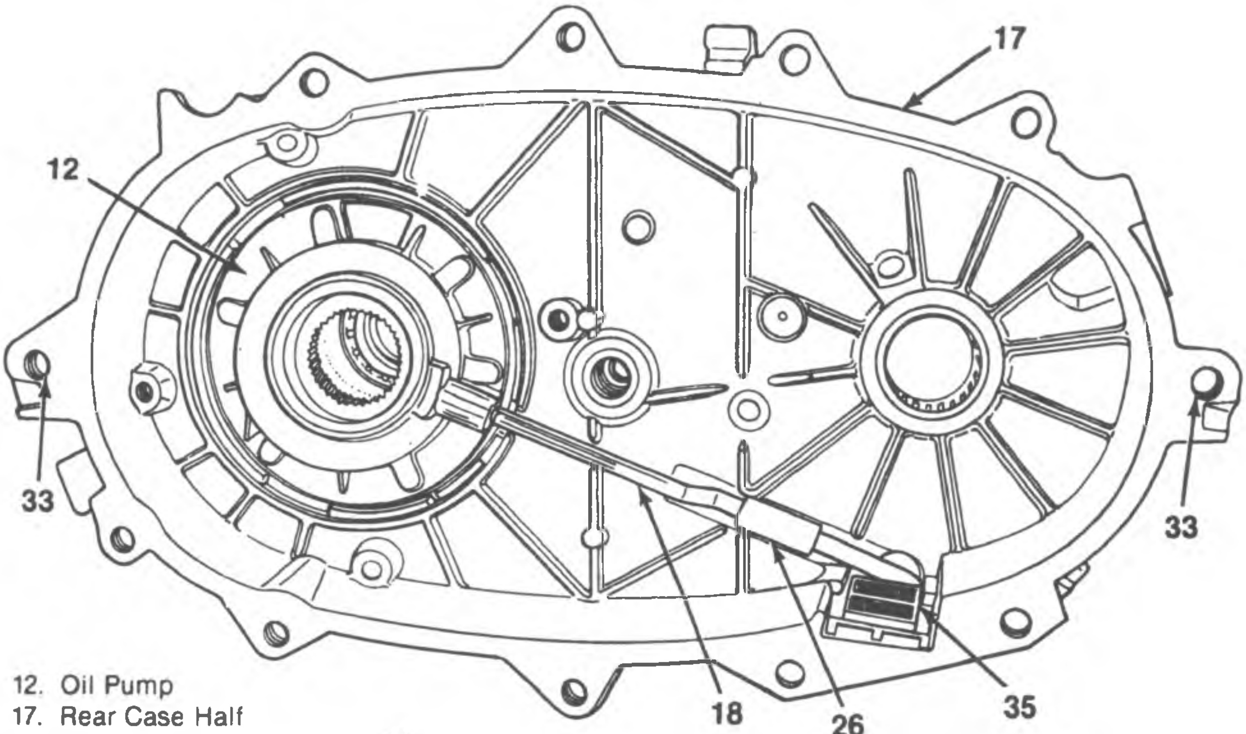
Tighten

- 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 200 N.m (150 ft. lbs.).



12. Oil Pump
17. Rear Case Half
18. Oil Pump Pick Up Tube
26. Connector
33. Dowel Pin Location
35. Pump Pick Up Screen

Figure 17—Oil Pump, Pickup, Screen, Doweled Case Holes

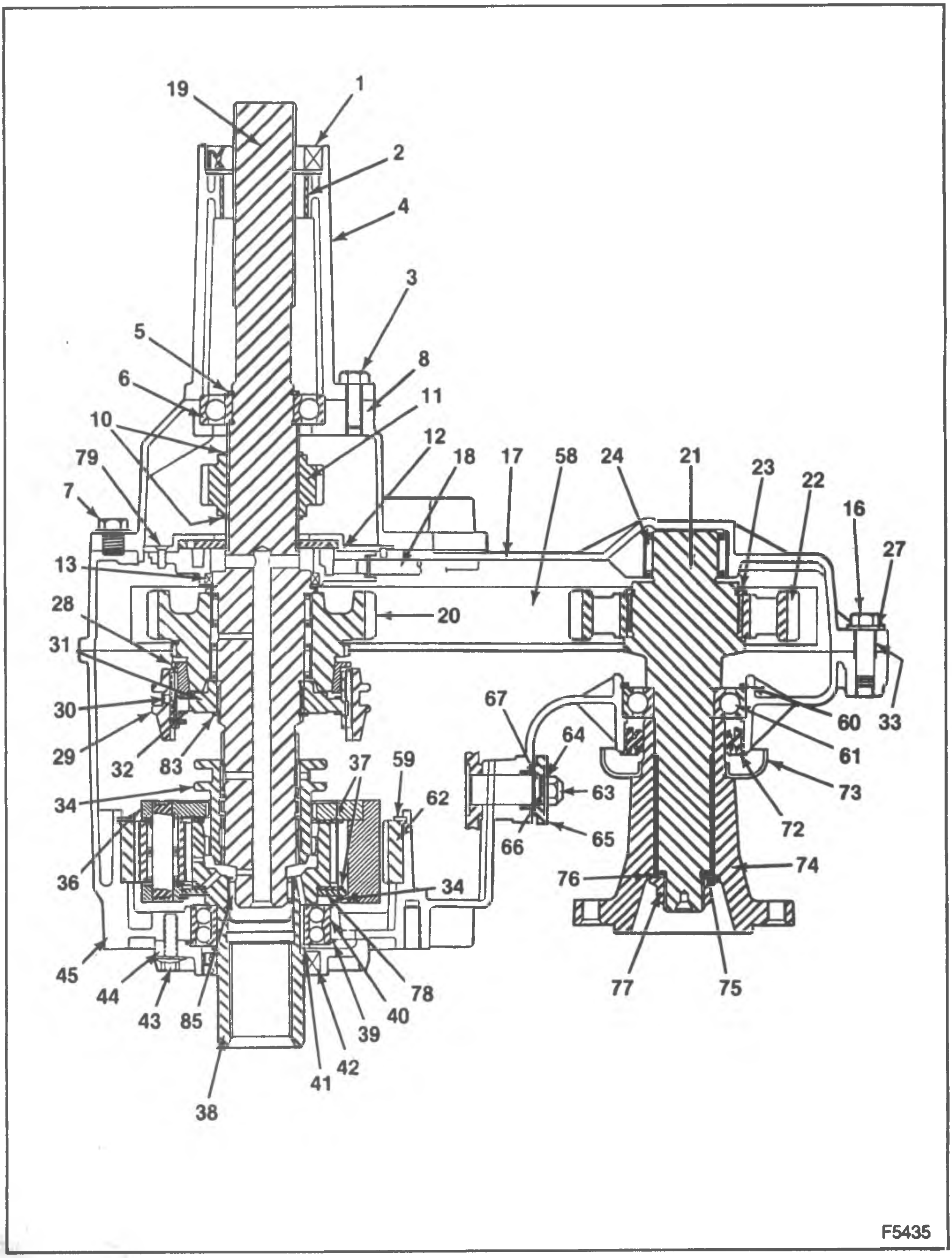


Figure 18—NP 241 Transfer Case Sectional View

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

F5436

Figure 19—NP 241 Transfer Case Legend

SPECIFICATIONS

NEW PROCESS 241 TRANSFER CASE

	N·m	Ft. Lbs.
Input Shaft Retainer Bolts	19	14
Shift Selector Lever Nut	27	20
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 Bolt	200	150
Drain and Fill Plugs	47	35
Lubricant: Dexron® II	4.6 Pints	
Four Wheel Drive Actuator Switch	24	17
Poppet Screw	15	11

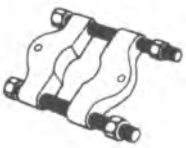
T2540

SPECIAL TOOLS

1.  J 2619-01

2.  J 2619-5

3.  J 8092

4.  J 22912-1

5.  J 29369-1

6.  J 29369-2

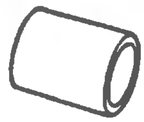
7.  J 9276-21

8.  J 33832

9.  J 36371

10.  J 36370

11.  J 36372

12.  J 36373

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

SECTION 7D3

NEW PROCESS 231 TRANSFER CASE

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

DESCRIPTION

The Model 231 transfer case is an aluminum case, chain drive, four position unit. It provides 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 range is undifferentiated. The range positions are selected by a floor mounted shifter.

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 gear assembly which consists of a 3-pinion planetary carrier and an annulus gear provide the four-wheel drive low range when engaged. The 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 gear reduction ratio, and assembly number. The information on this tag is necessary when servicing this transfer case. If the tag is removed or becomes dislodged during service operations, it should be reattached using an adhesive 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 mainshaft. 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 the 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

DISASSEMBLY

EXTERNAL COMPONENTS

Clean (Figures 2, 3, and 4)

- The transfer case exterior using solvent and a stiff brush.

Remove or Disconnect

1. Front output yoke nut (77), washer (76), rubber sealing washer (75) and front output yoke (74) from the front output shaft.
2. Vacuum switch (46) and O-ring seal (47).
3. Poppet screw (68), poppet spring (71) and poppet plunger (70).

MAINSHAFT EXTENSION AND OIL PUMP HOUSING

Remove or Disconnect (Figures 2, 3, and 4)

1. Rear extension 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 tone wheel (11) from the mainshaft (19).
6. Case bolts (3) from the case halves.
   - Note, the two longer case bolts and washers go into the doweled case holes (33).

Important

Some transfer case models have a bracket attached to them by the case half bolts. These bolts are different from the others and must be put back into the correct holes.

- Separate the case halves by inserting screwdrivers into the slots cast into the case ends and pry apart. Do not attempt to wedge the case halves apart at any point on the mating surfaces. Damage to the case may result.
  - 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 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

NOTICE: The annulus gear found in this transfer case is not serviceable or removable, and should only be replaced as a unit with the front case half. If the annulus gear is removed, damage will result to the case.

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.
3. 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.
4. Retainer (snap ring) (83) from the mainshaft (19).
5. Synchronizer assembly (81).
6. Drive sprocket (20) from the mainshaft (19) (figure 6).
7. Range shift fork (51) and range shift hub (34) from the planetary carrier (36).
   - It is necessary to rotate the sector shaft (55) to obtain clearance when removing the range fork (51) (figure 7).
8. Shift lever nut (63), washer (64), shift lever (65), sector and shaft assembly (55) 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. Input bearing (40) from the front case half (45) using J 36370 and J 8092.
13. Drive sprocket bearings (82) from the drive sprocket (20) using J 29170 and J 8092.
14. Needle bearings (84) from the input gear (38) using J 29369-1, J 9276-21 and J 2619-01 (figure 8).

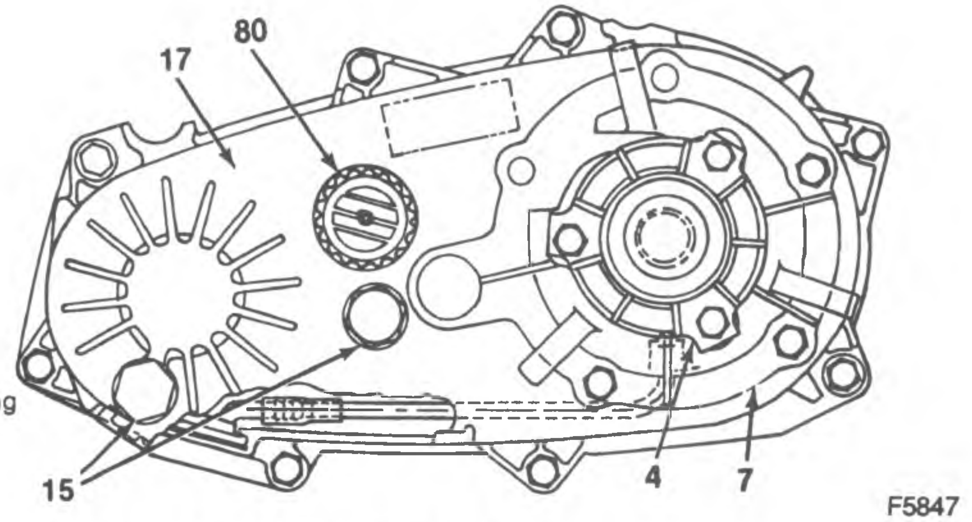


Figure 1—231 Rear Case Half

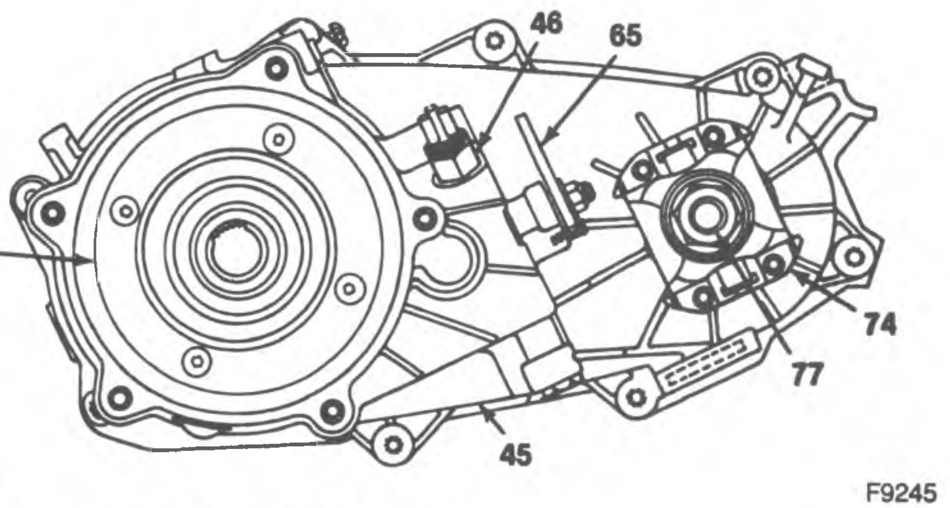


Figure 2—231 Front Case Half

15. Front output shaft seal (72) from the front case half (45).
16. Front output bearing retainer ring (snap ring) (60).
17. Front output bearing (61) from the front case half (45) using J 33790 and J 8092.
18. Seal (1) from the mainshaft extension housing (4).
19. Seal (42) from the input bearing retainer (44).
20. Front output rear bearing (24) from the rear case half (17) using J 2619-01 and J 29369-2 (figure 9).
21. Mainshaft bearing (6) from the oil pump retainer (8) using J 33790.
22. Magnets (25) from the front case half (45).

Disassemble

- Mark the location of the synchronizer hub and sleeve to aid in assembly. Synchronizer teeth must align with struts (30).

1. Main drive synchronizer stop ring (28) from the synchronizer sleeve (29).
2. Spring retainers (32) from the synchronizer hub (31).
3. Synchronizer hub (31) from the synchronizer (29).
4. Oil pump screws (79) from the oil pump (12).

NOTICE: The oil pump is not a serviceable unit and should be replaced if it is defective.

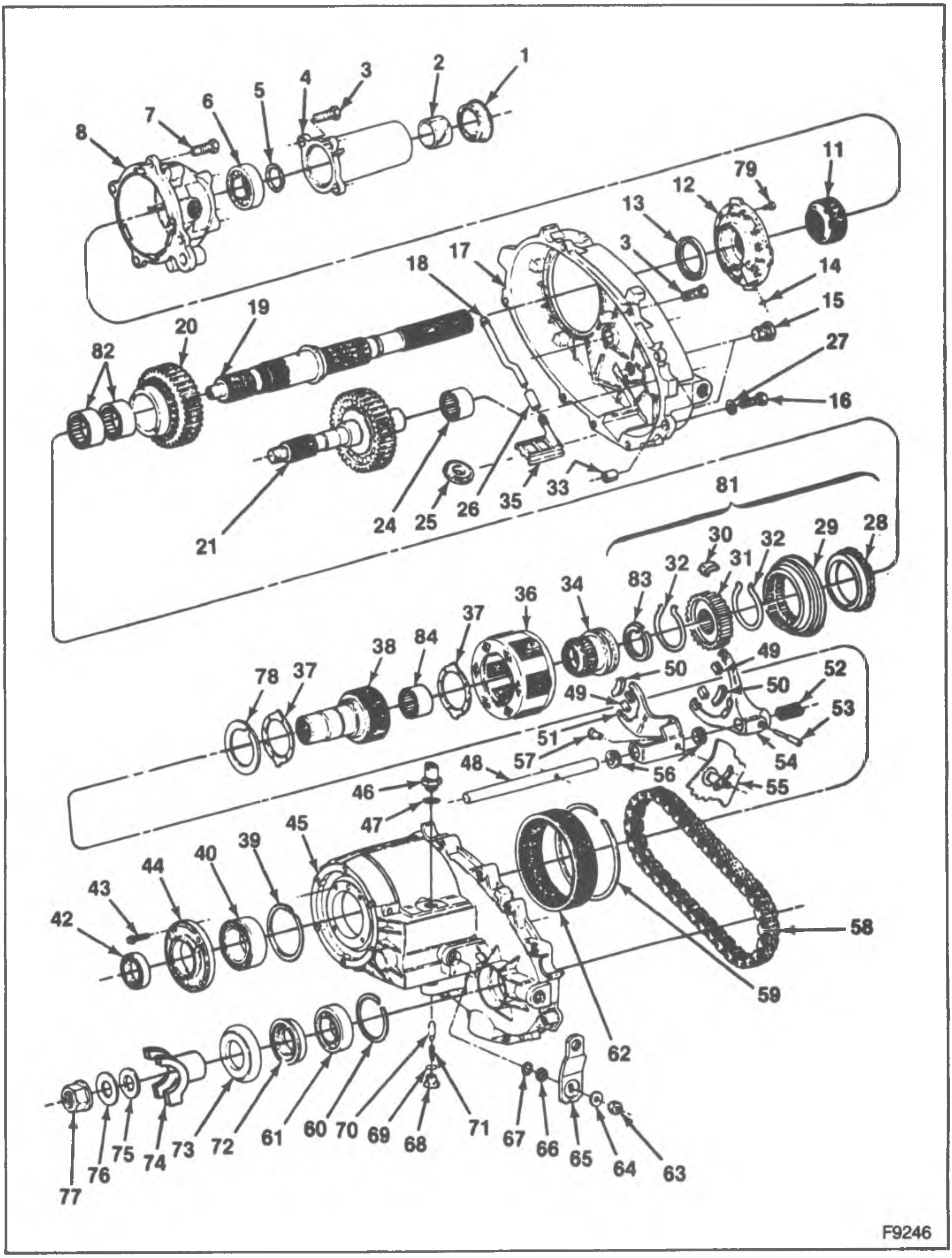


Figure 3—231 Transfer Case Components

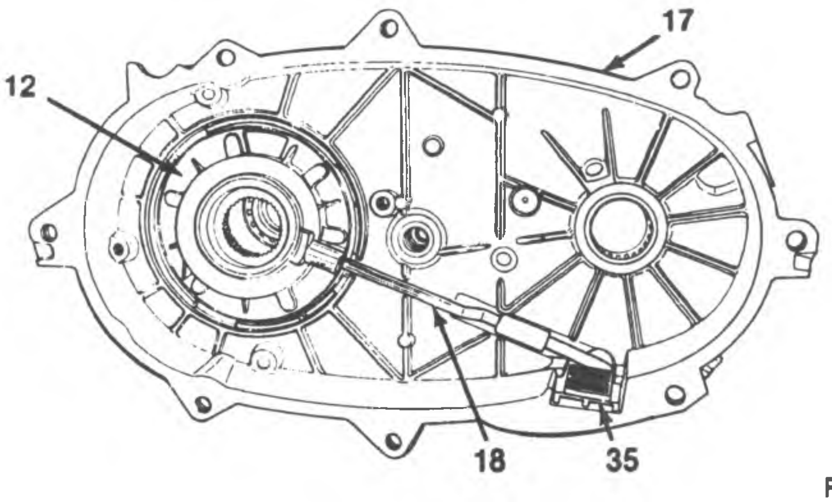
1. Oil Seal
2. Bushing
3. Rear Extension Housing Bolts/Case Bolts
4. Rear Extension
5. Retainer Snap Ring
6. Front Output Bearing
7. Pump Retainer Housing Bolts
8. Pump Retainer Housing
11. Speedometer Tone Wheel
12. Oil Pump
13. Oil Pump Seal
14. O-Ring
15. Plug
16. Bolt
17. Rear Case Half
18. Oil Pump Pick Up Tube
19. Mainshaft
20. Drive Sprocket
21. Front Output Shaft
24. Front Output Rear Bearing
25. Magnet
26. Oil Tube Connector
27. Washer
28. Main Drive Synchronizer Stop Ring
29. Synchronizer Sleeve
30. Strut (3)
31. Synchronizer Hub
32. Spring Retainer (2)
33. Dowel
34. Range Shift Hub
35. Pump Pick Up Screen
36. Planetary Carrier
37. Thrust Washer (2)
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. Vacuum 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 Seal
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

NOTE: Part numbers 48, 49, 50, 53, 54, must be serviced as an assembly.

NOTE: This annulus gear, number 62, is not serviceable or removable from the front case half. To replace it you must replace the front case half as an assembly.

F9247

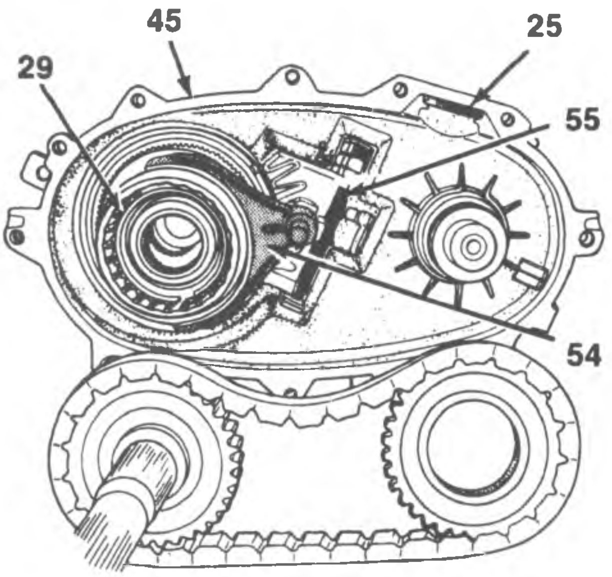
Figure 4—231 Transfer Case Components



12. Oil Pump
17. Rear Case Half
18. Oil Pump Pickup Tube
35. Oil Filter

F5851

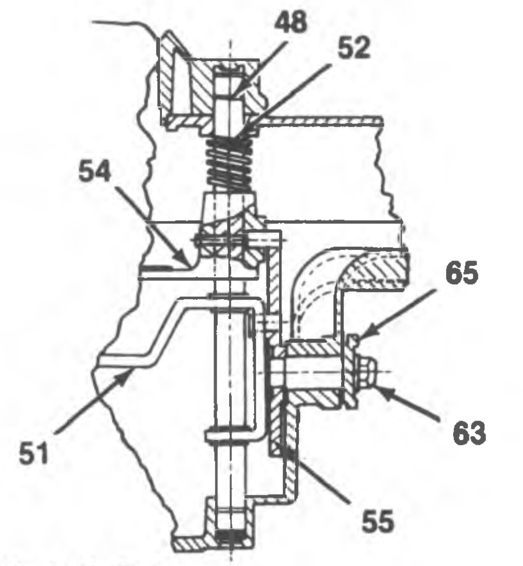
Figure 5—Oil Pump, Pickup Tube and Screen



25. Magnet
29. Synchronizer Sleeve
45. Front Case Half
54. Mode Fork
55. Sector With Shaft

F9303

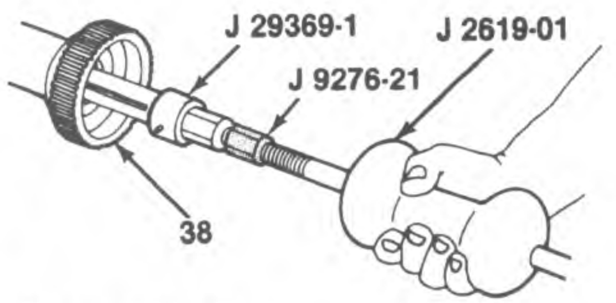
Figure 6—Mode Fork and Shaft Assembly



48. Shift Rail
51. Range Fork
52. Mode Fork Spring
54. Mode Fork
55. Sector With Shaft
63. Shift Lever Nut
65. Lever

F5389

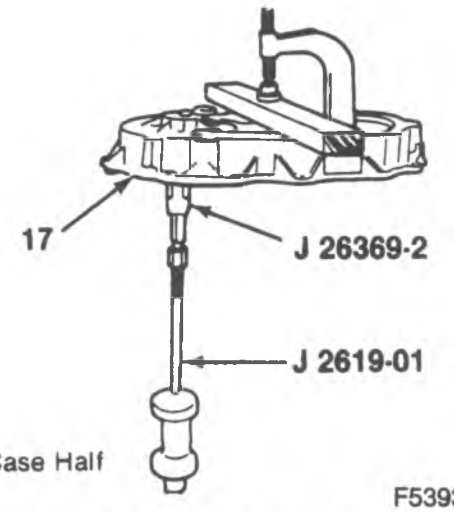
Figure 7—Shift Rail Assembly



38. Input Drive Gear

F5392

Figure 8—Removing the Input Gear Bearing



17. Rear Case Half

F5393

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 to remove any obstructions, or cleaning solvent residue.
6. All mating and sealing surfaces.

Inspect

1. Bearings and thrust washers for 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 thread holes.
7. Synchronizer stop rings for cracks, chips, spalling, or excessive wear.
8. Synchronizer hub and sleeve for cracks, chips, spalling, or excessive wear.
9. Pads on mode fork and range fork for wear and 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

BEARING AND SEAL REPLACEMENT

Install or Connect (Figures 10 through 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 automatic transmission fluid for lubricant during assembly.

1. Needle bearings (82) into the drive sprocket (20) using J 36370 and J 8092 (figure 10).
2. Needle bearings (24), into the rear case half (17) using J 36372 and J 8092.
   - Bearing must be flush with the boss on case housing.
3. Bearing (61) into the front case half (45) using J 8092 and J 33833.
4. Retainer (40).
5. Bearing (6) to the pump retainer housing (8) using J 33833 and J 8092 (figure 11).
6. Bearing (84) into the input gear (38) using J 36372 and J 8092.
7. Thrust washer (37) into planetary carrier (36).
8. Input gear (38) and thrust washer into planetry carrier (36).
9. Carrier lock ring.
10. Bearing into front case half using J 36372.
11. Oil seal (1) into the rear extension (4) using J 33843.
12. Input bearing retainer seal (42) into the input bearing retainer (44) using J 33831.
13. Front output shaft seal (72) into to the front case half (45) using J 33834 (figure 12).
14. Magnet (25) into front case half (45).

INTERNAL COMPONENTS

Assemble (Figures 13 through 15)

NOTICE: For steps 3, 5, 15, 17, 19 see "Notice" on page 7D3-1 of this section.

1. Synchronizer hub (31) to the synchronizer sleeve (29) along with the three struts (30).
   - Align the previously scribed marks.
2. Spring retainers (32) to the snychronizer hub (31).
3. Main drive synchronizer stop ring (28) to the synchronizer sleeve (29) and the synchronizer hub (31).
4. Drive sprocket (20) to mainshaft (19).
5. Synchronizer assembly to mainshaft (19).
6. Snap ring (83) to mainshaft.

Install or Connect

1. Planetary input gear assembly (38) through the input bearing (40) into the annulus (62) using a soft faced hammer.
2. Bearing retainer (snap ring) (39)to the input gear (38).
3. Input bearing retainer (44) and input bearing retainer bolts (43) to front case half (45).

- Apply RTV or equivalent on bearing retainer mating surfaces.
- Apply Loctite 242 or equivalent to bearing retainer bolts.

Tighten

- Bolts (43) to 19 N.m (14 ft. lbs).

4. Shift lever O-ring (67), plastic washer (66), into front case half (45).
5. Sector with shaft (55) into the front case half (45), 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).

6. Range shift hub (34) and range shift fork into the front case half (45).
   - It is necessary to rotate the sector to align the range shift fork.
7. Chain over main shaft onto drive gear.
   - Install mainshaft assembly, chain and front output shaft into case as an assembly.
8. Mainshaft assembly, mode shift fork (54) and rail through range shift fork into front case half (45) (figure 14).
9. Front output shaft (21) into chain front case half (45).
10. Fork shift spring (52) onto the mode shift rail (48).

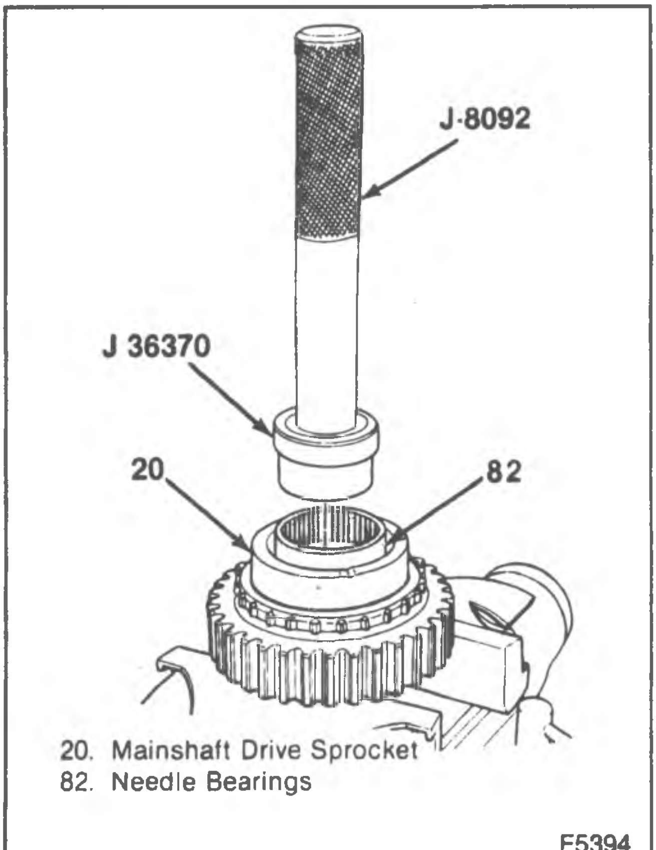


Figure 10—Front Drive Sprocket Needle Bearing Installation.

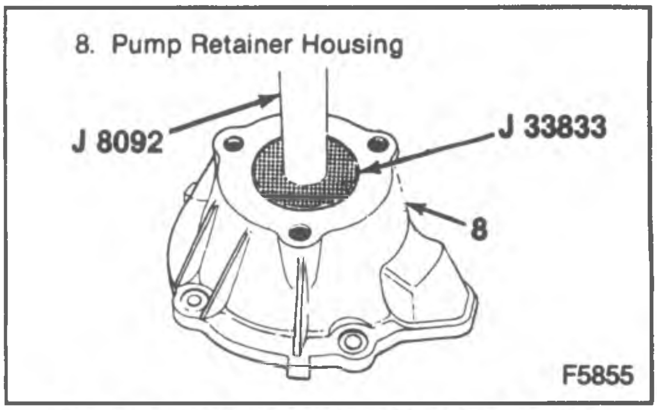


Figure 11—Pump Retainer Housing Bearing Installation

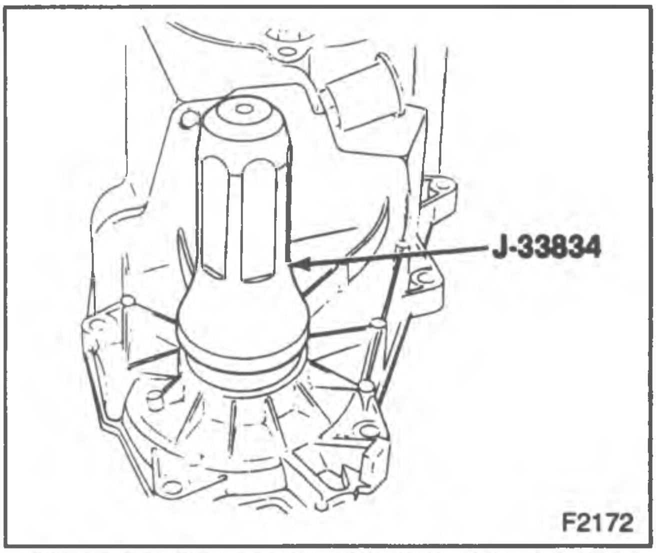


Figure 12—Front Output Shaft Seal Installation

11. Oil pick up tube (18), oil tube connector (26) and pump pick up screen (35) into the rear case half (17) (figure 15).
12. 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.

13. Oil pump (12) to the oil pump pick up tube (18).
    - Apply RTV sealer or equivalent to the case mating surfaces.
14. Rear case (17) over mainshaft (19)and onto the front case half (45).
    - Be careful not to damage the oil pump (12) when installing the case halves together.
15. Case bolts (3) into case halves.
    - Apply Loctite 242 or equivalent to case bolts.
    - The two longer case bolts and washers into the doweled case holes (33), or from their original holes on transfer cases with attaching brackets (figure 15).

Tighten

- Bolts to 31 N·m (23 ft. lbs).

16. Speedometer tone wheel (11) onto mainshaft (19).
17. 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.

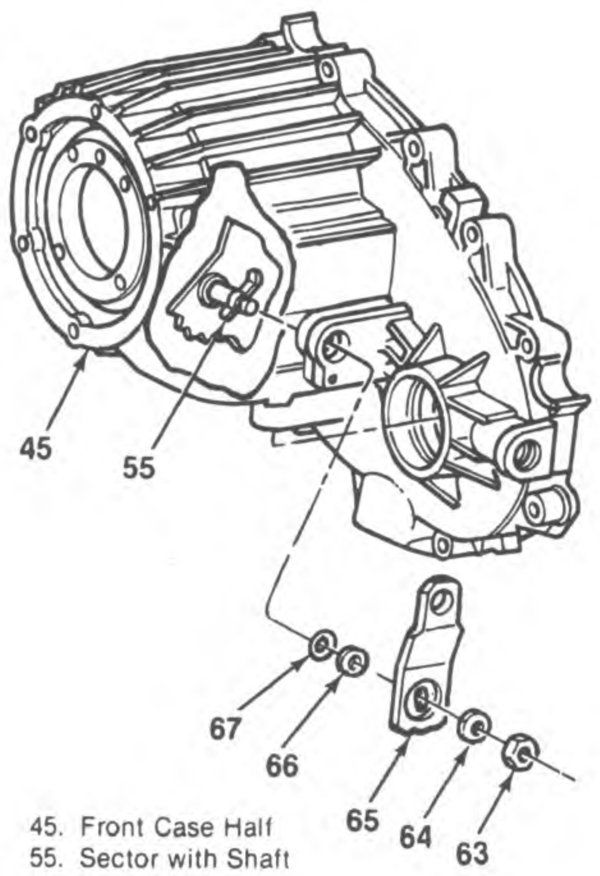
Tighten

- Bolts to 41 N·m (30 ft. lbs).

18. Output bearing retainer (snap ring) (5) to the mainshaft (19).
19. Rear extension housing (4) and extension housing bolts (3) to the pump retainer housing (8).
    - Apply RTV sealer to the extension housing mating surfaces.
    - Apply Loctite 242 or equivalent to the extension housing bolts.

Tighten

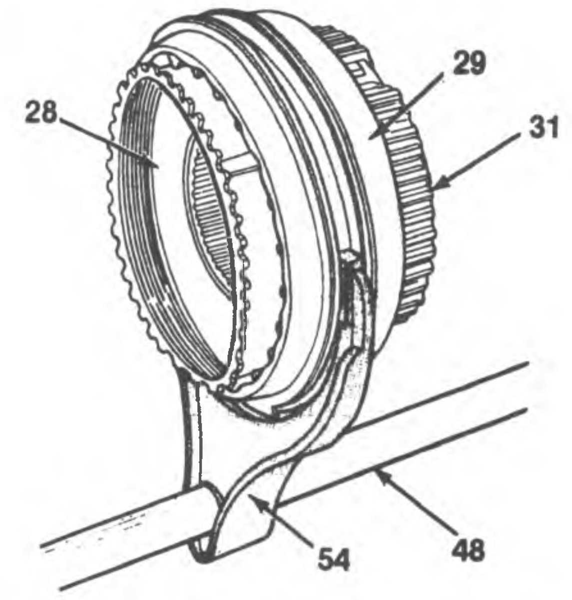
- Bolts to 31 N·m (23 ft. lbs.).



45. Front Case Half
55. Sector with Shaft
63. Torque Nut
64. Washer
65. Shift Lever
66. Plastic Washer
67. O-Ring Seal

F5433

Figure 13—Sector with Shaft



28. Synchronizer Stop Ring
29. Synchronizer Sleeve
31. Synchronizer Hub
48. Shift Rail
54. Mode Fork

F5432

Figure 14—Synchronizer Hub Assembly and Mode Fork

EXTERNAL COMPONENTS

Install or Connect

NOTICE: For steps 1 through 4 see "Notice" on page 7D3-1 of this section.

1. Selection plunger (70), poppet spring (71), O-ring seal (69), and poppet screw (68) into front case half (45).

Tighten

- Poppet screw to 15 N·m (11 ft. lbs.).

2. Speedometer sensor and O-ring to the pump housing (8).

Tighten

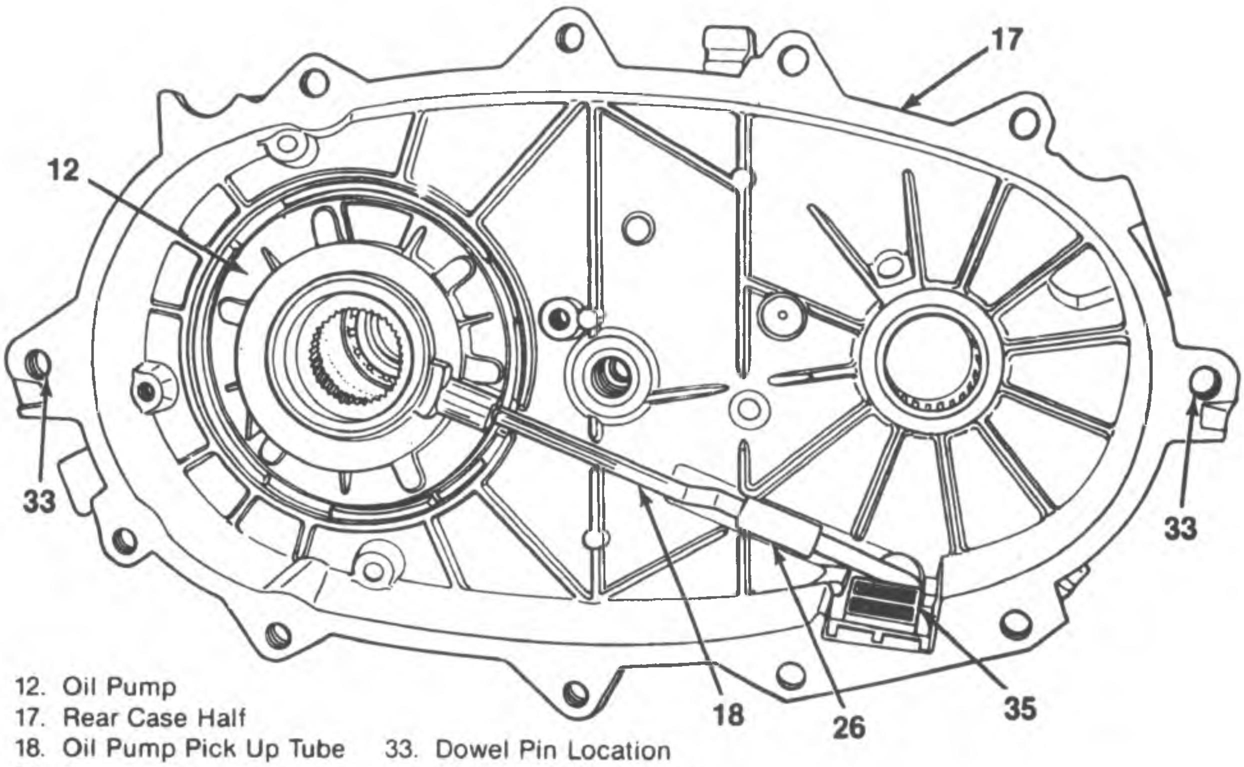
- Sensor to 31 N·m (23 ft. lbs.)

3. Vacuum 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).



12. Oil Pump
17. Rear Case Half
18. Oil Pump Pick Up Tube
26. Connector
33. Dowel Pin Location
35. Pump Pick Up Screen

F5434

Figure 15—Oil Pump Location

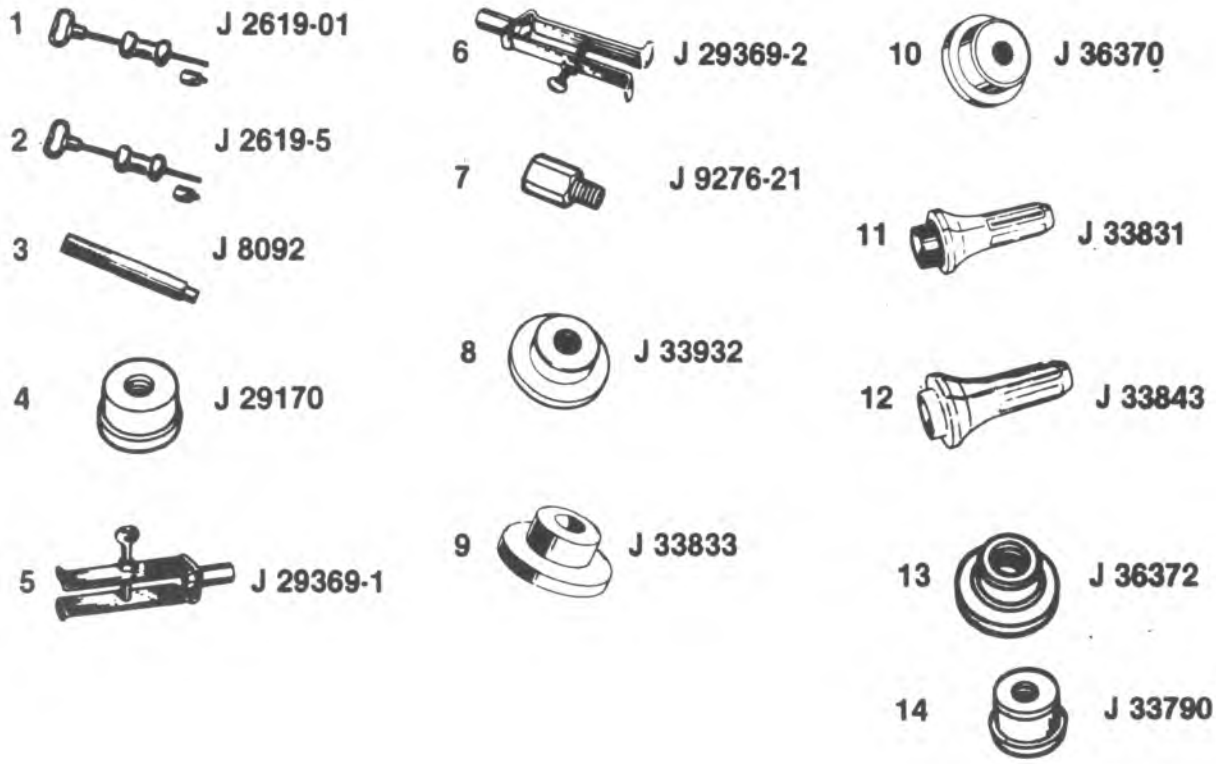
SPECIFICATIONS

NEW PROCESS 231 TRANSFER CASE

	N·m	Ft. Lbs.
Input Shaft Retainer Bolts	19	14
Shift Selector Lever Nut	31	23
Shift Selector Vacuum 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	
Speedometer Pickup Switch	31	23
Poppet Screw	15	11

T2541

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

S

T

V

CHEVROLET

TRUCKS