

SECTION 4B

REAR AXLE

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: "NOTICE: See 'Notice' on page 4B-1 of this section."

NOTICE: All rear axle fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.

CONTENTS

| <u>SUBJECT</u> | <u>PAGE</u> |
|---|--------------------|
| Description | 4B- 2 |
| Rear Axle Operation | 4B- 2 |
| Diagnosis of the Rear Axle | 4B- 3 |
| Diagnosis of Noise | 4B- 3 |
| Diagnosis of Tapered Roller Bearings | 4B- 6 |
| On-Vehicle Service | 4B-10 |
| Rear Axle Assembly Replacement | 4B-10 |
| Axle Shaft, Oil Seal and Bearing Replacement | |
| (8 ¹ / ₂ -9 ¹ / ₂ -Inch Ring Gear-Semi-Floating Axle) | 4B-10 |
| Brake Backing Plate Replacement (8 ¹ / ₂ -9 ¹ / ₂ -inch Ring Gear-Semi-Floating Axles) | 4B-13 |
| Wheel Stud Replacement (8 ¹ / ₂ -9 ¹ / ₂ -Inch Ring Gear-Semi-Floating Axles) | 4B-14 |
| Pinion Flange, Dust Deflector/Oil Seal Replacement | |
| (8 ¹ / ₂ -9 ¹ / ₂ -Inch Ring Gear-Semi-Floating Axles) | 4B-14 |
| Axle Shaft Replacement (9 ³ / ₄ -10 ¹ / ₂ -Inch Ring Gear-Full Floating Axles) | 4B-16 |
| Hub And Drum Assembly Replacement (9 ³ / ₄ -10 ¹ / ₂ -Inch Ring Gear-Full Floating Axles) | 4B-17 |
| Wheel Bearing/Cup Replacement (9 ³ / ₄ -10 ¹ / ₂ -Inch Ring Gear-Full Floating Axles) | 4B-18 |
| Non-Demountable Type Drum Replacement | 4B-19 |
| Wheel Bolt Replacement | 4B-19 |
| Bearing Adjustment | 4B-19 |
| Pinion Oil Seal/Companion Flange Replacement | |
| (9 ³ / ₄ -10 ¹ / ₂ -Inch Ring Gear-Full Floating Axles) | 4B-20 |
| Axle Vent Replacement (12-Inch Ring Gear-Full Floating Axle) | 4B-21 |
| Axle Shaft Replacement (12-Inch Ring Gear-Full Floating Axle) | 4B-21 |
| Bearing Adjustment (12-Inch Ring Gear-Full Floating Axle) | 4B-21 |
| Drive Pinion Oil Seal Replacement (12-Inch Ring Gear-Full Floating Axle) | 4B-22 |
| Specifications | 4B-24 |
| Special Tools | 4B-25 |

DESCRIPTION

Light duty trucks use various rear axles, classed by ring gear diameter such as:

8 $\frac{1}{2}$ -INCH AND 9 $\frac{1}{2}$ -INCH RING GEAR AXLES —SEMI-FLOATING

These axles are of the fabricated constructed type consisting of a cast carrier, bossed at each end into which two welded steel tubes are fitted. An overhung hypoid pinion and the ring gear are housed in the carrier. The differential has a two pinion arrangement.

Two steel welded tubes pressed into the crossbore of the cast carrier make up the axle housing. Welded-on brackets provide attachment points for the suspension components such as leaf springs and shock absorbers. The brake flange plate is attached to a welded-on flange.

The overhung hypoid drive pinion is supported by two preloaded tapered roller bearings. The pinion shaft is sealed by means of a molded, spring loaded, rubber seal. The hypoid ring gear is bolted to a one-piece differential case supported by two preloaded tapered roller bearings.

The 9 $\frac{1}{2}$ -inch ring gear axles have the ring gear side bearing preload controlled by a side bearing adjusting nut threaded into the carrier near the axle tubes. Backlash is adjusted by increasing or decreasing the shim thickness.

CHEVROLET 10 $\frac{1}{2}$ -INCH RING GEAR AXLE

This axle is the full floating type with a hypoid ring gear and drive pinion. The full floating construction allows easy removal of the axle shafts. The differential carrier is heavily ribbed to provide rigid support for the differential assembly.

A straddle-mounted drive pinion is supported at the front by two opposed tapered roller bearings. The pinion straddle bearing is a roller bearing assembly having an outer race and roller assembly. A precision ground diameter on the pinion pilot functions as an inner race.

Side bearing preload and ring gear-to-pinion backlash are controlled by side bearing adjusting nuts threaded into the carrier near the axle tubes. Pinion depth is controlled by a shim located between the pinion bearing retainer assembly and the differential carrier.

DANA 10 $\frac{1}{2}$ -INCH RING GEAR AXLE

The axle is a Salisbury-type design similar to the 8 $\frac{1}{2}$ -inch ring gear axle. The axle shafts are full floating, and the carrier must be spread to remove the differential, and the drive pinion uses two shim packs. The inner pack controls pinion depth and the outer pack controls pinion bearing preload.

DANA 9 $\frac{3}{4}$ -INCH RING GEAR AXLE

This Dana axle is similar to the Chevrolet 10 $\frac{1}{2}$ -inch ring gear axle however, the differential side bearing shims are located between the case and the side bearings.

ROCKWELL 12" RING GEAR AXLE

This single-speed, hypoid axle has a straddle mounted drive pinion which is supported at the rear by a straight roller bearing. The pinion front bearing has a double row ball bearing.

The differential is a conventional four-pinion type using thrust washers between the side gears and case and also between the differential pinions and the differential case.

A thrust pad mounted on the end threaded into the carrier housing limits the deflection of the ring gear under high torque service.

Involute splines are used in the axle shaft flange and in the wheel hubs. This design gives driving torque transmission from the axle shaft to the hub through the mating splines.

REAR AXLE OPERATION

A basic differential has a set of four gears. Two are called differential side gears and the other two are differential pinion gears. Some differentials have more than two pinions. Each side gear is splined to an axle shaft, therefore each axle shaft must turn when its side gear rotates.

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts.

Power flow through the differential is as follows: the drive pinion rotates the ring gear. The ring gear, being bolted to the differential case, rotates the case. The differential pinion, as it rotates with the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because the input force on the pinion gear is equally divided between the two side gears. Therefore, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears, rotate the axle shafts.

If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could then be solidly attached to the ring gear and both driving wheels would turn at equal speed.

ON-VEHICLE SERVICE

REAR AXLE ASSEMBLY REPLACEMENT (ALL AXLES)

- Raise the vehicle on a hoist and support the axle assembly with a suitable lifting device.
- For 9³/₄-inch ring gear and 10¹/₂-inch ring gear axles, raise the vehicle and place jack stands under the frame side rails for support.
- Drain the lubricant from the axle housing.

Remove or Disconnect

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
 - Tie the propeller shaft to a side rail or crossmember.
 - Tape the bearing cups to prevent loss of the rollers.
2. Wheel and brake drum or hub and drum assembly.
3. Parking brake cable from the lever and at the brake flange plate. Refer to BRAKES (SEC. 5).
4. Hydraulic brake lines from the connectors. Refer to BRAKES (SEC. 5).
5. Shock absorbers from the axle brackets. Refer to REAR SUSPENSION (SEC. 3D).
6. Vent hose from the axle vent fitting if used.
7. Height sensing and brake proportional valve linkage if used. Refer to BRAKES (SEC. 5).
8. Stabilizer shaft if used. Refer to REAR SUSPENSION (SEC. 3D).
 - Support the assembly with a hydraulic floor jack.
9. Nuts and washers from the U-bolts.
10. U-bolts, spring plates and spacers from the axle assembly.
 - Lower the jack and the axle assembly.

Install or Connect

1. Axle assembly under the vehicle.
 - Align the axle assembly with the springs.
2. Spacers, spring plates and U-bolts to the axle assembly.
 - Raise the axle assembly.
3. Washers and nuts to the U-bolts.
 - Thread the nuts on firmly.
 - Adjust alignment of semi-float axles.
4. Stabilizer shaft if used.
5. Height sensing and brake proportional valve linkage if used. Refer to BRAKES (SEC. 5).
6. Vent hose to the axle vent fitting if used.
7. Shock absorbers to the axle brackets. Refer to REAR SUSPENSION (SEC. 3D).

8. Hydraulic brake lines to the connectors. Refer to BRAKES (SEC. 5).
9. Parking brake cable to the lever and the flange plate. Refer to BRAKES (SEC. 5).
10. Wheel and brakedrum or hub and drum assembly.
11. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

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

Tighten

- All fasteners to "Specifications" later in this section.

Important

- Check axle lubricant level at the filler plug hole. Lubricate as needed.
- Bleed the brake system, check operation and adjust if necessary. Refer to BRAKES (SEC. 5).
- Check axle and brake operation.
- Check for fluid leaks and road test the vehicle.

AXLE SHAFT, OIL SEAL AND BEARING REPLACEMENT (8¹/₂-9¹/₂-INCH RING GEAR SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.
- Clean dirt from around the carrier cover.

Remove or Disconnect (Figure 6)

Tools Required:

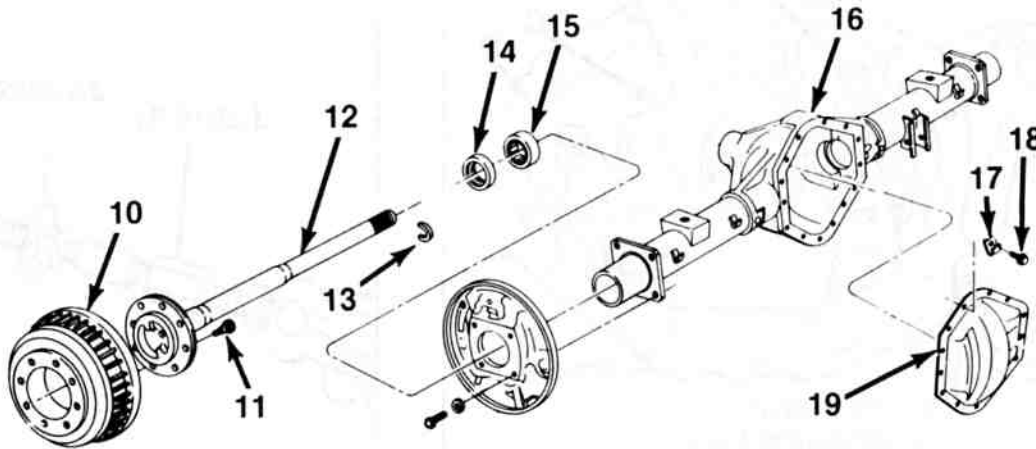
J-2619-01 Slide Hammer with Adapter

J-23689 Axle Shaft Bearing Remover (large shaft)

J-29712 Axle Shaft Bearing Remover (9¹/₂-inch ring gear)

1. Wheel and tire assembly. Refer to WHEELS AND TIRES (SEC. 3E).
2. Brake drum. Refer to BRAKES (SEC. 5).
3. Carrier cover (19).
 - Catch the oil in a drain pan.
 - Remove gasket material if used.

- 10. Drum
- 11. Bolt
- 12. Shaft
- 13. Lock
- 14. Seal
- 15. Bearing
- 16. Housing
- 17. Clip
- 18. Bolt
- 19. Carrier Cover



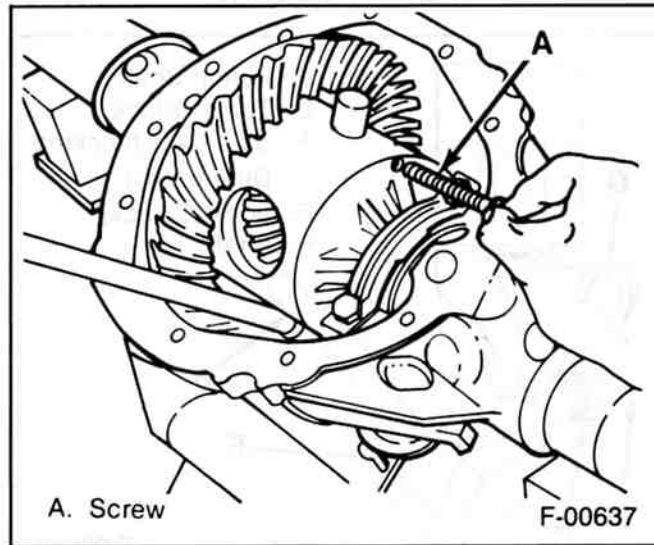
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Figure 6—Axle Shaft And Housing Detail
WITHOUT LOCKING DIFFERENTIAL

4. Screw (A) (figure 7).
5. Pinion shaft (B) (figure 8).

! Important

- Push the flanged axle shaft (12) toward the center of the vehicle.
- 6. Lock (13) from the button end of the axle shaft (12).
- 7. Axle shaft (12).
 - Withdraw the axle shaft (12) from the housing (16).
 - Be careful not to damage the oil seal (14).
 - Don't allow the thrust washer in the 9 1/2-inch ring gear axle to slide out when removing the axle shaft (12).



A. Screw

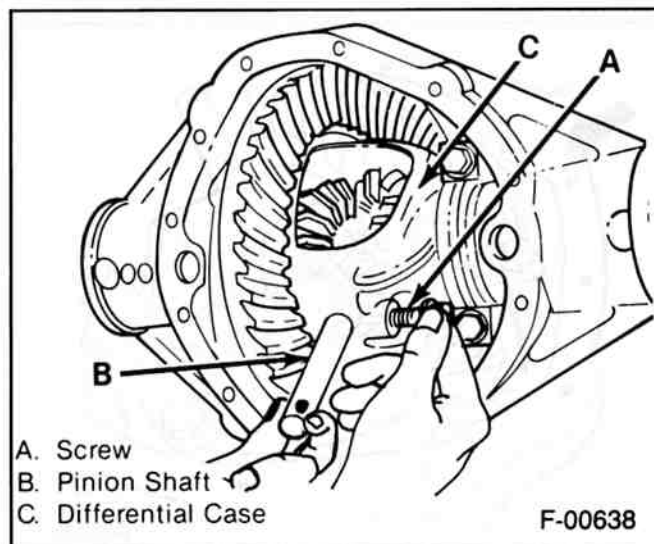
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Figure 7—Removing The Lock Screw
WITH LOCKING DIFFERENTIAL

4. Screw (A). Refer to figures 8, 9 and 10.
 - Hold the pinion shaft (B) when loosening the screw (A).
 - Withdraw the pinion shaft (B) part way and then position the differential case (C) for the best clearance (figure 9). Rotate the case (C) until the pinion shaft (B) touches the housing (D).
 - Use a screwdriver or similar tool to enter the case (D) and rotate the lock (13) until the open end points inward (figure 10).

! Important

- Do not force or hammer the axle shaft (12) to gain removal clearance.
- 5. Lock (13). Refer to figures 10 and 11.
 - With the lock (13) correctly positioned, push the axle shaft (12) inward and remove the lock (13).



A. Screw

B. Pinion Shaft

C. Differential Case

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Figure 8—Removing The Differential Pinion Shaft

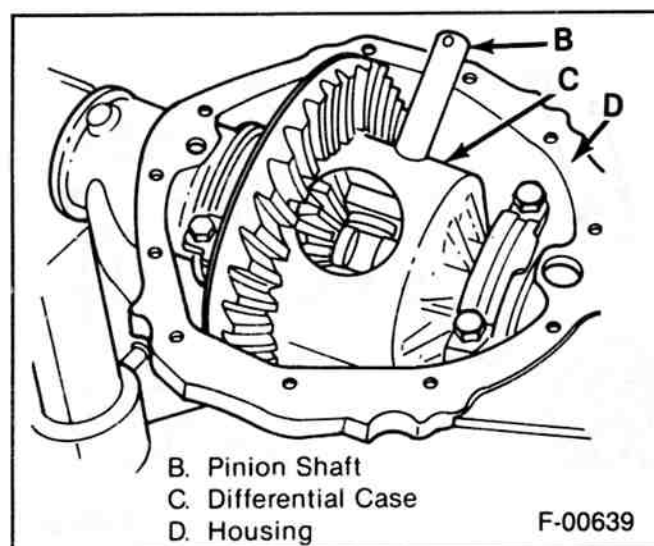


Figure 9—Positioning The Case For Best Clearance

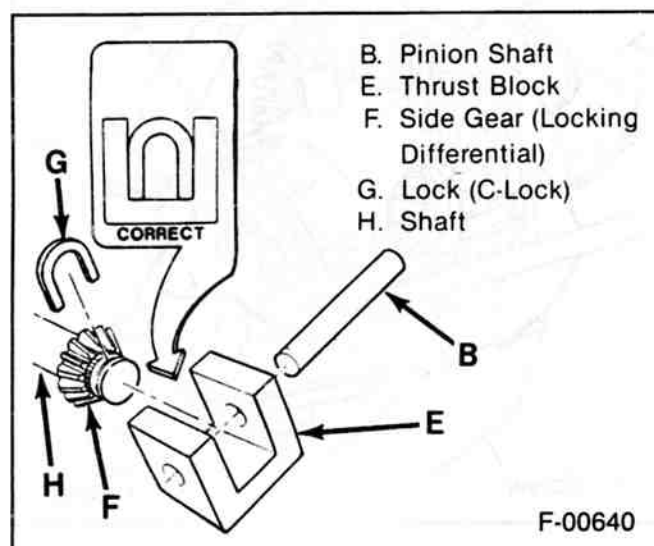


Figure 10—Aligning The C-Lock Correctly

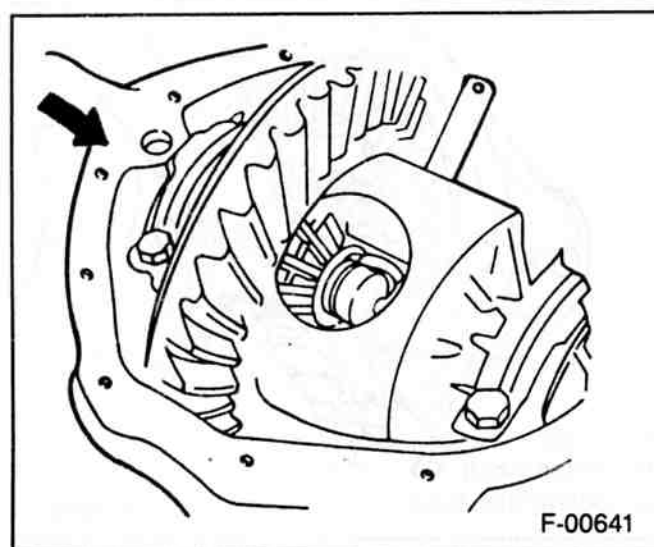


Figure 11—Push The Axle Shaft Inward

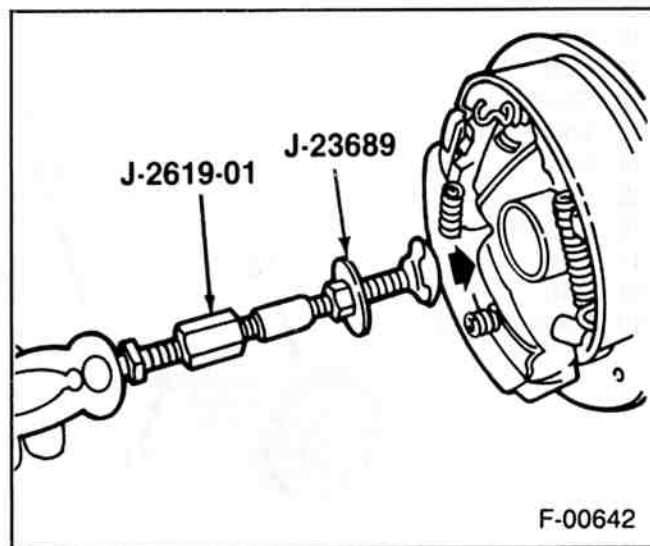


Figure 12—Removing The Bearing And Seal

6. Axle shaft (12).
 - Slide the axle shaft (12) out. Be careful not to damage the seal (14).
7. Seal (14).
 - Use the button end of the axle shaft (12) to pry the seal (14) out or use J-23689.
8. Bearing (15).
 - Use J-23689 for 8 1/2-inch ring gear axle and J-29712 for 9 1/2-inch ring gear axle. Attach J-2619-01 to J-23689.
 - Insert tool into the axle bore so that it grasps behind the bearing (15) (figure 12). Tighten nut and washer against the face of the bearing (15) or seal (14).

Inspect

- All parts. Replace as necessary.

Install or Connect (Figures 6 and 10)

Tools Required:

- J-8092 Driver Handle
- J-21128 Axle Shaft and Pinion Oil Seal Installer
- J-23690 Axle Shaft Bearing Installer
- J-29709 Axle Shaft Bearing Installer (9 1/2-inch ring gear)
- J-29713 Axle Shaft Seal Installer (9 1/2-inch ring gear)
- Lubricate the axle cavity between the seal (14) lips and the bearing (15) with wheel bearing lubricant. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Bearing (15).
 - Use J-23690 for the 8 1/2-inch gear axle and J-29709 for the 9 1/2-inch ring gear axle.

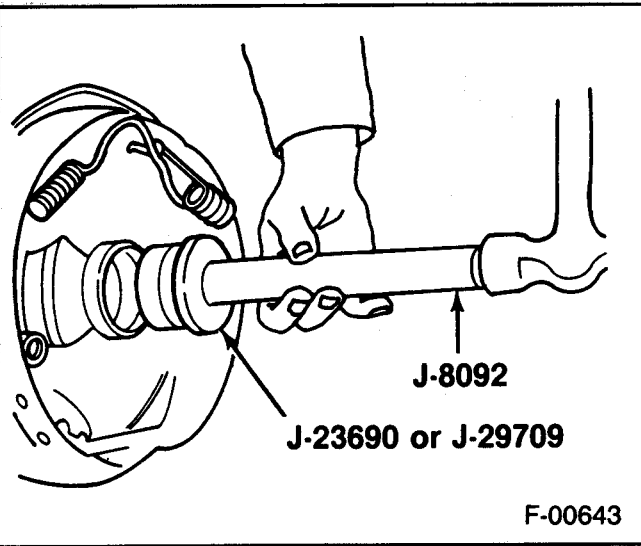


Figure 13—Installing The Wheel Bearing

- Bearing (15) into the axle (16) housing until the tool bottoms against the tube. Refer to figure 13.

2. Seal (14).

- Use J-21128 for 8 $\frac{1}{2}$ -inch ring gear axle and J-29713 for the 9 $\frac{1}{2}$ -inch ring gear axle.
- Drive the tool into the bore until the seal (14) bottoms flush with the end of the tube (figure 14).

3. Axle shaft (12).

- Be careful not to damage the seal (14) when inserting the axle shaft (12).
- Slide the axle shaft (12) into place allowing the splines to engage the differential side gear (F) figure 10.

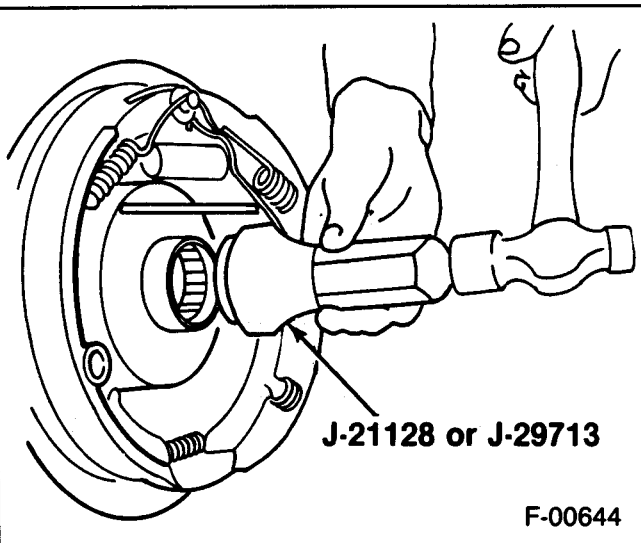


Figure 14—Installing The Seal

WITHOUT LOCKING DIFFERENTIAL

4. Lock (13).

- Lock on the button end of the axle shaft (12), then push the shaft outward to seat the lock in the counterbore of the differential side gear.

5. Pinion shaft (B) figure 8.

- Into the differential case (C) and pinion gears.
- Align the hole in the pinion shaft (B) with the screw hole in the differential case (C). Thread the screw (A) in and tighten to 18 N·m (25 ft. lbs.).

WITH LOCKING DIFFERENTIAL

4. Lock (13).

- Keep the pinion shaft (B) partially withdrawn (figure 9).
- Place the lock (G) in the position shown in figure 10.
- Carefully withdraw the axle shaft (12) until the lock (13) clears the thrust block.
- Align the pinion shaft (B) hole with the screw hole in the differential case (C) figure 8.

5. Screw (A). Refer to figure 8.



Tighten

- Screw (A) to 18 N·m (25 ft. lbs.).

6. Gasket if used, otherwise RTV. Be sure sealing surface is clean.

7. Carrier cover (19).

8. Bolts (18) and clip (17).

- Tighten bolts (18) in a crosswise pattern to assure uniform draw on the gasket if used.
- Fill axle to filler plug hole level. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) for proper lubricant.

9. Brake drum. Refer to BRAKES (SEC. 5).

10. Wheel and tire assembly. Refer to WHEELS AND TIRES (SEC. 3E).

- Lower the vehicle and road test.

BRAKE BACKING PLATE REPLACEMENT (8 $\frac{1}{2}$ - AND 9 $\frac{1}{2}$ -INCH RING GEAR—SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.



Remove or Disconnect

1. Wheel, tire and brake drum. Refer to BRAKES (SEC. 5).
2. Axle shaft. Refer to "Axle Shaft Replacement" earlier in this section.
3. Brake line from the cylinder inlet.

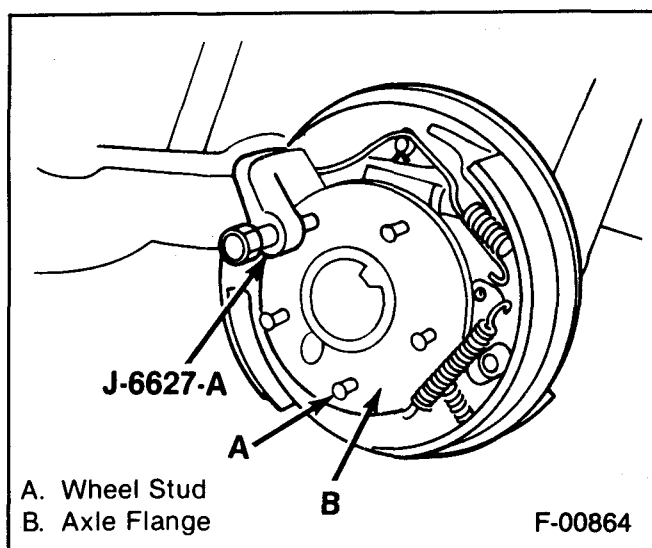


Figure 15—Pressing Out A Wheel Stud

- Brake components from the backing plate. Refer to BRAKES (SEC. 5).

4. Bolts and washers from the axle.
5. Backing plate.

Install or Connect

1. Backing plate to the axle.
2. Bolts and washers to the plate.
 - Attach components to the backing plate. Refer to BRAKES (SEC. 5).
3. Brake line to the cylinder inlet.
 - Refer to BRAKES (SEC. 5) for bleeding and adjustment procedure.
4. Axle shaft. Refer to "Axle Shaft Replacement" earlier in this section.
5. Wheel, tire and brake drum.

WHEEL STUD REPLACEMENT (8¹/₂-9¹/₂-INCH RING GEAR—SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist and allow the axle to hang free.

Remove or Disconnect

Tool Required:

J-6627-A Wheel Stud Remover

1. Wheel, tire and brake drum.
2. Stud from the axle flange using J-6627-A (figure 15).

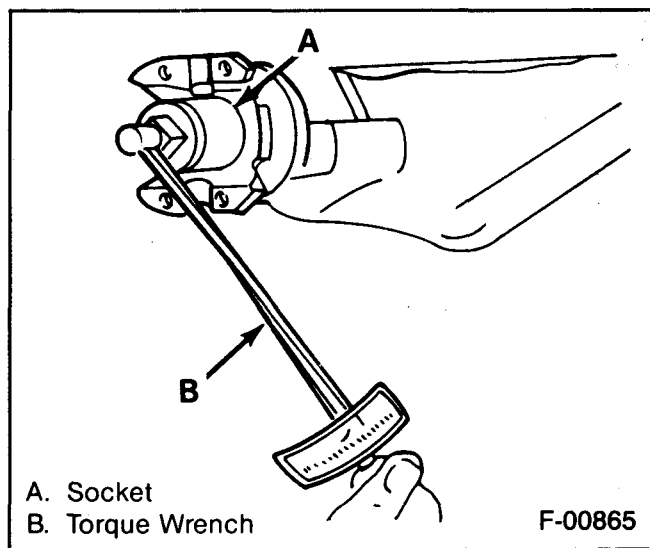


Figure 16—Measuring Pinion Rotating Torque

Install or Connect

1. Stud in the axle flange hole. Refer to figure 15.
 - Start the new stud into the axle flange hole by pressing firmly with your hand.
 - Thread on a lug nut with the flat side to the vehicle.
 - Tighten the lug nut and draw the stud head into the rear of the flange.
 - Thread the lug nut off.
2. Wheel, tire and brake drum.
 - Lower the vehicle.

PINION FLANGE, DUST DEFLECTOR/OIL SEAL REPLACEMENT (8¹/₂-9¹/₂-INCH RING GEAR SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.

Remove or Disconnect

Tool Required:

J-8614-01 Companion Flange Holder and Remover

1. Propeller shaft from the axle. Refer to PROPELLER SHAFT (SEC. 4A).
 - Tie the propeller shaft to a frame rail or crossmember.

Measure

- The torque required to rotate the pinion (figure 16). Record the torque value for later reference.

Important

- Scribe a line on the pinion stem, pinion nut and the companion flange and record the number of exposed threads on the pinion stem. Use the scribed reference and the exposed threads as a reinstallation guide (figure 17).
2. Nut using J-8614-01.
 - Position J-8614-01 on the flange so that the four notches on the tool face the flange (figure 18).
 3. Flange using J-8614-01
 - Use the special nut and forcing screw to remove the flange (figure 19).
 4. Oil seal. Use a screw driver to pry the seal out of the bore.

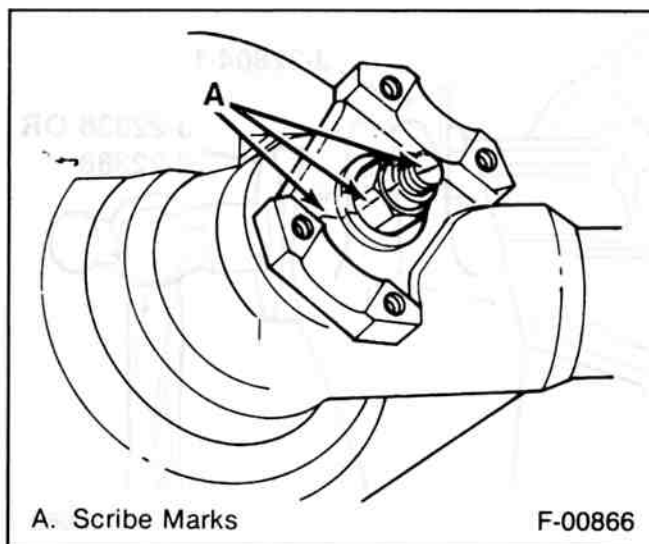


Figure 17—Scribed Marks

Inspect

- The pinion flange for a smooth oil seal surface, for worn drive splines, damaged ears and for smoothness of the bearing contact surface. Replace if necessary.
5. Dust deflector.
 - Tap the deflector from the flange if replacement is necessary.
 - Clean up the stake points on the flange.
 - Clean all foreign material from the contact area.

Install or Connect

Tools Required:

- J-8614-01 Companion Flange Holder and Remover
- J-22388 Pinion Oil Seal Installer (9 1/2-inch ring gear)
- J-22804-1 Pinion Oil Seal Spacer
- J-22836 Pinion Seal Installer (8 1/2-inch ring gear)

1. Dust deflector on the flange.
 - Stake new deflector at three new equally spaced positions. Staking must be such that the seal operating surface is not damaged.
2. Oil seal.
 - Pack the cavity between the lips of the oil seal with extreme pressure lithium-base lubricant.
 - Position the oil seal in the bore then place J-22804-1 over the oil seal and flat against the seal flange (figure 20).
 - Use J-22836 or J-22388 for the 9 1/2-inch ring gear to press the oil seal into the bore (figure 20).
 - Turn J-22804-1 from installed position 180 degrees to assure proper installation against the pinion flange.

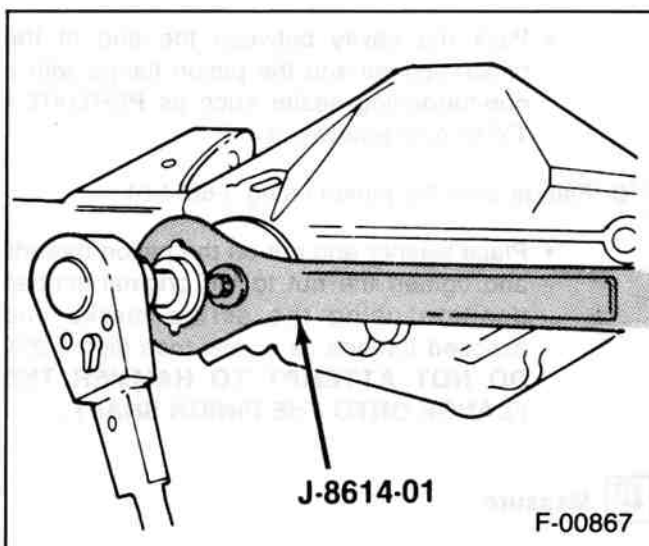


Figure 18—Removing The Drive Pinion Nut

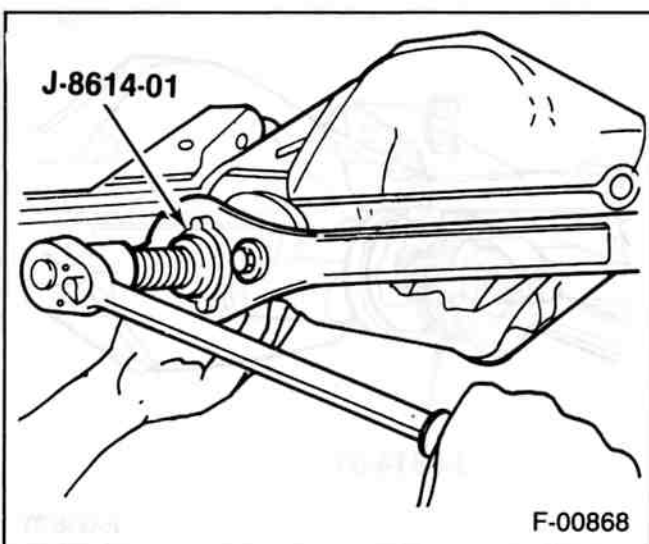


Figure 19—Removing The Drive Pinion Flange

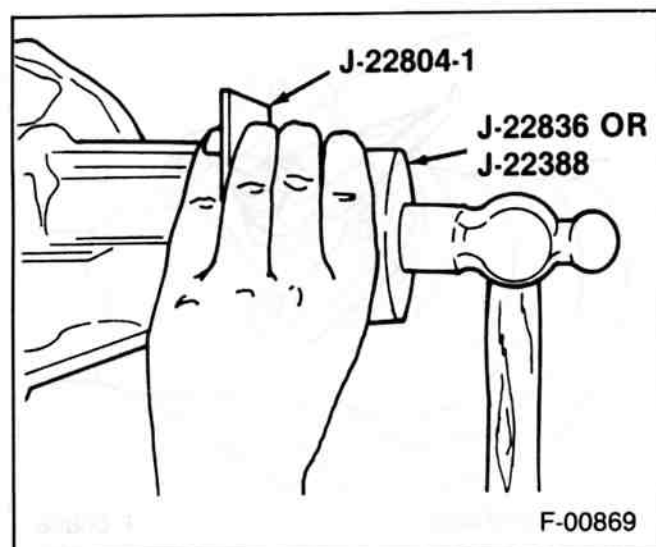


Figure 20—Installing The Pinion Seal

- Pack the cavity between the end of the pinion splines and the pinion flange with a non-hardening sealer such as PERMATEX TYPE A or equivalent.

3. Flange onto the pinion using J-8614-01.

- Place washer and nut on the pinion threads and tighten the nut to the original scribed position using the scribe marks and exposed threads as a reference (figure 21). **DO NOT ATTEMPT TO HAMMER THE FLANGE ONTO THE PINION SHAFT.**

Measure

- The rotating torque of the pinion and compare with the torque recorded earlier (figure 16).

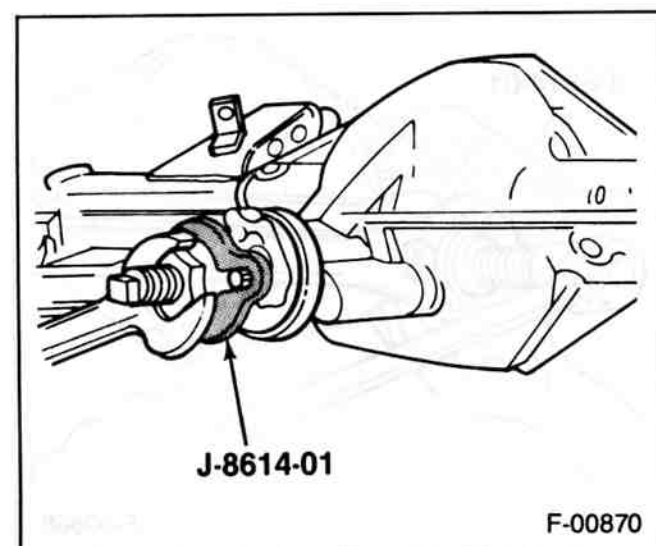


Figure 21—Installing The Pinion Flange

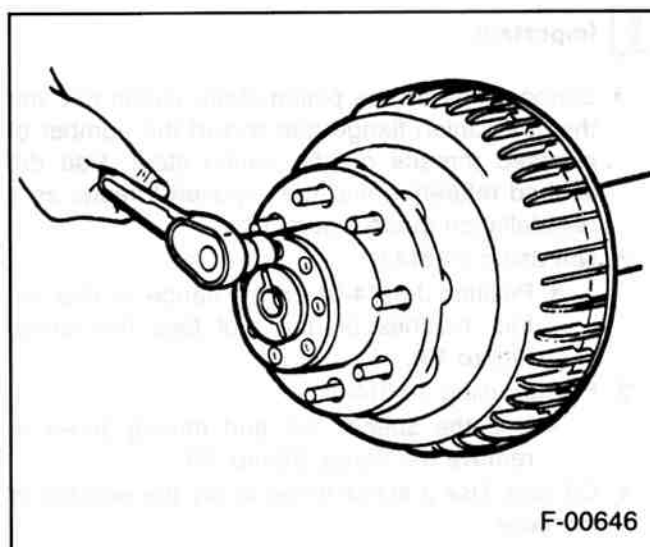


Figure 22—Installing Or Removing Flange-To-Hub Bolts

Tighten

- The pinion nut in additional small increments until the torque necessary to rotate the pinion exceeds the original recorded value by 0.35 N·m (3 in. lbs.).
4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
- Lower the vehicle and road test.

AXLE SHAFT REPLACEMENT (9³/₄-10¹/₂-INCH RING GEAR— FULL FLOATING AXLES)

- This procedure covers the 9³/₄-inch and 10¹/₂-inch ring gear, full floating axles.

Remove or Disconnect (Figure 23)

1. Bolts (35) (figures 22 and 23).
 - Rap the axle shaft (34) flange with a soft faced hammer to loosen the shaft.
 - Grip the rib on the axle shaft (34) flange with a locking plier and twist, to start shaft removal.
2. Axle shaft (34) from the tube.

Clean (Figure 23)

- Axle shaft (34) flange. Remove old RTV or gasket (33).
- Outside face of the hub assembly (31). Lubricant in the area will loosen the shaft-to-hub bolts (35).

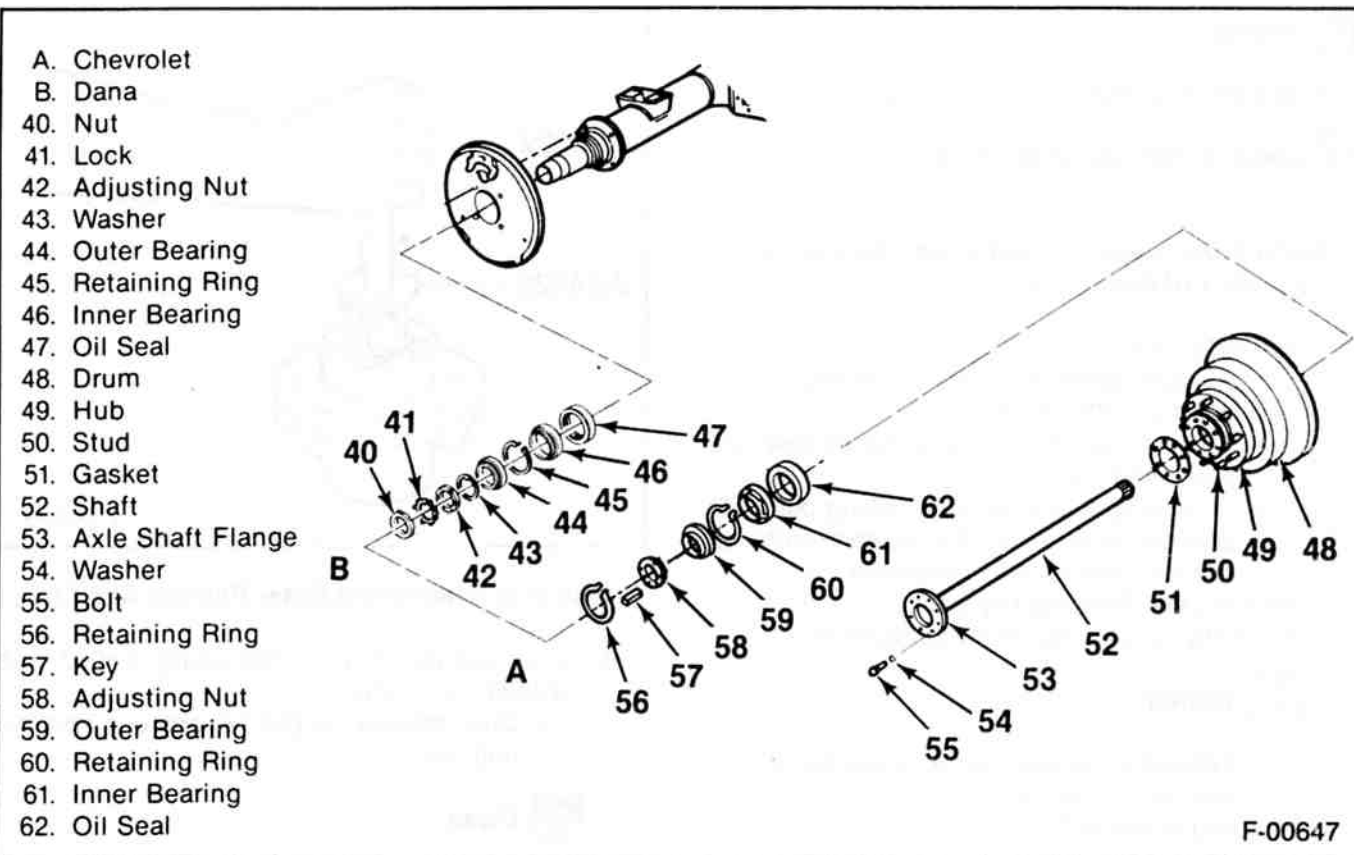


Figure 23—Full Floating Axle, Hub And Drum Assembly Detail

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 23)

1. Axle shaft (34) with a gasket or RTV applied.
 - Be sure the shaft splines mesh into the differential side gear.
 - Align the axle shaft holes with the hub holes.
2. Bolts (35) figures 22 and 23.

Tighten

- Bolts (35) to specified torque later in this section.

**HUB AND DRUM ASSEMBLY REPLACEMENT
(9³/₄-10¹/₂-INCH RING GEAR—
FULL FLOATING AXLES)**

Remove or Disconnect (Figure 23)

- Raise the vehicle until the wheel is free to rotate.
- Tool Required:

J-2222-C Wheel Bearing Nut Wrench

1. Wheel and tire.
2. Axle shaft (52) as outlined earlier in this section.
3. Nut (40) use J-2222-C or retaining ring (56). Refer to figure 24.
4. Lock (41) or key (57).
5. Adjusting nut (42, 58). Refer to figure 24.
6. Washer (43).
7. Hub and Drum (48, 49).

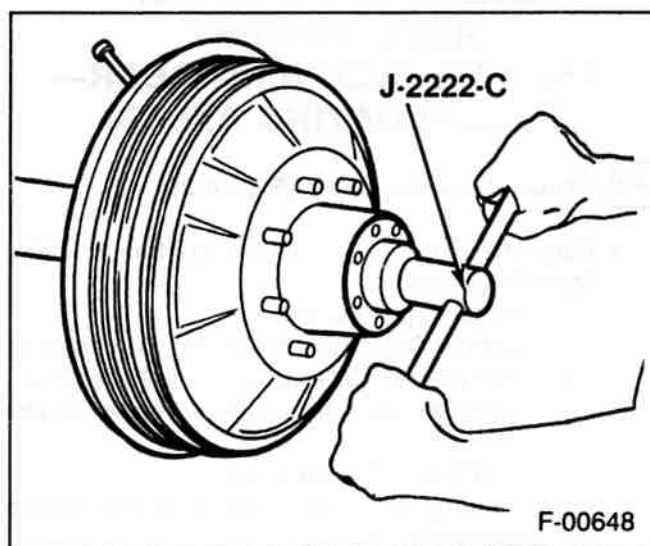


Figure 24—Removing Or Installing Nut

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 23)

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

Tool Required:

J-2222-C Wheel Bearing Nut Wrench

1. Hub and drum (48, 49) to the tube.
 - Be sure the bearings and the oil seal are positioned properly.
 - Apply a light coat of high melting point EP bearing lubricant to the contact surfaces and the outside of the axle tube.
2. Washer (43). Tang into key way.
3. Adjusting nut (42, 58). Refer to figure 24.

Tighten

- Adjusting nut (42, 58) to specified torque later in this section.
4. Lock (41) or key (57).
 - Bend the tang to the flat of the adjusting nut (42) or insert the key (57).
5. Nut (40) or retaining ring (56). Refer to figure 24.

Tighten

- Nut (40) to specified torque later in this section.
6. Axle shaft (52) earlier in this section.
7. Wheel and tire.
 - Lower the vehicle.

WHEEL BEARING/CUP REPLACEMENT (9³/₄-10¹/₂-INCH RING GEAR— FULL FLOATING AXLES)

Remove or Disconnect (Figure 23)

- Raise the vehicle till the wheels are free to rotate.

Tools Required:

J-8092 Driver Handle

J-24426 Outer Wheel Bearing Cup Installer

1. Axle shaft (52) as outlined earlier in this section.
2. Hub and drum (48, 49) as outlined earlier in this section.
3. Oil seal (47) or (62). Use a drift.
4. Inner bearing (46) or (61). Use a drift to remove the bearing and cup.
5. Retaining ring (45) or (60).
 - Use snap ring pliers to remove the ring.

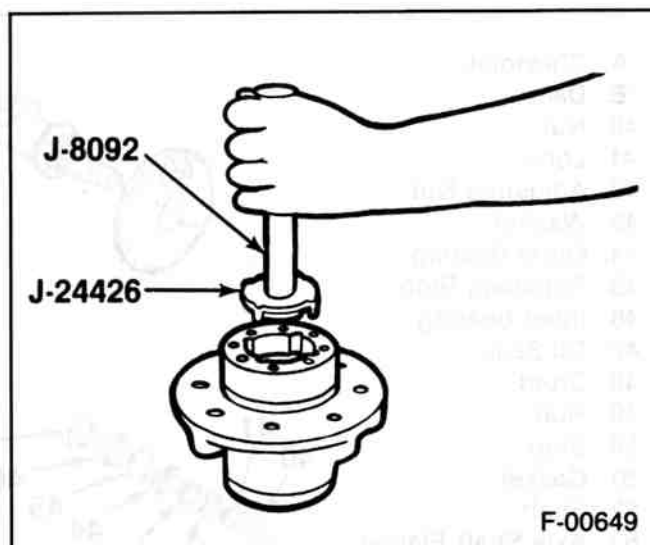


Figure 25—Removing Outer Bearing And Cup

6. Outer bearing (44) or (59) using J-8092 with J-24426 (figure 25).
 - Drive the bearing (44, 59) and cup from the hub (49).

Clean

- Old sealing compound from the oil seal (47, 62) bore in the hub (49).
- Bearing assemblies in a solvent using a stiff brush to remove the old lubricant. Dry the bearings with compressed air. **Do not spin them.**
- Lubricant from the axle housing and inside the hub (49).
- Gasket material from the hub (49), axle shaft (52).

Inspect

- Bearings for wear, chipped edges or other damage. Check for flat or rough spots on the rollers.
- Cups for pits and cracks.
- Oil seal for wear or roughness. Replace parts as necessary.

Install or Connect (Figure 23).

Tools Required:

J-8092 Driver Handle

J-8608 Pinion Bearing Cup Installer

J-24426 Outer Wheel Bearing Cup Installer

J-24427 Inner Wheel Bearing Cup Installer

J-24428 Axle Shaft Seal Installer

1. Outer bearing (44, 59) into the hub (49).
 - Outer cup into the hub (49) using J-8092 and J-8608. **Be sure J-8608 is installed upside down on the driver handle J-8092.**

- Drive the outer cup beyond the retaining ring groove.
- 2. Retaining ring (45) or (60) into the groove.
 - Drive the outer bearing cup against the retaining ring (45) or (60) using J-8092 and J-24426 (figure 25).
- 3. Inner bearing (46) or (61).
 - Drive the inner bearing cup into place until seated against the shoulder of the hub (49) using J-8092 and J-24427.
- 4. Oil seal (47) or (62). Use J-24428 to install the new oil seal (47, 62).
- 5. Hub and drum (48, 49) as outlined earlier in this section.
- 6. Axle shaft (52) as outlined earlier in this section.

NON-DEMOUNTABLE TYPE DRUM REPLACEMENT

- Construction of the non-demountable type drum and hub assembly is such that replacement cannot be done with the hub assembly installed on the vehicle.

↔ Remove or Disconnect

- Raise the vehicle.
- 1. Hub and drum assembly. Refer to "Hub and Drum Assembly Replacement" earlier in this section.
- 2. Retaining bolts, stud nuts or wheel studs.
 - Separate the drum, hub and oil deflector.
 - Press the wheel studs out of the drum. Replace parts as necessary.

→ Install or Connect

1. Drum to the hub.
 - Make certain drain holes are in alignment.
2. Oil deflector to the drum.
 - Apply a light coating of sealing compound to the oil deflector contact surface.
3. Retaining bolts, stud nuts or wheel studs.
 - Press the wheel studs into the drum.

WHEEL BOLT REPLACEMENT

- Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation. Press the wheel bolts out of the hub flange, then press new wheel bolts into place, making sure of a tight fit. When replacing all of the wheel bolts be sure that the hub oil deflector is in position under the wheel bolt heads. Refer to figure 26.

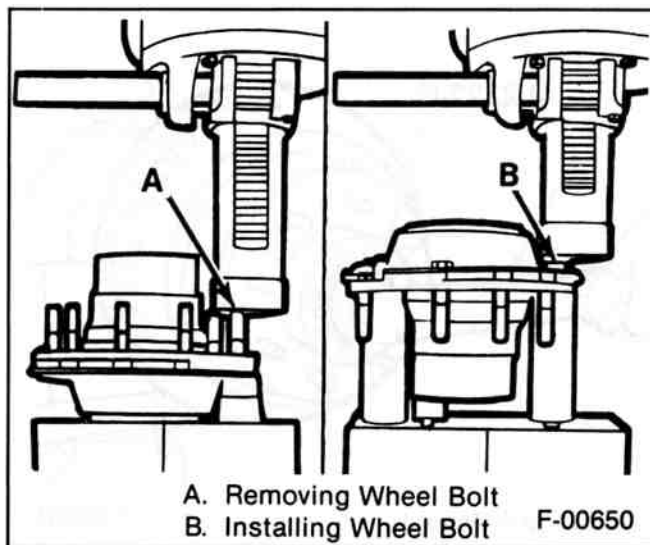


Figure 26—Wheel Bolt Replacement

BEARING ADJUSTMENT

- Make sure the brakes are fully released and do not drag.
- Check the wheel bearing play by grasping the tire at the top and pulling and pushing back and forth, or by using a pry bar under the tire. If the wheel bearings are properly adjusted, movement of the brake drum in relation to the brake flange plate will be barely noticeable and the wheel will turn freely. If the movement is excessive, adjust the bearings.

↔ Remove or Disconnect (Figure 23)

Tool Required:

J-2222-C Wheel Bearing Nut Wrench

- Raise the vehicle until the wheel is free to spin.
1. Axle shaft (52). Refer to "Axle Shaft Replacement" earlier in this section.
 - Be sure the keyway, threads and adjusting nut (42, 58) are clean and free of chips, burrs and shavings.
 2. Nut (40) if used or retaining ring (56).
 - Disengage the tang from the nut (40).
 3. Lock (41) if used or key (57).

⌚ Tighten

- Adjusting nut (42, 58) to 70 N·m (50 ft. lbs.) using J-2222-C (figures 27 and 28).
- Be sure the bearings are seated and in contact with the spindle shoulder.

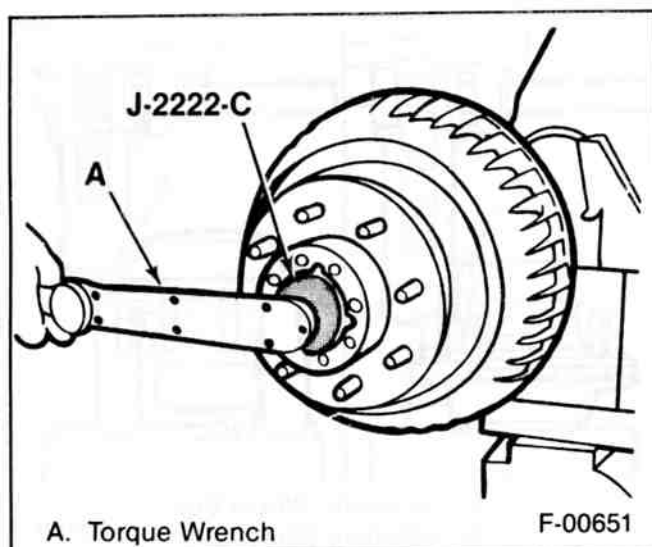


Figure 27—Tightening The Adjusting Nut



Adjust

- Nut (42, 58). Back the nut (42, 58) off until just loose using J-2222-C. Align the adjusting nut (58) slot with the keyway in the axle spindle. Do not back the adjusting nut (58) off more than one slot to gain alignment.



Install or Connect (Figure 23).

1. Key (57) if used or new lock (41).
 - Key (57) into the keyway and adjusting nut (58) slot.
 - Bend the lock (41) tang to the flat of the adjusting nut (42).
2. Retaining ring (56) or nut (40) if used.
 - Bend the lock (41) tang to the flat of the nut (40).
 - Be sure the retaining ring (56) is seated.

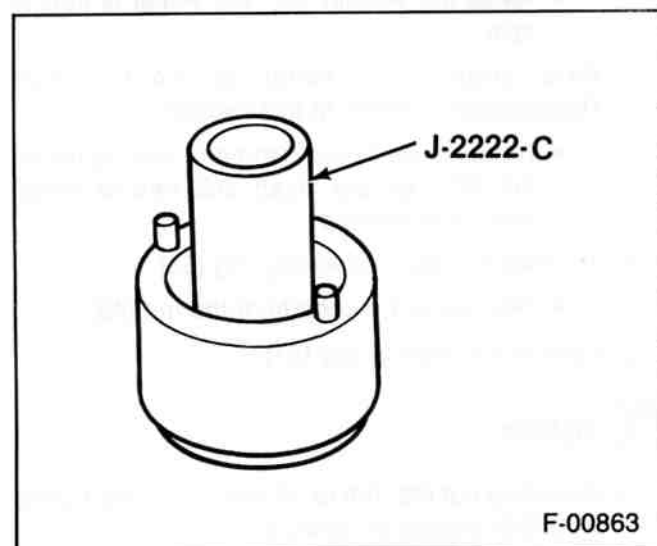


Figure 28—Wheel Bearing Nut Wrench

3. Axle shaft (52). Refer to "Axle Shaft Replacement" earlier in this section.

PINION OIL SEAL/COMPANION FLANGE REPLACEMENT

- The pinion oil seal and the companion flange may be replaced with the carrier assembly installed in the vehicle.



Remove or Disconnect

Tools Required:

- J-8614-01 Companion Flange Holder and Remover
- J-22281 Pinion Oil Seal Installer (DANA 9³/₄-inch ring gear axle)
- J-24384 Pinion Oil Seal Installer (DANA 10¹/₂-inch ring gear axle)
- J-24434 Pinion Oil Seal Installer (CHEVROLET 10¹/₂-inch ring gear axle)

- Raise the vehicle.

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
 - Tie the propeller shaft to a frame rail or crossmember.



Important

- Scribe a line on the pinion stem, pinion nut and companion flange to be used as a guide for reinstallation (figure 17).
2. Nut using J-8614-01 (figure 18).
 3. Flange using J-8614-01.
 - Use the special nut and forcing screw to remove the flange (figure 19).
 4. Oil seal.
 - Pry the oil seal from the bore. Do not damage the machined surfaces and then thoroughly clean foreign material from the contact area.
 - Replace parts as necessary.



Install or Connect

1. Oil seal into the bore.
 - Lubricate the cavity between the new seal lips with a high melting point bearing lubricant.
 - Use the proper seal installing tool listed under tools required.
2. Flange using J-8614-01.
 - Use scribed marks for reinstallation.
3. Nut, use J-8614-01 (figure 18).
 - Use scribe mark as an installation reference.

4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

AXLE VENT REPLACEMENT (12-INCH RING GEAR-FULL FLOATING AXLE)

- A threaded type axle vent is used on the Rockwell 12-inch ring gear axle and must be replaced if the vent cap is damaged or missing.



Clean

The area around the axle vent.



Remove or Disconnect

- Axle vent from the housing.



Install or Connect

- Axle vent to the housing.

AXLE SHAFT REPLACEMENT (12-INCH RING GEAR—FULL FLOATING AXLE)

- Raise the vehicle and place jack stands under the frame side rails.



Remove or Disconnect (Figure 29)

Tools Required:

J-2619-01 Slide Hammer

J-8117 Axle Shaft Puller Adapter

1. Bolts (70) and washers (71).
2. Hub cap (72).
- Thread J-8117 into the tapped hole on the axle shaft (74) flange.
- Attach J-2619-01 to J-8117.
3. Axle shaft (74) using J-2619-01.



Clean

- Old gasket material from the hub (86) and hub cap (72) and the axle shaft (74) flange and mating surface in the hub (86).



Install or Connect (Figure 29)

Tools Required:

J-2619-01 Slide Hammer

J-8117 Axle Shaft Puller Adapter

1. Axle shaft (74).

- Tap the axle shaft (74) into position using J-8117 and J-2619-01.
- Index the axle shaft (74) splines into the hub (86) splines.

2. Gasket (73).
3. Hub cap (72).
4. Washers (71) and bolts (70).

BEARING ADJUSTMENT (12-INCH GEAR—FULL FLOATING AXLE)

- Make sure the brakes are fully released and do not drag.
- Check the wheel bearing play by grasping the tire at the top and pulling and pushing back and forth, or by using a pry bar under the tire. If the wheel bearings are properly adjusted, movement of the hub or disc will be barely noticeable. If the movement is excessive, adjust the bearings.



Remove or Disconnect (Figure 29)

Tool Required:

J-25510 Wheel Bearing Nut Wrench

- Raise the vehicle until the wheel is free to spin.
1. Axle shaft (74). Refer to "Axle Shaft Replacement."
 2. Nut (90) using J-25510.
 - Release the tang.
 3. Lock washer (89).



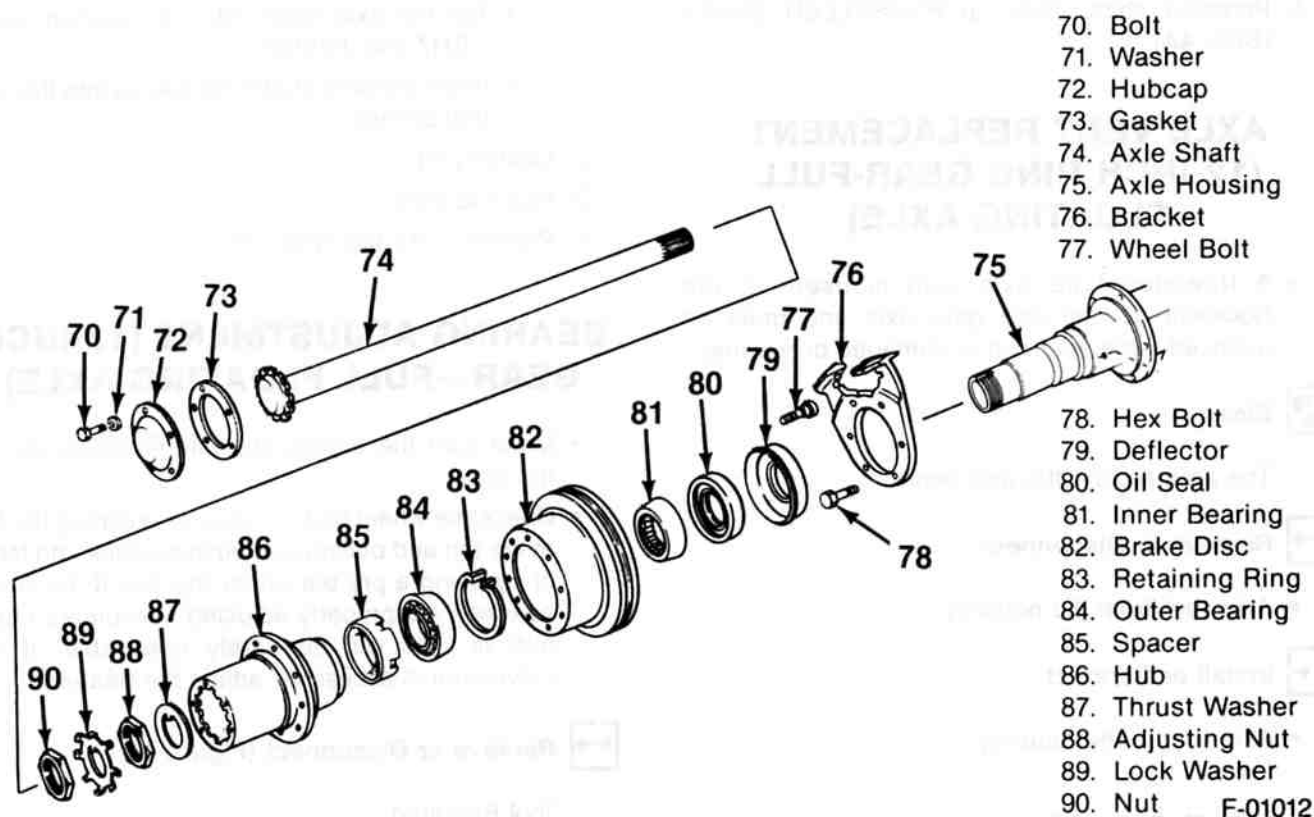
Adjust

- Nut (88) using J-25510. Tighten the nut (88) while the hub is rotating to 68 N·m (50 ft. lbs.). Make sure the bearing surfaces are in contact and then back the nut (88) off 1/8 turn.



Install or Connect (Figure 29)

1. Lock washer (89).
 - Bend a tang over a flat of the adjusting nut (88).
2. Nut (90) using J-25510.
 - Tighten the nut (90) to 339 N·m (250 ft. lbs.).
 - Bend a long tang of the lock washer (89) over a flat of the nut (90).
3. Axle shaft (74). Refer to "Axle Shaft Replacement."
 - Lower the vehicle.


Figure 29—Rockwell Axle And Hub Detail

DRIVE PINION OIL SEAL REPLACEMENT (12-INCH RING GEAR— FULL FLOATING AXLE)

- A pinion oil seal may be replaced on the Rockwell 12-inch ring gear axle with the carrier assembly installed in the vehicle.

Remove or Disconnect (Figure 30)

Tools Required:

J-8614-01 Companion Flange Holder and Remover

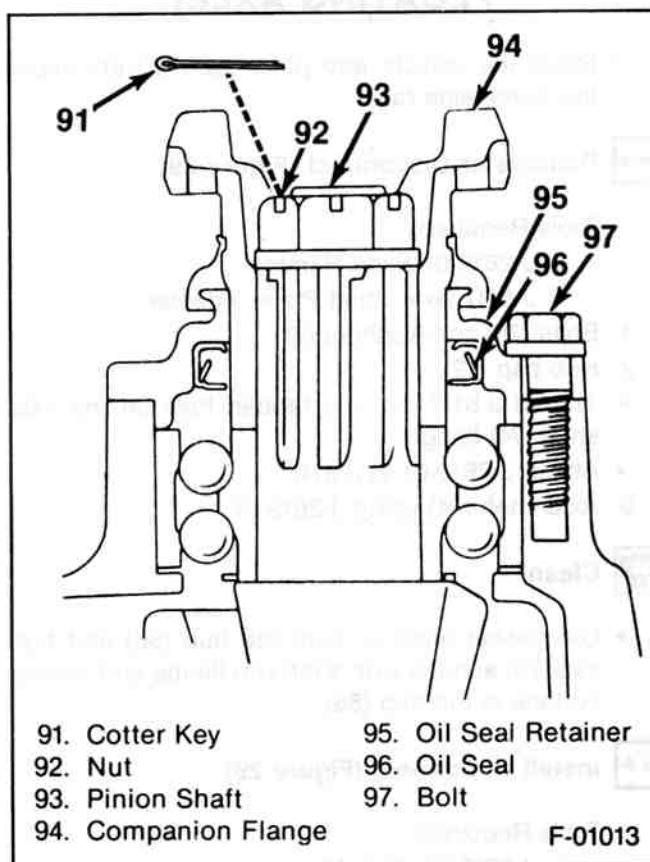
J-22281 Pinion Oil Seal Installer

- Raise the vehicle.

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

Important

- Scribe a reference line on the pinion stem, pinion nut and companion flange.
2. Cotter key (91) and nut (92) using J-8614-01.
 3. Companion flange (94).
 4. Bolts (97).
 5. Oil seal retainer (95).


Figure 30—Drive Pinion Oil Seal Detail

6. Oil seal (96).

- Pry the oil seal (96) from the bore being careful not to damage the machined surfaces.

**Clean**

- The seal contact area.

**Install or Connect (Figure 30)**

- Lubricate the cavity between the new seal (96) lips with a high melting point bearing lubricant. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Oil seal (96) into the bore using J-22281.

- Be sure the seal (96) bottoms against the

bore shoulder.

2. Oil seal retainer (95).
3. Bolts to the retainer (97).
4. Companion flange (94) use the scribed reference mark.
5. Nut (92) using J-8614-01.

**Tighten**

- Nut (92). Align the castellated nut with the hole in the pinion shaft (93) stem and the reference mark.
6. Cotter key (91).
 7. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

SPECIFICATIONS

TORQUES

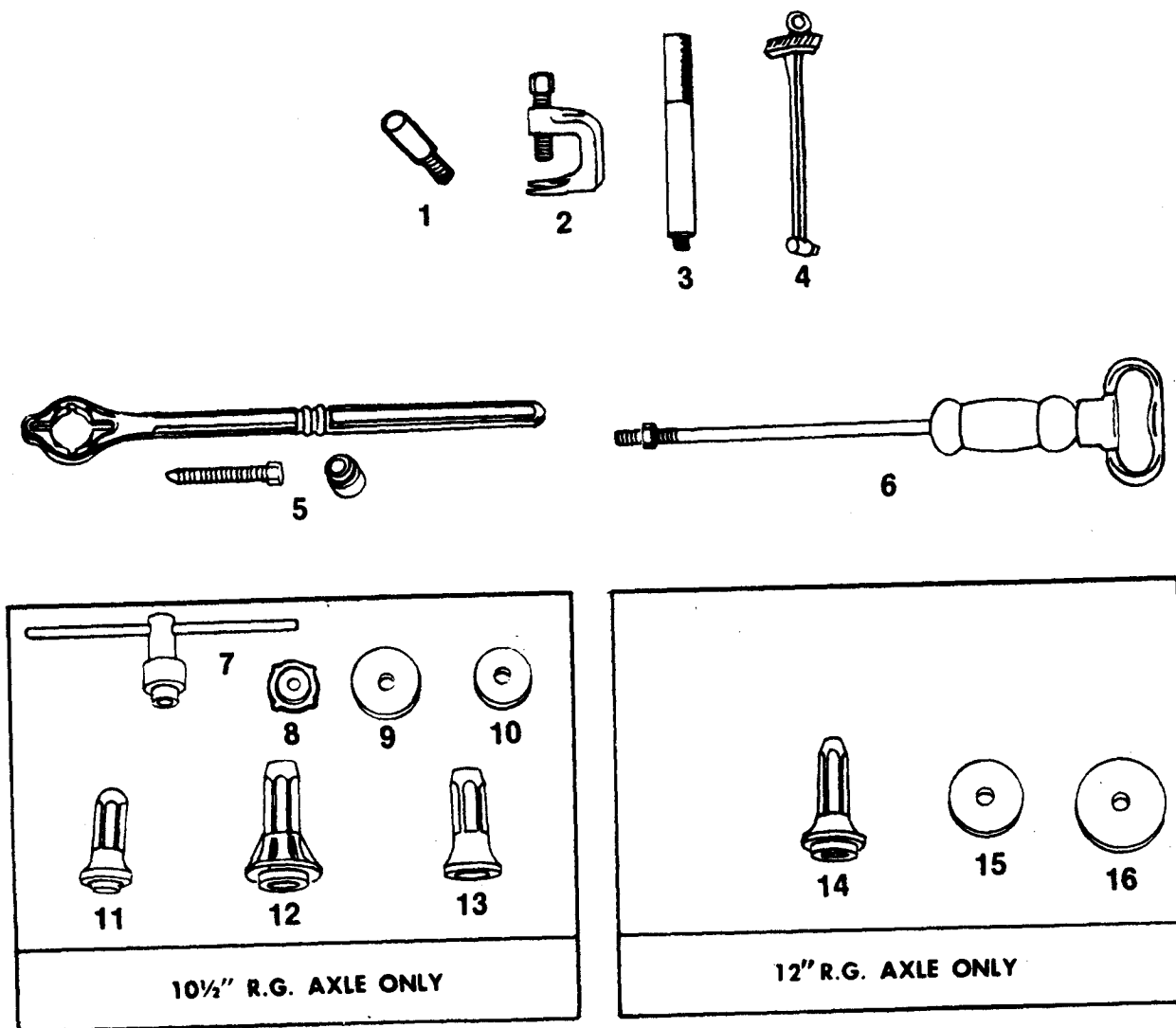
| | 8½" RING GEAR— SEMI FLOATING AXLE | | 9½" RING GEAR— SEMI FLOATING AXLE | | DANA 9¾"-10½" RING GEAR AXLE—FULL FLOATING | | CHEVROLET 10½" RING GEAR AXLE—FULL FLOATING | | ROCKWELL 12" RING GEAR AXLE—FULL FLOATING | |
|-------------------------------|---|----------|---|----------|---|----------|--|----------|--|----------|
| | N·m | FT. LBS. | N·m | FT. LBS. | N·m | FT. LBS. | N·m | FT. LBS. | N·m | FT. LBS. |
| Filler Plug | 34 | 25 | 24 | 18 | 14 | 10 | 24 | 18 | 47 | 35 |
| Lock Screw | 34 | 25 | 34 | 25 | — | — | — | — | — | — |
| Brake Backing Plate | 47 | 35 | 142 | 105 | 142 | 105 | 142 | 105 | — | — |
| Axle Shaft to Hub Bolts | — | — | — | — | 156 | 115 | 156 | 115 | — | — |
| Carrier Cover | 27 | 20 | 27 | 20 | 47 | 35 | 41 | 30 | — | — |
| Axle Lubricant Capacity | Liters | Pints | Liters | Pints | Liters | Pints | Liters | Pints | Liters | Pints |
| | 2.0 | 4.2 | 2.6 | 5.5 | 2.6 | 5.5 | 3.4 | 7.2 | 6.6 | 14.0 |

WHEEL BEARING ADJUSTMENT VALUES

| RING GEAR SIZE | BEARING ADJUSTING NUT TORQUE* | ADJUSTING NUT BACK-OFF* | OUTER LOCKNUT TORQUE | RESULTING BEARING ADJUSTMENT | TYPE OF BEARING |
|-------------------|----------------------------------|----------------------------|-------------------------|------------------------------------|--------------------|
| 9¾" Ring Gear | 68.0 N·m 50 ft. lbs. | ** | 88.1 N·m 65 ft. lbs. | 0.0254 to 0.254 mm | TAPERED ROLLER |
| 10 ½" Ring Gear | 68.0 N·m 50 ft. lbs. | — | — | .001 to .010 inch | |
| 12" Ring Gear | 68.0 N·m 50 ft. lbs. | ⅛ Turn | 339.0 N·m 250 ft. lbs. | End Play | |

*With wheel rotating.

**Back-off the nut and retighten to 47 N·m (35 ft. lbs.). Then back the nut off ⅛ turn.



1. J-8117 Axle Shaft Puller Adapter
2. J-6627-A Wheel Stud Remover
3. J-8092 Driver Handle
4. J-5853 Torque Wrench—Inch/Pound
5. J-8614-01 Companion Flange Holder And Remover
6. J-2619-01 Slide Hammer With Adapter
7. J-2222-C Wheel Bearing Nut Wrench
8. J-24426 Outer Wheel Bearing Cup Installer
9. J-24427 Inner Wheel Bearing Cup Installer
10. J-8608 Outer Pinion Bearing Cup Installer
11. J-24384 Pinion Oil Seal Installer
12. J-24428 Axle Shaft Seal Installer
13. J-24434 Pinion Oil Seal Installer
14. J-22281 Pinion Oil Seal Installer
15. J-8114 Wheel Bearing Outer Cup Installer
16. J-8093 Wheel Bearing Inner Cup Installer

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Figure 31—Special Tools

SECTION 5

BRAKES

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology NOTICE: See 'Notice' on page 5-1 of this section.

NOTICE: *This fastener is an important attaching part in that it could affect the performance of vital components and system, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.*

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. (A water dampened cloth should be used). Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

CONTENTS

| <u>SUBJECT</u> | <u>PAGE</u> |
|---|--------------------|
| Brake System Diagnosis | 5- 2 |
| Road Testing the Brakes | 5- 2 |
| Hydro-Boost System Tests | 5- 2 |
| Diagnosis of Brake System | 5- 4 |
| Diagnosis of Hydro-Boost System | 5- 7 |
| On - Vehicle Service | 5- 8 |
| Bleeding the Brake Hydraulic System | 5- 8 |
| Flushing the Brake Hydraulic System | 5- 9 |
| Brake Pipes and Hoses | 5- 9 |
| Combination Valve | 5-12 |
| Height Sensing Brake Proportioning Valve | 5-13 |
| Brake Pedal Assembly | 5-17 |
| Checking Pedal Travel | 5-17 |
| Brake Pedal Replacement | 5-17 |
| Brake Pedal Rod Replacement | 5-20 |
| Stoplamp Switch | 5-20 |
| Parking Brake System | 5-22 |
| Parking Brake Pedal or Handle Replacement | 5-22 |
| Cable Replacement | 5-23 |
| Propeller Shaft Brake Replacement | 5-27 |
| Parking Brake Adjustment | 5-27 |
| Master Cylinders | 5-30 |
| Description | 5-30 |
| Master Cylinder Replacement | 5-30 |
| Bench Bleeding | 5-30 |
| Vacuum Boosters | 5-32 |
| Description | 5-32 |
| Vacuum Booster Replacement | 5-32 |

CONTENTS (CONT.)

| SUBJECT | PAGE |
|---------------------------------------|------|
| Hydraulic Brake Booster (Hydro-Boost) | 5-33 |
| Description | 5-33 |
| Hydro-Boost Replacement | 5-33 |
| Bleeding the Hydro-Boost System | 5-36 |
| Disc Brakes | 5-37 |
| Description | 5-37 |
| Brake Lining Inspection | 5-37 |
| Brake Lining Replacement | 5-38 |
| Servicing the Rotor | 5-41 |
| Rebuilding the Caliper | 5-42 |
| Drum Brakes | 5-45 |
| Description | 5-45 |
| Brake Lining Replacement | 5-45 |
| Servicing the Brake Drum | 5-45 |
| Brake Adjustment | 5-47 |
| Wheel Cylinder Replacement | 5-47 |
| Rebuilding the Wheel Cylinder | 5-47 |
| Specifications | 5-49 |
| Special Tools | 5-51 |

BRAKE SYSTEM DIAGNOSIS

ROAD TESTING THE BRAKES

BRAKE TEST

The brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy, or covered with loose dirt so that all the tires do not grip the road equally. The testing will be adversely affected if the roadway is crowned so as to throw the weight of the vehicle toward the wheels on one side or if the roadway is so rough that the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light and heavy pressure; however, avoid locking the wheels and sliding the tires on the roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked turning wheels will stop the vehicle in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

EXTERNAL CONDITIONS THAT AFFECT BRAKE PERFORMANCE

- 1. **Tires**—Tires having unequal contact and grip on the road will cause unequal braking. The tires must be equally inflated and the tread pattern of the right and left tires must be about equal.

- 2. **Vehicle Loading**—When the vehicle has unequal loading, the most heavily loaded wheels require more braking power than the others.
- 3. **Front Wheel Bearings**—Loose front wheel bearings permit the disc to tilt and have spotty contact with the linings causing erratic action.
- 4. **Front End Alignment**—Misalignment of the front end, particularly in regard to limits on camber and caster, will cause the brakes to pull to one side.

HYDRO-BOOST SYSTEM TESTS

The Hydro-Boost system receives its source of power from the power steering system. Therefore a faulty power steering system may affect the operation of the booster, just as a problem in the booster may affect the steering system. Prior to performing any tests the following checks must be made.

- 1. Check all the power steering and brake pipe connections for leaks or restriction.

NOTICE: *Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.*

- 2. Check and fill the brake master cylinder with brake fluid.

3. Check and fill the power steering reservoir with power steering fluid. If fluid contains air refer to **POWER STEERING** (Sec. 3B3) for further diagnosis.
4. Check power steering pump belt for wear and tension. Adjust if needed, refer to **POWER STEERING** (Sec. 3B3).
5. Check engine idle speed, refer to the vehicles Emission Control Information label for idle specifications.
6. Check steering pump pressure. Refer to **POWER STEERING** (Sec. 3B3).

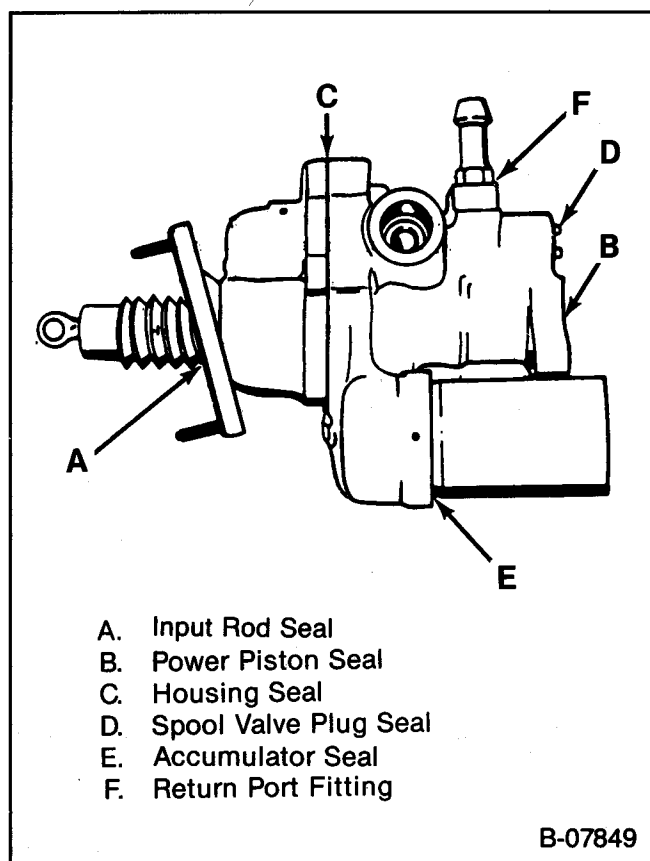
NOISE DIAGNOSIS

The following noises are associated with the Hydro-Boost and may or may not be cause for customer complaint. Some noises are normal and for the most part temporary in nature. Other noises may be a sign of excessive wear or the presence of air in either the booster or the steering system.

1. A moan or low frequency hum usually accompanied by a vibration in the pedal or steering column may be observed during parking maneuvers or other low speed maneuvers. This may be caused by a low fluid level in the power steering pump or by air in the fluid. Holding the pump at relief pressure (steering wheel held all the way in one direction) for more than five seconds will cause air to enter the system. Check the fluid level and fill if needed. The system must then sit for one hour to remove the air. If the condition persists, refer to **POWER STEERING** (Sec. 3B3).
2. A high speed fluid noise may be heard when the brake pedal is fully depressed, this condition is normal.
3. Whenever the accumulator pressure is used, a slight hiss may be noticed. It is the sound of the hydraulic fluid escaping through the accumulator valve, and is completely normal.
4. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This is caused by the fluid rushing through the accumulator charging orifice. It is normal and will only be heard once after the accumulator is emptied. However, if this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked using the procedure for the "Accumulator Leakdown Test" in this section.

BOOSTER FUNCTIONAL TEST

With the engine off, apply the brake pedal several times until the accumulator is completely depleted. Depress the brake pedal using 180 N (40 lbs.) of force and start the engine. The pedal will fall and then push back against your foot.



- A. Input Rod Seal
- B. Power Piston Seal
- C. Housing Seal
- D. Spool Valve Plug Seal
- E. Accumulator Seal
- F. Return Port Fitting

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Figure 1—Hydro-Boost Seal Leak Diagnosis

ACCUMULATOR LEAKDOWN TEST

1. Start the engine and charge the accumulator by applying the brake pedal or by turning the steering wheel from stop to stop. Turn off the engine and let the vehicle sit for one hour. After one hour there should be at least two power assisted applications with the engine off.
2. If the reserve system will not retain a charge for one hour, but functions normally immediately following charging, the accumulator valves are at fault and the booster must be disassembled and the accumulator valves replaced.
3. If the accumulator can be heard charging and discharging, but it does not hold a charge, disassemble the booster and replace the accumulator valves.
4. Deplete the accumulator by pressing the brake pedal several times. If the accumulator can has lost its gas charge, it is possible to rotate or wobble the accumulator can with respect to the housing. Replace the accumulator assembly.

SEAL LEAK DIAGNOSIS (FIGURE 1)

- A. **INPUT ROD SEAL.** A damaged seal will show up as a fluid leak from the mounting bracket vent hole. The booster must be removed from the vehicle and disassembled. The input rod bore should be checked for any scratches that may cause the leak. If scratches are present, the

housing cover must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.

B. POWER PISTON SEAL. Power piston seal damage will be noticed by fluid leaking out at the common master cylinder brake booster vent and possible reduction in power assist. The booster must be removed from the vehicle and disassembled. The piston should be checked for any scratches that may be the cause of the leak. If scratches are present, then the booster seal kit can be used to replace the appropriate seals.

C. HOUSING SEAL. If the housing seal is damaged, fluid will leak out from between the two housings. The booster must be removed from the vehicle and disassembled. The booster seal kit should be used to replace the housing and input rod and power piston seals.

D. SPOOL VALVE PLUG SEAL. Damage to this seal will be noticed by fluid leaking out past the plug. The booster need not be removed from the vehicle.

E. ACCUMULATOR SEAL. Damage to this seal will result in fluid leakage past the accumulator cap. The seal can be replaced while the booster is installed on the vehicle.

F. RETURN PORT FITTING. Tighten the fitting to 10 N·m (7 ft. lbs.). If the leak continues, replace the seal ring under the fitting.

DIAGNOSIS OF BRAKE SYSTEM

| PROBLEM | POSSIBLE CAUSE | CORRECTION |
|---------------------------------------|--|---|
| Uneven Brake Action (Brakes Pull). | <div>1. Incorrect tire pressure.</div> <div>2. Front end out of alignment.</div> <div>3. Loose suspension parts.</div> <div>4. Worn out brake lining.</div> <div>5. Incorrect lining material.</div> <div>6. Malfunctioning caliper assembly.</div> <div>7. Loose calipers.</div> <div>8. Contaminated brake linings.</div> <div>9. Malfunctioning rear brakes.</div> <div>10. Leaking wheel or piston cylinder seal.</div> <div>11. Restricted brake tubes or hoses.</div> <div>12. Unmatched tires on the same axle.</div> | <div>1. Inflate evenly on both sides to manufacturer's specifications.</div> <div>2. Check and align to manufacturer's specifications.</div> <div>3. Check all suspension mountings.</div> <div>4. Replace with lining of correct material.</div> <div>5. Replace with linings of correct material.</div> <div>6. Check for frozen or sluggish pistons and the lubrication of the retainer bolts. Caliper should slide.</div> <div>7. Check and torque.</div> <div>8. Repair as necessary. Replace linings in complete axle sets.</div> <div>9. Check for inoperative self adjusters. Weak return springs. Leaking wheel cylinders.</div> <div>10. Repair as necessary.</div> <div>11. Check for collapsed rubber hoses or damaged lines. Repair as necessary.</div> <div>12. Same style tires with about the same tread should be used on the same axle.</div> |

BRAKE PEDAL ASSEMBLY

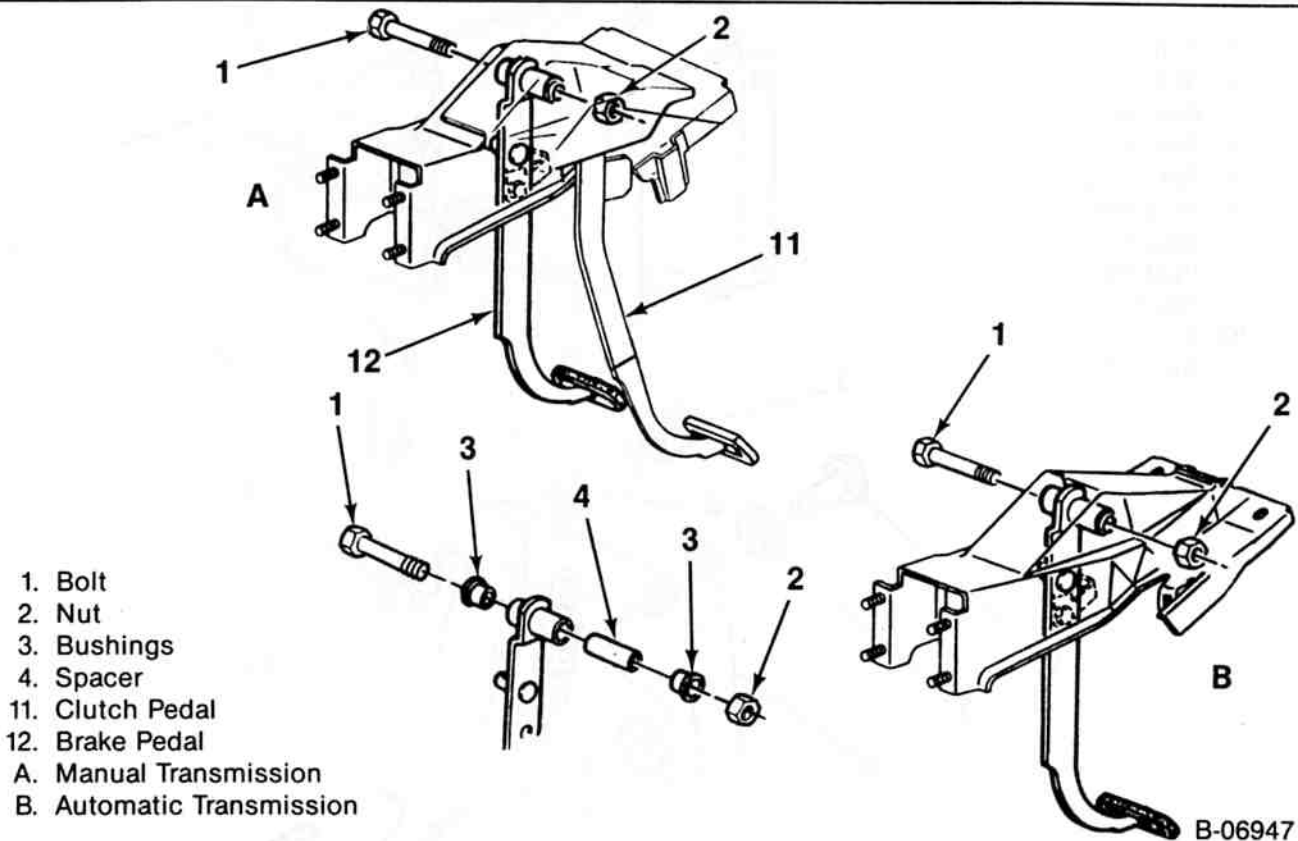


Figure 13—C-K Brake Pedal Components

CHECKING PEDAL TRAVEL

At frequent intervals the brake pedal should be checked for travel. Travel is the distance the pedal moves toward the floor from a full released position. This check should be made with the brakes cold and about 122 N (90 lbs.) of force on the pedal. On vehicles with power brakes the pedal must be pumped at least three times with the engine off before making the check. Follow the specifications below for the correct travel.

| | |
|---------------------|---------------------|
| C-K-G Manual..... | 115 mm (4.5-inches) |
| C-K-G Power..... | 90 mm (3.5-inches) |
| P (Except JF9)..... | 90 mm (3.5-inches) |
| P (JF9)..... | 150 mm (6.0-inches) |

BRAKE PEDAL REPLACEMENT

C-K AND P30 (32) MODELS

Remove or Disconnect (Figures 13 and 14)

1. Retainer (6).
 - Washer (7).

- Pin (10) and washer (9).
 - Pushrod (8).
 - Return spring (5).
2. Nut (2) and bolt (1).
 3. Brake pedal (12).
 - Clutch pedal (11) (if equipped).
 - Bushings (3).
 - Spacer (4).

Install or Connect (Figures 13 and 14)

1. Spacer (4).
 - Bushings (3).
 - Brake pedal (12).
 - Clutch pedal (11) (if equipped).

NOTICE: See "Notice" on page 5-1 of this section.

2. Bolt (1) and nut (2).

Tighten

- Nut to 34 N·m (25 ft. lbs.)
3. Return spring (5).

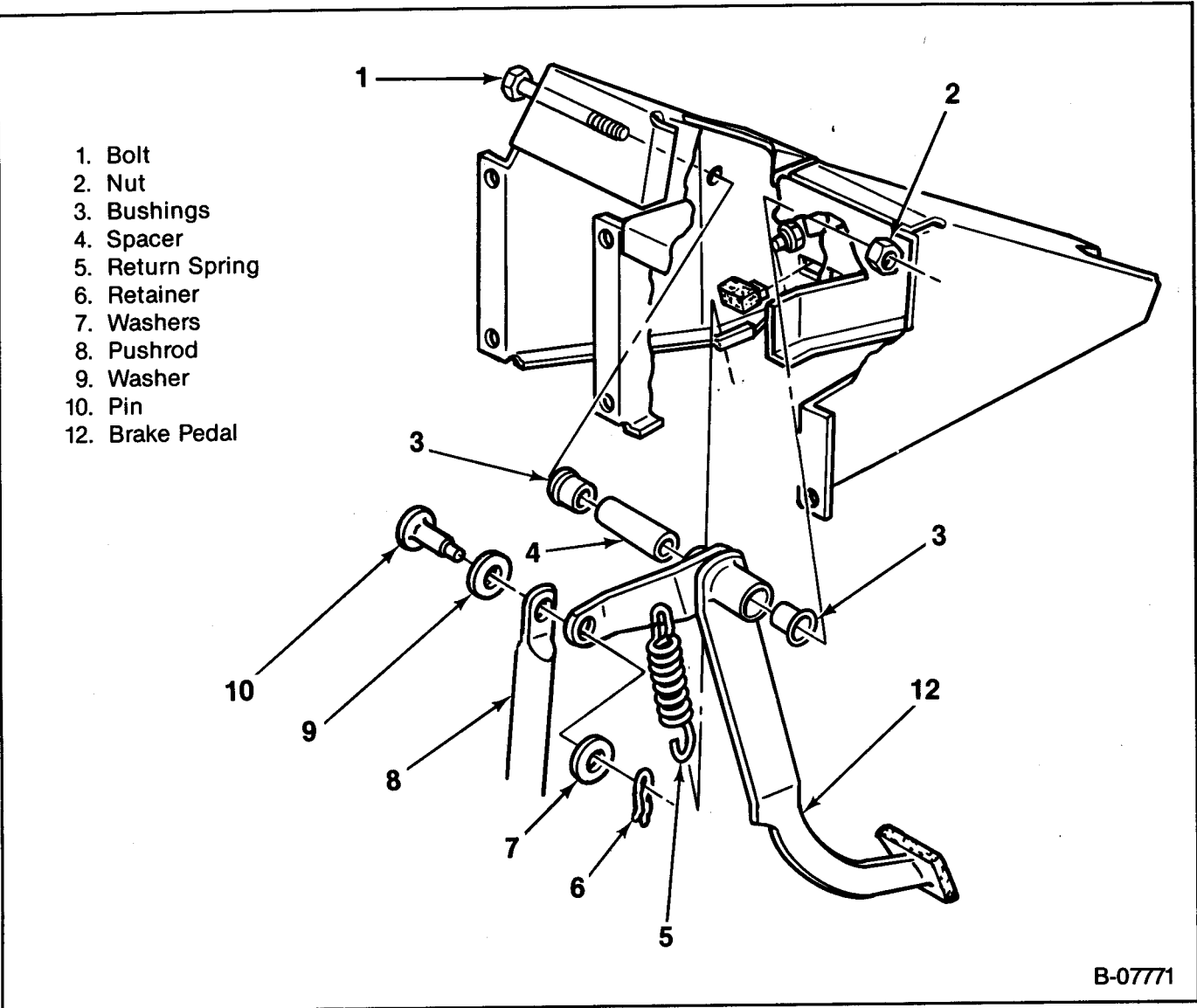


Figure 14—P30 (32) Brake Pedal Components

- 4. Washer (9) and pin (10).
 - Pushrod (8).
 - Washer (7) and retainer (6).
- 5. Check the stoplamp switch adjustment. Refer to "Stoplamp Switch."

G-MODEL

↔ Remove or Disconnect (Figure 15)

- 1. Retainer (6).
 - Washer (9).
 - Pushrod (8).
 - Washer (7).
- 2. Return spring. (5).
- 3. Retainer (14) or clutch attaching components (15) (if equipped).
- 4. Pin (13) or clutch pedal (11) (if equipped).
- 5. Brake pedal (12).
 - Bushings (3).

↔ Install or Connect (Figure 15)

- 1. Bushings (3).
 - Brake pedal (12).
- 2. Pin (13) or clutch pedal (11) (if equipped).
- 3. Retainer (14) or clutch attaching components (15) (if equipped).
- 4. Return spring (5).
- 5. Washer (7).
 - Pushrod (8).
 - Washer (9).
 - Retainer (6).
- 6. Check the stoplamp switch adjustment. Refer to "Stoplamp Switch."

SWITCH REPLACEMENT**↔ Remove or Disconnect**

1. Remove the negative battery cable.
2. Electrical connectors.
3. Switch.

→ Install or Connect

1. Switch.

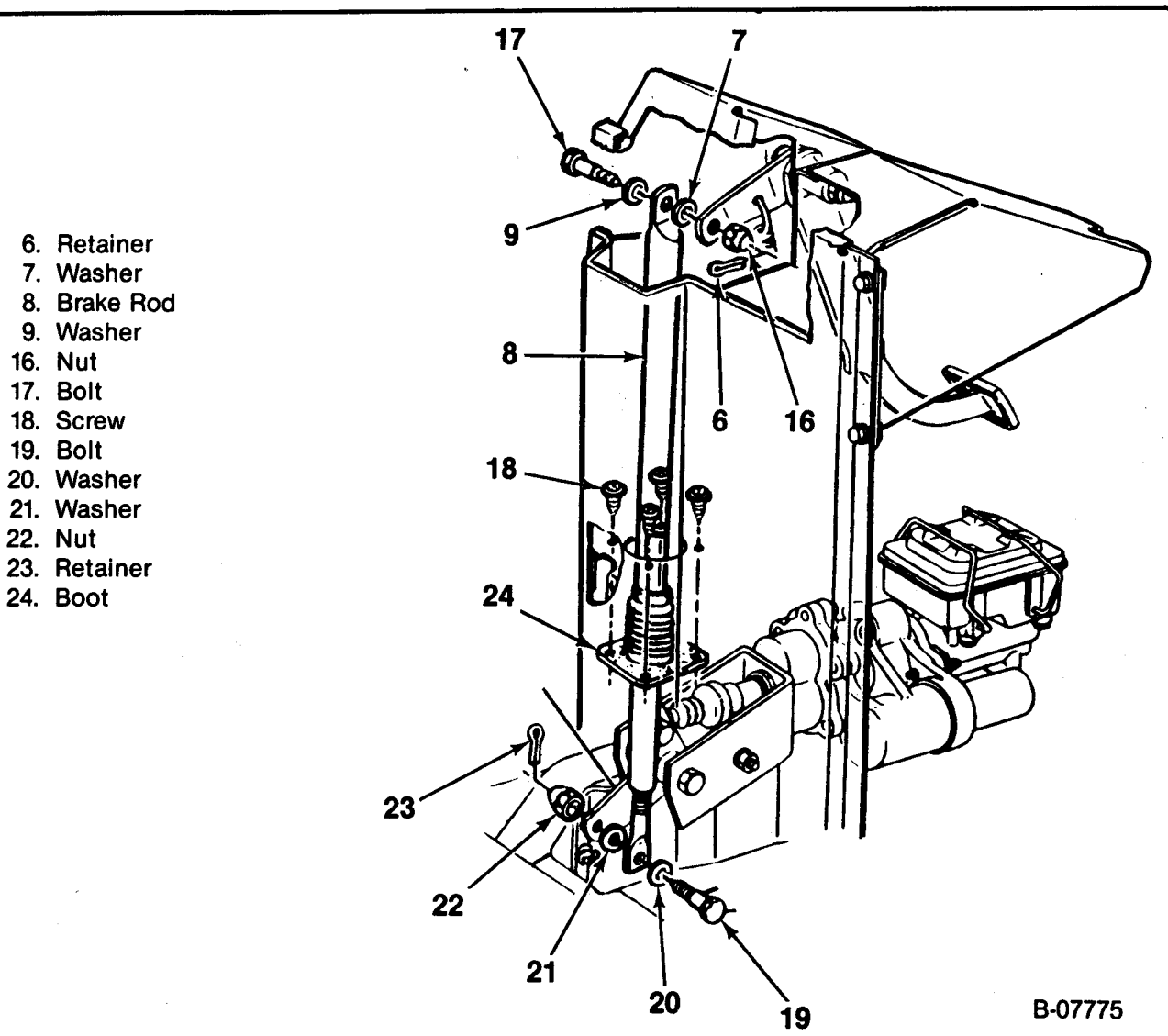
🔧 Adjust

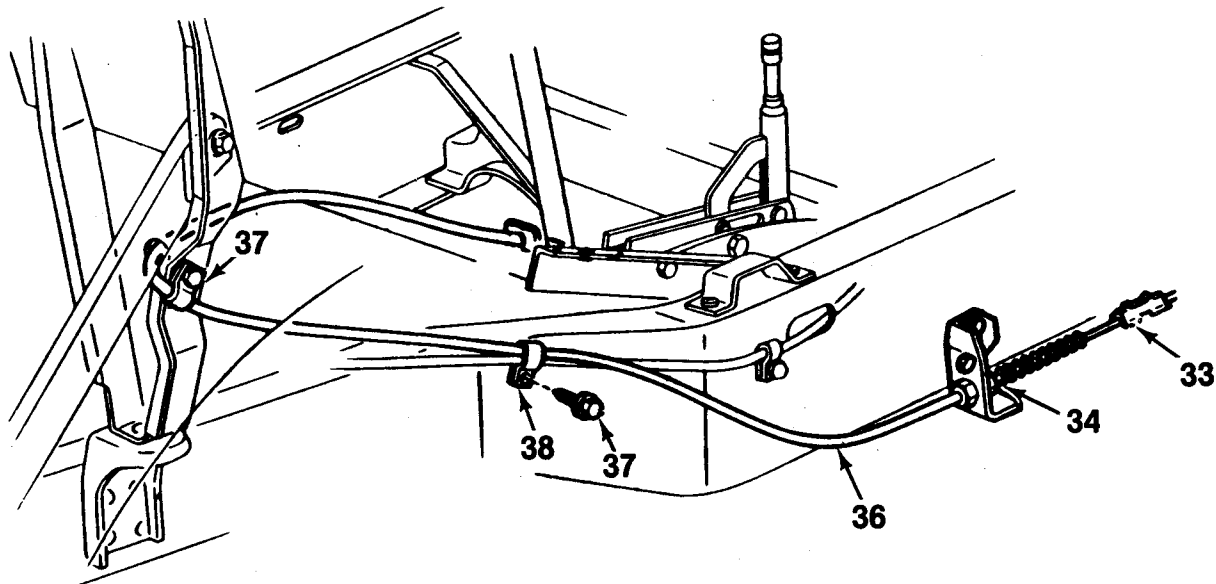
- Refer to "Switch Adjustment".

2. Electrical connectors.
3. Negative battery cable.

SWITCH ADJUSTMENT

1. Depress the brake pedal and press the switch in until it is firmly seated in the clip.
 - Audible "clicks" can be heard as the threaded portion of the switch is pushed through the clip.
2. Pull the brake pedal against the pedal stop until the audible "click" can no longer be heard.
3. Electrical contact should be made when the brake pedal is depressed the specified distance.
 - C-K models 25 - 31 mm (1.0 - 1.24 inches)
 - G-P models 11 - 24 mm (0.45 - 0.95 inches)

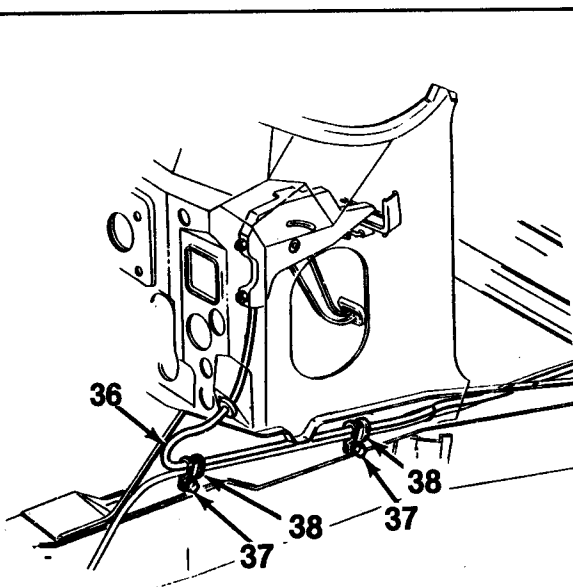
**Figure 17 — P30 (32) Brake Pedal Rod Components**



- 33. Connector
- 34. Frame Retaining Fingers
- 36. Cable Assembly
- 37. Bolt
- 38. Clip

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Figure 22—P Model Front Cable Components



- 36. Cable Assembly
- 37. Bolt
- 38. Clip

B-07781

Figure 23—G Model Front Cable Components

- 3. Cable.

Install or Connect (Figure 20)

- 1. Cable.
- 2. Connector (33).
- 3. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment" in this section.

- 4. Lower the vehicle.

REAR CABLE REPLACEMENT

Remove or Disconnect (Figure 20)

- Raise the vehicle and support it with suitable safety stands.
- 1. Nut (31) from the equalizer (32).
- 2. Connector (33).
- 3. Brake drum and shoe assembly, refer to "Drum Brakes" in this section.
- 4. Bend in retaining fingers at the backing plate.
- 5. Retaining clip at the frame support.
 - Cable assembly.

Install or Connect (Figure 20)

1. Cable assembly.
 - Make sure all the retaining fingers are completely through the backing plate.
2. Retaining clip at the frame support.
3. Brake shoes and drum assembly, refer to "Drum Brakes" in this section.
4. Connector (33).
5. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment" in this section.
6. Lower the vehicle.

PROPELLER SHAFT BRAKE REPLACEMENT

Remove or Disconnect (Figure 24)

- Raise the vehicle and support with suitable safety stands.
1. Propeller shaft, refer to PROPELLER SHAFT (Sec. 4A) in this manual.

CAUTION: See "Caution" on page 5-1.

2. Drum (66).
 - It may be necessary to back off the adjusting screw.
3. Return springs (56 and 71).
 - Return spring guide (72).
4. Hold down clips (65).
 - Hold down springs (64).
 - Washers (63).
5. Lever strut (55).
 - Strut spring (57).
6. Lever retaining ring (67).
7. Shoes (68).
8. Adjusting screw (60).
 - Adjusting screw spring (58).

Inspect

- All parts for discoloration due to heat, or stress. Replace if necessary.
- Brake drum for scoring and heat spots. Machine drum if needed.

Install or Connect (Figure 24)

- Lubricate the shoe pads and adjusting screw threads with a thin coat of white lithum grease.

1. Adjusting screw (60) and adjusting screw spring (58) to both shoes (68).
2. Shoe assembly (68).
 - Lever retaining ring (67).

3. Lever strut (55) and strut spring (57).
4. Washers (63).
 - Hold down springs (64).
 - Hold down clips (65).
5. Return spring guide (72).
 - Return springs (56 and 57)
6. Drum (66).
7. Propeller shaft, refer to PROPELLER SHAFT (Sec. 4A) in this manual.

Adjust

- Refer to "Parking Brake Adjustment" in this section.
8. Lower the vehicle.

PARKING BRAKE ADJUSTMENT

The parking brakes must be adjusted whenever the parking brake cables have been replaced or disconnected. Also if the brake holding ability is not adequate. Before adjusting the parking brakes check the condition of the service brakes. The service brakes must be adjusted properly before proceeding with the parking brake adjustment.

CABLE INSPECTION

Check the parking brake system for free operation. The brake lever must return to the released position without sticking or binding. If a problem is present check the cable routings for kinks or binding. Clean and lubricate the parking brake assembly and cables with Delco brake lube or equivalent.

FOOT PEDAL TYPE

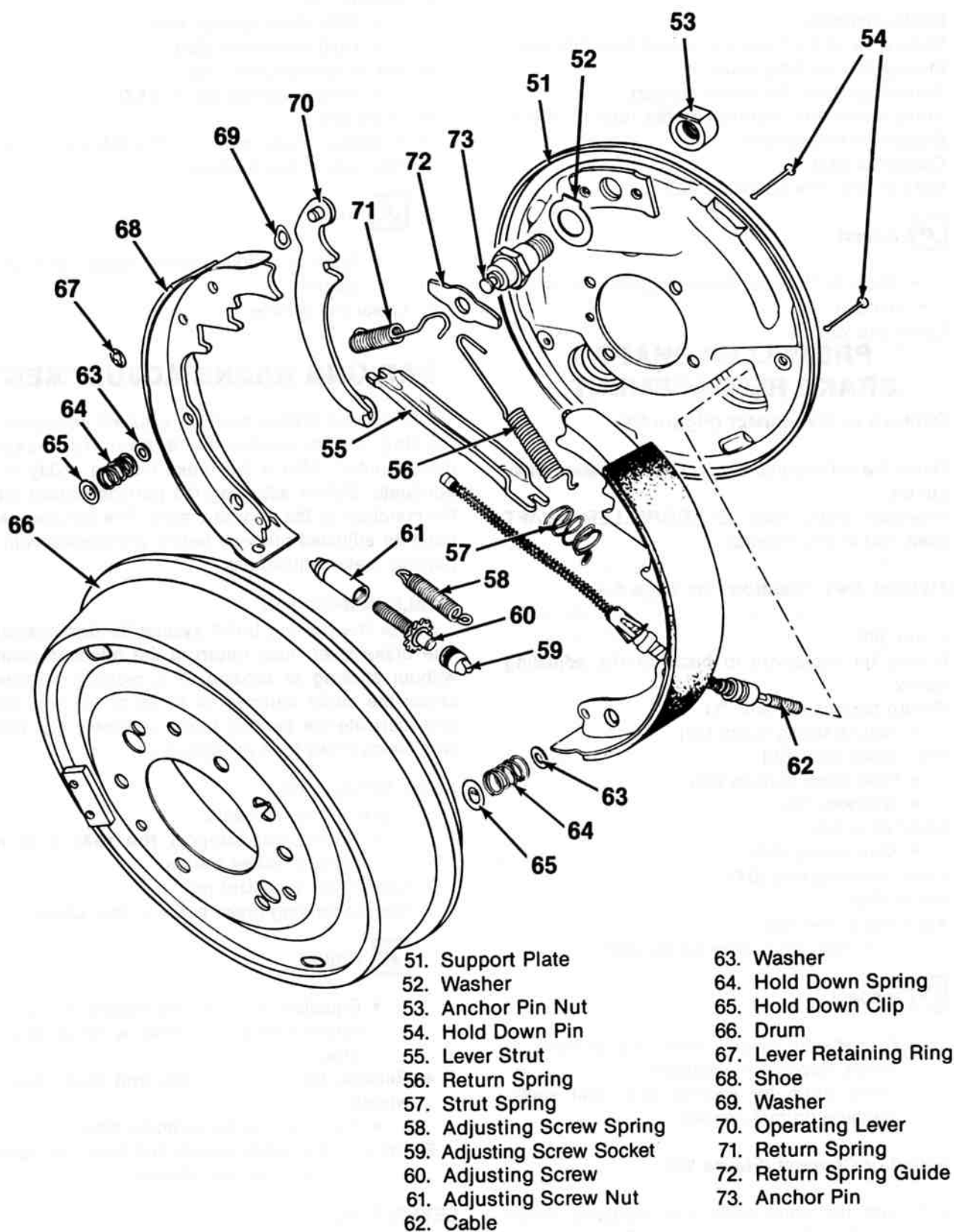
1. Block the front wheels.
 - Raise and support the rear axle with suitable safety stands.
2. Loosen the equalizer nut.
3. Set the parking brake pedal to four clicks.

Adjust

- Equalizer nut until the wheels will not rotate forward without a moderate drag.
4. Release the parking brake and rotate the rear wheels.
 - There should be no brake drag.
 5. Remove the safety stands and lower the vehicle.
 - Unblock the front wheels.

LEVER TYPE

1. Block the front wheels.
 - Raise and support the rear axle with suitable safety stands.
2. Turn the adjusting knob on the parking brake lever counterclockwise until it stops.
 - Apply parking brake.



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Figure 24—Propeller Shaft Brake Components

3. Loosen the equalizer nut.

**Adjust**

- Equalizer nut until a light drag is felt while rotating the wheels forward.
 - Knob on the parking brake lever until a definite snap over center is felt.
4. Release the parking brake and rotate the rear wheels.
 - There should be no brake drag.
 5. Remove the safety stands and lower the vehicle.
 - Unblock the front wheels.

INTERNAL EXPANDING (PROPELLER SHAFT)

CAUTION: See "Caution" on page 5-1 of this section.

1. Block the front wheels.
 - Raise and support the rear axle with suitable safety stands.
2. Remove the clevis pin connecting the pull rod and relay lever.
3. Rotate the brake drum to align the access hole with the adjusting screw.
 - **Manual transmissions** - the adjusting screw is located at the bottom of the shoe.
 - **Automatic transmission** - the adjusting screw is located at the top of the shoe.
 - When adjusting the parking brake for the first time, it will be necessary to remove the lanced area from the drum. The drum must be removed to clean out all the metal shavings. Refer to PROPELLER SHAFTS (Sec. 4A).

**Adjust**

- Adjusting screw until the drum cannot be rotated by hand.
 - Back off the adjusting screw ten notches. The drum should rotate freely.
4. Place parking brake lever in the full release position.
 5. Take up the slack in the cable to overcome the spring tension.

**Adjust**

- The clevis of the pull rod to align with the hole in the relay lever.
6. Install the clevis pin.
 - Install new cover in the drum access hold.
 7. Remove the safety stands and lower the vehicle.
 - Unblock the front wheels.

MASTER CYLINDERS

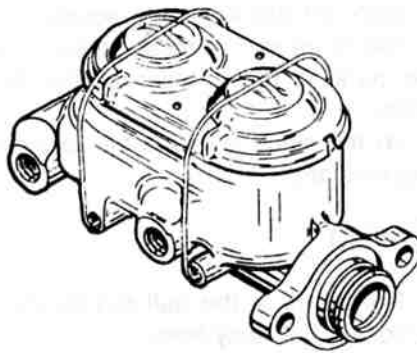


Figure 25—Cast Iron Master Cylinder

DESCRIPTION

There are two designs of master cylinders available depending on the brake option.

One is a full cast iron design incorporating a conventional front to rear brake split (figure 25). The primary piston provides the fluid pressure to the front brakes, while the secondary piston provides the fluid pressure to the rear brakes. If the pressure is lost from either system, the remaining system will function to stop the vehicle.

The second style master cylinder is designed for use with a system using the low drag calipers (figure 26). In addition to the standard master cylinder functions, a quick take-up feature is included. This provides a large volume of fluid to the wheels at low pressure with the initial brake application. This large volume of fluid is needed to overcome the clearance created by the seals retracting the pistons into the front calipers and the spring retraction of the rear drum brake shoes.

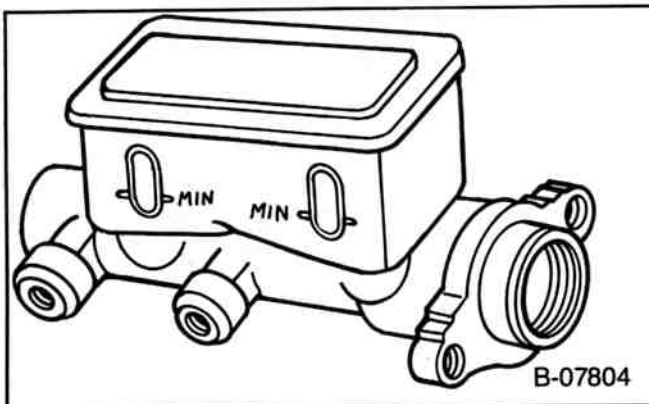


Figure 26—Composite Master Cylinder

MASTER CYLINDER REPLACEMENT

Remove or Disconnect (Figure 27)

- Apply the vehicles parking brakes.
- 1. Brake pipes.
- Cover the ends of the pipes to prevent dirt from entering the system.
- 2. Mounting nuts.
- 3. Master cylinder.
- If the vehicle is equipped with manual brakes, refer to "Brake Pedal Replacement" for the removal of the pushrod from the pedal.

Install or Connect (Figure 27)

- Prior to installation, refer to "Bench Bleeding" in this section.
- 1. Master cylinder.
- If the vehicle is equipped with manual brakes, refer to "Brake Pedal Replacement" for the installation of the pushrod to the pedal.

NOTICE: See "Notice" on page 5-1 of this section.

2. Mounting nuts.

Tighten

- Nuts to 34 N·m (25 ft. lbs.), G and P models.
- Nuts to 44 N·m (32 ft. lbs.), C and K models.
- 3. Brake pipes.
- 4. Bleed the brakes, refer to "Bleeding the Brake Hydraulic System" in this section.
- 5. Release the parking brakes.

BENCH BLEEDING

The purpose of bench bleeding is to remove the air from the master cylinder so when it is installed on the vehicle the brake system bleeding will be reduced.

1. Plug the outlet ports and mount the master cylinder in a vise with the front end tilted slightly down.
2. Fill the reservoir with clean brake fluid.

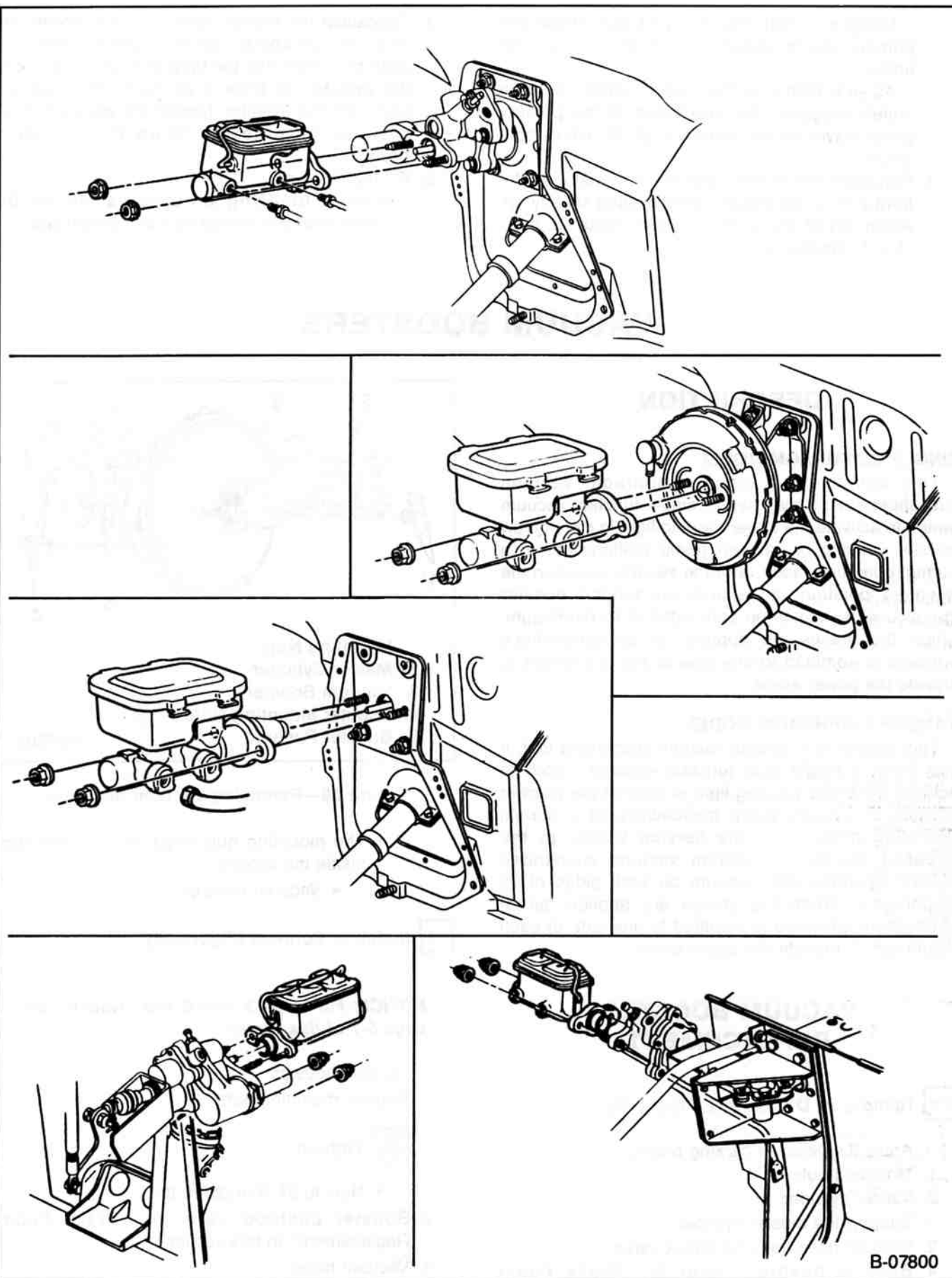


Figure 27—Master Cylinder Installations

Using a smooth rounded end tool, stroke the primary piston about 25 mm (1-inch) several times.

As air is bled from the master cylinder, with the outlets plugged, the resistance to the primary piston travel will not allow the full 25 mm (1-inch) stroke.

- 3. Reposition the master cylinder in the vise with the front end of the master cylinder tilted slightly up. Again stroke the primary piston about 25 mm (1-inch) several times.

- 4. Reposition the master cylinder in the vise to the level position. Loosen the plugs one at a time and push the piston into the bore to force the air from the cylinder. To prevent air from being sucked back into the cylinder, tighten the plug(s) before allowing the piston to return to its original position.

- 5. Fill the reservoir.
Normal bleeding procedures should be followed after the master cylinder is installed.

VACUUM BOOSTERS

DESCRIPTION

SINGLE DIAPHRAGM MODEL

This booster is a single diaphragm vacuum suspended unit. It may have a single function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a vacuum suspended booster operates with vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist.

TANDEM DIAPHRAGM MODEL

This booster is a tandem vacuum suspended unit. It may have a single dual function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist.

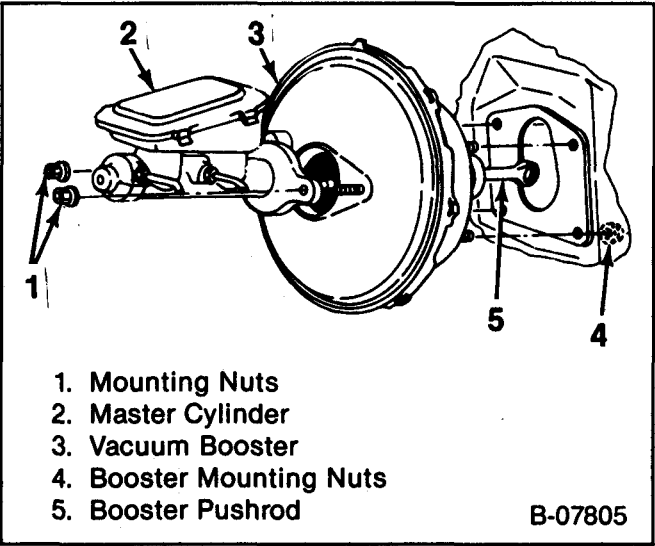


Figure 28—Removing Vacuum Boosters

- The mounting nuts must be removed from inside the vehicle.
- Vacuum booster.

Install or Connect (Figure 28)

VACUUM BOOSTER REPLACEMENT

Remove or Disconnect (Figure 28)

- Apply the vehicles parking brakes.
- 1. Mounting nuts.
- 2. Master cylinder.
- Support the master cylinder.
- 3. Vacuum hose from the check valve.
- 4. Booster pushrod; refer to "Brake Pedal Replacement" in this section.
- 5. Booster mounting nut.

NOTICE: For steps 2 and 6 see "Notice" on page 5-1 of this section.

- 1. Vacuum booster.
- 2. Booster mounting nuts.

Tighten

- Nuts to 34 N·m (25 ft. lbs.).
- 3. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
- 4. Vacuum hose.
- 5. Master cylinder.
- 6. Mounting nuts.


Tighten

- Mounting nuts to 34 N·m (25 ft. lbs.)

7. Release the parking brakes.

HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST)

DESCRIPTION

This system uses a hydraulic pump to power the system and a pneumatic accumulator as a reserve system.

In this system no special fluids are used, however, care must be taken to use the correct fluids. The master cylinder and brake system operate on standard hydraulic brake fluid, while the hydraulic pump operates on power steering fluid. For diagnosis of the Hydro-Boost System, refer to "Hydro-Boost Systems Tests" and "Diagnosis of Hydro-Boost System" in this section.

HYDRO-BOOST REPLACEMENT

C-K AND G MODELS


Remove or Disconnect (Figure 29)

- Apply the vehicles parking brakes.
- 1. Hydraulic lines from the booster.
- 2. Nuts (1).
- 3. Master cylinder (2).
 - Support the master cylinder.
- 4. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
- 5. Nuts (4) and (6).
- 6. Hydro-Boost unit (3).
 - Gasket (5).


Install or Connect (Figure 29)

NOTICE: For steps 2 and 5 see "Notice" on page 5-1 of this section.

- Gasket (5).
 - Hydro-Boost unit (3).
- Nuts (4) and (6).


Tighten

- Nuts to 34 N·m (25 ft. lbs.).
- 3. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
- 4. Master cylinder. (2).

5. Nuts (1).


Tighten

- Nuts to 34 N·m (25 ft. lbs.).

- Hydraulic lines.
- Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.
- Release the parking brakes.

P 30 (42) MODEL


Remove or Disconnect (Figure 30 and 31)

- Apply the vehicles parking brakes.
- 1. Hydraulic lines from the booster.
- 2. Nuts (1) and washers (7).
- 3. Master cylinder (2).
 - Support the master cylinder.
- 4. Pushrod retainer (10).
- 5. Retaining clip and washer.
 - Booster pushrod (9).
- 6. Nuts (4) and washers (8).
- 7. Hydro-Boost unit (3).


Install or Connect (Figure 30 and 31)

NOTICE: For steps 2 and 6 see "Notice" on page 5-1 of this section.

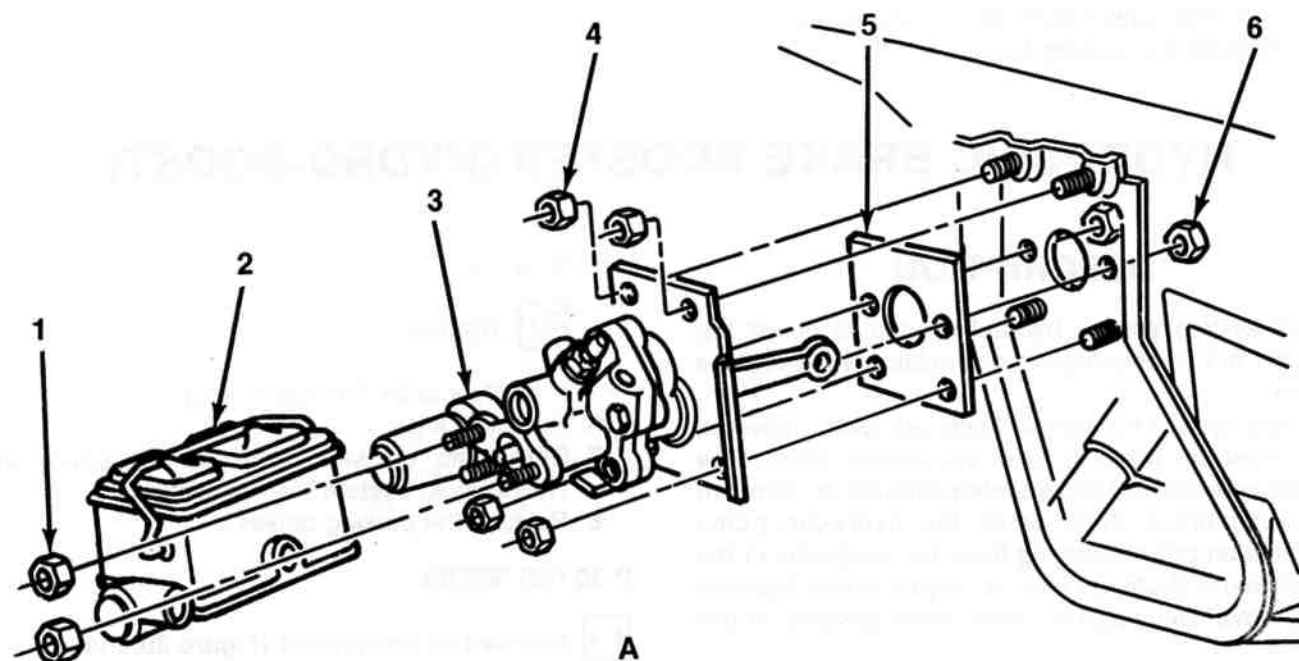
- Hydro-Boost unit (3).
- Washers (8) and nuts (4).


Tighten

- Nuts to 34 N·m (25 ft. lbs.).
- 3. Booster pushrod (9).
 - Washer and retaining clip.
- 4. Pushrod retainer (10).
- 5. Master cylinder (2).
- 6. Washers (7) and nuts (1).

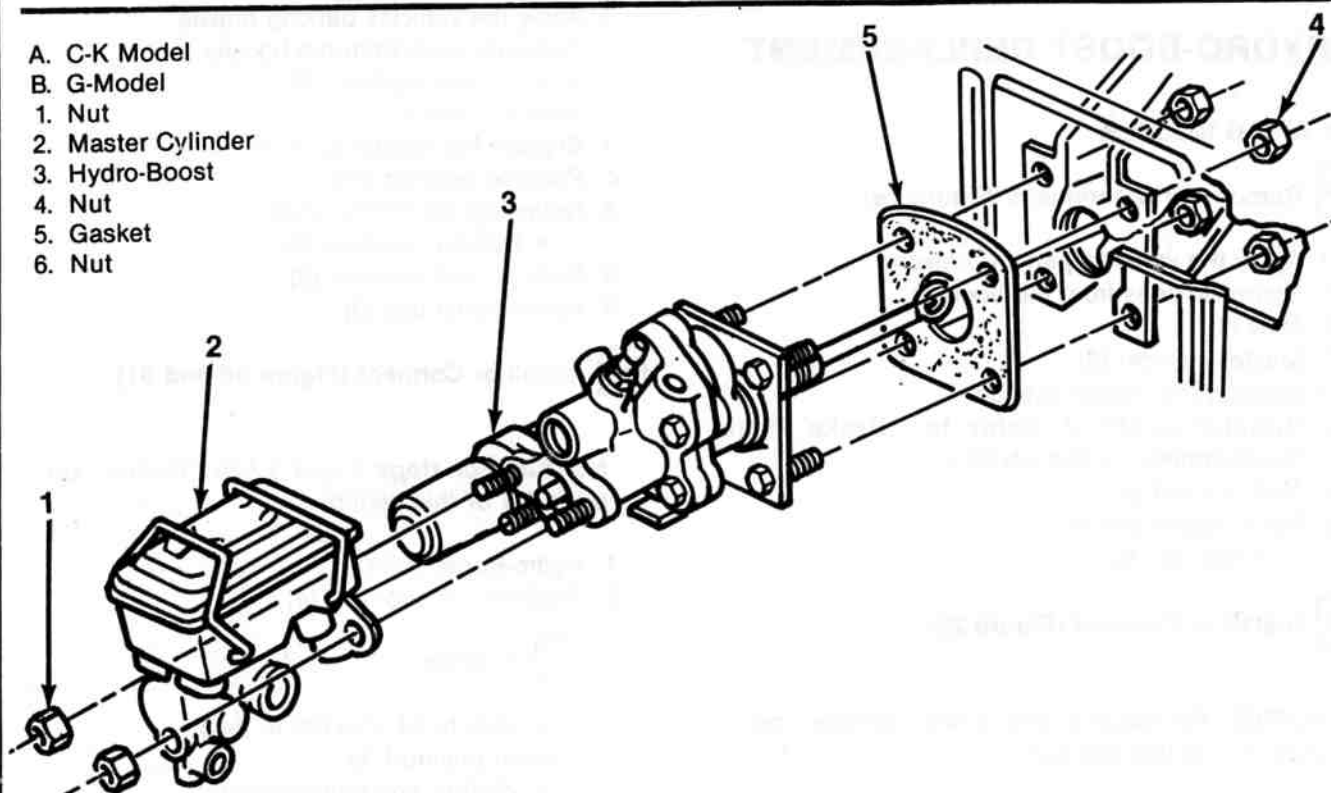

Tighten

- Nuts to 34 N·m (25 ft. lbs.).
- 7. Hydraulic lines.
- 8. Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.



A

- A. C-K Model
- B. G-Model
- 1. Nut
- 2. Master Cylinder
- 3. Hydro-Boost
- 4. Nut
- 5. Gasket
- 6. Nut



B

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Figure 29—C-K and G Model Hydro-Boost Replacement

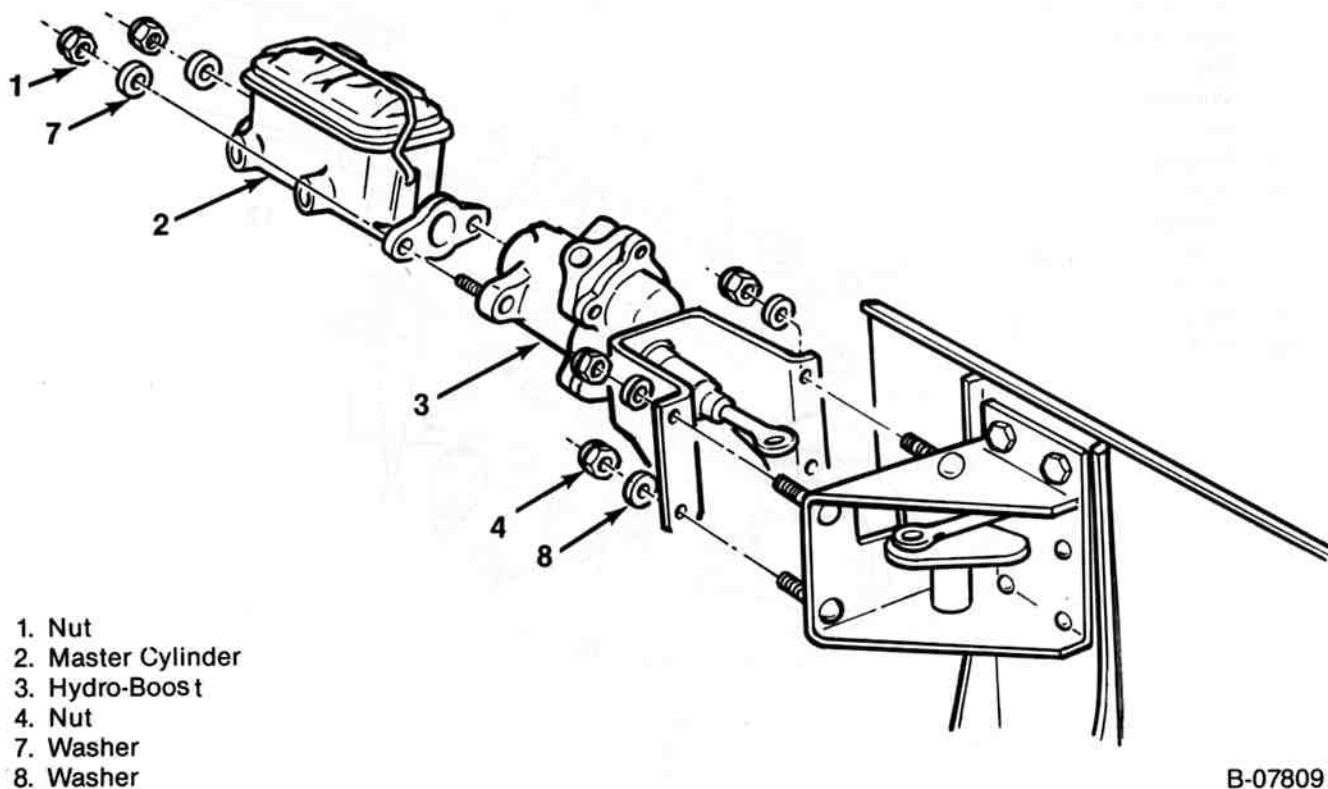


Figure 30—P 30 (42) Hydro-Boost Replacement

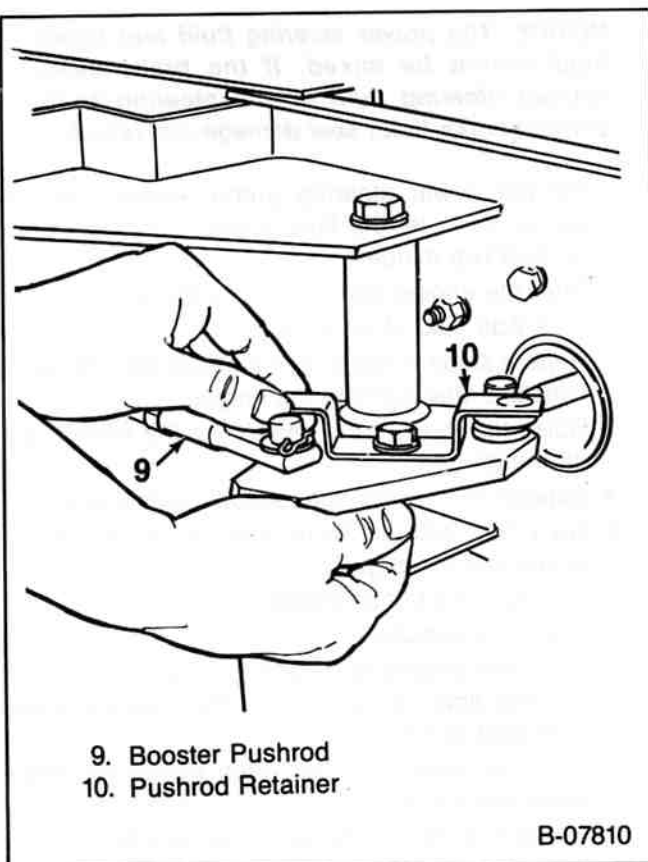


Figure 31—Removing Pushrod Retainer

9. Release the parking brakes.

P 30 (32) MODEL

↔ Remove or Disconnect (Figure 32)

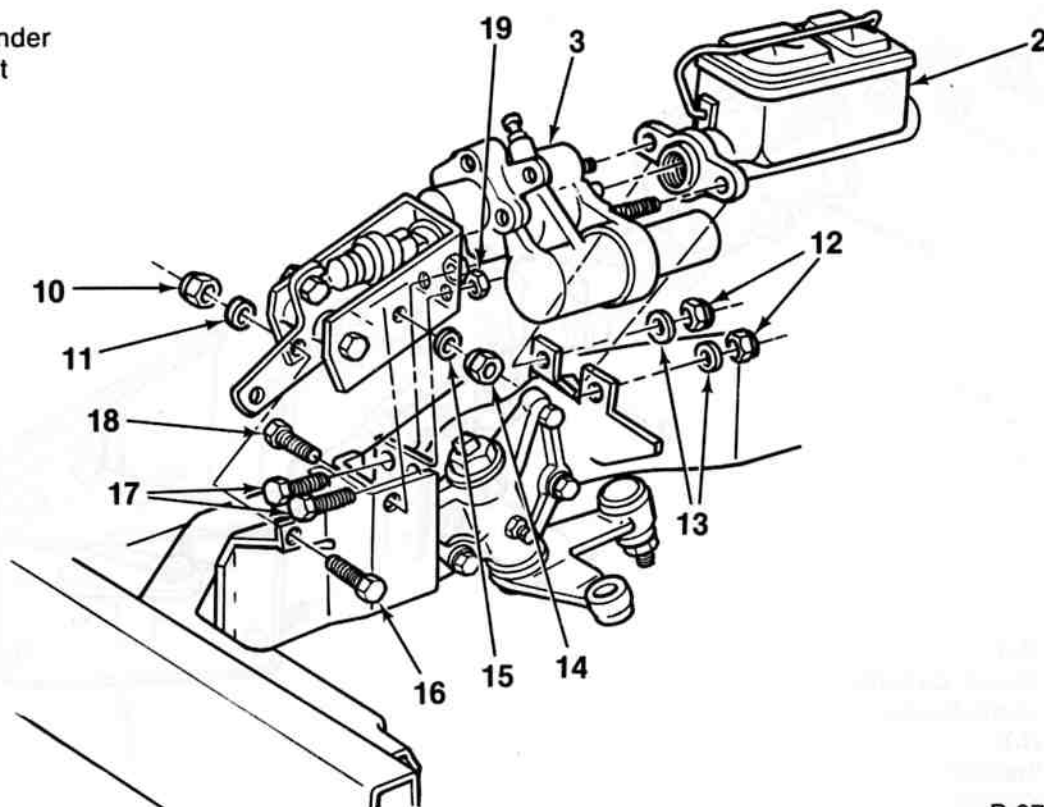
- Apply the vehicles parking brakes.
- 1. Hydraulic lines from the booster.
- 2. Nuts (12) and washers (13).
- 3. Master cylinder (2).
- Support the master cylinder.
- 4. Brake pedal rod, refer to "Brake Pedal Rod Replacement" in this section.
- 5. Nut (10) and washer (11).
 - Bolt (16).
- 6. Nut (14) and washers (15).
 - Bolt (18).
- 7. Nuts (12) and washer (13).
 - Bolts (17).
- 8. Hydro-Boost unit (3).

↔ Install or Connect (Figure 32)

NOTICE: For steps 2, 3, 4, and 7 see "Notice" on page 5-1 of this section.

1. Hydro-Boost unit (3).
2. Bolts (17).

- 2. Master Cylinder
- 3. Hydro-Boost
- 10. Nut
- 11. Washer
- 12. Nut
- 13. Washer
- 14. Nut
- 15. Washer
- 16. Bolt
- 17. Bolts
- 18. Bolt
- 19. Nut



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Figure 32—P 30 (32) Hydro-Boost Replacement

- Washers (13) and nuts (12). Leave finger tight.
- 3. Bolt (18).
 - Washer (15) and nut (14). Leave finger tight.
- 4. Bolt (16).
 - Washer (11) and nut (10). Leave finger tight.



Tighten

- Nuts (10, 14 and 12) to 34 N·m (25 ft. lbs.).
- 5. Brake pedal rod, refer to "Brake Pedal Rod Replacement" in this section.
- 6. Master cylinder (2).
- 7. Washers (13) and nuts (12).



Tighten

- Nuts to 34 N·m (25 ft. lbs.)
- 8. Hydraulic lines.
- 9. Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.
- 10. Release the parking brakes.

BLEEDING THE HYDRO-BOOST SYSTEM

Whenever the booster is removed and reinstalled, the steering system should be bled.

NOTICE: The power steering fluid and brake fluid cannot be mixed. If the brake seals contact steering fluid or the steering seals contact brake fluid, seal damage will result.

1. Fill the power steering pump reservoir to the proper level, let the fluid remain undisturbed for at least two minutes.
2. Start the engine and run momentarily.
 - Add fluid, if necessary.
3. Repeat steps 1 and 2 until the fluid level remains constant after running the engine.
4. Raise the front of the vehicle so the wheels are off the ground.
 - Support the vehicle with suitable safety stands.
5. Turn the wheels from stop to stop, lightly contacting the stops.
 - Add fluid, if necessary.
6. Lower the vehicle.
7. Start the engine and depress the brake pedal several times while rotating the steering wheel from stop to stop.
8. Turn the engine off and then pump the brake pedal 4-5 times.
9. Check fluid level, add fluid if necessary.
10. If the fluid is extremely foamy, allow the vehicle to stand a few minutes with the engine off. Then repeat steps 7, 8 and 9.

11. Check for the presence of air in the oil. Air in the oil will have a milky appearance. Air in the system will also cause the fluid level in the pump to rise when the engine is turned off. If it becomes

obvious that the pump will not bleed the air after a few attempts, refer to POWER STEERING (Sec. 3B3) for further diagnosis.

DISC BRAKES

DESCRIPTION

The disc brake assembly consists of a caliper and piston assembly, rotor, linings, and an anchor plate. The caliper is mounted to the anchor plate, which allows the caliper to move laterally against the rotor. The caliper is a one-piece casting with the inboard side containing the piston bore. A square cut rubber seal is located in a groove in the piston bore which provides the hydraulic seal between the piston and the cylinder wall.

OPERATION

As the brake pedal is depressed, hydraulic pressure is applied against the piston. This pressure pushes the inboard brake lining against the inboard braking surface of the rotor. As the force increases against the rotor, the caliper assembly moves inboard thus providing a clamping action on the rotor.

When the brake pressure is released, the piston seal returns to its normal position, pulling the piston back into the caliper bore. This will create a running clearance between the inner brake lining and the rotor.

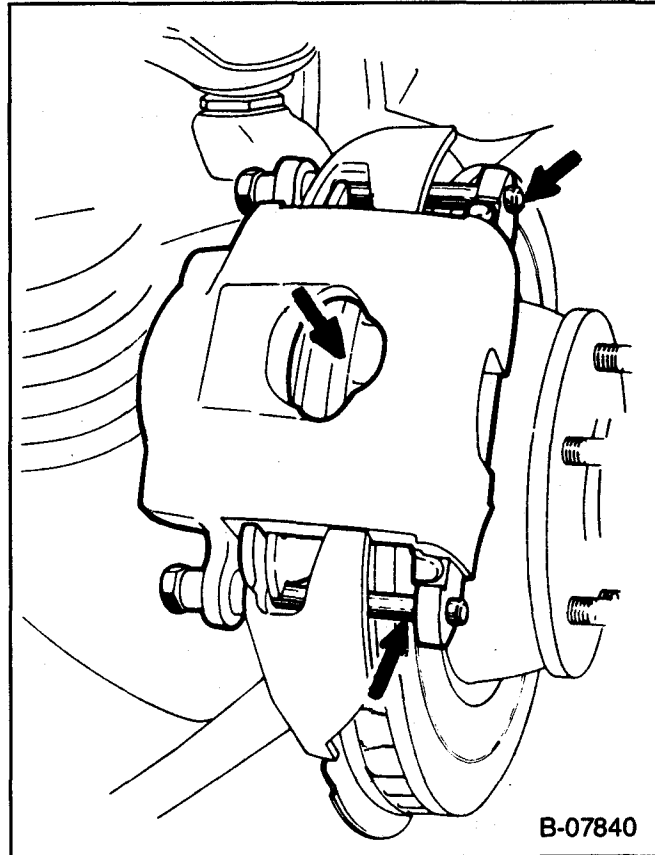


Figure 33—Lining Inspection Points

BRAKE LINING INSPECTION

Check the outer pad by looking at each end of the caliper (figure 33). Check the lining thickness on the inner pad by looking down through the inspection hole in the top of the caliper housing. Whenever the lining is worn to about the thickness of the pad, the lining should be removed for further measurements. The pad should be replaced anytime the lining is worn to within 0.08 mm ($1/32$ -inch) of a rivet head or the pad itself.

The disc brake pads have a wear indicator that makes a noise when the linings wear to a degree where replacement is required (figure 34).

Also check the flatness of the brake pads. Place the inboard and outboard lining surfaces together and check for a gap between the lining surfaces. This gap should not exceed 0.13 mm (.005-inch) at the middle of the lining surfaces. This applies to new or used brake pads.

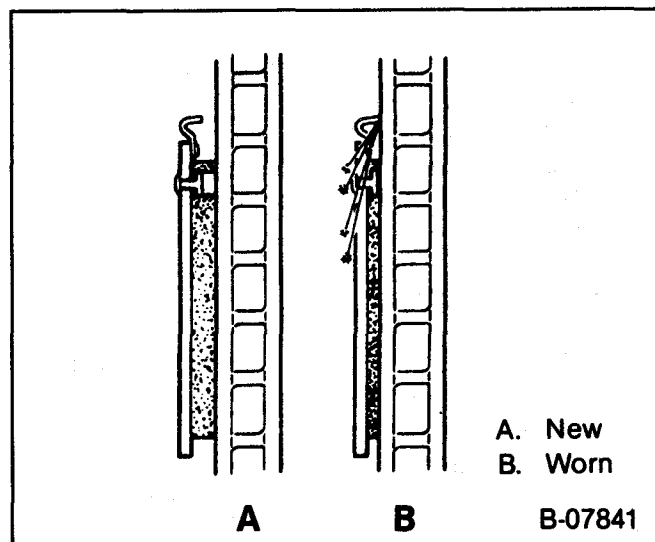


Figure 34—Warning Sensor

BRAKE LINING REPLACEMENT

3000/3100 MODELS

Remove or Disconnect (Figure 35)

- $\frac{2}{3}$ of the brake fluid from the master cylinder.
 - Raise the vehicle and support it with suitable safety stands.
 - Mark the relationship of the wheel to the hub.
1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

CAUTION: See "Caution" on page 5-1.

2. Position a C-clamp around the outer pad and caliper and tighten until the piston bottoms in its bore (figure 36).
 - C - clamp
3. Mounting bolts (1) (figure 37).
4. Caliper assembly.
 - Suspend the caliper from the suspension (figure 38).

Important

- Do not allow the brake components to hang from the flexible hoses as damage to the hoses may occur.
5. Inboard pad (6).
 - Retainer spring (5).
 6. Outboard pad (7).
 7. Sleeves (2).
 8. Bushings (3 and 4).

Inspect

- The inside of the caliper assembly for signs of fluid leakage, if found, refer to "Rebuilding the Caliper" in this section.
- Mounting bolts and sleeves for corrosion. Do not attempt to polish away corrosion, replace the bolts.

Install or Connect (Figure 35)

- Lubricate the sleeves and bushings with Delco Silicone Lube or equivalent.
1. Bushings (3 and 4).
 - Sleeves (2).
 2. Retainer spring (5) onto the inboard pad (6).
 - Inboard pad (6).
 - 3 Outboard pad (7).
 4. Caliper assembly.

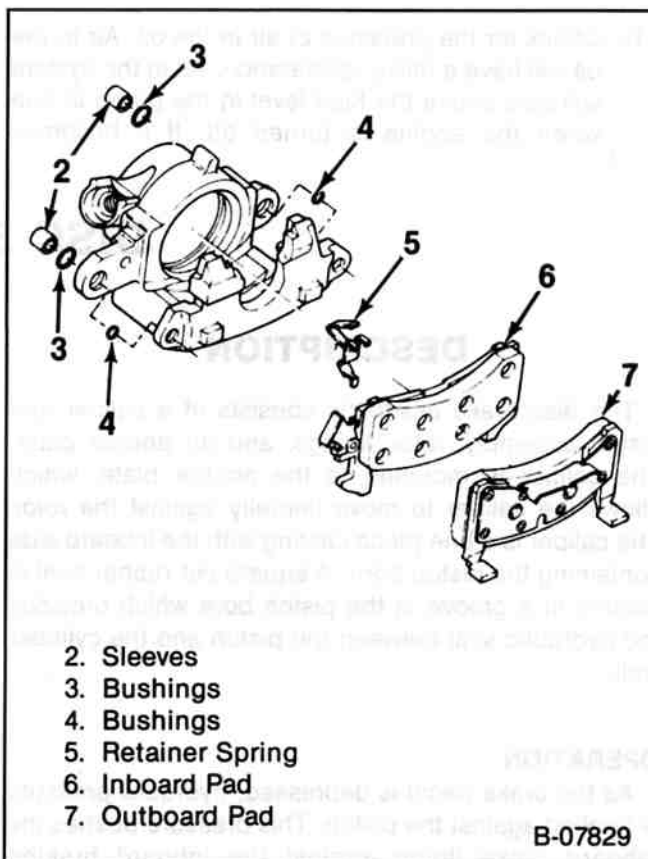


Figure 35—Replacing Disc Brake Linings (3000/3100 Models)

Important

- Make sure that the brake hose is not twisted or kinked since damage to the hose could result.

NOTICE: See "Notice" on page 5-1.

5. Mounting bolts (1) (Figure 37).

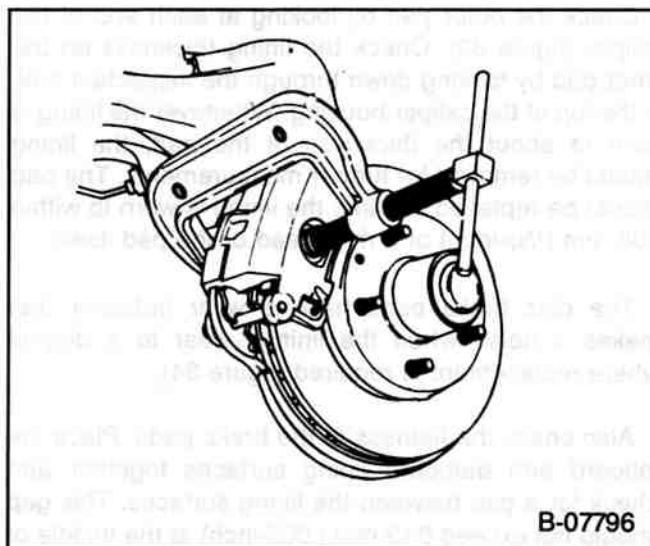
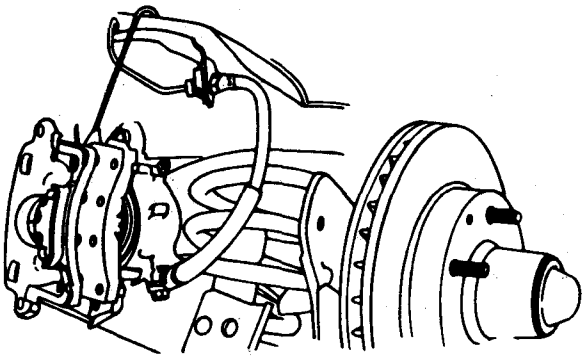


Figure 36—Compressing The Caliper Piston



F-00614

Figure 38—Suspending The Caliper

Tighten

- Bolts to 50 N·m (37 ft. lbs.)

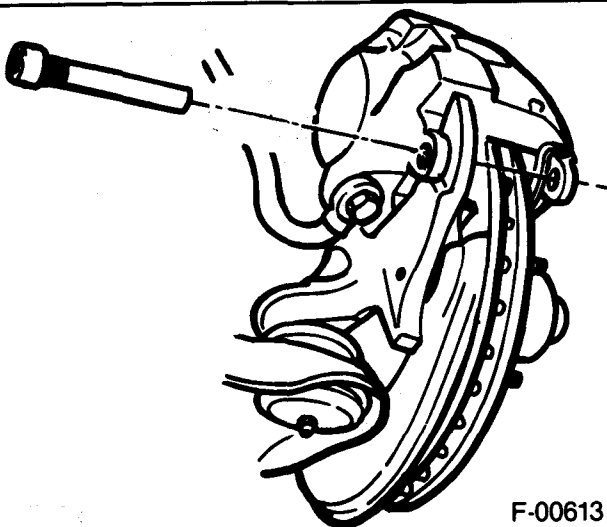
6. Compress the pad ears to the caliper (figure 39).


Measure (Figure 40)

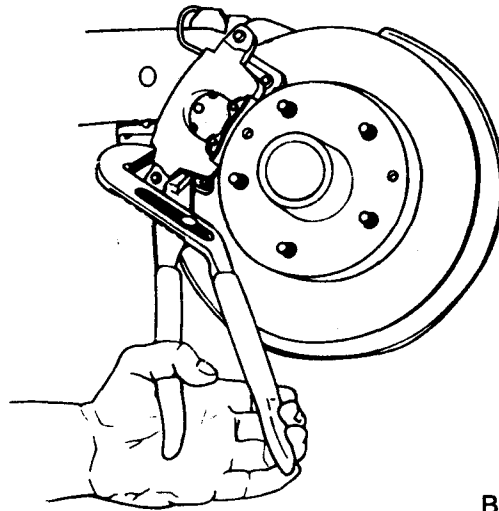
- The clearance between the caliper and the steering knuckle. The clearance at each end of the caliper should be measured individually and added together, this total should be between 0.26 - 0.60 mm (0.010 - 0.024-inches).

7. Wheel and tire assembly, refer to **WHEELS AND TIRES** (Sec. 3E).

8. Lower the vehicle.



F-00613

Figure 37—Removing The Mounting Bolts


B-07833

Figure 39—Compressing The Pad Ears

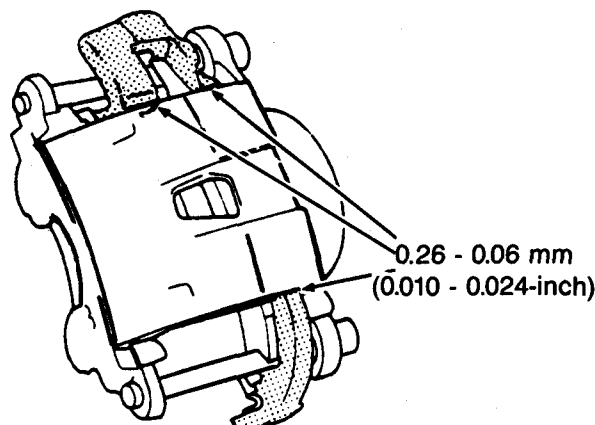
Important

- Before moving the vehicle, pump the brake pedal several times to make sure that the pedal is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

BENDIX MODEL

Remove or Disconnect (Figures 41 and 42)

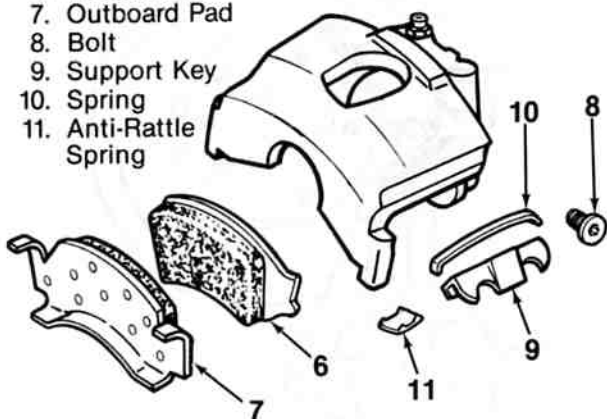
- $\frac{2}{3}$ of the brake fluid from the master cylinder.
- Raise the vehicle and support it with suitable safety stands.
- Mark the relationship of the wheel to the hub.



B-07830

Figure 40—Caliper Clearances

6. Inboard Pad
7. Outboard Pad
8. Bolt
9. Support Key
10. Spring
11. Anti-Rattle Spring



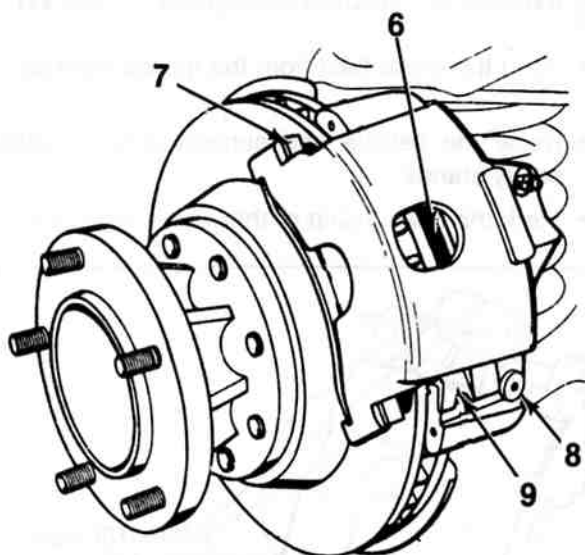
B-07831

Figure 41—Replacing Disc Brake Linings (Bendix Models)

1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

CAUTION: See "Caution" on page 5-1.

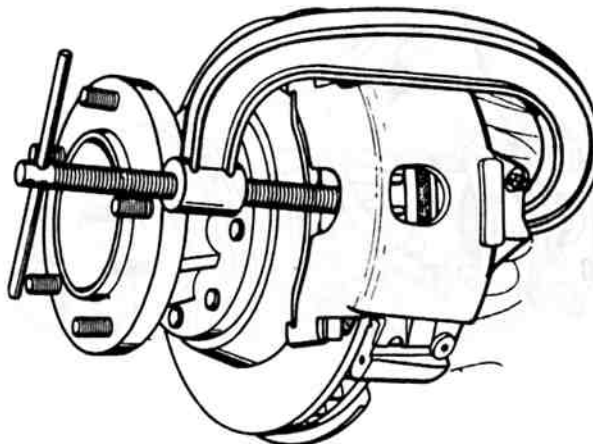
2. Position C - clamp and tighten until the piston bottoms in its bore (figure 43).
 - C - clamp.



6. Inboard Pad
7. Outboard Pad
8. Bolt
9. Support Key

B-07798

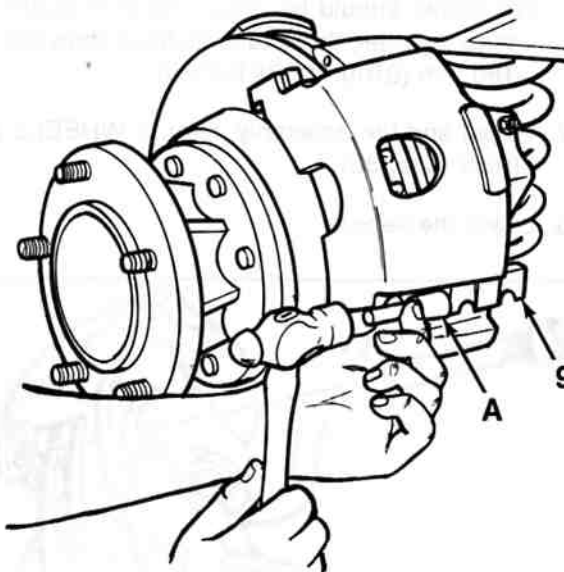
Figure 42—Bendix Disc Brake Assembly



B-07797

Figure 43—Compressing The Caliper Piston

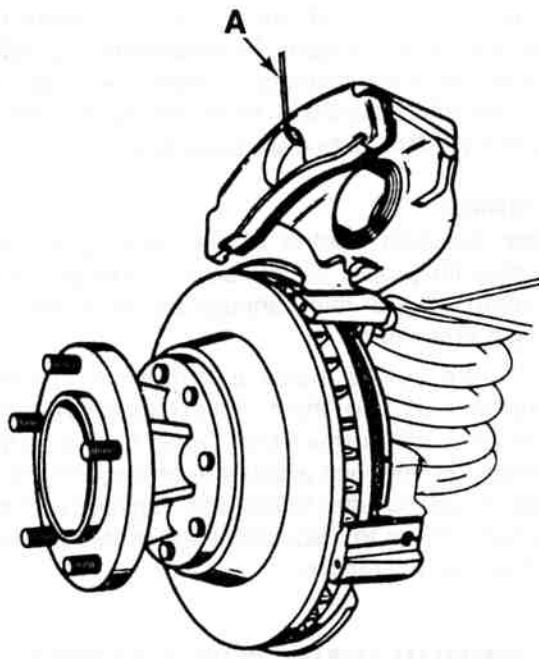
3. Bolt (8).
4. Support key (9) and spring (10).
 - Use a brass punch and a hammer to drive the support key out (figure 44).
5. Caliper assembly.
 - Suspend the caliper from the suspension (figure 45).



9. Support Key
- A. Brass Punch

B-07795

Figure 44—Removing The Support Key



A. Wire Hook

B-07844

Figure 45—Suspending The Caliper

! Important

- Do not allow the brake components to hang from the flexible hoses as damage to the hoses may occur.

6. Inboard pad (6) from the steering knuckle or rear caliper support.

- Anti-rattle spring (11).

7. Outboard pad (7).

🔍 Inspect

- The inside of the caliper assembly for signs of fluid leakage, if found, refer to "Rebuilding the Caliper" in this section.

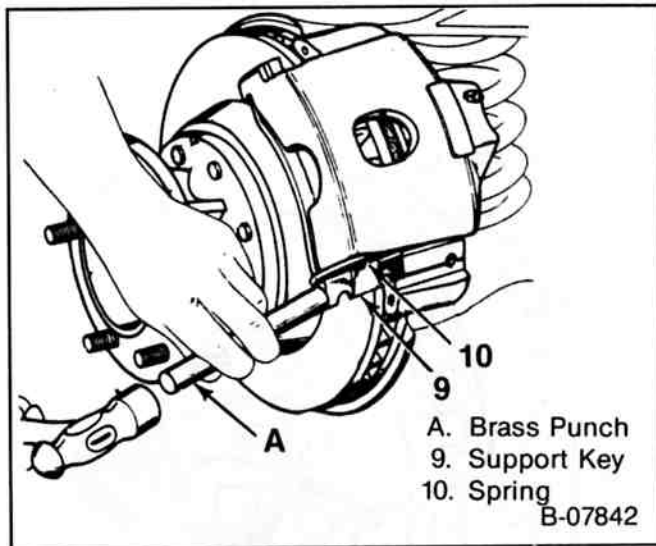
🧼 Clean

- Use a wire brush to remove any corrosion from the machined surfaces of the steering knuckle and caliper.

↔ Install or Connect (Figures 41 and 42)

- Lubricate the caliper and steering knuckle (or support) sliding surfaces and spring with Delco Silicone Lube or equivalent.

1. Inboard pad (6) and anti-rattle spring (11).
2. Outboard pad (7) into the caliper assembly.



A. Brass Punch
9. Support Key
10. Spring

B-07842

Figure 46—Installing The Support Key

3. Caliper assembly.

! Important

- Make sure that the brake hose is not twisted or kinked since damage to the hose could result.

4. Spring (10) and support key (9).

- Use a brass punch and a hammer to drive the support key in (figure 46).

NOTICE: See "Notice" on page 5-1.

5. Bolt (8).

- The boss on the bolt must fully fit into the circular cutout in the key.

🔧 Tighten

- Bolt to 20 N·m (15 ft. lbs.).

6. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

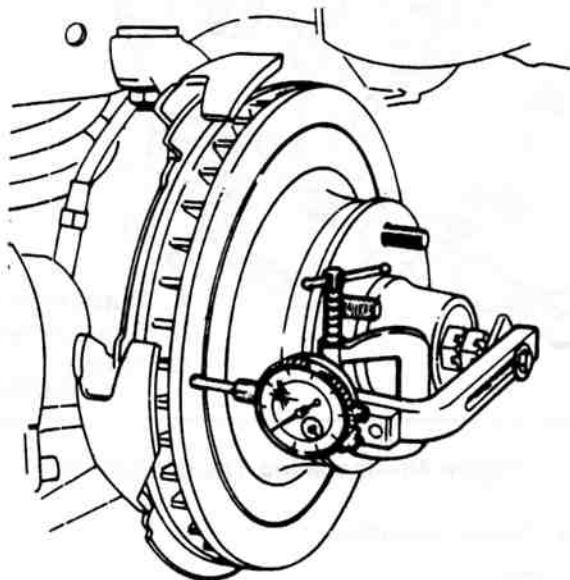
7. Lower the vehicle.

! Important

- Before moving the vehicle, pump the brake pedal several times to make sure that the pedal is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

SERVICING THE ROTOR

In the manufacturing of the brake rotor all the tolerances regarding surface finish, parallelism, and lateral runout are held very closely. The maintenance



B-07790

Figure 47—Checking For Lateral Runout

of these tolerances provide the surface necessary to prevent brake roughness.

Light scoring of the rotor surface not in excess of 0.38 mm (0.15-inch) in depth is normal. This condition does not affect the brake operation.

LATERAL RUNOUT

Lateral runout is the movement of the rotor from side to side as it rotates on the spindle. This could also be referred to as "rotor wobble".

This movement causes the brake pad and piston to be knocked back into it's bore. This results in additional pedal travel and a vibration during braking.

Checking Lateral Runout (Figure 47)

1. Tighten the wheel bearings to eliminate all freeplay.
2. Attach a dial indicator to some portion of the suspension.
 - The point of the styles must contact the rotor face about 25 mm (1-inch) from the rotor edge.
3. Move the rotor one complete rotation.
 - The lateral runout should not exceed 0.10 mm (0.004-inch).
4. Readjust the wheel bearings, refer to FRONT SUSPENSION (Sec. 3C).

PARALLELISM

Parallelism is the measurement of the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor. The rotor thickness must not vary more than 0.013 mm (0.0005-inch) from point to point.

MACHINING

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the specifications, after refinishing. Replace with a new brake rotor. Refer to "Specification" in this section for final machining tolerances.

REBUILDING THE CALIPER

3000/3100 MODELS



Disassemble (Figure 48)

- Drain all the fluid from the caliper.
- Pad the interior of the caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

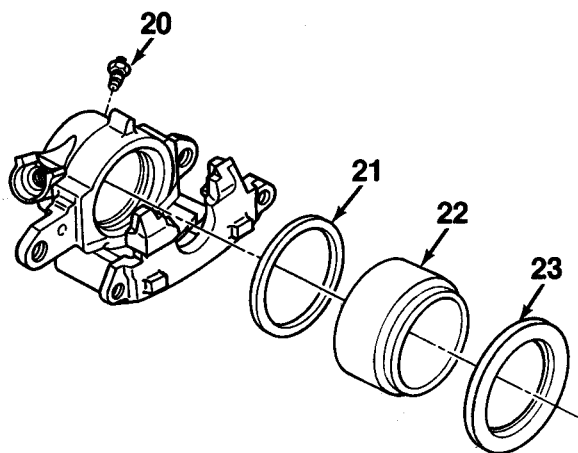
NOTICE: Use just enough air to ease the piston out of the bore. If piston is blown out—even with padding provided, it may be damaged.

1. Piston (22) (figure 49)
2. Boot (23) (figure 50).
 - Use care not to scratch the housing bore.
3. Piston seal (21).
 - Do not use any type of metal tool.
4. Bleeder valve (20).



Clean

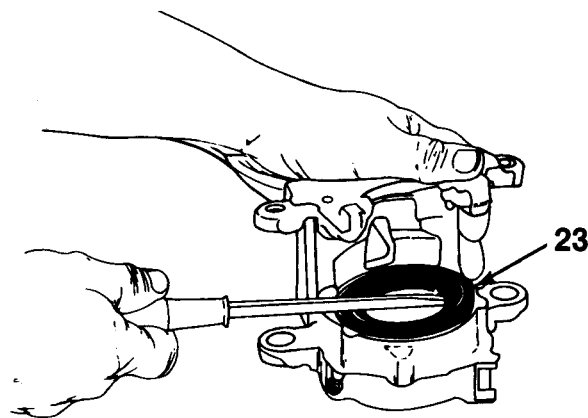
- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered compressed air to dry parts and blow out passages.



20. Bleeder Valve
21. Piston Seal
22. Piston
23. Boot

B-07834

**Figure 48—Models 3000/3100
Caliper Components**



23. Boot

B-07836

Figure 50—Removing The Boot

- Lubricate the new piston seal, caliper bore, and piston with clean brake fluid.
1. Piston seal (21).
 - Make sure the seal is not twisted in the caliper bore groove.
 2. Boot (23) onto the piston (22).
 - Piston (22).
 3. Boot (23) into the caliper housing counterbore using tool J-26267 (figure 51).



Inspect

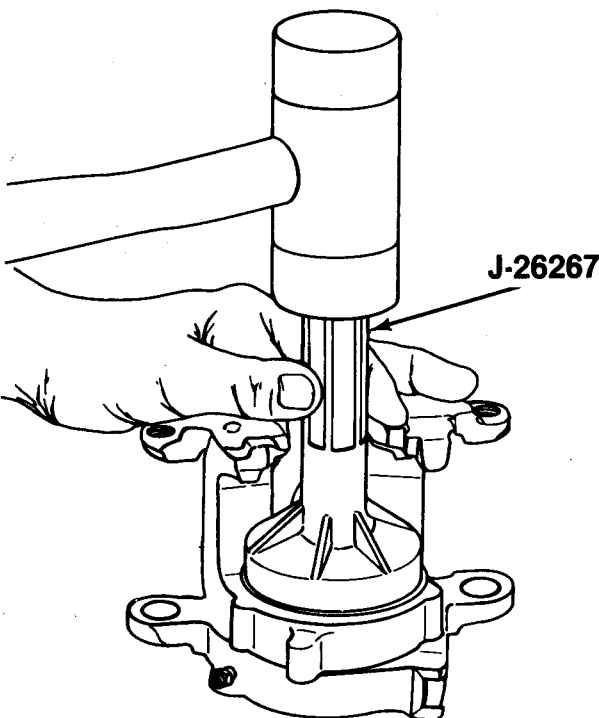
- Piston for scoring, corrosion and any damage to the chrome plating, replace if found.
- Caliper bore for scoring, pitting, or corrosion. Use crocus cloth to polish out any light corrosion. Replace caliper if corrosion cannot be removed.



Assemble (Figure 48)

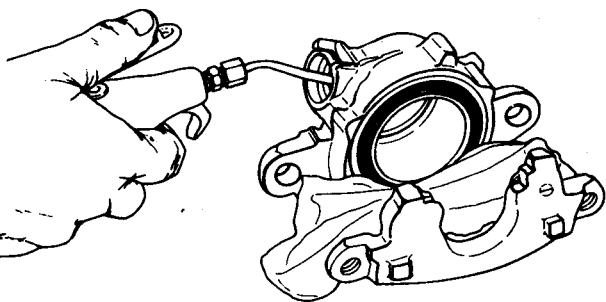
Tool required:

J-26267 Piston Seal Installer



B-07837

Figure 51—Installing The Caliper Boot



B-07835

Figure 49—Removing The Piston

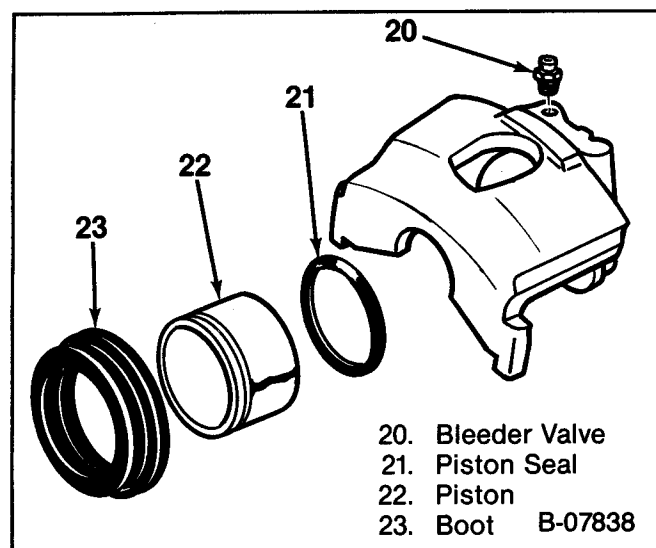


Figure 52—Bendix Model Caliper Components

4. Bleeder valve (20).

BENDIX MODEL

Disassemble (Figure 52)

- Drain all the fluid from the caliper.
- Pad the interior of the caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If piston is blown out—even with padding provided, it may be damaged.

1. Piston (22) (figure 49).
2. Boot (23).
3. Piston seal (21).
- Do not use any type of metal tool.
4. Bleeder valve (20).

Clean

- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered compressed air to dry parts and blow out passages.

Inspect

- Piston for scoring, corrosion and any damage to the chrome plating, replace if found.

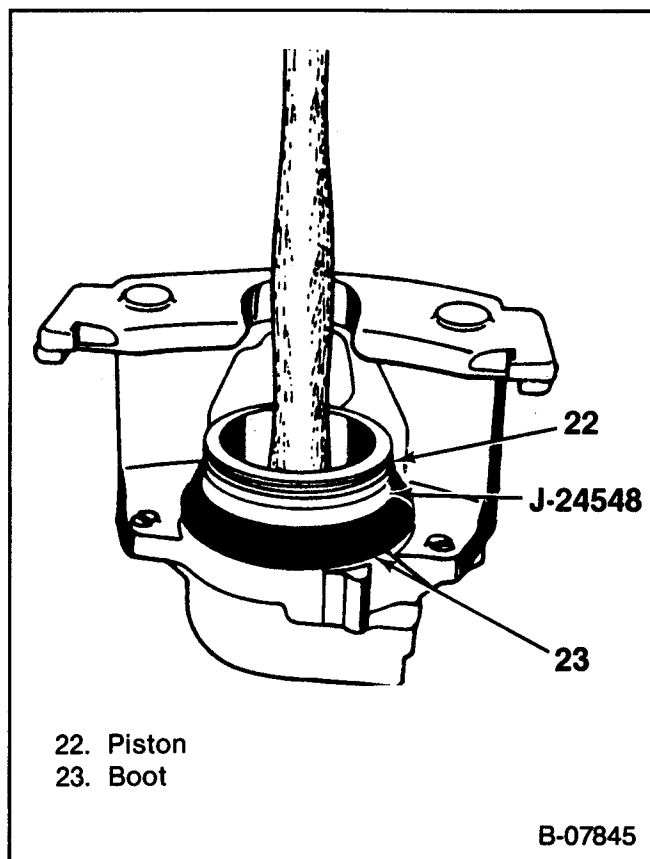


Figure 53—Installing The Piston

- Caliper bore for scoring, pitting, or corrosion. Use corcus cloth to polish out any light corrosion. Replace caliper if corrosion cannot be removed.

Assemble (Figure 52)

Tool required:

J-24548 Piston Seal Installer

- Lubricate the new piston seal, caliper bore, piston, and seal lips on boot with clean brake fluid.
1. Piston seal (21).
 - Make sure the seal is not twisted in the caliper bore groove.
 2. Boot (23) on tool J-24548.
 - Place the large diameter of the boot over the tool first and ride the smaller diameter onto the tool.
 - The large diameter must then slide off the tool.
 3. The large lip of the boot into the groove in the caliper bore.
 - The lip of the boot must be firmly slated in the groove.
 4. Piston (22) inside tool J-24548 (figure 53).
 - Press the piston half way into its bore.
 5. Remove tool J-24548.
 - Make sure the boot is firmly seated.
 6. Bleeder valve (20).

DRUM BRAKES

DESCRIPTION

The drum brake assembly is a duo - servo design. With this particular design, the force which is applied by the wheel cylinder to the primary shoe is multiplied by the primary lining friction to provide a large applied force to the secondary shoe. The torque from the brake shoes is transferred to the anchor pin and through the backing plate, to the axle flange. Brake adjustments are automatic and are made during reverse brake applications.

BRAKE LINING REPLACEMENT

Remove or Disconnect (Figure 54)

- Raise the vehicle and support with suitable safety stands.
- Mark the relationship of the wheel to the hub.
- 1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).
- Mark the relationship of the drum to the axle.

CAUTION: See "Caution" on page 5-1.

2. Drum
3. Return springs (12 and 13).
 - Shoe guide (7).
4. Hold down springs (14).
 - Hold down pins. (1).
5. Actuator lever (10) and lever pivot (15).
 - Lever return spring (16).
 - Actuator link (11).
6. Parking brake strut (8).
 - Strut spring (9).
7. Retaining ring (6).
 - Parking brake lever (4) and washer (4).
8. Shoes (5 and 19).
 - Adjusting screw assembly (17).
 - Adjusting screw spring (18).

Important

Do not interchange the right and left adjusting screws.

Inspect

- All parts for discoloration due to heat, or stress. Replace if necessary.
- All parts for signs of wear. Replace if necessary.

- Wheel cylinder for signs of leakage, refer to "Rebuilding The Wheel Cylinder."
- Brake drum for scoring, and machining tolerance, refer to "Servicing The Brake Drum."

Install or Connect (Figure 54)

- Lubricate the shoe pads and adjusting screw threads with a thin coat of white lithium grease.
- 1. Adjusting screw (17) and adjusting screw spring (18) to both shoes (19 and 5).
- The coils of the spring must not touch the adjusting screw.
- 2. Shoe assembly.
- 3. Parking brake lever (3) and washer (4) into the shoe.
 - Retaining ring (6).
- 4. Strut spring (9) onto the parking brake strut (8).
 - Parking brake strut (8).
- 5. Actuator lever (10) and lever pivot (15).
 - Actuator link (11).
 - Lever return spring (16).
- 6. Hold down pins (1).
 - Hold down springs (14).
- 7. Return springs (12 and 13).
- 8. Drum.
- Align the marks made during disassembly.
- 9. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).
- Align the marks made during disassembly.
- 10. Adjust the brakes, refer to "Brake Adjustment" in this section.

SERVICING THE BRAKE DRUM

Whenever the brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

CRACKED, SCORED, OR GROOVED DRUM

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to machine the drum braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth but should not be machined. At this stage, eliminating all the grooves in the drum and smoothing

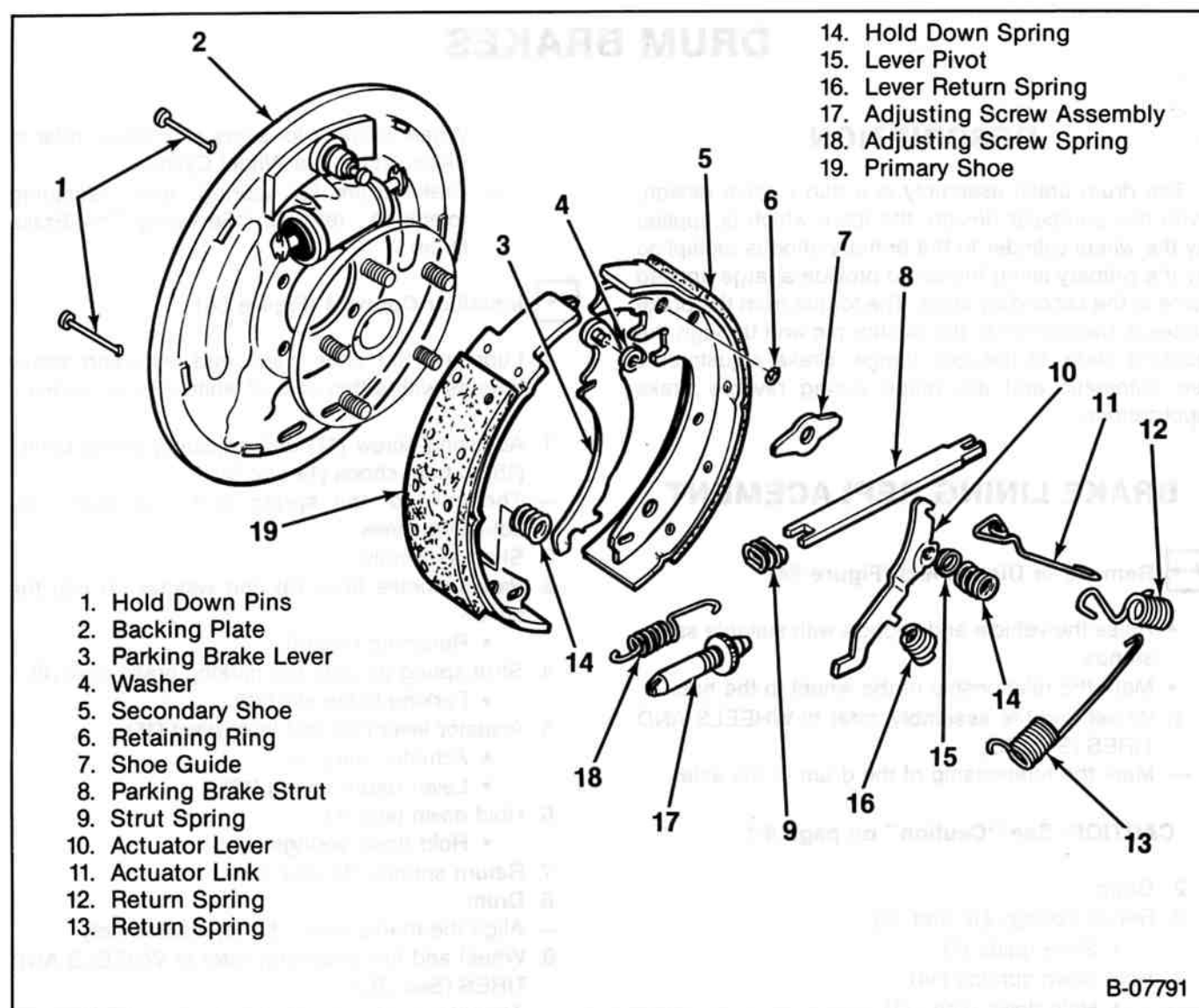


Figure 54—Drum Brake Components

the ridges on the lining would require the removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be machined. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible to obtain efficient brake performance.

OUT-OF-ROUND OR TAPERED DRUM

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsing brake pedal. When the braking surface of a brake drum exceeds the specification limits in taper (and/or) out-of-round, the drum should be machined to true up the braking surface. Out-of-round as well as taper and

wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of machined surface and at right angles to each other.

MACHINING THE DRUM

If a drum is to be machined, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when machined to a maximum diameter it must be replaced, refer to "Specifications" in this section. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter. Do not machine a brake drum that will not meet the specification, refer to "Specifications" in this section.

BRAKE ADJUSTMENT

A manual adjustment of the rear brakes is required after the rear linings have been replaced. The front disc brakes require not adjustment.

CAUTION: Refer to "Caution" on page 5-1.

1. Remove the lanced area in the brake backing plate.
 - The metal lanced area must be removed from the brake assembly.



Adjust

- Brake adjusting screw until the wheel can just be turned by hand.
- The brake drag should be equal at both wheels.
- Back off the adjusting screw 33 notches.



Important

- Brakes should have no drag after the screw has been backed off about 15 notches. If a heavy drag is present refer to "Parking Brake Adjustment."
2. Install an adjusting hole cover in the brake backing plate.
 3. Check parking brake adjustment.

WHEEL CYLINDER REPLACEMENT



Remove or Disconnect (Figure 55)

CAUTION: See "Caution" on page 5-1.

1. Brake linings, refer to "Brake Lining Replacement."
2. Brake pipe.
3. Bolts.
4. Wheel cylinder.



Install or Connect (Figure 55)

1. Wheel cylinder.
2. Bolts.



Tighten

- Bolts to 18 N·m (160 in. lbs.).
3. Brake pipe.
 4. Brake linings, refer to "Brake Lining Replacement."

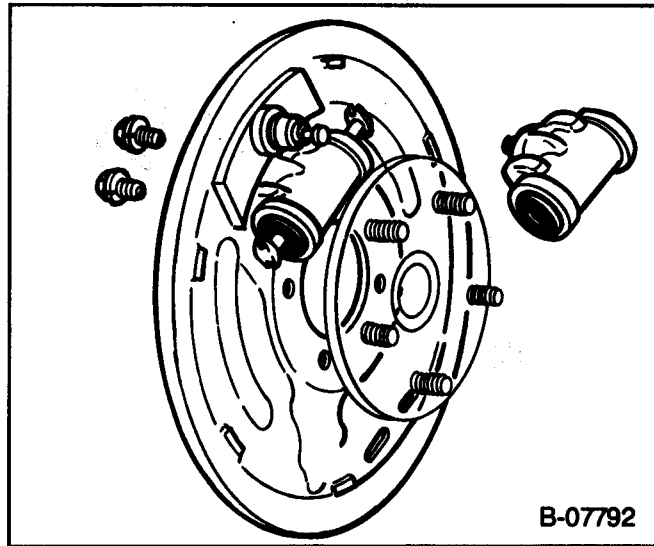


Figure 55—Removing The Wheel Cylinder

5. Bleed brake system, refer to "Bleeding the Brake Hydraulic System."

REBUILDING THE WHEEL CYLINDER



Disassemble (Figure 56)

1. Remove wheel cylinder, refer to "Wheel Cylinder Replacement."
2. Boots (54).
3. Pistons (53).
4. Seals (52).
5. Spring assembly (55).



Inspect

- Cylinder bore for scoring and corrosion.
- Spring assembly for signs of discoloration due to heat. Replace if necessary.



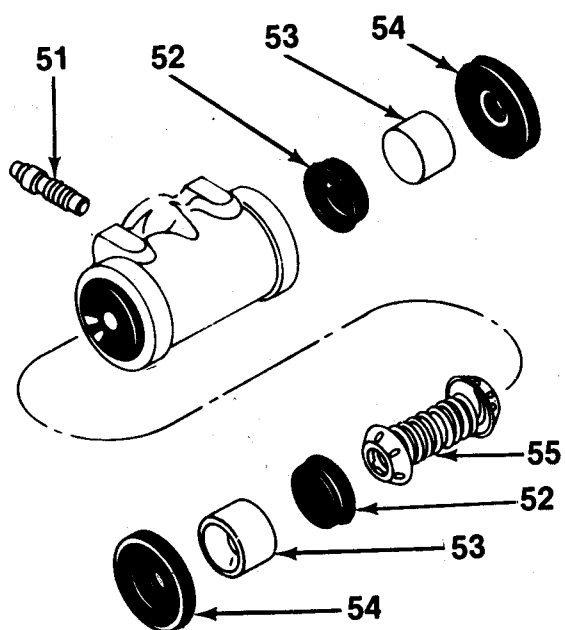
Clean

- Inside the cylinder bore with crocus cloth. If the bore is still scored replace the cylinder.
- Cylinder with clean brake fluid.



Assemble (Figure 56)

- Lubricate seals and cylinder bore with clean brake fluid.
1. Spring assembly (55).
 2. Seals (52).
 3. Pistons (53).



- 51. Bleeder Valve
- 52. Seal
- 53. Piston
- 54. Boot
- 55. Spring Assembly

B-07793

Figure 56—Wheel Cylinder Components

- 4. Boots (54).
- 5. Wheel cylinder, refer to "Wheel Cylinder Replacement."

TORQUE SPECIFICATIONS

| | C | K | G | P |
|---|---|-----------------------|-----------------------|-----------------------|
| Master Cylinder—to Dash or Booster | 44 N·m (32 ft. lbs.) | 44 N·m (32 ft. lbs.) | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) |
| Booster to Dash or Frame | 44 N·m (32 ft. lbs.) | 44 N·m (32 ft. lbs.) | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) |
| Combination Valve —Mounting Bolts | 17 N·m (150 in. lbs.) | 17 N·m (150 in. lbs.) | 23 N·m (17 ft. lbs.) | 23 N·m (17 ft. lbs.) |
| —Bracket | — | — | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) |
| Caliper—Mounting Bolt | 48 N·m (35 ft. lbs.) | | | |
| —Support Plate to Knuckle | 16 N·m (140 in. lbs.) | | | |
| Brake Pedal —Bracket to Dash | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) | 17 N·m (150 in. lbs.) | 34 N·m (25 ft. lbs.) |
| —Bracket to I.P. | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) | — | — |
| —Pivot Bolt Nut | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) | — | — |
| —Sleeve to Bracket | — | — | — | 9.5 N·m (85 in. lbs.) |
| —Stoplamp Switch Bracket | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) | 34 N·m (25 ft. lbs.) | — |
| —Push Rod to Pedal | — | — | — | 34 N·m (25 ft. lbs.) |
| —Push Rod Adjusting Nut | — | — | — | 30 N·m (22 ft. lbs.) |
| Parking Brake —to Dash | 12 N·m (100 in. lbs.) | 12 N·m (100 in. lbs.) | 12 N·m (100 in. lbs.) | — |
| —to I.P. Kick Panel or Floorpan | 17 N·m (100 in. lbs.) | 17 N·m (100 in. lbs.) | 12 N·m (100 in. lbs.) | 24 N·m (18 ft. lbs.) |
| —Cable Clips—Screws | 17 N·m (150 in. lbs.) | — | 12 N·m (100 in. lbs.) | 17 N·m (150 in. lbs.) |
| —Bolts | 17 N·m (150 in. lbs.) | — | 24 N·m (18 ft. lbs.) | 6 N·m (55 in. lbs.) |
| Propshaft Parking Brake —Adjusting Nut | — | — | — | 40 N·m (30 ft. lbs.) |
| —Bracket to Trans. | — | — | — | 27 N·m (20 ft. lbs.) |
| —Cable Clip to Frame | — | — | — | 17 N·m (150 in. lbs.) |
| —Cable Clip to Dash | — | — | — | 6 N·m (55 in. lbs.) |
| —Cable Clip to Trans. Brkt. | — | — | — | 27 N·m (20 ft. lbs.) |
| —Flange Plate | — | — | — | 40 N·m (30 ft. lbs.) |
| —Drum | — | — | — | 110 N·m (80 ft. lbs.) |
| Wheel Cylinder to Flange Plate Bolt | 5.5 N·m (50 in. lbs.)/20 N·m (180 in. lbs.) on JB5, JB6, JB7, and JB8 | | | |
| Rear Brake Anchor Pin | 190 N·m (140 ft. lbs.)/312 N·m (230 ft. lbs.) JB7 and JB8 | | | |
| Front Brake Hose —to Caliper | 44 N·m (32 ft. lbs.) | | | |
| —to Frame Nut | 7 N·m (58 in. lbs.) | | | |
| —Bracket Bolt | 17 N·m (150 in. lbs.) | — | 17 N·m (150 in. lbs.) | 17 N·m (150 in. lbs.) |
| Rear Brake Hose—to Axle Bracket | 27 N·m (20 ft. lbs.) | 27 N·m (20 ft. lbs.) | 10 N·m (90 in. lbs.) | 17 N·m (150 in. lbs.) |
| —Bracket to Axle | 17 N·m (150 in. lbs.) | 17 N·m (150 in. lbs.) | — | 17 N·m (150 in. lbs.) |
| Brake Line —Attaching Nuts | 17 N·m (150 in. lbs.) | | | |
| —Retaining Clips—Screws | 17 N·m (150 in. lbs.) | 17 N·m (150 in. lbs.) | 12 N·m (100 in. lbs.) | 17 N·m (150 in. lbs.) |
| —Bolts | — | — | 17 N·m (150 in. lbs.) | 24 N·m (18 ft. lbs.) |
| Brake Bleeder Valves | 7 N·m (60 in. lbs.) | | | |
| Hydro—Boost— —Pedal Rod — P30 (32) Models | — | — | — | 34 N·m (25 ft. lbs.) |
| —Pedal Rod Boot — P 30 (32) Models | — | — | — | 20 N·m (15 ft. lbs.) |
| —Pivot Lever Rod Retainer | — | — | — | 34 N·m (25 ft. lbs.) |
| —Pivot Lever Bolt | — | — | — | 60 N·m (45 ft. lbs.) |
| —Booster Brackets | — | — | — | 34 N·m (25 ft. lbs.) |
| —Booster Brace at Dash or Rad. Supt. | — | — | — | 17 N·m (150 in. lbs.) |
| —Power Steering Pump to Booster Line | 34 N·m (25 ft. lbs.) | | | |
| —Booster to Gear Line | 34 N·m (25 ft. lbs.) | | | |
| —Return Line at Booster and Gear | 34 N·m (25 ft. lbs.) | | | |
| —Return Line Clamp Screw | 1.6 N·m (15 in. lbs.) | | | |
| —Line Clamp to Bracket Screw | 17 N·m (150 in. lbs.) | | | |
| —Hose Clamp to Skirt Screw | 4.5 N·m (40 in. lbs.) | — | — | — |
| —Line Clamp to Frame Bolt | 17 N·m (150 in. lbs.) | — | — | 17 N·m (150 in. lbs.) |

SPECIAL TOOLS

| | |
|------------|-----------------------------|
| J-29567 | Brake Bleeder Adapter |
| J-23518-01 | Brake Bleeder Adapter |
| J-23709 | Combination Valve Depressor |
| J-23530 | Flaring Tool |
| J-23533-B | Tube Cutter |
| J-26267 | Piston Seal Installer |
| J-24548 | Piston Seal Installer |

SECTION 6

ENGINE

CONTENTS

| <u>SUBJECT</u> | <u>PAGE</u> |
|--|--------------------|
| Engine | 6A-1 |
| 4.3 Liter V6 | 6A3-1 |
| 4.8 Liter L6 | 6A4-1 |
| Small Block | 6A5-1 |
| 7.4 Liter V8 | 6A6-1 |
| 6.2 Liter Diesel | 6A7-1 |
| Engine Cooling | 6B-1 |
| Fuel System | 6C-1 |
| Carburetors | 6C1-1 |
| Diesel Fuel Injection | 6C2-1 |
| Engine Electrical | 6D-1 |
| Drivability And Emissions | 6E-1 |
| Drivability And Emissions — Carburetor | 6E8-1 |
| Drivability And Emissions — Diesel | 6E9-1 |
| Exhaust | 6F-1 |
| Vacuum Pump | 6H-1 |

SECTION 6A

ENGINE

CONTENTS

| <u>SUBJECT</u> | <u>PAGE</u> |
|---|--------------------|
| General Information | 6A- 2 |
| Statement on Cleanliness and Care | 6A- 2 |
| Tune-Up Information | 6A- 2 |
| Use of RTV Sealer and Anaerobic Gasket Eliminator | 6A- 2 |
| Replacing Engine Gaskets | 6A- 3 |
| Gasoline Engine Mechanical Diagnosis | 6A- 3 |
| Gasoline Engine Compression Check | 6A- 6 |
| Diagnosis of Hydraulic Lifters | 6A- 7 |
| Diagnosis of Diesel Engine | 6A- 9 |
| Compression Check (6.2L Diesel Engine) | 6A-11 |
| Cranking Speed Check | 6A-11 |
| Special Tools | 6A-11 |

All new General Motors vehicles are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards. In most cases, these adjustment points either have been permanently sealed and/or made inaccessible to prevent indiscriminate or routine adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, caps, etc., for purposes of servicing the product must be strictly followed and, wherever practicable, returned to the original intent of the design. For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian service manual supplement.

SECTION 6A6

7.4 LITER V8

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "NOTICE: See 'Notice' on page 6A6-1 of this section."

NOTICE: All engine fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CONTENTS

| <u>SUBJECT</u> | <u>PAGE</u> |
|--|--------------------|
| Description | 6A6-2 |
| Engine Lubrication | 6A6-2 |
| On-Vehicle Service | 6A6-4 |
| Rocker Arm Cover Replacement | 6A6-4 |
| Rocker Arm and Pushrod Replacement | 6A6-4 |
| Valve Adjustment | 6A6-5 |
| Valve Stem Seal and Valve Spring Replacement | 6A6-5 |
| Intake Manifold Replacement | 6A6-6 |
| Hydraulic Lifter Replacement | 6A6-7 |
| Rocker Arm Stud Replacement | 6A6-8 |
| Exhaust Manifold Replacement | 6A6-8 |
| Cylinder Head Replacement | 6A6-8 |
| Torsional Damper and Front Crankshaft Seal Replacement | 6A6-9 |
| Front Cover Replacement | 6A6-10 |
| Oil Pan Replacement | 6A6-12 |
| Oil Pump Replacement | 6A6-13 |
| Rear Crankshaft Oil Seal Replacement | 6A6-13 |
| Measuring Camshaft Lobe Lift | 6A6-15 |
| Camshaft Replacement | 6A6-15 |
| Connecting Rod and Piston Replacement | 6A6-17 |
| Oil Filter Bypass Valve | 6A6-19 |
| Main Bearing Replacement | 6A6-20 |
| Crankshaft Replacement | 6A6-21 |
| Flywheel Replacement | 6A6-22 |
| Engine Mountings | 6A6-23 |
| Engine Replacement | 6A6-25 |
| Specifications | 6A6-31 |
| Special Tools | 6A6-33 |

DESCRIPTION

7.4L engines are 90-degree V8 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number five (rear) bearing.

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 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.

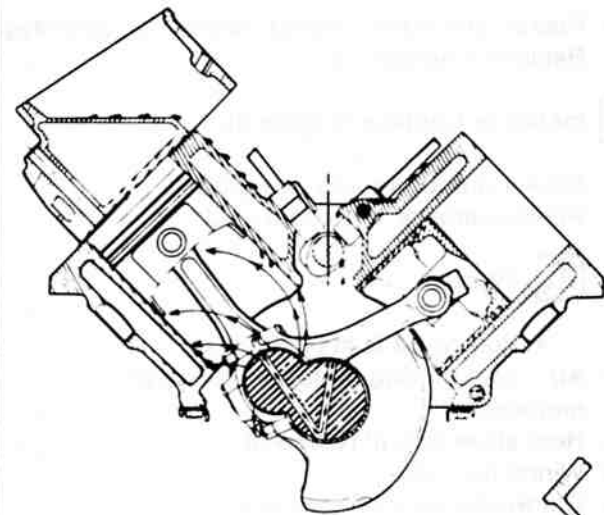
The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

ENGINE LUBRICATION

Lubrication schematics are shown in Figure 1. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

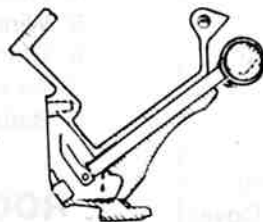
Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. Filtered oil flows into the main gallery and then to the camshaft and crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

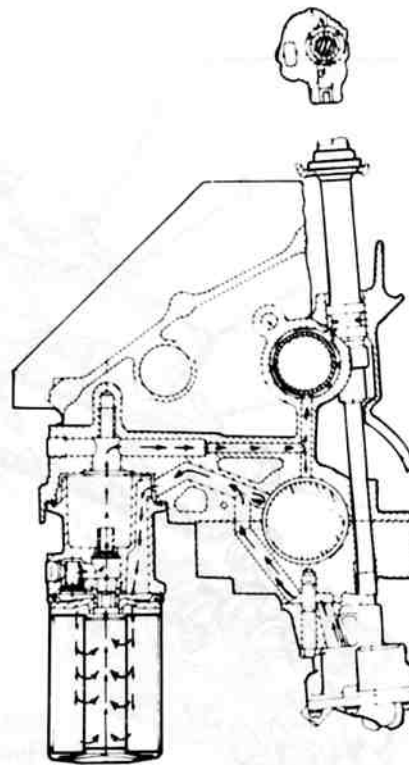


Cylinder walls are oiled by oil thrown off pressure fed connecting rod bearings.

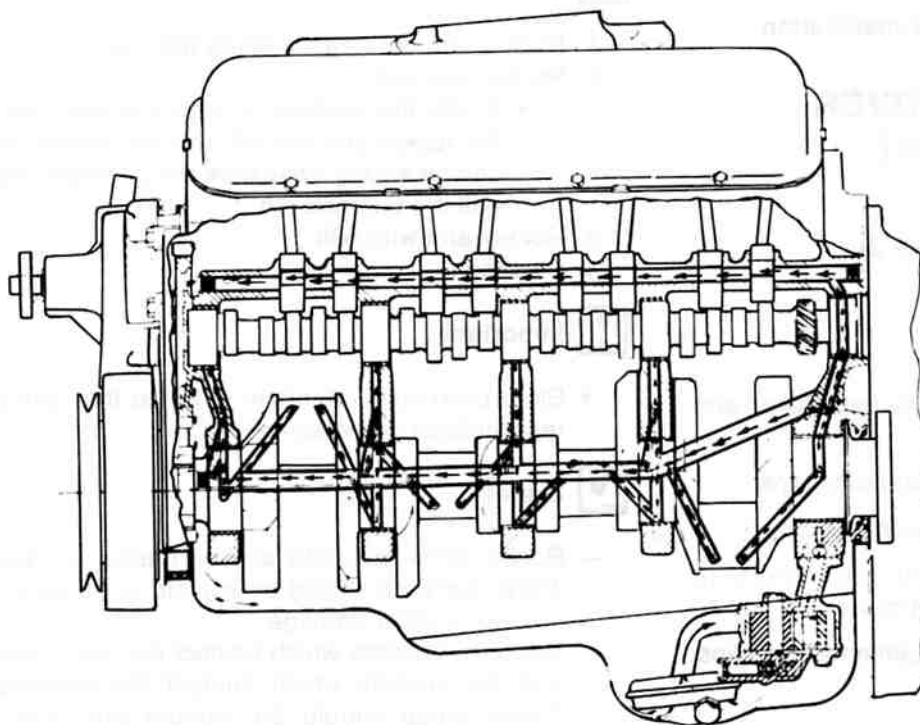
CYLINDER WALL AND CAMSHAFT LOBE OILING



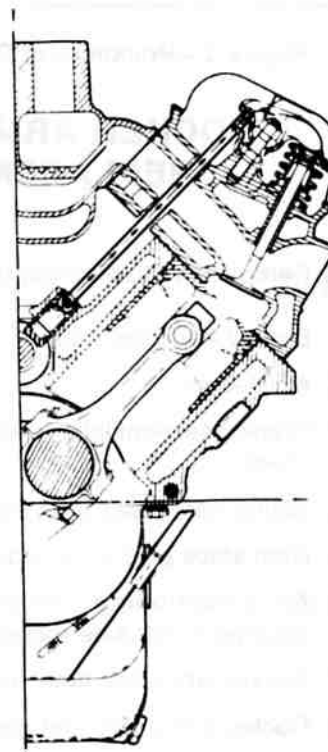
FUEL PUMP PUSH ROD OILING



OIL FILTER AND DISTRIBUTOR OILING



CRANKCASE AND CRANKSHAFT OILING



VALVE MECHANISM OILING

B-09187

Figure 1—Engine Lubrication Diagram

ON-VEHICLE SERVICE

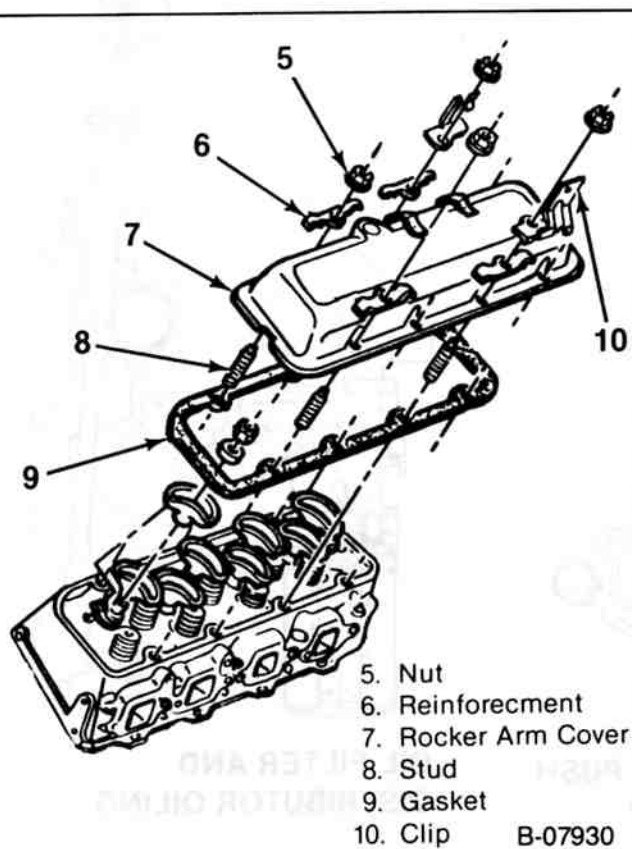


Figure 2—Rocker Arm Cover Installation

ROCKER ARM COVER REPLACEMENT

Remove or Disconnect (Figure 2)

1. Battery negative cable.
2. Air cleaner.
3. Crankcase ventilation hoses at the rocker arm cover.
4. Wiring harnesses from the rocker arm clips.
5. Heat stove pipe (right side rocker arm cover).
6. Air conditioning compressor rear brace (if equipped) (left side rocker arm cover).
7. Rocker arm cover nuts, reinforcements, and clips.
8. Rocker arm cover and gasket.

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surface for distortion. Replace if necessary.

Install or Connect (Figure 2)

1. Rocker arm cover and new gasket.
2. Reinforcements, clips, and nuts.

Tighten

- Nuts to 5.4 N·m (48 in. lbs.).
- 3. Air conditioning compressor rear brace (if removed).
- 4. Heat stove pipe (if removed).
- 5. Wiring harnesses.
- 6. Crankcase ventilation hoses.
- 7. Air cleaner.
- 8. Battery negative cable.

ROCKER ARM AND PUSHROD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover, as outlined previously.
2. Rocker arm nut.
 - If only the pushrod is to be replaced, back the rocker arm nut off until the rocker arm can be swung away from the pushrod. Then pull the pushrod out.
3. Rocker arm with ball.
4. Pushrod.

Important

- Store used components in order so they can be reassembled in the same location.

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.
- 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.

Install or Connect

1. Pushrod. Make sure the pushrod seats properly in the hydraulic lifter.
2. Rocker arm with ball.

Important

- When new rocker arms and/or balls are installed, coat their bearing surfaces with "Molykote" or equivalent.
3. Rocker arm nut.

Adjust

- Valves as outlined later.
4. Rocker arm cover, as outlined previously.

VALVE ADJUSTMENT

1. Remove the rocker arm cover as outlined previously.
2. Crank the engine until the mark on the vibration damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number 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 3). When the play has been removed, turn the adjusting nut in $\frac{3}{4}$ additional turn (to center the lifter plunger).
5. Crank the engine one revolution until the timing tab "O" mark and vibration damper mark are again in alignment. This is the number six firing position the following valves may be adjusted:
 - Exhaust: 2, 5, 6, 7
 - Intake: 3, 4, 6, 8
6. Install the rocker arm cover as outlined previously.

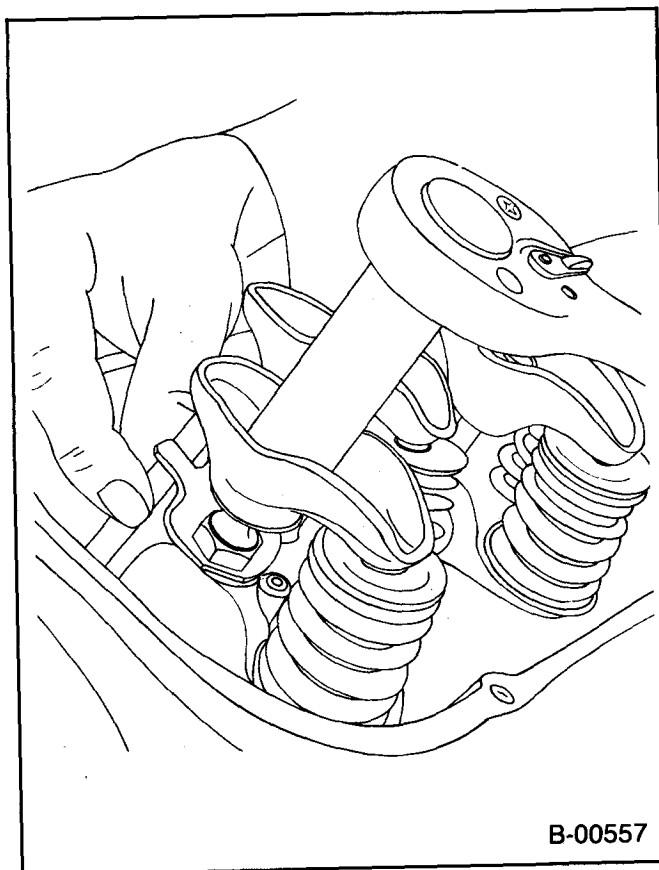


Figure 3—Adjusting The Valves

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 4 and 5)

Tools Required:

- J-23590 Air Adapter
- J-5892-A Spring Compressor

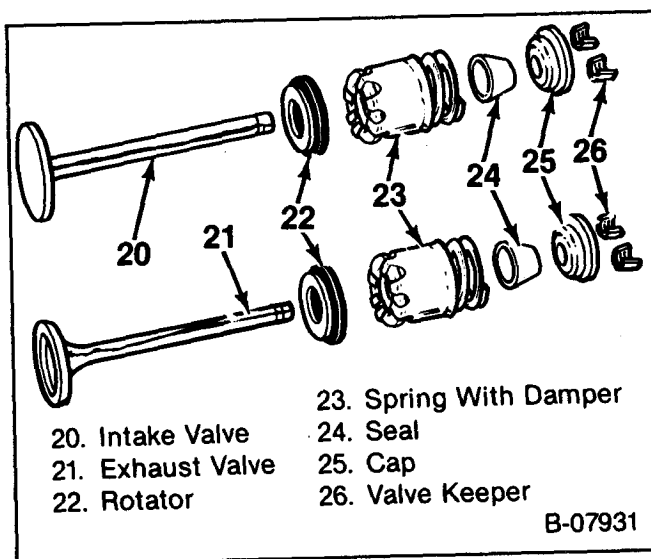


Figure 4—Valves And Components

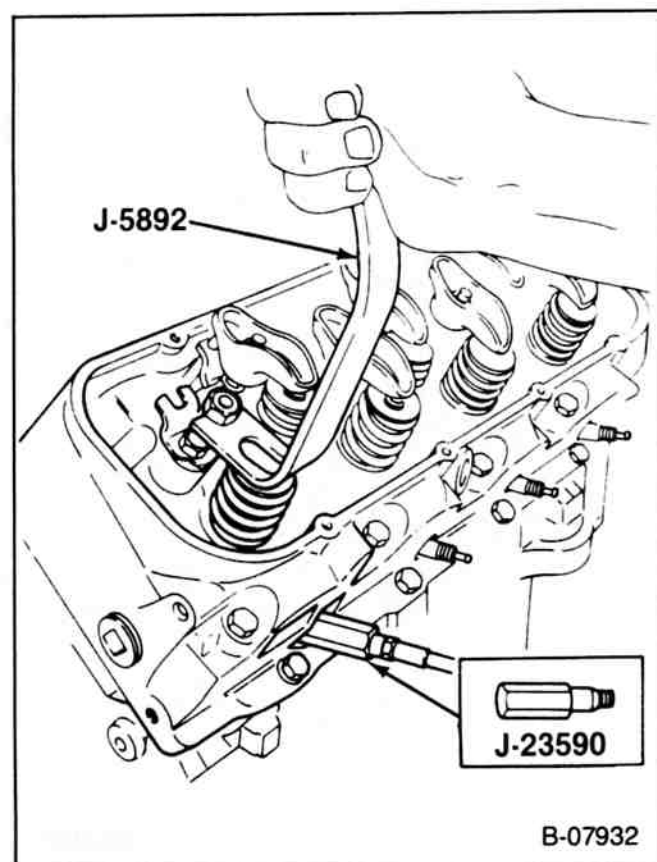


Figure 5—Compressing The Valve Spring

1. Rocker arm cover, as outlined previously.
2. Rocker arms, as outlined previously.
3. Spark plugs.
4. Valve keepers (26).
 - Install J-23590 into the spark plug hole.
 - Apply compressed air to hold the valves in place.
 - Install a rocker arm nut (figure 5).
 - Use J-5892-A to compress the valve spring (figure 5).
 - Remove the valve keepers.
 - Carefully release the spring tension. Remove J-5892-A.
5. Cap (25) and spring with damper (23).
6. Seal (24).

Install or Connect (Figures 4 and 5)

Tools Required:

J-23590 Air Adapter

J-5892-A Spring Compressor

1. New seal (24). Install the seal over the valve stem and seat it against the head.
2. Spring with damper (23), and cap (25).
3. Valve keepers (26).
 - With air pressure applied to the cylinder with J-23590, compress the spring with J-5892-A (figure 5).

- Install the valve keepers. Use grease to hold them in place.
- Carefully release spring pressure. Make sure the valve keepers stay in place.
- Remove J-5892-A and J-23590.

4. Spark plugs.
5. Rocker arms, as outlined previously.

Adjust

- Valves, as outlined previously.
6. Rocker arm covers, as outlined previously.

INTAKE MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Air cleaner.
 - Drain the cooling system.
3. Upper radiator hose, heater hose, and water pump bypass hose.
4. Accelerator, cruise control, and TVS cables, as equipped.
5. Fuel line at the carburetor.
6. Crankcase ventilation hoses.
7. Vacuum hoses, as necessary.
8. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
9. Air conditioning compressor and bracket (if equipped) and lay aside.
10. Accelerator bellcrank, return spring, and bracket.
11. Upper generator bracket.
12. Intake manifold bolts.
13. Intake manifold.
14. Gaskets and seals.

Clean

- Old gaskets from the block, heads, and intake manifold.
- Excessive carbon deposits from the exhaust and EGR passages.
- Excessive scale and deposits from the coolant passages.

Inspect

- Manifold for cracks and gasket surface damage.

Install or Connect (Figure 6)

1. Front and rear intake manifold seals to the block.
2. Side gaskets to the cylinder heads.
3. Intake manifold and bolts.

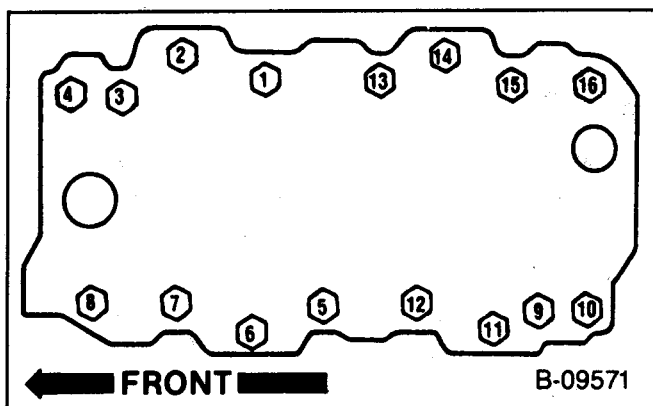


Figure 6—Intake Manifold Bolt Tightening Sequence

Tighten

- Bolts to 40 N·m (30 ft. lbs.). Use the tightening sequence shown in Figure 6.
- 4. Upper generator bracket.
- 5. Accelerator bellcrank, return spring, and bracket.
- 6. Air conditioning compressor and bracket (if equipped).
- 7. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
- 8. Vacuum hoses.
- 9. Crankcase ventilation hoses.
- 10. Fuel line.
- 11. Accelerator, cruise control, and TV cables.
- 12. Water pump bypass hose, heater hose, and upper radiator hose.
- 13. Air cleaner.
- 14. Battery negative cable.
- Fill the cooling system with the proper quantity and grade of coolant.

HYDRAULIC LIFTER REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

Tools Required:

J-3049 Lifter Remover (Plier Type) or
J-9290-01 Lifter Remover (Slide Hammer Type)

1. Rocker arm cover, intake manifold, and pushrod, as outlined previously.
2. Hydraulic lifters.
 - Remove the hydraulic lifters one at a time and place them in an organizer rack. The lifters must be installed in the same bore from which they were removed.
 - A stuck hydraulic lifter can be removed using J-3049 (figure 7) or J-9290-01 (figure 8).

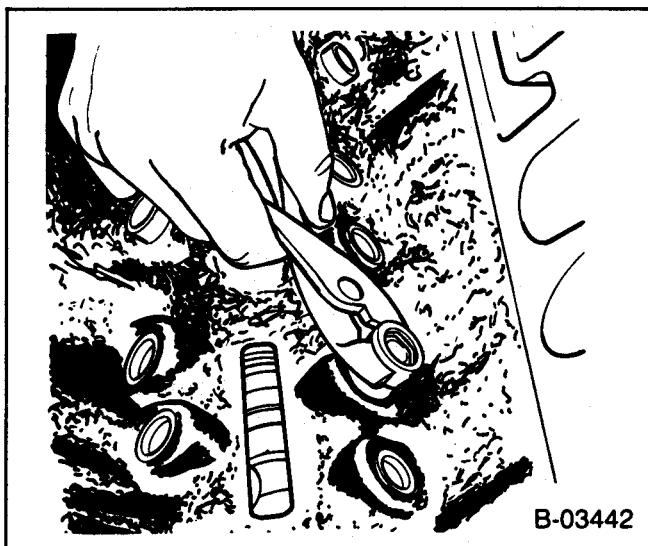


Figure 7—Removing The Valve Lifter

Inspect

- Hydraulic lifter body for scuffing and scoring. If the lifter body wall is worn or damaged, the mating bore in the block should also be checked.
- Check the fit of each hydraulic lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.
- The hydraulic lifter foot must be smooth and slightly convex. If worn, pitted, or damaged, the mating camshaft lobe should also be checked.

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Hydraulic lifters to the block. Lubricate the lifter

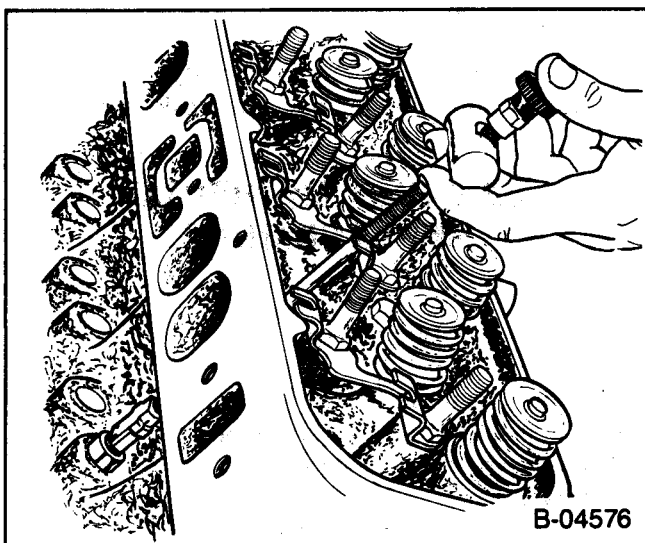


Figure 8—Removing The Valve Lifter

foot and body with Engine Oil Supplement or equivalent.

Important

- When any new hydraulic lifters or a new camshaft is installed, Engine Oil Supplement (or equivalent) should be added to the crankcase oil.
 - Replace all hydraulic lifters when a new camshaft is installed.
2. Intake Manifold, as outlined previously.
 3. Pushrod, as outlined previously.

Adjust

- Valves, as outlined previously.
4. Rocker arm cover, as outlined previously.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover and rocker arm, as outlined previously.
2. Rocker arm stud. Use a deep socket.

Install or Connect

1. Rocker arm stud.

Tighten

- Rocker arm stud to 68 N·m (50 ft. lbs.).
2. Rocker arm, as outlined previously.

Adjust

- Valves, as outlined previously.
3. Rocker arm cover, as outlined previously.

EXHAUST MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Air cleaner and heat stove pipe.
3. AIR hose at the check valve.
4. Spark plugs.
5. Exhaust pipe at the manifold.
6. Exhaust manifold bolts and spark plug heat shields (if used).

7. Exhaust manifold.

Clean

- Mating surface on the manifold and head.
- Threads on the exhaust manifold bolts.

Install or Connect

1. Exhaust manifold.
2. Exhaust manifold bolts and spark plug shields (if used).

Tighten

- Exhaust manifold bolts to specifications. Tighten the center bolts first, then continue outward each way.

- Models with stainless steel manifolds (RPO-NA5): 54 N·m (40 ft. lbs.).
- Models with cast iron manifolds (RPO-NB2): 24 N·m (18 ft. lbs.).

3. Exhaust pipe.
4. Spark plugs.
5. AIR hose.
6. Air cleaner and heat stove pipe.
7. Battery negative cable.

CYLINDER HEAD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
 - Drain the cooling system.
2. Intake manifold, as outlined previously.
3. Generator, and lay aside.
4. Exhaust manifold, as outlined previously.
5. Air conditioning compressor and front bracket (if equipped). Lay the compressor aside.
6. Rocker arm cover, as outlined previously.
7. Spark plugs.
8. Pushrods, as outlined previously.
9. Cylinder head bolts.
10. Cylinder head.
11. Head gasket.

Clean

- Carbon deposits from combustion chambers.
- All traces of old head gasket from cylinder head and block.
- Cylinder head bolt threads and threads in the block.

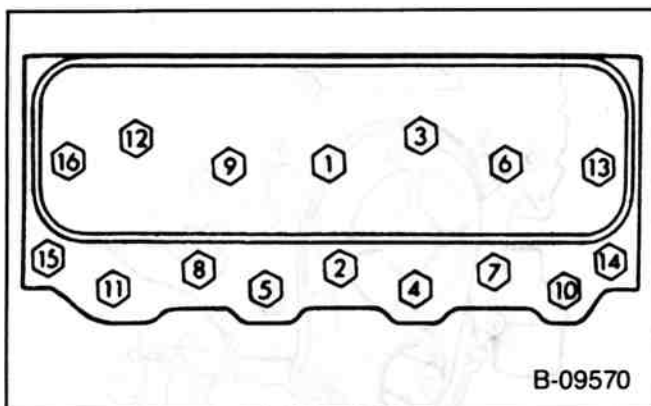


Figure 9—Cylinder Head Bolt Tightening Sequence

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Cylinder Head Repair

- Refer to the proper Unit Repair Manual.

Install or Connect (Figure 9)

1. Head gasket.
 - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
 - Do not use sealer on composition steel-asbestos gaskets.
 - Place the gasket over the block dowel pins with the bead up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound (GM part number 1052080 or equivalent) and install finger-tight.

Tighten

- Cylinder head bolts, a little at a time, using the sequence shown in figure 9. Proper torque is 130 N·m (95 ft. lbs.).
4. Pushrods, as outlined previously.

Adjust

- Valves, as outlined previously.
5. Rocker arm cover, as outlined previously.
 6. Spark plugs.
 7. Air conditioning compressor and front bracket (if equipped).
 8. Exhaust manifold, as outlined previously.
 9. Generator.
 10. Intake manifold, as outlined previously.
 11. Battery negative cable.

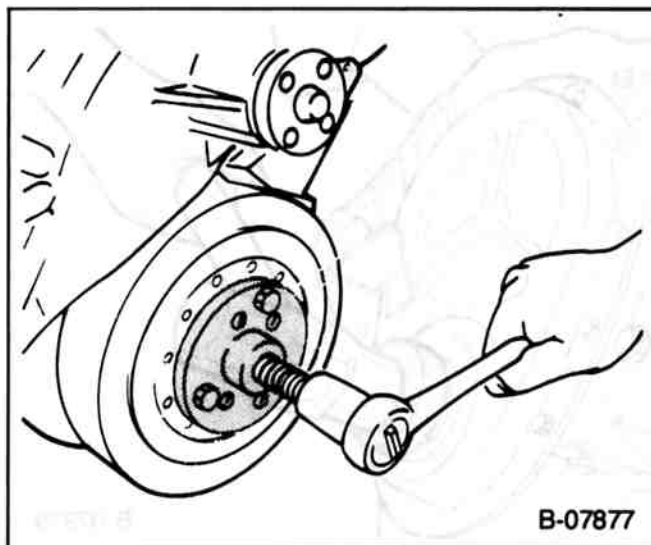


Figure 10—Removing The Torsional Damper

- Fill the cooling system with the proper quantity and grade of coolant.

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 10)

Tool Required:

J-23523-E Torsional Damper Puller and Installer

1. Fan belts, fan, and pulley.
2. Fan shroud assembly.
3. Accessory drive pulley.
4. Torsional damper bolt.
5. Torsional damper. Use J-23523-E (figure 10).
6. Front crankshaft seal. Pry out with a large screwdriver. Take care not to distort the front cover.
7. Crankshaft key, if necessary.

Inspect

- Oil seal contact area on the torsional damper shaft for grooving and roughness. Replace if necessary.

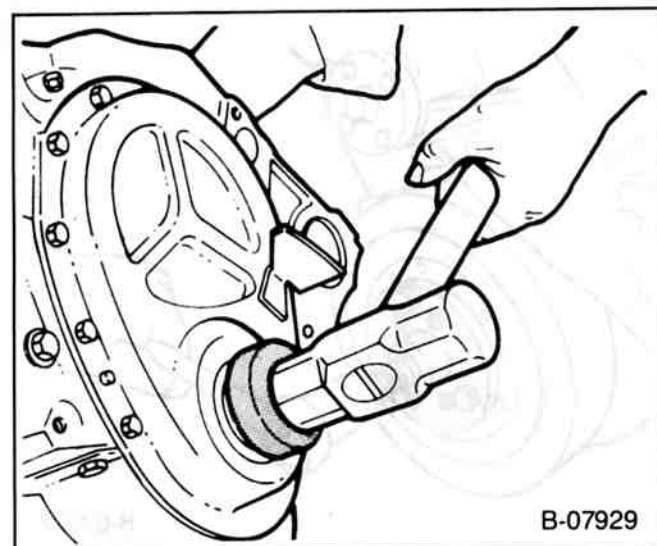
Install or Connect (Figures 11 and 12)

Tools Required:

J-22102 Seal Installer

J-23523-E Torsional Damper Puller and Installer

1. Crankshaft key, if removed.



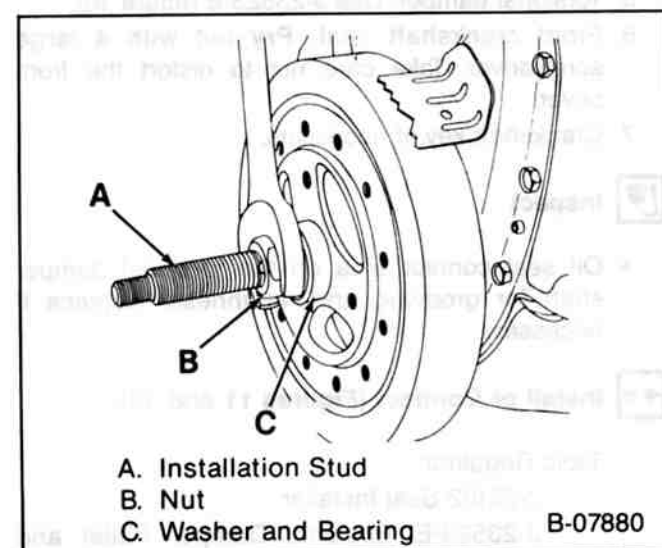
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Figure 11—Installing The Front Crankshaft Seal (Typical)

2. Front crankshaft seal. Use J-22102 (figure 11). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.

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.

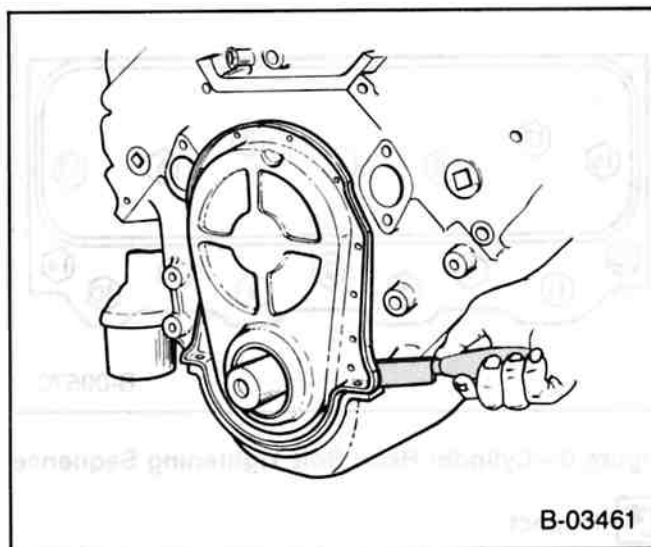
3. Stud (item A, figure 12) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.
4. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.



A. Installation Stud
B. Nut
C. Washer and Bearing

B-07880

Figure 12—Installing The Torsional Damper



B-03461

Figure 13—Cutting The Front Oil Pan Seal

5. Bearing, washer and nut (figure 12).
 - Turn the nut to pull the vibration damper into place.
 - Remove the tool.
6. Torsional damper bolt and washer.



Tighten

- Bolt to 115 N·m (85 ft. lbs.).
7. Accessory drive pulley.
 8. Fan shroud assembly.
 9. Fan pulley, fan, and fan belts.

FRONT COVER REPLACEMENT



Remove or Disconnect (Figures 13 through 16)

1. Battery negative cable.
2. Water pump. Refer to ENGINE COOLING (SEC. 6B).
3. Torsional damper, as outlined previously.
4. Oil pan to front cover bolts.
5. Front cover to block bolts.
6. Front cover.
 - Pull the cover forward enough to permit cutting of the front oil pan seal (figure 13).
 - Cut the front oil pan seal flush with the block on both sides (figure 13). Use a sharp cutting tool to ensure a clean cut.
 - Pull off the front cover.
7. Gasket and front oil pan seal.
8. Front crankshaft oil seal from the front cover. Pry out with a screwdriver. Take care not to distort the front cover.

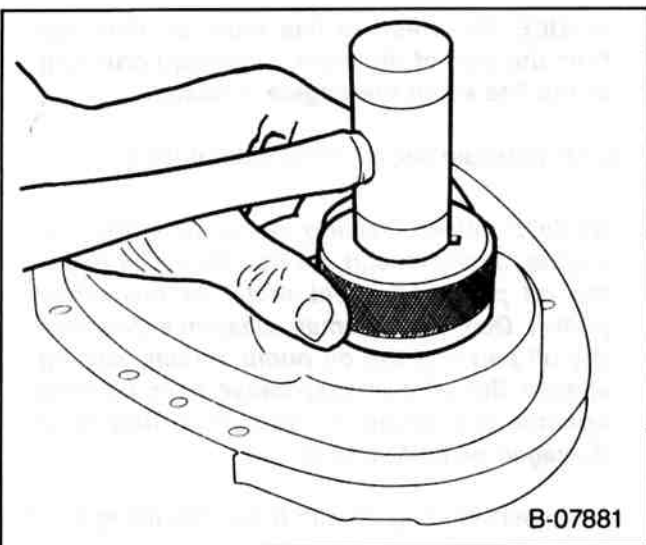


Figure 14—Installing The Front Crankshaft Seal (Typical)

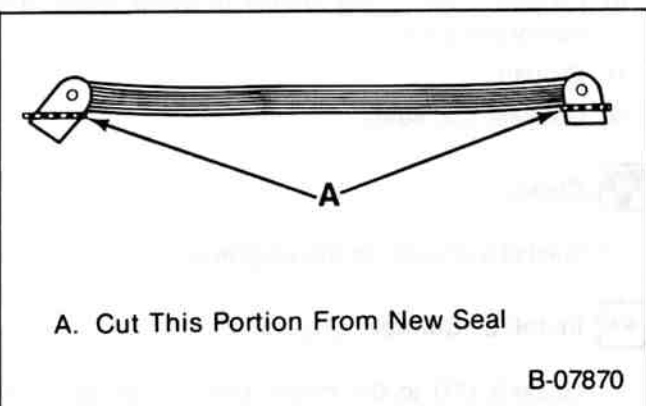


Figure 15—Front Oil Pan Seal Modification

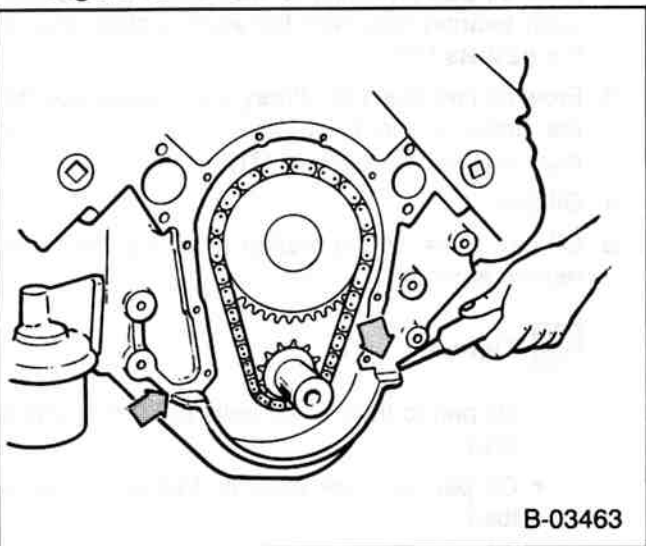


Figure 16—Applying Sealer



Clean

- Old gasket from the front cover, block, and oil pan.



Inspect

- Front cover for distortion and damage. Replace if necessary.



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

Tool Required:

J-22102 Seal Installer

1. Front crankshaft seal. Use J-22102 (figure 14). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.
2. Front oil pan seal.
 - Cut the tabs from a new seal (figure 15). Use a sharp cutting tool to ensure a clean cut.
 - Position the seal on the front cover. Push the seal locating tips into the holes in the front cover.
3. Front cover to block gasket to the front cover. Use gasket sealer to hold it in position.
 - Apply a 3 mm (1/8-inch) bead of RTV sealant (GM part number 1052366 or equivalent) to the front oil pan to block joint (figure 16).
4. Front cover to the engine. Press the cover down against the oil pan until the block dowel pins align with the holes in the cover. Position the cover against the block so that the dowels enter the cover holes without binding. Do not force the cover over the holes. Do not distort the cover flange or dowel pin holes. Hold the front cover in this position. Install and partially tighten the oil pan to front cover bolts.
5. Front cover to block bolts.



Tighten

- Front cover to block bolts to 10.8 N·m (96 in. lbs.).
 - Oil pan to front cover bolts to 7.9 N·m (70 in. lbs.).
6. Torsional damper, as outlined previously.
 7. Water pump. Refer to ENGINE COOLING (SEC. 6B).
 8. Battery negative cable.

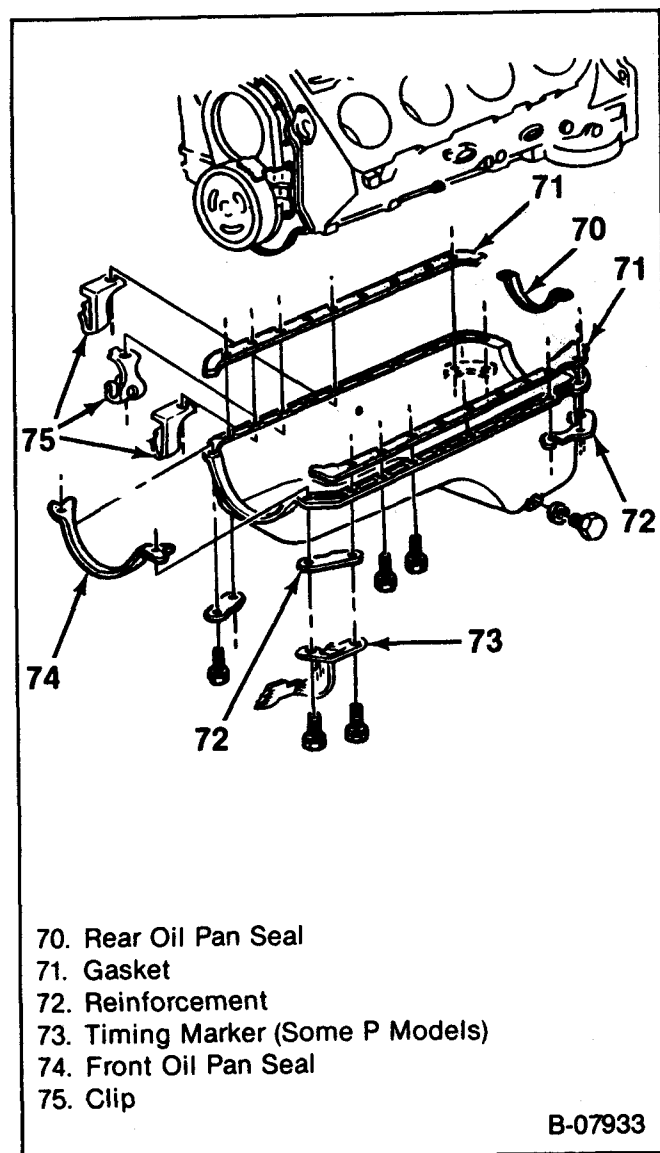


Figure 17—Oil Pan Installation

OIL PAN REPLACEMENT

Remove or Disconnect (Figure 17)

1. Battery negative cable.
2. Fan shroud from the radiator and push rearward.
3. Air cleaner.
4. Distributor cap.
 - Raise the vehicle.
 - Drain the engine oil.
5. Starter (vehicles with manual transmission).
6. Torque converter or clutch cover.
7. Oil filter.

NOTICE: Oil pressure line must be removed from the side of the block to prevent crushing of the line when the engine is raised.

8. Oil pressure line from the side of the block.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Support the engine with a suitable lifting fixture.
9. Engine mounting through-bolts.
 - Raise the engine only enough to permit oil pan removal.
 10. Oil pan bolts, timing marker (if used), clips, and reinforcements.
 11. Oil pan.
 12. Gaskets and seals.



Clean

- Gasket surfaces on the engine and oil pan.



Install or Connect (Figure 17)

1. Gaskets (71) to the block. Use gasket sealer to hold them in place.
2. Rear oil pan seal (70) to the groove in the rear main bearing cap, with the ends mating against the gaskets (71).
3. Front oil pan seal (74). Press the locating tips into the holes in the front cover. The ends should mate against the gaskets (71).
4. Oil pan.
5. Oil pan bolts, timing marker (if used), clips, and reinforcements.



Tighten

- Oil pan to front cover bolts to 7.9 N·m (70 in. lbs.).
- Oil pan to block bolts to 15.3 N·m (135 in. lbs.).
- Lower the engine.

NOTICE: See "Notice" on page 6A6-1 of this section.

6. Engine mounting through bolts.

**Tighten**

- Through-bolts to specifications. Refer to figures 35, 36, and 37.
- 7. Oil pressure line.
- 8. Oil filter.
- 9. Torque converter or clutch cover.
- 10. Starter (if removed).
 - Lower the vehicle.
- 11. Distributor cap.
- 12. Air cleaner.
- 13. Fan shroud.
- 14. Proper quantity and grade of engine oil.
- 15. Battery negative cable.

OIL PUMP REPLACEMENT**Remove or Disconnect**

1. Oil pan, as outlined previously.
2. Oil pump to main bearing cup bolt.
3. Oil pump.

**Inspect**

- Oil pump pickup tube for damage and looseness. If the tube is loose or damaged, the entire oil pump must be replaced, because the tube is welded to the pump body.

Oil Pump Repair

- Refer to the proper unit repair manual.

**Install or Connect**

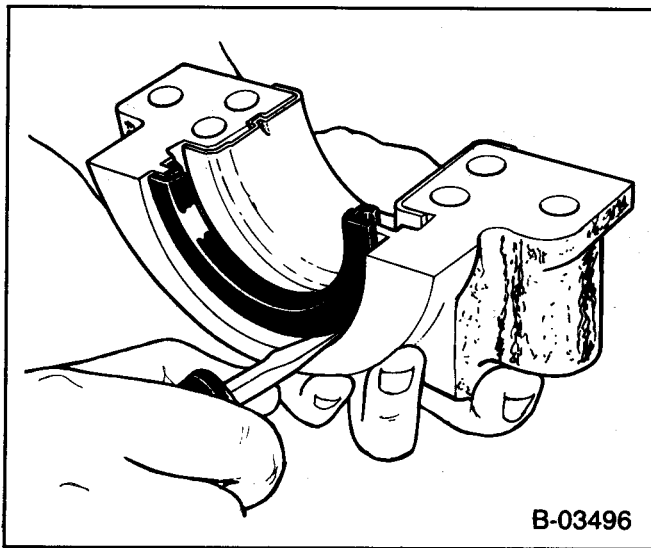
1. Oil pump to the engine. Align the slot in the oil pump shaft with the tang on the distributor shaft. The oil pump should slide easily into place. No gasket is used.
2. Oil pump to main bearing cap bolt.

**Tighten**

- Oil pump bolt to 90 N·m (65 ft. lbs.).
3. Oil pan, as outlined previously.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

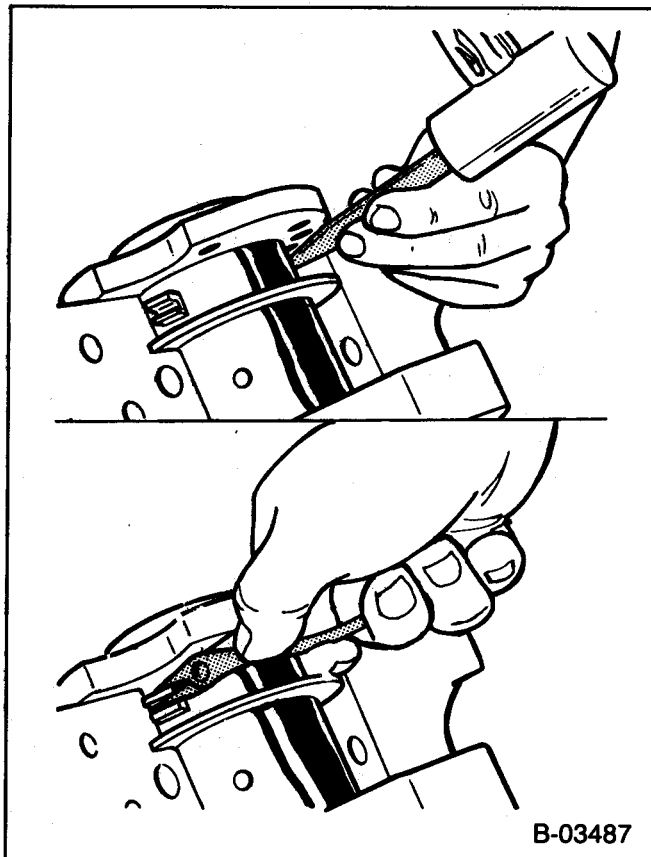
The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Always replace the upper and lower seal as a unit. Install the seal with the lip facing the front of the engine. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the

**Figure 18—Removing The Lower Oil Seal Half**

outside diameter of the seal. An installation tool should be used to protect the seal bead when positioning the seal. (Some seal kits include the tool as part of the service kit).

**Remove or Disconnect (Figures 18 and 19)**

1. Oil pan and oil pump, as outlined previously.
2. Rear main bearing cap.

**Figure 19—Removing The Upper Oil Seal Half**

3. Lower seal half (figure 18).
4. Upper seal half (figure 19).
 - Tap on the upper seal half, using a small drift and hammer.
 - Remove the upper seal half, using pliers.



Clean

- Sealing surfaces of the main bearing cap and block.



Inspect

- Crankshaft, seal channel, and sealing surfaces for nicks, scratches, etc.



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

1. Upper seal half.



Important

- An oil seal installation tool (figure 20) should be fabricated (if not provided in the seal kit) to prevent seal damage during installation. Extreme care should be taken when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal.
 - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
 - Position the tip of the tool between the crankshaft and the seal seat in the block (figure 21).
 - Position the seal half between the crankshaft and the tip of the tool. Make sure that the oil seal lip is positioned toward the front of the engine.
 - Roll the seal around the crankshaft using the tool as a "shoe-horn" to protect the seal bead from the sharp corner of the seal seat surface in the block. The installation tool must remain in position until the seal half is properly positioned with both ends flush with the block.
 - Remove the tool, being careful not to withdraw the seal half.
2. Lower seal half.
 - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
 - Insert the seal half into the rear main bearing cap. Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure. Make sure the oil seal lip faces the front of the engine (figure 21).
 3. Rear main bearing cap with the lower main bearing.

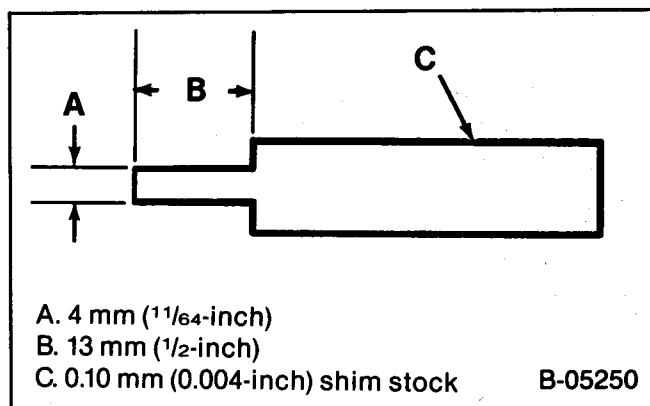


Figure 20—Oil Seal Installation Tool

- Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 22). Do not allow any sealant on either crankshaft or rear oil seal.

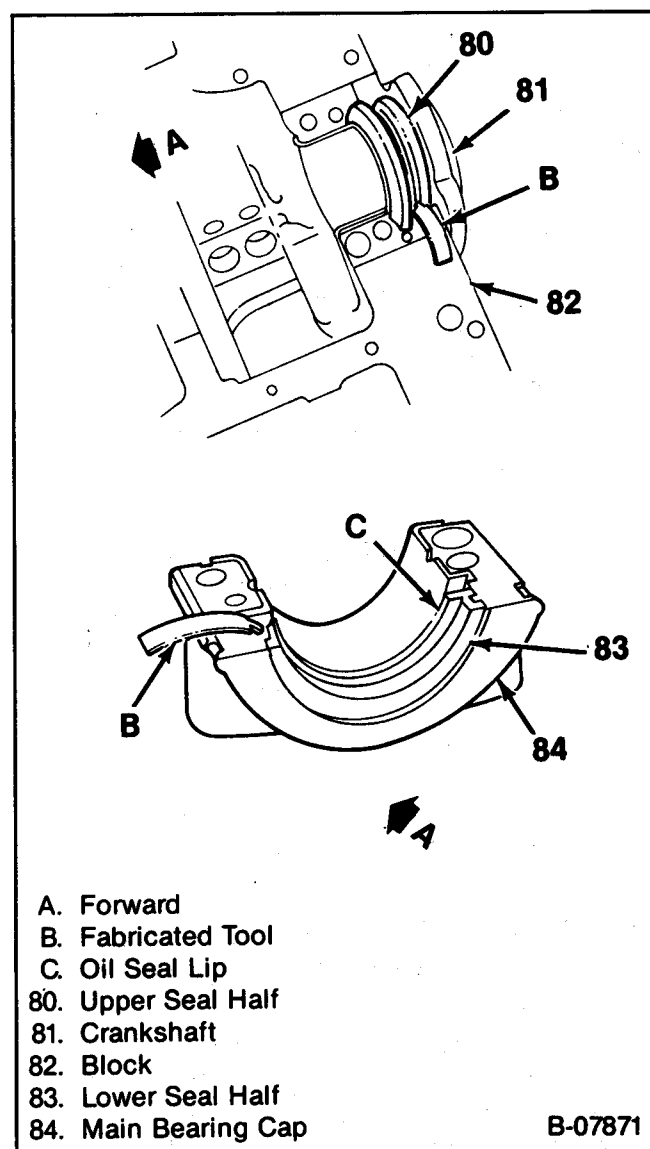


Figure 21—Installing The Rear Crankshaft Oil Seal

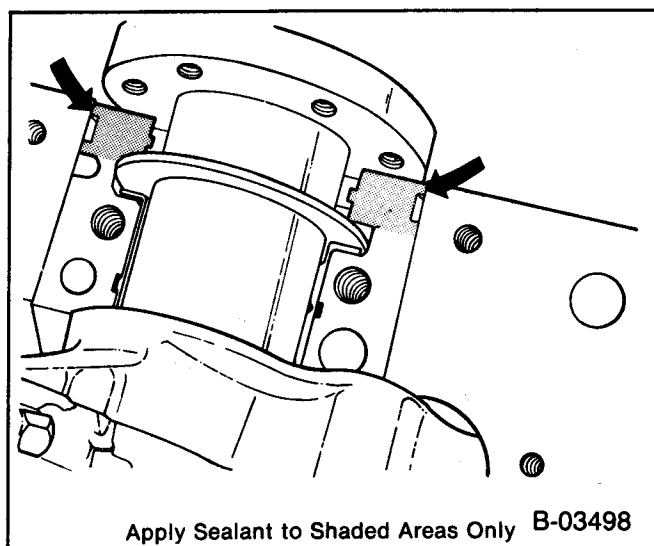


Figure 22—Applying Sealant To The Block

- Apply engine oil to the lower main bearing.
- Position the cap to the block. Install the cap bolts.



Tighten

- Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).
- 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 150 N·m 110 ft. lbs.).

4. Oil pan and oil pump, as outlined previously.
5. The proper quantity and grade of engine oil.

MEASURING CAMSHAFT LOBE LIFT

Tools Required:

J-8520 Camshaft Lobe Lift Indicator

1. Remove the rocker arm as outlined previously.
2. Refer to figure 23. Position the dial indicator (part of J-8520) so the plunger rests on the pushrod end, as shown. Make sure the pushrod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the pushrod will be in its lowest position.

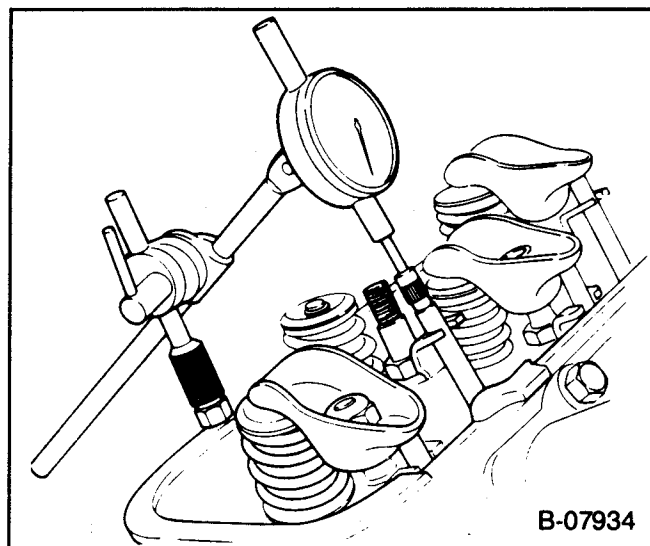


Figure 23—Measuring Camshaft Lobe Lift

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the pushrod is in fully raised position.



Important

- Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).
5. Compare the total lift recorded from the dial indicator with specifications.
 6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
 7. Install the rocker arm and adjust the valves as previously outlined.

CAMSHAFT REPLACEMENT



Remove or Disconnect (Figures 24, 25, and 26)

Tool Required:

J-1619 Crankshaft Sprocket Puller

1. Battery negative cable.
2. Air cleaner.
3. Grille.
4. Air conditioning condensor from its mounting and swing it forward.
5. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
6. Generator and bracket.
7. Rocker arm covers, as outlined previously.
8. Fuel line.

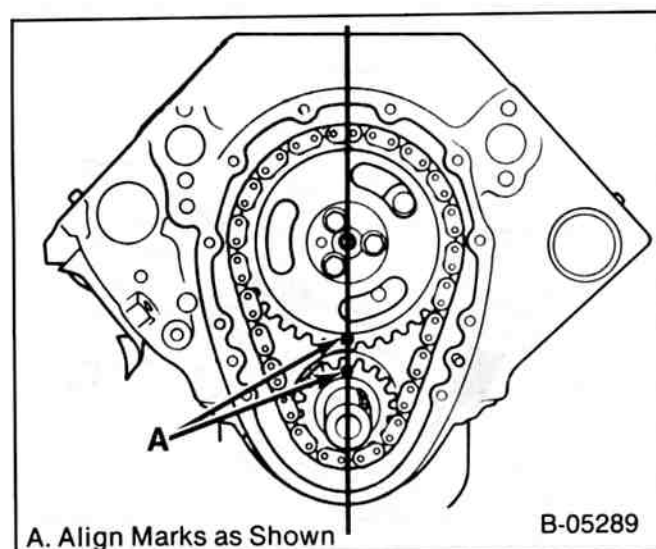


Figure 24—Timing Marks

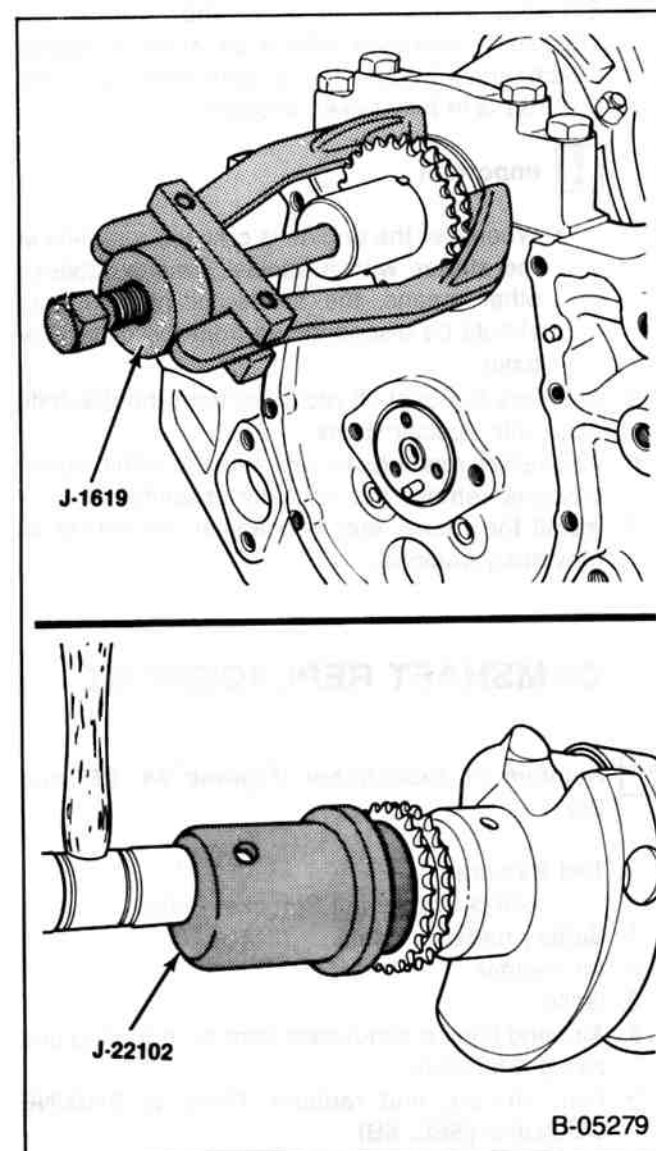


Figure 25—Replacing The Crankshaft Sprocket

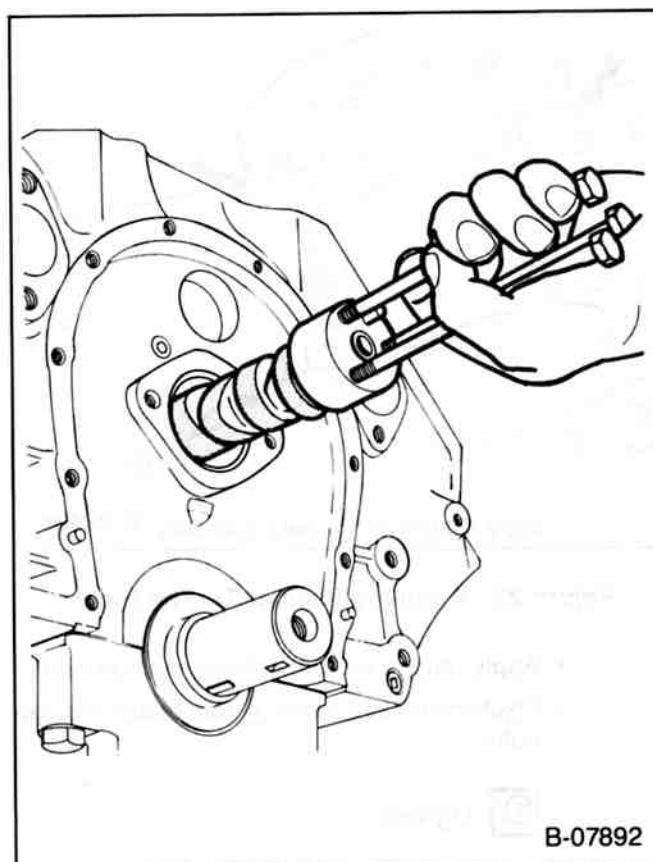


Figure 26—Replacing The Camshaft

9. Water pump. Refer to ENGINE COOLING (SEC. 6B).
10. Torsional damper, as outlined previously.
11. Front cover, as outlined previously.
12. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
13. Intake manifold, as outlined previously.
14. Pushrods and hydraulic lifters, as outlined previously.
15. Fuel pump and pushrod.
 - Align the timing marks (figure 24).
16. Camshaft sprocket bolts.
17. Camshaft sprocket and timing chain. The sprocket is a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
18. Crankshaft sprocket (if required). Use J-1619 (figure 25).
19. Camshaft.
 - Install two or three $\frac{5}{16}$ -18 bolts 100–125 mm (4–5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft (figure 26).
 - Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

Cleaning Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 24, 25, and 26)

Tool Required:

J-22102 Crankshaft Sprocket Installer

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).
- 1. Two or three $\frac{5}{16}$ -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 26). Handle the camshaft carefully to prevent damage to the camshaft bearings.
- 3. Crankshaft sprocket (if removed). Use J-22102 (figure 25). Make sure the timing mark faces outside.
- 4. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 24).
- 5. Camshaft sprocket bolts.

Tighten

- Bolts to 27 N·m (20 ft. lbs.).
- 6. Fuel pump and pushrod.
- 7. Hydraulic lifters and pushrods, as outlined previously.

Important

- Replace all hydraulic lifters and add GM Engine Oil Supplement (or equivalent) to the engine oil whenever a new camshaft is installed.

Adjust

- Valves, as outlined previously.
- 8. Intake manifold, as outlined previously.
- 9. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
- 10. Front cover, as outlined previously.
- 11. Torsional damper, as outlined previously.
- 12. Water pump. Refer to ENGINE COOLING (SEC. 6B).
- 13. Fuel line.
- 14. Rocker arm covers, as outlined previously.

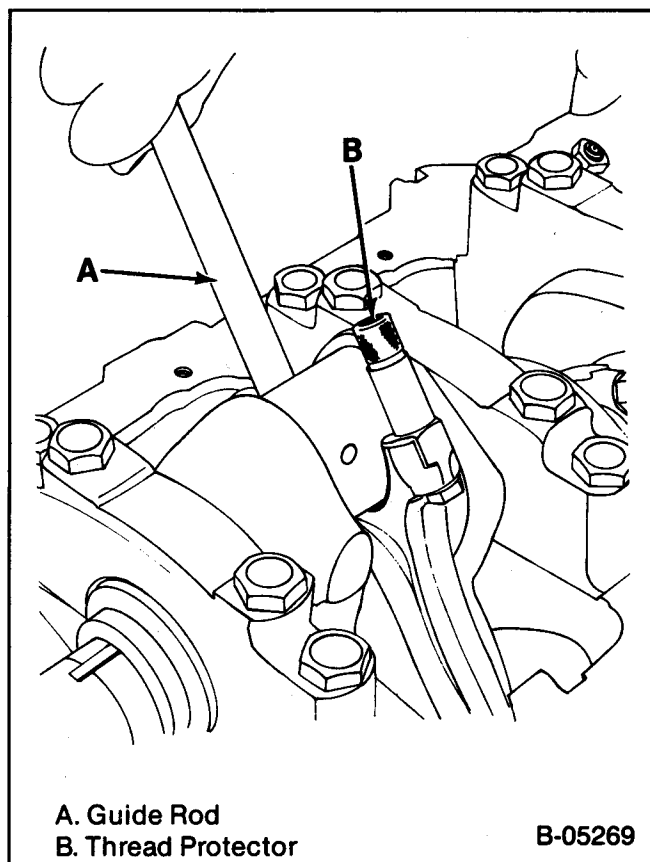


Figure 27—Replacing The Connecting Rod And Piston

- 15. Generator and bracket.
- 16. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
- 17. Air conditioning condensor.
- 18. Grille.
- 19. Air cleaner.
- 20. Battery negative cable.
- Fill the cooling system with the proper quantity and grade of coolant.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 27)

Tool Required:

J-5239 Guide Set

- 1. Cylinder head, as outlined previously.
- 2. Oil pan, as outlined previously.
- 3. Oil pump, as outlined previously (if necessary).
- 4. 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.
 - Turn the crankshaft until the piston is at TDC.
 - Remove the cloth and cuttings.
5. 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.
 6. Connecting rod and piston.
 - Attach J-5239 to the connecting rod bolts (figure 27).
 - Use the long guide rod of J-5239 to push the connecting rod and piston out of the bore.
 7. Connecting rod bearing.

Cleaning, Inspection, and Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

- Connecting rod and piston.
- Piston rings.
- Connecting rod and crankpin.
- Cylinder bores.

Install or Connect (Figures 27 through 31)

Tools Required:

J-5239 Connecting Rod Guide Set
J-8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder for which it was fitted. Used pistons must be installed in the cylinder they were removed from.

1. Connecting rod bearings.

- Be certain that the bearings are of the proper size.
- Install the bearings in the connecting rod and connecting rod cap.
- Lubricate the bearings with engine oil.

2. Piston and connecting rod to the proper bore.

- With the connecting rod cap removed, install J-5239 onto the connecting rod studs.
- Locate the piston ring end gaps as shown in figure 28. Lubricate the piston and rings with engine oil.
- Without disturbing the ring end gap location, install J-8037 over the piston (figure 29).
- The piston must be installed so that the valve clearance notches are towards the center of the engine (figure 30).

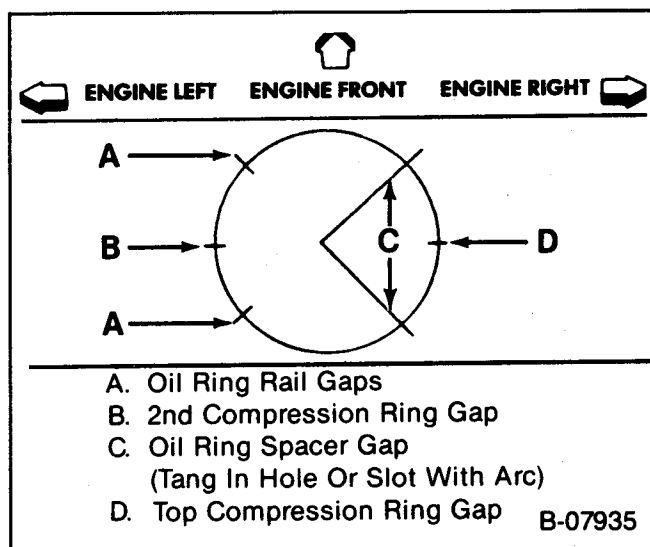


Figure 28—Ring End Gap Location

- Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 29). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J-5239 (figure 27). Hold the ring compressor against the block until all rings have entered the cylinder bore.

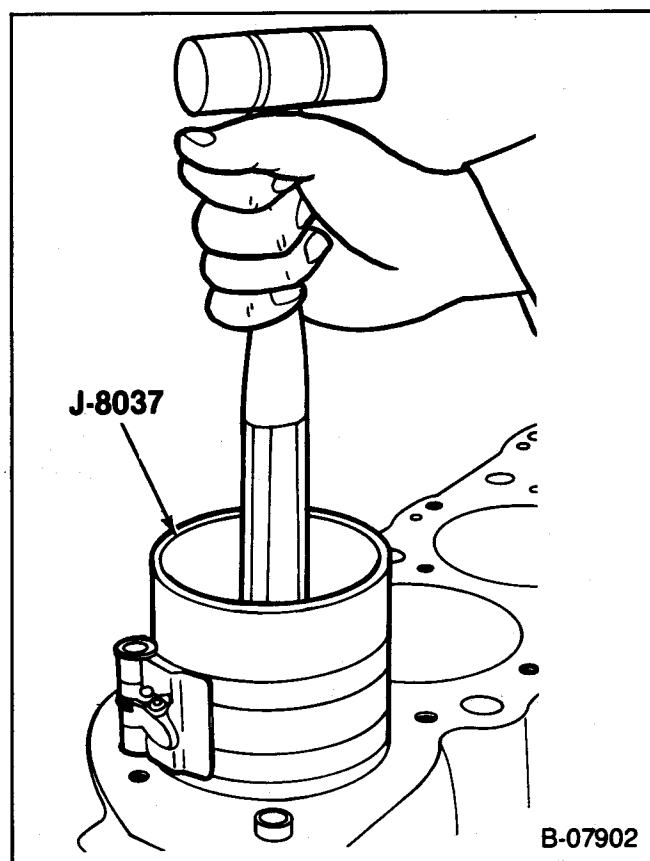


Figure 29—Installing The Piston

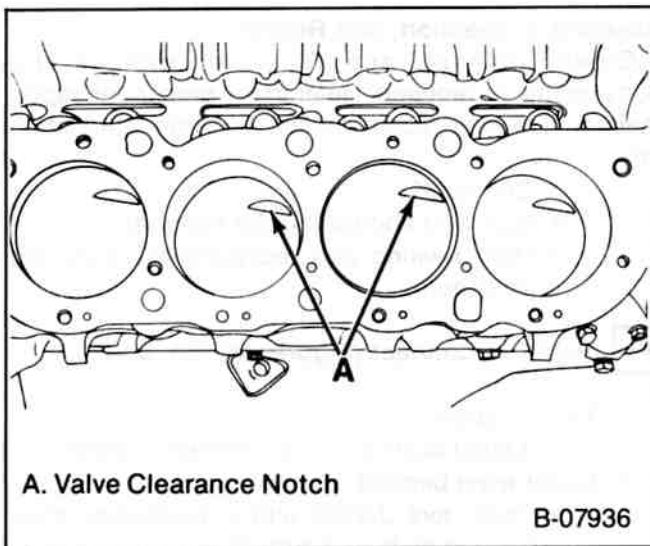


Figure 30—Pistons Installed

- 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, 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 and 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 the proper unit repair manual.
3. Connecting rod cap and bearing.
 4. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 66 N·m (48 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 31). The correct clearance is 0.013–0.023–inch.
5. Oil pump (if removed), as outlined previously.
 6. Oil pan and cylinder head, as outlined previously.

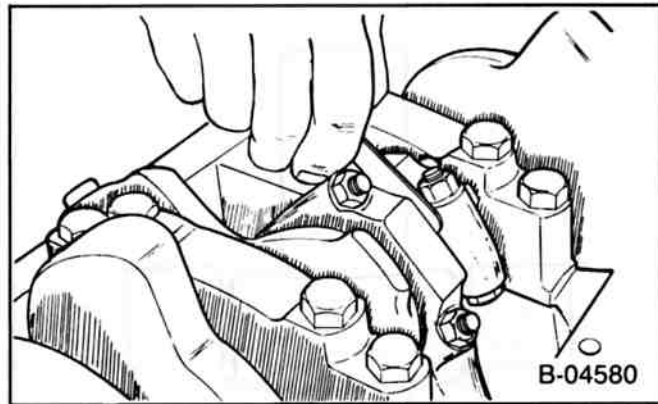


Figure 31—Measuring Connecting Rod Side Clearance

OIL FILTER BYPASS VALVE

↔ Remove or Disconnect (Figure 32)

1. Oil filter.

Inspect

- Bypass valve spring and valve disc for proper operation, cracks, and damage. If replacement is needed, the oil filter bypass valve (93) must be replaced, as follows:

2. Bolts (94).
3. Oil filter bypass valve.

Clean

- Valve chamber in the block.

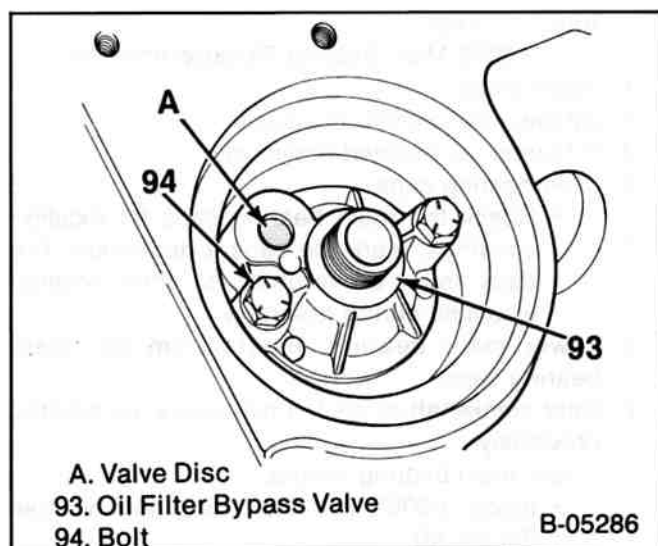


Figure 32—Oil Filter Bypass Valve

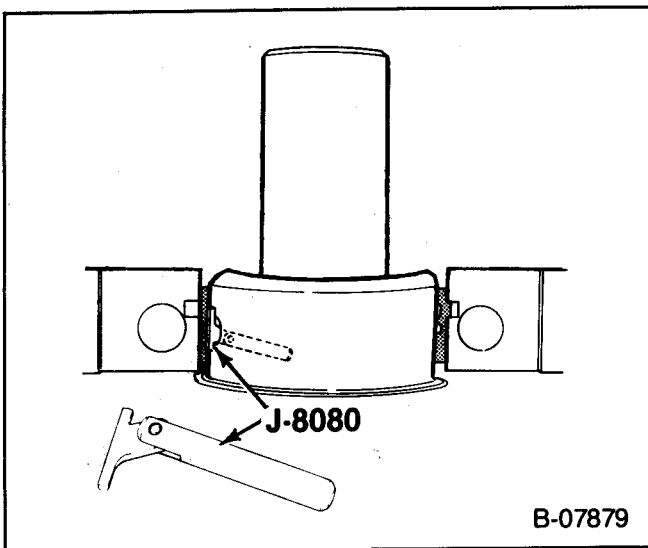


Figure 33—Removing The Main Bearing

Install or Connect (Figure 32)

1. Oil filter bypass valve (93).
2. Bolts (94).

Tighten

- Bolts (94) to 26 N·m (20 ft. lbs.).
- 3. Oil filter.
- 4. Engine oil, as needed.
 - Spark plugs.
 - Flywheel (if used), as outlined later.
 - Engine, as outlined later.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figure 33)

Tool Required:

J-8080 Main Bearing Remover/Installer

1. Spark plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
 - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Rear crankshaft oil seal, if necessary, as outlined previously.
8. Upper main bearing inserts.
 - Insert J-8080 into the crankshaft oil hole (figure 33).
 - Rotate the crankshaft to "turn" the bearing insert out of the block.

Cleaning, Inspection, and Repair

Clean, inspect, and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on:

- Crankshaft.
- Main and connecting rod bearings.
- Main bearing cap replacement (shimming procedure).

Install or Connect (Figures 22, 33, and 34)

Tool Required:

J-8080 Main Bearing Remover/Installer

1. Upper main bearing inserts.
 - Insert tool J-8080 into a crankshaft main bearing oil hole (figure 33).
 - Apply engine oil to inserts of the proper size.
 - Insert the plain end (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. Refer to the proper unit repair manual. If the engine is in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

3. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to 150 N·m (110 ft. lbs.).
- 4. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
- 5. Rear main bearing cap.
 - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 27). Do not allow any sealant on either crankshaft or rear oil seal.
 - Apply engine oil to the bearing insert.
 - Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

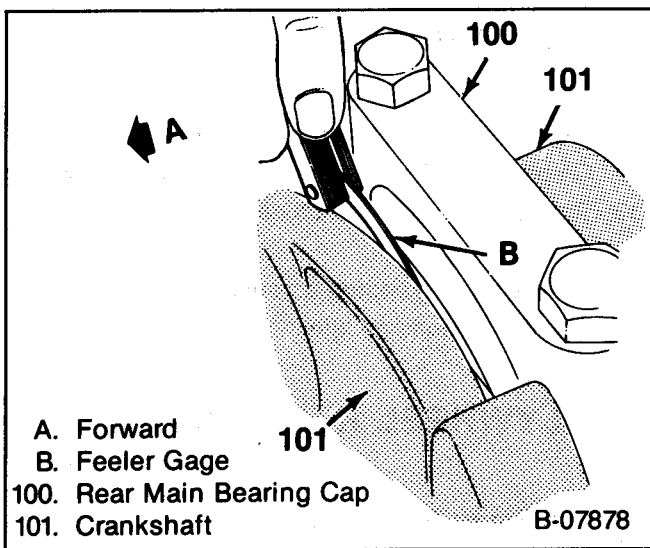


Figure 34—Measuring Crankshaft End Play

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 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 34). The proper clearance is 0.006–0.010–inch.

6. Oil pump, as outlined previously.
7. Oil pan, as outlined previously.
8. Spark plugs.

CRANKSHAFT REPLACEMENT

Remove or Disconnect (Figure 27)

Tool Required:

J-5239 Guide Set

1. Engine, as outlined later.
2. Flywheel (if used) as outlined later.
 - Mount the engine in a suitable engine stand.
3. Spark plugs.
4. Torsional damper, as outlined previously.
5. Front cover, as outlined previously.
6. Camshaft sprocket and timing chain, as outlined previously.
7. Oil pan and oil pump, as outlined previously.

8. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.
9. Connecting rods from the crankshaft.
 - Attach J-5239 to the connecting rod bolts (figure 27).
 - Use the long guide rod to push the pistons up in the bores.
10. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
11. Crankshaft.
12. Main bearing inserts.
13. Rear crankshaft seal, as outlined previously.

Cleaning, Inspection, and Repair

- Clean, inspect, and repair or replace the parts as outlined in the proper unit repair manual. Refer to the unit repair manual for information on:
 - Crankshaft.
 - Main and connecting rod bearings.
 - Procedures for measuring bearing clearances.

Install or Connect (Figures 22, 24, 27, 31, and 34)

Tool Required:

J-5239 Guide Set

1. Upper main bearing inserts to the block. Apply engine oil to the main bearings.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual.
4. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to 150 N·m (110 ft. lbs.).
5. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
 6. Rear main bearing cap to the block.
 - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 22). Do not allow any sealant on either crankshaft or rear oil seal.

- Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

**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 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 34). The proper clearance is 0.006–0.010-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 set at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block for the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.
7. Connecting rods to the crankshaft. Use J-5239 to pull the connecting rods down (figure 27). Make sure the connecting rod bearing insert stays in place.

**Measure**

- Connecting rod bearing clearance. Refer to the proper unit repair manual.
8. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
 9. Connecting rod cap nuts.

**Tighten**

- Connecting rod cap nuts to 66 N·m (48 ft. lbs.).

**Measure**

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 31). The correct clearance is 0.013–0.023-inch.
10. Camshaft sprocket and timing gears, as outlined previously.

**Important**

- Align the timing marks (figure 24).
11. Front cover, as outlined previously.
 12. Oil pan and oil pump, as outlined previously.
 13. Torsional damper, as outlined previously.
 14. Spark plugs.
 15. Flywheel (if equipped) as outlined later.
 16. Engine, as outlined later.

FLYWHEEL REPLACEMENT**Remove or Disconnect**

1. Transmission, flywheel housing, and clutch.
2. Flywheel bolts.
3. 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.

**Install or Connect**

1. Flywheel.
2. Flywheel bolts.

**Tighten**

- Flywheel bolts to 90 N·m (65 ft. lbs.).
3. Clutch, flywheel housing, and transmission.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
 - Hard rubber surface covered with heat check cracks.
 - Rubber cushion separated from the metal plate of the mounting.
 - Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
 - Rubber cushion separated from the metal plate of the mounting.
 - Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

FRONT MOUNTING REPLACEMENT



Remove or Disconnect (Figures 35, 36, and 37)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Support the engine with a suitable jack. Do not load the engine mounting.
1. Engine mounting through-bolt and nut.

NOTICE: Raise the engine only enough for sufficient clearance. Check for interference between the rear of the engine and the dash panel which could cause distributor damage.

- Raise the engine only enough to permit removal of the engine mounting.
2. Mounting assembly bolts, nuts, and washers.
 3. Mounting assembly.



Install or Connect (Figures 35, 36, and 37)

1. Mounting assembly.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Mounting assembly bolts, nuts, and washers.



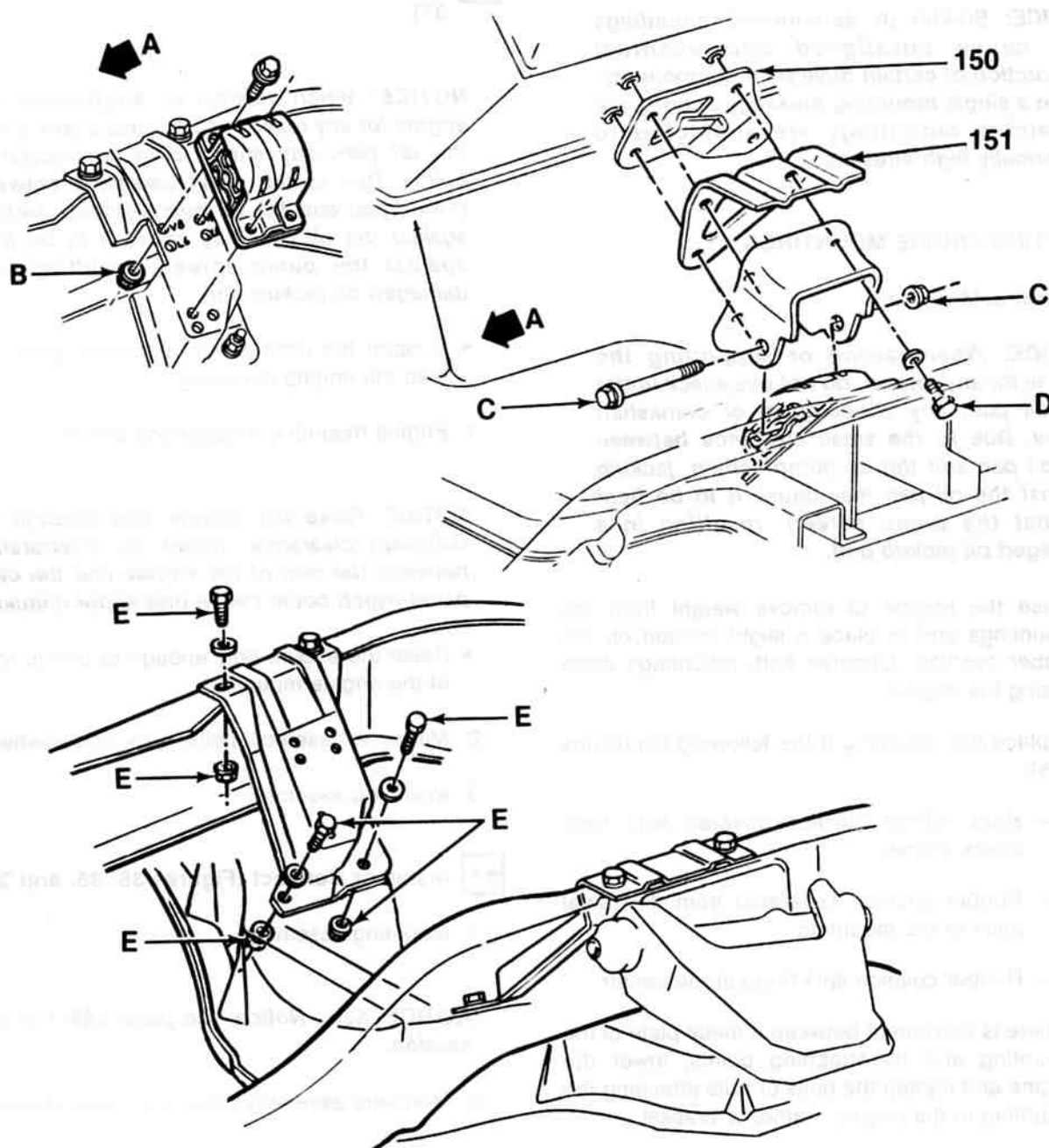
Tighten

- Fasteners to specifications. Refer to figures 35, 36, and 37.
3. Engine mount through-bolt and nut. Lower the engine until the bolt can be inserted. Install the nut.



Tighten

- Through-bolt nut to specifications. Refer to figures 35, 36, and 37.



- A. Forward
- B. 40 N·m (30 Ft. Lbs.)
- C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut To 75 N·m (55 Ft. Lbs.)
- D. 48 N·m (36 Ft. Lbs.)
- E. Torque Bolt To 48 N·m (36 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)
- 150. Transmission Strut Bracket (Automatic Transmission) Or Spacer (Manual Transmission)
- 151. Heat Shield (Engines With Federal Emissions — Left Side Only)

B-07937

Figure 35—Front Engine Mounting (C Models)

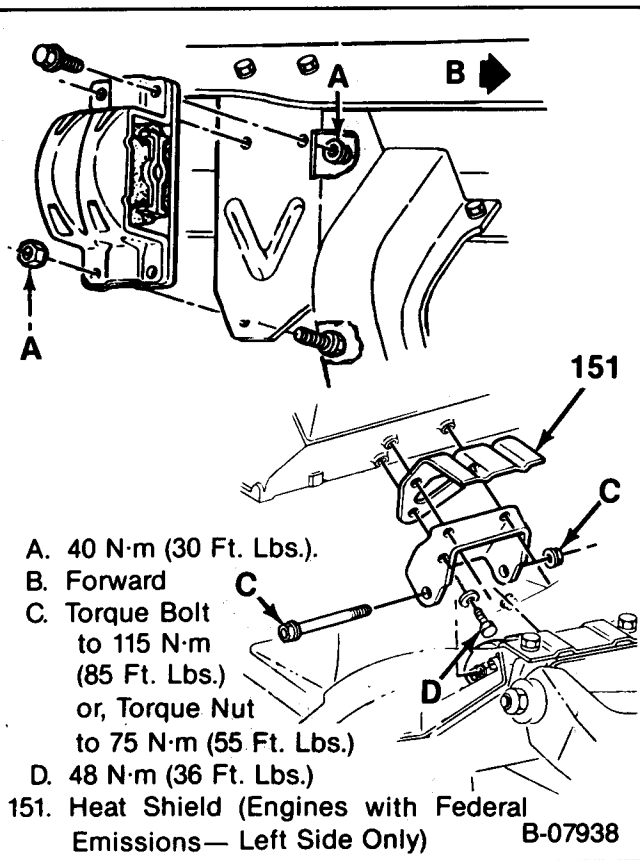


Figure 36—Front Engine Mounting (K Models)

REAR MOUNTING REPLACEMENT (EXCEPT P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

↔ Remove or Disconnect (Figures 38, 39, and 40)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Support the rear of the engine to relieve the weight on the rear mountings.
1. Mounting to crossmember nut(s) and washer(s).
 2. Mounting to transmission bolts and washers.
 - Raise the rear of the engine only enough to permit removal of the mounting.
 3. Mounting.

→ Install or Connect (Figures 38, 39, and 40)

1. Mounting.
- Lower the rear of the engine.

2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A6-1 of this section.

3. Mounting to crossmember nut(s) and washer(s).

⌚ Tighten

- Fasteners to specifications. Refer to figures 38, 39, and 40).

REAR MOUNTING REPLACEMENT (P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

↔ Remove or Disconnect (Figure 41)

1. Bolt, cushion, and spacer.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

- Raise the rear of the engine only enough to permit removal of the mounting.
2. Engine mounting.

→ Install or Connect (Figure 41)

1. Engine mounting. Align the hole in the mounting with the hole in the crossmember.
- Lower the engine.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Spacer, cushion, and bolt.

⌚ Tighten

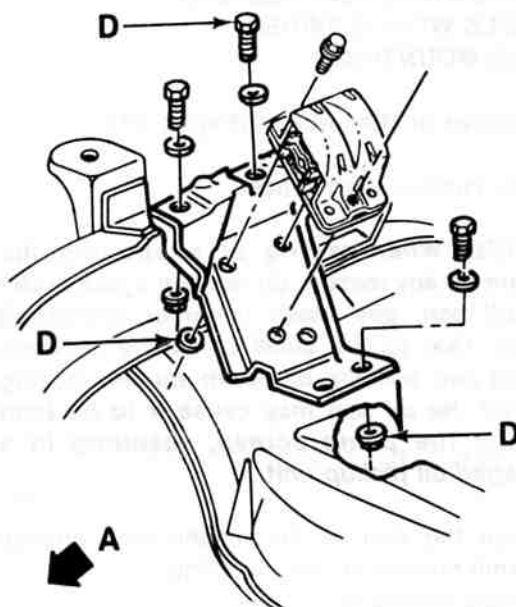
- Bolt to 90 N·m (65 ft. lbs.).

ENGINE REPLACEMENT

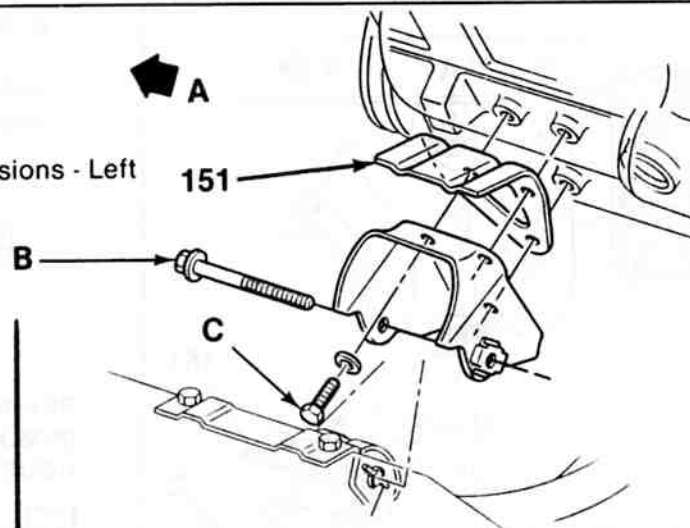
↔ Remove or Disconnect

1. Hood.
2. Battery negative cable.
3. Air cleaner.
4. Radiator and fan shroud. Refer to ENGINE COOLING (SEC. 6B).

- A. Front
 B. 100 N·m (75 Ft. Lbs.)
 C. 48 N·m (36 Ft. Lbs.)
 D. 40 N·m (30 Ft. Lbs.)
 151. Heat Shield (Engines with Federal Emissions - Left Side Only)



MODELS WITHOUT I-BEAM AXLE



MODELS WITH I-BEAM AXLE (RPO-FS3)

B-07939

Figure 37—Front Engine Mounting (P Models)

5. Necessary engine wiring:
 - Starter and solenoid wires.
 - Generator wires.
 - TRC solenoid and switch (if used) wires.
 - Temperature sensor wire.
 - Oil pressure sender wire.
 - Distributor wires.
 - Any other necessary wiring.
6. Accelerator, cruise control and TVS linkages, as equipped.
7. Fuel supply line from fuel pump.
8. Necessary vacuum hoses:
 - Evaporative emission hoses.
 - Vacuum booster hose (if used).
 - Cruise control hose (if used).
 - Any other necessary vacuum hoses.
9. Power steering pump, and lay aside.
10. Air conditioning compressor, and lay aside.
 - Raise the vehicle.
11. Exhaust pipes at the manifolds.
12. Starter.
13. Flywheel or torque converter cover.
14. Flex plate to torque converter bolts (automatic transmission).
 - Lower the vehicle.
 - Support the transmission.
 - Attach a suitable lifting fixture.
15. Bell housing to engine bolts.
16. Front engine mounting through bolts.
17. Engine.

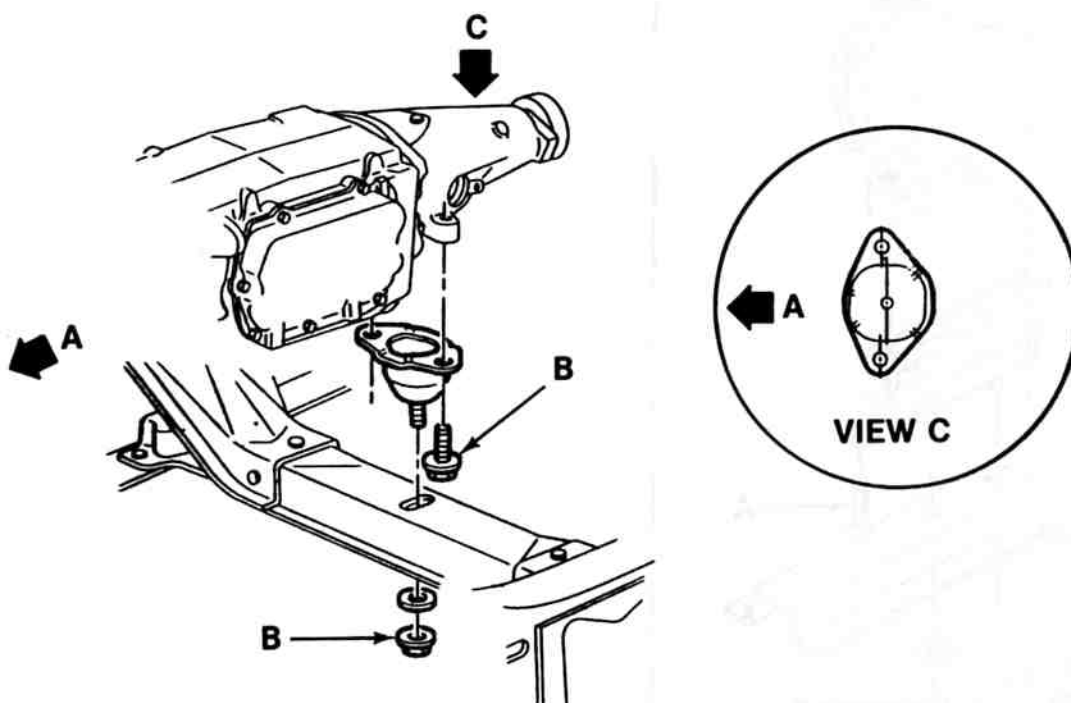


Install or Connect (Figures 36, 37, and 38)

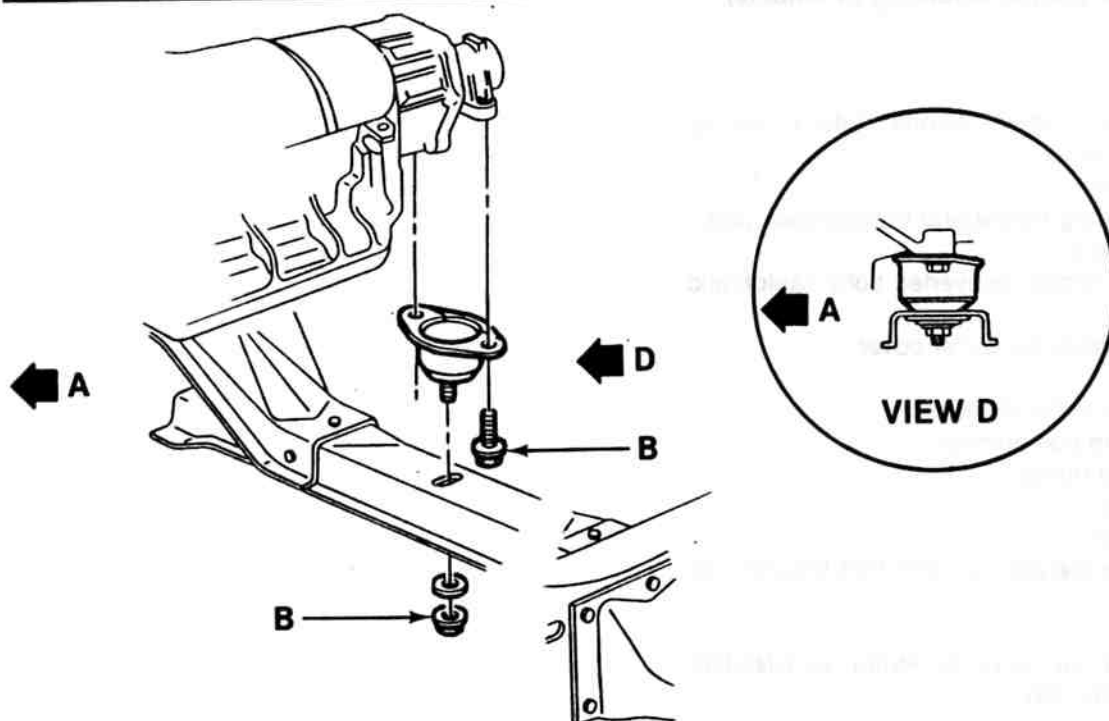
1. Engine in the vehicle.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Engine mounting through bolts and nuts.



ALL MODELS EXCEPT WITH THM 400 TRANSMISSION (RPO-M40)



MODELS WITH THM 400 TRANSMISSION (RPO-M40)

- A. Forward
- B. 48 N·m (36 Ft. Lbs.)

B-07921

Figure 38—Rear Engine Mounting (C Models)

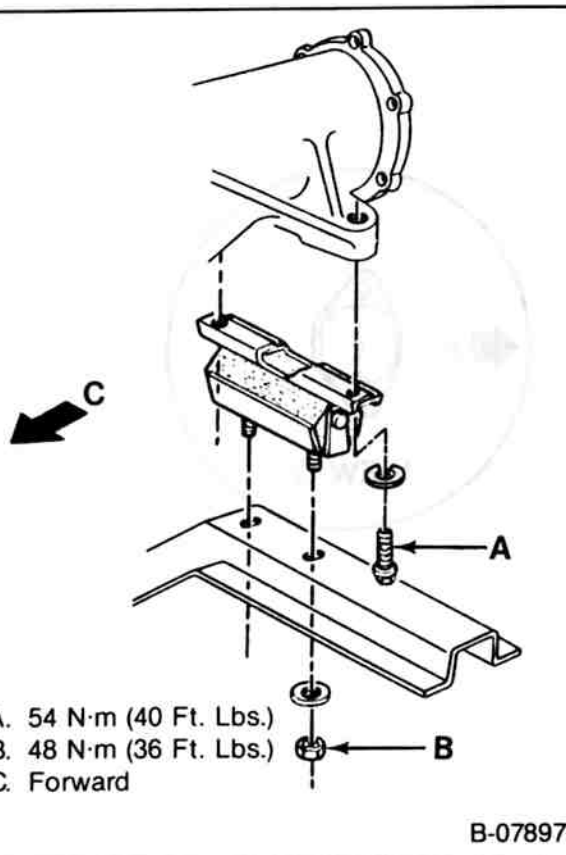
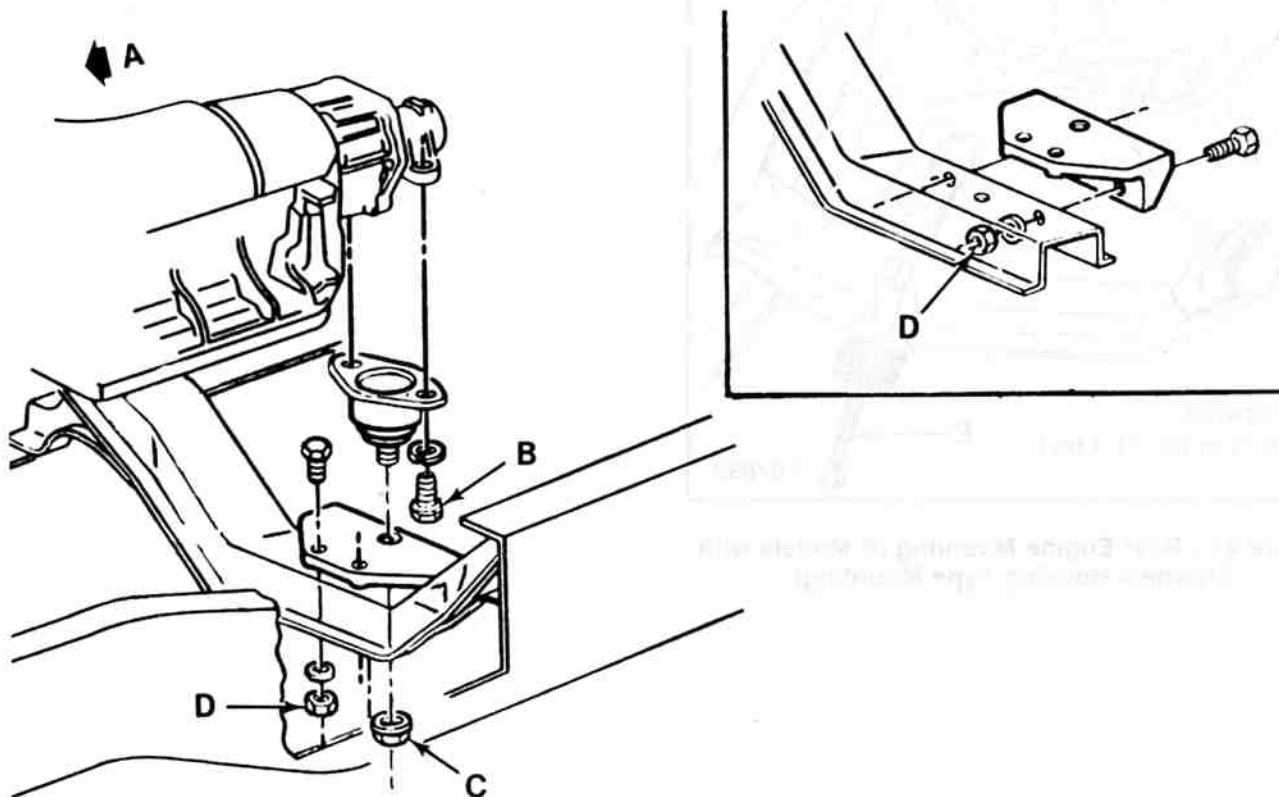


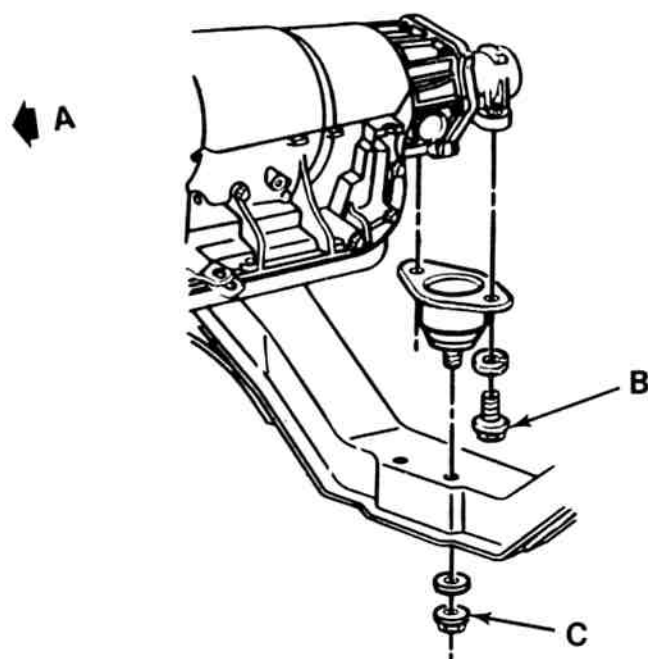
Figure 39—Rear Engine Mounting (K Models)

Tighten

- Fasteners to specifications. Refer to figures 36, 37, and 38.
- 3. Bell housing bolts.
 - Remove the lifting fixture and transmission jack.
 - Raise the vehicle.
- 4. Flex plate to torque converter bolts (automatic transmission).
- 5. Flywheel or torque converter cover.
- 6. Starter.
- 7. Exhaust pipes at the manifolds.
- 8. Air conditioning compressor.
- 9. Power steering pump.
- 10. Vacuum hoses.
- 11. Fuel supply line.
- 12. Accelerator, cruise control, and TVS linkages, as equipped.
- 13. Engine wiring.
- 14. Radiator and fan shroud: Refer to ENGINE COOLING (SEC. 6B).
- 15. Air cleaner.
- 16. Hood.
- 17. Battery negative cable.
- 18. Proper quantity and grade of coolant.



MODELS WITH PROPSHAFT PARKING BRAKE



- A. Forward
- B. 68 N·m (50 ft. lbs.)
- C. 48 N·m (36 ft. lbs.)
- D. 60 N·m (44 ft. lbs.)

MODELS WITHOUT PROPSHAFT PARKING BRAKE

B-07901

Figure 40—Rear Engine Mounting (P Models with Transmission Tail Type Mounting)

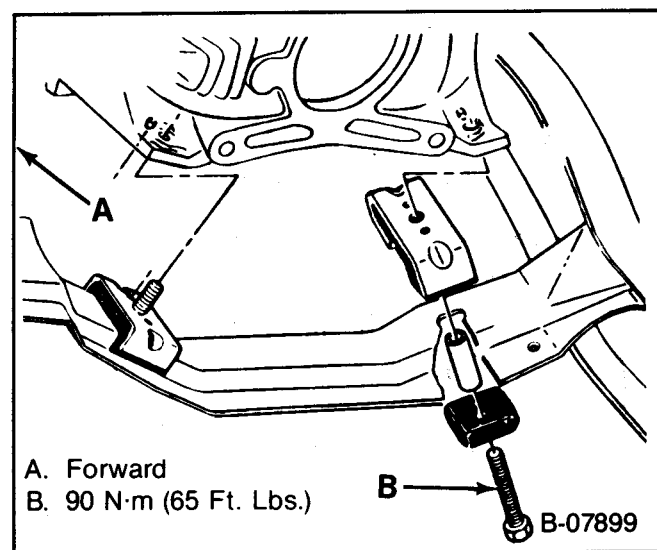


Figure 41—Rear Engine Mounting (P Models with Flywheel Housing Type Mounting)

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

| GENERAL DATA: | | | | |
|---|------------------|---------------|--|-----------------------------|
| Type | | | V8 | |
| Displacement | | | 7.4L (454 Cu. In.) | |
| RPO | | | LE8 | |
| Bore | | | 4.25 | |
| Stroke | | | 4.00 | |
| Compression Ratio | | | 8.0:1 | |
| Firing Order | | | 1 - 8 - 4 - 3 - 6 - 5 - 7 - 2 | |
| Oil Pressure | | | 10 psi @ 500 RPM Minimum; 40-60 psi @ 2000 RPM | |
| CYLINDER BORE: | | | | |
| Diameter | | | 4.2495-4.2525 | |
| Out Of Round | Production | | 0.001 (Maximum) | |
| | Service | | 0.002 (Maximum) | |
| Taper | Production | Thrust Side | 0.0005 (Maximum) | |
| | | Relief Side | 0.001 (Maximum) | |
| | Service | | 0.001 (Maximum) | |
| PISTON: | | | | |
| Clearance | Production | | 0.003-0.004 | |
| | Service Limit | | 0.005 (Maximum) | |
| PISTON RING: | | | | |
| C O M P R E S S I O N | Groove Clearance | Production | Top | 0.0017-0.0032 |
| | | | 2nd | 0.0017-0.0032 |
| | | 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 |
| O I L | Groove Clearance | Production | | 0.0050-0.0065 |
| | | Service Limit | | Hi Limit Production + 0.001 |
| | Gap | Production | | 0.015-0.055 |
| | | Service Limit | | Hi Limit Production + 0.010 |
| PISTON PIN: | | | | |
| Diameter | | | 0.9895-0.9898 | |
| Clearance In Piston | Production | | 0.00025-0.00035 | |
| | Service Limit | | 0.001 (Maximum) | |
| Fit In Rod | | | 0.0013-0.0021 Interference | |

SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

| | | | |
|--------------------------------|---------------------------------------|----------------|--|
| DISPLACEMENT | | | 7.4L |
| CRANKSHAFT: | | | |
| Main Journal | Diameter | #1, #2, #3, #4 | 2.7481-2.7490 |
| | | #5 | 2.7476-2.7486 |
| | Taper | Production | 0.0002 (Maximum) |
| | | Service Limit | 0.001 (Maximum) |
| | Out Of Round | Production | 0.0002 (Maximum) |
| | | Service Limit | 0.001 (Maximum) |
| Main Bearing Clearance | Production | #1,#2, #3, #4 | 0.0013-0.0025 |
| | | #5 | 0.0024-0.0040 |
| | Service Limit | #1, #2, #3, #4 | 0.0010-0.0025 |
| | | #5 | 0.0025-0.0035 |
| Crankshaft End Play | | | 0.002-0.006 |
| Crankpin | Diameter | | 2.1990-2.200 |
| | | | |
| | Taper | Production | 0.0005 |
| | | Service Limit | 0.001 |
| | Out Round | Production | 0.0005 |
| Service Limit | | 0.001 | |
| Rod Bearing Clearance | Production | | 0.0009-0.0025 |
| | Service Limit | | 0.003 (Maximum) |
| Rod Side Clearance | | | 0.0013-0.023 |
| CAMSHAFT: | | | |
| Lobe | Intake | | 0.2343 |
| Lift \pm 0.002 | Exhaust | | 0.2530 |
| Journal Diameter | | | 1.9482-1.9492 |
| VALVE SYSTEM: | | | |
| Lifter | | | Hydraulic |
| Rocker Arm Ratio | | | 1.70:1 |
| Valve Lash | | Intake | $\frac{3}{4}$ Turn Down From Zero Lash |
| | | Exhaust | |
| Face Angle (Intake & Exhaust) | | | 45° |
| Seat Angle (Intake & Exhaust) | | | 46° |
| Seat Runout (Intake & Exhaust) | | | 0.002 (Maximum) |
| Seat Width | | Intake | $\frac{1}{32}$ - $\frac{1}{16}$ |
| | | Exhaust | $\frac{1}{16}$ - $\frac{3}{32}$ |
| Stem Clearance | Production | Intake | 0.0010-0.0027 |
| | | Exhaust | 0.0012-0.0029 |
| | Service | Intake | High Limit Production + 0.001 |
| | | Exhaust | High Limit Production + 0.002 |
| Valve Spring | Free Length | | 2.12 |
| | Pressure lbs. @ in. | Closed | 74-86 lbs. @ 1.80 in. |
| | | Open | 195-215 lbs. @ 1.40 in. |
| | Installed Height $\pm \frac{1}{32}$ " | | $1\frac{5}{64}$ |
| | Valve Spring Fit In Damper | | 0.042-0.094 Interference |

SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

| Item | N·m | Ft. Lbs. | In. Lbs. |
|---|------|----------|----------|
| Rocker Arm Cover Nuts | 5.4 | — | 48 |
| Intake Manifold Bolts | 40 | 30 | — |
| Rocker Arm Studs | 68 | 50 | — |
| Exhaust Manifold Bolts | | | |
| Models with stainless steel manifolds (RPO-NA5) | 54 | 40 | — |
| Models with cast iron manifolds (RPO-NB2) | 24 | 18 | — |
| Cylinder Head Bolts | 130 | 95 | — |
| Torsional Damper Bolts | 115 | 85 | — |
| Front Cover to Block Bolts | 10.8 | — | 96 |
| Oil Pan to Front Cover Bolts | 7.9 | — | 70 |
| Oil Pan to Block Bolts | 15.3 | — | 135 |
| Oil Pump Bolt | 90 | 65 | — |
| Main Bearing Caps | 150 | 110 | — |
| Camshaft Sprocket Bolts | 26 | 20 | — |
| Connecting Rod Cap Nuts | 66 | 48 | — |
| Oil Filter Bypass Valve Bolts | 26 | 20 | — |
| Flywheel Bolts | 90 | 65 | — |
| Oil Pump Cover Bolts | 9.0 | — | 80 |
| Flywheel Housing Bolts | 40 | 30 | — |
| Water Pump Bolts | 40 | 30 | — |
| Water Outlet Bolts | 40 | 30 | — |
| Spark Plugs | 30 | 22 | — |

SPECIAL TOOLS

| | |
|-----------|---|
| J-23590 | Air Adapter |
| J-5892-A | Spring Compressor |
| J-3049 | Hydraulic Lifter Remover (Plier Type) |
| J-9290-1 | Hydraulic Lifter Remover (Slide Hammer Type) |
| J-1619 | Crankshaft Sprocket Puller |
| J-22102 | Front Crankshaft Seal and Crankshaft Sprocket Installer |
| J-23523-E | Torsional Damper Remover and Installer |
| J-8520 | Camshaft Lobe Lift Indicator |
| J-5239 | Guide Set |
| J-8037 | Ring Compressor |
| J-8080 | Main Bearing Remover/Installer |