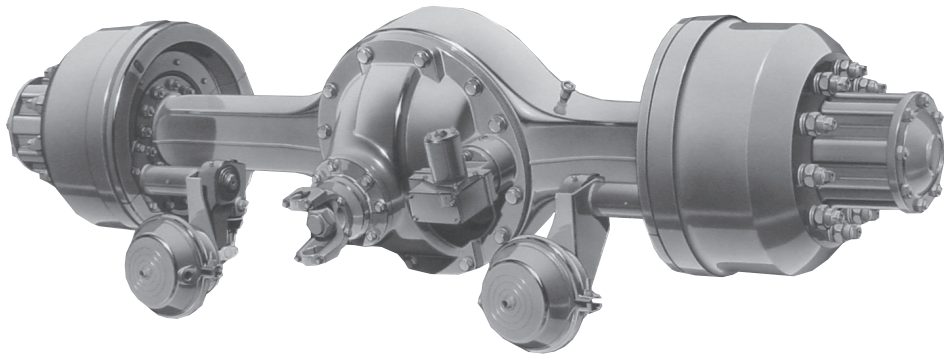


# Two-Speed Differentials

## RS-220/RS-230/RS-240

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Maintenance Manual MM-0144






## Before You Begin

This manual provides instructions for Meritor's two-speed differential models RS-220, RS-230 and RS-240. Before you begin procedures:

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Caution and Warning safety alerts that precede instructions or procedures you will perform. These alerts help to avoid damage to components, serious personal injury, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

## Safety Alerts, Torque Symbol and Notes

 <b>WARNING</b>	A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.
 <b>CAUTION</b>	A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components and possible serious injury.
	A torque symbol alerts you to tighten fasteners to a specified torque value.
<b>NOTE</b>	A Note provides information or suggestions that help you correctly service a component.

## Access Information on Meritor's Web Site

Additional maintenance and service information for Meritor's commercial vehicle systems component lineup is also available at [www.meritor.com](http://www.meritor.com).

To access information, click on Products & Services/Tech Library Icon/HVS Publications. The screen will display an index of publications by type.

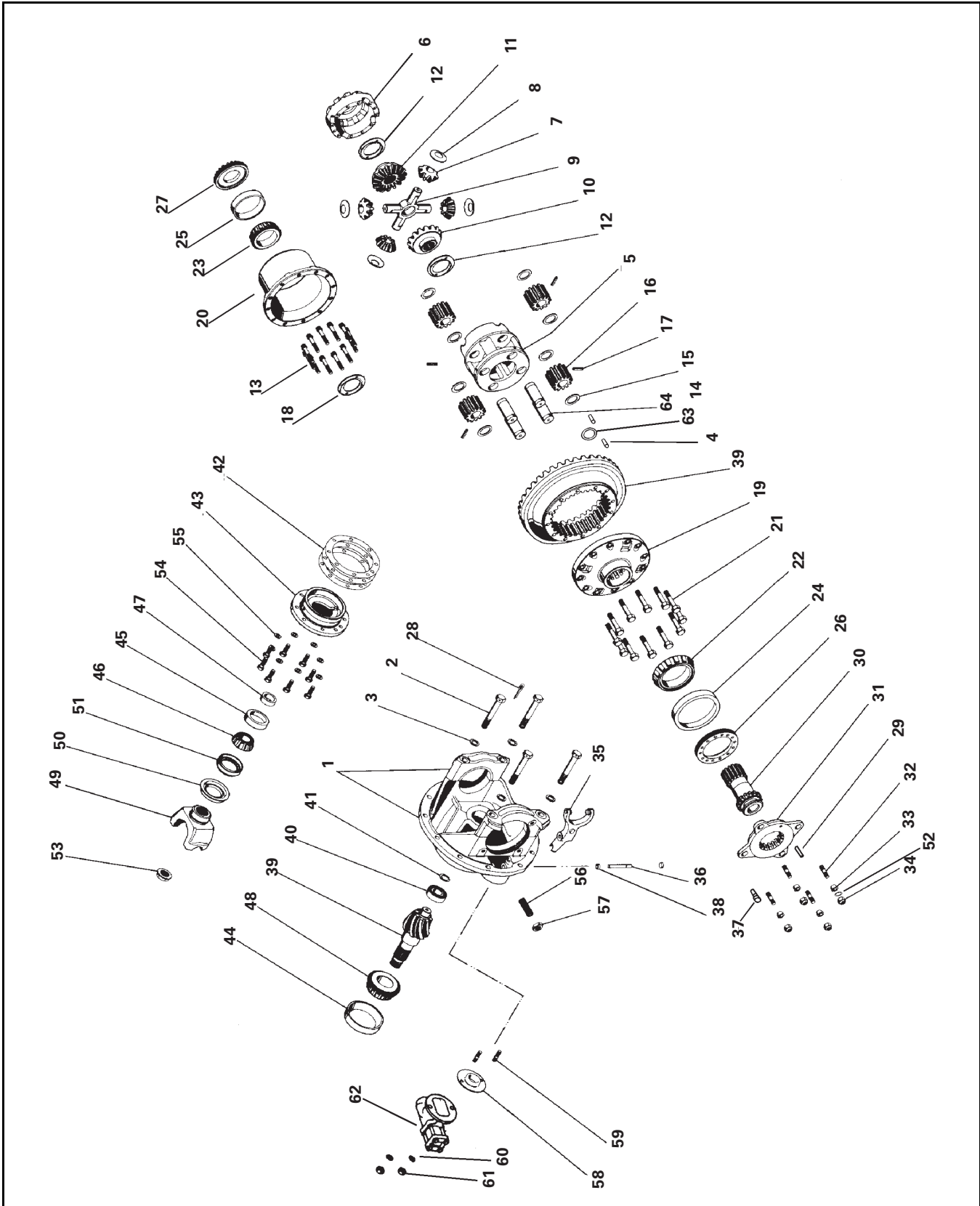
## Additional Information

Call Meritor's Customer Service Center at 800-535-5560 to order the following publications.

- *Lubrication* (Maintenance Manual 1)
- *Single Reduction Rear Differential Carriers* (Maintenance Manual 5A)
- *Drive Axle Housings* (Maintenance Manual 8)
- *Drivetrain Plus™ by Meritor Technical Electronic Library* on CD. Features product and service information on most Meritor, ZF Meritor and Meritor WABCO products. Order TP-9853.

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# Exploded View



## Series 220/230/240

Item	Description
1	Carrier
2	Capscrews — Differential Bearing Cap
3	Washer
4	Roll Pin
5	Planetary Carrier
6	Case — Main Differential Case Half
7	Pinions — Differential
8	Thrust Washers — Differential Pinion
9	Spider — Differential
10	Side Gears (Short Hub-Differential)
11	Side Gears (Long Hub-Differential)
12	Thrust Washers — Differential Side Gear
13	Fasteners (Case Assembly)
14	Shaft for Differential Pinions
15	Washer
16	Planetary Gears
17	Pin
18	Thrust Washer
19	Case Half — Flange
20	Case Half (Plain)
21	Fasteners — Bearing Cage
22	Bearing Cone — Differential
23	Cone — Differential Bearing
24	Bearing Cup — Differential
25	Cup — Differential Bearing
26	LH Adjusting Ring
27	RH Adjusting Ring
28	Cotter Pin
29	Lock Screw
30	Sun Gear
31	Clutch Plate
32	Studs — Clutch Plate

Item	Description
33	Tapered Dowel
34	Nut
35	Shift Fork
36	Shift Shaft
37	Capscrews — Lock Plate
38	Plug
39	Ring Gear and Pinion
40	Spigot Bearing
41	Snap Ring
42	Adjusting Shims (Bearing Cage)
43	Bearing Cage — Drive Pinion
44	Bearing Cup — Pinion Inner
45	Bearing Cup — Outer
46	Bearing Cone — Outer
47	Pinion Bearing Spacer
48	Bearing Cone — Pinion Inner
49	Input Yoke or Flange
50	Deflector
51	Oil Seal for Pinion
52	Washer
53	Pinion Nut
54	Screws for Bearing Cage
55	Washer
56	Thrust Screw
57	Jam Nut Thrust Screw
58	Diaphragm
59	Studs
60	Washer
61	Nut
62	Shift Unit (Mechanism of Speed Change)
63	Spacer
64	Planetary Pin

## Introduction

### Welding on an Axle

For complete welding instructions, refer to Maintenance Manual 8, *Drive Axle Housings*. Call Meritor's Customer Service Center at 800-535-5560 to order this publication.

### Models

- RS-15-220
- RS-17-220 and 224
- RS-19-220 and 224
- RS-21-230
- RS-23-240

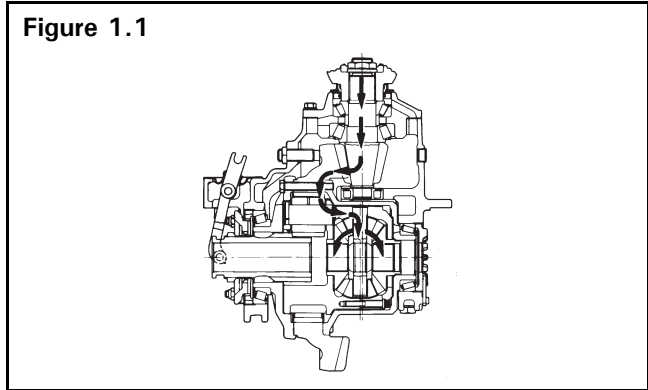
The differentials are two-speed drive units with planetary gear ratios that possess the following characteristics:

1. Generoid system ring gear and pinion
2. Pinion with its spindle resting on two tapered roller bearings that absorb the axial and radial loads and a roller bearing on the pilot head that absorbs the radial loads
3. Differential carrier and ring gear assembly mounted on tapered roller bearings
4. Side and pinion gears with tapered straight teeth
5. The second ratio has a planetary system of straight teeth located under a hypoid ring gear.

### First Gear Ratio — High Speed

At high speed the sun gear engages with the case half and blocks the operation of the planetary system gears. With the planetary reducer blocked, the tractive force is transmitted directly to the differential gear. Therefore, the tractive unit will work as a single reduction drive system, allowing the vehicle to develop higher speeds. **Figure 1.1.**

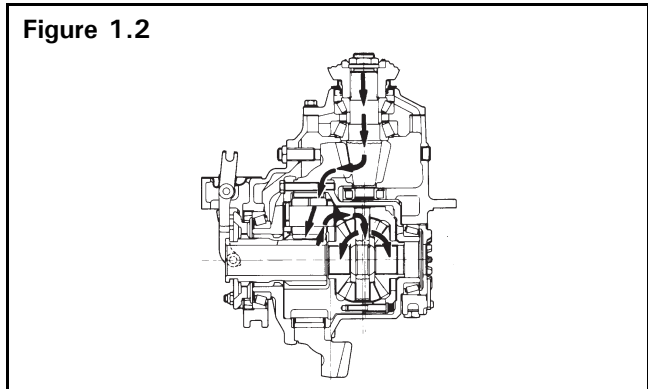
Figure 1.1



### Second Gear Ratio — Low Speed

At low speed the sun gear engages with the lock plate. The speed shift command is activated by an electric, pneumatic or vacuum mechanism, installed in the differential and actuated from the vehicle's cab. When the control is activated, the sun gear changes from its previous position and engages in the lock plate, freeing the planetary system gears. Therefore, the tractive unit will work as a double reduction drive system, allowing the vehicle to develop higher tractive capability. **Figure 1.2.**

Figure 1.2



## WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Disassembly

Before starting service operations, identify the unit to be serviced, referring to the identification plates located on the housing and the carrier.

## Remove the Axle Shafts

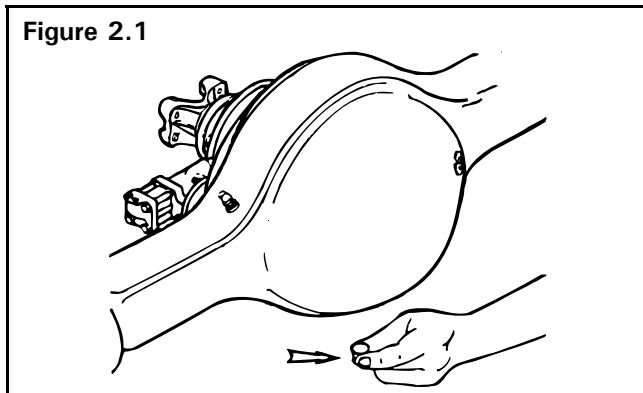
1. Raise the end of vehicle where the axle is mounted. Use a jack or other lifting tool and place safety stands under each side of the axle.

## WARNING

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

2. Disconnect the driveline universal joint from the pinion input yoke or flange on the carrier.
3. Place jack stands under each spring seat of the axle to hold vehicle in the raised position.
4. Remove the plug from the bottom of the axle housing and drain the axle lubricant from the housing assembly. **Figure 2.1.**
5. Loosen the nuts, lock and tapered washers from the studs that hold the axle shafts.

Figure 2.1



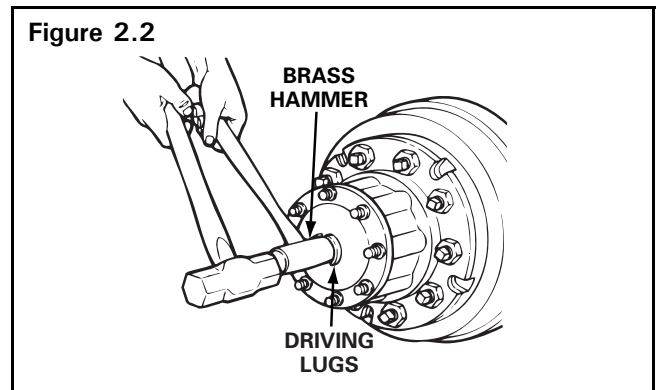
## Brass Drift Method

## WARNING

Do not strike the round driving lugs on the flange of an axle shaft. Pieces can break off and cause serious personal injury.

1. Hold a 1-1/2-inch diameter brass drift against the center of the axle shaft, inside the round driving lugs. **Figure 2.2.**

Figure 2.2



2. Strike the end of the drift with a large hammer (five to six pounds) and the axle shaft and tapered dowels will loosen. You can use a 1-1/2-inch diameter brass hammer.
3. Mark to identify each axle shaft before it is removed from the axle assembly.

## Section 2 Disassembly



4. Remove the tapered dowels and separate the axle shafts from the main axle hub assembly. **Figures 2.3 and 2.4.**
5. Install a cover over the open end of each axle assembly hub where an axle shaft was removed.

Figure 2.3

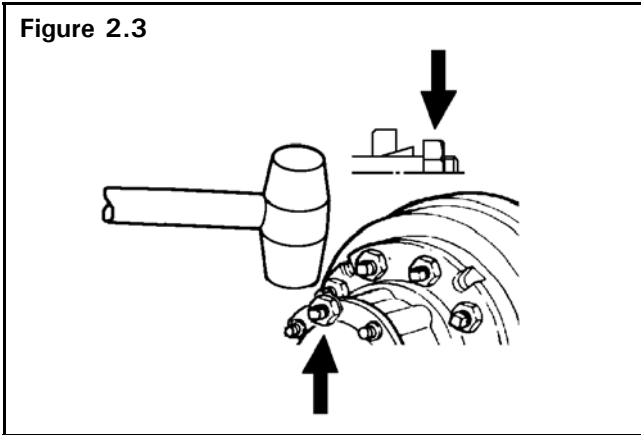
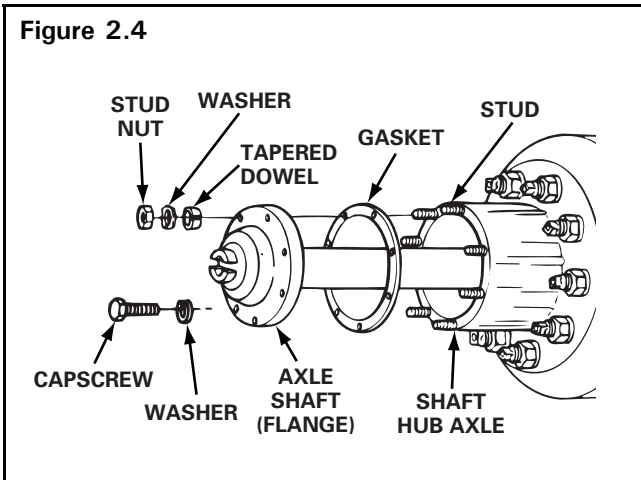


Figure 2.4



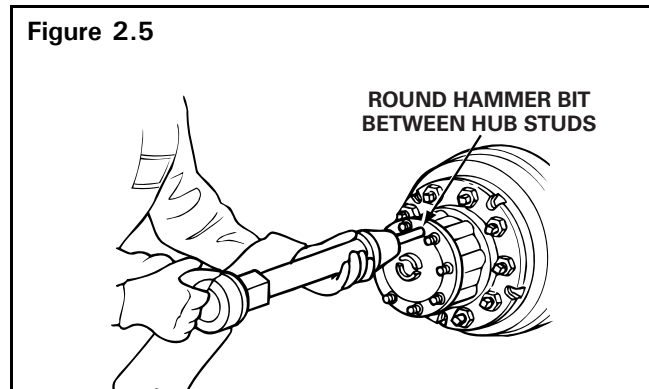
### Air Hammer Vibration Method

#### CAUTION

Do not use a chisel or wedge to loosen the axle shaft and tapered dowels. Damage to the axle shaft, the gasket and seal, and the axle hub can result.

1. Use a round hammer bit and an air hammer such as Chicago Pneumatic CP-4181-Puler, or equivalent, to loosen tapered dowels and axle shaft.
2. Place the round hammer bit against the axle shaft (flange) between the hub studs. Operate the air hammer at alternate locations between the studs to loosen the tapered dowels and axle shaft from the hub. **Figure 2.5.**

Figure 2.5



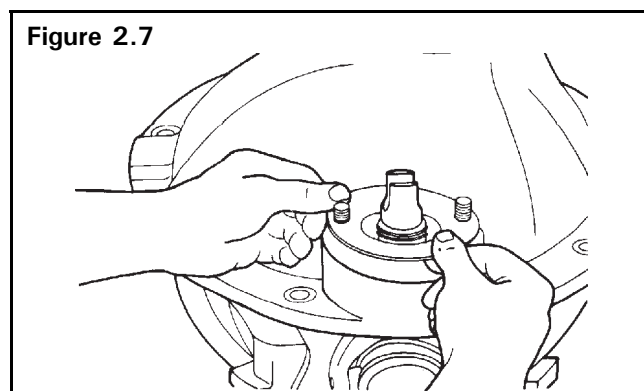
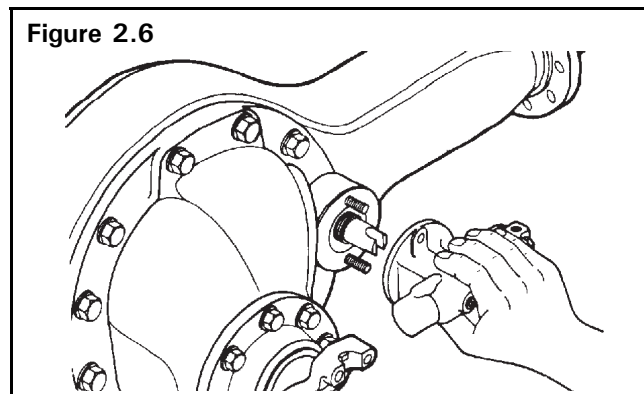
3. Mark to identify each axle shaft before it is removed from the axle assembly.
4. Remove the tapered dowels and separate the axle shaft from the main axle hub assembly. **Figure 2.4.**



### Disassemble the Gear Shift Mechanism

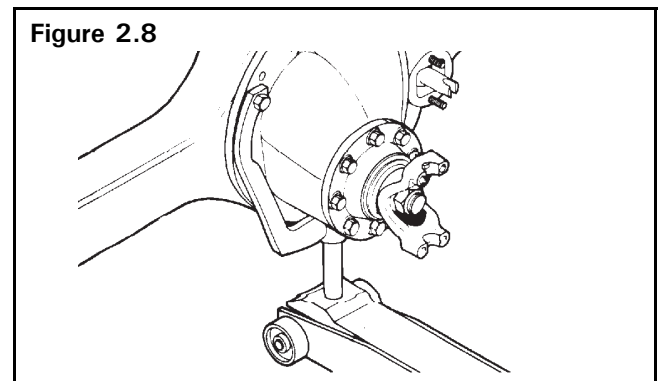
**NOTE:** Disassembly may be tight because of residual tension in the gear shift mechanism. This is a normal occurrence.

1. Uncouple the mechanism's actuation line.
2. Remove the nuts and washers from the gear shift mechanism fasteners.
3. Remove the gear shift mechanism. **Figure 2.6.**
4. If there is a diaphragm installed, remove it manually. If replacement is necessary, separate the diaphragm from the retention spring. **Figure 2.7.**



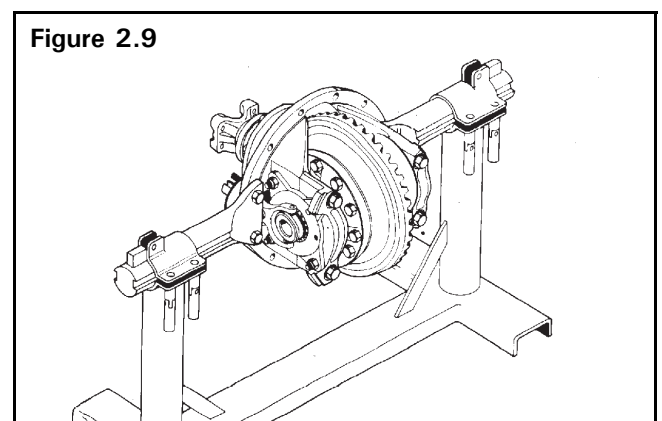
### Remove the Carrier from the Axle

1. Manually remove the gear shift mechanism (in the opposite direction to the differential) until it is in the low speed position (LS). This operation tends to eliminate the interference between the sun gear and the mouth of the housing, helping to make the disassembly of the differential easier.
2. Remove the nuts and washers from the differential fastening studs and screws.
3. Disassemble the differential from the housing using appropriate devices and a hydraulic jack. **Figure 2.8.**



**NOTE:** You can use the bolts that secure the carrier to remove the flange from the carrier, if necessary. There are two threaded holes for Model 220, and three threaded holes for Models 230 and 240.

4. To remove the carrier from the gasket, strike it firmly with a plastic mallet, if necessary.
5. Place the carrier in a repair stand. **Figures 2.9 and 2.10.**

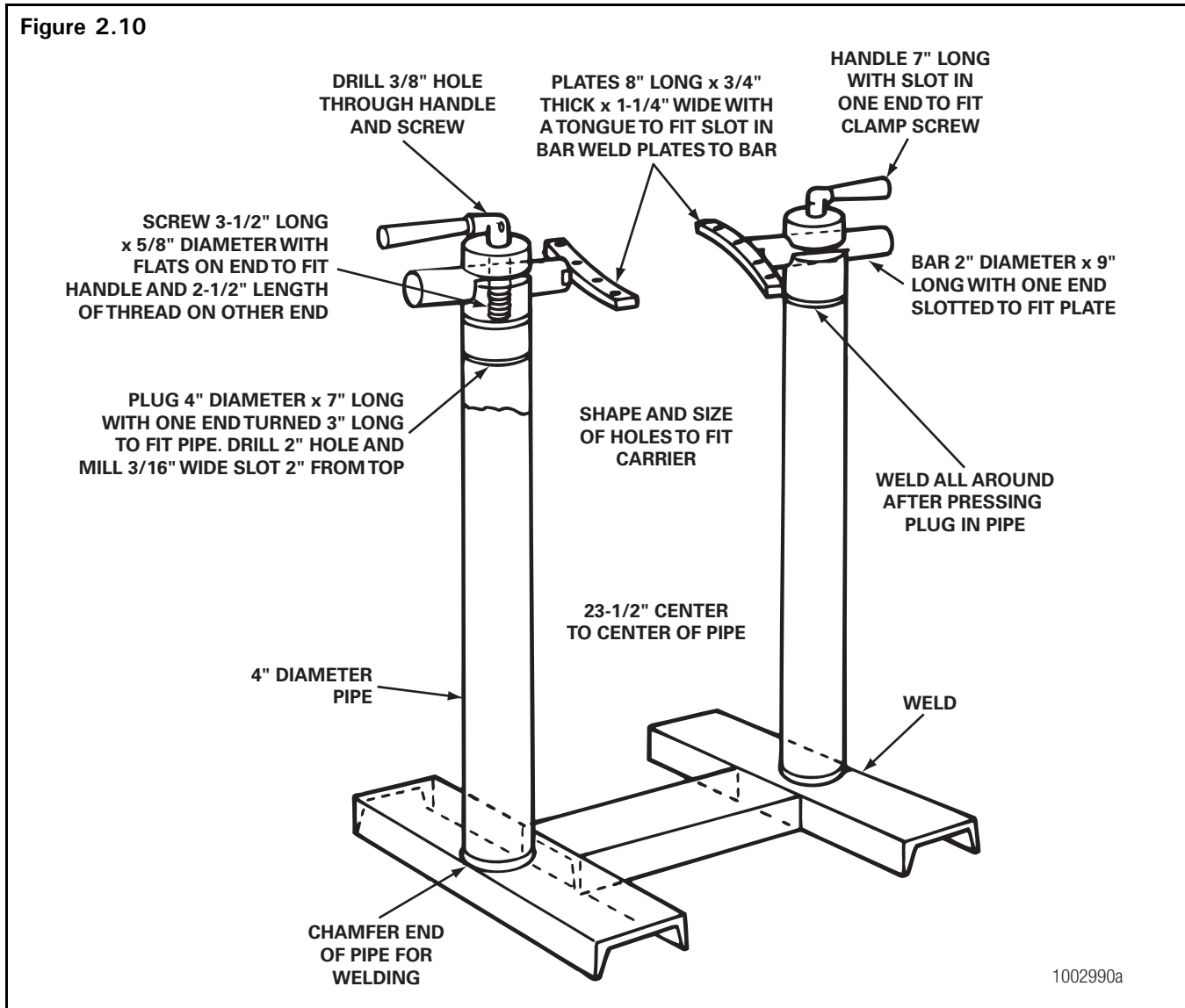


## Section 2 Disassembly



A carrier stand, part number J 3409-D, is available from SPX Kent-Moore, 28635 Mound Road, Warren, MI 48092-3499.

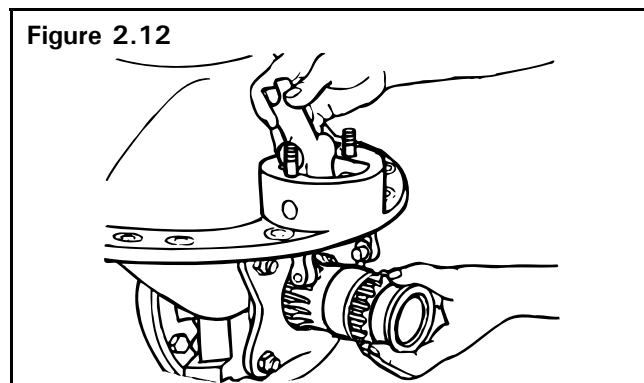
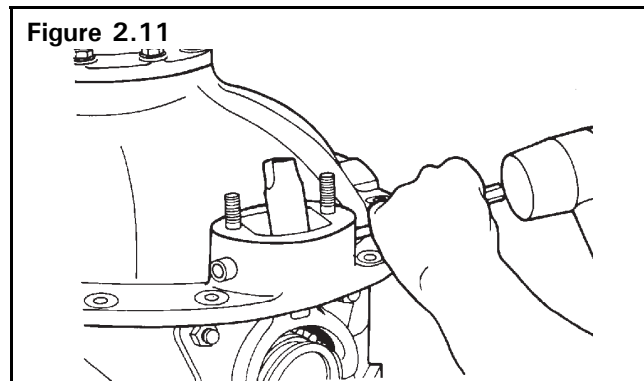
Figure 2.10



**Remove the Differential and Ring Gear  
from the Carrier** **WARNING**

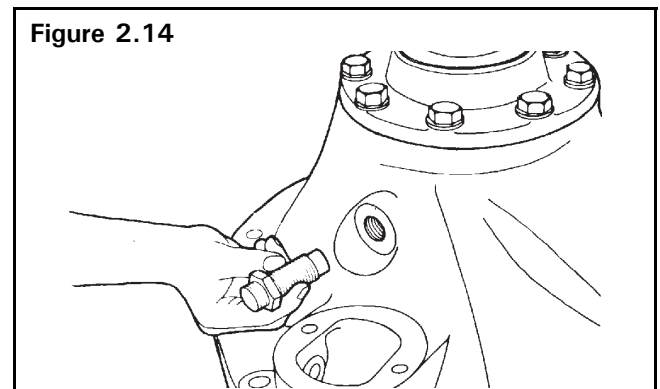
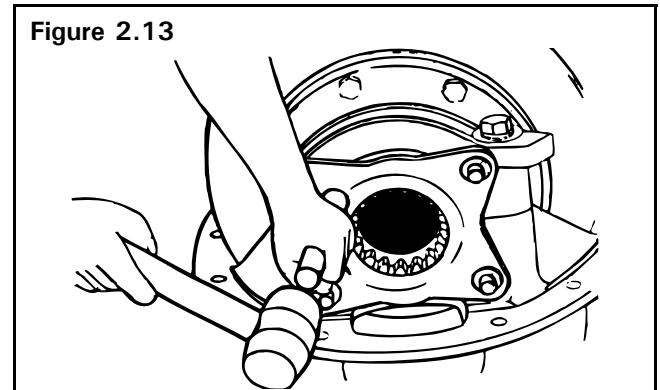
Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

1. Hit the plugs and the bolt of the selector command using a brass drift punch and a plastic mallet. **Figure 2.11.**
2. Remove the bolts from the top of the carrier.
3. Simultaneously remove the selector and the sun gear. **Figure 2.12.** If necessary, rotate the sun gear to facilitate its removal.
4. Remove the clutch plate fasteners. Remove the clutch plate.

 **CAUTION**

Do not strike the plate directly or insert wedges or chisels between the plate and the differential carrier. Damage to components can result. **Figure 2.13.**

5. Remove the ring gear adjustment thrust screw and jam nut. **Figure 2.14.**

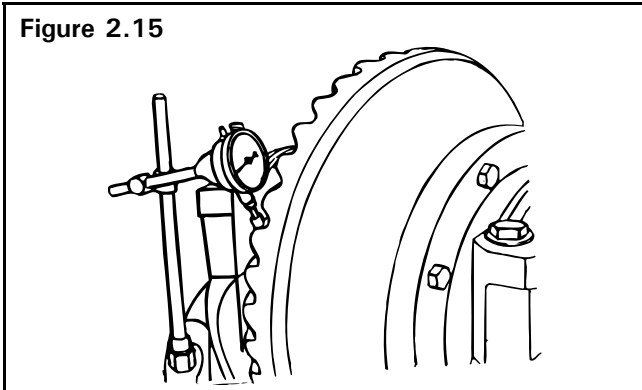


## Section 2 Disassembly

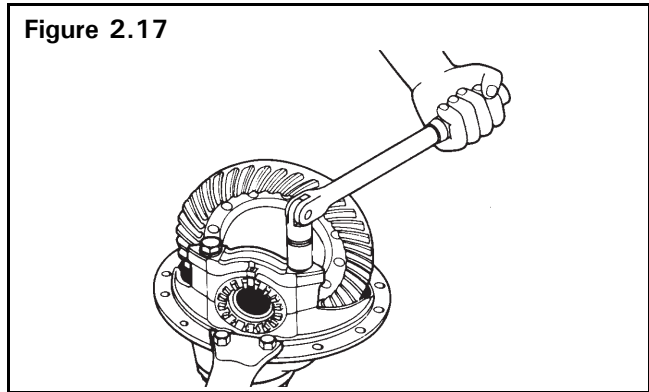


6. Clean oil from the ring gear and pinion teeth. Dry the parts immediately. Refer to Section 3 for procedures
7. Measure and note the ring gear backlash. Refer to the Check Hypoid Gear Set Backlash in Section 8. **Figure 2.15.**

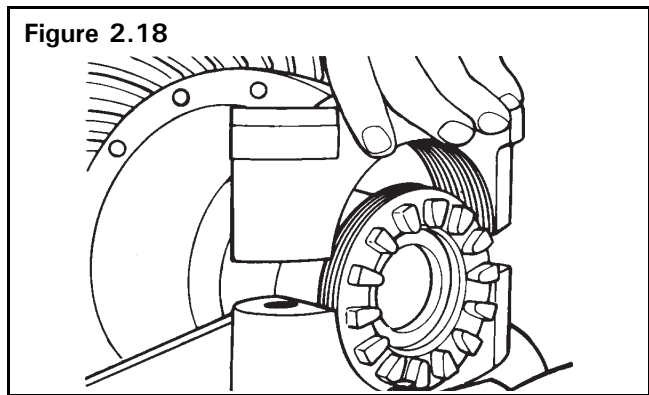
**Figure 2.15**



**Figure 2.17**

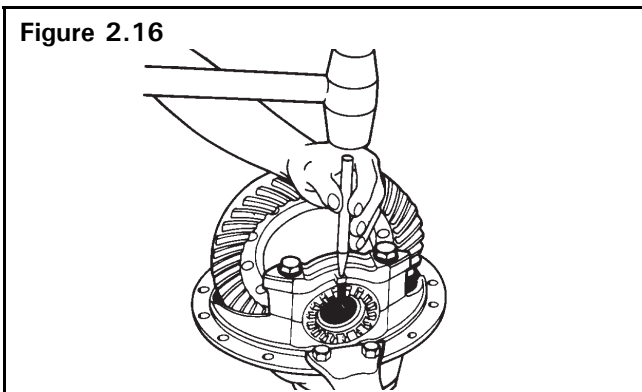


**Figure 2.18**

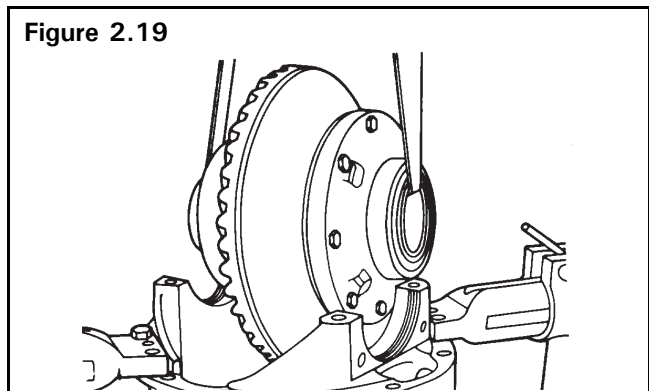


8. Remove the cotter key from the right side adjustment nut. **Figure 2.16.**
9. Remove the capscrews and washers that hold the bearing caps on the carrier. **Figure 2.17.**
10. Manually remove the caps and the adjustment nuts. If necessary, strike the caps gently with a plastic mallet. **Figure 2.18.**
11. Remove the carrier. **Figure 2.19.**

**Figure 2.16**



**Figure 2.19**



### Disassemble the Differential and Ring Gear Assembly

1. Remove the capscrews that hold the case halves together. **Figure 2.20.**
2. Separate the flange case half from the ring gear using an appropriate puller. **Figure 2.21.**
3. Disassemble the case halves and the thrust washer using an appropriate hook. **Figure 2.22.**
4. Separate the ring gear from the plain half of the case to replace some of the parts, if necessary.

 **WARNING**

Observe all warnings and cautions provided by the tool manufacturer to avoid serious personal injury and damage to components.

5. If necessary, remove the bearing cones from the case halves, using an appropriate puller or a press. **Figures 2.23 and 2.24.**
6. Mark the two halves of the case and the spider so that the original position is identified when reassembled. **Figure 2.25.**

Figure 2.20

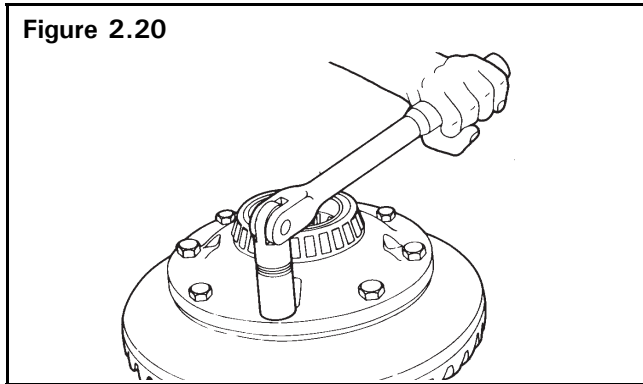


Figure 2.21

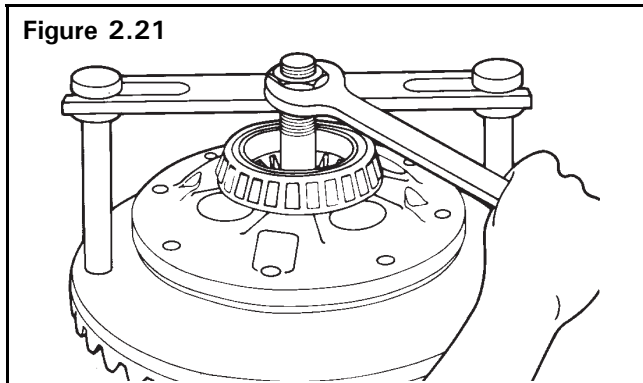


Figure 2.22

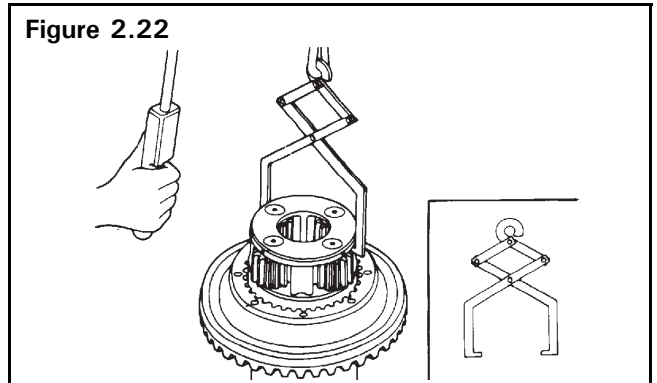


Figure 2.23

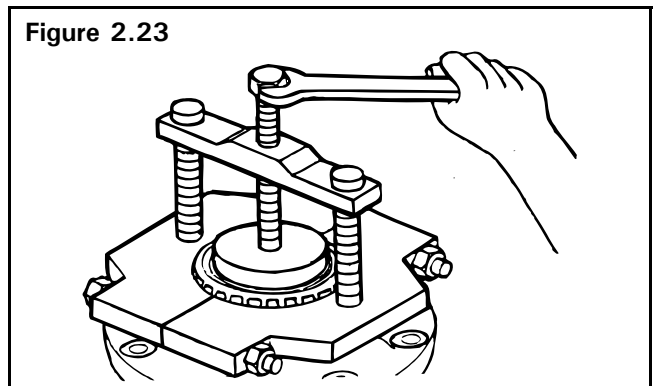


Figure 2.24

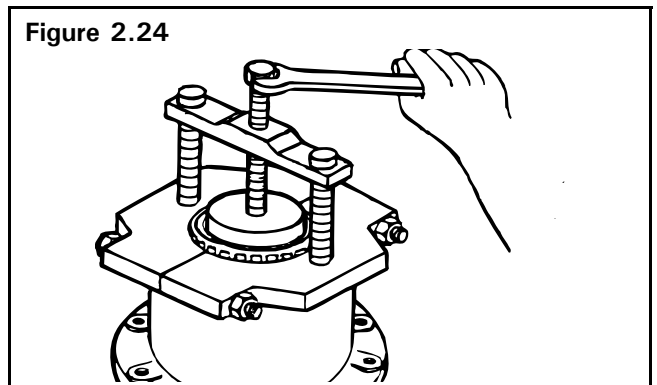
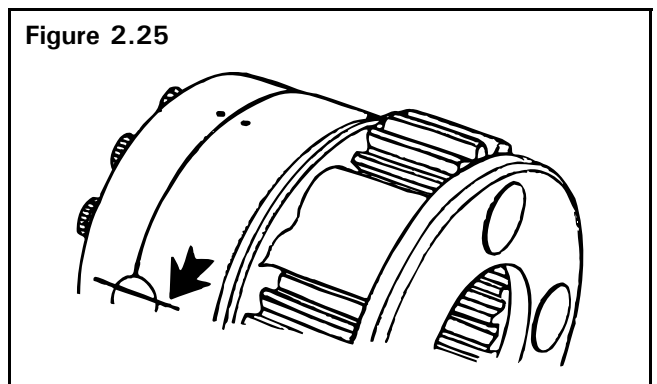


Figure 2.25

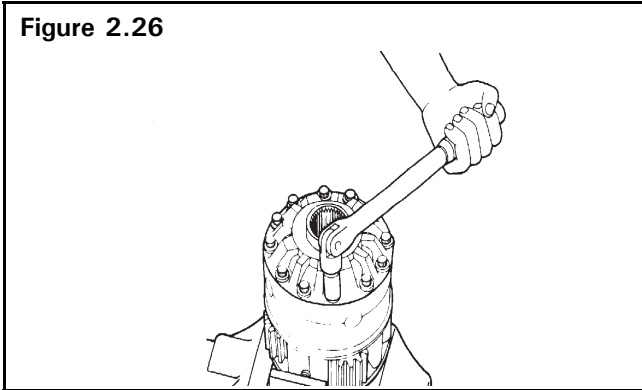


## Section 2 Disassembly

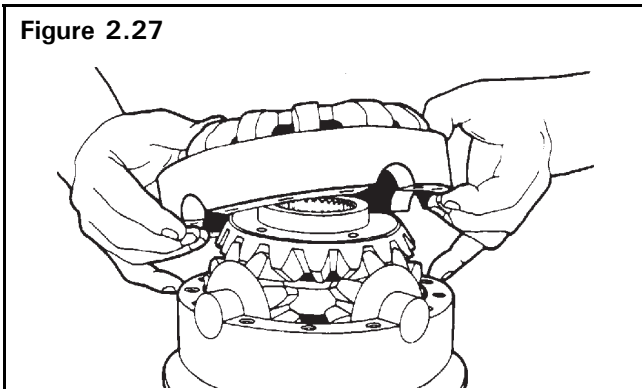


7. Using a vise, secure the case. Remove the fasteners. **Figure 2.26.**
8. Separate the case halves. Remove the internal components in the sequence specified in **Figures 2.27, 2.28, 2.29 and 2.30.** To disassemble the case, use a press or a hammer and a brass bar, making contact with the inner surface of the case.

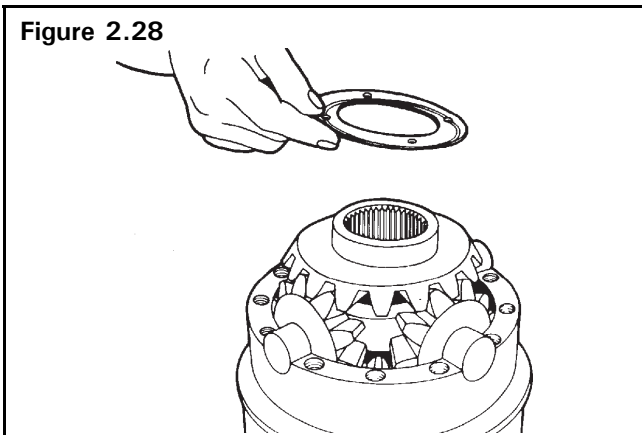
**Figure 2.26**



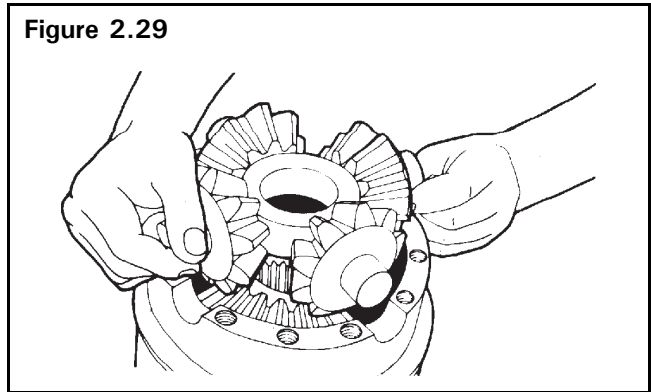
**Figure 2.27**



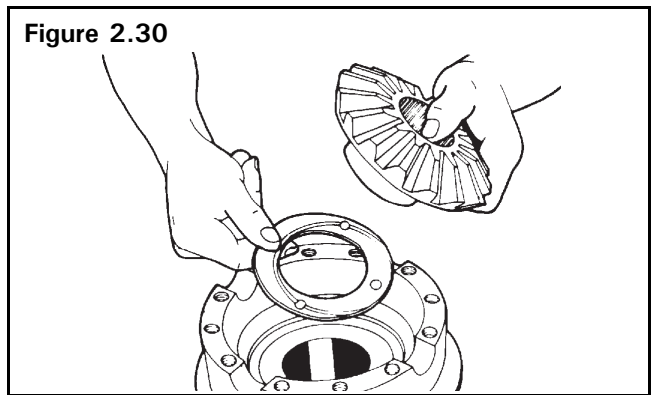
**Figure 2.28**



**Figure 2.29**

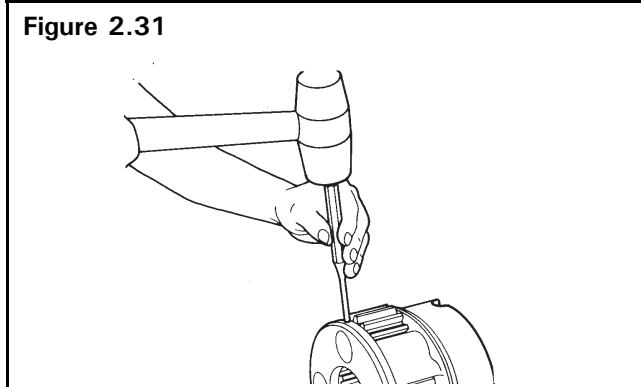


**Figure 2.30**

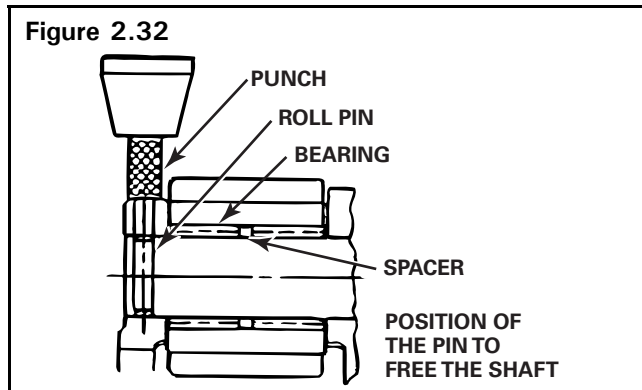


9. Lower the case from the tool.
10. Mark the side gear shafts and the case before disassembly so that the original position of the parts is kept when reassembling.
11. Using a hammer and a punch, lightly tap the pin towards the inside of the gear enough to free the shaft for removal. **Figures 2.31 and 2.32.**

**Figure 2.31**

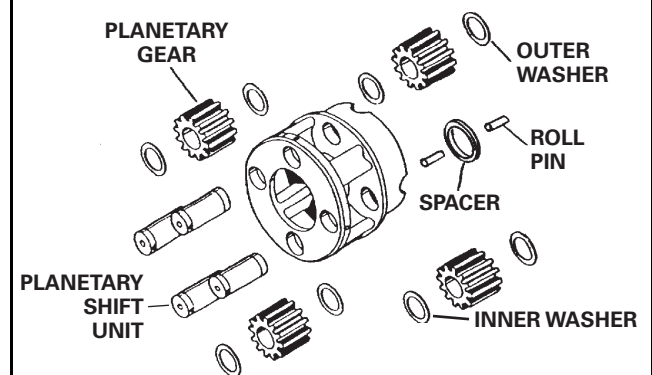


**Figure 2.32**



12. Be careful when punching the pins. The hole is blind and the end of the pin could scuff the side gear case. The burrs could damage the shaft bore during the disassembly.
13. Remove the shafts.
14. Remove the side gears carefully without loosening and mixing the bearings.
15. Remove the inner and outer washers. **Figure 2.33.**
16. Place the bearings and spacers in plastic bags.

**Figure 2.33**



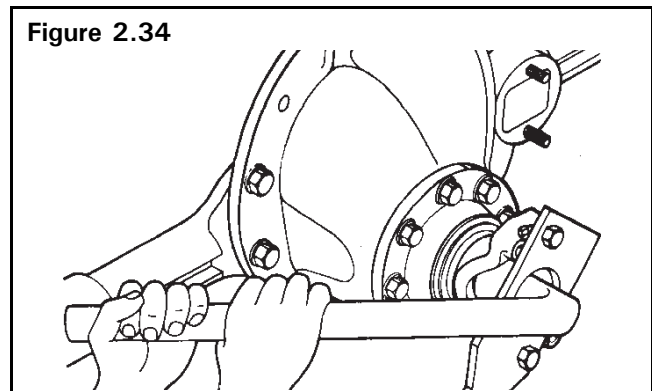
### Remove the Drive Pinion and Bearing Cage from the Carrier

#### CAUTION

Do not use a hammer or mallet to loosen and remove the yoke or flange, which can damage parts. Driveline runout and driveline imbalance can also occur after assembly.

1. Secure the yoke with an appropriate yoke bar and loosen the pinion nut. **Figure 2.34.**

**Figure 2.34**

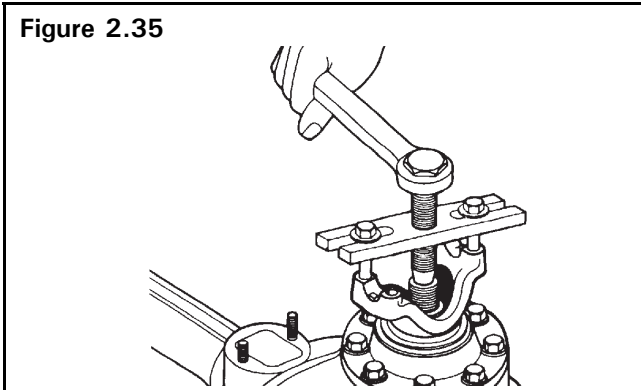


## Section 2 Disassembly



2. Remove the yoke using an appropriate yoke puller. **Figure 2.35.**

Figure 2.35

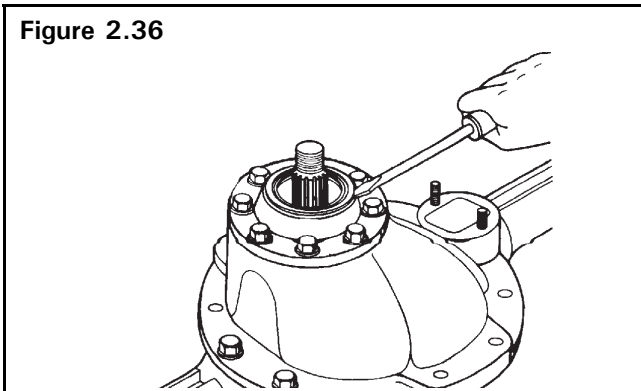


### CAUTION

Do not use a hammer to remove the pinion oil seal. Damage to the bearing case, shims or carrier can result.

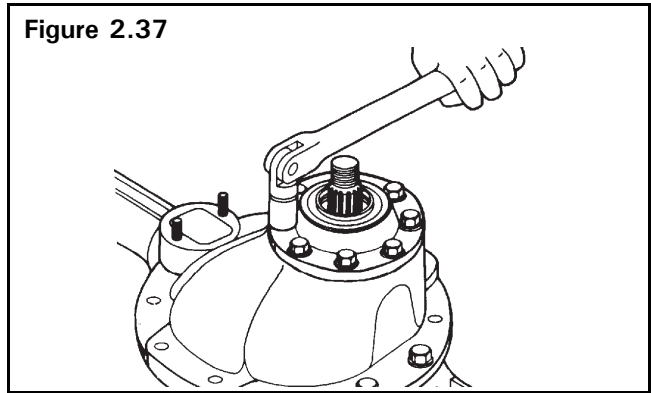
3. Remove and separate the pinion oil seal by inserting a screwdriver between the seal's flange and the pinion case and levering at various points so as to expel the seal gradually without damaging the pinion case. **Figure 2.36.**

Figure 2.36



4. Remove the pinion case fastening screws and washers. **Figure 2.37.**

Figure 2.37



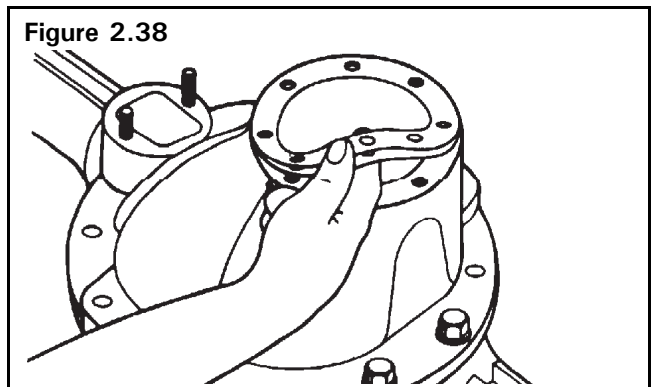
### CAUTION

Do not insert wedges or chisels between the pinion and differential cases. Damage to components can result.

5. Separate and tie the pinion case adjusting shims to maintain their original position for reassembly, if you will reuse the shims. **Figure 2.38.**

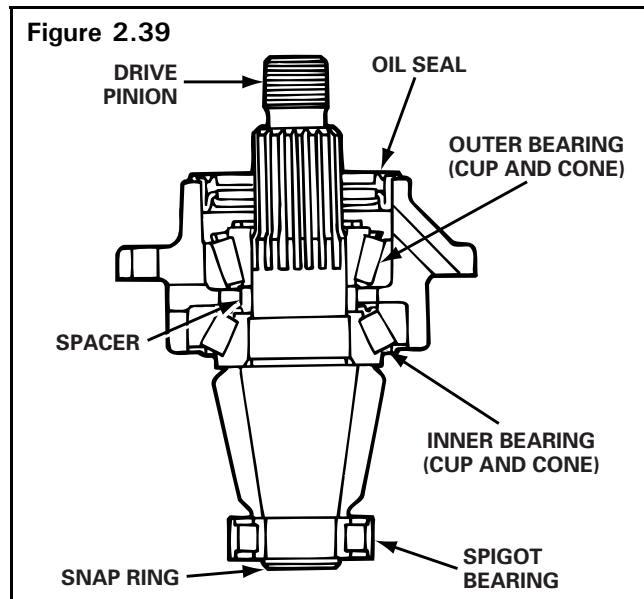
- **If shims are to be discarded because of damage:** Measure the total thickness of the pack. Note the dimension. The dimension is needed to calculate the depth of the drive pinion in the carrier when the gear set is installed.

Figure 2.38





## Disassemble the Drive Pinion and Bearing Cage



**WARNING**

Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

1. Place the drive pinion and bearing cage in a press. The pinion shaft must be toward the top of the assembly. **Figure 2.40.**
2. Support the bearing cage under the flange area with metal or wood blocks. **Figure 2.40.**
3. Press the drive pinion through the bearing cage. **Figure 2.40.**

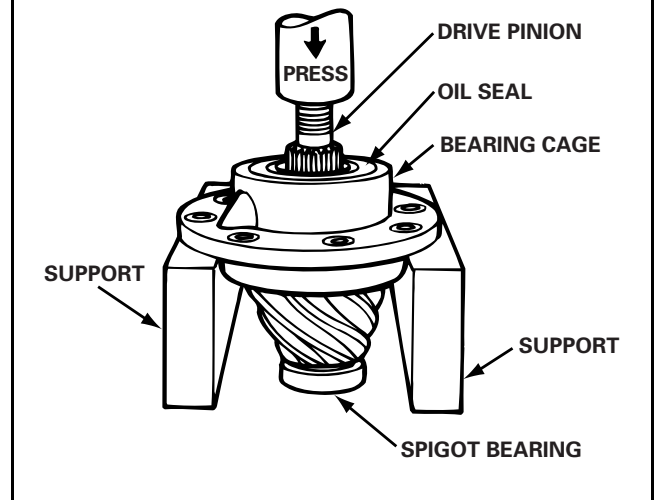
**WARNING**

Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

**NOTE:** The inner bearing cone and bearing spacer will remain on the pinion shaft.

4. If a press is not available, use a leather, plastic or rubber mallet to drive the pinion through the bearing cage.

**Figure 2.40**



5. Use a press and a sleeve to remove the triple-lip or unitized oil seal from the bearing cage.

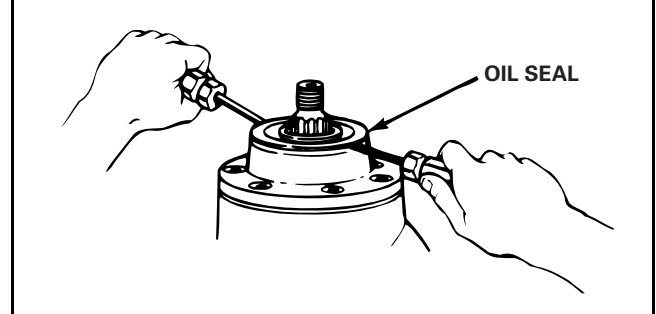
- If a press is not available: Place a tool with a flat blade under the flange to remove the oil seal from the cage. **Figure 2.41.**

**CAUTION**

Be careful when removing the seal. Do not damage the wall of bore, which can cause the seal to leak. Damage to components can result.

6. When the oil seal has been removed, always replace it with a new seal during component reassembly.

**Figure 2.41**



## Section 2 Disassembly



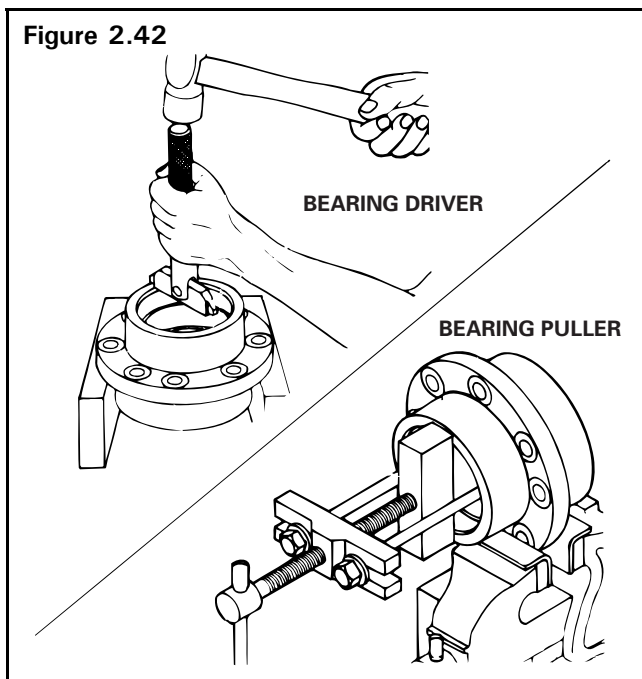
### WARNING

Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

7. If you need to replace the pinion bearings, remove the inner and outer bearing cups from the inside of cage. Use a press and sleeve, bearing puller or a small drift hammer. The type of tool used depends on the design of the bearing cage. **Figure 2.42.**

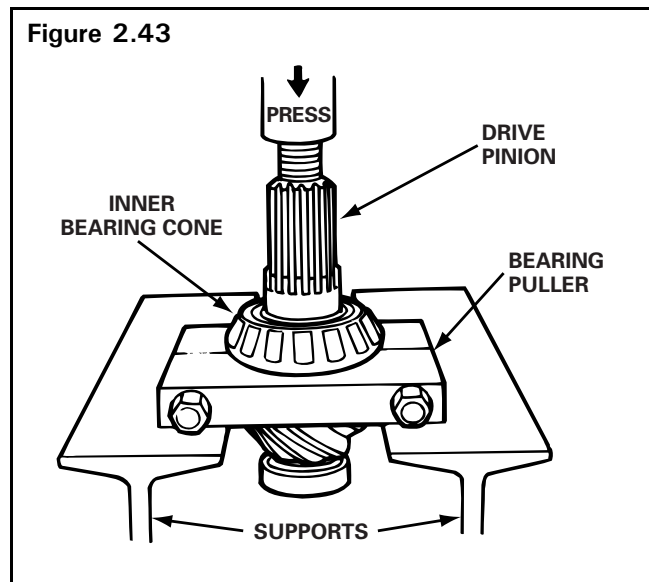
- If you use a press: Support the bearing cage under the flange area with metal or wood blocks.

Figure 2.42



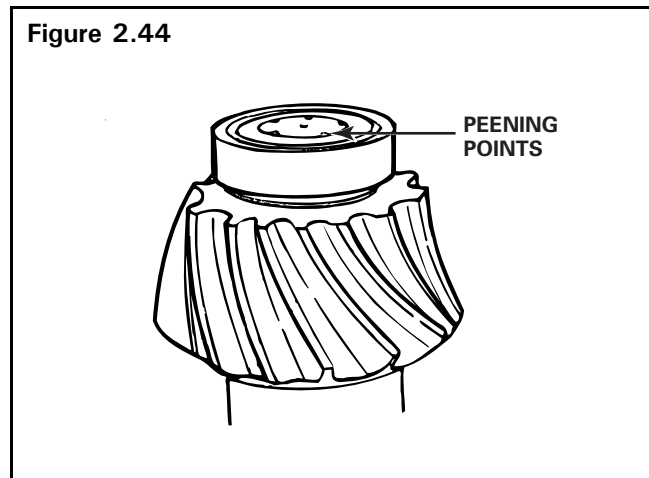
8. If you need to replace the pinion bearings, remove the inner bearing cone from the drive pinion with a press or bearing puller. The puller **MUST** fit under the inner race of the cone to remove the cone correctly without damage. **Figure 2.43.**

Figure 2.43

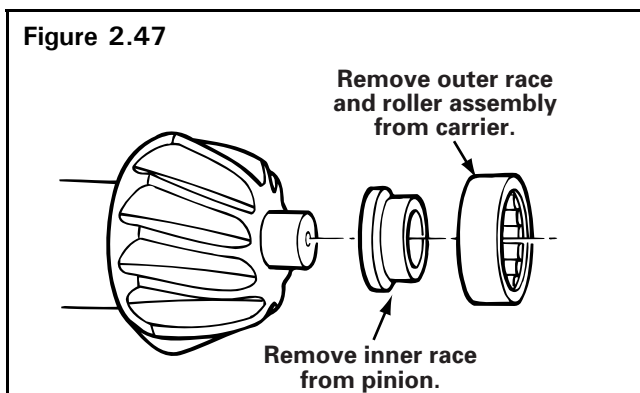
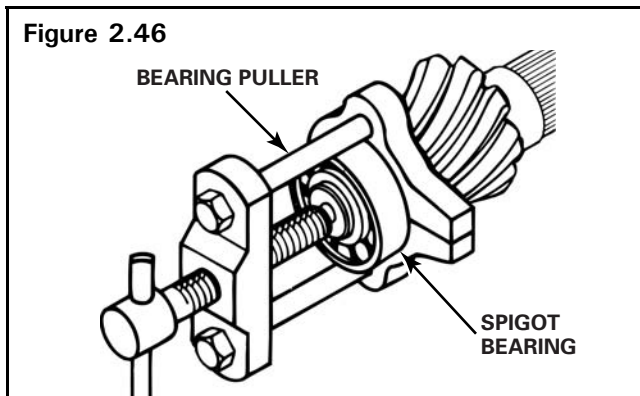
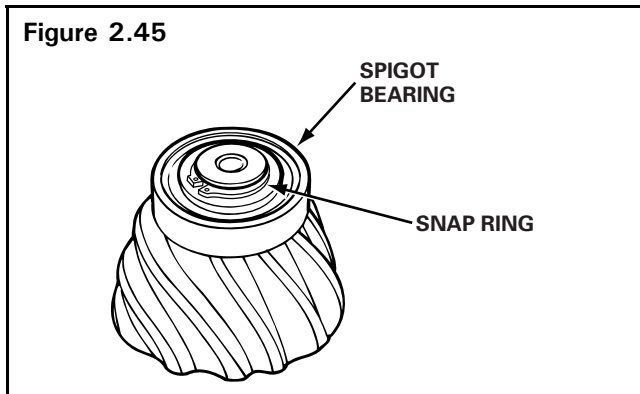


9. If you need to replace the spigot bearing, place the drive pinion in a vise. Install a soft metal cover over each vise jaw to protect the drive pinion. Some spigot bearings are fastened to the drive pinion with a special peening tool. **Figure 2.44.**

Figure 2.44



10. Remove the snap ring (if applicable) from the end of drive pinion with snap ring pliers that expand. **Figure 2.45.**
11. Remove the spigot bearing from the drive pinion with a bearing puller. **Figure 2.46.**
12. If equipped with a two-piece spigot bearing, remove the inner race from the pinion using a bearing puller.
13. Remove the outer race/roller assembly from the carrier using a drift or a press. **Figure 2.47.**



## Section 3

# Prepare Parts for Assembly



### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Clean Parts

### Ground and Polished Parts

1. Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used for this purpose. **DO NOT USE GASOLINE.**

### WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners. To avoid serious personal injury when you use solvent cleaners, you must carefully follow the manufacturer's product instructions and these procedures:

- Wear safe eye protection.
  - Wear clothing that protects your skin.
  - Work in a well-ventilated area.
  - Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.
  - You must use hot solution tanks or alkaline solutions correctly. Follow the manufacturer's instructions carefully.
2. Use a tool with a flat blade, if required, to remove sealant material from parts. Be careful not to damage the polished or smooth surfaces.

### CAUTION

Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts will result.

3. **DO NOT** clean ground or polished parts with water or steam. Do not immerse ground or polished parts in a hot solution tank or use strong alkaline solutions for cleaning, or the smooth sealing surface may be damaged.

## Rough Parts

1. Clean rough parts with the same method as cleaning ground and polished parts.
2. Rough parts can be cleaned in hot solution tanks with a weak or diluted alkaline solution.
3. Parts must remain in hot solution tanks until heated and completely cleaned.

### WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners and petroleum-based cleaners. To avoid serious personal injury when you use solvent cleaners, you must carefully follow the manufacturer's product instructions and these procedures:

- Wear safe eye protection.
  - Wear clothing that protects your skin.
  - Work in a well-ventilated area.
  - Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.
  - You must use hot solution tanks or alkaline solutions correctly. Follow the manufacturer's instructions carefully.
4. Parts must be washed with water until all traces of the alkaline solution are removed.

## Axle Assembly

1. A complete axle assembly can be steam cleaned on the outside to remove dirt.
2. Before the axle is steam cleaned, close or place a cover over all openings in the axle assembly. Examples of openings are breathers or vents in air chambers.

## Breather

### CAUTION

Clogged breathers can cause the internal pressure of the unit to increase, causing oil to leak out of the seals.

Clean the breather carefully (with compressed air). Replace it if it is damaged.

### Dry Parts After Cleaning

1. Parts must be dried immediately after cleaning and washing.
2. Dry the parts using soft, clean paper or cloth rags.

#### CAUTION

**Damage to bearings can result when they are rotated and dried with compressed air.**

3. Except for bearings, parts can be dried with compressed air.

### Prevent Corrosion on Cleaned Parts

1. Apply axle lubricant to cleaned and dried parts that are not damaged and are to be assembled.
2. To store parts, apply a special material that prevents corrosion to all surfaces. Wrap cleaned parts in a special paper that will protect the parts from moisture and prevent corrosion.

### Inspection

#### Wheel Bearings

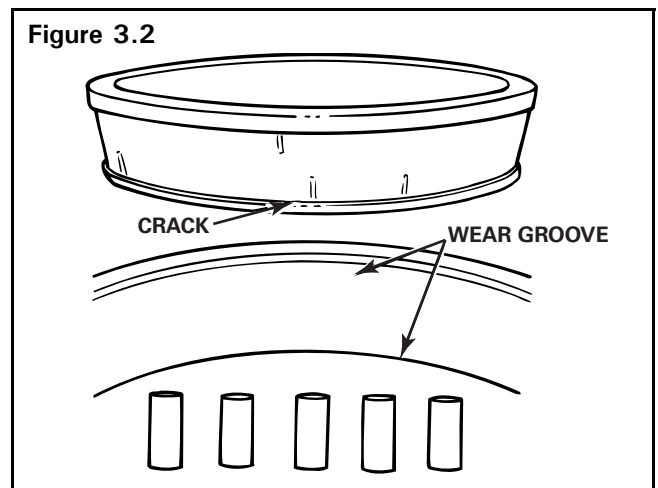
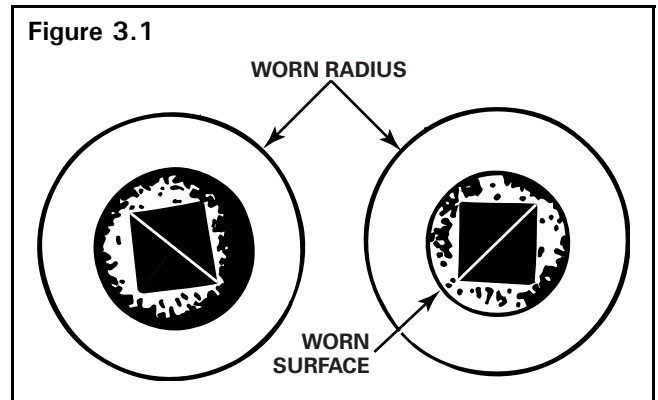
Inspect the wheel bearings when the hub is removed from the knuckle spindle.

Remove all lubricant from the bearings, knuckle, hub and hubcap.

Inspect the cup, the cone and the rollers and cage of all bearings. If any of the following conditions exist, you must replace the bearing.

1. The center of the large diameter end of the rollers is worn level or below the outer surface. **Figure 3.1.**

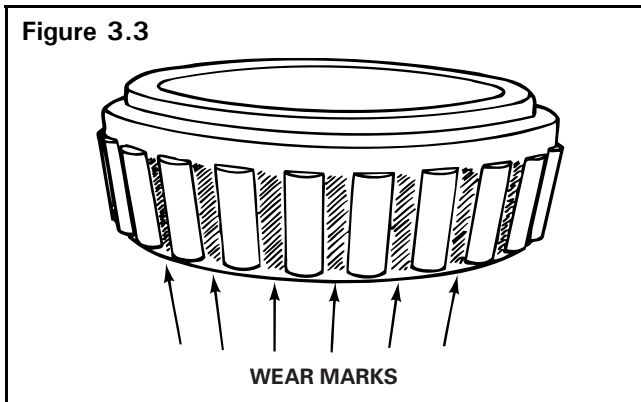
2. The radius at the large diameter end of the rollers is worn to a sharp edge. **Figure 3.1.**
  - A visible roller groove in the cup or the cone inner race surfaces. The groove can be seen at the small or large diameter end of both parts. **Figure 3.2.**
  - Deep cracks or breaks in the cup, the cone inner race or the roller surfaces. **Figure 3.2.**
  - Bright wear marks on the outer surface of the roller cage. **Figure 3.3.**
  - Damage on the rollers and on the surfaces of the cup and the cone inner race that touch the rollers. **Figure 3.4.**
  - Damage on the cup and the cone inner surfaces that touch the rollers. **Figure 3.5.**



## Section 3 Prepare Parts for Assembly



Figure 3.3

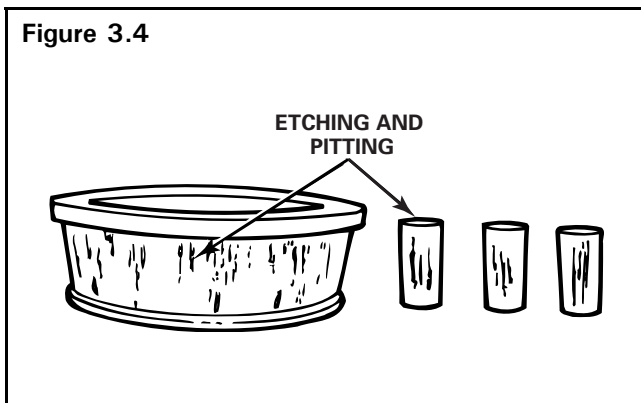


### Hypoid Generoid Ring Gear and Pinion

Inspect the ring gear and pinion assembly for wear or damage, such as cracks, depressions, scores and chips. Check the seats of the bearing cones and the splines of the pinion.

**NOTE:** The generoid hypoid drive pinions and ring gears are machined in matched sets to ensure the ideal position of tooth contact. When a damaged drive pinion or ring gear needs to be replaced, both drive gear and pinion must be replaced at the same time.

Figure 3.4

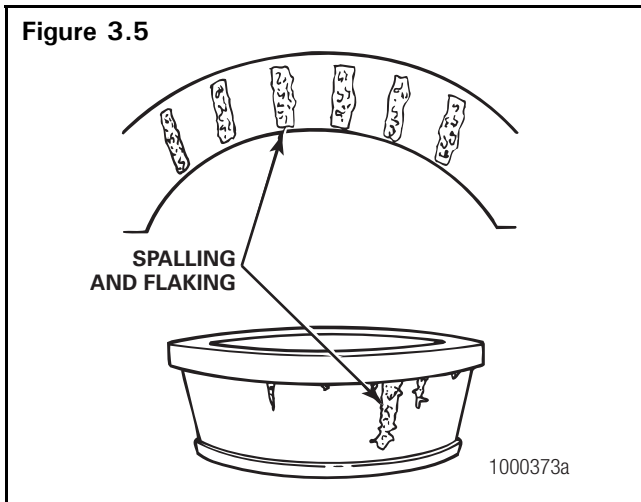


### Housing

Check the components of the differential system and replace the parts that present depressions, cracks, excessive out-of-roundness of bores and half rounds or major wear. Also inspect the work areas specified below.

1. Thrust washer seatings, half rounds for installing the arms of the spiders on both halves of the satellite case.
2. Side gear and pinion bearing surface.
3. Diameters of the trunnion ends of the spider.
4. Teeth and splines of the side gears.
5. Teeth and bore of all side pinions.

Figure 3.5



**NOTE:** If it is necessary to replace a pinion or side gear, the whole set should be replaced, including the thrust washers. A combination of new and used parts could cause premature failure of the assembly.

### Planetary System

1. Inspect the diameters and the teeth of the side and sun gears and the straight ring gear teeth for wear and damage. Those that have cracks, depressions, scoring or chipping must be replaced.
2. Inspect the bearing surface of the side gear thrust washers. If any of them show excessive wear or grooves, replace them all.
3. Inspect the bearing rollers and the spacers.

4. Check the mounting surface for the side gear shafts in the case halves. Check that the bores are free of burrs at both ends.
5. Inspect the diameters of the side gear shafts. If any should show signs of wear, grooves, depressions, etc., replace them all.
6. Check the speed selector and teeth synchronization at low speed (lock plate and sun gear). Replace the parts that show signs of excessive wear or are marked or grooved.

### **Axle Shafts**

Check for notches and excessive wear of the splines and for out-of-roundness of the flange bores.

### **Case**

Check for cracks on any surface or burrs on the machined parts.

### **Yoke**

Replace the yoke if it shows excessive wear in the retainer area.

### **Carrier**

Check for signs of cracks, loose studs, burrs or grooves on the machined surfaces.

### **Storage**

After the parts have been cleaned, dried and inspected, they must be assembled immediately or covered with a film of oil as specified in Section 6 for the purpose of preventing oxidation.

The parts that are to be stored or packed must be covered with a coating of oil or any antioxidant and kept in closed boxes or wrapped for protection from dust, moisture or rust (except for components already protected by paint, etc.).

## Section 4 Adhesives



### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Adhesives

### Installing Fasteners with Pre-Applied Adhesive, Meritor Liquid Adhesive 2297-C-7049, Loctite® 680 Liquid Adhesive or Equivalent

#### Installing New Fasteners with Pre-Applied Adhesive Patches

1. Clean the oil and dirt from threaded holes. Use a wire brush. There is no other special cleaning required.

### CAUTION

Do not apply adhesives or sealants on new fasteners with pre-applied adhesive patches or inside closed threaded holes. If other adhesives or sealants are used, the new adhesive will not function correctly.

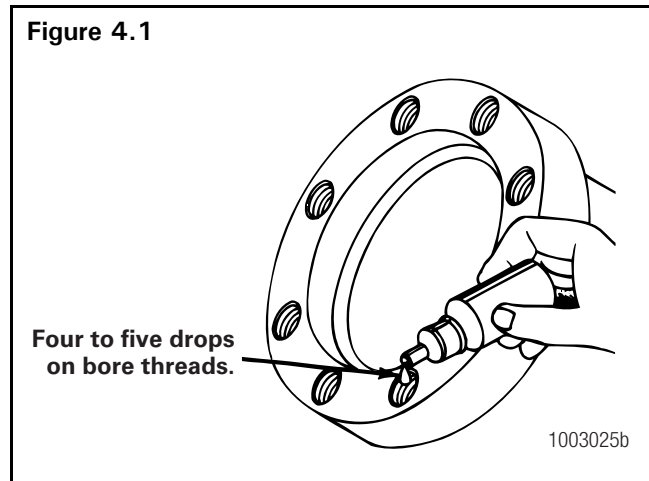
2. Assemble parts using the new pre-applied adhesive fasteners. There is no drying time required for fasteners with pre-applied adhesive.
3. Tighten the fasteners to the required torque value for that size fastener.

#### Installing Original or Used Fasteners Using Meritor Liquid Adhesive 2297-C-7049 or Loctite 680 or Equivalent

**NOTE:** There is no drying time required for Meritor Liquid Adhesive 2297-C-7049, Loctite 680 or equivalent.

1. Clean the oil, dirt and old adhesive from all threads and threaded holes. Use a wire brush.
2. Apply four or five drops of Meritor Liquid Adhesive, Loctite 680 or equivalent inside each threaded hole or bore ONLY. Make sure the adhesive is applied inside to the bore threads. **Figure 4.1.**

Figure 4.1



### CAUTION

Do not apply adhesive directly to the fastener threads. Air pressure in a closed hole will push the adhesive out and away from mating surfaces as the fastener is installed.

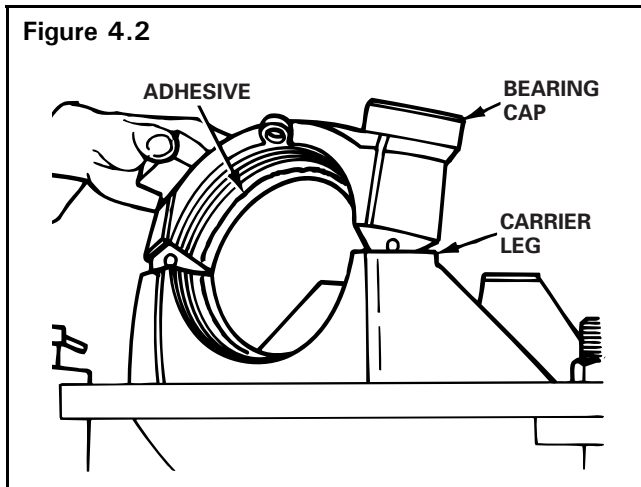
3. Tighten the fasteners to the required torque value for that size fastener.

#### Application of Meritor Adhesive 2297-T-4180 in Bearing Bores for the Differential

1. Use adhesive 2297-T-4180 for all axles.
2. Clean the oil and dirt from outer diameters of bearing cups and bearing bores in the carrier and bearing caps. There is no special cleaning required.
3. Apply axle lubricant to the bearing cones and the inner diameters of the bearing cups of the main differential. DO NOT get oil on the outer diameter of the bearing cup and DO NOT permit oil to drip on the bearing bores.
4. Apply a single continuous bead of the adhesive to the bearing bores in the carrier and bearing caps. Apply the adhesive 360° around the smooth, ground surfaces only. Do not place adhesive on threaded areas. **Figure 4.2.**



Figure 4.2



**NOTE:** Meritor adhesive 2297-T-4180 will become hard (dry) in approximately two hours. The following two steps of the procedure must be done in two hours from the time the adhesive was applied. If two hours have passed since application, clean the adhesive from the parts again and apply new adhesive.

5. Install the main differential assembly, bearing cups and bearing caps into the carrier. Use the normal procedure.
6. Adjust preload of the differential bearings, backlash and tooth contact patterns of the gear set as required using the normal procedures.

### Application of Three Bond 1216 or Equivalent Silicone Gasket Material

#### **WARNING**

When you apply some silicone gasket materials, small amounts of acid vapor are present. To prevent possible serious injury, the work area must be well ventilated. If the silicone gasket material gets into your eyes, flush them with water for 15 minutes. Have your eyes checked by a doctor as soon as possible.

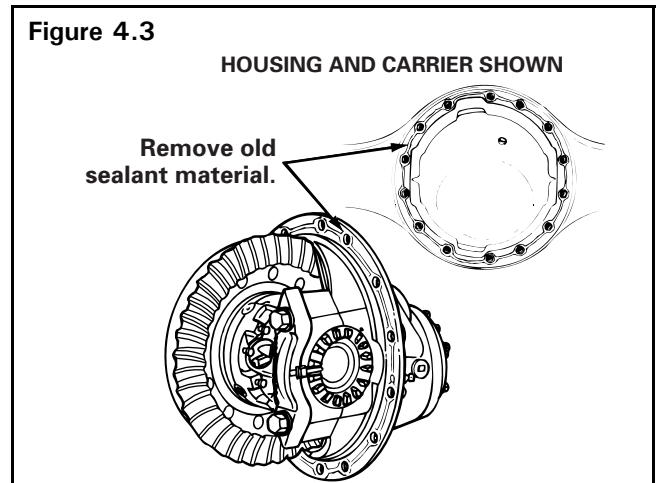
The following silicone gasket products or equivalent can be used for Meritor components:

- Three Bond Liquid Gasket No. TB 1216 (Grey)
- Loctite Ultra Grey Adhesive/Sealant #18581
- Meritor part number 2297-F-7052

1. Remove all old gasket material from both surfaces. **Figure 4.3.**

2. Clean the surfaces where silicone gasket material will be applied. Remove all oil, grease, dirt and moisture without damaging the mating surfaces. **Figure 4.3.**

Figure 4.3



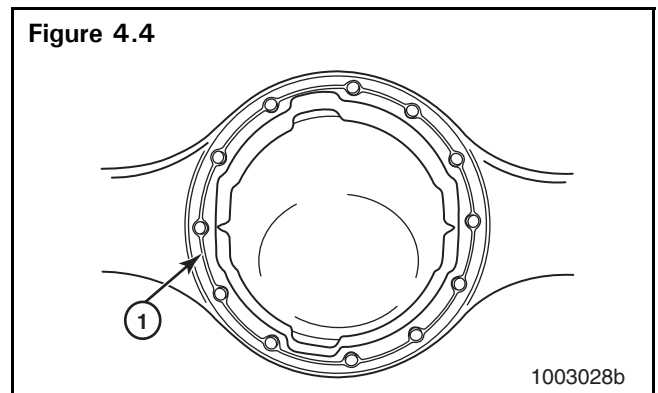
3. Dry both surfaces.

#### **CAUTION**

The amount of silicone gasket material applied must not exceed 0.125-inch (3 mm) diameter bead. Too much gasket material can block lubrication passages and result in damage to components.

4. Apply 0.125-inch (3 mm) diameter continuous bead of the silicone gasket material around one surface. Also apply the gasket material around the edge of all fastener holes on that surface. **Figure 4.4.**

Figure 4.4



## Section 4 Adhesives



- Assemble the components immediately to permit the silicone gasket material to compress evenly between the parts. Tighten fasteners to the required torque value for that size fastener. There is no special procedure or additional torque value required.
- Wait 20 minutes before filling the assembly with lubricant.

### Features of Liquid Adhesives

The liquid adhesive sets at ambient temperature and, being liquid, rapidly covers all the spaces between the threads uniformly, obtaining a more efficient and secure bond than the existing conventional systems.

Product	Type	Color	Setting Time (Hours)
Loctite	271	Red	2
	241	Blue	6
	221	Violet	6
Three Bond	1334	Red	6
	1305	Green	6
	1341	Blue	10

### Disassemble Parts

Use approved mechanical procedures to take apart components assembled with liquid adhesive.



#### WARNING

To avoid damage to the heads of the fasteners, do not use an impact wrench nor hit the fastener with a hammer. If there is difficulty removing fasteners from components, for instance, due to rounding of the hex or because of the effort required, reduce the resistance of the bond by heating the head of the fastener to approximately 302°F (150°C), while trying to loosen it. This procedure must be carried out slowly to prevent thermal stresses to the other components.

### Clean Threads and Holes

Carefully clean the dirt, oil, grease or moisture from the threaded holes and from the fastener threads. This must be done with trichlorethylene or other chlorinated solvents.

### Assemble Parts

Before beginning this operation, check the places where the adhesive is to be applied as specified in Section 5. If the assembly has fasteners that had adhesive applied originally but were not removed during the disassembly, check the torque value of each fastener. Apply the minimum torque value recommended by Meritor. If the fastener does not turn, remove it and follow the procedure described in this section.

### Applying Liquid Adhesives

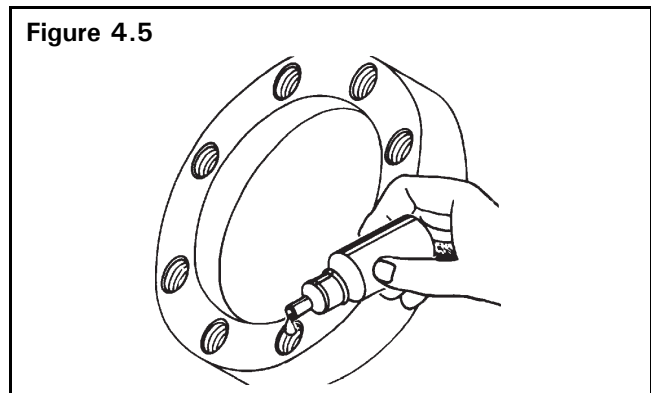


#### WARNING

Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

- Apply the liquid adhesive so that it covers all the spaces between the threads. In threaded holes, apply 4 to 6 drops to the thread.  
**Figure 4.5.**
  - When it is a closed hole:** Apply the liquid adhesive to its thread. Do not apply adhesive directly to the fastener threads. Air pressure in the hole will push the adhesive out and away from the mating surfaces as the fastener is installed.
- Tighten all fasteners to the torque values specified in Section 7.

Figure 4.5



## Chemical Gasket Material

### Description

Chemical gasket material is a substance with a pasty consistency that sets at ambient temperature forming a resistant packing. The gasket materials adopted by Meritor are FAG 3 (Loctite) and Neutral Silicone (Dow Corning 768 or Rhodia 567/666).

### Clean Parts

Carefully remove all old gasket material from both surfaces to be joined and clean both surfaces removing dirt, oil, grease or moisture. The residue from the previous gasket must be removed with a flat-bladed tool or sandpaper and afterwards cleaned with an oil-free solvent such as xylol, toluol or methyl ethyl ketone.

Take care not to scratch the surfaces because this could cause leaks in the future.

### Dry Parts

Make sure that the surfaces to be joined are perfectly dry before applying the gasket material.

### Applying Silicone Gasket Materials

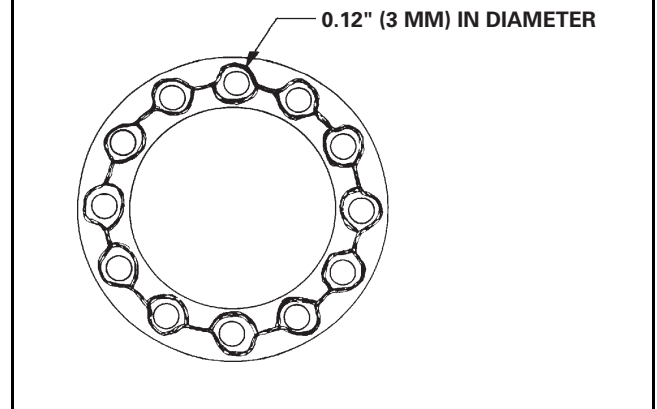


#### **WARNING**

**Take care when you use silicone gasket materials to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.**

1. Apply the gasket material around one surface and around the edge of all fastener holes to ensure a complete seal that will prevent oil leakage through the gasket. If using Neutral Silicone, apply a continuous bead approximately 0.12-inch (3 mm) in diameter or apply FAG-3 with a brush. **Figure 4.6.**

Figure 4.6



#### **CAUTION**

**Do not apply excessive amount of gasket material because it will be displaced into the unit, causing difficulty with future disassemblies. Faults in the application of the gasket material bead could be the cause of future leakage.**

2. After applying the gasket material, assemble the components immediately to permit the gasket material to compress evenly between the parts.
3. Tighten the fasteners to the required torque value specified in Section 7.

## WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Assembly

### Assemble the Drive Pinion, Bearings and Bearing Cage

1. Check that the cup seatings are clean and free of burrs.
2. Install the new bearing cups (front and back) using an appropriate tool or a press. **Figure 5.1.**
3. Make sure that during the assembly, material is not being scraped off the drive pinion bearing cage.
4. Make sure that the cups are correctly seated in their respective places. **Figure 5.1.**

## WARNING

Observe all warnings and cautions provided by the tool manufacturer to avoid serious personal injury and damage to components.

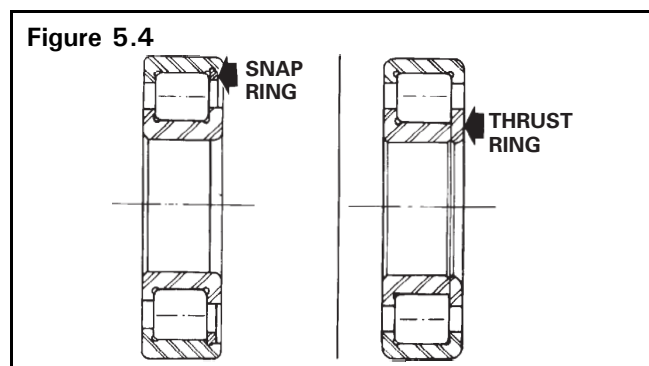
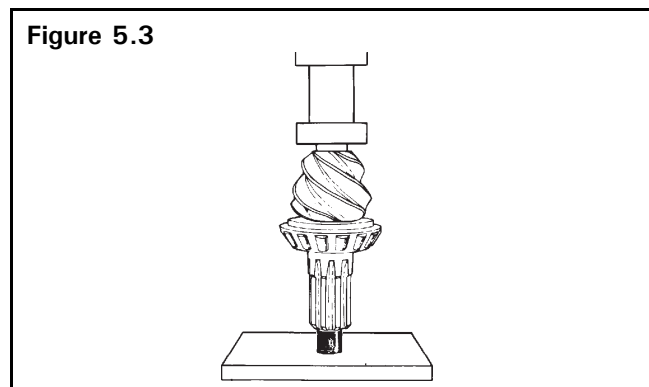
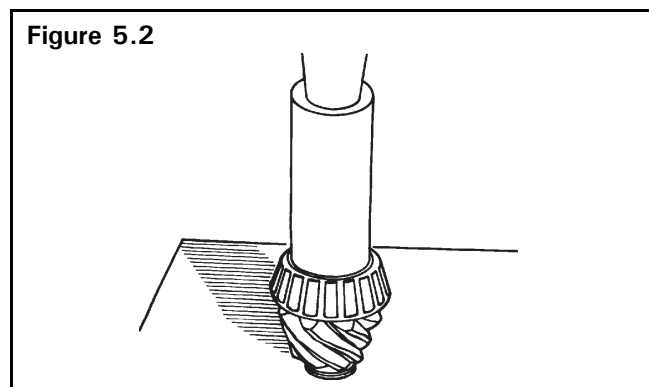
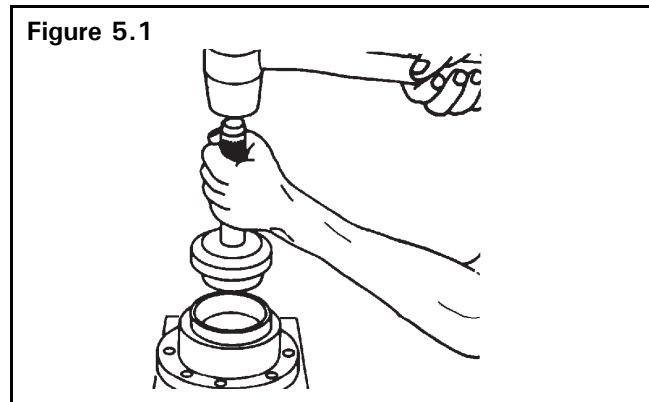
5. Install a new rear bearing cone making sure that it is perfectly seated on the head of the pinion by using appropriate tools or a press. **Figure 5.2.**
6. Install a new bearing on the drive pinion using appropriate tools or a press. **Figure 5.3.**

## CAUTION

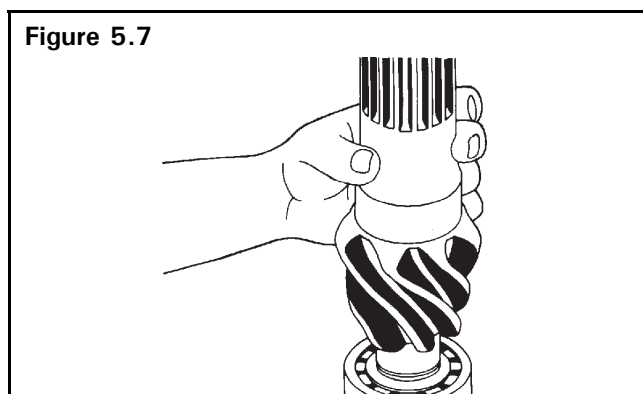
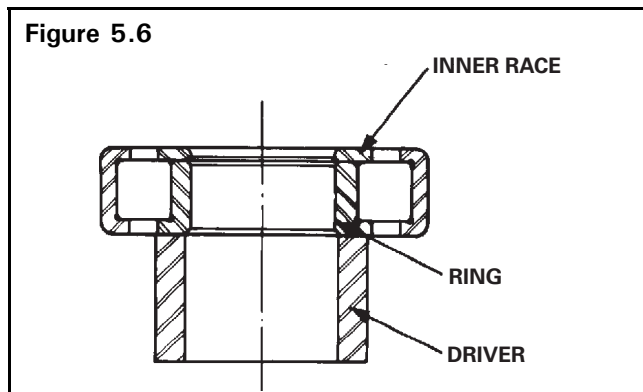
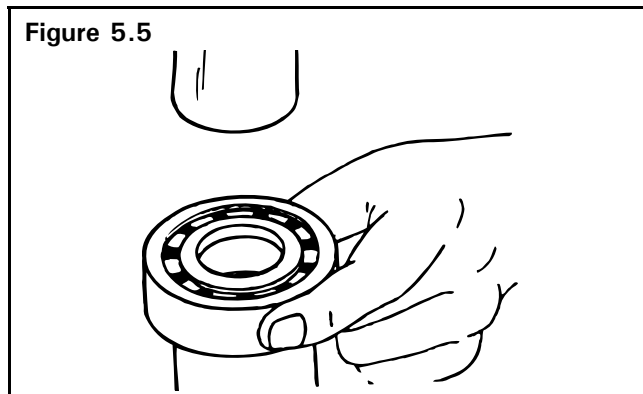
Make sure that the cone is correctly seated on the pinion. For installation use an adequate driver that pushes only on the inner race of the bearing to prevent damage to components.

### 230 and 240 Differentials

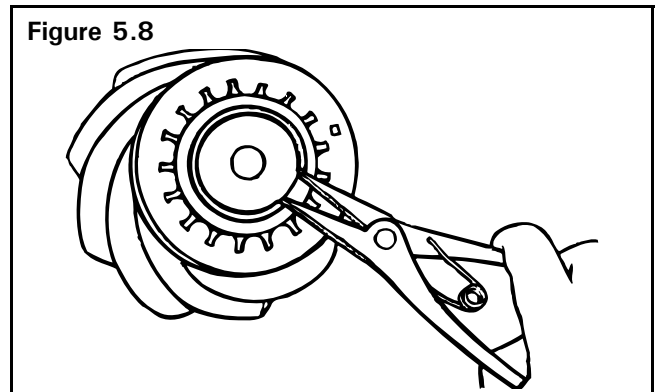
The drive pinion for the 230 and 240 differentials may require an optional method of installation. **Figure 5.4.**



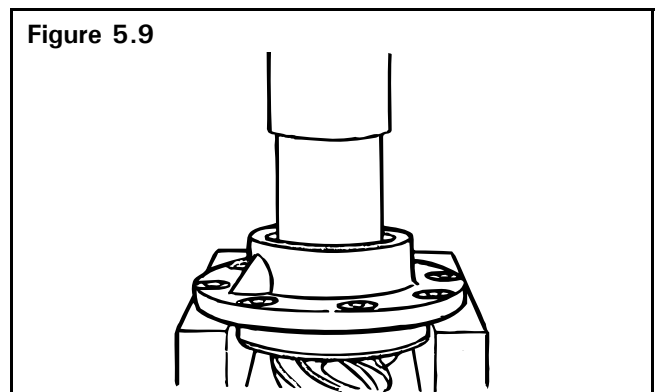
7. Rest an appropriate driver on the press table and position the new spigot bearing on the driver. **Figure 5.5.**
8. Make sure that the holes of the driver, inner race and thrust ring are perfectly aligned. The thrust ring should face the pinion head preventing any damage that will occur if not properly installed. **Figure 5.6.**
9. Position the pinion on the spigot bearing. **Figure 5.7.**



10. Press the pinion until it rests firmly against the spigot bearing.
11. Release the pressure and lower the drive pinion and spigot bearing assembly.
12. Install a new snap ring with appropriate snap ring pliers. **Figure 5.8.**



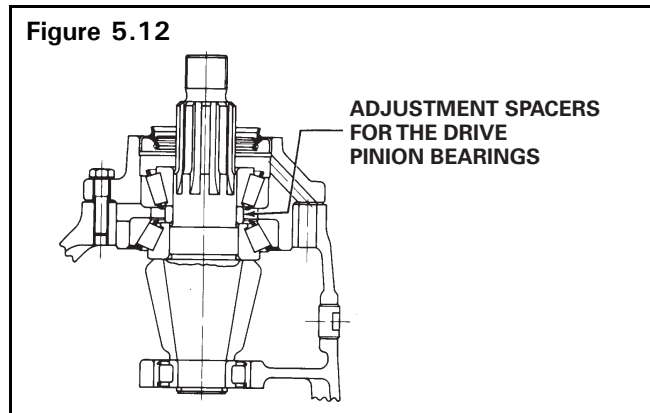
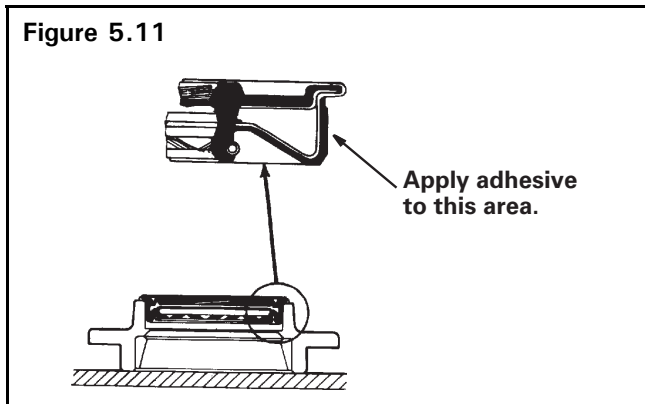
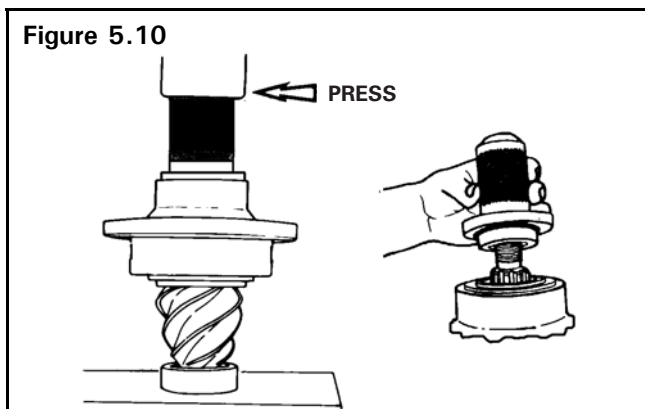
13. Lubricate the bearing cups and cones with the oil recommended in Section 6.
14. Place the bearing adjustment shims on the shaft of the hypoid pinion.
15. Position the hypoid pinion in the cage.
16. Press the front bearing cone and check the preload. Refer to Determine Bearing Preload in Section 8. **Figure 5.9.**
  - **Before you install the seal:** Check that the seat is free of oil or grease.



# Section 5 Assembly



17. Install a new pinion seal using an appropriate tool. **Figure 5.10.**
18. Apply lithium soap grease to the lips of the seal and apply pressure. **Figure 5.11.**
19. Apply sealing paste (3M industrial adhesive 847) to the outer surface of the seal. **Figure 5.11.**
20. Position the yoke on the pinion splines.
21. Place and finger tighten the pinion nut.
22. Install adjustment spacers between the drive pinion bearings. **Figure 5.12.**



## Select Spacers for Drive Pinion Bearings

There are spacers of different thicknesses available as shown in **Tables A and B.** The thickness of the spacer is engraved on each one.

<b>New Bearings</b>	1.7-4.0 N•m 15-35 lb-in
<b>Used Bearings</b>	1.1-2.3 N•m 10-20 lb-in

Obtain these values before you install the seal onto the drive pinion bearing cage.

**Table A: Models 220/224/230**

Code	Thickness MM	Code	Thickness MM
028070	11.89	028089	12.37
028071	11.91	028090	12.40
028072	11.94	028091	12.42
028073	11.96	028092	12.45
028074	11.99	028093	12.47
028075	12.01	028094	12.50
028076	12.04	028095	12.52
028077	12.07	028096	12.55
028078	12.09	028097	12.57
028079	12.12	028098	12.60
028080	12.14	028099	12.62
028081	12.17	028100	12.65
028082	12.19	028101	12.67
028083	12.22	028102	12.70
028084	12.24	028103	12.73
028085	12.27	028104	12.75
028086	12.30	028105	12.78
028087	12.32	028106	12.80
028088	12.34	028107	12.83

**Table B: Model 240**

Code	Thickness MM	Code	Thickness MM
029034	18.30	029053	18.79
029035	18.33	029054	18.82
029036	18.35	029055	18.85
029037	18.38	029056	18.87
029038	18.40	029057	18.90
029039	18.43	029058	18.92
029040	18.45	029059	18.95
029041	18.48	029060	18.98
029042	18.51	029061	19.00
029043	18.53	029062	19.03
029044	18.56	029063	19.05
029045	18.59	029064	19.08
029046	18.61	029065	19.11
029047	18.64	029066	19.13
029048	18.66	029067	19.16
029049	18.69	029068	19.18
029050	18.72	029069	19.21
029051	18.74	029180	19.24
029052	18.77		

It is recommended to initially install the spacers shown on **Table C** to obtain the desired adjustment. The identification is marked on the outer diameter or on one of the faces of the spacer.

**Table C**

Model	Thickness of the Spacers	
	mm	inches
220/224/230	12.30-12.50	0.484-0.492
240	18.79-18.90	0.740-0.744

## Determine Bearing Preload

### Using a Press

1. Lubricate all the drive pinion bearings with the oil specified in Section 6.



### WARNING

Observe all warnings and cautions provided by the tool manufacturer to avoid serious personal injury and damage to components.

2. Press the outer bearing and rotate the drive pinion bearing cage various times to ensure a proper seating between the cups and the cones. Keep the drive pinion bearing cage on the press with a load applied according to **Table D**.

**Table D**

Model	Load (ton)
220/224	11
230	11
240	14

3. Wind a cord around the diameter of the bearing cage several times and hook a dynamometer (high quality scale) to the end.
4. Pull the cord with the dynamometer. Read the value (pounds or kilograms) on the scale. Refer to **Table E**.

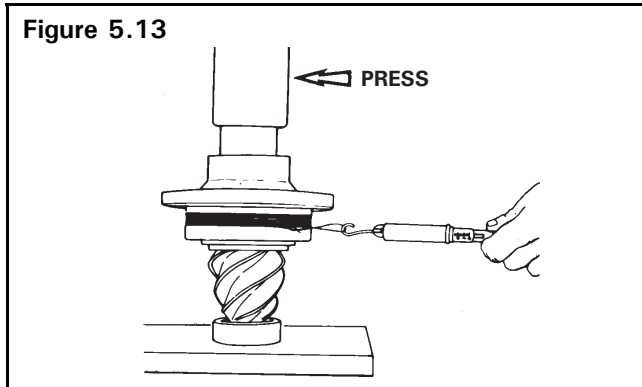
**Table E**

Model	New Bearing		Used Bearing	
	kg	lb	kg	lb
240	2.1-4.8	4.5-10.6	1.3-2.8	3.0-6.0
220/224/230	2.6-6.2	5.8-13.5	1.7-3.6	3.8-7.7

## Section 5 Assembly



5. Write down and record the torque value after the cage starts, not the starting torque.  
**Figure 5.13.**



6. Measure the diameter of the bearing cage where the cord was wound. Divide the dimension in half to get the radius dimension. Refer to **Table F**.

**Table F**

Model	Radius	
	cm	inches
240	8.4	3.31
220/224/230	6.6	2.60

7. Multiply the value shown on **Table E** by the value on **Table F**.
- Kg x cm = result in kg per square cm  
Lb x inches = result in lbs per square inch
8. Check if the result obtained matches the specified limits.
- To convert lb-in to N•m multiply by 0.113 and to convert kg-cm to N•m multiply by 0.098.
  - If the value of the preload is above the maximum specified limits, install thicker bearing spacers.
  - If the value of the preload is below the minimum specified limits, install thinner bearing spacers.

### Examples of Calculations Data

Radius – 8.4 cm (3.31-inches)  
Dynamometer reading 2.3 kg (5.0 lb)

### Calculation Procedure

2.3 kg x 8.4 cm = 19.3 kg per square cm  
5.0 lb x 3.31-inches = 16.55 lbs per square inch

### Conversion to N•m

19.3 x 0.098 = 1.9 N•m  
16.55 x 0.113 = 1.9 N•m

### Without a Press

If a press is not available, use the following procedure.

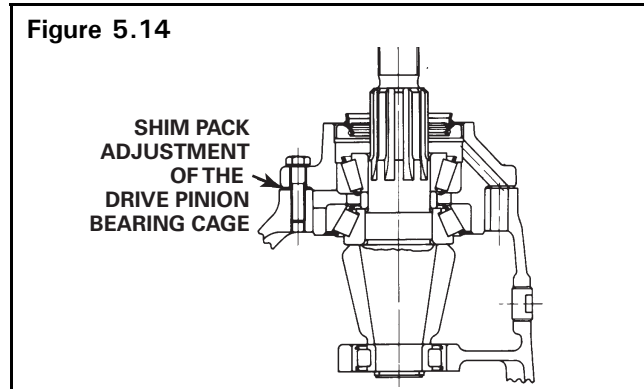
1. Lubricate all the drive pinion bearings with the oil specified in Section 6.
2. Install the yoke (without the drive pinion seal).
3. Immobilize the drive pinion (with the yoke) using an appropriate device.
4. Tighten the drive pinion nut to the minimum torque value specified in Section 7.
5. Turn the drive pinion bearing cage several times to ensure a proper seating of the bearing cups and cones.
6. Carry out Steps 3 through 7 from the Using a Press procedure in this section.
7. If the value of the preload obtained is below the minimum specified limit, gradually tighten the drive pinion nut (if necessary, up to the value specified in Section 7) to obtain the desired preload.
8. Write down and record the torque value after the cage starts, not the starting torque.
9. If after tightening to the maximum specified torque value the preloads are not obtained, replace the spacer with thinner ones and repeat the verification process.
10. Remove the yoke and continue with the assembly of the differential.



## Select Drive Pinion Bearing Cage Adjustment Shims

This adjustment helps to position the drive pinion in relation to the ring gear for the purpose of ensuring the ideal position of tooth contact.

The desired distance is obtained by the installation of a shim packet below the drive pinion bearing case. **Figure 5.14.**



There are shim packs of different thicknesses available for this adjustment. Refer to **Table G**. The pack should always consist of at least three pieces, and the thicker pieces should be placed on the outside to ensure maximum sealing capability.

**Table G**

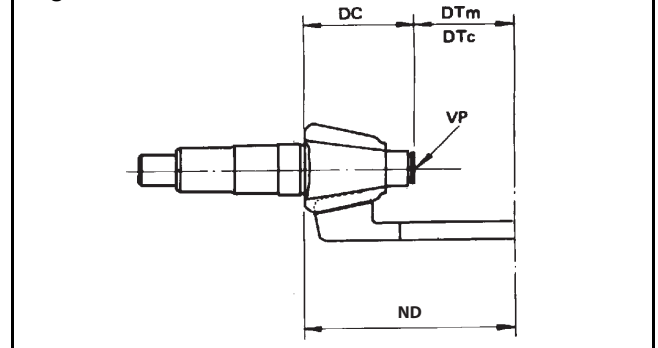
Model	Radius	Thickness Inches (mm)
240	028 455-6	0.010 (0.25)
	028 454-8	0.005 (0.13)
	028 453-0	0.003 (0.08)
220/224	027 288-4	0.005 (0.13)
230	027 289-2	0.010 (0.25)
	027 290-6	0.003 (0.08)

## Determine the Shim Packs

### Using a Caliper

1. Write down the nominal mounting dimension (ND) for the drive pinion. This dimension is the nominal distance taken from the center of the ring gear to the rear drive pinion bearing cone face. **Figure 5.15.** Refer to **Table H**.

**Figure 5.15**

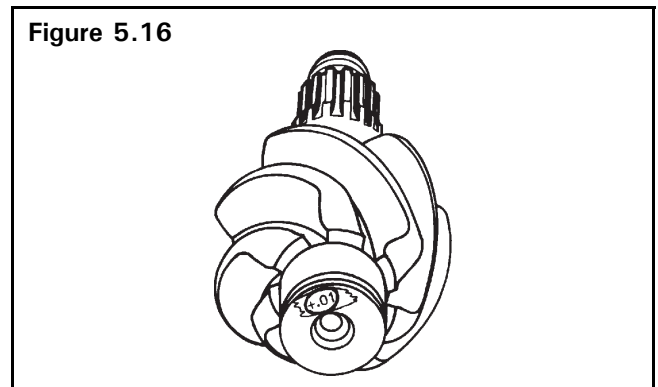


**Table H**

Model	ND
240	219.08
230	206.38
220/224	200.00

2. Identify and write down the drive pinion variation (PV).

All drive pinions have an individual variation with respect to their ND. This variation, expressed in hundredths of a millimeter, and a + or - sign is stamped on the pinion's head. **Figure 5.16.**



## Without Using Caliper

This process consists of a mathematical calculation, and the result is sufficiently accurate when the ring gear and drive pinion set is replaced.

Other components that affect the proper position of the drive pinion are the carrier, the drive pinion bearing cage and the inner pinion bearing. Therefore, if there is a need to change any of these components, this mathematical process may be used as a first attempt to select the shims to properly adjust the tooth contact of the ring gear and drive pinion.

1. Take note of the variation value (PV) on the drive pinion to be replaced.
2. Observe the variation value (PV) on the new drive pinion. If the value is the same as the original drive pinion, the thickness of the original shim pack must be maintained.

If the value is different, perform the following calculations:

- A. Measure and write down the thickness of the original shim pack (pack thickness PT).
- B. Check the variation value (PV) stamped on the head of the original drive pinion. If the number is (+), subtract this value from the dimension of the thickness of the original shim pack. If it is (-), add it.

The resulting value will establish a master thickness for shim packs used for the assembly of a drive pinion whose ND dimension is equal to zero.

- C. Take note of the value obtained in Step B to use in the calculation of the thickness of the shim pack for the new drive pinion.
- D. Observe the variation value (PV) of the new drive pinion. If the value is (+), add it to the value obtained in Step C. If it is (-), subtract it.
- E. The final result obtained will establish the thickness of the new shim pack to be used in the installation of the new hypoid ring gear/drive pinion set.

## Example of Calculation "1"

### Data:

PT (original pack) . . . . .	0.09
PV (original drive pinion) . . . . .	+0.05
PV (new pinion).. . . . .	-0.13

### Calculations

PT (original pack) . . . . .	0.90
PV (original drive pinion) . . . . .	-0.05
PT (master pack) . . . . .	= 0.85
PV (new drive pinion).. . . . .	-0.13
PT (new pack) . . . . .	= 0.72

## Example of Calculation "2"

### Data:

PT (original pack) . . . . .	0.90
PV (original drive pinion) . . . . .	-0.05
PV (new drive pinion).. . . . .	-0.13

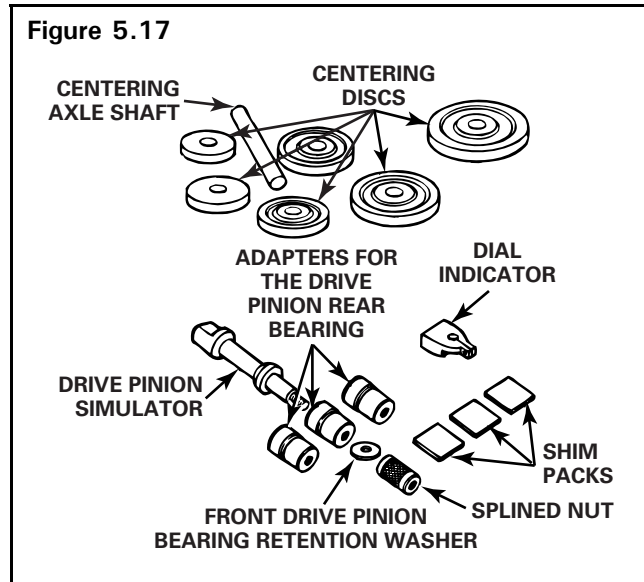
### Calculations

PT (original pack) . . . . .	0.90
PV (original drive pinion) . . . . .	+0.05
PT (master pack) . . . . .	= 0.95
PV (new pinion).. . . . .	-0.13
PT (new pack) . . . . .	= 0.82

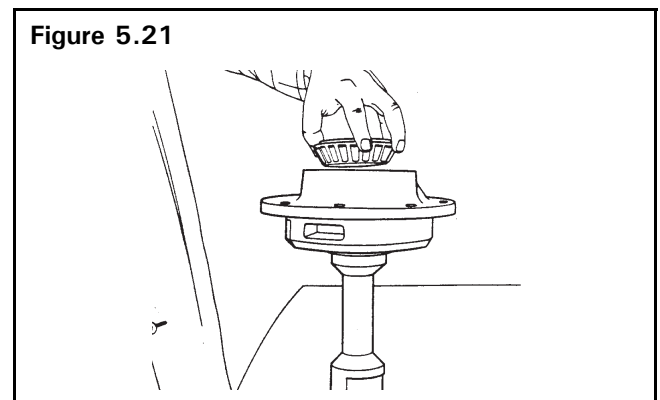
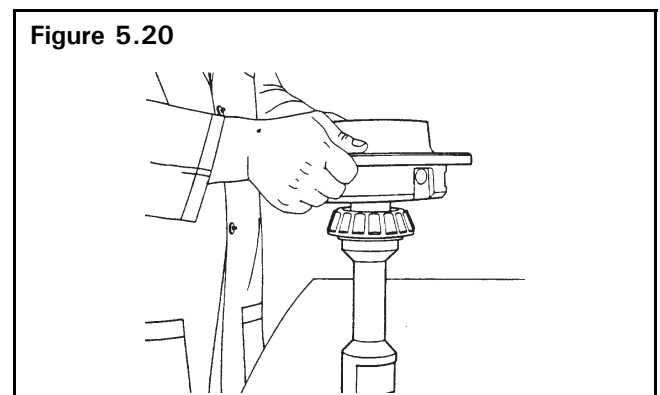
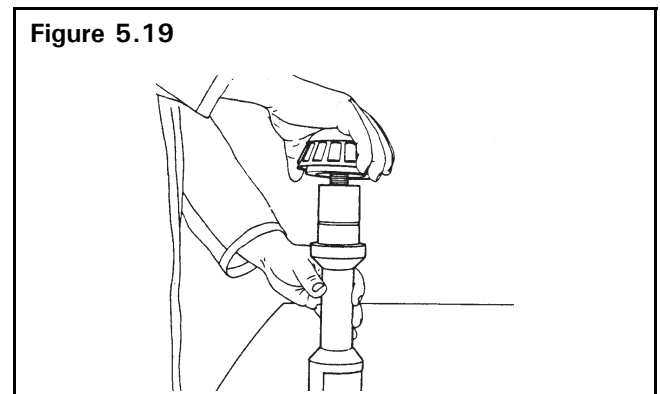
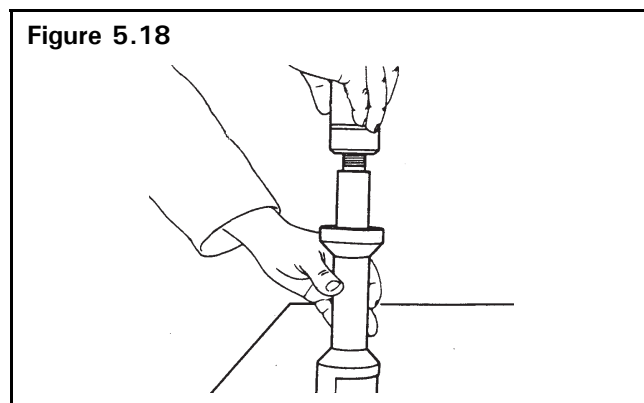
## Determine Shim Packs Using a Special Tool

1. In the following operations make sure that all parts are clean, especially where indicated below:
  - Between the contact surfaces of the special tool components
  - The contact surfaces of the special tool components
  - The contact surfaces of the carrier and the drive pinion bearing case

The special tool contains the following components. **Figure 5.17.**




2. According to the model of the rear axle, install the adapter of the rear bearing in the drive pinion simulator. **Figure 5.18.**
3. Install the rear drive bearing pinion on the adapter. **Figure 5.19.**
4. Install the drive pinion bearing cage with the face that will be inserted in the carrier facing down, on the rear drive pinion bearing. **Figure 5.20.**
5. Install the front bearing on the other face of the drive pinion bearing cage. **Figure 5.21.**



## Section 5 Assembly



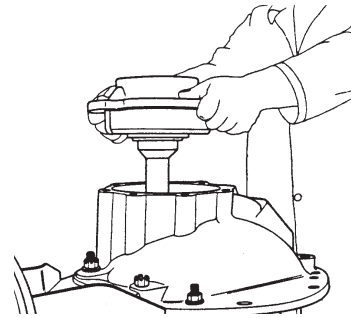
6. Install the drive pinion front bearing lock washer and the splined nut, tightening manually. **Figure 5.22.**
7. Check if the drive pinion and the carrier surface contacts are clean and free of scratches or scores.
8. Install the drive pinion, without shims, in the carrier and regulate its height. **Figure 5.23.**
9. Install four capscrews and initially tighten in a cross sequence. **Figure 5.24.**
10. Then with a torque wrench in the same cross sequence, apply the following torque values: 67-91 lb-ft (90-125 N•m). **Figure 5.25.** 
11. Check if the differential case assembly bearing housing and the special tool centering disks are perfectly clean and lubricate them with a film of oil.
12. According to the model of the differential, install the appropriate centering discs, with their respective shafts in the bearing housing of the differential case.
13. According to the model of the rear axle, select the appropriate shim pack. Refer to the chart below.

Model	Shim Pack
220/224	4.72 mm
230	11.10 mm
240	23.80 mm

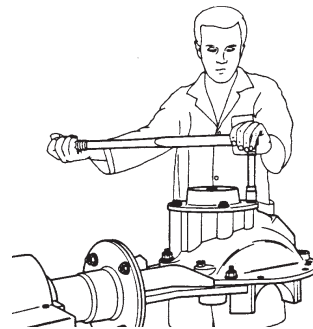
**Figure 5.22**



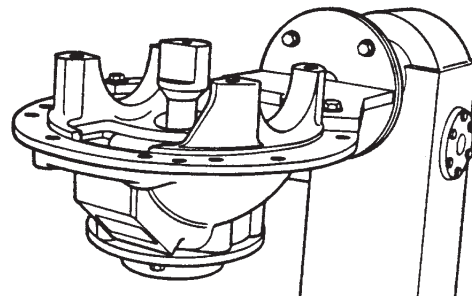
**Figure 5.23**



**Figure 5.24**

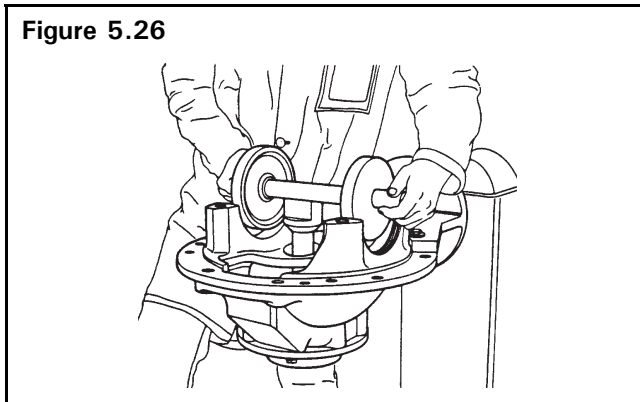
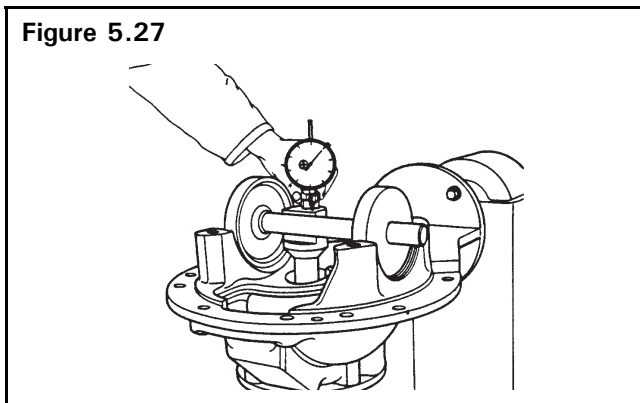
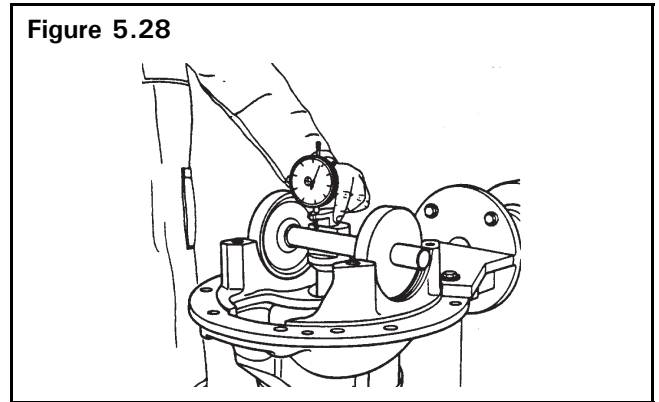


**Figure 5.25**



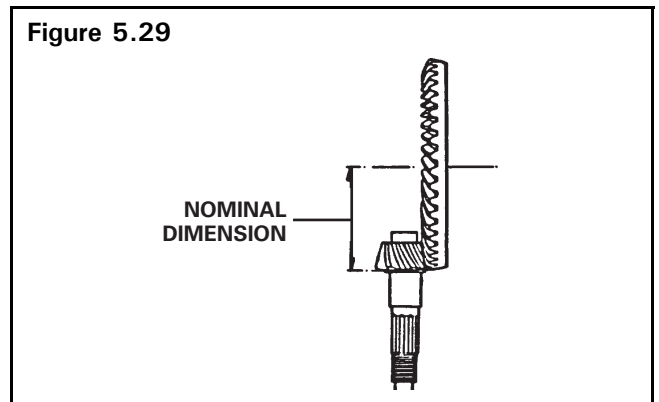
14. Install the shim pack on the top of the drive pinion simulator after checking if the contact surfaces of both parts are absolutely clean. **Figure 5.26.**
15. Install a dial indicator in the holder. Place the holder and the indicator pointer on the gauge surface of the shim and adjust the dial to zero (0). **Figure 5.27.**
16. Place the dial indicator support on the gauge surface of the shim pack. Place the pointer on the centering shaft. Slide the pointer across the centering shaft until maximum value is indicated. **Figure 5.28.**

Write down the maximum value (Mv) indicated by the pointer of the dial indicator.

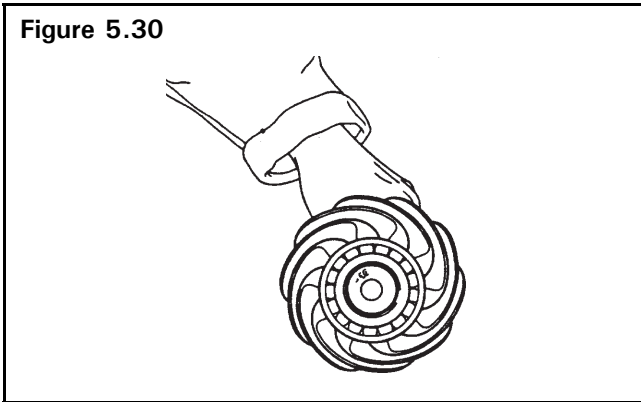
**Figure 5.26**

**Figure 5.27**

**Figure 5.28**


17. Nominal dimension is the distance taken from the rear drive pinion bearing cone wide face to the center of the ring gear. **Figure 5.29.** Each differential model has a specific nominal dimension as shown in the chart below:

Differential Model	Specific Nominal Dimension
220/224	200.00 mm
230	206.38 mm
240	219.08 mm

**Figure 5.29**


18. Check and write down the number engraved on the end of the pinion. This value indicates how many hundredths of a millimeter have to be added or subtracted from the corrected nominal dimension. **Figure 5.30.**



19. Subtract the corrected specific nominal dimension (Csnd) from the differential nominal dimension maximum value (Mv).

The result will be the thickness of the shim pack(s) to be added to obtain proper drive pinion/ring gear tooth contact.

$$\text{Csnd} = \text{SND} - \text{engraved number}$$

$$\text{Shim pack thickness} = \text{Mv} - \text{Csnd}$$

Example:

The following are the values for a 220 differential:

1. Differential nominal dimension maximum value (Mv) is determined using a special tool:

$$\text{Mv} = 200.70$$

2. Number engraved on the top of the drive pinion:

$$- .06$$

3. Specific nominal dimension (SND) of this differential model:

$$\text{SND} = 200.00$$

From these values we can determine the corrected specific nominal dimension (Csnd):

Number -6 engraved on the end of the drive pinion signifies that the variation in the height of the pinion in relation to the differential nominal dimension is 0.06 mm lower than the specific nominal dimension (SND), so:

$$\text{SND} - \text{engraved number} = \text{Csnd}$$

$$200.00 - 0.06 = 199.94$$

Therefore, 199.94 is the corrected specific nominal dimension (Csnd) for the differential.

To determine the thickness of the shim pack(s) needed to obtain a proper drive pinion/ring gear tooth contact, we subtract Csnd (corrected specific nominal dimension) from Mv (maximum value).

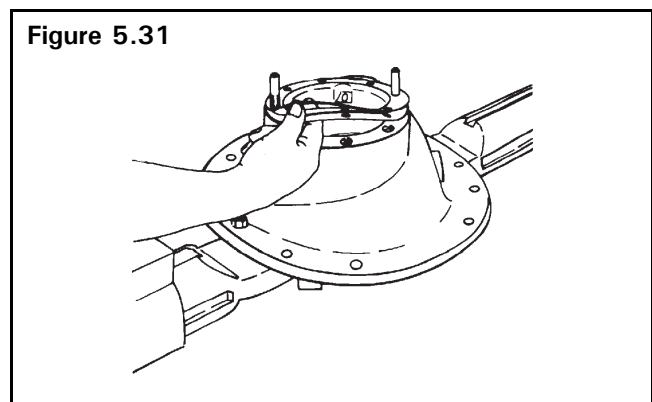
$$\text{Mv} - \text{Csnd} = \text{Thickness of the shim pack}$$

$$200.70 - 199.94 = 0.76 \text{ mm}$$

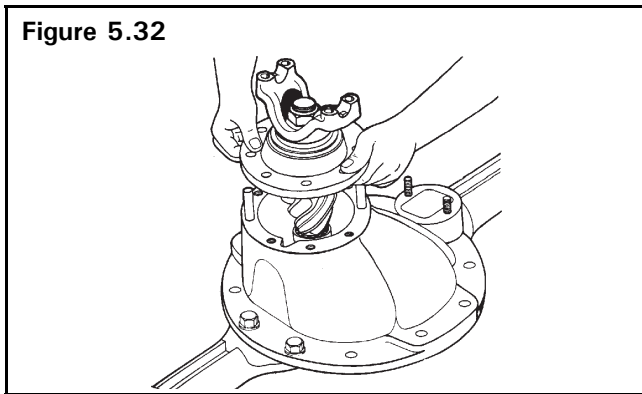
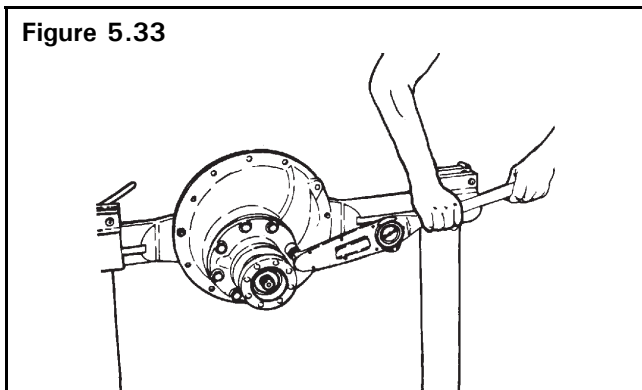
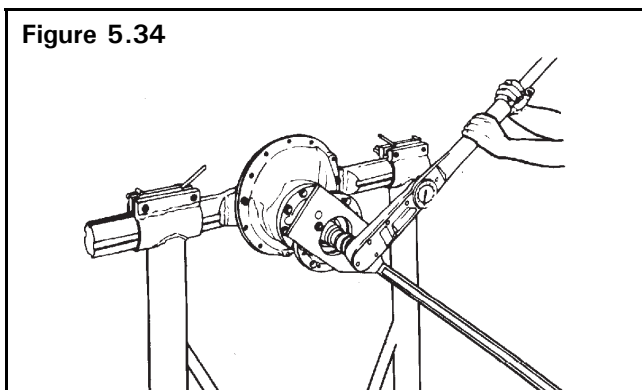
We therefore have to insert 0.76 mm of shims between the carrier and the drive pinion assembly to obtain proper drive pinion/ring gear tooth contact.

### Install the Drive Pinion, Bearing Cage and Shim Pack into the Carrier

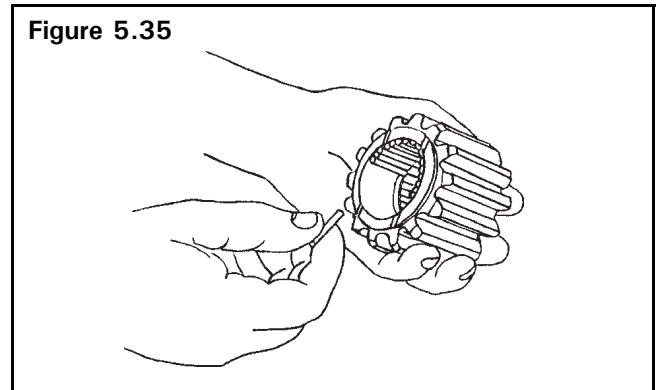
1. Select and install the adjustment shims for the pinion case using guide studs (refer to Section 8) and apply FAG-3 sealant gasket on the differential case before installing the shims. **Figure 5.31.**



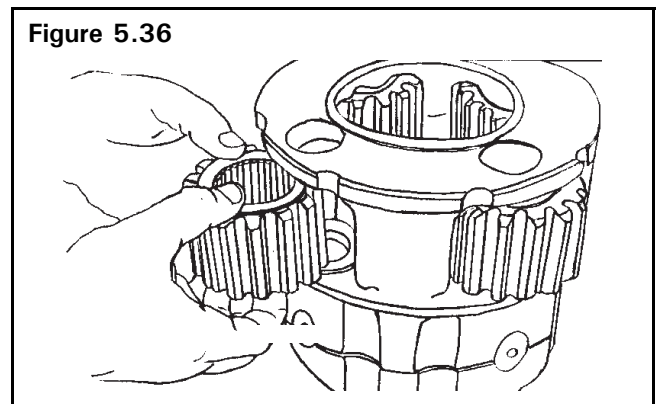
2. Install the drive pinion bearing cage.  
**Figure 5.32.**
3. Install the washers and fasteners and tighten them to the torque value specified in Section 7. **Figure 5.33.**
4. Hold the yoke with an adequate tool and tighten the pinion nut to the minimum torque value specified in Section 7. **Figure 5.34.**
5. Using a torque wrench, tighten the pinion nut (to the maximum limit allowed) according to the table of values specified in Determine Bearing Preload in this section.

**Figure 5.32****Figure 5.33****Figure 5.34****Assemble the Main Differential and Ring Gear Assembly**

1. Apply Shell 71032 Alvania EP-2 or Texaco 995 Multifak EP-2 grease in the holes of the side gears. Install the bearings and the spacers on their respective gears. **Figure 5.35.**

**Figure 5.35**

2. Check the gear holes for burrs and make sure that the original position of the components has not changed.
3. Position the side gears and the inner and outer thrust washers in the side gear case gradually. Align the washer holes with the holes in the case for easier insertion of the shafts. **Figure 5.36.**
4. Install the side gear shafts.

**Figure 5.36**

## Section 5 Assembly



5. Install the roller pins. **Figure 5.37.**
6. Hold the main differential case (side gear half) using an appropriate device. **Figure 5.38.**
7. Position the tapered side gear (short hub) with its thrust gear in the case. **Figure 5.39.**
8. Make sure when installing the side gears in the main differential case that they are assembled according to their original positions. **Figure 5.41.**
9. Install the pinions thrust washers and the spider. **Figure 5.40.**
10. Position the tapered side gear (long hub) and thrust washer.
11. Install the main differential case (plain half) without changing the original alignment.
12. Install four fasteners in the main differential case equidistant to each other. Tighten them to the torque value specified in Section 7.
13. Lower the main differential case assembly from the device.
14. Check the rotation resistance of the main differential case assembly. Refer to Section 8.

Figure 5.39

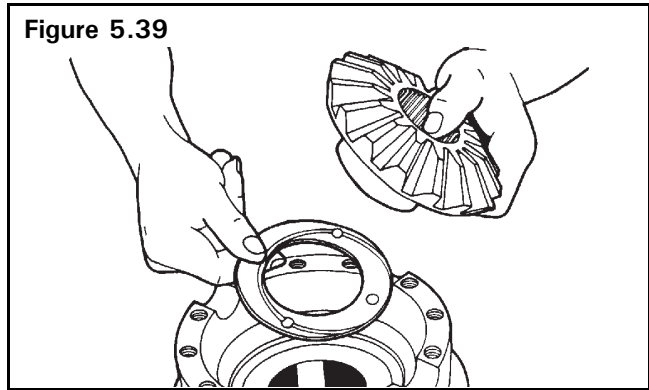


Figure 5.40

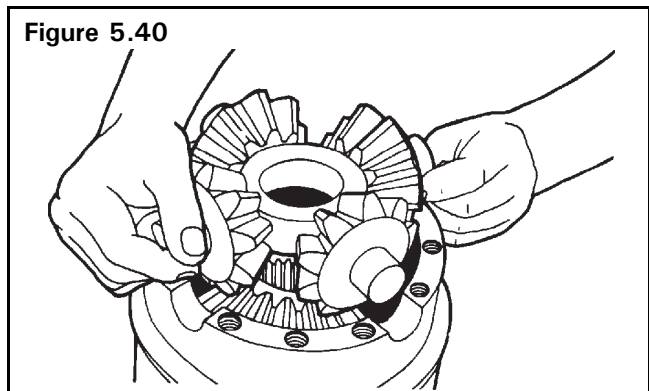


Figure 5.37

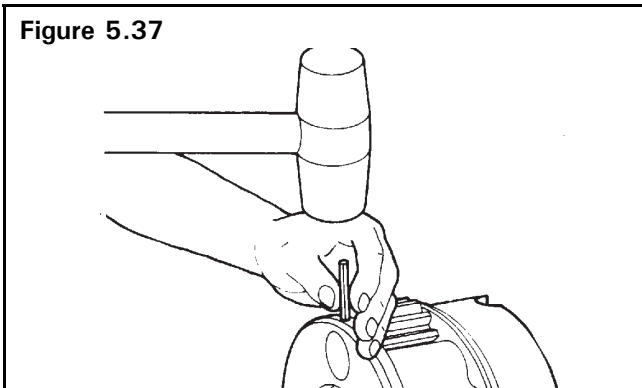


Figure 5.38

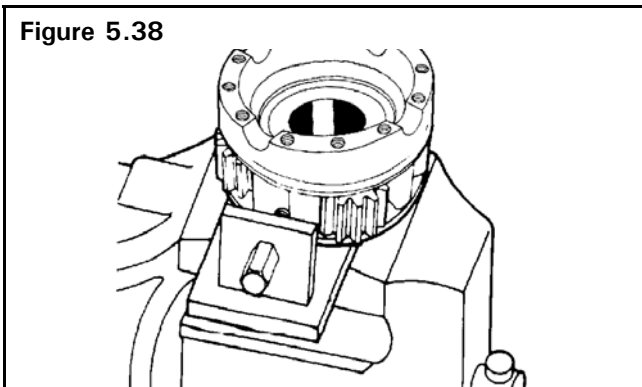
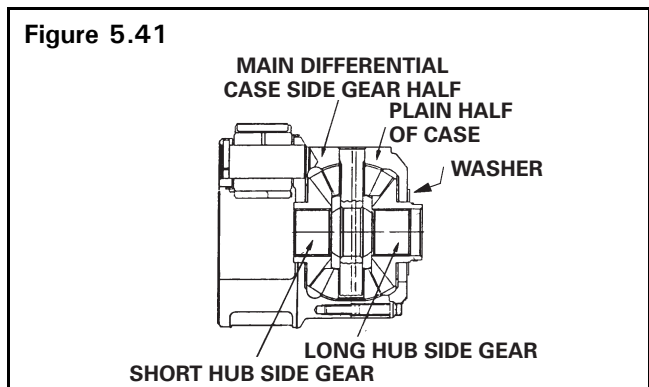


Figure 5.41





 **WARNING**

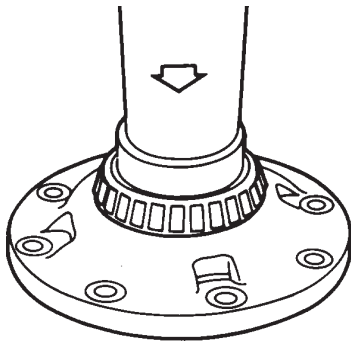
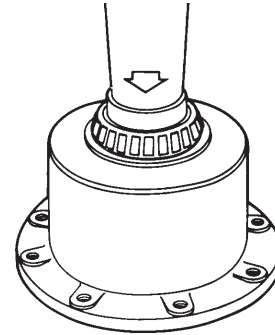
Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

15. Apply Loctite No. 271 or Three Bond 1305 liquid adhesive to the threads of the remaining fasteners for the main differential case assembly. Refer to Section 4.
16. Install and torque the remaining fasteners in the main differential case assembly in accordance with the specified torque values in Section 7.
17. Apply grease to the thrust washer and install with care as to not allow any grease to fall into the differential case.

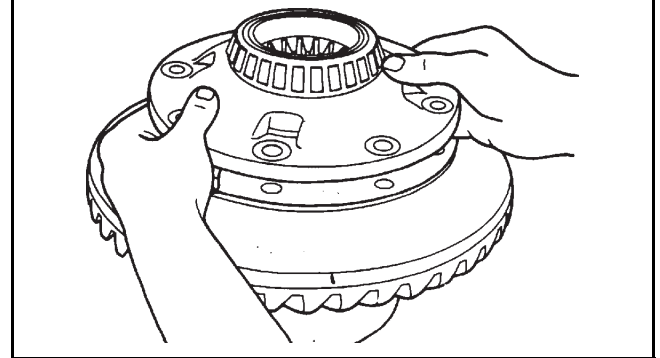
**Assemble the Differential Case Halves** **WARNING**

Observe all warnings and cautions provided by the tool manufacturer to avoid serious personal injury and damage to components.

1. Check the new bearing cones for burrs and cleanliness.
2. Install the new bearing cones in both halves of the differential case using an appropriate tool or a press. **Figures 5.42 and 5.43.**
3. Make sure that the cups are perfectly seated.
4. Install the differential case (plain half) onto the ring gear.

**Figure 5.42****Figure 5.43**

5. Install the pinion case and its thrust washer using a lifting device.
6. Install the flange half case to the ring gear. **Figure 5.44.**

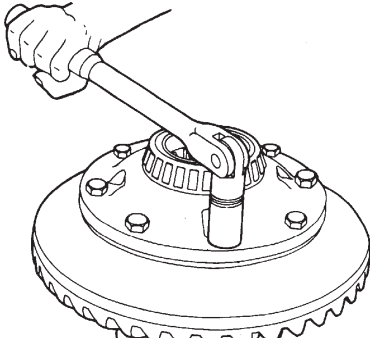
**Figure 5.44**

### **WARNING**

Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

7. Apply Loctite No. 271 or Three Bond 1305 liquid adhesive to the threads of the ring gear fasteners. Refer to Section 4.
8. Install and tighten the ring gear fasteners as specified in Section 7. **Figure 5.45.**

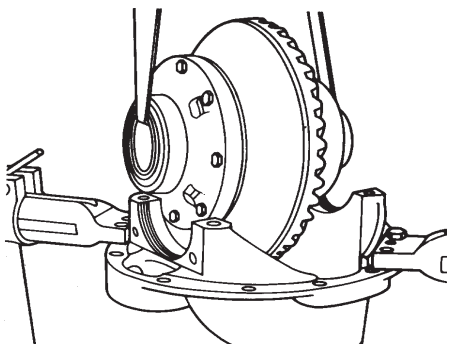
**Figure 5.45**



### **Install the Differential and Ring Gear Assembly**

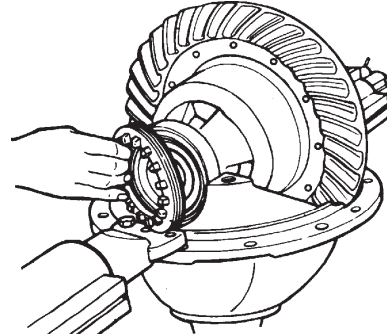
1. Temporarily install the bearing cups, washers and the bearing cap capscrews. Tighten the fasteners according to the specifications in Section 7.
2. Install the cones in the cups and mount the differential case assembly. **Figure 5.46.**

**Figure 5.46**



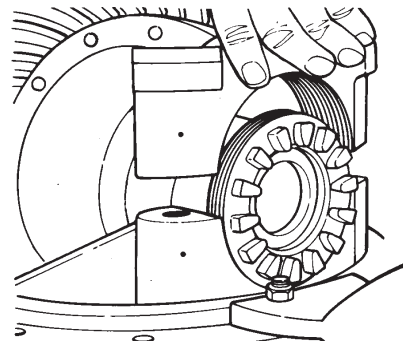
3. Install the left side adjusting ring (ring gear side) first to prevent movement that would hinder the assembly operation.
4. Install the adjustment nuts, turning them normally until they contact the bearings. **Figure 5.47.**

**Figure 5.47**



5. Install the bearing caps, tightening them slightly. Try to turn the rings. **Figure 5.48.**
  - **If it is not possible to turn the rings manually:** Remove the bearing caps and reinstall the adjusting rings to prevent damage to the differential case and the bearing caps.

**Figure 5.48**



## WARNING

Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

6. Apply Loctite 271 or Three Bond 1305 liquid adhesive to the threads of the bearing caps fasteners. Refer to Section 4.
7. The liquid adhesive must be applied only after the adjustments of the bearing preload, gear backlash and ring gear and pinion teeth contact adjustments have been performed.
8. Install and tighten the ring gear fasteners to the specifications found in Section 8.
  - **To adjust differential bearing preload and gear backlash:** Refer to Section 8.
  - **To check the tooth contact of hypoid gear sets:** Refer to Section 8.
  - **To install and adjust the ring gear thrust screw:** Refer to Adjust the Ring Gear Thrust Screw in this section.
9. Apply FAG-3 liquid gasket material to the thread of the ring gear's thrust screw.

### Assemble the Gear Shift Command Mechanism

## WARNING

Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

1. Install the lock plate using one of the following procedures.

### Model 220

- A. Position the lock plate.
- B. Apply Loctite 241 or Three Bond 1334 on the threads of the lock plate fasteners. Refer to Section 4.
- C. Install and tighten the new toothed plate fasteners as specified in Section 7.

### Models 230/240

- A. Install the four lock plate fastening studs so that there is a 1.05-1.07-inch (26.6-27.2 mm) space between the top of the studs and the machined surface of the housing.
  - B. Place the lock plate on the studs.
  - C. Install the new tapered washers.
  - D. Apply Loctite 241 or Three Bond 1334 to the stud threads. Refer to Section 4.
  - E. Install and tighten the fastening nuts as specified in Section 8. **Figure 5.49.**
2. Install a new pin to block the adjusting nut on the ring gear side and a cotter pin to block the nut on the opposite side.
  3. Position the sun gear and the shift fork. **Figure 5.50.**

Figure 5.49

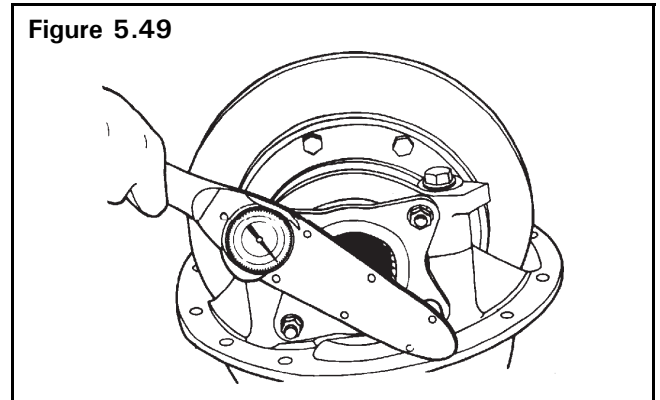
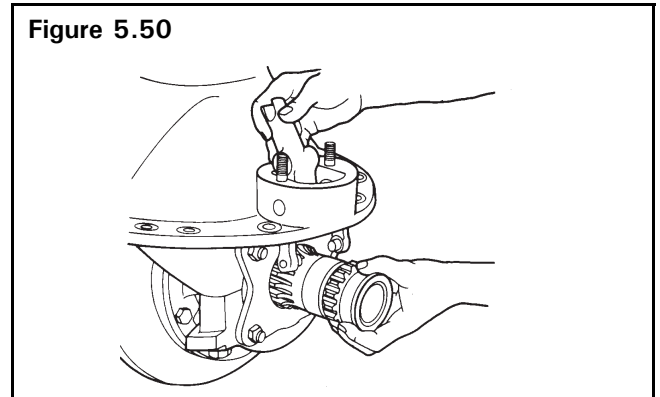
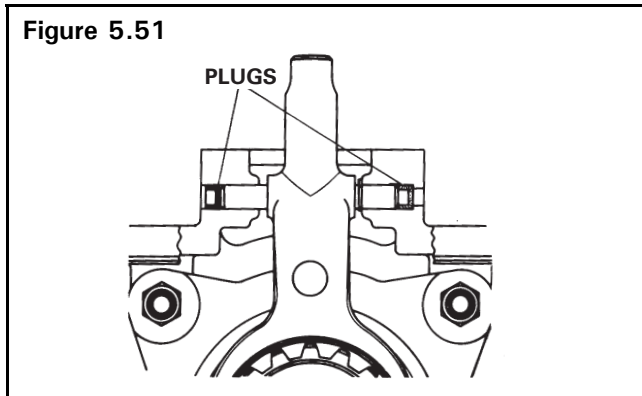


Figure 5.50

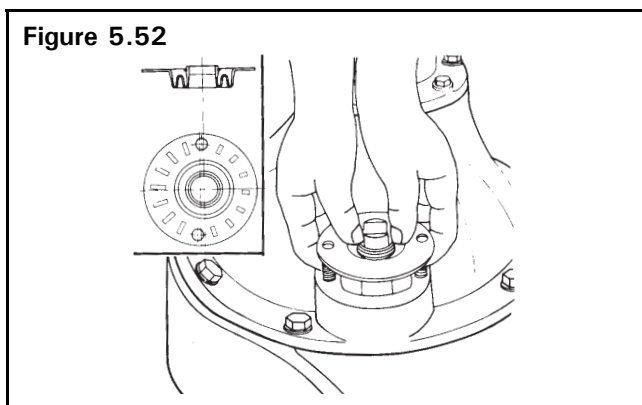


4. Apply 3M Industrial Adhesive 847 to the outer surface of the plugs.
5. Install the new plugs and the shift shaft. **Figure 5.51.**



### Install the Shift Mechanism Diaphragm (if equipped)

1. Clean and inspect the shift shaft for scores and burrs.
2. Apply lithium grease soap. Apply pressure to the shift shaft.
3. Before you install the diaphragm, verify that the fastener holes in the assembly-side of the diaphragm align with the studs.
4. Position the diaphragm and the retention on the shift shaft. **Figure 5.52.**



5. Slowly press on the center of the diaphragm without forcing it, until it touches the base of the mechanism.
6. Be sure that the center of the diaphragm is approximately 0.106-inches (2.7 mm) above the surface of the flange to prevent it from being sucked in.
7. Check that the diaphragm is not twisted.
8. Clean excess grease from the shift fork.

### Install the Differential Carrier into Axle Housing

#### **WARNING**

Take care when you use Loctite to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.

1. Check if any of the differential fastening studs on the carrier (if applicable) are loose. Apply Loctite or Three Bond 1305 to loosen studs according to Section 4.
2. Reinstall and tighten the studs until all the threads are completely inserted in the holes.

#### **WARNING**

Take care when you use silicone gasket materials to avoid serious personal injury. Follow the manufacturer's instructions to prevent irritation to the eyes and skin.


3. Apply Neutral Silicone to the mouth of the carrier as indicated in Section 4 under Chemical Gasket Material.
4. The shifting mechanism should be set at low speed (LS) to facilitate the installation of the differential.
5. Position the differential in the carrier.
6. Begin the installation of the differential in the carrier with four flat washers and four nuts spaced equidistantly.

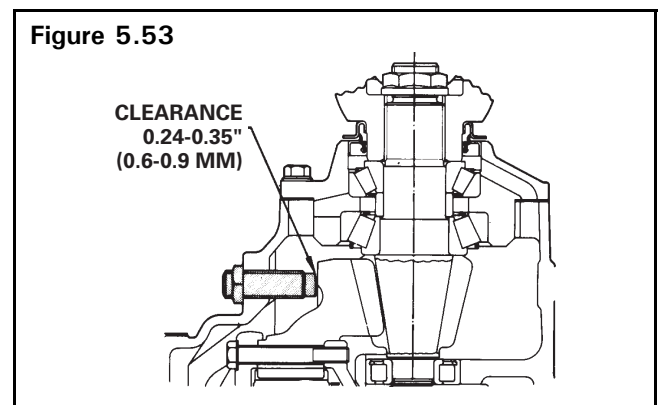
 **CAUTION**

Do not try to install the differential using a hammer because this could deform the flange and cause oil leaks.

7. Install the flat and tapered (if any) washers on all of the studs located in places that are not easily accessible. In some instances it is impossible to install them after the differential is in final position in the carrier.
8. Tighten the four nuts with flat washers in an alternating sequence to properly align the differential assembly to the carrier.
9. Tighten the four nuts to the specified torque located in Section 7. Repeat torque.
10. If the differential has capscrew fasteners, apply Loctite 241 or Three Bond 1334 liquid adhesive. Refer to Section 4.
11. Install the shift mechanism in the carrier, applying chemical gasket material (neutral silicone).
12. The shift fork position for change of speeds must be in alignment with the rest position of the shift mechanism actuator.
13. Install the washers and fastening nuts of the shift mechanism and tighten them to the torque value specified in Section 7.
14. Connect the drive shaft and align it with the mechanism.
15. Install the axle shafts.
16. Install and tighten the drain plug according to the torque value indicated in Section 7. After tightening the plug, at least one of the threads should be above the mounting surface.
17. Fill with oil according to specifications in Section 6.
18. Install and tighten the oil fill and level plug according to specifications in Section 7. After tightening the plug, at least one of the threads on the head of the plug should be above the mounting surface.

**Adjust the Ring Gear Thrust Screw****Model 240**

1. After you have made the adjustments to the assembly, install the thrust screw and nut until the tip contacts the rear surface of the ring gear.
2. Turn the screw back 1/3 of a turn to allow for a space of 0.24-0.35-inch (0.6-0.9 mm).
3. Tighten the jam nut to 200-260 N•m (150-190 lb-ft). **Figure 5.53.** 



## Section 6 Lubrication



The use of incorrect lubricants or inadequate additives generally is the major cause of differential failure. The lube oil specified for differentials must possess extreme pressure (EP) characteristics, API-GL-5 service classification of the American Petroleum Institute. This type of oil, better known as hypoid oil, possesses a lubricating film that has the capability of supporting the load pressure of heavy loads, which makes it adequate for hypoid gears, whose conditions are quite severe.

### Viscosity

In general, the high grade of viscosity of the monoviscous oil is adequate for higher ambient temperatures. Besides prolonging the service life of the gears, opting for a multiviscous oil will satisfy all the temperature conditions found. The following table represents the selection of oil viscosity.

### Inspection and Recommendations

Every 1,250 miles (2000 km) check if the oil level is correct. Drain the oil when it is still hot. This allows the lubricant to run freer and faster, reducing the time needed to completely drain the oil from the differential. Top off or refill until the lubricant drips lightly from the lower edge of the oil fill and level check hole.

The axle must not be washed internally with any type of solvent (kerosene, gasoline, diesel oil, etc.). After each oil change and before returning the vehicle to normal operation, drive it, limiting the speed to 25 mph (40 km/h) for 5 or 10 minutes or 1-2 miles (2-3 kilometers) to ensure that all the lines are properly full of lubricating oil. If the differential is a spare unit and it is not likely that it will be put back into service in the near future, all the bearings and gears should be covered with a good film of anticorrosive oil. In this event, the

differential must be stored in a closed box until it is used to protect it from dust and other impurities.

### Oil Change Periods

#### New or Reconditioned Units

For the initial period (breaking in), the differential oil change must be done between 1,250 and 3,100 miles (2000 and 5000 km). This initial oil change is recommended to ensure that the metallic particles that form to a greater degree during this phase are removed.

#### Post-Breaking in Period

On vehicles that operate on highway with workloads under their maximum permitted capacity, the oil change can be performed every 100,000 miles (160 000 kilometers) or once a year, whichever comes first.

On vehicles that operate on the highway or off-road doing heavy-duty jobs, hauling the heaviest loads permitted, the oil change should be performed at intervals of 25,000-31,000 miles (40 000-50 000 km) or every 6 months, whichever comes first.

### Magnetic Plug

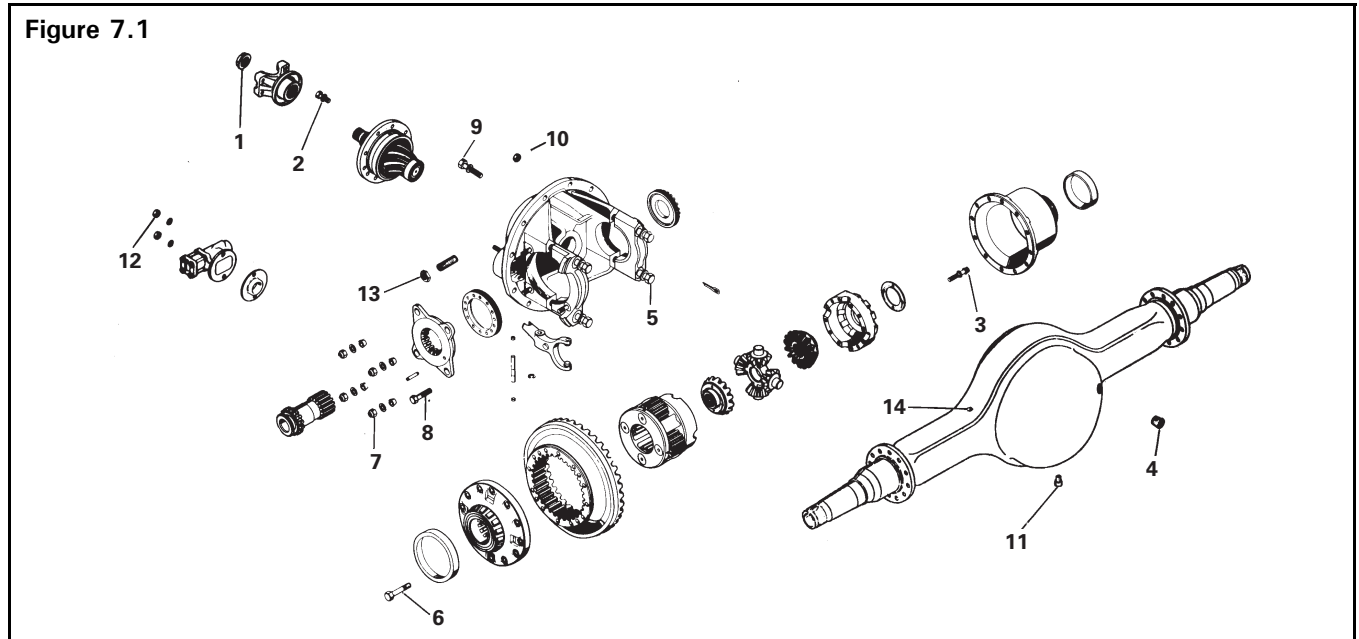
Meritor recommends the use of magnetic plugs for the axle oil draining port.

**NOTE:** The magnetic plug loses its efficiency very soon when it accumulates too many metallic particles and should be cleaned before this happens. After removal and cleaning, the plug can be reused. It is recommended that this procedure be practiced repeatedly between oil change periods.

Meritor Lubricant Specification	Description	Cross Reference	Minimum Outside Temperature	Maximum Outside Temperature
0-76-A	Hypoid Gear Oil	GL-5, S.A.E. 85W/140	+10°F (-12.2°C)	- - - **
0-76-B	Hypoid Gear Oil	GL-5, S.A.E. 80W/140	-15°F (-26.1°C)	- - - **
0-76-D	Hypoid Gear Oil	GL-5, S.A.E. 80W/90	-15°F (-26.1°C)	- - - **
0-76-E	Hypoid Gear Oil	GL-5, S.A.E. 75W/90	-40°F (-40°C)	- - - **
0-76-J	Hypoid Gear Oil	GL-5, S.A.E. 75W	-40°F (-40°C)	+35°F (+1.6°C)
0-76-L	Hypoid Gear Oil	GL-5, S.A.E. 75W/140	-40°F (-40°C)	- - - **

\*\* There is no upper limit on these outside temperatures, but the axle sump temperature **must never exceed +250°F (121°C)**.

The torque values indicated apply to parts covered with a thin film of anticorrosive oil. For dry parts, apply a torque value 10% higher than that specified. For parts lubricated with oil from the unit, apply a torque value 10% lower than that specified.



Item	Description	Specified Torque N•m (lb-ft)			Liquid Adhesive	
		220/224	230	240		
1	Drive pinion nut	1000-1250 (740-920)	1000-1250 (740-920)	1250-1530 (920-1130)		
2	Capscrews (pinion bearing case fasteners)	90-125 (67-91)	90-125 (67-91)	90-125 (67-91)	Fag-3	
3	Capscrews (differential case fasteners)	130-160 (95-115)	130-160 (95-115)	130-160 (95-115)	High Torque	
4	Plug (oil fill and level)	47 minimum (35 minimum)	47 minimum (35 minimum)	47 minimum (35 minimum)		
5	Capscrews (bearing caps fasteners)	295-360(220-265)	295-360(220-265)	575-705(425-520)	High Torque	
6	Capscrews (ring gear and differential case)	205-250(150-185)	205-250(150-185)	205-250(150-185)	High Torque	
7	Nuts (lock plate fasteners)	—	175-220(130-160)	175-220(130-160)	Medium Torque	
8	Capscrews (lock plate fasteners)	575-640(425-475)	—	—	Medium Torque	
9	Capscrews (carrier fasteners)	270-330(200-245)	270-330(200-245)	270-330(200-245)	Medium Torque	
10	Nuts (carrier fasteners)	250-305(185-225)	250-305(185-225)	—	Medium Torque	
11	Drain plug	47 minimum (35 minimum)	47 minimum (35 minimum)	47 minimum (35 minimum)		
12	Nuts (fasteners for speed change control)	46-62 (34-46)	46-62 (34-46)	46-62 (34-46)	Medium Torque	
13	Shift shaft lock nut	—	—	200-260(150-190)	Fag-3	
14	Vent plug	0.125" 27 NPTF	14 minimum (10 minimum)	14 minimum (10 minimum)	14 minimum (10 minimum)	
		0.375" 18 NPT	27 minimum (20 minimum)	27 minimum (20 minimum)	27 minimum (20 minimum)	

Some assemblies may be equipped with optional fastening with studs. This will not change the torque value for the nuts.



## Section 8 Adjustments and Preloads



### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Adjustments and Preloads

### Determine Preload

1. Secure the main differential case assembly. Engage the tool with the splines of one of the differential side gears. **Figure 8.1.** You can build an appropriate tool from an axle shaft with a nut welded to the end to attach a torque wrench. **Figure 8.2.**
2. Check the satellite/planetary assembly rotating resistance value with a torque wrench attached to the nut on the tool. The reading should be between 0 and 50 lb-ft (68 N•m). **Figure 8.3.**



Figure 8.1

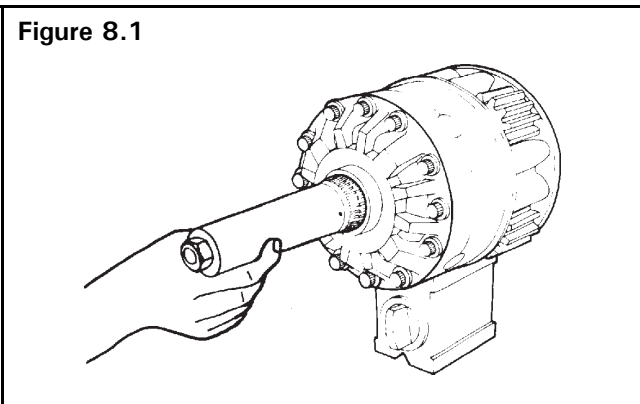


Figure 8.2

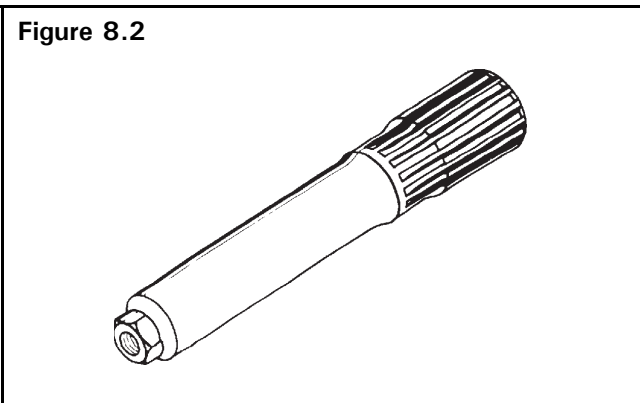
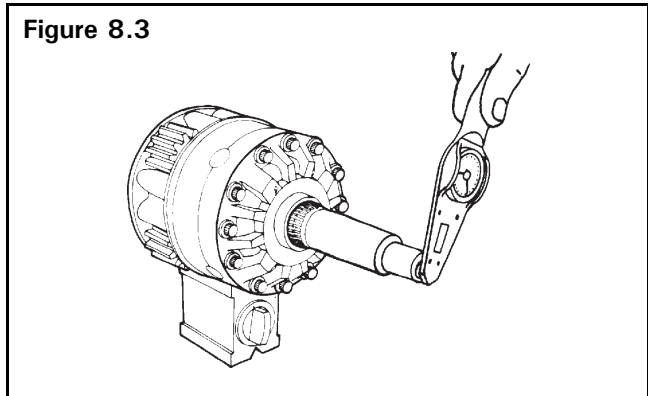


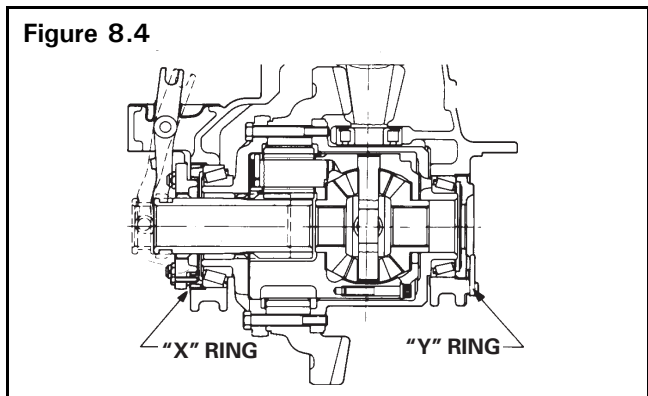
Figure 8.3




### Determine Bearing Preload

1. The preload is obtained by the correct positioning of the bearing adjusting rings. **Figure 8.4.** Gradually tighten the "X" ring until the backlash of the ring gear/drive pinion is eliminated (Zero clearance). Tightening must be gradual so that the ring does not press on the bearing (cup and cone) after the ring gear presses against the drive pinion.

Figure 8.4



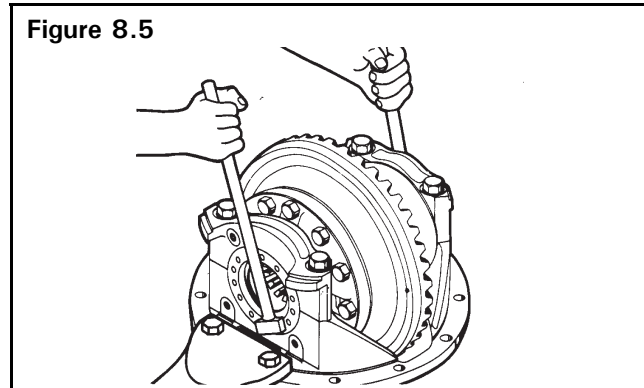
2. Gradually tighten the "Y" ring until the radial clearance of the bearings is eliminated.
3. Loosen the "X" ring 3 or 4 notches.
4. To obtain the desired preload, tighten the "Y" ring until the axial clearance is eliminated, and then tighten 2-3 notches more (for new bearings) or 1-2 notches (for used bearings) or tighten to a torque value of 25-30 lb-ft (34-41 N•m). 
5. Check the engagement clearance of the hypoid set of gears. Refer to Check Hypoid Gear Set Backlash in this section.



### Alternative Method

#### CAUTION

Always use a "T" bar or bars that engage in two opposite notches when you move the bearing adjusting rings. Do not use a chisel or strike the adjusting rings with a hammer. Damage to components can result.



1. Loosen bearing adjusting ring "Y" until axial clearance of the bearings is obtained.
2. Tighten same ring "X" until the backlash of the hypoid set teeth is eliminated (Zero clearance).

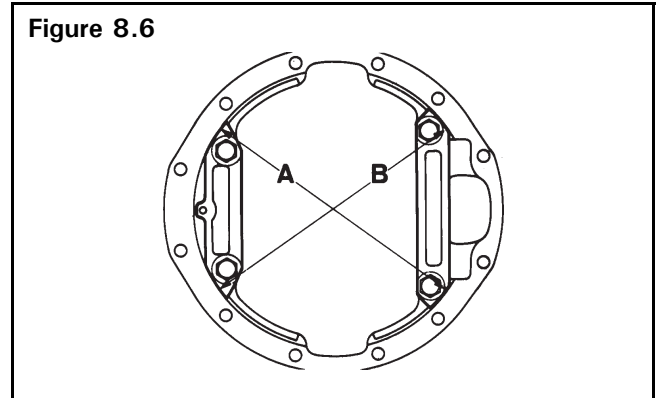
**NOTE:** Tightening must be gradual so that the ring does not press on the bearing (cup and cone) after the ring gear presses against the drive pinion.

3. Measure the distance between opposite surfaces of the bearing caps (diagonals A and B) with a micrometer and record the measurement. **Figure 8.6.**
4. Loosen same ring "X" three or four notches or holes. Tighten ring "Y" gradually to expand the bearing caps between 0.006- to 0.013-inch (0.15-0.33 mm) for new bearings or 0.003- to 0.006-inch (0.08-0.16 mm) for used bearings, which is the bearing preload.
5. Measure again and compare this distance with the results obtained in Step 3. **Figure 8.7.**
6. Check if the expansion specified in Step 4 was obtained.
  - **If the dimension obtained is less than the specifications:** Repeat the tightening process, alternating with measuring/ comparison until the specified expansion is reached.
7. The differential case (flange and plain half) and

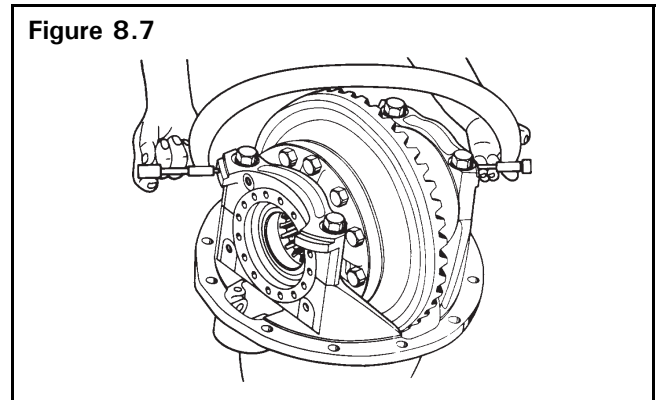
the lock plate must be inspected and replaced if they present assembly difficulties.

8. Check the runout of the rear surface of the ring gear. **Figure 8.8.** If the value is greater than 0.019-inches (0.20 mm), check the causes and correct.

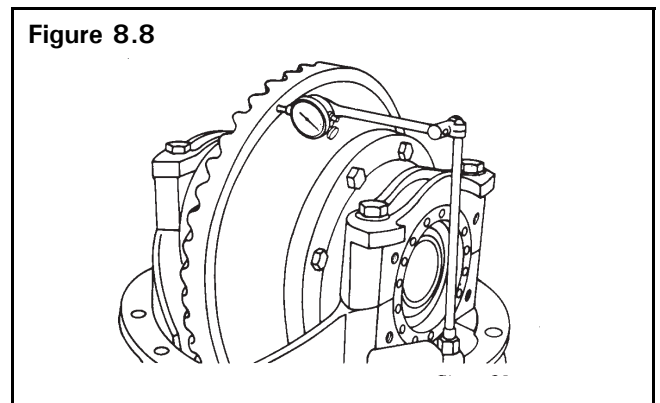
**Figure 8.6**



**Figure 8.7**



**Figure 8.8**



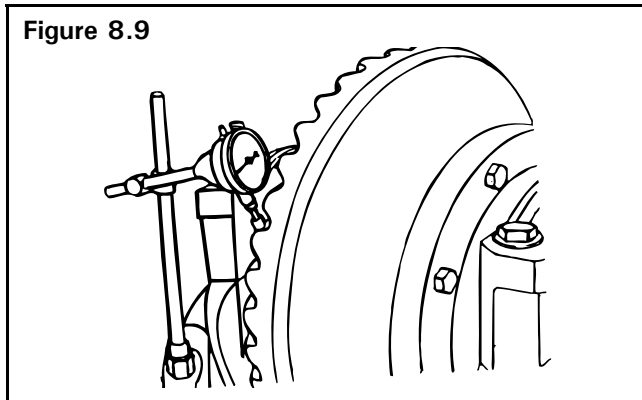
## Section 8 Adjustments and Preloads



### Check Hypoid Gear Set Backlash

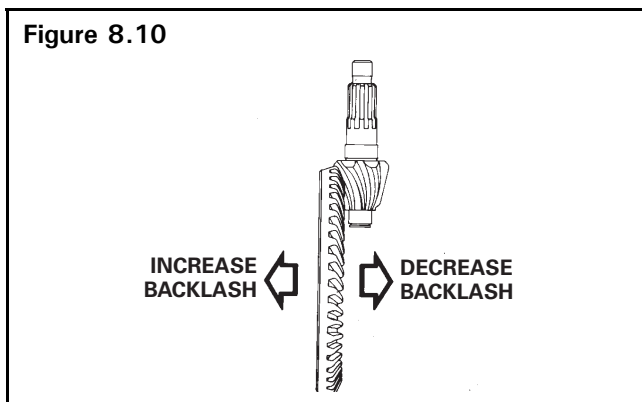
Check the backlash of the hypoid gear set using the following procedure.

1. Rest the pointer of a dial indicator on one of the ring gear teeth. **Figure 8.9.**



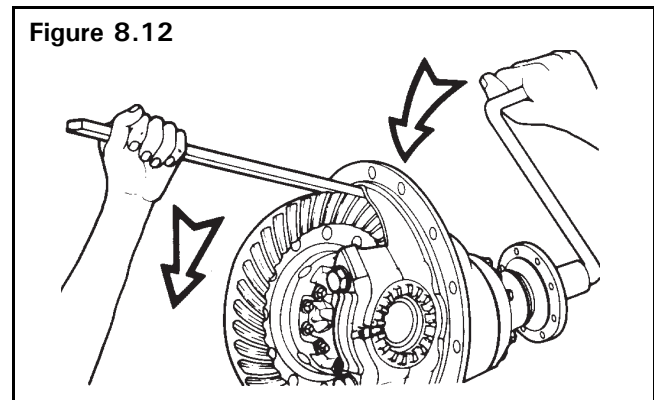
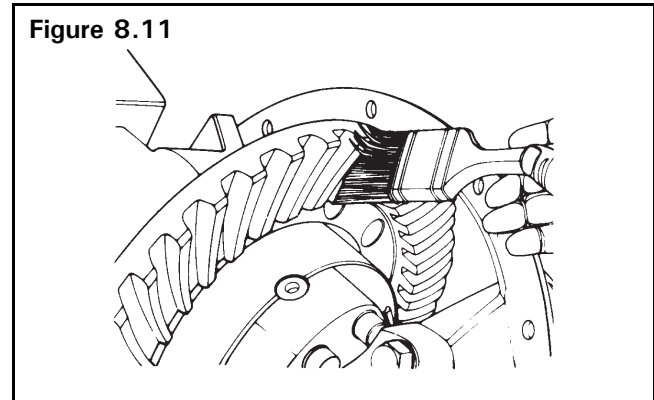
2. Immobilize the drive pinion, manually rotate the ring gear in both directions and take the reading. The value for the backlash should be between 0.010- to 0.016-inches (0.25-0.40 mm).

- **If you reuse the hypoid gear set:** Meritor recommends that the original backlash (measured before disassembling the differential) be maintained.
- **If it is necessary to increase or decrease the backlash:** Loosen ring "X" and tighten ring "Y" in the same proportion to avoid altering the bearing preload. **Figure 8.10.**



### Verification Process

1. Apply yellow iron oxide (diluted in fine oil) on some of the ring gear's teeth. **Figure 8.11.**
2. Break the ring gear with a bar or a board and rotate the drive pinion manually until impressions of the tooth contacts on the convex side (forward drive) of the ring gear are obtained. **Figure 8.12.**



3. Check if the contact obtained by the manual process is consistent with the pattern. **Figure 5.29.** If not, use the correction methods explained under Incorrect Contact Patterns in this section.
4. Immediately clean the yellow iron oxide from the teeth of the hypoid gear set.

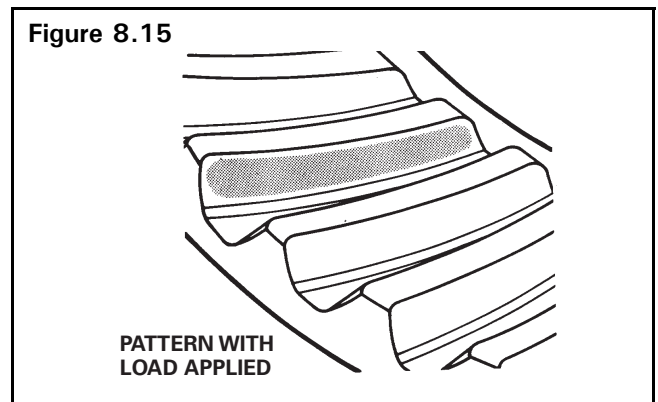
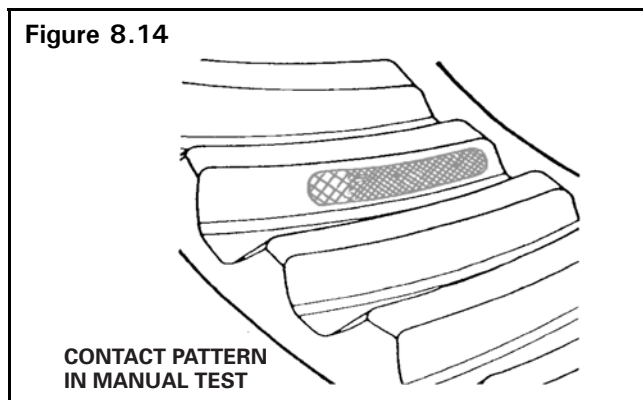
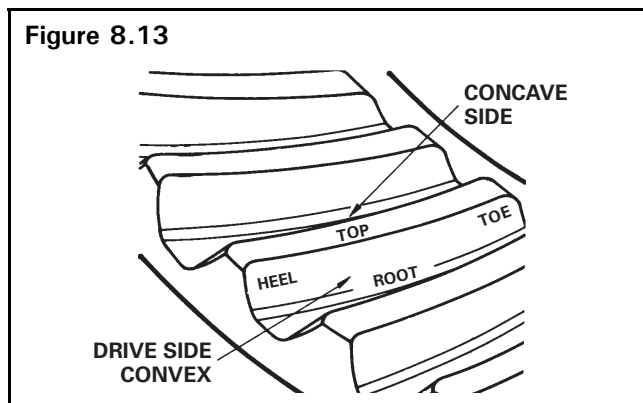
## Correct Contact Patterns

For clarification purposes, **Figure 8.13** offers the terminology used in this section.

The contact pattern for the manual process indicates that the position of the gears is correct, covering a contact area from the center to the toe and the heel/top and the root of the tooth. This area of contact covers approximately 70-80% of the tooth's area. **Figure 8.14**.

If the convex side is satisfactory, the contact of the concave side (reverse drive) can be automatically accepted.

The pattern with a load applied shows the resulting contact when the gears approved by the manual process suffer the action of a load (work operation). The contact area extends the length of the tooth, and the top of the pattern is near to the top of the ring gear's tooth. **Figure 8.15**.



## Incorrect Contact Patterns

### Tooth Height Variations

If the drive pinion is not at the proper depth, the contact can show tooth height variation. If so, alter the position, varying the thickness of the shim pack of the drive pinion bearing case. Refer to **Table I**.

**Table I**

Contact Obtained	Meaning	Correction
Shallow Contact	The pinion is too close to the ring gear. The resulting contact is too close to the top of the tooth. <b>Figure 8.16</b> .	Bring the drive pinion closer by reducing the thickness of the drive pinion bearing cage shim packet. (Refer to Section 5.) This will cause the contact to move towards the root of the tooth. <b>Figure 8.14</b> .
Deep Contact	This indicates that the drive pinion is too close to the ring gear, causing the contact to be too close to the root of the tooth. <b>Figure 8.17</b> .	Withdraw the drive pinion by increasing the thickness of the drive pinion bearing cage shim packet. (Refer to Section 5.) This will cause the contact to move towards the top of the tooth. <b>Figure 8.14</b> .

# Section 8 Adjustments and Preloads

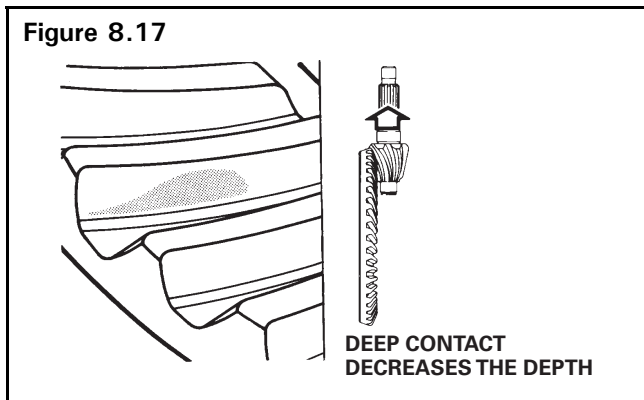
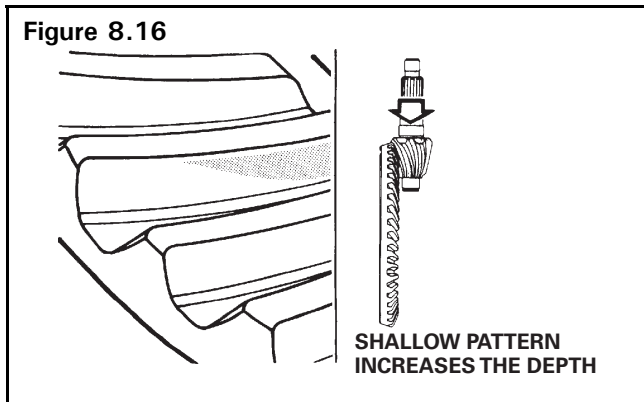
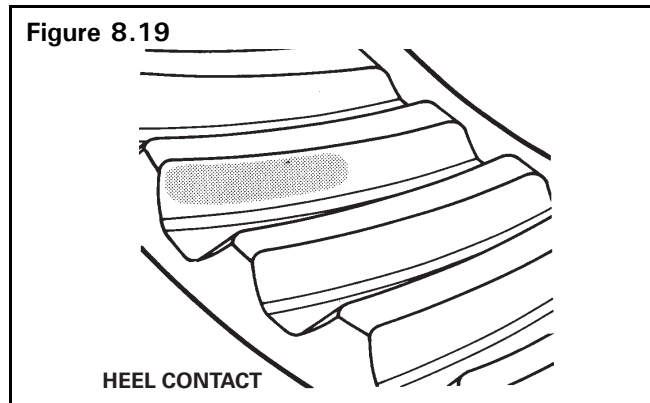
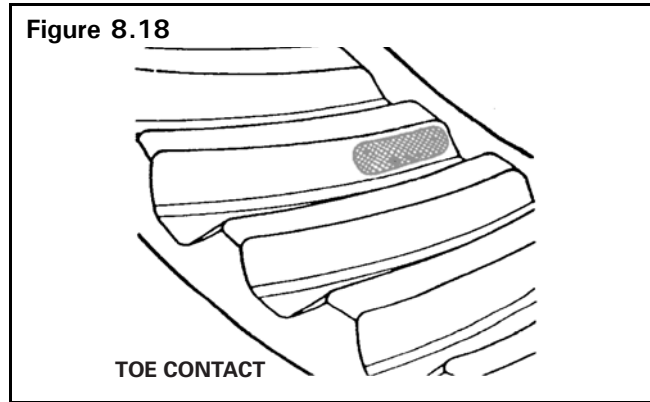


## Tooth Pattern Variations

Immediately check if the contact shows variation with respect to the tooth pattern. If variation should exist, alter the depth of the ring gear by varying the backlash. Refer to **Table J**.

**Table J**

Contact Obtained	Meaning	Correction
Toe Contact	This indicates that the ring gear is too close to drive pinion, causing the contact to be too close to the toe of the tooth. <b>Figure 8.18.</b>	Retract the ring gear to increase the backlash (if necessary to the maximum permitted) for the contact area to move towards the heel, drawing closer in the manner indicated in <b>Figure 8.14.</b> Refer to Check Hypoid Gear Set Backlash in this section.
Heel Contact	The ring gear is too far away from the drive pinion. The resulting contact is too close to the heel. <b>Figure 8.19.</b>	Draw the ring gear closer, decreasing the backlash (if necessary to the maximum permitted) to move the contact area towards the toe, drawing closer as shown in <b>Figure 8.14.</b>





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