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**906 W. GORE ST. ORLANDO, FL 32805**

[PARTS@EPROGEAR.COM](mailto:PARTS@EPROGEAR.COM)

## ROCKWELL DIFFERENTIAL CARRIER

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## DIFFERENTIAL CARRIER

## 1 INTRODUCTION.

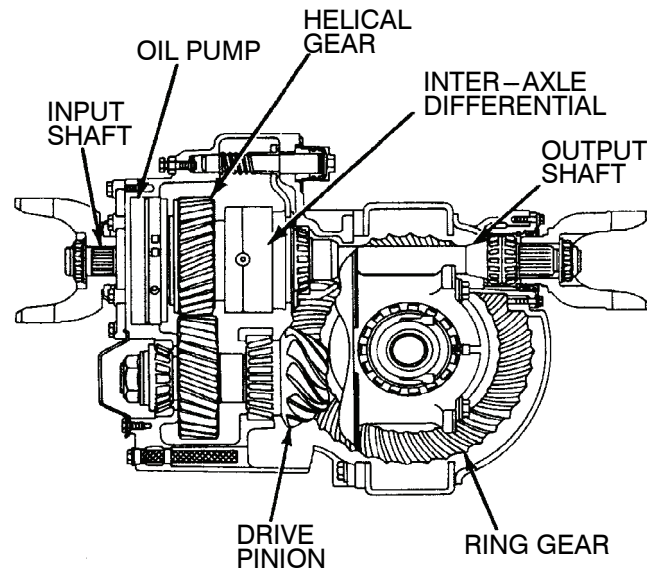


Figure 1. Forward Rear Axle.

The differential carriers used on the RT axles are hypoid pinion and ring gear arrangements. The front axle receives input power to the pinion gear via an input for top shaft. The top shaft is equipped with a helical gear that transfers the power to the lower (pinion) shaft helical gear. The pinion shaft rotates causing the differential ring gear to turn. The differential spider (cross shafts) and spider pinion gears are bolted to the ring gear through the use of a two piece differential case.

The side gears of the differential spider are splined to accept the splined ends of the axle shafts. The differential spider allows either axle to rotate at a different rate than the opposite side.

The forward axle is equipped with a pressurized lubrication system. This filtered system has an oil pump that is driven by the input shaft and circulates lubricant to the journals in the forward and rear input shaft bearings and through the inter-axle differential. Figure 1.

The inter-axle differential is located behind the upper helical gear on the input shaft. The forward side gear of the inter-axle differential is part of the upper helical gear hub and the through-shaft is splined to the rear side gear of the inter-axle differential.

Both the forward and rear axles are equipped with a driver-controlled main differential lock. This differential lock is operated by an air-actuated shift unit that is mounted on the carrier. When the differential lock is activated, the shift collar is moved along the splines of the axle shaft toward the differential case. When the splines on the collar are engaged with the splines on the differential case, the axle shaft and the differential assembly are locked together.

When the carrier operates in the locked position, there is no differential action between the wheels of the axle. When the carrier is operated in the unlocked position, there is normal differential action between the wheels at all times.

The rear axle differential receives power from the front axle by the through-shaft in the front housing and a short drive shaft between axles. The gear train and spider arrangement in the rear axle is similar to the front axle system.

This group covers the removal, disassembly and repair of the differential carrier. Other groups may be referred to in order to perform total axle service. These groups are:

GROUP	TITLE	REASON	NOTE
85	Lubrication	Lubricants	
405	Tandem Rear Axle and Suspension Installation	Axle Remover	
430	Inter-Axle Differential	Inter-Axle differential repair	(5) Remove the covers from the wheel hubs. (6) Shift the main differential to the unlocked (disengaged) position. Install the axle shafts with two sets of splines and new gaskets in the correct location as follows: Figure 3.
440	Rear Axle Assembly	Axle shaft removal	
450	Bear Brake Assembly	Brake repair	(a) Push the axle shaft and gasket into the hub and housing until the shaft stops against the differential lock collar.
580	Driveshafts and Universal Joints	Driveshaft removal	(b) Push down and in on the axle shaft flange and rotate the shaft until the splines of the shaft and the shift collar are engaged. (c) Push the axle shaft further into the housing until the shaft stops against the differential side gear. (d) Push down on the axle shaft flange and rotate the shaft until the splines of the shaft and the side gear are engaged. (e) Push the axle shaft completely into the housing until the axle shaft flange and gasket are flush against the wheel hub.

**2 DIFFERENTIAL CARRIER AND OUTPUT SHAFT REMOVAL.**

- (1) Remove the oil filter shield from the input bearing cage.

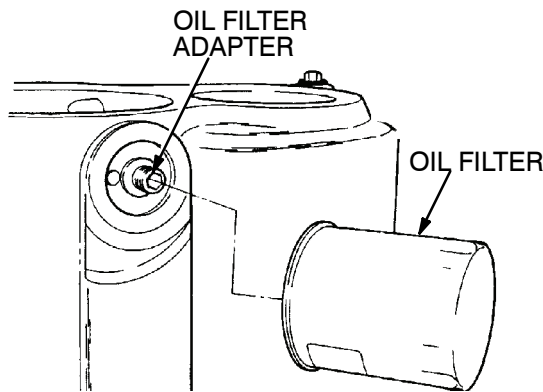


Figure 2. Oil Filter Removal.

- (2) Use a filter strap wrench to remove the oil filter. Discard the filter and replace it with a new filter at assembly. Figure 2.

**CAUTION**

There can be approximately one pint of lubricant remaining in the filter. Be careful that the oil does not spill when removing the filter.

- (3) If necessary, remove the oil filter adapter.
- (4) The main differential lock must be shifted into and held in the locked (engaged) position. The locked position gives enough clearance between the shift collar and the axle housing to permit the removal of the carrier.

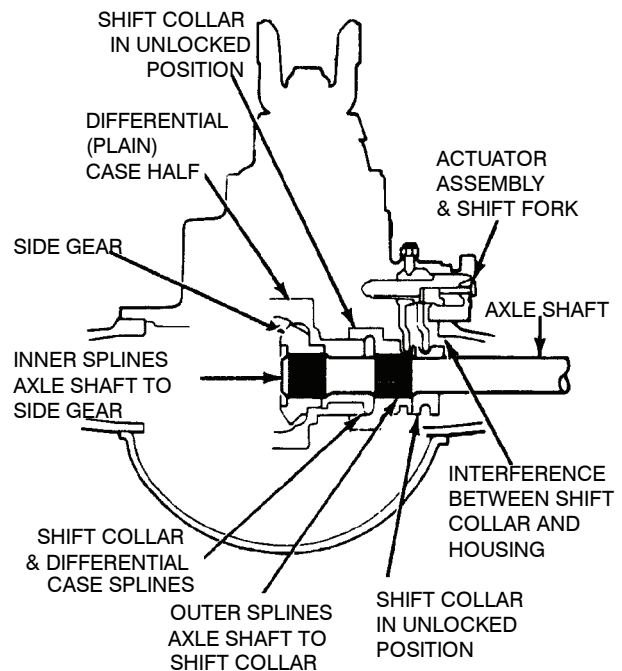
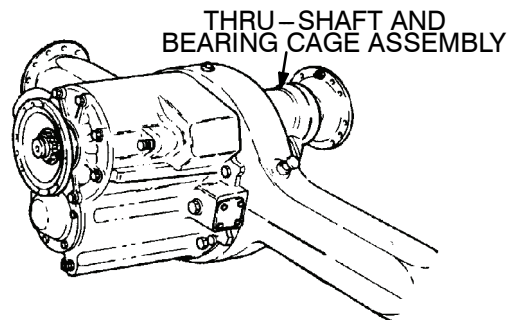


Figure 3. Installing Axle Shaft in Differential Lock Side of Axle Assembly.

- (7) To shift into the locked position, use either of the following "Air Pressure" or "Manual Engaging" methods. (See sections 2.1 and 2.2).
- (8) Disconnect the forward and rear drive shafts.
- (9) Disconnect the air lines at the inter-axle differential shift unit.
- (10) Remove the output shaft bearing cage capscrews and washers. Pull the bearing cage, bearings and output shaft assembly from the axle housing. If necessary, loosen the cage from the housing with a soft mallet. Be careful that the oil seal is not damaged. Figure 4.



(Axle shown with flanges instead of yokes)

Figure 4. Output Shaft and Bearing Cage Removal

- (11) The output shaft is disassembled and assembled in Service Group 430-8.
- (12) Put a hydraulic roller jack under the differential carrier to support the assembly. Figure 5.
- (13) Remove all but the top two carrier-to-housing capscrews or stud nuts and washers. Figure 5.
- (14) Loosen, but do not remove, the top two carrier-to-housing fasteners. The fasteners will hold the carrier in the housing.
- (15) Loosen the differential carrier in the axle housing. Use a leather mallet to hit the mounting flange of carrier at several points.
- (16) After the carrier is loosened, remove the top two stud nuts and washers that hold the assembly in the axle housing.
- (17) Carefully remove the carrier from the axle housing using the hydraulic roller jack. Use

a pry bar that has a round end to help remove the carrier from the housing.

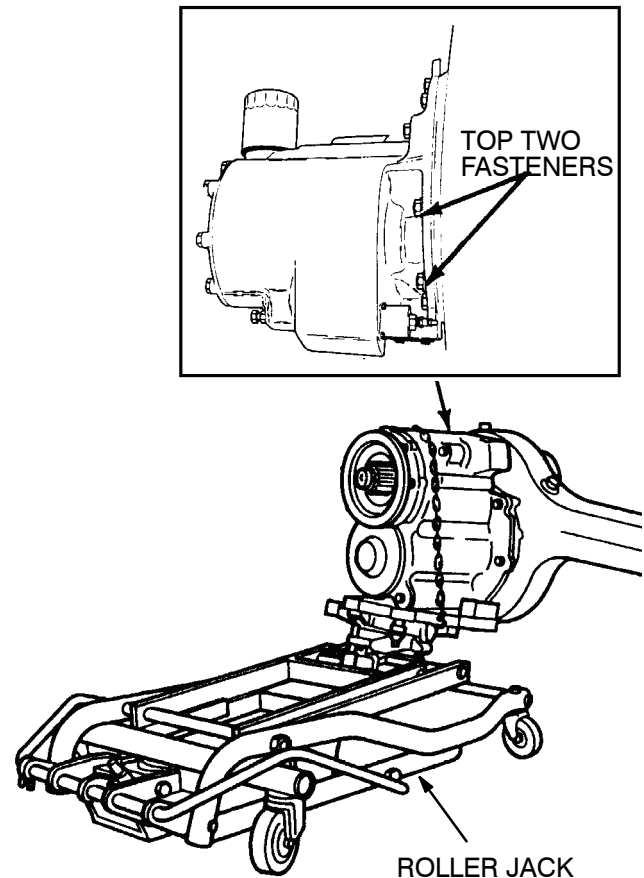


Figure 5. Supporting and Removing the Carrier

### ⚠ CAUTION

**When using a pry bar, be careful not to damage the carrier or housing flange. Damage to these surfaces will cause oil leaks.**

- (18) On axles with a main differential lock, if air pressure is used to shift the differential to the locked (engaged) position, release the air pressure. Disconnect the air hose from the shift unit.
- (19) Lift the differential carrier by the input yoke or flange and put the assembly in a repair stand. Use a lifting tool for this procedure. **DO NOT LIFT BY HAND.** Figure 6.

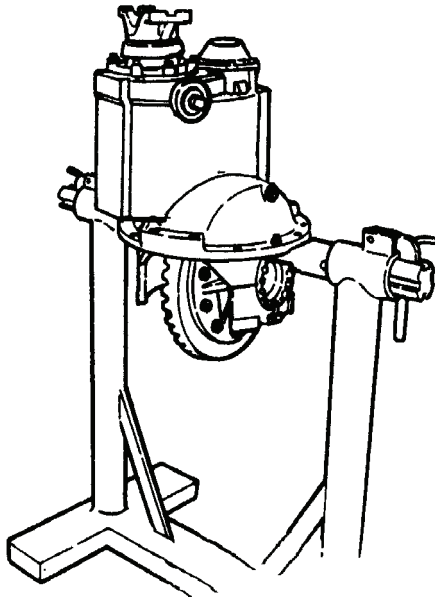


Figure 6. Carrier Mounted in Stand

### 2.1 Air Pressure Method:

- (1) Raise the differential lock side wheel end of the drive axle off the floor with a hoist or jack.

#### **⚠ WARNING**

**Do not start the vehicle engine and engage the transmission with one wheel raised from the floor. When the differential is in locked (engaged) position, power will go to the wheel on the floor and cause the vehicle to move.**

- (2) Put a jack stand under the raised wheel end spring seat to hold the vehicle in the raised position.

#### **⚠ WARNING**

**Do not work under a vehicle supported only by jacks. Jacks can slip or tip over and cause injury.**

- (3) Disconnect the driveline from the input yoke.
- (4) Disconnect the vehicle air line from the inter-axle differential and main differential lock actuator assemblies.
- (5) Connect an auxiliary air supply to the differential lock actuator assembly.

### NOTE

**If an auxiliary air supply is not available, continue to “Manual Engaging Method” of locking the differential.**

- (6) Apply and hold air pressure to the actuator assembly. The air pressure will move the shift collar to engage with the splines on the differential case half and lock the assembly.
- (7) Make sure that the shift collar has moved the full distance on the splines of the differential case half. Rotate the left-hand wheel until the left-hand wheel makes one complete rotation (forward or backward). The differential is fully engaged at this time and you will not be able to rotate the wheel.

Continue to hold the main differential in the locked position with air pressure until the carrier assembly is completely removed from the axle housing.

- (8) Remove the axle shafts from the housing.

**2.2 Manual Engaging Method.** If an auxiliary air supply is not available or if the differential carrier is to be stored for later use, use this manual engaging method. See Figure 7.

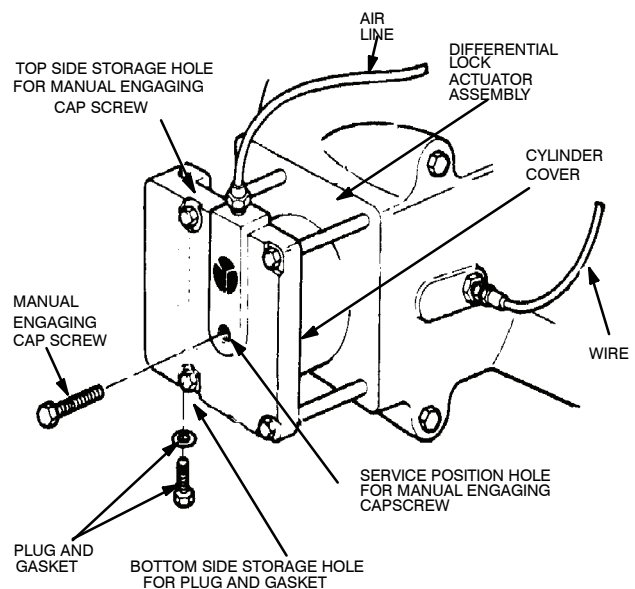


Figure 7. Manually Locking the Differential.

- (1) Follow steps 1 through 4 of the “Air Pressure Method.”
- (2) Remove the plug and gasket from the hole in the center of the cylinder cover.
- (3) Remove the manual engaging capscrew from the top storage hole in the cylinder cover.



- (4) Install the plug and gasket into the bottom storage hole in the cylinder cover.

### NOTE

The storage hole for the plug and gasket is located on the opposite end of the storage hole for the manual engaging capscrew.

- (5) Install the manual engaging capscrew into the threaded hole in the center of the cylinder cover.
- (6) Turn the manual adjusting capscrew to the right until the head is approximately 1/4 inch from the cylinder cover. DO NOT turn the capscrew beyond its normal stop. The capscrew is now in the service position and the main differential lock is completely engaged.

### CAUTION

There will be a small amount of spring resistance felt when you turn in the manual engaging capscrew. If a high resistance is felt before reaching the locked (engaged) position, STOP TURNING THE CAPSCREW or the cover, the fork and capscrew threads will be damaged.

- (7) A high resistance on the capscrew indicates that the splines of the shift collar and the differential case half are not aligned or engaged. To align, the splines, use the following procedure:
  - (a) Rotate the left-hand wheel to align the splines of the shift collar and case half while you turn in the manual engaging capscrew.
  - (b) When the normal amount of spring resistance is again felt on the capscrew, the splines are engaged. Continue to turn in the manual engaging capscrew until the head is approximately 1/4 inch from the cylinder above.
- (8) Remove both axle shafts.

## 3 CHECKING RING GEAR BACKLASH.

Check the backlash at three places on the ring gear. See the following procedure.

### NOTE

Unless a new ring gear and drive pinion are installed, the backlash of the ring gear must be checked and recorded before the carrier is disassembled. The backlash reading is necessary for the correct installation of the ring gear and the drive pinion.

- (1) Turn the carrier so that the ring gear is toward you.
- (2) Install a dial indicator on the flange of the carrier. Put the tip of the indicator against the "drive" side of a tooth on the ring gear. Adjust the dial indicator to the "zero" (0) setting. Figure 8.

### NOTE

When you rotate the ring gear to measure the backlash, if necessary, make sure the drive pinion does not move.

- (3) Look at the dial indicator and slightly rotate the ring gear in both directions. Record the reading on the dial indicator.

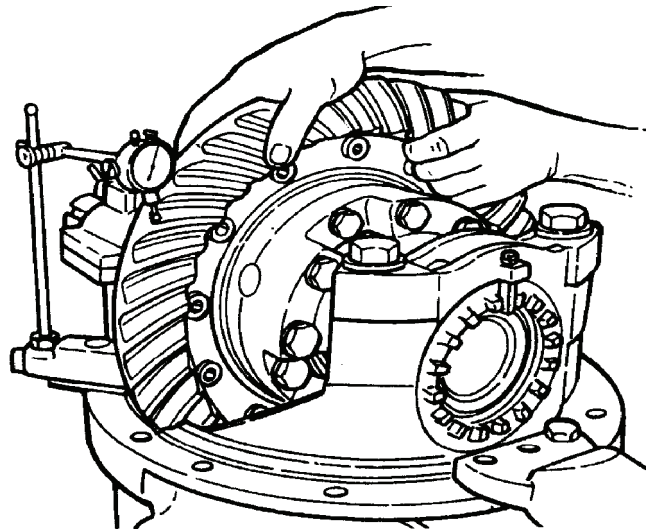


Figure 8. Checking Ring Gear Backlash.

## 4 REMOVING THE INPUT SHAFT AND INTER-AXLE DIFFERENTIAL ASSEMBLY.

- (1) Move the carrier so that the input shaft is toward you.
- (2) Remove the capscrews and the washers that fasten the cover of the drive pinion on

the differential carrier. Remove the cover. Remove all gasket material from the cover and the differential carrier. Figure 9.

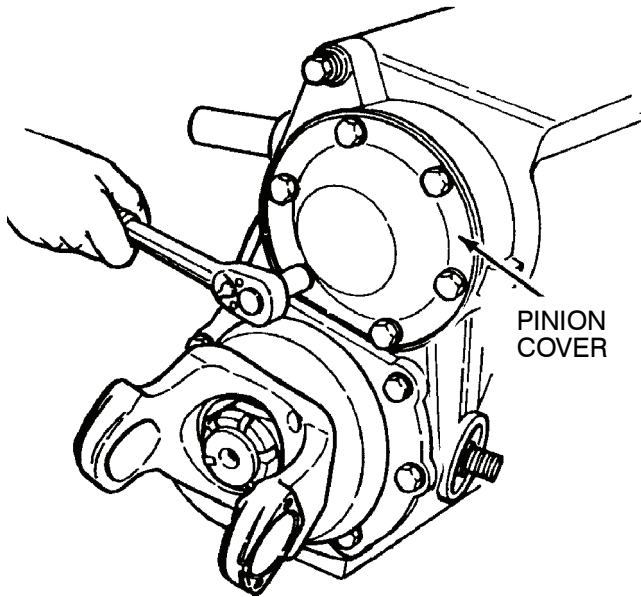


Figure 9. Drive Pinion Cover Removal.

**DO NOT REMOVE**, the nut that fastens the yoke to the input shaft. Figure 11.

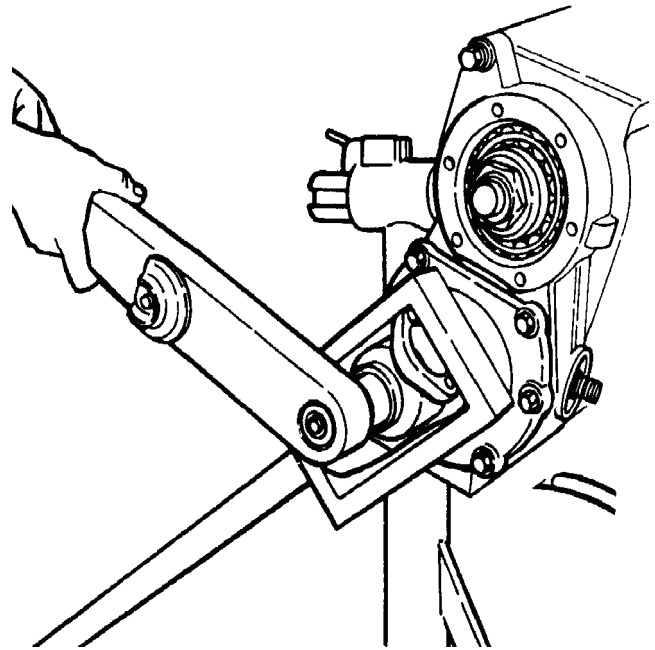


Figure 11. Input Shaft Yoke Nut.

- (3) Use the correct holding tool to hold the input yoke in a stationary position. Loosen, **BUT DO NOT REMOVE**, the nut on the drive pinion. Figure 10.

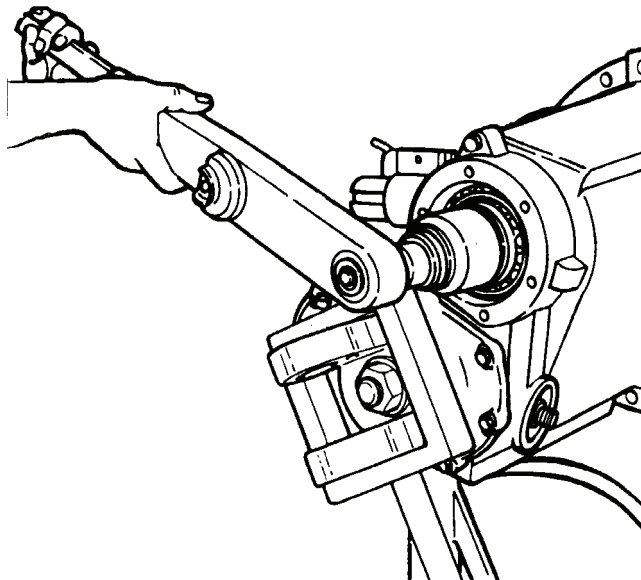


Figure 10. Drive Pinion Nut.

- (5) Remove the capscrews and the washers that fasten the input bearing cage to the differential carrier. Figure 12.

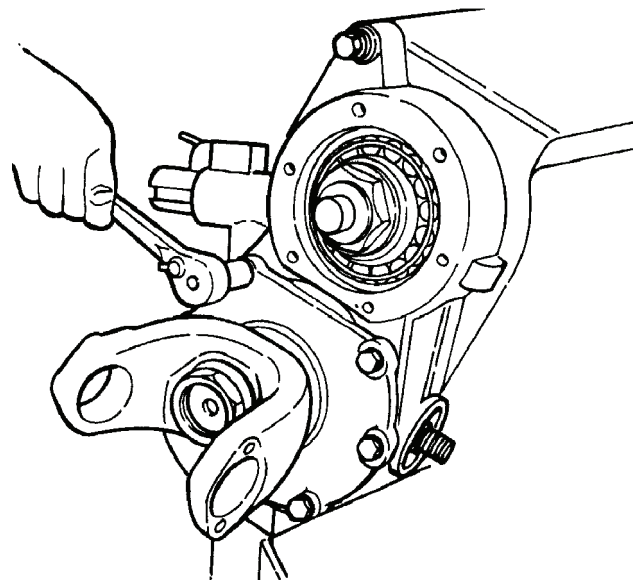


Figure 12. Input Shaft Bearing Cage.

- (4) Use the correct holding tool to hold the input yoke in a stationary position. Loosen, **BUT**

- (6) Move the carrier so that the input shaft is in a vertical position with the yoke on the top. Connect a lifting device to the input yoke.



**NOTE**

Before the input shaft assembly is completely removed from the carrier, put alignment marks on the helical drive gear and the helical driven gear.

- (7) Remove the input shaft, the oil pump, and the inter-axle differential from the carrier according to the following procedure.

**CAUTION**

There are two notches on the case of the inter-axle differential. One of the notches on the case must be aligned with helical driven gear. If the notch is not aligned over the gear, the gear will prevent the removal of the input shaft assembly and cause damage to the assembly.

- (a) Lift the input shaft assembly until the bearing cage is separated from the carrier. If necessary, tap on the bearing cage with a brass or plastic mallet to separate the cage from the carrier. Figure 13.
- (b) Slowly lift the input shaft assembly. See the following:

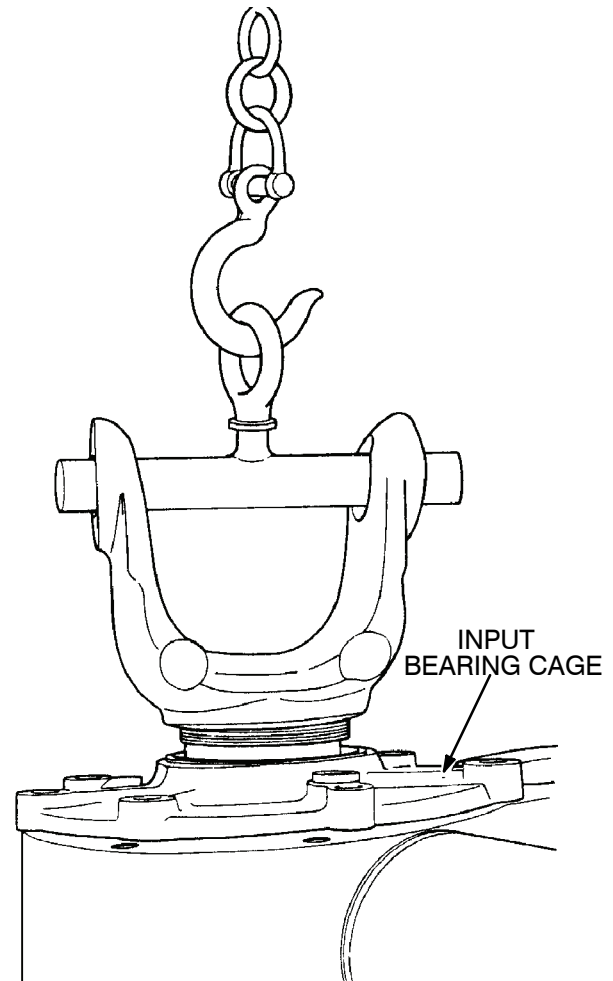


Figure 13. Input Shaft and Bearing Cage Removal.

**NOTE**

There are two notches on the side of the inter-axle differential case. When one of the notches is aligned with the helical driven gear, the case can be removed.

- \* If the input shaft assembly comes out of the carrier easily, remove the assembly.
- \* If the input shaft assembly cannot be removed easily, the case of the inter-axle differential must be rotated. Rotate the input shaft until one of the notches on the case is aligned over the helical driven gear. Remove the input shaft assembly from the carrier. Figure 14 and Figure 15.

- (c) Put the input shaft assembly on a bench.

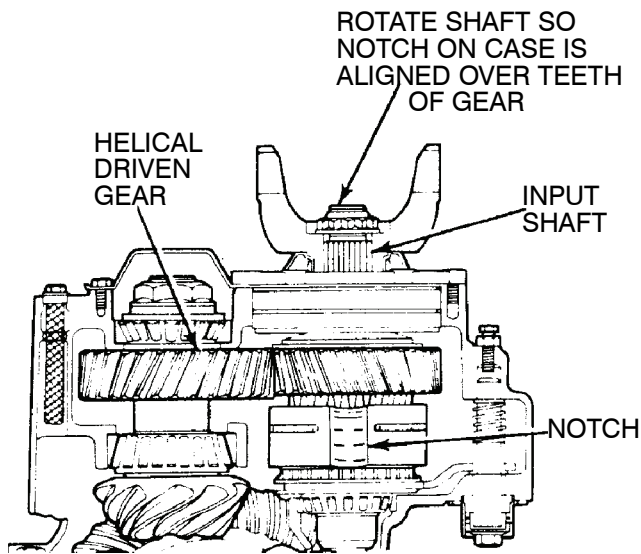


Figure 14. Input Shaft Assembly.

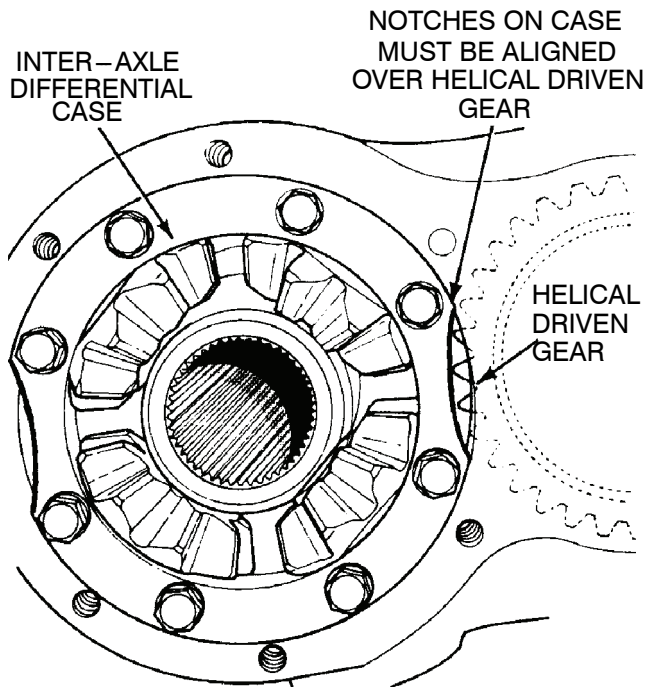


Figure 15. Case to Gear Alignment.

- (8) Remove the shims from between the bearing cage and the differential carrier.
- (9) Remove the rear side gear and the bearing cone from the carrier. Remove the collar. Figure 16.

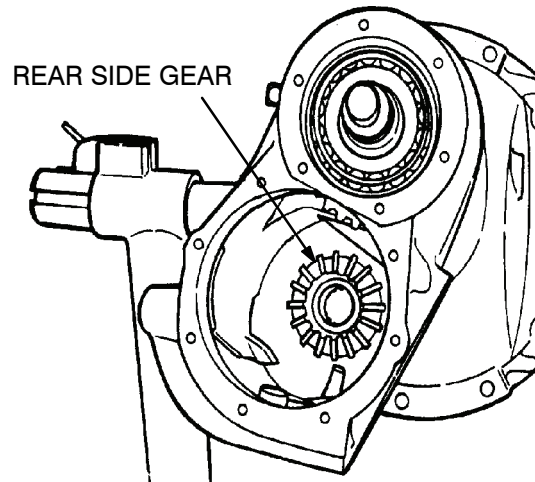


Figure 16. Rear Side Gear Removal.

**NOTE**

If either the bearing cup or cone on the rear side gear need replacement, both parts must be replaced in a set from the same manufacturer.

- (10) If necessary, use a press, a sleeve and a bearing puller to remove the cone from the rear side gear. Figure 17.
- (11) If necessary, use a brass drift and a hammer to remove the cup of the rear side gear cone from the differential side of the carrier.

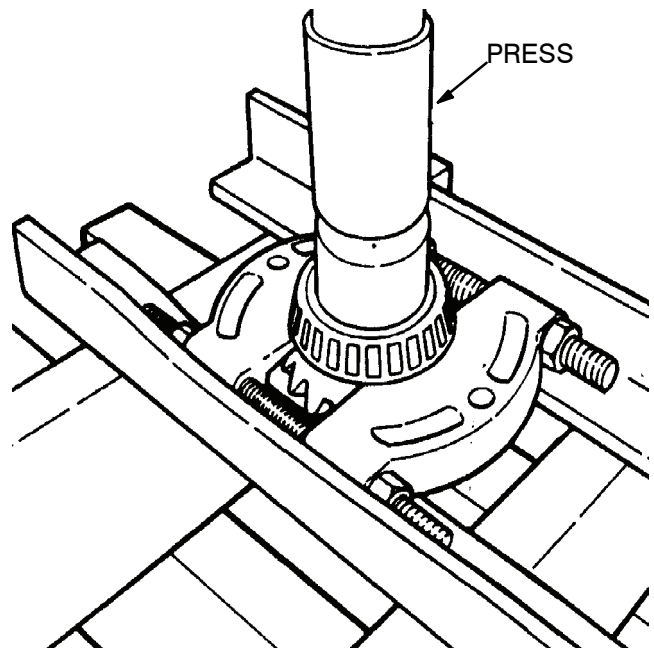


Figure 17. Rear Side Gear Bearing Cone Removal.

5 INPUT SHAFT DISASSEMBLY.

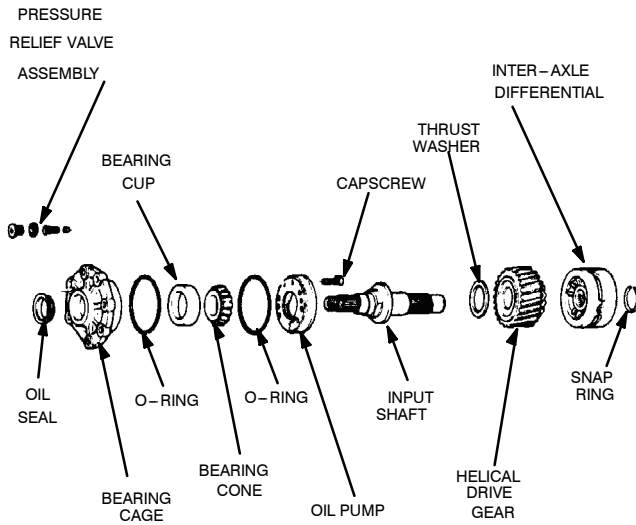


Figure 18. Input Shaft Assembly.

- (1) Use the correct tool to remove the yoke from the input shaft. Figure 19.

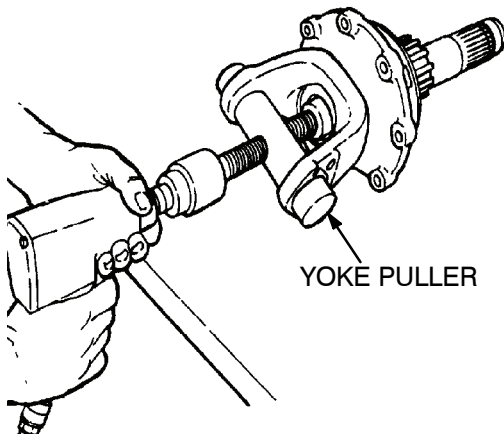


Figure 19. Input Shaft Yoke Removal.

- (2) Pry under the flange of the oil seal to remove the oil seal from the input bearing cage. Replace the oil seal if the oil seal is damaged. Figure 20.

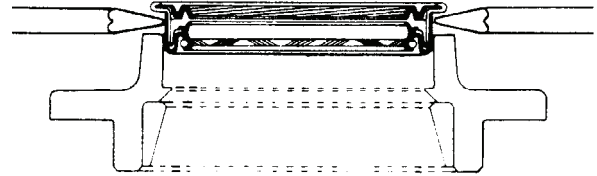


Figure 20. Input Bearing Cage Oil Seal Removal.

**WARNING**

Wear safety glasses to prevent injury when servicing snap rings.

- (3) Remove the snap ring that fastens the inter-axle differential assembly to the input shaft. Remove the inter-axle differential assembly from the input shaft. Figure 21.

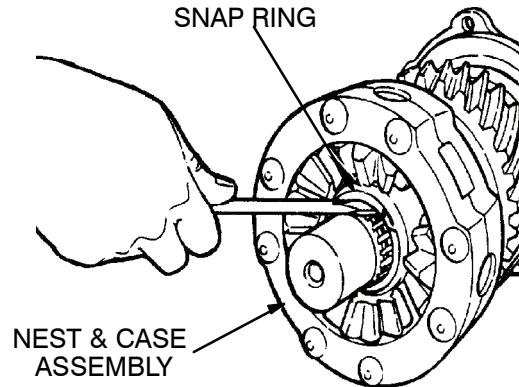


Figure 21. Inter-Axle Differential Removal.

**NOTE**

Disassemble the inter-axle differential only if any of the components are damaged and must be replaced. Refer to Service Group 430-8.

The inter-axle differential of the 140 and 145 series carriers are serviced as an assembly and are not to be disassembled.

- (4) Remove the helical drive gear from the input shaft. Remove the thrust washer from the gear. Figure 22.

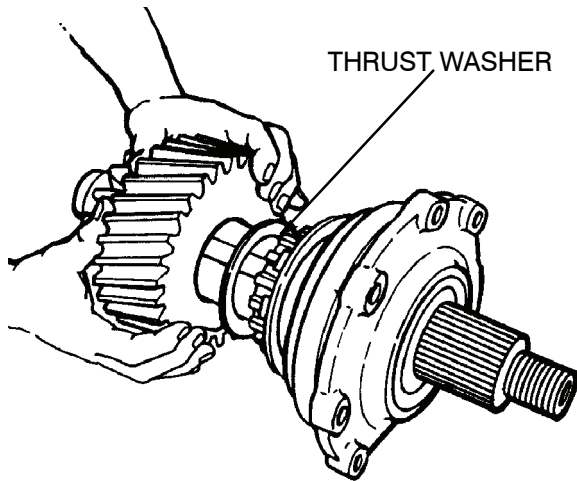


Figure 22. Drive Gear Removal.

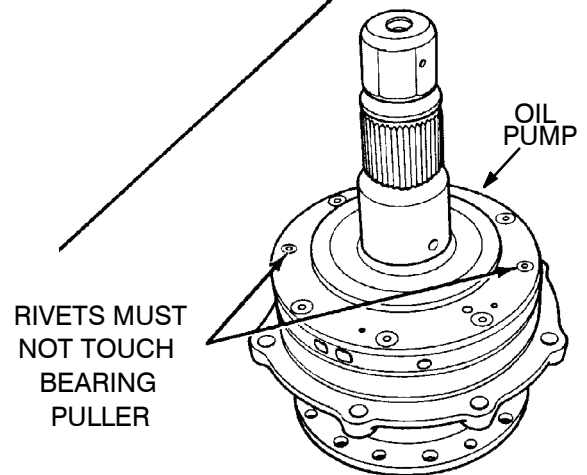
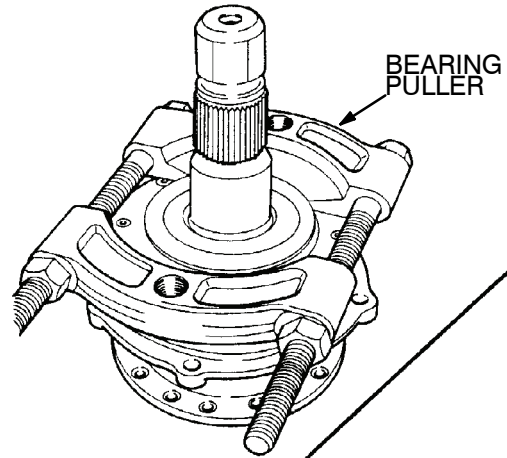


Figure 23. Bearing Puller Installation.

**NOTE**

Two oil pump designs are used: a “drive-flat” design and a “spline” design.

- (5) Remove the input bearing cage and the oil pump from the input shaft. See the following procedure.

**⚠ CAUTION**

Use the following procedure. If the procedure is not followed, the oil pump or the bearing cage will be damaged during removal. Pressure must never be applied directly to the surface of the pump or the bearing cage.

- (a) Put puller under the oil pump. Make sure the rivets on the back of the pump do not touch the bearing puller. The bearing puller provides a level surface so that the shaft is pressed straight out of the assembly. Figure 23.
- (b) Put the assembly on a press so that the assembly rests on the puller. Figure 24.
- (c) Put a protector on top of the threaded part of the shaft. Press the input shaft from the assembly. Remove the bearing puller. Figure 24.

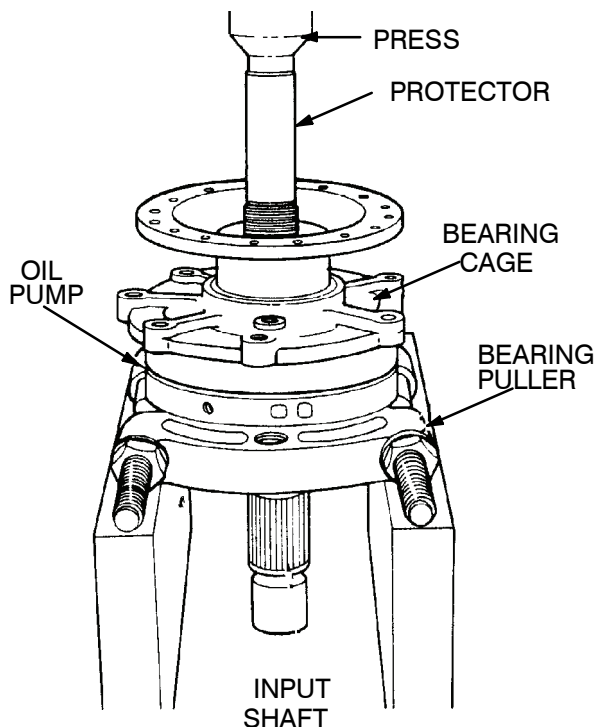


Figure 24. Separating the Input Shaft From the Bearing Cage.

- (d) Remove the capscrews that fasten the oil pump to the input bearing cage. Separate the oil pump from the cage. Figure 25.

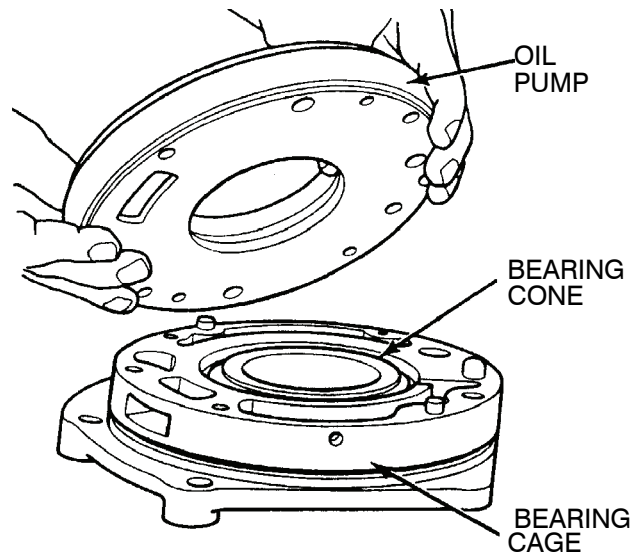


Figure 25. Oil Pump Removal.

- (e) Replace the pump if the pump is worn, or damaged. For example: If the drive flats or the splines in the pump do not move.
- (6) Remove the O-rings from the bearing cage and the oil pump assembly.
- (7) Remove the cone from the input bearing cage.

**NOTE**

If either the bearing cup or cone need replacement, both parts must be replaced in a set from the same manufacturer.

- (8) If necessary, use a press and a sleeve to remove the cup from the input bearing cage.
- (9) If necessary, remove the pressure relief valve assembly from the front of the bearing cage. Remove the plug, the spring and the relief valve from the bore. Figure 26.

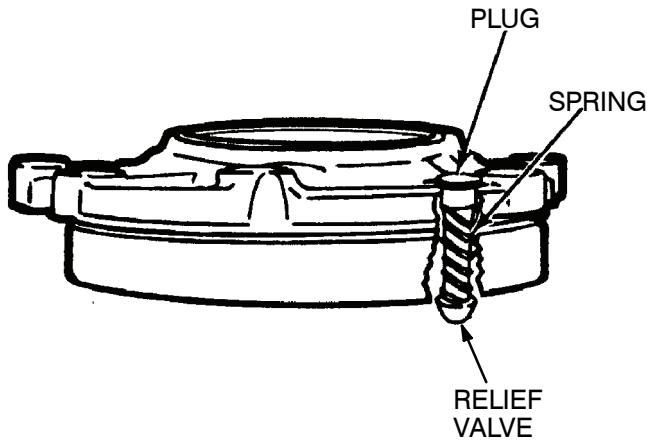


Figure 26. Pressure Relief Valve Removal.

**6 REMOVING THE AIR SHIFT COMPONENTS FOR THE INTER-AXLE DIFFERENTIAL LOCK.**

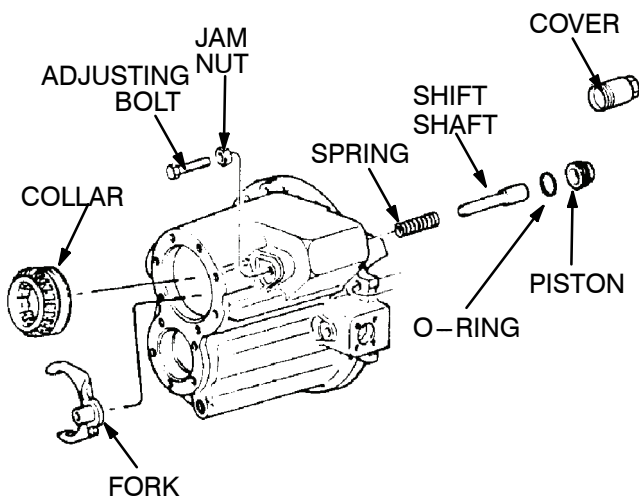


Figure 27. Inter-Axle Differential Shift Components.

- (1) Remove the adjusting bolt and the jam nut.

**NOTE**

The following shift components are removed by reaching in through the input shaft bore.

- (2) Remove the shift shaft from the differential carrier. When the shift shaft is removed, the fork and the spring may fall.

**NOTE**

The cover is welded to the carrier housing and cannot be removed.

- (3) Remove the piston from the shift shaft or cover.
- (4) Remove the O-ring from the piston and inspect for damage.
- (5) Remove the shift collar and the fork.

**7 REMOVING THE MAIN DIFFERENTIAL LOCK.**

- (1) To remove the differential lock sliding shift collar, tap out the two retainer roll pins until they are level with the inner face of the shift fork. Release the differential lock if it is manually engaged. Figure 28.

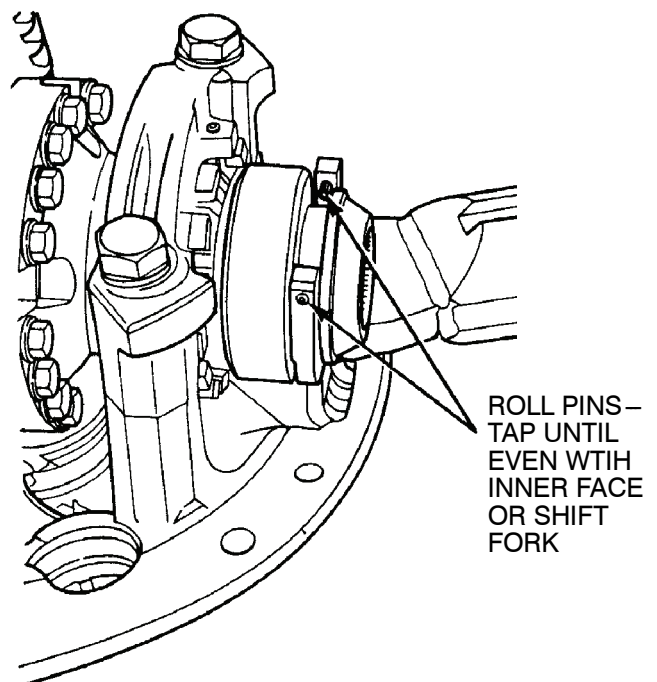


Figure 28. Sliding Shift Collar Removal.

- (2) Remove the differential air shift unit. Refer to Service Group 431-14.



## 8 REMOVING THE MAIN DIFFERENTIAL CASE AND RING GEAR ASSEMBLY.

- (1) Move the carrier so that the ring gear is toward you.
- (2) Use a punch and a hammer to mark the position of the bearing caps on the legs of the differential carrier. Figure 29.
- (3) If lock pins are used on the adjusting rings, use a hammer and a drift to remove the lock pins for adjusting rings on the bearing caps. Figure 29. If cotter pins are used on the adjusting rings, remove the cotter pins.

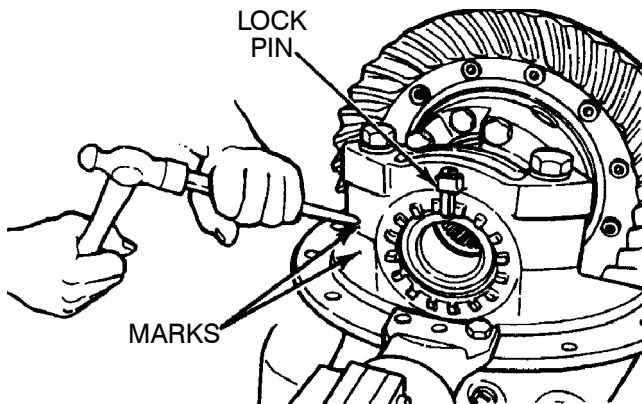


Figure 29. Lock Pin Removal.

### ⚠ CAUTION

Do not hit the adjusting ring with a hammer. Do not use a hammer and a drift to loosen the adjusting rings. These methods damage the adjusting rings.

- (4) Use a "T"-bar wrench or equivalent tool to loosen the adjusting rings. DO NOT REMOVE THE ADJUSTING RINGS. If necessary, loosen but do not remove the cap screws on the bearing caps to move the adjusting rings. Figure 30.

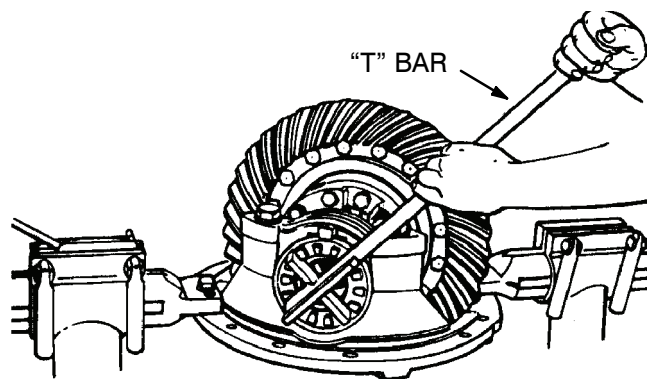


Figure 30. Adjusting Rings.

- (5) Remove the capscrews and the washers that fasten the bearing caps to the differential carrier. Mark the bearing caps and the carrier to make sure the caps are correctly installed at installation.

### NOTE

Each bearing cap must be installed on the carrier leg from which it was removed. The caps are matched to the carrier leg. **DO NOT MIX BEARING CAPS ON CARRIER LEGS.**

- (6) Remove the bearing caps, the adjusting rings and the bearing cups from the differential carrier. Figure 31.

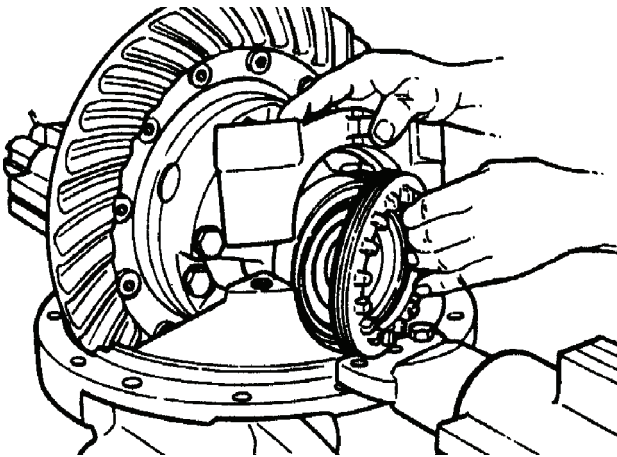


Figure 31. Bearing Caps and Adjusting Rings Removal.

- (7) Use a lifting sling to remove the main differential case and ring gear assembly from the carrier. Figure 32.

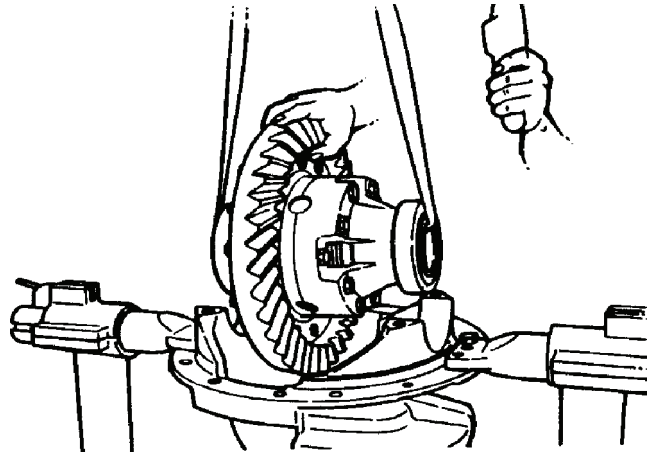


Figure 32. Main Differential Case and Ring Gear Removal.

## 9 DISASSEMBLING THE MAIN DIFFERENTIAL CASE AND RING GEAR.

- (1) If the alignment marks on the case halves are not visible, use a punch and a hammer to mark the case halves. The alignment marks permit correct assembly of the case halves. Figure 33.

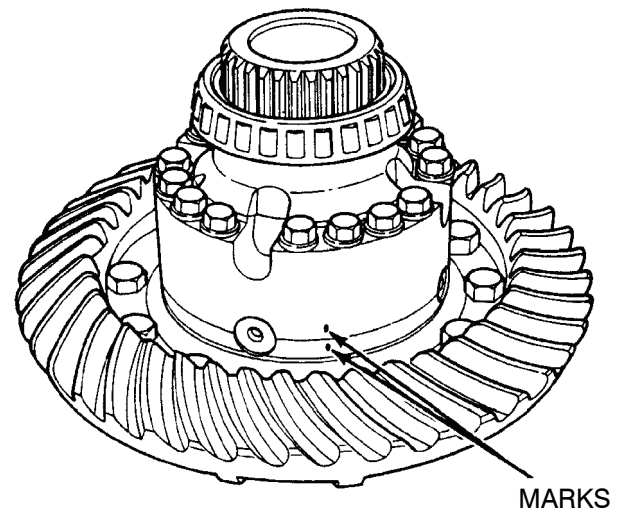


Figure 33. Alignment Marks.

- (2) Remove the capscrews and the washers that fasten the halves of the main differential together.
- (3) Remove the spider, the pinions, the thrust washers and the side gears from the case halves. Figure 34.

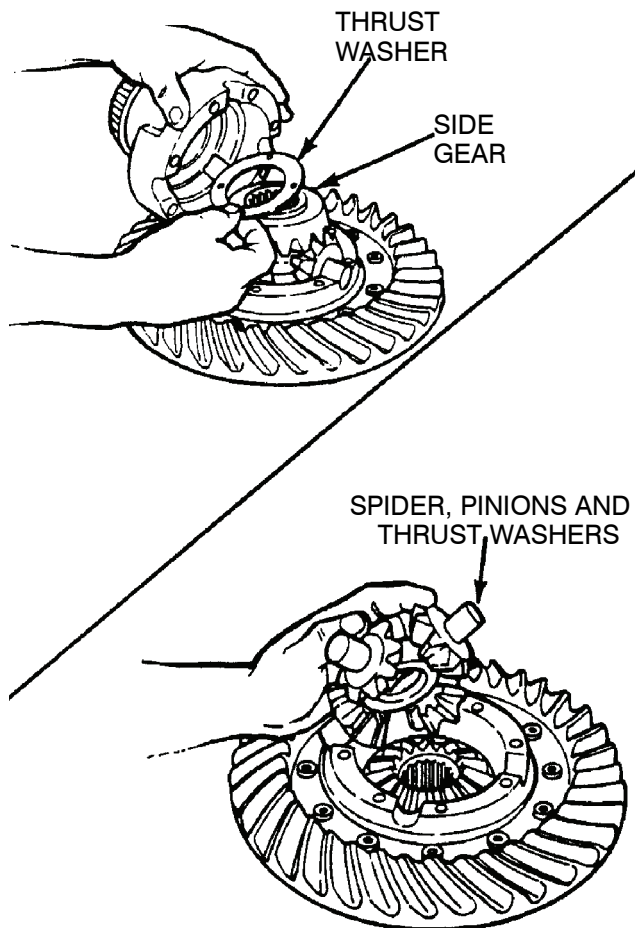


Figure 34. Main Differential Disassembly.

- (4) If the ring gear needs to be replaced, see the following procedure.
  - (a) Remove the bolts, washers, and nuts that fasten the ring gear to the differential case.
  - (b) Put the ring gear and case assembly on a press so that the teeth of the gear are toward you. Put supports under the gear. Put a sleeve or a flat metal plate on top of the case. Press the main differential case from the ring gear. Figure 35.

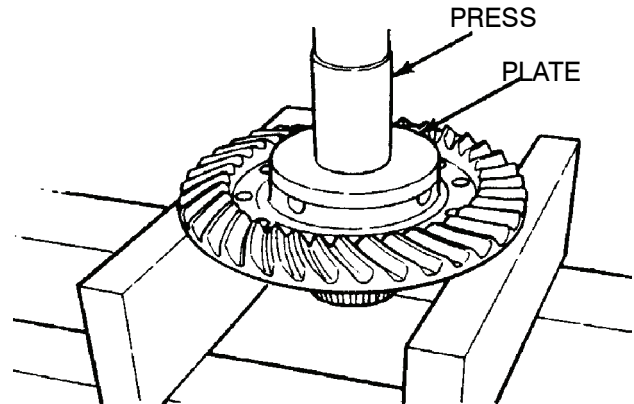


Figure 35. Removing Case Half From Ring Gear.

- (c) If a press is not available, put the assembly on a block of wood so that the teeth of the ring gear are away from you. The wood block must be larger than the gear and case assembly. Use a brass drift and a hammer to hit the ring gear at several points to separate the gear from the case. The wood block prevents damage to the ring gear when the gear is removed from the case. Figure 36.

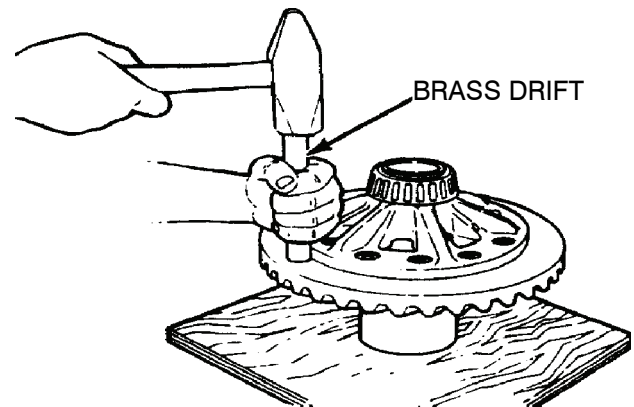


Figure 36. Removing Ring Gear From Case Half.

#### NOTE

**If either the bearing cup or the cone need to be replaced, both parts must be replaced in a set from the same manufacturer.**

- (5) If the bearing cones on the main differential case need to be replaced, use a bearing puller to remove the cones. Figure 37.

#### NOTE

**The bearing cones are not interchangeable.**

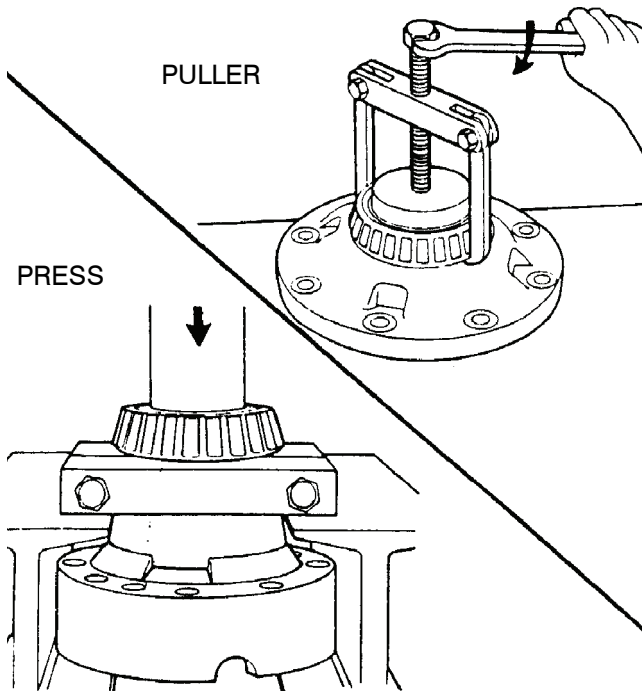


Figure 37. Bearing Removal.

**10 REMOVING AND DISASSEMBLING THE FORWARD DRIVE PINION ASSEMBLY.**

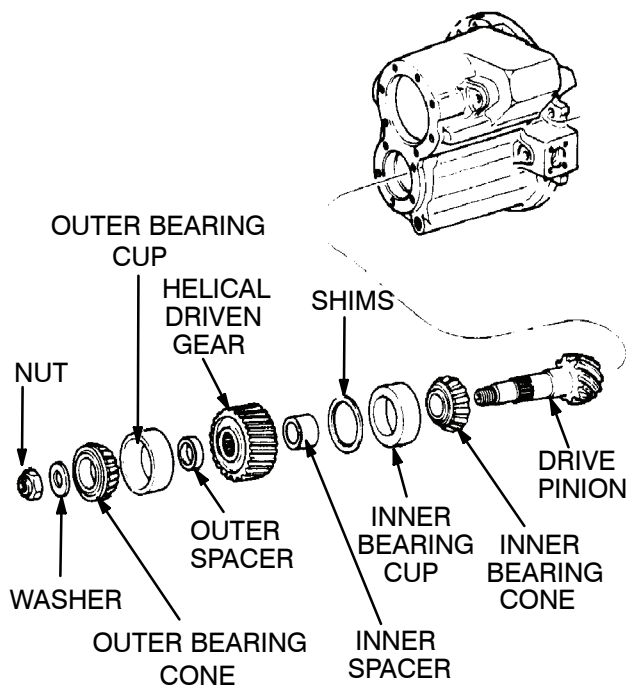


Figure 38. Drive Pinion Assembly.

**NOTE**

The nut for the drive pinion was loosened when the input shaft assembly was removed.

- (1) Remove the nut and washer from the drive pinion.
- (2) Remove the drive pinion from the carrier according to the following procedure. Figure 39.
  - (a) Put the differential carrier in a press so that the threaded end of the drive pinion is toward the top of the press. Put the supports under the mounting flange of the carrier.
  - (b) Put a protector on the top of the shaft of the drive pinion.

**CAUTION**

Make sure the drive pinion does not fall on the floor when the drive pinion is pressed from the carrier.

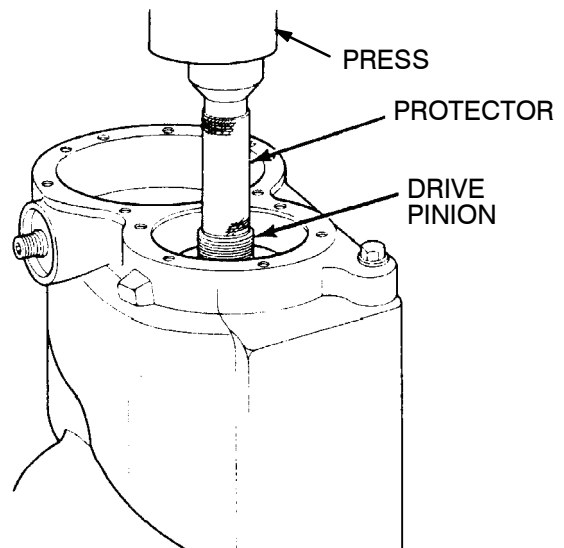


Figure 39. Drive Pinion Removal.

- (c) Press the pinion through the outer bearing cone and the helical driven gear. Remove the drive pinion from the bottom of the carrier.
- (d) Remove the outer spacer, the outer bearing cone and the helical driven gear from the carrier. Remove the inner spacer from the drive pinion.

**NOTE**

If either the bearing cup or the cone need to be replaced, both parts must be replaced in a set from the same manufacturer.

If new ring gear and drive pinion are being installed, the inner bearing cup must be removed to change the shim pack between the cup and the carrier.

- (3) If necessary, remove the inner and the outer bearing cups from the carrier. Use a hammer and a drift to remove the cups from the carrier. Remove the shims that are between the inner bearing cup and carrier. Replace any shims that are damaged. Measure and record the thickness of the shim pack for use during assembly. Figure 40.

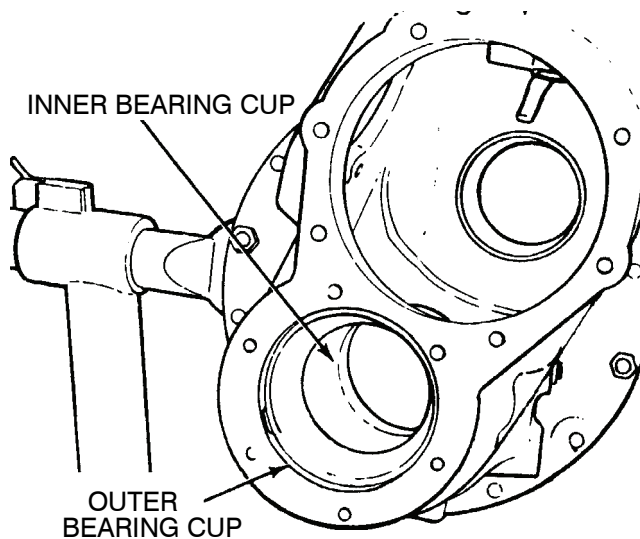


Figure 40. Carrier Bearing Cups Removal.

- (4) If necessary, remove the inner bearing cone from the drive pinion. Put a bearing puller under the inner race to support the bearing. Put a protector on top of the pinion shaft and press the drive pinion out of the bearing cone. Figure 41.

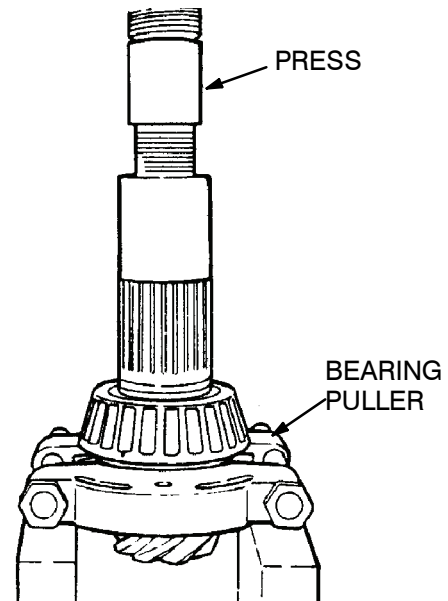


Figure 41. Inner Bearing Cone Removal.

## 11 CLEANING, INSPECTION AND REPAIR.

### ⚠ CAUTION

Exercise care to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

### ⚠ WARNING

**GASOLINE SHOULD BE AVOIDED!** DO NOT clean these parts in a hot solution tank or with water and alkaline solutions, such as sodium hydroxide, orthosilicates or phosphates.

**11.1 Cleaning Ground /Polished Surfaces.** Parts having ground and polished surfaces, such as gears, bearings, shafts and collars, should be cleaned in a suitable solvent, such as kerosene, diesel fuel oil or dry cleaning solvent.

**11.1.1 Gasket Removal.** Clean all mating surfaces where fiber or liquid gasket material is used. It may be necessary to use a scraper to completely remove gasket materials. Be careful not to damage mating surfaces.

**11.1.2 Steam Cleaning.** Steam cleaning is not recommended for assembled drive units after they have been removed from the housing. When this method of cleaning is used, water is trapped in cored passage of castings and in close clearances between parts, as well as on parts. This can lead to corrosion (rust) of

critical parts of the assembly and the possibility of circulating rust particles in the lubricant. Premature failure of bearings, gears and other parts can be caused by this practice. Assembled drive units cannot be properly cleaned by steam cleaning, dipping or slushing. Complete drive unit disassembly is a necessary prerequisite to thorough cleaning.

## 11.2 Cleaning Rough Parts.

### CAUTION

**Exercise care to avoid skin rashes and inhalation of vapors when using alkali cleaners.**

Rough parts, such as differential carrier castings, cast brackets and some brake parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts are not ground or polished. The parts should remain in the tank long enough to be thoroughly cleaned and heated through. This will aid the evaporation of the rinse water. The parts should be thoroughly rinsed after cleaning to remove all traces of alkali.

**11.2.1 Complete Assemblies.** Completely assembled axles, torque dividers and transfer cases may be steam cleaned on the outside only, to facilitate initial removal and disassembly, providing all openings are closed. Breathers, vented shift units, and all other openings should be tightly covered or closed to prevent the possibility of water entering the assembly.

**11.2.2 Drying.** Parts should be completely dried immediately after cleaning. Use soft, clean, lintless absorbent paper towels or cloth free of abrasive material such as lapping compound, metal filings or contaminated oil. Bearings should never be dried by spinning with compressed air.

**11.2.3 Corrosion Prevention.** Parts that have been cleaned, dried, inspected and are to be immediately reassembled should be coated with light oil to prevent corrosion. If these parts are to be stored for any length of time, they should be treated with a good rust preventive and wrapped in special paper or other material designed to prevent corrosion.

**11.3 Inspection.** Inspect all bearings, cups and cones, including those not removed from parts of the drive unit, and replace if rollers or cups are worn, pitted or damaged in any way. Remove parts needing replacement with a suitable puller or in a press with

sleeves. Avoid use of drifts and hammers. They may easily mutilate or distort component parts.

If any of the following bearing conditions exist, bearings must be replaced:

- (1) Large ends of rollers worn flush to the recess, or the radii at the large ends of the rollers worn sharp. Refer to Figure 42.

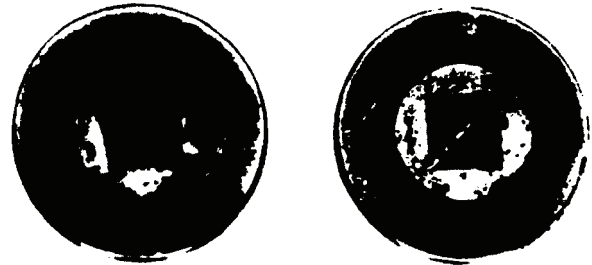


Figure 42.

- (2) Visible step wear, particularly at the small end of the roller track or deep indentations, cracks or breaks in the bearing cup and /or cone surfaces. Refer to Figure 43.

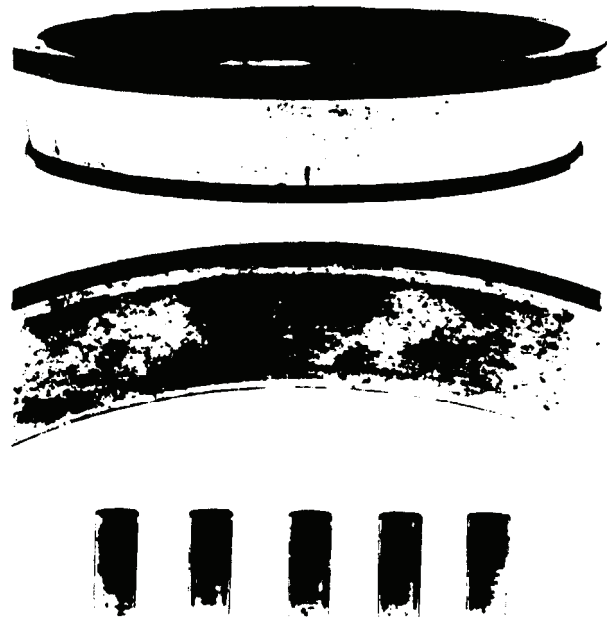


Figure 43.

- (3) Bright rubbing marks on the dark phosphate surfaces of the bearing cage. Refer to Figure 44.



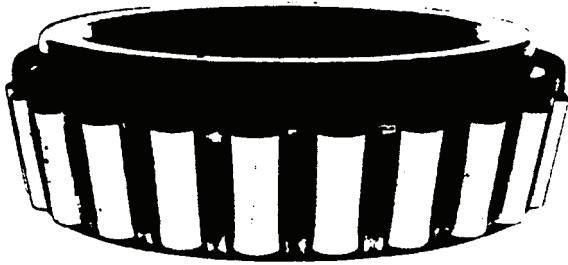


Figure 44.

- (4) Etching or pitting on functioning surfaces. Refer to Figure 45.



Figure 45.

- (5) Spalling or flaking on the bearing cup and/or cone surfaces. Refer to Figure 46.

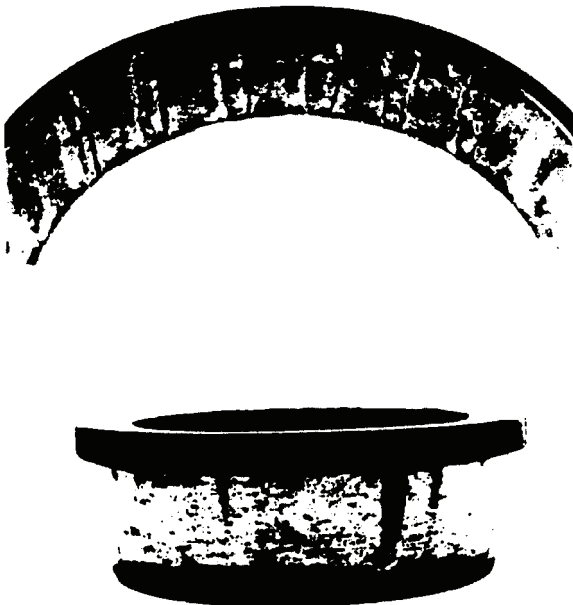


Figure 46.

- (6) Inspect hypoid/generoid gears for wear or damage. Gears which are worn, ridged,

pitted or scored should be replaced. When it is necessary to replace either the pinion or gear of a set, the entire gear set must be replaced.

- (7) Inspect the differential assembly for the following:
- Pitted, scored or worn thrust surfaces of differential case halves, thrust washer spider trunnions and differential gears: Thrust washers must be replaced in sets. The use of a combination of old and new washers will result in premature failure.
  - Wear or damage to the differential pinion and side gear teeth. Always replace differential pinions and side gears in sets.
- (8) Inspect spur gears of the transfer train for wear or damage. Gears which are worn, ridged, pitted or scored should be replaced.
- (9) Inspect axle shafts for signs of fractures or other indication of failure.

#### 11.4 Repair.

- Replace all worn or damaged parts. Hex nuts with rounded corners, all washers if damaged, oil seals and gaskets or silicone gasket material should be replaced at the time of overhaul.
- Remove nicks and burrs from machined or ground surfaces. Threads must be clean and free to obtain accurate adjustment and correct torque. A fine mill file or India stone is suitable for this purpose. Studs must be tight prior to reassembling the parts.
- When assembling component parts, use a press where possible.
- Tighten all the nuts to specified torque.
- DO NOT REPAIR WELD** -- In the interest of safety and preserving the service life of axle assemblies, we recommend that axle assemblies NOT be repair welded. Repair welding can detract from the structural integrity of a component, particularly as to heat-treated parts. The benefit of heat-treatment may be nullified by welding.

It can be very risky and harmful to repair weld components of any kind. Repair welding can be approved only where strict controls are imposed and skillful welders use equipment usually found only at a manufacturing plant. This lessens the possibly harmful effects of repair welding.

In deciding whether to repair or scrap any damaged part, always keep in mind that we, as manufacturers, never hesitate to scrap any part which is in any way doubtful.

## 11.5 Silicone (RTV) Gasket.

## NOTE

Where silicone RTV gasket material is used, use Oshkosh No. 69895AX sealant, available in 3 oz. tubes.

**11.5.1 Service.** Removal of all gaskets including silicone RTV is accomplished by peeling or scraping the used gasket off both mating surfaces.

**11.5.2 Application.** Application of silicone RTV gasket material is as follows:

- (1) Remove dirt, grease or moisture from both mating surfaces.
- (2) Dry both surfaces.

**⚠ CAUTION**

Minor concentrations of acetic acid vapor may be produced during application. Adequate ventilation should be provided when silicone (RTV) is applied in confined areas.

Further, eye contact with silicone (RTV) gasket materials may cause irritation; if eye contact takes place, flush eyes with water for 15 minutes and have eyes examined by a doctor.

- (3) Apply a continuous thin bead, approximately 3/16" diameter completely around one mating surface and around the edge of all fastener holes to assure complete sealing and prevent leakage.
- (4) Assemble the components immediately to permit silicone (RTV) gasket material to spread evenly. Wait 20 minutes before refilling axle with lubricant.

When rebuilding any assembly, always use torque values on fasteners as specified in the Torque Chart in this group.

## NOTE

Failure to use appropriate gasket material will cause leaks.

## 12 GEAR SET IDENTIFICATION.

## NOTE

Before a new gear set is installed in the carrier, read the following information: **ALWAYS CHECK THE GEAR SET FOR CORRECT MARKS TO MAKE SURE THE GEARS ARE A MATCHED SET.**

The location of the marks are shown in Figure 47.

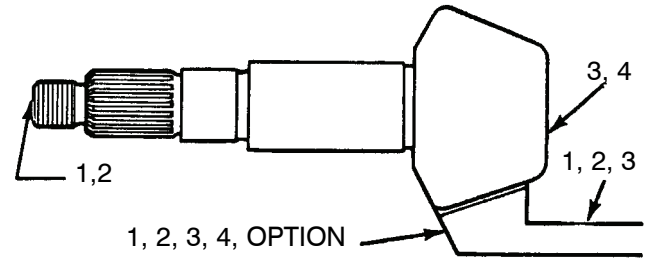


Figure 47.

- (1) Part Number
  - (a) Examples of part numbers on gear sets: Ring Gear, 37024K. Drive Pinion, 37024K2.
  - (b) Location on Drive Pinion: Tip of Pinion Shaft at the Threaded End.
  - (c) Location on Ring Gear: Front Face or Outer Diameter of Ring Gear.
- (2) Tooth Combination Number
  - (a) Example of a Tooth Combination Number: 11-41. The number indicates that the drive pinion has 11 teeth and the ring gear has 41 teeth.
  - (b) Location on Drive Pinion: Tip of Pinion Shaft at the Threaded End.
  - (c) Location of Ring Gear: Front Face or Outer Diameter of Ring Gear.
- (3) Gear Set Match Number
 

Rockwell drive pinions and ring gears are available only in matched sets. The ring gear and the drive pinion in a set have a match number.

  - (a) Example of a Gear Set Match Number: M29.

## NOTE

A gear set match number has any combination of a letter and a number.

- (b) Location on Drive Pinion: On the end of the Gear Head of the Drive Pinion.
- (c) Location of Ring Gear: Front Face or Outer Diameter of Ring Gear.
- (4) Pinion Cone Variation Number

**NOTE**

The pinion cone variation number is not used when checking for a matched gear set. The number is used when you adjust the depth of the pinion in the carrier.

- (a) Examples of Pinion Cone Variation Numbers: PC + 3, PC - 5, +2, +1. Figure 48.
- (b) Location on Gear Set: On the end of the Gear Head of the Drive Pinion or the Outer Diameter of the Ring Gear. Figure 48.

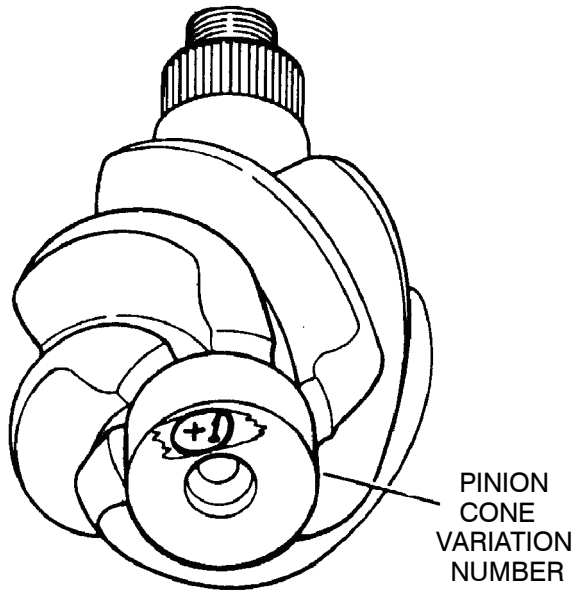


Figure 48.

**13 NEW PINION SHIM PACK THICKNESS (PINION DEPTH).**

**NOTE**

Use this procedure if a new drive pinion and ring gear set is installed or if the depth of the original drive pinion has to be adjusted.

A means of accurately installing a new pinion into a carrier is to mathematically calculate proper pinion cage shim pack thickness.

Following are the procedures to use:

- (1) Measure the thickness of original shim used with gear set being replaced. Use a micrometer or vernier gauge. Record this measurement for future use.

**NOTE**

The value calculated in step "1" will establish a "standard shim thickness," without a variation. This value will be used in calculating the shim thickness used with a new pinion and gear set.

- (2) Observe "P.C." or variation number on the original pinion being replaced. If this number is a plus (+) value, subtract it from original shim measurement taken in Step 1. If this number is a minus (-) value, add it to original shim measurement taken in Step 1. Make a note of this calculated "standard shim thickness".
- (3) Observe "P.C." or variation number on new pinion or ring gear.

Add or subtract this number the same as the variation sign is (+ add or - subtract) to calculated "standard shim thickness" found in Step "2".

The resulting answer indicates thickness (in thousandths) of new shim to be used. Refer to following examples which cover all possible combinations of + or - original and new "P.C." variations.

EXAMPLES OF CALCULATION:

EXAMPLE NO. 1		METRIC
Original Shim Thickness	.030"	.762mm
Original Variation (PC-2)	<u>+.002"</u>	<u>+.050mm</u>
Standard Shim Thickness	.032"	.812mm
New Variation (PC -5)	<u>-.005"</u>	<u>-.127mm</u>
New Shim Thickness	.027"	.685mm

EXAMPLE NO. 2		METRIC
Original Shim Thickness	.030"	.762mm
Original Variation (PC+2)	<u>-.002"</u>	<u>-.050mm</u>
Standard Shim Thickness	.028"	.712mm
New Variation (PC-5)	<u>-.005"</u>	<u>-.127mm</u>
New Shim Thickness	.023"	.585mm

EXAMPLE NO. 3		METRIC
Original Shim Thickness	.030"	.762mm
Original Variation (PC-2)	<u>+.002"</u>	<u>+.050mm</u>
Standard Shim Thickness	.032"	.812mm
New Variation (PC+5)	<u>+.005"</u>	<u>+.127mm</u>
New Shim Thickness	.037"	.939mm

EXAMPLE NO. 4		METRIC
Original Shim Thickness	.030"	.762mm
Original Variation (PC+2)	<u>-.002"</u>	<u>-.050mm</u>

Standard Shim Thickness	.028"	.712mm
New Variation (PC+5)	<u>+.005"</u>	<u>+.127mm</u>
New Shim Thickness	.033"	.839mm

**NOTE**

Remember that all drive pinion and gear sets are manufactured and sold only in matched sets. Therefore, if either a pinion or a ring gear should require replacement, both must be replaced in a matched set.

**14 ASSEMBLING AND INSTALLING THE FORWARD DRIVE PINION ASSEMBLY.**

- (1) Place carrier in a press with carrier legs facing upward. Position original pinion inner bearing cup shims into bearing bore of carrier and position cup over bore. Refer to Figure 49.

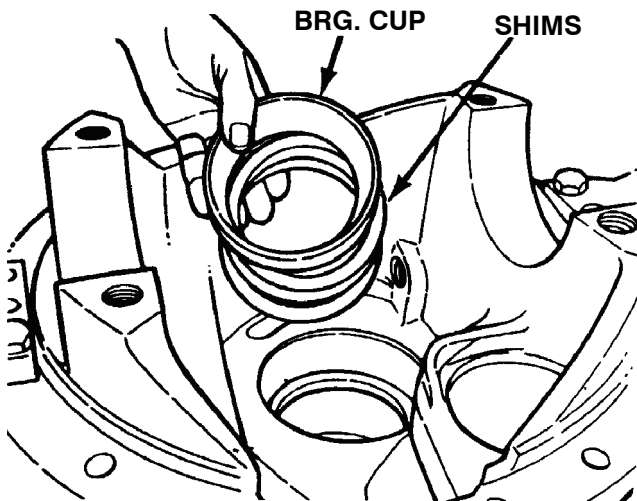


Figure 49.

- (2) Block up carrier in a safe manner and press inner (rear) bearing cup into bore against shim, or shim combination, using a suitable sleeve. If a press is not available use a sleeve or brass drift and mallet to tap bearing cup into position. Refer to Figure 50.

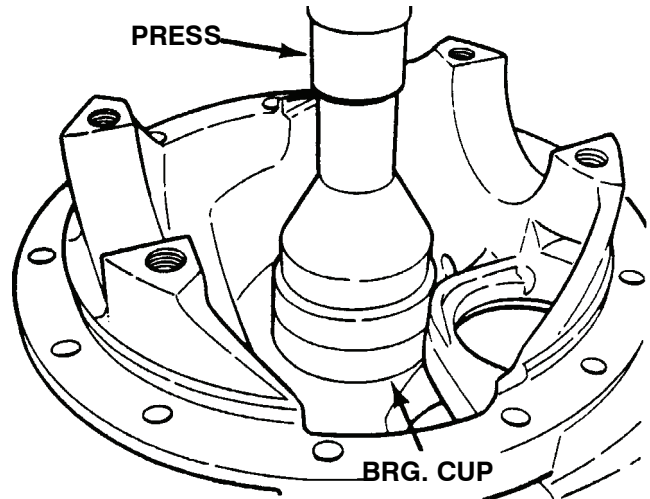


Figure 50.

- (3) Reposition carrier in press with carrier legs facing downward and block up in a safe manner. Using a suitable sleeve, press outer pinion bearing cup into bore of carrier until it bottoms. If a press is not available, use a sleeve or brass drift and mallet to tap the cup into position. Refer to Figure 51.

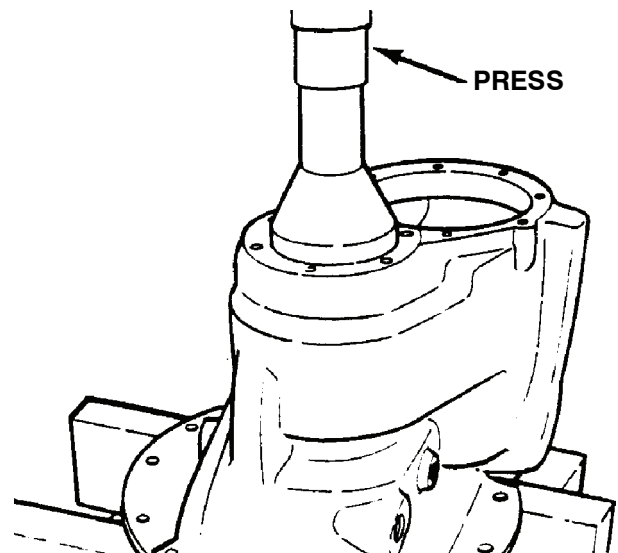


Figure 51.

**15 FORWARD CARRIER PINION BEARING PRE-LOAD.**

**NOTE**

The pinion bearing pre-load is controlled by thickness of the spacer mounted on the drive pinion shaft, between the outer bearing cone and the helical driven gear.

Correct pre-load for new bearings is 5-45 in. lb. (rolling resistance) or 10-30 in. lb. (rolling resistance) for re-used bearings.

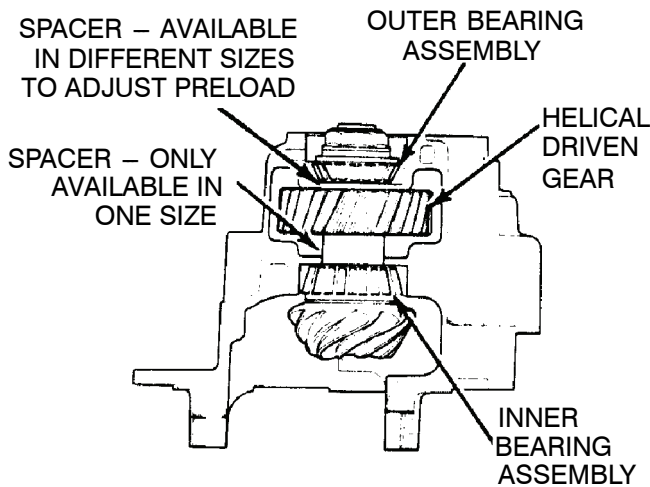


Figure 52.

- (1) Press inner (rear) bearing cone squarely against pinion head. Use a suitable sleeve that will bear against cone (inner) race. Refer to Figure 53.

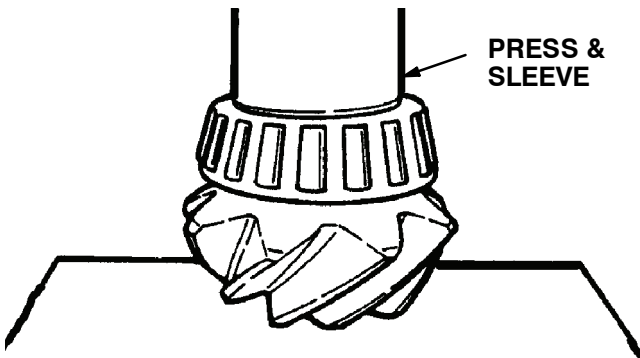


Figure 53.

- (2) Put the helical driven gear over the pinion bore in the carrier so that the splines inside

the gear are toward the front of the carrier. Put the large spacer on top of the helical driven gear so that the spacer is toward the inner bearing cup. Figure 54.

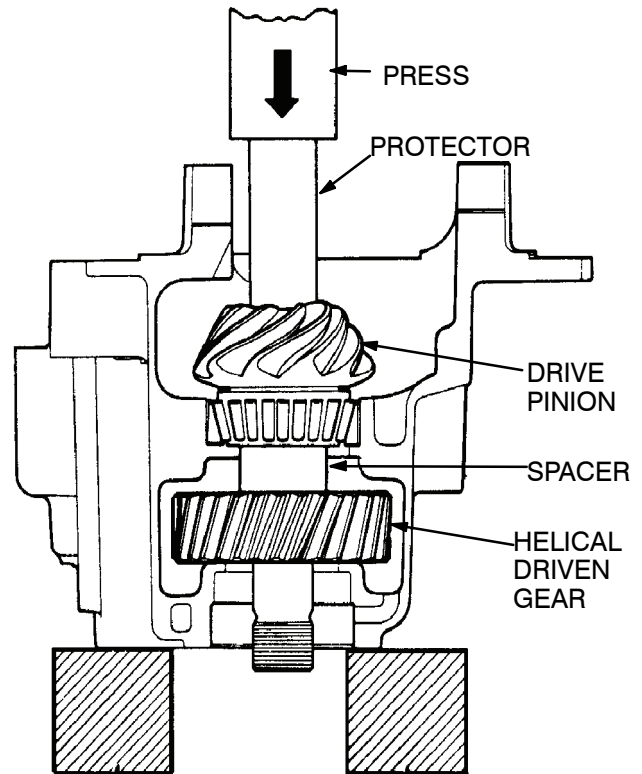


Figure 54.

- (3) Reinstall drive pinion into carrier, aligning splines of helical gear and pinion shaft. Line up parts as required.

**NOTE**

Do not exert pressure after the inner bearing cone and cup make contact as damage to bearing may result.

- (4) Press pinion shaft through cone spacer and helical gear until inner bearing cone on pinion contacts the bearing cup in carrier. It should be noted at this time that helical gear is not completely seated on the pinion shaft. Refer to Figure 54.
- (5) Reposition carrier in press with carrier flanges facing downward. Support carrier with press plates under carrier to housing flanges. Block up pinion under pinion head, high enough to allow inner bearing cone and cup to be in contact. See Figure 55.

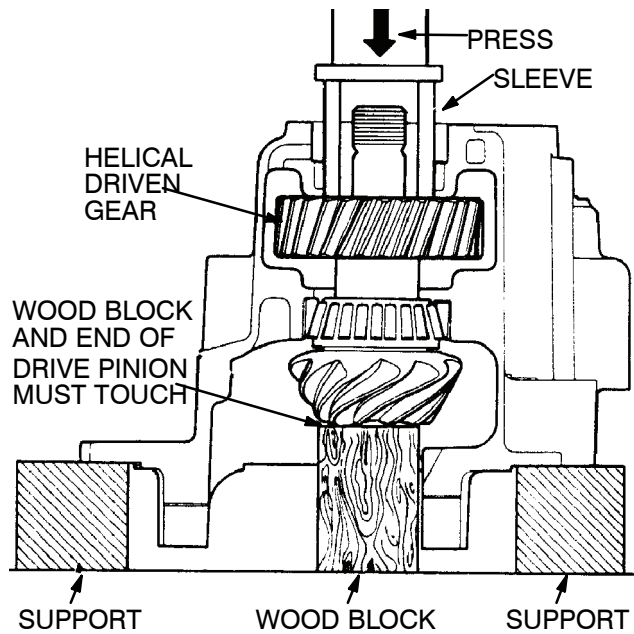


Figure 55.

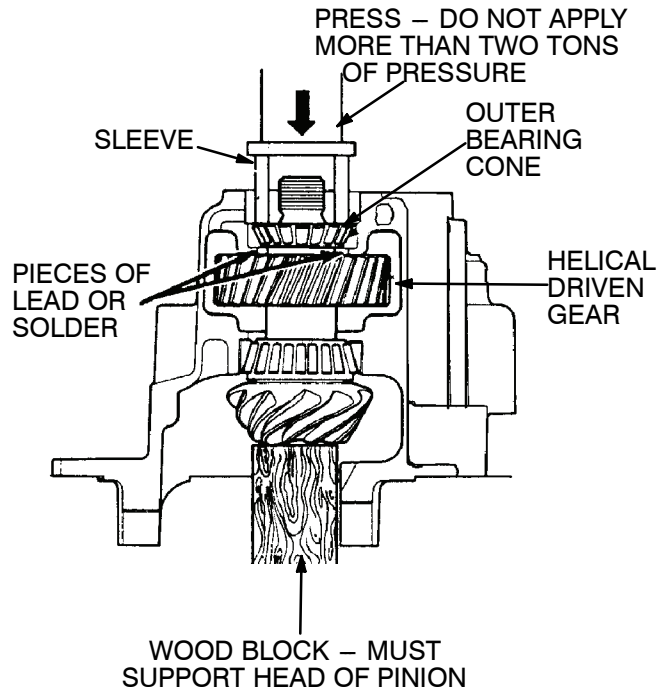


Figure 56.

**CAUTION**

Do not apply pressure after the helical driven gear touches the spacer in front of the inner bearing on the drive pinion. If pressure is applied after the parts touch each other, the gear will damage the spacer.

- (6) Press helical gear completely onto splined portion of the pinion shaft. Continue pressing on the gear until contact with the spacer is achieved. Use a suitable sleeve that will slip over the pinion shaft and against the gear hub. Refer to Figure 55.

**15.1 GEAR SPACER.**

- (1) Cut two lengths of bar lead or solder approximately 9/16" long and 5/8" thick. The lead pieces will be used as gauge blocks in determining thickness of spacer required between the helical driven gear and the outer bearing.
- (2) Position both pieces of lead or solder on top of the helical driven gear 180° apart. Position outer bearing cone over pinion shaft into the cup. Use a suitable sleeve on top of the outer bearing cone. Refer to Figure 56.
- (3) Remove the supports from the bottom of the carrier. Use a press to apply 2 tons of force to the outer bearing cone. The force of the press compresses the lead or solder pieces to the correct size. DO NOT APPLY MORE THAN 2 TONS OF FORCE. See Figure 56.

- (4) Remove block from under pinion head and press pinion shaft down through outer bearing cone only. Do not press shaft through helical gear.
- (5) Remove outer bearing cone and both pieces of lead or solder from pinion shaft.
- (6) Measure thickness of compressed pieces of lead with a micrometer and calculate average value of both pieces. Add .004" to average value to determine the thickness required for variable gear spacer to obtain the proper pinion gearing pre-load.

**EXAMPLE:**

Lead thickness No. 1	.504"
Lead thickness No. 2	<u>+ .506"</u>
<b>TOTAL</b>	<b>1.010"</b>
Average thickness	$1.010" \div 2 = .505"$
Add .004"	<u>+ .004"</u>
<b>Thickness of gear spacer</b>	<b>.509"</b>

- (7) Block up pinion under pinion head, high enough to allow inner bearing cone and cup to be in contact. Press helical gear completely onto pinion shaft until contact with the spacer is achieved. Use suitable sleeve that will slip over pinion shaft and against gear hub. See Figure 55.
- (8) Install the correct size of spacer on the shaft of the pinion in front of the helical driven gear.



**NOTE**

**Make sure the wood block is still under the head of the drive pinion. The inner bearing cone on the pinion must touch the cup in the carrier.**

- (9) Put the outer bearing cone on the drive pinion shaft. Put a sleeve on the top (inner race) of the outer bearing cone and apply press pressure of approximately two (2) tons. As pressure is applied, rotate carrier in both directions to properly seat bearings. Refer to Figure 57.

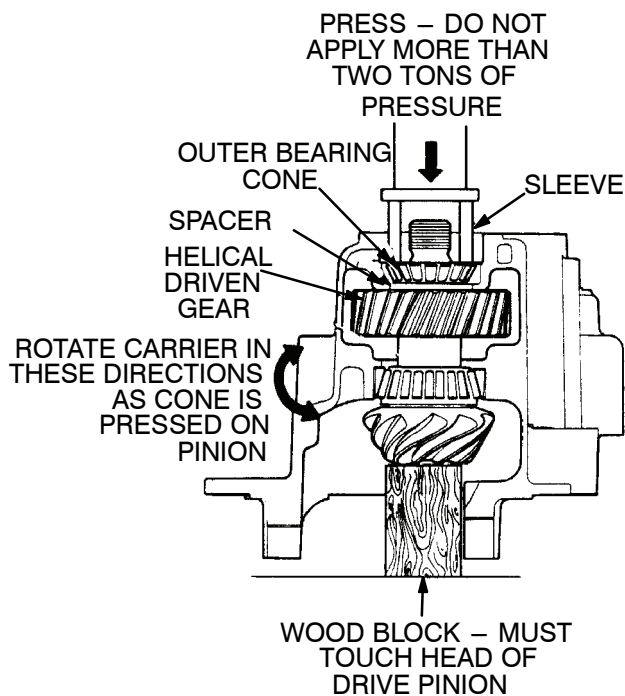


Figure 57.

- (10) Remove carrier from press and mount in a repair stand. Install washer and nut onto pinion. Place a hardwood block between pinion head and carrier wall to hold pinion stationary and torque nut to 1200–1500 ft–lbs (1627–2034 N·m).

**15.2 Checking Bearing Pre-Load.**

- (1) Make a check for proper pinion bearing pre-load by installing an appropriate wrench socket over pinion nut and attaching an inch–pound (in. lb) torque wrench to socket. Refer to Figure 58.

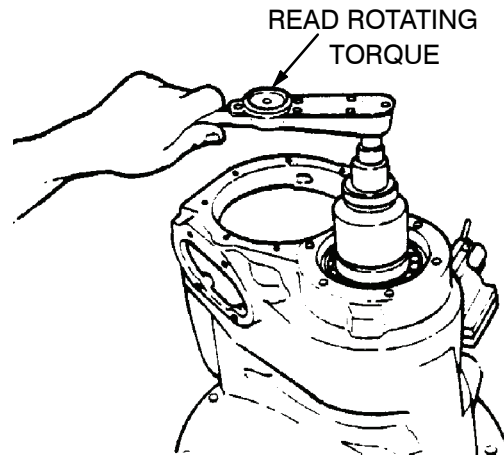


Figure 58.

- (2) Rotate drive pinion with torque wrench and observe reading on dial. Use rotating torque, not starting torque.
- (3) Correct bearing pre-load is 5–45 in. lb. for new bearings or 10–30 in. lb. for re-used bearings.
- (4) A second method of checking pre-load rotating torque is as follows:
- Wrap a cord around pinion nut washer. Attach a common pound scale to end of cord and while observing scale, pull out on a horizontal line.
  - Next, calculate for radius of washer by measuring outer diameter of washer and dividing by two (2). Multiply the pound reading from scale by washer radius (in inches) to obtain inch-pound torque value. Refer to Figure 59.

**EXAMPLE:**

Assume O.D. of washer to be 3 inches and pounds pull to be 9.

$$\text{Washer radius} = 3" \div 2 = 1.5"$$

$$\text{Torque Value} = 1.5" \times 9 \text{ lbs.} = 13.5 \text{ in. lb.}$$

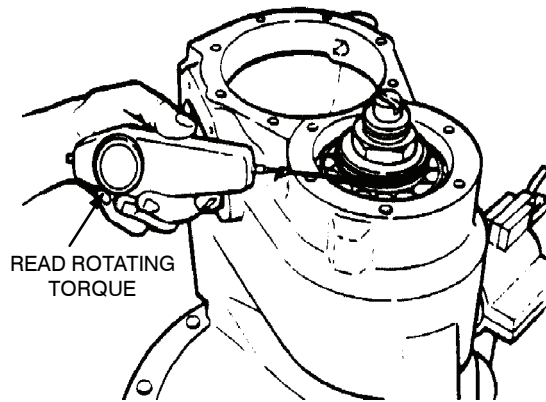


Figure 59.

**NOTE**

If a change in pinion depth is required after establishing bearing pre-load, a like change in gear spacer thickness must be made to retain correct bearing pre-load. When increasing thickness of shim between the pinion inner bearing cup and carrier, increase the thickness of the gear spacer a like amount. The opposite is true when decreasing thickness.

- (c) If pinion bearing rotating torque value is within correct limits, continue with balance of reassembly. However, if torque is not within correct limits, remove outer bearing cone and cone spacer from pinion shaft. Install a thicker or thinner outer cone spacer as required.
- (5) Reassemble parts onto pinion shaft and re-check bearing pre-load.

**16 DIFFERENTIAL ASSEMBLY.****NOTE**

The gear should not be pressed or driven on case, as this would cause excessive metal particles to lodge between gear and case, thus resulting in gear runout. Proper installation should, therefore, incorporate preheating the gear as described above to assure correct interference fit and to eliminate metal pick-up.

- (1) Proper service replacement of differential ring gear into differential case half is necessary for correct gear adjustment and longer

drive unit service life. For correct installation, it is recommended to heat ring gear in water to approximately 160 degrees – 180 degrees F for about ten minutes before assembly. This will allow an easier fit of gear over differential case pilot, without using a press, and without damaging case and ring gear mating surfaces.

- (2) Assemble all bolts through gear side and secure with washers and locknuts on case side. Torque to 196–262 ft. lbs. (265–355 Nm.)
- (3) If new bearings are to be used, press squarely and firmly on differential case halves with suitable sleeve. Refer to Figure 60.

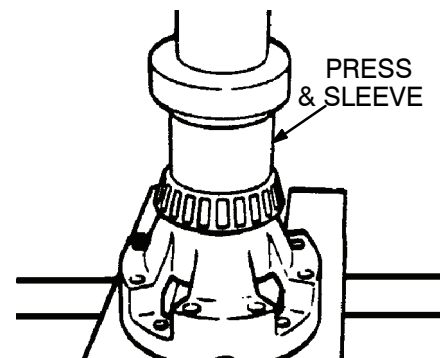


Figure 60.

- (4) Pre-lubricate differential case inner walls and all component parts with the recommended axle lubricant.
- (5) Position thrust washer and side gear in gear case half.
- (6) Place spider with pinions and thrust washers in position. Refer to Figure 61.

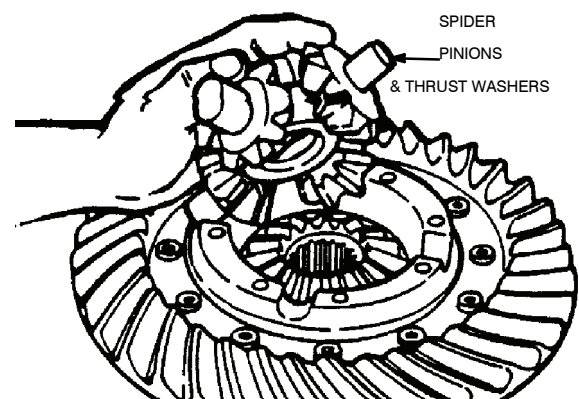


Figure 61.

- (7) Install second side gear and thrust washer. Refer to Figure 62.

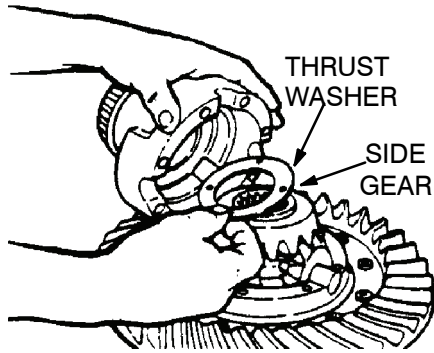


Figure 62.

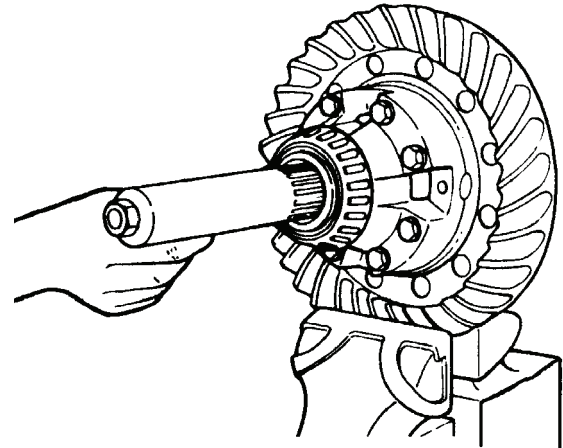


Figure 63.

- (8) Position other case half over assembly, aligning match marks of both halves. Draw assembly together with four (4) equally spaced capscrews and washers.

#### NOTE

It is recommended to use new Dri-Loc fasteners or to apply Liquid Adhesive (OTC part number 45244AX) in fastener holes to secure main differential case halves together. However, do not use these type fasteners or apply Liquid Adhesive to threaded holes until after differential nest rolling check has been made. At this time, use only regular fasteners without adhesive coatings.

- (9) Install remaining capscrews and washers. Torque to 220–310 ft. lbs. (298–420 N·m.)

### 17 DIFFERENTIAL ROLLING RESISTANCE CHECK.

- (1) A suitable “checking tool” can be made by cutting an axle shaft to an appropriate length and welding a nut on the end to accept a wrench socket. Refer to Figure 63.

#### NOTE

**Use soft metal covers over vise jaws to protect ring gear.**

- (2) Place differential and ring gear assembly in a vise. Refer to Figure 64.

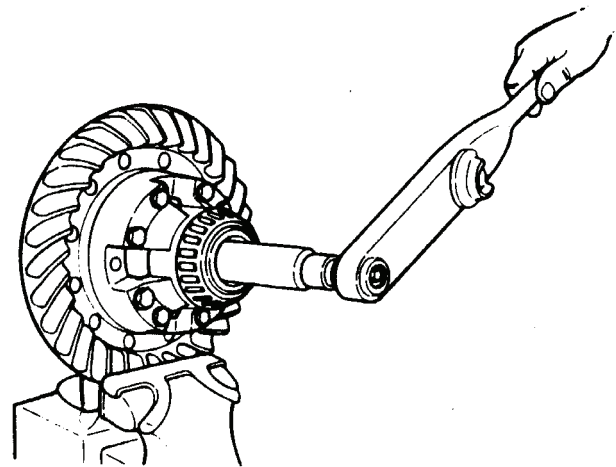


Figure 64.

- (3) Insert checking tool made from splined axle shaft end (refer to Figure 64) into differential nest. Allow splines of tool to engage with spline of one side gear only.
- (4) Using a suitable socket and torque wrench, rotate differential nest while observing scale on torque wrench. Refer to Figure 65.

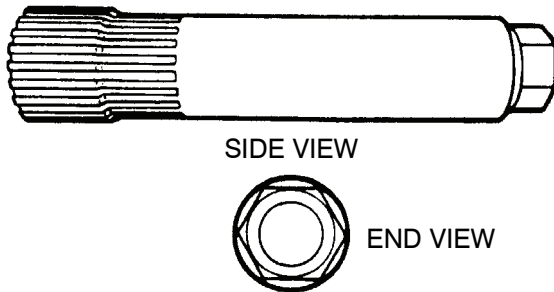


Figure 65.

- (5) Differential rolling resistance must be 50 ft. lb. or less when applied to one side gear. If the torque value exceeds 50 ft. lbs., check the following for the problem:
- Case Halves
  - Side Gears
  - Thrust Washers
  - Spider
  - Pinions

#### 17.1 Dri-Loc Fasteners or Liquid Adhesive.

##### NOTE

No cure time is required for Rockwell Liquid Adhesive prior to rebuilding axle and returning it to service.

When servicing drive units assembled with Dri-Loc fasteners or for Liquid Adhesive in threaded holes where the fasteners do not require removal, check each fastener for tightness by applying the minimum amount of torque specified for that size fastener. If fastener does not rotate, it is satisfactory. If fastener rotates to any degree, it must be removed from component and adhesive must be applied to threaded hole.

If fastener removal becomes difficult due to worn heads or unusually high break-away torque, locking strength of either Liquid Adhesive or Dri-Loc can be reduced by heating. Heat fastener for only a few seconds at a time while trying to loosen it.

##### NOTE

DO NOT EXCEED 350°F (+177°C) maximum. Heating should be done slowly to avoid thermal stresses in other components. Application of heat reduces strength of the adhesive and Dri-Loc below recommended installation torque.

It is not recommended to remove fasteners with an impact wrench or by striking with a hammer.

- (1) If Dri-Loc fasteners or Liquid Adhesive application are to be used, remove existing fasteners from case halves and apply adhesives using instructions on containers.
- (2) Wipe excess oil residue from fasteners and threaded holes. The fasteners and holes should be relatively oil free, however, no special cleaning is required. When reusing Dri-Loc fasteners, it is not necessary to remove Dri-Loc residue from threads.
- (3) Apply Liquid Adhesive to threaded holes only, by letting four or five drops run down the side of each hole. Before threading in fasteners, visually check to make sure that adhesive has contacted the threads. Refer to Figure 66.

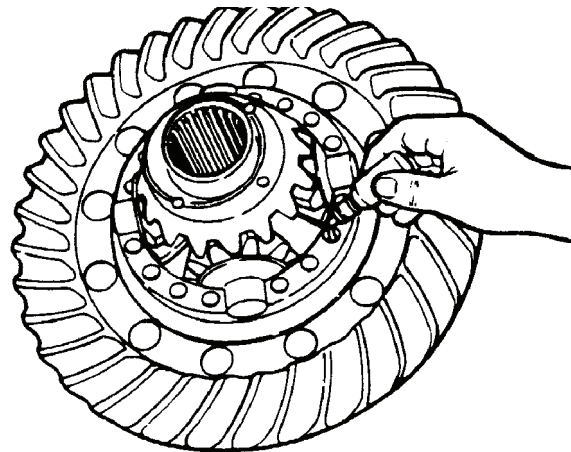


Figure 66.

- (4) Tighten fasteners to specified torque.

## 18 DIFFERENTIAL GEAR INSTALLATION.

### 18.1 Bearings.

- (1) Before installing differential and gear assembly, temporarily install bearing cups, threaded adjusting rings and bearing caps in the correct location as marked. Install cap, capscrews and washers and tighten to specified torque value.

- (2) Bearing cups must be of a hand push fit in bores, otherwise bores must be reworked with a scraper or emery cloth until a hand push fit is obtained. Use a blued bearing cup as a gauge and check the fits as work progresses. Refer to Figure 67.

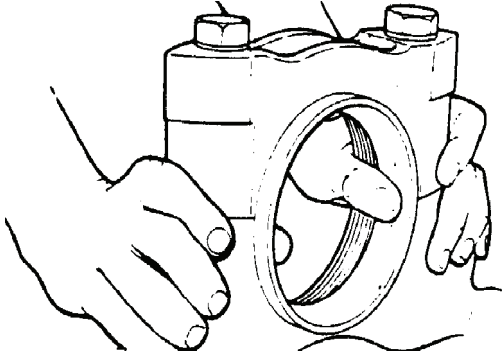


Figure 67.

- (3) After checking relating parts, coat differential bearing cones and cups with recommended axle lubricant.

### 18.2 Differential Assembly Installation.

- (1) Place bearing cups over assembled differential bearing cones, then position differential assembly in the carrier. Refer to Figure 68.

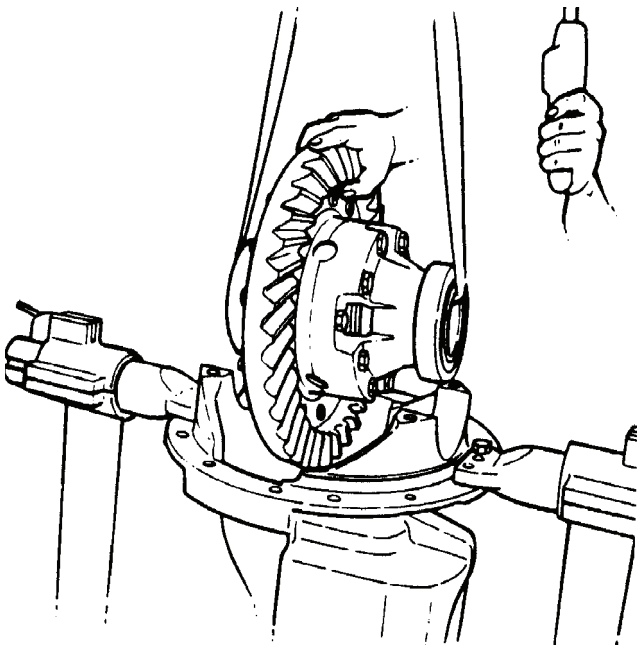


Figure 68.

- (2) Insert bearing adjusting rings and turn hand-tight against bearing cups. Refer to Figure 69.

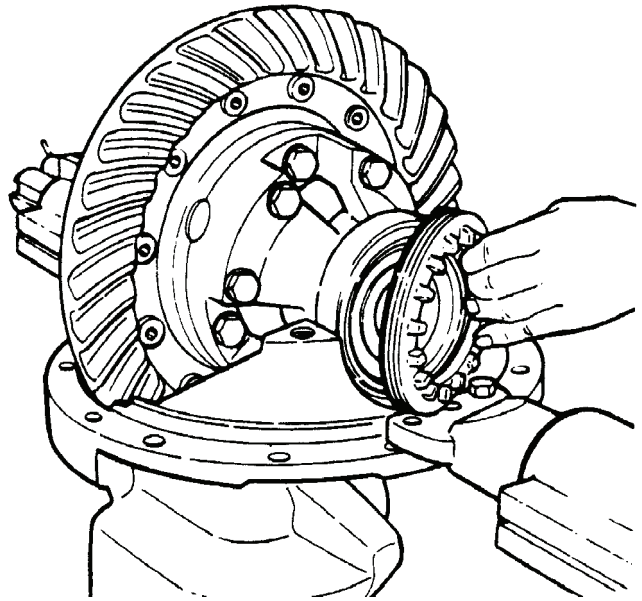


Figure 69.

### ⚠ CAUTION

If bearing caps do not position properly, adjusting nuts might be cross-threaded. Remove caps and reposition the adjusting rings. Forcing caps into position will result in irreparable damage to carrier housing or bearing caps.

- (3) Install bearing caps in correct location, as marked, and tap lightly into position. Refer to Figure 70.

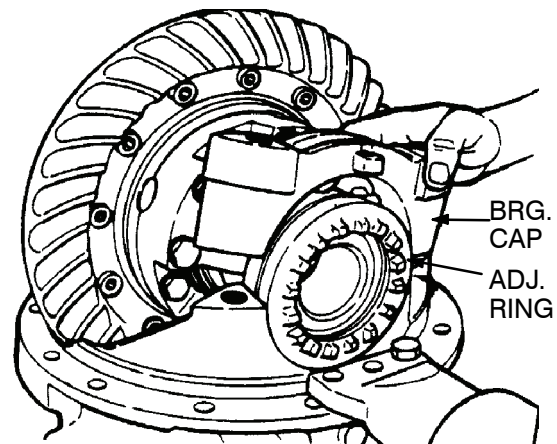


Figure 70.

- (4) Install carrier leg capscrews and washers. Torque to 480–600 ft. lbs. (650–810 Nm). Install adjusting ring cotter keys after final adjustments are made.

## 19 DIFFERENTIAL BEARING PRE-LOAD ADJUSTMENT.

### (A) Dial Indicator Method.

- (1) Using dial indicator at back face of gear, loosen bearing adjusting ring on side opposite dial indicator only. Loosen enough to notice end play on indicator when moving with pry bars Refer to Figure 71.

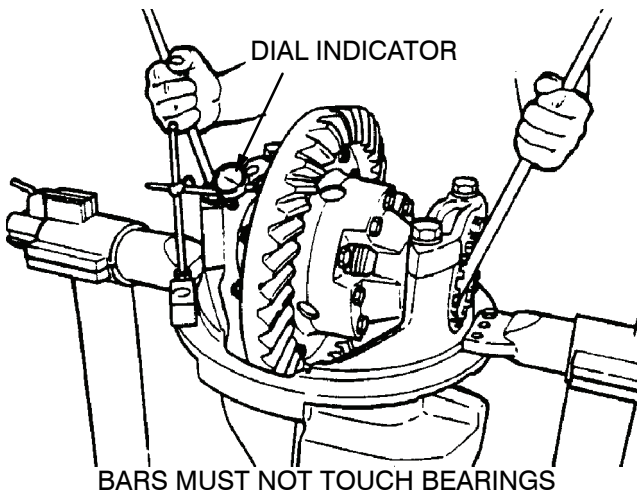


Figure 71.

- (2) Tighten same adjusting ring enough to obtain .000 end play.
- (3) Next, tighten each bearing adjusting ring one notch from .000 end play to pre-load differential bearings. The side bearings of the differential now have a preload of 15–35 in–lbs. (1.7–3.9 Nm).

- (B) **Micrometer Method.** An alternate method or a means of checking pre-load adjustment is to tighten adjusting rings until the carrier legs are spread .006" to .013" (15–35 in. lb. rolling resistance). When measuring for carrier leg spread, use a large micrometer or vernier gauge and measure at legs diagonally opposed. Refer to Figure 72.

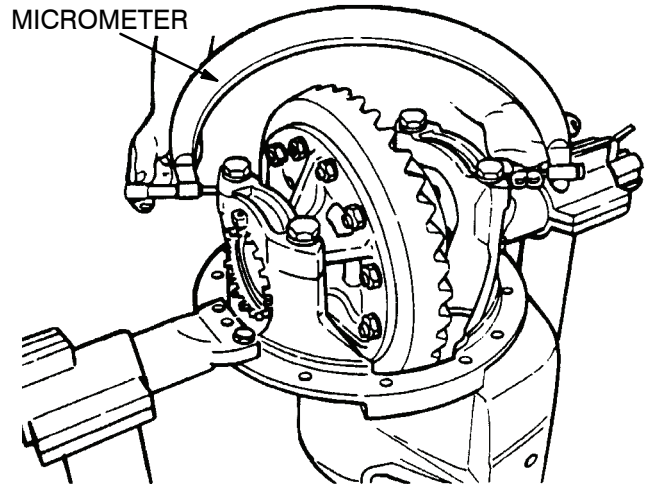


Figure 72.

- (1) Turn both adjusting rings hand–tight against the differential bearings.
- (2) Measure between opposite outside surfaces of the bearing caps. Note this measurement. See Figure 72.
- (3) Tighten each adjusting ring one notch.
- (4) Measure the distance between opposite outside surfaces of the bearing caps again. Compare this new measurement with the measurement noted in step 2. The difference between these dimensions is the amount the bearing caps have expanded.
- (5) If the difference in dimensions is not at or within the specification, repeat steps 3 through 5.

## 20 CHECKING RING GEAR RUNOUT.

- (1) Using dial indicator, check drive gear for excessive run–out. If run–out exceeds .008", remove differential and gear assembly from carrier and check for cause and correct. Refer to Figure 73.



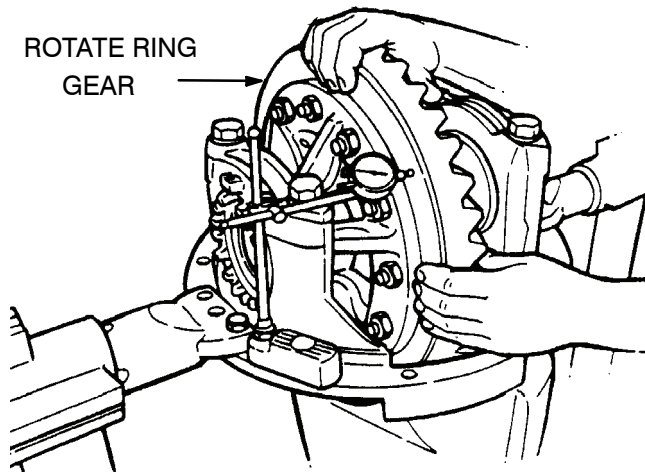


Figure 73.

## 21 GEAR BACKLASH ADJUSTMENT.

If original drive pinion and gear are used, adjust backlash to established setting recorded before disassembly.

If a new gear set is used, backlash should be adjusted to .012" (.305 mm).

- (1) Attach a dial indicator to carrier mounting flange. Position indicator plunger against a tooth surface (drive side) of ring gear.
- (2) While observing dial indicator, rotate ring gear slightly in both directions against pinion teeth. It may be desired to hold drive pinion stationary when rotating gear. Make a note of reading. Refer to Figure 74.

### NOTE

**Adjust backlash by moving ring gear ONLY. DO NOT MOVE PINION.**

- (3) For an original gear set, adjust backlash between .010" and .020" as required, by backing off one differential bearing adjusting ring and advancing opposite ring same amount.
  - (a) Moving gear toward pinion will decrease backlash.
  - (b) Moving gear away from pinion will increase backlash. Refer to Figure 75.

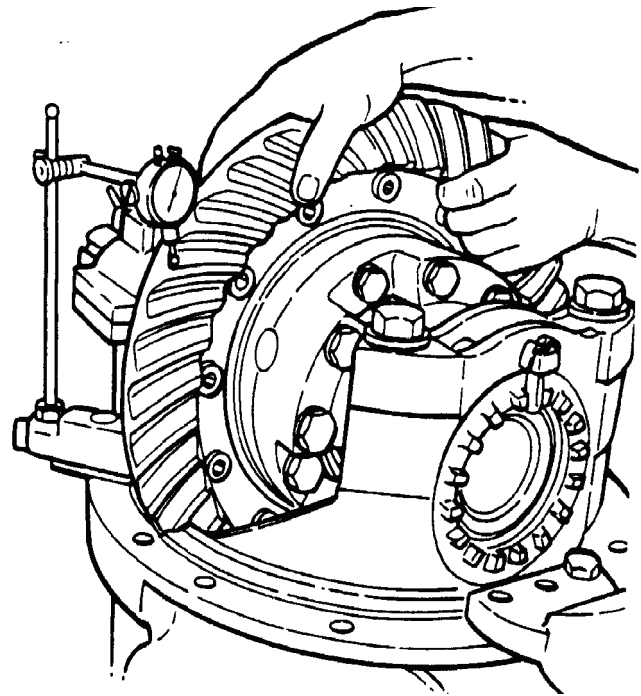


Figure 74.

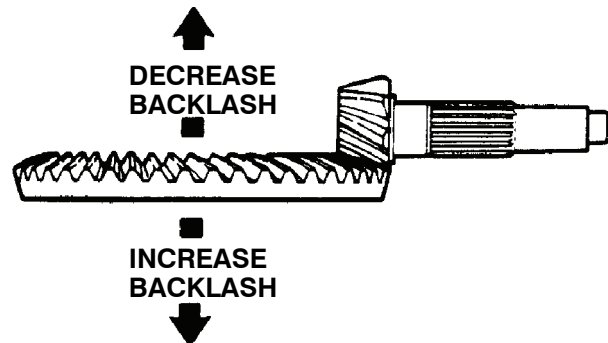


Figure 75.

## 22 TOOTH CONTACT PATTERNS.

### 22.1 Gear Marking and Tooth Contact.

- (1) Apply gear marking compound, i.e. oiled red lead, lightly to the gear teeth. When the pinion is rotated, the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts.
- (2) Sharper impressions may be obtained by applying a small amount of resistance to the gear with a flat steel bar and using a wrench to rotate the pinion. When making adjustments, check the drive side of the gear teeth. Coast side should be automatically correct when drive side is correct. As a rule, coating about twelve teeth is sufficient for checking purposes.

- (3) After obtaining a satisfactory tooth contact, especially in relation to the top and bottom of the tooth, the backlash can be altered within the limits of .010"–.020" (.255 mm–.510 mm) to obtain a better contact position relative to length of tooth. Refer to "Gear Backlash Adjustment".
- (4) A high backlash setting can be used to keep the contact from starting too close to the toe, and a low backlash setting can be used to keep the contact from starting too far away from toe.
- (5) After correct tooth contact has been established, install adjusting ring locks (cotter pins).

**22.2 "Reading" Tooth Contact Patterns.** With adjustments properly made (pinion at correct depth and backlash set at .010") the contact discussed next will be obtained. The area of contact favors the toe and is centered between the top and bottom of the tooth.

#### 22.2.1 Good Tooth Contact (Gears Unloaded).

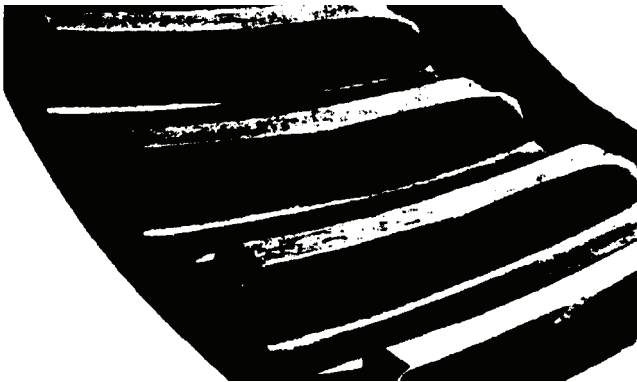


Figure 76.

The hand rolled pattern shown in Figure 76 (gears unloaded) will result in a pattern centered on length of tooth when gears are under load, shown in Figure 77. The loaded pattern will be almost full length and top of pattern will approach the top of the gear.

#### 22.2.2 Good Tooth Contact (Gears Loaded).

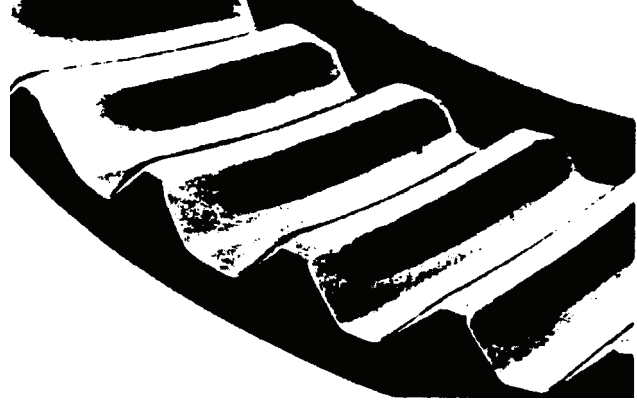


Figure 77.

- (1) The pattern on coast side of teeth will appear the same width as drive side. However, over-all length will be centered between the toe and heel of gear tooth.
- (2) If correct contact location shown cannot be established with a backlash of .015" (.381 mm), adjust backlash as required between limits of .010"–.020" (.255 mm–.510 mm). Refer to "Gear Backlash Adjustment".
- (3) Set used gears so tooth contact matches existing wear patterns. Hand rolled patterns of new gears will be smaller in area and should be at the toe end, and in the center, of the gear tooth.

**22.2.3 Poor Tooth Contacts.**

- (1) A high contact indicates pinion is too far out. Set the pinion to the correct depth by increasing thickness of shim between pinion inner bearing cup and carrier. Refer to Figure 78.

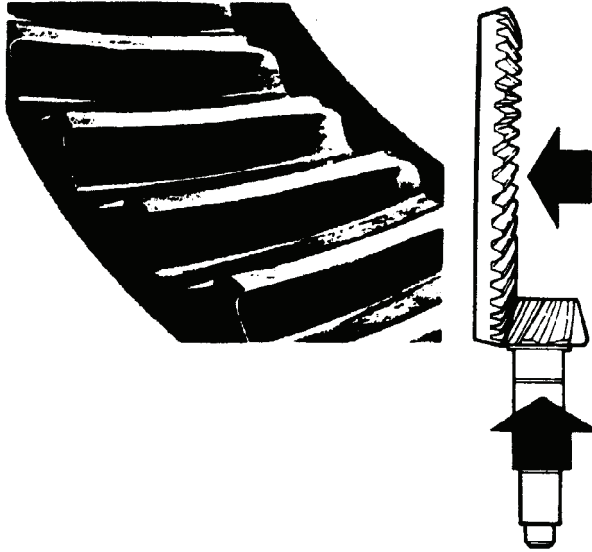


Figure 78.

- (2) Slight outward movement of hypoid gear may be necessary to maintain correct backlash .010" – .020" (.255 mm – .510 mm).
- (3) A low contact indicates pinion is too deep. Set the pinion to the correct depth by decreasing thickness of shim between pinion inner bearing cup and carrier. Refer to Figure 79.

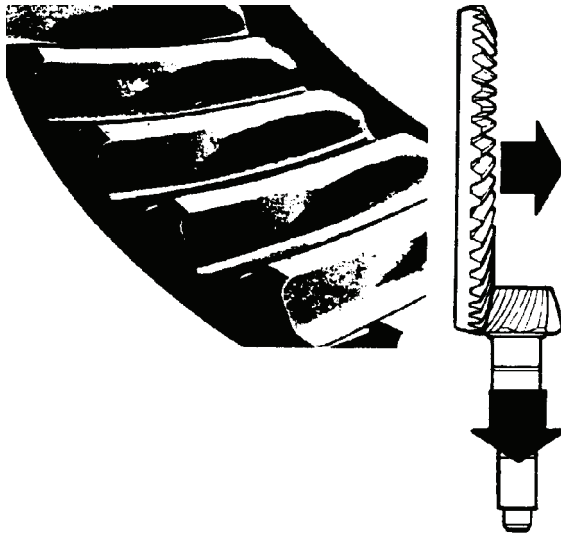


Figure 79.

- (4) Slight inward movement if the hypoid gear may be necessary to maintain correct backlash .010" – .020".
- (5) Adjust ring gear backlash, within the specified range, to move the contact patterns to the correct location on the gear teeth.
- (6) Install the lock pins on the bearing caps so that the pins are between the lugs of the adjusting rings. See Figure 74.

**23 ADJUST REAR CARRIER DRIVE GEAR THRUST SCREW.**

- (1) After correct gear tooth contact patterns have been established, install the thrust screw into the carrier and tighten directly against the ring gear. Figure 80.

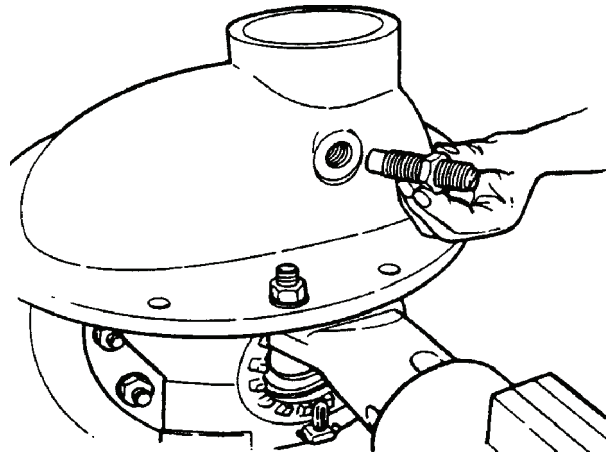


Figure 80.

- (2) To secure the correct adjustment of .025" – .045" clearance, loosen the adjusting screws 1/2 turn and lock into position with nut. Tighten nut to the torque listed for its size:

THREAD SIZE	TORQUE VALUE LB-FT (N.M)	
.75-16	150-190	(203-258)
.88-14	150-300	(203-407)
1.12-16	150-190	(203-258)
M22 X 1.5	148-210	(200-285)
M30 X 1.5	236-295	(320-400)

**24 INSTALLING THE MAIN DIFFERENTIAL LOCK.**

- (1) Install the differential lock sliding shift collar and tap the two retainer roll pins until they are level with the outer face of the shift fork. Release the differential lock if it is manually engaged. Figure 81.

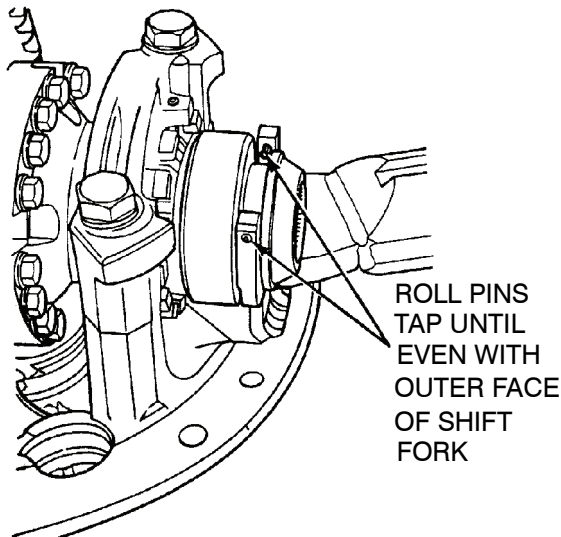


Figure 81. Sliding Shift Collar.

- (2) Install the differential lock shift unit. Refer to Service Group 431-14.

**25 INSTALLING THE AIR SHIFT COMPONENTS FOR THE INTER-AXLE DIFFERENTIAL LOCK.**

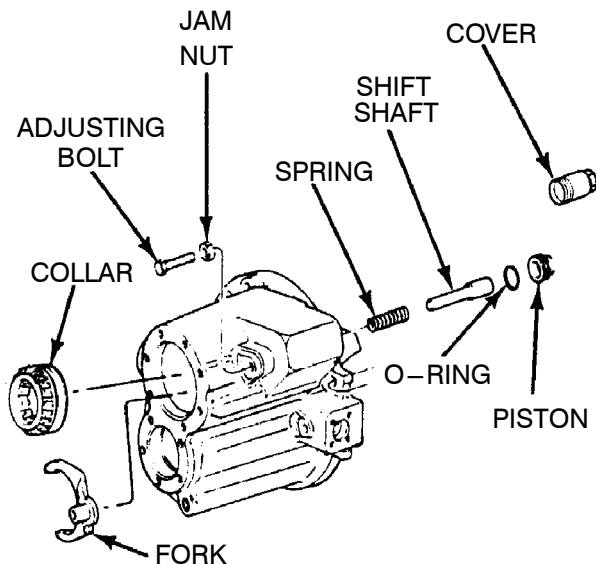


Figure 82.

**NOTE**

The cover is welded to the carrier housing and cannot be removed.

- (1) Install the O-Ring on the piston.

**NOTE**

The shift components are installed by reaching in through the input shaft bore.

- (2) Install the piston on the shift shaft or cover.
- (3) Install the shift collar and the fork.
- (4) Install the shift shaft and spring in the differential carrier while guiding the shaft through the shift fork.
- (5) Install the adjusting bolt and the jam nut.

**26 ASSEMBLING THE INPUT SHAFT ASSEMBLY.**

- (1) Apply the lubricant used in the axle housing to the parts as they are being assembled.
- (2) If removed, install the bearing cup in the input bearing cage. Use a press and a sleeve to install the cup in the cage. The cup is correctly installed when the bottom of the cup touches the bottom of the bore in the cage. Figure 83.

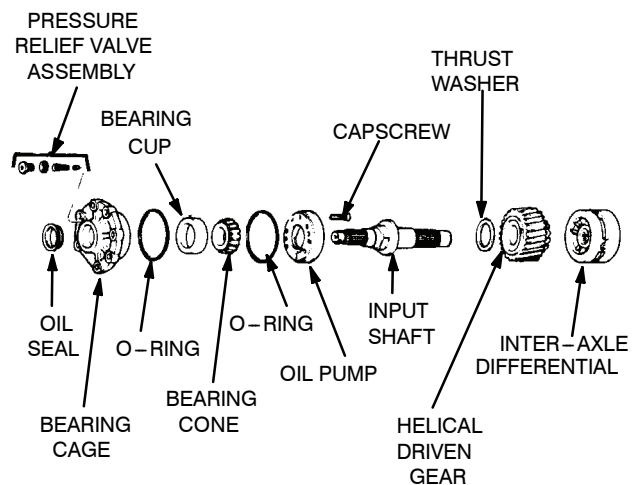


Figure 83.

- (3) If removed, install the oil seal in the input bearing cage according to the following procedure:
  - (a) Apply the specified lubricant that is used in the axle housing to the inner bore of the bearing cage.

**⚠ CAUTION**

Hold the seal only on the outer diameter. Do not touch the lips in the inner diameter of the seal. If you touch the lips on the inner diameter of the seal, you will contaminate the lips and cause a leak between the shaft and the seal.

- (b) Put the oil seal in the bearing cage so that the flange is parallel to the top of the cage.
- (c) Use a press and a driver or a flat metal plate to install the oil seal in the bearing cage. Figure 84.

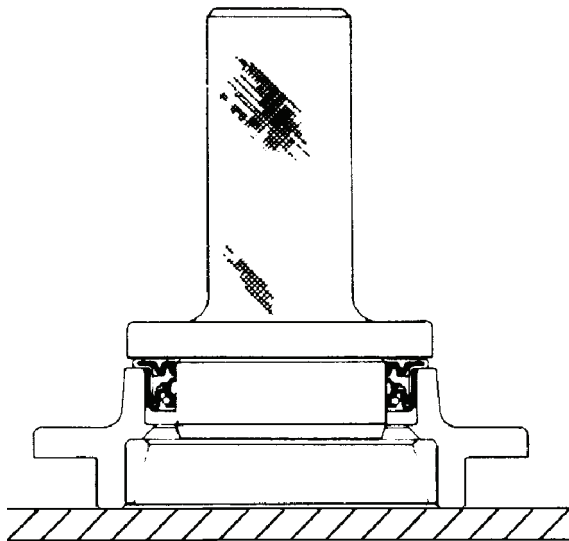


Figure 84.

**⚠ CAUTION**

Do not apply pressure after the flange of the seal touches the top of the cage or you will damage the cage.

- (d) Apply pressure until the metal flange of the seal touches the top of the cage.

- (e) After the seal is installed, a gap of 0.015–0.030 inch (.381–0.762 mm) can exist between the flange and the cage. The gap is a normal condition because of the flexible coating on the flange of the seal. Use a feeler gauge to measure the gap between the complete flange-to-cage area. If the gap varies more than 0.010 inch (0.254 mm) between the highest and lowest measurement, remove and again install the seal. Figure 85.

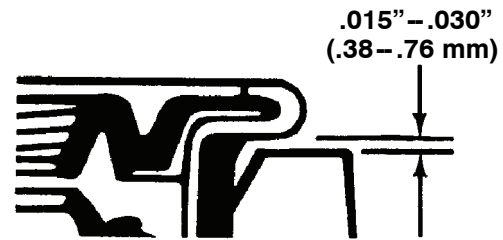


Figure 85.

- (4) Install the input bearing cage and oil pump according to the following procedure:

**⚠ CAUTION**

Make sure the drive flats in the bore of the pump are aligned with the flats on the input shaft. If the flats are not aligned, the pump will be damaged.

- (a) Put the input shaft so that the threads are toward you. If dowel pins are used, install the oil pump on the input shaft so that the dowel pin hole in the pump is toward the threads on the shaft. If a 'drive flat' design pump is used, make sure that the drive flats in the bore of the pump are aligned with the flats on the input shaft. If a spline design pump is used, make sure the splines in the pump are aligned with the splines on the shaft. Figure 86.

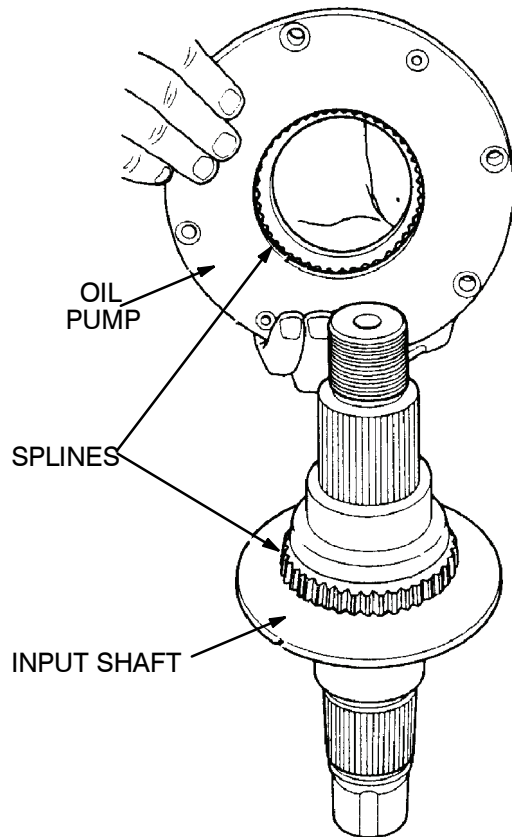


Figure 86.

**NOTE**

If the bearing cone is replaced, the bearing cup must also be replaced. Replace the cup and the cone in a matched set from the same manufacturer.

**CAUTION**

When the bearing cone and the oil pump are installed on the input shaft, put supports under the input shaft. Do not put supports under the oil pump. The oil pump will be damaged if pressure is applied to the body of the pump.

- (b) Put supports under the input shaft.

- (c) Use a press and a sleeve to install the bearing cone on the input shaft. The cone is correctly installed when the bottom of the cone touches the shoulder on the shaft. Figure 87.

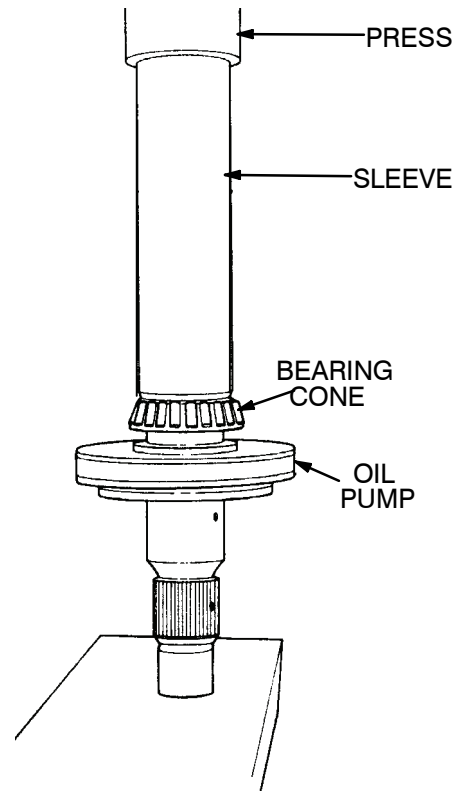


Figure 87.

- (d) Install the input bearing cage over the input shaft on the oil pump. If dowel pins are used, make sure that the dowel pins in the cage are aligned with the holes in the oil pump.
- (e) Install the capscrews that fasten the oil pump to the input bearing cage. Tighten the capscrews to 22–33 lb–ft (30–45 Nm).
- (f) Install the O-rings on the oil pump and the input bearing cage.

**CAUTION**

Do not use a hammer or a mallet to install the yoke or the flange. A hammer or mallet will damage the yoke or the flange.



- (5) If removed, install the pressure relief valve assembly in the input bearing cage. Install the relief valve, the spring and the plug in the bore. Tighten the plug to 20–40 lb–ft (27–54 Nm). Figure 88.

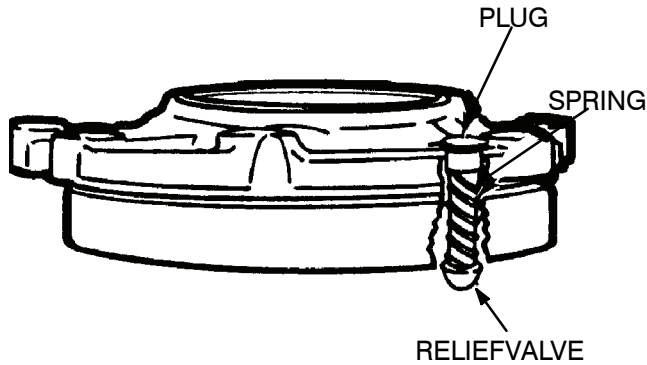


Figure 88.

- (6) Use a press and a sleeve to install the yoke on the input shaft. Make sure that the splines inside the yoke are aligned with the splines on the input shaft. If a press and a sleeve are used, make sure that the input shaft is supported. Figure 89.

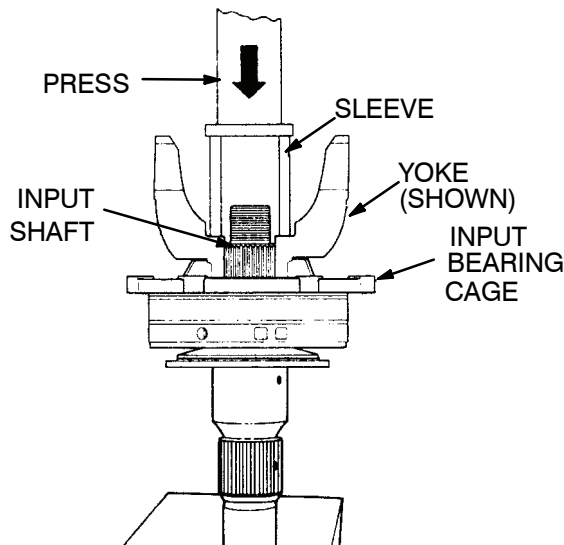


Figure 89.

- (7) Install the nut that fastens the yoke or the flange to the input shaft. Tighten the nut by hand. **DO NOT TIGHTEN THE NUT TO THE SPECIFIED TORQUE UNTIL THE BEARING CAGE AND PUMP ASSEMBLY IS INSTALLED IN THE HOUSING.**
- (8) Put the thrust washer in the pilot bore on the end of the helical drive gear. Install the helical drive gear and the thrust washer on the input shaft so that the thrust washer is toward the input bearing cage. Figure 90.

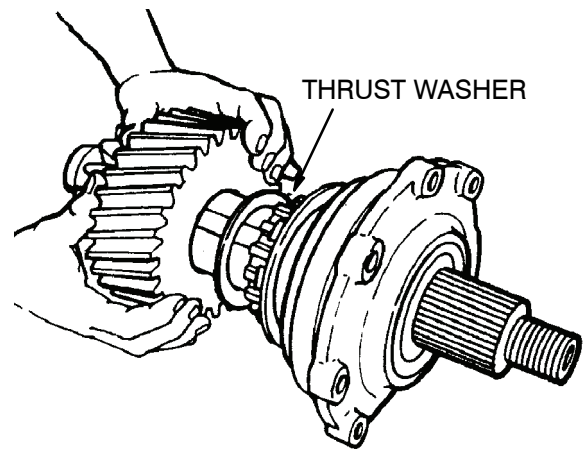


Figure 90.

#### NOTE

If disassembled, assemble the inter-axle differential. Refer to Service Group 430–8.

#### ⚠ WARNING

To prevent injury, wear safety glasses when servicing snap rings.

- (9) Install the inter-axle differential on the input shaft so that the teeth in the differential case are away from the helical drive gear. Install the snap ring that fastens the case to the shaft. Figure 91.

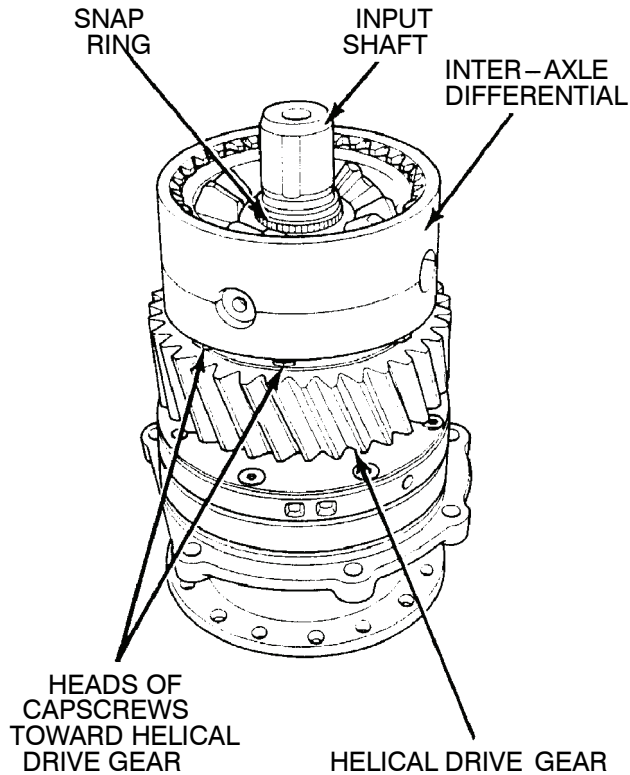


Figure 91.

**NOTE**

If the bearing cup is replaced, the bearing cone must also be replaced. Replace the cup and the cone with a matched set from the same manufacturer.

- (10) If removed, install the bearing cup for the rear side gear in the differential carrier. Use a press and a sleeve to install the cup in the carrier. If a press is not available, use a sleeve or a long, brass drift and a hammer to install the cup. The cup is correctly installed when the bottom of the cup touches the bottom of the bore. Figure 92.

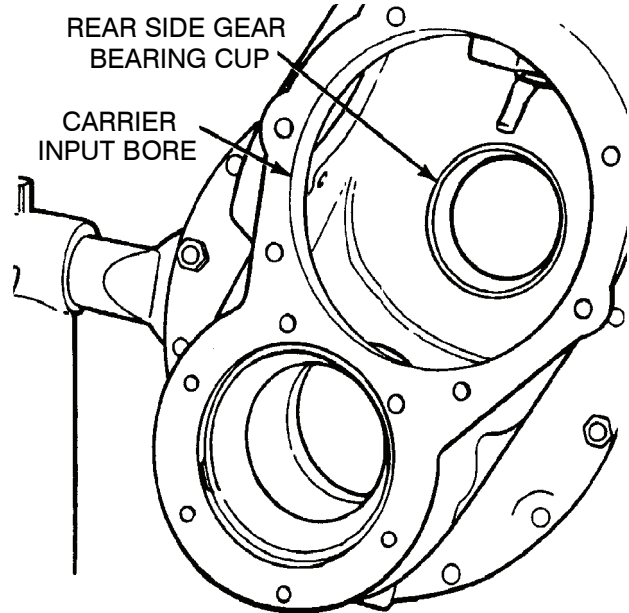


Figure 92.

**NOTE**

If the bearing cone is replaced, the bearing cup must also be replaced. Replace the cup and the cone in a matched set from the same manufacturer.

- (11) If removed, install the bearing cone on the rear side gear. Use a press and a sleeve to install the cone on the gear. The cone is correctly installed when the bottom of the cone touches the shoulder on the side gear.

## 27 INSTALLING THE INPUT SHAFT ASSEMBLY.

### NOTE

The shim pack under the input bearing cage is installed after the end play of the input bearing is checked and adjusted.

- (1) Put the differential carrier in a repair stand so that the ring gear is toward the floor.
- (2) Install the rear side gear and bearing assembly through the clutch collar and into the differential carrier. Figure 93.

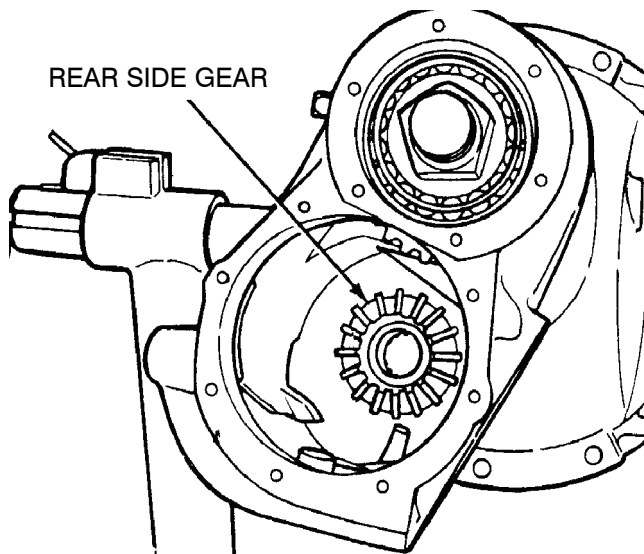


Figure 93.

- (3) Install the input shaft assembly in the differential carrier according to the following procedure:
  - (a) Connect a lifting device to the input yoke. Lift the input shaft assembly over the bore in the differential carrier.

- (b) Lubricate the O-rings with the oil that is used in the carrier.
- (c) Rotate the inter-axle differential case so that one of the notches on the case is aligned with the helical driven gear in the carrier. Figure 94.

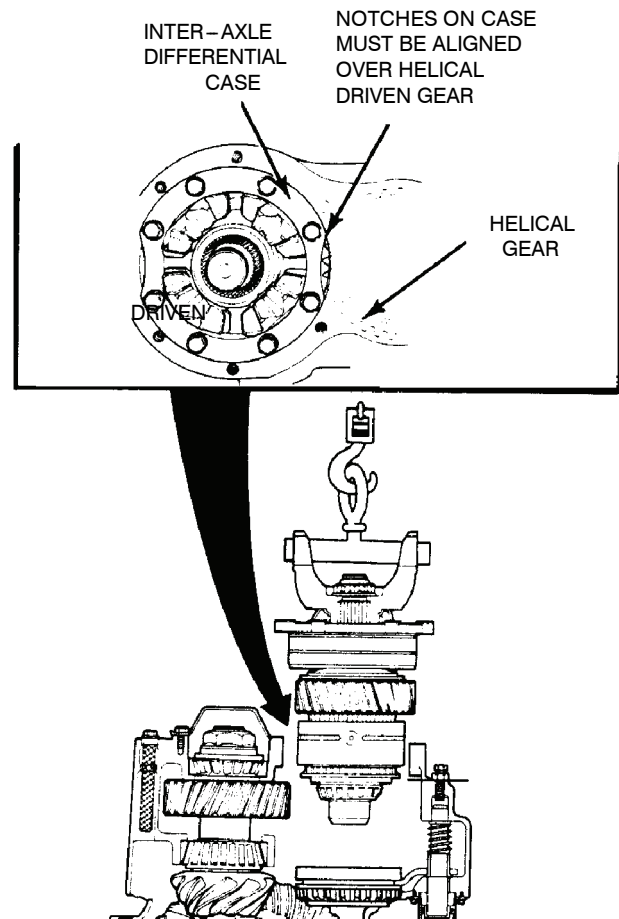


Figure 94.

- (d) Lower the input shaft assembly into the differential carrier. Figure 95.

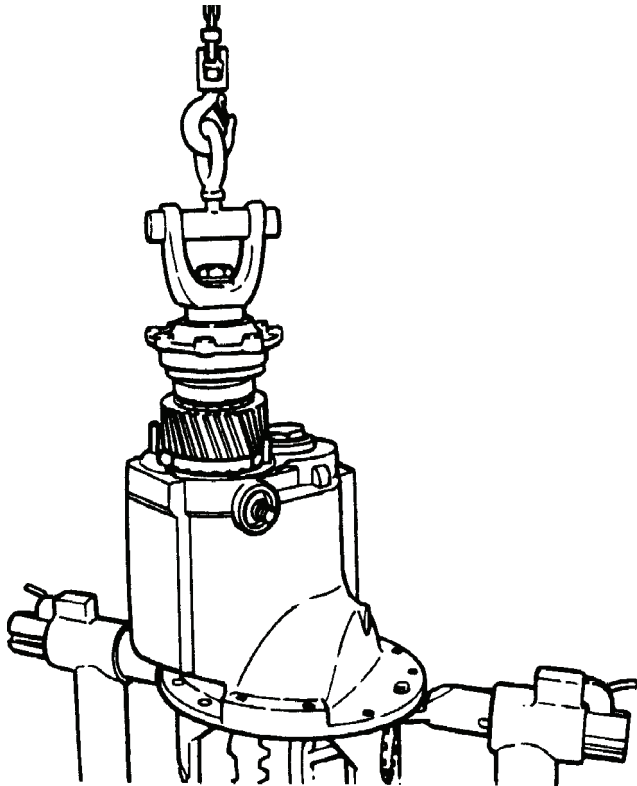


Figure 95.

**28 CHECKING AND ADJUSTING INPUT BEARING END PLAY.**

- (1) Put a wood block between the ring gear and the differential case to keep the ring from rotating.

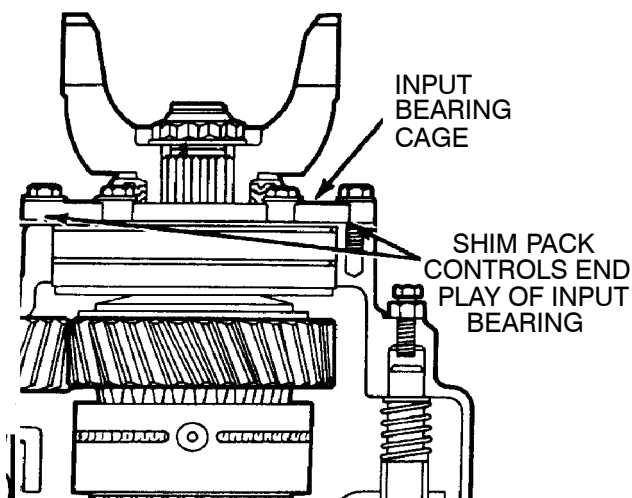


Figure 96.

- (2) Install capscrews, but not the washers, that fasten the input bearing cage to the carrier. Rotate the input shaft in each direction to make sure the bearings are correctly installed while tightening the capscrews by hand. **DO NOT TIGHTEN THE CAPSCREWS TO THE SPECIFIED TORQUE.**
- (3) Use a feeler gauge to measure the gap between the input bearing cage and the differential carrier. Check the gap at four equally-spaced places on the cage. Figure 97.

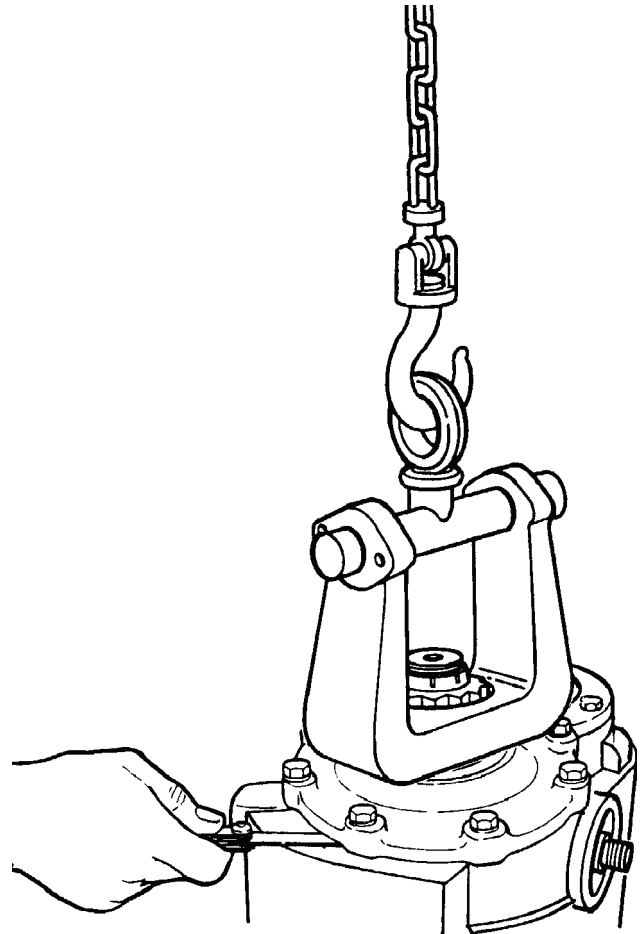


Figure 97.

- (4) Add up the four measurements and determine the average gap between the cage and the carrier. Add 0.005 inch (0.13 mm) to the average gap measurement to determine the size of the shim pack between the cage and the carrier.
- (5) Use at least three shims to build a shim pack. Put the thickest shims in the middle of the shim pack.
- (6) Remove the capscrews that fasten the input bearing cage to the carrier.

- (7) Install the shim pack according to the following procedure:
- Connect a lifting device to the input yoke. Lift the input shaft assembly until there is a distance of 1/4-1/2 inch (6–12mm) between the cage and carrier mounting surface.
  - Install the shim pack under the bearing cage. Make sure that the hole pattern of the shim pack matches the hole pattern of the cage. Figure 98.

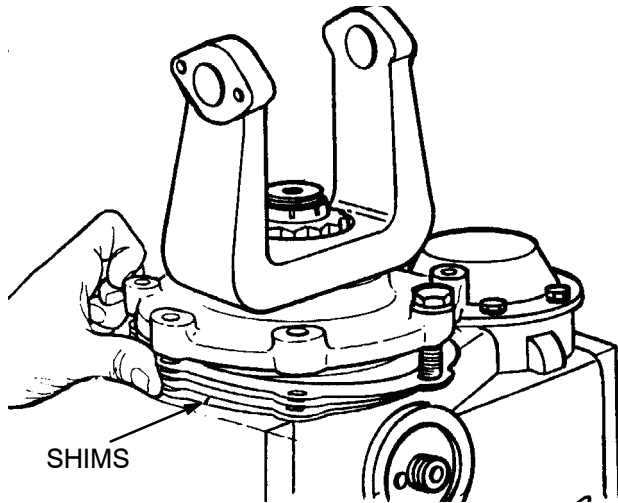


Figure 98.

- Put the shield for the oil filter in position on the bearing cage.
  - Install the capscrews and the washers that fasten the cage to the carrier. Make sure that the capscrews are aligned with the holes in the shim pack. Tighten the capscrews so that the threads engage in the holes of the carrier.
  - Lower the input shaft assembly so that the cage and the shim pack are installed against the carrier. Remove the lifting device from the yoke or flange.
  - Tighten the capscrews to 75–105 lb–ft (100–145 Nm) while rotating the input shaft in each direction to make sure that the bearings are correctly installed.
  - Remove the block of wood between the ring gear and the differential carrier.
- (8) Put a holding tool on the input yoke and tighten the nut to 600–800 ft–lbs (813–1085 N·m).
- (9) Check the end play of the input shaft according to the following procedure:

- Rotate the input shaft in each direction and push the yoke toward the bearing cage. This makes sure that the input shaft assembly is at the bottom of its travel.
- Use a dial indicator with a magnetic base or a C-clamp base to check the end play of the input bearing. Make sure the pointer of the dial indicator is against the top of the input shaft. Set the dial indicator at zero (0). Figure 99.

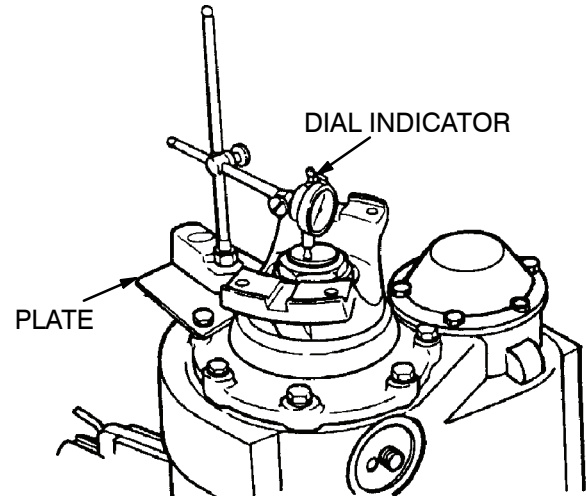


Figure 99.

- Use a pry bar and a support to push the yoke away from the carrier. Read the dial indicator. The reading must be 0.002–0.008 inch (0.050–0.200 mm). Figure 100.

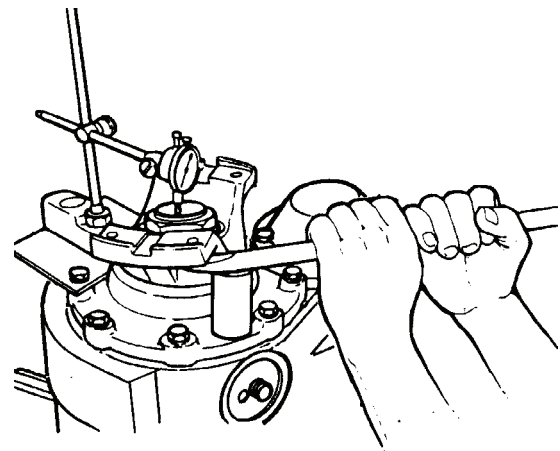


Figure 100.

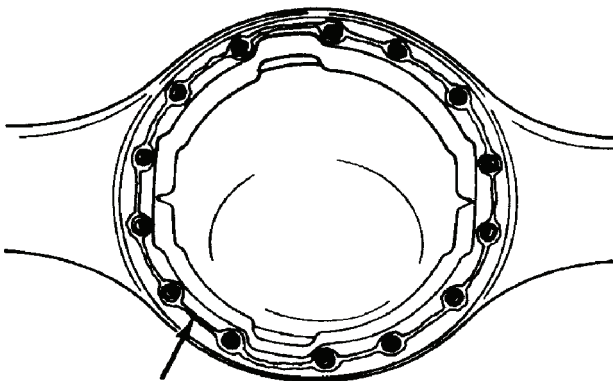
- (10) If the end play of the input bearing is not within 0.002–0.008 inch (0.50–0.200 mm), add or remove shims from the shim pack. Repeat steps 5–9 of this procedure.

## 29 INSTALLING THE DIFFERENTIAL CARRIER IN THE AXLE HOUSING.

### **⚠ WARNING**

Be careful when using cleaning solvents. Follow the solvent manufacturer's instructions for safe use to prevent injury.

- (1) Clean the inside of the axle housing and the mounting surface where the carrier fastens. Use a cleaning solvent and rags to remove dirt. Blow dry the cleaned areas with air.
- (2) Inspect the axle housing for damage. Repair or replace the axle housing if necessary.
- (3) Check for loose studs in the mounting surface of the housing where the carrier fastens. Remove and clean any studs that are loose.
- (4) Apply liquid adhesive to the threaded holes. Install the studs in the axle housing. Tighten the studs to 150–230 lb–ft (203–312 Nm).
- (5) Apply silicone gasket material to the mounting surface of the housing where the carrier fastens. Figure 101.



1/8" (3.2 MM) DIA.  
SILICONE GASKET BEAD

Figure 101.

### **⚠ CAUTION**

The main differential lock **MUST** be shifted into and held in the locked (engaged) position. The locked position gives enough clearance between the shift collar and the axle housing to permit the installation of the carrier.

- (6) Use one of the following procedures to engage the main differential lock:

#### 29.1 Air Pressure Method:

- (a) Before the carrier is installed into the housing, install the left–hand axle shaft through the shift collar and into the side gear. (The axle shaft is being used as a spline alignment tool.)

### **NOTE**

A similar tool can be made from a damaged left–hand axle shaft by cutting off approximately 24 inches from the spline end.

- (b) Align the splines of the shift collar and differential case half by rotating the axle shaft tool or drive pinion.

### **⚠ WARNING**

Do not use your hands to hold the collar in position. Injury can result when air pressure is applied to the actuator.

- (c) Connect an auxiliary air supply to the actuator assembly.
- (d) Apply and hold pressure to the actuator assembly. The air pressure will move the shift collar to engage the differential case half and lock the assembly.
- (e) If the shift collar has not moved the full distance on the splines of the differential case half, rotate the axle shaft tool to complete the shift.
- (f) Remove the axle shaft tool from the carrier.

### **NOTE**

Continue to hold the main differential in the locked (engaged) position with air pressure until the carrier is completely installed in the axle housing. If no air supply is available, use the “Manual Engaging Method” to lock (engage) the differential.

#### 29.2 Manual Engaging Method:

- (a) Align the splines of the shift collar and the differential case half. This can be done by hand or by installing the left–hand axle shaft through the shift collar and into the side gear. See step A and B of the “Air Pressure Method.”
- (b) Install the manual engaging capscrew into the threaded hole in the center of the cylinder cover.



### ⚠ CAUTION

There will be a small amount of spring resistance felt when you turn in the manual engaging capscrew. If a high resistance is felt before reaching the locked (engaged) position, STOP TURNING THE CAPSCREW or the cover, the fork and capscrew threads will be damaged.

### NOTE

A high resistance on the capscrew indicates that the splines of the shift collar and the differential case half are not aligned or engaged.

Lift the shift collar as required and rotate to align the splines of collar and case half while you turn in the manual engaging capscrew. When the normal amount of spring resistance is again felt on the capscrew, the splines are engaged. Continue to turn the manual engaging capscrew.

- (c) Turn the manual engaging capscrews to the right until the head of the capscrew is approximately 1/4 inch from the cylinder cover. DO NOT turn the capscrew beyond its normal stop. The capscrew is now in the service position and the main differential lock is completely engaged. Figure 102.

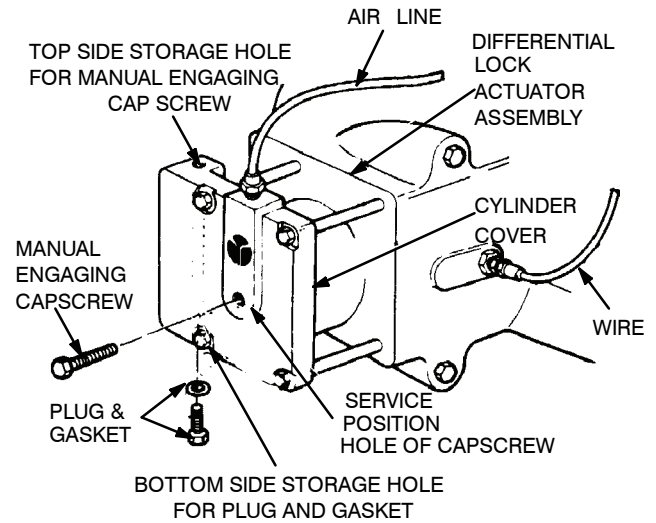


Figure 102.

- (7) Install the carrier into the axle housing. Use a hydraulic roller-jack or a lifting tool. Figure 103.

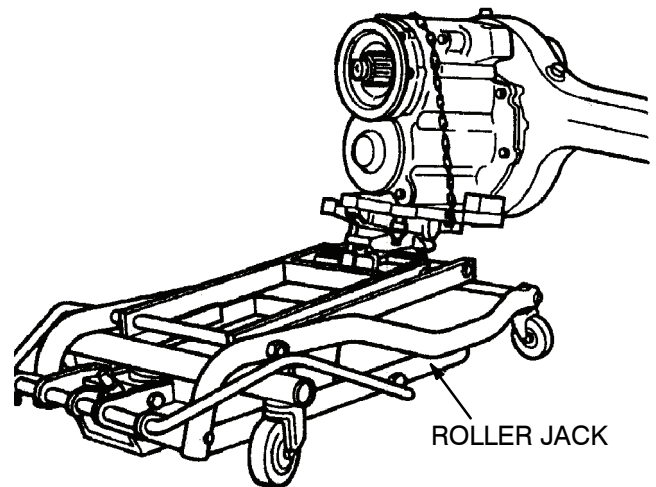


Figure 103.

**CAUTION**

Do not use a hammer or a mallet to install the carrier. A hammer or a mallet will damage the mounting flange of the carrier and cause oil leaks.

- (8) Install the nuts and the washers or the capscrews and the washers in the four corner locations around the carrier and the axle housing. Tighten the fasteners by hand. DO NOT TIGHTEN TO THE SPECIFIED TORQUE. Figure 104.

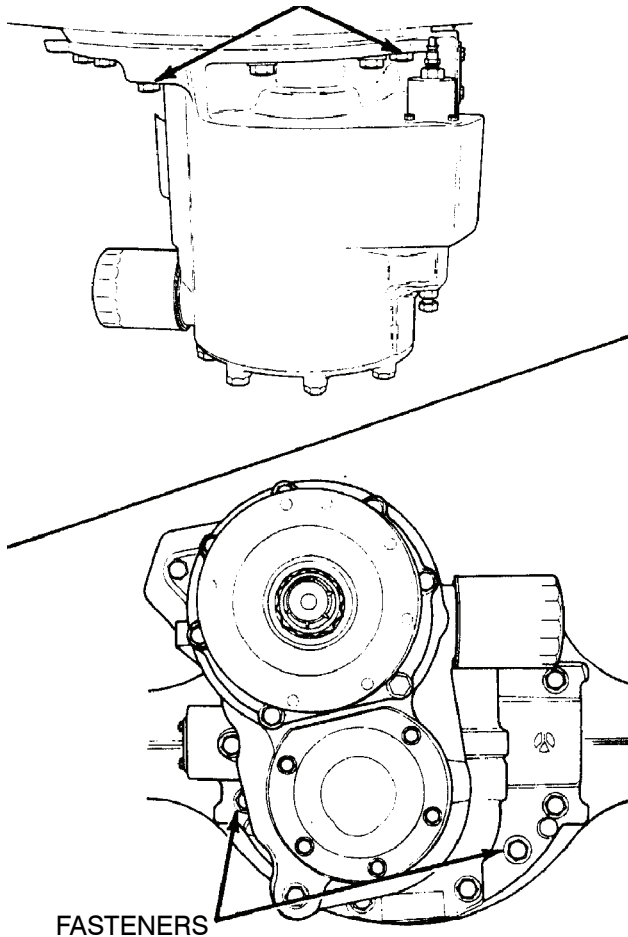


Figure 104.

- (9) Carefully push the carrier into position. Tighten the four fasteners two or three turns each in a pattern opposite each other. Figure 104.
- (10) Repeat step 9 until the four fasteners are torqued to 150–230 ft–lbs (203–312 N·m).
- (11) Install the other fasteners and the washers that hold the carrier in the axle housing.

Tighten the fasteners to 150–230 lb–ft (203–312 N·m).

- (12) Remove the plug and gasket from their position. Remove the manual engaging capscrew from its service position.

**NOTE**

When the manual engaging capscrew is removed from the service position in the actuator, the main differential lock becomes disengaged.

- (13) Clean the plug, gasket, cylinder cover, and threaded hole in the center of the cylinder cover.
- (14) Install the plug and gasket into their operating position in the cylinder cover. Install the manual engaging capscrew into its storage position. See Figure 105.

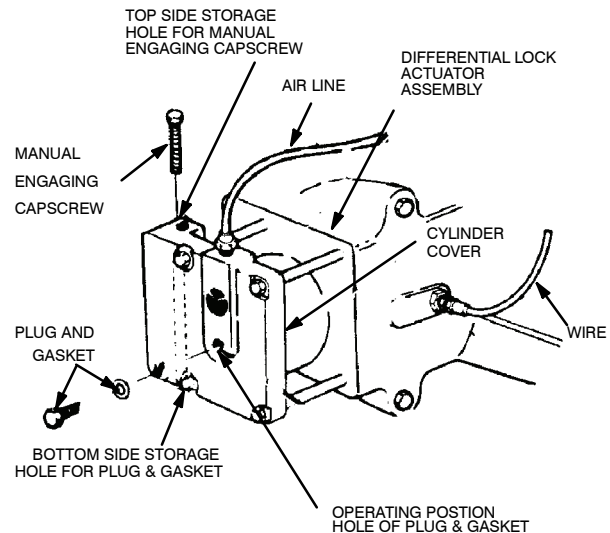


Figure 105.

- (15) Tighten the plug to 44–55 lb–ft (60–75 N·m) torque. Tighten the manual engaging capscrew to 15–25 lb–ft (20–34 N·m).
- (16) Install the gasket between the output shaft bearing cage and the axle housing.
- (17) Put the output shaft and bearing cage assembly in the axle housing. Rotate the output shaft to align the splines of the output shaft with the splines of the rear side gear.
- (18) Install the washers and the capscrews that fasten the output bearing cage to the axle housing. Tighten the capscrews to 35–50 lb–ft (47–68 N·m).

(19) Adjust the shift fork for the inter-axle differential lock according to the following procedure. The movement of the shift fork is controlled by the adjusting screw for the air-shift cylinder.

- (a) Loosen the jam nut on the adjusting screw. Loosen the adjusting screw so that the screw does not touch the shift shaft. Figure 106.

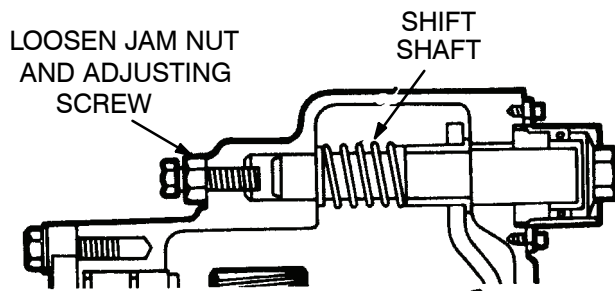


Figure 106.

- (b) Apply and hold 60 psi (414 kPa) of air pressure to the shift cylinder so that the shift collar engages the splines in the inter-axle differential case. Air pressure must be held until after the jam nut is tightened.
- (c) Tighten the adjusting screw until the tip of the screw touches the end of the shift shaft. When the screw touches the shaft, tighten the adjusting screw an additional 1/4–1/2 turn. Figure 107.

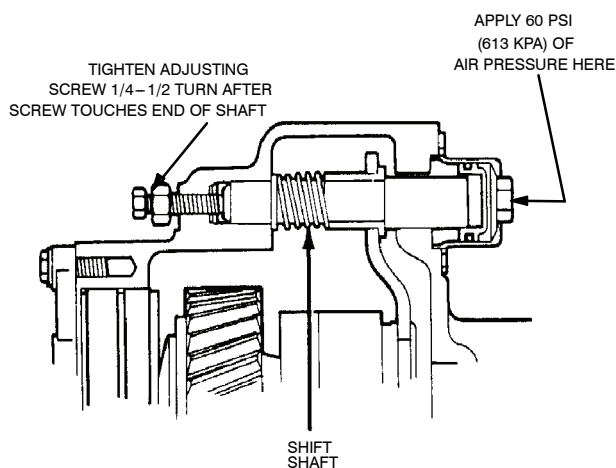


Figure 107.

- (d) Release the air pressure.
- (e) Check that the inter-axle differential is disengaged by holding the input yoke and rotating the output yoke. The output yoke must rotate with less than 50lb-ft (68 N.m) torque applied.
- (f) Apply and hold 60 psi (414 kPa) of air pressure to the shift cylinder to make sure that the shift collar engages the splines in the inter-axle differential case. When the input yoke is rotated, the output yoke must rotate. Release the air pressure.
- (g) Apply a rust prevention oil such as Rockwell Part Number 1199-U-1113 or equivalent to the inlet of the air cylinder.
- (20) On axles with a differential lock, connect the electrical connector to the sensor unit. Make sure the differential lock is disengaged.

### CAUTION

**If the oil filter is tightened more than 3/4 of a turn after it touches the carrier, the oil filter will be damaged and leak fluid.**

- (21) Lubricate the gasket of the new oil filter with the lubricant that is used in the axle housing. Install the oil filter on the adapter. Tighten the oil filter 3/4 of a turn after the gasket on the filter touches the carrier. If necessary, use an oil filter wrench to tighten the filter. Figure 108.

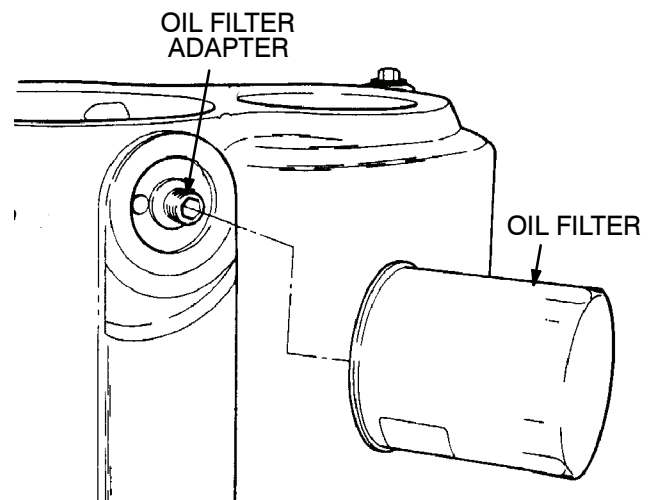


Figure 108.

### 30 REMOVING AND DISASSEMBLING THE REAR DRIVE PINION ASSEMBLY.

- (1) Hold the flange or yoke with a suitable tool and remove the pinion shaft nut and washer. Figure 109.
- (2) Remove the flange or yoke with a suitable puller.

**IMPORTANT: Driving the flange off will cause runoff.**

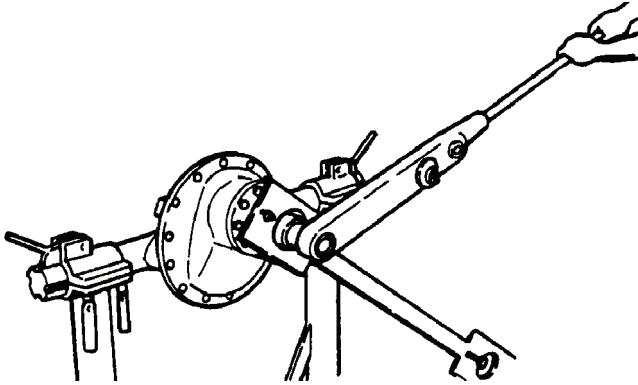


Figure 109.

- (3) Remove pinion cage stud nuts or capscrews.

**IMPORTANT: The use of a pinch bar will damage the shims. Driving pinion from inner end with a driver will damage the bearing locking groove.**

- (4) Remove the bearing cage and shims from the carrier.
- (5) Wire the shim pack together to aid adjustment at reassembly.
- (6) Tap the pinion shaft out of the cage with a soft mallet, or press the shaft from the cage.
- (7) Remove the inner bearing cone and the spacer or spacer combination from the pinion shaft.
- (8) Remove the oil seal from the bearing cage.

### NOTE

**Bearing cups and cones must be replaced together as a matched set.**

- (9) If necessary, remove the outer and inner bearing cups from the cage with a suitable puller.
- (10) Remove the spigot bearing only if required by first removing the retainer snap ring if so equipped, from groove in pinion end.

### CAUTION

**A protective shield should be used when pressing the spigot bearing from the shaft in case the bearing shatters.**

### NOTE

**Some spigot bearings may not be retained by a snap ring but are staked into position on the pinion.**

- (11) Using a press and suitable fixture or bearing puller, remove spigot bearing from pinion end. Be careful not to damage the pinion outer diameter.

### 31 ASSEMBLING AND INSTALLING THE REAR DRIVE PINION ASSEMBLY.

### NOTE

**If a new drive pinion and ring gear set is being installed, refer to "Gear Set Identification."**

**Before assembling, coat bearing cups and cones with recommended axle lubricant.**

- (1) Press the spacer and the inner bearing cone firmly against the pinion shoulder with a suitable sleeve placed against the bearing inner race.
- (2) Press the spigot bearing into position on the pinion end. Figure 110. If pinion end has a groove, retain bearing with snap ring. If spigot bearing is to be staked into position, continue with step 3.

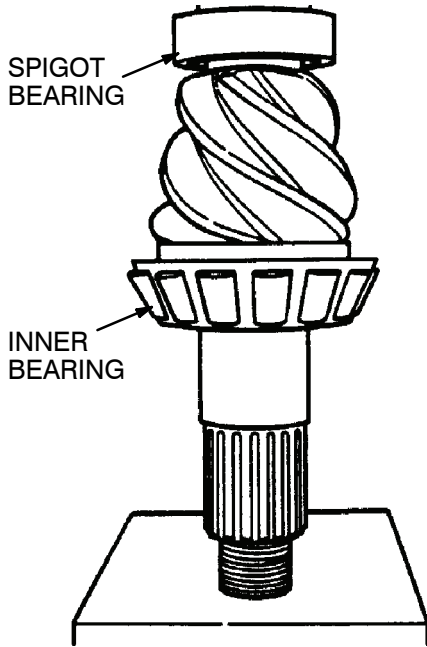


Figure 110.

- (3) To retain the spigot bearing on the pinion end, stake the pinion at six points, as shown, using a proper staking tool. Figure 111.

**CAUTION**

Do not strike the spigot bearing or attempt to stake the bearing using a punch and hammer or damage will result.

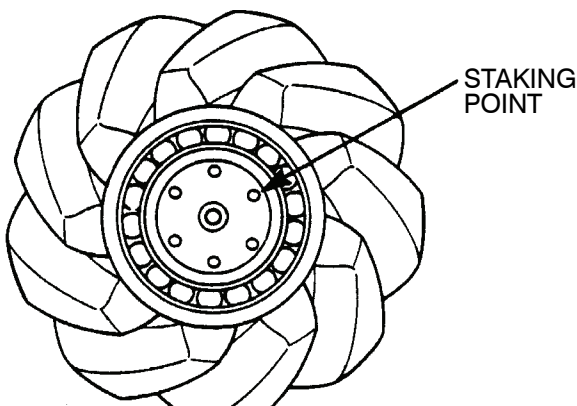


Figure 111.

Specification:

Apply 3,000 kg (6,614 lb.) pressure on a 10 mm or .375 inch ball.

Peen the end of drive pinion at a minimum of five points. Figure 112.

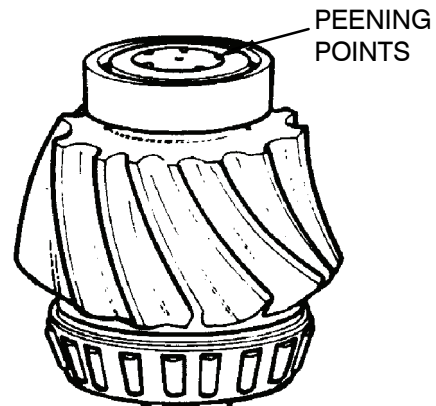


Figure 112.

When a peen tool and press are used, calculate the pressure required on the tool as follows:

$$3,000 \text{ kg (6,614 lb.)} \times \text{amount of balls in tool} = \text{kilograms or pounds}$$

Example: 6,614 lb. x 3 balls = 19,842 pounds

For information about the peen tool write to Rockwell International, Communications Department, 2135 West Maple Road, Troy, Michigan 48084.

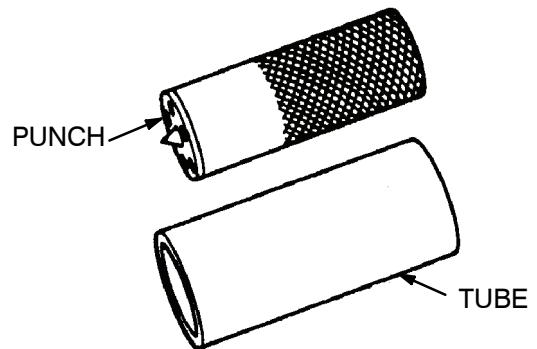


Figure 113.

- (a) Put the drive pinion and the tube of the peen tool in a press, spigot bearing toward the top. Figure 114.
- (b) Calculate the amount of pressure that will be required on the peen tool. See specification and example calculation.
- (c) Put the punch of the peen tool over the end of the pinion and spigot bearing. Apply the required amount of pressure on the punch. Figure 114.

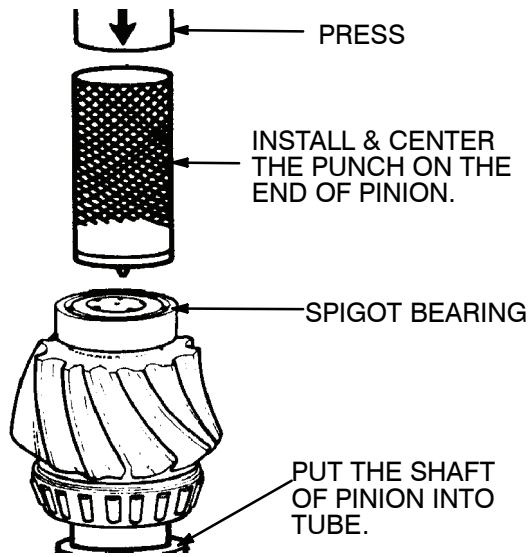


Figure 114.

### ⚠ CAUTION

Do not align new points with grooves in end of drive pinion or in old points. If the new peen points are put in the wrong areas, the spigot from bearing will not be held correctly on the pinion.

- (d) Rotate the punch as many times as required for a minimum of five points. Repeat step C for each point.

### NOTE

If a three ball peen tool is used, rotate the tool 180° (degrees).

- (4) Install Two-Piece Spigot Bearing Assemblies with the following procedure:
  - (a) With a press or a soft mallet and sleeve, install the inner race of the spigot bearing on to the nose of the pinion. Use a sleeve of the correct size and press the bearing race until it is squarely against its shoulder on the nose of the pinion. Figure 115.

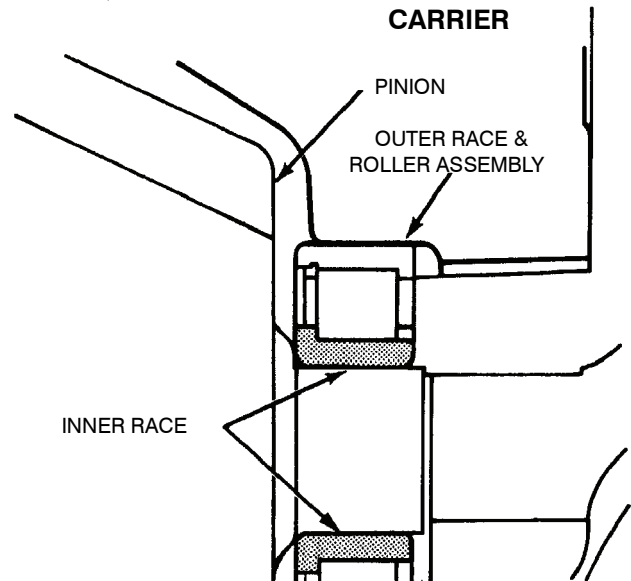


Figure 115.

- (b) With a press or a soft mallet and sleeve, install the outer race and roller assembly into its bore in the carrier. Use a sleeve that is the same size as the outer race and press the bearing until it is squarely against the shoulder in the bottom of its bore.
- (5) Apply axle lubricant on bearing cups in the cage and bearing cones.
- (6) Install the drive pinion into the bearing cage.
- (7) Install the bearing spacer or spacers on pinion shaft against the inner bearing cone. Figure 116.
- (8) Install the outer bearing cone on pinion shaft against the spacer. Figure 116.



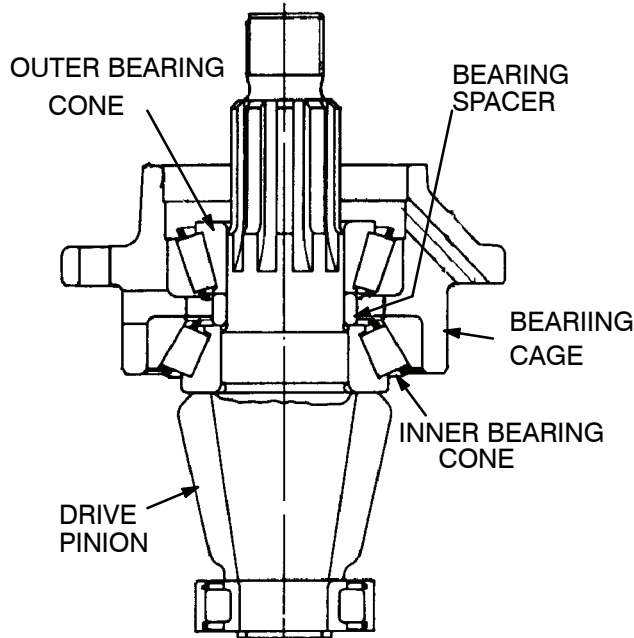


Figure 116.

- (9) Adjust pinion bearing preload.
- (10) Coat the seal lip with Lubriplate and install the seal into bore in the pinion cage using a mallet and sleeve.
- (11) If original gears are reused, install the original shim pack under the cage. If new gears are used, alter the original shim pack thickness as required. Refer to adjusting the pinion cage shim pack thickness.
- (12) Position the pinion and bearing cage assembly with proper shim pack in the carrier pinion cage bore. Tap the assembly into place with a mallet. Install cage to carrier capscrews and torque to 75-105 lb-ft (102-142N·m).
- (13) Install yoke, washer, and nut onto pinion shaft. Tighten nut to 600-800 lb-ft (813-1085 N·m) torque.

### 32 REAR CARRIER PINION BEARING PRE-LOAD.

Specifications:

New pinion bearings – 5 to 45 lb.-in. (.56 to 5.08 N.m) torque.

Used pinion bearings in good condition – 10 to 30 lb.-in. (1.13 to 3.39 N.m) torque.

### NOTE

If a press is not available, or the press does not have a pressure gauge, use the yoke method to adjust preload.

- (1) Press Method:
  - (a) Put the drive pinion and cage assembly in a press, gear head (teeth) toward the bottom.
  - (b) Install a sleeve of the correct size against the inner race of the outer bearing. Figure 117.

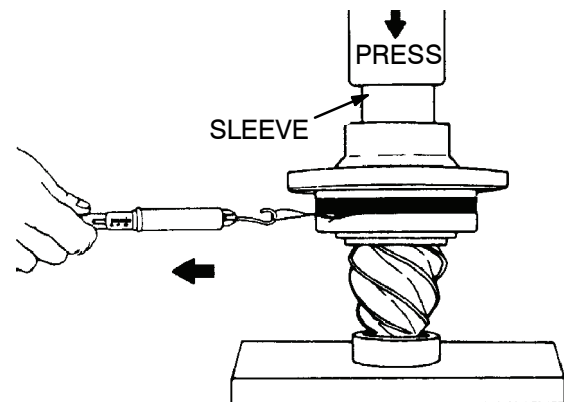


Figure 117.

- (c) Apply and hold the correct amount of pressure to the pinion bearings. See chart 1. As pressure is applied, rotate the bearing cage several times so that bearings make normal contact.
- (d) While pressure is held against the assembly, wind a cord around the bearing cage several times.
- (e) Attach a spring scale to the end of the cord.
- (f) Pull the cord with scale on a horizontal line. As the bearing cage rotates, read the value indicated on scale. Make a note of reading. Figure 117.

### NOTE

Do not read starting torque. Read only the torque value after the cage starts to rotate. Starting torque will give a false reading.

- (g) Measure the diameter of bearing cage where the cord was wound. Measure in inches or centimeters. Figure 118.

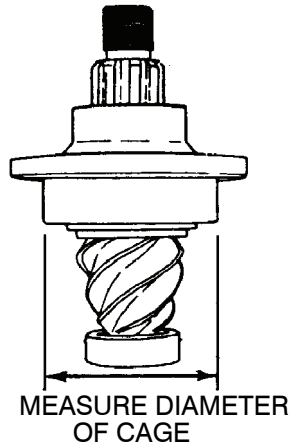


Figure 118.

- (h) Divide the dimension in half to get the radius. Make a note of radius dimension.
- (i) Use the following procedure to calculate the bearing preload (torque).

Pounds pulled x Radius (inches) =  
lb.-in. preload x .113 = N.m preload  
OR

Kilograms pulled x Radius (centimeters)  
= kg-cm preload x .098 = N.m preload

Examples:

Reading from spring scale = 7.5  
pounds (3.4 kg)

Diameter of bearing cage = 6.62 inches  
(16.8 cm)

Radius of bearing cage = 3.31 inches  
(8.4 cm)

$7.5 \text{ lb.} \times 3.31 \text{ in.} = 24.8 \text{ in.-lb. preload} \times$   
 $.098 = 2.8 \text{ N.m preload}$

- (j) If the preload (torque) of pinion bearings is not within specifications, do the following procedure:

To increase preload, install a thinner bearing spacer. To decrease preload, install a thicker bearing spacer.

- (k) Repeat steps A through i.

## CHART 1

Thread Size of Pinion Shaft	Press Pressure Needed on Bearings for Correct Pre-load. pounds/tons (kg/metric tons)	Torque Value Needed on Pinion Nut for Correct Bearing Pre-load. lb.-ft. (N.m)
7/8"-20	22,000 /11 (9979 / 10)	200–275 (271–373)
1"-20	30,000/ 15 (13608/ 13.6)	300–400 (407–542)
1 1/4" -12	54,000/ 27 (24494/ 24.5)	700–900 (949–1220)
1 1/4" -18	54,000/ 27 (24494/ 24.5)	700–900 (949–1220)
1 1/2" -12	54,000/ 27 (24494/ 24.5)	800–1100 (1085–1491)
1 1/2" -18	54,000/ 27 (24494/ 24.5)	800–1100 (1085–1491)
1 3/4" -12	50,000/ 25 (22680/ 22.7)	900–1200 (1220–1627)
2" -12	50,000/ 25 (22680/ 22.7)	1200–1500 (1627–2034)

## (2) Yoke Method:

- (a) Install the input yoke, nut and washer on the drive pinion. The yoke **MUST** be against the outer bearing.

**NOTE**

If the fit between the yoke splines and drive pinion splines are tight, use a press to install the yoke. Figure 119.

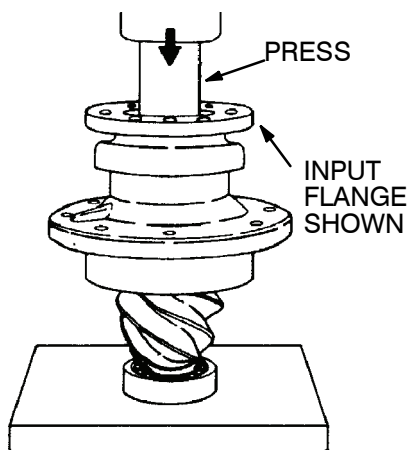


Figure 119.

**CAUTION**

**Do not install tight fit yokes on shafts using a hammer or mallet. A hammer or mallet will damage the yoke.**

- (b) Temporarily install the drive pinion and cage assembly in the carrier. Do not install shims under the bearing cage. Figure 120.

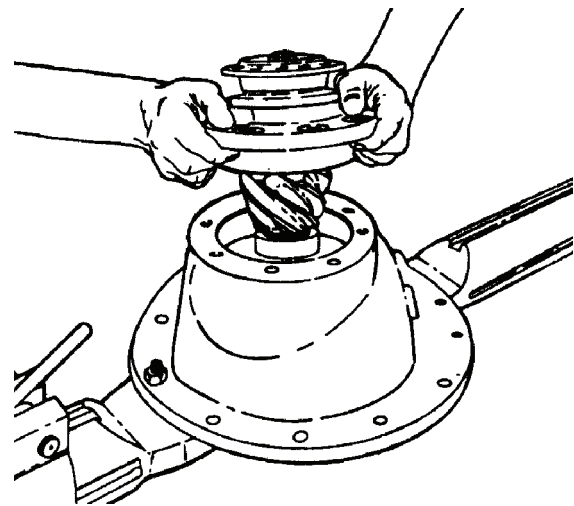


Figure 120.

- (c) Install the bearing cage to carrier capscrews. Washers are not required at this time. Tighten the capscrews hand tight.
- (d) Fasten a yoke or flange bar to the input yoke. The bar will hold the drive pinion in position when the nut is tightened. Figure 121.

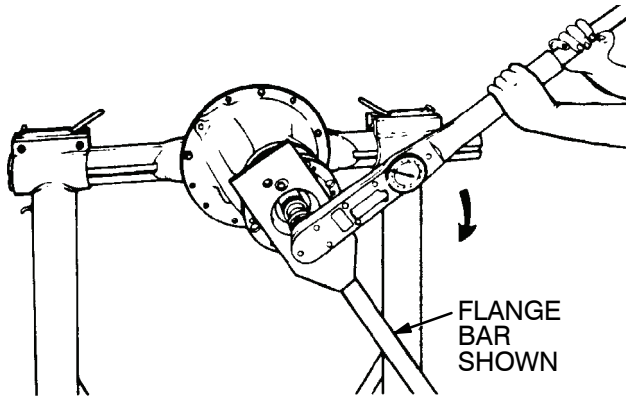


Figure 121.

- (e) Tighten the nut on drive pinion to the correct torque value. Figure 121. See chart 1.
- (f) Remove the yoke or flange bar.
- (g) Attach a torque wrench on the drive pinion nut. Rotate the drive pinion and read the value indicated on torque wrench. Figure 122.

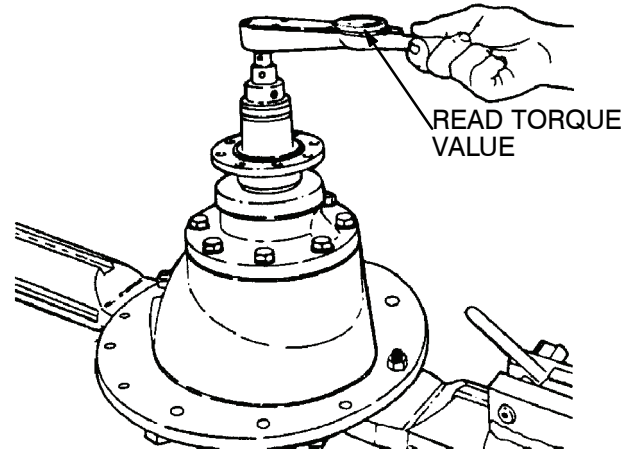


Figure 122.

- (h) If the preload (torque) of pinion bearings is not within specifications, remove the pinion and cage assembly from carrier. Do the following procedure:
  - To increase preload, install a thinner bearing spacer.
  - To decrease preload, install a thicker bearing spacer.
- (i) Repeat steps a through i.
- (j) After adjusting preload of pinion bearings, remove the drive pinion and bearing cage from carrier.

**33 TROUBLESHOOTING.**

PROBLEM	PROBABLE CAUSE	REMEDY
Wheel bearing seizure. Noisy bearing.	<ol style="list-style-type: none"> <li>1. Improper lubrication.</li> <li>2. Lubricating practices.</li> <li>3. Worn or seized bearings.</li> <li>4. Incorrect inner/outer locknut torque placing too much or too little preload on wheel bearing.</li> <li>5. Bent or broken axle due to overload or improper vehicle use.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove axle. Replace bearings.</li> <li>2. Use correct lubrication and lubrication methods.</li> <li>3. Remove axle. Replace bearings.</li> <li>4. Properly torque locknuts and secure with tang washer.</li> <li>5. Remove axle and replace. Avoid overloads. Proper use of vehicle is essential.</li> </ol>
Noisy axle or axle seizure.	<ol style="list-style-type: none"> <li>1. Bent axle housing causing misalignment of axle and differential components.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace axle housing. Avoid overload and improper use of vehicle.</li> </ol>
Seizure or noisy differential components.	<ol style="list-style-type: none"> <li>1. Fractured ring gear teeth due to excessive overload or improper differential bearing preload and ring gear backlash adjustment.</li> <li>2. Scored and scuffed teeth of ring gear and pinion caused by insufficient lubrication, excessive torque input or worn pinion bearings.</li> <li>3. Overheated ring gear and pinion causing discoloration and distortion by operating at prolonged excessive temperatures.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace ring gear and pinion as a matched set. Properly operate vehicle within approved rated capacity. Correct bearing preload and backlash adjustments.</li> <li>2. Replace ring gear and pinion as a matched set. Replace worn pinion bearings. Use high quality lubricant and maintain at required level. Change at recommended intervals. Properly adjust new bearings.</li> <li>3. Replace ring gear and pinion as a matched set. Check and change lubricant at regular intervals. Use correct lubricant for axle type, operating temperatures and conditions.</li> </ol>

PROBLEM	PROBABLE CAUSE	REMEDY
Seizure or noisy differential components – Continued.	<ol style="list-style-type: none"> <li data-bbox="570 254 987 495">4. Pitted drive pinion teeth due to extreme severe service. Under excessive loading, deflection throws pinion out of correct position in relation to the ring gear causing high pressure which exceeds the strength of oil film.</li> <li data-bbox="570 520 987 642">5. Drive pinion teeth fatigue fracture caused by concentration of stresses from abnormal operation.</li> <li data-bbox="570 667 987 758">6. Shock fracture of side gears and pinions caused by abusive operation of vehicle.</li> <li data-bbox="570 846 987 995">7. Differential scoring and seizure of spider arms and side pinions caused by wheel spinning, inadequate lubrication and overstress.</li> <li data-bbox="570 1083 987 1205">8. Differential side gear fatigue fractures caused by abusive use of vehicle or misalignment of axle shaft and housing.</li> <li data-bbox="570 1293 987 1352">9. Differential splines of side gears worn.</li> <li data-bbox="570 1472 987 1593">10. Differential thrust washer surfaces scored or worn caused by severe service or foreign material in lubricant.</li> <li data-bbox="570 1713 987 1835">11. Damaged gear support case, or worn bearing hub, caused by severe service or foreign material in lubricant.</li> </ol>	<ol style="list-style-type: none"> <li data-bbox="1044 254 1458 344">4. Replace ring gear and pinion as a matched set. Use correct quality lubricant.</li> <li data-bbox="1044 520 1458 642">5. Replace ring gear and pinion as a matched set. Avoid abusive and abnormal vehicle operation.</li> <li data-bbox="1044 667 1458 821">6. Replace damaged side gears, side pinions and spider as a set. Correct operation of vehicle. Do not overload vehicle.</li> <li data-bbox="1044 846 1458 1058">7. Replace side gears, side pinions and spider as a set. Avoid wheel spinning and overstress. Use only quality lubricant, maintained at required level and change at recommended intervals.</li> <li data-bbox="1044 1083 1458 1268">8. Replace side gears and pinion. Replace worn or faulty wheel bearings. Realign or replace axle shaft and axle bearings. Minimize abusive vehicle operation.</li> <li data-bbox="1044 1293 1458 1446">9. Replace all side gears with worn splines. Avoid abusive vehicle operation causing repeated shock load on splines.</li> <li data-bbox="1044 1472 1458 1684">10. Replace scored or worn thrustwashers. Refer to tolerance and wear for replacement tolerance. Maintain correct lubrication level and change at regular intervals.</li> <li data-bbox="1044 1713 1458 1898">11. Replace support case and bearing hub. Operate vehicle correctly. Change oil and make certain all foreign material is removed from axle housing.</li> </ol>



PROBLEM	PROBABLE CAUSE	REMEDY
Seizure or noisy differential components – Continued.	<p>12. Worn roller bearings, rollers cups and cones caused by foreign material in lubricant.</p> <p>13. Differential carrier – loose bearing adjuster lock caused by malfunctioning of axle shift system or improper driver shifting technique.</p> <p>14. Differential carrier worn pinion pilot bearing bore caused by overloading vehicle.</p> <p>15. Improper input shaft end beam.</p> <p>16. Improper drive pinion bearing preload.</p> <p>17. Incorrect ring gear and pinion both contact causing ring gear and/or pinion failure.</p> <p>18. Improper bearing preloads, alignment, or torque specification for axle assembly components.</p>	<p>12. Replace bearings. Use recommended lubricant and change at regular intervals.</p> <p>13. Replace worn bearing adjuster. Replace a worn adjuster lock with oversize (interference fit) lock. Worn lock can be rebuilt with weld. Observe correct procedures when shifting. Repair axle shift system if not working properly.</p> <p>14. Replace differential carrier if pinion pilot bearing exceeds clearance.</p> <p>15. Adjust input shaft end play. Add or remove shims to correct specifications.</p> <p>16. Adjust drive pinion bearing preload. Refer to Section 10, Maintenance, for procedure.</p> <p>17. Replace parts if worn or broken. Make pinion position and backlash adjustment. Refer to Section 10, Maintenance, for tooth contact patterns and adjustments.</p> <p>18. All adjustments, preloads, alignment procedures, and torque specifications must be adhered to for proper axle operation and to prevent premature component failure.</p>