

Roadranger®

Dana Spicer Drive Axles

2-Speed
Double Reduction



One Great Drivetrain from Two Great Companies

Service Manual AXSM-0040 July 1995



For the most current information, visit the Roadranger web site at www.roadranger.com

The description, testing procedures, and specifications contained in this service publication were current at the time of printing.

Eaton Corporation reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice and without incurring obligation.

The recommendations of the vehicle manufacturer should be considered as the

primary source of service information regarding this Eaton product. This manual is intended to be used as a supplement to such information.

Any reference to brand names in this publication is made simply as an example of the types of tools and materials recommended for use and, as such, should not be considered as an endorsement. Equivalents, if available, may be used.

IMPORTANT NOTICE

The symbol shown below is used throughout this publication to call your attention to areas in which carelessness or failure to follow specific procedures may result in personal injury and/or component malfunction or damage.

Anyone departing from the instructions contained in this publication through procedures used or choice of tools, materials, and parts may jeopardize his personal safety and/or the safety of the vehicle user.



WARNINGS: Used in areas where failure to follow listed procedures creates a **high probability of personal injury** to the **servicing technician**.

CAUTIONS: Used in areas where failure to follow listed procedures **may cause personal injury due to component damage or subsequent malfunction**.

SPECIAL NOTICE ON FASTENER TORQUE



THIS SYMBOL IS USED THROUGHOUT THIS MANUAL TO CALL YOUR ATTENTION TO FASTENERS REQUIRING A SPECIAL INSTALLATION TORQUE

All ways use genuine Eaton replacement parts

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PARTS IDENTIFICATION/NOMENCLATURE

General Information

The service procedures and specifications in this publication cover the Eaton[®]) Axles listed in the charts below.

For Eaton Brake service information, refer to BRSM-O033 Service Manual.

For shift system service information refer to Eaton Shift System Manual A SM-0029

For Parts identification, refer to your appropriate Eaton parts manual, reference Eaton product literature order form TCFM-0018 for listings.

Axle Series	Early Axle Series Axle Model Nos.	
	2-Speed	Double Reduction
15	15201	15301
16	16244	16344
17	17201, 17221	17301, 17321
18	18201, 18221	18301, 18321
21	21221	21321
22	22221, 22223	22321
23	23221	23321
26	26221	26321
30	30227	30327
35	-	35327

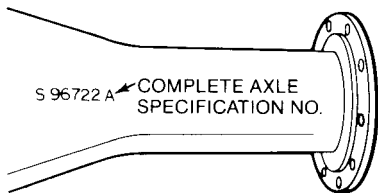
NOTE: Throughout the manual, axle series identification is used to indicate variances between axles.

Late Axle Models Axle Model Nos.		
2-Speed	Double Reduction	
15040T	15040P	
19050T	19050P	
19055T	19055P	
19060T	19060P	
21060T	21060P	
21065T	21065P	
22060T	22060P	
22065T	22065P	
23070T	23070P	
23080T	23080P	
23085T	23085P	
26080T	26080P	
26085T	26085P	
	30055P	
	35055P	

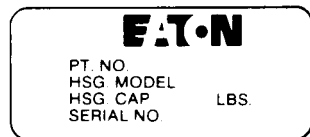
Axle Identification

Axle and differential carrier identification is either stamped on the carrier itself or on a metal tag affixed to the carrier. Location on the carrier is the same.

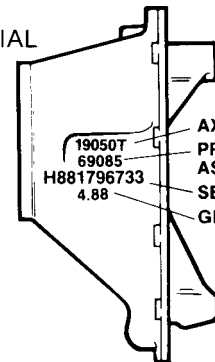
OLD STYLE TAG



METAL IDENTIFICATION TAG

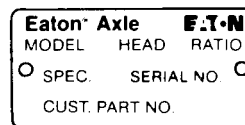


TOP VIEW OF DIFFERENTIAL CARRIER



AXLE MODEL NO.
PRODUCTION ASSEMBLY NO.
SERIAL NO.
GEAR RATIO

NEW STYLE TAG



METAL IDENTIFICATION TAG

Late Axle Model No.

19 050 T

Ground Load Capacity (x1000) (Lbs.)

GCW (x1000) (Lbs.)

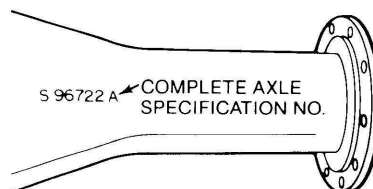
Gearing
S — Single Reduction
T — 2-Speed
P — Double Reduction

Axle Specification Number

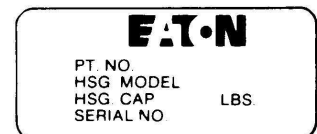
The complete axle is identified by the specification number stamped on the rear right-hand side of the axle housing. This number identifies all component parts of the axle as built by Eaton, including special OEM requirements such as yoke or flange.

In addition, some axles may include a metal identification tag (see illustration).

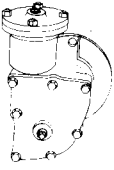
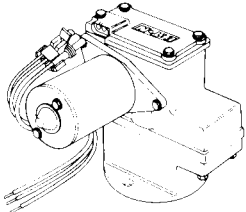
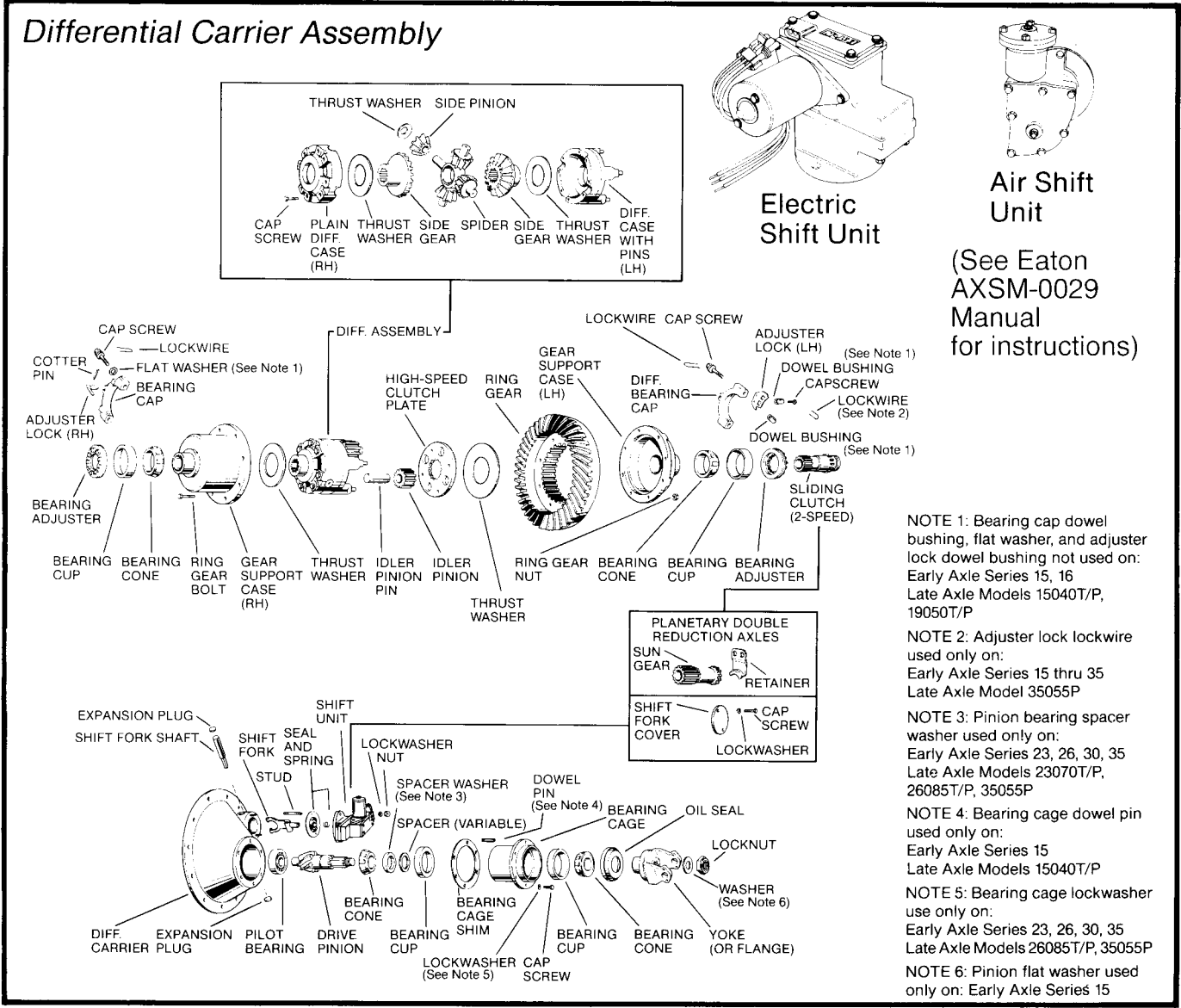
This tag only identifies the housing. It does not identify the differential carrier assembly components.



METAL IDENTIFICATION TAG



Differential Carrier Assembly



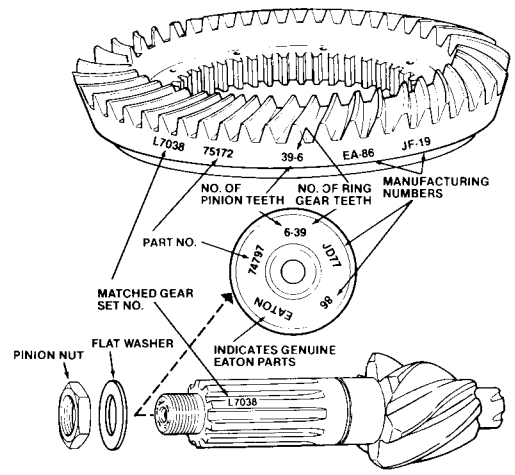
(See Eaton AXSM-0029 Manual for instructions)

- NOTE 1:** Bearing cap dowel bushing, flat washer, and adjuster lock dowel bushing not used on: Early Axle Series 15, 16 Late Axle Models 15040T/P, 19050T/P
- NOTE 2:** Adjuster lock lockwire used only on: Early Axle Series 15 thru 35 Late Axle Model 35055P
- NOTE 3:** Pinion bearing spacer washer used only on: Early Axle Series 23, 26, 30, 35 Late Axle Models 23070T/P, 26085T/P, 35055P
- NOTE 4:** Bearing cage dowel pin used only on: Early Axle Series 15 Late Axle Models 15040T/P
- NOTE 5:** Bearing cage lockwasher use only on: Early Axle Series 23, 26, 30, 35 Late Axle Models 26085T/P, 35055P
- NOTE 6:** Pinion flat washer used only on: Early Axle Series 15

Ring Gear and Pinion Identification

Ring Gear and Drive Pinion are matched parts and must be replaced in sets. Check the appropriate Eaton Axle parts book for part numbers and ordering instructions.

To aid in identifying gear sets, both parts are stamped with such information as number of pinion and ring gear teeth, individual part number and matched set number (refer to drawing).



Lubrication

The ability of a drive axle to deliver quiet, trouble-free operation over a period of years is largely dependent upon the use of good quality gear

lubricant in correct quantity. The most satisfactory results can be obtained by following the directions contained in this book.

The following lubrication instructions represent the most current recommendations from the Eaton Corporation, Axle Brake Division.

o e d c n t

Approved Lubricants - General: Gear lubricants acceptable under military specification (MILSPEC) MIL-L-2105D (Lubricating Oils, Gear, Multipurpose) are approved for use in Eaton Drive Axles. The MIL-L-2105D specification defines performance and viscosity requirements for multigrade oils. It supersedes both MIL-L-2105B, MIL-L-2105C and cold weather specification MIL-L-10324A. This specification applies to both petroleum-based and synthetic-based gear lubricants if they appear on the most current "Qualified Products List" (PL-2105) for MIL-L-2105D.

NOTE: The use of separate oil additives and/or friction modifiers are not approved for use in Eaton Drive Axles.

Approved Lubricants - Synthetic based: Synthetic-based gear lubricants exhibit superior thermal and oxidation stability, and generally degrade at a lower rate

when compared to petroleum-based lubricants. The performance characteristics of these lubricants include extended change intervals, improved fuel economy, better extreme temperature operation, reduced wear and cleaner component appearance. The family of Eaton Roadranger™ gear lubricants represents a premium quality synthetic lube which fully meets or exceeds the requirements of MIL-L-2105D. These products, available in both 75W-90 and 80W-140, have demonstrated superior performance in comparison to others qualified under the MILSPEC, as demonstrated by extensive laboratory and field testing.

Lube Sampling and Condition Monitoring: For information, contact your local Eaton representation at phone numbers listed on the back cover of this manual.

Makeup Lube: Maximum amount of non-synthetic makeup lube is 100 .

Viscosity/Ambient Temperature Recommendations: The following chart lists the various SAE Grades covered by MIL-2105D and the associated ambient temperature range for each. Those SAE Grades shown with an asterisk (*) are available in the Roadranger family of synthetic gear lubricants.

The lowest ambient temperatures covered by this chart are -40°F and -40°C. Lubrication recommendations for those applications which consistently operate below this temperature range, must be obtained through the Eaton Corporation, Axle Brake Division

Grade	Ambient Temperature Range
75W	-40°F to -15°F (-40°C to -26°C)
75W-80	-40°F to 80°F (-40°C to 21°C)
75 W-90*	-40°F to 100°F (-40°C to 38°C)
75 W-140	-40°F and above (-40°C and above)
80W-90	-15°F to 100°F (-26°C to 38°C)
80W-140*	-15°F and above (-26°C and above)
85 W-140	10°F and above (-12°C and above)

Element

Lubrication Change Internals - General: The initial lubricant change is one of the most important factors in axle component life and durability, because of the elimination of break-in contaminants. These contaminants are primarily iron from the initial break-in wear of rotating components, and silicon from the sand used in manufacture of cast components.

For either a new or rebuilt drive axle, the lubricant should be changed within the first 3000 to 5000 miles of operation. Subsequent lubricant changes should be based on a combination of the intervals stated in the following chart and user judgment based heavily on the application and operating environment.

Lubrication Change Intervals - Severe Service: Severe service applications are those which require the axle to be consistently operated near its maximum GCW or GVW ratings, dusty or wet environments, or consistent operation on grades greater than 8%. For these applications, the ON/OFF HIGHWAY portion of the chart should be used.

NOTE: At both the initial and all subsequent lubricant changes, Eaton recommends that the magnetic filler and drain plugs, and the breather be cleaned.

Guidelines - Lube Change Intervals for Drive Axles				
Lubricant Type	On Highway Miles	Maximum Change Interval	On/Off Highway Severe Service Miles	Maximum Change Interval
Mineral Based	100,000	early	40,000	Yearly
Eaton Approved Synthetic	250,000	3 year	100,000	Yearly

Changing Lube

DRAINING Drain into suitable container with lube at normal operating temperature. Inspect drain plug for excessive metal particle accumulation symptomatic of extreme wear. Clean and replace plug after draining.

NOTE: After initial lube change, the entire unit should be inspected if excessive particle accumulation is observed.

FILLING Remove filler hole plug and fill housing with approved lubricant until level with bottom of filler hole.

Lube Capacities DO NOT OVERFILL A LES

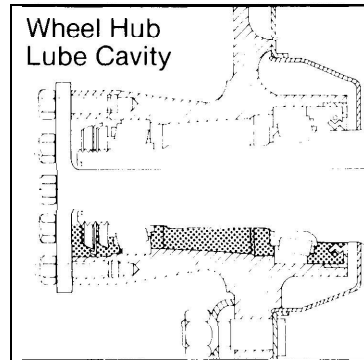
Late Axle Model	Pints (Liters)		Early Axle Series	Eaton Housing (Rectangular Arm)		Vendor Housing (Round Arm)	
	Pints	(Liters)		Pints	(liter)	Pints	(liter)
15040T/P	24.0	()	15	23	(11)	19	(9)
19050T/P	33	()	16	33	(16)	24	(11)
19055T/P, 19060T/P	35	()	17/18	37	(18)	29	(14)
21060T/P, 21065T/P, 22060T/P, 22065 T/P ...	35	()	21/22	37	(18)	-	-
23070T/P	39.0	()	23/26	41	(19)	34	(16)
23080T/P	41	()	30/35	41	(19)	-	-
23085T/P	41	()					
26080T/P	41	()					
30055 P	36	()					
35055 P	36	()					

NOTE Capacities do not apply to housings not designed by Eaton

Axles installed at angles exceeding 6° or operated regularly on grades exceeding 12% may require stand-pipes to allow proper fill levels. For specific information, contact Eaton representative at phone numbers listed on back cover of this manual.

Wheel End Lubrication

IMPORTANT: In cases where wheel equipment is being installed, either new or after maintenance activity, the lube cavities are empty. Bearings and seals must be manually supplied with adequate lubricant or they will be severely damaged before the normal motion of the vehicle can supply lube to the hub ends of the housing.



To avoid the risk of premature damage to wheel bearings and seals, they must be "prelubed" any time the wheel equipment is

being installed. There are two methods of doing this. The correct method will depend on the type of wheel equipment being used.

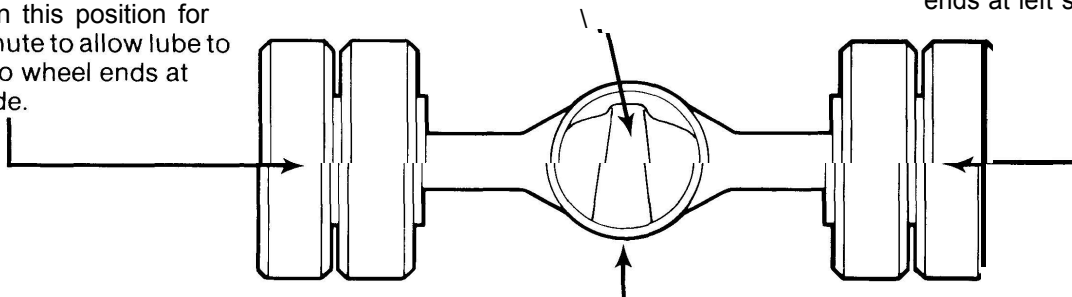
Lubrication When Hubs Have No Filler Holes (Preferred Method*)

(Follow procedure in numerical sequence.)

1. Fill axle with lube through axle housing cover filler hole.

2. Jack up left side of axle. Maintain this position for one minute to allow lube to flow into wheel ends at right side.

3. Jack up right side of axle. Maintain this position for one minute to allow lube to flow into wheel ends at left side.



4. With vehicle level again, add lube through axle housing cover filler hole. The axle should require two additional pints of lube to bring level up to bottom of filler hole.

*The above procedure is the preferred method since it optimizes the lube supply to the wheel end components and axle sump.

Hubs Equipped with Lube Filler Holes

Pour a pint of standard axle lubricant into the hub through the cavity filler hole provided.

Wheel Bearing Adjustment

Wheel bearings should be adjusted at regular intervals using the following procedure

PREPARATION Provide means to capture lubricant that will escape when axle shafts are removed. Remove axle shafts. Jack the wheel to be adjusted clear of the ground. After securely blocking the vehicle to prevent rolling, release the parking brake, allowing the wheel to rotate freely.

1. Remove outer adjusting nut and doweled (or tanged) washer.
2. Visually inspect spindle for damage or wear. Inspect the nut and spindle threads for damage. Make certain that the nut turns without binding by cleaning the threads and applying a light coat of oil prior to adjusting the wheel bearings. Inspect tanged washer (if used). Replace washer if tangs are broken or badly misshaped.
3. Torque inner nut to 200 lbs.-ft.(272 N.m) while rotating the wheel. Loosen the nut one full turn. Re-torque to 50 lbs.-ft. (68 N.m). Back off nut 1/4 of a full turn.
4. Install doweled (or tanged) washer. If the dowel pin and washer (or washer tang and nut flat) are not aligned, remove washer, turn it over and reinstall. For further alignment, loosen the inner nut slightly.

5. install outer nut and torque as follows

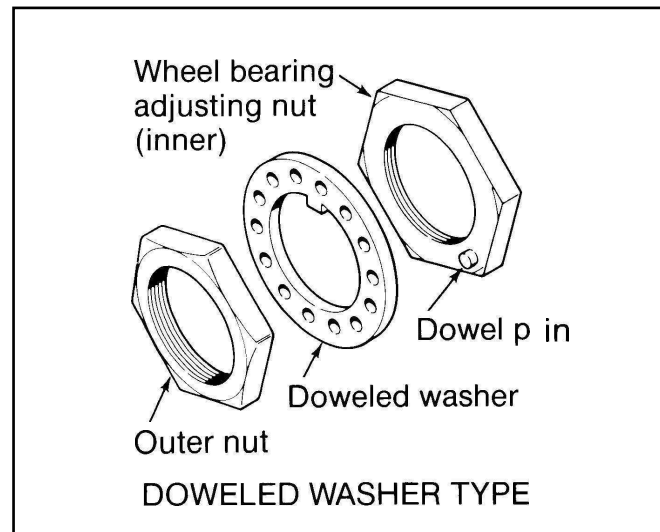
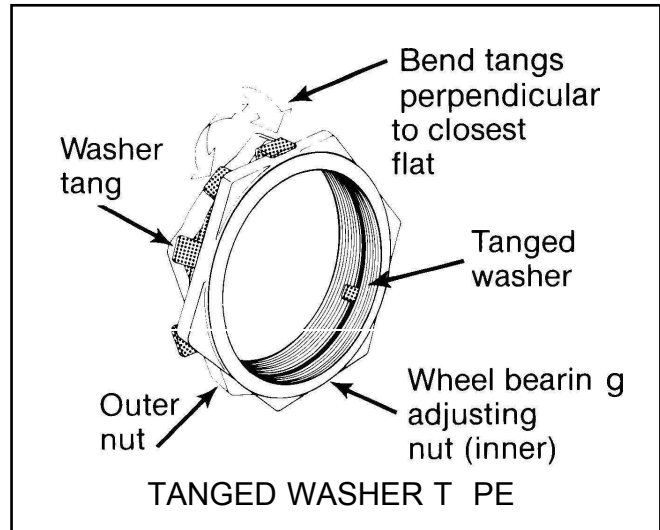
- Doweled washer type lock - 300 lbs.-ft. (408 N.m)
- Tanged washer type lock - 250 lbs.-ft. (339 N.m)

This adjustment procedure should allow wheel to turn freely within .001" to .005" (0.025 to 0.125 mm) end-play.

NOTE: The end-play should be measured using a dial indicator. If the tires and wheels are on the hub, prying the wheel end before making the end-play measurement will produce a more accurate reading.



WARNING: Never work under a vehicle supported only by a jack. Insure that the vehicle will not roll before releasing brakes.



6. If using the tanged washer type lock, secure adjusting nuts by bending one wheel nut washer tang over each nut. Bend tangs over the closest flat perpendicular to the tang (see illustration).

7. Reinstall axle shaft. Refill axle to proper lube level.


Cleaning

Proper cleaning requires complete disassembly.

The differential carrier assembly may be steam cleaned only while mounted in housing provided all openings are plugged.

Wash steel parts with machined surfaces in a commercial solvent.

Wash castings or other rough parts in solvent or clean in hot solution tanks using mild alkali solutions, heating parts thoroughly before rinsing.

 **WARNING:** Gasoline is not an acceptable cleaning solvent because of its extreme combustibility. It is unsafe in the workshop environment.

Rinse all parts thoroughly. Dry immediately with clean rags. Lightly oil parts and wrap in corrosion-resistant paper if not reused immediately. Store parts in a clean, dry place.

Inspection

All axle components should be closely inspected after cleaning to determine which require replacement. For more detailed inspection guidelines and failure analysis, see Eaton Failure Analysis Service Manual A SM-0020

In General:

Inspect steel parts for notches, visible steps or grooves. Look for scuffing, deformation or discoloration related to improper lubrication.


Inspect gear teeth for signs of excessive wear, pitting or cracking along contact lines before reusing. Check tooth contact pattern.

Inspect machined surfaces of cast or

malleable parts for cracks, scoring, and wear. Look for elongation of drilled holes, wear on machined surfaces and nicks or burrs in mating surfaces.

Inspect fasteners for rounded heads, bends, cracks or damaged threads.

The axle housing should be inspected for cracks or leaks, loose studs or cross-threaded holes.

 **CAUTION:** Any damage which affects the alignment or structural integrity of the housing requires housing replacement. Repair by welding or straightening should not be attempted. This process can affect the housing metallurgy and cause it to fail completely when under load.

Repair and Replacement

Replace lower-cost parts, such as thrust washers, seals, etc., that protect the axle from premature wear and do not add greatly to the cost of your rebuild.

Replace heavily worn but unbroken parts, since the damage done, should they fail, would greatly exceed their replacement cost.

Steel parts such as shafts or gears are not repairable. If worn or damaged, they should

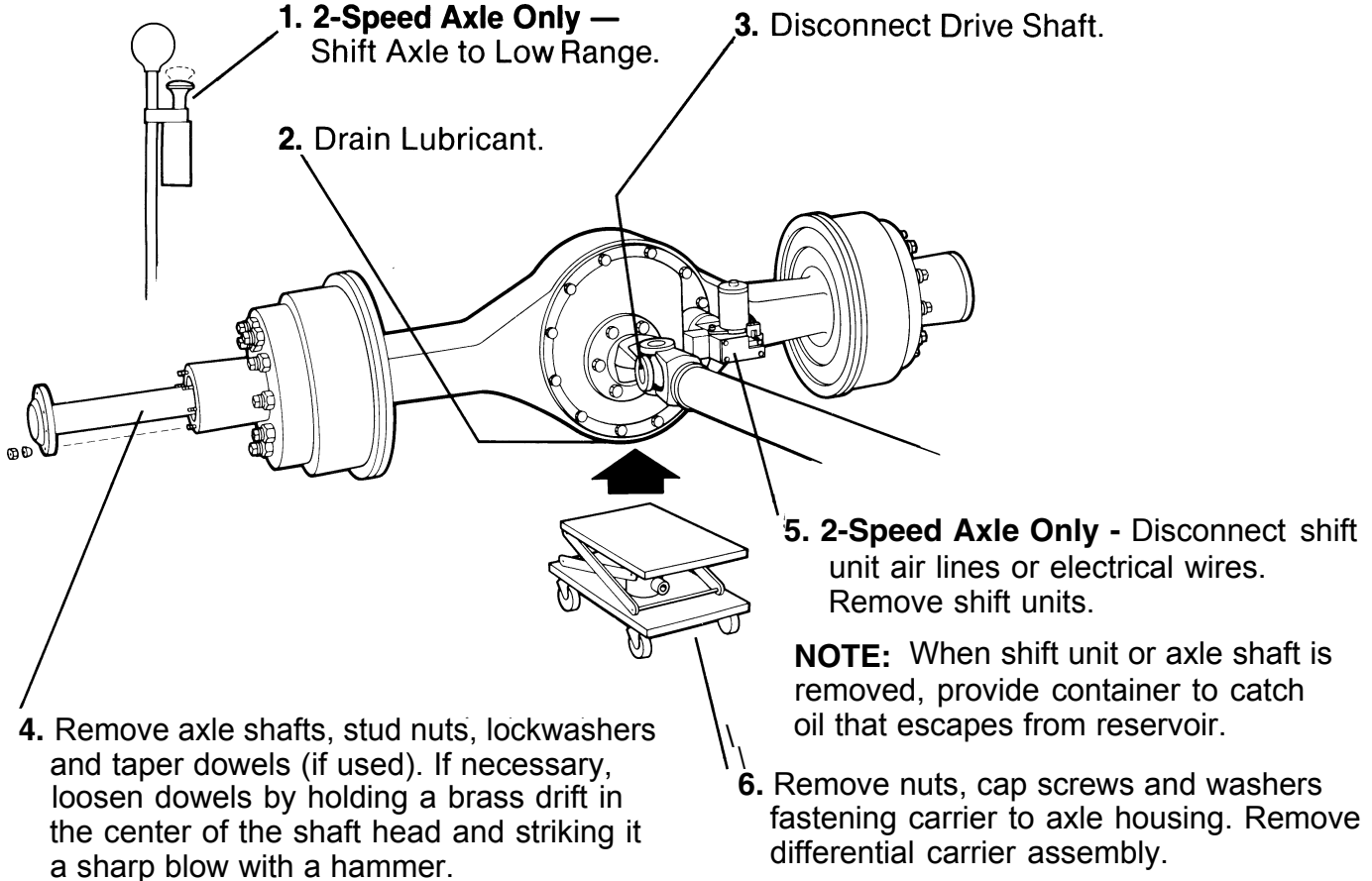
be replaced, along with mating parts as necessary.

Seals and washers should be routinely replaced. Fasteners with self-locking patches may be reused if secured with several drops of Loctite 277.

Axle housing repairs are limited to removal of nicks or burrs on machined surfaces or replacement of damaged studs.

Differential Carrier Assembly Removal

(Follow procedure in numerical sequence.)



WARNING: Do not strike the axle shaft flange with a hammer. Do not use chisels or wedges to loosen shaft or dowels.



WARNING: Do not lie under carrier while removing fasteners or after fasteners are removed. Use transmission jack to support and remove differential carrier assembly.

NOTE: If replacing carrier assembly as a unit, turn to Assembly Section 3, page 31, for instructions.

Disassemble Differential Carrier

NOTE: If gear set is to be reused, check tooth contact pattern and ring gear backlash before disassembling differential carrier. Best results are obtained when established wear patterns are maintained in used gearing. Omit this step if the gear set is to be replaced.

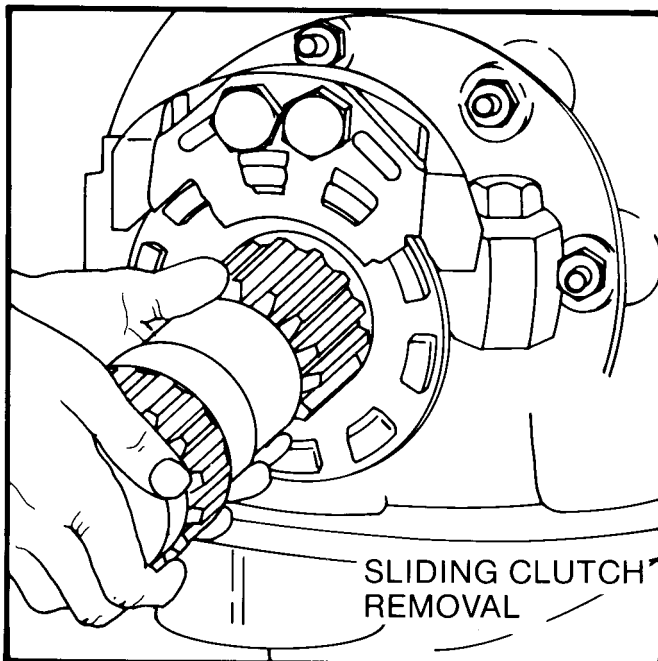
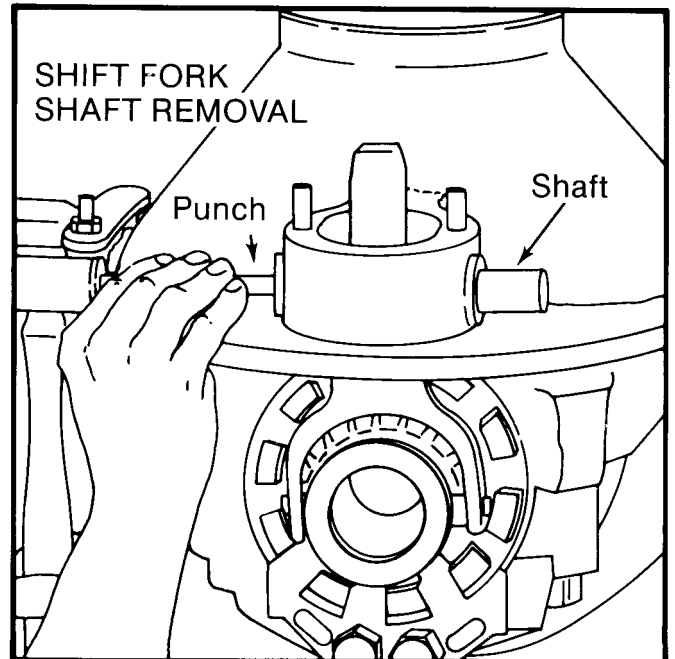
1. Mount differential carrier assembly in repair stand. Loosen but do not remove pinion nut.

Disassemble Differential Carrier (cont'd)

2. Remove shift fork seal and spring. Remove expansion plugs, then working at the lower (or small) plug hole, drive out the shift fork shaft.



WARNING: When using a drift, punch or similar tool, wear safety glasses.

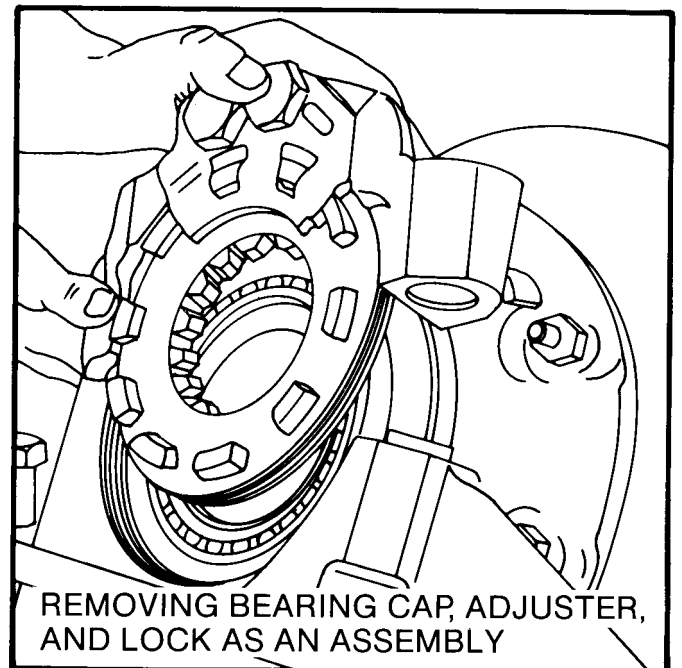


3. **2-Speed Axles Only:** Remove sliding clutch. **Planetary Double Reduction Axles:** A sun gear is used in place of sliding clutch gear. To remove sun gear, remove the retainer which holds gear in position, then remove sun gear.

NOTE: When reusing gear set, punch mark bearing adjusters and bearing caps for location and easier adjustment during reassembly.

4. On teeth-side of ring gear, cut lockwire and remove bearing cap screws. Remove cap, adjuster and lock.

On back-side of ring gear, cut lockwire and remove bearing cap screws. If the gear set is to be reused, remove bearing cap, adjuster and lock as an assembly. This will facilitate correct positioning of ring gear during reassembly.

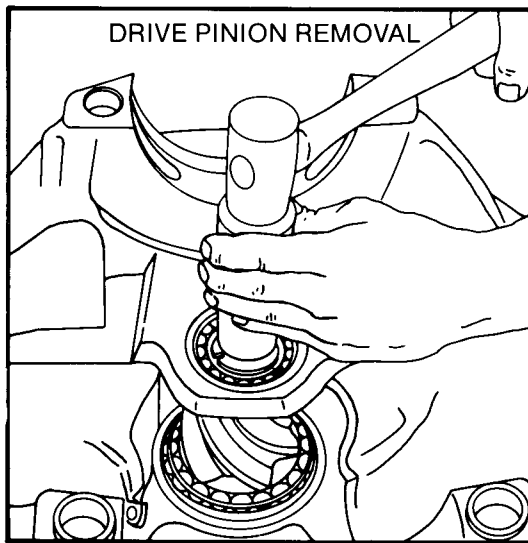
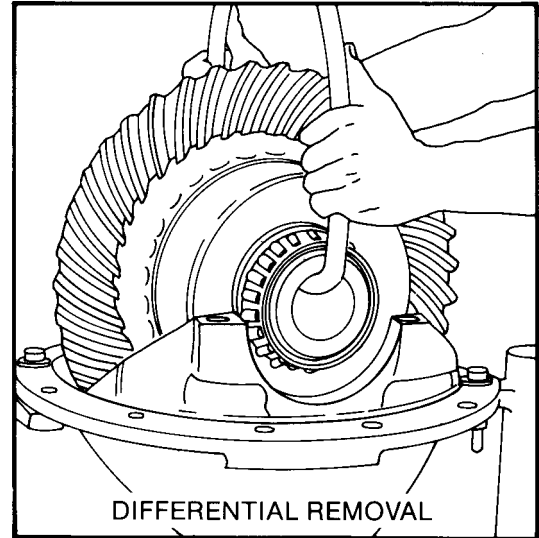


Disassemble Differential Carrier (cont'd)

5. Remove bearing cups. Using a chain hoist lift ring gear and differential assembly out of carrier. ▶

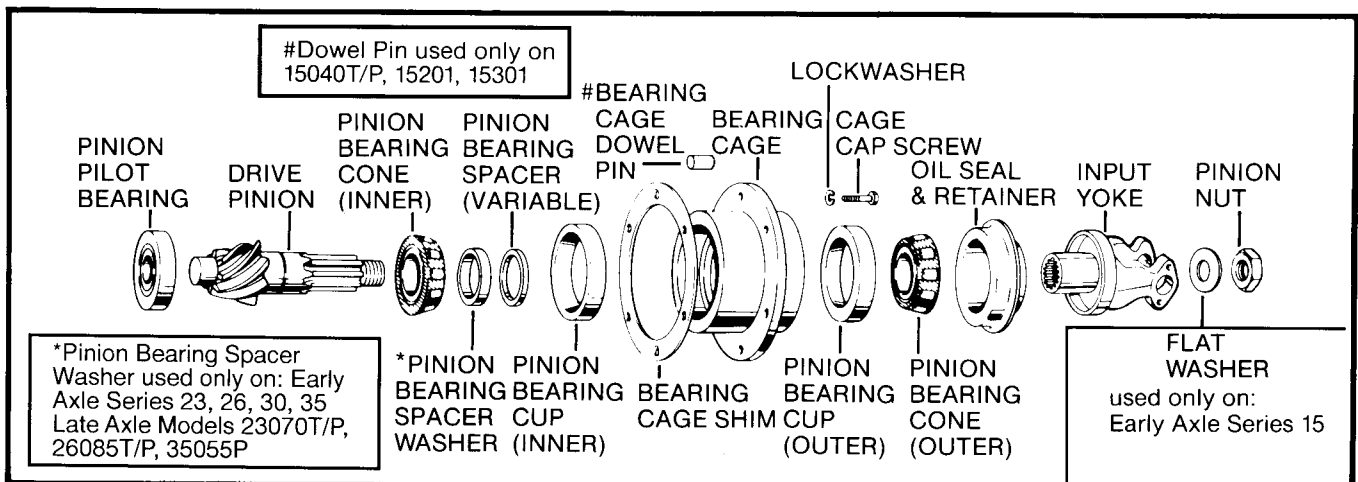
CAUTION: During removal of drive pinion assembly, do not allow pinion to drop on hard surface.

6. Invert carrier in stand for drive pinion removal.



◀ 7. Remove pinion bearing cage cap screws, invert carrier in stand, then drive pinion cage assembly out of carrier. If the gear set is to be reused, keep the shim pack intact for use during reassembly. If the original shims cannot be reused, record the number of shims in the pack and the size of each.

Disassemble Drive Pinion

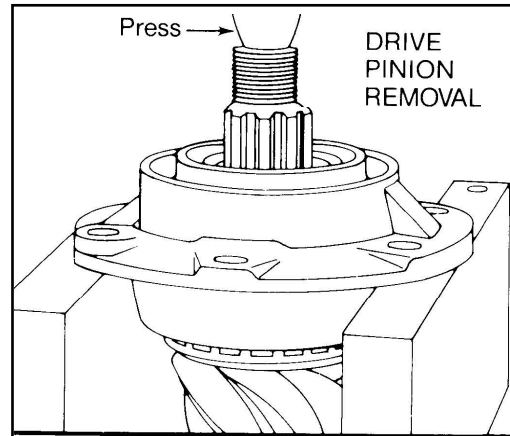
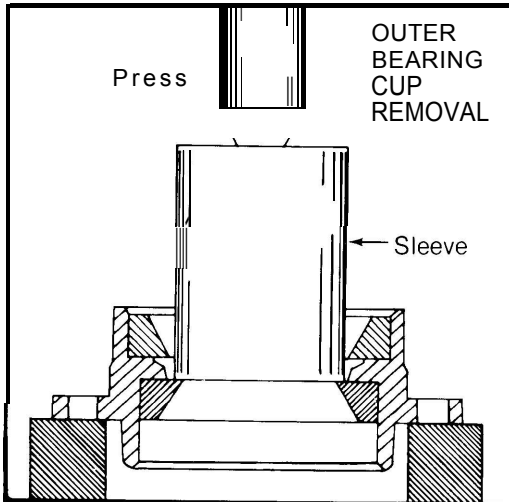


CAUTION: During the following yoke removal procedure, do not allow pinion to drop on hard surface.

1. If pinion nut was not loosened during earlier disassembly, clamp yoke in vise jaws. Use brass pads to prevent damage. Loosen and remove pinion nut. To remove yoke, use suitable puller or press pinion out of yoke.

Disassemble Drive Pinion (cont'd)

2. Support cage and press pinion out of bearing cage. ▶



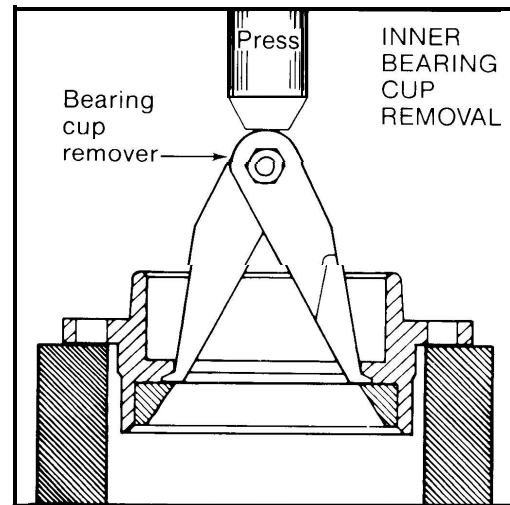
▶ 3. Press oil seal and outer bearing cup out of cage. Discard oil seal.

4. On Early Axle Series 23 thru 35 and 23070 T/P, 26085 T/P, 35055 P, remove and retain bearing spacer washer from pinion. On all axles, remove and retain bearing spacer.

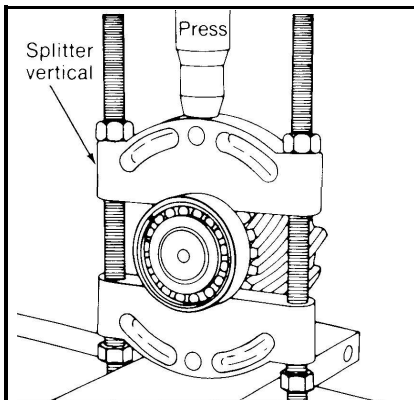
5. Using a bearing cup remover, remove inner bearing cup. ▶

NOTE: Bearing cup remover, part number -3940 (Ent Moore Co.) or equivalent can be used to remove inner bearing cup.

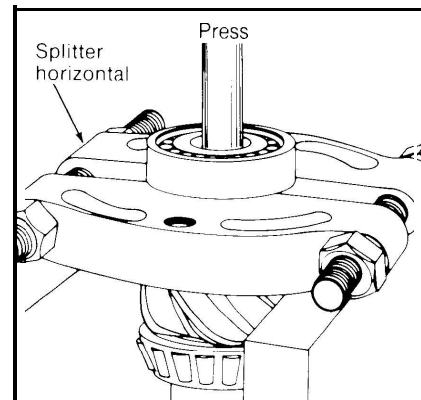
6. Remove pilot bearing and inner bearing cone from pinion, using a split-type puller. Use two procedure steps to remove each bearing (see illustrations below).



PILOT BEARING REMOVAL

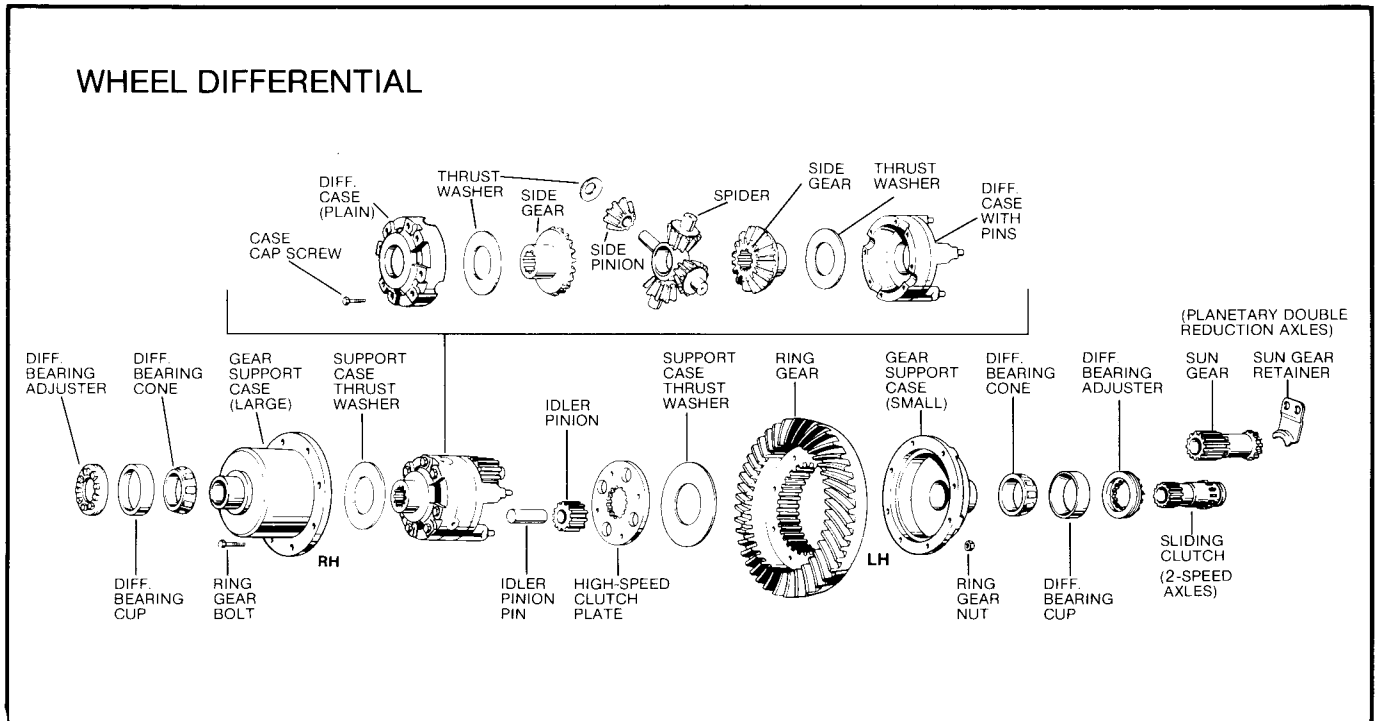


FIRST, mount splitter vertically to split bearing.



SECOND, mount splitter horizontally to remove bearing.

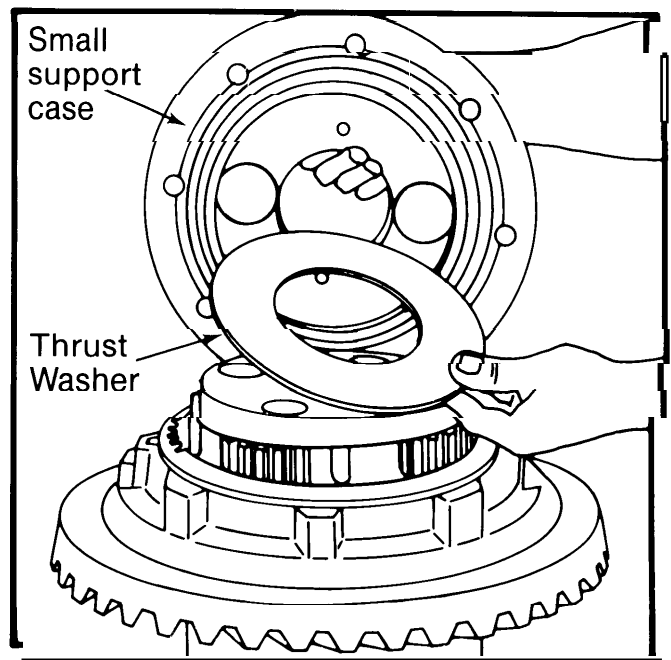
Disassemble Wheel Differential



1. Remove nuts and bolts fastening ring gear and support cases.
2. Remove small support case and thrust washer.
3. Remove ring gear.

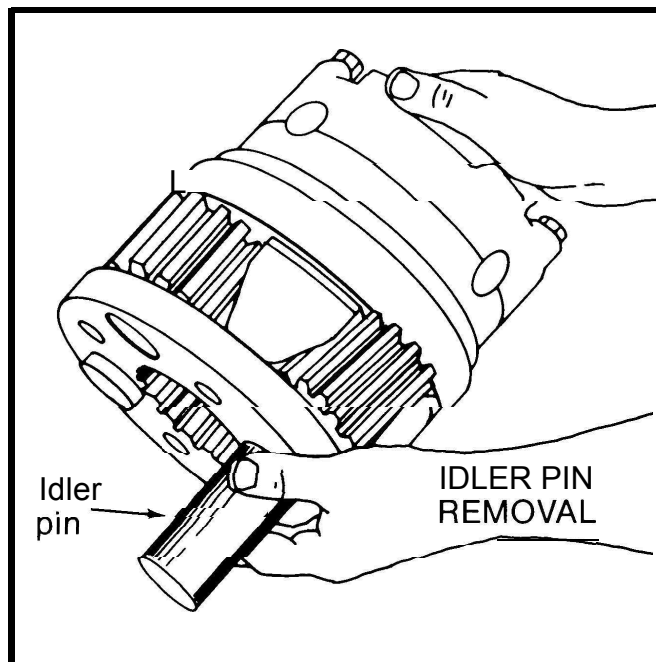
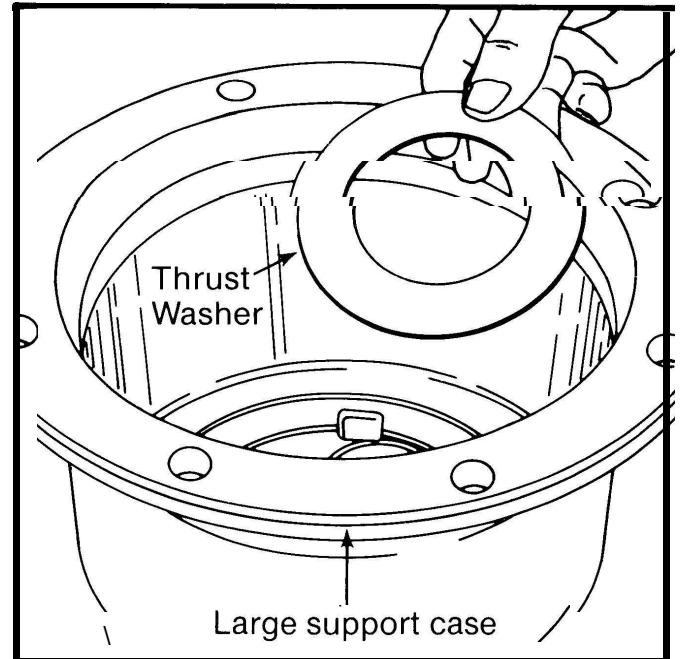
NOTE: A soft-faced hammer or mallet may be required to dislodge gear from its mounting.

4. To remove differential assembly, place support case assembly on a bench or on the floor. Position case on its side, then slowly roll the case and slide differential assembly out of the case.



Disassemble Wheel Differential (cont'd)

5. Remove thrust washer from large support case.

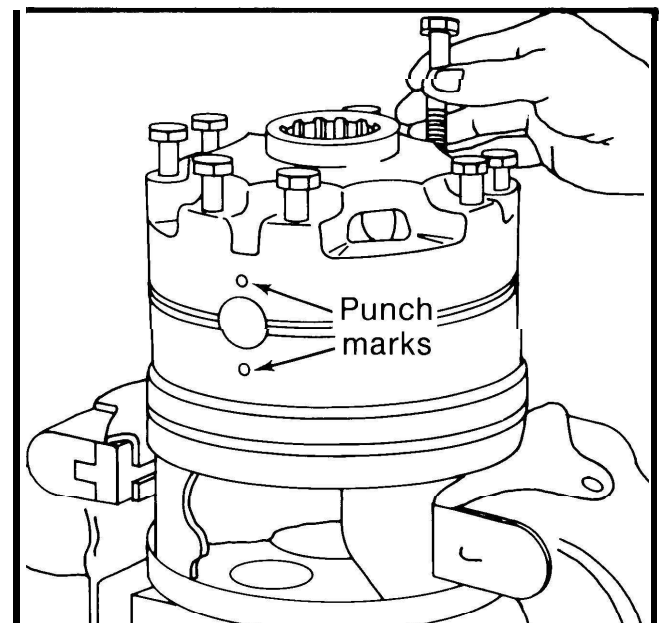


6. Invert differential assembly to remove idler pins, then remove idler pinions.

7. Punch mark differential cases for correct location in reassembly. Remove cap screws and separate case halves.

8. Lift off thrust washer and side gear.

9. Lift out spider, side pinions and thrust washers. Remove side gear and thrust washer.



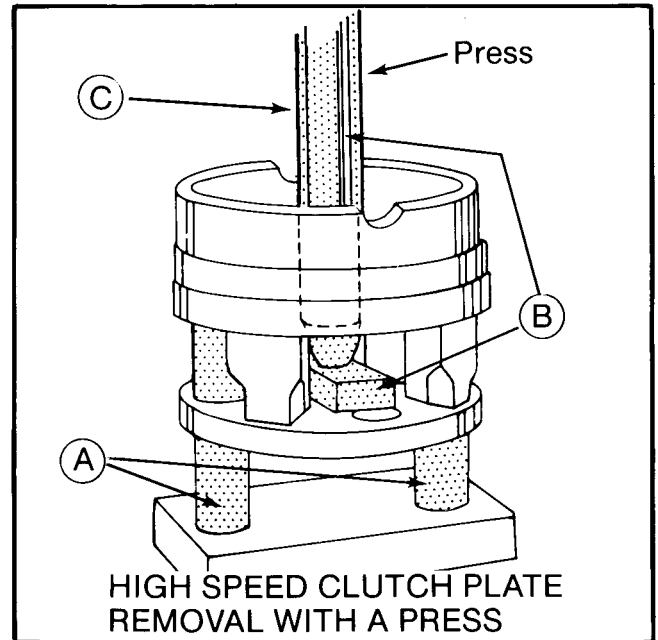
Disassemble Wheel Differential (cont'd)

10. First, try to lift off high-speed clutch plate by hand. If it cannot be removed easily, press off plate as follows (Refer to illustration).

A. Insert properly sized adapters (round metal stock) into two idler pin holes and invert the case assembly in a press. The clutch plate should be down. The adapter length should provide space for removal of the plate.

B. Use bar stock to block the center hole in the clutch plate and press against it with the press ram.

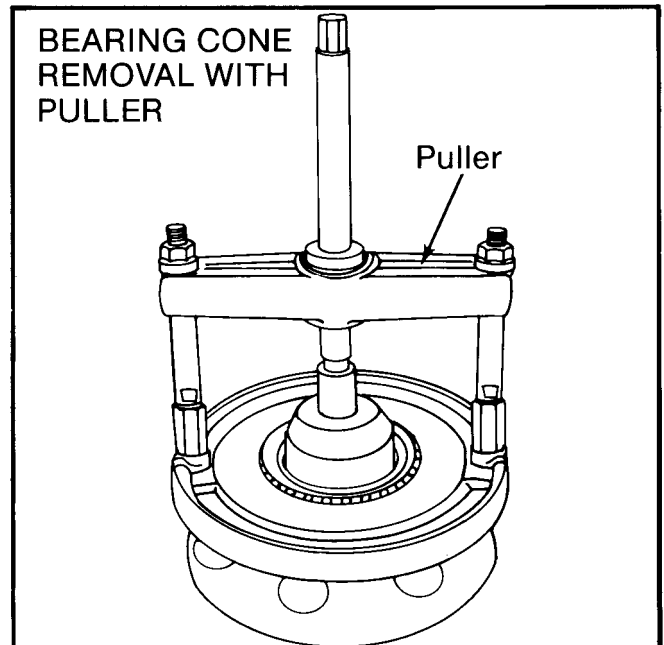
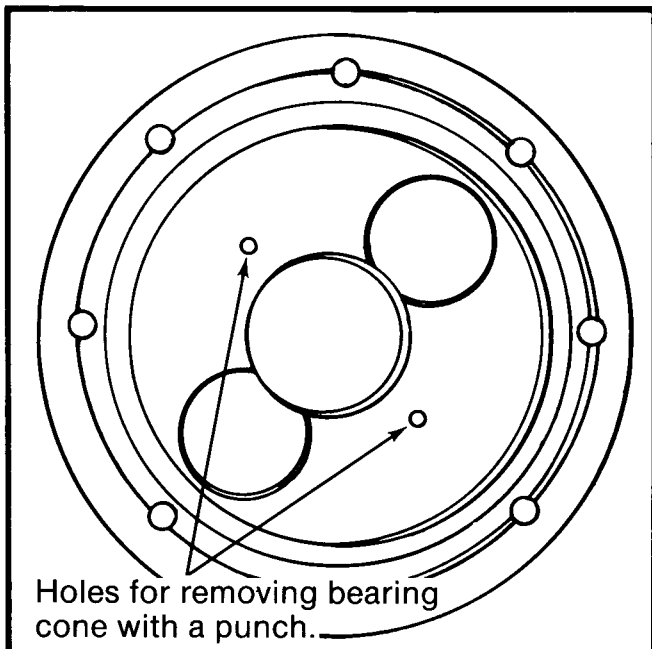
C. Continue to press until the plate breaks loose from the plate dowel pins.



11. Remove bearing cones from support cases using suitable puller (see illustration).

NOTE: Holes are provided in case to enable removal of bearing cone with a pilot punch (see illustration). Tap alternately through each hole until cone is removed.

WARNING: When using a drift, punch or similar tool, wear safety glasses.



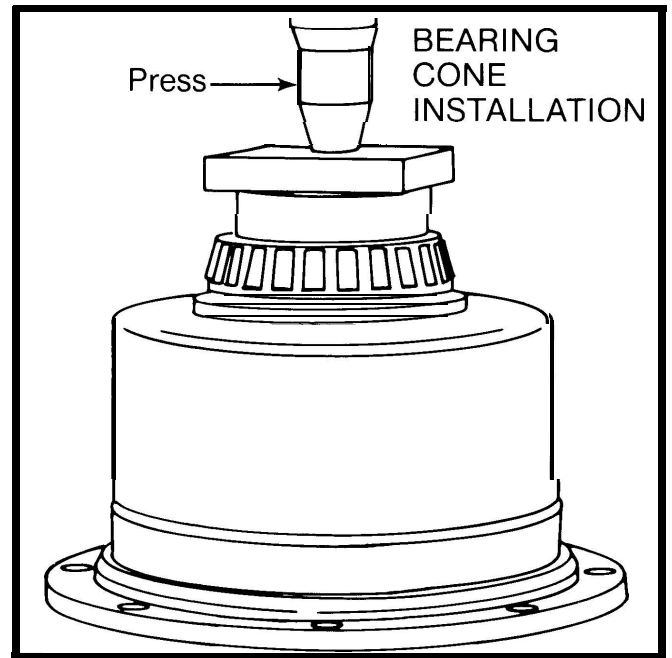
Assemble Wheel Differential

NOTE: Lubricate internal parts with gear lube during reassembly.

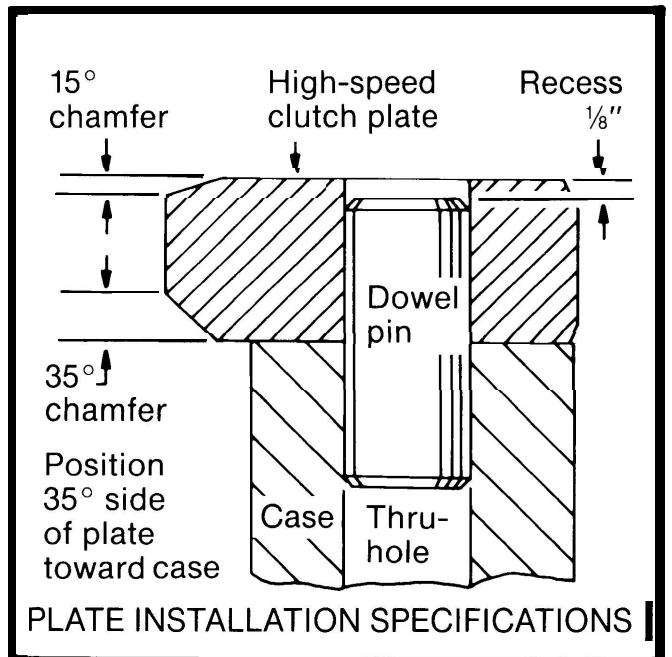
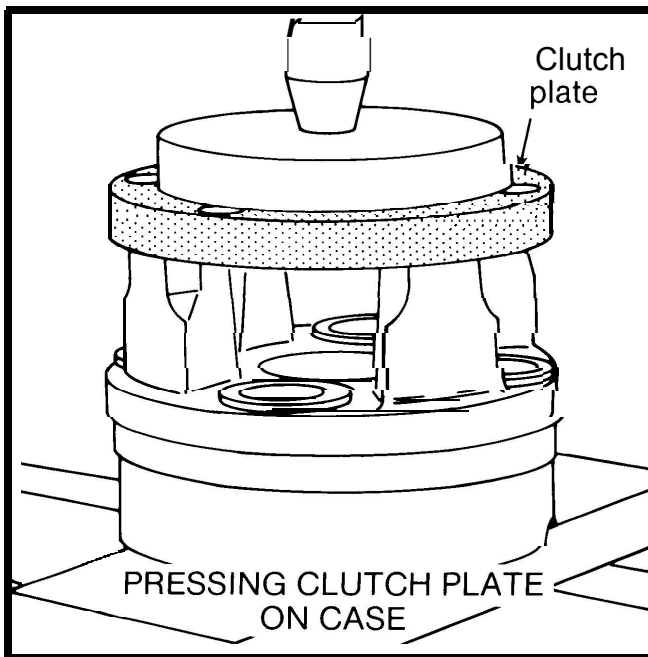
1. Press bearing cones on support cases (see illustration).

CAUTION: To prevent bearing cone damage, use suitable sleeve that only contacts the inner race of the cone.

2. Position high-speed clutch plate with chamfered end of the clutch teeth toward idler pinions. Press clutch plate on case (see illustrations below).



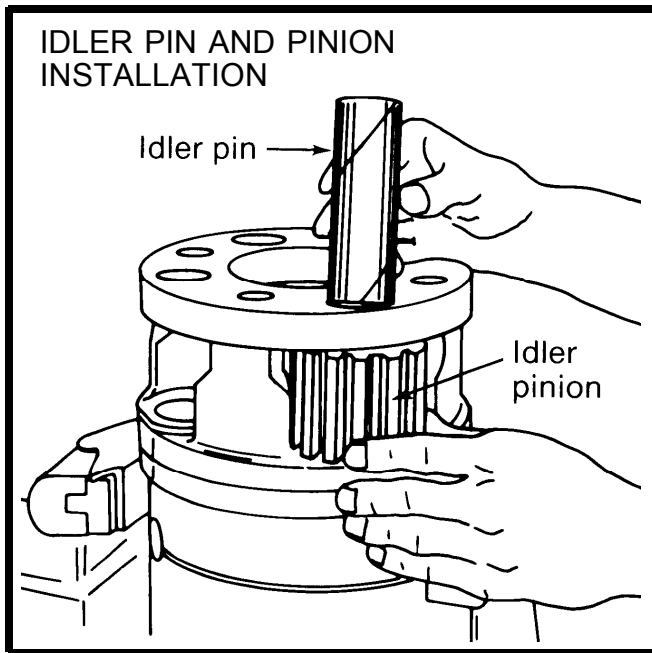
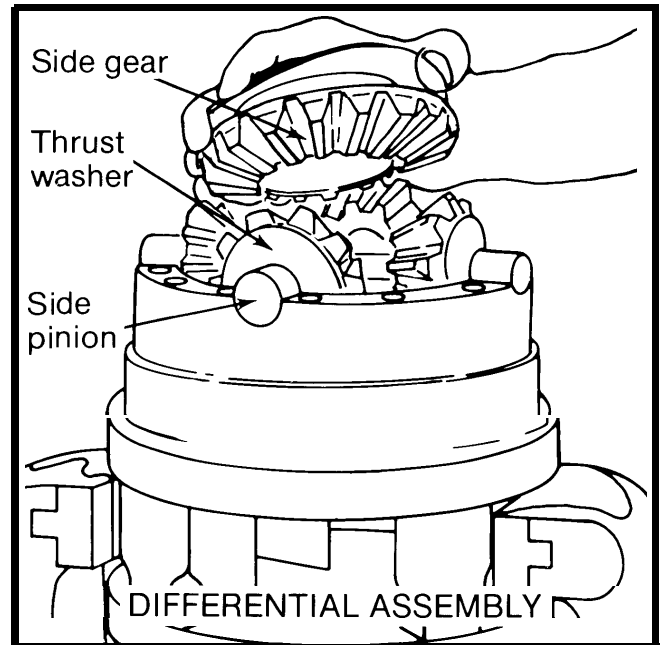
CLUTCH PLATE INSTALLATION



CAUTION: It is important that the ends of the dowel pins are recessed 1/8" below surface of the clutch plate. If pins extend beyond plate surface, press pins to proper depth. Don't press them in too far.

Assemble Wheel Differential (cont'd)

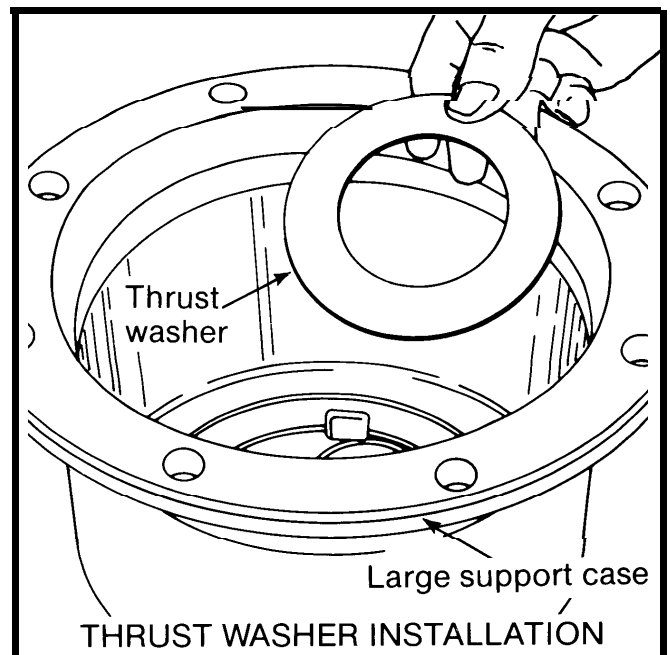
3. Place thrust washer and side gear in differential case (with pins).
4. Assemble side pinions and thrust washers on spider. Place this assembly in differential case.
5. Place side gear and thrust washer in position on side pinions.
6. Align punch marks and place plain case on case (with pins). Install cap screws and torque (see chart back page).



NOTE: Turn side gear hub to check for free differential rotation. Rotation may require up to 50 ft.-lbs. (65 N·m) torque.

7. Install idler pins and pinions.

8. Place thrust washer in large support case.

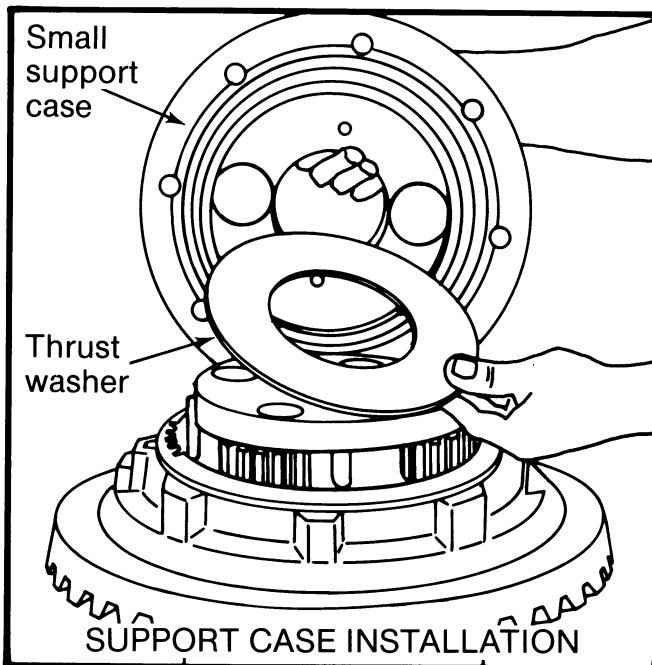
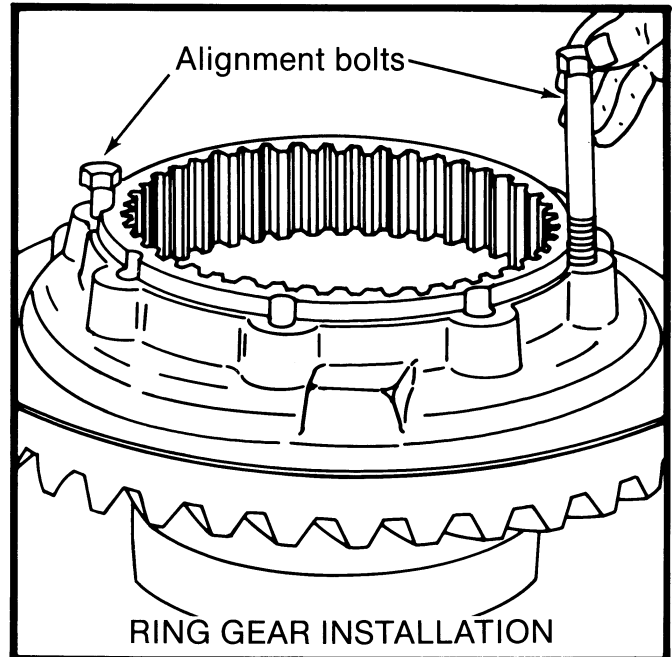


Assemble Wheel Differential (cont'd)

9. During installation of ring gear, temporarily use two bolts in mounting holes to assure bolt hole alignment. Place ring gear on large support case (see illustration), then remove the two bolts.

10. Place support case and ring gear assembly upright on a bench or the floor. Carefully lower differential assembly into case. Engage idler pinions with ring gear teeth to complete the installation.

NOTE: During differential installation, be sure thrust washer stays in its proper mounting position.

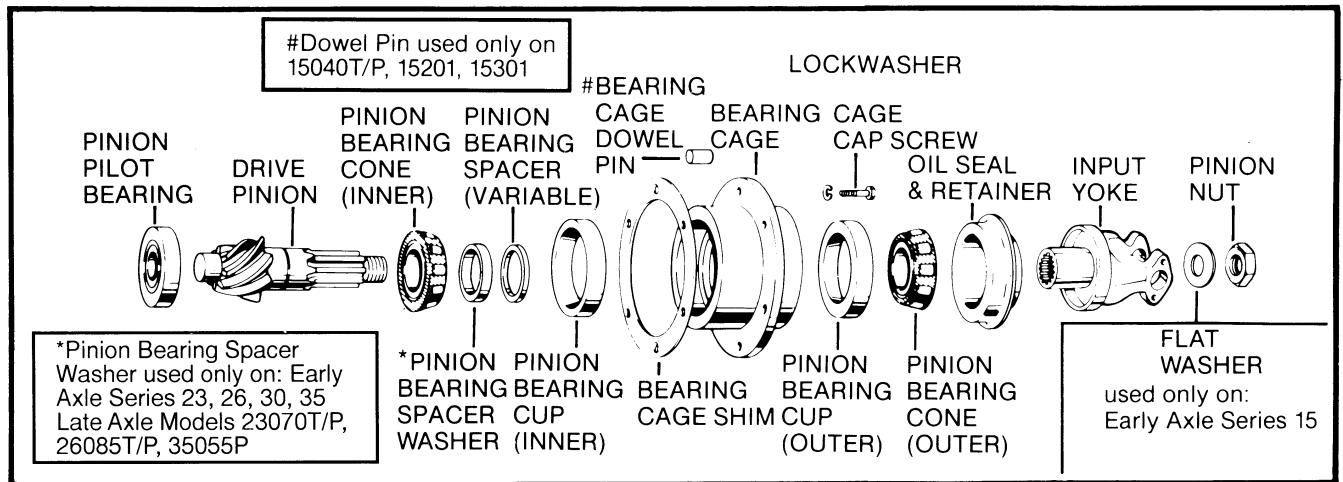


11. install thrust washer and small support case over differential assembly.

12. Carefully install ring gear bolts, making certain flat on bolt head is seated against the outside diameter of the large support case. Install and torque nuts (see chart, back page).

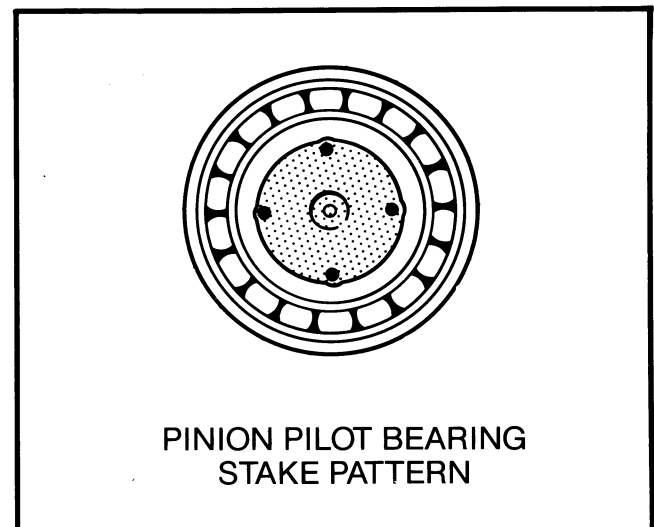
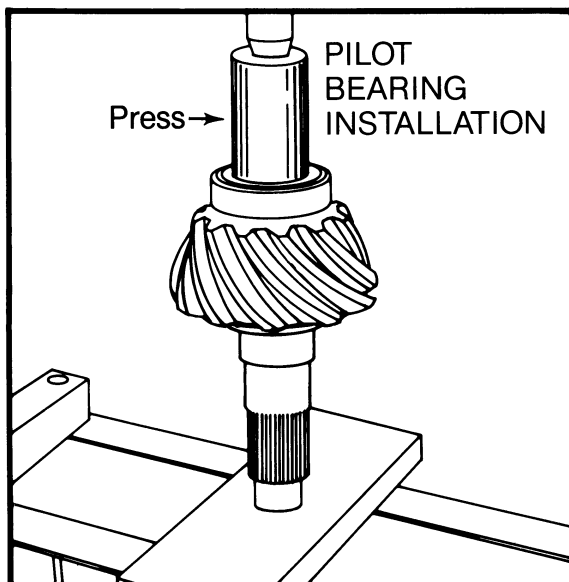
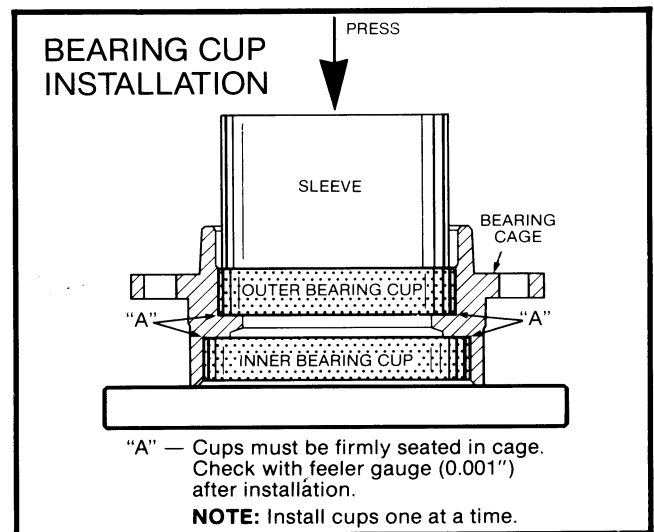
NOTE: Temporarily install sliding clutch (or sun gear) and check planetary for free rotation.

Assemble Drive Pinion



NOTE: Lubricate parts with gear lube during reassembly. When installing bearing cones and pilot bearing, use properly-sized sleeves that only contact the inner bearing race.

1. Before installing cups, check for burrs on bearing surfaces and remove. Press bearing cups in cage.
2. Press pilot bearing on pinion. Stake bearing using staking tool. See illustration for stake pattern.
3. Perform Trial Build-Up Pinion Preload Test following procedures on next page.



Pinion Bearing Preload Adjustment Trial Build Up Test

The pinion bearing spacer thickness controls bearing preload. The spacer size for correct preload can be predetermined by using a "Initial Build-Up" procedure as described below

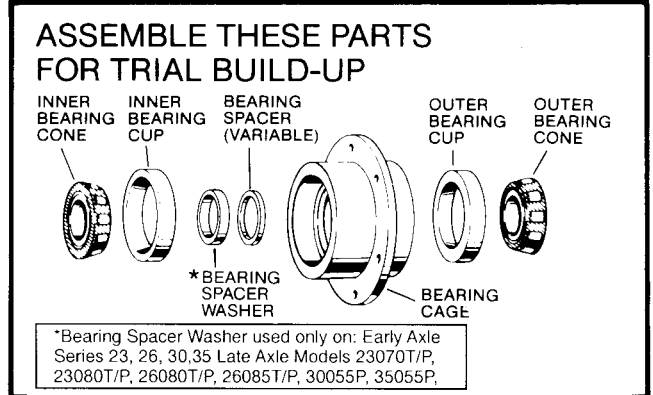
1. Assemble pinion bearing cage, cups and bearing spacer... (without pinion or oil seal). See illustration for spacer washer application. Use nominal size spacer (see chart).

NOTE: During assembly procedure, center bearing spacer between the two bearing cones.

2. Lubricate bearings and place the assembly in the press. Position sleeve or spacer so that load is applied directly to the backface of the outer bearing cone.

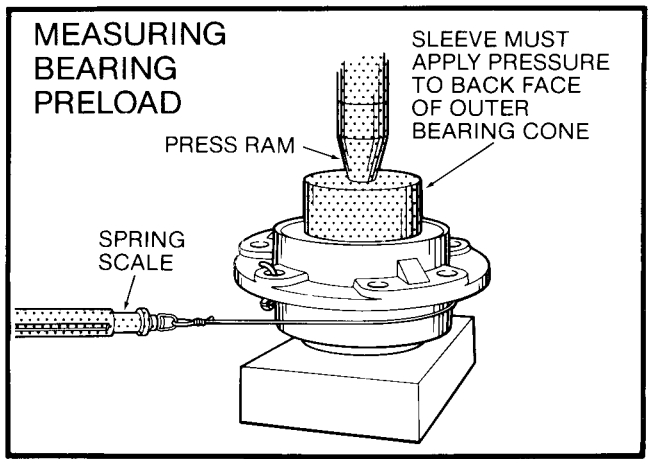
3. Apply press load to the assembly (see chart). Wrap soft wire or strong string around the bearing cage, attach spring scale and pull steadily. Preload is correct when torque required to rotate the pinion bearing cage is from 10-20 LBS.-IN. (1.1-2.3 N.m). This specification is translated into spring scale readings in the chart below.

4. If necessary, adjust pinion bearing preload by changing the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.



NOMINAL PINION BEARING SPACER THICKNESS

Early Axle Series	Late Axle Models	IN.	mm
15	15040T/P	0.528	13.41
16/17/18/21/22	19050T/P 19055T/P 21065T/P 22065T/P	0.638	16.21
23/26/30/35	23070T/P 23080T/P 26080T/P 26085T/P 30055P 35055P	0.185	4.70



SPECIFICATIONS FOR PINION BEARING TRIAL BUILD-UP PRELOAD TEST
Torque to rotate bearing cage 10-20 LBS.-IN. (1.1 — 2.3 N.m)

Early Axle Series	Press Force		Spring Scale Reading		Late Axle Models	Press Force		Spring Scale Reading	
	Tons	Tonnes	Lbs.	N.		Tons	Tonnes	Lbs.	N.
15	12-13	10.9-11.8	5-9	21-42	15040T/P	12-13	10.9-11.8	5-9	21-42
16	11.5-12.5	10.4-11.3	4-8	18-36	19050T/P	11.6-12.5	10.4-11.3	4-8	18-36
17/18	14-15	12.7-13.6	4-8	18-36	19055T/P	14-15	12.7-13.6	4-7	17-33
21/22	14-15	12.7-13.6	4-7	17-33	21065T/P				
23/26					22065T/P				
30/35	18.5-19.5	16.8-17.7	3-7	15-30	23070T/P	18.5-19.5	16.8-17.7	3-7	15-30
					23080T/P				
					26080T/P				
					26085T/P				
					30055P				
					35055P				

NOTE: Use a calibrated load cell to insure proper loading.

Trial Build-Up Test (cont'd)

⚠ CAUTION: Use the correctly sized spacer. Do not use shim stock or grind spacers. These practices can lead to loss of bearing preload and gear or bearing failure.

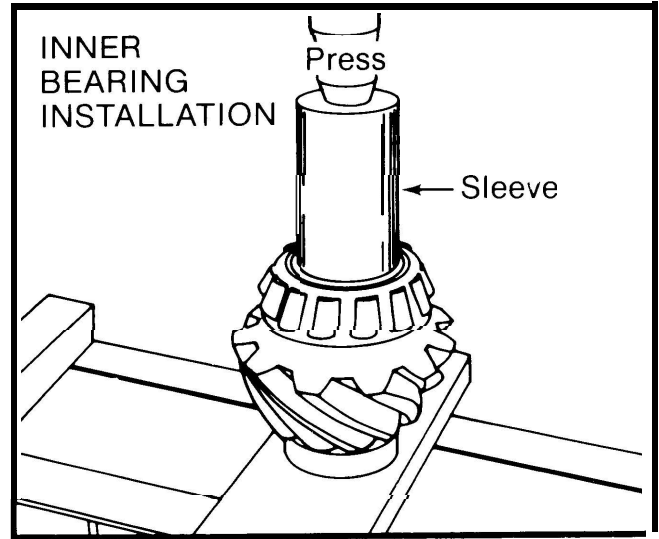
5. Once correct bearing preload has been established, note the spacer size used. Select a spacer 0.001" larger for use in the final pinion bearing cage assembly. The larger spacer compensates for slight "growth" in the bearings which occurs when they are pressed on the pinion shank.

NOTE: With the first stage of bearing preload adjustment ("Trial Build-Up") completed, continue reassembly of bearing cage and pinion.

6. Press inner bearing cone on pinion using a properly sized sleeve.

7. Install bearing spacer washer where used. See illustration on preceding page for applications.

8. Install bearing cage and cup assembly on pinion. Insert outer bearing cone in cage, then press bearing cone and cage assembly on pinion.



9. At this stage of pinion reassembly, recheck bearing preload adjustment by performing "Final Bearing Preload Test" (see following procedures).

Final Pinion Bearing Preload Test

1. With pinion and bearing cage assembled as previously described, measure bearing preload using either of the two following methods

⚠ VISE METHOD: Install yoke and nut, tightening nut to correct torque (see chart). Mount the pinion assembly in a vise, clamping yoke firmly. Apply clamp load (see chart next page). Check bearing cage rolling torque (see Step 2).

⚠ PRESS METHOD: Press should be equipped with a calibrated load cell to insure proper clamp load. Position a sleeve so that load is applied directly to backface of the outer bearing cone. Apply clamp load (see chart next page). Check bearing cage rolling torque (see Step 2).

Final Pinion Bearing Preload Test

(cont'd)

2. Measure Pinion Bearing Preload - Use a spring scale to test the assembly rolling torque. To use the spring scale, wrap soft wire around the bearing cage, attach the scale and pull. Preload is correct when torque required to rotate the pinion bearing cage is from 15 to 35 LBS.-IN. (1.7-4.0 N.m). This specification is translated into spring scale readings in the chart below.

3. Adjust Pinion Bearing Preload - If necessary, adjust pinion bearing preload. Disassemble the pinion bearing cage as recommended in this manual and change the pinion bearing spacer. A thicker spacer will decrease preload. A thinner spacer will increase preload.

IMPORTANT: Use the correctly sized spacer. Do not use shim stock or grind spacers. These practices can lead to loss of bearing preload and gear or bearing failure.

SPECIFICATIONS FOR FINAL PINION BEARING PRELOAD TEST						
Torque to rotate bearing cage — 15-35 LBS.-IN. (1.7-4.0 N.m)						
Early Axle Series	Pinion Nut Torque		Press Force		Spring Scale Reading	
	Lbs.-ft.	N.m	Tons	Tonnes	Lbs.	N.
15	360-440	488-596	12-13	11-12	7-16	31-73
16	360-440	488-596	12-13	11-12	6-14	27-62
17/18*	480-600	650-813	14-15	13-14	6-14	27-62
17/18**	560-700	759-949	14-15	13-14	6-14	27-62
	*1¼"-12 Pinion Nut	**1½"-18 Pinion Nut				
21/22	560-700	759-949	14-15	13-14	6-13	25-58
23/26/30/35	840-1020	1139-1383	18-19	16-17	5-12	22-52
Late Axle Models						
15040T/P	376-461	510-625	12-13	11-12	7-16	31-73
19050T/P	376-461	510-625	12-13	11-12	6-14	27-62
19055T/P						
21065T/P	542-664	735-900	15-16	14-15	6-13	25-58
22065T/P						
23070T/P						
23080T/P						
26080T/P						
26085T/P	789-966	1070-1310	18-19	16-17	5-12	22-52
30055P						
35055P						

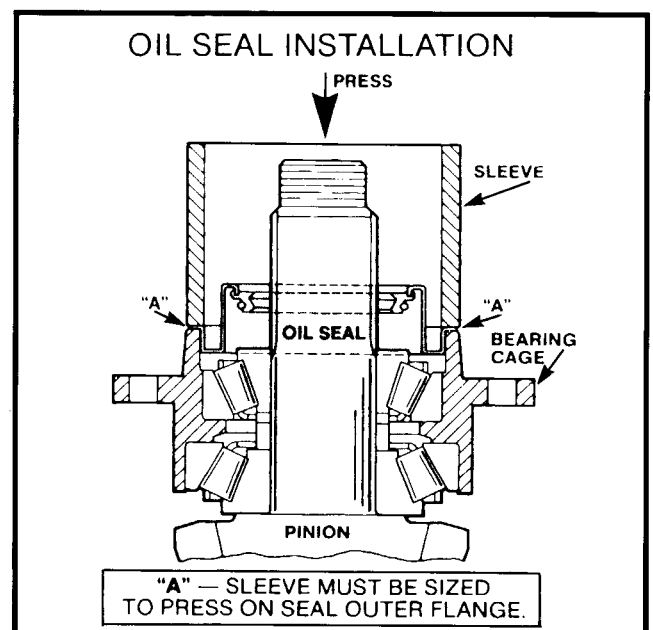
Install Pinion Oil Seal and Yoke

1. With pinion bearing preload adjustment complete, install oil seal. Use a press and properly sized sleeve to prevent distortion or contact with seal lips during installation (see illustration).

2. Make sure yoke is clean and dry. Install yoke and nut (or nut and washer on some models). Tighten nut to correct torque (see chart above).



NOTE: After tightening nut, recheck pinion bearing rolling torque, then proceed with pinion installation in carrier.



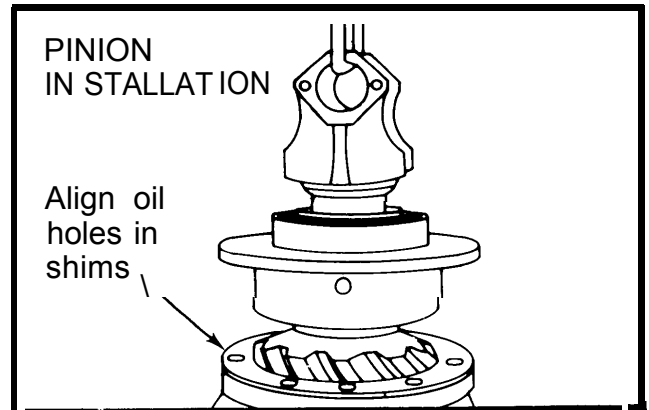
Install Drive Pinion

1. Place shim pack on carrier.

NOTE: If gear is to be reused, install same quantity and size of shims removed during disassembly. When installing a new gear set, use nominal shim pack (see chart).

NOMINAL SHIM PACK

Early Axle Series	IN.	mm
15	0.021	0.53
16	0.022	0.56
17/18	0.023	0.58
21/22	0.025	0.64
23,26, 30, 35	0.024	0.61
Late Axle Models	IN.	mm
15040T/P	0.021	0.53
19050T/P	0.022	0.56
19055T/P, 21065T/P	0.025	0.64
22065T/P		
23070T/P, 23080T/P		
26080T/P, 26085T/P	0.024	0.61
30055P		
35055P		



2. Install pinion assembly. Install bearing cage cap screws. Torque cap screws (see chart, back page).



NOTE: After tightening pinion nut, recheck pinion bearing rolling torque.

Install Differential and Ring Gear Assembly

NOTE: Lubricate bearings during the following assembly procedures.

1. Place ring gear and differential assembly in carrier. Insure that ring gear and drive pinion mesh properly.

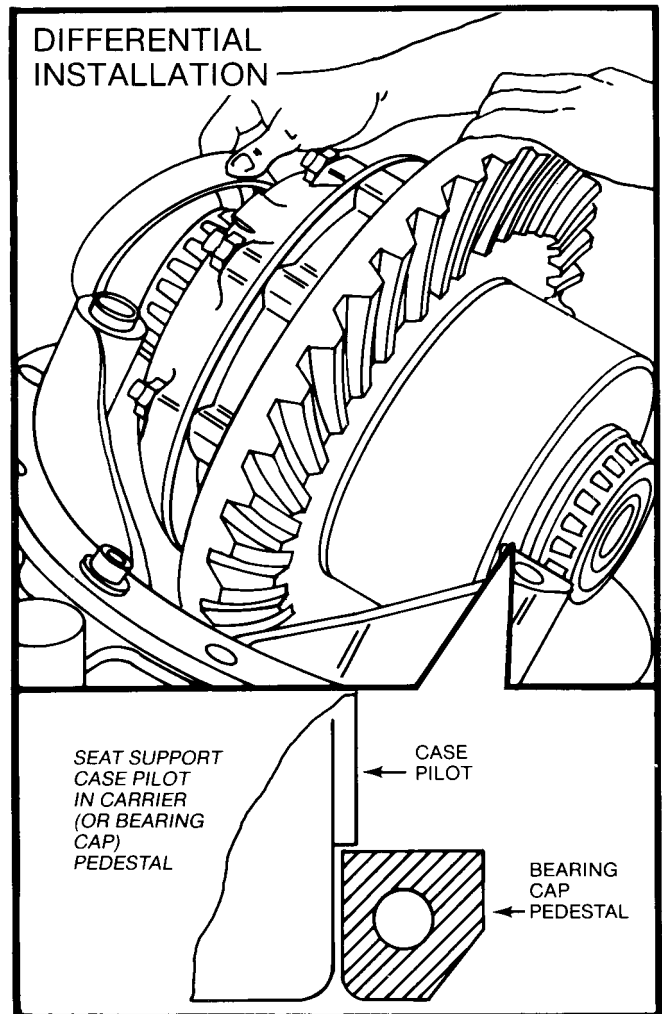
NOTE: During installation, tilt carrier to allow support case pilot to rest in carrier bore, then install bearing cup as shown in illustration. Also install bearing cup on opposite side of differential.

CAUTION: When installing bearing caps and adjusters, exercise care not to cross threads.

2. Install bearing adjusters and caps.

3. Install and tighten bearing cap screws finger-tight. If this is difficult, use hand wrench.

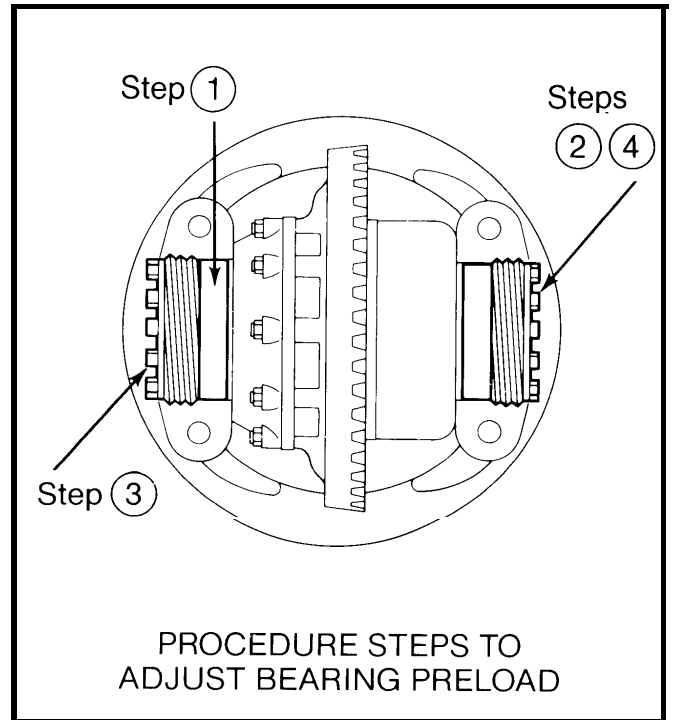
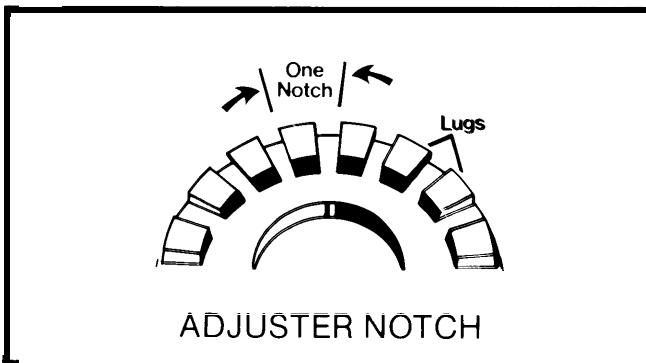
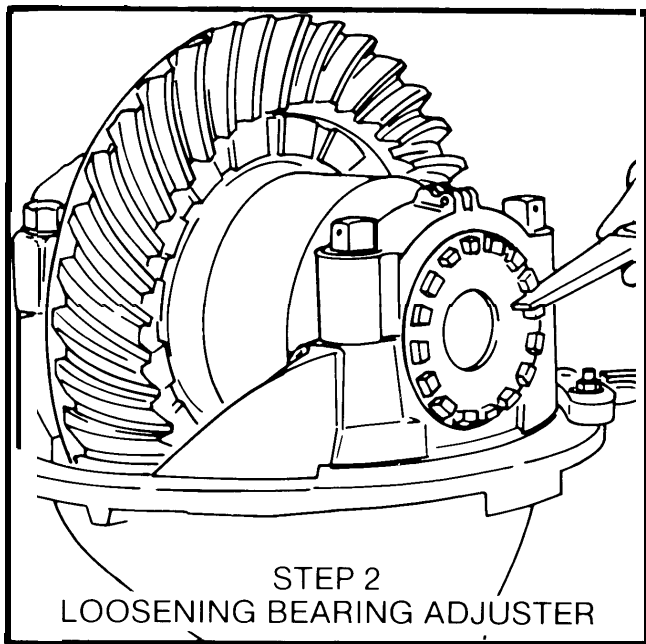
NOTE: The assembly is now ready for adjustment of differential bearing preload, ring gear backlash and gear tooth contact (see next page).



Adjust Differential Bearing Preload

Correct differential bearing preload insures proper location of these bearings under load and helps position the ring gear for proper gear tooth contact.

1. Lubricate differential bearings
2. Loosen the bearing adjuster on the same side as the ring gear teeth until its first thread is visible.



3. Tighten the bearing adjuster on the back-face side of the ring gear until there is no backlash. This can be tested by facing the ring gear teeth and pushing the gear away from the body while gently rocking the gear from side to side. There should be no free movement.

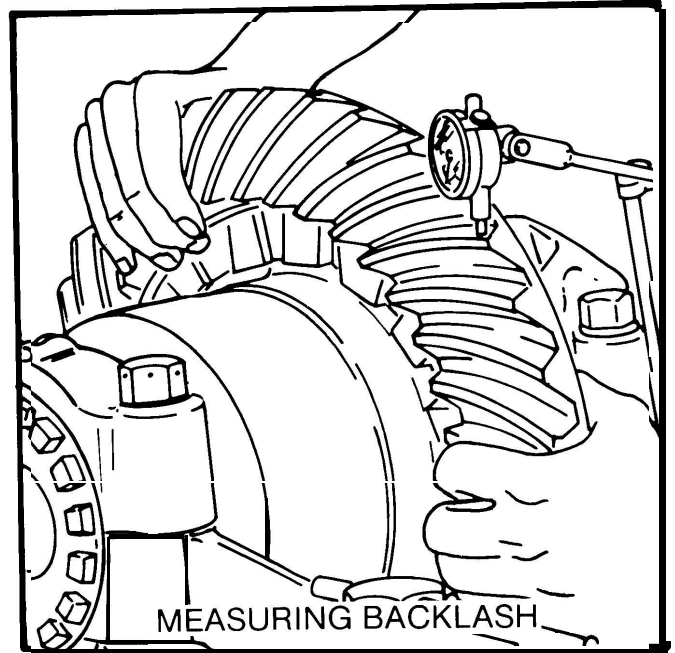
Rotate the ring gear and check for any point where the gear may bind. If such a point exists, loosen and retighten the back side adjuster. Make all further adjustments from the point of tightest mesh.

4. At teeth side of ring gear, tighten adjuster until it contacts the bearing cup. Continue tightening adjuster two or three notches and this will preload bearings and provide approximate backlash. Measure backlash and adjust if necessary (see following page).

Adjust Ring Gear Backlash

IMPORTANT: Check backlash as described below and adjust if necessary.

1. Measure backlash with a dial indicator. The indicator should be positioned on a ring gear tooth, at the extreme heel end, perpendicular to the tooth surface.



BAC LASH SPECIFICATIONS (Normal)

New Gearing:

Early Axle Series 15 through 18

Late Axle Models 15040T/P through 19055T/P0.006"-0.016" (0.15-0.41mm)

Early Axle Series 21 through 35

Late Axle Models 21065T/P through 35055T/P 0.008"-0.018" (0.20-0.46mm)

NOTE: For new gearing, check ring gear backlash after each shim change and adjust if necessary.

Used Gearing: Reset to normal backlash recorded before disassembly.

To REMOVE backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Tighten the opposite adjuster one notch.

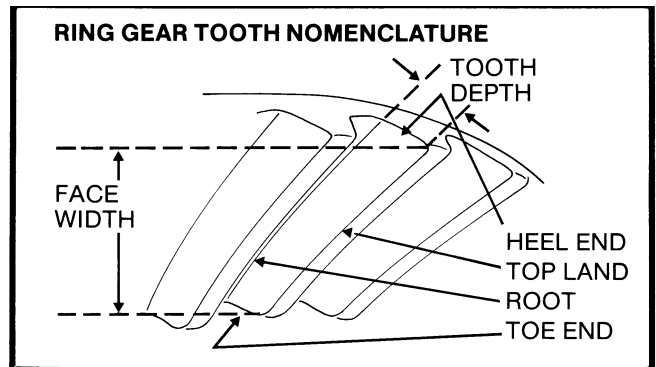
Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

To ADD backlash: Loosen the adjuster on the teeth side of the ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.

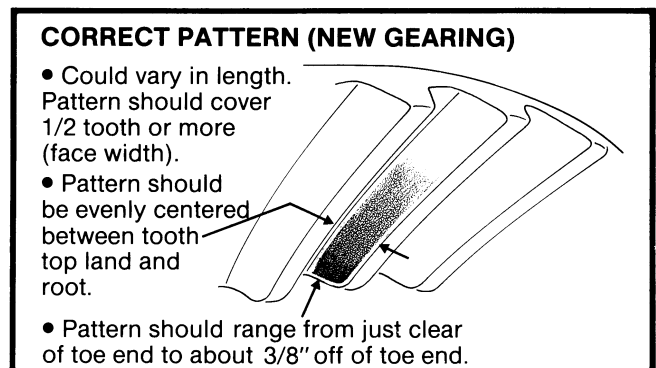
Adjust Ring Gear Tooth Contact

After differential bearing preload and gear backlash adjustment is complete, check gear tooth contact pattern and adjust if necessary.



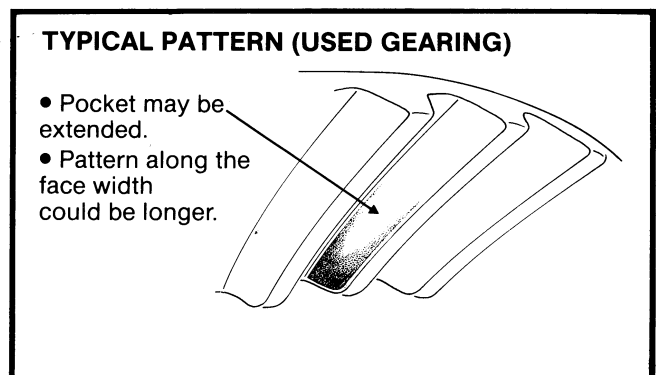
CORRECT TOOTH CONTACT PATTERN (NEW GEARING)

Paint ring gear teeth with marking compound and roll the gear to obtain a contact pattern as shown in the drawings. The length of the pattern in an unloaded condition is approximately one-half to two-thirds of the ring gear tooth in most models and ratios.



CORRECT TOOTH CONTACT PATTERN (USED GEARING)

Used gearing may not display the square, even contact pattern found in new gear sets. The gear may have a "pocket" at heel end of contact pattern. The more use a gear has had, the more the pocket becomes the dominant characteristic of the pattern.



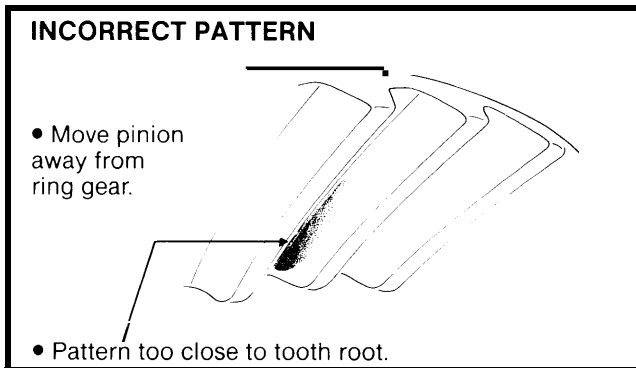
Adjust used gear sets to display the same contact pattern observed before disassembly. A correct pattern is up slightly off the toe and centers evenly along the face width between the top land and root. Otherwise, the length and shape of the pattern are highly variable and are considered acceptable as long as there is some pattern on toe end of the tooth.

NOTE: Tooth contact patterns are a function of the relative positions of the ring gear and pinion. An improper pattern will require relocation of either or both. Always adjust pinion position first, if necessary, then ring gear position. Recheck backlash when done.

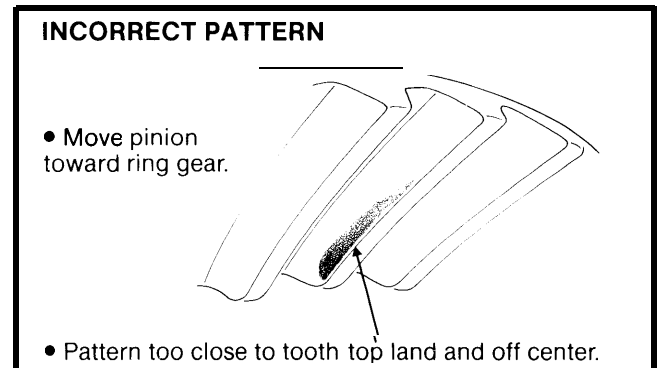
Adjust Ring Gear Tooth Contact (cont'd)

Adjust Pinion Position

If the contact pattern shows incorrect tooth depth contact, change drive pinion position by altering the shim pack under the cage and cup assembly. Used gears should achieve proper contact with the same shims removed from the axle at disassembly.



If the pattern is too close to the root of the gear tooth, add pinion shims.

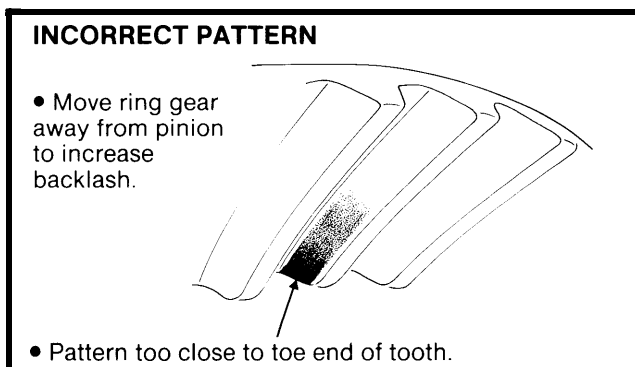


If the pattern is too close to the top land of the gear tooth, remove pinion shims

NOTE: Check ring gear backlash after each shim change and adjust if necessary to maintain correct backlash (see backlash specs, page 27). Always recheck tooth contact pattern after making shim pack changes.

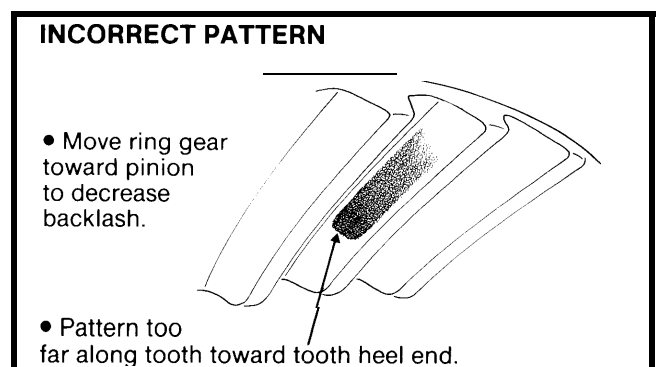
Adjust Backlash

If the contact pattern shows incorrect face width contact, change backlash and recheck the contact pattern.



With the pattern concentrated at the toe (too far down the tooth), ADD BACK LASH by loosening the bearing adjuster on the teeth side of ring gear several notches. Loosen the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.



If the pattern is concentrated at the heel (too far up-the tooth), REMOVE BACK LASH by loosening the bearing adjuster on the teeth side of ring gear several notches. Tighten the opposite adjuster one notch.

Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup. Continue tightening the same adjuster 2 or 3 notches. Recheck backlash.


Adjust Ring Gear Tooth Contact (cont'd)

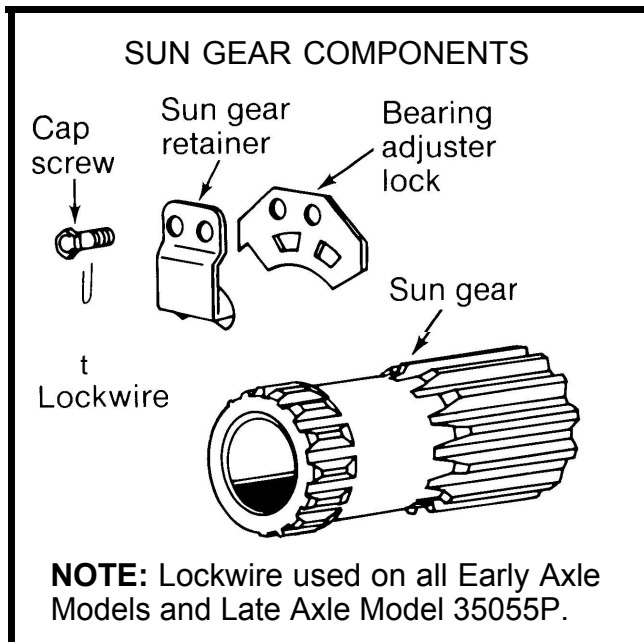
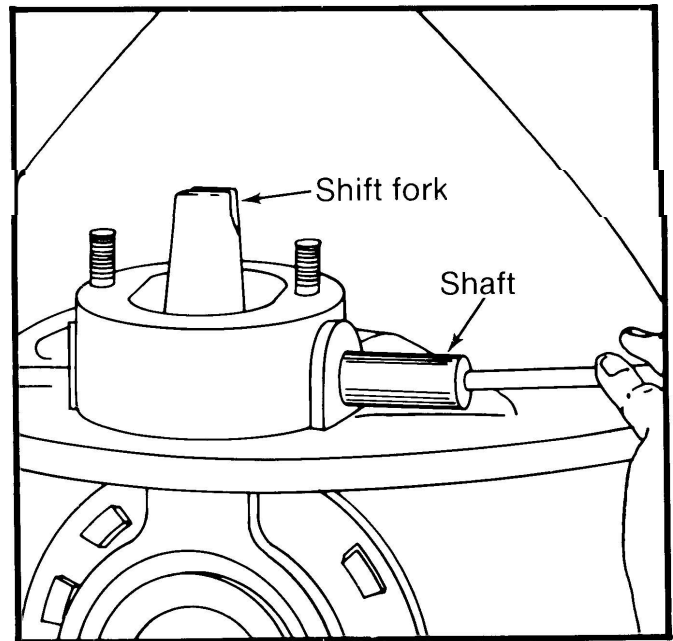
When preload, backlash, and tooth contact are correct, align differential bearing adjusters and locks, then tighten differential

bearing cap screws to correct torque (see chart, back page)




Differential Carrier Final Assembly

1. Install adjuster lock and cap screw on ring gear teeth side.
2. **2-Speed Axles** (on backface side of ring gear) Install adjuster lock, dowel bushings and cap screws. Torque cap screws (see chart, back page). Lockwire differential bearing cap, and adjuster lock cap screws. 
3. **2-Speed Axles:** Position shift fork in carrier opening, then install sliding clutch. With clutch installed, engage shift fork yoke with clutch collar. Then install shift fork shaft. Install expansion plugs to seal openings. Install shift unit seal and spring.



IMPORTANT (2-SPEED AXLES) Electric shift unit replacement. Before installing a rebuilt or new shift unit, check fit of shift fork to slider block pivot using a "Fit-Up" Card or Template (Eaton P/N 128039.) These cards are furnished with new shift units, retrofit and slider block kits. Instructions are contained on the card or refer to Eaton Service Manual EA-29.

4. **Planetary Double Reduction Axles** (on backface side of ring gear) Install sun gear and retainer, then install cap screws that fasten both retainer and adjuster lock. Tighten screws to correct torque (see chart, back page) and lockwire. 

Lockwire cap screws when used. See illustration for application.

Install Differential Carrier Assembly

NOTE: Before installing carrier assembly, inspect and thoroughly clean interior of axle housing.

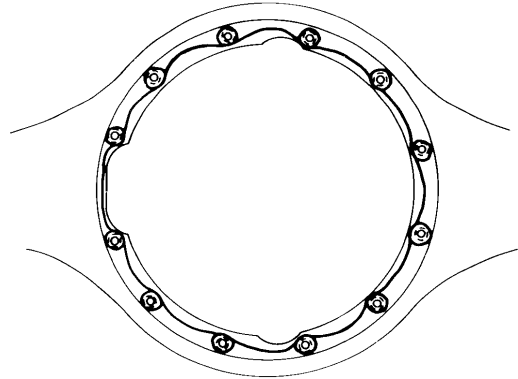
NOTE: Use silicone rubber gasket compound on axle housing mating surface as shown in the illustration. Gasket compound will set in 20 minutes. Install carrier before compound sets or reapply.

1. Install differential carrier assembly in axle housing. Install cap screws, nuts and lockwashers. Tighten to correct torque (see chart, back page). **T**
2. Install axle shafts and stud nuts. Connect driveline.
3. Fill axle with correct lube (see Lubrication Section 2, page 6 and 7).

NOTE: Before installing electric shift unit, see **IMPORTANT NOTE** on page 30.

4. For electric shift units, connect electrical wires. Install shift unit, nuts and washers. Tighten nuts to correct torque (see chart, back page). **T**

AXLE HOUSING SILICONE GASKET COMPOUND PATTERN

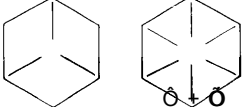


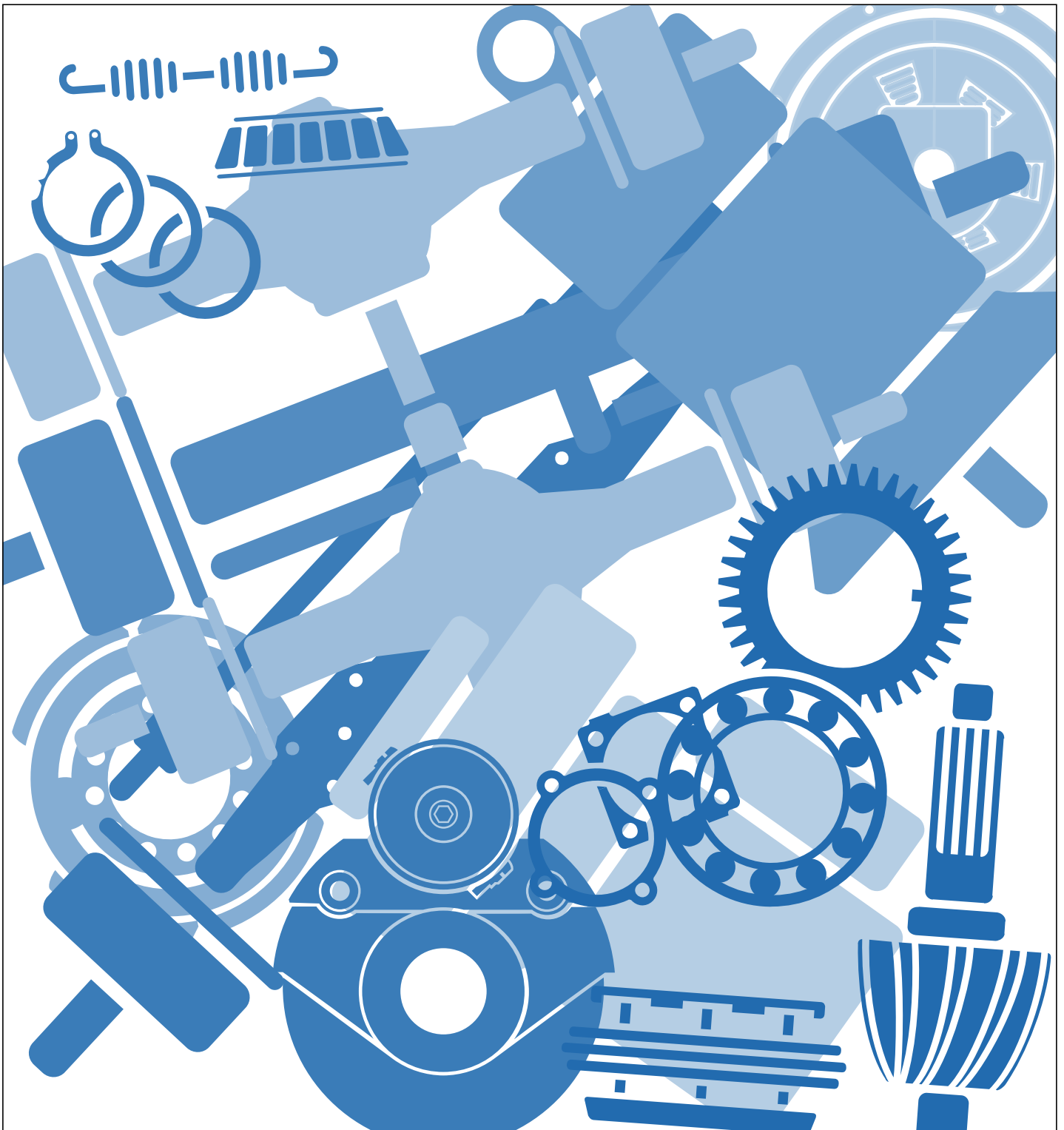
Apply 1/8" diameter bead completely around housing surface and around each threaded hole.

For air shift units, connect airline. Install shift unit, nuts and washers. Tighten nuts to correct torque (see chart, back page). **T**

NOTE: When axle has been disassembled or housing, gears, axle shafts or wheel equipment replaced, check axle assembly for proper differential action before operating vehicle. Wheels must rotate freely and independently.

Fastener Torque Specifications

Fastener	Early Axle Series	Late Axle Models	Thread Size	Grade	lbs.-ft.	N.m
Differential Case Cap Screw	15-16 17-35	15040T/P-19050T/P 19055T/P-35055P	7/16-14 1/2-13	8 8	60-70 90-110	81-94 122-149
Ring Gear Bolt Nut	15 16 17-35	15040T/P 19050T/P 19055T/P-35055P	7/16-20 1/2-20 9/16-18	9 8 8	70-90 95-115 110-130	94-122 129-156 149-176
Pinion Bearing Cage Cap Screw	15-22 23-35	15040T/P-22065T/P 23070T/P-35055P	9/16-12 5/8-11	5 5	110-125 160-176	149-170 216-238
Bearing Cap Cap Screw	15 16 17-35	15040T/P 19050T/P 19055T/P-35055P	5/8-11 11/16-11 13/16-10	8 8 8	170-190 240-280 370-430	230-257 325-379 501-583
Carrier to Housing Cap Screw	15 16 17-35 17-35	15040T/P 19050T/P 19055T/P-26085T/P 23070T/P 35055P NUT	7/16-14 1/2-13 5/8-11 5/8-11 5/8-18	5 8 5 8 8	48-56 95-115 160-176 220-240 220-240	65-75 129-156 216-238 298-325 298-325
35 Series Housing Cover	35	35055P NUT	7/16-14 1/2-13 1/2-20	5 5 8	35-51 75-85 110-130	47-69 101-115 149-176
Pinion Nut	15 16 17-18 17-22 23-35		1-20 1-1/8-18 1-1/4-12 1-1/2-18 1-3/4-12		360-440 360-440 480-600 560-700 840-1020	488-596 488-596 650-813 759-949 1139-1383
Pinion Nut *Metric		15040T/P 19050T/P 19055T/P-22065T/P 23070T/P-35055P	*M30x1.5 *M30x1.5 *M36x1.5 *M42x1.5		376-461 376-461 542-664 789-966	510-625 510-625 735-900 1070-1310
Bearing Adjuster Lock Cap Screw	15-16 17-35	15040T/P-19050T/P 19055T/P-35055P	9/16-12 5/8-11	5 5	115-125 160-176	155-169 216-238
Shift Unit Stud/Nut	All 2-Speed Models		Electric Shift Unit 7/16-20 AirShift Unit 7/16-20	8 8	35-45 55-61	47-61 74-82
Shift Fork Opening Cover Cap Screw	All Double Reduction Models		7/16-14	5	35-45	47-61
<p>Correct tightening torque values are extremely important to assure long Eaton Axle life and dependable performance. Under-tightening of attaching parts is just as harmful as over-tightening.</p> <p>Exact compliance with recommended torque values will assure the best results.</p> <p>The data includes fastener size, grade and torque tightening values. Axle models are included to pinpoint identification of fasteners for your particular axle.</p> <p>To determine bolt or cap screw grade, check for designation stamped on bolt head (see illustration).</p>				<p>Bolt head markings for grade identification</p>  <p>Grade 5 Grade 8</p>		



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