DANA SPICER®
Off-Highway Products

Service Manual

Industrial Planetary Axles - Heavy Planetary Rigid 25D

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80-1041 6/13

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the **CLARK-HURTH COMPONENTS** product.

Extreme care has been exercised in the design, selection of materials, and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the product, its principle of operation, troubleshooting, and adjustments, it is urged that the mechanic study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

Whenever repair or replacement of component parts is required, only **Clark-Hurth Components**-approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger proper operation and performance of the equipment. **Clark-Hurth Components** does not warrant repair or replacement parts, nor failures resulting from the use of parts which are not supplied by or approved by **Clark-Hurth Components.** IMPORTANT: **Always furnish the Distributor with the serial and model number when ordering parts.**

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NOTE: Metric Dimensions Shown in Brackets [ ].

DESCRIPTION
The axle assembly has a spiral bevel type ring gear and pinion with further reduction provided by planetary gear set within the wheel hub.

PRIMARY REDUCTION
The spiral bevel pinion and ring gear transmit power through the center differential pinions, side gears, and to the axle shaft. The spiral bevel differential assembly is mounted on tapered roller bearings which are adjusted by positioning of the two threaded adjusting nuts mounted in the differential carrier and cap assembly. The tapered roller pinion bearing pre-load is adjusted and maintained by a hardened and precision ground spacer positioned between inner and outer bearings. Spacer is selected at assembly.

SECONDARY REDUCTION
In the wheel hub, a self-centering sun gear is spline fitted to the axle shaft and drives three planetary pinion gears. These gears in turn mesh with and react against a rigidly mounted internal ring gear. The planet gears rotate on needle roller bearings mounted on hardened and ground pins located in the planet carrier which in turn drives the wheel hub. Positive lubrication keeps all moving parts bathed in lubricant to reduce friction, heat, and wear.

(LCB) LIQUID COOLED BRAKES
The liquid cooled brake is ideal for use in contaminated or temperature sensitive environments and in machines where extra long maintenance intervals are required. Braking action of the liquid cooled brakes is achieved through the application of the hydraulic piston with the rotating graphitic friction surfaces which react with stationary stator plates. The stator plates are retained by scalloped tangs at the outside diameter, which in turn transfer the reaction torque to the rigid outside housing.

Tangs on the O.D. of the friction discs prevent the discs from dropping out of alignment when the wheel hub is removed for wheel bearing adjustments. This provides ease of service reassembly.

Hub splines are long enough to engage all friction discs before bearings or seals are set. This provides ease of assembly and assures the ability to accurately adjust wheel bearings.

Wheel bearings can be serviced as in any normal bearing service procedure.

RECOMMENDED LUBRICANTS FOR CLARK DRIVE AXLES

Initial Fill

Grade 85W140 qualified MIL-L-2105C gear lubricant as specified in Clark MS-8 engineering standard is preferred for initial fill for most ambient temperatures. (See chart on page 2) For other ambient temperature ranges use proper viscosities of MIL-L-2105C.

Other lubricants approved to MIL-L-2105C specifications are acceptable for initial fill or top off.

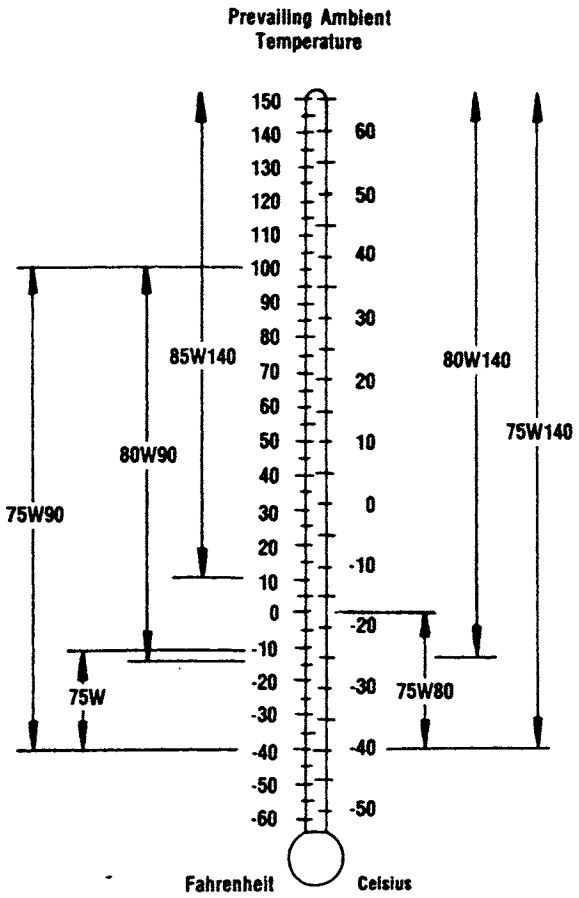
Service Fill

Multipurpose gear lubricants approved to the MIL-L-2105C specifications are recommended. MIL-L-2105C classifies multigrade gear lubricants on the basis of the viscosities at various temperatures.

Listed on page 2 are the recommended multigrade viscosities for use at the prevailing operating temperatures in Clark Drive Axles.

MS-8 EXTREME GEAR LUBRICANT

MS-8 specifications cover a gear lubricant for use in heavy-duty axles. It is a highly refined base stock properly compounded with selected extreme pressure additives. MS-8 meets MIL-L-2105C but is fortified with an additive package that provides added protection during the break-in period and reduced wear and improved efficiency during subsequent operation.



For proper viscosity lube, refer to fahrenheit or celsius chart below.

Gear Lubricant Chart

Ambient Temperature Ranges				Multigrade Viscosities MIL-L-2105C See (a) note below.
-40°F	to	-10°F	(-40°C to -23°C)	75W See (b) note below.
-40°F	to	0°F	(-40°C to -18°C)	75W80
-40°F	to	+100°F	(-40°C to -38°C)	75W90
-40°F	+	Above	(-40°C + Above)	75W140
-15°F	to	100°F	(-26°C to 38°C)	80W90
-15°F	+	Above	(-26°C + Above)	80W140
+10°F	+	Above	(-12°C + Above)	85W140

Notes:

(a) The MIL-L-2105C Specification replaced the MIL-L-2105B Specification.

(b) The MIL-L-2105C 75W Classification replaced the MIL-L-10324A Subarctic Specification.

Note: Specifications are subject to change.

Liquid Cooled Brakes (LCB)

A. The following oils are allowable to use on the actuator side of the 10,000 & 20,000 series liquid cooled brakes.
1 - Motor Oil API SE/CD.
2 - MIL-L-46152B/MIL-L-2104 C or D.
3 - ATF C-3 or *DEXRON®. Not *DEXRON II® **(See Note Below).**
4 - Hydraulic Oils.
5 - Water/Oil Invert Emulsion.
6 - Synthetic Gear Oils (Chemical Ester)

B. Brake sump cooling oils (when external cooling is used). The following cooling oils are recommended in order of preference.
1 - Organic Esters
2 - Hydraulic Oil
3 - MIL-L-46152B/MIL-L-2104 C or D.
4 - ATF C-3 or *DEXRON®. Not DEXRON II® **(See Note Below).**
5 - Motor Oil API SE/CD.
6 - Invert Emulsion
and all of the oils in A above can be used in the brake sump except water/oil invert emulsion must not be used with the LCB 10,000 series shipped from Clark before 1 June 1984 because of incompatibility with the friction discs.

C. Axle assemblies with Liquid Cooled Brakes having a common brake and gear sump (no brake external cooling used), use
1 - Gear Lubricant meeting Clark specifications MS-8,
2 - MIL-L-2105C.

NOTE: DEXRON II® is not compatible with graphic friction plate material unless it meets the approved C-3 specifications.

*DEXRON is a registered trademark of General Motors Corporation.

CHECKING OIL LEVEL IN DRIVE AXLES

For off-highway operation, check lubricant level after each 250 hours of operation. Always maintain lubricant level to bottom of filler plug hole. Drain oil every 2,500 hours or one year, whichever comes first.

For highway operation, lubrication should be checked each 5,000 miles [8,000 km]. Maintain lubricant level to bottom of filler plug hole. Drain oil every 25,000 miles [40,000 km] or one year, whichever comes first.

To check oil level in axles with differential drive and planetary wheel ends, the axle should be run first, then allowed to stand for a minimum of five minutes on level ground. This procedure will allow oil to drain back to its normal level. After the five minute interval, remove oil filler plug at axle center and in the planetary wheel ends for oil level inspection. If oil level is not to the bottom of the filler hole, add necessary lubricant.*

LIQUID COOLED BRAKE - LUBRICATION

The self-contained liquid cooled brake system uses the same lube as the axle center section and wheel ends. There are no seals between the spindles and wheel hubs. Oil that lubricates the differential and planetary wheel ends also lubricates and cools the brake assembly. The oil level is the same height as the planet and axle center and the brake may be filled and oil level checked at the planet carrier assembly or planet carrier cover.

Brake oil changes would be accomplished at the same time the axle lube is changed. Contaminates resulting from braking will not affect axle within normal oil change periods.

CAUTION: On all axles with liquid cooled brakes, check brake drain plug for presence of axle lube for axles without forced cooling, or cooling fluid for axles with forced cooling.

LIQUID COOLED BRAKE - DRAINING

To drain the brake housing, remove the bottom drain plug from the brake housing. Remove the inlet plug below the bleeder screw. Allow enough time for housing to drain completely.

CHECKING AND FILLING PLANETARY WHEEL ENDS

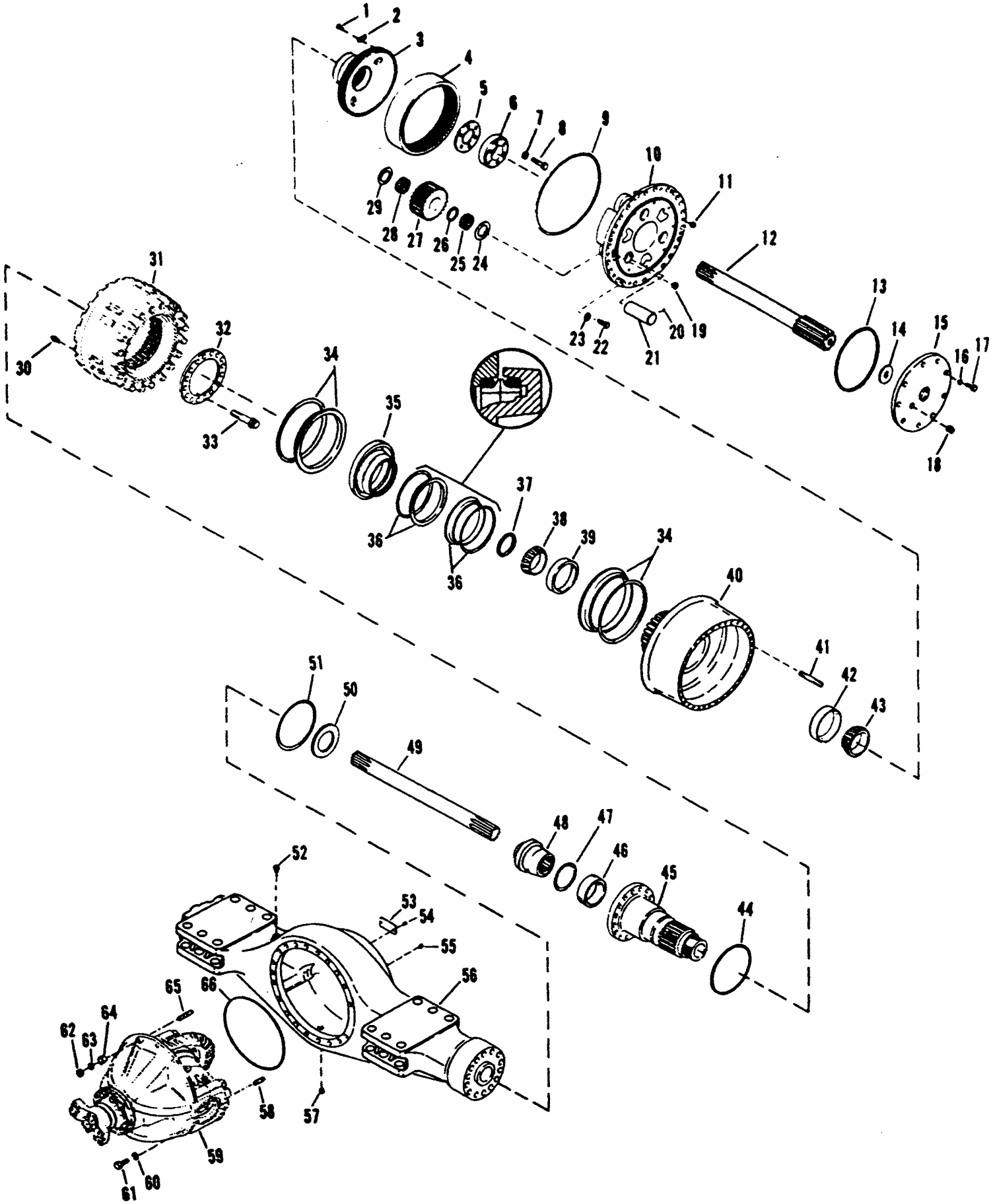
Always check lubricant level in planetary wheel ends, with wheel hub oil level plug in a down position. Remove oil level plug. If lubricant is below oil level hole, remove filler plug and fill to oil level hole.* Reinstall pipe plugs.

DRAINING THE AXLE CENTER AND WHEEL ENDS

Draining is best accomplished immediately after the vehicle has operated a short time or completed a trip. The lubricant is then warm and will flow freely, allowing full drainage in minimum time. This is particularly desirable in cold weather.

Remove plug at bottom of axle housing and allow sufficient time for lubricant to drain. With planetary wheel ends, rotate wheel until filler hole is down. Remove plug and allow sufficient time for draining. Be sure planet cover oil level hole is in proper position when refilling wheel ends.

> * **NOTE:** When filling the axle housing, planetary wheel ends, and brakes, allow enough time for lubricant to flow through the various components in the differential, planetary housing, and the brake assembly. After filling is completed, allow a few minutes for lubricant to attain its level and recheck each wheel end and the axle center. Add lubricant if necessary.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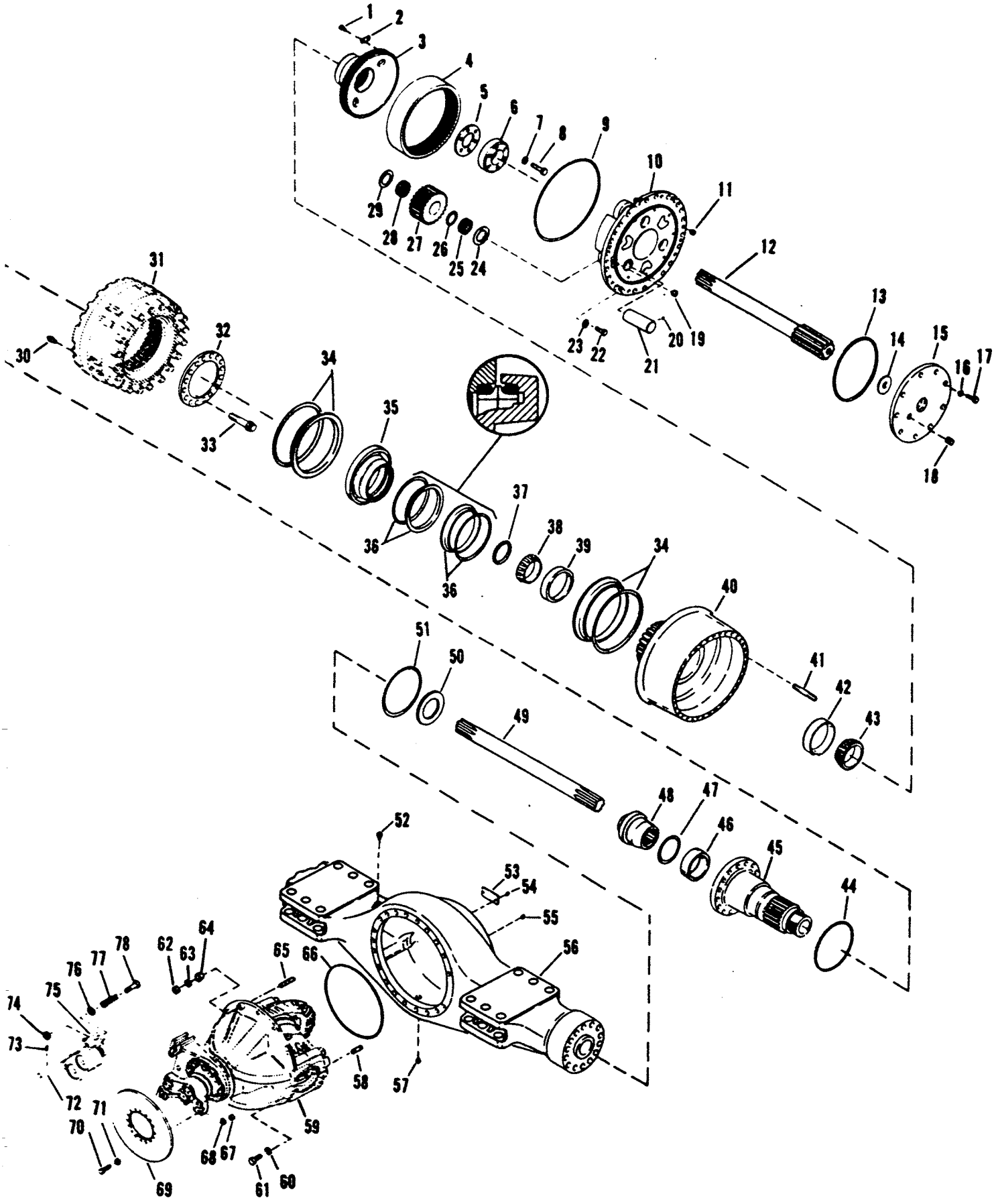
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OVERHAUL OF AXLE ASSEMBLY WITH LIQUID COOLED BRAKES

The instructions contained herein cover the disassembly and reassembly of the axle assembly in a sequence that would normally be followed after the unit has been overhauled. Mount axle on steel horses or on V-blocks. Allow axle housing mounting pads to rest on crossbars of horses to provide necessary rigidity.

NOTE: Drain axle wheel ends and center section thoroughly before disassembly, see liquid cooled brake lubrication section for draining and filling brakes.

CAUTION: Cleanliness is of extreme importance in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

CAUTION: Before removing wheel hub and drum assembly install a "C" clamp on each end of axle housing to prevent axle assembly from flipping off repair stand.

NOTE: Differential can not be removed until both wheel ends are disassembled and inner axle shafts, axle shaft and sun gear are removed.

STEP 1: Drain oil from wheel ends, brakes, and center section.

STEP 2: Remove planet cover screws (17).

STEP 3: Remove planet cover (15).

STEP 4: Remove planet carrier to wheel hub capscrews (22).

STEP 5: Remove axle shaft and sun gear (12).

STEP 6: Pry planet carrier (10) out of wheel hub far enough to install a hook and chain hoist.

STEP 7: Remove planet carrier assembly (10).

SUPPORT WHEEL HUB ASSEMBLY (40) WITH A CHAIN HOIST BEFORE STEP 8.

STEP 8: Remove wheel bearing adjusting plate (6) capscrews (8).

STEP 9: Remove adjusting plate (6) & shims (5).

STEP 10: Remove internal gear and hub assembly (3 & 4). Use caution that wheel hub does not come off without a chain hoist attached.

STEP 11: Support wheel hub with a chain hoist and pry wheel hub splines out of liquid cooled brake (L.C.B.) (31) discs.

STEP 12: Remove wheel hub (40).

STEP 13: Remove face seal (34) from housing end cap.

SUPPORT BRAKE ASSEMBLY (31) WITH A CHAIN HOIST BEFORE STEP 14.

STEP 14: Remove brake assembly to spindle capscrews (33).

STEP 15: Support brake assembly with a lifting strap and remove brake (31). Use caution as spindle (45) may come off with brake (31).

STEP 16: Remove brake assembly to spindle "O" ring (44).

STEP 17: Remove spindle (45), axle shaft coupling (48), & inner axle shaft (49).

REPEAT PROCEDURE ON OPPOSITE WHEEL END FOR COMPLETE DISASSEMBLY.

SEE DIFFERENTIAL SECTION FOR DIFFERENTIAL SERVICE.

REASSEMBLY OF AXLE

(See cleaning and inspection page)

At reassembly apply thread locking compound where noted.

Guideline for application where to apply:

A. On bolts, capscrews, and studs (anchor end) apply compound on female threaded component part.

B. On nuts, apply compound to the male thread on the mating fastener.

C. Apply compound to coat the full length and circumference of thread engagement.

D. Remove excess compound from mating parts after fastener installation.

DIFFERENTIAL ASSEMBLY INSTALLATION

STEP 18: Install a new differential to axle housing "O" ring (66) on differential carrier. Check differential mounting flange of axle housing to be sure it is free of dirt and burrs. Align differential assembly with axle housing studs. Lower into position. Use caution as not to damage studs. Apply Locktite #262 to threads of studs.

STEP 19: Install taper dowels (64) on studs. Install lockwashers (63) and stud nuts (62). Tighten taper dowel stud nuts first. Tighten stud nuts 242-250 lbf.ft. [329-338N.m] torque.

STEP 20: If thrust washer (50) was replaced or removed, install washer (50) in axle housing (56).

STEP 21: Position the inner axle shaft (49) in axle housing (56) with small diameter splines into the differential side gears. Make sure axle splines are in full position in differential side gears.

STEP 22: Position axle housing coupling (48) on inner axle shaft (49) being certain coupling splines are in full position with inner axle shaft splines.

STEP 23: Install bushing (46) in spindle (45). Position square cut "O" ring (47) on spindle (45) pilot and square cut inner spindle "O" ring (51) on spindle (45). **CAUTION:** make sure square cut "O" rings are not twisted and are fully seated in their grooves. Apply a light coat of Dow Corning RTV-Q3-7069 to pilot of spindle (45).

NOTE: It is recommended a threaded aligning rod or two be used to facilitate assembly of the spindle (45) & brake (31) to the axle housing (56). The thread size of the rod is 1 1/4" -7 N.C. and the overall length of the rod should be 7" or 8" long.

STEP 24: Install one or two alignment rods in top spindle attaching bolt holes.

STEP 25: Install spindle (45) on aligning rods using caution as not to disrupt "O" rings (45 & 51).

STEP 26: Install spindle to brake outer square cut "O" ring (44) in outer groove of spindle (45) make sure square cut ring is not twisted and is in full position in ring groove.

STEP 27: Install brake assembly (31) on spindle aligning rods. Use **CAUTION** as not to disrupt outer square cut "O" ring (44)

STEP 28: Install brake assembly to spindle ring (32). Apply thread locking compound per guidelines. Install brake to axle housing capscrews (33) remove aligning rods. Tighten capscrews 1850 to 2000 lbf.ft. [2510-2710 N.m.].

SEE SECTION ON DUO-CONE SEAL INSTALLATION.

STEP 29: Position a square cut "O" ring (37) in the hub seal retainer (35). Install half of the hub seal (36), (per installation instructions) in seal retainer (35). Install retainer (35), "O" ring (37) & retainer face seal (36) on spindle (45) and into brake assembly (31).

STEP 30: Position wheel hub (40) and inner cone bearing (38) on spindle (45) against seal retainer (35).

STEP 31: Position one outboard face seal (34) in brake end as explained in face seal installation section.

STEP 32: Position outboard face seal (34) & inboard hub face seal (36) in wheel hub (40) per face seal installation instructions.

STEP 33: Align wheel hub (40) splines with brake (31) discs. Insert hub (40) splines into brake assembly (31). Use **CAUTION** as not to damage hub seals (36). Align hub splines with friction plates in brake assembly -- do not force this operation. When fully into position face seals in hub and brake will be together.

STEP 34: Install internal gear (4) and hub (3) assembly into wheel hub (40) and on spindle splines.

SEE WHEEL BEARING ADJUSTMENT PROCEDURE SECTION

AFTER WHEEL BEARING ADJUSTMENT HAS BEEN MADE.

STEP 35: Install a new planet carrier (10) to wheel hub (40) "O" ring (9) on carrier.

STEP 36: Install planet carrier (10) in wheel hub (40) aligning notches in planet carrier housing with notches in wheel hub.

STEP 37: **NOTE:** There are only three 12-point screws (22) that hold the planet carrier (10) on the wheel hub (40) until the wheel and rim are installed. Tighten screws 475 to 525 lbf.ft. [645-710 N.m.].

STEP 38: Install axle shaft and sun gear (12) into planet carrier (10) through spindle (45) and into coupling (48). Make sure axle shaft (12) splines are in full position in coupling (48).

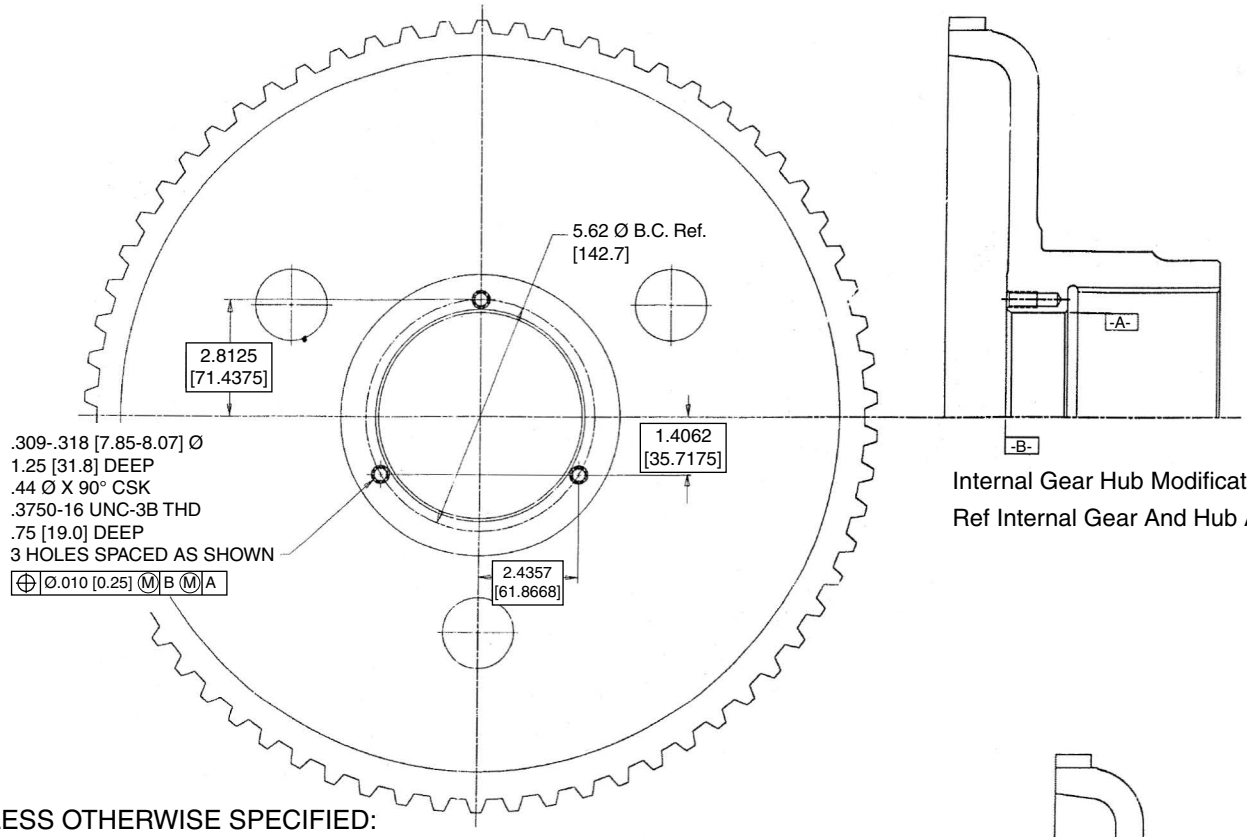
STEP 39: Position a new "O" ring (13) on planet cover (15). With the wheel hub drain & filler plug (19) in the top most position, install the planet cover (15) with the arrow pointing down.

STEP 40: Install planet cover capscrews (17) & washers (16). Tighten 125-140 lbf.ft. [170-190 N.m.] torque.

SEE AIR TESTING AXLE CENTER AND WHEEL ENDS.

SEE LIQUID COOLED BRAKE TESTING PROCEDURE.

SEE FACE SEAL BREAK IN PERIOD.

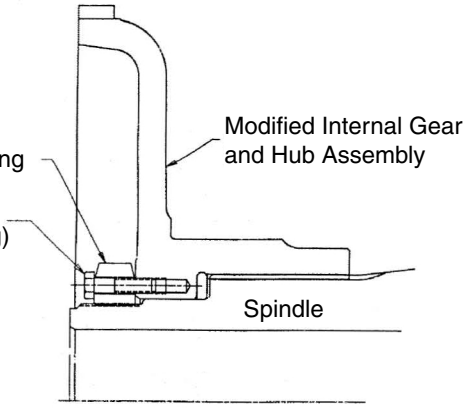


Internal Gear Hub Modification

Ref Internal Gear And Hub Assembly

UNLESS OTHERWISE SPECIFIED:
.xx[.x] = ±.03[.8]
.xxx[.xx] = ±.010[.25]
[.xxxx[.xxx]] = BASIC
ANGLES = ±1°

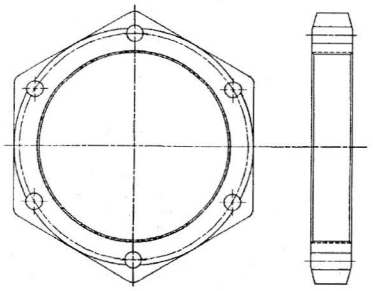
Must be free of burrs and sharp edges



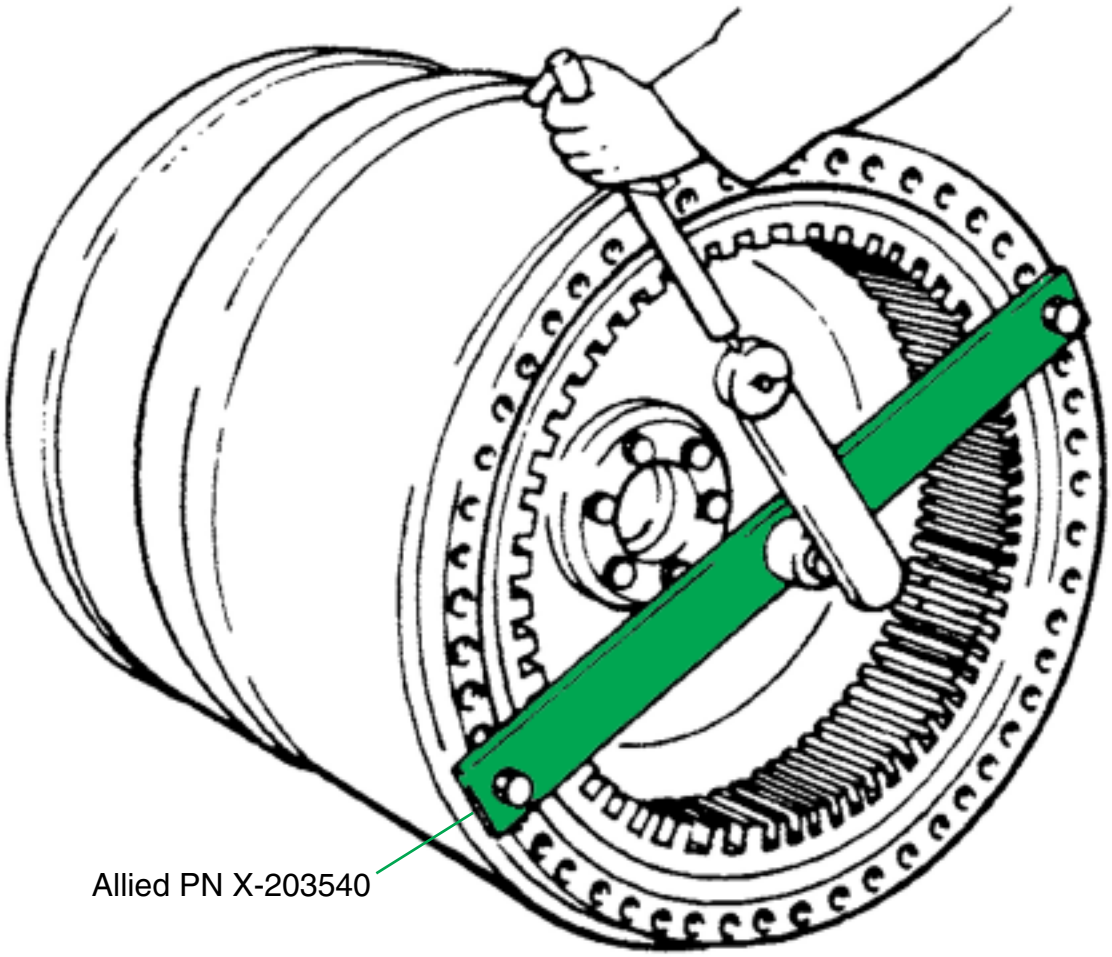
Wheel Bearing Adjustment

1. Before wheel bearing adjustment is made, it is imperative all tapered bearings cones and cups be pressed to fully seated position. Do not depend on the wheel bearing adjusting nut to “shoulder” tapered bearings cups and cones.
2. Coat washer face of nut and spindle threads with brush-applied MS-260 lubricant. (Anti-Seize or Never-Seez)
3. Install nut and tighten to 1000 LBF-FT [1356 NM] torque. Shock internal gear hub with heavy bar or mallet. Rotate wheel hub 2 to 3 times. Repeat shocking and rotating. Recheck nut torque - if nut moves, retorque to 1000 LBF-FT [1356 NM] and repeat shocking and rotating as above. Continue above procedure until 1000 LBF-FT [1356 NM] does not advance nut.
4. Loosen nut ¼ to ½ turn, shock to loosen and measure the no-load rolling torque (normally 25-100 LBF-FT [34-135 NM]).
5. Torque to 700 LBF-FT [949 NM], then advance nut until 3 holes in nut line up with tapped holes in internal gear hub.
6. Check rolling torque - must be in the range of:

   Used bearings - 5-15 LBF-FT [7-20 NM] above no-load rolling torque
   New bearings - 20-80 LBF-FT [27-108 NM] above no-load rolling torque
7. If over the maximum rolling torque, reduce nut torque as required to obtain the 5-15/20-80 LBF-FT [7-20/27-108 NM] but not less than 400 LBF-FT [542 NM] on nut. If this occurs, remove nut and internal gear hub. Rotate internal gear hub 3-4 spline teeth or reverse nut and reassemble. Repeat bearing preload procedure.
8. If under the minimum rolling torque, increase nut torque until preload is in the 5-15/20-80 LBF-FT [7-20/27-108 NM] rolling torque range with nut holes aligned. However, do not exceed 1400 LBF-FT [1898 NM].
9. Loctite the capscrew threads with Loctite no 262 and install at 35-40 LBF-FT [48-54 NM] tightening torque.



Nut-Bearing Adjusting



Use torque wrench and adaptor (Allied PN X-203540), properly centered, or other appropriate measuring device to determine “no-load” rolling torque.

INTERNAL GEAR AND HUB DISASSEMBLY

STEP 1: Remove internal gear hub (3) to gear capscrews (1) and retaining plate (2). Separate gear (4) and hub (3).

STEP 2: If bearing (43) is to be replaced, drive bearing cone from hub (3), or use a bearing puller.

INTERNAL GEAR AND HUB REASSEMBLY

(See Cleaning And Inspection Page)

STEP 3: Check that bearing seat on hub is free of nicks and burrs. Press bearing cone (43) on internal gear hub (3) using bearing driver.

STEP 4: Position internal gear hub (3) in internal ring gear (4).

STEP 5: Install hub (3) to ring gear (4) retaining plates (2) and capscrews (1). Tighten 125 to 140 lbf.ft. [170-190 N.m].

DISASSEMBLY OF PLANET CARRIER ASSEMBLY

STEP 1: Place planet carrier assembly in press and press out pinion shaft (12). Take care to catch pinion shaft lock ball (19) released as shaft is pressed out.

STEP 2: Carefully remove pinion shaft (21), Planet pinion (27), pinion thrust washers (24 & 29), pinion rollers (25 & 28),and pinion roller spacer (26). Rollers will drop from pinions. Take care to prevent losing them.

REASSEMBLY OF PLANET CARRIER ASSEMBLY

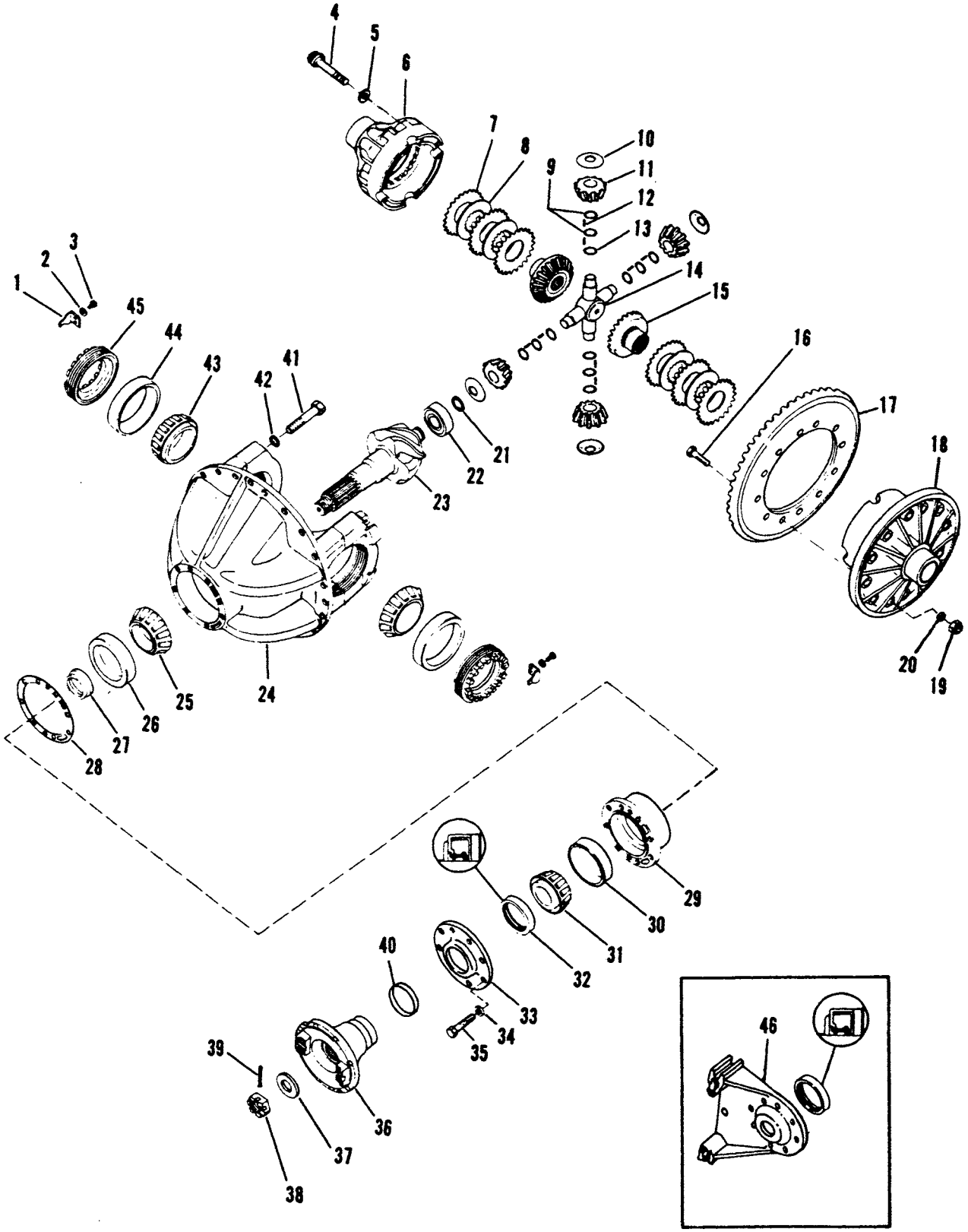
(See Cleaning and Inspection Page)

STEP 3: Coat inside of planet pinion (27) with chassis grease to retain pinion needle rollers (25 & 28). Each pinion contains a double row of needle rollers, with a spacer (26) between rows. Install a row of rollers (25), roller spacer (26), and another row of rollers (28) in each pinion. (see service parts list for needle roller quantity.)

STEP 4: Position assembly pinion and two pinion thrust washers (24 & 29) in planet carrier (10), making sure tangs on thrust washer (24 & 29) engage the grooves on the carrier.

STEP 5: Press in pinion shaft (21), making sure the pinion shaft ball recess aligns with groove in carrier. Insert pinion shaft ball (19) and complete press. Press end of pinion shaft flush with face of carrier.

STEP 6: Stake pinion shaft lock ball (19) groove in two places to retain shaft.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DIFFERENTIAL AND CARRIER REMOVAL

NOTE: DIFFERENTIAL CAN NOT BE REMOVED UNTIL BOTH WHEEL ENDS ARE DISASSEMBLED & INNER AXLE SHAFTS, AXLE SHAFT AND SUN GEAR ARE REMOVED.

STEP 1: Remove differential to axle housing stud nuts and washers. Remove taper dowels. Remove threaded hole plugs from differential housing flange. Install a longer capscrew in threaded holes and tighten evenly to facilitate differential removal.

STEP 2: Remove differential and carrier assembly straight off of studs. Remove "O" ring.

DIFFERENTIAL AND CARRIER DISASSEMBLY

STEP 3: Mount differential on differential overhaul stand. Check and record ring gear backlash with a dial indicator. This information is necessary for reassembly unless a new gear is installed.

STEP 4: Install companion flange retainer tool, remove cotter pin(39), and loosen nut (38) securing flange to pinion shaft. This will facilitate later flange removal.

STEP 5: Use center punch to match mark bearing caps to carrier (24) assembly. This is to insure correct match in reassembly.

STEP 6: Remove adjusting nut lock screw (3), washer (2), & lock (1).

STEP 7: Remove bolts (41) securing bearing caps to carrier assembly. Remove caps and adjusting nuts (45). Insert metal bar through differential to facilitate hoisting.

STEP 8: Raise ends individually and remove bearing cups (44).

STEP 9: While hoisting carefully, tilt differential assembly (items 4 through 20) to an angle. This will permit ring gear to clear pinion shaft inner bearing boss in carrier assembly. Remove differential assembly.

LIMITED SLIP DIFFERENTIAL DISASSEMBLY

NOTE: MATCH MARK CASE HALVES AND SPIDER TO INSURE CORRECT REASSEMBLY.

STEP 10: Remove differential half case bolts (4).

STEP 11: Remove differential plain half case (6). Limited slip discs (7 & 8) and side gear (15) may remain in half case. Remove discs and side gear.

STEP 12: If side gear and discs remained on differential pinions, remove from pinions.

STEP 13: Remove differential pinions (11), washers (10) and spider (14) as an assembly. **NOTE:** There are two rows of needle rollers (12) under each pinion gear (11). Do not lose these rollers.

STEP 14: Remove flange half case side gear and limited slip discs from case. Use a split puller if half case taper bearings (43) are to be replaced. Remove ring gear nuts (19) and bolts (16) if ring gear (17) is to be replaced.

DIFFERENTIAL REASSEMBLY

(See Cleaning And Inspection Page)

STEP 15: Position inner needle roller bearing spacer (13) on differential spider (14). See cross section reference after **STEP 20.**

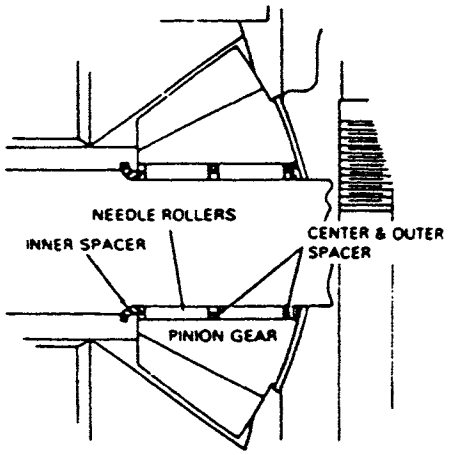
STEP 16: Using a rubber band to facilitate assembly, install one row of needle roller bearings (12).

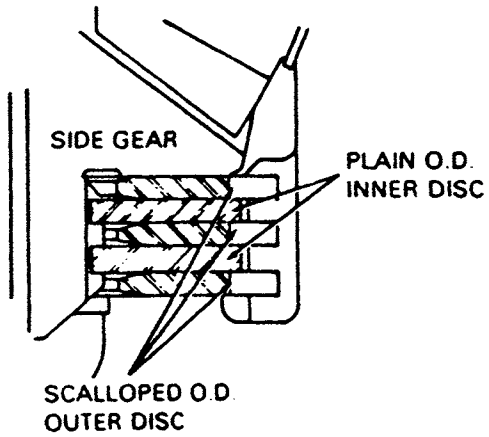
STEP 17: Install center roller bearing spacer (9).

STEP 18: Using another rubber band install outer row of needle roller bearings (12).

STEP 19: Position pinion gear (11) on needles (12). Remove first rubber band. Slide Pinion gear over second row of needles, remove second rubber band.

STEP 20: Install outer roller bearing spacer (9) and pinion thrust washer (10). A rubber band was used on each end of the spider after pinion installation to keep pinion gear in place until assembly into flange half case.





STEP 21: Install limited slip outer clutch disc (7). (Teeth on the outer diameter). See cross section reference after **STEP 20.**

STEP 22: Install one limited slip inner clutch disc (8). (Teeth on the inner diameter).

STEP 23: Alternate outer (7) and inner (8) clutch discs, starting with an outer disc and ending with an outer disc. Quantity of discs are 3 outer discs (7) and 2 inner discs (8) for each side gear.

STEP 24: Align side gear (15) splines with teeth in inner clutch discs (8).

STEP 25: Remove rubber bands holding pinion gears into position on differential spider. Place spider assembly (14) on side gear (15).

STEP 26: Position plain half (6) side gear on pinions.

STEP 27: Install one outer disc (7) and one inner disc (8) on side gear, alternate discs until a quantity of 3 outer discs and 2 inner discs are installed. Start with an outer disc and end with an outer disc. Align outer clutch disc teeth to facilitate assembly into plain half case.

STEP 28: Align match mark on plain half case with mark on flanged half case. Install plain half case over limited slip clutch plates and side gear. Apply Locktite #262 thread locking compound to threads of case bolts. Tighten bolts to specified torque. If differential cone bearings (43) were removed, press one bearing on the plain half case and one on the flange half case.

STEP 29: Remove nut (38), washer (37), and companion flange (36). Use puller if necessary to remove flange.

STEP 30: Remove bolts (35) securing seal retainer (33 or 46) to carrier, remove retainer. If necessary, tap with soft mallet to break seal between parts.

STEP 31: Using pry slots provided, remove bearing cone (31), bearing cage (29), bearing spacer (27), and bearing cage shims (28). Retain bearing cage shim pack intact for reuse in reassembly.

STEP 32: Press pinion & bearing assembly (22, 23 & 25) from carrier (24).

STEP 33: Press center bearing cone (25) from pinion assembly (22 & 23).

STEP 34: Remove inner bearing snap ring (21). Press inner bearing (22), from pinion (23).

REASSEMBLY OF RING GEAR AND DIFFERENTIAL CASE

(See Cleaning And Inspection Page)

NOTE: Lubricate All differential bearings, gears, and thrust washers with Clark approved lubricant.

STEP 35: Check ring gear mounting surface of flanged half (18) of differential case for burrs. Remove burrs with file.

STEP 36: Position ring gear (17) on flanged half case (18). Install bolts (16) & washers (20). Install bolt nuts (19), tighten to specified torque.

REASSEMBLY OF PINION SHAFT

STEP 37: Press inner bearing (22) on pinion shaft (23). Install bearing retainer ring (21).

STEP 38: Press center bearing (25) onto pinion shaft (23).

STEP 39: With center bearing cup (26) and outer bearing cup (30) in bearing cage (29), position cage & cup assembly on pinion (23) & bearing assembly.

STEP 40: A pinion bearing spacer and shim kit is provided for service repair of differential and carrier assemblies. This kit, consisting of a spacer and quantity of shims, is used to obtain proper pinion bearing preload as described below. Position bearing spacer (27) (with chamfer toward threaded end of shaft) and .010 [0,25 mm] shim on pinion shaft (23) and install outer pinion bearing cone (31).

STEP 41: Press outer pinion bearing cone (31) on pinion shaft (23) & into bearing cup (30) in bearing cage (29).

STEP 42: Install bearing cage (29) and pinion shaft assembly in differential carrier housing (24) without bearing cage shims (28). Use five identical oil seal retainer bolts with flat washers to pull pinion shaft assembly fully into carrier assembly. Make sure oil passages are aligned. Tighten five bolts 300 to 330 lbf.ft. [410 - 450 N.M.].

STEP 43: Temporarily install companion flange on end of pinion shaft without installing pinion oil seal retainer. Install flange washer and nut. Install companion flange retaining tool on companion flange and torque companion flange nut to 1000 LBF. FT. [1356 N.M.].

STEP 44: Use "inch-pound" torque wrench to check bearing preload. If bearing preload is not between 13 and 23 lbf.-In [1,5-2,6 N-m], disassemble parts and add shims to decrease preload or remove shims to increase preload.

NOTE: Flange will be removed after ring gear to pinion tooth contact and backlash has been set.

RING GEAR TO PINION MOUNTING DISTANCE PROCEDURE

A pinion setting gauge must be used to achieve a precise mounting distance between the ring gear, differential carrier housing, and pinion. The gauge should be used if either carrier housing and/or ring and pinion is changed. The use of the gauge will determine the amount of shims to be used under the pinion bearing cage to achieve an exact mounting distance between the ring and pinion.

By using the gauge and adding the proper thickness of shims, an optimum tooth contact will be obtained.

Setting the ring and pinion mounting distance without the gauge will require a trial and error procedure. A shim must be installed under the pinion bearing cage and then the unit must be completely assembled per service manual instructions.

The procedure must be repeated until proper tooth contact is obtained.

The following procedure is used to achieve a proper ring gear to pinion mounting distance using a pinion setting gauge.

Locating position of the pinion as described will produce a proper tooth contact with the ring gear when it and the differential assembly are assembled and adjusted to proper backlash setting.

Pinion setting gauge can be purchased from Service Tools, 2013 4th Street, N.W., Owatonna, MN, 55060. Kit No. VME10004-2.

The function of the gauge is to measure the distance from the centerline of the differential bearing bores to the ground surface

on the gear end of the pinion gear. This measurement, when subtracted from the value etched on the ring gear will indicate the size of the shim pack required to position the pinion gear in proper relation to the ring gear.

On the outer diameter of the ring gear, a ring gear to pinion mounting distance value will be etched. Add .469 to it. (.469 is half the thickness of the gauge bar.) Record this value. This value may be different on each ring and pinion set due to manufacturing variations.

Insert a 4" base 5/32 diameter, 6" to 7" extension depth micrometer into the guide bore of the micrometer arbor. Slide clamps over base of micrometer. With the thumb screws reacting on base, secure micrometer.

IMPORTANT: The micrometer extension must pass freely through the micrometer bar guide bore and the base of the micrometer must rest on the micrometer arbor when mounted.

STEP 45: Use a file and emery cloth to remove all burrs and nicks from machined bearing surfaces of differential carrier housing.

STEP 46: Paint bearing surfaces of carrier housing with a gear tooth marking compound.

STEP 47: Mount adapter discs on micrometer arbor and set in position in carrier housing. Exercise care to be sure that micrometer and extension do not contact any part of the carrier in this operation. Apply pressure by hand and rotate adapter discs slightly to obtain a contact with bearing surfaces.

STEP 48: Remove checking gauge assembly and check for full bearing contact on bearing surfaces.

STEP 49: If contact is full and proper, again position checking gauge assembly in carrier and check distance to ground surface on pinion. **DO NOT** APPLY **PRESSURE** TO ARBOR OR MICROMETER. Turn micrometer carefully and evenly until tip of extension contacts the ground surface of the pinion. As an example the distance measures 6.470 inches, the reading on the micrometer being .470 inch. Subtract this reading from the value etched on the ring gear plus half the thickness of the gauge bar .469, and this equals the amount of shims (28) to be added between the pinion bearing cage (29) and the carrier housing (24).

Example:	6.470	Value etched on ring gear
	+ .469	One half thickness of gauge bar
	6.939	Total
	6.909	Initial micrometer reading
	.030	Add this value in shims

Remove bolts holding pinion bearing cage and pinion in differential carrier and remove bearing cage and pinion assembly. Install required shim pack (28) and reinstall cage and pinion assembly in carrier. Tighten cage screws 300 to 330 lbf.ft. [410-450 N.m] torque temporarily. After adding required amount of shims, again mount checking gauge assembly and take a check reading. The reading should now be 6.939 inches plus or minus .002 inch. In other words, the reading should be equal to the value etched on the ring gear plus .469 half the thickness of gauge bar, within .002 inch.

REASSEMBLY OF DIFFERENTIAL AND CARRIER

STEP 50: Insert bar through differential to facilitate hoisting. Position differential into carrier, tilting it so that ring gear will clear inner bearing boss in carrier.

STEP 51: Position differential bearing cup (44) and adjusting nut (45) on lifting bar on one side of differential and lift bar slightly with hoist. Position bearing cup and adjusting nut on carrier. Repeat procedure and install opposite bearing cup and adjusting nut. Turn adjusting nuts by hand to be sure of proper thread alignment.

STEP 52: Position bearing caps on bearing (43 & 44) and adjusting nuts (45), making sure match marks made during disassembly are properly aligned. Install cap bolts (41) and washers (42), tighten lightly. Do not torque at this time.

STEP 53: Tighten bearing adjusting nuts (45) to adjust bearing to zero end play.

STEP 54: Using a dial indicator, move ring gear by loosening one adjusting nut (45) and tightening opposite adjusting nut. Adjust position until gear backlash is to backlash specifications (etched on ring gear for new gear set) or adjust to backlash noted at disassembly for used gears. When proper backlash is achieved, tighten opposite adjusting nut to set preload on taper bearings, using only thumb and forefinger to move ring gear. When ring gear becomes difficult to move, preload on bearing is set.

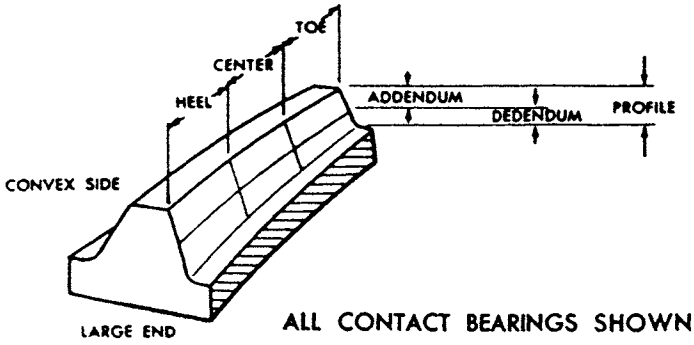
STEP 55: Tighten differential cap bolts 1475 to 1625 lbf.ft. [2000 - 2200 N.m] torque. With dial indicator, recheck ring gear and pinion backlash. Recheck differential bearings for preload as described in STEP 54. Remove companion flange nut (38), washer (32), and flange (36). Remove bolts and flat washers securing pinion cage to differential carrier. Remove pinion cage & cup assembly (26, 29 & 30), outer pinion bearing (31) will also come off. Coat shim surface of carrier housing and shim surface of bearing cage with Locktite Sealer #515. Reinstall shims and pinion and cage assembly on carrier housing. Coat outer diameter of oil seals (32) with Loctite Sealer #515 and press in retainer (33 or 46) with lip of seal in.

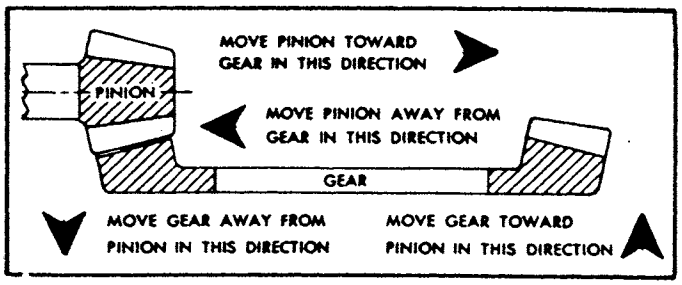
STEP 56: Coat retainer to cage surface with same sealer. Coat lip of sealer with Lubriplate. Install oil seal retainer bolts and tighten 300 to 330 lbf.ft. [410 -450 N.m] torque. Coat flange splines with Dow Corning RTV-Q3-7069 sealant. Position companion flange on pinion shaft. Install washer and nut. Tighten nut to 100 lbf.ft. [1356 N.m] torque.

STEP 57: Use dial indicator to check back face of ring gear. Rotate at least one full turn. Runout must not exceed .005 [0, 12 mm] total indicator reading. If runout is excessive remove assembly and check for burrs or dirt under mounting surface of ring gear. Reassemble and recheck.

STEP 58: Install adjusting nut lock (1) with bolt (3) and lockwasher (2). Tighten 40 to 45 lbf. ft. [54-61 N.m] torque.

SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART





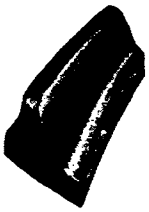
ALL CONTACT BEARINGS SHOWN BELOW ARE ON **LEFT HAND** SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.

FIG. 1

TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD

FIG. 2

TOE BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.



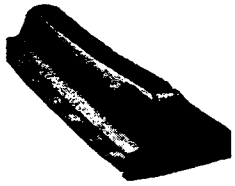


FIG. 3

HEEL BEARING ON BOTH SIDES OF TOOTH — GEARSET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.

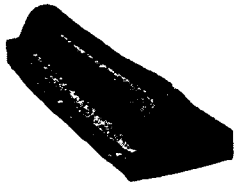


FIG. 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR (INCREASE MOUNTING DISTANCE.

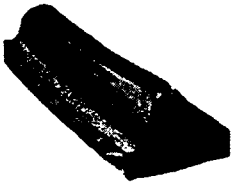


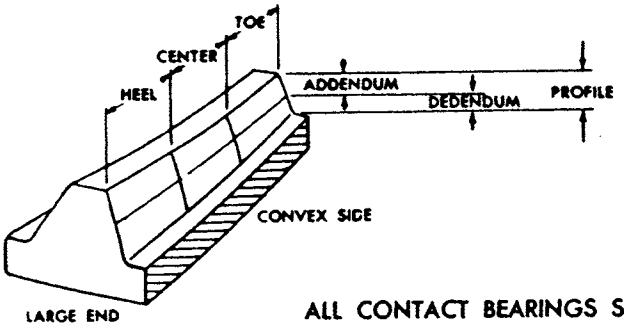
FIG. 5

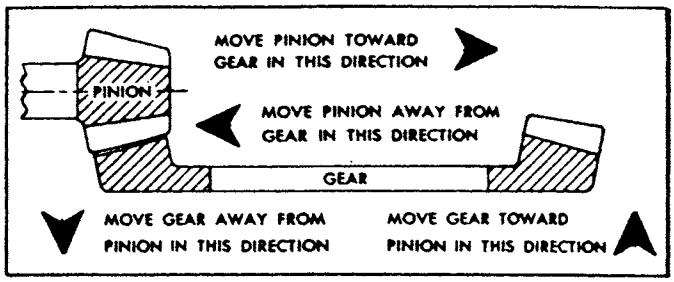
HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR (DECREASE MOUNTING DISTANCE.

BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.

SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART





ALL CONTACT BEARINGS SHOWN BELOW ARE ON **RIGHT HAND** SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.

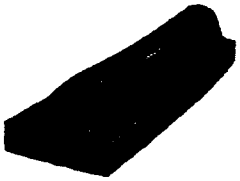


FIG. 1

TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD

FIG. 2

TOE BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.

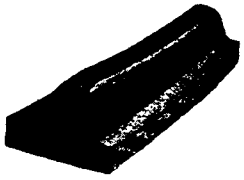


FIG. 3

HEEL BEARING ON BOTH SIDES OF TOOTH — GEARSET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.

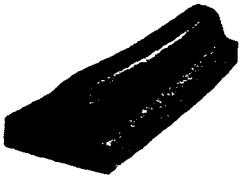


FIG. 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR (INCREASE MOUNTING DISTANCE.

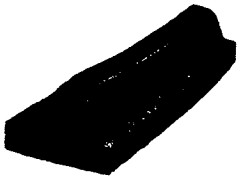
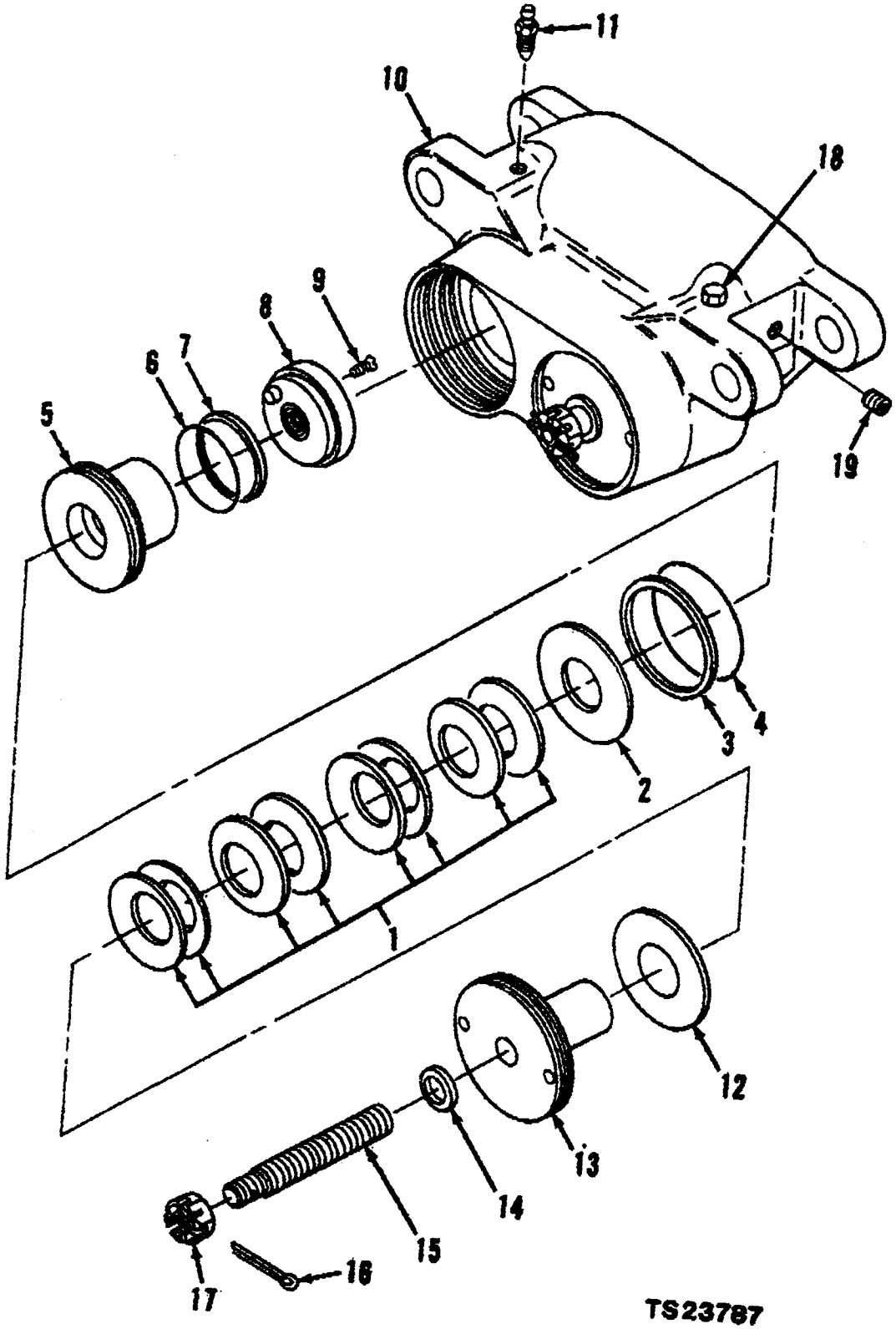


FIG. 5

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR (DECREASE MOUNTING DISTANCE.

BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.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Put the machine in the SERVICE POSITION.

Checking and Adjustment of the Parking Brake

Note: DO NOT adjust the parking brake with the parking brake head installed on the axle or with the steel plate between the linings because the cap threads can be damaged.

WARNING: The brake system has fluid stored under high pressure. Before servicing brake system, park machine on a level surface. Lower all implements to the ground. Shut engine off. Block wheels and pump brake pedal until system is completely discharged.

WARNING: Relieve the hydraulic pressure from the parking brake by pulling the parking brake ON knob out.

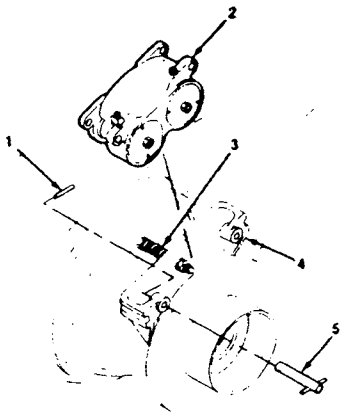
1. Disconnect the brake hose at the parking brake head.Install a cap on the hose.

2. Connect a portable hydraulic hand pump and a gauge with a minimum capacity of 2000 psi (13 800 kPa) (140 kgf/cm²) to the parking brake inlet port.

3. Slowly build up pressure until the parking brake begins to release. This can be observed visually (approximately 1300 psi (8963,2 kPa) (91,4 kgf/cm²).

4. Record the pressure necessary to begin releasing the park brake. The correct pressure should be a MINIMUM of 1300 psi (8963,2 kPa) (91,4 kgf/cm²). If the pressure is above 1300 psi proceed to steps 20 thru 25. If the pressure is less than 1300 psi proceed to steps 5 thru 30.

Put the machine in the SERVICE POSITION.



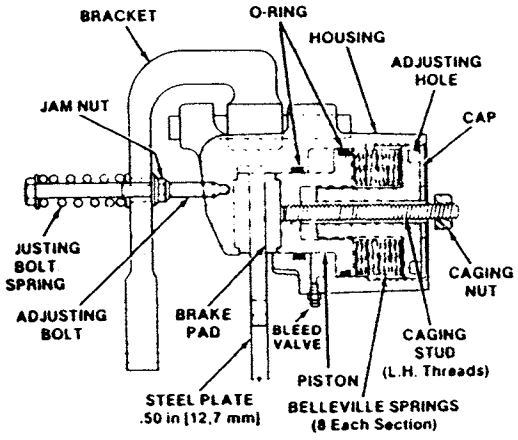
TS17337

5. Loosen the jam nut on the bolt (3) and remove the bolt from the parking brake head (2).

6. Install a strap or sling and hoist on the parking brake head. Raise the sling to take the weight of the brake head off the support pins (5).

7. Remove the roll pins (1) from the support pins (5). Remove the support pins. Remove the brake head (2) from the machine.

8. Release the portable hydraulic pump pressure. This will release the spring tension on the cap.



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9. Turn the cap counterclockwise with a spanner wrench using the adjusting holes until the outside of the cap is even with the brake housing. Apply only enough pressure from the portable hydraulic hand pump to move the piston back.
10. Follow this procedure until a .50 in. (12,7 mm) thick plate can be inserted between the brake linings.

11. Release the pressure from the portable hydraulic hand pump and remove the portable hydraulic hand pump.
12. Turn the cap clockwise until the brake linings make contact with the .50 in. (12,7 mm) thick plate.

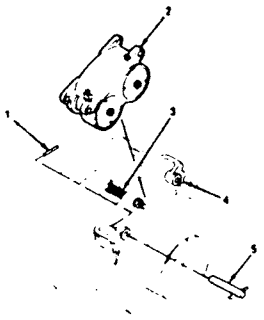
13. Remove the plate.
14. Turn the cap clockwise 6 1/2 revolutions.

Note: If necessary, turn the cap in clockwise more than 6 1/2 revolutions to obtain the correct release pressure.

15. Connect a portable hydraulic hand pump to the fitting on the parking brake head.

16. Slowly build up pressure until the parking brake begins to release. This can be observed visually (approximately 1300 psi (8963,2 kPa) (91,4 kgf/cm^2). Build up enough pressure to fully release the parking brake.

Put the machine in the SERVICE POSITION.



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17. Install the brake head (2) on the bracket.

18. Install the support pins (5) in the parking brake head (2) and bracket (4).

19. Install the roll pins (1) in the support pins (5).

20. Release the pressure from the parking brake head into the hand pump.

21. Disconnect the portable hydraulic hand pump.

22. Remove the cap from the hose and connect it to the fitting on the parking brake head.

23. Run the machine for one minute to get normal operating pressure in the brake system. Stop the engine.

24. Put the parking knob in the release position.

25. Open the bleed valve on the parking brake head slowly until fluid with no air bubbles flows from it. Close the bleed valve.

26. Align the centering bolt with the threaded hole in the parking brake head. Turn the centering bolt clockwise against the tension of the centering bolt spring.

27. Apply part number 2108203 thread locking compound to brake head threads only. Turn the adjusting bolt into the brake head approximately .40 in (10,2 mm).

28. Turn the jam nut clockwise or counterclockwise until either brake lining does not contact the parking brake disc.

Note: Spring height must be 2.75 ± .03 (69,8 ± 0,76 mm) with properly adjusted brake with new linings.

29. Make sure that the parking brake operates correctly.

30. Run the machine and check the system for leaks.

PARKING BRAKE HEAD DISASSEMBLY AND ASSEMBLY

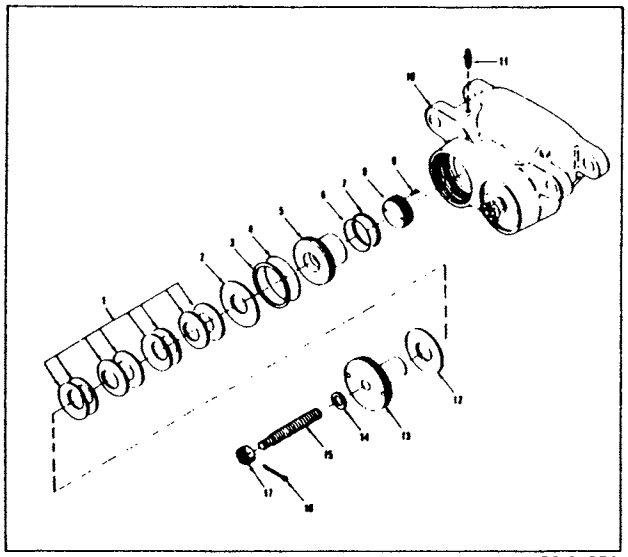

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Fig. 1—Parking Brake Head

1—Belleville Washer
2—Washer
3—Back-up Ring
4—O-ring
5—Piston
6—O-ring
7—Back-up Ring
8—Brake Pad
9—Screw
10—Housing
11—Bleeder
12—Washer
13—Cap
14—Washer
15—Stud
16—Cotter Pin
17—Nut

Disassembly of the Parking Brake Head

1. Remove the screws from the brake pad if used. Remove the brake pad from the piston and the housing by prying them off. Examine the brake pad (8) on the piston and on the housing for even wear. Replace the pads if they are .431 in (10,9 mm) thick or less. Brake pads must be replaced as a set.

2. Use the adjusting holes in the cap (13) to turn the cap counterclockwise. Turn the cap until it is free of the housing (10). Remove the spring and piston assembly (1-9,12-17).

3. Remove the cotter pin (16) from the caging nut (17) and stud (15). Remove the caging nut and washer (14).

4. Remove the cap (13) and washer (12). **Note the arrangement of the Belleville springs** (1). Remove the springs and washer (2). Inspect the Belleville springs for wear and distortion.

5. Remove the back-up ring (3) and o-ring (4) from the piston. Clean the pad end of the piston. Remove old brake pad adhesive if used.

6. Place the piston, caging stud (15) up, in a vise with soft jaws. Install the caging nut (17) and an additional jam nut on the stud. Tighten the jam nut against the caging nut. Use the caging nut to turn the stud out of the piston. Save the cotter pin for the assembly of the brake head. Remove the jam nut and the caging nut.

7. Remove the piston from the vise.

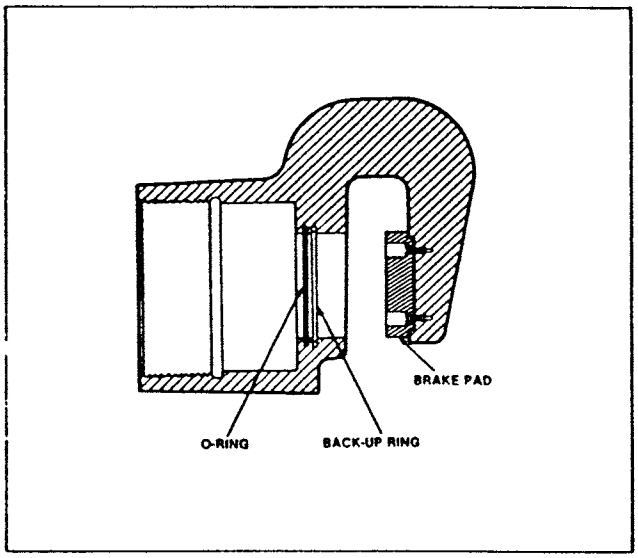

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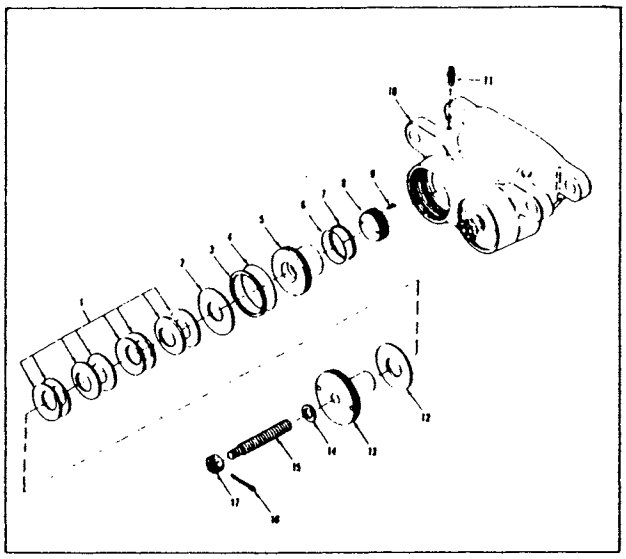
Fig. 2—Brake Head Housing

8. Remove the o-ring and back-up ring from the brake head housing.

9. Clean the brake head housing and pistons in solvent. Dry the parts.

Cleaning solvents can cause skin rashes or fire hazards. Do not inhale solvent vapors.

10. Repeat steps 1-7 for the other spring and piston assembly.



TS-21976

Fig. 3—Parking Brake Head

1—Belleville Washer
2—Washer
3—Back-up Ring
4—O-ring
5—Piston
6—O-ring
7—Back-up Ring
8—Brake Pad
9—Screw
10—Housing
11—Bleeder
12—Washer
13—Cap
14—Washer
15—Stud
16—Cotter Pin
17—Nut

Assembly of the Parking Brake Head

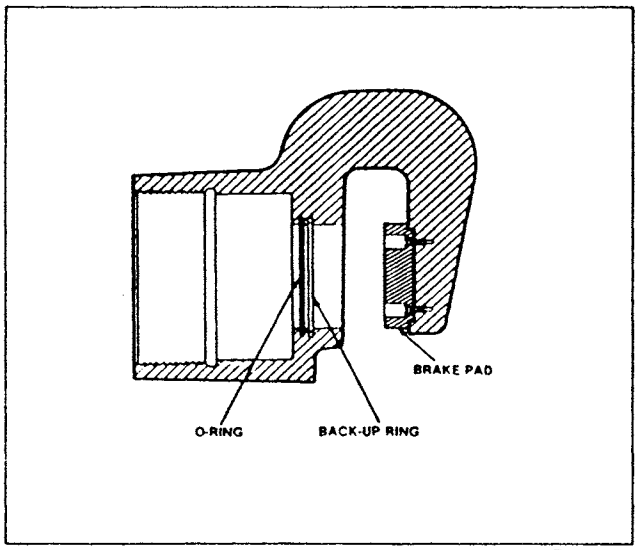
1. Place the piston (5), caging stud end up, in a vise with soft jaws. Install the caging nut (17) and an additional jam nut on the caging nut. Tighten the jam nut against the caging nut. Install the stud on the piston. Use the nut to tighten the stud. Remove the jam nut. Remove the caging nut. Remove the piston from the vise.

2. Install new o-rings (4,6) and back-up rings (3,7) on the piston (5).

3. Install the Belleville springs (1), in groups of two, as shown. Alternate the direction of the springs, starting with the outside edge of the first group against the washer (2). When properly assembled, the outside edge of the last group of two springs will be against the cap washer (12).

4. Install the washer (12) on the caging stud (15). Install the cap (13) on the caging stud. Check that the spring guide on the cap is seated in the counterbore on the piston (5).

5. Install the washer (14) on the caging stud (15). Install the caging nut (17) on the stud. Align the slots in the nut with the bore in the stud. Install the cotter pin (16) in the nut and stud.



TS-17361

Fig. 4—Brake Head Housing

6. Install a new back-up ring and o-ring in the brake head housing.

7. Apply a light coat of clean hydraulic fluid to the o-rings and back-up rings. Install the spring and piston assembly (1-9,12-17) in the brake head housing (10). Use the adjusting holes in the cap to turn the cap. Turn the cap clockwise until it is even with the housing.

8. Install the brake pad on the piston. Install the brake pad in the parking brake housing.

9. Repeat steps 1-8 for the other spring and piston assembly.

See CHECKING AND ADJUSTMENT OF THE PARKING BRAKE, in the MAINTENANCE section and in SM24 of Group 400 of this manual, before installing the parking brake head.

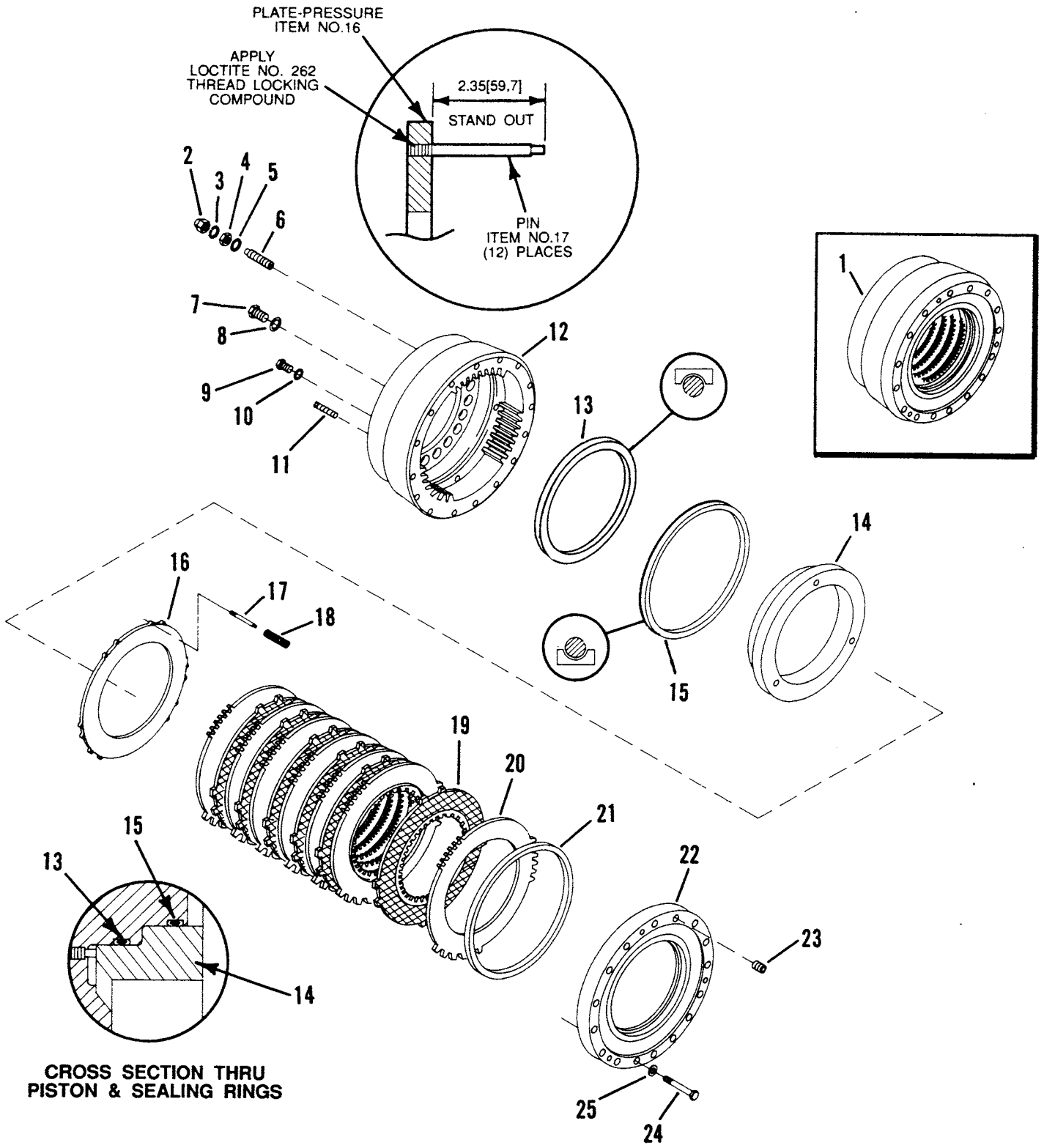


PLATE-PRESSURE
ITEM NO.16
APPLY
LOCTITE NO. 262
THREAD LOCKING
COMPOUND
2.35[59,7]
STAND OUT
PIN
ITEM NO.17
(12) PLACES
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
CROSS SECTION THRU
PISTON & SEALING RINGS

SERIES III LIQUID COOLED BRAKE (6 PLATE)

DRAIN BRAKE ASSEMBLY

SERVICE INSTRUCTION

The following instructions will cover the disassembly and reassembly of the liquid cooled brake in a sequence that would normally be followed after the unit is removed from the axle assembly and is to be completely overhauled.

Caution: Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

LIQUID COOLED MULTI-DISC BRAKE

DISASSEMBLY

1. Remove brake assembly from axle. Note: Face seal in one axle end must not be mixed with face seal on the opposite axle end.

2. Remove brake cover to brake housing bolts (24) and washers (25). Remove puller screw hole plugs (23) and install bolts in threaded holes. Use a strap and hoist.

3. Remove brake cover (22) & cover to housing square cut seal ring (21).

4. Remove retractor springs (18).

5. Remove reaction discs (20) and disc and lining assemblies (19).

6. Remove piston pressure plate and spring guide pin assembly (16 and 17).

7. Note: Three .250-20 UNC studs or bolts with a washer welded or brazed on the end to make a lifting eye will facilitate brake piston removal. Install lifting eyes in three threaded holes in brake piston (14) and using a strap and hoist remove piston (14). Note: Make sure piston actuating inlet ports are not plugged for ease of piston removal.

8. Remove piston seal assembly (inboard) (13) and (outboard) (15).

9 Turn brake housing (12) over and remove slack adjuster acorn nut (2), "O" ring (3), jam nut (4), "O" ring (5) and slack adjuster screw (6). Remove all three slack adjuster assemblies.

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

HOUSING, COVERS ETC.

Inspect housings, covers and bearing caps to be certain they are thoroughly cleaned and that mating surfaces are free from nicks or burrs. Check all parts carefully for evidence of cracks or condition which would cause subsequent oil leaks or failures.

PISTON AND HOUSING SEALS

Replacement of seals is more economical when unit is disassembled than premature overhaul to replace these parts at a future time. Further loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting or scratching, seriously impairs its efficiency.

REASSEMBLY

10. Apply a light film of mineral oil to inboard and outboard piston seals. Position the inboard piston seal assembly (13) in brake housing. (12).

11. Position the outboard piston seal assembly (15) in housing (12).

12. Using fabricated lifting eyes, strap and hoist carefully and evenly position piston (14) into housing (12). Use extreme care as not to damage the inboard (13) and outboard (15) piston sealing rings. Use even pressure on the outer diameter of the piston to overcome the piston inboard and outboard piston sealing ring (13 & 15). NOTE: Make sure piston inlet port is open or piston will not go in.

13. Position piston pressure plate and pin assembly (16) in housing (12) against piston (14).

14. Position one reaction disc (20) against the pressure plate (16).

15. Position one disc and lining assembly (19) against the 1st reaction disc. Alternate reaction plates (20) and disc and linings (19) until you have seven reaction plates and six disc and lining assemblies in brake housing (12). You start with a reaction plate (20) and end with a reaction plate (20).

16. Install all retractor springs (18), twelve in all on spring guide pins (17).

17. Position a new square cut seal ring (21) in cover (22).

18. Carefully position brake cover (22) on brake assembly.

19. Apply loctite number 262 thread locking compound to the female threaded component of the brake housing (12).

20. Install the brake cover (22) to housing (12) washers (25) and capscrews (24). Tighten capscrews in a criss cross pattern evenly 300 to 330 LBF.FT torque (410-450 N.M.)

After assembly is completed, pressure test as follows.

INSTRUCTION FOR LIQUID COOLED BRAKE ASSEMBLY PRESSURE CHECK

1) After completing assembly and with bleeder plugged, apply 12 psi [83 kPa] air pressure to the brake fluid actuation port. Shut off air at inlet to hold pressure on brake.
2) Let pressure stabilize for 30 seconds. This is to compensate for temperature change. Piston movement and seating of seal lips.
3) Repressure to 12 PSI [83 kPa] if required and hold for 15 seconds with no pressure drop.
4) Repeat repressuring until 12 PSI [83 kPa] holds for 15 seconds minimum, but not over 3 repressuring.
5) If after 3 repressuring, brake will still not hold pressure, tear down and determine the cause of leak, rebuild and retest.
6) Apply 1000 PSI [6895 kPa] hydraulic pressure using mineral oil to the fluid actuation port and shut off pressure at inlet to hold pressure on brake. Maintain pressure without drop for 30 seconds minimum. Repeat twice. If brake will not maintain pressure, tear down and determine cause of leak. Rebuild and retest.

Install Face Seals as Follows.

INSTRUCTION FOR INSTALLING FACE SEAL

1) Clean wheel and brake housing bores with solvent prior to installation of the seal.
2) All parts of seal should be free of grease, oil, dirt and scale.
3) Sealing rings must be handled with care. Lapped sealing faces must not be damaged, scratched or contaminated with dirt or grease.

4a) Seals with "Belleville" Type Rubber:
Install each seal half (consisting of 1 (one) rubber ring and 1 (one) metal ring) as a unit into housing. Check that the seal is not cocked and that rubber ring is seated evenly at the bottom of the bore.

29 August 1994

The following procedure is suggested to measure and evaluate brake wear:

This procedure is to be used when measured and compared to the dimension recorded on each new brake assembly:

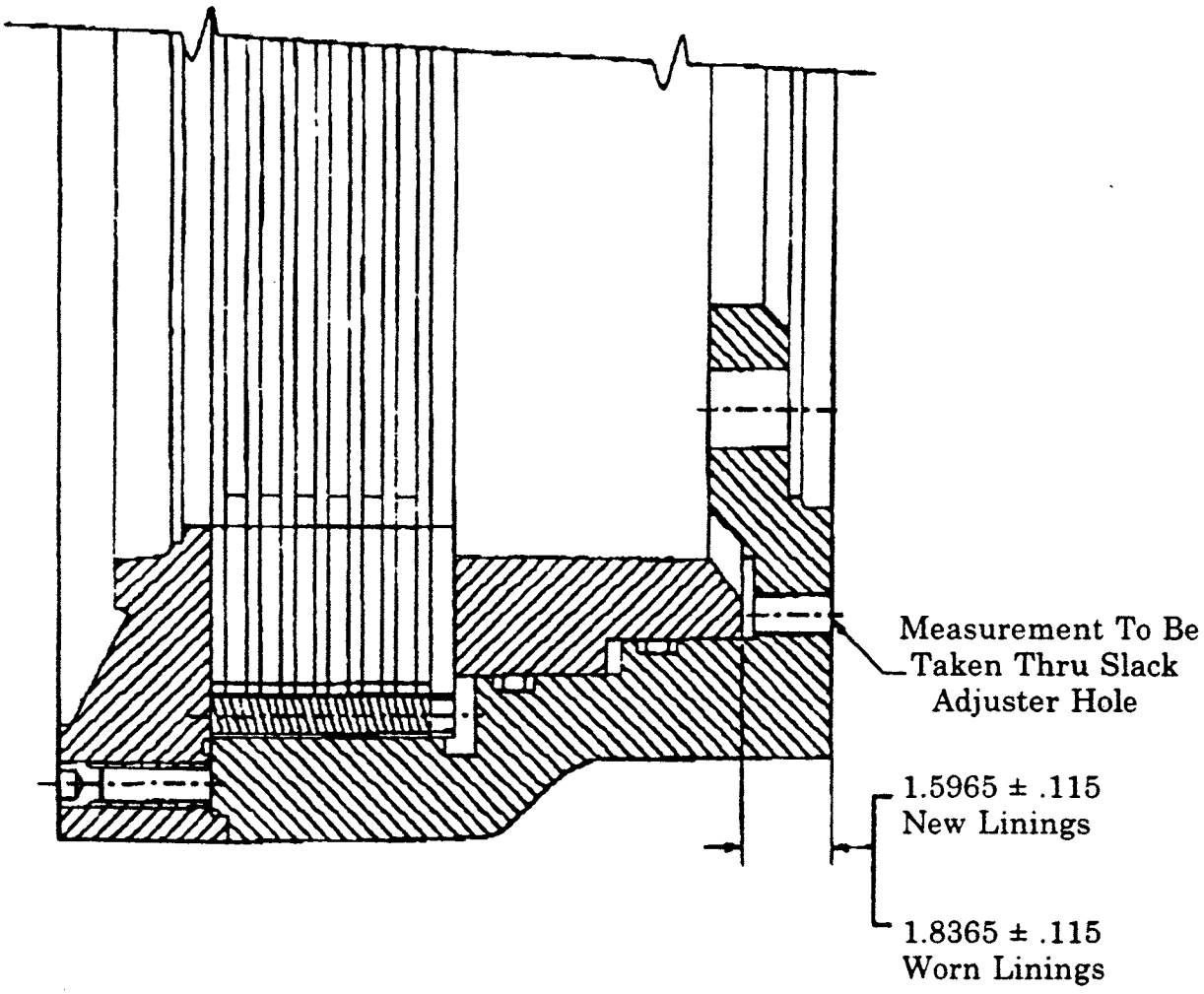
Step 1: Remove slack adjuster mechanism exposing the brake piston.

Step 2: Apply brake and maintain 80 to 120 PSI hydraulic pressure measured at the actuating port.

Step 3: While maintaining pressure in Step 2 above, measure depth from slack adjuster port face surface to the inboard surface of the brake piston.

Step 4: Record depth measurement when new, as well as the specific slack adjuster hole location used to obtain dimension. All future measurements will be compared to this value.

Step 5: The brake plates are considered worn when the friction material face reaches the bottom of the cooling oil grooves. The mean value based on equalized brake wear is 0.240 inches.


Measurement To Be
Taken Thru Slack
Adjuster Hole
1.5965 ± .115
New Linings
1.8365 ± .115
Worn Linings

4b) Seals with "Toric" Type Rubber:
When installing the rubber toric on the seal ring, make sure that it is uniformly seated on the retaining lip and is not twisted. Place the seal in the installation tool and locate this assembly squarely against the housing. Use sudden and even pressure against the tool to push the toric under the retaining lip of the housing cavity. Insure that the toric uniformly captured under the housing cavity retaining lip and is not twisted or pinched. The seal ring face should be parallel to the housing within .040 inches (1.0 mm).

5) After installing the seal halves into the wheel hub and brake housing, wipe both metal sealing faces clean with lint free cloth. Then apply a coat of clean extreme pressure oil to the metal seal faces with a lint free applicator. Oil must not wet surfaces other than sealing faces.

Install Liquid Cooled Brake on Axle End. Reassemble Axle End and Adjust Wheel Bearings as Follows:

25D DRIVE AXLE WHEEL BEARING ADJUSTMENT PROCEDURE FOR AXLES USING BOLTED ON RETAINING PLATE AND SHIM PACKS WITH LIQUID BRAKES.

1) Measure retaining plate thickness with micrometer and record.
2) Install retaining plate, washers and cap screws, but without shims.
3) Tighten all cap screws while striking rim and surrounding parts to seat bearings.
4) Loosen cap screws one half turn maximum, then roll hub and drum over five (5) times or more until hub spins freely.
5) Use torque wrench adapter, properly centered, or other appropriate measuring device, to determine "No Load Rolling Torque".
6) Tighten all cap screws evenly till rolling torque is 30-50 LBF. FT more than "No Load Torque".
7) Measure distance of face of retaining plate to end of spindle with internal micrometer at 3 locations 120 degrees apart, record same, add up and divide by 3 to obtain average value.
8) Subtract retaining plate thickness (Step 1) from average value (step 7) and add .005 to obtain value of shim pack thickness.
9) Choose and check shim pack with micrometer and record.
10) Remove retaining plate, roll wheel hub over five (5) times or more, then apply anaerobic locking compound loctite 262 to tapped holes only, add shim pack, mount retaining plate, and tighten cap screws 300 to 330 LBF.FT.
11) Recheck rolling torque after turning wheel hub five (5) or more revolutions. Torque must be with +/- 25 LBF. FT of value measured in step No. 6.
12) If final rolling torque is too high, repeat steps 10 and 11 after adding .001 or more to shim pack.

13) If final rolling torque is too low, repeat steps 10 and 11 after removing .001 or more from shim pack.

FACE SEAL BREAK-IN PERIOD

When machine is immediately driven from production floor or after face seal has been rebuilt or replaced, it is imperative that a 15 minute break-in period be conducted at not more than 25 RPM wheel speed, which is 5 MPH MAX. and in 1st gear operation only. This is to allow the seal rubbers and metal rings to properly seat.

RECOMMENDED LIQUID COOLED BRAKE COOLING OILS

It is recommended that axles with external cooled liquid cooled brakes (LCB) use "Tractor Hydraulic Fluids" meeting Allison C4 designation for cooling oil. This fluid has E.P. additive for improved face seal life and friction modifiers for high torque and quiet brake operation.

LIQUID COOLED BRAKE - LUBRICATION

The self contained liquid cooled brake system uses the same lube as the axle center section and wheel ends. There are no seals between the spindles and wheel hubs. Oil that lubricates the differential and planetary wheel ends also lubricates and cools the brake assembly. The oil level is the same height as the planet and axle center and the brake may be filled and oil level checked at the planet carrier assembly or planet carrier cover. Brake oil changes would be accomplished at the same time the axle lube is changed. Contaminates resulting from braking will not affect axle within normal oil change periods.

NOTE: FOR FORCED COOLING, CONTACT CLARK-HURTH AXLE ENGINEERING.

LIQUID COOLED BRAKE TESTING PROCEDURE

1. Connect a porto-power unit to brake line inlet.

2. Pump porto-power up to about 500 P.S.I. [3447,4 kPa] and bleed brake. After all air is out of brake, pump porto-power up to 1000 P.S.I, [6894,8 kPa] and lock off. The gauge will show about 100 P.S.I. [689,5 kPa] drop. At this point the gauge should hold. After three (3) to five (5) minutes unlock gauge, let pressure bleed off so the gauge shows zero, then pump porto-power up to about 100 P.S.I. [689,5 kPa]. Lock off porto-power. Gauge should hold at 100 P.S.I. [689,5 kPa]. Let stand for about five minutes. If pressure holds, the brake does not leak. If there is a drop in pressure on the gauge the brake is leaking and will require a complete disassembly to replace the piston inner and/or outer sealing ring.

3. After making a satisfactory test, relieve pressure on the porto-power and remove. Reinstall brake line and bleed brakes in a normal manner.

FACE SEAL BREAK-IN PERIOD AND RECOMMENDED LIQUID COOLED BRAKE COOLING OILS

WHEN MACHINE IS IMMEDIATELY DRIVEN FROM PRODUCTION FLOOR OR AFTER FACE SEAL HAS BEEN REBUILT OR REPLACED, IT IS IMPERATIVE THAT A 15 MINUTE BREAK-IN PERIOD BE CONDUCTED AT NOT MORE THAN 25 RPM WHEEL SPEED, WHICH IS 5 MPH MAX. AND IN 1ST GEAR OPERATION ONLY. THIS IS TO ALLOW THE SEAL RUBBERS AND METAL RINGS TO PROPERLY SEAT.

IT IS RECOMMENDED THAT AXLES WITH EXTERNAL COOLED LIQUID COOLED BRAKES (LCB) USE "TRACTOR HYDRAULIC FLUIDS" MEETING ALLISON C4 DESIGNATION FOR COOLING OIL. THIS FLUID HAS E.P. ADDITIVE FOR IMPROVED FACE SEAL LIFE AND FRICTION MODIFIERS FOR HIGH TORQUE AND QUIET BRAKE OPERATION.

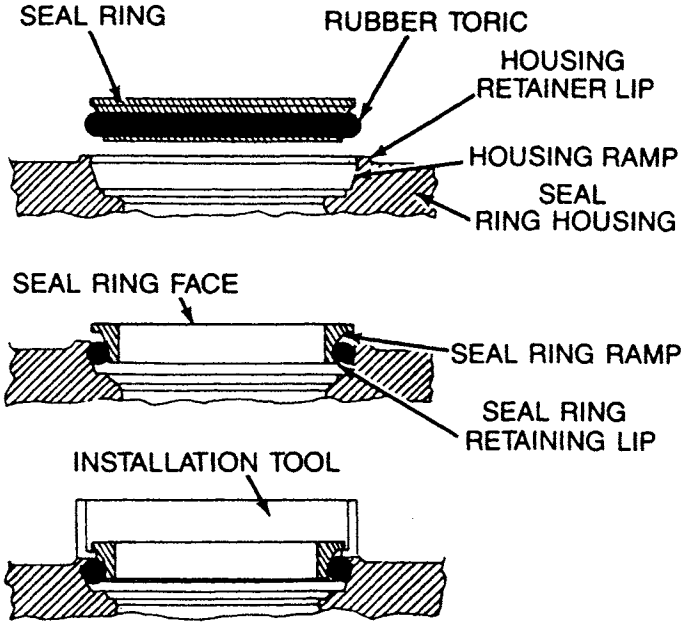
INSTRUCTIONS FOR INSTALLING FACE SEAL.

1. Clean wheel hub and brake housing bores with solvent prior to installation of the seal.
2. All parts of seal should be free of grease, oil, dirt and scale.
3. Sealing rings must be handled with care. Lapped sealing faces must not be damaged, scratched or contaminated with dirt or grease.
4. Seals with "Toric" type rubber:

   When installing the rubber toric on the seal ring, make sure that it is uniformly seated on the retaining lip and is not twisted. Place the seal in the installation tool and locate this assembly squarely against the housing. Use sudden and even pressure against the tool to push the toric under the retaining lip of the housing cavity. Insure that the toric is uniformly captured under the housing cavity retaining lip and is not twisted or pinched. The seal ring face should be parallel to the housing within .040 inches [1.0 mm].
5. After installing the seal halves into the wheel hub and brake housing, wipe both metal sealing faces clean with lint free cloth. Then apply a coat of clean MS 8 oil to the metal seal faces with a lint free applicator. Oil must not wet surfaces other than sealing faces.

CORRECT ASSEMBLY OF DUO-CONE SEALS

TERMINOLOGY



TOOL NUMBER IU 6441.
CONTACT NEAREST CATERPILLAR DEALER.

THERE ARE FIVE FAILURE MODES

1. Oil Leakage
2. Galling
3. Pumping Mud Past The Toric
4. Toric Failure
5. Seal Ring Breakage

Failures are caused by combinations of factors rather than one single cause, but all have one common denominator contributing to failure—**ASSEMBLY ERROR.**

STEP -1-

INSTALL THE RUBBER TORIC ON THE SEAL RING

Toric must be on the bottom of the seal ring ramp. Make sure it is—**STRAIGHT.**

DON'T TWIST THE TORIC

Handle seal ring carefully. Nicks and scratches on the seal ring face—**CAUSE LEAKS.**

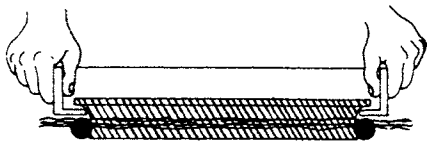
STEP -2-

REMOVE ANY OILY FILM FROM HOUSING AND SEAL RING RAMP, AND FROM THE TORIC

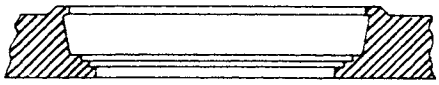
Both ramps must be dry.

Under no circumstances should oil from adjacent bearing installations or seal ring face lubrication get on the ramp or toric—**UNTIL AFTER BOTH SEAL RINGS ARE TOGETHER IN THEIR FINAL ASSEMBLED POSITION.**

STEP -3-



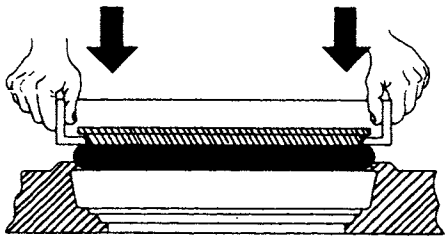
Wet toric in Tri-Chloroethane to let it slip easily under the housing retainer lip.



DON'T USE STANOSOL OR ANY OTHER LIQUID THAT LEAVES AN OILY FILM OR DOES NOT EVAPORATE QUICKLY.

STEP -4-

Set seal ring with toric squarely on the seal housing. **APPLY** sudden pressure to pop toric under housing retaining lip.



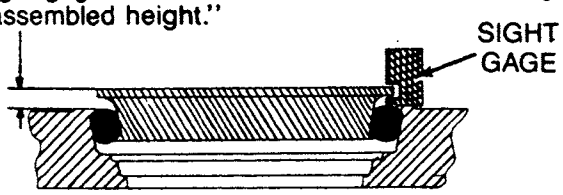
Toric can twist if it is dry on one spot or if there are burrs or fins on the housing retaining lip.

A bulging toric or cocked seal can contribute to eventual failure.

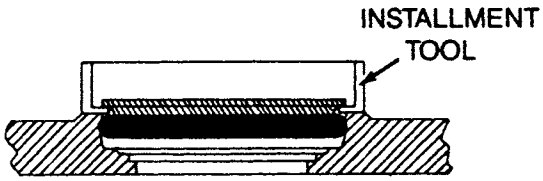
STEP -5-

CHECK WITH SIGHT GAGE

Sight gage used to check variation in seal ring "assembled height."



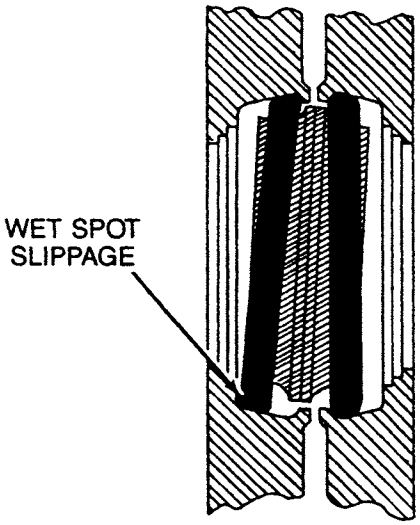
Height variation around the assembled ring should not exceed .040" (1.0 MM).



Make any required adjustments with installment tool—
DO NOT PUSH DIRECTLY ON THE SEAL RING.

BEFORE ASSEMBLING BOTH SEALS AND HOUSING TOGETHER...

WAIT—at least two minutes to let all Tri-Chloroethane evaporate (some may still be trapped between toric and housing ramp).



1. A wet spot between housing and ramp can cause sliding and cock the seal.
2. Cocked seals cause uneven pressure on the seal face and it can cause the seal to wobble.
3. Uneven pressure causes leakage or scoring.
4. Wobbling seals can cause dirt entry problems in the field.

STEP -6-

WIPE SEAL FACES

No foreign particles should be on the seal ring faces. Something as small as a **PAPER TOWEL RAVELING** will hold the seal faces apart and cause leakage.

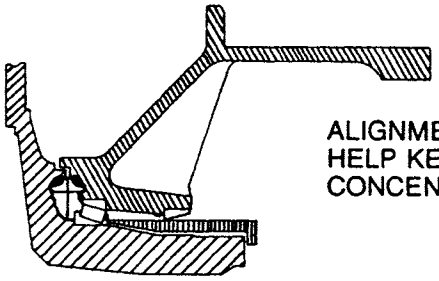
APPLY a thin film of clean oil on the seal faces by using an applicator, disposable tissue, or a clean finger.

STEP -7-

FINALLY!

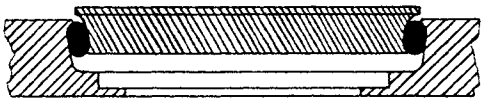
Assemble both housings and seal rings together. **MAKE SURE THEY ARE SQUARE AND CONCENTRIC.**

Bring seals together slowly and carefully. Slamming can damage or break seal on impact.

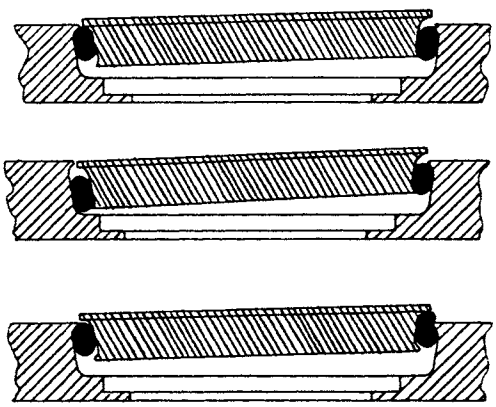


EXAMPLES

CORRECT ASSEMBLY

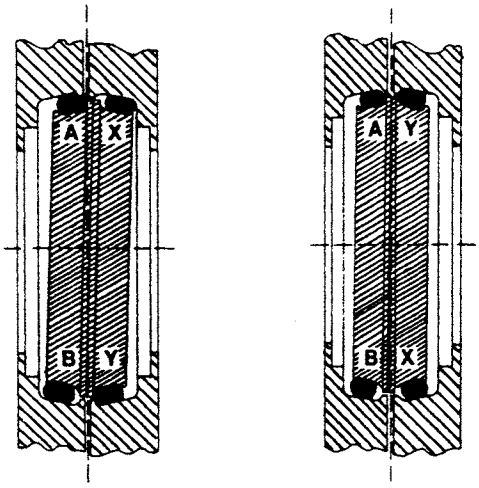


INCORRECT ASSEMBLIES



RESULTS OF INCORRECT ASSEMBLY

Points "A" and "B" remain stationary. Points "X" and "Y" rotate 180°. This causes high pressure at "A" and "Y" and possible galling.



ORIGINAL "AS ASSEMBLED" POSITION

ROTATED 180° FROM "ORIGINAL" POSITION

Whereas at "B" and "X" there is low pressure and possible leakage.

NOTES

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION

Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

BEARINGS

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

HOUSINGS

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions, providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION

Care should be exercised to avoid skin rashes and inhalation of vapors when using alkali cleaners.

Thoroughly dry all parts cleaned immediately by using moisture-free compressed air or soft lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or laping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

BEARINGS

Carefully inspect all rollers, cages, and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lintless cloth or paper to protect them until installed.

OIL SEALS, GASKETS, AND RETAINING RINGS

Replacement of spring loaded oil seals, gaskets, and snap rings is more economical when unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under lip of seal seriously impairs its efficiency. At reassembly, lubricate lips of oil seals with Lubriplate.

GEARS AND SHAFTS

If magna-flux process is available, use process to check parts. Examine teeth and ground and polished surfaces on all gears and shafts carefully for wear, pitting, chipping, nicks, cracks, or scores. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shafts are true. Differential pinions and side gears must be replaced as sets. Differential ring gear and bevel pinion must also be replaced as a set if either is damaged.

HOUSING AND COVERS

Inspect housing, covers, planet spider, and differential case to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which cause subsequent oil leaks or failures.

REASSEMBLY OF AXLE

The reassembly instructions describe the procedure to be followed when reassembling and installing components of axle. Instructions cover reassembly of only one side of axle. Reassembly of opposite side is identical unless otherwise noted.

IMPORTANT: Both Grade 5 and Grade 8 fastening hardware have been used in the production of the axle assemblies covered in this manual. A table of proper torque values for both Grade 5 and Grade 8 hardware is provided at the rear of this manual. Grade of hardware may be determined by the "hash" marks contained on the head of each bolt; Grade 5 having three hash marks and Grade 8 having six hash marks as indicated on table of proper torque value page.

Torque values specified in text of this manual are for Grade 8 hardware where presently used in production. Grade 5 torque values are also specified when that grade hardware is presently used. On all axles being overhauled, bolts should be identified as described above and torque value chart consulted for correct torque.

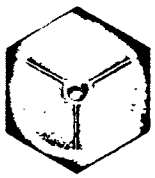
At reassembly apply thread locking compound where noted.

Guidelines for application where to apply:

A. On bolts, capscrews, and studs (anchor end) apply compound on female threaded component part.
B. On nuts, apply compound to the male thread of the mating fastener.
C. Apply compound to coat the full length and circumference of thread engagement.
D. Remove excess compound from mating parts after fastener installation.

TORQUE FOR BOLTS, CAPSCREWS, STUDS AND NUTS

Grade 5 Identification, 3 Radial Dashes 120° Apart on Head of Bolt



Grade 5

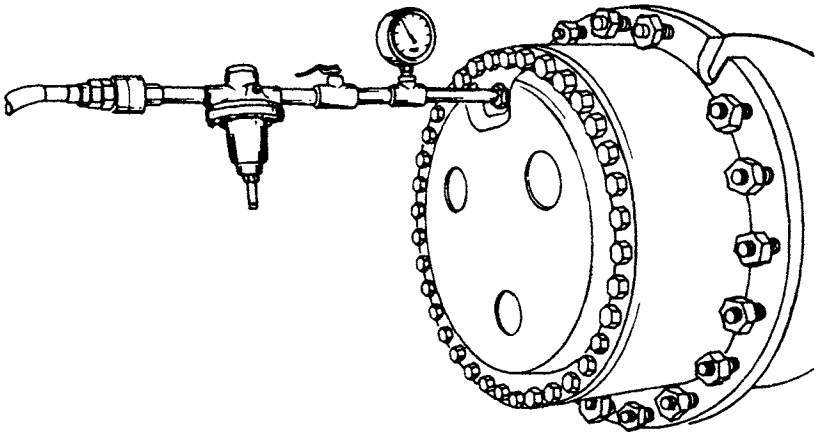
Grade 8 Identification, 6 Radial Dashes 60° Apart on Head of Bolt

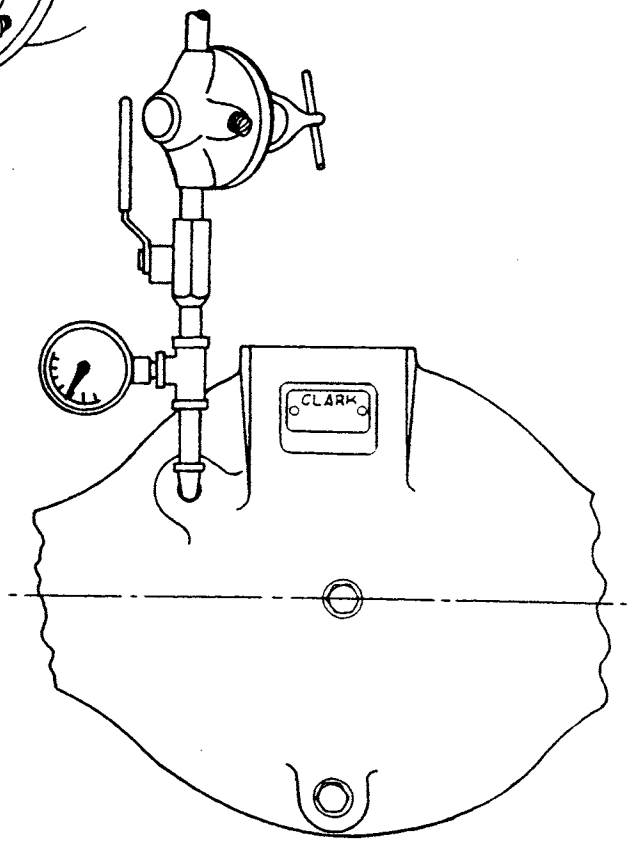
Grade 8

Fastener Size	Grade 5 Lubricated and Plated	Grade 8 Lubricated and Plated
1/4 - 20 1/4 - 28	80 - 90 Lbs. In. [9 - 10 N.m]	110 - 120 Lbs. In. [13 - 14 N.m]
5/16 - 18 5/16 - 24	180 - 200 Lbs. In. [21 - 23 N.m]	215 - 240 Lbs. In. [24 - 27 N.m]
3/8 - 16 3/8 - 24	25 - 28 Lbs. Ft. [34 - 38 N.m]	35 - 40 Lbs. Ft. [48 - 54 N.m]
7/16 - 14 7/16 - 20	40 - 45 Lbs. Ft. [54 - 61 N.m]	60 - 65 Lbs. Ft. [82 - 88 N.m]
1/2 - 13 1/2 - 20	65 - 70 Lbs. Ft. [88 - 95 N.m]	90 - 100 Lbs. Ft. [125 - 135 N.m]
9/16 - 12 9/16 - 18	90 - 100 Lbs. Ft. [125 - 135 N.m]	125 - 140 Lbs. Ft. [170 - 190 N.m]
5/8 - 11 5/8 - 18	125 - 140 Lbs. Ft. [170 - 190 N.m]	175 - 190 Lbs. Ft. [240 - 260 N.m]
3/4 - 10 3/4 - 16	220 - 245 Lbs. Ft. [300 - 330 N.m]	300 - 330 Lbs. Ft. [410 - 450 N.m]
7/8 - 9 7/8 - 14	330 - 360 Lbs. Ft. [450 - 490 N.m]	475 - 525 Lbs. Ft. [645 - 710 N.m]
1 - 8 1 - 12	475 - 525 Lbs. Ft. [645 - 710 N.m]	725 - 800 Lbs. Ft. [985 - 1085 N.m]
1-1/8 - 7 1-1/8 - 12	650 - 720 Lbs. Ft. [880 - 975 N.m]	1050 - 1175 Lbs. Ft. [1425 - 1600 N.m]
1-1/4 - 7 1-1/4 - 12	900 - 1000 Lbs. Ft. [1220 - 1360 N.m]	1475 - 1625 Lbs. Ft. [2000 - 2200 N.m]

APPROVED BY AXLE ENGINEERING
REVISED 24 MARCH 1980

AIR CHECKING THE AXLE WHEEL ENDS AND CENTER SECTION





It is recommended an air check be made on each wheel end after assembly. This checking device is comprised of a minimum 30 P.S.I. [206 kPa] air gauge, an air shut-off valve, an air regulator valve, pipe tee, pipe nipple, reducing bushing and air line connector. The oil level plug is removed from the planet cover and the checking device is installed in its place. Remove the breather in the axle center and install a pipe plug in the breather hole. The regulator is opened to 12 P.S.I. [82 kPa] on the gauge. The air shut-off (installed between the regulator and gauge) is then closed. A 12 P.S.I. [82 kPa] pressure must be retained for 15 seconds. If there is a pressure drop in less than 15 seconds there is an air leak at the wheel hub oil seal. If an air leak is detected it will require a wheel end disassembly to correct the leak. Make both wheel end air checks and the following center section air checks before disassembling any of the axle to correct an air leak.

Air check the axle center section the same way as the wheel ends except the checking device is installed in the air breather hole in the axle center. If an air leak is detected, locate leak and correct. After air check is made, reinstall air breather in axle center.

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