Product: WHEEL LOADER
Model: 928G WHEEL LOADER 7SR
Configuration: 928G Wheel Loader 7SR00001-02267 (MACHINE) POWERED BY 3116 Engine


**Media Number -SENR1217-05** **Publication Date -01/07/2005** **Date Updated -11/04/2018**

SENR12170008

# Differentials & Pinion

**SMCS -** 3280-017

# Remove & Install Differentials & Pinion Assemblies (928G & IT28G)

| Tools Needed | | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| 138-7573 | Link Bracket | 2 | | | | | |
| 138-7574 | Link Bracket | | 2 | | | | |
| 8B-7551 | Puller Assembly | | | 1 | | | |
| 5F-7343 | Puller Assembly | | | | 1 | | |
| 4C-8348 | Spanner Wrench Assembly | | | | | 1 | |
| 4C-8346 | Wrench Assembly | | | | | | 1 |

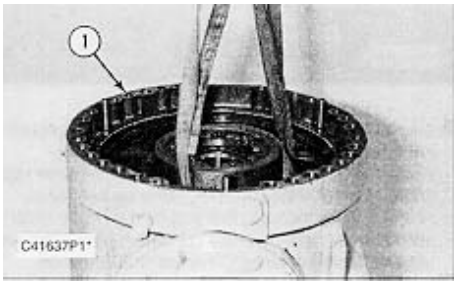
Start By:

**a.** remove front axle housing group (fixed)

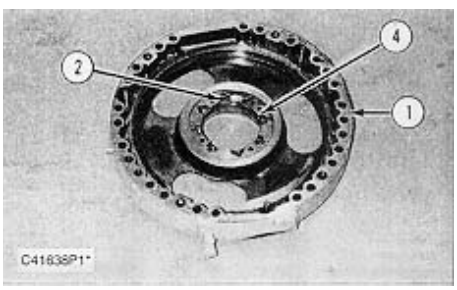
**b.** remove rear axle housing group (oscillating)

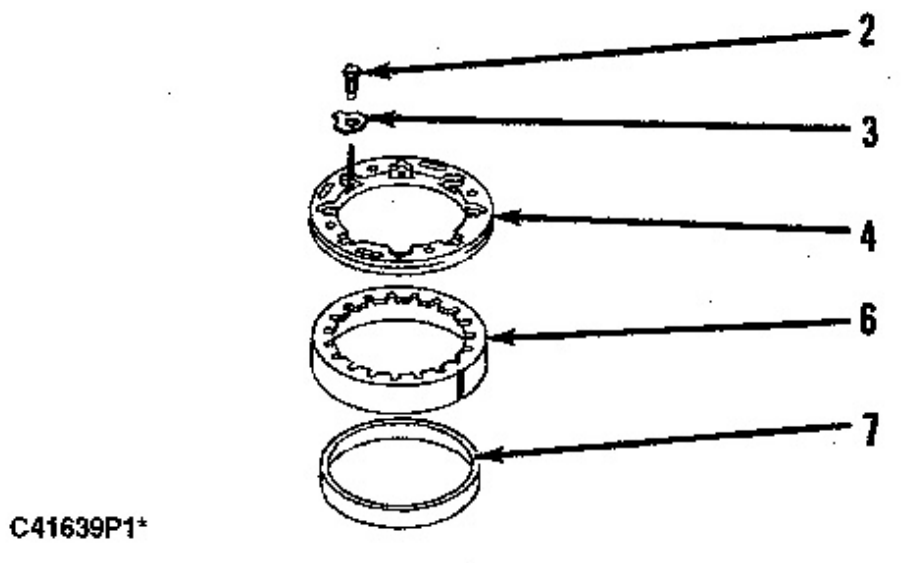
**c.** install steering frame lock link

**1.** Remove one of the brake groups from the axle housing group. See the topic, "Remove & Install Brake Groups" in this module.




**2.** Fasten a hoist to intermediate housing assembly (1) as shown. Remove the four bolts that hold intermediate housing assembly (1) to the differential center housing. Remove the intermediate housing assembly. The weight of the intermediate housing assembly is **approximately 57 kg (125 lb).**

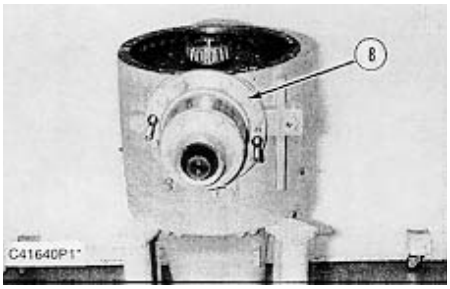


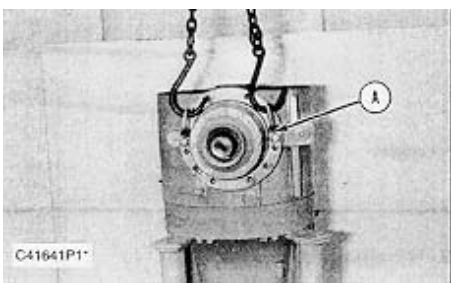

**3.** Remove bolt (2) and washer (3).

**NOTE:** Two different size adjusting nuts are used in the bevel gear group. Use Tool (E) or (F) to remove the appropriate size adjusting nuts.

**4.** Use appropriate Tool, Tool (E) or (F), to remove adjusting nut (4). Remove the pin, sleeve (6) and bearing cap (7) from intermediate housing assembly (1).

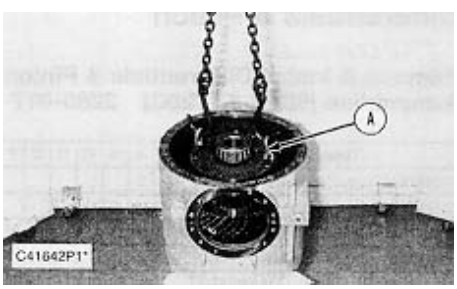



**5.** Remove two of the bolts (8), located 180° apart from each other, that hold the pinion assembly to the differential center housing. Install two suitable size guide bolts that are approximately **152.4 mm (6.00 in) long** in the bolt holes as shown.

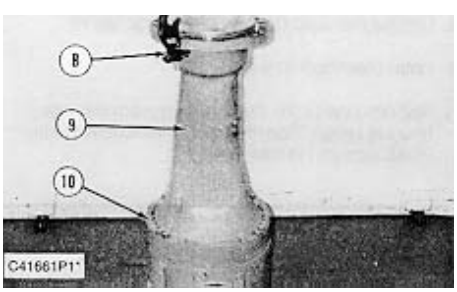



**6.** Remove the remaining bolts (8) that hold the pinion assembly to the differential center housing. Slide the pinion out on the guide bolts far enough to install Tool (A). Fasten a hoist to the pinion assembly as shown.

**7.** Remove the pinion assembly from the differential center housing. The weight of the pinion assembly is approximately **66 kg (145 lb).** Remove the shims and O-ring seal from the pinion housing.




**8.** Fasten Tool (A) and a hoist to the differential as shown. Carefully lift the differential out of the differential center housing. The weight of the differential is approximately **109 kg (240 lb).**

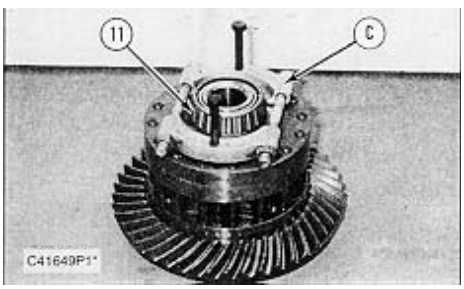



**9.** Turn the remainder of the axle housing group over, and fasten it to the transmission repair stand. Fasten Tool (B) and a hoist to the rim flange on axle shaft assembly (9) as shown. Remove twenty six bolts (10) and the washers that hold the axle shaft assembly to the differential center housing.

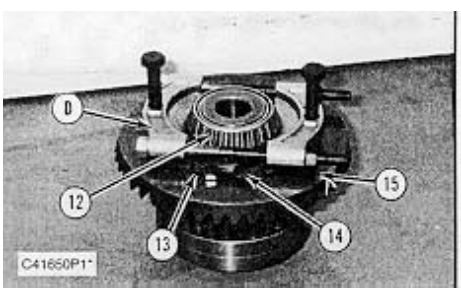
Remove the axle shaft assembly. The weight of the axle shaft assembly is approximately **295 kg (650 lb).**

**10.** Remove the brake group from the differential center housing. See "Remove & Install Brake Groups" in this module.

**11.** Repeat Steps 2 through 4 to remove and disassemble the other intermediate housing assembly (1) that is on the differential center housing.




**12.** Remove bearing cone (11) from the differential with Tool (C).

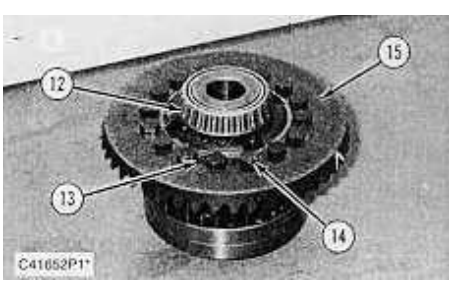


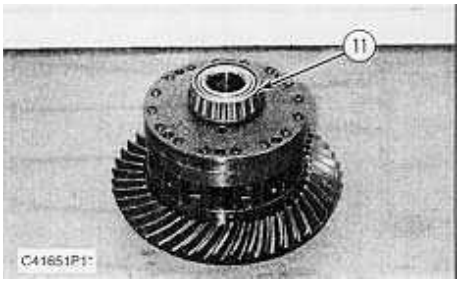

**13.** Turn the differential over, and remove bearing cone (12) with Tool (D).

**14.** Use a press to remove the four large spring pins and four small spring pins (13) from the differential.

**15.** Remove twenty bolts (14) that hold bevel gear (15) in position. Using a press, remove bevel gear assembly (15) from the differential.

**NOTE:** The following procedure is for the installation of the differential and pinion assembly. Also, the following procedure controls bearing preload and gives the same results for new or used bearings.





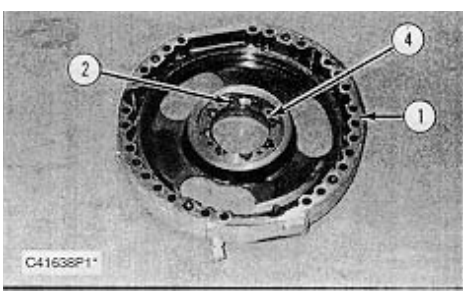

**16.** Heat bevel gear (15) to a temperature of **120°C (248°F)** for a maximum of four hours. Install the bevel gear on the differential.

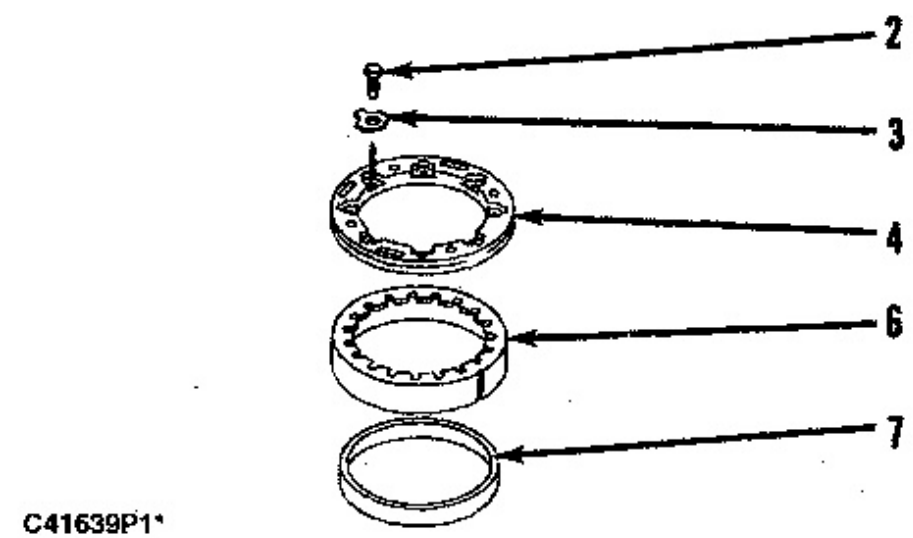
**NOTE:** Lubricate the threads of bolts (14). Lubricate the washers.

**17.** Install four large pins (13) partially into bevel gear (15). Install four small pins (13) into the larger pins. Press the pins into bevel gear (15) until they are even with the outside surface of the bevel gear. Install sixteen bolts (14) that hold the bevel gear to the differential. Tighten bolts (14) to a torque of **95 ± 10 N·m (70 ± 7 lb ft).** Tighten each bolt an additional **180 ± 5 degrees.** Check to be sure the bevel gear is seated on the differential group shoulder.

**18.** Press bearing cone (11) and bearing cone (12) on the differential case. Check for full seating of the bearing cones.

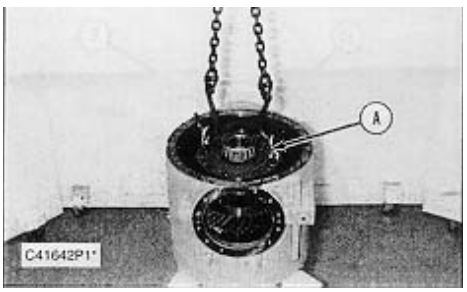
**NOTE:** Cup freezing or cone heating may be used if cups or cones are reset with a driver or press after the parts have reached a uniform temperature. Limit cone heating to **135°C (275°F)** maximum for a maximum of 4 hours. Lubricate the bearings after they have cooled to prevent rusting.



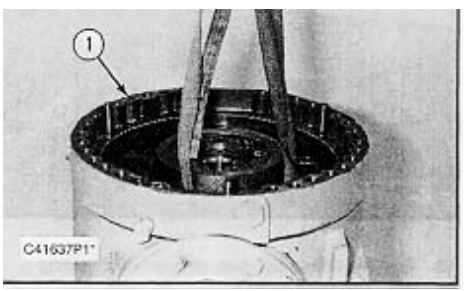



**19.** Install bearing cup (7), sleeve (6), and the pin in the intermediate housing. Lubricate the threads on the adjusting nut (4), and install it in intermediate housing assembly (1).

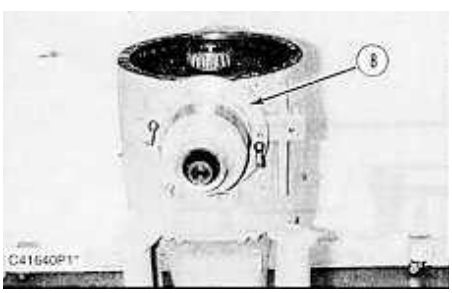
**20.** Assemble the other intermediate housing (1) as in Step 19.

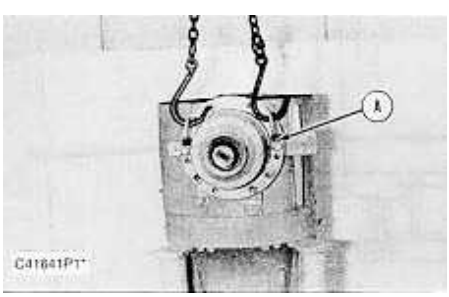



**21.** Position the differential center housing on a transmission repair stand with the open side facing upward. Fasten Tool (A) and a hoist to the differential, and lower it on to the three dowels in the differential center housing.




**22.** Fasten a hoist to intermediate housing assembly (1). Install the intermediate housing assembly on the differential center housing. Install and tighten the four bolts that hold it.



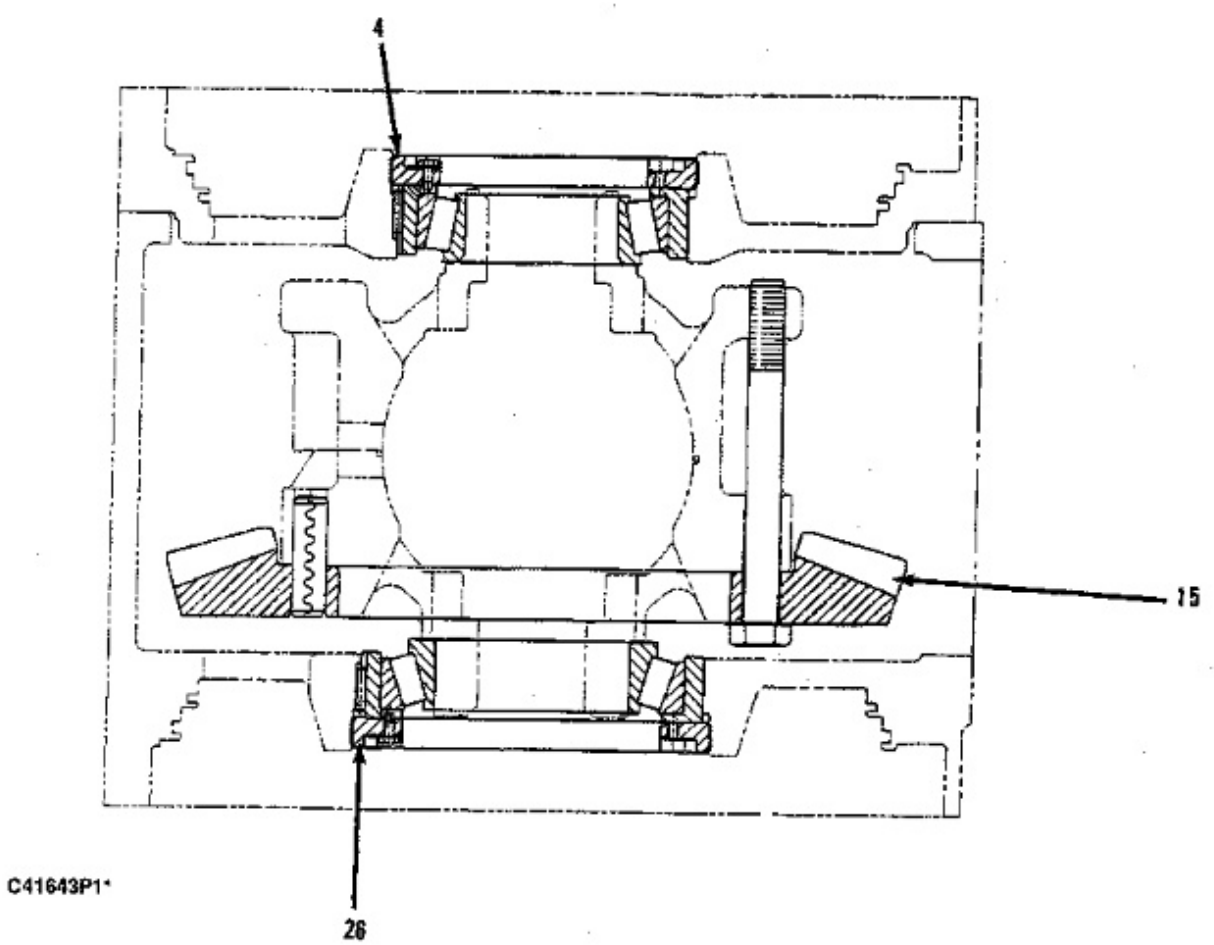

**NOTE:** Use the original thickness of shims or a new shim pack measured to the same thickness as the original shim pack. If the original shim pack is not available, use 60% of a new shim pack.

**23.** Lubricate and install the O-ring seal used on the pinion housing. Install the original shim pack on the pinion housing. Install the two guide bolts in the differential center housing. Fasten Tool (A) and a hoist to the pinion assembly, and install it in the differential center housing. Install twelve bolts (8)

that hold the pinion assembly in position. Tighten the bolts to a torque of **300 ± 40 N·m (220 ± 30 lb ft).**

**NOTE:** The shim pack thickness may have to be changed when adjusting the tooth contact pattern between the bevel gear and pinion shaft.

**24.** Reposition the differential center housing on the transmission repair stand so the differential center housing and the pinion assembly are horizontal (the same position as they are in vehicle).




**25.** Tighten adjusting nuts (4) and (26) with Tool (E) and (F) to a position that maintains gear backlash (but not tight gear mesh) and a slight bearing end play.

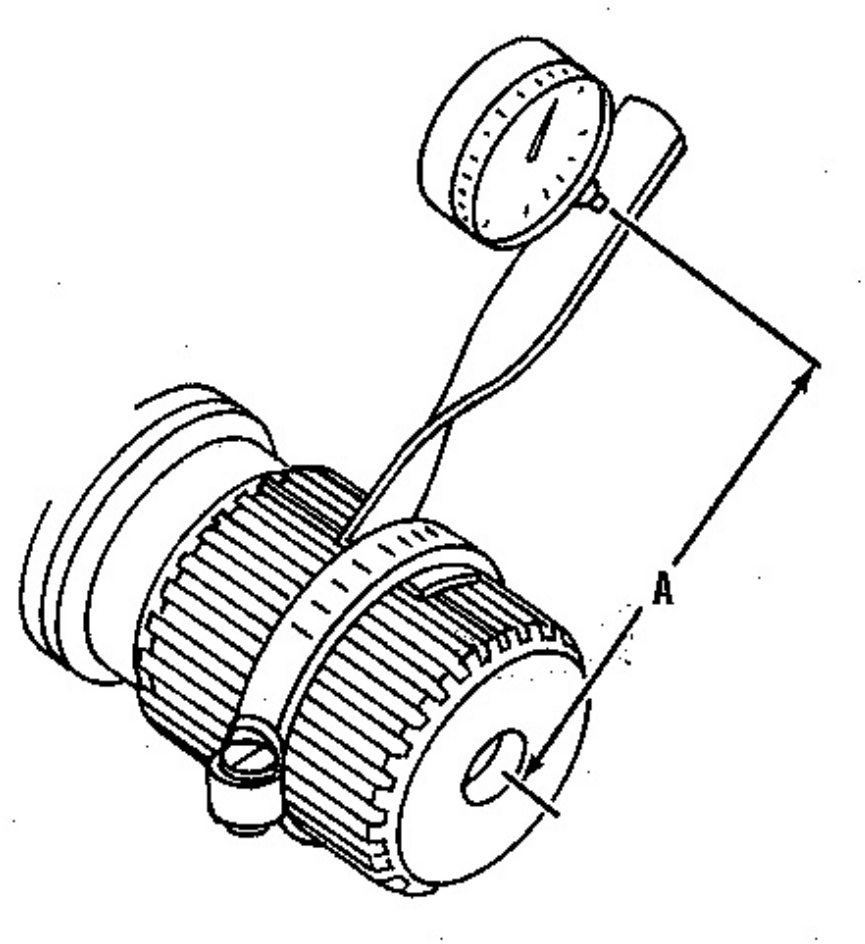
**26.** Measure the torque required to rotate the pinion shaft. Record the measured torque. Use a **1U6690 Socket** on the pinion shaft nut for this measurement.

**27.** While rotating the pinion shaft back and forth, tighten adjusting nut (26) to zero backlash position. Then back off adjusting nut (4) 20° plus the increment to the nearest lock position.

**28.** Tighten adjusting nut (4) while rotating the pinion shaft. Tighten nut (4) until a torque increase of **0.2 to 0.6 N·m (2.0 to 5.0 lb in)** over the torque recorded in Step 26 is measured. This is the seated position.

**NOTE:** As a check for correct assembly and adjustment, the rolling torque of the bevel gear group measured at the pinion shaft should be **1.4 to 6.0 N·m (12 to 32 lb in)** for new bearings and **0.7 to 3.0 N·m (6.1 to 27 lb in)** for used bearings.

**29.** Tighten adjusting nut (4) to 80 degrees. Then tighten nut (4) an additional increment to the nearest locking position.




C31973P1*

Pinion Shaft Spline (backlash measurement).

**(A)** Distance of dial indicator from pinion centerline.

**30.** Measure the backlash between bevel gear (15) and the pinion shaft. The backlash must be **0.25 + 0.10 - 0.08 mm (.010 + .004 - .003 in).** Do this by placing a dial indicator (as shown) tangent to the spline, making sure the yoke or spline adapter is tight to the spline.

**31.** The following chart give examples of backlash at the pinion shaft, by showing the different distances from the pinion centerline to the dial indicator:

| EXAMPLES OF BACKLASH AT PINION SHAFT | | | |
|---|---|---|---|
| Dimension (A) mm (in) | Nominal Backlash mm (in) | Maxium Backlash mm (in) | Minimum Backlash mm (in) |
| 50 (2) | 0.28 (.011) | 0.40 (.016) | 0.18 (.007) |
| 100 (4) | 0.55 (.022) | 0.80 (.032) | 0.35 (.014) |
| 150 (6) | 0.83 (.033) | 1.20 (.047) | 0.53 (.021) |
| 200 (8) | 1.10 (.043) | 1.60 (.063) | 0.70 (.028) |

**32.** If the backlash does not meet specifications, loosen one adjusting nut the same amount as the opposite adjusting nut is tightened. This will maintain the bearing preload.

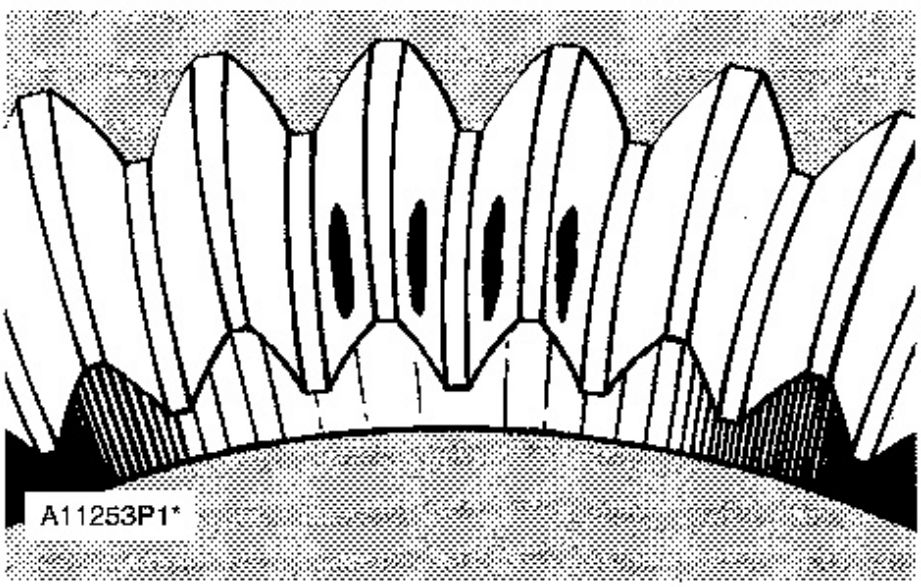



Illustration A

**33.** After the backlash preload adjustments have been made, the tooth contact between the pinion shaft and bevel gear (15) must then be checked. Do the procedure that follows:

**a.** Put a small amount of Prussian blue, red lead or paint on three or four adjacent teeth of bevel gear (15).

**b.** Rotate the pinion shaft several revolutions in one direction and then several revolutions in the opposite direction. Then turn pinion shaft in one direction until the marked teeth can be seen.

**c.** The correct area of teeth contact starts near the inside of the inside end of the teeth of bevel gear (15) and goes a maximum of 50% of the length of the teeth. See Illustration A for an example of the correct area of tooth contact.

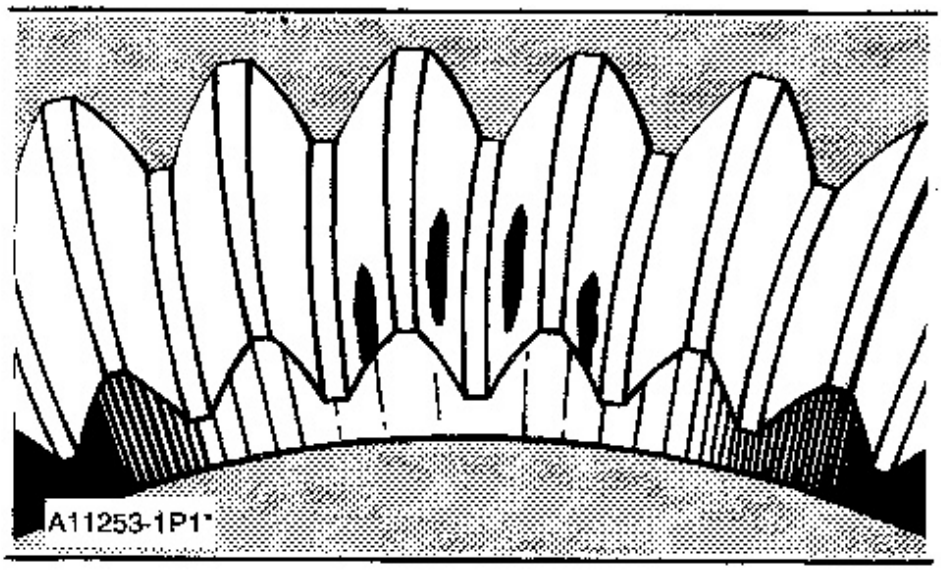



Illustration B

**34.** If the tooth contact looks like the marks in Illustration B, do the procedure that follows:

**a.** Remove some of the shims from behind the pinion housing.
**b.** Do Steps 29, 30 and 31 for the backlash adjustment procedure again.
**c.** Do Step 32 again.

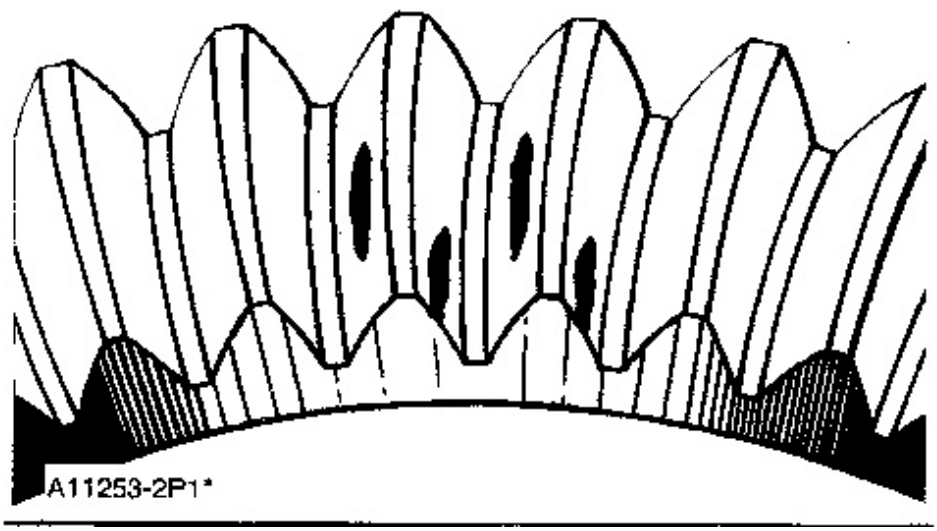



Illustration C

**35.** If the tooth contact looks like the marks in Illustration C, do the procedure that follows:

**a.** Add shims behind the pinion housing.
**b.** Do Steps 29, 30 and 31 again.
**c.** Do Steps 32 again.

**NOTE:** Always be sure the backlash adjustment is correct before an adjustment is made to the area of the tooth contact. Several adjustments to the backlash and tooth contact may be necessary to get the correct adjustments. Always remember that a change to gear clearance (backlash) will also change the gear contact. A change in gear contact will also change gear clearance (backlash).

**36.** After adjustments are made, remove the Prussian blue, red lead or paint from the gears.

**37.** Install one bolt and lock (2) in each adjusting nut (4) and (26), tighten both bolts and bend the locks.

**38.** Install the brake groups and the axle shaft assemblies on the differential center housing. See the topic, "Remove & Install Brake Groups" and "Disassemble & Assemble Axle Shaft Assemblies" in this module.

End By:

**a.** install rear axle housing group (oscillating)

**b.** install front axle housing group (fixed)

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Model: 928G WHEEL LOADER 7SR
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**Media Number -SENR1217-05** **Publication Date -01/07/2005** **Date Updated -11/04/2018**

SENR12170009

# Pinion Assemblies

**SMCS -** 3254-015; 3254-016

# Disassemble Pinion Assemblies (928G & IT28G)

| Tools Needed | A |
|---|---|
| 5P-0954 Socket | 1 |

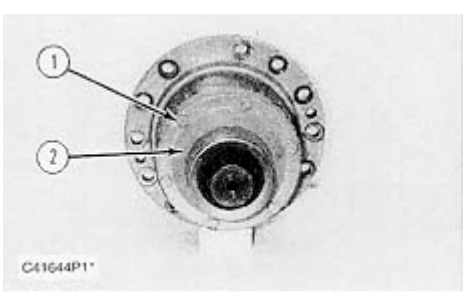
Start By:

**a.** remove differentials and pinion assemblies.

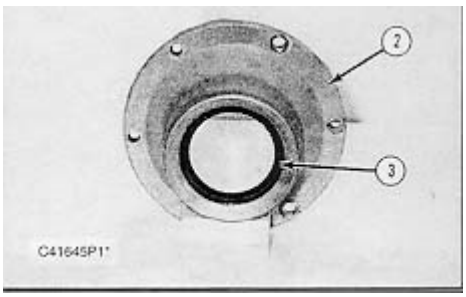
### Fluid Spillage Containment

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.

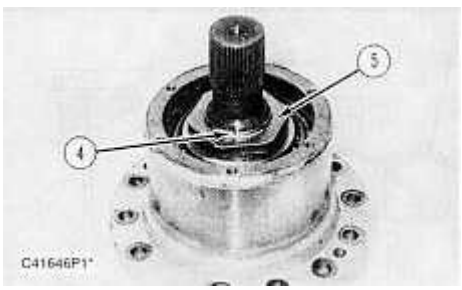
**NOTE:** The disassembly procedure is the same for the front and rear pinion assemblies.

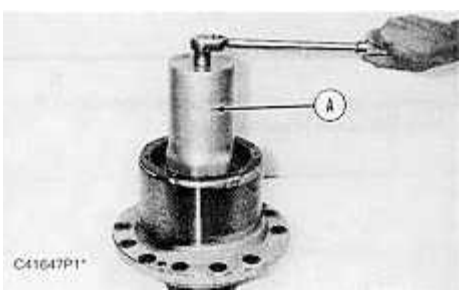


**1.** Remove six bolts (1) and the washers that hold retainer (2) to the pinion housing. Remove the retainer.



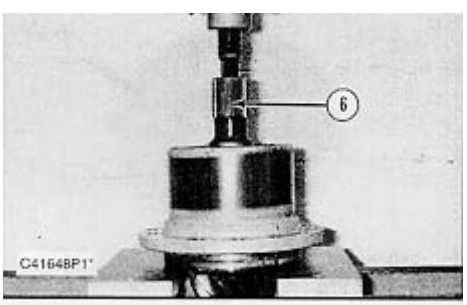

**2.** Remove lip-type seal (3) from retainer (2).



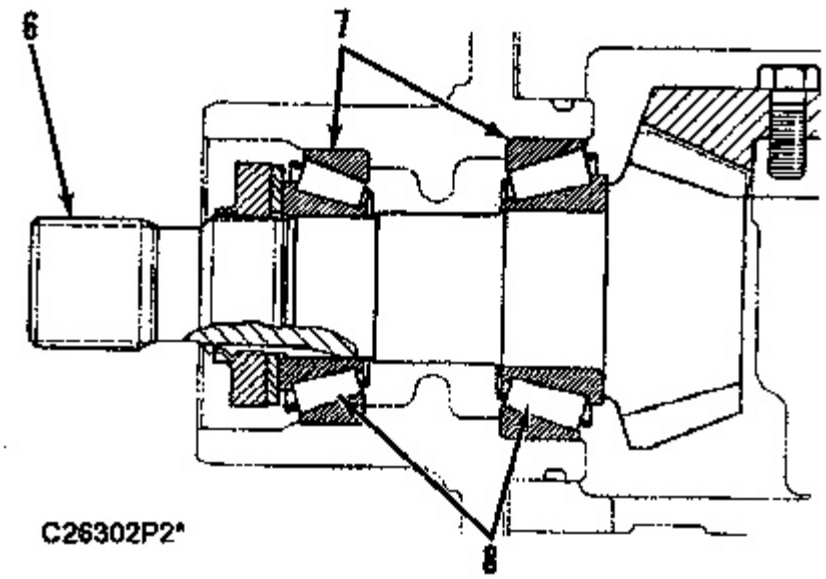




**3.** Bend crimp (4) away from the slot in the pinion shaft with a hammer and punch.

**4.** Use Tool (A) to remove nut (5) from the pinion shaft.




**5.** Using a press, remove pinion shaft (6) from the pinion housing.




**6.** Remove bearing cones (8) and bearing cups (7) from the pinion housing.

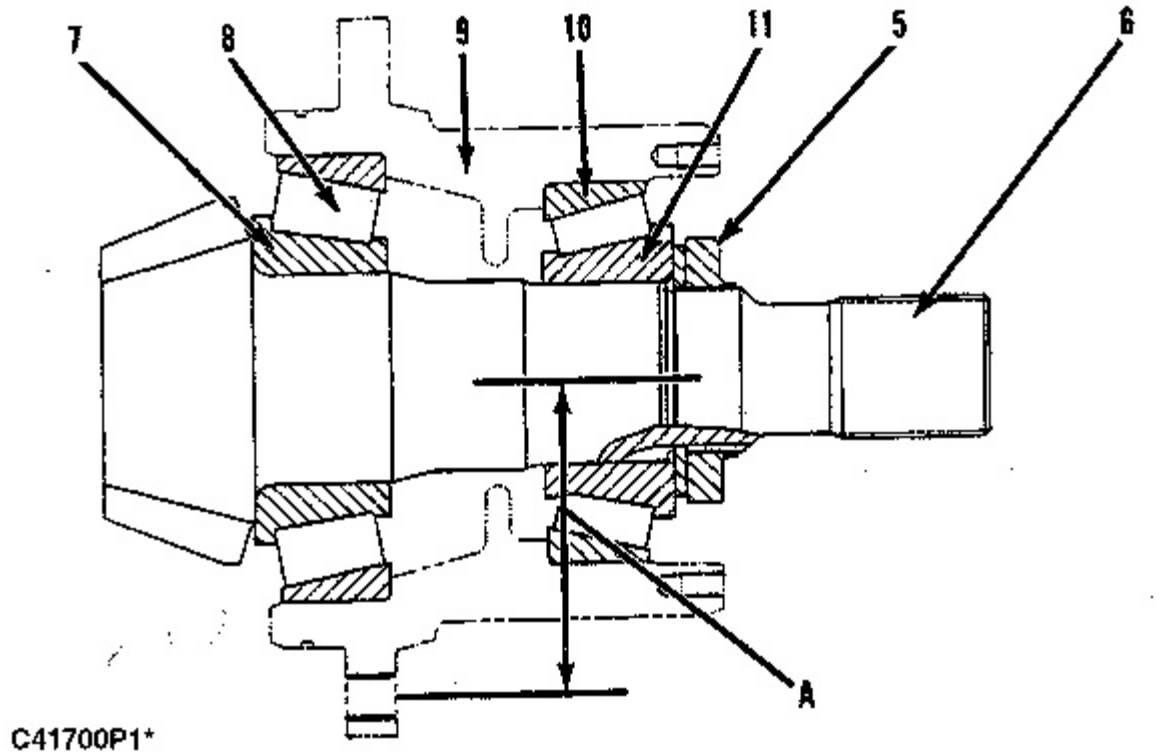
# Assemble Pinion Assemblies (928G & IT28G)

| Tools Needed | A |
|---|---|
| 5P-0954 Socket | 1 |

**NOTE:** The same assembly is used for both the front and rear pinon assemblies.

**Fluid Spillage Containment**

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.




**NOTE:** Cup freezing or cone heating may be used if cups or cones are reset with a driver or press after parts have reached a uniform temperature. Limit cone heating to **135°C (275°F)** maximum for a maximum of 4 hours. Lubricate bearings after they have cooled to prevent rusting.

**1.** Install bearing cups (8) and (10) in pinion housing (9). The bearing cups must be seated against the shoulders in pinion housing (9).

**2.** Install bearing cone (7) on pinion (6). Bearing cone (7) must be against (seated) the shoulder on pinion (6). Lubricate bearing cone (7).

**3.** Install pinion (6) in housing (9). Press bearing cone (11) into place leaving a small amount of end play. Lubricate bearing cone (11). Lubricate and install the washer and nut (5).

**4.** Position the assembly vertically in a soft jawed vise. Tighten the vise against the teeth on pinion shaft (6). Install an appropriate size bolt and nut through an outer mounting bolt hole in pinion housing (9).

**5.** Place a **203 mm (8.0 in)** torque wrench on this bolt so that it is in line with the center of pinion shaft (6).

**6.** While turning pinion housing (9) with the torque wrench, tighten nut (5) until the torque wrench reading in the following chart is reached.

| PINION ROLLING TORQUE | | |
|---|---|---|
| | Actual Torque At The Pinion | Torque Wrench Reading |
| New Bearings | 0.9-18 N•m (8-16lb in) | 0.5-1.1 N•m (5-10 lb in) |
| Used Bearings | 0.45-0.90 N•m (4-8 lb in) | 0.25-0.55 N•m (2.5-5.0 lb in) |

*When using a 203 mm (8.0 in) torque wrench.

*When using a 203 mm (8.0 in) torque wrench.

Check to be sure that there is zero end play of pinion shaft (6).

**7.** If pinion rolling torque exceeds the specification, back off nut (5) one-eighth turn, and reset bearing cone (11) and the washer against nut (5). Perform Steps 5 and 6 again.

**NOTE:** If any other length torque wrench is used, find the torque wrench reading by using the following formula:

$$C = \frac{B \times T}{B + A}$$

Where:

"C" is the reading on the torque wrench (in N·m)

"B" is the length of the torque wrench (in meters)

"A" is the bolt circle radius of pinion housing (9) in meters and is equal to **0.102 m (4.015 in).**

"T" is the rolling torque specification for pinion bearing preload which is **0.7 to 1.4 N·m (6 to 12 lb in).**

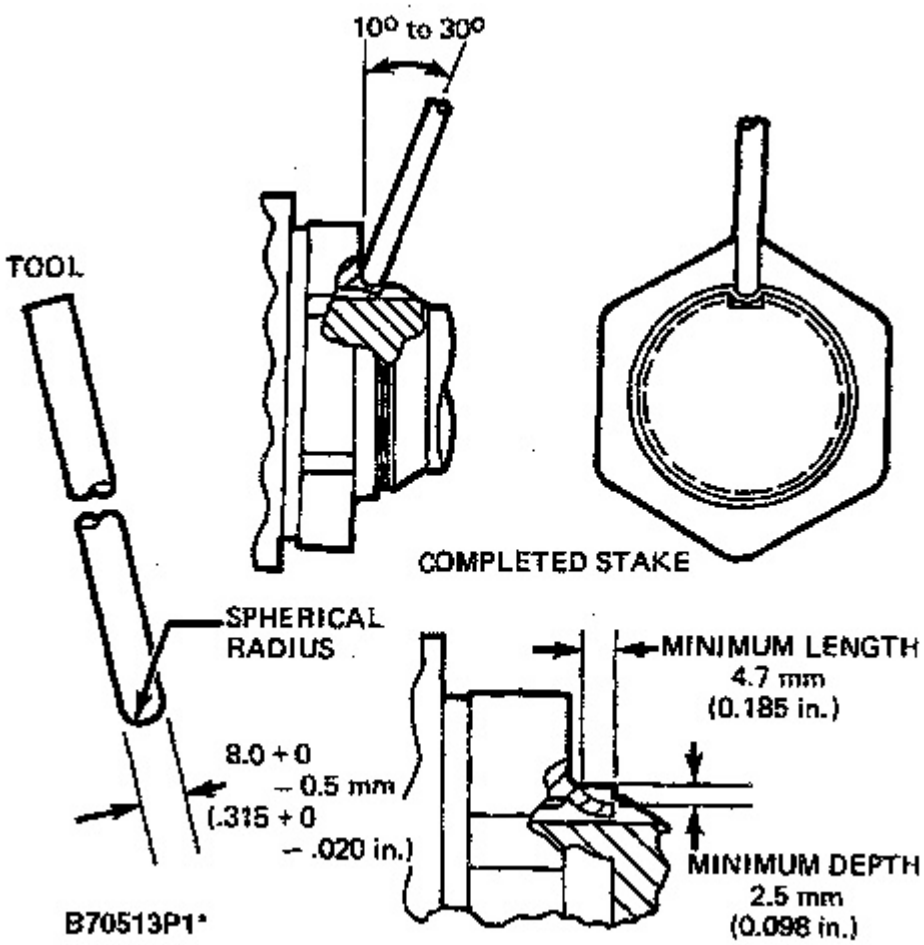
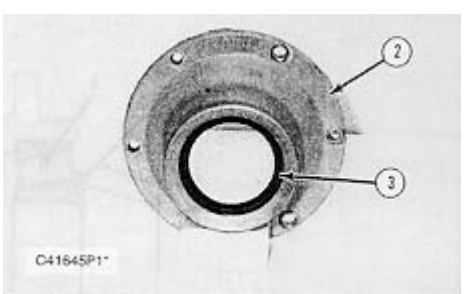


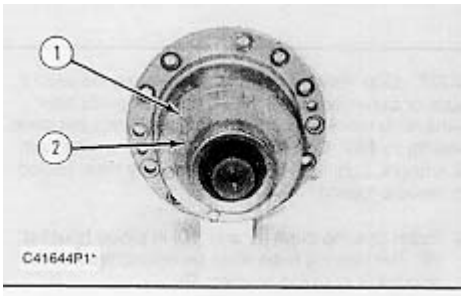

Illustration A

**8.** When the torque needed to turn the pinion is correct, stake nut (5) by peening the collar on the nut into the key slot in pinion shaft (6). See Illustration A for the correct tooling and dimensions.

**NOTE:** The nut may be reused if the collar is not cracked during removal or restaking.




**9.** Install lip-type seal (3) in retainer (2) with the lip of the seal facing toward the outside of the pinion housing.




**10.** Put retainer (2) in position on the pinion housing, and install six bolts (1) and the washers which hold it.

End By:

**a.** install differentials and pinion assemblies

---

Product: WHEEL LOADER
Model: 928G WHEEL LOADER 7SR
Configuration: 928G Wheel Loader 7SR00001-02267 (MACHINE) POWERED BY 3116 Engine

**Disassembly and Assembly**
**IT28G INTEGRATED TOOL CARRIER & 928G WHEEL LOADER POWER TRAI**
**Media Number -SENR1217-05** **Publication Date -01/07/2005** **Date Updated -11/04/2018**

SENR12170010

# Differential (Standard)

**SMCS -** 3258-015; 3258-016

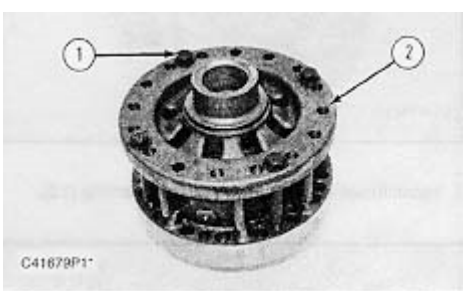
# Disassemble Differential (Standard) (928G & IT28G)

Start By:

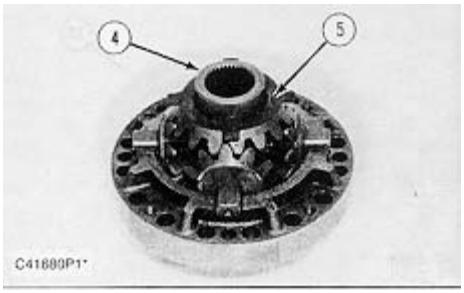
**a.** remove differentials and pinion assemblies

### Fluid Spillage Containment

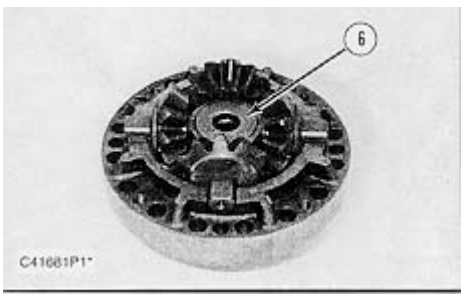
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.



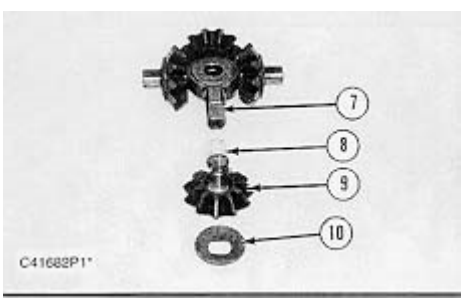

**1.** Remove four bolts (1) and the washers that hold case assembly (2). Remove the case assembly.




**2.** Remove thrust washer (5) and bevel gear (4).

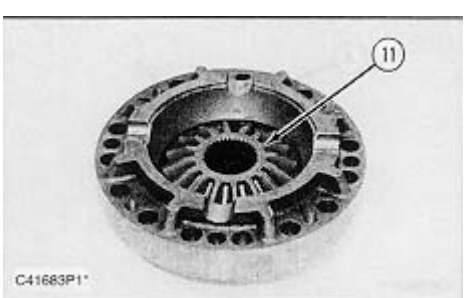



**3.** Remove spider and gear assembly (6).

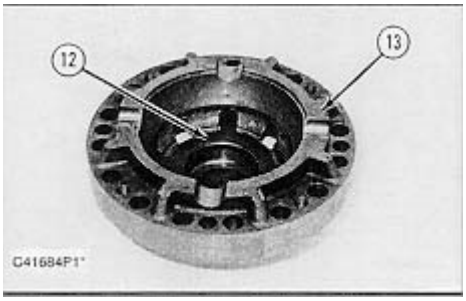



**4.** Disassemble the spider and gear assembly. Remove thrust washer (10), bevel pinion (9), and sleeve bearing (8) from spider (7).

**5.** Disassemble the remainder of the spider and gear assembly as in Step 5.




**6.** Remove bevel gear (11) from the case assembly.

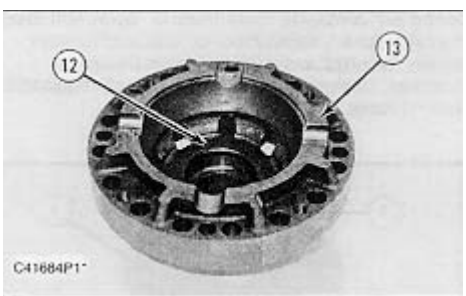



**7.** Remove thrust washer (12) from case assembly (13).

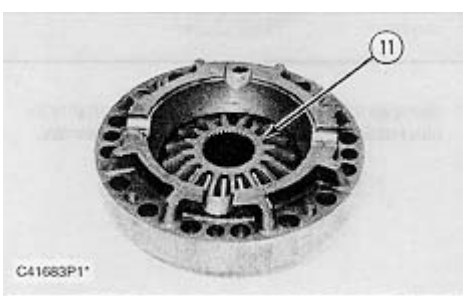
# Assemble Differential (Standard) (928G & IT28G)

**Fluid Spillage Containment**

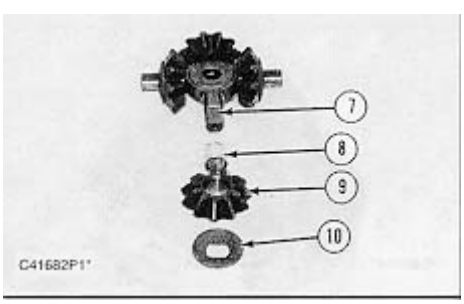
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.




**1.** Install thrust washer (12) in case assembly (13).

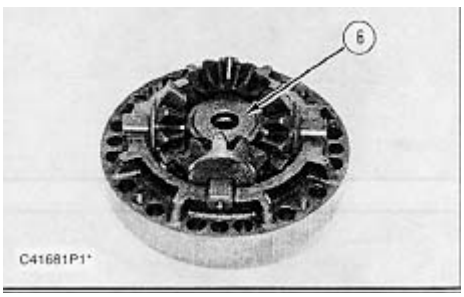



**2.** Install bevel gear (11) in the case assembly.

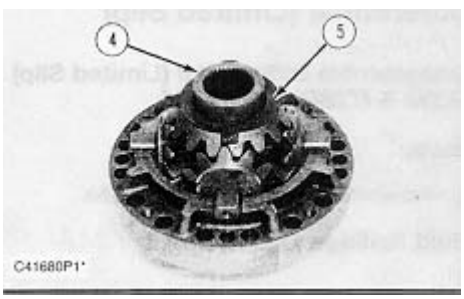


**3.** Assemble the spider and gear assembly. Install sleeve bearing (8), bevel pinion (9) and thrust washer (10) on spider (7).

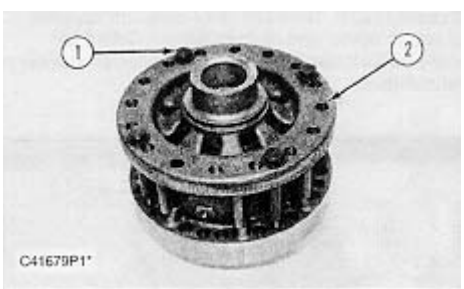
**4.** Assemble the remainder of the spider and gear assembly as in Step 3.




**5.** Install spider and gear assembly (6) in the case assembly.




**6.** Install bevel gear (4) and thrust washer (5) in the case assembly.




**7.** Put case assembly (2) in position, and install four bolts (1) and the washers that hold it.

End By:

**a.** install differentials and pinion assemblies

Product: WHEEL LOADER
Model: 928G WHEEL LOADER 7SR
Configuration: 928G Wheel Loader 7SR00001-02267 (MACHINE) POWERED BY 3116 Engine


**Media Number -SENR1217-05** **Publication Date -01/07/2005** **Date Updated -11/04/2018**

SENR12170011

# Differential (Limited Slip)

**SMCS -** 3263-015; 3263-016

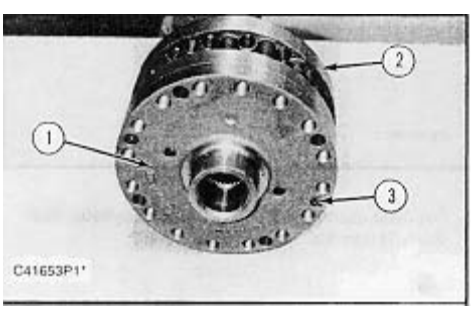
# Disassemble Differential (Limited Slip) (928G & IT28G)

Start By:

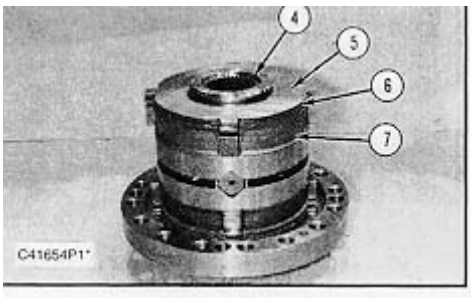
**a.** remove differentials and pinion assemblies

### Fluid Spillage Containment

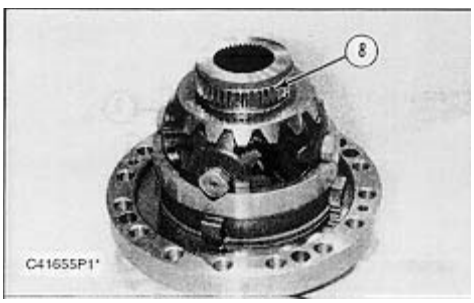
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.



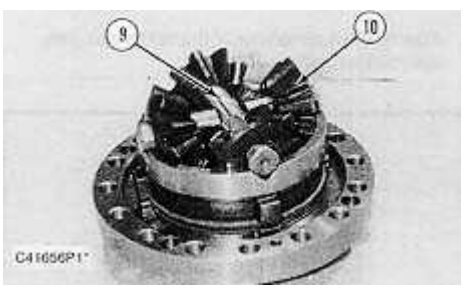

**1.** Remove two socket head bolts (3). Turn the differential up on differential housing cover (1), and remove differential housing (2).

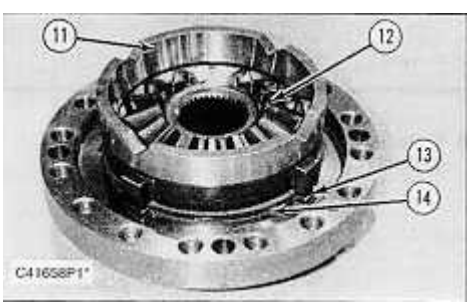



**2.** Remove thrust washer (4), two outer discs (5), two inner discs (6) and pressure ring (7).

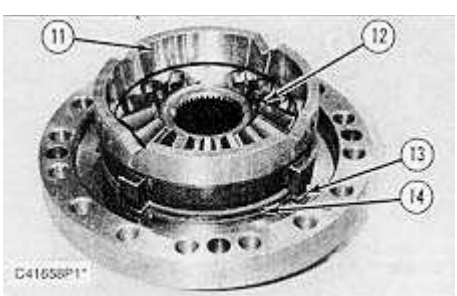


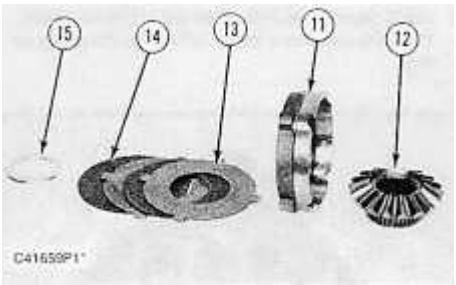

**3.** Remove bevel gear (8).




**4.** Remove four bevel pinions (10) and two pinion shafts (9).



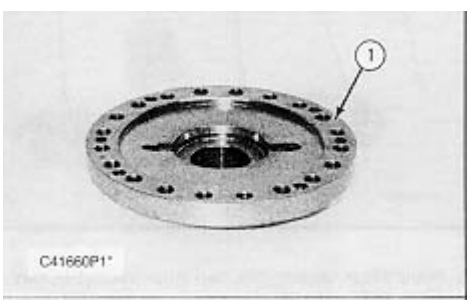



**5.** Remove bevel gear (12), pressure ring (11), two outer discs (13), two inner discs (14) and thrust washer (15).

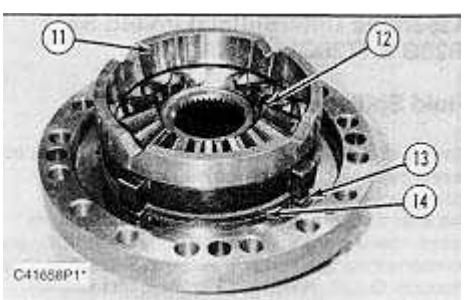
# Assemble Differential (Limited Slip) (928G & IT92G)

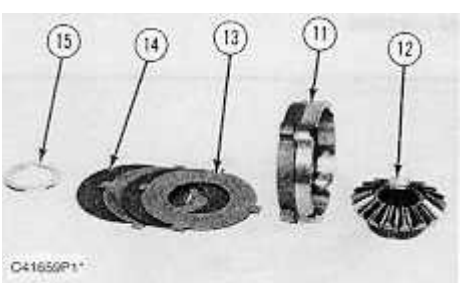
**Fluid Spillage Containment**

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids. Refer to "Tools And Shop Products Guide", NENG2500 for tools and supplies suitable to collect and contain fluids in Caterpillar machines. Dispose fluids according to local regulations and mandates.




**1.** Put differential housing cover (1) in the position shown.



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