

# **SERVICE REPAIR**

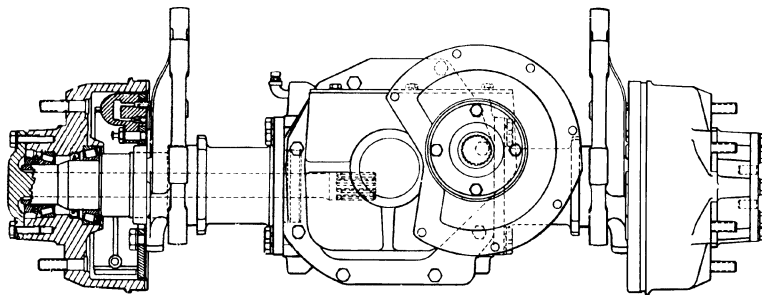
# **MANUAL**

Hyster D114 (E25XM, E30XM, E35XM, E40XMS) Electric  
Forklift

# ***HYSTER***

# **DRIVE AXLE, SPEED REDUCER, AND DIFFERENTIAL**

**E1.50-1.75XM  
(E25-35XM, E25-35XM<sub>2</sub>) [D114];  
E2.00XMS  
(E40XMS, E40XM<sub>2</sub>S) [D114];  
E1.50-2.00XM (E25-35Z, E40ZS) [E114]**



HM070102

# ***HYSTER***

# SAFETY PRECAUTIONS

## MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- **DISCONNECT THE BATTERY CONNECTOR** before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See **HOW TO PUT THE LIFT TRUCK ON BLOCKS** in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a **DO NOT OPERATE** tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

**NOTE:** The following symbols and words indicate safety information in this manual:



### **WARNING**

**Indicates a condition that can cause immediate death or injury!**



### **CAUTION**

**Indicates a condition that can cause property damage!**

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This section is for the following models:

E1.50-1.75XM (E25-35XM, E25-35XM<sub>2</sub>) [D114];  
 E2.00XMS (E40XMS, E40XM<sub>2</sub>S) [D114];  
 E1.50-2.00XM (E25-35Z, E40ZS) [E114]

**Thanks very much for your reading,  
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**"THE  
QUALITY  
KEEPERS"**

**HYSTER  
APPROVED  
PARTS**

## General

This section has the description and repair procedures for the differential, speed reducer, axle, and the wheel bearings for the axle housing.



### WARNING

The lift truck must be put on blocks for some types of maintenance and repair. The removal of the following assemblies will cause large changes in the center of gravity: mast, drive unit, battery, and the counterweight. When the lift truck is put on blocks, put additional blocks in the following positions to maintain stability:

- a. Before removing the mast and drive unit, put blocks under the counterweight so that the lift truck cannot tip backward.
- b. Before removing the battery and counterweight, put blocks under the mast assembly so that the lift truck cannot tip forward.

The surface must be solid, even, and level when the lift truck is put on blocks. Make sure that any blocks used to support the lift truck are solid, one-piece units.

Observe the previous warning before doing any repairs.

## Description

The drive unit is fastened to the frame of the lift truck with trunnions and bolts. The outer ends of the axle housings are the spindles for the wheel bearings. The cups for the tapered roller bearings for the wheel bearings are pressed into the hubs. The nut on the end of the spindle holds the hub and adjusts the preload on the wheel bearings. The axle shafts are fastened to the hubs by capscrews and the studs and nuts that fasten the wheels.

The drive axles have an oil seal between the inner and outer bearings of the hub and a second oil seal near the inner bearing.

The speed reducer and differential are parts of the same assembly. See Figure 7. One speed reducer gear is installed on the shaft of the traction motor. A second speed reducer gear is fastened to the pinion shaft for the differential.

## Drive Unit Assembly Repair

### REMOVE COMPLETE DRIVE UNIT ASSEMBLY AS A UNIT



### WARNING

The lift truck must be put on blocks for some types of maintenance and repair. The removal of the following assemblies will cause large changes in the center of gravity: mast, drive unit, battery, and the counterweight. When the lift truck is put on blocks, put additional blocks in the following positions to maintain stability:

- a. Before removing the mast and drive unit, put blocks under the counterweight so that the lift truck cannot tip backward.
- b. Before removing the battery and counterweight, put blocks under the mast assembly so that the lift truck cannot tip forward.

The surface must be solid, even, and level when the lift truck is put on blocks. Make sure that any blocks used to support the lift truck are solid, one-piece units.

**NOTE:** The drive unit assembly can be removed with the traction motor as one unit. However, many service technicians remove the traction motor before the drive unit is removed. Motor removal reduces the total weight of the drive unit assembly. If another lift truck is not available, remove the motor first. See Traction Motor, Remove to remove the traction motor.

Use the following procedure to remove the complete drive unit as one assembly using another lift truck:

1. Operate the hydraulic pump and tilt the mast fully backward. Put blocks under the bottom of the outer channel of the mast. Tilt the mast forward until the wheels just touch the floor. Put

blocks under the frame and counterweight of the lift truck and at the steer wheels to prevent truck movement.

2. Remove the battery as described in the **Operating Manual** or the section **Periodic Maintenance** 8000 SRM 552 for lift truck models E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) and the section **Periodic Maintenance** 8000 SRM 1060 for lift trucks E1.50-2.00XM (E25-35Z, E40ZS) (E114). Remove the floor plates and the access panel in the bottom of the battery compartment.
3. Remove the mast assembly as described in the section **Mast** 4000 SRM 522. Drain the oil from the differential. Remove the floor plates.
4. Disconnect the brake lines to the wheel cylinders. Put caps on the open fittings and ports.
5. Disconnect the parking brake cables at the lever assembly as described in the section **Brake System** 1800 SRM 620. Remove the tilt hose clamps from the speed reducer.
6. Disconnect the power cables from the traction motor. Make an identification of which cable is connected to each terminal. Disconnect the wires to the brush wear indicator and the thermal switch if installed.
7. Carefully move the other lift truck forks under the drive unit and install a block across the ends of the forks as a support for the motor. Slowly and carefully raise and tilt the forks to support the drive unit.
8. Make sure blocks are installed under the counterweight to maintain stability. Remove the capscrews and washers that hold the drive unit assembly to the trunnions. Remove the trunnion caps.
9. Disconnect the hydraulic line to the main control valve so that the motor mount can be disconnected. Put caps on the open hydraulic fittings and ports. Remove the capscrews that fasten the speed reducer mount at the frame. Disconnect the motor mount.
10. On lift truck models E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114), if there is a seat brake, put a weight on the seat that will hold the seat in the down position. Remove the nut,

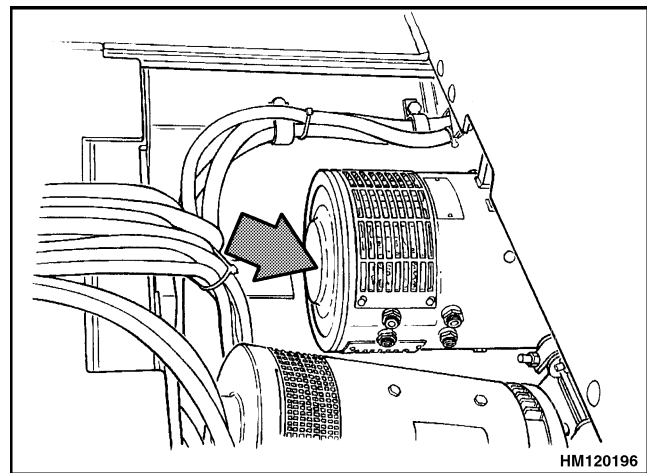
capscrew, washers, and bushing at the pivot of the brake linkage. Make a note of the arrangement of the parts for correct assembly during installation. Disconnect the spring between the linkage and the brake assembly.

**NOTE:** It can be necessary to raise the front of the lift truck frame using a crane and chains as shown in Figure 4.

11. Slowly and carefully move the drive unit assembly out from under the lift truck. Use the lift truck or a crane and slings to move the assembly to a work area to make repairs.

### TRACTION MOTOR, REMOVE

This procedure describes the removal of the traction motor through the battery compartment. See Figure 1. A lifting device can be fastened to the overhead guard to lift the motor. If a crane will be used, remove the overhead guard for crane access. The steering pump and motor must be removed for clearance. See the section **Steering System for Electric Lift Trucks** 1600 SRM 485 for lift trucks E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) and the section **Steering System for AC Electric Lift Trucks** 1600 SRM 1054 for lift trucks E1.50-2.00XM (E25-35Z, E40ZS) (E114) for removal.



**NOTE:** TRACTION MOTOR SHOWN IS USED ON E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) TRUCKS. TRACTION MOTOR USED ON E1.50-2.00XM (E25-35Z, E40ZS) (E114) IS SIMILAR.

*Figure 1. Traction Motor*



**NOTE:** The traction motor can also be removed from under the lift truck with the use of a floor jack, but it is more difficult. If the traction motor is removed from under the lift truck, the lift truck must be on blocks with enough clearance for the jack and traction motor. Some lift trucks require removal of hydraulic lines to remove the traction motor from under the lift truck.

1. Remove the battery as described in the **Operating Manual** or the section **Periodic Maintenance** 8000 SRM 552 for lift truck models E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) and the section **Periodic Maintenance** 8000 SRM 1060 for lift trucks E1.50-2.00XM (E25-35Z, E40ZS) (E114). Remove the floor plates and the access panel in the bottom of the battery compartment.
2. On lift truck models E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114), if there is a seat brake, put a weight on the seat that will hold the seat in the down position. Remove the nut, capscrew, washers, and bushing at the pivot of the brake linkage. Make a note of the arrangement of the parts for correct assembly during installation. Disconnect the spring between the linkage and the brake assembly.
3. Disconnect the power cables from the traction motor. Make an identification of which cable is connected to each terminal. Disconnect the wires to the brush wear indicator and the thermal switch if installed.

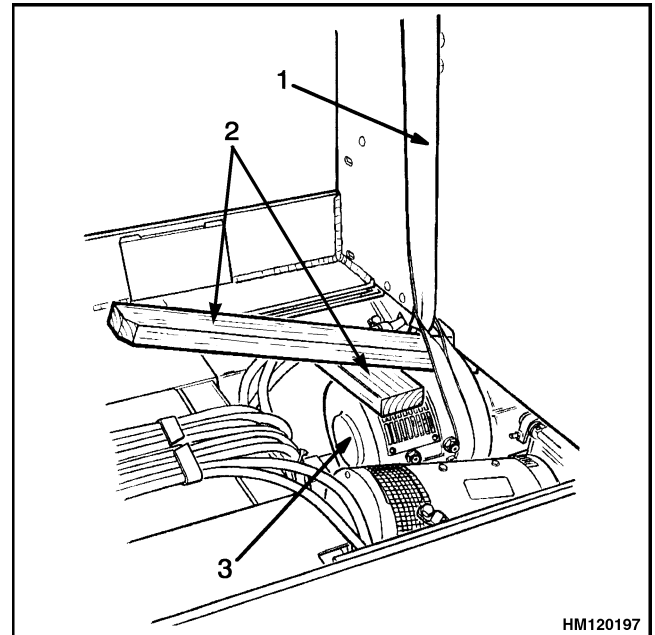


### WARNING

The motor is heavy. Make sure that any lifting device has enough capacity to lift the weight. The motor can weigh approximately 90 to 140 kg (200 to 310 lb).

4. Temporarily put the lift truck on blocks as described in the section **Periodic Maintenance** 8000 SRM 552 for lift truck models E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) and the section **Periodic Maintenance** 8000 SRM 1060 for lift trucks E1.50-2.00XM (E25-35Z, E40ZS) (E114). Raising the lift truck will allow easier access to the bottom bolts between the traction motor and the speed reducer. Install a sling to hold the traction

motor. Use a wood block and a board under the sling as shown in Figure 2 to control the traction motor during removal. Use the crane to hold the weight of the traction motor.



**NOTE:** TRACTION MOTOR SHOWN IS USED ON E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) TRUCKS. TRACTION MOTOR USED ON E1.50-2.00XM (E25-35Z, E40ZS) (E114) IS SIMILAR.

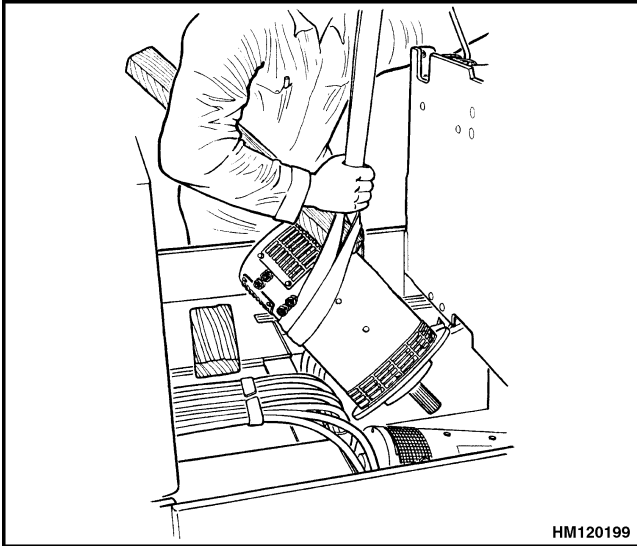
1. SLING
2. USE A WOOD BLOCK AND BOARD UNDER SLING FOR A LEVER
3. TRACTION MOTOR

**Figure 2. Install Sling to Lift Traction Motor**

5. Disconnect the motor mount. Remove the bolts between the speed reducer housing and the motor.

**NOTE:** The traction motors are in different configurations for different applications of the lift trucks. Traction motors weigh approximately 90 to 140 kg (200 to 310 lb). Make sure that the sling cannot slide and permit the traction motor to fall.

6. Use the crane to move the traction motor to a work space to make repairs as shown in Figure 3.



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**NOTE:** TRACTION MOTOR SHOWN IS USED ON E1.50-1.75XM, E2.00XMS (E25-40XMS, E25-40XM<sub>2</sub>S) (D114) TRUCKS. TRACTION MOTOR USED ON E1.50-2.00XM (E25-35Z, E40ZS) (E114) IS SIMILAR.

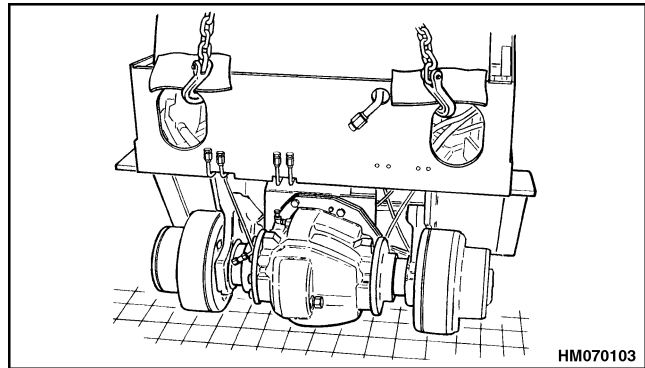
**Figure 3. Use Crane to Lift and Move Traction Motor**

**DRIVE UNIT AND SPEED REDUCER, REMOVE**

The procedure in this section will describe removal of the rest of the drive unit after the traction motor has been removed.

1. Remove the mast assembly as described in the section **Mast** 4000 SRM 522. Drain the oil from the differential. Remove the floor plates.
2. Disconnect the brake lines to the wheel cylinders. Put caps on the open fittings and ports.
3. Disconnect the parking brake cables at the lever assembly. See the section **Brake System** 1800 SRM 620. Remove the tilt hose clamps from the speed reducer.
4. Disconnect the power cables from the traction motor. Make an identification of which cable is connected to each terminal. Disconnect the wires to the brush wear indicator and the thermal switch if installed.
5. Remove the drive wheels and lower the lift truck so that the drive unit is on the floor. The crane and chains must be the support for the front of

the frame. See Figure 4. The steer wheels support the rear of the lift truck.



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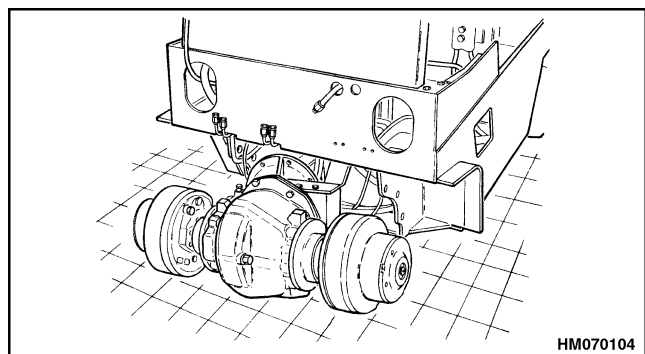
**NOTE:** DRIVE UNIT IS DIFFERENT. PROCEDURE IS THE SAME.

**Figure 4. Lower Drive Unit to Floor**

6. Make sure blocks are installed under the counterweight to maintain stability. Remove the capscrews and washers that hold the drive unit assembly to the trunnion. Remove the trunnion caps.
7. Remove the capscrews that hold the speed reducer housing to the mounts at the frame.

**NOTE:** It may be necessary to raise the front of the lift truck frame using a crane and chains as shown in Figure 4.

8. Slowly and carefully move the drive unit assembly out from under the lift truck. See Figure 5. Use a lift truck or a crane and slings to move the assembly to a work area to make repairs.



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**NOTE:** DRIVE UNIT IS DIFFERENT. PROCEDURE IS THE SAME.

**Figure 5. Slide Drive Unit from Under Lift Truck**

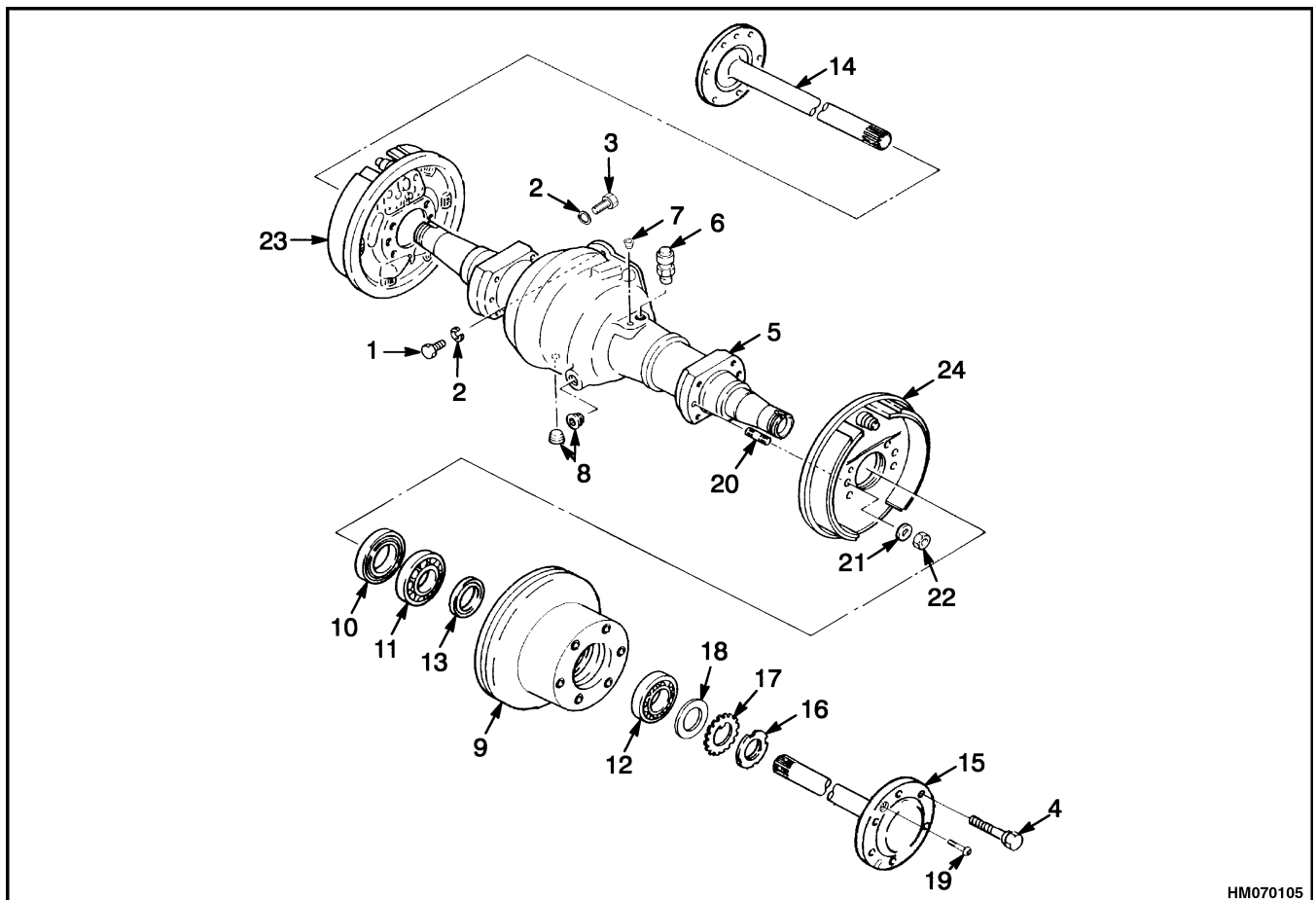
**DRIVE AXLE, DISASSEMBLE**

1. Remove the two capscrews that fasten each axle to the hub. See Figure 6. Remove the axles. If the axles are difficult to remove from the hub, hit the end of the axle flange with a hammer to loosen the axle seal and splines. Do not use a pry bar between the axle flange and the hub. Use of a pry bar can damage the seal surface and cause leaks.
2. Install blocks under the axle housing as a support when the hubs are removed.

**WARNING**

**The hub is heavy. Use care to prevent injury.**

3. Bend the lock plate so that the castle nut can be removed from the axle spindle. Remove the nut, lock plate, washer, and bearing. Carefully slide the hub on the support surface to remove it from the spindle. Hold the hub to keep the hub and spindle aligned to prevent oil seal damage. Do not permit oil or grease to get on the brake shoes.
4. Remove the inner bearing and oil seals from the spindle.



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- |                  |                   |                       |
|------------------|-------------------|-----------------------|
| 1. CAPSCREW      | 9. HUB            | 17. LOCKWASHER        |
| 2. WASHER        | 10. OIL SEAL      | 18. WASHER            |
| 3. CAPSCREW      | 11. BEARING       | 19. CAPSCREW          |
| 4. BOLT          | 12. BEARING       | 20. STUD              |
| 5. HOUSING       | 13. OIL SEAL      | 21. WASHER            |
| 6. BREATHER PLUG | 14. RH AXLE SHAFT | 22. LOCK NUT          |
| 7. PLUG          | 15. LH AXLE SHAFT | 23. RH BRAKE ASSEMBLY |
| 8. PLUG          | 16. LOCK NUT      | 24. LH BRAKE ASSEMBLY |

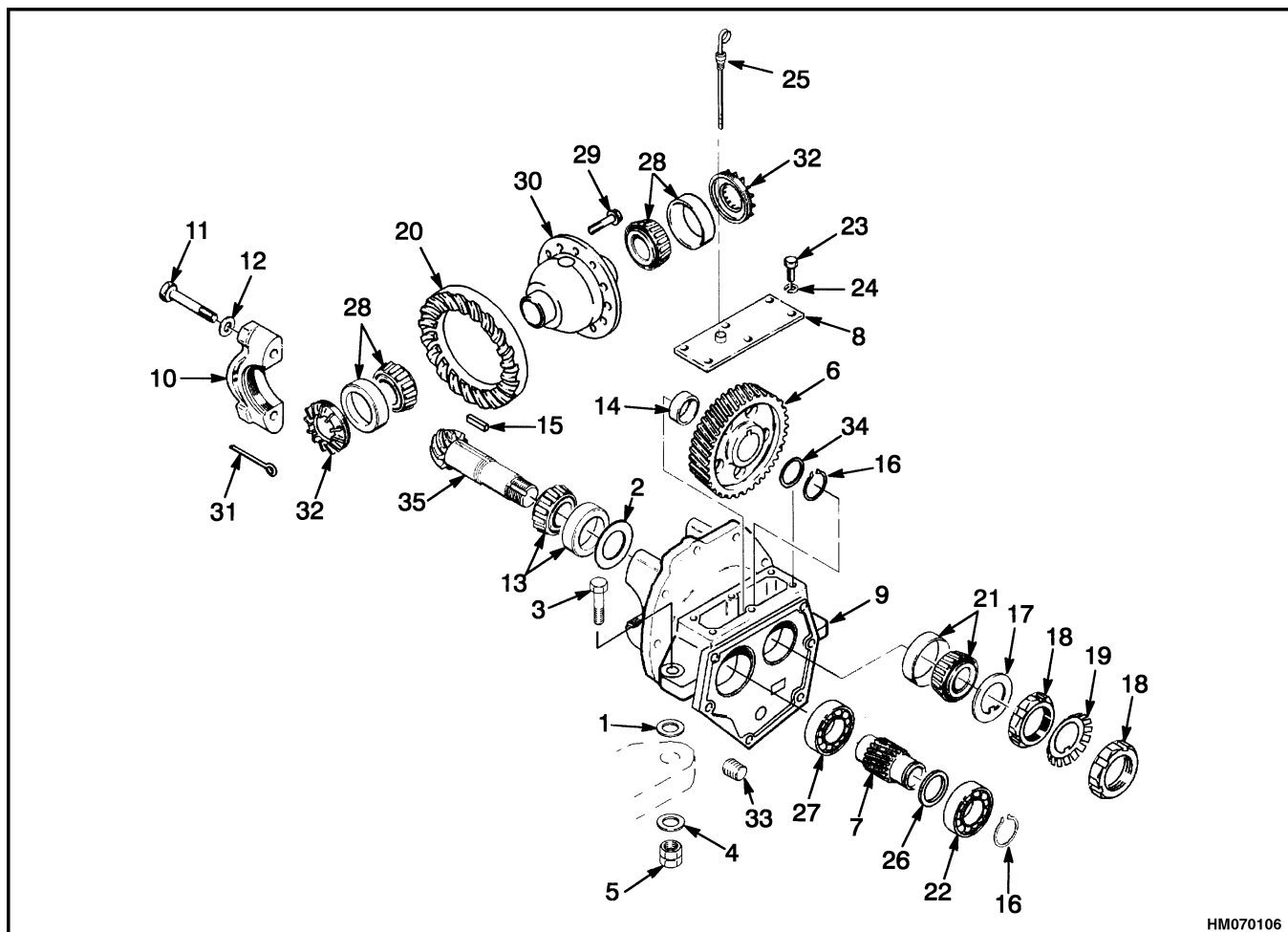
**Figure 6. Drive Axle Assembly**

5. If the brakes must be repaired, disassemble the brake assembly as described in the section **Brake System** 1800 SRM 620. If necessary, remove the brake assemblies. Remove the six washers and special lock nuts that fasten each back plate to the axle. Slide each brake assembly from the axle spindle.
6. Use a sling and crane as a support for the speed reducer. Remove the ten capscrews and washers that hold the speed reducer to the axle and differential housing. Remove the speed reducer and differential assembly from the differential housing.

2. Disassemble only the parts of the speed reducer and differential that must be repaired. If a new ring gear and pinion are not to be installed, but other new parts of the differential must be installed, check the contact pattern before disassembly. The pattern and the gear clearance are used as references for assembly. See Assembly of Drive Unit in this section for the procedures.
3. Remove the cotter pins from the adjustment nuts. Make marks on the parts so that they will be assembled again in the same positions. Remove the bearings, adjustment nuts, bearing cups, and the differential assembly. Make sure that you do not change the parts from the right and left sides of the differential.
4. Use a soft piece of metal (copper or aluminum) to prevent the speed reducer gear from turning when the nut is removed. Place the soft piece

**DIFFERENTIAL AND SPEED REDUCER, DISASSEMBLE**

1. Remove the six capscrews and washers that hold the cover to the top of the speed reducer. See Figure 7. Remove the cover.



*Figure 7. Speed Reducer and Differential Assembly*

*Legend for Figure 7*

- |                      |                    |                    |
|----------------------|--------------------|--------------------|
| 1. SHIM              | 13. BEARING        | 25. DIPSTICK       |
| 2. SHIM              | 14. SPACER         | 26. SPACER         |
| 3. CAPSCREW          | 15. KEY            | 27. BALL BEARING   |
| 4. WASHER            | 16. RETAINING RING | 28. BEARING        |
| 5. NUT               | 17. WASHER         | 29. BOLT           |
| 6. INTERMEDIATE GEAR | 18. NUT            | 30. DIFFERENTIAL   |
| 7. INPUT GEAR        | 19. LOCKWASHER     | 31. COTTER PIN     |
| 8. COVER             | 20. RING GEAR      | 32. ADJUSTMENT NUT |
| 9. HOUSING           | 21. BEARING        | 33. PLUG           |
| 10. CAP              | 22. BALL BEARING   | 34. SHIM           |
| 11. CAPSCREW         | 23. CAPSCREW       | 35. PINION         |
| 12. WASHER           | 24. WASHER         |                    |

of metal between the speed reducer gears or between the intermediate gear and the housing. Remove the nuts and lockwasher from the pinion shaft.

5. Remove the washer with the key tab and the bearing cup. Use a brass hammer to remove the pinion from the speed reducer case. The speed reducer gear and spacer will slide from the pinion shaft as it is removed from the speed reducer case. Make a note of the shim arrangement between the bearing and the spacer.
6. Remove the speed reducer gear and spacer from the housing.
7. Remove the key from the pinion shaft. Use a press to remove the bearing cone from the pinion.
8. Use a press or a puller to remove the bearing cups from the differential case.
9. Remove the ring gear. Remove the twelve cap screws. Do not use a press or a hammer to remove the ring gear.
10. Disassemble the differential. Remove the shaft, spider gears, and axle gears. See Figure 8.
11. Remove the retaining ring for the input gear to the speed reducer. Remove the gear and bearings. Use a puller to remove the inner bearing from the speed reducer case.

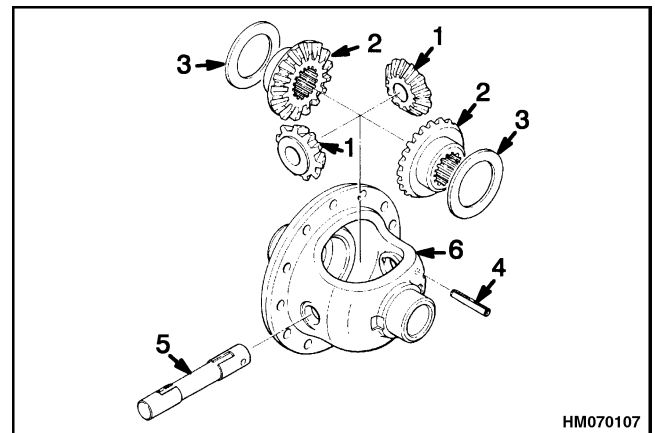
**CLEAN****WARNING**

Always wear safety glasses.

**Cleaning solvents may be flammable and toxic and can cause severe skin irritation. When using cleaning solvents, always comply with the solvent manufacturer's recommended safety precautions.**

**Compressed air can move particles so that they cause injury to the user or to other personnel. Make sure that the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.**

Clean all the parts of the drive unit assembly with a cleaning solvent. Dry the parts with compressed air.



- |                  |          |
|------------------|----------|
| 1. SPIDER GEAR   | 4. PIN   |
| 2. AXLE GEAR     | 5. SHAFT |
| 3. THRUST WASHER | 6. CASE  |

*Figure 8. Differential Assembly*

**INSPECT**

Inspect all the parts of the drive unit assembly for wear or damage. Normally all bearings are replaced on an assembly that is disassembled. Always use new seals during assembly. Make sure all surfaces that take a sealant or gasket have been completely cleaned and all sealant or gasket removed. Inspect all machined surfaces for wear, scratches or other damage.

1. Check the pinion and ring gear for wear. Inspect the spider gears and axle gears for worn teeth. Inspect the shaft for wear where the gears turn. The shaft and the holes for the shaft in the differential case must fit tightly.
2. Inspect the bearings and seals for defects.
3. The splines for the axle shafts must not be damaged.

**Assembly of Drive Unit**

**FIND CORRECT SHIM SET FOR HYPOID GEAR**

**NOTE:** If the ring gear and pinion are worn or damaged, a new set must be installed. The ring and pinion must have the same reference numbers. When the pinion bearings are replaced or the ring and pinion are replaced, the shim arrangement must be adjusted for the new parts. Service technicians must often make more than one adjustment before the clearances are correct. The installation procedures in Pinion, Assemble and Install and Differential and Ring Gear, Assemble and Install must also be done each time the adjustment is changed. The adjustments are correct when the gear clearance and contact pattern between the ring and pinion are correct, and the preload on the pinion bearings is correct.

Distance is the distance from the center of the ring gear to the bearing shoulder behind the pinion gear. Shims must be added between the bearing cup and the housing for correct alignment of the pinion and ring gear.

Look at the number on the pinion that was removed. Subtract the variation number that is on the new pinion. The remainder is the amount of shim thickness that must be adjusted from the shim set on the pinion that was removed. For examples, see Table 1. In example 3, you can see that a negative number shows that shims must be removed. Examples 1 and 2 and 4 show that shims must be subtracted from the original shim set. Use this new shim set as a reference. The final adjustment of the shim set is according to the contact pattern on the ring gear teeth. See Ring and Pinion Tooth Contact Adjustment.

The dimension on the end of the pinion is the variation from the standard Gauge Distance. The Gauge

*Table 1. Shims Adjustment for Pinion*

<b>Examples</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
If the numbers are given in inches: Number on OLD GEAR Number on NEW GEAR	+0.012 - (+0.010)	+0.012 - (-0.010)	+0.010 - (+0.012)	-0.010 - (-0.012)
Shims to be Removed from Old Set	+0.002 in.	+0.022 in.	-0.002 in. (Add Shims)	+0.002 in.
If the numbers are given in millimeters: Number on OLD GEAR Number on NEW GEAR	+0.31 - (+0.26)	+0.31 - (-0.26)	+0.26 - (+0.31)	-0.26 - (-0.31)
Shims to be Removed from Old Set	+0.05 mm	+0.57 mm	-0.05 mm (Add Shims)	+0.05 mm

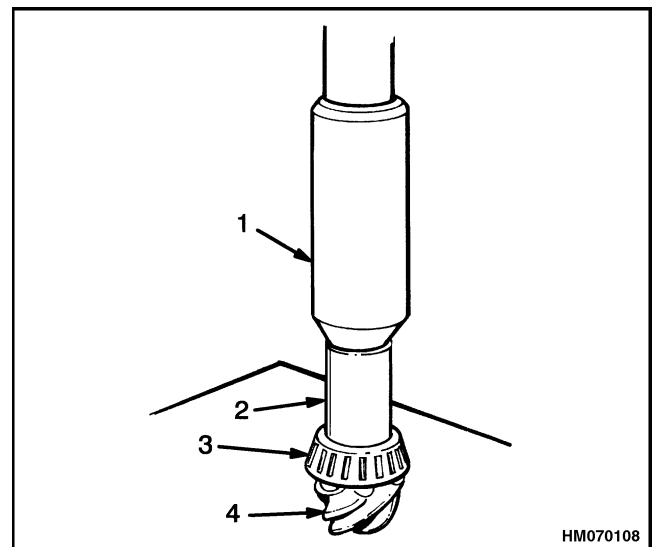
## PINION, ASSEMBLE AND INSTALL

**NOTE:** If the pinion and ring gear were not replaced, install the original shim set. If a new ring gear and pinion are being installed, first find the correct shim set as described in Differential and Ring Gear, Assemble and Install.

1. Install the shims in the speed reducer housing for the pinion shaft. If the bearing cups for the pinion were removed, install them in the housing.
2. Use a press to install the bearing cone on the pinion. Put differential oil in the bearing and install the spacer on the pinion shaft. See Figure 9.
3. Install the correct shim set into the pinion gear bore. Put the spacer and intermediate gear in the housing. See Figure 10. Align the key slots for the intermediate gear and pinion shaft. Install the pinion in the housing and through the spacer and speed reducer gear. Install the key in the key slots.
4. Install the other shim set on the pinion shaft against the speed reducer gear. The original shim set can be used if both the pinion and intermediate gear were not replaced. Install the retaining ring. The clearance between the shim set and intermediate gear must be 0.1 mm (0.004 in.) maximum. If necessary, remove shims for the correct clearance.
5. Put differential oil in the bearing and install the bearing cone, the washer, and one lock nut. Do NOT install the new lockwasher with the tab or the other lock nut at this time.
6. Use a soft piece of metal (copper or aluminium) to prevent the speed reducer gear from turning when the lock nut is tightened. Place the soft

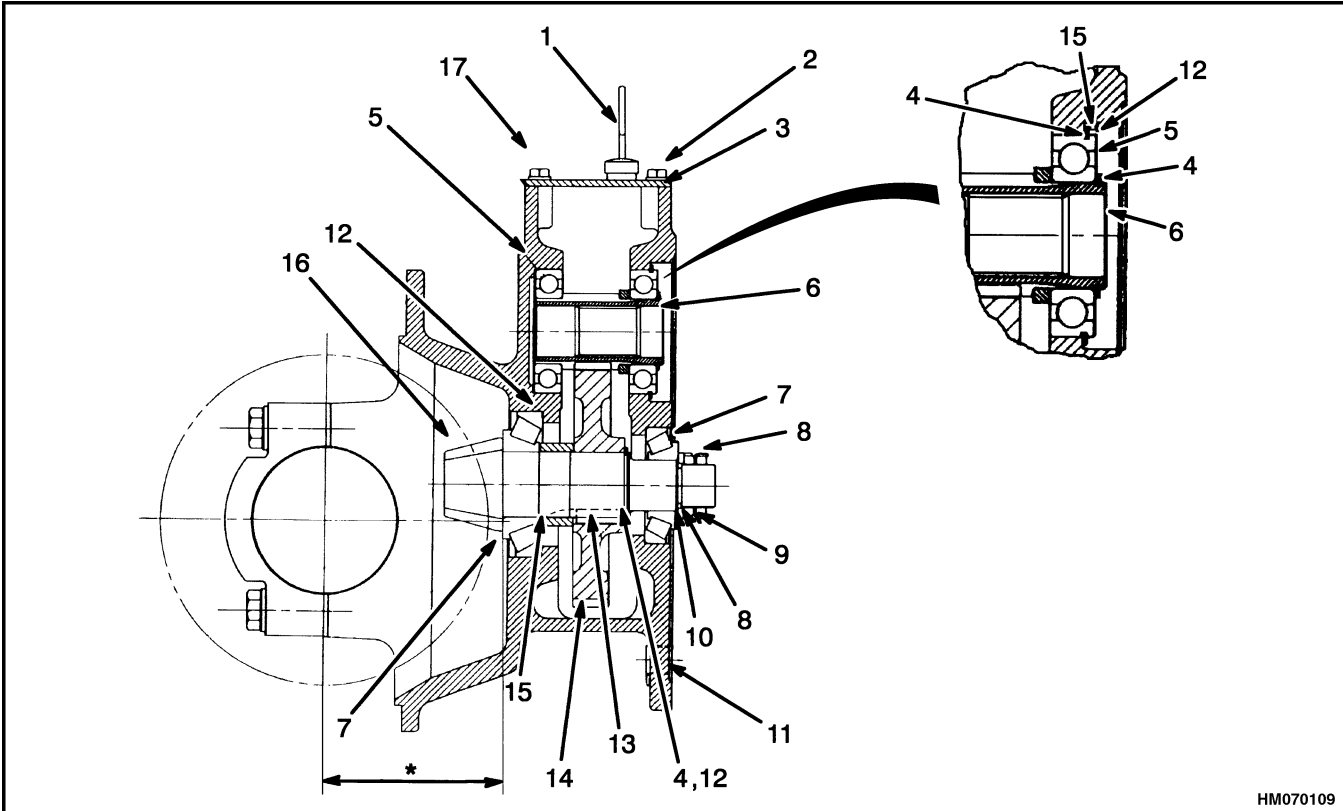
piece of metal between the intermediate gear and the housing. Tighten the lock nut, remove the soft piece of metal, and check for a rotating torque of 5.4 to 5.9 N•m (48 to 52 lbf in) at the lock nut. Lightly hit the outside of the housing to adjust the bearings in their seats. Do the sequence of this step until the measured rotating torque is correct.

7. Install the lockwasher and the other lock nut on the pinion shaft. Tighten the lock nut. Do NOT bend the lockwasher tab into the lock nut until the correct clearance and backlash have been set. Refer to Step 11 of Differential and Ring Gear, Assemble and Install. Also refer to Find Correct Shim Set for Hypoid Gear.



- |           |                 |
|-----------|-----------------|
| 1. PRESS  | 3. BEARING CONE |
| 2. SLEEVE | 4. PINION       |

**Figure 9. Use Press to Install Pinion Parts**



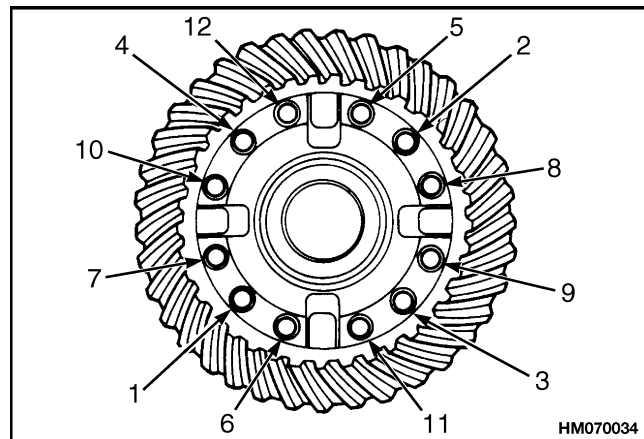
- |                          |                   |  |
|--------------------------|-------------------|--|
| 1. DIPSTICK              | 7. ROLLER BEARING | 13. KEY                                    |
| 2. COVER                 | 8. LOCK NUT       | 14. INTERMEDIATE GEAR                      |
| 3. SPEED REDUCER HOUSING | 9. LOCKWASHER     | 15. SPACER                                 |
| 4. RETAINING RING        | 10. WASHER        | 16. HYPOID GEAR SET (PINION AND RING GEAR) |
| 5. BALL BEARING          | 11. PLUG          | 17. CAPSCREW                               |
| 6. INPUT GEAR            | 12. SHIMS         |  |

\*THE GAUGE DISTANCE IS 122 mm (4.8 in.) PLUS OR MINUS THE VARIATION SHOWN ON THE END OF THE PINION. THE ADJUSTMENT MUST BE WITHIN  $\pm 0.1$  mm ( $\pm 0.004$  in.) OF THE ACTUAL DISTANCE.

**Figure 10. Speed Reducer Assembly**

**DIFFERENTIAL AND RING GEAR, ASSEMBLE AND INSTALL**

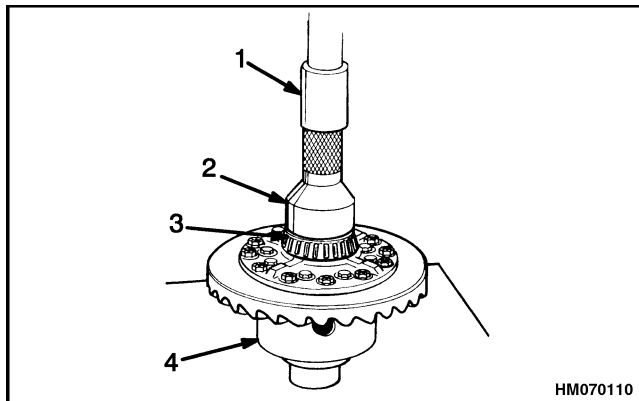
1. If the ring gear was removed from the differential case, make sure the bolt holes are aligned and install the ring gear on the differential case. Do not use a press or a hammer to install the ring gear. Apply Loctite® 277 to the threads of the bolts. Install the twelve capscrews. Tighten the capscrews in a cross pattern to 152 to 167 N•m (112 to 123 lbf ft). See Figure 11. Make sure the ring gear is in the correct position against the flange of the differential case.



**Figure 11. Tighten Hex Head Screws in Cross Pattern**



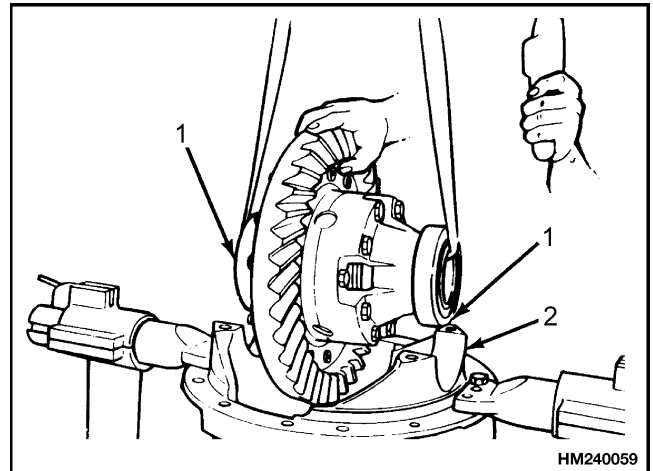
2. Lubricate and install the axle gears and thrust washers in the differential case as shown in Figure 8.
3. Install the spider gears and shaft in the differential case. Install the roll pin that holds the shaft in the differential case as shown in Figure 8.
4. Install the bearing cones on the differential case. See Figure 12.



- |           |                      |
|-----------|----------------------|
| 1. PRESS  | 3. BEARING CONE      |
| 2. SLEEVE | 4. DIFFERENTIAL CASE |

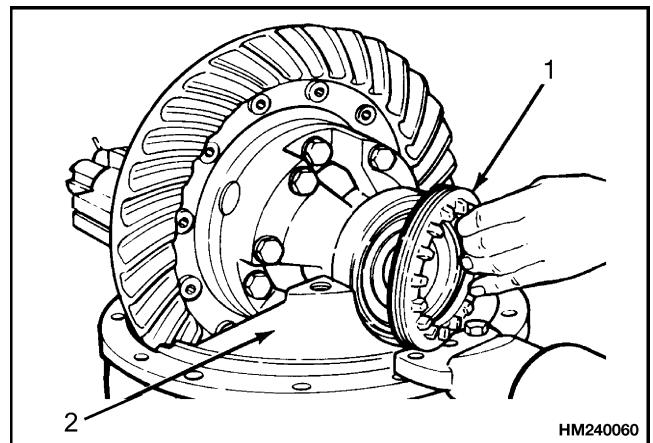
**Figure 12. Bearing Cones Installation**

5. Apply axle lubricant on the inner diameter of the bearing cups and on both bearing cones that are installed on the differential. Do not permit lubricant on the outer diameter of the bearing cups or the bearing bores of the housing.
6. Install the differential assembly into the housing. See Figure 13. The bearing cups must fit correctly into the bores of the housing.
7. Install the two bearing adjustment nuts into position in the housing bores. See Figure 14. Use your hand to tighten each adjustment nut against the bearing cup.



- |                |            |
|----------------|------------|
| 1. BEARING CUP | 2. HOUSING |
|----------------|------------|

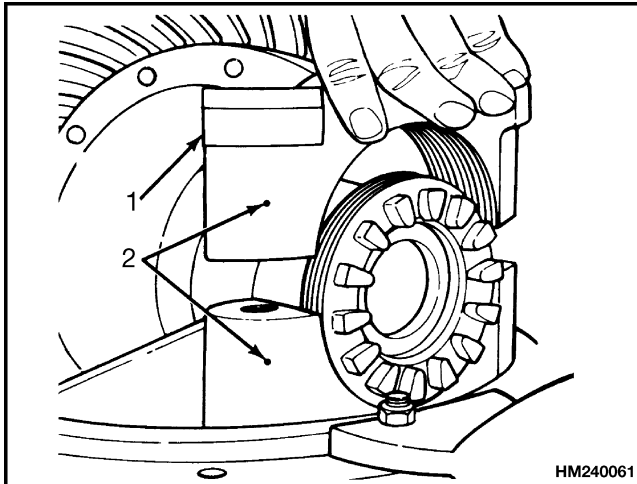
**Figure 13. Differential Assembly Installation into Housing**



- |                   |            |
|-------------------|------------|
| 1. ADJUSTMENT NUT | 2. HOUSING |
|-------------------|------------|

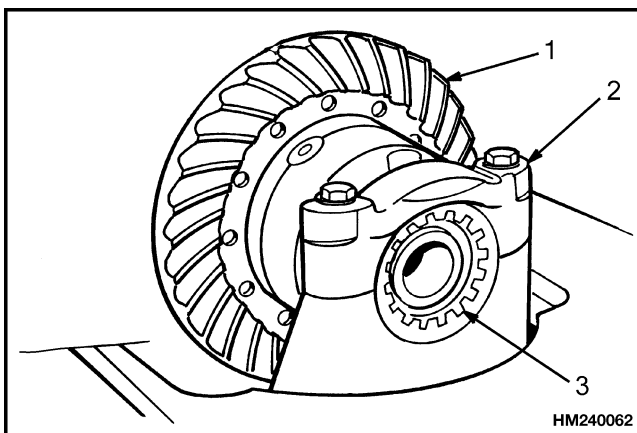
**Figure 14. Adjustment Nuts Installation**

8. Align the marks on the bearing caps with the marks on the housing. See Figure 15 and Figure 16. Apply Loctite® to the threads, and install and tighten the bolts for the bearing caps to 263 to 315 N•m (194 to 233 lbf ft).



- 1. BEARING CAP
- 2. ALIGNMENT MARKS

**Figure 15. Bearing Caps Installation**



- 1. RING GEAR
- 2. BEARING CAP
- 3. ADJUSTMENT NUT

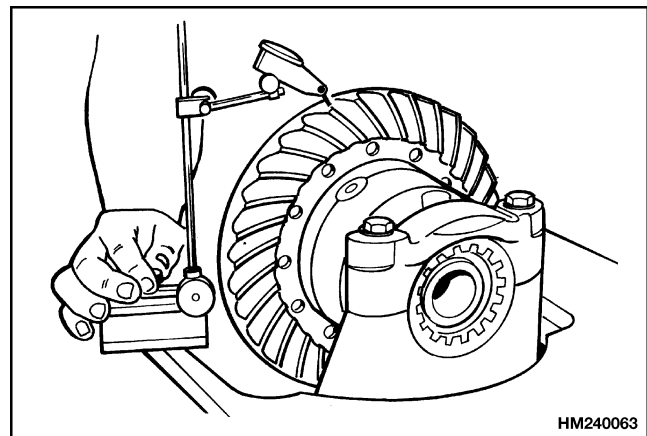
**Figure 16. Bearings Caps and Adjustment Nuts Installation**

9. Tighten the adjustment nuts to remove the clearance between the adjustment nuts and the bearings. Make sure there is clearance between the ring gear and pinion. Loosen the adjustment nut only until there is zero clearance between the bearings and the adjustment nuts. Tighten each adjustment nut two notches more than zero clearance to put a preload on the bearings.

10. Check the clearance between the ring gear and pinion. The ring gear and pinion must have a

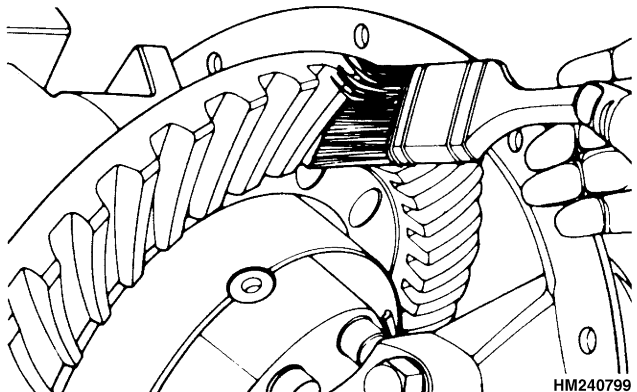

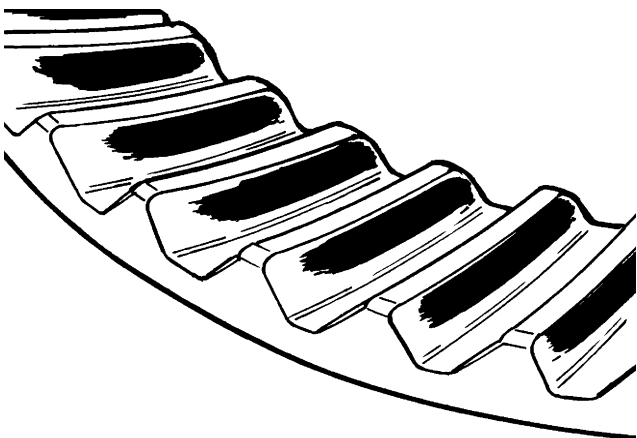
clearance of 0.15 to 0.2 mm (0.006 to 0.008 in.). See Figure 17. Use the adjustment nuts to move the ring gear toward the pinion to decrease the clearance. Move the ring gear away from the pinion to increase the clearance. Loosen one adjustment nut the same amount as the other adjustment nut is tightened to adjust the clearance between the ring gear and pinion. When the clearance is correct, tighten the capscrews for the bearing caps to 263 to 315 N•m (194 to 233 lbf ft).

- 11. Check the pattern on the teeth of the ring gear. Apply an indicator color (Prussian Blue or Yellow) or grease to the teeth. Use a pry bar between the edge of the ring gear and the housing to keep the ring gear from turning freely. Turn the pinion shaft. Compare the pattern on the ring gear teeth with the patterns shown in Ring and Pinion Tooth Contact Adjustment. Adjust the gear clearances as necessary. As shown in the adjustment procedures above, the pinion can also need adjustment. Refer to Find Correct Shim Set for Hypoid Gear and Pinion, Assemble and Install to adjust the pinion. An adjustment of the pinion to move the contact pattern also normally requires an adjustment of the ring gear clearance as described in Step 10.
- 12. After the adjustments and wear pattern are correct, install the cotter pins to lock the adjustment nuts.

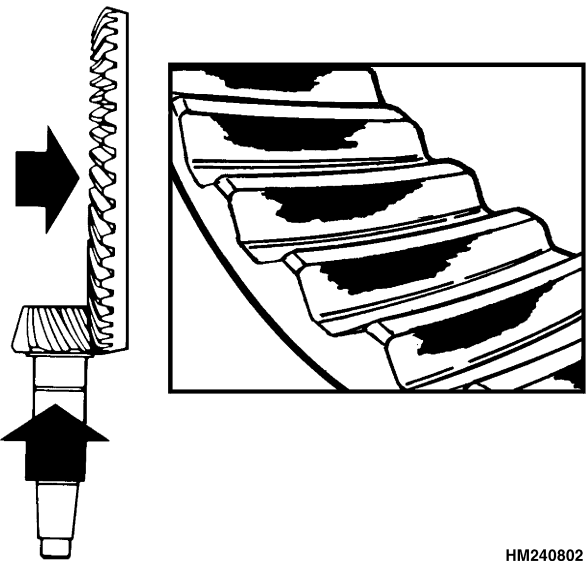
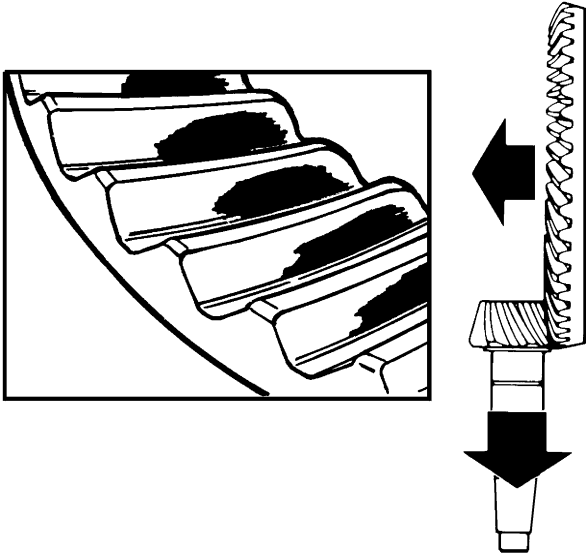


**Figure 17. Clearance Check Between Ring Gear and Pinion**

**Table 2. Ring and Pinion Tooth Contact Adjustment**

<p>1. Apply a colored dye or grease to approximately 12 of the ring gear teeth.</p>	 <p style="text-align: right;">HM240799</p>
<p>2. Rotate ring gear forward and backward so that the 12 gear teeth go past the drive six times to get to the contact patterns. Repeat if needed to get a clearer pattern.</p>	
<p>3. Check the tooth contact pattern on the ring gear. Make sure that the pattern is checked on the side of the tooth where the pinion applies the force.</p>	
<p><b>Correct Tooth Contact</b></p>	
<p>The contact area is the center between the top and bottom of the tooth. The contact area is toward the inner circumference of the ring gear.</p>	<p><b>NOTE:</b> Normal pattern during adjustment shown.</p>  <p style="text-align: right;">HM240800</p>
<p>The contact area is the center between the top and the bottom of the tooth. The contact area will be almost the full length of the tooth.</p>	<p><b>NOTE:</b> Wear pattern from operation shown.</p>  <p style="text-align: right;">HM240801</p>

*Table 2. Ring and Pinion Tooth Contact Adjustment (Continued)*

<b>Incorrect Tooth Contact</b>	
<p>The pinion is too far away from the center of the gear. Add shims to move pinion toward ring gear. Check that the clearance is correct. Some movement of ring gear away from pinion may be necessary.</p>	 <p style="text-align: right;">HM240802</p>
<p>The pinion is too close to the center of the ring gear. Remove shims to move pinion away from the ring gear. Check that the clearance is correct. Some movement of the ring gear toward the pinion may be necessary.</p>	 <p style="text-align: right;">HM240879</p>

**INPUT GEAR FOR SPEED REDUCER, ASSEMBLE**

1. Install the ball bearing in the end of the bore in the speed reducer case. Install the spacer, the other ball bearing, and the retainer on the input gear. Install the input gear assembly into the speed reducer case. Install the retaining ring to fasten the bearing in the housing.

2. Measure the clearance between the bearing and the retainer on the input gear. There must be 0 to 0.1 mm (0 to 0.004 in.) clearance. If necessary, remove the retainer and add enough shims so that the clearance is no more than 0.1 mm (0.004 in.). Install the retainer.

3. Make sure the cover of the speed reducer is clean without any old sealant on the cover or housing. Use new sealant and install the cover using the six capscrews and washers. Tighten the cover capscrews to 21 to 25 N•m (15 to 18 lbf ft).
4. If the traction motor will be installed as part of the drive unit assembly, it can be installed now. Install traction motor as described in Traction Motor, Install.

### DRIVE AXLE AND HUB ASSEMBLY, ASSEMBLE

1. Make sure the axle housing and differential assembly are clean with no old sealant. Apply liquid sealant to the axle housing, and install the differential assembly and speed reducer into the axle housing. The two M10 × 1.5 × 30 bolts go into the top holes that fasten the housings together. Install the other six M10 × 1.5 × 35 bolts to fasten the two housings together. Tighten the bolts to 41 to 49 N•m (30 to 37 lbf ft).

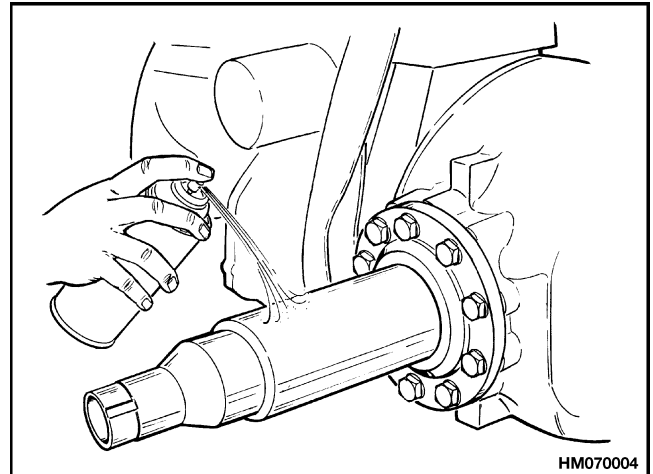
**NOTE:** If any of the studs for the nuts that fasten the brake assemblies are damaged, the studs must be replaced. Use two nuts tightened together on the stud to remove the old stud. It can be necessary to heat the stud area to remove a stud. Use Loctite® on the replacement stud. Use two nuts tightened together on the stud and tighten the stud to 18.8 to 31.3 N•m (13.9 to 23.1 lbf ft). Remove the two installation nuts.

2. Install the special nuts that hold each brake assembly on the drive axle assembly. Tighten the special nuts to 98 N•m (72 lbf ft).
3. Lubricate the axle spindles with differential oil and slide the brake assembly on to the axle spindles. See Figure 18. Install the washers and lock nuts that hold the brake assembly. Tighten the lock nuts to 98 N•m (72 lbf ft).

**NOTE:** The outer wheel bearing is lubricated by gear oil from the axle housing. The inner wheel bearing is lubricated by wheel bearing grease. Do not use too much grease to lubricate the inner wheel bearing so that grease is pushed past the seal into the area for the brakes.

4. Install new oil seals in each hub. Install the oil seal with the lip toward the outer bearing. Install

the inner bearing and seal. Put wheel bearing grease on the inner bearing.



**Figure 18. Lubricate Axle Spindles**

5. Install the hub on the axle spindle. Be careful that the seals are not damaged during installation.
6. Install the outer bearing cone on the spindle. Install the washer and lockwasher. Install the lock nut. Tighten the nut until the hub cannot rotate, then loosen nut 30 to 60° until the hub turns freely. The torque must be less than 27 N•m (20 lbf ft). Tighten the nut to 34 N•m (25 lbf ft) or until the first alignment position after 34 N•m (25 lbf ft). Bend the lock plate over the nut. See Figure 19.
7. Adjust the clearance of the brake shoes as described in the section **Brake System** 1800 SRM 620.
8. Make sure the surfaces are clean with no old sealant and put liquid sealant on the flange of the axle shaft. See Figure 20. Install the axle shafts. Install the two capscrews and tighten them.

**NOTE:** If any of the studs for the drive wheels are damaged, the studs must be replaced. Use two nuts tightened together on the stud to remove the old stud. It can be necessary to heat the stud area to remove a stud. Use Loctite® on the replacement stud. Use two nuts tightened together on the stud and tighten the stud to 30 to 50 N•m (22 to 37 lbf ft). Remove the two installation nuts.