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This section is for the following models:

S/E2.00-3.20XL (S/E40-60XL) [A187, B187, C187, C108];
 E2.00-3.20XM (E45-65XM, E45-65XM₂) [F108];
 S2.00-3.20XM (S40-65XM) [D187];
 N30XMH, N30XM₂H [A210, C210];
 V30ZMD [D210/E210];
 E2.00-3.20XM (E45-65Z) [G108]

General

This section has the description and repair procedures for the steering axle. See the following sections for additional information on the parts of the steering system:

- **Steering Control Unit (Ross HGF)** 1600 SRM 257 for lift truck models S/E2.00-3.20XL (S/E40-60XL) (A187, B187, C187, and C108)
- **Steering Housing and Control Unit** 1600 SRM 720 for lift truck models E2.00-3.20XM (E45-65Z) (G108), E2.00-3.20XM (E45-65XM₂) (F108), and V30ZMD (D210/E210)
- **Steering Housing and Control Unit** 1600 SRM 512 for lift truck models E2.00-3.20XM (E45-65XM) (F108), S2.00-3.20XM (S40-65XM) (D187), and N30XMH, N30XMH₂H (A210, C210)
- **Hydraulic System and Gear Pump** 1900 SRM 130 for lift truck models S2.00-3.20XL (S40-60XL) (A187, B187, and C187)
- **Hydraulic System** 1900 SRM 286 for lift truck models E2.00-3.20XL (E40-60XL) (C108)
- **Hydraulic System** 1900 SRM 513 for lift truck models S2.00-3.20XM (S40-65XM) (D187)
- **Hydraulic System** 1900 SRM 559 for lift truck models N30XMH, N30XM₂H (A210, C210), V30ZMD (D210/E210), E2.00-3.20XM (E45-65XM, E45-65XM₂) (F108) and E2.00-3.20XM (E45-65Z) (G108)
- **Steering System** 1600 SRM 459 for lift truck models S2.00-3.20XL (S40-60XL) (A187, B187, and C187)
- **Steering System for Electric Lift Trucks** 1600 SRM 485 for lift truck models E2.00-3.20XL (E40-60XL) (C108), E2.00-3.20XM (E45-65XM₂) (F108), and N30XMH, N30XM₂H (A210, C210)
- **Steering System for AC Electric Lift Trucks** 1600 SRM 1054 for lift truck models V30ZMD (D210/E210) and E2.00-3.20XM (E45-65Z) (G108)

Description

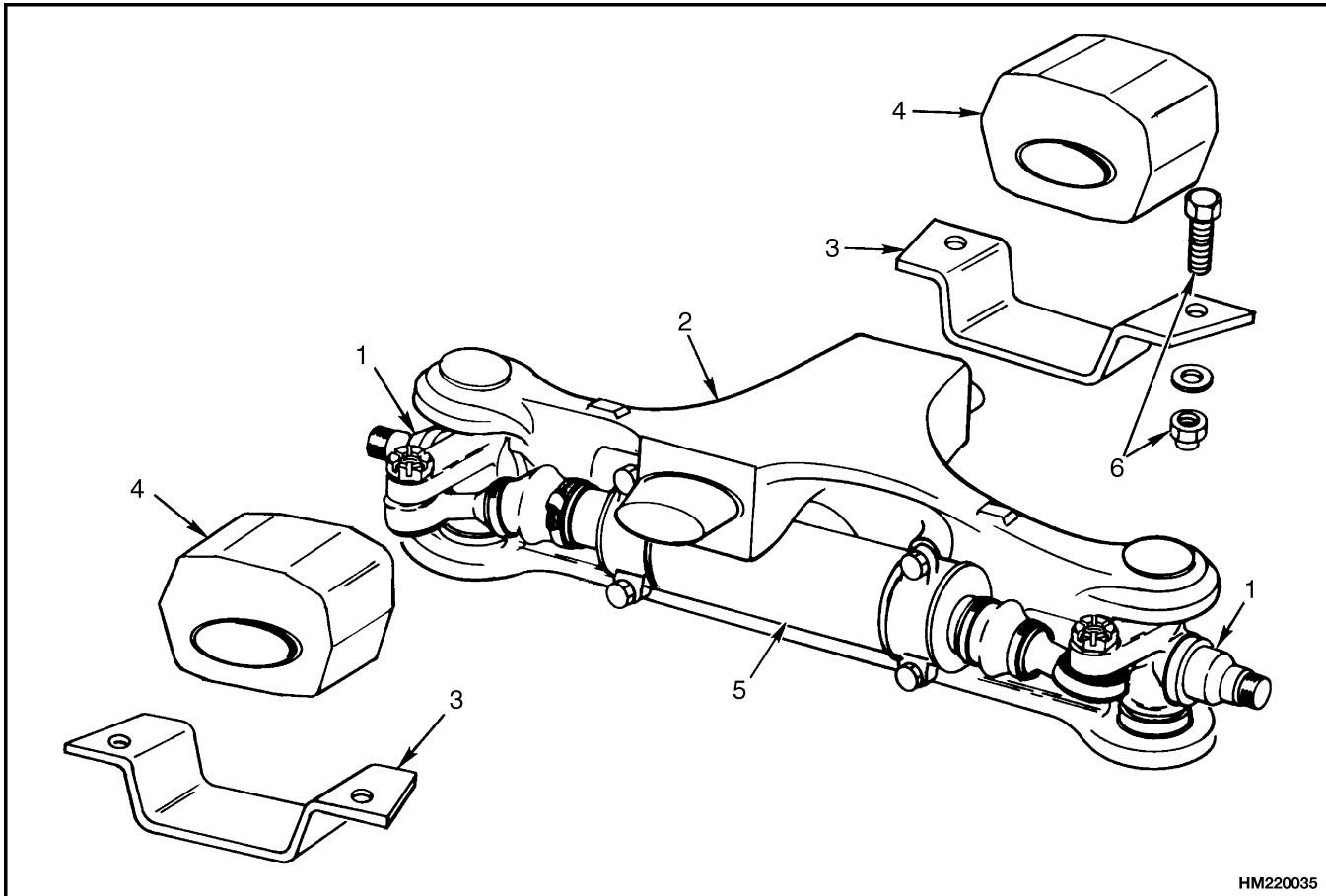
The steering axle assembly includes an axle frame, steering cylinder, and two spindle assemblies. See Figure 1. The steering axle is articulated and is connected to the frame by center pivot mounts. The center pivot mounts permit the steering axle to move in the frame mount when the lift truck travels over rough surfaces.

The end caps of the steering cylinder are also the mounts for the cylinder and are held to the shell by the mount capscrews. There are O-rings, seals, and wipers in the end caps to seal the caps to the shell and rod. The ends of the piston rod extend from both ends of the cylinder. A single piston and the seal are at the center of the rod. Oil pressure on one side of the piston moves the piston in the bore. The piston pushes an equal amount of oil from the opposite side of the cylinder.

When the piston reaches the end of the stroke, a relief valve in the steering circuit controls the oil pressure. The tie rods that connect the spindle arms to the cylinder are not adjustable.

Each spindle turns on two tapered roller bearings in mounts in the axle frame. The preload on the bearings is controlled by shims at the lower bearing cap.

The wheels rotate on two tapered roller bearings and are held on the spindles by a castle nut. The bearing preload of the wheels is adjusted by the castle nut. The grease seals protect the bearings from dirt and water.



- 1. SPINDLE ASSEMBLY
- 2. AXLE FRAME
- 3. BRACKET

- 4. RUBBER MOUNT
- 5. STEERING CYLINDER
- 6. NUT AND BOLT

Figure 1. Steering Axle

(More Content includes: Brake system, Capacities, and specifications, Frame, Hydraulic, System, Industrial battery, Main control, Valve, Mast repair, Fasteners, Schematics diagrams, Steering axle, Steering system, Wire harness repair And more)

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Steering Axle Assembly Replacement

REMOVE



WARNING

PUTTING THE LIFT TRUCK ON BLOCKS

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

- If the mast and drive axle are removed, put blocks under the counterweight so the lift truck cannot fall backward.
- If the battery (electric lift trucks) or counterweight is removed, put blocks under the mast so that the lift truck cannot fall forward.

Put the lift truck on blocks on a solid, even, and level surface. Make sure the blocks or stands have enough capacity to hold the lift truck. Use additional blocks next to the tires as necessary to prevent movement of the lift truck. Make sure the lifting devices used during repairs can lift the weight of the parts and assemblies.

See the Operating Manual or Periodic Maintenance section for your lift truck model, for the procedures to put the lift truck on blocks.

The steering axle can be removed without removing the counterweight; the job is easier with the counterweight removed. See Figure 1.

1. Install an eye bolt in top of counterweight. Remove counterweight. See the sections
 - **Frame** 100 SRM 558 for lift truck models E2.00-3.20XM (E45-65XM, E45-65XM₂ (F108), N30XMH, N30XM₂H (A210, C210), V30ZMD (D210/E210), and E2.00-3.20XM (E45-65Z) (G108)
 - **Frame** 100 SRM 284 for lift truck models E2.00-3.20XL (E40-60XL) (C108)
 - **Frame** 100 SRM 505 for lift truck models S2.00-3.20XM (S40-65XM) (D187)
 - **Frame** 100 SRM 254 for lift truck models S2.00-3.20XL (S40-60XL) (A187, B187, and C187)

for procedures to remove the counterweight.

2. Make sure wheels are set for straight travel. Put lift truck on stands so the steering axle will have enough clearance to be removed. The top of the axle frame must have clearance under the bottom of the frame at the rear of the lift truck.
3. Disconnect hydraulic lines at steering cylinder. Install plug fittings in cylinder and put caps on hydraulic lines. Plug fittings will prevent spindles from turning as axle is removed from under the lift truck.
4. Slide floor jack or forks of another lift truck under steering axle. Raise lifting device until it holds the weight of the axle assembly. Remove four capscrews and nuts that fasten two brackets under rubber mounts. Remove brackets and slowly lower axle assembly onto wheels. Carefully roll axle assembly away from lift truck.

INSTALL

1. Install rubber mounts on axle. Make sure face of rubber mount with the part number is away from the axle. Make sure part number will be right side up after axle assembly is installed. See Figure 1.
2. Apply lubricant that is approved for use with rubber to rubber mount. The lubricant is used where mount and frame join.
3. Use floor jack or another lift truck to put steering axle into position in frame. Make sure rubber mounts fit inside frame brackets for mounts.
4. Install bottom brackets. Tighten four bracket bolts and nuts to 88 N•m (65 lbf ft).
5. Remove plugs and caps and connect hydraulic lines to steering cylinder.
6. Operate steering system to remove air from system. Turn steering wheel several times from one stop to the other. Check for hydraulic leaks.

Wheels Repair

REMOVE AND DISASSEMBLE

1. Put axle on blocks so wheels just touch the floor. Remove grease cap. Remove cotter pin and castle nut. Remove bearing cone. Slide wheel from spindle. Remove inner bearing cone and seal from spindle. See Figure 2.
2. If the bearings must be replaced, use a brass drift to remove bearing cups and wear sleeve.
3. Repeat procedure for other wheel.

CLEAN



WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety procedures.

Clean all parts with solvent. Make sure bearings are clean.

INSPECT

Inspect the spindle and make sure that it does not have any rough or sharp areas that would prevent the bearings from being correctly installed. If necessary, smooth any rough or sharp areas before installing the bearings.

ASSEMBLE AND INSTALL

1. If necessary, use a press to install new bearing cups in wheel. See Figure 2 or Figure 3. If necessary, install new wear sleeve in wheel. Install

grease seal on spindle. Lubricate bearing cones with grease. Make sure bearings are filled with grease. Install inner bearing cone on spindle.



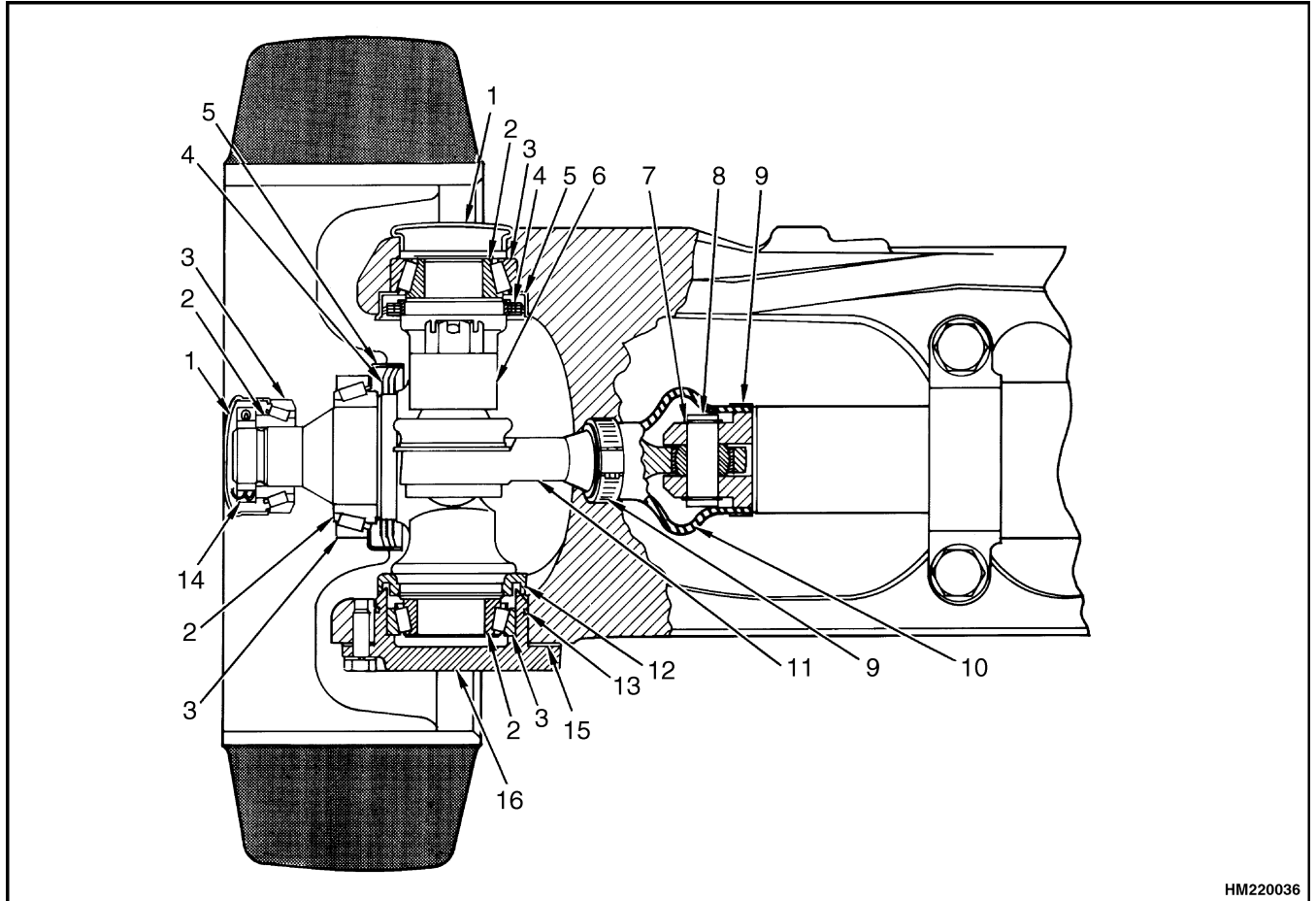
CAUTION

Do not damage the seals during installation.

2. Carefully slide wheel onto spindle. Install outer bearing cone, and install the washer.

NOTE: If the lift truck is an older model, go to Step 8.

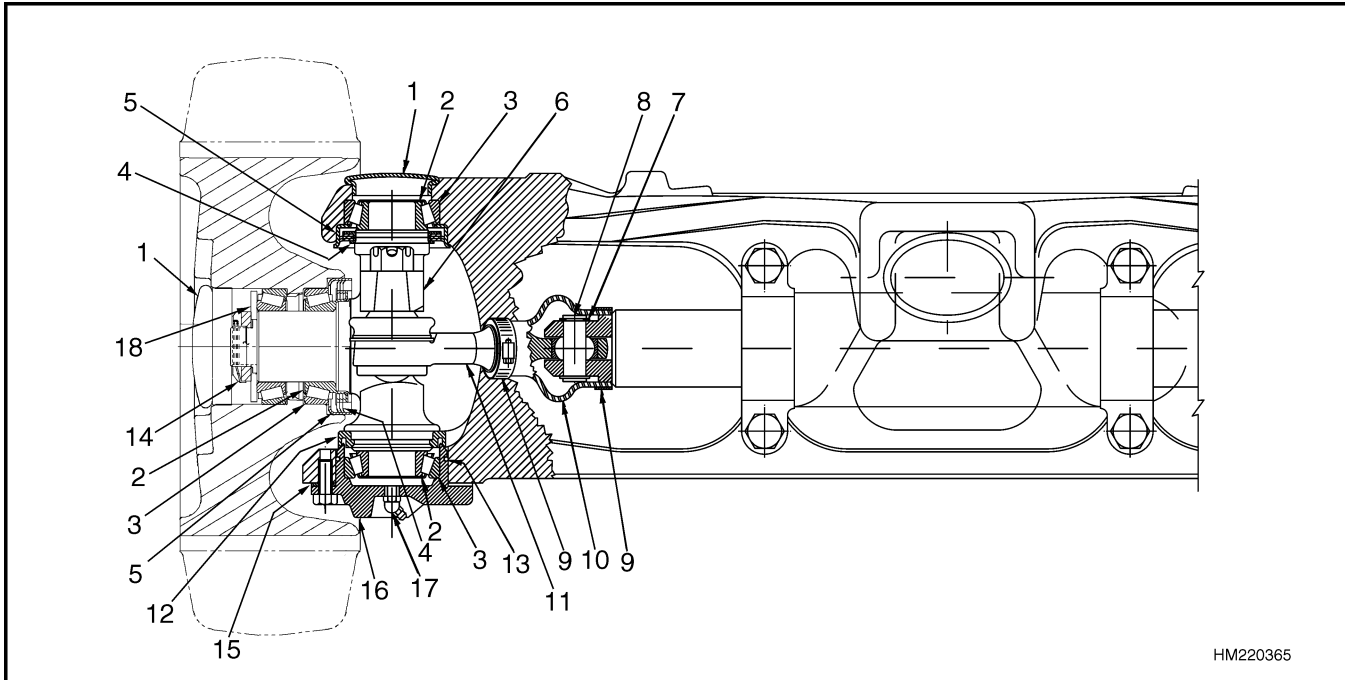
3. Install castle nut. Tighten castle nut to 68 N•m (50 lbf ft), while rotating the hub in both directions to properly set bearings. Loosen nut by 1/4 turn. Tighten nut to 3 N•m (27 lbf in).
4. Pull on the wheel axially to ensure that there is no end play. If there is end play, repeat Step 1 through Step 3.
5. Adjust castle nut left or right to closest spindle hole alignment position. Lock nut in place with cotter pin. If cotter pin cannot be installed, or there is not at least one full thread visible past the nut, then reposition the washer and repeat Step 3 through Step 5.
6. Install grease cap.
7. Repeat procedure for the other wheel.
8. Install castle nut. Tighten castle nut to 200 N•m (150 lbf ft). Loosen nut to less than 27 N•m (20 lbf ft). Tighten nut to 34 N•m (25 lbf ft). Tighten castle nut until cotter pin can be installed. Install cotter pin.



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- | | |
|-----------------|------------------------------|
| 1. GREASE CAP | 9. CLAMP |
| 2. BEARING CONE | 10. DUST COVER |
| 3. BEARING CUP | 11. TIE ROD |
| 4. SEAL | 12. SEAL |
| 5. WEAR SLEEVE | 13. O-RING |
| 6. SPINDLE | 14. CASTLE NUT |
| 7. SNAP RING | 15. SHIMS - MEASURE GAP HERE |
| 8. PIN | 16. BEARING CAP |

Figure 2. Spindle and Tie Rod Assembly (Early Models)



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- | | |
|-----------------|------------------------------|
| 1. GREASE CAP | 10. DUST COVER |
| 2. BEARING CONE | 11. TIE ROD |
| 3. BEARING CUP | 12. SEAL |
| 4. SEAL | 13. O-RING |
| 5. WEAR SLEEVE | 14. CASTLE NUT |
| 6. SPINDLE | 15. SHIMS - MEASURE GAP HERE |
| 7. SNAP RING | 16. BEARING CAP |
| 8. PIN | 17. LUBE FITTING |
| 9. CLAMP | 18. WASHER |

Figure 3. Spindle and Tie Rod Assembly (Later Models)

Spindles, Bearings, and Tie Rods Repair

REMOVE AND DISASSEMBLE

1. Remove the tires and wheels. See the Wheels Repair section in this SRM.

CAUTION

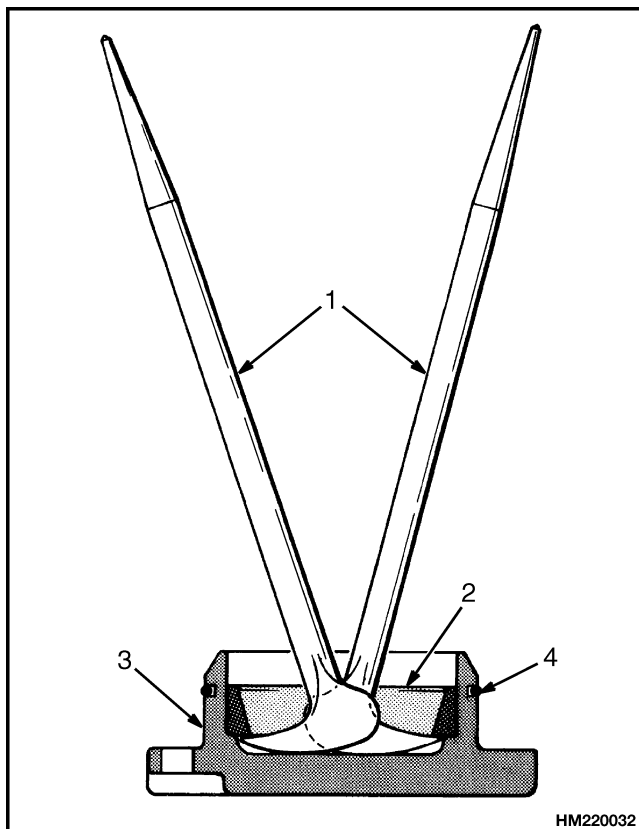
Do not hit the threads or the nut of the tie rod.

2. If the tie rod is to be replaced, remove the cotter pin and castle nut. Remove pin, inside the dust cover, securing tie rod to the steering cylinder.
3. Use a special puller to remove the tapered stud from the spindle arm. To loosen the stud, use another hammer behind the arm to hold the arm. Hit the spindle arm with a large hammer.
4. Remove the grease cap from the spindle. Remove the capscrews from the bearing cap. Remove the bearing cap and shims. If necessary, remove the bearing cup from the bearing cap as shown in Figure 4.
5. Tilt the spindle and lift the spindle from the axle. See Figure 5 or Figure 6. If necessary, remove the bearing and seals from the spindle. If necessary, remove the wear sleeve and bearing cup from the axle frame.
6. Repeat the procedure for the other spindle and tie rod.

ASSEMBLE AND INSTALL

1. Install new seals on the spindle. Lubricate the seals with grease. If necessary, press new bearing cones on the spindle.
2. Lubricate the bearings with wheel bearing grease. Verify the bearings are filled with grease. If necessary, press the new bearing cups into the steering axle frame and bearing cap. Install the wear sleeve in the steering axle frame.
3. Install the spindle in the steering axle. Install the bearing cap without the O-rings. Measure the clearance between the bearing cap and the axle. See Figure 2 or Figure 3. Remove the bearing cap and install enough shims to give a preload of 0.00 to 0.13 mm (0.000 to 0.005 in.).

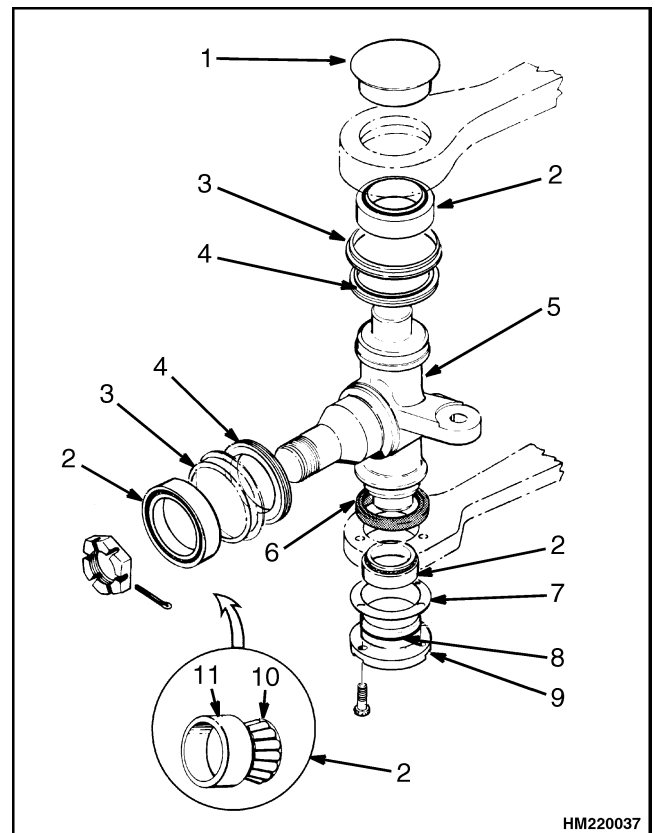
4. Install the O-ring on the bearing cap. Install the bearing cap and capscrews. Tighten the capscrews to 44 N•m (32 lbf ft).
5. Install the tie rod to the spindle arm and steering cylinder. If removed, tighten the castle nut to 163 N•m (120 lbf ft). Tighten the castle nut until the cotter pin can be installed.
6. Install the grease cap on the top of the steering axle.
7. Install the pin, inside the dust cover, to secure tie rod to the steering cylinder.
8. Install the tires and wheels. See the Wheels Repair section in this SRM.
9. Repeat the procedure for the other spindle and tie rod.



- | | |
|----------------|----------------|
| 1. PRY BAR | 3. BEARING CAP |
| 2. BEARING CUP | 4. O-RING |

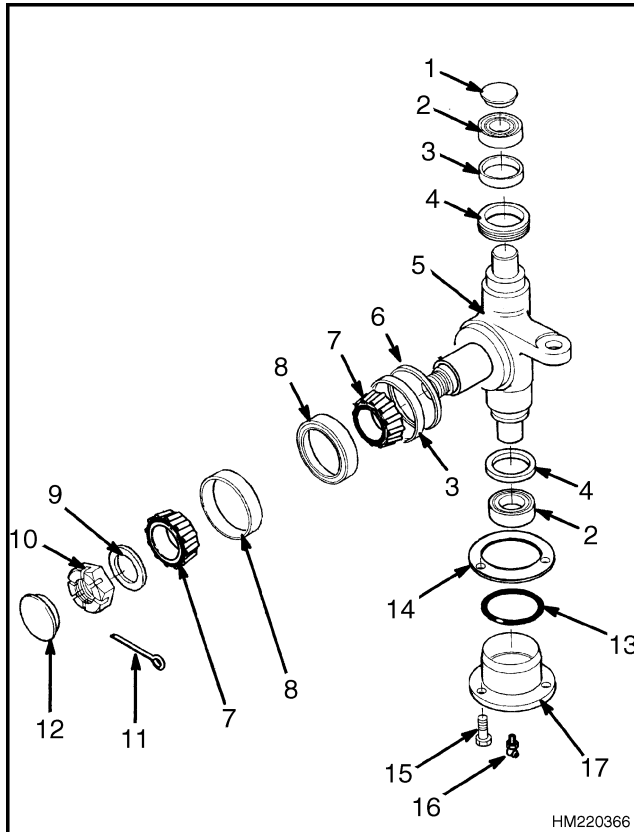
Figure 4. Bearing Cup Removal

NOTE: The spindle bearings must have no clearance. Install shims 0.00 to 0.13 mm (0.000 to 0.005 in.) less than the measured gap.



- | | |
|---------------------|------------------|
| 1. GREASE CAP | 6. SEAL |
| 2. BEARING ASSEMBLY | 7. SHIMS |
| 3. WEAR SLEEVE | 8. O-RING |
| 4. SEAL | 9. BEARING CAP |
| 5. SPINDLE | 10. BEARING CONE |
| | 11. BEARING CUP |

Figure 5. Spindle Assembly (Early Models)

*Legend for Figure 6*

- | | |
|---------------------|--------------------------------------|
| 1. GREASE CAP | 11. COTTER PIN |
| 2. BEARING ASSEMBLY | 12. HUB CAP |
| 3. WEAR SLEEVE | 13. O-RING |
| 4. SEAL | 14. SHIMS (AS REQUIRED) |
| 5. SPINDLE | 15. CAPSCREW AND LOCKWASHER ASSEMBLY |
| 6. OIL SEAL | 16. LUBRICATION FITTING |
| 7. BEARING CONE | 17. BEARING CAP |
| 8. BEARING CUP | |
| 9. WASHER | |
| 10. CASTLE NUT | |

Figure 6. Spindle Assembly (Later Models)

Steering Cylinder Repair

REMOVE AND DISASSEMBLE

NOTE: The end caps of the steering cylinder are held in the shell by the cylinder mount capscrews. To prevent oil leaks at the caps, hold the caps on the shell during removal.

1. Disconnect hydraulic lines at steering cylinders. See Figure 1 and Figure 7. Install caps in fittings on cylinder and put fittings on hydraulic lines.
2. Loosen clamps on both dust covers on the ends of the steering cylinder rod. Slide dust covers off rod.
3. Remove snap ring from pin in each end of rod. Remove pin.
4. Remove capscrews, washers, and nuts that fasten cylinder to axle frame. Hold end caps on shell and remove steering cylinder.
5. Hold end of steering cylinder over a container. Remove plug for hydraulic fitting from each end

cap. Push rod toward end of shell that is over container. Oil will drain from cylinder. Repeat procedure for other end.

6. Carefully slide one end cap from shell. Carefully pull rod out of shell, keeping rod centered in shell during removal. Remove end cap from rod. Remove other end cap from shell. Remove all seals, wipers, and O-rings.

CLEAN AND INSPECT

WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety procedures.

1. Clean all parts in solvent.

2. Inspect piston rod for grooves or damage. Remove small scratches with fine emery cloth. Inspect cylinder bore for damage. Inspect mounts for cracks.

ASSEMBLE AND INSTALL

1. Put O-rings, seals, and wipers in warm hydraulic oil. Install O-rings, seals, and wipers as shown in Figure 1 and Figure 7.

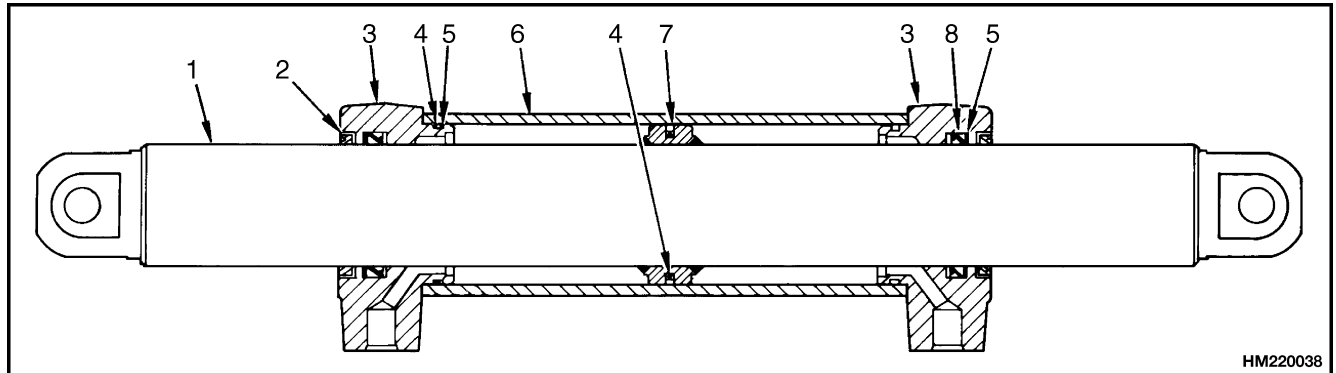


CAUTION

Do not damage the O-rings, seals, or wipers during installation.

2. Lubricate O-rings, seals, and wipers with O-ring lubricant and carefully install one end cap on cylinder rod.

3. Carefully slide cylinder rod and piston into shell. Keep cylinder rod aligned in center of shell during installation so the parts are not damaged. Install end caps into shell. Put caps on hydraulic fittings of end caps.
4. Hold end caps and install cylinder on axle frame using capscrews. Tighten capscrews to 225 N•m (166 lbf ft).
5. Align tie rods at each end of cylinder rod. Install pins and snap rings.
6. Remove plugs and caps and connect hydraulic lines to steering cylinder. Operate steering system to remove air from cylinders and system. Turn steering wheel several times from one stop to the other.



- | | |
|------------|----------------|
| 1. ROD | 5. BACKUP RING |
| 2. WIPER | 6. SHELL |
| 3. END CAP | 7. PISTON SEAL |
| 4. O-RING | 8. ROD SEAL |

Figure 7. Steering Cylinder

Torque Specifications

Axle Mounting Bolts and Nuts

88 N•m (65 lbf ft)

Hub Nut (Initial), Older Lift Truck Models

200 N•m (150 lbf ft)

Hub Nut (Final), Older Lift Truck Models

34 N•m (25 lbf ft)

Hub Nut (Initial), Newer Lift Truck Models

68 N•m (50 lbf ft)

Hub Nut (Final), Newer Lift Truck Models

3 N•m (27 lbf in)

Spindle Bearing Cap Capscrews

44 N•m (32 lbf ft)

Tie Rod Nut

163 N•m (120 lbf ft)

Steer Cylinder Mounting Capscrews

225 N•m (166 lbf ft)

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
The steering wheels do not move when the steering wheel is turned.	The oil level is low or there is no oil in the tank.	Fill tank. Check for leaks.
	The steering control unit is damaged.	Repair or install new control unit.
	No oil flow from the steering control unit to the steering cylinder.	Repair or install new components. Check for leaks.
Slow or difficult steering.	Relief valve for the steering system needs adjustment.	Adjust or install new relief valve.
	Low oil pressure from the hydraulic pump.	Check for restrictions. See Troubleshooting Chart in the Hydraulic System SRM for your lift truck.
	Seal in the steering cylinder has a leak.	Install new seal.
	Steering control unit is worn or has damage.	Repair or install new control unit.
Steering wheel turns the tires in the wrong direction.	The hydraulic lines are not connected correctly at the steering cylinder or at the steering control unit.	Connect lines properly. Remove air from system.
Steering function continues after the steering wheel stops.	The steering control unit was assembled wrong or has damage.	Repair or install new control unit.
There is air in the steering system.	The oil level in the tank is low.	Add hydraulic oil as necessary. Check for leaks.
	Air was not removed after repair to the hydraulic or steering system.	Remove air from system.
	The hydraulic pump has an air leak at the inlet.	Repair system. Remove air from system.