SERVICE REPAIR

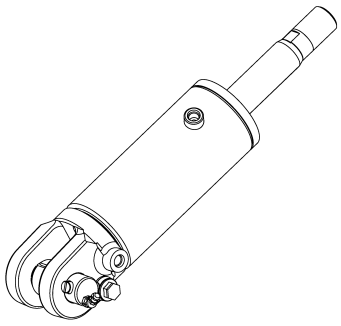
MANUAL

Hyster F114 (E25Z, E30Z, E35Z, E40ZS) Forklift

HYSTER

CYLINDER REPAIR
(MAST S/N A551, A555, A559, A661, A662, A663, A66, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, AND E564)

S30FT, S35FT, S40FTS [E010];
E1.50-2.00XM (E25-35Z, E40ZS) [E114, F114];
H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) [F001];
S2.0-3.5FT (S40-70FT, S55FTS) [F187];
J1.60-2.00XMT (J30-40ZT) [J160];
H2.0-3.5FT (H40-70FT) [L177];
S4.0, 4.5, 5.5FT, S5.5FTS (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) [G004, H004];
J2.00-3.20XM (J40-65Z) [B416];
E2.00-3.20XM (E45-65Z) [G108];
H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) [N005, P005, R005, S005];
E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) [E098];
S50CT [A267];
H2.0-2.5CT (H50CT) [A274]



HYSTER

PART NO. 1580516

2100 SRM 1139

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- 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 hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

This section is for the following models:

(S30FT, S35FT, S40FTS) [E010];
E1.50-2.00XM (E25-35Z, E40ZS) [E114, F114];
H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) [F001];
S2.0-3.5FT (S40-70FT, S55FTS) [F187];
J1.60-2.00XMT (J30-40ZT) [J160];
H2.0-3.5FT (H40-70FT) [L177];
S4.0, 4.5, 5.5FT, S5.5FTS (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) [G004, H004];
J2.00-3.20XM (J40-65Z) [B416];
E2.00-3.20XM (E45-65Z) [G108];
H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) [N005, P005, R005, S005];
E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) [E098];
(S50CT) [A267];
H2.0-2.5CT (H50CT) [A274]

General

This section contains repair procedures for tilt cylinders, main lift cylinders, and free-lift cylinders. The number and the design of the parts can be different, but the operation of the cylinders is the same.

Description

This manual covers many different types of cylinders. Each cylinder will be described in detail.

Tilt cylinders are fastened between the frame of the lift truck and the outer weldment of the mast to change the angle of the mast and forks.

Two single-stage main lift cylinders and a free-lift cylinder are used to raise the carriage and extend the mast weldments.

The two main lift cylinders are installed at the back of the outer mast. The base of each lift cylinder sits on a mount at the bottom crossmember of the outer mast. The top of each main lift cylinder rod fits into a guide on the top crossmember of the inner mast. The free-lift cylinder is installed in the inner mast. Each of the lift cylinders has an internal lowering control valve. A single external lowering control valve is connected by tubing and hoses to all the lift cylinders.

NOTE: On lift truck models listed below there are two free-lift chains and chain sheaves.

- S2.0-3.5FT (S40-70FT, S55FTS) (F187)
- H2.0-3.5FT (H40-70FT) (L177)
- E2.00-3.20XM (E45-65Z) (G108)
- J2.00-3.20XM (J40-65Z) (B416)
- S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)
- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
- S50CT (A267)

On lift truck models listed below there is one free-lift chain and chain sheave.

- S30FT, S35FT, S40FTS (E010)
- E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
- J1.60-2.00XMT (J30-40ZT) (J160)
- H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)

On lift truck models listed below, equipped with a three-stage full free-lift mast, there are two free lift chains and chain sheaves. On lift truck models listed below, equipped with a two-stage limited free-lift mast, there are no free lift chains or sheaves.

- H2.0-2.5CT (H50CT) (A274)

On all lift trucks, the free-lift chains connect at one end of the mid-crossmember of the inner mast. Two chain sheaves are installed on a crosshead on the rod of the free-lift cylinder. The chains then go over sheaves on the crosshead and connect to the carriage.

Safety Procedures When Working Near Mast

The following procedures MUST be used when inspecting or working near the mast. Additional precautions and procedures can be required when repairing or removing the mast.

WARNING

Mast parts are heavy and can move. Distances between parts are small. Serious injury or death can result if part of the body is hit by parts of the mast or the carriage.

- **Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is OFF and the key is removed. Put a DO NOT OPERATE tag in the operator's compartment. Disconnect the battery and put a tag or lock on the battery connector.**
- **Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.**
- **DO NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.**
- **DO NOT use blocks to support the mast weldments nor to restrain their movement.**
- **Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in this section.**

WHEN WORKING NEAR THE MAST ALWAYS:

- **Lower the mast and carriage completely. Push the lift/lower control lever forward and make sure there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.**

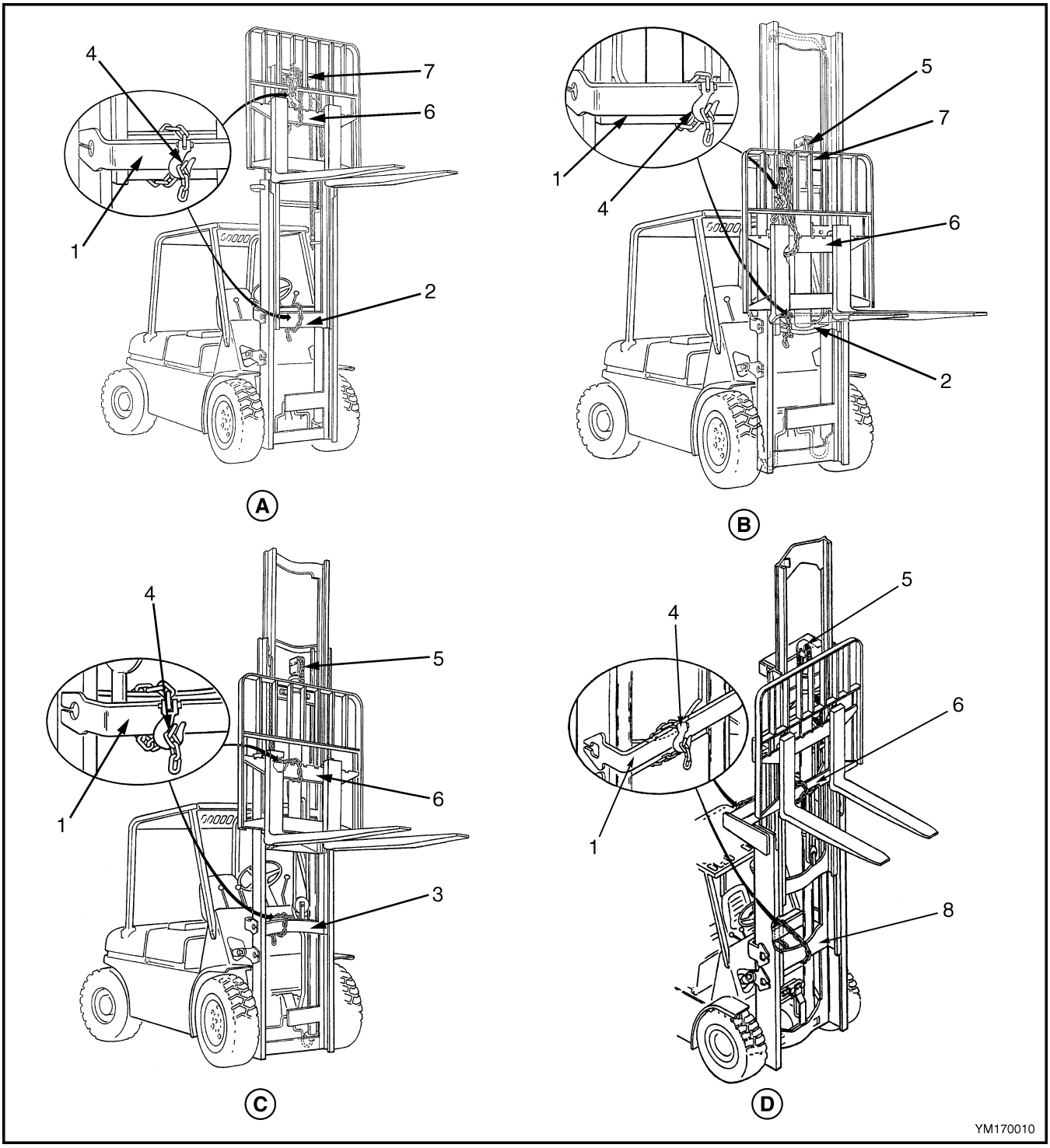
  OR

- **If parts of the mast must be in a raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:**

1. Put mast in vertical position.
2. Raise mast to align bottom crossmember of weldment that moves in outer weldment with crossmember on outer weldment. On the two-stage and free-lift mast, the moving part is the inner weldment. On the three-stage mast, it is the intermediate weldment. On the four-stage mast, it is the first intermediate weldment. See Figure 1.
3. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so the movable member cannot lower. Put hook on back side of mast. Make sure hook is completely engaged with a link in the chain. Make sure safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
4. Lower mast until there is tension in safety chain and free-lift cylinder (two-stage full free-lift, three-stage, and four-stage) is completely retracted. If running, turn the power **OFF**. Apply the parking brake. Install a **DO NOT REMOVE** tag on the safety chain(s).
5. Install another safety chain (3/8-in. minimum) between the top or bottom crossmember of the carriage bar and a crossmember on the outer weldment.
6. After lowering or restraining the mast, shut off the power, and remove key.

NOTE: Place a **DO NOT OPERATE** tag in the operator's compartment.

7. Disconnect battery and put a tag or lock on battery connector.



A. TWO-STAGE LFL MAST
B. TWO-STAGE FFL MAST
C. THREE-STAGE FFL MAST
D. FOUR-STAGE FFL MAST

1. OUTER WELDMENT
2. INNER WELDMENT
3. INTERMEDIATE WELDMENT
4. HOOK
5. FREE-LIFT CYLINDER
6. CARRIAGE BAR
7. CROSSMEMBER
8. FIRST INTERMEDIATE WELDMENT

Figure 1. Two-Stage LFL, Two-Stage FFL, Three-Stage FFL, and Four-Stage FFL Masts

Tilt Cylinder Repair

REMOVE

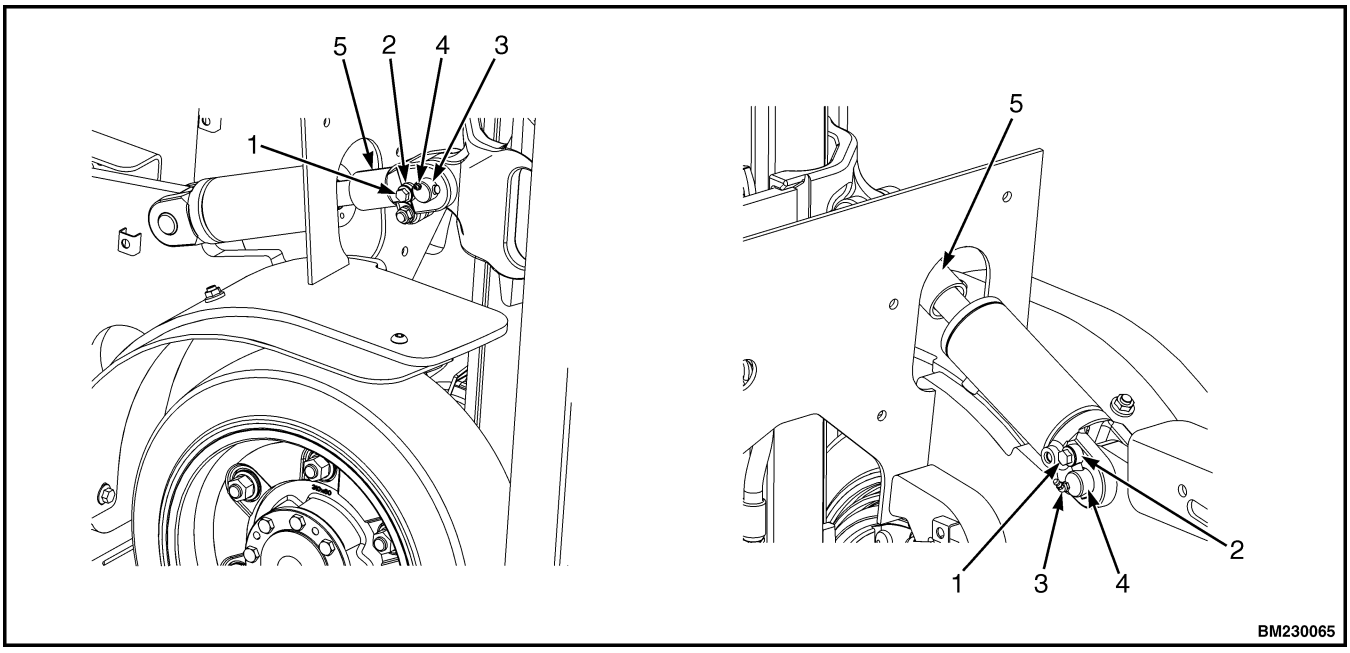
WARNING

Before removing the tilt cylinder(s), tilt the mast forward. Use a chain to hold the mast to the frame and prevent the mast from moving forward.

WARNING

DO NOT push the anchor pins out of the rod end with your fingers. DO NOT permit the tilt cylinders to drop and cause damage.

1. At the mast, remove the capscrew and retainer from the anchor pin. Using a drift pin or similar tool, push the anchor pin out of the rod end. See Figure 2.
2. Stroke cylinder to the full back tilt position.
3. Disconnect the hydraulic lines at the tilt cylinder. Install caps on the hydraulic lines and in the cylinder ports.
4. Use a lifting device to move large tilt cylinders. Remove the capscrew and retainer from the anchor pin. Using a drift pin or similar tool, push the anchor pin out of the frame.
5. Using a lifting device, remove the tilt cylinder from the lift truck.
6. Repeat above steps for the remaining tilt cylinder.



NOTE: HYDRAULIC HOSES ARE SHOWN DISCONNECTED FOR CLARITY.

1. CAPSCREW
2. RETAINER
3. LUBRICATION FITTING
4. ANCHOR PIN
5. TILT SPACER

Figure 2. Tilt Cylinder Removal

DISASSEMBLE

NOTE: The following steps have detailed disassembly instructions. Perform only those steps required to repair the tilt cylinder.

NOTE: Note the position of the rod end and number of turns used to remove the rod end.

1. Place the tilt cylinder in a soft jaw vise. Remove the rod end and, if equipped, tilt spacer from the rod.

See Figure 3 for lift truck models

- E2.00-3.20XM (E45-65Z) (G108)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
- H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
- H2.0-3.5FT (H40-70FT) (L177)
- H4.0FT5/FT6; H4.5FTS5, H4.5FT6, H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
- H2.0-2.5CT (H50CT) (A274)
- J2.00-3.20XM (J40-65Z) (B416)
- S30FT, S35FT, S40FTS (E010)
- S2.0-3.5FT (S40-70FT, S55FTS) (F187)
- S4.0, 4.5, 5.5FT, S5.5FTS (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)
- S50CT (A267)

See Figure 4 for lift truck models

- E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
- J1.60-2.00XMT (J30-40ZT) (J160)

2. Using a pin-type spanner wrench, remove the gland from the tilt cylinder. Remove the rod and piston assembly from the cylinder.

NOTE: To prevent damage to sealing surfaces, use brass tools when removing seals and O-rings.

3. Remove and discard the O-ring, backup ring, seal, and wiper from the gland.

NOTE: Perform Step 4 only if the piston or rod has been damaged.

4. Place the rod in a soft-jaw vise and remove the nut and piston from the rod.

5. Remove and discard the O-ring and piston seal from the piston. See Figure 3.

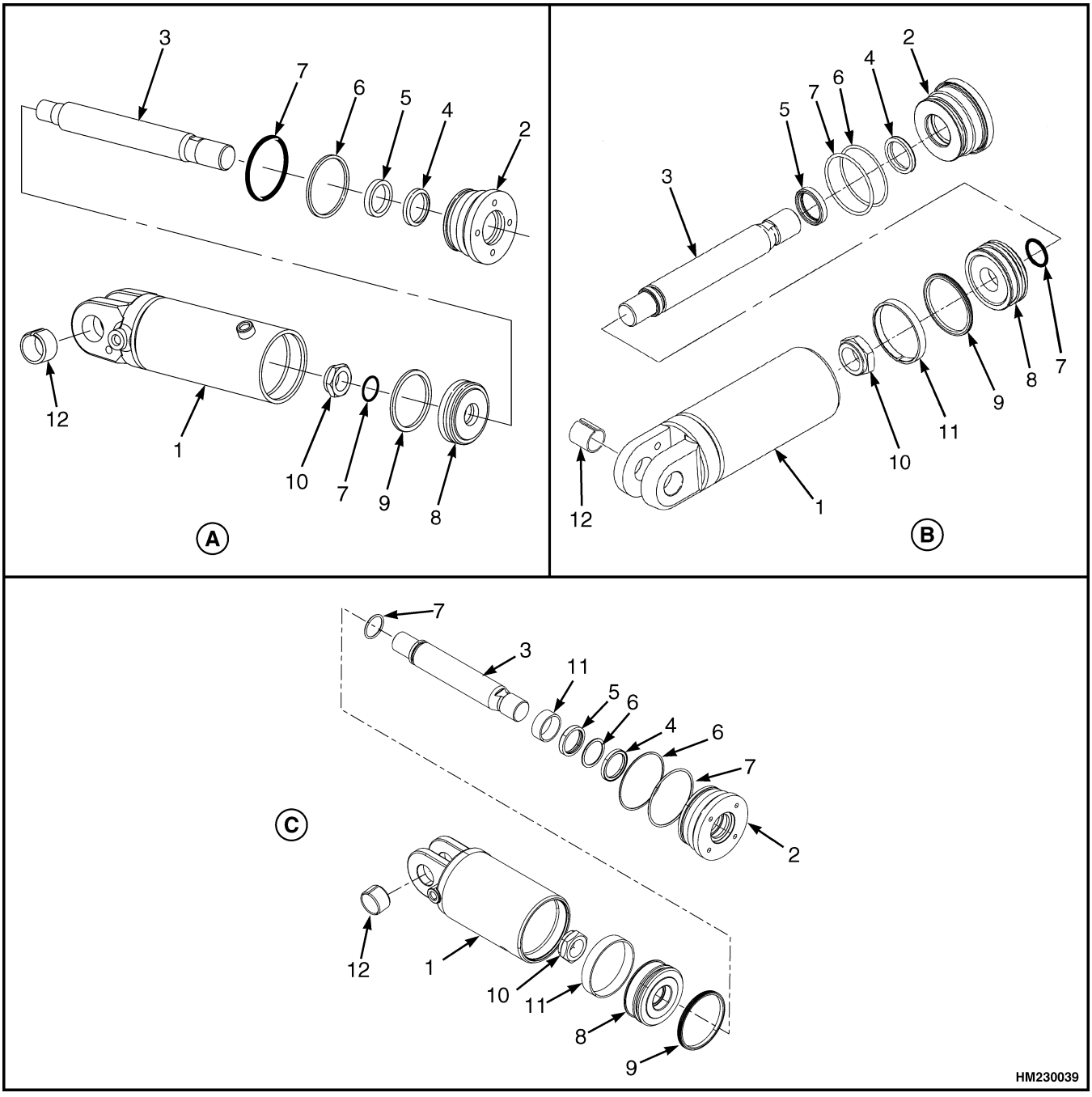


Figure 3. Tilt Cylinder

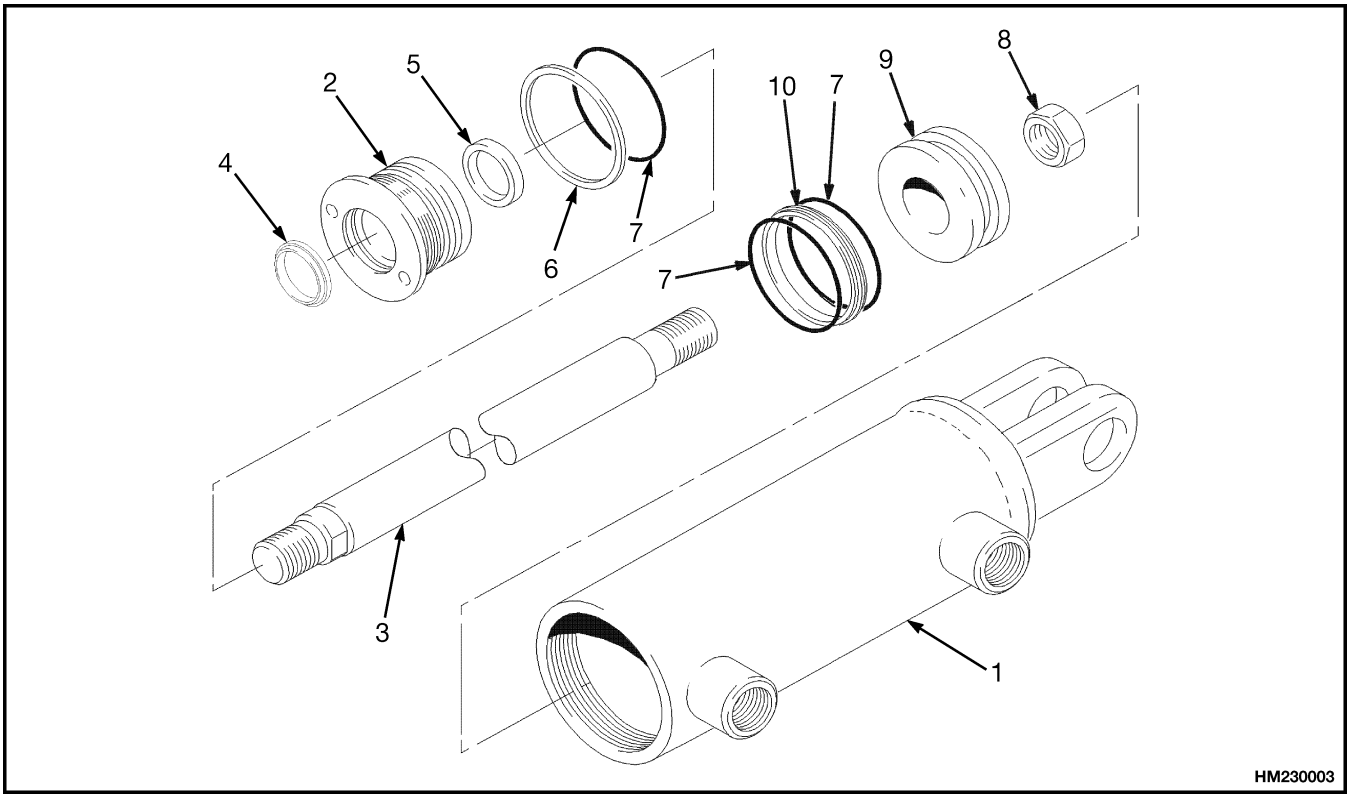
Legend for Figure 3

A. S2.0-2.5FT (S40-S55FT, S55FTS) (F187), S30FT, S35FT, S40FTS (E010), H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001), H2.0-2.5FT (H40-50FT) (L177), E2.00-3.20XM (E45-65Z) (G108), J2.00-3.20XM (J40-65Z) (B416), S50CT (A267), AND H2.0-2.5CT (H50CT) (A274)

B. S3.0-3.5FT (S60-S70FT) (F187) AND H3.0-3.5FT (H60-70FT) (L177)

C. S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005) AND E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)

1. SHELL
2. GLAND
3. ROD
4. WIPER RING
5. SEAL
6. BACKUP RING
7. O-RING
8. PISTON
9. PISTON SEAL
10. NUT
11. WEAR RING
12. BUSHING



1. CYLINDER SHELL
2. RETAINER
3. ROD
4. WIPER RING
5. SEAL
6. BACKUP RING
7. O-RING
8. NUT
9. PISTON
10. PISTON SEAL

Figure 4. Tilt Cylinder for Lift Truck Models E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114) and J1.60-2.00XMT (J30-40ZT) (J160)

INSPECT

Inspect the gland for damage to the threads and the seal surfaces. Replace the gland if damaged.

Inspect the piston for any damage to the seal surfaces and replace if damaged.

Inspect the rod for damage to the rod surface and ensure that the rod is not bent. Replace the rod if found to be damaged.

Inspect the inner surface of the cylinder tube for damage. If the tube is found to be damaged, replace the cylinder.

Inspect the bushings for damage. If damaged, replace bushings.

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.

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

CAUTION

DO NOT allow cleaning solvent to come in contact with rubber components, as it will damage those components.

Clean all metal parts in solvent and dry with compressed air.

ASSEMBLE

NOTE: To prevent damage to sealing surfaces, use brass tools when installing seals and O-rings.

1. Install a new piston seal and O-ring on the piston. See Figure 3.

NOTE: Perform Step 2 only if the piston was removed from the rod.

2. Place the rod in a soft-jaw vise and lube the threads of the nut with hydraulic oil. Install the piston on the rod and tighten the nut to:

   a. 170 to 220 N•m (125 to 162 lbf ft) on lift truck models
      - S2.0-2.5FT (S40-S55FT, S55FTS) (F187)
      - S30FT, S35FT, S40FTS (E010)
      - E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
      - H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
      - H2.0-2.5FT (H40-50FT) (L177)
      - E2.00-3.20XM (E45-65Z) (G108)
      - J2.00-3.20XM (J40-65Z) (B416)
      - S50CT (A267)
      - H2.0-2.5CT (H50CT) (A274)

   b. 320 to 400 N•m (240 to 295 lbf ft) on lift truck models
      - S3.0-3.5FT (S60-S70FT) (F187)
      - H3.0-3.5FT (H60-70FT) (L177)

   c. 163 to 190 N•m (120 to 140 lbf ft) on lift truck model
      - J1.60-2.00XMT (J30-40ZT) (J160)

   d. 400-440 N•m (295 to 325 lbf ft) on lift truck models
      - S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)
      - H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
      - E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)

3. Install a new wiper, seal, backup ring, and O-ring on the gland.

4. Install the rod and piston assembly in the cylinder. Using a pin-type spanner, install the gland in the cylinder. Tighten the gland to:

a. 170 to 237 N•m (125 to 175 lbf ft) for lift truck models

- S2.0-2.5FT (S40-S55FT, S55FTS) (F187)
- H2.0-2.5FT (H40-50FT) (L177
- S50CT (A267)
- H2.0-2.5CT (H50CT) (A274)

b. 163 to 190 N•m (120 to 140 lbf ft) for lift truck models

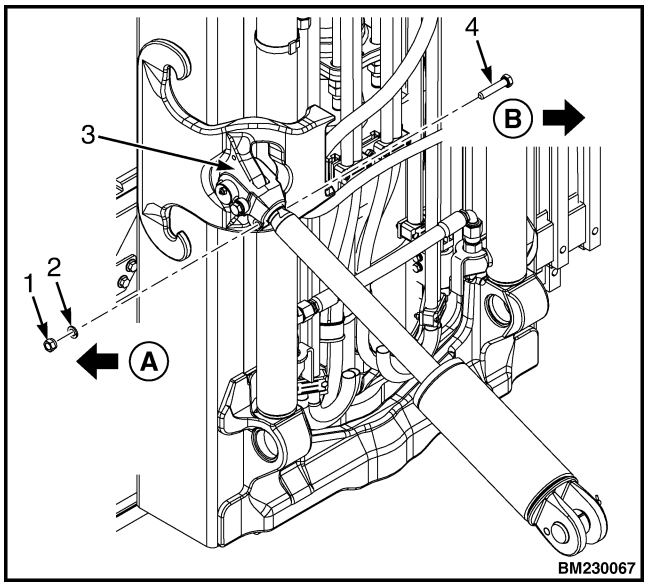
- S30FT, S35FT, S40FTS (E010)
- E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
- J1.60-2.00XMT (J30-40ZT) (J160)
- H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
- E2.00-3.20XM (E45-65Z) (G108)
- J2.00-3.20XM (J40-65Z) (B416)

c. 400 to 500 N•m (295 to 370 lbf ft) for lift truck models

- S3.0-3.5FT (S60-S70FT) (F187)
- H3.0-3.5FT (H60-70FT) (L177),
- S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)
- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)

5. Place cylinder in a soft-jaw vise and install tilt spacer, if equipped, and rod end on rod as noted during removal. Lubricate threads on capscrew with lubricant, Hyster P/N 186061. Install capscrew in rod end so that capscrew head is on the inboard side of rod end. Install washer and nut on capscrew. Washer and nut must be on the outboard side of rod end. See Figure 5. Tighten nut to 90 N•m (66 lbf ft).

6. Repeat the above steps for the other tilt cylinder.



NOTE: LEFT TILT CYLINDER SHOWN. TILT CYLINDER AND MAST FOR LIFT TRUCK MODELS H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005) SHOWN, ALL OTHERS SIMILAR. PARTS OF MAST OMITTED FOR CLARITY.

A. OUTBOARD SIDE **B.** INBOARD SIDE

1. NUT
2. WASHER
3. ROD END
4. CAPSCREW

Figure 5. Rod End Installation

INSTALL

1. Using a lifting device, place the cylinder in mounting position on the lift truck frame. Install the anchor pin. Install the retainer and capscrew. See Figure 2. Lubricate the threads on the capscrew with lubricant, Hyster P/N 186061, and tighten capscrew to:

a. 38 N•m (28 lbf ft) for lift truck models

- S30FT, S35FT, S40FTS (E010)
- H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
- S2.0-3.5FT (S40-S70FT, S55FTS) (F187)
- H2.0-3.5FT (H40-70FT) (L177)
- E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
- E2.00-3.20XM (E45-65Z) (G108)
- J2.00-3.20XM (J40-65Z) (B416)
- J1.60-2.00XMT (J30-40ZT) (J160)
- S50CT (A267)
- H2.0-2.5CT (H50CT) (A274)

b. 66 N•m (49 lbf ft) for lift truck models

- S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)

c. 66 to 73 N•m (49 to 54 lbf ft) for lift truck models

- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)

d. 77 N•m (57 lbf ft) for lift truck model

- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)

2. Connect the hydraulic lines to the tilt cylinder. Slowly stroke the cylinders until the rod holes line up with the mast tilt anchor holes.

3. Install anchor pin and retainer on tilt anchor.

4. Repeat above steps for remaining tilt cylinder.

5. Remove chain holding the mast to the frame.

WARNING

DO NOT put hands between the cylinder rod end and the mast. Serious injury can occur.

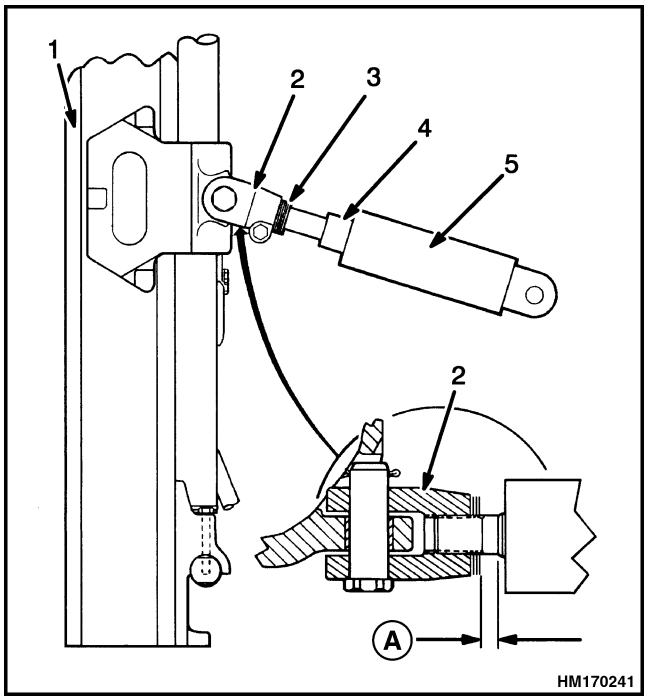
6. Operate the tilt cylinders. Check for correct operation and leakage. Adjust the tilt cylinders.

TILT CYLINDERS, ADJUST

WARNING

When the tilt cylinders have tilt limit spacers, make sure they are installed during installation procedures. Without the tilt limit spacers, the mast can tilt too much and cause an accident or serious injury.

Check the tilt cylinder stroke by slowly tilting the mast fully forward and backward several times. Both tilt cylinders must stop their stroke at the same time. Adjust the rod ends as shown in Figure 6. There must be no twist in the mast weldments.



A. DIMENSION A = 15 mm (0.60 in.)

1. MAST
2. ROD END
3. SHIMS
4. TILT LIMIT SPACER
5. TILT CYLINDER

Figure 6. Tilt Cylinder Adjustments; for All Models Except J1.60-2.00XMT (J30-40ZT) (J160), S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), and H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)

1. Adjust the stroke of the tilt cylinders WITHOUT tilt limit spacers as follows:

a. Adjust the rod ends to

(1) 15 mm (0.6 in.) for lift truck model

- S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), See Figure 7.

(2) 20 mm (0.8 in.) for lift truck models

- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005) See Figure 7.

(3) 32 mm (1.25 in.) for lift truck model

- J1.60-2.00XMT (J30-40ZT) (J160) See Figure 7.

b. Slowly tilt the mast backward until one cylinder rod stops. On the opposite cylinder, loosen the capscrews on the rod end. Measure the distance from the end of the cylinder to the back end of the rod end. Use a wrench and turn the cylinder rod IN until the dimension starts to decrease, then stop. Repeat this procedure until both cylinder rods stop at the same position within:

(1) 1 mm (0.04 in.) for lift truck models

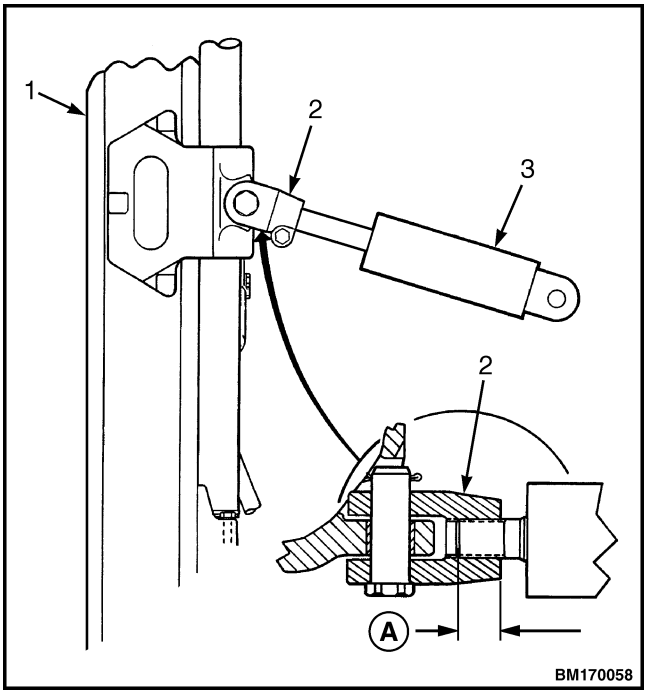
- S30FT, S35FT, S40FTS (E010)
- H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
- S2.0-3.5FT (S40-S70FT, S55FTS) (F187)
- H2.0-3.5FT (H40-70FT) (L177)
- E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114)
- E2.00-3.20XM (E45-65Z) (G108)
- J2.00-3.20XM (J40-65Z) (B416)
- J1.60-2.00XMT (J30-40ZT) (J160)
- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
- S50CT (A267)
- H2.0-2.5CT (H50CT) (A274)

(2) 0.5 mm (0.02 in.) for lift truck model

- S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004)

(3) After the adjustments are complete, tighten the nuts on the rod ends to 90 N•m (66 lbf ft).

c. Tilt the mast fully backward and measure the tilt angle. See the Nameplate for tilt angles. If necessary, adjust both rod ends equally for the correct angle.



A. 32 mm (1.25 in.) FOR J1.60-2.00XMT (J30-40ZT) (J160) SHOWN.

1. MAST
2. ROD END
3. TILT CYLINDER

Figure 7. Tilt Cylinder Adjustments for Lift Truck Models J1.60-2.00XMT (J30-40ZT) (J160), S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), and H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005) Only

2. Adjust the stroke of the tilt cylinders WITH tilt limit spacers as follows:

a. Adjust the rod ends to 15 mm (0.6 in.) for all tilt cylinders as shown in Figure 6.

b. Slowly tilt the mast forward until one cylinder rod stops. On the opposite cylinder, loosen the capscrews on the rod end. Use a wrench and turn the cylinder rod IN as necessary. Repeat this procedure until both cylinder rods stop at the same position within 1 mm (0.04 in.).

c. Slowly tilt the mast backward until one rod end just contacts the spacer. Add shims to fill the gap at the opposite rod end until both rod ends contact the spacers within 0.5 mm (0.02 in.).

d. After the adjustments are complete, tighten the nuts on the rod ends to 90 N•m (66 lbf ft).

e. Tilt the mast fully backward and measure the tilt angle. See the nameplate for tilt angles. If necessary, add an equal number of shims to both rods for the correct angle.

TILT CYLINDER LEAK CHECK

WARNING

Never allow anyone under a raised carriage. DO NOT put any part of your body in or through the lift mechanism unless all parts of the mast are completely lowered and the engine is STOPPED.

DO NOT try to find hydraulic leaks by putting your hand on hydraulic components under pressure. Hydraulic oil can be injected into the body by the pressure.

1. Put a capacity load on the forks. Use a safety chain to hold the load to the carriage. Raise the load approximately 2.5 m (8 ft). Put the mast in a vertical position.

2. Measure the distance that the rod for tilt cylinder extends from the shell. Check the distance the rod moves in five or ten minutes. Multiply the rate in Table 1 by the time of the test and compare the numbers.

Table 1. Movement Rates (Maximum) for Tilt Cylinders

Lift Truck Model	Hydraulic Oil Temperature/Mast Tilt Rate			
	20°C (68°F)		60°C (140°F)	
	mm/min	in./min	mm/min	in./min
S2.0-3.5FT (S40-S70FT, S55FTS) (F187), E2.00-3.20XM (E45-65Z) (G108) J2.00-3.20XM (J40-65Z) (B416), and S50CT (A267)	1.0	0.04	6.8	0.30
S30FT, S35FT, S40FTS (E010)	1.0	0.04	5.4	0.21
H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)	1.0	0.04	5.7	0.23
H2.0-3.5FT (H40-70FT) (L177) and H2.0-2.5CT (H50CT) (A274)	1.0	0.04	6.3	0.25
E1.50-2.00XM (E25-35Z, E40ZS) (E114) and J1.60-2.00XMT (J30-40ZT) (J160)	0.8	0.03	5.0	0.20
S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)	1.1	0.04	7.3	0.30
E1.50-2.00XM (E25-35Z, E40ZS) (F114)	.63	0.25	4.3	0.16
E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)	.74	.029	4.94	1.94

3. If the tilt rate is greater than the specifications, lower the mast and remove the load from the forks. Install a valve between the port at the front of the tilt cylinder and the hydraulic line. The valve must be able to completely shut off the flow of hydraulic oil. Put the load on the forks again. Close the valve. Tilt the mast forward just past the vertical position. If the mast continues to tilt SLOWLY forward, the seals on the piston are leaking.

4. If the mast does not move, open the valve and check the movement again. If the mast moves forward when the gate valve is open, check for leaks in the hydraulic lines and fittings. If no leaks are found, the main control valve can be worn or damaged. Remove the load from the forks when the checks are complete.

TORQUE SPECIFICATIONS

Piston Rod Nut

S2.0-2.5FT (S40-S50FT, S55FTS) (F187), S30FT, S35FT, S40FTS (E010), E1.50-2.00XM (E25-35Z, E40ZS) (E114,F114), H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001), H2.0-2.5FT (H40-50FT) (L177), J2.00-3.20XM (J40-65Z) (B416), E2.00-3.20XM (E45-65Z) (G108), S50CT (A267), and H2.0-2.5CT (H50CT) (A274)
170 to 220 N•m (125 to 162 lbf ft)

S3.0-3.5FT (S60-S70FT) (F187), H3.0-3.5FT (H60-70FT) (L177)
320 to 400 N•m (240 to 295 lbf ft)

J1.60-2.00XMT (J30-40ZT) (J160)
163 to 190 N•m (120 to 140 lbf ft)

S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005), and E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
400 to 440 N•m (295 to 325 lbf ft)

Gland

S2.0-2.5FT (S40-S50FT, S55FTS) (F187), H2.0-2.5FT (H40-50FT) (L177), S50CT (A267), and H2.0-2.5CT (H50CT) (A274)
170 to 237 N•m (125 to 175 lbf ft)

S3.0-3.5FT (S60-S70FT) (F187), H3.0-3.5FT (H60-70FT) (L177), S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004), H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005), E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
400 to 500 N•m (295 to 370 lbf ft)

S30FT, S35FT, S40FTS (E010), E1.50-2.00XM (E25-35Z, E40ZS) (E114), J1.60-2.00XMT (J30-40ZT) (J160), and H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)
163 to 190 N•m (120 to 140 lbf ft)

Tilt Cylinder Mounting Capscrew

For lift truck models S2.0-2.5FT (S40-S50FT, S55FTS) (F187), S30FT, S35FT, S40FTS (E010), E1.50-2.00XM (E25-35Z, E40ZS) (E114), H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001), J1.60-2.00XMT (J30-40ZT) (J160), H2.0-2.5FT (H40-50FT) (L177), S50CT (A267), and H2.0-2.5CT (H50CT) (A274)
38 N•m (28 lbf ft)

For lift truck models S4.0, 4.5, 5.5FT, S5.5FTS, (S80, 100, 120FT; S80, 100FTBCS; S120FTS; S120FTPRS) (G004, H004) and H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT (H80, 90, 100, 110, 120FT) (N005, P005, R005, S005)
68 N•m (50 lbf ft)

For lift truck models E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)
77 N•m (57 lbf ft)

Tilt Cylinder Rod End Nut

90 N•m (66 lbf ft)

Lift Cylinder Repair

MAIN LIFT CYLINDERS

Remove

WARNING

Before working on or near the mast, see Safety Procedures When Working Near Mast.

NOTE: The following procedures are for the removal of the lift cylinders with the mast installed on the lift truck.

1. Remove the carriage as described in the carriage removal procedures located in the section

   Mast Repairs (S/N A551, A555, A559, A661, A662, A663, A664, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564) 4000SRM1148 for the lift truck models shown below:

   - S30FT, S35FT, S40FTS (E010)
   - H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001) GLP/GDP16VX. GLP/GDP18VX, GLP/GDP20SVX (GP/GLP/GDP030VX, GP/GLP/GDP035VX, GP/GLP/GDP040SVX) (C810)
   - S2.0-3.5FT (S40-70FT, S55FTS) (F187)
   - H2.0-3.5FT (H40-70FT) (L177)
   - E1.50-2.00XM (E25-35Z, E40ZS) (E114, F114)
   - E2.00-3.20XM (E45-65Z) (G108)
   - J2.00-3.20XM (J40-65Z) (B416)
   - J1.6-2.00XMT (J30-40ZT) (J160)

Mast Repairs (S/N A513, A514, A613, A614, A702, A703, A704, A705, A706, A707, A751, A752, B513, B514, B586, B587, B588, B589, B590, B591, B749, B750, B751, B752, B753, B754) 4000SRM1250 for lift truck models shown below:

- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT, (H80-120FT) (N005, P005, R005, S005)
- S4.0-5.5FT, S5.5FTS, (S80-120FT; S80-100FTBCS; S120FTS; S120FTPRS) (G004, H004)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)

Mast Repair (S/N A698, A699, B551) 4000SRM1431 for lift truck models shown below:

- S50CT (A267)
- H2.0-2.5CT (H50CT) (A274)

NOTE: Perform Step 2 only if working on a lift truck equipped with a two- or three-stage mast. Perform Step 3 if working on a lift truck equipped with a four-stage mast.

2. Raise the mast until it is almost fully extended.

- On the two-stage mast, use safety chains to connect the bottom crossmember of the inner mast section to the top crossmember of the outer mast section.
- On the three-stage mast, use safety chain to connect the bottom crossmember of the intermediate mast section to the top crossmember of the outer mast section. Use another safety chain to connect the bottom crossmember to a crossmember on the intermediate or outer mast section.

Lower the mast so the safety chains hold the weight of the mast sections.

3. Raise the mast until it is almost fully extended. Use a safety chain to connect middle crossmember of first intermediate mast section to top crossmember on outer mast section. Lower mast so safety chain holds weight of the mast sections.

WARNING

Be careful when removing or install snap rings. These snap rings can come loose during removal or installation with enough force to cause an injury. Always use the correct snap ring pliers and wear eye and face protection during removal or installation.

4. If working on a two or three-stage mast, the snap ring and shims (washers) at the top of the cylinder are to be reomved.

5. If working on a four-stage mast, on the left lift cylinder, remove the snap ring from top of the cylinder rod. On right lift cylinder, remove spacer and retainer from cylinder rod.

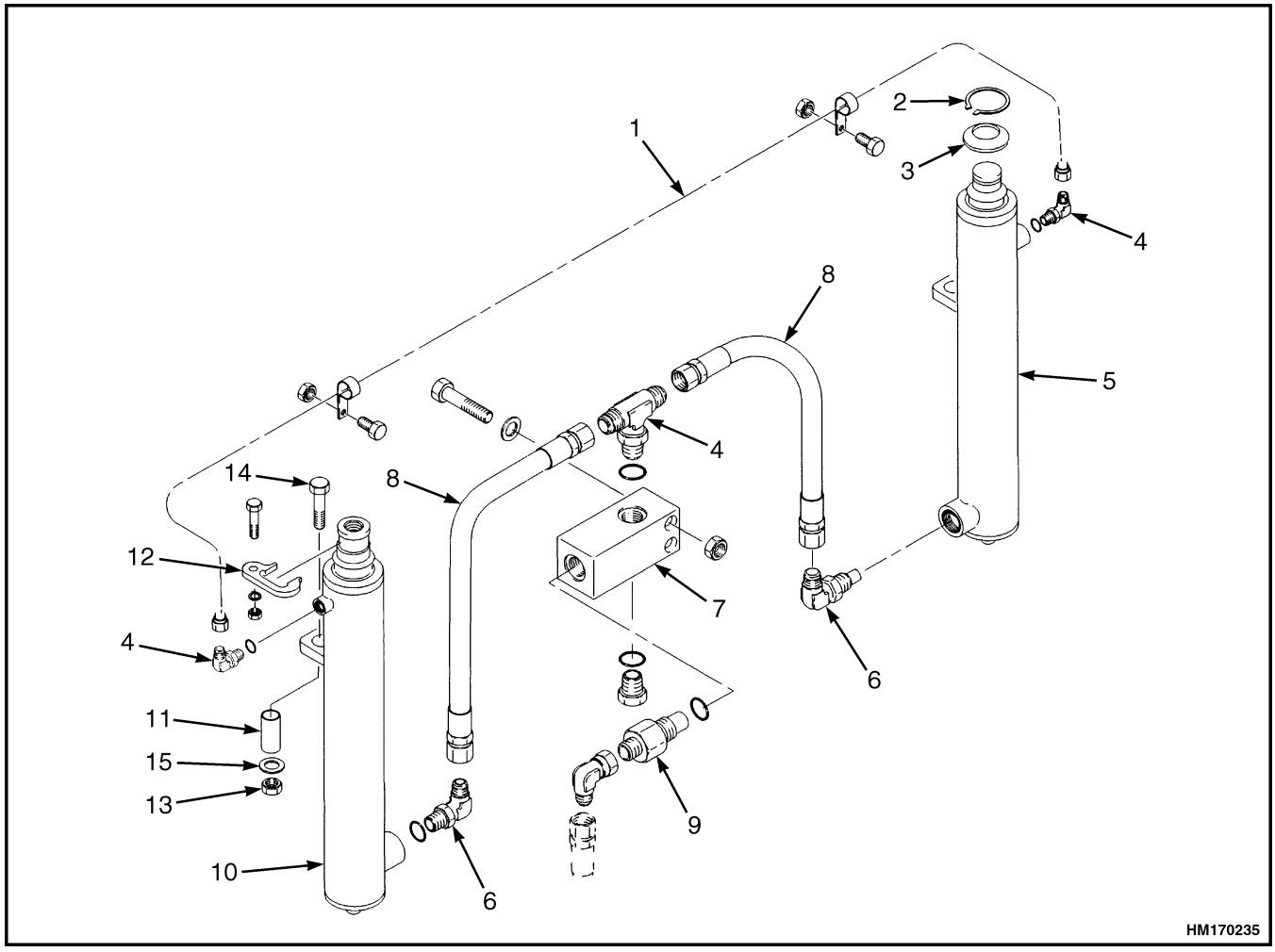
WARNING

Hydraulic oil is hot after system operation and can cause burns. DO NOT disconnect any hydraulic hoses until the oil in the hydraulic system is cool.

6. Put a drain pan under the area of the hydraulic fittings. Disconnect and cap the hydraulic lines at the cylinder. Retract the rod into the lift cylinder.

7. Remove the nut, washer, spacer, and capscrew at the mounting plate. On two or three-stage mast, disconnect the main lift chain at the mount. See Figure 8.

8. Use a lifting device, as necessary, to remove lift cylinder from mast. Remove the lift cylinder from the front of the mast. On a lift cylinder being removed from a four-stage mast, keep shims from top of left cylinder with cylinder.



NOTE: BALANCE LINE IS USED ON FOUR-STAGE FFL MAST ONLY.

1. BALANCE LINE
2. SNAP RING
3. SHIM
4. FITTING AND O-RING
5. LEFT MAIN LIFT CYLINDER
6. LOWERING CONTROL VALVE FITTING
7. HOUSING
8. HOSE
9. LOWERING CONTROL VALVE
10. RIGHT MAIN LIFT CYLINDER
11. SPACER
12. RETAINER
13. NUT
14. BOLT
15. WASHER

Figure 8. Main Lift Cylinders, Remove

Disassemble

CAUTION

Carefully disassemble the main lift cylinders so the piston rods and sliding surfaces are not damaged.

NOTE: To disassemble the left main lift cylinder on lift trucks equipped with a two-stage FFL mast, see the section Two-Stage FFL Left Side Main Lift Cylinder.

NOTE: To prevent damage to sealing surfaces, use brass tools when removing seals and O-rings.

1. Loosen gland with spanner wrench.
2. Remove gland from shell.
3. Remove rod and piston assembly from shell. Drain hydraulic oil into container.
4. Remove and discard O-rings, seals, backup rings, wiper rings, and wear rings.

   See Figure 9 for lift trucks equipped with a two-stage LFL mast

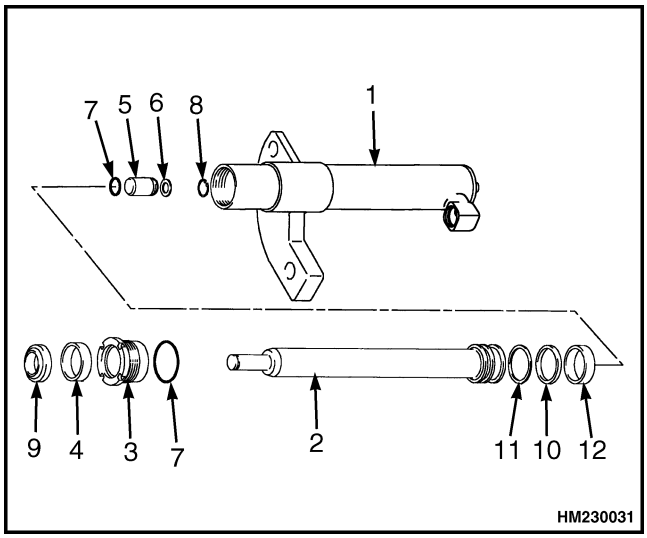
   See Figure 10 for lift trucks equipped with a three-stage FFL mast

WARNING

Be careful when removing or install snap rings. These snap rings can come loose during removal or installation with enough force to cause an injury. Always use the correct snap ring pliers and wear eye and face protection during removal or installation.

NOTE: Step 2 does not apply to lift trucks equipped with a two-stage FFL mast or to lift trucks shown below:

- H4.0FT5/FT6; H4.5FTS5, H4.5FT6; H5.0-5.5FT, (H80-120FT) (N005, P005, R005, S005)
- S4.0-5.5FT, S5.5FTS, (S80-120FT; S80-100FTBCS; S120FTS; S120FTPRS) (G004, H004)
- E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (E098)



1. SHELL
2. ROD
3. GLAND
4. ROD SEAL
5. CHECK VALVE
6. WASHER
7. O-RING
8. SNAP RING
9. WIPER RING
10. SEAL
11. BACKUP RING
12. WEAR RING

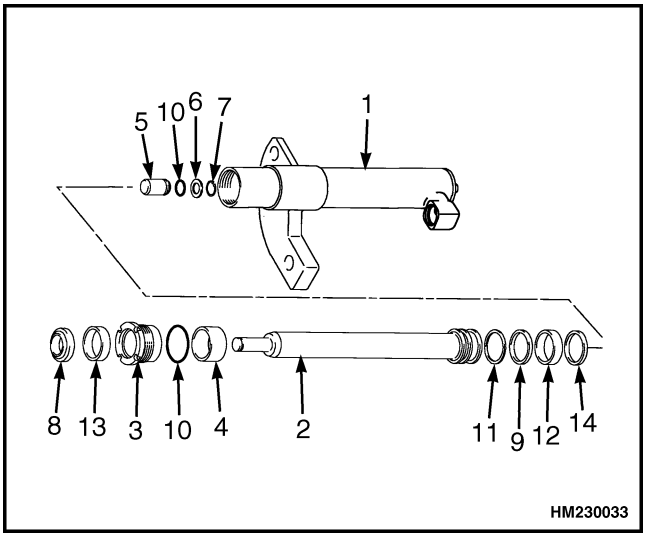
Figure 9. Two-Stage LFL Main Lift Cylinder

5. Remove snap ring, washer, and check valve from base of piston.

   See Figure 9 for lift trucks equipped with a two-stage LFL mast

   See Figure 10 for lift trucks equipped with a three-stage FFL mast

6. Repeat disassembly procedure for the opposite cylinder.



1. SHELL
2. ROD
3. GLAND
4. SPACER
5. CHECK VALVE
6. WASHER
7. SNAP RING
8. WIPER RING
9. SEAL
10. O-RING
11. BACKUP RING
12. WEAR RING
13. ROD SEAL
14. PISTON RING

Figure 10. Three-Stage FFL Main Lift Cylinder

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.

WARNING

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

CAUTION

DO NOT allow cleaning solvent to come in contact with rubber components. It will damage those components.

1. Clean all metal parts in solvent and dry with compressed air.

Inspect

Inspect the gland for damage to the threads and the seal surfaces. If damaged, replace gland.

Inspect the piston for any damage to the seal surfaces. If damaged, replace piston.

Inspect the rod for damage to the rod surface and ensure that the rod is not bent. If damaged, replace rod.

Inspect the inner surface of the cylinder tube for damage. If damaged, replace cylinder assembly.

Assemble

NOTE: The procedures in this section cover all lift cylinders except for the left main lift cylinder on two-stage FFL masts. See the section Two-Stage FFL Left Side Main Lift Cylinder for the procedures.

NOTE: To prevent damage to sealing surfaces, use brass tools when installing seals and O-rings.

1. Lubricate all internal parts of the lift cylinder with clean hydraulic oil. Use new O-rings, seals, and wear rings.

   See Figure 9 for lift trucks equipped with a two-stage LFL mast

   See Figure 10 for lift trucks equipped with a three-stage FFL mast