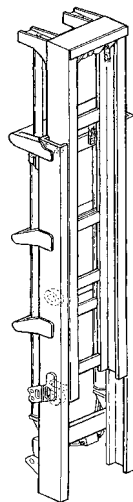


MAST REPAIR

**N50FA; N40-45FR [D138]; N30XMH,
N30XMH₂ [C210]; N25XMDR3, N30-
40XMR3 [C470]; N50XMA3 [C471];
N30XMDR3, N45XMR3 [G138]; N30XMXDR3,
N45XMXR3 [B264]; W30-40ZA [B453];
W20-30ZR [B455]; W25-30-40ZC [B454];
W25-30ZA₂ [B495]; V30ZMD [D210/E210]**



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 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

General	1
Safety Procedures When Working Near Mast	2
Load Backrest Extension, Carriage, Load Rollers, Side Rollers, and Forks	3
Load Backrest Extension, Remove and Install	3
Carriage Assembly, Remove and Install	3
Carriage Load Rollers, Remove and Install	6
Side Rollers, Disassemble and Assemble	6
Fork, Replace	7
Hook-Type Forks	7
Remove	8
Install	8
Two-Stage Mast Assembly	8
Remove	8
Clean and Inspect	11
Lift Cylinders, Remove and Install Dual-Lift Cylinders	13
Lift Cylinder, Remove and Install Single Main-Lift Cylinders	14
Remove	15
Install	15
Inner Mast Assembly, Remove and Install	16
Hoses, Replace	16
Hose and Cable Sheaves, Replace	18
Two-Stage Lift Chains	18
Remove and Install	19
Clean and Inspect	19
Two-Stage Chain Sheave, Remove and Install	19
Load Rollers and Wear Plugs, Remove and Install	20
Two-Stage Mast Assembly, Install	21
Three-Stage Mast Assembly	22
Three-Stage Mast Assembly, Remove	22
N30XHM, N30XMH ₂ (C210), and V30ZMD (D210/E210) Only	25
Clean and Inspect	25
Free-Lift Cylinder, Remove and Install	26
Main Cylinders (Standard), Remove and Install	28
Main Cylinders N30XMH, N30XMH ₂ (C210) and V30ZMD (D210/E210), Remove and Install	28
Inner and Intermediate Mast Assemblies, Remove and Install	29
Hoses, Replace	31
Hose and Cable Sheaves, Replace	31
Free-Lift Hose Sheave	31
Carriage Sheaves	32
Three-Stage Lift Chains, Remove and Install	32
General	32
Free-Lift Chains	32
Main-Lift Chains	33
Three-Stage Chain Sheaves, Disassemble and Assemble	33
Free-Lift Chain Sheaves	33
Main-Lift Chain Sheaves	33
Load Rollers and Wear Plugs, Remove and Install	34
Three-Stage Mast Assemble, Install	35
Mast Operation Check	36
Hydraulic System Leaks Check	36
Lift Chains Check	37

TABLE OF CONTENTS (Continued)

General.....	37
Clean and Inspect.....	37
Lubrication.....	37
Mast Adjustments.....	38
General.....	38
Adjust Wear Plugs - Mast	39
Adjust Free-Lift Chain (Three-Stage Only)	40
Adjust Main-Lift Chains	41
Two-Stage.....	41
Three-Stage	42
Adjust Wear Strips	42
Carriage Adjustments.....	43
Adjust Wear Plug - Carriage	43
Adjust Side Rollers - Carriage	43
Adjust Thrust Rollers - Carriage	44
Troubleshooting.....	45

This section is for the following models:

N50FA N40-45FR [D138];
N30XMH, N30XMH₂ [C210];
N25XMDR3, N30-40XMR3 [C470];
N50XMA3 [C471];
N30XMDR3, N45XMR3 [G138];
N30XMXDR3, N45XMXR3 [B264];
W30-40ZA [B453];
W20-30ZR [B455];
W25-30-40ZC [B454];
W25-30ZA₂ [B495];
V30ZMD [D210/E210]

General

This manual has the removal, installation, and adjustment procedures for the two-stage (limited free-lift) and three-stage (full free-lift) masts. The description and operation of the masts are outlined in the section **Mast, Description** 4000 SRM 480. A troubleshooting chart is listed at the end of this section. Repair procedures for the reach carriages are covered in the section **Reach Carriages** 4500 SRM 483 or **Reach Carriages** 4500 SRM 971. Repair procedures for the attachment carriage are covered in **Attachment** 5000 SRM 580.

These mast assemblies and carriages have wear plugs and can have wear strips to allow for wear and adjustment. The wear plugs are in the stub shafts of the load rollers and slide against the center of the channel. A setscrew and jam nut keep each wear plug in the correct position. The load rollers take the forward and back stress loads during operation of the mast. The load rollers have ball bearings with grease seals. The wear strips are made of a friction material and slide against the outside edge of the channel flange.



WARNING

The mast and carriage assemblies, and their components, are heavy. To help prevent damage or an injury, a lifting device must be used during all service procedures.

The mast assemblies must have the mast weldments parallel with equal clearance on each side between all weldments. Correct operation also depends on periodic cleaning, lubrication, and adjustment. See Mast Operation Check, Hydraulic System Leaks Check, Lift Chains Check, Mast Adjustments, and Carriage Adjustments at the rear of this section.

NOTE: For the correct maintenance and inspection procedures for the masts, hydraulic cylinders, forks, chains, and carriages for your lift truck, see the section **Periodic Maintenance** 8000 SRM 1027, **Periodic Maintenance** 8000 SRM 555, **Periodic Maintenance** 8000 SRM 1379, or **Periodic Maintenance** 8000 SRM 970.

NOTE: The standard carriage, the reach carriage, and the attachment carriage can be removed from the mast assembly with the load backrest extension and forks attached. Both the two-stage and three-stage mast assembly can also be removed with the carriage installed. It is recommended that the attachment carriage be removed prior to removing the three-stage mast assembly. Do only those procedures necessary for your repair.

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 of the mast or carriage are completely lowered or a safety chain is installed.**
- **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 manual.**

WHEN WORKING NEAR THE MAST, ALWAYS:

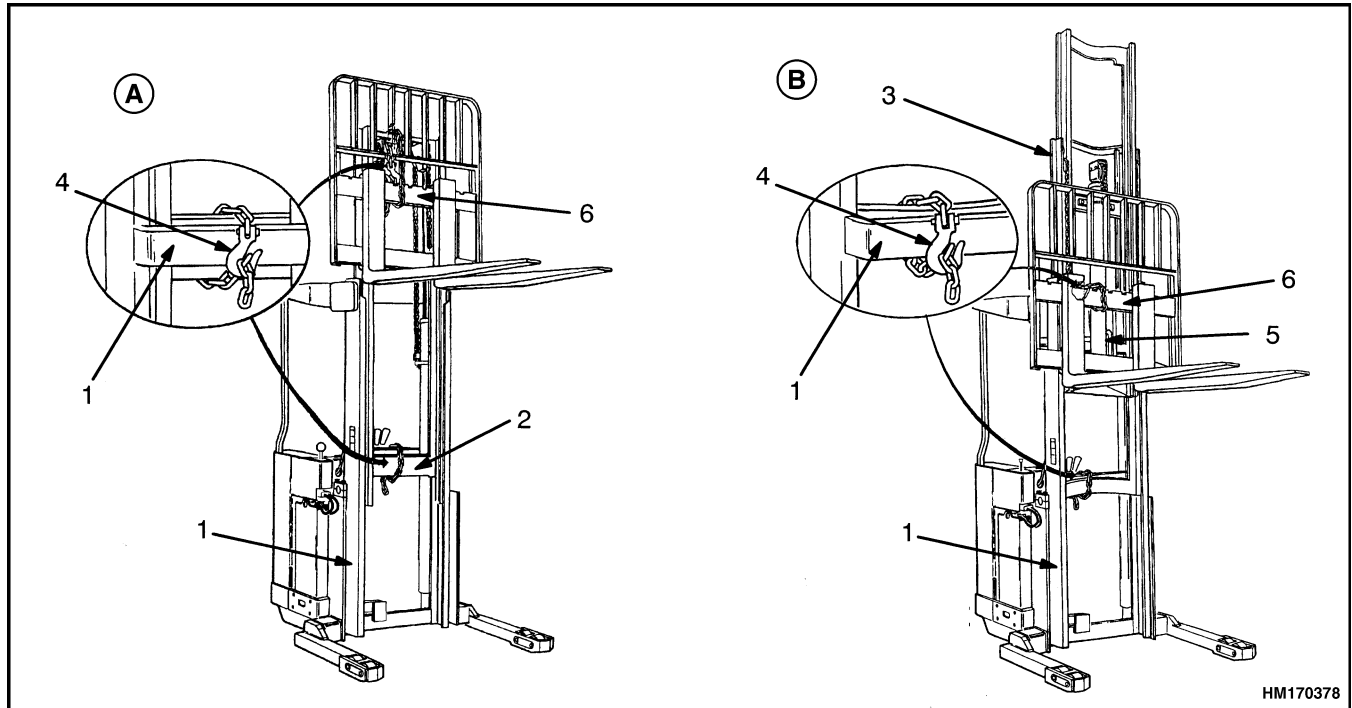
- **Lower the mast and carriage completely. Push the lift/lower control and make sure there is no movement in the mast. Release the lift/lower control. Make sure all parts of the mast that move are fully lowered.**

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:**

NOTE: Mast operator guard must be removed to install safety chain. Remove safety chain and install the guard after repairs are complete.

1. Raise the mast to align the bottom crossmember of the weldment that moves in the outer weldment with a crossmember on the outer weldment. On the two-stage mast, the moving part is the inner weldment. On the three-stage mast, it is the intermediate weldment. See Figure 1.
2. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so the movable member cannot lower. Put the hook on the back side of the mast. Make sure the hook is completely engaged with a link in the chain. Make sure the safety chain does not touch lift chains, chain sheaves, tubes, hoses, fittings, or other parts on the mast.
3. Lower the mast until there is tension in the safety chain and the free-lift cylinder (three-stage mast only) is completely retracted. Move the key to the **OFF** position and remove the key from the key switch. Put a **DO NOT OPERATE** tag in the operator's compartment. Disconnect the battery and put a tag or lock on the battery connector. Install a **DO NOT REMOVE** tag on the safety chain(s).
4. Install another safety chain (3/8-inch minimum) between the top or bottom crossmember of the carriage and a crossmember on the outer weldment.



A. TWO-STAGE MAST

1. OUTER WELDMENT
2. INNER WELDMENT

B. THREE-STAGE MAST

3. INTERMEDIATE WELDMENT
4. SAFETY CHAIN HOOK
5. FREE-LIFT CYLINDER
6. CROSSMEMBER

Figure 1. Safety Chain the Mast, Typical Mast

Load Backrest Extension, Carriage, Load Rollers, Side Rollers, and Forks

LOAD BACKREST EXTENSION, REMOVE AND INSTALL

1. Loosen the two upper capscrews that fasten the load backrest extension to the carriage.
2. Remove these two capscrews and lay the load backrest extension on the forks.
3. Remove the two lower capscrews that fasten the load backrest extension to the carriage.
4. Lift the load backrest extension off the forks.
5. Reverse the procedure to install the load backrest extension. Tighten the capscrews to 203 N•m (150 lbf ft).

CARRIAGE ASSEMBLY, REMOVE AND INSTALL

See the section **Attachment 5000 SRM 580** or **Attachment 5000 SRM 1254** to remove and install the attachment carriage.

NOTE: The carriage can be removed with the forks and load backrest extension attached or with the forks and load backrest removed. Do only those procedures necessary for your repair. See Fork, Replace to remove the forks. See Load Backrest Extension, Remove and Install to remove the load backrest extension.

NOTE: Most repairs of the reach carriage can be completed without removing it from the mast. See the section **Reach Carriages 4500 SRM 483** or **Reach Carriages 4500 SRM 971** for repair procedures.

Load Backrest Extension, Carriage, Load Rollers, Side Rollers, and Forks

4000 SRM 482

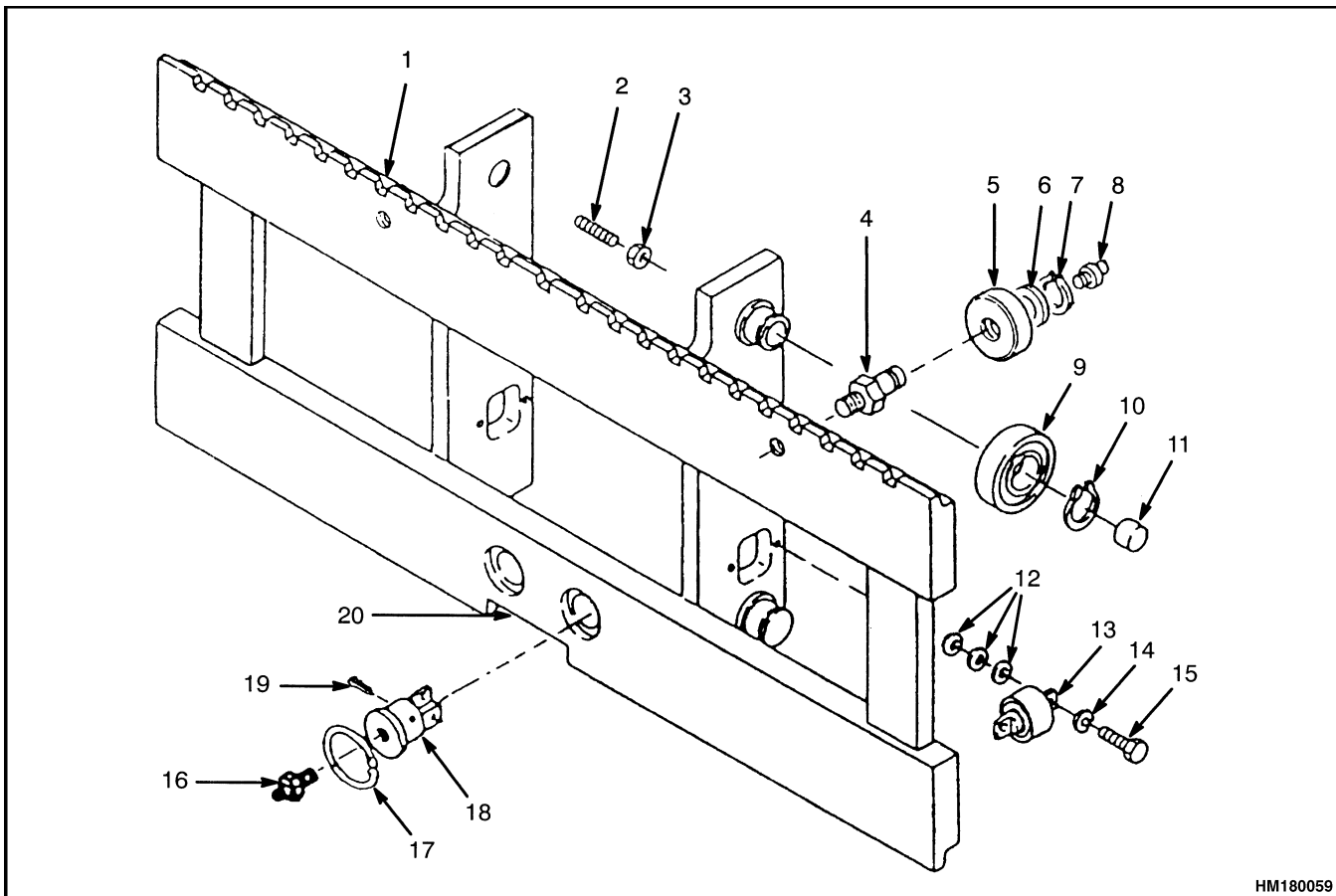
Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

Remove the carriage as follows:

1. On reach units, operate the REACH/RETRACT control button to retract the forks fully. Install safety chains so that the forks cannot extend. Install the safety chains around the center plates of the scissor arm weldment and a crossmember of the mast. Make sure a safety chain does not touch the mount for the hose sheave, lift chains, chain or hose sheaves, hoses, tubes, or fittings.
2. Operate the LIFT/LOWER control to raise the carriage assembly until the thrust rollers of the

inner frame (reach) or the carriage frame are above the top of the outer weldment.

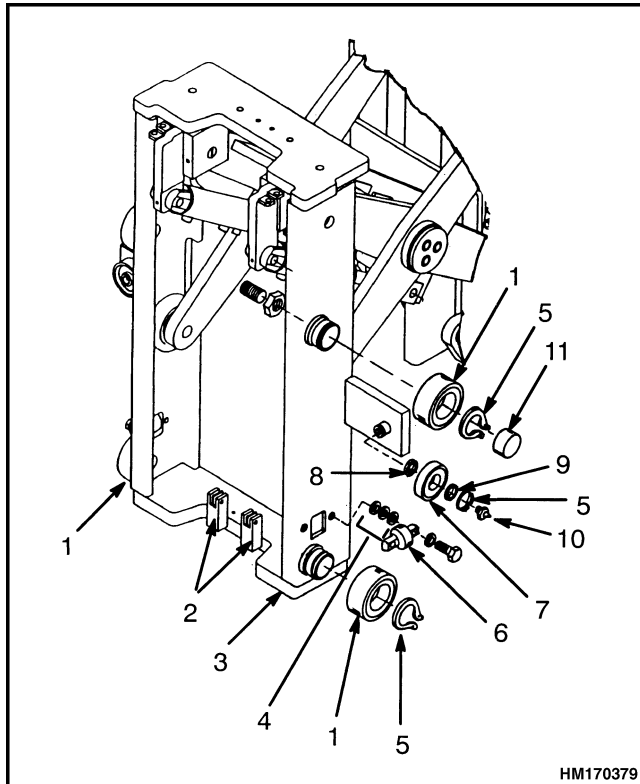
3. Move the key to the **OFF** position and disconnect the battery. Remove the operator guard from the mast assembly.
4. Use safety chains to fasten the movable member of the mast to the outer weldment so that it cannot move.
5. Remove the snap rings, washers, thrust rollers, and spacers. For standard units, see Figure 2. For reach units, see Figure 3.



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- | | | |
|-------------------|-------------------|------------------------|
| 1. CARRIAGE FRAME | 8. GREASE FITTING | 15. SCREW |
| 2. SCREW | 9. LOAD ROLLER | 16. GREASE FITTING |
| 3. NUT | 10. SNAP RING | 17. SNAP RING |
| 4. STUD | 11. WEAR PLUG | 18. CHAIN ANCHOR |
| 5. THRUST ROLLER | 12. SHIM | 19. COTTER PIN |
| 6. WASHER | 13. SIDE ROLLER | 20. FORK REMOVAL NOTCH |
| 7. SNAP RING | 14. LOCKWASHER | |

Figure 2. Typical Standard Carriage



- | | |
|-------------------------|--------------------|
| 1. LOAD ROLLER (4 OR 6) | 6. SIDE ROLLER |
| 2. CHAIN ANCHORS | 7. THRUST ROLLER |
| 3. INNER FRAME | 8. SPACER |
| 4. SHIMS | 9. WASHER |
| 5. SNAP RING | 10. GREASE FITTING |
| | 11. WEAR PLUG |

Figure 3. Inner Frame Assembly (Reach Carriage)



WARNING

Lift chains, hoses, and cables can roll over the sheaves to fall and cause an injury if the ends are not fastened. Keep control of the ends of the lift chains, hoses, and cables as they are removed. Use wire to connect the ends of the lift chains, hoses, or cable temporarily to the masts.

- On three-stage masts, remove the safety chains installed in Step 4. Lower the carriage assembly for access to the chain anchors at the back of the free-lift cylinder. Use safety chains to fasten the movable member of the mast to the outer weldment so that it cannot move. Move the key to the **OFF** position and disconnect the battery.
- On reach units, install lifting eyes in the carriage assembly for chains or slings. Fasten chains or slings to the carriage assembly so the carriage

cannot tip as it is removed from the mast weldment. Fasten the chains to the lifting eyes on reach units. Fasten the chains or slings to the carriage frame on standard units. Use the crane to raise the carriage assembly so the lift chains become loose.

- Disconnect the hydraulic lines (sideshift or reach only) at the carriage. Put tags on the fittings for correct connection during installation. Make sure to put caps on the open fittings to keep dirt out of the system. Disconnect the electrical connections (reach only) at the selector valve.

NOTE: Removing the pins at the chain anchors will disconnect the lift chains without changing the chain adjustment. Always adjust the chains if new lift chains or other components are installed.

- Hold the lift chains to keep them from falling. Remove the pins in the chain anchors at the back of the outer weldment of two-stage masts. Remove the pins in the chain anchors at the back of the free-lift cylinder of three-stage masts. Disconnect the lift chains. Carefully move the lift chains through the sheaves and lay the lift chains over the carriage.



WARNING

The carriage assembly is heavy and can cause an injury if it tips or falls. Make sure the carriage assembly has stability during and after removal.



CAUTION

Do not damage lift chains, hoses, or electrical cables as the carriage assembly is lifted out of the mast weldment.

- Carefully lift the carriage assembly out of the channels of the inner weldment. Carefully lower the carriage assembly to the floor.



WARNING

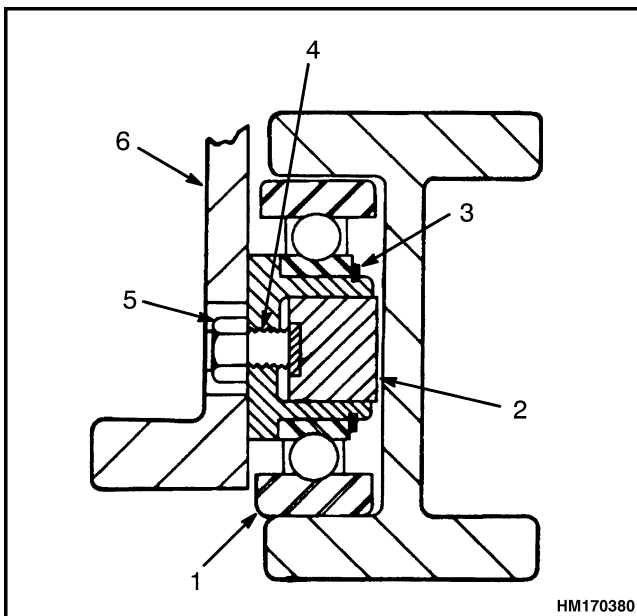
Make sure that the carriage has stability and cannot fall to cause an injury. If the forks are removed, put the carriage on the floor so that the load rollers are up.

NOTE: The carriage side rollers must be adjusted while the carriage is out of the mast. Adjust the side rollers as described in Adjust Side Rollers - Carriage before installing the carriage.

11. To install the carriage assembly, reverse the removal procedures. Always use new cotter pins when installing the lift chains. Apply Loctite™ to the studs of the thrust rollers during installation.
12. Adjust the carriage assembly. See Carriage Adjustments. Test the carriage assembly for correct operation.

CARRIAGE LOAD ROLLERS, REMOVE AND INSTALL

1. Remove the carriage assembly from the mast assembly to remove and install the carriage load rollers. See Carriage Assembly, Remove and Install.
2. Remove the jam nuts and setscrews for the load rollers. See Figure 4.

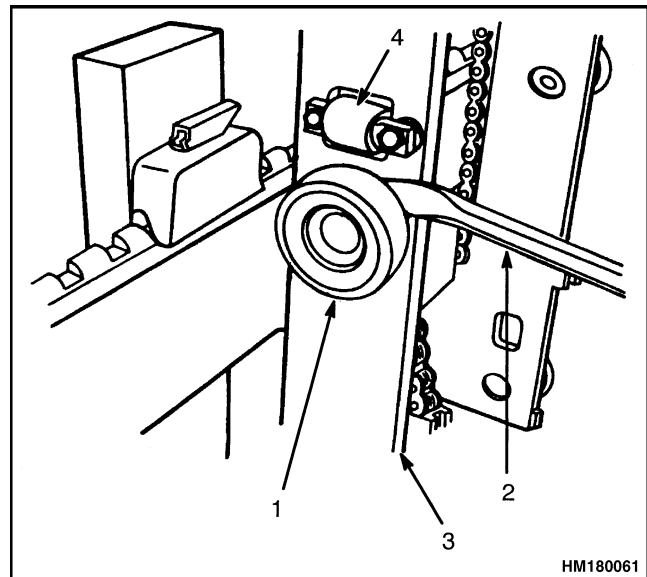


1. LOAD ROLLER
2. WEAR PLUG
3. SNAP RING
4. SETSCREW
5. JAM NUT
6. MAST OR CARRIAGE

Figure 4. Load Roller and Wear Plug Assembly

3. If necessary, replace the wear plugs by pushing at the back of the wear plug.
4. Remove the snap rings from the stub shaft for the load roller.

5. Use a pry bar to remove the load roller from the stub shaft for the load roller. See Figure 5.
6. Use a cloth to clean each load roller. Inspect the load rollers for cracks, flat spots, or bearings that do not turn freely. Replace any roller that shows wear or is damaged.
7. Install the carriage. See Carriage Assembly, Remove and Install.
8. Adjust the carriage. See Carriage Adjustments.



1. LOAD ROLLER WITH SNAP RING REMOVED
2. PRY BAR
3. MAST OR CARRIAGE COMPONENT (CARRIAGE SHOWN)
4. SIDE ROLLER

Figure 5. Removing Load Roller

SIDE ROLLERS, DISASSEMBLE AND ASSEMBLE

1. Remove the carriage assembly from the mast to replace the side rollers. See Carriage Assembly, Remove and Install to remove the carriage. See Figure 2 and Figure 3.
2. Remove the capscrews that fasten the side roller bracket.

NOTE: Observe the position of the shims.

3. Inspect and replace all damaged or worn parts.

4. Reverse the procedure to install the side rollers. Adjust the carriage side rollers during assembly. See Carriage Adjustments.

NOTE: To remove and replace load rollers, wear plugs, weldments, or lift cylinders, it is necessary to remove the two-stage mast assembly from the truck.

FORK, REPLACE

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

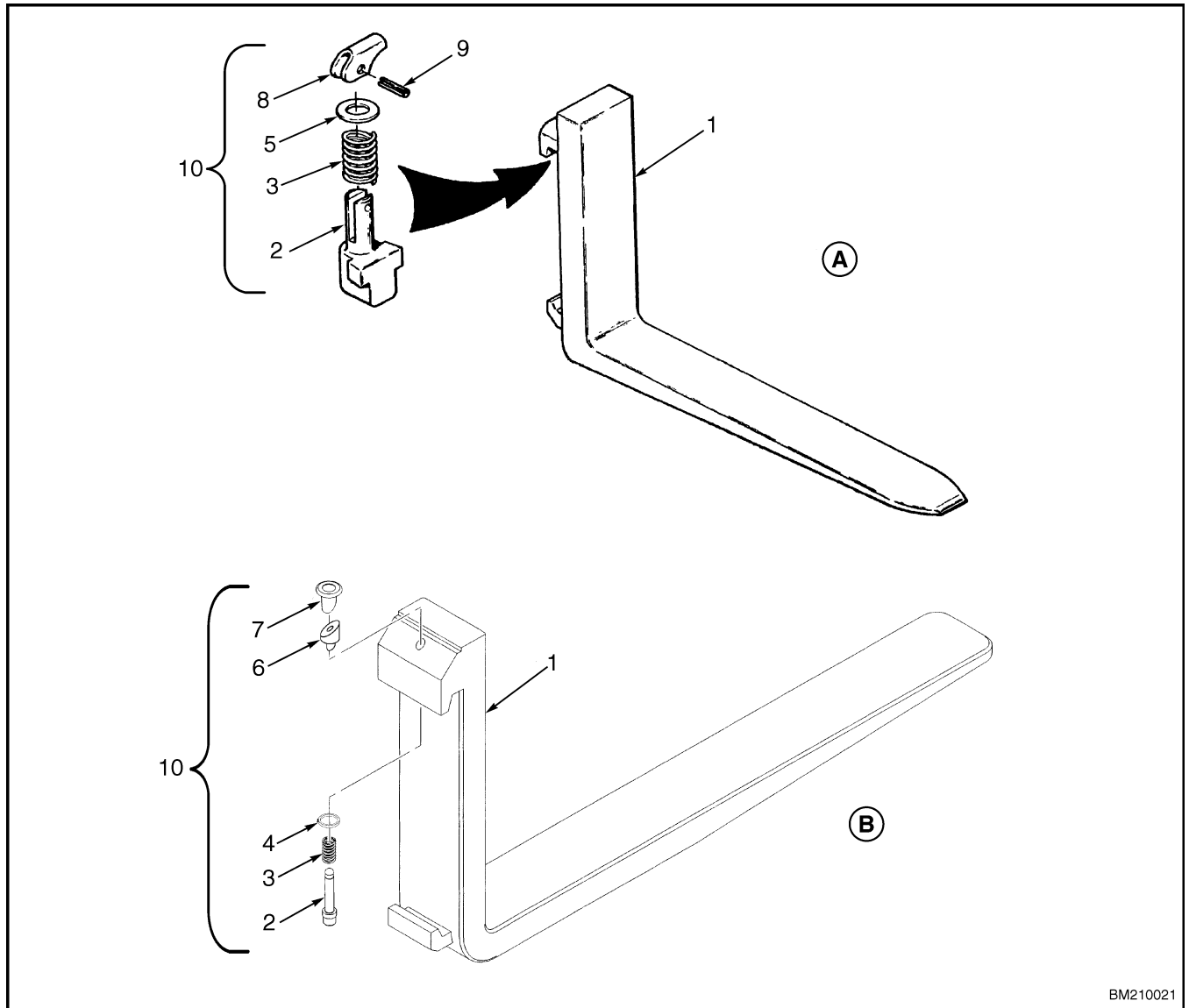
Hook-Type Forks



WARNING

Forks are heavy and can cause an injury. Do not try to remove forks without using a lifting device.

These forks are connected to the carriage by hooks. See Figure 6. Latch pins fit through the top fork hooks and into slots on the top crossmember of the carriage to keep the forks in position.



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Figure 6. Forks

Two-Stage Mast Assembly**4000 SRM 482****Legend for Figure 6****A. OLD STYLE LATCH PIN ASSEMBLY**

1. FORK
2. LATCH PIN
3. SPRING
4. WASHER
5. WASHER

B. NEW STYLE LATCH PIN ASSEMBLY

6. WEDGE
7. KNOB
8. LEVER
9. ROLL PIN
10. LATCH PIN ASSEMBLY

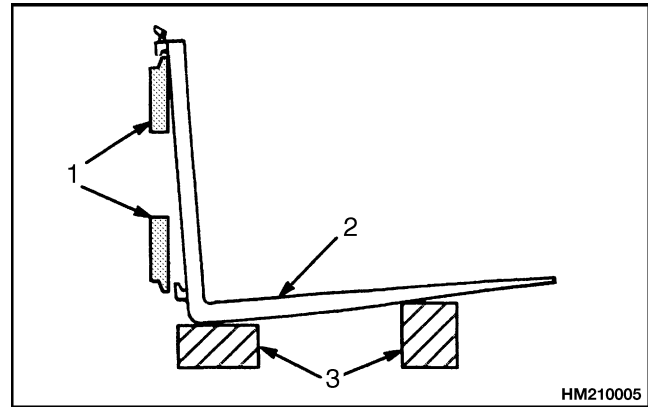
Remove

Lift the latch lever and slide the fork to the fork removal notch on the carriage. The removal notch is in the bottom crossmember of the carriage as shown in Figure 2. Lower the carriage with a block under the fork or raise the fork tip. See Figure 7. The bottom hook of the fork will move through the fork removal notch. Lower the carriage further or raise the fork so that the top hook of the fork is disengaged from the top crossmember. Move the carriage away from the fork, or use the lifting device to move the fork away from the carriage. Follow the same procedure to remove the other fork.

Install

Move the fork or carriage so that the top hook on the fork engages the top crossmember of the carriage. Raise the carriage or lower the fork to move the lower hook through the removal notch. Slide the fork on

the carriage so that both upper and lower hooks are engaged and the latch pin engages a notch.



1. CARRIAGE BARS
2. HOOK FORK
3. BLOCKS

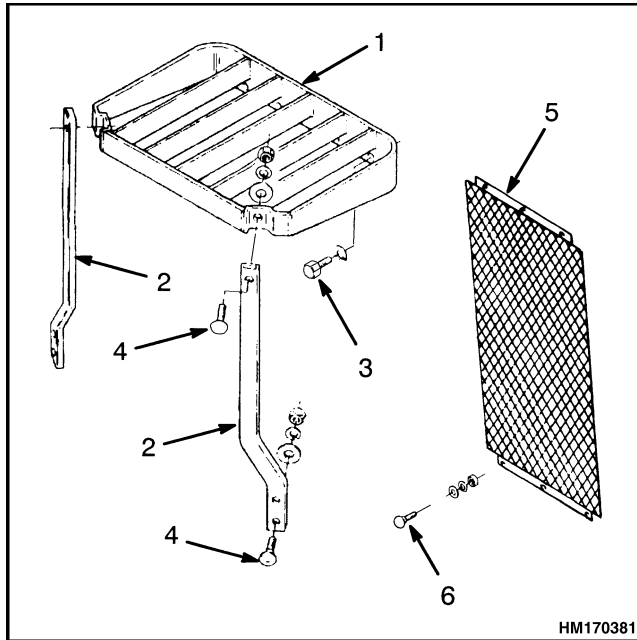
Figure 7. Hook Fork Removal**Two-Stage Mast Assembly****REMOVE**

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

NOTE: If the mast assembly will be disassembled after it is removed from the truck, **first** remove the standard carriage or the reach carriage as a complete assembly. See Carriage Assembly, Remove and Install. If the reach carriage will be removed with the mast assembly, operate the REACH/RETRACT control button to retract the forks fully. Install safety

chains so that the forks cannot extend. Install the safety chains around the center plates of the scissor arm weldment and a crossmember of the mast. Make sure a safety chain does not touch the mount for the hose sheave, lift chains, chain or hose sheaves, hoses, tubes, or fittings. If installed, operate the SIDESHIFT control to move the sideshift frame to the center position.

1. Remove the capscrews and nuts that fasten the operator guard and remove the guard. See Figure 8 or Figure 9.



- | | |
|-------------------|------------------------|
| 1. OVERHEAD GUARD | 4. LEG CAPSCREW |
| 2. LEG | 5. MAST OPERATOR GUARD |
| 3. MAST CAPSCREW | 6. CAPSCREW |

Figure 8. Overhead Guard and Operator Guard Narrow Aisle Trucks

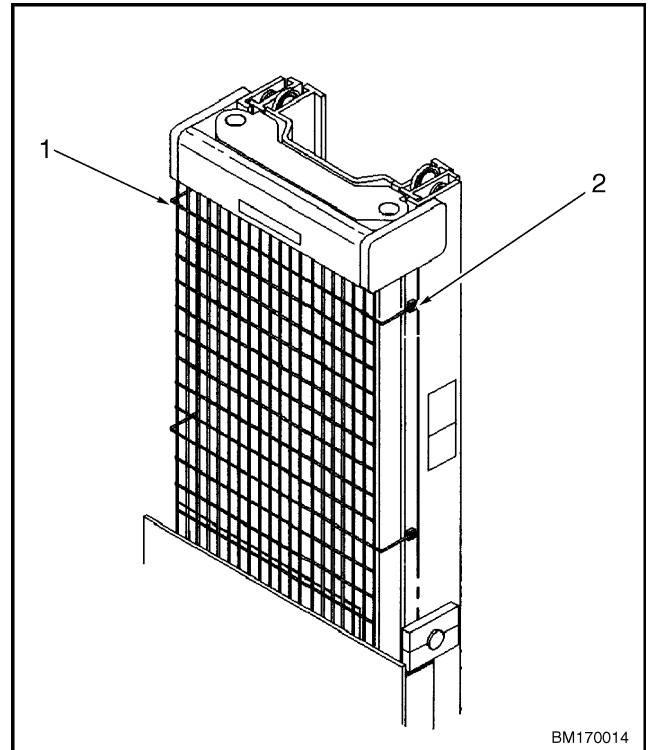
- For the Narrow Aisle lift trucks, remove the cap screws that fasten the rear legs to the overhead guard. See Figure 8. The overhead guard will be removed with the mast assembly.



CAUTION

DO NOT move the control button for the reach, retract, tilt, or sideshift functions. Oil will flow from the hoses for these functions.

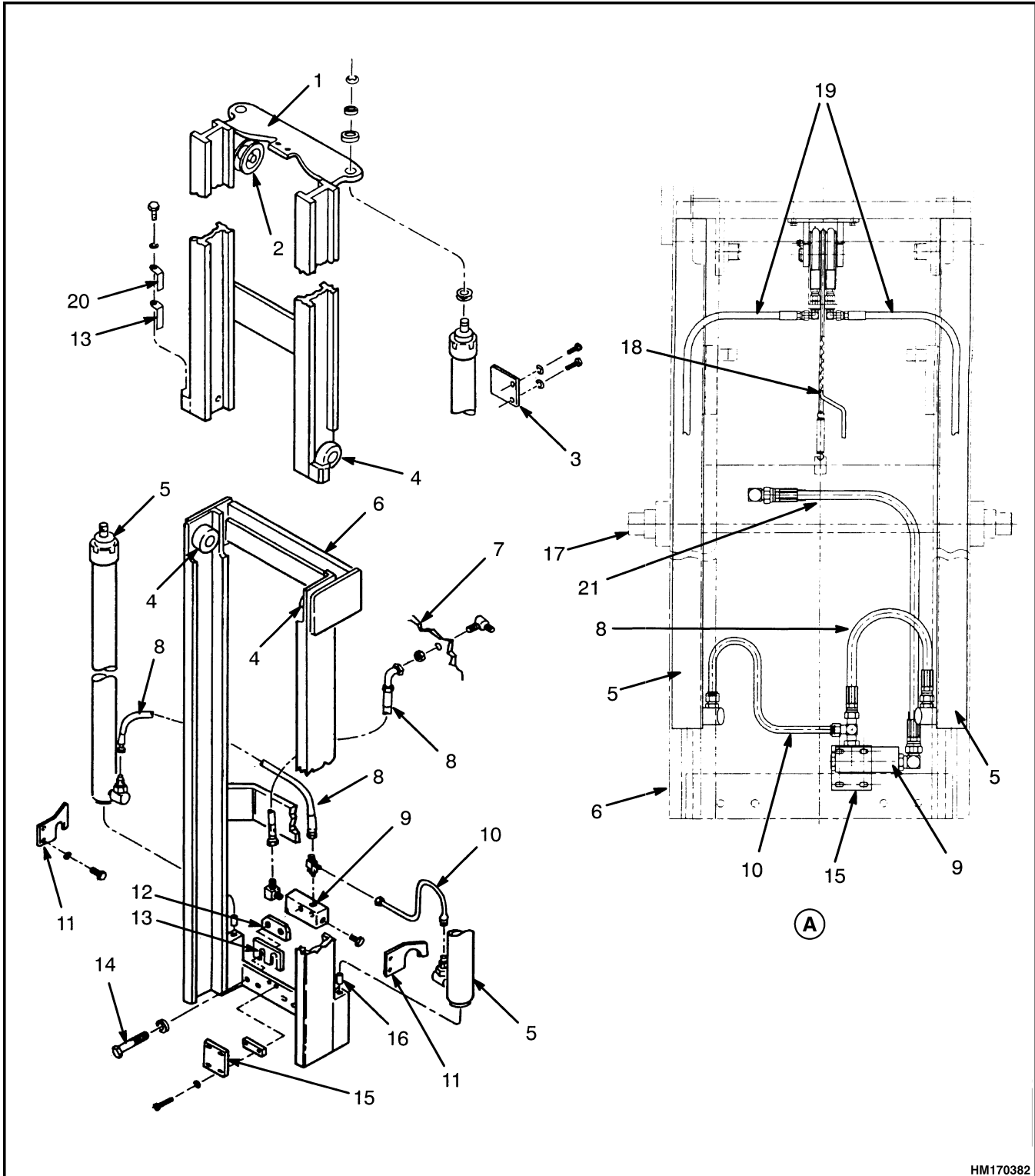
- Operate the LIFT/LOWER control to raise the inner weldment for access to the four cap screws, the shims, and the nutplates that fasten the bottom of the outer weldment to the truck frame. See Figure 10 or Figure 11.



- | | |
|-------------------|-------------|
| 1. OPERATOR GUARD | 2. CAPSCREW |
|-------------------|-------------|

Figure 9. Operator Guard Walkie High Lift Trucks

- Install safety chains to keep the mast components from moving. Remove the cap screws, washers, and clamps that fasten the lift cylinder hoses to the mast weldments. **DO NOT** disconnect any hydraulic fittings.
- Remove the safety chains installed in Step 4. Do not damage hydraulic hoses as the mast lowers. Carefully operate the LIFT/LOWER control to lower the inner weldment fully. Make sure that all hydraulic pressure is removed from the system by holding the control in the LOWER position for approximately 5 seconds.



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Figure 10. Two-Stage Mast Assembly (Dual-Lift Cylinders)

*Legend for Figure 10***A. BACK VIEW**

1. INNER WELDMENT
2. CHAIN SHEAVE
3. RETAINER
4. LOAD ROLLER
5. LIFT CYLINDER
6. OUTER WELDMENT
7. LIFT TRUCK FRAME
8. HYDRAULIC HOSE (LIFT)
9. FLOW REGULATOR HOUSING
10. HYDRAULIC TUBE (LIFT)
11. LOCK PLATE

12. NUTPLATE
13. SHIM
14. MOUNT CAPSCREWS FOR MAST ASSEMBLY
15. REGULATOR MOUNT PLATE
16. LOCATING DOWEL PIN
17. TRUNNION STUB SHAFT
18. ELECTRIC CABLE FOR REACH CARRIAGE
19. HOSES FOR REACH OR SIDESHIFT CARRIAGE
20. WEAR STRIP
21. HYDRAULIC HOSE TO TRUCK

NOTE: On models with trunnion caps, mark the trunnion caps so they can be reassembled in the same position and on the same trunnion from which they are removed.

6. Use chains to connect a crane or other lifting device to the top of the mast assembly. Make sure the chains will not damage the sheaves or other parts of the mast assembly. Make sure the chains and crane have the capacity to lift approximately 2000 kg (4409 lb). Use safety chains to fasten all the mast weldments together so they cannot move. If the reach carriage is installed, install a chain or sling to the reach carriage to keep the mast assembly from tipping during removal. Remove the hardware securing the mast to the frame.
7. Operate the crane until it gives support to the weight of the mast assembly. Move the crane to a position so that the mast assembly will be lifted vertically. Raise the mast assembly high enough to clear the trunnions. Move the mast assembly approximately 30 cm (1 ft) away from the truck for access to the hoses.
8. Install labels on all plugs and wires for the electrical cable for correct connection during installation. Disconnect the plugs and wires so that the cable is completely disconnected from the truck. The plugs are near the cable tension device inside the electrical compartment above the battery.
9. Move the mast assembly away from the truck.

NOTE: To disassemble models with an overhead guard, position the mast with the overhead guard on the bottom as a support. Install a secure support under the other end. Make sure the mast is level. Keep the safety chains installed.

10. If the mast will be disassembled, position the mast with the carriage up across wooden beams on a level floor. Make sure the mast is level. Keep the safety chains that were installed in Step 6 on the mast assembly.

11. If the mast will NOT be disassembled, position the mast across beams on a level floor with the overhead guard on top.

CLEAN AND INSPECT**WARNING**

Cleaning solvents can be flammable and toxic and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.

**CAUTION**

DO NOT use steam to clean the lift chains, sheaves, or load rollers. The sheaves and roller bearings are sealed and permanently lubricated. Do not use compressed air on the bearings. The air can force the lubricant out of the bearings.

1. Clean the mast weldments with steam or solvent.

**WARNING**

Some parts may be damaged by welding. To prevent an injury, always get authorization from your dealer for Hyster lift trucks before welding on the mast, forks, or carriage.

2. Inspect the sliding and rolling surfaces of the channels for damage (dents) and wear (grooves). Inspect all welds for cracks.

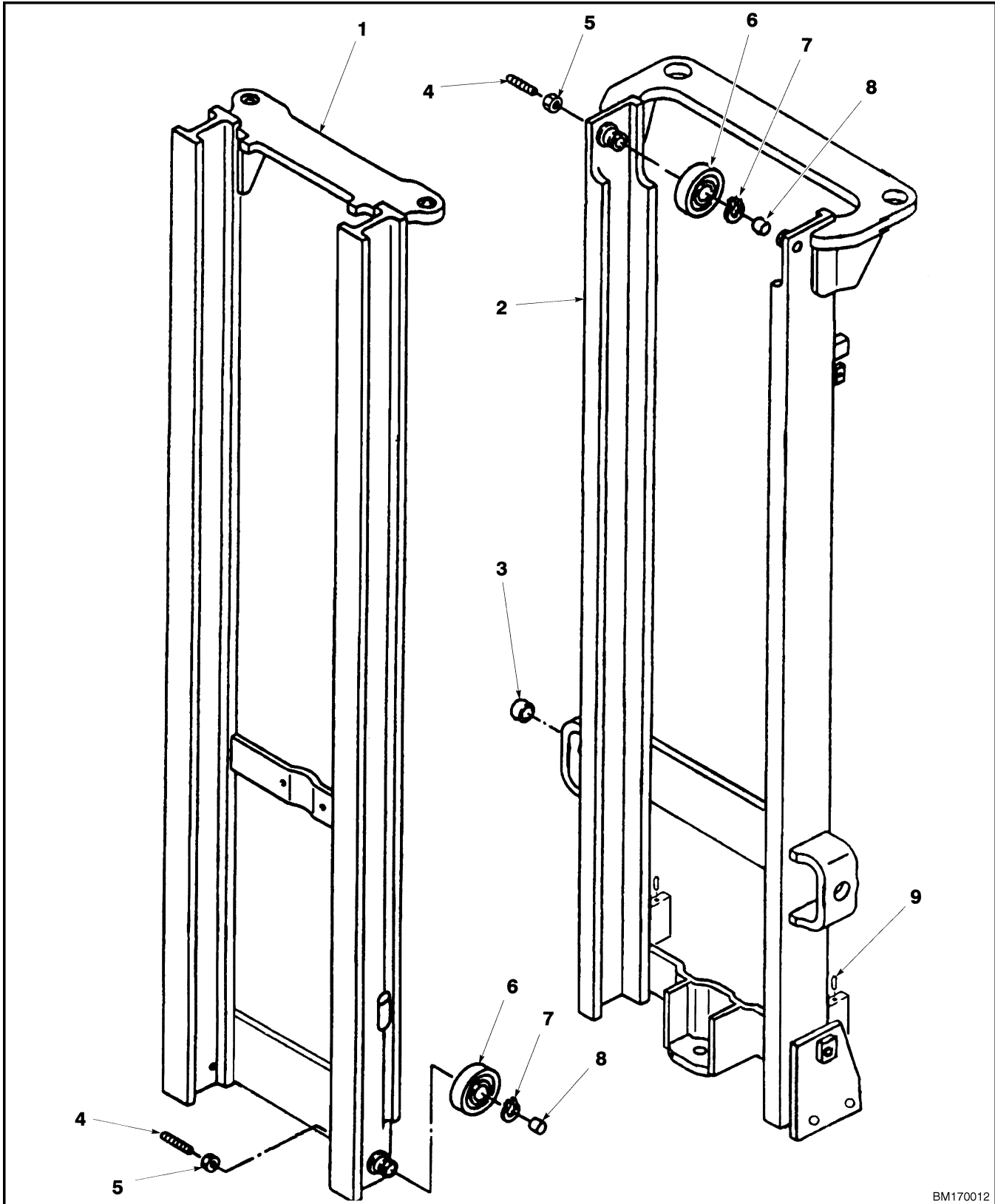


Figure 11. Two-Stage Mast Assembly (Single-Lift Cylinder)

Legend for Figure 11

- | | | |
|-------------------|----------------|--------------|
| 1. INNER WELDMENT | 4. SCREW | 7. SNAP RING |
| 2. OUTER WELDMENT | 5. NUT | 8. PLUG |
| 3. BUSHING | 6. LOAD ROLLER | 9. PIN |

LIFT CYLINDERS, REMOVE AND INSTALL DUAL-LIFT CYLINDERS

NOTE: It is necessary to remove the mast assembly from the truck to remove the lift cylinders.

1. Remove the mast assembly as described in Remove.

**WARNING**

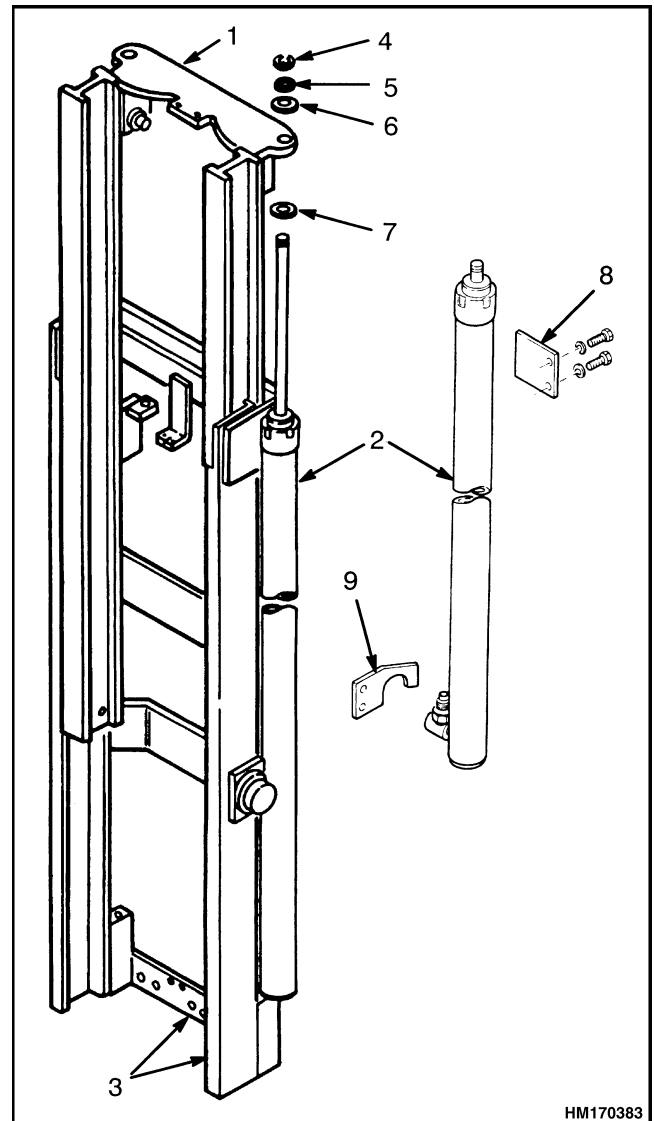
The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

2. Remove the safety chains that fasten the mast weldments together and use a pry bar to move the inner weldment approximately 75 mm (3 in.) out of the outer weldment carefully and slowly.
3. Remove the capscrews, washers, and lock plate at the base of the lift cylinder.

**WARNING**

Be careful when removing or installing snap rings. These snap rings are large and 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. Remove the snap ring, backup washer, rubber bushing, and shims (if applicable) that fasten one cylinder rod to the inner weldment. See Figure 12. If shims are used, make a note of the shim arrangement. Normally, the shim arrangement for the replacement cylinder will be similar.
5. Remove the hose or tube between the lift cylinder and the flow regulator. See Figure 10. Install a cap on the regulator fitting to prevent leakage.



- | | |
|-------------------|------------------------|
| 1. INNER WELDMENT | 6. RUBBER BUSHING |
| 2. LIFT CYLINDER | 7. SHIMS (IF REQUIRED) |
| 3. OUTER WELDMENT | 8. RETAINER |
| 4. SNAP RING | 9. LOCK PLATE |
| 5. WASHER | |

Figure 12. Lift Cylinder Removal

Two-Stage Mast Assembly**4000 SRM 482**

6. Install a sling and crane to support the cylinder. Remove the lift cylinder retainer, capscrews, and washers.
7. Push the cylinder toward the top of the mast assembly to move the lift cylinder off the locating dowel pin. Continue to push the cylinder so that the rod moves into the cylinder to allow removal from the inner weldment.
8. Repeat Step 2 through Step 7 to remove the other lift cylinder.

NOTE: See the section **Lift Cylinders** 4000 SRM 481 to disassemble and repair the cylinder.

9. Reverse the procedure to install the lift cylinders.

LIFT CYLINDER, REMOVE AND INSTALL SINGLE MAIN-LIFT CYLINDERS

For the following instructions, refer to Figure 13 and Figure 14.

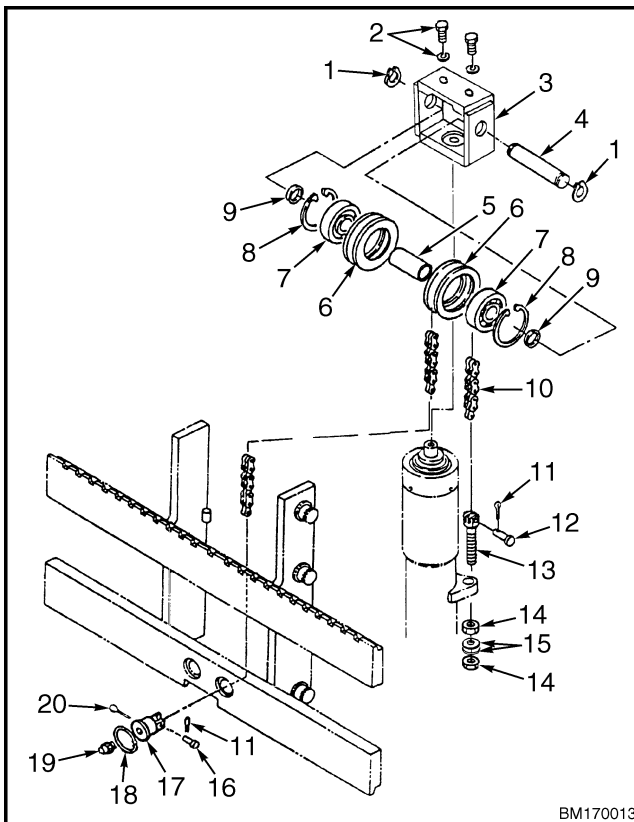


Figure 13. Lift Chains and Sheaves, Single-Lift Cylinder

Legend for Figure 13

1. SNAP RING
2. CAPSCREW AND LOCKWASHER
3. SUPPORT BRACKET
4. SHAFT
5. SPACER
6. SHEAVE
7. BALL BEARING
8. RETAINING RING
9. WASHER
10. LIFT CHAIN
11. COTTER PIN
12. PIN
13. CHAIN ANCHOR
14. NUT
15. LOCKWASHER
16. PIN
17. CHAIN ANCHOR
18. SNAP RING
19. LUBE FITTING
20. COTTER PIN

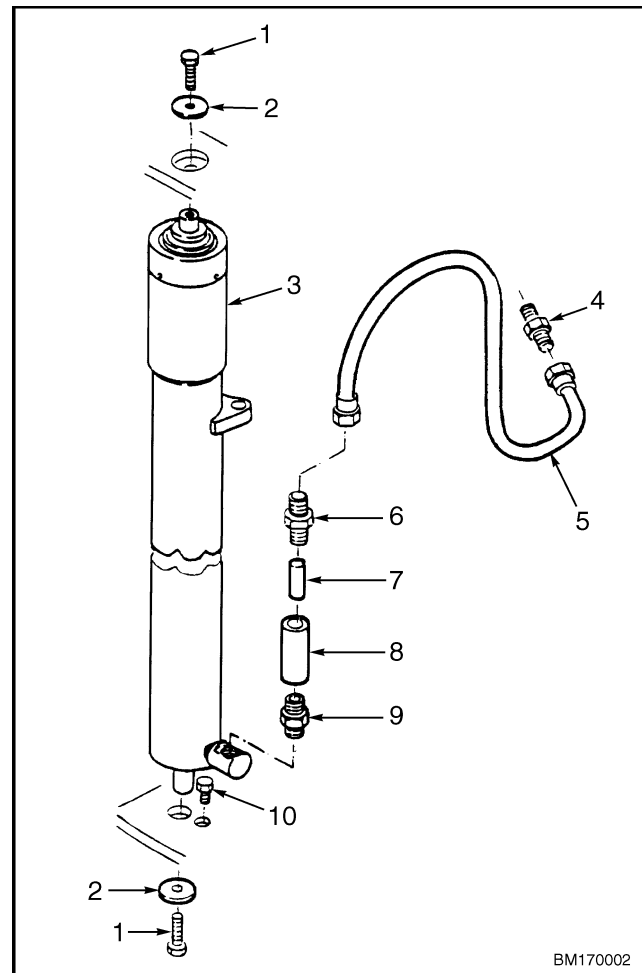


Figure 14. Two-Stage Single-Lift Cylinder - Hydraulic Connections

Legend for Figure 14

1. CAPSCREW
2. WASHER
3. LIFT CYLINDER
4. FITTING
5. TUBE
6. FITTING
7. FLOW REGULATOR
8. HOUSING
9. FITTING
10. CAPSCREW

Remove

NOTE: It is not necessary to remove the mast assembly from the truck to remove the lift cylinder.

1. Move lift truck to a safe, level area.
2. Block wheels to prevent movement of lift truck.
3. Remove load backrest from carriage.
4. Raise the inner mast weldment high enough to align the crossmember with the crossmember of the outer mast weldment.



WARNING

To prevent possible personal injury or damage to equipment, always install a safety chain to restrain the moving parts of the mast.

5. Install a safety chain around the two crossmembers. See Safety Procedures When Working Near Mast.
6. Remove capscREW, washer, and lockwasher that hold bottom of lift cylinder to mast.
7. Remove safety chain.
8. Lower carriage completely so that forks rest on the floor. This will relieve the hydraulic pressure on the lift cylinder and strain on the lift chains.
9. Place a drip pan under mast and carriage.



WARNING

Hydraulic oil in hoses may still be under high pressure even though the mast is fully lowered. To prevent possible injury, slowly loosen hose connections.

10. Slowly loosen hydraulic tube and allow excess oil to drain into drip pan.



CAUTION

To prevent dirt or contaminants from entering the hydraulic system, always install caps on the tube and flow regulator.

11. Remove hydraulic tube from lift cylinder. Install caps on the tube and flow regulator.
12. Clean up spilled oil.
13. Remove lift chains from cylinder and chain sheaves.
14. Install a sling around the cylinder at the chain weldment.
15. Attach the sling to a crane or other suitable lifting device to support the cylinder.
16. Remove two capscREWS and lockwashers that hold support bracket to inner mast weldment.
17. Using the crane, tilt cylinder forward and lift cylinder out of mast weldment.

Install

1. Using the crane, align base of cylinder with lower crossmember of outer mast weldment.
2. Tilt lift cylinder backward and align support bracket with two screw holes in inner mast weldment.
3. Install two capscREWS and lockwashers that hold support bracket to inner mast weldment.
4. Align base of cylinder with screw hole in lower crossmember of outer mast weldment.
5. Install capscREW, washer, and lockwasher that hold bottom of lift cylinder to mast.
6. Remove caps on the tube and flow regulator.
7. Install tube on flow regulator.
8. Clean up spilled oil.
9. Place lift chains over the top of the chain sheaves.
10. Install lift chains to chain anchors.
11. Exercise cylinder by raising and lowering mast several times.
12. Check hydraulic oil level in tank and fill to proper level if necessary.

13. Install load backrest to carriage.

INNER MAST ASSEMBLY, REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

To remove the inner weldment from the mast assembly, the mast assembly must be removed from the lift truck. The lift cylinders and chain sheaves must also be removed.

1. Remove the mast assembly as described in Remove. Remove the lift cylinders. See Lift Cylinders, Remove and Install Dual-Lift Cylinders. Remove the chain sheaves. See Two-Stage Chain Sheave, Remove and Install.
2. If it is necessary to repair the inner mast assembly, the load rollers and wear plugs must be removed. See Load Rollers and Wear Plugs, Remove and Install.
3. Use a crane or lifting device to support the inner weldment while sliding the inner weldment far enough out to clear the outer weldment.

4. Reverse the removal procedure to install the inner mast assembly into the outer weldment.

HOSES, REPLACE

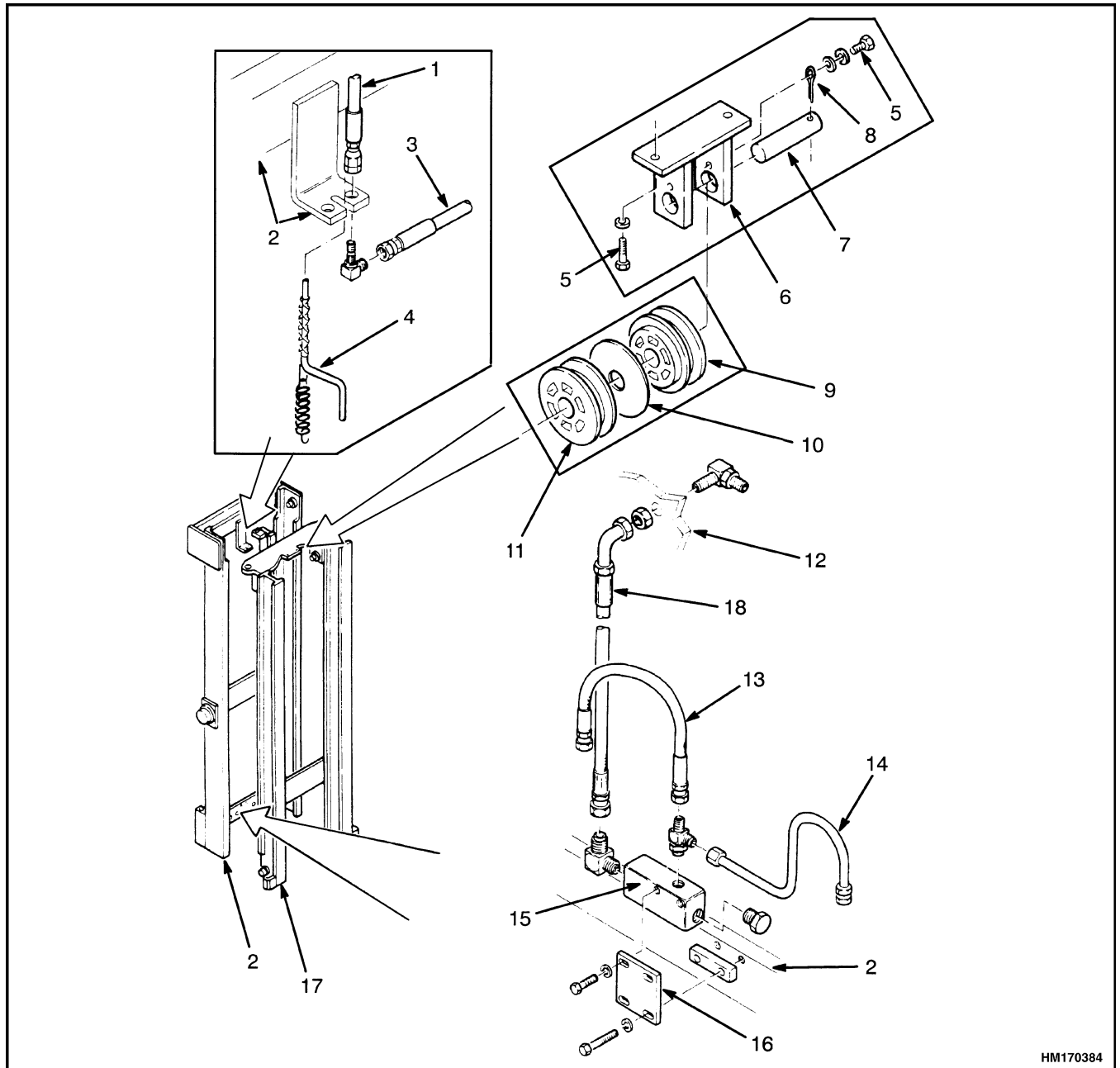
Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

1. To replace any hydraulic hoses, fully lower the carriage. See Figure 10 and Figure 15. Make sure that the system does not have hydraulic pressure. Hold the control (for each function) in the forward position for approximately 5 seconds to release the pressure. Make sure the hydraulic pump does NOT operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.
2. Disconnect hose and install caps to prevent dirt from entering the hydraulic system.
3. Replace the hose. Operate the system to remove all the air from the oil and to check for leaks.

Legend for Figure 15

NOTE: COMPONENTS IN BOXES - STANDARD WITH SIDESHIFT OR REACH CARRIAGES.

- | | |
|---|-----------------------------|
| 1. TO SHEAVE AND CARRIAGE (1 OF 2) | 10. SHIM (AS REQUIRED) |
| 2. OUTER MAST | 11. HOSE SHEAVE |
| 3. TO TRUCK (1 OF 2) | 12. LIFT TRUCK FRAME |
| 4. ELECTRICAL CABLE AND TENSION DEVICE (REACH ONLY) | 13. HYDRAULIC HOSE - LIFT |
| 5. CAPSCREW | 14. HYDRAULIC TUBE - LIFT |
| 6. SHEAVE SUPPORT | 15. FLOW REGULATOR HOUSING |
| 7. SHAFT | 16. REGULATOR MOUNT PLATE |
| 8. COTTER PIN | 17. INNER WELDMENT |
| 9. HOSE AND CABLE SHEAVE | 18. HYDRAULIC HOSE TO TRUCK |



HM170384

Figure 15. Hose and Cable Assemblies - Two-Stage Mast (Dual-Lift Cylinders)

HOSE AND CABLE SHEAVES, REPLACE

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 15.

NOTE: The following procedure describes how to replace the hose and cable sheaves without removing the carriage or mast assembly from the lift truck. If the mast assembly has been removed, carefully move the carriage or inner weldments using a pry bar.



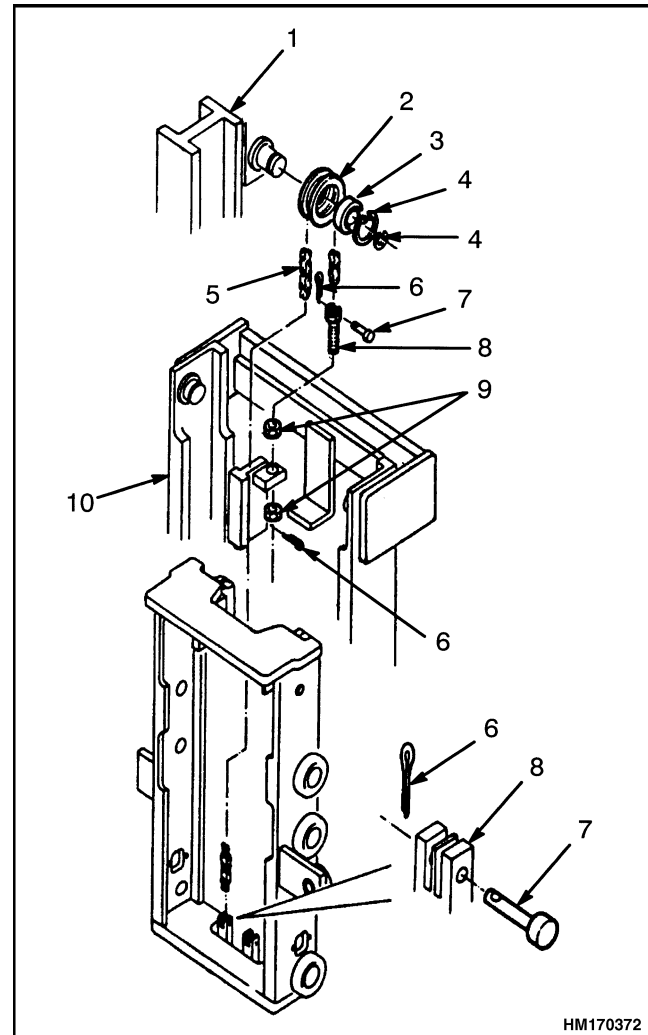
WARNING

The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

1. To replace any hydraulic hoses, fully lower the carriage. Make sure the system does not have hydraulic pressure. Hold the control (for each function) in the forward position for approximately 5 seconds to release the pressure. Make sure the hydraulic pump does not operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.
2. Fasten the hoses to the top of the inner mast at the sheaves. Disconnect or remove the hoses at the carriage. Install hose caps to prevent dirt from entering the hydraulic system.
3. Disconnect the spring of the tension device for the electrical cable. Fasten the cable to the top of the inner mast at the sheave. Install tags on the wires of the electrical cable at the reach carriage for correct connection later. Disconnect the electrical cable.
4. Remove the capscrew, washers, and cotter pin in the shaft at the sheave assembly. Use a drift to remove the shaft at the sheaves carefully. Do not let the sheaves or shims fall.
5. Follow the reverse procedure to install the hose and cable sheaves. Make sure to operate the carriage hydraulic function(s) and check for leaks after the hoses are connected.

TWO-STAGE LIFT CHAINS

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 16 and Figure 23.



NOTE: REACH CARRIAGE SHOWN. CHAIN ANCHOR ON STANDARD CARRIAGE SIMILAR.

1. INNER WELDMENT
2. CHAIN SHEAVE
3. BEARING
4. SNAP RING
5. LIFT CHAIN
6. COTTER PIN
7. PIN
8. CHAIN ANCHOR
9. ADJUSTMENT NUTS
10. OUTER WELDMENT

Figure 16. Removing Chain Sheave

Remove and Install

1. Operate the LIFT/LOWER control to raise the carriage so that the forks are approximately 150 mm (6 in.) off the floor. Use safety chains to fasten the carriage to the outer weldment so that it cannot move.
2. Lower the carriage so the safety chains are the support for the carriage and the lift chains do not have tension.



WARNING

Keep control of the lift chains when disconnecting them from the chain anchor. This procedure will prevent the lift chains from falling and causing an injury or damage.

3. Remove the cotter pins that fasten the chain anchor pins. Remove the chain anchor pins. Remove the lift chains.



WARNING

Never replace only the worn section of a lift chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains.

4. Clean and inspect the lift chains. See Lift Chains Check, Clean and Inspect. Replace the lift chains if necessary.
5. To install the lift chains, reverse the removal procedure.
6. Adjust and test the lift chains for correct operation as described in Lift Chains Check.

Clean and Inspect

Clean and inspect the lift chains as described in Lift Chains Check. See Figure 23.

TWO-STAGE CHAIN SHEAVE, REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

1. Operate the LIFT/LOWER control to raise the carriage so the forks are approximately 150 mm

(6 in.) off the floor. See Figure 16. Use safety chains to fasten the carriage to the outer weldment so it cannot move.

2. Lower the carriage so the safety chains are the support for the carriage and the lift chains do not have tension.



WARNING

Keep control of the lift chains when disconnecting them from the chain anchor. This procedure will prevent the lift chains from falling and causing an injury or damage.

3. Remove the cotter pin from the pin that fastens the lift chain to the chain anchor near the top of the outer weldment. Remove the anchor pins.
4. Put the lift chains over the carriage.



WARNING

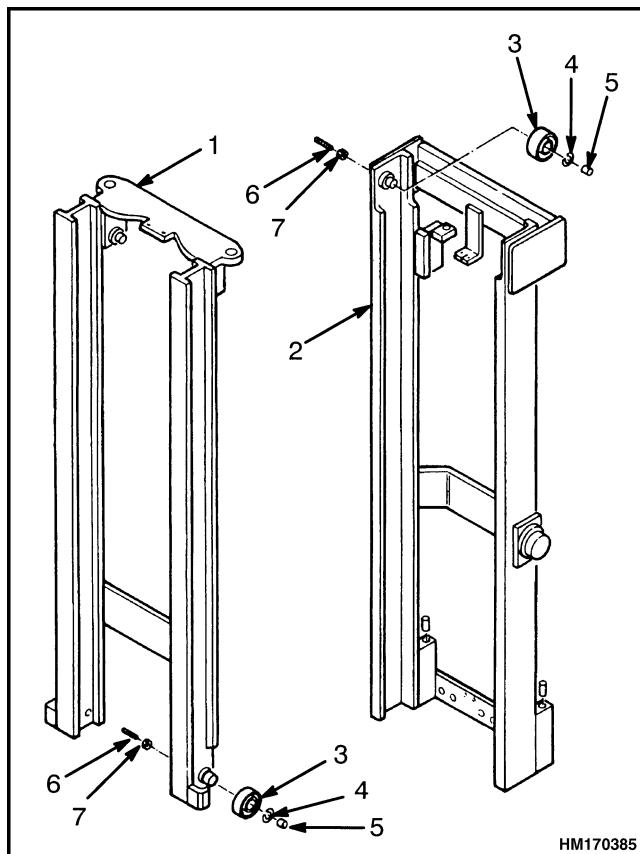
Be careful when removing or installing snap rings. These snap rings are large and can come loose during removal or installation with enough force to cause an injury. Always use the correct snap ring pliers and wear eye and face protection during removal or installation.

5. Remove the snap ring from the sheave mounting stud.
6. Use a pry bar to remove the sheave from the stud.
7. Remove the internal snap ring from the chain sheave.
8. Inspect all parts for wear or damage. Replace any worn or damaged parts.
9. If necessary, use a press to remove and install new ball bearings in the sheaves for the lift chains.
10. Reverse the procedure to install the chain sheaves.
11. Operate the truck and test for correct operation of the chain sheave.

LOAD ROLLERS AND WEAR PLUGS, REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

1. Remove the mast assembly as described in Remove. Remove the lift cylinders as described in Lift Cylinders, Remove and Install Dual-Lift Cylinders. See Figure 4, Figure 5, and Figure 17. Remove the chain sheaves as described in Two-Stage Chain Sheave, Remove and Install. The mast assembly must be horizontal with the carriage side on top.



- | | |
|-------------------|--------------|
| 1. INNER WELDMENT | 4. SNAP RING |
| 2. OUTER WELDMENT | 5. WEAR PLUG |
| 3. LOAD ROLLER | 6. SETSCREW |
| | 7. JAMNUT |

Figure 17. Mast Load Rollers

WARNING

The mast weldments can move and cause an injury. Make sure the mast assembly is level to prevent unexpected movement of the mast weldments.

2. Remove the safety chains that fasten the mast weldments together. Use a pry bar to move the inner weldment carefully and slowly out of the bottom of the outer weldment for access to the load rollers. The inner mast load rollers are at the bottom. The outer mast load rollers are at the top. Use safety chains to fasten the inner weldment to the outer weldment so they do not separate completely.

WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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.

3. Always install the safety chains to prevent the weldments from moving BEFORE starting to replace any load roller. Remove the snap rings that fasten the load rollers.

NOTE: Replace wear plugs at this time to save the cost of removal and disassembly of the mast assembly for wear plug replacement.

4. Use a pry bar to remove the load roller from the mast weldment. See Figure 5.
5. Use a cloth to clean each load roller. Inspect the load rollers for cracks, flat spots, or bearings that do not turn freely. Replace any roller that shows wear or is damaged.
6. Reverse the procedure to install the load rollers.
7. Adjust the wear plugs. See Mast Adjustments. The wear plugs are adjusted after the mast assembly is installed on the lift truck.

TWO-STAGE MAST ASSEMBLY, INSTALL

Read and follow all WARNINGS and CAUTIONS. If the carriage is installed on the mast, it must have a safety chain installed as described in Safety Procedures When Working Near Mast.



WARNING

Do not install the two-stage mast assembly unless it is completely assembled. Mast parts can move and cause an injury if not fastened together during assembly.

NOTE: The inner mast assembly must be in a position to allow access to the mount capscrews at the bottom of the outer weldment. Use safety chains to fasten the mast weldments together so they cannot move.

1. Use the crane or lifting device to lift the mast assembly and move it close enough to the truck to make the necessary connections. Make sure the truck and mast assembly cannot move.
2. Install and tighten the mast and carriage hoses on their correct bulkhead fittings according to the labels installed during removal.
3. Move the mast assembly into position. Lower the mast assembly so that the outer weldment is aligned with the trunnion blocks on the lift truck frame.

NOTE: Make sure all hoses and the electrical cable are not between a mast crossmember and the truck.

4. Align the trunnion caps according to the marks made during removal. Install the capscrews but leave them loose.
5. Connect all the wires of the electrical cable according to the labels made during removal.



CAUTION

Install tape on all electrical wires for the reach carriage if the wires are not connected to the carriage. If the wires are not connected, they can make a short circuit and cause damage.

6. Operate the LIFT/LOWER control to raise the inner weldment for access to the bottom of the outer weldment.
7. Install safety chains between the outer and inner weldments to keep the inner weldment from moving.
8. Use a pry bar to align and install the four mount capscrews and the nutplates that fasten the bottom of the mast to the truck frame. See Figure 10. Move the bottom of the weldment in or out and add shims until the mast is adjusted between vertical to 1/2-degree back tilt.
9. Tighten the four mount capscrews to 203 N•m (150 lbf ft).
10. Install the hose clamps and hose bracket. Operate the LIFT/LOWER control to raise the inner weldment high enough to remove the safety chains carefully. Remove the safety chains.
11. Tighten the four trunnion cap capscrews to 203 N•m (150 lbf ft). Use the crane to lower the inner weldment until the chain and crane are no longer the support. Remove the chain and crane.
12. Install the mast operator guard and capscrews that fasten the rear legs to the overhead guard.
13. Make all adjustments and test the operation of the mast assembly before returning the truck to service. See Mast Operation Check.

Three-Stage Mast Assembly

THREE-STAGE MAST ASSEMBLY, REMOVE

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 18 and Figure 19.

NOTE: If the mast assembly will be disassembled after it is removed from the truck, first remove the standard carriage, the reach carriage, or the attachment carriage as a complete assembly. See Carriage Assembly, Remove and Install. If the reach carriage will be removed with the mast assembly, operate the REACH/RETRACT control button to retract the forks fully. Install safety chains so the forks cannot extend. Install the safety chains around the center plates of the scissor arm weldment and a crossmember of the mast. Make sure a safety chain does not touch the mount for the hose sheave, lift chains, chain or hose sheaves, hoses, tubes, or fittings. If installed, operate the SIDESHIFT control button to move the sideshift frame to the center position.

NOTE: For mast removal on the N30XMH, refer to the procedure for N30XMH Only.

1. Remove the capscrews and nuts that fasten the mast operator guard and remove the guard. See Figure 8 or Figure 9.
2. Remove the capscrews that fasten the rear legs to the overhead guard. See Figure 8. The overhead guard will be removed with the mast assembly.



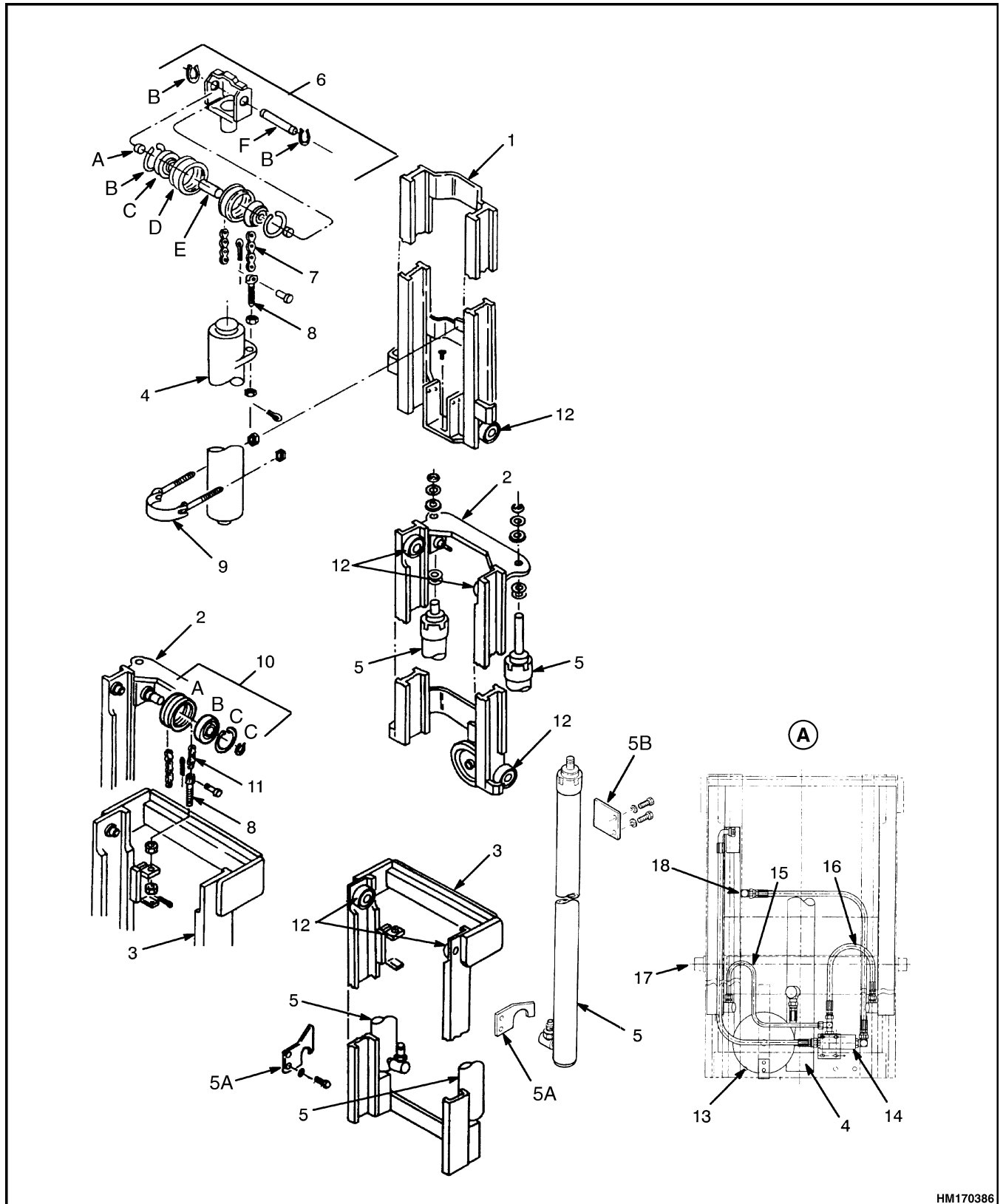
CAUTION

Do NOT move the control button for the reach, retract, tilt, or sideshift functions. Oil will flow from the hoses for these functions.

3. Operate the LIFT/LOWER control to raise the inner weldment high enough to remove the four

capscrews, shims, and nutplates that fasten the bottom of the mast to the truck frame. See Figure 10.

4. Install safety chains to keep the mast components from moving. Remove the capscrews, washers, and clamps that fasten the lift cylinder hoses to the mast weldments. Do NOT disconnect any hydraulic fittings.
5. Remove the safety chains installed in Step 4. Do not damage hydraulic hoses as the mast lowers. Carefully operate the LIFT/LOWER control to lower the inner weldment fully. Make sure all hydraulic pressure is removed from the system.
6. Mark the trunnion caps so they can be reassembled in the same position and on the same trunnion from which they are removed. Use chains to connect a crane or other lifting device to the top of the mast assembly. Make sure the chains will not damage the sheaves or other parts of the mast assembly. Make sure the chains and crane have the capacity to lift approximately 2000 kg (4409 lb). Use safety chains to fasten all the mast weldments together so they cannot move. If installed, install a chain or sling to the reach carriage to keep the mast assembly from tipping during removal. Remove the four capscrews that fasten the trunnion caps.
7. Operate the crane until it gives support to the weight of the mast assembly. Move the crane to a position so that the mast assembly will be lifted vertically. Raise the mast assembly high enough to clear the trunnions. Move the mast assembly approximately 30 cm (1 ft) away from the truck for access to the hoses.



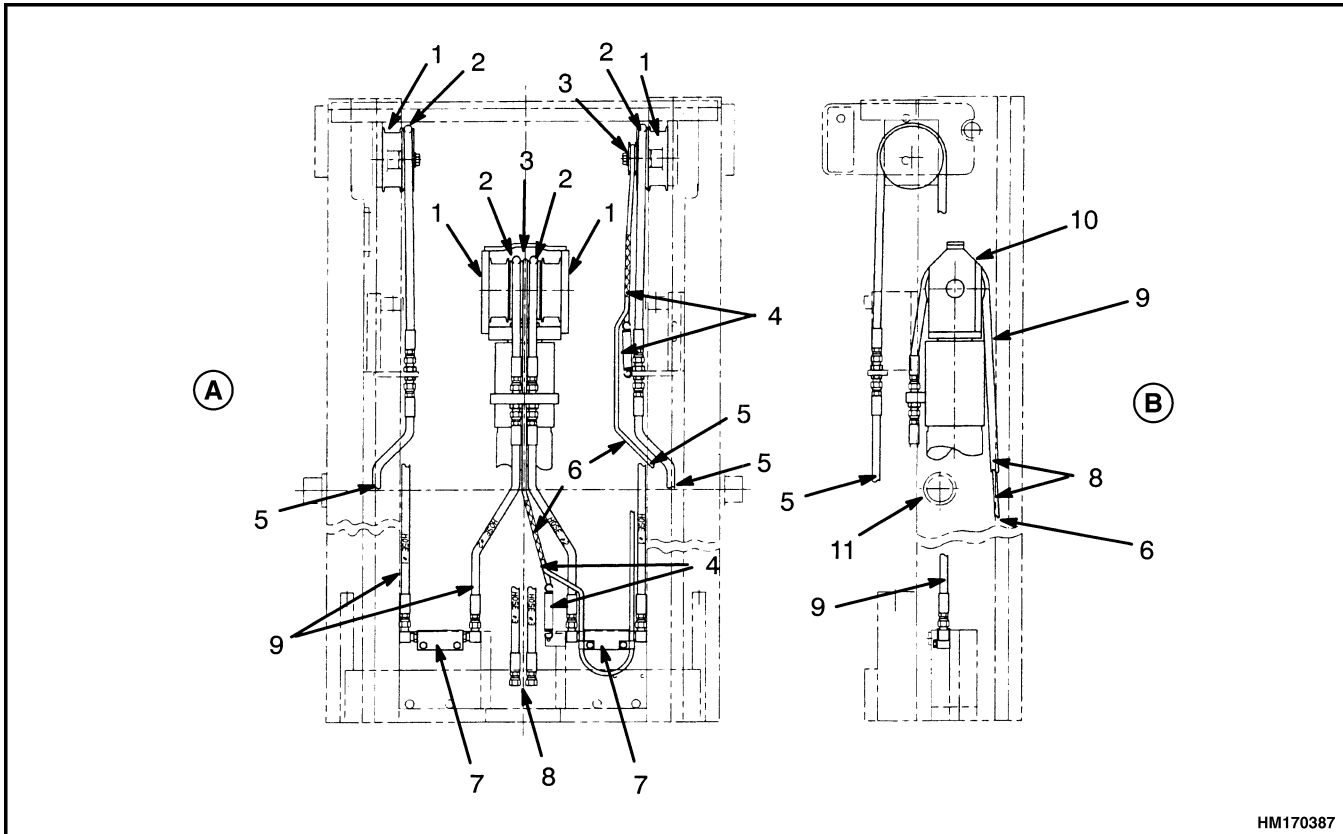
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Figure 18. Three-Stage Mast Assembly

Legend for Figure 18

A. REAR VIEW HOSE ROUTING - LIFT

- | | |
|----------------------------|--------------------------------|
| 1. INNER WELDMENT | 8. CHAIN ANCHOR |
| 2. INTERMEDIATE WELDMENT | 9. CLAMP |
| 3. OUTER WELDMENT | 10. CHAIN SHEAVE ASSEMBLY (RH) |
| 4. FREE-LIFT CYLINDER | A. CHAIN SHEAVE |
| 5. MAIN-LIFT CYLINDER | B. BALL BEARING |
| A. LOCK PLATE | C. SNAP RING |
| B. RETAINER | 11. MAIN-LIFT CHAIN |
| 6. SHEAVE SUPPORT ASSEMBLY | 12. LOAD ROLLER |
| A. SPACER | 13. FREE-LIFT HOSE SHEAVE |
| B. SNAP RING | 14. FLOW REGULATOR HOUSING |
| C. BALL BEARING | 15. HYDRAULIC TUBE (MAIN LIFT) |
| D. CHAIN SHEAVE | 16. HYDRAULIC HOSE (MAIN LIFT) |
| E. SPACER (STANDARD ONLY) | 17. TRUNNION STUB SHAFT |
| F. SHAFT | 18. TO TRUCK CONTROL VALVE |
| 7. FREE-LIFT CHAIN | |



HM170387

A. REAR VIEW

1. CHAIN SHEAVE
2. HOSE SHEAVE
3. CABLE SHEAVE
4. CABLE TENSION DEVICE
5. TO TRUCK
6. ELECTRICAL CABLE FOR REACH CARRIAGE

B. RIGHT SIDE VIEW

7. MANIFOLD BLOCK
8. TO CARRIAGE
9. HYDRAULIC HOSES
10. SHEAVE SUPPORT
11. TRUNNION STUB SHAFT

Figure 19. Three-Stage Hose Routing for Sideshift or Reach Carriage

8. Install labels on the bulkhead hoses for correct connection during installation. Disconnect the mast and carriage hoses from their fittings as required. Install caps on the fittings and hoses to prevent leakage.
9. Install labels on all plugs and wires for the electrical cable for correct connection during installation. Disconnect the plugs and wires so that the cable is completely disconnected from the truck. The plugs are near the cable tension device, inside the electrical compartment and above the battery.
10. Move the mast assembly away from the truck.
11. If the mast will be disassembled, put the mast on a level floor with the overhead guard on the bottom as a support. Install a support under the other end. Make sure the mast is level. Keep the safety chains that were installed in Step 6 on the mast assembly.
12. If the mast will NOT be disassembled, put the mast on a level floor with the overhead guard on top.

N30XHM, N30XMH₂ (C210), and V30ZMD (D210/E210) Only

1. For the N30XMH, N30XMH₂ (C210), and V30ZMD (D210/E210) though not necessary, it is recommended the attachment be removed. See the section **Attachment** 5000 SRM 580.



CAUTION

Do NOT move the control button for the traverse, rotate, or auxiliary functions. Oil will flow from the hoses for these functions.

2. Use a chain to connect a crane or other lifting device to the top of the mast assembly. Make sure the chains will not damage the sheaves or other parts of the mast assembly. Make sure the chains and lifting device have the capacity to lift approximately 1500 kg (3500 lb), 2250 kg (5000 lb) with the attachment. Use safety chains to fasten all the mast weldments together so that they cannot move. If installed, install a chain or sling to

the attachment to keep the mast assembly from tipping during removal.

3. Operate the crane until it supports the weight of the mast assembly. Remove the four capscrews that fasten the mast mounting feet and the four setscrews that position the mast.
4. Move the mast assembly approximately 30 cm (1 ft) away from the truck for access to the hoses.
5. Install labels on the bulkhead hoses for correct assembly during installation. Disconnect the mast and carriage hoses. Install caps on the fittings and hoses to prevent leakage.
6. Move the mast assembly away from the truck.

CLEAN AND INSPECT



WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.



CAUTION

Do NOT use steam to clean the lift chains, sheaves, or load rollers. The sheaves and roller bearings are sealed and permanently lubricated. Do not use compressed air on the bearings. The air can force the lubricant out of the bearings.

1. Clean the mast weldments with steam or solvent.



WARNING

Some parts can be damaged by welding and can cause an injury. Get authorization from your dealer for Hyster lift trucks before welding on the mast, forks, or carriage.

2. Inspect the sliding and rolling surfaces of the channels for damage (dents) and wear (grooves). Inspect all welds for cracks.

FREE-LIFT CYLINDER, REMOVE AND INSTALL

NOTE: Cylinder seals can be replaced without removing the cylinder from the mast assembly.

NOTE: The following procedure describes how to remove the free-lift cylinder without removing the carriage or mast assembly from the lift truck. If the carriage has been removed, perform only Step 4 through Step 12 to remove and install the cylinder.

1. On reach units, operate the REACH/RETRACT control button to retract the forks fully. Use safety chains to fasten the parts of the reach carriage so that the forks cannot extend.
2. Raise the carriage approximately 60 cm (2 ft). Use safety chains between the carriage and inner weldment to prevent the carriage from lowering. Operate the LIFT LOWER control to retract the free-lift cylinder.
3. If installed, remove the load backrest extension as described in Load Backrest Extension, Remove and Install.
4. Fasten the free-lift chains so they cannot move over the sheaves. Remove the cotter pins from the pins that fasten each free-lift chain to the chain anchor at the free-lift cylinder. Carefully remove these pins. This removal procedure will not change the chain adjustment.
5. If there are also hose and cable sheaves in the sheave support, disconnect the carriage hoses

at the free-lift cylinder. Install caps on the hydraulic fittings. Disconnect the spring of the cable tension device. See Figure 18, Figure 19, and Figure 20.

6. Lift the sheave support assembly out of the free-lift cylinder and put the lift chains, hoses, cable, and sheave support over the carriage or fasten them out of the way.
7. Hold the LIFT/LOWER control in the LOWER position for approximately 5 seconds to retract the free-lift cylinder rod fully and to remove all hydraulic pressure. It may be necessary to push the rod into the cylinder while the control is in the LOWER position.



WARNING

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.

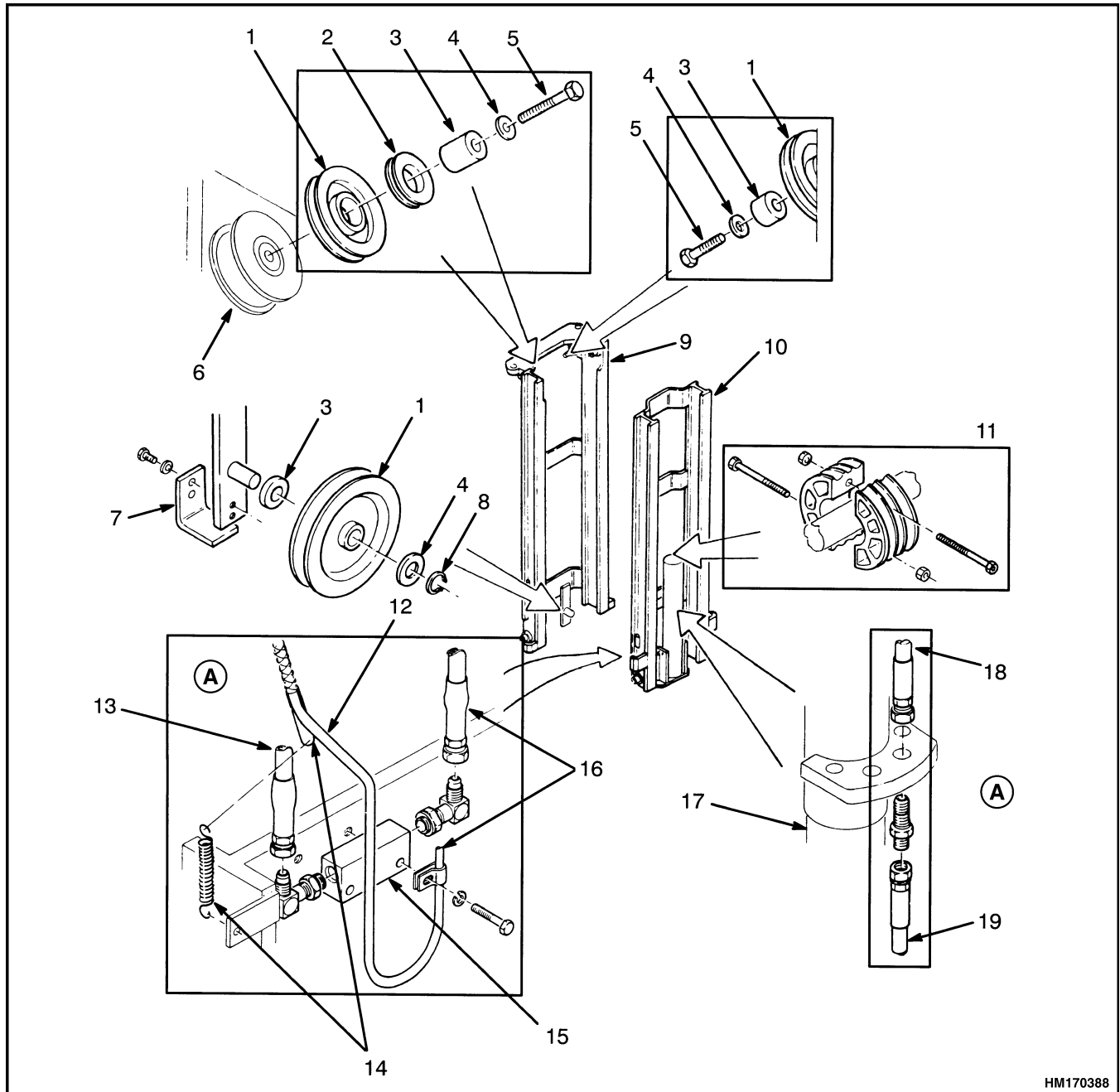
8. Loosen, but do not remove, the nuts for the main-lift chains at the chain anchors near the top of the outer weldment. The inner weldment will lower so that the free-lift hose does not have tension.
9. Disconnect the hydraulic hose from the free-lift cylinder and install caps on the fittings.

Legend for Figure 20

NOTE: COMPONENTS IN BOXES - STANDARD WITH SIDESHIFT OR REACH.

A. REAR VIEW

- | | |
|-------------------------------|--|
| 1. HOSE SHEAVE | 11. HOSE AND CABLE SHEAVE ASSEMBLY AT SHEAVE SUPPORT |
| 2. ELECTRICAL CABLE SHEAVE | 12. ELECTRICAL CABLE (REACH ONLY) |
| 3. SPACER | 13. TO SHEAVE SUPPORT AND CARRIAGE |
| 4. WASHER | 14. TENSION DEVICE FOR ELECTRICAL CABLE |
| 5. CAPSCREW | 15. MANIFOLD BLOCK |
| 6. CHAIN SHEAVE FOR MAIN LIFT | 16. TO TRUCK |
| 7. HOSE GUARD | 17. FREE-LIFT CYLINDER |
| 8. SNAP RING | 18. HYDRAULIC HOSE FROM SHEAVE SUPPORT |
| 9. INTERMEDIATE WELDMENT | 19. HYDRAULIC HOSE TO CARRIAGE |
| 10. INNER WELDMENT | |



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Figure 20. Hose and Cable Assemblies - Inner and Intermediate Weldments

10. Remove the cylinder strap. Use a crane and sling to lift the free-lift cylinder off the locating screw and out of the inner weldment. If the free-lift cylinder must be disassembled, see the section **Lift Cylinders** 4000 SRM 481.
11. Reverse the procedure to install the cylinder. Make sure the locating screw for the base of the free-lift cylinder is installed before installing the cylinder. Use a crane and sling to install the cylinder on the inner weldment.
12. Adjust the main-lift chains. Check for hydraulic leaks and correct operation after the cylinder is installed. See **Adjust Main-Lift Chains**.

MAIN CYLINDERS (STANDARD), REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS.

NOTE: It is necessary to remove the mast assembly from the truck to remove the main cylinders.

1. Remove the mast assembly as described in Three-Stage Mast Assembly, Remove.



WARNING

The mast weldments can move and cause an injury. Make sure the mast assembly is level with the carriage side on top to prevent unexpected movement of the mast weldments.

2. Remove the safety chains that fasten the mast weldments together and use a pry bar to move the intermediate weldment approximately 75 mm (3 in.) out of the outer weldment carefully and slowly.
3. Remove the capscrews, washers, and lock plate at the base of one main cylinder.



WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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. Remove the snap ring, backup washer, rubber bushing, and shims (if applicable) that fasten the cylinder rod to the intermediate weldment. See Figure 12 and Figure 18. If shims are used, make a note of the shim arrangement. Normally, the shim arrangement for the replacement cylinder will be similar.
5. Remove the hose or tube between the main cylinder and the flow regulator. See Figure 18. If necessary, use a pry bar to move the carriage and mast weldments carefully for access. Install a cap on the regulator fitting to prevent leakage.

6. Install a sling and crane to support the cylinder. Remove the main cylinder retainer, capscrews, and washers.
7. Push the cylinder toward the top of the mast assembly to move the main cylinder off the locating dowel pin. Continue to push the cylinder until the rod moves into the cylinder to allow removal from the intermediate weldment.
8. Repeat Step 2 through Step 7 to remove the other main cylinder.

NOTE: See the section **Lift Cylinders** 4000 SRM 481 to disassemble and repair the cylinder.

9. Reverse the procedure to install the main cylinders.

MAIN CYLINDERS N30XMH, N30XMH₂ (C210) AND V30ZMD (D210/E210), REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS. See Figure 12 and Figure 18.

NOTE: It is not necessary to remove the mast assembly from the truck to remove the main cylinders.

1. Raise the mast until the secondary upright has raised approximately 30 cm (1 ft).

NOTE: The carriage will raise before the secondary upright.

2. Remove the capscrews, washers, and lock plate at the base of one main cylinder.
3. Place blocks securely between the stationary and secondary uprights.
4. Lower the secondary upright onto the blocks and continue lowering until the carriage is fully lowered as well.



WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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.

5. Use a crane and sling to support the cylinder. Remove the snap ring, backup washer, rubber bushing, and shims (if applicable) that fasten the cylinder rod to the intermediate weldment. See Figure 12. If shims are used, make a note of the shim arrangement. Normally, the shim arrangement for the replacement cylinder will be similar.
6. Move the hoist handle forward until the hoist cylinder is fully retracted and all pressure is relieved from the lift circuit.
7. Remove the hose or tube between the main cylinder and the flow regulator. See Figure 18. If necessary, use a pry bar to carefully move the carriage and mast weldments for access. Install a cap on the regulator fitting to prevent leakage.
8. Place a winch chain between the stationary upright and the overhead guard.
9. Remove the tilt rod pins.
10. Using the winch chain, allow the mast to tilt far enough forward to lift the cylinder off the dowel pins and out of the truck.
11. Push the cylinder toward the top of the mast assembly to move the main cylinder off the locating dowel pin. Continue to push the cylinder until the rod moves into the cylinder to allow removal from the intermediate weldment.
12. Repeat the Step 2 through Step 11 to remove the other main cylinder.

NOTE: See the section **Lift Cylinders** 4000 SRM 481 to disassemble and repair the cylinder.

13. Reverse the procedure to install the main cylinders.
14. If a cylinder is replaced, it may be necessary to re-shim both cylinders to make sure that the end

stroke (fully extended) is equal on both. This will prevent racking when the mast is raised to the maximum fork height. Refer to the appropriate Parts Manual for the location and correct shim part numbers.

INNER AND INTERMEDIATE MAST ASSEMBLIES, REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 18, Figure 19, Figure 20, and Figure 21.

1. The load rollers and wear plugs must be removed to remove the inner or intermediate weldments. See Load Rollers and Wear Plugs, Remove and Install.
2. The lift chains, hoses, and electrical cable, if installed, must also be removed to remove the inner or intermediate weldments. To remove the lift chains, hoses, and sheaves, see Three-Stage Lift Chains, Remove and Install; Hoses, Replace; Three-Stage Chain Sheaves, Disassemble and Assemble; and Hose and Cable Sheaves, Replace.
3. Use safety chains to fasten the intermediate weldment to the outer weldment. Use a crane or lifting device to support the inner weldment while sliding it out of the intermediate weldment.
4. Remove the safety chains that fasten the intermediate weldment to the outer weldment. Use a crane or lifting device to support the intermediate weldment while sliding it out of the outer weldment.
5. Reverse the removal procedure to install both the intermediate and inner weldments into the outer weldment. Install the load rollers and wear plugs during assembly of the mast weldments.

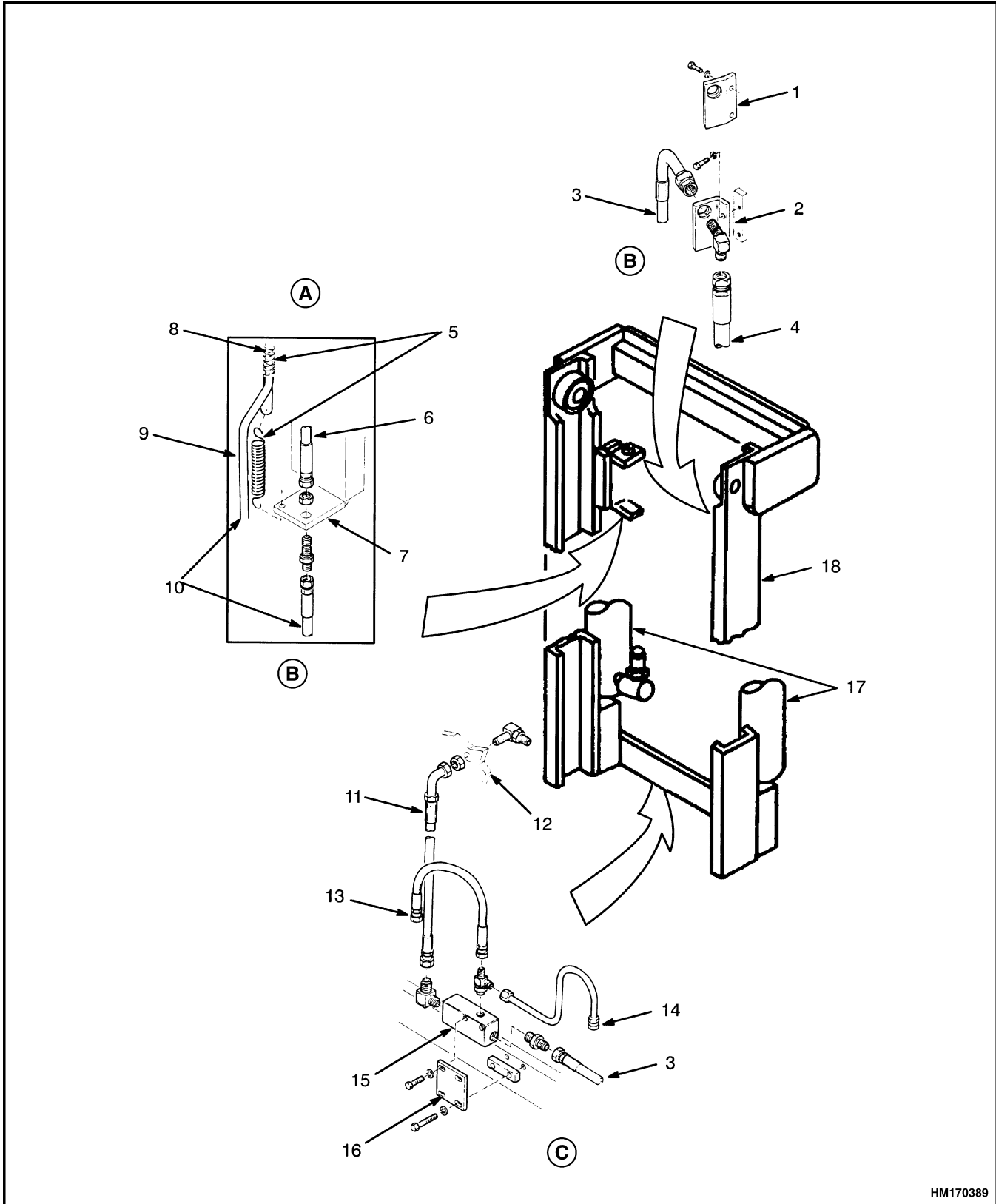


Figure 21. Hose and Cable Assemblies - Outer Weldment

Legend for Figure 21

- | | |
|---|---|
| A. REACH OR SIDESHIFT CARRIAGE ONLY
B. REAR VIEW

1. HOSE BRACKET
2. HOSE BRACKET
3. TO FLOW REGULATOR
4. TO FREE-LIFT CYLINDER
5. TENSION DEVICE
6. CARRIAGE HOSE TO MANIFOLD BLOCK (EACH SIDE OF WELDMENT)
7. HOSE BRACKET (EACH SIDE OF WELDMENT)
8. TO REACH CARRIAGE
9. ELECTRICAL CABLE FOR REACH CARRIAGE | C. FRONT VIEW

10. TO LIFT TRUCK
11. HYDRAULIC HOSE (LIFT)
12. LIFT TRUCK FRAME
13. HOSE TO RIGHT MAIN CYLINDER
14. TUBE TO LEFT MAIN CYLINDER
15. FLOW REGULATOR HOUSING
16. REGULATOR MOUNT PLATE
17. MAIN LIFT CYLINDERS
18. OUTER WELDMENT |
|---|---|

HOSES, REPLACE

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 18 and Figure 19.

1. To replace any hydraulic hoses, fully lower the carriage. Make sure the system does not have hydraulic pressure. Hold the control (for each function) in the forward position for approximately 5 seconds to release the pressure. Make sure the hydraulic pump does NOT operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.

NOTE: Access can be difficult for some fittings. If necessary, operate the system to move mast weldments or the carriage. Make sure to follow the Safety Procedures When Working Near Mast after moving components BEFORE starting work. Make sure the system does not have pressure as described in Step 1.

2. Disconnect hose and install caps to prevent dirt from entering the hydraulic system.
3. Replace the hose. Operate the system to remove all the air from the oil and to check for leaks.

HOSE AND CABLE SHEAVES, REPLACE

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS. See Figure 19 and Figure 20.

NOTE: The following procedures describe how to replace the hose and cable sheaves without removing the carriage or mast assembly from the lift truck. If the mast assembly has been removed, carefully move the carriage inner or intermediate weldments using a pry bar as necessary.

Free-Lift Hose Sheave**WARNING**

The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

Remove the sheave for the hose to the free-lift cylinder as follows:

1. Fully retract the forks if the reach carriage is installed. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector. Install safety chains between the tops of the inner and outer carriage weldments of the reach carriage to prevent carriage operation.
2. Operate the LIFT/LOWER control to raise the inner weldment. Use safety chains to fasten the carriage and inner weldment so that they cannot move and so that the bottom of the inner weldment is approximately 60 cm (2 ft) off the floor.
3. Lower the carriage so the safety chains are the support for the carriage and inner weldment. The lift hose for the free-lift cylinder must not have tension.
4. Remove the snap ring, washer, free-lift hose sheave, and spacer at the bottom of the intermediate weldment. See Figure 20.
5. Follow the reverse procedure to install the hose sheave for the free-lift cylinder.

Carriage Sheaves

Remove the sheaves for the hoses and cable to the carriage as follows:

1. Fully lower the carriage. Fully retract the forks if the reach carriage is installed. Install safety chains between the tops of the inner and outer carriage weldments of the reach carriage to prevent carriage operation.
2. Make sure that the system does not have hydraulic pressure. Hold the control (for each function) in the **FORWARD** position for approximately 5 seconds to release the pressure. Make sure the hydraulic pump does NOT operate. Move the key to the **OFF** position. Disconnect the battery and put a tag or lock on the battery connector.
3. Fasten the carriage hoses and electrical cable, if installed, to the top of the sheave support at the free-lift cylinder. Disconnect or remove the hoses at the carriage. Install caps to prevent dirt from entering the hydraulic system.
4. Install tags on the connectors and wires of the electrical cable at the carriage for correct connection later. Disconnect the electrical cable.
5. Install tags on the hydraulic hoses at the carriage for correct connection later. Disconnect the hoses and install caps to prevent dirt from entering the hydraulic system.
6. Remove the two capscrews and nuts that fasten the two halves of the hose and cable sheave together. See Figure 20. Do not let the sheave halves fall.
7. Carefully remove the capscrews that fasten the hose and cable sheaves at the top of the intermediate weldment. See Figure 20. Do not let any of the parts fall. These capscrews fasten to the stub shafts of the chain sheaves.
8. Follow the reverse procedure to install the hose and cable sheave for the carriage. Make sure to operate the carriage hydraulic function(s) and check for leaks after the hoses are connected.

THREE-STAGE LIFT CHAINS, REMOVE AND INSTALL

General



WARNING

Keep control of the lift chains when disconnecting them from the chain anchor. This procedure will prevent the lift chains from falling and causing injury or damage.



WARNING

Never replace only the worn section of a lift chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains.

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS. See Figure 18 and Figure 19.

Free-Lift Chains

1. Operate the LIFT/LOWER control to raise the carriage. Use safety chains to fasten the carriage so that it cannot move and the forks are approximately 60 cm (2 ft) off the floor.
2. Lower the carriage so the safety chains are the support for the carriage and the lift chains do not have tension.

NOTE: Removing the pins at the chain anchors will disconnect the lift chains without changing the chain adjustment. Always adjust the chains if new lift chains or other components are installed.

3. Fasten both free-lift chains so they cannot move over the sheaves of the sheave support. Remove the chain anchor pins at each end of both free-lift chains. Hold each chain to keep it from moving too fast and carefully remove them.
4. Inspect the free-lift chains as described in Lift Chains Check. Replace the free-lift chains if necessary.
5. Reverse the procedure to install the free-lift chains.
6. Adjust the free-lift chains as described in Adjust Free-Lift Chain (Three-Stage Only).

Main-Lift Chains

1. Raise the mast until the lower chain anchors are visible on the inner weldment.
2. Use safety chains to fasten the inner weldment so that it cannot move. Operate the LOWER control to lower the masts until the safety chains are a support for the inner weldment and lift chains do not have tension.

NOTE: Removing the pins at the chain anchors will disconnect the lift chains without changing the chain adjustment. Always adjust the chains if new lift chains or other components are installed.

3. Fasten both main-lift chains so they cannot move over the sheaves. Remove the chain anchor pins at each end of both main-lift chains. Hold each chain to keep it from moving too fast and carefully remove them.
4. Inspect the main-lift chains as described in Lift Chains Check. Replace the main-lift chains if necessary.
5. Reverse the procedure to install the main-lift chains.
6. Adjust the main-lift chains as described in Adjust Main-Lift Chains.

THREE-STAGE CHAIN SHEAVES, DISASSEMBLE AND ASSEMBLE

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS. See Figure 18 and Figure 19.

Free-Lift Chain Sheaves

1. If necessary, remove the free-lift chains as described in Three-Stage Lift Chains, Remove and Install.



WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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.

2. Remove the snap ring from the shaft in the sheave support.
3. Use a drift to tap the shaft out of the sheave support.
4. Remove the sheaves and spacers as a group. Inspect all components for wear or damage. Replace any part that is worn or damaged.
5. Reverse the procedure to install the chain sheaves.

Main-Lift Chain Sheaves

1. If necessary, remove the main-lift chains as described in Three-Stage Lift Chains, Remove and Install.
2. Remove both pins from the chain anchors at the rear of the free-lift cylinder. Remove each lift chain from the sheaves.



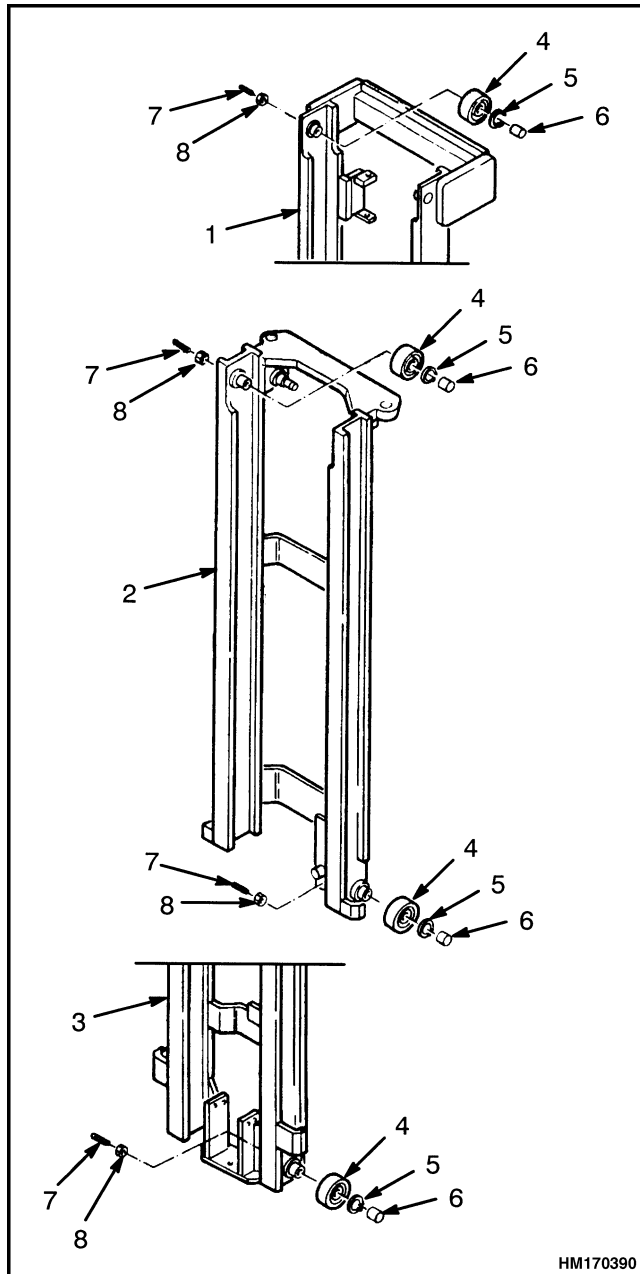
WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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.

3. Remove the snap ring from the chain sheave bracket.
4. Use a pry bar to remove the chain sheave from the bracket. Inspect all components for wear or damage. Replace any item that is worn or damaged.
5. Reverse the procedure to install the chain sheaves.

LOAD ROLLERS AND WEAR PLUGS, REMOVE AND INSTALL

Read and follow the Safety Procedures When Working Near Mast, as well as all WARNINGS and CAUTIONS. See Figure 22.



- | | |
|--------------------------|----------------|
| 1. OUTER WELDMENT | 4. LOAD ROLLER |
| 2. INTERMEDIATE WELDMENT | 5. SNAP RING |
| 3. INNER WELDMENT | 6. WEAR PLUG |
| | 7. SETSCREW |
| | 8. JAMNUT |

Figure 22. Three-Stage Load Rollers

1. Remove the mast assembly as described in Three-Stage Mast Assembly, Remove. Remove the free-lift cylinder as described in Free-Lift Cylinder, Remove and Install. Remove the main lift cylinders as described in Main Cylinders (Standard), Remove and Install and Main Cylinders N30XMH, N30XMH₂ (C210) and V30ZMD (D210/E210), Remove and Install. The mast assembly must be horizontal with the carriage side on top.



WARNING

The mast weldments can move and cause an injury even if the mast assembly has been removed from the lift truck. Make sure the mast assembly is level to prevent the components from moving without being moved. Use safety chains to prevent movement after components are in the correct position.

2. Remove the safety chains that fasten the mast weldments together, and use a pry bar to carefully and slowly move the correct mast weldment for access to the load rollers. The inner weldment load rollers are at the bottom. The load rollers for the outer weldment are at the top. The load rollers for the intermediate weldment are at the top and the bottom of the weldment. Use safety chains to fasten the inner weldment to the outer weldment so that they do not separate completely.

NOTE: If the inner weldment and the intermediate weldment will be disassembled from the outer weldment, do not install the load rollers at this time.



WARNING

Be careful when removing or installing snap rings. These snap rings are large and 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.

3. Always install safety chains to prevent the weldments from moving BEFORE starting to replace any load roller. Remove the snap rings that fasten the load rollers.

NOTE: Replace wear plugs at this time to save the cost of removal and disassembly of the mast assembly for wear plug replacement.

4. Use a pry bar to remove the load roller from the mast weldment. See Figure 5.
5. Use a cloth to clean each load roller. Inspect the load rollers for cracks, flat spots, or bearings that do not turn freely. Replace any roller that shows wear or is damaged.
6. Reverse the procedure to install the load rollers.
7. Adjust the wear plugs after all load rollers and wear plugs are replaced. See Adjust Wear Plugs - Mast. The wear plugs are adjusted after the mast assembly is installed on the lift truck.

THREE-STAGE MAST ASSEMBLY, INSTALL

Read and follow all WARNINGS and CAUTIONS. If the carriage is installed on the mast, it must have a safety chain installed as described in Safety Procedures When Working Near Mast.



WARNING

Do not install the three-stage mast assembly unless it is completely assembled. Mast parts can move and cause an injury if not fastened together during assembly.

NOTE: The inner and intermediate mast assemblies must be in a position to allow access to the mount capscrews at the bottom of the outer weldment. Use safety chains to keep the mast assembly from moving as described in Safety Procedures When Working Near Mast.

1. Use the crane or lifting device to lift the mast assembly and move it close enough to the truck to make the necessary connections. Make sure the truck and mast assembly cannot move.
2. Install and tighten the mast and carriage hoses on their correct bulkhead fittings according to the labels installed during removal.
3. Move the mast assembly into position. Lower the mast assembly until the outer weldment is aligned with the trunnion blocks on the lift truck frame.

NOTE: Make sure all hoses and the electrical cable are not between a mast crossmember and the truck.

4. **Steps 4a through 4d for the N30XMH, N30XMH₂ (C210) and V30ZMD (D210/E210) only.**

- a. Position the mast assembly so the mast mounting feet are properly aligned.
- b. Install the four setscrews until the mast assembly is vertical.
- c. Install the four capscrews and tighten them to 220 N•m (160 lbf ft). Remove the chain and crane.
- d. Make all adjustments and test the operation of the mast assembly before returning the truck to service. See Mast Operation Check.

NOTE: Make sure all hoses and the electrical cable are not between a mast crossmember and the truck.

5. Align the trunnion caps according to the marks made during removal. Install the capscrews but leave them loose.
6. Connect all the wires of the electrical cable according to the labels made during removal.



CAUTION

Install tape on all electrical wires for the reach carriage that are not connected to the carriage. If the wires are not connected, they can cause a short circuit and cause damage.

7. Operate the LIFT/LOWER control to raise the inner and intermediate weldments high enough for access to the bottom of the outer weldment.
8. Install safety chains between the outer, intermediate, and inner weldments to keep the intermediate and inner weldments from moving.
9. Use a pry bar to align and install the four mount capscrews and the nutplates that fasten the bottom of the mast to the truck frame. See Figure 10. Move the bottom of the weldment in or out and add shims until the mast is adjusted between vertical to 1/2 degree back tilt.
10. Tighten the four mount capscrews to 203 N•m (150 lbf ft).
11. Install the hose clamps and hose bracket. Operate the LIFT/LOWER control to raise the inner weldment high enough to carefully remove the safety chains. Remove the safety chains.
12. Tighten the four trunnion cap capscrews to 203 N•m (150 lbf ft). Use the crane to lower the inner and intermediate weldments until

Hydraulic System Leaks Check

4000 SRM 482

the chain and crane are no longer the support. Remove the chain and crane.

13. Install the mast operator guard and capscrews that fasten the rear legs to the overhead guard.

14. Make all adjustments and test the operation of the mast assembly before returning the truck to service. See Mast Operation Check.

Mast Operation Check

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS.



WARNING

DO NOT try to locate hydraulic leaks by putting hands on pressurized hydraulic components. Hydraulic oil can be injected into the body by pressure.

1. Check for leaks in the hydraulic system. Check the condition of the hydraulic hoses and tubes.
2. Slowly raise and lower the mast several times without a load. The mast components must raise and lower smoothly in the correct sequence.

NOTE: Some parts of the mast move at different speeds during raising and lowering.

3. The weldments and the carriage must lower completely.
4. Check that the controls for the carriage operate the functions of the carriage. See the symbols by each of the controls and refer to the **Operating Manual** for your lift truck. Make sure all of the hydraulic lines are connected correctly and do not leak.

Hydraulic System Leaks Check

1. Slowly raise and lower the mast several times without a load. On lift trucks with carriage functions, operate the carriage functions several times. Put a capacity (see the Nameplate) load on the forks, and raise and lower the load several times. Lower the load. Check for leaks and repair as necessary.
2. Raise the carriage and the capacity load 1 m (3 ft). If the carriage lowers slowly with the control valve in a neutral position, there are leaks inside the hydraulic system. The maximum speed that the carriage is allowed to lower is 50 mm (2 in.) in 10 minutes when the hydraulic oil is 30°C (86°F). If the oil temperature is 70°C (158°F), the maximum speed that the carriage can lower is 150 mm (6 in.) per 10 minutes.
3. Check the lift cylinders for internal leaks. Remove the load from the forks. Install a gate valve in each of the supply lines between the main control valve and the mast. Put a capacity load on

the forks again. Raise the carriage 1 m (3 ft). Close both gate valves. If the carriage or inner mast lowers slowly, the seals in the lift cylinders have leaks.

4. If the carriage does not move, open both gate valves and check the movement again. If the carriage lowers when the gate valves are open, check for leaks in the hydraulic lines and fittings. If no leaks are found, the main control valve may have a defect. Remove the load from the forks.
5. On Reach trucks, slowly tilt the forks forward. If the forks continue to slowly tilt forward when the control valve is in a neutral position, there are leaks inside the hydraulic system. The maximum speed that the forks are allowed to tilt forward is 13 mm (0.50 in.) per 10 minutes (measured at the tilt cylinder). This maximum speed is measured when the hydraulic oil is 30°C (86°F). If the oil temperature is 70°C (158°F), the maximum speed is 39 mm (1.5 in.) per 10 minutes.

6. If the leak rate for the tilt function is greater than specifications, remove the load from the forks. Install a gate valve between the port at the rod end of the tilt cylinder and the hydraulic line. Put the load on the forks again. Close the valve. Tilt the forks approximately halfway back. If the forks tilt slowly forward, the piston seals are leaking.
7. If the forks do not move, open the gate valve and check for movement again. If the forks move forward when the gate valve is open, check for leaks in the hydraulic lines or fittings. If no leaks are found, the main control valve or solenoid valves can be damaged. Remove the load from the forks.

Lift Chains Check

GENERAL

NOTE: These procedures are for both the two-stage and three-stage mast assemblies.

CLEAN AND INSPECT

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS.



WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. Wear protection for eyes and skin. When using cleaning solvents, always follow the recommendations of the manufacturer.



CAUTION

DO NOT use steam to clean the lift chains, sheaves, or load rollers. The sheaves and bearings are sealed and permanently lubricated. Do not use compressed air on the bearings. The air can force the lubricant out of the bearings.

1. Clean the lift chains using solvent. Inspect the lift chains for wear or damage. See Figure 23.

A lift chain becomes longer when it is worn. If a lift chain is 3 percent longer than a new lift chain, the lift chain must be replaced. Use a chain scale to measure the chains. If a chain scale is not available, check the lift chains with the measurements given in Figure 23.



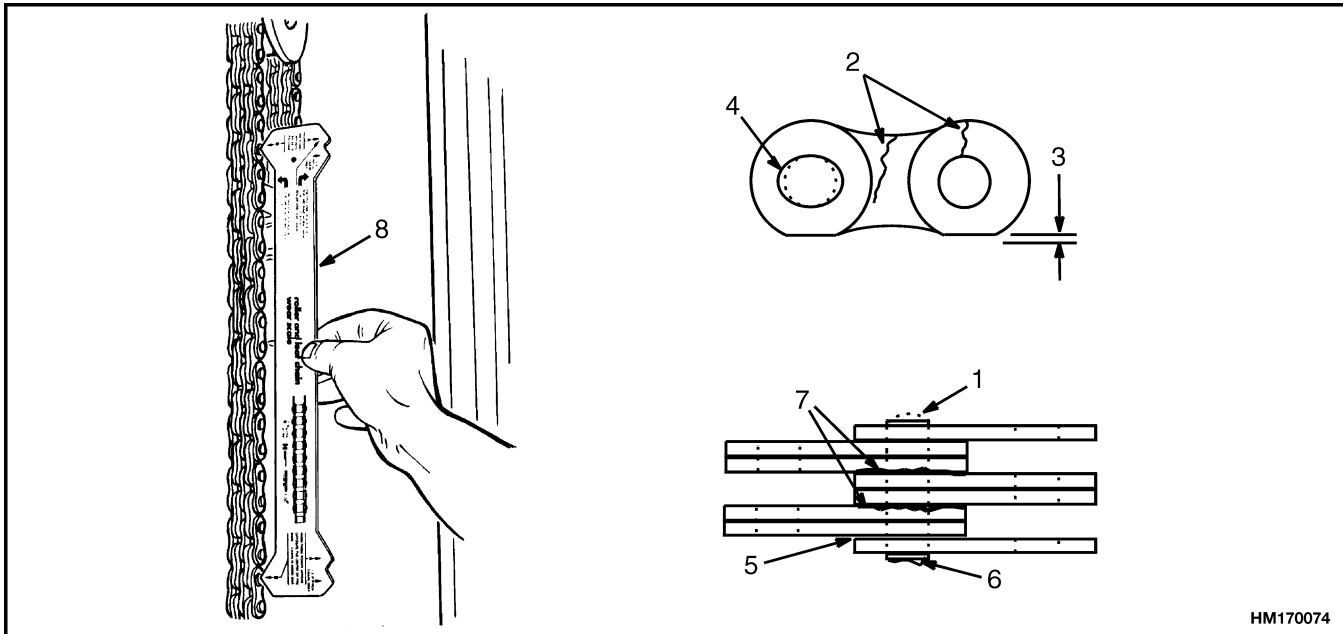
WARNING

Never replace only the worn section of a lift chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains.

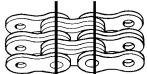
2. Inspect the chain anchors and pins. Replace any parts that are worn or damaged.
3. Inspect the chain sheaves. Replace any parts that are worn or damaged.

LUBRICATION

Clean and inspect the chains before lubrication. Use SAE 30 engine oil as a lubricant for the chains. The recommendation for adding lubricant is to remove the chains from the lift truck and soak them in oil. See Two-Stage Lift Chains, Remove and Install or Three-Stage Lift Chains, Remove and Install to remove the lift chains for lubrication.



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Pitch 	Total Length of 20 Links (Pitch) of New Chain	Wear Limit Maximum of 20 Links
25.4 mm (1.00 in.)	508 mm (20.0 in.)	523 mm (20.6 in.)
31.8 mm (1.25 in.)	635 mm (25.0 in.)	654 mm (25.7 in.)
38.1 mm (1.50 in.)	762 mm (30.0 in.)	785 mm (30.9 in.)
44.5 mm (1.75 in.)	889 mm (35.0 in.)	915 mm (36.0 in.)
50.8 mm (2.00 in.)	1016 mm (40.0 in.)	1047 mm (41.2 in.)

NOTE: The instructions for measuring chain wear are shown on the Chain Wear Scale.

- | | |
|--------------|---------------------|
| 1. WORN PIN | 5. LOOSE LEAVES |
| 2. CRACKS | 6. DAMAGED PIN |
| 3. EDGE WEAR | 7. RUST |
| 4. HOLE WEAR | 8. CHAIN WEAR SCALE |

Figure 23. Lift Chains Check

Mast Adjustments

GENERAL

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS.

NOTE: These procedures are for both the two-stage and three-stage mast assemblies. Move the lift truck

to an area with a smooth, level floor to make sure the adjustments are accurate.

The mast weldments must be aligned so that they are parallel to each other during operation. Keeping the weldments parallel will have the result of smoother operation and wear.

The only adjustment for the load rollers is the adjustment of the wear plugs. These adjustments are made for minimum side clearance and to keep the weldments parallel with equal clearance on each side between all weldments.

Wear plugs and wear strips allow adjustment for alignment and wear. Always adjust the wear plugs and wear strips for one weldment before making adjustments on other weldments.

Chains are adjusted for the following reasons:

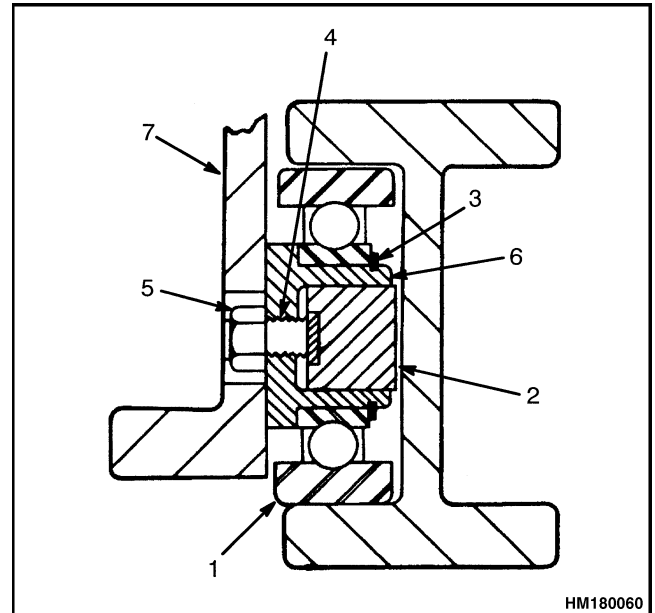
- So each lift chain of a pair has an equal load to prevent too much load and wear on one chain of a pair.
- So mast weldments move in the correct sequence.
- So chains move over chain sheaves correctly.

Adjustments must be made to both the free-lift (three-stage only) and main-lift chain sets. Each lift chain is adjusted at the chain anchor.

ADJUST WEAR PLUGS - MAST

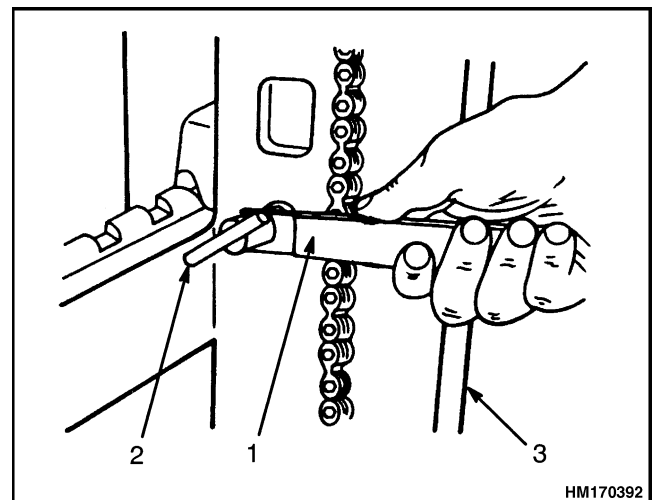
Adjust the wear plugs as follows:

1. Loosen the jam nut on the wear plug. See Figure 24 and Figure 25. Raise and lower the mast weldments several times to find the point of minimum clearance of the weldment.
2. Adjust the wear plugs to attain zero clearance between the wear plug and the weldment channel at the tightest point. Adjust wear plugs on opposite sides to keep the weldment in the center.
3. Adjust the clearance to approximately 0.02 in. by turning the adjustment handle 1/8 turn counter-clockwise. Keep the clearance equal on both sides. Keep the weldments parallel to each other.
4. Tighten each jam nut without moving the setscrew.
5. Raise and lower the weldments without a load. Check that there is minimum clearance, as described in Step 3, with free movement. If the weldments do not move smoothly during lowering, follow the WARNING and adjust the wear plugs equally for more clearance.



- | | |
|-------------------|-----------------|
| 1. LOAD ROLLER | 5. JAM NUT |
| 2. WEAR PLUG | 6. STUB SHAFT |
| 3. RETAINING RING | 7. MAST CHANNEL |
| 4. SETSCREW | |

Figure 24. Load Roller and Wear Plug Assembly



- | |
|----------------------|
| 1. SPECIAL TOOL |
| 2. ADJUSTMENT HANDLE |
| 3. WELDMENT |

Figure 25. Wear Plugs Adjustment

**WARNING**

NEVER loosen the wear plugs if a mast weldment does not move freely during checks after an adjustment. The weldments or carriage can suddenly move and cause an injury. Raise the weldment, move the key to the OFF position, and install safety chains as described in Safety Procedures When Working Near Mast. Loosen the wear plugs to allow movement.

6. If necessary, operate the system so that the lift chains are the supports and carefully remove the safety chains. Raise and lower the weldments with a load. Check that there is minimum clearance, as described in Step 3, with free movement. If the weldments do not move smoothly during lowering, follow the WARNING and adjust the wear plugs equally for more clearance.

7. Repeat Step 1 through Step 6 for each weldment.

ADJUST FREE-LIFT CHAIN (THREE-STAGE ONLY)

NOTE: Make sure the forks of the reach carriage are parallel to the floor (no forward or backward tilt). See Figure 26.

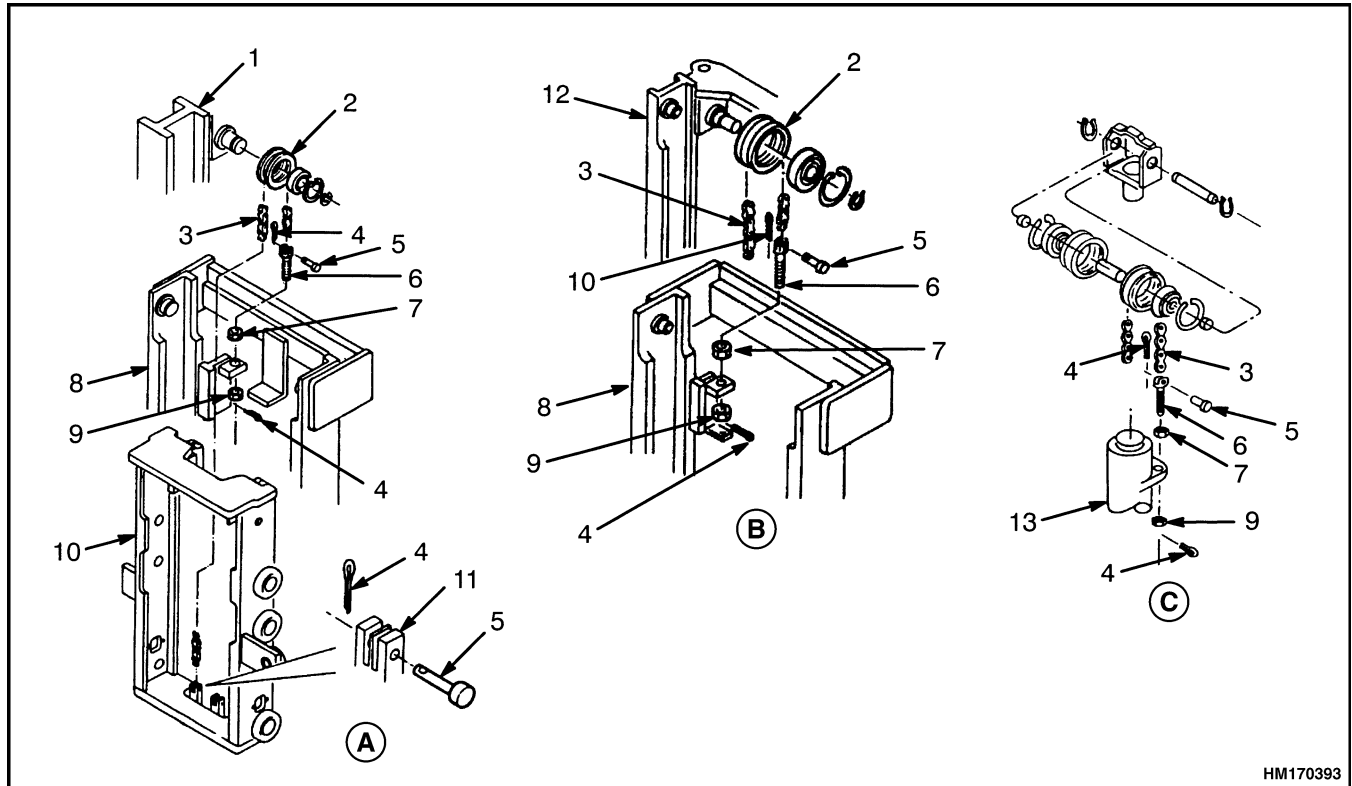
1. Fully lower the carriage. Measure the distance from the floor to the bottom of the carriage. The correct distance is 82.55 mm (3.25 in.). For the N30XMH, N30XMH₂ (C210), and V30ZMD (D210/E210) the distance is 76 mm (3.0 in.).
2. If the distance is correct, the free-lift chains are adjusted for the correct height. Perform Step 5 next. If the distance is NOT correct, perform all of the steps.

3. Raise the mast until the free-lift cylinder chain anchors at the rear of the free-lift cylinder can be accessed from the operator compartment. Install safety chains as described in Safety Procedures When Working Near Mast. Remove the mast operator guard for easier access to the chain anchors. See Figure 8. Loosen both lock nuts at the chain anchors to make any adjustments.
4. Adjust the nuts of the chain anchors equal amounts for the correct distance (Step 1).
5. Check chain tension by pushing on both chains at the same time. If the tension is not the same, adjust the nuts on the chain anchors until the tension is the same and the distance (Step 1) is also correct. When the tension is equal on both chains, the chain sheave assembly will be level. Tighten the lock nuts.

**CAUTION**

When the chain adjustments are complete, make sure the cotter pin at the bottom of the chain anchor can be installed under the adjustment nut. If there is no room to install the cotter pin, the chains are too short. Make sure the lock nuts on the chain anchors are tight against the mount plate. If there are not enough threads on the chain anchor for correct adjustment, new chains are too long or old chains are too worn. See Lift Chains Check.

6. Check the mast operation as described in Mast Operation Check.
7. Install the mast operator guard if removed.

**A. TWO-STAGE**

1. INNER WELDMENT
2. CHAIN SHEAVE
3. LIFT CHAIN
4. COTTER PIN
5. ANCHOR PIN

B. THREE-STAGE MAIN-LIFT

6. CHAIN ANCHOR
7. LOCK NUT
8. OUTER WELDMENT
9. ADJUSTMENT NUT
10. REACH CARRIAGE

C. THREE-STAGE FREE-LIFT

11. TYPICAL FIXED ANCHOR
12. INTERMEDIATE WELDMENT
13. FREE-LIFT CYLINDER

Figure 26. Lift Chains Adjustment**ADJUST MAIN-LIFT CHAINS**

NOTE: On three-stage masts, the free-lift chains must be adjusted **before** adjusting the main-lift chains.

NOTE: The nuts used to adjust the main-lift chains are on the chain anchors near the top of the outer weldment. See Figure 26.

Read and follow the instructions in General of this section.

Masts with free lift cylinder - Adjust chain anchors at main lift cylinders so top of inner mast weldment is even with top of outer mast weldment ± 1.5 mm (0.06 in.)

All masts - Adjust chains (inner chains on masts with free lift cylinder) so bottom of carriage is 82.55 mm

(3.25 in.) above floor. Verify that chains (of each chain set) are adjusted for equal tension.

Two-Stage

1. Fully lower the carriage. Measure the distance from the floor to the bottom of the carriage. The correct distance is 82.55 mm (3.25 in.).
2. If the distance is correct, the chains are adjusted for the correct height. Perform Step 5 next. If the distance is NOT correct, perform all of the steps.
3. Remove the mast operator guard. See Figure 8. Loosen both lock nuts at the chain anchors to make any adjustments.
4. Adjust the nuts of the chain anchors equal amounts for the correct distance (Step 1).

Mast Adjustments

4000 SRM 482

5. Check chain tension by pushing on both chains at the same time. If the tension is not the same, adjust the nuts on the chain anchors until the tension is the same and the distance (Step 1) is also correct. Tighten the lock nuts.

NOTE: When the chain adjustments are complete, make sure the cotter pin at the bottom of the chain anchor can be installed under the adjustment nut. If there is no room to install the cotter pin, the chains are too short. Install the correct chains. Make sure the lock nuts on the chain anchors are tight against the mount plate. If there are not enough threads on the chain anchor for correct adjustment, new chains are too long or old chains are too worn. Links can be removed from old chains if the chains are less than 3 percent longer than the correct new chain. Replace old chains that are too long or new chains that are not the correct length.

6. Tighten the chain anchor jam nuts.
7. Check the mast operation as described in Mast Operation Check.
8. Install the mast operator guard if removed.

Three-Stage

1. Adjust the main-lift chains for equal tension.
2. Check chain tension by pushing on both main-lift chains at the same time. If the tension is not the same, remove the mast operator guard if installed. See Figure 8. Loosen both lock nuts at the chain anchors to make any adjustments.
3. Adjust the nuts on the chain anchors until the tension is the same. Tighten the lock nuts.
4. Check the mast operation as described in Mast Operation Check.
5. Install the mast operator guard (if removed).

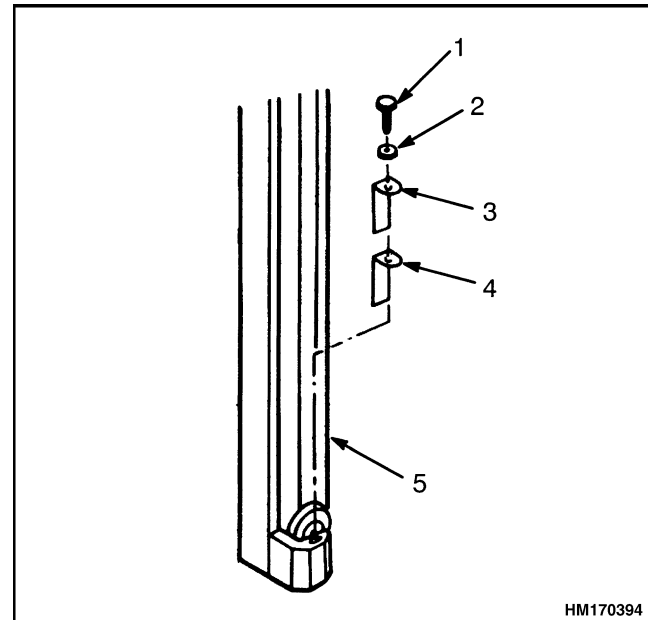
ADJUST WEAR STRIPS

NOTE: The wear plugs and lift chains must be adjusted before the wear strips are checked for wear, replaced, and adjusted.

The wear strips and shims are fastened to the lower guide blocks of weldments that move. See Figure 27.

The wear strips and shims are adjusted:

- For minimum clearance to prevent too much side movement of the weldments.
- To keep the weldments parallel.



NOTE: WEAR STRIPS AND SHIMS ON THE THREE-STAGE INNER WELDMENT CAN BE USED ON EITHER SIDE. THERE ARE RIGHT AND LEFT WEAR STRIPS AND SHIMS ON TWO-STAGE INNER AND THE THREE-STAGE INTERMEDIATE WELDMENTS.

- | | |
|---------------|---------------------|
| 1. CAPSCREW | 4. SHIM |
| 2. WASHER | 5. WELDMENT CHANNEL |
| 3. WEAR STRIP | |

Figure 27. Typical Wear Strip Assembly

NOTE: Wear strips and shims on the three-stage inner weldment can be used on either side. There are right and left wear strips and shims on the two-stage inner and the three-stage intermediate weldments. See Figure 10 and Figure 27.

Check and adjust the wear strips as follows:

1. If installed, remove the mast operator guard. See Figure 8. Raise the carriage for access to the wear strips. Install safety chains as described in Safety Procedures When Working Near Mast.
2. Remove the cap screws, washers, wear strips, and shims. Replace all worn or damaged parts. One wear strip and one shim on each side is usually the correct adjustment. There must be the same number of shims under the wear strip on both

sides of the weldment. Equal shims will keep the weldment parallel with equal clearance.

3. Use a pry bar to move the weldment to install shims for minimum clearance. Install the shims

and new wear strips as shown in Figure 27. Remove the safety chains.

4. Make sure the mast operates correctly as described in Mast Operation Check.

Carriage Adjustments

Read and follow the Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS.

For the N30XMH, N30XMH₂ (C210) and V30ZMD (D210) carriage checks and adjustments, see the section **Attachment** 5000 SRM 580. For lift trucks V30ZMD (D210/E210) serial number 1519 and after, see section **Attachment** 5000 SRM 1254.

ADJUST WEAR PLUG - CARRIAGE

Adjust the wear plugs as follows:

1. Fully lower the carriage and make sure the lift chains are the support for the carriage. If the lift chains are loose, operate the system to raise the carriage until the lift chains are the support.



WARNING

NEVER loosen the wear plugs if a carriage does not move freely during checks after an adjustment. The carriage can suddenly move and cause an injury. Raise the carriage, move the key to the OFF position, and install safety chains as described in Safety Procedures When Working Near Mast.

2. Loosen the jamnut on the wear plug using the special tool available from your dealer for Hyster lift trucks. See Figure 24 and Figure 25.
3. Adjust the wear plugs to attain zero clearance between the wear plug and the weldment channel.
4. Adjust the clearance to approximately 1/2 mm (0.02 in.) by turning the adjustment handle 1/8 turn counterclockwise. Keep the clearance between the carriage and mast weldments equal on

both sides. Keep the carriage parallel to the mast weldment.

5. Tighten each jamnut without moving the setscrew.
6. If necessary, carefully remove the safety chains. Raise and lower the carriage without a load. Check that there is minimum clearance with free movement. If the carriage does not move smoothly during lowering, follow the WARNING and adjust the wear plugs equally for more clearance.
7. Raise and lower the carriage with a load. Check that there is minimum clearance with free movement. If the carriage does not move smoothly during lowering, follow the WARNING and adjust the wear plugs equally for more clearance.

ADJUST SIDE ROLLERS - CARRIAGE

1. If necessary, remove the carriage from the mast. See Carriage Assembly, Remove and Install.
2. Measure the width of the inside face of the inner weldment in several places. See Figure 28. Make a note of the location and the value of the minimum measurement.
3. Measure and record the distance across the side rollers of the carriage assembly. See A of Figure 29.
4. Add or remove shims under the side rollers so the distance across the rollers is 1/2 mm (0.02 in.) less than the measurement of Step 2. See Figure 29.

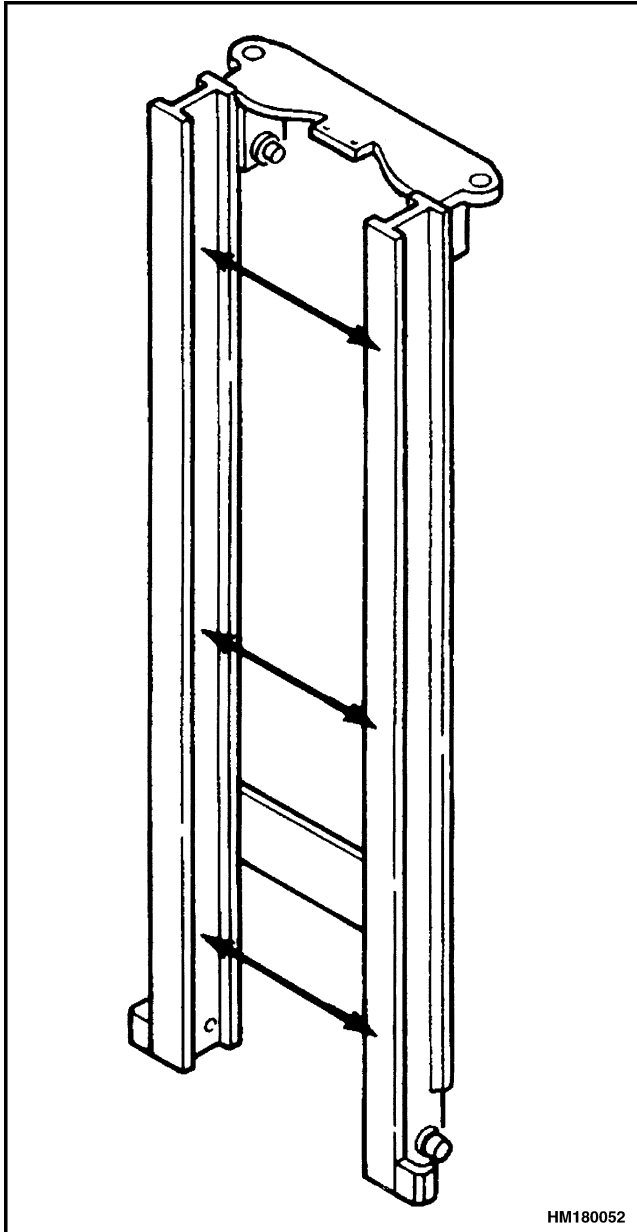


Figure 28. Measuring Channel Width

NOTE: Make sure the total shim thickness for each side is the same for each set of side rollers. Equal shim thickness will keep the clearance equal between the carriage and mast weldment on both sides.

5. Install the carriage. See Carriage Assembly, Remove and Install.

ADJUST THRUST ROLLERS - CARRIAGE

1. Measure the width between the outside edges of the inner weldment in several places. See Figure 28. Make a note of the location and the value of the maximum measurement.
2. Measure and record the distance between the inside faces of the thrust rollers of the carriage assembly. See B of Figure 29.
3. If distance B is more than 4 mm less than the maximum measurement of Step 1, install smaller size thrust rollers. If distance B is more than 4 mm greater than the maximum measurement of Step 1, install larger size thrust rollers. Install the same size rollers on each side for a minimum clearance at the maximum measurement point (Step 1). Thrust rollers have outside diameters of 74, 76, or 78 mm.

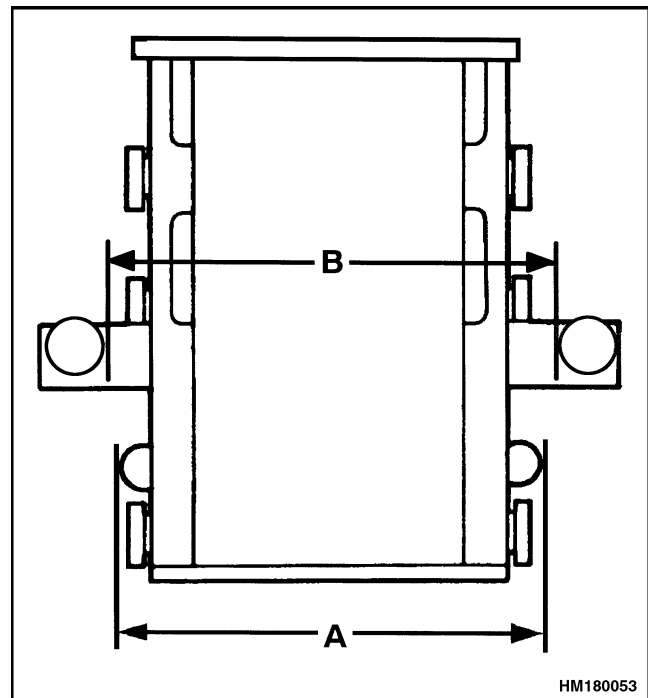


Figure 29. Carriage Side and Thrust Roller Widths

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
No operation of lift cylinders.	No oil or not enough oil to supply cylinders.	Check oil level and add oil as needed.
	Bad hydraulic leaks, bad pump or pump drive, relief valve set too low, bad check valve.	Repair hydraulic leaks. Replace pump or pump drive. Replace check valve. Reset relief valve to correct setting.
Slow operation of lift cylinders.	Not enough oil supply to cylinder(s).	Check oil level and add oil as needed.
	Bad cylinder seal(s). Check for seal leaks inside the cylinder by installing a gate valve in the hydraulic line. See Hydraulic System Leaks Check of this section.	Replace cylinder seals.
	Relief valve pressure is wrong.	Adjust relief valve to correct pressure setting.
	The spring for the relief valve is weak or damaged.	Repair relief valve.
Rough movement of the mast assembly.	Air in the hydraulic system.	Remove air from hydraulic system.
	Bent rods, cylinders with distortion or damage.	Replace cylinders.
	Mast assembly damaged or not in alignment.	Repair damage or realign mast assembly.
	Wear plugs or wear strips adjusted too tight.	Adjust plugs or strips correctly.
	Improper lubrication of mast channels.	Lubricate mast channels properly.

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