SERVICE REPAIR

MANUAL

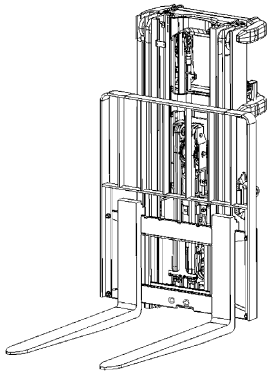
Hyster J160 (J30ZT J35ZT J40ZT) Forklift

HYSTER

MAST REPAIRS (S/N A551, A555, A559, A661, A662, A663, A664, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, AND E564)

2-, 3-, AND 4-STAGE MASTS

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



HYSTER

PART NO. 1580524

4000 SRM 1148

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

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

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

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

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

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This section is for the following models:

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

General

WARNING

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

This section has the repair procedures for the Two-Stage, Limited Free-Lift (LFL); Two-Stage, Full Free-Lift (FFL); Three-Stage, Full Free-Lift (FFL); and Four-Stage, Full Free-Lift (FFL) masts and carriages. Procedures for Carriage Adjustments are located at the end of this section.

NOTE: For models J1.60-2.00XMT (J30-40ZT) [J160], this section applies to only to Four-Stage masts. Refer to **Mast Repairs** 4000SRM0522 for Two-Stage and Three-Stage masts for these particular models.

NOTE: Hoses have a service life that is determined by application and time. Install a new hose if the hose is worn, damaged, soft or hard, and no longer flexible. If necessary, make a comparison to a new hose that is the correct replacement for the hose you are inspecting.

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

- **Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is OFF and the key is removed. Put a DO NOT OPERATE tag in the operator's compartment. Disconnect the battery and put a tag or lock on the battery connector.**
- **Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.**
- **DO NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.**
- **Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in this section.**

WHEN WORKING NEAR THE MAST ALWAYS:

- **Lower the mast and carriage completely: Turn the key switch to the ON position and push the lift/lower control lever forward until there is no movement in the mast. Make sure that all parts of the mast that move are fully lowered.**

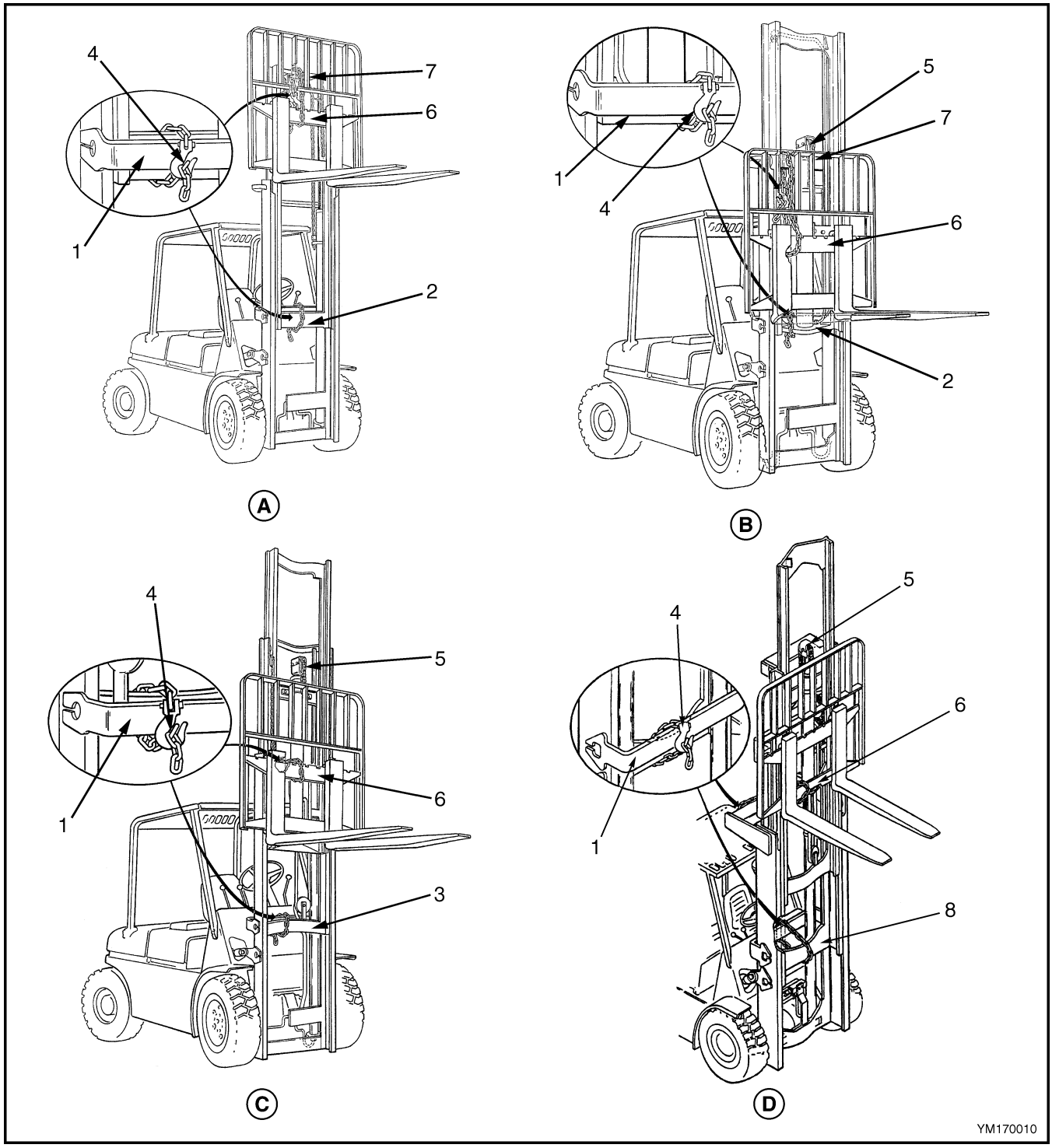
  OR

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

1. Put mast in vertical position.
2. Raise mast to align bottom crossmember of mast upright that moves in outer mast with crossmember on outer mast. On the two-stage mast, the moving part is the inner mast. On the three-stage mast, it is the intermediate mast. On the four-stage mast, it is the first intermediate mast. See Figure 1.
3. Use a 3/8-inch minimum safety chain with a hook to fasten the crossmembers together so the movable member cannot lower. Put hook on back side of mast. Make sure hook is completely engaged with a link in the chain. Make sure safety chain does not touch lift chains or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
4. Lower mast until there is tension in safety chain and free-lift cylinder (full free-lift models) is completely retracted.

NOTE: Apply the parking brake. After lowering or restraining the mast, shut off the power, and remove key. Put a **DO NOT OPERATE** tag in the operator's compartment. Disconnect battery and put a tag or lock on battery connector.

5. Install another safety chain (9.5 mm (3/8 in.) minimum) between the top or bottom bar of the carriage (item 6, Figure 1) and a crossmember on the outer mast as a secondary safety device. Install a **DO NOT REMOVE** tag on the safety chain(s).



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

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

Figure 1. Safety Chaining the Mast

Fork Replacement

Forks are held on the carriage by hooks and kept in position by pins inserted through top fork hooks into slots in top carriage bar. If pin does not remain engaged in carriage slot, replace with new pin.

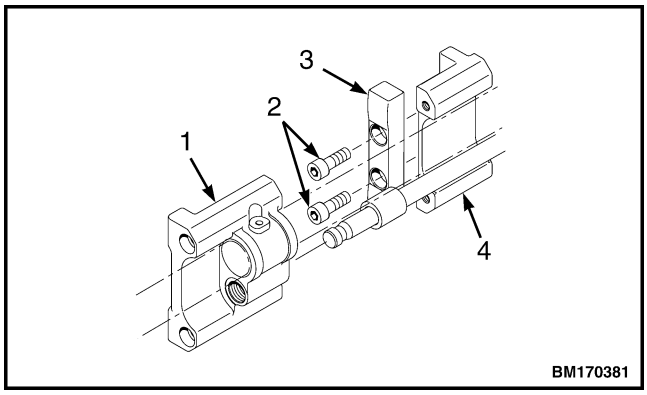
On lift truck models not equipped with a fork positioner attachment, or equipped with a fork positioner manufactured before August, 2012, forks are held on the carriage by hooks and kept in position by pins inserted through the top fork hooks into slots in top carriage bar. See Figure 4.

CAUTION

Remove fork latch pins if adding a fork positioner attachment. Damage to forks and other carriage components can occur if fork latch pins are not removed prior to using attachment.

The forks are held on the carriage by hooks. Forks on a standard carriage or an integral sideshift carriage not equipped with a fork positioner attachment, are held in position by pins that fit through the top fork hooks and into slots in the top carriage bar. If pin does not remain engaged in carriage slot, replace with new pin. Always check that pins for forks keep forks in position on carriage. Replace damaged fork pin parts. Forks are removed from carriage by aligning forks with fork removal notch. Fork removal notch is in bottom bar of carriage. See Figure 4.

Forks used on an integral sideshift carriage equipped with a fork positioner attachment are held in position with fork carriers (inner and outer) that slide along the fork positioner cylinder. Depending on the size and configuration of forks installed on lift truck, there may be a spacer bar between the inner and outer fork carriers. See Figure 2. The forks are removed from the carriage by aligning the forks with fork removal notch. Fork removal notch is in the bottom bar of carriage. See Figure 4.



1. OUTER FORK CARRIER
2. CAPSCREW
3. SPACER BAR*
4. INNER FORK CARRIER

*SPACER BAR USED ON 977 mm (38.5 in.) AND 1067 mm (42 in.) CLASS II CARRIAGES.

Figure 2. Fork Carrier Components

REMOVE, LIFT TRUCKS NOT EQUIPPED WITH FORK POSITIONER OR EQUIPPED WITH FORK POSITIONER BEFORE AUGUST, 2012

WARNING

DO NOT try to remove a fork without a lifting device. Each hook fork for these lift trucks can weigh 45 to 115 kg (99 to 254 lb).

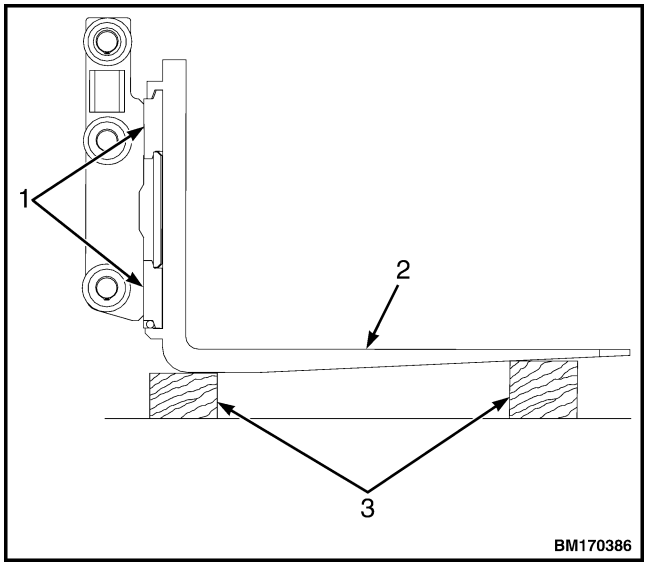
CAUTION

There are NO pins in forks on lift trucks equipped with a fork positioner.

NOTE: Forks are to be replaced in sets, not individually, by trained personnel only.

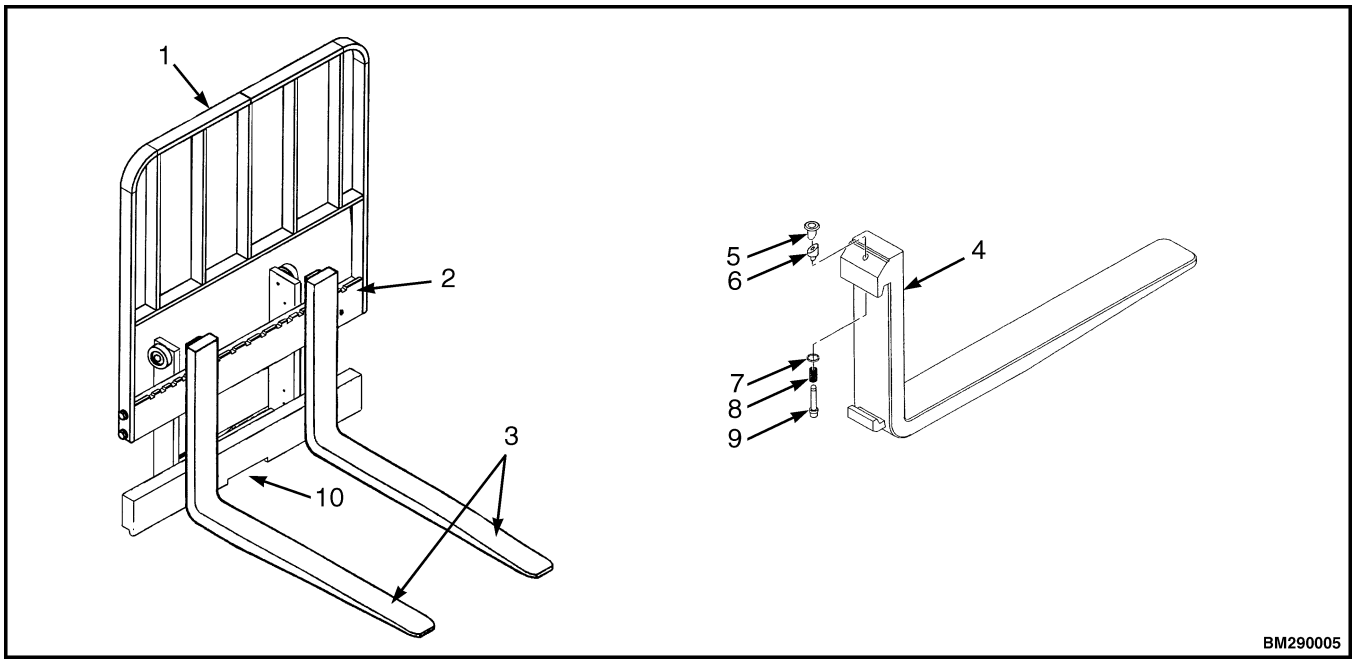
NOTE: If lift truck is equipped with a fork positioner, see the section Carriages Repair for procedures to remove the forks.

1. Slide fork to fork removal notch in bottom bar of carriage. See Figure 3 and Figure 4Figure 5.
2. Lower fork onto blocks so bottom hook of fork moves through fork removal notch. See Figure 4Figure 5.
3. Lower carriage further so top hook of fork is disengaged from top carriage bar.
4. Move carriage away from fork or use a lifting device to move fork away from carriage.



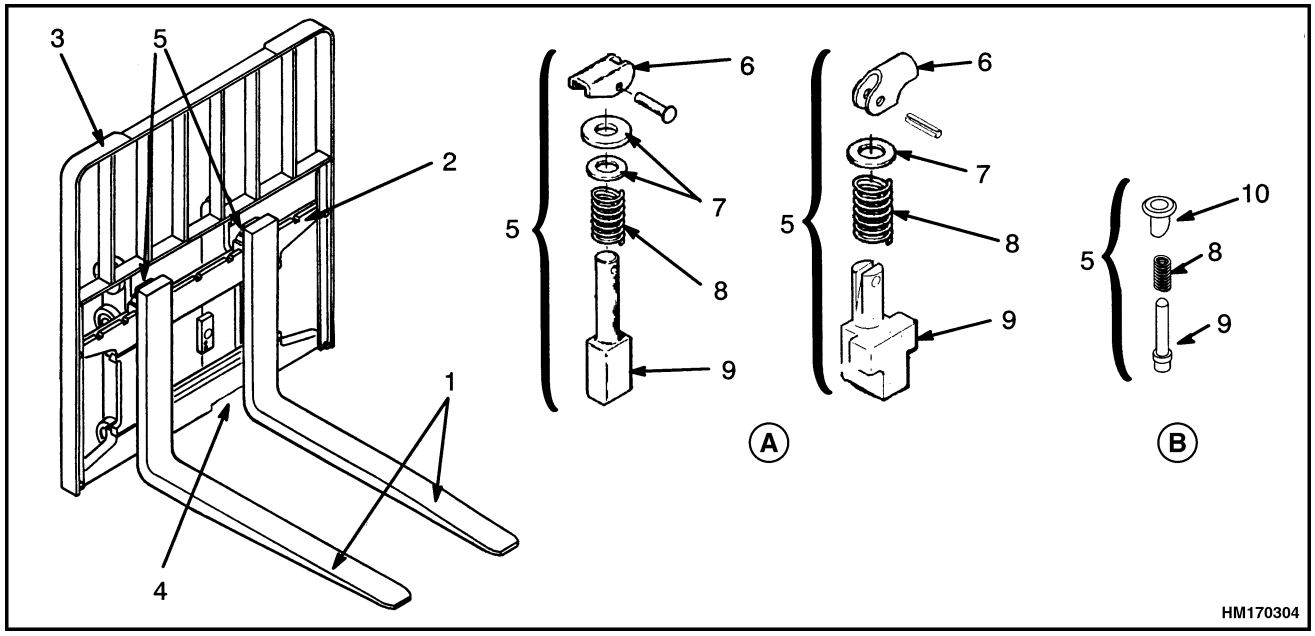
1. CARRIAGE BARS
2. HOOK FORK
3. BLOCKS

Figure 3. Hook Fork Removal



1. LOAD BACKREST
2. CARRIAGE
3. FORKS
4. FORK
5. KNOB
6. WEDGE
7. WASHER
8. SPRING
9. PIN
10. FORK REMOVAL NOTCH

Figure 4. Carriage and Forks, Hook Forks



A. EARLIER MODELS

1. FORKS
2. CARRIAGE
3. LOAD BACKREST EXTENSION
4. FORK REMOVAL NOTCH
5. LATCH PIN ASSEMBLY

B. LATER MODELS

6. LEVER
7. WASHER
8. SPRING
9. PIN
10. KNOB

Figure 5. Carriage and Forks

REMOVE, LIFT TRUCKS MANUFACTURED AFTER AUGUST, 2012 AND EQUIPPED WITH FORK POSITIONER

WARNING

DO NOT try to remove a fork without a lifting device. Each hook fork for these lift trucks can weigh 45 to 115 kg (99 to 254 lb).

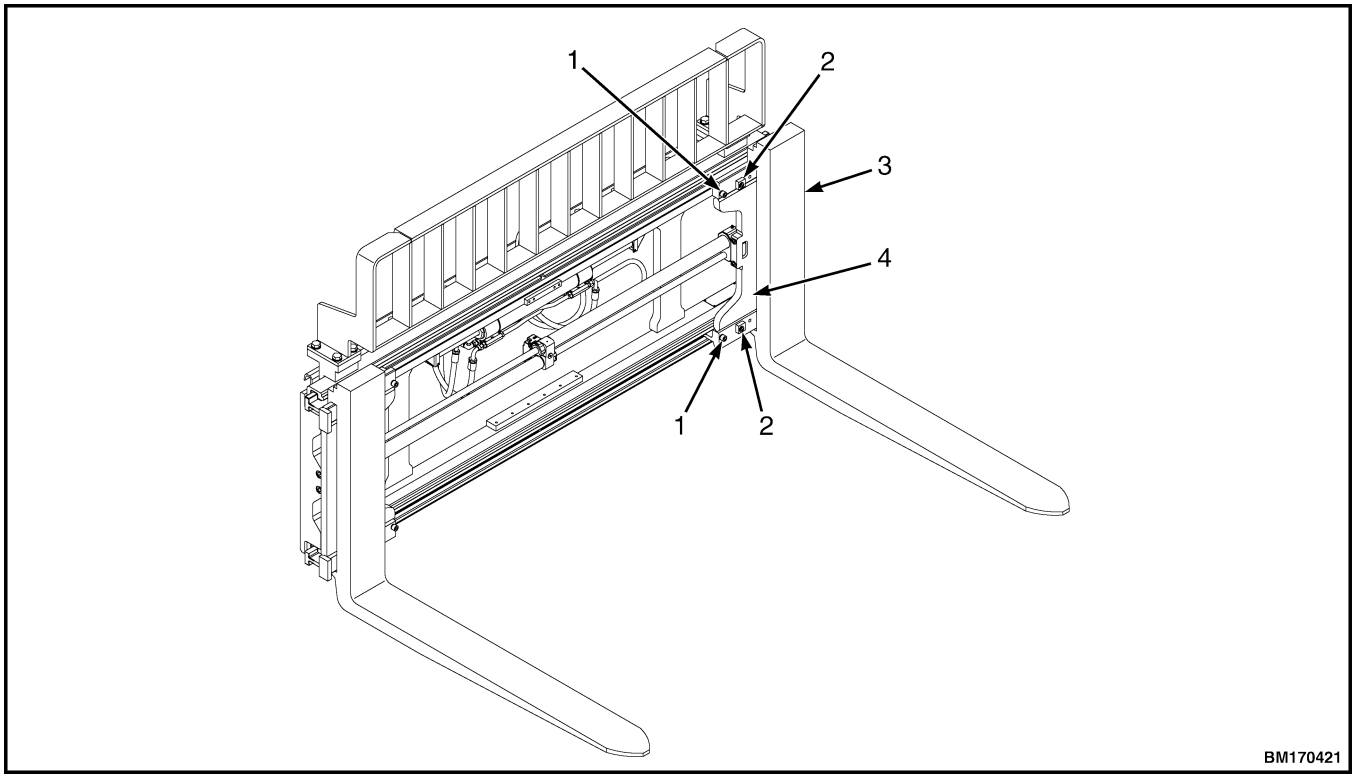
CAUTION

Remove fork latch pins if adding a fork positioner attachment. Damage to forks and other carriage components can occur if fork latch pins are not removed prior to using attachment.

NOTE: Forks are to be replaced in sets, not individually, by trained personnel only.

NOTE: Before removing forks, make a notation of the hole position of the fork carrier blocks and retainer capscrews on the fork carrier. See Figure 6.

1. Lower forks onto blocks for support. See Figure 3.
2. Remove retainer capscrews and fork carrier blocks from fork carriers. See Figure 6.
3. Attach a lifting device to forks. Slide forks off carriers.
4. Move carriage away from fork or use a lifting device to move fork away from carriage.



1. RETAINER CAPSCREWS
2. FORK CARRIER BLOCKS
3. FORKS
4. FORK CARRIER

Figure 6. Forks Removal, Lift Trucks Equipped with Fork Positioner Manufactured After August, 2012

INSTALL, LIFT TRUCKS NOT EQUIPPED WITH FORK POSITIONER OR EQUIPPED WITH FORK POSITIONER BEFORE AUGUST, 2012

NOTE: If lift truck is equipped with a fork positioner, see Carriages Repair for procedures to remove the forks.

WARNING

DO NOT try to install a fork without a lifting device. Each hook fork for these lift trucks can weigh 45 to 115 kg (99 to 254 lb).

1. Move fork and carriage so top hook of fork can engage upper carriage bar.
2. Raise carriage to move bottom hook of fork through fork removal notch.
3. Slide fork on carriage so both upper and lower hooks engage carriage bars. See Figure 3.
4. Install latch pin in top hook and notch in upper carriage bar. See Figure 4Figure 5.

INSTALL, LIFT TRUCKS MANUFACTURED AFTER AUGUST, 2012 AND EQUIPPED WITH FORK POSITIONER

WARNING

DO NOT try to install a fork without a lifting device. Each hook fork for these lift trucks can weigh 45 to 115 kg (99 to 254 lb).

CAUTION

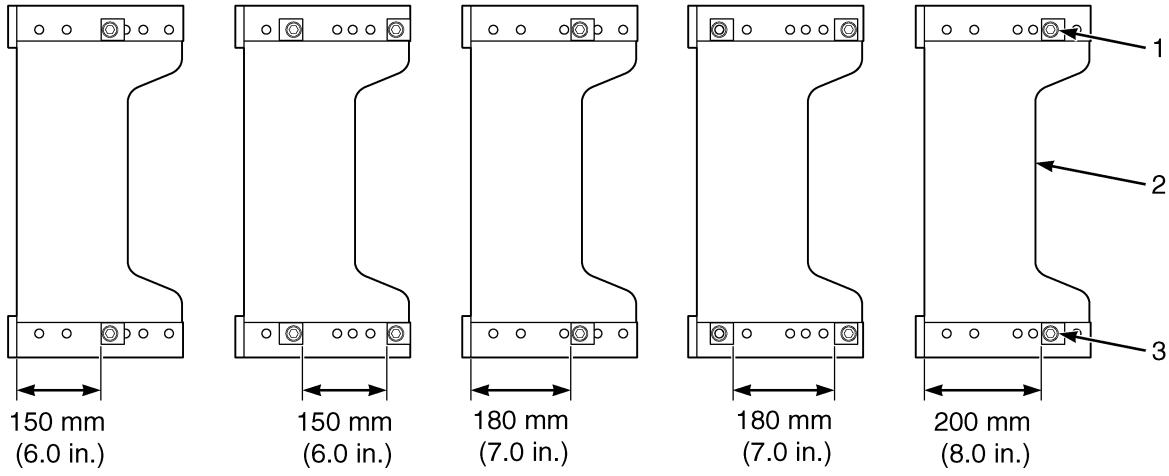
Remove fork latch pins if adding a fork positioner attachment. Damage to forks and other carriage components can occur if fork latch pins are not removed prior to using attachment.

NOTE: Forks are to be replaced in sets, not individually, by trained personnel only.

1. Move carriage into position to install forks.
2. Use lifting device and slide forks onto fork carriers. See Figure 7.

NOTE: Install fork carrier blocks and retainer capscrews in hole positions on fork carriers as noted during removal.

3. Install fork carrier blocks and retainer capscrews in hole positions on fork carriers as noted during removal.
4. Tighten retainer capscrews to 100 N•m (75 lbf ft).



NOTE: DIMENSIONS SHOWN ON BOTTOM OF FORK CARRIERS ARE THE WIDTH OF THE FORK BEING INSTALLED. THE TWO STAGE LFL CARRIAGE AND THE THREE STAGE FFL CARRIAGE ARE THE SAME.

1. RETAINER CAPSCREW
2. FORK CARRIER
3. FORK CARRIER BLOCK

Figure 7. Hole Location, Fork Mounting on Fork Carriers

CHECKS, LIFT TRUCKS NOT EQUIPPED WITH FORK POSITIONER OR EQUIPPED WITH FORK POSITIONER BEFORE AUGUST, 2012

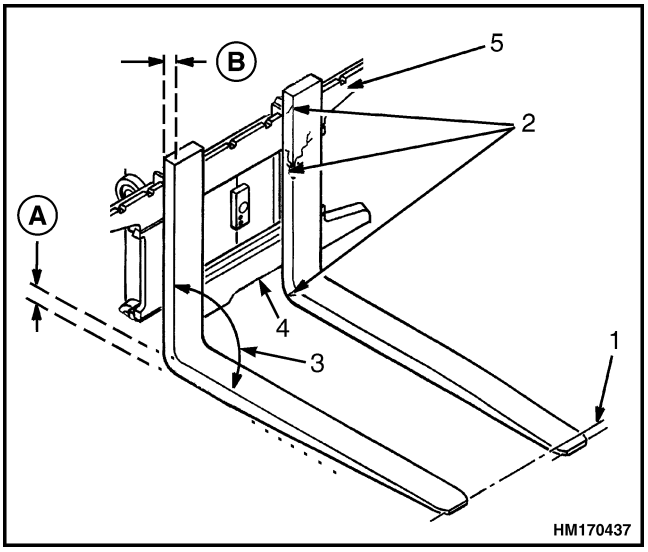
WARNING

Never repair damaged forks by heating or welding. Forks are made of tempered steel using special procedures. Always replace damaged forks as a pair.

1. Inspect forks for cracks and wear.
2. Check alignment of fork tips. Difference in height of fork tips must be less than three percent of fork length. See Table 1 and Figure 8. Some applications may require closer alignment. If forks DO NOT meet specification they both must be replaced.

Table 1. Fork Tip Alignment

Fork Tip Alignment Specifications			
Standard Fork Lengths		Maximum Fork Tip Difference$_1$	
mm	(in.)	mm	(in.)
914	(36)	27	(1.08)
1067	(42)	32	(1.26)
1219	(48)	37	(1.44)
1372	(54)	41	(1.62)
1524	(60)	46	(1.80)
1829	(72)	55	(2.16)
$_1$Difference of alignment between fork tips must be no more than 3% of the total fork length.			



A. HEEL OF FORK (MUST BE 90% OF DIMENSION B)
B. ORIGINAL FORK THICKNESS (DIMENSION B)

1. TIP ALIGNMENT (MUST BE WITHIN 3% OF FORK LENGTH)
2. CRACKS
3. MAXIMUM ANGLE 93°
4. FORK REMOVAL NOTCH
5. CARRIAGE

Figure 8. Fork Check

3. Check that the bottom of each fork is not excessively worn.

4. Check for smooth and proper operation of the fork lock pins. Repair or replace any damaged or broken fork lock pins or components and lubricate, as necessary. See Figure 4.

CHECKS, LIFT TRUCKS MANUFACTURED AFTER AUGUST, 2012 AND EQUIPPED WITH FORK POSITIONER

WARNING

Never repair damaged forks by heating or welding. Forks are made of tempered steel using special procedures. Always replace damaged forks as a pair.

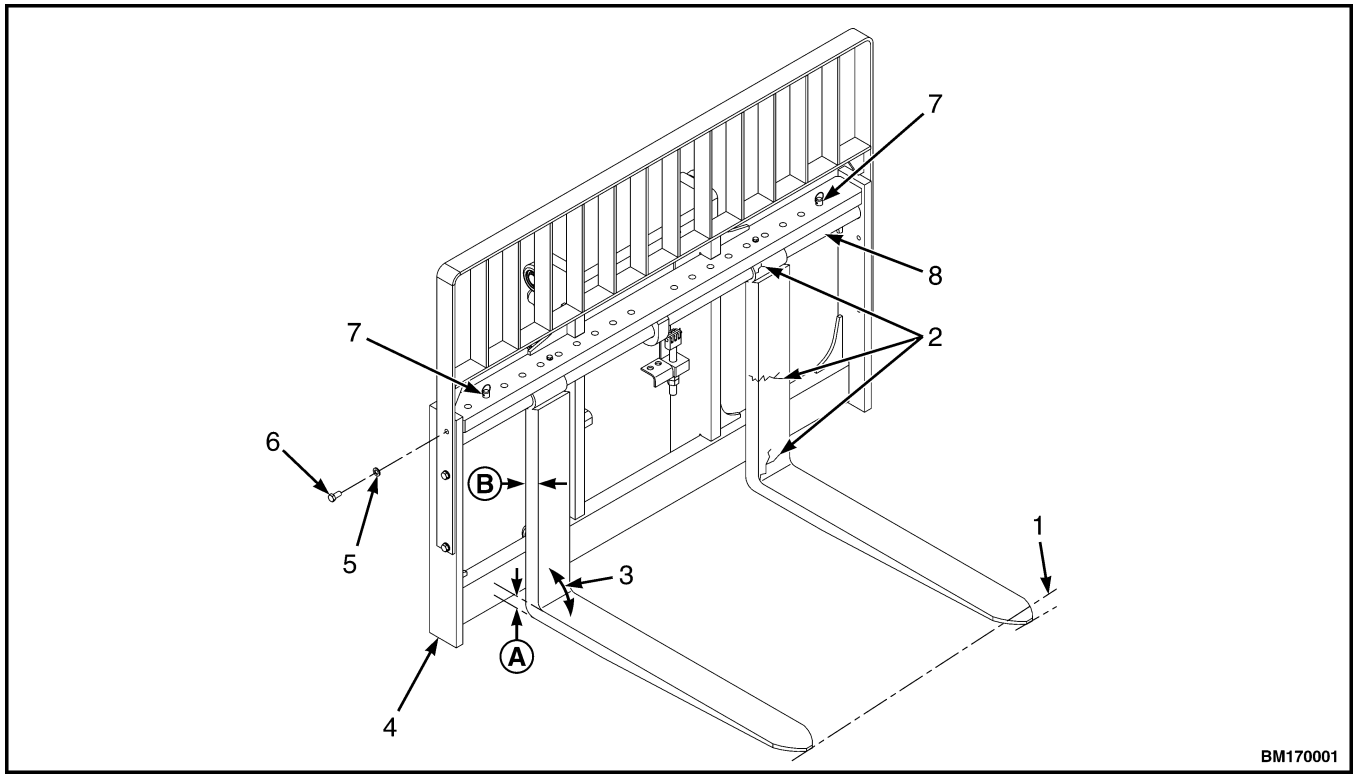
1. Inspect forks for cracks and wear.

2. Check alignment of fork tips. Difference in height of fork tips must be less than three percent of fork length. See Table 2 and Figure 9. Some applications may require closer alignment. If forks DO NOT meet specification they both must be replaced.

3. Check that the bottom of each fork is not excessively worn.

Table 2. Fork Tip Alignment

Fork Tip Alignment Specifications			
Standard Fork Lengths		Maximum Fork Tip Difference$_1$	
mm	(in.)	mm	(in.)
1219	(48)	37	(1.44)
1981	(78)	59	(2.32)
$_1$Difference of alignment between fork tips must be no more than 3% of the total fork length.			



A. HEEL OF FORK (MUST BE 90% OF DIMENSION B)

1. TIP ALIGNMENT (MUST BE WITHIN 3% OF FORK LENGTH)
2. CRACKS
3. MAXIMUM ANGLE 89°
4. CARRIAGE

B. ORIGINAL FORK THICKNESS (DIMENSION B)

5. WASHER
6. CAPSCREW
7. PIN
8. ROD

Figure 9. Pin Type Fork Check

Carriages Repair

STANDARD CARRIAGE

Remove

1. Remove the forks. See Fork Replacement.

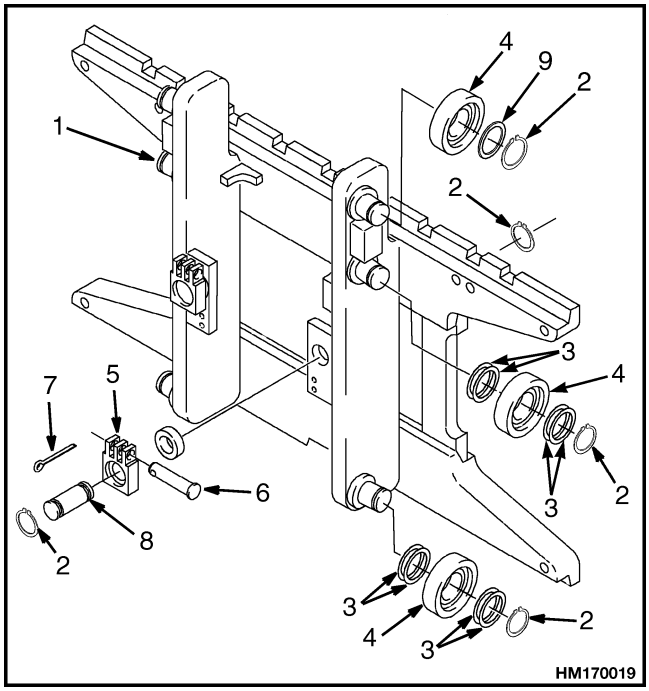
2. Remove the four capscrews securing the load backrest to the carriage. Remove the load backrest.

3. Connect a lifting device to the carriage. Lift the carriage so that the lift chains become loose.

WARNING

When disconnecting the lift chains, keep control of the ends. Use wire to temporarily connect the ends of the lift chains to the mast. This procedure will prevent the lift chains from falling from the sheaves and causing an injury or damage.

4. Remove the pin from each chain anchor at the carriage. See Figure 10. Disconnect the lift chains from the carriage. Use wire to connect the ends of the lift chains to a part of the mast. Make sure the chains can move freely when the inner mast is raised.



NOTE: TWO-STAGE LFL CARRIAGE SHOWN.

1. CARRIAGE
2. SNAP RING
3. SHIM
4. LOAD ROLLER
5. CHAIN ANCHOR
6. CHAIN PIN
7. COTTER PIN
8. ANCHOR PIN
9. SPACER

Figure 10. Standard Carriage

WARNING

To help prevent possible injury, make sure the carriage is stable when the inner mast is above the load rollers of the carriage.

5. Use the lift cylinders to raise the inner or intermediate mast. If the hydraulic system cannot be used, disconnect the lift cylinders from the inner or intermediate mast. See the section **Cylinder Repair (Mast S/N A551, A555, A559, A661, A662, A663, A66, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564)** 2100SRM1139.

6. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the top of the inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage. Install safety chains to secure the mast in its extended position and disconnect the crane. See Safety Procedures When Working Near Mast.

7. Move the lift truck away from the carriage. Completely lower the inner mast so it cannot move.

Repair

NOTE: The carriage can have four or six load rollers. When the carriage has four load rollers, shims are used behind all of the load rollers. When the carriage has six load rollers, shims are installed on the bottom and middle rollers only.

1. If any of the load rollers must be replaced, make a note of the location and number of the shims. Install the shims, load rollers, and snap rings. See Carriage Adjustments for correct adjustment of the load rollers.

WARNING

Improper welding procedures can damage the structure of the mast or cause incorrect function of the mast. Consult your Hyster® lift truck dealer for more information before welding on the mast.

2. If the carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.

Install

1. Use the hydraulic system of the lift truck or a crane to raise the inner mast. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the top of the inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage. Install safety chains to secure the mast in its extended position and disconnect the crane. See Safety Procedures When Working Near Mast.

2. Move the lift truck toward the carriage until the inner mast is aligned with the carriage rollers. If the inner mast has been raised and secured using a crane and safety chains, connect the crane, raise the inner mast, and remove the safety chains. Carefully lower the inner mast until it engages all of the load rollers. Disconnect the crane, if attached, and reconnect the lift cylinders. See the section **Cylinder Repair (Mast S/N A551, A555, A559, A661, A662, A663, A66, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564)** 2100SRM1139.

3. Check the clearance of the load rollers. See Carriage Adjustments in this section.

NOTE: Use new cotter pins each time the anchor pins are removed.

4. Connect the lift chains to the chain anchors at the carriage. Install the cotter pins in the anchor pins. Adjust the lift chains as described in Carriage Adjustments in this section.

5. Install the backrest on the carriage. Tighten the capscrews to 195 N•m (144 lbf ft).

6. Install the forks. See Fork Replacement.

STANDARD CARRIAGE, REMOVE

1. Put a one-quarter capacity load on the forks. The load must give the carriage stability so the carriage cannot fall when it is disconnected from the mast.

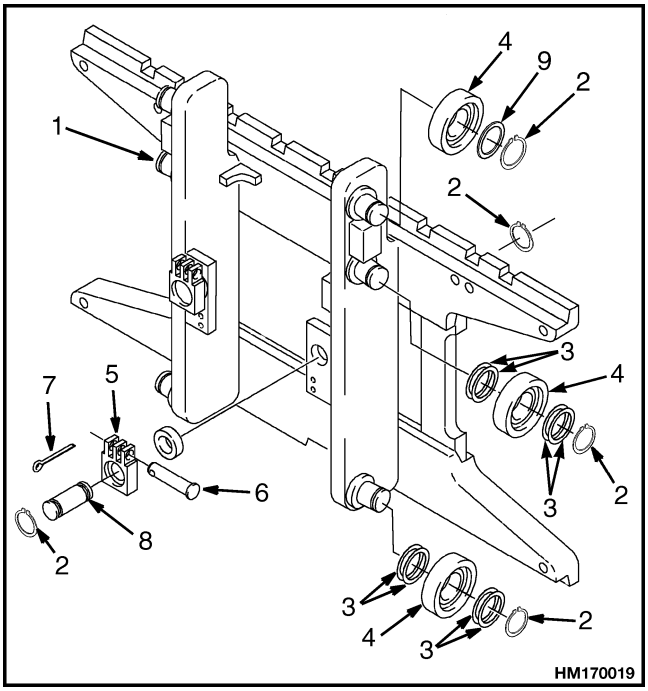
2. Lower the carriage and forks on blocks so the lift chains become loose.

3. Remove the load backrest.

WARNING

When disconnecting the lift chains, keep control of the ends. Use wire to temporarily connect the ends of the lift chains to the mast. This procedure will prevent the lift chains from falling from the sheaves and causing an injury or damage.

4. Remove the pin from each chain anchor at the carriage. See Figure 11. Disconnect the lift chains from the carriage. Use wire to connect the ends of the lift chains to a part of the mast. Make sure the chains can move freely when the inner mast is raised.



NOTE: TWO-STAGE LFL CARRIAGE SHOWN.

1. CARRIAGE
2. SNAP RING
3. SHIM
4. LOAD ROLLER
5. CHAIN ANCHOR
6. CHAIN PIN
7. COTTER PIN
8. ANCHOR PIN
9. SPACER

Figure 11. Standard Carriage

WARNING

To help prevent possible injury, make sure the carriage is stable when the inner mast is above the load rollers of the carriage.

5. Use the lift cylinders to raise the inner or intermediate mast. If the hydraulic system cannot be used, disconnect the lift cylinders from the inner or intermediate mast. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the top of the inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage.

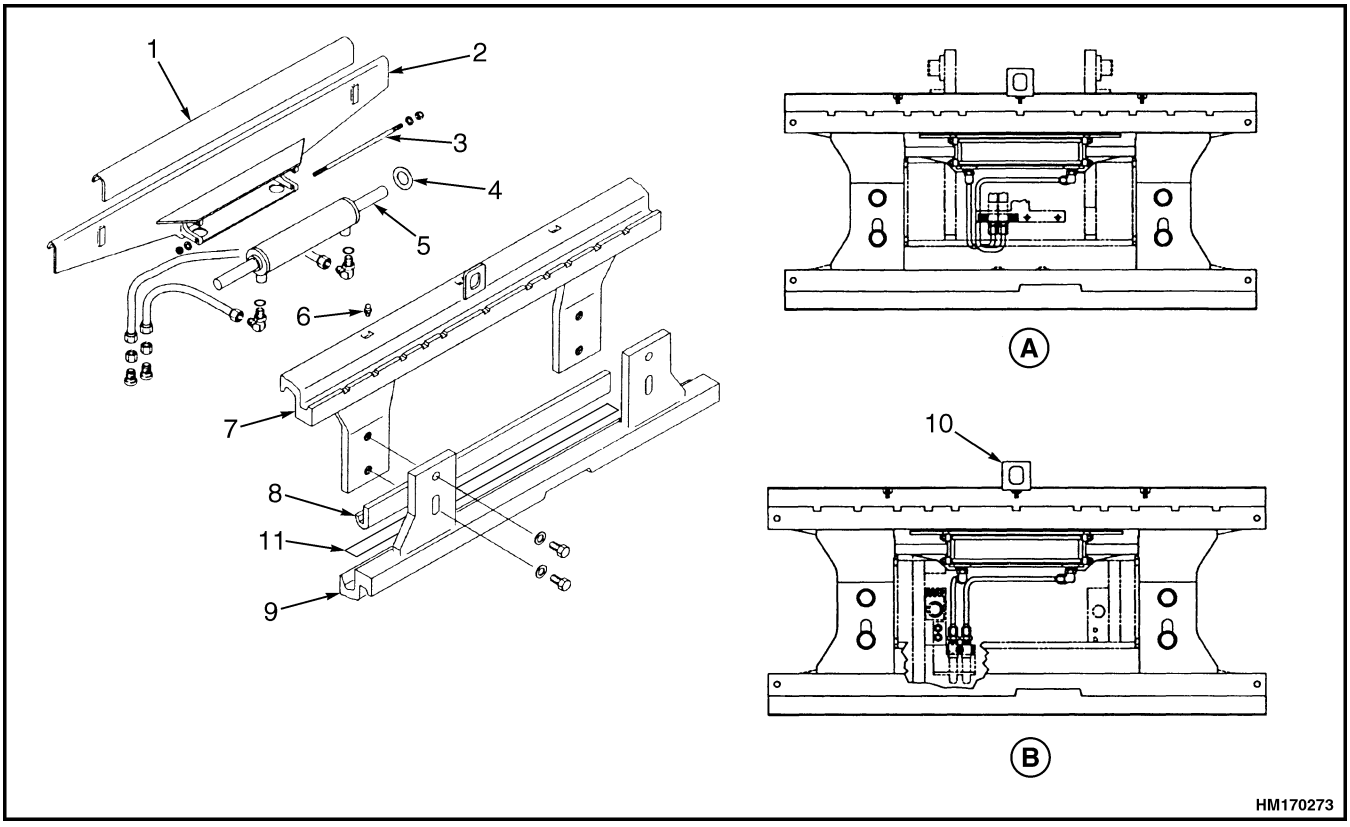
6. Move the lift truck away from the carriage. Completely lower the inner mast so it cannot move.

7. Connect a lifting device to the carriage. Remove the load from the forks with another lift truck. Lower the carriage to the floor so the load rollers are facing up.

8. If the forks are removed, use a lifting device to put the carriage on the floor so the load rollers are up.

HANG-ON SIDESHIFT CARRIAGE, REMOVE

1. Lower the carriage completely. Remove the forks and the load backrest extension.



A. HYDRAULIC CONNECTIONS - TWO-STAGE, FULL FREE-LIFT AND THREE-STAGE, FULL FREE-LIFT

B. HYDRAULIC CONNECTIONS - TWO-STAGE, LIMITED FREE-LIFT

1. TOP BEARING
2. CYLINDER SUPPORT BRACKET
3. THREADED ROD
4. SHIM
5. SIDESHIFT CYLINDER
6. GREASE FITTING
7. UPPER APRON
8. BOTTOM BEARING
9. LOWER APRON
10. LIFTING EYE
11. SHIM STRIP

Figure 12. Hang-On Sideshift Carriage

2. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the lifting eye on the sideshift carriage. See Figure 12.

3. Remove the two upper capscrews from the lower apron. Slowly loosen the two bottom capscrews, but do not remove them. The slotted holes will allow the lower apron to move down so the sideshift carriage can be removed.

4. Carefully lift the sideshift carriage from the standard carriage. The sideshift cylinder support bracket and cylinder will stay on the standard carriage. Remove the bearings.

WARNING

Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

5. Disconnect the hydraulic lines at the sideshift cylinder. Put caps on the open hydraulic lines. Remove the cylinder support bracket from the standard carriage. If necessary, remove the threaded rods and shims in order to remove the sideshift cylinder.

STANDARD CARRIAGE AND HANG-ON SIDESHIFT CARRIAGE, REPAIR

NOTE: The carriage can have four or six load rollers. When the carriage has four load rollers, shims are used behind all of the load rollers. When the carriage has six load rollers, shims are installed on the bottom and middle rollers only.

1. If any of the load rollers must be replaced, make a note of the location and number of the shims. Install the shims, load rollers, and snap rings. See Carriage Adjustments for correct adjustment of the load rollers.

2. If the carriage aprons have any protruding welds or damaged notches, repair by grinding, filing, or welding.

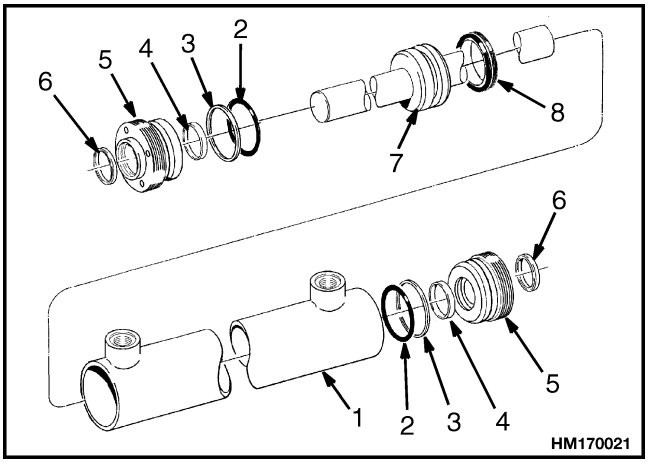
3. The repair procedure for the sideshift cylinder is as follows (see Figure 12 and Figure 13):

   a. Remove the retainers from the shell. Pull the rod from the shell.

   b. Replace seals, O-rings, or backup rings as necessary. Use the installation guides to prevent damage to the seals.

   c. Lubricate all internal parts with clean hydraulic oil.

   d. Install the piston and rod in the shell. Apply Loctite® 242 to the threads of the retainers. Install the retainers and tighten them to 27 N•m (20 lbf ft).



1. SHELL
2. O-RING
3. BACKUP RING
4. ROD SEAL
5. RETAINER
6. WIPER
7. PISTON AND ROD
8. PISTON SEAL

Figure 13. Sideshift Cylinder

4. Replace the cylinder rod seals as follows:

   a. Clamp the cylinder in a soft-jawed vise. **DO NOT** clamp on the cylinder shell.

   b. With the cylinder rod centered, unscrew the retainer from each end of the cylinder. Slide the retainers off the cylinder rod.

NOTE: If new retainers that are already assembled with seals are being installed, proceed to Step f.

   c. Remove the seals and O-ring from each retainer with a brass O-ring tool. **DO NOT** scratch the grooves.

WARNING

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

   d. Clean the retainers and the cylinder rod with cleaning solvent. Lubricate the new seals and O-rings with hydraulic oil.

   e. Install the seals into the retainer grooves. Form the seals into a "kidney" shape to ease placement into the groove. Note the direction of the rod seals. **Pressure seals are installed with the lip toward the pressure side of the cylinder.**

   f. Apply a film of hydraulic oil to the inside of the retainers. Carefully slide them onto the cylinder rod. Tighten the retainers to 165 N•m (122 lbf ft).

STANDARD CARRIAGE, INSTALL

1. Use the hydraulic system of the lift truck or a crane to raise the inner mast. If the hydraulic system cannot be used, disconnect the lift cylinders from the inner or intermediate mast. See **Lift Cylinders** section. Connect a crane [the capacity of the crane must be at least 681 kg (1501 lb)] to the top of the inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage. Install safety chains to secure the mast in its extended position and disconnect the crane. See Safety Procedures When Working Near Mast.

2. Move the lift truck toward the carriage until the inner mast is aligned with the carriage rollers. If the inner mast has been raised and secured using a crane and safety chains, connect the crane, raise the inner mast, and remove the safety chains. Carefully lower the inner mast until it engages all of the load rollers. Disconnect the crane, if attached, and reconnect the lift cylinders. See the **Lift Cylinders** section.

3. Check the clearance of the load rollers. See Carriage Adjustments in this section.

NOTE: Use new cotter pins each time the anchor pins are removed.

4. Connect the lift chains to the chain anchors at the carriage. Install the cotter pins in the anchor pins. Adjust the lift chains as described in Carriage Adjustments in this section.

5. Install the backrest on the sideshift carriage. Tighten the capscrews to 195 N•m (144 lbf ft).

6. Install the forks. See Fork Replacement.

HANG-ON SIDESHIFT CARRIAGE, INSTALL

1. Install the sideshift cylinder in the cylinder support bracket. See Figure 12. Use an equal number of shims on both sides of the cylinder to limit side-to-side movement within the bracket. Maximum movement is 0.6 mm (0.024 in.). Install the threaded rods to hold the cylinder in position and tighten to 18 N•m (159 lbf in).

2. Install the cylinder support bracket on the standard carriage. Make sure the bracket is engaged in the center notch in the top carriage bar.

3. Connect the hydraulic lines to the sideshift cylinder. See Figure 12. Lubricate the ends of the cylinder rod with multipurpose grease.

4. Install the top bearing on the cylinder support bracket. Lubricate only the outer surface of the bearing with multipurpose grease.

5. Connect the top and bottom aprons by installing the two bottom capscrews. **DO NOT** tighten the capscrews. Lubricate only the outer surface of the bottom bearing with multipurpose grease. Install the bottom bearing in the lower apron.

6. Install the shim strips under the bottom bearing strip (be sure the shims are seated between the shim stops) so the bottom bearing strip will just clear the lower lip of the standard carriage bar when the lower apron is brought into position.

7. Make sure the standard carriage is completely lowered. Connect a crane [the capacity of the crane must be at least 908 kg (2002 lb)] to the lifting eye. Install the sideshift carriage on the standard carriage. Put blocks under the bottom apron of the sideshift carriage so the bottom bearing moves tight against the standard carriage when the lifting device is lowered.

   Install the two top capscrews into the sideshift carriage. Tighten the capscrews to the following torque:

   - On H/S1.50-1.75XM, H/S2.00XMS (H/S25-35XM, H/S40XMS), E1.50-1.75XM (E25-35XM, E25-35XM$_2$) [D114], E2.00XMS (E40XMS, E40XM$_2$S [D114], E1.50-2.00XM (E25-35Z, E40ZS) [E114], H/S2.00-2.75XM (H/S40-55XM), S/E/J2.00-2.50XL (S/E/J40-50XL), J1.60-2.00XMT (J30-40XMT), J2.00-2.50XM (J40-50XM) [A216], and J2.00-2.50XM (J40-50Z) [A416] units, tighten all of the capscrews to 435 N•m (321 lbf ft).
   - On H/S3.00-3.20XM (H/S60-65XM), J3.00-3.20XM (J60XM) [A216], J3.00-3.20XM (J60Z) [A416], E2.00-3.20XM (E45-65Z) [G108], and S/E/J3.00XL (S/E/J60XL) units, tighten all of the capscrews to 755 N•m (557 lbf ft).

8. Install the load backrest extension on the sideshift carriage. Tighten the capscrews to 195 N•m (144 lbf ft).

9. Remove the lifting device. Lubricate the top bearings at the grease fittings.

INTEGRAL SIDESHIFT CARRIAGE

Remove

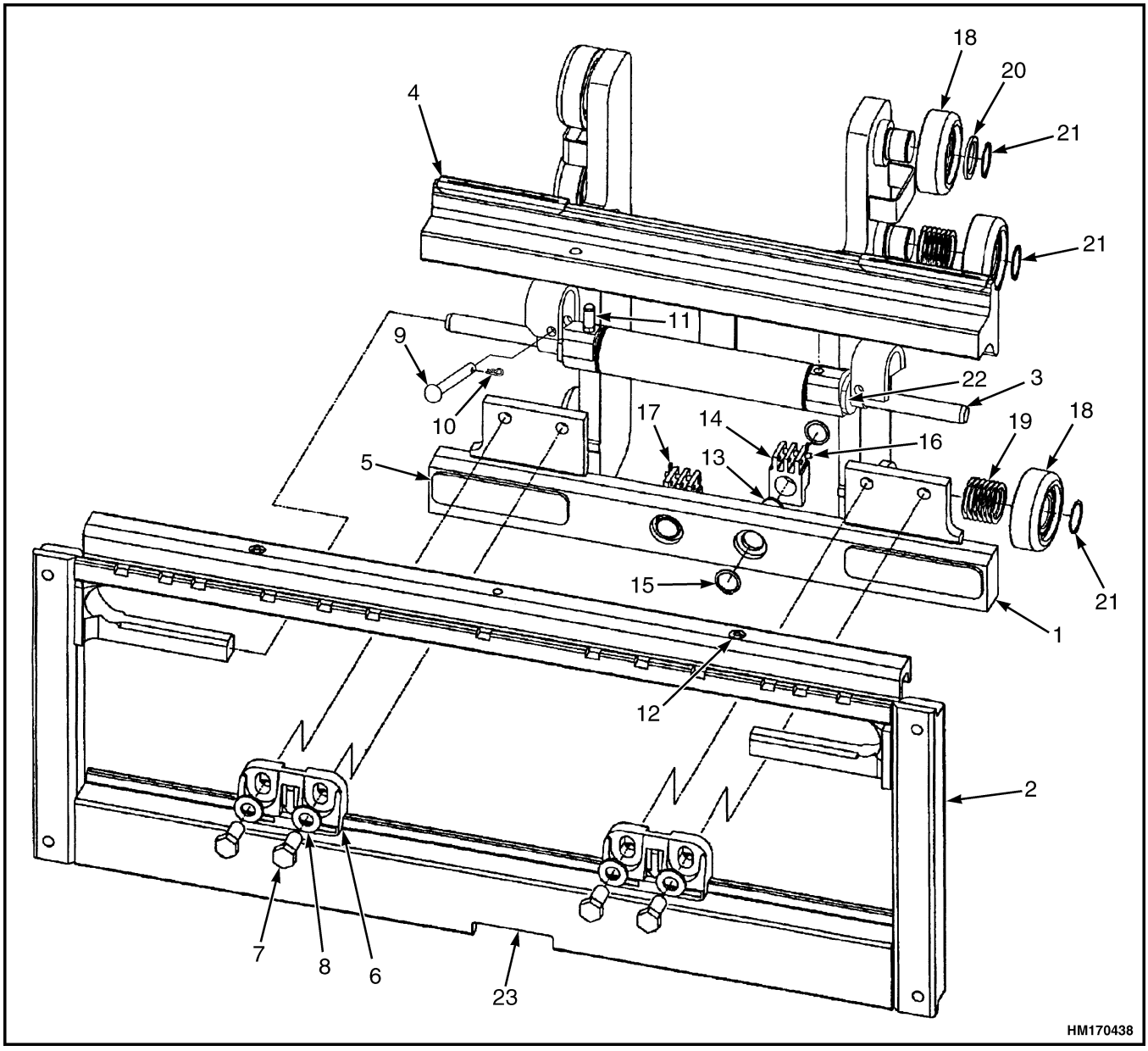
1. Lower the carriage completely. Remove the forks and the load backrest extension. See section Fork Replacement.

   See Figure 14 for lift truck models

   - S2.0-3.5FT (S40-70FT, S55FTS) (F187)
   - H2.0-3.5FT (H40-70FT) (L177)
   - J2.00-3.20XM (J40-65Z) (B416)
   - E2.00-3.20XM (E45-65Z) (G108)

   See Figure 15 for lift truck models

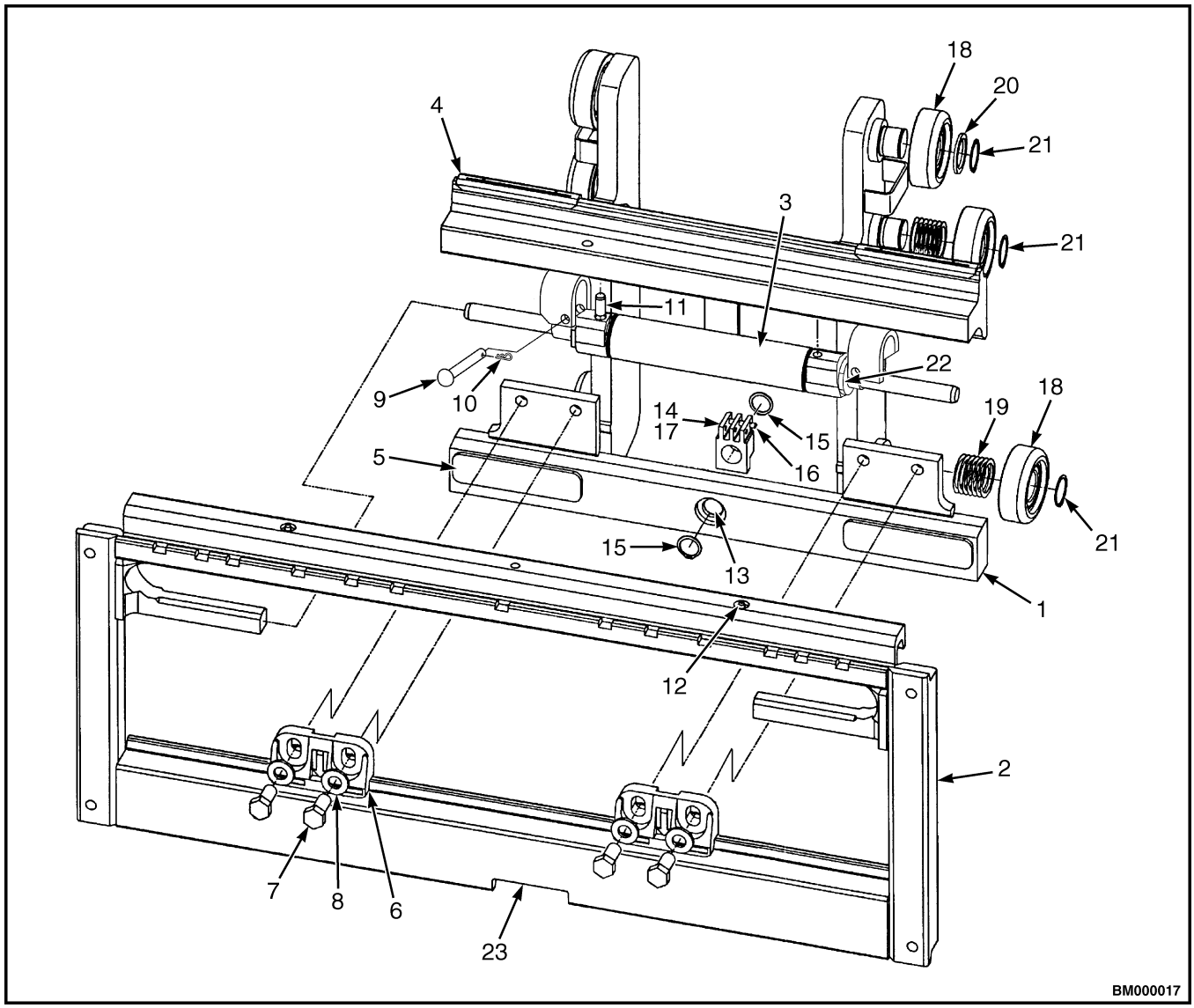
   - S30FT, S35FT, S40FTS (E010)
   - E1.50-2.00XM (E25-35Z, E40ZS) (E114/F114)
   - J1.60-2.00XMT (J30-40ZT) (J160)
   - H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)



NOTE: TWO- AND THREE-STAGE FFL IS SHOWN.

1. INNER CARRIAGE
2. OUTER FRAME
3. SIDESHIFT CYLINDER
4. UPPER BEARING
5. LOWER BEARING
6. LOWER HOOK
7. CAPSCREW
8. WASHER
9. CLEVIS PIN
10. HAIRPIN
11. PIN
12. LUBE FITTING
13. PIN
14. CHAIN ANCHOR
15. SNAP RING
16. PIN
17. COTTER PIN
18. LOAD ROLLER
19. SHIMS
20. SPACER
21. SNAP RING
22. SPACER
23. FORK REMOVAL NOTCH

Figure 14. Integral Sideshift Carriage for Lift Truck Models S2.0-3.5FT (S40-70FT, S55FTS) (F187); H2.0-3.5FT (H40-70FT) (L177); J2.00-3.20XM (J40-65Z) (B416); and E2.00-3.20XM (E45-65Z) (G108)



NOTE: TWO- AND THREE-STAGE FFL IS SHOWN.

1. INNER CARRIAGE
2. OUTER FRAME
3. SIDESHIFT CYLINDER
4. UPPER BEARING
5. LOWER BEARING
6. LOWER HOOK
7. CAPSCREW
8. WASHER
9. CLEVIS PIN
10. HAIRPIN
11. PIN
12. LUBE FITTING
13. PIN
14. CHAIN ANCHOR
15. SNAP RING
16. PIN
17. COTTER PIN
18. LOAD ROLLER
19. SHIMS
20. SPACER
21. SNAP RING
22. SPACER
23. FORK REMOVAL NOTCH

Figure 15. Integral Sideshift Carriage for Lift Truck Models S30FT, S35FT, S40FTS (E010); E1.50-2.00XM (E25-35Z, E40ZS) (E114/F114); J1.60-2.00XMT (J30-40ZT) (J160); and H1.6FT, H1.8FT, H2.0FTS (H30FT, H35FT, H40FTS) (F001)

WARNING

Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

NOTE: Tag hydraulic lines prior to disconnecting to insure correct connection during installation.

NOTE: If lift truck is equipped with quick disconnect hoses, see section Disconnecting Attachment Hydraulic Quick Disconnect Hoses.

2. Disconnect the hydraulic lines at the sideshift cylinder. Put caps on the open hydraulic lines.

3. Remove the lower mounting hooks by removing the four capscrews securing the hooks.

4. Remove two hairpins, two pins, and sideshift cylinder from the carriage.

See Figure 14 for lift truck models

- S2.0-3.5FT (S40-70FT, S55FTS) (F187)
- H2.0-3.5FT (H40-70FT) (L177)
- J2.00-3.20XM (J40-65Z) (B416)
- E2.00-3.20XM (E45-65Z) (G108)

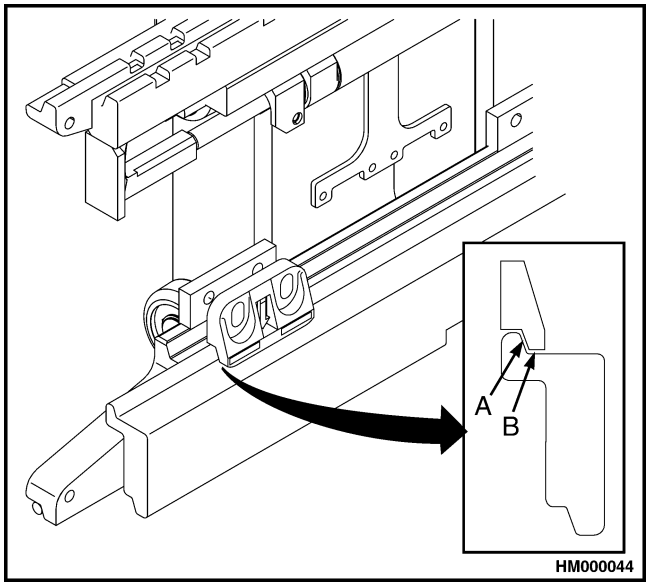
See Figure 15 for lift truck models

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

5. Use a crane with a capacity of at least 450 kg (992 lb) to lift the outer frame away from the inner carriage. Lay the outer frame flat on a pallet or workbench.

Clean and Inspect

1. Inspect the lower mounting hooks for wear. Replace the hooks if they are worn beyond the wear limit. The wear limit clearance range is 0.76 mm (0.03 in.) minimum and 1.52 mm (0.06 in.) maximum. See **A** in Figure 16.



A. WEAR LIMIT - 0.76 mm (0.03 in.) MINIMUM AND 1.52 mm (0.06 in.) MAXIMUM.
B. CLEARANCE ADJUSTMENT - 0.76 mm (0.03 in.) MINIMUM AND 1.52 mm (0.06 in.) MAXIMUM.

Figure 16. Lower Mounting Hooks Wear Limit and Clearance Adjustment

2. Clean and inspect the carriage bars for damage and smoothness. Ensure the bars are parallel and the ends are flush.

3. Clean the bearing areas. Inspect the sideshift bearings for wear as follows:

a. Remove the upper bearings from the upper apron. If either upper bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both upper bearings by driving the upper bearings from the upper apron.