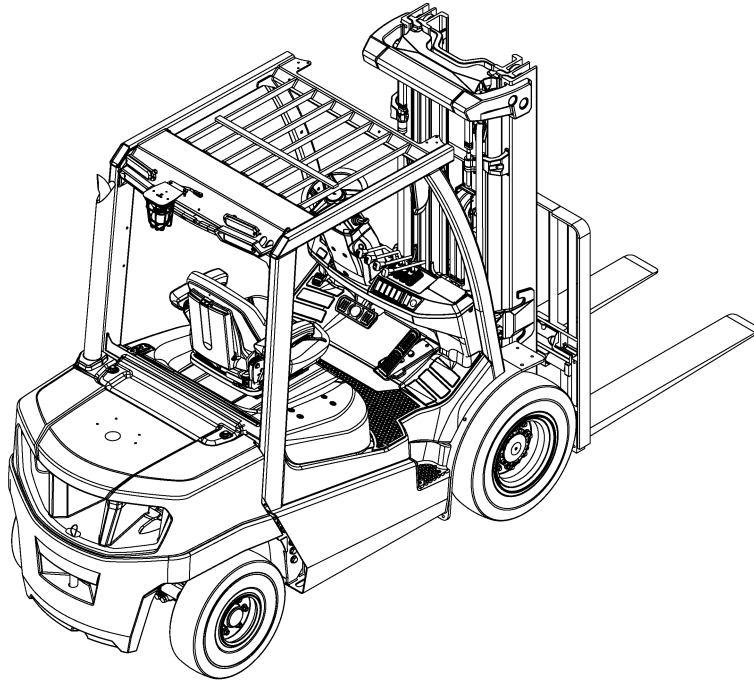


FRONT END

H2.0A, H2.5A6, H2.5A, H3.0A, H3.5A (H40A, H50A6,
H60A, H70A) [R177]



HYSTER

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; always use a lifting mechanism.
- Wear safety glasses.
- **DISCONNECT THE BATTERY** 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 of the service manual.
- 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.
- Strictly follow all **WARNING** and **CAUTION** notes in the operating manual, safety labels, service manual, and other instructions.
- Gasoline, Liquid Propane Gas (LPG), Compressed Natural Gas (CNG), Hydrogen Gas (H₂), and Diesel fuels are flammable and potentially explosive. Hydraulic, transmission, and other fluids and oils are also flammable. Be sure to follow the necessary safety precautions when handling these substances or working on systems containing these substances.
- Lead acid batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.
- Lithium-ion batteries should only be used in working environments where the temperature is within the recommended operating range (typically between 0 - 40°C (32 - 104°F)). Extreme temperatures, moisture, improper charging or damage to the battery can cause a fire or explosion.
- Whenever Diagnostic tools are needed for engine, only licensed or certified persons can use Diagnostic tools.

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, if present) are on orange background. The **CAUTION** symbol (and word, if present) are on yellow background.



WARNING

Installing improper electrical accessories or installing an electrical accessory incorrectly can increase the risk of equipment damage, personal injury and fire. **DO NOT** install electrical accessories to the truck unless you have been trained and authorized to do so. Personnel installing the electrical accessories must document the changes made to the truck. **DO NOT** install accessories which affect the truck's compliance with standard ANSI/ITSDF B56.1, UL 558, or UL 583, or which otherwise affect the safe operation of the truck.



WARNING

Installing improper electrical accessories or installing an electrical accessory incorrectly can increase the risk of equipment damage, personal injury and fire. **DO NOT** install electrical accessories to the truck unless you have been trained and authorized to do so. Personnel installing the electrical accessories must document the changes made to the truck. **DO NOT** install accessories which affect the truck's compliance with standard EN 1175:2025.



WARNING

California Proposition 65 - Operating, servicing and maintaining a powered industrial truck can expose you to chemicals including engine exhaust, carbon monoxide, phthalates, and lead, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

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**"THE
QUALITY
KEEPERS"**

**HYSTER
APPROVED
PARTS**

Introduction

GENERAL

202001-001

NOTE: For any fasteners in this manual that feature standard torque specifications, please refer to **Metric and Inch (SAE) Fasteners 8000SRM0231** for correct specifications.

DISCHARGING THE CAPACITORS



WARNING

DO NOT make repairs or adjustments unless you have been properly trained and authorized to do so. Improper repairs and adjustments can create dangerous operating conditions. **DO NOT** operate a lift truck that needs repairs. Report the need for repairs to your supervisor immediately. If repair is necessary, attach a **DO NOT OPERATE** tag on the steering wheel and disconnect the battery.

Disconnect the battery and discharge the capacitors before opening any compartment covers or inspecting or repairing the electrical system. **DO NOT** place tools on top of the battery. If a tool causes a short circuit, the high current flow from the battery can cause personal injury or property damage.

Some check and adjustments are performed with the battery connected. **DO NOT** connect the battery until the procedure instructs you to do so. Never wear any metallic items on your fingers, arms, or neck. Metal items can accidentally make an electrical connection and cause injury. Before performing any tests or adjustments, block the lift truck to prevent unexpected movement.

The capacitors in the transistor controller(s) can hold an electrical charge for about 10 minutes after the battery is disconnected. To prevent an electrical shock and personal injury, discharge the capacitor(s) before inspecting or repairing any component in the drive unit compartment. Make certain that the battery had been disconnected.

DO NOT short across the motor controller terminals with a screwdriver or jumper wire.

Make certain the Emergency-Stop Switch has not been activated. This will isolate the controller and prevent the capacitors from discharging properly. The proper way to disconnect the battery is by separating the battery connectors.

DISCHARGING THE CAPACITORS: For trucks with rapid-charge option, the horn cannot be used to discharge capacitors prior to service. Disconnect the battery, then wait five minutes before performing any service on the truck.

1. Ensure the capacitors are discharged by performing Step 2 through Step 6 below.
2. Turn the key or keyless switch to **OFF** position.
3. Disconnect the battery by separating the connector on the battery cable from the connector on the lift truck.
4. Block the drive wheels to prevent the lift truck from moving.
5. Make sure the Emergency-Stop Switch **HAS NOT** been activated. If the Emergency-Stop Switch is activated, rotate the switch to the right until it pops up.
6. Press the horn button on the steering column. Wait 30 seconds to be sure capacitors are fully discharged. If the horn does not sound when the switch is actuated, wait 10 minutes before proceeding with service.
For lift trucks equipped with rapid-charge option, the horn cannot be used to discharge capacitors prior to service. Disconnect the battery, then wait five minutes before performing any service on the truck.

SAFETY PROCEDURES WHEN WORKING NEAR MAST

202001-210



WARNING

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. See the Service Manual section for the specific mast being repaired.

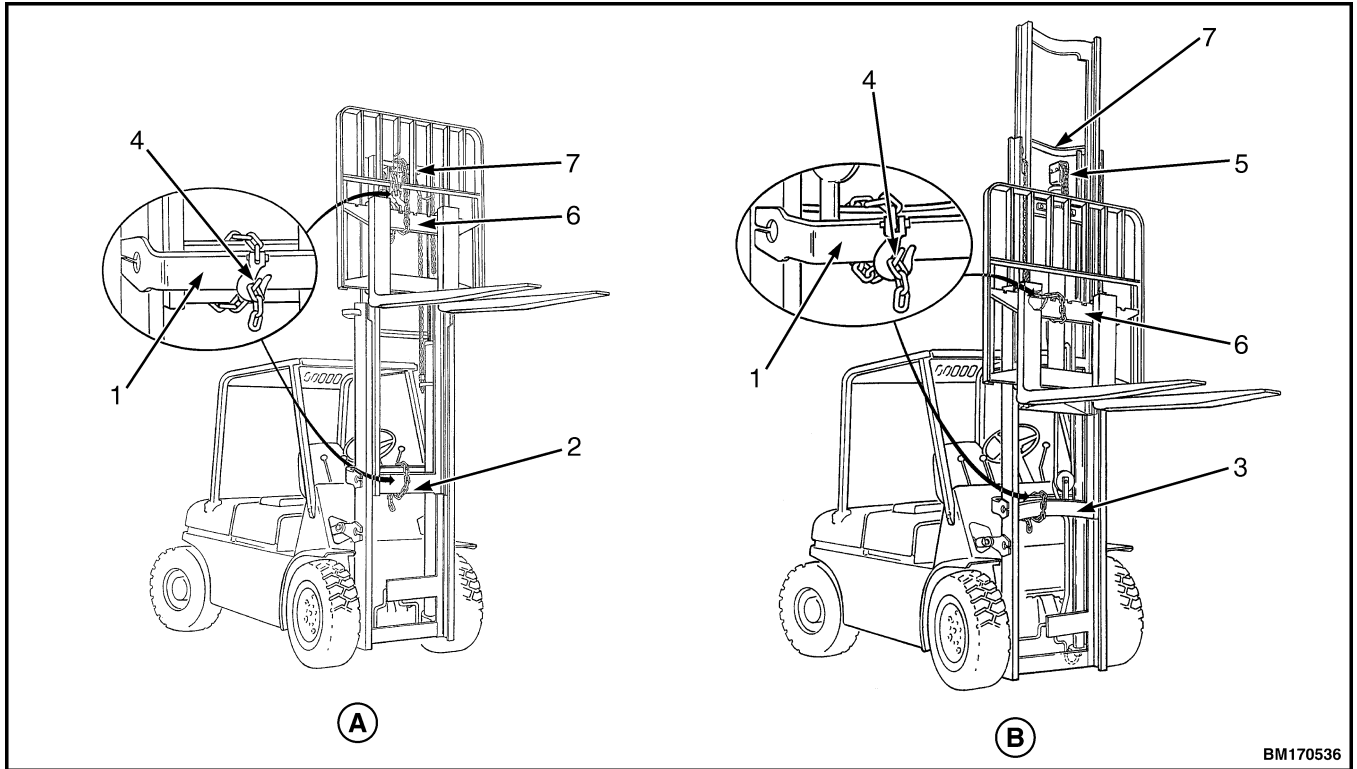
- Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is off and the key is removed. Put a **DO NOT OPERATE** tag in the operator's compartment. Disconnect the battery on electric lift trucks 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 or 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 the correct Service Manual for the mast.

WHEN WORKING NEAR THE MAST ALWAYS:

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

OR

- If parts of the mast must be in a raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:
 1. Put mast in vertical position.
 2. Raise mast to align bottom crossmember of weldment that moves within the outer weldment with a stationary crossmember on the outer weldment. On the two-stage and free-lift mast, the moving part is the inner weldment. On the three-stage mast, it is the intermediate weldment. 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 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 or chain sheaves, tubes, hoses, fittings, or other parts on the mast.
 4. Lower mast until there is tension in the safety chain and the free-lift cylinder (three-stage) is completely retracted. If running, stop the engine. Apply parking brake. Install a **DO NOT REMOVE** tag on the safety chain(s).
 5. Install another 3/8 inch minimum safety chain between the top or bottom crossmember of the carriage and a crossmember on the outer weldment. See Figure 1.
 6. After lowering or restraining the mast, shut off power and remove key. Put a **DO NOT OPERATE** tag in the operator's compartment.
 7. Disconnect battery on electric lift trucks and put a tag or lock on battery connector.



BM170536

A. TWO-STAGE LFL MAST

- 1. OUTER WELDMENT
- 2. INNER WELDMENT
- 3. INTERMEDIATE WELDMENT
- 4. HOOK

B. THREE-STAGE FFL MAST

- 5. FREE-LIFT CYLINDER
- 6. TOP CROSSMEMBER
- 7. TOP OF OUTER WELDMENT

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

Fork and carriage repair

FORK REMOVAL AND REPLACEMENT 202001-072

STANDARD CARRIAGE AND INTEGRAL SIDESHIFT CARRIAGE



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).

NOTE: Forks are to be replaced in sets by trained personnel only. **DO NOT** replace forks individually.



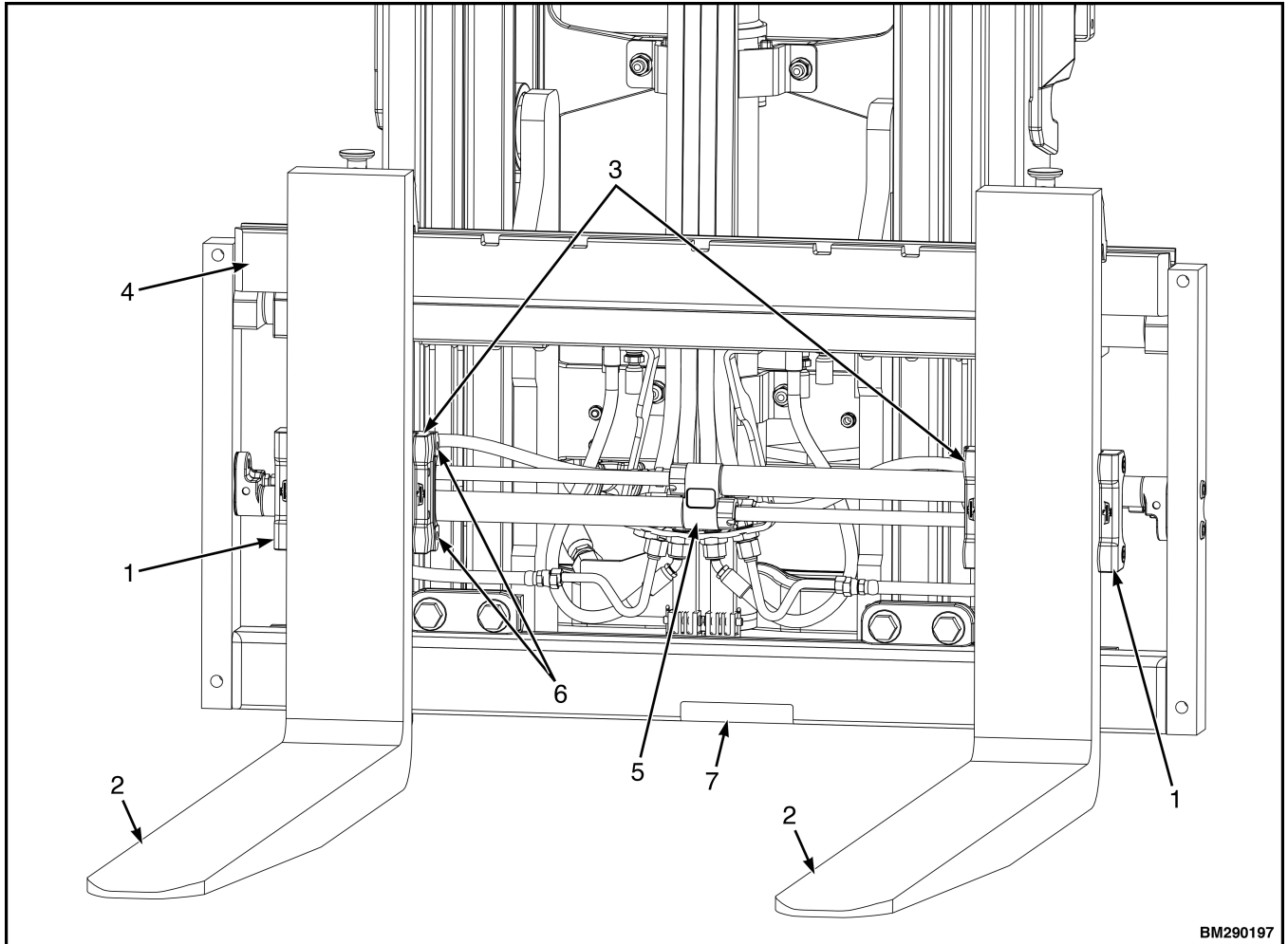
CAUTION

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: If lift truck is equipped with a fork positioner attachment, perform Step 1 and Step 2, before proceeding to Step 4. If lift truck is **NOT** equipped with a fork positioner attachment, perform Step 3 and Step 4.

Remove forks

1. For lift trucks featuring a fork positioner:
 - For lift trucks featuring a Cascade fork positioner option, lower the carriage and remove the two capscrews from the inner fork carrier. Remove inner fork carrier from the fork positioner. See Figure 2.
 - For lift trucks featuring a Bolzoni fork positioner option, lower the carriage and remove the two capscrews and fork lock from the fork carrier. See Figure 3.
2. Slide the fork carrier and fork to the fork removal notch on the carriage. See Figure 2 or Figure 3.

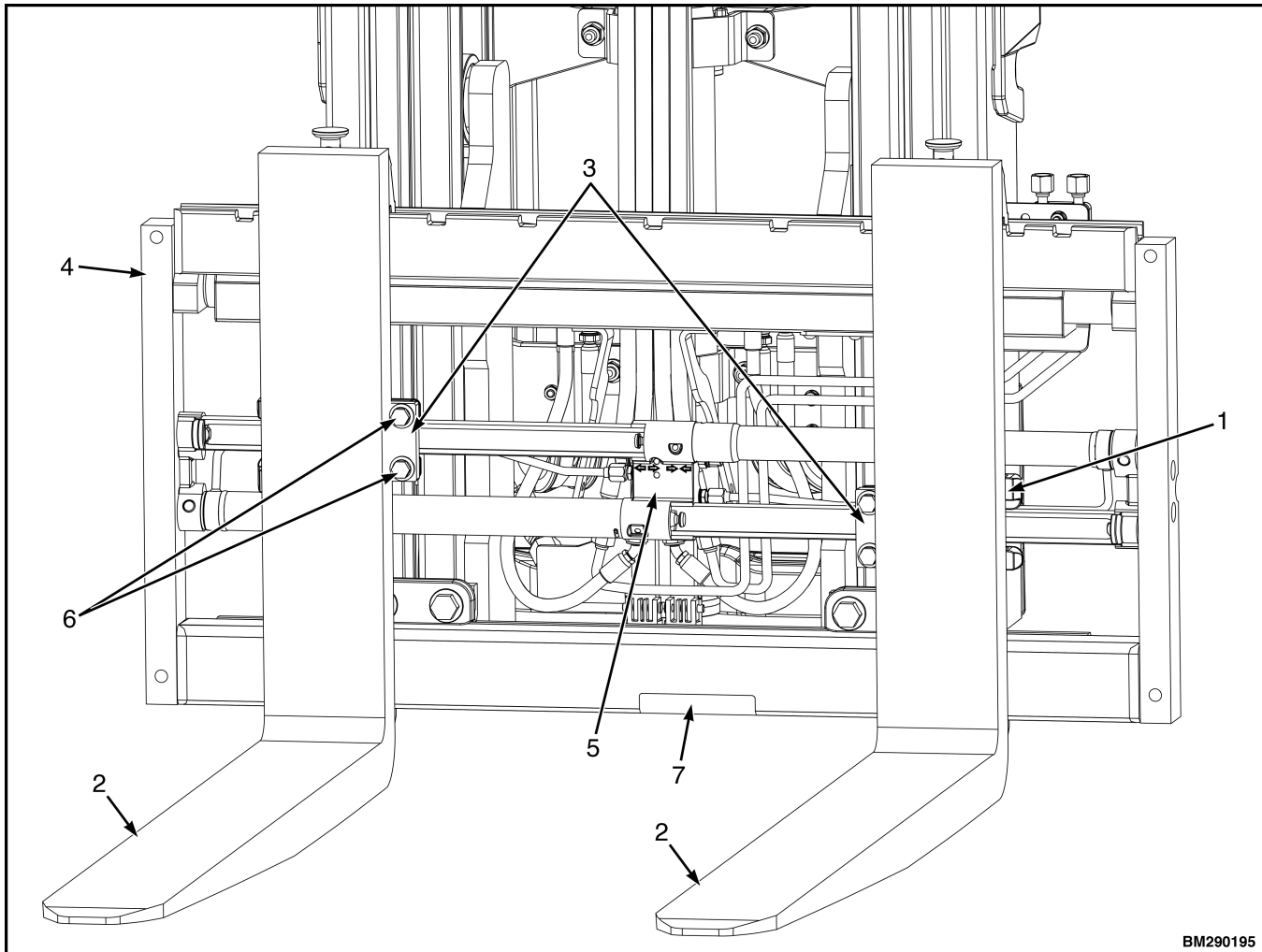


BM290197

- 1. OUTER FORK CARRIER
- 2. FORKS
- 3. INNER FORK CARRIER
- 4. CARRIAGE ASSEMBLY

- 5. FORK POSITIONER
- 6. CAPSCREWS
- 7. FORK REMOVAL NOTCH

Figure 2. Fork positioner (Cascade option)

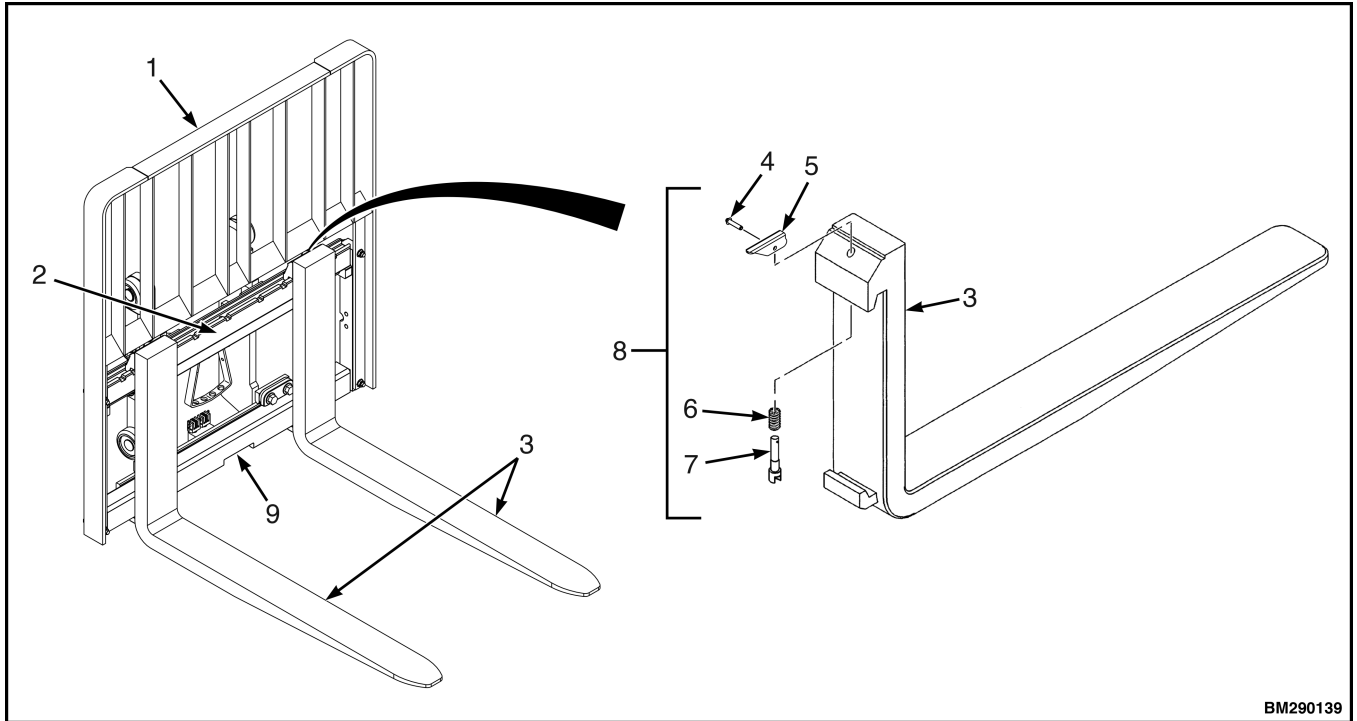


BM290195

- | | |
|----------------------|-----------------------|
| 1. FORK CARRIER | 5. FORK POSITIONER |
| 2. FORKS | 6. CAPSCREWS |
| 3. FORK LOCK | 7. FORK REMOVAL NOTCH |
| 4. CARRIAGE ASSEMBLY | |

Figure 3. Fork positioner (Bolzoni option)

- | | |
|---|--|
| 3. Slide the fork to the center of the carriage, aligned with the fork removal notch on the bottom bar of the carriage. See Figure 4. | 6. Move the carriage away from the fork or use a lifting device to move the fork away from the carriage. |
| 4. Lower the fork onto blocks (see Figure 5), so the bottom hook of the fork moves through the fork removal notch. | 7. Repeat all steps to remove the other fork. |
| 5. Lower the carriage further so the top hook of the fork is disengaged from the top carriage bar. | |

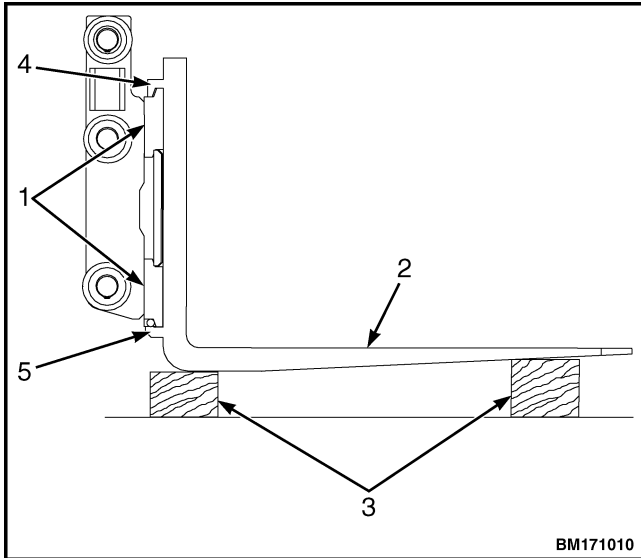


BM290139

- 1. LOAD BACKREST
- 2. CARRIAGE
- 3. FORKS
- 4. PIN
- 5. LATCH

- 6. SPRING
- 7. PIN
- 8. PIN ASSEMBLY
- 9. FORK REMOVAL NOTCH

Figure 4. Carriage and Forks



1. CARRIAGE BARS
2. HOOK FORK
3. BLOCKS
4. TOP HOOK
5. BOTTOM HOOK

Figure 5. Hook Fork, Remove

Install



WARNING

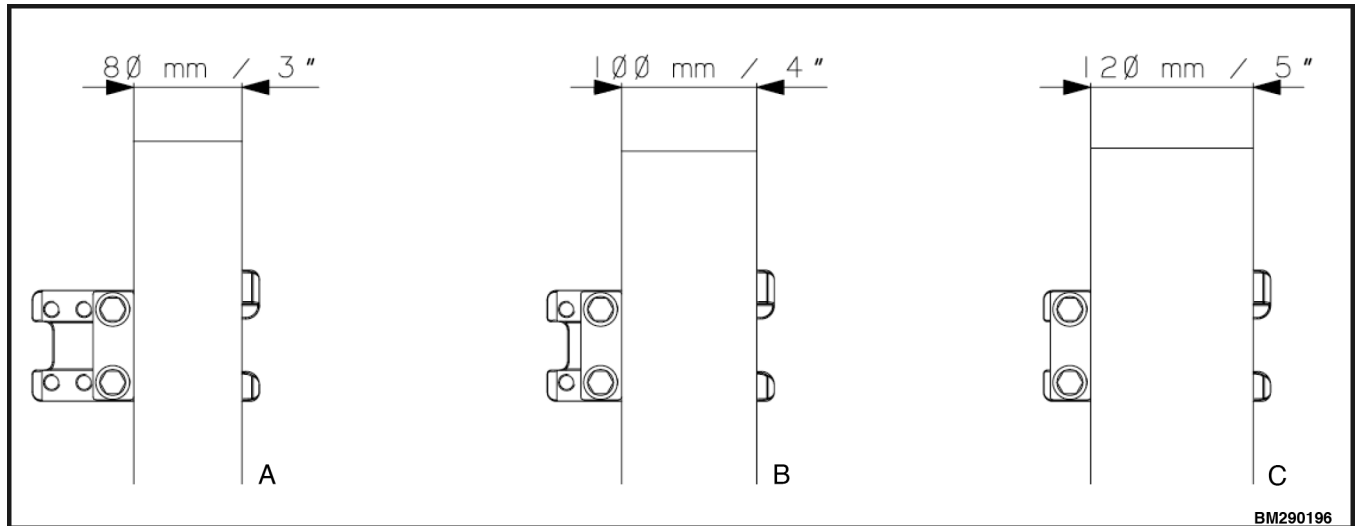
DO NOT try to install a fork without a lifting device. Each hook fork for these lift trucks can weigh 50 to 110 kg (110 to 243 lb).

NOTE: Forks are to be replaced in sets by trained personnel only. **DO NOT** replace forks individually.

1. Move the fork and carriage so the top hook of the fork can engage the upper carriage bar.
2. Raise the carriage to move the bottom hook of the fork through the fork removal notch.
3. Slide the fork on the carriage so both the upper and lower hooks engage the carriage bars. See Figure 5.
4. For lift trucks featuring a Cascade fork positioner option:
 - Position the fork in the outer fork carrier (item 1, Figure 2).
 - Install inner fork carrier (item 3, Figure 2) using two capscrews (item 6).
 - Tighten the capscrews to 35 N•m (25 lbf ft).

For lift trucks featuring a Bolzoni fork positioner option:

 - Confirm you are using the correct fork width for the fork positioner carrier. See Figure 6.
 - Position the fork in the fork carrier (item 1, Figure 3).
 - Apply Loctite 243 threadlock to the screws (item 6, Figure 3) that attach the fork lock (item 3).
 - Insert the screws to secure the fork lock.
 - Tighten the capscrews to 84 N•m (62 lbf ft).
5. Install latch pin in the top hook and notch in the upper carriage bar. See Figure 4.
6. Repeat all steps to install the other fork.



- A. POSITION OF THE FORK STOP FOR 3" WIDE FORKS
 B. POSITION OF THE FORK STOP FOR 4" WIDE FORKS
 C. POSITION OF THE FORK STOP FOR 5" WIDE FORKS

Figure 6. Mountable fork widths

Checks



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. Check alignment of fork tips. The difference in height of fork tips must be less than three percent of the length of the forks. See Table 1 and Figure 7.
 Some applications may require closer alignment. If forks do not meet specification, they both must be replaced.
2. Check for smooth and proper operation of fork lock pins or components and lubricate, as necessary.
3. Check that the pins for the forks keep the forks in position on the carriage (see Figure 4). If the pin does not remain engaged in the carriage slot, replace with a new pin. If the pin is damaged, replace pin parts.
4. Inspect fork wear. Ensure heel wear is not more than 10% of original thickness. If fork wear is more than 10% fork must be replaced or

rerated. Perform fork wear inspection using a BOL256N1 caliper ruler Hyster P/N 4092984 as follows. See Figure 8.

- a. Determine the normal thickness of the "N" of the fork using the scale or ruler portion of the caliper ruler. Measurement has to be done on the fork shank using the caliper ruler.
- b. Position the caliper at the end of the heel internal radius (item A, Figure 7) with the opening corresponding to the measure thickness of the fork shank in Step a above (e.g. N 1.75 use N 1.75 opening). This is typically the section of the fork where wear is the greatest. Note that the opening distance has been reduced by 10% from the nominal thickness.



WARNING

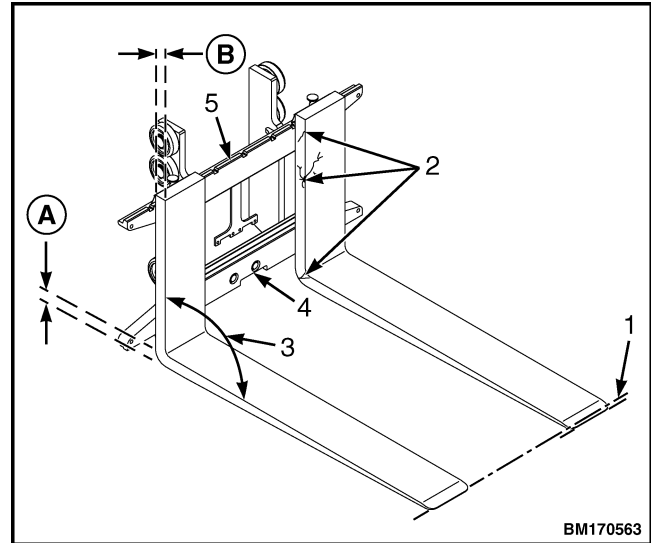
To reduce the risk of fork breakage or personal injury, replace both forks before resuming operation.

- c. If the fork enters the opening, it is mandatory to replace it. Furthermore, a 10% reduction in fork blade thickness results in 20% reduction in operating capacity.

Table 1. Fork Tip Alignment

Fork Tip Alignment Specifications			
Standard Fork Lengths		Maximum Fork Tip Difference*	
mm	(in.)	mm	(in.)
914	(36)	27	(1.08)
1000	(39)	30	(1.17)
1016	(40)	30	(1.2)
1067	(42)	32	(1.26)
1100	(43)	33	(1.29)
1200	(47)	36	(1.41)
1207	(47.5)	36	(1.42)
1219	(48)	37	(1.44)
1372	(54)	41	(1.62)
1524	(60)	46	(1.80)
1829	(72)	55	(2.16)

*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 7. Fork Checks

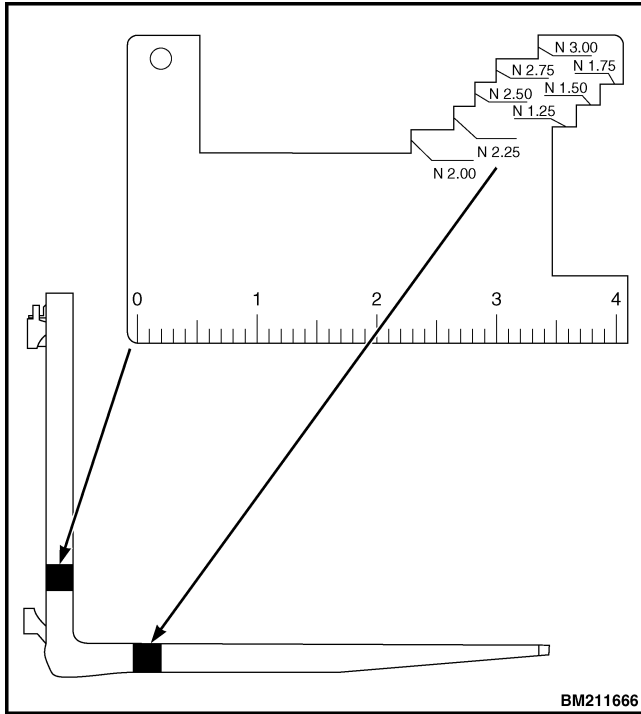


Figure 8. Fork Wear Check

**CARRIAGE REPAIR, 2-STAGE LIMITED
FREE LIFT
202001-222**

STANDARD CARRIAGE

Remove

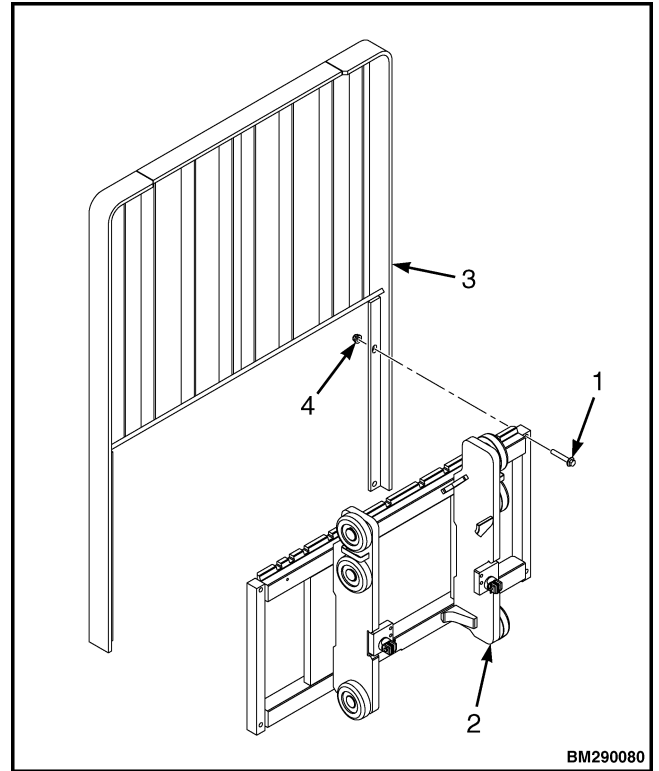
1. Lower the carriage completely. Remove the forks. See the Fork removal and replacement section of this manual for procedure.



WARNING

The load backrest is heavy and must be removed with a lifting device.

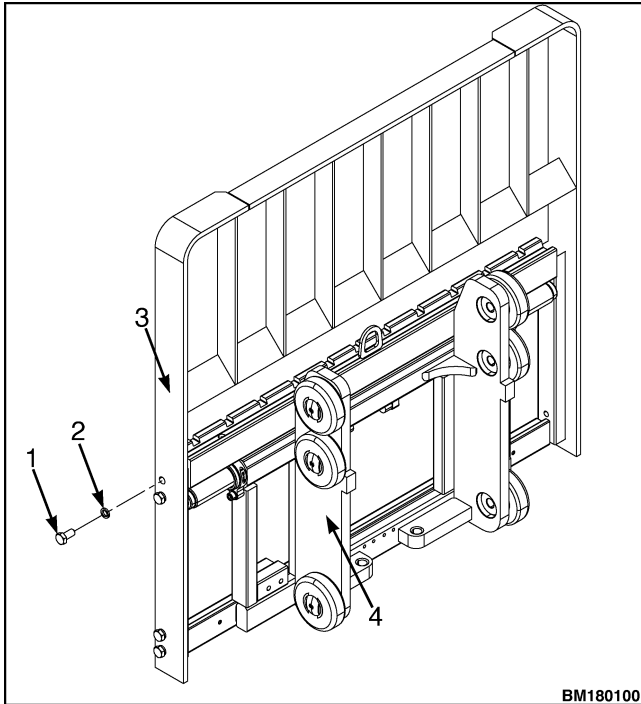
2. For front mounted load backrests, remove four capscrews, nuts, and load backrest from the carriage. See Figure 9.



1. CAPSCREW
2. CARRIAGE
3. LOAD BACKREST
4. NUT

Figure 9. Remove load backrest (front mounted)

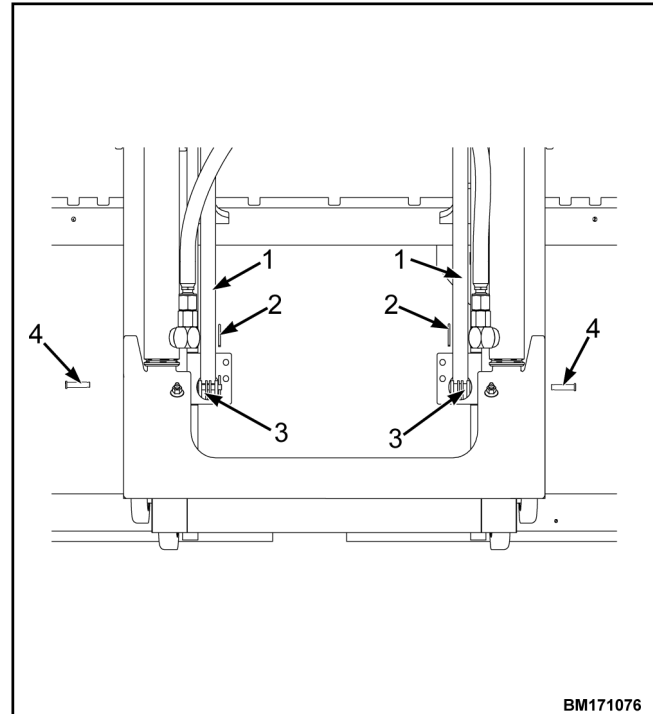
3. For side mounted load backrests, remove eight capscrews, washers, and load backrest from carriage. See Figure 10.



1. CAPSCREW
2. WASHER
3. LOAD BACKREST
4. CARRIAGE

Figure 10. Remove load backrest (side mounted)

4. Connect a lifting device to the carriage. Lift the carriage so that lift chains become loose.
5. Remove the chain anchor pin from each chain anchor at the carriage. See Figure 11.



1. MAIN LIFT CHAIN
2. COTTER PIN
3. CHAIN ANCHOR
4. CHAIN ANCHOR PIN

Figure 11. Lower chain anchors

6. Disconnect the lift chains from the carriage. Use wire to attach the ends of the lift chains to the mast. Make sure the chains can move freely when the inner mast is raised.
7. Use the lift cylinders to raise the inner mast. If hydraulic system cannot be used, disconnect lift cylinders from inner mast. See the section Cylinder repair in **Hydraulics** service manual for your lift truck for procedures.
8. Connect a crane with a capacity of at least 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.
9. Move the lift truck away from the carriage. Completely lower inner mast so it cannot move.

Clean and Inspect



CAUTION

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

1. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.



WARNING

Compressed air can move particles and make them become airborne, which may cause injury. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.



WARNING

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



CAUTION

DO NOT use cleaning solvent, compressed air, or steam to clean lift chain sheaves or load rollers. The bearings in the lift chain sheaves and load rollers are sealed and lubricated. Cleaning solvent, compressed air, and steam can damage the load roller bearings.

2. Clean any oil, grease, dirt, and other debris from the carriage frame. Use a cleaning solvent and compressed air to dry.



CAUTION

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.

3. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
4. Clean and inspect all chain anchors and chain anchor pins. Check chain anchors and chain anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard used cotter pins. See

Install

1. Move the lift truck toward the carriage until the inner mast is aligned with the carriage rollers.
2. 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.
3. Disconnect the crane, if attached, and reconnect lift cylinders. See **Cylinder repair in Hydraulics** service manual for your lift truck for procedures.
4. Check the clearance of the load rollers. See **Carriage Adjustments** section for procedures.
5. Connect the lift chains to chain anchors at the carriage. Install cotter pins in the chain anchor pins. Adjust the lift chains as described in **Lift Chains Adjustment**.
6. Install the load backrest to the sideshift carriage.
 - a. For front mounted load backrests, install capscrews and nuts to secure load backrest to carriage. Torque nuts to 53 N•m (39.1 lbf ft). See Figure 9.
 - b. For side mounted load backrests, install capscrews and washers to secure load backrest to carriage. Torque capscrews to 155 N•m (114.3 lbf ft). See Figure 10.
7. Install forks. See the **Fork removal and replacement** section for procedures.

INTEGRAL SIDESHIFT CARRIAGE

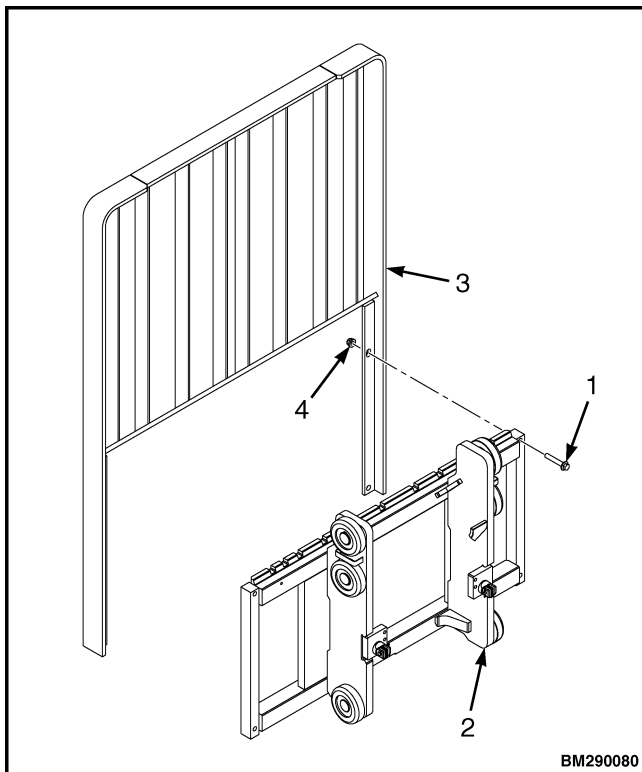
Remove

1. Lower the carriage completely. Remove the forks. See the Fork removal and replacement section of this manual for procedure.

WARNING

The load backrest is heavy and must be removed with a lifting device.

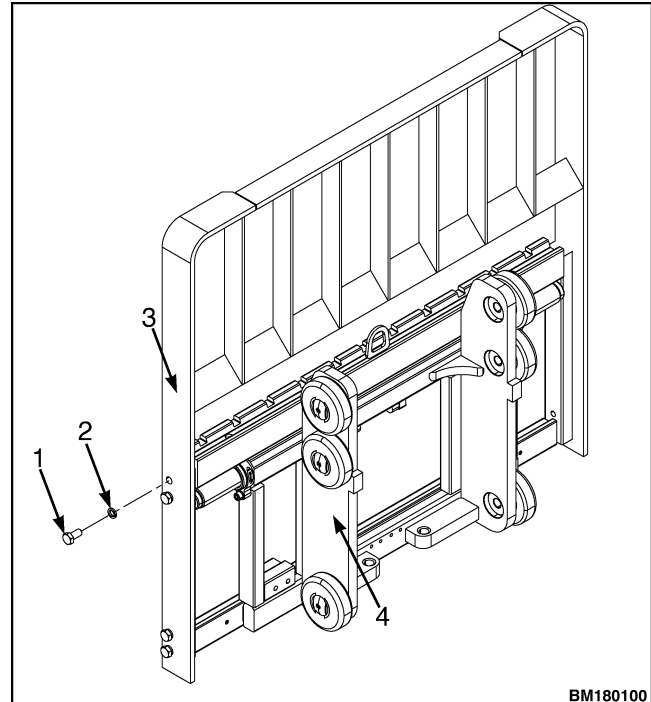
2. For front mounted load backrests, remove four capscrews, nuts, and load backrest from the carriage. See Figure 12.



1. CAPSCREW
2. CARRIAGE
3. LOAD BACKREST
4. NUT

Figure 12. Remove load backrest (front mounted)

3. For side mounted load backrests, remove eight capscrews, washers, and load backrest from carriage. See Figure 13.



1. CAPSCREW
2. WASHER
3. LOAD BACKREST
4. CARRIAGE

Figure 13. Remove load backrest (side mounted)

WARNING

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from hydraulic system prior to disconnecting hydraulic hoses.

4. Confirm the lift truck is turned off, and relieve hydraulic pressure to the sideshift cylinder by moving sideshift lever in both directions several times.

WARNING

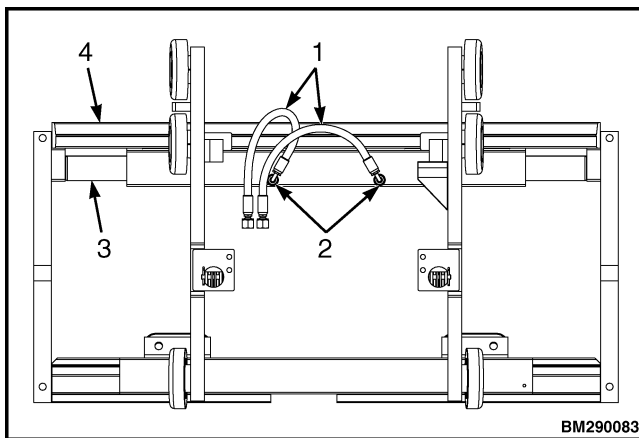
Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible. The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

**WARNING**

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

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

5. Disconnect the hydraulic hoses from the sideshift cylinder. Put caps and plugs on the open lines and cylinder ports. See Figure 14.

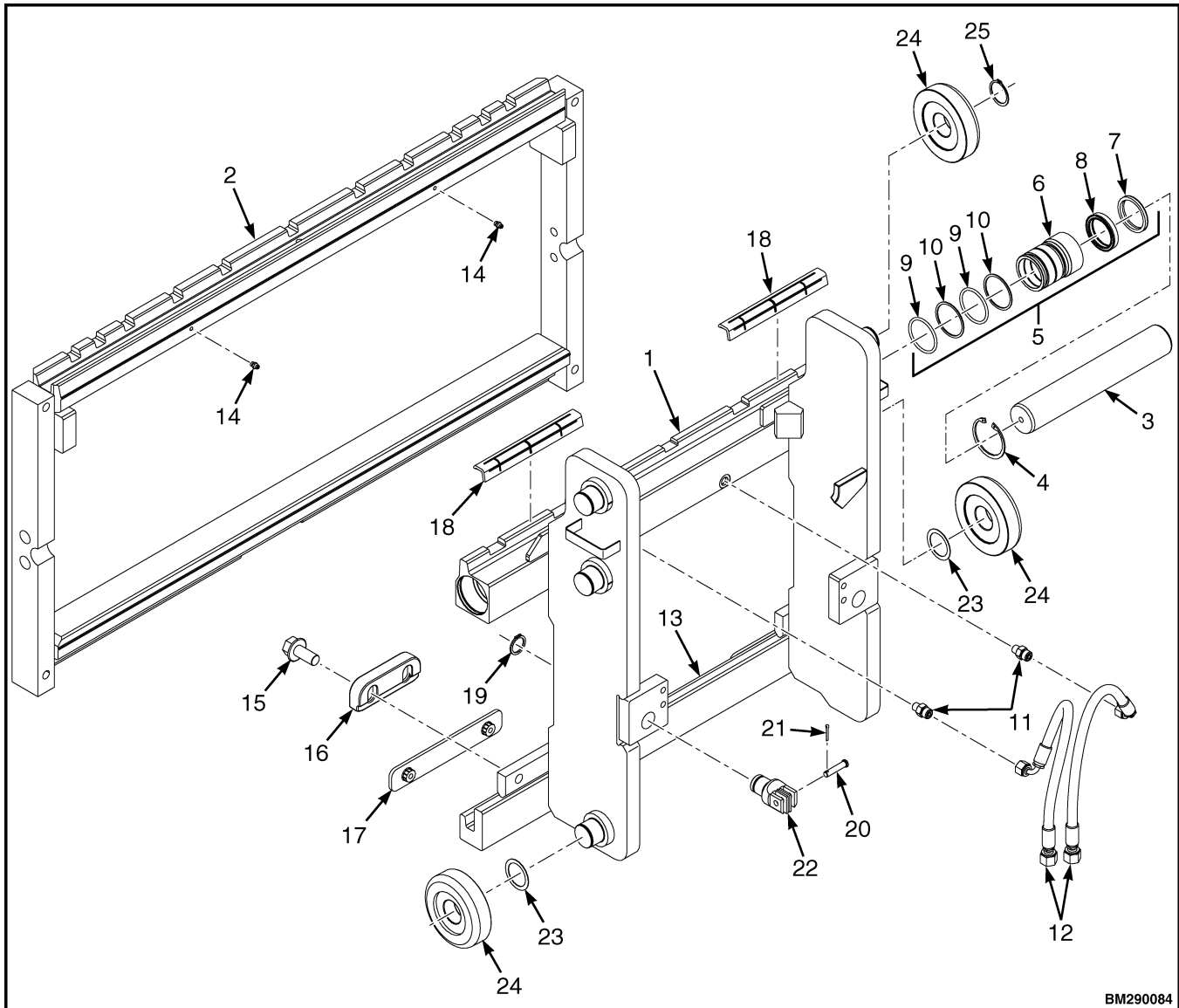


NOTE: CLASS II INTEGRAL SIDESHIFT CARRIAGE SHOWN. CLASS III INTEGRAL SIDESHIFT CARRIAGE IS SIMILAR.

1. HYDRAULIC HOSES
2. HOSE FITTINGS
3. INTEGRAL SIDESHIFT CYLINDER
4. INTEGRAL SIDESHIFT CARRIAGE ASSEMBLY

Figure 14. Integral Sideshift Carriage Hydraulic Hoses

6. Remove the lower mounting hooks by removing the four capscrews and washers securing the hooks. See Figure 15.
7. Use a crane with a capacity of at least 63 kg (139 lb) to lift the outer frame away from the inner frame. Lay the outer frame flat on a pallet or work bench. See Figure 16.



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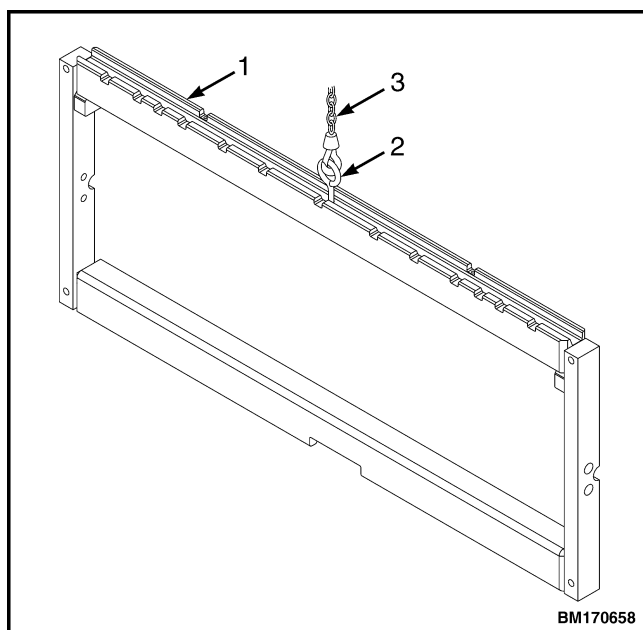
- | | |
|-----------------------|---------------------|
| 1. CARRIAGE | 14. GREASE FITTING |
| 2. OUTER FRAME | 15. CAPSCREW |
| 3. CYLINDER ROD | 16. HOOK (LOWER) |
| 4. SNAP RING | 17. BEARING (LOWER) |
| 5. GLAND | 18. BEARING (UPPER) |
| 6. GLAND ASSEMBLY | 19. SNAP RING |
| 7. ROD WIPER | 20. PIN |
| 8. SEAL | 21. COTTER PIN |
| 9. O RING | 22. CHAIN ANCHOR |
| 10. BACKUP RING | 23. SHIM |
| 11. FITTING, STRAIGHT | 24. LOAD ROLLER |
| 12. HOSE ASSEMBLY | 25. SNAP RING |
| 13. BEARING STRIP | |

Figure 15. Integral Sideshift Component Parts

8. Remove the integral sideshift cylinder from the carriage. See **Hydraulics** service manual for procedures.

Disassemble

1. Remove the upper bearings by driving the bearings from the inner frame. See Figure 17.
2. Remove the lower bearings by prying the lower bearings from the inner frame. See Figure 17.
3. If damaged, remove the lube fittings from outer frame. See Figure 15.
4. Disassemble the integral sideshift cylinder. See **Hydraulics** service manual for procedures.



NOTE: THE OUTER FRAME SHOWN MAY BE DIFFERENT FROM WHAT IS ON YOUR LIFT TRUCK. HOWEVER, THE PROCESS FOR REMOVING THE OUTER FRAME FROM THE INNER FRAME IS THE SAME.

1. OUTER FRAME
2. LIFTING HOOK
3. LIFTING DEVICE

Figure 16. Remove Outer Frame

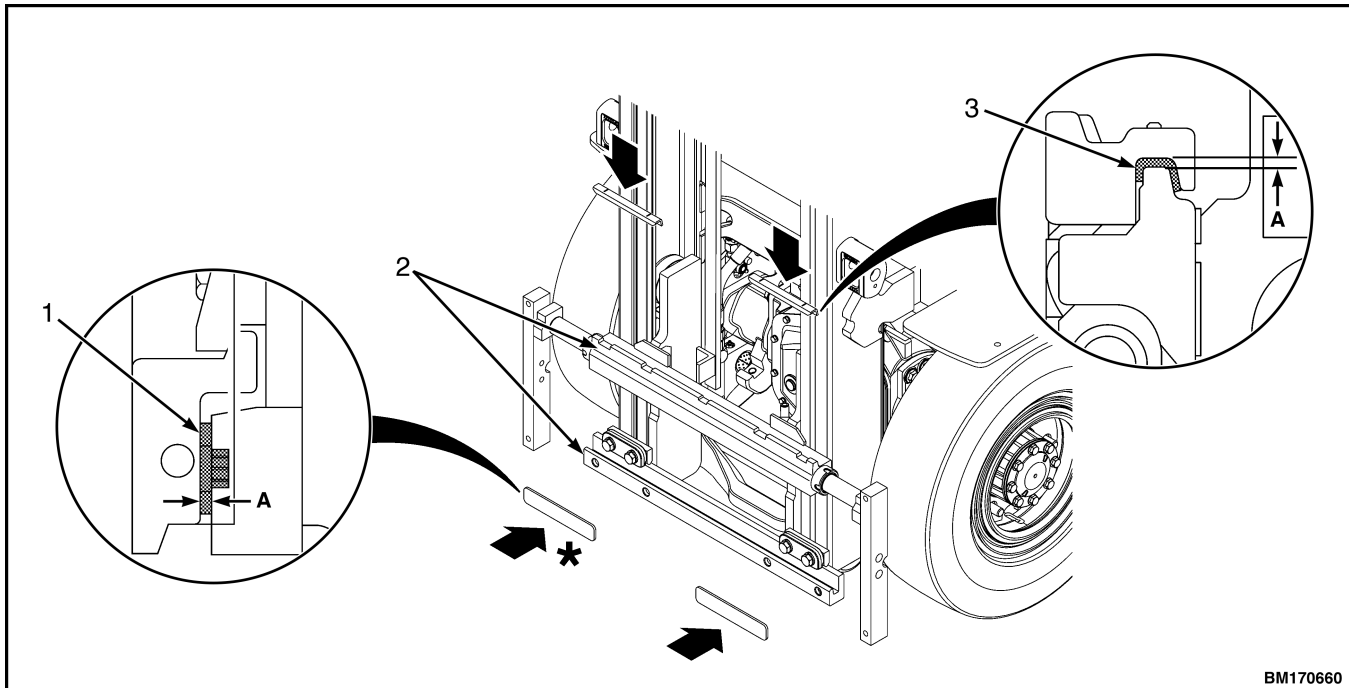
Clean and Inspect



CAUTION

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.

1. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
2. Clean bearing areas. Inspect sideshift bearings for wear as follows:
 - a. If either upper bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both upper bearings (see Step 1 above). See Assemble section to install new upper bearings.
 - b. If either lower bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace lower bearings by prying the lower bearings from the inner frame (see Step 2 above). See Assemble section to install new lower bearings.
3. Inspect the sideshift cylinder. See **Hydraulics** service manual for procedures.
4. Inspect all load rollers for wear or damage (see Figure 15). If load rollers must be replaced, make a note of the location and number of shims. Install shims, load rollers and snap rings.
5. Clean and inspect all chain anchors and chain anchor pins. Check chain anchors and chain anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard used cotter pins. See Figure 15.



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A. MINIMUM THICKNESS 2.5 mm (0.1 in.)

1. LOWER BEARINGS
2. CARRIAGE BARS

3. UPPER BEARINGS

*Bold Arrows Indicate Which Side To Apply Grease.

Figure 17. Upper and Lower Bearings

Assemble

1. Assemble the integral sideshift cylinder. See **Hydraulics** service manual for procedures.
2. If lube fittings were removed, install new lube fittings into the outer frame. See Figure 15.

NOTE: Use a wood block or a plastic hammer to fully seat upper bearings onto the inner frame. Proper lower hook clearance requires the upper bearings be fully seated.

3. Apply a 1 mm (0.040 in.) layer of multipurpose grease to upper and lower bearing surfaces. Install upper and lower bearings onto the inner frame.
 - a. To install new upper bearings, align the pins on the bottom side of bearing to notches on the top carriage bar and slide into place on the top carriage. See Figure 17.

- b. To install new lower bearings, align the two lower bearing pins on the backside of the lower bearing to the holes on the lower carriage bar and tap bearing into place on the lower carriage bar using a rubber or brass hammer. See Figure 17.

Install

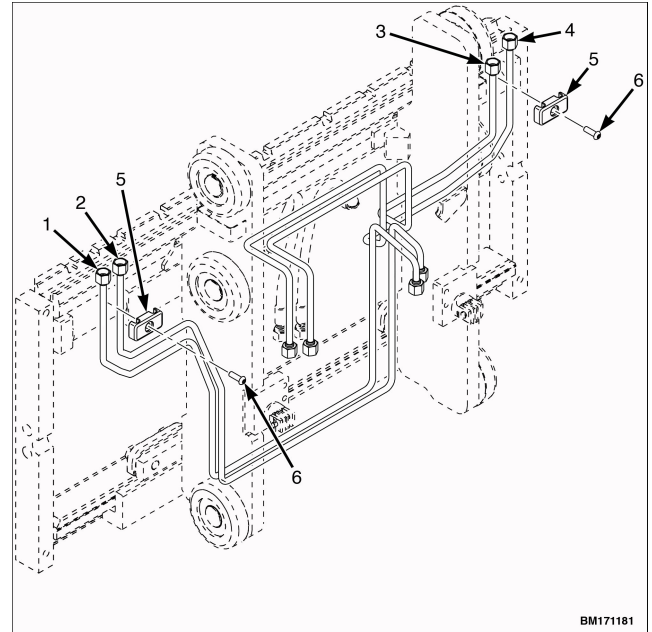
1. Install the integral sideshift cylinder onto the carriage. See **Hydraulics** service manual for procedures.
2. Use a crane with a capacity of at least and install the outer frame onto the inner frame. See Figure 16.
3. Install the lower mounting hooks using four capscrews. Tighten to 150 to 180 N•m (111 to 133 lbf ft).
4. Connect hydraulic hoses, as tagged during removal, to the sideshift cylinder. See Figure 14.

5. Install the load backrest to the sideshift carriage.
 - a. For front mounted load backrests, install capscrews and nuts to secure load backrest to carriage. Torque nuts to 53 N•m (39.1 lbf ft). See Figure 12.
 - b. For side mounted load backrests, install capscrews and washers to secure load backrest to carriage. Torque capscrews to 155 N•m (114.3 lbf ft). See Figure 13.
6. Install forks. See the Fork removal and replacement section for procedures.

AUXILIARY EXTENSION TUBES (STANDARD CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 18.
2. Loosen the capscrew retaining the clamp and RH tubes to the carriage. See Figure 18.
3. Repeat for the LH tubes. See Figure 18.



1. LH TUBE
2. LH TUBE
3. RH TUBE
4. RH TUBE
5. TUBE CLAMP
6. CAPSCREW

Figure 18. Auxiliary extension tubes (LFL)

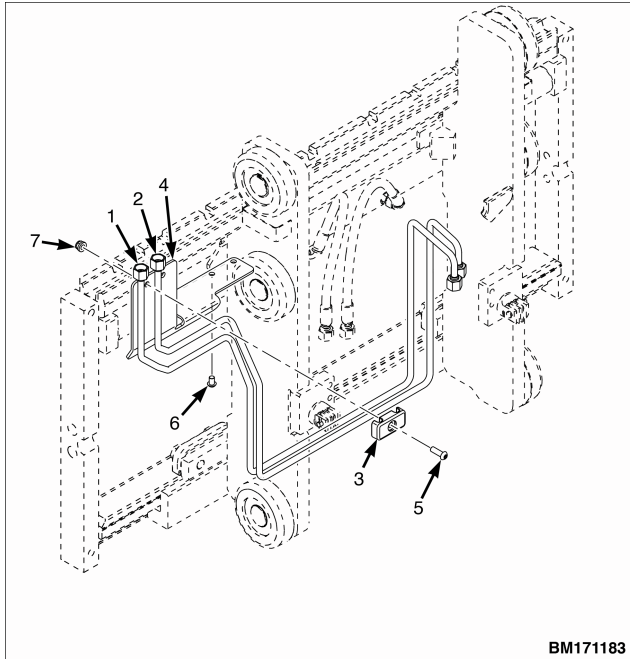
Install

1. Align the RH tubes and tube clamp with the holes on the carriage. See Figure 18.
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 18.
3. Repeat Step 1 and Step 2 for the LH tubes. See Figure 18.

AUXILIARY EXTENSION TUBES (ISS CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 19.
2. Loosen the capscrew retaining the tube clamp and tubes to the carriage. See Figure 19.



1. TUBE
2. TUBE
3. TUBE CLAMP
4. BRACKET
5. CAPSCREW
6. SCREW
7. NUT

Figure 19. Auxiliary extension tubes (ISS LFL)

Install

1. Align the tubes and tube clamp with the holes on the carriage. See Figure 19.
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 19.

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STANDARD CARRIAGE

Remove

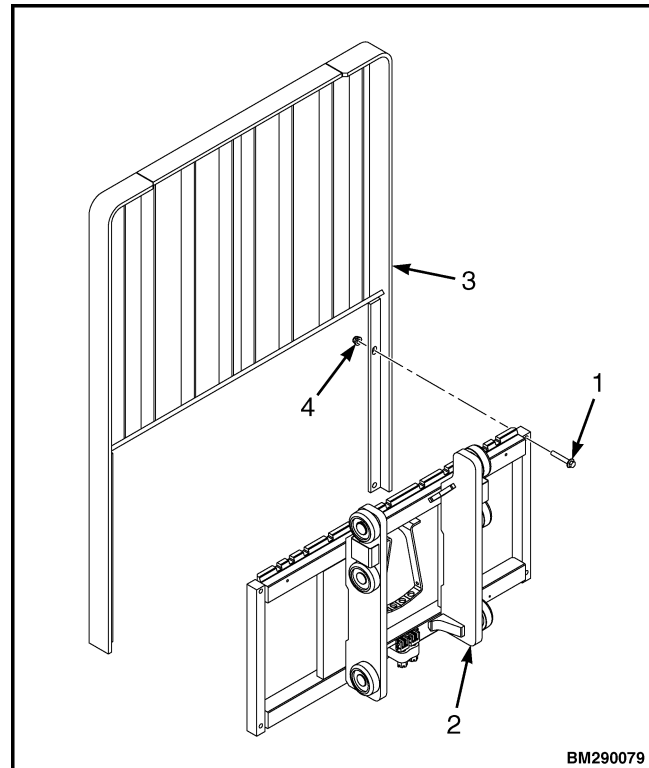
1. Lower the carriage completely. Remove the forks. See the Fork removal and replacement section of this manual for procedure.



WARNING

The load backrest is heavy and must be removed with a lifting device.

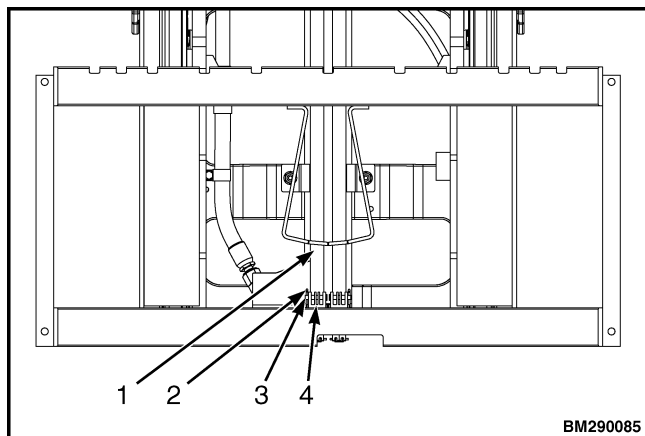
2. Remove the four capscrews and nuts, and the load backrest from the carriage. See Figure 20.



1. CAPSCREW
2. CARRIAGE
3. LOAD BACKREST
4. NUT

Figure 20. Remove load backrest

3. Connect a lifting device to the carriage. Lift the carriage so that lift chains become loose.
4. Remove the cotter pin that retains each lifting chain to the chain anchor at the carriage. See Figure 21.



1. MAIN LIFT CHAIN
2. COTTER PIN
3. CHAIN ANCHOR PIN
4. CHAIN ANCHOR

Figure 21. Lower chain anchors

5. Disconnect the lift chains from the carriage. Use wire to attach the ends of the lift chains to the mast. Make sure the chains can move freely when the inner mast is raised.
6. Use the lift cylinders to raise the inner mast. If hydraulic system cannot be used, disconnect lift cylinders from inner mast. See the **Hydraulics** service manual for procedures.
7. Connect a crane with a capacity of at least 244 kg (538 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 mast in its extended position and disconnect the crane. See Safety Procedures When Working Near Mast.
8. Move the lift truck away from the carriage. Completely lower inner mast so it cannot move.
9. If the load rollers must be replaced, make a note of the location and number of shims for to aid in installation.

Clean and Inspect

1. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.

WARNING

Compressed air can move particles and make them become airborne, which may cause injury. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.

WARNING

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

CAUTION

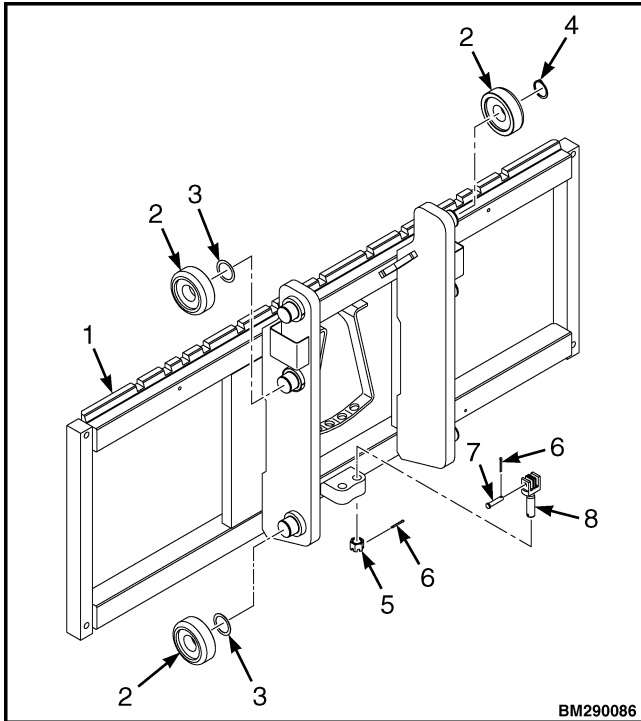
DO NOT use cleaning solvent, compressed air, or steam to clean lift chain sheaves or load rollers. The bearings in the lift chain sheaves and load rollers are sealed and lubricated. Cleaning solvent, compressed air, and steam can damage the load roller bearings.

2. Clean any oil, grease, dirt, and other debris from the carriage frame. Use a cleaning solvent and compressed air to dry.

CAUTION

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.

3. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
4. Clean and inspect all chain anchors and chain anchor pins. Check chain anchors and chain anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard used cotter pins. See Figure 22.



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

Figure 22. Standard carriage components

Install

1. Move the lift truck toward the carriage until the inner mast is aligned with the carriage rollers.
2. If the inner mast has been raised and secured using a crane and safety chains, connect the crane, raise inner mast, and remove safety chains. Carefully lower the inner mast until it engages all of the load rollers.
3. Disconnect the crane, if attached, and reconnect lift cylinders. See **Hydraulics** service manual for procedure.
4. If the load rollers were replaced, make a note of the location and number of shims. Install shims, load rollers, and snap rings.

5. Check the clearance of the load rollers. See Carriage Adjustments section for procedures.
6. Connect lift chains to chain anchors at the carriage. Install cotter pins in chain pins. Adjust lift chains as described in Lift Chains Adjustment.
7. Install the load backrest to the sideshift carriage. Insert hardware and tighten nuts to 53 N·m (39.1 lbf ft). See Figure 20.
8. Install forks. See the Fork removal and replacement section for procedures.

INTEGRAL SIDESHIFT CARRIAGE

Remove

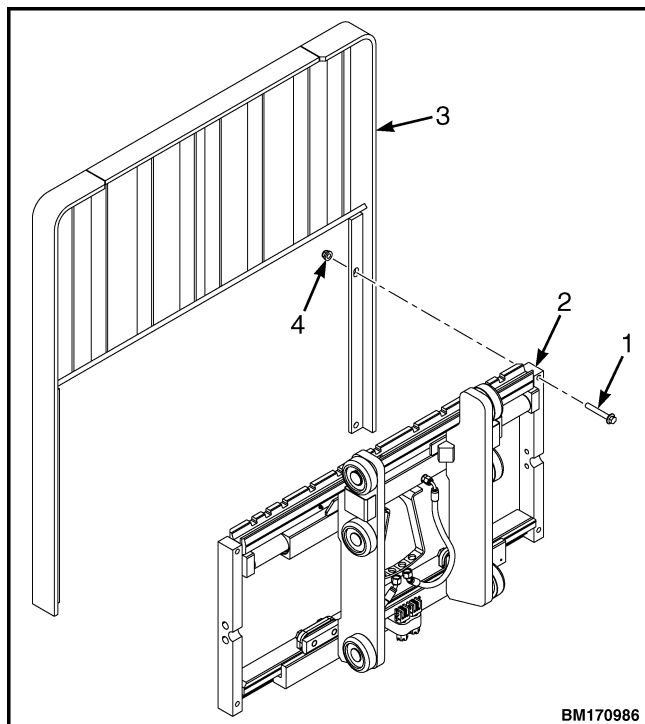
1. Lower the carriage completely. Remove the forks. See the Fork removal and replacement section of this manual for procedure.



WARNING

The load backrest is heavy and must be removed with a lifting device.

2. Remove the four capscrews and nuts, and the load backrest from the carriage. See Figure 23.



1. CAPSCREW
2. CARRIAGE
3. LOAD BACKREST
4. NUT

Figure 23. Remove load backrest



WARNING

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from hydraulic system prior to disconnecting hydraulic hoses.

3. Confirm the lift truck is turned off, and relieve hydraulic pressure to the sideshift cylinder by moving sideshift lever in both directions several times.



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.

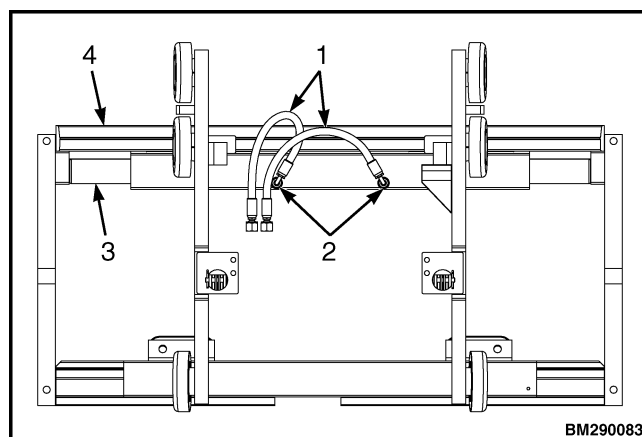


WARNING

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

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

4. Disconnect the hydraulic hoses from the sideshift cylinder. Put caps and plugs on the open lines and cylinder ports. See Figure 24.

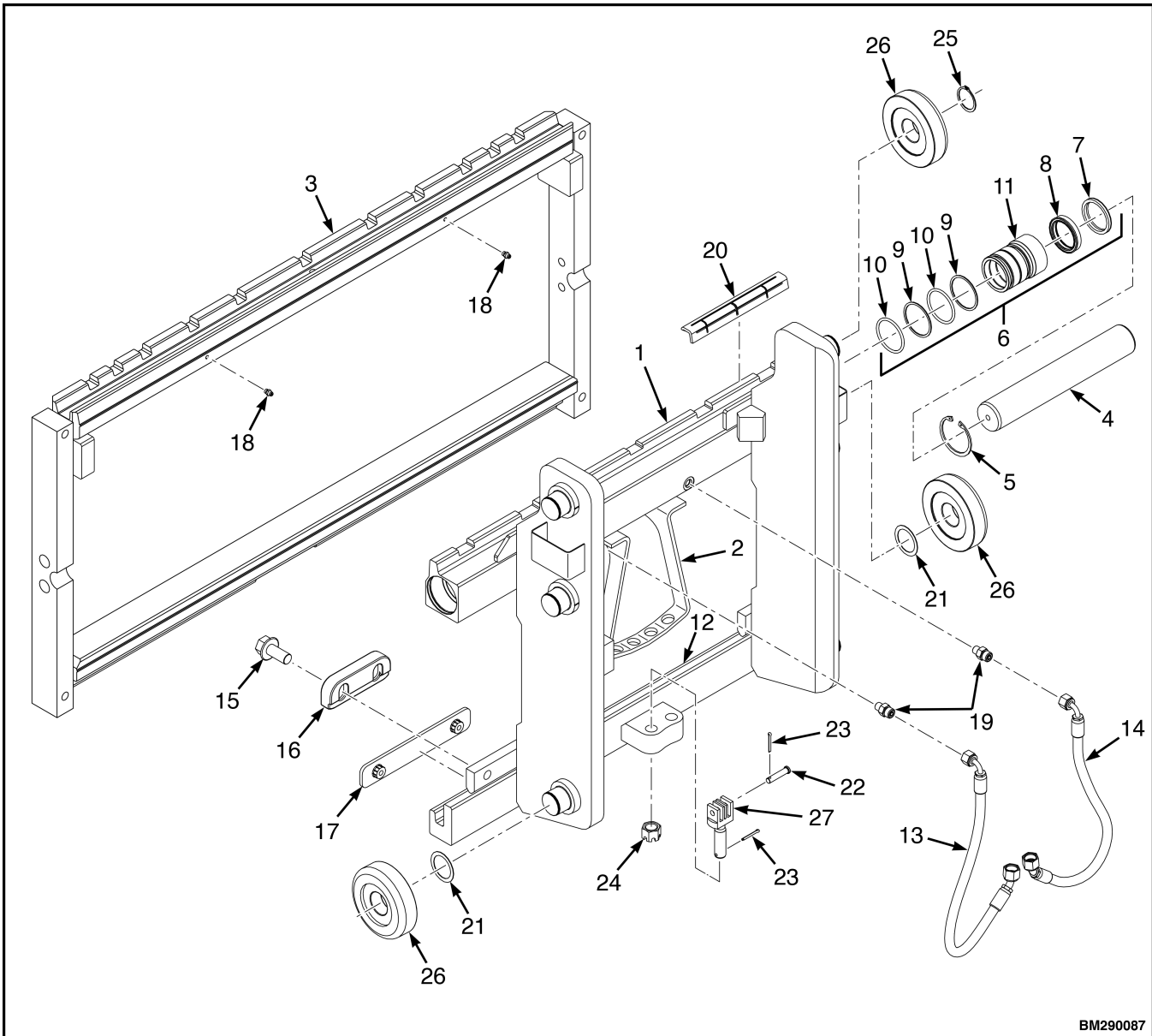


NOTE: CLASS III INTEGRAL SIDESHIFT CARRIAGE SHOWN. CLASS II INTEGRAL SIDESHIFT CARRIAGE IS SIMILAR.

1. HYDRAULIC HOSES
2. HOSE FITTINGS
3. INTEGRAL SIDESHIFT CYLINDER
4. INTEGRAL SIDESHIFT CARRIAGE ASSEMBLY

Figure 24. Integral Sideshift Carriage Hydraulic Hoses

5. Remove the lower mounting hooks by removing the four capscrews securing the hooks. See Figure 25.
6. Use a crane with a capacity of at least 63 kg (139 lb) to lift the outer frame away from the inner frame. Lay the outer frame flat on a pallet or work bench. See Figure 26.



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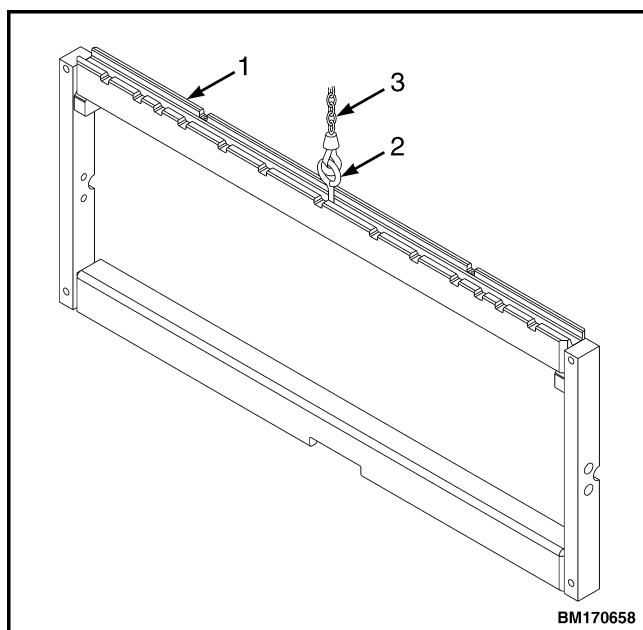
- | | |
|-------------------|-----------------------|
| 1. CARRIAGE | 15. CAPSCREW |
| 2. HOSE PLATE | 16. HOOK (LOWER) |
| 3. FRAME | 17. BEARING (LOWER) |
| 4. CYLINDER ROD | 18. GREASE FITTING |
| 5. SNAP RING | 19. FITTING, STRAIGHT |
| 6. GLAND ASSEMBLY | 20. BEARING (UPPER) |
| 7. ROD WIPER | 21. SHIM |
| 8. SEAL | 22. PIN |
| 9. BACKUP RING | 23. COTTER PIN |
| 10. O RING | 24. NUT |
| 11. GLAND | 25. SNAP RING |
| 12. BEARING STRIP | 26. LOAD ROLLER |
| 13. HOSE ASSEMBLY | 27. CHAIN ANCHOR |
| 14. HOSE ASSEMBLY | |

Figure 25. Integral Sideshift Component Parts

7. Remove the integral sideshift cylinder from the carriage. See **Hydraulics** service manual for procedures.

Disassemble

1. Remove the upper bearings by driving the bearings from the inner frame. See Figure 27.
2. Remove the lower bearings by prying the lower bearings from the inner frame. See Figure 27.
3. If damaged, remove the lube fittings from outer frame. See Figure 25.
4. Disassemble the integral sideshift cylinder. See **Hydraulics** service manual for procedures.



NOTE: THE OUTER FRAME SHOWN MAY BE DIFFERENT FROM WHAT IS ON YOUR LIFT TRUCK. HOWEVER, THE PROCESS FOR REMOVING THE OUTER FRAME FROM THE INNER FRAME IS THE SAME.

1. OUTER FRAME
2. LIFTING HOOK
3. LIFTING DEVICE

Figure 26. Remove Outer Frame

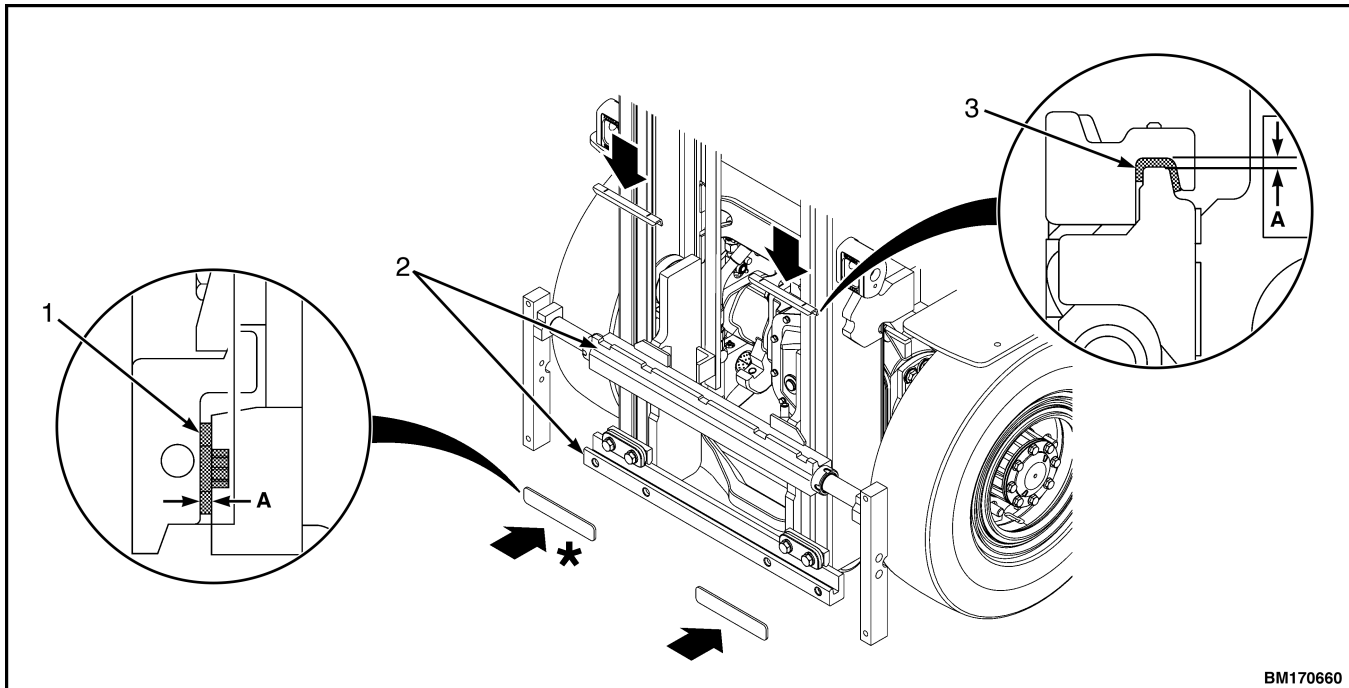
Clean and Inspect



CAUTION

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.

1. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.
2. Clean bearing areas. Inspect sideshift bearings for wear as follows:
 - a. If either upper bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both upper bearings (see Step 1 above). See Assemble section to install new upper bearings.
 - b. If either lower bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace lower bearings by prying the lower bearings from the inner frame (see Step 2 above). See Assemble section to install new lower bearings.
3. Inspect the sideshift cylinder. See **Hydraulics** service manual for procedures.
4. Inspect all load rollers for wear or damage (see Figure 25). If load rollers must be replaced, make a note of the location and number of shims. Install shims, load rollers and snap rings.
5. Clean and inspect all chain anchors and chain anchor pins. Check chain anchors and chain anchor pins for wear and serviceability. Discard worn or unserviceable chain anchors and chain anchor pins. Discard used cotter pins. See Figure 25.



A. MINIMUM THICKNESS 2.5 mm (0.1 in.)

1. LOWER BEARINGS
2. CARRIAGE BARS

3. UPPER BEARINGS

*Bold Arrows Indicate Which Side To Apply Grease.

Figure 27. Upper and Lower Bearings

Assemble

1. Assemble the integral sideshift cylinder. See **Hydraulics** service manual for procedures.
2. If lube fittings were removed, install new lube fittings into the outer frame. See Figure 25.

NOTE: Use a wood block or a plastic hammer to fully seat upper bearings onto the inner frame. Proper lower hook clearance requires the upper bearings be fully seated.

3. Apply a 1 mm (0.040 in.) layer of multipurpose grease to upper and lower bearing surfaces. Install upper and lower bearings onto the inner frame.
 - a. To install new upper bearings, align the pins on the bottom side of bearing to notches on the top carriage bar and slide into place on the top carriage. See Figure 27.

- b. To install new lower bearings, align the two lower bearing pins on the backside of the lower bearing to the holes on the lower carriage bar and tap bearing into place on the lower carriage bar using a rubber or brass hammer. See Figure 27.

Install

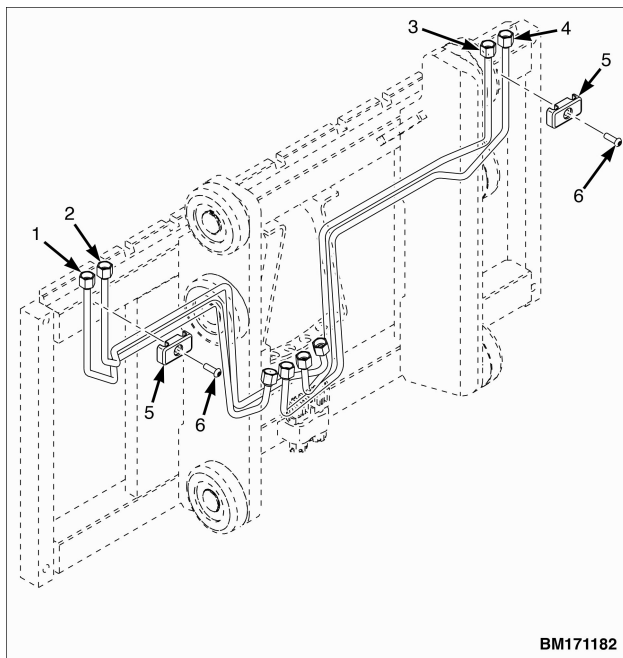
1. Install the integral sideshift cylinder onto the carriage. See **Hydraulics** service manual for procedures.
2. Use a crane with a capacity of at least 63 kg (139 lb) and install the outer frame onto the inner frame. See Figure 26.
3. Install the lower mounting hooks using four capscrews. Tighten to 150 to 180 N•m (111 to 133 lbf ft).
4. Connect hydraulic hoses, as tagged during removal, to the sideshift cylinder. See Figure 24.

5. Install the load backrest to the sideshift carriage. Insert hardware and tighten nuts to 53 N•m (39.1 lbf ft). See Figure 23.
6. Install forks. See the Fork removal and replacement section for procedures.

AUXILIARY EXTENSION TUBES (STANDARD CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes.
2. Loosen the capscrew retaining the clamp and RH tubes to the carriage.
3. Repeat for the LH tubes.



1. LH TUBE
2. LH TUBE
3. RH TUBE
4. RH TUBE
5. TUBE CLAMP
6. CAPSCREW

Figure 28. Auxiliary extension tubes (FFL)

Install

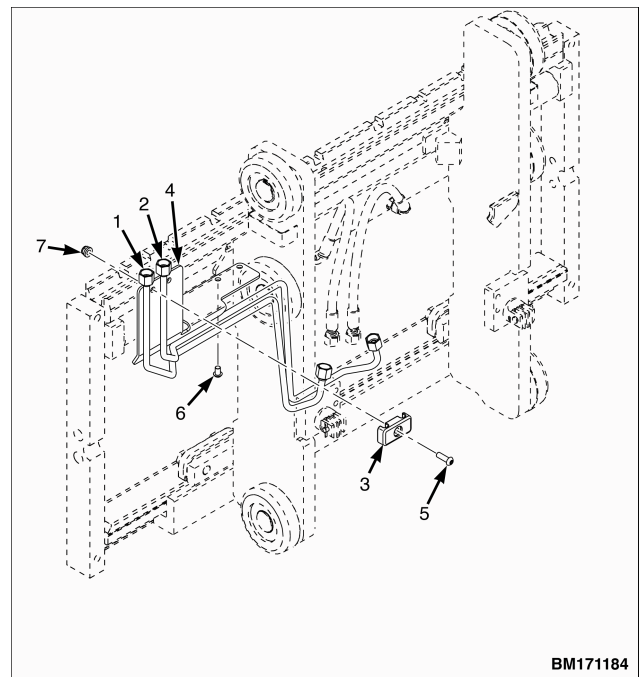
1. Align the RH tubes and tube clamp with the holes on the carriage.

2. Insert the capscrew to retain the clamp and hoses to the carriage.
3. Repeat Step 1 and Step 2 for the LH tubes.

AUXILIARY EXTENSION TUBES (ISS CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 29.
2. Loosen the capscrew retaining the clamp and tubes to the carriage. See Figure 29.



1. TUBE
2. TUBE
3. TUBE CLAMP
4. BRACKET
5. CAPSCREW
6. SCREW
7. NUT

Figure 29. Auxiliary Extension Tubes (ISS FFL)

Install

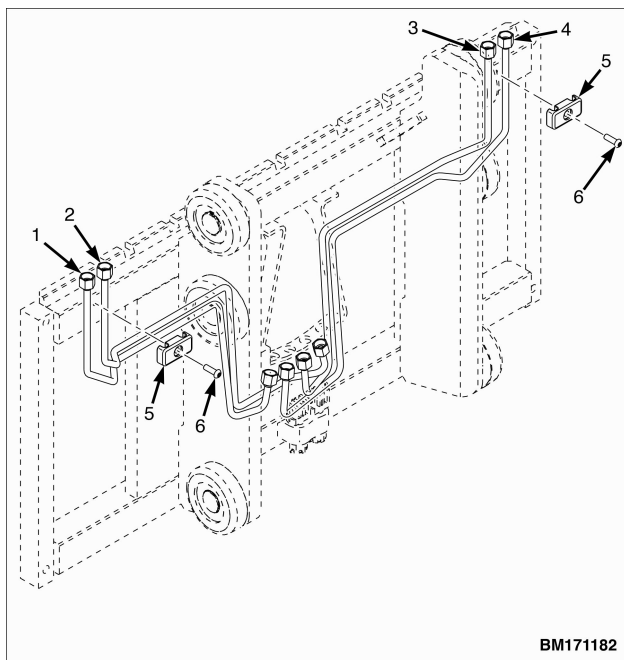
1. Align the tubes and tube clamp with the holes on the carriage. See Figure 29.
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 29.

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AUXILIARY EXTENSION TUBES (STANDARD CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 30.
2. Loosen the capscrew retaining the clamp and RH tubes to the carriage. See Figure 30.
3. Repeat for the LH tubes. See Figure 30.



1. LH TUBE
2. LH TUBE
3. RH TUBE
4. RH TUBE
5. TUBE CLAMP
6. CAPSCREW

Figure 30. Auxiliary extension tubes (FFL)

Install

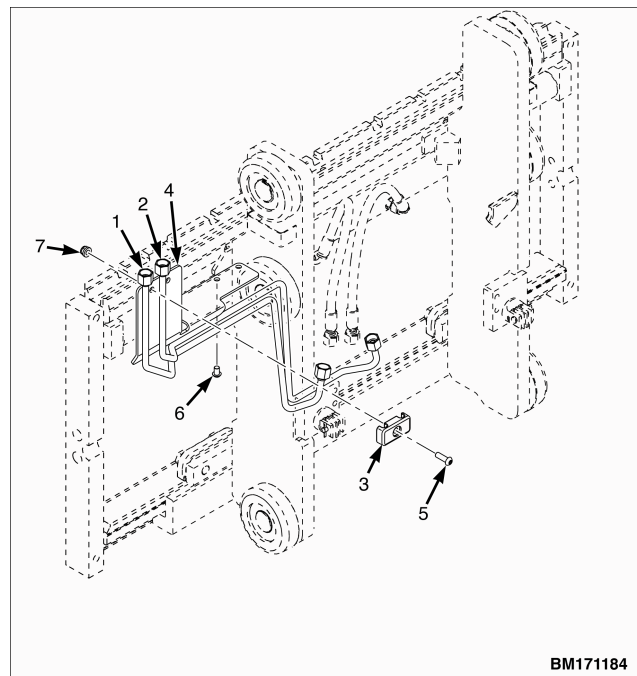
1. Align the RH tubes and tube clamp with the holes on the carriage. See Figure 30.

2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 30.
3. Repeat Step 1 and Step 2 for the LH tubes. See Figure 30.

AUXILIARY EXTENSION TUBES (ISS CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 31.
2. Loosen the capscrew retaining the clamp and tubes to the carriage. See Figure 31.



1. TUBE
2. TUBE
3. TUBE CLAMP
4. BRACKET
5. CAPSCREW
6. SCREW
7. NUT

Figure 31. Auxiliary extension tubes (ISS FFL)

Install

1. Align the tubes and tube clamp with the holes on the carriage. See Figure 31.

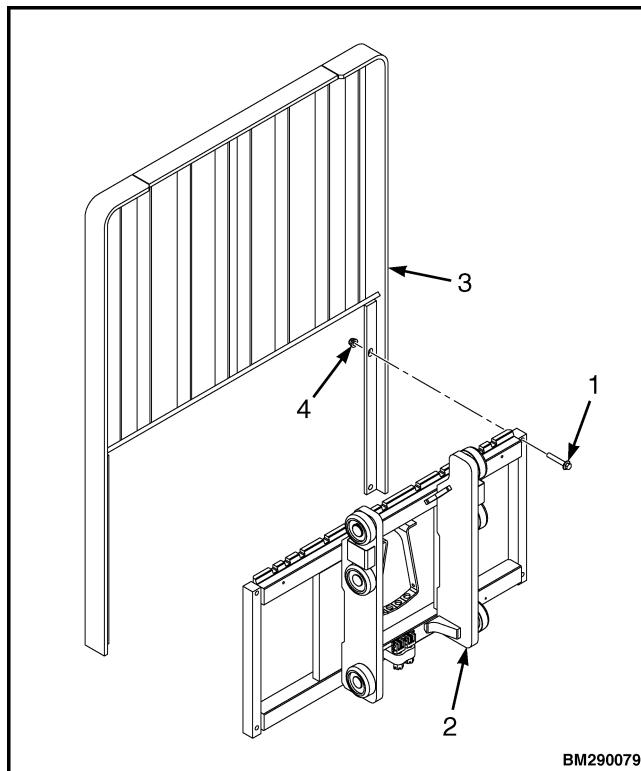
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 31.

CARRIAGE REPAIR, 4-STAGE FULL FREE LIFT
202001-341

STANDARD CARRIAGE

Remove

1. Lower the carriage completely. Remove the forks. See Fork removal and replacement the section of this manual for procedures.
2. Remove the four capscrews and nuts, and the load backrest from the carriage. See Figure 32.

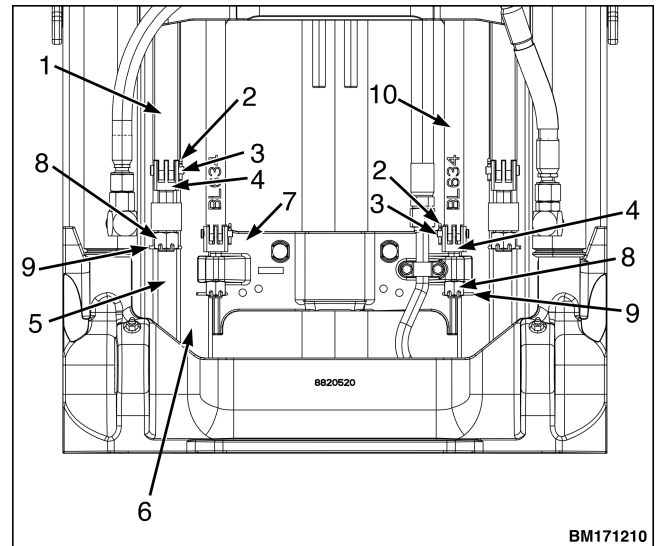


1. CAPSCREW
2. CARRIAGE
3. LOAD BACKREST
4. NUT

Figure 32. Load Backrest

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

4. Remove the chain anchor pin from each chain anchor at the carriage. See Figure 33.



1. LIFT CHAIN
2. COTTER PIN
3. CHAIN ANCHOR PIN
4. CHAIN ANCHOR
5. INTERMEDIATE MAST
6. INNER MAST
7. INNER BOTTOM CROSSMEMBER
8. CASTLE NUT
9. COTTER PIN
10. LIFT CHAIN

Figure 33. Lower chain anchors



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 and causing an injury or damage.

5. Disconnect the lift chains from the carriage. Make sure the chains can move freely when the inner mast is raised.
6. Use the lift cylinders to raise the inner mast. If hydraulic system cannot be used, disconnect lift cylinders from inner mast. See section Cylinder repair in **Hydraulics** 1900SRM2302 for procedures.

7. Connect a crane with a capacity of at least 154 kg (340 lb) to top of inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage. Install safety chains to secure mast in its extended position and disconnect the crane. See Safety Procedures When Working Near Mast.
8. Move lift truck away from carriage. Completely lower inner mast so it cannot move.

Clean and Inspect



CAUTION

If the load rollers must be replaced, make a note of the location and number of shims. Install shims, load rollers, and snap rings. Shims are installed on the bottom and middle load rollers only. See Carriage Adjustments. for correct adjustment of load rollers.

1. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.



WARNING

Compressed air can move particles and make them become airborne, which may cause injury make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.



WARNING

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



CAUTION

DO NOT use cleaning solvent, compressed air, or steam to clean lift chain sheaves or load rollers. The bearings in the lift chain sheaves and load rollers are sealed and lubricated. Cleaning solvent, compressed air, and steam can damage the load roller bearings.

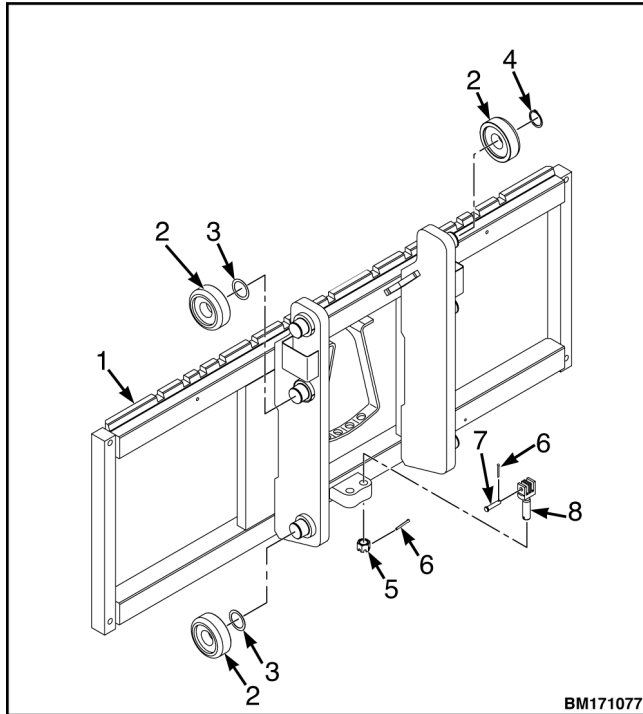
2. Clean any oil, grease, dirt, and other debris from the carriage frame. Use a cleaning solvent and compressed air to dry.



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.

3. Clean and inspect carriage bars for damage and smoothness. Ensure carriage bars are parallel and ends are flush. If carriage bars have any protruding welds or damages notches, repair by grinding, filing, or welding.
4. Clean and inspect all chain anchors and chain anchor pins. Check chain anchors and chain anchor pins for wear and serviceability, discard if worn or unserviceable. Discard used cotter pins. See Figure 34.



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

Figure 34. Standard carriage components

Install

1. Move the lift truck toward the carriage until the inner mast is aligned with the carriage rollers.
2. If the inner mast has been raised and secured using a crane and safety chains, connect the crane, raise inner mast, and remove safety chains. Carefully lower the inner mast until it engages all of the load rollers.
3. Disconnect the crane, if attached, and reconnect lift cylinders. See **Hydraulics** 1900SRM2302 service manual for procedure.
4. Check the clearance of the load rollers. See **Carriage Adjustments.** section for procedures.

NOTE: Use new cotter pins each time chain pins are removed.

5. Connect lift chains to chain anchors at the carriage. Install cotter pins in chain pins. Adjust lift chains as described in **Lift Chains Adjustment** section.
6. Install the load backrest to the sideshift carriage. Insert hardware and tighten nuts to 53 N•m (39.1 lbf ft). See Figure 32.
7. Install forks. See **Fork removal and replacement** section for procedures.

INTEGRAL SIDESHIFT CARRIAGE

Remove

1. Lower carriage completely. Remove forks. See **Fork removal and replacement** section for procedures.
2. Remove four capscrews, nuts, washers, and load back rest from carriage. See Figure 32.



WARNING

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from hydraulic system prior to disconnecting hydraulic hoses.

3. Relieve hydraulic pressure to the sideshift cylinder by moving sideshift lever in both directions several times.



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.

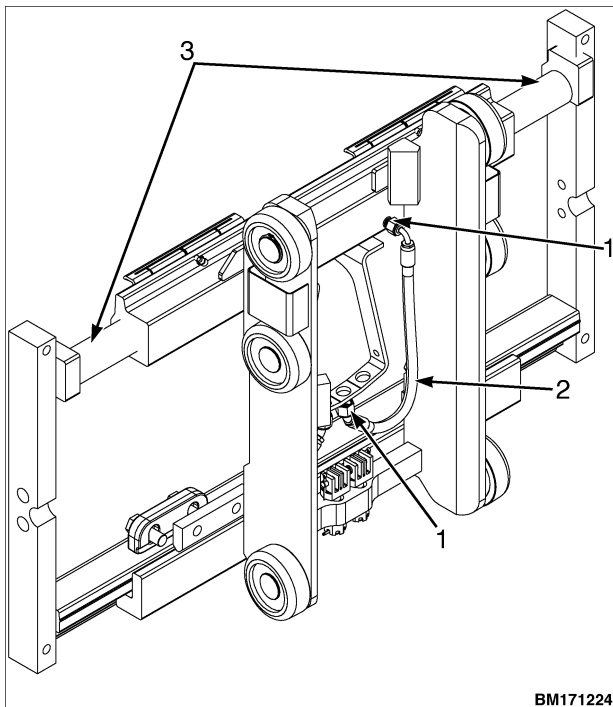
**CAUTION**

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

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

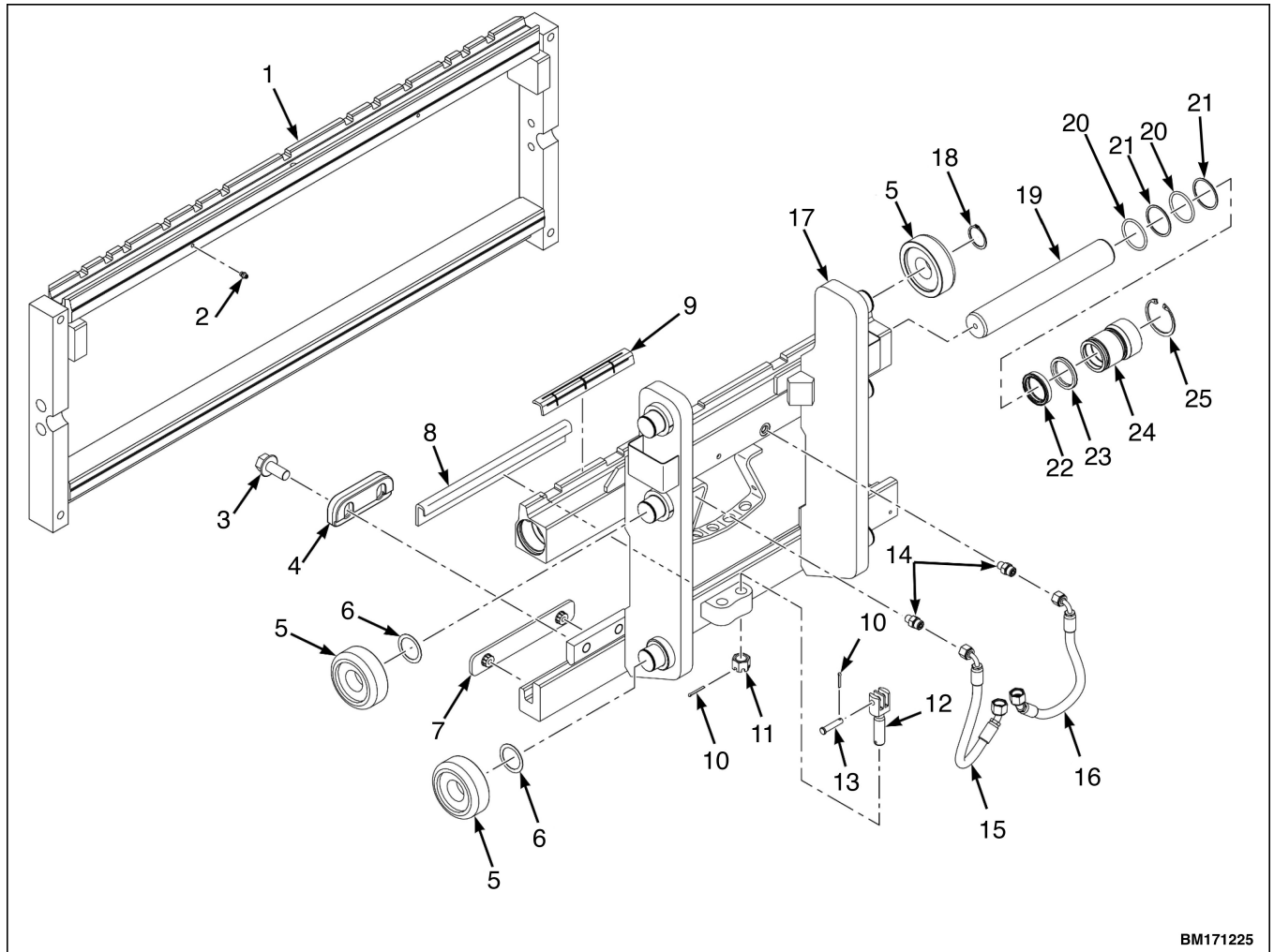
4. Disconnect hydraulic lines from sideshift cylinder. Put caps and plugs on open lines and cylinder ports. See Figure 35.

5. Remove lower mounting hooks by removing four capscrews securing the hooks. See Figure 36.



1. HYDRAULIC FITTINGS
2. INTEGRAL SIDESHIFT HYDRAULIC HOSES
3. INTEGRAL SIDESHIFT CYLINDER

Figure 35. Integral Sideshift Carriage Hydraulic Hose Connections

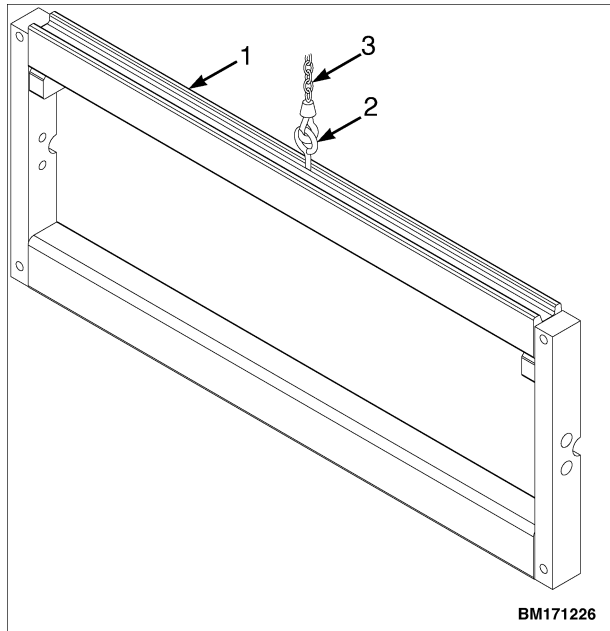


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- | | |
|-------------------------------------|---------------------------|
| 1. FRAME | 14. STRAIGHT FITTING |
| 2. LUBE FITTING | 15. HOSE ASSEMBLY |
| 3. CAPSCREW | 16. HOSE ASSEMBLY |
| 4. LOWER HOOK | 17. ISS CARRIAGE WELDMENT |
| 5. LOAD ROLLER | 18. SNAP RING |
| 6. SHIM | 19. CYLINDER ROD |
| 7. LOWER BEARING | 20. O-RING |
| 8. STRIP BEARING LOWER CARRIAGE BAR | 21. BACKUP RING |
| 9. UPPER BEARING | 22. SEAL |
| 10. COTTER PIN | 23. ROD WIPER |
| 11. CASTLE NUT | 24. GLAND |
| 12. CHAIN ANCHOR | 25. SNAP RING |
| 13. CHAIN ANCHOR PIN | |

Figure 36. Integral Sideshift Carriage Component Parts

6. Remove sideshift cylinder from carriage. See **Hydraulics 1900SRM2302** service manual for procedure.
7. Use a crane with a capacity of at least 62.3 kg (137.35 lb) to lift outer frame away from the inner frame (see Figure 37). Lay outer frame flat on a pallet or workbench.



1. OUTER FRAME
2. LIFTING HOOK
3. LIFTING DEVICE

Figure 37. Remove Outer frame

Disassemble

1. Remove the upper and lower bearings from the inner frame. See Figure 38.
2. If damaged, remove lube fittings from outer frame. See Figure 36.
3. Disassemble sideshift cylinder. See **Hydraulics** 1900SRM2302 for procedure.

Clean and Inspect



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.

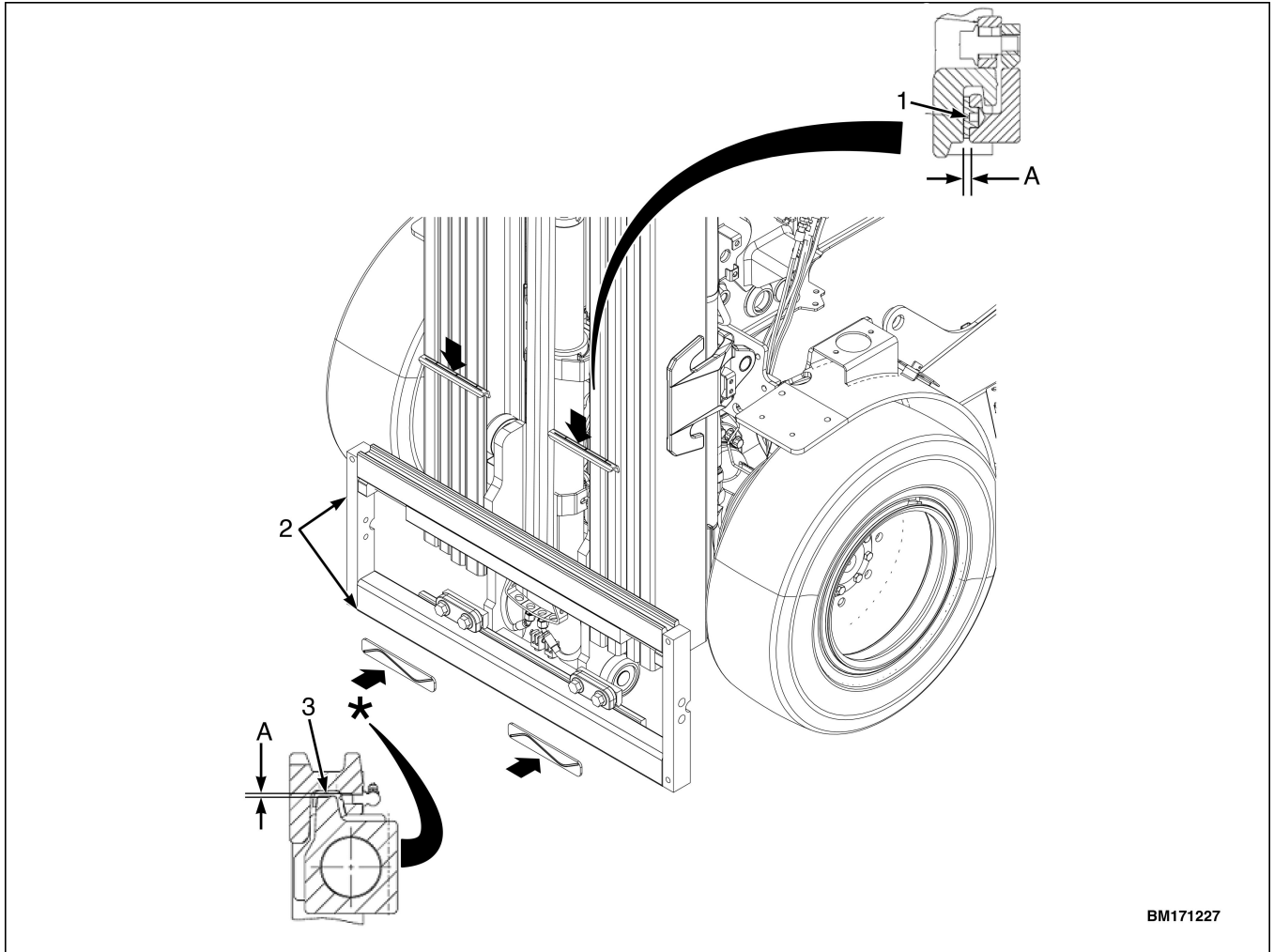
1. Clean and inspect the carriage bars for damage and smoothness. Ensure the carriage bars are parallel and the ends are flush. If carriage bars have any protruding welds or damaged notches, repair by grinding, filing, or welding.

2. Clean the bearing areas. Inspect the sideshift bearings for wear as follows:
 - a. 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 inner frame. See Figure 38.
 - b. If either lower bearing is worn to less than 2.5 mm (0.1 in.) thickness, replace both lower bearings by prying the lower bearings from the inner frame. See Figure 38.
3. Inspect sideshift cylinder. See **Hydraulics** 1900SRM2302 for procedure.
4. Inspect load rollers for wear and damage (see Figure 36). If load rollers must be replaced, make a note of the location and number of the shims to ensure correct installation. See Carriage Adjustments.

Assemble

1. Assemble sideshift cylinder. See **Hydraulics** 1900SRM2302 for procedures.
 2. If lube fittings were removed, install new lube fittings into outer frame. See Figure 36.
- NOTE:** Use a wood block or a plastic hammer to fully seat the upper bearings onto the inner frame. Proper lower hook clearance requires the upper bearings be fully seated.
3. Apply a 1.0 mm (0.040 in.) layer of multipurpose grease to upper and lower bearing surfaces. Install the upper and lower bearings onto inner frame:

- a. To install new upper bearing, align the pins on the bottom side of bearing to notches on top carriage bar and slide into place on top carriage. See Figure 38.
- b. To install new lower bearing, align the circular pins on backside of lower bearing to holes on lower carriage bar and tap into place on lower carriage bar using a rubber or brass hammer. See Figure 38.



BM171227

A. MINIMUM THICKNESS, 2.5 mm (0.1 in.)

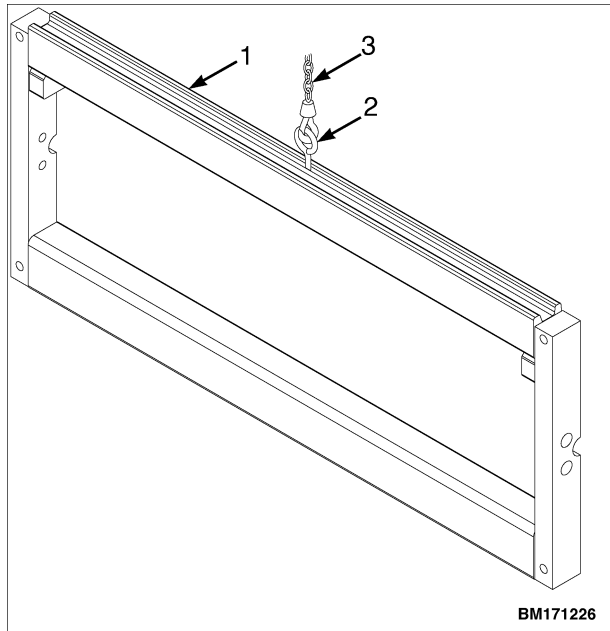
- 1. UPPER BEARINGS
- 2. CARRIAGE BARS

- 3. LOWER BEARINGS

Figure 38. Upper and Lower Bearings

Install

- 1. Use a crane, with a capacity of 62.3 kg (137.35 lb) and install outer frame onto inner frame. See Figure 39.



1. OUTER FRAME
2. LIFTING HOOK
3. LIFTING DEVICE

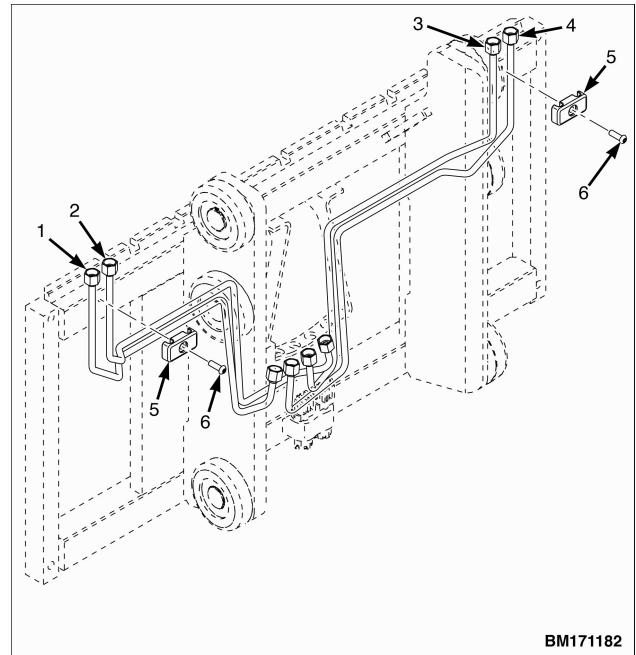
Figure 39. Install outer frame

2. Install lower mounting hook using four capscrews and washers. Tighten capscrews to 150 to 180 N·m (111 to 133 lbf ft).
3. Connect hydraulic lines, as noted during removal, to side shift cylinder. See Figure 36.
4. Install load backrest, capscrews, and locknuts onto integral sideshift carriage. Tighten locknuts to 53 N·m (39 lbf ft). See Figure 32.
5. Install forks. See Fork removal and replacement section of this manual for procedures.

AUXILIARY EXTENSION TUBES (STANDARD CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 40.
2. Loosen the capscrew retaining the clamp and RH tubes to the carriage. See Figure 40.
3. Repeat for the LH tubes. See Figure 40.



1. LH TUBE
2. LH TUBE
3. RH TUBE
4. RH TUBE
5. TUBE CLAMP
6. CAPSCREW

Figure 40. Auxiliary Extension Tubes (FFL)

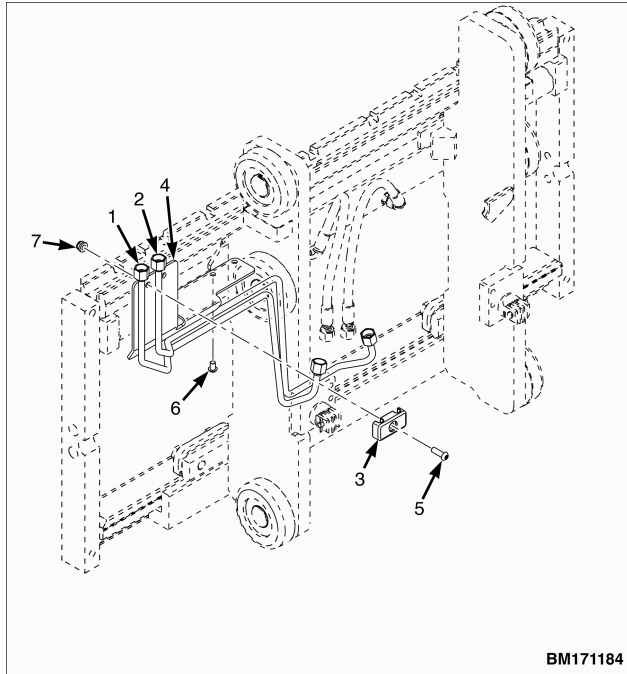
Install

1. Align the RH tubes and tube clamp with the holes on the carriage. See Figure 40.
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 40.
3. Repeat Step 1 and Step 2 for the LH tubes. See Figure 40.

AUXILIARY EXTENSION TUBES (ISS CARRIAGE)

Remove

1. Disconnect header hoses and free lift hoses from each of the auxiliary extension tubes. See Figure 41.
2. Loosen the capscrew retaining the clamp and tubes to the carriage. See Figure 41.



1. LH TUBE
2. LH TUBE
3. RH TUBE
4. RH TUBE
5. TUBE CLAMP
6. CAPSCREW

Figure 41. Auxiliary extension tubes (ISS FFL)

Install

1. Align the tubes and tube clamp with the holes on the carriage. See Figure 41.
2. Insert the capscrew to retain the clamp and hoses to the carriage. See Figure 41.

FORK POSITIONER 202001-330

The lift truck models covered in this manual may be equipped with an optional fork positioner on an integral sideshift carriage. The two fork positioner options are provided by:

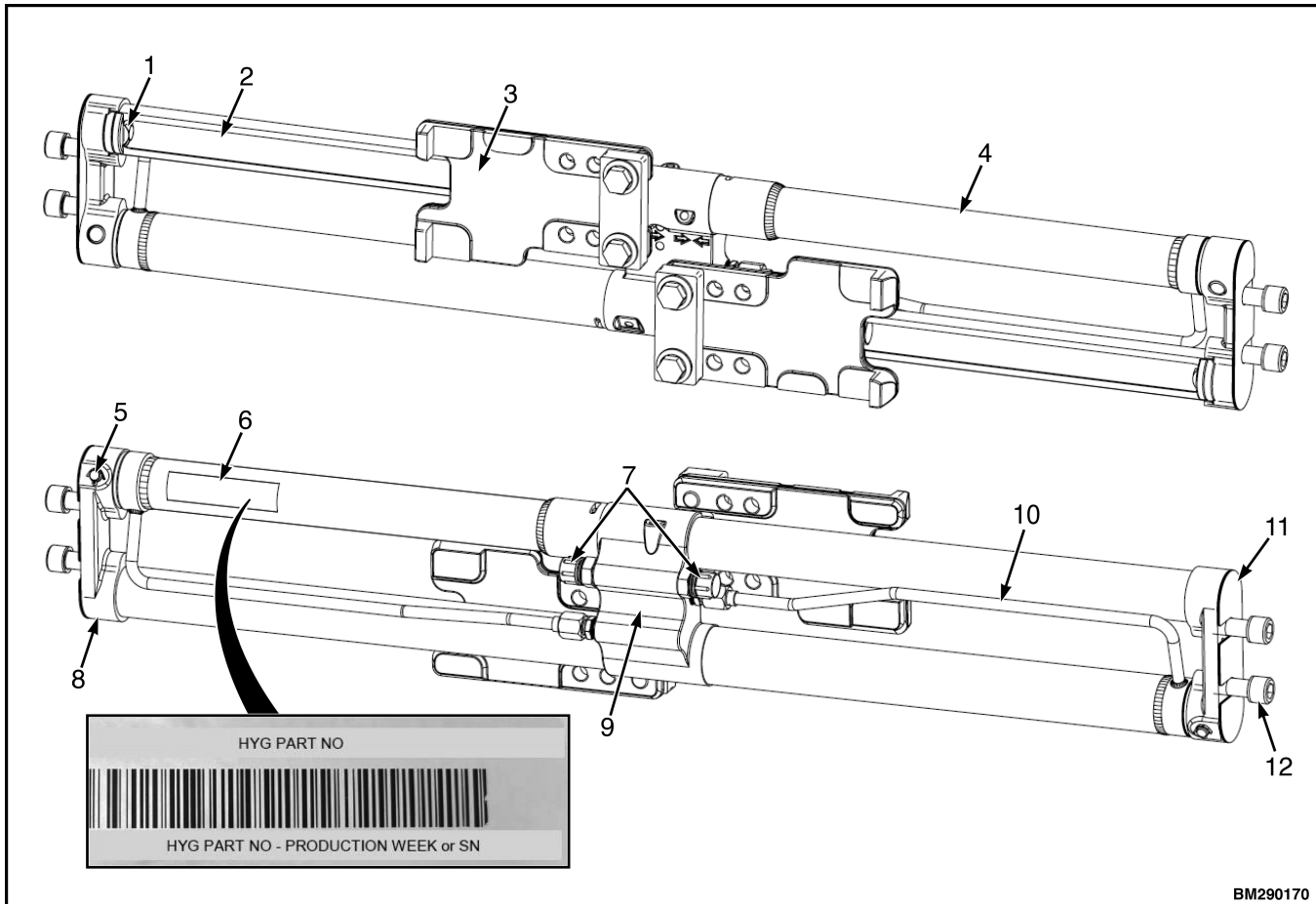
- Cascade
- Bolzoni

The components of the two fork positioner options will vary, however the function is the same. For procedures to service, repair, and maintain the Cascade fork positioner, see the manufacturer's maintenance manual, available from your authorized Hyster dealer. For procedures to maintain or repair the Bolzoni fork positioner, see the **Periodic Maintenance 8000SRM2305** manual or see Bolzoni fork positioner section in this manual.

BOLZONI FORK POSITIONER

FORK POSITIONER ASSEMBLY

The following information and procedures specify the requirements, removal and installation, disassemble and assemble procedures for the Bolzoni fork positioner into an integrated sideshift carriage.



- | | |
|-------------------------------------|----------------------|
| 1. SHOCK ABSORBER | 7. FITTING |
| 2. GUIDE TUBE | 8. SIDE LOCK |
| 3. FORK CARRIERS | 9. VALVE ASSEMBLY |
| 4. FORK POSITIONING LINEAR ACTUATOR | 10. HYDRAULIC SYSTEM |
| 5. ACTUATOR FIXING PIN | 11. SPACER |
| 6. IDENTIFICATION PLATE | 12. SCREW |

Figure 42. Fork positioner components

Remove the fork positioner

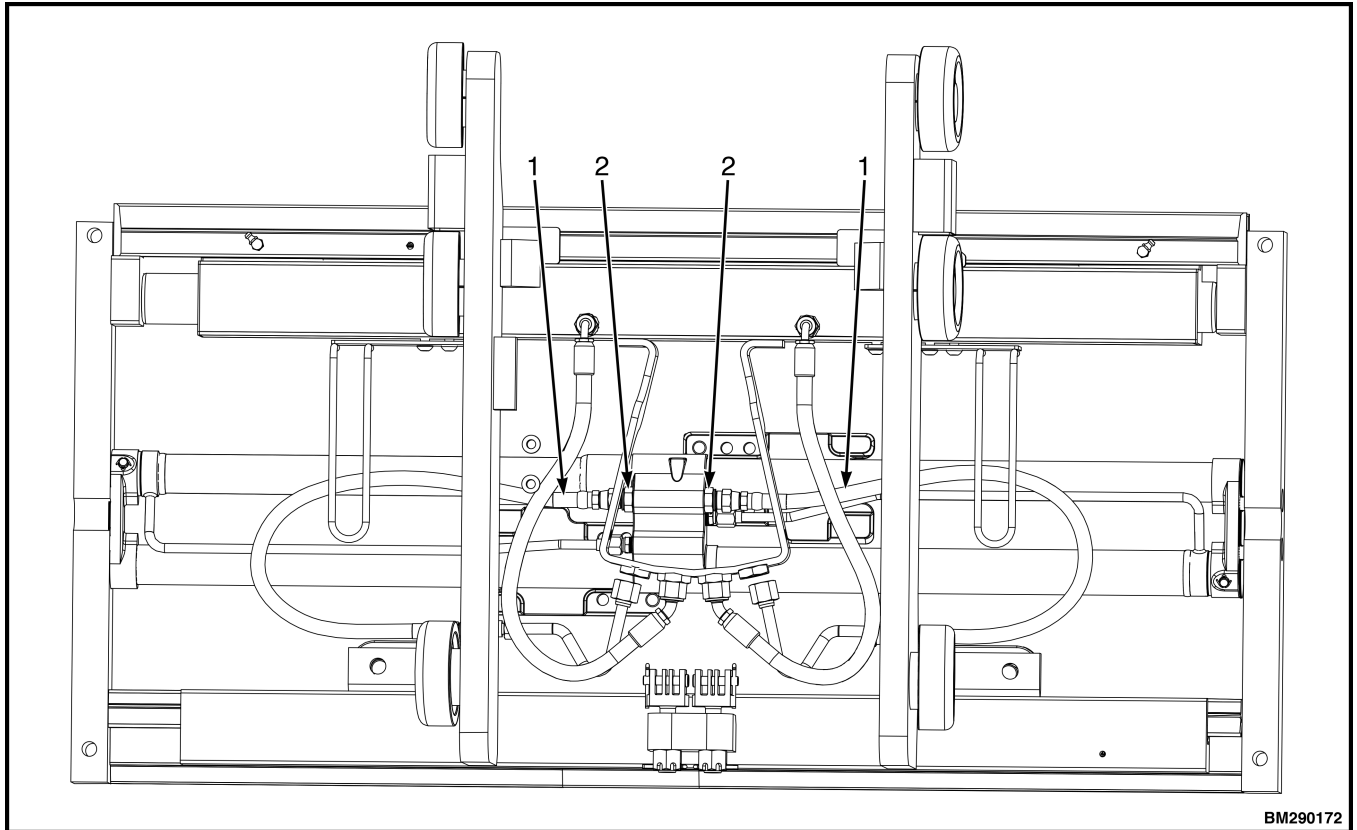


WARNING

Before any maintenance operation, turn off the forklift and remove pressure from the hydraulic circuit by repeatedly moving the positioner levers in both directions while the forklift is off. Ensure that no one turns the ignition key or manipulates the forklift's control levers for the entire duration of maintenance.

NOTE: REMOVAL, INSTALLATION AND MAINTENANCE MUST BE CARRIED OUT BY SPECIALIZED AND WELL-TRAINED TECHNICAL PERSONNEL ONLY.

- a. Remove forks, see Fork removal and replacement.
- b. Disconnect the hydraulic hoses using 19 mm wrench. See Figure 43.

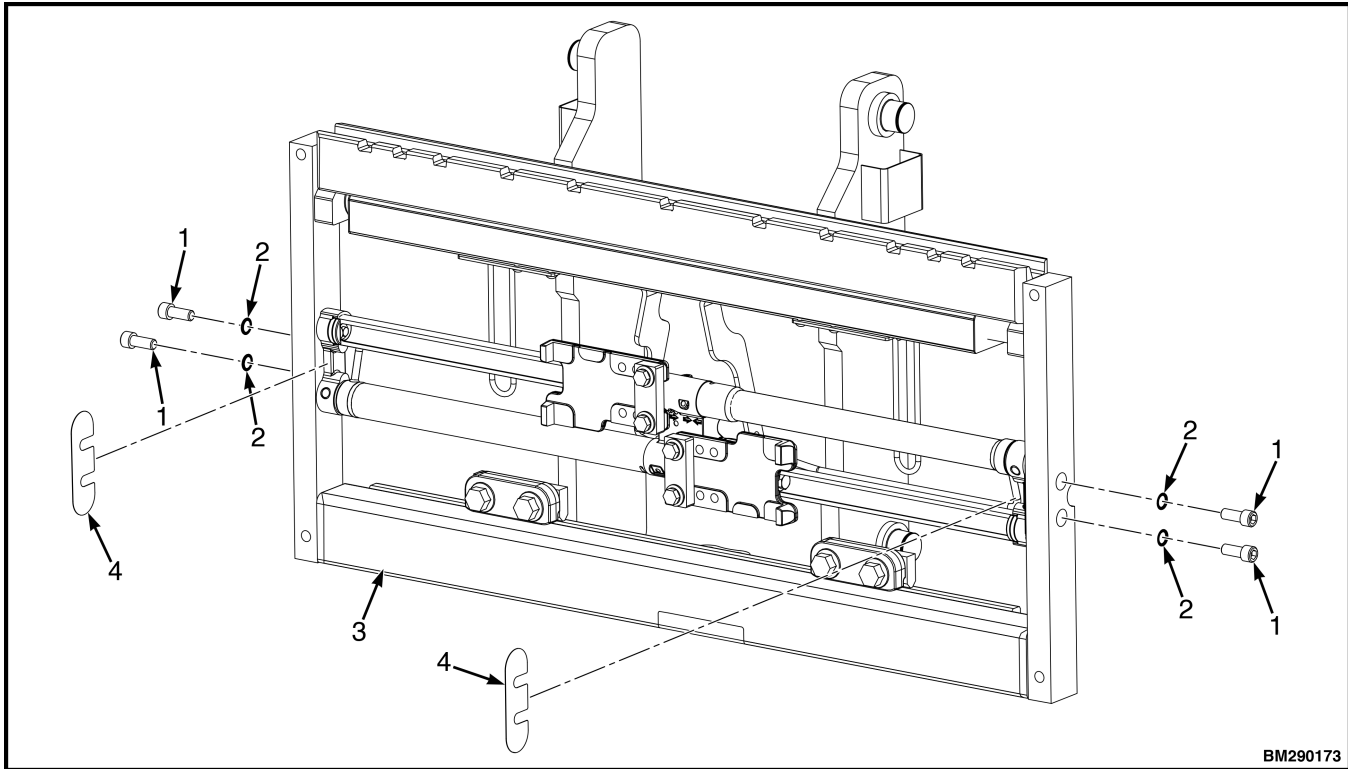


1. HYDRAULIC HOSE

2. FITTING

Figure 43. Hydraulic disconnect

- c. Use a 10 mm wrench to remove the fork positioner side mounting screws (item 1, Figure 44) and washers (item 2) from the outer frame of the integrated sideshift carriage.
- d. Remove the shims (item 4, Figure 44) if equipped, between the fork positioner and the outer frame of the integrated sideshift carriage (item 3).



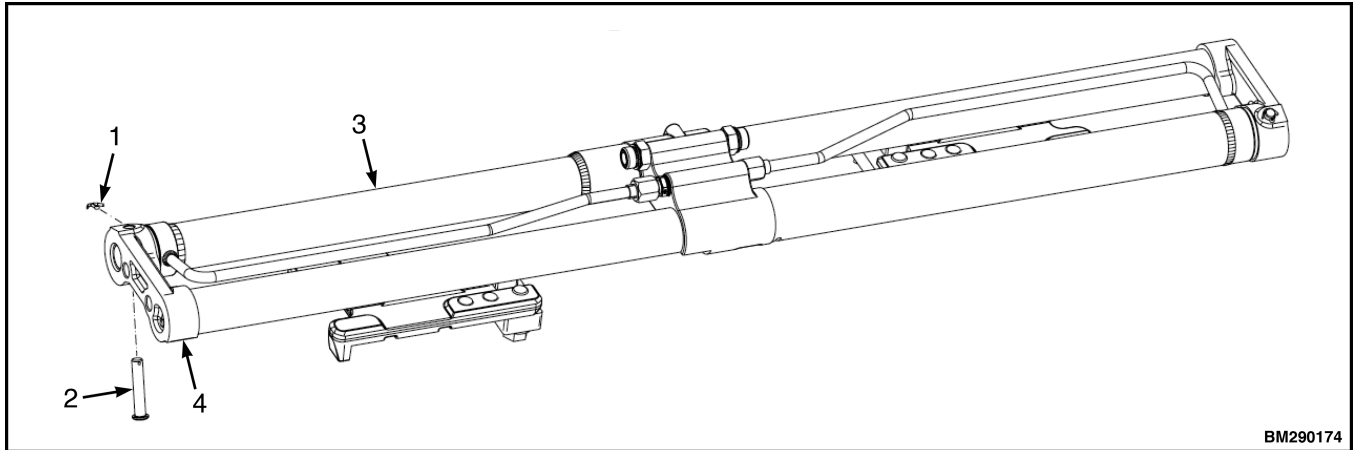
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- | | |
|-------------------------|-----------------------|
| 1. SIDE MOUNTING SCREWS | 3. SIDESHIFT CARRIAGE |
| 2. WASHERS | 4. SHIMS |

Figure 44. Side mounting screws remove

Remove fork carriers and guides

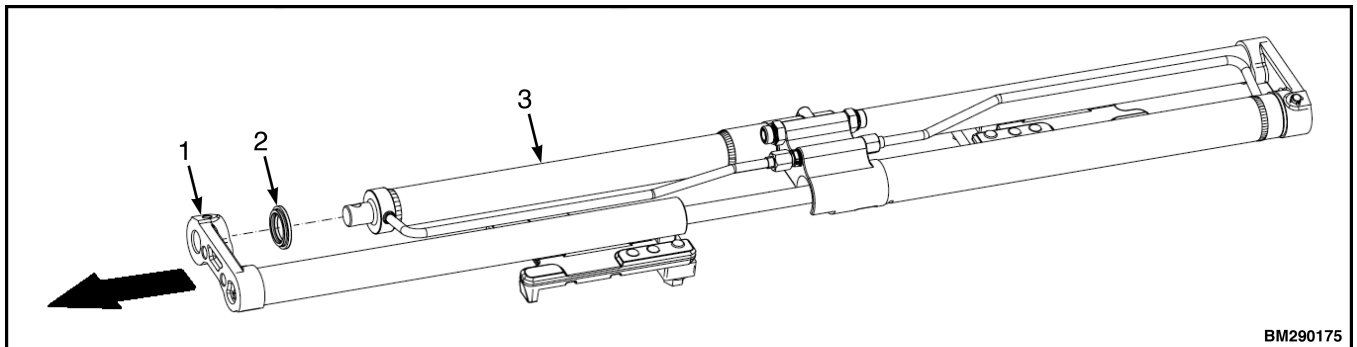
1. The following procedure removes the fork carriers and fork positioner from the integrated sideshift carriage.
 - a. Bring the fork carriers about halfway.
 - b. Remove the fork positioner from the integrated sideshift carriage and place it horizontally. See Remove the fork positioner.
 - c. Use pliers to remove the cotter pin (item 1, Figure 45) and pin (item 2) from both end brackets of fork positioner assembly.



- | | |
|---------------|-----------------------------|
| 1. COTTER PIN | 3. END BRACKET |
| 2. PIN | 4. FORK POSITIONER ASSEMBLY |

Figure 45. Pin removal

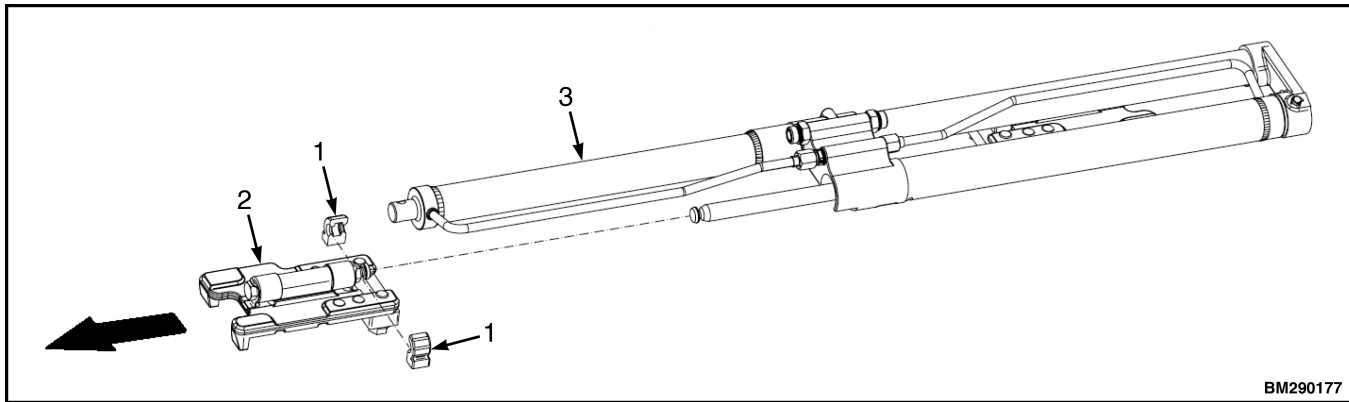
- d. Remove the end bracket (item 1, Figure 46) and shock absorber (item 2) from both ends of fork positioner assembly (item 3).



- | | |
|-------------------|-----------------------------|
| 1. END BRACKET | 3. FORK POSITIONER ASSEMBLY |
| 2. SHOCK ABSORBER | |

Figure 46. Bracket removal

- e. Remove couplings (item 1, Figure 47) and fork carrier (item 2) from fork positioner cylinder (item 3).
- f. Repeat for opposite end of fork positioner assembly.



1. COUPLINGS
2. FORK CARRIER

3. FORK POSITION CYLINDER

Figure 47. Fork carrier removal

- g. With the bracket and shock absorber removed, use 10 mm socket wrench to remove the support (item 1, Figure 48), washer (item 2), and screw (item 3) from guide (item 4).
- h. Repeat for opposite end of fork positioner assembly.

Replace fork carrier bushings

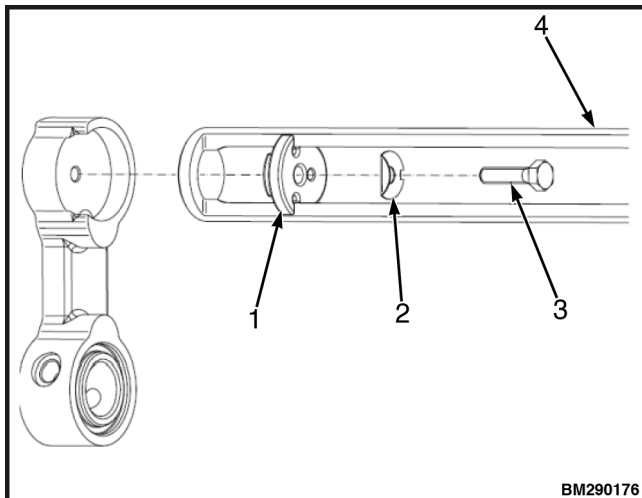
1. Remove screw (item 4, Figure 47), screw (item 1), lockwashers (item 2), and bushings (item 3) from carrier (item 5). Discard lockwashers.



WARNING

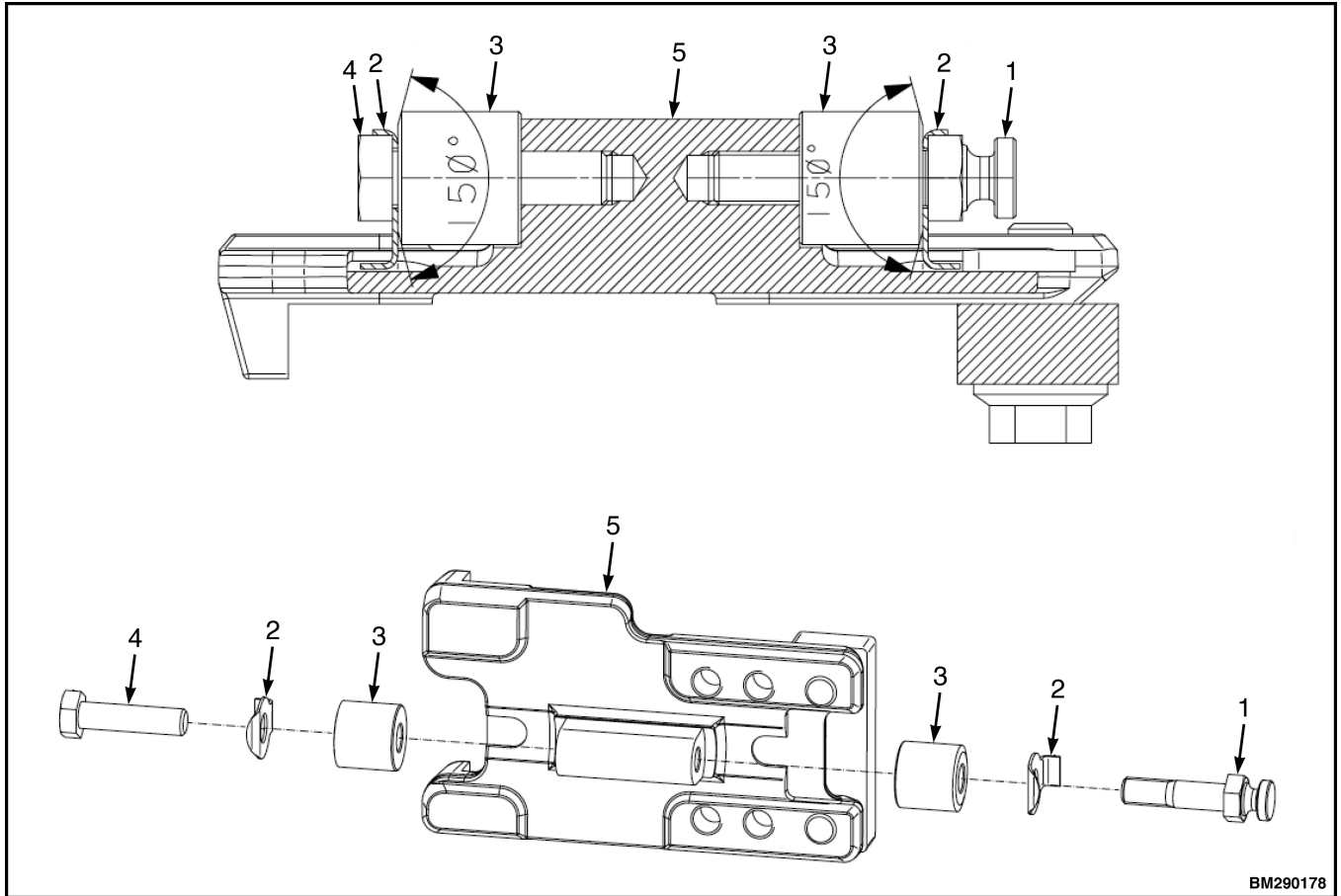
When replacing fork carrier bushings, mount them as shown in Figure 49; screws in positions 1 and 4 must be fitted with "Loctite 270" threadlocker; lock washers in position 2 must be replaced for reassembly.

2. Apply Loctite 270 threadlocker to screws (items 1 and 4, Figure 49).
3. Install bushing (item 3, Figure 49), new lockwasher (item 2), and screw (item 1) onto fork carrier (item 5).
4. Install bushing (item 3, Figure 49), new lockwasher (item 2), and screw (item 4) onto fork carrier (item 5).
5. Tighten both screws to 69 N·m (51 lbf ft).



1. SUPPORT
2. WASHER
3. SCREW
4. GUIDE

Figure 48. Bracket and guide disassemble



- 1. SCREW
- 2. LOCKWASHER
- 3. BUSHING

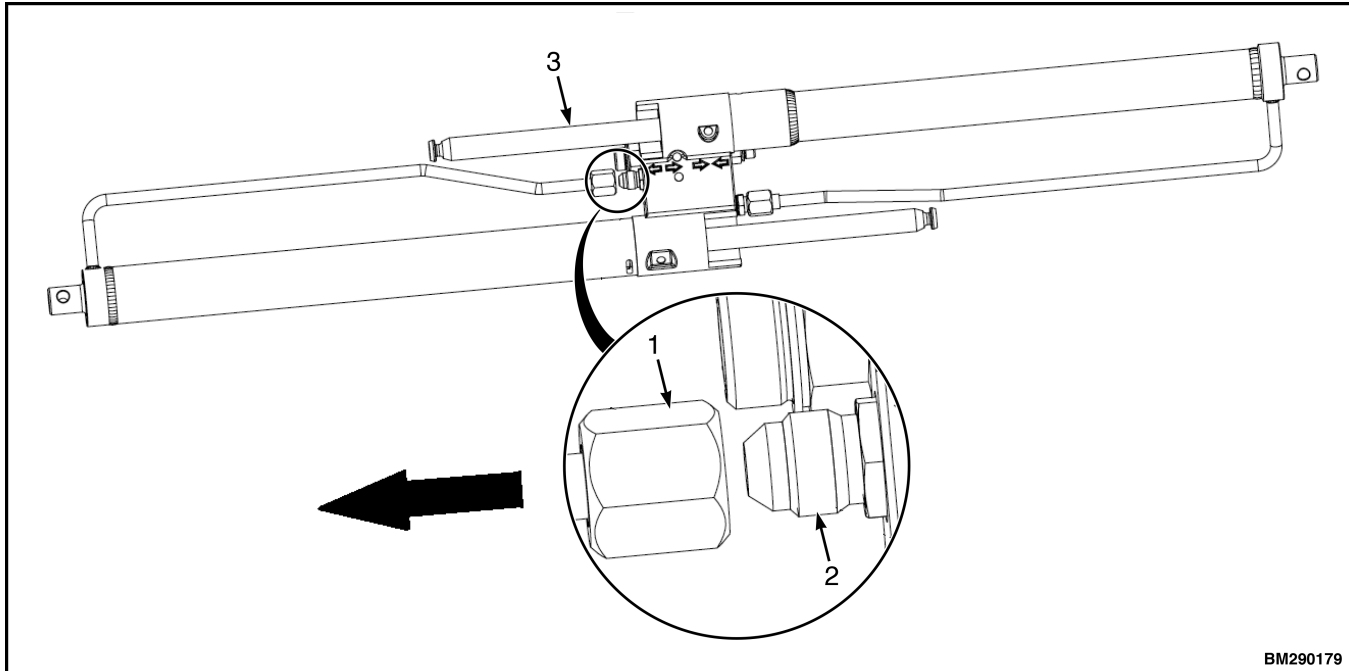
- 4. SCREW
- 5. CARRIER

Figure 49. Fork carrier bushings replacement

Disassemble actuators

- 1. Remove fork carriers and guides as described in Remove fork carriers and guides.

- 2. Unscrew nut (item 1, Figure 50) from fitting (item 2) and disengage completely.



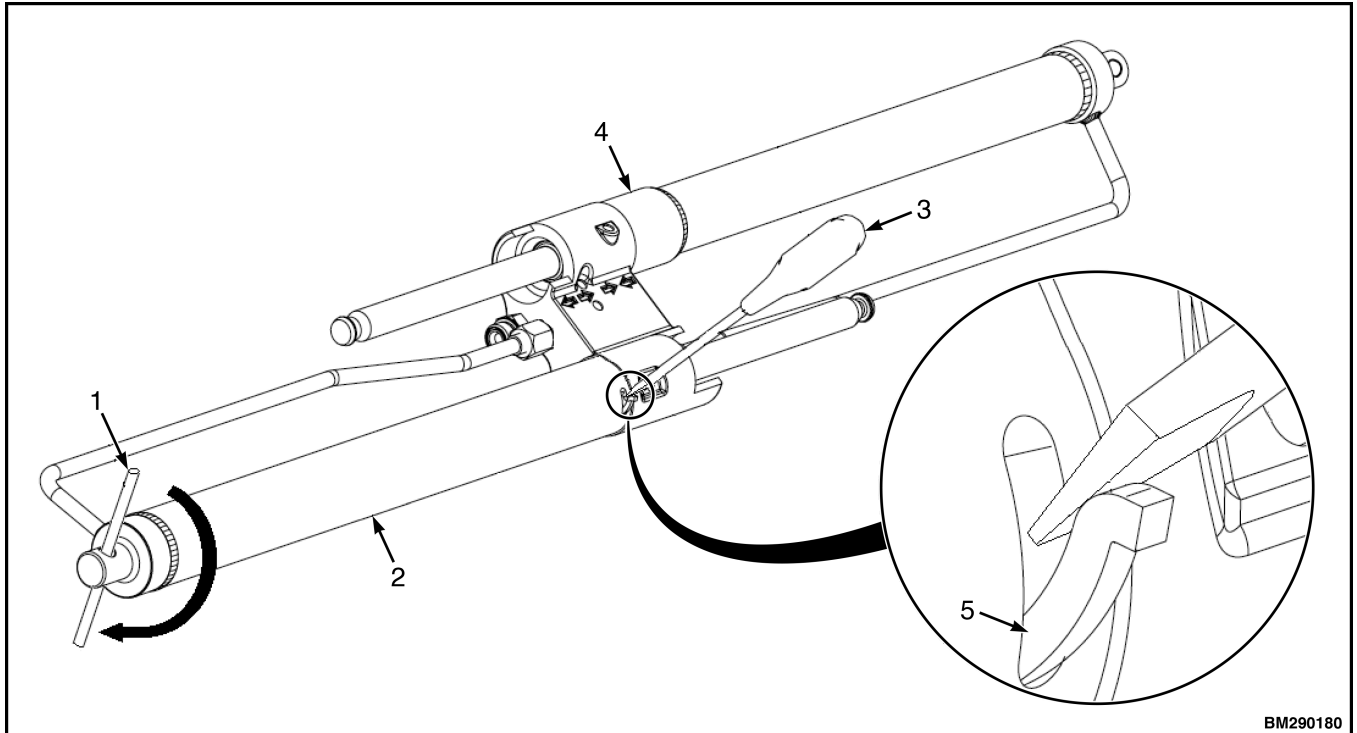
1. NUT
2. FITTING

3. ACTUATOR

Figure 50. Nut and fitting removal

3. Use a star screw driver (item 3, Figure 51) to lift the ring (item 5); simultaneously rotate the actuator housing (item 2) using a pin driver (item 1) in the direction shown in until the ring is completely out.

For housing (item 4, Figure 51) the direction of rotation is the opposite.



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- 1. PIN DRIVER
- 2. ACTUATOR HOUSING
- 3. STAR SCREWDRIVER

- 4. HOUSING
- 5. RING

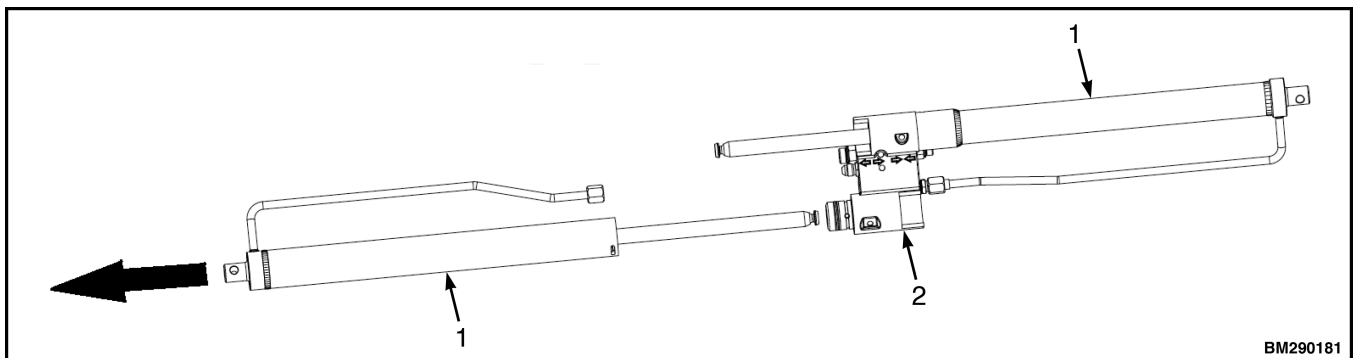
Figure 51. Disassemble actuator



CAUTION

Tag each actuator to ensure they are not mixed up when reassembling; the bore of the actuators is not the same.

- 4. Remove the actuator by pulling it out of the housing. See Figure 52. Repeat for 2nd actuator.



BM290181

- 1. ACTUATOR

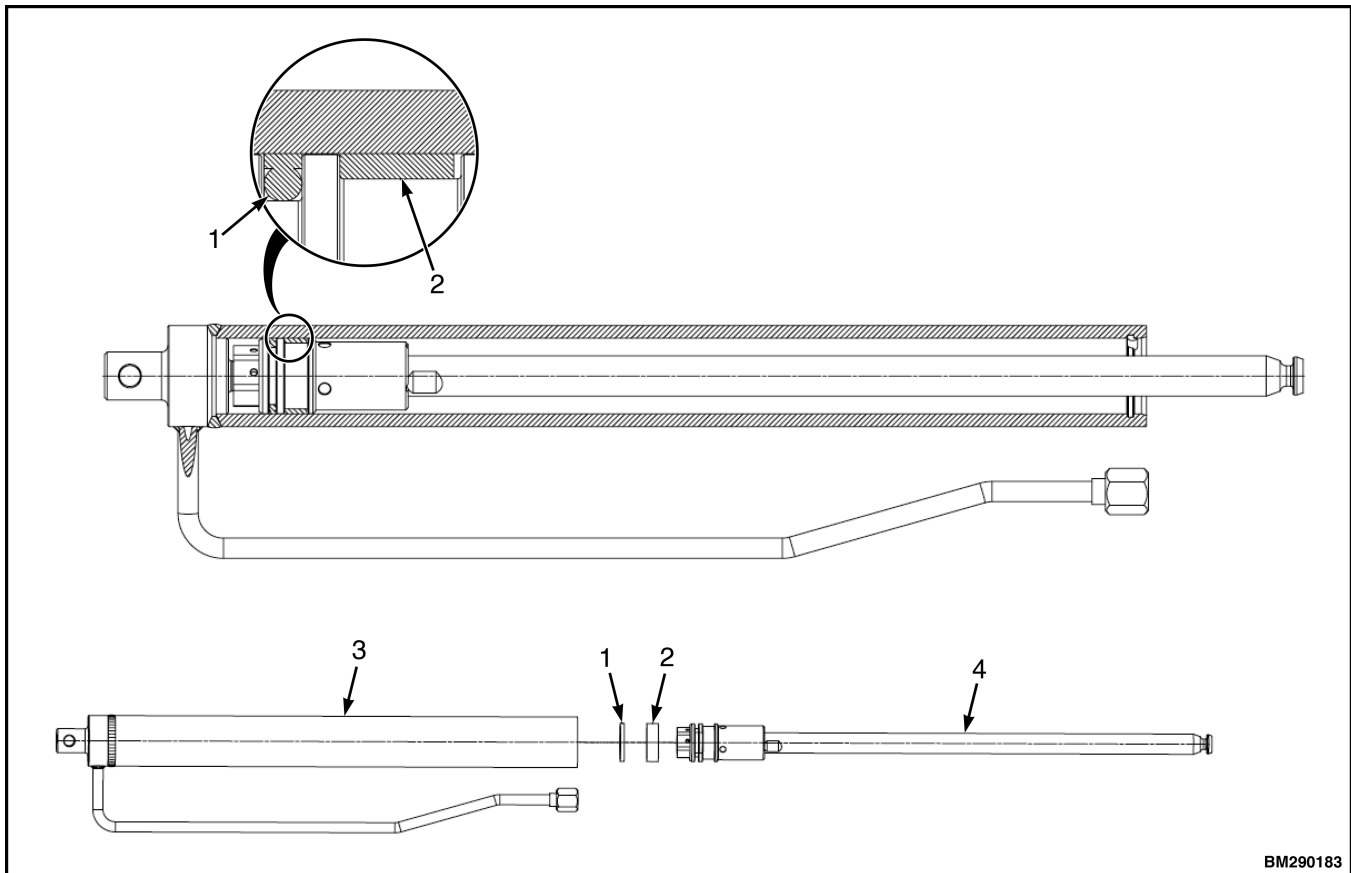
- 2. HOUSING (CENTRAL BODY)

Figure 52. Actuator and housing

Replace actuator seals

1. Remove actuators as specified in Disassemble actuators.

2. Place the seals as shown in Figure 53.



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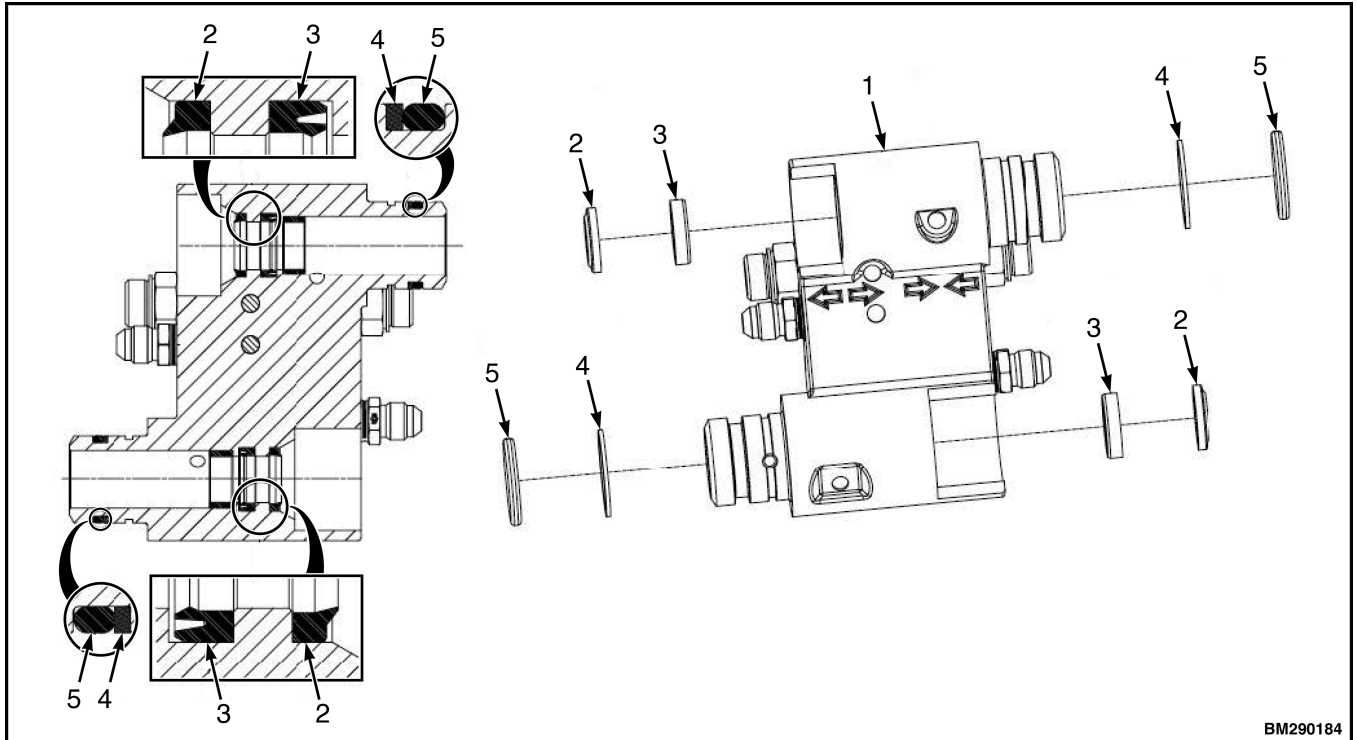
- 1. SEAL
- 2. SEAL

- 3. GUIDE ASSEMBLY
- 4. PISTON ROD

Figure 53. Seal replacement for fork positioning actuators

Replace actuator valve seals

1. Replace valve seals as shown in Figure 54.



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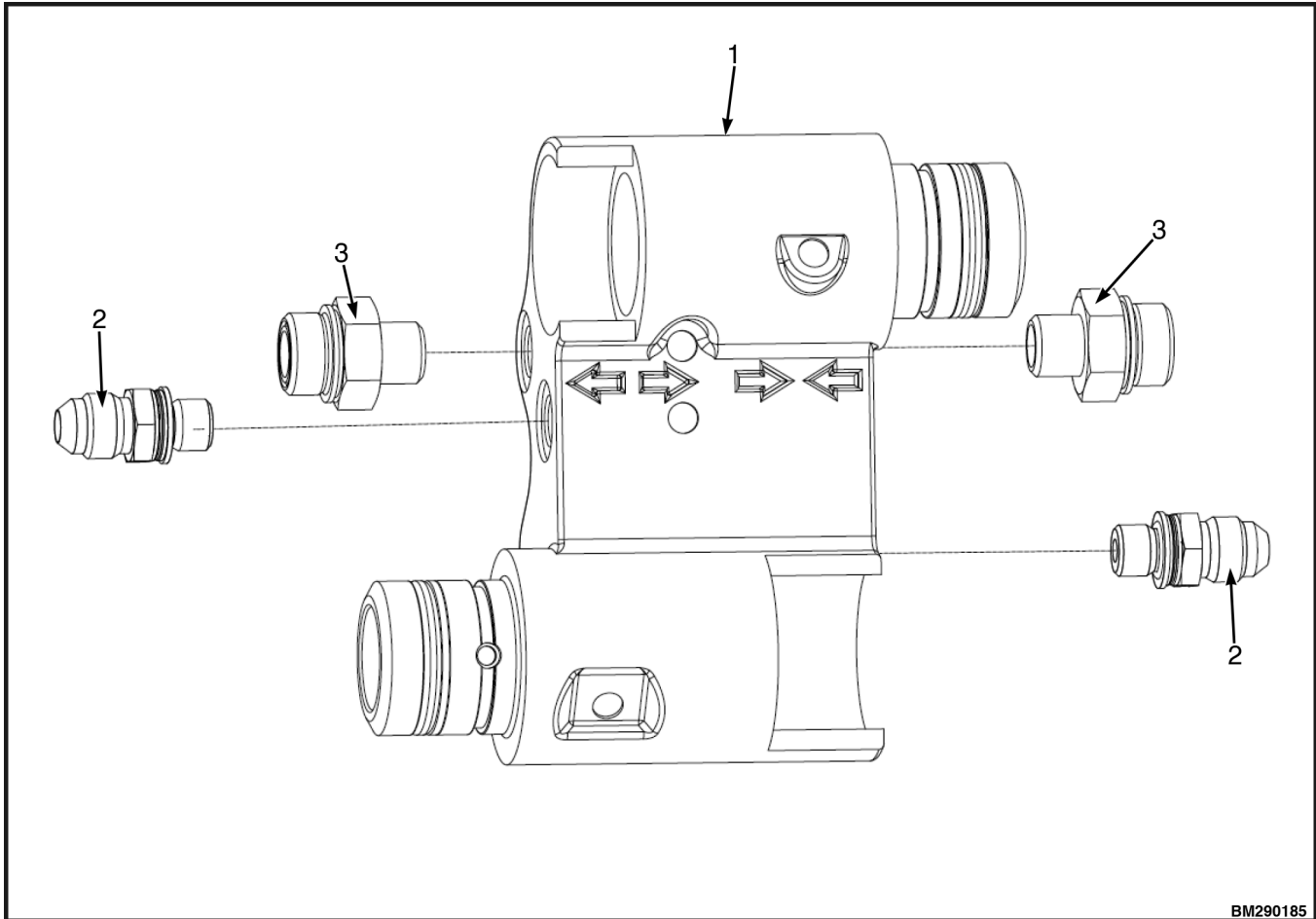
- 1. CENTRAL BODY VALVE
- 2. WIPER
- 3. SEAL

- 4. SEAL
- 5. RING

Figure 54. Replacing seals

Replace actuator valve fittings

- 1. When replacing fittings (items 1 and 2, Figure 55), on the valve, use a 19 mm wrench to tighten fittings to 20 N•m (15 lbf ft).



- 1. VALVE
- 2. FITTING

- 3. FITTING

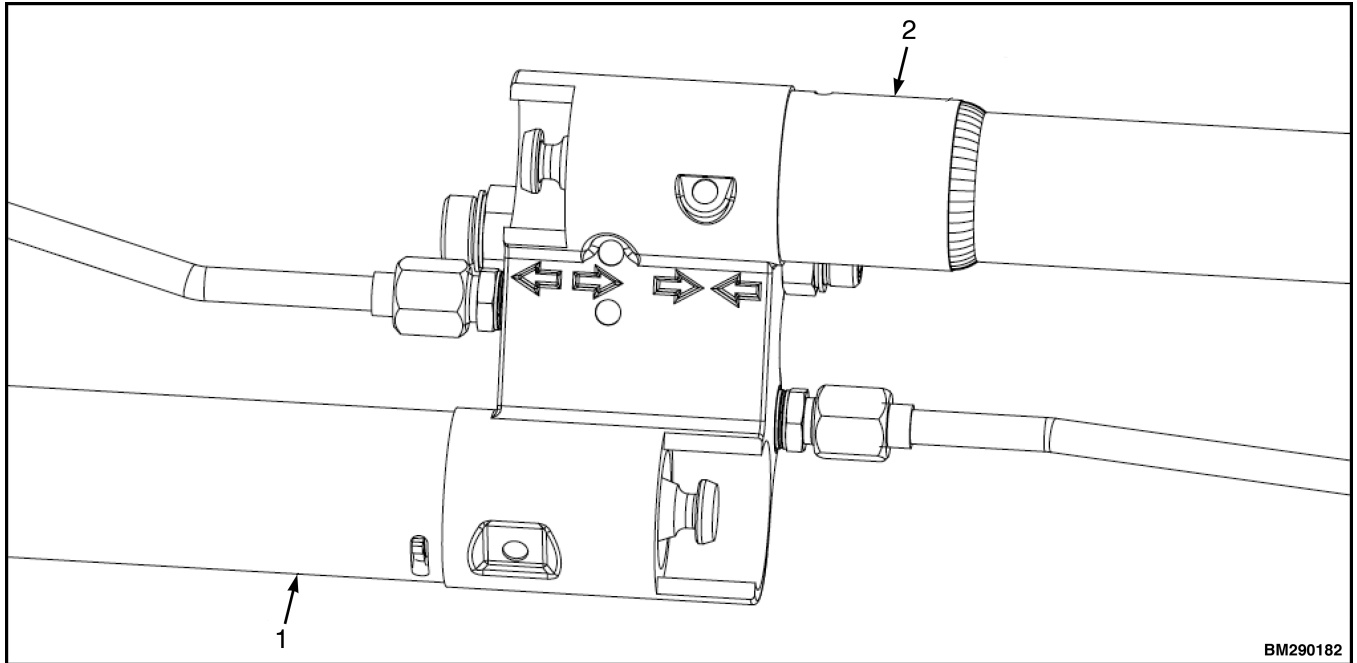
Figure 55. Fitting replacement

Assemble actuator

NOTE: Check tags to be sure the correct actuator is installed into the correct housing port.

1. Install the actuator by pushing it into the housing.

Install opposite actuator by pushing into the actuator housing. The actuators have different bores; ensure they are not mixed up during reassembly. For correct positioning, refer to Figure 56.



1. ACTUATOR HOUSING

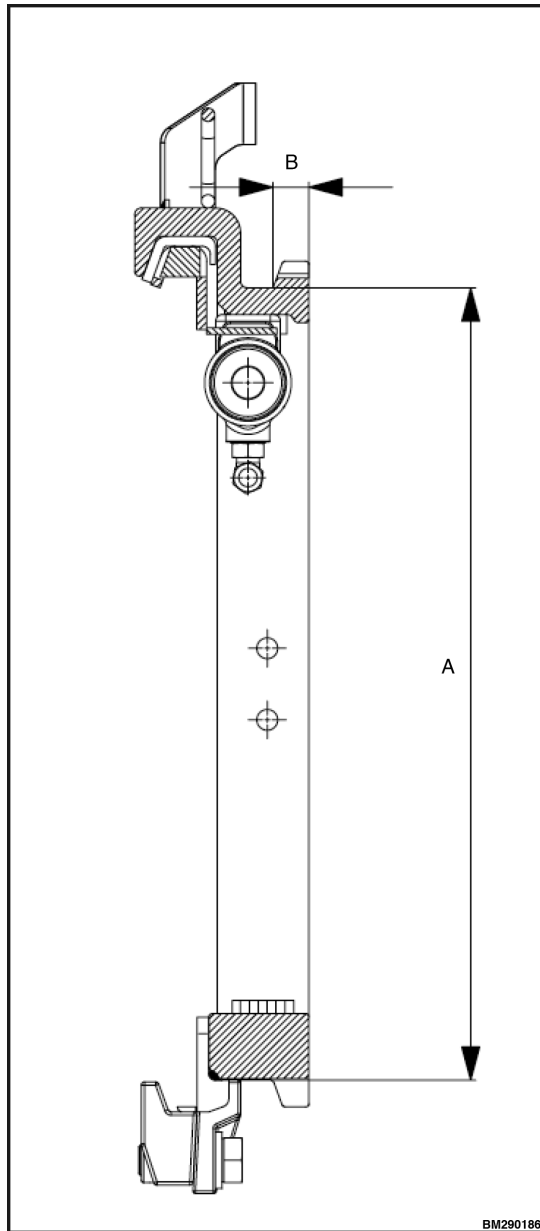
2. HOUSING

Figure 56. Correct actuator positioning

2. Using pin drive and star screw driver, install new ring to each actuator and housing, rotating the in the opposite direction of removal.
3. Engage fitting and nut completely.

Forklift and integrated sideshift (ISS) carriage requisites

Measurements



	ISO 2328 Dimension "A"		ISO 2328 Dimension "B"	
	Min.	Max.	Min.	Max.
Class II	380 mm (14.96 in.)	381 mm (15 in.)	15 mm (0.59 in.)	16 mm (0.63 in.)
Class III	474.5 mm (18.68 in.)	476 mm (18.74 in.)	20.5 mm (0.82 in.)	21.5 mm (0.85 in.)

Figure 57. ISS Carriage Frame



WARNING

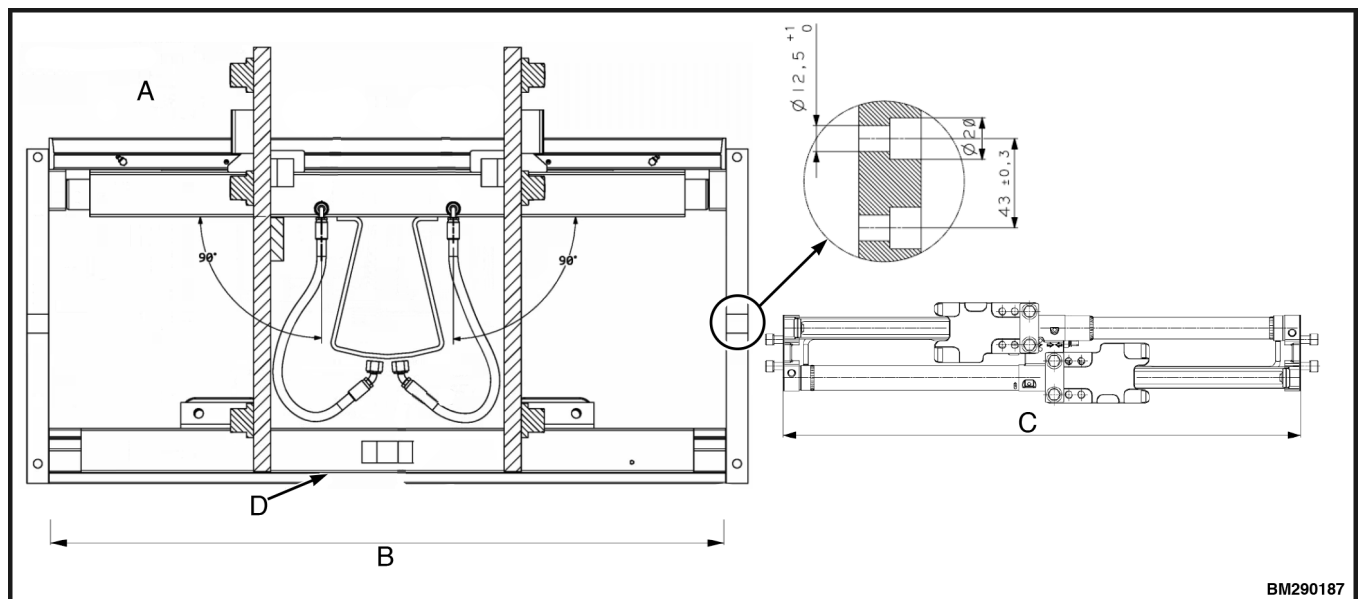
Before installing the fork positioner, clean and grease the guide profiles (item A, Figure 58) of the integrated side-shift carriage. Check for damage, dents or deformity. If the carriage is damaged or out of shape it must be replaced before installing the fork positioner. Verify the presence of mounting holes, on the sides of the carriage frame, as shown (item E).

1. The internal width (item B, Figure 58) of the integrated sideshift carriage frame must be compatible with the length of the fork

positioner (item C). See Table 2 for lengths available. Furthermore, the integral sidesift carriage must have the outlet (item D) on the lower frame bar, with shape and dimensions according to ISO 2328, for fork assembly.

Table 2. Available nominal positioner lengths

833 mm (32.8 in.)
903 mm (35.55 in.)
993 mm (39.09 in.)
1146 mm (46.1 in.)



- A. GUIDE PROFILE
- B. INTERNAL WIDTH
- C. FORK POSITIONER LENGTH

- D. OUTLET ON THE LOWER FRAME BAR
- E. FORK POSITIONER MOUNTING HOLES

Figure 58. Integrated side-shift carriage measurements

2. The recommended hydraulic system contains an independent control and two auxiliary power hoses with a minimum diameter of 6 mm (0.25 in.).

in both directions while the forklift is off. Ensure that no one turns the ignition key or moves the forklift's command lever for the entire duration of maintenance.

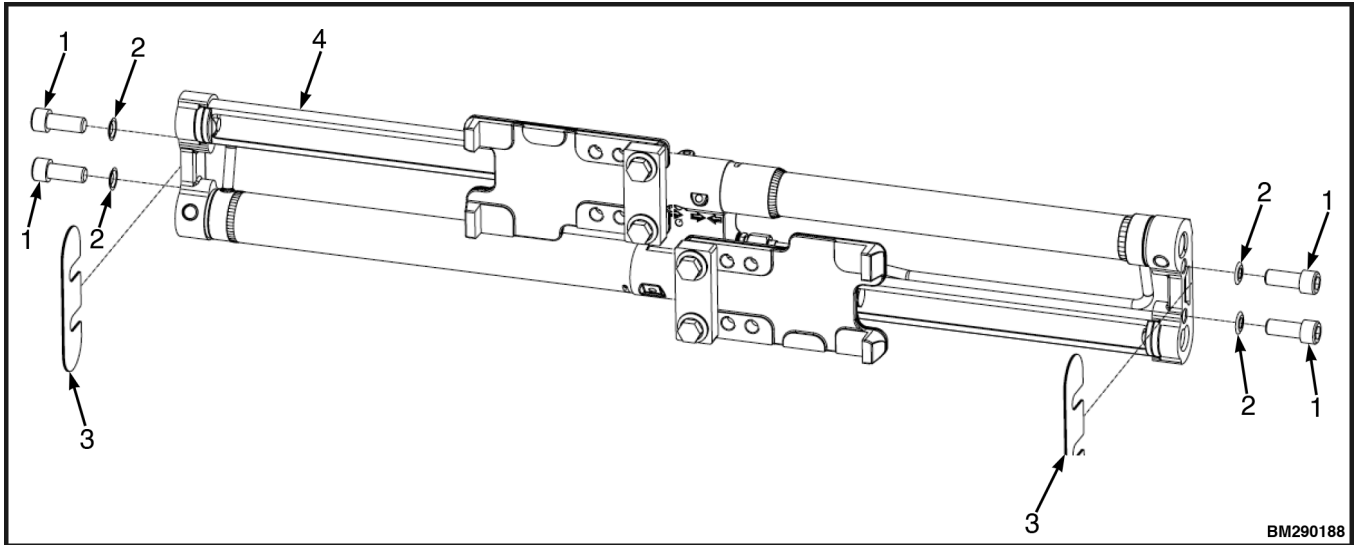
Installing the Fork Positioner



WARNING

Before any maintenance operation, turn off the forklift and remove pressure from the hydraulic circuit by repeatedly moving the positioner levers

1. Installing the positioner to integrated sideshift carriage.
 - a. If not already done, use a 10 mm wrench to remove the side mounting screws, washers, and shims from the fork positioner. See Figure 59.



- | | |
|-----------|-----------------------------|
| 1. SCREW | 3. SHIM |
| 2. WASHER | 4. FORK POSITIONER ASSEMBLY |

Figure 59. Side fastening screws

- b. Place the Bolzoni fork positioner inside the frame of the integral sideshift carriage, orienting it as shown in Figure 60, aligning the holes with those on the sides of the carriage outer frame.

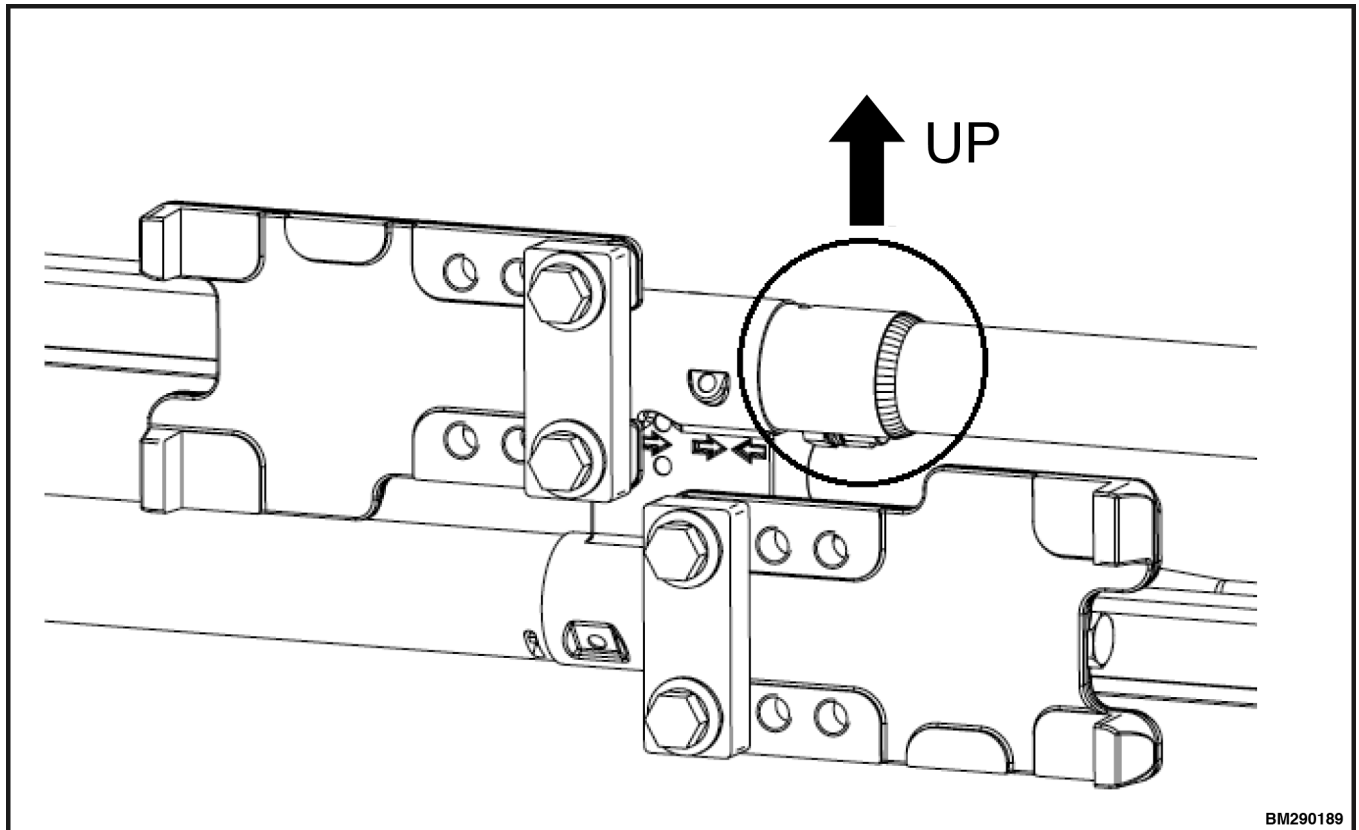
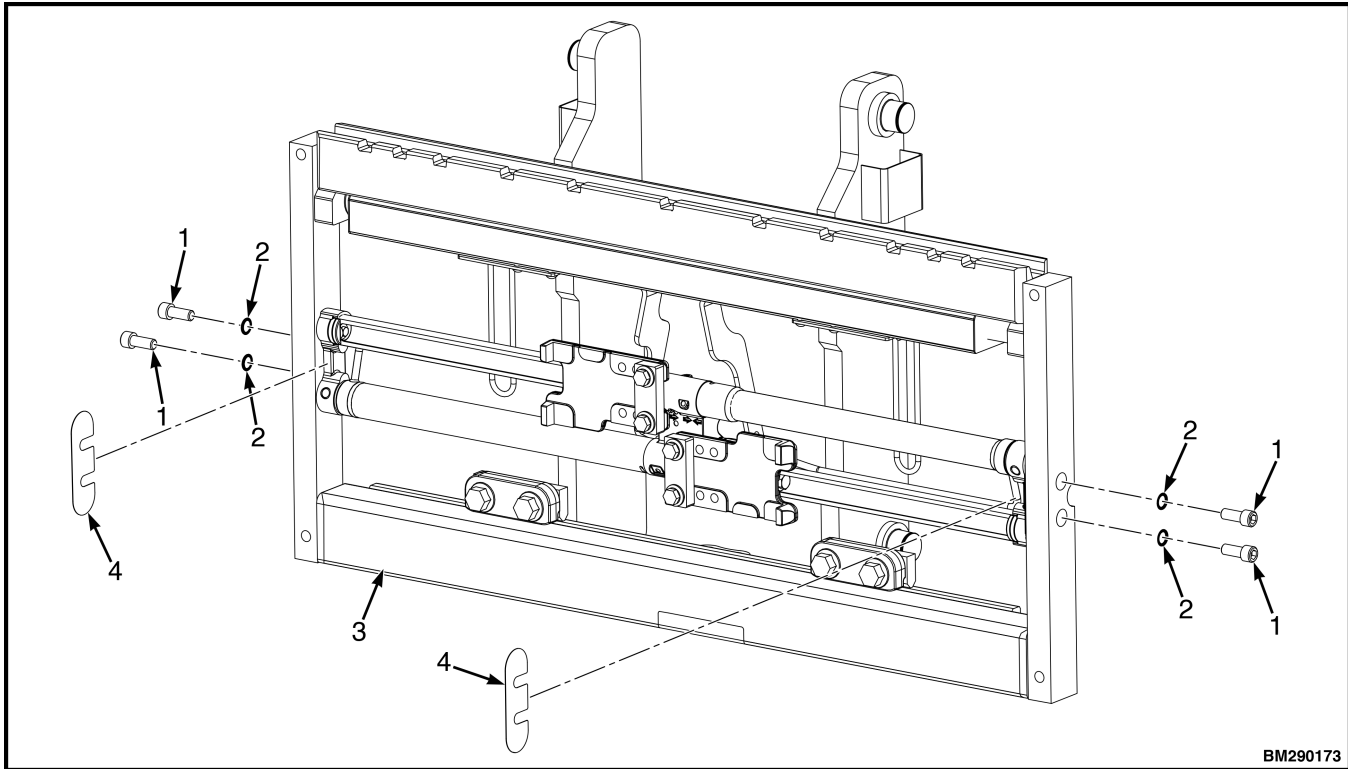


Figure 60. Fork positioner and carriage positioning

- c. Insert the washers and side mounting screws in carriage outer frame and fork positioner. See Figure 61. Tighten the screws by hand without fully tightening them.



- | | |
|-------------------------|-----------------------|
| 1. SIDE MOUNTING SCREWS | 3. SIDESHIFT CARRIAGE |
| 2. WASHERS | 4. SHIMS |

Figure 61. Insert washers and screws

- d.** Insert an appropriate number of shims (item 4, Figure 61), depending on the lateral play between the Bolzoni fork positioner and the integral sideshift carriage (item 3). Divide the required number of shims equally between the two sides.
- e.** Tighten the screws, on the right side only, using the 10 mm wrench to 142 N•m (105 lbf ft). See Figure 62.

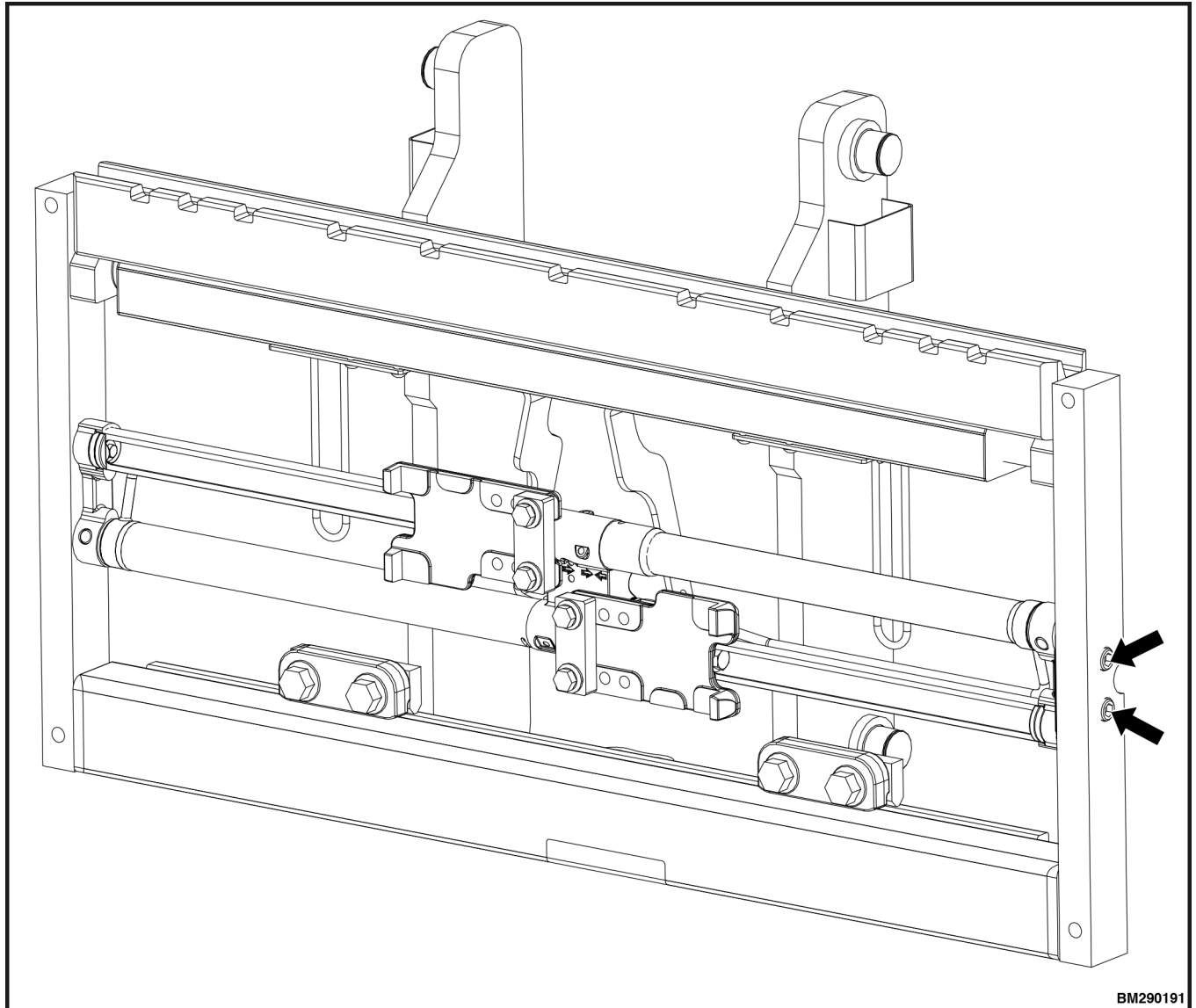
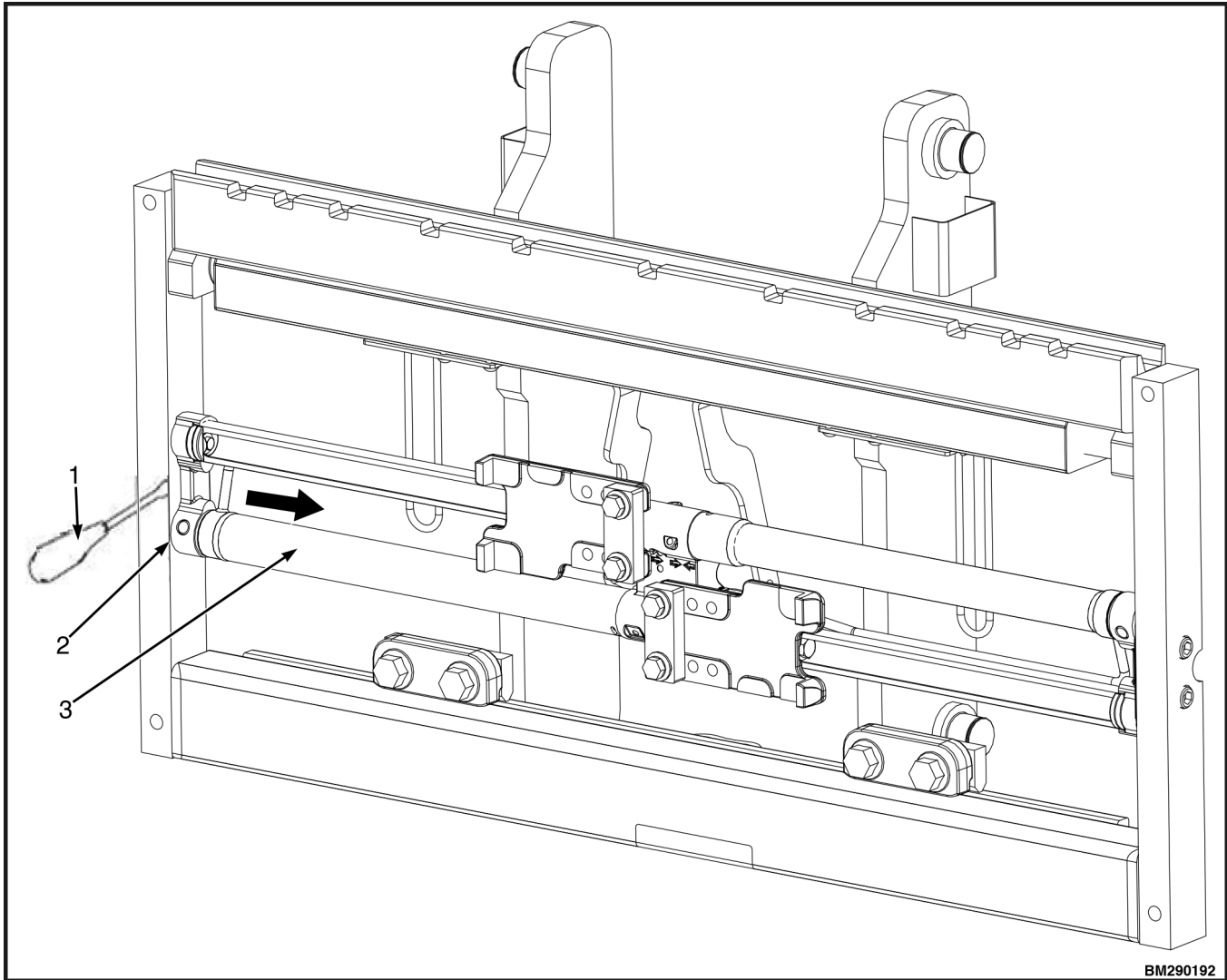


Figure 62. Right side screw tightening

- f.** Pry beneath the shims (item 2, Figure 63) on the left side using a star screwdriver (item 1), then push the fork positioner assembly (item 3) completely apart.

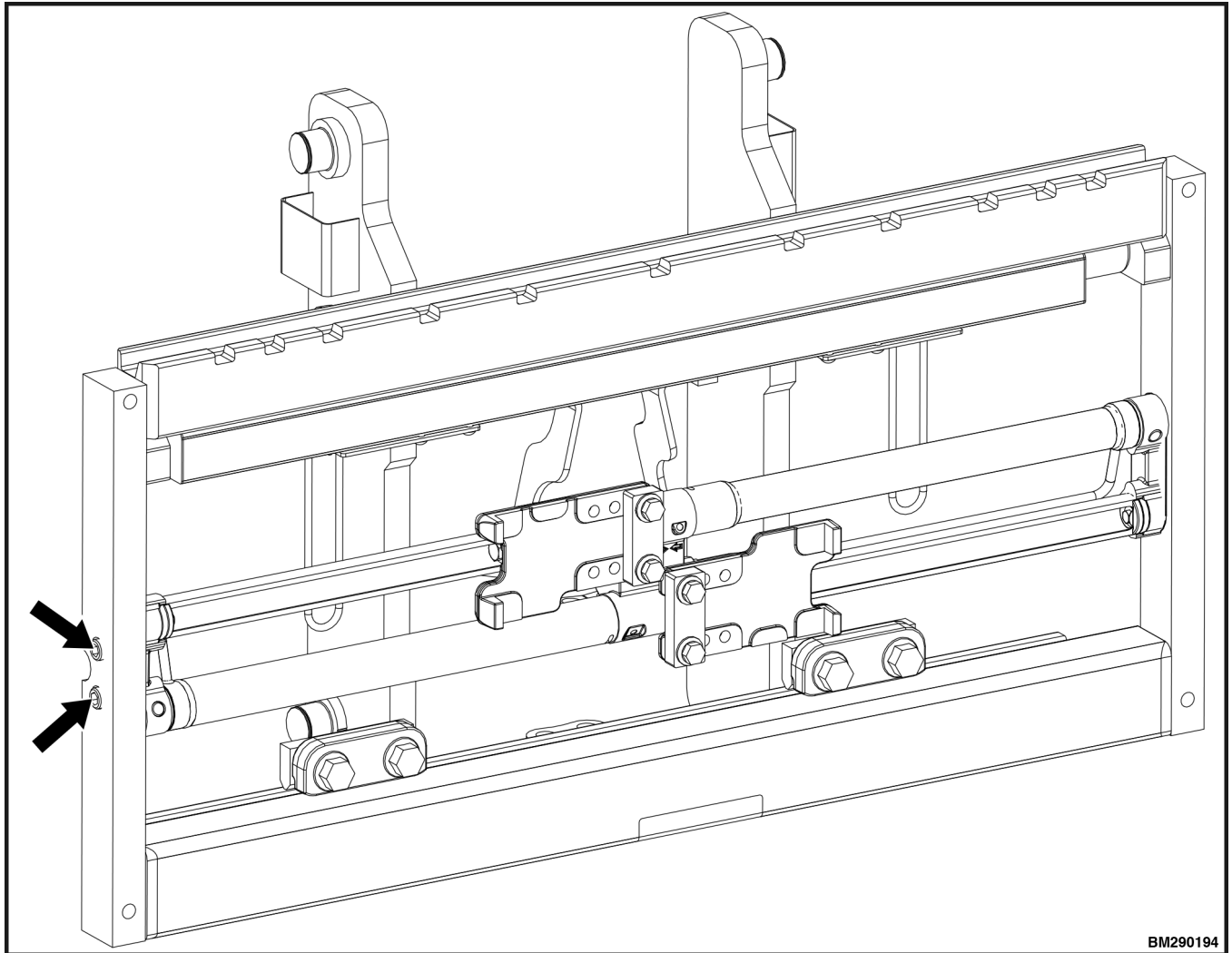


1. STAR SCREWDRIVER
2. SHIMS

3. FORK POSITIONER ASSEMBLY

Figure 63. Fork positioner adjustment

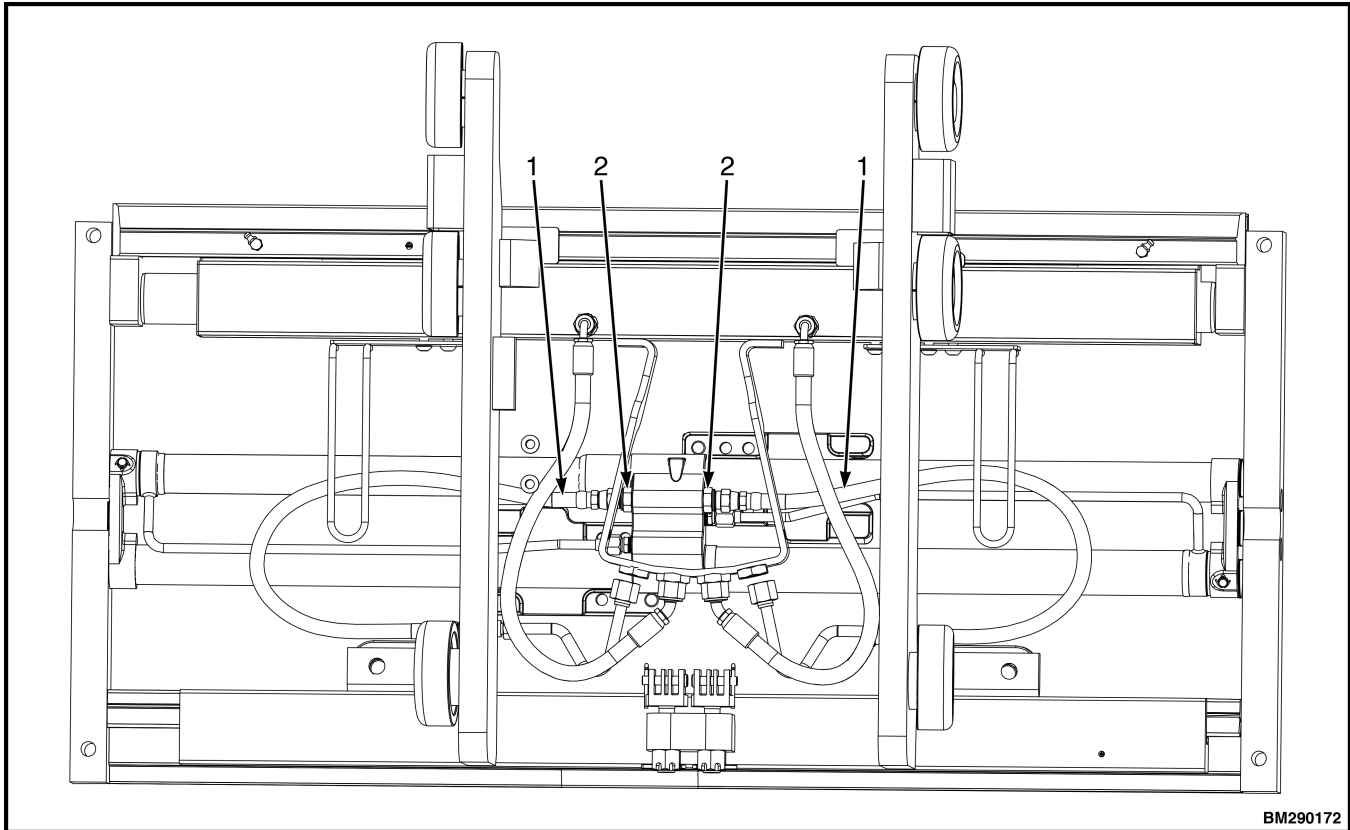
- g. Also on the left side, if necessary, add additional shims to completely eliminate any residual play.
- h. Use the 10 mm wrench to tighten the remaining screws to 142 N·m (105 lbf ft). See Figure 64.



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Figure 64. Left side screw tightening

- i. Reconnect the hydraulic hoses to the fork positioner using the 19 mm wrench. See Figure 65.



1. HYDRAULIC HOSE

2. FITTING

Figure 65. Hydraulic hose connect

- j. Install the forks, see Fork removal and replacement.

Mast repair

2-STAGE LIMITED FREE LIFT (LFL) MAST REPAIR 202001-074

REPAIR MAST WITH SERIAL NUMBER G507/G562

Remove



WARNING

The mast is heavy. The mast can weigh approximately 824 kg (1816.6 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.



WARNING

Mast weldments can slide when the mast is moved. A weldment that slides can cause serious injury.



WARNING

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



CAUTION

Make sure all the mast weldments are fastened together. Make sure the safety chains will not damage the sheaves, tubing, or other parts of the mast.

NOTE: If mast needs to be disassembled, remove the forks and carriage. See sections *Fork removal and replacement* and *Carriage repair, 2-stage limited free lift* in this manual for procedures. If only the main lift cylinders need to be removed for repair, the mast does not need to be removed from the lift truck. See *Lift cylinder repair in Hydraulics* service manual for procedures to remove the main lift cylinders.

NOTE: The length of the lift chains must be checked before the mast is removed. See the lift chain measurement section in *Clean and Inspect*.

1. Fully lower all mast weldments. Tilt mast fully forward.
2. Connect a crane with a capacity of at least 824 kg (1816.6 lb) to top of mast using chains to support mast in an upright position when tilt cylinders are disconnected. See section *Safety Procedures When Working Near Mast* in this manual.



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.

Completely lower the forks to relieve hydraulic pressure before disassembling any part of the lift pump or disconnecting any hoses.

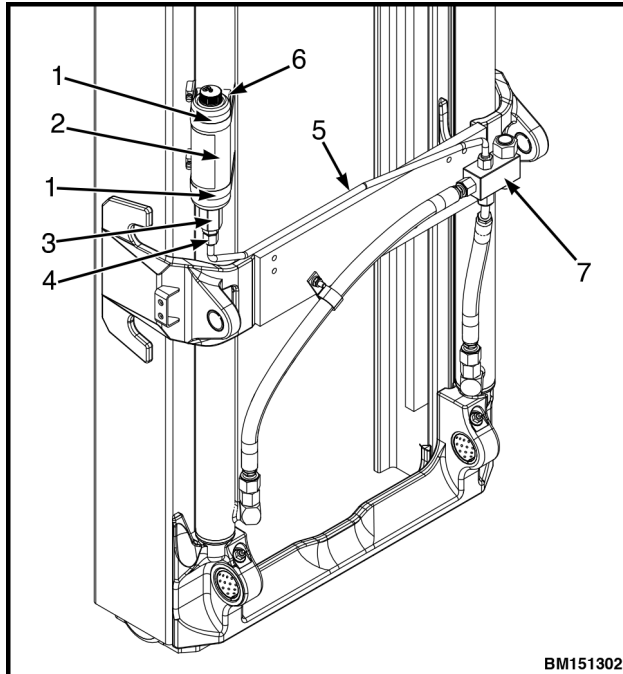
The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.



CAUTION

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

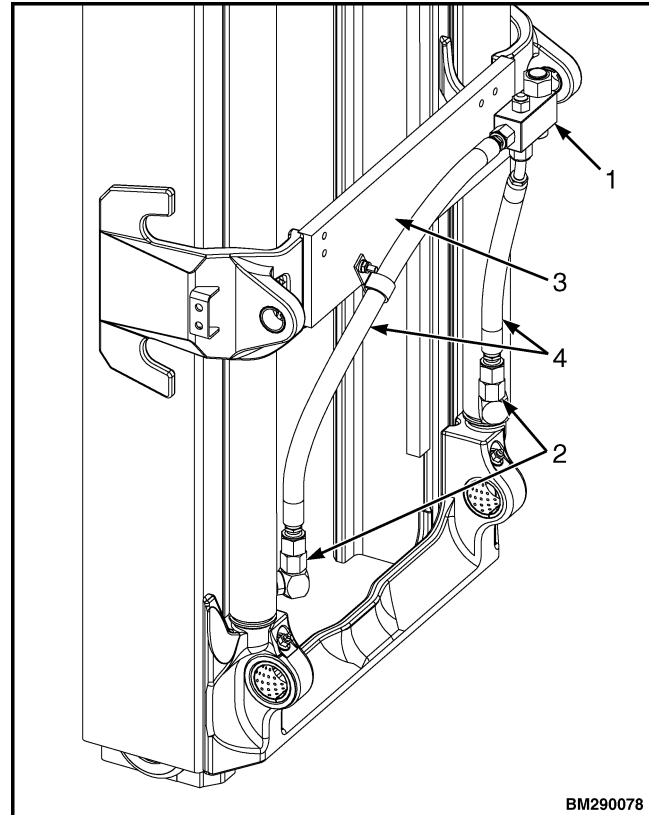
3. Position a drip pan under the area of the hydraulic fittings. See Figure 67.
4. Disconnect the flow control fitting from the mast accumulator. See Figure 66.



1. STRAP
2. ACCUMULATOR
3. FLOW CONTROL FITTING
4. TUBE FITTING
5. HYDRAULIC TUBE
6. SPACER
7. MANIFOLD

Figure 66. Mast accumulator

5. Loosen the two strap clamps securing the mast accumulator and remove the accumulator. See Figure 66.
6. Disconnect the hydraulic tube from the manifold. See Figure 66.
7. Disconnect the hydraulic hose at the manifold on the outer mast. See Figure 67.



1. MANIFOLD
2. HYDRAULIC VELOCITY FUSE
3. MAST
4. HYDRAULIC HOSES

Figure 67. Mast hoses and manifold



WARNING

Use a driver, NOT your fingers, to push the anchor pins from the clevises on the tilt cylinders. The cylinder or mast can move and cause serious injury.

8. Remove capscrews, washers, anchor pins, and pivot pins at the tilt cylinder mounts on the outer mast. See Figure 68.
9. Using a brass drift pin, remove the tilt rod bushings from the outer mast. Discard tilt rod bushings. See Figure 69.

NOTE: Allow mast to tilt forward enough to gain access to the mast mount capscrews.

10. Disconnect lower mast mounts from the lift truck by removing the capscrews that retain the mast pivot pins to the mounts on the drive axle. See Figure 70 and Figure 71.



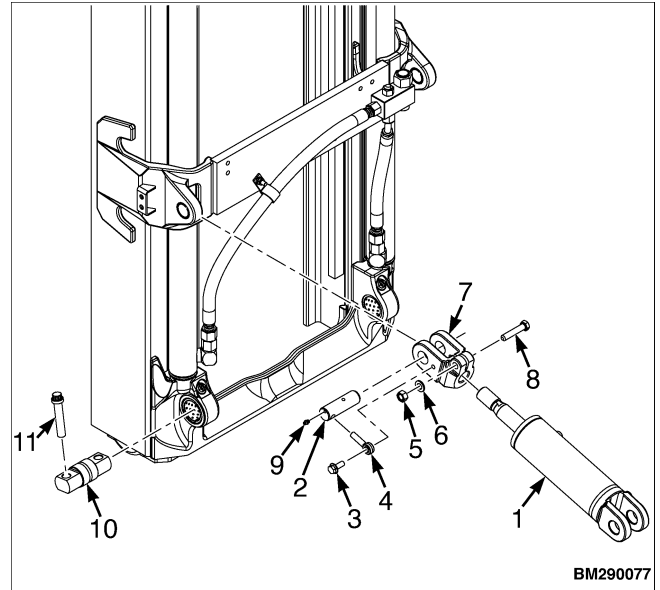
WARNING

The mast is heavy. The mast can weigh approximately 824 kg (1816.6 lb) . Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

11. Use the crane to lift the mast assembly from lift truck. Position mast across wooden beams on the floor with the carriage side up.

NOTE: If mast mounting bushing needs to be replaced, go to Step 14 for procedures.

12. Check the mast and mounting flanges for wear or damage by removing the mast pivot pins from the outer mast. See Figure 71.
13. Check that pins fit snug in the outer mast. If pins can be moved up and down a minimum of 4 mm (0.20 in.), replace the bushings in the outer mast and/or mast pivot pins as required. See Figure 69.
14. Remove the lube fitting, lube capscrew, and washer from mast mounts. See Figure 73. Use a brass drift pin to remove the mast mounting bushings from the outer mast. Discard mast mounting bushings. See Figure 69.



1. TILT CYLINDER
2. PIVOT PIN
3. CAPSCREW
4. PIN ANCHOR
5. NUT
6. WASHER
7. ROD END
8. CAPSCREW
9. GREASE FITTING
10. MAST MOUNTING PIN
11. CAPSCREW

Figure 68. Mast Mounting, Tilt Cylinder

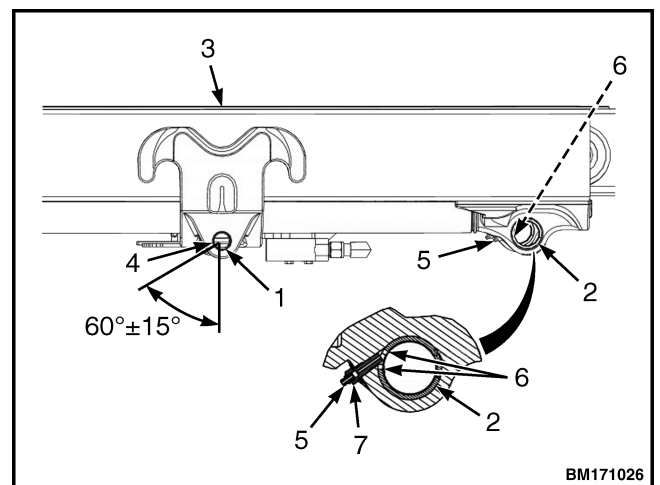
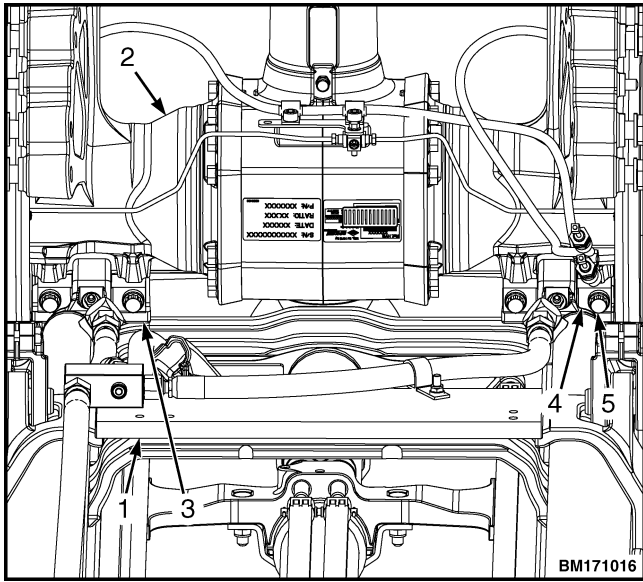


Figure 69. Tilt Rod and Mast Mounting Bushings

Legend for Figure 69.

- | | |
|-----------------------------------|------------------|
| 1. TILT ROD BUSHING | 5. LUBE FITTING |
| 2. MAST MOUNTING BUSHING (BRONZE) | 6. BUSHING HOLE |
| 3. OUTER MAST | 7. LUBE CAPSCREW |
| 4. BUSHING SPLIT | |



- | |
|-------------------|
| 1. MAST |
| 2. DRIVE AXLE |
| 3. HANGER MOUNTS |
| 4. MAST PIVOT PIN |
| 5. CAPSCREW |

Figure 70. Mast Mounts, Drive Axle

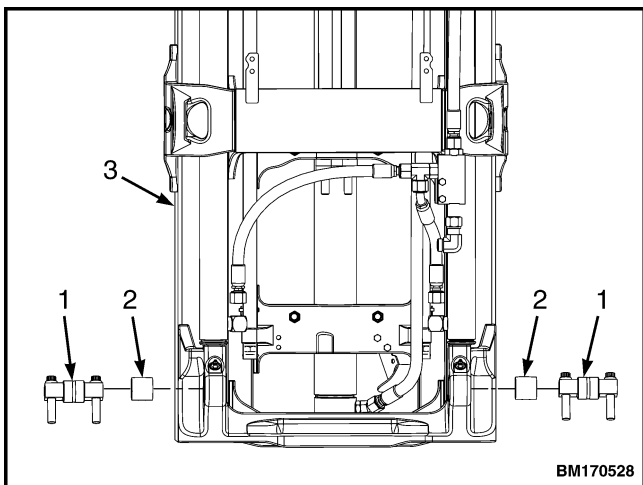


Figure 71. Mast Pivot Pins

Legend for Figure 71.

- | |
|-----------------------------------|
| 1. MAST PIVOT PIN |
| 2. MAST MOUNTING BUSHING (BRONZE) |
| 3. OUTER MAST |

Disassemble



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.



WARNING

Completely lower forks to relieve hydraulic pressure before disconnecting any hydraulic hoses.



WARNING

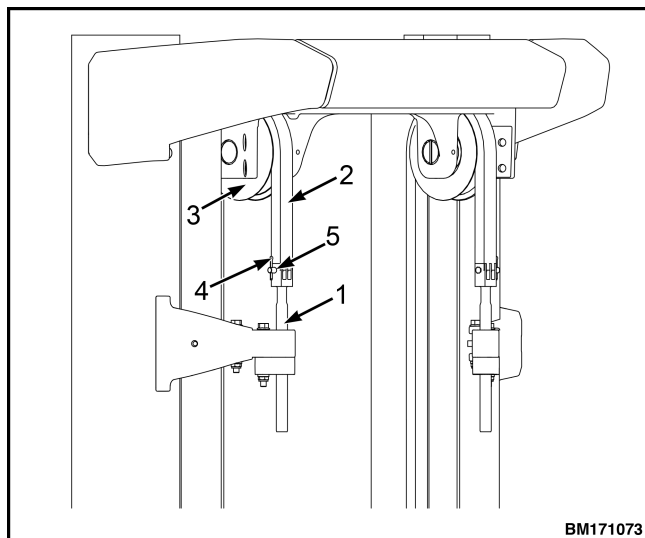
Hydraulic oil is hot after system operation and can cause burns. **DO NOT** disconnect any hydraulic hoses until the oil in the system has cooled.



CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses from the mast. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

1. Clean the area around hydraulic fittings for lift cylinders. Disconnect fittings at the lift cylinders and put caps on the open lines. See Figure 73.
2. Disconnect the two main lift chains from the chain anchors near the top of the main lift cylinders. See Figure 72.



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

Figure 72. Chain anchors

3. Disconnect hydraulic lines and fittings between lowering control valve housing and main lift cylinders. Remove capscrews and nuts and remove lowering control valve housing and valve from bracket on outer mast. See Figure 73.



WARNING

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

4. Remove the nut, capscrew, spacer, and washer at the mount near top of each main lift cylinder. Remove snap rings and washers from top of each main lift cylinder. Disconnect main lift chains at the mounts. See Figure 73.



WARNING

The mast weldments can slide when the mast is moved. A weldment that slides can cause injury.

5. Slide the inner mast from the outer mast approximately 30 cm (12 in.) to disengage the main lift cylinders from the inner mast. Remove the main lift cylinders from the outer mast.
6. Slide the inner mast from the bottom of the outer mast 30 cm (12 in.). See Figure 73.
7. Remove the wear strips and load rollers from the top of the outer mast. See Figure 74 and Figure 73.
8. Remove the load rollers from the bottom of the inner mast. Make a note of each shim arrangement and load roller location. The shim arrangements will be the same during assembly. See Figure 74.

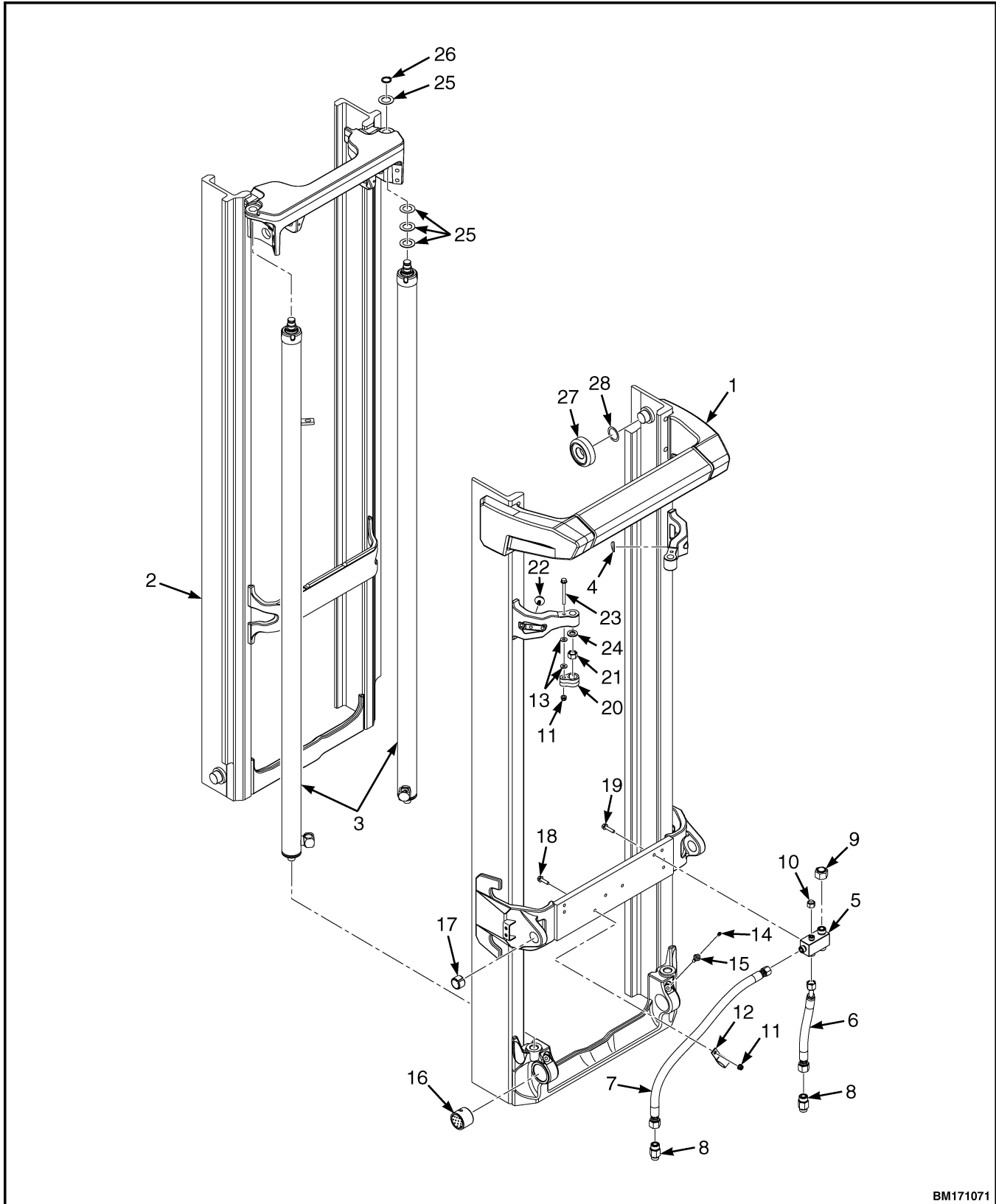


WARNING

The mast is heavy. The mast can weigh approximately 824 kg (1816.6 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

NOTE: When replacing the outer mast, copy the part number and date code information from the old channel and stamp that information on the new channel with a letter **R** at the end to indicate that it has been replaced.

9. Slide inner mast halfway out of the top of the outer mast. Connect a crane with a capacity of at least 824 kg (1816.6 lb) to the center of the inner mast. See Figure 75. Slide inner mast out of the outer mast until the mast stub shafts of the inner mast are in the notches of the outer channels. Remove the inner mast from the outer mast.
10. Remove chain sheaves and disassemble them as necessary for repair and cleaning. See Figure 74.

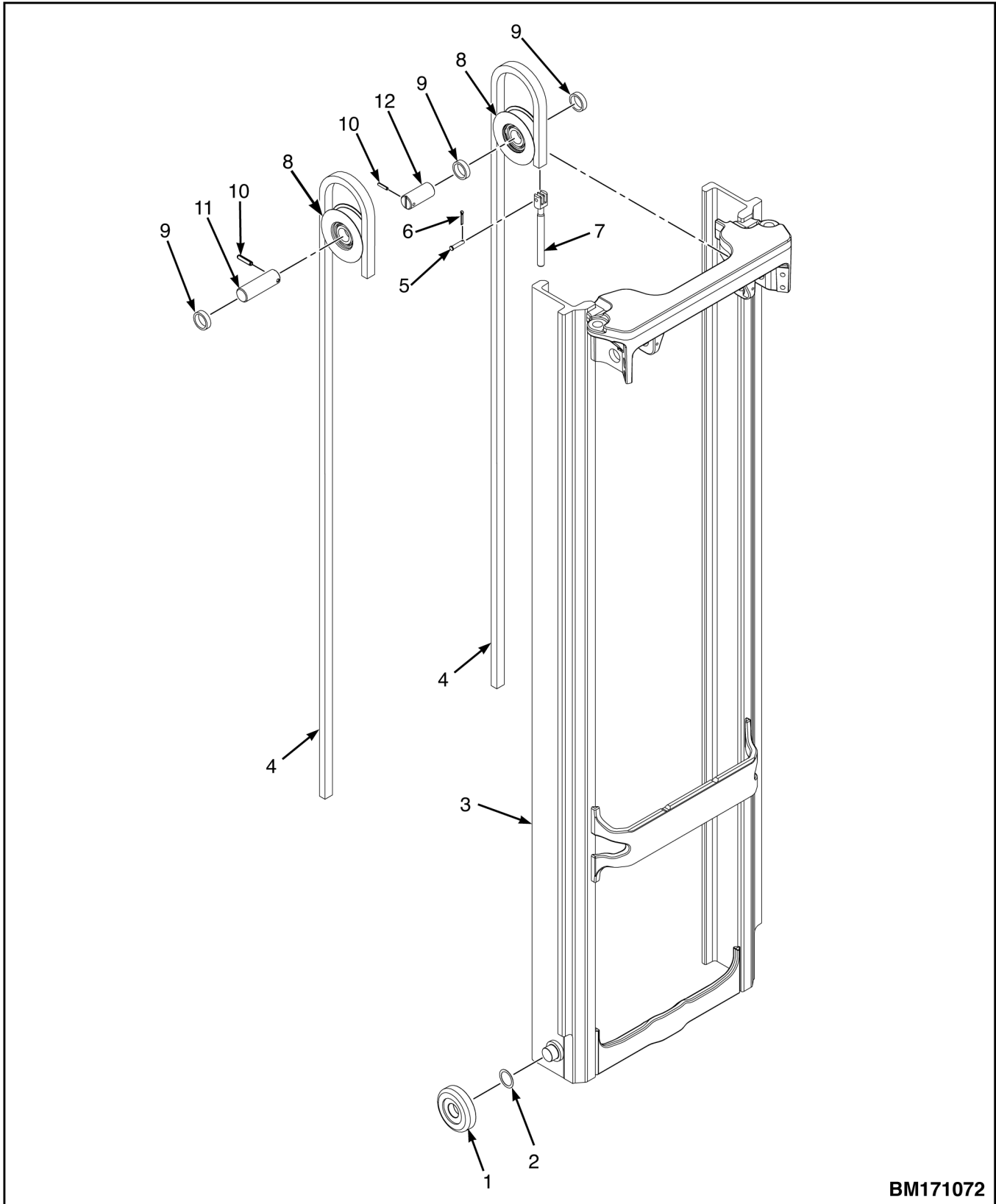


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Figure 73. Main lift cylinders and outer mast

Legend for Figure 73.

- | | |
|----------------------------|-----------------|
| 1. OUTER MAST | 15. WASHER |
| 2. INNER MAST | 16. BUSHING |
| 3. LIFT CYLINDER | 17. BUSHING |
| 4. NUT | 18. CAPSCREW |
| 5. MANIFOLD | 19. CAPSCREW |
| 6. HOSE | 20. RESTRAINT |
| 7. HOSE | 21. NUT |
| 8. HYDRAULIC VELOCITY FUSE | 22. RUBBER PAD |
| 9. FITTING | 23. CAPSCREW |
| 10. CAPSCREW | 24. CABLE |
| 11. LOCKNUT | 25. SHIM |
| 12. CLAMP | 26. SNAP RING |
| 13. LUBE FITTING | 27. LOAD ROLLER |
| 14. LUBE CAPSCREW | 28. SHIM |

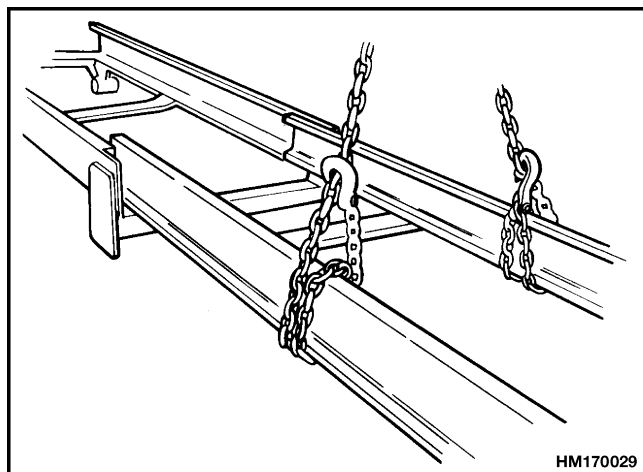


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Figure 74. Inner Mast Components

Legend for Figure 74.

- | | |
|-----------------|--------------------------|
| 1. LOAD ROLLER | 9. BUSHING |
| 2. SHIM | 10. ROLL PIN |
| 3. INNER MAST | 11. HOSE SHEAVE PIN (LH) |
| 4. CHAIN | 12. HOSE SHEAVE PIN (RH) |
| 5. PIN | 13. WEAR STRIP |
| 6. COTTER PIN | 14. SHIM |
| 7. CHAIN ANCHOR | 15. O-RING |
| 8. CHAIN SHEAVE | |

**Figure 75. Connecting A Crane****Clean and Inspect****CAUTION**

DO NOT use steam or high-pressure water to clean the load rollers or the lift chains. Steam and high-pressure water can remove the lubrication from the bearings in the load rollers. Water in the bearings of the sheaves and the link pins of chains can also shorten the service life of these parts.

1. Inspect chain sheaves and load rollers (see Figure 74 and Figure 73) for wear or damage. **DO NOT** use steam to clean lift chain sheaves or load rollers. The bearings in the sheaves and load rollers are sealed and lubricated.

**WARNING**

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

**WARNING**

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

2. Clean lift chains by soaking in solvent for 30 minutes to remove all dirt and grease. Hang lift chains up and remove solvent using compressed air.

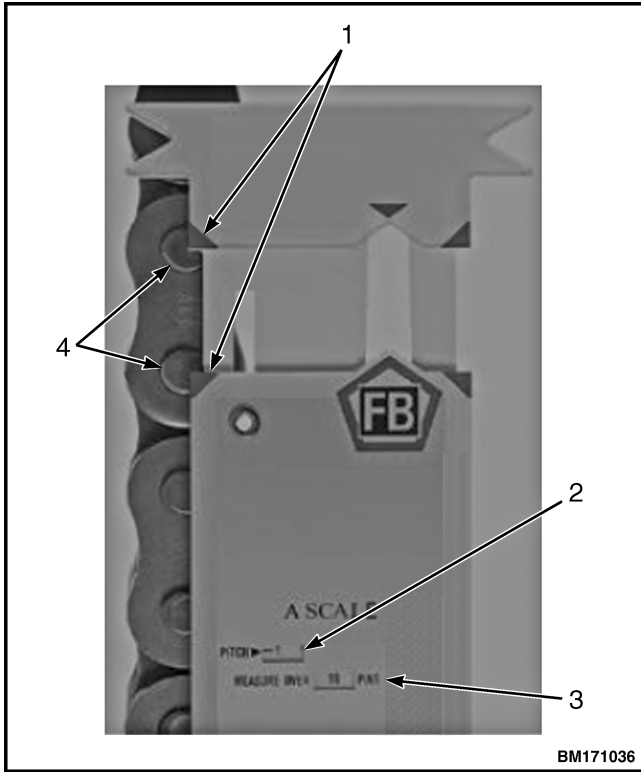
**WARNING**

Never replace only the worn section of a chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains. Damage to the lift truck and serious injury can occur if lift chains are not replaced correctly.

NOTE: The chains must be inspected in the area of chain that passes over chain sheave during the first portion of a lift. These links will show maximum wear.

3. Inspect the lift chains for wear and damage. A lift chain becomes longer when it is worn. If a chain is 3% longer than a new lift chain, the lift chain must be replaced.
 - a. Locate chain wear gauge (Hyster Part No. 4044579).
 - b. Before using the chain wear gauge, inspect the V-jaws on the top and bottom of the gauge (see items 1 and 2, Figure 77) to make sure they are not bent or damaged. Confirm the gauge is not warped or bent and slides easily. Close the gauge completely and confirm the calibration window reads "OK".

- c. Use the chain wear gauge to identify the leaf chain pitch, by aligning the two arrows on the edge of the gauge with the two pin centers of one of the OUTER link plates. See Figure 76.



- 1. ARROWS
- 2. PITCH WINDOW
- 3. MEASURE OVER PINS WINDOW
- 4. PIN CENTER

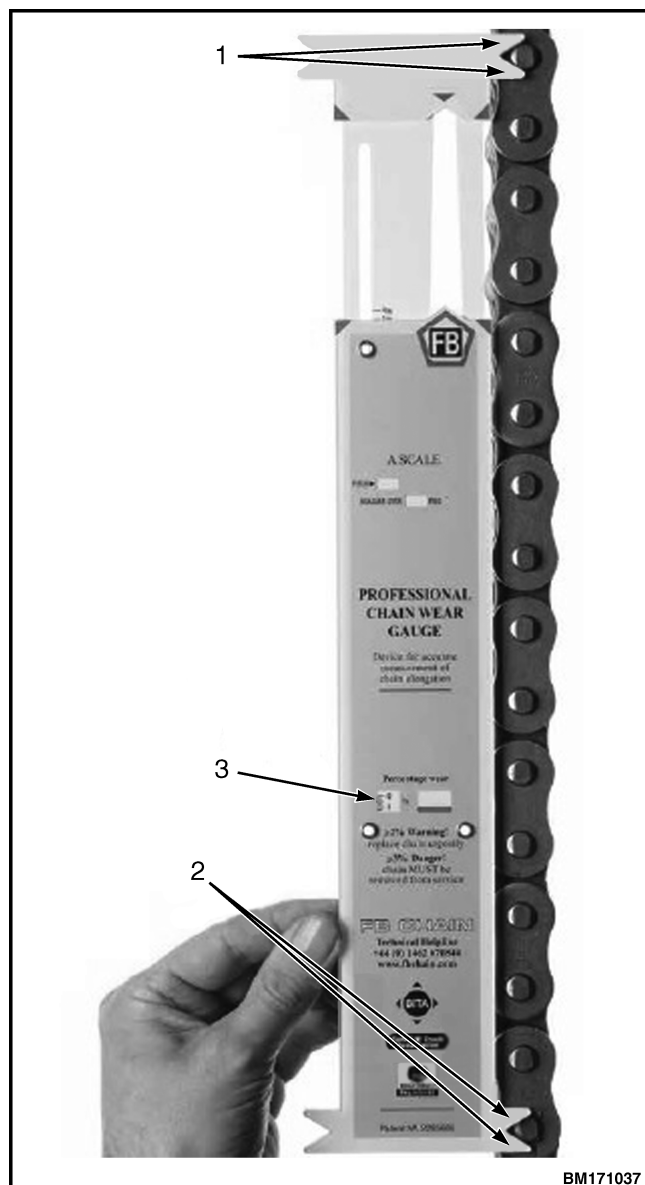
Figure 76. Measure pitch

- d. The nominal pitch of the leaf chain will appear in the "Pitch" window on the chain wear gauge. See Figure 76.

- e. Select and use the correct side of the gauge relevant to the measured nominal pitch as follows:

A Scale	B Scale
3/8"	1 3/4"
1/2"	2"
5/8"	3/4"
1"	1 1/4"
1 1/2"	2 1/2"
3"	

- f. Once the pitch has been determined, the number of pins that the chain wear is to be measured over will display in the 'Measure over Pins' window. See Figure 76.
- g. Find a portion of the chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear. Choose three separate locations in this section to perform the measurement.
- h. Make sure the leaf chain is bearing a load and place the top 'V' jaw of the chain wear gauge over the first pin of the selected section. See Figure 77. Extend the slide until the bottom 'V' jaw locates over the selected bottom pin (as previously determined in Step f of this procedure). The percentage of wear will appear in the box in 0.25% (1/4%) increments.



1. TOP V-JAW
2. BOTTOM V-JAW
3. PERCENTAGE OF WEAR

Figure 77. V-jaws

WARNING

Although the chain wear gauge will show wear up to 4%, any leaf chain used for lifting with a measured elongation of 3% or more is dangerous and must be replaced immediately.

- i. If the chain wear gauge shows a 2% or greater elongation, the red indicator will completely fill the window. This is an indication that the chain requires replacing.

4. Lubricate lift chains by soaking them in SAE 30 engine oil for 30 minutes. Hang chains over a drip pan for one hour to remove excess oil.

NOTE: Chain anchor pins **Must** be replaced anytime chains are replaced.

5. Inspect chain anchors, chain anchor pins, and chain anchor restraints. Replace any parts that are worn or damaged. See Figure 74.

WARNING

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

WARNING

Steam can cause serious burns. Wear protective clothing, gloves, and eye protection. Never expose your skin to steam.

6. Clean mast weldments with steam or solvent.

WARNING

Improper welding procedures can damage the structure of the mast or cause incorrect function of the mast which can result in serious injury to personnel. Consult your lift truck dealer for more information before welding on the mast

7. Inspect sliding surfaces for wear or damage. Inspect the load roller contact surfaces for wear or damage. Inspect all welds for cracks.

Assemble

WARNING

The mast is heavy. The mast can weigh approximately 824 kg (1816.6 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

NOTE: Shims for the load rollers keep the mast weldments parallel and provide correct clearance. During assembly, shims should be reinstalled in the same location they were in before disassembly. Check clearance and adjust shims for wear or for changes caused by repairs. The strip bearings are also adjusted by using shims and should also be reinstalled in the same location they were in before disassembly. See the Carriage Adjustments section in this service manual for the adjustment procedures.

NOTE: When the mast has header hoses, see Header Hoses, 2-stage limited free lift (LFL) for procedures to install and adjust the header hoses.

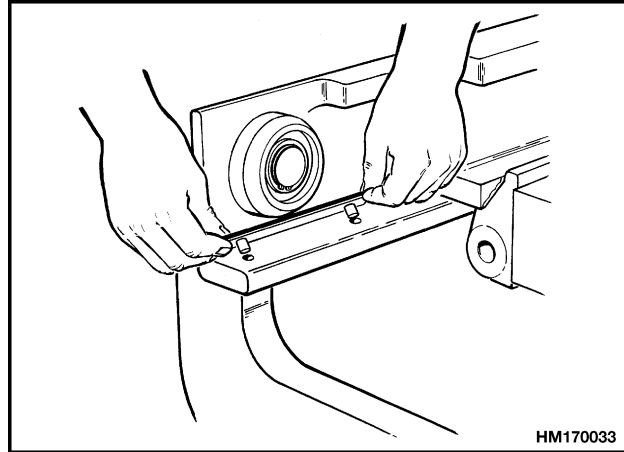


Figure 78. Wear strips

1. Connect a crane with a capacity of at least 824 kg (1816.6 lb) to the center of the inner mast. See Figure 75. Fit the stub shafts through the notches in the outer mast. Slide the inner mast into the outer mast so the stub shafts are seen at the top and bottom of the weldments. See Figure 74.
2. Install the wear strips and shims on the outer mast. See Figure 78. Apply chassis lube to the bearing surface. Check the clearance of the wear strips as described in **Mast Adjustments** section in this manual.
3. Install load rollers and shims on both weldments. Check the clearance of the load rollers as described in section **Mast Adjustments** in this service manual.
4. Install the main lift cylinders. Push the inner mast to engage the rods of the main lift cylinders. Install shims and snap rings at the top of the main lift cylinder. See Figure 73.
5. Install capscrews, restraints and nuts at the mounts for main lift cylinders. Tighten each nut to 25.2 N•m (18.6 lbf ft). See Figure 73.
6. Align the manifold on the outer mast and insert the two capscrews to retain the manifold. See Figure 67. Tighten to 19.2 N•m (14.2 lbf ft).
7. Install the two strap clamps for retaining the mast accumulator onto the left-hand tilt cylinder. See Figure 66. Orient the screws on the strap clamps toward the mast channel and up against the lift cylinder, to minimize clamp twist during torquing.
8. Install the mast accumulator and two spacers into the strap clamps. See Figure 66. Ensure the accumulator is oriented with the warning label facing out. Confirm the strap clamps are not covering any warning labels by adjusting the clamps and moving up or down accordingly.
9. Torque the screws on the strap clamps to 11.3 N•m (8.3 lbf ft). Trim off the excess straps.
10. Connect one end of the hydraulic tube to the fitting on the manifold and the other end to the flow control fitting on the accumulator. See Figure 66.
11. Tighten the fittings to standard torque.
12. Connect the hydraulic hoses and fittings between the manifold and the main lift cylinders. See Figure 73.
13. Install the chain sheaves at the inner mast. Be sure to install both pins that hold the shaft for the chain sheave in position. See Figure 74.

14. Connect the lift chains to the chain anchors at the main lift cylinder mounts. See Figure 72.
15. Attach wires between the ends of the lift chains and the crossmember to control the lift chains during mast installation.

Install

1. Install new bushings into mast mounts at bottom of outer mast. Be sure to align the hole in the bushing with the lube fitting hole in the bottom of the outer mast. See Figure 69. Bushing must be flush with outer mast surface.
2. Apply an even coat of grease to pivot pins and install them into mast mounts at bottom of outer mast. See Figure 71.
3. Install washer and lube capscrew in hole in bottom of outer mast. Tighten lube capscrew to 17 N·m (12.5 lbf ft). Install lube fitting onto lube capscrew. Tighten lube fitting to 6 N·m (53 lbf in). See Figure 69.



WARNING

The mast is heavy. The mast can weigh approximately 824 kg (1816.6 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

4. Connect crane to top of mast using chains. Make sure all mast uprights are fastened together. Make sure chains will not damage sheaves, tubing, or other parts of mast. Make sure crane has a capacity of at least 824 kg (1816.6 lb).
5. Use crane to position mast assembly onto its lower mounts. Position mast so pivot pins seat into hanger mounts on drive axle. Install capscrews that hold mast pivot pins to drive axle hangers. Tighten capscrews to 270 N·m (199 lbf ft). See Figure 70.
6. Install new bushings into the tilt anchors on the outer mast. Be sure tilt bushing split is installed at the correct angle as shown in Figure 69.



WARNING

Use a pry bar, NOT your fingers, to align the tilt cylinder clevises with the outer mast. The cylinder or mast can shift and cause serious injury.

NOTE: Use multipurpose grease #2 with 2 to 4% molybdenum disulfide for normal operations.

7. Apply an even coat of grease to pivot pins and connect tilt cylinders to mast using pivot pins. Install anchor pins and capscrews to rod ends. See Figure 68. Apply anti-seize compound to capscrew threads and tighten 38 N·m (28 lbf ft).
8. Connect hydraulic lines to lowering control valve.
9. Install carriage as described in section **Carriage repair, 2-stage limited free lift.**



WARNING

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

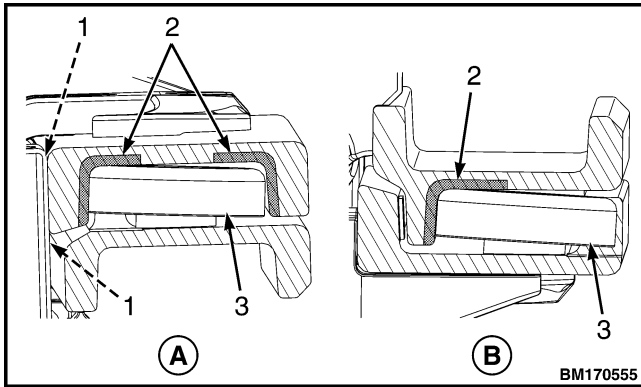
10. Check tilt cylinder adjustments as described in the Tilt cylinder repair section of this manual. Operate mast and check for leaks and correct operation. Check lift chains as described in Clean and Inspect section in this manual.

NOTE: Before checking for mast side kicking, the mast must be fully assembled to include the carriage, forks, load backrest and any attachments.

11. Raise mast, without a load to its full height and check for side kicking. Mast side kicking is when the mast moves either to the right or left as it is being raised to its full height. If mast is side kicking, see Carriage Adjustments section in this manual for procedures to correct mast side kicking.

NOTE: Load rollers and sheaves have sealed bearings and do not need additional lubrication.

12. Lubricate sliding surfaces and load roller surfaces along full length of channels as shown in Figure 79. Apply lubricant only to surfaces indicated.



- A. UPPER LOAD ROLLERS
B. LOWER LOAD ROLLERS

1. LUBRICATE STRIP BEARING SURFACES
2. LUBRICATE LOAD ROLLER SURFACES
3. LOAD ROLLER

Figure 79. Lubricate Mast

2-STAGE FULL FREE LIFT (FFL) MAST REPAIR

202001-076

REPAIR MAST WITH SERIAL NUMBER F509/F564

Remove

WARNING

The mast is heavy. The mast can weigh approximately 714 kg (1574.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

WARNING

Mast weldments can slide when the mast is moved. A weldment that slides can cause serious injury.

CAUTION

Make sure all the mast weldments are fastened together. Make sure the safety chains will not damage the sheaves, tubing, or other parts of the mast.

NOTE: If the mast needs to be disassembled, remove the forks and carriage. See the sections Fork removal and replacement and Carriage repair, 2-stage full free lift in this service manual for procedures. If only the main lift cylinders need to be removed for repair, the mast does not need to be removed from the lift truck. See the section Lift cylinder repair, in **Hydraulics** service manual for procedures.

NOTE: The length of the lift chains must be checked before the mast is removed. See Clean and Inspect section in this manual for procedures.

1. Fully lower all mast weldments. Tilt the mast fully forward. Connect a crane with a capacity of at least 714 kg (1574.1 lb) to the top of the mast using chains to support the mast in an upright position when the tilt cylinders are disconnected. See the section Safety Procedures When Working Near Mast in this manual.

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.

WARNING

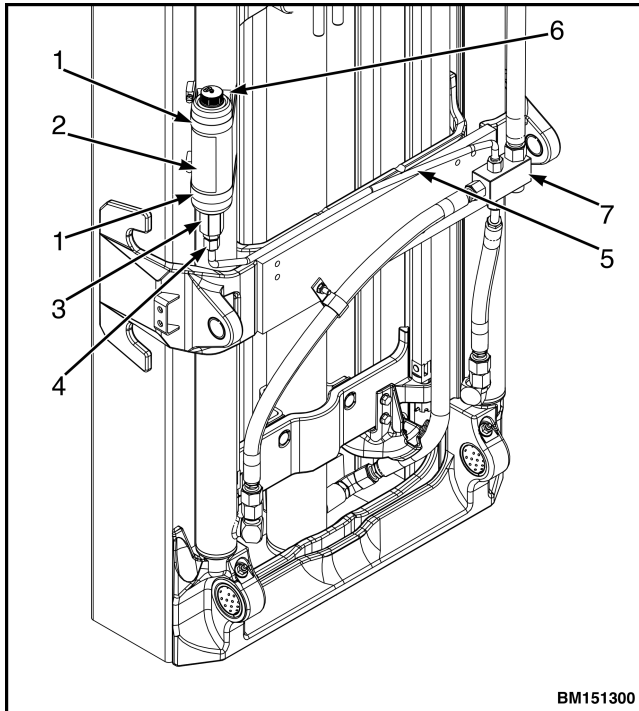
Completely lower the forks to relieve hydraulic pressure before disassembling any part of the lift pump or disconnecting any hoses.

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

CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

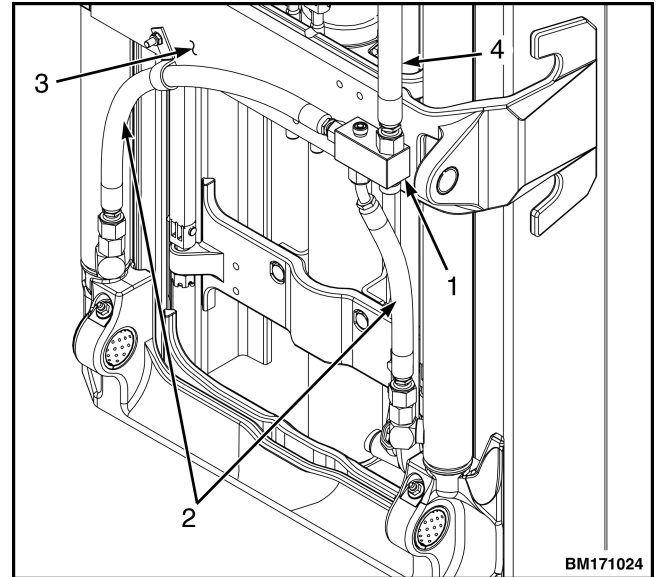
2. Position a drip pan under the area of the hydraulic fittings. See Figure 81.
3. Disconnect the flow control fitting from the mast accumulator. See Figure 80.



1. STRAP
2. ACCUMULATOR
3. FLOW CONTROL FITTING
4. TUBE FITTING
5. HYDRAULIC TUBE
6. SPACER
7. MANIFOLD

Figure 80. Mast accumulator

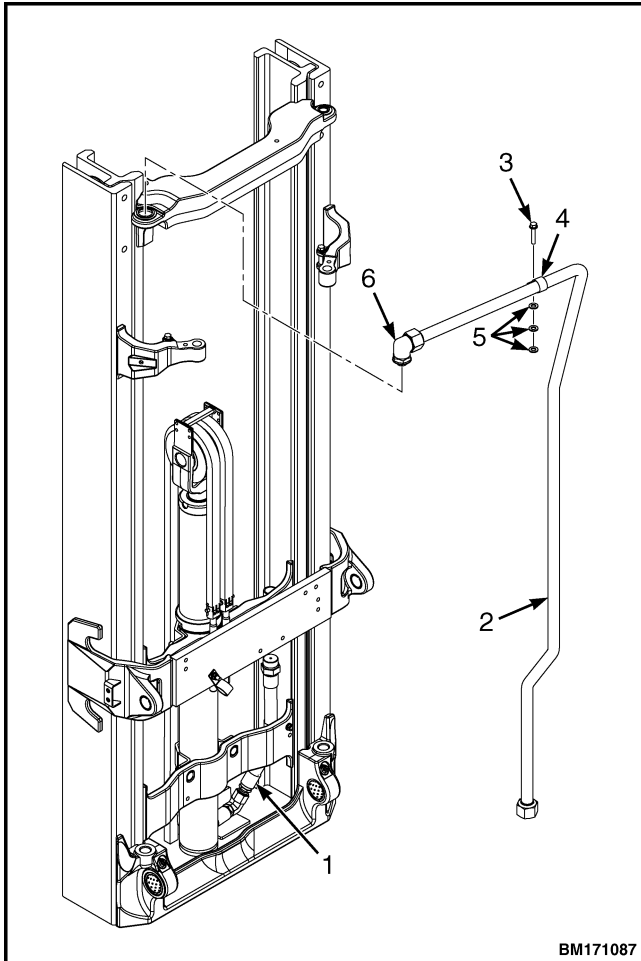
4. Loosen the two strap clamps securing the mast accumulator and remove the accumulator. See Figure 80.
5. Disconnect the hydraulic tube from the manifold. See Figure 80.
6. Disconnect the hydraulic hoses at the manifold on the outer mast. See Figure 81.



1. MANIFOLD
2. HYDRAULIC HOSES
3. MAST
4. LIFT CYLINDER HOSE

Figure 81. Manifold and hoses

7. Disconnect the main hose from the fitting at the bottom of the free lift cylinder. See Figure 82.
8. Disconnect the main tube, clamp and fitting. Remove the main tube and main hose. See Figure 82.



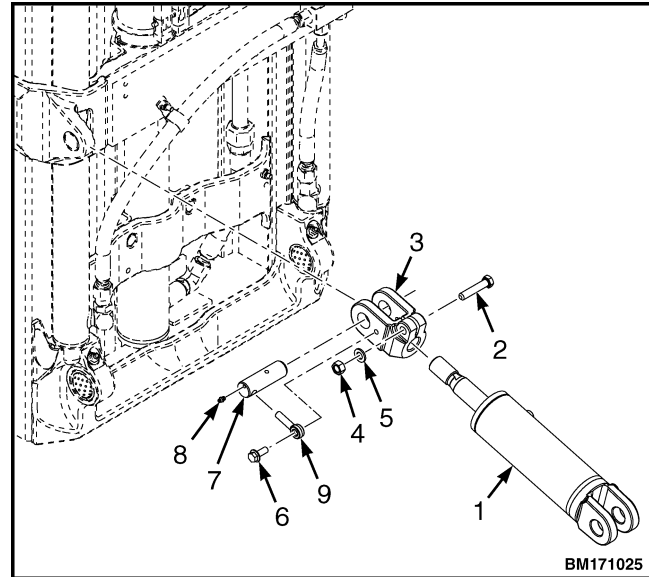
1. MAIN HOSE
2. MAIN TUBE
3. CAPSCREW
4. CLAMP
5. WASHER
6. FITTING

Figure 82. Main hose and tube

WARNING

Use a driver, **NOT** your fingers, to push the anchor pins from the clevises on the tilt cylinders. The cylinder or mast can move and cause serious injury.

9. Remove the capscrews, washers, anchor pins, and pivot pins at the tilt cylinder mounts on the outer mast. See Figure 83.



1. CYLINDER
2. CAPSCREW
3. ROD END
4. NUT
5. WASHER
6. CAPSCREW
7. PIVOT PIN
8. GREASE FITTING
9. ANCHOR PIN

Figure 83. Mast mounting

10. Use a brass drift pin to remove the tilt rod bushings from the outer mast. Discard the tilt rod bushings. See Figure 84.

NOTE: Allow the mast to tilt forward enough to gain access to the mast mount capscrews.

11. Disconnect the lower mast mounts from the lift truck by removing the capscrews that hold the mast pivot pins to the mounts on the drive axle. See Figure 85 and Figure 86.

WARNING

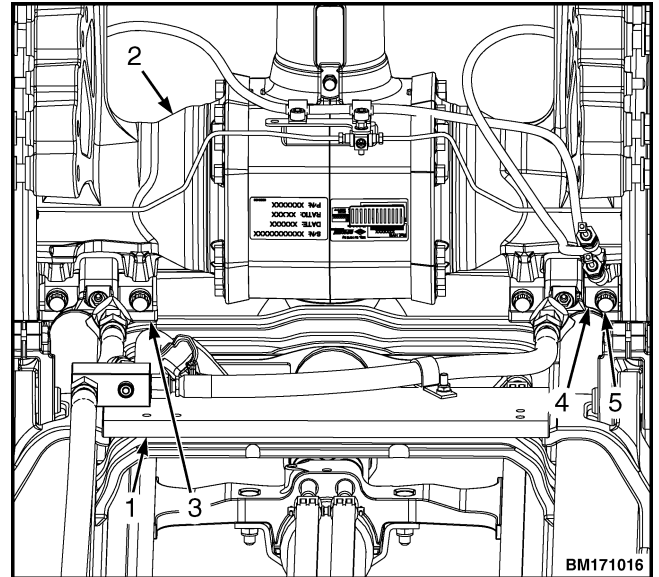
The mast is heavy. The mast can weigh approximately 714 kg (1574.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

12. Use the crane to lift the mast assembly from the lift truck. Position the mast across wooden beams on the floor. Make sure the side where the carriage mounts is facing upward.

NOTE: If mast mounting bushing needs to be replaced in Step 13, go to Step 14 for procedures.

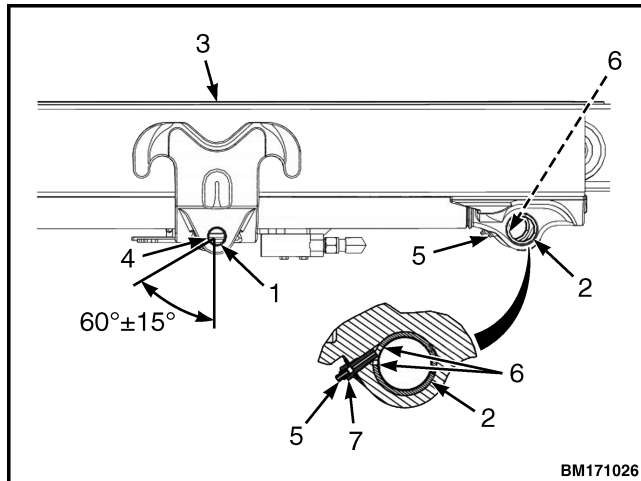
13. Check the mast and mounting flanges for wear or damage by removing the mast pivot pins from the outer mast. See Figure 86. Check that the pins fit snug in the outer mast. If pins can be moved up and down a minimum of 4 mm (0.20 in.), replace bushings in outer mast and/or mast pivot pins as required.

14. Remove the two lube capscrews with the lube fittings attached, and washer from the mast mounts. See Figure 90. Use a brass drift pin to remove mast mounting bushings from outer mast. Discard mast mounting bushings. See Figure 84.



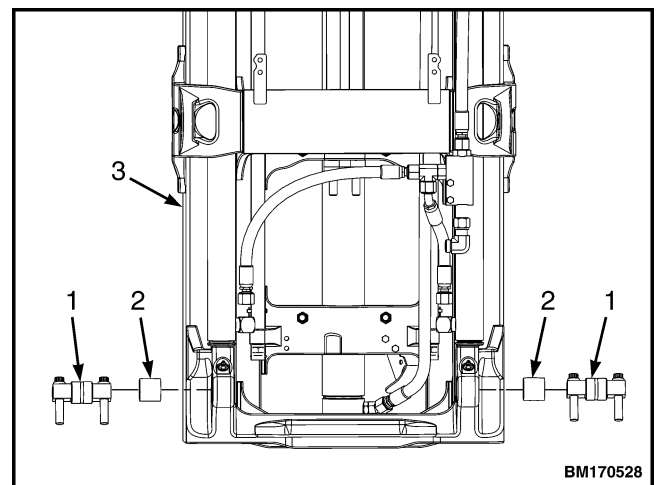
1. MAST
2. DRIVE AXLE
3. HANGER MOUNTS
4. MAST PIVOT PIN
5. CAPSCREW

Figure 85. Mast mounts, drive axle



1. TILT ROD BUSHING
2. MAST MOUNTING BUSHING (BRONZE)
3. OUTER MAST
4. BUSHING SPLIT
5. LUBE FITTING
6. BUSHING HOLE
7. LUBE CAPSCREW

Figure 84. Tilt rod and mast mounting bushings



1. MAST PIVOT PINS
2. MAST MOUNTING BUSHING (BRONZE)
3. OUTER MAST

Figure 86. Mast pivot pins

Disassemble

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.

WARNING

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

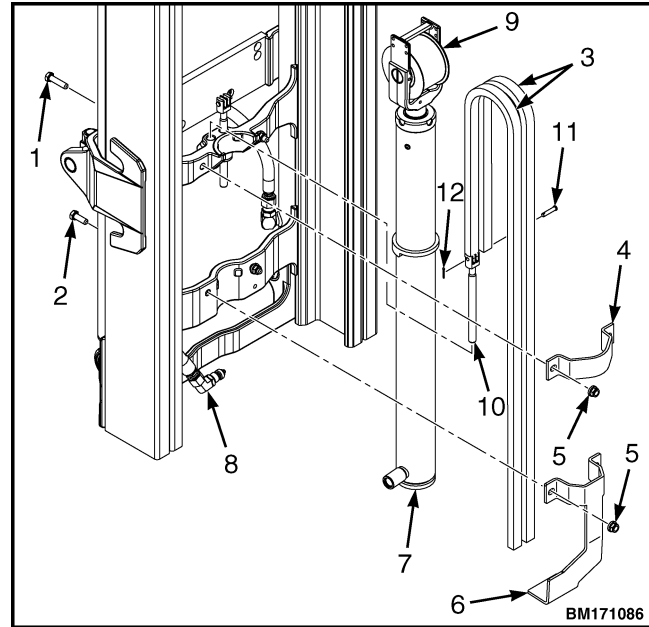
WARNING

Completely lower forks to relieve hydraulic pressure before disconnecting any hydraulic hoses.

CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

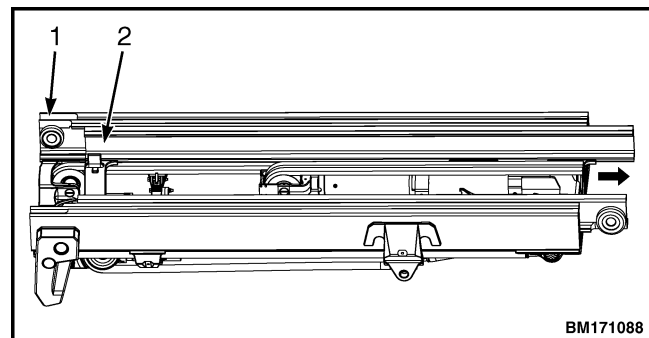
1. Remove the cotter pin and the chain anchor pin to disconnect the free-lift chains from the chain anchors and remove chains at the crosshead. See Figure 87.
2. Remove the cotter pin and the chain anchor pin to disconnect the free-lift chains from the chain anchors and remove chains at the crosshead. See Figure 87.
3. Disconnect and remove the hydraulic fitting (8, Figure 87) from the free-lift cylinder.
4. Loosen the nuts and capscrews to remove the upper and lower brackets clamping the free-lift cylinder (4 and 6, Figure 87). For masts with serial number featuring F564, remove the spacers from the upper and lower brackets. Remove the free-lift cylinder.



1. CAPSCREW
2. CAPSCREW
3. FREE LIFT CHAIN
4. UPPER BRACKET
5. NUT
6. LOWER BRACKET
7. FREE-LIFT CYLINDER
8. HYDRAULIC FITTING
9. CROSSHEAD
10. CHAIN ANCHOR
11. CHAIN ANCHOR PIN
12. COTTER PIN

Figure 87. Free-lift cylinder assembly and component parts

5. Push the inner mast toward the bottom of the mast assembly until the bottom load rollers can be seen. See Figure 88.



1. OUTER MAST
2. INNER MAST

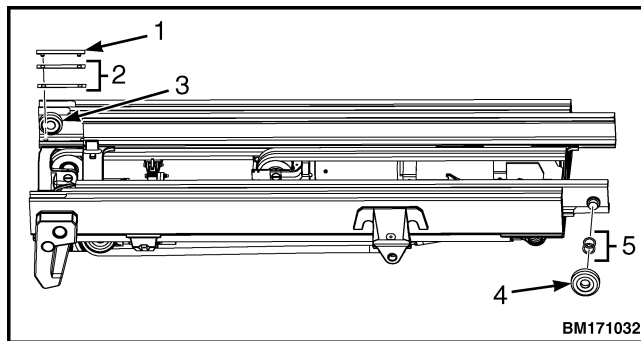
Figure 88. Slide inner mast

WARNING

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

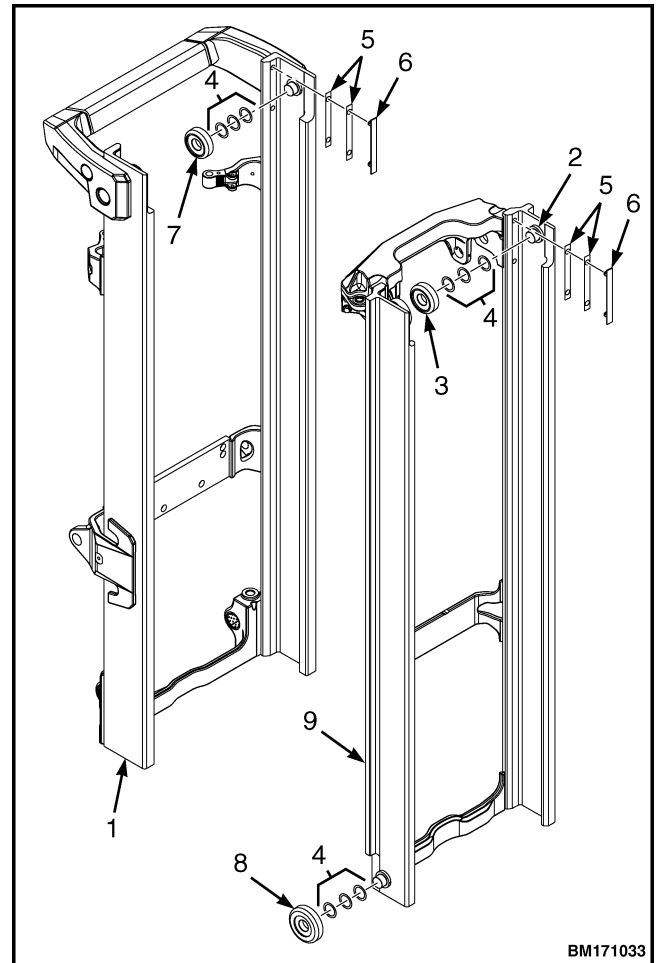
NOTE: Make a note of each shim arrangement and load roller location. The shim arrangements will be the same during assembly.

6. Remove the load rollers and shims at the bottom of the inner mast (4 and 5, Figure 89). Remove the load rollers and shims at the top of the outer mast (3, Figure 89).



1. WEAR STRIP
2. SHIM
3. UPPER LOAD ROLLER
4. LOWER ROAD ROLLER
5. SHIMS

Figure 89. Load rollers



1. OUTER MAST
2. STUBSHAFT
3. LOAD ROLLER (INNER MAST-UPPER)
4. SHIM
5. SHIM
6. WEAR STRIP
7. LOAD ROLLER (OUTER MAST)
8. LOAD ROLLER (INNER MAST-LOWER)
9. INNER MAST

Figure 90. Outer and inner mast assembly

WARNING

The mast is heavy. The mast can weigh approximately 714 kg (1574.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

1. Slide inner mast halfway out of the top of the outer mast. Connect a crane with a capacity of at least 155 kg (341.7 lb) to the center of the inner mast. See Figure 91. Slide the inner mast out of the outer mast until the stub shafts are in the notches of the outer mast. Remove the inner mast from the outer mast.
2. Disassemble chain sheaves as necessary for repair and cleaning. See Figure 87. Remove hydraulic hoses and fittings from mast weldments as necessary.

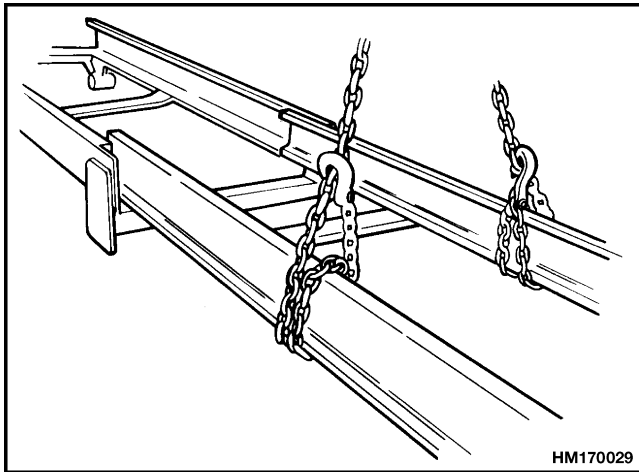


Figure 91. Connecting a Crane

Clean and Inspect

CAUTION

DO NOT use steam or high-pressure water to clean the load rollers or the lift chains. Steam and high-pressure water can remove the lubrication from the bearings in the load rollers. Water in the bearings of the sheaves and the link pins of chains can also shorten the service life of these parts.

1. Inspect chain sheaves and load rollers for wear or damage. See Figure 90, and inner mast (4 and 5, Figure 89). **DO NOT** use steam to clean lift chain sheaves or load rollers. The bearings in the sheaves and load rollers are sealed and lubricated.

WARNING

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

WARNING

Compressed air can move particles and make them become airborne, which may cause injury. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.

2. Clean the lift chains by soaking in solvent for 30 minutes to remove all dirt and grease. Hang lift chains up and remove solvent using compressed air.

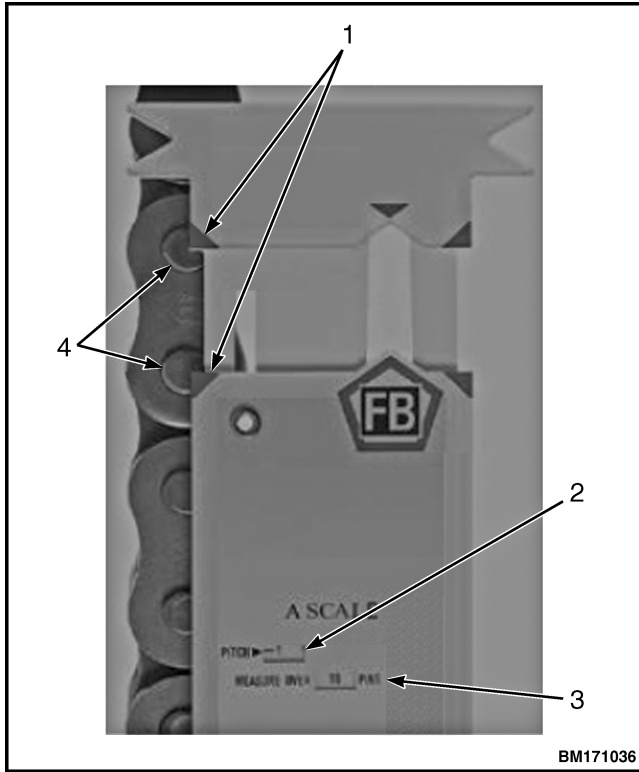
WARNING

Never replace only the worn section of a chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains. Damage to the lift truck and serious injury can occur if lift chains are not replaced correctly.

NOTE: The chains must be inspected in the area of chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear.

3. Inspect the lift chains for wear and damage. A lift chain becomes longer when it is worn. If a chain is 3% longer than a new lift chain, the lift chain must be replaced.
 - a. Locate chain wear gauge (Hyster Part No. 4044579).
 - b. Before using the chain wear gauge, inspect the V-jaws on the top and bottom of the gauge (see items 1 and 2, Figure 93) to make sure they are not bent or damaged. Confirm the gauge is not warped or bent and slides easily. Close the gauge completely and confirm the calibration window reads "OK".

- c. Use the chain wear gauge to identify the leaf chain pitch, by aligning the two arrows on the edge of the gauge with the two pin centers of one of the OUTER link plates. See Figure 92.



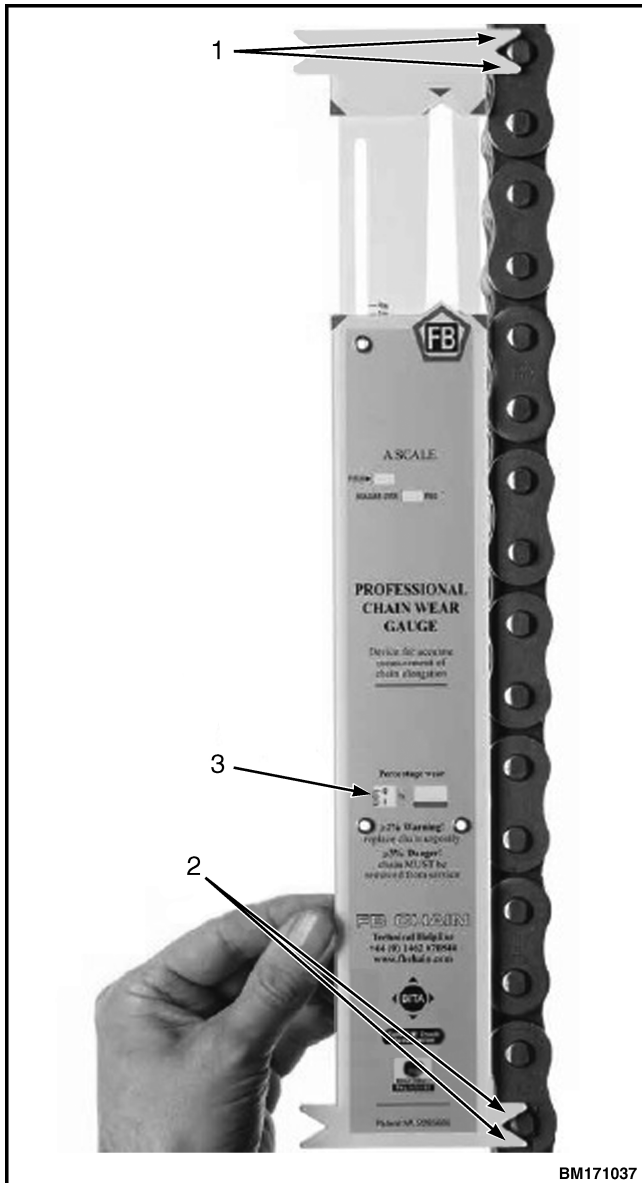
- 1. ARROWS
- 2. PITCH WINDOW
- 3. MEASURE OVER PINS WINDOW
- 4. PIN CENTER

Figure 92. Measure pitch

- d. The nominal pitch of the leaf chain will appear in the "Pitch" window on the chain wear gauge. See Figure 92.
- e. Select and use the correct side of the gauge relevant to the measured nominal pitch as follows:

A Scale	B Scale
3/8"	1 3/4"
1/2"	2"
5/8"	3/4"
1"	1 1/4"
1 1/2"	2 1/2"
3"	

- f. Once the pitch has been determined, the number of pins that the chain wear is to be measured over will display in the 'Measure over Pins' window. See Figure 92.
- g. Find a portion of the chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear. Choose three separate locations in this section to perform the measurement.
- h. Make sure the leaf chain is bearing a load and place the top 'V' jaw of the chain wear gauge over the first pin of the selected section. See Figure 93. Extend the slide until the bottom 'V' jaw locates over the selected bottom pin (as previously determined in Step f of this procedure). The percentage of wear will appear in the box in 0.25% (1/4%) increments.



1. TOP V-JAW
2. BOTTOM V-JAW
3. PERCENTAGE OF WEAR

Figure 93. V-jaws

WARNING

Although the chain wear gauge will show wear up to 4%, any leaf chain used for lifting with a measured elongation of 3% or more is dangerous and must be replaced immediately.

- i. If the chain wear gauge shows a 2% or greater elongation, the red indicator will completely fill the window. This is an indication that the chain requires replacing.

4. Lubricate lift chains by soaking them in SAE 30 engine oil for 30 minutes. Hang chains over a drip pan for one hour to remove excess oil.

NOTE: Chain anchor pins must be replaced anytime chains are replaced.

5. Inspect chain anchors, chain anchor pins, and chain anchor restraints. Replace any parts that are worn or damaged.

WARNING

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

WARNING

Steam can cause serious burns. Wear protective clothing, gloves, and eye protection. Never expose your skin to steam.

6. Clean mast weldments with steam or solvent.

WARNING

Improper welding procedures can damage the structure of the mast or cause incorrect function of the mast which can result in serious injury to personnel. Consult your lift truck dealer for more information before welding on the mast

7. Inspect sliding surfaces for wear or damage. Inspect load roller contact surfaces for wear or damage. Inspect all welds for cracks.

Assemble

NOTE: Shims for the load rollers keep the weldments parallel and provide correct clearance. During assembly, shims should be reinstalled in the same location they were in before disassembly. Check the clearance and adjust the shims for wear or for changes caused by repairs. The strip bearings are also adjusted by using shims. Shims for strip bearings should also be reinstalled in the same location they were in before disassembly. See Mast in this manual for the procedures.

1. Put the outer mast on the floor. Make sure the side where the carriage mounts is facing upward. Connect a crane with a capacity of at least 714 kg (1574.1 lb) to the center of the inner mast. Fit the lower stub shafts of the inner mast into the notches in the top of the outer mast. Slide the inner mast into the outer mast so the stub shafts are seen at the top and bottom of both weldments.
2. Install the load rollers and the shims on the outer mast and at the bottom of the inner mast. See Figure 90. Adjust the inner mast and check the clearance of the load rollers as described in Mast section in this manual.

NOTE: Load roller must be in place before strip bearings can be shimmed.

3. Install strip bearings and shims on the channels of the outer mast. See Figure 94. Apply chassis lube to the bearing surfaces. Check the clearance of the strip bearings as described in Mast section in this manual.

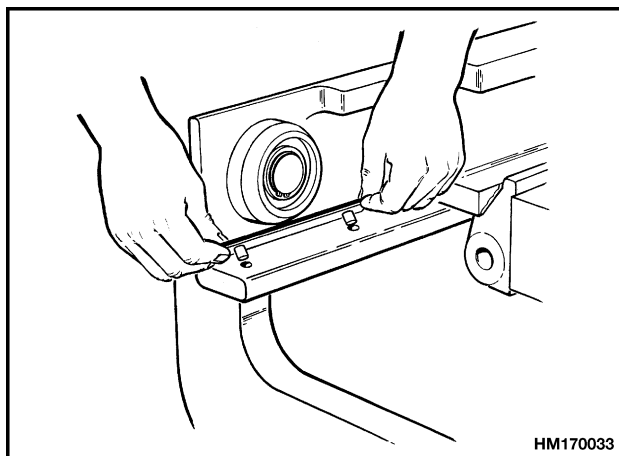
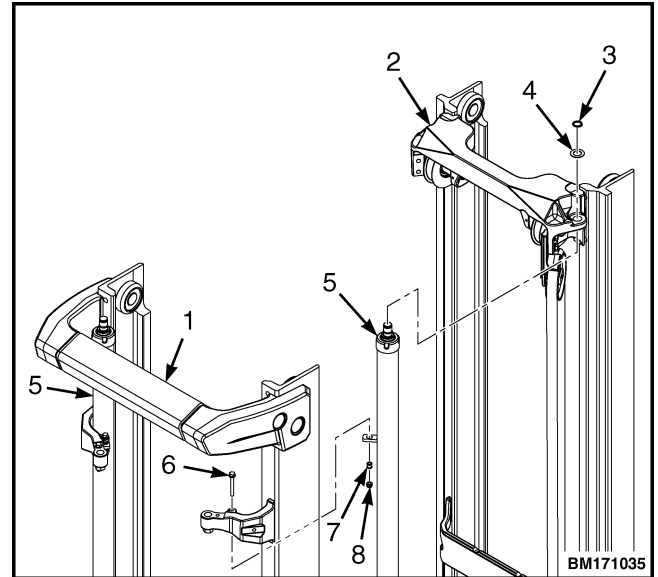


Figure 94. Strip Bearings



1. OUTER MAST
2. INTERMEDIATE MAST
3. SNAP RING
4. WASHER
5. MAIN LIFT CYLINDER
6. CAPSCREW
7. ISOLATOR
8. NUT

Figure 95. Main lift cylinders

4. Install the manifold on the outer mast. Tighten the cap screws retaining the manifold to 19.2 N·m (14.2 lbf ft). Connect the hydraulic lines and fittings between the housing and the main lift cylinders. See Figure 81.
5. Install the two strap clamps for retaining the mast accumulator onto the left-hand tilt cylinder. See Figure 80. Orient the screws on the strap clamps toward the mast channel and up against the lift cylinder, to minimize clamp twist during torquing.
6. Install the mast accumulator and two spacers into the strap clamps. See Figure 80. Ensure the accumulator is oriented with the warning label facing out. Confirm the strap clamps are not covering any warning labels by adjusting the clamps and moving up or down accordingly.
7. Torque the screws on the strap clamps to 11.3 N·m (8.3 lbf ft). Trim off the excess straps.

8. Connect one end of the hydraulic tube to the fitting on the manifold and the other end to the flow control fitting on the accumulator. See Figure 80.
9. Tighten the fittings to standard torque.
10. Install capscrews and isolators at the mount for main lift cylinders. Tighten nuts to 25.2 N•m (18.6 lbf ft). See Figure 95.
11. Connect a crane with a capacity of at least 714 kg (1574.1 lb) to the center of the inner mast. See Figure 91. Slide the inner mast into the intermediate mast so the stub shafts are seen at the top and bottom of both.

NOTE: Use multipurpose grease #2 with 2 to 4% Molybdenum Disulfide for normal operations.

NOTE: The load rollers must be in place before strip bearings can be shimmed.

12. Install strip bearings and shims on the channels of the intermediate mast. See Figure 90 and Figure 94. Apply grease to the bearing surfaces. Install the load rollers and the shims on the intermediate and inner masts. Before doing the next step, adjust the inner mast as described in Mast section in this manual.
13. Connect the main lift chains to the chain anchors at the main lift cylinder mounts. Put the lift chains over the chain sheaves and connect them to the anchors at the bottom of the inner mast.
14. Install the free-lift cylinder in the mounts on the inner mast. Install the upper and lower brackets for the cylinder and tighten the nuts to 81.5 N•m (60 lbf ft). The nuts are installed on the bracket side of the free-lift cylinder. See Figure 87.
15. Install the chain sheave for the free-lift cylinder. Tighten the capscrew for the chain sheave to 66 N•m (49 lbf ft). Install the hydraulic hose and tubing for the free-lift cylinder.
16. Connect free-lift chains to the chain anchors at the crossmember. Attach a wire between the end of the lift chain and the bottom of the mast to control the lift chain during mast installation. See Figure 87.

Install

1. Install the new bushings into the mast mounts at the bottom of the outer mast. Be sure to align the hole in the bushing with the lube fitting hole in the bottom of the outer mast. See Figure 84. Bushing must be flush with outer mast surface.
2. Apply an even coat of grease to pivot pins and install them into mounts at bottom of outer mast. See Figure 86.
3. Install washer and lube capscrew in the hole in the bottom of the outer mast. Tighten the lube capscrew to 17 N•m (12.5 lbf ft). Install lube fitting onto lube capscrew and tighten fitting to 6 N•m (53 lbf in). See Figure 84.



WARNING

The mast is heavy. The mast can weigh approximately 714 kg (1574.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

4. Connect crane to top of mast using chains. Make sure all mast uprights are fastened together. Make sure chains will not damage sheaves, tubing, or other parts of mast.
5. Use crane to position mast assembly onto its lower mounts. Position mast so pivot pins seat into hanger mounts on drive axle. Install capscrews that hold mast pivot pins to drive axle hangers. Tighten capscrews to 270 N•m (199 lbf ft). See Figure 85.
6. Install new tilt rod bushings into the tilt anchors on the outer mast. Be sure tilt bushing split is installed at the correct angle as shown in Figure 84.

WARNING

Use a pry bar, **NOT** your fingers, to align the tilt cylinder clevises with the outer mast. The cylinder or mast can shift and cause serious injury.

NOTE: Use multipurpose grease #2 with 2 to 4% molybdenum disulfide for normal operations.

7. Apply grease to pivot pins and connect the tilt cylinders to the mast using pivot pins. Install anchor pins and capscrews to rod ends. Apply anti-seize compound to capscrew threads and tighten to 38 N•m (28 lbf ft). See Figure 86.
8. Connect the hydraulic hoses and free lift hose to the manifold valve. See Figure 81.
9. Install the carriage as described in Carriage repair, 2-stage full free lift section in this manual.

WARNING

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

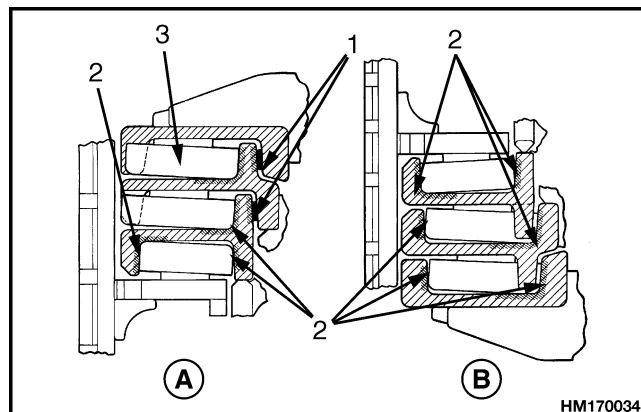
10. Check tilt cylinder adjustment as described in Lift cylinder repair, in **Hydraulics** service manual for your lift truck. Operate mast and check for leaks and correct operation. Check lift chains as described in Clean and Inspect.

NOTE: Before checking for mast side kicking and adjusting the chain anchors on the main lift cylinders, the mast must be fully assembled to include the carriage, forks, load backrest and any attachments if the lift truck is equipped with one.

11. Adjust chain anchors on the main lift cylinders until the tops of the inner and outer mast are at the same level within ± 1.5 mm (0.06 in.). See Figure 90.
12. Raise mast, without a load to its full height and check for side kicking. Mast side kicking is when the mast moves either to the right or left as it is being raised to its full height. If the mast is side kicking, see the Mast section in this manual for procedures to correct mast side kicking.

NOTE: The load rollers and sheaves have sealed bearings and do not need additional lubrication.

13. Lubricate sliding surfaces and load roller surfaces along full length of channels as shown in Figure 96. Apply lubricant only to surfaces indicated.



- A. UPPER LOAD ROLLERS
B. LOWER LOAD ROLLERS

1. LUBRICATE STRIP BEARINGS SURFACES
2. LUBRICATE LOAD ROLLER SURFACES
3. LOAD ROLLER

Figure 96. Lubricate Mast

3-STAGE FULL FREE LIFT (FFL) MAST REPAIR
202001-075

REPAIR MAST WITH SERIAL NUMBER G508/G563

Remove

WARNING

The mast is heavy. The mast can weigh approximately 973 kg (2145.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

WARNING

Mast weldments can slide when the mast is moved. A weldment that slides can cause serious injury.

CAUTION

Make sure all the mast weldments are fastened together. Make sure the safety chains will not damage the sheaves, tubing, or other parts of the mast.

NOTE: If mast needs to be disassembled, remove the forks and carriage. See the sections Fork removal and replacement and **Carriage repair, 3-stage full free lift** in this service manual for procedures. If only the main lift cylinders need to be removed for repair, the mast does not need to be removed from the lift truck. See the section Lift cylinder repair, in **Hydraulics** service manual for procedures.

NOTE: The length of the lift chains must be checked before the mast is removed. See Clean and Inspect section in this manual for procedures.

1. Fully lower all mast weldments. Tilt mast fully forward. Connect a crane with a capacity of at least 973 kg (2145.1 lb) to the top of the mast using chains to support the mast in an upright position when the tilt cylinders are disconnected. See the section Safety Procedures When Working Near Mast in this manual.

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.

WARNING

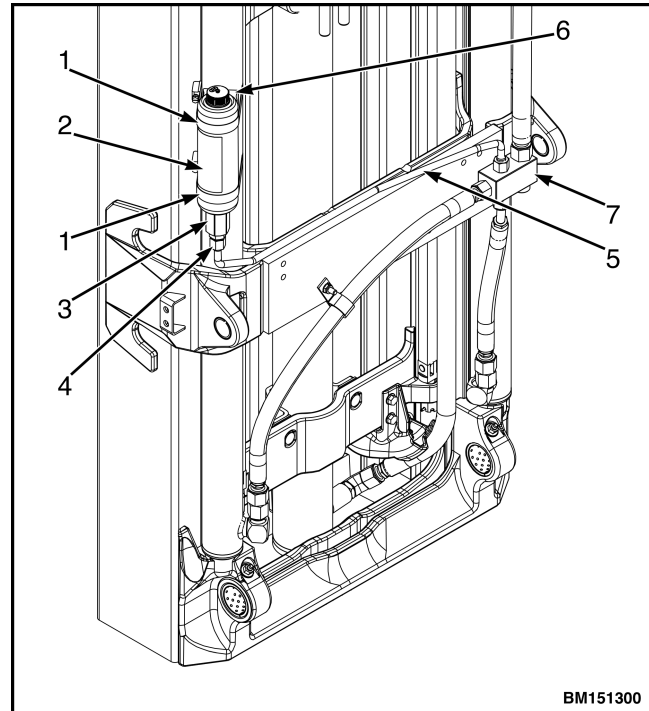
Completely lower forks to relieve hydraulic pressure before disassembling any part of the lift pump or disconnecting any hoses.

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

CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

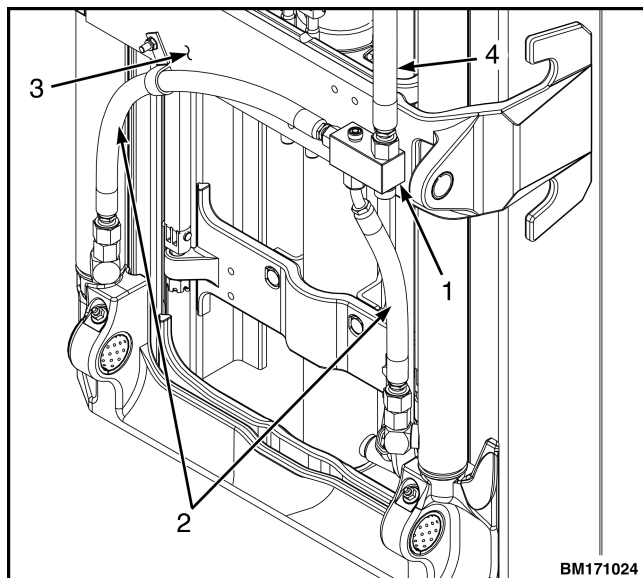
2. Position a drip pan under the area of the hydraulic fittings. See Figure 98.
3. Disconnect the flow control fitting from the mast accumulator. See Figure 97.



1. STRAP
2. ACCUMULATOR
3. FLOW CONTROL FITTING
4. TUBE FITTING
5. HYDRAULIC TUBE
6. SPACER
7. MANIFOLD

Figure 97. Mast accumulator

4. Loosen the two strap clamps securing the mast accumulator and remove the accumulator. See Figure 97.
5. Disconnect the hydraulic tube from the manifold. See Figure 97.
6. Disconnect the hydraulic hoses at the manifold on the outer mast. See Figure 98.



1. MANIFOLD
2. HYDRAULIC HOSES
3. MAST
4. LIFT CYLINDER HOSE

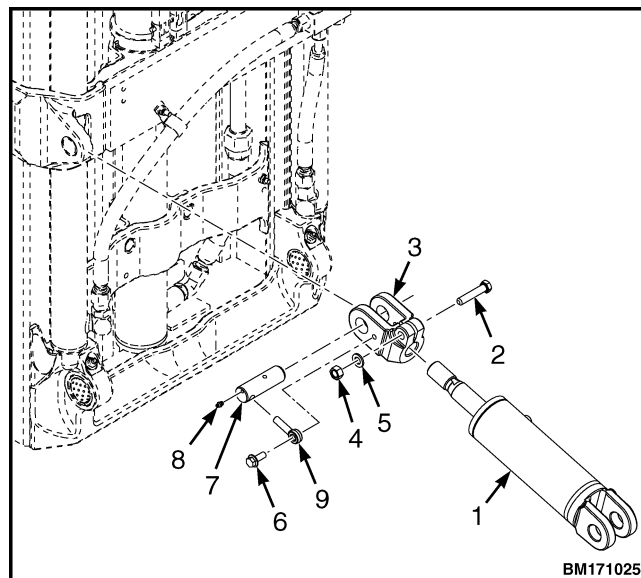
Figure 98. Manifold and hoses



WARNING

Use a driver, **NOT** your fingers, to push the anchor pins from the clevises on the tilt cylinders. The cylinder or mast can move and cause serious injury.

7. Remove the capscrews, washers, anchor pins, and pivot pins at the tilt cylinder mounts on the outer mast. See Figure 99.



1. CYLINDER
2. CAPSCREW
3. ROD END
4. NUT
5. WASHER
6. CAPSCREW
7. PIVOT PIN
8. GREASE FITTING
9. ANCHOR PIN

Figure 99. Mast mounting

8. Use a brass drift pin to remove the tilt rod bushings from the outer mast. Discard the tilt rod bushings. See Figure 100.

NOTE: Allow the mast to tilt forward enough to gain access to the mast mount capscrews.

9. Disconnect the lower mast mounts from the lift truck by removing the capscrews that hold the mast pivot pins to the mounts on the drive axle. See Figure 101 and Figure 102.



WARNING

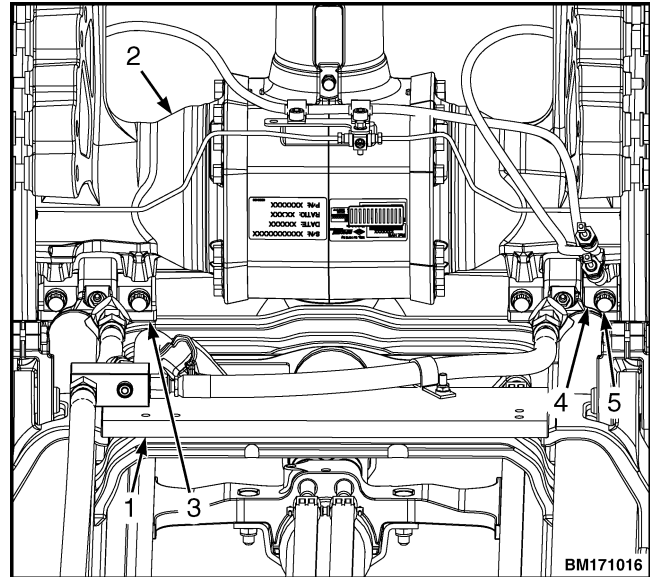
The mast is heavy. The mast can weigh approximately 973 kg (2145.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

10. Use the crane to lift the mast assembly from the lift truck. Position the mast across wooden beams on the floor. Make sure the side where the carriage mounts is facing upward.

NOTE: If mast mounting bushing needs to be replaced in Step 11, go to Step 12 for procedures.

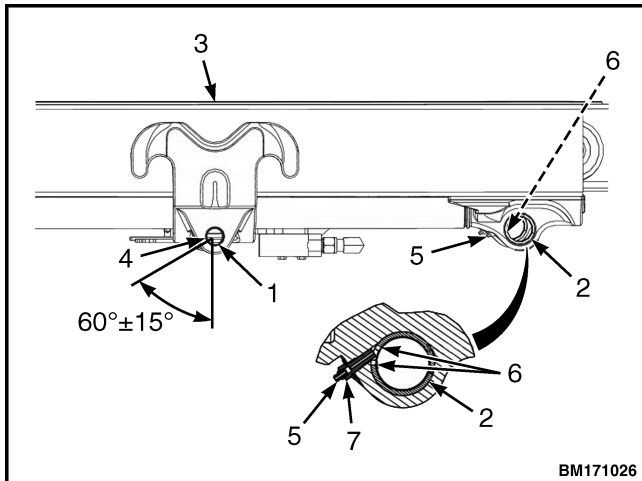
11. Check the mast and mounting flanges for wear or damage by removing the mast pivot pins from the outer mast. See Figure 102. Check that the pins fit snug in the outer mast. If pins can be moved up and down a minimum of 4 mm (0.20 in.), replace bushings in outer mast and/or mast pivot pins as required.

12. Remove the two lube capscrews with the lube fittings attached, and washer from the mast mounts. See Figure 108. Use a brass drift pin to remove mast mounting bushings from outer mast. Discard mast mounting bushings. See Figure 100.



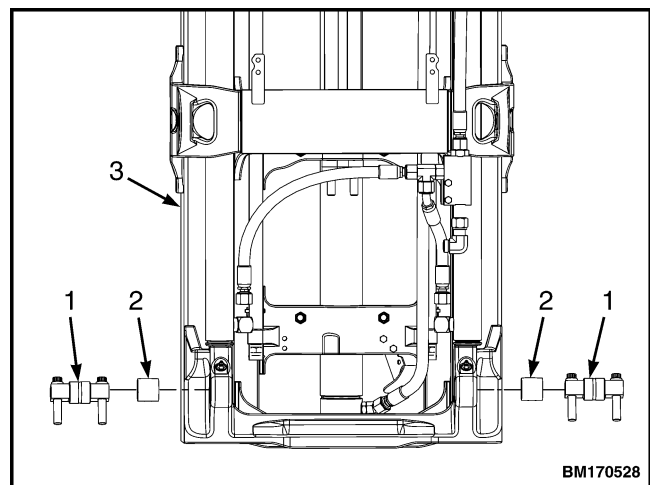
- 1. MAST
- 2. DRIVE AXLE
- 3. HANGER MOUNTS
- 4. MAST PIVOT PIN
- 5. CAPSCREW

Figure 101. Mast mounts, drive axle



- 1. TILT ROD BUSHING
- 2. MAST MOUNTING BUSHING (BRONZE)
- 3. OUTER MAST
- 4. BUSHING SPLIT
- 5. LUBE FITTING
- 6. BUSHING HOLE
- 7. LUBE CAPSCREW

Figure 100. Tilt rod and mast mounting bushings



- 1. MAST PIVOT PINS
- 2. MAST MOUNTING BUSHING (BRONZE)
- 3. OUTER MAST

Figure 102. Mast pivot pins

Disassemble



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.



WARNING

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



WARNING

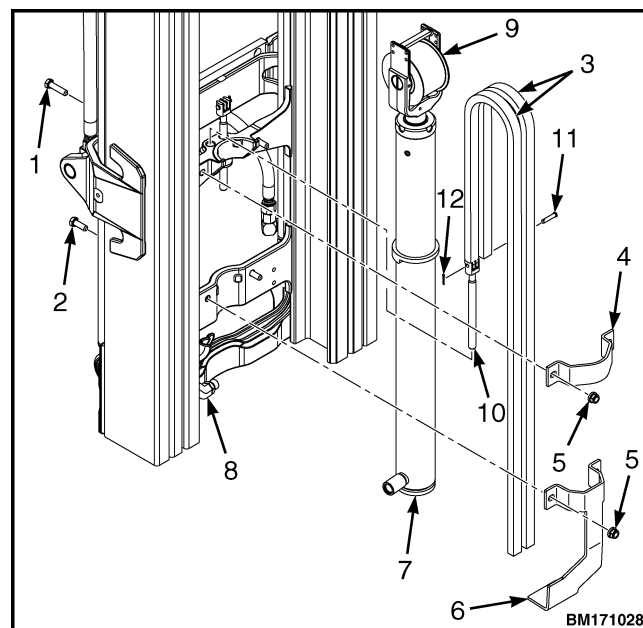
Completely lower forks to relieve hydraulic pressure before disconnecting any hydraulic hoses.



CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

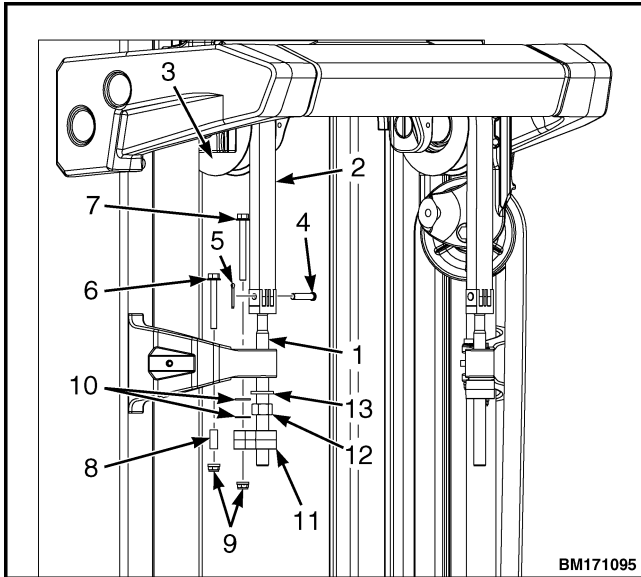
1. Remove the cotter pin and the chain anchor pin to disconnect the free-lift chains from the chain anchors and remove chains at the crosshead. See Figure 103.
2. Disconnect and remove the hydraulic fitting (8, Figure 103) from the free-lift cylinder.
3. Loosen the nuts and capscrews to remove the upper and lower brackets clamping the free-lift cylinder (4 and 6, Figure 103). For masts with serial number featuring G563, remove the spacers from the upper and lower brackets. Remove the free-lift cylinder.



1. CAPSCREW
2. CAPSCREW
3. FREE LIFT CHAIN
4. UPPER BRACKET
5. NUT
6. LOWER BRACKET
7. FREE-LIFT CYLINDER
8. HYDRAULIC FITTING
9. CROSSHEAD
10. CHAIN ANCHOR
11. CHAIN ANCHOR PIN
12. COTTER PIN

Figure 103. Free-lift cylinder assembly and component parts

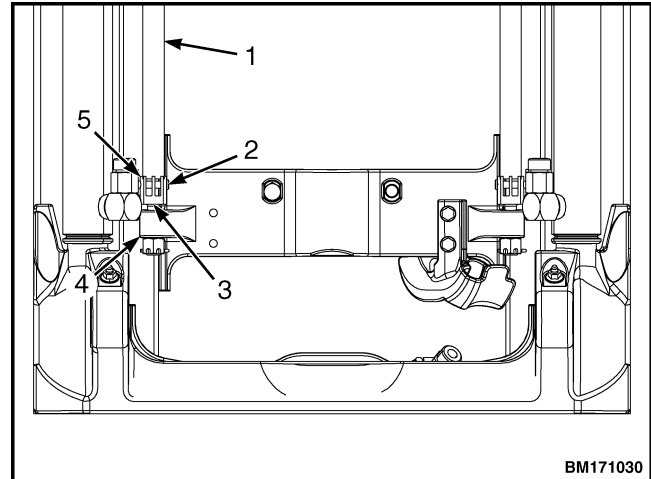
4. Disconnect the two main lift chains from the upper chain anchors near the top of the main lift cylinders. See Figure 104.



- 1. CHAIN ANCHOR
- 2. MAIN LIFT CHAIN
- 3. CHAIN SHEAVE
- 4. CHAIN ANCHOR PIN
- 5. COTTER PIN
- 6. CAPSCREW
- 7. CAPSCREW
- 8. SPACER
- 9. LOCKNUTS
- 10. WASHER
- 11. RETAINER
- 12. NUT
- 13. WASHER

Figure 104. Upper chain anchors

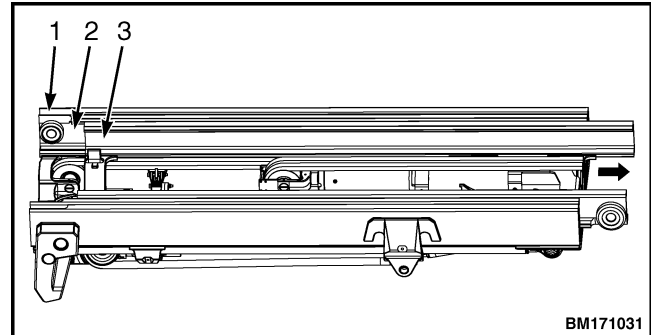
- 5. Disconnect the other end of the main lift chains from the chain anchors at the bottom of the inner mast. See Figure 105.



- 1. MAIN LIFT CHAIN
- 2. CHAIN ANCHOR PIN
- 3. CHAIN ANCHOR
- 4. INNER MAST
- 5. COTTER PIN

Figure 105. Lower chain anchors

- 6. Push the inner mast toward the bottom of the mast assembly until the bottom load rollers can be seen. See Figure 106.



- 1. OUTER MAST
- 2. INTERMEDIATE MAST
- 3. INNER MAST

Figure 106. Slide inner mast



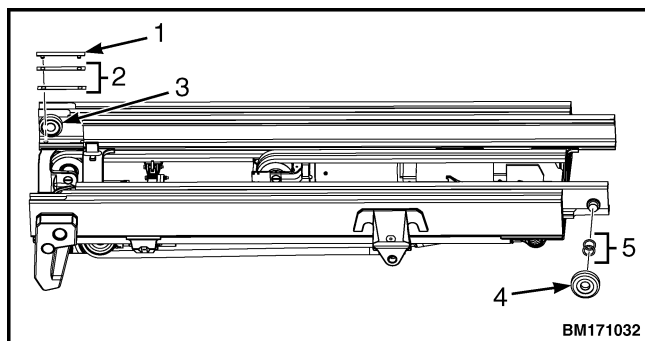
WARNING

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

- 7. Remove the strip bearings at the top of the intermediate mast. See Figure 107.

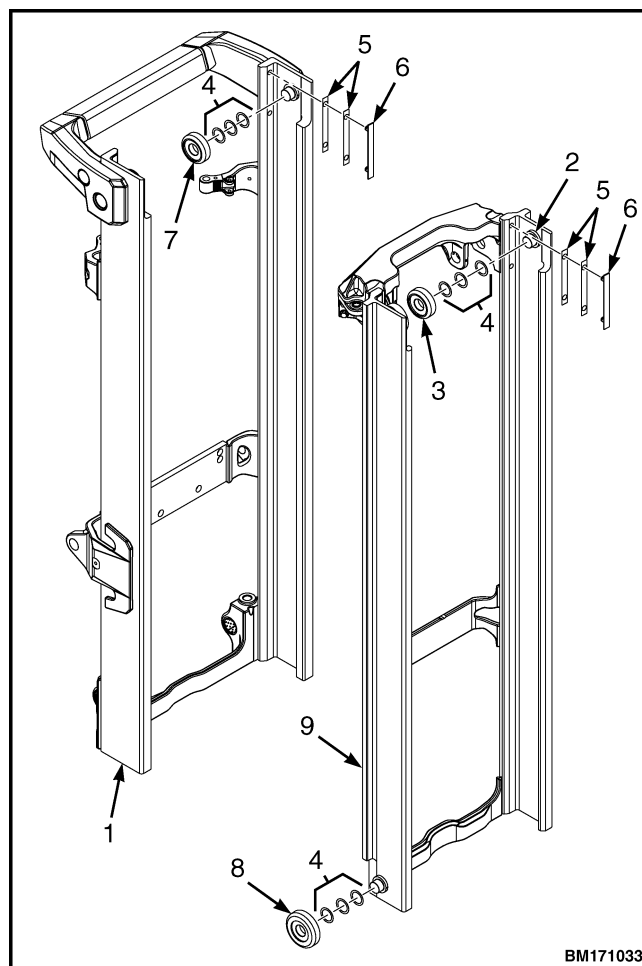
NOTE: Make a note of each shim arrangement and load roller location. The shim arrangements will be the same during assembly.

8. Remove the load rollers and shims at the bottom of the inner mast (4 and 5, Figure 107). Remove the load rollers and shims at the top of the intermediate mast (3, Figure 107).



1. WEAR STRIP
2. SHIM
3. UPPER LOAD ROLLER
4. LOWER ROAD ROLLER
5. SHIMS

Figure 107. Load rollers



1. OUTER MAST
2. STUBSHAFT
3. UPPER LOAD ROLLER (INTERMEDIATE MAST)
4. SHIM
5. SHIM
6. WEAR STRIP
7. LOAD ROLLER (OUTER MAST)
8. LOAD ROLLER (INTERMEDIATE MAST)
9. INTERMEDIATE MAST

Figure 108. Outer and intermediate mast assembly



WARNING

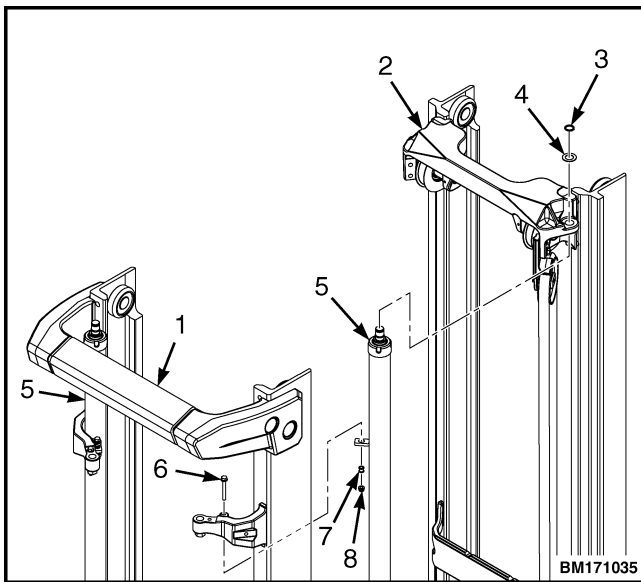
The mast is heavy. The mast can weigh approximately 973 kg (2145.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

1. Slide inner mast halfway out of the top of the intermediate mast. Connect a crane with a capacity of at least 139 kg (306 lb) to the center of the inner mast. See Figure 110. Slide the inner mast out of the intermediate mast until the stub shafts are in the notches of the intermediate mast. Remove the inner mast from the intermediate mast.

**WARNING**

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

2. Remove capscrews and isolator near the top of each main lift cylinder. Remove snap rings and washer from top of each main lift cylinder. Disconnect main lift cylinder at the mounts. See Figure 109.



1. OUTER MAST
2. INTERMEDIATE MAST
3. SNAP RING
4. WASHER
5. MAIN LIFT CYLINDER
6. CAPSCREW
7. ISOLATOR
8. NUT

Figure 109. Main lift cylinders

3. Push intermediate mast to disengage the main lift cylinders. Remove the main lift cylinders. See Figure 109.
4. Slide intermediate mast from the bottom of the outer mast 30 cm (12 in.). Remove the strip bearings at the top of the outer mast. Remove the snap rings and load rollers from both weldments. Make a note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly. See Figure 108.

**WARNING**

The mast is heavy. The mast can weigh approximately 973 kg (2145.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

5. Slide intermediate mast halfway out of the top of the outer mast. Connect a crane with a capacity of at least 158 kg (348 lb) to the center of the intermediate mast. See Figure 110. Slide the intermediate mast out of the outer mast until the stub shafts are in the notches of the outer mast. Remove the intermediate mast from the outer mast.
6. Disassemble chain sheaves as necessary for repair and cleaning. See Figure 103. Remove hydraulic hoses and fittings from mast weldments as necessary.

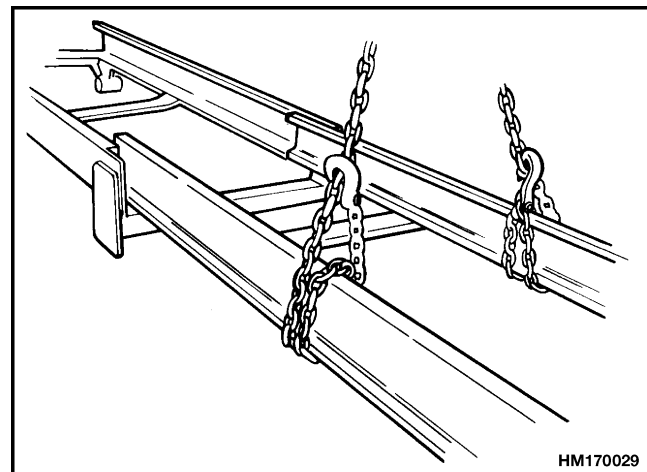


Figure 110. Connecting a Crane

Clean and Inspect



CAUTION

DO NOT use steam or high-pressure water to clean the load rollers or the lift chains. Steam and high-pressure water can remove the lubrication from the bearings in the load rollers. Water in the bearings of the sheaves and the link pins of chains can also shorten the service life of these parts.

1. Inspect chain sheaves and load rollers for wear or damage. See Figure 108, and inner mast (4 and 5, Figure 107). **DO NOT** use steam to clean lift chain sheaves or load rollers. The bearings in the sheaves and load rollers are sealed and lubricated.



WARNING

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



WARNING

Compressed air can move particles and make them become airborne, which may cause injury. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.

2. Clean the lift chains by soaking in solvent for 30 minutes to remove all dirt and grease. Hang lift chains up and remove solvent using compressed air.

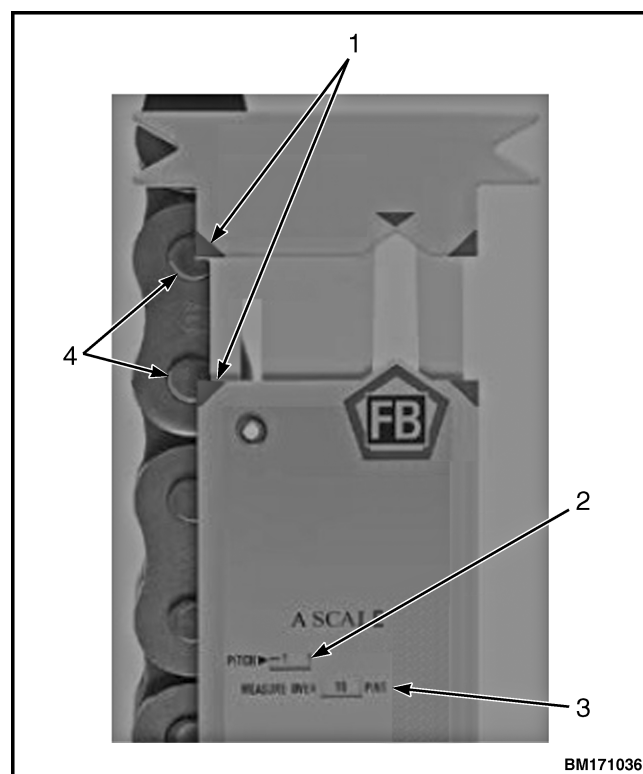


WARNING

Never replace only the worn section of a chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains. Damage to the lift truck and serious injury can occur if lift chains are not replaced correctly.

NOTE: The chains must be inspected in the area of chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear.

3. Inspect the lift chains for wear and damage. A lift chain becomes longer when it is worn. If a chain is 3% longer than a new lift chain, the lift chain must be replaced.
 - a. Locate chain wear gauge (Hyster Part No. 4044579).
 - b. Before using the chain wear gauge, inspect the V-jaws on the top and bottom of the gauge (see items 1 and 2, Figure 112) to make sure they are not bent or damaged. Confirm the gauge is not warped or bent and slides easily. Close the gauge completely and confirm the calibration window reads "OK".
 - c. Use the chain wear gauge to identify the leaf chain pitch, by aligning the two arrows on the edge of the gauge with the two pin centers of one of the OUTER link plates. See Figure 111.



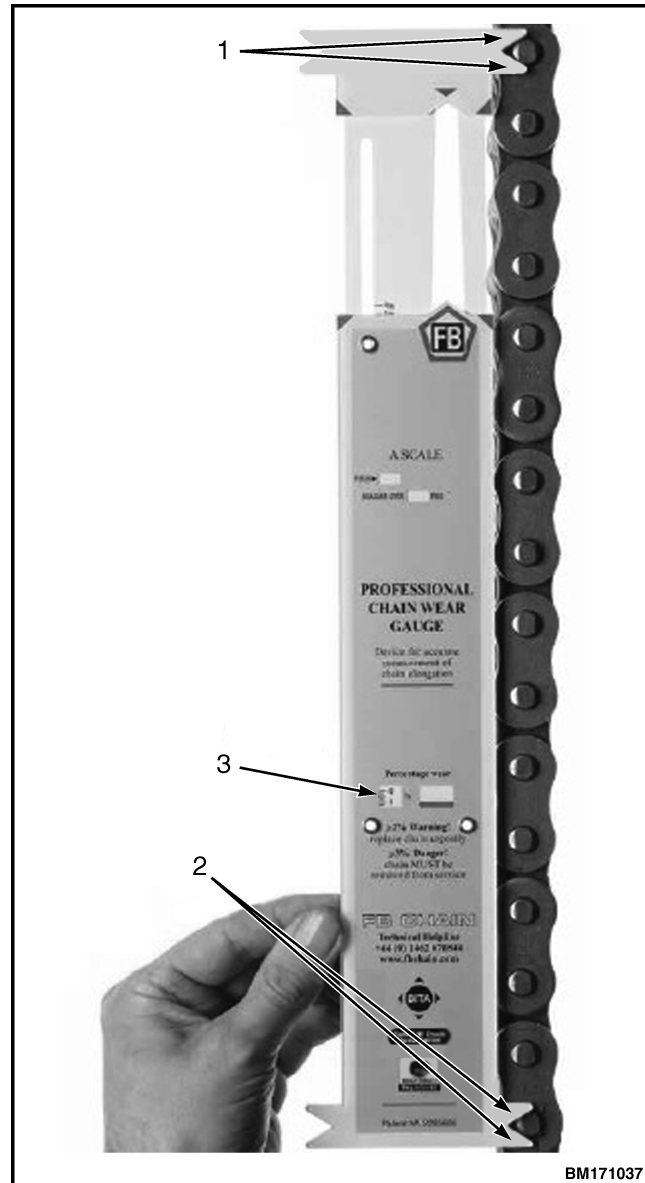
1. ARROWS
2. PITCH WINDOW
3. MEASURE OVER PINS WINDOW
4. PIN CENTER

Figure 111. Measure pitch

- d. The nominal pitch of the leaf chain will appear in the "Pitch" window on the chain wear gauge. See Figure 111.
- e. Select and use the correct side of the gauge relevant to the measured nominal pitch as follows:

A Scale	B Scale
3/8"	1 3/4"
1/2"	2"
5/8"	3/4"
1"	1 1/4"
1 1/2"	2 1/2"
3"	

- f. Once the pitch has been determined, the number of pins that the chain wear is to be measured over will display in the 'Measure over Pins' window. See Figure 111.
- g. Find a portion of the chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear. Choose three separate locations in this section to perform the measurement.
- h. Make sure the leaf chain is bearing a load and place the top 'V' jaw of the chain wear gauge over the first pin of the selected section. See Figure 112. Extend the slide until the bottom 'V' jaw locates over the selected bottom pin (as previously determined in Step f of this procedure). The percentage of wear will appear in the box in 0.25% (1/4%) increments.



1. TOP V-JAW
2. BOTTOM V-JAW
3. PERCENTAGE OF WEAR

Figure 112. V-jaws



WARNING

Although the chain wear gauge will show wear up to 4%, any leaf chain used for lifting with a measured elongation of 3% or more is dangerous and must be replaced immediately.

- i. If the chain wear gauge shows a 2% or greater elongation, the red indicator will completely fill the window. This is an indication that the chain requires replacing.
4. Lubricate lift chains by soaking them in SAE 30 engine oil for 30 minutes. Hang chains over a drip pan for one hour to remove excess oil.

NOTE: Chain anchor pins must be replaced anytime chains are replaced.

5. Inspect chain anchors, chain anchor pins, and chain anchor restraints. Replace any parts that are worn or damaged.



WARNING

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



WARNING

Steam can cause serious burns. Wear protective clothing, gloves, and eye protection. Never expose your skin to steam.

6. Clean mast weldments with steam or solvent.



WARNING

Improper welding procedures can damage the structure of the mast or cause incorrect function of the mast which can result in serious injury to personnel. Consult your lift truck dealer for more information before welding on the mast

7. Inspect sliding surfaces for wear or damage. Inspect load roller contact surfaces for wear or damage. Inspect all welds for cracks.

Assemble

NOTE: Shims for the load rollers keep the weldments parallel and provide correct clearance. During assembly, shims should be reinstalled in the same location they were in before disassembly. Check the clearance and adjust the shims for wear or for changes caused by repairs. The strip bearings are also adjusted by using shims. Shims for strip bearings should also be reinstalled in the same

location they were in before disassembly. See Mast Adjustments section in this manual for the adjustment procedures.

1. Put the outer mast on the floor. Make sure the side where the carriage mounts is facing upward. Connect a crane with a capacity of at least 158 kg (348 lb) to the center of the intermediate mast. Fit the lower stub shafts of the intermediate mast into the notches in the top of the outer mast. Slide the intermediate mast into the outer mast so the stub shafts are seen at the top and bottom of both weldments.
2. Install the load rollers and the shims on the outer mast and at the bottom of the intermediate mast. See Figure 108. Adjust the intermediate mast and check the clearance of the load rollers as described in Mast Adjustments section in this manual.

NOTE: Load roller must be in place before strip bearings can be shimmed.

3. Install strip bearings and shims on the channels of the outer mast. See Figure 113. Apply chassis lube to the bearing surfaces. Check the clearance of the strip bearings as described in Mast Adjustments section in this manual.

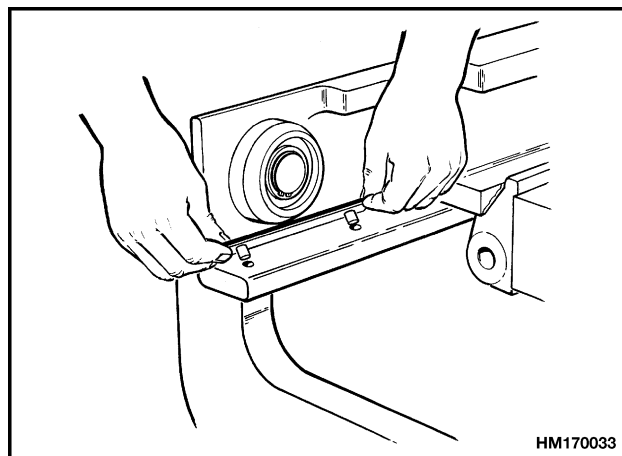
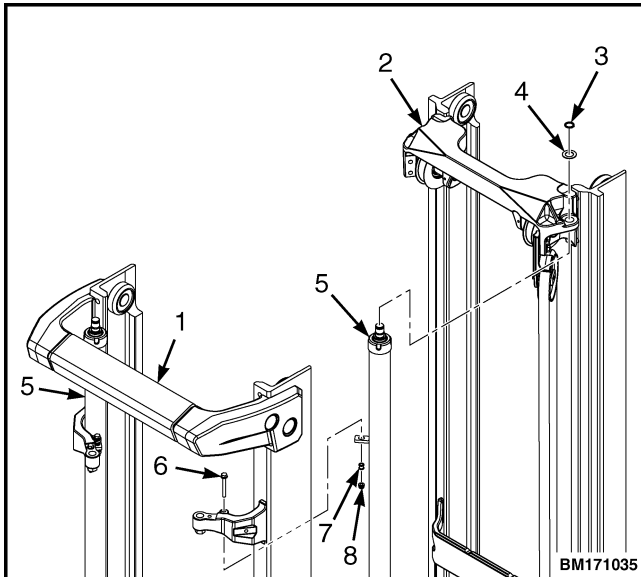


Figure 113. Strip Bearings

NOTE: The clearance check and adjustment in Step 4 is only an initial setup. The final check and adjustment is done after the mast is installed on the lift truck.

4. Install the main lift cylinders. Push the intermediate mast to engage the main lift cylinders. Check the clearance at the top of the main lift cylinder mounts. Add or remove washers at the top of the cylinder rods in the same location they were in before disassembly. Install the snap ring and washer at the top of the main lift cylinders. See Figure 114.



1. OUTER MAST
2. INTERMEDIATE MAST
3. SNAP RING
4. WASHER
5. MAIN LIFT CYLINDER
6. CAPSCREW
7. ISOLATOR
8. NUT

Figure 114. Main lift cylinders

5. Install the manifold on the outer mast. Tighten the cap screws retaining the manifold to 19.2 N•m (14.2 lbf ft). Connect the hydraulic lines and fittings between the housing and the main lift cylinders. See Figure 98.
 6. Install the two strap clamps for retaining the mast accumulator onto the left-hand tilt cylinder. See Figure 97. Orient the screws on the strap clamps toward the mast channel and up against the lift cylinder, to minimize clamp twist during torquing.
 7. Install the mast accumulator and two spacers into the strap clamps. See Figure 97. Ensure the accumulator is oriented with the warning label facing out. Confirm the strap clamps are not covering any warning labels by adjusting the clamps and moving up or down accordingly.
 8. Torque the screws on the strap clamps to 11.3 N•m (8.3 lbf ft). Trim off the excess straps.
 9. Connect one end of the hydraulic tube to the fitting on the manifold and the other end to the flow control fitting on the accumulator. See Figure 97.
 10. Tighten the fittings to standard torque.
 11. Install chain sheaves at the intermediate mast. See Figure 104.
 12. Install capscrews and isolators at the mount for main lift cylinders. Tighten nuts to 25.2 N•m (18.6 lbf ft). See Figure 114.
 13. Connect a crane with a capacity of at least 139 kg (306 lb) to the center of the inner mast. See Figure 110. Slide the inner mast into the intermediate mast so the stub shafts are seen at the top and bottom of both.
- NOTE:** Use multipurpose grease #2 with 2 to 4% Molybdenum Disulfide for normal operations.
- NOTE:** The load rollers must be in place before strip bearings can be shimmed.
14. Install strip bearings and shims on the channels of the intermediate mast. See Figure 108 and Figure 113. Apply grease to the bearing surfaces. Install the load rollers and the shims on the intermediate and inner masts. Before doing the next step, adjust the inner mast as described in Mast Adjustments section in this manual.
 15. Connect the main lift chains to the chain anchors at the main lift cylinder mounts. Put the lift chains over the chain sheaves and connect them to the anchors at the bottom of the inner mast.
 16. Install the free-lift cylinder in the mounts on the inner mast. Install the upper and lower brackets for the cylinder and tighten the nuts to 81.5 N•m (60 lbf ft). The nuts are installed on the bracket side of the free-lift cylinder. See Figure 103.

17. Install the chain sheave for the free-lift cylinder. Tighten the capscrew for the chain sheave to 66 N•m (49 lbf ft). Install the hydraulic hose and tubing for the free-lift cylinder.
18. Connect free-lift chains to the chain anchors at the crossmember. Attach a wire between the end of the lift chain and the bottom of the mast to control the lift chain during mast installation. See Figure 103.

Install

1. Install the new bushings into the mast mounts at the bottom of the outer mast. Be sure to align the hole in the bushing with the lube fitting hole in the bottom of the outer mast. See Figure 100. Bushing must be flush with outer mast surface.
2. Apply an even coat of grease to pivot pins and install them into mounts at bottom of outer mast. See Figure 102.
3. Install washer and lube capscrew in the hole in the bottom of the outer mast. Tighten the lube capscrew to 17 N•m (12.5 lbf ft). Install lube fitting onto lube capscrew. See Figure 100.



WARNING

The mast is heavy. The mast can weigh approximately 973 kg (2145.1 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

4. Connect crane to top of mast using chains. Make sure all mast uprights are fastened together. Make sure chains will not damage sheaves, tubing, or other parts of mast. Make sure crane has a capacity of at least 630 kg (1389 lb).
5. Use crane to position mast assembly onto its lower mounts. Position mast so pivot pins seat into hanger mounts on drive axle. Install capscrews that hold mast pivot pins to drive axle hangers. Tighten capscrews to 270 N•m (199 lbf ft). See Figure 101.

6. Install new tilt rod bushings into the tilt anchors on the outer mast. Be sure tilt bushing split is installed at the correct angle as shown in Figure 100.



WARNING

Use a pry bar, NOT your fingers, to align the tilt cylinder clevises with the outer mast. The cylinder or mast can shift and cause serious injury.

NOTE: Use multipurpose grease #2 with 2 to 4% molybdenum disulfide for normal operations.

7. Apply grease to pivot pins and connect the tilt cylinders to the mast using pivot pins. Install anchor pins and capscrews to rod ends. Apply anti-seize compound to capscrew threads and tighten to 38 N•m (28 lbf ft). See Figure 102.
8. Install the LH hydraulic hose and free lift hose to the manifold valve. See Figure 98.

NOTE: RH hydraulic hose (from RH main lift cylinder to manifold valve) if white or colored line is printed on hose this must be traveling in a straight line along curve of hose and not twisted when installation is complete.

9. Install angled fitting on manifold valve. Ensure angle of fitting follows the natural curve of the hose. Torque fitting to standard torque so it is immobile.
10. Once angle is solid, install straight fitting onto RH main lift cylinder. Use backing wrench on straight fitting to hold the clocked angle of angled fitting. Torque straight fitting to standard torque.
11. Install the carriage as described in Carriages Repair, Three-Stage FFL Mast section in this manual.



WARNING

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

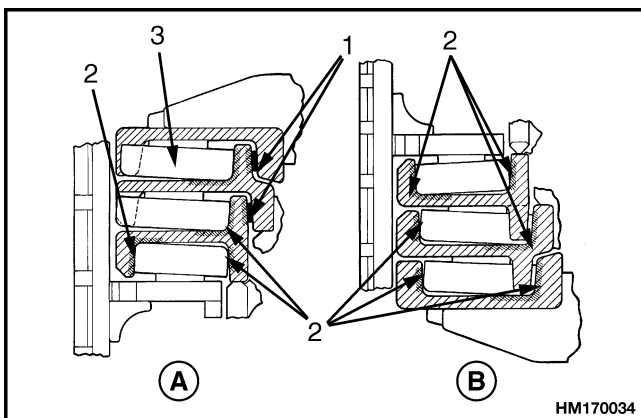
12. Check tilt cylinder adjustment as described in section Lift cylinder repair, in this manual. Operate mast and check for leaks and correct operation. Check lift chains as described in Clean and Inspect.

NOTE: Before checking for mast side kicking and adjusting the chain anchors on the main lift cylinders, the mast must be fully assembled to include the carriage, forks, load backrest and any attachments if the lift truck is equipped with one.

13. Adjust chain anchors on the main lift cylinders until the tops of the inner and outer mast are at the same level within ± 1.5 mm (0.06 in.). See Figure 108.
14. Raise mast, without a load to its full height and check for side kicking. Mast side kicking is when the mast moves either to the right or left as it is being raised to its full height. If the mast is side kicking, see the Mast Adjustments section in this manual for procedures to correct mast side kicking.

NOTE: The load rollers and sheaves have sealed bearings and do not need additional lubrication.

15. Lubricate sliding surfaces and load roller surfaces along full length of channels as shown in Figure 115. Apply lubricant only to surfaces indicated.



- A. UPPER LOAD ROLLERS
B. LOWER LOAD ROLLERS

1. LUBRICATE STRIP BEARING SURFACES
2. LUBRICATE LOAD ROLLER SURFACES
3. LOAD ROLLER

Figure 115. Lubricate Mast

4-STAGE FULL FREE LIFT (FFL) MAST REPAIR 202001-077

REPAIR MAST WITH SERIAL NUMBER E515/B954

Remove



WARNING

The mast is heavy. The mast can weigh approximately 772 kg (1702 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast. Serious injury can occur if the mast falls.



WARNING

Mast weldments can slide when the mast is moved. A weldment that slides can cause serious injury.



CAUTION

Make sure all mast weldments are fastened together. Make sure the safety chains will not damage sheaves, tubing, or other parts of the mast.

NOTE: If the mast needs to be disassembled, remove the forks and carriage. See sections and Carriage repair, 4-Stage Full Free Lift for procedures. If only main lift cylinders need to be repaired, the mast does not need to be removed from lift truck. See **Hydraulics** 1900SRM2302 for procedures. For header hose installation and adjustment procedures, see the section Header Hoses, 4-Stage Full Free Lift (FFL).

NOTE: The length of lift chains must be checked before mast is removed. See Lift Chains Adjustment section in this manual.

1. Fully lower all mast weldments. Tilt the mast fully forward. Connect a crane with a capacity of at least 772 kg (1702 lb) to all top crossmembers of mast weldments using chains to support mast in an upright position when tilt cylinders are disconnected.



WARNING

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

Completely lower forks to relieve hydraulic pressure before disconnecting any hoses.



CAUTION

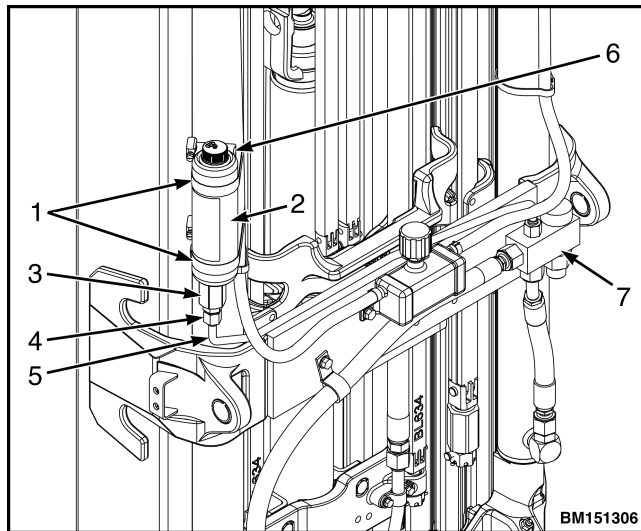
Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hosts from the mast. If hydraulic system becomes contaminated, damage to hydraulic system can occur.



CAUTION

Disposal of lubricants and fluids must meet local environmental regulations.

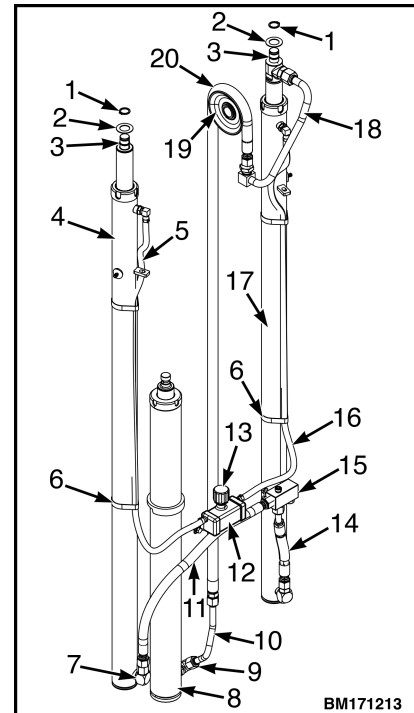
2. Position a drip pan under area of hydraulic fittings. See Figure 117.
3. Disconnect the flow control fitting from the mast accumulator. See Figure 116.



1. STRAP
2. ACCUMULATOR
3. FLOW CONTROL FITTING
4. TUBE FITTING
5. HYDRAULIC TUBE
6. SPACER
7. MANIFOLD

Figure 116. Mast accumulator

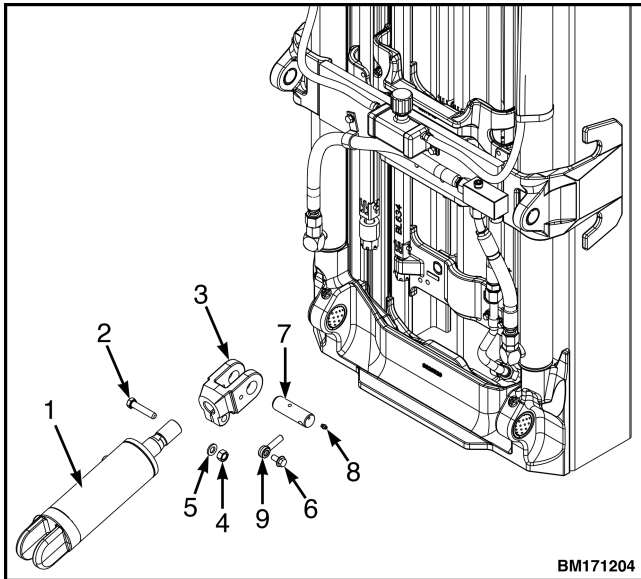
4. Loosen the two strap clamps securing the mast accumulator and remove the accumulator. See Figure 116.
5. Disconnect the hydraulic tube from the manifold. See Figure 116.
6. Disconnect the hydraulic hoses at the manifold on the outer mast. See Figure 117.



1. SNAP RING
2. SHIM
3. O-RING
4. LEFT-HAND MAIN LIFT CYLINDER
5. LEFT-HAND HOSE
6. HOSE RETAINER
7. HYDRAULIC VELOCITY FUSE
8. FREE-LIFT CYLINDER
9. FLOW VALVE
10. TUBE ASSEMBLY
11. HOSE ASSEMBLY
12. DRAIN BACK COLLECTION TANK
13. BREATHER ASSEMBLY
14. HOSE ASSEMBLY
15. MAST CONNECTION BLOCK MANIFOLD
16. RIGHT-HAND HOSE
17. RIGHT-HAND CYLINDER
18. TUBE ASSEMBLY
19. FREE-LIFT HOSE SHEAVE
20. FREE-LIFT HOSE ASSEMBLY

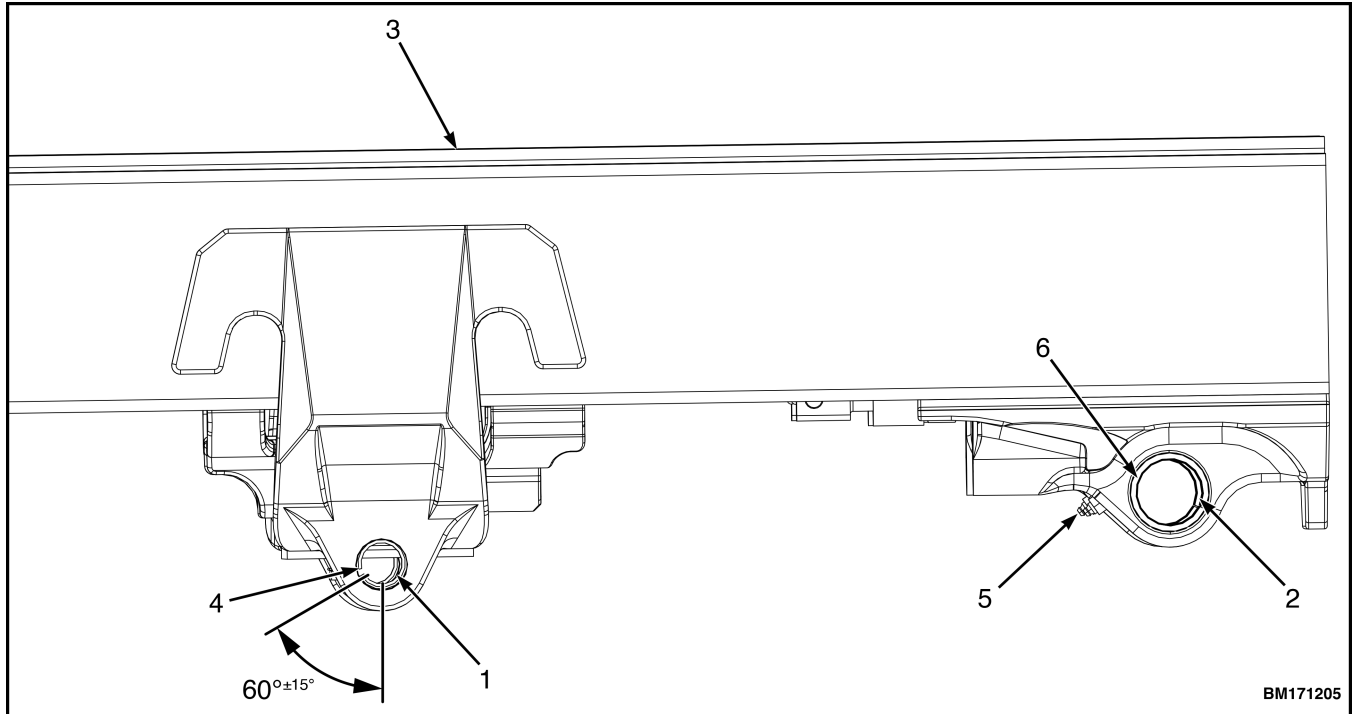
Figure 117. Main Lift, Free-Lift Cylinders and Hoses, 4-Stage FFL

7. Disconnect the hydraulic line at lowering control valve on outer mast. See Figure 117.
8. Remove capscrews, washers, nuts, anchor pins, and pivot pins at the tilt cylinder mounts on the outer mast. See Figure 118.
9. Using a brass drift pin, remove tilt rod bushings from outer mast. Discard tilt rod bushings. See Figure 119.



1. TILT CYLINDER
2. CAPSCREW
3. ROD END
4. NUT
5. WASHER
6. CAPSCREW
7. PIVOT PIN
8. GREASE FITTING
9. ANCHOR ROD

Figure 118. Mast Mount - Tilt, 4-Stage Mast



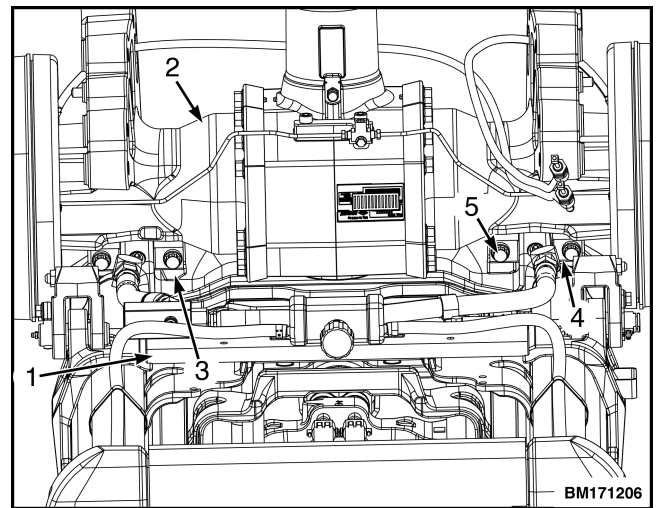
- 1. TILT ROD BUSHING
- 2. MAST MOUNTING BUSHING
- 3. OUTER MAST

- 4. BUSHING SPLIT
- 5. LUBE FITTING
- 6. BUSHING HOLE

Figure 119. Tilt Rod and Mast Mounting Bushings

NOTE: Tilt mast forward enough to allow for access to mast mount capscrews.

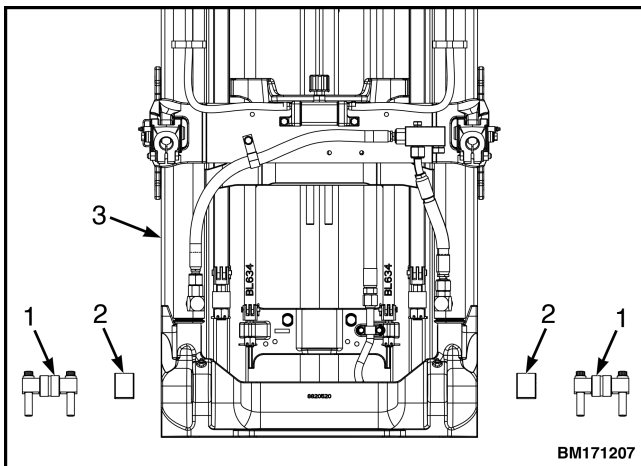
- 10. Disconnect lower mast mounts from lift truck by removing capscrews that hold mast pivot pins to mounts on drive axle. See Figure 119 and Figure 120.



- 1. MAST
- 2. DRIVE AXLE
- 3. HANGER MOUNTS
- 4. MAST PIVOT PINS
- 5. CAPSCREW

Figure 120. Mast Mounts, Drive Axle

11. Use lifting device to lift mast assembly from lift truck. Position outer mast across wooden beams on floor with carriage side up.
12. Check mast and mounting flanges for wear or damage by removing mast pivot pins from outer mast. Check that pins fit snug in the outer mast. If pins can be moved up and down a minimum of 4 mm (0.20 in.), replace bushings in outer mast and/or mast pivot pins as required. Use a brass drift pin to remove mast mounting bushings from outer mast. See Figure 119 and Figure 121.



1. MAST PIVOT PINS
2. MAST MOUNTING BUSHING (BRONZE)
3. OUTER MAST

Figure 121. Mast Pivot Pin

Disassemble



WARNING

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

Completely lower forks to relieve hydraulic pressure before disconnecting any hydraulic hoses.

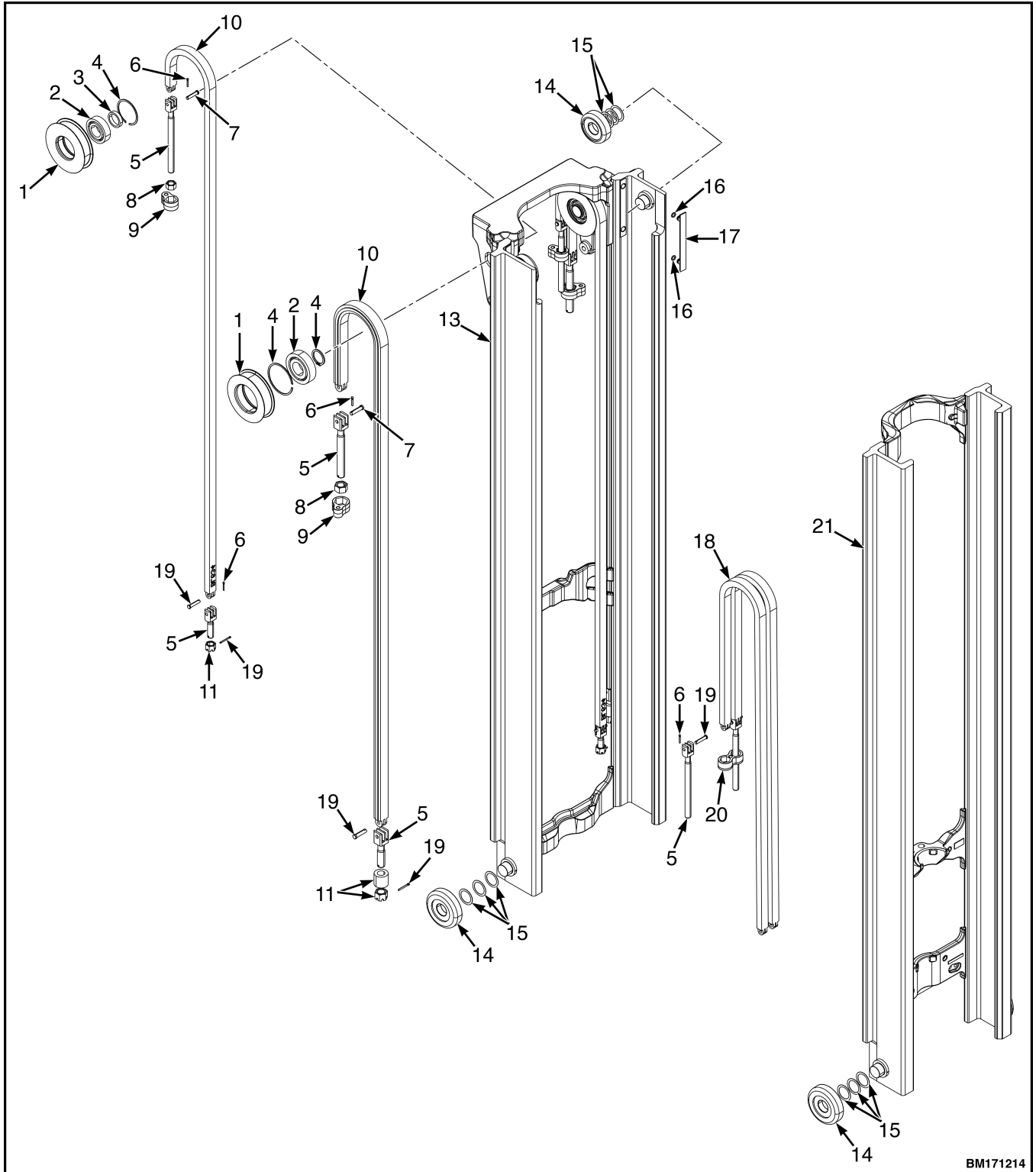


CAUTION

Protect the hydraulic system from dirt and contaminants when disconnecting hydraulic hoses from the mast. If hydraulic system becomes contaminated, damage to the hydraulic system can occur.

NOTE: If only main lift cylinders need to be removed from repair, the mast does not need to be removed from lift truck. See **Hydraulics** 1900SRM2302 for procedures to remove main lift cylinders.

1. Disconnect and remove hydraulic lines for free-lift cylinder. Remove brackets for free-lift cylinder. Remove free-lift cylinder. Disconnect free-lift chains at crossmember. See Figure 122.



BM171214

Figure 122. Second Intermediate and Inner Mast

Legend for Figure 122.

- | | |
|----------------|---------------------------|
| 1. SHEAVE | 12. CHAIN ANCHOR TUBE |
| 2. BEARING | 13. 2ND INTERMEDIATE MAST |
| 3. SPACER | 14. LOAD ROLLER |
| 4. SNAP RING | 15. SHIM |
| 5. ANCHOR | 16. O-RING |
| 6. COTTER PIN | 17. WEAR STRIP |
| 7. ANCHOR PIN | 18. FREE-LIFT CHAIN |
| 8. LOCKNUT | 19. PIN |
| 9. RESTRAINT | 20. FREE-LIFT RESTRAINT |
| 10. LIFT CHAIN | 21. INNER MAST |
| 11. CASTLE NUT | |

2. Disconnect the lift chains from the anchor pins attached to the crossmember of the inner mast and the anchor pins attached to the outer mast. Remove the lift chains. Push the inner mast toward the bottom of the mast assembly until the bottom load rollers are visible. See Figure 122 and Figure 123.

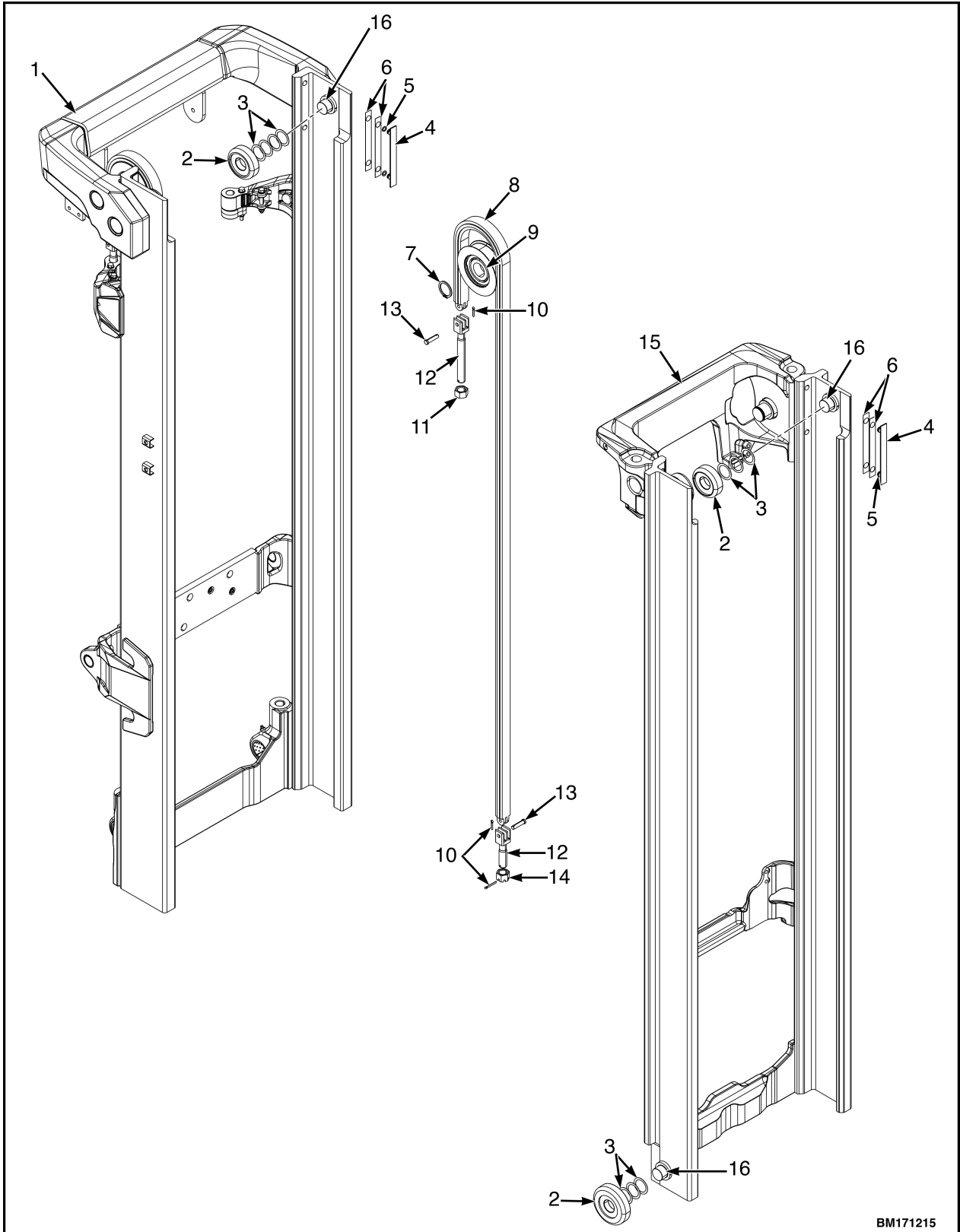


Figure 123. Outer and First Intermediate Masts

Legend for Figure 123.

- | | |
|----------------|---------------------------|
| 1. OUTER MAST | 9. SHEAVE |
| 2. LOAD ROLLER | 10. COTTER PIN |
| 3. SHIM | 11. NUT |
| 4. WEAR STRIP | 12. CHAIN ANCHOR |
| 5. O-RING | 13. ANCHOR PIN |
| 6. SHIM | 14. CASTLE NUT |
| 7. SNAP RING | 15. 1ST INTERMEDIATE MAST |
| 8. LIFT CHAIN | 16. STUB SHAFT |

3. Remove strip bearings at top of second intermediate mast. Remove load rollers at bottom of inner. See Figure 122. Remove load rollers at top of second intermediate mast. Make a note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly.

**WARNING**

The mast is heavy. The mast can weigh approximately 772 kg (1702 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

4. Slide inner mast halfway out of top of second intermediate mast. Connect crane to center of inner mast. See Figure 124. Slide inner mast out until stubshafts are in notches of second intermediate mast. Remove inner mast from second intermediate mast.

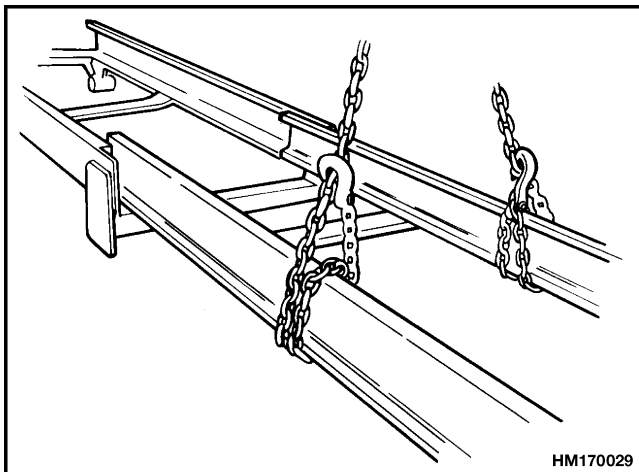


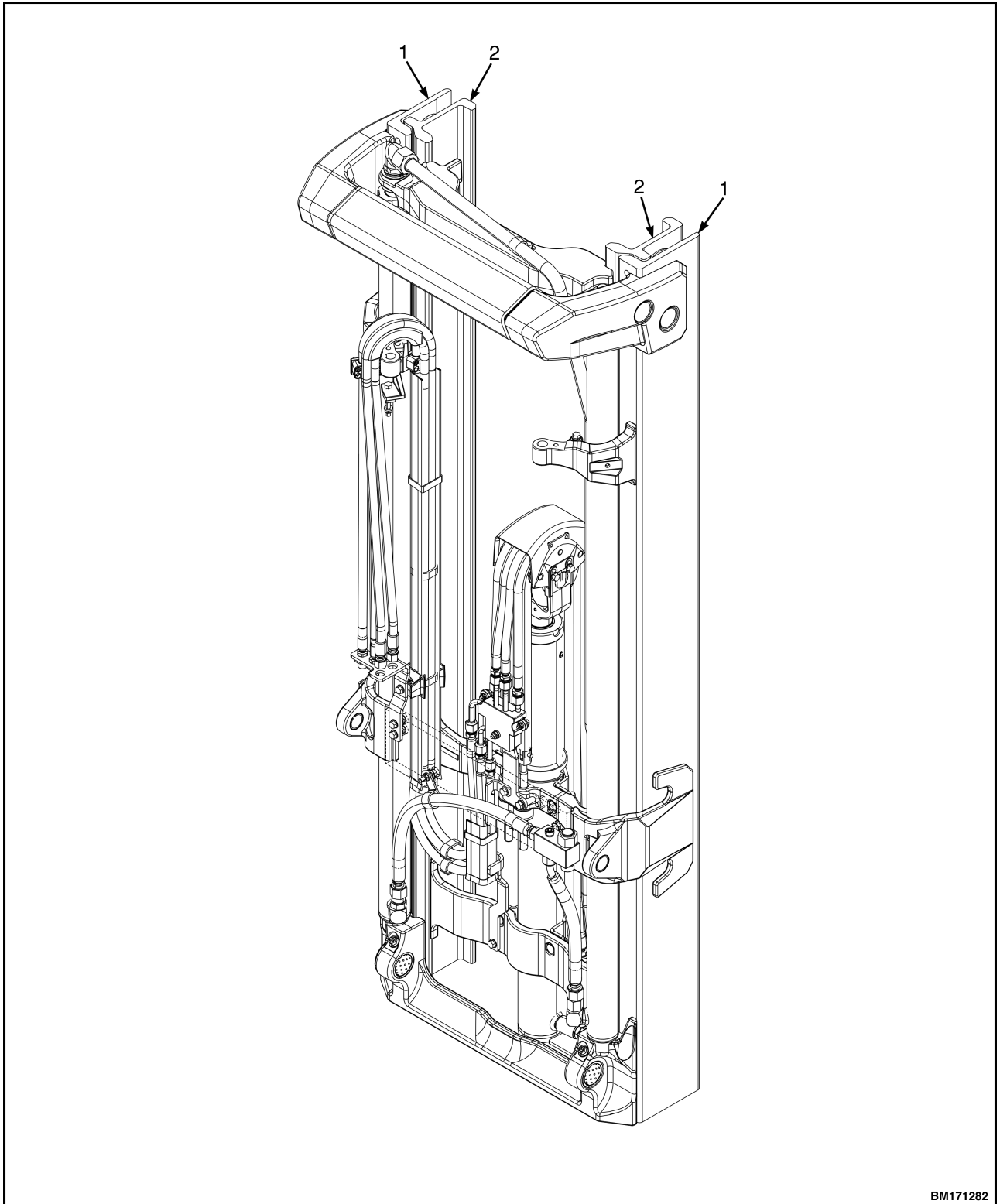
Figure 124. Mast Disassembly

5. Disconnect lift chains at bottom of second intermediate mast and top of outer mast. Remove lift chains. Push second intermediate mast toward bottom of mast assembly until bottom load rollers are seen. See Figure 122 and Figure 123.
6. Remove strip bearings and spacers at top of first intermediate mast. Remove load rollers at bottom of second intermediate mast. Remove load rollers at top of first intermediate mast. Make a note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly. See Figure 122 and Figure 123.

**WARNING**

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

7. Slide second intermediate mast halfway out of top of first intermediate mast. Connect crane to center of second intermediate mast. See Figure 124. Slide second intermediate mast out until stub shafts are in notches of first intermediate mast. Remove second intermediate mast.
8. Remove nut, washer, and capscrew from outer mast crossmember and bracket weldment and remove house channels from outer mast. See Figure 125.



BM171282

Figure 125. Hose Channel Removal, Four-Stage FFL Mast

Legend for Figure 125.

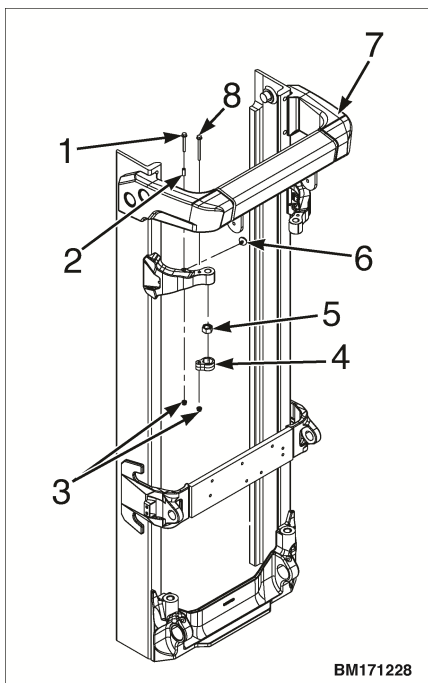
NOTE: FOUR FUNCTION MAST WITH FOUR HOSE CHANNELS SHOWN. THREE FUNCTION MAST WILL HAVE TWO HOSE CHANNELS.

1. HOSE CHANNEL

9. Disconnect hydraulic hoses at top and bottom of main lift cylinders. Disconnect tube assembly from right-hand main lift cylinder and free-lift hose assembly cylinder. Disconnect free-lift cylinder hose assembly. Disconnect tube assembly from free-lift cylinder. See Figure 117.

10. Remove snap rings, shims, and O-rings at top of main lift cylinders. See Figure 117.

11. Remove capscrews, spacers, rubber pads, locknuts, chain anchor restraints, and nuts from mount new top of each main lift cylinder. See Figure 126.



1. CAPSCREW
2. SPACER
3. LOCKNUT
4. CHAIN ANCHOR RESTRAINT
5. NUT
6. RUBBER PAD
7. OUTER MAST
8. CAPSCREW

Figure 126. Main Lift Cylinder Mount

2. INNER MAST

12. Push first intermediate mast to disengage lift cylinders. Remove main lift cylinders. Keep shims from top of lift cylinders.

13. Slide first intermediate mast from bottom of outer mast approximately 30 cm (12 in.). Remove strip bearings at top of outer mast. Remove snap rings and load rollers from both mast uprights. Make note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly.

14. Slide intermediate mast halfway out of top of outer mast. Connect crane to center of first intermediate mast. See Figure 124. Slide first intermediate mast out of outer mast until stub shafts are in notches of outer mast. Remove first intermediate mast from outer mast.

15. Disassemble chain sheaves as necessary for repair and cleaning. Remove hydraulic lines and fittings from mast uprights as necessary.

Clean and Inspect**CAUTION**

DO NOT use steam or high-pressure water to clean the load rollers or the lift chains. Steam and high-pressure water can remove the lubrication from the bearings in the load rollers. Water in the bearings of the sheaves and the link pins of chains can also shorten the service life of these parts.

1. Inspect chain sheaves and load rollers for wear or damage. See Figure 123, and inner mast (4 and 5, Figure 122). **DO NOT** use steam to clean lift chain sheaves or load rollers. The bearings in the sheaves and load rollers are sealed and lubricated.

**WARNING**

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



WARNING

Compressed air can move particles and make them become airborne, which may cause injury. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent eye injury.

2. Clean the lift chains by soaking in solvent for 30 minutes to remove all dirt and grease. Hang lift chains up and remove solvent using compressed air.



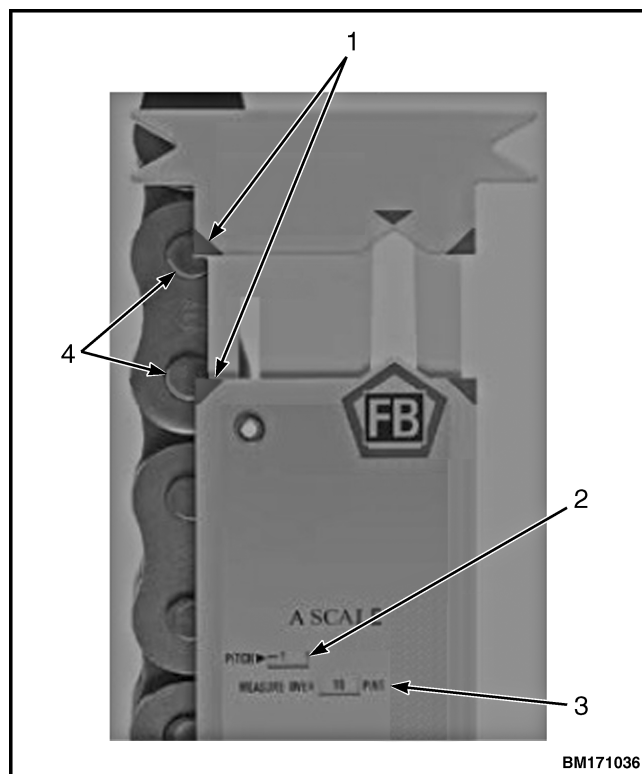
WARNING

Never replace only the worn section of a chain. Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains. Damage to the lift truck and serious injury can occur if lift chains are not replaced correctly.

NOTE: The chains must be inspected in the area of chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear.

3. Inspect the lift chains for wear and damage. A lift chain becomes longer when it is worn. If a chain is 3% longer than a new lift chain, the lift chain must be replaced.

- a. Locate chain wear gauge (Hyster Part No. 4044579).
- b. Before using the chain wear gauge, inspect the V-jaws on the top and bottom of the gauge (see items 1 and 2, Figure 128) to make sure they are not bent or damaged. Confirm the gauge is not warped or bent and slides easily. Close the gauge completely and confirm the calibration window reads "OK".
- c. Use the chain wear gauge to identify the leaf chain pitch, by aligning the two arrows on the edge of the gauge with the two pin centers of one of the OUTER link plates. See Figure 127.



1. ARROWS
2. PITCH WINDOW
3. MEASURE OVER PINS WINDOW
4. PIN CENTER

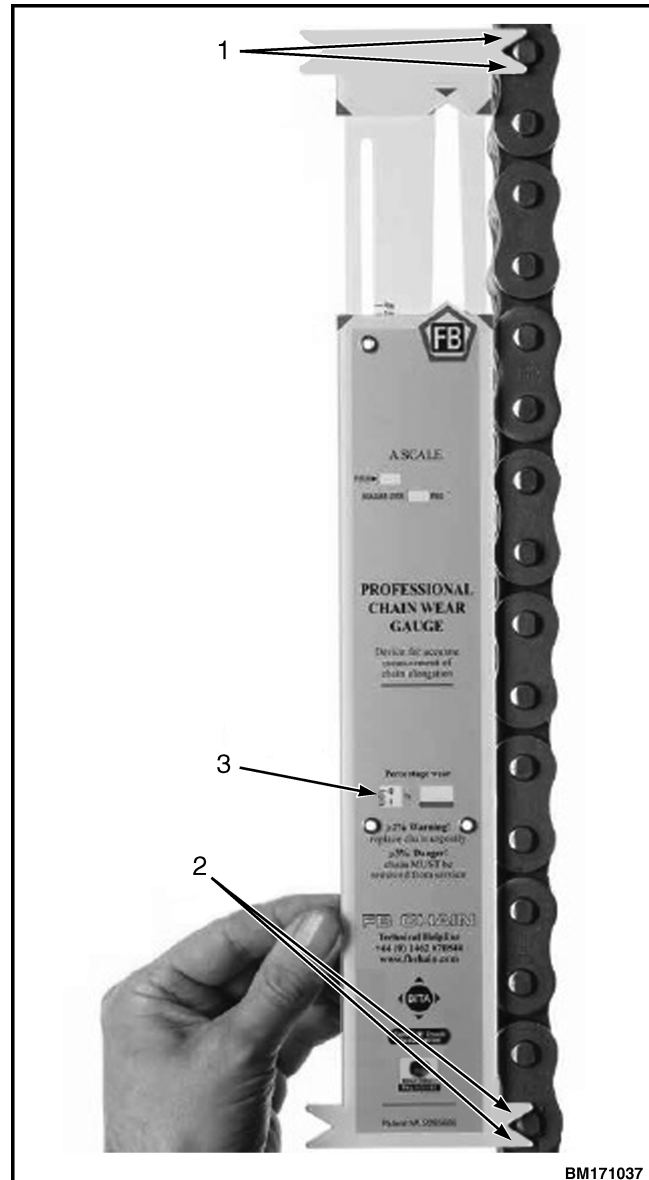
Figure 127. Measure pitch

- d. The nominal pitch of the leaf chain will appear in the "Pitch" window on the chain wear gauge. See Figure 127.
- e. Select and use the correct side of the gauge relevant to the measured nominal pitch as follows:

A Scale	B Scale
3/8"	1 3/4"
1/2"	2"
5/8"	3/4"
1"	1 1/4"
1 1/2"	2 1/2"
3"	

- f. Once the pitch has been determined, the number of pins that the chain wear is to be measured over will display in the 'Measure over Pins' window. See Figure 127.

- g.** Find a portion of the chain that passes over the chain sheave during the first portion of a lift. These links will show maximum wear. Choose three separate locations in this section to perform the measurement.
- h.** Make sure the leaf chain is bearing a load and place the top 'V' jaw of the chain wear gauge over the first pin of the selected section. See Figure 128. Extend the slide until the bottom 'V' jaw locates over the selected bottom pin (as previously determined in Step f of this procedure). The percentage of wear will appear in the box in 0.25% ($\frac{1}{4}\%$) increments.



1. TOP V-JAW
2. BOTTOM V-JAW
3. PERCENTAGE OF WEAR

Figure 128. V-jaws



WARNING

Although the chain wear gauge will show wear up to 4%, any leaf chain used for lifting with a measured elongation of 3% or more is dangerous and must be replaced immediately.

- i. If the chain wear gauge shows a 2% or greater elongation, the red indicator will completely fill the window. This is an indication that the chain requires replacing.
- 4. Lubricate lift chains by soaking them in SAE 30 engine oil for 30 minutes. Hang chains over a drip pan for one hour to remove excess oil.
- 5. Inspect chain anchors, chain anchor pins, and chain anchor restraints. Replace any parts that are worn or damaged.

**WARNING**

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

**WARNING**

Steam can cause serious burns. Wear protective clothing, gloves, and eye protection. Never expose your skin to steam.

- 6. Clean mast weldments with steam or solvent.

**WARNING**

Improper welding procedures can damage the structure of the mast or cause incorrect function of the mast which can result in serious injury to personnel. Consult your lift truck dealer for more information before welding on the mast

- 7. Inspect sliding surfaces for wear or damage. Inspect load roller contact surfaces for wear or damage. Inspect all welds for cracks.

Replacing lift chains

**WARNING**

Replace the complete chain. Never replace only one chain of a chain pair. Replace both chains at the same time.

NOTE: Chains must be replaced completely and in pairs. **Chains must not be joined or spliced.**

NOTE:

- Both lift chains must be replaced every 7,500 hours or if the above inspection reveals 3% stretch or rolled pin. See **Periodic Maintenance** manual for more information.

NOTE: When cutting the chain from bulk, be sure to completely grind off the heads of the rivets before driving out the rivets. It is essential to avoid damage to the bores in the link plates.

**WARNING**

When replacing the chain pairs, always replace the chain anchors and the chain attaching hardware.

1. Install new chain anchors in the outer mast and crossmember of the inner mast. See Figure 123.
2. Connect the lift chains to the chain anchors attached to the outer mast. Insert the anchor pins and cotter pins to secure. See Figure 123.
3. Route the lift chains over the chain sheaves and connect the chains to the chain anchors attached to the crossmember of the inner mast. Insert the anchor pins and cotter pins to secure. See Figure 123.

Assemble

**WARNING**

The mast is heavy. The mast can weight approximately 772 kg (1702 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast.

**WARNING**

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

NOTE: Shims for the load rollers keep the mast weldments parallel and provide correct clearance. During assembly, shims should be reinstalled in the same location they were in before disassembly. Check clearance and adjust shims for wear or for changes caused by repairs. The strip bearings are also adjusted by using shims and should also be reinstalled in the same location they were in before disassembly. See Mast Adjustments in this service manual for adjustment procedures.

1. Put outer mast on floor with mast pivots toward floor. Connect crane to center of first intermediate mast. See Figure 124. Fit lower stubshafts of first intermediate mast into notches in top of outer mast. Slide first intermediate mast into outer mast so stubshafts are seen at top and bottom of both mast uprights.
2. Install strip bearings and shims on channels of outer mast. See Figure 129. Apply grease to bearing surfaces.

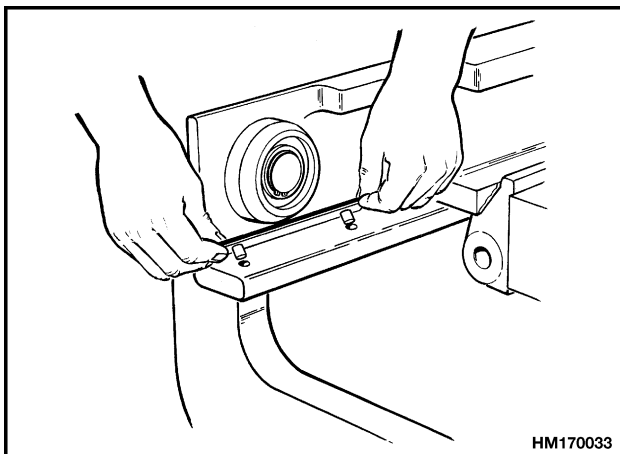


Figure 129. Strip Bearings

3. Install load rollers and shims on outer mast and at bottom of first intermediate mast. Before performing Step 4, adjust first intermediate mast as described in Mast Adjustments in the service manual. Install chain sheaves, shims, and snap rings on first intermediate weldment.

WARNING

Be careful when removing or installing snap rings on the main lift cylinders. These snap rings can come loose during removal or installation with

enough force to cause an injury. Always use the correct snap ring pliers and wear eye and face protection when removing and installing snap rings onto main lift cylinders.

4. Install main lift cylinders in mounts at bottom of outer mast. See Figure 123. Push intermediate mast to engage lift cylinders. Check clearance at top of lift cylinder mounts. Add or remove shims at top of left cylinder rod until both cylinders are even. Install retaining at top of right cylinder. Install snap ring and washer at top of lift cylinders. Install nuts capscrews, washers, and spacers at lift cylinder mounts on outer mast. Tighten nuts to 40 N·m (30 lbf ft).
5. Install housing for lowering control valve on outer mast. Tighten nuts for lowering control valve to 18 N·m (13 lbf ft). Install lowering control valve in housing. Connect hydraulic lines and fittings between lowering control valve and main lift cylinders. See Figure 117.
6. Install chain sheaves and snap rings on second intermediate mast. See Figure 122.
7. Install hose channels onto outer mast using capscrews, nuts, and washers. Tighten capscrews to 8 N·m (71 lbf in). See Figure 125.

WARNING

The mast is heavy. The mast can weigh approximately 772 kg (1702 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast. Serious injury can occur if the mast falls.

WARNING

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

8. Connect crane to center of second intermediate mast. See Figure 124. Slide mast into first intermediate mast so stub shafts are seen at top bottom of both mast uprights.

9. Install strip bearings and shims on channels of first intermediate mast. See Figure 129. Apply grease to bearing surfaces. Install load rollers and shims on first and second intermediate mast. Before performing Step 10, adjust second intermediate mast as described in Mast Adjustments .
10. Connect lift chains to chain anchors at outer mast. Put lift chains over chain sheaves on first intermediate mast and connect them to anchors at bottom of second intermediate mast.
11. Connect crane to center of inner mast. See Figure 124. Slide mast into second intermediate mast so stub shafts are seen at top and bottom of both uprights.
12. Install strip bearings and shims on channels of second intermediate mast. Apply grease to bearing surfaces. Install load rollers and shims on second intermediate and inner mast. Before performing Step 13, adjust inner mast as described in Mast Adjustments .
13. Connect the lift chains to the chain anchors attached to the outer mast. Insert the anchor pins and cotter pins to secure. See Figure 123.
14. Route the lift chains over the chain sheaves and connect the chains to the chain anchors attached to the crossmember of the inner mast. Insert the anchor pins and cotter pins to secure. See Figure 123.
15. Install free-lift cylinder in mounts on inner mast. Install brackets for cylinder and tighten nuts and capscrew to 40 N•m (30 lbf ft). See Figure 122.
16. Install hose sheave for free-lift cylinder. See Figure 130. Install hydraulic hose and tubing that connect free-lift cylinder to right main lift cylinder. See Figure 117.
17. Connect free-lift chains to chain anchors at inner crossmember. Attach wire between other end of lift chain and bottom of mast to control free-lift chain during installation of mast.

Install

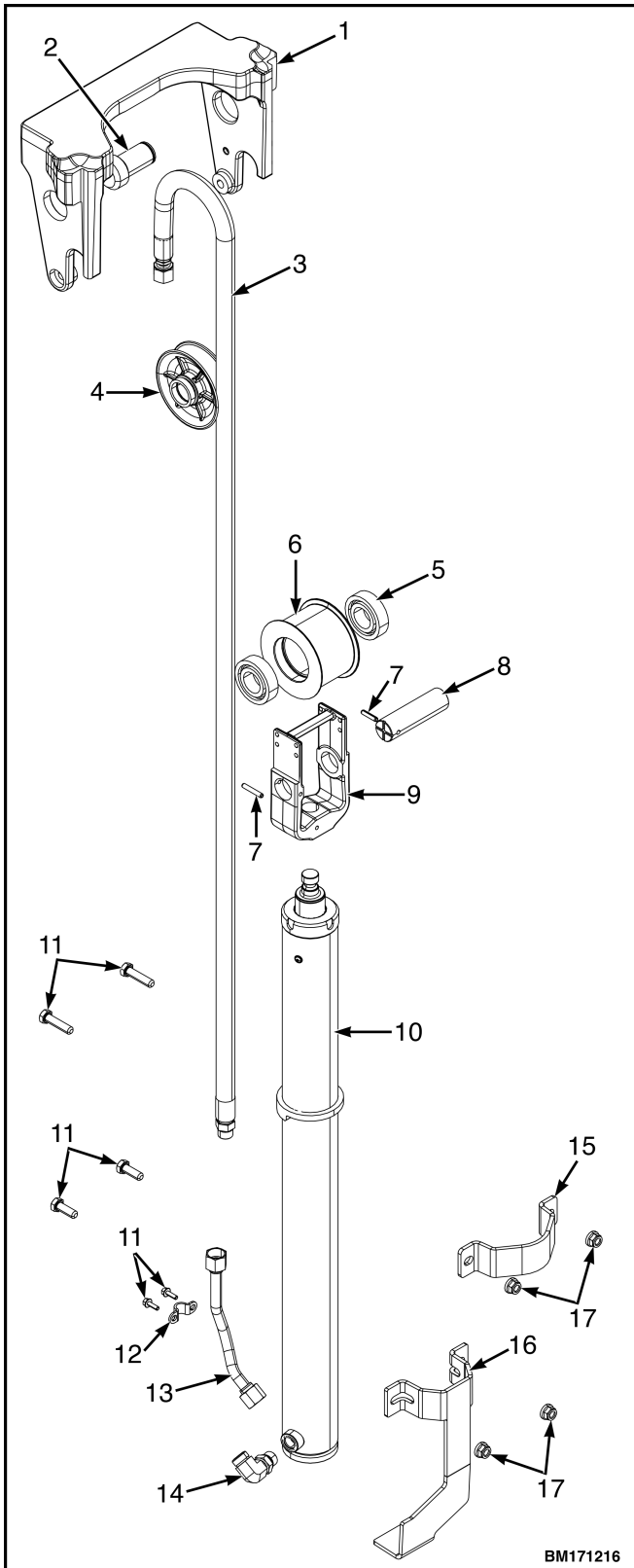
1. Install new bushings into mast mounts at bottom of outer mast. Be sure to align hole in bushing with lube fitting hole in the bottom outer mast and that bushing split is installed at correct angle as shown in Figure 119. Bushing must be flush with outer mast surface.
2. Apply an even coat of grease to mast pivot pins and install them into mounts at the bottom of the outer mast. See Figure 121.



WARNING

The mast is heavy. The mast can weigh approximately 772 kg (1702 lb). Make sure all lifting devices (hoists, cables, chains, slings, etc.) are suitable and of adequate capacity to lift the mast. Serious injury can occur if the mast falls.

3. Connect a lifting device to top of mast using chains. Make sure all mast uprights are fastened together. Make sure chain will not damage chain sheaves, tubing, or other parts of the mast.

**Legend for Figure 130.**

1. CROSSMEMBER
2. STUBSHAFT
3. HOSE
4. HOSE SHEAVE
5. BEARING
6. CHAIN SHEAVE
7. ROLL PIN
8. PIN
9. CROSSHEAD
10. FREE-LIFT CYLINDER ASSEMBLY
11. CAPSCREW
12. BRACKET
13. TUBE ASSEMBLY
14. FLOW VALVE
15. TIE DOWN CLAMP
16. TIE DOWN CLAMP
17. LOCKNUT

4. Use lifting device and position mast so that pivot pins seat into hanger mounts on drive axle. See Figure 120. Install cap screws that hold mast pivot pins to drive axle hangers and tighten cap screws to 270 N·m (199 lbf ft), See Figure 121.
5. Install new tilt rod bushings into outer mast. Be sure to install bushings with split at correct angle as shown in Figure 119.

**WARNING**

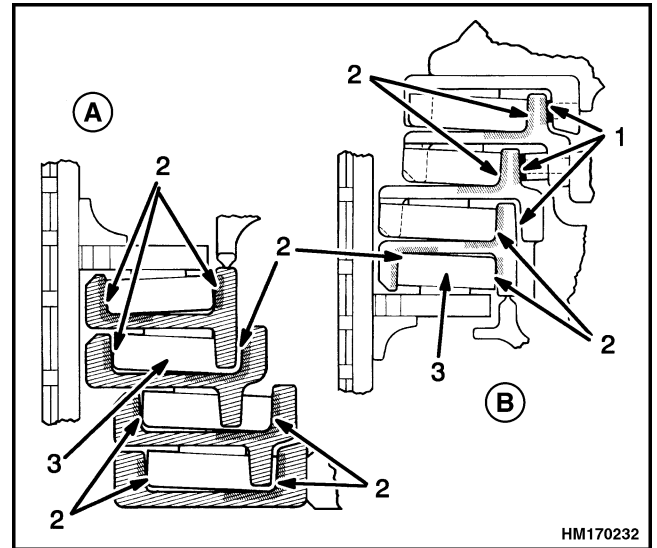
Use a pry bar, **NOT** your fingers, to align the tilt cylinder clevises with the outer mast. The cylinder or mast can shift and cause serious injury.

NOTE: Use multipurpose grease #2 with 2 to 4% molybdenum disulfide for normal operations.

6. Apply grease to pivot pins and connect tilt cylinders to mast using pivot pins. Install anchor pins and cap screws to rod ends. Apply anti-seize compound to cap screw threads and tighten to 38 N·m (28 lbf ft). See Figure 118.
7. Connect hydraulic hose to lowering control valve. See Figure 117.
8. Install the manifold on the outer mast. Tighten the cap screws retaining the manifold to 19.2 N·m (14.2 lbf ft). Connect the hydraulic lines and fittings between the housing and the main lift cylinders. See Figure 117.

Figure 130. Free-Lift Cylinder Assembly

9. Install the two strap clamps for retaining the mast accumulator onto the left-hand tilt cylinder. See Figure 116. Orient the screws on the strap clamps toward the mast channel and up against the lift cylinder, to minimize clamp twist during torquing.
10. Install the mast accumulator and two spacers into the strap clamps. See Figure 116. Ensure the accumulator is oriented with the warning label facing out. Confirm the strap clamps are not covering any warning labels by adjusting the clamps and moving up or down accordingly.
11. Torque the screws on the strap clamps to 11.3 N•m (8.3 lbf ft). Trim off the excess straps.
12. Connect one end of the hydraulic tube to the fitting on the manifold and the other end to the flow control fitting on the accumulator. See Figure 116.
13. Tighten the fittings to standard torque.
14. Install carriage as described in Carriage repair, 4-Stage Full Free Lift and install forks as shown in section Fork removal and replacement in this service manual.
15. Check tilt cylinder adjustment. See **Hydraulics** 1900SRM2302 for adjustment procedures.
16. Operate mast and check for leaks and to ensure mast is operating correctly. Check lift chains as described in section Lift Chains Adjustment .
17. Adjust chain anchors on outer mast until tops of the second intermediate and outer mast are at the same level within ± 1.5 mm (0.06 in.). See Figure 123. Adjust chain anchors on first intermediate mast until the top of inner and outer mast are at the same level within ± 1.5 mm (0.06 in.).
18. Raise mast, without a load to its full height and check for side kicking. Mast side kicking is where the mast, without a load, moves either to the right or left as it is being raised to its full height. If mast is side kicking, see Mast Adjustments section for procedures to correct mast side kicking.
19. Lubricate sliding surfaces and load roller surfaces along full length of channels as shown in Figure 131. Apply lubricant only to surfaces indicated.



- A. LOWER LOAD ROLLERS
 B. UPPER LOAD ROLLERS
1. LUBRICATE STRIP BEARING SURFACES
 2. LUBRICATE LOAD ROLLER SURFACES
 3. LOAD ROLLER

Figure 131. Mast Lubrication

Header Hose Repair

HEADER HOSES, 2-STAGE LIMITED FREE LIFT (LFL) 202001-220

REMOVE

Read and follow the Safety Procedures When Working Near Mast as well as all **WARNINGS** and **CAUTIONS** before removing any header hoses.

NOTE: Access to some of the fittings can be difficult. If necessary, operate hydraulic system to move mast weldments or carriage. Make sure the hydraulic system does not have pressure as described in Step 1.

1. To replace any header hoses, fully lower carriage. Make sure hydraulic system does not have hydraulic pressure. Hold the control for each function in the forward position for approximately five seconds to release pressure. Make sure hydraulic pump does not operate. Move key or keyless switch, if equipped, to the **OFF** position.
2. Disconnect the battery and put a tag or lock on the battery connector.
3. Disconnect header hoses and install caps on ends to prevent dirt and debris from entering the hydraulic system.

INSTALLATION



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.



WARNING

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



WARNING

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

1. Some lift trucks are equipped with auxiliary hydraulic functions that are fastened to the carriage. Examples of attachments that use these auxiliary functions are sideshift carriages, roll clamps, and fork positioners. These auxiliary functions require header hoses for their operation.

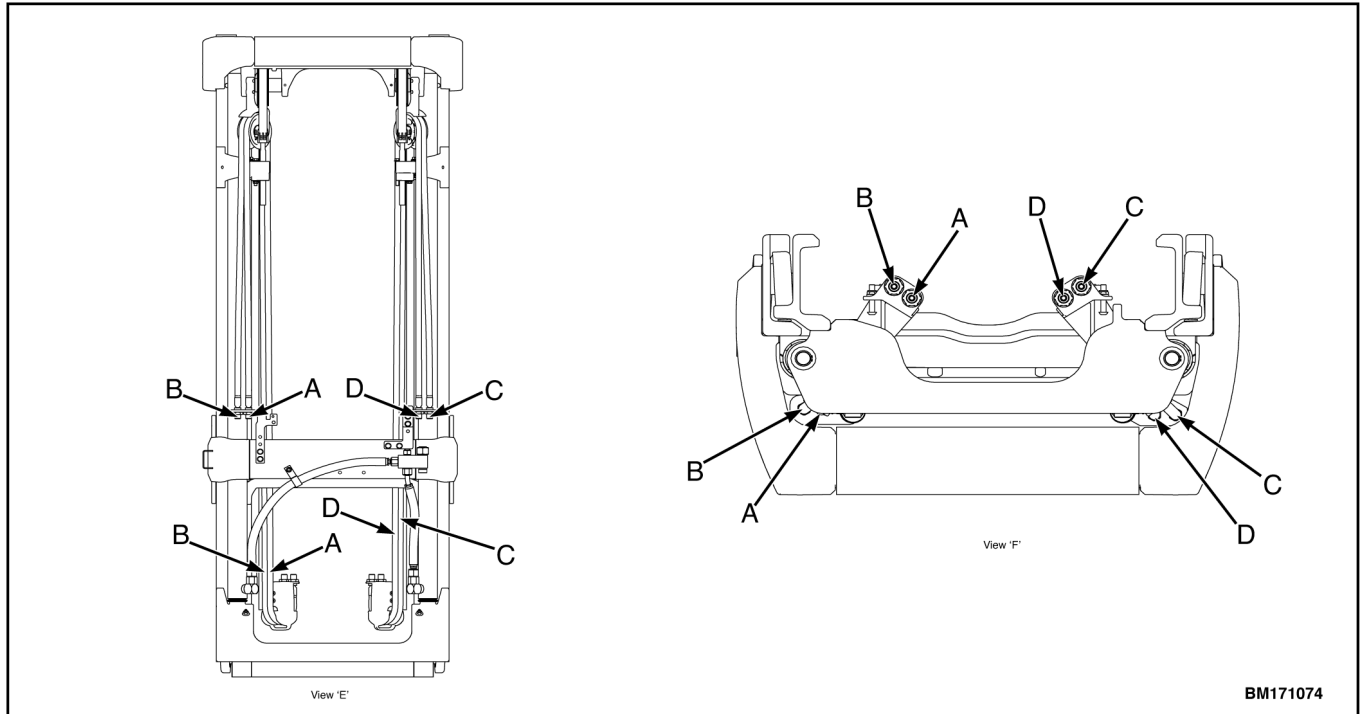
NOTE: The procedures in this section are for the four function option. Lift trucks equipped with three-function option will only have hoses **A** and **B**. See Figure 132.

NOTE: The carriage height must be correct before the header hose tension can be measured. See section for Lift chains adjustment in Header Hoses, 3-stage full free lift (FFL) for carriage adjustment procedures.

Mark each hose with a single letter: **A**, **B**, **C**, and **D**.

All four hoses are the same length. Before installing new header hoses, add tension marks to each hose. See Figure 133.

2. Clamp one end of the hose in a vise. **DO NOT** clamp on the threads. Pull on the other end until hose is straight. **DO NOT** apply enough force to stretch the hose.



A. HEADER HOSE
B. HEADER HOSE
C. HEADER HOSE

D. HEADER HOSE
E. REAR VIEW
F. TOP VIEW

Figure 132. Header Hose Alignment for Two-Stage LFL Mast

NOTE: Header hose tension specification is 1.5% \pm 1%. Install hose caps to marked end (truck end) of hoses.

3. Put reference marks on the header hoses. Starting at either end of each of the hoses, place a mark at 100 ± 10 mm (4.0 ± 0.40 in.). This is dimension **M1**. See Figure 133.
4. From dimension **M1**, place another mark at 500 ± 2.0 mm (20.0 ± 0.08 in.). This is dimension **M2**. See Figure 133.
5. Attach three-function hoses (**A** and **B**) and four-function hoses (**C** and **D**) to turnaround brackets on carriage. See Figure 133.
6. Route hoses over the turnaround brackets and secure the end of the hose to the turnaround bracket with hose clamps and worm screw clamps. Worm screw clamps go through the hose clamps and around the turnaround bracket to protect the header hoses. See Figure 133.
7. Route hoses up over hose sheaves and secure hoses to hose sheaves with spacers.
8. Clamp marked end of hoses to brackets on mid-outer crossmember. See Figure 133.
9. With header hoses installed on mast and the carriage correctly adjusted (see Adjustment) and the forks off the ground, measure header hose tension on mast as follows:
 - a. Measure the distance between marks **M1** and **M2**. See Figure 133.
 - b. The header hose specification between marks **M1** and **M2** is 507.5 ± 5 mm (20.0 ± 0.08 in.).

- c. If tension mark measurement is one millimeter lower than specification, adjust the plate attached to the bracket on the mid-outer crossmember, downward by one hole and re-measure tension mark. If tension mark is still 502 mm (19.8 in.) or lower, replace hose and re-set plate to the upper position.
- d. If tension mark is 512 mm (20.2 in.) or higher, adjust carriage to maximum height allowed. See Adjustment section for procedures.

Legend for Figure 133.

- | | |
|---|---|
| A. DIMENSION =
100 ±10 mm
(4.0 ±0.40 in.) | B. DIMENSION =
500 ±2.0 mm
(20.0 ±0.08 in.) |
| 1. HOSE SHEAVE | 4. HOSE GUIDE BRACKET (THREE-FUNCTION) |
| 2. MID-OUTER CROSSMEMBER BRACKET | 5. HOSE GUIDE BRACKET (FOUR-FUNCTION) |
| 3. BRACKET | |

Distance Installed	Hose Tension
502 mm (19.8 in.)	1%
507 mm (20.0 in.)	2%
512 mm (20.2 in.)	3%

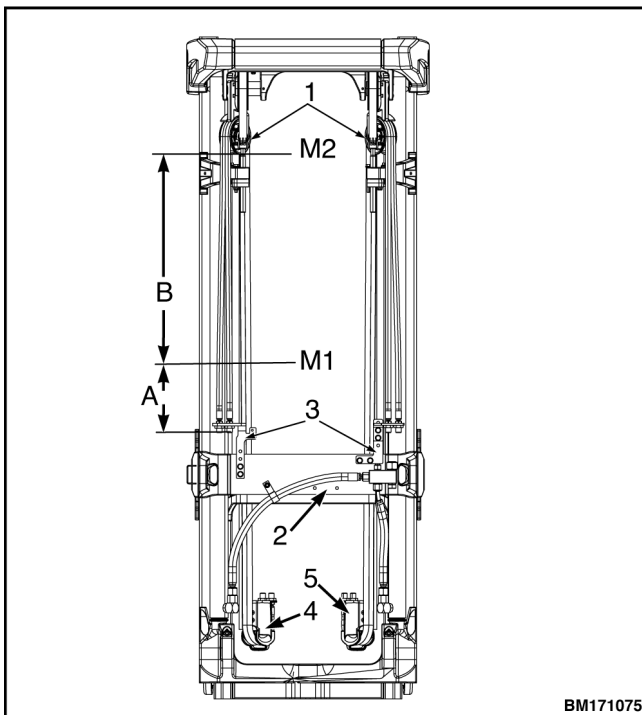


Figure 133. Header Hose Dimensions and Installation, Two-Stage LFL Mast

ADJUSTMENT

NOTE: Tire size variations and adjusting of the lift chains may require adjustment of header hose tension. Lift chain adjustment for tire wear will reduce header hose tension.

1. To increase header hose tension, raise carriage at least 100 mm (4.0 in.).
2. Place a block under lower carriage bar and lower the carriage onto the block to relieve hose tension. Chain the carriage to the inner mast. See Safety Procedures When Working Near Mast in this manual.
3. Loosen the hardware retaining the bracket to the mid-outer crossmember for the three and/or four function hoses needing adjustment. Lower bracket and tighten nut to 18 N•m (159 lbf in). See Figure 133.
4. Release the chain. Remove the block, and lower the carriage.
5. With no load on the forks, check the header hose adjustment by operating the mast through the full lift cycle two times.

HEADER HOSES, 2-STAGE FULL FREE LIFT (FFL) 202001-221

REMOVE

NOTE: Read Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS before removing any of the header hoses. Make sure to take note of the header hose fittings. It may be necessary to operate the hydraulic system, and move the mast weldments or the carriage to gain better access to the hose fittings. This must be performed BEFORE performing the procedures in Safety Procedures When Working Near Mast.

NOTE: If the hydraulic system was used to move the mast weldments or the carriage, make sure the hydraulic system does not have pressure as described in Step 4.

1. Cycle the mast 2-3 times to ensure proper routing of the header hoses. Hoses should conform to the sheaves. Hoses should not rub against adjacent crossmembers or the load backrest.
2. Tilt the mast 2-3 times to ensure that the hoses, routed between the truck cowl and mast, are able to move freely during both forward and back tilt.
3. Fully lower the carriage.
4. Confirm the hydraulic system is not under hydraulic pressure, by holding the control lever for each function in the forward position for approximately five seconds. Make sure the hydraulic pump does not operate.
5. Move the key or keyless switch, if equipped, to the **OFF** position.
6. Disconnect the battery and put a tag or lock on the battery connector.
7. Disconnect the header hoses and install caps on ends to prevent dirt and debris from entering the hydraulic system.

INSTALLATION



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.

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

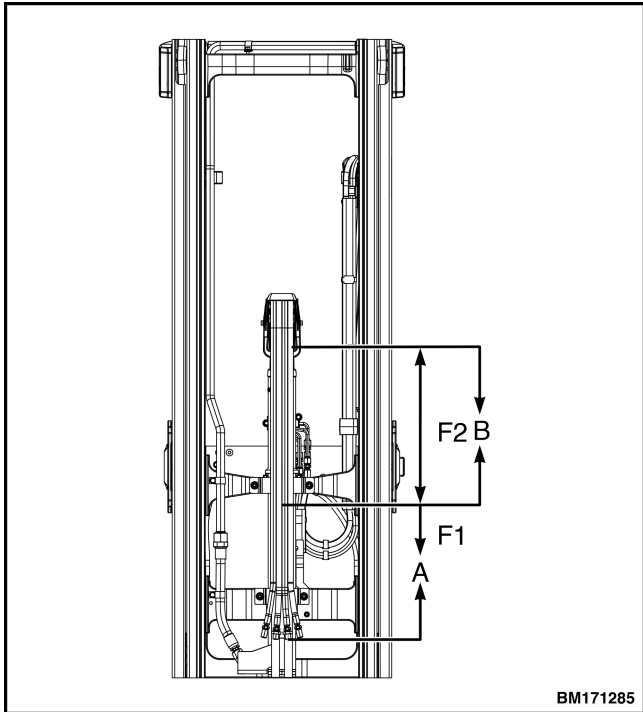
Some lift trucks are equipped with auxiliary hydraulic functions that are fastened to the carriage. Examples of attachments that use these auxiliary functions are sideshift carriages, roll clamps, and fork positioners. These auxiliary functions require header hoses for their operation.

NOTE: The following procedures are for the four function option featuring hoses A, B, C and D. The three function option will have hoses A and B only.

NOTE: The carriage height must be correct before the header hose tension can be measured. See Carriage Adjustments section in this manual for the carriage adjustment procedure.

NOTE: The process for measuring the header hoses may have changed from previous editions of this series code. Please read this manual carefully.

1. Before installing new header hoses, add tension marks to each of the existing header hoses.
2. Clamp one end of the hose in a vise. **DO NOT** clamp on the threads. Pull on the other end until hose is straight. **DO NOT** apply enough force to stretch the hose.
3. Put reference marks (gray or white) on each of the free-lift header hoses.
 - a. Starting at the carriage end of the hose atplace a mark at 400 ± 10 mm (15.7.0 \pm 0.40 in.). This is dimension F1. See Figure 134.
 - b. Starting at F1, place another mark at 500 ± 2.0 mm (19.7 \pm 0.08 in.). This is dimension F2. See Figure 134.

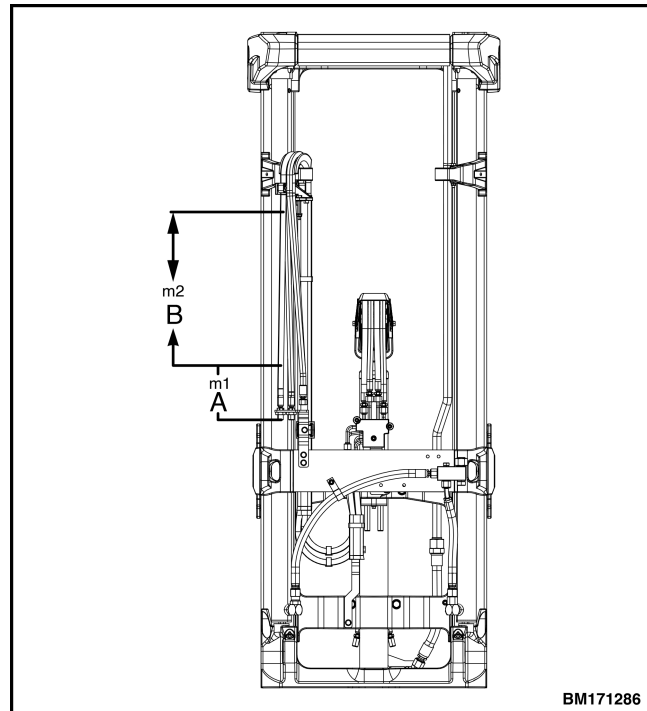


- A. DIMENSION = 400 ± 10 mm (15.7 \pm 0.40 in.)
- B. DIMENSION = 500 ± 2.0 mm (19.7 \pm 0.08 in.)

Install length	Hose tension
507.5 ± 5 mm (20 \pm 0.2 in.)	1.5% \pm 1%

Figure 134. Free-lift header hose reference marks

4. Put reference marks on main lift header hoses.
 - a. Starting at the truck end of the hose, place a mark at 100 ± 10 mm (3.4 \pm 0.34 in.). This is dimension M1. See Figure 135.
 - b. Starting at the truck end of the hose, place another mark at 500 ± 2.0 mm (19.7 \pm 0.08 in.). This is dimension M2. See Figure 135.

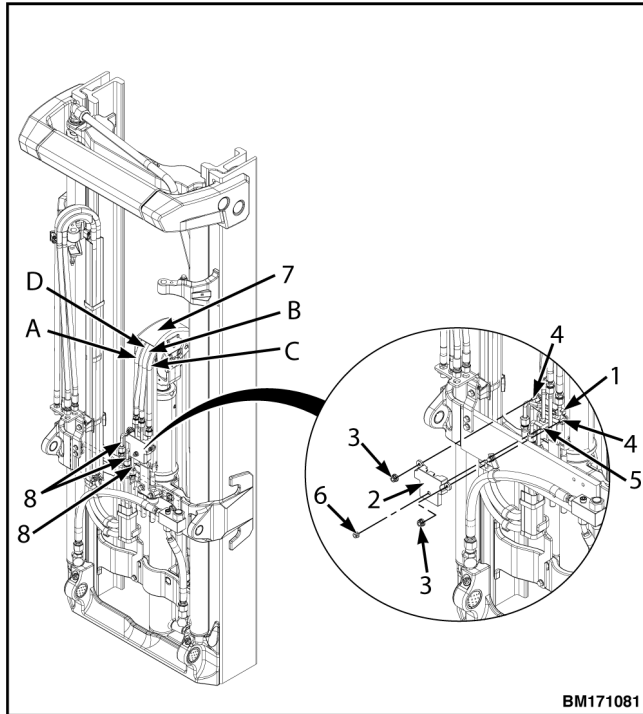


- A. DIMENSION = 100 ± 10 mm (3.4 \pm 0.34 in.)
- B. DIMENSION = 500 ± 2.0 mm (19.7 \pm 0.08 in.)

Install length	Hose tension
507.5 ± 5 mm (20 \pm 0.2 in.)	1.5% \pm 1%

Figure 135. Main lift header hose reference marks

5. Route the free-lift hoses through the crosshead and attach the free-lift hoses to the free-lift tubes. See Figure 136.

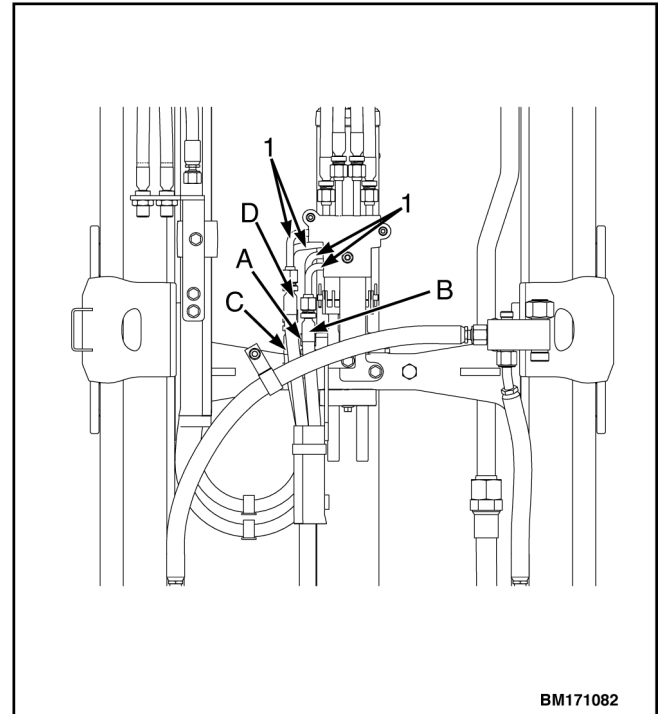


- A. FREE-LIFT HEADER HOSE A
- B. FREE-LIFT HEADER HOSE B
- C. FREE-LIFT HEADER HOSE C
- D. FREE-LIFT HEADER HOSE D

- 1. INNER CLAMP
- 2. OUTER CLAMP
- 3. NUTS
- 4. CAPSCREWS
- 5. BOLT
- 6. NUT
- 7. CROSSHEAD
- 8. FREE-LIFT TUBES

Figure 136. Free-lift header hoses and tubes

- 6. For three and four function main lift hoses (hoses A, B, C and D), attach hoses to free-lift tube assemblies. See Figure 137.

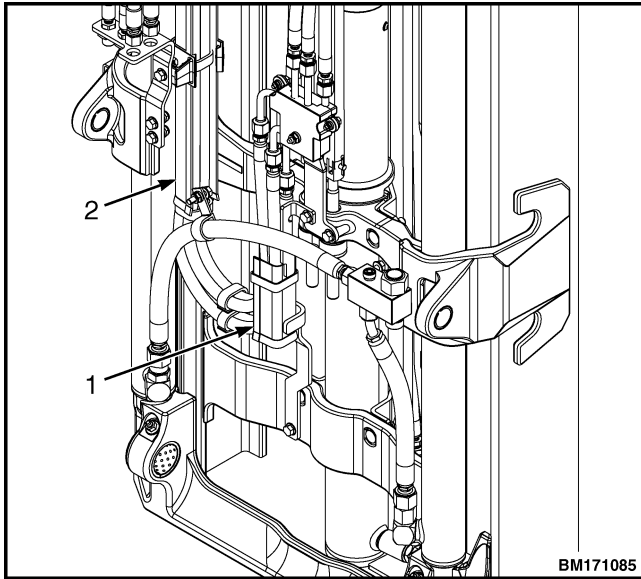


- A. MAIN LIFT HEADER HOSE A
- B. MAIN LIFT HEADER HOSE B
- C. MAIN LIFT HEADER HOSE C
- D. MAIN LIFT HEADER HOSE D

- 1. FREE-LIFT TUBE ASSEMBLIES

Figure 137. Main lift header hose installation

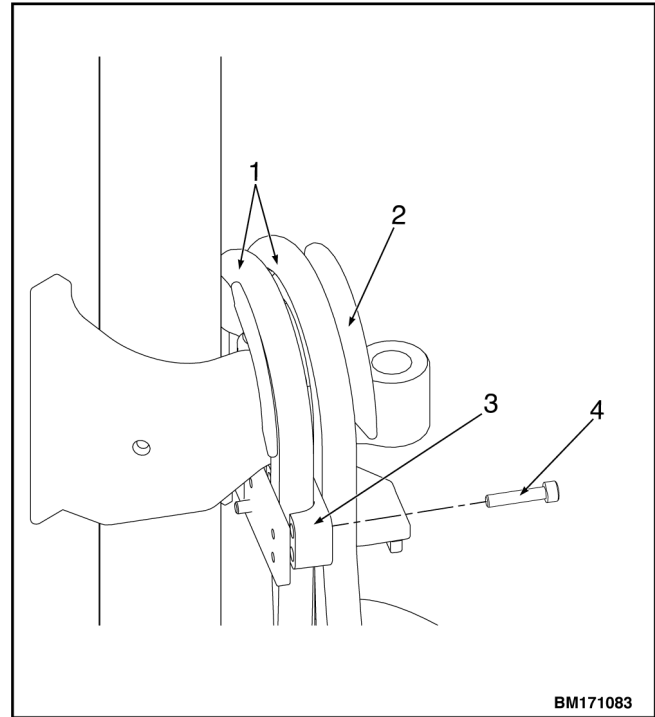
- 7. Route the three and four function main lift hoses through the bottom hose bracket and main hose bracket. See Figure 138.



- 1. BOTTOM HOSE BRACKET
- 2. MAIN HOSE BRACKET

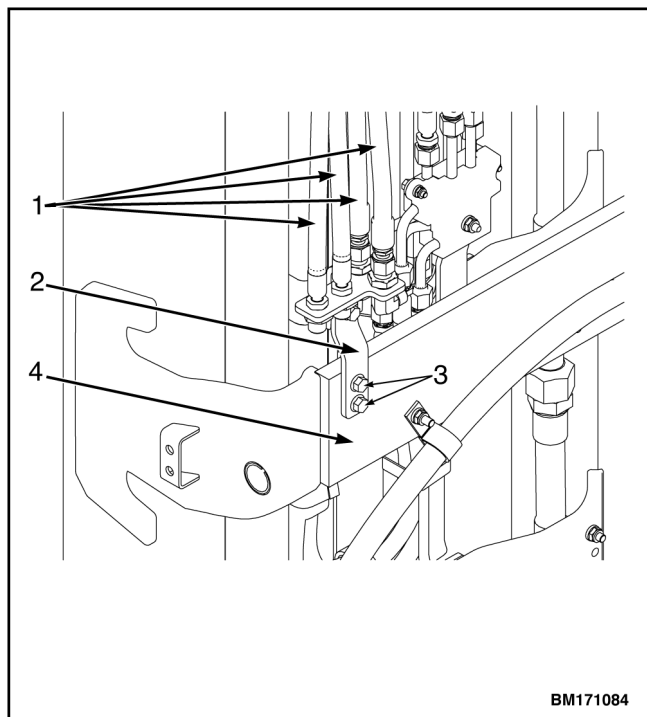
Figure 138. Header hose turnaround brackets

- 8. Route the hoses up over the hose turnaround bracket and secure hoses to the turnaround bracket with spacer. See Figure 139. Attach marked end of hoses to bracket on mid-outer crossmember. See Figure 140.



- 1. HEADER HOSE
- 2. TURNAROUND BRACKET
- 3. CLAMP
- 4. CAPSCREW

Figure 139. Hose turnaround bracket



1. HOSES
2. BRACKET
3. CAPSCREWS
4. MID-OUTER CROSSMEMBER

Figure 140. Mid-outer crossmember

NOTE: The header hose tension specification between marks F1 and F2 is 507.5 ± 5 mm (20 ± 0.2 in.).

9. With header hoses now installed on mast and the carriage correctly adjusted, and the forks off the ground, measure and record the distance between marks F1 and F2 as follows:
 - a. If tension mark measurement is less than 502.5 mm (19.8 in.), raise crosshead plate one hole and take measurement again to insure it is within specifications.
 - b. If tension mark measurement is more than 512.5 mm (20.2 in.), lower crosshead plate one hole and take measurement again to insure it is within specifications.
 - c. If crosshead can not be moved, or if after moving crosshead plate two holes in either direction, header hose tension is still not correct, replace the hose and re-set crosshead plate to starting position and do Step a and Step b again with new hose.

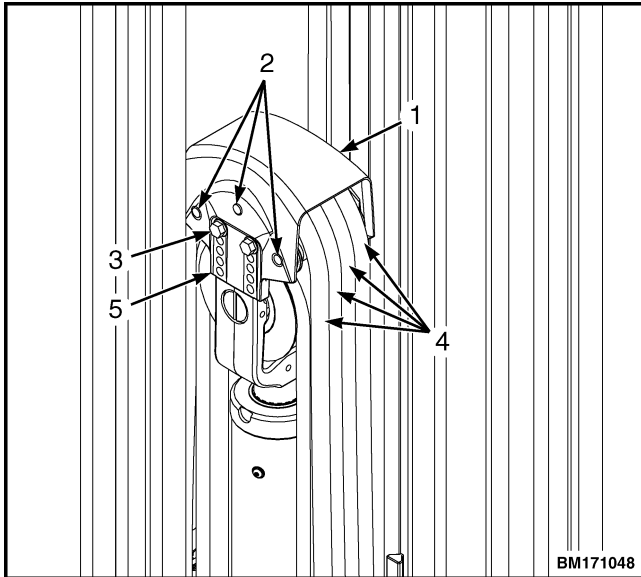
NOTE: The header hose tension specification between marks M1 and M2 is 507.5 ± 5 mm (20 ± 0.2 in.).

10. With header hoses installed on mast and the carriage correctly adjusted, and the forks off the ground, measure the distance between marks M1 and M2 as follows:
 - a. If tension mark measurement is less than 502.5 mm (19.8 in.), or more than 512.5 mm (20.2 in.), replace hose and reset upper bracket to original position and measure again with new hose.
11. Raise and lower mast two to three times to check for proper routing of hoses. Hoses should smoothly go over the hose sheaves and not rub against crossmembers or the load backrest.
12. Tilt the mast two to three times and check that the hoses routed between truck cowl and mast move freely during both forward and backward tilt.

ADJUSTMENT

NOTE: Tire size variations and adjusting of the lift chains may require adjustment of free-lift and main lift header hose tension. Lift chain adjustment for tire wear will reduce header hose tension.

1. To adjust the free-lift header hoses, perform the following:
 - a. Raise carriage at least 100 mm (4 in.) from the bottom of the forks.
 - b. Place blocks under the lower carriage bar and lower the carriage onto blocks to relieve hose tension. Chain carriage to inner mast. See Safety Procedures When Working Near Mast in this manual.
 - c. Loosen the three cap screws on the crosshead plate, see Figure 141.



1. CROSSHEAD HOSE GUARD
2. HEADER HOSE ROLLER ASSEMBLY
3. CAPSCREWS
4. HEADER HOSES
5. CROSSHEAD PLATE

Figure 141. Free-lift header hose adjustment

- d. Move the free-lift header hose roller assembly up to increase hose tension, and down to decrease hose tension. Tighten capscrews to 16 N·m (11.8 lbf ft).
2. To adjust main lift header hoses, perform the following:
 - a. Raise the inner mast and place a block under inner mast.
 - b. Chain inner mast weldment to the outer or intermediate mast weldment. See Safety Procedures When Working Near Mast in this manual.
 - c. Lower the inner mast onto the block.
 - d. Loosen the the capscrews retaining the upper bracket to adjust the bracket until correct hose tension is achieved. See Figure 140. Tighten capscrew to 25.2 N·m (18.6 lbf ft).

HEADER HOSES, 3-STAGE FULL FREE LIFT (FFL) 202001-211

REMOVE

NOTE: Read Safety Procedures When Working Near Mast as well as all WARNINGS and CAUTIONS before removing any of the header hoses. Make sure to take note of the header hose fittings. It may be necessary to operate the hydraulic system, and move the mast weldments or the carriage to gain better access to the hose fittings. This must be performed BEFORE performing the procedures in Safety Procedures When Working Near Mast.

NOTE: If the hydraulic system was used to move the mast weldments or the carriage, make sure the hydraulic system does not have pressure as described in Step 4.

1. Cycle the mast 2-3 times to ensure proper routing of the header hoses. Hoses should conform to the sheaves. Hoses should not rub against adjacent crossmembers or the load backrest.
2. Tilt the mast 2-3 times to ensure that the hoses, routed between the truck cowl and mast, are able to move freely during both forward and back tilt.
3. Fully lower the carriage.
4. Confirm the hydraulic system is not under hydraulic pressure, by holding the control lever for each function in the forward position for approximately five seconds. Make sure the hydraulic pump does not operate.
5. Move the key or keyless switch, if equipped, to the **OFF** position.
6. Disconnect the battery and put a tag or lock on the battery connector.
7. Disconnect the header hoses and install caps on ends to prevent dirt and debris from entering the hydraulic system.

INSTALLATION



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.

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

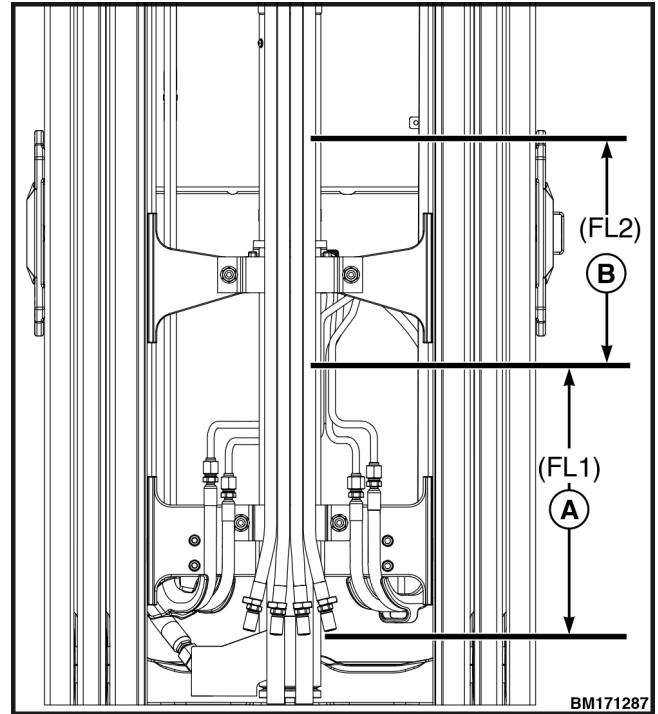
Some lift trucks are equipped with auxiliary hydraulic functions that are fastened to the carriage. Examples of attachments that use these auxiliary functions are sideshift carriages, roll clamps, and fork positioners. These auxiliary functions require header hoses for their operation.

NOTE: The following procedures are for the four function option featuring hoses A, B, C and D. The three function option will have hoses A and B only.

NOTE: The carriage height must be correct before the header hose tension can be measured. See Carriage Adjustments section in this manual for the carriage adjustment procedure.

NOTE: The process for measuring the header hoses may have changed from previous editions of this series code. Please read this manual carefully.

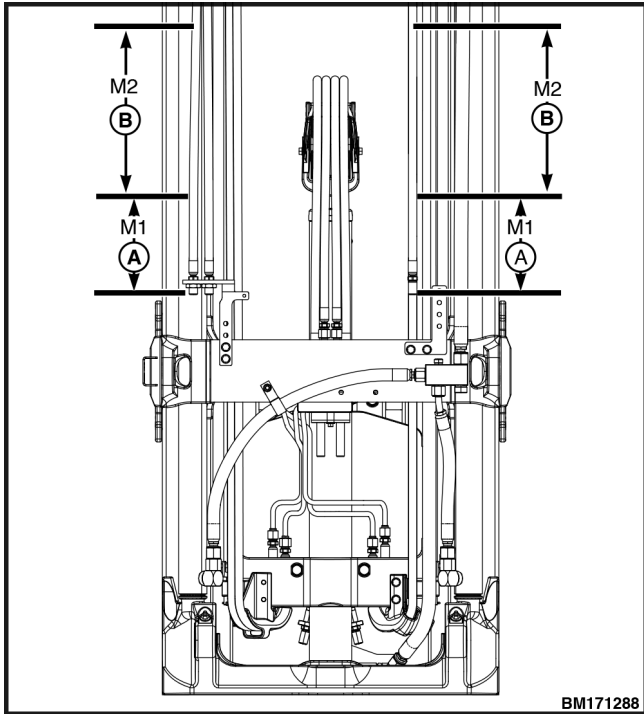
1. Before installing new header hoses, add tension marks to each of the existing header hoses.
2. Clamp one end of the hose in a vise. DO NOT clamp on the threads. Pull on the other end until hose is straight. DO NOT apply enough force to stretch the hose.
3. Put reference marks (gray or white) on each of the free-lift header hoses.
 - a. Starting at the carriage end of the hose, place a mark at 400 ± 10 mm ($15.7.0\pm 0.40$ in.). This is dimension FL1. See Figure 142.
 - b. Starting at FL1, place another mark at 500 ± 2.0 mm (19.7 ± 0.08 in.). This is dimension FL2. See Figure 142.
4. Put reference marks on main lift header hoses.
 - a. Starting at the truck end of the hose, place a mark at 100 ± 10 mm (3.4 ± 0.34 in.). This is dimension M1. See Figure 143.
 - b. Starting at M1, place another mark at 500 ± 2.0 mm (19.7 ± 0.08 in.). This is dimension M2. See Figure 143.



- A. DIMENSION = 400 ± 10 mm (15.7 ± 0.40 in.)
 B. DIMENSION = 500 ± 2.0 mm (19.7 ± 0.08 in.)

Install length	Hose tension
507.5 ± 5 mm (20 ± 0.2 in.)	$1.5\% \pm 1\%$

Figure 142. Free-lift header hose reference marks

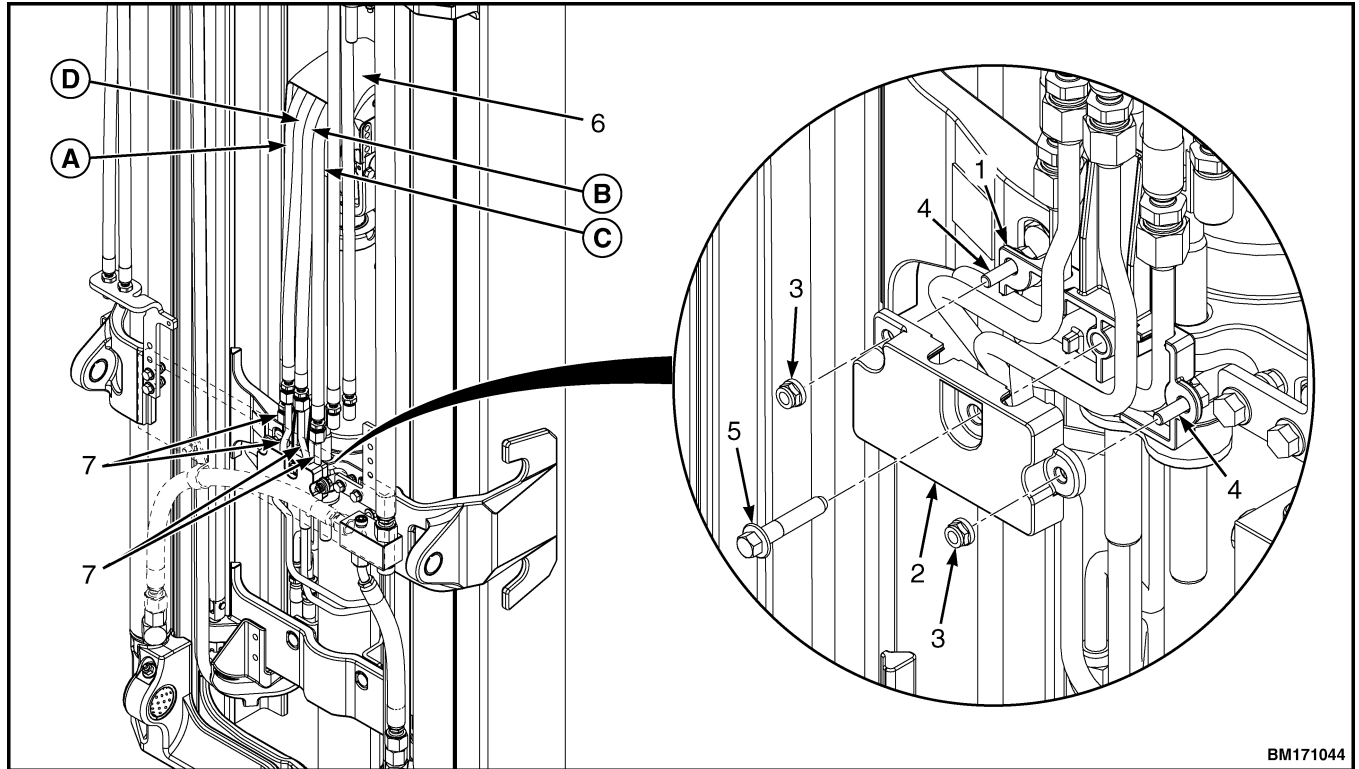


5. Route the free-lift hoses through the crosshead and attach the free-lift hoses to the free-lift tubes. See Figure 144.

- A. DIMENSION = 100 ± 10 mm (3.4 ± 0.34 in.)
 B. DIMENSION = 500 ± 2.0 mm (19.7 ± 0.08 in.)

Install length	Hose tension
507.5 ± 5 mm (20 ± 0.2 in.)	$1.5\% \pm 1\%$

Figure 143. Main lift header hose reference marks



BM171044

- A. FREE-LIFT HEADER HOSE A
- B. FREE-LIFT HEADER HOSE B

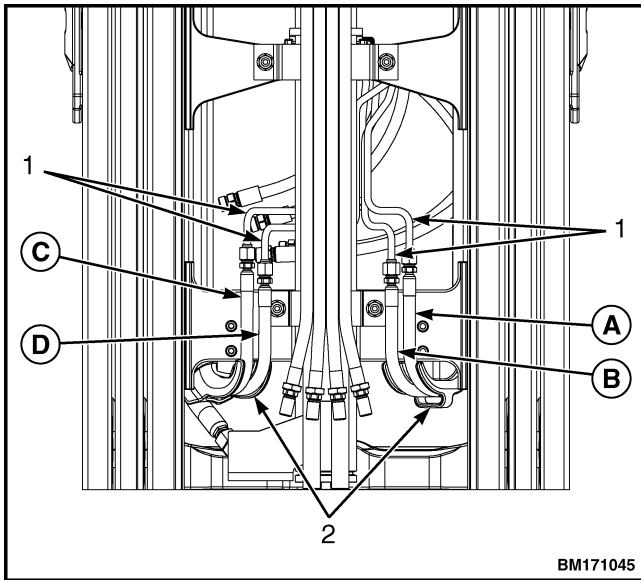
- C. FREE-LIFT HEADER HOSE C
- D. FREE-LIFT HEADER HOSE D

- 1. INNER CLAMP
- 2. OUTER CLAMP
- 3. NUTS
- 4. CAPSCREWS

- 5. BOLT
- 6. CROSSHEAD
- 7. FREE-LIFT TUBES

Figure 144. Free-lift header hoses and tubes

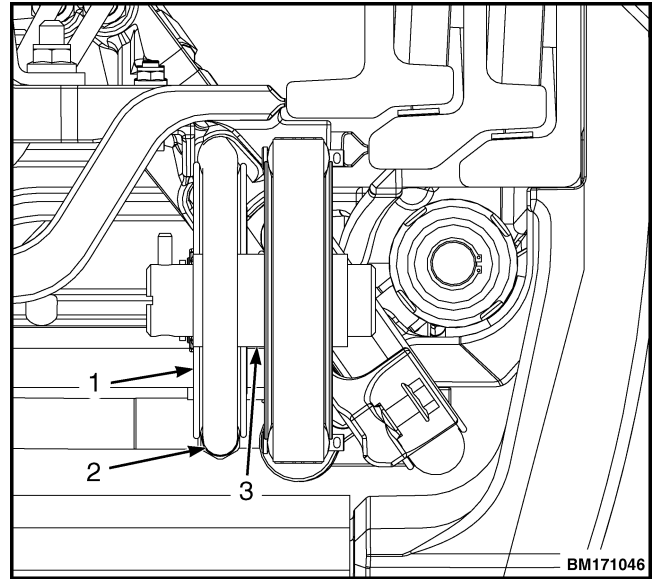
6. For three and four function main lift hoses (hoses A, B, C and D), attach hoses to free-lift tube assemblies. See Figure 145. Route the hoses through the turnaround bracket.



- A. MAIN LIFT HEADER HOSE A
 - B. MAIN LIFT HEADER HOSE B
 - C. MAIN LIFT HEADER HOSE C
 - D. MAIN LIFT HEADER HOSE D
1. FREE-LIFT TUBE ASSEMBLIES
 2. TURNAROUND BRACKET

Figure 145. Main lift header hose installation

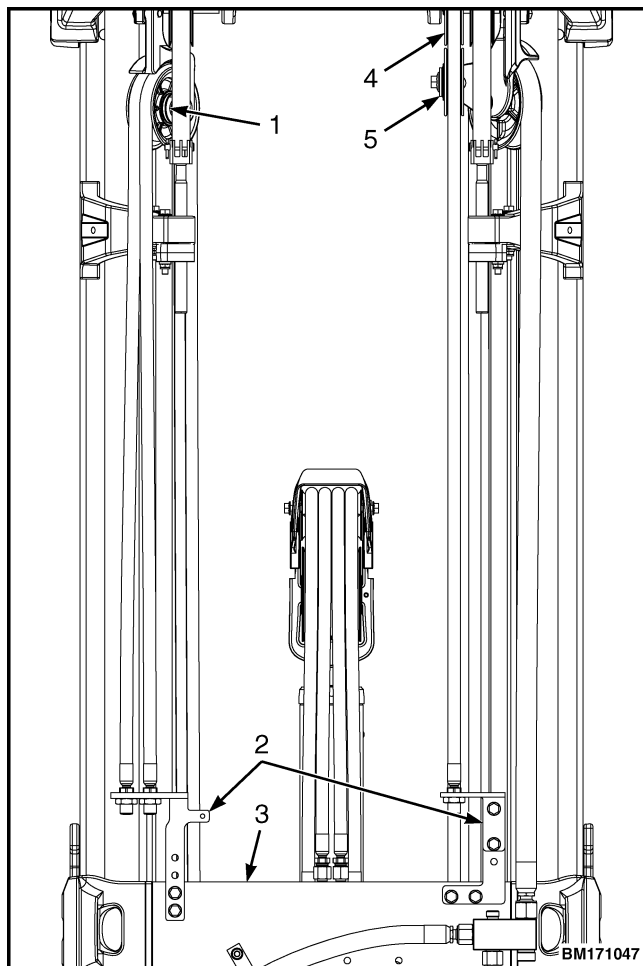
7. Route three and four function main lift hoses up over hose sheaves. See Figure 146 and Figure 147.



1. HOSE SHEAVE
2. HEADER HOSE
3. SPACER

Figure 146. Hose sheave spacer

8. Attach marked end of hoses to bracket on mid-outer crossmember. See Figure 147.



1. HOSE SHEAVE (HOSE A AND B)
2. MOUNTING BRACKETS
3. MID-OUTER CROSSMEMBER
4. HOSE SHEAVE (HOSE C)
5. HOSE SHEAVE (HOSE D)

Figure 147. Hose sheaves

NOTE: The header hose tension specification between marks FL1 and FL2 is 507.5±5 mm (20±0.2 in.).

9. With header hoses now installed on mast and the carriage correctly adjusted, and the forks off the ground, measure and record the distance between marks FL1 and FL2 as follows:
 - a. If tension mark measurement is less than 502.5 mm (19.8 in.), raise crosshead plate one hole and take measurement again to insure it is within specifications.

- b. If tension mark measurement is more than 512.5 mm (20.2 in.), lower crosshead plate one hole and take measurement again to insure it is within specifications.
- c. If crosshead can not be moved, or if after moving crosshead plate two holes in either direction, header hose tension is still not correct, replace the hose and re-set crosshead plate to starting position and do Step a and Step b again with new hose.

NOTE: The header hose tension specification between marks is 507.5±5 mm (20±0.2 in.).

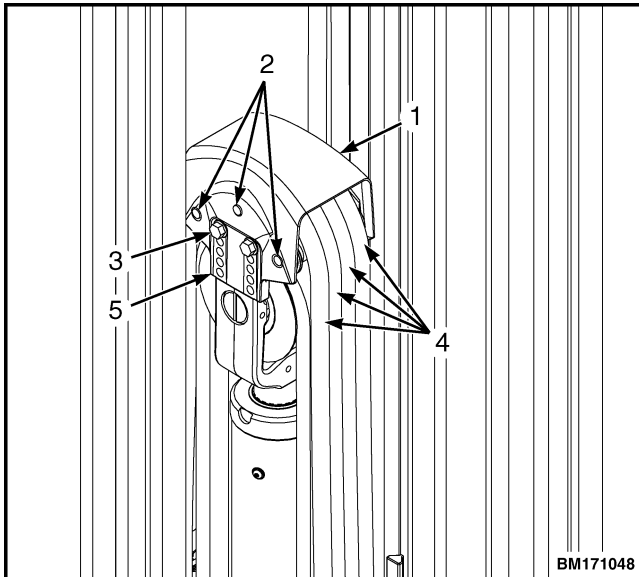
10. With header hoses installed on mast and the carriage correctly adjusted, and the forks off the ground, measure the distance between marks M1 and M2 as follows:
 - a. If tension mark measurement is less than 502.5 mm (19.8 in.), or more than 512.5 mm (20.2 in.), replace hose and reset upper bracket to original position and measure again with new hose.
11. Raise and lower mast two to three times to check for proper routing of hoses. Hoses should smoothly go over the hose sheaves and not rub against crossmembers or the load backrest.
12. Tilt the mast two to three times and check that the hoses routed between truck cowl and mast move freely during both forward and backward tilt.

ADJUSTMENT

NOTE: Tire size variations and adjusting of the lift chains may require adjustment of free-lift and main lift header hose tension. Lift chain adjustment for tire wear will reduce header hose tension.

1. To adjust the free-lift header hoses, perform the following:
 - a. Raise carriage at least 100 mm (4 in.) from the bottom of the forks.
 - b. Place blocks under the lower carriage bar and lower the carriage onto blocks to relieve hose tension. Chain carriage to inner mast. See Safety Procedures When Working Near Mast in this manual.

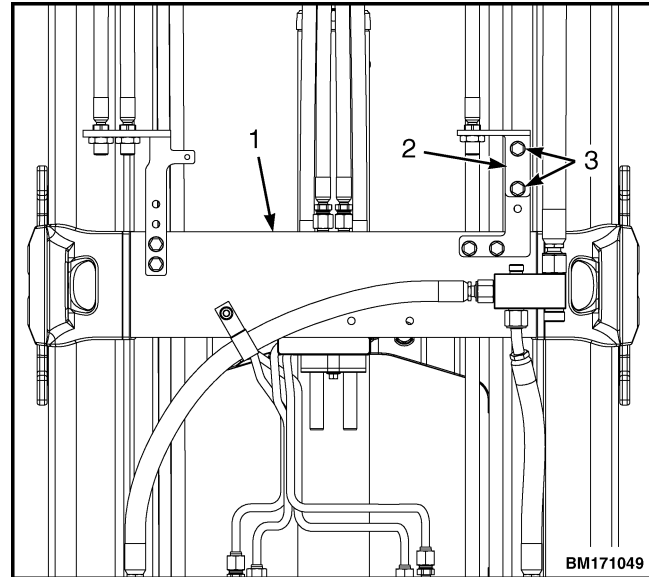
- c. Loosen the three capscrews on the crosshead plate, see Figure 148.



1. CROSSHEAD HOSE GUARD
2. HEADER HOSE ROLLER ASSEMBLY
3. CAPSCREWS
4. HEADER HOSES
5. CROSSHEAD PLATE

Figure 148. Free-lift header hose adjustment

- d. Move the free-lift header hose roller assembly up to increase hose tension, and down to decrease hose tension. Tighten capscrews to 16 N·m (11.8 lbf ft).
2. To adjust main lift header hoses, perform the following:
- a. Raise the inner mast and place a block under inner mast.
 - b. Chain inner mast weldment to the outer or intermediate mast weldment. See Safety Procedures When Working Near Mast in this manual.
 - c. Lower the inner mast onto the block.
 - d. Loosen the capscrews retaining the upper bracket to adjust the bracket until correct hose tension is achieved. See Figure 149. Tighten capscrew to 25.2 N·m (18.6 lbf ft).



1. MID-OUTER CROSSMEMBER
2. UPPER BRACKET
3. CAPSCREWS

Figure 149. Mid-outer crossmember

HEADER HOSES, 4-STAGE FULL FREE LIFT (FFL) 202001-299

REMOVE

Read and follow Safety Procedures When Working Near Mast as well as all **WARNINGS** and **CAUTIONS** before removing any header hoses.

1. To replace any header hoses, fully lower carriage. Make sure hydraulic system does not have hydraulic pressure. Hold the control for each function in the forward position for approximately five seconds to release pressure. Make sure hydraulic pump does not operate. Move key or keyless switch, if equipped, to the **OFF** position.
2. Disconnect battery and put a tag or lock on battery connector.
3. Disconnect header hoses and install caps on ends to prevent dirt and debris from entering the hydraulic system.

INSTALL**WARNING**

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

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

**WARNING**

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

Before installing header hoses, make sure you know the lift height of the mast. The tension on header hoses is adjusted according to lift height. The lift height is on the Nameplate of the lift truck and on the right side of the outer mast.

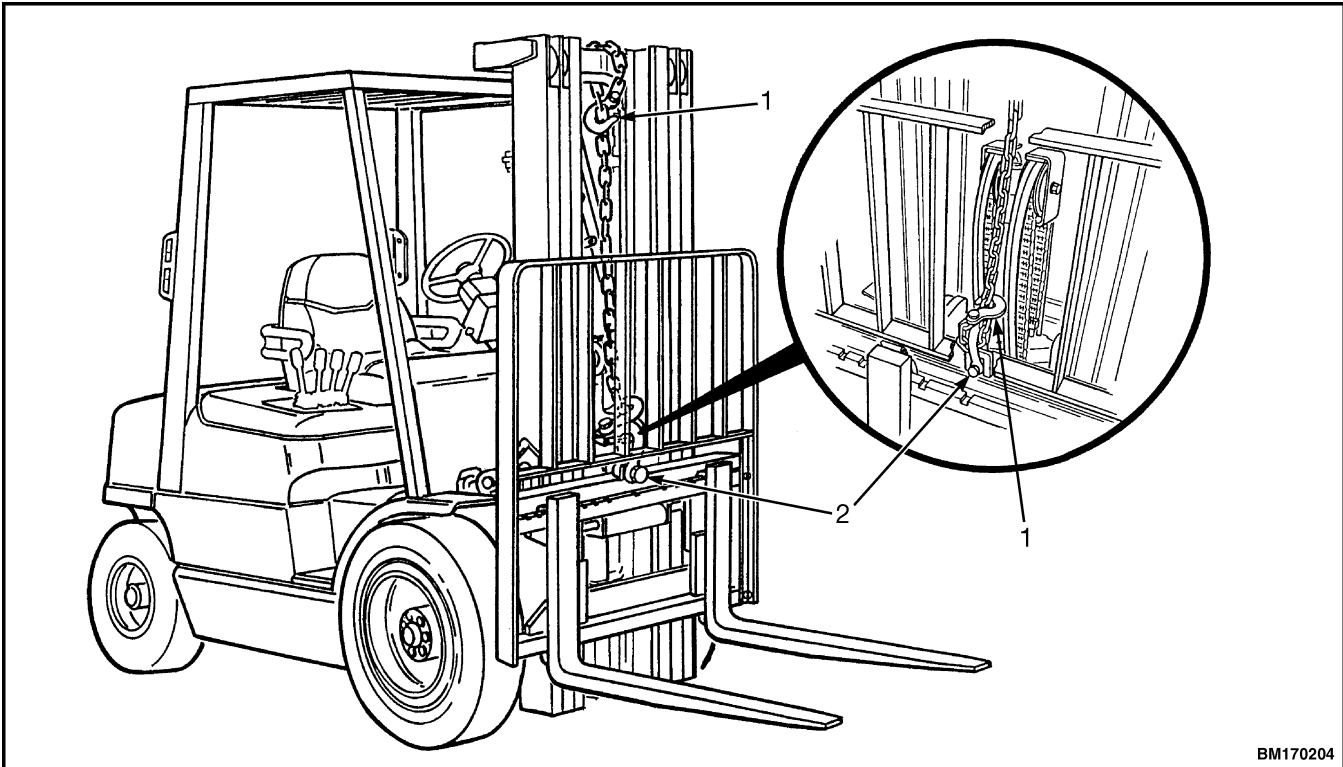
Some lift trucks are equipped with auxiliary hydraulic functions that are fastened to the carriage. Examples of attachments that use these auxiliary functions are sideshift carriages, roll clamps, and fork positioners. These auxiliary functions require header hoses for their operation.

NOTE: This procedure is for mast equipped with a four-function option. The three-function option will have hoses **A** and **B** only.

NOTE: The carriage height must be correct before header hoses can be adjusted. See **Carriage Adjustments** section for the procedures.

NOTE: If header hoses were removed, use these procedures to install the header hoses. If mast components have not been assembled, assemble mast as described in **Assemble** section for 4-Stage full free lift (FFL) Mast Repair.

1. Raise carriage so free-lift chains are not tight. Raise inner channel so main lift chains are not tight. Install chains to prevent inner channel and carriage from moving. The chains must not be in the path of the header hose. See Figure 150.



BM170204

1. HOOK

2. SHACKLE

Figure 150. Chaining the Carriage (FFL)

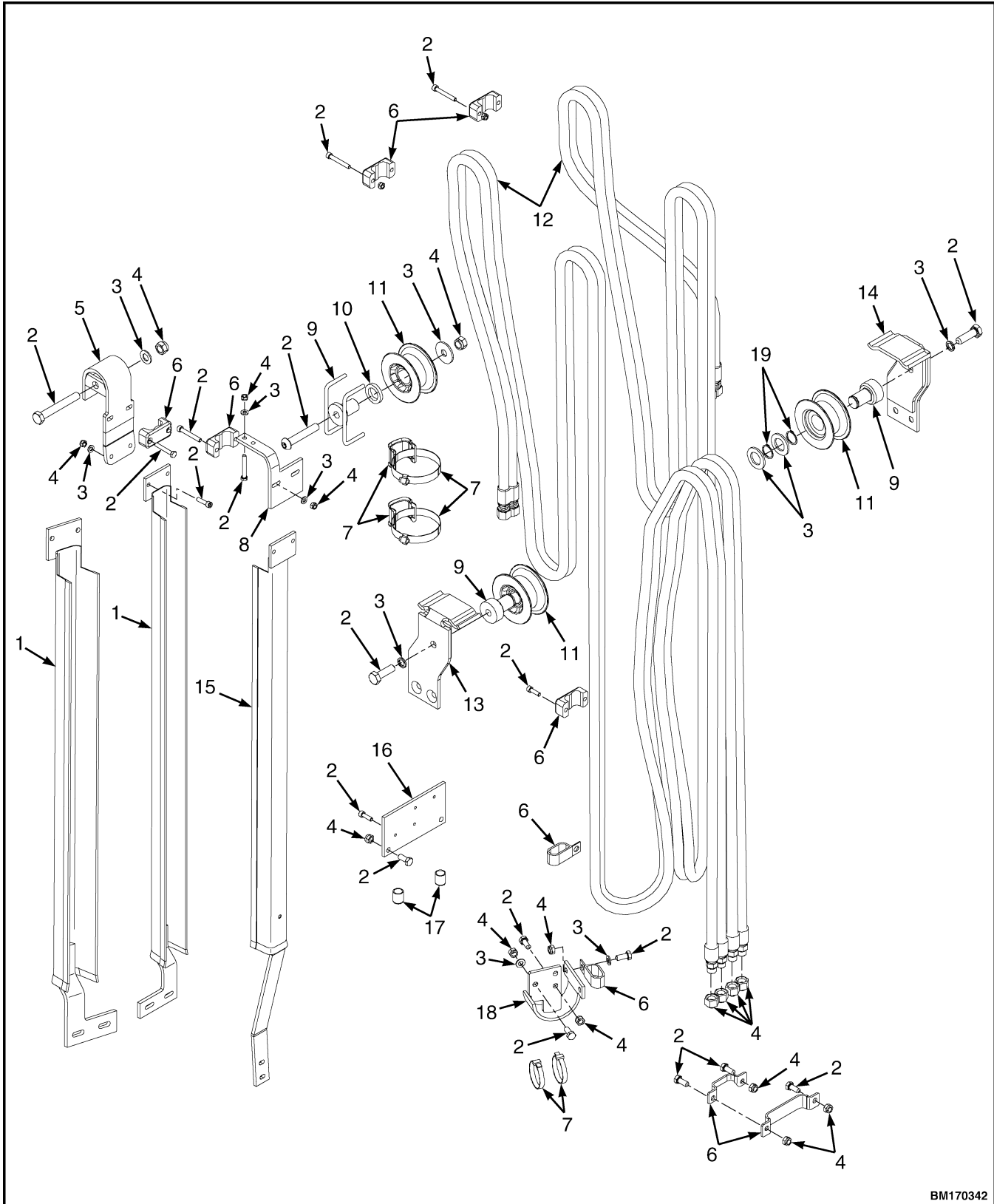
2. Install all hose sheaves loosely. **DO NOT** tighten capscrews and nuts until header hoses are installed.
3. Make sure replacement header hose is correct part number for your mast assembly. Make sure header hoses are straight on a flat surface.

Mark header hose at points **M1**, **M2**, and **M3** (mm) as shown in Table 3. Measure from end of hose with small fitting.

Table 3. Standard Four-Stage FFL Hose Dimensions

Lift Height		Channel Length (Reference)		Dimension "M1"		Dimension "M2"	
mm	in.	mm	in.	mm	in.	mm	in.
6058	238.5	2040	80.3	400 ±10	15.7 ±0.4	M1 + 500 ±10	M1 + 19.7 ±0.08
6220	244.9	2240	88.2	400 ±10	15.7 ±0.4	M1 + 500 ±10	M1 + 19.7 ±0.08
6362	250.5	2140	84.3	400 ±10	15.7 ±0.4	M1 + 500 ±10	M1 + 19.7 ±0.08
6669	262.6	2240	88.2	400 ±10	15.7 ±0.4	M1 + 500 ±10	M1 + 19.7 ±0.08
6970	274.4	2340	92.1	400 ±10	15.7 ±0.4	M1 + 500 ±10	M1 + 19.7 ±0.08

4. Loosely assembly hose sheaves as shown in Figure 151:
 - a. Put coating of multipurpose grease on stub shafts before assembly.
 - b. The nuts for the sheave capscrew (axle) must be on the inside of each assembly.
 - c. **DO NOT** tighten any nuts or capscrews. They must be loose to allow installation of hoses on hose sheave.
5. Install plate at middle hose clamp and tighten capscrews to 8 ml (71 in.).



BM170342

Figure 151. Header Hoses, Hose Sheaves, and Routing - Four-Stage FFL Mast

Legend for Figure 151.

NOTE: THREE FUNCTION MAST SHOWN. FOUR FUNCTION MAST HAS TWO DRIVER SIDE CHANNELS.

- | | |
|----------------------------------|--------------------------------|
| 1. HOSE CHANNEL (LOAD SIDE) | 11. HOSE SHEAVE |
| 2. CAPSCREW | 12. HEADER HOSES |
| 3. WASHER | 13. RIGHT HOSE GUARD |
| 4. NUT | 14. LEFT HOSE GUARD |
| 5. HOSE CHANNEL BRACKET WELDMENT | 15. HOSE CHANNEL (DRIVER SIDE) |
| 6. HOSE CLAMP | 16. PLATE |
| 7. STRAP CLAMP | 17. CAP |
| 8. HOSE CHANNEL BRACKET | 18. BOTTOM HOSE GUIDE |
| 9. STUBSHAFT | 19. SNAP RING |
| 10. SPACER | |
-
6. Install bottom hose guides as shown in Figure 151. Put some grease on bottom of guides so hoses can slip to equalize the pressure. Ensure that inside hose goes through the rear of bottom hose guide and tracks to the inside. The outside hose goes through front of the bottom hose guide and becomes the outside. Tighten capscrews and nuts of bottom hose guide to 18 N•m (13 lbf ft). **DO NOT** tighten capscrews and nuts for strap clamps at this time.
 7. Install hose guides (flare toward outside) and snap rings to chain sheaves. Install free-lift sheaves, chains, and hose guards as shown in Figure 151 and Figure 152.
 8. Route hoses over hose sheave 2 (on free-lift cylinder) with marks **E** aligned with either the top edge of clamp or bottom edge of clamp (item 1 or 2 in Figure 152). Tighten capscrews and nuts of clamps to 8 N•m (71 lbf in).
 9. Route hose assembly down and under hose guide and install strap clamps over hoses. Tighten capscrews and nuts of strap clamps to 18 N•m (159 lbf in).
 10. Route hoses over hose sheave 1 (item 10, Figure 152). Install clamps over hoses. Align mark **H** with bottom edge of clamp. Tighten capscrews to 8 N•m (71 lbf in).
 11. Route hoses through hose channels (load side) and over hose channel brackets. Install clamps over hoses. See Figure 151.
 12. Align mark **G** with bottom edge of clamp at top of outer mast. Tighten clamp hardware to 8 N•m (71 lbf in). See Figure 152.
 13. Slowly operate hydraulic system so lift chains are tight. Remove chains that fasten carriage and channel weldment. Slowly raise carriage using hydraulic system. Make sure hoses move through all sheaves correctly.
 14. Slowly operate mast through a few cycles to make sure hoses track correctly. Tighten strap clamps at bottom hose clamps to 18 N•m (159 lbf in). Tighten capscrews and nuts for hose sheaves to 53 N•m (39 lbf ft). Fasten clamps as shown in Figure 151 and Figure 152.

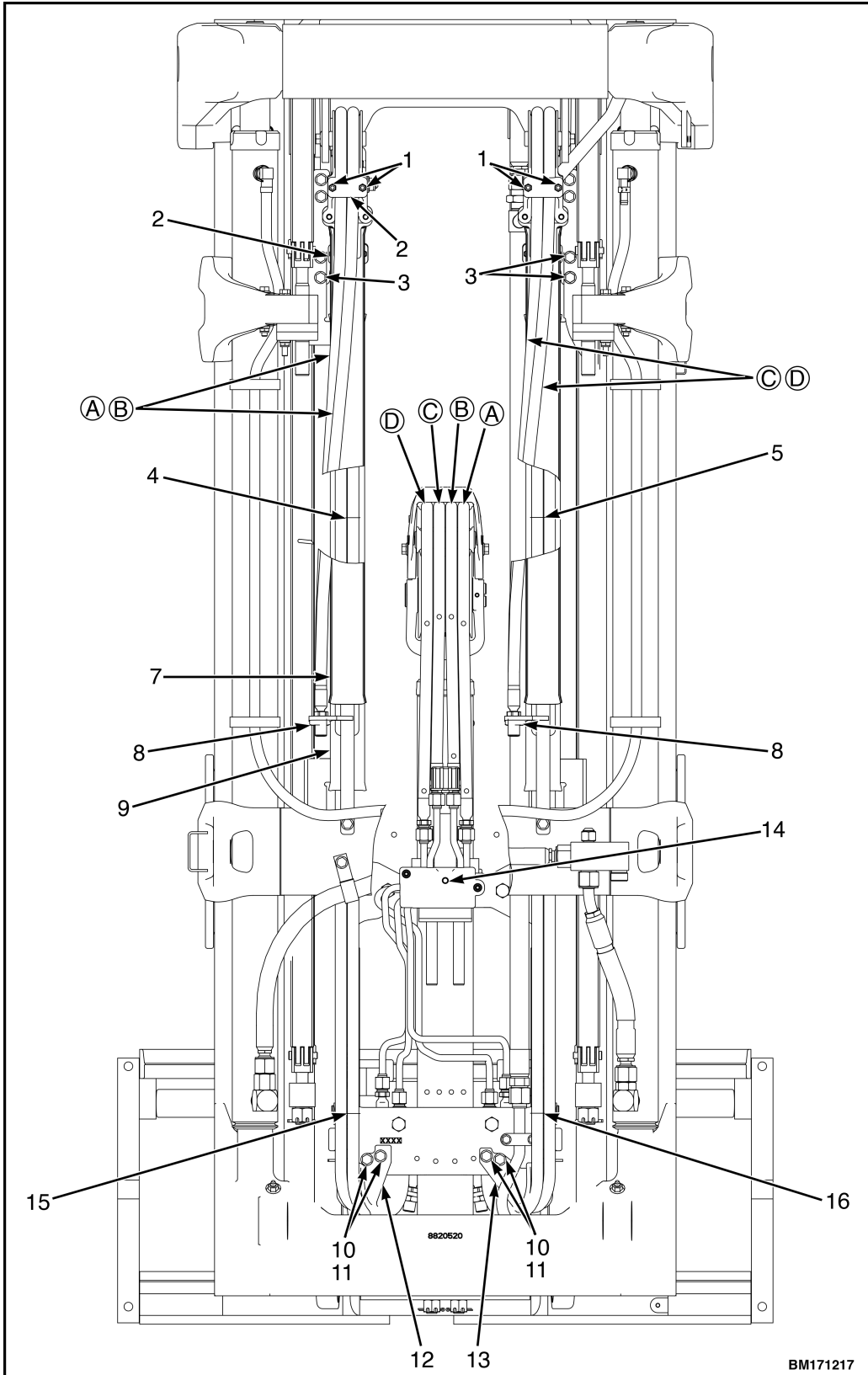
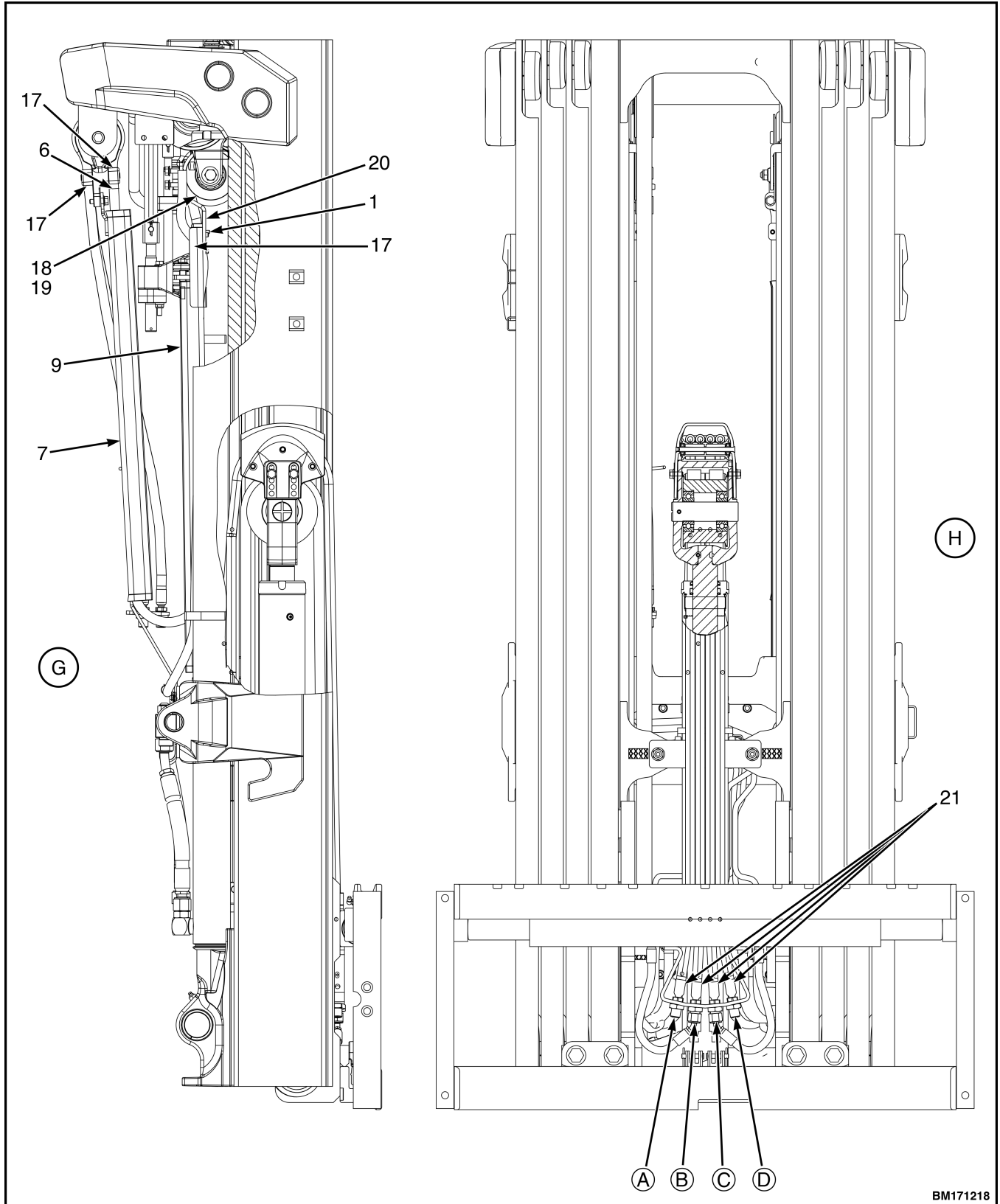
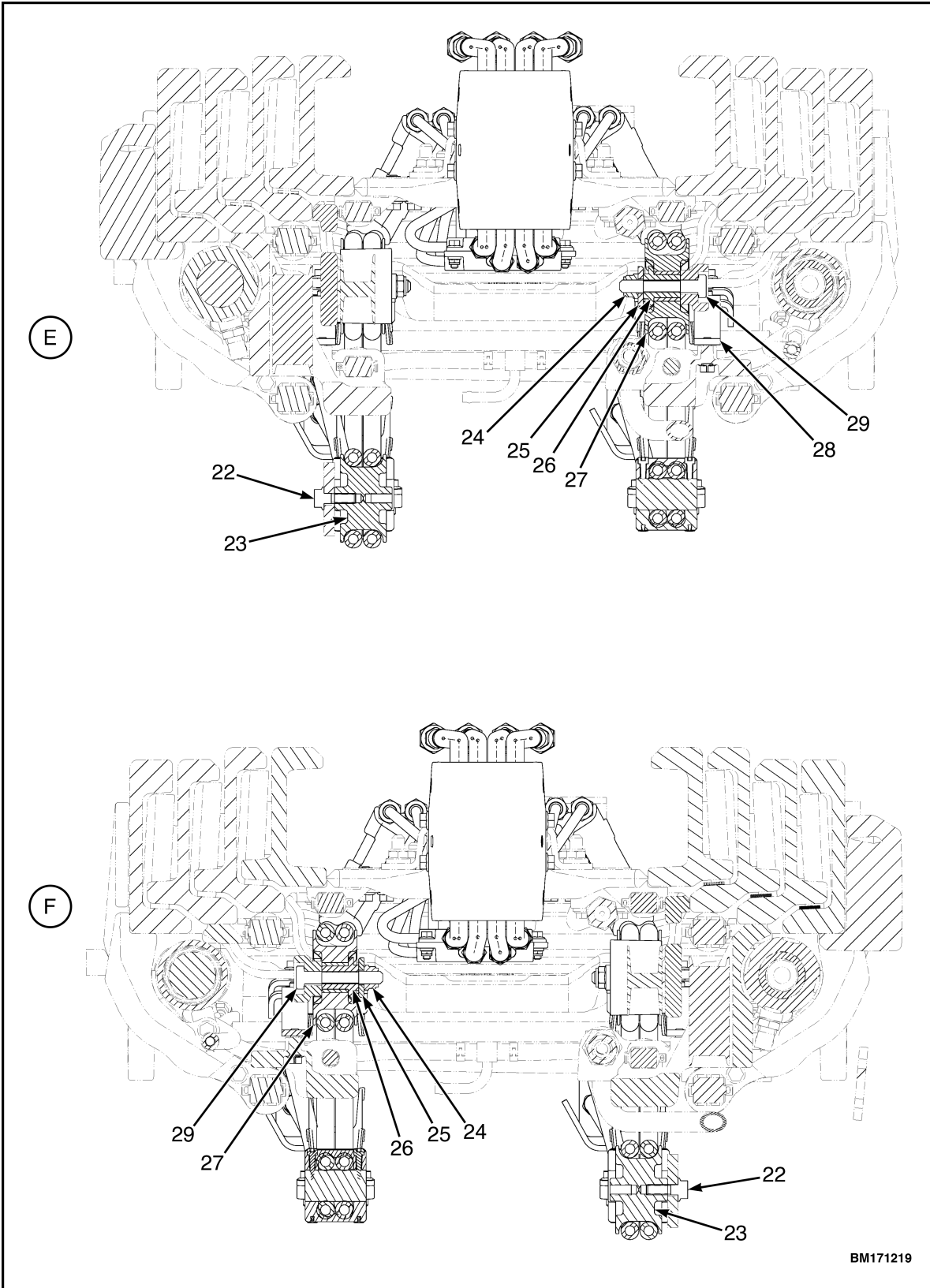


Figure 152. Four-Stage FFL Mast Header Hose Arrangement (Sheet 1 of 3)



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Figure 152. Four-Stage FFL Mast Header Hose Arrangement (Sheet 2 of 3)



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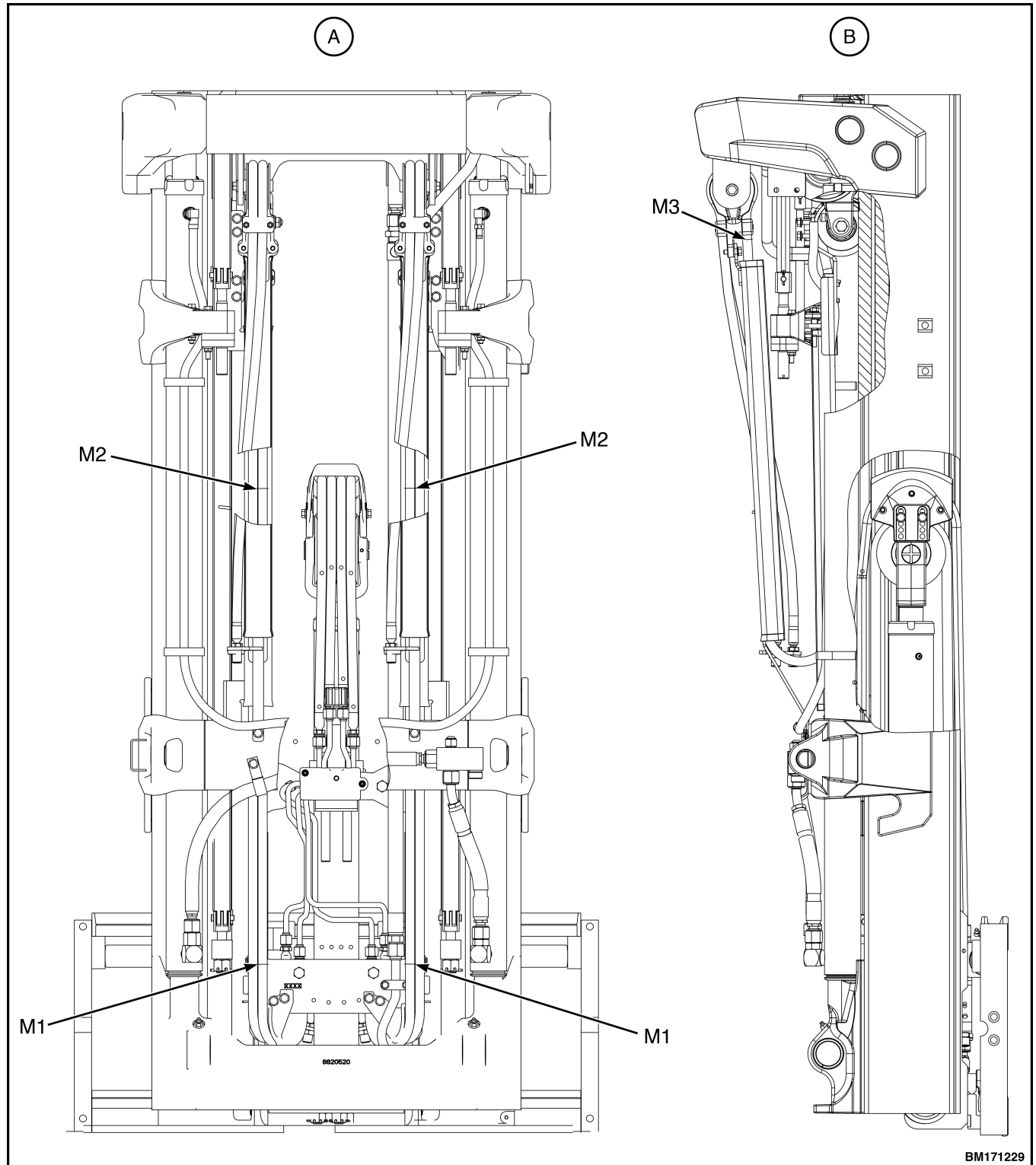
Figure 152. Four-Stage FFL Mast Header Hose Arrangement (Sheet 3 of 3)

Legend for Figure 152.**NOTE:** SOME MAST COMPONENT PARTS OMITTED FOR CLARITY.

- | | |
|---|-----------------------------|
| A. HEADER HOSE A | E. HOSE SHEAVES REAR VIEW |
| B. HEADER HOSE B | F. HOSES SHEAVES FRONT VIEW |
| C. HEADER HOSE C | G. SIDE VIEW |
| D. HEADER HOSE D | H. FRONT VIEW |
| 1. CAPSCREW | 16. ALIGNMENT MARK M1 |
| 2. CLAMP | 17. CLAMP |
| 3. CAPSCREW | 18. STUBSHAFT |
| 4. ALIGNMENT MARK M2 | 19. HOSE SHEAVE |
| 5. ALIGNMENT MARK M2 | 20. PLATE |
| 6. FREE-LIFT ALIGNMENT MARK BELOW CLAMP | 21. NUT |
| 7. CHANNEL (DRIVE SIDE) | 22. CAPSCREW |
| 8. NUT | 23. HOSE GUIDE |
| 9. CHANNEL (LOAD SIDE) | 24. LOCKNUT |
| 10. LOCKNUT | 25. HOSE SHEAVE CAP |
| 11. CAPSCREW | 26. STUBSHAFT |
| 12. TURN-AROUND (3 & 4 FUNCTION) | 27. HOSE SHEAVE |
| 13. TURN-AROUND (4 FUNCTION) | 28. PLATE |
| 14. CAPSCREW | 29. CAPSCREW |
| 15. ALIGNMENT MARK M1 | |

HEADER HOSE TENSION MEASUREMENT INSTRUCTIONS

1. Cycle mast 2-3 times to ensure proper routing of the hoses, hoses should conform to the sheaves. Hoses should not rub against adjacent crossmembers or the load backrest.
2. Tilt the mast 2-3 times to ensure that the hoses, routed between the truck cowl and mast, are able to move freely during both forward and back tilt.
3. The header hose tension specification is 507.5 ± 5 mm (19.98 \pm 0.2 in.) (1.5 \pm 1%).
4. The marks are placed on the main lift header hoses starting at carriage end of the hose mark each hose at dimensions M1 and M2.
 - a. $M1 = 400 \pm 10$ tolerance
 - b. $M2 = M1 + 500 \pm 2$ tolerance
5. Measure the header hose tension on the mast with hoses installed per header hose instructions in Step 4 above, with carriage or forks adjusted per mast assembly adjustment with forks off the ground.
6. Measure and record the distance between marks M1 and M2 to the nearest millimeter.
7. Reference marks (grey or white), placed 500 mm (19.7 in.) apart on unstretched hose prior to header hose assembly, are used to measure hose tension.
8. If free lift header hose tension is out of spec:
 - a. tension mark measurement is < 505 , raise crosshead one hole and re-measure.
 - b. tension mark measurement is > 515 , lower crosshead one hole and re-measure.
 - c. if unable to move crosshead, or moved 2 holes and tension is still incorrect, replace hose and reset crosshead.
9. If main lift header hose tension is out of spec, replace hose.
10. For the free loop portion of the main lift hose, mark M3 as shown in Figure 153.



- M1 = 400 ±10 TOLERANCE
- M2 = M1 ±2 TOLERANCE

- M3 = FREE LOOP TENSION MARK

Figure 153. Header Hose Tension Measurements

ADJUSTMENT

When properly adjusted, the hoses will not be so tight that they compress when they pass over hose sheaves, nor will they be so loose that they touch the load backrest or any crossmember that is next to a sheave.

1. Cap off hoses when attachments have been removed.
2. Check the hoses and cables are routed properly.
3. Slowly raise the free-lift and main cylinders to take up slack in lift chains.
4. Tighten strap clamps at the bracket weldment.
5. Cycle mast a few times to ensure proper tracking of hoses.
6. Secure hose assemblies to main lift cylinders with hose clamp and screw clamp.

NOTE: If the hose tension between the carriage and the clamp at the free-lift bracket is correct, go to Step 7.

If the hose tension between carriage and clamp at free-lift bracket is incorrect, loosen the clamps and pull (if hoses are loose) or push (if hoses are too tight) on the hoses so they move 15.0 mm (0.6 in.) side to side. Tighten hardware 8 N•m (71 lbf in).

NOTE: If the hose tension between the clamp and upper bracket and clamp at free-lift bracket is correct, go to Step 8.

7. If the tension of the hoses is incorrect, loosen clamps and pull hoses down (if too loose) or push hoses up (if too tight) so they can move 15.0 mm (0.6 in.) side to side. Tighten hardware to 8 N•m (71 lbf in).
8. With no load on the forks, check the header hose adjustment by operating the mast through the full lift cycle two times. If necessary, repeat until the hoses are properly adjusted.
9. Loosen clamp at top of mast near sheave 1 (item 10, Figure 151). Pull on hoses so that they move by clamp width of 30 mm (12 in.). Tighten clamp hardware to 8 N•m (71 lbf in).

Adjustment Procedures

CARRIAGE ADJUSTMENTS 202001-344

1. Install the load rollers on the carriage. Install the shims for the load rollers onto the stubshaft in the same sequence as when disassembled. There are no shims under the top load rollers.
2. Use an overhead lifting device to raise the carriage.
3. Find the point of tightest fit between the carriage load rollers and inner mast channels.
4. Remove the carriage from the mast. Adjust shim arrangement for each roller for clearance between roller and inner channel. Repeat Step 1 through Step 3 until clearance is no greater than 0.8 mm (0.030 in.) or less, then 0.1 mm (0.050 in.) at the point of tightest fit.
5. Keep shim arrangement on each side of carriage approximately equal. The carriage must be centered within the inner mast within 1.5 mm (0.06 in.).
6. Check lateral movement of carriage.
 - a. Fully lower the carriage to the ground.
 - b. Use small pry bar between top of carriage side plate and the inner channel flange.
 - c. Move carriage back and forth and check movement.
 - d. Carriage lateral movement must not be greater than 2.5 mm (0.10 in.).
 - e. If carriage lateral movement is greater than 2.5 mm (0.10 in.), add or remove shims and repeat Item a. through Item d. until correct movement is achieved.
7. After adjustment, lubricate channels with a thin layer of grease. Adjust hydraulic hoses and make sure connections are correct, if the carriage is equipped with hydraulic attachments.
8. If the carriage is equipped with hydraulic attachments, adjust the hydraulic hoses and make sure connections are correct.

LIFT CHAINS ADJUSTMENT 202001-345

LIFT CHAINS



WARNING

When working on or near the mast, see **Safety Procedures When Working Near Mast** at the beginning of this manual.

During test procedures for the hydraulic system, fasten the load to the carriage with chains to prevent it from falling. Keep all personnel away from the lift truck during the tests.

Never allow anyone under a raised carriage. **DO NOT** put any part of your body in or through the lift mechanism unless all parts of the mast are completely lowered and the engine is **STOPPED**. Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

When the lift chains are correctly adjusted:

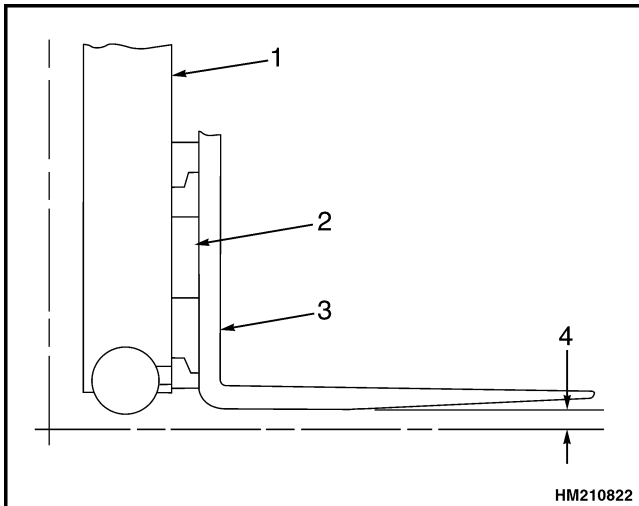
- The tension will be the same on each chain of the chain set. Check tension by pushing on both chains at the same time.
- The chain length will be correct.
- The chains must travel freely through the complete cycle.

NOTE: When the lift chain adjustments are complete, make sure the threads on the nuts of the chain anchors are completely engaged. Inspect the torque of the prevailing torque nut (locknut) used to adjust the chain anchor with every lift chain adjustment. After carriage and or mast section(s) are adjusted for proper ground clearance, prevent the carriage and or mast section(s) from fully lowering (see **Safety Procedures When Working Near Mast**). With slack chain(s), check locknut torque. If 2.5 N·m (22.1 lbf in) for ½-20, 4.5 N·m (39.8 lbf in) for ⅝-18 nuts, 6.0 N·m (53.1 lbf in) for ¾-16 of torque cannot be reached; replace locknut. The chain anchors, after adjustment, must be able to move on their mountings.

NOTE: Prior to performing adjustment procedures, make sure the forklift truck is parked on a level surface and the mast is in the vertical position.

Lift Trucks Equipped with Forks

1. Adjust the chain anchors that support the carriage, until the bottom of the fork heel is 12 +3.0/-6.0 mm (0.47 +0.12/0.24 in.) above the floor level. See Figure 154.



1. MAST
2. CARRIAGE
3. FORK
4. HEEL OF FORK IS 12 +3.0/-6.0 mm (0.47 +0.12/0.24 in.) ABOVE FLOOR LEVEL

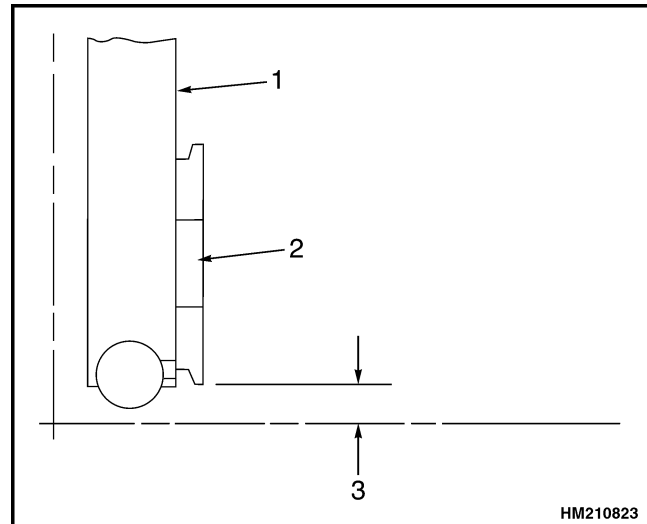
Figure 154. Lift Chain Adjustment, With Forks

Lift Trucks Equipped with Hook-Type Carriage and Attachment Without Forks

1. Adjust the chain anchors that support the carriage, until the bottom of the lower carriage bar is above the floor level.

Table 4. Hook-Type Carriage Chain Adjustment

Class II and III	82.5 ±3.0 mm (3.25 ±0.12 in.)
Class IV	133.5 ±3.0 mm (5.26 ±0.12 in.)



1. MAST
2. CARRIAGE
3. DISTANCE FROM FLOOR TO LOWER CARRIAGE BAR

Figure 155. Lift Chain Adjustment, Hook-Type Carriage

**MAST ADJUSTMENTS
202001-346**

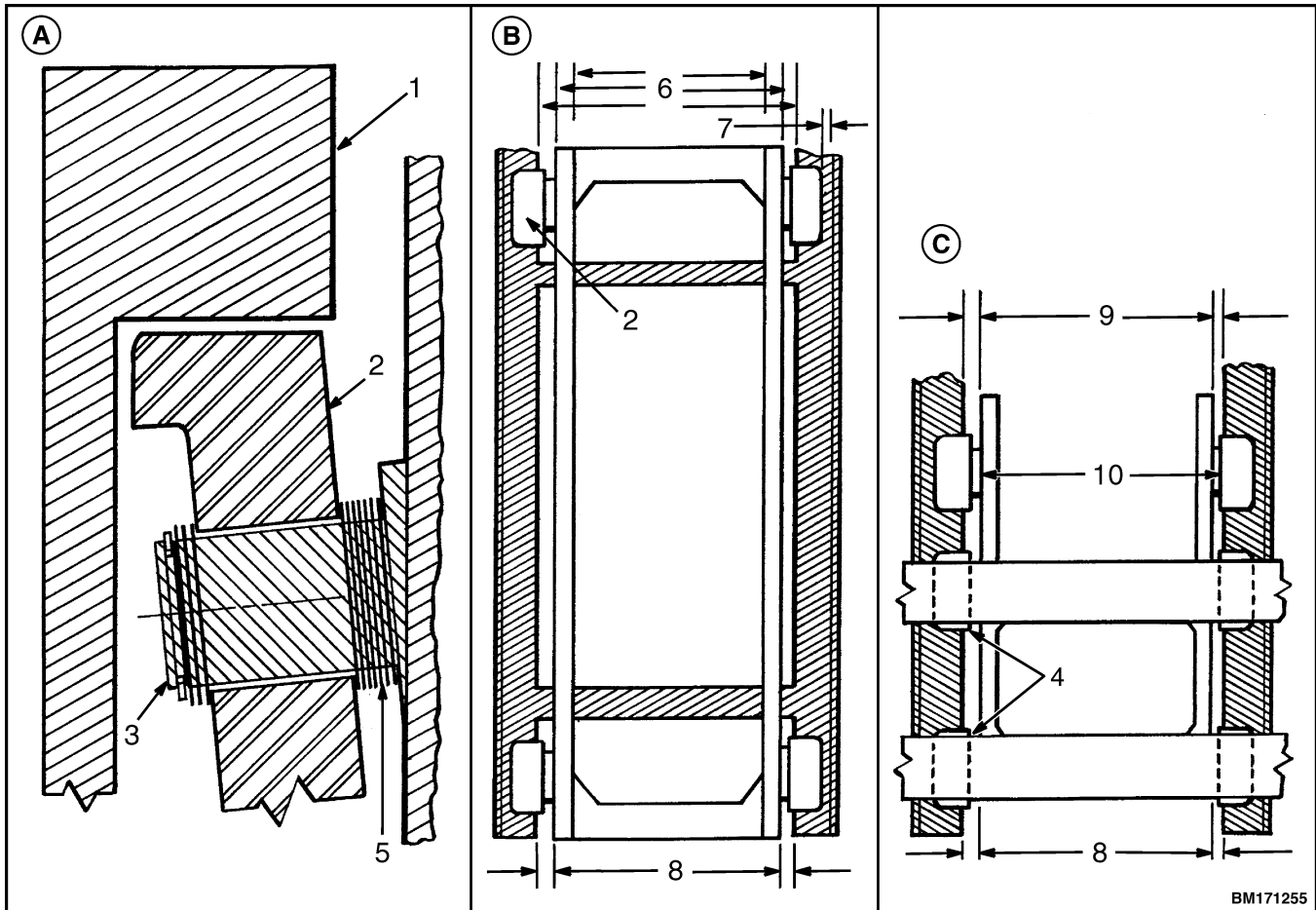
MAST

Load Roller, Adjust

NOTE: During assembly, shims should be reinstalled in the same location they were in before disassembly. Check clearance and adjust shims after repairs have been completed.

1. Load rollers control the alignment of the mast uprights. See Figure 156. The alignment conditions are provided on a list below with the most important condition first.
 - a. Mast uprights must be parallel to each other.
 - b. Use shims to adjust load rollers so there is zero clearance between load roller and channel at point of tightest fit.
 - c. The number of shims under a load roller must be approximately the same as the stub shaft in the opposite side of the upright. This ensures uprights will be approximately in the center.

2. Perform following steps to adjust mast load rollers:
 - a. Use a crowbar to move mast uprights from side to side to measure movement. Measure movement in a minimum of three different positions of each mast upright.
 - b. Separate mast uprights and change shim arrangements as required. Assemble uprights. Slide upright all the way to the top and bottom to find the tightest fit.
 - c. Repeat Step a and Step b until there is zero clearance at point of tightest fit.
 - d. Measure distance between channels of mast uprights on top and bottom. Change shims to keep distance equal between top and bottom so mast uprights are parallel. Also make sure the mast uprights are parallel within 1.5 mm (0.060 in.).
3. Adjust strip bearings. See Figure 157. Insert shims under strip bearing. Adjust clearance until there is less than 0.8 mm (0.030 in.) at the tightest fit. See Figure 156.



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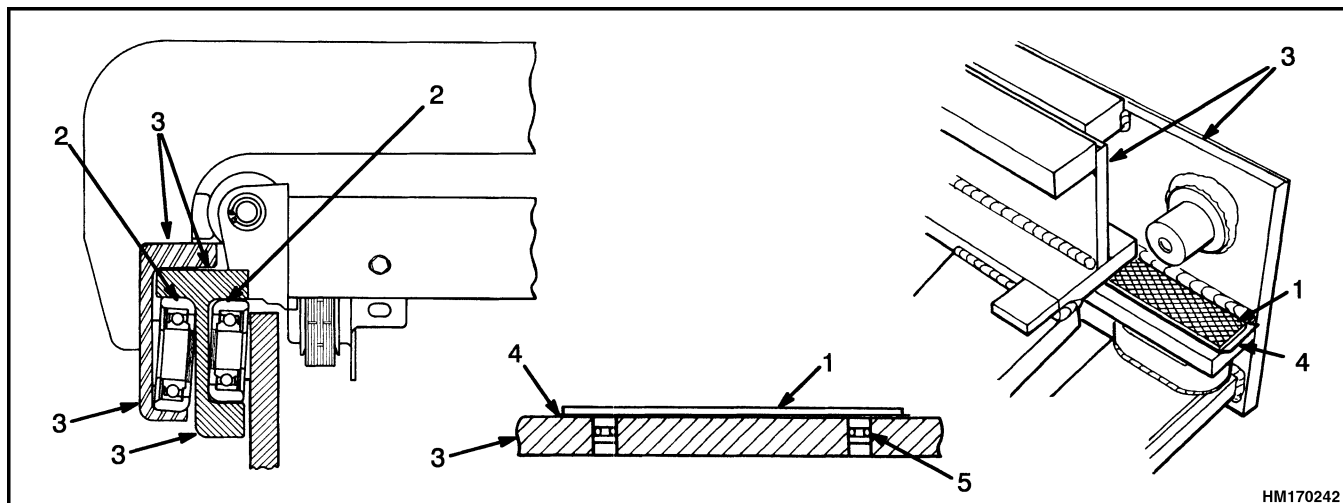
- A. TOP VIEW
- B. MAST FRONT VIEW

- C. CARRIAGE FRONT VIEW

- 1. CHANNEL
- 2. LOAD ROLLER
- 3. STUB SHAFT
- 4. SHIM FOR ZERO CLEARANCE AT POINT OF TIGHTEST FIT
- 5. SHIMS

- 6. PARALLEL TO CHANNEL ± 1.5 mm (± 0.060 in.)
- 7. ZERO CLEARANCE AT POINT OF TIGHTEST FIT
- 8. EQUAL SPACE ± 1.5 mm (± 0.060 in.)
- 9. PARALLEL TO CHANNEL ± 1.5 mm (± 0.060 in.)
- 10. PUT SPACER ON OUTSIDE OF TOP LOAD ROLLER, UNDER SNAP RING

Figure 156. Mast Adjustments



1. STRIP BEARING
2. LOAD ROLLER
3. MAST UPRIGHT

4. SHIMS
5. O-RING

Figure 157. Strip Bearings Arrangement

Mast Side Kicking, Adjust

Mast side kicking is where the mast, without a load, moves either to the right or left as it is being fully raised. When this happens, it is an indication that one of the main lift cylinders is raising at a faster rate than the other. Before checking for mast side kicking, mast must be completely assembled to include the carriage, forks, load backrest, and any attachments, if lift truck is equipped with one.

To adjust the mast for side kicking, do the following:

1. Place lift truck on a level surface and apply parking brake.
2. Raise mast and visually inspect it as it reaches its full height.

3. If the mast is moving to the left, shims will need to either be added or removed from top of right, shims will need to either be added or removed from top of left main lift cylinder.
4. If shims will be added, use smallest shim size that can be used on mast that is being adjusted. See the **Parts Manual** for shim sizes and part numbers.
5. Raise mast again and visually inspect it to ensure that it is no longer side kicking. If side kicking is still present, repeat Step 3 and Step 4.

Bolzoni attachment installation

PAPER ROLL CLAMP INSTALLATION 202001-078

This content is under development and will be released when available.

BALE CLAMP INSTALLATION 202001-079

This content is under development and will be released when available.

ROTATOR INSTALLATION 202001-080

This content is under development and will be released when available.



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