Service Manual

ES30/ES40
E40/E50/E60/E65
EV40/EV50/EV60
MT

Full Free Lift 3-Stage Mast

LIFT-TEK®

Manual Part Number 248645 R3

Contents

Section 1 Introduction

1.1 Introduction

This manual provides the installation instruction, periodic maintenance, troubleshooting and service procedures for the Lift Tek E-Series roller masts.

In any communication about the mast, refer to the mast serial number stamped in the nameplate. If the nameplate is missing, these numbers are also stamped on a plate on the left-hand side of the mast. See Figure 1.

WARNING: Do not install a Lift Tek Mast on a truck with a capacity greater than the truck rated capacities shown below

TRUCK CAPACITY AT 24IN. (610 mm) LOAD CENTER				
	EV40	EV50	EV60	
ES30	ES40			
	E40	E50	E60	E65
3000 lbs.	4000 lbs.	5000 lbs.	6000 lbs.	6500 lbs.
(1361 kg)	(1814 kg)	(2268 kg)	(2718 kg)	(2948 kg)

Modifications and additions which affect capacity or safe operation shall not be performed without prior written approval from Lift Technologies per ANSI B56. 1.

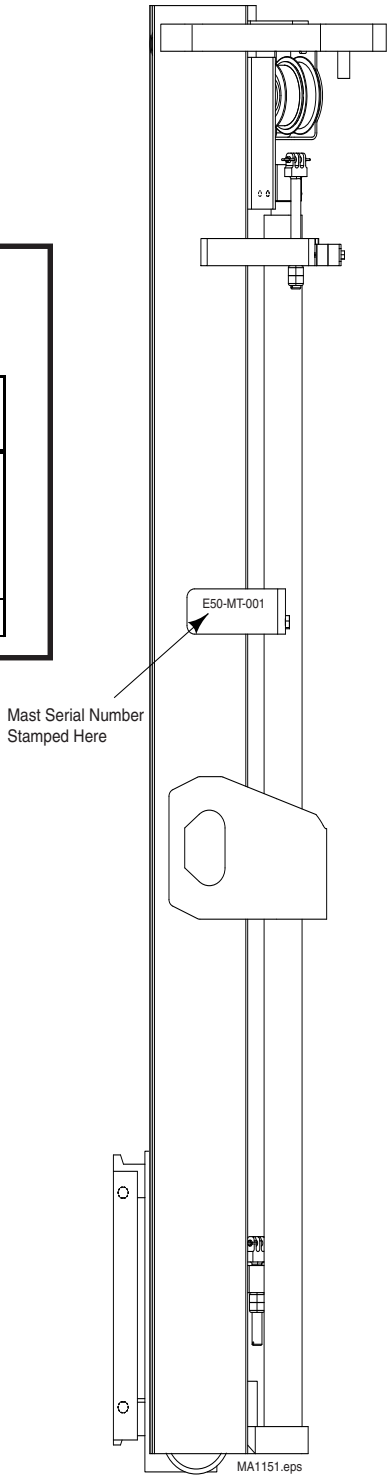


Figure 1. Mast Serial Number Location

1.2 Special Definitions

WARNING

A statement preceded by **WARNING** is information that should be acted upon to prevent **bodily injury**. A **WARNING** is always inside a ruled box.

CAUTION

A statement preceded by **CAUTION** is information that should be acted upon to prevent **machine damage**.

IMPORTANT

A statement preceded by **IMPORTANT** that possesses special significance.

NOTE

A statement preceded by **NOTE** is information that is handy to know and may make your job easier.

2.1 Truck System Requirements

To achieve maximum lifting capacity of the mast, the truck relief valve should be set to relieve at the pressure indicated in the chart below. This chart also indicates the hose fitting size to use between the truck control valve and masts valve.

TRUCK SUPPLY REQUIREMENTS

Lift Tek Mast	Relief Pressure	Hose Size	Fitting* Size
ES/EV/E 30/40/50/60/65	2600 psi	No. 8 min.	13/32 in. Orifice

* Valve inlet port is 3/4 in. SAE O-ring. See Figure 2.

WARNING: For proper truck stability or to prevent interference, tilt restriction may be required. Contact the truck manufacturer.

IMPORTANT: Lift Tek Masts are compatible with SAE 10W petroleum base oil per Mil. Spec. MIL-0-5606 or MIL-0-2104 B only. Use of synthetic or aqueous base hydraulic oil is not recommended. If fire resistant hydraulic oil must be used, contact Lift Tek.

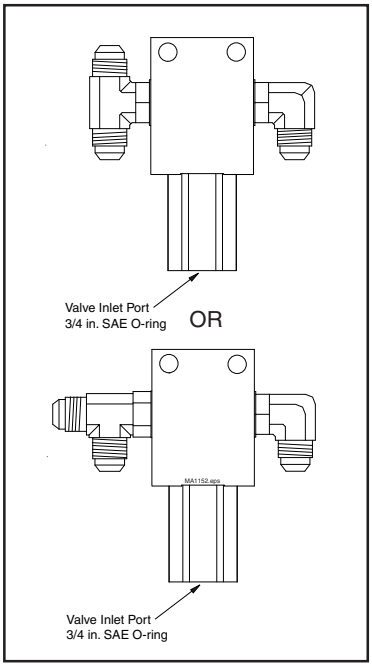


Figure 2. Valve inlet Port.

2.2 Mounting Bracket Installation

If it is necessary to install mounting brackets and crossmembers to fit your lift truck, consult with the nearest Lift Tek Service Department listed on the back cover. You must supply dimensions **A** through **F** shown in Figure 3. Failure to install the correct brackets and crossmembers can result in mast structural failure, bodily injury and loss of warranty.

WARNING: Failure to install the correct brackets and crossmembers can result in mast structural failure, bodily injury and loss of warranty.

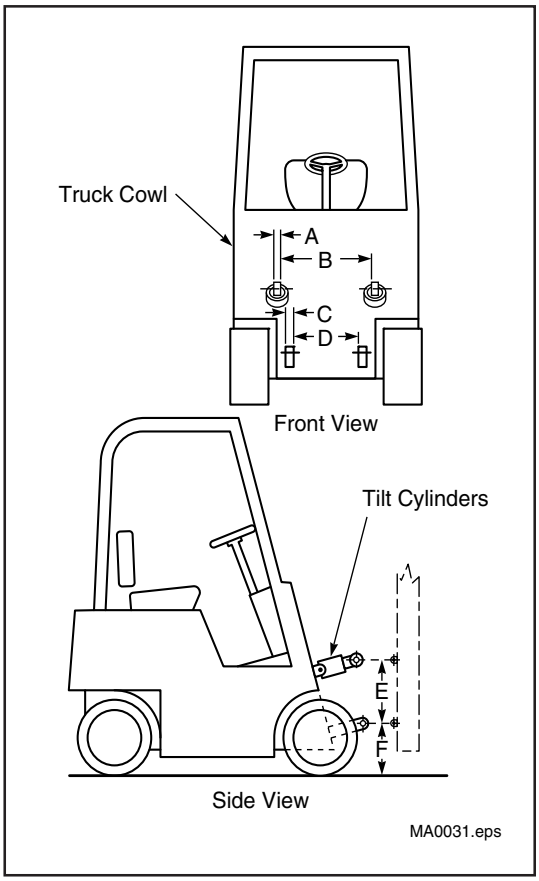


Figure 3. Determining Mounting Bracket Location.

Section 2 Installation Instructions

2.3 Mast Installation

1. **Raise** and block the front end of the truck 1ft. (30 cm) per ASME B56.1 or drive the truck over a service pit.

2. Install the bearings to lower the axle mounts.

3. Lubricate the bearing surfaces of the lower axle and tilt cylinder mounting brackets with chassis grease.

4. Lift the mast using an overhead hoist with a lifting strap attached under all of the upper crossmembers. Position the mast lower the axle mounts on the truck axle. Install the mount caps and capscrews. Tighten the capscrews to the truck manufacturer's torque specifications.

IMPORTANT: Prior to connecting the tilt cylinders to the mast, make sure the cylinders "bottom" evenly. Adjust the tilt cylinders to prevent the mast from "racking" during tilting. Refer to your truck service manual for procedures.

5. Connect the lift truck hose to the mast valve.

6. Connect the tilt cylinders to the mast anchor brackets. Tighten the pin capscrews to the truck manufacturer's torque specifications.

NOTE: Use as few fittings as possible and always use 45° fittings instead of 90° fittings. Keep the hose lengths to a minimum. Avoid sharp bends or pinch points when routing the hose.

The instructions and illustrations are typical for most trucks. If your truck does not match, Catact lift-Tek support.

Contact Lift Tek if additional fittings are required. See back cover.

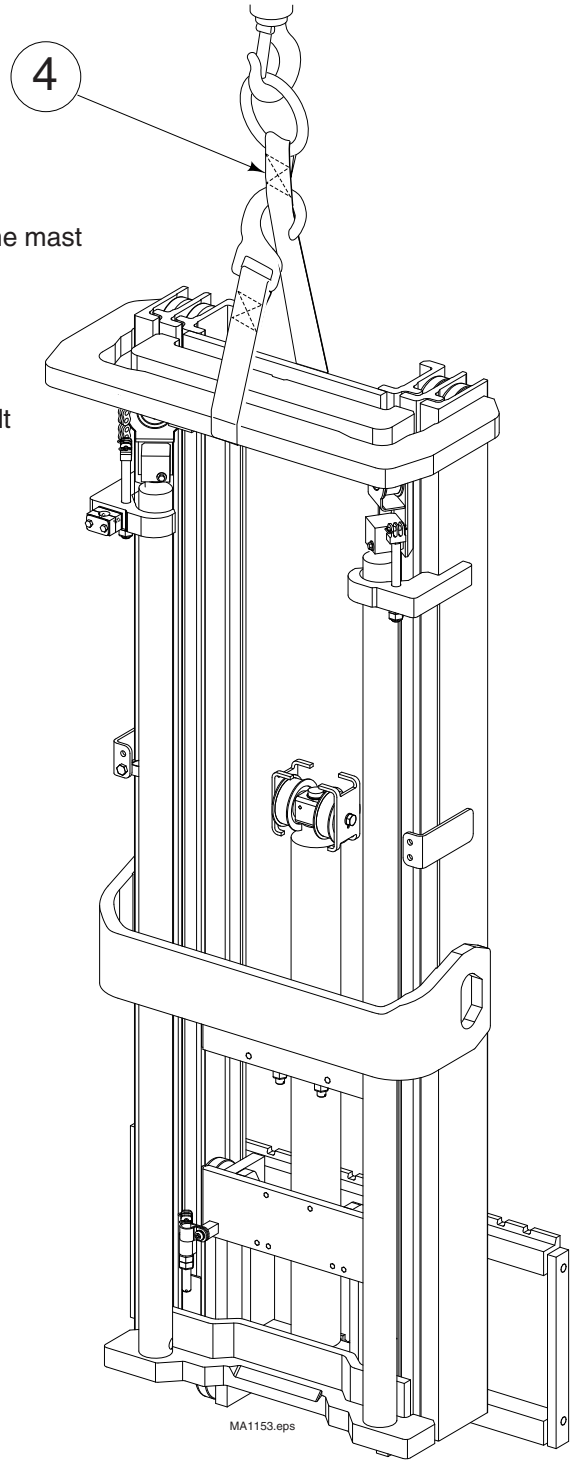


Figure 4. Mast Installation.

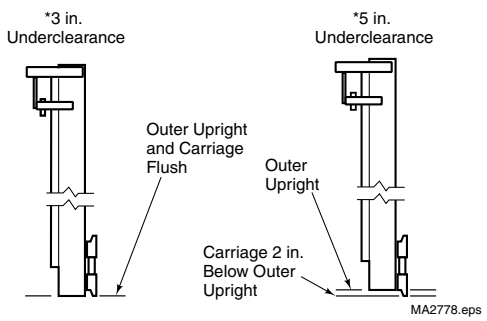
2.4 Inspection and Adjustments

2.4-1 Chain Inspection and Tension

The hoist Chains have been factory lubricated using heat and pressure to force the lubricant thoroughly into the chain links. Avoid removal or contamination of this factory applied lubricant. **Do not wash, sand blast, etch, steam clean, or paint the chains for internal mast installation.**

If the mast has been cleaned using a pressure washer or heavy detergents that may rinse the chain lubrication out from within the links, then the recommended method for reestablishing chain lubrication is to soak the chains in SAE 40wt oil for at least 8 hours, preferably with the oil heated to 100° F to 120° F to facilitate complete lubricant penetration. Excess oil may be wiped off prior to installation.

The chains must be adjusted with equal tension to ensure proper load distribution and mast operation. To determine equal tension, extend the unload mast to put the chains under tension. Press the center of a strand of chain with your thumb, then press at the same place on the other chain of the pair. Each chain in a pair should have equal “give”. If they do not have equal tension, preform the hoist chain adjustments described in Sections 5.6-3 and 5.6-4.



*NOTE: Underclearance is based on mast production series, actual mast underclearance may vary by truck model.

Figure 5. Upright and Carriage Position.

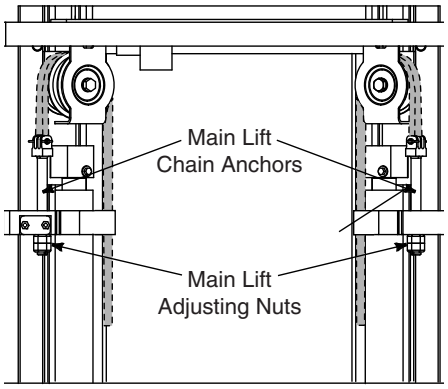


Figure 6. Main Lift Chains.

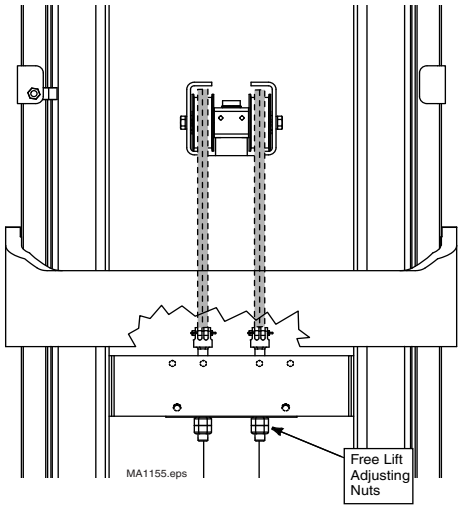


Figure 7. Free Lift Chains.

2.4-4 Free lift Cylinder Supply Hose Tracking Adjustment

Make sure the cylinder supply hose is not twisted and travels evenly in the hose guide. Check the hose to be sure it is not scuffing. Adjust the hose by loosening the hose clamp on the outer upright as shown in figure 8 and twisting the hose. Tighten the clamp while holding the hose in place. Tension on the hose can be adjusted by sliding the hose through the loosened clamp as required.

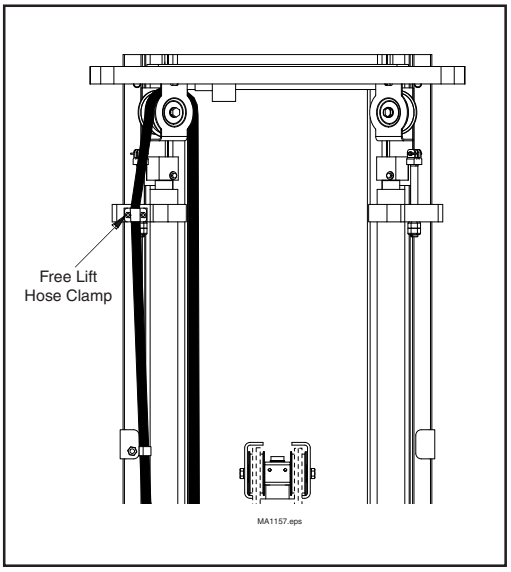


Figure 8. Free Lift Cylinder Supply Hose Adjustment.

2.4-5 Upright Rail Lubrication

Lubricate the full length of each upright rail with chassis lube or Kendall SR-12X as shown in Figure 9.

2.4-6 Cylinder Bleeding

WARNING: The cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.

When new or after repair, the cylinders may have air trapped in them that must be removed. To bleed air do the following:

1. **Without a load** extend the free lift cylinder and continue to extend the main lift cylinders to 90% of full stroke. Retract all cylinders completely. Repeat **three** times.

2. Extend the cylinders **without a load** at 50% full engine speed then build full system pressure at the end of the main lift cylinder stroke. Electric trucks-limit the control valve movement to achieve 50% speed. Retract all cylinders. Repeat **four** times.

3. Cycle the mast with a **half load** (50% mast rated capacity) through full cylinder extension several times. The cylinders should extend smoothly. Repeat the steps if cylinder extension is not smooth.

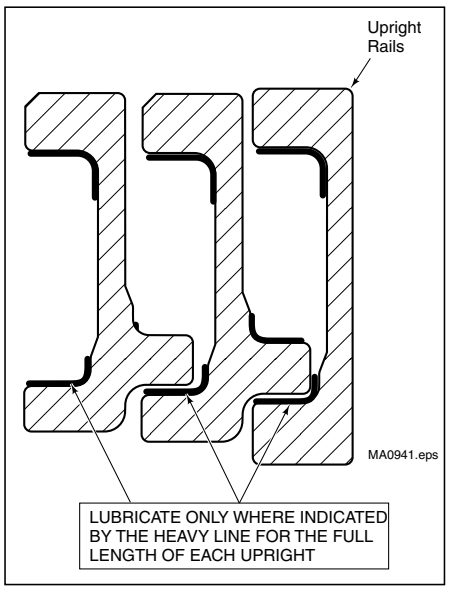


Figure 9. Channel lubrication.

2.4-7 Mast Skewing

Check for mast skewing as described in Section 5.5-6.

2.5 Single Function Internal Reeving Installation

1. Install fittings and caps to the carriage termination bracket and install bracket to carriage as shown.

2. Assemble crosshead sheaves and new chain guards as shown.

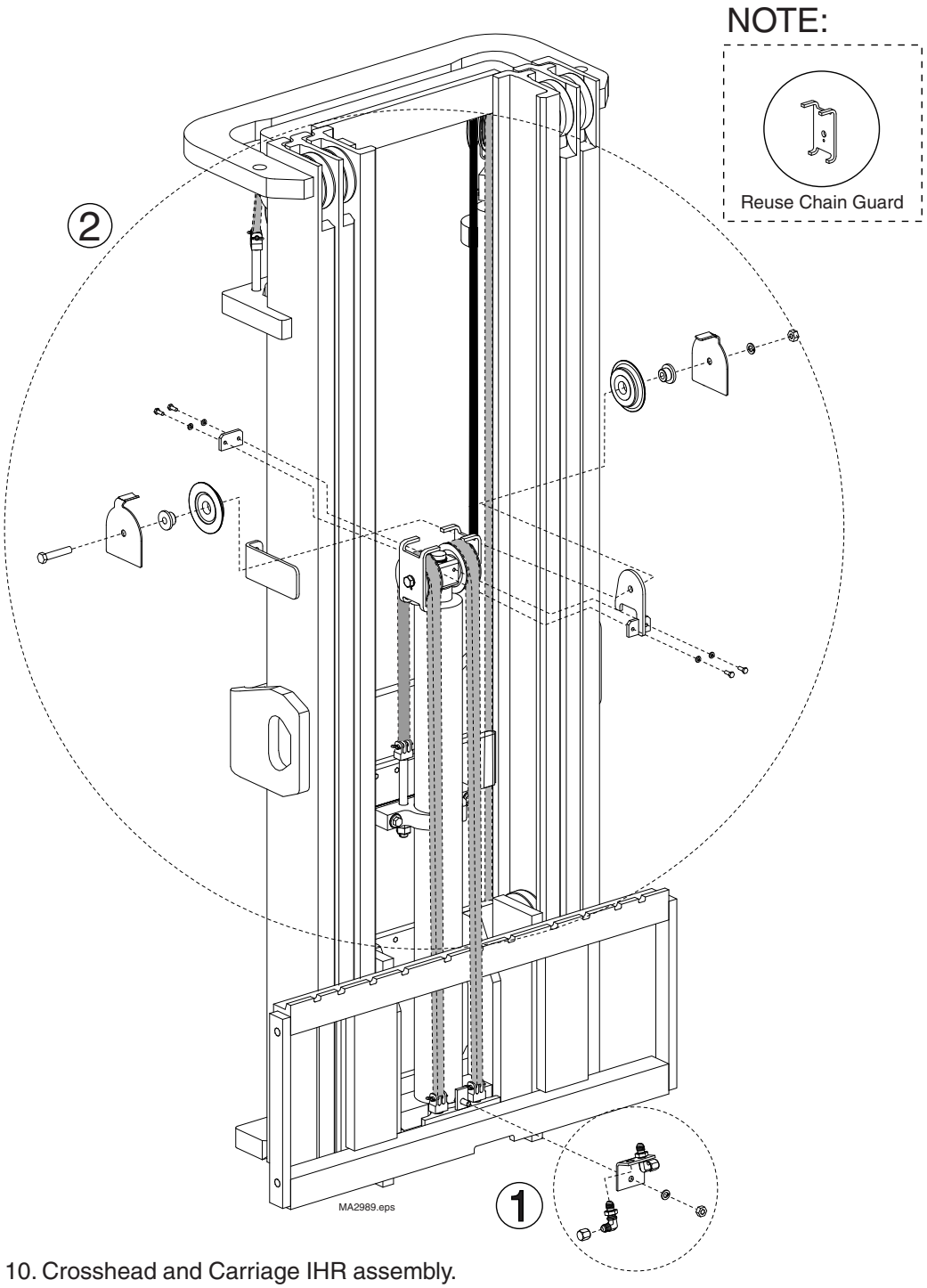


Figure 10. Crosshead and Carriage IHR assembly.

2.5 Single Function Internal Reeving Installation (Continued)

3. Install bracket on middle inner crossmember (E-Series Only).

4. Install upper bracket and one clamp piece on lower inner crossmember as shown.

5. Install lower bracket and one clamp piece on lower inner crossmember as shown.

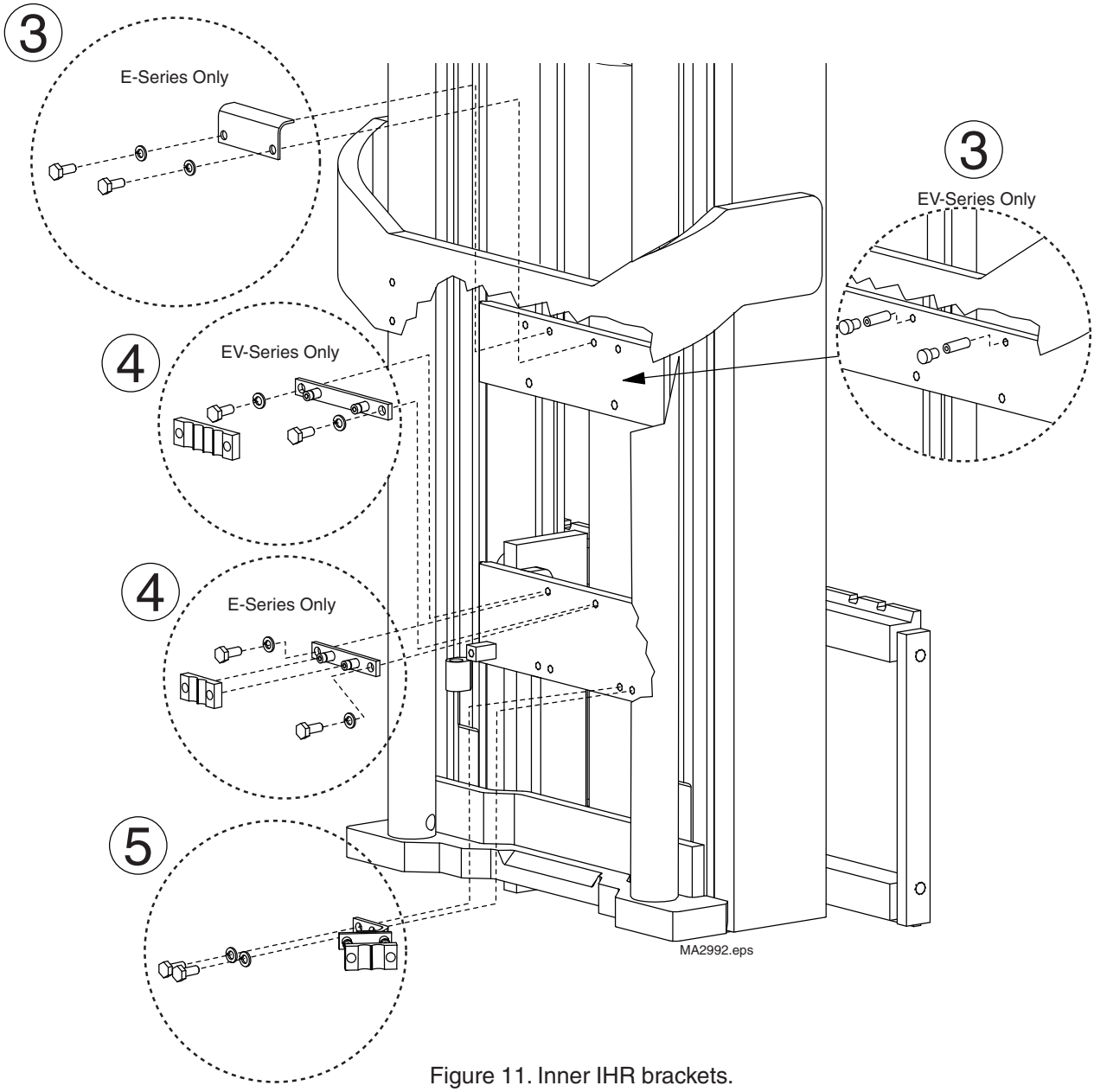


Figure 11. Inner IHR brackets.

2.5 Single Function Internal Reeving Installation (Continued)

6. Install guard and sheave onto upper intermediate stubshaft as shown.

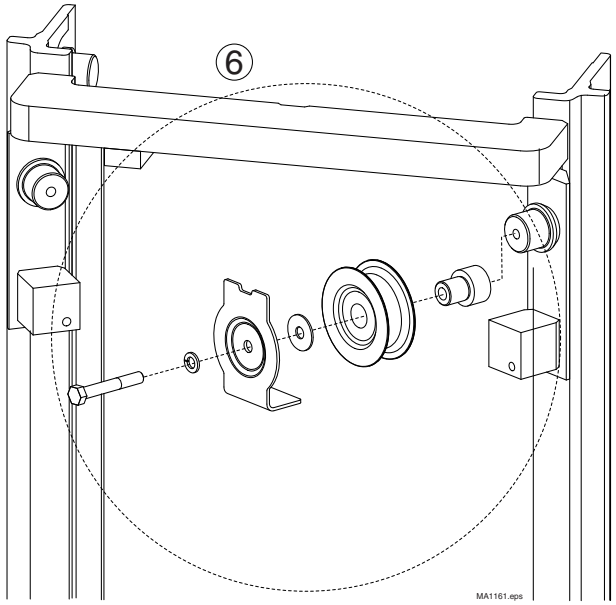


Figure 12. Upper intermediate sheave.

7. Install bracket and one clamp piece on outer tab as shown.

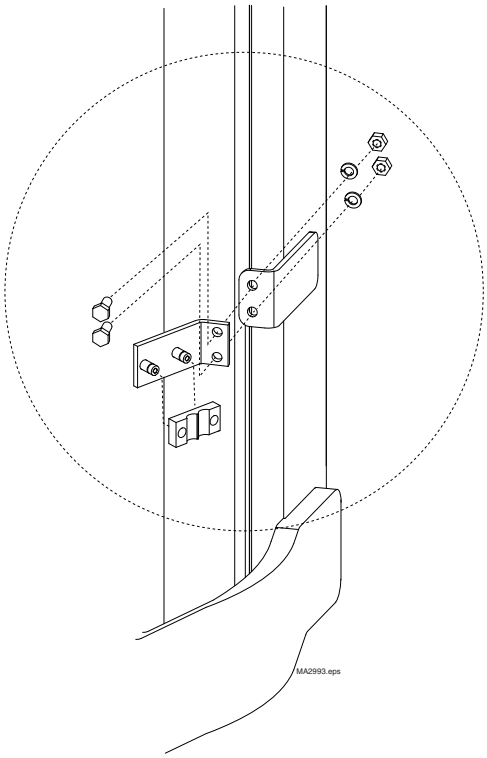


Figure 13. Outer tab.

2.5 Single Function Internal Reeving Installation (Continued)

9. Attach hoses to fittings on carriage termination bracket.

10. Route hoses over crosshead and down over the middle crossmember guard.

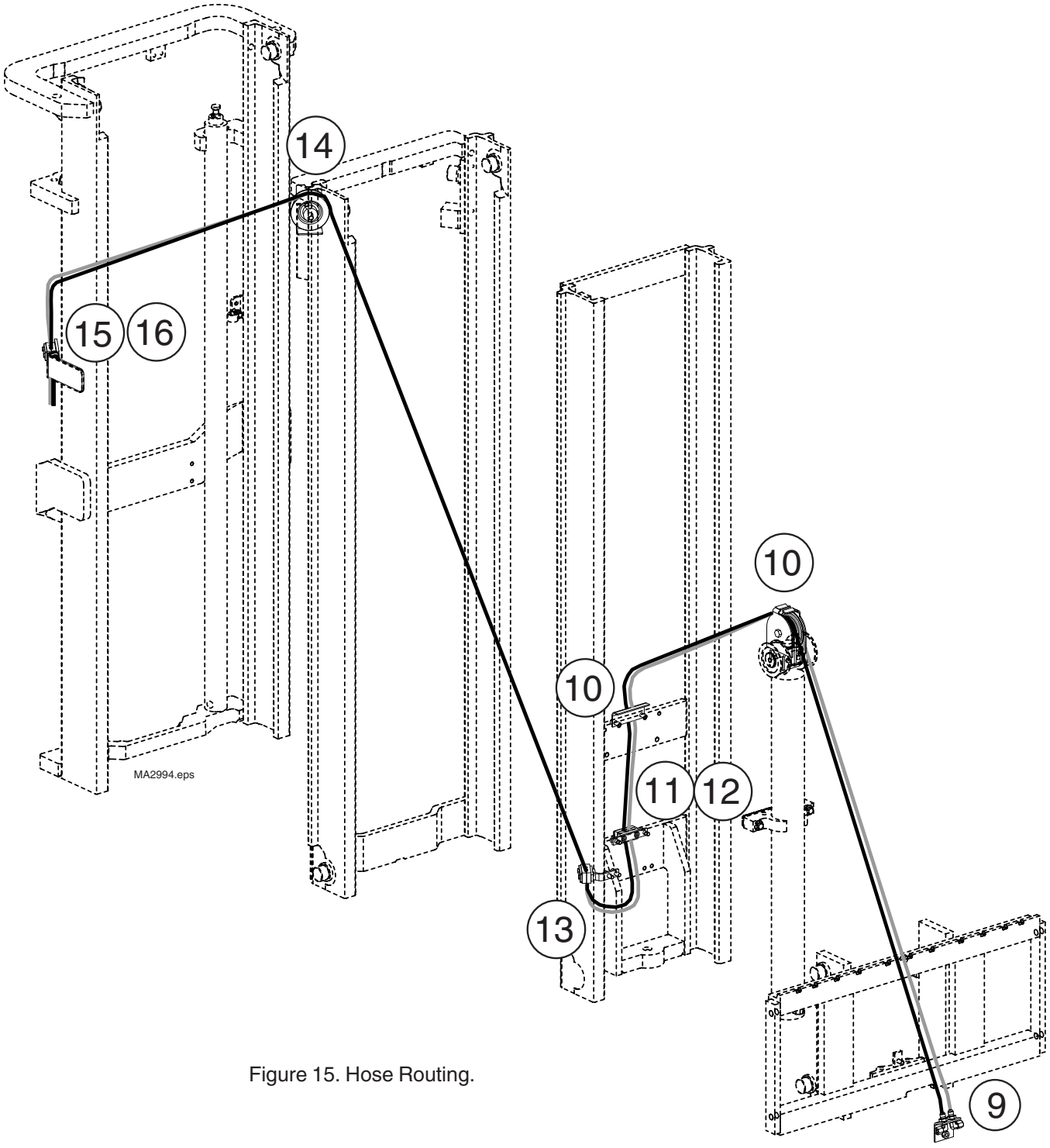


Figure 15. Hose Routing.

2.5 Single Function Internal Reeving Installation (Continued)

11. Route hoses through clamp piece on top lower inner bracket and install second clamp piece, coverplate and bolts loosely.

12. Pull hoses to proper tension and tighten clamp bolt.

13. Route hoses to second bracket on lower inner (right hose to outboard slot on clamp piece and left hose to inboard slot on clamp piece) with gentle loop and install second clamp piece, coverplate and bolt tightly.

14. Route hoses up through sheave on upper intermediate.

15. Route hoses through clamp piece on outer bracket and install second clamp piece.

16. Pull hoses to proper tension and tighten clamp bolts.

2.5 Double Function Internal Reeving Installation

1. Install fittings and caps to the carriage termination bracket and install bracket on carriage as shown.

2. Assemble crosshead sheaves and guards as shown.

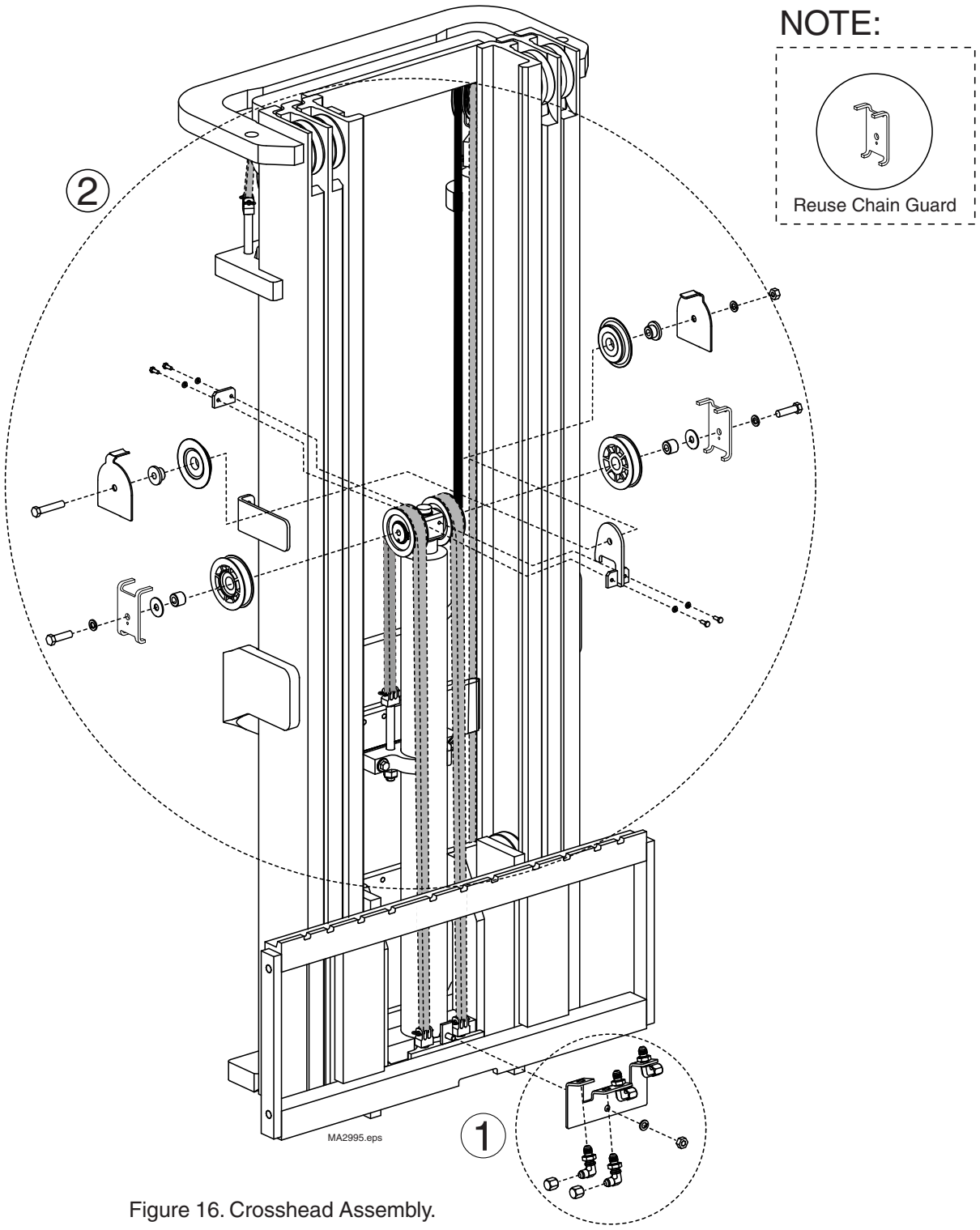


Figure 16. Crosshead Assembly.

2.5 Double Function Internal Reeving Installation (Continued)

3. Install bracket on middle inner crossmember as shown (E-Series Only). For the EV-Series, Install the roll pins and caps in the top holes of the middle inner crossmenber.

4. Install upper bracket and one clamp piece on lower inner crossmember as shown.

5. Install lower bracket and one clamp piece on lower inner crossmember as shown.

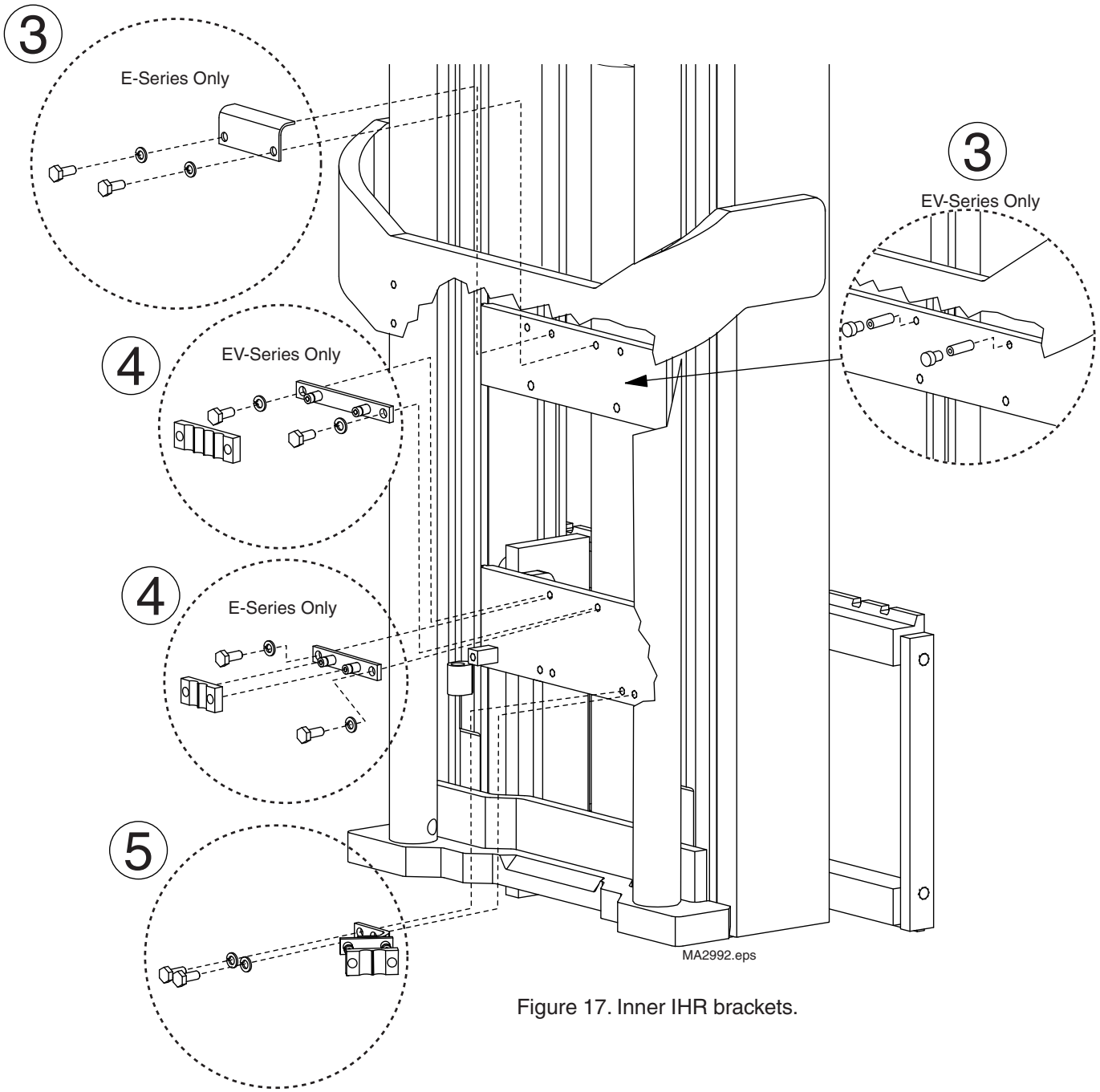


Figure 17. Inner IHR brackets.

2.5 Double Function Internal Reeving Installation (Continued)

6. Install guard and sheave onto upper intermediate stubshaft as shown.

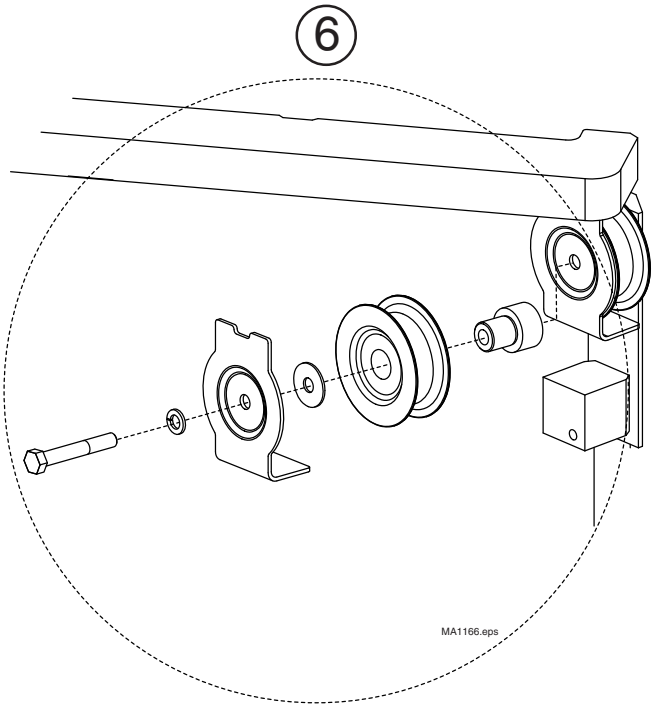


Figure 18. Upper intermediate sheave.

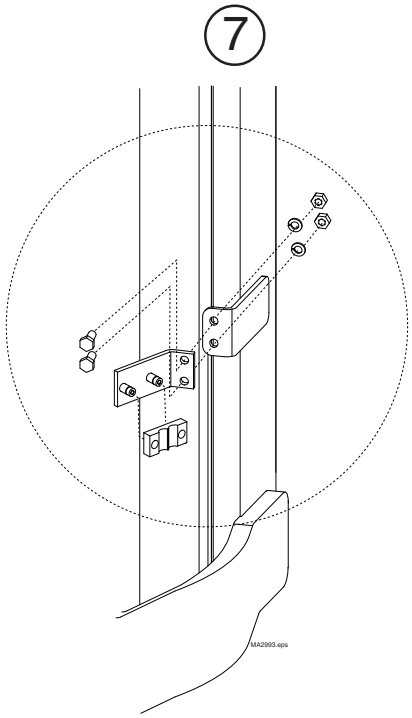


Figure 19. Outer tab.

7. Install bracket and one clamp piece on outer tab as shown.

8. Install lower left bracket and one clamp on lower inner crossmember as shown.

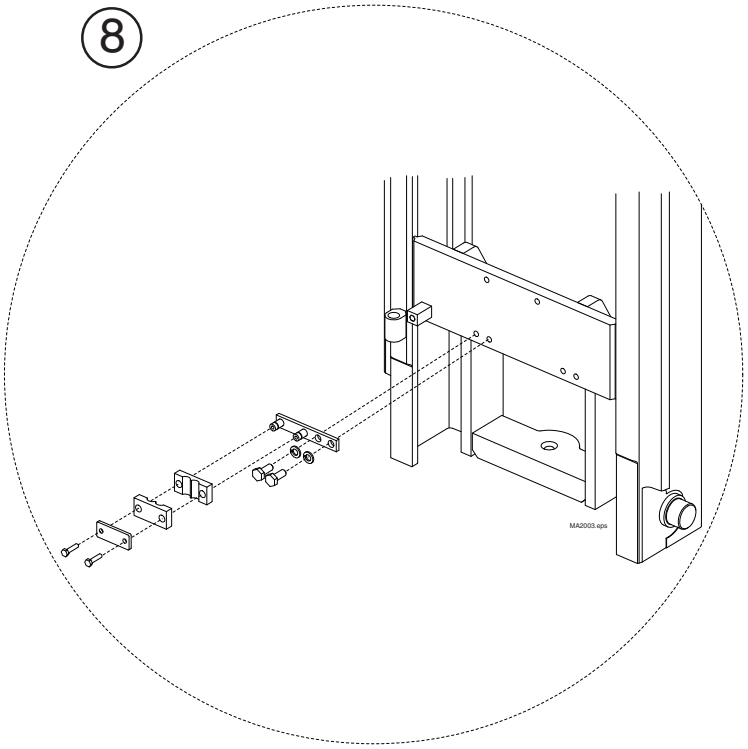


Figure 20. Lower Left bracket.

2.5 Double Function Internal Reeving Installation (Continued)

9. Install bracket on the upper intermediate crossmember as shown.

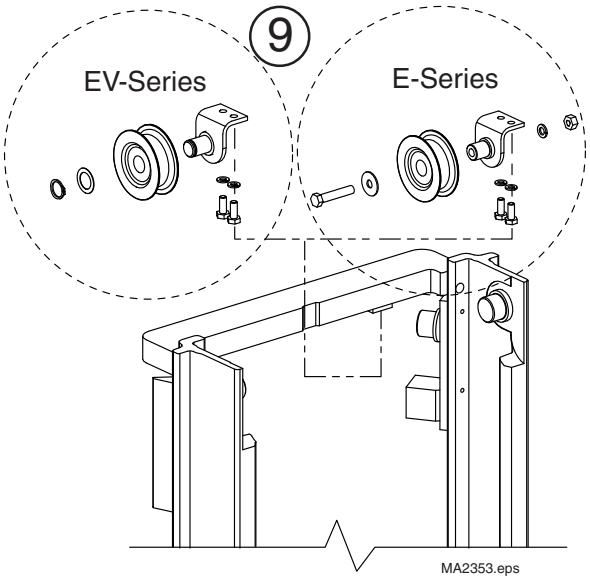


Figure 21. Upper Intermed. bracket.

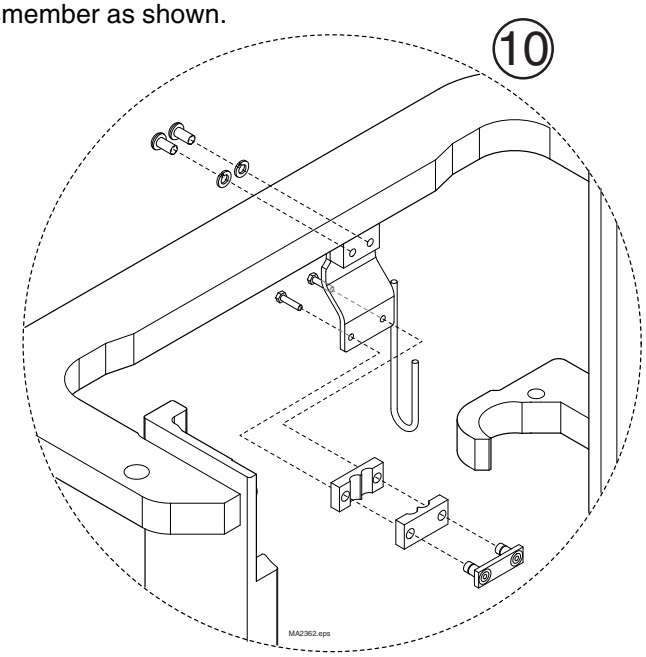


Figure 22. Upper Outer bracket.

10. Install bracket and one clamp piece to the bottom of the upper outer crossmember as shown.

11. Install bracket and one clamp piece on outer tab as shown.

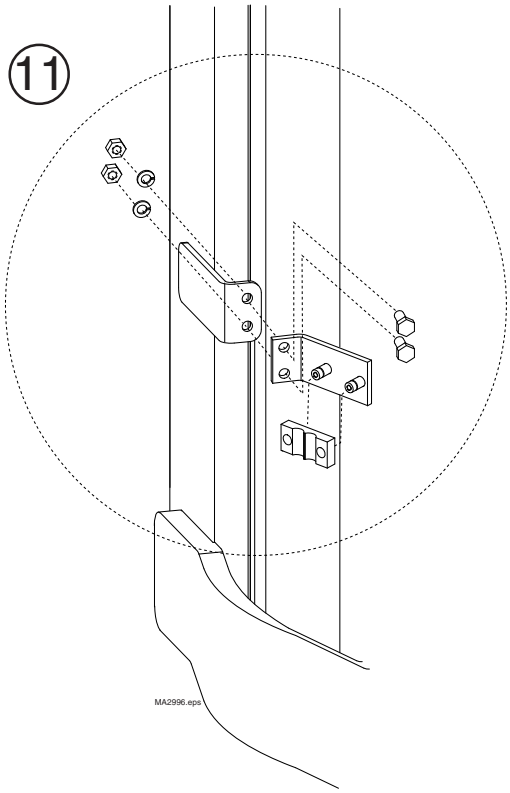


Figure 24. Middle Outer bracket.

2.5 Double Function Internal Reeving Installation (Continued)

13. Attach hoses to the carriage termination bracket fittings as shown in Figure 25a for E-Series and 25b for EV-Series.

14. Route outside hoses over outside sheaves on the crosshead and route middle hoses over sheaves above crosshead.

15. Route middle hoses over middle inner guard (E-Series Only). For the EV-Series, route the two outside hoses outside of the roll pins on the middle inner crossmemeber and the two inside hoses to the inside of the roll pins.

16. Route hoses through clamp piece on top lower inner bracket and install second clamp piece, coverplate and bolts loosely.

17. Pull hoses to proper tension and tighten clamp bolts.

18. Pull outside hoses down to middle inner crossmember, place hose clamps on hoses, slightly above the middle crossmember (E-Series Only).

19. Pull hoses to proper tension and attach clamps to middle inner crossmember (E-Series Only).

20. Route the outside right hose in front of the lower crossmember and middle right hose behind the lower to second bracket on lower inner (middle hose to inboard slot on clamp piece and outside hose to outboard slot on clamp piece) with gentle loop and install second clamp piece, coverplate and bolt tightly.

21. Route hoses down through sheave on the upper intermediate.

22. Route hoses up through clamp piece on outer bracket and install second clamp piece, coverplate and bolts loosely.

23. Pull hoses to proper tension and tighten clamp bolts.

24. At lower inner crossmember, route the outside left hose in front of the lower crossmember and the middle left hose behind the lower crossmember to left side bracket on lower inner (middle hose to inboard slot on clamp piece and outside hose to outboard slot on clamp piece) with gentle loop and install second clamp piece, coverplate and bolt tightly.

25. Route hoses up to the sheave at the upper intermediate crossmember shown in Figure 25a and 25b (install hoses onto sheave prior to installing stubshaft and sheave on bracket).

26. Route hoses down to bracket attached to upper outer crossmember. Tension hoses and clamp using parts as shown in Figure 22.

27. Route hoses through guide bar on the bracket and down to clamp piece on outer bracket and install second clamp piece, cover plate and bolts loosely. Orient hoses so they follow an orderly path from upper bracket to clamp.

2.5 Double Function Internal Reeving Installation (Continued)

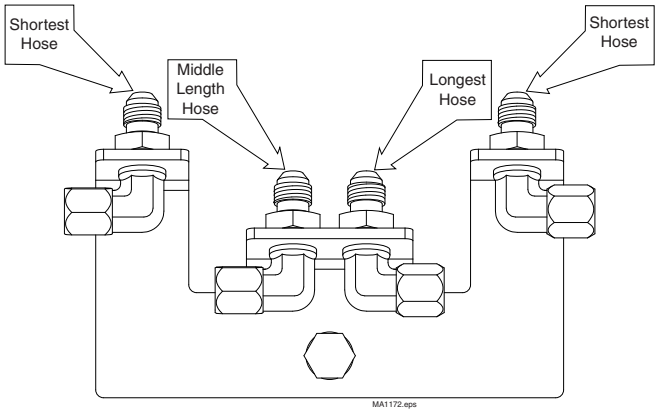


Figure 25a. Carriage Termination bracket.

Figure 26a. Hose Routing - E-Series Only.

2.5 Double Function Internal Reeving Installation (Continued)

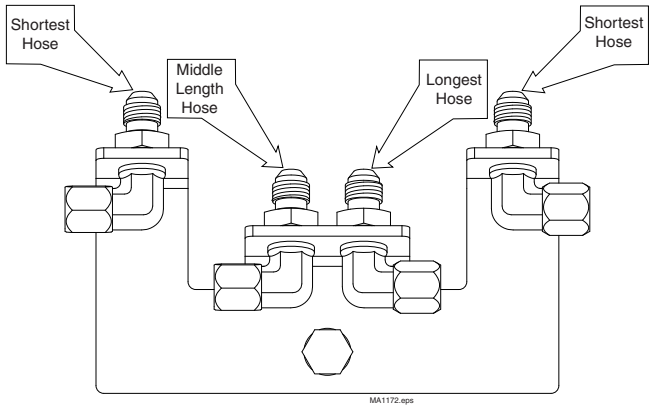


Figure 25b. Carriage Termination bracket.

Figure 26b. Hose Routing - EV-Series Only.

Section 3 Periodic Maintenance

3.1 Periodic Maintenance

For proper operation and an extended service of life, your Lift Tek Mast should be inspected and serviced regularly as part of your normal lift truck maintenance schedule according to the following outlines and ANSI B56.1 procedures.

The recommended intervals are for masts operating under normal conditions. If the mast is operating in severe conditions or corrosive atmospheres, the inspections should be performed more frequently.

WARNING: Never work on the mast with a load on the forks or attachment, in the raised position without supports or while anyone is near the lift truck control handles per ANSI B56.1

3.1-1 Daily Inspection

Perform the following at the beginning of each work shift:

1. Extend the carriage a few inches off the ground and make sure the chains are under equal tension. Refer to Section 5.6-3 and 5.6-4 for chain adjustment.
2. Extend the mast to its fullest height to make sure the mast rails and carriage extend freely without binding.
3. While the mast is extended, inspect the upright rails for proper lubrication. Refer to Section 5.5-5 Step for rail lubrication.
4. Make sure the internal reeving hoses (if equipped) travel evenly in the hose guides. Adjust the hose ends if required. Tighten the fittings making sure they do not twist.
5. In applications with high humidity or condensation, chain lubrication as described under Item 1 of the 100 hour inspection may be needed more frequently to reduce the risk of corrosion.

100 Hour Inspection

After each 100 hours of lift truck operation, and in addition to the daily inspection:

1. Inspect and lubricate the full length of the chains with SAE 40 wt. oil or equivalent.

CAUTION: The chains must be coated with a film of lubricant at all times.

500 Hour Inspection

After each 500 hours of lift truck operation, and in addition to the Daily and 100 Hour Inspection:

1. Each pair of load rollers on the uprights and carriage should be shimmed so that a total side to side clearance no greater than 1/16 in. (1.5 mm) occurs at the tightest point throughout the travel of the member. Pry between the upright and load roller so that the opposite load roller is tight against the upright. Measure the clearance for the pair of rollers at XXX shown. See Figure 13.
2. Check the chains for wear and stretch. Refer to Section 5.6-1 for complete chain inspection.

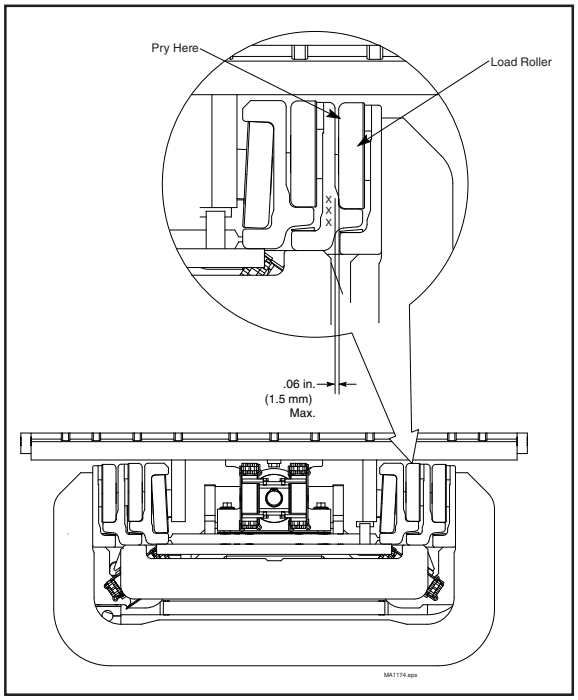


Figure 13. Load Roller Clearances.

Section 4 Troubleshooting

The following table lists problems that may be encountered on your Lift Tek Mast, the probable causes and recommended corrective action that should be taken to restore the mast to normal operating condition.

> ⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without a load) is in the raised position.

PROBLEM	PROBABLE CAUSE	SOLUTION
Cylinders don't lift load or won't move		
Empty	**a)** Plugged inlet hose	**a)** Unplug hose or replace.
	b) Insufficient oil.	**b)** Check the truck hydraulic system for correct oil level in tank, defective pump or pump drive, leaks in the lines or disconnect control valve linkage. Repair or replace as necessary.
	c) Bent or jammed plunger.	**c)** Repair or replace as necessary.
Loaded	**a)** Plugged piston check valve.	**a)** Unplug check valve or replace.
	b) Truck relief valve setting low.	**b)** Raise truck relief setting to specified level
	c) Over capacity.	**c)** Reduce load to specified capacity.
	d) Mechanical bind due to bent plunger or bad rollers.	**d)** Remove mechanical bind by replacing/freeing plunger and rollers.
Cylinders drift	**a)** External leak in pressure line.	**a)** Tighten or replace as necessary.
	b) Truck valve defective-cycle to full lift height to verify.	**b)** Repair or replace truck valve.
	c) External leaks at retainer.	**c)** Replace all cylinder seals.
	d) Piston check valve leaking.	**d)** Replace check valve.
Spongy or jerky action	**a)** Sticky or defective truck relief valve.	**a)** remove and check the truck relief valve. If contaminated oil caused the malfunction, drain and flush the system, change the filter and refill with fresh oil.
	b) Bent or damaged cylinder plunger.	**b)** Disassemble, check and repair cylinder assembly.
	c) Load rollers not properly adjusted or defective.	**c)** Adjust or replace as necessary.
	d) Mast channels improperly lubricated.	**d)** Lubricate mast.
	e) Low Battery charge.	**e)** Charge battery.
	f) Low pump volume.	**f)** Install accumulator.
	g) Low oil level.	**g)** Fill oil reservoir.
	h) Insufficient hydraulic tank capacity or baffles.	**h)** Install larger tank baffles
Weldments banging during exit from Free Lift (Lifting)	**a)** Insufficient cushion oil exists on top of the Free Lift cylinder to properly dampen the weldment transition.	**a)** Open top of Free Lift cylinder and add oil as described in Step 8 of Section 5.2.9. If the problem persists, or reoccurs frequently, then replacement of the Free Lift cylinder seals is recommended.
Weldments banging during entry into Free Lift (Lowering)	**a)** Insufficient cushion oil exists on top of the Free Lift cylinder to properly dampen the weldment transition.	**a)** Replace Main Lift cylinder seal.

5.1 Mast Removal

1. Raise and block the front end of the truck 1ft. (30cm) per ANSI 56.1 or drive the truck over a service pit.

2. Disconnect the lift truck supply hose from the mast valve. Plug the hose end and cap the valve fitting.

> **WARNING:** Do not stand on or near the mast while suspended by the hoist.

3. Attach overhead hoist strap as shown in Figure 28. Take up slack in the chain.

4. Disconnect the tilt cylinders (if applicable) from the mast anchor brackets.

5. Disconnect the mast lower mounts (if applicable).

6. Lift away the mast.

7. For mast installation, refer to Section 2.3.

> **WARNING:** Do not stand the mast upright unless it is chained to a support.

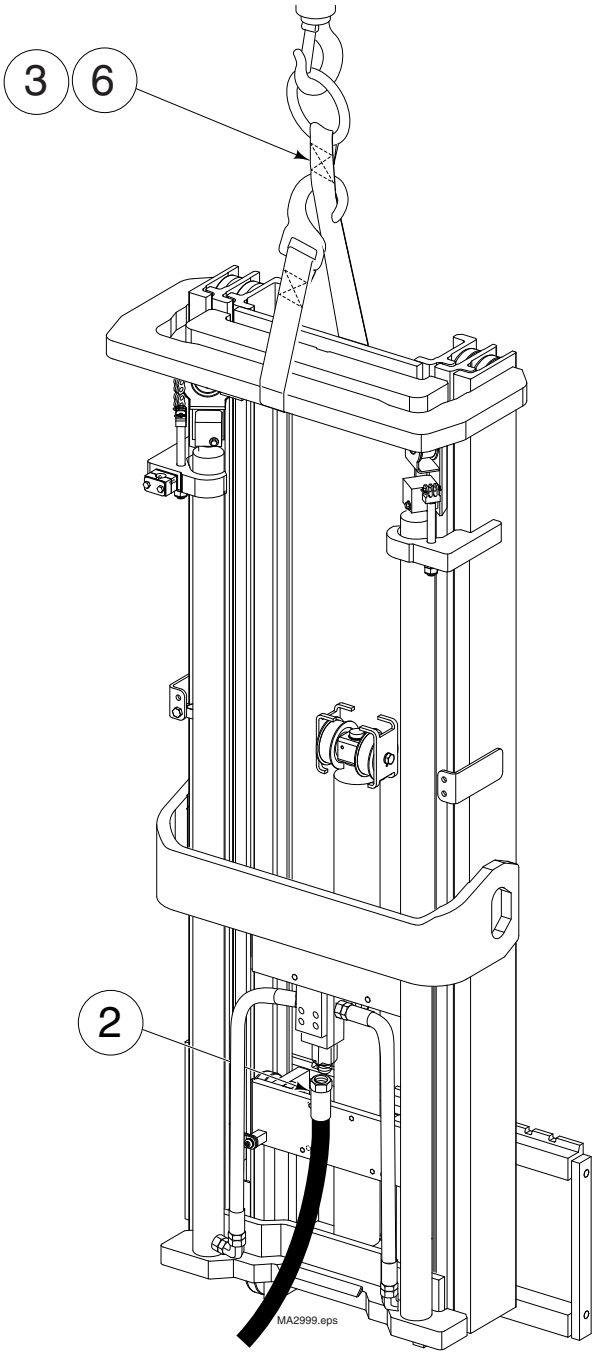


Figure 28. Mast Removal

5.2 Cylinders

5.2-1 Main Lift Cylinder Description

The main lift cylinders are single stage piston type cylinders. They consist of a shell and a telescoping rod/ piston assembly. During extension oil pressure is acting against the full piston area. The truck hoist control valve holds the cylinder in place once extension has stopped.

The shell is internally threaded at the top end to hold the retainer. The retainer seals provide a high-pressure hydraulic seal against the rod. The retainer also limits the upward stroke of the rod.

A piston is attached to the bottom end of the rod. The piston seal provides a high-pressure hydraulic seal against the shell. A check valve is located in the bottom of the piston. The check valve allows residual oil between the shell and rod to escape when the cylinder is extending.

A hydraulic fuse valve is located in the right hand cylinder inlet port. In case of a hose failure between the lowering control valve and cylinders, the fuse limits the lowering speed of the cylinder. Down stroke cushioning is provided in the main lift cylinder. This function cushions the piston as the cylinder nears the fully lowered position.

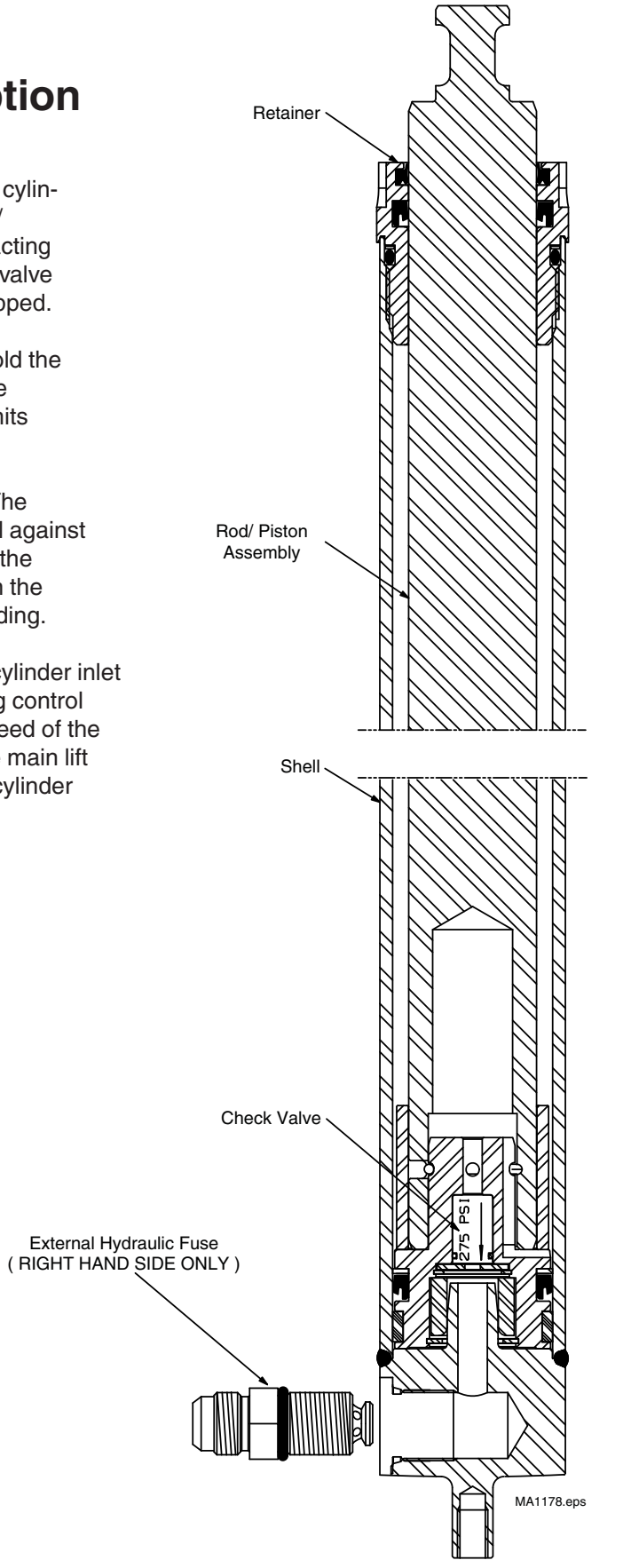


Figure 29. Main Lift Cylinder

5.2-2 Free Lift Cylinder Description

The free lift cylinder is a single stage piston type cylinders. It consists of a shell and a rod/piston assembly. During extension the oil pressure is acting against the full piston area. The truck hoist control valve holds the cylinder in place once extension has stopped.

The shell is internally threaded at the top end to hold the retainer. The retainer seal provide a high-pressure hydraulic seal against the rod. The retainer also limits the upward stroke of the rod.

A piston is attached to the bottom end of the rod. The piston seal provides a high-pressure hydraulic seal against the shell. A check valve is located in the bottom on the piston. The check valve allows residual oil between the shell and rod to escape when the cylinder is extending. Upstroke cushioning is provided in the free lift cylinder. This cushions the cylinder when the cylinder nears the fully extended position.

A hydraulic fuse/cushion valve is located in the cylinder port. In case of a hose failure between the lowering control valve and cylinder, the fuse limits the lowering speed of the cylinder.

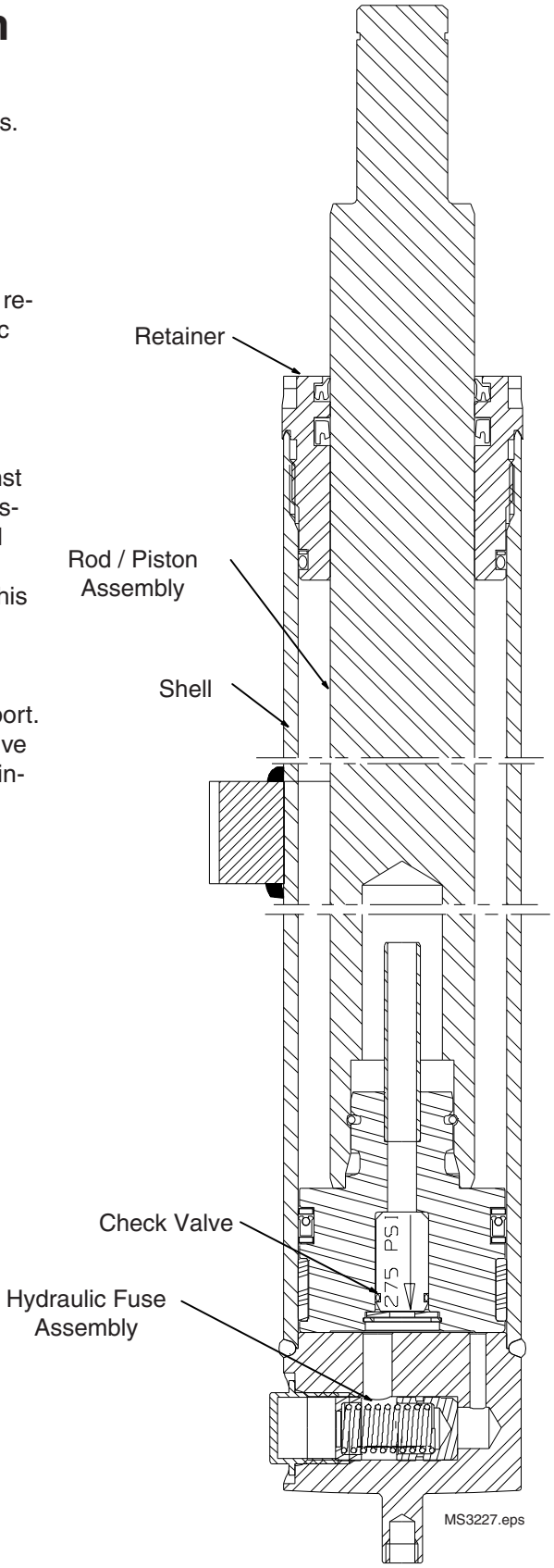


Figure 30. Free Lift Cylinder

5.2-4 Cylinder Operation

Cylinders Raising

1. When the truck hoist control valve is actuated, oil enters the lowering control valve through the inlet port and flows unrestricted through the lowering control cartridge.

2. Oil flows to the cylinder inlet ports. Due to the larger bore diameter of the free lift cylinder compared to both main lift cylinders, the free lift cylinder will raise completely before the main lift cylinders raise.

3. Oil flows through the free lift cylinder hydraulic fuse valve to the bottom of the piston. Lifting force is created against the bottom of the piston causing the rod to raise. Oil in the area between the rod and shell is allowed to escape through the check valve in the piston as the rod raises to the end of its stroke.

4. Oil flows through the hydraulic fuse valve or fitting to the bottom of the piston. Lifting force is created against the bottom of the piston causing the rod to raise. Oil in the area between the rod and shell is allowed to escape through the check valve in the piston as the rod raises.

5. When oil flow from the truck hoist control valve is discontinued, the cylinders are held in position by the closed center spool of the truck valve.

Cylinders Lowering

1. When the truck hoist control valve is actuated, the main lift retract fully then the free lift cylinder rod lowers, forcing oil out through the hydraulic fuse valve.
NOTE: The restriction setting of each hydraulic fuse is higher (allows more oil flow) than the setting of the lowering control valve. The hydraulic fuses restrict flow only in the instance of a lowering control valve or hose failure.

2. Oil flows to the lowering control valve where it is restricted at a controlled speed determined by the load being handled.

3. As the main lift cylinder pistons lower over the spear in the bottom of the shell, a high pressure area is developed between the piston and shell which engages the cushion valve to restrict flow. This slows the piston/rod just prior to bottoming providing a smooth transition to the free lift cylinder lowering.

Triple Mast (MT) Hydraulic Schematic

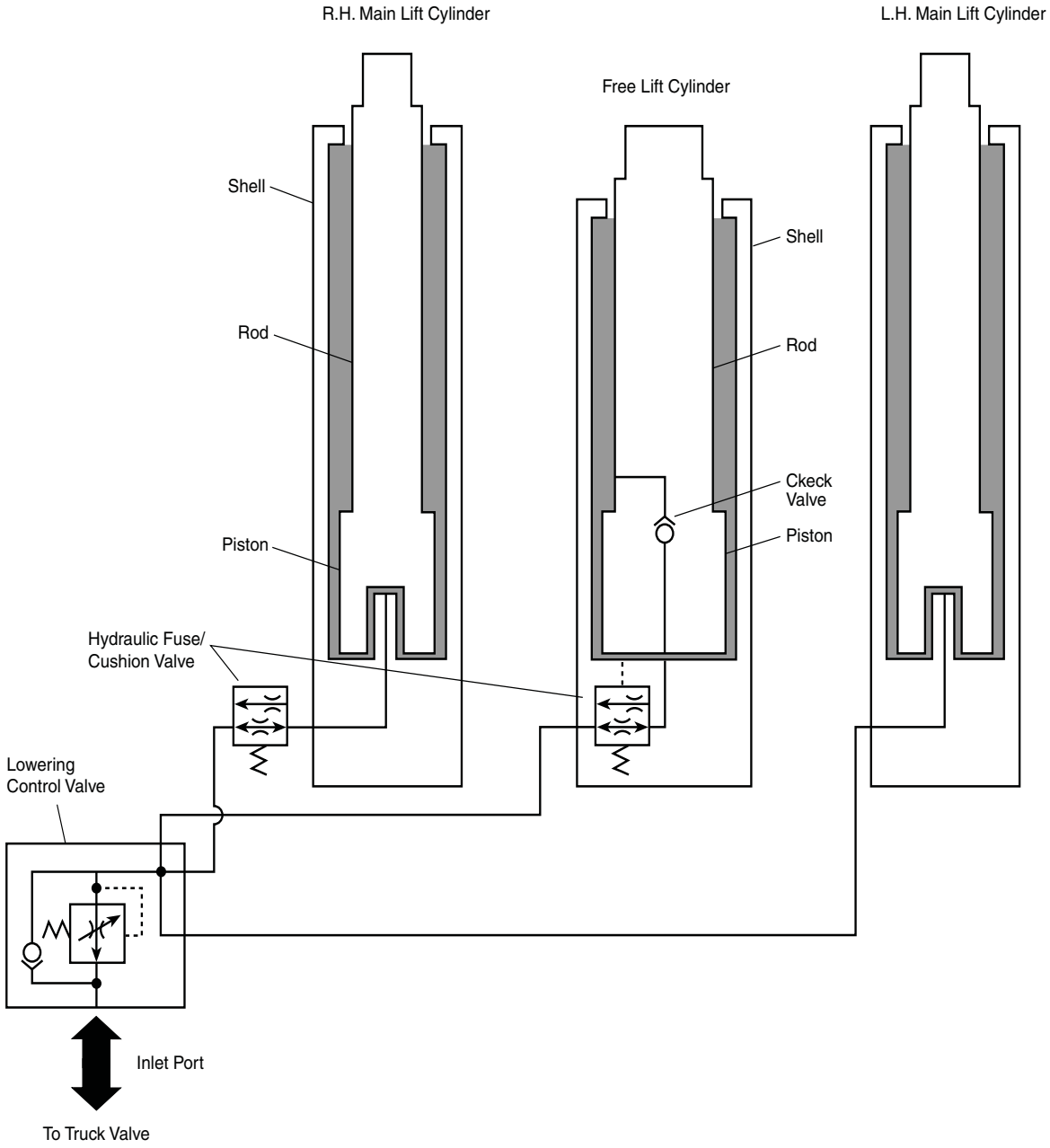


Figure 31. Cylinder Operation

5.2-5 Main Lift Cylinder Removal- Mast on Floor

1. Remove the mast from the truck as described in Section 5.1

2. Lay the mast down on wooden blocks as shown. Extend inner and intermediate rails to expose the lower fittings on the main lift cylinders.

3. Disconnect the cylinder supply hoses from the cylinder inlet ports. Remove the fittings from the cylinder ports and install plug fittings.

4. **A**.Remove the bolts fastening the cylinder rods to the intermediate upright. Remove the bolts at the base of the cylinders that attach the cylinders to the lower outer crossmember.

B. Remove nuts from chain mounts. Remove mount from cylinder and lay over carriage.

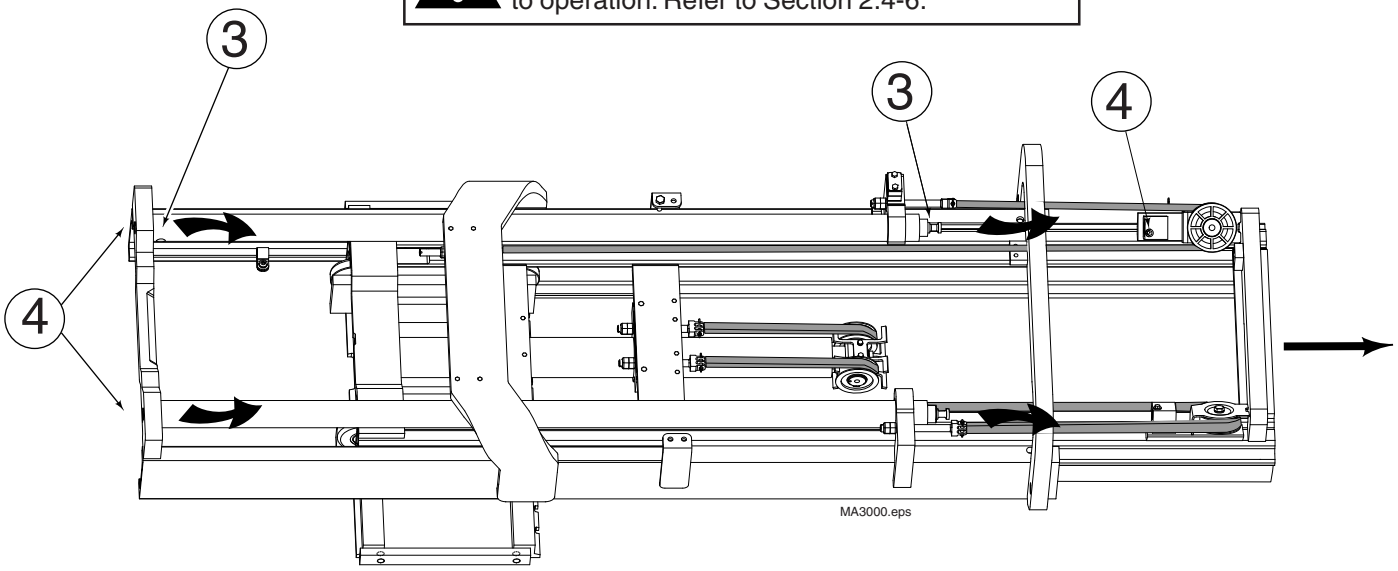
5. Pull the inner and intermediate upright outward as required to allow the main lift cylinders to be removed.

6. Lift the cylinder from the base mount and angle inward to remove.

7. Note the number of shims (if equipped) on each cylinder rod.

8. For reassembly, reverse the above procedures except as follows:

WARNING: Main lift cylinders must be bled to remove trapped air prior to returning the mast to operation. Refer to Section 2.4-6.



The mast is shown from the underside for clarity

Figure 32. Cylinder Removal.

5.2-6 Free Lift Cylinder Removal- Mast on Floor

1. Remove the mast from the truck as described in Section 5.1.

2. Lay the mast down as shown.

3. Roll the carriage toward the center of the cylinder to slacken the chains and internal reeving hoses (if equipped).

4. Disconnect the hose from the cylinder 45° fitting. Cap the fitting and plug the hose.

5. Remove the chain guards from the crosshead. For reassembly, tighten the capscrews to a torque of 48-52 ft.-lbs. (65-70 Nm).

6. Remove the snap ring fastening the crosshead to the cylinder rod.

7. Pull the crosshead with chains and hoses (if equipped) off the cylinder rod.

8. Remove the cylinder mounting bolts the keeping shims for reassembly.

9. Remove the cylinder from the mast.

10. For reassembly, reverse the above procedures.

IMPORTANT: The chain anchor nuts on the carriage must be replaced with new self-locking nuts if removed or adjusted.

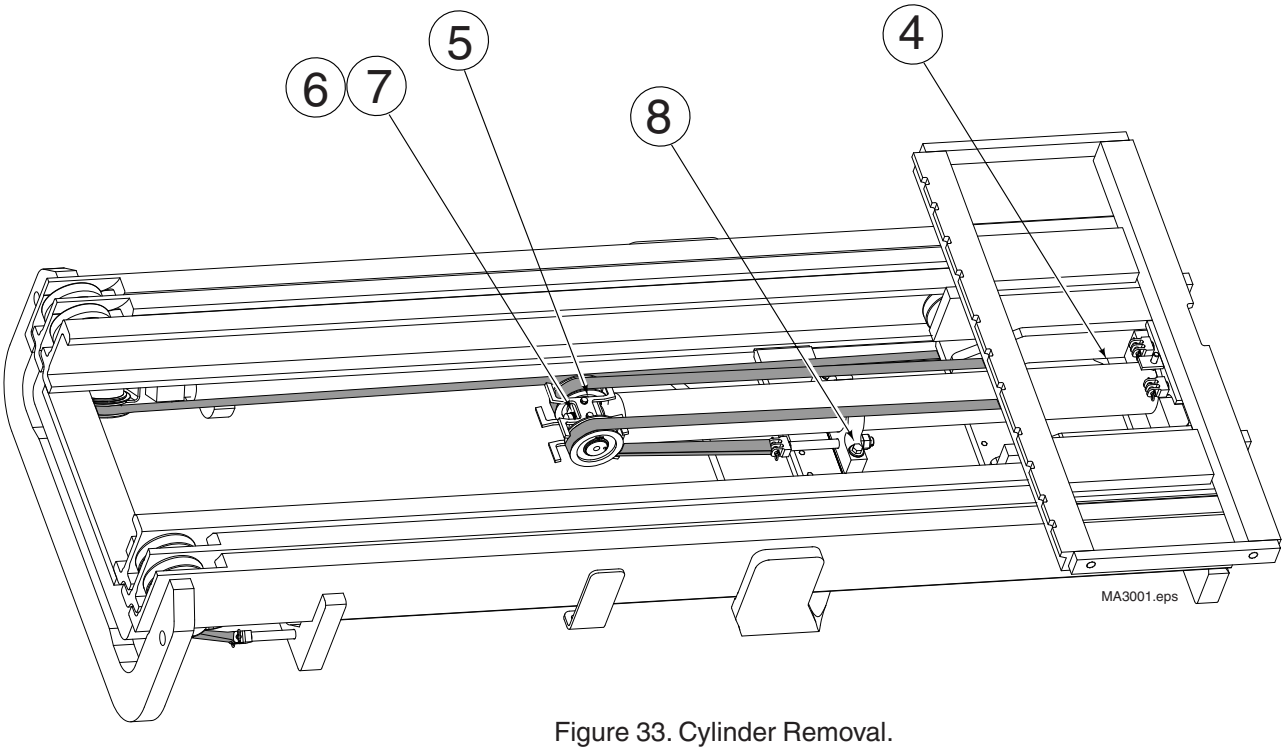


Figure 33. Cylinder Removal.

5.2-7 Free Lift Cylinder Removal- Mast on Truck

1. Completely lower the carriage. Remove forks or attachment if equipped. Make sure the free lift cylinder is completely retracted. Attach an overhead hoist to the top carriage bar.

> **WARNING:** The carriage must be supported by a block while removing the cylinder to avoid possible injury.

2. Raise the carriage to the center of the cylinder to slacken the chains and internal reeving hoses (if equipped). Block the carriage in place using a 4 X 4 X 24 in. (10 X 10 X 60 cm) wood block between the lower carriage bar and the floor.

3. Remove the chain guards from the crosshead. For reassembly, tighten the capscrews to a torque of 48-52 ft.-lbs. (65-70 Nm).

4. Remove the snap ring fastening the crosshead to the cylinder rod.

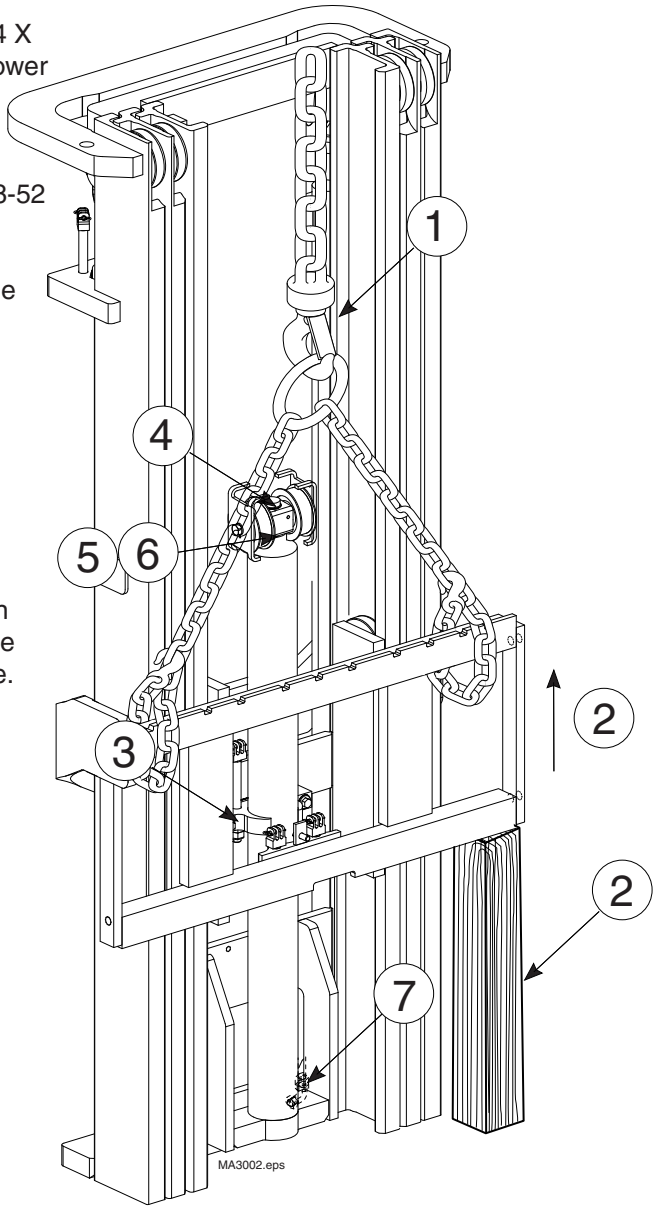
5. A. Pull the crosshead with chains and hoses (if equipped) off the cylinder rod and lay over upper carriage bar.

B. Remove cylinder mounting bolts, keeping the shims for reassembly.

6. Pry the cylinder up out of the support casting to gain access to the cylinder hose fitting. Remove the hose from the 45° fitting. Cap the fitting and plug the hose.

7. Remove the cylinder from the mast from the top.

8. For reassembly, reverse the above procedures.



SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

Figure 34. Cylinder Removal.

5.2-8 Main Lift Cylinder Service

1. Remove the cylinder from the mast as described in Section 5.2-5.

2. Use a claw type spanner wrench to remove the retainer. See Figure 35.

3. Remove the rod/piston assembly from the shell.

4. Remove the Hydraulic Fuse or fitting as equipped.

5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth. **NOTE:** Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part. If the piston requires replacing, refer to Section 5.2-10.

6. Replace the retainer and piston seals, back-up rings O-rings and bearing. Lubricate the new seals with petroleum jelly prior to installation. **Note the correct seal directions**. The cylinder will not operate correctly if the seals are installed backwards.

7. When replacing the piston check valve O-ring, make sure the check valve is reinstalled with the arrow pointed in the correct direction.

8. Install the rod retainer on the rod. Install the rod/piston assembly into the cylinder shell. Tighten the retainer to the torque value listed below using the claw spanner wrench and a strap wrench.

EV/E-40/50/60 - 180-200 ft.-lbs. (244-271 Nm)

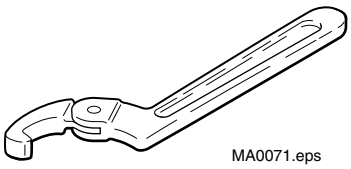


Figure 35. Claw Type Spanner Wrench..

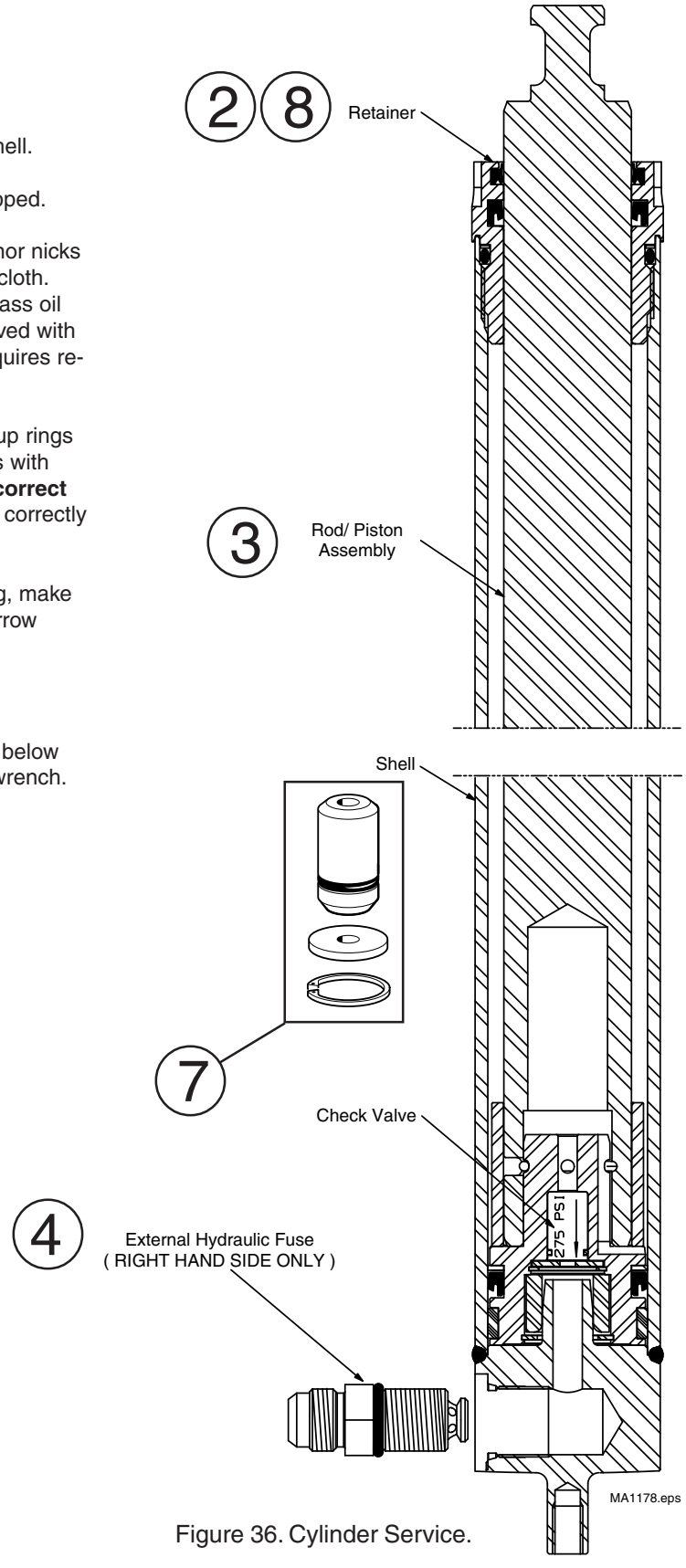


Figure 36. Cylinder Service.

5.2-9 Free Lift Cylinder Service

1. Remove the cylinder from the mast as described in Section 5.2-6 or 5.2-7.

2. Use a claw type spanner wrench to remove the retainer. See Figure 37.

3. Remove the rod/piston assembly from the shell.

4. Remove the hydraulic fuse.

5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400 grit emery cloth. **NOTE:** Minor nicks are those that will not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part. If the piston requires replacing, refer to Section 5.2-10.

6. Replace the retainer and piston seals, back-up rings, O-rings and bearing. Lubricate the new seals with petroleum jelly prior to installation. **Note the correct seal directions.** The cylinder will not operate correctly if the seals are installed backwards.

7. When replacing the piston check valve O-ring, make sure the check valve is reinstalled with the arrow pointed in the correct direction.

8. Install the rod retainer on the rod. Install the rod/piston assembly into the cylinder shell. Pour 75 - 80cc hydraulic oil into the cylinder cavity between the shell and rod. Tighten the retainer to a torque of 280-300 ft.-lbs. (380-407 Nm) using the claw spanner wrench and a strap wrench.

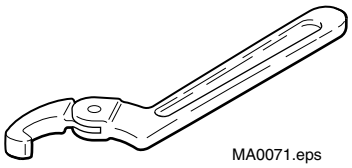


Figure 37. Claw Type Spanner Wrench..

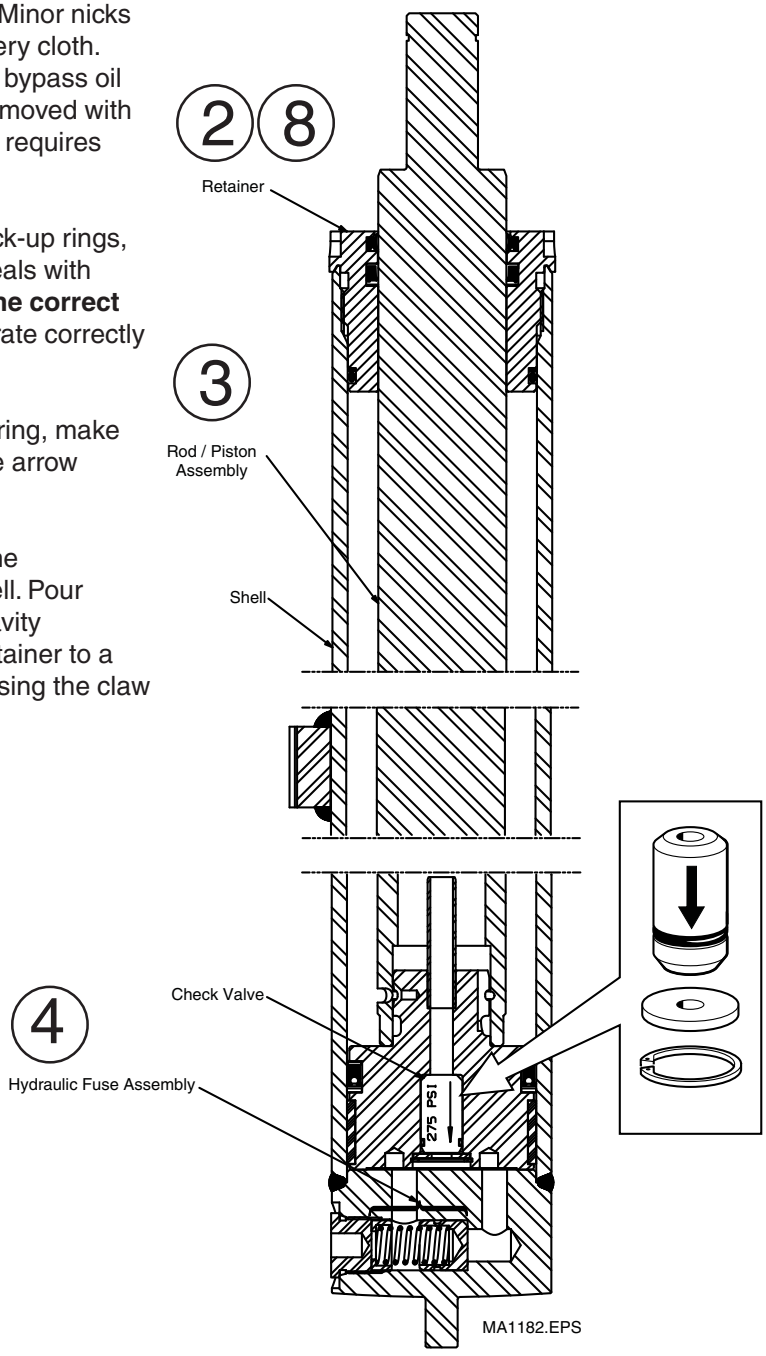


Figure 38. Cylinder Service.

5.2-10 Piston Removal

1. Remove the rod/piston assembly from the cylinder shell as described in Section 5.2-8 or 5.2-9.
2. **Use** a strap wrench and 400 grit emery cloth to secure the rod while turning the piston with a pin type spanner wrench.
3. Turn the piston until the snap wire end is visible through the hole. Use a screwdriver to start the wire end out the hole. Turn the piston to feed the wire out.
4. Pull the piston from the rod.
5. For reassembly, reverse the above procedures except as follows:
   *Install a new snap wire when installing the piston.

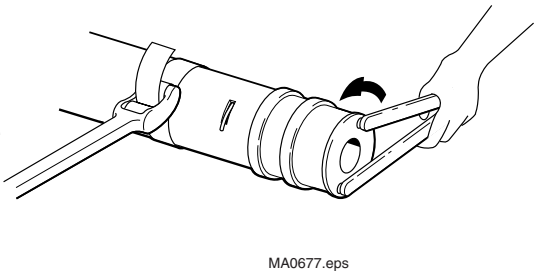


Figure 39. Piston Removal.

5.2-11 Cylinder Bleeding

WARNING: The cylinders must be bled to remove air. Air in the cylinders will compress on the first extension which could rupture the cylinders causing serious bodily injury and property damage.

After repair, the cylinders may have air trapped in them that must removed. To bleed air refer to Section 2.4-6.

5.3 Valve

5.3-1 Valve Cartridge Service

1. Completely lower the mast.
2. Remove the truck supply hose from the valve cartridge. See Figure 40. Plug the hose.
3. Remove the valve cartridge from the valve. Note the stamped part no. on the Cartridge for ordering a replacement.

WARNING: Replacing the valve cartridge with a different part no. cartridge may cause the mast to malfunction.

4. For reassembly, reverse the above procedures.

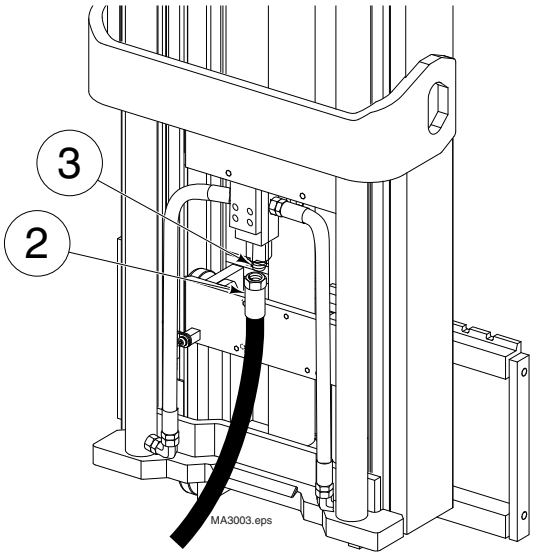


Figure 40. Valve Cartridge Service. Typical Illustration

5.4 Carriage

5.4-1 Description

The carriage shown below is the structure to which hook-type forks or attachments are attached. The carriage travels within the rails of the mast inner upright on four (or six optional) rollers. On a six roller carriage, only the bottom four rollers are shim adjustable whereas the top two rollers are held in place by a retainer plate. The rollers are held in the uprights. Carriage load rollers are interchangeable. A pair of chain anchors are used to connect the carriage chains to the carriage.

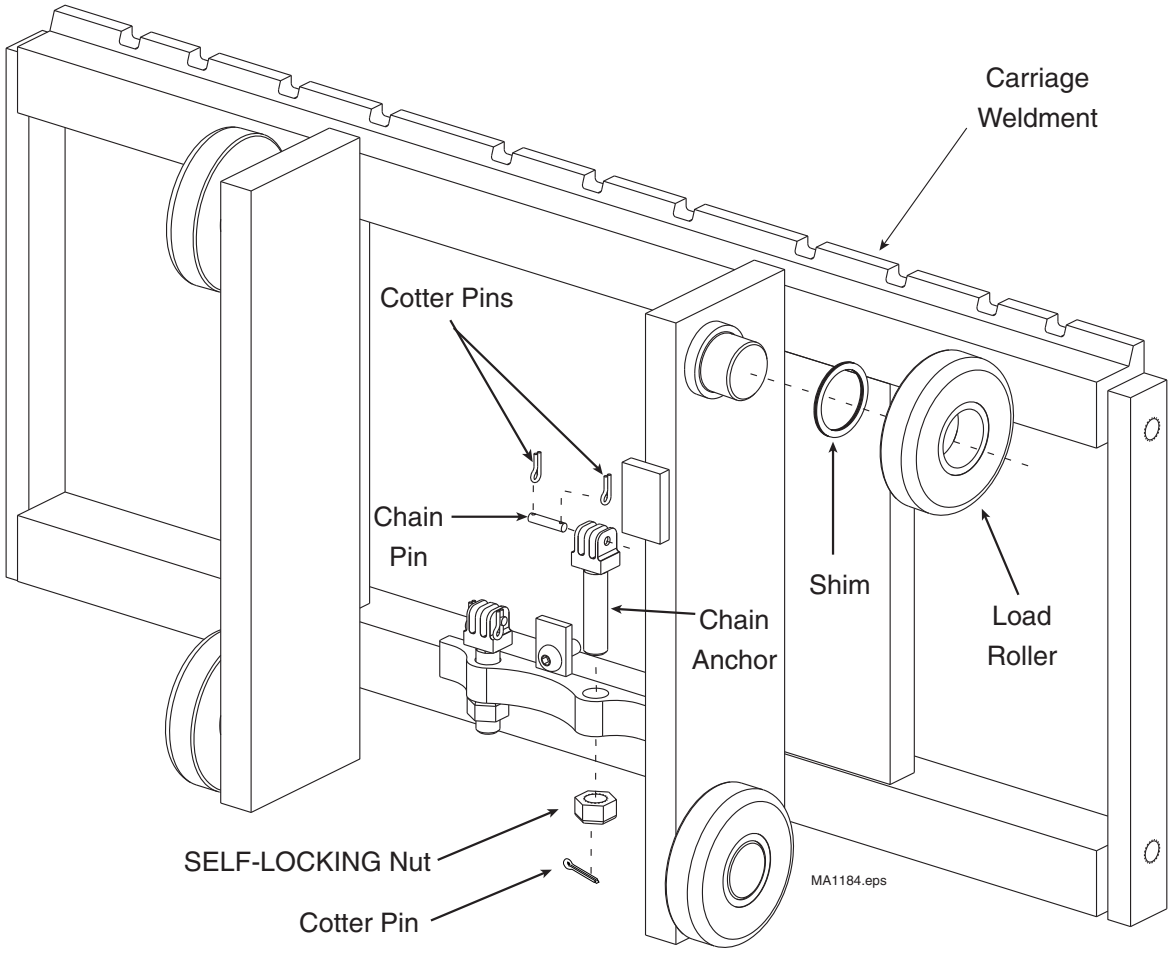


Figure 41. Carriage Service.

IMPORTANT: The chain anchor nuts must be replaced with new self-locking nuts if removed or adjusted.

5.4-2 Carriage Removal-Mast on Truck

1. Raise the mast high enough to place a 20 in. (50 cm) long, 4X4 in. (10 X 10cm) wood block between the intermediate lower crossmember and the ground. Lower the carriage to be even with the bottom of the inner upright.

2. Attach an overhead hoist to the carriage. Raise the carriage to slacken the carriage chains.

3. Remove the chain anchor nuts. **Note: Nuts must be replaced with new nuts after removal.**

4. Disconnect the internal reeving hoses from the carriage fittings (if equipped). Plug the hose ends.

5. Using the overhead hoist, lower the carriage to the bottom of the mast to remove.

6. Note the number of shims behind each load roller for reassembly.

7. For reassembly, reverse the above procedures except as follows:

*inspect the carriage as described in Section 5.4-4.

*Lubricate the inner upright rails with chassis lube or Kendall SR-12X. See Figure 42.

*Assemble shims and load rollers on the stub shafts. The shims should be installed (except on the top two rollers of a six roller carriage) to provide a total side to side clearance no looser than 1/16 in. (1.5 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side to side.

*Install chain anchors to carriage using new self-locking nuts and ensuring cotter pins are installed in the bottom hole of each chain anchor.

*Check and adjust the free lift chains as described in Section 5.6-4 and 5.6-6.

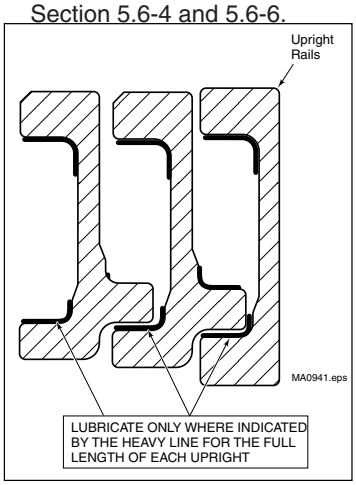
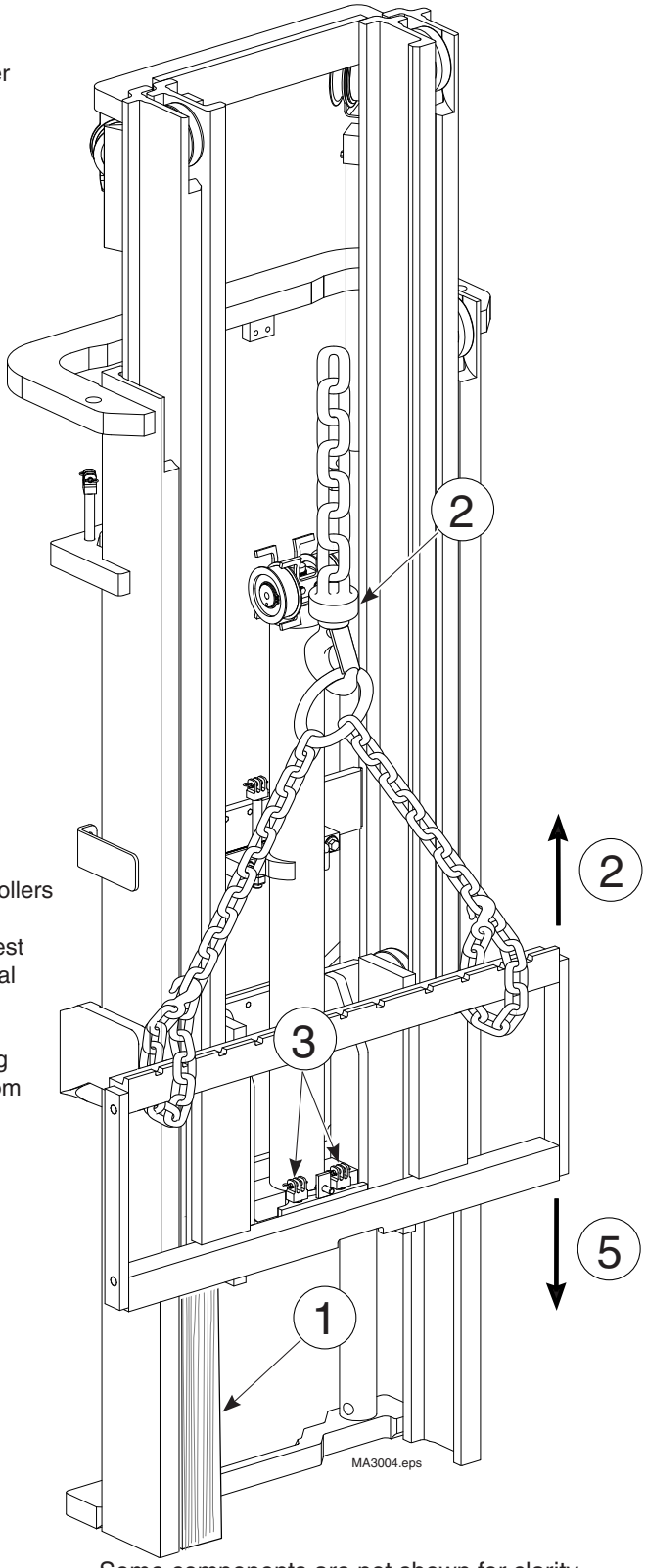


Figure 42. Rail Lubrication.



Some components are not shown for clarity.

Figure 43. Carriage Removal.

5.4-3 Carriage Removal- Mast on Floor

1. Remove mast from truck as described in Section 5.1.

2. Remove chain anchor nuts. **Note** install new self-locking chain anchor nuts during reassembly. Remove the chain anchors.

3. Disconnect the internal reeving hoses for the carriage fittings (if equipped). Plug the hose ends.

4. Roll the carriage to the bottom of the mast.

5. Attach an overhead hoist to the carriage fork bars. Remove the carriage through the bottom of the mast.

6. Note the number of shims located behind each load roller for reassembly.

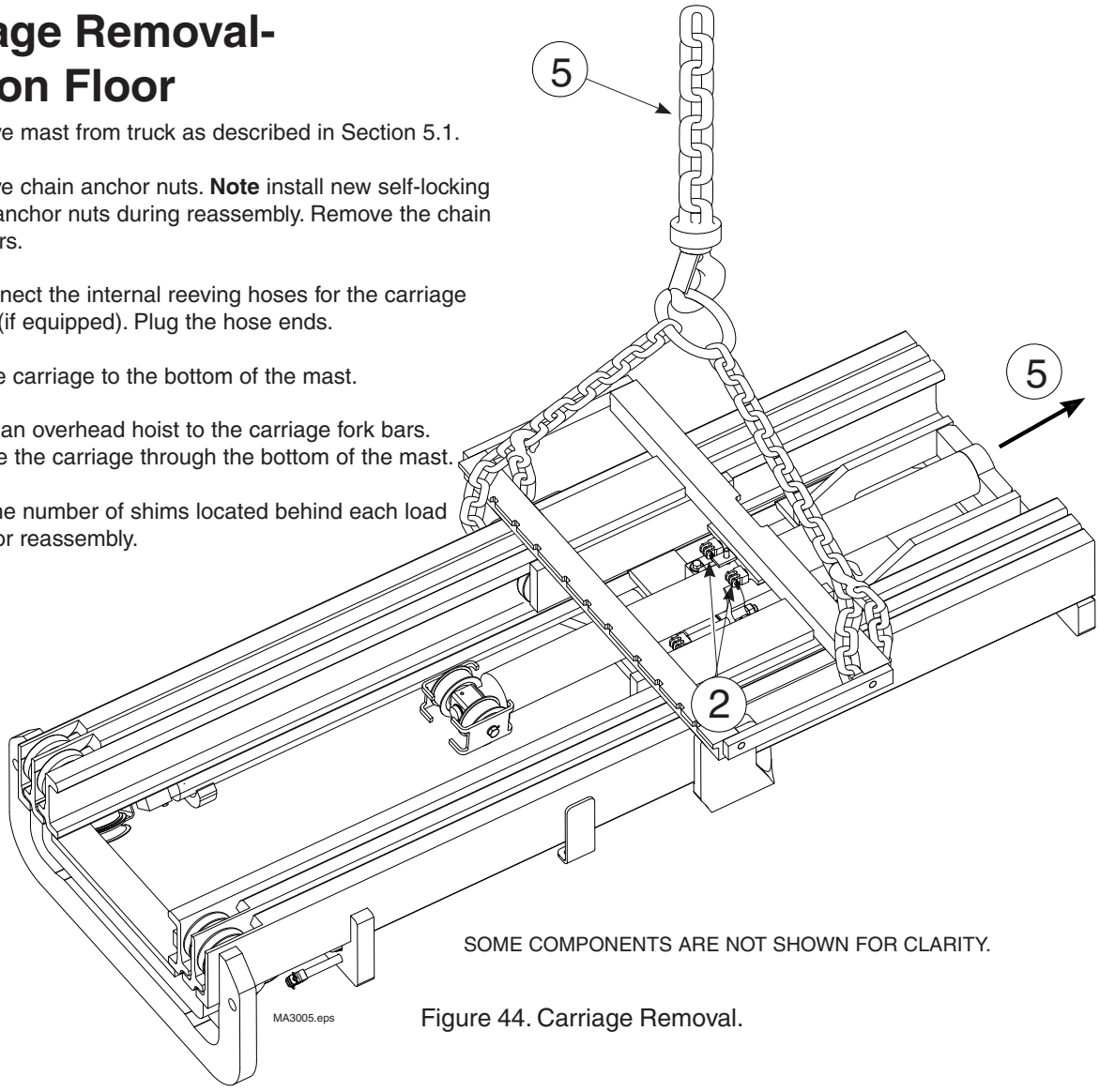


Figure 44. Carriage Removal.

7. For Reassembly, reverse the above procedures except as follows:

*inspect the carriage as described in Section 5.4-4.

*Lubricate the inner upright rails with chassis lube or Kendall SR-12X . See Figure 45.

*Assemble shims and load rollers on the carriage stub shafts. The shims should be installed (except on the top two rollers of a six roller carriage) to provide a total side to side clearance no looser than 1/16 in. (1.5 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims side to side.

*Install new self-locking nuts on carriage chain anchors if nuts are remove or adjusted.

*Check and adjust the free lift chains as described in Section 5.6-4 and 5.6-6.

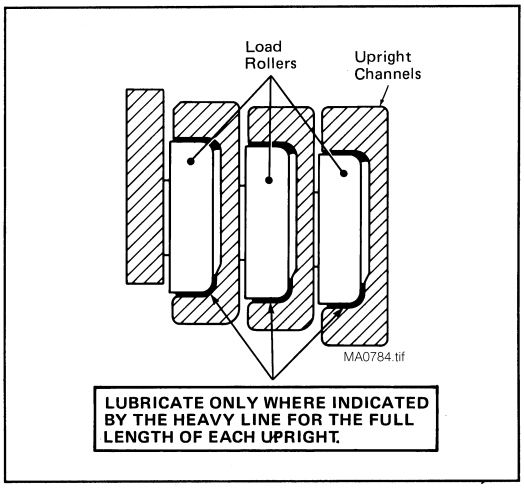


Figure 45. Rail Lubrication.

5.4-4 Carriage Inspection

1. Inspect the rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced.

2. Inspect the roller bearings by turning the rollers on their shafts. Rollers with roughness or noticeable restrictions to turning should be replaced.

3. Inspect all welds between the carriage side plates and the carriage fork bars. If any welds are cracked, replace the carriage.

4. Inspect the roller stub shafts. If they are damaged or if there are cracks at the base of the stub shafts, the carriage must be replaced or repaired. Contact Lift Tek for repair procedures.

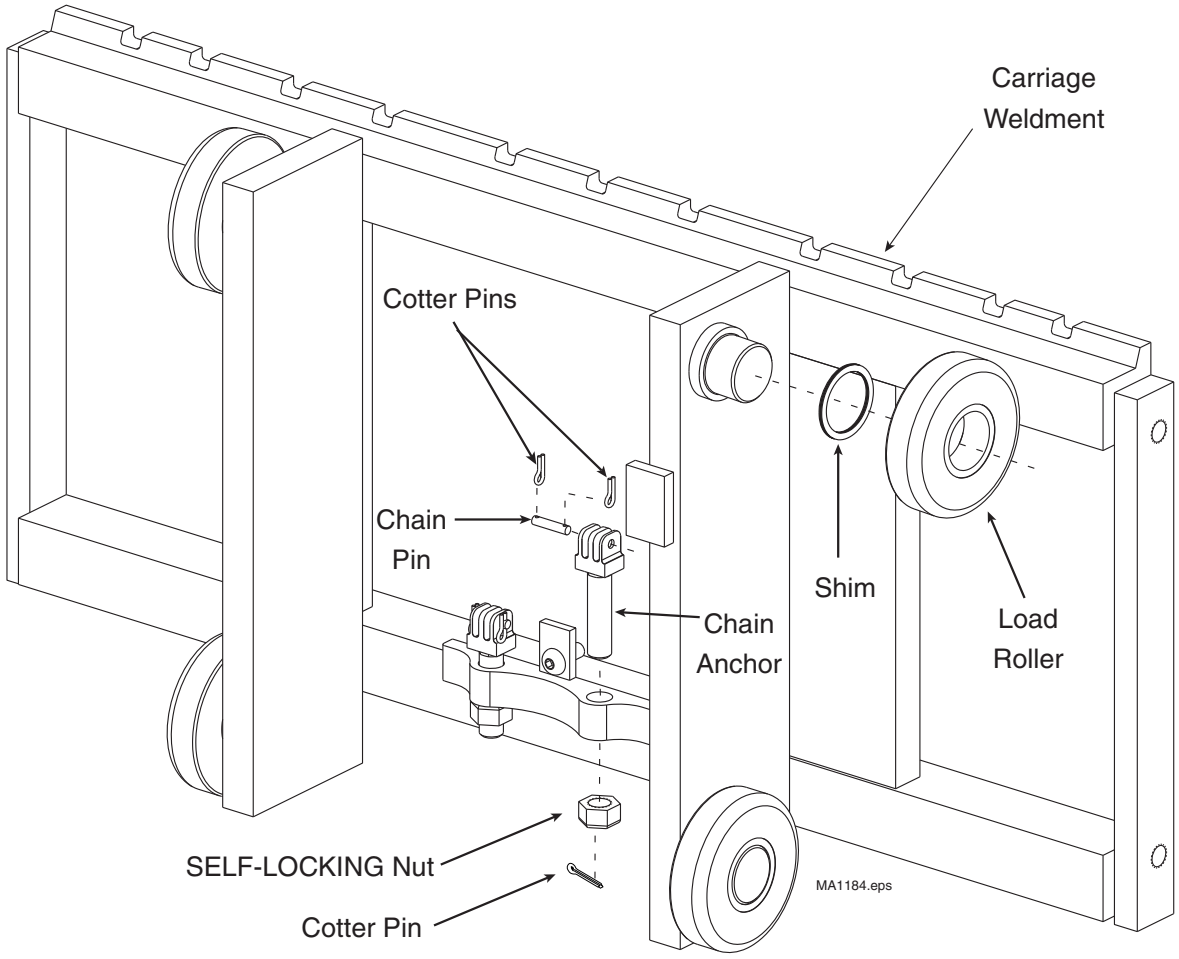


Figure 46. Carriage .

IMPORTANT: The chain anchor nuts must be replaced with new self-locking nuts if removed or adjusted.

5.5 Mast Uprights

5.5-1 Upright Description

Outer Upright Assembly

The outer upright assembly is mounted to the truck. A pair of shim adjustable load rollers are attached to stub shafts located near the top of the upright. A pair of adjustable hoist chain anchors are located on the top of each rail. A pair of shim adjustable wear plugs are located near the top of the outer. The main lift cylinder are secured to the outer by retaining bolts located near bottom of the outer.

Intermediate Upright Assembly

The intermediate upright assembly telescopes within the outer upright assembly. A pair of shim adjustable load rollers are attached to stub shafts located at the top and bottom of the upright. A free lift hose sheave and a pair of chain sheaves are located near the top of the upright to provide a rolling surface for the main lift chains. The main lift cylinders are secured to the intermediate using retaining bolts located on the cylinder mounting block.

Inner Upright Assembly

The inner upright assembly telescopes within the intermediate upright assembly. A pair of shim adjustable load rollers are attached to stub shafts located at the bottom of the upright. The main lift chain anchors are attached on mounts welded to the back of the rail sections. The free lift cylinder is attached to the middle crossmember. The free lift cylinder rests on the lower crossmember.

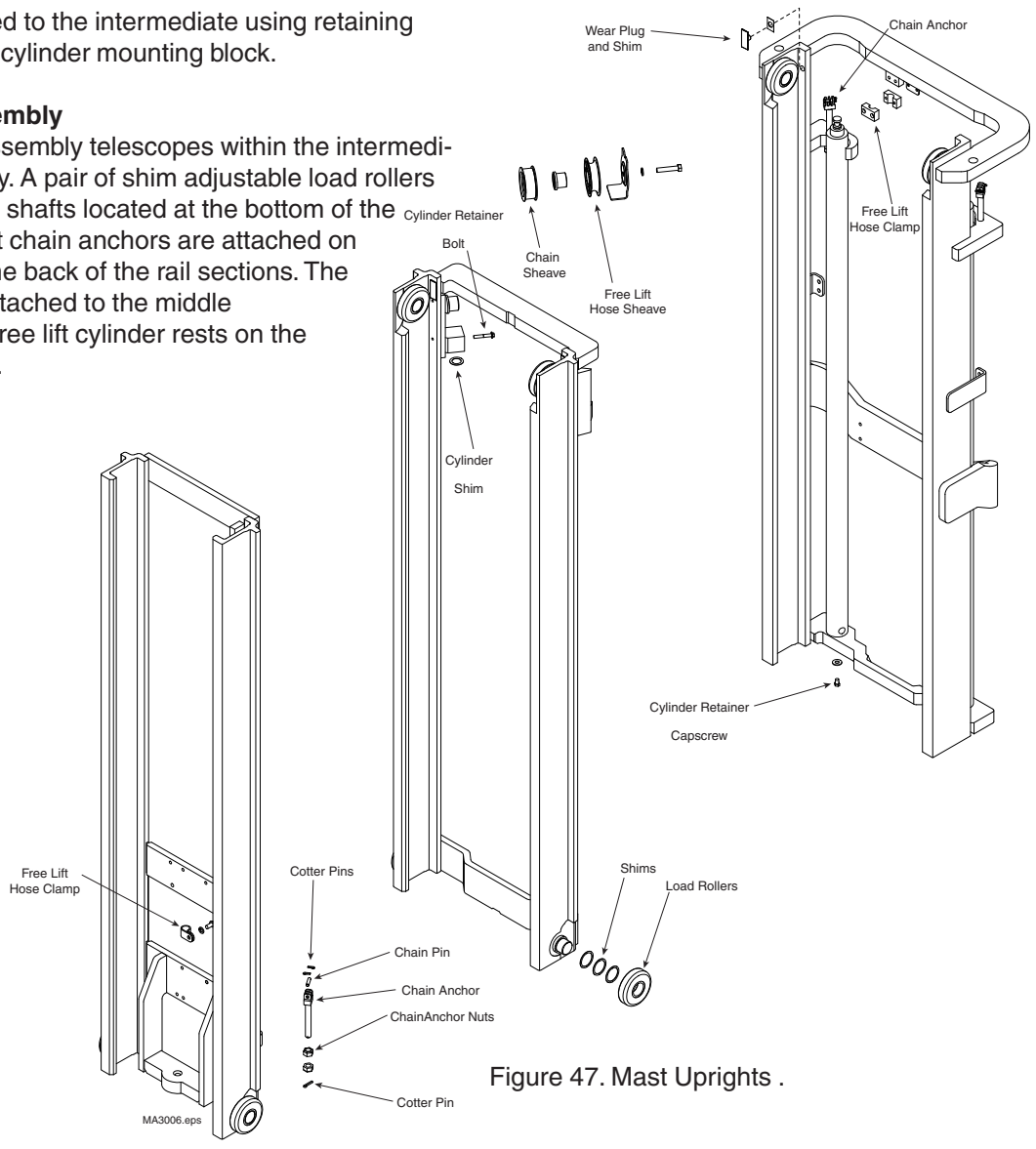


Figure 47. Mast Uprights .

5.5-2 Upright Operation

Fully Lowered

The main Lift chains are anchored to the outer upright top crossmember then travel over the intermediate upright chain sheaves and attach to the inner upright anchors.

The free lift chains are anchored to the free lift cylinder then travel over the free lift cylinder chain sheaves and attach to the carriage chain anchors.

Free Lift

Actuating the truck hoist valve causes the free lift cylinder to raise which draws the carriage to the top of the inner upright.

Full Extension

When the free Lift cylinder nears the end of its stroke the main lift cylinders begin to rise. The extension of the cylinders causes the intermediate and inner uprights to raise.

Lowering

The two main lift cylinders lower at the same time. As the main lift cylinders near bottoming out, the free lift cylinder begins to lower resulting in the lowering of the carriage.

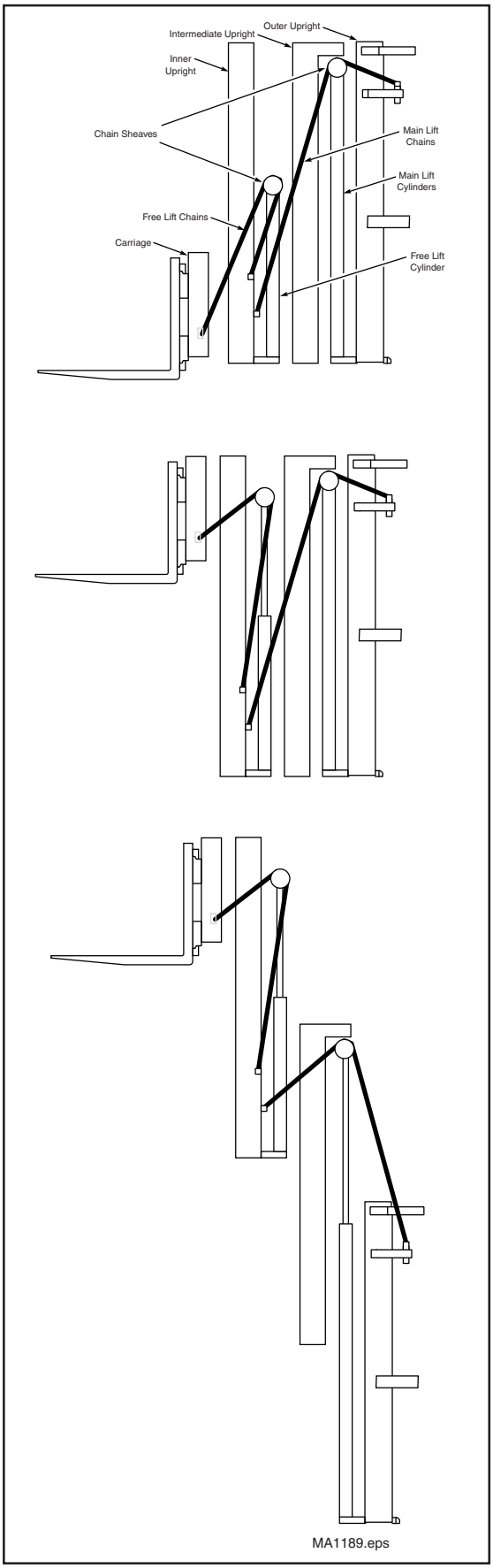


Figure 48. Upright Operation .

5.5-3 Upright Disassembly

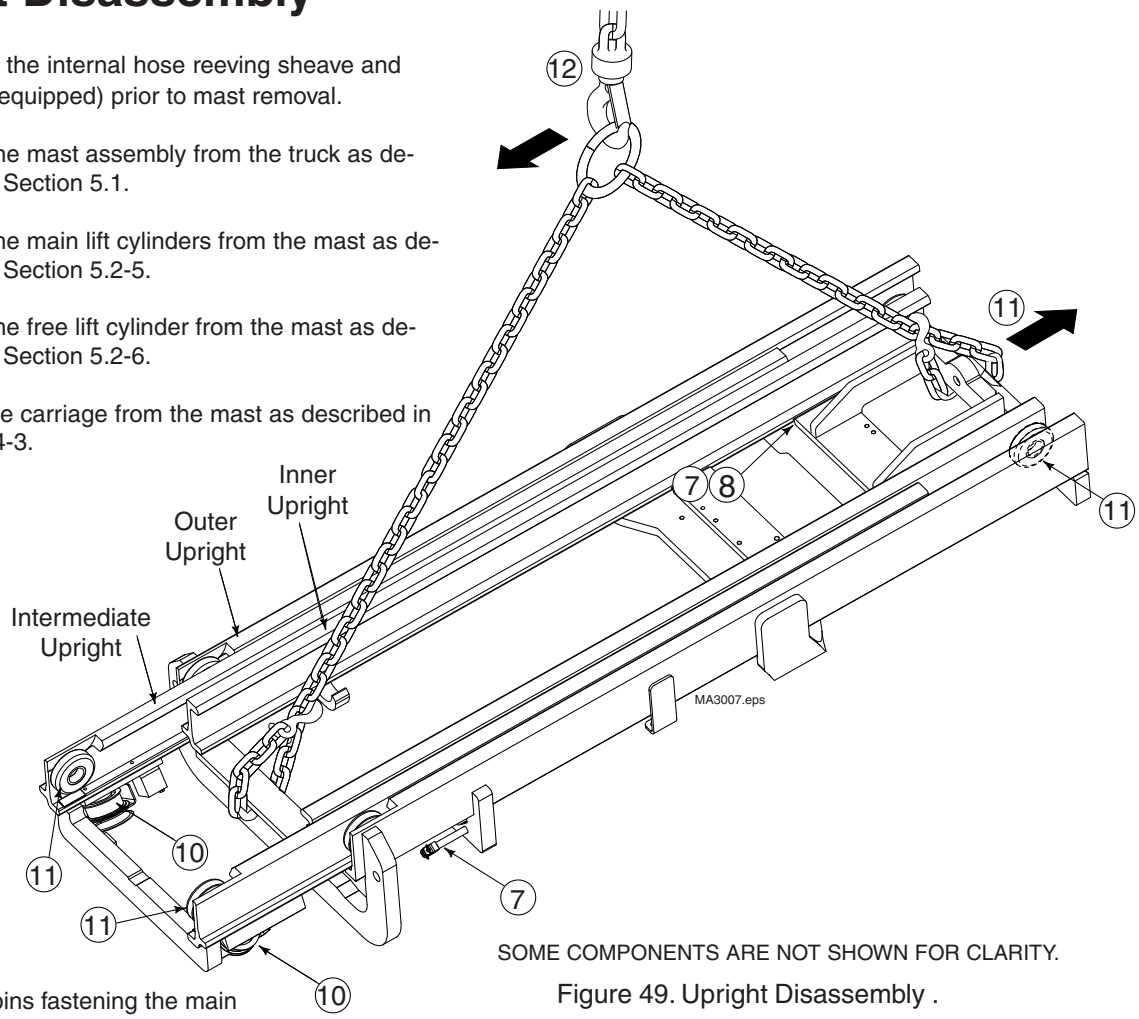
NOTE Remove the internal hose reeving sheave and hoses (if equipped) prior to mast removal.

1. Remove the mast assembly from the truck as described in Section 5.1.

2. Remove the main lift cylinders from the mast as described in Section 5.2-5.

3. Remove the free lift cylinder from the mast as described in Section 5.2-6.

4. Remove the carriage from the mast as described in Section 5.4-3.



SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

Figure 49. Upright Disassembly .

5. Remove the pins fastening the main lift chains to the inner upright chain anchors. Pull the main lift chains back through the chain sheaves.

CAUTION: The chain anchor nuts should be used one time only and be replaced after removal.

6. Remove the main lift chain anchors (long anchors) from the inner upright lower back side. Tag the anchors for reassembly.

7. Remove the free lift cylinder supply hose and sheave. Remove the main lift chain sheaves.

8. Roll the inner upright downward to expose the inner and intermediate upright load rollers. Remove the load rollers. Note the number of shims behind each load roller.

9. Attach an overhead hoist to the inner upright. Remove the inner upright through the top of the intermediate upright.

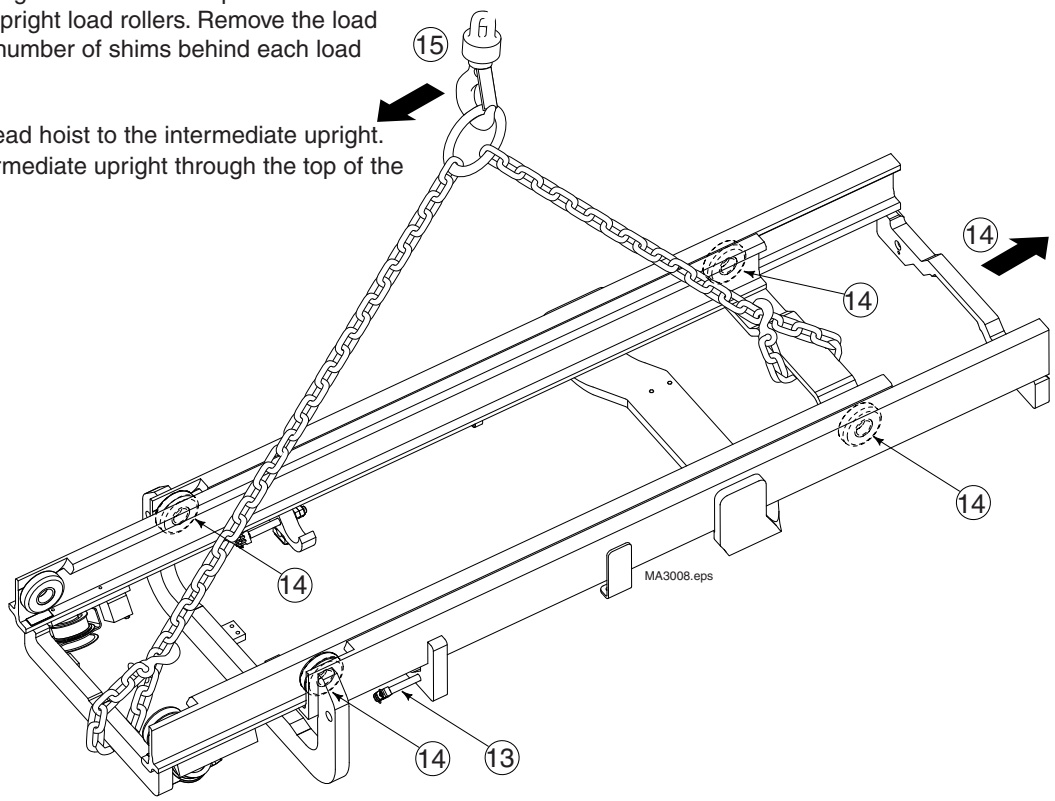
5.5-3 Upright Disassembly (Continued)

CAUTION: The chain anchor nuts should be used one time only and be replaced after removal.

10. Remove the main lift chain anchors (long anchors) and chains from the outer upright crossmember. Tag the anchors for reassembly.

11. Roll the inner upright downward to expose the intermediate and outer upright load rollers. Remove the load rollers. Note the number of shims behind each load roller.

12. Attach an overhead hoist to the intermediate upright. Remove the intermediate upright through the top of the outer upright.



SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

Figure 50. Upright Disassembly .

5.5-4 Upright Inspection

1. Inspect the load rollers for excessive wear or damage. Rollers with visible flat spots or cracks should be replaced. See Figure 51.

2. Inspect the load roller bearings by turning the rollers on their shafts. Rollers with roughness or noticeable restrictions to turning should be replaced.

3. Inspect the load roller stub shafts. If they are damaged or have cracks at the base, the upright mast must be replaced or repaired.

4. Inspect the outer and intermediate upright thrust plugs. If the wear surface is worn to less than 1/16 in. (1.5 mm), they should be replaced.

5. Inspect the hoist chains as described in Section 5.6-1.

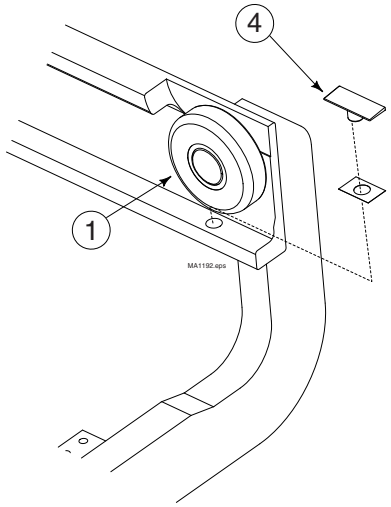


Figure 51. Upright Inspection .

5.5-5 Upright Reassembly

1. Lubricate the outer upright rails with chassis lube or Kendall SR-12X. See Figure 52 Rail Lubrication.

2. Attach an overhead hoist to the intermediate upright. Install the intermediate uptight through the top of the outer upright.

3. Install the thrust plugs to the uprights.

4. Assemble shims and load rollers to the outer upright and lower intermediate upright stub shafts. The shims should be installed to provide a total side to side clearance no looser than 1/16 in. (1.5 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side to side. **NOTE:** Roll the upright past the thrust plugs before checking roller clearances.

5. Lubricate the intermediate upright rails with chassis lube or Kendall SR-12X. See Figure 52.

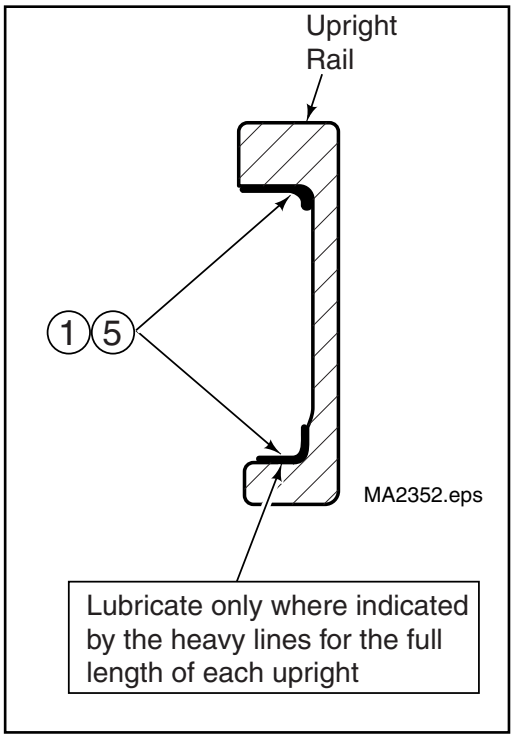


Figure 52. Rail Lubrication

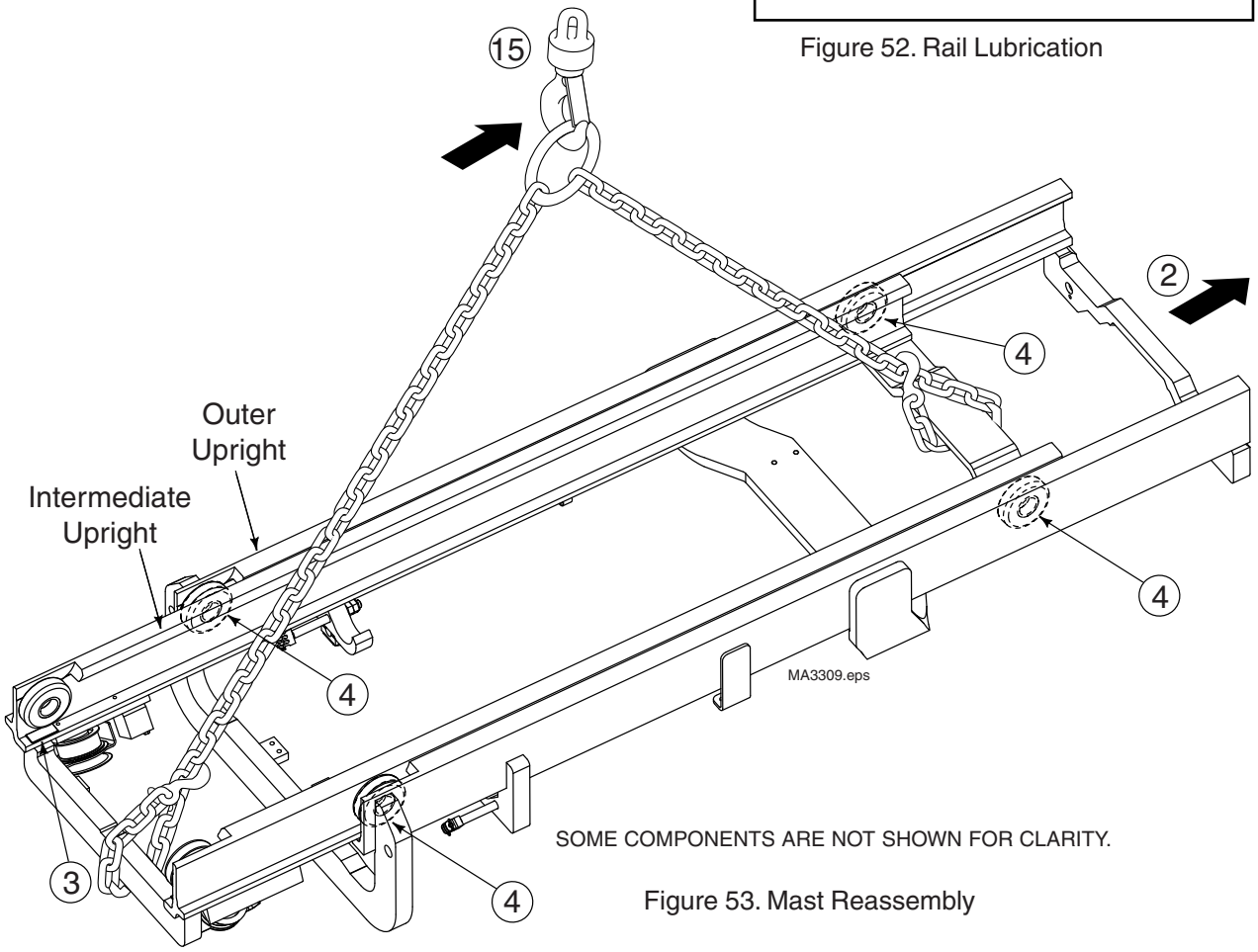


Figure 53. Mast Reassembly

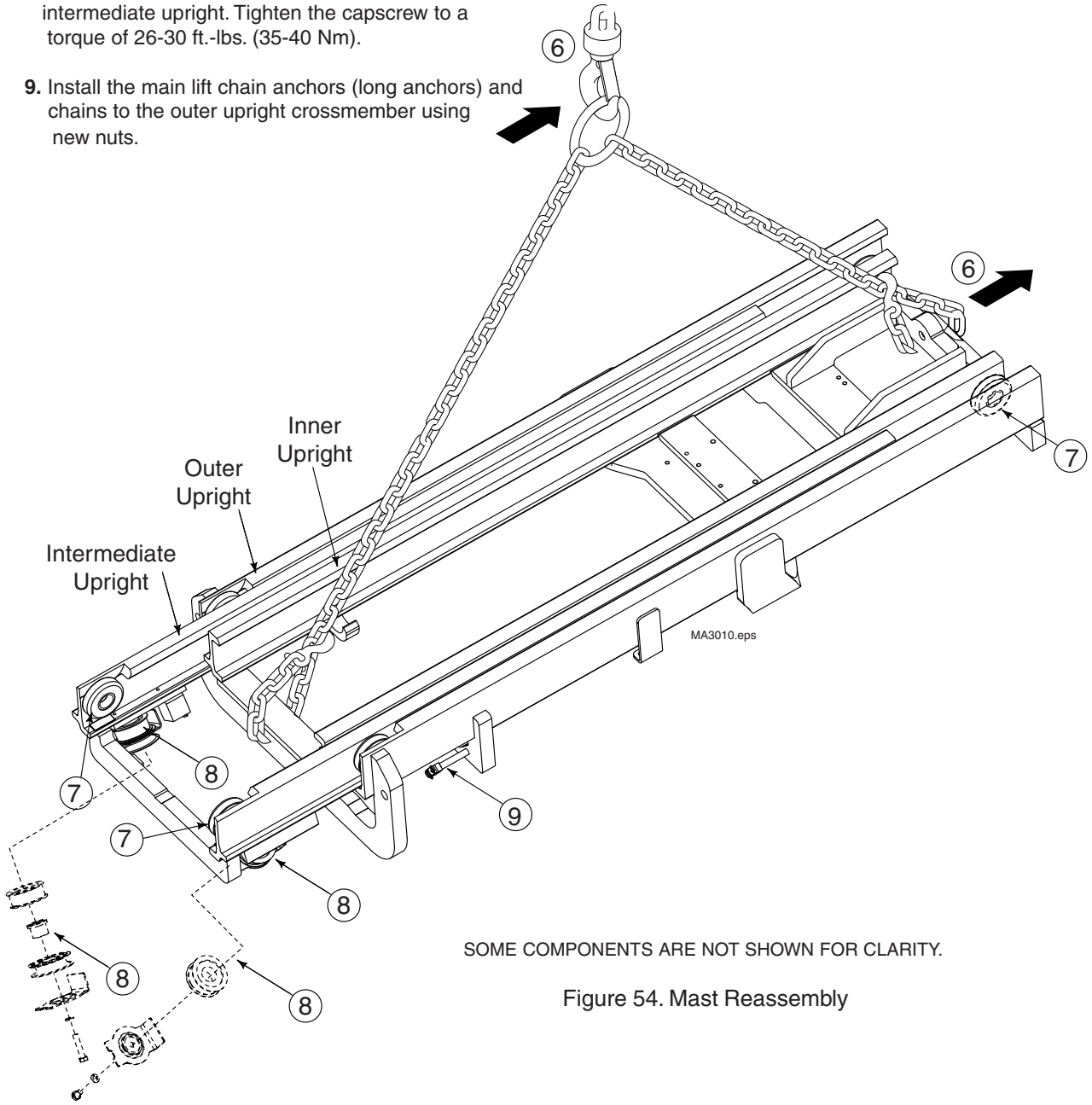
5.5-5 Upright Reassembly (Continued)

6. Attach an overhead hoist to the inner upright. Install the inner upright through the top of the intermediate upright. Adjust thrust plugs with shims as required.

7. Assemble shims and load rollers to the intermediate upright top and inner upright lower stub shafts. The shims should be installed to provide a total side clearance no loosest than 1/16 in. (1.5 mm) at the tightest point throughout the travel in the upright. Use an equal amount of shims side to side. **NOTE:** Roll the upright past the thrust plugs before checking roller clearances.

8. Install the chain sheaves and free lift hose sheave to the intermediate upright. Tighten the capscrew to a torque of 26-30 ft.-lbs. (35-40 Nm).

9. Install the main lift chain anchors (long anchors) and chains to the outer upright crossmember using new nuts.



SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

Figure 54. Mast Reassembly

5.5-5 Upright Reassembly (Continued)

9. Install the chain anchors (long anchors) to the back side of the inner upright lower crossmember using new nuts.

10. Pull the main lift chains over the chain sheaves and attach to the lower inner upright chain anchors.

11. Install the free lift cylinder supply hose clamp on the outer upright and route hose over the sheave on the intermediate top upright.

12. Install the carriage as described in Section 5.4-2 and 5.4-3.

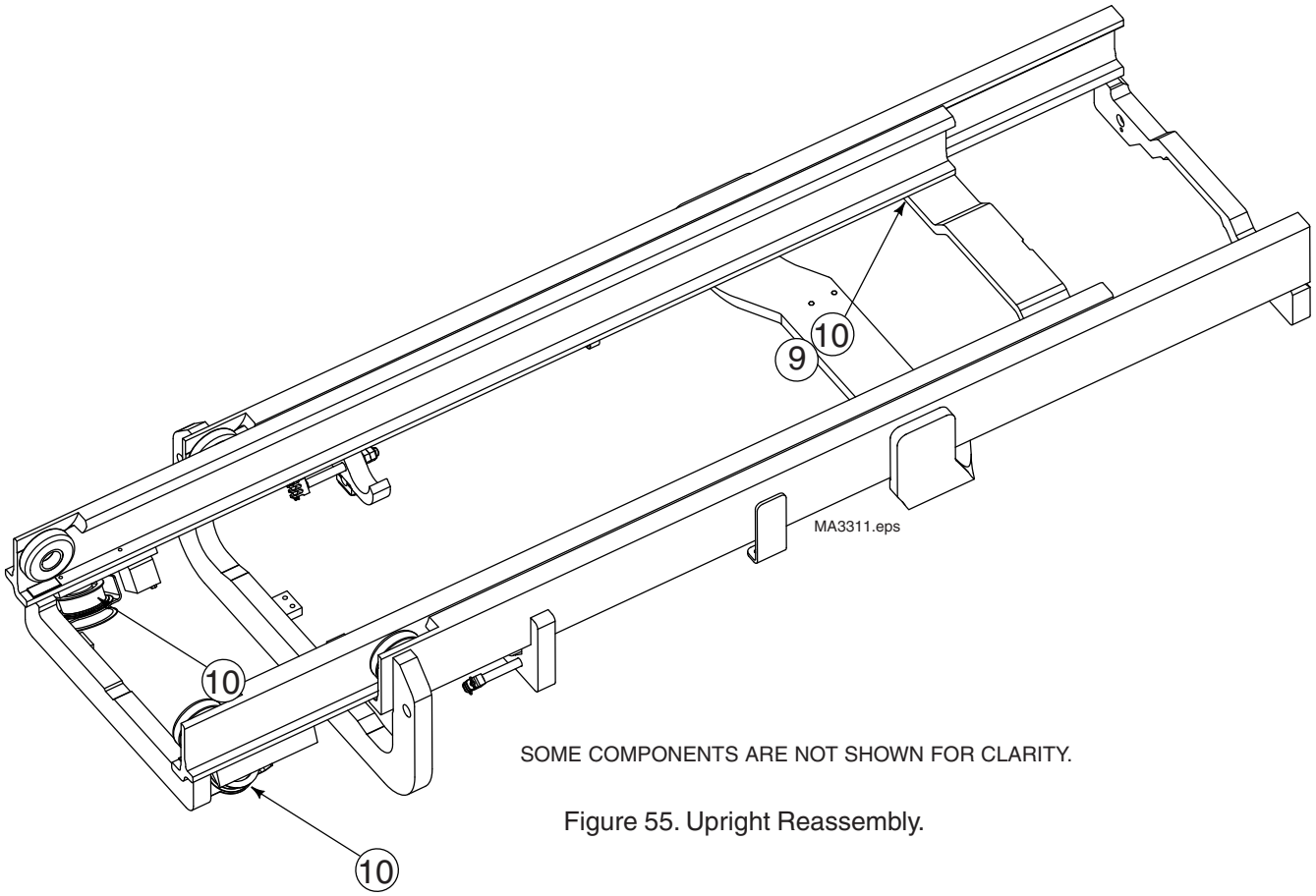
13. Install the free lift cylinder as described in Section 5.2-6.

14. Install the main lift cylinders as described in Section 5.2-5.

15. Install the mast to the truck as described in Section 5.1.

18. Adjust the main lift and free lift chains as described in Sections 5.6-3 and 5.6-4. Check for mast skewing as described in Section 5.5-6.

17. Install the internal reeving sheave and hoses (if equipped) as described in Section 2.5.



SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

Figure 55. Upright Reassembly.

5.5-6 Mast Skewing

WARNING: The intermediate upright must be supported by angle iron to avoid possible injury.

1. Extend the mast to the full lift height.

*If the mast kicks to the right at full extension, a shim (part no. 200524) needs to be installed to the right hand main lift cylinder rod.

*If the mast kicks to the left at full extension, a shim (part no. 200524) needs to be installed to the left hand main lift cylinder rod.

2. Place a 4 X 4 X 20 in. (10 X 10 X 50 cm) wood block between the upper intermediate and the upper outer crossmembers. Lower the mast onto the block.

3. Remove the bolt from the cylinder to be adjusted. Open the truck valve to allow the center (free lift) cylinder to fully retract. Tap the main lift cylinder rod down past the cylinder mount to install the shim.

4. Slowly hydraulically power the main lift cylinder back into the cylinder mount and reinstall the bolt.

5. Repeat steps 3 through 4 until skewing is removed.

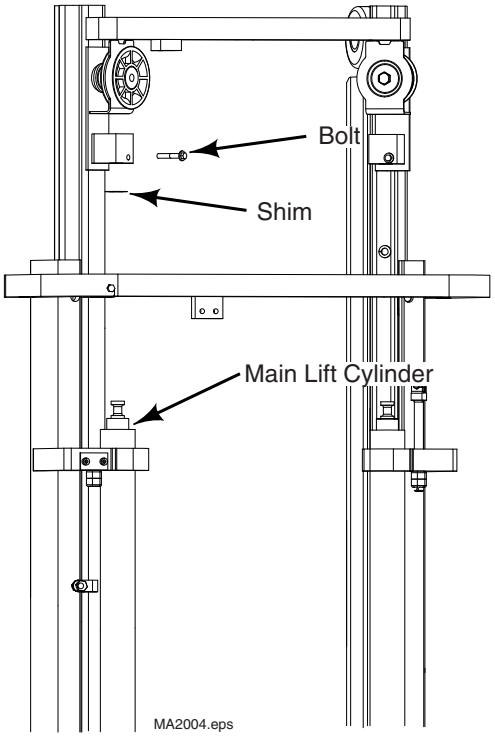


Figure 56.Shim Installation.

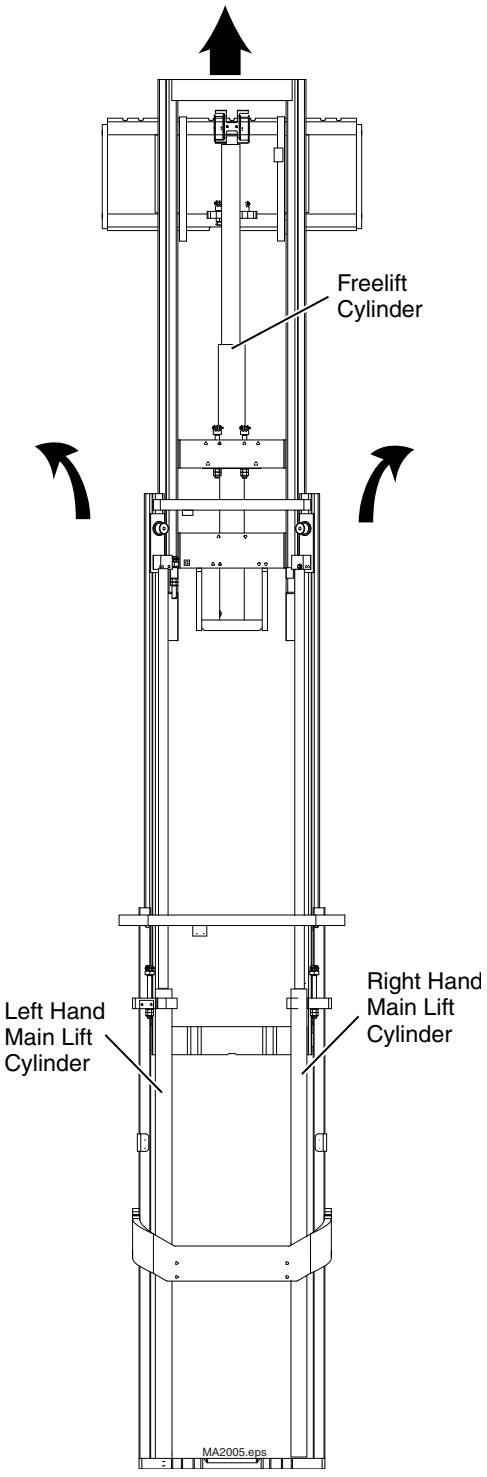


Figure 57.Extended Upright.

SOME COMPONENTS ARE NOT SHOWN FOR CLARITY.

5.6 Chains

5.6-1 Inspection and Tension

Each pair of chains has been factory-lubricated using heat and pressure to force the lubricant thoroughly into the chain links. Avoid removal or contamination of this factory applied lubricant. **Do not wash, sand blast, etch, steam clean, or paint the chains on initial mast installation.**

The chains must be adjusted with equal tension to ensure proper load distribution and mast operation. To determine equal tension, extend the unloaded mast to put the chains under tension. Press the center of a strand of chain with your thumb, then press at the same place on the other chain of the pair. Each chain in a pair should have equal "give". If tension is not equal, adjust the chains as described in **Chain Adjustment.**

Inspect the chains. If inspection reveals that one strand of a pair of chains requires replacement, **both** strands of the pair should be replaced.

*Check for rust and corrosion.

*Check for cracked side plates. If you find cracked side plates, replace **both** strands of chain.

*Check for tight joints. If tight joints are caused by rust or corrosion, loosen them with SAE 40 wt. oil or penetrating oil. If they cannot be loosened, or if the tight joints are caused by bent pins or plates or by peened plate edge, replace **both** strands of the chain.

*Check for protruding or turned pins. Replace **both** strands of the chain.

*Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment os sheaves, anchors or other components. Correct the misalignment. If wear is excessive, replace **both** strands of chain.

*Check for worn, broken or misaligned chain anchors. Replace or adjust as required.

*Lubricate the full length of the chains with SAE 40 wt. oil or Bowman Heavy Load Red Grease.

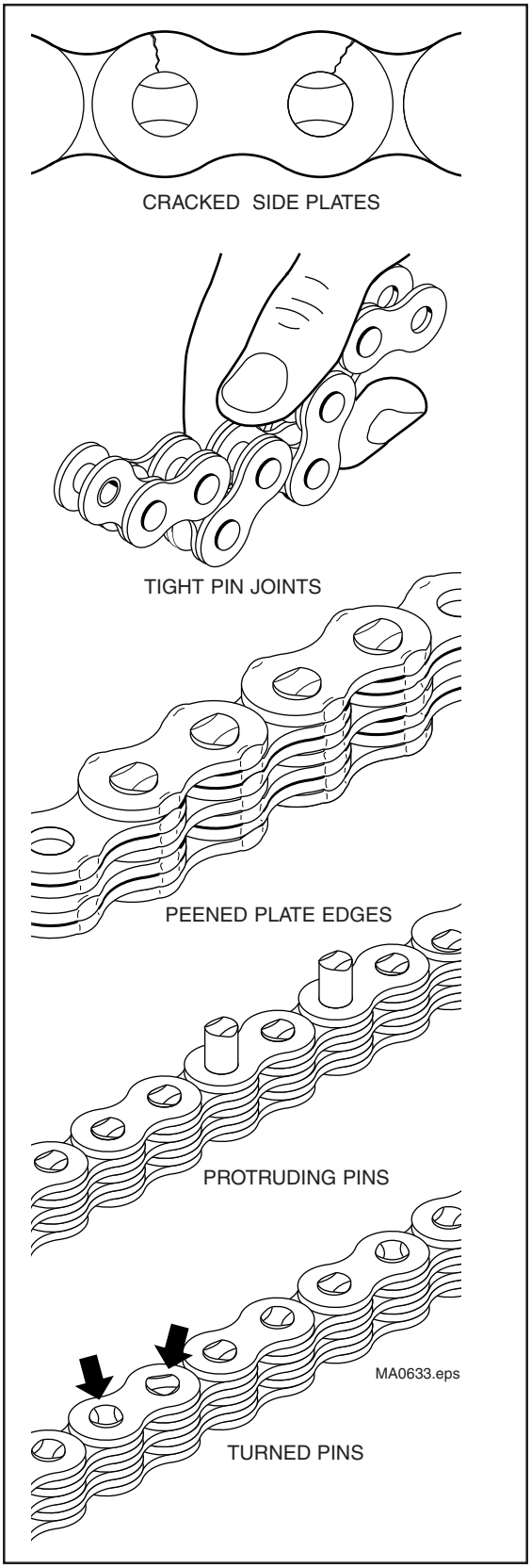


Figure 58.Chain Inspection.

5.6-2 Measuring Chain Stretch

Regular inspection and lubrication of the chains will increase their service life and reduce downtime.

If the chains stretch beyond the recommended amount, they should be replaced in pairs. Chain stretch can be measured with chain wear scale. Measure the chains according to the instructions printed on the chain wear scale, without a load on the carriage.

*to check the free lift chains, raise the carriage 1 ft. (30 cm) off the ground to put tension on the chains.

*To check the main lift chains, raise the mast until the inner upright starts to extend ensuring tension on the chains.

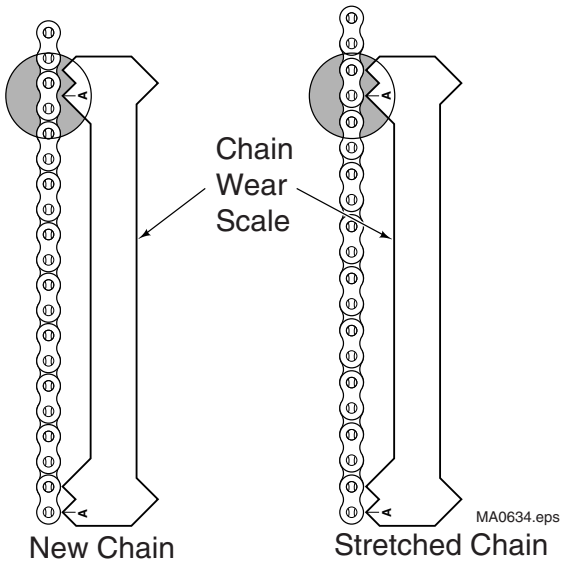


Figure 59.Measuring Chain Stretch.

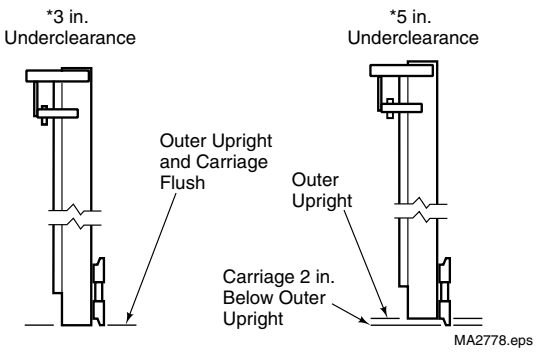
5.6-3 Main Lift Chain Adjustment

The main lift chains should be adjusted so that when the unloaded mast is fully lowered, the uprights are positioned as shown in figure 60.

1. Adjust one chain to achieve the correct upright position when fully lowered. See Figure 62.

2. Adjust the each pair to achieve equal chain tension. Tighten the nuts together to a torque of 50-70 ft.-lbs. (98-96 Nm). Ensure cotter pins are installed in the hole at the bottom of each chain anchor.

3. Raise and lower the mast several times to confirm the adjustments.



*NOTE: Underclearance is based on mast production series, actual mast underclearance may vary by truck model.

Figure 60.Upright and Carriage Position.

5.6-4 Free Lift Chain Adjustment

The free lift chains should be adjusted so that when the unloaded mast is fully lowered, the upright channels and carriage are positioned as shown in Figure 60.

1. Locate the threaded chain anchors on the front side of the inner upright crossmember on each side of the cylinder. Adjust one chain to achieve the correct upright position when fully lowered. See Figure 61.

2. Adjust the each pair to achieve equal chain tension. Tighten the nuts together to a torque of 50-70 ft.-lbs. (68095 Nm).

3. Raise and lower the mast several times to confirm the adjustments.

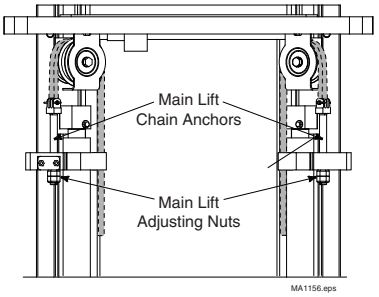


Figure 62.Main Lift Chains.

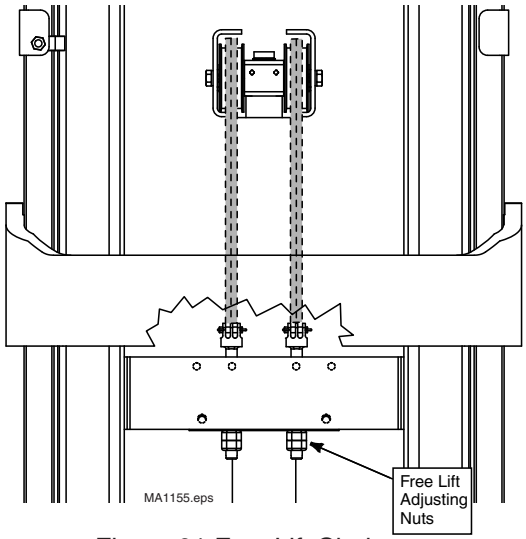


Figure 61.Free Lift Chains.

5.6-5 Main Lift Chain Service

WARNING: The intermediate upright must be supported by a block to avoid possible injury.

1. Raise the inner upright 3 ft. (90 cm). Place a 3 ft. (90 cm) block under the free lift cylinder support casting, then lower the cylinder support onto the block. The main lift chains should be slack.

2. Remove the cotter pins and chain pins from the chain anchors. Remove the chains.

3. Inspect the chain anchors for cracks or turned pins. Replace as required.

4. For reassembly, reverse the above procedures. Adjust the chains as described in Section 5.6-3.

5.If the mast has been cleaned using a pressure washer or heavy detergents that may rinse the chain lubrication out from within the links, then the recommended method for reestablishing chain lubrication is to soak the chains in SAE 40wt oil for at least 8 hours, preferably with the oil heated to 100° F to 120° F to facilitate complete lubrication penetration. Excess oil can be wiped off prior to installation.

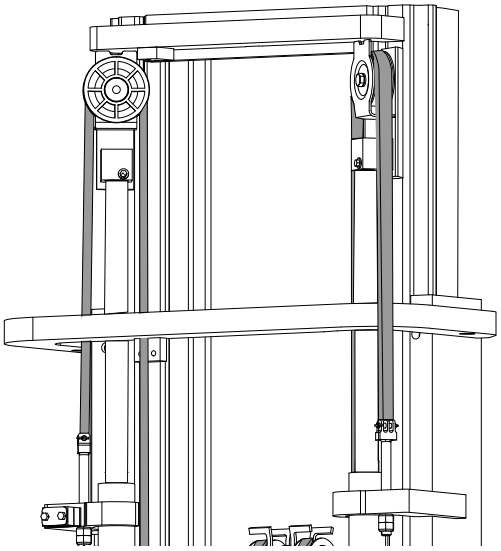


Figure 63.Main Chains.

5.6-6 Free Lift Chain Service

WARNING: The carriage must be supported by a block to avoid possible injury.

1. Raise the carriage 12 in. (30 cm). Place a 12 in. (30 cm) block under the carriage, then lower the carriage onto the block. The free lift chains should be slack. See Figure 64.

2. Remove the cotter pins and chain pins from the chain anchors. Remove the chains.

3. Inspect the chain anchors for cracks or turns pins. Replace as required. If lower chain nut is removed, it must be replaced with a new self-locking nut.

4. For reassembly, reverse the above procedures. Adjust the chains as described in Section 5.6-4.

5.If the mast has been cleaned using a pressure washer or heavy detergents that may rinse the chain lubrication out from within the links, then the recommended method for reestablishing chain lubrication is to soak the chains in SAE 40wt oil for at least 8 hours, preferably with the oil heated to 100° F to 120° F to facilitate complete lubrication penetration. Excess oil can be wiped off prior to installation.

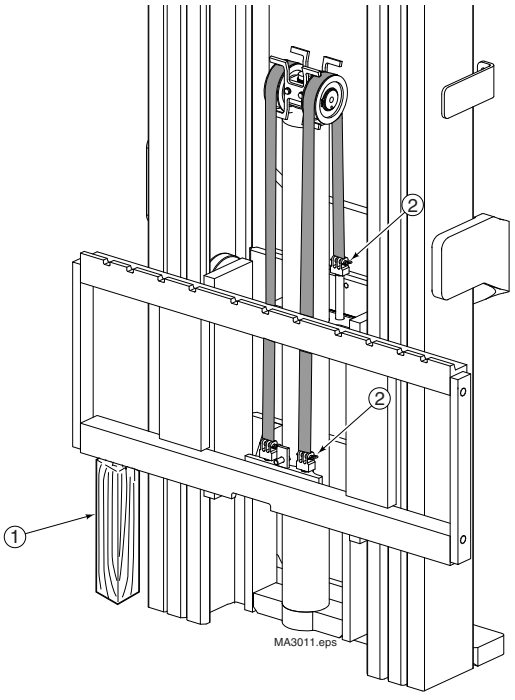


Figure 64.Free Lift Chains.

Manual Change Summary

R0 - 09/18/07

Release.

R1 - 06/15/09

Update FL cylinder illustration on page 25.

R2 - 09/04/13

Revise carriage description on page 34 and carriage installation step 7 on pages 35 and 36.

R3 - 02/27/14

Add paragragh for reestablishing chain lubrication to pages 7 and 48.
Revised the second paragragh on page 7.
Misc grammer corrections and add item 5 to section 3.1-1. change oil call out in 100 hour inspection. Page 21
Move warning to top of chart and add “banging or slamming” item to chart. page 22
Change the word plunger to rod on pages 24, 25, 26, 32 and 33.
Add “or turned pins” to item 3 in Section 5.6-5 and 5.6-6 on page 48.
Reviseoil volume call out on item 8 page 32.

Do you have any questions that need to be answered right now?

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