Service Manual

45C Viewmast® II Quad Free-lift Roller Masts

Serial Numbers 668175 through 692606

Manual Number 669223

cascade®

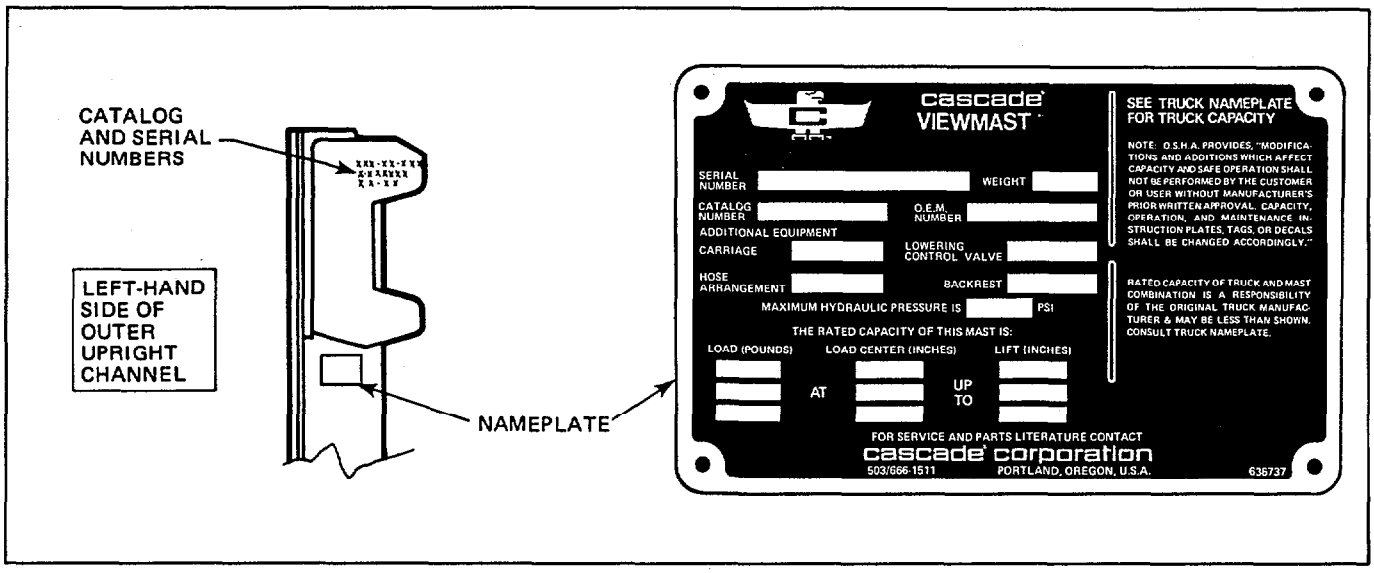
Contents

Section 1 Introduction

This manual provides the installation instruction, maintenance, troubleshooting, and service procedures for the Cascade Quad Viewmast® II, a four stage, full free-lift roller mast.

The Quad Viewmast® II provides **exceptional visibility** for the lift truck driver. The mast carriage and upright channels are **all-roller** mounted, which results in smooth operation and long service life. A unique, three-stage hoist cylinder provides fast operation and **uniform lifting and lowering speeds of the carriage.**

In any communication about your Cascade Quad Viewmast® II, always refer to the mast catalog and serial numbers stamped on the mast nameplate. If the nameplate is missing, these numbers are also stamped on the left-hand side plate of the upper crossbar.



⚠ WARNING

Do not install a Quad Viewmast® II on a truck with a rated capacity **greater** than the capacity shown below.

CASCADE QUAD VIEWMAST II	TRUCK CAPACITY AT 24-INCH LOAD CENTER
45C	6000 Pounds

Rated capacity of the truck/mast combination is a responsibility of the original truck manufacturer and may be less than shown on the mast nameplate. Consult the truck nameplate.

Section 2 Installation Instructions

2.1 Truck System Requirements

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

Cascade Viewmast® II	Minimum Relief Pressure	Maximum Relief Pressure	Hose Sizes	Fitting Thread Sizes
45C Quad	2150 PSI	2200 PSI	#8	3/4–16

WARNING: For proper truck stability or to prevent interference, tilt restriction may be required. Contact the truck manufacturer or one of the Cascade Service Departments listed on the back cover for the specific tilt modification required. Note: To achieve the proper tilt restriction, contact the lift truck manufacturer, or your truck service manual.

IMPORTANT: Standard Viewmast® II masts are compatible with SAE 10W petroleum base oil per Mil. Spec. MIL-0-5606 or MIL-02104 B only. Use of synthetic or aqueous base hydraulic oil is not recommended. If fire resistant hydraulic oil must be used, contact one of the Cascade Service Departments listed on the back cover.

2.2 Mounting Bracket Installation

If it is necessary to install mounting brackets and crossmembers to fit your truck, consult with the nearest Cascade Service Department listed on the back cover. You must supply dimensions **A** through **F** shown below in Figure 1. 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.

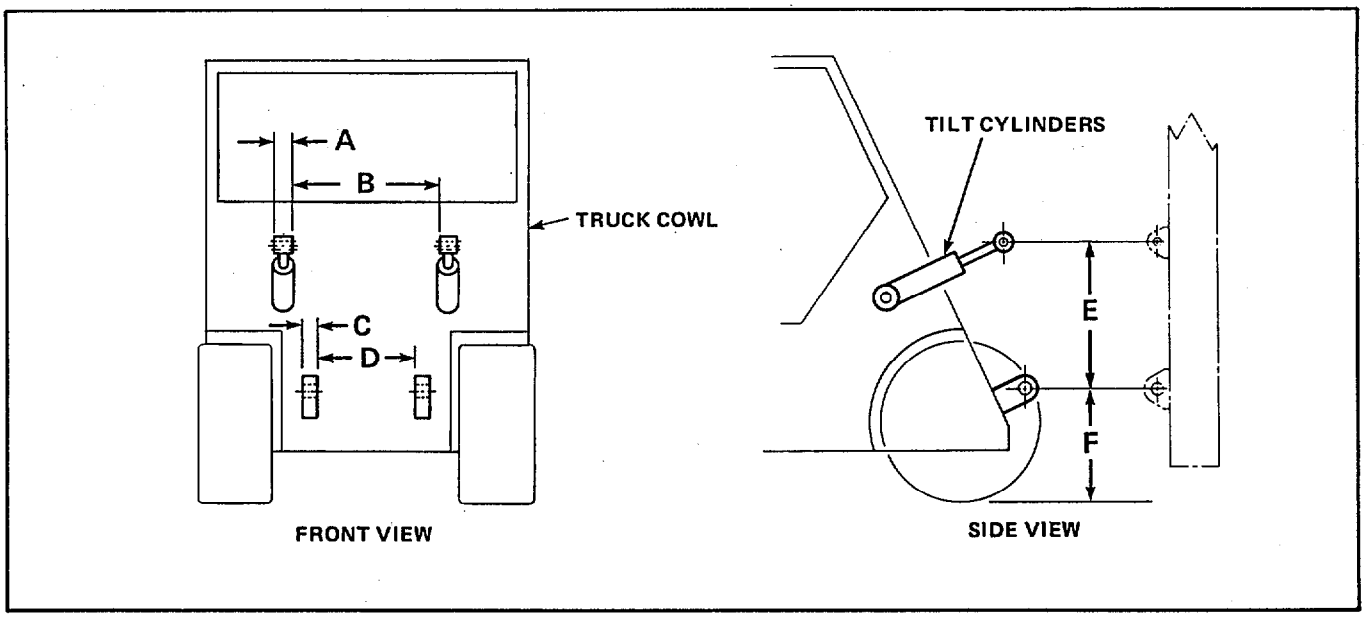


Figure 1. Determining Mounting Bracket and Crossmember Location.

2.2 Mounting Bracket Installation(Cont.)

1. Mounting bracket and crossmember welding must be performed by a qualified welder only, using the following procedures:
   a. Disassemble the outer channel from the mast prior to welding. See Section 5.3-6 for disassembly procedures.
   b. Clean all surfaces to be welded. Remove paint, oil, grease and other contaminants.
   c. Locate the mounting brackets and crossmembers on the mast channels.

      Clamp in place with a "C" clamp. Protect the mast channel inner surfaces from weld splatter.
   d. Use only 7018 low hydrogen electrodes AWS E7018, 5/32" diameter. Electrodes must be in good condition. Bake as required to remove all moisture per electrode manufacturers procedures.
   e. Use DC reverse polarity, or an AC welding machine. Set the amperage at 175 amps.
   f. Preheat the upright and mounting bracets to 100° F. Montior with a Tempstick (crayon). Do not weld in a drafty area.

> **WARNING:** Weld areas that will be vertical seams when the mast is standing upright only. DO NOT WELD ANY HORIZONTAL SEAMS.

   g. Weld areas that will be vertical seams when the mast is standing upright only. DO NOT WELD ANY HORIZONTAL SEAMS. See Figure 2.
   h. Weld the mounting brackets and crossmember with a .25 in. minimum fillet, holding a close arc. Weld in the flat position only. Do not oscillate or use a wash bead pattern. Make the weld in three passes. Let the weld slow cool.
   i. Remove slag and inspect the weld. The following defects are not allowed: undercut, overlap, stress cracks and porosity. Clean the weld area and repaint with Cascade paint part number 668209.

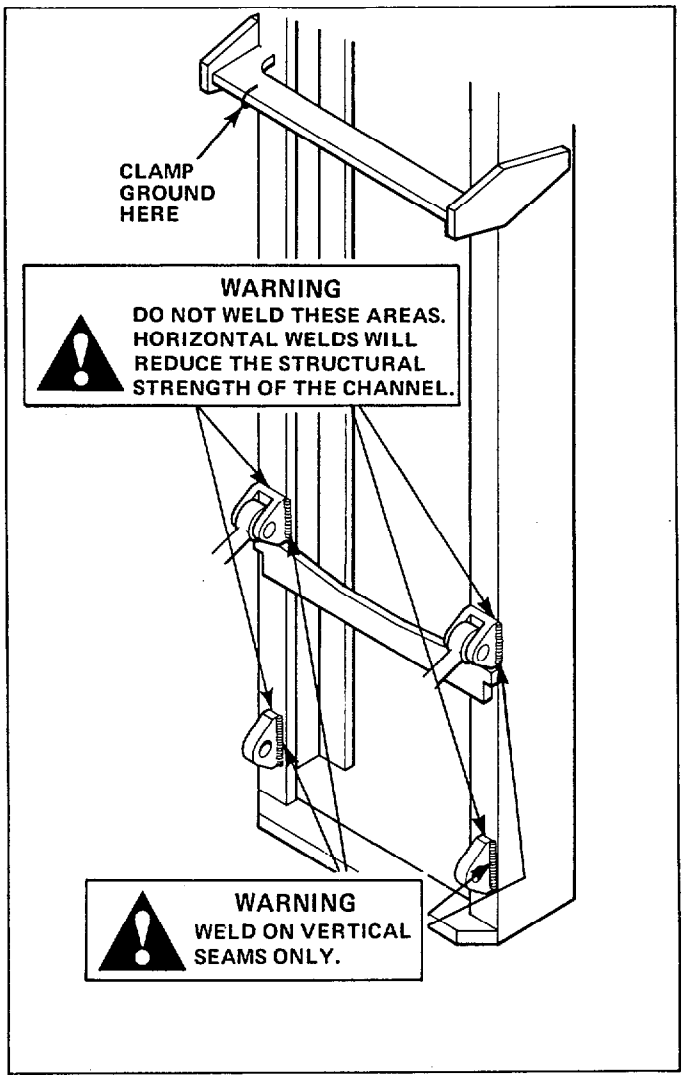


Figure 2. Clamp Ground and Weld.

2. The measurement shown in Figure 3 should be taken after welding and cooling the mast. This dimension must be maintained for the uprights to slide together.
3. Reassemble the mast as described in Section 5.3-8.

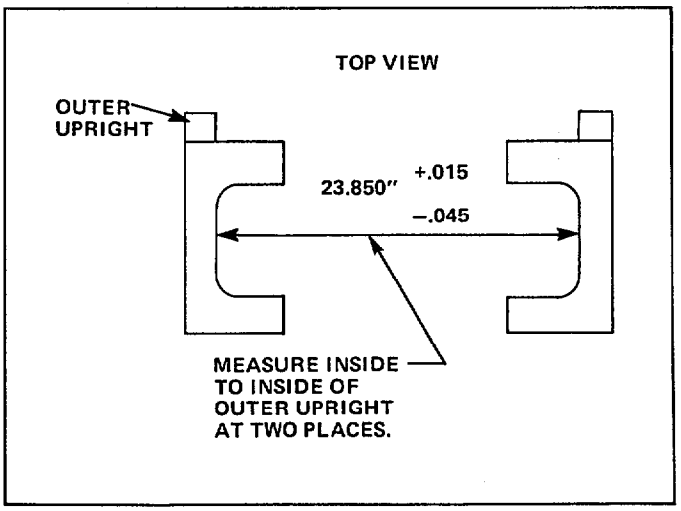


Figure 3. Dimensional Inspection

2.3 Mast Installation

1. Lubricate the bearing surfaces of the base and tilt cylinder mounting brackets with chassis grease.
2. Lift the mast by a link chain wrapped twice around the upper channel crossmembers. Position the mast into place on the lift truck and secure the base mountings.

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

3. Connect the tilt cylinders to the cylinder anchor brackets.
4. Before connecting the truck hose to the mast cylinder hose, connect the truck hose to the truck return fitting and actuate the control valve to flush the system with hydraulic oil.
5. Connect the lift truck hose to the cylinder hose on the mast. See Figure 4. The lift truck hose can be SAE 100 R2 or R9. NOTE: Use as few fittings as possible and always use 45° elbows instead of 90° elbows. Keep the hose lengths to a minimum. Avoid sharp bends or pinch points when routing the hose.

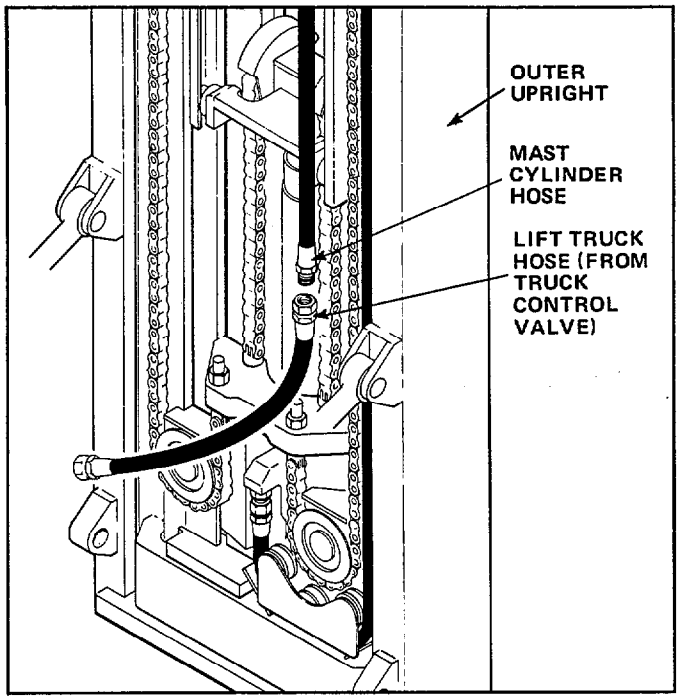


Figure 4. Cylinder and Truck Hose Connection

2.4 Operational Inspection and Adjustments

CAUTION
The factory set adjustments may not be correct for your truck. Check each of the following before using the mast for the first time.

- ☐ Bleed air from the mast cylinder as described in Section 5 1-7. Do not use bleed screw on side of cylinder shell.
- ☐ The hoist cylinder must sequence as described in Section 5.1-8.
- ☐ Inspect the chains and check chain tension as described in Section 5.4-1.
- ☐ Check crosshead rollers for proper adjustment as described in Section 5.1-9.
- ☐ Inspect the cylinder hose for correct tension and tracking over the rollers. Refer to Section 5.3-13.

Section 3 Periodic Maintenance

For proper operation and an extended service life, your Viewmast II should be inspected and serviced regularly as part of your normal lift truck maintenance schedule according to the following outlines.

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

WARNING: Never work on the mast with a load on the forks or attachment or while anyone is near the lift truck control handles.

3.1 Daily Inspection

Perform the following at the beginning of each work shift:

- ☐ Extend the carriage a few inches off the ground and make sure the carriage chains are under equal tension. Refer to Section 5.4-1.
- ☐ Extend the mast to its full height to make sure the hoist cylinder sequences properly. The primary plunger should extend fully, then the master and slave plungers should extend together. Make sure the mast channels and carriage extend freely without binding. Refer to Section 5.1-8.
- ☐ While the mast is extended, inspect the upright channels for proper lubrication. Refer to Section 5.3-8 step 1.
- ☐ With the mast extended, make sure the hoist chains are under equal tension. Refer to Section 5.4-1.
- ☐ Lower the mast and make sure the cylinder sequences properly. The master and slave plungers should lower first, then the primary plunger should lower. Make sure the mast channels and carriage lower freely without binding. Refer to Section 5.1-4.
- ☐ Make sure the cylinder hose is not twisted and is traveling smoothly in the hose guides. Check the hose to be sure it is not scuffing. Minor adjustments to the hose can be made by loosening the hose clamp and twisting the hose slightly to fit in the guides. Refer to Section 5.3-13.
- ☐ Be sure the urethane cushions at the base of the outer and intermediate channels are not flattened or distorted.
- ☐ Check crosshead roller clearance to assure proper operation without binding. Refer to Section 5.1-9.

3.2 100 Hour inspection

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

- ☐ Inspect and lubricate the full length of each pair of hoist chains with SAE 40 oil.

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

- ☐ Check each pair of hoist chains for wear and stretch. Refer to Section 5.4.

3.3 500 Hour Inspection

After each 500 hours of lift truck operation, in addition to the daily and 100 hour inspection:

- ☐ Check the clearances for load rollers. Refer to Section 5.3-12.

Section 4 Troubleshooting

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

NOTE: Any time oil is added to the truck reservoir, check the hoist cylinder for possible entrapment of air. Refer to Section 5.1-7.

PROBLEM	PROBLEM CAUSE	SOLUTION
Hoist cylinder doesn't lift load or won't move–		
• Empty	**a)** Plugged inlet hose	**a)** Unplug hose or replace
	b) Insufficient oil	**b)** Check truck hydraulic system for correct oil level in tank, defective pump or pump drive, leaks in the lines or disconnected control valve linkage. Repair or replace as necessary.
	c) Bent or jammed plungers.	**c)** Replace defective plungers.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
• Loaded	**a)** Plugged piston check valve–master may move.	**a)** Unplug check valve or replace.
	b) Reversed piston check valve–master may move.	**b)** reverse direction of check valve – arrow-up.
	c) Truck relief setting low.	**c)** Raise truck relief setting to specified level. Do not exceed 2200 PSI.
	d) Over capacity.	**d)** Reduce load to specified capacity.
	e) Mechanical bind due to bent plunger(s), bad rollers and/or bad cross head rollers.	**e)** Remove mechanical bind by replacing/ freeing plungers and rollers.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	f) Slave piston check valve defective – will lift through free lift.	**f)** Replace slave piston/check valve assembly.
Mis-sequencing–		
• Empty or light load Primary up–1st Slave up–2nd Master up - 3rd, if at all.	**a)** Sequence rod adjusted too long.	**a)** Adjust sequence rod. (Turn clockwise.)
	b) Bent plungers.	**b)** Repair or replace as necessary.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	c) Slave piston check valve plugged or defective.	**c)** Replace slave piston/check valve assembly.
	d) Master piston ball check not seating properly. (Master will move during primary stage.)	**d)** Clean and/or replace piston ball check assembly.
	e) Master piston I.D. O-ring seal leaking. (Master will move during primary stage.)	**e)** Replace O-ring and back-up ring.
	f) Relief valve defective. (Master will move during primary stage.)	**f)** Replace relief valve–do not adjust or repair.
	g) Master seal worn out. (Master will move during primary stage.)	**g)** Replace all cylinder seals.
	h) Master piston check valve open.	**h)** Replace check valve.
	i) Sequence rod out of adjustment. (Too long.)	**i)** Adjust sequence rod. (Clockwise.)
• Loaded Primary up–1st Master/Slave–2nd Slave stops short of full lift.	**a)** Slave piston check valve defective. **NOTE:** Cylinder relief valve will squeal and cylinder will extend slowly.	**a)** Replace slave piston/check valve assembly.
	b) Piston sequence valve defective. (Master will move during primary stage.)	**b)** Repair or replace valve.
	c) Master piston ball check not seating properly. (Master will move during primary stage.)	**c)** Clean and/or replace piston ball check assembly.
	d) Master piston I.D. O-ring seal leaking. (Master will move during primary stage.)	**d)** Replace O-ring and back-up ring.

PROBLEM	PROBLEM CAUSE	SOLUTION
• Loaded (Continued)	**e)** Master seal worn out. (Master will move during primary stage.)	**e)** Replace all cylinder seals.
	f) Sequence rod stroke adjusted too short.	**f)** Adjust sequence rod. (Turn counter-clockwise.)
	g) Bent plungers.	**g)** Repair or replace as necessary.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	h) Check valve defective. (Open.)	**h)** Clean or replace as necessary.
	i) Relief valve defective. (Master moves at all times.)	**i)** Replace relief valve. Do not adjust or repair.
	j) Worn slave piston seals.	**j)** Replace seals.
• Empty or loaded Master up–1st–slow Primary up–2nd (or during) master) Slave up–3rd	**a)** Relief valve open.	**a)** Replace relief valve - do not adjust or repair
Hoist cylinder drifts–		
• All plungers down	**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) Slave piston check valve defective. **NOTE:** Slave section drops approximately 4" and stops.	**c)** Replace slave piston/check valve assembly.
	d) External leaks at retainers.	**d)** Replace all cylinder seals.
• Slave plunger down–Master plunger up.	**a)** Relief valve defective.	**a)** Replace relief valve–do not adjust or repair.
	b) Master piston check valve leaking.	**b)** Replace check valve.
Master plunger drifts up when load is lifted, then stops. (Approximately 1–2".)	**a)** Air in cylinder.	**a)** Bleed air from cylinder.
Spongy or jerky action.	**a)** Air in cylinder.	**a)** Bleed air from cylinder.
	b) Sticky or defective truck relief valve. ⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	**b)** Remove and check truck relief valve. If contaminated oil caused the malfunction, drain and flush the system, change the filter, and refill with fresh oil.
	c) Bent or damaged cylinder plunger(s).	**c)** Disassemble, check and repair cylinder assembly.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	d) Load rollers improperly adjusted or defective.	**d)** Adjust or repair as necessary.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	e) Mast channels improperly lubricated.	**e)** Lubricate mast.
	⚠ **WARNING:** Extreme care should be used when working on a unit when the carriage (with or without load) is in a raised position.	
	f) Low battery charge.	**f)** Charge battery.
	g) Low pump volume.	**g)** Install accumulator.
	h) Low oil level.	**h)** Fill oil reservoir and bleed cylinder.
	i) Insufficient hydraulic tank capacity or baffles.	**i)** Install larger tanks or baffles.
	j) Improperly sequencing mast cylinder.	**j)** Adjust sequence rod.
	k) Other.	**k)** Contact Cascade Corporation.

5.1 Hoist Cylinder

5.1-1 Description

The hoist cylinder, shown in Figure 7 , is a three-stage, displacement cylinder. It consists of a shell with three hollow, telescoping plunger assemblies. The slave plunger (smallest diameter) telescopes into the primary plunger, and the primary plunger telescopes into the master plunger (largest diameter).

The shell, master plunger, and primary plunger are threaded at one end to receive retainers. A retainer is threaded into the shell to limit the stroke of the master plunger. A retainer is threaded onto the master plunger which secures an aluminum bearing to limit the stroke of the primary plunger. A retainer is threaded onto the primary plunger which secures an aluminum bearing to limit the stroke of the slave plunger.

Each retainer has a Bi-Element seal assembly to provide a high-pressure hydraulic seal between the retainer and its adjacent plunger. In addition, each retainer has a static (non-moving) O-ring assembly and a plunger wiper.

A piston assembly is threaded onto the base of the master and slave plungers. Both cylinder pistons have a Bi-Element seal assembly to provide a high-pressure hydraulic seal between the piston and the plunger or shell.

IMPORTANT: During cylinder operation, the pressure produced in the cavity between the cylinder shell and the master plunger is greater than that produced at the cylinder base (truck pressure). Thus, the seal assembly on the master plunger piston (item 37, Figure 7) **must** be installed with the lip toward the plunger end of the cylinder.

The pistons also have static O-ring seals to seal between the piston and the plunger or shell.

A synthetic bearing is installed on the master plunger piston and cast iron half-rings are installed at the base of the primary plunger.

The master plunger piston also serves as a housing for a poppet-operated check valve, a relief valve, and a sequence valve assembly. The sequence valve assembly ensures the proper sequencing of the cylinder plungers during extension and retraction. It is comprised of a spring-loaded ball and seat assembly actuated by a spring-cushioned plunger. The sequence valve plunger is actuated by a rod. The valve plunger is attached to the rod at the rod's lower end. The rod extends through a square hole in the base of the primary plunger and into the central cavity of the slave plunger and terminates near the top of the slave plunger.

A spacer is installed at the top of the sequence valve actuating rod. It is held in place by a spring that bears between the spacer and the shoulder of a special adjusting nut, threaded onto the upper end of the rod. Access to the adjusting nut can be gained by removing the bleed fitting threaded into a port at the top of the slave plunger. To turn the nut, insert a 3/16-inch, long-handle, Allen wrench. Refer to paragraph 5.1-8 for complete adjustment instructions.

An adjustable lowering control valve is located at the supply port on the cylinder shell. It consists of a spring, adjustable piston, adjusting nut, and a threaded cover. By adjusting the piston you can control the lowering speed of the cylinder. See paragraph 5.1-3 for complete adjusting instructions.

5.1-2 Bi-Element Seal Assemblies (Fig. 13)

The hoist cylinder assembly contains five Bi-Element seal assemblies. See Figure 5. Each seal assembly is comprised of a seal element and an anti-extrusion element. The seals are used in combination with nylon back-up rings. The seals are installed in the cylinder assembly with the seal element facing the highest pressure.

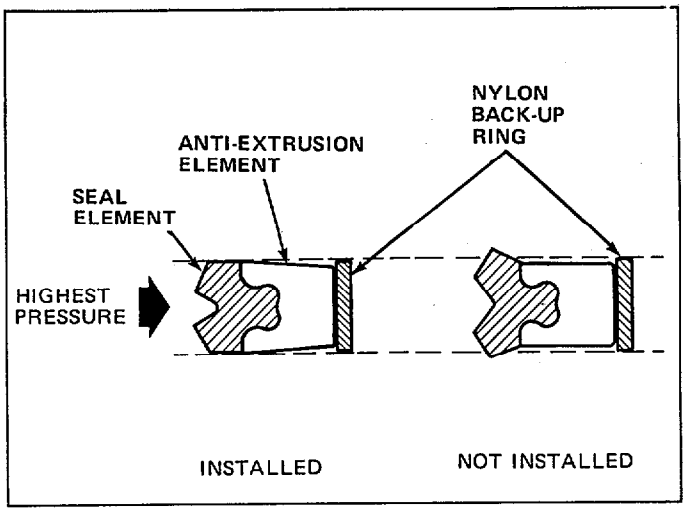


Figure 5. Bi-Element Seal Assemblies

5.1-3 Lowering Control Valve Removal and Adjustment

The lowering control valve components are not serviceable. The valve must be replaced as a complete assembly when necessary.

1. Remove the plug and lowering control valve from the cylinder port.
2. Adjust as follows:
   - To SLOW the LOWERING SPEED, back the nut out while keeping the piston stationery with a screwdriver. See Figure 6.
   - To INCREASE the LOWERING SPEED, tighten the nut while keeping the piston stationery with a screwdriver.
3. Reinstall the valve and tighten to a torque of 10–15 ft.-lbs. Install the plug and tighten to a torque of 95–100 ft.-lbs.

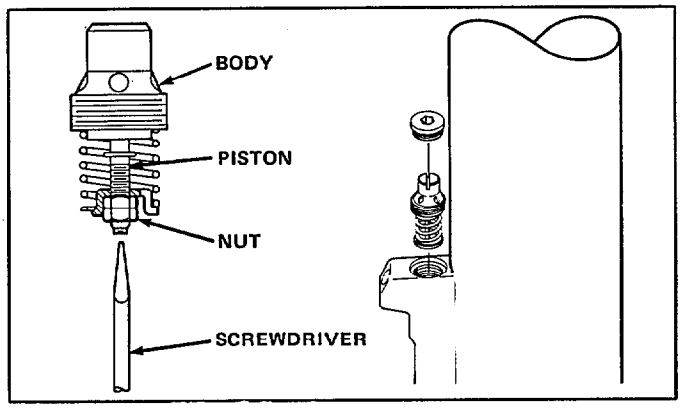
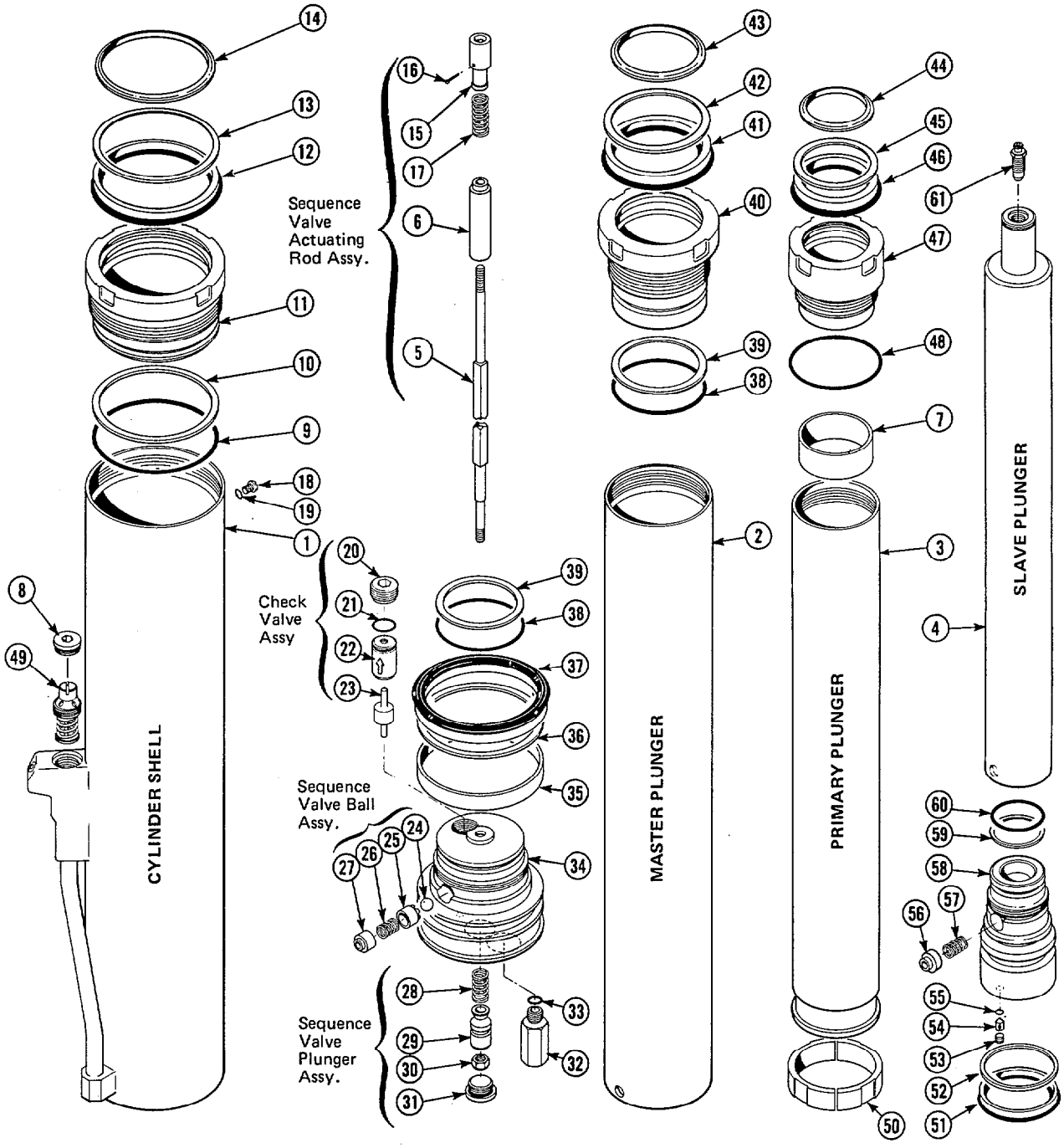


Figure 6. Lowering Control Valve



1. Cylinder shell
2. Master plunger
3. Primary plunger
4. Slave plunger
5. Sequence valve actuating rod
6. Spacer
7. Bearing
8. Plug
9. O-ring
10. Back-up ring
11. Master plunger retainer
12. Seal
13. Nylon ring
14. Wiper
15. Sequence valve adjusting nut
16. Cotter pin
17. Sequence valve rod spring
18. Bleed screw
19. Seal
20. Valve retaining washer (threaded)
21. O-ring
22. Check valve
23. Check valve poppet
24. Sequence valve ball
25. Sequence valve ball spacer
26. Sequence valve ball spring
27. Sequence valve ball plug
28. Sequence valve plunger spring
29. Sequence valve plunger
30. Sequence valve plunger nut
31. O-ring plug
32. Relief valve
33. Relief valve O-ring
34. Master plunger piston
35. Bearing
36. Nylon ring
37. Seal
38. O-ring
39. Back-up ring
40. Primary plunger retainer
41. Seal
42. Nylon ring
43. Wiper
44. Wiper
45. Nylon ring
46. Seal
47. Slave plunger retainer
48. O-ring
49. Lowering control valve
50. Primary plunger half-ring
51. Seal
52. Nylon ring
53. Setscrew
54. Check valve
55. O-ring
56. Plug
57. Spring
58. Slave plunger piston
59. Back-up ring
60. O-ring
61. Bleed fitting

Figure 7. Exploded View of Hoist Cylinder Assembly

5.1-4 Cylinder Operation (Figure 8)

View A

The entire cylinder assembly is filled with oil at the beginning of its lifting sequence. Since the cylinder is fully lowered, the check valve is unseated by its actuating poppet in contact with the base of the cylinder shell. Since the sequence valve ball is seated, oil in the cavity between the cylinder shell and the master plunger (referred to as "sequencing oil") is trapped. The master plunger is thus prevented from moving. As a result, when oil from the truck enters the cylinder through the inlet port, it flows through the angled port in the master plunger piston and through the unseated check valve to the primary and slave plunger cavity.

View B

Since the area of the primary plunger piston is greater than that of the slave plunger, the primary plunger begins to extend. As the primary plunger reaches the end of its stroke, its base contacts the spacer at the top of the sequence valve actuating rod. The actuating rod thus shifts upward, pulling the sequence valve plunger upward with it. The sequence valve plunger unseats the sequence valve ball. The point at which this event occurs may be adjusted by turning the special adjusting nut at the top of the sequence valve actuating rod.

View C

The trapped sequence oil is at a pressure greater than that from the truck. (This pressure intensification results because the area of the piston that forms the cavity between the cylinder shell and the master plunger is less than the area of the base of the master plunger piston. Remember that pressure equals force divided by area. Since the area of the piston in the sequence oil cavity is less, the pressure in the cavity is greater.) Thus, as soon as the sequence valve ball is unseated, the previously trapped high-pressure sequencing oil flows past the unseated sequence valve ball to the primary plunger cavity and seats the unseated check valve. Oil from the truck can thus no longer flow to the plunger cavities and truck pressure begins to extend the master plunger.

View D

As the master plunger extends, the sequencing oil flows past the unseated sequence valve ball and extends the slave plunger from within the extended primary plunger. This occurs until the cylinder is fully extended.

Since the volume of the sequencing oil cavity is nearly identical to the volume of the slave plunger cavity, master and slave plungers extend at the same speed. The volume of oil required to lift the master plunger is approximately **twice** that required to extend the primary plunger (the first plunger to extend). Thus, the master plunger extends at **half** the speed that the primary plunger extended. However, since the master and slave plungers extend simultaneously at the same speed, the **combined speed** of the master and slave plungers equals the speed of the primary plunger. As a result, the cylinder assembly extends (and lowers) at a constant speed throughout its complete sequence of operation.

A relief valve (shown in View C) is included in the master plunger piston. If the pressure of the sequencing oil should exceed a value preset by the relief valve, the valve will unseat to allow pressure to be relieved to the base of the cylinder. This could occur each time the cylinder is extended or when excessive pressure build-up of the sequencing oil, such as would occure when the cylinder is at rest, is heated by ambient air. A check valve is located in the base of the slave plunger piston. The check valve allows release of trapped oil which could occur is oil leaks past the seal and gets caught between the piston and retainer.

The lowering of the cylinder assembly is a reversal of extension.

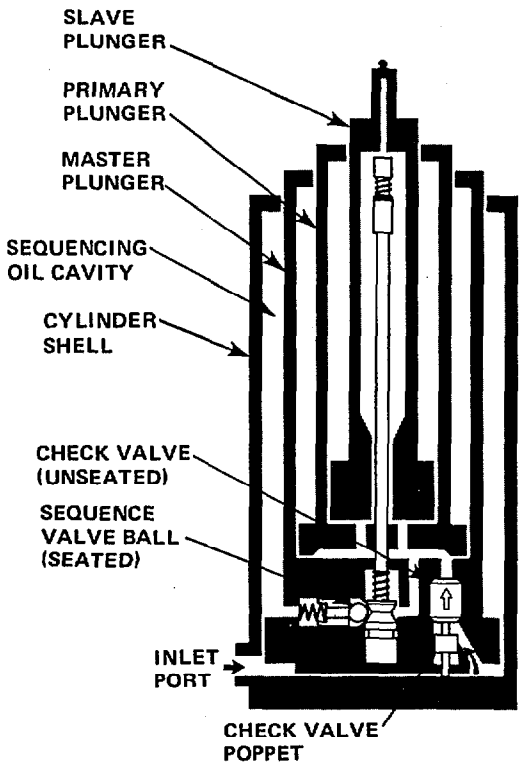
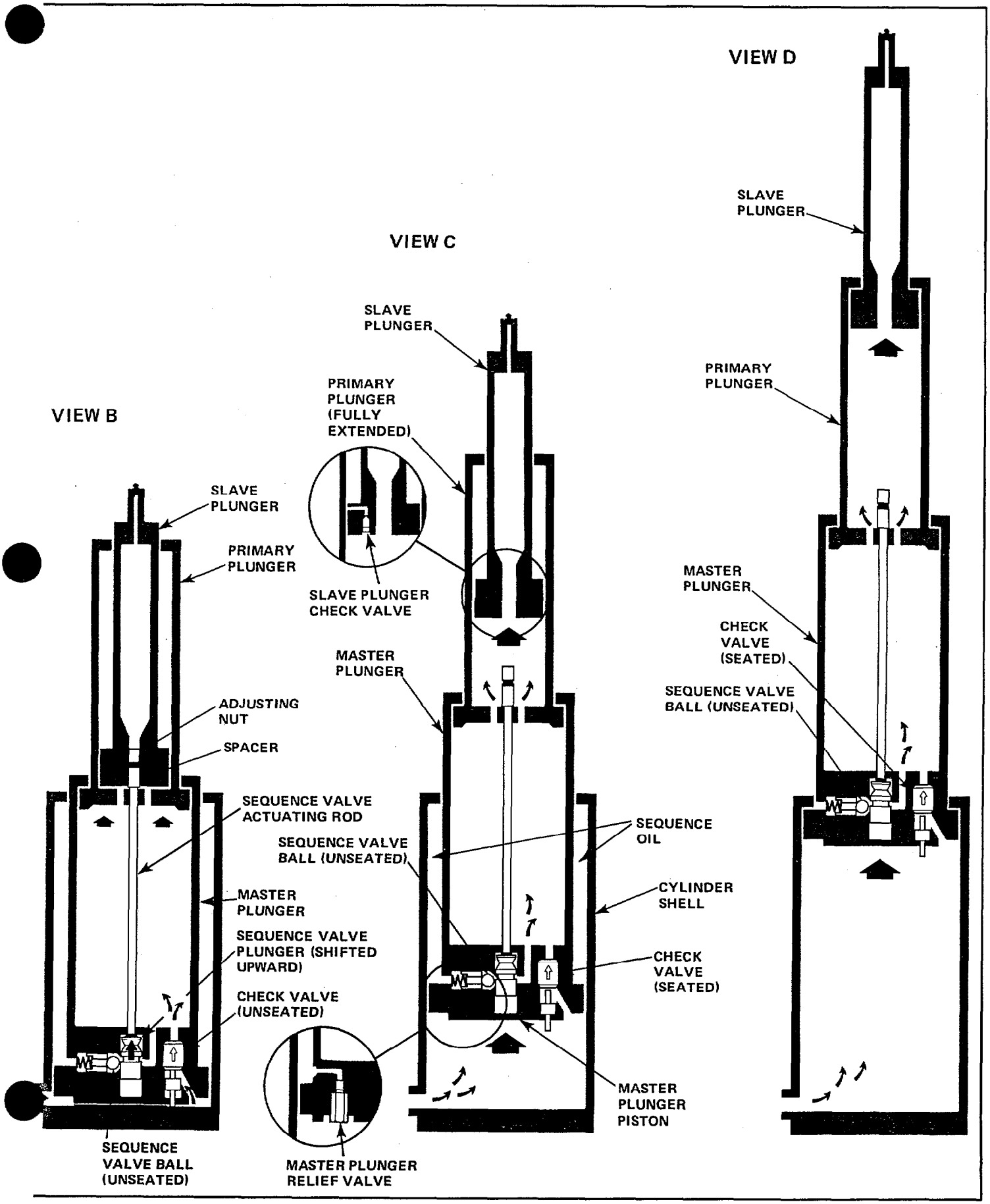


Figure 8. Hoist Cylinder Sequence of Operation


VIEW B
SLAVE PLUNGER
PRIMARY PLUNGER
ADJUSTING NUT
SPACER
SEQUENCE VALVE ACTUATING ROD
MASTER PLUNGER
SEQUENCE VALVE PLUNGER (SHIFTED UPWARD)
CHECK VALVE (UNSEATED)
SEQUENCE VALVE BALL (UNSEATED)
VIEW C
SLAVE PLUNGER
PRIMARY PLUNGER (FULLY EXTENDED)
SLAVE PLUNGER CHECK VALVE
MASTER PLUNGER
SEQUENCE VALVE BALL (UNSEATED)
SEQUENCE OIL
CYLINDER SHELL
CHECK VALVE (SEATED)
MASTER PLUNGER PISTON
MASTER PLUNGER RELIEF VALVE
VIEW D
SLAVE PLUNGER
PRIMARY PLUNGER
MASTER PLUNGER
CHECK VALVE (SEATED)
SEQUENCE VALVE BALL (UNSEATED)

5.1-5 Cylinder Removal

1. Make sure the hoist cylinder is fully lowered.

CAUTION: Always lubricate new seals, O-rings, and wipers with petroleum jelly or hydraulic oil prior to installation.

> **WARNING:** Never work on the mast with a load on the forks or attachment nor while anyone is near the lift truck control handles.

2. Loosen the bleed screw no more than required to bleed off any hydraulic pressure that may remain in the cylinder. The bleed screw is located on the side of the cylinder shell just below the large piston retainer. Tighten the screw securely.
3. Remove the carriage according to the removal procedures specified in the carriage section, 5.2.
4. Remove the pad at the top of the cylinder crosshead.
5. Remove the snap ring that retains the crosshead assembly to the hoist cylinder rod.
6. Remove the crosshead.
7. Wash the cylinder assembly with solvent to remove any foreign material on the shell. Especially clean around the plunger retainers. Blow dry with compressed air. **If you are going to replace the seals, O-rings, and/or wipers in the plunger retainers only,** you can do so with the cylinder in place on the mast according to the following procedures (refer to Figure 9).
   a. Unthread and remove all three retainers. **Do not remove any of the cylinder plungers.**
   b. Replace the seals, O-rings, and/or wipers in the retainers as required. Carefully note their positions (see Figure 9). Avoid excessive stretching of the O-ring on the large diameter retainer.
   c. Install the retainers as described in section 5.1-6, steps 17, 18, and 21. Torque all retainers as shown in Figure 9.

If you are going to replace components in addition to those described above, the cylinder must be removed from the mast. Continue as follows.

8. Remove the hose at the cylinder. Be prepared to collect oil.
9. Cap the opening on the cylinder with a steel cap. Plug the hose.

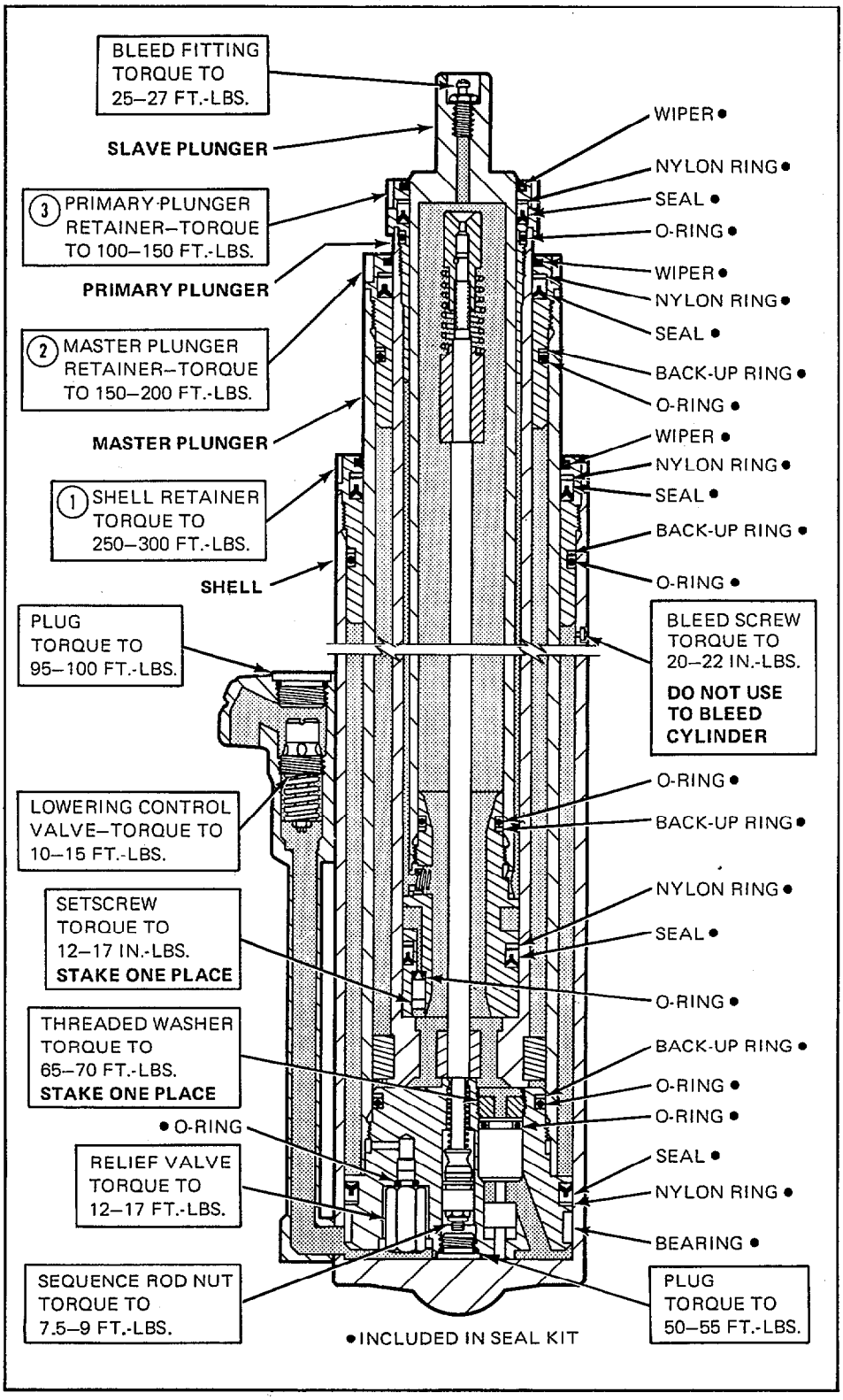


Figure 9. Hoist Cylinder Components

10. Using a lifting strap and hoist, remove the cylinder from the mast.
11. Lay the completely collapsed cylinder on 4 X 4's. NOTE: Cut 2 (two) 2" deep V-cuts in each 4 X 4.

5.1-6 Cylinder Disassembly, Service and Reassembly

1. Use a claw type spanner wrench to remove the cylinder shell retainer. (item 1, Figure 9).
2. Slide the master, primary, and slave plungers out of the cylinder shell as an assembly.
3. Before removing the master plunger piston first remove the O-ring plug at the bottom of the piston. Use a socket wrench to remove the sequence valve rod nut shown in Figure 10.

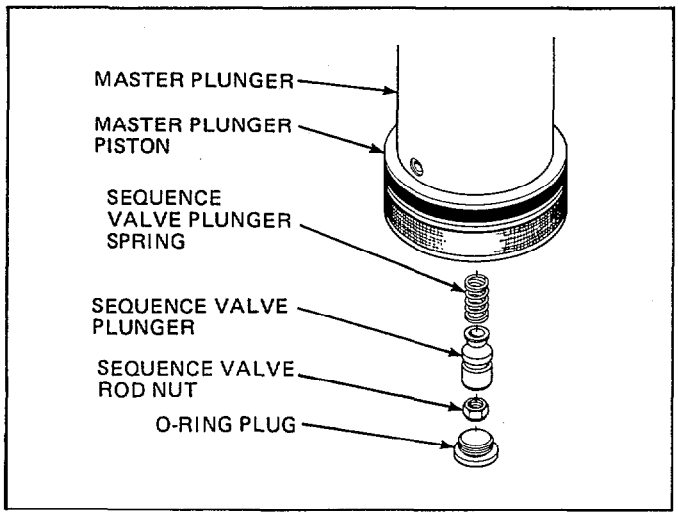


Figure 10. Sequence Valve Plunger Assembly

4. To remove the piston, depress the plug protruding through a hole at the base of the master plunger with a screwdriver or a punch. See Figure 11. Use a spanner wrench to unscrew and remove the piston from the plunger. You may need a helper to hold the plunger with a strap wrench. NOTE: When you have turned the piston the first 180°, use your screwdriver or punch to prevent the plug from snapping into the hole on the other side of the plunger. Be prepared to catch the sequence valve plug, spring, spacer, and ball when you remove the piston from the plunger.

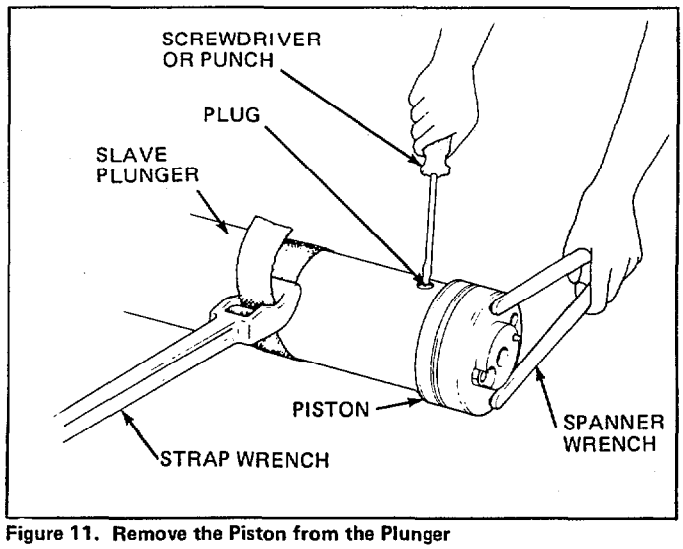


Figure 11. Remove the Piston from the Plunger

5. Remove the two remaining retainers (items 2 and 3, Figure 9) with a claw type spanner wrench. Pull the master, primary, and slave plungers apart.
6. To remove the slave plunger piston, depress the plug protruding through the hole near the base of the slave plunger with a screwdriver or a punch. See Figure 11. Use a spanner wrench to unscrew and remove the piston. Also remove the sequence valve rod and component pieces at this time.
7. Remove all seals from the pistons and the three retainers.

   CAUTION: To prevent damage to the pistons, pry up the seals using a dull screwdriver. Cut the seals with wirecutters or a knife. DO NOT SCRATCH THE GROOVE.
8. Remove the threaded washer and setscrew retaining the check valves in the pistons. See Figure 12. The washer and setscrew are staked in one place. Unstake them and remove the valves.

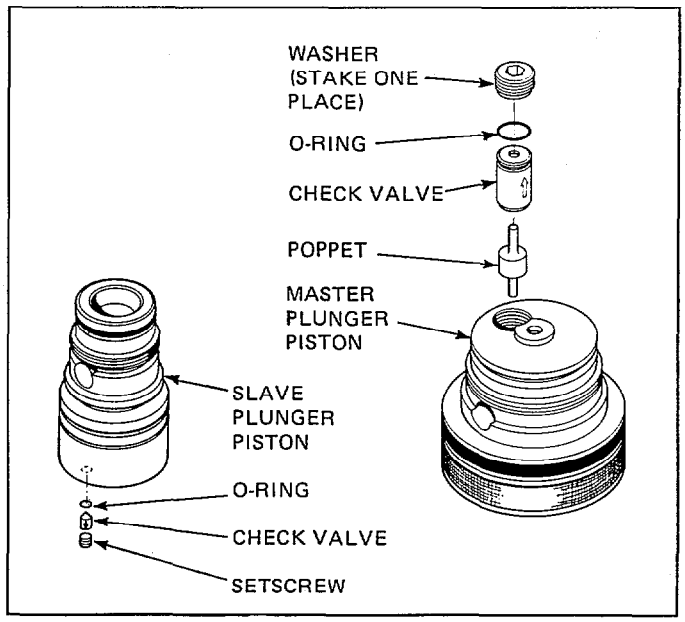


Figure 12. Check Valve Assembly

9. Remove the relief valve located on the bottom of the master plunger piston. See Figure 13. It is recommended that the relief valve be replaced.
10. Thoroughly clean the piston, retainers, and all loose parts.
11. Check the plunger inside diameter, retainers, and pistons for any nicks or burrs. Remove burrs and minor nicks with an emery cloth or butterfly. NOTE: Minor nicks are those that will not bypass oil when under pressure.

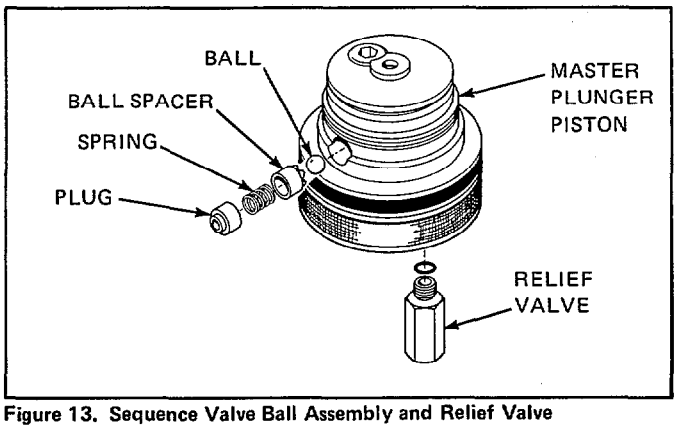


Figure 13. Sequence Valve Ball Assembly and Relief Valve

5.1-6 Cylinder Disassembly, Service and Reassembly (Cont.)

12. Lubricate the new seal kit with STP and install the seals according to Figure 9.
13. Install the new O-rings on the check valves and reinstall the check valve components on the pistons. See Figure 12.

    IMPORTANT: Make sure you reinstall the check valve with the arrows (stamped on the valve body) pointing as Shown in Figure 12.
14. Install the sequence valve rod spring, spacer and adjusting nut on the rod, if they were disassembled. Tighten the nut until a measurement of 2.80" is attained from the bottom of the spring to the top of the nut. See Figure 14. Install a new cotter pin and bend the pin ends around the nut. Slide the assembly into the slave plunger.

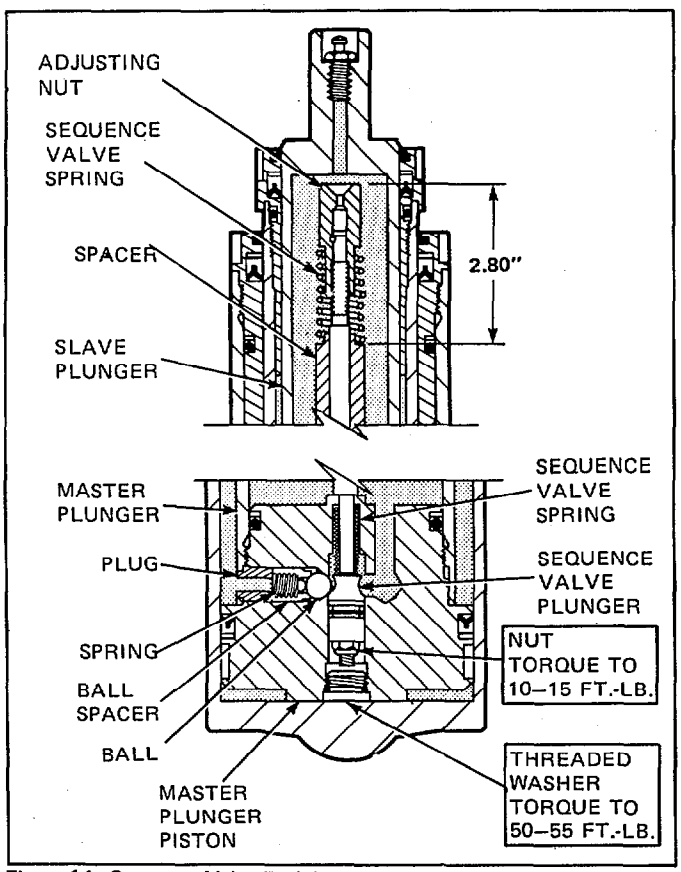


Figure 14. Sequence Valve Rod Assembly

15. Reinstall the ball, ball spacer, spring and plug in the master plunger piston. See Figure 13. Make sure the ball seats correctly.
16. Screw the piston into the master plunger. As the piston is threaded on, the plug will snap into one of the two holes in the plunger. Use a screwdriver or punch to push the plug in and keep turning the piston until it seats. Then back off no more than 1/2 turn until the plug snaps into one of the holes. See Figure 11.

    Install the relief valve on the master plunger piston and tighten to a torque of 12–17 ft.-lbs.

> **WARNING:** Make sure the plug is securely in the plunger hole. Failure to do this can cause the cylinder piston to work loose inside the cylinder.

17. Place the 4.50" O.D. retainer loader over the end of the master plunger. Apply a thick film of petroleum jelly to the loader and inner surface of the cylinder shell retainer. Load the retainer onto the master plunger then remove the loader.

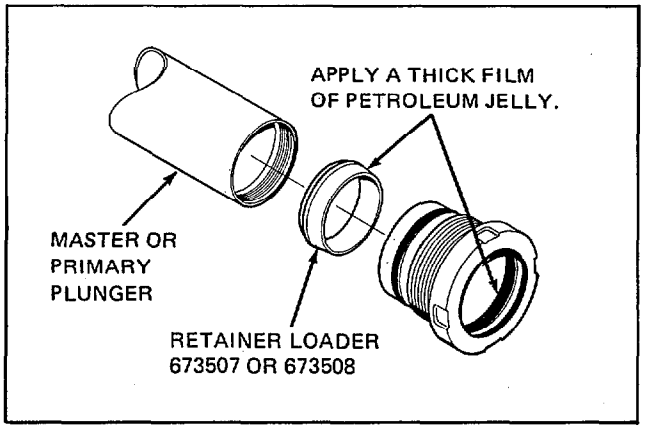


Figure 15. Retainer Loader

18. Place the 3.25" O.D. retainer loader over the end of the primary plunger. Apply a thick film of petroleum jelly to the loader and inner surface of the master plunger retainer. Load the retainer onto the primary plunger. See Figure 15.
19. Slide the primary plunger into the master plunger. Tighten the retainer to a torque of 150-200 ft.-lbs.
20. Place the sequence rod assembly in the primary plunger with the threaded end through the master plunger piston. Install the sequence valve spring, plunger and nut onto the rod through the bottom of the master plunger piston. Tighten the nut to a torque of 7.5–9 ft.-lbs. See Figure 14. Install the threaded washer and tighten to a torque of 50–55 ft.-lbs. **STAKE THE WASHER IN PLACE!**
21. Place the 2.50" O.D. retainer loader over the end of the slave plunger. Apply a thick film of petroleum jelly to the loader and inner surfaces of the primary plunger retainer. Load the retainer onto the slave plunger. See Figure 16.

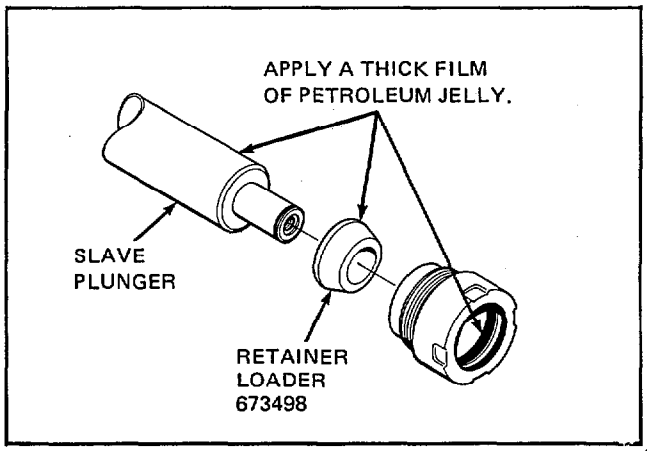


Figure 16. Retainer Loader

22. Assemble the spring and plug and insert them into the slave plunger piston. Screw the slave plunger piston into place. Tighten the piston until it seats, then back off until the plug pops into a plunger hole.

5.1-6 Cylinder Disassembly, Service and Reassembly (Cont.)

WARNING: Make sure the plug is securely in the plunger hole. Failure to do this can cause the cylinder piston to work loose inside the cylinder.

23. Slide the slave plunger into the primary plunger. Tighten the retainer to a torque of 100–150 ft.-lbs.

24. Place the 5.25" I.D. piston loader in the cylinder shell. The loader must cover all of the threads but not contact the thread relief chamfer. The length of the stop fins can be trimmed with a sharp knife if more engagement is needed. The piston will not enter the shell if the loader contacts the thread relief chamfer. Apply petroleum jelly to the master plunger seals and loader I.D. Slide the master plunger into the cylinder shell. Tighten the retainer to a torque of 250–300 ft.-lbs. See Figure 17.

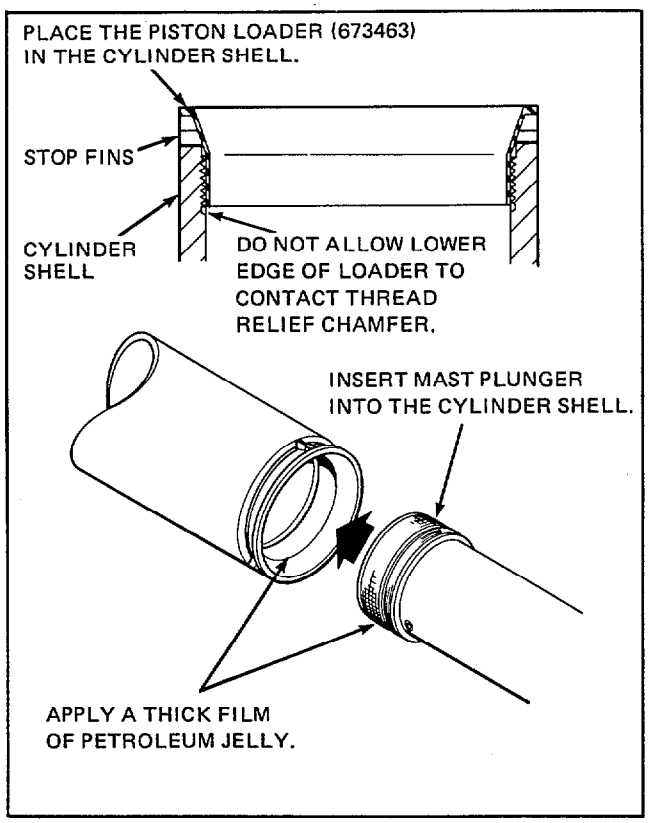
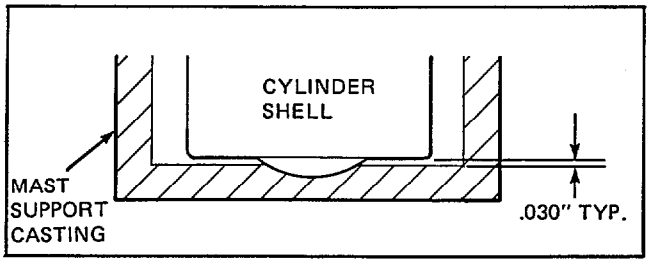


Figure 17. Master Plunger Loader

25. To install the cylinder on the mast, reverse the removal instructions, Section 5.1-5.
CAUTION: Be sure the cylinder is properly seated in the mast support casting, with the pin in the hole.



5.1-7 Bleeding the Cylinder

Before the mast is put in service, air must be bled from the hoist cylinder according to the following procedures. **Do not use bleed screw on side of cylinder shell to bleed air.**

1. Assemble the forks (or attachment) onto the mast carriage.
2. Without a load on the forks, extend and retract the mast through one complete cycle.
3. With the mast fully lowered, check the truck hydraulic tank and top off if necessary.
4. Extend and retract the mast completely at least four more times. This action will force air in the system to the center cavity under the bleed fitting. Leave the mast in the extended position 20–30 minutes prior to lowering and bleeding.
5. Extend the carriage to about 10 inches off the ground.
6. The Customer User Kit 668677 includes a metal hex tube wrench 661507 and a length of clear plastic hose 661922. Slide the plastic hose through the hex tube wrench and onto the bleed fitting located at the top of the cylinder crosshead. Put the other end of the tube in a container to collect oil. See Figure 18.

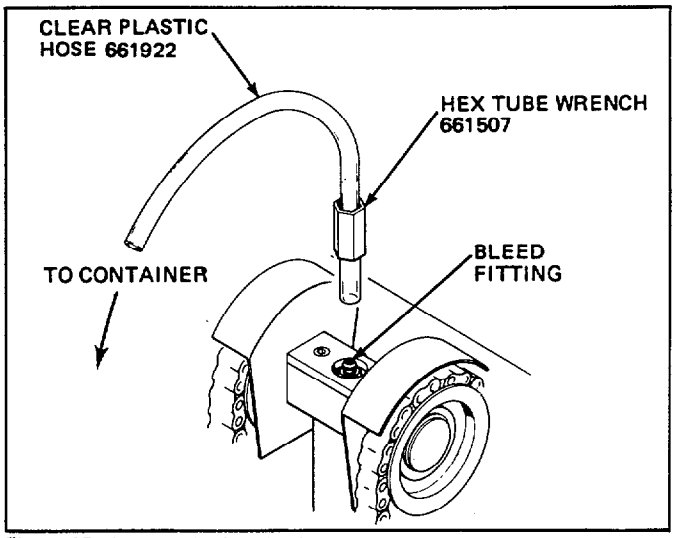


Figure 18. Hoist Cylinder Bleed Kit

CAUTION: Stay clear of the carriage and the forks or attachment.

7. Open the bleed fitting no more than 1/4 turn with the hex tube wrench. The weight of the carriage will force air and hydraulic oil out of the cylinder through the bleed fitting.
8. If the carriage reaches the bottom of its travel before all the air is bled, close the bleed fitting and repeat Steps 5 through 7.
9. When the oil stream no longer contains air bubbles, close the bleed fitting and torque to 25–27 ft.-lb.
10. Top off the truck hydraulic tank with clean, fresh oil.
11. Extend and retract the mast completely.
NOTE: Normal mast bounce is approximately 2" between the uprights or a total of 6" at the carriage. If mast bounce exceeds this repeat steps 2 through 10.

5.1-8 Cylinder Sequencing

WARNING
Never work on the hoist cylinder with a load on the forks or attachment, or while anyone is near the lift truck control handles.

Before putting the mast in service, operate the mast through a few complete cycles and check for proper sequencing.

The hoist cylinder is comprised of three plungers: primary, master, and slave. See Figure 19. When the mast is actuated from the fully lowered position, the primary plunger should extend from within the master plunger to the end of its stroke. Then the master and slave plungers should extend simultaneously to the end of their strokes.

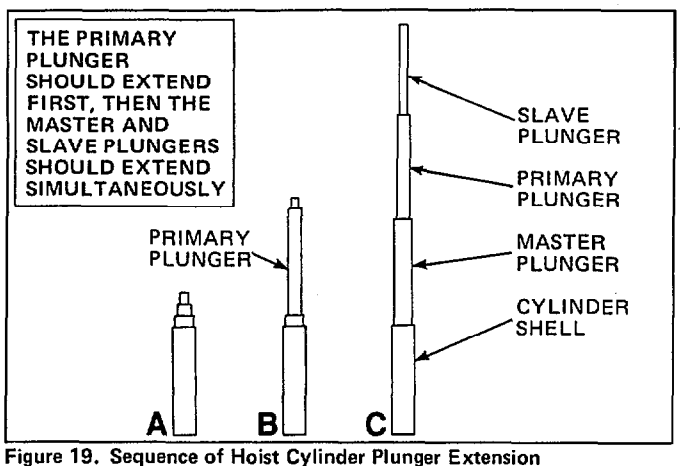


Figure 19. Sequence of Hoist Cylinder Plunger Extension

When the cylinder is lowered from the fully extended position, the slave and master plungers should completely lower simultaneously, then the primary plunger should lower. (Depending upon mast lifting height, the plungers may not completely retract into the cylinder shell.)

The sequencing of the hoist cylinder is controlled by an internal sequence valve. If the plungers **do not sequence properly,** then adjust the sequence valve as follows:

CAUTION
Before proceeding, make sure the cylinder is fully lowered.

1. Remove the bleed fitting at the top of the slave plunger.
2. Insert a 3/16-inch, long handle, hex socket wrench 662611 into the bleed hole and engage the adjusting nut.
3. Turn the adjusting nut counterclockwise until it bottoms. The nut is crimped slightly to prevent free-turning so it may be a little stiff. **Don't force the nut after it bottoms.** See Figure 20.

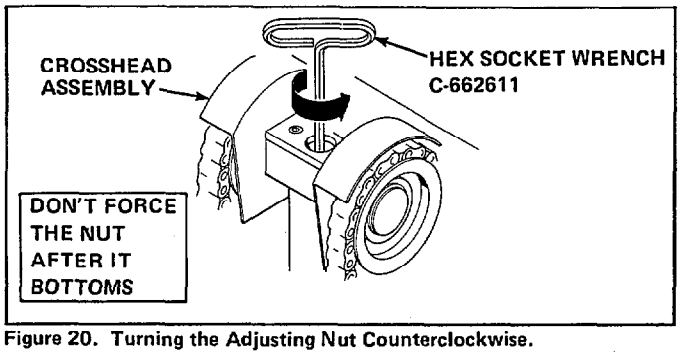


Figure 20. Turning the Adjusting Nut Counterclockwise.

Turn the adjusting nut clockwise two full turns to provide an initial adjustment. Remove the wrench and install the bleed fitting.

4. Operate the cylinder with about a half-capacity load to check for proper sequencing. If the slave plunger extends fast and the master plunger does not extend at all, the
5. sequence valve is not opening. Turn the adjusting nut clockwise **one turn only.** Reinstall the bleed fitting and retest. Continue this process until the cylinder sequences properly. See Figure 19.

NOTE: The adjusting screw has a capacity of approximately 13 turns.

6. As soon as the cylinder sequences properly, turn the adjusting nut clockwise **one more turn only** to assure a positive adjustment.
7. Extend and retract the cylinder completely. If it does not operate smoothly or if it appears to be "spongy", bleed air from the cylinder as specified in paragraph 5.1-7.

5.1-9 Crosshead Adjustment

The sum total clearance between the tire shoulders and the Mast I-Beam must be .060" as shown in Figure 21. If one tire is touching the I-Beam (which is acceptable) the other tire should have .060" clearance.

Adjust the Crosshead to attain the clearance as follows.

1. Loosen the hex locking nut. See Figure 21.
2. Use a hex socket wrench to turn the shaft to attain the clearance shown in Figure 21.
3. Tighten the hex locking nut to a torque of 30–35 ft.-lbs.

CAUTION
Insufficient tightening can result in the tire loosening and the crosshead jamming between the I-Beams.

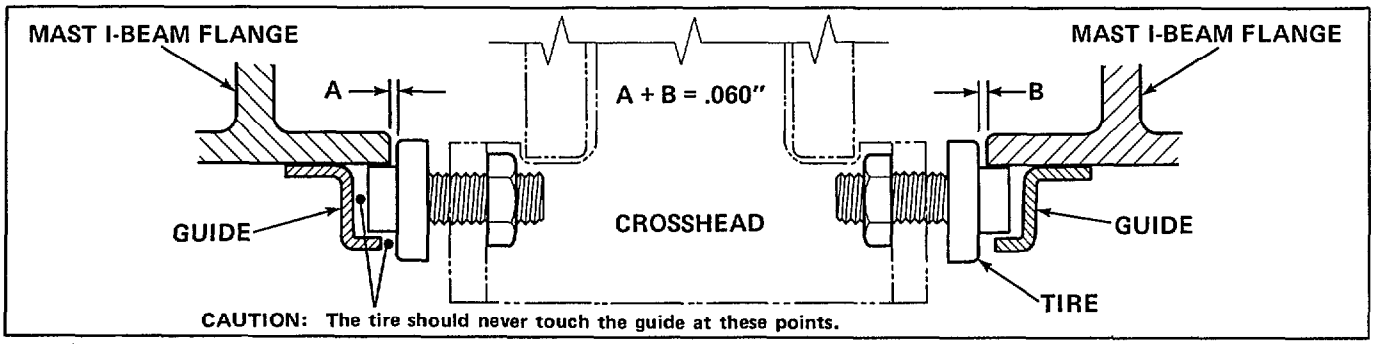


Figure 21. Crosshead Adjustment

5.2 Carriage

5.2-1 Description

The carriage, shown in Figure 22 , is the structure to which hook-type forks or the attachment is attached. The carriage travels within the channels of the mast inner upright on six, shim-adjustable load rollers. The two upper load rollers are secured to their stub shafts by keepers; the four lower load rollers are held in place by the inner channel when the carriage is assembled onto the mast. All six load rollers are interchangeable. A pair of adjustable chain anchors are used to connect the carriage chains to the carriage.

5.2-2 Carriage Removal

The carriage may be removed with the mast installed on the truck according to the following procedures.

1. Lift the carriage to gain access to the carriage stop screws on the inner upright. See Figure 23. Screw in the stop screws to clear the stop bar on the carriage.
2. Block the carriage off the ground and lower the mast to slacken the carriage chains. Connect a sling to the carriage and secure it with some suitable lifting device.

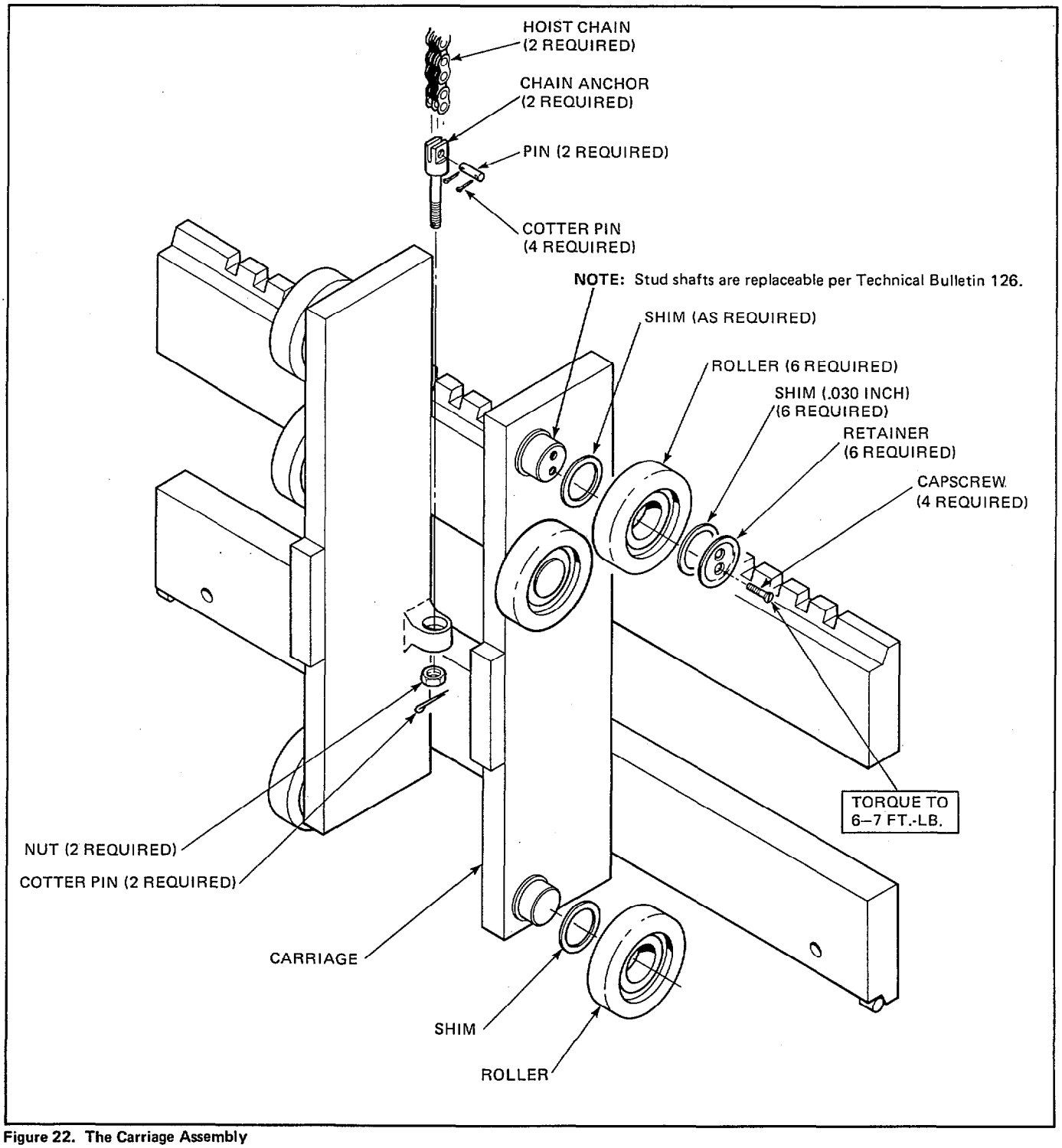


Figure 22. The Carriage Assembly

5.2-2 Carriage Removal (Cont.)

3. Remove the cotter pins and pin retaining the chains to the chain anchor on the carriage weldment. See Figure 22.
4. Power the hoist cylinder to extend until the inner upright channel clears the carriage load rollers. Back the truck away from the carriage. (If the hoist cylinder is inoperative, raise the inner upright channel with a hoist, crane, or some other suitable lifting device.)

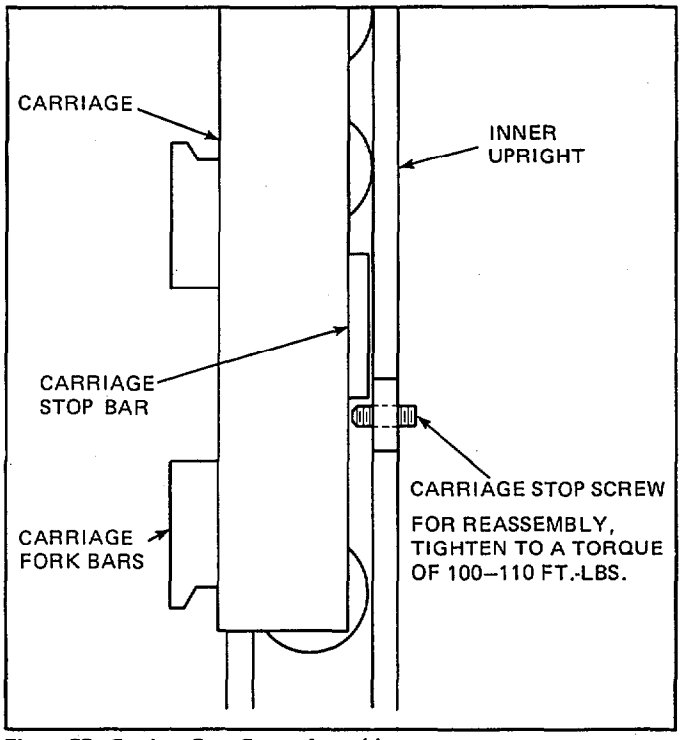


Figure 23. Carriage Stop Screw Assembly

5.2-3 Cleaning and Inspection

1. Remove the load rollers and thoroughly clean the carriage assembly with cleaning solvent. **Note the number of shims on the rollers so that an appropriate number of shims can be installed during reassembly.**
2. Inspect the rollers for excessive wear or damage. Roller assemblies with visible flat spots or cracks should be replaced.
3. Inspect the roller bearings by turning the rollers on their shafts. Roller assemblies with roughness or noticeable restrictions to turning should be replaced.
4. Inspect all welds between the carriage side plates and the carriage fork bars. If any weld seams are cracked, replace the carriage.
5. Inspect the 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. Refer to Technical Bulletin 126 for stub shaft replacement.
6. Inspect the carriage hoist 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 chains.
   - Check for tight joints. If tight joints are caused by rust or corrosion, loosen them with SAE 30 oil or penetrating oil. If they cannot be loosened or if tight joints are caused by bent pins or plates or by peened plate edges, replace **both** strands of chains.
   - Check for protruding or turned pins. Replace **both** strands of chains.
   - Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment of sheaves, anchors, or other components. Correct the misalignment. If wear is excessive, replace **both** strands of chains.
   - Check for worn, broken, or misaligned chain anchors. Replace or adjust as required.

5.2-4 Carriage Installation (with the mast installed on the truck)

1. Make sure the inner upright channel members are lubricated with chassis lube or Kendall SR-12X (Cascade part number 599474). See Figure 24.

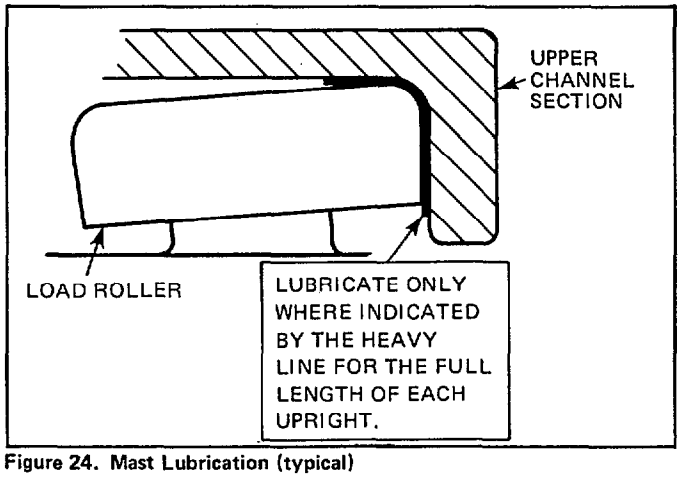


Figure 24. Mast Lubrication (typical)

2. Assemble the load rollers onto their stub shafts using an appropriate number of shims. See Figure 22. The shims should be installed to provide a total clearance no looser than 0.030 inch at the tightest point throughout the travel of the carriage. Refer to Section 5.3-12 for load roller shimming.
3. With a sling, position the carriage assembly in place on blocks in front of the mast.
4. Raise the inner upright sufficiently for the carriage load rollers to be fitted within the inner upright channels. Lower the inner upright over the carriage.
5. Lift the carriage the full length of the inner upright channel and check side play and freedom of movement. Adjust load roller clearance as specified in step 2.
6. Thread in the carriage stop screw assemblies. See Figure 23. Tighten to a torque of 100–110 ft.-lbs.

   CAUTION: Failure to thread in the stop screw assemblies can cause the mast uprights to sequence incorrectly.
7. Install the carriage hoist chains.
8. Lower the carriage and check and adjust the load chains as shown in Section 5.2–5.
9. Check the total freedom of the carriage movement as described in Section 5.3-10, step 7.

5.2-5 Carriage Chain Adjustment

The carriage hoist chains should be adjusted so that when the unloaded mast is fully lowered, the carriage is positioned as shown in Figure 25.

To adjust the carriage chains:

1. Locate the adjusting nuts on the carriage. See Figure 26.
2. Adjust one carriage chain to achieve the correct carriage position when fully lowered, as shown in Figure 25.
3. Adjust the other carriage chain to achieve equal chain tension.

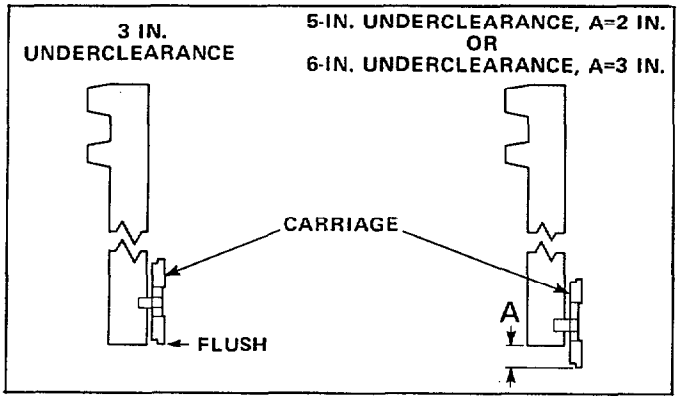


Figure 25. Correct Carriage Positions when Mast is Fully Lowered

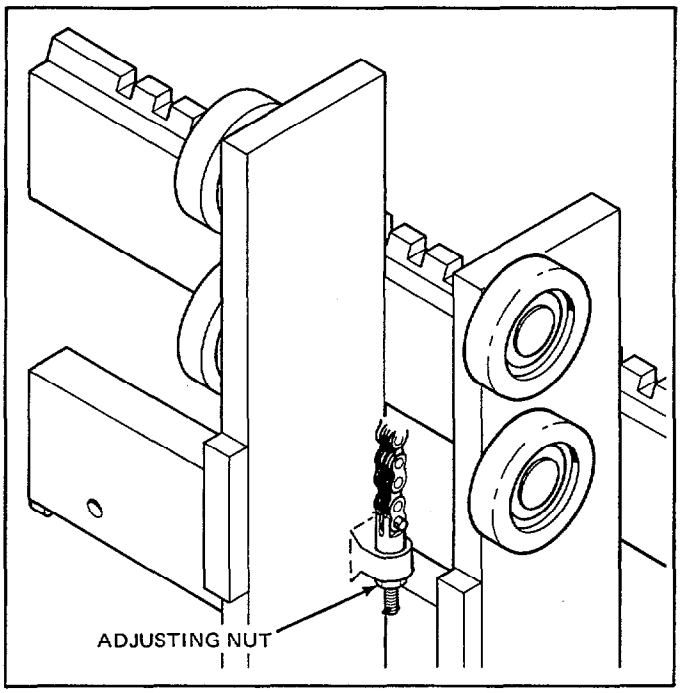


Figure 26. Carriage Chain Adjusting Nut

5.3 Mast Upright Assembly

5.3-1 Upright Description

The Quad Viewmast®II is comprised of four upright assemblies: outer, outer intermediate, inner intermediate, and inner. See Figure 27.

1. Outer Upright Assembly
   The outer upright is mounted to the truck. A pair of shim-adjustable load rollers fits onto stub shafts which are mounted on removable plates. See Figure 27. Non-adjustable chain anchors are also located on each plate. A pair of urethane cushions are attached to the lower crossmember to provide a cushion for the outer intermediate upright when the mast is fully lowered.

2. Outer Intermediate Upright Assembly
   The outer intermediate upright assembly telescopes within the outer upright assembly. A pair of shim adjustable load rollers is attached to canted stub shafts at the top of the upright and a pair is attached near the bottom of the upright. In addition, a pair of chain sheaves is located near the bottom of the intermediate upright to provide a rolling surface for the hoist chain. A pair of non-adjustable chain anchors are located on the top crossmember. Bearing blocks (item 15, Figure 27) and capscrews located on each side of the upright at the bottom **limit** the outer intermediate upright assembly when the mast is extended and tilted back. These blocks are movable to provide the tightest fit. A cushion is attached to the outer intermediate upright lower crossmember to cushion the inner intermediate upright when the mast is fully lowered.

3. Inner Intermediate Upright Assembly
   The inner intermediate upright assembly telescopes within the outer intermediate upright assembly. A pair of shim adjustable load rollers is attached to canted stub shafts at the top of the upright and a pair is attached at the bottom of the upright. In addition, a pair of chain sheaves is located on the back side of the upright to provide a rolling surface for the hoist chain. A pair of adjustable chain anchors is located near the bottom of the upright. The hoist cylinder rests on a cradle which is integral with the lower crossmember of the inner intermediate upright assembly.

4. Inner Upright Assembly
   The inner upright assembly telescopes within the inner intermediate upright assembly. A pair of shim-adjustable load rollers is attached to canted stub shafts near the bottom of the assembly. A pair of adjustable chain anchors is located on the middle crossmember of the inner upright assembly to which the hoist chains are attached. In addition, a pair of non-adjustable chain anchors is located on the middle crossmember to which the carriage hoist chains are attached.

5. Mast Operation
   Figure 28 illustrates diagrammatically the operation of the Quad Viewmast® II.

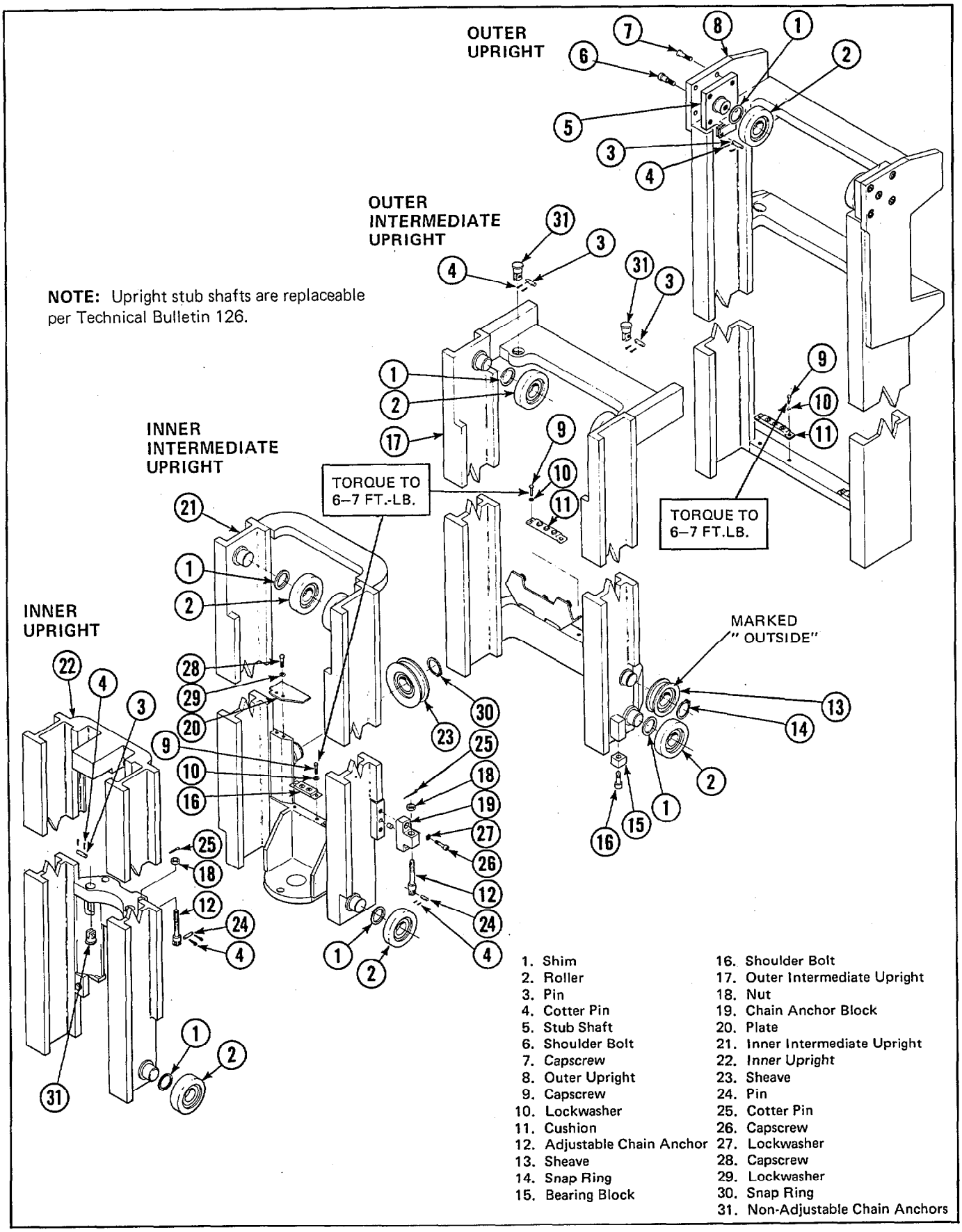
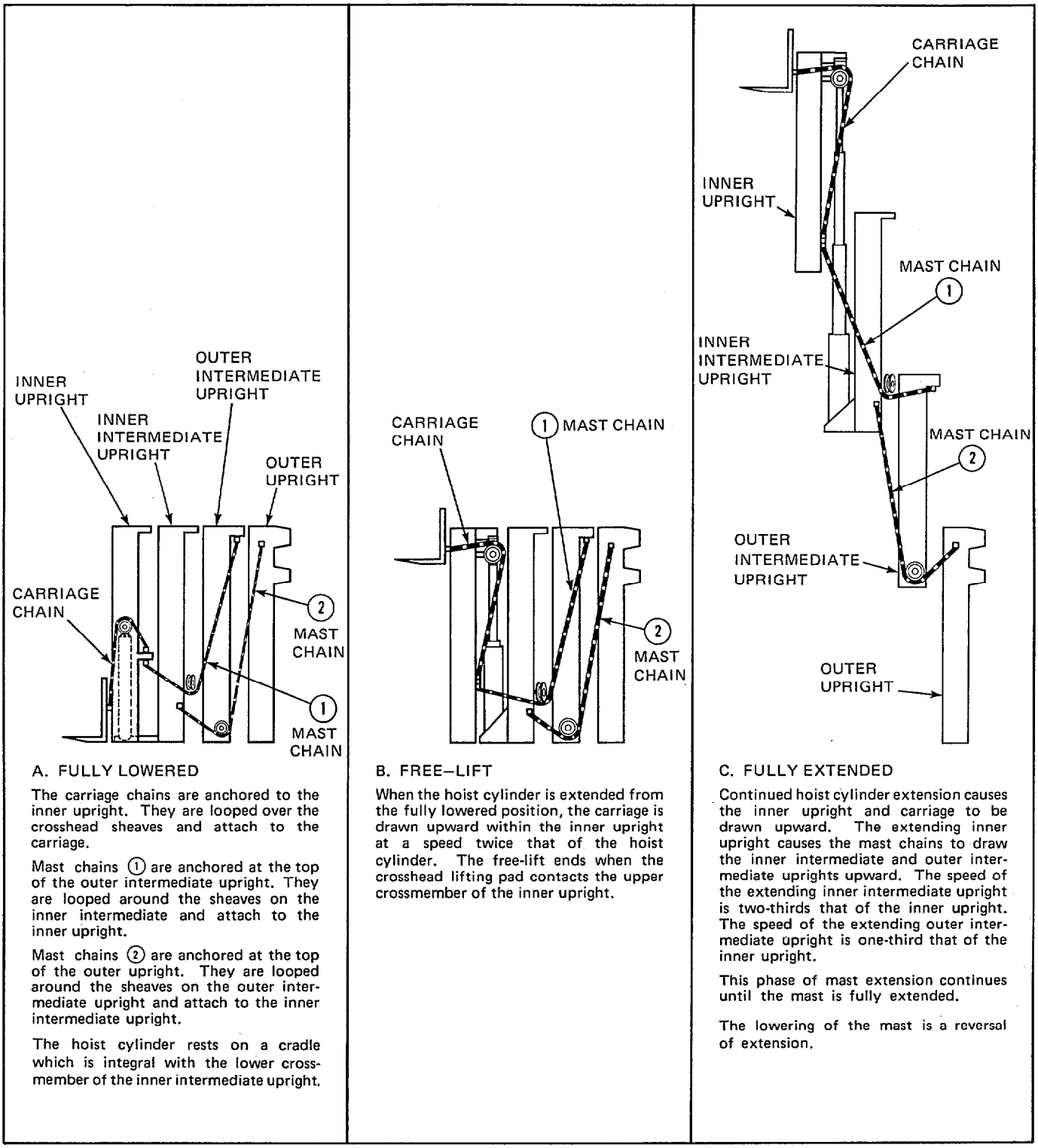


Figure 27. Exploded View of Mast Upright Assembly

5.3-1 Upright Description (Cont.)



A. FULLY LOWERED

The carriage chains are anchored to the inner upright. They are looped over the crosshead sheaves and attach to the carriage.

Mast chains (1) are anchored at the top of the outer intermediate upright. They are looped around the sheaves on the inner intermediate and attach to the inner upright.

Mast chains (2) are anchored at the top of the outer upright. They are looped around the sheaves on the outer intermediate upright and attach to the inner intermediate upright.

The hoist cylinder rests on a cradle which is integral with the lower crossmember of the inner intermediate upright.

B. FREE–LIFT

When the hoist cylinder is extended from the fully lowered position, the carriage is drawn upward within the inner upright at a speed twice that of the hoist cylinder. The free-lift ends when the crosshead lifting pad contacts the upper crossmember of the inner upright.

C. FULLY EXTENDED

Continued hoist cylinder extension causes the inner upright and carriage to be drawn upward. The extending inner upright causes the mast chains to draw the inner intermediate and outer intermediate uprights upward. The speed of the extending inner intermediate upright is two-thirds that of the inner upright. The speed of the extending outer intermediate upright is one-third that of the inner upright.

This phase of mast extension continues until the mast is fully extended.

The lowering of the mast is a reversal of extension.

Figure 28. Mast operation

5.3-2 Crosshead Description

The crosshead, shown in Figure 29, is attached to the top of the hoist cylinder. Rollers attached to the crosshead move within guides on the inner upright assembly to guide the hoist cylinder as it extends and retracts. A pair of chain sheaves attached to the crosshead provide a rolling surface for the carriage hoist chains.

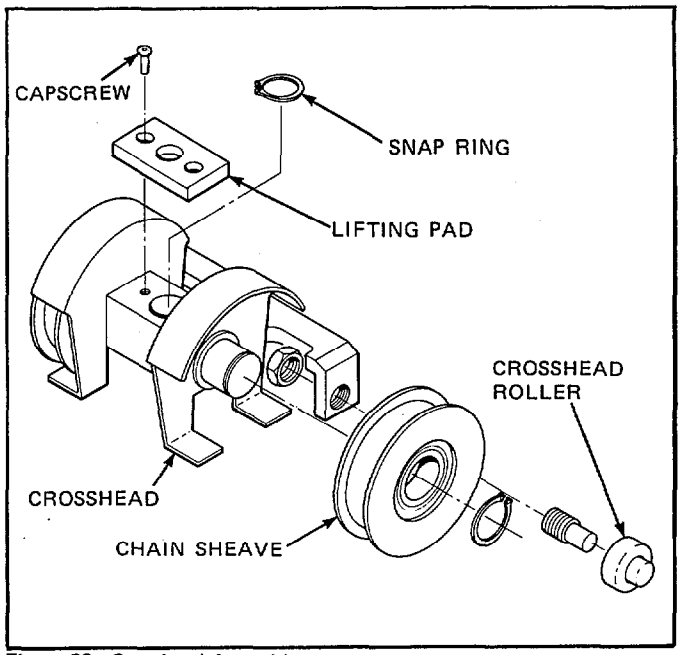


Figure 29. Crosshead Assembly

5.3-3 Mast Removal

WARNING: Never work on the mast with a load on the forks or attachment or while anyone is near the lift truck control handles.

1. Make sure the mast is fully lowered. Make sure the mast is straight up (not tilted forward or backward).
2. Remove the forks or attachment from the mast carriage. Remove any auxiliary equipment that would interfere with mast removal.
3. Remove the truck auxiliary hose from the hoist cylinder hose. See Figure 30. Be prepared to collect oil. Cap the cylinder hose and plug the truck auxiliary hose.
4. Loosen the hoist cylinder bleed screw no more than required to bleed off any hydraulic pressure that may remain in the cylinder. The bleed screw is located on the cylinder shell just below the retainer. Tighten the screw.
5. Wrap a link chain twice around the four upper mast channel crossmembers and secure with a hoist, crane, or some other suitable lifting device.
6. Disconnect the tilt cylinders from the tilt cylinder anchor brackets.
7. Disconnect the mast base mounting brackets.
8. Lift off the mast and set it on a work surface with the carriage up. If the mast is equipped with a hose reel, block under the mast sufficiently to clear the reel, or remove the reel.

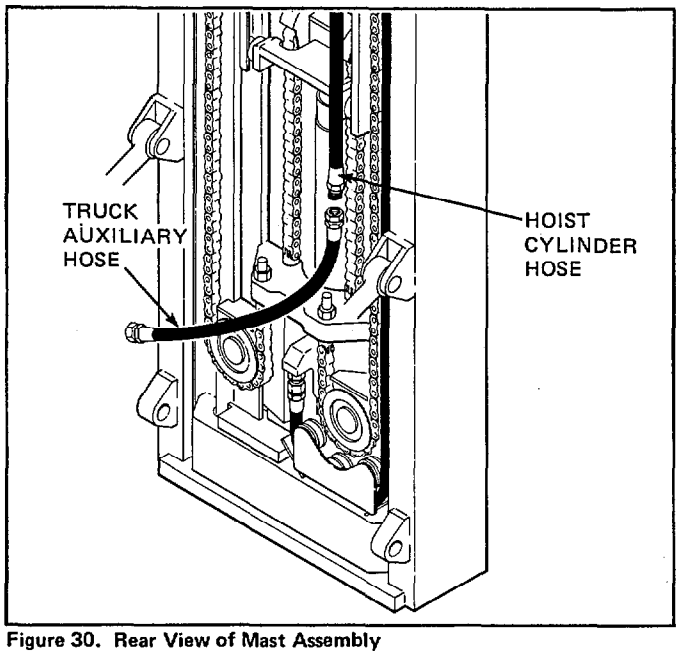


Figure 30. Rear View of Mast Assembly

5.3-4 Carriage Removal (with mast removed from the truck)

1. Connect a sling to the carriage and secure it with a suitable lifting device.
2. Remove the pins that secure the carriage hoist chains to the chain anchors located on the carriage weldment. See Figure 31.

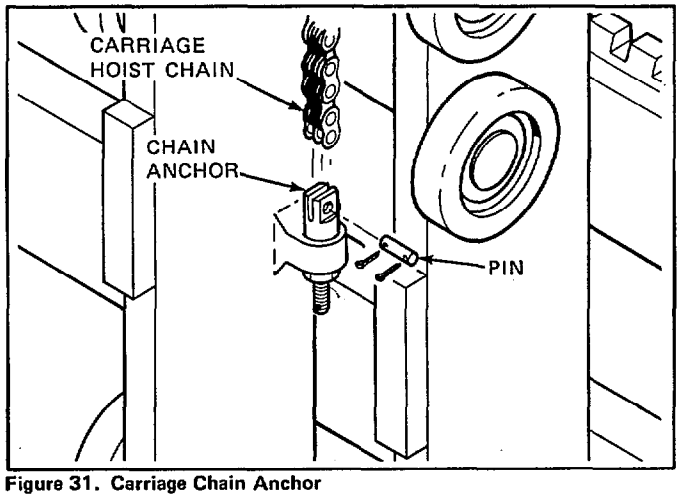


Figure 31. Carriage Chain Anchor

3. Move the carriage towards the top of the mast to gain access to the carriage stop screw. See Figure 23. Use an allen wrench to back the screw out enough to clear the stop bar on the carriage.
4. With the lifting device secured to the carriage, remove the carriage out the bottom of the mast assembly.
5. Remove the carriage hoist chains from the inner upright middle crossmember.
6. For carriage cleaning and inspection, refer to paragraph 5.2–3.

5.3-5 Crosshead and Cylinder Removal (with mast removed from the truck)

1. Remove the cylinder hose connected near the middle of the hoist cylinder. Be prepared to collect oil.
2. Connect a sling around the hoist cylinder and secure it with a suitable lifting device.
3. Remove the pad at the top of the cylinder crosshead. See Figure 29.
4. Pull the carriage hoist chains through the crosshead sheaves.
5. Remove the snap ring that retains the crosshead assembly to the hoist cylinder rod and remove the crosshead.
6. With the lifting device secured to the sling, lift the cylinder from the mast.
7. For cylinder service, refer to Section 5.1.

5.3-6 Upright Disassembly (with mast removed from the truck)

Refer to Figure 32.

> **WARNING:** Disassembly of the mast uprights with the mast mounted on the truck is NOT recommended.

1. Remove the carraige and hoist cylinder. Refer to Sections 5.3-4 and 5.3-5.
2. Manually extend the mast until the mast chain anchors on the inner upright are exposed.
3. Remove the pins that secure the mast chains to the chain anchors and remove the chain anchors from the inner upright. Back out the stop screws also located on the inner upright.
4. Roll the inner upright toward the top of the mast until the inner upright load rollers are exposed by the cutouts at the top of the inner intermediate upright.
5. Use a sling and hoist, (or some other appropriate lifting device) to lift the inner upright out of the inner intermediate upright and set it on a work surface.
6. Manually extend the inner intermediate upright until the hoist chain anchor blocks are exposed. Remove the pins that secure the hoist chains and remove the hoist chain anchors.
7. Roll the inner intermediate towards the top of the mast until the load rollers are exposed at the cutouts at the top of the outer intermediate.

   CAUTION: Pull on the hoist chains to keep them straight.

8. Use a sling and hoist (or some other appropriate lifting device) to lift the inner intermediate out of the outer intermediate upright. Set it on a work surface.
9. Remove the pins and chain anchors on the top crossmember of the outer intermediate upright. Remove the hoist chain.
10. Remove the capscrews securing the roller plate to the outer upright and remove the plate. NOTE: As you pull out the plate the hoist chain will come with it.
11. Use a sling and hoist (or some other appropriate lifting device) to slide the outer intermediate upright out of the outer upright.

5.3-7 Cleaning and Inspection

1. Remove the load rollers and chain sheaves from the uprights, carriage, and crosshead. Note the number of shims on the rollers so that an appropriate number of shims can be installed during reassembly.
2. Thoroughly clean the upright, carriage, and crosshead assemblies with cleaning solvent.
3. Inspect the rolling surfaces of the upright channels. Excessive wear, grooves, or scoring could be the result of faulty load rollers and/or improper mast lubrication.
4. Inspect the load rollers and chain sheaves. Roller and sheave assemblies with visible flat spots, excessive wear, or cracks should be replaced.
5. Inspect the load roller and chain sheave bearings by turning them on a shaft. Roller and sheave assemblies with roughness or noticeable restrictions to turning should be replaced.
6. Inspect the rollers on the crosshead. If they do not turn freely or are damaged or excessively worn, replace the roller assemblies. Torque the roller nut to 30—35 ft.-lbs.
7. Inspect the stub shafts. An assembly with a damaged stub shaft or a cracked stub shaft base should be repaired or replaced. Refer to Technical Bulletin 126 for stub shaft replacement.
8. Inspect the cushions on the lower crossmember of the upright channels. If the cushions are damaged, crushed, or missing, replace them.
9. Inspect the crosshead lifting pad. If it is damaged or crushed, replace it.
10. Inspect the hoist 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 chains.
    - Check for tight joints. If tight joints are caused by rust or corrosion, loosen them with SAE 30 oil or penetrating oil. If they cannot be loosened or if tight joints are caused by bent pins or plates or by peened plate edges, replace **both** strands of chains.
    - Check for protruding or turned pins. Replace **both** strands of chains.
    - Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment of sheaves, anchors, or other components. Correct the misalignment. If wear is excessive, replace **both** strands of chains.
    - Check for worn, broken, or misaligned chain anchors. Replace or adjust as required.

5.3-8 Upright Reassembly (with uprights lying horizontally)

1. Lubricate the full length of each upright channel with chassis lube or Kendall SR-12X (Cascade part No. 599474) as shown in Figure 33.
2. Assemble the upright load rollers onto their stub shafts using an appropriate number of shims. See Figure 32. These shims should be installed to provide a clearance no looser than 0.030 inch at the tightest point throughout the travel of the member. Refer to Section 5.3-12 for load roller shimming.
3. Assemble the mast chain sheaves and rollers on their stub shafts. See Figure 32.

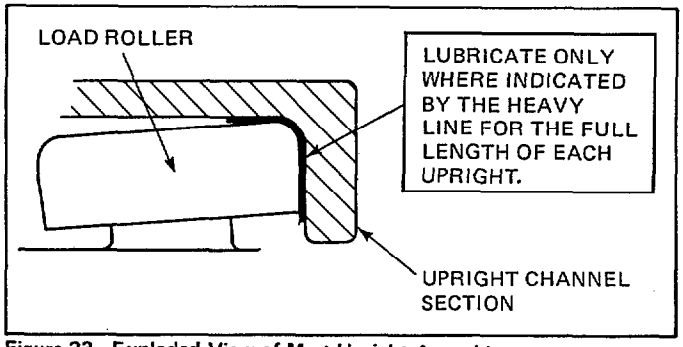


Figure 33. Exploded View of Mast Upright Assembly

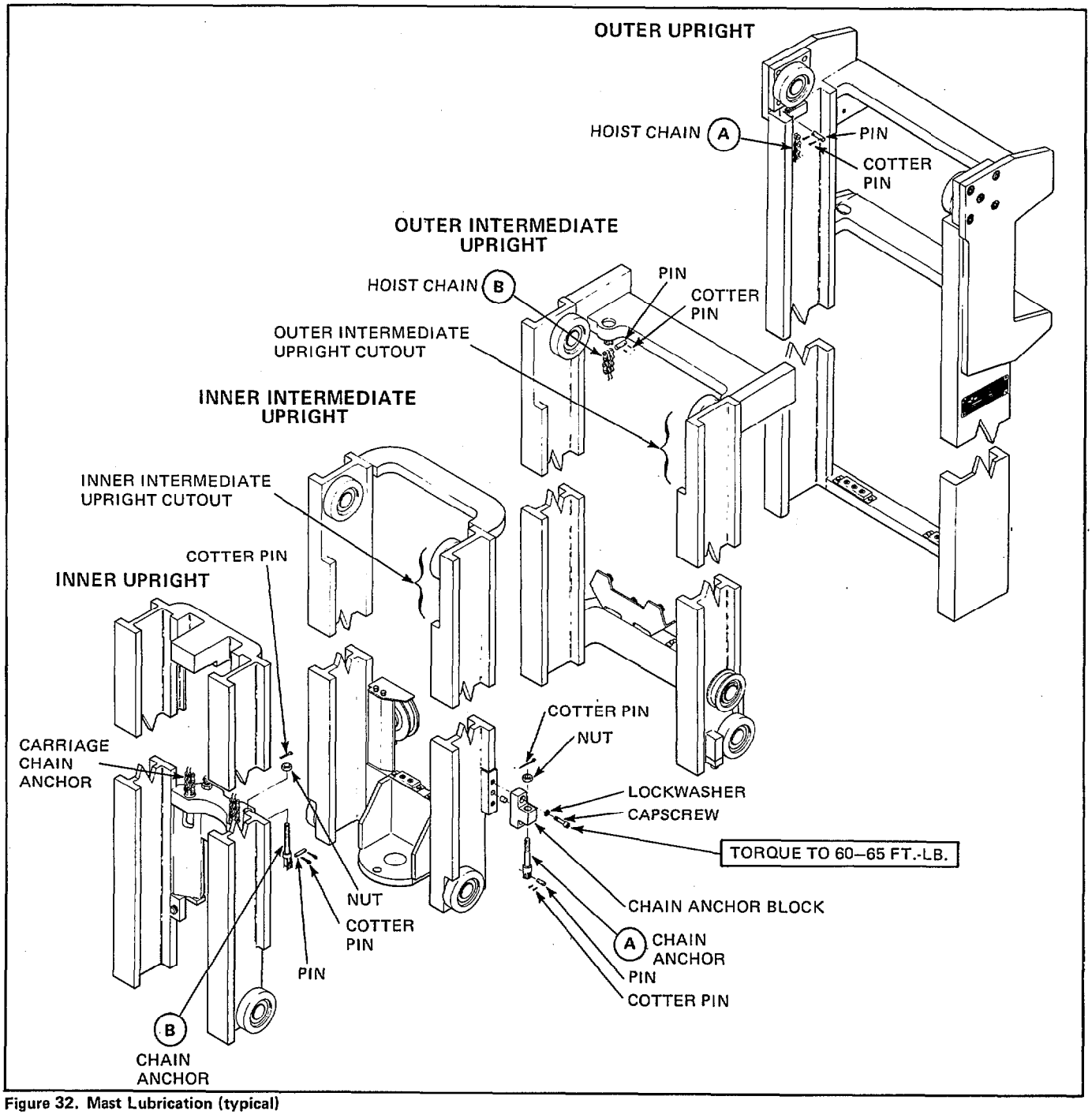


Figure 32. Mast Lubrication (typical)

5.3-8 Upright Reassembly (Cont.) (with uprights lying horizontally)

4. Use a sling and hoist (or some other appropriate lifting device) to position the outer intermediate upright near the top of the outer upright as shown in Figure 34.
5. Loop chains Ⓐ around the chain roller located near the bottom of the outer intermediate upright. Keep the chain taut as you slide the uprights together.
6. Connect chains Ⓐ to the outer upright roller plate anchors using new cotter pins. Install the plates to the outer upright. Tighten the capscrews to a torque of 55–60 ft.-lbs.
7. Connect chains Ⓑ to the outer intermediate upper crossmember using new cotter pins. See Figure 32.

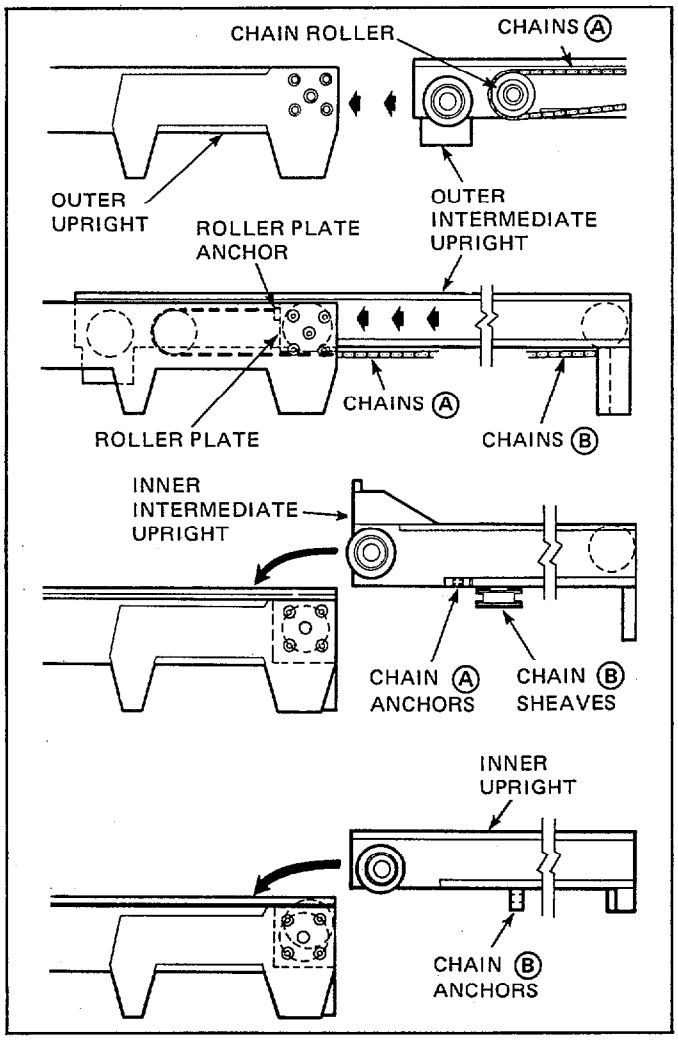


Figure 34. Upright Reassembly

8. Use a sling and hoist to position the inner intermediate upright at the top of the two assembled uprights. See Figure 34.
9. Loop chains Ⓑ around the chain Ⓑ sheaves on the inner intermediate upright. Keep the chains taut as you lower the upright into the outer intermediate and slide them together. Adjust load roller clearance no greater than .030 inch at the tightest point of member travel. Refer to Section 5.3–12.
10. Connect the loose end of chains Ⓐ to the inner intermediate upright chain Ⓐ anchors. See Figure 34.
11. Use a sling and hoist to position the inner upright over the three assembled uprights.
12. Lower the inner upright into the inner intermediate and slide the uprights together. Adjust load roller clearance no looser than 0.030 inch at the tightest point throughout the travel of the members. Refer to Section 5.3-12.
13. Connect chains Ⓑ to the chain Ⓑ anchors on the inner upright lower crossmember.
14. Manually retract the upright assembly. Check for side play and freedom of movement.

5.3-9 Crosshead and Cylinder Installation (with uprights lying horizontally)

1. Assemble the crosshead chain sheaves in place on the crosshead assembly. See Figure 35.

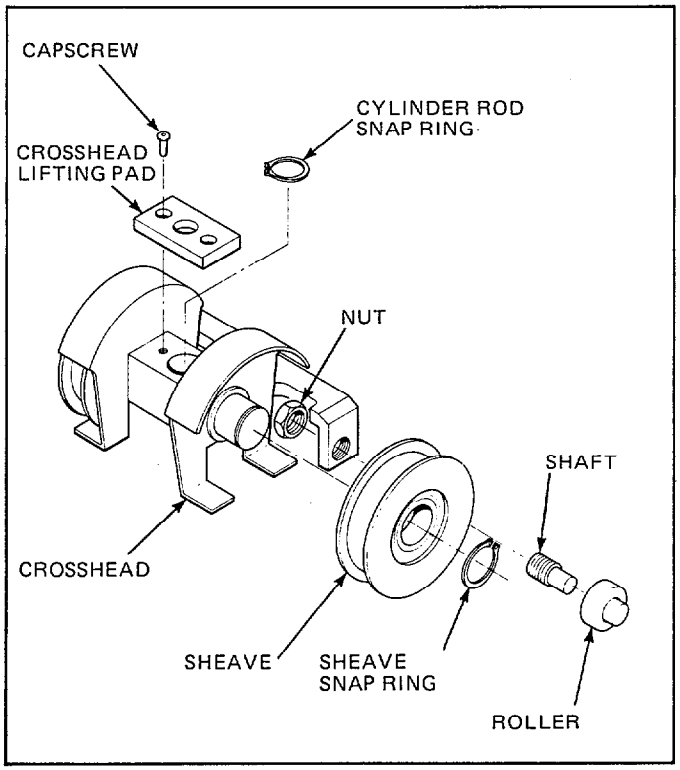


Figure 35. Crosshead Assembly

2. Connect the carriage hoist chains to the anchors on the inner upright crossmember. See Figure 32. Screw in the stop screws on the inner upright and tighten to a torque of 30–35 ft.-lbs.
3. Connect a sling around the hoist cylinder and secure it with a suitable lifting device.
4. Position the hoist cylinder in place in the bracket at the base of the inner intermediate upright.
5. Position the crosshead assembly in place at the top of the hoist cylinder. Make sure the crosshead rollers fit into their guides on the inner upright channels.
6. Secure the crosshead to the cylinder rod using the snap ring. Refer to Figure 35.
7. Install the crosshead lifting pad. Refer to Figure 35.

5.3-10 Carriage Installation (with uprights lying horizontally)

1. Assemble the carriage load rollers onto their stub shafts using an appropriate number of shims. See Figure 36. The shims should be installed to provide a clearance no looser than 0.030 inch at the tightest spot throughout its travel. Refer to Section 5.3-12 for load roller shimming.
2. Make sure the carriage stop screw assemblies are retracted. See Figure 37.
3. Connect a sling to the carriage. With a suitable lifting device, position the carriage in place through the bottom of the inner upright.

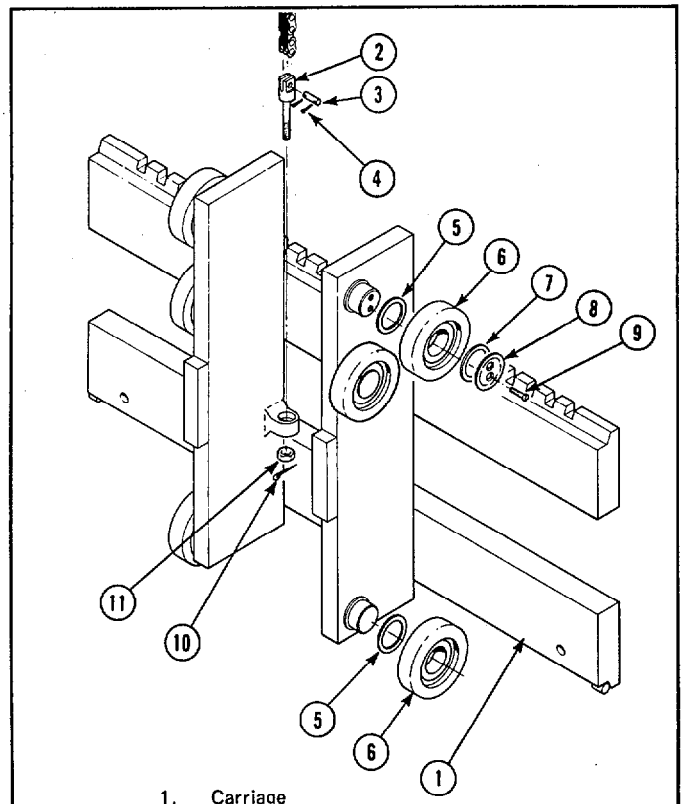


Figure 36. Carriage Assembly

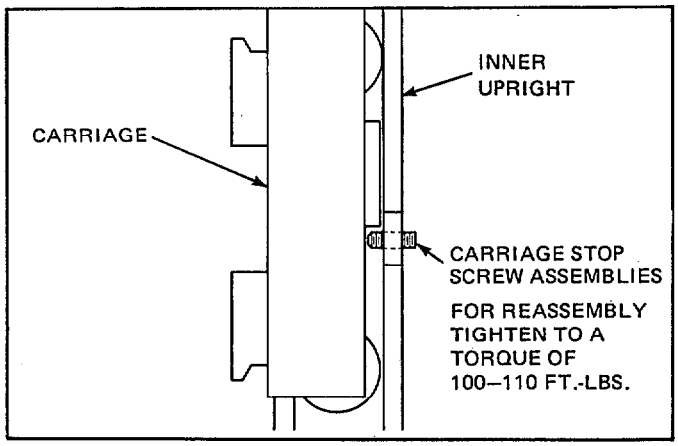


Figure 37. Carriage Stop Screw Assembly

4. Roll the carriage the full length of the inner upright channel and check side play and freedom of movement. Adjust the load roller clearances as specified in Step 1 above.
5. Thread in the carriage stop screw assemblies. See Figure 37.

   CAUTION: Failure to thread in the stop screw assemblies can cause the mast uprights to sequence incorrectly.
6. Roll the carriage chains over the crosshead sheaves and connect the chains to the carriage weldment.

5.3-11 Mast Installation

1. Clean and lubricate the bearing surfaces of the base and tilt cylinder mounting brackets with wheel bearing grease.
2. Lift the mast by a link chain wrapped twice around the four upper channel crossmembers.
3. Position the mast into place on the lift truck and secure the base mountings.
4. Connect the cylinder hose to the hoist cylinder.

> **IMPORTANT**
> Prior to connecting the tilt cylinders to the mast, make sure the cylinders bottom evenly. Adjust the tilt cylinders as required to prevent the mast from "racking."

5. Connect the tilt cylinders to the tilt cylinder anchor brackets.
6. Connect the truck auxiliary hose to the cylinder hose.
7. Perform the mast operational inspection and adjustments as described in Section 2.4.
8. Lower the carriage. Stand on left end of lower carriage bar. Measure distance between left bottom of carriage bar and ground. Stand on right end of lower carriage bar and measure distance at same point as before. The difference between the two measurements should not exceed ¼"± .06. See Figure 38.

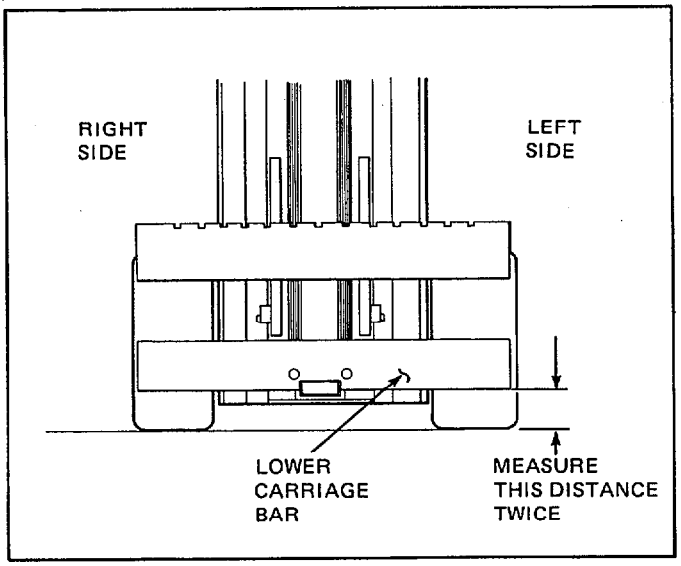


Figure 38. Measuring Carriage Looseness

5.3-12 Load Roller Shimming

Each pair of load rollers on the uprights and carriage should be shimmed so that a total clearance no greater than 0.030 inch occurs at the tightest point throughout the travel of the member. See Figure 39. This clearance will be achieved if each pair of rollers are shimmed the maximum amount that still permits assembly without mechanical assistance.

Install a pair of load rollers and use an equal number of shims on each side of the assembly (within one shim). A standard shim (631881) is 0.030 inch thick.

To check the clearance, pry between the upright and load roller as shown below so the opposite load roller is tight against the upright. Measure the clearance for the pair of load rollers at the XXX shown. Repeat for each pair of rollers.

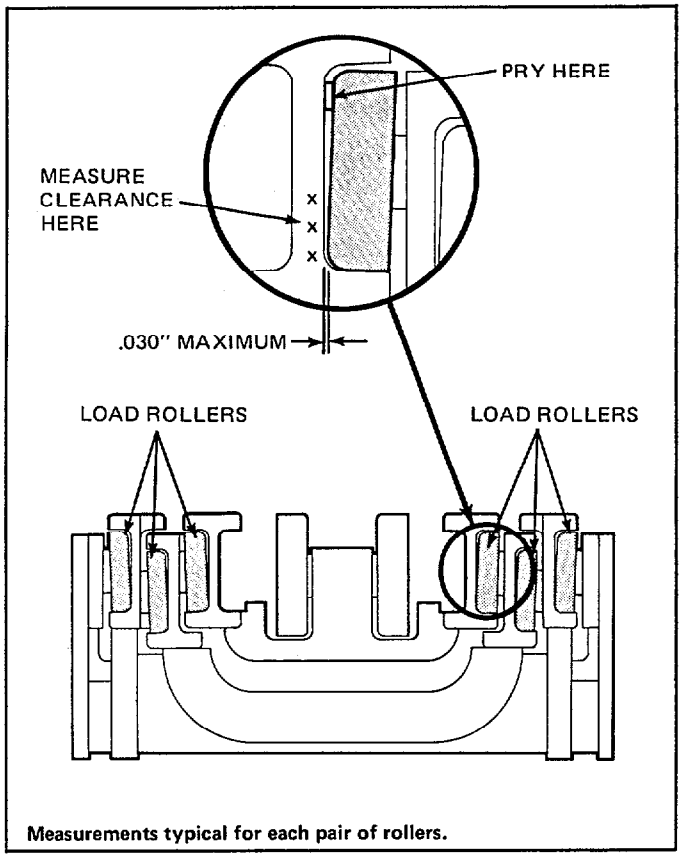


Figure 39. Roller Clearance

5.3-13 Hose Tracking Adjustment

Loosen the connector fitting at the cylinder port shown in Figure 40. Position the cylinder hose to track in the center of the rollers, then tighten fittings. Extend the mast above freelift. Loosen the hose clamp at the top of the mast. Adjust the tension on the hose. The hose must form a smooth continuous curve over the rollers without contacting the bracket.

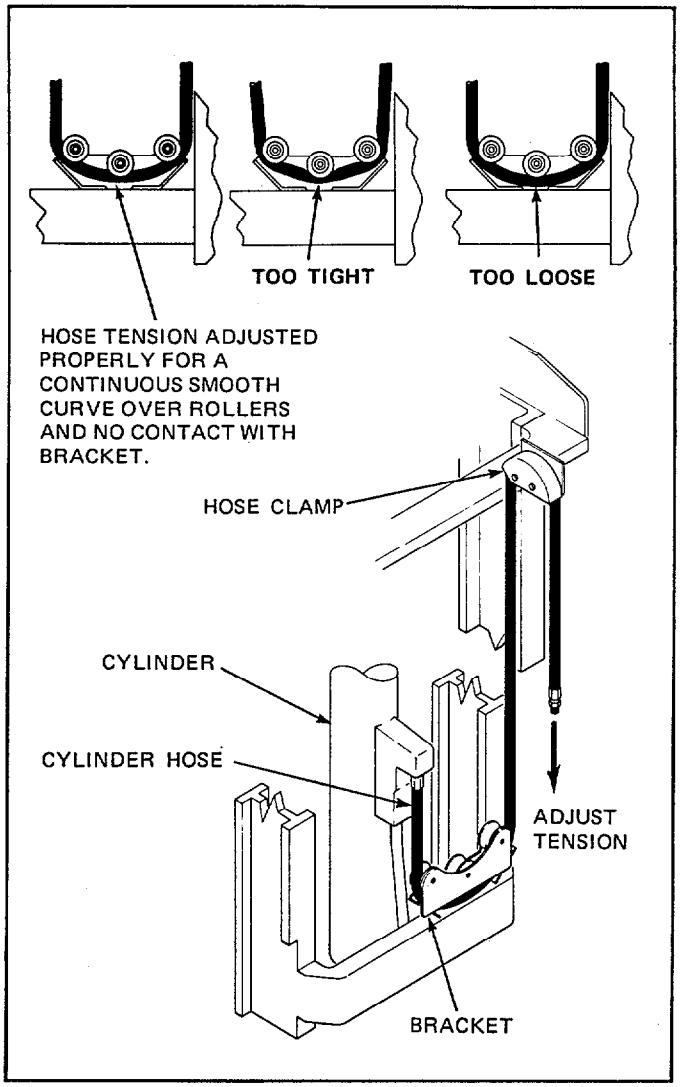


Figure 40. Quad Lift Cylinder Hose

5.4 Hoist Chains

5.4-1 Inspection and Tension

Each pair of 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 on initial mast installation.**

Hoist 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". Do this with all hoist chains. If they do not have equal tension perform the Mast or Carriage chain adjustment in paragraphs 5.4-3 and 5.4-4.

Inspect the hoist 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 chains.
- Check for tight joints. If tight joints are caused by rust or corrosion, loosen them with SAE 40 oil or penetrating oil. If they cannot be loosened or if tight joints are caused by bent pins or plates or by peened plate edges, replace **both** strands of chains.
- Check for protruding or turned pins. Replace **both** strands of chains.
- Check for chain side wear. If pins and outside plates show signs of wear, check for misalignment of sheaves, anchors, or other components. Correct the misalignment. If wear is excessive, replace **both** strands of chains.
- Check for worn, broken, or misaligned chain anchors. Replace or adjust as required.

5.4-2 Measuring Chain Stretch

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

If the hoist chains stretch beyond the recommended amount, they should be replaced in pairs. Chain stretch can be measured with chain wear scale 661923 included with the Customer User Kit. Measure the chains as shown in Figure 41 according to the instructions printed on the chain wear scale, without, a load on the carriage.

1. To check the carriage hoist chains, raise the carriage a few inches off the ground to put tension on the chains.
2. To check the mast hoist chains, the mast must be extended sufficiently to expose the chains.

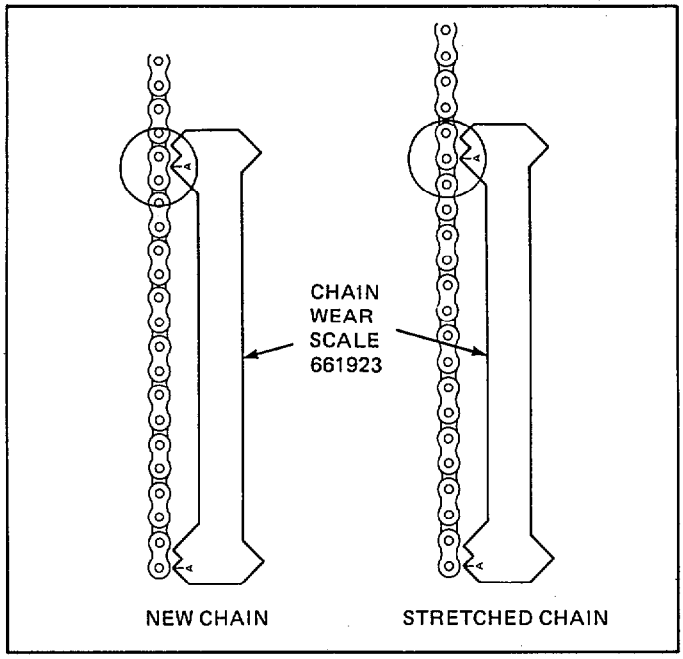
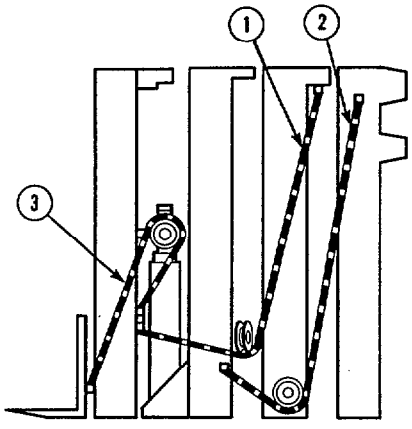


Figure 41. Check Chain Stretch

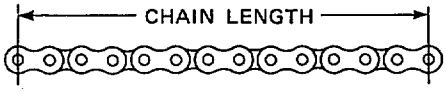
If the chains are removed from the mast, you can check chain stretch without using the chain wear scale. If the overall length of a hoist chain exceeds 103% of its original length, the chains should be replaced in pairs. The following table provides the length of the hoist chains when new and their limits of stretch.

HOIST CHAIN TABLE



Overall Retracted Channel Length	Length• of Hoist Chain ① When New (inches)	103% Limit (inches)	Length• of Hoist Chain ② When New (inches)	103% Limit	Length• of Carriage Chain ③ When New (inches)	103% Limit
68	63.0	64.9	63.7	65.7	54.7	56.4
74	69.0	71.1	69.7	71.8	60.7	62.6
80	75.0	77.3	75.7	78.0	66.7	68.7
86	81.0	83.4	81.7	84.2	72.7	74.9
92	87.0	89.6	87.7	90.4	78.7	81.1
98	93.0	95.8	93.7	96.6	84.7	87.3
104	99.0	102.0	99.7	102.7	90.7	93.4

• Chain length is measured from hole center to hole center of end links.



5.4-3 Mast Chain Adjustment

The mast chain should be adjusted so that when the unloaded mast is fully lowered, all upright channels are even with each other at the bottom within 1/8 inch. See Figure 42.

1. To adjust, raise the mast until the mast chain adjusting nut is just above the outer upright. See Figures 42 and 43. Tighten or loosen the adjusting nut to adjust one chain to achieve the equal dimension. Adjust the other mast chain until equal tension is achieved.

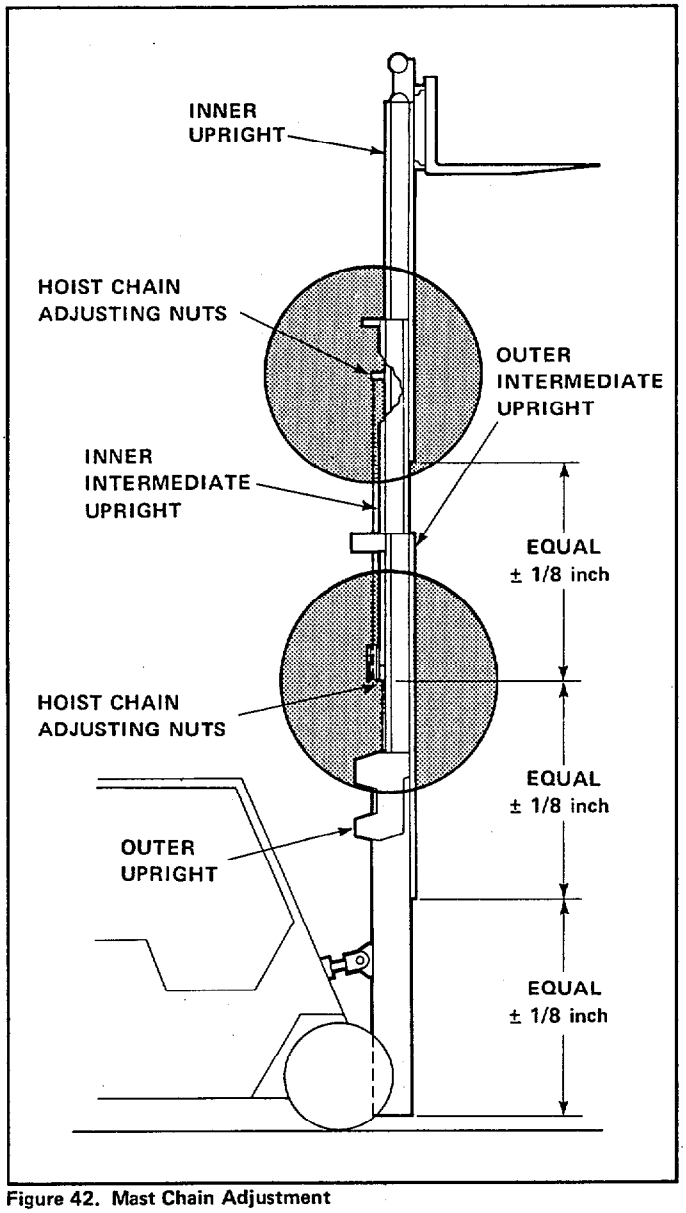


Figure 42. Mast Chain Adjustment

2. Lower the mast and check your adjustment. All channels should be even with each other at the bottom within 1/8 inch.

5.4-4 Carriage Chain Adjustment

The carriage chains should be adjusted so that when the unloaded mast is fully lowered, the carriage is positioned as shown in Figure 44.

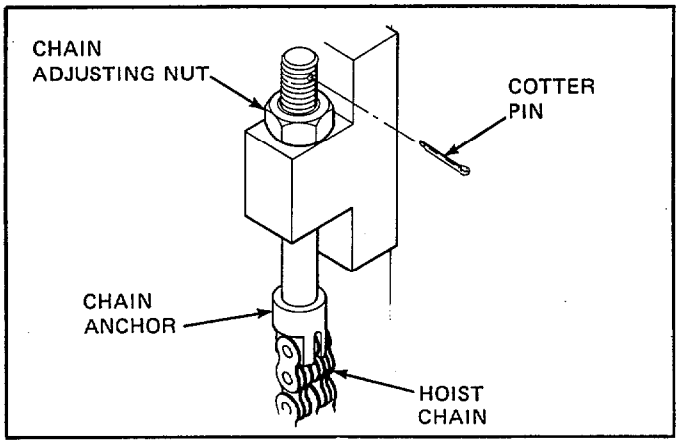


Figure 43. Mast Chain Anchor

To adjust the carriage chains:

1. Locate the adjusting nuts on the carriage sideplates.
2. Adjust one carriage chain (see Figure 45) to achieve the correct carriage position when fully lowered.

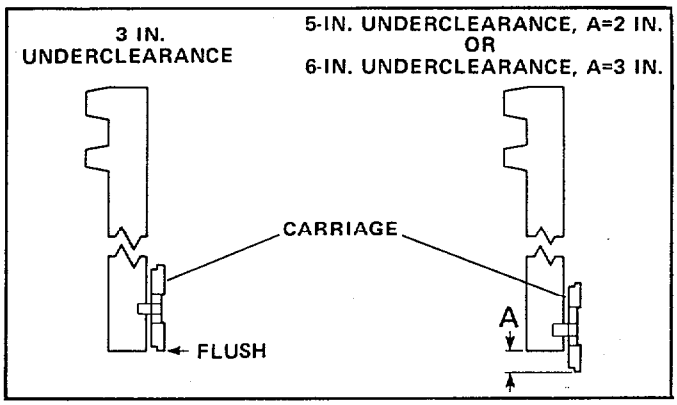


Figure 44. Correct Carriage positions when Mast is fully lowered.

3. Adjust the other carriage chain to achieve equal chain tension.

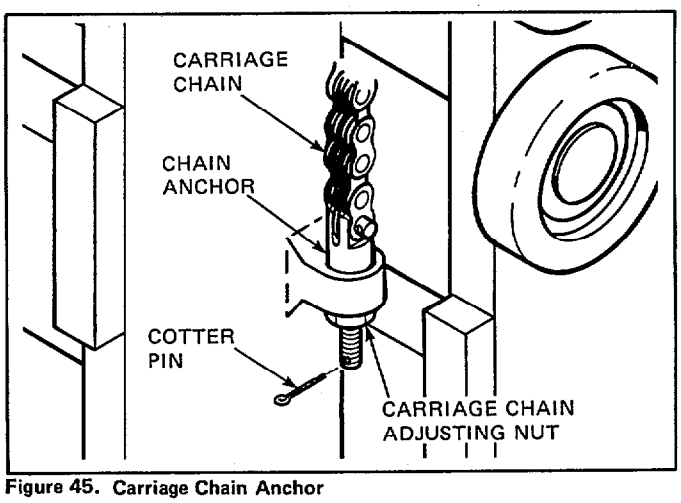


Figure 45. Carriage Chain Anchor

5.4-5 Outer Upright Chain Removal and Replacement

WARNING: Replace one chain at a time.

1. Raise the mast until the chain anchors on the inner intermediate are exposed. See Figure 46. Attach a C-clamp to the side of the mast you are not working with. See Figure 46 below.

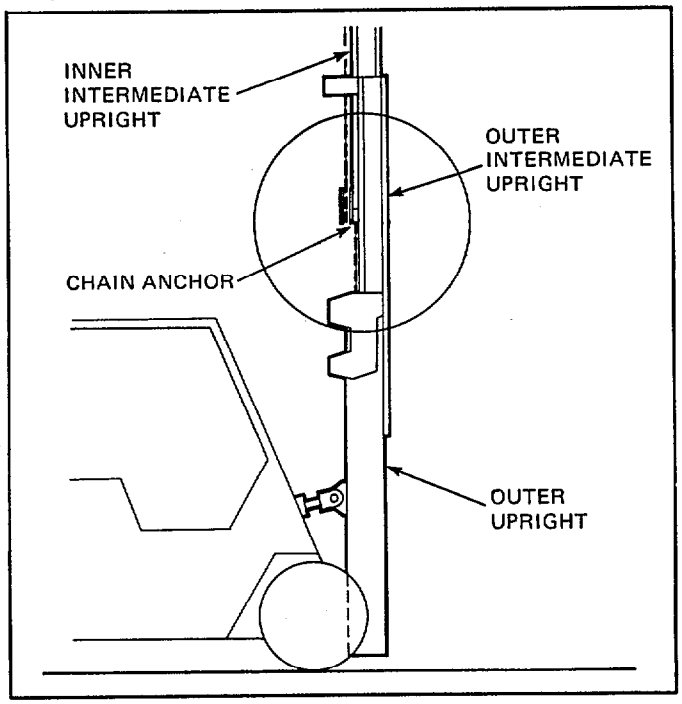


Figure 46. Exposing the Chain Anchors

WARNING: Attach a C-clamp to the side of the mast you are not working with. See Figure 47.

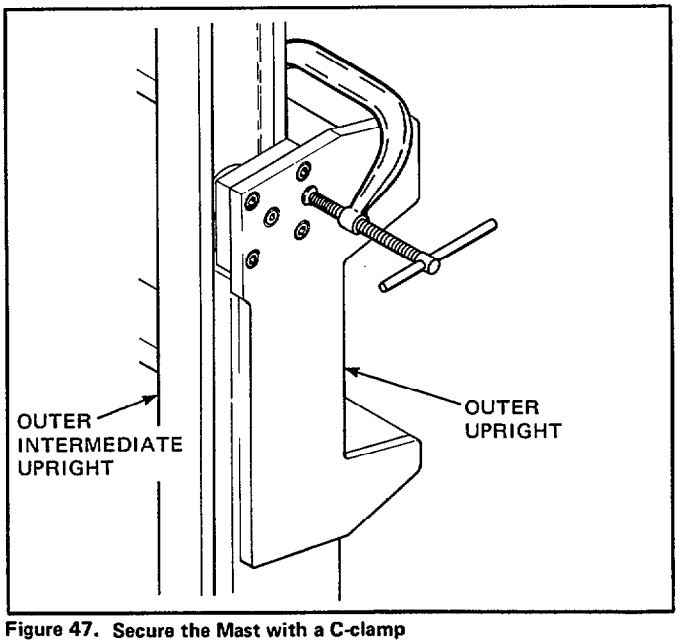


Figure 47. Secure the Mast with a C-clamp

2 Remove the chain from the chain anchor and connect the end of the new chain to the end of the old chain with mechanics wire. See Figure 48.

3. Remove the 5 capscrews retaining the roller plate to the outer upright. See Figure 48.

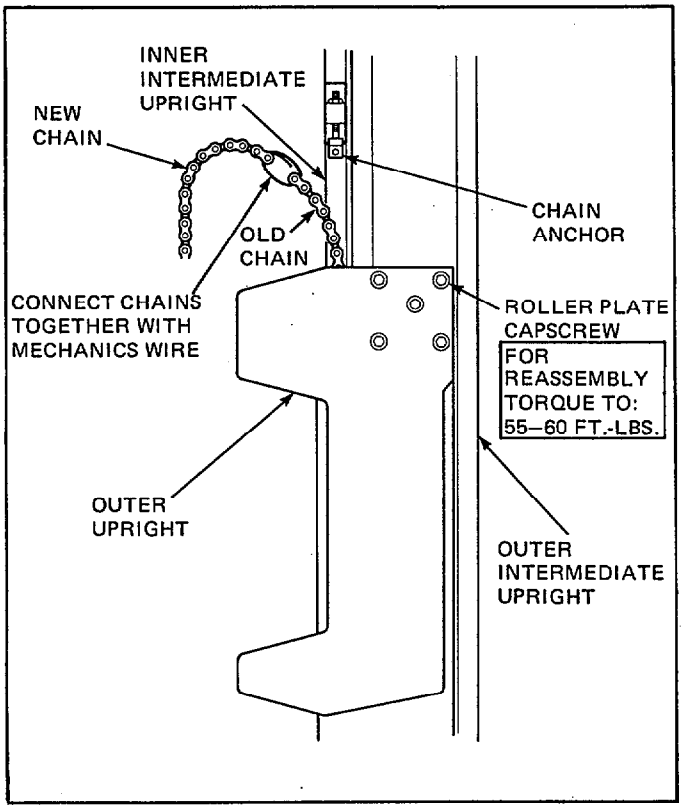


Figure 48. Chain Replacement

4. Pull the plate and old chain out of the channel. As you pull the plate out feed the new chain through keeping it taut.
5. Remove the old chain from the plate and install the new chain using new cotter pins. The roller can be replaced at this time if necessary.
6. Install the roller plate and torque the capscrews to 55–60 ft.-lbs.
7. Install the chain end to the chain anchor using new cotter pins. Adjust for tension after installing both new chains.

WARNING: When working on the other side make sure the C-clamp is in position on the side you have just completed.

Section 6 Standard Labor Times

6.1 Determining Labor Times

Standard Labor Time is the average time required to perform each operation described in Section 5 Service. Each Standard Labor Time is identified by the Service Section paragraph number and title that corresponds to that operation.

The Standard Labor Times are based on the assumption a qualified serviceman is working on a reasonably clean mast with adequate tools. We realize the actual time required to perform an operation may occasionally be greater than that listed, especially if a "first time" serviceman lacks the needed tools, or if a bolt is frozen. But considering all factors that can affect the job, Cascade can only honor warranty labor claims based on these carefully evaluated averages:

We strongly urge servicemen to read the applicable Service Sections of the manual before repairs are initiated. If problem diagnosis is difficult, call one of the Cascade Service Departments listed on the back cover.

To arrive at the total Standard Labor Time for a job, list each operation and add the times. As an example, to replace bushings, your list should look something like this:

5.2	Carriage Removal and Installation	1.5
5.4	Carriage Chain Replacement	1.0
	Total Standard Labor Time (hours)	2.5

6.2 Standard Labor Times

Paragraph Number		Times (hours)
5.1-5	Cylinder Removal and Installation	1.0
5.1-5	Steps 1-7, Replace Cylinder Retainer Seals	2.0
5.1-6	Cylinder Disasembly, Service and Reassembly	3.0
5.1-7	Cylinder Bleeding Procedure	.3
5.2	Carriage Removal, Inspection, and Installation	1.5
5.3-3	Mast Removal and Installation	1.5
5.3-4	Mast Disassembly, Service and Reassembly	8.0
5.3-5	Crosshead Removal, Adjustment, and Installation	.75
5.3-13	Hose Tracking Adjustment	.3
5.4	Carriage Chain Replacement (Two)	1.0
5.4-4	Outer Upright Chain Replacement (Two)	2.0

Do you have questions you need answered right now? Call your nearest Cascade Service Department.

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