

MAIN CONTROL VALVE

H8.00-12.00XM (H170-280HD)

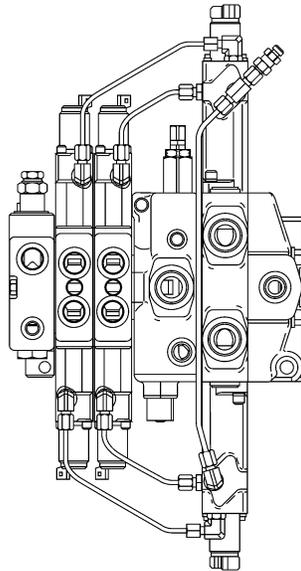
[F007, G007, H007];

H13.00-14.00XM (H330-330HD)

[E019, F019, G019];

H16.00XM-6 (H360HD) [E019, F019, G019];

H10.00-12.00XM-12EC
(H360HD-EC) [E019, F019, G019]



HM140078

HYSTER

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This section is for the following models:

H8.00-12.00XM (H170-280HD) [F007, G007, H007];
H13.00-14.00XM (H330-330HD) [E019, F019, G019];
H16.00XM-6 (H360HD) [E019, F019, G019];
H10.00-12.00XM-12EC (H360HD-EC) [E019, F019, G019]

General

This section has a description and the repair procedures for the main control valve in the hydraulic system. The following sections have repair procedures for other components of the hydraulic system. These

sections must be read before doing any maintenance or repair on the main control valve:

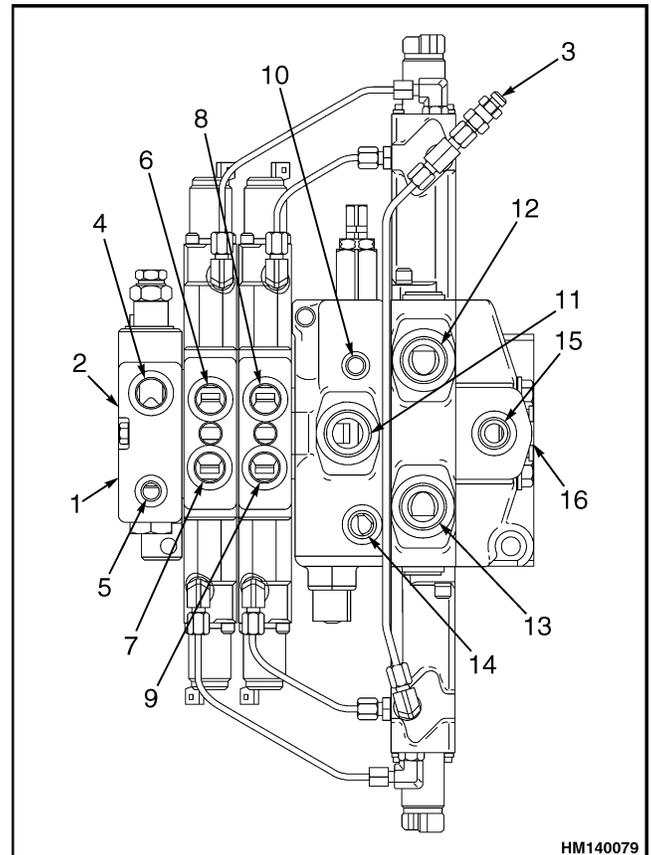
Steering System 1600 SRM 936

Hydraulic System 1900 SRM 938

Description

The main control valve controls the operation of the lift, tilt, and auxiliary cylinders. See Figure 1, Figure 2, and Figure 3. The main control valve is fastened to a plate in the frame, under the cab, and has inlet and outlet sections. The valve is also divided into a tilt/auxiliary section and a lift section. Both inlet sections have a primary relief valve. The outlet section of the tilt/auxiliary section contains an unloader valve.

Each section of the valve has a spool and valve body and two electrical solenoids. On the fork lift truck the control spools for the tilt and auxiliary are the same, however a different type of spool is used in the lift section of the valve. On trucks with empty container handler the spools for tilt and auxiliary are different. All spools have metering notches to improve the control of oil flow. When a control lever is operated, an electrical signal is generated and activates electrical solenoids at the end of a spool. As a result, hydraulic pressure sets the spool. Each spool has springs that return the spool to the **NEUTRAL** position as soon as the control lever is released.



- | | |
|------------------------|-------------------------|
| 1. PILOT INLET | 9. AUXILIARY FUNCTIONS |
| 2. CHECK PORT | 10. CHECK PORT |
| 3. BLEED LINE END CAPS | 11. PUMP INLET |
| 4. PUMP INLET | 12. LIFT CYLINDER |
| 5. TANK RETURN | 13. LIFT CYLINDER |
| 6. TILT CYLINDER | 14. TANK |
| 7. TILT CYLINDER | 15. TANK |
| 8. AUXILIARY FUNCTIONS | 16. MAIN OUTLET TO TANK |

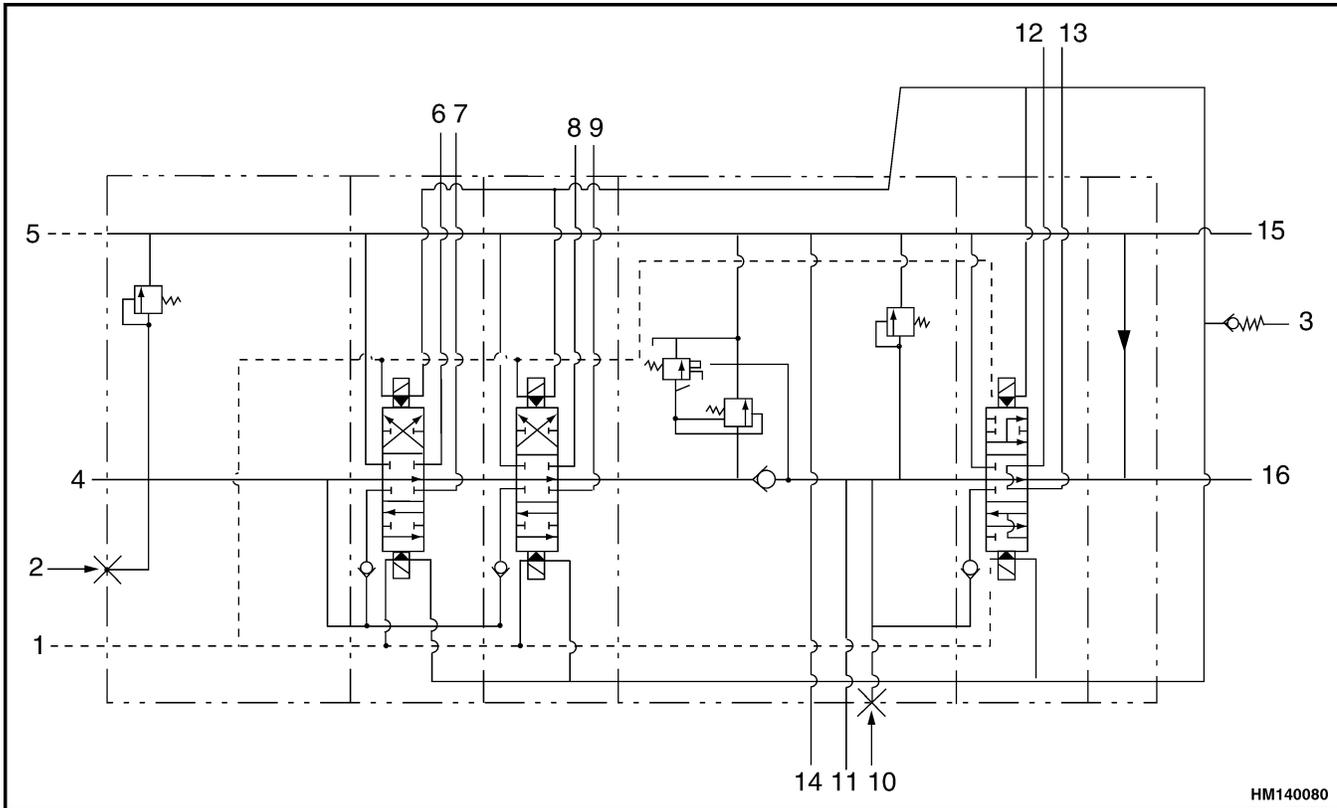
Figure 1. Main Control Valve

(More Content includes: Brake system, Capacities, and specifications, Frame, Hydraulic, System, Industrial battery, Main control, Valve, Mast repair, Fasteners, Schematics diagrams, Steering axle, Steering system, Wire harness repair And more)

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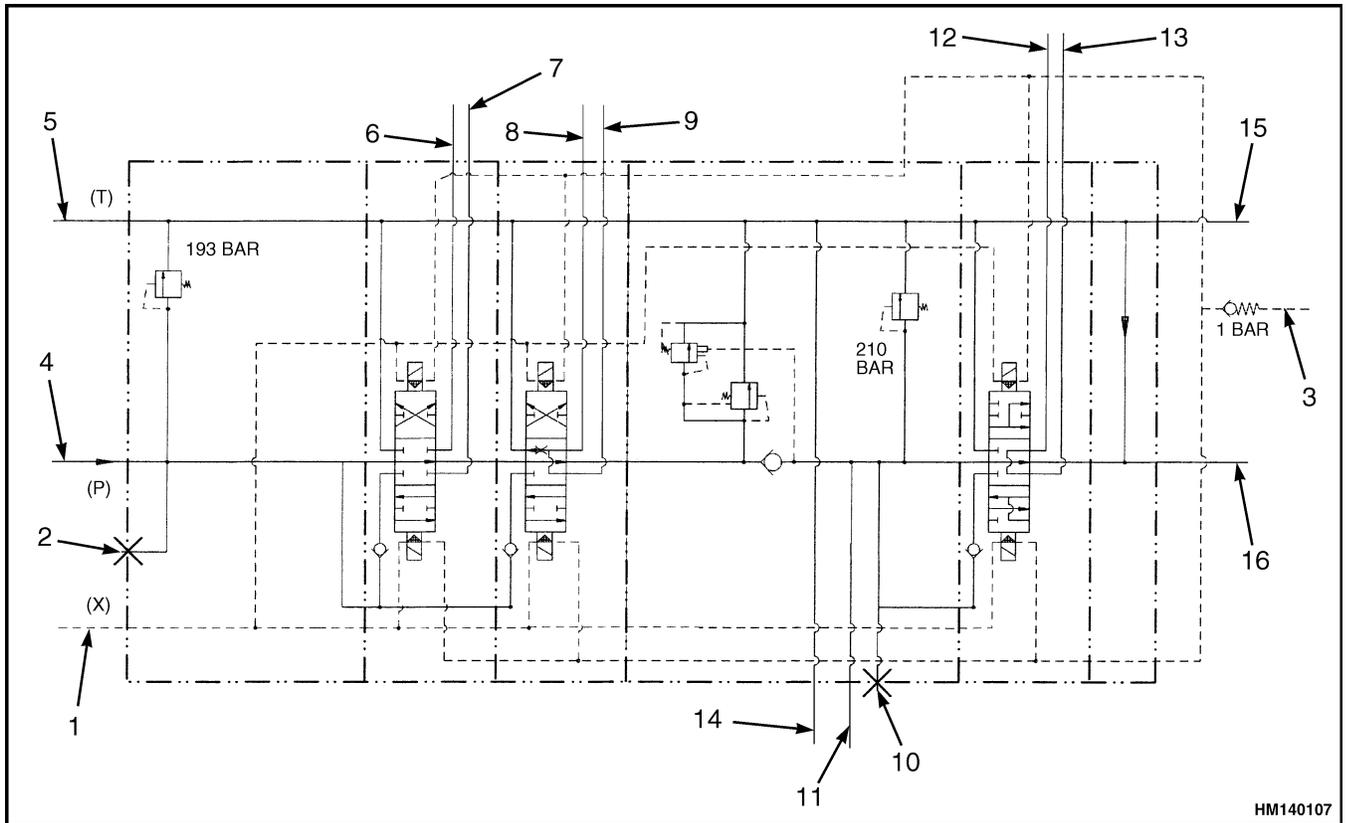
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| 7. TILT CYLINDER | 15. TANK |
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Figure 2. FLT Main Control Valve Schematic



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Figure 3. ECH/FLT Main Control Valve Schematic, Fixed P & T

Operation

The main control valve controls the lift, lower, tilt, and auxiliary functions. The valve has separate sections for each spool. In these valves, the spools can be operated without preventing the flow of oil to the other spools. The lift spool receives oil directly from a tandem large pump and small pump, through the tilt/auxiliary section. When the pressure demand in the lift section is above 14 MPa (2030 psi), oil from the small pump is diverted back to the tank.

This main control valve has three passages through each section: the open-center passage, the parallel passage, and the drain passage. See Figure 4 and Figure 5. When the spools are in the **NEUTRAL** position, the oil flows through the open-center passage and returns to the hydraulic tank. A spool makes a restriction in the open-center passage when the spool is moved from the **NEUTRAL** position. This restriction causes an increase in pressure in the parallel passage. This passage is common to all sections of the valve, but oil cannot flow freely through it. The pressure in the parallel passage causes the oil to flow through a check valve into a supply cavity in the valve body. The spool opens a path from the supply cavity to the hydraulic cylinders to do work.

LIFT SECTION

Each port in the lift section of the control valve is connected to a lift cylinder. See Figure 4. When the spool is moved to the **LIFT** position, the spool makes a restriction in the open-center passage. The increased pressure in the parallel passage causes oil to flow through the check valve to the supply cavity.

NOTE: The maximum mast speed, that can be obtained, depends on the load. When the required operating pressure in the hydraulic system is less than 14 MPa (2030 psi), the mast automatically lifts within the high speed range. A description of the two-speed lift system is in **Hydraulic System** 1900 SRM 938.

When the spool is in the **LOWER** position, the spool opens the paths from the lift cylinders to the drain

cavity. The maximum **LOWER** speed is controlled by the lower control valves in the lift cylinders. Oil from the pump can flow through the open-center passage when the spool is in the **LOWER** position or the **NEUTRAL** position. The **NEUTRAL** position of the spool closes the passages to the ports for the lift cylinders.

TILT/AUXILIARY SECTION

The operation of the tilt spool and the auxiliary spool is the same. These spools control the direction of flow in a hydraulic circuit for a cylinder or cylinders. The cross section of the tilt section of the control valve looks like Figure 5. When the tilt spool is moved from **NEUTRAL** position, oil flows out of one port in the valve section and returns through the other port. When the supply cavity for one port is opened, the other port is connected to the drain cavity.

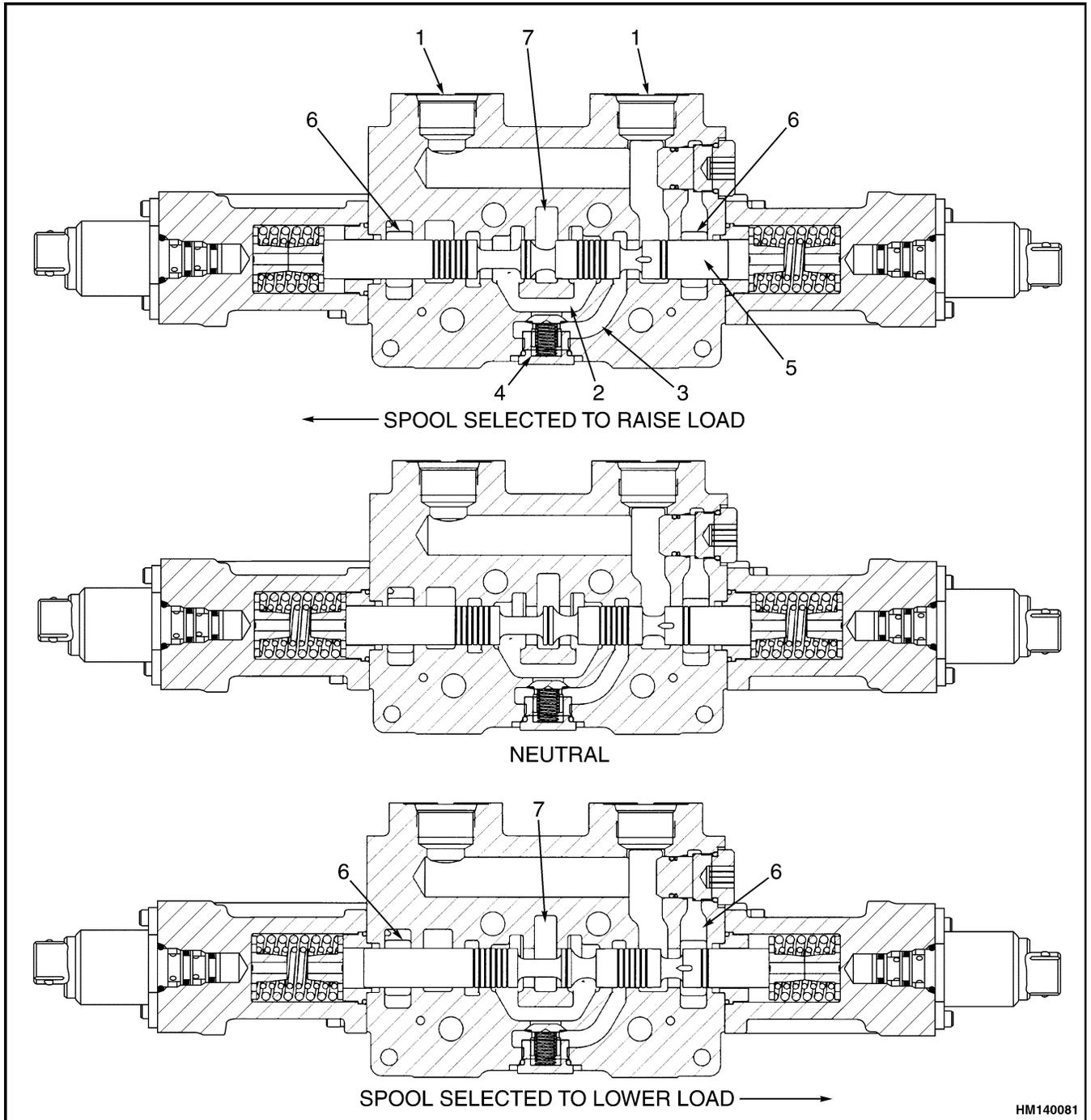
NOTE: On each tilt control cylinder is a relief valve that prevents cavitation in the tilt cylinders when the mast is tilted forward with a load. See **Hydraulic System** 1900 SRM 938 for a complete hydraulic system diagram.

RELIEF VALVES

The relief valves limit the maximum pressure in the hydraulic system. A relief valve for the lift circuit is installed in the midinlet section of the main control valve. A second relief valve is installed in the inlet section for the tilt and auxiliary circuits. When the pressure in a hydraulic circuit reaches the setting of the relief valve, the valve opens a path between the inlet and the tank.

UNLOADER VALVE

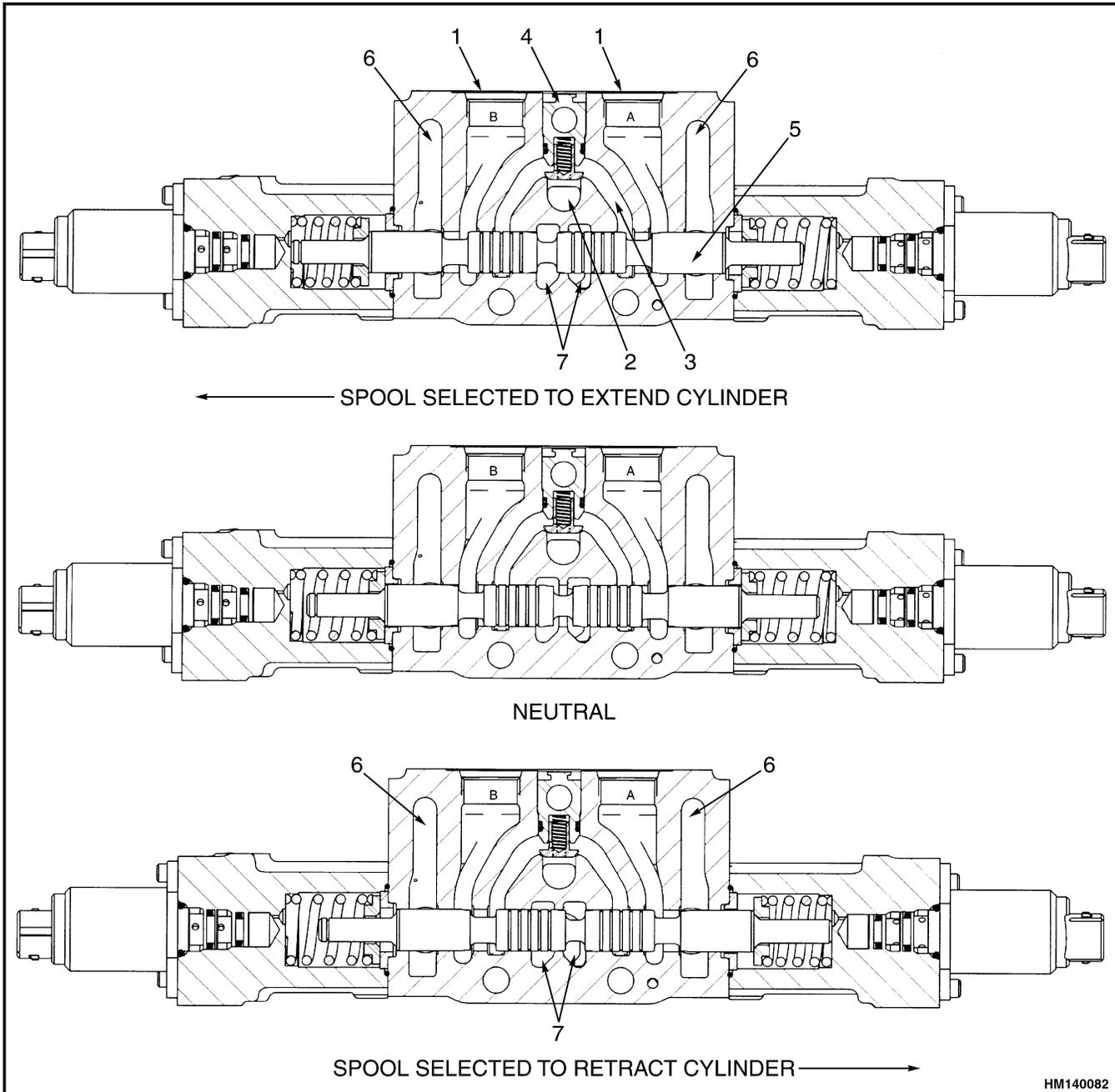
The unloader valve measures the pressure at the inlet side of the lift section. If the pressure exceeds 14 MPa (2030 psi), the unloader valve diverts oil back to the tank from the small pump.



- 1. PORT TO LIFT CYLINDER
- 2. PARALLEL PASSAGE
- 3. SUPPLY CAVITY
- 4. CHECK VALVE

- 5. LIFT/LOWER SPOOL
- 6. DRAIN CAVITY
- 7. OPEN-CENTER PASSAGE

Figure 4. Lifting and Lowering



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|--------------------------|------------------------|
| 1. PORT TO LIFT CYLINDER | 5. LIFT/LOWER SPOOL |
| 2. PARALLEL PASSAGE | 6. DRAIN CAVITY |
| 3. SUPPLY CAVITY | 7. OPEN-CENTER PASSAGE |
| 4. CHECK VALVE | |

Figure 5. Tilt and Auxiliary

Main Control Valve Repair

REMOVE



WARNING

Lower carriage completely before working on control valve or hydraulic system.

Do not work under a raised carriage. Put mast in a vertical position and lower carriage completely before disconnecting any parts of hydraulic system. The mast can lower suddenly and cause injury if the carriage is not lowered. This procedure will make sure that the carriage cannot lower suddenly and cause injury or death.

Proceed as follows:

1. Shut off engine.
2. Turn key switch to **ON** position.



WARNING

Move all control levers back and forth a minimum of 20 times to remove all hydraulic pressure from pilot system.

3. Turn the key switch to the **OFF** position.
4. Tilt cab to access control valve. See the section **Operator's Cab** for your lift truck.
5. Disconnect electric wires at spools of control valve.
6. Disconnect return hose at control valve. Keep end of hose above hydraulic tank until a plug is installed in hose. Tag lines and disconnect other lines at control valve. Put caps on open lines and plugs on ports.

NOTE: Only remove the main control valve from mounting plate when part to be repaired is not accessible. Disassemble main control valve as necessary for repairs. Most repairs are for replacement of O-rings.

7. Remove bolts that fasten control valve to mounting plate and remove valve. Clean outside of valve before disassembly.

DISASSEMBLE

1. To remove a spool, remove end cap from valve section. Carefully pull spool from valve section. Put tags on spools that are removed. Spools must be installed in the sections from which they are removed.
2. Remove seal retainer for top of spool. Remove O-rings and wipers from both ends of the section of the valve.
3. Remove auxiliary side and lift side as follows:

Auxiliary Side



CAUTION

Make sure to protect machined surfaces for O-rings when the sections are separated. Small defects can cause leaks.

1. Remove Nyloc nut (8) and plate. See Figure 6.
2. Remove nut (6) from the top through rod.
3. Remove nuts (6) from the two bottom through rods.

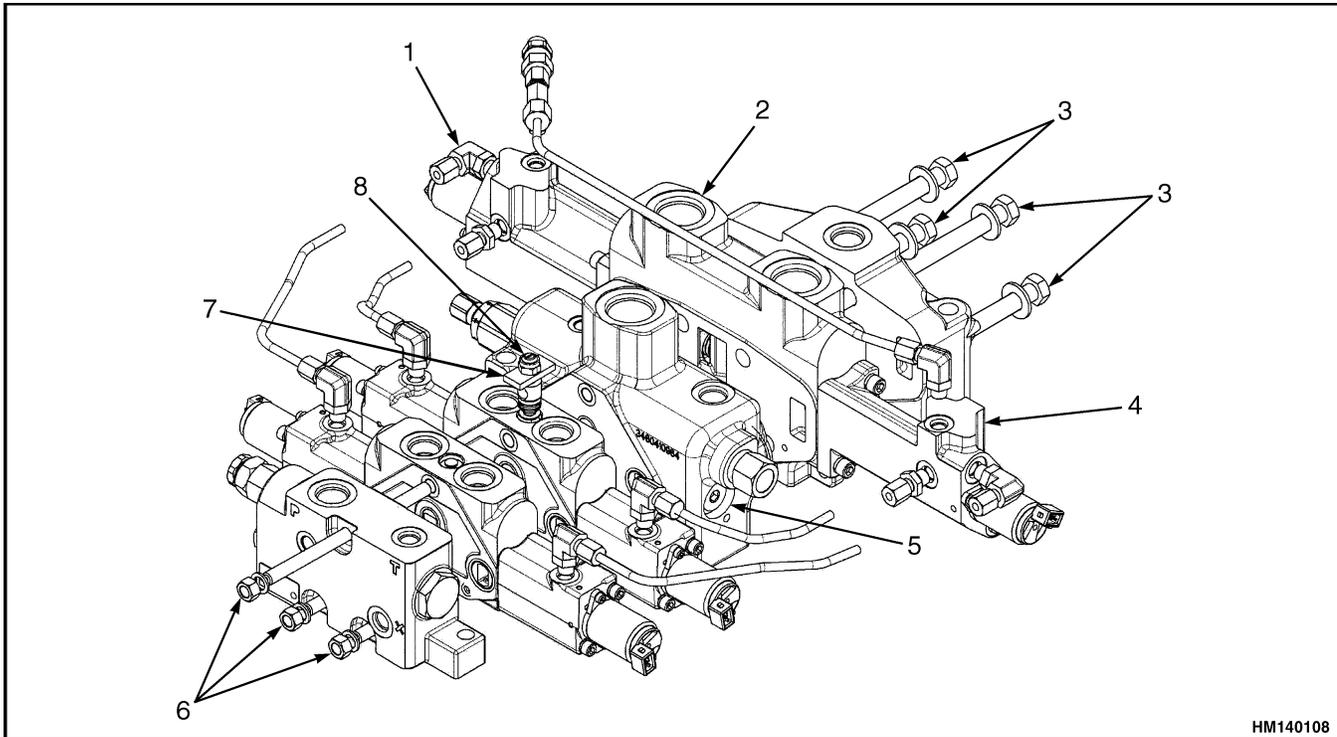
NOTE: The check valve and spring of each section are held by the through rods. Keep each check valve with the section in which it was installed.

4. Carefully slide each section from the through rods.
5. Remove O-rings installed between sections.

NOTE: Do not try to repair a relief valve. Replace relief valve that you cannot correctly adjust or that has damage.

Lift Side

1. Support lift side sections and remove the four through bolts (3). See Figure 6 and Figure 7.
2. Remove O-rings installed between sections.



- | | |
|-----------------|-------------------|
| 1. CHECK VALVE | 5. CENTER SECTION |
| 2. LIFT SECTION | 6. NUTS |
| 3. BOLTS | 7. NUTPLATE |
| 4. OUTLET | 8. NYLOC NUT |

Figure 6. Main Control Valve

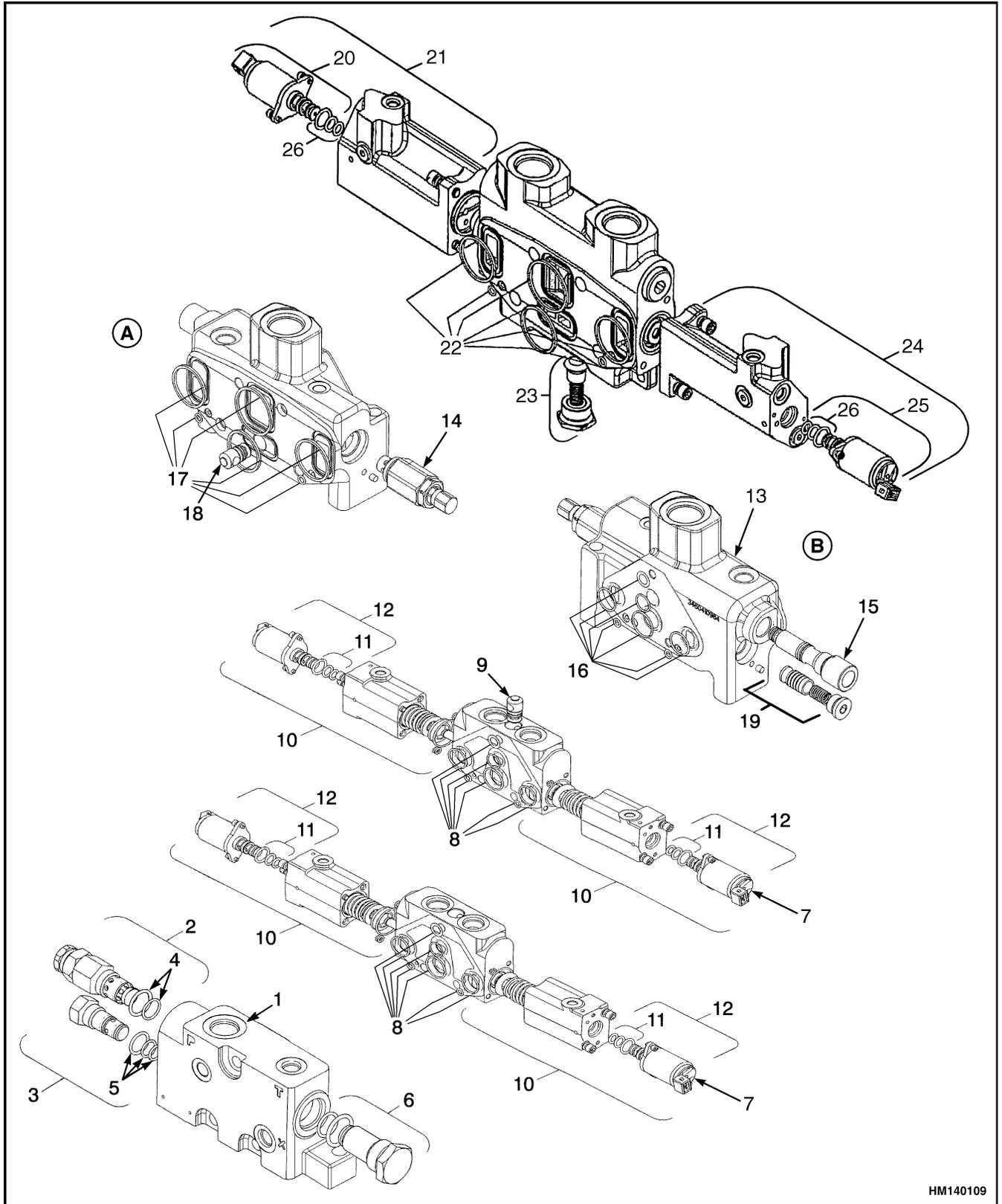
Legend for Figure 7

A. OUTLET VIEW OF CENTER SECTION

1. INLET SECTION
2. SECONDARY RELIEF VALVE
3. ADAPTOR
4. RELIEF VALVE SEALS
5. CARTRIDGE SEALS
6. PRESSURE VALVE
7. VALVE
8. INTERFACE SEAL KIT
9. CHECK VALVE
10. END CAP
11. SEAL KIT
12. SOLENOID
13. CENTER SECTION

B. INLET VIEW OF CENTER SECTION

14. RELIEF VALVE
15. CARTRIDGE
16. INTERFACE SEAL KIT
17. INTERFACE SEAL KIT
18. CHECK VALVE
19. PISTON
20. SOLENOID
21. END CAP ASSEMBLY
22. SOLENOID SEALS
23. SOLENOID
24. END CAP ASSEMBLY
25. DROP SOLENOID
26. SOLENOID SEAL KIT



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Figure 7. Main Control Valve Sections

CLEAN AND INSPECT

WARNING

Cleaning solvents can be flammable and toxic and cause skin irritation. When cleaning solvents are used, always follow the solvent manufacturer's recommended safety procedures. Wear protective goggles or a face shield to prevent eye injuries.

1. Clean all parts of control valve with solvent. Carefully dry parts with compressed air.
2. Check spools and bores for defects. If a spool or bore has damage, replace valve section that has the damaged part or parts. Make sure that bores and grooves for O-rings are smooth and do not have dirt or defects.
3. Check the check valves and relief valves for damage. Replace valves as necessary.

ASSEMBLE

Auxiliary Side

CAUTION

Before installing parts in valve body, make sure all parts are clean. Replace all seals and O-rings. Lubricate all parts with clean hydraulic oil during assembly.

CAUTION

Verify that nuts and rods torque specifications are to the values listed. Incorrect torque values may cause a malfunction of the spools.

1. Install new seals in bore in each section. See Figure 6.
2. Install new O-rings between sections.
3. Install check valves.
4. Slide sections over the three through rods (6).
5. Install nuts, finger tight, on the three through rods.
6. Torque the three nuts. Top nut to 40 N•m (29.5 lbf ft) and the two bottom nuts to 27 N•m (20 lbf ft). Use sequence top, bottom left, bottom right, and top.

NOTE: When installing a replacement through rod, or tightening of a loose through rod is required, torque through rod to 25 N•m (18.5 lbf ft).

7. Install plate and nyloc nut. Torque to 15 N•m (11 lbf ft).
8. Install springs.
9. Lubricate spools with clean hydraulic oil. Make sure that dirt does not get on any of the parts. Carefully install spools in valve body. Make sure that spools move freely in bores. Install seal retainers and end caps.

Lift Side

CAUTION

Before installing parts in valve body, make sure all parts are clean. Replace all seals and O-rings. Lubricate all parts with clean hydraulic oil during assembly.

CAUTION

Verify that bolt torque specifications are to the values listed. Incorrect torque values may cause a malfunction of the spools.

1. Install new seals in bore in each section. See Figure 6.
2. Install new O-rings between sections.
3. Install check valves.
4. Assemble sections, finger tight, using the four through bolts (3).
5. Torque the four through bolts to 101.5 N•m (75 lbf ft). Use sequence top left, bottom right, top right, and bottom left.
6. Install springs.
7. Lubricate spools with clean hydraulic oil. Make sure that dirt does not get on any of the parts. Carefully install spools in valve body. Make sure that spools move freely in bores. Install seal retainers and end caps.

INSTALL

1. Install control valve on mounting plate in frame.
2. Connect electrical cables at solenoids.

3. Connect hydraulic lines to control valve. Connect return line after connecting other lines.
4. Add clean hydraulic oil to tank. For correct specifications, see the section **Periodic Maintenance** for your lift truck.

**WARNING**

Do not try to locate hydraulic leaks by putting hands on pressurized hydraulic components.

Pressure Relief Valve Check and Adjustment

CHECK AND ADJUST

1. If engine is operating, stop engine. Connect a 0 to 25 MPa (0 to 3625 psi) gauge to test port. Test port is on inlet section of main control valve.

**CAUTION**

Do not remove cap/adjustment nut on relief valve. The cap/adjustment nut is the adjustment for relief pressure and the retainer for a sleeve, shims, spring, and poppet.

2. Hold cap/adjustment nut on relief valve and loosen jam nut.
3. Start engine. Operate hydraulic system until temperature of hydraulic oil is 55 to 65°C (130 to 150°F). Run engine at maximum rpm when making pressure checks.
4. Check relief valve in the lift section by raising mast until it stops. Check the relief valve in the tilt/auxiliary section by raising the mast to a position whereby the mast can be fully tilted forward without touching the ground. Tilt mast forward until it stops. Hold appropriate lever and read gauge when relief valve opens.

**WARNING**

The cap/adjustment nut holds parts that can cause injury if released when the system has pressure. DO NOT remove cap/adjustment nut. Only turn cap/adjustment nut a small amount for each check. Move cap/adjustment nut 0.08 mm (0.003 in.) to change relief pressure approximately 690 kPa (100 psi). The cap/adjustment nut has minimum thread engagement at a setting of approximately 6.9 MPa (1000 psi).

Hydraulic oil can be injected into the body by pressure.

5. Operate hydraulic system and check for leaks and correct operation. Adjust relief valves as described in Pressure Relief Valve Check and Adjustment.

5. To change the setting, slowly turn cap/adjustment nut as necessary. See Specifications for correct setting. If the cap/adjustment nut is tight against housing, pressure cannot be increased further. Replace relief valve. Loosen cap/adjustment nut to decrease pressure. When adjustment is correct, hold cap/adjustment nut and tighten jam nut to 55 to 67 N•m (40 to 50 lbf ft).

6. Remove gauge when checks are complete.

REPLACE

NOTE: Do not try to repair a relief valve. Replace relief valve that cannot be correctly adjusted or that has been damaged.

**WARNING**

Move all control levers back and forth a minimum of 20 times to remove all hydraulic pressure from the system.

1. Shut off engine.
2. Turn the key switch to the **ON** position.
3. Turn the key switch to the **OFF** position.
4. Tilt cab to access control valve. See the section **Operator's Cab** for your lift truck.
5. Remove relief valve. Use wrench on body of relief valve.
6. Install new relief valve assembly. Use wrench on body of valve and tighten to 81 to 108 N•m (60 to 80 lbf ft).
7. Adjust relief pressure settings for the hydraulic system as described in this section.

Specifications

Unit	Relief Valve Settings
Relief Valve - Lift Section	21.0 MPa (3050 psi)
Relief Valve - Tilt/Auxiliary Section	19.3 MPa (2807 psi)

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Oil leaks at the end caps of the spools.	End cap seals have defects.	Replace seals.
	Spool has a defect.	Replace defective spool.
	Valve body has a defect.	Replace control valve section.
Spool will not move.	No pilot pressure.	Check and repair pilot valve and/or priority valve, if necessary.
	Dirt between spool and bore.	Clean valve as necessary.
	Spool is bent or damaged.	Replace defective spool.
	No electrical signal.	Check electrical system and repair.
	Through bolts, or nuts on through rods, not at correct torque specifications	Tighten or loosen through bolts to correct torque specifications
Spool will not return to NEUTRAL .	Calibration of levers or joystick not to specifications.	Recalibrate levers or joystick.
	Return spring is damaged.	Replace damaged spring.
	Dirt between spool and bore.	Clean valve as necessary.
	Spool is bent or damaged.	Replace defective spool.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Cylinders move slowly or do not move.	Pressure relief valve has a defect.	Repair or adjust relief valve.
	Large leaks between spool and bore.	Replace control valve section.
	Hydraulic pump has a defect.	Repair or replace hydraulic pump.
	Air is in hydraulic system.	Remove air from hydraulic system.
	Restriction in hydraulic lines.	Repair or replace hydraulic lines.
	Load is greater than capacity.	Handle only correct load.
Fast lift speed function does not operate.	Cylinder seal has defects.	Repair or replace cylinder.
	Low pilot pressure.	Check and repair pilot valve.
	Defective unloader valve.	Check and repair or replace unloader valve.
Hydraulic pressure is high.	Calibration of levers or joystick not to specification.	Recalibrate levers or joystick.
	Pressure relief valve has a defect.	Repair or replace relief valve.
	Pressure relief valve is not adjusted correctly.	Adjust relief valve.
Tilt cylinders extend when tilt spool is in NEUTRAL position.	Restriction in return line.	Replace hydraulic line.
	Cylinder seal has defects.	Repair cylinder.
Tilt cylinders extend when tilt spool is in NEUTRAL position.	Hydraulic lines have leaks.	Replace hydraulic lines.
	Oil leaks between control valve spool and bore, and tilt relief valve has a defect.	Repair main control valve and relief valve.
	Calibration of levers or joystick not to specification.	Recalibrate levers or joystick.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Tilt cylinders extend suddenly when tilt spool is moved to BACK TILT position.	Check valve to determine if tilt spool has a defect, and/or tilt relief valve has a defect.	Replace spool or relief valve if necessary.
Delay occurs between command and movement.	Pilot return line or 1 bar check valve is blocked.	Repair or replace hydraulic lines.
Tilt cylinders extend suddenly when tilt lever is moved to FORWARD TILT position.	Tilt relief valve has a defect.	Repair or adjust relief valve.
Lift cylinders retract when lift lever is in NEUTRAL position.	Check valve for lift spool has a defect.	Replace check valve.
	Cylinder seal has defects.	Repair cylinder.
	Hydraulic lines have leaks.	Replace hydraulic lines.
	Oil leaks between lift spool and bore.	Repair main control valve.
	Calibration of levers or joystick not to specification.	Recalibrate levers or joystick.

