STEERING AXLE

S3.50-5.50XL (S70-120XL) [D004];
S3.50-5.50XM (S70-120XM) [E004, F004];
E3.50-5.50XL (E70-120XL, E70-120XL$_3$) [C098];
H3.50-5.00XL (H70-110XL) [G005];
H6.00-7.00XL (H135-155XL, H135-155XL$_2$) [F006, G006];
H8.00-16.00XL (H165-360XL) [D019, E007];
H8.00-12.00XM (H170-280HD) [F007, G007, H007];
H13.00-14.00XM (H300-330HD) [E019, F019, G019];
H16.00XM-6 (H360HD) [E019, F019, G019]; H10.00-12.00XM-12EC (H360HD-EC) [E019, F019, G019]E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) [D098/E098]

HYSTER

PART NO. 897108

1600 SRM 326

STEERING AXLE H6.00-7.00XL (H135-155XL, H135-155XL$_2$) (F006, G006), H8.00-16.00XL (H165-360XL) (D019, E007), AND H8.00-12.00XM (H170-280HD) (F007, G007, H007), H13.00-14.00XM (H300-330HD) (E019, F019, G019), H16.00XM-6 (H360HD) (E019, F019, G019), H10.00-12.00XM-12EC (H360HD-EC) (E019, F019, G019)

Remove

WARNING

Put the lift truck on blocks. Follow the procedures for raising the lift truck described in the Operating Manual for this lift truck. The surface must be solid, even, and level. Make sure the blocks are solid, one-piece units. Make sure the lifting devices used during repairs can lift the weight of the parts.

The steering axle can be removed without removing the counterweight.

1. Make sure wheels are set for straight travel. Put blocks under frame in front of steer wheels, so steering axle can be removed. Top of axle frame must have clearance under counterweight so steering axle can be removed.

2. It is not required, but it can make removal of the axle easier if the wheels are removed. Disconnect hydraulic lines at steering cylinder. Install caps on cylinder and put plugs in hydraulic lines. Caps will prevent spindles from turning when axle is removed from under the lift truck.

3. Remove two dust covers from openings of bearing caps.

4. Slide a floor jack or forks of another lift truck under steering axle. Raise lifting device until it holds weight of axle assembly. Remove four capscrews and washers that fasten two bearing caps to frame. Remove bearing caps and slowly lower axle assembly. Carefully remove axle assembly from under lift truck.

Install

WARNING

Excessive play in the pivot bushings will result in increased shock loadings to the pivot pins and increased movement of the axle, and may affect steering responsiveness. If movement in the pivot bushings is more than 4 mm (0.16 in.), or damage to the O-ring seals exists, replace the bushings, flanges, and O-rings.

1. Install O-ring, spacer, and shims on each pivot shaft. Lubricate pivot shafts with multipurpose grease and install fiber bushing. See Figure 2 and Figure 4.

2. Use a floor jack or another lift truck to put steering axle into position in frame. Make sure fiber bushings fit into mounts of frame.

3. Install bearing caps.

   H6.00-7.00XL (H135-155XL, H135-155XL$_2$) (F006, G006) units. Tighten capscrews to 320 N•m (236 lbf ft).

   H8.00-16.00XL (H165-360XL) (D019, E007), and H8.00-12.00XM (H170-280HD) (F007, G007, H007), H13.00-14.00XM (H300-330HD) (E019, F019, G019), H16.00XM-6 (H360HD) (E019, F019, G019), H10.00-12.00XM-12EC (H360HD-EC) (E019, F019, G019) units. Tighten capscrews to 380 N•m (280 lbf ft). After installation, make sure there is zero clearance between shims and frame. Add or remove shims as necessary to get zero clearance.

4. Install dust covers in openings of bearing caps.

5. Remove plugs and caps, and connect hydraulic lines to steering cylinder. Install wheels if they were removed.

6. Operate steering system to remove air from system. Turn steering wheel several times from one wheel stop to other wheel stop. Check for hydraulic leaks.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Slow or difficult steering.	Relief valve for the steering system needs adjustment.	Adjust or install new relief valve.
	Low oil pressure from the hydraulic pump.	Check for restrictions. See Troubleshooting Chart in the **Hydraulic System** SRM for your lift truck.
	Seal in the steering cylinder has a leak.	Install new seal.
	Steering control unit is worn or has damage.	Repair or install new control unit.
Steering wheel turns the tires in the wrong direction.	The hydraulic lines are not connected correctly at the steering cylinder or at the steering control unit.	Connect lines properly. Remove air from system.
Steering function continues after the steering wheel stops.	The steering control unit was assembled wrong or has damage.	Repair or install new control unit.
There is air in the steering system.	The oil level in the tank is low.	Add hydraulic oil as necessary. Check for leaks.
	Air was not removed after repair to the hydraulic or steering system.	Remove air from system.
	The hydraulic pump has an air leak at the inlet.	Repair system. Remove air from system.

4. Remove plug from the bottom of the axle housing and drain the oil from the axle assembly.

5. Disconnect the drive shaft at the differential. If a speed reducer or gear box is installed, remove the speed reducer or gear box.

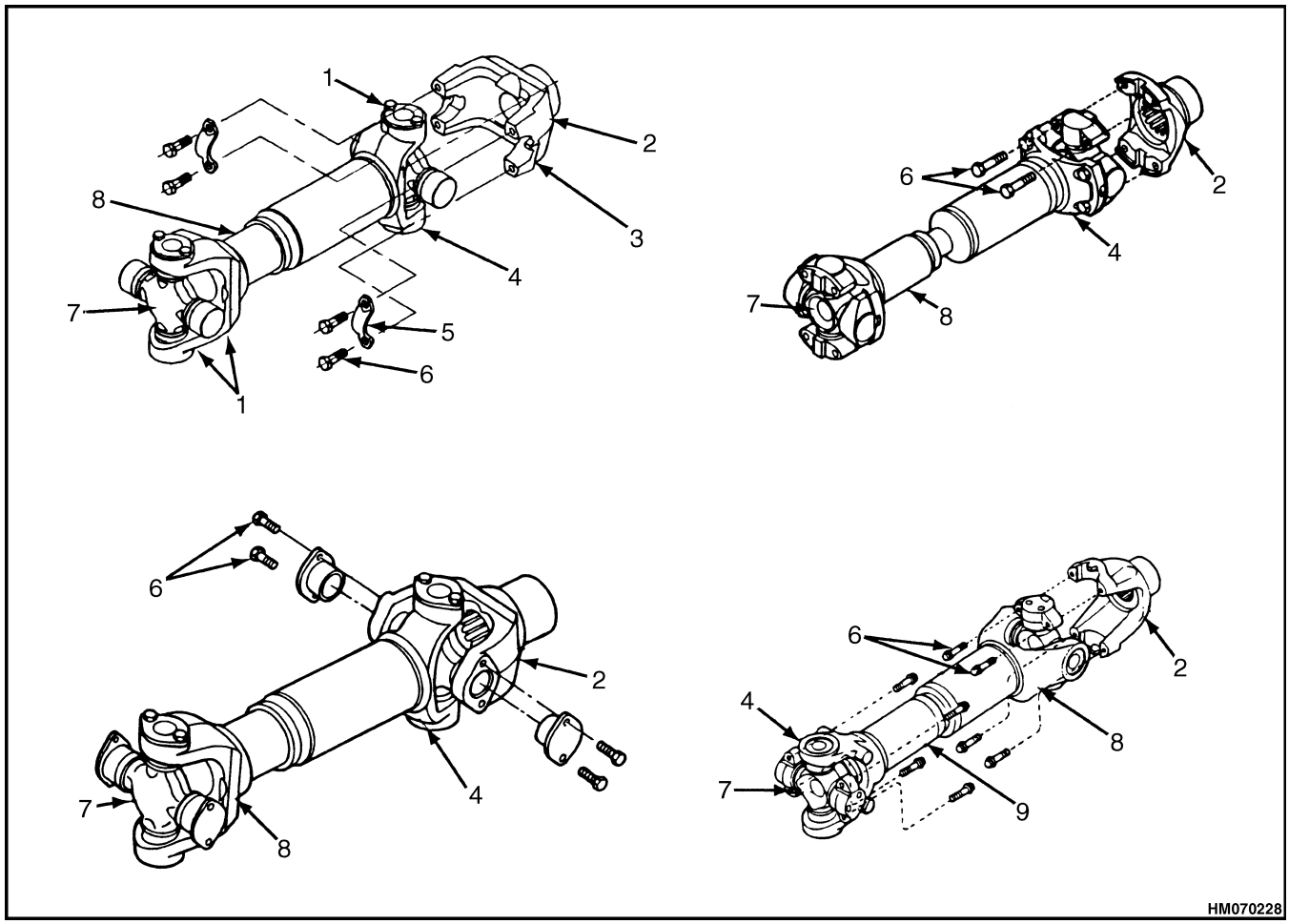
6. Some units have a drum or disc brake attached to the output yoke. Disconnect any brake linkage or brake lines. See the **Brake** section for your unit.

7. Disconnect the driveline universal joint from the pinion input yoke or flange on the differential carrier. See Figure 3.

8. Remove the axle shafts from the axle housing. See the **Drive Axle** section for your model of lift truck for the procedures.

   a. On Straddle Trucks™, disconnect the drive axle universal joints at the differential yokes. Remove the capscrews that fasten the bearing retainers to the differential housing. Pull the yoke, stub shaft and bearing retainer from the housing.

9. Place a transmission jack under the differential carrier for support. See Figure 4.



1. BEARING CUPS
2. END YOKE
3. YOKE SADDLE
4. WELD YOKE
5. BEARING STRAP
6. CAPSCREWS
7. U-JOINT CROSS
8. SLIP YOKE
9. TUBING

Figure 3. Typical Driveline Universal Joint

ASSEMBLE

Pinion, Bearings, and Pinion Carrier, Assemble

NOTE: Some of the parts described below are not found on some differential carrier models. See Figure 1.

1. Put differential oil on the bearings and cups. Install the cups in the pinion carrier. See Figure 1.
2. Install the inner bearing and spigot bearing against the pinion shoulders. Use a sleeve and press to push against the inner bearing race.

CAUTION

If a new pinion is installed, a new ring gear must also be installed. The pinion and ring gear are a set (see Figure 32) and must be installed together.

NOTE: During assembly at the factory, one spacer is used. Two thinner spacers are used if the pinion or bearings are replaced. These spacers are selected for correct bearing preload.

NOTE: Some spigot bearings are fastened to the pinion with a snap ring, and some are fastened with a punch. Others can have a two-piece bearing. See Figure 24.

3. Install the spigot bearing washer and snap ring. Put the pinion assembly in the pinion carrier. Install the spacers on the pinion. See Figure 19.
4. Use a press to install the outer bearing against the spacer. Rotate the carrier to make sure the bearings are installed correctly.
5. Use either the Press Method or the Yoke or Flange Method, and apply the correct preload. See Specifications, Table 6. Check the bearing preload as described in Pinion Bearings, Adjust Preload of this section.

Pinion Bearings, Adjust Preload

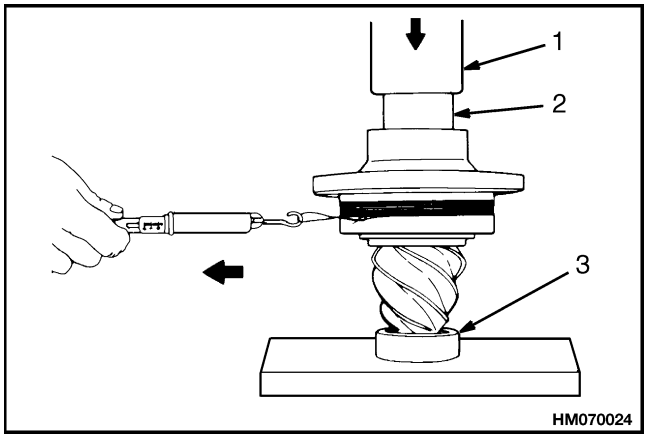
Press Method

WARNING

Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

NOTE: If a press is not available, or the press does not have a pressure gauge, use the Yoke or Flange Method to adjust pinion bearing preload.

1. Place the drive pinion and carrier assembly in a press with the gear head (teeth) toward the bottom.
2. Install a sleeve of the correct size against the inner race of the outer bearing. See Figure 19.
3. Apply and hold the correct amount of pressure to the pinion bearings. See Specifications, Table 6. As pressure is applied, rotate the pinion carrier several times so that the bearings make normal contact.
4. While pressure is held against the assembly, wrap a cord several times around the pinion carrier. Fasten a Newton or pound scale to the cord. See Figure 26.

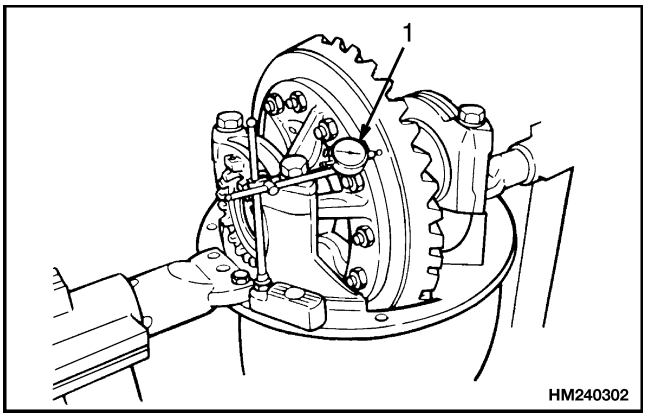


1. PRESS
2. SLEEVE
3. PINION BEARING

Figure 26. Bearing Preload Check

Differential Bearings, Preload Adjust

1. Make sure the ring gear is not touching the pinion. Install a dial indicator as shown in Figure 46. Adjust the dial indicator so that the plunger or pointer is against the back surface of the ring gear.



1. DIAL INDICATOR

Figure 46. Bearing Preload Adjustment

CAUTION

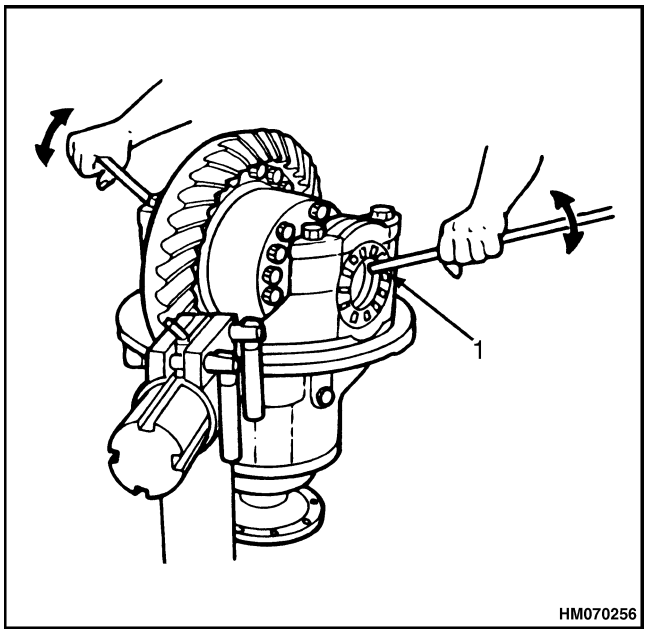
Always use a tool that engages two or more opposite notches in the adjustment ring. A T-bar spanner type wrench can be used for this purpose. Be sure the wrench fits correctly so that the lugs will not be damaged.

2. Loosen the bearing adjustment ring that is on the same side as the dial indicator so that a small amount of end play shows on the dial indicator.

3. Push the differential assembly left and right with pry bars while you read the dial indicator. Use one of the methods described below:

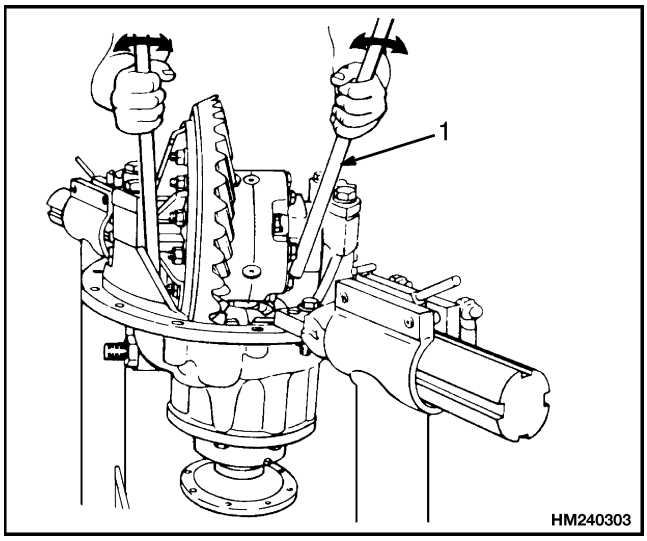
a. Use two pry bars that fit between the bearing adjustment rings and ends of the differential case. The pry bars must not touch the differential bearings. See Figure 47.

b. Use two pry bars between the differential case or ring gear and the carrier at locations other than described in Step a. The pry bars must not touch the differential bearings. See Figure 48.



1. BARS MUST NOT TOUCH BEARINGS

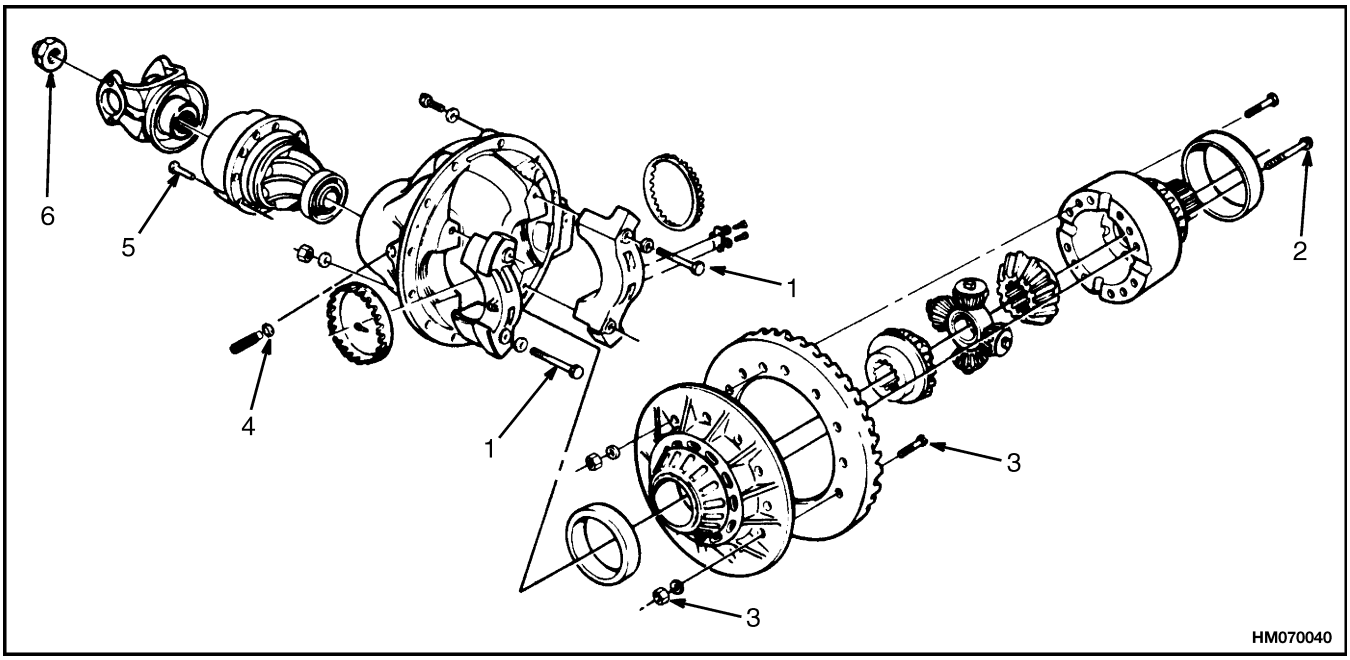
Figure 47. Gear Movement Check



1. BARS MUST NOT TOUCH BEARINGS

Figure 48. Gear Movement Check

4. Tighten the bearing adjustment ring that was just loosened so that there is no movement of the differential assembly.



NOTE: SEE TABLE 7 FOR TORQUE VALUES.

Figure 55. Fasteners Location (Typical Differential Assembly)

Table 7. Torque Specifications

Item No.	Location	Size	N•m*	lbf ft*
1	Bearing Cap Capscrews	9/16" - 12	156 to 190	115 to 140
		5/8" - 11	217 to 258	160 to 190
		3/4" - 10	393 to 475	290 to 350
		7/8" - 14	504 to 590	372 to 435
		7/8" - 9	637 to 746	470 to 550
2	Differential Case Capscrews**	3/8" - 16	41 to 68	30 to 50
		7/16" - 14	81 to 102	60 to 75
		1/2" - 13	122 to 163	90 to 120
		1/2" - 20	142 to 183	105 to 135
		5/8" - 11	251 to 319	185 to 235
		5/8" - 18	285 to 366	210 to 270
3	Ring Gear to Case Capscrews	1/2" - 13	122 to 163	90 to 120
		5/8" - 11	203 to 258	150 to 190
		5/8" - 18	258 to 285	190 to 210

See Figure 55 for Item Nos.
*Torque values are for threads lubricated with machine oil unless Loctite is used.
**Use Loctite No. 272 on the capscrews.

General

This section has a description and the repair procedures for several different types of tilt cylinders. The number and the design of the parts can be different, but the operation of the tilt cylinders is the same.

Description

The tilt cylinders [Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6] are used to move the mast forward and backward. To extend the cylinder rod (tilt forward), oil enters the tilt cylinder port behind the piston. The oil pressure pushes the cylinder rod out of the cylinder. Oil in front of the piston returns to the hydraulic tank. To retract the cylinder rod (tilt backward), the oil enters the port in front of the piston. The oil pressure pushes the cylinder rod into the tilt cylinder. The oil behind the piston returns to the hydraulic tank.

Tilt Cylinder Repair

REMOVE

WARNING

Before removing the tilt cylinder(s), tilt the mast forward. Use a chain to hold the mast to the frame and prevent the mast from moving forward.

1. Disconnect the hydraulic lines at the tilt cylinder. Install caps on the hydraulic lines and ports.

WARNING

Do not push the anchor pins out of the rod end with your fingers. Do not permit the tilt cylinders to drop and cause damage.

2. Remove the retainers for the anchor pins. Push the anchor pins out of the rod end with a tool.

3. Use a lifting device to move large tilt cylinders. Remove the anchor pins from the frame anchors. Remove the tilt cylinder from the frame.

DISASSEMBLE

1. Put the tilt cylinder in a vise with soft jaws. Remove the rod end from the rod.

2. Remove the retainer from the tilt cylinder. Remove the rod and piston from the cylinder.

3. Disassemble the tilt cylinder as necessary. See Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6.

CLEAN

WARNING

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

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

Clean all parts in solvent and dry with compressed air.

ASSEMBLE

Tilt Cylinders With O-Ring or Single-Lip Seals

NOTE: Always use new seals and O-rings. Make sure all parts are clean. Lubricate all parts with clean hydraulic oil.

NOTE: During 1980 and 1981, a change was made in the tilt cylinders used in most lift trucks. The O-ring seal between the retainer and the cylinder shell was moved from above the threads to the area below the threads. A backup ring was added to increase the strength of the O-ring. The assembly of the tilt cylinders is the same, but caution must be used so that the O-ring seal is not damaged by the threads.

4. If the mast does not move, open the gate valve and check the movement again. If the mast moves forward when the gate valve is open, check for leaks in the hydraulic lines and fittings. If no leaks are found, the main control valve can be worn or damaged. Remove the load from the forks when the checks are complete.

Table 1. Movement Rates (Maximum) for Tilt Cylinders

Lift Truck Model	Hydraulic Oil Temperature/Mast Tilt Rate			
	20°C (68°F)		60°C (140°F)	
	mm/min	in./min	mm/min	in./min
A1.00-1.50XL (A20-30XL)	1.3	0.05	9.1	0.50
E1.25-5.50XL, XL_3(E25-120XL, XL_3)	0.8	0.03	5.0	0.20
E3.50-5.50XL, E4.50XLS (E70-120Z, E100ZS) (D098)	0.74	0.03	5.0	0.20
J1.60-2.00XMT (J30-40XM)	0.8	0.03	5.0	0.20
E2.00-3.20XM (E40-65XM) (F108)	0.8	0.03	5.0	0.20
J2.00-3.20XM (J40-60XM, J40-60XM_2) (A216) E1.50-1.75XM, E2.00XMS (E25-40XMS, 40XM_2S) (D114)	0.8	0.03	5.0	0.20
J2.00-3.20XM (J40-65Z) (A416) E1.50-2.00XM (E25-35Z, E40ZS) (E114)	0.8	0.03	5.0	0.20
H1.25-1.75XL (H25-35XL)	0.8	0.03	5.0	0.20
S/H1.50-1.75XM, S/H2.00XMS (S/H25-35XM, S/H40XMS)	0.8	0.03	5.0	0.20
H2.00-3.00XL (H40-60XL)	1.1	0.04	7.3	0.30
S/H2.00-3.20XM (S/H40-65XM)	1.0	0.04	6.8	0.30
H3.50-7.00XL (H70-155XL)	1.3	0.05	8.9	0.34
H8.00-16.00XL (H165-360XL)	1.8	0.07	11.7	0.05
H8.00-14.00XM (H170-330HD), H16.00XM-6 (H360HD), H10.00-12.00XM-12EC (H360HD-EC)	1.8	0.07	11.7	0.05
H20.00-32.00F (H440-700F/FS)	1.3	0.05	3.8	0.15
H36.00-48.00C (H800-1050C)	1.3	0.05	3.8	0.15
J2.00-3.00XL (J40-60XL)	0.8	0.03	5.0	0.20
J25-35A,B	1.3	0.05	3.8	0.15
S1.25-5.50XL (S25-120XL)	0.8	0.03	5.0	0.20
S6.00-7.00XL (S135-155XL)	1.2	0.05	8.2	0.32

TABLE OF CONTENTS

This section is for the following models:

All Models

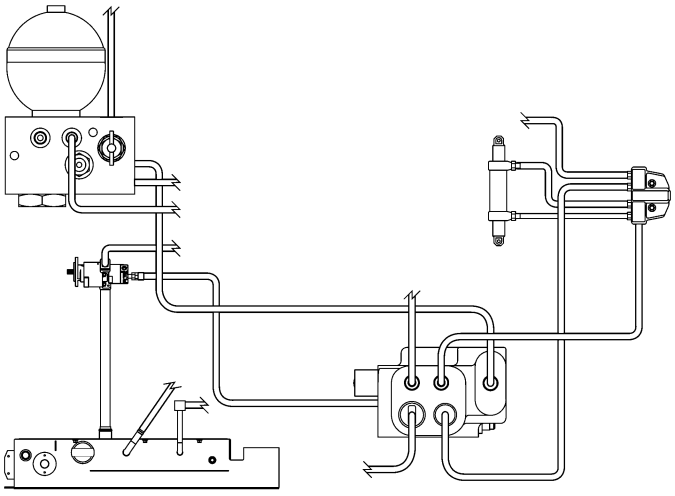
CONVERSION TABLE

Table 7. Conversion Table for Metric and English Units

Multiply	By	To Get	Multiply	By	To Get
Area					
inches ^{2} (in. ^{2})	× 6.452	= centimeters ^{2} (cm ^{2})	centimeters ^{2} (cm ^{2})	× 0.155	= inches ^{2} (in. ^{2})
feet ^{2} (ft ^{2})	× 0.093	= meters ^{2} (m ^{2})	meters ^{2} (m ^{2})	× 10.764	= feet ^{2} (ft ^{2})
Linear					
inches (in.)	× 25.4	= millimeters (mm)	millimeter (mm)	× 0.039	= inches (in.)
feet (ft)	× 0.305	= meters (m)	meter (m)	× 3.281	= feet (ft)
yards (yd)	× 0.914	= meters (m)	meter (m)	× 1.094	= yards (yd)
miles (mi)	× 1.609	= kilometers (km)	kilometer (km)	× 0.621	= miles (mi)
Mass					
ounces (oz)	× 28.35	= grams (g)	grams (g)	× 0.035	= ounces (oz)
pounds (lb)	× 0.454	= kilograms (kg)	kilograms (kg)	× 2.205	= pounds (lb)
tons (2,000 lb)	× 907.18	= kilograms (kg)	kilograms (kg)	× 0.001	= tons (2,000 lb)
tons (2,000 lb)	× 0.907	= metric ton (t)	metric ton (t)	× 1.102	= tons (2,000 lb)
Power					
horsepower (hp)	× 0.746	= kilowatts (kW)	kilowatts (kW)	× 1.34	= horsepower (hp)
Pressure					
pounds/in. ^{2} (psi)	× 6.895	= kilopascal (kPa)	kilopascals (kPa)	× 0.145	= pounds/in. ^{2} (psi)
pounds/in. ^{2} (psi)	× 0.007	= megapascal (MPa)	megapascals (MPa)	× 145.04	= pounds/in. ^{2} (psi)
Temperature					
(°Fahrenheit−32)	× 0.56	= °Celsius (C)	(°Celsius × 1.8) +32		= °Fahrenheit
Torque					
pound inches (lbf in.)	× 0.113	= Newton meter (N•m)	Newton meter (N•m)	× 8.851	= pound inches (lb $_f$ in.)
pound feet (lbf ft)	× 1.356	= Newton meter (N•m)	Newton meter (N•m)	× 0.738	= pound feet (lb $_f$ ft)
Velocity					
miles/hour (mph)	× 1.609	= kilometer/hour (km/h)	kilometer/hr (km/h)	× 0.621	= miles/hour (mph)
Volume					
inches ^{3} (in. ^{3})	× 16.387	= centimeters ^{3} (cm ^{3})	centimeters ^{3} (cm ^{3})	× 0.061	= inches ^{3} (in. ^{3})
inches ^{3} (in. ^{3})	× 0.016	= liters (l)	liters (l)	× 61.024	= inches ^{3} (in. ^{3})
quarts, U.S. (qt)	× 0.946	= liters (l)	liters (l)	× 1.057	= quarts, U.S. (qt)
quarts, U.S. (qt)	× 0.83	= quarts, Imp. (qt)	quarts, Imp. (qt)	× 1.205	= quarts, U.S. (qt)
gallons, U.S. (gal)	× 3.785	= liters (l)	liters (l)	× 0.264	= gallons, U.S. (gal)
gallons, U.S. (gal)	× 0.83	= gallons, Imp. (gal)	gallons, Imp. (gal)	× 1.205	= gallons, U.S. (gal)
ounces (oz)	× 29.57	= milliliters (ml)	milliliters (ml)	× 0.034	= ounces (oz)

STEERING SYSTEM

H8.00-12.00XM (H170-280HD) [F007, G007, H007]; H13.00-14.00XM (H300-330HD) [E019, F019, G019]; H16.00XM-6 (H360HD) [E019, F019, G019]; H10.00-12.00XM-12EC (H360HD-EC) [E019, F019, G019]



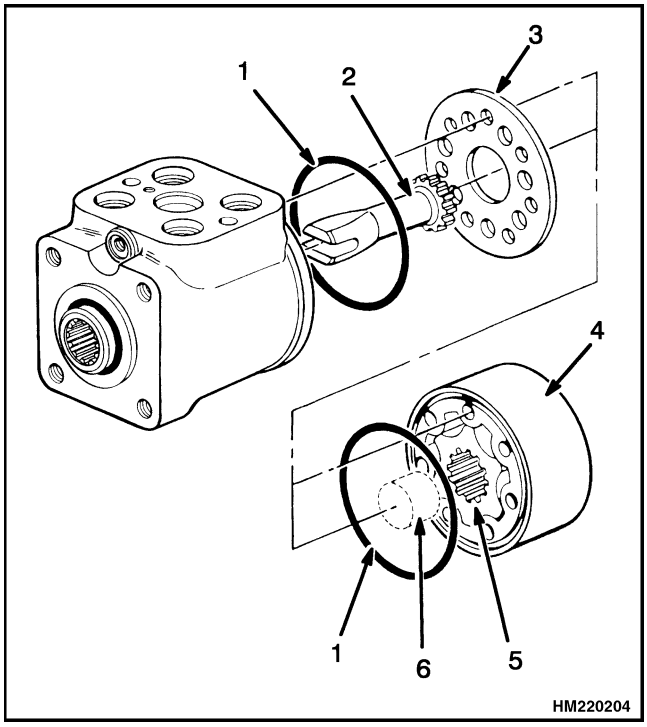
HM220310

HYSTER

PART NO. 1494140

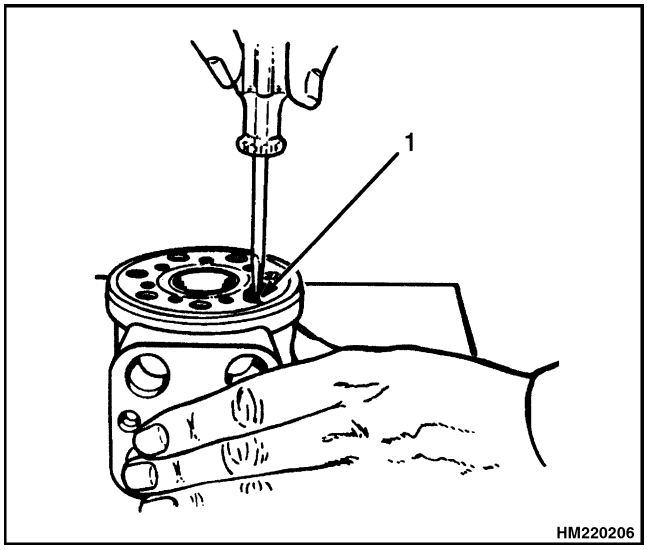
1600 SRM 936

STEP 3.
Remove spacer, stator, rotor, and port plate. Put a mark on stator so that same side is toward body of control unit. Remove O-rings. Remove center shaft.



1. O-RING
2. CENTER SHAFT
3. PORT PLATE
4. STATOR
5. ROTOR
6. SPACER

STEP 4.
Remove retainer for check ball. Remove check ball.



1. RETAINER

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Lift truck steers slowly. Steering wheel is hard to turn.	Oil level is low. There is no oil in tank.	Fill tank to correct level.
	Lines to control unit are damaged.	Repair oil lines.
	Sleeve and spool in control unit are worn.	Repair steering control unit.
	Parts of metering section are worn.	Repair steering control unit.
	Check valve in control unit does not open.	Clean or repair steering control unit.
	Check valve or relief valve in manifold block is damaged or is not adjusted correctly.	Clean or replace manifold block.
	Priority valve is not operating correctly.	Clean or repair priority valve.
	Steering relief pressure is too low.	Adjust relief pressure.
	Engine idle speed is too low.	Adjust idle speed to specifications.
Steering wheel turns tires in wrong direction.	Lines at control unit are not correctly connected.	Connect lines correctly.
Tires continue to turn after steering wheel stops.	Neutral position springs are broken.	Repair steering control unit.
	Sleeve or spool has damage.	Repair steering control unit.
Steering wheel kicks back in both directions.	Center shaft is not correctly aligned with metering section.	Assemble steering control unit correctly.

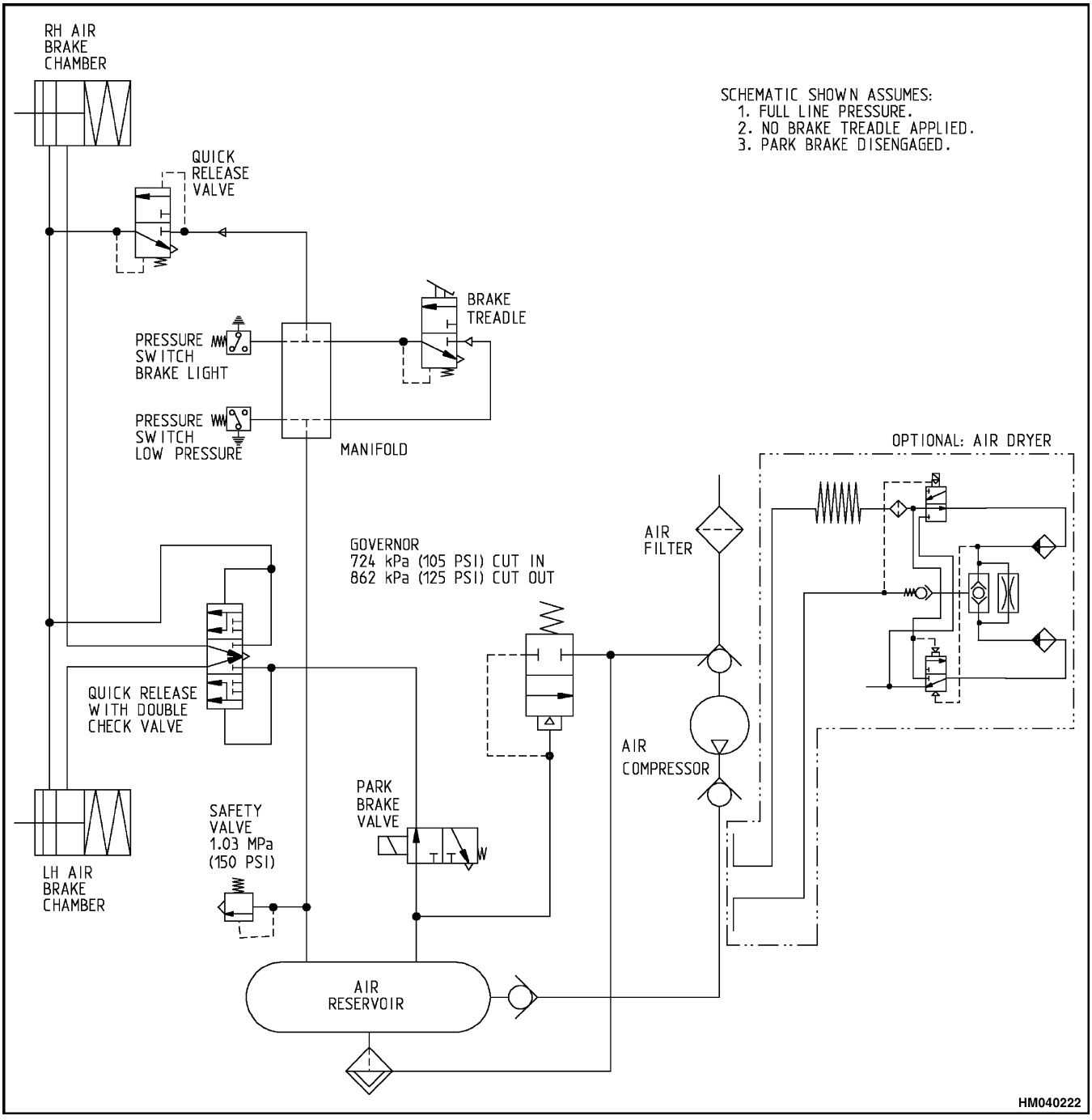
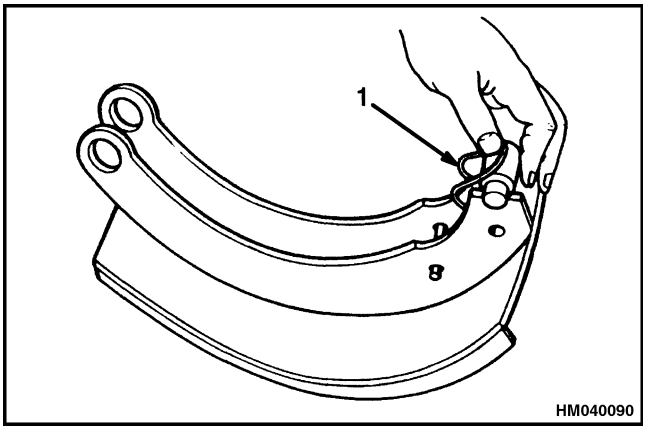


Figure 2. Brake System Schematic



1. RETAINER

Figure 12. Roller Removal

CAMSHAFT, REMOVE

1. Remove brake shoes. See Brake Shoe, Remove.

2. Disconnect actuator arm at clevis on air chamber.

3. Remove snap ring and washer(s) from end of camshaft. Pull actuator arm off camshaft. See Figure 9.

4. Check for wear at camshaft bushings as shown in Figure 13. If radial clearance of camshaft is more than 0.76 mm (0.030 in.) on a dial indicator setup, replace bushings. See the section **Planetary Drive Axle**, **(Dry System)** 1400 SRM 945 to remove planetary hub. Remove washer(s) and seal from camshaft and pull camshaft from spider. Use a driver of the correct size to remove bushings from spider and bracket. See Figure 14.

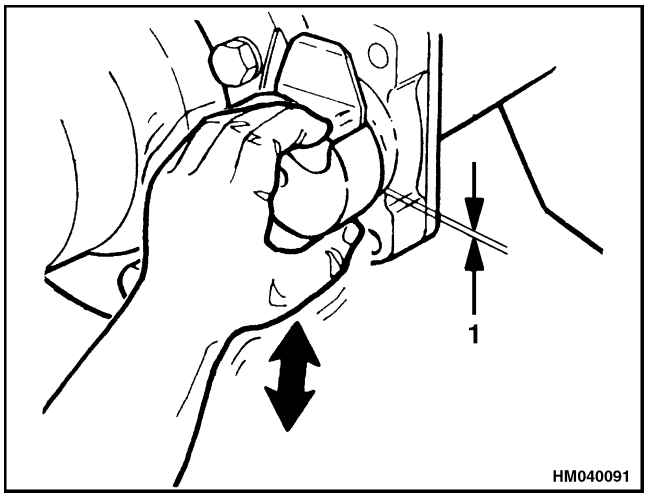
5. Remove thrust washer and seal from camshaft.

CLEAN

1. Carefully remove brake drum. Do not release dust from brake linings into air when brake drum is removed.

WARNING

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



1. RADIAL CLEARANCE MEASUREMENT

Figure 13. Camshaft Bushing Wear Check

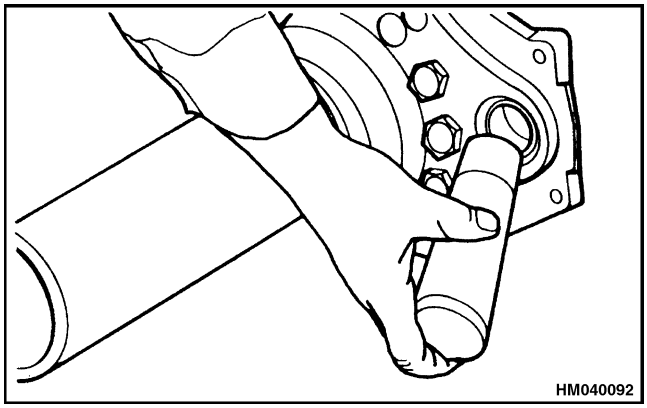


Figure 14. Bushing Removal

CAUTION

Do not use an oil solvent to clean wheel cylinder. Use a solvent approved for cleaning of brake parts. Do not permit oil or grease in brake fluid or on brake linings.

2. Use a solvent approved for cleaning of brake parts to wet brake lining dust. Follow instructions and cautions of the manufacturer for use of solvent. If solvent spray is used, do not make brake lining dust with spray.

3. When brake lining dust is wet, clean parts. Put any rags or towels in a plastic bag or an airtight container while they are still wet. Put a DANGEROUS FIBERS warning label on plastic bag or airtight container.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
SERVICE BRAKES, PARK FUNCTION (REVIEW CAUSES UNDER SERVICE BRAKES ALSO)		
Parking brake does not release.	Air pressure is too low.	Repair or replace compressor or leakage.
	Parking brake valve has a defect.	Repair or replace valve.
	Parking brake electrical switch is defective.	Replace electrical switch.
	Spring chamber(s) has a defective diaphragm or leak.	Replace diaphragm.
Parking brake does not apply enough force to hold lift truck.	Brake shoes are not correctly adjusted.	Adjust brakes.
	Linings or drums have excessive wear.	Install new brake shoes.
	Parking brake valve has a defect.	Replace valve.
	Spring(s) in air chamber(s) is broken.	Replace spring(s).
	A release bolt keeps a spring partially compressed.	Adjust release bolt.

Table 1. Main Control Valve Port Settings

More Flow to Ports P and A1		More Flow to Port EF	
Steering Activated	P low	P high	No steering
Steering Activated	LS1 high	LS1 low	No steering
Low Pilot Pressure	A2 low	A2 high	High pilot pressure

The resulting oil pressure at port A1, that leads to the pilot valve, depends on the position of the flow divider and the actual flow through ports P and A1. Pressure may vary 20 to 165 bar (290 to 2393 psi). Pressure will raise when the flow divider sends more oil to ports P and port A1 while oil flow is restricted.

The force of a spring in the flow divider causes a certain minimum pressure to be reached at port P, before the connection to port EF is opened.

If port EF is opened at too low of an oil pressure, it will result in a low oil supply for the steering system. This will result in difficulty in turn the steering wheel quickly. If port EF is opened at too high of an oil pressure, this will result in heat generation at the pressure reducer in the pilot valve.

The pressure level at which port EF will open can be adjusted by turning a screw at the modulator valve. See Checks and Adjustments.

Restrictors in the steering priority flow valve assist in the smooth operation of the modulating flow divider, to prevent pressure shocks for the hydraulic pump and the pump drive.

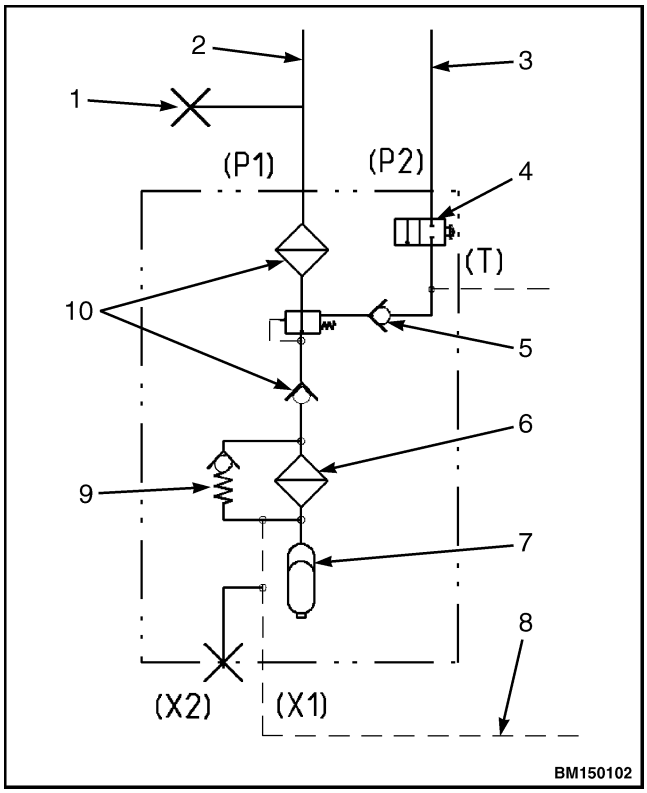
The 185 bar (2683 psi) relief valve has no particular function, because the relief valve in the steering hand pump determines the maximum pressure of 165 bar (2393 psi) for line LS1.

PILOT VALVE

The function of the pilot valve is to create a constant level of oil pressure for the pilot circuit of the main control valve.

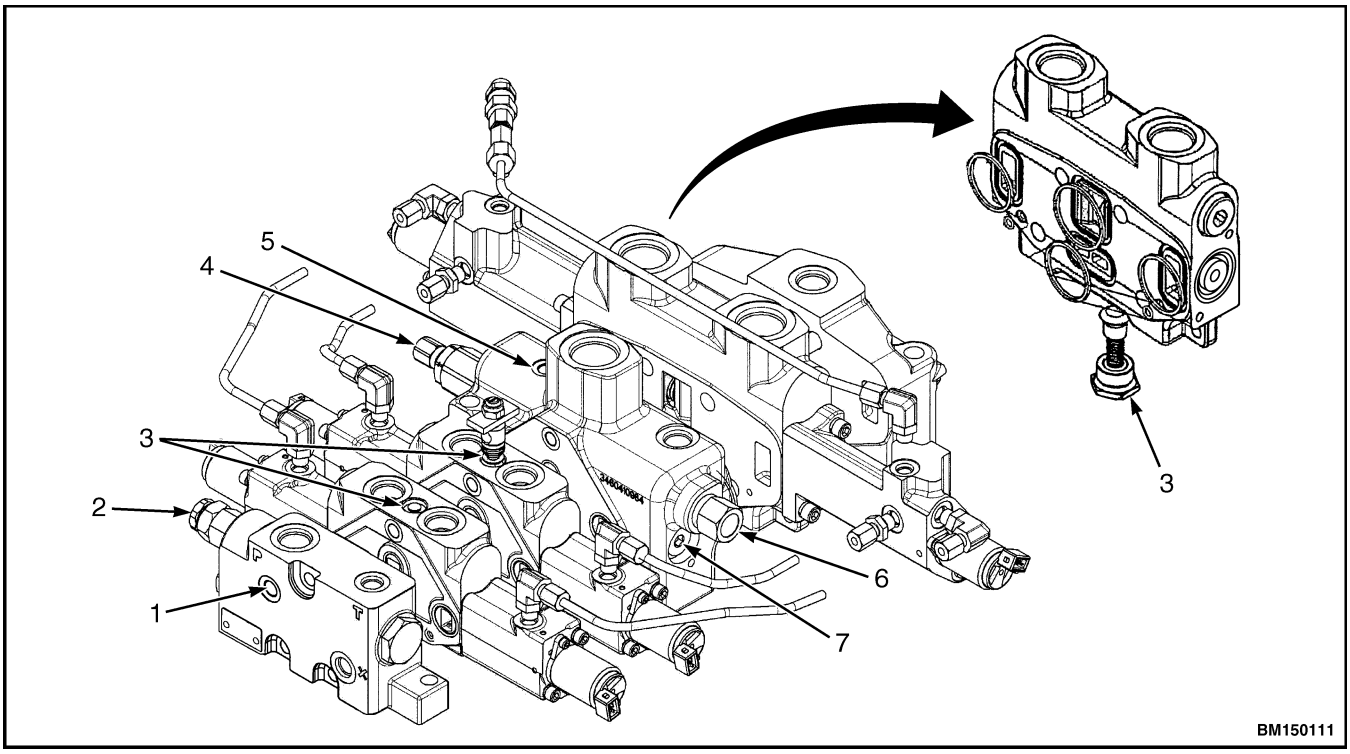
Port A1 of the steering priority flow valve sends fluctuating oil pressure to port P1 of the pilot valve. The pressure reducing valve in the pilot valve limits pilot system oil pressure to 45 to 50 bar (653 to 725 psi). Excess oil pressure is returned to the tank.

Pilot system pressure is also connected with the modulator valve. When pilot pressure is low, between 15 to 29 bar (218 to 421 psi), it will result in more oil flow from the steering priority flow valve to the pilot valve. When pilot pressure is getting higher, 35 to 38 bar (493 to 551 psi), it will result in a reduction of oil flow to the pilot valve. See Figure 4 and Figure 5.



1. CHECK VALVE
2. FROM STEERING PRIORITY VALVE
3. FROM HOIST CYLINDER
4. MANUAL VALVE
5. TANK BYPASS VALVE
6. FILTER
7. ACCUMULATOR
8. PILOT PRESSURE
9. FILTER BYPASS VALVE
10. PRESSURE REDUCING VALVE

Figure 4. Pilot Valve Schematic



1. 193 bar (2799 psi) CHECK PORT
2. 193 bar (2799 psi) RELIEF VALVE
3. CHECK VALVE
4. 210 bar (3046 psi) RELIEF VALVE
5. 210 bar (3046 psi) CHECK PORT
6. UNLOADER CARTRIDGE
7. UNLOADER PISTON

Figure 16. Main Control Valve Check Ports

CHECK VALVES

To check proper functioning of the check valves, the related cylinder(s) must be under load. Operate the hydraulic lever until the cylinders move. Hold the lever and let the engine run at idle speed. If the cylinders return in the opposite direction, the check valve leaks. Replace a leaking check valve.

UNLOADER VALVE

NOTE: When lifting a capacity load, pressure reading at the tilt check port will remain zero. Pressure reading at the lift check port will be near 210 bar (3046 psi).

Attach a pressure gauge at the 193 bar (2799 psi) and 210 bar (3046 psi) pressure check ports. When lifting a light load, pressure readings at these ports will be similar. When the lift cylinders have reached the extended position, pressure at the tilt check port will drop to zero and pressure at the lift check port will raise to 210 bar (3046 psi). When lowering, pressure at the lift check port will drop to zero.

Function Disable

NOTE: When re-enabling these functions, recalibration is necessary. For description see Hydraulic Controls Program.

It is possible to disable the 3rd and the 4th proportional function and the sideshift function. In case you want to disable or re-enable, select the following programs in the Hydraulic Controls Program:
- Lever Calibration, for 3rd and 4th Proportional Function.
- Joystick Calibration, for Sideshift.

GENERAL STARTUP

Minimum system requirements

- IBM compatible laptop computer with minimum Pentium 133 MHz processor
- Windows 98, Windows NT, Windows 2000, or Windows XP
- CD reader
- An open PC serial communication port: Communication port 1 or 2.
- Communication cable (Hyster Part Number 2045306)
- Hydraulic Controls Program (Hyster Part Number 1508366)

Install the Hydraulic Controls Program

Install the Hydraulic Controls Program on the PC according to the directions received with the software.

DelayTimeFile (Reset)

By default, the synchronization speed of older User-Interface programs is set at 600 MHz. Laptops with higher processor speeds can experience communication synchronization issues, that show up after opening the program and selecting "PWM". Typical error messages include: "Run time error 13", "Run time error 6", and "No Communication with PV3". Starting with User-Interface program V3.3, this issue can be resolved as follows:

1. Install the Hydraulic User-Interface program V3.3.
2. Go to "Start", "Control Panel" and "System Properties" on the computer and record the processor speed.
3. Open Microsoft Explorer (File Manager) and go to directory "c:\program files\node_syst".
4. Double click on file "delayTimeFile.dat" and open it with "Notepad" or "Wordpad". When the file opens, a default number that corresponds to the processor speed will be listed (Example: 85555). Replace this number by highlighting and entering the value as described in step 6.
5. From Table 2, chose the number that corresponds to the processor speed. If the actual processor speed is not listed, select the next lowest value. Do not select a speed that is greater than the actual processor speed.
6. Highlight and replace the number in the "delayTimefile.dat" file as discussed in step 4. Replace the number with one from Table 2. Save the new number by opening "file" in the toolbar and selecting "Save". Exit the file. Reboot the PC before using the Hydraulic Controls Program.

Table 2. Processor Speed Settings

Number	Processor Speed
33333	150 MHz
44444	250 MHz
55555	350 MHz
65535	450 MHz
75555	550 MHz
85555	600 MHz
140000	775 MHz
198000	950 MHz
255000	1.1 GHz (1100 MHz)
312000	1.3 GHz (1300 MHz)
369000	1.5 GHz (1500 MHz)
426000	1.8 GHz (1800 MHz)
483000	2.0 GHz (2000 MHz)
540000	2.2 GHz (2200 MHz)
597000	2.4 GHz (2400 MHz)
654000	2.5 GHz (2500 MHz)
711000	2.71 GHz (2700 MHz)
768000	2.9 GHz (2900 MHz)
825000	3.0 GHz (3000 MHz)

Table 9. Input/Output Module 1 (Continued)

		Before February 2003	Starting February 2003	Starting February 2003	Starting February 2003
PIN	**WIRE**	**Alternating A/B (FLT)**	**Alternating A/B (FLT)**	**Fixed PT (FLT)**	**ECH**
8	407	1V Switch Supply	1V Switch Supply	1V Switch Supply	1V Switch Supply
9	429	Sideshift Output	Aux 1 Output	Aux 0 Output	Sideshift RH Output
10	428	Sideshift Output	Aux 0 Output	Aux 0 Output	Sideshift LH Output
11	427	Clamp/Aux 3 Output	Aux 3 Output	Aux 1 Output	Retraction Output
12	426	Clamp/Aux 2 Output	Aux 2 Output	Aux 1 Output	Extension Output

Table 10. Input/Output Module 2

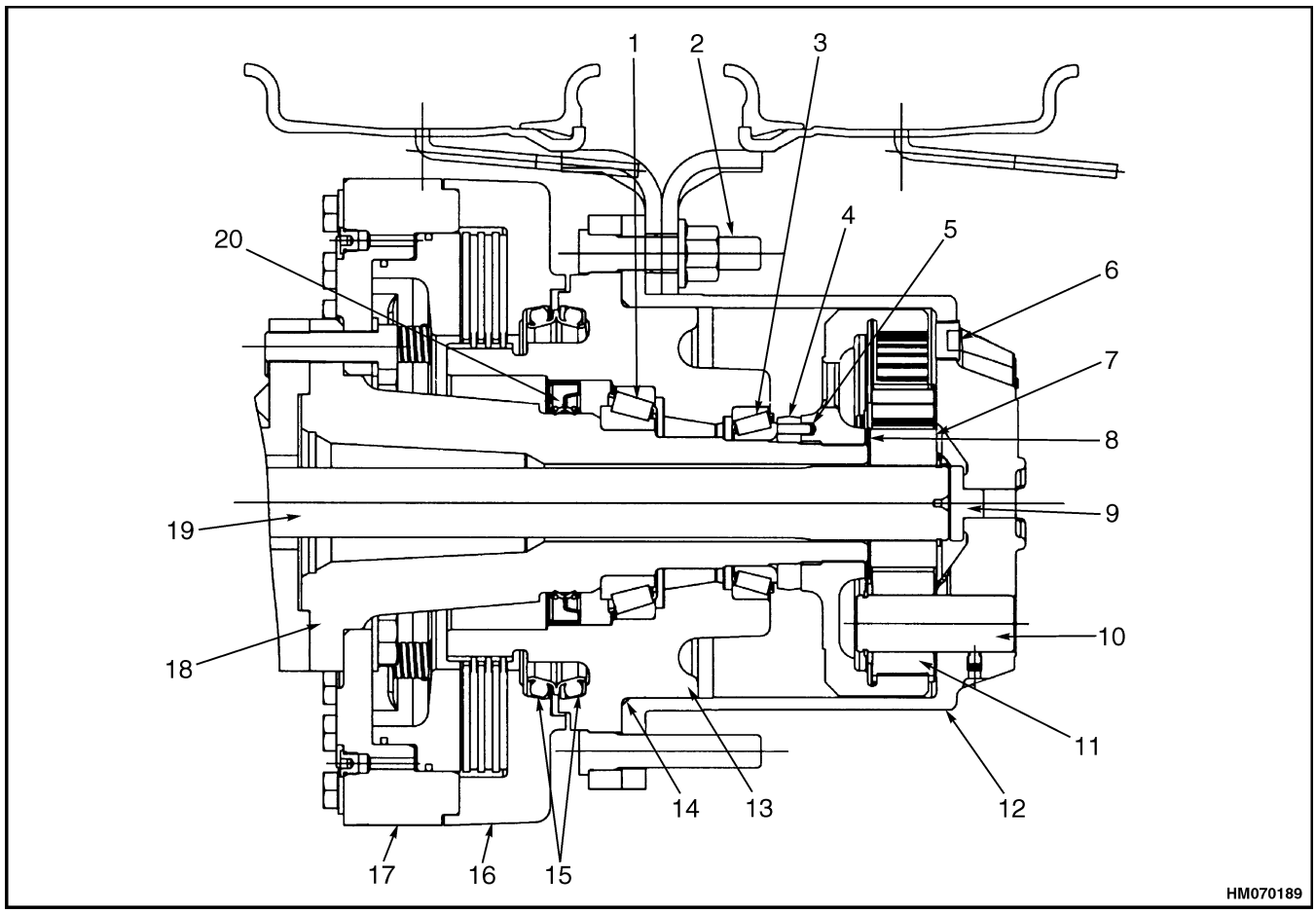
		Before February 2003	Starting February 2003	Starting February 2003	Starting February 2003
PIN	**WIRE**	**Alternating A/B (FLT)**	**Alternating A/B (FLT)**	**Fixed PT (FLT)**	**ECH**
1		Aux 4 Switch Input	Aux 4 Switch Input	Aux 4 Switch Input	Unused Analog Input
2		Aux 5 Switch Input	Aux 5 Switch Input	Aux 5 Switch Input	Unused Analog Input
3		Aux 6 Switch Input	Unused Analog Input	Aux 6 Switch Input	Unused Analog Input
4	470	Unused Analog Input	Inhibit 0 Switch Input	Inhibit 0 Switch Input	Unused Analog Input
5	405	5V Supply	5V Supply	5V Supply	Not Used
6	406	Digital Ground	Digital Ground	Digital Ground	Not Used
7	404	4V Switch Supply	4V Switch Supply	4V Switch Supply	Not Used
8	407	1V Switch Supply	1V Switch Supply	1V Switch Supply	Not Used
9		Unused Output	Aux 1 Output	Aux 0 Output	Unused Output
10		Aux 6 Output	Aux 0 Output	Aux 0 Output	Unused Output
11		Aux 5 Output	Aux 5 Output	Aux 1 Output	Unused Output
12		Aux 4 Output	Aux 4 Output	Aux 1 Output	Unused Output

General

This section has a description and the repair procedures for the planetary gear axle.

Description

The planetary axles incorporate a single reduction carrier/differential assembly with hypoid gearing. The final reduction is of planetary spur designed gearing built into the wheel hubs. See Figure 1 and Figure 2. The axles have only cast housings. See Figure 3. See the section **Differential** for your lift truck.



1. INNER BEARING
2. WHEEL STUD
3. OUTER BEARING
4. LOCK NUT
5. PIN
6. MAGNETIC DRAIN PLUG
7. SUN GEAR
8. SUN GEAR THRUST WASHER
9. THRUST BUTTON
10. PLANETARY PINION SHAFT
11. PLANETARY GEAR
12. PLANETARY SPIDER
13. WHEEL HUB
14. O-RING
15. FACE SEAL
16. WET BRAKE DISC HOUSING
17. WET BRAKE PISTON HOUSING
18. SPINDLE
19. AXLE SHAFT
20. OIL SEAL

Figure 1. Wheel End Cross Section H8.00-12.00XM (H170-280HD)

Parts Inspection

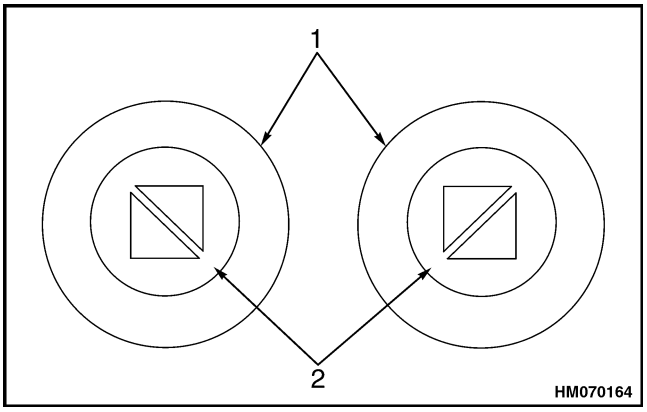
NOTE: It is important to carefully inspect all parts for wear and damage before you assemble the axle carrier.

Replace damaged parts.

TAPERED ROLLER BEARINGS

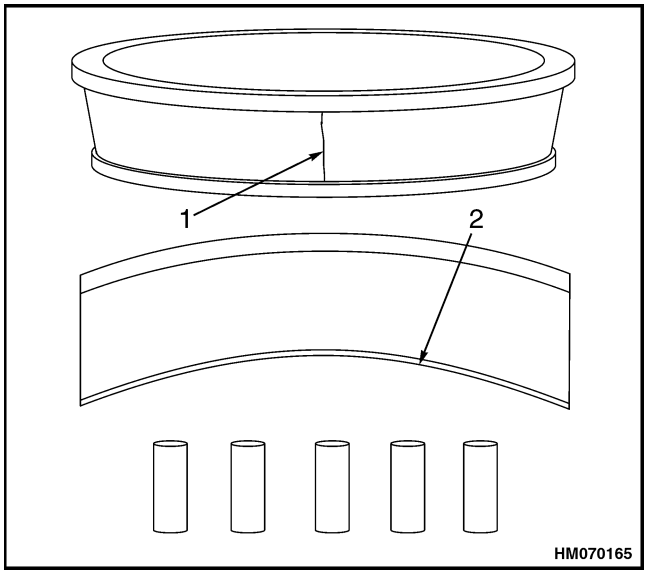
NOTE: Inspect cup, cone, rollers, and cage of all tapered roller bearings in the assembly. If any of the following conditions exist, replace the bearing.

- The centers of the large diameter end of the rollers are worn level with or below surface. See Figure 9.
- The centers of the large diameter end of the rollers are worn to a sharp edge. See Figure 9.
- A visible roller groove is worn in the cup or cone inner race surfaces. You can see the groove at the small or large diameter ends of both parts. See Figure 10.
- Deep cracks or breaks are present in the cup, cone inner race, or roller surfaces. See Figure 11.
- Bright wear marks are present on the outer surface of the roller cage. See Figure 11.
- Etching and pitting are present on the rollers and on surfaces of the cup and cone inner race that touches the rollers. See Figure 12.
- Spalling or flaking is present on the cup and cone inner race surfaces that touch the rollers. See Figure 13.



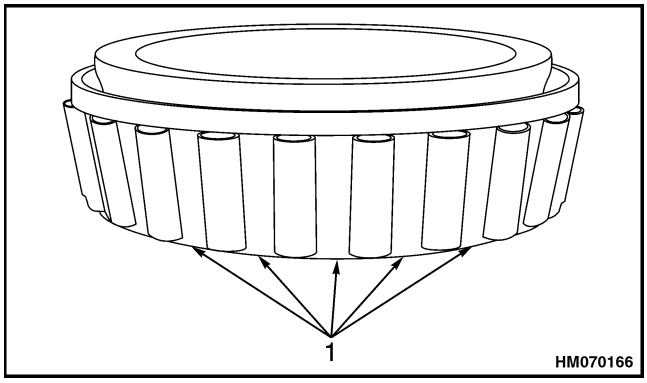
1. WORN RADIUS 2. WORN SURFACE

Figure 9. Tapered Roller Bearings



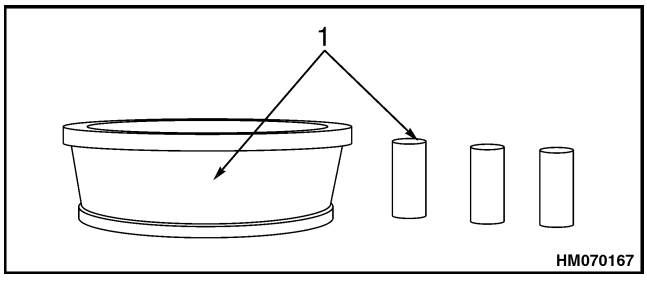
1. CRACK 2. WEAR GROOVES

Figure 10. Tapered Roller Bearings



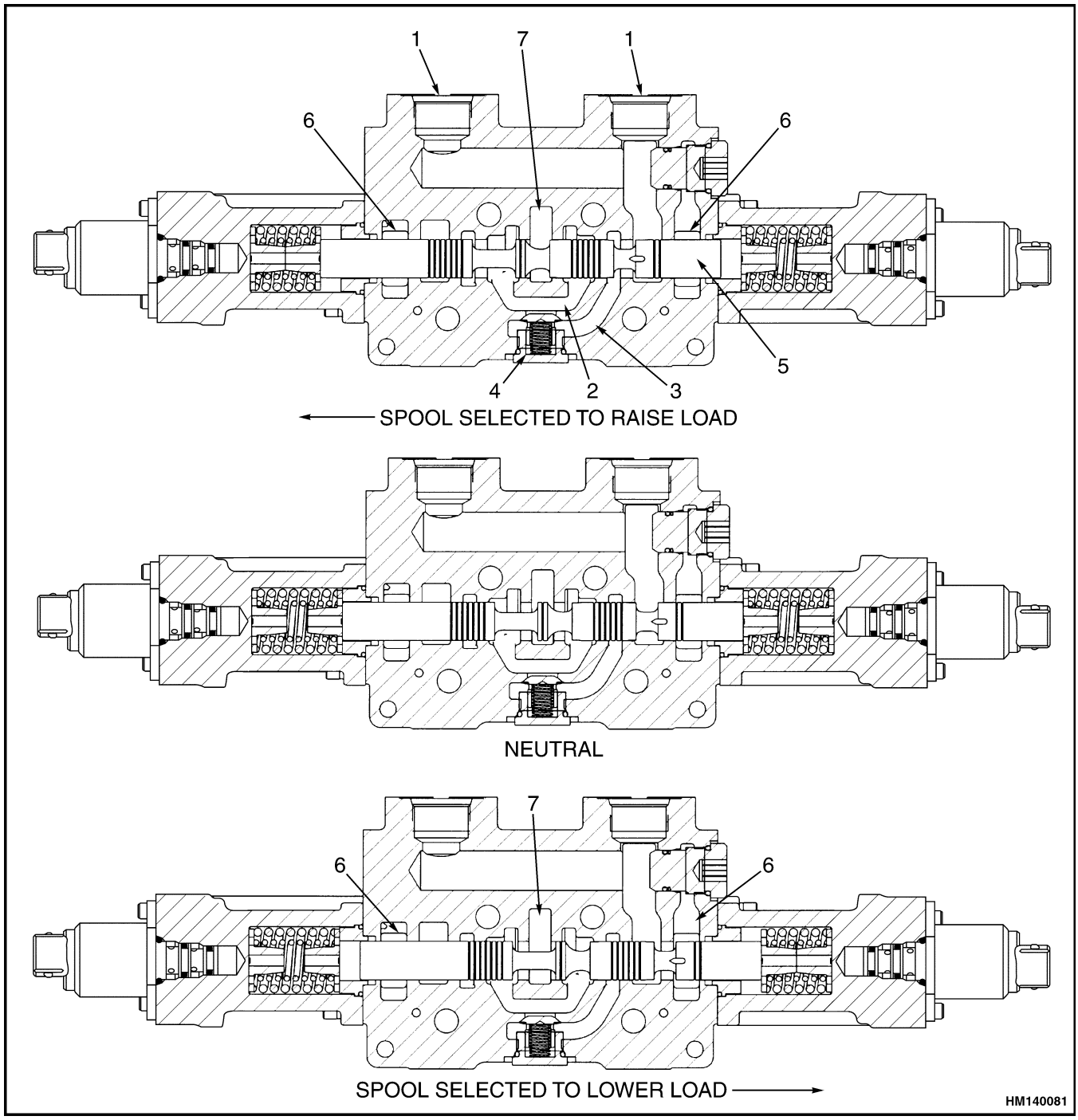
1. WEAR MARKS

Figure 11. Tapered Roller Bearings



1. ETCHING AND PITTING

Figure 12. Tapered Roller Bearings



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

WARNING

To prevent serious personal injury and possible damage to components, be very careful when using lifting devices during service and maintenance procedures.

- **Inspect to make sure that neither lifting strap is damaged.**
- **Do not subject lifting straps to any shock or drop loading.**

4. Use a lifting device to support brake drum. See Figure 6.

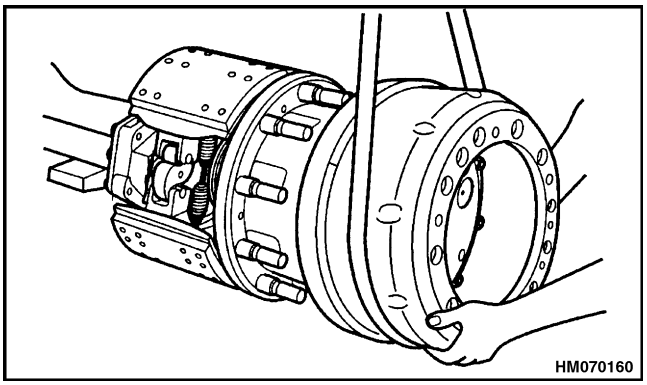


Figure 6. Wheel End Assembly

5. Install capscrews into threaded holes in brake drum. Gradually tighten capscrews in equal amounts to push drum off pilot surface of planetary spider. See Figure 1 and Figure 2.

6. With lifting device, carefully remove brake drum. See Figure 6.

7. Remove five slotted head machine screws that attach planetary spider to wheel hub.

PLANETARY SPIDER AND GEARING ASSEMBLY H8.00-12.00XM (H170-280HD)

NOTE: If only the planetary pinions are removed for inspection without removing the pinion shaft, proceed to Step 5. See Figure 7.

1. With a lifting device, remove planetary spider from wheel hub. Set its large flange side on workbench.

2. Matchmark outer ends of pinion shafts and planetary spider to aid in reassembly if original pinion shafts are used.

3. Remove setscrew from each pinion shafts.

WARNING

Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

CAUTION

To avoid damage to the pinion shaft, provide a soft cushioned area to receive the pinion shaft when it is removed from the spider.

4. Use a press to remove pinion shafts. If a press is not available, use a brass drift and mallet to drive out shaft. Press or drive pinion shaft out toward large flange end of planetary spider.

5. Remove snap ring, inner thrust washer, planetary pinion, and outer thrust washer from each pinion shaft.

6. Remove axle shaft thrust button only if it is worn. Press it out TOWARD large end of planetary spider.

NOTE: The sun gear thrust washer may come out with the axle shaft and sun gear assembly.

7. Remove axle shaft, planetary sun gear, and snap ring assembly.

8. If necessary, remove snap ring from axle shaft to allow for removal of sun gear and sun gear thrust washer.

9. If necessary, remove sun gear thrust washer from end of planetary ring gear.

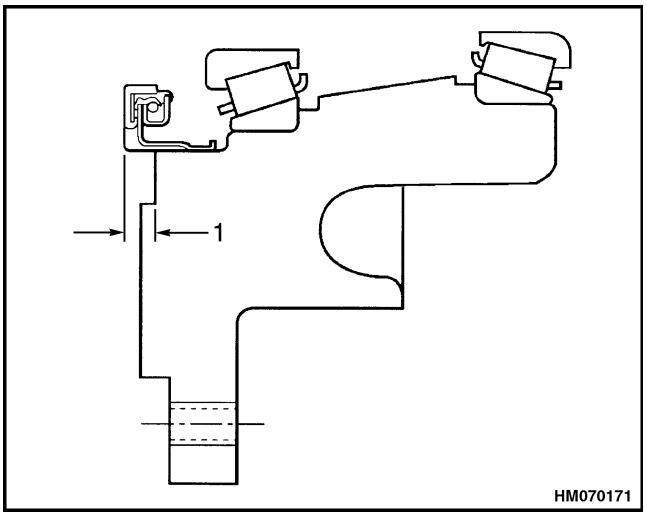
10. Remove planetary ring gear.

11. Remove wheel bearing adjusting nut.

CAUTION

The outer bearing cone will be loose as you pass it over the end of the spindle. Hold cone securely to avoid dropping it and damaging cone.

12. Remove wheel hub assembly. Wheel bearings and oil seal will come off with wheel hub.



1. 8.64 mm (0.34 in.)

Figure 18. Wheel Hub Seal

6. Apply a light film of axle lubricant to hub oil seal rubber ribs in oil seal bore.

7. Install wheel hub, inner bearing, and oil seal assembly onto spindle. Keep hub assembly aligned with spindle.

8. Apply axle lubricant to outer bearing cone rollers. Install outer bearing cone onto planetary ring gear hub.

9. Install ring gear hub and bearing assembly onto spindle.

ADJUST WHEEL BEARING PRELOAD

NOTE: To adjust wheel bearing preload, bearings must be seated and rollers in proper alignment.

WARNING

Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.

1. Install wheel bearing adjusting nut. Tighten nut to 542 N•m (400 lbf ft).

2. Rotate hub in both directions. At the same time, tap hub several times with a brass or plastic mallet.

3. Tighten nut to 542 N•m (400 lbf ft) again.

4. Back off nut approximately 1/4 turn to relieve preload produced in Step 3.

5. Tighten nut to 271 N•m (200 lbf ft).

NOTE: Step 6 and Step 7 vary between H8.00-12.00XM (H170-280HD) and H13.00-14.00XM (H300-330HD), H16.00XM-6 (H360HD), and H10.00XM-12EC (H360HD-EC). Verify correct procedures.

WARNING

Carefully align adjusting nut dowel pin within a ring gear tooth spline to avoid damage to pin. A damaged dowel pin will cause adjusting nut to back off and loosen wheel during vehicle operation. This can result in serious personal injury and damage to components.

6. **H8.00-12.00XM (H170-280HD)**.
Carefully align adjusting nut dowel pin within a ring gear tooth spline to avoid damage to dowel pin. Tighten adjusting nut to produce proper alignment. Do not back off adjusting nut.

H13.00-14.00XM (H300-330HD), H16.00XM-6 (H360HD), and H10.00XM-12EC (H360HD-EC).
Install lock plate.

7. **H8.00-12.00XM (H170-280HD)**.
Install planetary ring gear onto spindle. The dowel pin in adjusting nut must be installed in hole in ring gear face to allow ring gear to seat against adjusting nut.

H13.00-14.00XM (H300-330HD), H16.00XM-6 (H360HD) and H10.00XM-12EC (H360HD-EC).
Install lock plate mounting screws. Tighten mounting screws to 27 to 41 N•m (20 to 30 lbf ft).

8. Apply a thin layer of axle grease to face of sun gear thrust washer.

9. Install sun gear thrust washer. Washer tangs must engage holes in ring gear.

10. Install planetary sun gear and snap ring onto axle shaft.

11. Install axle shaft and sun gear assembly. For correct installation:
- Axle shaft must make contact with differential side gear.

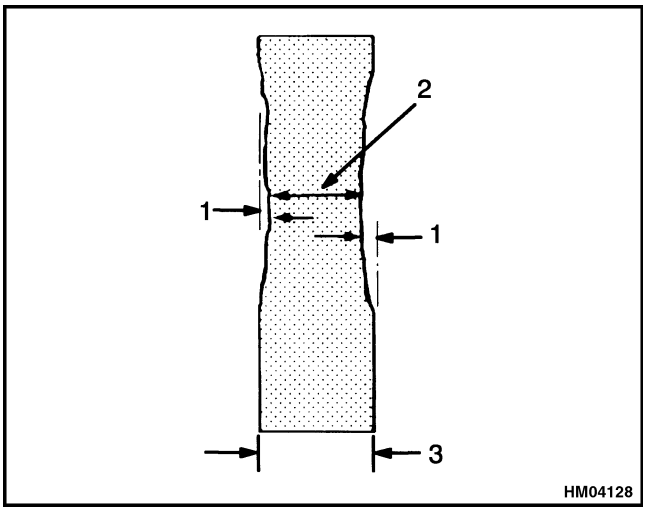
TABLE OF CONTENTS

DISASSEMBLE

Disassemble caliper to remove and service as necessary.

INSPECT

Inspect parts and bores for scratches. If there are scratches or other damage, replace damaged parts. Inspect rotor as shown in Figure 7.



1. MAXIMUM ROTOR WEAR 1.5 mm (0.06 in.)
2. MINIMUM ROTOR THICKNESS 11.0 mm (0.43 in.)
3. ROTOR THICKNESS 13.0 mm (0.51 in.)

Figure 7. Inspect Rotor for Parking Brake Caliper

INSTALL

NOTE: Brake setting is required after mounting new brake pads or brake disc, as well as during all repair stages and in the event of insufficient braking performance.

NOTE: All mounting and setting work must be carried out on the brake when cold.

1. Remove cap.
2. Release lock nut and turn setscrew counterclockwise until ram comes to rest against face of piston.
3. Mount caliper to bracket and secure with bolts.
4. Mount pressure connection and apply the necessary release pressure to brake until bank of disc springs are completely pretensioned.
5. Adjust brakes.

ADJUST

NOTE: During this adjustment process, the parking brake must be released and the disc springs pretensioned.

1. Put blocks in front and back of tires so the vehicle cannot move.
2. Remove cap.
3. Release lock nut and turn setscrew clockwise until brake pads touch brake disc.
4. Turn setscrew counterclockwise and set clearance specified. See Table 1.
5. Hold setscrew in position and tighten lock nut.
6. Replace cap and tighten.
7. Bleed piston chamber using bleeder. See Figure 6.
8. Operate brake valve several times and check braking efficiency of parking brake on a slope.

Table 1. Brake Pad Adjustment

Type	Adjustment Screw	Clearance mm (in.)		Revolutions
Small	M16 (size 8)	Minimum	0.5 mm (0.020 in.)	1/4
		Rated Clearance	**1.0 mm (0.039 in.)**	**1/2**
		Maximum	1.5 mm (0.059 in.)	3/4
Large	M20 (size 10)	Minimum	1.0 mm (0.039 in.)	2/5
		Rated Clearance	**2.0 mm (0.079 in.)**	**4/5**
		Maximum	3.0 mm (0.118 in.)	1-1/5

2. If planetary ring gear did not remain with planetary spider assembly during assembly's removal, remove ring gear from planetary ring gear hub.

WARNING

Observe all warnings and cautions provided by press manufacturer to avoid damage to components and serious personal injury.

WARNING

Use a brass or leather mallet for assembly and disassembly procedures. Do not hit steel parts with steel hammer. Pieces of a part can break off and cause serious personal injury.

CAUTION

To avoid damage to pinion shaft, provide a soft cushioned area to receive pinion shaft when it is removed from spider.

NOTE: If it is necessary to service the planetary spider assembly, see the section **Planetary Drive Axle, (Wet System)** 1400 SRM 944 (E019, F007, F019, G007, G019, and H007 only).

3. Remove axle shaft, sun gear, and snap ring assembly.

NOTE: Sun gear thrust washer may come out with axle shaft and sun gear assembly.

4. Remove sun gear thrust washer from end of spindle.

5. Remove two lock plate capscrews. Remove lock plate from ring gear hub.

6. Matchmark position of wheel bearing adjusting nut to ring gear hub and spindle. Remove adjusting nut.

7. Remove planetary ring gear hub. Outer wheel bearing cone will remain on ring gear hub. If it is damaged, remove it from hub.

8. Remove wheel hub with brake driver splines from friction discs. Hub oil seal and inner bearing assembly will remain in hub.

CAUTION

One-half of duo-cone face seal comes off with hub. The other half will remain in brake disc housing. Do not set hub down onto face seal. Damage to face seal can result.

NOTE: Wrap and label face seal halves separately. Store them in a safe place to prevent damage and reassemble them later in same positions.

9. Remove face seal half from hub assembly.

10. Remove rest of face seal from brake housing assembly.

CAUTION

Do not damage hub oil seal bore surface in wheel hub. Damage to this surface will result in oil leakage after assembly.

NOTE: If it is necessary to replace hub oil seal and bearings, see the section **Planetary Drive Axle, (Wet System)** 1400 SRM 944 (E019, F007, F019, G007, G019, and H007 only).

11. See Brake Piston Housing and Wheel Spindle for disassembly of brake disc housing assembly.

Wheel End With Outer Bearing on Spindle Journal H8.00-12.00XM (H170-280HD), H16.00-22.00XM-12EC (H400-500HD/HDS-EC) and H16.00-18.00XM/XMS-12 (H400-450HD/HDS)

WARNING

Support planetary spider with lifting strap before removing planetary spider from wheel hub. Planetary spider that is not supported correctly can fall. Serious personal injury and damage to components can result.

1. With lifting device, remove planetary spider assembly from wheel hub and set it on workbench. See Figure 10.

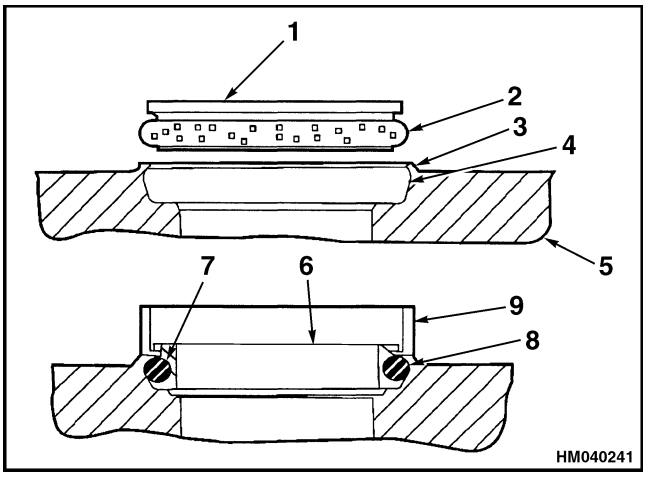
Duo-Cone Face Seal Into Brake Disc Housing and Into Hub

CAUTION

Install face seal halves in same positions where they were located prior to disassembly. Mixing up face seal halves can cause component damage.

NOTE: Duo-cone face seal half with O-ring must be installed in brake disc housing and into hub before hub can be assembled to housing.

Install duo-cone face seal in brake disc housing and in hub as follows. See Figure 20.



1. SEAL RING
2. O-RING
3. HOUSING RETAINER LIP
4. HOUSING RAMP
5. SEAL RING HOUSING
6. SEAL RING FACE
7. SEAL RING RAMP
8. SEAL RING RETAINING LIP
9. INSTALLATION TOOL

Figure 20. Seal Ring

WARNING

Solvent cleaners can be flammable, poisonous, and cause burns. Examples of solvent cleaners are carbon tetrachloride, emulsion-type cleaners, and petroleum-based cleaners. To avoid serious personal injury when using solvent cleaners, carefully follow the manufacturer's instructions and these procedures.

- **Wear safe eye protection.**
- **Wear clothing that protects skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline or solvents that contain gasoline. Gasoline can explode.**
- **Use hot solution tanks or alkaline solutions correctly. Carefully follow manufacturer's instructions.**

CAUTION

Check for solvent residue on all seating surfaces. Solvents that leave residue on O-ring, metal face seal, or brake disc housing seal seating surface can cause O-ring to roll into seal, rather than slide. Damage to seal can result.

1. Verify formed seal ring, O-ring, and brake disc housing are clean and free of any oil or other contaminants. If required, use solvent that evaporates quickly, leaves no residue, and is compatible with O-rings.

CAUTION

Install O-ring into seal ring and verify it is flat. Do not twist O-ring when installing onto seal ring. Twisted O-ring will not seal correctly, allowing leakage of lubricant and pumping of debris past ring. Damage to components can result.

2. Install O-ring onto formed seal ring so that it rests in radius of tail of seal ring and is not twisted. Install O-ring onto seal ring as follows.

CAUTION

Do not use Stanosol or any other liquid that leaves an oily film and does not evaporate quickly since this may result in incorrect seating of O-ring in housing, resulting in seal leakage.

CAUTION

Check retaining lip of seal seating area for burrs or fins which can cause seal to leak. Damage to components can result.

   a. Wet rubber O-ring with isopropyl alcohol as lubricant and install it onto formed seal ring so that it is seated at bottom of seal ring ramp and against retaining lip. See Figure 21.

MINIMUM BRAKE DISC THICKNESS

Disc Type	Minimum Thickness
Friction	4.87 mm (0.192 in.)
Stationary	4.25 mm (0.167 in.)

HYDRAULIC FLUID FOR BRAKE ACTUATION

CAUTION

Do not use automotive (glycol-based) brake fluid in place of required petroleum-based brake actuation fluid, since this can result in seal damage (swelling).

Component	Example
Petroleum-Based Hydraulic Fluid (Mineral Oil)	Meets MIL-H-5606 specifications

NOTE: See fluid and specification recommendations of equipment manufacturer.

BRAKE COOLANT SPECIFICATIONS

CAUTION

Operating temperature of the coolant must never reach or exceed 120°C (250°F). If operating temperature of coolant reaches or exceeds 120°C (250°F), internal components of brake will be damaged. A forced cooling system may be required to ensure coolant temperature remains below 120°C (250°F).

Coolant	Example
Petroleum-Based SAE 10W, SAE 20W, or SAE 10W30	See recommendations of vehicle manufacturer.

COOLANT CHANGE INTERVALS

Break-In Interval	Change fluid in brake housing after the first month or the first 200-250 hours of operation, whichever comes first.
Normal Maintenance Interval	Change fluid every 6 months or every 3000 hours of operation, whichever comes first.

HYDRAULIC FLUID SPECIFICATIONS

Use only the brake hydraulic fluid specified by the manufacturer of the vehicle. Do not use different hydraulic fluids. The wrong fluid will damage seals on piston.

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
	BRAKE DOES NOT APPLY	
Low or no pressure to brake.	Empty fluid reservoir.	Fill reservoir to correct level with specified fluid.
	Damaged hydraulic system.	Repair hydraulic system.
	Leakage of brake actuation fluid.	Refer to **Brake Leaks Actuation Fluid** in this section.

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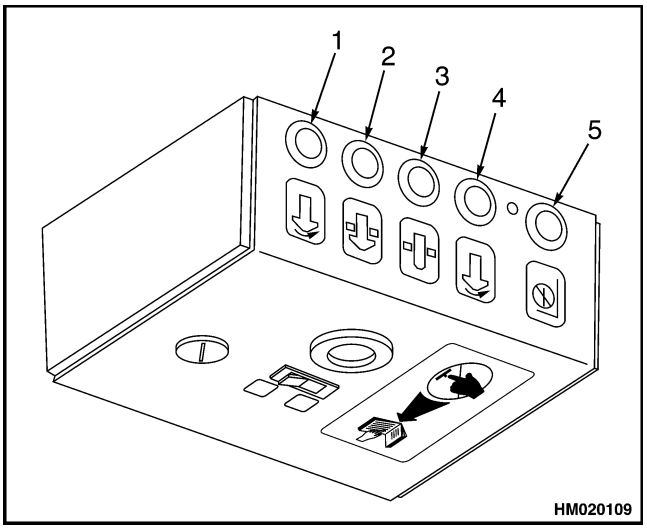
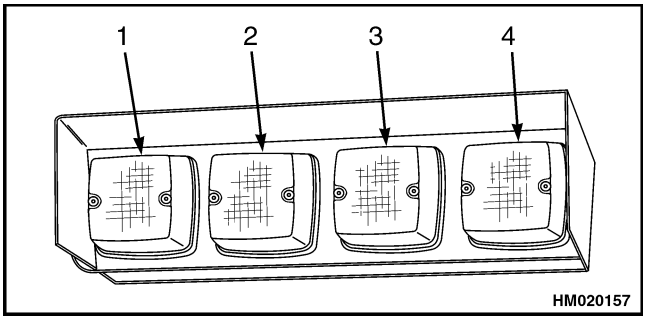


1. LEFT AMBER LED
2. GREEN LED
3. RED LED
4. RIGHT AMBER LED
5. BLUE LED

Figure 5. Indicator LEDs



1. LEFT AMBER LIGHT
2. GREEN LIGHT
3. RED LIGHT
4. RIGHT AMBER LIGHT

Figure 6. Indicator Lights

LIFT INTERRUPT AND OVERRIDE

WARNING

Only use override feature for the positioning of twist locks to enable proper locking. Do not use override feature for general lifting and transport of container.

When attachment is seated and any of the twist locks are between unlocked and locked position, the blue LED inside operator's cab will illuminate and lift interrupt system will not allow lifting of mast.

To override lift interrupt feature, turn override key switch clockwise and push override button while using lift lever.

OVERLOWERING INTERRUPT AND OVERRIDE

WARNING

When lifting after using the override feature, verify that chains, hoses, and cables are not obstructed in any way.

An overlowering interrupt feature is incorporated on models 553 and 558. The overlowering interrupt function prevents further lowering of attachment when both end beams have been raised in relation to outer booms. This prevents slacking of chains, hoses, and wires over the mast. It also reduces shock on attachment. The blue LED in operator's cab will illuminate when lowering interrupt is activated.

To override overlowering interrupt feature, turn override key switch clockwise and push override button while using lowering lever.

Carriage and Attachment Repair

REMOVE

WARNING

When working on or near mast, see Safety Procedures When Working Near Mast in Mast in the section Masts 4000 SRM 445.

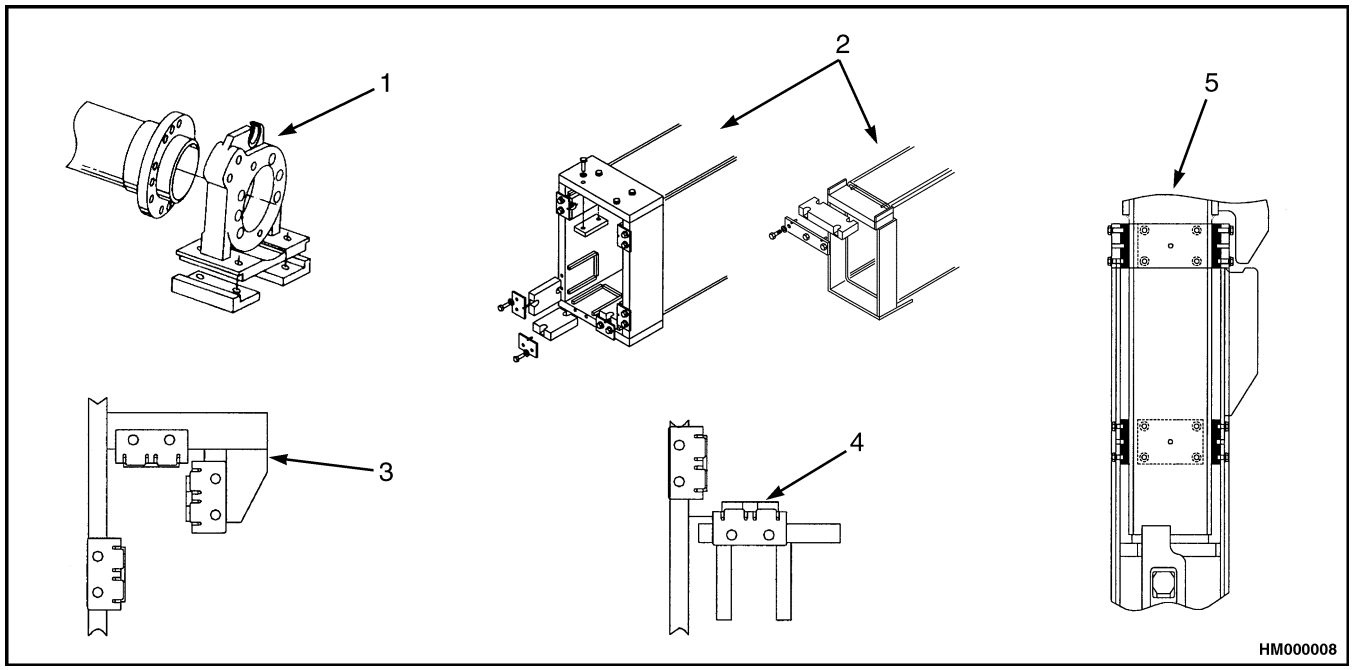
Do not work under a raised carriage. Lower carriage or use a chain to prevent carriage and inner mast from lowering. Attach all moving parts of mast to parts that DO NOT move with a chain and make secure.

1. Put mast in a vertical position. Lower carriage onto blocks so lift chains and hoses are not under tension. Shut off engine.

Slide Pad Replacement

NOTE: To gain access to the far end slide pads on end beam, the vertical end beam needs to be removed.

1. Loosen bolts and brackets holding slide pads in place. See Figure 13.
2. Remove slide pad and replace if worn.
3. Mount bracket and bolts as necessary to hold pads in place.



1. EXTENSION CYLINDER SUPPORT
2. MAIN FRAME AND EXTENSION BEAM
3. UPPER SIDESHIFT SLIDE PADS
4. LOWER SIDESHIFT SLIDE PADS
5. END BEAM SLIDE PADS

Figure 13. Slide Pads

Adjustments

TWIST LOCK ANGLE ADJUSTMENT

Model 558 Only

1. Disconnect rod (10) from flag indicator (12). See Figure 4.
2. Remove socket head screw and washer (49), and disconnect rod (10) from pin (14).
3. Remove ring pin (2), socket head screw (3), and lockwasher (4). Remove pin (14).
4. Put piston of the twist lock cylinder in fully NOT-LOCKED position.
5. Put twist lock in fully NOT-LOCKED position.

⚠ WARNING

Twist locks can get caught in corner casting of container if twist locks have not been aligned and adjusted properly.

6. Loosen bolts (29) at tie rod end (28) and adjust to required length by turning rod end on cylinder assembly (11). Tighten bolts (29).
7. Insert pin (14).
8. Install lockwasher (4), socket head screw (3), and ring pin (2) holding tie rod end (28) on crank.
9. Install rod (10) onto flag indicator (12) and onto pin (14) using socket head screw and washer (49).

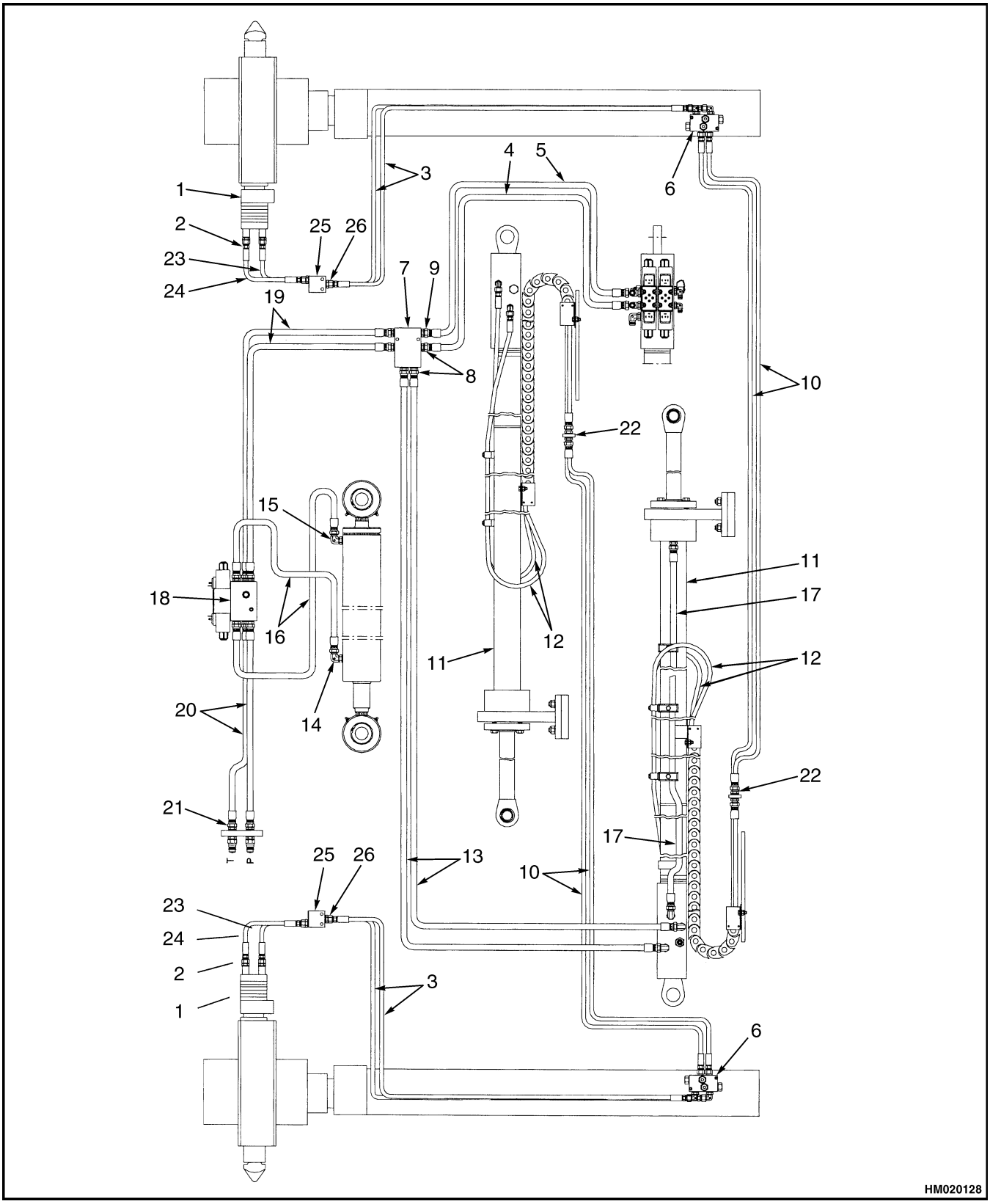


Figure 15. Hydraulic System Model 553

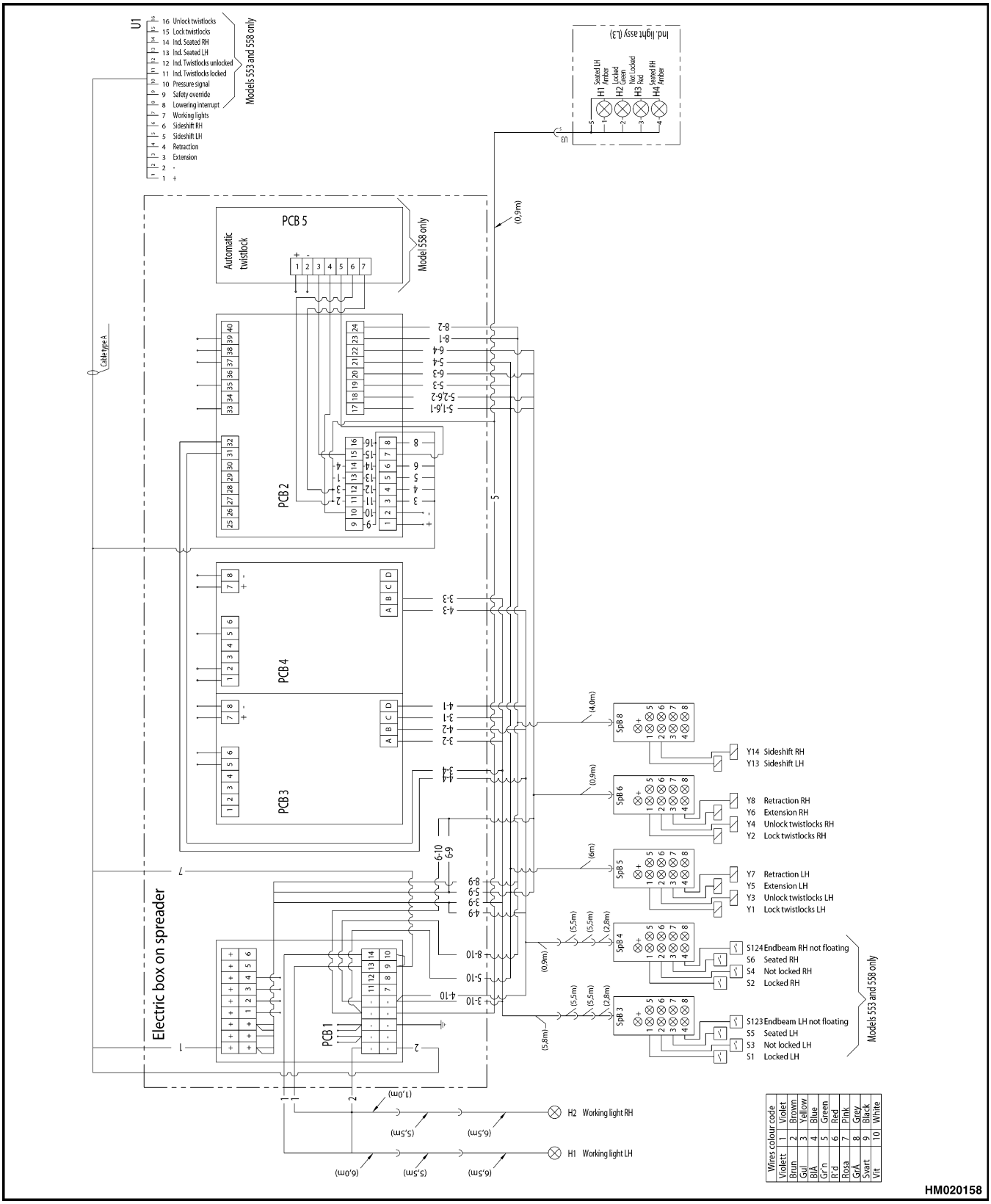


Figure 22. Wiring Diagram

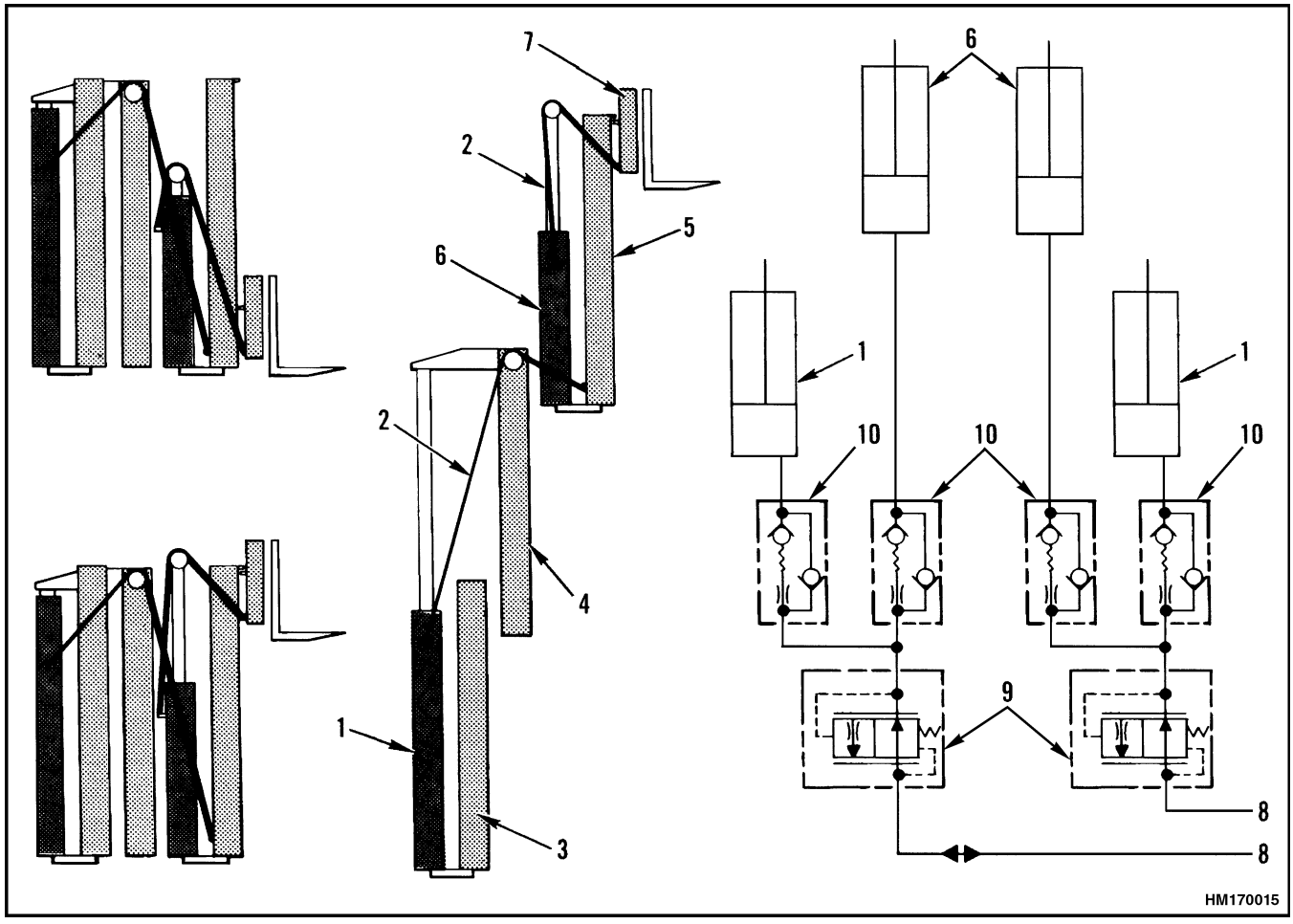
THREE-STAGE MAST

The three-stage mast has an outer, intermediate, and an inner mast. See Figure 3. The outer mast is connected to the lift truck by the pivot mounts and the tilt cylinders. The top of the outer mast has one side roller/bearing block on each side. The lower end of the intermediate and inner masts has two load rollers on each side and one side roller/bearing block on each side directly above the lowest load roller. These load rollers travel along the channels. The load rollers control the front to back movement between the masts. The side roller/bearing blocks control the side-to-side movement between the masts. Wear plates and shims are installed at the top of both channels of the outer mast and intermediate mast. In later versions, the bearing block function may be incorporated in the load rollers.

The three-stage mast may have three or four single-stage lift cylinders.

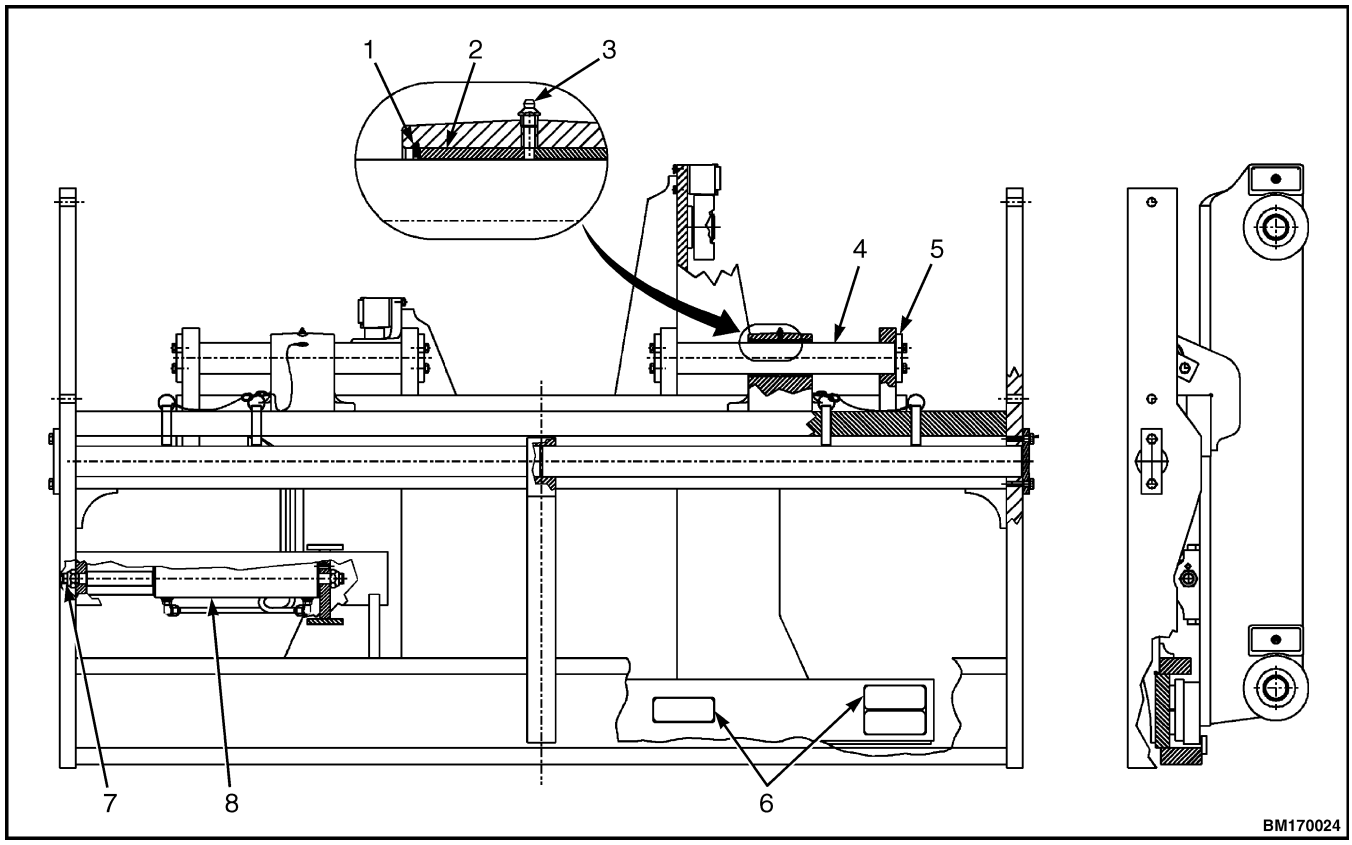
With three single-stage lift cylinders, the two main lift cylinders are installed at the back of the outer mast and the third free-lift cylinder is installed in the inner mast. The base of each lift cylinder is held by a mount plate at the bottom of the outer mast. The top of each lift cylinder (rod end) fits into guides at the top of the intermediate mast and is fastened with a capscrew.

With four single-stage lift cylinders, two free-lift cylinders have been installed. They are mounted on each side of the inner mast.



1. LIFT CYLINDER (2)
2. LIFT CHAIN
3. OUTER MAST
4. INTERMEDIATE MAST
5. INNER MAST
6. FREE-LIFT CYLINDERS
7. CARRIAGE
8. FROM MAIN CONTROL VALVE
9. EXTERNAL LOWERING CONTROL VALVE
10. INTERNAL LOWERING CONTROL VALVE

Figure 3. Three-Stage Mast



1. SNAP RING
2. BUSHING
3. LUBE FITTING
4. SLIDER BAR
5. KEEPER PLATE
6. BEARING BLOCK
7. LOCK NUT/WASHER
8. SIDESHIFT CYLINDER

Figure 8. Sideshift Carriage, Front View

Directional Control Valve Repair

REMOVE

1. Tilt mast.
2. Lower carriage.
3. Switch off engine.
4. Apply parking brake.
5. Apply brake pedal 8-10 times to remove hydraulic pressure.
6. Disconnect hydraulic lines.
7. Put caps on open lines.
8. Tag hydraulic lines.
9. Mark for identification and disconnect electrical plugs.
10. Loosen bolts holding valve section bracket if present.
11. Loosen bolts and remove valve section from bracket.

DISASSEMBLE

1. Carefully disassemble valve sections. See Figure 17.
2. Discard O-rings.

CLEAN AND INSPECT

WARNING

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

1. Clean all parts in solvent.

NOTE: Replace any damaged parts.

2. Check components for damage.

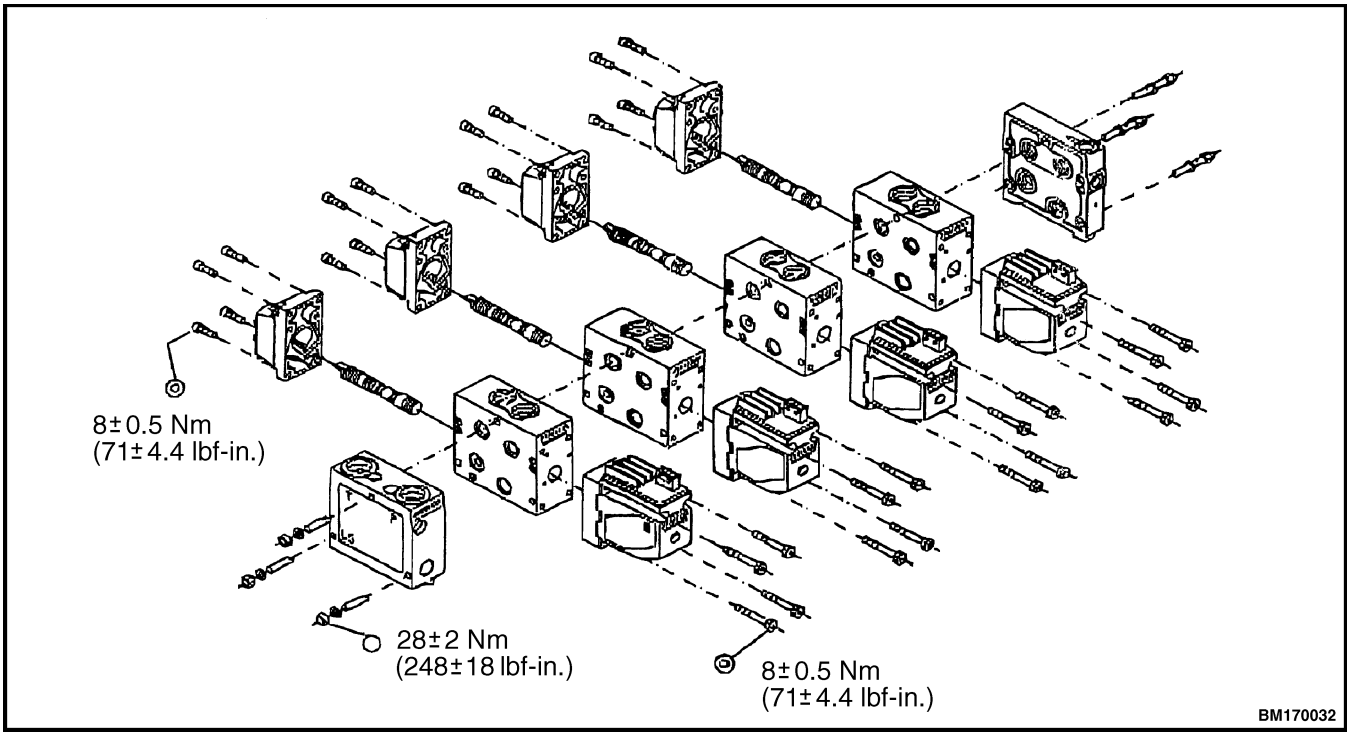


Figure 17. Directional Control Valve

Install

1. Fasten mast elements together using chain with hooks.

WARNING

Verify the lifting device has the rated capacity of 500 kg (1102 lb) to lift the lift cylinders.

2. Connect lifting device capable of lifting to the top of mast.
3. Verify chains will not damage hydraulic lines or other parts of the mast.
4. Raise the mast assembly to the vertical position, and position on the lift truck.
5. Lubricate mast mounting pins and bushings.
6. Install the mast mounting pins with grease fitting toward the center of the lift truck.
7. Install shims on mounting pins to restrict lateral movement of mast to 2.85 to 3.15 mm (0.11 to 0.12 in.).
8. Install the capscrews for the mounting pins.
9. Tighten capscrews to the following:
   - 435 N•m (321 lbf ft) for H8.00-12.00XM (H190-280HD) units.
   - 522 N•m (385 lbf ft) for H13.00-14.00XM (H300-330HD), H16.00XM-6 (H360HD), and H10.00-12.00XM-12EC (H360HD-EC) units.

NOTE: The capscrews on the rod end must be toward the floor, with the nuts toward the center of the truck.

10. Connect the tilt cylinders to the outer mast.
11. Install mast tilt pin and bushings.
12. Install pin anchor and torque to 165 N•m (122 lbf ft).
13. Tighten capscrews clamping the tilt cylinder rod end to 66 N•m (49 lbf ft).
14. Install connection hoses and header hoses.
15. Install the carriage. See Carriage Repair.
16. Connect hydraulic supply hoses to the mast assembly.
17. Start engine.
18. Check all functions.
19. Check for leaks.
20. Adjust lift chains, carriage, and tilt cylinders.

THREE-STAGE MAST (FOUR CYLINDERS)

Remove

WARNING

Lower the lift mechanism completely. Never allow anyone under a raised carriage. Do not put any part of your body in or through the lift mechanism unless all parts of the mast are completely lowered and the engine is STOPPED.

Before making any repairs, use blocks and chains on the inner mast and carriage so that they cannot move. Make sure the moving parts are attached to a part that does not move.

Do not try to locate hydraulic leaks by putting hands on pressurized hydraulic components. Hydraulic oil can be injected into the body by pressure.

NOTE: If the mast must be disassembled, remove the forks and carriage. If the carriage is not removed it must be fastened to a cross member on the mast. Use a chain or straps to keep the carriage from moving when the mast is removed.

1. Place truck on flat surface.
2. Apply parking brake.
3. Fully lower the mast.
4. Tilt mast forward.
5. Shut down the engine.
6. Clean area around the hydraulic fittings for the lift cylinders.
7. Disconnect hydraulic lines at the bottom of the lift cylinders.
8. Tag hydraulic lines.
9. Put metal caps on open lines and metal plugs on cylinders.
10. Disconnect header hoses. See Figure 23.
11. Tag header hoses.

Lift Cylinders Repair

A lowering control valve is installed in the base of the lift cylinders. See Figure 33, Figure 34, and Figure 35. The lowering control valve permits easy entry of hydraulic oil into the cylinders, but gives a restriction when the rods retract. This restriction controls the maximum speed at which a load on the forks can be lowered.

The lowering control valve is shown in Figure 33. The position of the orifice sleeve is controlled by oil flow. The position of the plunger is controlled by oil pressure and spring tension. During lifting, oil entering the cylinder goes through the center of the main sleeve to the large holes. The oil continues between the plunger and bore to move the orifice sleeve to the end of the plunger. The flange of the orifice sleeve is then aligned with the large part of the bore in the body. This alignment lets the oil flow around the orifice sleeve to the inlet port of the cylinder.

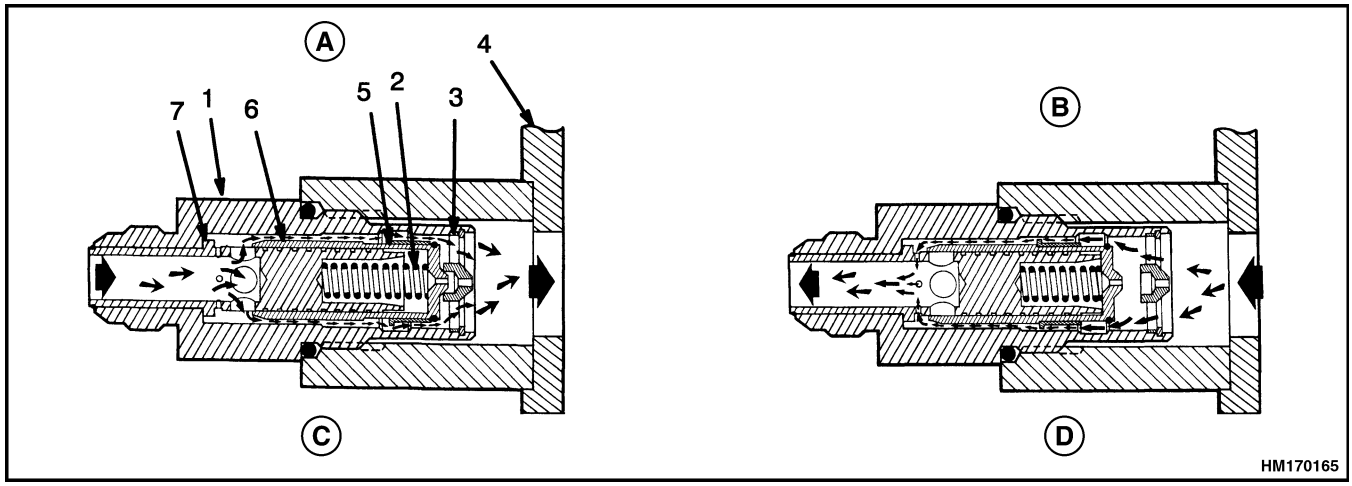
During the lowering operation, oil from the cylinder moves the orifice sleeve. The sleeve moves away from the larger area of the bore in the valve body. This movement makes a restriction to the oil flow. When the pressure increases, the plunger begins to move against the spring. The movement begins to close the openings of the large holes in the main sleeve. Additional pressure will push the plunger against the main sleeve to close the large holes completely. All the oil must go through the small holes to the center of the main sleeve. This restriction limits cylinder rod lowering to a maximum controlled speed.

Spacers are used in some cylinders to limit the stroke of the rod. Worn spacers must be replaced with the same size spacer.

The most common maintenance problem is the repair of oil leaks. If the bore of the shell of the lift cylinder is damaged and cannot be repaired, the lift cylinder must be replaced.

REMOVE

Remove the lift cylinders while disassembling the mast. See the procedures in Two- and Three-Stage Mast, Disassemble or Three-Stage Mast (Four Cylinders), Disassemble.

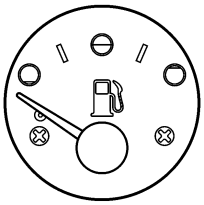
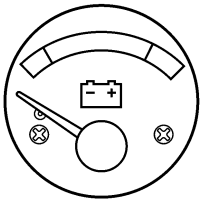
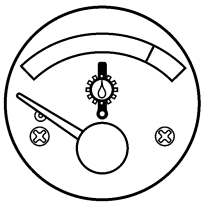


A. FREE FLOW
B. RESTRICTED FLOW
C. LIFTING
D. LOWERING

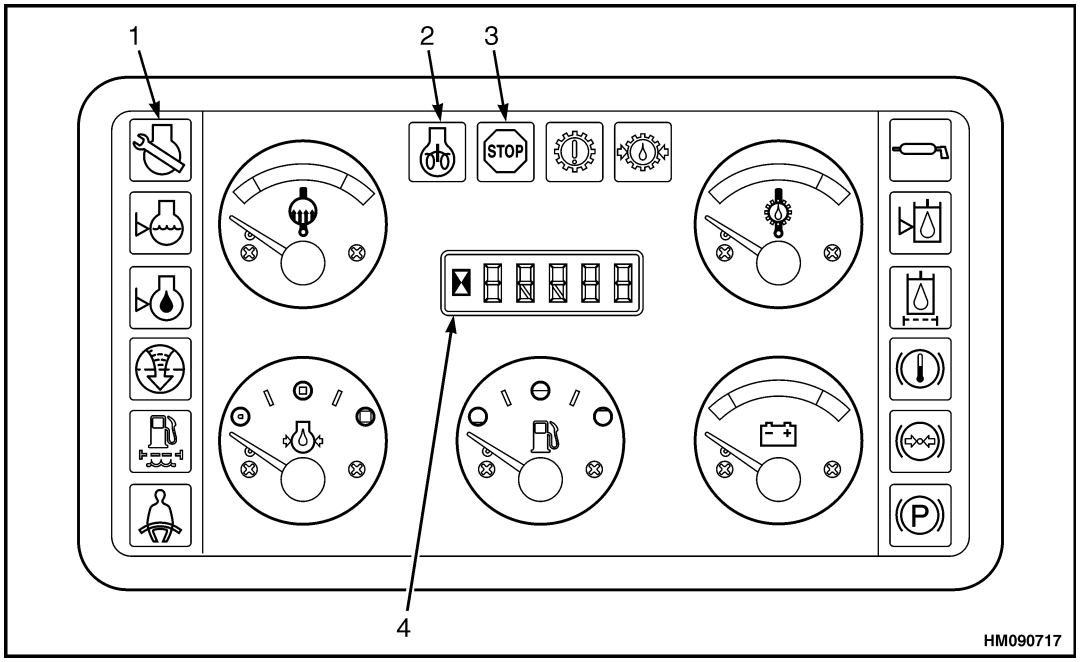
1. VALVE BODY
2. SPRING
3. WASHER
4. CYLINDER
5. ORIFICE SLEEVE
6. PLUNGER
7. MAIN SLEEVE

Figure 33. Lowering Control Valve

Table 1. Instrument Panel and Indicators (Continued)

Item No.	Item	Function
NOTE: For all warning lights, there is a light check after power-up.		
18	Fuel Level Gauge  HO190305	When the fuel level is 10% or less of the tank capacity, the gauge symbol will **FLASH** red. The central warning lights will come **ON**. The LCD display shows fuel intermittently. **NOTE:** If equipped with an LPG engine, the needle will show a tank capacity of 50%. The needle will drop immediately to zero when fuel pressure is below 20 kPa (32 psi). The gauge symbol will **FLASH** red. The central warning lights will be **ON**. The LCD display shows fuel intermittently.
19	Voltmeter Gauge  HO190277	The voltmeter indicates the system voltage. When the ignition is **ON** and the engine is not running, the gauge symbol will be red. When the engine is running for more than 5 minutes and the system voltage is below 22.5 VDC, the gauge symbol will **FLASH** red. The central warning lights will come **ON**. The buzzer will sound.
20	Transmission Oil Temperature Gauge  HO190306	Gauge indicates the transmission oil temperature. During normal operation, the needle will be in the green zone. If the temperature is high or one of the temperature sensors is out of range, shorted to ground or not connected, the gauge symbol will **FLASH** red. There will be a fault code on the error LCD display. The buzzer may sound. The central warning lights will be **ON**. The transmission may shift to **NEUTRAL** and/or engine performance may decrease.

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Incorrect Indication	Battery is discharged.	Charge battery.
	Meter movement or needle is damaged or has a malfunction.	Replace fault display.
	Separate sender malfunction.	Replace sender.
	Sender will not sense because system has corrosion.	Clean and flush system. Check for bent or cracked sensor tubing.



1. MAINTENANCE WARNING LIGHT
2. DIAGNOSTIC WARNING LIGHT
3. ENGINE STOP WARNING LIGHT
4. HOURMETER/FAULT CODE DISPLAY

Figure 1. Instrument Cluster

Table 1. Error Code Descriptions

Warning Lights			Fault Code Readout	
Diagnostic Warning Light	**Engine Stop Warning Light**	**Maintenance Warning Light**	**Fault Code**	**Description**
	ON		111	Engine control module, critical internal failure.
	ON		115	Engine speed/position sensor circuit, loss of both signals from magnetic pickup sensor.
	ON		116	Fuel timing pressure sensor circuit, shorted high.
	ON		117	Fuel timing pressure sensor circuit, shorted low.
ON			118	Fuel pressure sensor circuit-primary, shorted high.
ON			119	Fuel pressure sensor circuit-primary, shorted low.
ON			121	Engine speed/position sensor circuit, lost of one signal from the magnetic pickup sensor.
ON			122	Intake manifold pressure sensor #1 circuit, shorted high.
ON			123	Intake manifold pressure sensor #1 circuit, shorted low.
ON			124	Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level
ON			125	Intake manifold 1 pressure - Data valid but below normal operating range - Moderately severe level.
	ON		131	Accelerator pedal position sensor circuit, shorted high.

Table 1. Error Code Descriptions (Continued)

Warning Lights			Fault Code Readout	
Diagnostic Warning Light	**Engine Stop Warning Light**	**Maintenance Warning Light**	**Fault Code**	**Description**
ON			1141	Injector Cylinder #2 - Mechanical system not responding properly or out of adjustment
ON			1142	Injector Cylinder #3 - Mechanical system not responding properly or out of adjustment
ON			1143	Injector Cylinder #4 - Mechanical system not responding properly or out of adjustment
ON			1144	Injector Cylinder #5 - Mechanical system not responding properly or out of adjustment
ON			1145	Injector Cylinder #6 - Mechanical system not responding properly or out of adjustment
ON			1239	Accelerator Pedal Position Sensor 2 Circuit - Voltage above normal, or shorted to high source
ON			1241	Accelerator Pedal Position Sensor 2 Circuit - Voltage below normal, or shorted to low source
	ON		1242	Accelerator Pedal Position Sensor 1 and 2 - Data erratic, intermittent, or incorrect
ON			1256	Control Module Identification Input State Error - Data erratic, intermittent, or incorrect
	ON		1257	Control Module Identification Input State Error - Data erratic, intermittent, or incorrect
ON			1852	Water in Fuel Indicator - Data valid but above normal operational range - Moderately severe level
ON			1911	Injector Metering Rail 1 Pressure - Data valid but above normal operational range - Most severe level
ON			2111	Coolant Temperature 2 Sensor Circuit - Voltage above normal, or shorted to high source
ON			2112	Coolant Temperature 2 Sensor Circuit - Voltage below normal, or shorted to low source
ON			2113	Coolant Temperature 2 - Data valid but above normal operational range - Moderately severe level
	ON		2114	Coolant Temperature 2 - Data valid but above normal operational range - Most severe level
ON			2115	Coolant Pressure 2 Circuit - Voltage above normal, or shorted to high source
ON			2116	Coolant Pressure 2 Circuit - Voltage below normal, or shorted to low source
ON			2117	Coolant Pressure 2 - Data valid but below normal operational range - Moderately severe level
ON			2118	Primary fuel delivery pressure, high warning.

List of All Special Tools and Equipment Needed for the Assembly

WARNING

Read all the instructions contained in this manual before starting any work on the unit. Also read all procedures contained in the Operating Manual before operating the truck.

1. **LIFT tools:**

   - A crane with a minimum capacity of 6,500 kg (14,330 lb) when the boom is raised at the top of the mast. This means the boom must have a length of the mast's retracted height +1 m (3 ft) + slings height + hook and cables height, and at that height, it must have the capacity to hoist 6,500 kg (14,330 lb).
   - Cables or slings of sufficient capacity (see components weight chart).
   - Blocks of hard wood of various lengths, widths, and thickness.
   - A small mechanical hoisting winch of 1500 kg (3300 lb) capacity.
   - Strips and two solid ropes of approximately 150 kg (330 lb) capacity each.
   - A lift truck with sufficient lift height to reach the top of the mast.
   - A safety platform fastened on the truck carriage.

2. **Tooling:**

   - Metric ring and open-end spanners/wrenches: size 13, 19, 22, 24, 30, 40, 41, and 48.
   - Imperial ring and open-end spanners/wrenches: size 1/2, 15/16, 1 1/16, 1 1/8, 1 13/16, 1 7/8, 2, and 2 7/8.
   - A torque wrench with a capacity up to 550 N•m (approximately 406 lbf ft).
   - Gloves and protective clothing.
   - Safety glasses and helmets.
   - A hydraulic jack with a minimum capacity of 2/3 of the weight of the lift truck. See the nameplate.
   - A safety cage for inflating tires.

3. **Trained Technicians:**

   - It is recommended that personnel involved in the assembly of the machine have followed a specific training session on those units or have a proven understanding of the product to be able to perform the job professionally.
   - The minimum personnel required to do the job is two mechanics.

General Considerations Before Starting the Job

NOTE: This assembly guide is extensive to cover different situations. Assembly of new trucks depends primarily upon how the truck was transported and which carriage is supplied. If the truck was transported overseas, it will be more disassembled than if shipped by land. Use the portions of the assembly guide that meet your needs.

CAUTION

The following assembly procedures are for assembling the lift truck after shipment from the factory. Be sure to check all fluid levels and tire pressures before removing the lift truck from the trailer. If in doubt, check the torque of all relevant hardware.

1. **Safety First!**

   When lifting parts or assemblies, make sure that all slings, chains, or cables are correctly fastened and balanced before lifting. Verify all lifting devices have enough capacity to lift the weight. If in doubt, do not hesitate to use a device with a higher capacity than required. Always use common sense and avoid dangerous situations.

2. **Plan enough personnel** to do the job. Never lift heavy parts by hand. Always use a lifting mechanism.

3. **The rental price** of a crane, which will be needed to lift the major components, is very expensive. Plan the job as well as possible in order to limit the costs to the minimum required.

4. **Check** that all the items ordered are available upon receipt of the machine and its components. Unpack the case accompanying the machine and identify all the components contained in it. Check that all capscrews, nuts, pins, washers, and brackets are present.

WARNING

Check all wheel nuts after 2 to 5 hours of operation. Tighten the nuts in a cross pattern to the correct torque value shown in the MAINTENANCE SCHEDULE table. When the nuts stay tight for 8 hours, the interval for checking the torque can be extended to 500 hours.

CAUTION

Insufficient mounting torque can cause rim slippage, resulting in broken valves, worn parts, and damaged tires. Excessive mounting torque can cause damage by stripping studs, collapsing spacer band, or forcing rims out of round.

STEP 12.
Verify the tires are not touching the ground. Tighten the wheel nuts in steps according to the correct sequence until the torque of 68 to 136 N•m (50 to 100 lbf ft) has been reached. Verify that the wheel(s) is tight against the hub, then tighten until the final torque of 640 to 680 N•m (472 to 502 lbf ft) has been reached. Perform the torque adjustment a minimum of two times. See Drive Wheels, STEP 12

STEP 13.
Lower the lift truck, and remove the hydraulic jack.

STEP 14.
Remove the wooden blocks in front and behind the steer tires.

WHEEL NUT TORQUE

STEP 1.
Check the wheel nut torque of each wheel. When the wheel nut torque for one or more wheels is not correct, the wheel nut torque must be adjusted. Perform the torque adjustment a minimum of two times.

WARNING

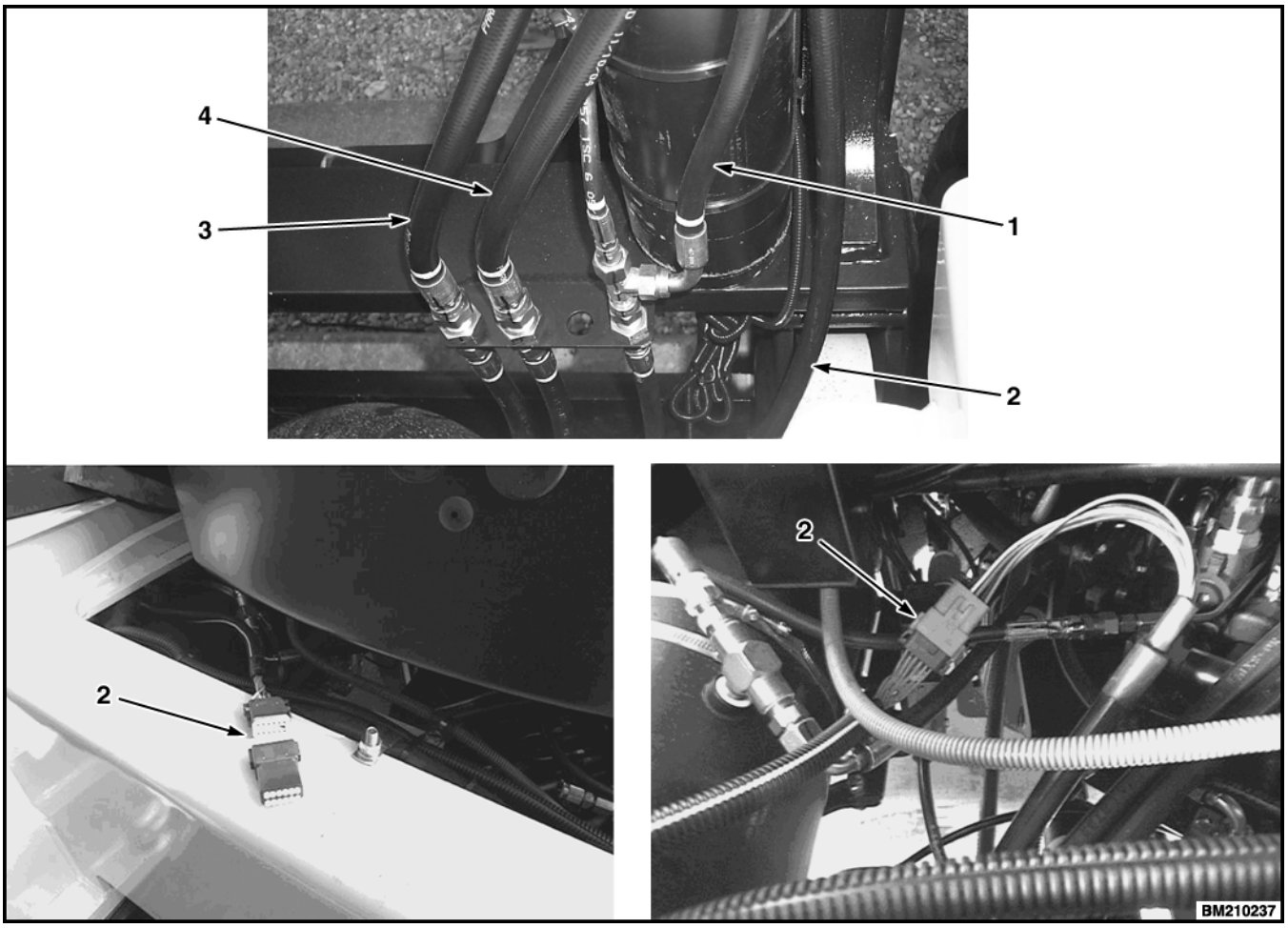
Verify the jack needed for lifting one side of the lift truck has a capacity equal to at least 2/3 of the weight of the lift truck. Refer to the nameplate for the correct weight. The standing surface must be solid and even. Always wear safety glasses, safety shoes, and gloves.

STEP 2.
Put blocks in front and behind each tire that will remain on the ground. Put a jack under the mounting pad of the axle and lift one side of the lift truck. (the opposite side). Raise the lift truck so the tires are just above the surface. Put additional blocks under the frame to support the lift truck so the lift truck is stable.

WARNING

Check all wheel nuts after 2 to 5 hours of operation. Tighten the nuts to the correct torque again. When the nuts stay tight after an 8-hour check, the interval for checking can be extended to 500 hours.

STEP 3.
Verify the tires are not touching the ground. Tighten the wheel nuts in the correct sequence until the torque indicated has been reached. The torque for drive and steer wheels is between 640 to 680 N•m (472 to 501 lbf ft). See Drive Wheels, STEP 12.

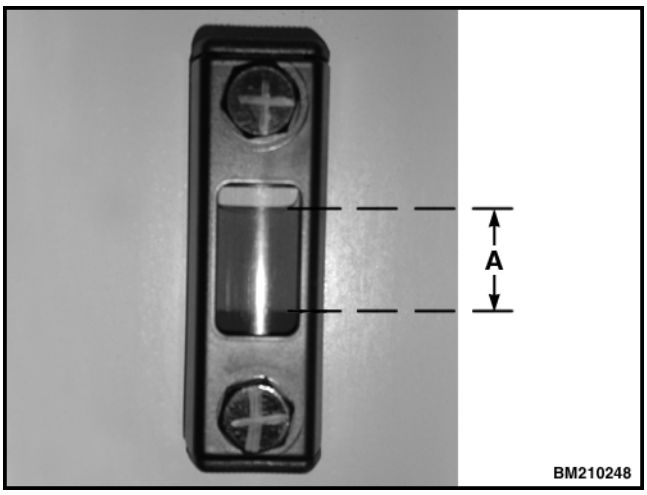


1. HEADER HOSE D (FIXED SUPPLY AND RETURN)
2. ELECTRICAL CABLE
3. HEADER HOSE C
4. HEADER HOSE B

Figure 13. Header Hoses and Electrical Cable

Hydraulic Oil Check

1. Fully lower the mast and operate the tilt function until the mast is vertical.
2. Allow the oil to settle for one minute prior to checking the oil level.
3. Check the sight gauge on the side of the hydraulic tank to verify the oil level. A correct oil level will indicate in the green zone of the sight gauge. See Figure 27.



A. CORRECT OIL LEVEL

Figure 27. Hydraulic Oil Level Check

CAUTION

Additives in the hydraulic system oil may damage the hydraulic system. Before using additives, contact your local HYSTER dealer.

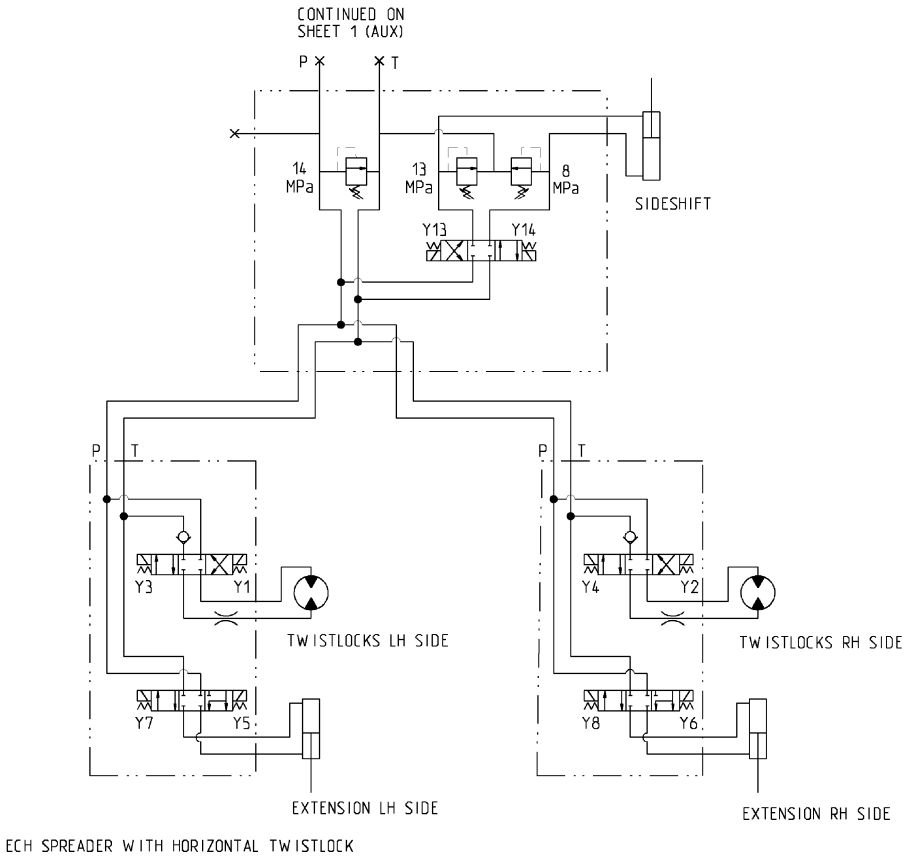
4. If additional hydraulic oil is required, use a 22 mm Allen wrench and remove the plug from the hydraulic tank filter cover. Add hydraulic oil as required. See Figure 28.

NOTE: The type of hydraulic oil is determined by the truck configuration (wet or dry brakes).

- **Trucks with Dry Brakes** - require the following type of oil or equivalent:
  1. Shell Tellus Oil 46
  2. Texaco Rando HD 46
  3. Exxon Nuto H46
  4. Mobil DTE 25
- **Trucks with Wet Brakes** - require the following type of oil or equivalent:
  1. John Deere JDM-J20C

Figure 28. Hydraulic Oil Fill

NOTES



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Sheet 2 of 2
Revision 1

BM210707

Figure 2. Hydraulic Schematic ECH (Sheet 2 of 2)

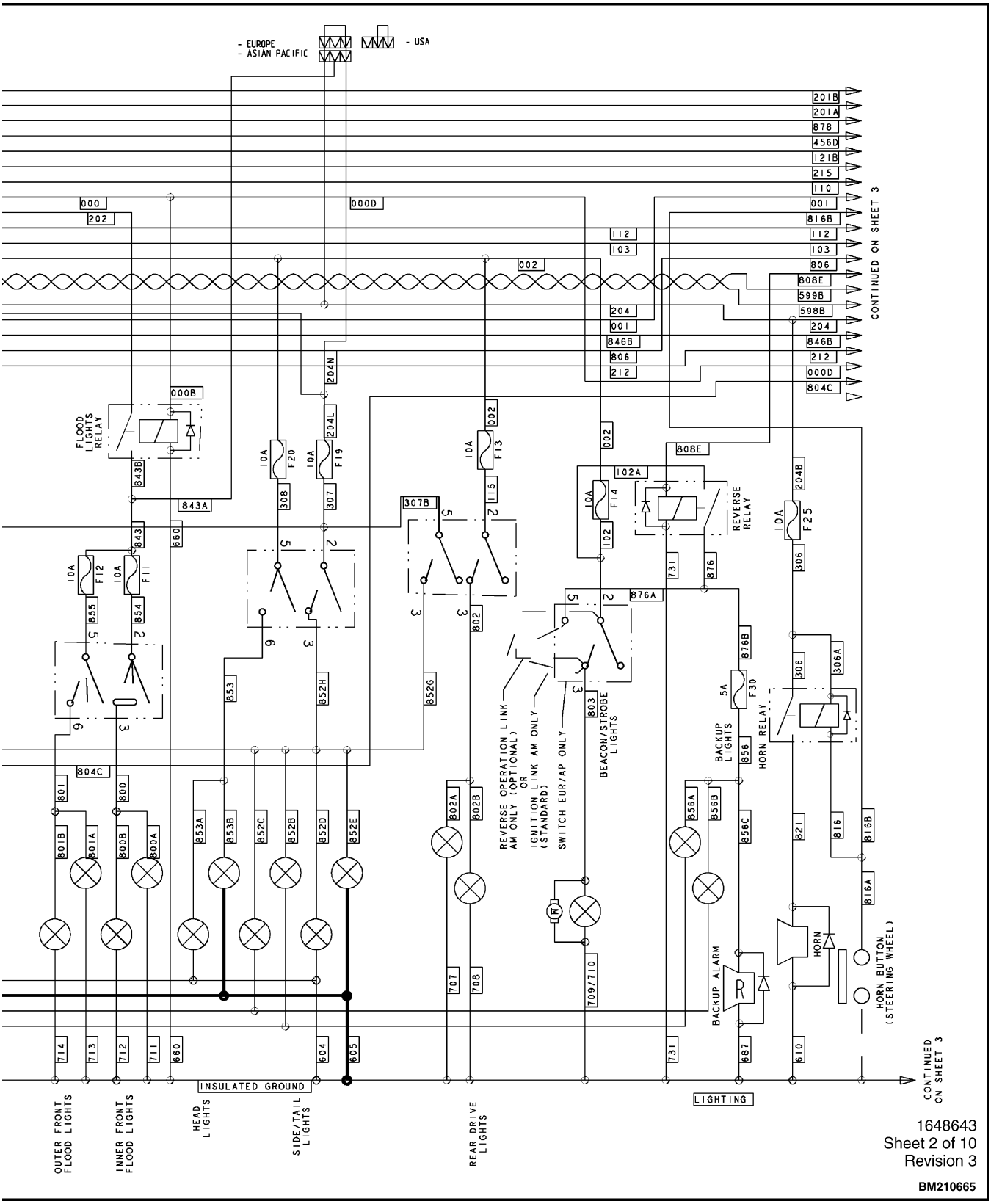


Figure 5. Diesel Engine Electrical Schematic (Sheet 2 of 10)

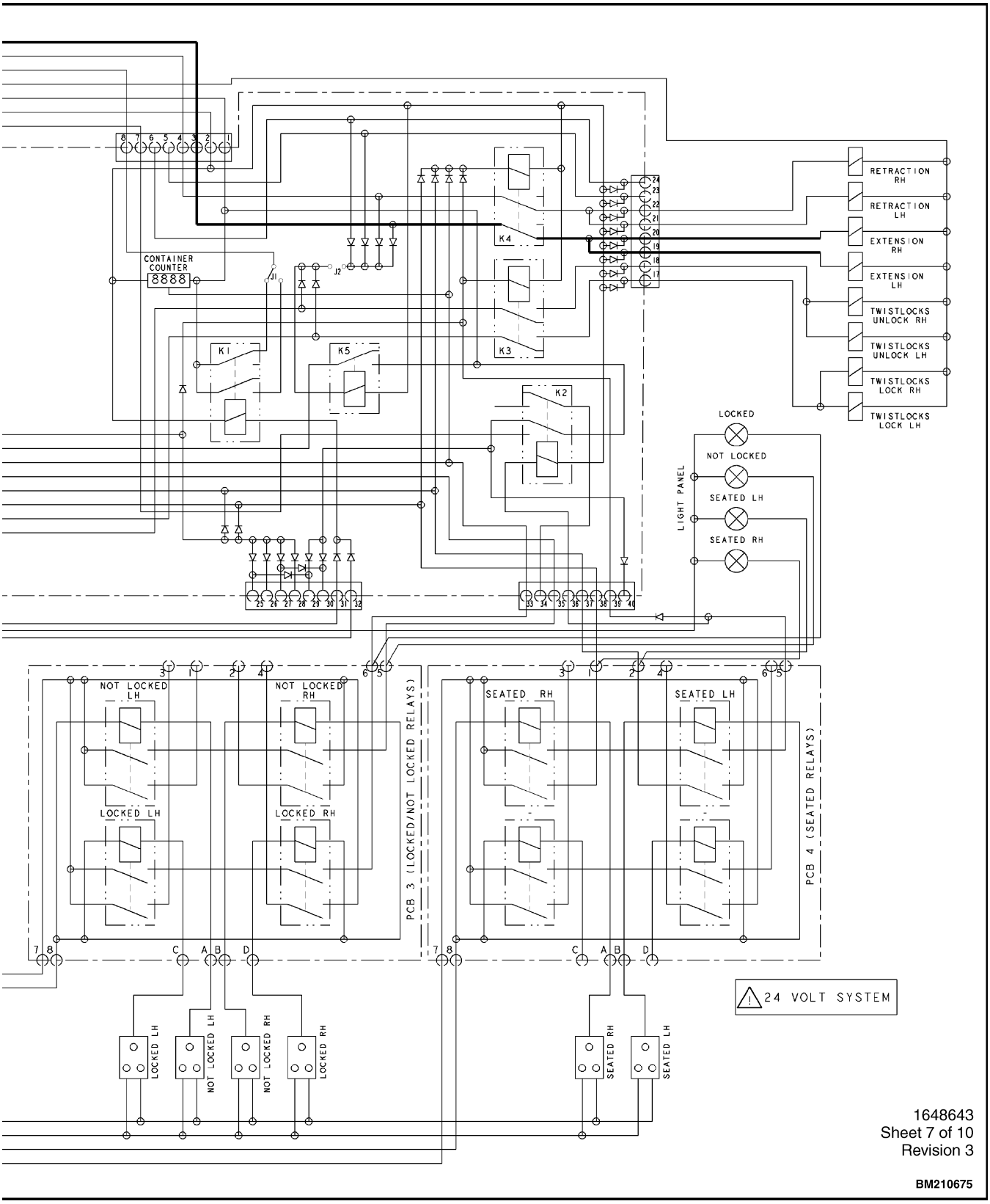


Figure 5. Diesel Engine Electrical Schematic (Sheet 7 of 10)

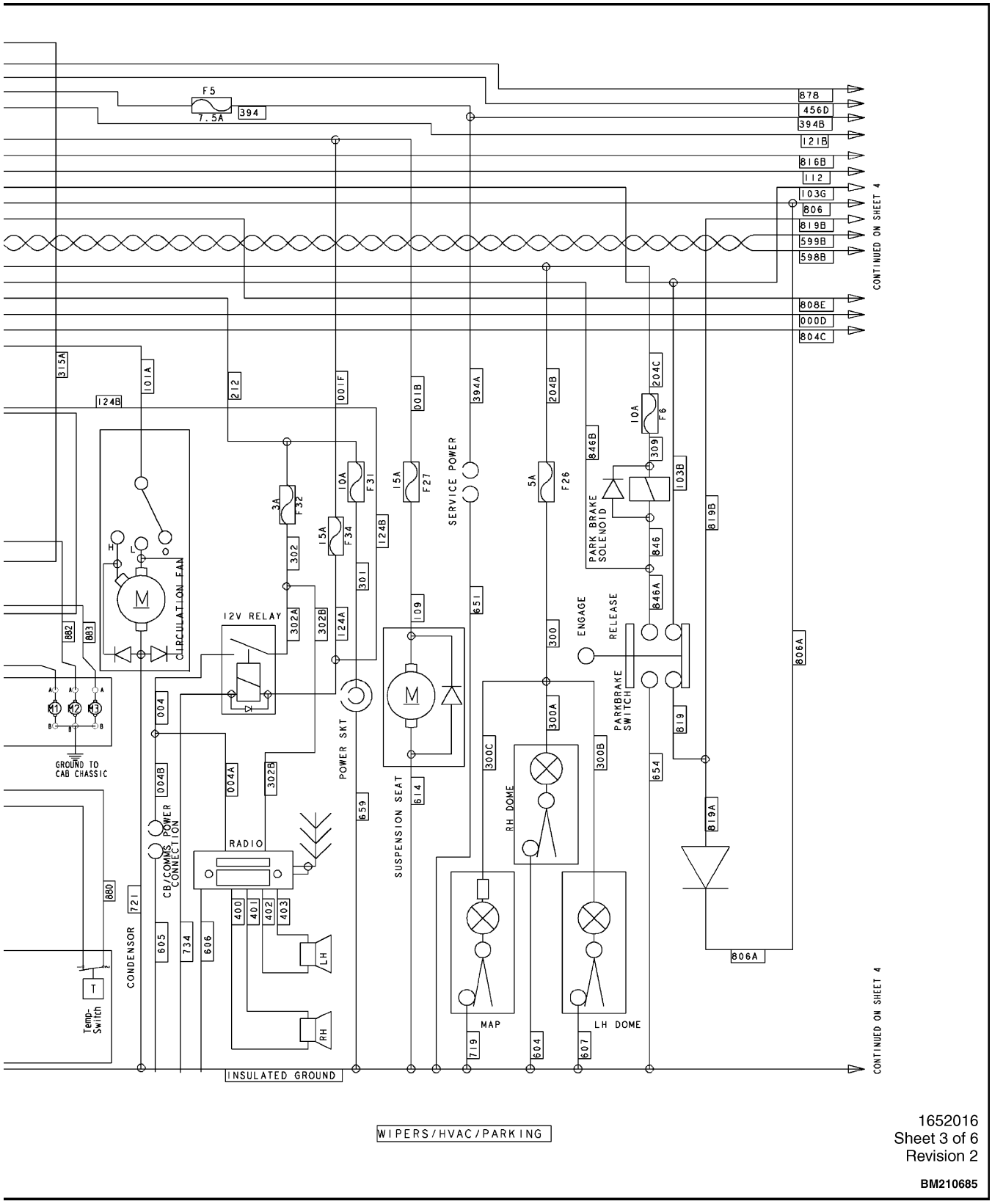
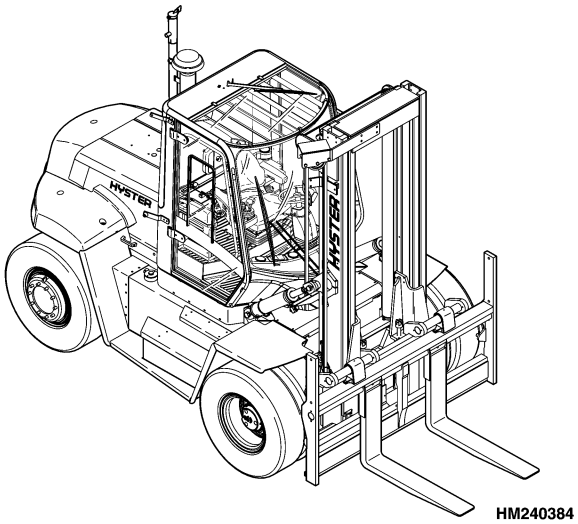


Figure 6. LPG Engine Electrical Schematic (Sheet 3 of 6)

PERIODIC MAINTENANCE

H8.00-12.00XM (H170-280HD) [H007];
H13.00-14.00XM (H300-330HD) [G019];
H16.00XM-6 (H360HD) [G019];
H10.00-12.00XM-12EC (H360HD-EC) [G019]



HM240384

HYSTER

PART NO. 1663927

8000 SRM 1347

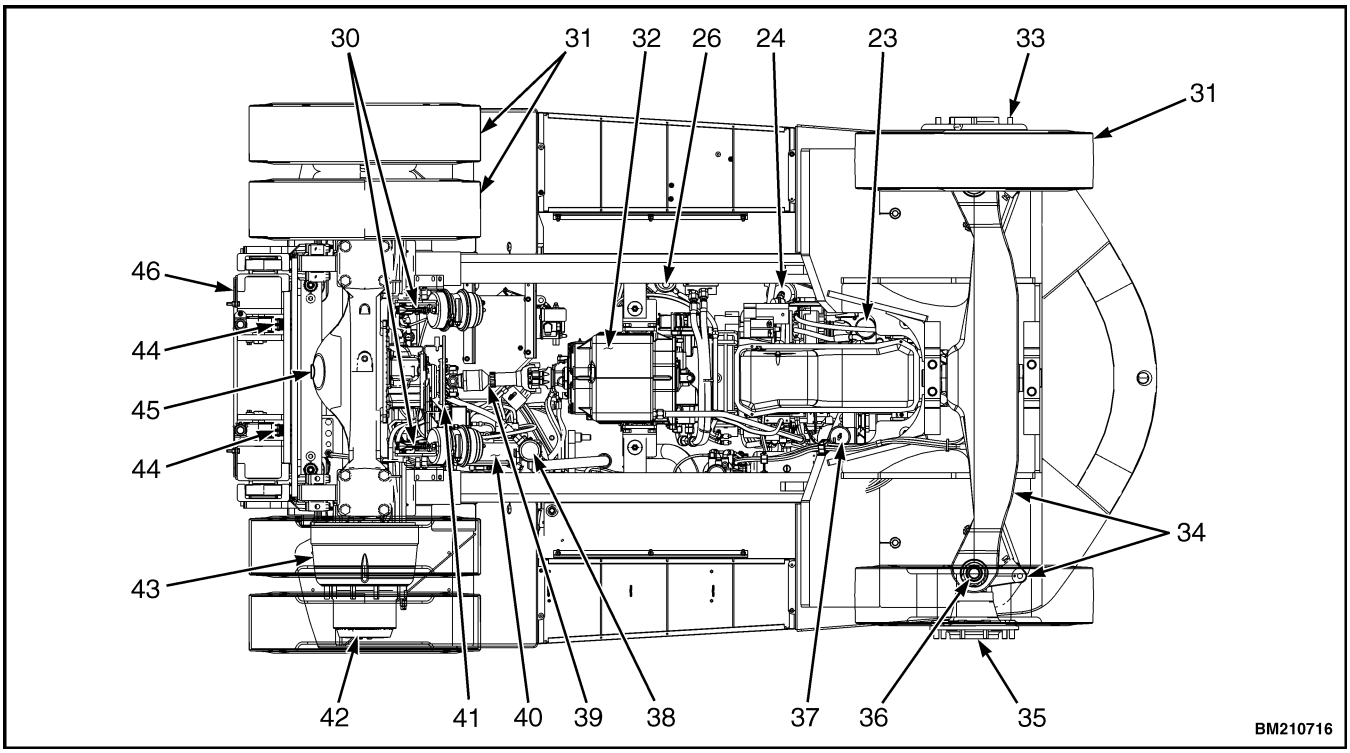


Figure 3. Maintenance Points (Sheet 3 of 3)

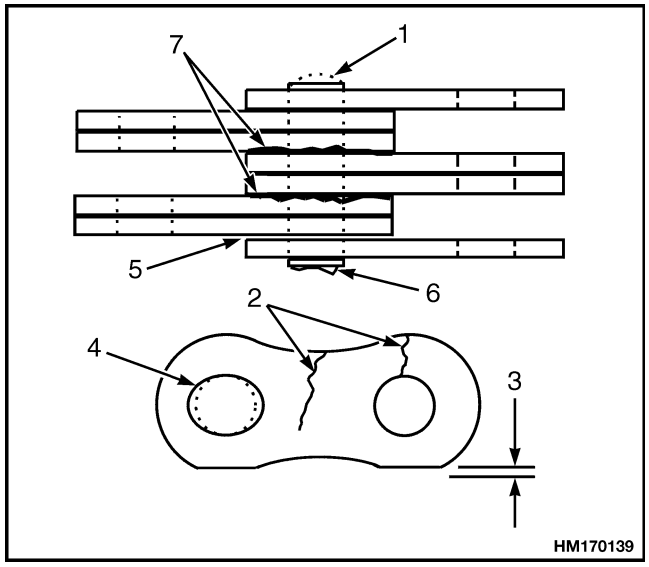
Table 1. Daily Inspections — Condition Check

Item No.	Item	Procedure
	Safety Labels	Check for presence and readability. See **Parts Manual**.
31	Tires and Tire Pressure	Check condition and pressure. See Nameplate.
33	Wheel Nuts	Check torque. 615 to 710 N•m (454 to 524 lbf ft)
46	Mast, Carriage, and Attachment	Check condition and operation.
	Header Hose Assembly	Visually inspect hoses for leaks, wear, and damage. Check for proper tracking during operation.
44	Lift Chains	Check condition and lubricate with engine oil.
	Forks	Check condition.
2	Air Precleaner for Dust Bowl	Check dust level in bowl. Empty bowl if dust level is high.
	Fuel, Oil, and Coolant Leaks	Check for leaks.
	Coolant Hoses	Inspect for cracks, cuts, and collapsing.
See Figure 3 for Item Nos.		

7. Inspect the lift chains for cracks or broken links and pins. Check to see if the pins are in there original position and are not moving out of the lift chains. Replace both lift chains if any of the defects is present as shown in Figure 7.

8. Inspect the chain anchors and pins for cracks and damage.

9. Make sure the lift chains are adjusted so that they have equal tension. **Adjustment or repair of the lift chains must be done by authorized personnel**.



1. WORN PIN
2. CRACKS
3. EDGE WEAR
4. HOLE WEAR
5. LOOSE LEAVES
6. DAMAGED PIN
7. RUST

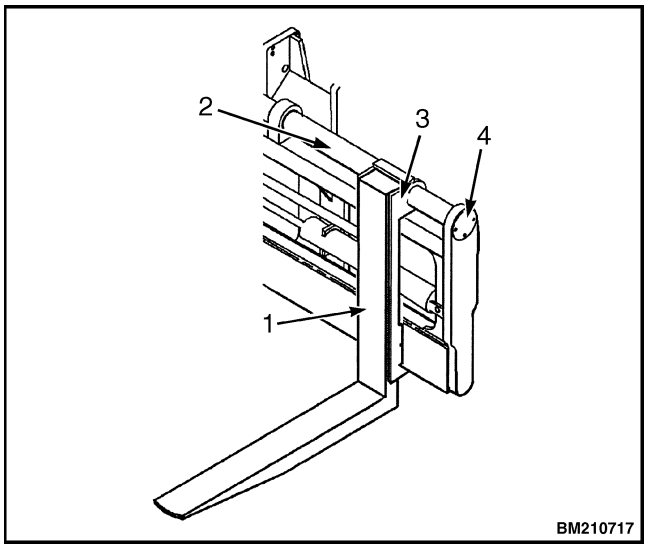
Figure 7. Check Lift Chains

Header Hose Assembly

Visually inspect the header hoses and fittings for leaks, wear, and damage. Check for proper tracking during operation. Check hose cover for cuts, cracks, or exposed reinforcement. Check clamps/sheaves for defective or broken devices or sheaves. Adjust, repair, or replace hoses and/or components as necessary.

Forks, Adjust

The forks are fastened to the carriage with large fork pins. See Figure 8. The position of the forks can be changed manually or hydraulically. To change the position manually, lift the securing pin(s) out of the carriage and slide the fork to a differently positioned securing pin hole. Insert the securing pin to lock the fork.



1. PIN-TYPE FORK
2. FORK PIN
3. FORK GUIDE
4. FORK PIN RETAINER

Figure 8. Forks

Forks, Remove

WARNING

Do not try to remove a fork without a lifting device. Forks can weigh up to 680 kg (1500 lb) each.

A fork can be removed from the carriage for replacement of the fork or other maintenance.

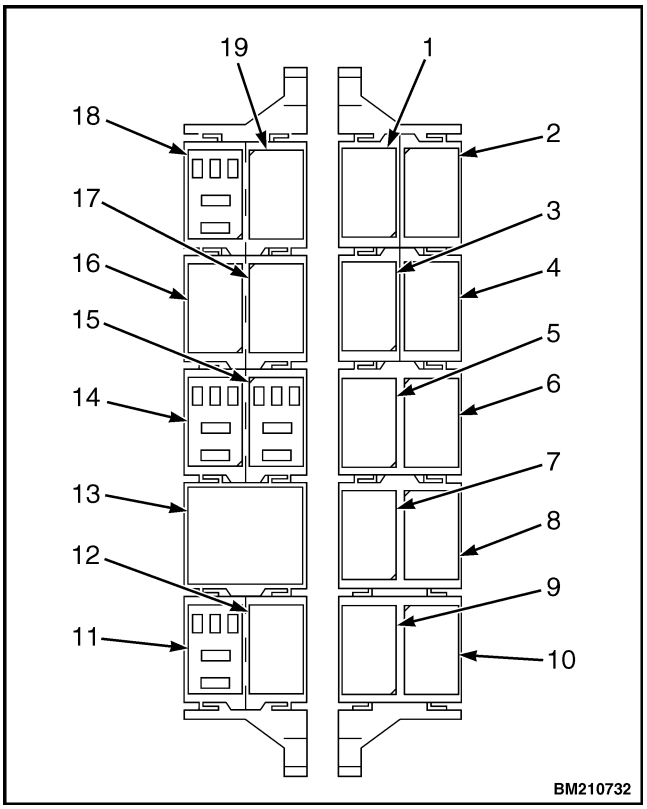
Put the lift truck on a level surface and lower the forks. Tilt the mast so that the forks have stability. Remove the retainers for the fork pins and pull the pins from the carriage. Move the lift truck away from the forks.

Forks, Install

Install the forks as follows:

1. Put the forks approximately 1 m (3.3 ft) in front of the carriage.

2. Slowly move the lift truck toward the forks until the fork pins can be installed. Install the forks in the fork guides, then install the fork pins. Install the retainers for the fork pins.



1. FLOOD LIGHTS
2. LIGHTS
3. START INHIBIT
4. NEUTRAL
5. LOWER INTERRUPT
6. REVERSE
7. 12V RELAY
8. HORN
9. RELAY AC FAN 2
10. RELAY AC FAN 3
11. OPEN
12. RELAY AC FAN 1
13. FLASHER
14. OPEN
15. OPEN
16. SEAT SWITCH
17. IGNITION
18. OPEN
19. OVERRIDE

Figure 19. Cummins Relays (Located Left of the Fuse Panel)

Engine and Transmission Fault Codes

When there is an engine or transmission fault, the instrument cluster will display a fault code on the hourmeter/fault code display. The instrument cluster logs the fault code. The engine fault code starts with a "E" and the transmission fault starts with a "t" or a "tE" followed by the warning code. If a fault appears, report this problem immediately. **DO NOT** operate the lift truck until the problem is corrected.

Cooling System

WARNING

DO NOT remove the radiator cap when the engine is hot. When the radiator cap is removed from the expansion bottle, the pressure is released from the system. If the system is hot, the steam and boiling coolant can cause burns.

CAUTION

DO NOT operate the engine when the gauge needle is in the red area.

CAUTION

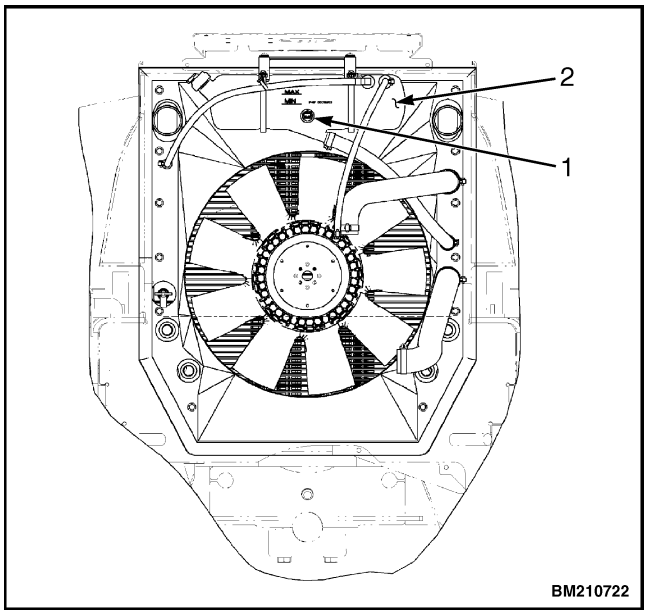
Additives in the coolant may damage the cooling system. Before using additives, contact your local Hyster dealer.

NOTE: A coolant level switch has been mounted to monitor the coolant level. When the coolant level is low, the red warning light will be **ON**.

There is a gauge for engine coolant temperature. During normal operation the gauge needle will be in the green area.

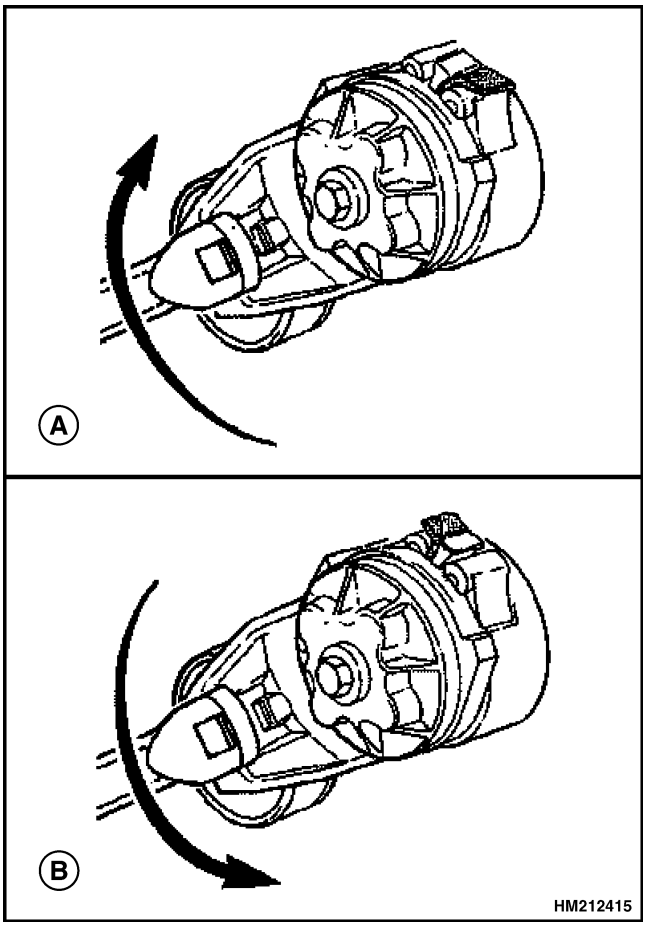
Check the coolant level in the expansion bottle when the engine is cool. If coolant is added, use Shell HD Premium Coolant only. Add coolant until just below the tube in the filler neck of the expansion bottle. See Figure 20.

Check the radiator fins. Clean the radiator with compressed air or water as needed. Be careful not to bend the radiator fins.



1. COOLANT LEVEL SWITCH
2. EXPANSION BOTTLE

Figure 20. Cooling System



A. PIVOT DIRECTION TO RELIEVE TENSION FROM BELT
B. RELEASE TENSIONER TO APPLY TENSION TO BELT

Figure 27. Belt Tensioner

3. Remove any built up dirt from the idler pulley.

4. Inspect the idler pulleys for wear and cracks. See Figure 28.

5. Inspect the drive belt pulleys and idlers for cracks or broken grooves. See Figure 29.

6. Reroute the drive belt as follows:

a. Pivot the tensioner and install the drive belt, slipping the belt over the pump pulley last.

b. Release the tensioner to apply tension to the drive belt.

c. Check the alignment of the belt with the tensioner and other pulleys.

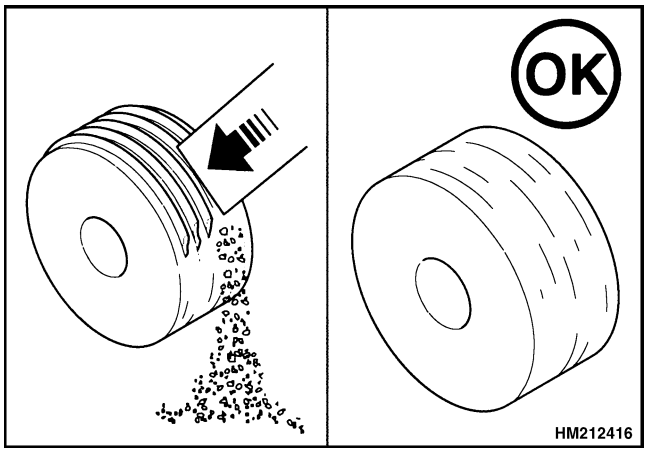


Figure 28. Idler Pulley

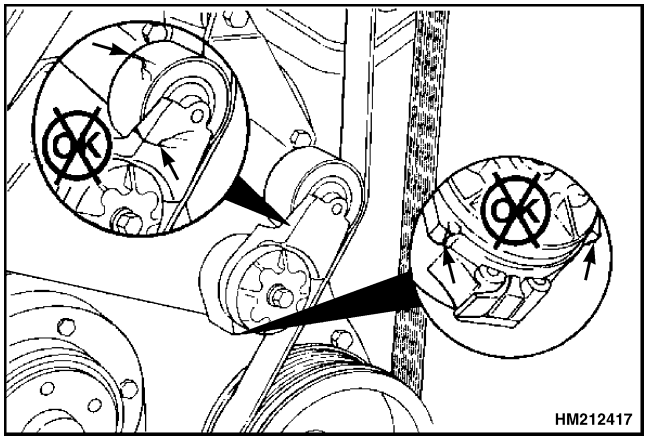


Figure 29. Drive Belt Pulleys and Idlers

CAUTION

Connect the positive (+) cable first or lift truck damage may occur.

7. Connect the cables to the battery.

8. Operate the engine and check for belt squeal. Excessive belt squeal indicates belt slipping.

Safety Procedures When Working Near Mast

The following procedures must be used when inspecting or working near the mast. Additional precautions and procedures can be required when repairing or removing the mast. See the correct Service Manual section for the specific mast being repaired.

WARNING

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

- **Never put any part of the body into or under the mast or carriage unless all parts are completely lowered or a safety chain is installed. Also make sure that the power is off and the key is removed. Put a DO NOT OPERATE tag in the operator's compartment.**
- **Be careful of the forks. When the mast is raised, the forks can be at a height to cause an injury.**
- **Do NOT climb on the mast or lift truck at any time. Use a ladder or personnel lift to work on the mast.**
- **Do NOT use blocks to support the mast weldments nor to restrain their movement.**
- **Mast repairs require disassembly and removal of parts and can require removal of the mast or carriage. Follow the repair procedures in the correct Service Manual section for the mast.**

WHEN WORKING NEAR THE MAST ALWAYS:

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

   OR

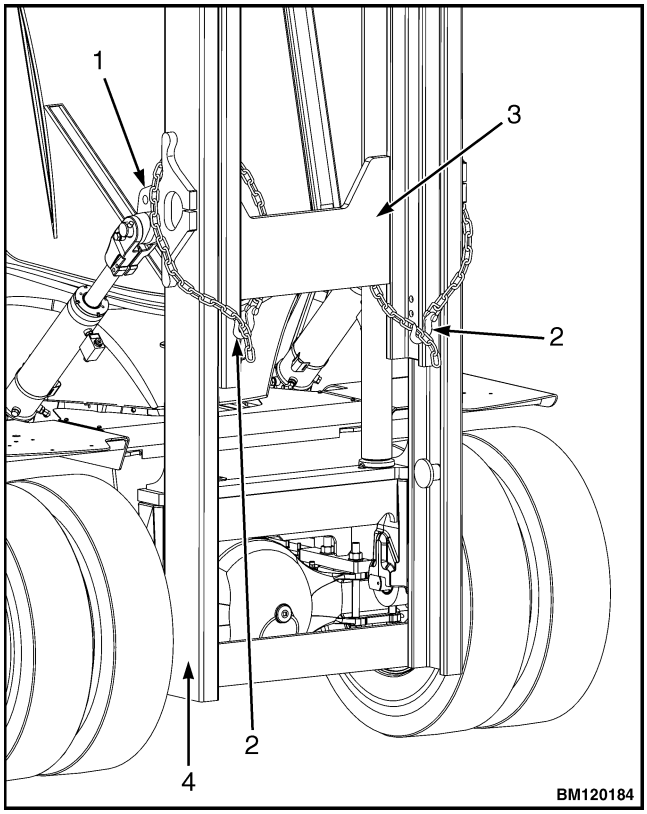
2. If parts of the mast must be in raised position, install a safety chain to restrain the moving parts of the mast. Connect moving parts to a part that does not move. Follow these procedures:

   a. Put the mast in a vertical position.

   b. Raise the mast to align the bottom of the inner weldment to below the anchor for the tilt cylinders. See Figure 42.

   c. Use two safety chains with links at least a 1/2-in. thick. The chains must have equal length. Route one chain over the tilt cylinder bracket, between the lift cylinder and mast and under the inner weldment. Use a hook to link the chain ends together to form a short loop. Install the second chain at the other side of the mast in the same manner as the first chain and create loops of the same length. Make sure the hooks are completely engaged with a link in the chain.

   d. Lower the mast until there is tension in the safety chains. If the engine is running, stop the engine. Apply the parking brake. Install a **DO NOT REMOVE** tag on the safety chains. Put a **DO NOT OPERATE** tag in the operator's compartment.



1. TILT CYLINDER BRACKET
2. HOOK
3. INNER WELDMENT
4. OUTER WELDMENT

Figure 42. Mast

Mast Speeds

Unit	Lifting				Lifting				Lowering			
	B LPG Plus				QSB6.7				B LPG Plus/QSB6.7			
	NOTE: Cummins LPG Plus engine not available for H10.00-12.00XM-12EC (H360HD-EC) models.											
	No Load		Rated Load		No Load		Rated Load		No Load		Rated Load	
	m/ sec	ft/ min	m/ sec	ft/ min	m/ sec	ft/ min	m/ sec	ft/ min	m/ sec	ft/ min	m/ sec	ft/ min
H170HD	0.69	136	0.37	73	0.78	155	0.53	104	0.48	95	0.50	98
H8.00XM	0.69	136	0.37	73	0.73	143	0.48	95	0.48	95	0.50	98
H9.00XM	0.69	136	0.37	73	0.73	143	0.48	95	0.48	95	0.50	98
H10.00XM	0.50	98	0.26	51	0.53	104	0.34	67	0.46	91	0.49	97
H250HD	0.50	98	0.26	51	0.57	130	0.41	80	0.46	91	0.49	97
H12.00XM	0.50	98	0.26	51	0.53	104	0.34	67	0.46	91	0.49	97
H13.00XM	0.41	81	0.22	43	0.44	87	0.29	57	0.44	87	0.48	95
H14.00XM	0.41	81	0.22	43	0.44	87	0.29	57	0.44	87	0.48	95
H16.00XM-6	0.41	81	0.22	43	0.44	87	0.29	57	0.44	87	0.48	95
H10.00XM-12EC	N/A	N/A	N/A	N/A	0.63	124	0.43	84	0.45	89	0.47	93
H12.00XM-12EC	N/A	N/A	N/A	N/A	0.63	124	0.43	84	0.45	89	0.47	93
H360HD-EC	N/A	N/A	N/A	N/A	0.64	126	0.43	84	0.45	89	0.47	93
H190HD	0.69	136	0.37	73	0.78	155	0.53	104	0.48	95	0.5	99
H210HD	0.69	136	0.37	73	0.78	155	0.53	104	0.48	95	0.5	99
H230HD	0.5	98	0.26	51	0.57	130	0.41	80	0.46	91	0.49	96
H280HD	0.5	98	0.26	51	0.57	130	0.41	80	0.46	91	0.49	96
H300HD	0.41	81	0.22	43	0.48	95	0.32	63	0.44	87	0.48	94
H330HD	0.41	81	0.22	43	0.48	95	0.32	63	0.44	87	0.48	94
H360HD	0.41	81	0.22	43	0.48	95	0.32	63	0.44	87	0.48	94

Torque Specifications, Cummins Diesel

LUBRICATION SYSTEM

Plug, Oil Sump, Aluminum Oil Pan
60 N•m (44 lbf ft)

Plug, Oil Sump, Steel Oil Pan
80 N•m (59 lbf ft)

All other torque specifications are found in Cummins Engine Manual. Contact Cummins Engine for any torque specifications not listed for this engine.

General

This section has the removal and installation instructions for major assemblies attached to the frame. The removal and installation procedures for some assemblies are described in the following service manuals:

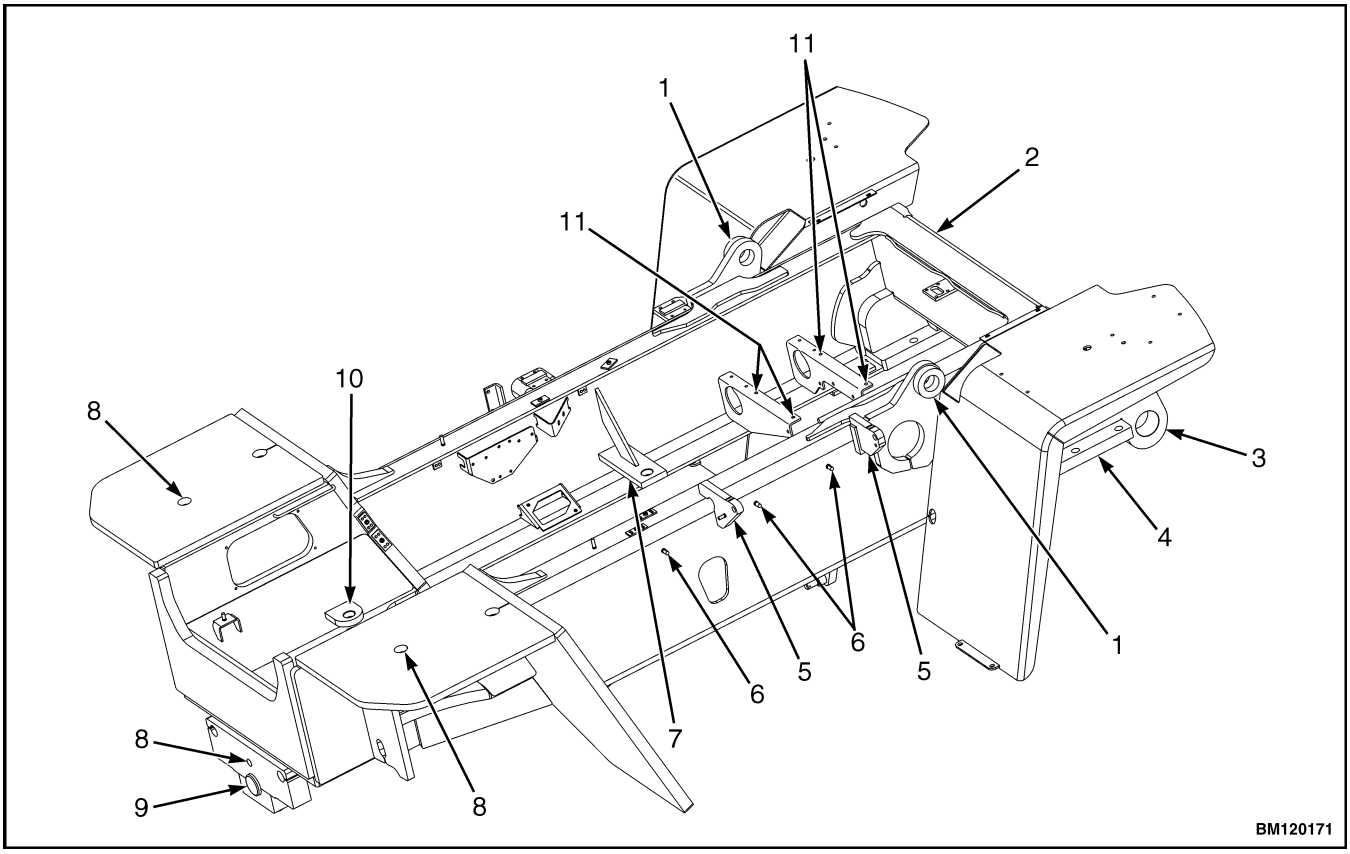
- **Operator's Cab** 100 SRM 1100
- **Multiple Aligned Cooling System** 700 SRM 1350
- **Planetary Drive Axle**, **(Wet System)** 1400 SRM 944
- **Planetary Drive Axle**, **(Dry System)** 1400 SRM 945
- **Steering System** 1600 SRM 1365
- **Hydraulic System** 1900 SRM 938
- **Masts and Carriages**, **Starting 2003** 4000 SRM 1062

Description

CAUTION

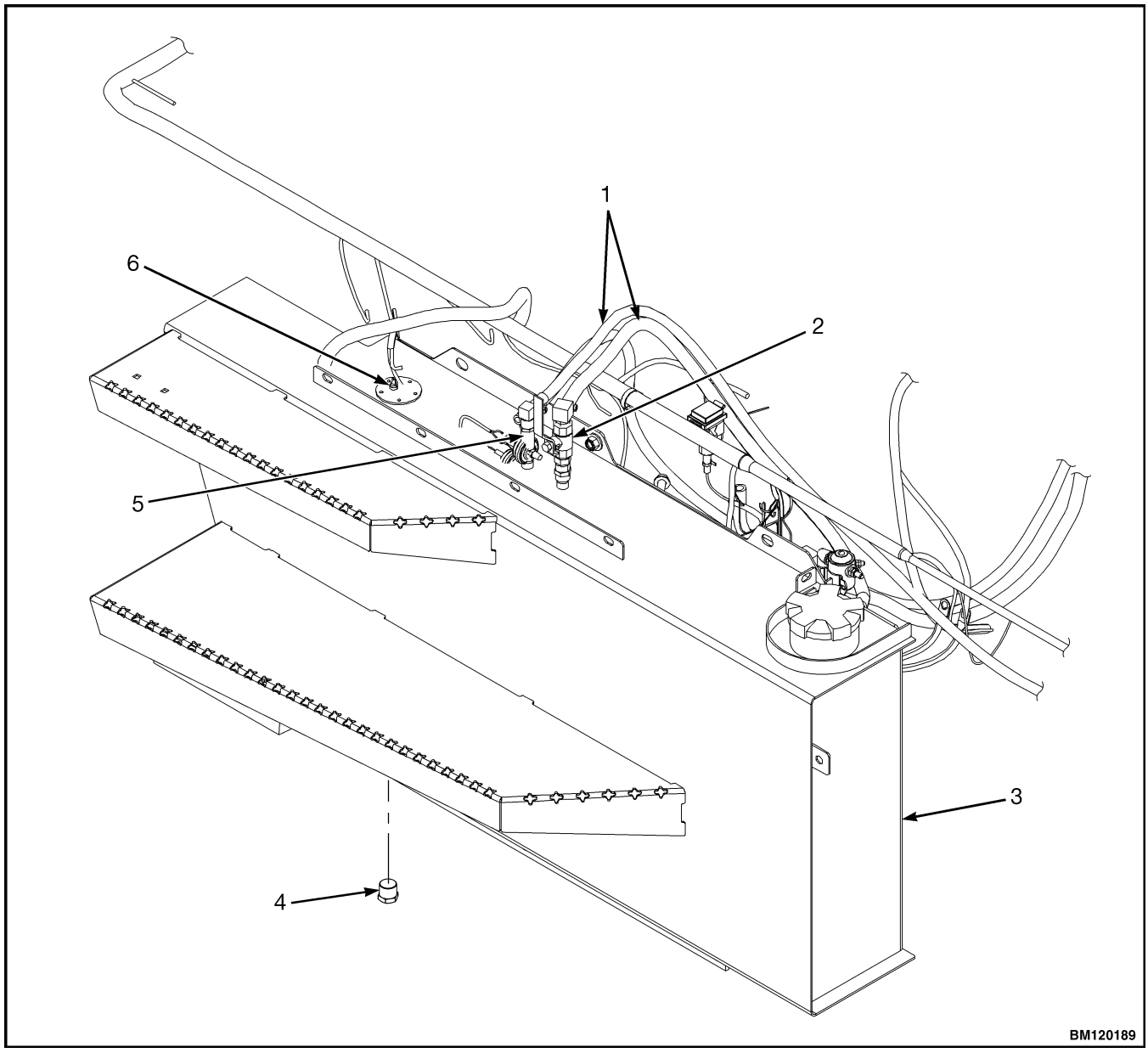
Do not initiate repairs to the frame without consulting a Hyster service representative or damage to the lift truck may occur.

The frame is a weldment with mounts for the major assemblies. See Figure 1. The mounts are designed to keep the attaching parts in position and transfer the normal forces acting on them.



1. TILT CYLINDER MOUNT
2. MAIN FRAME
3. MAST MOUNT
4. DRIVE AXLE MOUNT
5. SIDE TILTING CAB MOUNT
6. FUEL/HYDRAULIC TANK MOUNT
7. TRANSMISSION MOUNT
8. MAIN COUNTERWEIGHT MOUNT
9. STEER AXLE MOUNT
10. ENGINE MOUNT
11. MAIN CONTROL VALVE MOUNT

Figure 1. Frame



1. FUEL HOSE
2. FUEL SHUTOFF VALVE
3. FUEL TANK
4. DRAIN PLUG
5. CHECK VALVE
6. FUEL SENDER CONNECTOR

Figure 8. Fuel Tank

23. Connect the three electrical wires located at the left side of the engine to the alternator. See Figure 11.

24. Connect the two electrical wires located at the left side of the engine to the starter. See Figure 11.

25. Connect the electrical wire located at the left side of the transmission to the transmission control valve. See Figure 11.

26. Connect the electrical wire located at the left side of the transmission for the output speed sensor to the transmission. See Figure 11.

27. Connect the ECM connector and engine supply connector located at the right side of the engine to the engine. See Figure 12.

28. Connect the two electrical wires located at the right side of the engine for the engine oil pressure sensor to the engine. See Figure 12.

29. Connect the electrical wire, located at the right side of the engine, for the fuel filter sender to the engine. See Figure 12.

30. Connect the electrical wire located at the right side of the transmission for the converter out temp sensor to the transmission. See Figure 12.

31. Connect the electrical wire, located at the right side of the transmission, for the turbine speed sensor to the transmission. See Figure 12.

32. Install the two clamps that hold the two electrical wires at the top of the engine that run from the right to the left side. Reposition the two electrical wires to the right side of the frame.

33. Fill the engine coolant core to the correct level with the correct coolant specified in the maintenance table. See **Periodic Maintenance** 8000 SRM 1347.

34. Install the pressure cap to the expansion tank.

35. Fill the transmission to the correct level with fluid specified in the maintenance table. See **Periodic Maintenance** 8000 SRM 1347.

36. Check all oil levels.

37. Install the hood. See the section Hood Assembly, Install.

CAUTION

Connect the positive (power) cable first or lift truck damage may occur.

38. Connect the positive (power) and negative (ground) cables to the batteries.

39. Completely lower the cab.

40. Start the engine and check for leaks and correct operation.

Counterweight

GENERAL

The shape of the main counterweights are the same, however, the weight is different for each model. The model weights are shown in Table 1.

Table 1. Counterweight Weights

Model	Weight
H170HD	2,900 kg (6,393 lb)
H8.00XM (H190HD)	3,070 kg (6,768 lb)
H9.00XM (H210HD)	3,385 kg (7,463 lb)
H10.00XM (H230HD)	4,295 kg (9,469 lb)
H250HD	4,470 kg (9,855 lb)

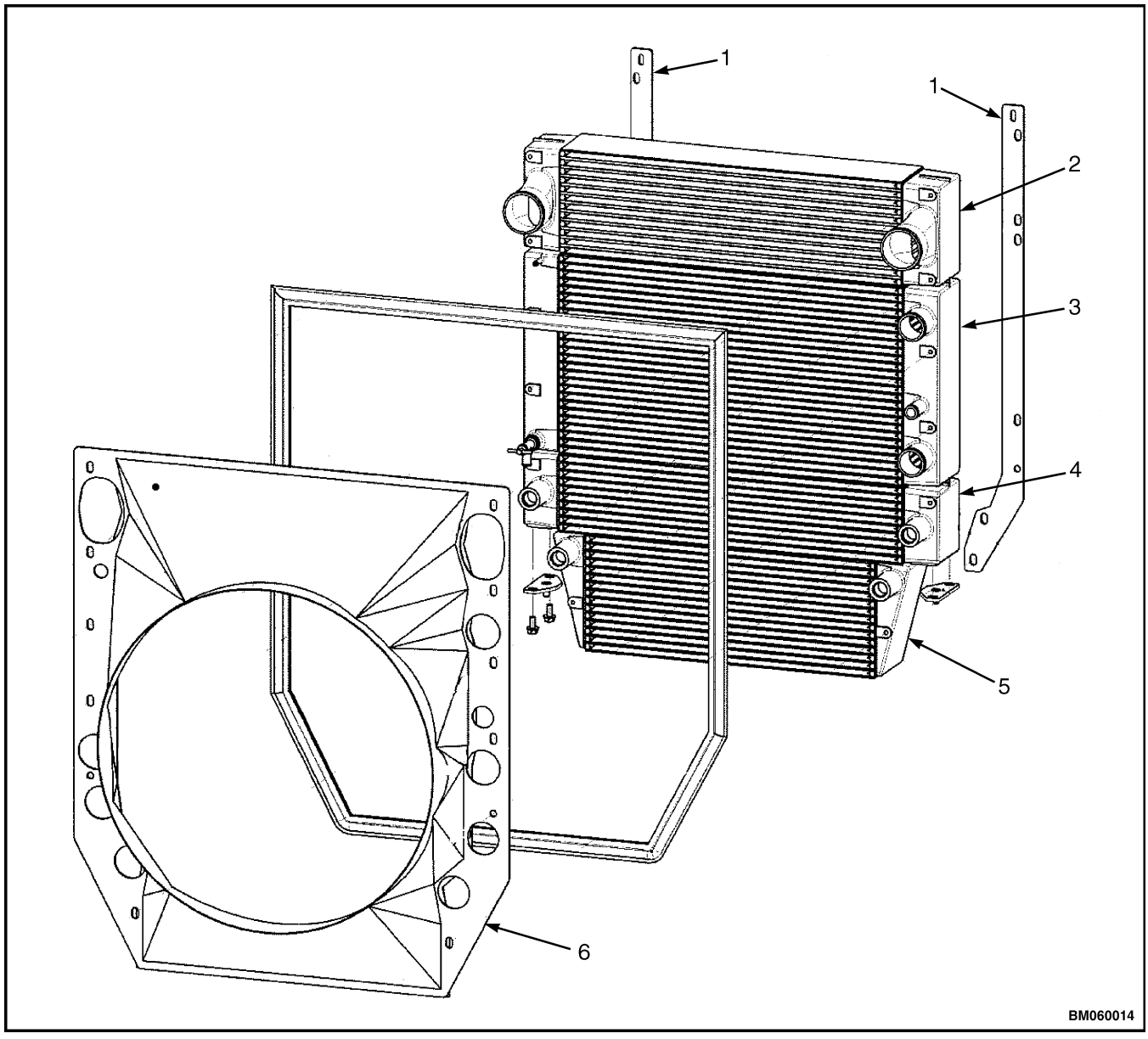
Table 1. Counterweight Weights (Continued)

Model	Weight
H12.00XM (H280HD)	5,150 kg (11,354 lb)
H13.00XM (H300HD)	5,360 kg (11,817 lb)
H14.00XM (H330HD)	5,995 kg (13,217 lb)
H16.00XM-6 (H360HD)	7,050 kg (15,543 lb)
H10.00XM-12EC	5,995 kg (13,217 lb)
H12.00XM-12EC (H360HD-EC)	7,050 kg (15,543 lb)

General

This section describes the total repair of the cooling system and the individual repair of separate cooling sections in the cooling system. See Figure 1. Procedures for cleaning the radiator and troubleshooting are also included in this section. Because each core can be separately serviced, there will be two different repair procedures as follows:

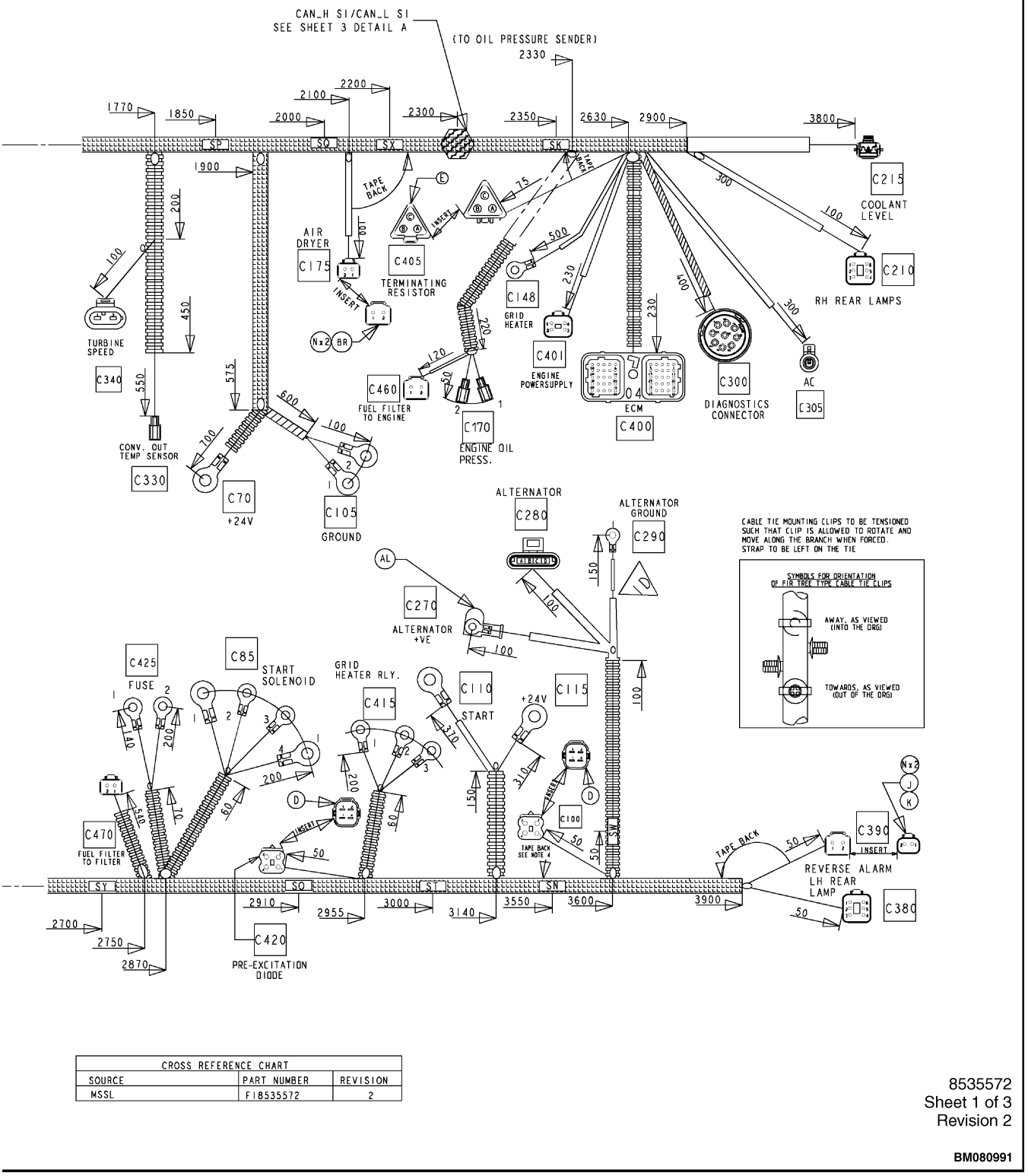
- Complete removal of the cooling system
- Removal of a core



1. PLATE
2. CHARGE AIR COOLER CORE
3. ENGINE COOLANT CORE
4. HYDRAULIC OIL COOLER CORE
5. TRANSMISSION OIL COOLER CORE
6. SHROUD

Figure 1. Cooling Sections

Item No.	Connector	Description
7	C105	Ground
8	C70	+24V
9	C115	+24V
10	C110	Starter Solenoid
11	C425	Fuse
12	C85	Starter Relay
13	C480	LPG Relay
14	C490	Fuse Box 1
15	C500	Fuse Box 2
16	C510	Fuse Box 3
17	C440	LPG Solenoid
18	C460	Low Pressure Switch
19	C82	Cab Tilt Power
20	C520	Resistor
21	C470	DC/DC Converter
22	C150	Engine Speed
23	C80	Valve
24	C90	Drum Speed
25	C35	Hydraulic Cooler
26	C350	Low
27	C120	Output Speed
28	C370	Tilt
29	C360	Aux
30	C25	LH Hub Brake Temp
31	C30	Tilt
32	C20	Front Lamps
33	C40	Aux
34	C50	Lift
35	C310	Park Brake Solenoid
36	C450	Acc Pedal
37	C15	RH Hub Brake Temp (wet brake option)
		Hydraulic Tank Temp (dry brake option)
38	C10	Front End
39	C130	Battery
40	C340	Turbine Speed



CROSS REFERENCE CHART		
SOURCE	PART NUMBER	REVISION
MSSL	F18535572	2

8535572
Sheet 1 of 3
Revision 2

BM080991

Figure 7. Diesel Main Wire Harness (G019)

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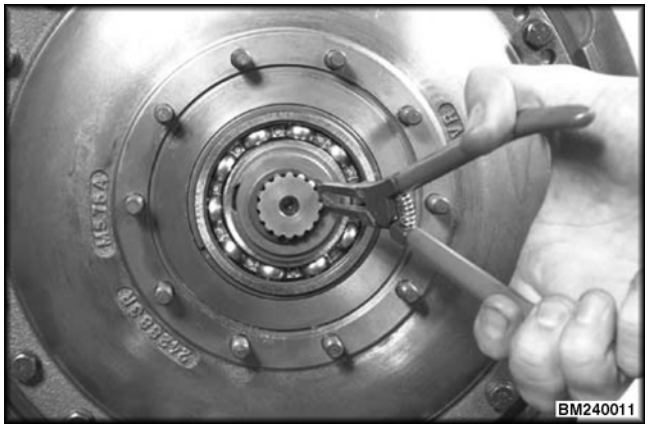
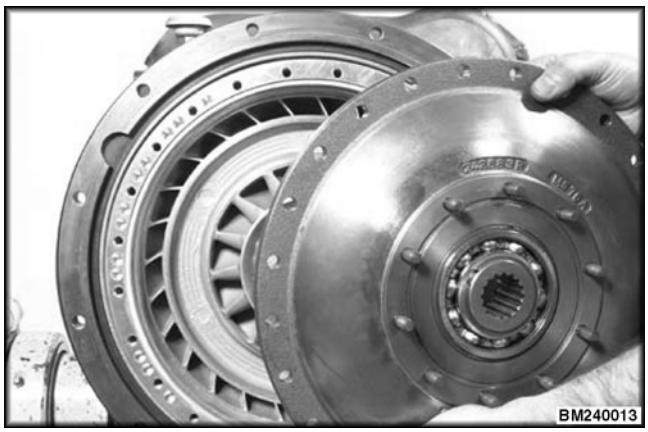
STEP 10.
Remove the retaining ring from the turbine shaft that retains the turbine hub.



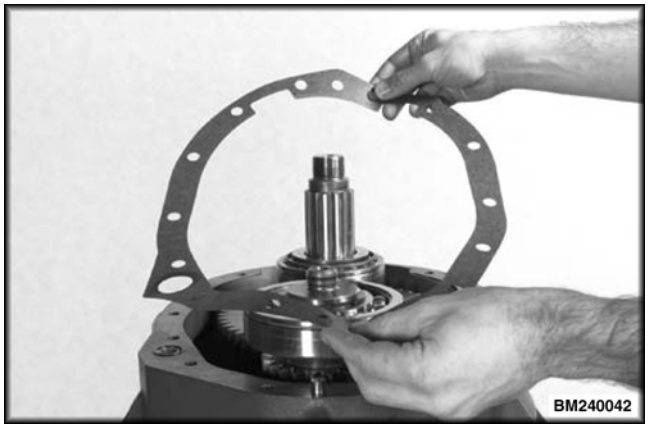
NOTE: Use a suitable container to catch the oil remaining in the converter.

STEP 11.
Remove the bolts and washers retaining the impeller cover to the impeller.

STEP 12.
Remove the impeller cover and turbine as an assembly.



STEP 41.
With the rear cover removed, remove the rear cover to transmission case gasket.



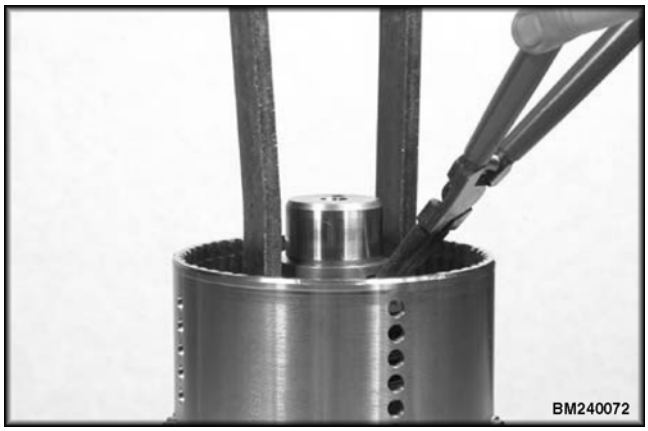
STEP 42.
Remove the output shaft rear locking ball.

STEP 43.
Remove the low clutch shaft rear bearing retainer ring.

WARNING

The spring has a force of 1350 N•m (996 lbf ft).

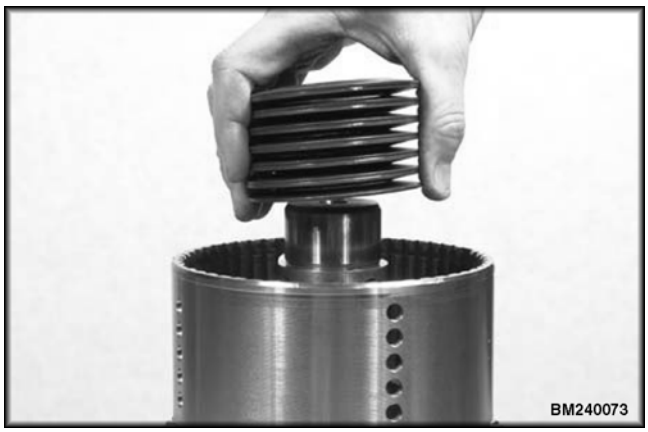
STEP 4.
Compress the piston return disc spring pack and remove the spring retainer snap ring.



CAUTION

Do not mix the disc springs with any other disc springs as they are matched in spring packs.

STEP 5.
Remove piston return spring disc pack.

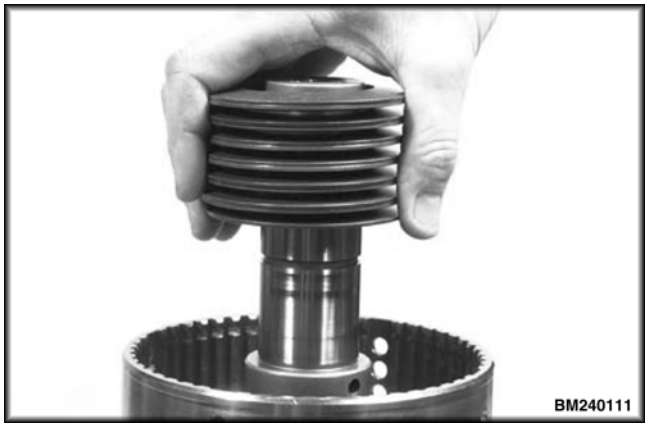


STEP 6.
Remove return spring spacer.

CAUTION

Do not mix the disc springs with any other disc springs as they are matched in spring packs.

STEP 11.
Remove the return disc springs.



STEP 12.
Remove the piston spacer.

STEP 13.
Remove the clutch piston.

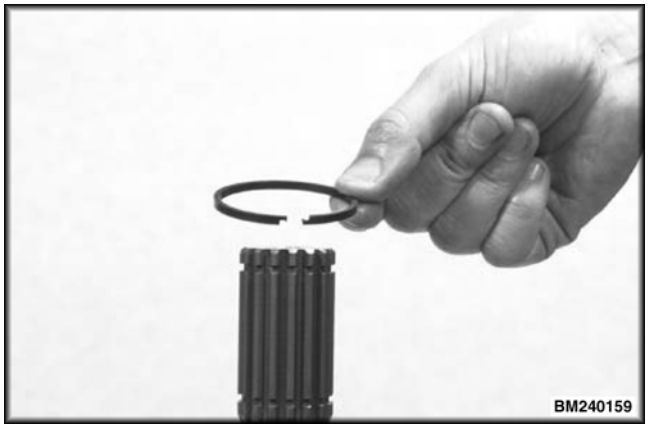
STEP 5.
Remove the oil baffle.

Turbine, Disassemble

STEP 1.
Remove the turbine retaining ring.

STEP 2.
Tap the turbine from the turbine cover with a soft hammer.

STEP 3.
Install the oil seal ring.



Third Clutch Shaft, Assemble

WARNING
Hot parts. Wear protective clothing and gloves to prevent burns.

STEP 1.
Warm the bearing to 120°C (248°F). Install the bearing on the shaft with the groove up.

STEP 2.
Install the bearing retaining ring.

WARNING

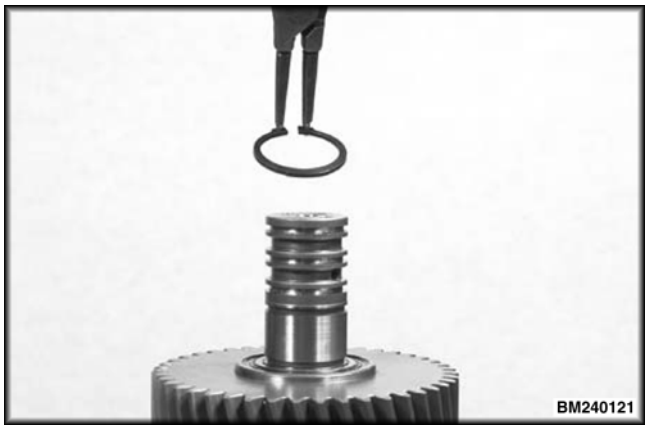
Hot parts. Wear protective clothing and gloves to prevent burns.

STEP 8.

Warm the reverse gear and hub to 120°C (248°F). Install the reverse gear and hub into the clutch drum. Align the splines on the reverse gear with internal teeth of the friction discs and gently place the gear into position.

STEP 9.

Install the bearing retaining snap ring.



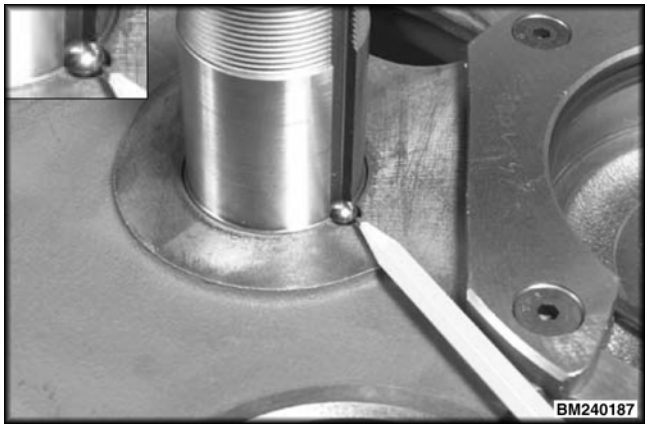
WARNING

Hot parts. Wear protective clothing and gloves to prevent burns.

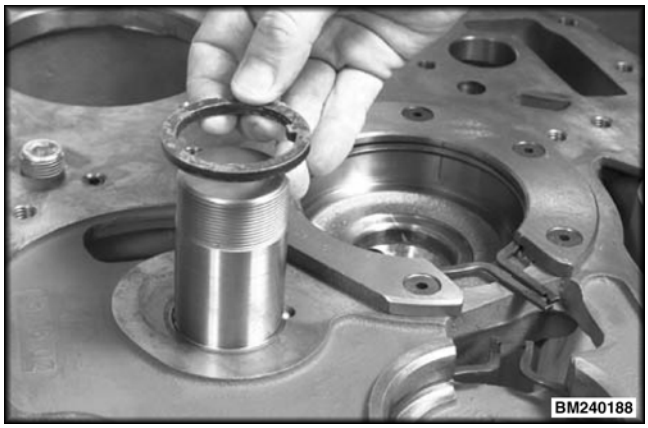
STEP 10.

Warm the front bearing to 120°C (248°F). Install the bearing on the shaft with the groove up.

STEP 3.
Drop the lock ball into position.



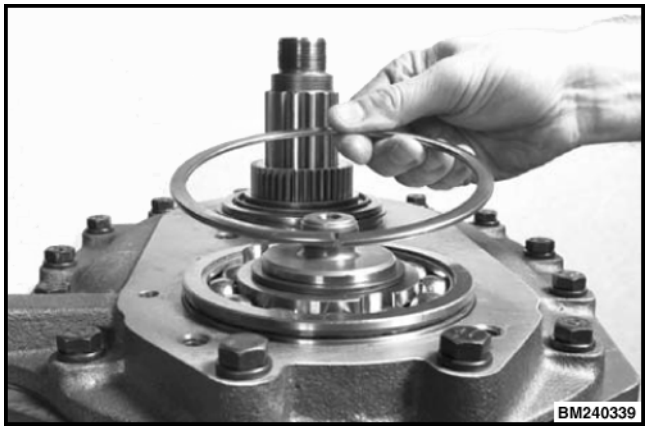
STEP 4.
Install idler shaft spacer.



WARNING
Hot parts. Wear protective clothing and gloves to prevent burns.

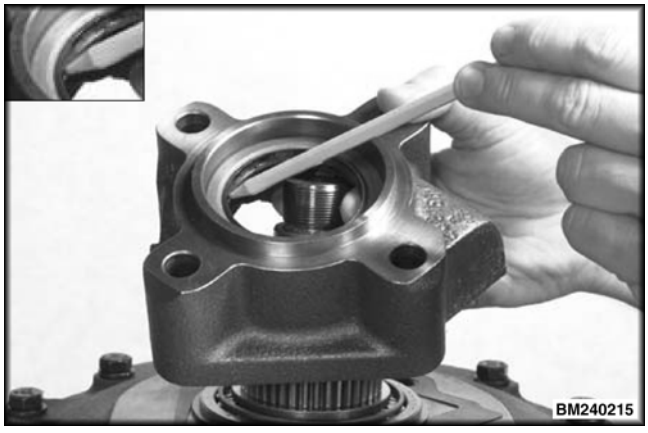
STEP 5.
Warm the lower bearing race to 120°C (248°F) and install on shaft.

STEP 17.
Install the output shaft rear bearing locating ring in the groove.



STEP 18.
Place the gasket into position on the output shaft.

STEP 19.
Apply a very light coat of Permatex #2 to the outer diameter of the rear output seal. Press the seal into the bearing cap with the lip of the seal in. Verify that the seal depth is 11.18 mm (0.44 in.).



STEP 48.
Install the impeller cover to impeller capscrews and lockwashers. Tighten the capscrews to the torque specified in the Torque Specifications.

STEP 49.
Install the turbine hub to turbine shaft retaining ring.

STEP 50.
Install a new O-ring over the impeller cover bearing.

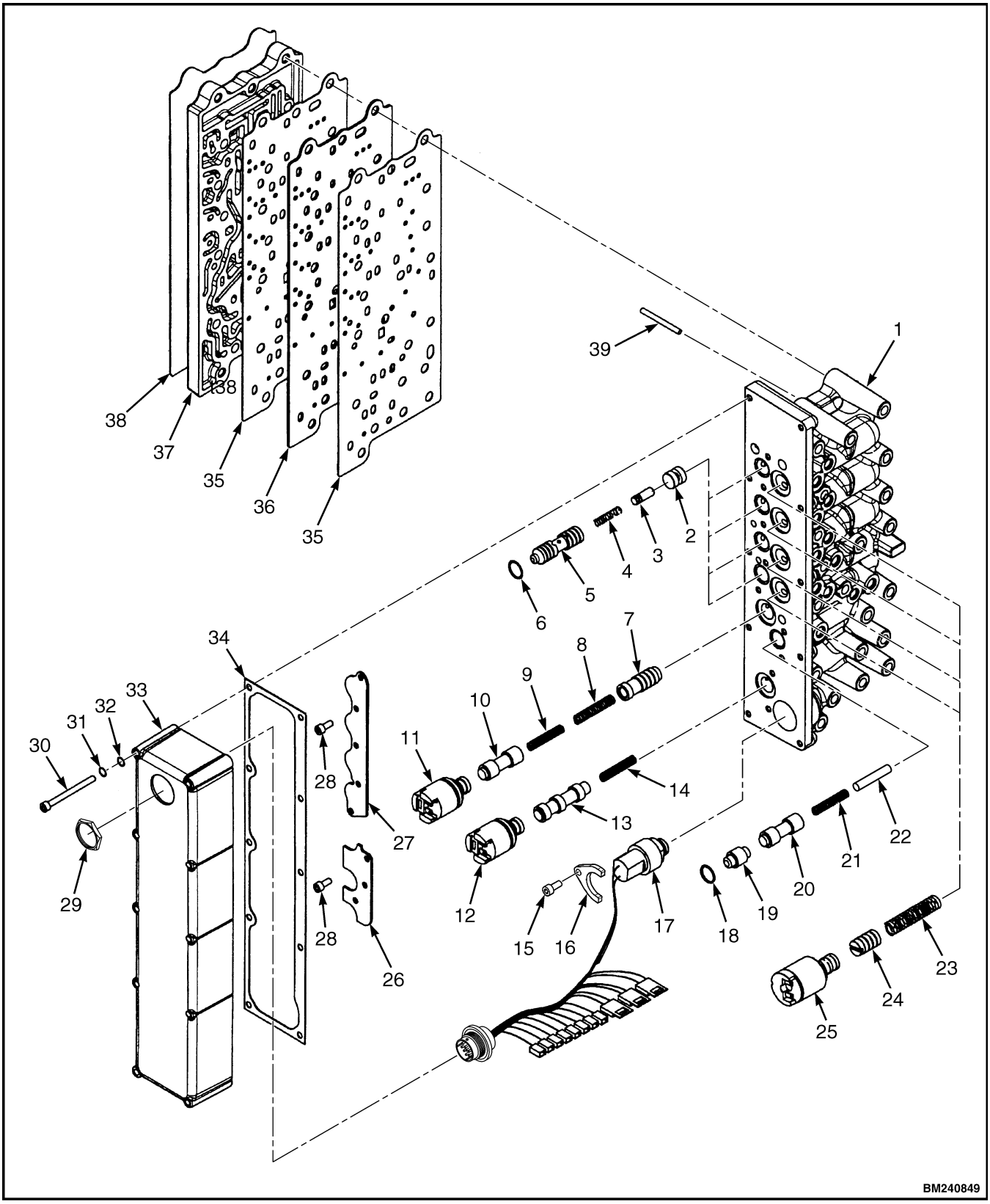


Figure 10. Control Valve

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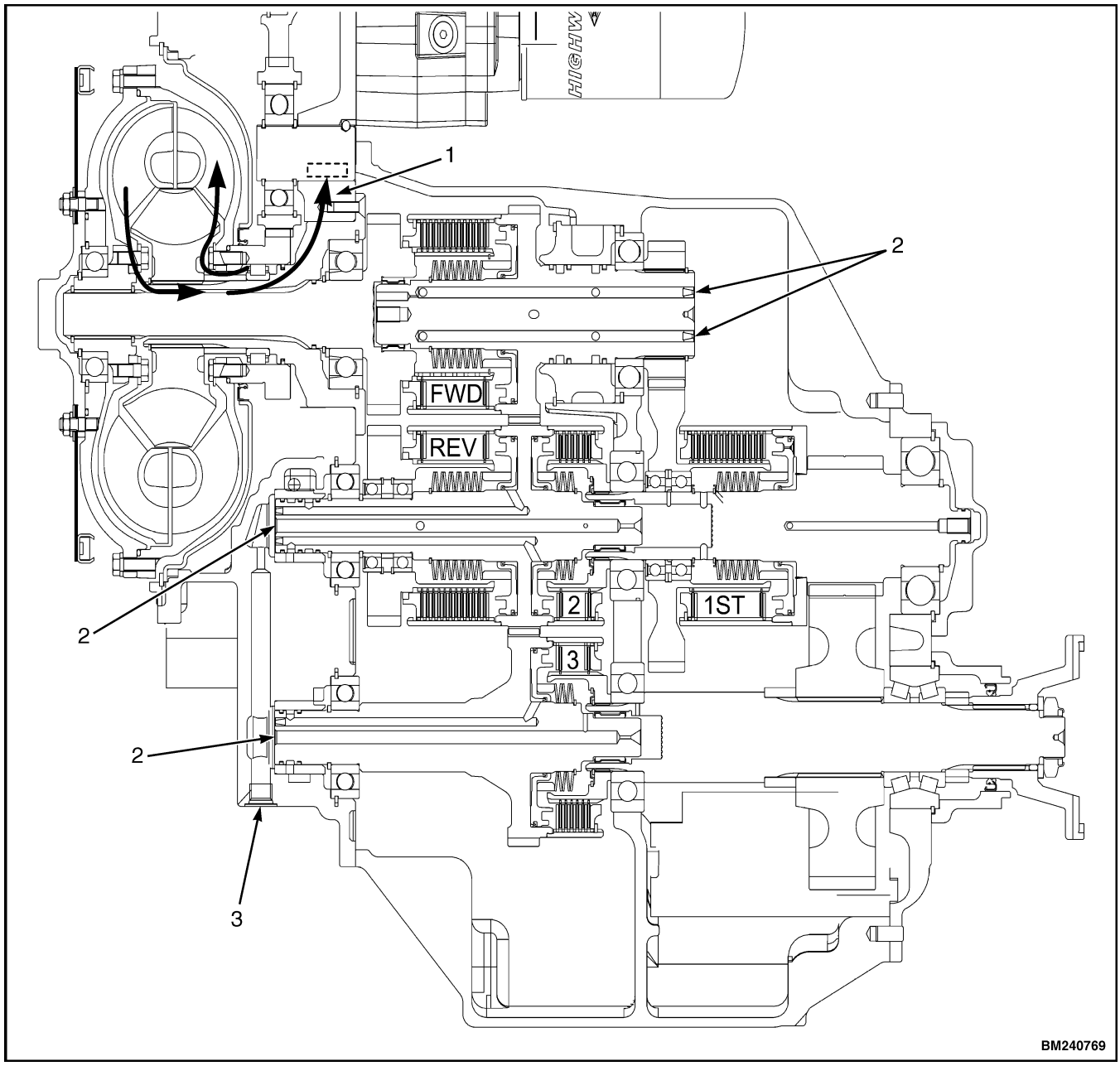
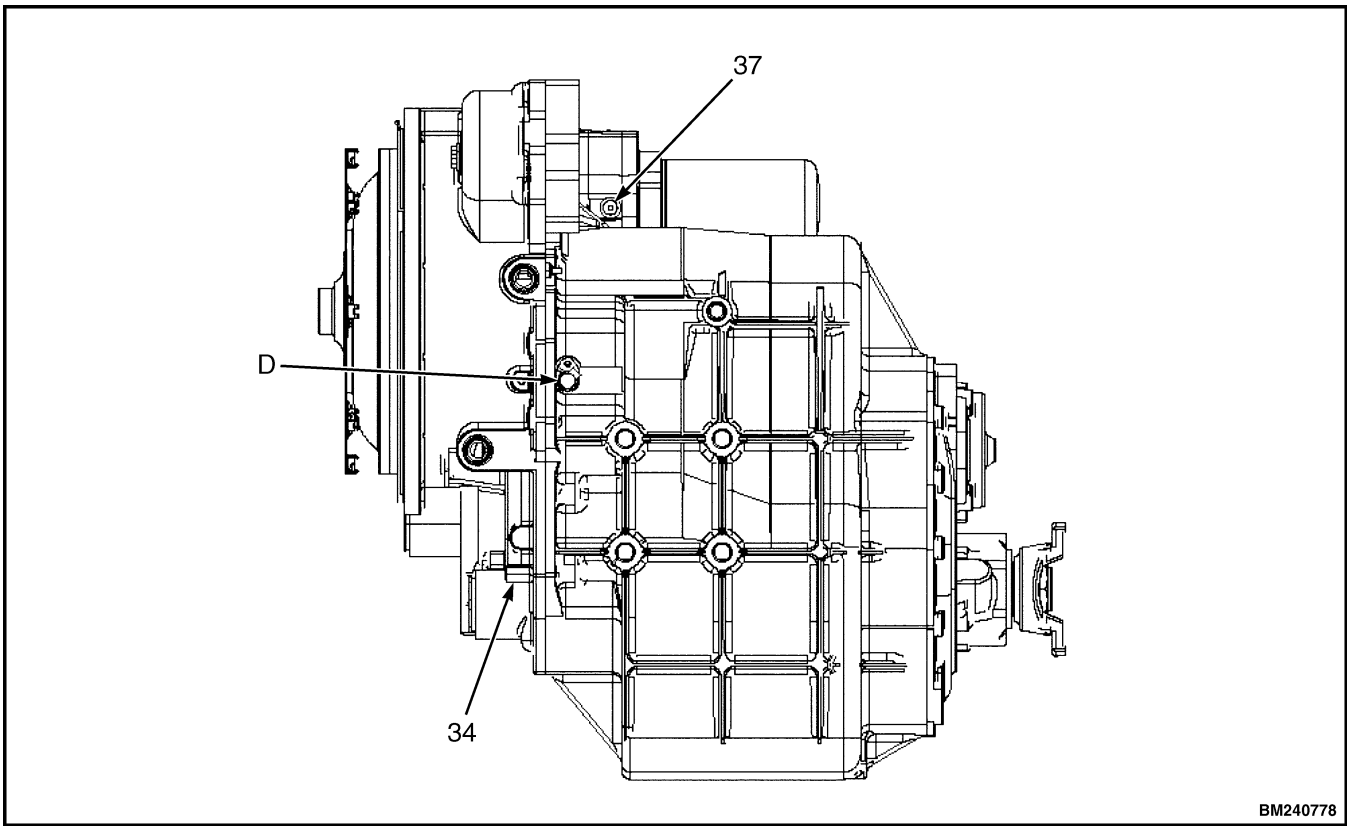
To speed up the warming up process, a thermostat valve is fitted between the torque converter outlet port and the transmission radiator. The thermostat starts opening at 70°C (158°F) and is completely opened at 85°C (185°F). At temperatures below 70°C (158°F), oil flow is directly returned to the transmission. At temperatures above 85°C (185°F), the entire oil flow from the outlet port has to pass the radiator before it is returned to the transmission.



1. OIL FLOW
2. OIL CHANNEL
3. LUBRICATION PRESSURE PORT

Figure 5. Cooling and Lubrication



NOTE: FOR LEGEND, SEE TABLE 3 AND TABLE 4.

Figure 12. Check Ports, Right View

Table 3. Transmission Housing Check Ports

Port Number	Description	Figure	Fitting
31	Filter Out - Regulator Pressure	Figure 10	0.5625 - 12 UN - 2B O-ring
32	Torque Converter Out - To Cooler	Figure 9	1/8 - 87 NPTF
34	Lubrication Range Clutches	Figure 12	0.5625 - 18 UNF -2B O-ring
37	Torque Convertor In	Figure 12	0.500 - 20 UNF - 2B O-ring
41	Clutch Pressure 1st	Figure 11	0.5625 - 18 UNF -2B O-ring
43	Clutch Pressure 3rd	Figure 11	1/4 NPTF Thread
45	Clutch Pressure Forward	Figure 11	0.5625 - 18 UNF -2B O-ring

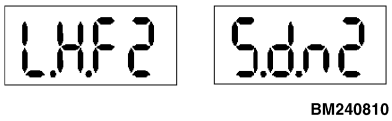


Figure 19. Indication of Protection Mode

TEST FUNCTION GROUP

To enter the Test Function Group, press the S-button while turning the ignition switch to **ON**. Release the S-button when the display shows: '8.8.8.8.'. After releasing the S-button the display will show: 'diSP'. See Figure 20.

Figure 20. Test Function Group Mode

The only way to leave the test function group is by switching the ignition switch to **OFF**.

Figure 21 schematically shows that by pressing the M button the display scrolls to a next display group, and by pressing the S button the display scrolls to a next sub group. When button M is pressed to scroll to a next display group, the display will first show the sub group that is highest on the display group list (diSP, dinP, etc). Starting from these positions it will be possible to scroll to sub groups that are lower on the sub group list. To return to the highest positioned sub group, press the S-button after having reached the lowest positioned sub group.

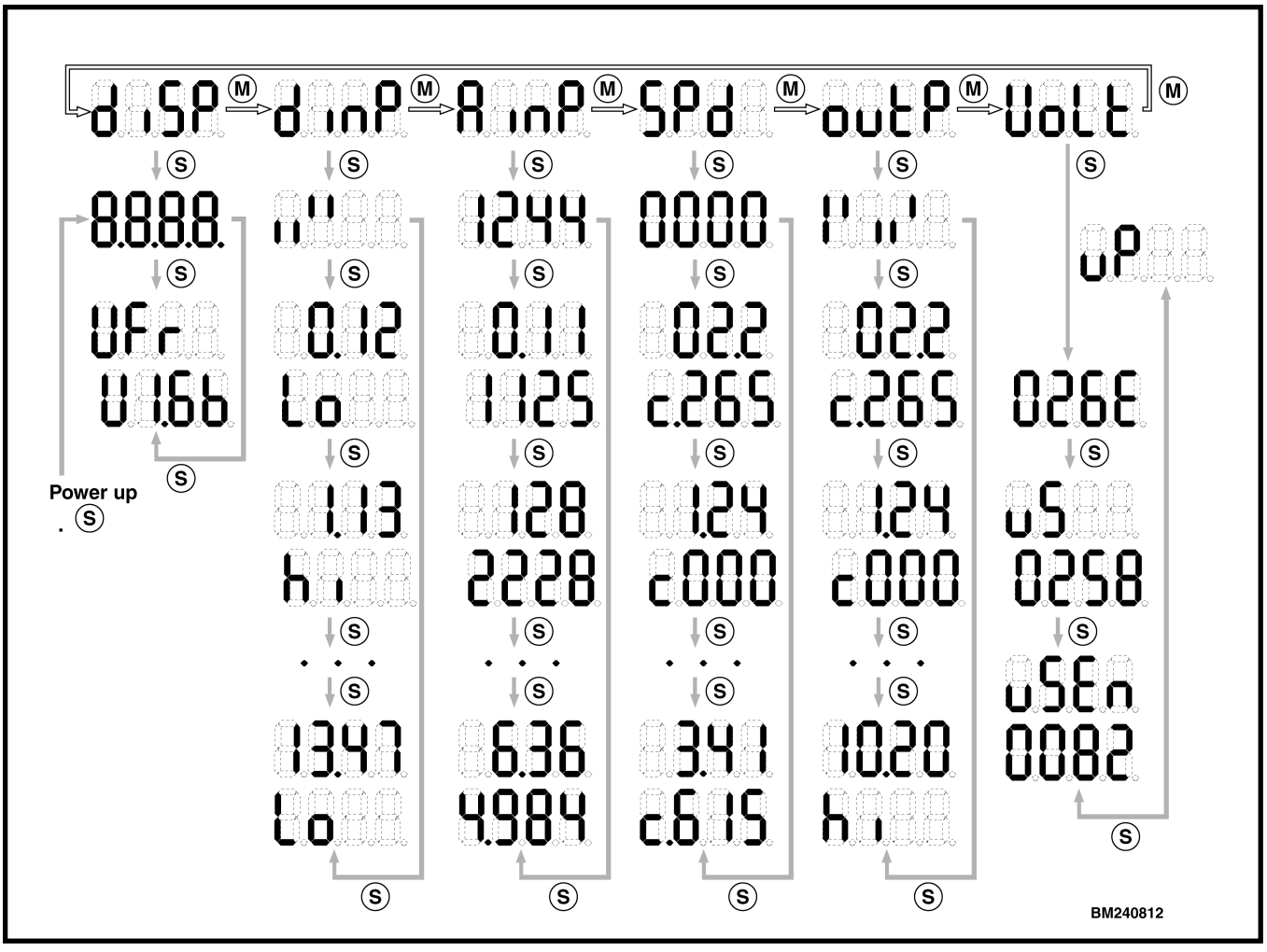


Figure 21. Test Function Group Schematic

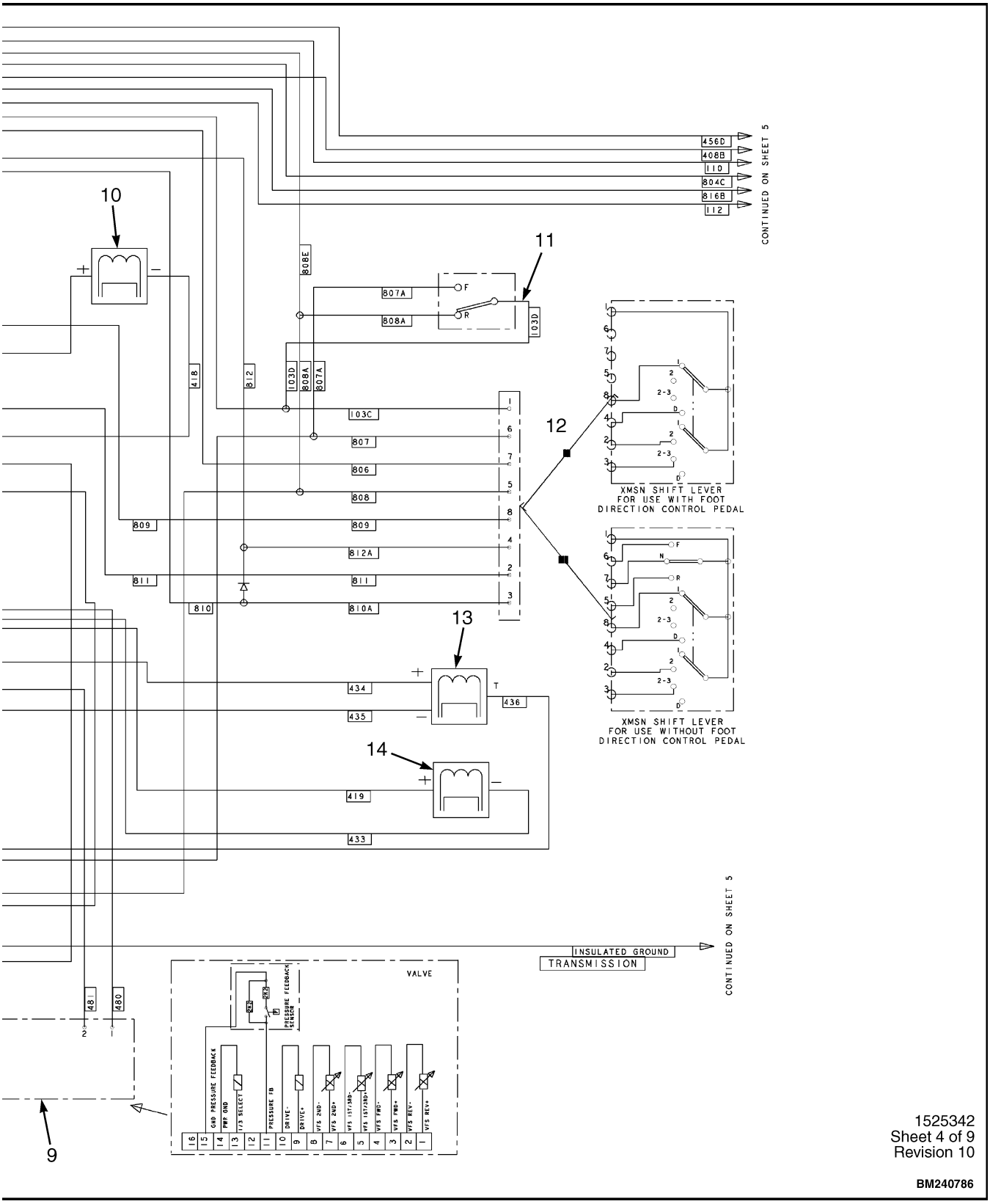


Figure 35. APC200 Wiring Diagram

Legend for Figure 39 (Continued)

Pin No.	Wire No.	APC200 Name	Wire Description	APC200 Pin	Mating Connector			
					Code	Pin	Figure	Description
P3	---	DIGIN9	OPEN	P3	---	---	---	---
R3	479	ANI3	Inching Sensor Output	R3	C130	27	See Figure 43	Under Floor
S3	646	VFSGND	Transmission ECM Ground	S3	C70	3	See Figure 42	Cab Supplies

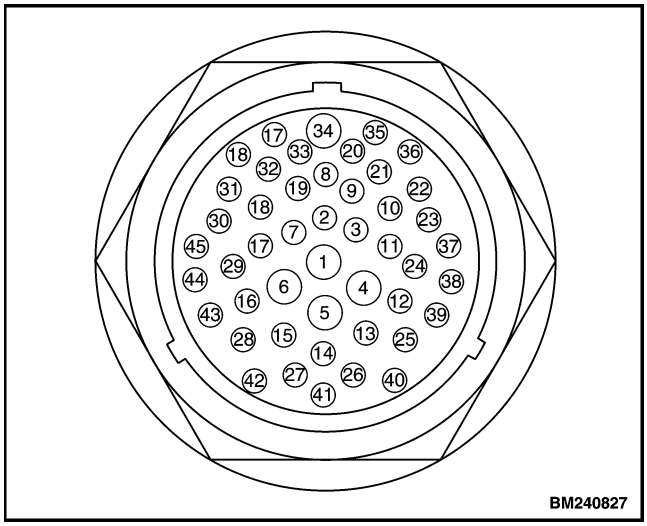


Figure 40. Armrest Connector C80 of Wire Harness Cab Side Console

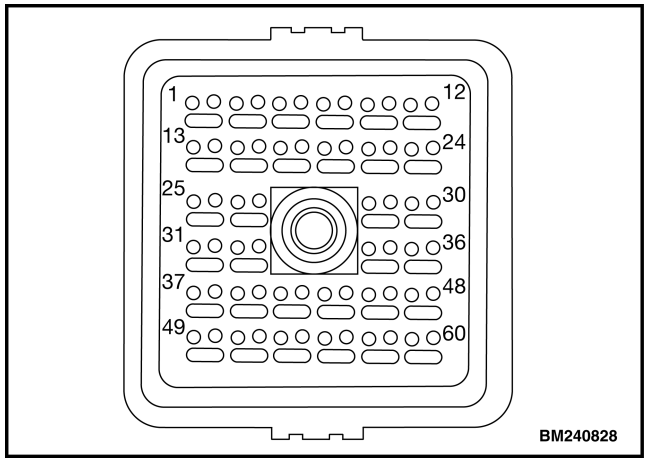
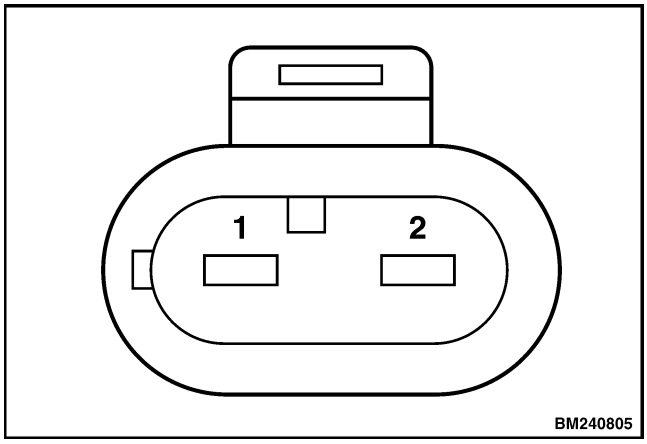
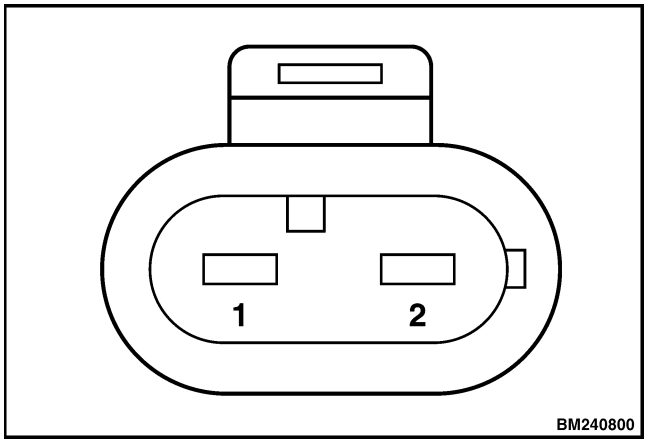


Figure 41. Cab Signals Connector C60 of Wire Harness Cab Side Console



Pin No.	Wire No.	APC200 Name	Wire Description	APC200 Pin	Mating Connector			
					Code	Pin	Figure	Description
1	419	SS1+	Output Speed Sensor +	D3	C144	43	See Figure 53	Cab Signals
2	433	SS1-	Output Speed Sensor -	E3	C144	44	See Figure 53	Cab Signals

Figure 50. Output Speed Connector C120 of Wire Harness Frame



Pin No.	Wire No.	APC200 Name	Wire Description	APC200 Pin	Mating Connector			
					Code	Pin	Figure	Description
1	437	SS3+	Turbine Speed Sensor+	R2	C144	48	See Figure 53	Cab signals
2	478e	SGND	Ground	K3	C144	11	See Figure 53	Cab signals

Figure 51. Turbine Speed Connector C340 of Wire Harness Frame

Table 12. Transmission Exceed Codes

Code	Description
tE001	The vehicle speed is too high to make the requested downshift.
tE101	The vehicle speed is too high to make the requested direction change.
tE201	The engine speed is too high to make the requested direction change.
tE300	The reduced vehicle speed limitation is active.
tE301	The reduced vehicle speed limitation is active, however, the vehicle speed is above the limit.
tE302	The vehicle speed is above the maximum vehicle speed limit.
tE400	An abnormal deceleration is detected.
tE401	An abnormal deceleration is detected.
tE501	The amount of time the transmission was in gear exceeded the time to recalibrate the transmission.
tE600	Operator is not seated with shift lever not in **NEUTRAL** and/or the parking brake not activated.

Table 13. APC200 Fault Codes

Fault Code	Fault Explanation	APC200 Action	Troubleshooting
00.50	There is a problem related to the internal RAM (in CPU) of the APC200.	The APC200 reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Replace the APC200.
00.51	There is a problem related to the system RAM (in CPU) of the APC200.	The APC200 reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Replace the APC200.
00.52	There is a problem related to the external RAM of the APC200.	The APC200 reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Replace the APC200.
00.53	There is a problem related to the Flash program memory of the APC200.	The APC200 reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Replace the APC200.
20.60	Pressure feedback line, ANI0 (wire 490) is in the 1500 - 4000 ohm range, indicating there is no system pressure present. The speed sensor indicates that ANI0 should be in the 500 - 1500 ohm range.	The APC200 reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Check the wiring between the controller and the pressure feedback sensor. Check the pressure feedback sensor (engine running/stopped).
20.61	Pressure feedback line, ANI0 (wire 490) is in the 500 - 1500 ohm range, indicating system pressure is present. The speed sensor indicates that ANI0 should be in the 1500 - 4000 ohm range.	Controller reverts to a Shut Down Mode and will deactivate the total neutral solenoid.	Check the wiring between the APC200 and the pressure feedback sensor. Check the pressure feedback sensor (engine running/stopped).

Table 13. APC200 Fault Codes (Continued)

Fault Code	Fault Explanation	APC200 Action	Troubleshooting
83.01	Total Neutral Solenoid Minus, DO3 (wire 489) related fault: wire 489 is not connected or shorted to ground.	The APC200 reverts to a Shut Down Mode and disengages all clutches.	Check the wiring between the controller and the Total Neutral solenoid minus line. Check the Total Neutral solenoid itself.
90.xx - 99.xx	System Error. Software related fault.	The APC200 reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
90.90	Wrong firmware is flashed into the APC200.	The APC200 reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
93.10	Initialization of statistical data in flash memory, caused by firmware upgrade or memory conflict.	The APC200 will flag the fault, but no actions will be taken.	Load the correct firmware into the APC200.
93.11	Initialization of logged error data in flash memory, caused by firmware upgrade or memory conflict.	The APC200 will flag the fault, but no actions will be taken.	Load the correct firmware into the APC200.
95.71	Data in the APC200 is not compatible with the data expected by the APC200 firmware. Wrong APT file (data file) is in the APC200 (typically after APC200 firmware upgrade).	The APC200 reverts to a Shut Down Mode and disengages all clutches.	Load the correct firmware into the APC200.
99.95	CAN peak load detected: APC200 temporarily could not process all incoming messages, due to an excessive peak of CAN requests.	The APC200 will reply on the CAN messages which are available in its buffer.	No action required.
xx.49	Fault with undefined cause. Software related fault.	The APC200 will flag the fault - action will depend on the fault.	Replace APC200 controller.

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AIR CONDITIONING

General

NOTE: Replacement, Installation, and Repairs to air conditioning units that require discharging and/or refilling of the refrigeration fluid may only be performed by a certified and qualified technician.

The air conditioning system consists of a compressor, condenser, dryer, evaporator valve, evaporator, and interconnected sensors and switches. See Figure 8.

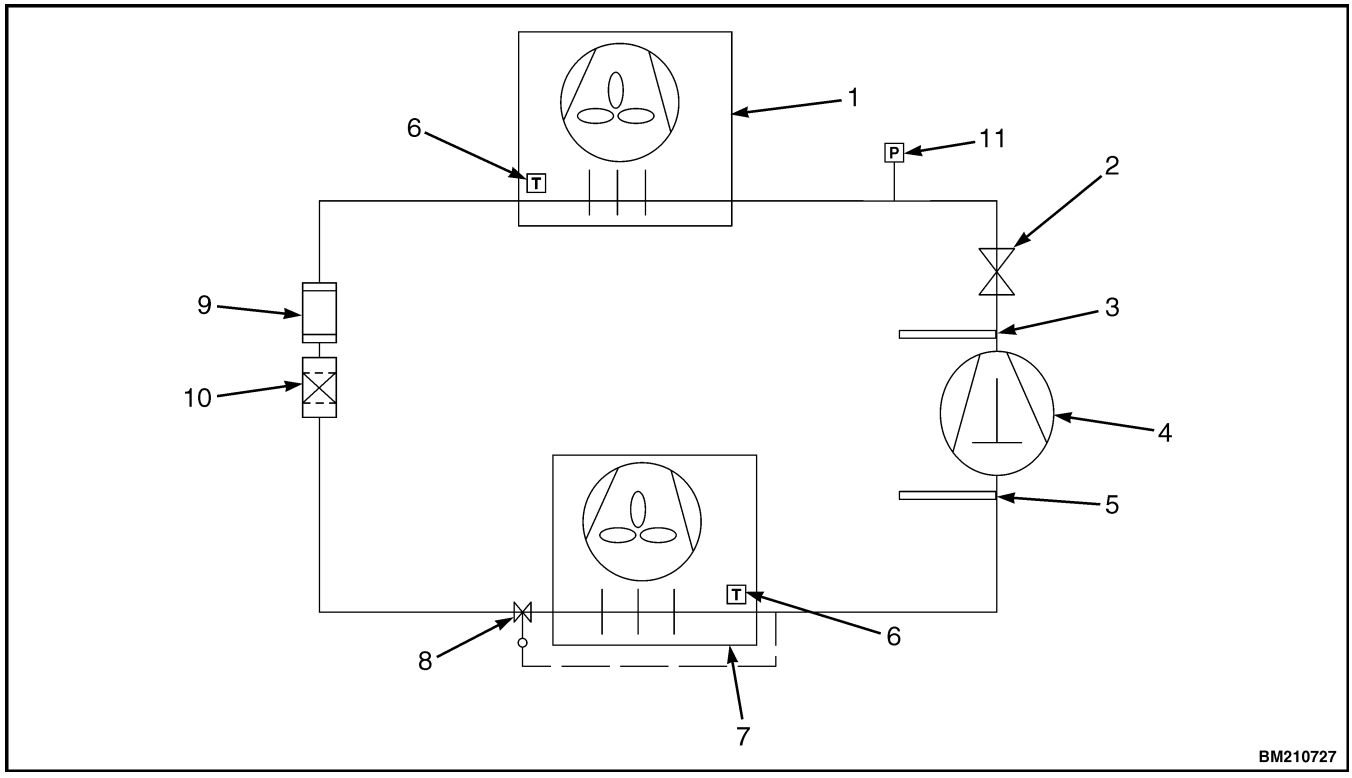
The engine drives the compressor when the clutch at the compressor has been activated. Activation of the clutch is determined by several sensors and switches that are connected in series. See the electrical schematic in **Diagrams** 8000 SRM 1346. The compressor compresses the refrigerant and pumps it continuously through the air conditioning system. As the refrigerant is being compressed it also raises in temperature. The absorbed heat is dissipated in the condenser, which is installed outside of the cab. Ventilators at the condenser accelerate heat dissipation.

After leaving the condenser, the liquefied refrigerant passes a dryer that also serves as a reservoir for the refrigerant.

By sudden expansion of the refrigerant in the evaporator, a substantial temperature drop is obtained, which is used to cool the evaporator. The evaporator cools the air for the cab interior.

The expansion valve regulates the flow of the refrigerant, depending on the pressure difference between the dryer and the compressor inlet. A minimum pressure difference is necessary to open the valve.

After leaving the evaporator, the refrigerant re-enters the compressor.



1. CONDENSER
2. NON-RETURN VALVE
3. SERVICE CONNECTION HP
4. COMPRESSOR
5. SERVICE CONNECTION LP
6. ANTI-ICE SENSOR
7. EVAPORATOR
8. EVAPORATOR VALVE
9. DRYER
10. RESERVOIR
11. PRESSURE SWITCH

Figure 8. Refrigerant Cycle

5. Remove the two capscrews that retain the electrical tilt pump to the bracket.

6. Remove the electrical tilt pump from the bracket.

Install

1. Position the electrical tilt pump to the bracket.

2. Install the two capscrews that retain the electrical tilt pump to the bracket.

3. Position the bracket with electrical tilt pump to the frame.

4. Install the two nuts that retain the bracket with electrical tilt pump to the frame.

5. Remove the plugs and install the two hoses to the electrical tilt pump.

6. Connect the electrical connector located at the electrical tilt pump. See Figure 3.

7. Operate the electric tilt pump to check for leaks and to remove air from the cab tilt system.

8. Check the hydraulic oil level. See the section Oil Filling for Cab Tilt System.

9. Operate cab tilt system to ensure proper operation.

HAND PUMP

Remove

1. Remove the two capscrews that retain the hand pump to the frame.

NOTE: Keep the hydraulic hose connection locations from the hand pump upwards to avoid spilling hydraulic oil.

2. Tag the three hydraulic hoses for identification.

3. Remove the three hydraulic hoses and place plugs on the three hose ends.

Install

1. Remove the plugs from the three hose ends and install the three hydraulic hoses to the hand pump.

2. Install the two capscrews that retain the hand pump to the frame.

3. Remove the fill cap of the hand pump and fill reservoir with hydraulic oil.

NOTE: If necessary, refill until the cab tilt system functions properly.

4. Check if the cab tilt system functions properly.

CAB TILT CYLINDER

Remove

1. Tilt/Raise cab until it locks in partially open position. See the section Raising and Lowering Cab.

2. Place support under the cab to prevent the cab from suddenly lowering.

3. Remove the split pin and washer from the pin that retains the cab tilt cylinder to the cab tilt frame.

4. Remove the pin that retains the cab tilt cylinder to the cab tilt frame.

5. Place the topside of the cab tilt cylinder inside the frame.

6. Put tags on the two hydraulic hoses for identification.

7. Disconnect the two hydraulic hoses from the cab tilt cylinder and install caps on the hydraulic fittings and plugs in the hydraulic hoses. See Figure 17.

8. Remove the split pin from the pin that retains the cab tilt cylinder to the frame.

9. Remove the cab tilt cylinder from under the frame.

Disassemble

1. Put the cab tilt cylinder in a horizontal position with the fittings pointing downwards in a vise with soft jaws.

2. Place a drain pan under the fittings.

3. Remove the caps from the fittings and drain the hydraulic oil from the cab tilt cylinder.

4. Remove the wiper from the cylinder shell. See Figure 17.

4. Locate the rear tab on the underside of the seat cushion over the rectangle hole in the metal pan.
5. Apply downward pressure over the tab.
6. Slide the cushion around until you feel the tab partially located in the rectangle hole.
7. With the cushion angled approximately 35° to 45°, apply a sharp blow to the front of the seat cushion. The tab will enter the hole with an audible click.
8. Pull the cushion upward to make sure the cushion is correctly locked in position.

BACK CUSHION

Remove

1. Position the seat assembly completely to the front.
2. If equipped, remove the headrest.
3. Remove the two guides out the back cushion, located at the top side that retain the headrest to the back pan.
4. Remove the two screws that retain the back cushion to the back pan.
5. Remove the back cushion.

Install

1. Position the back cushion.
2. Install the two screws that retain the back cushion to the back pan.
3. Install the two guides into the back cushion, located at the top side that retain the headrest to the back pan.
4. If equipped, install the headrest.
5. Reposition the seat assembly to the correct operating position.

SEAT SUSPENSION

Remove

1. Remove the seat. See the section Seat, Remove.
2. Remove the four capscrews that retain the seat suspension to the cab floor.
3. Remove the seat suspension from the cab floor.

Install

1. Position the seat suspension onto the cab floor.
2. Install the four capscrews that retain the seat suspension to the cab floor.
3. Install the seat. See the section Seat, Install.

BOOT

Remove

1. Remove the seat. See the section Seat, Remove.
2. Using a small pry bar, remove the 22 plastic plugs that retain the boot to the seat suspension.
3. Remove the boot.

Install

1. Install the boot.
2. Install the 22 plastic plugs that retain the boot to the seat suspension.
3. Install the seat. See the section Seat, Install.

SHOCK ABSORBER

Remove

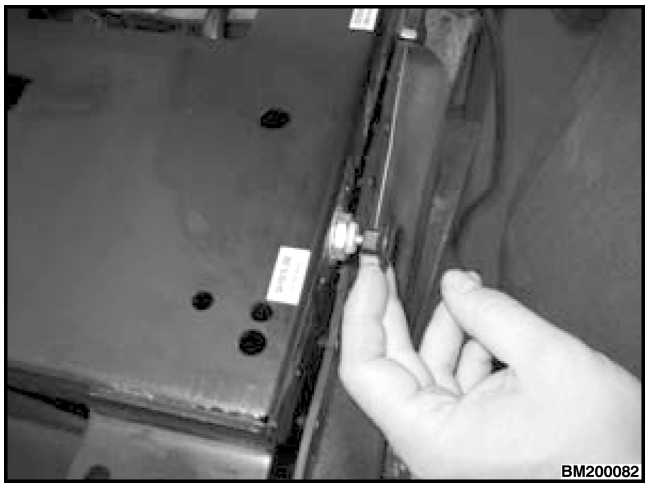
1. Remove the seat. See the section Seat, Remove.
2. Remove the seat suspension. See the section Seat Suspension, Remove.
3. Remove the boot. See the section Boot, Remove.

Install

1. Install the boot. See the section Boot, Install.
2. Install the seat suspension. See the section Seat Suspension, Install.
3. Install the seat. See the section Seat, Install.

STEP 13.
Insert the air valve through the upper housing. Install the lockwasher and nut. Tighten the nut to 10 to 18 N•m (88 to 159 lbf in). Install the air valve knob.

STEP 14.
Using a 1/16" Allen wrench, install the air control knob.



STEP 15.
Install the boot. See the section Boot, Install.

STEP 16.
Install the seat suspension in the operator's cab. See the section Seat Suspension, Install.

STEP 17.
Install the seat on the suspension. See the section Seat, Install.

Legend for Figure 27

1. SCREW
2. WASHER
3. SCREW
4. WASHER
5. SOCKET
6. HORN BUTTON
7. SPINNER KNOB
8. STEERING WHEEL
9. HARNESS
10. UPPER STEERING COLUMN COVER
11. LEFT HAND STEERING COLUMN COVER
12. RIGHT HAND STEERING COLUMN COVER
13. LEFT HAND STEERING COLUMN COVER
14. RIGHT HAND STEERING COLUMN COVER
15. STEERING COLUMN ASSEMBLY
16. BOOT
17. MAIN WARNING LIGHTS
18. STEERING CONTROL UNIT (UNDER CAB FLOOR)
19. ADJUSTMENT HANDLE

STEERING COLUMN ASSEMBLY

Remove

1. Turn the battery disconnect switch to the **OFF** position.

2. Remove all unsecured items from the cab.

3. Remove the left and right cab door.

4. Clear all obstacles from the right-hand side, as seen from the operator's position, of the lift truck. Provide a minimum of 2.0 m (7.0 ft) of clearance space.

5. Disconnect the battery ground cable.

6. Raise cab to the fully open position. See the section Raising and Lowering Cab.

7. Disconnect the steering column connector positioned under the cab. See Figure 28.

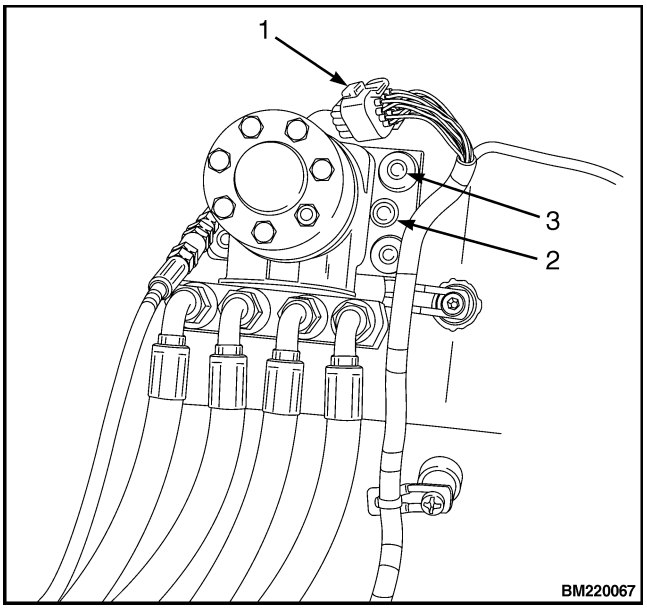


Figure 28. Steering Pump

Legend for Figure 28

1. STEERING COLUMN CONNECTOR
2. STEERING COLUMN CAPSCREWS
3. STEERING CONTROL UNIT CAPSCREWS

CAUTION

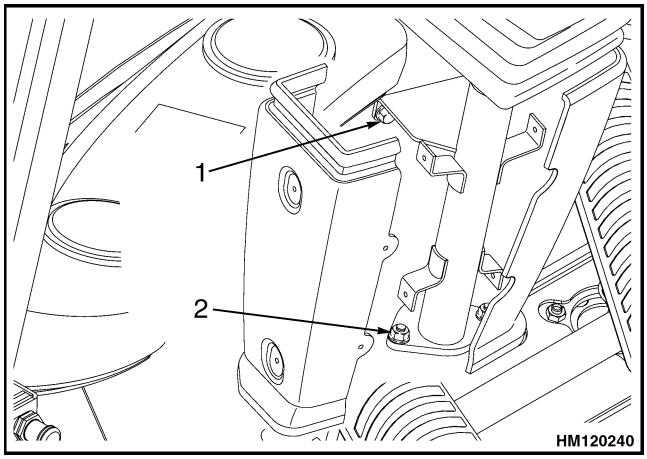
Use caution when removing the steering control unit or damage to the cab may occur.

8. Remove the four capscrews that retain the steering control unit under the cab. See Figure 28.

9. Lower the cab until it is in the fully lowered and latched position. See the section Raising and Lowering Cab.

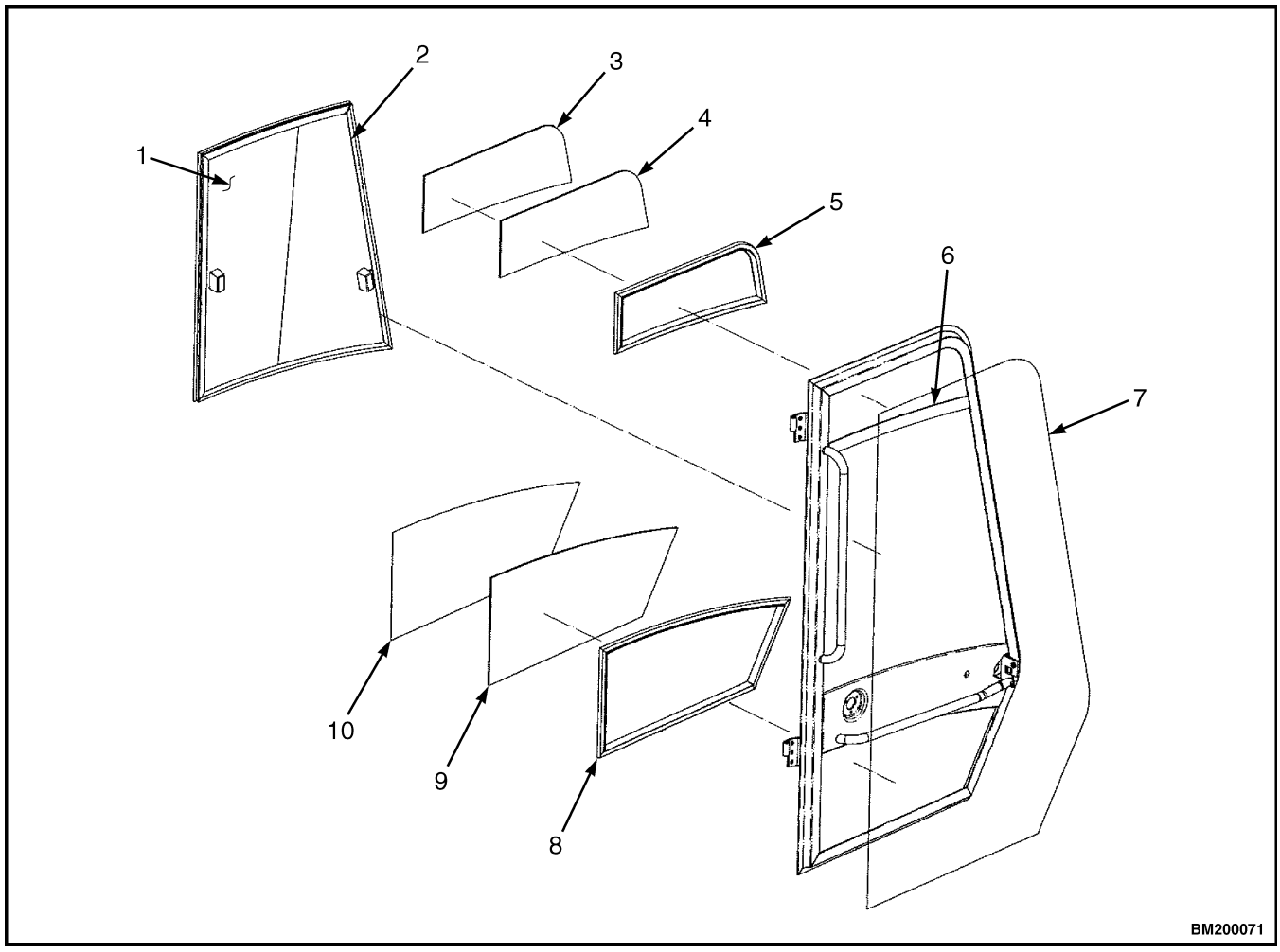
10. Remove the screws that retain the left- and right hand steering column covers. See Figure 27.

11. Remove the two steering column to cab floor capscrews retaining the steering column to the cab floor. See Figure 29.



1. STEERING COLUMN TO BRACKET CAPSCREWS
2. STEERING COLUMN TO CAB FLOOR CAPSCREWS

Figure 29. Steering Column



1. SLIDING WINDOW
2. SEAL
3. WINDOW EDGE PROTECTION SEAL
4. UPPER WINDOW
5. GLUED SEAL
6. DOOR
7. SEAL
8. GLUED SEAL
9. LOWER WINDOW
10. WINDOW EDGE PROTECTION SEAL

Figure 34. Doors/Glass Assemblies