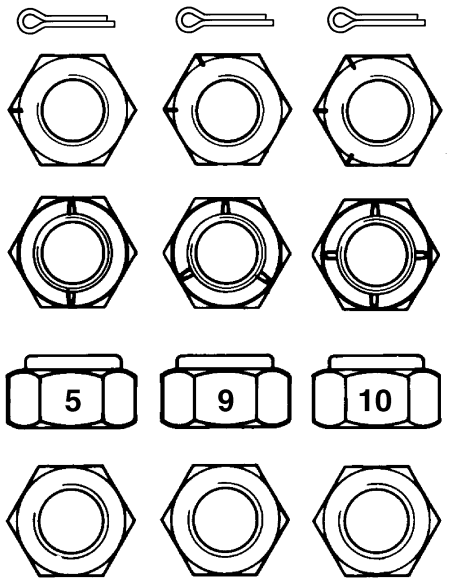
Yale®

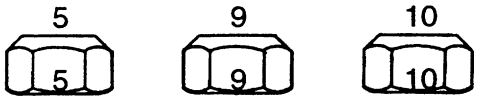
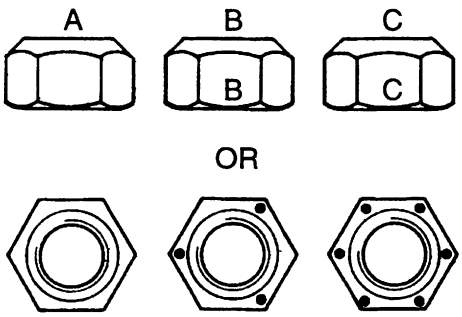
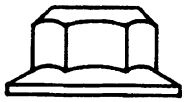
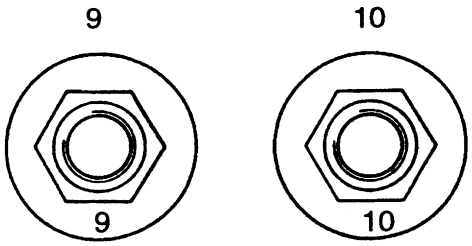
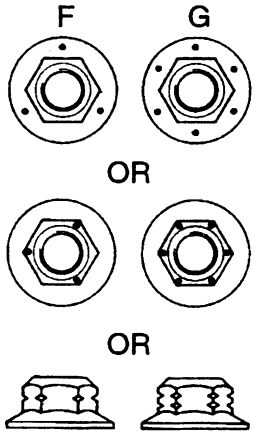
Maintenance

METRIC AND INCH (SAE) FASTENERS



HM210064

Table 3. Torque Nuts

TYPE OF FASTENER	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS	INCH FASTENERS STRENGTH LEVELS: SAE GRADES
 ALL METAL PREVAILING TORQUE NUTS		
 ALL METAL PREVAILING TORQUE FLANGE NUTS		 HM210068

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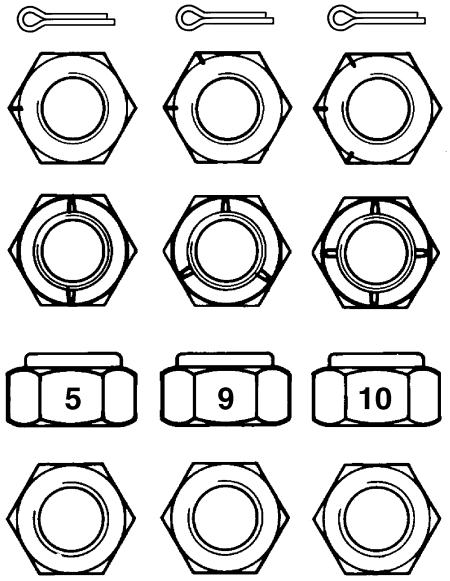


HM210064

FASTENER TORQUE TABLES

*Table 5. Torque Values for Metric Fasteners**

Size and Pitch	Property Class 5.8[1]		Grade 8.8[2]		Grade 10.9[3]	
	N•m	lbf ft	N•m	lbf ft	N•m	lbf ft
M3 × 0.5 M3.5 × 0.6 M4 × 0.7 M5 × 0.8 M6 × 1	0.62 0.97 1.44 2.91 4.94	0.5 0.7 1.1 2.1 3.6	0.99 1.55 2.30 4.65 7.90	0.7 1.1 2.1 3.6 6	1.34 2.11 3.13 6.33 10.8	1.0 1.6 2.3 4.7 8
M8 × 1.25 M8 × 1 M10 × 1.5 M10 × 1.25	12.0 12.8 23.8 25.1	9 9 18 19	19.2 20.5 38.0 40.1	14 15 28 30	26.1 27.9 52 55	19 21 38 41
M12 × 1.75 M12 × 1.25 M14 × 2 M14 × 1.5	41.4 45.3 66 72	31 33 49 53	66 72 105 115	49 53 77 85	90 98 145 155	66 72 105 115
M16 × 2 M16 × 1.5 M20 × 2.5 M20 × 1.5	105 110 200 225	77 81 150 165	165 175 320 355	122 130 235 260	225 240 435 485	165 175 320 360
M24 × 3 M24 × 2 M27 × 3 M27 × 2	345 375 505 550	255 275 370 405	555 605 810 875	410 445 600 645	755 820 1,100 1,190	560 605 810 880
M30 × 3.5 M30 × 3 M30 × 2 M33 × 3.5 M33 × 2	690 715 765 940 1,030	510 530 565 695 760	1,100 1,140 1,220 1,500 1,640	810 840 900 1,100 1,210	1,500 1,550 1,660 2,040 2,240	1,100 1,140 1,230 1,510 1,660
M36 × 4 M36 × 3 M39 × 4 M39 × 3	1,200 1,280 1,560 1,640	885 945 1,150 1,210	1,930 2,040 2,490 2,630	1,430 1,510 1,840 1,940	2,620 2,780 3,390 3,570	1,940 2,050 2,500 2,640
M42 × 4.5 M42 × 3 M45 × 4.5 M45 × 3 M48 × 5 M48 × 3	1,930 2,070 2,410 2,580 2,900 3,160	1,430 1,530 1,780 1,910 2,140 2,330	3,080 3,320 3,850 4,120 4,630 5,040	2,280 2,450 2,840 3,040 3,420 3,720	4,200 4,510 5,240 5,610 6,300 6,860	3,100 3,330 3,870 4,140 4,650 5,060

* Unless otherwise specified [1] Approximately equal to Grade 2 [2] Approximately equal to Grade 5 [3] Approximately equal to Grade 8

TABLE OF CONTENTS

This section is for the following models:

Table 3. Error Code Descriptions (Continued)

Warning Lights		Fault Code Readout	
Diagnostic Warning Light	Engine Stop Warning Light	Engine Fault Code	Description
ON		E0366	Fuel pump control module, supply voltage circuit - data incorrect.
ON		E0367	Fuel pump control module, increment angle time sensor error.
ON		E0368	Fuel pump control module, timing error.
ON		E0369	Fuel pump control module, engine synchronization error.
ON		E0372	Fuel pump control module, idle validation error.
	ON	E0373	Fuel pump control module, fuel shutoff error.
ON		E0374	Fuel pump control module, self-test error.
ON		E0375	Fuel pump control module, electronic calibration code error.
ON		E0376	Fuel pump control module, fueling or engine speed mismatch.
ON		E0377	Fuel pump control module, stuck relay error.
ON		E0381	Intake air heater #1 (relay enable) circuit - data incorrect.
ON		E0382	Intake air heater #2 (relay enable) circuit - data incorrect.
ON		E0385	OEM sensor supply voltage circuit, shorted high.
ON		E0386	Sensor Supply 1 Circuit - Voltage Above Normal or Shorted to High Source
ON		E0387	Accelerator pedal position sensor supply voltage circuit, shorted high.
ON		E0389	Fan clutch circuit error.
ON		E0391	Fuel shutoff valve supply voltage error.
		E0412	SAE J1587/J1708 data link circuit communication error.
ON	ON	E0415	Engine Oil Rifle Pressure - Data Valid But Below Normal Operating Range - Most Severe Level
ON		E0418	Water in Fuel Indicator - Data Valid But Above Normal Operating Range - Least Severe Level
ON		E0421	Engine oil temperature high, over temperature warning.
ON		E0422	Engine coolant level sensor circuit - Data Erratic, Intermittent, or Incorrect
ON		E0425	Engine Oil Temperature - Data erratic, intermittent, or incorrect.
		E0426	SAE J1939 datalink, - Data erratic, intermittent or incorrect
ON		E0428	Water in Fuel Indicator Sensor Circuit - Voltage Above Normal or Shorted to High Source
ON		E0429	Water in Fuel Indicator Sensor Circuit - Voltage Below Normal or Shorted to Low Source
ON		E0431	Accelerator Pedal or Lever Idle Validation Switch - Data Erratic, Intermittent, or Incorrect
ON	ON	E0432	Accelerator Pedal or Lever Idle Validation Switch Circuit - Out of Calibration
ON		E0433	Intake Manifold Pressure Sensor Circuit - Data erratic, intermittent, or incorrect.
ON		E0434	Power Lost without Ignition Off - Data erratic, intermittent, or incorrect.
ON		E0435	Engine Oil Rifle Pressure - Data Erratic, Intermittent, or Incorrect

Table 3. Error Code Descriptions (Continued)

Warning Lights		Fault Code Readout	
Diagnostic Warning Light	Engine Stop Warning Light	Engine Fault Code	Description
ON		E2963	Engine Coolant Temperature High - Data valid but above normal operational range - Least severe level.
ON		E2571	Engine Charge Air Cooler Outlet Temperature - Voltage Above Normal or Shorted to High Source
ON		E2572	Engine Charge Air Cooler Outlet Temperature - Voltage Below Normal or Shorted to Low Source
ON	ON	E2634	VGT Actuator Controller - Bad Intelligent Device or Component
ON	ON	E2635	VGT Actuator Driver Circuit - Condition Exists
ON	ON	E2636	VGT Actuator Driver Circuit - Abnormal Update Rate
ON		E2637	Aftertreatment 1 Diesel Oxidation Catalyst Face Plugged - Root Cause Not Known
ON		E2638	Aftertreatment Diesel Oxidation Catalyst System - Data Valid But Below Normal Operating Range - Least Severe Level
ON		E2639	Aftertreatment Particulate Filter Differential Pressure - Data Valid But Above Normal Operating Range - Least Severe Level
ON		E2646	Engine Coolant Temperature - Condition Exists
ON		E2659	Engine Coolant Temperature - Condition Exists
ON		E2699	Crankcase Depression Valve - Mechanical System Not Responding or Out of Adjustment
ON		E2728	Aftertreatment Fuel Injector 1 - Data Valid But Above Normal Operating Range - Moderately Severe Level
ON		E2742	Aftertreatment Exhaust Gas Temperature 2 - Data Valid But Below Normal Operating Range - Least Severe Level
ON		E2743	Aftertreatment Exhaust Gas Temperature 2 - Data Valid But Below Normal Operating Range - Moderately Severe Level
ON		E2754	Engine Diesel Particulate Filter Intake Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
ON		E2764	Exhaust Gas Pressure - Data Valid But Above Normal Operating Range - Moderately Severe Level
ON		E2765	Engine Injector Bank 1 Barcodes - Out of Calibration
ON		E2771	Aftertreatment 1 Outlet NOX Sensor - Abnormal Update Rate
ON		E2774	Engine Exhaust Gas Recirculation (EGR) System - Condition Exists
ON		E2777	Particulate Trap Active Regeneration Inhibited Due to Inhibit Switch - Condition Exists
ON		E2778	Aftertreatment Fuel Rate - Data Valid But Above Normal Operating Range - Moderately Severe Level
ON		E2789	Engine Coolant Temperature - Data Valid But Below Normal Operating Range - Moderately Severe Level
ON		E2961	Exhaust Gas Recirculation Temperature - Data Valid But Above Normal Operating Range - Least Severe Level

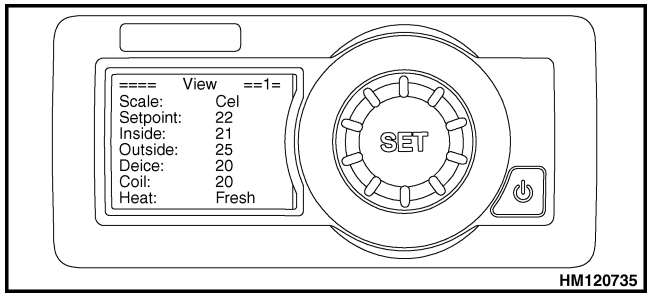
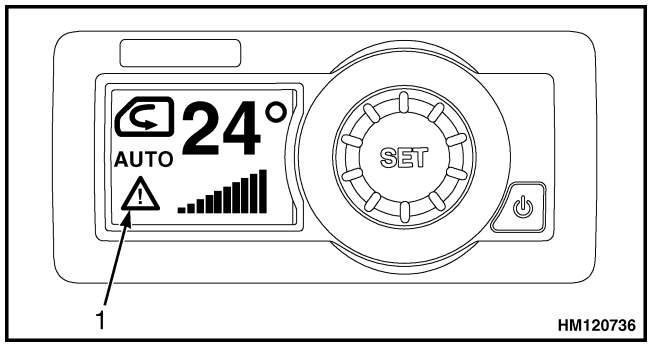


Figure 6. Climate Control View Display

Error List

The Main Display shows a warning sign in the left hand bottom corner of the Main Display if a fault occurs. See Figure 7.



1. WARNING SIGN

Figure 7. Climate Control Warning

The Error List page shows for each of the temperature sensors and for the water valve the number of occurrences that the connection was shortened or open since the last reset date. For the Water Valve there is an additional indication for the number of times that the Water Valve was stuck. See Figure 8.

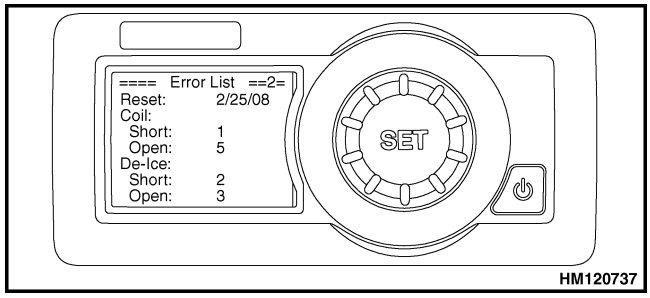


Figure 8. Climate Control Error Display

To further establish the cause of failure, see Temperature Sensors or Water Valve.

To reset the number of occurrences and the reset date, turn the Set Button one click in a counter clockwise direction and push the Set Button for a dialog box. When the dialog box is shown, press the Set Button once to reset all values.

Statistics

The Statistics page shows operating hours and cycle times since the last reset date. To reset the Statistics Page, go to the Error Page, turn the Set Button one click counter clockwise. A dialog box will appear. When the dialog box is shown, press the Set Button once to reset all values. See Figure 9.

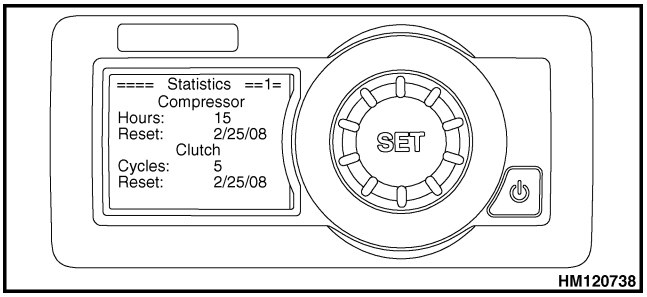


Figure 9. Climate Control Statistics Display

Exit

To leave the Service menu scroll to Exit and push the Set Button.

Temperature Sensors

In addition to the normally present de-ice temperature sensor in the evaporator, there are three further temperature sensors that influence the reaction of the controller:

- Outside Temperature Sensor, which is located outside the cab under the condenser.
- Coil sensor, which is located behind the evaporator and heater coil, in the suctioned air flow of the blower fan.
- Inside Sensor, which is located in the side console, measures the cab interior temperature. Interior air flow past the sensor is through a tube that connects between suction side of the blower fan and inside sensor.

Troubleshooting

Disconnect the sensor for which an error has been indicated. Use an Ohm meter to measure its resistance. See Table 1 that provides an overview of the resistance value for different temperatures. The

15. Install the nut to retain the rotary control assembly to the instrument panel top console. See Figure 12.

16. Install the heat control knob at the instrument panel top console. See Figure Switch Locations.

17. Position the fuse panel cover to the right side of the instrument panel and install the four retaining screws. See Figure Fuse Panel and Cover Location.

Heater/Air Conditioner Assembly

Remove

WARNING

Before removing the heater hoses, make sure the heater hoses are cool. Hot coolant may cause severe burns.

1. Turn the key switch to the **ON** position.

2. Place the recirculation knob on the instrument panel in position 1 or position 2.

3. Turn the key switch to the **OFF** position.

4. Remove the four screws that retain the fuse panel cover to the right side of the instrument panel and remove the cover to gain access to the underside of the instrument panel. See Figure Fuse Panel and Cover Location.

5. Disconnect the wire harness for the fan speed knob, heater knob, and recirculation knob from the connectors at the underside of the instrument panel top console.

6. Tag and disconnect the electrical wires for the air conditioner switch at the underside of the instrument panel top console.

WARNING

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

7. Remove the pressure cap to release the pressure and place it back on the radiator expansion tank.

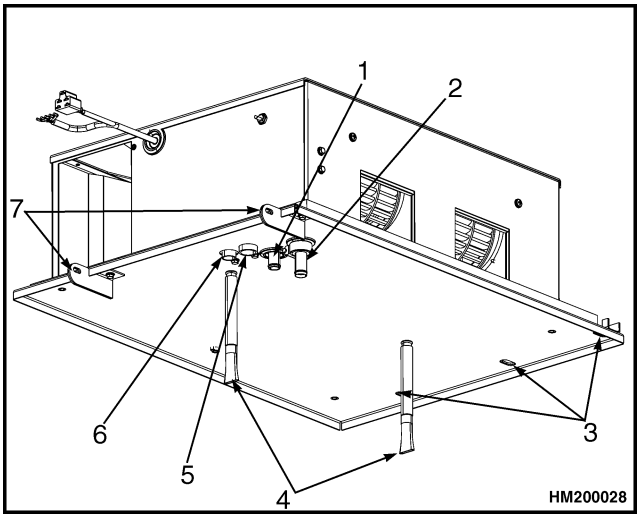
8. Tilt/raise the cab to the fully open position. Refer to the section Figure Fuse Panel and Cover Location.

9. Tag and disconnect the two heater hoses from the heater inlet and outlet ports and plug the heater hoses and ports. See Figure 19.

CAUTION

Repairs to the air conditioning system that require discharging and/or refilling of the refrigeration fluid must be performed only by a certified air conditioning specialist.

10. Contact a certified air conditioning specialist to have the refrigerant extracted from the air conditioning system.



1. HEATER INLET
2. HEATER OUTLET
3. HEATER ASSEMBLY CAPSCREW LOCATION
4. CONDENSATION DRAINS
5. AIR CONDITIONING OUTLET
6. AIR CONDITIONING INLET
7. HEATER HINGE BRACKET

Figure 19. Heater/Air Conditioner Assembly

11. Disconnect and plug the hose fittings leading to the evaporator.

NOTE: The heater assembly fits tightly underneath the cab and will require a limited amount of force to swing the heater assembly down and away from the cab.

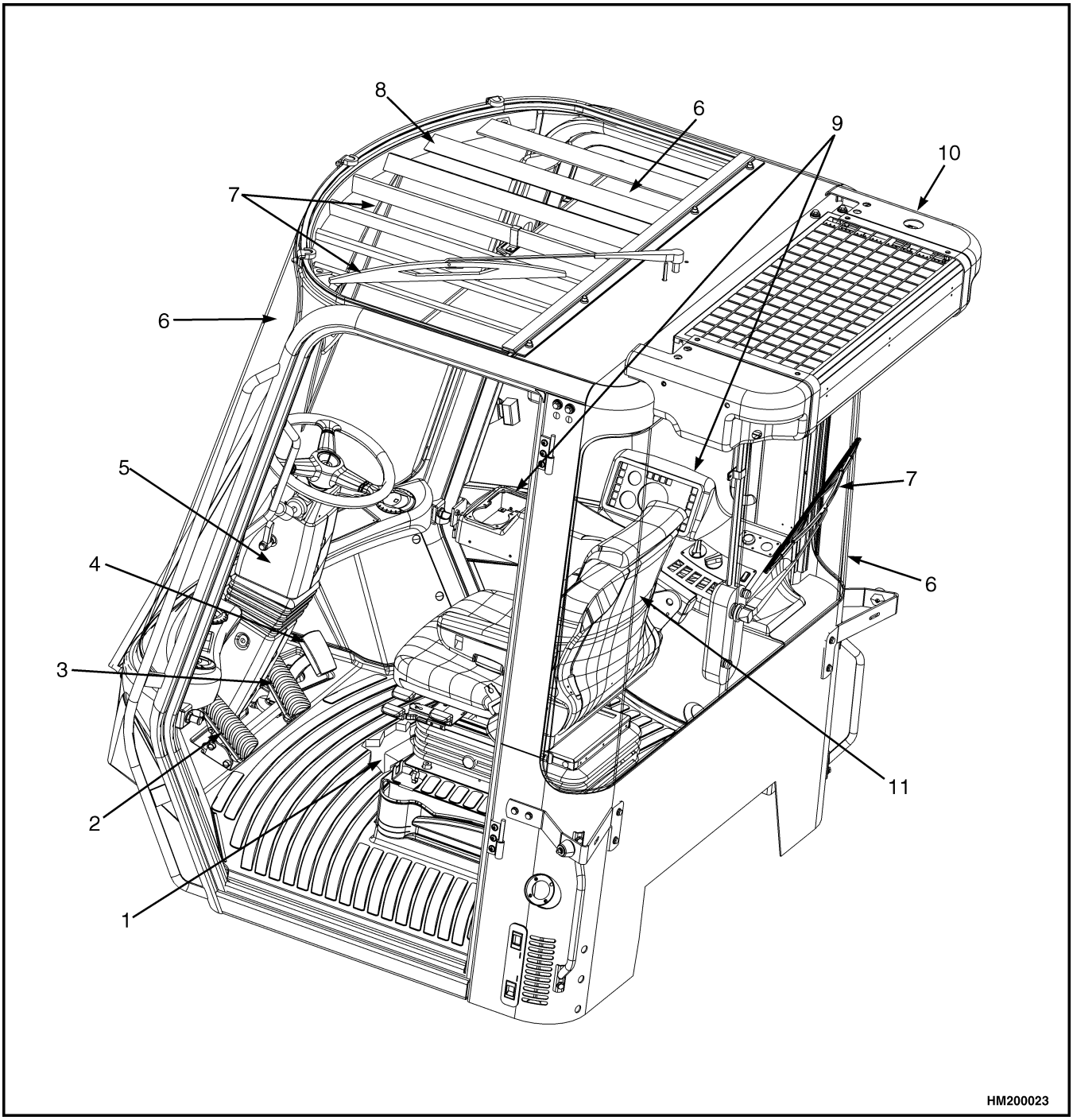
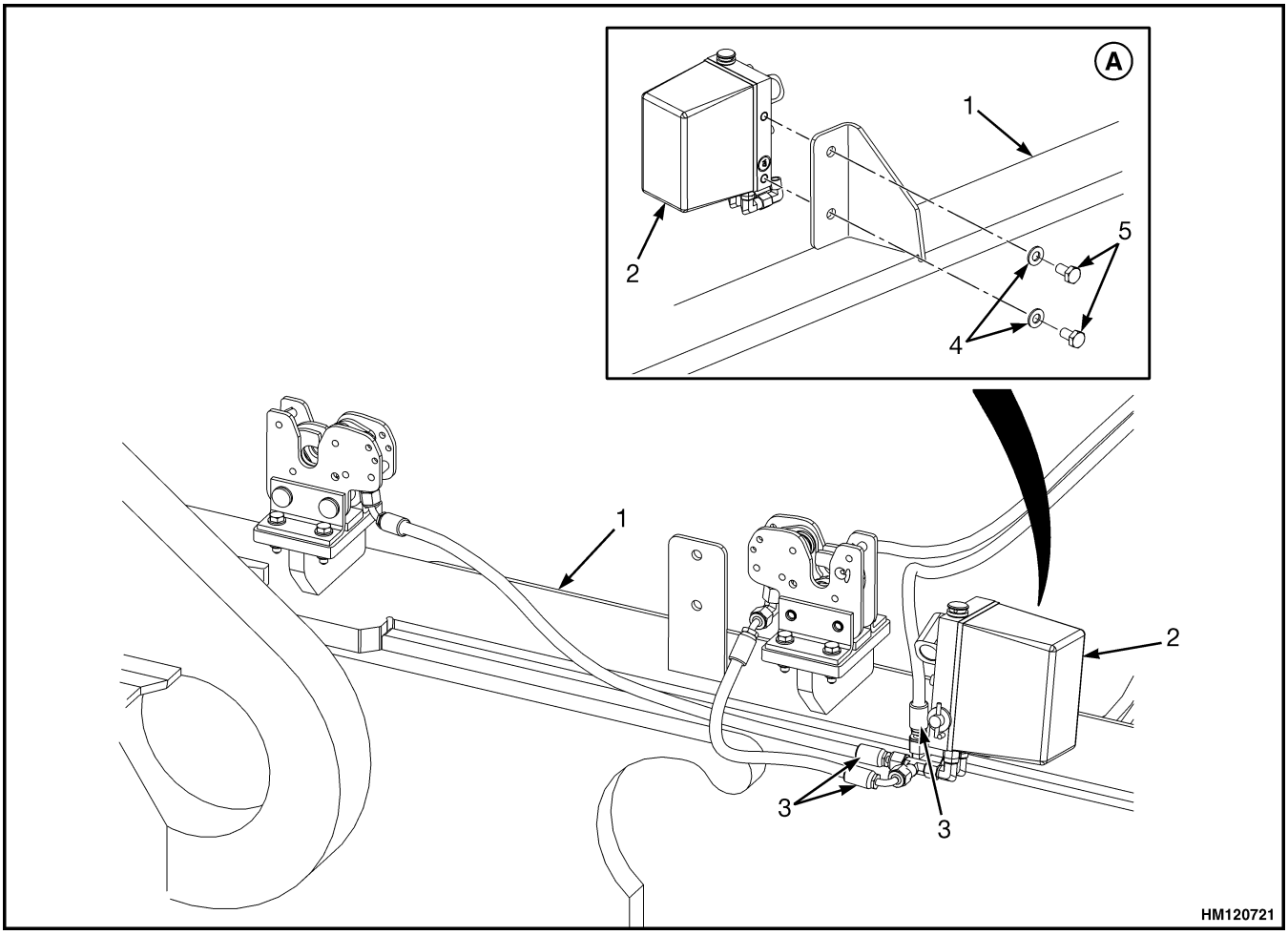


Figure 1. Operator's Cab



A. 180 DEGREES TURNED

1. FRAME
2. HAND PUMP
3. HYDRAULIC HOSE
4. WASHER
5. CAPSCREW

Figure 15. Hand Pump

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

5. Tag and disconnect the three hydraulic hoses and place plugs on the three hose ends. See Figure 15.

Install

1. Remove the plugs from the three hose ends and connect the three hydraulic hoses to the hand pump. See Figure 15.

2. Position the hand pump on the frame and install the two capscrews and washers that retain the hand pump to the frame. See Figure 15.

3. Position the left-hand panel to the frame and install the two capscrews and washers to retain the left-hand panel to the frame.

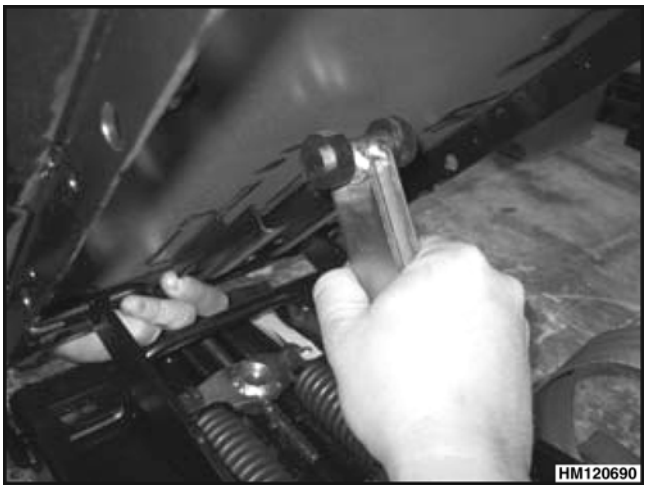
4. If equipped, connect the electrical connector to the cab tilt push-button. See Tilting the Cab and Figure 8.

5. Lower the cab to the fully lowered and latched position. Refer to the section Tilting the Cab.

STEP 7.
Remove the pivot shaft.

STEP 8.
For mechanical seats: Lift the lower housing and place the suspension scissor in the highest raised position.

STEP 9.
For mechanical seats: Lift the rear of the lower housing while sliding the lower housing forward to disengage the height adjustment rollers from the roller channels of the lower housing.



STEP 23.
Install the boot. Refer to the section Boot Replacement.

STEP 24.
Install the seat suspension in the cab. Refer to Seat Suspension Replacement.

STEP 25.
Install the seat. Refer to the section Seat.

Compressor

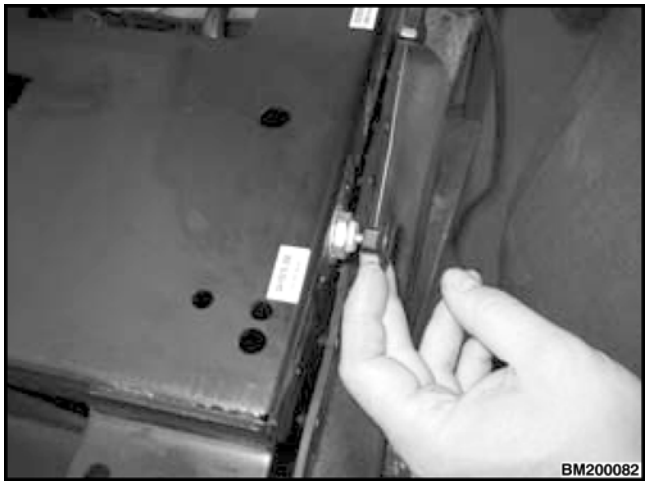
Remove

STEP 1.
Remove the seat from the suspension. Refer to Seat.

STEP 2.
Remove the seat suspension from the cab. Refer to the section Seat Suspension Replacement.

STEP 3.
Remove the boot. Refer to Boot Replacement.

STEP 4.
Using a 1/16" Allen wrench, remove the air control knob.



POWER ASSIST ARMREST

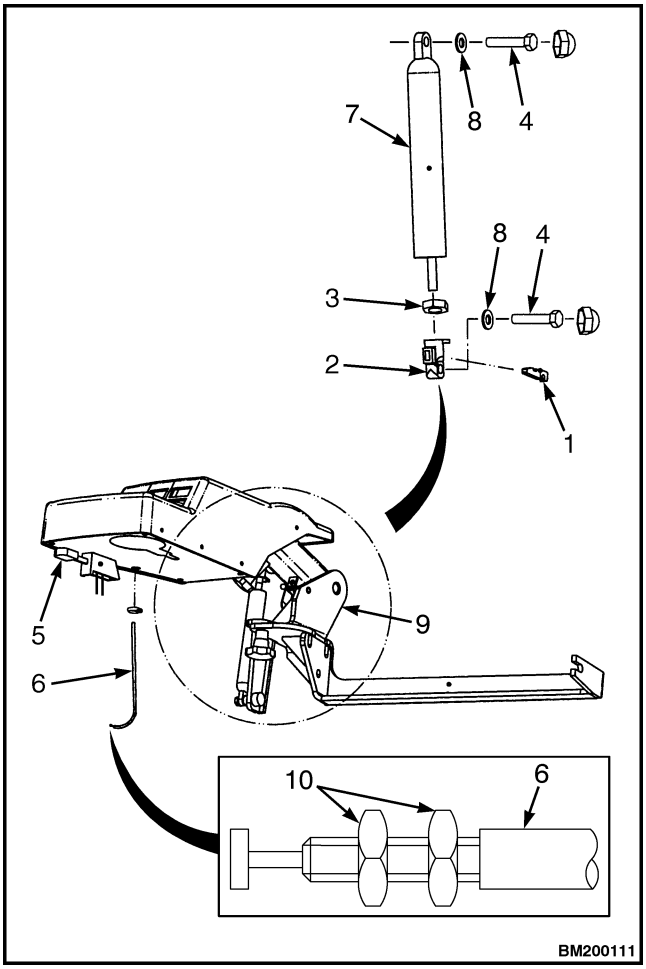
Release Cable

Remove

1. Raise the power assist armrest.
2. Loosen the two adjustment nuts that retain the cable to the armrest. See Figure 22.
3. Disconnect the cable from the armrest and slide the cable out of the slot in the armrest. See Figure 22.
4. Disconnect the cable at the rod end of the gas spring and slide the cable out of the slot.
5. Remove the cable from the power assist armrest through the front side of the power assist armrest.

Install

1. Install the cable through the power assist armrest from the front side of the power assist armrest.
2. Connect the cable at the rod end of the gas spring.
3. Connect the cable to the armrest. See Figure 22.
4. Adjust the cable length with the two nuts to obtain a free lever movement of 1.5 to 2.0 mm before the gas spring will unlock.
5. Tighten the two nuts that retain the cable to the armrest. See Figure 22.
6. Lower the power assist armrest.



1. LEVER
2. ROD END
3. LOCK NUT
4. MOUNTING CAPSCREW
5. ARMREST
6. CABLE
7. GAS SPRING
8. WASHER
9. ARMREST FRAME
10. NUT

Figure 22. Power Assist Armrest

Gas Spring

Remove

1. Raise the power assist armrest, and make sure the gas spring has reached its maximum extended length.
2. Disconnect the cable from the rod end of the gas spring.

3. Tighten the capscrew and spring that retain the adjustment handle to the adjustment mechanism.

Main Warning Lights

Remove

NOTE: The main warning lights are part of the top steering column cover. When the main warning lights must be replaced, the complete top steering column cover must be replaced.

1. Remove the steering wheel. Refer to the section Steering Wheel and Horn.
2. Remove the six screws and washers that retain the top steering column cover to the upper left-hand and right-hand steering column covers. See Figure 28.
3. Tag and disconnect the two wires from the main warning lights inside the top steering column cover by loosening the two screws.
4. Remove the top steering column cover from the steering column.

Install

1. Position the top steering column cover on the steering column.
2. Connect the two wires to the main warning lights inside the top steering column cover and tighten the two screws.
3. Position the top steering column cover to the upper left-hand and right-hand steering column covers and install the six retaining screws and washers.
4. Install the steering wheel. Refer to the section Steering Wheel and Horn.

Shift Lever

Remove

1. Remove the steering wheel. Refer to the section Steering Wheel and Horn.
2. Remove the six screws and washers that retain the top steering column cover to the upper left-hand and right-hand steering column covers. See Figure 28.
3. Remove the upper steering column cover from the steering column.
4. Remove the two screws that retain the shift lever to the steering column and remove the shift lever.
5. Disconnect the electrical connector from the shift lever.

Install

1. Connect the electrical connector to the shift lever.
2. Position the shift lever to the steering column and install the two retaining screws.
3. Install the six screws and washers that retain the top steering column cover to the upper left-hand and right-hand steering column covers.
4. Install the steering wheel. Refer to the section Steering Wheel and Horn.
5. Make sure the shift lever functions correctly.

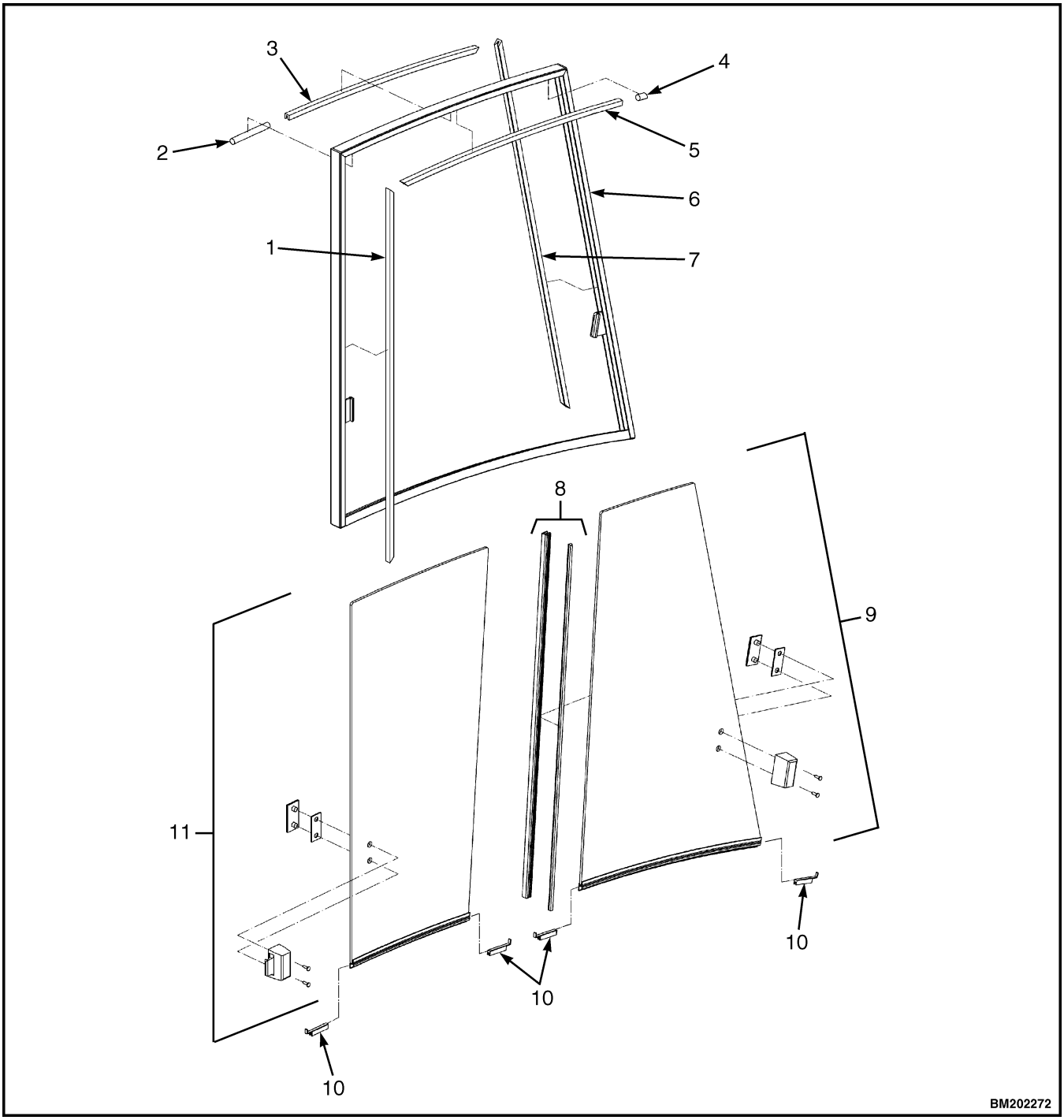
Turn Signal Lever

Remove

1. Remove the steering wheel. Refer to the section Steering Wheel and Horn.
2. Remove the top steering column cover from the steering column. Refer to the section Steering Column Assembly.
3. Remove the two screws and wire that retain the turn signal lever to the steering column.
4. Remove the turn signal lever.
5. Tag and disconnect the three wires connected to the turn signal lever by loosening the three screws.

Install

1. Connect the three wires to the turn signal lever and tighten the three screws.
2. Position the turn signal lever to the steering column.
3. Install the two screws and wire that retain the turn signal lever to the steering column.



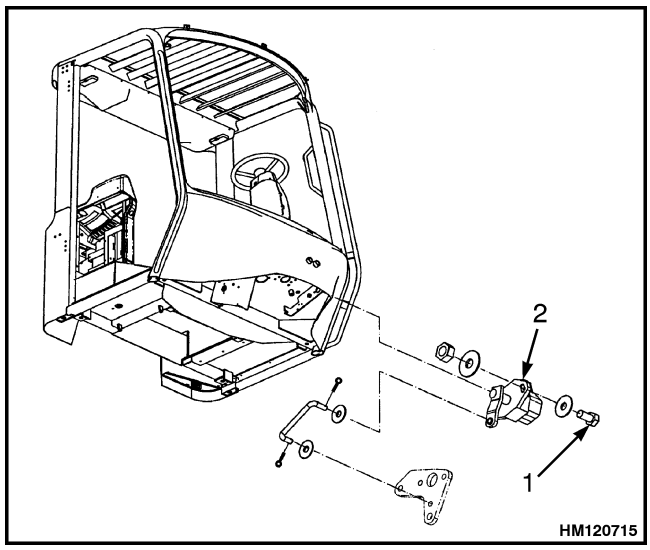
1. WINDOW SEAL
2. WINDOW STOPPER
3. WINDOW SEAL
4. WINDOW STOPPER
5. WINDOW SEAL
6. SLIDING WINDOW FRAME
7. WINDOW SEAL
8. WEATHER STRIP (PRE-ASSEMBLED)
9. FRONT SLIDING WINDOW (PRE-ASSEMBLED)
10. SLIDING TRACKS
11. REAR SLIDING WINDOW (PRE-ASSEMBLED)

Figure 39. Sliding Window Assembly

NOTE: When the inching pedal is fully depressed, the analog output should be about 3.70 Volt.

NOTE: A slight preload of the potentiometer arm is required to achieve the output voltage for the inching pedal up position. Use the Dana Dashboard software to check the output voltage.

1. Connect a laptop computer to the diagnostic plug in the side console.
2. Turn the key switch to the **ON** position.
3. Select "Inching Pedal Calibration Mode".
4. Make sure the analog input of the inching pedal sensor is between 800 and 900 mV.
5. If the analog input is not within specifications, proceed as follows:
   a. Tilt/raise the cab until the latch locks in the partial open position. Refer to the section Tilting the Cab.
   b. Loosen the two inching pedal sensor mounting capscrews. See Figure 49.



1. SENSOR MOUNTING CAPSCREW
2. INCHING PEDAL SENSOR

Figure 49. Sensor Adjustment

   c. Rotate the inching pedal sensor in the slotted holes underneath the inching pedal until the output voltage of the released (up position) inching pedal is between 800 and 900 mV.
   d. Tighten the two sensor-mounting capscrews and make sure the output voltage of the inching pedal sensor is still between 800 and 900 mV, with the inching pedal in the up position.
   e. Check output voltage of the sensor with the pedal fully depressed. Theoretically the output voltage can be between 2.50 V and 4.00 V. A practical output value is 3.70 V.
   f. Perform inching pedal calibration after the sensor has been adjusted.
   g. Lower the cab to the fully lowered and latched position. Refer to the section Tilting the Cab.
6. Turn the key switch to the **OFF** position.
7. Disconnect the laptop computer from the diagnostic plug.

Sensor Adjustment using the APC200 Display

NOTE: This procedure does not require a laptop.

NOTE: Before calibrating the inching pedal sensor, the inching pedal must be adjusted correctly. See the section Brake Pedal Adjustment.

1. Press and hold the "S" button, and turn the key switch to the **ON** position. During the first 15 seconds, the display will show:

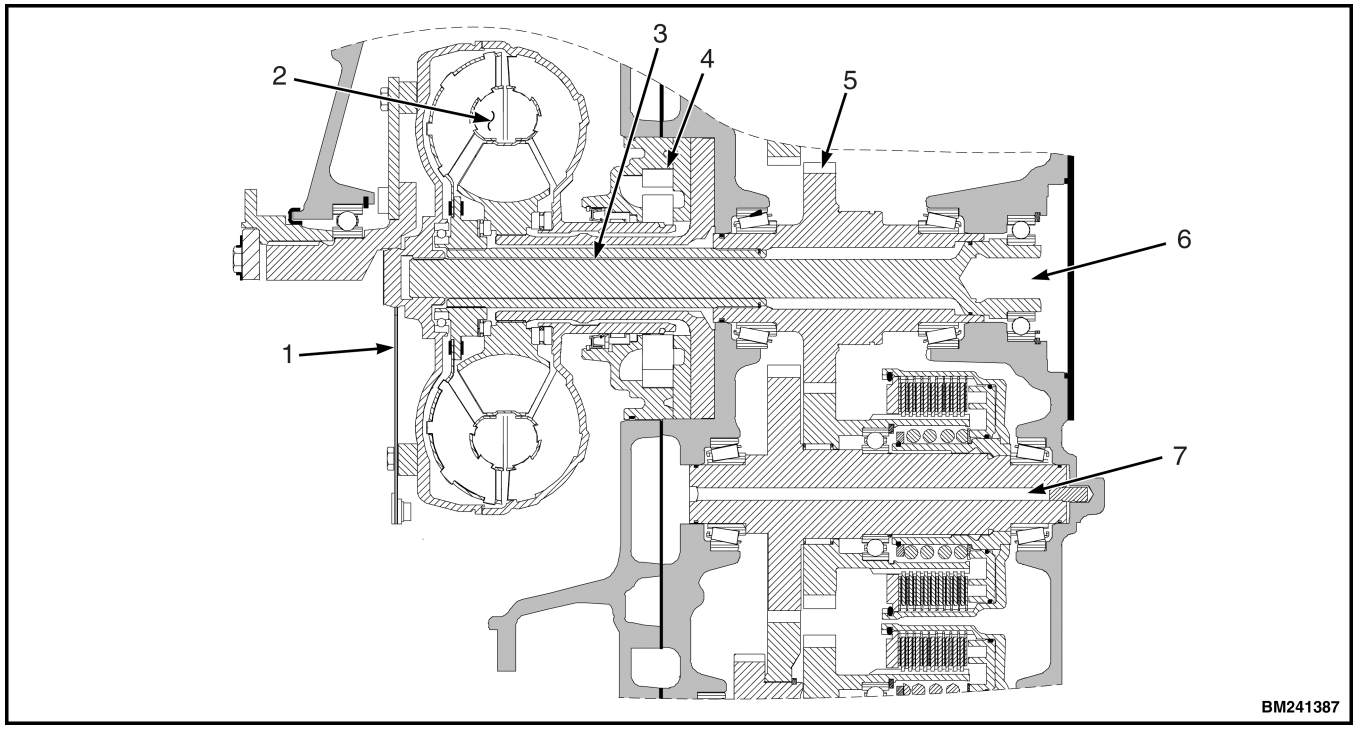
HM241971

2. Release the "S" button after 15 seconds when the display shows:

HM241637

3. Push the "M" button until the APC200 display shows the analog input:

HM241972



1. DRIVE PLATE
2. TORQUE CONVERTER
3. INPUT SHAFT
4. TRANSMISSION PUMP
5. INPUT GEAR
6. HYDRAULIC PUMP DRIVE
7. CLUTCH

Figure 1. Torque Converter

The flexing properties of the drive plate reduce transfer of axial forces between engine crankshaft and torque converter. The torque converter drives the transmission pump and the PTO drives the attached pump(s) for the hydraulic system of the truck. The torque converter, transmission pump and hydraulic pump(s) turn at proportional engine speed.

The oil pressure generated by the transmission pump is used for lubrication, internal cooling, and hydraulic control of the transmission. Without oil pressure the transmission cannot function.

The torque converter hydraulically connects the engine flywheel with the transmission input shaft. It functions as a fluid clutch to smoothly transfer power from the engine to the transmission, and as a torque multiplier when speed difference between engine and transmission input shaft increases. The torque converter has a specific torque multiplication factor that matches the engine power characteristics. Speed difference between engine and transmission input shaft is a measure of engine power being transferred. With increasing speed difference, there is also an increased amount of heat generated in the converter. The heat generated is removed by the transmission oil which flows through the torque converter.

The different speed ratios between input shaft and drive shaft are obtained by engaging and disengaging different clutches. See Figure 2. Three groups of gears are continuously engaged with each other: the input gears, the interconnecting gears, and the output gears. See Figure 3.

If clutches belonging to one group would be engaged simultaneously, the transmission would lock. The clutches Forward and Reverse should not be engaged at the same time. Also, the speed clutches for the 1st, 2nd, and 3rd speed should not be engaged at the same time. Erroneous clutch engagement is prevented by the transmission control system.

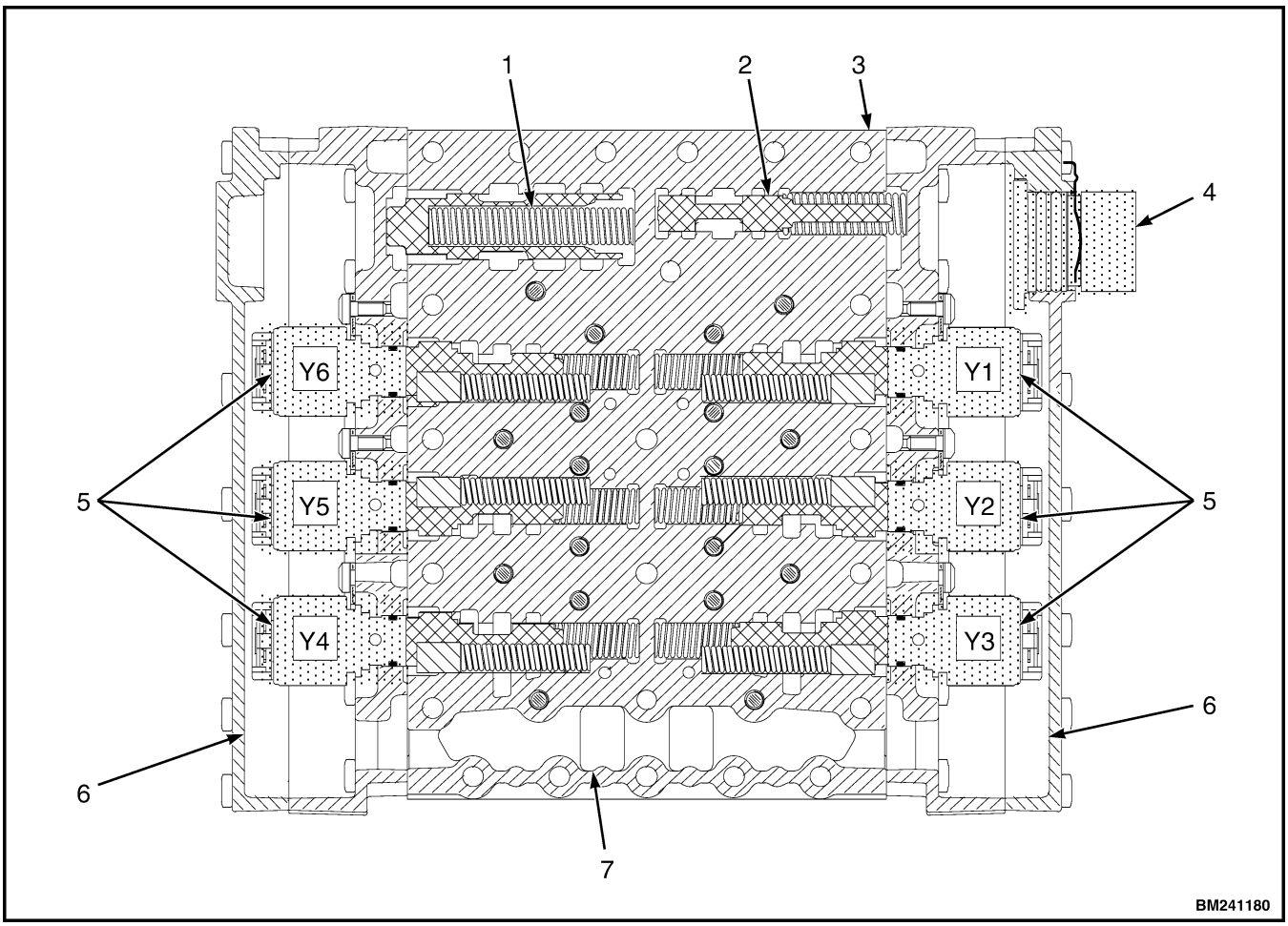
Diagrams YRM shows the wire harnesses that are relevant for the TCU wiring. Actual location of the connectors can be derived from their position on the harness and from their description. At the legend of the wire harness figures, pin location figures are shown for connectors interconnecting between harnesses.

To identify the harness problem, first determine connectivity between the TCU and the connector of the component that was indicated in the ZF Transmission Fault Codes. If an unsatisfactory result is returned, measure connectivity from harness to harness.

HYDRAULIC CONTROL VALVE

The hydraulic control valve is located at the left-hand side of the transmission and contains the pressure regulator valves and check ports. Function of the hydraulic control valve depends on available pump supply pressure and the activation of the pressure regulators. Activation of the pressure regulators is controlled by the TCU. Hydraulic function of the control valve is schematically shown in Figure 6.

The location of the different pressure regulators are shown in Figure 11.



1. MAIN PRESSURE VALVE
2. PRESSURE REDUCING VALVE
3. HOUSING
4. CABLE HARNESS CONNECTOR
5. PRESSURE REGULATOR
6. COVER
7. VALVE BLOCK

Figure 11. Solenoid Locations

The location of the main components of the control valve are shown in Figure 12.

transmission and then process any error messages found by following troubleshooting tips provided.

The Testman system consists of a laptop computer, diagnostic software, a USB (Universal Serial Bus) cable, Programming adapter, and an adapter cable.

Connection

Install the Testman software on a laptop per instructions delivered with the Testman software. The help text contains all information required to work with the diagnostic software and also provides the necessary guidance.

Connect the adapter cable to the truck. The truck diagnostic connector is located in the side console of the cab. See Figure 18. Start the Testman software and establish communication. Ensure the ignition key is turned to the **ON** position.

TRUCK CONFIGURATION

To activate the correct drive program in the TCU, the controller is configured at the end of the assembly line.

Truck configuration is only required if the TCU is replaced or reprogrammed. The TCU needs to be configured with Testman, using the truck configuration menu.

When the truck configuration data is not available from the TCU a Testman Warning Screen indicates the configuration is lost and truck configuration is required. See Figure 19.

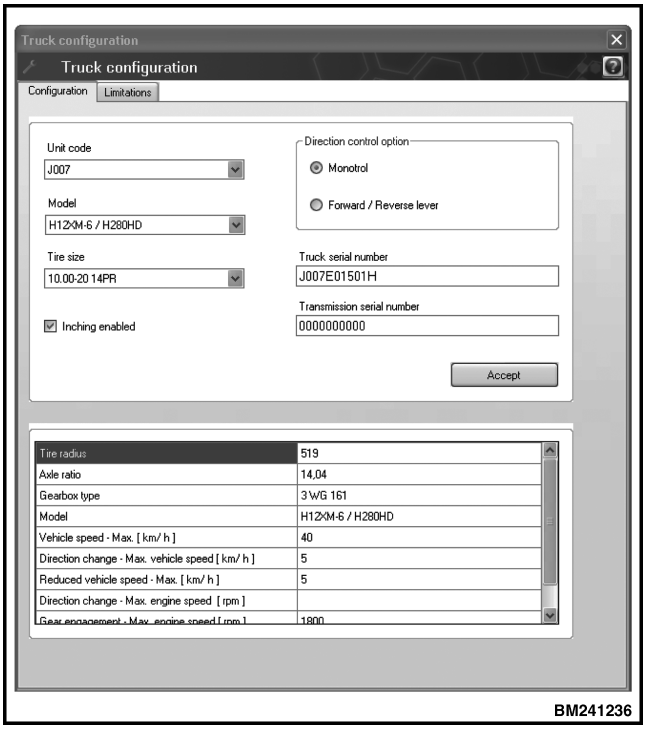


Figure 19. Testman Configuration Screen

NOTE: The truck configuration screen opens with default fields and does not retrieve information from the controller other than the truck serial number and Transmission serial number. Stored values can be found in the Truck Information menu. **Only hit "ACCEPT" in the configuration screen when a new controller is installed or the controller is reprogrammed**. Accepting incorrect Configuration leads to wrong drive program selection or loss of TCU configuration.

Configuration

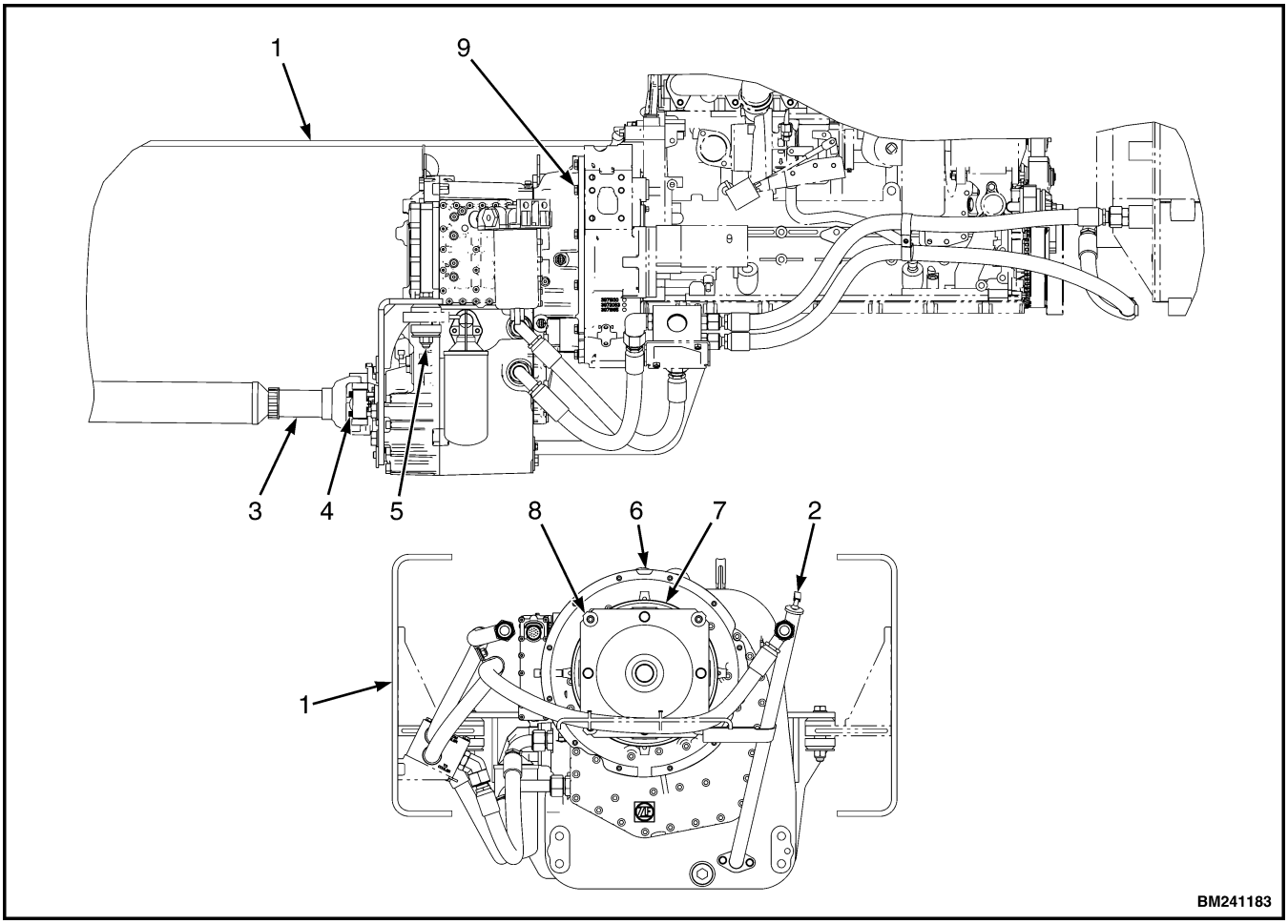
In the Truck configuration menu, Unit Code, Model, Tire Size, Direction Control Option, Truck Serial Number and Transmission Serial Number are mandatory fields. All fields have to be set during the configuration in order to activate the correct drive program for the truck.

Inching is default enabled but can be disabled at customer request. Disabling inching will activate declutch mode in the controller.

Limitations

Testman offers the ability to adjust certain default maximum values to meet customer specific

Fault Code Displayed	Description	Reaction From TCU
t1306	Error at valve power supply VPS2.	TCU shifts to **Neutral**.
t1307	S.C. to ground at DLM longitudinal output.	Output will be on until TCU power down, even if fault vanishes (loose connection).
t1308	S.C. to battery voltage at DLM longitudinal output.	No reaction.
t1309	O.C. at DLM Longitudinal output.	No reaction.
t1403	S.C. to battery voltage at display output.	No reaction.
t1404	S.C. to ground at display output.	No reaction.
t1405	**DISPID1** time out.	TCU select parameter set with ID0.
t1406	Illegal ID request via CAN.	Transmission to stay in **Neutral**.
t1501	General **EEPROM** fault.	No reaction.
t1502	Configuration lost.	Transmission to stay in **Neutral**.
t1502	FWD configuration lost.	Gear range set from 1st to 4th.
t1503	Application error.	Transmission to stay in **Neutral**.
t1504	Limp home request.	Shift into **Neutral**.
t1505	Clutch failure.	Transmission to stay in **Neutral**.
t1506	Clutch Adjustment Data lost or Inch Pedal Calibration Data lost.	Default values = 0 for AEB offsets used.
t1507	Substitute Clutch Control.	TCU changes to **Substitute Clutch Control** mode.

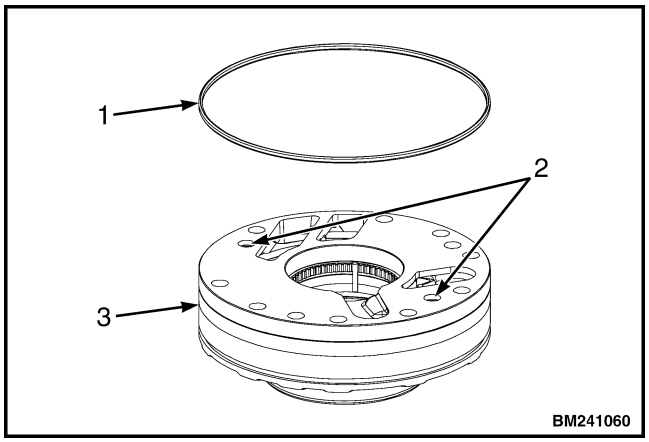


1. FRAME (REFERENCE)
2. DIPSTICK ASSEMBLY
3. DRIVE SHAFT
4. OUTPUT YOKE
5. TRANSMISSION MOUNT
6. TRANSMISSION
7. TORQUE CONVERTER
8. CAPSCREWS
9. CAPSCREWS

Figure 1. Transmission Arrangement

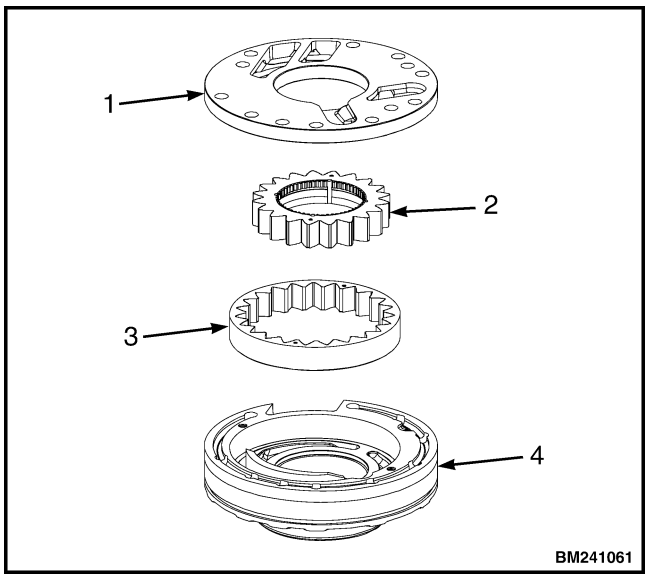
Oil Pump, Disassemble

STEP 1.
Remove the O-ring and capscrews from the oil pump. Discard the O-ring.



1. O-RING
2. CAPSCREWS
3. OIL PUMP

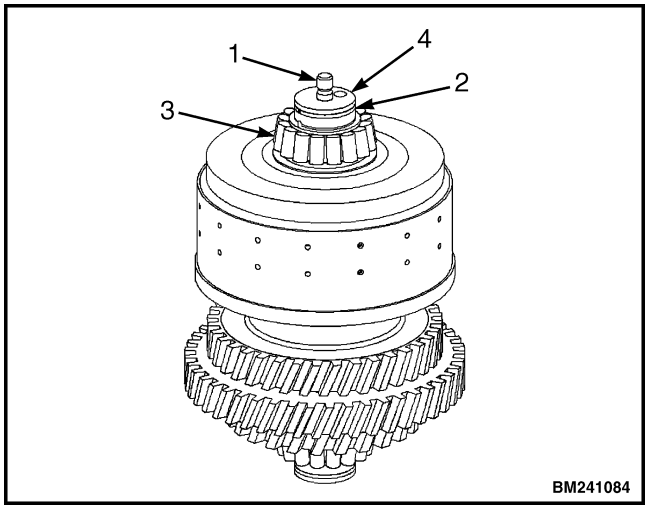
STEP 2.
Remove the cover, inner rotor, and outer rotor from the oil pump housing. Inspect the pump housing, inner rotor outer rotor, and cover for wear marks. If any wear is shown, replace the oil pump.



1. COVER
2. INNER ROTOR
3. OUTER ROTOR
4. OIL PUMP HOUSING

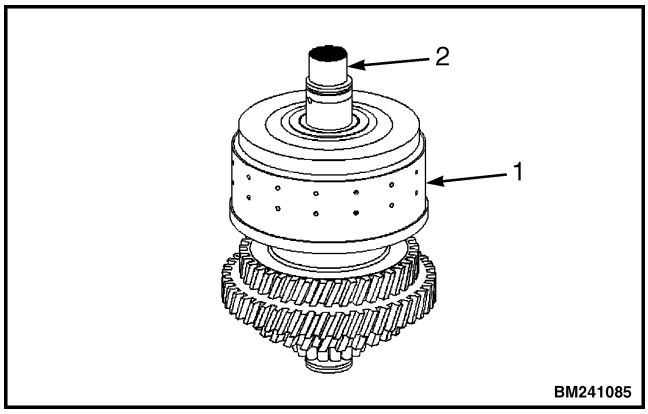
Reverse Clutch, Disassemble

STEP 1.
Remove the threaded stud and piston ring. Using a bearing puller, remove the tapered roller bearing from the clutch shaft.



1. THREADED STUD
2. PISTON RING
3. TAPERED ROLLER BEARING
4. CLUTCH SHAFT

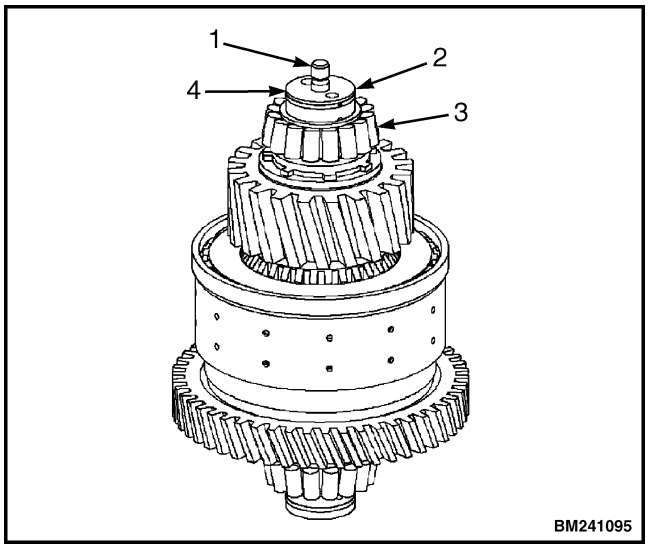
STEP 2.
Remove the clutch pack carrier from the clutch shaft.



1. CLUTCH PACK CARRIER
2. CLUTCH SHAFT

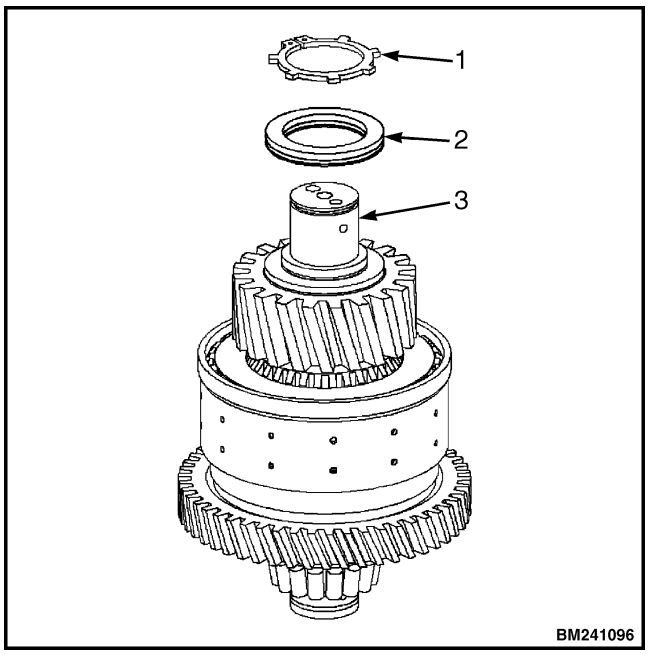
Second Speed Clutch, Disassemble

STEP 1.
Remove the threaded stud and piston ring. Using a bearing puller, remove the tapered roller bearing from the clutch shaft.



1. THREADED STUD
2. PISTON RING
3. TAPERED ROLLER BEARING
4. CLUTCH SHAFT

STEP 2.
Remove the retaining ring and axial bearing assembly from the clutch shaft.

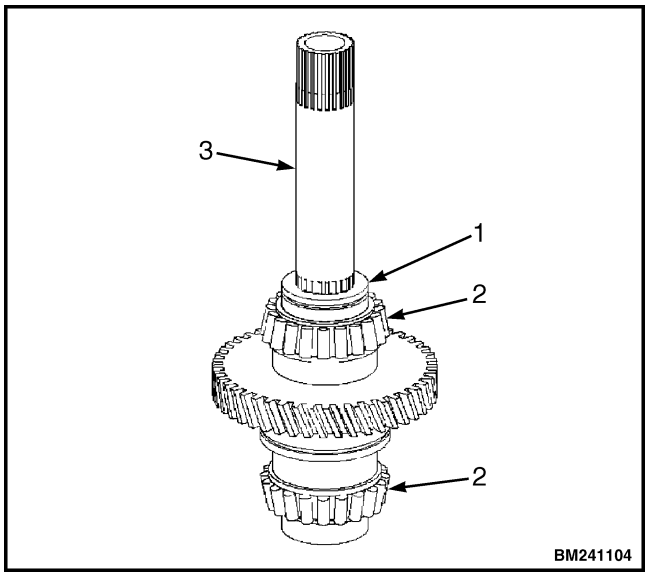


1. RETAINING RING
2. AXIAL BEARING ASSEMBLY (3 PIECES)
3. CLUTCH SHAFT

ASSEMBLE

Input Shaft, Assemble

STEP 1.
Using a press, install two tapered roller bearings on the input shaft until they bottom out, and install the piston ring on the input shaft.



1. PISTON RING
2. TAPERED ROLLER BEARING
3. INPUT SHAFT

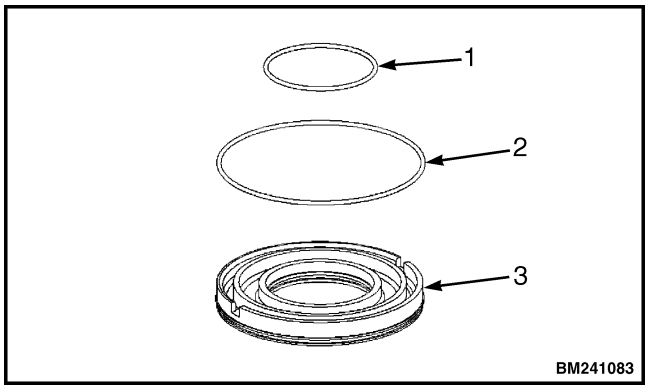
Third Speed Clutch, Assemble

CAUTION

Make sure that the O-rings are not deformed during installation, and DO NOT roll the O-rings onto the piston.

NOTE: Prior to installing O-rings, coat with transmission oil to make installation easier.

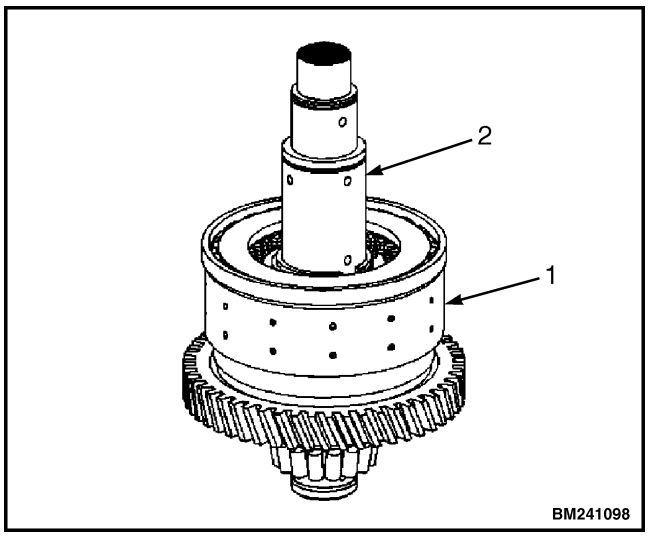
STEP 1.
Install new inner and outer O-rings on the piston.



1. INNER O-RING
2. OUTER O-RING
3. PISTON

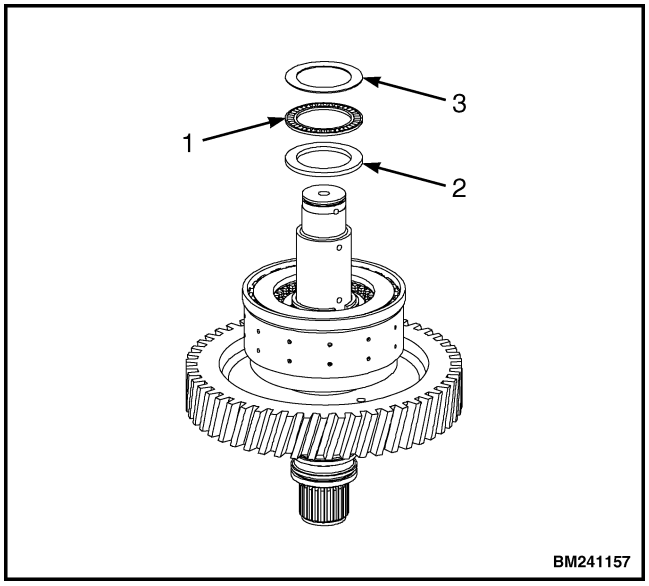
NOTE: Manually align the inner teeth of the disks prior to performing STEP 13.

STEP 13.
Install the clutch pack carrier until it bottoms out.



1. CLUTCH PACK CARRIER
2. CLUTCH SHAFT

STEP 14.
Install the running disk chamfer side up, axial bearing, and axial washer on the clutch shaft.



1. AXIAL BEARING
2. RUNNING DISK
3. AXIAL WASHER

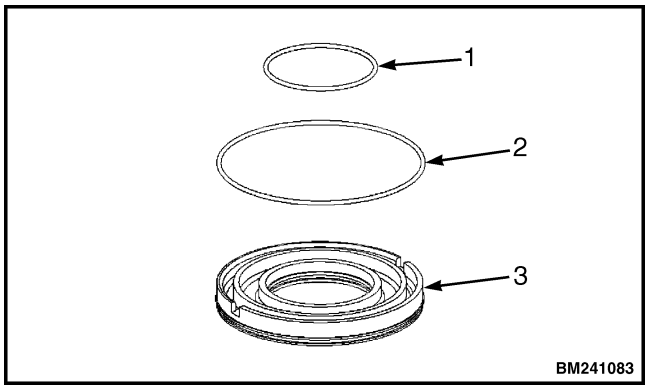
Reverse Clutch, Assemble

CAUTION

Make sure that the O-rings are not deformed during installation, and DO NOT roll the O-rings onto the piston.

NOTE: Prior to installing O-rings, coat with transmission oil to make installation easier.

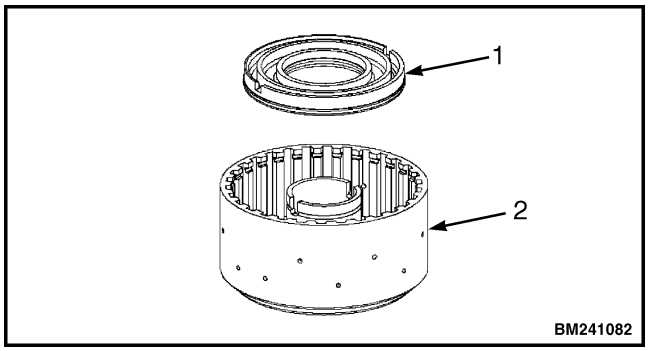
STEP 1.
Install new inner and outer O-rings on the piston.



1. INNER O-RING
2. OUTER O-RING
3. PISTON

NOTE: Check piston relief valve functionality prior to installation.

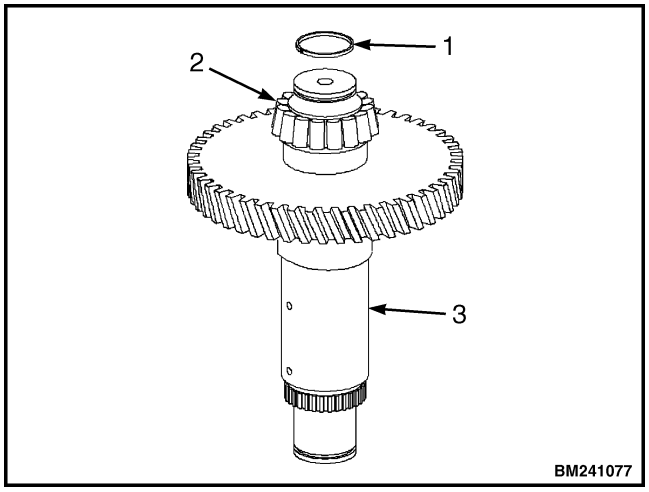
STEP 2.
Using the spring compression tool, Yale P/N 582013808, install the piston into the clutch pack carrier, as noted during disassembly, until it bottoms out.



1. PISTON
2. CLUTCH PACK CARRIER

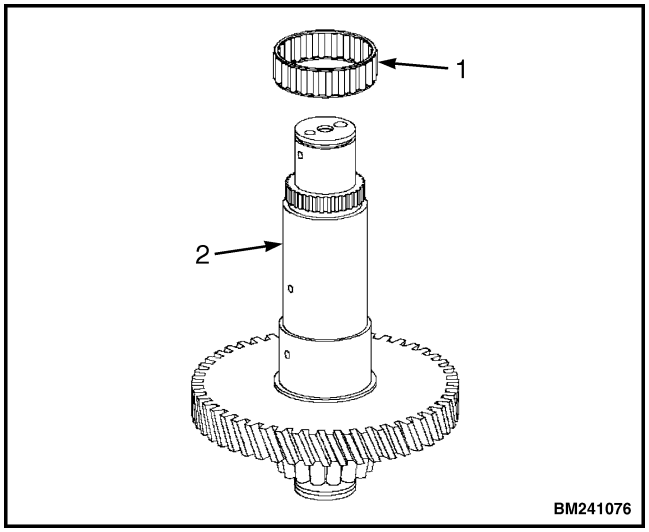
NOTE: Installation tool, Yale P/N 582013809, consists of two parts: an inner installer and pressure piece.

STEP 11.
Using a press, install the tapered roller bearing on the clutch shaft until it bottoms out, and install the piston ring.



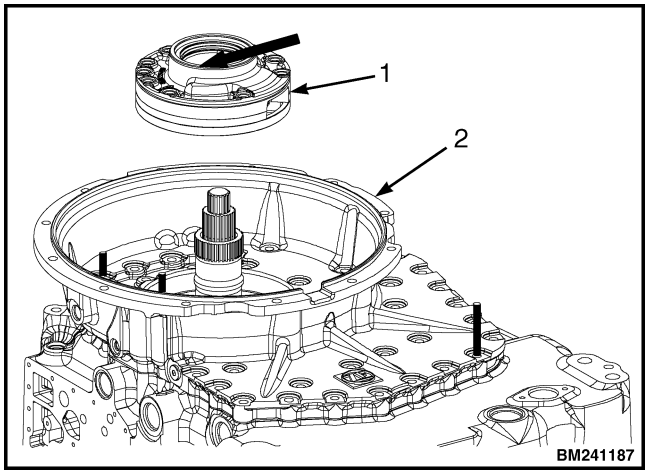
1. PISTON RING
2. TAPERED ROLLER BEARING
3. CLUTCH SHAFT

STEP 12.
Install the needle bearing on the clutch shaft.



1. NEEDLE BEARING
2. CLUTCH SHAFT

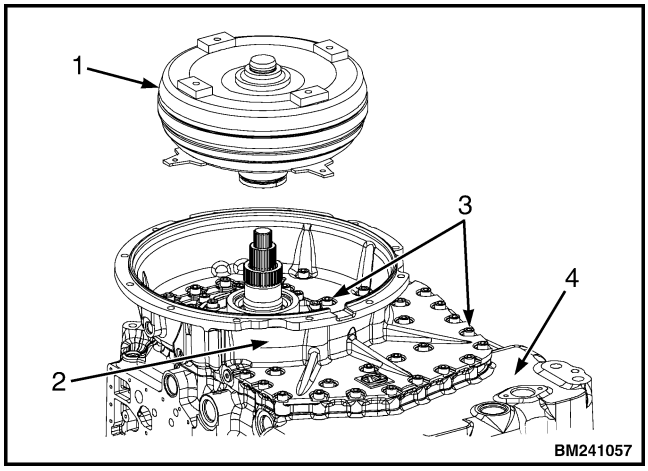
STEP 14.
Install the oil pump into the torque converter bell housing.



1. OIL PUMP
2. TORQUE CONVERTER BELL HOUSING

NOTE: Capscrews used for the oil pump have an O-ring instead of a washer and the O-ring must coated with clean transmission oil.

STEP 15.
Install capscrews on the torque converter bell housing and transmission housing. The bell housing will align the oil pump. Install the oil pump capscrews. Tighten all capscrews to 46 N•m (34 lbf ft). Install the torque converter into the torque converter bell housing.

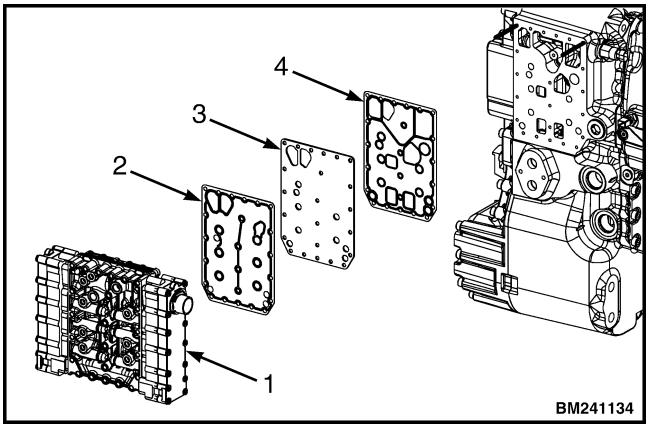


1. TORQUE CONVERTER
2. TORQUE CONVERTER BELL HOUSING
3. CAPSCREW
4. TRANSMISSION HOUSING

INSTALL

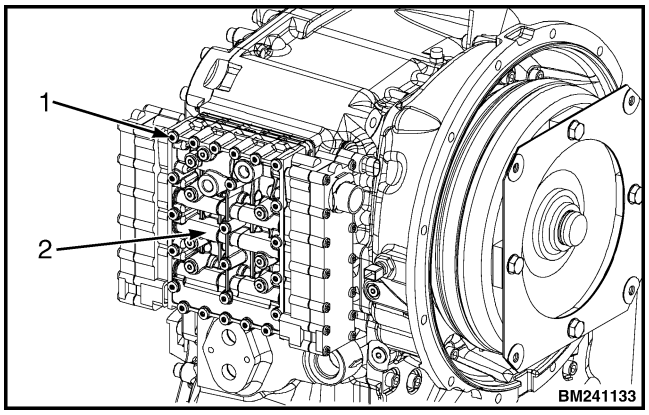
NOTE: The intermediate plate can be reused if it is not damaged.

STEP 1.
Install the new rear sealing plate, intermediate plate, and new front sealing plate, as noted during removal, onto the alignment pins. Install the control valve assembly, and torx mounting screws onto the transmission. Tighten the torx mounting screws in a opposite pattern to 9.5 N•m (84 lbf in).



1. CONTROL VALVE ASSEMBLY
2. FRONT SEALING PLATE
3. INTERMEDIATE PLATE
4. REAR SEALING PLATE

STEP 2.
Remove the two alignment screws. Install two torx screws, one at each end at the top of the control valve in their place. Tighten to 9.5 N•m (84 lbf in).

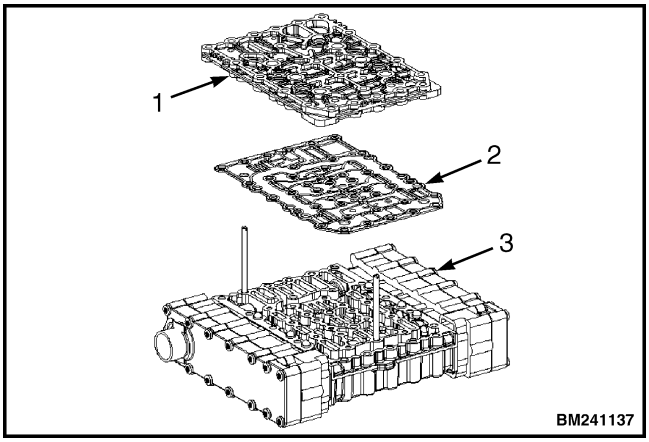


1. TORX SCREWS
2. CONTROL VALVE ASSEMBLY

STEP 3.
Connect the electrical connector from the transmission control valve.

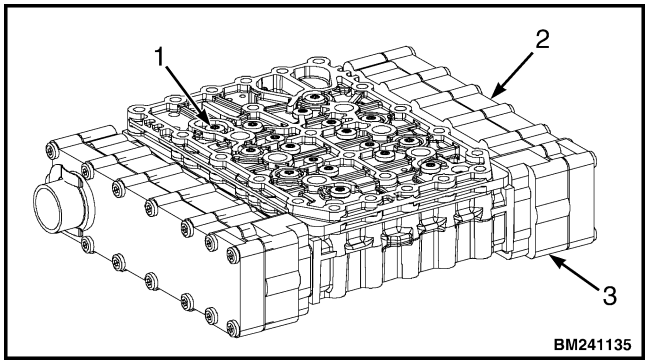
STEP 4.
Connect the vehicle negative battery terminal.

STEP 13.
Install the new sealing plate and the duct plate on the control valve body.



1. DUCT PLATE
2. SEALING PLATE
3. CONTROL VALVE BODY

STEP 14.
Install the 23 torx screws into the duct plate. Tighten the torx screws to 10.5 N•m (93 lbf in)



1. TORX SCREWS
2. DUCT PLATE
3. CONTROL VALVE BODY

STEP 15.
Install the control valve assembly on the transmission. See Control Valve Replacement, Install.

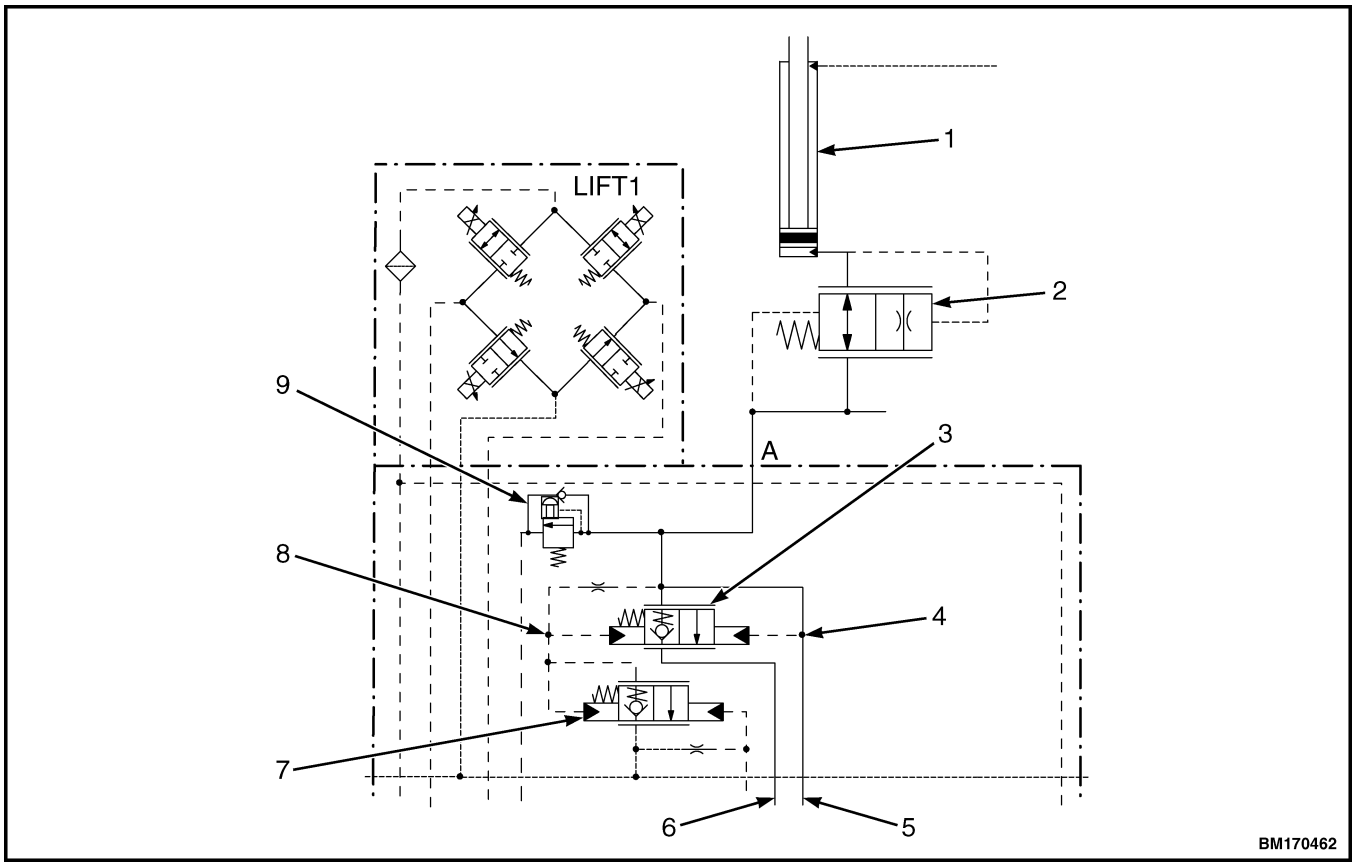
Pilot Operated Check Valves

The lift spool in the main control valve does not seal completely in the neutral position. To obtain zero leakage, a pilot operated check valve is mounted in the main control valve between lift spool and lift cylinder. See Figure 2.

When raising the mast, oil supply will pass through a check valve in the pilot operated check valve. To lower mast, the pilot operated check valve must be moved into the open position. The position of the pilot operated check valve, is determined by oil pressure at the cylinder side of the check valve, and by the combined force of a spring and oil pressure at pilot side of check valve. Spring force will keep the check valve closed when equal pressures exist at the pilot side and cylinder side of the check valve.

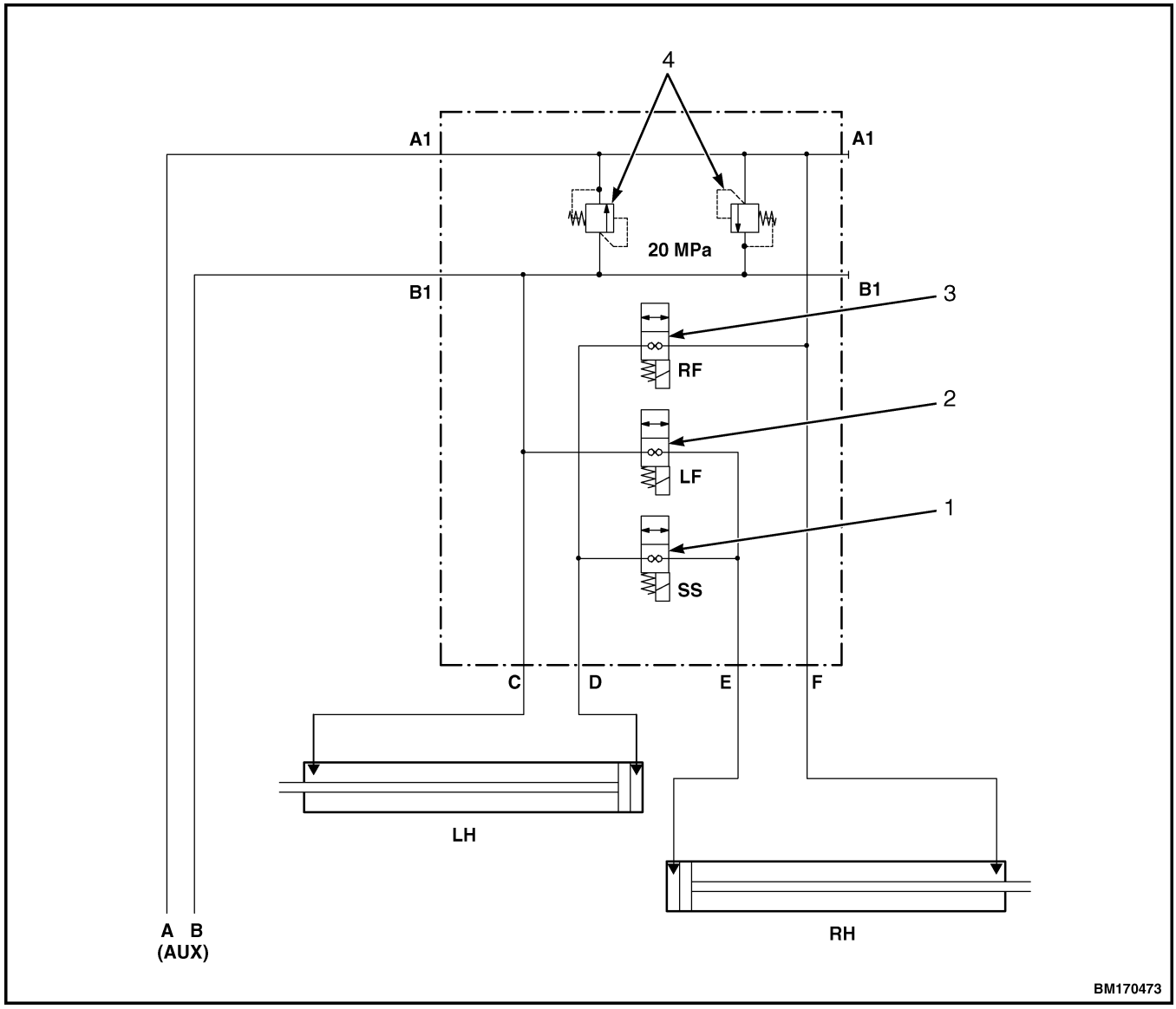
The pilot operated check valve opens when pressure at the cylinder side of valve exceeds the combined force of spring and oil pressure at the pilot side. Oil pressure at the pilot side of the check valve reliefs to tank by opening the pilot operated selector valve. The pilot operated selector valve is opened by pilot pressure from the lift spool, when the lift spool has moved into the lowering position.

Lowering the lift cylinders can be interrupted by returning the lift spool into the neutral position, which interrupts pilot supply to the pilot operated selector valve, causing the selector valve to close. The closed selector valve allows lift cylinder pressure to build up at the spring side of the check valve, causing the pilot operated check valve to close as well. See Figure 2.



1. PILOT OPERATED CHECK VALVE
2. EMERGENCY LOWERING VALVE (IN LH LIFT SECTION ONLY)
3. PILOT SIDE
4. PILOT OPERATED SELECTOR VALVE
5. CYLINDER SIDE

Figure 2. Pilot Operated Valves – Schematic



A. TO MAIN CONTROL VALVE PORT AUX B
B. TO MAIN CONTROL VALVE PORT AUX A
C. TO ROD SIDE LH FORK POSITIONER CYLINDER
D. TO PISTON SIDE LH FORK POSITIONER CYLINDER
E. TO PISTON SIDE RH FORK POSITIONER CYLINDER
F. TO ROD SIDE RH FORK POSITIONER CYLINDER

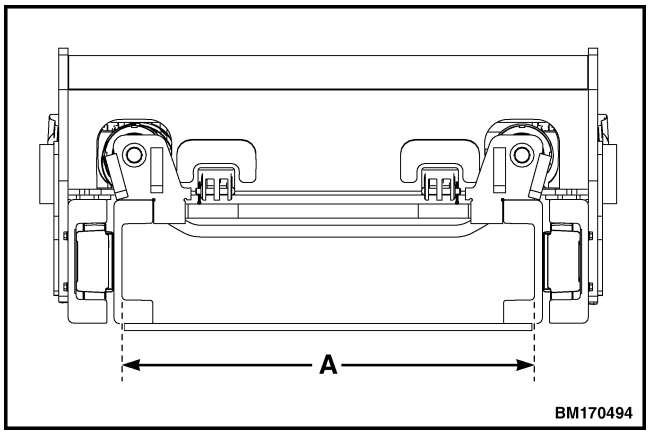
1. SIDE SHIFT SOLENOID
2. LH FORK POSITIONER SOLENOID
3. RH FORK POSITIONER SOLENOID
4. RELIEF VALVE

Figure 15. Schematic for Dual Function Valve

Install

NOTE: Install bearing blocks with curved side towards load roller.

1. Measure distance between inside of left hand and right hand channel of inner mast. Measure entire length of inner mast to establish shortest distance. Establish shortest distance with an accuracy of 0.5 mm (0.02 in.). See Figure 26.



A. DISTANCE BETWEEN INNER MAST CHANNELS

Figure 26. Inner Mast Channel Measurement

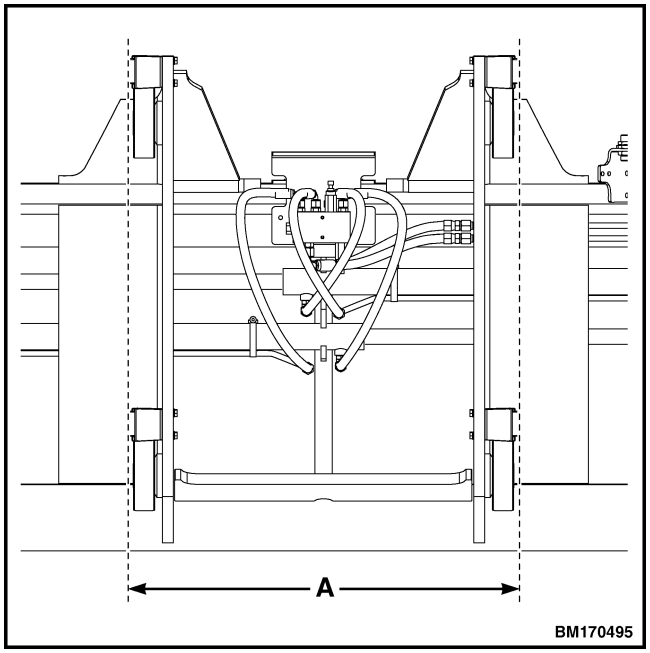
2. Temporarily place new bearing blocks for carriage in bearing block brackets and measure distance between outer faces of bearing blocks. See Figure 27.

3. Determine number of required shims by deducting distance as established in Step 2 from distance as established in Step 1.

4. To obtain required clearance between mast and carriage deduct another 0.5 to 1.0 mm (0.02 to 0.04 in.) from distance as established in Step 3.

NOTE: A maximum of five shims can be added behind bearing block in case bearing block is reused. If more than five shims are required, replace bearing blocks.

5. Divide shims equally between left and right bearing blocks. Shims are available in thicknesses of 0.5 mm (0.02 in.), 1.5 mm (0.06 in.), and 3.0 mm (0.12 in.).



A. DISTANCE BETWEEN THE OUTER FACES OF THE BEARING BLOCKS

Figure 27. Bearing Block Measurement

Carriage Load Rollers

Replace

Starting 2014, the masts have been provided with greasable load rollers, which are retained by three bolts. Masts built before 2014 have non-greasable load rollers, which are retained by a snap ring.

1. Remove carriage. See section Carriage, Remove.

2. Remove dirt to allow inspection of load rollers. Do not clean.

3. Inspect rollers. The seals must be in good condition. Axial bearing play must be less than 0.7 mm (0.028 in.). Grease must still be present in bearing. The roller must allow smooth rotation.

Relief Valve Replacement

Remove

1. Remove relief valve from housing.

Install

1. Use new O-rings for installation.
2. Install valve and tighten to 220 to 230 N•m (162 to 170 lbf ft).

MAST

Lift Chains and Top Chain Anchor

Remove

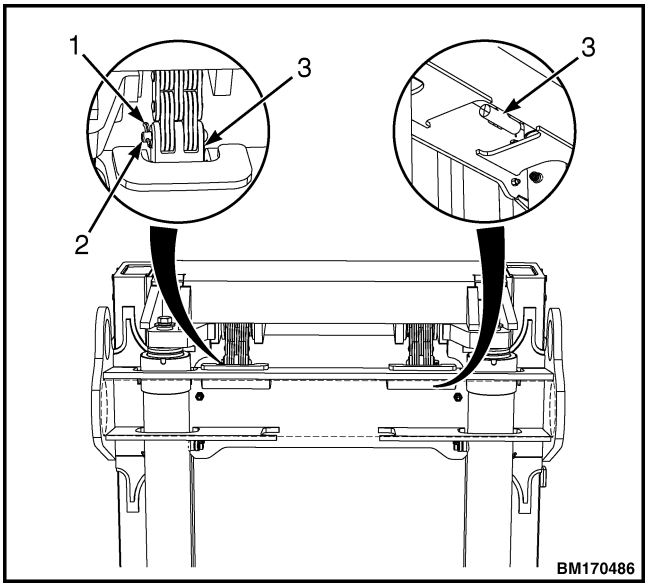
1. Place truck on a solid, level surface.
2. Place blocks of approximately 30 cm (1 ft) under carriage frame and lower mast until carriage rests on blocks.
3. Use the emergency lowering valve until the lift cylinders are retracted completely and the lift chains are slack.
4. Turn the engine **OFF**.

NOTE: Lift chains are heavy. See Table 6 for weights of different chain lengths.

5. Attach a hook to one of the lift chains at top front side of mast, approximately two feet below chain sheave. The hook must be strong enough to hold weight of chain. Lead hook through links of chain and attach hook to a lifting device.
6. Remove split pin and washer from chain pins at carriage chain anchors and then remove chain pins.
7. Lift chain slightly until tension is removed from chain pin that connects with chain anchor at top of mast.
8. Remove split pin and washer from chain pin at top chain anchor. See Figure 39.
9. Support chain anchor and remove chain pin.
10. Remove chain anchor.
11. Lower lifting device and put lift chain on a pallet.
12. Follow Step 6 through Step 11 to remove other lift chain.

Install

1. Attach a hook to one of the lift chains at approximately 1 m (3 ft) from chain end. The hook must be strong enough to hold weight of chain. Lead hook through links of chain and attach hook to a lifting device.
2. Lift chain until it is in front of chain sheave.
3. Attach a rope at the end of chain and lead rope over sheave, through chain anchor hole in weldment at top of mast. Pull rope to move chain end above chain anchor hole.
4. Mount chain anchor through hole. See Figure 39.
5. Inspect chain pin for damage.
6. Install chain pin to connect lift chain to chain anchor. Install split pin and washer to secure chain pin.
7. Remove rope.
8. Lower lifting device and remove hook from chain.



1. SPLIT PIN
2. CHAIN PIN
3. CHAIN ANCHOR

Figure 39. Top Chain Anchor

g. Install a new bearing block if more than 5 shims are required for correct shimming.

h. When reinstalling a bearing block, tighten securing bolt to 9 N•m (80 lbf in).

i. Do not yet install bearing block at top of outer mast.

j. After bearing block assembly is correctly shimmed, tighten four bracket bolts to 44 N•m (32.5 lbf ft).

WARNING

See Table 6 for the correct weight of the inner mast. Make sure the lifting device has the proper capacity rating.

5. Attach a lifting device to center of inner mast and install inner mast into outer mast until it is approximately 1 m (3 ft) from completely retracted position.

6. Attach a lifting device to lift cylinders and install lower end into bottom cross member of outer mast.

7. Install securing washer with bolt at bottom of cylinders. Tighten bolt to 35 N•m (26 lbf ft).

8. Install bearing blocks at top of outer mast with correct number of shims for a total play of 0.5 to 1.0 mm (0.02 to 0.04 in.).

9. Support lift cylinder to align its top end with mounting hole in inner mast.

10. Install shims on lift cylinder if originally installed. If a different cylinder is installed, establish correct shimming. See section Lift Cylinder, Install.

11. Retract inner mast to seat both lift cylinders.

12. Install securing washer with bolt at top of lift cylinder. Tighten bolt to 200 N•m (148 lbf ft). See Figure 50.

13. Install and shim isolator blocks to obtain a play of 0.5 to 1.5 mm (0.02 to 0.06 in.) between blocks and inner mast channel. Tighten nut to 53 N•m (39 lbf ft).

14. Position hoist chains at top of mast and lead one chain end over sheave to top chain anchor.

15. Connect lift chain by installing chain pin and securing it with washer and a new split pin.

16. Install lowering control valve at bottom of lift cylinders.

17. Install hoses connecting between lift cylinders at top and bottom.

18. Install header hoses and electric cable provisionally over sheave and secure with straps.

Install

NOTE: Inspect mast pins and bushings for wear prior to install. Replace if required.

1. Install the bushings, grease the mast pin and insert the pin with the grease fitting pointing to the center of the truck.

2. Apply grease to the mast shims to stick them against the RH hanger. Position one shim at the inside and two or three shims at the outside of the RH hanger. Turn the shims with their opening facing up. Do **NOT** install shims at the LH hanger.

3. See for the correct weight of mast. Make sure lifting device has proper capacity rating.

4. Connect a lifting device to lifting eyes on outer mast. See Figure 48.

5. Lift and position mast in front of lift truck.

6. Lower mast hangers on mast pins.

7. Connect mast pins with hangers using 4 capscrews.

Tighten capscrews to 435 N•m (321 lbf ft) for lift truck models D876, E876, and F876

Tighten capscrews to 522 N•m (385 lbf ft) for lift truck models D877, E877, and F877

8. Connect tilt cylinders to mast as follows:

a. Turn engine **ON**.

b. Extend tilt cylinders until rods are almost in correct position.

c. Lift tilt cylinders to align holes in rods with holes in mast.

d. Install tilt cylinder pins with lube fittings facing outside of truck. See Figure 54.

2. If removed, install the piston on rod using a new O-ring. Tighten nut to 950 to 980 N•m (700 to 725 lbf ft).

CAUTION

Be careful not to damage the smooth surface of the piston rod when installing the piston rod into the cylinder shell in a horizontal position (parallel to the cylinder shell).

NOTE: Keep the piston rod in the center of the cylinder shell during installation to prevent damage to the parts.

3. Lubricate cylinder shell bore with clean hydraulic oil. Push piston rod assembly into cylinder shell.

4. Push gland onto cylinder shell. Lubricate threads of cylinder shell with clean oil and tighten gland to 550 to 600 N•m (400 to 450 lbf ft).

5. Assemble rod end onto rod.

Install

NOTE: The locking bolts on rod end of tilt cylinder should always be on bottom side with nuts towards center of truck. See Figure 68.

1. Inspect bushings for tilt cylinder pins in brackets for frame and outer mast. Replace bushings if worn or damaged.

2. When reinstalling bushings, make sure that, at mast side, split in bushing is turned away by 45° from centerline of tilt cylinder and is in virtually highest position. See Figure 70.

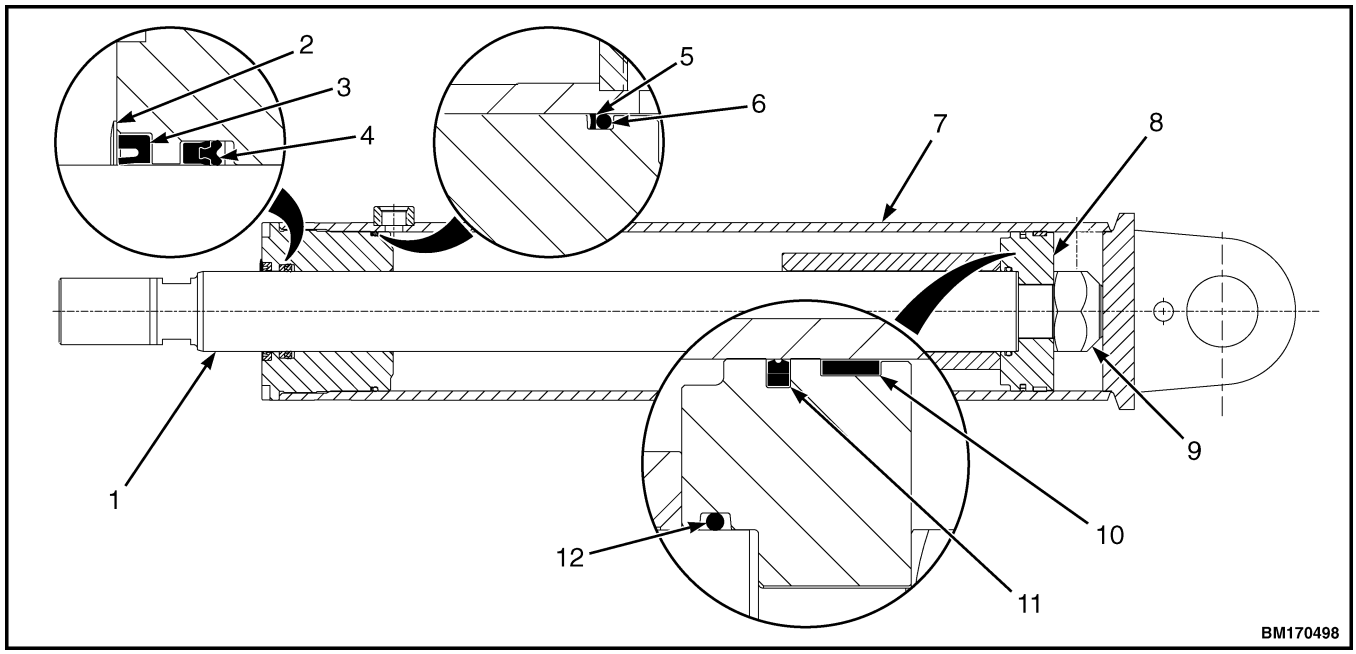
3. Use a lifting device to move tilt cylinder to truck.

4. Align cylinder and frame brackets.

5. Grease tilt cylinder pin and insert it in frame bracket.

6. Install eye bolt and the capscrew. See Figure 69.

7. Align cylinder and mast brackets.



1. ROD
2. HOLE PLUG
3. ROD WIPER
4. ROD SEAL
5. BACKUP RING
6. O-RING
7. CYLINDER SHELL
8. PISTON
9. LOCK NUT
10. GUIDE RING
11. PISTON SEAL
12. O-RING

Figure 69. Tilt Cylinder Assembly

Troubleshooting

INTRODUCTION

This troubleshooting list does not cover every possible problem. It is intended to help finding the cause of problem in the mast system.

Before searching for the cause of a problem, make sure that all daily condition checks and fluid level checks have been performed and that required repairs have been completed. See **Periodoc Maintenance** YRM.

If a problem occurs directly after a repair, verify if assembly instructions have been followed correctly. If a problem has aggravated, verify if hydraulic oil cleanliness meets 21/17/13 according ISO 4406.

For diagnosing and verification of settings, make use of the **Hydraulic User Interface Programme**YRM. See **Hydraulic Control System**YRM.

Follow each step in the sequence shown in one of the three main search criteria:

- **No Hydraulic Movement with Engine Running**
- **No Lowering Possible with Engine OFF**
- **Incorrect Movement**

If this troubleshooting list did not help solving your problem, read the Description and Operation section in this YRM to find further possible causes of failure.

NO HYDRAULIC MOVEMENT WITH ENGINE RUNNING

Initial Basic Check

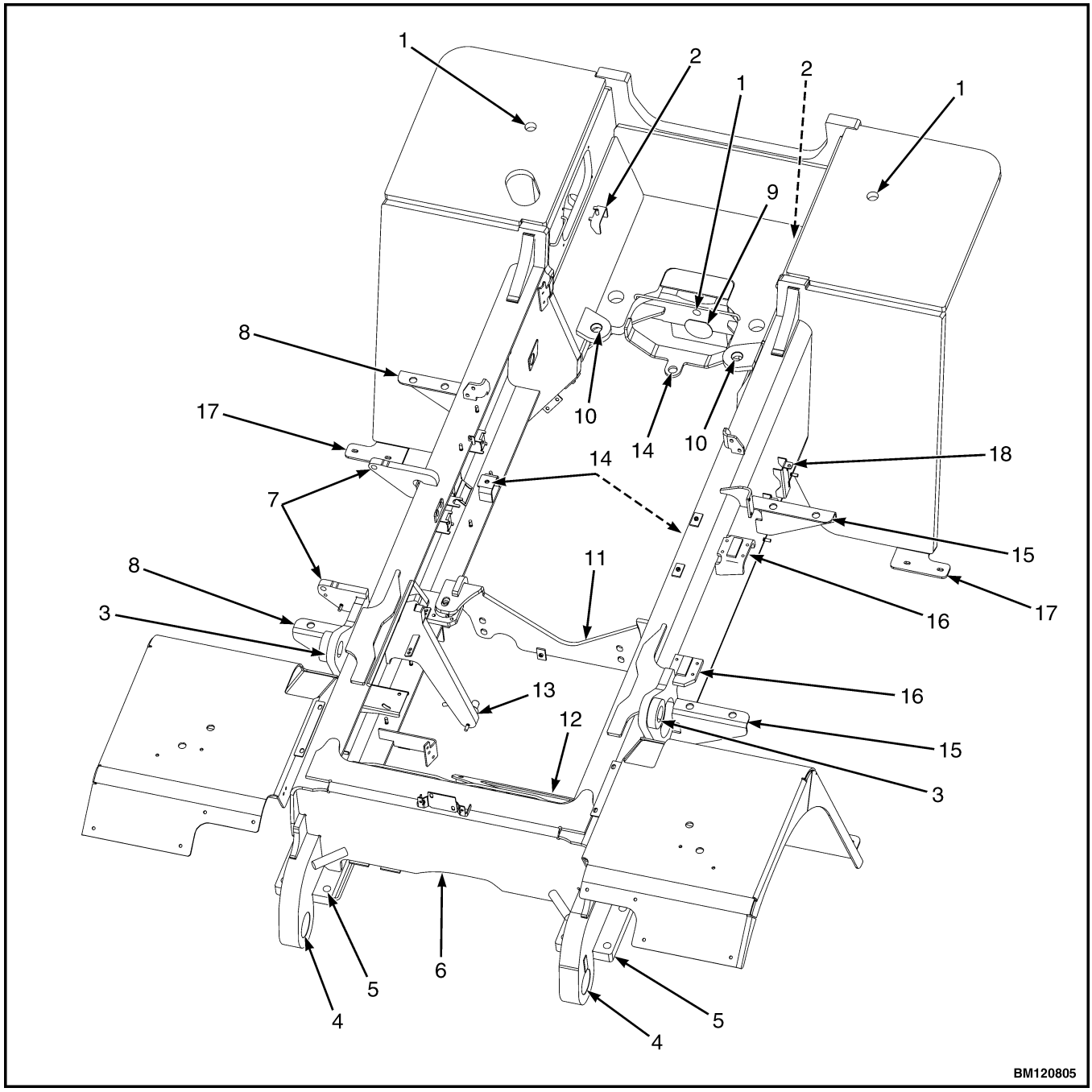
Make sure the Transmission Calibration Switch is in the **OFF** position.

Turn the Key Switch to the **ON** position to verify that all warning lights and indicator lights on the instrument panel will light up.

After two seconds all indicator lights must be **OFF**, except for the Wait to Start Light, Central Warning Lights and Brake System Low Pressure Warning Light.

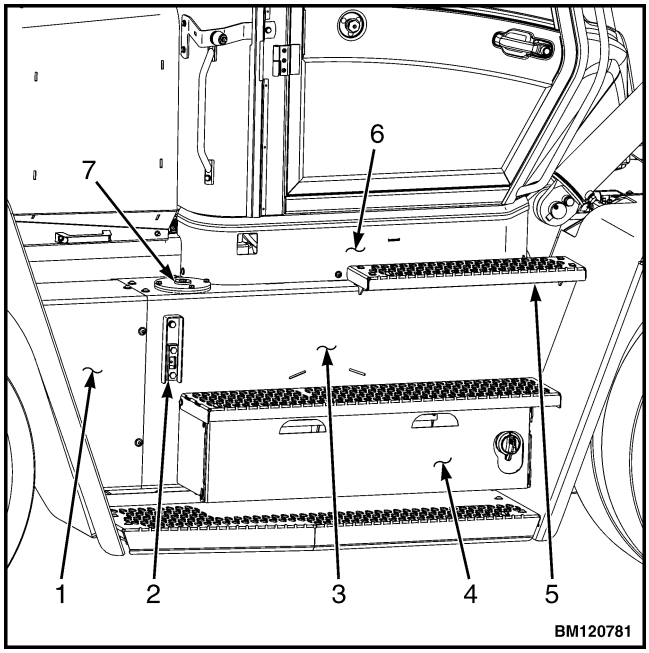
Start the engine after the Wait to Start Light is **OFF**.

- *If any of the above steps fail, follow the steps mentioned under **Electrical Supply***
- *If the Brake System Low Pressure Warning Light is still **ON** after 10 seconds, follow the steps mentioned under **Hydraulic Supply**.*
- *If the Central Warning Lights are **ON** and a fault code is displayed, follow the steps mentioned under **Fault Code**.*



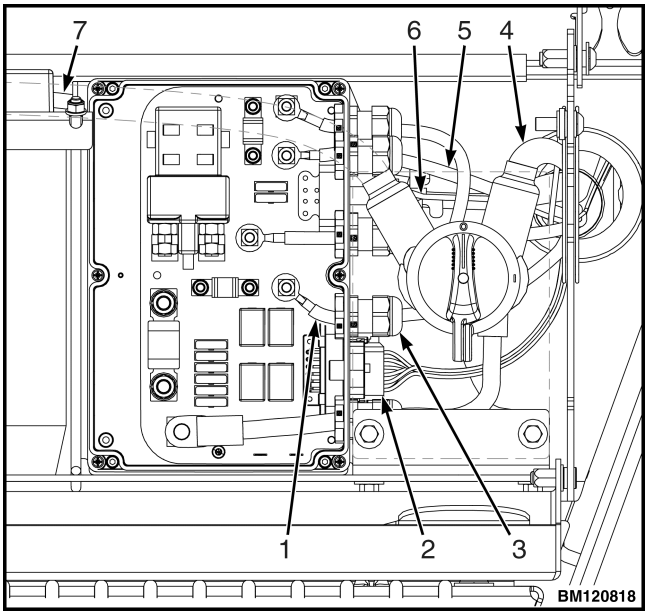
1. MAIN COUNTERWEIGHT MOUNT
2. COOLING ASSEMBLY MOUNT
3. TILT CYLINDER MOUNT
4. MAST MOUNT
5. DRIVE AXLE MOUNT
6. MAIN FRAME
7. SIDE TILTING CAB MOUNT
8. HYDRAULIC TANK MOUNT
9. STEER AXLE MOUNT
10. ENGINE MOUNT
11. TRANSMISSION MOUNT
12. MAIN CONTROL VALVE MOUNT
13. CAB TILT CYLINDER MOUNT
14. EXHAUST SYSTEM MOUNT
15. HYDRAULIC TANK MOUNT
16. CAB LOCK MOUNT
17. RUNNING BOARD BRACKETS
18. DEF TANK MOUNT

Figure 1. Frame Mounts



1. RIGHT-HAND EXTENSION PLATE
2. LEVEL INDICATOR
3. HYDRAULIC TANK
4. BATTERY BOX
5. STEP
6. RIGHT-HAND PANEL
7. HYDRAULIC RETURN FILTER

Figure 14. Hydraulic Tank



1. CAB FUSEBOX
2. PDM
3. GLAND
4. STARTER MOTOR
5. TO FUSE ALTERNATOR
6. FRAME SUPPLY
7. BATTERY NEGATIVE (GROUND)

Figure 15. Disconnect Cables from the Battery Box

CAUTION

Disconnect the negative (ground) cable first or lift truck damage may occur.

8. Disconnect the negative (ground) and positive (power) cables from the batteries.

NOTE: The battery box is attached to the hydraulic tank. To be able to remove the hydraulic tank/battery box assembly it is necessary to disconnect all cables which are connected to the truck. Leave the cable gland on the cable to avoid damage to the cable.

9. Remove the PDM box cover by removing six screws.

10. Disconnect and remove all cables which are connected to the truck from the battery box. See Figure 15.

11. Close the PDM box cover to prevent the parts from getting damaged.

12. Disconnect and remove the batteries from the battery box.

13. Remove the step from the top of the hydraulic tank, by removing the cap screws and washers.

14. The running board between the front fender and the counterweight weighs 12.7 kg (28 lb), therefore support the running board with a hand pallet truck or forklift truck.

15. Remove the cap screws and washers from the running board.

16. Lift the running board slightly to remove the isolators.

17. Remove the running board from the truck.

9. Disconnect the Powertrain harness from the Frame harness. See Figure 23.

10. Disconnect the ECM/EAS harness from the attached parts according to Figure 23.

11. Disconnect the Frame harness from the Alternator. See Figure 22.

12. Attach the remaining cables to the engine and transmission to prevent the cables from getting damaged.

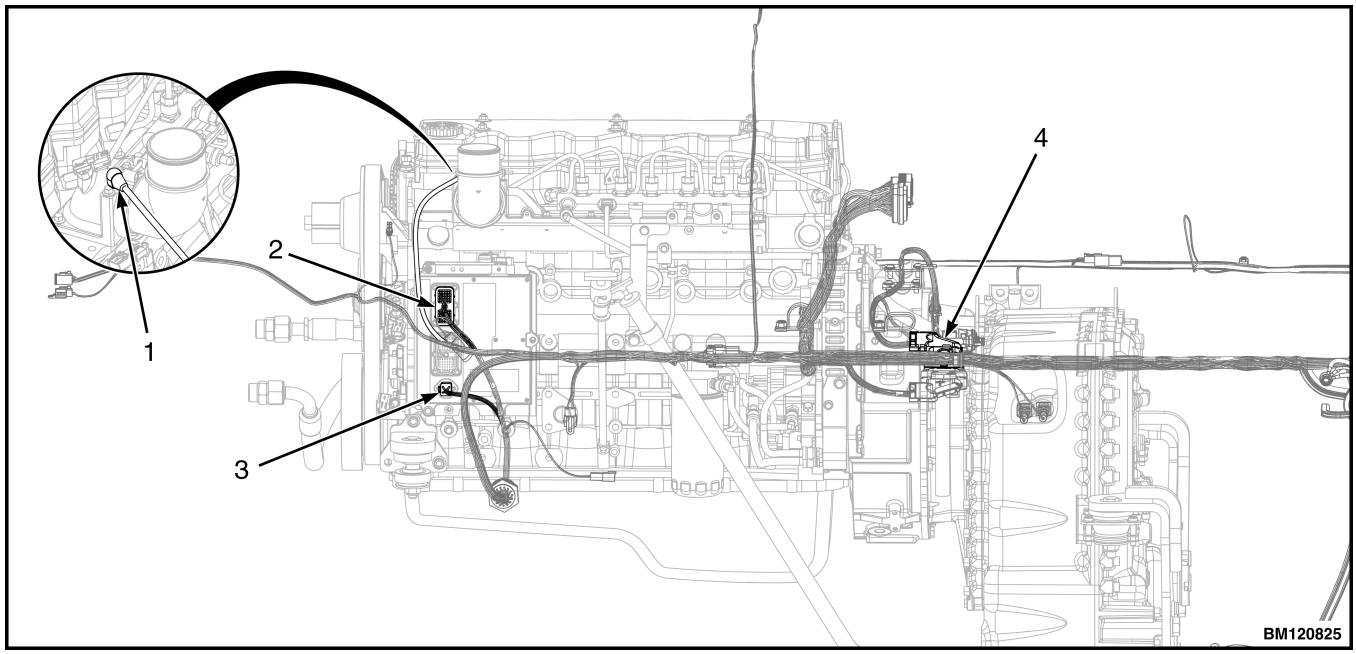
13. The drive shaft weighs 20.5 kg (45 lb).

Connect a lifting device to the drive shaft. Remove the bolts from the drive shaft flanges and remove the drive shaft.

14. Remove the dipstick tube from the transmission and plug the opening.

NOTE: The hexagon nut that connects the fan clutch to the fan spacer has **LEFT HAND THREAD**.

15. Reach between the fan blades with a tool and remove the four cap screws which hold the fan and fan spacer. Leave the fan inside the shroud.



1. TS19 – GRID HEATER
2. CPS02 – ECM_TIER3
3. CPS05 – ECM POWER TIER3
4. CPP02 – FRAME_POWERTRAIN

Figure 23. Engine Electrical Connections Right-Hand Side (Tier 3/Stage IIIA)

Connect Drive Shaft, Fan, Tubes, Pipes, Cables, Wires and Lines

1. The drive shaft weighs 20.5 kg (45 lb). Connect a lifting device to the drive shaft. Install the drive shaft and tighten the bolts 50 N•m (37 lbf ft).

2. Reinstall the transmission dipstick tube. Make sure the O-ring between tube and transmission is not damaged. Torque the cap screws to 38 N•m (28 lbf ft).

NOTE: The hexagon nut that connects the fan clutch to the fan spacer has **LEFT HAND THREAD**.

3. Lift the fan out of the shroud.

4. Install the fan spacer and the fan to the fan pulley.

5. Install the four cap screws which hold the fan and fan spacer to the fan pulley, and torque to 43 N•m (31.7 lbf ft).

6. Loosen the cables that are attached to the engine and transmission.

7. Install the battery cables from the starter.

8. Connect the ECM and grid heater connectors.

9. Connect the frame harness to the alternator. See Figure 31.

10. Loosen the fuel hoses from the engine.

11. Install the fuel supply and return lines to the engine. See Figure 37.

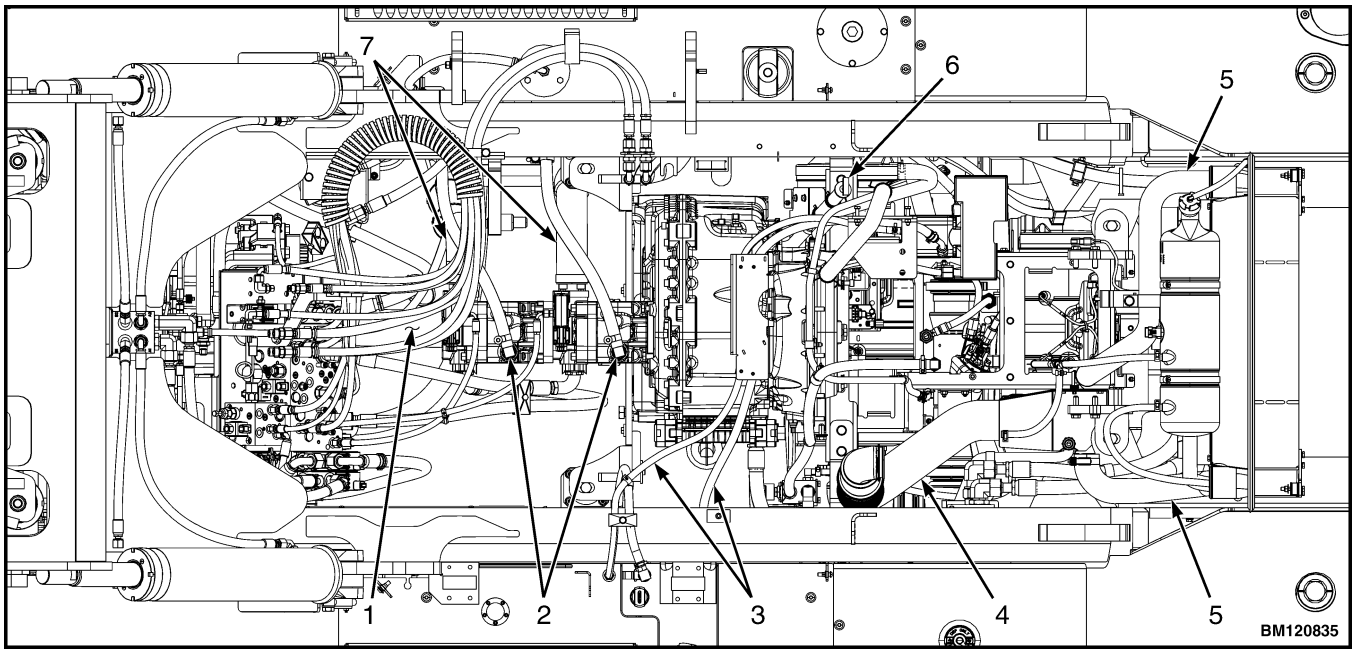
12. Open the fuel shutoff valve at the top of the fuel tank.

Refill the Systems

1. Install the hydraulic hoses between transmission pumps, transmission filter and hoses coming from the transmission cooler.

2. Fill the transmission with 27 liter (7 gal) of transmission oil as specified in the Maintenance Schedule of the **Periodic Maintenance** 8000YRM1939.

3. Refill the hydraulic tank with filtered oil, either through a device or through the return filters.



1. DRIVE SHAFT
2. HYDRAULIC OIL SUPPLY HOSES
3. FUEL SUPPLY AND RETURN LINES
4. EXHAUST PIPE
5. AIR SUPPLY PIPES
6. TRANSMISSION DIPSTICK
7. HYDRAULIC OIL SUCTION HOSE

Figure 37. Engine and Transmission Hoses Connections (Tier 4F/Stage IV)

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

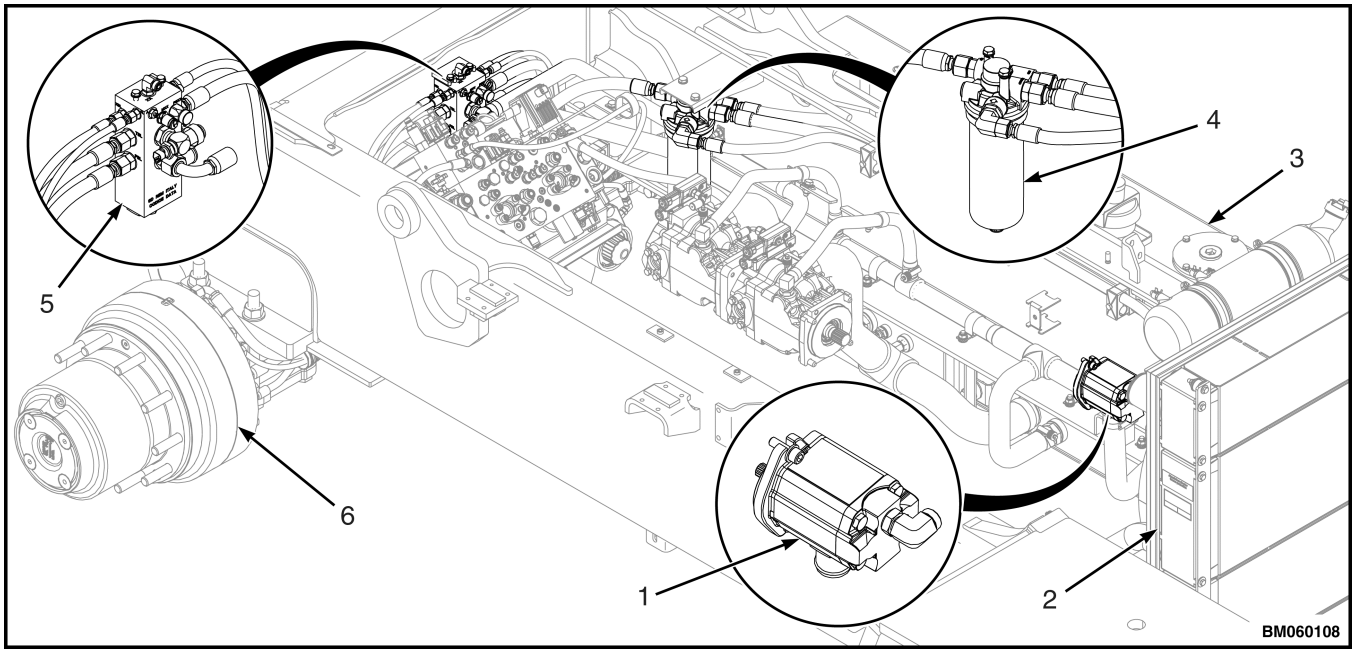
WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.



1. GEAR PUMP
2. COOLER
3. HYDRAULIC TANK
4. HYDRAULIC FILTER
5. BRAKE MANIFOLD
6. SERVICE BRAKES

Figure 8. Hydraulic Oil Cooling System Components

Oil Filtration and Oil Cooling

Pump supply is filtered by a 5 micron filter element which is mounted on a filter adapter. The filter is protected by a 340 kPa (49 psi) bypass valve.

The hydraulic cooling filter adapter includes a thermostatic valve which starts opening at 65°C (149°F). When this valve is fully open at 80°C (176°F), all oil flowing through the filter assembly is directed to the hydraulic oil cooling core. Oil from the cooling core returns to the filter adapter, and flows further to the brake manifold. See Figure 9.

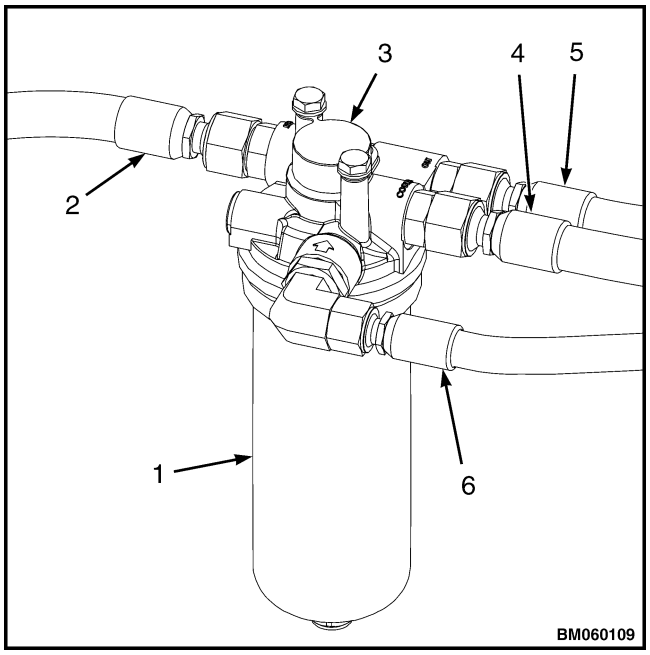
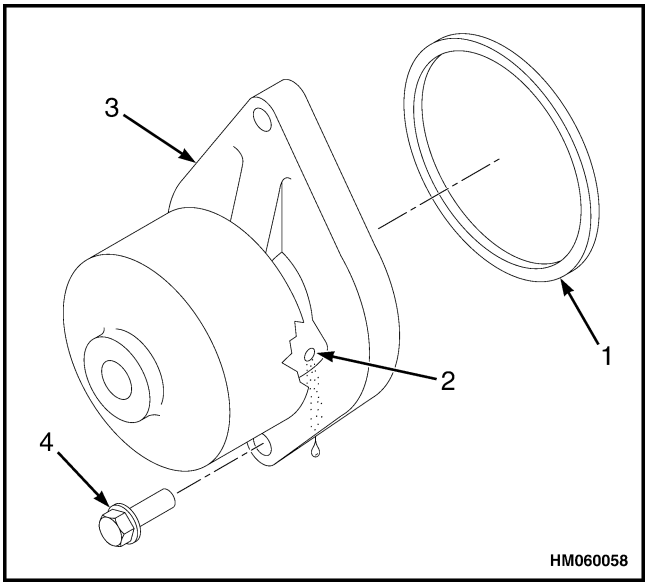


Figure 9. Hydraulic Cooling Filter and Connecting Hoses

3. Remove the two capscrews that retain the water pump, and remove the water pump. Discard O-ring.

Install

1. Install a new O-ring in the water pump housing.
2. Install the water pump on the engine. Ensure the weephole is below the shaft.
3. Install the two capscrews for the pump and torque to 24 N•m (18 lbf ft).



1. O-RING
2. WEEP HOLE
3. WATER PUMP
4. CAPSCREWS

Figure 16. Water Pump

4. Guide the drive belt over the fan and route it over the pulleys except for the pulley for the water pump. See Drive Belt.
5. Pivot the tensioner and slip the drive belt over the water pump pulley.
6. Refill the cooling system. See Filling the Engine Cooling System.
7. Operate the engine and check for leaks. Verify correct coolant level.

THERMOSTAT

Remove

1. Drain the engine cooling system to below the thermostat level. See Draining the Engine Cooling System.
2. Remove the top engine coolant hose from the coolant outlet flange on top of the cylinder block.
3. Remove the three capscrews that hold the coolant outlet flange in place.
4. Remove the coolant outlet flange and remove the thermostat. Discard gasket.

Inspect

1. Inspect the thermostat and its seal for cracks, tears and damage. Replace a defective thermostat with a new one.
2. The functionality can be tested by immersing the thermostat in water.
3. Heat the water and check the thermostat.

   It must begin to open at 82 - 84°C (180 - 183°F).

   It must begin fully open at 95°C (203°F).

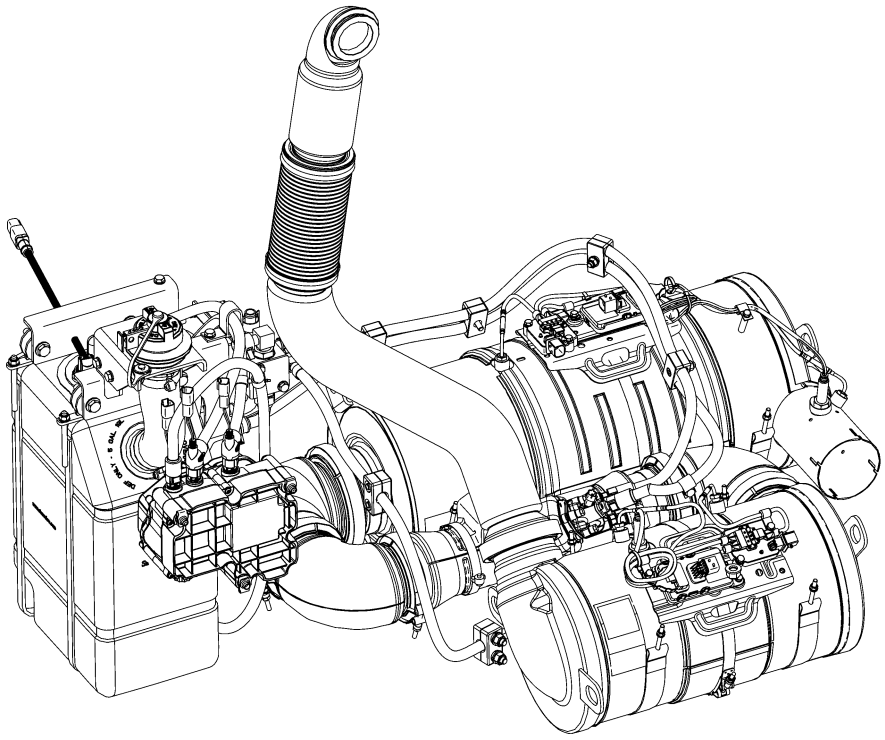
   The thermostat is fully open, when the thermostat flange and its housing are at least 14.3 mm (0.56 in.) apart. If the thermostat does not meet these specifications, replace it with a new one. See Figure 17.

Yale®

Maintenance

DEF SYSTEM

GDP80-120DC, GDP100DCS (GDP190-280DC, GDP230DCS) [G876];GDP130-160EC (GDP300-360EC) [G877];GDP160-12EC, GDP180-7.5EC (GDP180-9EC, GDP160-9EC) [A674]

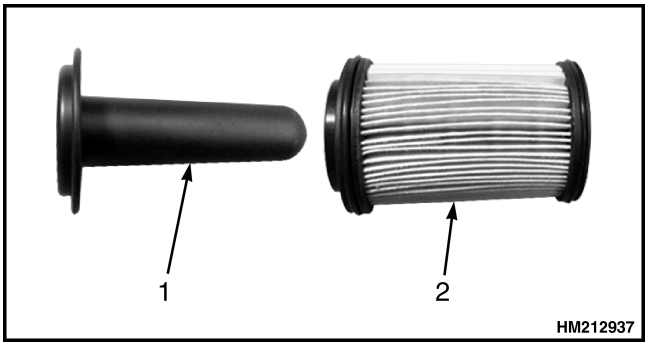


PART NO. 550123391

0900 YRM 1930

Included in the DEF pump assembly are a filter, electrical heater, reverting valve, pressure sensor and a back flow valve.

The filter protects the dosing valve and the SCR against impurities and must be replaced every 5000 working hours. Inside the filter is a plastic insert that minimizes the volume of DEF at the inner side of the filter. This smaller volume reduces the required purging time and the required time for defrosting.



1. FILTER INSERT
2. FILTER ELEMENT

Figure 9. DEF Pump Filter Set

The electrical heater is located around the filter element for defrosting.

The reverting valve determines the direction of DEF flow for the pumping phase or purging phase.

The pressure sensor measures existing DEF pressure at the dosing valve.

Pumping Phases

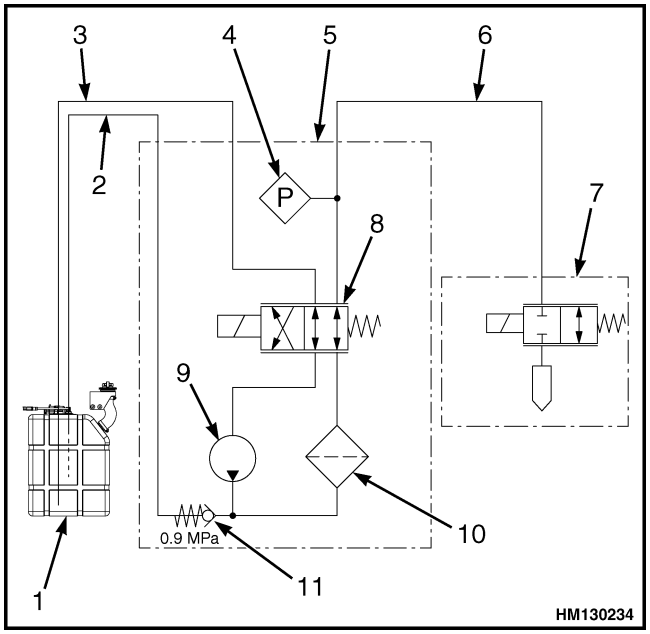
Defrosting

If ambient temperature is below -4°C (25°F), the ECM activates the DEF Heating System. The DEF system will not start priming until every related component is defrosted.

Priming

After verifying certain preconditions, the ECM tests functionality of the DEF system. Preconditions to be met:

- System defrosted
- Engine started successfully
- SCR temperature higher than 200°C (392°F)



1. DEF TANK
2. RETURN HOSE
3. SUCTION HOSE
4. PRESSURE SENSOR
5. DEF PUMP ASSEMBLY
6. PRESSURE HOSE
7. DOSING VALVE
8. REVERTING VALVE
9. PUMP
10. FILTER
11. BACKFLOW VALVE

Figure 10. DEF Pump Priming State

Functionality Test

- Pump must be running and build up pressure to 900 kPa (130 psi)
- If OK, dosing valve will open for 2 seconds
- DEF pressure should decrease and recover quickly after the dosing valve has closed again

Dosing

Required conditions to start dosing:

- System successfully primed
- Catalyst inlet and outlet temperature both above 200°C (392°F)
- No active fault code related to the SCR System
- DEF temperature in tank above -4°C (25°F)
- DEF tank level above 6%

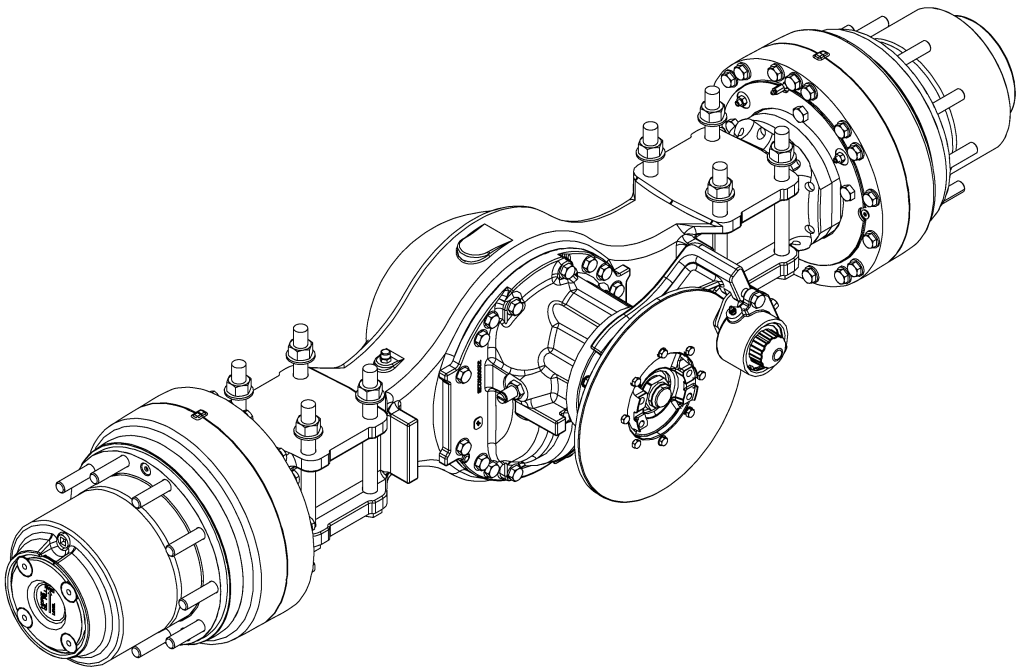
Yale

Maintenance

PLANETARY DRIVE AXLE AND DRIVE SHAFT

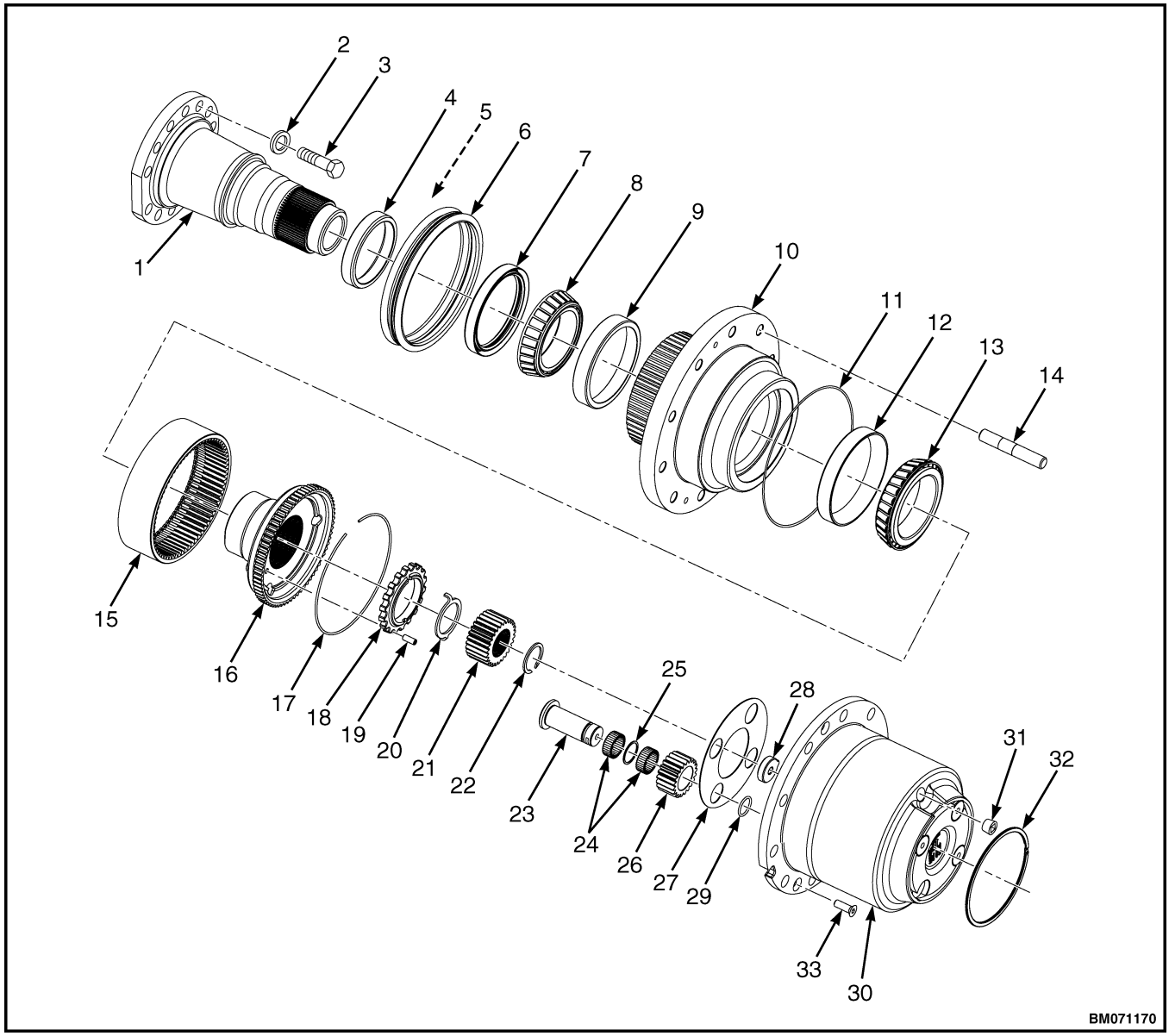
WET BRAKE SYSTEM

GDP80-120DC, GDP100DCS (GDP190-280DC, GDP230DCS) [G876]; GDP130-160EC (GDP300-360EC) [G877]



PART NO. 550123392

1400 YRM 1931



1. SPINDLE
2. FLAT WASHER
3. CAP SCREW
4. WEAR SLEEVE
5. WET DISC BRAKE (NOT SHOWN)
6. TORIC RING FACE SEAL ASSEMBLY
7. OIL SEAL ASSEMBLY
8. INNER BEARING CONE
9. INNER BEARING CUP
10. WHEEL HUB
11. O-RING
12. OUTER BEARING CUP
13. OUTER BEARING CONE
14. WHEEL STUD
15. RING GEAR
16. RING GEAR HUB
17. LOCK RING
18. SPINDLE NUT
19. SET SCREW
20. SUN GEAR THRUST WASHER
21. PLANETARY SUN GEAR
22. SNAP RING
23. PLANETARY GEAR SHAFT
24. NEEDLE ROLLERS
25. SPACER
26. PLANETARY PINION GEAR
27. THRUST PLATE
28. THRUST BUTTON
29. O-RING
30. PLANETARY SPIDER
31. MACHINE SCREW
32. MAGNETIC DRAIN PLUG
33. SPIRAL RETAINING RING

Figure 9. Planetary Gear Assembly

CAUTION

Apply isopropanol to the Toric Ring. Check the retaining lip of the seal seating area for burrs or fins, which can cause a seal to leak. Damage to components can result.

3. Apply isopropanol as a lubricant to the Toric Ring and place in the seating area. If installation does not appear smooth, flat and correct, remove the seal from the spindle and repeat the process.

CAUTION

To prevent slippage of the Toric Ring, allow sufficient evaporation time for the assembly lubricant before proceeding with further assembly. Damage to components can result.

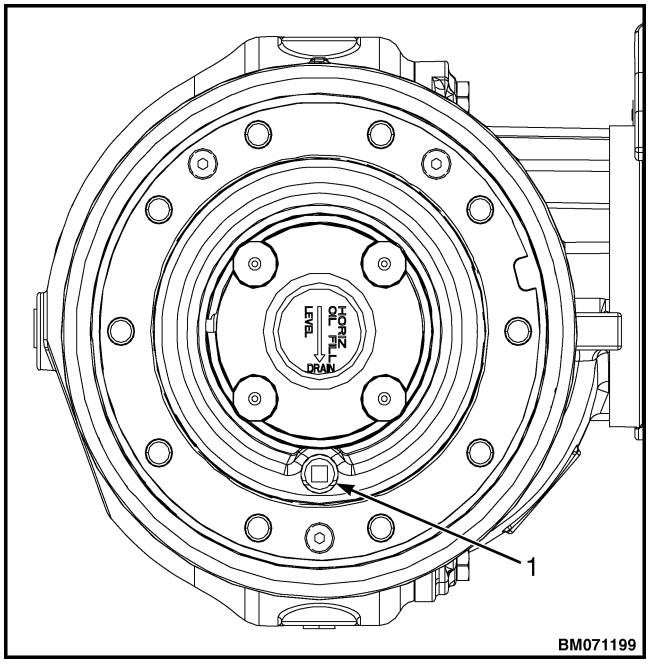
4. Seat Toric Ring correctly. Once correctly in place, the Toric Ring must roll on ramp only.

DRIVE AXLE

Remove

NOTE: The drive axle does not have to be removed when repairing the wheel hub and only needs to be removed when repairing or replacing the differential.

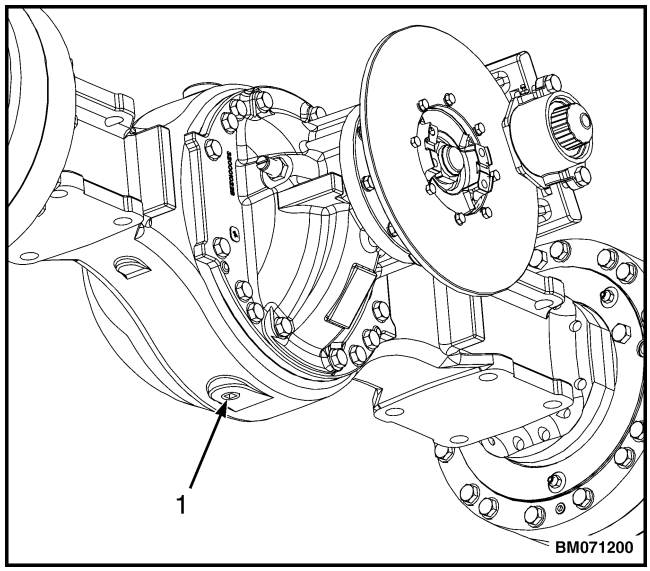
1. Remove the drive shaft. See chapter Drive Shaft, Remove.
2. Remove the mast. Refer to **2-Stage Mast** 4000YRM1647.
3. Put the lift truck on blocks. See chapter Step 1, Putting the Lift Truck on Blocks.
4. Remove the air pressure from the tires and remove the drive wheels. Refer to **Periodic Maintenance** 8000YRM1939.
5. Put a drain pan under the planetary housing.
6. Rotate the wheel hub to put the magnetic oil plug in the drain position.
7. Remove the magnetic oil drain plug and drain the oil. See Figure 38.



1. OIL DRAIN PLUG

Figure 38. Planetary Spider Oil Drain

8. Put a drain pan under the differential.
9. Remove the magnetic drain oil plug and drain the oil. See Figure 39.
10. Tag and disconnect the eight brake hoses from the brake covers. Place caps on the end of the brake hoses. See Figure 40.
11. Tag and disconnect the electrical connectors on the brake covers.
12. Remove the parking brake caliper and disc to prevent from damage during removal of the drive axle. Refer to **Brake and Hydraulic Cooling System** 1800YRM1933.
13. Connect a lifting device to the drive axle.
14. Use another lift truck to support the drive axle.
15. Put tension on lifting device to have it carry the weight of the drive axle.
16. Remove the bolts, nuts and washers that retain the drive axle to the frame.
17. Lower the drive axle and move it away from the truck.

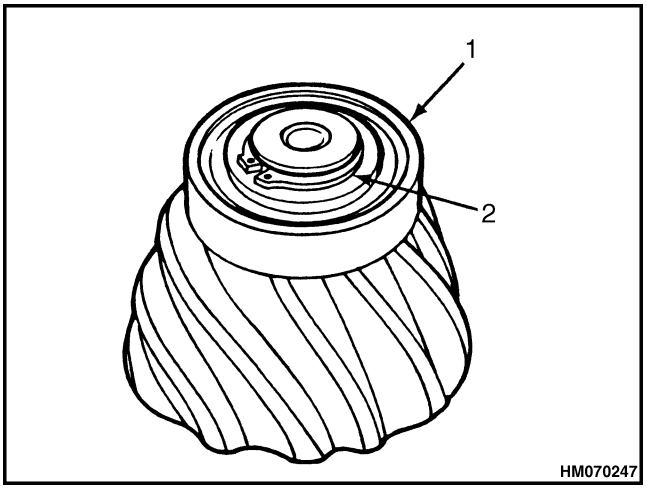


1. OIL DRAIN PLUG

Figure 39. Differential Oil Drain

7. Remove the snap ring from the end of drive pinion with snap ring pliers that expand. See Figure 62.

8. Remove the spigot bearing from the drive pinion.



1. SPIGOT BEARING
2. SNAP RING

Figure 62. Snap Ring Removal

Clean and Inspect

WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

WARNING

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

Clean and inspect the following parts of the differential:

Yoke

Clean the surface of the yoke journal with a cleaning solvent and inspect the original yoke seal surface for any grooves.

Drive Axle

Clean the parts of the axle with solvent and dry with compressed air. Inspect all machined surfaces and bearings for wear and damage.

Tapered Roller Bearings

Inspect the cup, cone, rollers, and cage of all tapered roller bearings in the assembly. If bearings show signs of wear, cracks, or damage, replace with new bearing. Refer to the chapter Step 2, Inspect for more information.

Pinions and Gears

Inspect the pinions and gears for wear or damage. Gears that are worn or damaged must be replaced.

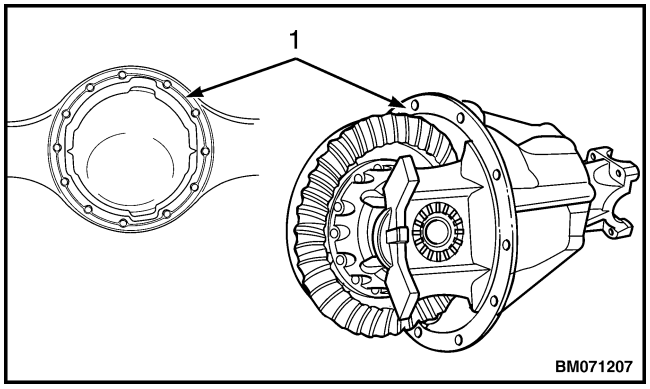
Axle Shafts

Inspect the axle shafts for wear and cracks at the flange, shaft and splines. If axle shafts show signs of wear or damage, replace the axle shafts.

Main Differential Assembly

Inspect all parts of the main differential assembly for wear or damage. Parts that are damaged must be replaced. See Figure 64.

1. Use a tool with a flat blade, if required, to remove all old gasket material from surfaces. See Figure 63.



1. OLD SEALANT MATERIAL

Figure 63. Old Sealant Material Removal

10. Install one thrust washer and side gear into the flange case half.

11. Install the spider (cross), differential pinions and thrust washers into the flange case half. See Figure 85.

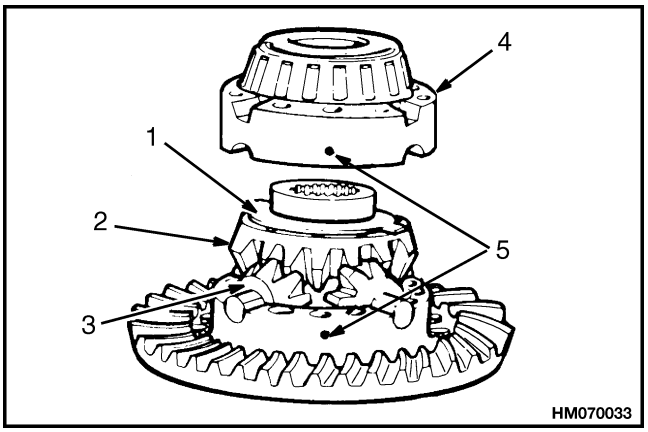
12. Install the second side gear and thrust washer over spider and differential pinions.

13. Align the marks and assemble the two halves of the differential case.

14. Use Loctite No. 272® on the threads of the cap screws. Install four of the cap screws, washers and nuts into the case halves in a cross pattern. The distance between the fasteners must be equal.

15. Tighten the fasteners to the correct torque value as shown in Table 4 in a pattern as shown on Figure 86.

16. Check that the differential gears can freely rotate in the case.



1. THRUST WASHER
2. SIDE GEAR
3. SPIDER GEARS
4. CASE HALF
5. ALIGNMENT MARKS

Figure 85. Differential Pinion and Side Gears

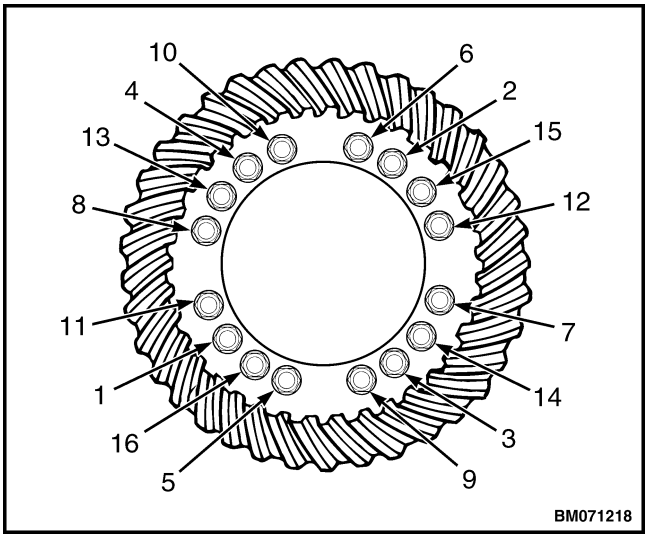
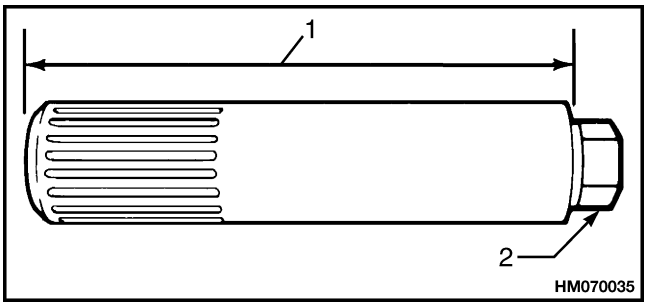


Figure 86. Fasteners Tightening Sequence

Assemble Differential and Ring Gear, Check Differential Gears Rotating Torque

NOTE: Make a tool for checking the rotating torque of the differential gears. The tool can be made from an axle shaft that has the same spline size of the differential side gear. See Figure 87.

1. Put the differential and ring gear assembly in a vise. Install soft metal covers for the jaws of the vise to protect the ring gear.



1. APPROXIMATELY 305 mm (12 in.)
2. WELD NUT TO END OF SHAFT

Figure 87. Differential Gear Check Tool

Table 4. Drive Axle Torque Chart (Continued)

Fastener	Thread Size	Torque Value	
		N·m	lbf ft
Plug, Oil Fill, Carrier	.75-14 1.5-11.5 M24 x 1.5	25 minimum 120 minimum 35 minimum	34 minimum 163 minimum 47 minimum
Cap Screw, Lock Plate	.31-18 M8 x 1.25	20-30 21-26	27-41 28-35

LUBRICATION SPECIFICATIONS

See **Periodic Maintenance** 8000YRM1939.

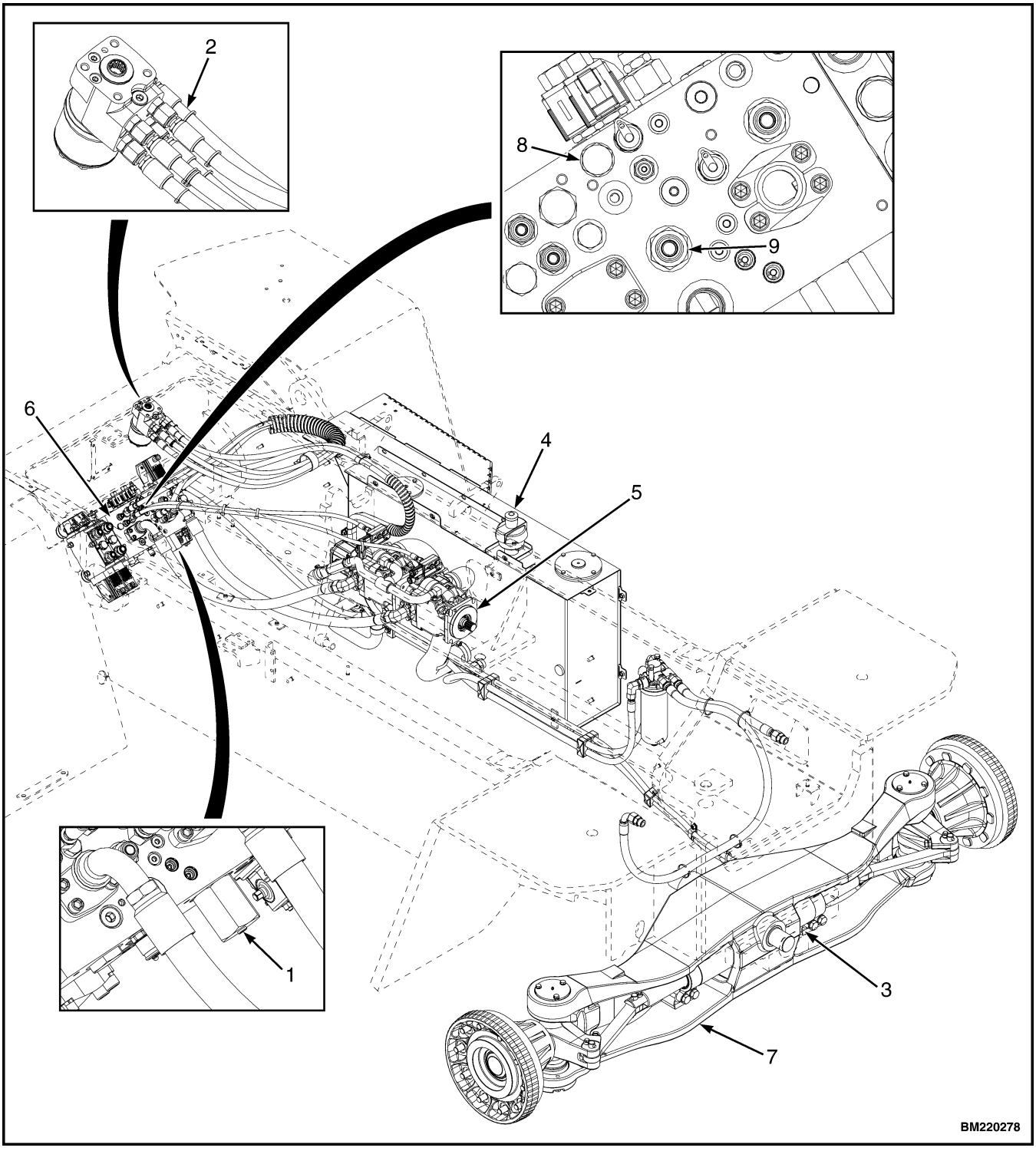
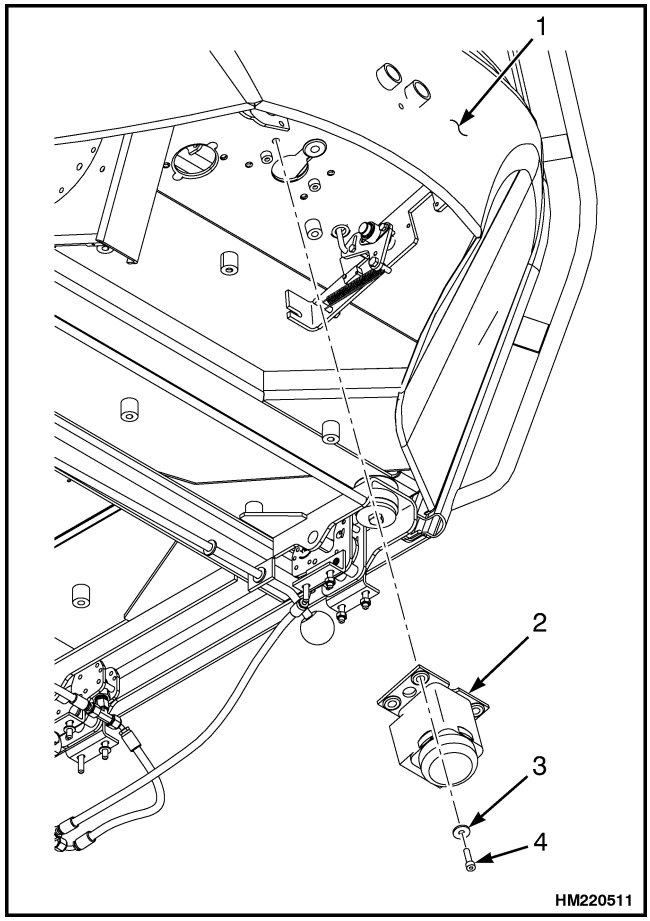


Figure 2. Steering System Main Component Identification



1. OPERATOR'S CAB
2. STEERING CONTROL UNIT
3. WASHER
4. CAPSCREW

Figure 9. Steering Control Unit, View Under Operator's Cab

Install

CAUTION

DO NOT force the steering control unit onto the steering column shaft, as damage can occur.

1. Place the steering control unit in position under the cab while aligning the steering column shaft with the slot in the steering control unit.

2. Install the four capscrews and washers that retain the steering control unit to the underside of the operator's cab.

3. Remove the plugs and caps from hydraulic hoses and the ports on the steering control unit.

4. Connect the hydraulic hoses to the steering control unit according to the identification tags. Tighten the hoses to the correct torque as described in the section Torque Specifications.

5. For G876 and G877, check the fluid level in the hydraulic tank. Add hydraulic fluid if necessary, as specified in the maintenance table in the manual **Periodic Maintenance** 8000YRM1939.

For A674, check the fluid level in the hydraulic tank. Add hydraulic fluid if necessary, as specified in the maintenance table in the manual **Periodic Maintenance** 8000YRM1983.

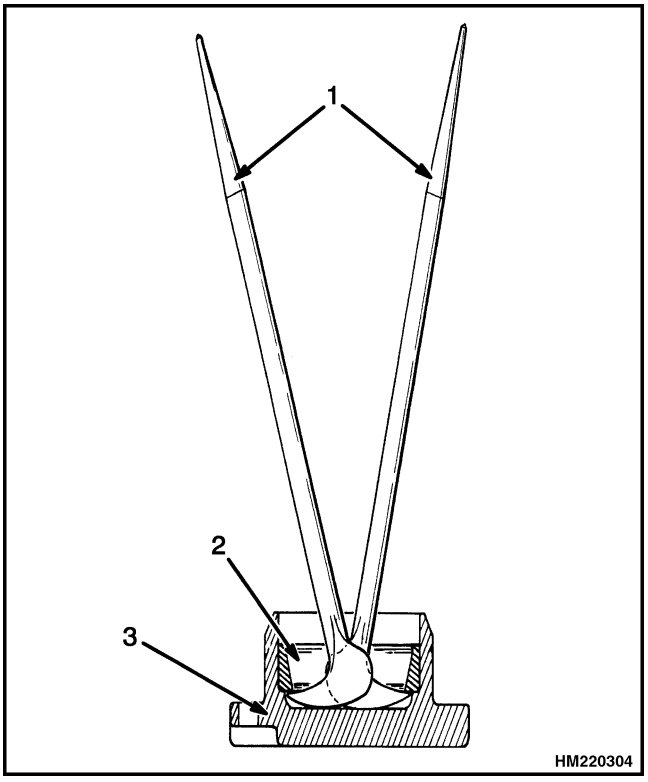
6. Start the engine and operate the steering system. Ensure the steering control unit operates correctly.

WARNING

DO NOT try to locate hydraulic leaks by placing hands on pressurized hydraulic components. Hydraulic oil can be injected into the body by pressure.

7. Check for leaks.

8. Lower the cab until it is in the fully lowered and latched position. Refer to the manual **Operator's Cab** 0100YRM1390.



1. PRY BAR
2. BEARING CUP
3. BEARING CAP

Figure 17. Bearing Cup Removal

Clean

WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

1. Clean all parts in solvent. Ensure bearings are clean and dry.

Assemble and Install

1. Install new seals on spindle. Lubricate seals with grease. See Figure 13.

2. Lubricate bearings with wheel bearing grease. Ensure bearings are filled with grease. If necessary, press new bearing cups into steering axle frame and bearing cap. Install wear sleeve in steering axle frame.

3. Install spindle in steering axle and make the following bearing adjustment:

NOTE: Spindle bearings must have no clearance. Install shims 0.00 to 0.13 mm (0.000 to 0.005 in.) less than measured clearance.

   a. Install bearing cap without shims. Tighten three capscrews to 20 N•m (15 lbf ft). Rotate spindle, then tighten capscrews to 20 N•m (15 lbf ft) again. Loosen capscrews and tighten again to 14 N•m (10 lbf ft). Measure gap. Install correct amount of shims to equal the gap. Tighten capscrews to 77 N•m (56.8 lbf ft).

4. Install new O-ring, grease plate and three capscrews to top of steering frame. See Figure 13.

5. Install tie rod as described in Tie Rods procedures.

6. Repeat procedure for other spindle.

7. Install hubs and wheels as described in Wheels and Hubs, Assemble and Install.

STEERING AXLE (A674)

Remove

WARNING

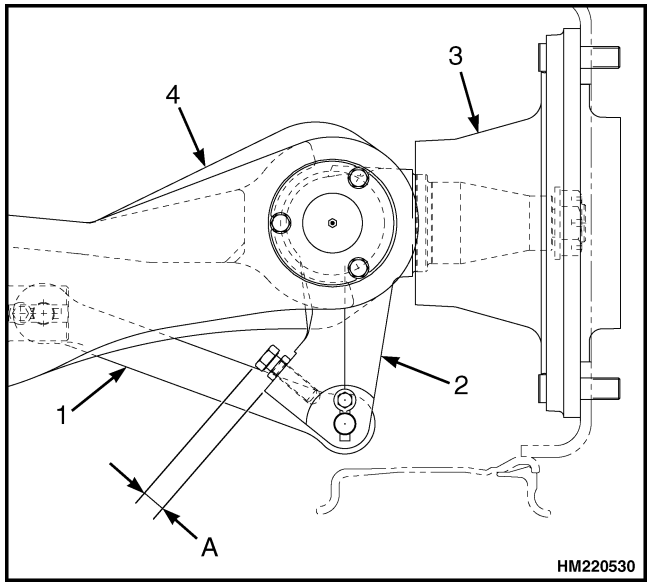
Put the lift truck on blocks. Follow the procedures for raising the lift truck described in the Operating Manual for this lift truck. The surface must be solid, even, and level. Ensure the blocks are solid, one-piece units. Ensure the lifting devices used during repairs can lift the weight of the parts.

WARNING

Completely remove the air from the tire before removing the tire and wheel from lift truck. Air pressure in the tires can cause the tire and wheel parts to explode, causing serious injury or death.

NOTE: The steering axle can be removed without removing the counterweight.

1. Remove the steer wheels. Raise axle to remove weight from tires, but have tires still touching the floor. Loosen wheel nuts just enough so they can be easily removed. Raise axle further so tires can be removed. Use a tire jack to remove tires and wheels.



A. ADJUSTMENT

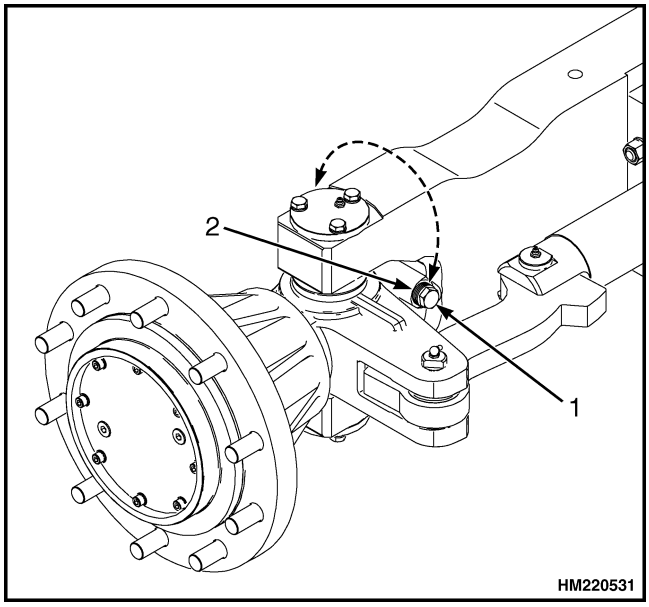
1. TIE ROD
2. SPINDLE
3. WHEEL HUB
4. STEERING AXLE

Figure 26. Steering Angle Adjustment (G876/G877/A674)

MAXIMUM STEERING ANGLE ADJUSTMENT (A674)

1. The turning radius of the truck can be changed by differently positioning the washers which support the adjusting bolt. See Figure 27.

2. A shorter turning radius is obtained by moving more washers from the front side to the rear side of the spindle. The maximum allowable number of washers at the rear side is 7.



1. ADJUSTING BOLT
2. WASHERS

Figure 27. Steering Angle Adjustment (A674)

Torque Specifications

STEERING CONTROL UNIT

Capscrews, Cover (Final Torque Value)
30 N•m (265 lbf in)

Capscrews, Manifold Block
40 N•m (30 lbf ft)

STEERING AXLE

Capscrews, Bearing Cap
77 N•m (56.8 lbf ft)

Castle Nut (Final Torque Value)
3 N•m (25 lbf in)

Capscrews, Steer Axle Mount
270 N•m (199 lbf ft)

WHEEL NUTS

Drive Wheels (Final Torque Value)
615 to 710 N•m (454 to 524 lbf ft)

Steer Wheels (Final Torque Value)
615 to 710 N•m (454 to 524 lbf ft)

STEERING CYLINDER

Capscrews, Steer Cylinder Mount
435 N•m (321 lbf ft)

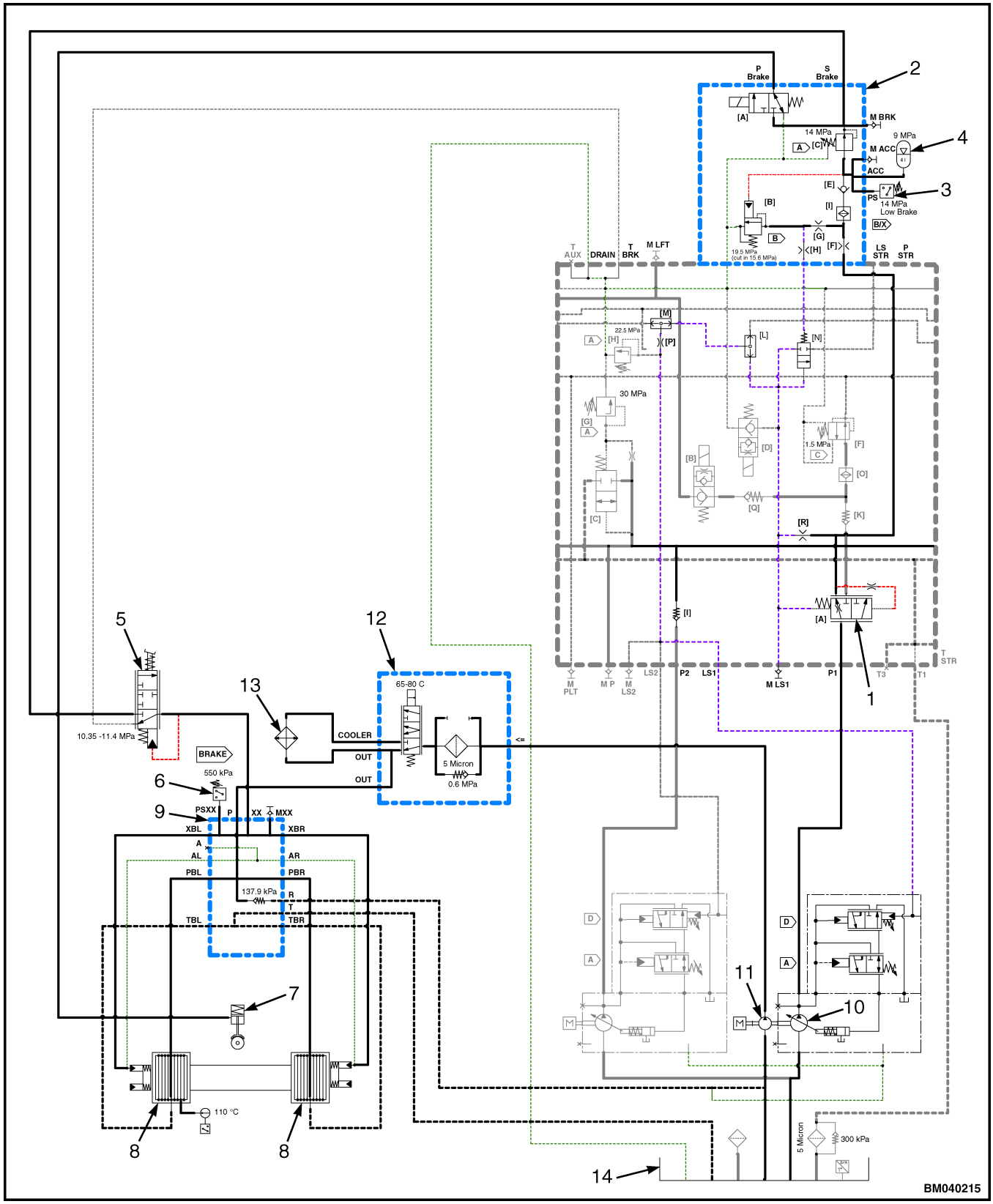
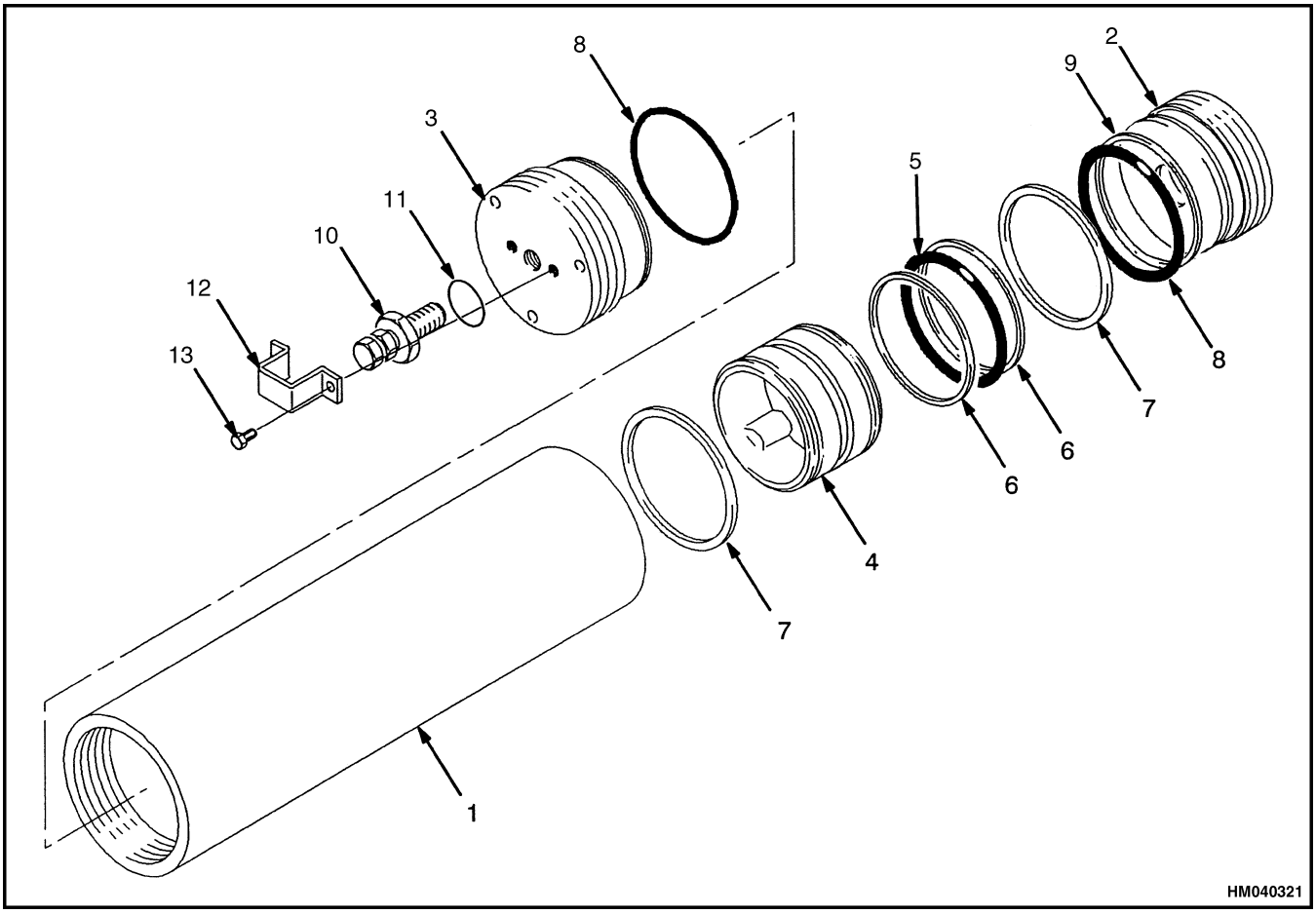


Figure 1. Brake System Schematic



1. SHELL
2. HYDRAULIC END CAP
3. GAS VALVE CAP
4. PISTON
5. V O-RING
6. BACKUP WASHER
7. WEAR RING
8. O-RING
9. BACKUP WASHER
10. GAS VALVE
11. O-RING
12. GAS VALVE GUARD
13. SCREW

Figure 6. Removing Gas Valve

11. Remove the O-ring from the gas valve.

12. Install three pins into the holes in the gas cap.

13. Using a long bar, work against the pins to unscrew the gas cap from the shell.

14. Install three pins into the holes in the hydraulic cap.

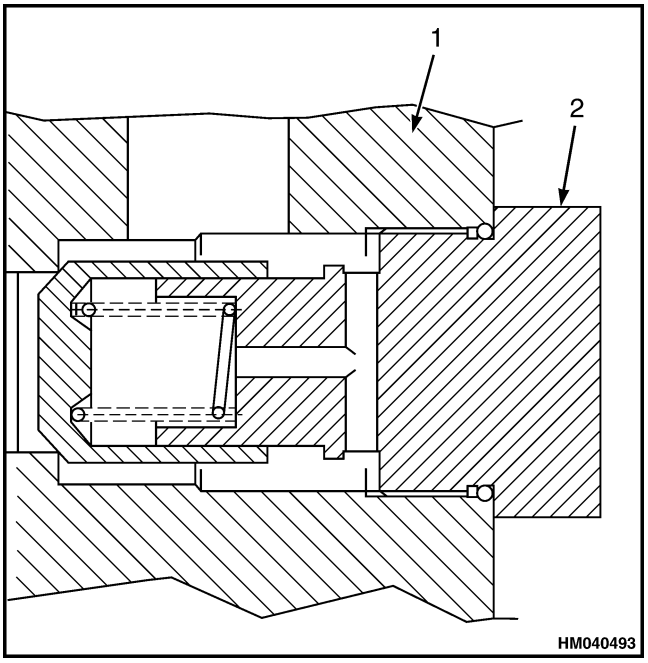
15. Using a long bar, work against the pins to unscrew the hydraulic cap from the shell.

16. Remove the O-ring and O-ring backup washer from the gas cap and hydraulic cap.

17. Remove the piston by pushing a bar into the shell from the hydraulic cap location.

18. Remove the wear rings from the piston.

19. Remove the V O-ring and V O-ring backup washers from the piston with a smooth pointed instrument by moving the tool around the piston while pushing the V O-ring from the piston.



1. BRAKE FLOW DISTRIBUTION MANIFOLD
2. REMOVABLE CARTRIDGE

Figure 15. Brake Flow Distribution Manifold

CLEAN AND INSPECT

1. Inspect the brake flow distribution manifold bore for scratches and corrosion. Use a fine emery cloth to remove scratches or corrosion.

ASSEMBLE

NOTE: Always use new O-rings.

1. Install the new O-ring(s) to the cartridge. See Figure 15.

2. Install the cartridge in the brake flow distribution manifold and tighten. Refer to the section Torque Specifications for the correct torque procedure.

INSTALL

1. Position the brake flow distribution manifold to the inside of the frame. Install the four capscrews and washers that retain the brake flow distribution manifold to the inside of the frame.

2. Remove the cap from the hydraulic hoses and the open ports of the brake flow distribution manifold.

3. Connect the hydraulic hose that leads to the gear pump to the brake flow distribution manifold and tighten the hose clamp.

4. Connect the brake hoses to the brake flow distribution manifold, according to the identification tags. Refer to the section Torque Specifications for the correct torque procedure.

5. Connect the coolant supply and return hoses to the brake flow distribution manifold, according to the identification tags. Refer to the section Torque Specifications for the correct torque procedure.

6. Connect the hydraulic return line filter hose, hydraulic brake treadle valve hose, and hydraulic brake cooling valve hose on top of the brake flow distribution manifold, according to the identification tags. Refer to the section Torque Specifications for the correct torque procedure.

7. Install the hydraulic plate inside the frame. Refer to the manual **Hydraulic System** 1900YRM1934. .

CAUTION

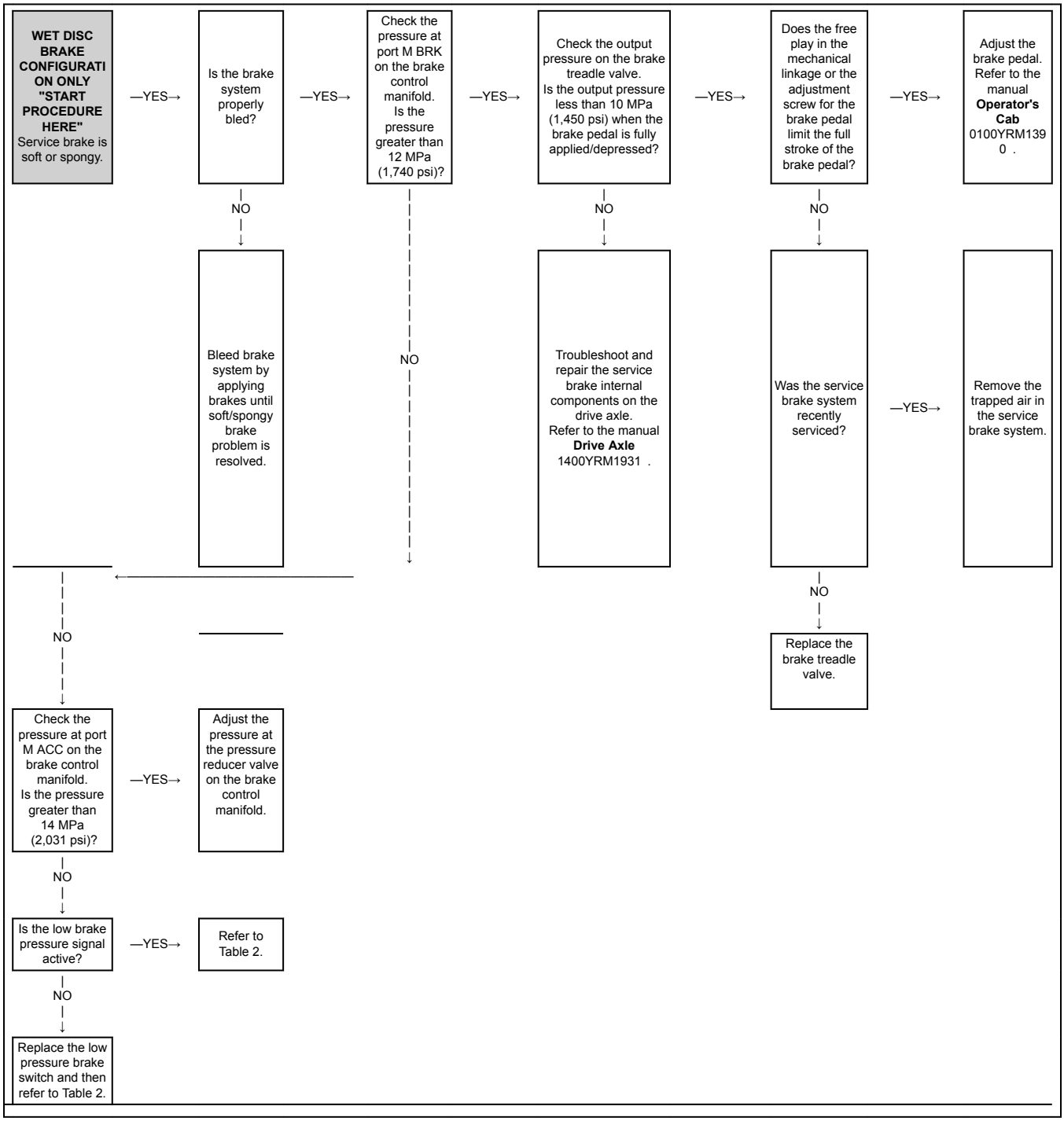
Use a filtration system when filling the hydraulic tank to prevent dirt and contamination from entering the hydraulic system. If dirt or contamination enters the hydraulic system, damage may occur to the components of the hydraulic system.

8. Fill the hydraulic tank with clean hydraulic oil as specified in the maintenance table. Refer to the manual **Periodic Maintenance** 8000YRM1939 for A674 **Periodic Maintenance** 8000YRM1983.

9. Lower the cab until it is in the fully lowered and latched position. Refer to the manual **Operator's Cab** 0100YRM1390.

10. Operate the brake system and check for leaks.

Table 3. Service Brake Is Soft or Spongy



SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Yale® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **YALE APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

Example 1

No hydraulic function selected:

Required function pressure (P2) = 0 bar (0 psi)

LS pressure regulator (D) preset setting = 30 bar (435 psi)

System pressure (P1) = 30 bar (435 psi)

Example 2

Hydraulic function selected:

Required function pressure (P2) = 100 bar (1450 psi)

LS pressure regulator (D) preset setting = 30 bar (435 psi)

System pressure (P1) = 130 bar (1885 psi)

BASIC PRINCIPLES OF PRESSURE CONTROL SYSTEMS

NOTE: It is strongly recommended that this section is read from the beginning (Direct Acting Relief Valves) through the end (Pressure Reducer Valve) without skipping over sections.

This section explains the basic principles of pressure control systems.

Pressure control valves (relief valves) are used in hydraulic systems to perform the following functions:

- Limit maximum system pressure in a hydraulic circuit or subsystem to provide overload protection.
- Provide resistance to flow at a different selectable pressure range.
- Reduce/lower pressure from the main hydraulic system to a lower pressure in a subsystem.

For the definition of some of the terms used in this section, refer to Table 2.

Table 2. Definition of Terms

Term	Definition
Relief Valve	Limits the maximum allowable pressure in the hydraulic system and will direct part or all of the hydraulic pump flow to the hydraulic tank when the preset pressure setting is reached.
Cracking Pressure	The pressure at which the relief valve begins to open and divert flow to the hydraulic tank.
Full Flow Pressure	The measured system pressure when all of the hydraulic pump flow is diverted by the relief valve to the hydraulic tank.
Pressure-Rise	The difference between the full flow pressure and the cracking pressure.
Metering In	Hydraulic oil flow into the actuator.
Metering Out	Hydraulic oil flow out of the actuator.

PRIORITY VALVE (A)

Fundamentals

Priority valves are based on pressure compensated flow control valves. For additional information on flow control valves, refer to the section Basic Principles of Flow Control Systems.

Description

The priority valve prioritizes the oil flow, ensuring adequate flow to the steering system and brake accumulator charging system at all times.

Operation

When steer and/or Brake Accumulator Charge function are operated, the (highest) load sense pressure of these functions is directed to the Priority Valve and the Primary Variable Displacement pump.

Due to this Load Sense pressure the primary Variable Displacement pump will supply the requested flow to the Priority Valve.

The priority Valve will ensure adequate flow is supplied to the priority functions by maintaining a fixed pressure drop over the priority functions. When the Primary Variable Displacement pump supplies more flow than requested by the priority function the Priority Valve will direct the excessive flow to the main pressure/supply gallery of the Main Control Valve.

Component Functionality Test

To functionally test this component, see Priority Valve (A), for component removal, inspection, functionality test, and reinstall information.

CHECK VALVE (I)

NOTE: Check Valve (I) is **NOT** applicable for single pump configuration.

Function Description

Check Valve (I) prevents oil back flow from entering into the Secondary Variable Displacement pump, during periods when only the Primary Variable Displacement pump is operating.

Function Operation

Check Valve (I) prevents oil being supplied by the Primary Pump from entering into the secondary pump, creating system instability and pump damage.

Component Functionality Test

To functionally test this component, see Check Valve (I), for component removal, inspection, functionality test, and reinstall information.

PILOT SUPPLY CIRCUIT

Function Description

The pilot supply system controls the pilot pressure to the lift, tilt, and auxiliary sections.

When the engine is running, pressure is supplied to the pilot supply circuit by the Primary Variable Displacement Pump through Priority Valve (A).

When the engine is not running, pressure from the Lift Cylinders is supplied to the pilot supply circuit through Selector Valve (B). The selection of Selector Valve (B) is done by the Hydraulic Controller, when the ignition key is **ON** and the Hoist Lever is selected to the lower position.

PILOT SUPPLY VALVE (F)

Fundamentals

Pilot supply valve (F) is a pressure-reducer valve based on a pressure control valve. For additional information on pressure control valves refer to the section Basic Principles of Pressure Control Systems.

Function Description

Pilot Supply Valve (F) provides constant pilot pressure to the Directional Control valve End Caps, ensuring accurate, positional control of the main spools.

Additional information about the Directional Control Valve and the Electrical Actuation Module (Solenoid End Cap) can be found on Directional Control Valve Section and Electrical Actuation Module (Solenoid End Cap).

6. Remove the four capscrews and isolators retaining the hydraulic plate to the frame of the lift truck. See Figure 19.

7. Lift the complete assembly hydraulic plate and hydraulic control valve attached and place on flat surface.

8. Remove the four retaining screw that retain the hydraulic valve to the hydraulic plate. See Figure 19.

9. Pull the hydraulic control valve from the hydraulic control plate.

10. Place the hydraulic control valve on a flat surface for disassembly.

11. Remove the two capscrews that retain the brake control manifold to the Main Control Valve and set it aside for reassembly. See Figure 20.

Inspect

1. Inspect load sense selector valve (D) and coil for damage or abnormal wear.

Assemble

1. Replace the O-rings. See Figure 31.

Install

1. Install load sense selector valve (D) back into the Main Control Valve. Torque to 35 to 40 N•m (26 to 30 lbf ft). See Figure 21.
2. Install coil back onto valve and torque nut to 4 to 6 N•m (35 to 53 lbf in). See Figure 21.

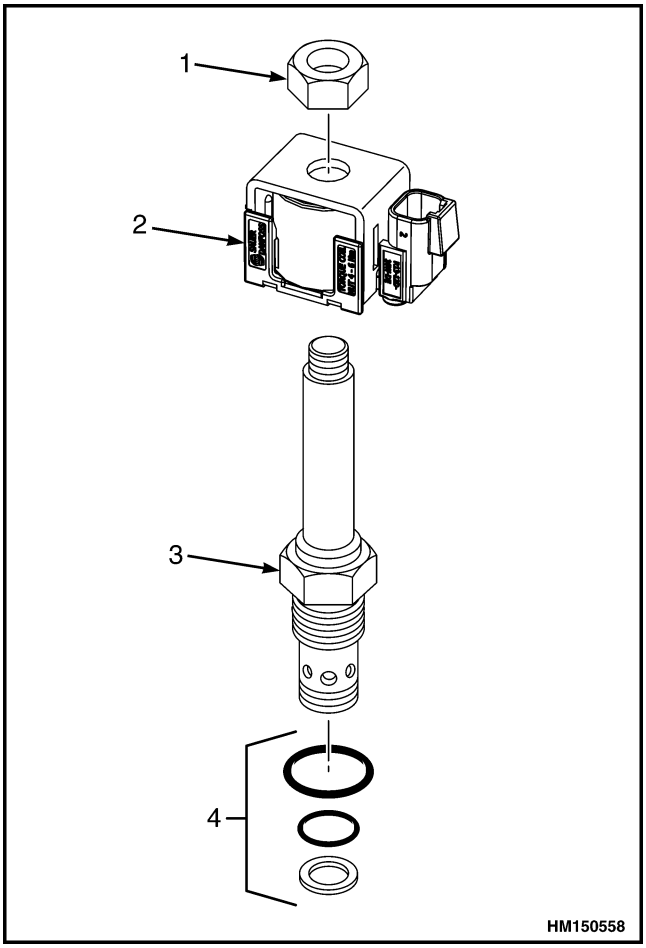
LIFT PRESSURE SELECTOR VALVE (B)

Remove

1. Remove the nut that retains the coil to the Lift Pressure Selector Valve (B), see Figure 32.
2. Remove lift pressure selector valve (B) from the Main Control Valve Mid Section. See Figure 21.

Clean

1. Remove the old O-rings and clean the valve with a petroleum based solvent. See Figure 32.



1. NUT
2. COIL
3. LIFT PRESSURE SELECTOR VALVE (B)
4. O-RINGS

Figure 32. Lift Pressure Selector Valve (B)

Inspect

1. Inspect lift pressure selector valve (B) and coil for damage or abnormal wear.

Assemble

1. Replace the O-rings. See Figure 32.

Install

1. Install lift pressure selector Valve (B) back into Main Control Valve. Torque to 35 to 40 N•m (26 to 30 lbf ft).
2. Install the coil back onto valve and torque the nut to 4 to 6 N•m (35 to 53 lbf in).

WARNING

- **Wear safe eye protection.**
- **Wear clothing that protects your 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. Follow the manufacturer's instructions carefully.**

CAUTION

- **Use only solvent cleaners to clean ground or polished metal parts. Hot solution tanks or water and alkaline solutions will damage these parts. Isopropyl alcohol, kerosene, or diesel fuel can be used for this purpose.**

1. Make sure to remove all old O-rings.

Inspect

1. Inspect end cap for damage or abnormal wear.

Assemble

1. Replace all O-rings.

Install

1. Hook the main spool correctly in the Manual End Cap. When main spool is not correctly hooked in the Manual End Cap it will result in unintended function movement. Place the Manual End Cap on the valve assembly.
2. Place the Manual End Cap on to the valve assembly. Install top two capscrews and hand tighten to hold in position. See Figure 43.
3. Install remaining capscrews and torque all four in a X pattern to ensure even torque. Refer to the section Torque Specifications for the correct torque procedure.

Troubleshooting

LIFT, TILT, AND/OR AUX FUNCTION DOES NOT MOVE WHEN APPLIED. STEERING IS OPERATING NORMAL.

NOTE: Turning the ignition key OFF will reset the LEDs.

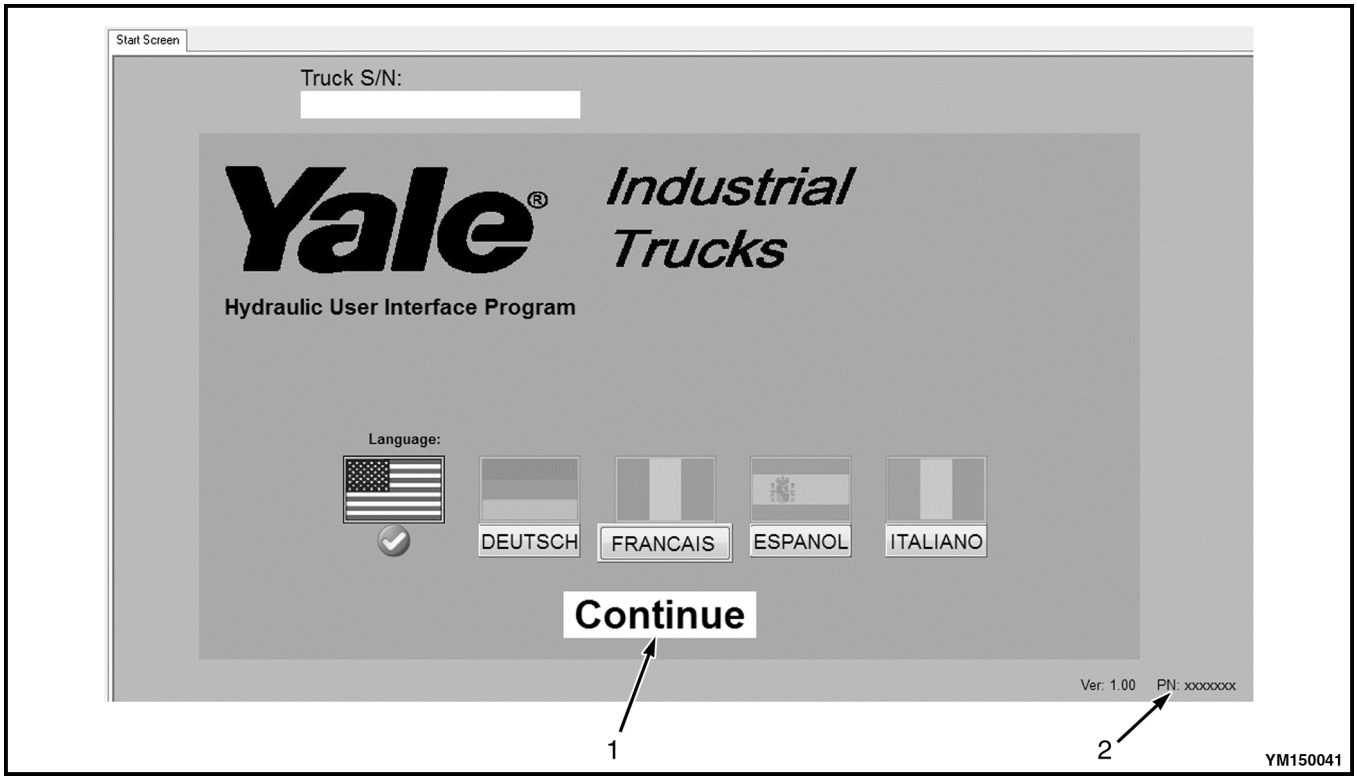
1. Check which LEDs are illuminated on the Electrical Actuation Modules (End Caps) on each Main Control valve section. Are the LEDs green? If yes, go to Step a. If no, go to Step 3.
   a. Are any of the Electrical Actuation Modules (End Caps) leaking? If yes, go to Step b.
   b. Measure pilot pressure at MPLT. Is pilot pressure higher than 1.6 MPa (232 psi)? If yes, go to Step c. If no, replace leaking Electrical Activation Module (End Cap).
   c. Replace leaking Electrical Activation Module (End Cap). Check if pilot pressure at MPLT is not higher than 1.5 MPa (217 psi).
2. Measure pressure at MPLT. Is pressure at MPLT above 1 MPa (145 psi)? If yes, go to Step a. If no, go to Step b.
   a. Check the flow output values of the hydraulic controller to the main valve (refer to Hydraulic Flow Control Settings.
   b. Replace Pilot Supply Valve (F).
3. Is LED flashing RED? If yes, go to Step a. If no, go to Step 4.
   a. Validate electric input signals of this specific Electrical Actuation Module.
4. Is LED constant RED? If yes, go to Step a. If no, Resume operation.
   a. Turn ignition key **OFF**. Add spanner/ manual lever to the connection point on the side of the mechanical end cap. Is it possible to smoothly rotate the spanner for 15 degrees both ways? If yes, go to Step b. If no, go to Step c.
   b. Replace Electrical Activation Module (End Cap).
   c. Replace the Directional Control Valve Section.

Start Screen/Language Selection

The start screen is the first screen shown when starting the Hydraulic User Interface Program. In this screen the user can select the desired language. See Figure 4.

Once the language is selected, click on the Continue button (1) to proceed to the next screen.

The start screen also contains the part number (2) of the diagnostic file.



1. CONTINUE BUTTON
2. PART NUMBER

Figure 4. Start Screen

Drive/Hydraulic Priority

The Drive Over Hydraulics feature makes it possible to accelerate the truck while lifting a load. The feature reduces hydraulic lift, tilt and auxiliary take-off in the lower engine speed range while driving. The amount of Drive vs Hydraulics can be adjusted in the drop down box. The default setting is neutral. If the application requires more drive than hydraulic capability, select the Drive priority. If the application requires more hydraulic capability than drive, select the hydraulic priority. See Figure 24.

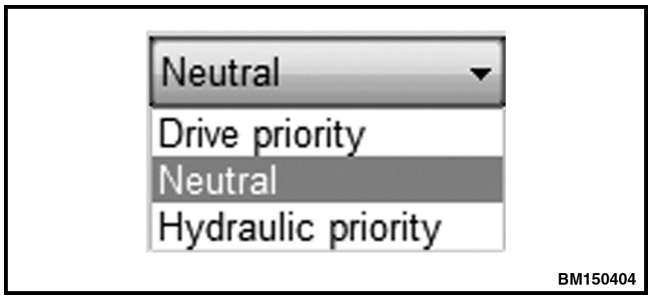


Figure 24. Drive/Hydraulic Priority Selection

Automatic Throttle Up

The Automatic Throttle Up feature controls engine speed depending on the lever position of a proportional hydraulic function. Automatic Throttle Up is only active if the transmission is in neutral or if the inching pedal is depressed. Automatic Throttle Up is enabled by default for all engine types. By clicking the function icon (see Figure 25) the Automatic Throttle Up selection screen is opened. See Figure 26.

In the Automatic Throttle Up selection screen the feature can be disabled per sub-function.

The three sub functions are:

- Lift (Typically the 1st lever or joystick back/forth)
- Tilt (Typically the 2nd lever or joystick left/right)
- Auxiliary (Typically the 3rd and 4th lever or joystick thumbwheel and joystick rotate)

HIP/ECO Operating Mode

The HIP/ECO key switch is available on Tier 4 engine types only. This key switch allows the selection of either the HIP (High Performance) Operating Mode or the ECO (Economy) Operating Mode.

The High Performance Operating Mode is the normal operating mode. In the ECO Operating Mode the maximum engine speed is reduced and engine response is more gentle, which results in an improved fuel efficiency.

The key switch is located in the side console and has a label which indicates the key positions to select one of the two operating modes.

Functionality of the key switch can be disabled in the Hydraulic User Interface program, which results in a continuous activation of the of the High Performance Operating Mode, irrespective of the key switch position.

Figure 25. Link to Automatic Throttle Up Selection

The HCU expects 0V on C1-p6 to deactivate the Lower Interrupt. If the Lower Interrupt doesn't work or is active when it should not be, check the wiring to the HCU (See **Diagrams** 8000YRM1938).

CONTROLLER INFORMATION

In the Controller Information screen the user can find details about the software and hardware revisions of the HCU. See Figure 41.

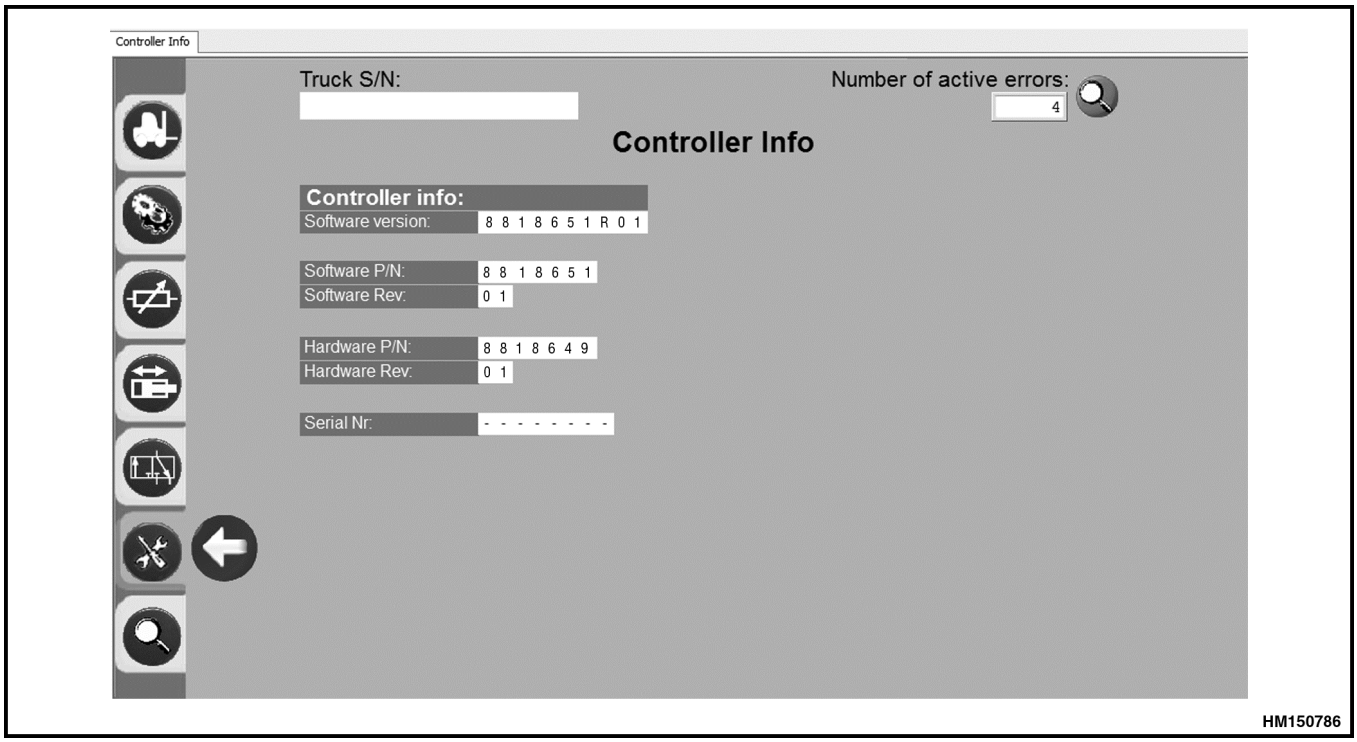


Figure 41. Controller Information Screen

Table 4. Fork Lift Truck With Alternating PT (Continued)

Pin	Type	Controller Function
C1-P9	Sensor Power Ground -	Sensor Ground
C1-P10	NA	AUX 2A switch
C1-P11	NA	AUX 1 inhibit switch (Optional)
C1-P12	NA	AUX 3A switch
C1-P13	DIN	Reserved for Container Handler
C1-P14	NA	AUX 2B switch
C1-P15	NA	AUX 3B switch
C1-P16	DIN	Error Status PVE Actuator – Lift1
C1-P17	DIN	Error Status PVE Actuator – Lift2
C1-P18	DIN	Error Status PVE Actuator – Tilt
C1-P19	DIN	Error Status PVE Actuator – Aux
C1-P20	NA	NA
C1-P21	NA	NA
C1-P22	NA	NA
C1-P23	DIN/AIN	Joystick/Lever Lift
C1-P24	DIN/AIN	Joystick/Lever Lift
C1-P25	NA	NA
C1-P26	DIN	Additional Speed Limiter (Optional)
C1-P27	NA	NA
C1-P28	DIN	HIP/ECO Mode Switch
C1-P29	NA	NA
C1-P30	AIN	Pressure Sensor Lift Section (optional)
C1-P31	Rheostat	Hydraulic Tank Oil Temperature
C1-P32	Rheostat	Hydraulic Brake Oil Temperature
C1-P33	NA	Aux1 solenoid
C1-P34	NA	Aux0 solenoid
C1-P35	NA	Aux3 solenoid
C1-P36	NA	Aux2 solenoid
C1-P37	NA	NA
C1-P38	NA	NA
C1-P39	PVE Power	Power Supply PVE Actuators
C1-P40	DOUT	Emergency Lowering Valve
C1-P41	PWMOUT	PVE Actuator - Lift
C1-P42	DOUT	Dynamic Pump Control Solenoid
C1-P43	PWMOUT	PVE Actuator - Tilt
C1-P44	PWMOUT	PVE Actuator - Aux

The Truck Configuration screen will display. See Figure 54.

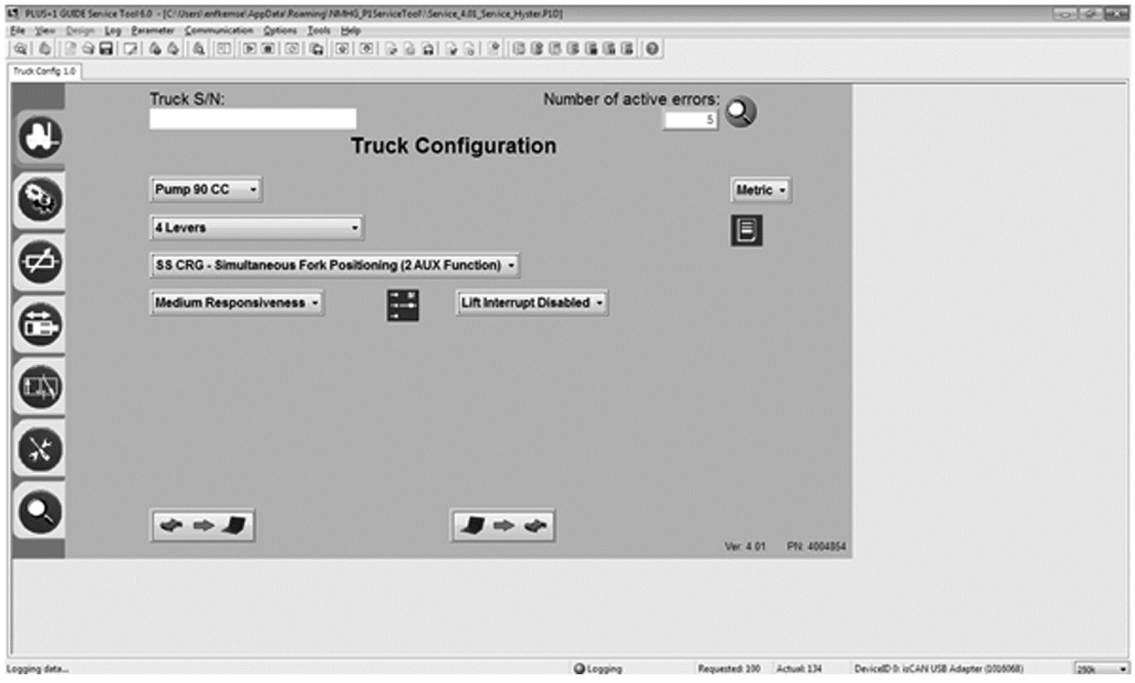


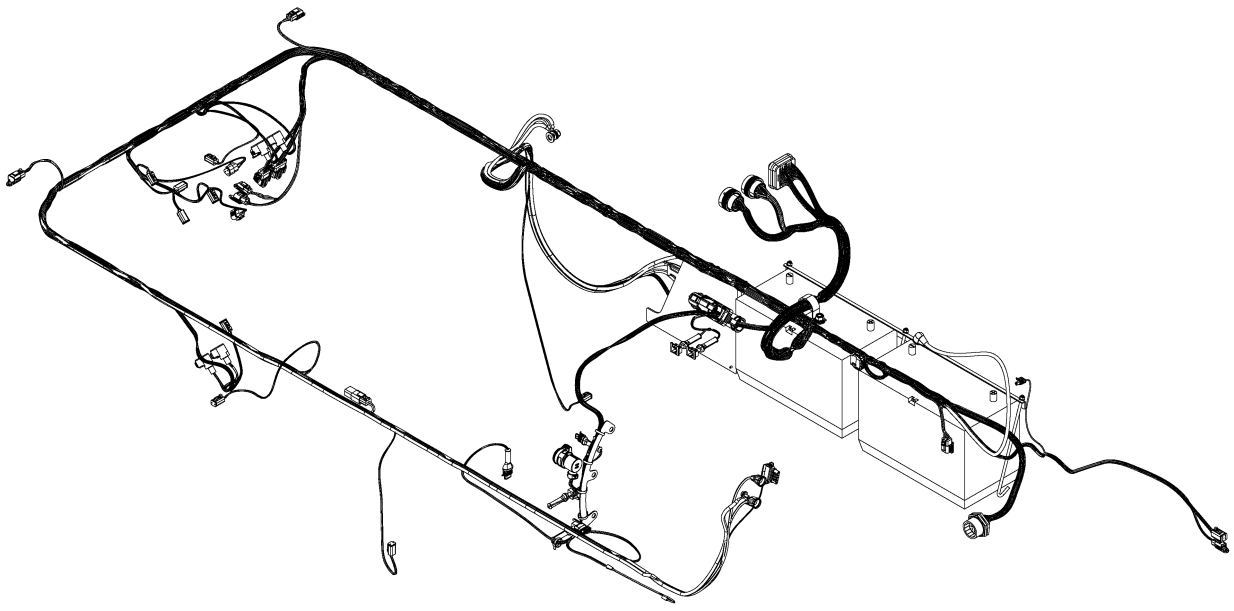
Figure 54. Truck Configuration Screen

Yale®

Maintenance

ELECTRICAL SYSTEM

GDP80-120DC, GDP100DCS (GDP190-280DC, GDP230DCS) [G876];GDP130-160EC (GDP300-360EC) [G877];GDP160-12EC, GDP180-7.5EC (GDP180-9EC, GDP160-9EC) [A674]



PART NO. 550123397

2200 YRM 1936

Legend for Figure 2.

1. FRAME
2. SIDE CONSOLE
3. CAB POWER
4. CAB SIGNALS
5. AUX SIGNALS
6. REAR
7. POWERTRAIN
8. POWERED CAB TILT
9. MAST WORK LIGHTS
10. MAST WORK LIGHTS RH
11. MAST WORK LIGHTS LH
12. MAST
13. FRONT-END
14. MAST ECH
15. FRONT LIGHTS LH
16. FRONT LIGHTS RH
17. HOOD SPINE
18. ENGINE
19. DEF
20. ECM
21. EAS/ECM
22. TWIST MODULE
23. ECO-ELO/HIP
24. ARM REST
25. ECH ADAPTOR
26. CAB UNDERFLOOR
27. STEERING COLUMN
28. CLOSED CAB
29. CAB LIGHTS LH
30. CAB LIGHTS RH
31. REAR WIPER EXTENSION
32. WASH PUMPS

Not shown in the harness overview and in the 3D-views are harnesses that are merely an extension cord for some of the connectors, or jumpers that connect between wires. The lay-out of these harnesses can be read from the electrical schematic. For the actual location of these harnesses, read the code of the mating connector from the electrical schematic and look up the figure and item number from Connector Overview. For example: the Closed Cab harness connects with the Cab Lights RH, which connects to CPS 64. See Top Cab Harness Connectors.

Not shown on the figures for the frame harnesses are the connectors for engine components such as sensors, fan clutch and grid heater relays.

There are four jumper options:

- Jumper Power Supply by Ignition provides power supply for side, tail and hazard lights when the ignition switch is turned to the ON position. See schematic location [99, H]. This harness is to be plugged into connector CPS651, which connects pin A with pin B.
- Jumper Power Supply by Battery directly provides power supply from the batteries to the circuit for side, tail and hazard lights, allowing activating these lights irrespective of the ignition switch position. See schematic location [98, H]. This harness is to be plugged into connector CPS650, which connects pin B with pin C.
- The strobe light jumper allows activation by ignition by connecting a jumper between pin number 2 and pin 3 of the strobe switch. See schematic location [72, L].
- Operator Presence Switch Jumper, which is removed when connecting the optional seatbelt sequencer.

Harness Interconnection

On the electrical schematic the interconnection between two harnesses is indicated by a harness dividing line, which will run across the two mating harness connectors. See Figure 1, item 15.

ELECTRICAL CONNECTORS

Connector Types

Connector types are identified by letter codes. Multiple pin or socket connectors have a three letter code. Terminators, that are not isolated when detached, have a two letter code. The explanation of the letter codes is shown in Table 4.

Table 4. Connector Types

Letter Code	Explanation
CRP	Connector Receptacle Pin
CRS	Connector Receptacle Socket
CPP	Connector Plug Pin
CPS	Connector Plug Socket
TS	Terminal Socket
TP	Terminal Pin

Table 8. Legend for Central Warning Lights and Instrument Panel (Continued)

Item	Description	Pin Number	Central Warning Light	Buzzer
14	Parking Brake Warning Light	7	----	----
15	Battery Voltage Gauge & Low Battery Voltage Warning Light	1	●	----
16	Fuel Level Gauge & Low Fuel Level Warning light	24	●	----
17	**Tier 3/Stage IIIA**: Engine Oil Pressure Gauge & Low Oil Pressure Warning light	CAN	●	●
	Tier 4F/Stage IV: Engine Diesel Emission Fluid (DEF) Level Gauge & Low DEF Level Warning Light	CAN	●	----
18	Seat Belt Warning Light	2	----	----
19	Engine Fuel Filter Water Separator Warning Light	CAN	●	
20	Engine Coolant Low Level Warning Light	CAN	●	●
21	Engine Oil Low Pressure Warning Light	CAN	●	●
22	Engine Air Filter Restriction Warning Light	20	●	----
23	Engine Wait To Start Warning Light	CAN	----	----

Instrument Panel Connectors

The instrument panel connects with the system through connector CPS94, which is located at the rear of the instrument panel. See Figure 9 and Table 9.

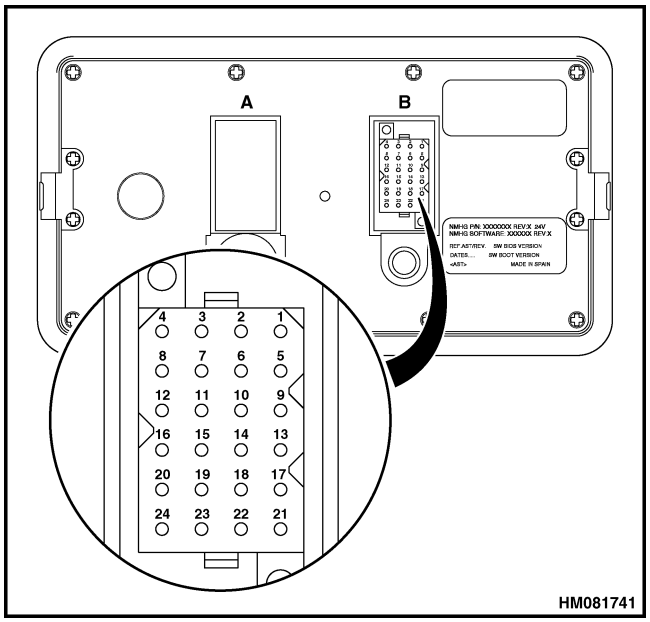


Figure 9. Instrument Panel Connectors

Table 9. Pin Descriptions

Pin	Description
1	Battery positive input (Diagnostic Switch)
2	Seat switch input

Table 10. Connector Overview (Continued)

Connector	Description	Location	Harness
CRP17	Rear LIght	[88,I], [89,G]	Tail Light
CRP175	ECO-eLo/HIP	[102,H]	ECO-Elo/HIP
CRP18	Rear Light	[88,I], [89,G]	Tail Light
CRP183	LUBRICATION PUMP	[187,D]	Lubrication Pump
CRP184	LUBRICATION SWITCH	[188,D]	Lubrication Switch
CRP21	Mast_L-RH-Mast_Lts	[95,I]	Mast Light Extension
CRP28	Wsh_Pumps-SideConsole	[155,G]	Wash_Pumps
CRP30	SteerColumn-Underfloor	[116,I], [161,B], [69,D], [92,J]	Steer Column
CRP300	BACKUP_ALARM	[84,F]	Rear
CRP33	Underfloor-Sideconsole	[115,H], [154,G], [164,B], [26,I], [30,I], [67,G], [82,H], [91,G]	Cab Underfloor
CRP35	Aux_Signals	[108,D], [114,D], [147,F], [42,B]	Sideconsole
CRP420	Seat_Belt_Switch	[122,I]	Armrest
CRP440	Seat_Switch	[122,J]	Armrest
CRP49	LH_Marker_Lights-LH_Lts	[87,A]	Frame Lights
CRP55	Mast_Lts_LH-Mas_Lts	[96,H]	Mast Light Extension
CRP60/61	Front_Lights-Frame	[86,C], [86,E]	Front Drive Light
CRP62	Hydraulics-Frame	[131,F], [127,A], [112,F]	Hydraulics
CRP63	SideConsole-Closed_Cab	[153,G], [164,G], [173,D], [73,G]	Sideconsole
CRP64	RH_Cab_Lights	[76,E]	Closed Cab/Open Cab
CRP65	LH_Cab_Lights	[76,G]	Closed Cab/Open Cab
CRP650	Lights_Jumper	[97,G]	Sideconsole
CRP660	Speed_Lim_Jumper	[103,B]	Sideconsole
CRP67	RH_Marker_Lights-RH_Lts	[87,E]	Side Indicator
CRP68	Rear-Frame	[84,I]	Rear
CRP69/72	Tail_Lights	[87,I]	Tail light
CRP70	Eng_Shut-down_Jumper	[25,C], [27,C]	Sideconsole
CRP72	LH_Tail_Lights	[87,J], [151,F]	Tail light
CRP74	Wiper_Rear-Sideconsole	[150,G]	Rear Wiper Extension

Table 15. Legend for Side Console Harness Connectors (Continued)

Item	Connector	Description
40	CPS33	Side Console - Underfloor
41	CRP34	Diode Calibration
42	CPS39	Lights Diode
43	CRP81	Side Console - Arm Rest
44	CPS37	Fuses 1-10
45	CPS50	Fuses 11-20
46	CPS51	Fuses 21-30
47	CPS109	Fuses 31-40
48	CPS53	Attachment Lights Switch
49	CPS52	Side/Front Lights Switch
50	CPS48	Flood/Rear Drive Lights Switch
51	CPS47	Beacon/Strobe Switch
52	CPS77	Hazard Switch
53	CPS87	Regeneration Enable/Disable Switch
54	CPS25	Diagnostic Switch

Tire Sizes

NOTE: Refer to Truck Nameplate for correct tire pressure.

Model	Tire Size	Tire Pressure
GDP/GLP80-90DB (GDP/GLP190-210DB)	9.00 × 20-14 ply	900 kPa (130 psi)
GDP/GLP100-120DB (GDP/GLP230-280DB)	10.00 × 20-16 ply	900 kPa (130 psi)
GDP/GLP100-120DB (GDP/GLP230-280DB)	12.00 × 20-16 ply	1000 kPa (145 psi)
GDP/GLP130-160EB (GDP/GLP300-360EB)	12.00 × 20-16 ply	1000 kPa (145 psi)
All Michelin XZM Radial Tires		1000 kPa (145 psi)

Hydraulic System

Item	Quantity
Cummins Diesel Hydraulic Pump Capacity @ 2300 rpm	
90 cc (3 oz)	196 liter/min (51.7 gal/min)
120 cc (4 oz)	262 liter/min (69.2 gal/min)
25 cc (0.8 oz) Wet Brake Cooling Pump	57 liter/min (15.0 gal/min)
Relief Pressures *	
Main Control Valve	22.5 MPa (3262.5 psi)
Steering Circuit	16 ±1 MPa (2320 ±145 psi)
*Oil temperature 20°C (68°F)	

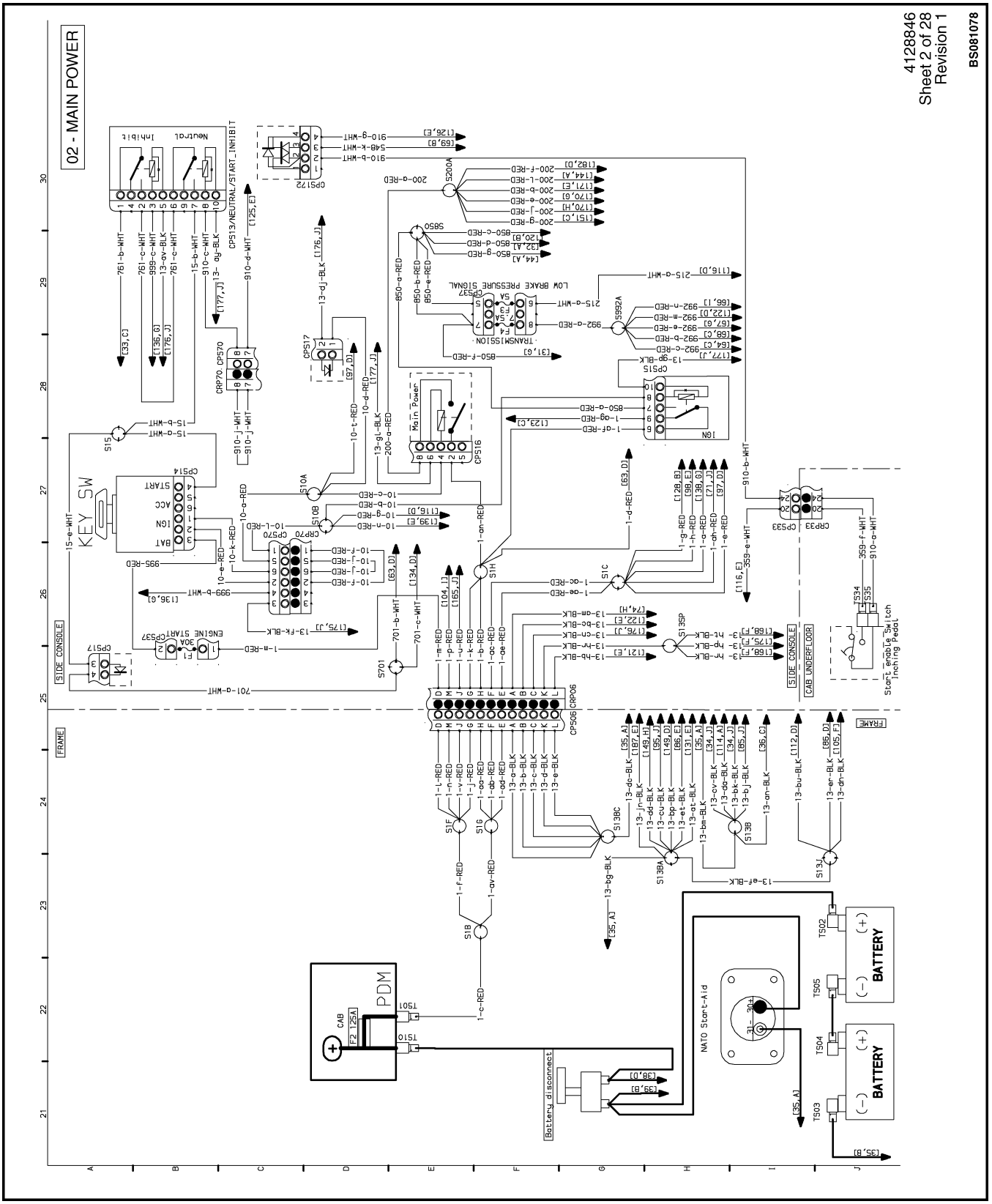


Figure 1. Electrical Schematic T3/T4 Final (Sheet 2 of 28)

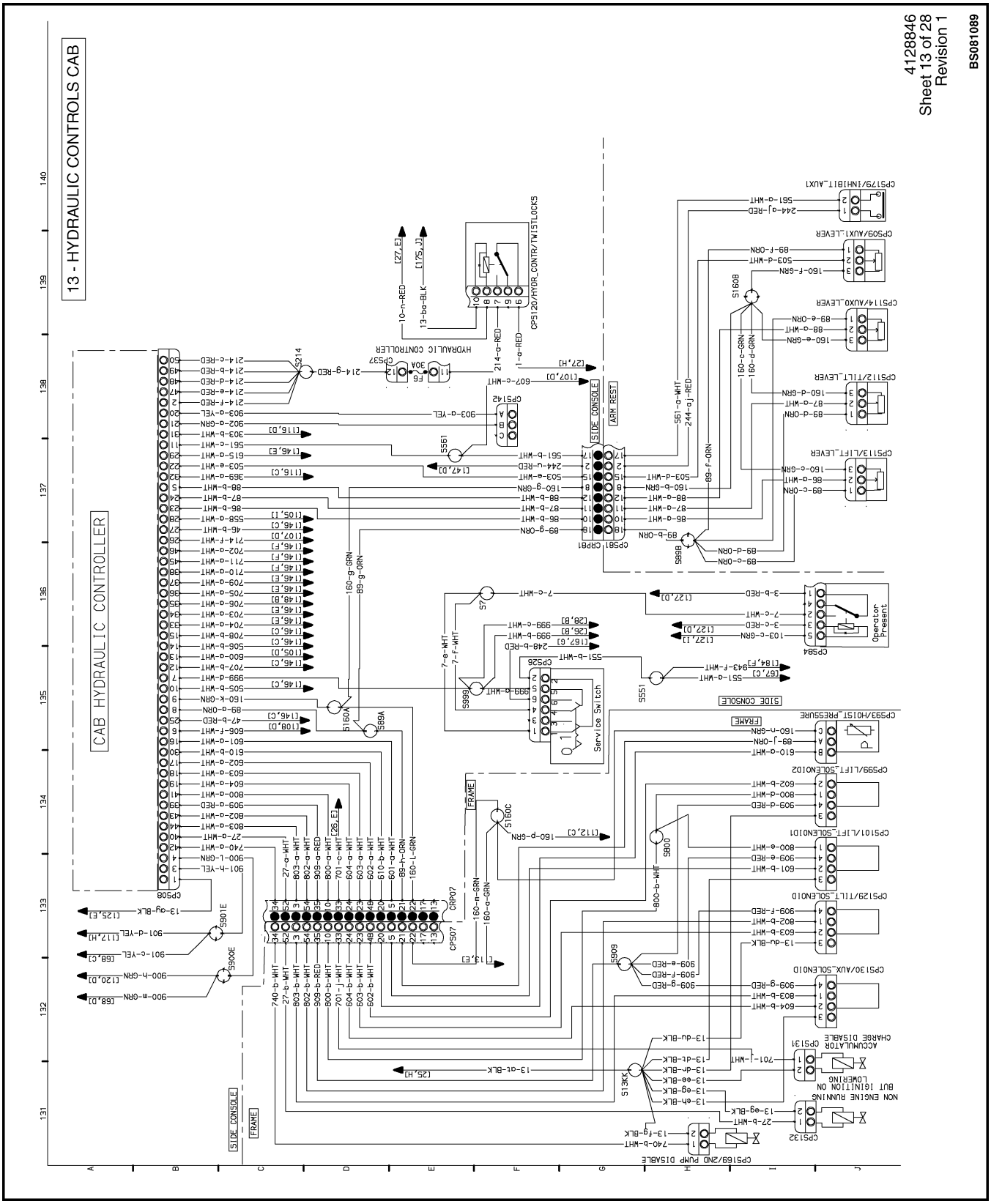


Figure 1. Electrical Schematic T3/T4 Final (Sheet 13 of 28)

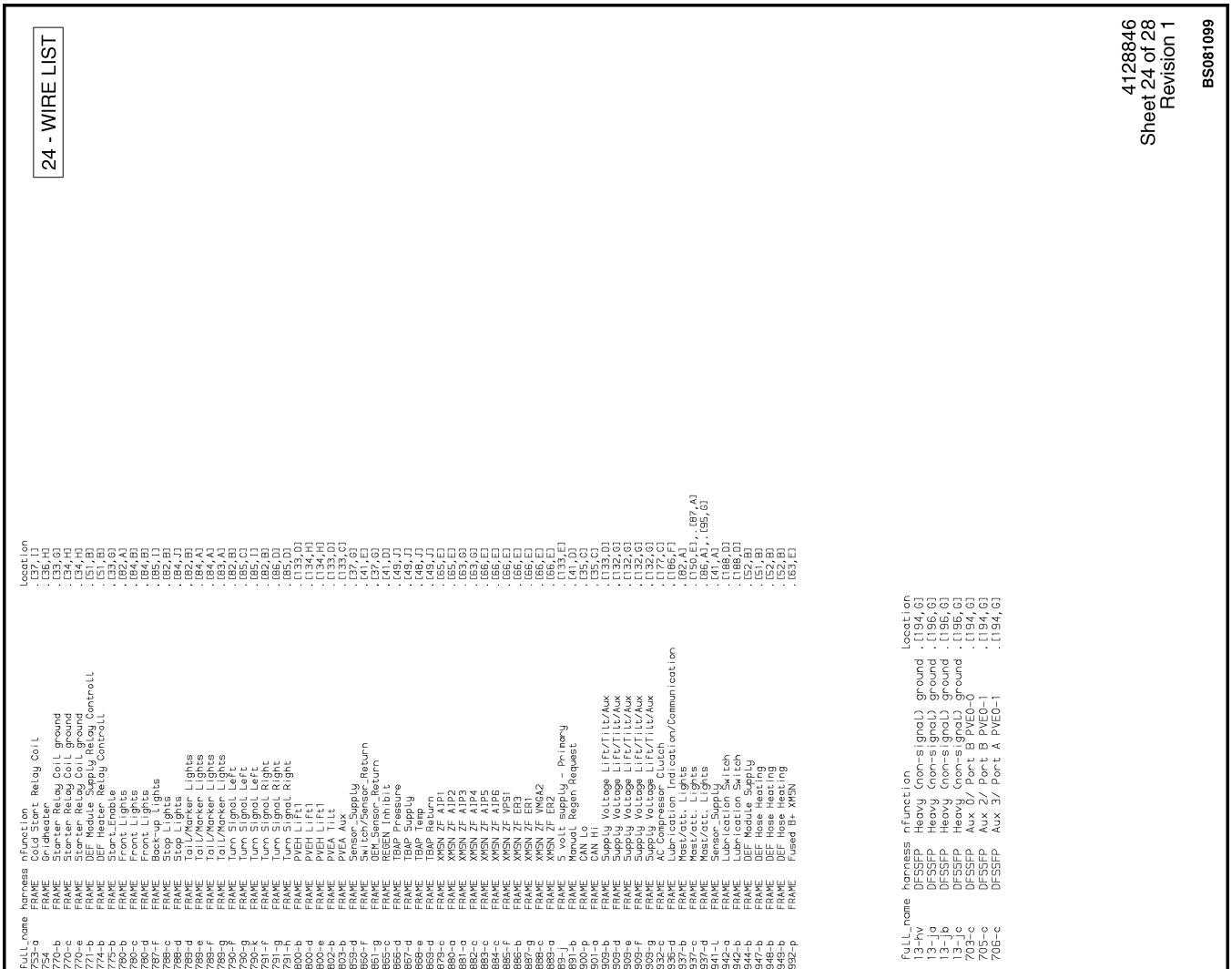
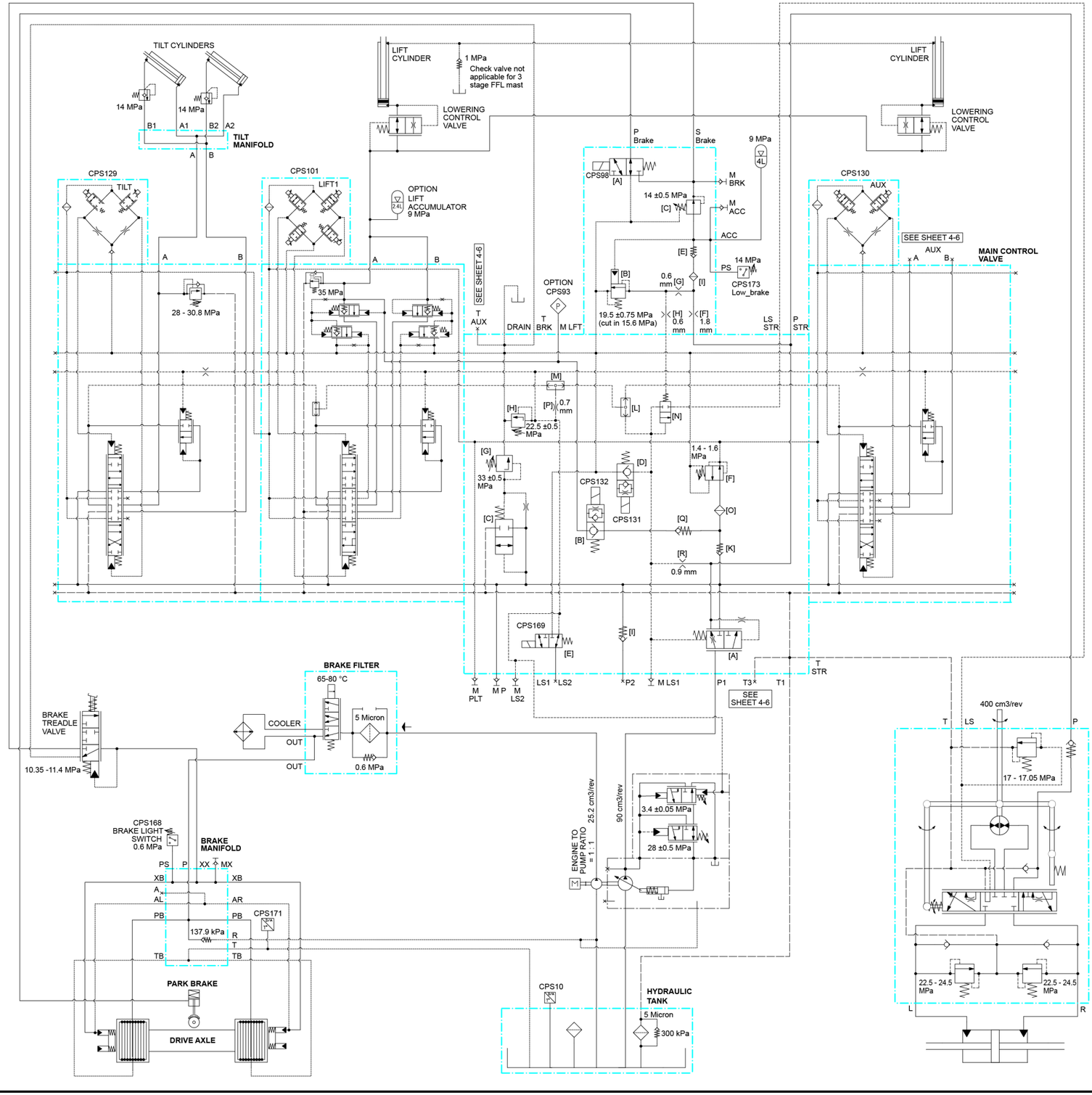


Figure 1. Electrical Schematic T3/T4 Final (Sheet 24 of 28)



Legend

——— = Pressure line
– – – – = Tank Return line
..... = Drain line
..... = Pilot line
- - - - = LS line
—·— = Valve Boundary

Pressure settings and system back pressures as specified on this circuit are component settings set at an oil temperature of 60° C and engine running at idle.

The next list indicates the system setting(s) that can be measured at the measuring ports that are available in the system:

MPLT: Pilot Pressure 1.5 ±0.1 MPa measured during lift (No load)
MP: Pump pressure in Pressure Gallery
MLS1: LS signal supplied by steering and charging to pump
LS relief steering system 17 - 18 MPa
MLS2: LS signal supplied by Lift/Tilt/Aux/Steering/Charging to pump
LS relief 22.5 ±0.5 MPa

M BRK : Supply pressure to brake pedal 14 ±0.5 MPa
M ACC : Pressure in accumulator, cut out pressure 19.5 ±0.75 MPa, Accumulator pre-charge pressure 9 ±0.75 MPa
M XX : Output pressure brake pedal max. applied between 10.34 - 11.4 MPa

MAIN CONTROL VALVE
Component reference

Centre Section

Item:	Description:
[A]	Priority Valve
[B]	Emergency Pilot Pressure Valve
[C] + [G]	Full Flow Relief Valve
[D]	Transmission Calibration Valve
[E]	Second Pump Disable Solenoid
[F]	Pilot Pressure Reducer Valve
[H]	Load Sense Relief Valve

Brake Section

Item:	Description:
[A]	Park Brake Selector Valve
[B]	Accumulator Charging Valve
[C]	Brake Pressure Reducer Valve

90 cm3 Pump Option

4112015
Sheet 1 of 6
Revision 1

BS081104

Figure 3. Hydraulic Schematic (Pump Option) (Sheet 1 of 3)

TABLE OF CONTENTS (Continued)

Daily Fluid Level Checks

Table 2. Daily Fluid Level Checks

Daily Fluid Level Checks	Procedure	Page
Windshield Washer Fluid Level	• Check level in reservoir. Add fluid as required.	See Page 45
Hydraulic System Oil	• Check level indicator with mast fully lowered. • Add hydraulic oil as required through the tank return filter and record added volume and hour meter reading. Use JDM-J20C ISO VG46.	See Page 32
Coolant Level	• Check level at the expansion tank. • Add coolant as required and record added volume and hour meter reading. For coolant see Approved Oils, Fluids, and Grease.	See Page 18
Engine Oil Level	• Maintain level at two/thirds of full range on dipstick when cold. See Approved Fuel and Engine Oils for required specifications.	See Page 26

Daily Checks from the Driver Seat with Engine Running

NOTE: First read Safety Procedures Before Starting Maintenance and Daily Checks from the Driver Seat with Engine Running.

Table 3. Daily Checks from the Driver Seat with Engine Running

Daily Checks from the Driver Seat with Engine Running	Procedure	Page
Operator Restraint System	• Check condition and operation of seat belt, seat rails and steering column latch. Repair as required.	See Page 39
Horn, Gauges, Lights, Alarms and Control System	• Visual and audible verification. Repair as required.	See Page 31
Fault Codes	• The display should be free of fault codes. The central warning light will be **ON** when a fault code is shown. • Stop the engine when the Engine Stop Warning Light is **ON**. Report any fault code to have the fault diagnosed and repaired.	See Page 28
Engine Air Filter	• Replace Main Filter Element when warning light is **ON**, and record hour meter reading. • • Also replace the Safety Element at every third replacement of the Main Filter Element. See **Parts Manual**.	See Page 24

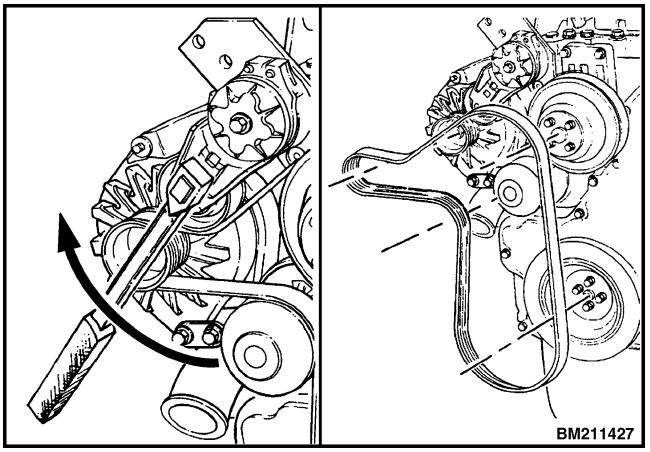


Figure 10. Drive Belt

Pulley Alignment

Use a straightedge and an inclinometer to establish misalignment between the belt and the different pulleys. Maximum misalignment is 3 degrees. See Figure 11.

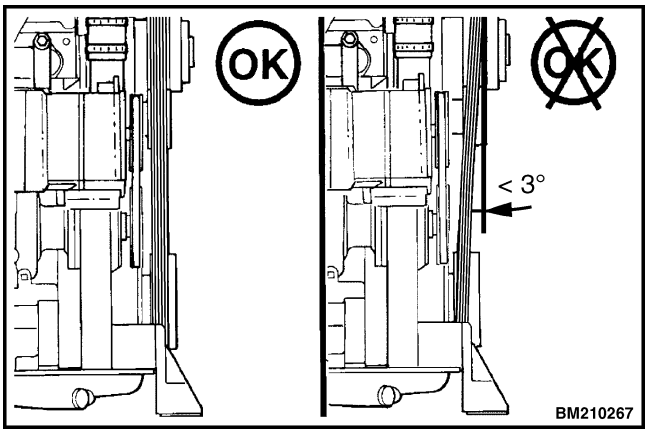


Figure 11. Pulley Alignment

Tensioner Condition

1. Check that neither the top nor bottom tensioner arm stop is touching the cast boss on the tensioner body. If either of the stops is touching a cast boss, the drive belt must be replaced. Make sure that the correct belt part number is being used if either condition exists. See Figure 12.

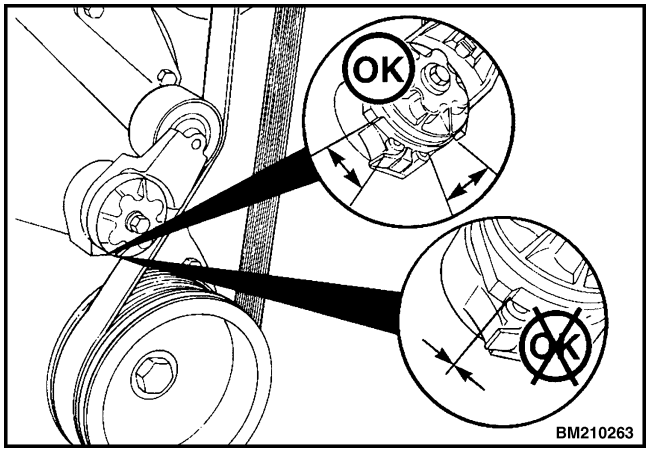


Figure 12. Cooling Fan Belt Tensioner Arm Stops with Drive Belt

2. Remove the drive belt from the tensioner. Verify that the bottom tensioner arm stop is in contact with the bottom tensioner arm stop boss on the tensioner body. If these two are not touching, the tensioner must be replaced. See Figure 13.

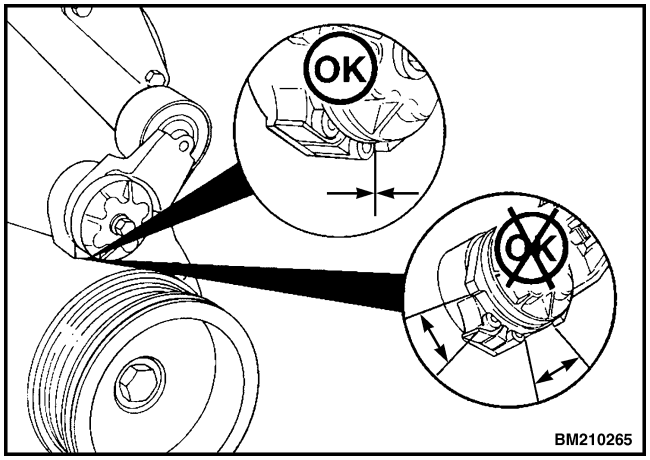
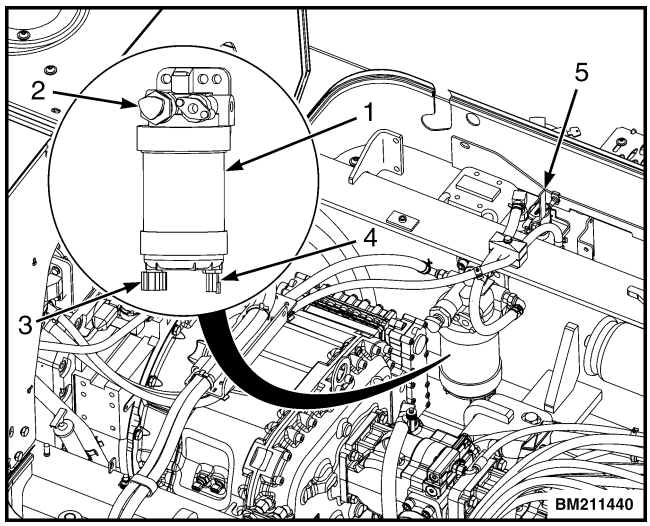


Figure 13. Cooling Fan Belt Tensioner Arm Stops without Drive Belt

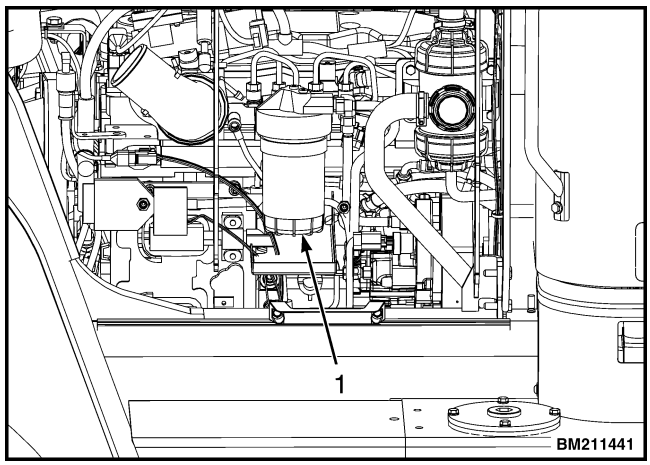
3. Check the tensioner pulley and body for cracks. If any cracks are noticed, the tensioner must be replaced. See Figure 14.

- Install the new fuel/water separator and reconnect the connector.
- Open the fuel shutoff valve.
- Rotate the handpump at the filter head until it springs open.
- Operate the handpump at the filter head until fuel escapes from the de-aeration plug.
- Push and rotate the handpump to lock the hand pump.



1. FUEL/WATER SEPARATOR
2. HANDPUMP
3. DRAIN VALVE
4. ELECTRICAL CONNECTOR
5. SHUTOFF VALVE

Figure 35. Fuel/Water Separator



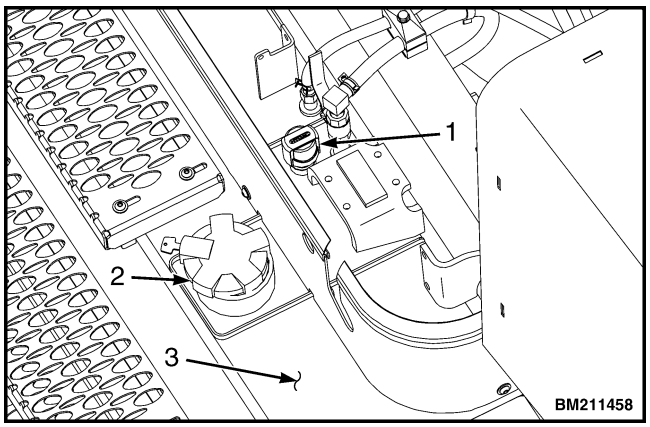
1. FINAL FUEL FILTER

Figure 36. Final Fuel Filter

FUEL TANK BREATHER

Every 5,000 Hours

Use a spanner to remove and replace the breather. See Figure 37.



1. FUEL TANK BREATHER
2. FUEL TANK FILL CAP
3. FUEL TANK

Figure 37. Fuel Tank Breather

HEADER HOSE ASSEMBLY

Daily and Every 250 Hours

1. Check if hoses are aged, kinked, crushed or twisted.

2. Check the hose covers for cuts, cracks, or exposed reinforcement.

3. Check proper hose tension.

4. Check hoses and fittings for hydraulic leaks.

5. Check the clamps and sheaves for defective or broken parts.

6. Check proper tracking during operation.

Adjust, or replace components as required. For procedures see **2-Stage Mast** 4000YRM1647.

HORN, GAUGES, LIGHTS, ALARMS AND CONTROL SYSTEM

Daily and Every 250 Hours

Turn the key to the **ON** position. Verify that all warning lights and indicator lights will light up. After two seconds all warning lights will be **OFF**, except for the Wait to Start Light , Central Warning Lights, Brake

1. Clean all parts with solvent. Make sure bearings are clean and dry.

2. Inspect the bearings, bearing cups and seal. Replace as required. Use appropriate pushers when replacing cups with a press.

3. Inspect spindle and hub for cracks and damage. Ensure spindle and hub do not have any rough or sharp areas that would prevent the bearings from being correctly installed. If required, smoothen any rough or sharp areas before installing the bearings.

4. Inspect the contact surface between spindle and seal. Smoothen as required.

Assemble and Install

1. Apply grease and install inner bearing cone and seal on hub. See Approved Oils, Fluids, and Grease. Install the seal in the hub until it almost touches the face of the inner bearing cone.

2. Fill the cavity inside the hub with grease.

NOTE: The hub assembly for this truck model weighs about 60 kg (132 lb). Use a lifting device when installing the hub assembly on the spindle.

3. Use a lifting device to position the hub on the spindle.

4. Install the outer bearing cone, washer and castle nut.

5. Install washer and castle nut. Tighten castle nut to 203 N•m (150 lbf ft) while rotating wheel hub in both directions to properly seat the bearings. Loosen castle until wheel hub turns freely with no end play.

6. Tighten castle nut to 34 N•m (25 lbf ft).

7. Align the castle nut with the cotter pin hole at first alignment position at or above 34 N•m (25 lbf ft) and install and lock the cotter pin.

8. Completely fill hub cap with grease and install cap in hub.

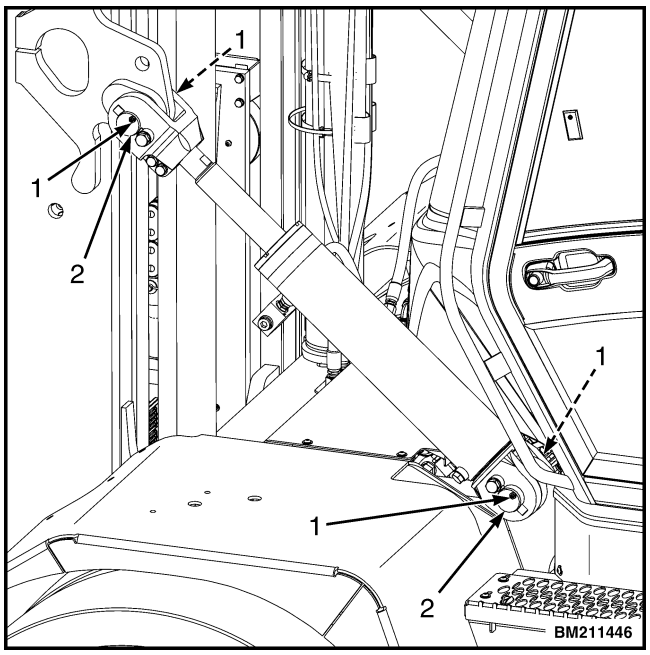
9. Install wheel on hub. Be careful not to damage threads on studs.

10. Start with wheel nut at the top and tighten nuts to 65 to 130 N•m (48 to 96 lbf ft) in sequence shown. Make sure there is no dirt between wheel and hub. The wheel must fit over the pilot surface and be tight against the hub. Tighten nuts to 615 to 710 N•m (454 to 524 lbf ft). See Figure 58.

TILT CYLINDER PIVOT PINS

Every 250 Hours

The tilt cylinder pivot pins have four grease fittings, two fittings per tilt cylinder. The grease fittings are located at the end of each pivot pin. Apply grease until it escapes from the bushings. See Approved Oils, Fluids, and Grease and Figure 49.



1. GREASE FITTING
2. TILT PIVOT PIN

Figure 49. Tilt Cylinder Pivot Pin

TRANSMISSION

Daily and every 250 Hours

Inspect for leaks and check the condition of all hoses and external components of the transmission. Make sure the transmission is shifting smoothly. If a problem is present, report the problem immediately.

Do not operate the lift truck until the problem is corrected.

3. Check that all wheel parts are correctly installed. Hit the side ring and/or lock ring lightly to make sure that it is in the seat.

4. If installation is correct, add air pressure to the tire. The correct pressure is shown on the Nameplate.

5. Check that all wheel parts are correctly installed. If installation is not correct, remove all of the air pressure from the tire. Remove the valve core to make sure all of the air pressure has been removed and make adjustments. The clearance at the ends of the lock ring will be 4 to 14 mm (0.15 to 0.55 in.) when the tire has the correct air pressure.

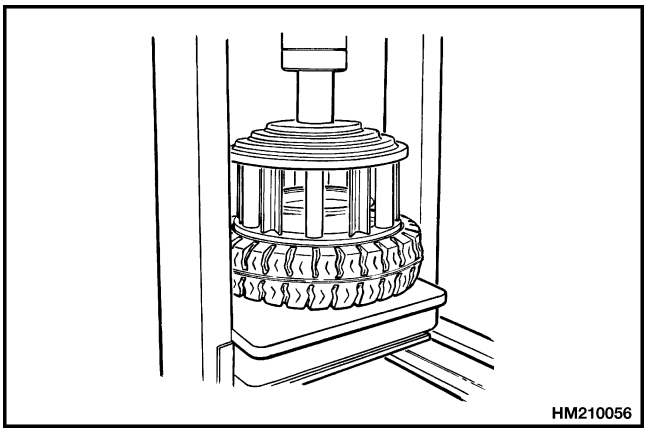
Remove Solid Rubber Tire from Wheel

WARNING

Completely remove the air pressure from the tire before it is removed from the lift truck. If dual wheels are installed, remove the air from both tires. Air pressure in the tires can cause the tire and rim to explode causing serious injury or death.

Keep tire tools in firm contact with the wheel. If the tool slips, it can move with enough force to cause serious injury. See Figure 56.

Always use a cage when removing the solid rubber tire from the rim or personal injury may occur.



NOTE: There are two types of wheels used on this series of lift trucks. If pneumatic shaped solid rubber tires are installed, the four-piece wheel assemblies must be used. If pneumatic tires are installed, the three-piece wheel assemblies must be used. See Figure 56.

STEP 1.
Put the wheel rim on the bed of the press. Put the cage in position on the tire. Use the press to push the tire away from the side ring.

STEP 2.
Put the tire tool into the slot between the side ring and/or lock ring and the wheel rim. Remove the side ring, lock ring, and wedge band.

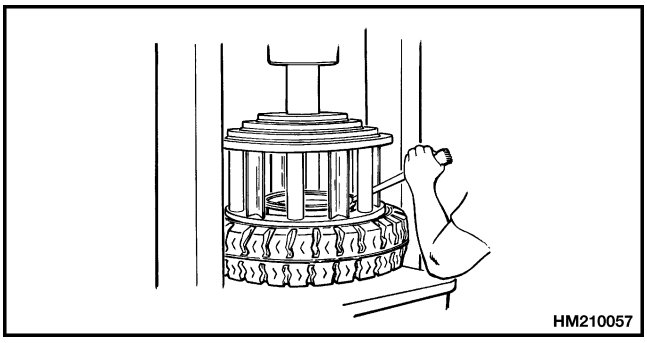
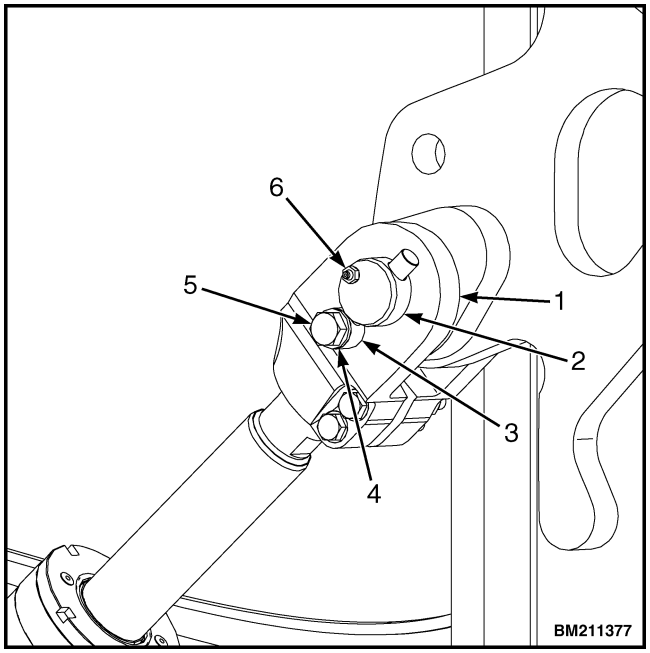


Table 3. Mast (Continued)

Model	Lift Height	Length	Width	Height	Weight	Truck Height
GDP 130-160 EB/EC GDP 300-360 EB/EC 2-Stage NFL	3,660 mm (144 in.)	3,440 mm (135.4 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	2,506 kg (5,524 lb)	3,623 mm (142.6 in.)
	4,560 mm (179.5 in.)	3,890 mm (153 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	2,771 kg (6,109 lb)	4,073 mm (160.3 in.)
	5,310 mm (209 in.)	4,262 mm (167.7 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	3,119 kg (6,876 lb)	4,448 mm (175.1 in.)
	6,110 mm (240 in.)	4,661 mm (183.5 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	3,313 kg (6,862 lb)	4,848 mm (190.8 in.)
	6.610 mm (260.2 in.)	4,912 mm (193.3 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	3,439 kg (7,581 lb)	5,098 mm (200.7 in.)
	6,920 mm (272.4 in.)	5,151 mm (202.7 in.)	1,220 mm (48 in.)	684 mm (26.9 in.)	3,500 kg (7,716 lb)	5,365 mm (211.2 in.)
	9,910 mm (390 in.)	6,646 mm (261.6 in.)	1,220 mm (48 in.)	696 mm (27.4 in.)	4,000 kg (8,818 lb)	6,859 mm (270 in.)
GDP 130-160 EB/EC GDP 300-360 EB/EC 3-Stage NFL	4,310 mm (169.6 in.)	2,880 mm (113.3 in.)	1,500 mm (59 in.)	760 mm (29.9 in.)	3,262 kg (7,191 lb)	3,062 mm (120.5 in.)
	4,910 mm (193.3 in.)	3,080 mm (121.2 in.)	1,500 mm (59 in.)	760 mm (29.9 in.)	3,385 kg (7,462 lb)	3,262 mm (128.4 in.)
	5,910 mm (232.6 in.)	3,413 mm (134.3 in.)	1,500 mm (59 in.)	760 mm (29.9 in.)	3,591 kg (7,916 lb)	3,595 mm (141.5 in.)
	6,910 mm (272 in.)	3,747 mm (147.5 in.)	1,500 mm (59 in.)	760 mm (29.9 in.)	3,997 kg (8,811 lb)	3,930 mm (154.7 in.)



1. ROD END
2. ANCHOR PIN
3. EYE BOLT
4. WASHER
5. CAP SCREW
6. GREASE NIPPLE

Figure 12. Tilt Cylinder Pin

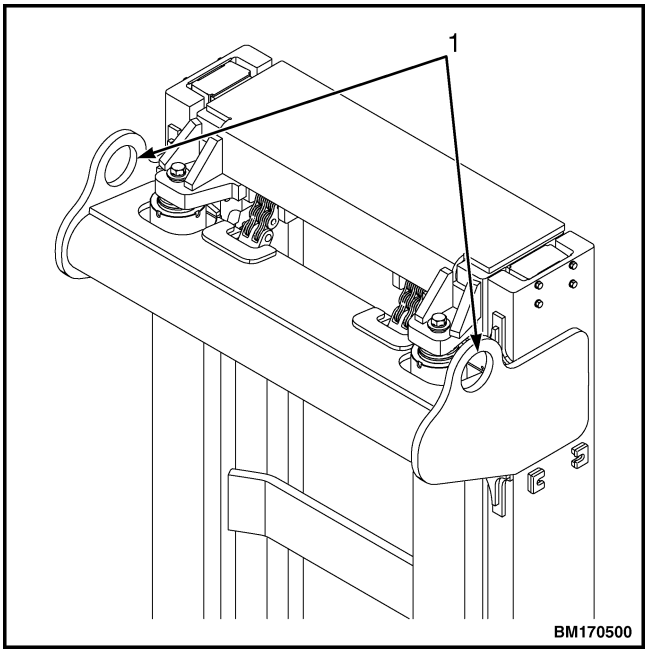
8. Place blocks against both sides (front and back) of the tires to prevent movement of the lift truck.

9. Apply grease to the mast shims to stick them against the RH hanger. Position one shim at the inside and two or three shims at the outside of the RH hanger. Turn the shims with their opening facing up. Do NOT install shims at the LH hanger.

10. Connect a lifting device to the lifting eyes on the outer mast. See Figure 13.

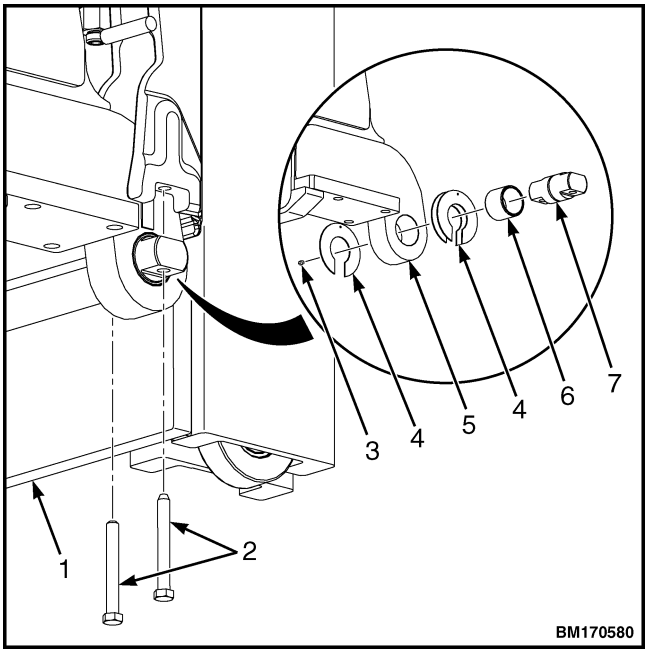
11. Position the mast in front of the truck.

12. Lower the mast hanger on the mast mounting pins. See Figure 14.



1. LIFTING EYES

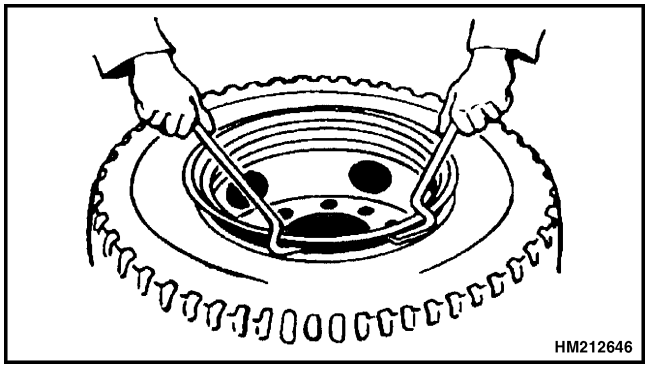
Figure 13. Lifting Eyes



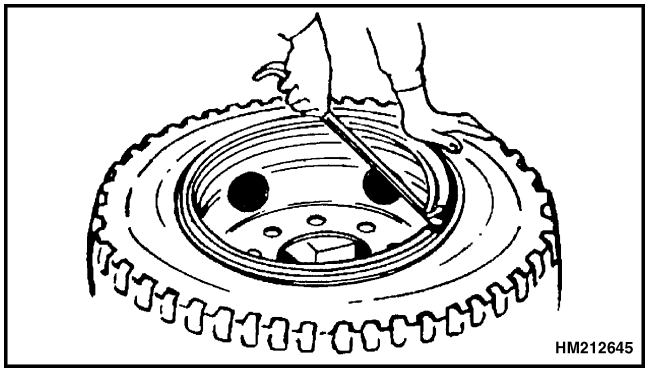
1. MAST
2. CAPSCREWS
3. GREASE FITTING
4. SHIM
5. FRAME
6. BUSHING
7. MAST MOUNTING PIN

Figure 14. Mast Mount to Frame

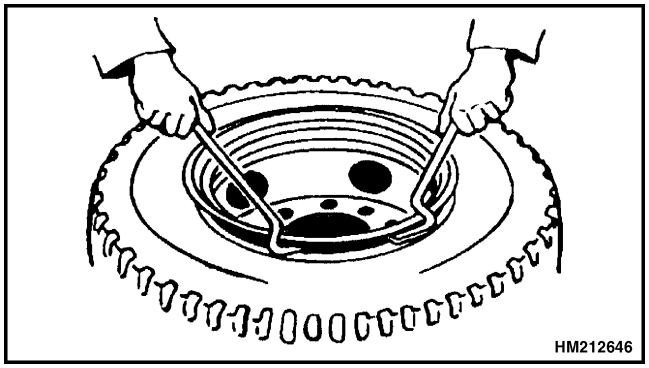
STEP 2.
Loosen the tire bead from the side ring and/or lock ring.



STEP 3.
Put the tire tool into the slot between the side ring and/or lock ring and the wheel rim. Remove the side ring and/or lock ring.

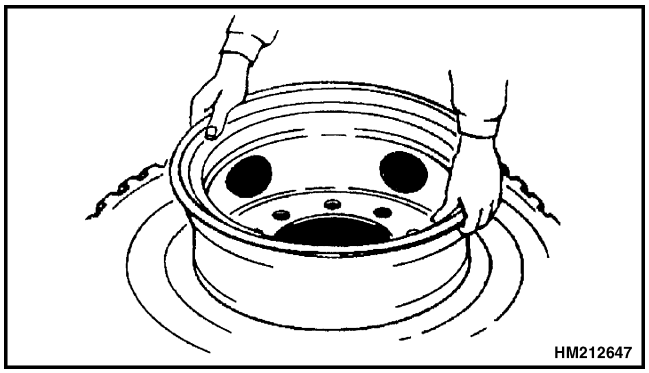


STEP 4.
Turn the tire over. Separate the tire from the wheel rim.



STEP 5.
For tires with an inner tube, push the air valve through the rim opening into the tire.

STEP 6.
Remove the wheel rim from the tire. Remove the inner tube and flap.



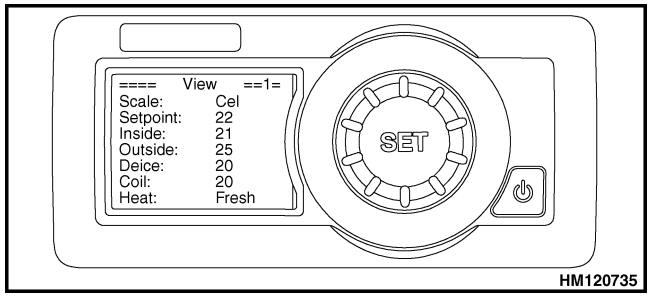


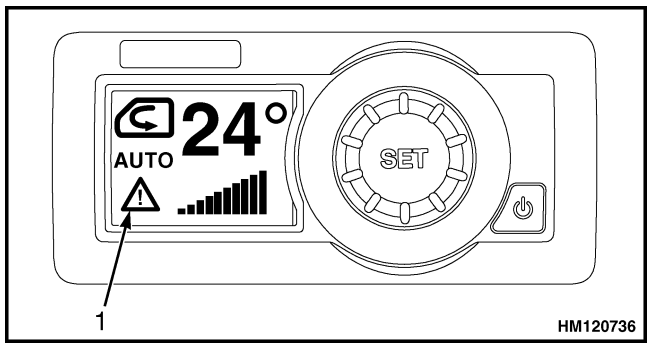
Figure 6. Climate Control View Display

Error Types

1. **Open**: Open circuit error for temperature sensors or heater valve position sensor.
2. **Short**: Short circuit error for temperature sensors or heater valve position sensor.
3. **Stuck**: Heater Valve failure to rotate.
4. **Fault**: A/C system has been disabled due to pressure switch opening four times consecutively. This error locks out the A/C system until the operator manually resets.
5. **PS Low**: Pressure in A/C system is low when compressor clutch turned on.

Error List

The Main Display shows a warning sign in the left hand bottom corner of the Main Display if a fault occurs. See Figure 7.



1. WARNING SIGN

Figure 7. Climate Control Warning

The Error List page shows for each of the temperature sensors and for the water valve the number of occurrences that the connection was shortened or open since the last reset date. For the Water Valve there is an additional indication for the number of times that the Water Valve was stuck. See Figure 8.

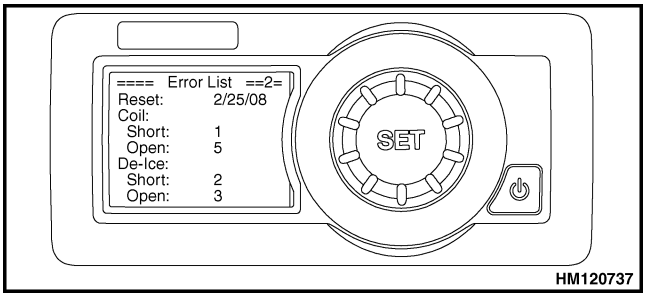


Figure 8. Climate Control Error Display

To further establish the cause of failure, see Temperature Sensors or Water Valve.

To reset the number of occurrences and the reset date, turn the Set Button one click in a counter clockwise direction and push the Set Button for a dialog box. When the dialog box is shown, press the Set Button once to reset all values.

Statistics

The Statistics page shows operating hours and cycle times since the last reset date. To reset the Statistics Page, go to the Error Page, turn the Set Button one click counter clockwise. A dialog box will appear. When the dialog box is shown, press the Set Button once to reset all values. See Figure 9.

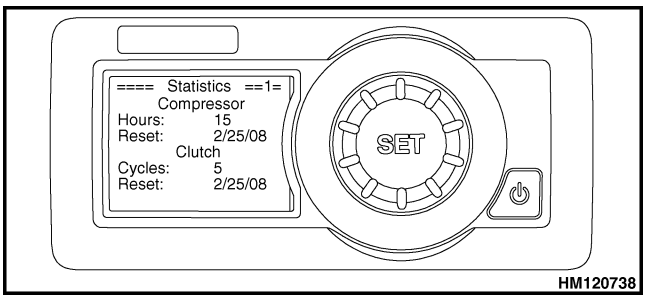


Figure 9. Climate Control Statistics Display

Exit

To leave the Service menu scroll to Exit and push the Set Button.

Temperature Sensors

In addition to the de-ice temperature sensor in the evaporator, there are three further temperature sensors that influence the reaction of the controller: See Figure 10.

- Outside Temperature Sensor, which is located outside the cab under the condenser.

7. Connect the heater inlet hose to the heater core pipe located at the underside of the heater assembly and tighten the hose clamp.

8. Lower the cab to the fully lowered and latched position. Refer to the section Raising and Lowering Cab.

9. Add coolant as needed. Depending on your lift truck see **Periodic Maintenance** YRM .

10. Start the engine and check for leaks. Add coolant as needed.

11. Make sure the heater functions correctly.

Blower

Remove

1. Tilt/raise the cab to the fully open position. Refer to the section Raising and Lowering Cab.

NOTE: The heater assembly fits tightly underneath the cab and will require a limited amount of force to swing the heater assembly down and away from the cab.

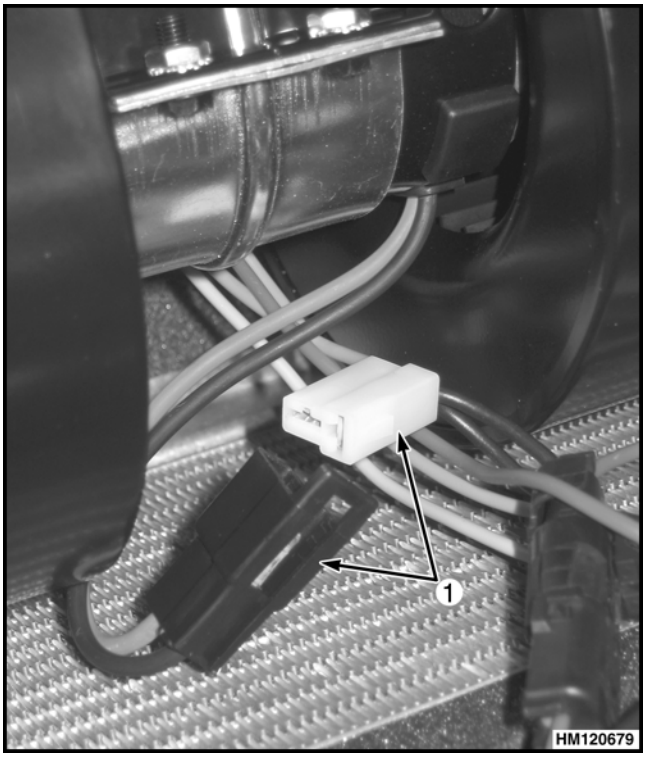
2. Remove the three capscrews that retain the heater assembly to the cab and swing the heater assembly down. See Figure 13 for the location of the capscrews.

3. Remove the 10 screws that retain the top cover to the heater assembly.

4. Remove the top cover from the heater assembly.

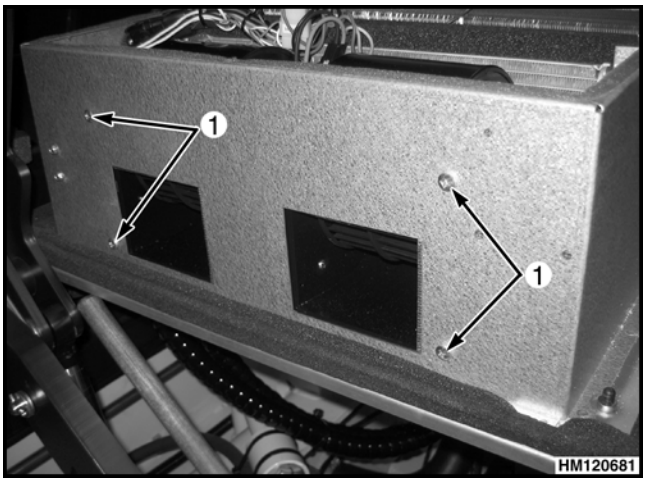
5. Tag and disconnect the electrical connector connected to the blower assembly. See Figure 16.

6. Remove the four screws that retain the blower to the heater assembly housing. See Figure 17.



1. ELECTRICAL CONNECTOR

Figure 16. Blower Electrical Connector



1. BLOWER RETAINING CAPSCREWS

Figure 17. Blower Retaining Screws

7. Partially remove the blower assembly from the heater assembly housing and tag and disconnect the four electrical wires from the blower assembly. See Figure 18.