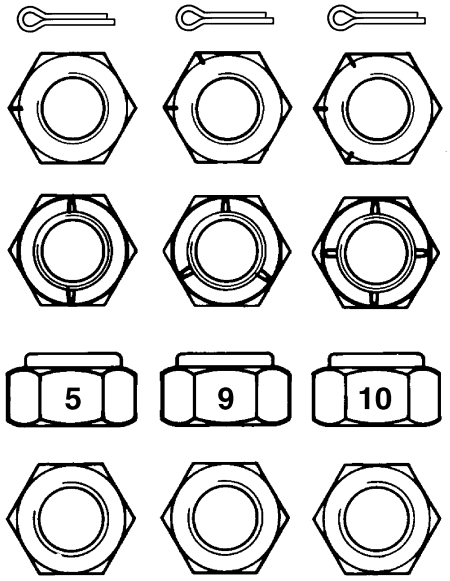
Yale®

Maintenance

METRIC AND INCH (SAE) FASTENERS



HM210064

The crankshaft converts the reciprocating motion of the pistons and rods into rotating motion. The crankshaft is located near the bottom of the block assembly. Because it is mounted in bearings, the crankshaft can rotate freely within the block.

The piston and rod assembly absorbs the power released when the fuel-air mixture is ignited. The piston is usually made of aluminum alloy and is machined so that it fits the cylinder properly when it reaches operating temperature.

A piston usually contains three rings. The bottom ring controls oil flow to the cylinder wall, the other two rings seal the combustion chamber during engine operation. The connecting rod assembly, usually made from forged steel, connects the piston to the crankshaft and transmits the energy created by the burning of the fuel-air mixture, to the crankshaft. The small' end of the connecting rod is connected to the piston by a piston pin or wrist pin. The lower end, or large end, of the connecting rod contains the rod bearing. This bearing allows the rod to be fastened to the crankshaft while still allowing it to rotate.

CAMSHAFT AND TIMING SET

The camshaft operates the engine's intake and exhaust valves. These valves channel the fuel-air mixture into the cylinders and remove the exhaust products from the cylinder. The camshaft is often responsible for other functions. For example, in a diesel engine, the camshaft operates the fuel, oil and vacuum pumps.

Either a chain, belt or gears drive the camshaft at one-half the speed of the crankshaft. The chain and its sprockets, the gears, or the belt and its sprockets are referred to as the timing set'. A timing set includes all the components used to drive the camshaft.

CYLINDER HEAD ASSEMBLY

Cylinder heads are made from cast iron or cast aluminum. An engine has one or two cylinder heads, depending on how many cylinders of the engine. The cylinder heads are located on top of the cylinder block. The cylinder heads have one intake valve and one exhaust valve for each cylinder. In spark ignited engines, the heads contain some of the ignition system parts. In many engines, a large portion of the valve train is located in the cylinder head. Many of the cooling system components may also be located in and around the cylinder head, such as the outlet housing, thermostat, and water jacket.

VALVE TRAIN ASSEMBLY

The valve train assembly is responsible for transmitting the valve signals from the camshaft to the engine valves. In some engine designs, the entire valve train is located in the block assembly. In other designs, the entire valve train is located in the cylinder head. Some of the components included in the valve train are: valve lifters (tappets), push rods, rocker arms, rocker shafts or stud valves and valve keepers, valve seats, valve springs, and other attachment parts.

MANIFOLDS

There are two types of manifolds connected to an engine: an intake manifold to take air into the cylinders and an exhaust manifold to discharge the exhaust gas. The purpose of the intake manifold is to distribute the air or fuel-air mixture uniformly to each of the engine cylinders.

To maximize volumetric efficiency, some engines have tuned intake manifolds, in which the port cross-sectional area and length are adjusted to a size that fills the cylinders most efficiently. A leaking intake system may allow unfiltered air to reach the cylinders. A leak can cause detonation, misfire, and exhaust-emission problems during engine operation and evaporative hydrocarbon emissions when the engine is not operating. Leakage of air into the fuel-air mixture unbalances the engine by producing lean mixtures and upsetting the calibration of the fuel metering system.

Many exhaust manifolds are made from cast iron or nodular iron. Some manifolds are made from stainless steel or heavy gauge steel. The exhaust manifold contains an exhaust port for each exhaust port in the cylinder head, and a flat machined surface on the manifold fits against a matching surface on the exhaust port area of the cylinder head. Some manifolds have a gasket between the manifold and the cylinder head.

The engine exhaust manifold is a casting or assembly of passages through which the products of combustion leave the exhaust-valve ports in the cylinder head or cylinder block and enter the exhaust piping system. The purpose of the exhaust manifold is to collect and carry the exhaust gases away from the cylinders with a minimum of back pressure.

The entire exhaust system, including the exhaust manifold, catalytic converter, muffler, and piping affects the efficiency of combustive gas evacuation from the engine cylinders. Exhaust back pressure, when present; represents a direct loss of engine power.

Legend for Figure 9020-10-47

1. CAMSHAFT POSITION (CMP) SENSOR
2. INTAKE AIR TEMPERATURE (IAT)
3. MASS AIR FLOW (MAF), IF APPLICABLE
4. THROTTLE POSITION SENSOR (TPS)
5. ELECTRONIC GOVERNOR SENSOR AND MOTOR ASSEMBLY, IF APPLICABLE
6. IDLE AIR CONTROL (IAC)
7. MANIFOLD ABSOLUTE PRESSURE (MAP)
8. FUEL INJECTOR
9. ENGINE COOLANT TEMPERATURE SENSOR (ECT)
10. POSITIVE CRANKCASE VENTILATION (PCV) VALVE
11. PRE OR POST OXYGEN (O_2) SENSOR(S)
12. CATALYTIC CONVERTER
13. ECT SENSOR (ECU)
14. ELECTRONIC THROTTLE ASSEMBLY (ETA)

Principles of Operation (Lift Trucks Built After January, 2007)

The primary components of the Gasoline Multiport Fuel Injection (MFI) are the fuel tank, electric fuel pump, fuel filter, fuel rails, fuel pressure regulator, fuel injectors, Oxygen (O_2) sensor(s), Electronic Control Unit (ECU), and catalytic converter.

The system operation is summarized as follows: The fuel tank is integrated within the frame of the truck. An in-tank fuel pump assembly provides fuel from the tank through an in line disposable fuel filter to the fuel rail. The fuel pressure in the rail is controlled with a pressure regulator. The regulator maintains the proper pressure difference between the fuel in the rail and the air within the intake manifold. Fuel that passes the regulator is returned to the tank through the fuel return line.

The gas flows from the fuel filter to the fuel rails where the fuel pressure is regulated. During engine operation the regulator maintains the proper amount of fuel pressure to the top of the injector. During lower RPM operation where fuel requirements are minimal, excess fuel is returned to the fuel tank for recirculation. The Fuel pressure regulator has no adjustments and is integrated into the fuel rail assembly. The fuel rail also contains a Schrader valve which is utilized to test the regulated pressure of the fuel system.

The fuel pressure is maintained on the top of the injector by the fuel pressure regulator. The injector is fed a "pulse" signal through the wiring harness which causes the injector to open. During regular operating conditions the ECU controls the opening and duration of opening of the injector. During lower RPM operation the injector signals or “pulses” are less frequent then when the engine is operating at higher rpms. The certified engine has been calibrated to deliver the precise amount of fuel for optimum performance and emission control.

Throttle Control Device - Drive By Wire (DBW) Engine speed control is maintained by the amount of pressure applied to the foot pedal located in the engine compartment. In a DBW application, there is no direct connection between the foot pedal and the throttle shaft. Speed and load control are determined by the ECU. Defaults programmed into the ECU software and throttle position sensors allow the ECU to maintain safe operating control over the engine. In a drive by wire application the Electronic Throttle Assembly (ETA) is connected to the intake manifold of the engine. The ETA utilizes an electric motor connected to the throttle shaft. In addition, a Foot Pedal Position Sensor (FPP) is located in the operator's compartment.

When the engine is running electrical signals are sent from the foot pedal position sensor to the engine ECU when the operator depresses or release the foot pedal. The ECU then sends an electrical signal to the motor on the electronic throttle control to increase or decrease the angle of the throttle blade thus increasing or decreasing the air/fuel charge to the engine. The electronic throttle control device incorporates two internal Throttle Position Sensors (TPS) which provide output signals to the ECU as to the location of the throttle shaft and blade. The TPS information is used by the ECU to correct for speed and load control as well as emission.

To obtain maximum effect from the catalyst and accurate control of the air fuel ratio, the emission certified engine is equipped with an onboard computer or Electronic Control Unit (ECU). The ECU is a 32 bit controller which receives input data from sensors mounted to the engine and fuel system and then outputs various signals to control engine operation. One specific function of the ECU is to maintain a closed loop fuel control which is accomplished by use of the Heated Exhaust Gas Oxygen (O_2) sensor(s) (HEGO) mounted in the exhaust system. The HEGO sensor sends a voltage signal to the ECU which then outputs signals to the EPR to change the amount of fuel being delivered from the regulator to the engine.

DIESEL FUEL SYSTEM

Kubota V3800 and V2403

The Kubota V3800 and V2403 fuel systems are a Common Rail System. This fuel system is usually referred to by the generic term High-Pressure Common Rail (HPCR).

The V3800 engine application, fuel from the tank flows first through the in-line fuel filter. The in-line fuel filter provides 150 micron filtration before the electric lift pump. From the in-line fuel filter, the fuel flows through electric lift pump to the fuel/water separator filter (with a 3-micron rating). The V2403 engine sends fuel from the tank directly to the water separator. The water separator is integrated into the primary filter. There is a water in fuel sensor in the bottom of the filter. The VSM monitors this sensor, and when water is detected sends a signal to activate the Water Separator Indicator light on the DSC. This light alerts the operator to drain water from the water separator, which can be done via the drain fitting at the bottom of the filter housing.

After the fuel/water separator filter, the fuel flows to the high-pressure fuel pump, however, on V2403 applications, the fuel first flows through a mechanical lift pump before entering the high pressure pump. This high-pressure fuel pump is controlled by the engine’s ECM. High pressure fuel flows from the pump, through the HPCR to the electronically-controlled injectors. Injection timing, duration, and pressure are controlled by the ECM, and the HPCR system allows multiple injections per combustion event.

The high-pressure pump pressurizes fuel in the high-pressure accumulator (rail). Here, fuel in the accumulator is staged, ready for injection at the appropriate pressure for the particular engine operating conditions. The driver's requirements are signaled through the accelerator pedal and registered by the ECM together with the operating status. The ECM then uses maps to calculate the required injection pressure, the duration of injection (specifying the fuel mass), and the timing of injection. Each engine cylinder has an injector containing an integral control valve; the opening and closing points of the valve define the beginning and end of the injection process.

High fuel pressure produces a fine mist of fuel that burns clean in the combustion chamber and the common rail allows for multiple injections of fuel during each combustion cycle.

The full authority electronic controls allow greater adjustment over injection timing providing improved cold start performance.

Kubota Fuel Flow

Refer to Figure 9020-10-121 for an example of the Kubota diesel fuel system.

Fuel from the tank flows first through the in-line fuel filter. The in-line fuel filter provides 150 micron filtration before the engine driven mechanical lift pump. From the in-line fuel filter, the fuel flows through mechanical lift pump to the fuel/water separator filter. The water separator is integrated into the primary filter.

After the fuel/water separator filter, fuel flows to the injection pump. The fuel injection pump is mechanically controlled by a throttle cable. High pressure fuel flows from the pump to the mechanically controlled injectors.

For the Kubota V3600 and the 2.4L, the fuel injection pump pressurizes fuel at the fuel injector until injector "cracking" pressure is reached. The driver's requirements are signaled through the accelerator pedal cable linkage to the fuel injection pump. Each engine cylinder has an injector containing an integral control valve; the opening and closing points of the valve define the beginning and end of the injection process

CAUSE H - ENGINE MECHANICAL PROBLEMS.

PROCEDURE OR ACTION:

1. Check for low cylinder compression. Perform an engine compression test. For GM and Mazda engines, see Engine Compression Test (GM, Mazda, PSI). For Kubota engines, see Engine Compression Test (Kubota Diesel Engine). For Yanmar engines, see Engine Compression Test (Yanmar Diesel). For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** .
   Does engine pass compression test?
   YES: For Mazda and GM engines, check for vacuum leaks and go to CAUSE I. For Kubota and Yanmar engines, go to CAUSE I. For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** .
   NO: Check engine for the following:
   - Severe worn camshaft.
   - Intake/Exhaust valve seizure.
   - Seized or broken piston ring.
   - Worn piston ring, piston or cylinder.
   - Seized crankpin metal or bearing.
   - Foreign matter trapped in combustion chamber.
   - Improper open/close timing of intake/exhaust valves.
   - Improper arrangement of piston ring joints.
   - For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** . Refer to the appropriate **GM Engines**, **Mazda Engine**,**Kubota Diesel Engines**or **Yanmar Diesel Engines** manual, depending on lift truck model.

CAUSE I - INTAKE OR EXHAUST SYSTEM IS TOO RESTRICTIVE

PROCEDURE OR ACTION:

1. Check intake system for excessive restriction.
   Is "Intake Restriction Indicator" lamp illuminated on DSC while engine is running?
   YES: Air cleaner element is clogged. Replace air filter element. Refer to the appropriate **Periodic Maintenance** manual, depending on lift truck model.
   NO: Go to Step 2.

PROCEDURE OR ACTION:

CAUTION

Wear proper hearing protection while performing this test.

2. Check exhaust system for excessive restriction. For **Mazda and GM** engines, disconnect the exhaust pipe from the catalytic converter's inlet and attempt to start engine. For **Diesel** engines, disconnect the exhaust pipe from the diesel exhaust purifier inlet (if equipped) or muffler inlet and attempt to start the engine.
   Does engine start easier?
   YES: Exhaust system is plugged. Inspect for exhaust system for damage. If not damaged, replace catalytic converter. For diesel engines, replace diesel exhaust purifier and/or muffler. Refer to the appropriate **Frame**, **Kubota Diesel Engines**, **Yanmar Diesel Engines**, **Mazda Engine** or **GM Engines** manual, depending on lift truck model. For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** .
   NO: Resume operation.

CAUSE D - DILUTION BY FUEL

PROCEDURE OR ACTION:

1. Check the following:
   - Intake or exhaust valve seizure.
   - Seized or broken piston ring.
   - Worn piston ring, piston or cylinder.

   Does engine have seized, worn or broken valves, piston rings or cylinder?
   YES: Repair engine. Refer to appropriate **GM Engines**, **Mazda Engine**, **Kubota Diesel Engines**, or **Yanmar Diesel Engines** manual, depending on lift truck model. For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** .
   NO: Resume operation.

CAUSE E - ENGINE OIL CONTAMINATED.

PROCEDURE OR ACTION:

1. Take Oil Sample for analysis to find cause of engine oil discoloration:
   Does analysis results indicate a likely cause of oil discoloration?
   YES: Repair cause indicated by oil analysis.
   NO: Resume operation.

END SYMPTOM

TABLE OF CONTENTS

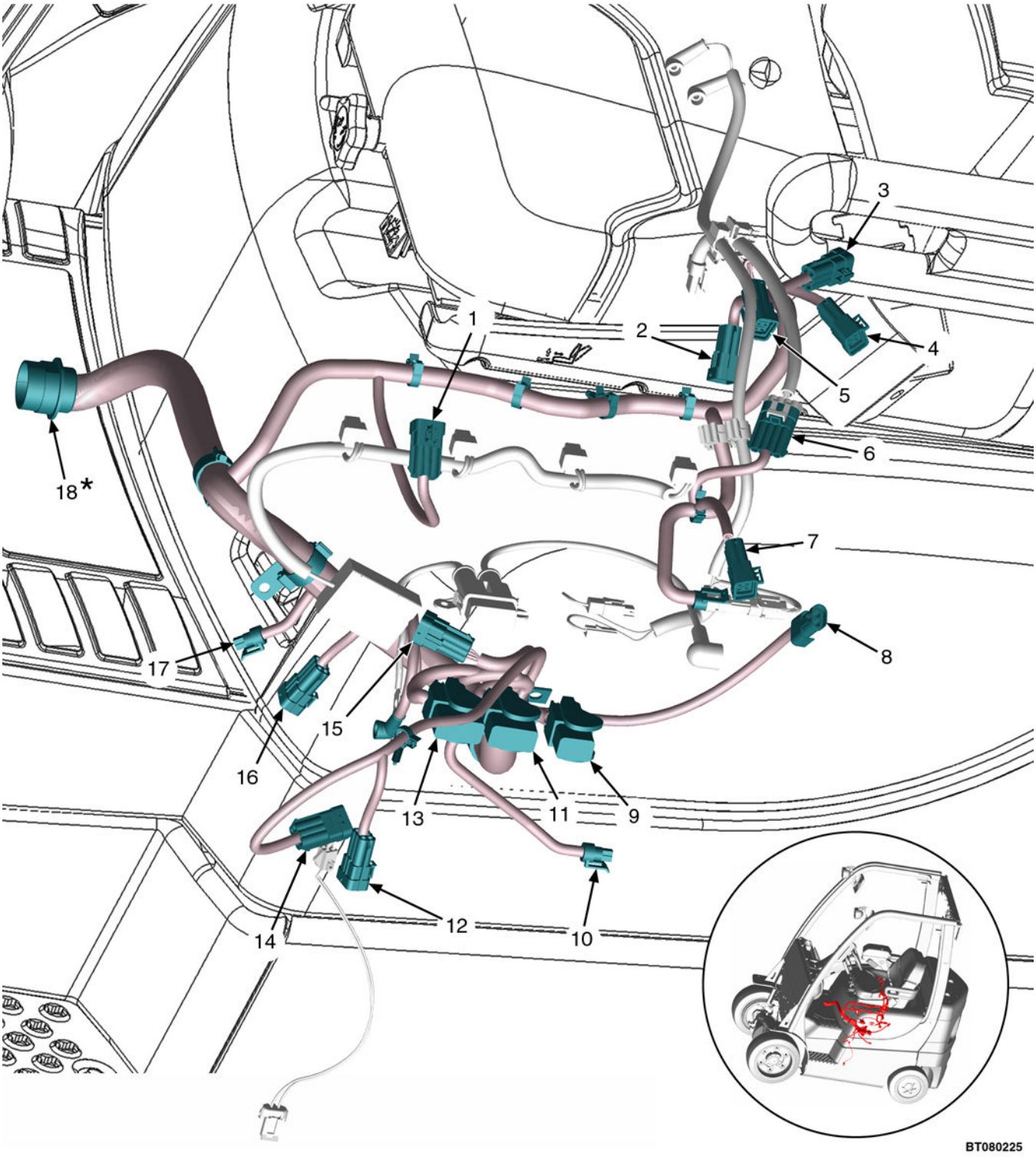
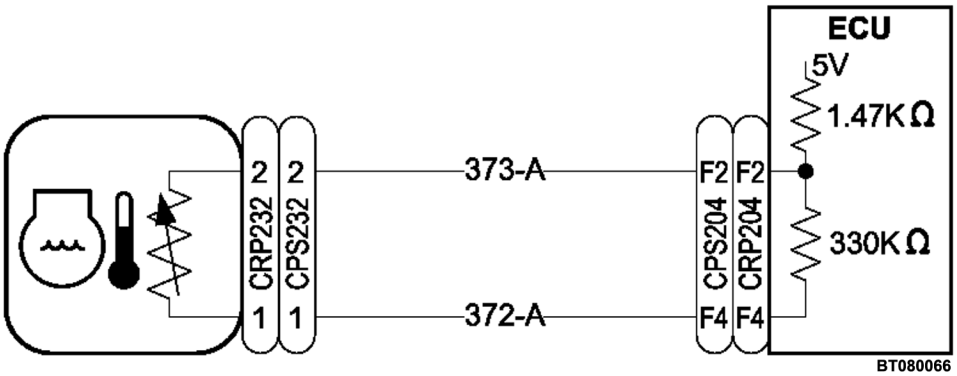


Figure 9030-03-10. Gas Engine Harness Assembly (GM 2.4L Engine) (Sheet 1 of 2)

END POSSIBLE CAUSES

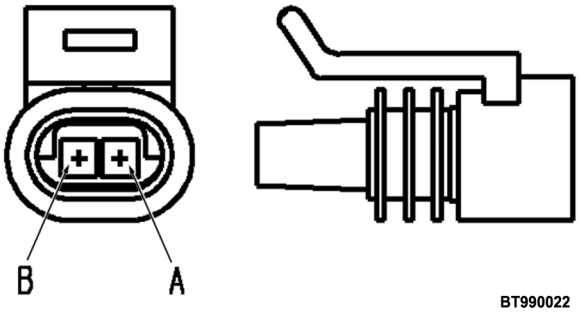
DIAGRAMS



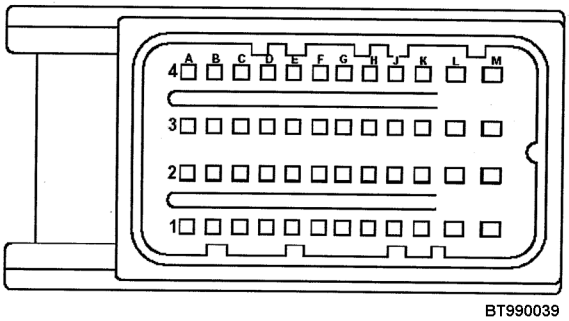
- WIRE # 372 = SENSOR GROUND
- WIRE # 373 = SENSOR SIGNAL

Engine Coolant Temperature Sensor Schematic, (GM)

CONNECTOR(S)

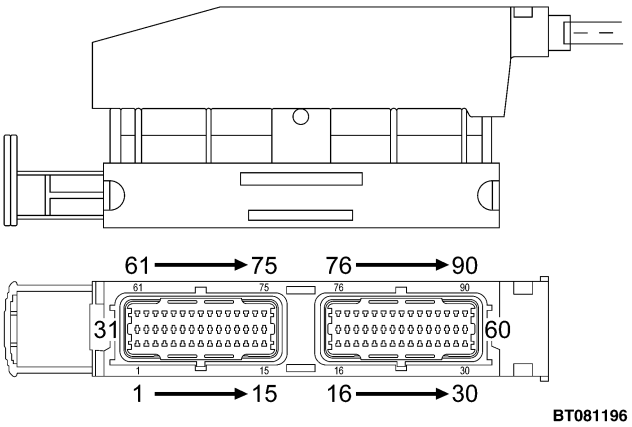


Coolant Temperature Sensor Connector CPS 232, GM



GM ECU Connector CPS 204

END FAULT



GM (2011) and Mazda ECU Connector CPS 202 (2007 Mazda EPA and 2011 LPG GM-PSI)

END FAULT

Switched Battery (IGN) Voltage Supply OORH

Measured Voltage Above Allowable Threshold.

CODES

DTC 521982-3 - Switched Battery Voltage 3 (IGN 3) OORH (TCU)
DTC 522760-3 - Switched Battery Voltage 1 (IGN 1) OORH
DTC 522761-3 - Switched Battery Voltage 2 (IGN 2) OORH
DTC 522762-3 - Switched Battery Voltage 3 (IGN 3) OORH

POSSIBLE CAUSE

A. IGN VOLTAGE SHORTED TO UNSWITCHED BATTERY SOURCE IN PDM OR PDM/VSM HARNESS
B. IGN VOLTAGE SHORTED TO UNSWITCHED BATTERY SOURCE IN PDM OUTPUT HARNESS
C. IGN VOLTAGE SHORTED TO SWITCHED BATTERY SOURCE IN PDM OR PDM/VSM HARNESS
D. IGN 2 VOLTAGE SHORTED TO BATTERY SOURCE
E. FUNCTIONAL FAILURE IN CONTROLLER

NOTE
Please refer to the end of this procedure for supporting diagrams.

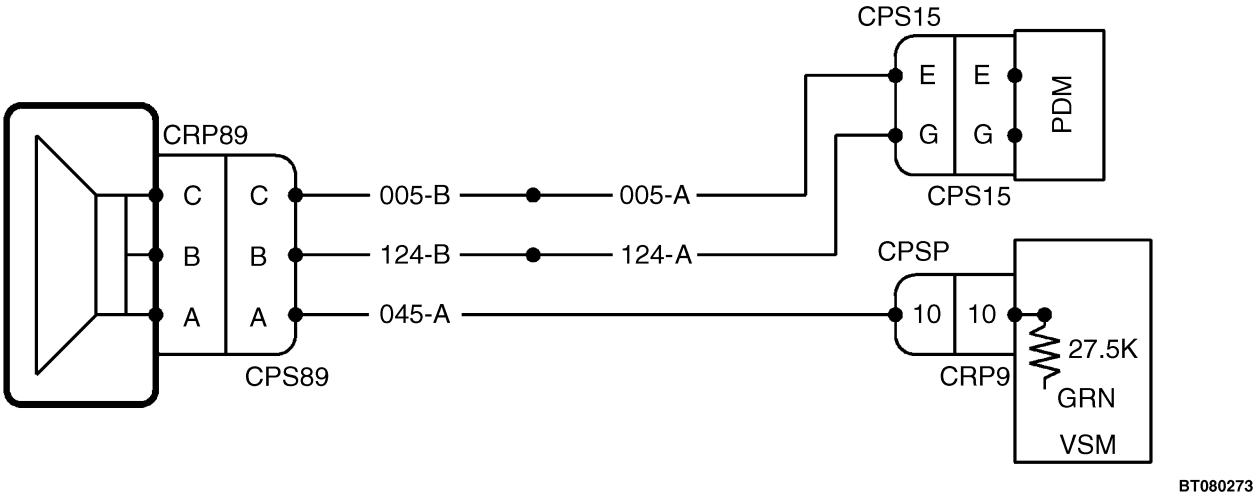
COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any faults detected/observed?
   YES:
   - If DTC is 522760-3, 522762-3, or 522198-2 go to CAUSE A.
   - If DTC is 522761-3, go to CAUSE E.

   Repair/replace connector or wiring associated with faults found. See **Electrical System** 2200YRM1142.
   NO: Problem not verified. Resume operation.

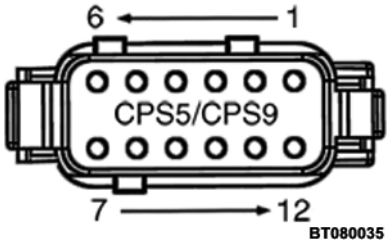
DIAGRAMS



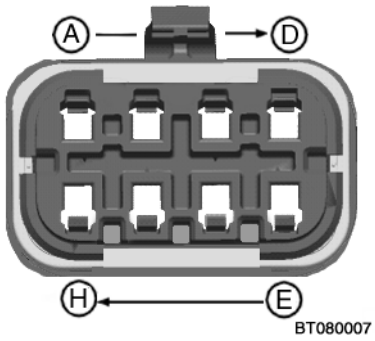
- WIRE # 005, (RED) = VOLTAGE SUPPLY
- WIRE # 045, (WHITE) = HORN OUTPUT DRIVER
- WIRE # 124, (BLACK) = DRIVER RETURN

Horn Alarm Schematic

CONNECTOR(S)



VSM Connector CPS 9



PDM Connector CPS 15

END FAULT

CAUSE A - SENSOR HEATER DRIVER RETURN SHORTED TO GROUND

PROCEDURE OR ACTION:

WARNING

DO NOT attempt to remove the HEGO sensor while exhaust system is HOT. Damage to personnel or equipment may occur.

CAUTION

Use care when removing the O_2 sensor. Due to repeated heating and cooling cycles and high operating temperatures it is possible to damage the O_2 sensor or exhaust port threads during removal.

If reusing a HEGO sensor be sure NO anti-seize is on the sensor head to be in exhaust gas stream.

1. Ensure truck power is **OFF**.
2. Select ohms on DMM scale. Verify DMM zero reading.
3. Disconnect the sensor connector and the indicated connector from the ECU. See Harness Assembly Data.
4. At the sensor connector, measure the resistance between the sensor heater return pin and ground.
   Is the resistance less than 0.5 ohms?
   YES: The sensor heater return wire is shorted to ground. Locate and repair/replace shorted wire/connection. Refer to appropriate **Electrical System** manual, depending on lift truck model.
   NO: Replace sensor. Refer to appropriate **Electrical System** manual, depending on lift truck model. Go to Step 5.
5. Restore all connections/components. Repeat Component Operational Check.
   Does DTC reoccur?
   YES: Go to CAUSE B.
   NO: Problem has been corrected. Resume operation.

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified or problem resolved. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any of the connectors/wiring damaged?
   YES: Repair/replace connector or wiring associated with faults found. Refer to the appropriate **Electrical System**YRM . Repeat Step 1.
   NO: Go to CAUSE A.

CAUSE A - FUEL INJECTOR OPEN CIRCUIT

PROCEDURE OR ACTION:

1. Ensure truck power is **OFF**.
2. At injector indicated by DTC, disconnect connector.
3. At ECU, as indicated in schematic, remove indicated connector.
4. Set DMM to ohms scale. Verify DMM zero reading.
5. Measure the resistance between each indicated pin on injector connector and corresponding pin on ECU connector.
   Is resistance less than 0.5 ohms?
   YES: Go to CAUSE B.
   NO: The injector harness has an open connection. Locate and repair/replace open wire/connection. Refer to the appropriate **Wiring Harness Repair**YRM .

CAUSE B - SUCTION CONTROL VALVE (SCV) OPEN CIRCUIT (KUBOTA ONLY)

PROCEDURE OR ACTION:

1. Ensure truck power is **OFF**.
2. Disconnect the wiring harness connector from the SCV.
3. At ECM, as indicated in schematic, remove indicated connector.
4. Verify DMM to ohms scale. Verify DMM zero reading.
5. Measure the resistance between each indicated pin on SCV wiring harness connector and corresponding pin on ECU connector.
   Is resistance low or close to zero ohms?
   YES: Go to CAUSE C.
   NO: The SCV wiring harness has an open connection. Locate and repair/replace open wire/connection. Refer to the appropriate **Wiring Harness Repair**YRM .

CAUSE C - SUCTION CONTROL VALVE (SCV) SHORTED TO GROUND (KUBOTA ONLY)

PROCEDURE OR ACTION:

1. Ensure truck power is **OFF**.
2. Verify DMM to ohms scale. Verify DMM zero reading.
3. Measure the resistance between each indicated pin on SCV wiring harness connector and ground.
   Is resistance low or close to zero ohms?
   YES: The SCV wiring harness has an shorted connection. Locate and repair/replace open wire/connection. Refer to the appropriate **Wiring Harness Repair**YRM .
   NO: If lift truck is equipped with an Injector Driver Module, go to CAUSE D. Otherwise, go to CAUSE E.

CAUSE A - FOOT DIRECTIONAL CONTROL (FDC) SWITCH OPEN CIRCUIT

PROCEDURE OR ACTION:

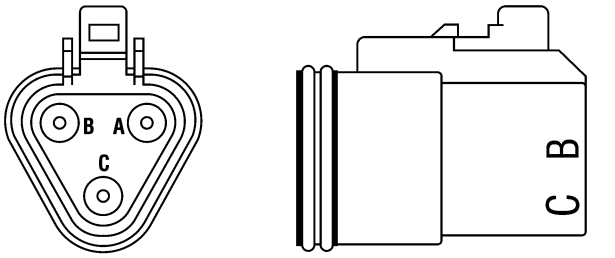
1. Ensure truck power is **OFF**.
2. Change DMM to ohms scale. Verify DMM zero reading.
3. Disconnect the indicated VSM connector.
4. At the VSM harness connector, measure resistance between the FWD switch signal and the FWD switch return pins while pressing the on the Foot Directional Control (FDC) switch for a FWD command.
   Is resistance less than 0.5 ohms?
   YES: Go to Step 5.
   NO: Switch or harness is open. Go to Component Operational Check.
5. At the VSM harness connector, measure resistance between the REV switch signal and the REV switch return pins while pressing the on the Foot Directional Control (FDC) switch for a REV command.
   Is resistance less than 0.5 ohms?
   YES: Go to CAUSE B.
   NO: Switch or harness is open. Go to Component Operational Check.
6. Disconnect the harness connector at the Foot Directional Control (FDC) switch.
7. Measure the resistance of all wires between the pins on the switch connector and the corresponding pins on the VSM connector.
   Is the resistance of all wire connections less then 0.5 ohms?
   YES: The foot switch has an open circuit. Replace the Foot Directional Control (FDC) switch. See **Electrical System** 2200YRM1142.
   NO: The foot switch/VSM harness has an open circuit. Locate and repair/replace the open wire/connection. See **Wire Harness Repair** 2200YRM1128.

CAUSE B - FOOT DIRECTIONAL CONTROL (FDC) SWITCH SIGNAL SHORTED TO SUPPLY VOLTAGE

PROCEDURE OR ACTION:

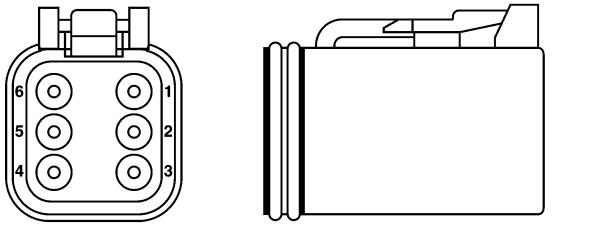
1. Reconnect indicated connectors to foot switch and VSM.
2. Turn truck power **ON**.
3. Change DMM to volts scale.
4. At switch connector, using procedure for probing the harness, measure voltage across switch signal pin (+) and switch ground pin (-).
   Is voltage equal to or greater than supply voltage (approximately 5 Vdc)?
   YES: If voltage is approximately equal to supply voltage, go to Step 5.
   NO: If voltage is approximately equal to battery voltage, go to CAUSE C.
5. Disconnect VSM connector and repeat measurement from Step 4.
   Is voltage equal to approximately 5 Vdc?
   YES: Switch signal wire is shorted to a 5Vdc source. Refer to Electrical Schematic in **Diagrams and Schematics** 8000YRM1152 for voltage source. Locate and repair/replace shorted wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Go to CAUSE D.

CONNECTOR(S)



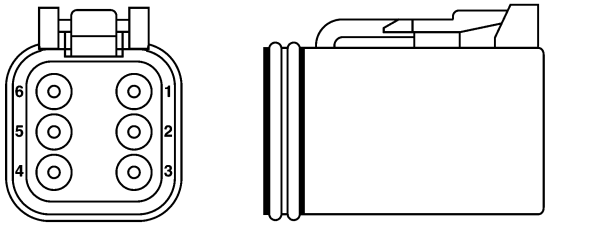
BT080304

Intermediate Speed CPS 63 Connector



BT080303

TISS CPS 134 Connector



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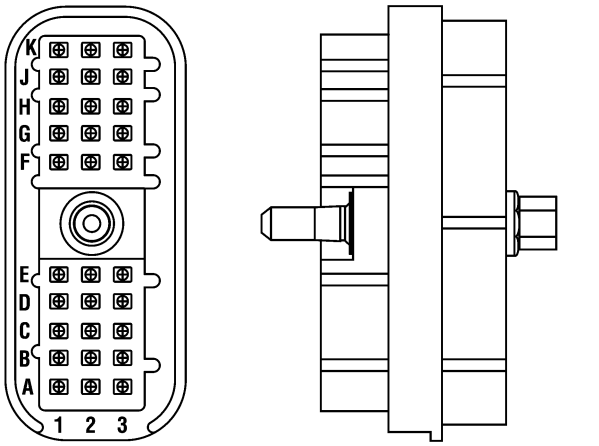
TOSS CPS 135 Connector



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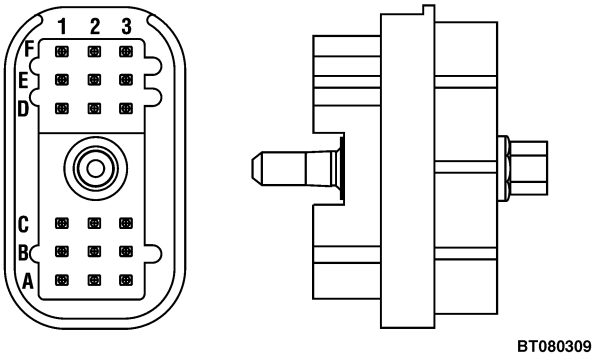
APC 214-CPS 128 Connector

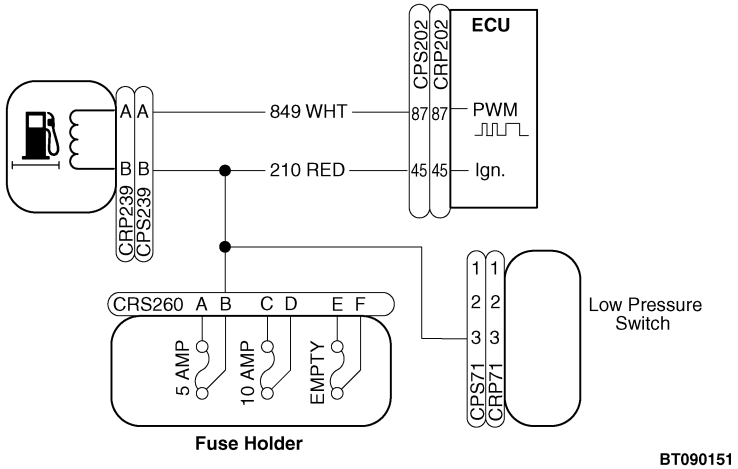


BT080309

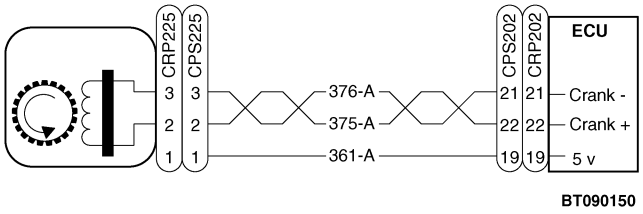
APC 214-CPS 129 Connector

END FAULT

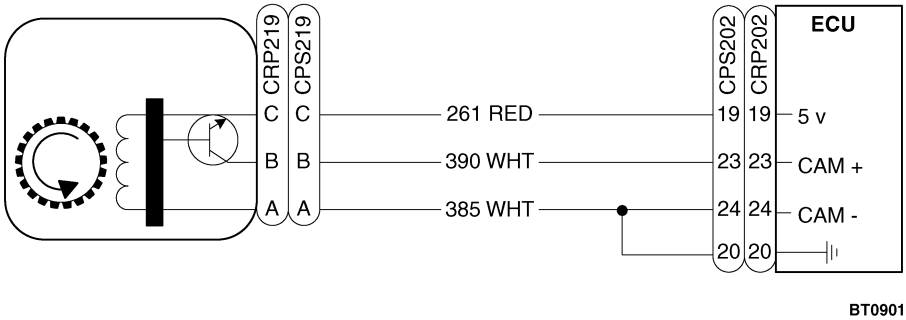
DIAGRAMS



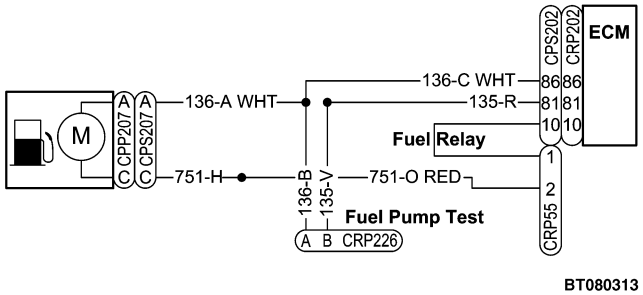
LPG Lockoff Solenoid (4.3L LPG GM-PSI)



Crank Position Sensor (4.3L LPG GM-PSI)



Cam Position Sensor (4.3L LPG GM-PSI)



Fuel Pump and Relay

Throttle Position Sticky

CODES

DTC 522614-7 - Throttle Not at Limp Mode Position (GM Engines Only)
DTC 522616-8 - Throttle Not at Command Position (GM Engines Only)
DTC 522617-5 - Throttle Not at Fully Closed/Open Position (GM Engines Only)

POSSIBLE CAUSE

A. MECHANISM STICKY

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any faults detected/observed?
   YES: Repair/replace connector or wiring associated with faults found. See **Electrical System** 2200YRM1142.
   NO: Go to CAUSE A.

CAUSE A - MECHANISM STICKY

PROCEDURE OR ACTION:

1. Turn truck power **ON** and start engine.
2. Check for proper operation of the throttle body and the ECU mechanism by exercising the accelerator pedal with the vehicle in neutral. For GM 2.4L gasoline and LPG engines the engine should idle at 775 to 825 rpm with no pedal and continuing to the governor speed which should be 2675 to 2725 rpm at full pedal. For GM 4.3L gasoline and LPG engines the engine should idle at 725 to 775 rpm with no pedal and continuing to the governor speed which should be 2375 to 2425 rpm at maximum full pedal.
   Is throttle mechanism operating smoothly/tracking with accelerator operation?
   YES: Problem corrected. Resume operation.
   NO: Ensure truck power is **OFF**. Clean any fuel residue from mechanism and go to Step 3.
3. Check for proper operation of the throttle body and the ECU mechanism by exercising the accelerator pedal with the vehicle in neutral. For GM 2.4L gasoline and LPG engines the engine should idle at 775 to 825 rpm with no pedal and continuing to the governor speed which should be 2675 to 2725 rpm at full pedal. For GM 4.3L gasoline and LPG engines the engine should idle at 725 to 775 rpm with no pedal and continuing to the governor speed which should be 2375 to 2425 rpm at maximum full pedal.
   Is throttle mechanism operating smoothly/tracking with accelerator operation?
   YES: Problem corrected. Resume operation.
   NO: Ensure truck power is **OFF**. Replace Electronic Throttle Body. For GM 2.4L Gasoline engines see **Gasoline Fuel System** 0900YRM1126. For GM 2.4L LPG engines see **LPG Fuel System** 0900YRM1124. For GM 4.3L Gasoline engine see **Gasoline Fuel System** 0900YRM1244. For GM 4.3L LPG engine see **LPG Fuel System, GM 4.3L Engine with GFI** 0900YRM1242.

END POSSIBLE CAUSES

END FAULT

DTC 523539-2
Pump Protection Failure Flag

POSSIBLE CAUSE

A. BAD SUCTION CONTROL VALVE (SCV)
B. WIRING HARNESS FAILURE
C. FUEL LEAKS
D. BAD RAIL PRESSURE SENSOR
E. BAD FUEL PUMP

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

NOTE: Watch for codes similar to 157-0, 633-7, 1347-3, 1347-4, and 1347-7.

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC. Start engine.
   Does reported DTC reoccur?
   YES: Stop engine. Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any of the connectors/wiring damaged?
   YES: Repair/Replace connector or wiring associated with faults found. Refer to the appropriate **Electrical System**YRM . Repeat Step 1.
   NO: Go to CAUSE A.

CAUSE A - BAD SUCTION CONTROL VALVE (SCV)

PROCEDURE OR ACTION:

1. Ensure truck power is **OFF**.
2. Set DMM to ohms scale. Verify DMM zero reading.
3. Disconnect wiring harness connector from SCV connector.
4. Measure resistance across each pin of the SCV and ground. Refer to the appropriate **Diagrams and Schematics** and **Wiring Harness Repair**YRM for pin out locations.
   Is resistance zero or less than specifications?
   YES: The SCV has shorted to ground. Replace SCV. Reconnect SCV connector to wiring harness. Go toStep 5.
   NO: Go to CAUSE B.
5. Turn truck power **ON** and start engine.
   Does reported DTC reoccur?
   YES: Go to CAUSE B.
   NO: Problem not verified or problem resolved. Resume operation.

CODES

DTC 94-0 - Primary Fuel Pressure Higher Than Expected
DTC 94-1 - Primary Fuel Pressure Lower Than Expected

POSSIBLE CAUSE

A. FUEL PRESSURE SENSOR WIRING FAULT
B. FUEL PRESSURE FAULT
C. FAULTY CONTROLLER

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code. Make sure electrical connection is a good physical connection (i.e. sockets and pins are seated correctly; connector "clicks" indicating locking tab works correctly). See Harness Assembly Data.
   Are any of the connectors/wiring damaged?
   YES: Repair/replace connector or wiring associated with faults found. Refer to appropriate **Electrical System** manual, depending on lift truck model.
   NO: Go to CAUSE A.

CAUSE A - FUEL PRESSURE SENSOR WIRING FAULT

PROCEDURE OR ACTION:

NOTE: Key in ON position.

1. Disconnect the fuel pressure manifold connector CPS254 and measure voltage between socket C and B(-).
   Is voltage 5 ± 0.5 Vdc?
   YES: Proceed to Step 2.
   NO: Inspect five volt signal circuit for open or short.
2. Measure voltage between the fuel pressure manifold connector CPS254, socket A and socket C.
   Is voltage 5 ± 0.5 Vdc?
   YES: Disconnect battery, ECU connector CRS202, and proceed to Step 3.
   NO: Inspect ground circuit for open or short.
3. Measure resistance between the following:
   - ECU connector CRS202, socket 48 and fuel pressure manifold connector CPS254, socket B.
   - ECU connector CRS202, socket 54 and fuel pressure manifold connector CPS254, socket D.

   Is resistance <1 ohm?
   YES: Connect battery and connectors, proceed to CAUSE B.
   NO: Inspect appropriate circuit for open, short, or source of excessive resistance.

CAUSE B - DEF PHASE CIRCUIT FAULT

PROCEDURE OR ACTION:

1. Disconnect the supply unit connector CPS507 and the ACU connector CPS205. Measure resistance between the ACU connector CPS205, socket 2 and the supply unit connector CPS507, socket D.
   Is resistance ≤ 1 ohm?
   YES: Proceed to Step 2.
   NO: Inspect U Phase circuit for open, short, or source of excessive resistance.
2. Measure resistance between the ACU connector CPS205, socket 21 and the supply unit connector CPS507, socket E.
   Is resistance ≤ 1 ohm?
   YES: Proceed to Step 3.
   NO: Inspect V Phase circuit for open, short, or source of excessive resistance.
3. Measure resistance between the ACU connector CPS205, socket 32 and the supply unit connector CPS507, socket L.
   Is resistance ≤ 1 ohm?
   YES: Proceed to CAUSE C.
   NO: Inspect W Phase circuit for open, short, or source of excessive resistance.

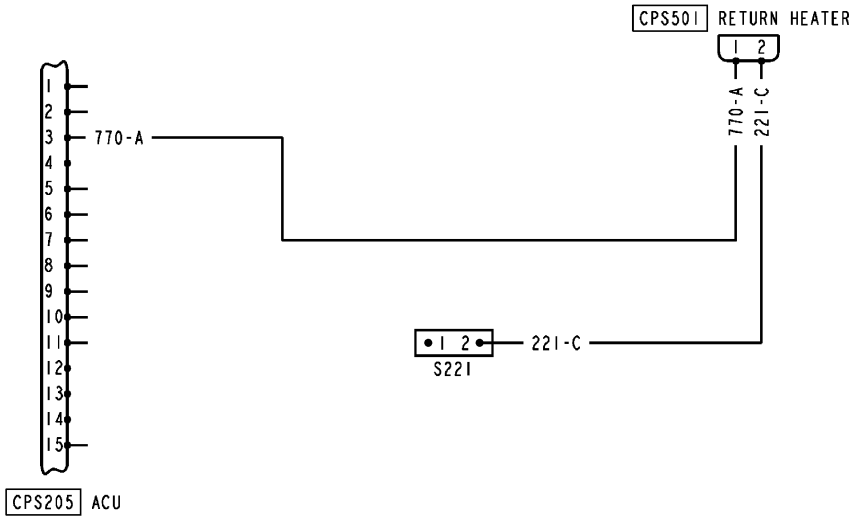
CAUSE C - DEF SUPPLY PUMP UNIT FAULT

PROCEDURE OR ACTION:

1. If no wiring or communication faults are present, replace faulty supply pump unit, clear DTC and retest system.

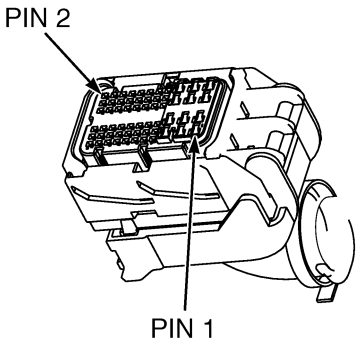
END POSSIBLE CAUSES

DIAGRAMS

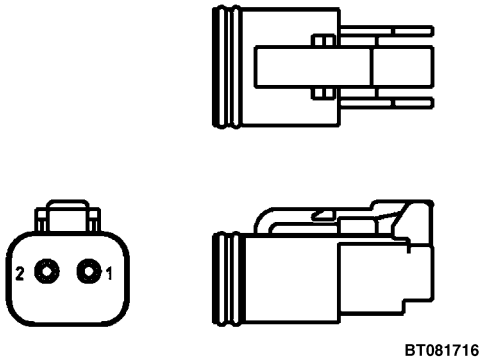


Troubleshooting Scenes

CONNECTOR(S)



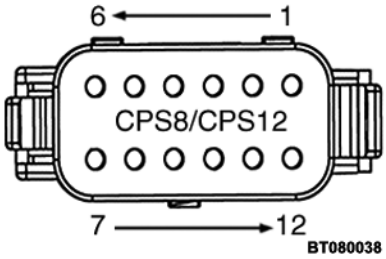
Return Tube Heater



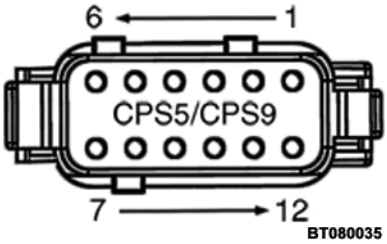
ACU

END FAULT

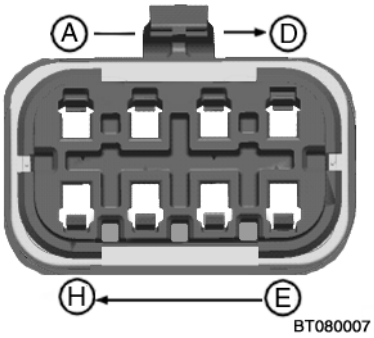
Horn Sounds Continuously



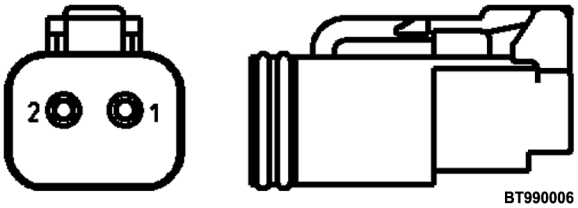
Connector CPS8



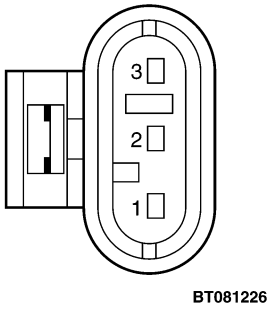
Connector CPS9



PDM Connector CPS15



Connector CPS 76 and 79



Connector CPS 89

Poor Brake Performance (Dry Brake Axle Only)

POSSIBLE CAUSE

A. LOW BRAKE FLUID IN RESERVOIR.
B. AIR IS PRESENT IN BRAKE SYSTEM.
C. BRAKES OUT OF ADJUSTMENT.
D. BRAKE SHOES ARE WORN OR DAMAGED.
E. MASTER CYLINDER IS DAMAGED.
F. WHEEL CYLINDER LEAKING OR NOT OPERATING PROPERLY.
G. BRAKE DRUM IS CRACKED.
H. BACK PLATE IS DAMAGED.

CAUSE A - LOW BRAKE FLUID IN RESERVOIR.

PROCEDURE OR ACTION:

1. Inspect reservoir and master cylinder assembly for leaks. Verify that all brake system fittings are tight. Correct cause of brake fluid leakage as necessary.
2. Check brake fluid reservoir for proper fluid level.
   Is brake fluid below minimum mark in reservoir?
   YES: Fill reservoir with brake fluid. See **Operating Manual**.
   NO: Go to CAUSE B.

CAUSE B - AIR IS PRESENT IN BRAKE SYSTEM.

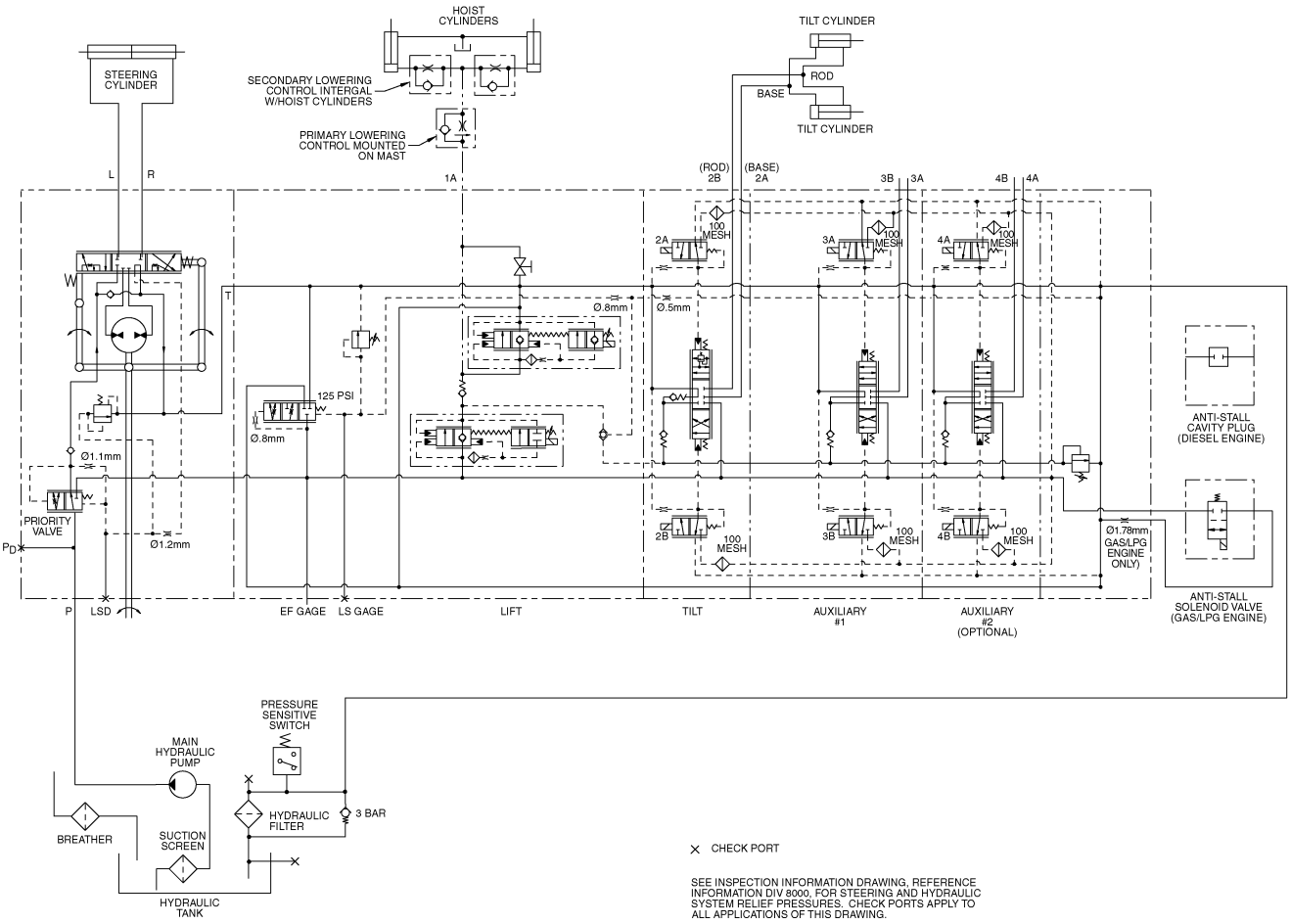
PROCEDURE OR ACTION:

1. Verify that reservoir and master cylinder assembly are not leaking and all brake system fittings are tight. Correct cause of leakage as necessary.
2. Press brake pedal several times. Free brake pedal travel is 10 - 12 mm (0.393 - 0.472 in.).
   Does brake pedal travel more than 10 - 12 mm (0.393 - 0.472 in.)?
   YES: Bleed air from brake lines. Refer to appropriate **Brake System** manual, depending on lift truck model. Inspect for cause of oil or brake fluid leaks and correct as necessary.
   NO: Go to CAUSE C.

CAUSE C - BRAKES OUT OF ADJUSTMENT.

PROCEDURE OR ACTION:

1. Raise front axle so both wheels are off ground. Secure lift truck. Refer to appropriate **Periodic Maintenance** manual, depending on lift truck model.
2. Rotate tires and check for correct brake tension.
3. Check that brake adjustor is visible and brakes are correctly adjusted. Adjustment is 0.026 mm (0.001 in.) diameter per one notch of star wheel. With a minimum drum radius of 155 mm (6.10 in.), properly adjusted brake shoe clearance is 0.1 - 0.35 mm (0.004 - 0.014 in.) at maximum point of shoe width.
   Is brake shoes and brake drum clearance out of adjustment?
   YES: Replace brake shoes. Refer to appropriate **Brake System** manual, depending on lift truck model. Inspect for cause of oil or brake fluid leaks and correct as necessary.
   NO: Go to CAUSE D.



1676486
Sheet 1 of 1
Revision 3

BT150077

Figure 9050-10-8. 4.0-5.5 Ton Truck Electro-Hydraulic Control Valve

Cycle Times Too Fast - Fast Actuation (E-Valve)

POSSIBLE CAUSE

A. MAX FUNCTION SPEED SETTING TOO HIGH.
B. RAMP SETTING TOO HIGH FOR FUNCTION.
C. ENGINE HIGH IDLE SETTING NOT CORRECT.
D. ORIFICES MISSING OR INSTALLED WRONG IN CYLINDER PORTS (ON AFTERMARKET CYLINDERS).
E. FAULTY MLCV FOR LOWERING FUNCTION ONLY.
F. UNLOADER VALVE PRODUCING TOO MUCH MARGIN PRESSURE.

CAUSE A - MAX FUNCTION SPEED SETTING TOO HIGH.

PROCEDURE OR ACTION:

1. Adjust function speed setting on DSC. If problem is still present, go to CAUSE B.

CAUSE B - RAMP SETTING TOO HIGH FOR FUNCTION.

PROCEDURE OR ACTION:

1. Adjust function ramp setting on DSC. If problem is still present, go to CAUSE C.

CAUSE C - ENGINE HIGH IDLE SETTING NOT CORRECT.

PROCEDURE OR ACTION:

1. Check for correct engine high idle setting.
   Is engine high idle set correctly?
   YES: Go to CAUSE D.
   NO: See Engine Idle Speed Incorrect.

CAUSE D - ORIFICES MISSING OR INSTALLED WRONG IN CYLINDER PORTS (ON AFTERMARKET CYLINDERS).

PROCEDURE OR ACTION:

1. Check cycle times. See aftermarket specifications.
   Do cycle times meet specifications?
   YES: Go to CAUSE E.
   NO: Inspect and repair orifices in cylinder ports. See aftermarket service manuals.

CAUSE B - PPRV GETTING STRAY SIGNAL.

PROCEDURE OR ACTION:

1. Check for proper harness installation. See **Wire Harness Repair** 2200YRM1128.
   Is valve harness installed wrong?
   YES: Install valve harness properly.
   NO: Go to Step 2.
2. Check for shorts in valve harness. See **Wire Harness Repair** 2200YRM1128.
   Does valve harness have shorts?
   YES: Repair or replace valve harness.
   NO: Go to CAUSE C.

CAUSE C - PROPORTIONAL PRESSURE REDUCING VALVE TOO LOW.

PROCEDURE OR ACTION:

1. Test Proportional Pressure Reducing Valve (PPRV) pilot pressure. See PPRV Pilot Pressure Test.
   Is PPRV pressure at specifications?
   YES: Go to CAUSE D.
   NO: Clean screen on PPRV. If problem is still present, replace PPRV. See **Main Control Valve** 2000YRM1137.

CAUSE D - NOT ENOUGH PILOT PRESSURE BEING PRODUCED BY PPRV.

PROCEDURE OR ACTION:

1. Remove PPRV and inspect inlet filter. See **Main Control Valve** 2000YRM1137.
   Is inlet filter clean?
   YES: Go to CAUSE E.
   NO: Clean or replace PPRV filter.

CAUSE E - STUCK SPOOL IN CONTROL VALVE.

PROCEDURE OR ACTION:

1. Remove, disassemble, and inspect spool. See **Main Control Valve** 2000YRM1137.
   Does the spool move freely in bore and in good condition?
   YES: See Observed Symptoms-Gear Pump, Secondary Function and Tilt Back Will Not Move With Joystick or MLM Movement (E-Valve), Page 9050-33-66.
   NO: Repair or replace valve spool or section.

END SYMPTOM

Steering Cylinder Leakage Test

Cylinder leakage causes heat and poor performance in a steering system. This test is done to determine if the leakage is in the steering cylinder or the steering control unit. For steering circuit schematic, see Figure 9050-10-31.

Table 9050-43-20. Test Specifications

Engine Speed	Low Idle
Oil Temperature	21 to 43°C (70 to 110 °F)
Maximum Leakage	10 ml (0.35 oz) Per Minute

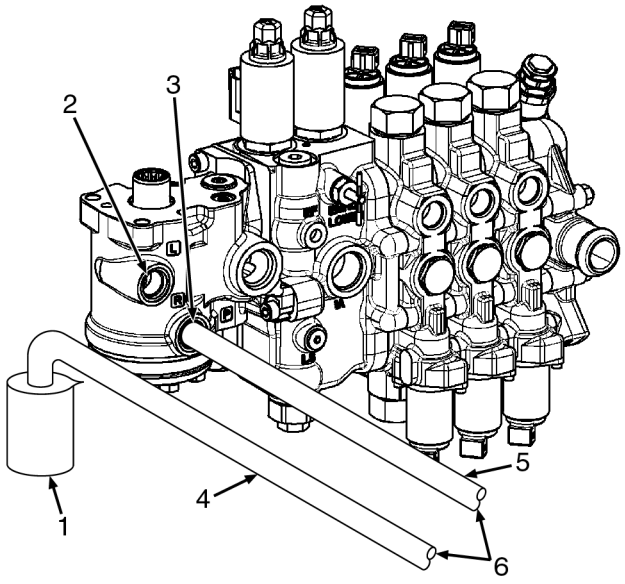
Table 9050-43-21. Service Tools

Container	
Left and Right Work Port Size	SAE #8 O-ring Port (3/4-16 UNF)

1. Lower forks to ground and turn steering wheel until steer axle is against right axle stop. Stop engine and apply park brake.

2. Remove covers of Steering Control Unit (SCU) to expose steering cylinder hose connections.

3. Check hydraulic temperature. If not within specifications, see Hydraulic Warm-Up Procedure.



1. CONTAINER
2. "L" LEFT STEERING PORT PLUG
3. "R" RIGHT STEERING PORT PLUG
4. LEFT STEERING HOSE
5. RIGHT STEERING HOSE
6. TO STEERING CYLINDER

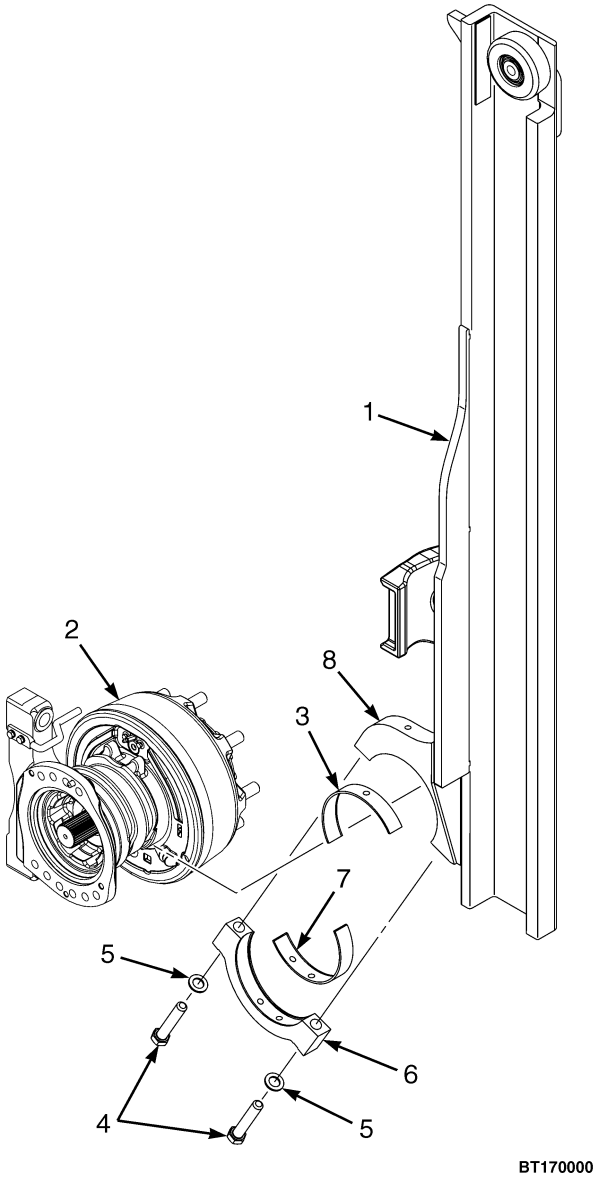
Figure 9050-43-63. Steering Cylinder Leakage Test

WARNING

Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.

WARNING

Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing hoses from cylinders.



Legend for Figure 9070-10-4

1. MAST
2. DRIVE AXLE HOUSING
3. UPPER BUSHING
4. CAPSCREWS
5. WASHER
6. LOWER HANGER MAST
7. LOWER BUSHING
8. UPPER HANGER MAST

Figure 9070-10-4. Mast Mounts (Trunnion-Style)

Truck Feels Unstable

POSSIBLE CAUSE

A. OPERATING WITH TOO LARGE A LOAD
B. LOW PNEUMATIC TIRE INFLATION
C. LOAD IS BEING CARRIED TOO HIGH
D. AXLE MOUNTS ARE LOOSE
E. OPERATING AT TOO HIGH A SPEED
F. FAILED WHEEL BEARINGS
G. LOOSE TIE RODS
H. OPERATING OFF HARD SURFACES
I. MAST IS TOO LOOSE

CAUSE A - OPERATING WITH TOO LARGE A LOAD

NOTE: See Serial Number plate or **Operating Manual** for lift capacity.

PROCEDURE OR ACTION:

NOTE: Carrying a load that exceeds truck capacity will cause the steer axle wheels to loose contact with ground and negatively affect control of truck.

1. Check load weight and compare to truck capacity rating.

CAUSE B - LOW PNEUMATIC TIRE INFLATION

PROCEDURE OR ACTION:

1. Check and adjust tire inflation. See **Operating Manual**.

CAUSE C - LOAD IS BEING CARRIED TOO HIGH

PROCEDURE OR ACTION:

1. Carry load as low as possible to lower center of gravity and improve stability.

CAUSE D - AXLE MOUNTS ARE LOOSE

PROCEDURE OR ACTION:

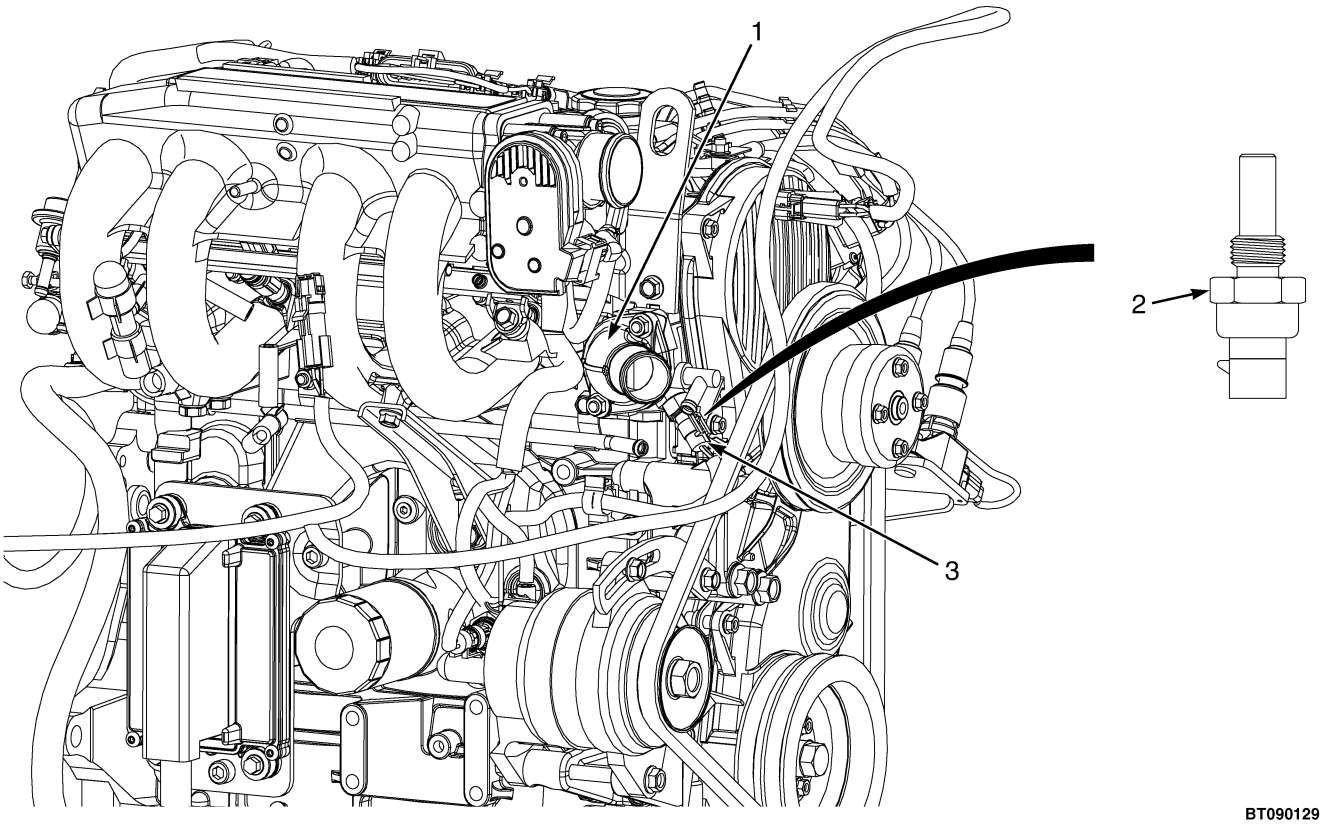
1. Inspect axle bearing and rubber mounts.

CAUSE E - OPERATING AT TOO HIGH A SPEED

PROCEDURE OR ACTION:

1. See **Operating Manual** for correct operating speeds.

CHECK	PROCEDURE	ACTION
Mast Channel Check	**NOTE:** This is a visual check of the mast to determine if parts are worn or out of adjustment. 1. Raise mast to full height without load and stop engine. 2. Inspect outer and inner channels for wear pattern and gouging. 3. Move forks to lowered position. 4. Inspect the inner channel wear pattern for wear or gouging. ***Do channels show signs of excess wear?*** *Continue:* 5. Inspect spacing between channels. ***Is the channel spacing even on each side?***	**YES:** Repair mast channels. Refer to appropriate **Mast Repair** manual, depending on lift truck model. **NO:** Mast wear is OK. Continue with this procedure. **YES:** Channel spacing is OK. Go to next check. **NO:** Adjust or repair mast. Refer to appropriate **Mast Repair** manual, depending on lift truck model.
Carriage Adjustment Check	1. Stop engine and lower forks to approximately 50 mm (2 in.) off ground. 2. Rock the carriage frame side to side. ***Does carriage move more than 0.5 mm (0.020 in.) at tightest point?***	**YES:** Adjust or repair carriage bearings. Refer to appropriate **Mast Repair** manual depending on lift truck model. **NO:** Carriage adjustment is OK. Go to next check.
Chain Sheave Check	1. Stop engine and lower forks. 2. Inspect wear pattern on chain sheaves. ***Does sheave show a wear pattern without side wear?***	**YES:** Chain sheaves are OK. Go to next check. **NO:** Replace chain sheaves. Refer to appropriate **Mast Repair** manual, depending on lift truck model.
Carriage Adjustment Check (Standard and Integral Side Shift)	1. Lower forks and stop engine. 2. Inspect wear on carriage stop. ***Does carriage stop show a wear pattern on it?***	**YES:** Chains are out of adjustment. Refer to appropriate **Mast Repair** manual, depending on lift truck model. **NO:** Checks complete.



1. THERMOSTAT HOUSING
2. ECT SENSOR
3. WIRING CONNECTOR

Figure 9020-10-35. Mazda LPG Engine Coolant Temperature (ECT) Sensor (Lift Trucks Built After January, 2010)

Fuel Tank

The fuel tank shown in Figure 9020-10-36 is the reservoir for the LPG system. The fuel tank keeps the fuel in liquid condition. The pressure of the fuel is 1.7 MPa (250 psi) when the tank is full at a temperature of 27°C (81°F). The tank has a pressure relief valve that is set at 3.4 MPa (490 psi). The inlet tube for the pressure relief valve is in the vapor area at the top of the tank.

The tank has a fuel gauge that measures the percentage of fuel in the tank. A liquid level valve near the pressure relief valve is used to indicate the maximum liquid level permitted. The tank is filled until liquid fuel flows from the liquid level valve. One end of the outlet tube inside the tank is near the lower surface of the tank. The other end of the tube is fastened to the outlet port. A shutoff valve is connected to the outlet port of the tank. The shutoff valve can prevent fuel from leaving the tank when the outlet line is disconnected. A quick-disconnect fitting is installed for easy tank removal. The tank has a guard for the valves and fittings. The guard has a hole for the alignment dowel on the mount. The tank is fastened to the lift truck by metal straps with latches. A fuel pressure sensor in the line from the tank energizes an indicator light on the instrument panel when the tank is nearly empty and the fuel pressure decreases.

GM/TGFI 4.3L (Six Cylinder) Gasoline System Components

Depending on your lift truck, the GM/TGFI 4.3L gasoline system schematic is shown in Figure 9020-10-102 or Figure 9020-10-103.

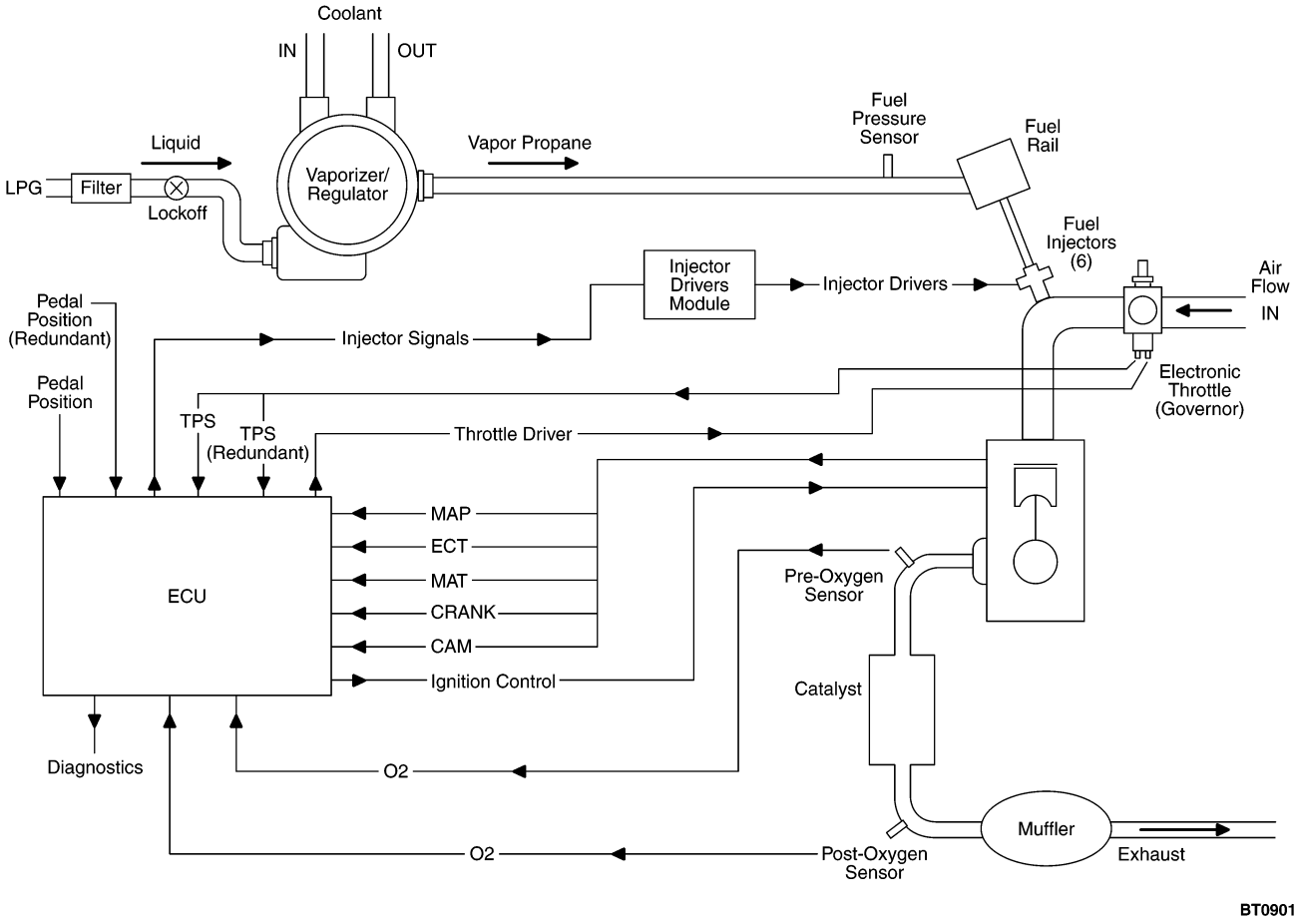
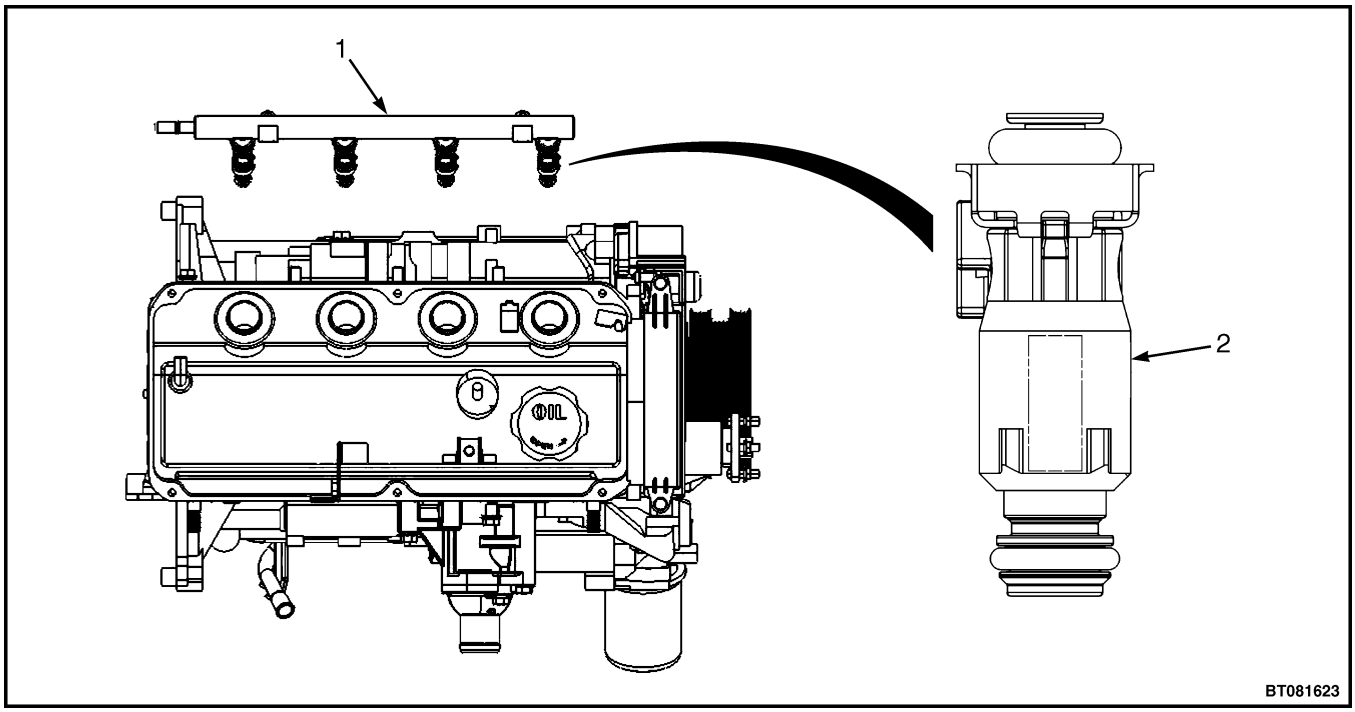


Figure 9020-10-102. GM/TGFI 4.3L Gasoline System Components (Lift Trucks Built Before January, 2010)

Fuel Rail and Fuel Injector

The fuel flows from the fuel pressure and temperature manifold assembly to the fuel rails where the fuel is delivered to the fuel injectors.



1. FUEL INJECTOR RAIL
2. FUEL INJECTOR

Figure 9020-10-191. Fuel Rail and Injectors

The fuel supply is maintained on the top of the injector from the injector rail. The injector is fed a “pulse” ground signal through the wire harness which causes the injector to open. During regular operating conditions the ECM controls the opening and duration of opening of the injector. During lower RPM operation the injector signals or “pulses” are less frequent then when the engine is operating at higher RPMs. The certified engine has been calibrated to deliver the precise amount of fuel for optimum performance and emission control.

High Engine Fuel Consumption

POSSIBLE CAUSE

A. FUEL LEAKS.
B. FUEL SYSTEM PROBLEM.
C. ENGINE SENSORS PROBLEM (GM AND MAZDA ENGINES ONLY).
D. IGNITION SYSTEM PROBLEM (GASOLINE AND LPG ENGINES ONLY).
E. THERMOSTAT PROBLEM.
F. INTAKE OR EXHAUST SYSTEM IS TOO RESTRICTIVE.
G. ENGINE MECHANICAL PROBLEM.
H. OTHER SYSTEMS.
I. HIGH ALTITUDE/HIGH AMBIENT TEMPERATURE OPERATION (YANMAR DIESEL ENGINE ONLY).

CAUSE A - FUEL LEAKS.

PROCEDURE OR ACTION:

1. Check for external fuel leaks.
   Does engine have a fuel leak?
   YES: See Observed Symptoms, Fuel Leaks, Page 9020-30-67.
   NO: Go to CAUSE B.

CAUSE B - FUEL SYSTEM PROBLEM.

PROCEDURE OR ACTION:

1. For Mazda and GM engines, check the following:

PROCEDURE OR ACTION:

2. Check fuel system for proper operation. Use PC Service tool to verify O_2 sensor is toggling between 0.2 Volts and 0.8 Volts.
   Is O_2 sensor toggling between 0.2 Volts and 0.8 Volts?
   YES: Go to CAUSE C.
   NO: See Observed Symptoms, Engine Does Not Start/Engine is Hard to Start, Page 9020-30-4.

PROCEDURE OR ACTION:

3. For diesel engines:
   - Check fuel injection pump timing (Too Late).
   - Check for uneven injection volume from fuel injection pump.
   - Check fuel injection nozzles for any uneven spray patterns and injection volume.

   Is fuel system working properly?
   YES: Go to CAUSE C.
   NO: Repair fuel system. For Yanmar engines, refer to appropriate **Yanmar Diesel Engines** manual, depending on lift truck model. For Cummins 4.5L and QSB 3.3L engines, contact your local **YALE** dealer or see **Yale Axcess Online** .

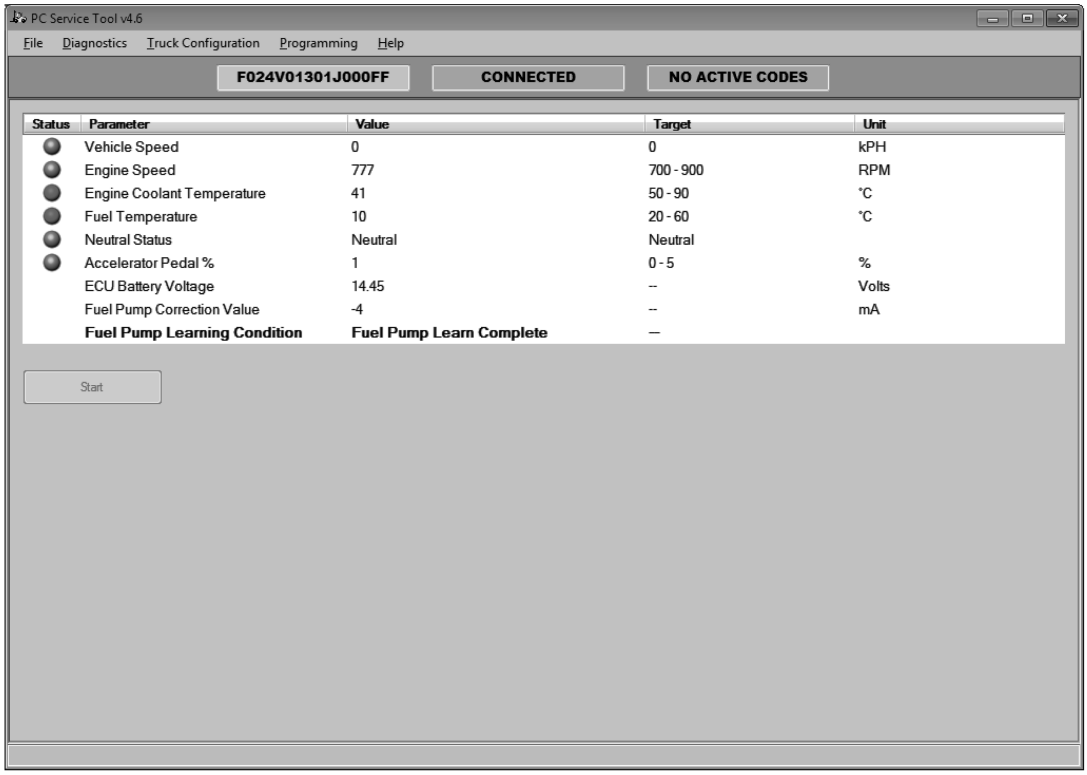


Figure 9020-40-222. Waiting for Each Status to Reach Target Value Before Fuel Pump Learning Condition

Injector Compensation

Use this utility when fuel injectors are replaced or when there is a need to report injector data. This basic utility enables you to read injector data out of the ECM, register injectors, load known values, and save to data file. See Figure 9020-40-223.

1. Connect CAN interface cable.
2. Start PC Service Tool.
3. Select **Programming⇒Manufacturer Specific⇒Fuel Pump Learning Condition**.

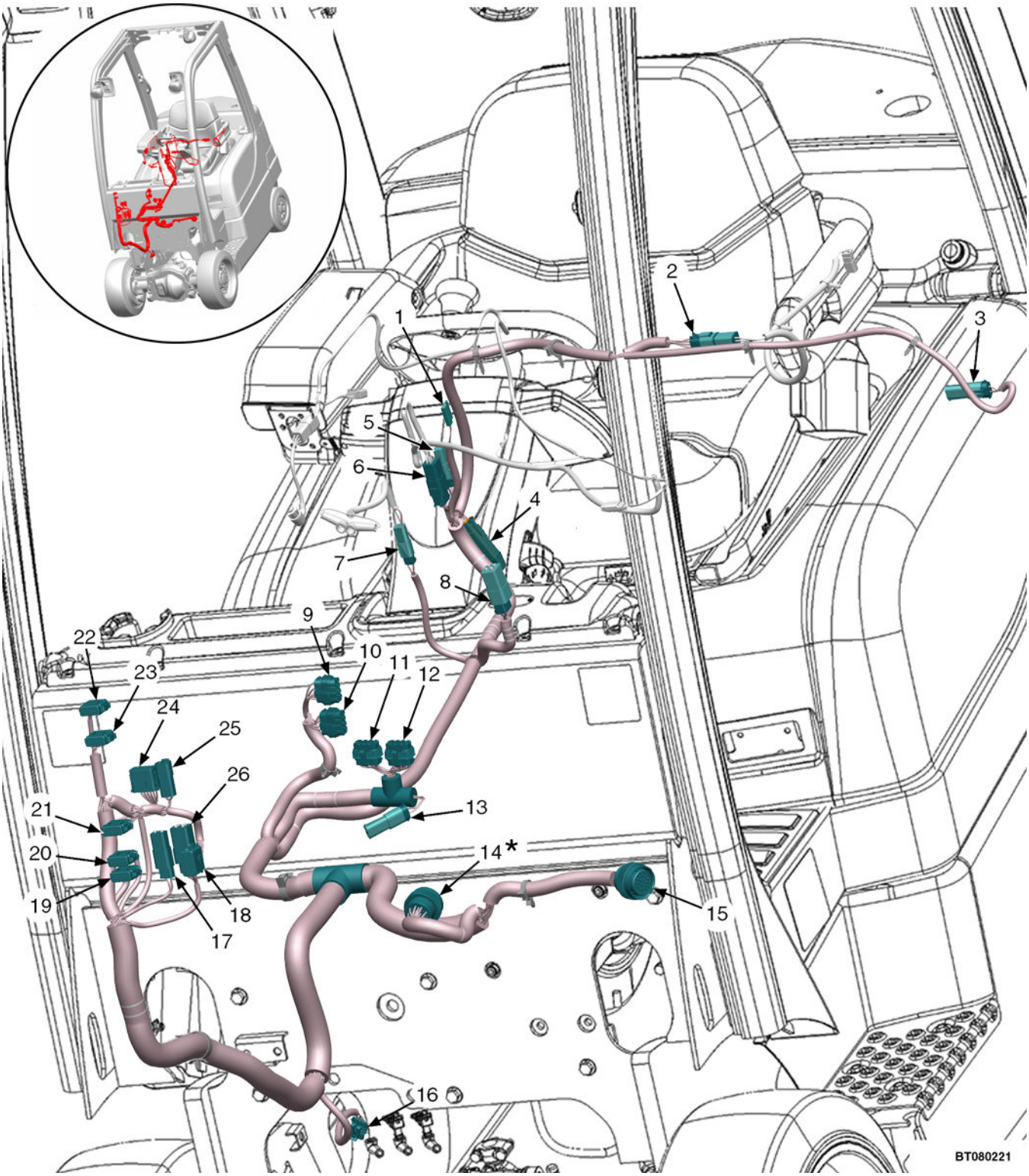


Figure 9030-03-5. RH Chassis Harness Assembly (GM 2.4L Engine) (Sheet 1 of 2)

CAUTION

Only replace blown fuses with fuses of the same value, after the fuse-blowing fault has been detected and cleared.

All switched operations are controlled and monitored by the VSM. All distributed circuits are fused.

CAUTION

Accessory Power connections are provided at the PDM and VSM. These connectors have unswitched and switched battery along with a heavy duty ground

When connecting accessories check the current rating of the new device to ensure it will not exceed the fused capacity of the circuit.

a. Other PDM Interfaced Devices

(1) Back Up Alarm. This device is controlled by the VSM detecting the selection of reverse direction. The circuit is designed to allow a customer to connect their desired audible warning device. A connection is provided in the counterweight.

(2) Fuel Relay. This device is controlled by two controllers:

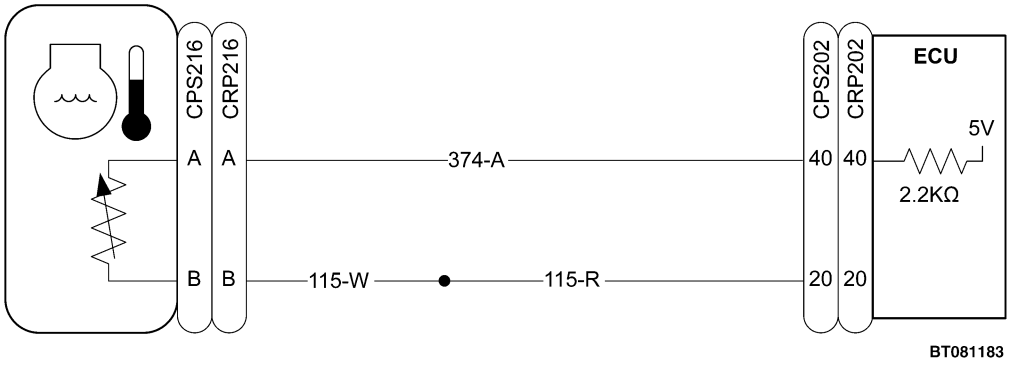
- The VSM turns on the high side of the relay coil at Power On
- The ECU turns on the low side of the coil at Power On but will turn off this driver if no engine cranking is detected within 2 seconds. This is to prevent continued operation of the fuel pump or the flow of LPG to an engine that is not running. Activating the start operation will turn this driver on again.

(3) Lights (Lift Trucks Without Cab). The Lights are controlled from the DSC in the same manner as the starter. Pushing the relevant button will activate the selected lights based on the software configuration options that have been chosen. Front Work Lights can also be turned on without activating System Power On but they will turn off after a preselected time. If the lights are operating at the time the system is Powered Off then the Lights will time out in like manner. The work lights are halogen lamps. The Front Marker/Turn and Rear Lamp Assembly (Tail/Stop/Turn/Backup) are all LED assemblies.

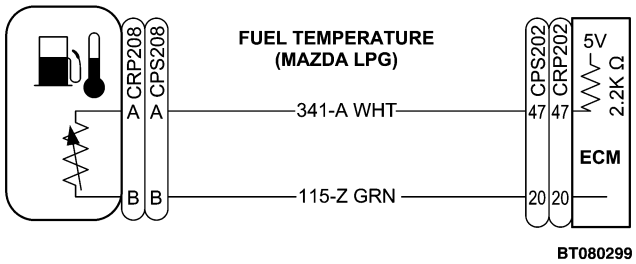
CAUTION

Do not replace LED assemblies with incandescent lamp assemblies.

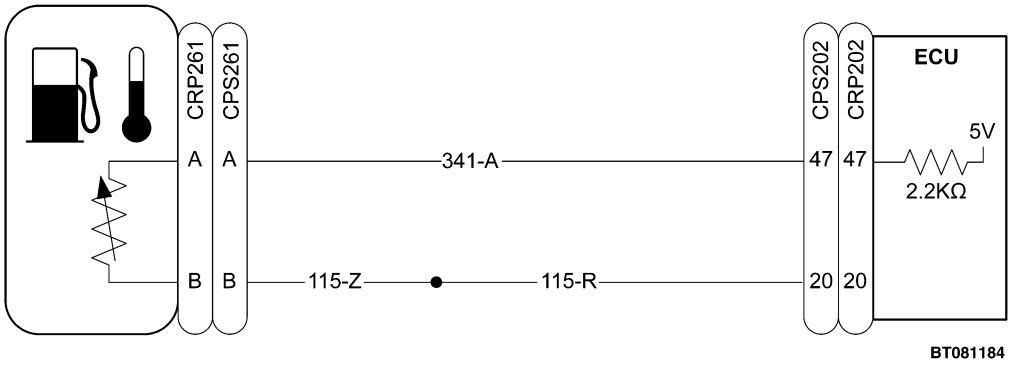
The individual LEDs are not serviceable, only the assemblies. See Figure 9030-10-41.



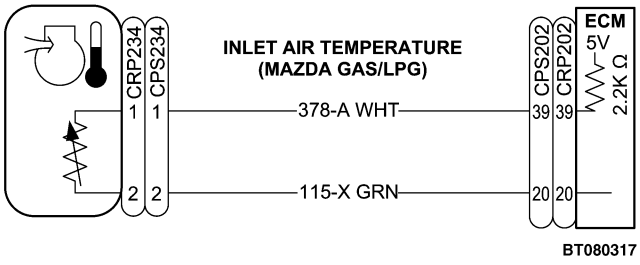
Engine Coolant Temperature (2007 Mazda EPA)



Fuel Temperature

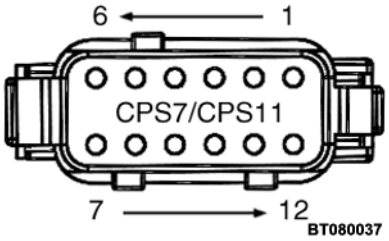


Fuel Temperature (2007 Mazda EPA)

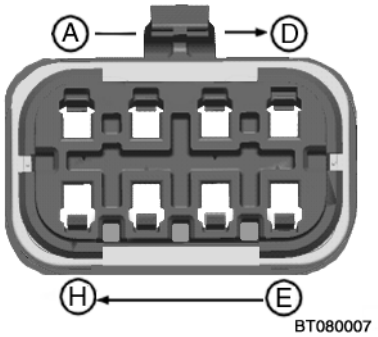


Inlet Air Temperature (2007 Mazda EPA)

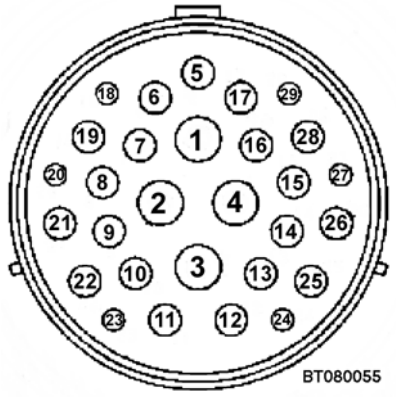
CONNECTOR(S)



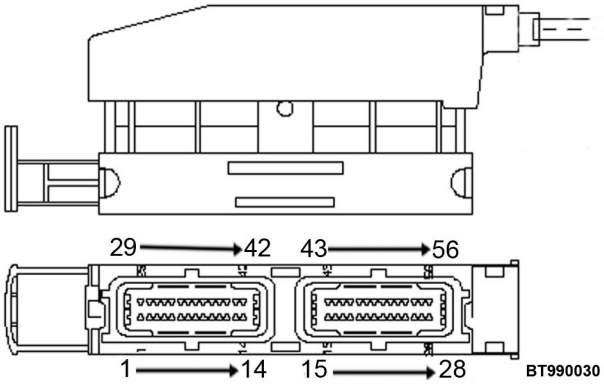
VSM Connector CPS 11



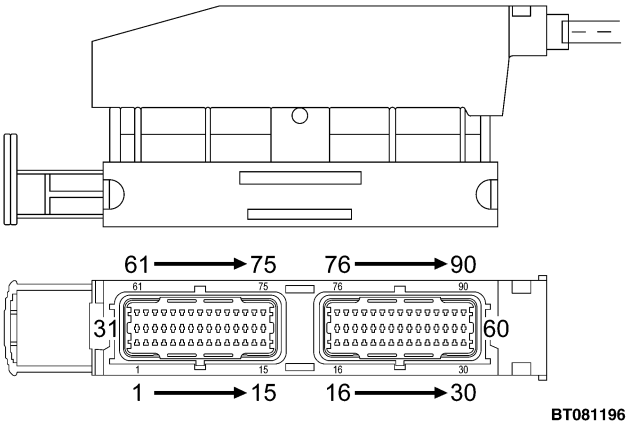
PDM Connector CPS 15



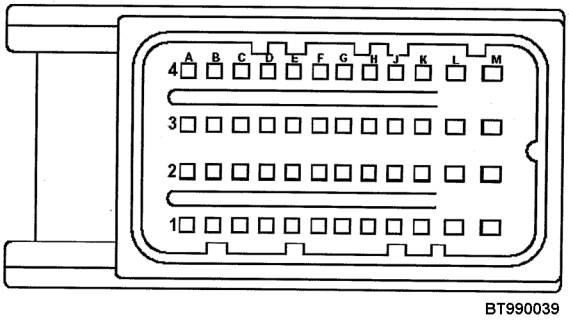
Engine Harness Connector CPS 55



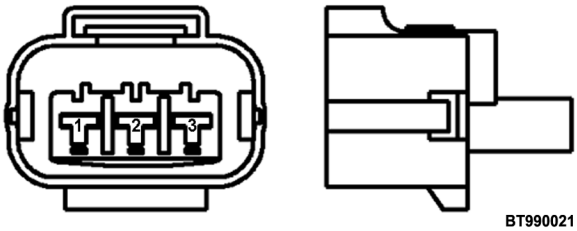
Mazda ECU Connectors CPS 202 and 203



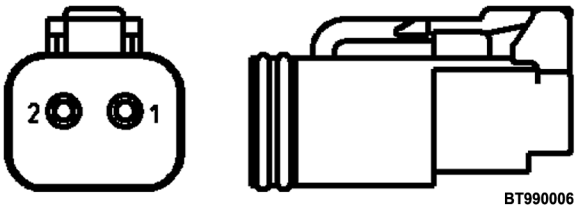
GM (2011) and Mazda ECU Connector CPS 202 (2007 Mazda EPA and 2011 LPG GM-PSI)



(GM 2010) ECU Connector CPS 204



Throttle Position Sensor Connector CPS 213 (Mazda)



Throttle Position Actuator Connector CPS 220

CAUSE A - LAMP DRIVER OUTPUT SHORTED TO BATTERY

PROCEDURE OR ACTION:

1. Ensure that truck power is **OFF**.
2. Change DMM to volts scale. Verify DMM zero reading.
3. Disconnect indicated connectors at applicable lamp device.
4. At device harness connector, measure voltage across DTC indicated lamp driver output pin (+) and the negative terminal (-) of battery.
   Is battery voltage present?
   YES: Lamp driver output is shorted to unswitched battery source. Refer to electrical schematic in **Diagrams and Schematics** 8000YRM1152 for possible source of battery voltage. Locate and repair/replace shorted wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Go to Step 5.
5. Turn truck power **ON**.
6. Repeat voltage measurement from Step 4.
   Is battery voltage present?
   YES: Lamp driver output is shorted to switched battery source. Refer to electrical schematic in **Diagrams and Schematics** 8000YRM1152 for possible source of battery voltage. Locate and repair/replace shorted wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Go to CAUSE B.

CAUSE B - INTERMITTENT SHORT OR OTHER POWER SOURCES

PROCEDURE OR ACTION:

1. Reconnect lamp assembly.
2. Turn truck power **ON**.
3. Cycle power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
4. Operate other Cab/Overhead Guard devices while observing device and display.
   Is the indicated device activated or the DTC displayed?
   YES: Lamp driver is shorted to other operated device. Refer to electrical schematic in **Diagrams and Schematics** 8000YRM1152 for possible source of other drive voltage. Locate and repair/replace shorted wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Go to CAUSE C.

DTC 522810-3
Alternator Charge Excitation Signal OORH
Alternator Excitation Signal Is Above Allowable Threshold

POSSIBLE CAUSE

A. EXCITATION SIGNAL SHORTED TO UNSWITCHED BATTERY (+)
B. EXCITATION SIGNAL SHORTED TO SWITCHED BATTERY (+)
C. EXCITATION SIGNAL OPEN CIRCUIT BETWEEN THE PDM AND ALTERNATOR
D. FUNCTIONAL FAILURE IN CONTROLLER

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

NOTE: This fault can be caused by a shorted resistor in the PDM. Open the PDM and verify that the 68? resistor is correctly installed. (See PDM Component Locator Diagram.) Remove resistor and use DMM to check that resistor value is 68? +/- 7?. Replace if outside of this value.

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any faults detected/observed?
   YES: Repair/replace connector or wiring associated with faults found. See **Electrical System** 2200YRM1142.
   NO: Go to CAUSE A.

CAUSE C - FUNCTIONAL FAILURE IN CONTROLLER

PROCEDURE OR ACTION:

1. Ensure all previous procedures have been completed.
2. Ensure truck power is **OFF**.
3. Ensure that all connections to the controller are completely inserted.
4. Ensure truck power is **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 5.
   NO: Problem corrected. Resume operation.
5. At the DSC, press **ENTER** to access Main Menu.
6. Scroll to VIEW VERSIONS, press **ENTER**.
7. Scroll to TRUCK SERIAL NUMBER, press **ENTER**.
8. View the TRUCK SERIAL NUMBER on the display.
   Does the truck serial number on display match serial number on truck nameplate (VSM Only)?
   YES: Go to Step 9.
   NO: Controller has been substituted from another truck. Replace VSM with VSM that has the correct truck serial number or obtain new VSM with correct Serial number/ CDF. Refer to appropriate **Electrical System** manual, depending on lift truck model.
9. **Resident Service Approval Required prior to VSM replacement for Trucks under warranty.** Make sure to indicate the DTC code(s) on the warranty claim and include an accurate problem description leading to the controller replacement.
10. For other controllers, Replace indicated controller. (ECU-ECM/GCU/TCU). Refer to appropriate **Electrical System** and **LPG Fuel System** or **Gasoline Fuel System** manual, depending on lift truck model.
11. Reinstall all removed components and ensure that all connectors are completely inserted.

NOTE: For Post 2007 Engine Connectors Interface, see Post 2007 Engine Connections.

12. Repeat Component Operational Check.

END POSSIBLE CAUSES

CAUSE B - IGNITION COIL FAILURE

PROCEDURE OR ACTION:

NOTE: Remove each ignition coil and test individually.

1. Measure resistance between ignition coil connector pins A and B.
   Is resistance ≤0.77Ω?
   YES: Proceed to Step 2.
   NO: Replace ignition coil and retest system.
2. Measure resistance between the ignition coil connector pin A and terminal contact C.
   Is resistance ≤8.91 kΩ?
   YES: Coil may be internally shorted.
   NO: Replace ignition coil and retest system.

END POSSIBLE CAUSES

DTC 524264-14
TISS/TOSS Special Conditions
Transmission Output Speed Not Proportional To Transmission Input Speed

POSSIBLE CAUSE

A. NO SENSOR SIGNAL OR INTERMITTENT SENSOR SIGNAL FROM TISS/TOSS1/TOSS2
B. CLUTCH PACK SLIPPING/CLUTCH PACK CALIBRATION REQUIRED

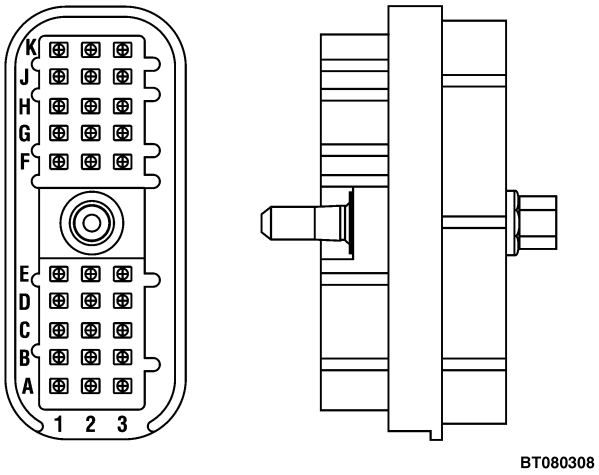
NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

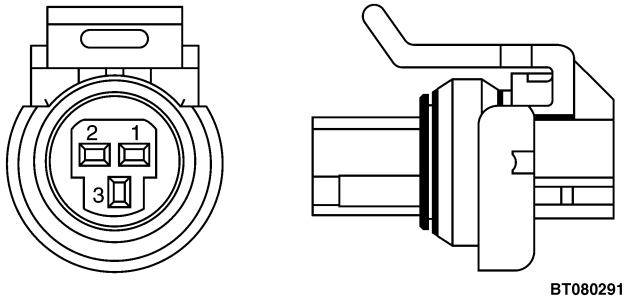
PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any faults detected/observed?
   YES: Repair/replace connector or wiring associated with faults found. See **Electrical System** 2200YRM1142.
   NO: Go to CAUSE A.

CONNECTOR(S)

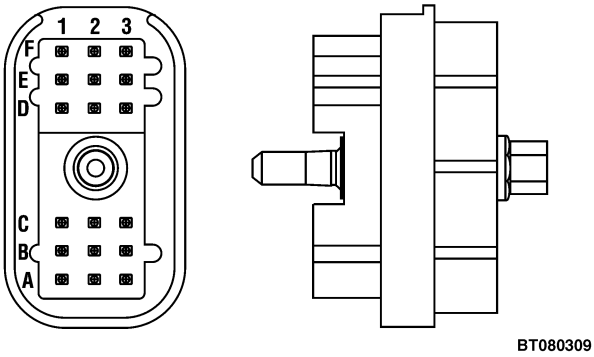


APC 214-CPS 128 Connector



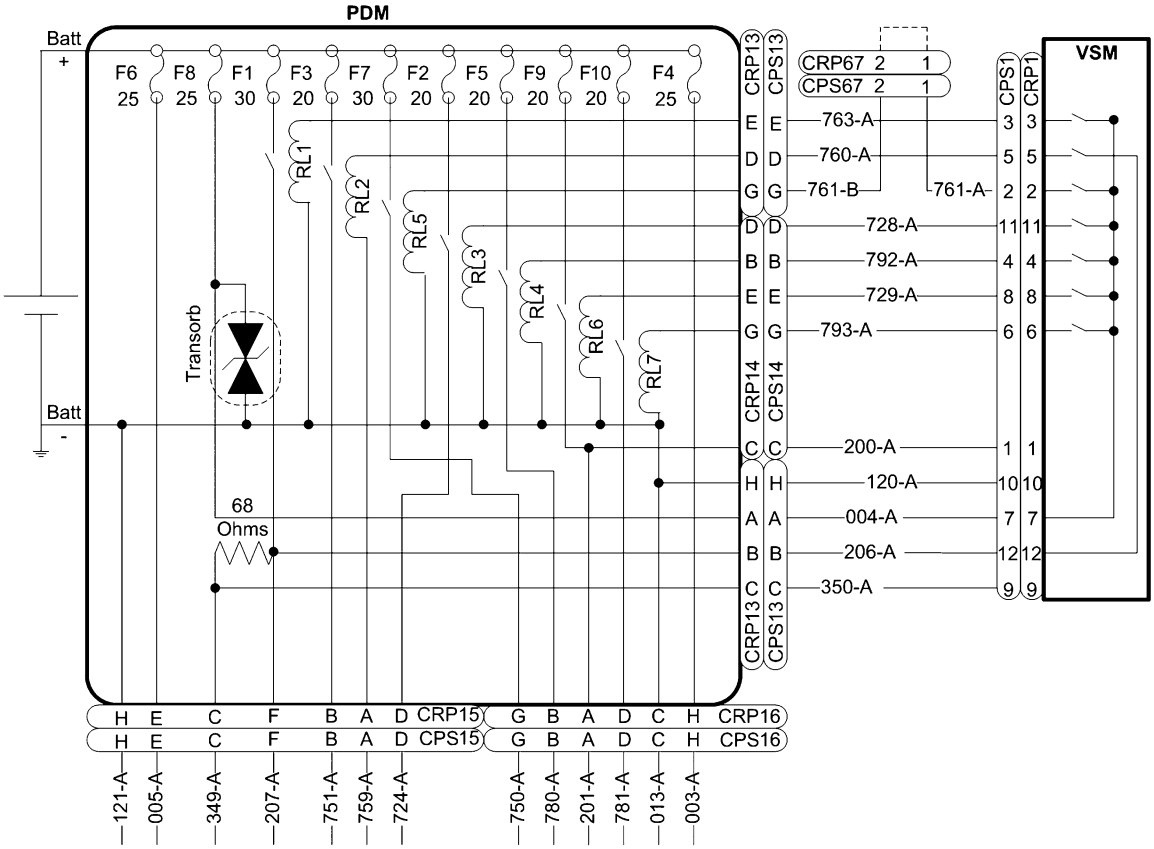
- **FWD HI PRESSURE CPS 141 CONNECTOR**
- **FWD2 PRESSURE CPS 142 CONNECTOR**
- **FWD LOW PRESSURE CPS 143 CONNECTOR**
- **REV1 PRESSURE CPS 144 CONNECTOR**
- **REV PRESSURE CPS 145 CONNECTOR**

Pressure Connector



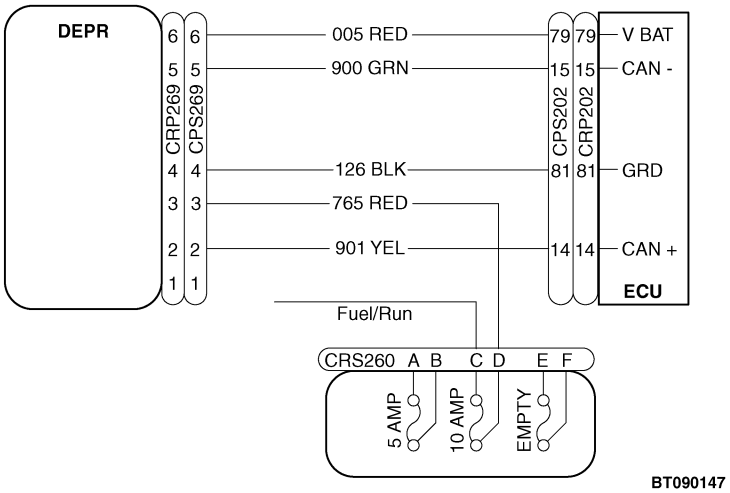
APC 214-CPS 129 Connector

END FAULT

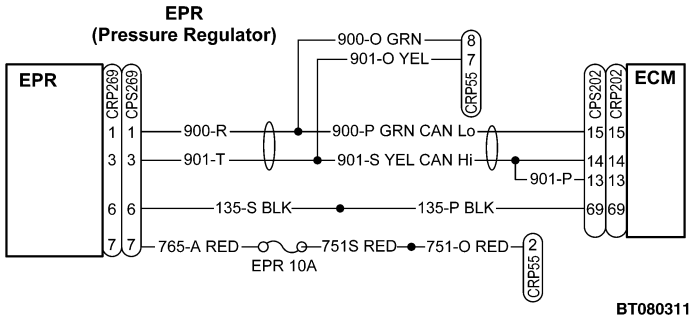


- WIRE # 003 (RED) = FUSED BATTERY POWER (F4)
- WIRE # 004 (RED) = FUSED BATTERY POWER (F8)
- WIRE # 005 (RED) = FUSED BATTERY POWER (F6)
- WIRE # 013 (BLK) = BATTERY GROUND
- WIRE # 109 (BLK = VSM POWER GROUND
- WIRE # 120 (BLK) = BATTERY GROUND
- WIRE # 121 (BLK) = BATTERY GROUND
- WIRE # 200 (RED) = IGN 1 POWER (RL6) OUTPUT
- WIRE # 201 (RED) = IGN 1 POWER (RL6) OUTPUT
- WIRE # 203 (RED) = IGN 2 VSM REGULATED OUTPUT
- WIRE # 206 (RED) = IGN 3 POWER (RL1) OUTPUT
- WIRE # 207 (RED) = IGN 3 POWER (RL1) OUTPUT
- WIRE # 349 (WHITE) = ALTERNATOR EXCITE
- WIRE # 350 (WHITE) = ALTERNATOR EXCITE
- WIRE # 724 (WHITE) = BACK UP ALARM OUTPUT (RL3)
- WIRE # 728 (RED) = RELAY 3 (BACK UP ALARM) DRIVER
- WIRE # 729 (RED) = RELAY 6 (IGN 1) DRIVER
- WIRE # 750 (WHITE) = START RELAY (RL5) OUTPUT
- WIRE # 751 (RED) = FUEL RELAY (RL2) OUTPUT
- WIRE # 759 (WHITE) = FUEL RELAY RETURN (ECU)
- WIRE # 760 (RED) = RELAY 2 (FUEL PUMP) DRIVER
- WIRE # 761 (RED) = RELAY 5 (STARTER) DRIVER
- WIRE # 763, (RED) = RELAY 1 (IGN3) DRIVER
- WIRE # 780 (WHITE) = FRONT WORK LIGHTS (RL4) OUTPUT
- WIRE # 781 (WHITE) = REAR WORK LIGHTS (RL7) OUTPUT
- WIRE # 792 (RED) = RELAY 4 (FRONT WORK LIGHTS) DRIVER
- WIRE # 793 (RED) = RELAY 7 (REAR WORK LIGHTS) DRIVER

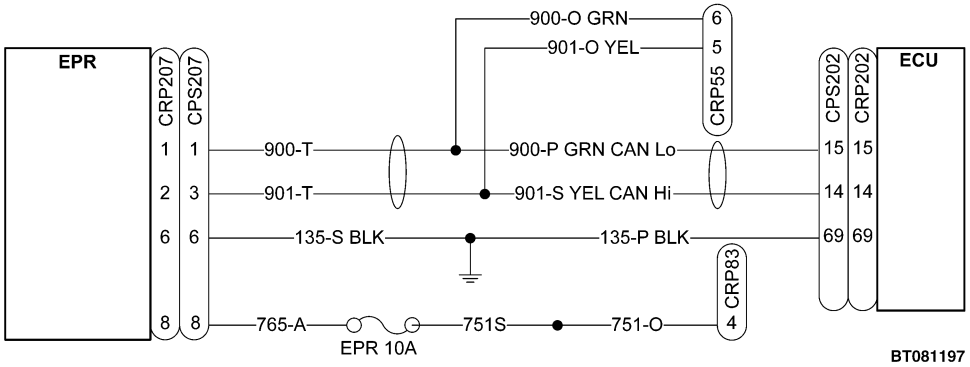
DIAGRAMS



Direct Electronic Pressure Regulator (4.3L LPG GM-PSI)



EPR Pressure Regulator



EPR Pressure Regulator (2007 Mazda EPA)

END FAULT

DTC 523541-4
EGR Lift Sensor Abnormal

POSSIBLE CAUSE

A. EGR LIFT SHORTED TO B+
B. BAD EGR VALVE
C. DAMAGED WIRING HARNESS
D. FUNCTIONAL FAILURE IN CONTROLLER

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified or problem resolved. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code.
   Are any of the connectors/wiring damaged?
   YES: Repair/replace connector or wiring associated with faults found. Refer to the appropriate **Electrical System** manual, depending on lift truck model. Repeat Step 1.
   NO: Go to CAUSE A.

CAUSE A - EGR LIFT SHORTED TO B+

PROCEDURE OR ACTION:

1. Ensure truck power is **OFF**.
2. Change DMM to volts scale.
3. Disconnect applicable connector at ECM.
4. Check for battery voltage on the sensor signal wire between ECM connector and sensor connector.
   Is battery voltage on the sensor signal wire?
   YES: Sensor signal wire is shorted to B+. Locate and repair/replace wire/connection. Refer to the appropriate **Wiring Harness Repair** manual, depending on lift truck model.
   NO: Go to CAUSE B.

CAUSE C - THERMOSTAT FAILURE

PROCEDURE OR ACTION:

NOTE: Allow engine to cool prior to next step.

1. Remove the thermostat from the engine. Do not discard thermostat.
2. Install new thermostat.

NOTE: Ensure coolant has the correct water-to-coolant concentration.

3. Raise coolant temperature to 65°C (149°F) or greater and initiate a Parked Regeneration.
   Was a Parked Regeneration initiated and completed?
   YES: Problem resolved. Discard faulty thermostat. Resume operation.
   NO: Install original thermostat. Go to CAUSE D.

CAUSE D - FUNCTIONAL FAILURE IN CONTROLLER

PROCEDURE OR ACTION:

1. Ensure all previous procedures have been completed.
2. Ensure truck power is **OFF**.
3. Ensure that all connections to the controller are completely inserted.
4. Ensure truck power is **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 5.
   NO: Problem corrected. Resume operation.
5. At the DSC, press **ENTER** to access Main Menu.
6. Scroll to VIEW VERSIONS, press **ENTER**.
7. Scroll to TRUCK SERIAL NUMBER, press **ENTER**.
8. View the TRUCK SERIAL NUMBER on the display.
   Does the truck serial number on display match serial number on truck nameplate (VSM Only)?
   YES: Go to Step 9.
   NO: Controller has been substituted from another truck. Replace VSM with VSM that has the correct truck serial number or obtain new VSM with correct Serial number/ CDF. Refer to the appropriate **Electrical System**YRM .
9. **Resident Service Approval Required prior to VSM replacement for Trucks under warranty.** Make sure to indicate the DTC code(s) on the warranty claim and include an accurate problem description leading to the controller replacement.
10. For other controllers, Replace indicated controller. Refer to the appropriate **Electrical System** and **Fuel System**YRM .
11. Reinstall all removed components and ensure that all connectors are completely inserted.
12. Repeat Component Operational Check.

END POSSIBLE CAUSES

This DTC is set when the stored QR data in ACU memory is vacant or incorrect.

CODES

DTC 3361-7 - DEF Injector QR Data Fault - No QR Data
DTC 3361-2 - DEF Injector QR Data Fault - Invalid QR Data

POSSIBLE CAUSE

A. CANBUS COMMUNICATION FAULT
B. ACU FAULT

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code. Make sure electrical connection is a good physical connection (i.e. sockets and pins are seated correctly; connector "clicks" indicating locking tab works correctly).
   Are any of the connectors/wiring damaged?
   YES: Repair/replace connector or wiring associated with faults found. Refer to appropriate **Electrical System** manual, depending on lift truck model.
   NO: Go to CAUSE A.

CAUSE A - CANBUS COMMUNICATION FAULT

PROCEDURE OR ACTION:

1. Measure voltage between the ACU connector CPS205, socket 16 and B(-).
   Is CAN HI voltage approximately 2.5 Vdc?
   YES: Proceed to Step 2.
   NO: Inspect CAN HI circuit for open or short. If voltage is 0 volts, the CAN HI circuit is shorted to ground or open. If voltage is above 5 volts, the CAN HI circuit is shorted to power.
2. Measure voltage between the ACU connector CPS205, socket 17 and B(-).
   Is CAN LO voltage approximately 2.5 Vdc?
   YES: Disconnect battery and proceed to Step 3.
   NO: Inspect CAN LO circuit for open or short. If voltage is 0 volts, the CAN LO circuit is shorted to ground or open. If voltage is above 5 volts, the CAN LO circuit is shorted to power.
3. Measure resistance between the ACU connector CPS205, socket 16 and socket 17.
   Is resistance 60 ± 6 ohms?
   YES: No communication faults are present, connect battery and proceed to CAUSE B.
   NO: If resistance is 120 ohms, the CANbus has an open circuit or a missing or damaged termination resistor. If resistance is 0 ohms, the CANbus circuits are shorted together.

This DTC is set when abnormal voltage has been detected on the Post NOx sensor circuit or an open or short circuit is present.

CODES

DTC 3226-12 - Post NOx Sensor Error
DTC 3233-12 - Post NOx Sensor Heater Error
DTC 3226-1 - Post NOx Sensor Error Tampering
DTC 523618-2 - No Communication with Post NOx Sensor

POSSIBLE CAUSE

A. POST NOX SENSOR WIRING FAULT
B. POST NOX SENSOR CANBUS COMMUNICATION FAULT
C. POST NOX SENSOR FAULT

NOTE
Please refer to the end of this procedure for supporting diagrams.

COMPONENT OPERATIONAL CHECK

PROCEDURE OR ACTION:

NOTE: The Post NOx Sensor is provided switched battery voltage from a 10A fuse. Ground is provided by the ECU connector V01. Sensor information is communicated over the CANbus system to the ECU and other components.

1. Turn power to **OFF** for no less than 30 seconds, and then to **ON** to clear displayed DTC.
   Does reported DTC reoccur?
   YES: Go to Step 2.
   NO: Problem not verified. Resume operation.
2. Conduct a quick visual inspection of all connectors/wiring associated with the displayed fault code. Make sure electrical connection is a good physical connection (i.e. sockets and pins are seated correctly; connector "clicks" indicating locking tab works correctly).
   Are any of the connectors/wiring damaged?
   YES: Repair/replace connector or wiring associated with faults found. Refer to appropriate **Electrical System** manual, depending on lift truck model.
   NO: Go to CAUSE A.

Circulating (Accessory) Fan Inoperative

CAUSE A - FAN CIRCUIT OPEN SUPPLY OR GROUND WIRE

PROCEDURE OR ACTION:

1. Remove connector CPS 43 from fan assembly.
2. Using DMM, measure the voltage across the pins of CPS 43.
   Is voltage approximately system voltage?
   YES: Circuit voltage and ground connections are OK. Go to CAUSE B.
   NO: Go to Step 3.
3. Change DMM to ohms scale. Verify zero reading.

CAUTION

For this next measurement, make sure measurement is taken at pin 1, (Black Wire). Pin 2 may have an applied voltage that could damage meter.

4. Measure resistance between pin 1 of the fan assembly connector and a clean frame ground.
   Is the resistance less than 0.5 ohms?
   YES: Wire # 003-G (RED) has open circuit to supply voltage. Locate and repair/replace open wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Wire # 123-J (BLACK) has open circuit to ground. Locate and repair/replace open wire/connection. See **Wire Harness Repair** 2200YRM1128.

CAUSE B - DEFECTIVE FAN

PROCEDURE OR ACTION:

1. Replace fan assembly. See **Electrical System** 2200YRM1142.
   Does fan operate properly?
   YES: Problem repaired. Resume operation
   NO: Go to CAUSE C.

CAUSE C - POWER SUPPLY CIRCUIT FAULT

PROCEDURE OR ACTION:

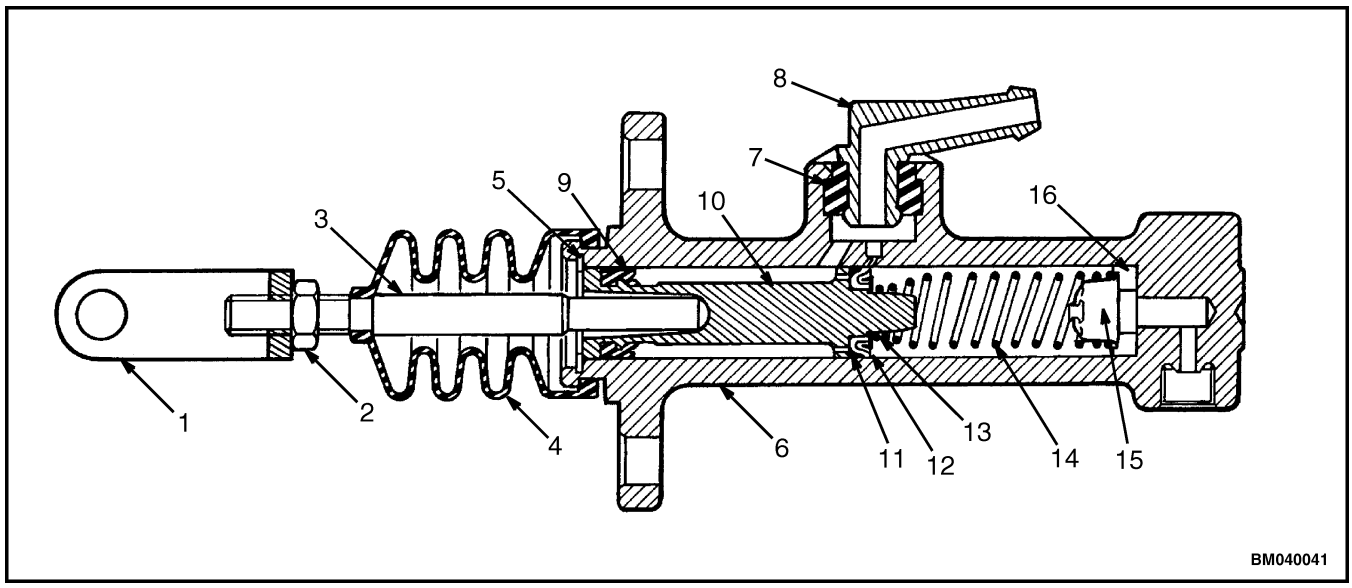
1. Open engine cover and remove cover from PDM.
2. Using DMM, measure voltage between each side of fuse F4 (+) and the negative terminal of battery (-).
   Is the voltage on each side of fuse approximately 12Vdc?
   YES: Go to Step 3.
   NO: Fuse is blown. Remove defective fuse and go to CAUSE D.
3. Open dash cover near VSM and disconnect harness connector CPS 21.
4. Using DMM, measure voltage across pins 1(+) and 2(-) of CPS 21.
   Is voltage approximately system voltage?
   YES: Wire #003-G (RED) has open circuit. Locate and repair/replace open wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Go to Step 5.
5. Move the negative (-) meter lead to a clean frame ground on the truck.
   Is voltage approximately system voltage?
   YES: Wire #123-J (BLACK) is open. Locate and repair/replace open wire/connection. See **Wire Harness Repair** 2200YRM1128.
   NO: Wire # 003-D (RED) has open circuit to supply voltage. Locate and repair/replace open wire/connection. See **Wire Harness Repair** 2200YRM1128.

Master Cylinder

The master cylinder is designed for a single-circuit system. The master cylinder has a piston that operates in the bore of the master cylinder. See Figure 9040-10-32.

NOTE: The reservoir is located to the right of the park brake and is attached to the cowl.

The reservoir is equipped with an indicator for low fluid level. A float in the reservoir moves up and down with the fluid level. When the fluid level is low, a magnet on the float activates a switch in the bottom of the reservoir. This switch signals the Vehicle System Manager (VSM) which illuminates a light on the Display Switch Cluster (DSC).



1. ROD END
2. NUT
3. PUSH ROD
4. BOOT
5. SNAP RING
6. CYLINDER HOUSING
7. SEAL
8. FITTING
9. PISTON SEAL
10. PISTON
11. SPACER
12. PISTON CUP
13. RETAINER
14. SPRING
15. CHECK VALVE
16. VALVE SEAT

Figure 9040-10-32. Master Cylinder

Brake Position Sensor

This sensor has two applications. It senses the inch/brake pedal position as well as the park brake hand lever position. The sensor is located to the left of the inch/brake pedal and left of the park brake handle.

Parking Brake

The parking brake system uses the service brake shoes. Additional linkage activates the parking brake system. When the lever is moved to apply the parking brake, the cables and linkage expand the brake shoes against the drums. The design of the parking brake linkage adjusts each cable so that the tension is the same when the lever is moved to apply the parking brake. The park brake sensor is located on the right side of the park brake handle.

Table 9040-40-12. Stall Speeds (Continued)

Truck	Torque Converter Stall Test ±100 RPM					
	Standard Techtronix 100		Techtronix 100X		Techtronix 200X	
	New Engine	Broken-In Engine	New Engine	Broken-In Engine	New Engine	Broken-In Engine
Yanmar 2.6L Diesel	1752 RPM	1845 RPM	N/A	N/A	N/A	N/A
Yanmar 3.3L Diesel	2150 RPM	2260 RPM	N/A	N/A	[1]	[1]
Yanmar 3.0L Diesel	1900 RPM	2000 RPM	N/A	N/A	[1]	[1]
4.0-5.5 Ton						
GM 4.3L Gas	2160 RPM	2210 RPM	2160 RPM	2210 RPM	[1]	[1]
GM 4.3L LPG	2070 RPM	2170 RPM	2070 RPM	2170 RPM	[1]	[1]
Yanmar 3.3L Diesel	2150 RPM	2260 RPM	N/A	N/A	[1]	[1]
Cummins 4.5L Diesel	1900 RPM	2050 RPM	1900 RPM	2050 RPM	[1]	[1]
QSB 3.3L Diesel	1955 RPM	1970 RPM	1955 RPM	1970 RPM	[1]	[1]
Kubota 3.8L Diesel	1900 RPM	1970 RPM	1900 RPM	1970 RPM	N/A	N/A
Kubota 3.6L Diesel	1950 RPM	2000 RPM	1950 RPM	2000 RPM	N/A	N/A
8.0-9.0 Ton						
GM 5.7L LPG	2160 RPM	2210 RPM	2160 RPM	2210 RPM	[1]	[1]
Kubota 3.8L Diesel	[1]	[1]	[1]	[1]	N/A	N/A
NOTE: [1] = Stall Test Not Applicable Due to VSM Control of Engine Power Output.						

Truck	Torque Converter Stall Test ±100 RPM					
	Standard Powershift		Techtronix 332		Techtronix 332ASH	
	New Engine	Broken-In Engine	New Engine	Broken-In Engine	New Engine	Broken-In Engine
6.0-7.0 Ton						
GM 4.3L Gas	2160 RPM	2210 RPM	[1]	[1]	[1]	[1]
GM 4.3L LPG	2070 RPM	2170 RPM	[1]	[1]	[1]	[1]
Cummins 4.5L Diesel	1900 RPM	2050 RPM	[1]	[1]	[1]	[1]
QSB 3.3L Diesel	1935 RPM	1950 RPM	[1]	[1]	[1]	[1]
Kubota 3.8L Diesel	2015 RPM	2050 RPM	[1]	[1]	N/A	N/A
Kubota 3.6L Diesel	1935 RPM	1950 RPM	[1]	[1]	N/A	N/A
NOTE: [1] = Stall Test Not Applicable Due to VSM Control of Engine Power Output.						

CAUSE H - UNSTABLE SECONDARY RELIEF VALVE.

PROCEDURE OR ACTION:

1. Install pressure gauge in hydraulic control valve. See Secondary Relief Valve Test and Adjustment.
2. Operate a secondary function while observing pressure gauge.
   Does pressure fluctuate during secondary function.
   YES: Go to CAUSE B.
   NO: Go to Step 3.
3. Hold secondary function over relief.
   Does relief pressure meet test specifications?
   YES: Go to CAUSE I.
   NO: Replace relief valve. **Main Control Valves** 2000YRM1334.

CAUSE I - HYDRAULIC SYSTEM OVERHEATING.

PROCEDURE OR ACTION:

1. See Observed Symptoms-Gear Pump, Abnormal Smell/Discoloration/Foaming of Oil, Page 9050-33-4. If symptom is still present, go to CAUSE J.

CAUSE J - UNSTABLE UNLOADER SPOOL.

PROCEDURE OR ACTION:

1. Inspect unloader valve for damage or contamination. See **Main Control Valve** 2000YRM1137.
   Is unloader valve free of contamination and in good condition?
   YES: Go to CAUSE K.
   NO: Clean or replace unloader valve. See **Main Control Valve** 2000YRM1137.

CAUSE K - UNSTABLE PRIORITY VALVE IN SCU.

PROCEDURE OR ACTION:

1. Perform Operational Diagnostic Procedures, Operational Checkout, Page 9010-05-11.
   Does priority flow divider valve pass the check?
   YES: Priority flow divider valve is OK.
   NO:
   - Cannot turn steering wheel, wheel locks up. See Observed Symptoms-Gear Pump, No Steering (All Other Hydraulic Functions OK), Page 9050-33-53.
   - Steering wheel turns but fails Priority Valve Flow Divider Valve Check, remove and clean flow divider spool. See **Main Control Valve** 2000YRM1137.

END SYMPTOM

CAUSE C - EXCESSIVE SPOOL LEAKAGE.

PROCEDURE OR ACTION:

1. Check spool for (see **Main Control Valve** 2000YRM1137):
   - Damage
   - Free movement
   - Debris or contamination

   Is spool and mating bore in good condition?
   YES: See Observed Symptoms-Gear Pump, Secondary Function Continues to Move for Awhile After Joystick or MLM Is Released (E-Valve), Page 9050-33-61.
   NO: Replace damaged parts.

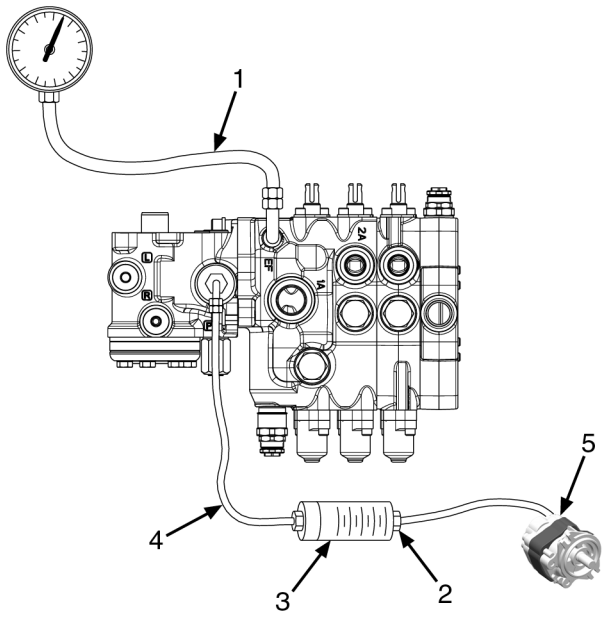
END SYMPTOM

Table 9050-43-7. Test Specifications (Continued)

Minimum Pump Output (Continued)	**For 6.0-7.0 Ton Cushion and Pneumatic Lift Trucks:** 6.0-7.0 Ton GM 4.3L Engines: **Primary Pump:** 72.8 liter/min (19.2 gal/min) **Secondary Pump:** 38.8 liter/min (10.24 gal/min) 6.0 Ton Cummins 4.5L and QSB 3.3L Engines: **Primary Pump:** 71.5 liter/min (18.9 gal/min) **Secondary Pump:** 33.8 liter/min (8.9 gal/min) 7.0 Ton Cummins 4.5L and QSB 3.3L Engines: **Primary Pump:** 63.5 liter/min (16.8 gal/min) **Secondary Pump:** 33.8 liter/min (8.9 gal/min) 8.0-9.0 Ton QSB 3.3L Engines: **Primary Pump:** 81 liter/min (21.3 gal/min) **Secondary Pump:** 54 liter/min (14.2 gal/min) 8.0-9.0 Ton GM 5.7L Engines: **Primary Pump:** 81 liter/min (21.3 gal/min) **Secondary Pump:** 54 liter/min (14.2 gal/min)
Excess Flow (EF) Test Pressure	Tilt Function Over Relief (Secondary Relief Valve Setting)

Table 9050-43-8. Service Tools

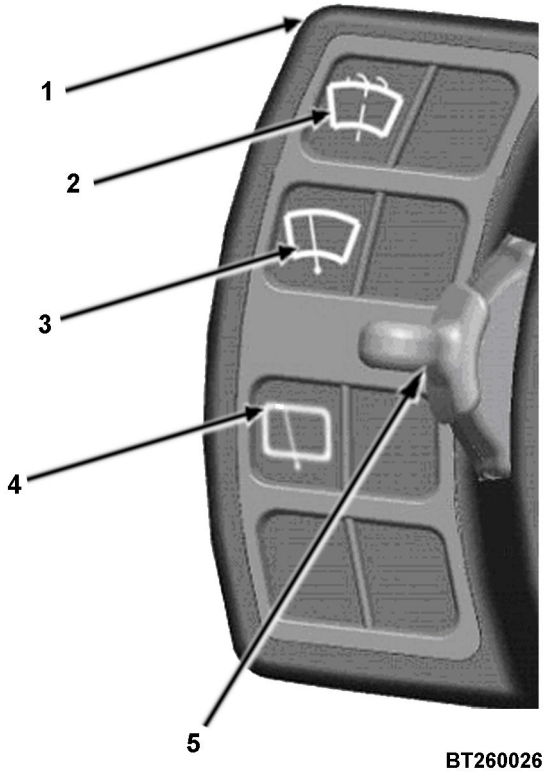
125 liter/min (33 gal/min) Flowmeter, rated at 24.0 MPa (3500 psi)	
0 - 35.0 MPa (0 - 5000 psi) Pressure Gauge	
Excess Flow (EF) Test Port Plug Size	SAE #4 O-ring Port (7/16-20 UNF)
Steering Control Valve Inlet Port Size	SAE #12 O-ring Port (1-1/16-12 UNF)



1. EXCESS FLOW (EF) TEST PORT WITH GAUGE
2. HYDRAULIC PUMP TO STEERING CONTROL UNIT (SCU) HOSE
3. FLOWMETER
4. SCU INLET ADAPTOR HOSE
5. HYDRAULIC PUMP

Figure 9050-43-53. Manual Hydraulic Valve Shown

operated by switches located on the Control Input panel on the left side of the DSC. See Figure 9060-10-21.



1. CONTROL INPUTS, LEFT SIDE, DSC
2. WASHER/WIPER SWITCH
3. FRONT WIPER SWITCH
4. REAR WIPER SWITCH
5. FWD/REV SWITCH (IF EQUIPPED)

Figure 9060-10-21. Wiper/Washer Controls

CAB SYSTEMS OPERATION

The cab-equipped lift trucks provide the operator with the following devices:

- Windshield Washer/Wiper System
- Heating System
- Air Circulating System

1. Washer/Wiper System Operation

a. The wiper/washer system is controlled by the VSM in response to operator inputs at the DSC. The operation of the front and rear wipers is essentially the same.

(1) Pushing the wiper button on the DSC sends a CAN message to the VSM which in turn sends a start signal to the selected wiper motor. The motor drives the wiper out of the park position and the wiper(s) continue(s) through the full sweep cycle. Wiper operation will continue until the wiper button on the DSC is pushed again.

If this is the first time the wipers have been turned on in this power cycle, the wiper delay automatically defaults to 0 seconds. Wiper delay control is enabled within 2 seconds of startup and can be adjusted as follows:

- The display on the DSC will show FRONT (REAR) WIPER DELAY on the top line and an 8 position bar graph on the bottom line.
- When this screen is displayed, pressing the SCROLL button, up or down, will increase or decrease the delay period between wiper sweeps.
- The segments of the bar graph on the bottom line of the display represent a delay setting of: 0, 1, 2, 4, 8, 12, 20, and 30 seconds.
- Once a delay has been set, the wiper system will default to that delay period each time the wiper system is turned on, within the same power cycle.
- The FRONT (REAR) WIPER DELAY screen will turn off 2 seconds after the last adjustment button is pressed, unless another action occurs that has a higher display priority.

(2) To change the delay period when the wipers are already operating, push and hold the wiper ON/OFF button for greater than one second. The FRONT (REAR) WIPER DELAY screen will be turned on and the delay adjustment can be made as previously described.

(3) Pushing the wiper button on the DSC, for less than one second while the wiper is operating, will remove the start command from the wiper motor. Once removed, the wiper will continue its sweep until it reaches the park position. This opens the park position switch and removes power from the wiper motor. The operation stops and the wiper remains in the park position.

Mast or Carriage Binding

POSSIBLE CAUSE

A. MAST OR CARRIAGE DAMAGED
B. MAST CHANNELS LACK LUBRICATION
C. MAST NOT SHIMMED CORRECTLY
D. CHAINS ARE LOOSE OR NOT EQUAL
E. CONTAMINATION IN CHANNELS IS BINDING LOAD ROLLERS
F. DAMAGED OR WORN LOAD ROLLERS OR STRIP BEARINGS
G. LIFT CYLINDER BINDING

CAUSE A - MAST OR CARRIAGE DAMAGED

NOTE: See **Operating Manual**.

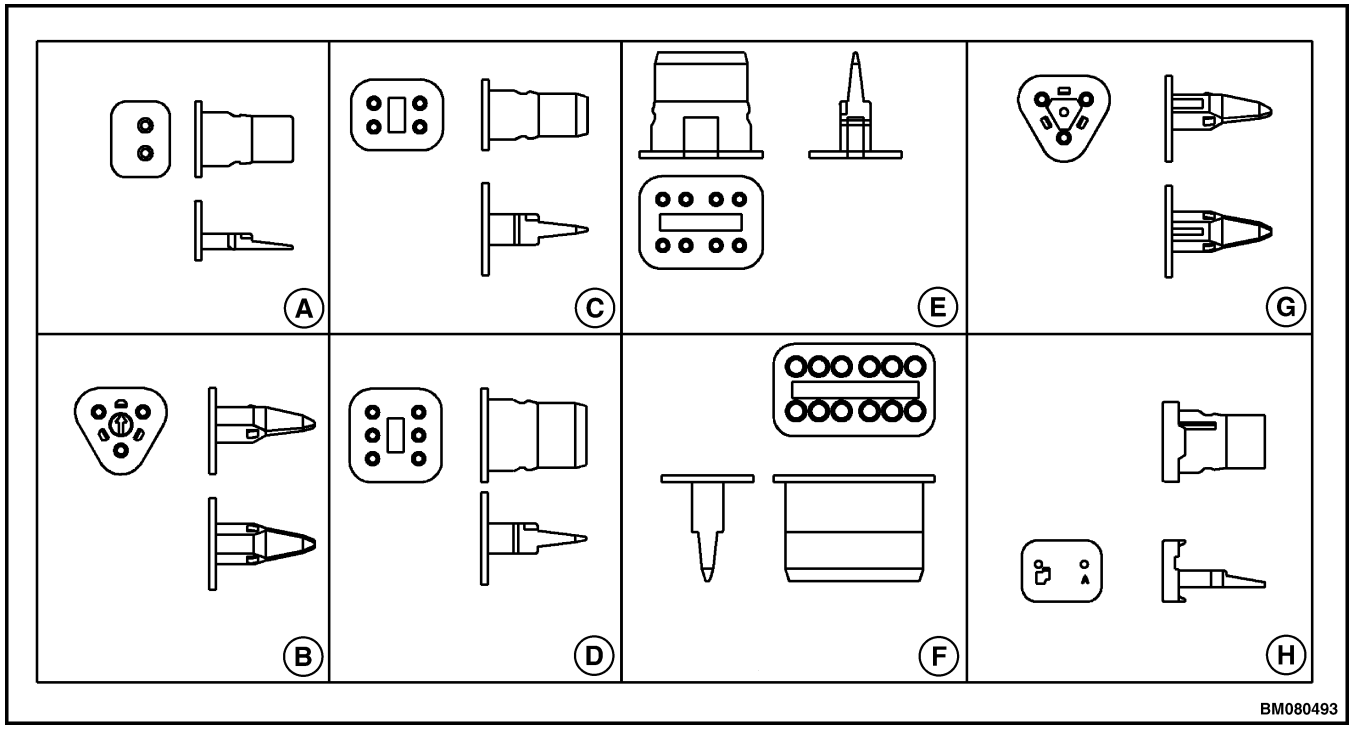
PROCEDURE OR ACTION:

1. Visually inspect mast and carriage for damage.
   Are components in good condition?
   YES: Go to CAUSE B.
   NO: Repair or replace damaged components. For 1.0-3.5 Ton Cushion and Pneumatic Trucks, see **Mast Repairs (S/N A551, A555, A559, A661, A662, A663, A664, B507, B508, B509, B551, B555, B559, B562, B563, B564, B661, B662, B663, C515, C551, C555, C559, D507, D508, D509, D515, D562, D563, D564, E509, and E564)** 4000YRM1148. For 4.0-7.0 Ton Cushion and Pneumatic Trucks, see **Mast Repairs, 2- and 3-Stage Masts (S/N A513, A514, A613, A614, A702, A703, A704, A705, A706, A707, A751, A752, B513, B514, B586, B587, B588, B589, B590, B591, B749, B750, B751, B752, B753, B754)** 4000YRM1250. For 8.0-9.0 Ton Cushion and Pneumatic Trucks, see **Mast Repair (S/N A513, A514, A613, A614, A643, A644, A683, A684)** 4000YRM1406.

CAUSE B - MAST CHANNELS LACK LUBRICATION

PROCEDURE OR ACTION:

1. Inspect grease on mast channels.
   Is a thin coat of grease spread evenly on channels?
   YES: Go to CAUSE C.
   NO: Apply grease to mast sliding surfaces. For 1.0-2.0 Ton Cushion and Pneumatic Trucks, see **Periodic Maintenance** 8000YRM1207. For 2.0-3.5 Ton Cushion and Pneumatic Trucks, see **Periodic Maintenance** 8000YRM1150. For 4.0-5.5 Ton Cushion and Pneumatic Trucks, see **Periodic Maintenance** 8000YRM1248. For 6.0-7.0 Ton Cushion Trucks, see **Periodic Maintenance** 8000YRM1319. For 6.0-7.0 Ton Pneumatic Trucks, see **Periodic Maintenance** 8000YRM1322. For 8.0-9.0 Ton Pneumatic Trucks, see **Periodic Maintenance** 8000YRM1407.



A. SECONDARY LOCK TYPE DA
B. SECONDARY LOCK TYPE DB
C. SECONDARY LOCK TYPE DC
D. SECONDARY LOCK TYPE DD
E. SECONDARY LOCK TYPE DE
F. SECONDARY LOCK TYPE DF
G. SECONDARY LOCK TYPE DG
H. SECONDARY LOCK TYPE DH

Figure 18. DT Connector Plug Secondary Locks

Legend for Figure 31.

A. FRONT OF TOOL
B. BACK OF TOOL

1. UPPER INSERT
2. ANVIL
3. INSULATION CRIMP ADJUSTMENT LEVER
4. CONTACT SUPPORT
5. LOCATOR
6. CERTI-CRIMP RATCHET
7. STRIPPED WIRE

The insulation adjust lever regulates the crimp height. See Insulation Crimp Adjustment.

The contact support prevents the contact from bending during crimping.

The locator functions two ways:

- position the contact between the upper insert and the anvil before crimping
- limits the insertion distance of the stripped wire into the contact.

The ejector pulls the locator down, and ejects the crimped contact when the tool handles are fully opened.

CAUTION

The crimping jaws bottom before the CERTI-CRIMP ratchet releases. This is a design feature that ensures maximum electrical and tensile performance of the crimp DO NOT readjust the ratchet.

The CERTI-CRIMP ratchet assures full crimping of the contact. Once engaged, the ratchet will not release until the handles have been fully closed.

Stripping Wire for Use with AMP Hand Crimping Tool

1. Choose the correct AWG for the contact being used.
2. See Table 2 for recommended strip length.

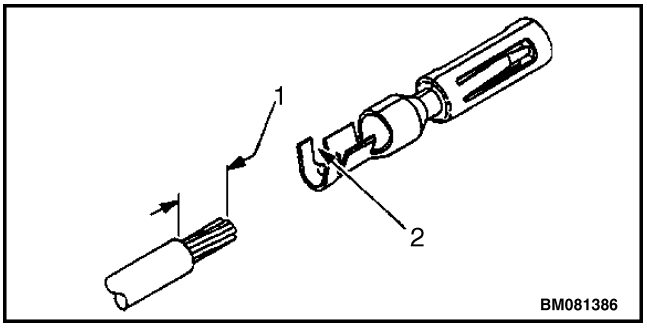
Table 2. Wire Size (AWG)

Wire Size (AWG)	Insulation Diameter Range	Tool Wire Size Marking	Contact	Wire Strip Length
16	1.7 to 2.7 mm (0.067 to 0.106 in.)	16	Yale P/N 520202601	5.5 mm (0.215 in.)
20 - 18		20 - 18		4.7 mm (0.185 in.)

CAUTION

DO NOT cut or nick the wire strands.

3. Strip wire to recommended strip length. A small piece of insulation should come off the wire after stripping. See Figure 32.

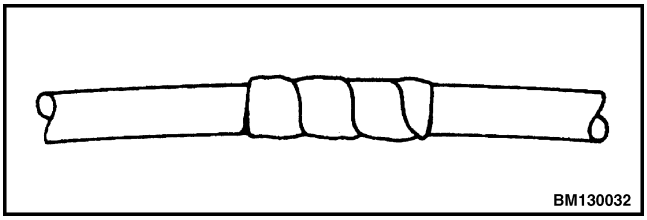


NOTE: SEE TABLE 2 FOR WIRE STRIP LENGTH.

1. STRIPPED WIRE
2. LOCATOR SLOT

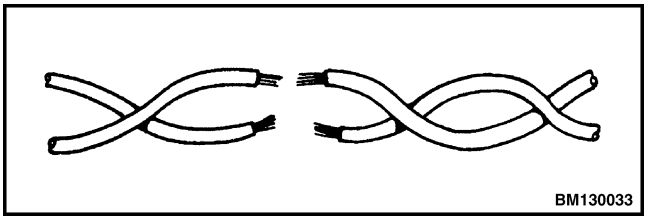
Figure 32. Strip Length

STEP 7.
Apply electrical tape over whole bundle to secure.

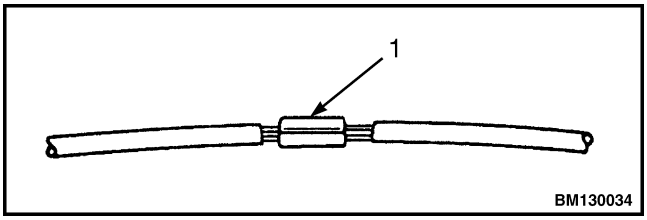


TWISTED LEADS REPAIR

STEP 1.
Locate damaged wire and remove insulation as required.



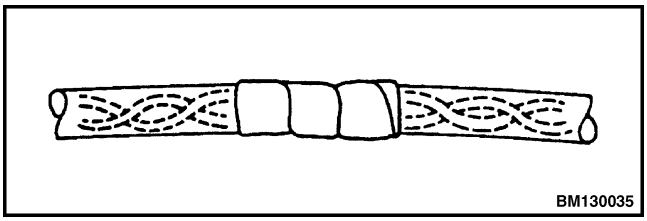
STEP 2.
Splice the two wires using splice clips and rosin core solder.

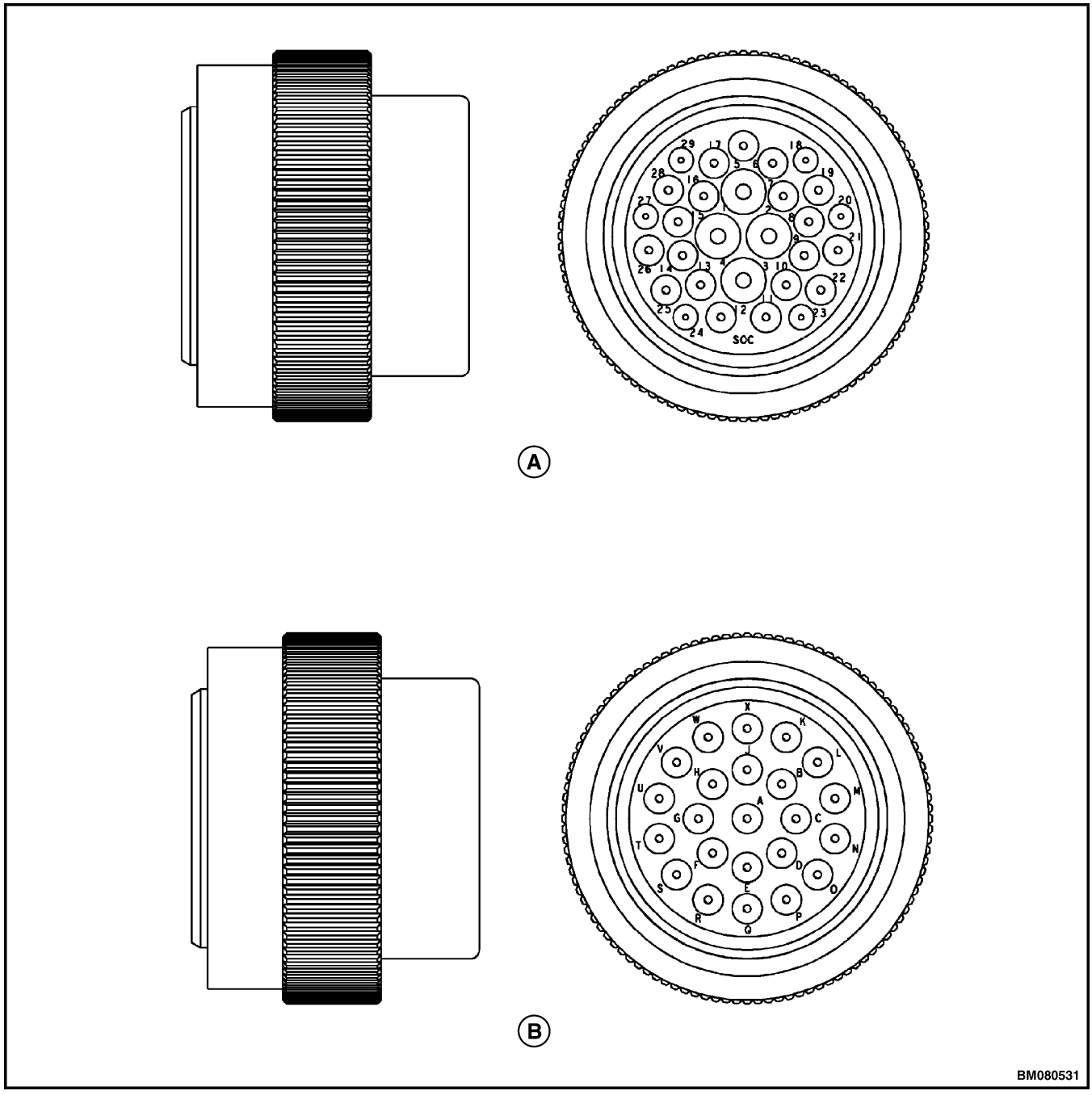


1. SPLICE AND SOLDER

STEP 3.
Cover splice with electrical tape to insulate from other wires.

STEP 4.
Twist and tape with electrical tape.





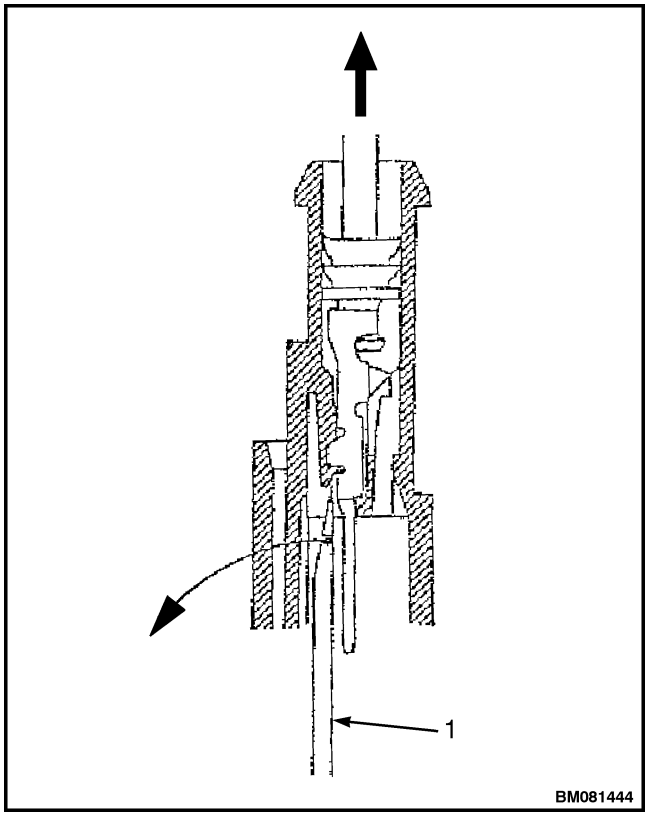
A. TYPE 1 B. TYPE 2

Figure 24. HD Connector Plugs

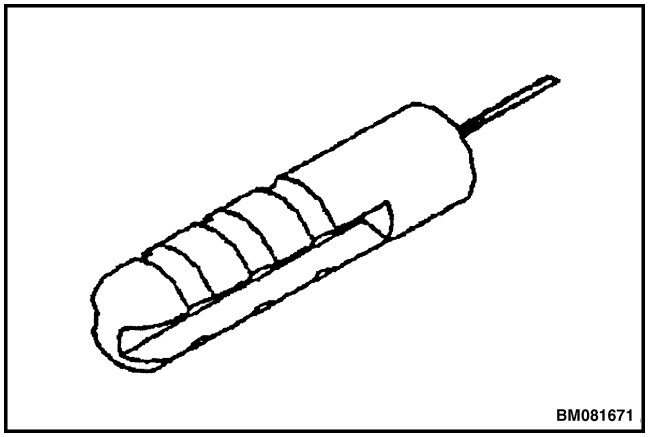
CAUTION

When rotating the extraction tool, be careful not to deform the tab.

STEP 4.
Insert the contact extraction tool, Yale P/N 580093887 , between contact and lance note, then rotate slightly as shown. Pull the wire up as shown.



1. CONTACT EXTRACTION TOOL



IMPACT SENSOR - VIEW IMPACT EVENT LOG

If your lift truck is configured for optional impact sensor, this function allows the supervisor to view the log of the operator password, impact severity, date, and time an impact event was recorded.

After entering the View Impact Event Log menu, press the * key to enter the log. See Table 37. The system stores up to 20 log entries. These entries can be viewed by using the scroll keys to move through each entry. When finished viewing the log, press the * key, scroll to the Exit Options menu, and choose the appropriate action.

Table 37. View Event Log Menu

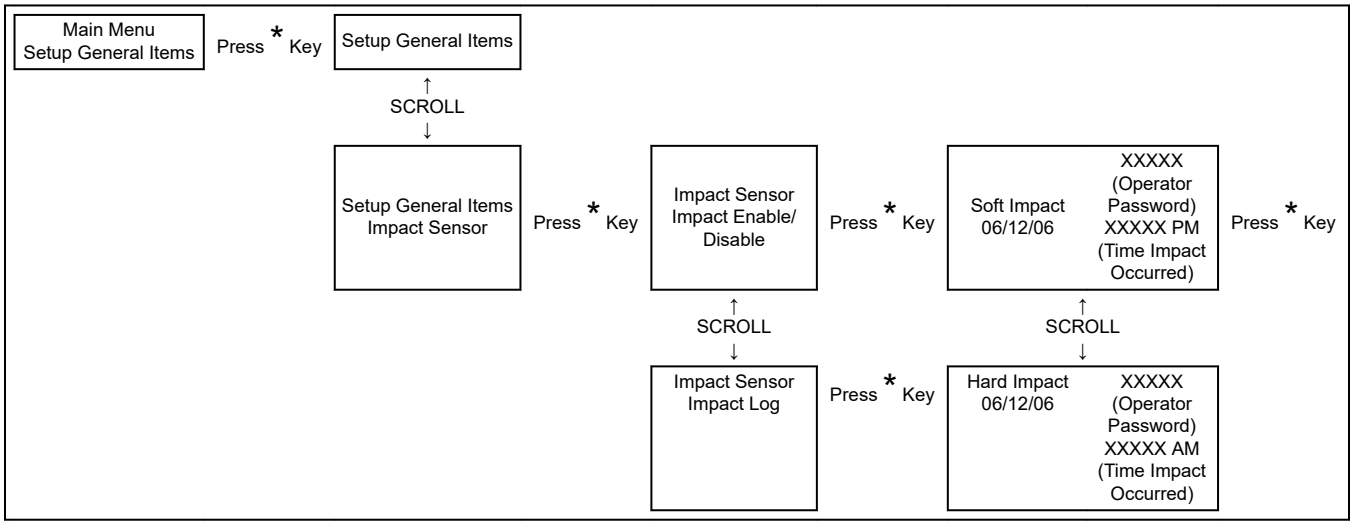
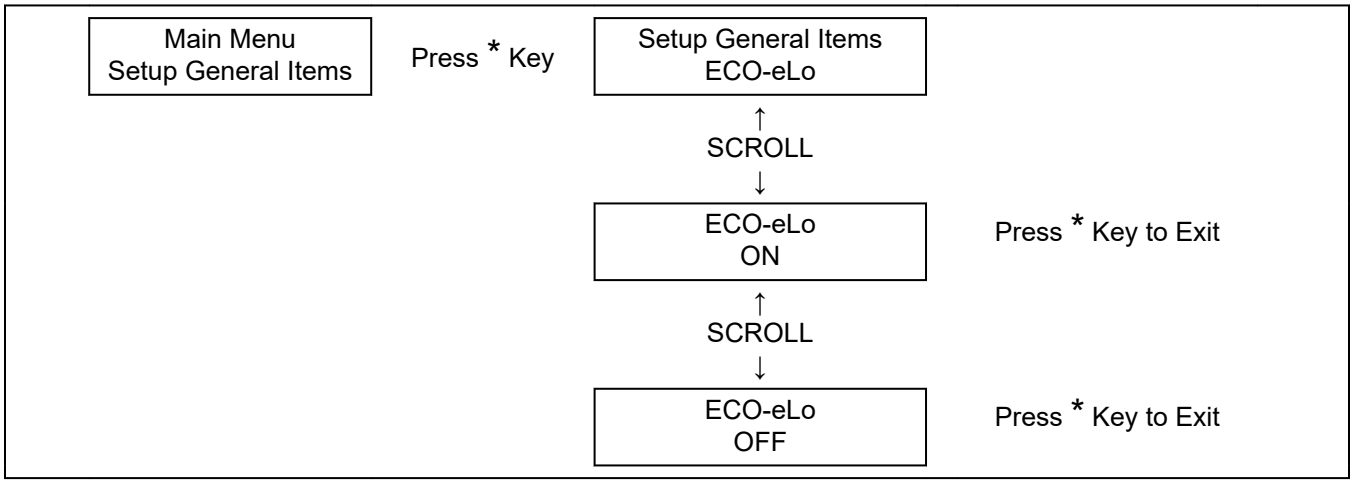


Table 55. ECO-eLo Settings Menu



Generation 2

NOTE: Lift truck models GLP/GDP20-35VX (C875, D875) and GLC20-35VX (GC/GLC040-070VX) (B910, C910) can be equipped with the Engine Mode feature below.

NOTE: Lift truck models GLC60-70VX (GLC135-155VX) (F879) with PSI PLG engine, GLC40-55VX, GLC55SVX (GLC080-120VX, GLC080-100VXBCS, GLC120VXSVX, GLC120VXPRS) (G818) with Kubota LPG engine, GLP60VX, GLP70VX (GLP135VX, GLP155VX) (F878) with PSI LPG engine, and GLP40VX5/VX6; GLP45SVX5, GLP45VX6; GLP50-55VX (GLP080-120VX) (K813) with Kubota or PSI LPG engine can be equipped with the Engine Mode feature below.

In addition to ECONOMY MODE (ECO-eLo), the operator may choose NORMAL MODE (Mode 1):

- ECO-eLo provides lowest available engine torque.
- Normal (Mode 1) provides normal engine torque.

Engine modes are set in the DSC. When one of the modes are selected the VSM sends a CANbus message request to the engine ECU to establish a set engine torque output.

Table 56. Engine Mode Settings Menu

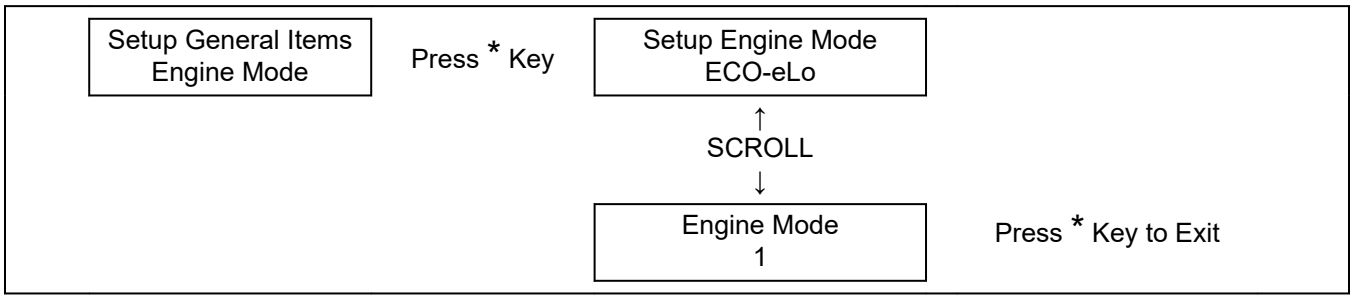
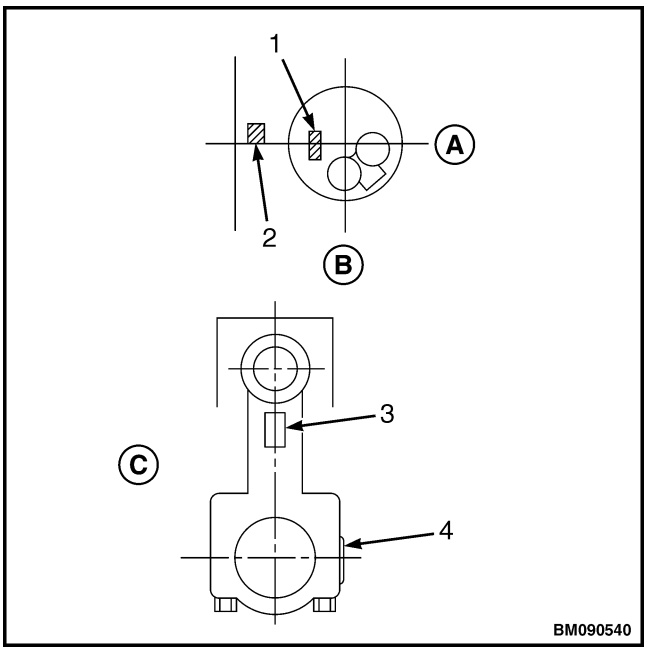


Table 15. Proc_Cal_013: Aux 3 Dir B Valve Output Threshold (Continued)

Action 6: STOP activating the Aux 3 Dir B Control. LOOK at the display. Go to the Calibration Step below that matches your display.		
If You See.....	Result out of range Repeat Calibration	
Press * One Time	**You Will See:**	Aux 3 Valve Output Dir B Press * at Creep
Return to Action 3. ***Pressure Method: Perform Actions 3, 4, and 6 again.*** ***Visual Method: Perform Actions 3, 5, and 6 again.***		
If You See.....	Calibrations Aux 3 Valve Output Dir B	
You May Quit and Save.....		
Perform Proc_Cal_003: Save and Exit.		

Pistons and Connecting Rods

1. Select the parts needed to assemble the piston and connecting rod for the Number 1 cylinder.
2. Lubricate and insert the wrist pin bushing into the small end of the connecting rod. See Figure 43.
3. Install one snap ring into the piston.
4. Position the connecting rod into the piston under the skirt. The match marks on the connecting rod must be opposite of the piston identification mark on the top of the piston. See Figure 64.



A. FUEL INJECTION PUMP SIDE
B. FLYWHEEL SIDE
C. CAMSHAFT SIDE

1. PISTON IDENTIFICATION MARK
2. CYLINDER SIZE MARK
3. EMBOSSED MARK (FLYWHEEL SIDE)
4. PUNCHED MARK

Figure 64. Piston and Connecting Rod Identification Marks

5. Lubricate and install the piston wrist pin through the piston and wrist pin bushing.
6. Install the second snap ring.
7. Using piston ring pliers, install the piston rings.
   a. Install each piston ring on the piston with the punched manufacture's mark facing upward. See Figure 65.

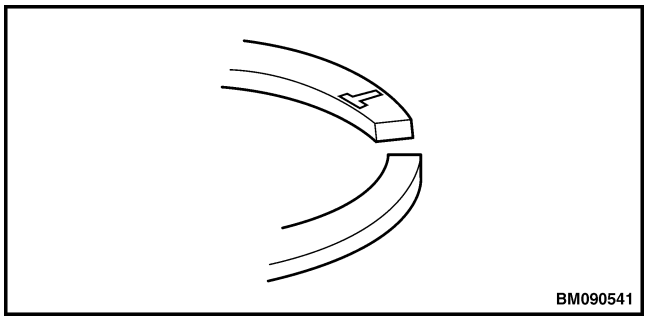
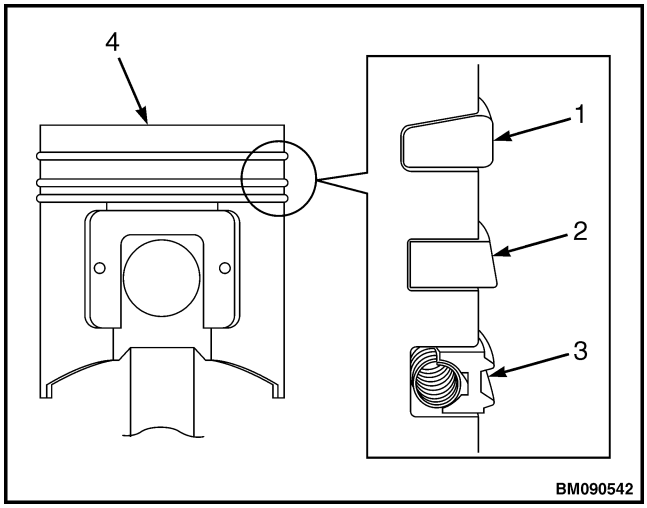


Figure 65. Piston Ring Mark

   b. Install the top compression ring, second compression ring, and oil ring. See Figure 66.



1. TOP COMPRESSION RING
2. SECOND COMPRESSION RING
3. OIL RING
4. PISTON

Figure 66. Piston Rings

Legend for Figure 55

A. OUTSIDE OF CAB

1. WIPER BLADE
2. WIPER ARM
3. LOCKWASHER
4. WASHER
5. NUTS
6. HARDWARE COVER
7. EXTERNAL TOOTH LOCKWASHER

B. INSIDE OF CAB

8. WIPER MOTOR HOUSING
9. THREADED SHAFTS
10. WIPER MOTOR BRACKET ASSEMBLY
11. WIPER MOTOR
12. FRONT WIPER MOTOR COVER
13. LOCKNUTS
14. CAPSCREW AND EXTERNAL TOOTH LOCKWASHER

5. Remove three lock nuts that secure front wiper motor cover to wiper motor housing. Remove cover.

See Figure 55 for later lift truck models

- GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878, E878)
- GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (H813, J813)
- GLP/GDP80VX, GLP/GDP80VX9, GLP/GDP90VX (GLP/GDP170VX, GLP/GDP175VX36, GLP/GDP190VX) (A909, B909)

6. Disconnect cab harness from wiper motor harness.

7. Remove wiper motor and bracket from wiper motor housing.

8. Remove three capscrews and external tooth lockwashers and remove wiper motor from wiper motor bracket assembly.

See Figure 54 for early lift truck models

- GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (F813, G813)
- GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878) lift trucks

See Figure 55 for later lift truck models

- GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878, E878)
- GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (H813, J813)
- GLP/GDP80VX, GLP/GDP80VX9, GLP/GDP90VX (GLP/GDP170VX, GLP/GDP175VX36, GLP/GDP190VX) (A909, B909)

Install, Lift Truck Models GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (F813, G813, H813, J813), GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878, E878), and GLP/GDP80VX, GLP/GDP80VX9, GLP/GDP90VX (GLP/GDP170VX, GLP/GDP175VX36, GLP/GDP190VX) (A909, B909)

1. Install wiper motor to wiper motor bracket using three capscrews and external tooth lockwashers.

See Figure 54 for lift truck models

- GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (F813, G813)
- Early model GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878)

See Figure 55 for later lift truck models

- GLP/GDP60VX, GLP/GDP70VX (GP/GLP/GDP135VX, GP/GLP/GDP155VX) (C878, D878, E878)
  GLP/GDP40VX5/VX6, GLP/GDP45SVX5, GLP/GDP45VX6, GLP/GDP50-55VX (GP/GLP/GDP080, 090, 100, 110, 120VX) (H813, J813)

appropriate oil sample should be taken to determine the success of the flush.

Mechanical Cleaning

The use of mechanical cleaning after a major pump or cylinder failure must be incorporated in the flushing strategy. This involves the use of a pneumatic projectile gun and sponge projectiles to clean tubes and hoses. It also involves disassembly of other components for cleaning using brushes and clean solvents. It is essential that the reservoir is mechanically cleaned to remove residual contamination particles.

Mechanical cleaning is labor intensive, but is the most effective method for restoring the system to reliable operation after major mechanical failure.

Cleaning of Components

The question of how to deal with system components arises when considering a hydraulic system flush.

Plumbing should be cleaned in isolation from pumps, valves and actuators. These can be cleaned while still installed in the equipment as discussed in the following sections. The decision to disassemble and mechanically clean components will depend on the type of equipment, your reliability objectives and the reason for the flush. Once the conductors and components have been cleaned and clean oil is installed, valves and actuators can be gradually included in the flushing circuit as the process proceeds.

HOW TO CLEAN TUBES AND HOSES

The use of sponge projectiles is very effective in cleaning tubes and hoses. The hoses and tubes can be cleaned while installed in the truck after a major component failure. The sponge projectiles clean hoses and tubes regardless of their length and angles. The sponge projectiles are shot with compressed air and travel at high speed, pushing residual oil and contaminants out. The hoses and tubes can be cleaned to levels unattainable by conventional methods. See Figure 1. Without the sponge projectile, the hose could not have been cleaned. This tool can minimize replacement costs of additional components caused by secondary contamination failures.

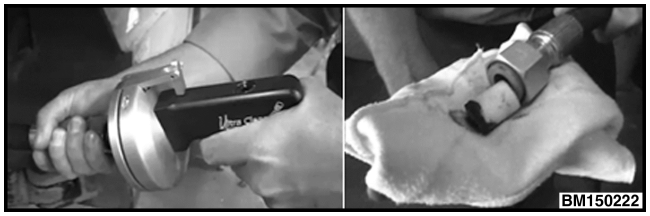


Figure 1. Sponge Projectile Tool

FILTER CADDY

Flushing the system is the total cleaning of the hydraulic system, which means actually removing all the oil, components, and cleaning or repairing them as required. Hoses and tubes are cleaned as described in the previous section. It is essential that the reservoir is mechanically cleaned to remove residual contamination particles. The reservoir suction screen and breather must be replaced.

Hydraulic cylinders must be cleaned and filled with clean oil to eliminate as much air as possible. Elimination of air avoids micro-dieseling. Micro-dieseling is combustion just like a diesel engine and occurs when hydraulic oil is compressed at high pressure in the presence of air or air bubbles. Micro-dieseling can burn the oil (turns oil blackish) and damage hoses and cylinders internally. Cylinders should not be extended to the end-stops or system relief pressure until the air in the system has been flushed.

Once the hydraulic system has been overhauled and all components cleaned and installed, the hydraulic reservoir needs to be refilled with filtered oil. The filter caddy (Figure 2 or Figure 3) is then used to clean the reservoir oil until a predetermined level of oil cleanliness is achieved. This operation is not possible without a filter caddy. The caddy insures that the reservoir and reservoir oil are clean before the pump is turned.

Next, the pump needs to be bled or the case filled with filtered oil. Only then can the hydraulic system be put into operation. The most critical part of the start-up procedure is when the hydraulic pump is turned for the first time.

Filter caddies are not capable of removing all contaminants from the hydraulic system. As previously explained, hidden particles in the most secluded areas of the hydraulic system make it impossible for any filter caddy to reach into all areas of complex hydraulic systems. However, a filter caddy is an essential tool once the system has been completely disassembled, cleaned and assembled.

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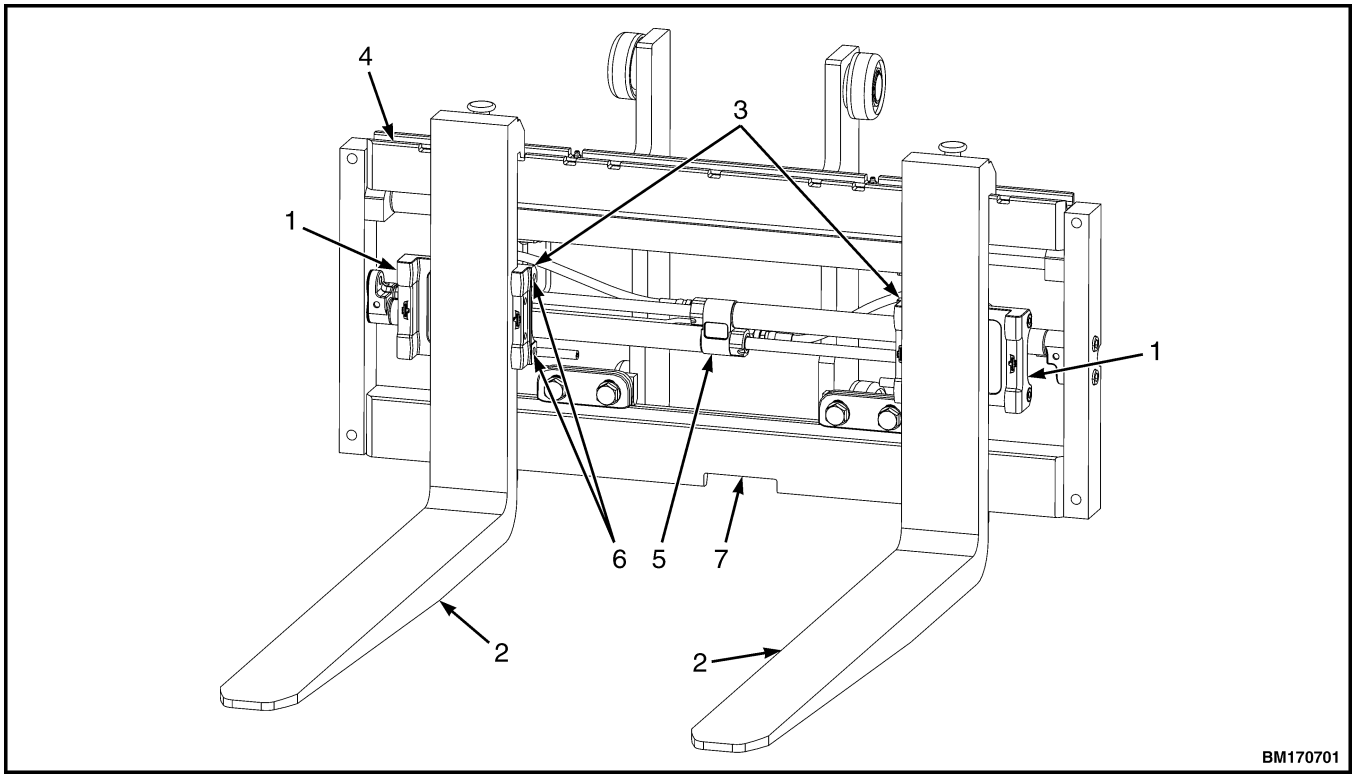


1. OUTER FORK CARRIER
2. FORKS
3. INNER FORK CARRIER
4. OUTER FRAME
5. FORK POSITIONER
6. CAPSCREWS
7. FORK REMOVAL NOTCH

Figure 9. Fork Positioner Fork Removal, Lift Truck Models Manufactured After December, 2016ERC22-35VG (ERC045-070VG) (A968), GLC20-35VX (GC/GLC40-70VX) (C910), and GP/GLP/ GDP040-070VX (D875)

Checks

WARNING

Never repair damaged forks by heating or welding. Forks are made of tempered steel using special procedures. Always replace damaged forks as a pair.

1. Inspect forks for cracks and wear. Check alignment of fork tips. The difference in height of fork tips must be less than three percent of the length of the forks. See Table 2 and Figure 10.

Some applications may require closer alignment. If forks do not meet specification, they both must be replaced.

2. Check for smooth and proper operation of the fork lock pins. Repair or replace any damaged or broken fork lock pins or components and lubricate, as necessary.

3. Inspect fork wear. Ensure heel wear is not more than 10% of original thickness. If fork wear is more than 10% , fork must be replaced or rerated. Perform fork wear inspection using a BOL256N1 caliper ruler Yale P/N 550088603 as follows. See Figure 11.

a. Determine normal thickness of "N" of fork using scale or ruler portion of caliper ruler. Measurement has to be done on fork shank using caliper ruler.

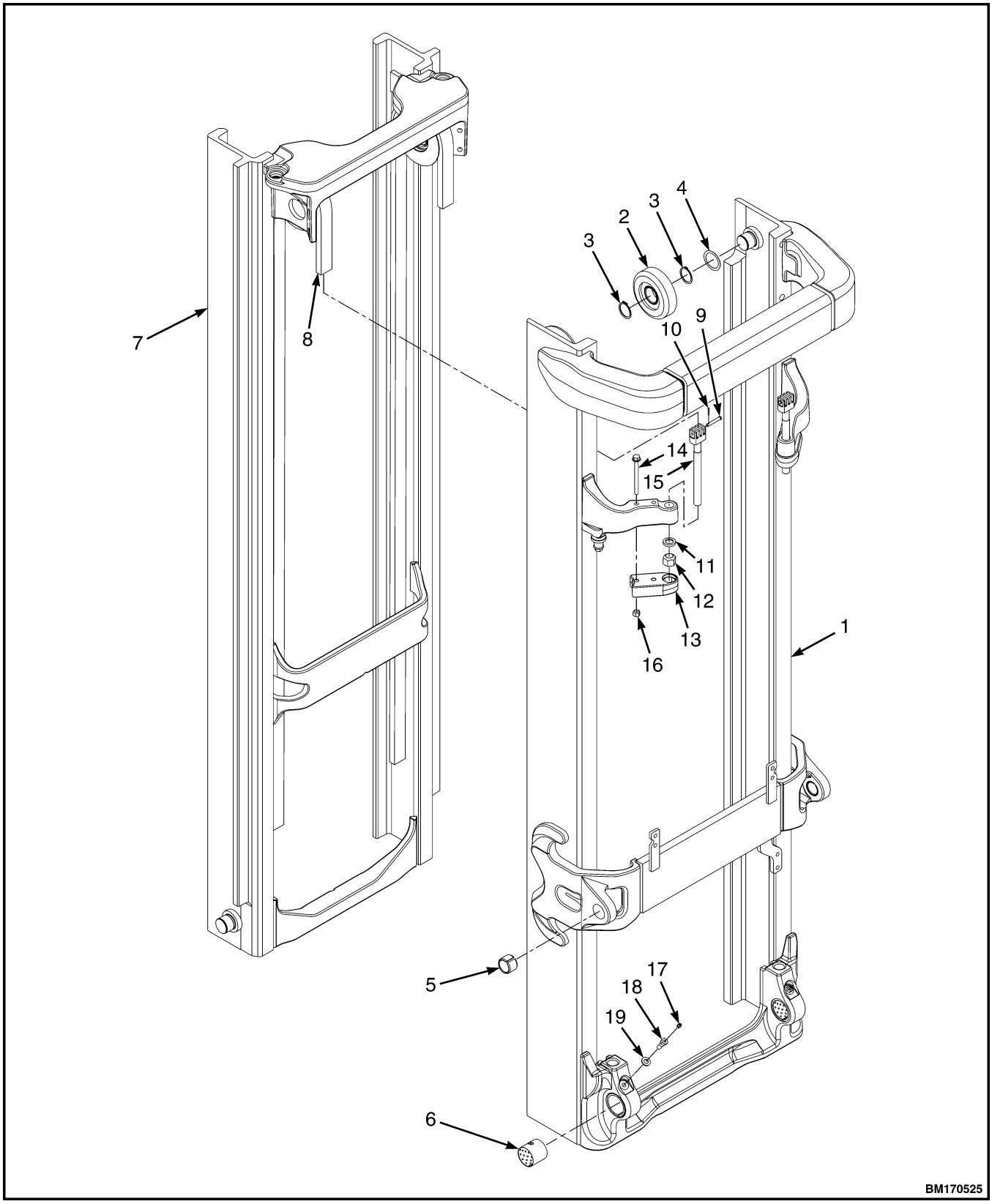
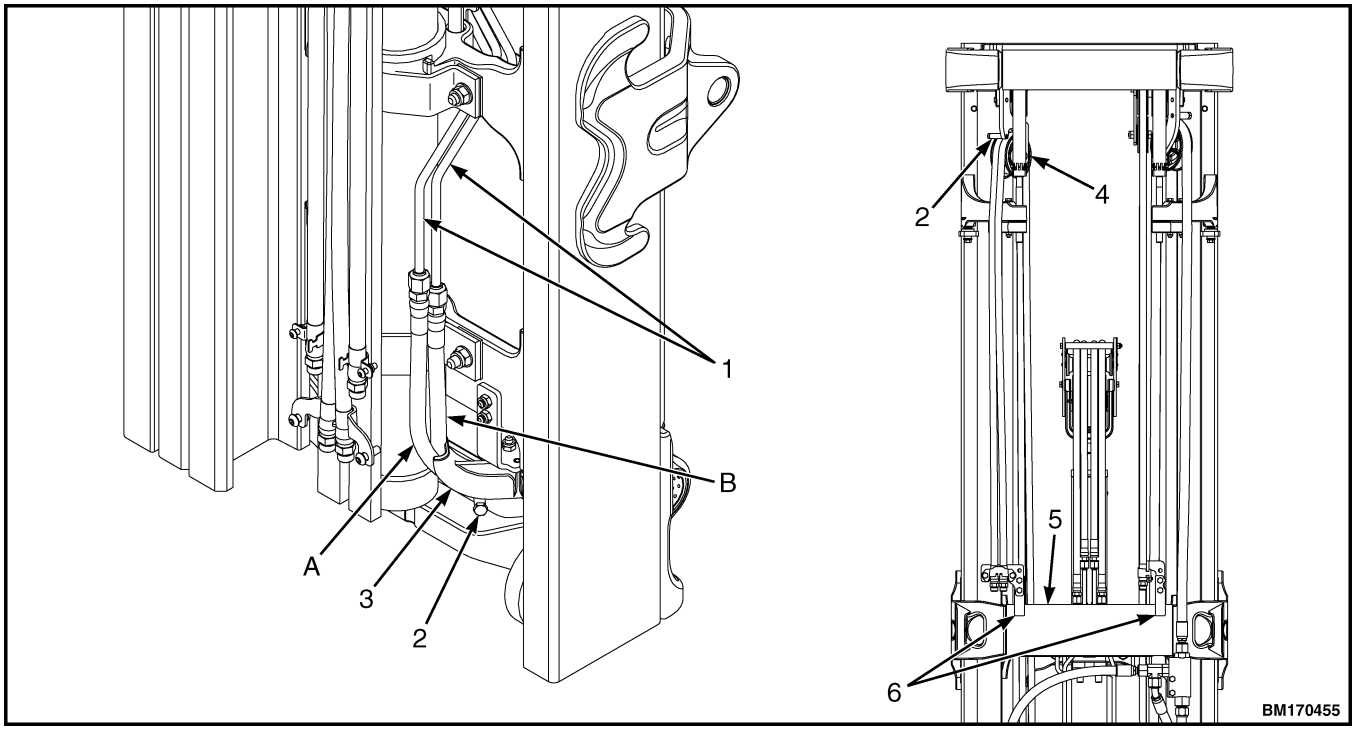


Figure 66. Outer Mast



A. THREE-FUNCTION HEADER HOSE **A**
B. THREE-FUNCTION HEADER HOSE **B**

1. FREE-LIFT HOSE TUBE
2. SPACER
3. TURNAROUND BRACKET
4. HOSE SHEAVE
5. MID-OUTER CROSSMEMBER
6. BRACKET (LOWER)

Figure 122. Three-Function Header Hose Installation

INTEGRAL SIDESHIFT CARRIAGE, LIFT TRUCKS MANUFACTURED DECEMBER, 2016 THROUGH LATE JUNE, 2018

This section covers lift truck models ERC22-35VG (ERC045-070VG) (A968), GLC20-35VX (GC/GLC40-70VX) (C910), and GP/GLP/GDP040-070VX (D875) equipped with an integral sideshift carriage and manufactured between December, 2016 and late June, 2018.

Remove

1. Lower carriage completely. Remove forks. See Fork Replacement for removal procedures.

2. Remove four capscrews, nuts, washers, and load backrest from carriage. See Figure 12.

WARNING

Before disconnecting the hydraulic hoses, relieve the pressure in the hydraulic system. Serious injury can occur if pressure is not relieved from hydraulic system prior to disconnecting hydraulic hoses.

3. Relieve hydraulic pressure to the sideshift cylinder by moving sideshift lever in both directions several times.

WARNING

Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

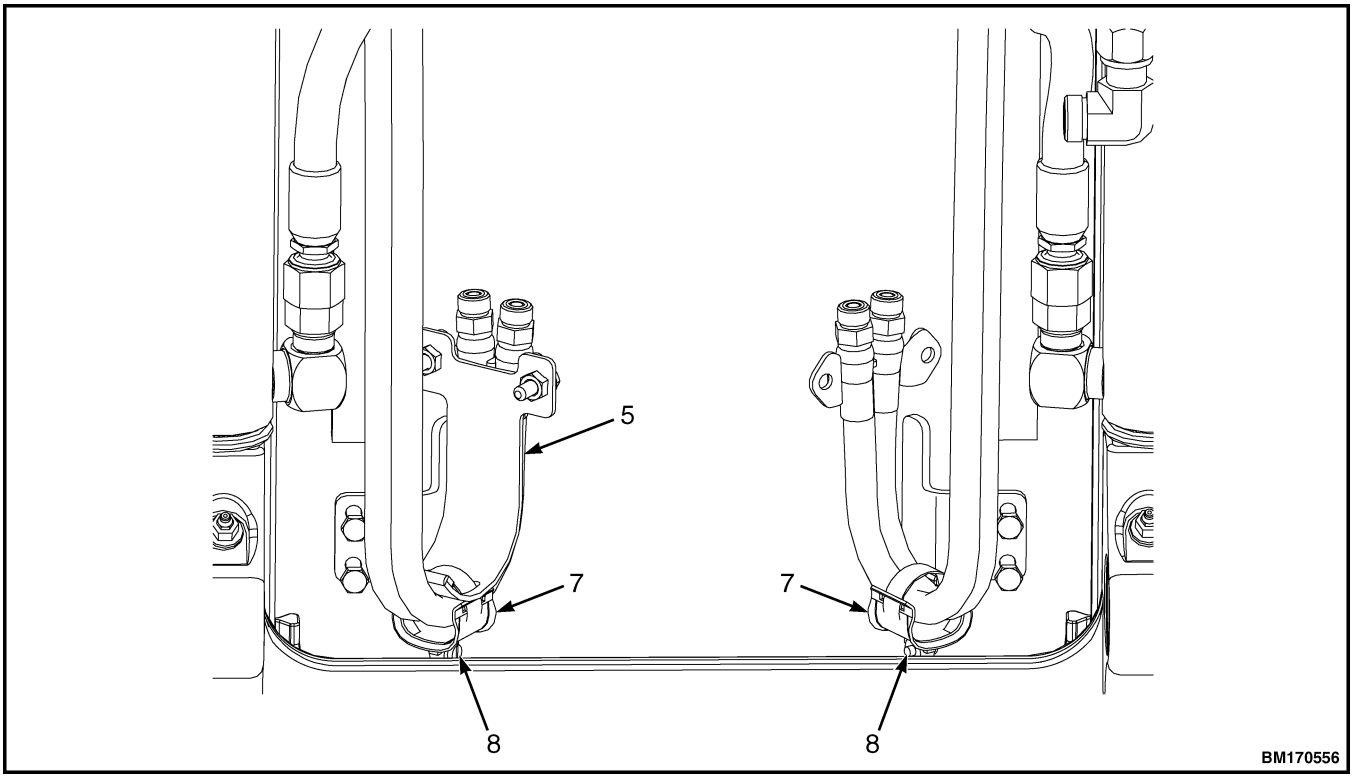
Never check for leaks by putting hands on hydraulic lines or components under pressure. Hydraulic oil under pressure can be injected into the skin.

CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

NOTE: Tag hydraulic lines and fittings prior to disconnecting to aid in connecting during installation.

4. Disconnect hydraulic lines from sideshift cylinder. Put caps and plugs on open lines and cylinder ports. See Figure 18.



A. DIMENSION = 100 ±10 mm (4.0 ±0.40 in.)

B. DIMENSION = 500 ±2.0 mm (20.0 ±0.08 in.)

1. SPACER
2. HOSE SHEAVE
3. MID-OUTER CROSSMEMBER
4. BRACKET
5. TURNAROUND BRACKET (THREE-FUNCTION)
6. TURNAROUND BRACKET (FOUR-FUNCTION)
7. HOSE CLAMP
8. WORM SCREW CLAMP

Distance Installed	Hose Tension
505 mm (19.8 in.)	1%
510 mm (20.1 in.)	2%
515 mm (20.3 in.)	3%

Figure 73. Header Hose Dimensions and Installation, Two-Stage LFL Mast (Sheet 2 of 2)

Adjustment

NOTE: Tire size variations and adjusting of the lift chains may require adjustment of header hose tension. Lift chain adjustment for tire wear will reduce header hose tension.

1. To increase header hose tension, raise carriage at least 100 mm (4.0 in.).

2. Place a block under lower carriage bar and lower carriage onto block to relieve hose tension. Chain carriage to inner mast. See Safety Procedures When Working Near Mast in this manual.

3. Loosen hardware on bracket on mid-outer crossmember for the three and/or four function hoses needing adjustment. Lower bracket and tighten nut to 18 N•m (159 lbf in). See Figure 74.

4. Release chain, remove block, and lower the carriage.

Legend for Figure 132.

1. INNER MAST
2. INTERMEDIATE MAST
3. CHAIN
4. HOSE ASSEMBLY
5. CAPSCREW
6. CAPSCREW
7. STUBSHAFT
8. FITTING
9. LOWERING CONTROL VALVE HOUSING
10. HOSE SHEAVE
11. BRACKET WELDMENT
12. CHAIN ANCHOR RESTRAINT
13. NUT
14. RING
15. CHAIN ANCHOR
16. COTTER PIN
17. PIN
18. FREE-LIFT CYLINDER
19. CLAMP
20. FREE-LIFT CROSSHEAD
21. ROLL PIN
22. CHAIN SHEAVE
23. BEARING
24. PLATE
25. WASHER

3. Disconnect the main lift chains from the chain anchors near the top of the main lift cylinders. See Figure 133. Disconnect the other end of the main lift chains at the bottom of the inner mast. Push the inner mast toward the bottom of the mast assembly until the bottom load rollers can be seen. See Figure 134.

WARNING

The weldments can slide when the mast is moved. A weldment that slides can cause injury. Use a crane to turn the mast slowly and carefully.

4. Remove the strip bearings at the top of the intermediate mast. Remove the load rollers at the bottom of the inner mast. Remove the load rollers at the top of the intermediate mast. Make a note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly. See Figure 134 and Figure 135.

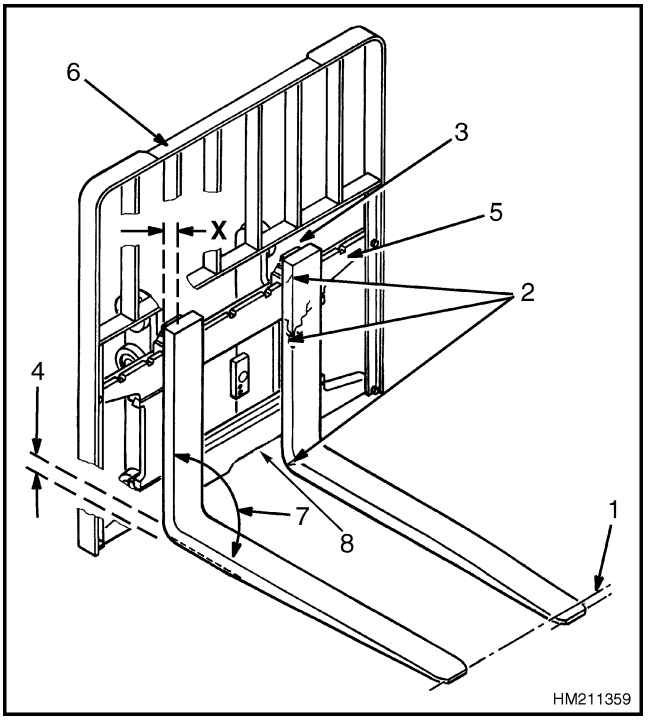
2. A fork can be removed from the carriage for replacement of the fork or other maintenance. Lift lock pin and slide a hook fork to the fork removal notch on carriage. See and . Lower fork onto blocks so that the bottom hook of the fork moves through fork removal notch. Lower carriage further so that the top hook of fork is disengaged from the top carriage bar. Move carriage away from the fork, or use a lifting device to move fork away from the carriage.

Inspect

1. Inspect forks for cracks and wear. Check that the fork tips are aligned as shown in .

2. Check that the bottom of fork is not worn. See , item 4.

3. Replace any damaged or broken parts that are used to keep the forks locked in position.



Length of Forks	3% Dimension
915 mm (36 in.)	27 mm (1.10 in.)
1067 mm (42 in.)	32 mm (1.26 in.)
1220 mm (48 in.)	37 mm (1.46 in.)
1372 mm (54 in.)	41 mm (1.61 in.)
1524 mm (60 in.)	46 mm (1.81 in.)
1830 mm (72 in.)	55 mm (2.17 in.)

1. TIP ALIGNMENT (MUST BE WITHIN 3% OF FORK LENGTH)
2. CRACKS
3. LATCH DAMAGE
4. HEEL OF FORK (MUST BE 90% OF DIMENSION X)
5. CARRIAGE
6. LOAD BACKREST EXTENSION
7. MAXIMUM ANGLE 93°
8. FORK REMOVAL NOTCH

Figure 20. Forks Check

Install the Wheels

WARNING

Lift truck tires and wheels are heavy. Use caution when removing and installing lift truck tires and wheels or personal injury can occur.

Install wheel on the hub. Tighten nuts in a cross pattern to a torque value of for drive wheel nuts and for steer wheel nuts. If the wheels are the two-piece rims, make sure nuts that fasten rim halves together are toward brake drum when they are installed.

Dual Drive Wheels, Install

WARNING

Lift truck tires and wheels are heavy. Use caution when removing and installing lift truck tires and wheels or personal injury can occur.

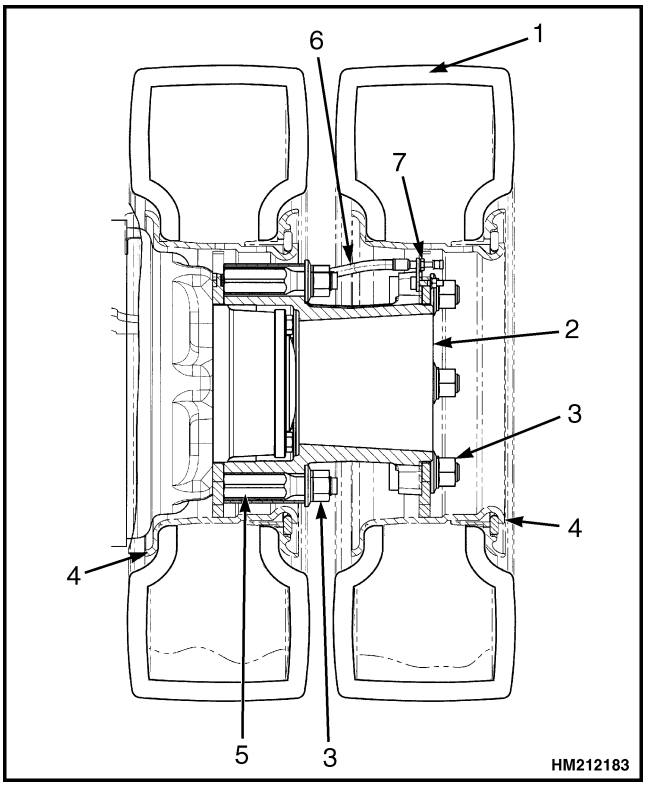
NOTE: Some lift trucks have dual drive wheels. The following procedures describe the steps to install the dual sets of wheels.

1. Install inner wheel on hub. If the wheels are the two-piece rims, make sure nuts that fasten rim halves together are toward brake drum when they are installed.

2. Install wheel adapter spacers on the inner wheel studs and tighten spacers to 100 to 125 N•m (74 to 92 lbf ft). Install the dual hub assembly and inner wheel nuts on the spacers and tighten the wheel nuts to . See Figure 84.

3. Install outer wheel on dual hub assembly. Tighten nuts to a torque value of . If the wheels are the two-piece rims, make sure nuts that fasten rim halves together are toward brake drum when they are installed.

4. Install the valve extension bracket and tighten the attaching nut to 8 N•m (70 lbf in). Install the valve extension hose into the bracket. See Figure 84.



1. TIRE
2. DUAL HUB ASSEMBLY
3. WHEEL NUT
4. WHEEL
5. WHEEL ADAPTER SPACER
6. VALVE EXTENSION
7. BRACKET

Figure 84. Dual Drive Wheels Installation

Legend for Figure 39

NOTE: EXHAUST SYSTEM FOR GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (C875) LIFT TRUCKS SHOWN.

NOTE: EXHAUST SYSTEM WITH CATALYTIC CONVERTER SHOWN.

1. CAPSCREW
2. WASHER
3. SPACER
4. ISOLATOR
5. LOCKNUT
6. MUFFLER
7. GASKET
8. ENGINE EXHAUST PIPE
9. CLAMP
10. CATALYTIC CONVERTER
11. SOCK
12. LOWER EXHAUST PIPE
13. COUNTERWEIGHT EXHAUST PIPE

Cylinder Head Repair

REMOVE AND DISASSEMBLE

WARNING

Disconnect the battery cables before making repairs to the engine.

1. Drain engine oil and coolant system.

2. Remove air cleaner.

See **Frame** 0100YRM1672 for lift truck models

- GLC20-35VX (GLC040-070VX, GLC055SVX (B910)
- GLP/GDP20-35VX (GLP/GDP040-070VX) (C875)

See **Frame** 0100YRM1754 for lift truck models

- GLC20-35VX (GLC040-070VX, GLC055SVX (C910)
- GLP/GDP20-35VX (GLP/GDP040-070VX) (D875)

3. Remove exhaust system. See **LPG Fuel System, Kubota 2.5L Engine** 0900YRM1677.

4. Remove cooling fan, fan belt, alternator, and starter. See Figure 13.

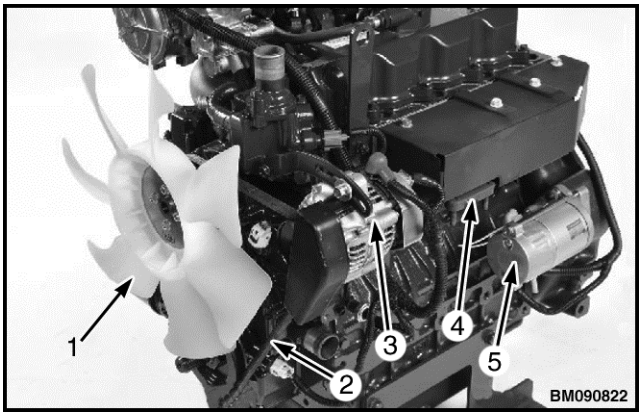


Figure 13. Engine Accessories

Legend for Figure 13.

1. COOLING FAN
2. FAN BELT
3. ALTERNATOR
4. EXHAUST MANIFOLD
5. STARTER

5. Disconnect vapor hose at both ends. See Figure 14.

6. Disconnect coolant inlet hose and coolant outlet hose.

7. Remove the vaporizer.

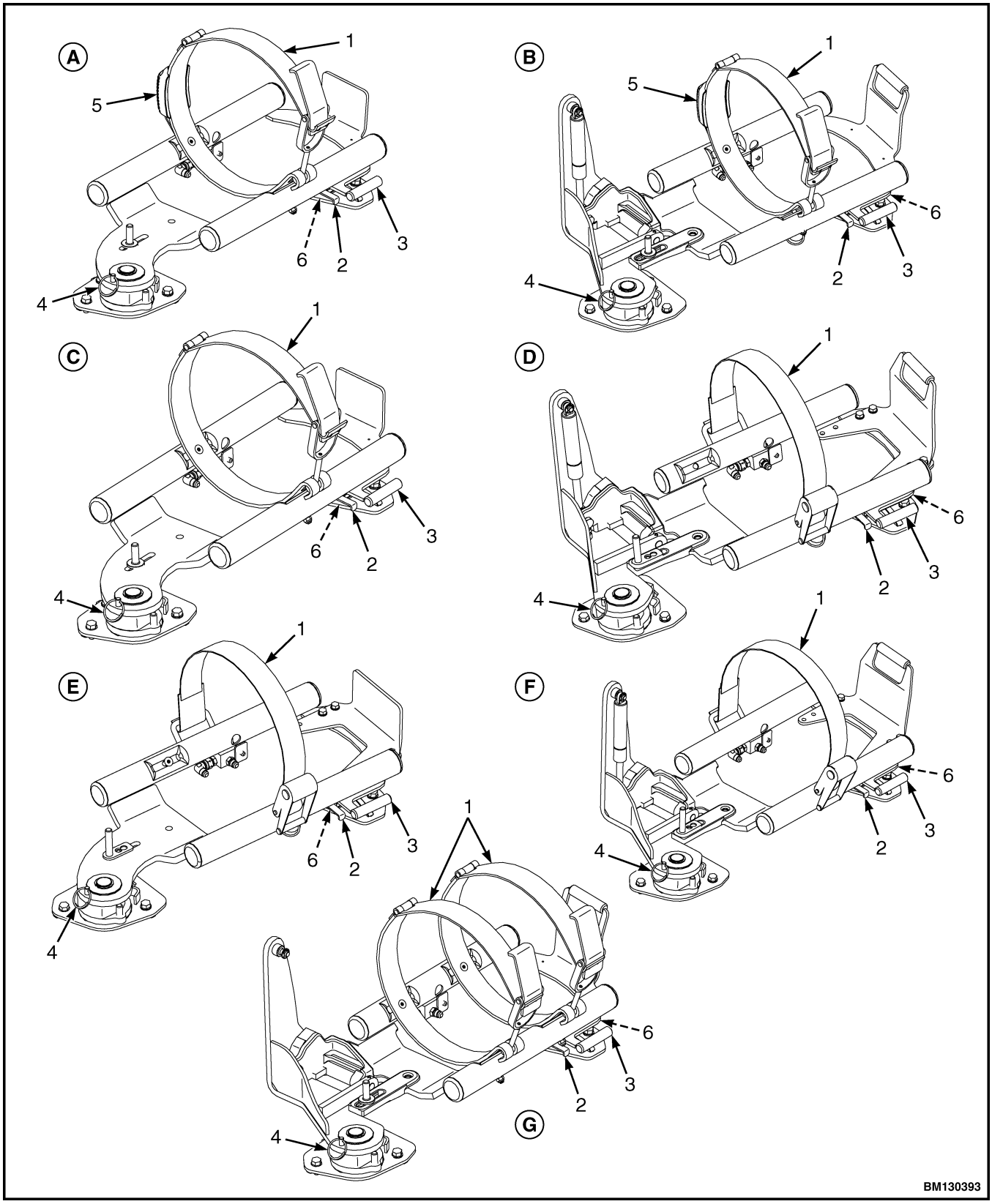
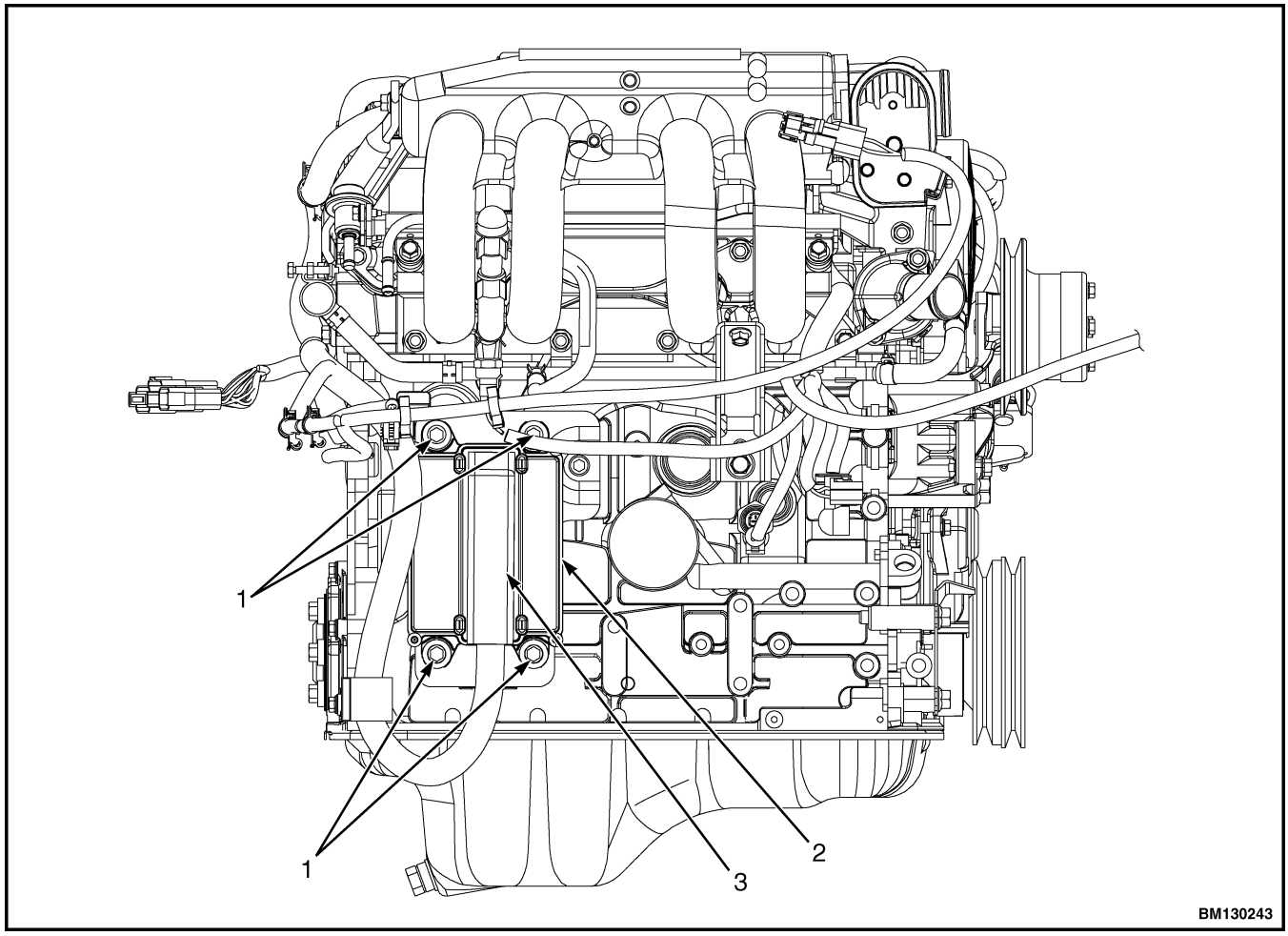
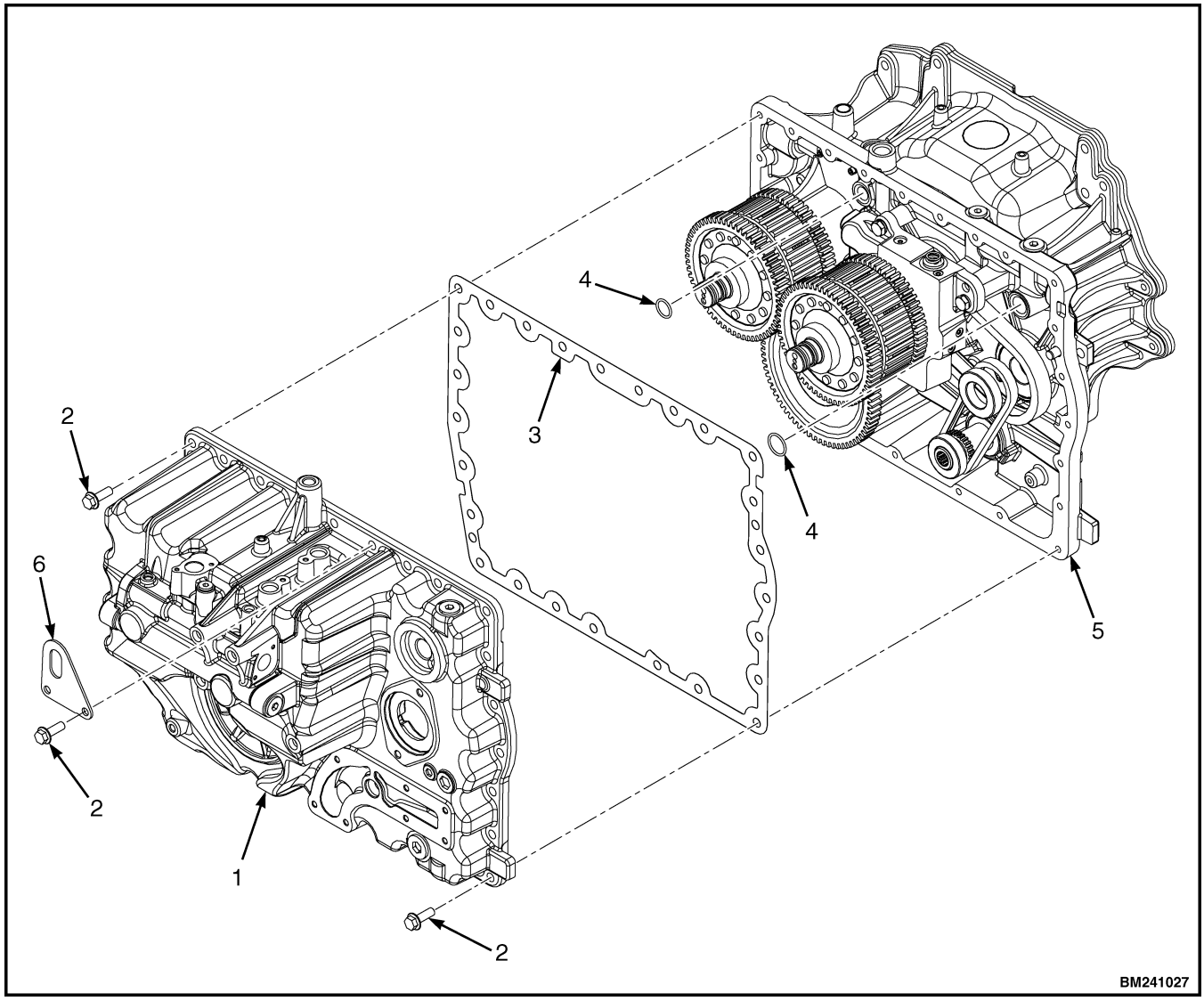


Figure 2. LPG Tank Bracket Styles



1. CAPSCREWS
2. ECM
3. WIRE HARNESS CONNECTOR

Figure 15. ECM and Wire Harness Connector

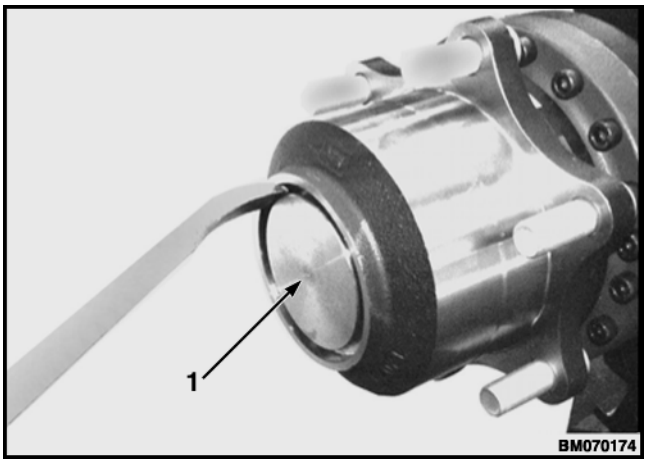


1. TRANSMISSION HOUSING
2. FLANGE BOLT
3. GASKET
4. O-RING
5. CONVERTER HOUSING
6. EYEBOLT BRACKET

Figure 10. Transmission and Converter Housings

Remove

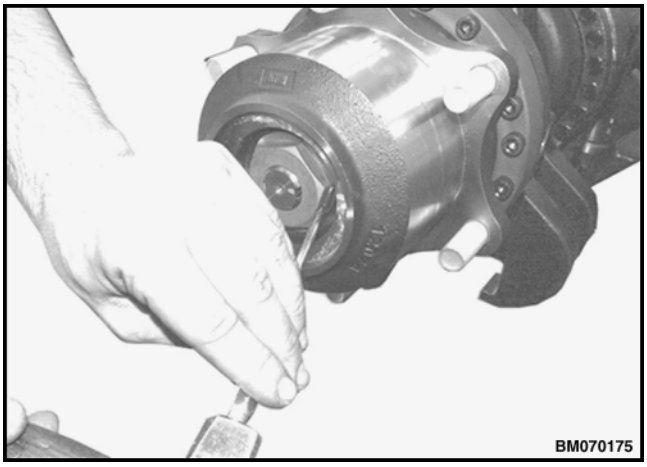
STEP 1.
Remove the plug using a prybar.



1. PLUG

NOTE: Once the lockwasher has been flattened, a new lockwasher must be used.

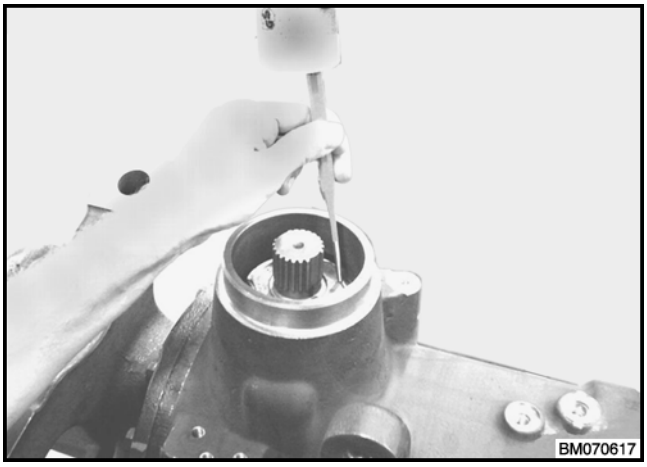
STEP 2.
Flatten the lockwasher using a punch and hammer.



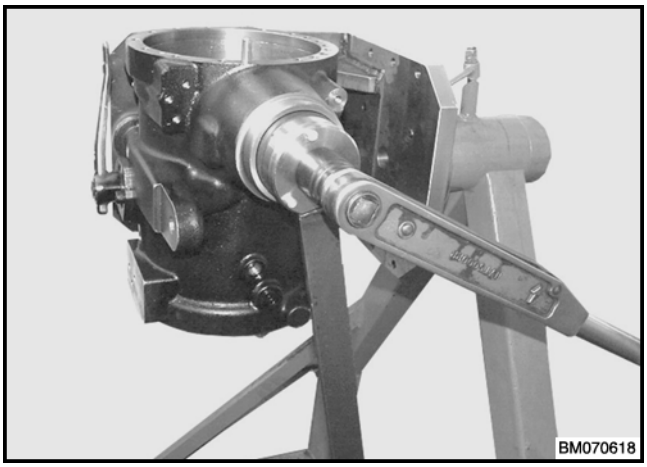
CAUTION

Install two nuts or suitable plastic pipes on the studs to prevent damage to the threads of the studs from the support bar.

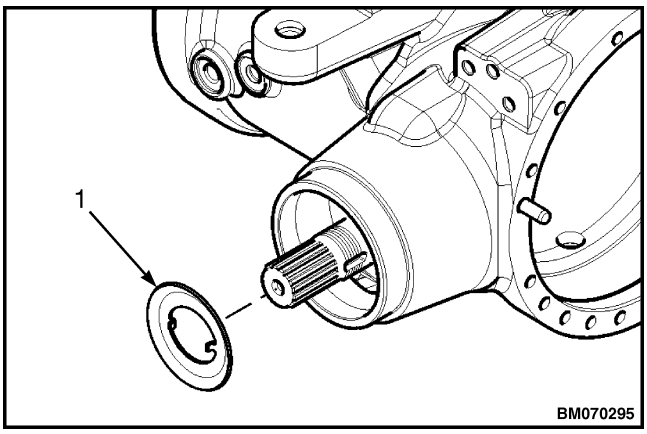
STEP 1.
Using a punch and hammer, flatten the lockwasher.



STEP 2.
Using special tools (Yale Part Numbers 580075044 and 580076168), remove the ring nut.

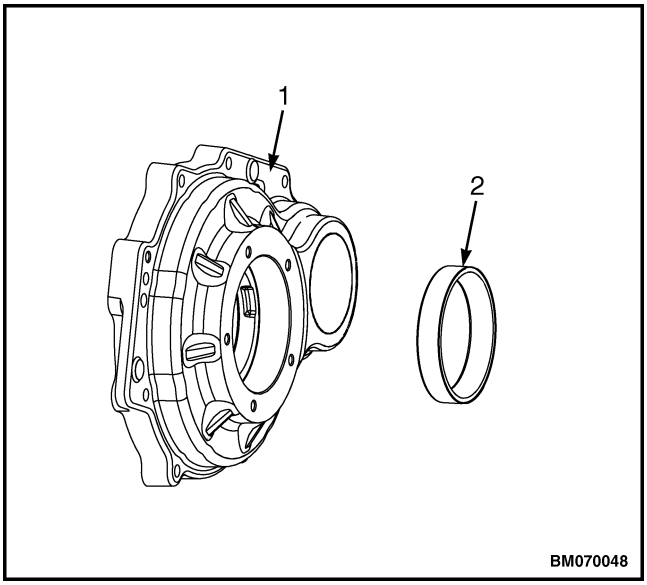


STEP 3.
Remove the lockwasher.



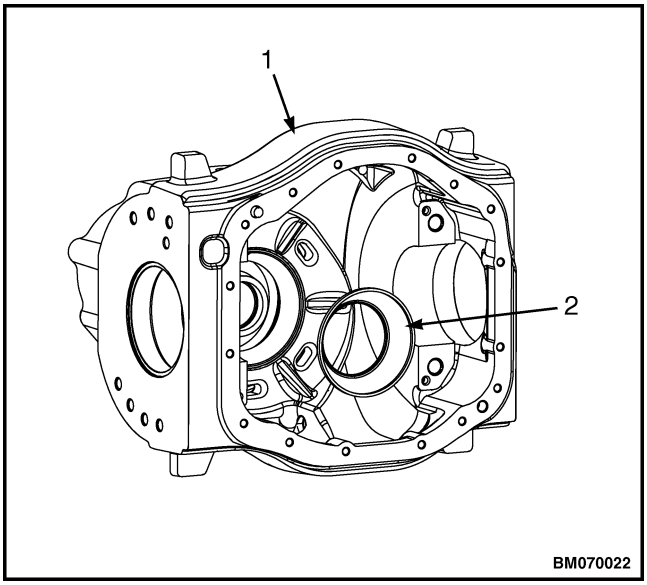
1. LOCKWASHER

STEP 13.
For lift truck models GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (C875), use a suitable soft drift to remove the bearing cup.



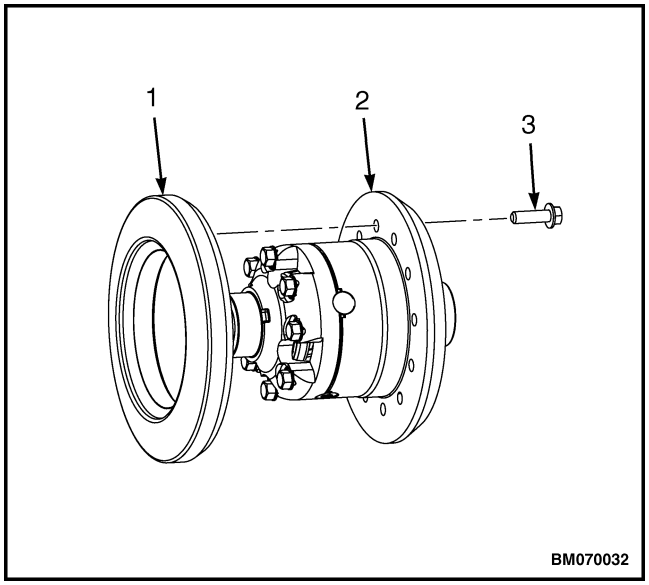
1. DROP BOX
2. BEARING CUP

STEP 14.
For lift truck models CLG20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (B910), use a suitable soft drift to remove the pinion inner bearing cup.



1. CENTER SECTION
2. INNER BEARING CUP

STEP 2.
Remove the capscrews retaining the ring gear to the differential assembly.

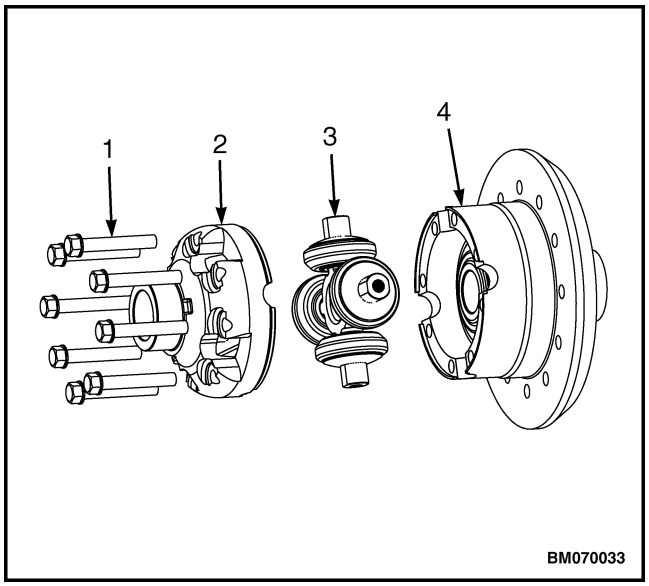


1. RING GEAR
2. DIFFERENTIAL ASSEMBLY
3. CAPSCREW

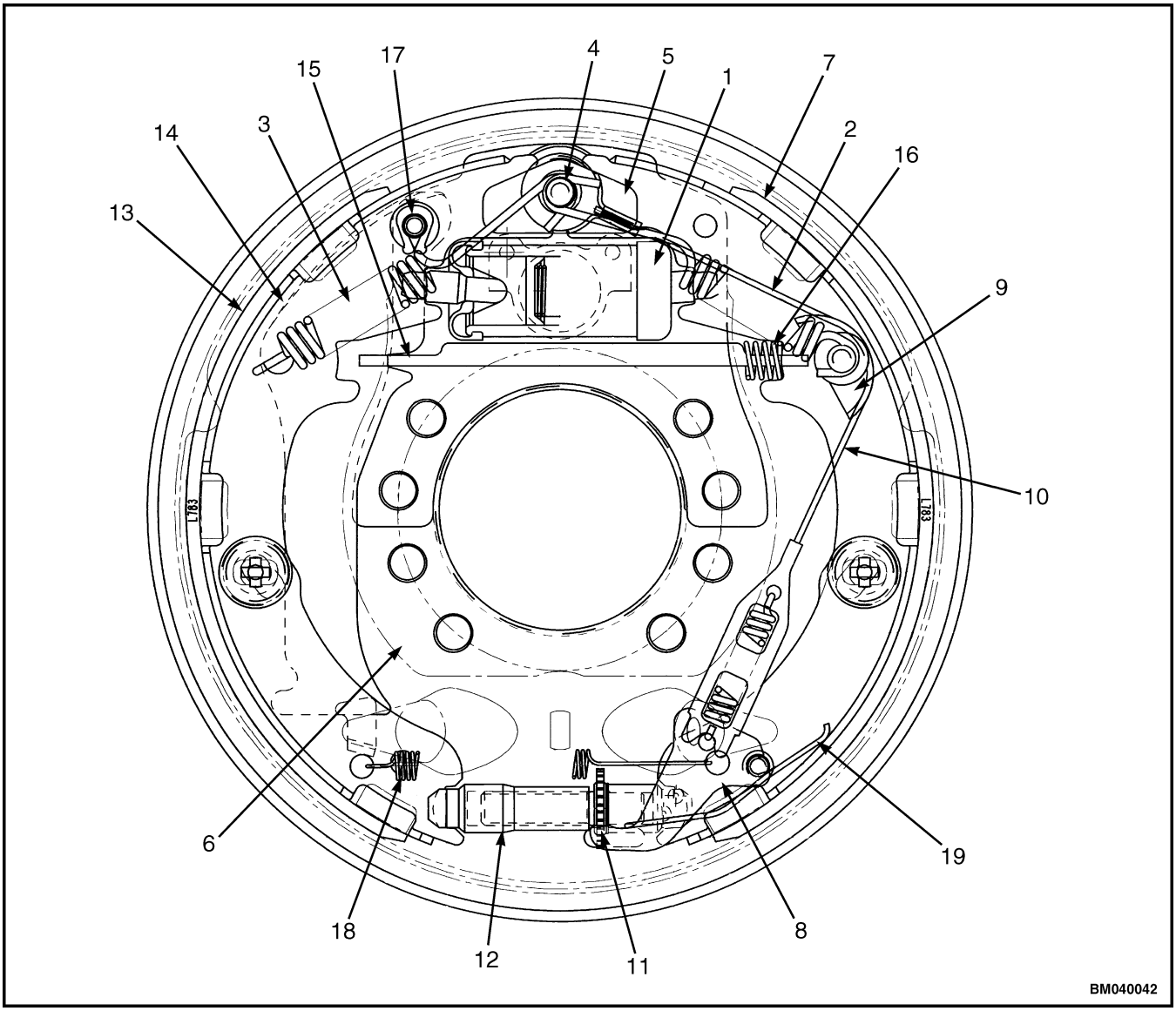
NOTE: Mark each side of the case halves before separating to ensure alignment at reassembly.

STEP 3.
Remove the capscrews retaining the case halves together and separate the case halves.

Inspect the case halves for wear or damage. If wear or damage is present, the entire differential assembly must be replaced.

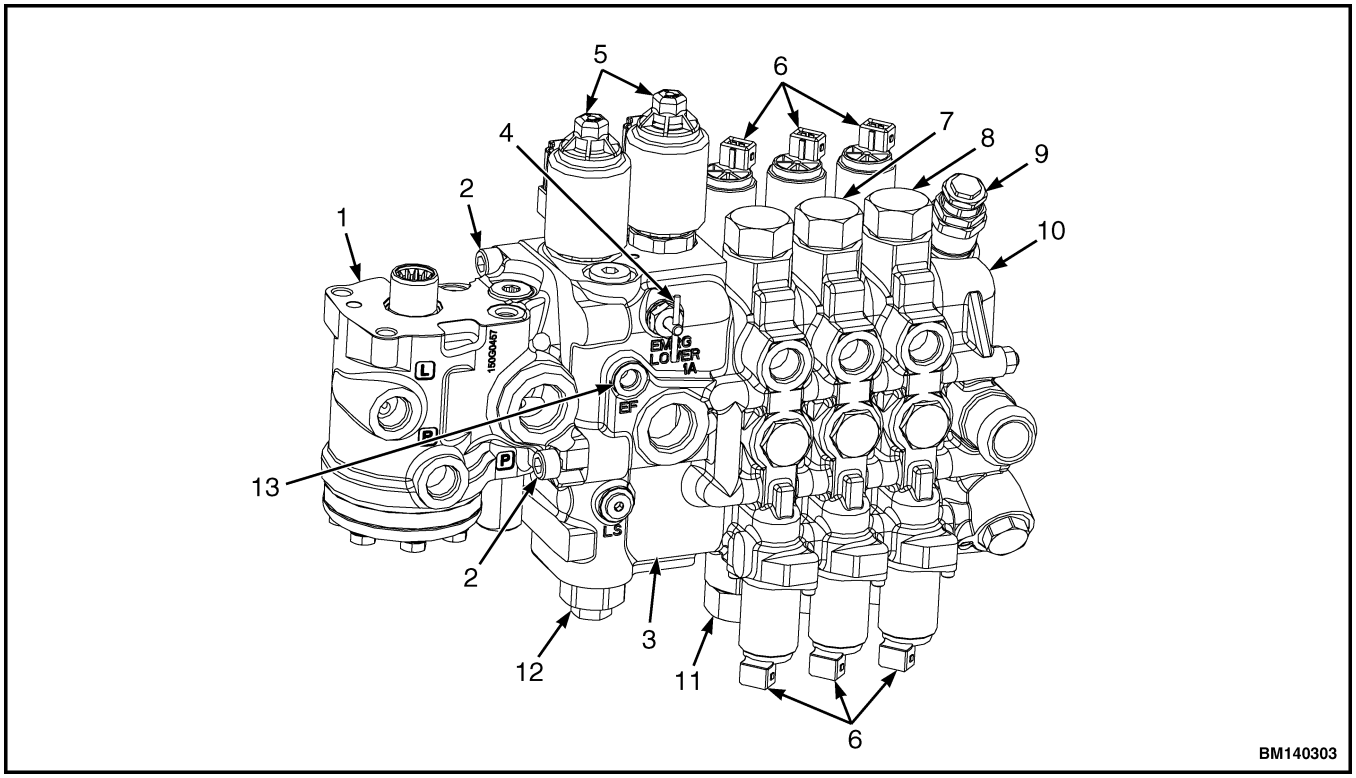


1. CAPSCREW
2. CASE HALF
3. SPIDER ASSEMBLY
4. CASE HALF



1. WHEEL CYLINDER
2. RETURN SPRING
3. RETURN SPRING
4. ANCHOR
5. ANCHOR GUIDE
6. BACK PLATE
7. SECONDARY BRAKE SHOE
8. LEVER
9. PIVOT PLATE
10. SPRING AND CABLE ASSEMBLY
11. ADJUSTER WHEEL
12. ADJUSTER ASSEMBLY
13. PRIMARY BRAKE SHOE
14. PARKING BRAKE LEVER
15. LINK, PARKING BRAKE
16. SPRING, PARKING BRAKE
17. PIVOT PIN, RETAINER, AND SPRING WASHER
18. ADJUSTER ACTUATOR SPRING
19. SPRING

Figure 3. Brake Assembly (Left-Hand Shown)



1. STEERING CONTROL UNIT (SCU)
2. SCU MOUNTING CAPSCREW
3. LIFT/LOWER SECTION
4. EMERGENCY LOWERING VALVE
5. ELECTRO-HYDRAULIC POPPET VALVE (EHPV)
6. PROPORTIONAL PRESSURE REDUCING VALVE (PPRV)
7. AUXILIARY I SECTION
8. AUXILIARY II SECTION
9. SECONDARY RELIEF VALVE (ADJUSTABLE)
10. OUTLET SECTION
11. TILT SECTION
12. PRIMARY RELIEF VALVE (ADJUSTABLE)
13. EF PORT

Figure 2. Electronic Control Valve Without Anti-Stall Solenoid

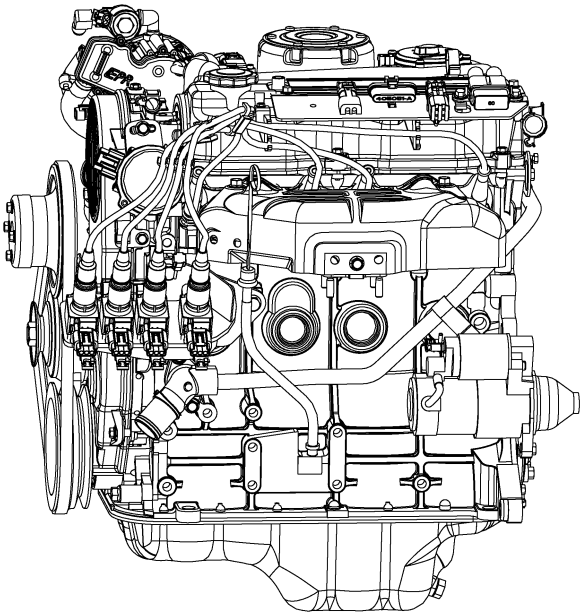
TABLE OF CONTENTS (Continued)

Yale

Maintenance

ELECTRICAL SYSTEM, MAZDA 2.2L ENGINE

GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) [B910]; GLP20-35VX (GP/GLP040-070VX) [C875]



PART NO. 550096329

2200 YRM 1686

General Information About Diagrams and Schematics

The chassis wiring used in these vehicles conforms to the electrical circuit identification standard **ES-1359** and in addition to surface marked ID circuit numbers, generally utilizes the colors that are indicated in Table 1.

Foot Directional Control , engine harnesses, wiring to sensors, and other applications vary with respect to wire colors.

Diagrams and schematics in this manual can be viewed and printed in color. If not printed or viewed in color, refer to the electrical circuit identification located on schematic circuits. When viewing a color version of the diagrams and schematics, the white chassis wires are seen as yellow. Other wires are shown in colors similar to actual colors, i.e. tan shows as yellow. Use circuit identification for true wire color.

Refer to **Diagnostic Troubleshooting Manual** 9000YRM1112 Section 9030, Group 03 - General Maintenance and Diagnostic Data, for further information.

Table 1. Wire Colors

Color	Use/Function
Red	Battery-level power circuits and 5 volt supply circuits
Black	Heavy current grounds
Green	Signal grounds
White	Other circuits
Twisted Pair (Yellow/Green) Yellow Green	**CANbus** CAN-Hi CAN-Lo
Twisted Pair (Dk Blue/Pink and Dk Blue/White) Dk Blue/Pink Dk Blue/White	**CANbus (Mazda)** CAN-Hi CAN-Lo
Letter on the VSM BUS	**Use/Function**
R	Regulated Output Voltage
D	Driver
I	Input

SYMBOL DEFINITIONS

See Table 2 for description of symbol definitions.

Table 2. Symbol Definitions

Symbol Name	Definition
Type S	Identifies information for UL Safety rated trucks. Applicable trucks are rated for GS, LPS, and DS depending on fuel type.
Arrow Symbol 	Go to specified page of schematic, located in lower right corner in the hexagon symbol.
-----X	Go to specified sheet of diagram. Sheet number is located in lower right corner of figure.

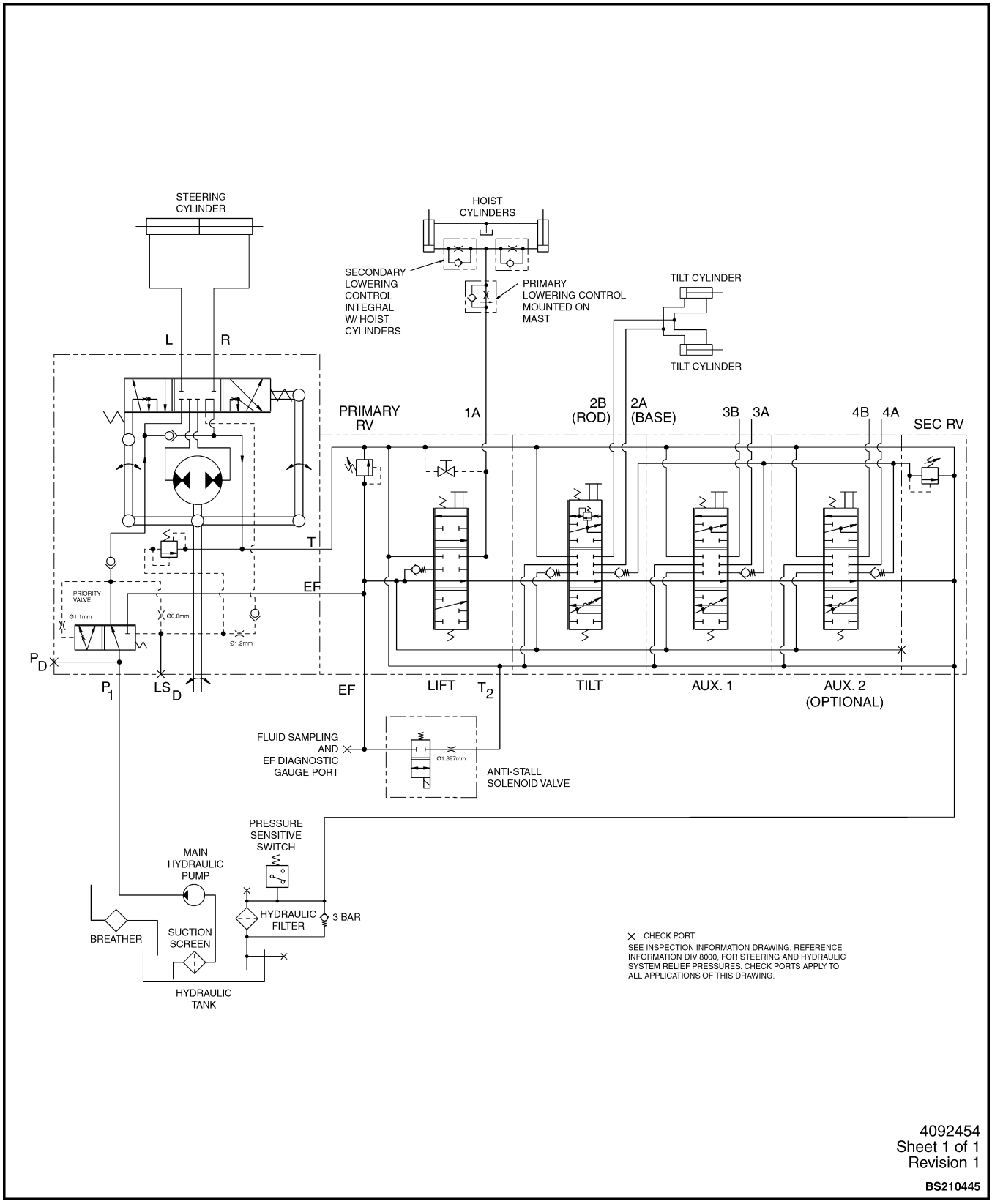
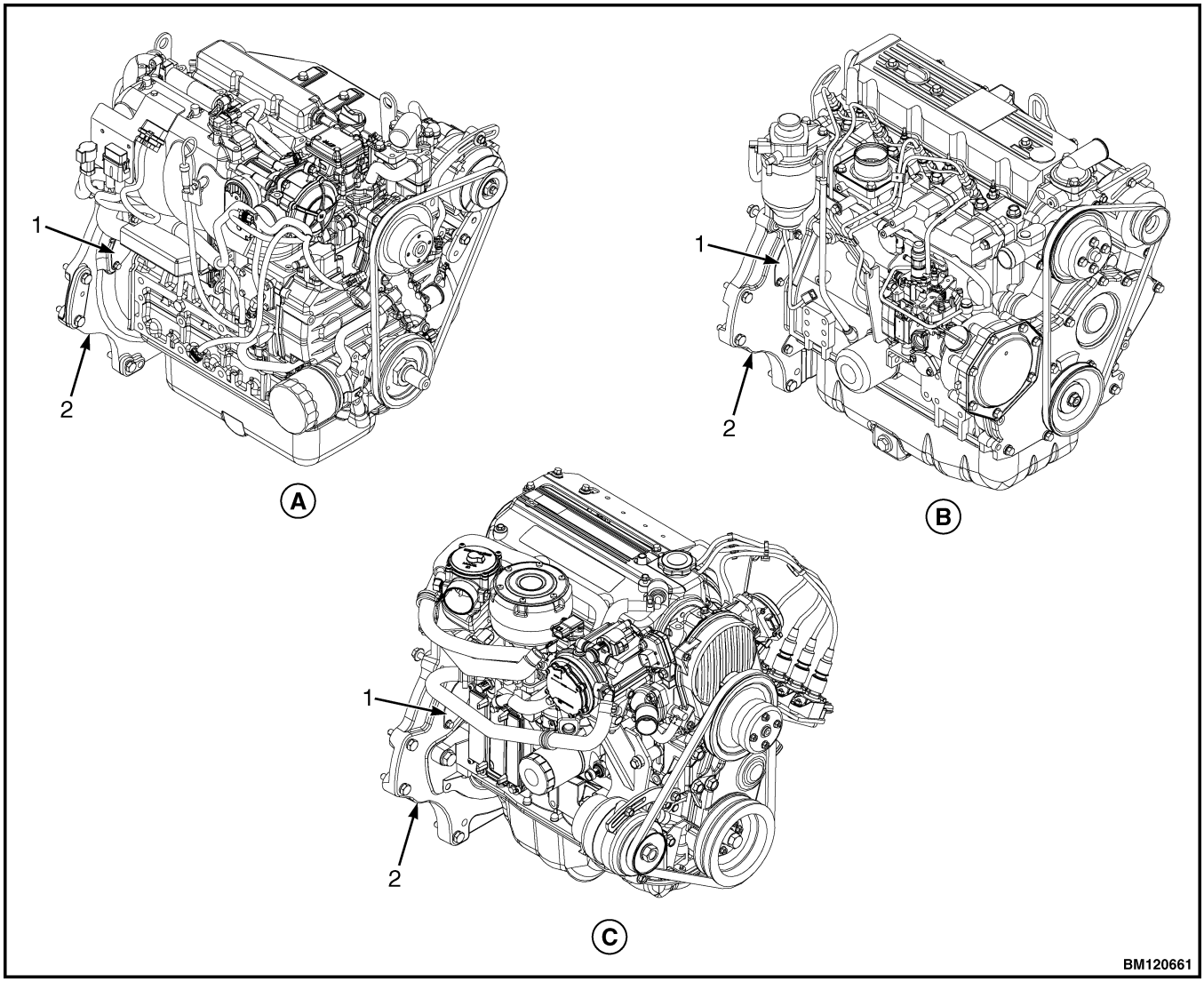


Figure 52. Manual Control Valve Hydraulic Schematic for Lift Truck Models GLC20-35VX (GC/GLC040-070VX, GC/GLC055SVX) (B910) and GLP/GDP20-35VX (GP/GLP/GDP040-070VX) (C875)



A. KUBOTA 2.5L ENGINE
B. YANMAR 3.3L ENGINE
C. MAZDA 2.2L ENGINE

1. ACCESS HOLE
2. FLYWHEEL HOUSING

Figure 22. Torque Converter Bolt Access

4. Remove access cover from torque converter housing. Install a lifting eye bolt into rear access cover bolt hole, and connect a lifting device to eye bolt. Remove ten capscrews that hold torque converter housing to flywheel housing. Carefully separate transmission from engine.

5. Remove torque converter housing from transmission housing. See Housings and Chain Drive Repair, Remove.

6. Remove idler gear and two bearings. See Figure 23.

Legend for Figure 14

1. HOSE
2. HOSE SHEAVE
3. STUB SHAFT WELDMENT
4. WASHER
5. CAPSCREW
6. CHAIN GUARD
7. SPACER
8. CHAIN SHEAVE
9. SNAP RING
10. PIN
11. CROSSHEAD
12. ALIGNMENT PIN
13. FREE-LIFT CYLINDER
14. STRAP
15. TUBE SPACER
16. BRACKET
17. LOWERING CONTROL VALVE
18. BEARING

Disassemble

Two-Stage FFL

NOTE: Perform only those steps below required to repair free-lift cylinder.

1. Loosen gland with spanner wrench.

2. Remove gland from rod and shell. See Figure 15.

3. Remove rod and piston assembly from shell. Drain any remaining hydraulic oil into drain pan.

NOTE: To prevent damage to sealing surfaces, use brass tools when removing seals and O-rings.

4. Remove and discard rod wiper, rod seal, backup ring, and O-ring from gland. See Figure 15.

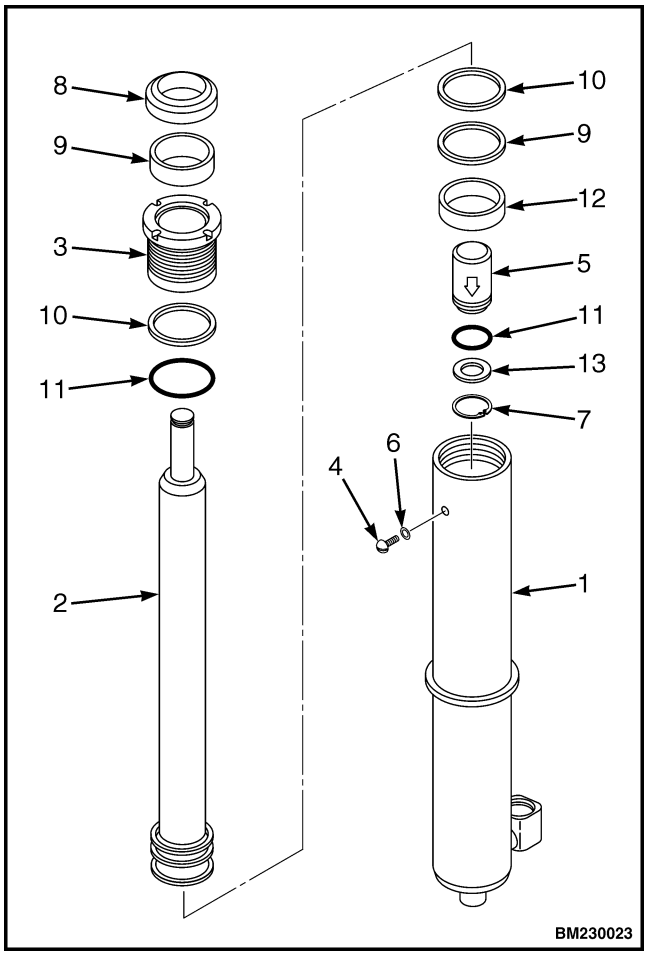
5. Remove and discard wear ring, rod seal, and backup ring from piston.

WARNING

Be careful when removing or installing snap rings. These snap rings can come loose during removal or installation with enough force to cause and injury. Always use the correct snap ring pliers, and wear eye and face protection during removal and installation.

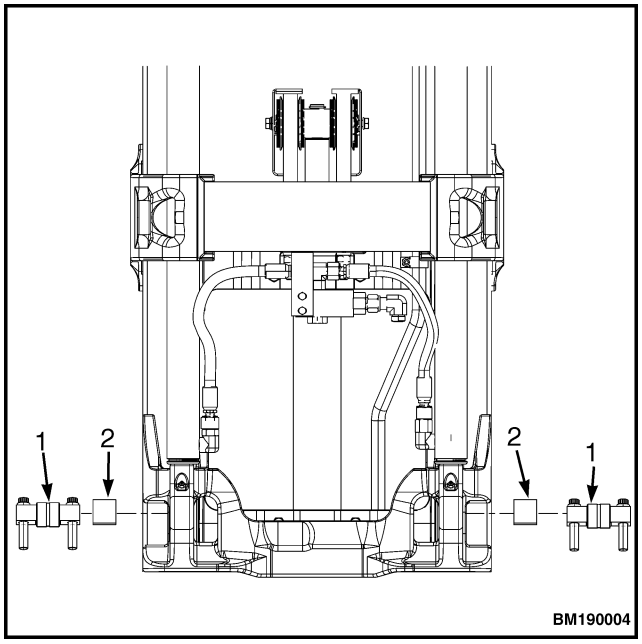
6. Remove snap ring, washer, and check valve from piston base. Remove and discard O-ring from check valve. See Figure 15.

7. Remove capscrew and seal from shell. Discard seal.



1. SHELL
2. ROD
3. GLAND
4. CAPSCREW
5. CHECK VALVE
6. SEAL
7. SNAP RING
8. ROD WIPER
9. ROD SEAL
10. BACKUP RING
11. O-RING
12. WEAR RING
13. WASHER

Figure 15. Free-Lift Cylinder, Two-Stage FFL



1. MAST PIVOT PINS
2. BUSHING

Figure 35. Mast Pivot Pin

DISASSEMBLE

WARNING

Always wear the proper protective equipment including eye protection and petroleum-resistant gloves when handling hydraulic oil. Thoroughly wash oil from exposed areas of skin as soon as possible.

Completely lower forks to relieve hydraulic pressure before disassembling any part of the lift pump or disconnecting any hydraulic hoses.

The hydraulic oil is hot at normal operating temperatures. Be careful when draining the oil.

CAUTION

Protect the hydraulic system from dirt and contaminants when servicing the hydraulic system.

NOTE: If main lift cylinders alone need to be removed and repaired, the mast does not need to be disassembled. See service manual **Cylinder Repair (Mast S/N D515, E509, E564)** 2100YRM1692 for procedures to remove and repair main lift cylinders.

1. Clean area around hydraulic fittings for main lift cylinders. Disconnect fittings at main lift cylinders and put caps on open lines. See Figure 36.

2. Remove lift chains and header hoses. Remove brackets and disconnect FFL supply tube from free-lift cylinder. Remove free-lift cylinder. Disconnect free-lift chains at the crossmember. See Figure 36 and Figure 37.

WARNING

Be careful when removing or installing snap rings. These snap rings can come loose during removal or installation with enough force to cause an injury. Always use the correct snap ring pliers, and wear eye and face protection during removal or installation.

3. Remove nut, capscrew, washers, and spacer at cylinder mount near top of each main lift cylinder. Remove snap rings and washers from top of right main lift cylinder Disconnect main lift chains at the mounts. See Figure 36.

4. Disconnect the FFL supply tube from left main lift cylinder and remove hydraulic fitting and snap ring from top of left main lift cylinder (from driver's view). Remove clamp, at top of inner mast, and FFL supply tube from inner mast. See Figure 36 and Figure 37.

WARNING

The mast weldments can slide when the mast is moved. A weldment that slides can cause injury.

5. Slide the inner mast from outer mast approximately 30 cm (12 in.) to disengage main lift cylinders from inner mast. Remove main lift cylinders from outer mast. See Figure 36.

6. Slide inner mast from bottom of outer mast approximately 30 cm (12 in.). Remove strip bearings and load rollers from top of the outer mast. Remove load rollers from bottom of the inner mast. Make a note of each shim arrangement and load roller location. The shim arrangements will be the same during assembly. See Figure 36 and Figure 37.