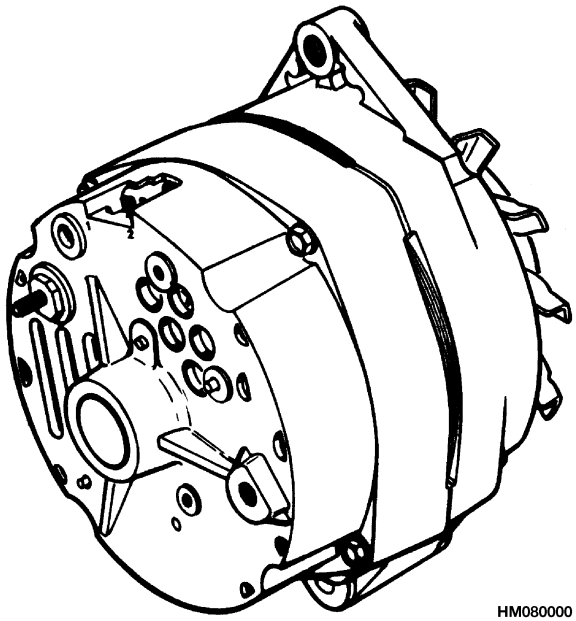
ALTERNATOR WITH REGULATOR

COVERS DELCO, MOTOROLA, AND LEECE-NEVILLE ALTERNATORS USED ON HYSTER LIFT TRUCKS



HM080000

HYSTER

PART NO. 899784

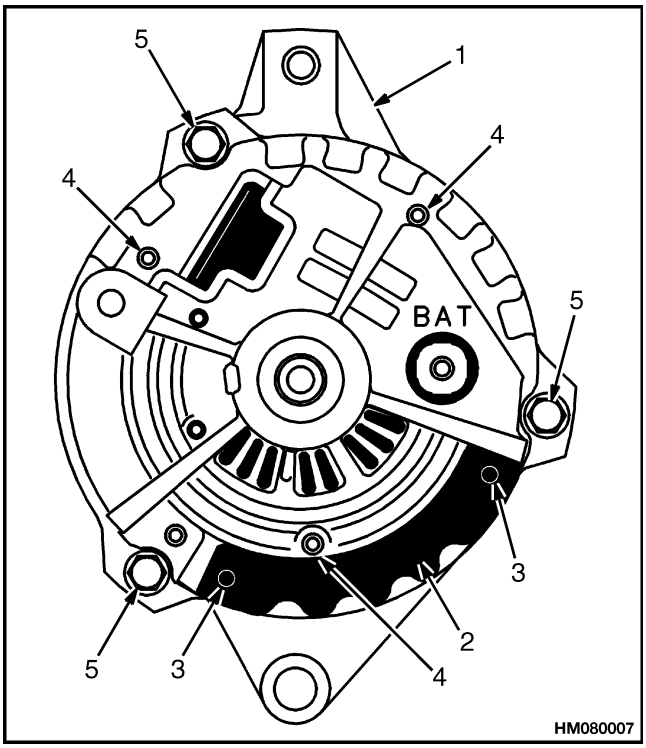
2200 SRM 2

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL

- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: www.heydownloads.com by clicking the link below

- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL



NOTE: TYPE B ONLY.

1. REAR HOUSING
2. COVER
3. COVER RIVETS OR PINS
4. BAFFLE PINS
5. BOLTS TO FASTEN HOUSINGS TOGETHER

Figure 7. Outside Rear Housing

8. Install a new cover using rivets or pins to fasten the cover to the rear housing.

9. If necessary, install the bearing in the front housing. Put the rotor in a vise with soft jaws and install the inner collar, front housing, outer collar, fan, collar pulley, and nut on the rotor. Tighten the nut to 54 to 108 N•m (40 to 80 lbf ft).

10. Align the front and rear housings using the marks made during disassembly. Push on both the inner and outer races of the rear bearing to push the two housings and stator together. Install the three bolts that fasten the alternator together.

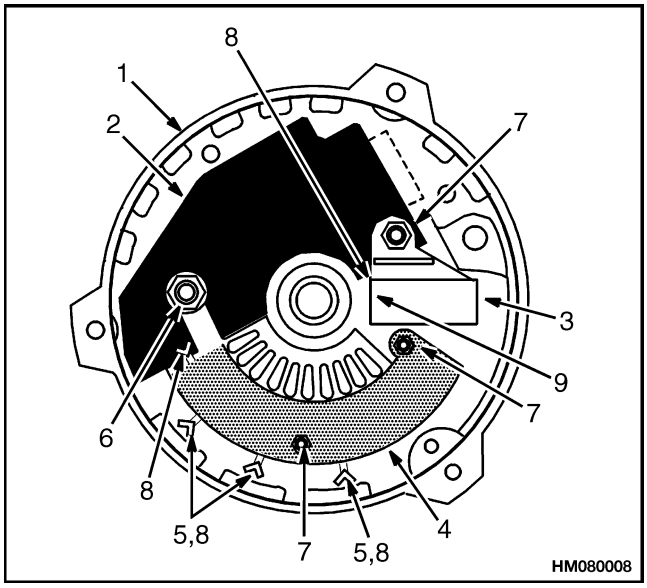
11. Push on both the inner and outer race of the rear bearing so that the outer race is 1.9 to 2.2 mm (0.075 to 0.087 in.) below the surface of the rear housing.

Install

1. Install the alternator in the bracket on the engine and adjust the tension of the belt.

2. Connect all wires and the connector according to the labels made during removal. Also see the schematic diagram for your alternator in Figure 2. Make sure all wires are connected correctly and all fasteners are tight. See Figure 7.

3. Check the indicator light or the ammeter to check the operation of the alternator. The indicator light can also be ON if the alternator output is too high on Type B alternators.



NOTE: TYPE B ONLY.

1. REAR HOUSING
2. VOLTAGE REGULATOR
3. BRUSH HOLDER
4. DIODE BRIDGE
5. TERMINALS FOR STATOR LEADS
6. NUT ON "BAT" TERMINAL
7. MOUNT SCREWS
8. SOLDERED OR WELDED CONNECTOR
9. BRUSH PIN

Figure 8. Inside Rear Housing

15. Using the correct tools, install the return springs as follows (see Figure 8):

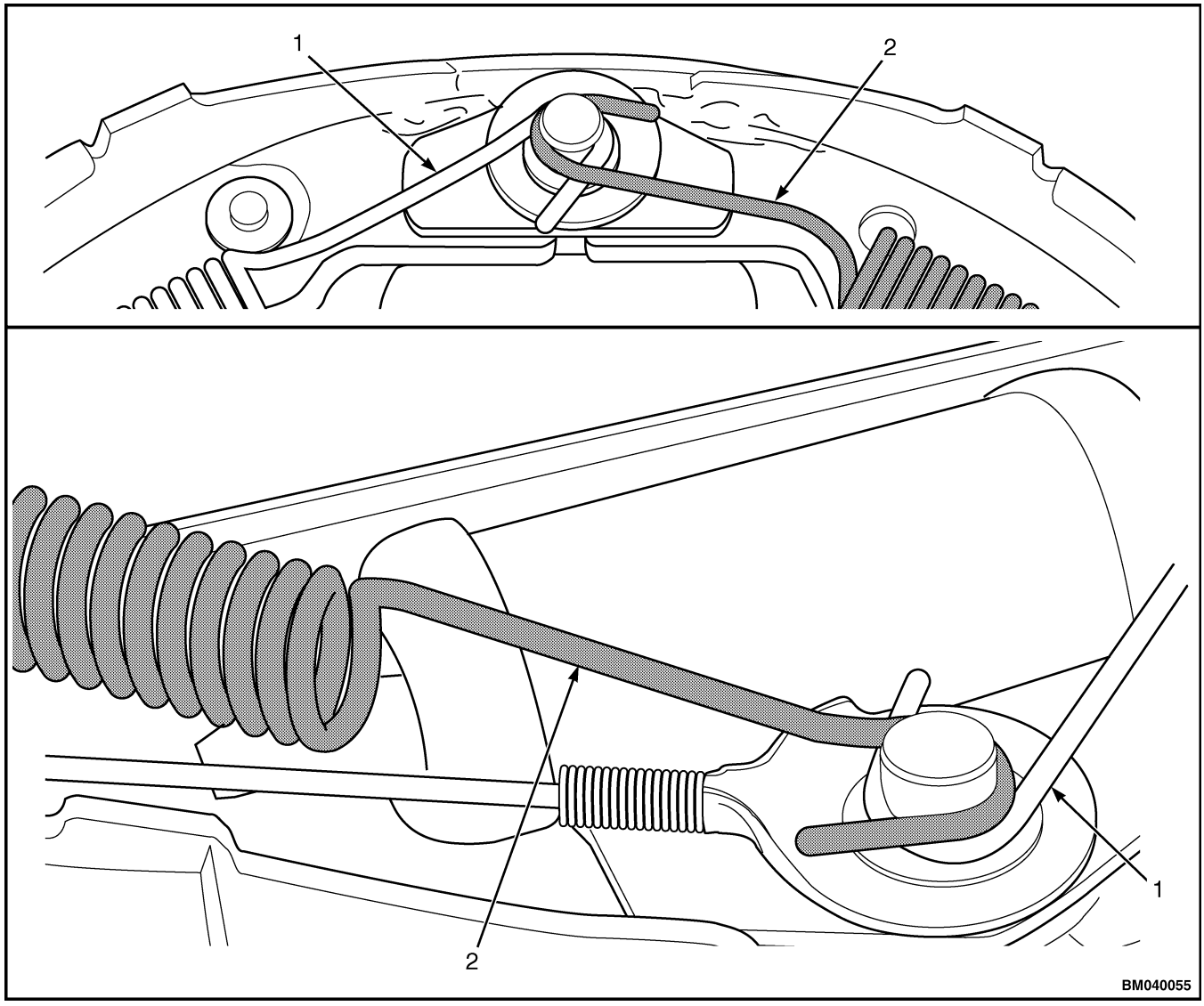
a. Install the white spring.

b. Install the washer and black spring.

16. Verify that the return springs are properly installed as shown in Figure 8.

17. Make sure the bottom edge of the adjuster wheel actuator is just above the center of the teeth of the adjuster wheel. Check for correct installation if the alignment is not correct.

18. Clean the bearings and lubricate them with wheel bearing grease. Install the bearings and seals in the brake drum. Install the assembly on the axle housing. See Figure 9 and Figure 10.



1. WHITE SPRING
2. BLACK SPRING

Figure 8. Proper Installation of Return Springs

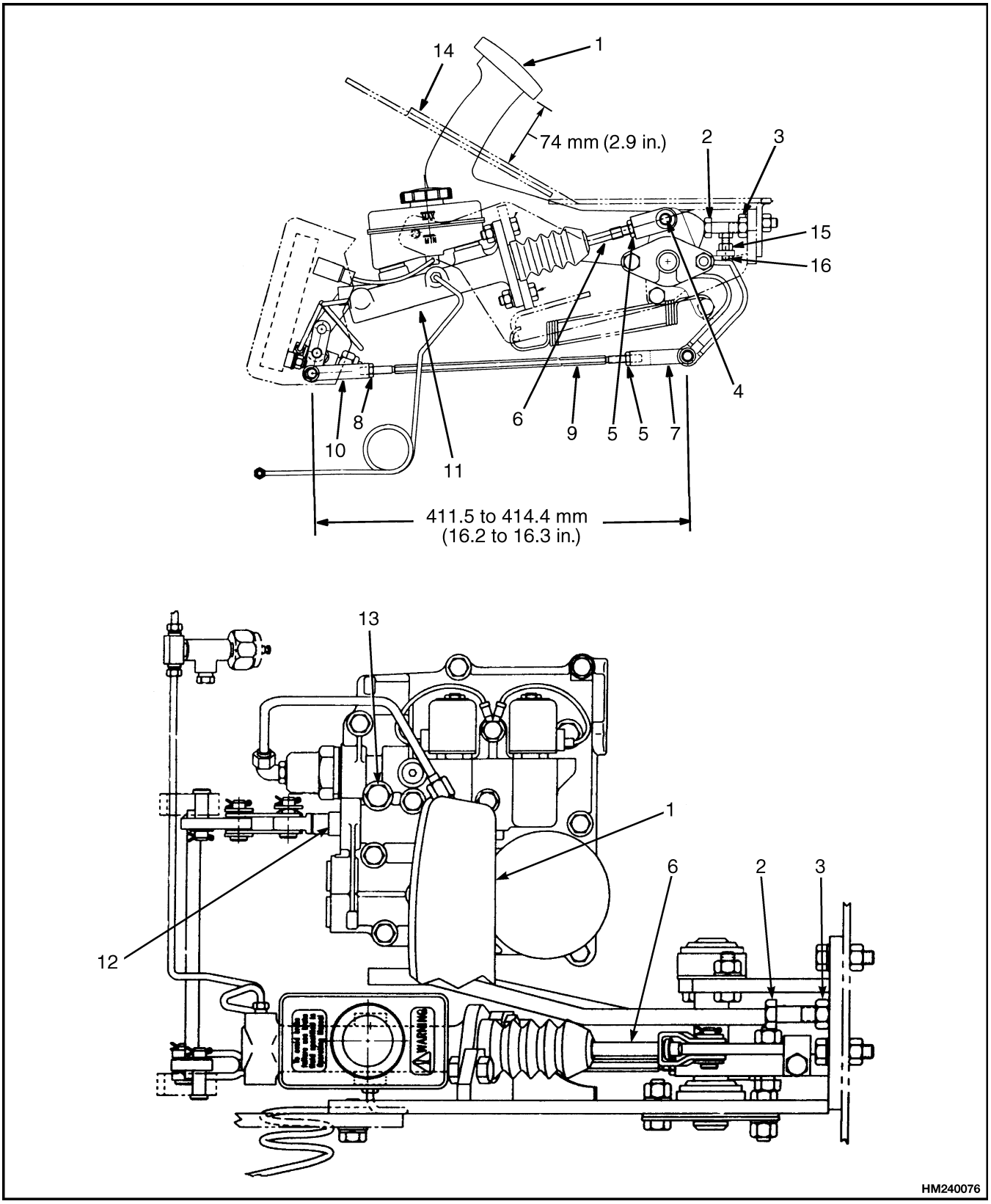


Figure 14. Inching/Brake Pedal Adjustment S2.00-3.20XM (S40-65XM)

TABLE OF CONTENTS

This section is for the following models:

S/H2.00-3.20XM (S/H40-65XM) [H177, D187]

©2004 HYSTER COMPANY

GM 3.0L Engine (Gas Only)								
Unit	Three-Stage Full Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H40XM	0.60	119	0.57	112	0.42	83	0.50	99
H45XM	0.60	119	0.56	111	0.42	83	0.50	99
H50XM	0.60	119	0.56	110	0.42	83	0.50	99
H55XM	0.60	119	0.55	109	0.42	83	0.50	99
H60XM	0.54	107	0.49	97	0.42	83	0.50	99
H65XM	0.54	107	0.49	96	0.42	83	0.50	99

GM 3.0L Engine (LPG Only)								
Unit	Two-Stage Limited Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H40XM	0.68	134	0.61	121	0.42	83	0.50	99
H45XM	0.68	134	0.60	119	0.42	83	0.50	99
H50XM	0.68	134	0.59	117	0.42	83	0.50	99
H55XM	0.68	134	0.58	115	0.42	83	0.50	99
H60XM	0.60	118	0.52	102	0.42	83	0.50	99
H65XM	0.60	118	0.51	101	0.42	83	0.50	99

GM 3.0L Engine (LPG Only)								
Unit	Two-Stage Full Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H40XM	0.61	121	0.56	110	0.42	83	0.50	99
H45XM	0.61	121	0.55	109	0.42	83	0.50	99
H50XM	0.61	121	0.54	107	0.42	83	0.50	99
H55XM	0.61	121	0.54	106	0.42	83	0.50	99
H60XM	0.58	115	0.51	100	0.42	83	0.50	99
H65XM	0.58	115	0.50	99	0.42	83	0.50	99

H2.00-3.20XM MAST SPEEDS (EUROPEAN MODELS) - GM 3.0L ENGINE

GM 3.0L Engine (Gas Only)								
Unit	Two-Stage Limited Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H2.00XM	0.64	125	0.59	117	0.42	83	0.50	99
H2.25XM	0.64	125	0.59	116	0.42	83	0.50	99
H2.50XM	0.64	125	0.58	115	0.42	83	0.50	99
H2.50-6XM	0.64	125	0.57	113	0.42	83	0.50	99
H3.00XM	0.56	110	0.51	100	0.42	83	0.50	99
H3.20XM	0.56	110	0.51	100	0.42	83	0.50	99

GM 3.0L Engine (Gas Only)								
Unit	Two-Stage Full Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H2.00XM	0.57	113	0.54	106	0.42	83	0.50	99
H2.25XM	0.57	113	0.53	105	0.42	83	0.50	99
H2.50XM	0.57	113	0.53	104	0.42	83	0.50	99
H2.50-6XM	0.57	113	0.52	103	0.42	83	0.50	99
H3.00XM	0.55	108	0.50	98	0.42	83	0.50	99
H3.20XM	0.55	108	0.50	98	0.42	83	0.50	99

GM 3.0L Engine (Gas Only)								
Unit	Three-Stage Full Free Lift							
	Lifting				Lowering			
	No Load		Rated Load		No Load		Rated Load	
	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
H2.00XM	0.60	119	0.57	112	0.42	83	0.50	99
H2.25XM	0.60	119	0.56	111	0.42	83	0.50	99
H2.50XM	0.60	119	0.56	110	0.42	83	0.50	99
H2.50-6XM	0.60	119	0.55	109	0.42	83	0.50	99
H3.00XM	0.54	107	0.49	97	0.42	83	0.50	99
H3.20XM	0.54	107	0.49	96	0.42	83	0.50	99

TRANSMISSION AND DIFFERENTIAL

Control Valve Capscrews
19 N•m (168 lbf in)

Front Cover Capscrews
38 N•m (28 lbf ft)

Torque Converter Drive Plate Capscrews
S2.00-3.20XM (S40-65XM) 38 N•m (28 lbf ft)
H2.00-3.20XM (H45-65XM) 45 N•m (33 lbf ft)

Torque Converter Housing
H2.00-3.20XM (H45-65XM) Only 38 N•m (28 lbf ft)

Torque Converter Housing-to-Engine Capscrews
S2.00-3.20XM (S40-65XM) Only 59 N•m (44 lbf ft)

Transmission Housing-to-Engine Capscrews H2.00-3.20XM (H45-65XM) Only
M10 Capscrews 38 N•m (28 lbf ft)
M12 Capscrews 66 N•m (49 lbf ft)

Differential Bearing Lock Plate
S2.00-3.20XM (S40-65XM) Only 19 N•m (168 lbf ft)

Differential Bearing Caps
H2.00-3.20XM (H45-65XM) Only 175 N•m (129 lbf ft)

Differential Adaptor to Transmission and to Differential Housing
S2.00-3.20XM (S40-65XM) Only 38 N•m (28 lbf ft)

Differential Case
H2.00-3.20XM (H45-65XM) Only 71 N•m (52 lbf ft)

Pinion Nut
750 N•m (553 lbf ft)

Ring Gear Bolts
S2.00-3.20XM (S40-65XM) 111 N•m (82 lbf ft)
H2.00-3.20XM (H45-65XM) 142 N•m (105 lbf ft)

Thrust Bolt Lock Nut
68 to 95 N•m (50 to 70 lbf ft)

ENGINE - MAZDA M4-2.0G AND M4-2.2G

Camshaft Pulley Lock Bolt
48 to 66 N•m (35 to 49 lbf ft)

Cooling Fan
8 to 11 N•m (71 to 97 lbf in)

Connecting Rod Cap
Mazda 2.0L 51 to 56 N•m (38 to 41 lbf ft)
Mazda 2.2L 66 to 70 N•m (48 to 51 lbf ft)

Crankshaft Pulley
Mazda 2.0L 30 to 33 N•m (22 to 24 lbf ft)
Mazda 2.2L 30 to 38 N•m (22 to 28 lbf ft)

Cylinder Head
81 to 88 N•m (60 to 65 lbf ft)

Engine Mount to Engine
40 N•m (30 lbf ft)

Exhaust Manifold
22 to 29 N•m (195 to 257 lbf in)

Flywheel
96 to 103 N•m (71 to 76 lbf ft)

Flywheel Housing
M8 Capscrews 21 to 25 N•m (186 to 221 lbf in)
M14 Capscrews 114 to 136 N•m (84 to 100 lbf ft)

Intake Manifold
19 to 31 N•m (168 to 274 lbf in)

Main Bearing Cap
84 to 90 N•m (62 to 66 lbf ft)

Oil Pan
7 to 12 N•m (62 to 106 lbf in)

Oil Pump
M8 Capscrews 19 to 26 N•m (168 to 230 lbf in)
M10 Capscrews 38 to 53 N•m (28 to 39 lbf ft)

Rocker Cover
Mazda 2.0L 30 to 40 N•m (22 to 30 lbf ft)
Mazda 2.2L 40 to 60 N•m (30 to 44 lbf ft)

Rocker Shaft Assembly
18 to 27 N•m (159 to 239 lbf in)

Spark Plugs
15 to 23 N•m (133 to 204 lbf in)

Starter
41 to 49 N•m (30 to 36 lbf ft)

Thermostat Cover
Mazda 2.0L 12 to 18 N•m (106 to 159 lbf in)
Mazda 2.2L 19 to 31 N•m (14 to 23 lbf ft)

3. Drain water from radiator. If water is dirty, fill system with water and repeat procedure until water is clean.

CAUTION

Follow the manufacturer's instructions when using a chemical radiator cleaner.

4. If water does not clean system, use chemical radiator cleaner.

CAUTION

Follow the manufacturer's instructions when using special equipment to reverse clean the radiator.

NOTE: On lift truck models S3.50-5.50XM (S70-120XM) (E004), the cooling system may be equipped with an optional radiator screen.

5. If radiator or cooling system is very dirty or has restriction, use reverse cleaning method. This method uses air pressure to force water through radiator in opposite direction of normal flow.

WARNING

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

6. Check radiator fins. Clean exterior of radiator with compressed air or water as needed.

FILL

1. Install drain plug in engine block. Close drain valve or install bottom radiator hose as needed.

WARNING

Do not use an alcohol or methanol-base antifreeze. They are flammable and can cause personal injury or damage to the lift truck.

NOTE: Units with a Mazda engine must use a boron-free type of antifreeze.

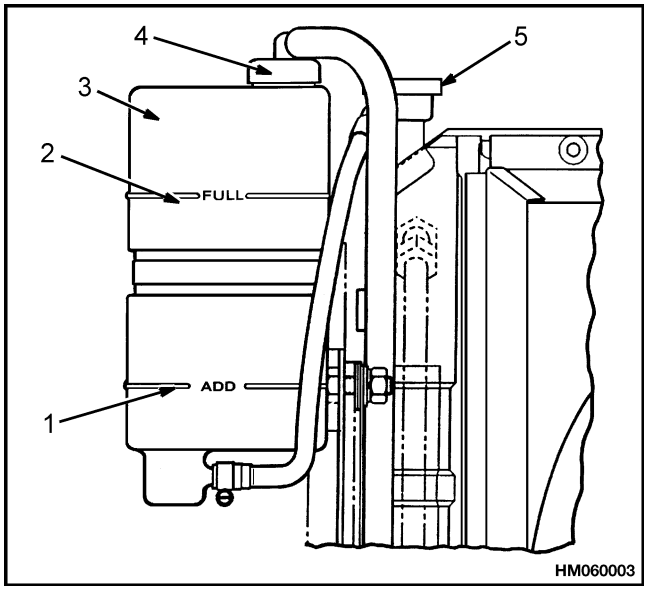
2. Fill cooling system with mixture of 50% water and 50% ethylene glycol antifreeze. Install radiator cap.

   The 50/50 mixture will protect the cooling system to −37°C (−35°F).

3. Use same coolant mixture to fill auxiliary coolant reservoir to **FULL** mark. See Figure 4.

4. Start and run engine until thermostat opens. (Top radiator hose will be warm.)

5. Check coolant level at auxiliary coolant reservoir. Add coolant as necessary to keep level between **FULL** and **ADD** marks.



1. **ADD** MARK
2. **FULL** MARK
3. AUXILIARY COOLANT RESERVOIR
4. FILL CAP
5. RADIATOR CAP

Figure 4. Auxiliary Coolant Reservoir

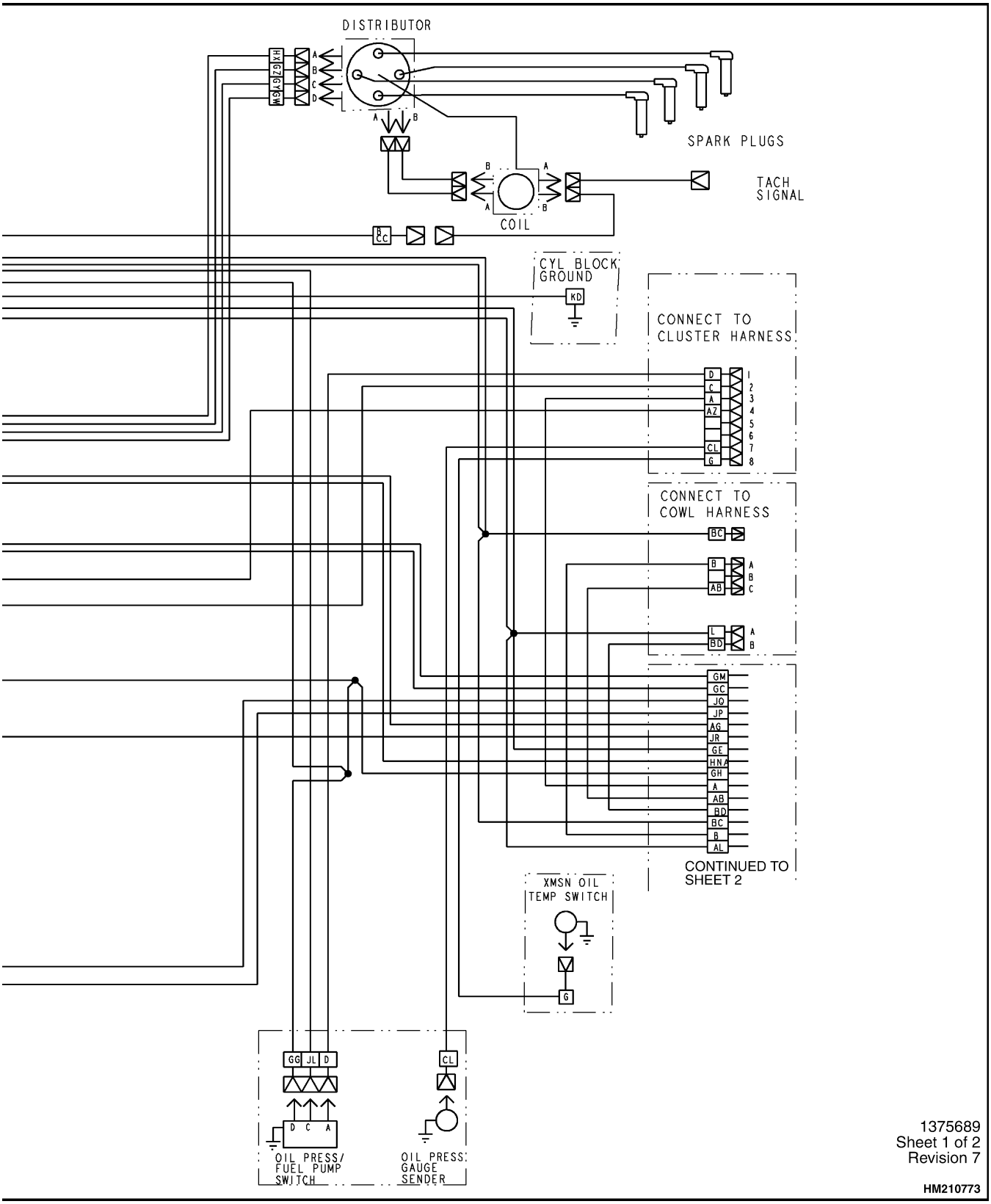
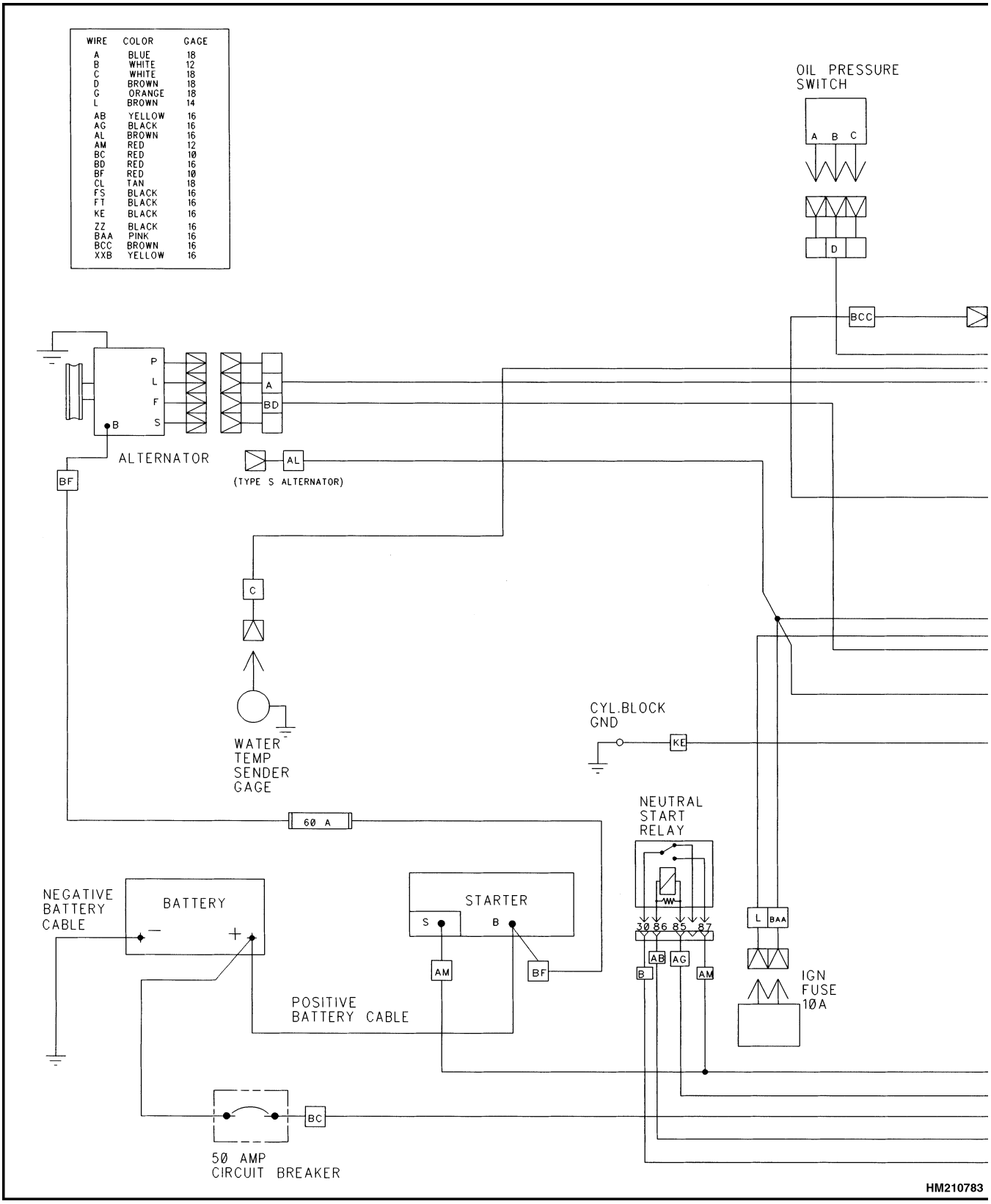


Figure 2. GM 3.0L Gasoline Engine Wiring Diagram (Late Models) (Sheet 1 of 2)


WIRE COLOR GAGE
A BLUE 18
B WHITE 12
C WHITE 18
D BROWN 18
G ORANGE 18
L BROWN 14
AB YELLOW 16
AG BLACK 16
AL BROWN 16
AM RED 12
BC RED 10
BD RED 16
BF RED 10
CL TAN 18
FS BLACK 16
FT BLACK 16
KE BLACK 16
ZZ BLACK 16
BAA PINK 16
BCC BROWN 16
XXB YELLOW 16
OIL PRESSURE SWITCH
A B C
D
BCC
P L F S
B
A
BD
ALTERNATOR
BF
AL
(TYPE S ALTERNATOR)
C
WATER TEMP SENDER GAGE
CYL.BLOCK GND
KE
60 A
NEUTRAL START RELAY
30 86 85 87
L BAA
AB AG
B AM
IGN FUSE 10A
NEGATIVE BATTERY CABLE
BATTERY
STARTER
S B
AM
BF
POSITIVE BATTERY CABLE
BC
50 AMP CIRCUIT BREAKER
HM210783

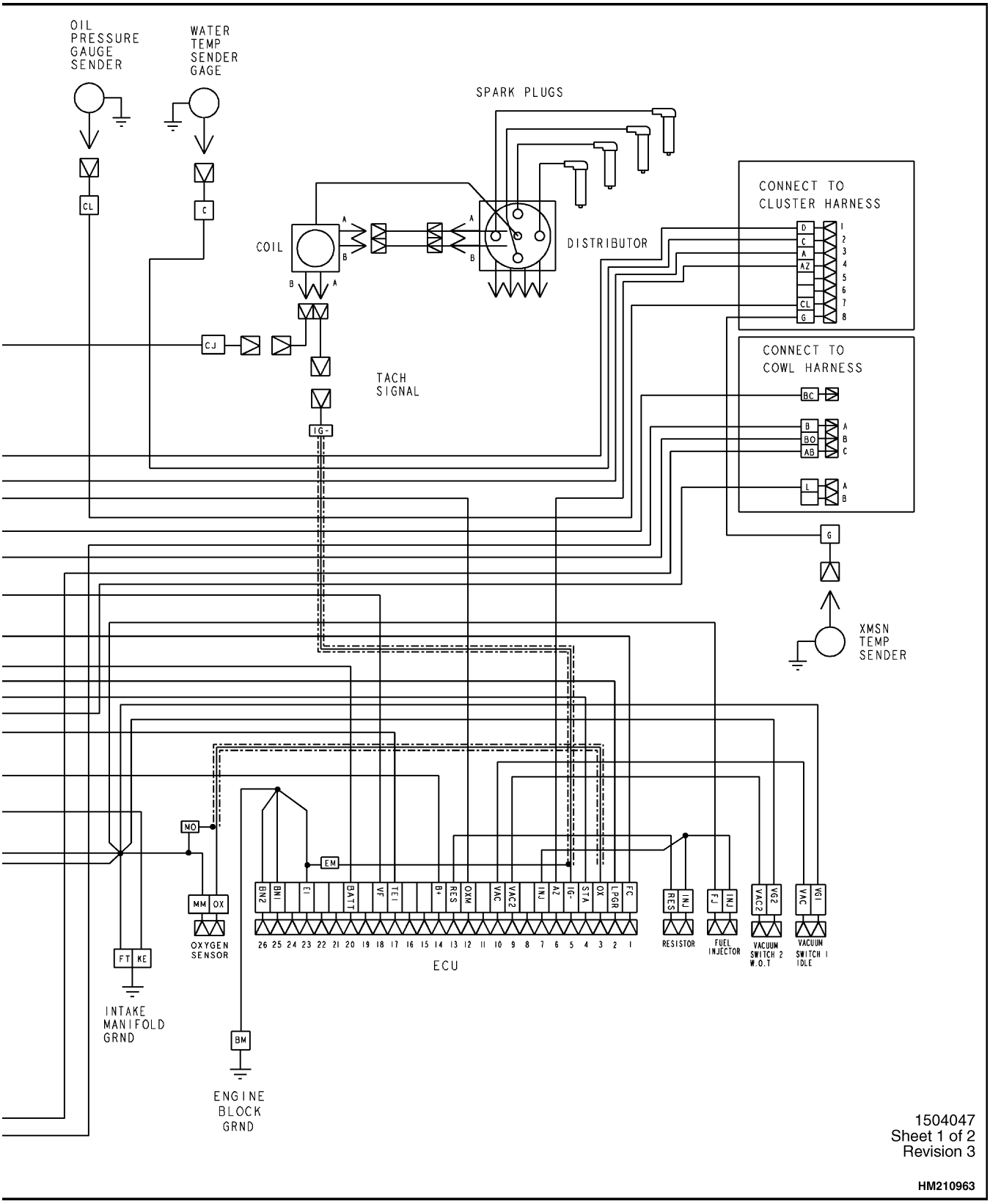
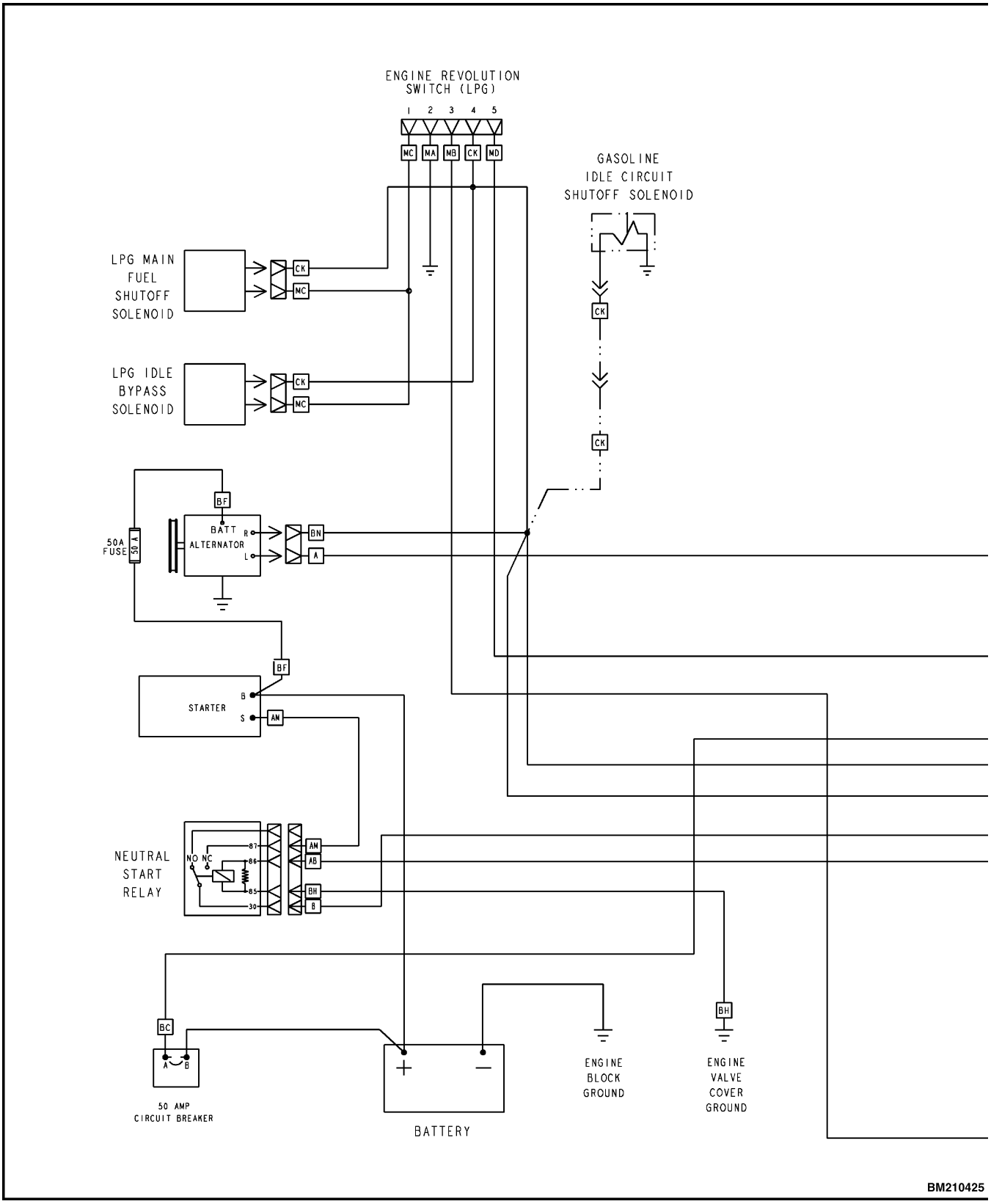
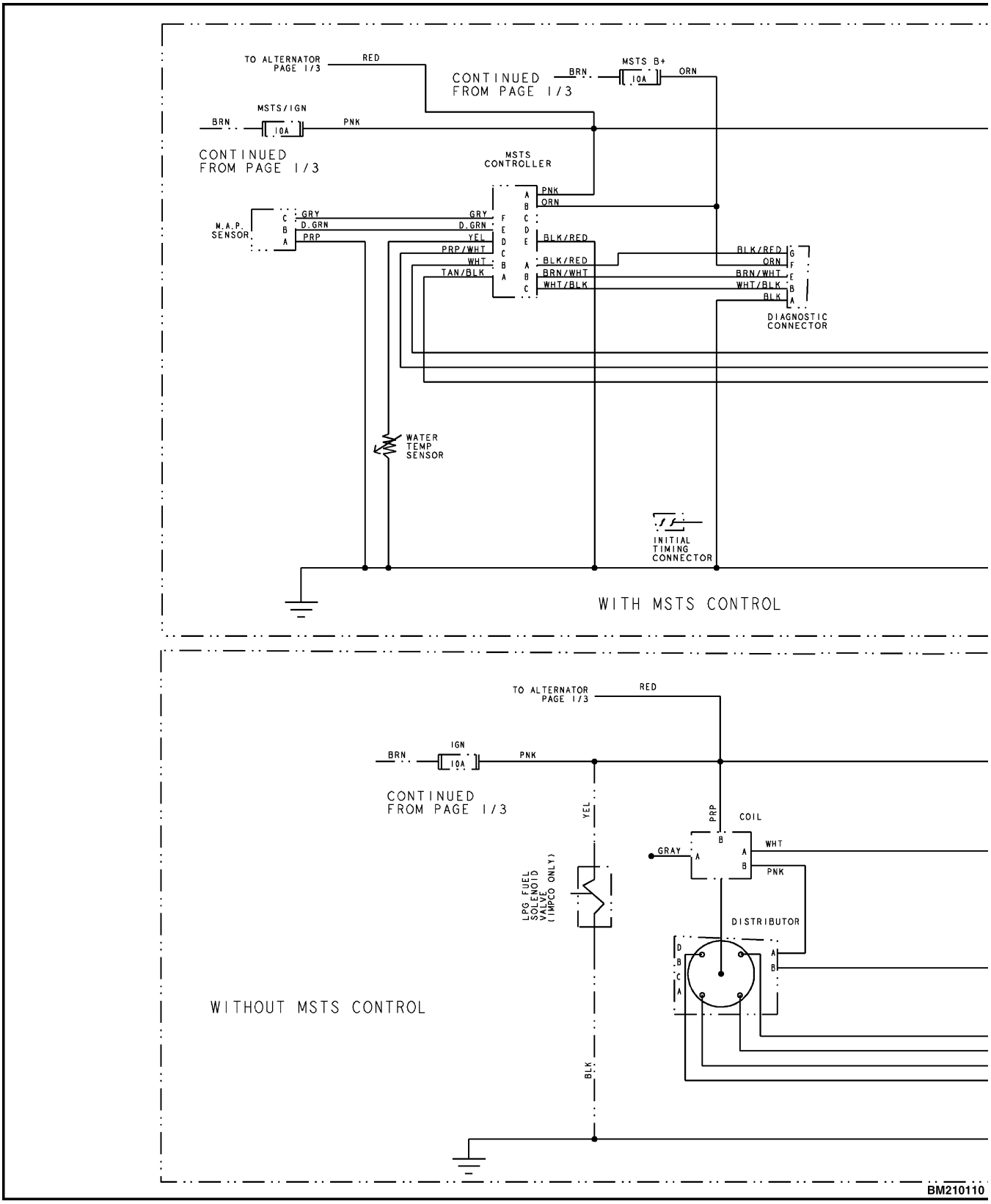


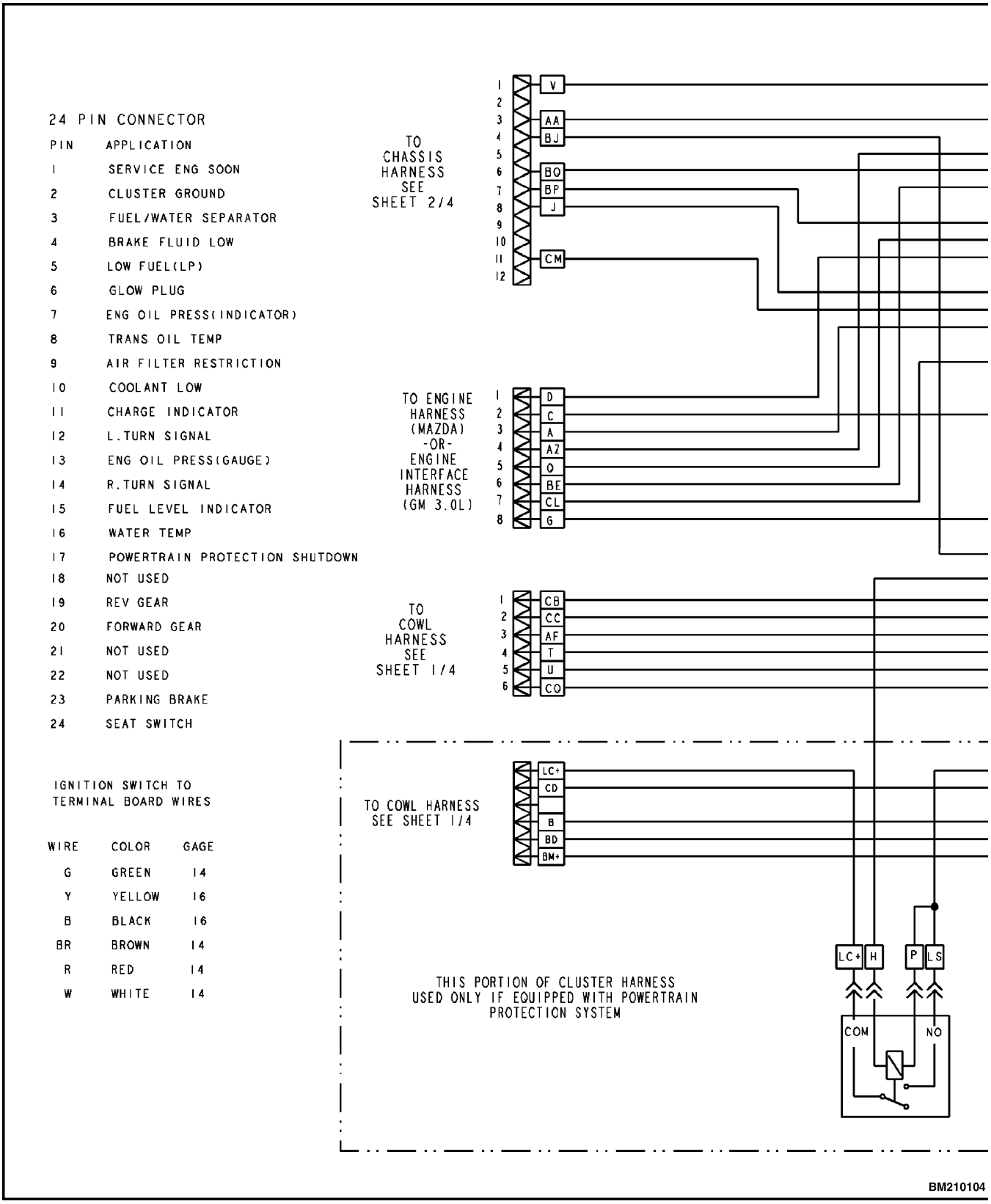
Figure 10. GM 3.0L LPG Engine Closed Loop (Sheet 1 of 2)

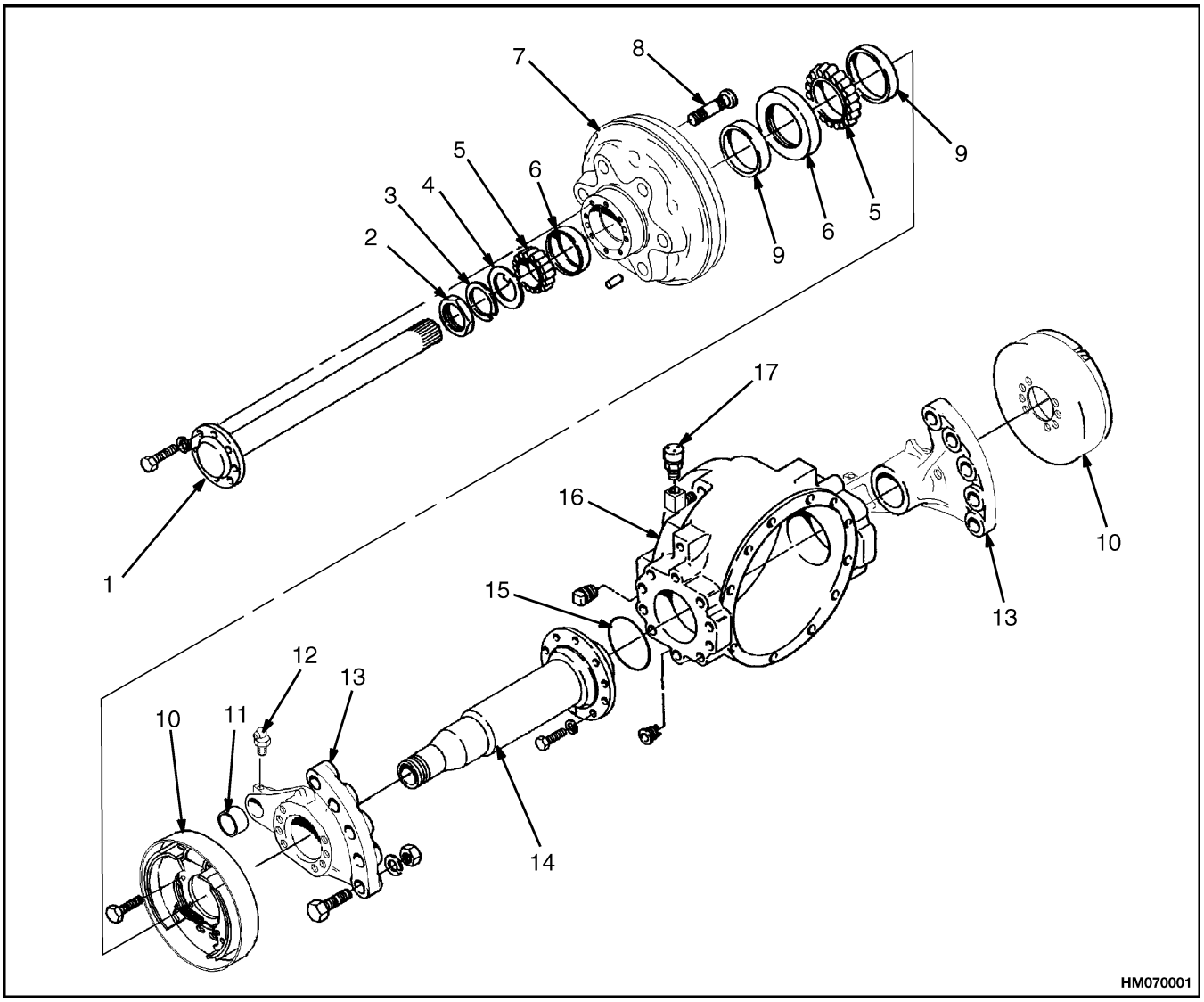

ENGINE REVOLUTION SWITCH (LPG)
1 2 3 4 5
MC MA MB CK MD
GASOLINE IDLE CIRCUIT SHUTOFF SOLENOID
LPG MAIN FUEL SHUTOFF SOLENOID
LPG IDLE BYPASS SOLENOID
CK
MC
BF
BATT
ALTERNATOR
R
L
BN
A
50A FUSE
50 A
STARTER
B
S
AN
NEUTRAL START RELAY
NO NC
87
86
85
30
AM
AB
BH
B
BC
A
B
50 AMP CIRCUIT BREAKER
BATTERY
ENGINE BLOCK GROUND
ENGINE VALVE COVER GROUND
BM210425

NOTES


TO ALTERNATOR PAGE 1/3
RED
CONTINUED FROM PAGE 1/3
BRN
MSTS B+
10A
ORN
MSTS/IGN
BRN
10A
PNK
CONTINUED FROM PAGE 1/3
MSTS CONTROLLER
PNK
ORN
M.A.P. SENSOR
GRY
D.GRN
PRP
GRY
D.GRN
YEL
PRP/WHT
WHT
TAN/BLK
BLK/RED
BLK/RED
BRN/WHT
WHT/BLK
BLK/RED
ORN
BRN/WHT
WHT/BLK
BLK
DIAGNOSTIC CONNECTOR
WATER TEMP SENSOR
INITIAL TIMING CONNECTOR
WITH MSTS CONTROL
TO ALTERNATOR PAGE 1/3
RED
BRN
IGN
10A
PNK
CONTINUED FROM PAGE 1/3
YEL
PRP
COIL
GRAY
WHT
PNK
LPG FUEL SOLENOID VALVE (IMPCO ONLY)
DISTRIBUTOR
WITHOUT MSTS CONTROL
BLK
BM210110

NOTES


24 PIN CONNECTOR
PIN APPLICATION
1 SERVICE ENG SOON
2 CLUSTER GROUND
3 FUEL/WATER SEPARATOR
4 BRAKE FLUID LOW
5 LOW FUEL(LP)
6 GLOW PLUG
7 ENG OIL PRESS(INDICATOR)
8 TRANS OIL TEMP
9 AIR FILTER RESTRICTION
10 COOLANT LOW
11 CHARGE INDICATOR
12 L.TURN SIGNAL
13 ENG OIL PRESS(GAUGE)
14 R.TURN SIGNAL
15 FUEL LEVEL INDICATOR
16 WATER TEMP
17 POWERTRAIN PROTECTION SHUTDOWN
18 NOT USED
19 REV GEAR
20 FORWARD GEAR
21 NOT USED
22 NOT USED
23 PARKING BRAKE
24 SEAT SWITCH
TO CHASSIS HARNESS SEE SHEET 2/4
V
AA
BJ
BQ
BP
J
CM
TO ENGINE HARNESS (MAZDA) -OR- ENGINE INTERFACE HARNESS (GM 3.0L)
D
C
A
AZ
Q
BE
CL
G
TO COWL HARNESS SEE SHEET 1/4
CB
CC
AF
T
U
CQ
IGNITION SWITCH TO TERMINAL BOARD WIRES
WIRE COLOR GAGE
G GREEN 14
Y YELLOW 16
B BLACK 16
BR BROWN 14
R RED 14
W WHITE 14
TO COWL HARNESS SEE SHEET 1/4
LC+
CD
B
BD
BM+
THIS PORTION OF CLUSTER HARNESS USED ONLY IF EQUIPPED WITH POWERTRAIN PROTECTION SYSTEM
LC+
H
P
LS
COM
NO
BM210104



1. AXLE SHAFT
2. NUT
3. LOCK PLATE
4. WASHER
5. BEARING CONE
6. BEARING CUP
7. HUB/BRAKE DRUM
8. WHEEL STUD
9. SEAL
10. BRAKE ASSEMBLY
11. MAST BUSHING
12. GREASE FITTING
13. AXLE HOUSING MOUNT
14. SPINDLE
15. O-RING
16. DIFFERENTIAL HOUSING
17. BREATHER

Figure 1. Drive Axle Parts

9. Remove the capscrews that hold the spindles to the differential housing. Remove the spindle. See Figure 2.

10. Disassemble the brake assembly as described in the section **Brake System** 1800 SRM 506. Remove the back plate from the mounts for the axle housing.

TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	PROCEDURE OR ACTION
The engine will not start.	Parts of the gasoline or LPG fuel system do not operate correctly.	See the sections for the Gasoline or LPG fuel systems.
	Both fuel tanks are empty.	Fill the fuel tanks.
	The fuel selector switch does not work.	Install a new fuel selector switch.
	The wiring for the fuel selector switch is broken or not connected.	Check and repair the wiring.
The engine does not run on LPG.	Parts of the LPG fuel system do not operate correctly.	See the section for the LPG fuel system.
	The LPG tank is empty.	Fill the LPG tank.
	The fuel selector switch does not work.	Install a new fuel selector switch.
	The wiring for the fuel selector switch is broken or not connected.	Check and repair the wiring.
	The LPG supply solenoid does not operate.	Check the wiring or install a new solenoid.
The engine does not run on gasoline.	Parts of the gasoline fuel system do not operate correctly.	See the section for the gasoline fuel system.
	The fuel tank is empty.	Fill the LPG tank.
	The fuel selector switch does not work.	Install a new fuel selector switch.
	The wiring for the fuel selector switch is broken or not connected.	Check the wiring and repair as necessary.
	The fuel injector or ECM does not operate.	Check the wiring or install a new fuel injector or ECM.

Starter Repair

REMOVE AND DISASSEMBLE

WARNING

Always disconnect the battery ground cable before making repairs to prevent possible damage and injury. Install a tag on the battery terminal so that no one connects the cable on the terminal.

NOTE: Use Troubleshooting, General Checks and Adjustments, Starter Checks, Ignition System Check and Adjustment, and Charging Circuit Checks of this section before starting any repair procedures. Make sure repair or replacement of the part is necessary before removal, disassembly, or replacement of part.

NOTE: Do only the steps that are necessary to replace the part that is damaged.

1. Disconnect battery cable at negative battery terminal. Install tag on battery terminal to warn against connecting cable.
2. Remove plate that fastens to engine between fuel pump and starter.
3. Put labels on electrical leads to starter for correct connection during installation. Remove all electrical leads fastened to starter.
4. Hold starter so that it will not fall. Remove two capscrews that fasten starter to flywheel housing. Remove starter.
5. Put starter on workbench. Remove nut, lockwasher, washer, and strap from motor terminal on solenoid. See Figure 4.
6. Remove three screws that fasten solenoid to drive housing. Remove solenoid. Remove spring and washers.
7. Remove two long bolts and two screws that fasten end cover of motor. Remove cover. Remove washers from armature shaft.
8. Lift brush springs and remove brushes from brush holders. Remove brush holder assembly from field housing. Move field housing from armature and drive housing.
9. Measure length of brushes. Measure from end to end of each brush. Standard length is 17 mm (0.67 in.). Minimum brush length is 11.5 mm (0.45 in.).

   Install new brushes as shown in Figure 5. Install new brush holder to replace negative brushes.
10. Remove spring seat, springs, and washer for lever. Remove armature, clutch assembly, solenoid plunger, and lever. Remove lever from clutch assembly.
11. Use a small pipe or tube to slide retainer off snap ring. Remove snap ring and retainer from armature shaft. Remove clutch assembly from armature shaft.

ASSEMBLE AND INSTALL

1. Install clutch assembly on armature shaft. See Figure 4. Install retainer and snap ring to hold clutch assembly on armature shaft.
2. Install lever on clutch assembly. Install solenoid plunger on lever. Install armature, clutch assembly, solenoid plunger, and lever in drive housing. Install washer, springs, and spring seat for lever in drive housing.
3. Install field housing over armature. Carefully install brush holder assembly in field housing. Make sure assembly is in correct position. Make sure brush leads are free.
4. Lift brush springs and install all brushes. Install washers on armature shaft. See Figure 4.
5. Install end cover, two long bolts, and two screws that fasten end cover.
6. Install solenoid washers, spring, and solenoid on drive housing using screws. Connect strap from motor to motor terminal of solenoid. Install washer, lockwasher, and nut on motor terminal. Tighten nut.
7. Install starter on flywheel housing using two capscrews.
8. Install all electrical leads to correct solenoid terminals as marked on labels. Install plate that fastens to engine between fuel pump and starter.
9. Connect battery cable to negative battery terminal.

CLUTCH AND BEARING, CHECK

1. Check gear teeth. If teeth are worn or damaged, replace clutch assembly.
2. Check teeth of ring gear on flywheel. If teeth are worn or damaged, replace ring gear. See **Engine** section for correct procedure.
3. Check that clutch bearing rotates freely and smoothly. Bearing must not be loose.

Ignition System Check and Adjustment

ENGINE TIMING, ADJUST

WARNING

Make sure the timing light and your hands and arms stay clear of the fan blade area. The rotating blades of the fan can cause damage or injury.

Check that the distributor is adjusted for the correct timing. See Figure 12.

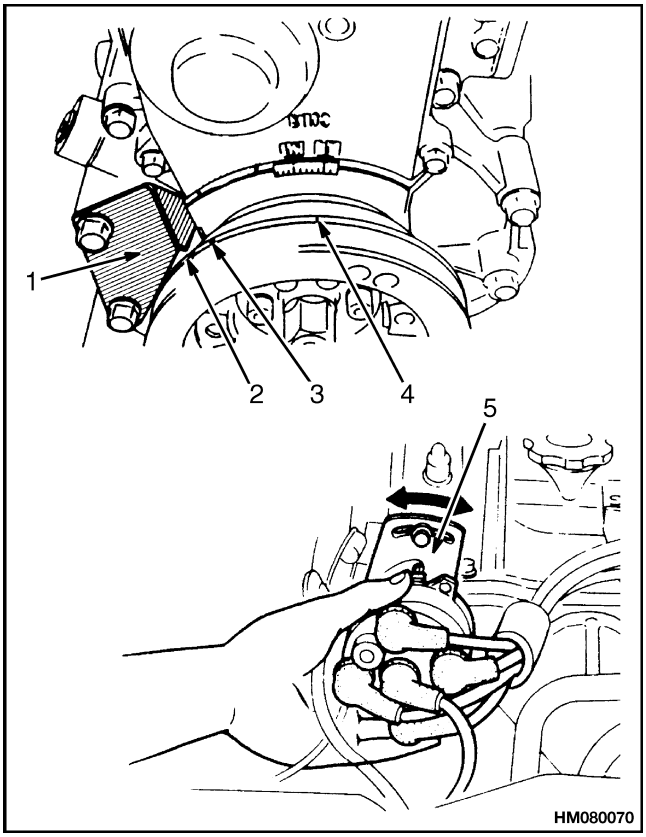


Figure 12. Ignition Timing

Legend for Figure 12

NOTE: S/H2.00-3.20XM (S/H40-65XM) IS SHOWN.

1. INDICATOR
2. WHITE TIMING MARK (0°/ TDC)
3. RED TIMING MARK (9° BTDC)
4. YELLOW TIMING MARK (NOT USED)
5. DISTRIBUTOR

1. Connect timing light to No. 1 spark plug wire. Disconnect vacuum hose that is connected to vacuum advance unit. Put plug in end of hose.
2. Operate engine at idle speed (725 rpm). Carefully hold timing light in position to illuminate indicator. Correct degree mark on pulley must be aligned with indicator on engine.

   The correct timing for the H1.50-1.75XM, H2.00XMS (S/H25-35XM, S/H40XMS) units is as follows:
   - **Gasoline Engine** = 0°/ TDC @ 725 ±25 rpm
   - **LPG Engine** = 8° BTDC @ 725 ±25 rpm

   The correct timing for the S/H2.00-3.20XM (SH40-65XM) units is as follows:
   - **Gasoline Engine** = 0°/ TDC @ 725 ±25 rpm
   - **LPG Engine** = 9° BTDC @ 725 ±25 rpm
3. If mark is not aligned, loosen clamp at base of distributor housing. Adjust position of distributor to align correct timing mark and indicator. Tighten clamp and check that timing is still correct.
4. Carefully remove timing light. Stop engine and disconnect timing light.
5. Unplug vacuum hose and connect hose to vacuum advance unit. Disconnect timing light from spark plug wire.

TABLE OF CONTENTS (Continued)

Graphing and Data Logging

Graphing the values and voltages can be a very useful tool in doing intermittent diagnosis. The system diagnostic monitoring software includes graphing and data logging capability. These features enhance the ability to diagnose and repair possible problems with the system. The graphing feature allows sensor inputs and select control output variables to be plotted in real-time while the engine is running. See Figure 3.

To plot a variable, you must first TAG the variable you wish to plot. To do this, use the mouse to highlight the variable, and then right click.

Next press the P key or double click the Plot/Log button to invoke the plotting feature. You may change the desired time interval for each display screen. The default is 10 seconds. This can be increased or decreased as necessary to display the desired results. You can also change the sample rate.

You are now ready to plot. Simply click the START button to observe the plotted variables. The plot sweeps across the screen from left to right. To pause the display screen press the SPACE BAR at any time during plotting. To continue plotting simply press the SPACE BAR again. To stop the plotting feature simply click the STOP button. To exit the plotting screen click the CLOSE button. The range of each variable is listed along the left side of the display and the time is listed along the bottom of the screen.

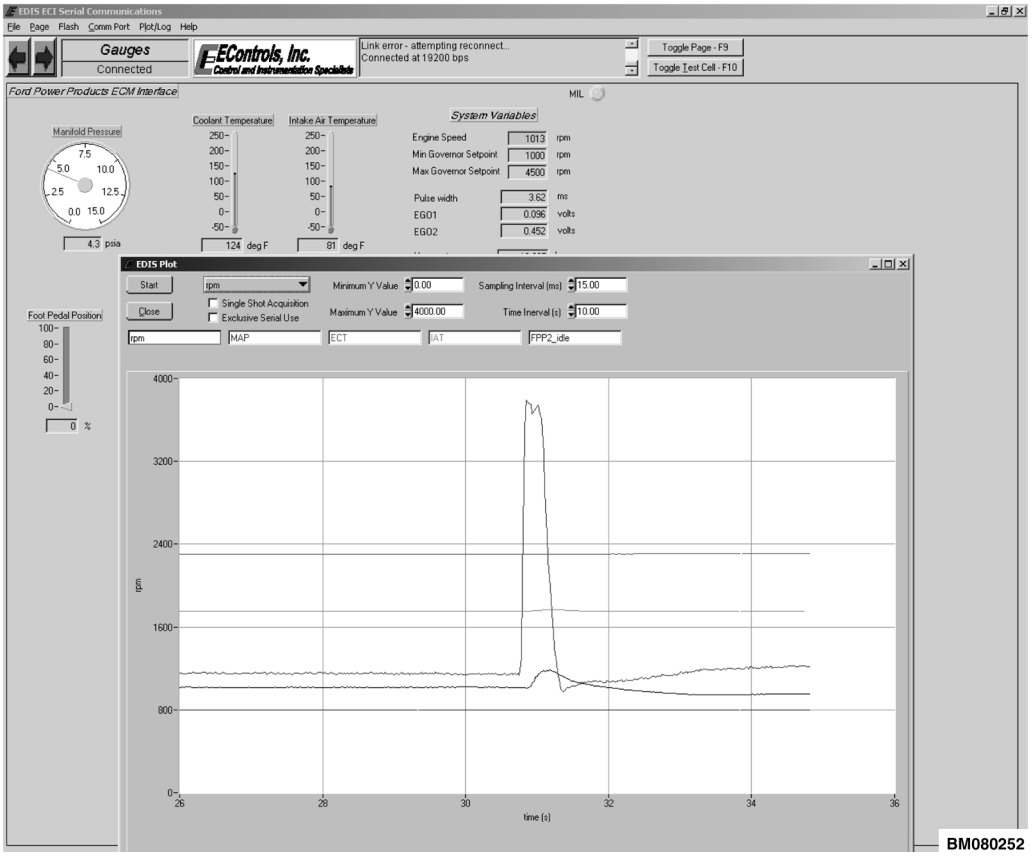
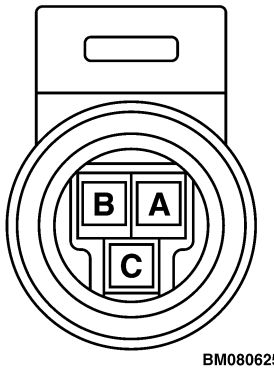


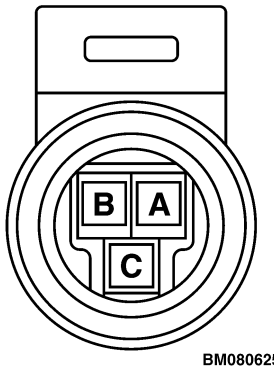
Figure 3. Graphing and Data Logging Screen

Table 11. Throttle Position Sensor Connector C009



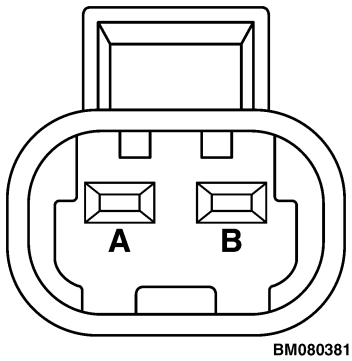
Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Purple/Light Blue	TPS 1

Table 12. Foot Pedal Position Connector C010



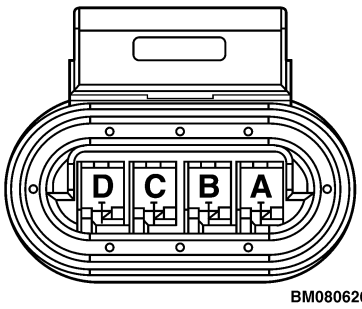
Pin	Wire Color	Function
A	Light Green/Red	5 Volt Reference
B	Black/Light Green	Analog Return
C	Dark Blue	Foot Pedal Position

Table 13. Governor Motor Connector C011



Pin	Wire Color	Function
A	Tan/Orange	DBW –
B	Pink/White	DBW +

Table 14. TMAP Connector C012



Pin	Wire Color	Function
A	Black/Light Green	Analog Return
B	Tan	IAT
C	Light Green/Red	5 Volt Reference
D	Light Green	MAP

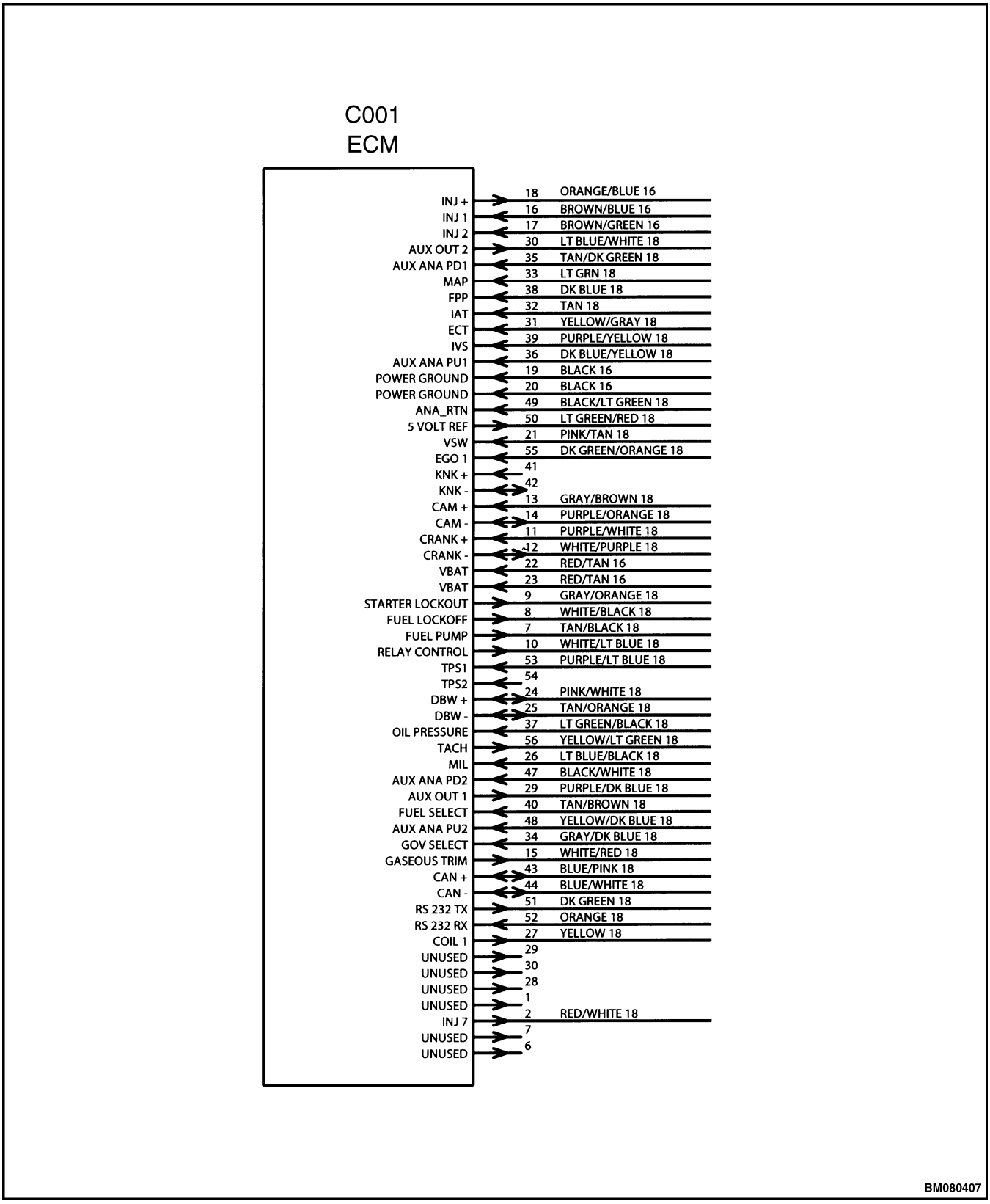


Figure 11. ECM Connector C001

Table 31. DTC 115 - Oil Pressure Low (Continued)

Step	Action	Value(s)	Yes	No
7	• Inspect ECM connector pin 37 for damage corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 9.	Go to step 8.
8	• Replace ECM. Is the replacement complete?		Go to step 9.	
9	• Remove all test equipment except the laptop computer. • Connect any disconnected components, fuses, etc. • Using the laptop computer, clear DTC information from the ECM. • Turn the ignition **OFF** and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature. • Observe the MIL. • Observe engine performance and driveability. • After operating the engine within the test parameters of DTC 115, check for any stored codes. Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

DTC 131 - MAP HIGH PRESSURE MOTOROLA® TMAP

Circuit Description

The TMAP is a combined inlet manifold temperature and pressure sensor connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, which also determines the fuel flow rate. See Figure 21.

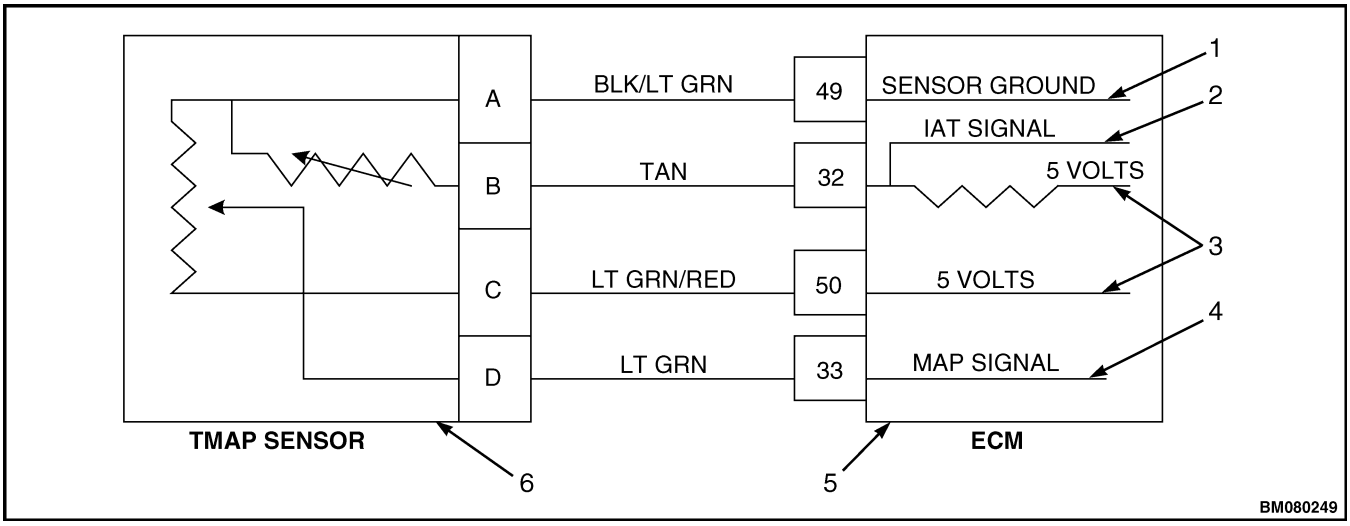
This fault will set when the MAP reading is higher than it should be for the given TPS, and RPM. When the fault is set, the Adaptive Learn will be disabled for the remainder of the key **ON** cycle and the MIL will be on. The engine will operate on a default MAP during this active fault.

Conditions for Setting the DTC

- Manifold absolute pressure.
- Check condition - engine speed is greater than 1800 rpm, TPS less than 10 percent, and steady MAP and TPS.
- Fault condition - MAP greater than 14 psia, TPS less than 10 percent, and engine speed is greater than 1800 rpm.
- MIL - on for active fault.
- Adaptive - disabled for remainder of key **ON** cycle.
- Miscellaneous - fueling is based on rpm and TPS limp-home condition during this fault.

Diagnostic Aids

If the engine is running rough, unstable, or missing due to a suspected mechanical problem, vacuum leak or other issue causing misfire, these problems must be taken care before using Table 37. Failure to follow this recommendation will result in a false MAP diagnostic and repair procedure.



1. SENSOR GROUND
2. INTAKE AIR TEMPERATURE (IAT) SIGNAL
3. 5 VOLTS
4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL
5. ELECTRONIC CONTROL MODULE (ECM)
6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

Figure 21. TMAP Sensor Circuit (Motorola® TMAP)

Table 40. DTC 135 - BP Low Pressure (Motorola® TMAP) (Continued)

Step	Action	Value(s)	Yes	No
10	• Check for continuity between TMAP sensor connector 5 volt reference pin C and engine ground. Do you have continuity?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 11.
11	• Inspect TMAP and ECM connector pins for corrosion, contamination or mechanical damage. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 16.
12	• Replace the ECM. Is the replacement complete?		Go to step 17.	
13	• Disconnect ECM connector C001. • Check for continuity between TMAP sensor connector pin D and ECM pin 33. Do you have continuity between them?		Go to step 14.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.
14	• Check for continuity between TMAP sensor connector pin D and engine ground. Do you have continuity?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 15.
15	• Inspect ECM connector and wire harness connector pins for corrosion, contamination or mechanical damage. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 18.	Go to step 16.
16	• Replace the ECM. Is the replacement complete?		Go to step 18.	

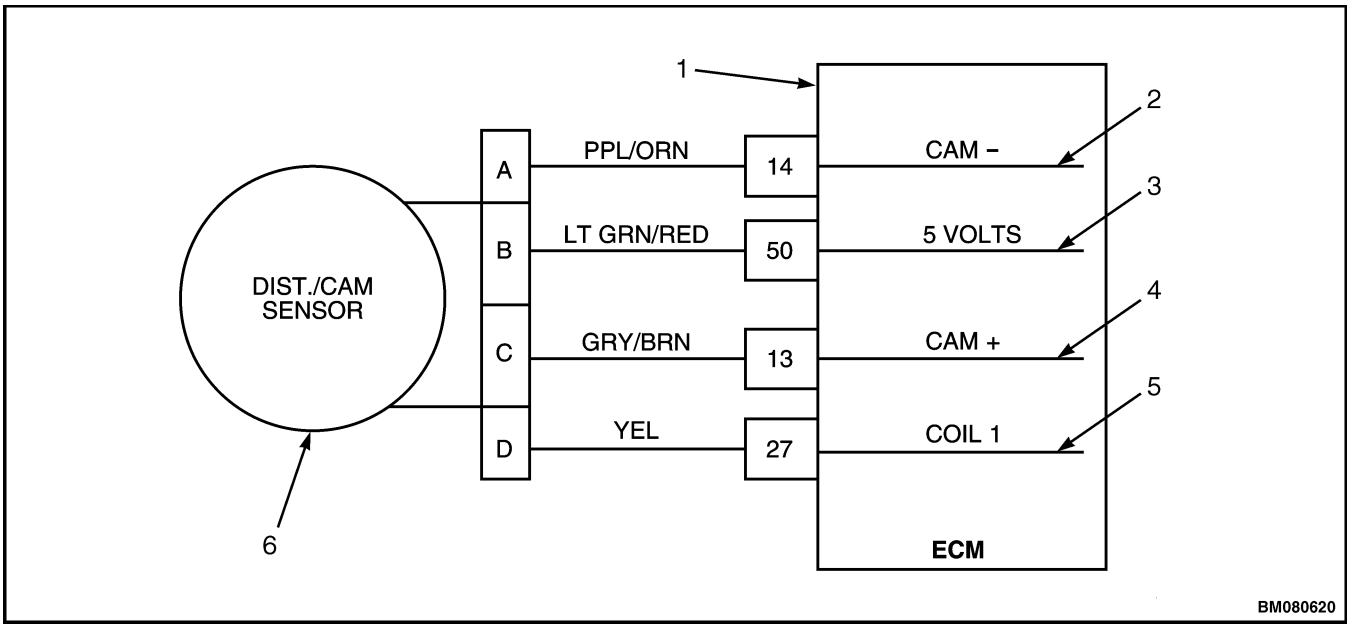
DTC 145 - CAMSHAFT SENSOR NOISE

Circuit Description

The camshaft position sensor (CKP) is used to synchronize the fuel and ignition systems. This fault will set if the ECM detects erroneous pulses from the camshaft position sensor (CKP) causing invalid cam re-sync. See Figure 28.

Conditions for Setting the DTC

- Camshaft position sensor.
- Check condition - engine cranking or running.
- Fault condition - one invalid cam re-sync for greater than 700ms.
- MIL - on for active fault and for 10 seconds after active fault.
- Adaptive - disabled for the remainder of the key **ON** cycle.



1. ELECTRONIC CONTROL MODULE
2. CAM –
3. 5 VOLTS
4. CAM +
5. COIL 1
6. DISTRIBUTOR/CAMSHAFT SENSOR

Figure 28. Camshaft Sensor Circuit

Table 44. DTC 145 - Camshaft Sensor Noise

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Check that the ECM ground terminals G1 and G2 are clean and tight. Are the ground terminals G1 and G2 clean and tight?		Go to step 3.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.

Table 47. DTC 221 - Closed Loop Multiplier High (Gasoline) (Continued)

Step	Action	Value(s)	Yes	No
6	• Replace HO_2S sensor. Is the replacement complete?		Go to step 7.	
7	• Remove all test equipment except the laptop computer. • Connect any disconnected components, fuses, etc. • Using the laptop computer, clear DTC information from the ECM. • Turn the ignition **OFF** and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature. • Observe the MIL. • Observe engine performance and driveability. • After operating the engine within the test parameters of DTC 221, check for any stored codes. Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

DTC 243 - ADAPTIVE LEARN HIGH (LPG)

Circuit Description

The heated oxygen sensor (HO_2S) is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the closed loop multiplier and adaptive multiplier. See Figure 36.

This fault will set if the adaptive multiplier exceeds the limits of normal operation.

Conditions for Setting the DTC

- Heated oxygen sensor.
- Check condition - engine running.
- Fault condition - adaptive multiplier out of range (greater than 30 percent).
- MIL - disabled.
- Adaptive - enabled.

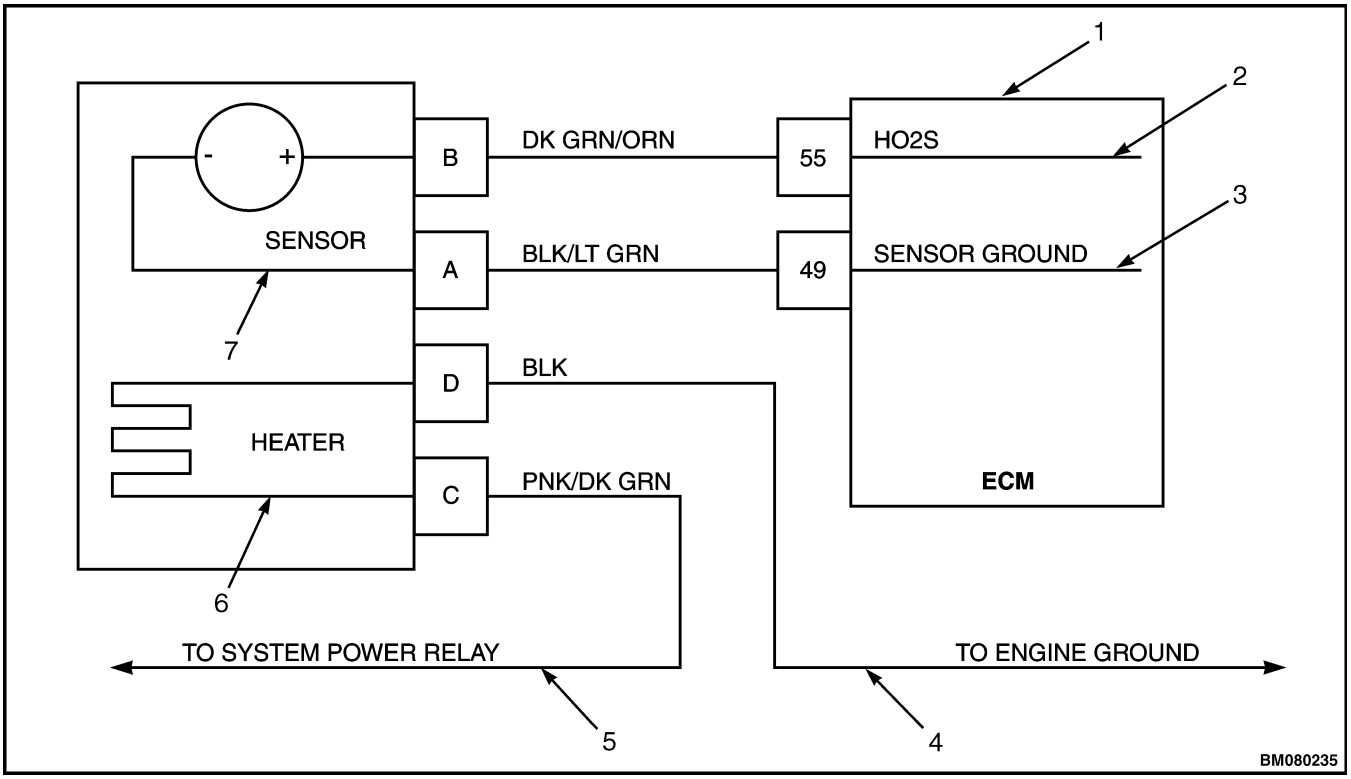
Diagnostic Aids

Always diagnose any other ECM codes that are present before beginning this diagnostic procedure.

Oxygen sensor wire - Heated Oxygen sensor wires may be misrouted and contacting the exhaust manifold.

Vacuum leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition, especially at light load.

Injectors - System will be lean if an injector driver or driver circuit fails open. The system will also be lean if an injector fails in a closed manner or is dirty.



1. ELECTRONIC CONTROL MODULE (ECM)
2. HEATED OXYGEN SENSOR (HO_2S)
3. SENSOR GROUND
4. TO ENGINE GROUND
5. TO SYSTEM POWER RELAY
6. HEATER
7. SENSOR

Figure 36. Heated Oxygen Sensor Circuit

Table 56. DTC 411 - Injector Driver 1 Open

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Key **ON** and engine running. • Laptop computer connected in system data mode. • Clear System DTC 411. Does DTC 411 reset with the engine idling?		Go to step 3.	Go to Preliminary and Intermittent Checks.
3	• Key **OFF**. • Disconnect the wire harness connector at the TBI injector. • Using a high impedance DVOM, measure the resistance between the 2 pins on the injector. Does the DVOM display a resistance value of 2.5 ohms or less?	2.5 ohms or less	Go to step 5.	Go to step 4.
4	• Replace the fuel injector. Is the replacement complete?		Go to step 12.	
5	• Measure the resistance between the injector driver BRN/LT BLU wire and battery ground. Does the DVOM display a resistance of 5.0 ohms or less?		Go to step 6.	Go to step 10.
6	• Disconnect ECM connector C001. • Measure the resistance between the injector driver wire BRN/LT BLU and battery ground. Does the DVOM display a resistance of 5.0 ohms or less?	5.0 ohms	Repair the shorted injector driver circuit as necessary. Refer to Wire Harness Repair. Go to step 12.	Go to step 10.
7	• Disconnect ECM wire harness connector C001. • Using a DVOM measure the resistance between the injector connector driver wire BRN/LT BLU and ECM connector pin 16. Does the DVOM display a resistance of 5.0 ohms or less between them?	5.0 ohms	Go to step 8.	Go to step 9.

DTC 514 - RTI 1 LOSS

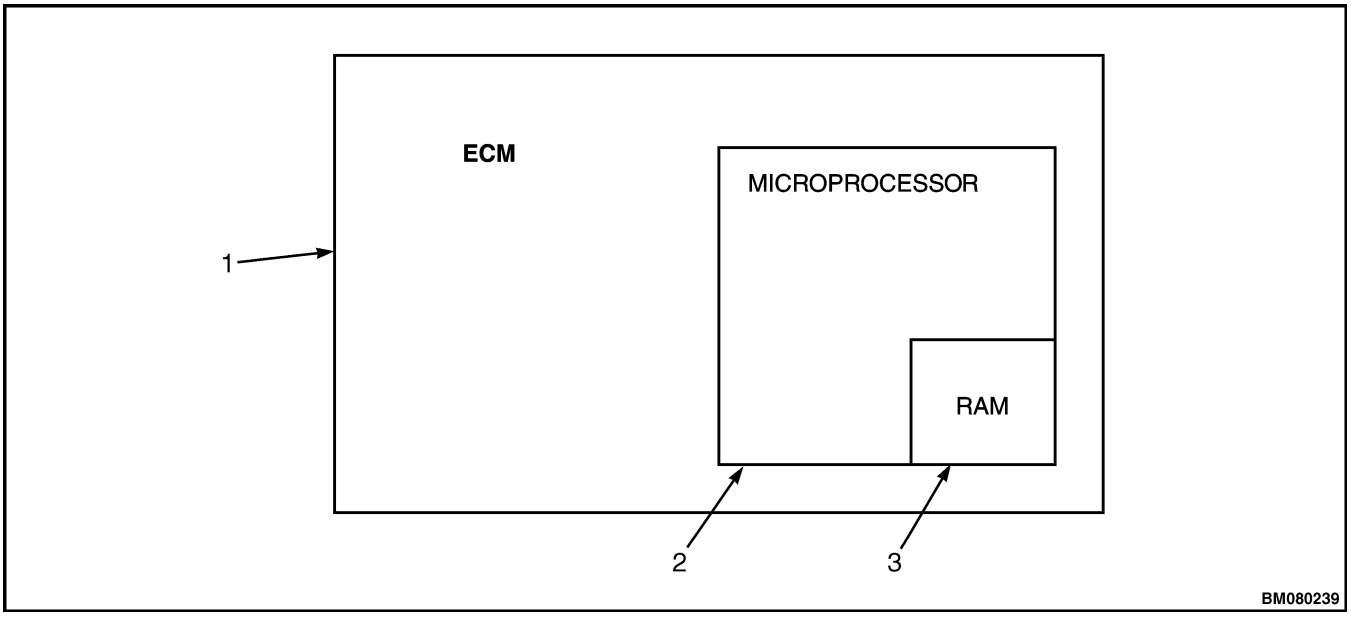
Circuit Description

The ECM runs checks that must be verified each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase. See Figure 45.

During this active fault, power derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20 percent. This is enforced until the fault is manually cleared.

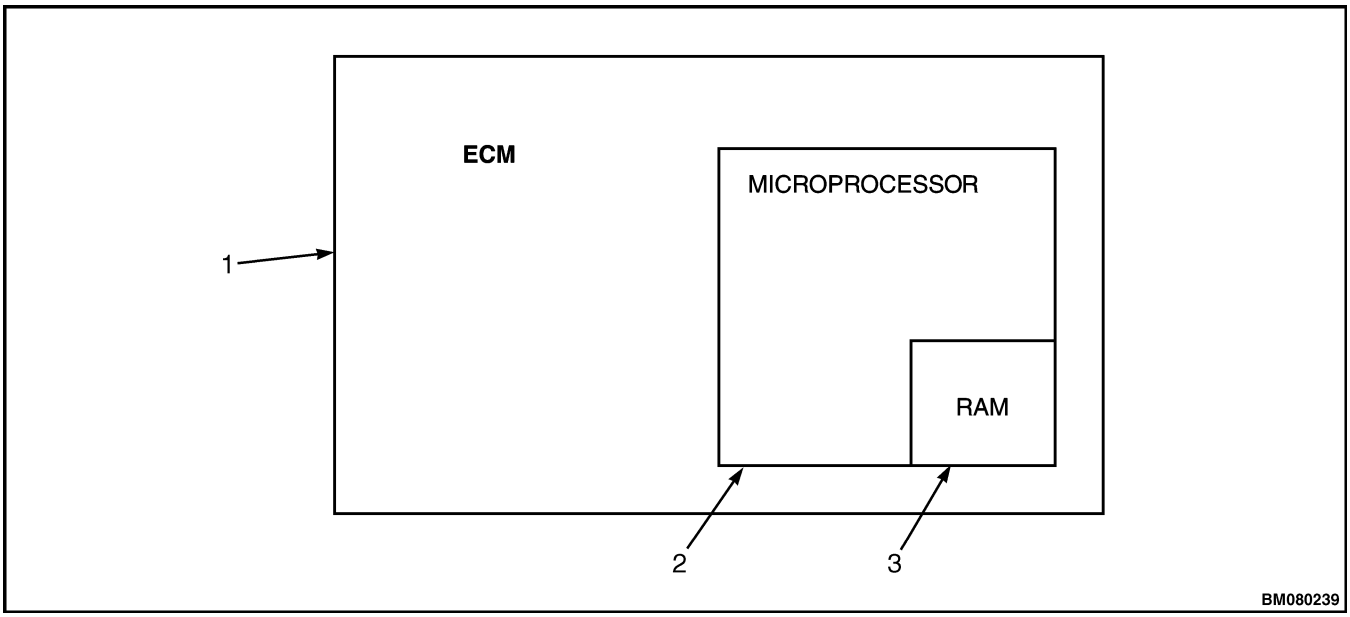
Conditions for Setting the DTC

- Electronic control module.
- Check condition - key **ON**.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Adaptive - disabled for the remainder of the key **ON** cycle.
- Closed loop - enabled.
- Power derate - level 2 until fault is cleared manually.



1. ELECTRONIC CONTROL MODULE (ECM)
2. MICROPROCESSOR
3. RAM

Figure 45. ECM Microprocessor



1. ELECTRONIC CONTROL MODULE (ECM)
2. MICROPROCESSOR
3. RAM

Figure 50. ECM Microprocessor

Table 66. DTC 555 - RTI 2 Loss

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Key **ON** and engine running. • Laptop computer connected in system data mode. • Clear system fault code Does DTC 555 reset with the engine idling?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	• Check all ECM power and ground circuits. Refer to GM 3.0L Wiring Schematics and Connectors. Are the power and ground circuits OK?		Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair.

DTC 631 - TPS1 SIGNAL VOLTAGE HIGH

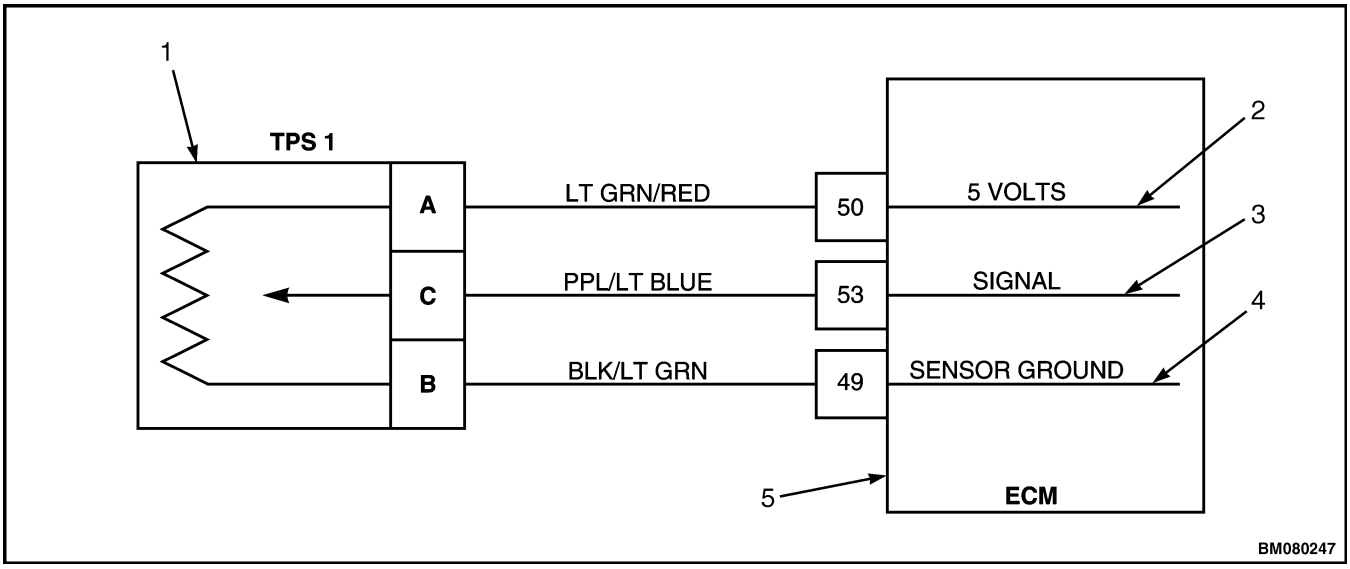
Circuit Description

The ECM uses a variable resistor to determine throttle plate position based on signal voltage, and is connected to the throttle shaft. Less opening results in higher voltage, and greater opening in lower voltage. The TPS value is used by the ECM to determine if the throttle is opening as commanded. See Figure 54.

This fault will set if voltage is above 4.8 volts for 0.3 seconds or longer while the engine is cranking or running. The MIL lamp will be on during the active fault and for 3 seconds after the active fault. Forced idle and low rev limit are enforced during this fault.

Conditions for Setting the DTC

- Throttle position sensor No. 1.
- Check condition - cranking or running.
- Fault condition - TPS sensor voltage exceeds 4.8 for 0.30 seconds or longer.
- MIL - on during active fault.
- Forced idle.
- Low rev limit.



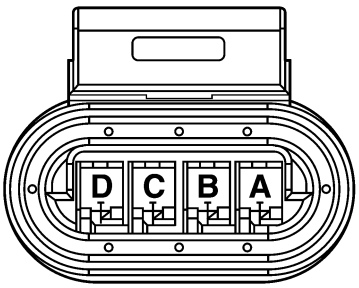
1. THROTTLE POSITION SENSOR (TPS) NO. 1
2. 5 VOLTS
3. SIGNAL
4. SENSOR GROUND
5. ELECTRONIC CONTROL MODULE (ECM)

Figure 54. TPS1 Circuit

Table 73. DTC 651 - Maximum Govern Speed Override (Continued)

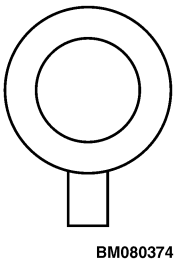
Step	Action	Value(s)	Yes	No
8	• Check engine for large manifold vacuum leaks. Did you find and correct the vacuum leak?		Go to step 9.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
9	• Remove all test equipment except the laptop computer. • Connect any disconnected components, fuses, etc. • Using the laptop computer, clear DTC information from the ECM. • Turn the ignition **OFF** and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature. • Observe the MIL. • Observe engine performance and driveability. • After operating the engine within the test parameters of DTC 651, check for any stored codes. Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

Table 89. Motorola TMAP Connector C013 (LPG Fuel System Only)



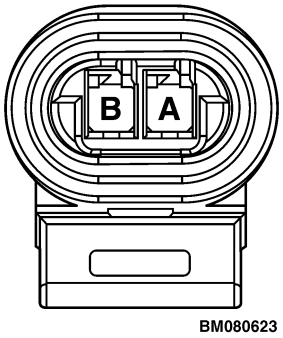
Pin	Wire Color	Function
A	Black/Light Green	Analog Return
B	Tan	IAT
C	Light Green/Red	5 Volt Reference
D	Light Green	MAP

Table 90. Starter Solenoid Connector C014



Pin	Wire Color	Function
A	White	Starter Relay

Table 91. ECT Connector C015



Pin	Wire Color	Function
A	Yellow/Gray	ECT
B	Black/Light Green	Analog Return

Table 92. Starter Relay C016

Pin	Wire Color	Function
87A	Light Blue/Pink	Start In (Interrupt Type)
87	Pink/Black	Start In (Autocrank)
86	Pink/Tan	VSW Fuse, F1
85	Grey/Orange	Starter Lockout
30	White	Starter Solenoid

Table 93. Power Relay C017

Pin	Wire Color	Function
87	Pink/Dark Green	Alternator Fuse, F3
86	Red/Tan	ECM VBAT
85	White/Blue	Relay Control
30	Red	Battery +

Table 94. Fuel Pump Relay C018

Pin	Wire Color	Function
87	Pink/Yellow	Fuel Pump
86	Pink/Tan	VSW Fuse, F1
85	Tan/Black	ECM, Fuel Pump
30	Red	Battery +

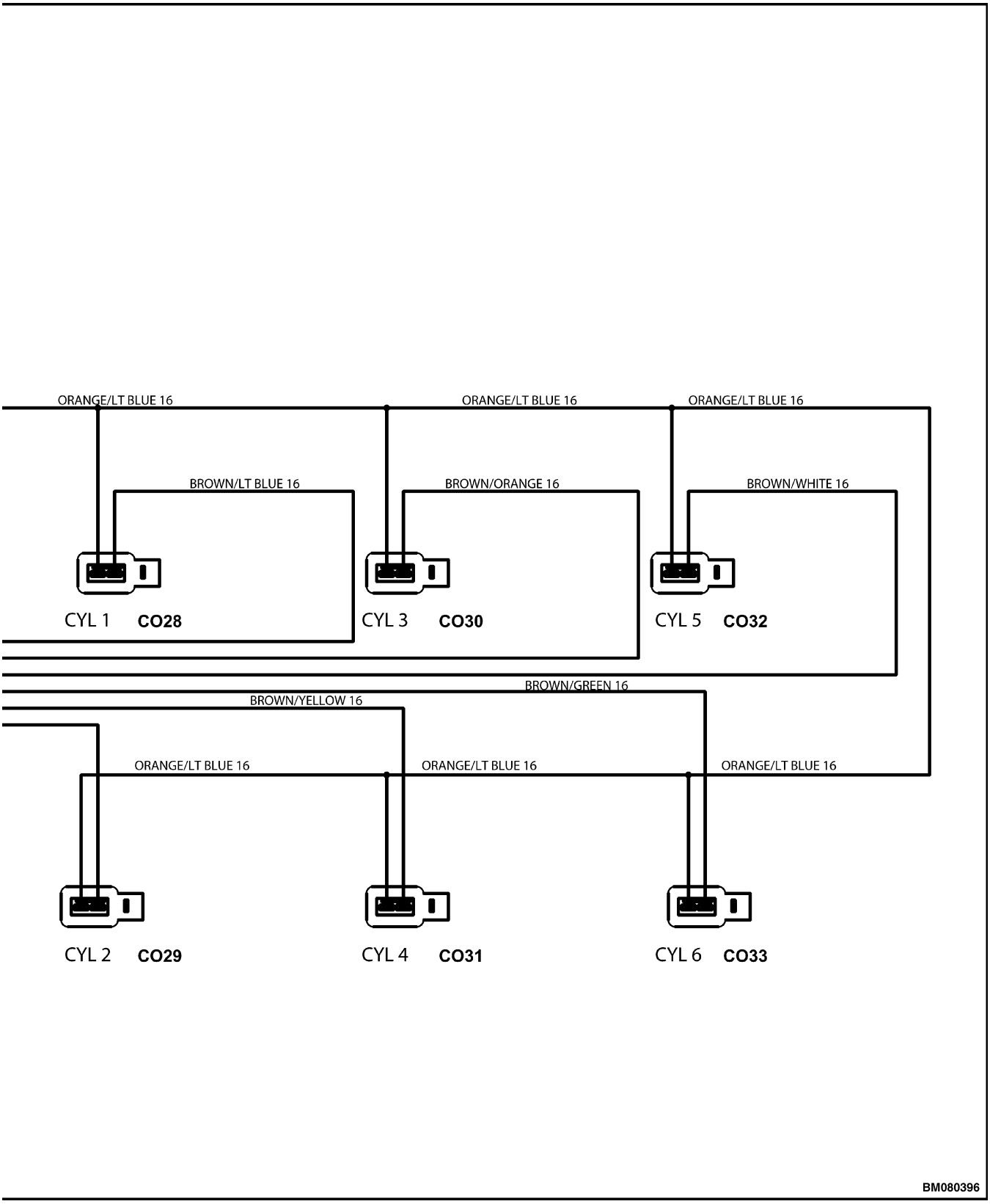


Figure 62. 4.3L Gasoline Jump Harness

Table 114. DTC 112 - IAT Low Voltage (Motorola® TMAP)

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Key **ON**. • Laptop computer connected in system data mode. Does laptop computer display IAT voltage of 0.05 or less?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	• Key **OFF**. • Disconnect the TMAP sensor wire harness connector. • Turn the key to the **ON** position. Does the laptop computer display IAT voltage of 4.9 volts or greater?		Go to step 4.	Go to step 5.
4	• Replace TMAP sensor. Is the replacement complete?		Go to step 9.	
5	• Key **OFF**. • Disconnect ECM wire harness connector. • Check for continuity between TMAP sensor connector ground pin A and TMAP sensor connector signal pin B. Do you have continuity between them?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 8.	Go to step 6.
6	• Check for continuity between TMAP sensor connector signal circuit pin B and engine ground. Do you have continuity?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 8.	Go to step 7.

Table 117. DTC 121 - ECT VOLTAGE HIGH (Continued)

Step	Action	Value(s)	Yes	No
8	• Using a jumper, connect the ECT signal pin A at the ECT connector to engine ground. Does laptop computer display ECT voltage of 0.05 or less?		Go to step 9.	Go to step 12.
9	• Key **OFF**. • Disconnect ECM wire harness connector. • Using a DVOM check for continuity between ECT sensor ground pin B and ECM connector pin 49. Do you have continuity between them?		Go to step 10.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 14.
10	• Inspect ECM connector pins 31 and 49 for damage, corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 14.	Go to step 11.
11	• Replace the ECM. Is the replacement complete?		Go to step 14.	
12	• Key **OFF**. • Disconnect ECM wire harness connector. • Using a DVOM, check for continuity between ECT connector signal pin A and ECM connector terminal 31. Do you have continuity between them?		Go to step 13.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 14.

DTC 131 - MAP HIGH PRESSURE MOTOROLA® TMAP

Circuit Description

The TMAP is a combined inlet manifold temperature and pressure sensor connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the airflow rate to the engine, which also determines the fuel flow rate. See Figure 78.

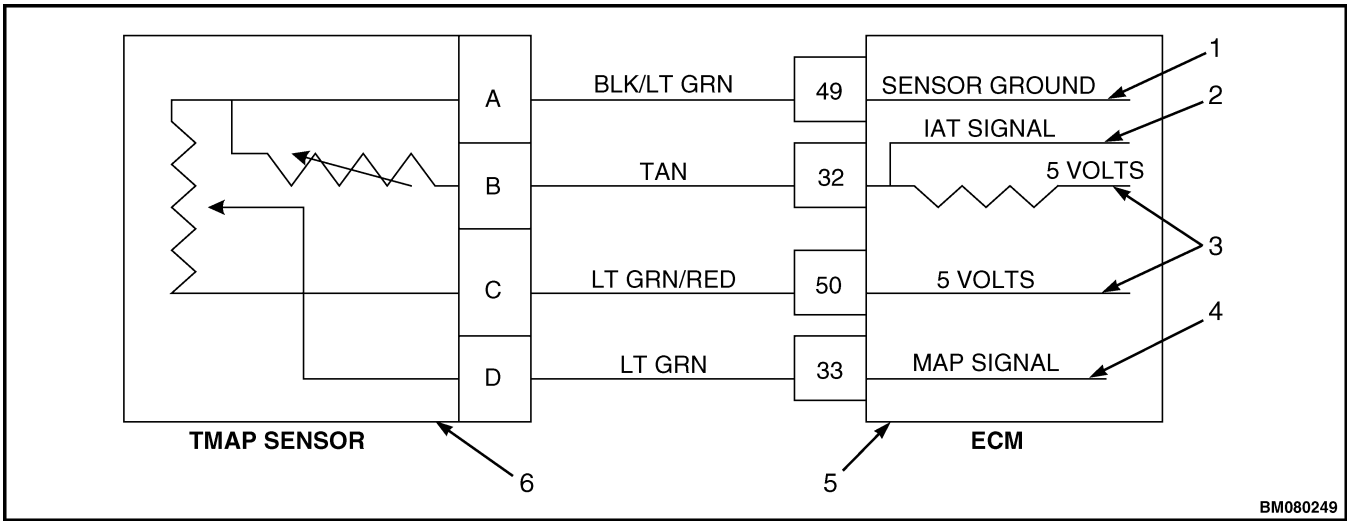
This fault will set when the MAP reading is higher than it should be for the given TPS, and RPM. When the fault is set, the Adaptive Learn will be disabled for the remainder of the key **ON** cycle and the MIL will be on. The engine will operate on a default MAP during this active fault. The fueling is then based on rpm and TPS limp-home condition.

Conditions for Setting the DTC

- Manifold absolute pressure.
- Check condition - engine speed is greater than 1800 rpm, throttle command less than 10 percent, and steady MAP and TPS.
- Fault condition - MAP greater than 14 psia, TPS less than 10 percent, and engine speed is greater than 1800 rpm.
- MIL - on for remainder of key **ON** cycle.
- Adaptive - disabled for remainder of key **ON** cycle.
- Miscellaneous - fueling is based on rpm and TPS limp-home condition during this fault.

Diagnostic Aids

If the engine is running rough, unstable, or missing due to a suspected mechanical problem, vacuum leak or other issue causing misfire, these problems must be taken care before using Table 122. Failure to follow this recommendation will result in a false MAP diagnostic and repair procedure.



1. SENSOR GROUND
2. INTAKE AIR TEMPERATURE (IAT) SIGNAL
3. 5 VOLTS
4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL
5. ELECTRONIC CONTROL MODULE (ECM)
6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

Figure 78. TMAP Sensor Circuit (Motorola® TMAP)

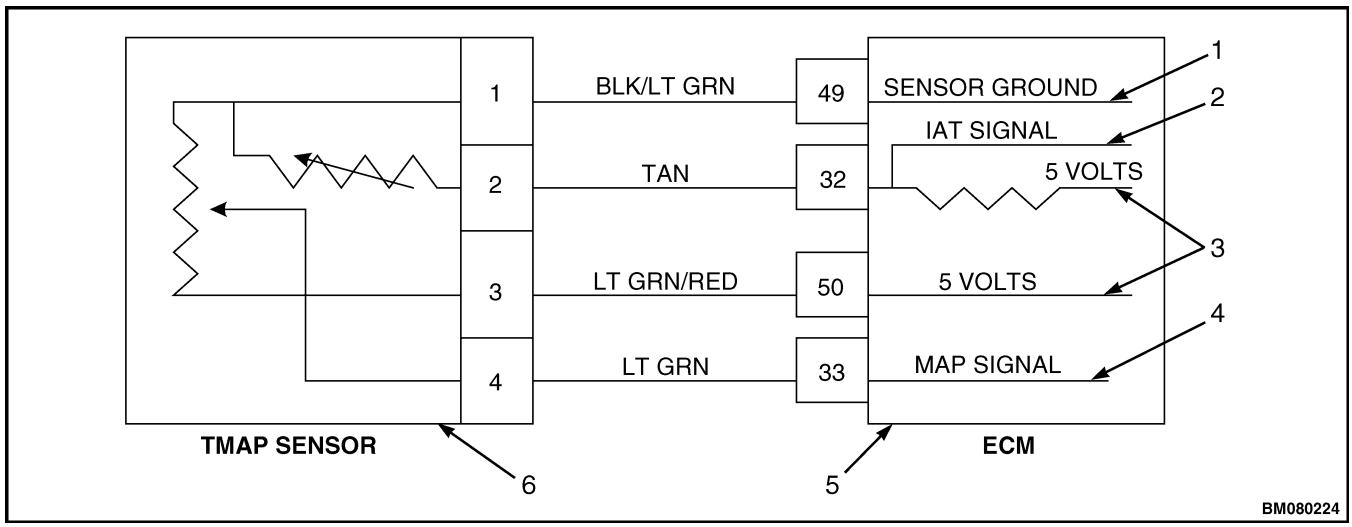
DTC 134 - BP HIGH PRESSURE BOSCH® TMAP

Circuit Description

The barometric pressure (BP) is estimated from the TMAP sensor. The barometric pressure value is used for fuel and airflow calculations. This fault will set if the BP pressure exceeds 16 psia for 1 second. MIL will be on and remain on for 2 seconds after the active fault. See Figure 81.

Conditions for Setting the DTC

- Barometric pressure.
- Check condition - key **ON**.
- Fault condition - BP greater than 16 psia.
- MIL - on for active fault and for 2 seconds after active fault.
- Adaptive - disabled for remainder of key **ON** cycle.
- Closed loop - enabled.



1. SENSOR GROUND
2. INTAKE AIR TEMPERATURE (IAT) SIGNAL
3. 5 VOLTS
4. MANIFOLD ABSOLUTE PRESSURE (MAP) SIGNAL
5. ELECTRONIC CONTROL MODULE (ECM)
6. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP) SENSOR

Figure 81. TMAP Sensor Circuit (Bosch® TMAP)

Table 128. DTC 135 - BP Low Pressure (Motorola® TMAP) (Continued)

Step	Action	Value(s)	Yes	No
17	• Replace TMAP sensor. Is the replacement complete?		Go to step 18.	
18	• Remove all test equipment except the laptop computer. • Connect any disconnected components, fuses, etc. • Using the laptop computer, clear DTC information from the ECM. • Turn the ignition **OFF** and wait 30 seconds. • Start the engine and operate the vehicle to full operating temperature. • Observe the MIL. • Observe engine performance and driveability. • After operating the engine within the test parameters of DTC 135 check for any stored codes. Does the engine operate normally with no stored codes?		System OK.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

DTC 142 - CRANK SYNC NOISE

Circuit Description

The crankshaft position sensor (CKP) is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The crankshaft position sensor (CKP) is used to measure engine rpm and its signal is used to synchronize the ignition and fuel systems. The ECM must see a valid crankshaft position signal while running. If no signal is present for 800 ms or longer, this fault will set. See Figure 85.

Conditions for setting the DTC

- Crankshaft position sensor.
- Check condition - engine running.
- Fault condition - 1 invalid crank re-sync.
- MIL - on during active fault and for 10 seconds after active fault.
- Adaptive - disabled for the remainder of the key **ON** cycle.

Table 132. DTC 145 - Camshaft Sensor Noise (Continued)

Step	Action	Value(s)	Yes	No
3	• Key **ON** and engine **OFF**. • Disconnect the CMP sensor connector C011. • Using a DVOM, check for voltage at the CMP sensor connector pin C and engine ground. Do you have voltage?	5.0 volts	Go to step 4.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
4	• Key **OFF**. • Disconnect ECM connector C001. • Using a DVOM, check for continuity between CMP connector pin A and ECM connector pin 14. Do you have continuity between them?		Go to step 5.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
5	• Using a DVOM, check for continuity between CMP connector pin B and ECM connector pin 13. Do you have continuity between them?		Go to step 6.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.
6	• Inspect the CMP connector C011 terminals for damage, corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 7.
7	• Inspect the ECM connector C001 terminals 13, 14, and 50 for damage, corrosion or contamination. Did you find a problem?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 11.	Go to step 8.
8	• Replace CMP sensor. Pay special attention to CMP sensor reluctor wheel inspection. Is the replacement complete?		Go to step 10.	
9	• Replace the ECM. Is the replacement complete?		Go to step 11.	

DTC 222 - CLOSED LOOP MULTIPLIER LOW (GASOLINE)

Circuit Description

The heated oxygen sensor (HO_2S) sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The ECM uses this information to correct the fuel flow with the closed loop multiplier and the adaptive multiplier. See Figure 92.

This fault sets if the closed loop multiplier exceeds the limits of normal operation. When the multiplier cannot correctly modify the fuel flow within its limits, it is limited at -35 percent.

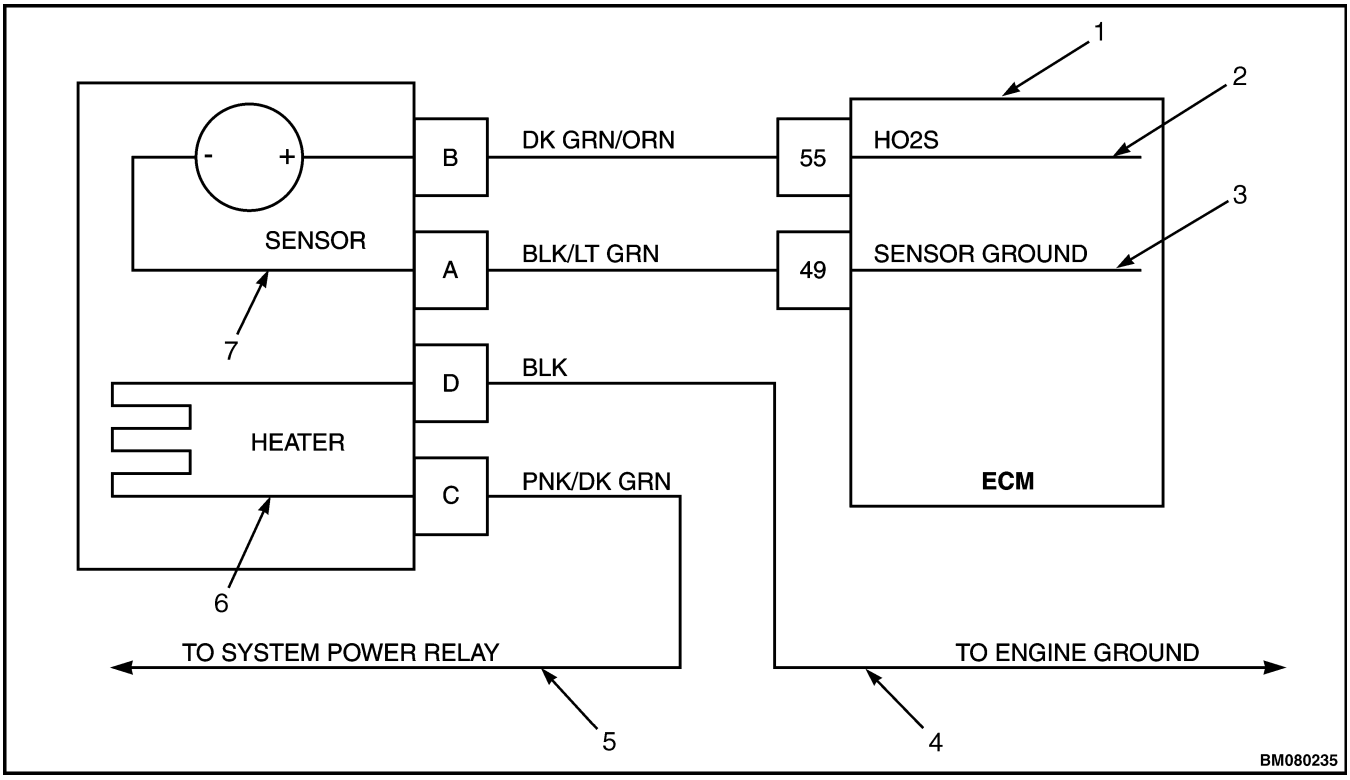
Conditions for Setting the DTC

- Heated oxygen sensor.
- Functional fault - closed loop multiplier out of range (at limit of -35%).
- MIL - on during active fault and for one update after active fault.
- Adaptive - enabled.
- Closed loop - enabled.

Diagnostic Aids

Always diagnose any other ECM codes that are present before beginning this diagnostic procedure.

Fuel system - the system will be rich if an injector fails in an open manner. High fuel pressure due to a faulty fuel regulator or obstructed fuel return line will cause the system to run rich.



1. ELECTRONIC CONTROL MODULE (ECM)
2. HEATED OXYGEN SENSOR (HO_2S)
3. SENSOR GROUND
4. TO ENGINE GROUND
5. TO SYSTEM POWER RELAY
6. HEATER
7. SENSOR

Figure 92. Heated Oxygen Sensor Circuit

Vacuum leaks - Large vacuum leaks and crankcase leaks can cause a lean exhaust condition, especially at light load.

Injectors - System will be lean if an injector driver or driver circuit fails open. The system will also be lean if an injector fails in a closed manner or is dirty.

Fuel pressure - Low fuel pressure, faulty fuel injector or damaged fuel pump assembly can cause fuel system to run lean

Exhaust leaks - if there is an exhaust leak, outside air can be pulled into the exhaust and past the 0_2 sensor causing a false lean condition.

Fuel quality - Contaminated or spoiled fuel can cause the fuel system to be lean.

Ground problem - ECM grounds must be good battery or engine ground.

Table 140. DTC 243 - Adaptive Learn High (LPG)

Step	Action	Value(s)	Yes	No
1	• Perform the On-board (OBD) system check. Are any other DTCs present?		Go to step 3.	Go to step 2.
2	Visually and physically check the following items: • The air intake duct for being collapsed or restricted. • The air filter for being plugged. • The HO_2S sensor installed securely and the wire leads not contacting the exhaust manifold or ignition wires. • ECM grounds for being clean and tight. Refer to GM 4.3L Wiring Schematics and Connectors. • Fuel system diagnostics. Refer to the section **Electronic Controlled LPG/Gasoline Fuel System**, **GM 3.0L and 4.3L EPA Compliant Engines** 900 SRM 1088. Was a repair made?		Go to step 7.	Go to step 4.
3	• Diagnose any other DTC codes before proceeding with this chart. Have any other DTC codes been detected, diagnosed and repaired?		Go to step 7.	Go to step 4.
4	• Key **ON** and engine running. • Using a DVOM, back probe the HO_2S sensor connector heater circuit pin C for positive and D for negative. Check for voltage. Do you have voltage?	Battery voltage	Go to step 5.	Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 7.

DTC 512 - INVALID INTERRUPT

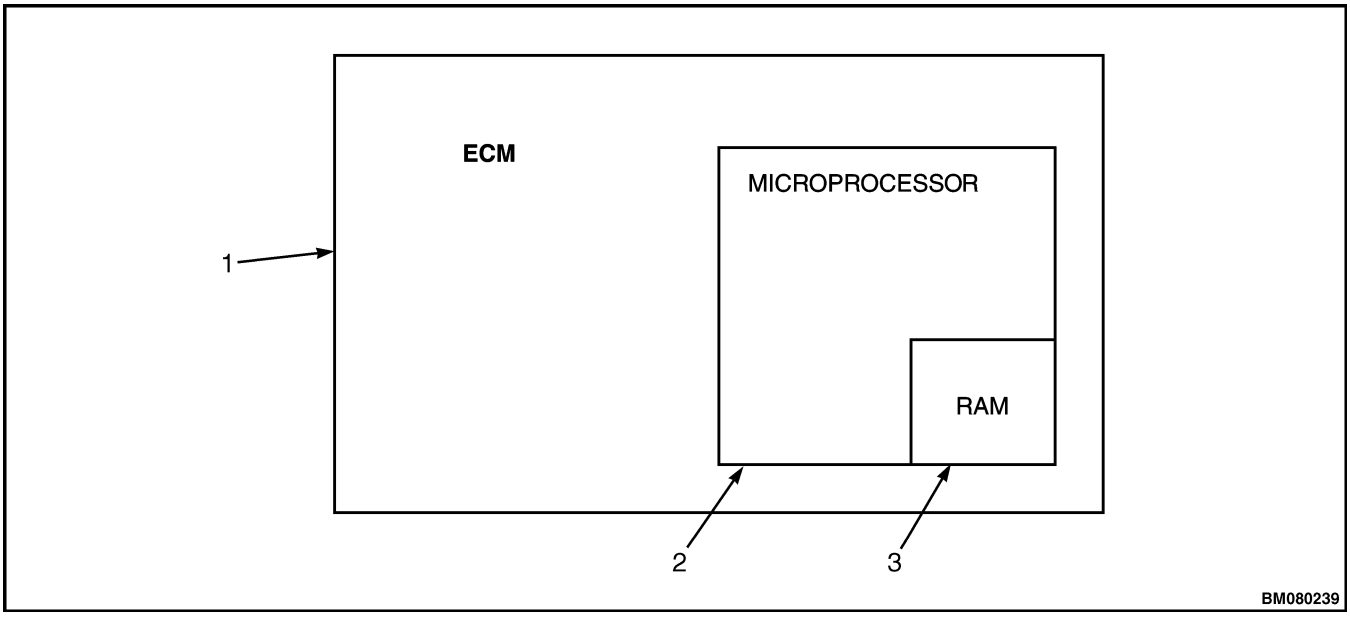
Circuit Description

The ECM has checks that must be verified each time an instruction is executed. Several different things can happen within the microprocessor that will cause this fault. The ECM will reset itself in the event this fault is set, and the MIL will be on until the code is cleared. This fault should be erased after diagnosis by removing battery power. It will not self-erase. See Figure 101.

During this active fault, power derate (level 2) will be enforced. When this is enforced, maximum throttle position will be 20 percent. This is enforced until the fault is manually cleared.

Conditions for Setting the DTC

- Electronic control module.
- Check condition - key **ON**.
- Fault condition - internal microprocessor error.
- MIL - on until code is cleared by technician.
- Adaptive - disabled for the remainder of the key **ON** cycle.
- Closed loop - enabled.
- Power derate - level 2 until fault is cleared manually.



1. ELECTRONIC CONTROL MODULE (ECM)
2. MICROPROCESSOR
3. RAM

Figure 101. ECM Microprocessor

Table 150. DTC 531 - External 5V Ref Lower Than Expected

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Key **ON** and engine running. • Laptop computer connected in system data mode. Does laptop computer display DTC 531?		Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	• Key **OFF**. • Disconnect ECM connector. • Using DVOM, check for continuity between ECM 5-volt reference LT GRN/ Red pin 50 and engine ground. Do you have continuity?		Go to step 5.	Go to step 4.
4	• Replace the ECM. Is the replacement complete?		Go to step 7.	
5	While monitoring the DVOM for continuity between ECM 5-volt reference and engine ground, disconnect each sensor (below) one at a time to find the shorted 5-volt reference. When continuity to ground is lost, the last sensor disconnected is the area of suspicion. Inspect 5-volt reference supply wire leads for shorts before replacing the sensor. • IAT • ECT/CHT • TMAP • FPP • TPS 1 • TPS 2 • Crankshaft Sensor • Camshaft Sensor While disconnecting each sensor one at a time, did you loose continuity?		Go to step 6.	

DTC 612 - FPP LOW VOLTAGE

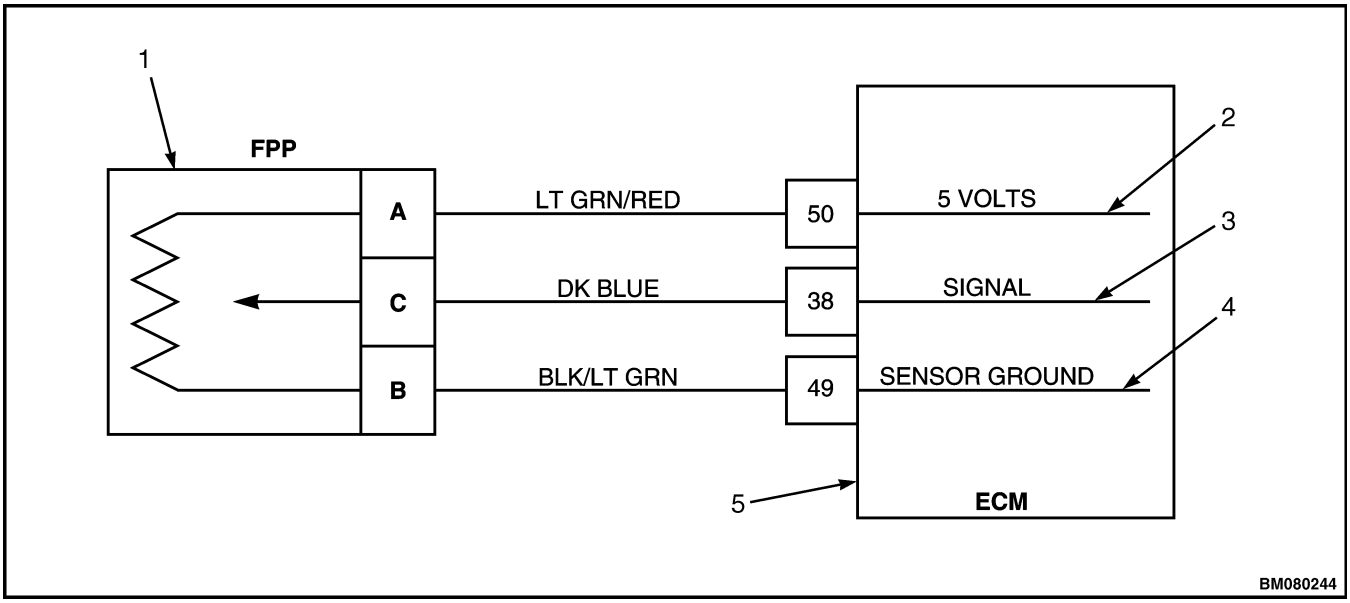
Circuit Description

The foot pedal position (FPP) sensor uses a variable resistor to determine signal voltage based on pedal position. Less depression of pedal results in lower voltage, and greater depression results in higher voltage.

This fault will set if voltage is less than 0.2 volts for greater than 0.30 seconds with engine cranking or running. Forced idle and low rev limit will be enforced during this fault. When these are enforced, maximum engine speed is 1500 rpm. The low rev limit is enforced for the remainder of the key **ON** cylce. See Figure 111.

Conditions for Setting the DTC

- Foot pedal position.
- Check condition - engine cranking or cranking.
- Fault condition - FPP sensor voltage less than 0.2.
- MIL - on during active fault.
- Adaptive - enabled.
- Forced idle enforced.
- Low rev limit enforced.



1. FOOT PEDAL POSITION (FPP) SENSOR
2. 5 VOLTS
3. SIGNAL
4. SENSOR GROUND
5. ELECTRONIC CONTROL MODULE (ECM)

Figure 111. Foot Pedal Position (FPP) Sensor Circuit

Table 155. DTC 612 - FPP Low Voltage

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL

- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: www.heydownloads.com by clicking the link below

- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL

Diagnostic Aids

It is possible that a faulty TPS may set this code without setting a TPS high or TPS low code. This is possible if the TPS fails in between the high/low limits for the TPS diagnostic.

Table 158. DTC 638 - Throttle Unable To Close

Step	Action	Value(s)	Yes	No
1	Did you perform the On-board diagnostics (OBD) system check?		Go to step 2.	Go to On-Board Diagnostics System Check/ Malfunction Indicator Lamp.
2	• Key **ON** and engine **OFF**. • Laptop computer connected in drive by wire (DBW) test mode. • Depress foot pedal until the throttle command is between 78 to 83 percent on the fault screen of the laptop computer. Is the TPS 1 voltage greater than 2.0 volts?	Greater than 2.0 volts.	Go to step 3.	Intermittent problem. Go to Preliminary and Intermittent Checks.
3	• Key **OFF**. • Disconnect the TPS connector. • Key **ON**. Does laptop computer display TPS1 voltage less than 0.2 volts?	Less than 0.2 volts.	Go to step 6.	Go to step 4.
4	• Key **OFF**. • Disconnect ECM connector C001. • Key **ON**. • Using a DVOM, check for voltage between ECM pin 53 and engine ground. Do you have voltage?		Repair the circuit as necessary. Refer to Wire Harness Repair. Go to step 12.	Go to step 5.
5	• Replace the ECM. Is the replacement complete?		Go to step 12.	
6	• Key **OFF**. • Probe TPS1 ground circuit at harness ECM connector pin 49 with test light connected to battery voltage. Does the test light come on?		Go to step 8.	Go to step 7.

CONNECTORS AND TERMINALS

CAUTION

Use care when probing a connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. NEVER probe through the Weather-Pack seals.

Be careful when using a probe to check the voltages on the terminals in a connector. It is easy to cause a short circuit between two terminals with opposite voltages. Electronic components can be easily damaged by a short circuit. Always use a **Jumper With A 15 Amp Fuse** between connectors when checking circuits. Never damage the insulation or a seal on a connector when making a check or doing troubleshooting. The **Connector Test Adapter Kit** has a variation of adapters and connectors that can be used when troubleshooting a circuit.

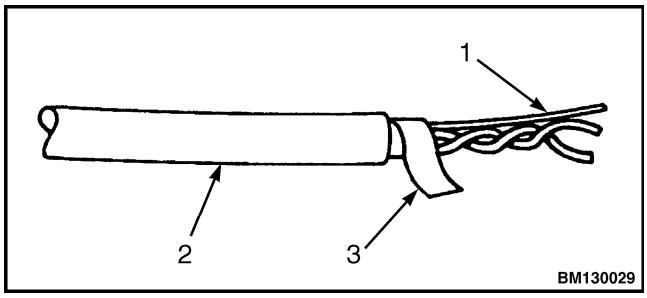
When Troubleshooting, open circuits are often difficult to see because of dirt, corrosion, or a terminal that is not in alignment in its socket. When Troubleshooting for an open circuit, always check for loose connections and a terminal that can have corrosion. A fault that is not regular nor constant can also be caused by a loose connection or a terminal that has corrosion.

Always verify the type of connector to be repaired. Some smaller models of connectors look similar but have a different construction.

Twisted/Shielded Cable Repair

STEP 1.
Remove outer jacket.

STEP 2.
Unwrap aluminum mylar tape. Do not remove mylar tape.



1. DRAIN WIRE
2. OUTER JACKET
3. MYLAR

STEP 3.
Untwist conductors and strip insulation as necessary.

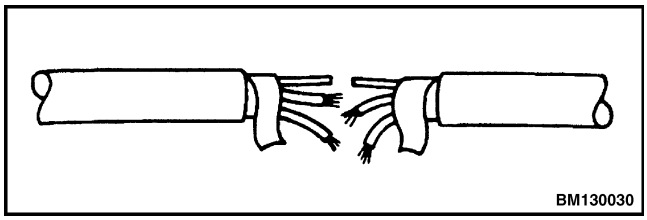
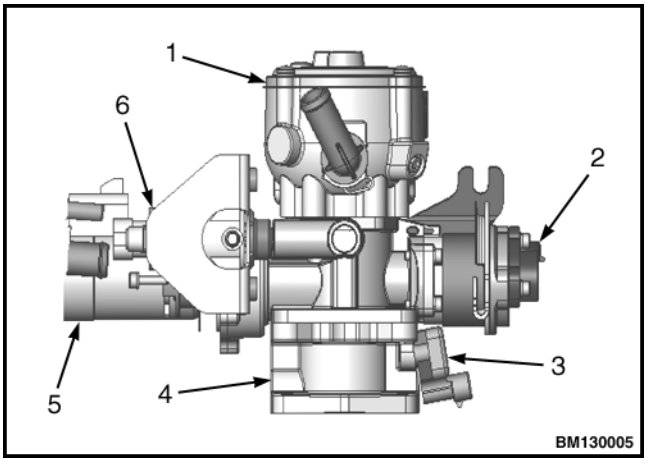


TABLE OF CONTENTS (Continued)

When the engine begins to crank, it draws in air with the air valve covering the inlet, and negative pressure begins to build. This negative pressure signal is communicated to the top of the air valve chamber through four vacuum ports in the air valve assembly. A pressure/force imbalance begins to build across the air valve diaphragm between the air valve vacuum chamber and the atmospheric pressure below the diaphragm. The air valve vacuum spring is calibrated to generate from 101.6 mm (4 in.) of water column at start to as high as 355.6 mm (14 in.) of water column at full throttle. The vacuum being created is referred to as air valve vacuum (AVV). As the AVV reaches 101.6 mm (4 in.) of water column, the air valve begins to lift against the air valve spring. The amount of AVV generated is a direct result of the throttle position. At low engine speed, the AVV is low and the air valve position is low, thus creating a small venturi for the fuel to flow. As the engine speed increases, the AVV increases and the air valve is lifted higher, thus creating a much larger venturi. This AVV is communicated from the mixer venturi to the LPR secondary chamber via the low pressure fuel supply hose. As the AVV increases in the secondary chamber, the secondary diaphragm is drawn further down, forcing the secondary valve lever to open wider.



1. MIXER
2. FOOT PEDAL POSITION (FPP) SENSOR
3. TEMPERATURE MANIFOLD ABSOLUTE PRESSURE (TMAP)
4. ADAPTER TO MANIFOLD
5. GOVERNOR MOTOR
6. FUEL TRIM VALVE (FTV)

Figure 5. Air/Fuel Mixer

The mixer is equipped with a low speed mixture adjustment, which is retained in a tamper-proof housing. The mixer has been preset at the factory and should not require any adjustment. In the event that the idle adjustment should need to be adjusted, refer to the LPG Fuel System Repair section of this manual.

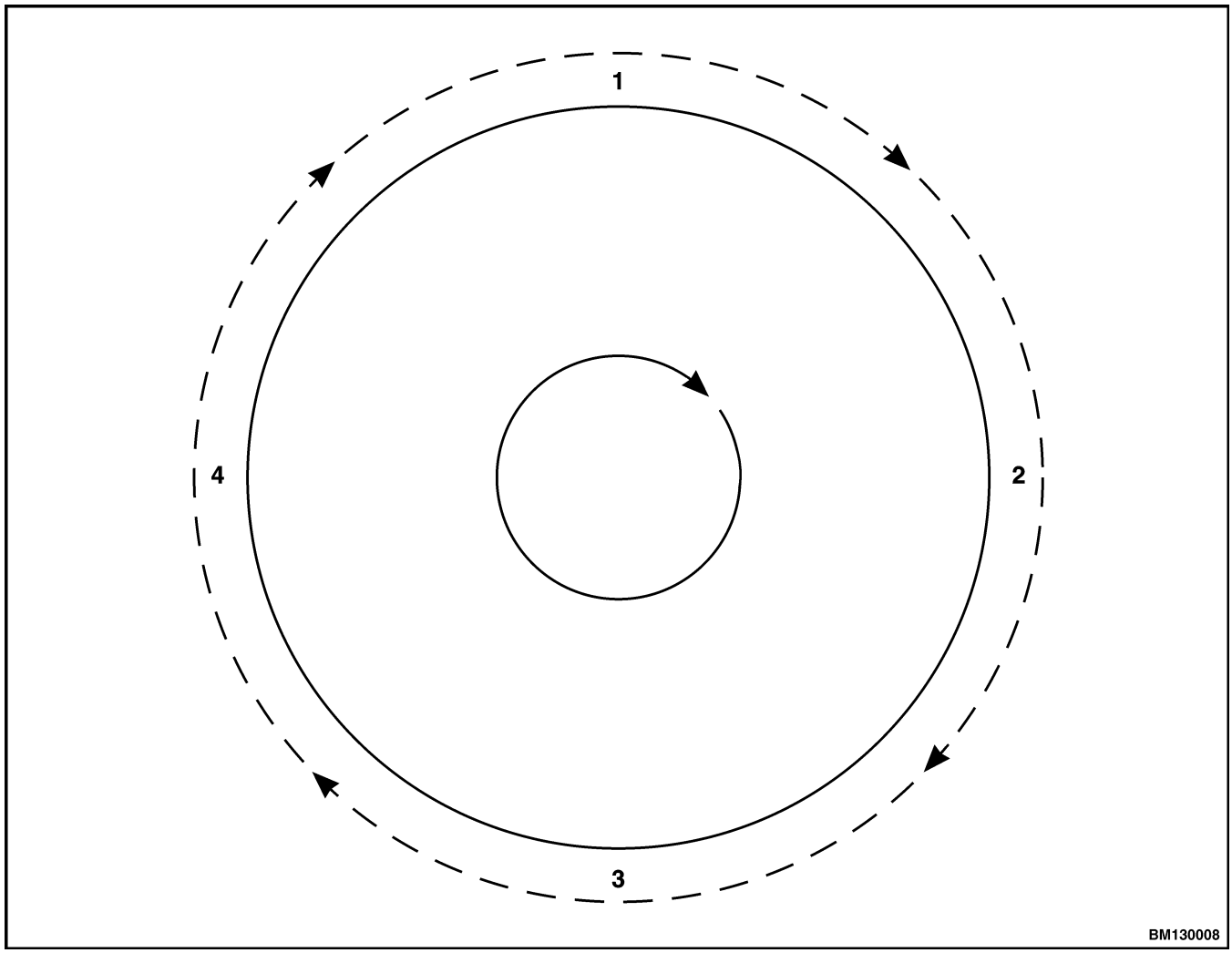
THROTTLE CONTROL DEVICE

Drive By Cable

Engine speed control is maintained by the amount of pressure applied to a foot pedal located in the operator's compartment. A cable is utilized to connect the foot pedal to the throttle shaft in the engine compartment. A coil spring mounted to the pedal and the throttle shaft will keep the throttle shaft in a normally closed position. When the foot pedal is depressed, the throttle shaft is rotated, opening the butterfly in the venturi of the throttle body allowing more air and fuel to enter the engine. When the ECM detects that the engine has reached maximum governed speed or requires adjustment for load, the ECM will correct the blade position by overriding the throttle shaft with the electronic governor.

The air fuel mixer is attached to the throttle control device or throttle body assembly, which is then connected to the intake manifold of the engine. See Figure 6. The throttle body maintains control of engine speed by increasing or decreasing the opening angle of the throttle blade in the throttle body bore, thus increasing or decreasing the fuel air mixture to the engine. The throttle blade shaft is connected to a spring-loaded cable connector which is connected to the foot pedal in the operator's compartment. The shaft incorporates a return spring to insure the blade position returns to idle when the operator removes his foot from the pedal. Also attached to the throttle shaft is a TPS, which provides a signal to the ECM to indicate the throttle blade angle for speed control and load control as well as emission control.

Also mounted to the throttle control device is an integrated electronic governor. The throttle control is maintained by a foot pedal located in the operator's compartment and connected to the throttle control device by a cable. The governor is controlled by the ECM and has no external adjustments. When the



1. ENGINE
2. INPUT HEGO SENSOR TO ECM
3. ECM CALCULATES THE CHANGE AND COMMANDS INJECTOR SIGNAL TO INCREASE OR DECREASE
4. OUTPUT INJECTOR PULSE INCREASES OR DECREASES FUEL DELIVERY TO THE ENGINE

Figure 18. Gasoline Closed Loop Control Schematic

HEATED EXHAUST GAS OXYGEN (HEGO) SENSOR

CAUTION

The HEGO sensor is an emissions control component. If the HEGO sensor fails to operate, replace only with a HYSTER approved part. The HEGO sensor is sensitive to silicone and silicone-based products and can become contaminated. Avoid using silicone sealers or hoses treated with silicone lubricant in the air stream or fuel supply lines.

The HEGO sensor is mounted in the exhaust system downstream of the engine. See Figure 19. The HEGO sensor is used to measure the amount of oxygen present in the exhaust stream and communicates that to the ECM via an electrical signal. The amount of oxygen present in the exhaust stream indicates whether the fuel air ratio is too rich or too lean. If the HEGO sensor signal indicates that the exhaust stream is too rich, the ECM will decrease or lean the fuel mixture by reducing the signals to the injectors during engine operation. If the mixture is too lean, the ECM will richen the mixture or increase the

4. Start engine and check for leaks.

FTV HOSE REPLACEMENT

Remove

1. Using a small screwdriver, push locking clips back on FTV connection at FTV and LPR.
2. Remove the hose and discard.

Install

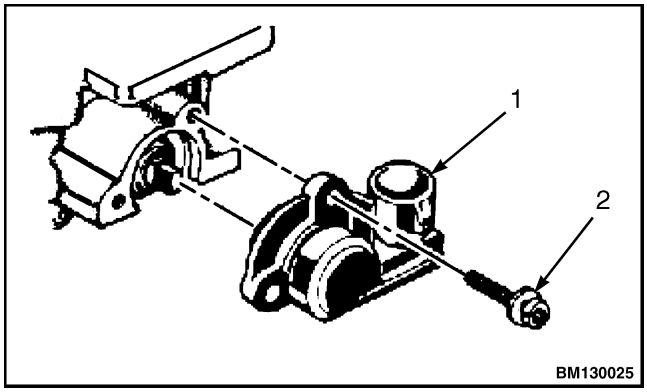
CAUTION

FTV hoses are specifically designed. DO NOT use any hose material. Only use HYSTER approved parts.

1. Install hose at the FTV and LPR and push locks in place.
2. Start engine and check for leaks.

THROTTLE POSITION SENSOR (TPS) REPLACEMENT

Refer to Figure 24 and Table 1 for the replacement procedures of the TPS.

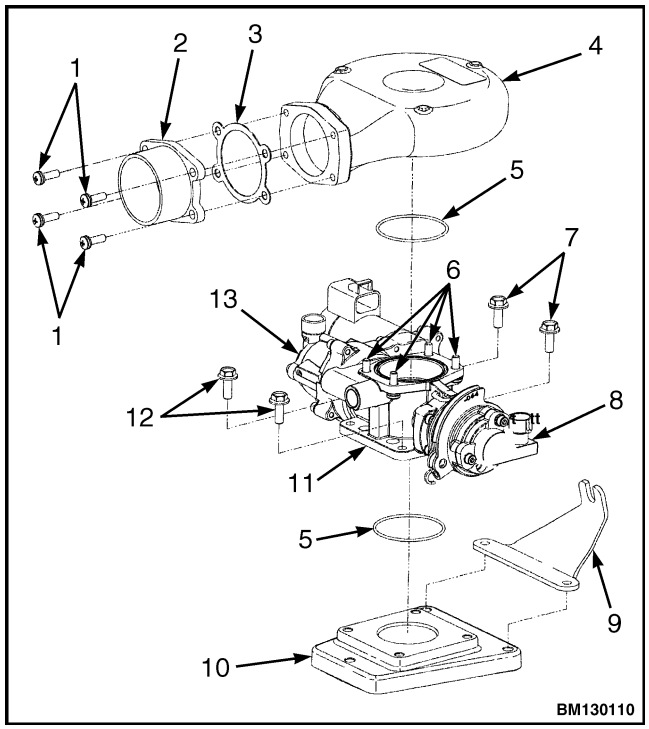


1. TPS 2. SCREW

Figure 24. Throttle Position Sensor (TPS)

Table 1. TPS Replacement Procedure

Step	Action	Value(s)	Yes	No
1	Were you instructed to replace the TPS from a DTC.		Go to step 2.	Go to On-Board Diagnostics System Check in the section **Electronic Control Module (ECM) Diagnostic Troubleshooting, GM 3.0L and 4.3L EPA Compliant Engines** 2200 SRM 1090.
2	• Key **OFF**. • Disconnect the negative battery cable and the throttle body governor motor connector. Are they disconnected?		Go to step 3.	



1. SCREWS
2. AIR INTAKE HOSE ADAPTER
3. GASKET
4. BONNET
5. O-RING
6. SCREWS
7. CAPSCREW
8. FOOT PEDAL POSITION (FPP) SENSOR
9. THROTTLE CABLE BRACKET
10. THROTTLE BODY TO MANIFOLD ADAPTER
11. THROTTLE BODY
12. CAPSCREWS
13. THROTTLE POSITION SENSOR (TPS)

Figure 28. Throttle Body Assembly, 4.3L Only

1. Disconnect the negative battery cable.

2. Remove the air intake duct.

3. Disconnect the FPP and TPS electrical connections.

4. Disconnect the governor motor electrical connection.

5. Disconnect the throttle cable.

6. From the bottom of the throttle body assembly, remove the four bonnet screws and remove the bonnet.

7. Remove the O-ring and discard.

8. Remove the four throttle body assembly to manifold bolts from the throttle body assembly and remove the throttle body assembly.

NOTE: Cover throttle body adapter opening to prevent debris from entering engine until assembly.

9. Remove the throttle body O-ring and discard.

Install

See Figure 28 for the following steps:

NOTE: Lightly lubricate both the O-rings of the throttle control device to TBI assembly.

1. Install the O-ring into the throttle body assembly.

2. Install the bonnet to the throttle body assembly and secure with the four screws and torque to 9 N•m (80 lbf in).

3. Secure the throttle body assembly to the manifold adapter with the four bolts and torque to 12 N•m (106 lbf in).

4. Connect the FPP and TPS electrical connections.

5. Connect governor motor electrical connector.

6. Connect the throttle cable.

7. Connect the air inlet duct.

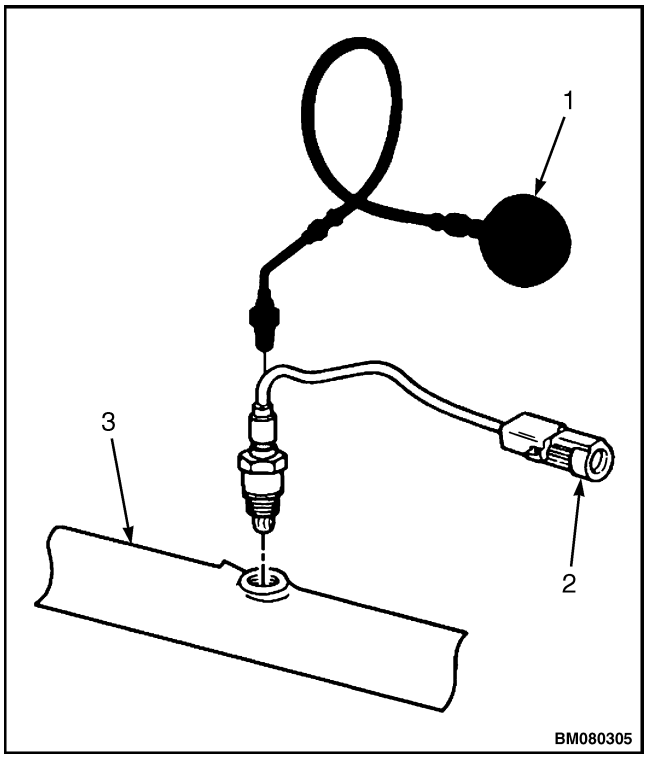
8. Connect the negative battery cable.

9. Start engine.

10. Connect the laptop computer and check for DTC codes or MIL lights. See the section **Electronic Control Module (ECM) Diagnostic Troubleshooting**, **GM 3.0L and 4.3L EPA Compliant Engines** 2200 SRM 1090.

6. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.

7. If there are no obvious reasons for the excessive back pressure, the catalytic converter is suspected to be restricted and should be replaced using current recommended procedures.



1. BACK PRESSURE GAUGE
2. OXYGEN SENSOR (O_2S)
3. EXHAUST MANIFOLD

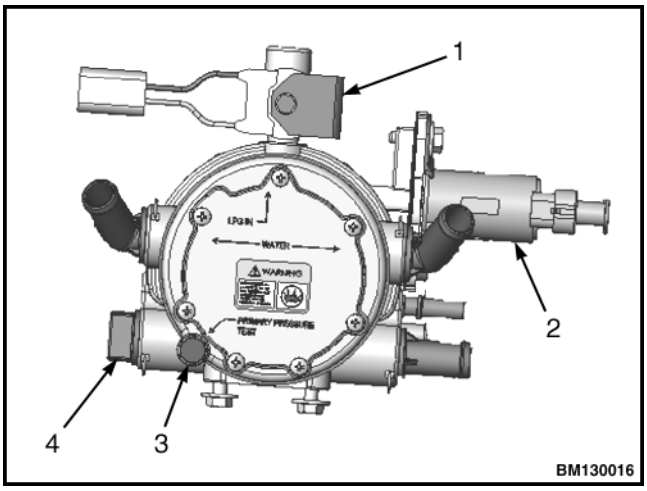
Figure 32. Exhaust Back Pressure Gauge

LPG System Diagnosis

FUEL SYSTEM DESCRIPTION

The ECM receives information from various engine sensors in order to control the operation of the FTV and the LPL solenoid. The LPL solenoids prevent fuel flow unless the engine is cranking or running. LPG is stored in the tank and delivered under pressure to the system as a liquid. During key **ON**, the LPL receives a 2-second prime pulse from the ECM which allows LPG to flow from the tank through fuel filter and fuel lines to the LPR at pressures up to 21.5 kPa (312 psi). See Figure 33.

In the LPR, the fuel is vaporized and the pressure is reduced in two stages. The first stage reduces the pressure to approximately 13.8 to 27.6 kPa (2 to 4 psi). The second stage reduces the pressure to approximately negative 38.1 mm (1.5 in.) of water column (WC).



1. LPL
2. PRESSURE TRIM VALVE
3. PRIMARY TEST PORT
4. SECONDARY TEST PORT

Figure 33. Low Pressure Regulator Assembly

- Step 26: A leaking injector can best be determined by checking for a fouled or saturated spark plug(s). If a leaking injector cannot be determined by a fouled or saturated plug, the following procedure should be used:
  1. Remove the throttle body housing leaving the fuel lines connected.
  2. Lift the throttle body enough to see the injector nozzle.

WARNING

To reduce the risk of fire or personal injury that may result from fuel spray on the engine, make sure fuel rail is positioned over injector port and injector retaining clips are intact.

3. Pressurize the fuel system and observe injector nozzle.

Table 7. Gasoline Fuel System Diagnosis, 3.0L Only

Step	Action	Value(s)	Yes	No
1	Were you referred to this procedure by a DTC diagnostic chart?	– –	Go to Step 3	Go to Step 2
2	Perform the on-board diagnostic (OBD) system check. Are any DTCs present in the ECM?	– –	Go to the applicable DTC table.	Go to Step 3
3	Verify that the gasoline fuel tank has a minimum of 1/4 tank of fuel. Does the vehicle have fuel?	– –	Go to Step 4	Add Fuel.
4	**1.** Connect a fuel pressure gauge at the fuel supply line. **2.** Turn ignition **ON**, fuel pump will run. **3.** Note the pressure. **4.** Turn ignition **OFF**, pressure may vary slightly then hold steady. Is pressure within specified values?	69 to 96 kPa (10 to 14 psi)	Go to Step 5	Go to Step 10
5	Did the fuel pressure hold steady after the pump stopped?	– –	Go to Step 6	Go to Step 22
6	**1.** Start engine and allow it to warm to normal operating temperature at idle. **2.** Fuel pressure noted in step 4 should drop. Did the pressure drop by the specified value?	21 to 69 kPa (3 to 10 psi)	Go to Step 27	Go to Step 7
7	**1.** Disconnect the vacuum hose from the pressure regulator. **2.** With the engine idling, apply 305 to 356 mm (12 to 14 in.) of vacuum to the pressure regulator, pressure should drop. Did the pressure drop by the specified value?	21 to 69 kPa (3 to 10 psi)	Go to Step 8	Go to Step 9
8	Locate and repair loss of vacuum to the pressure regulator. Is the action complete?		Go to Step 27	

Table 12. Hard Start

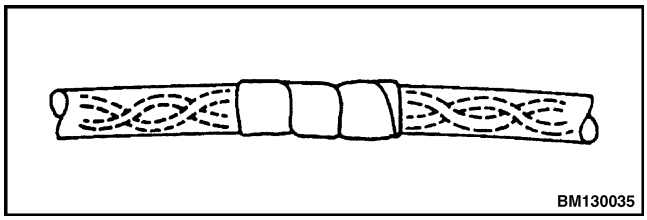
Checks	Action
Definition: The engine cranks, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Refer to Table 9. • Make sure the operator is using the correct starting procedure.
Sensor Checks	• Check the engine coolant temperature sensor with the laptop computer. Compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to DTC 122 and DTC 123 in the section **Electronic Control Module (ECM) Diagnostic Troubleshooting**, **GM 3.0L and 4.3L EPA Compliant Engines** 2200 SRM 1090. • Check the crankshaft position (CKP) sensor. • Check the TPS and FPP sensors.
Fuel System Checks	**NOTE:** A closed LPG manual fuel shutoff valve will create an extended crank or no start condition. • Verify the excess flow valve in the LPG manual shutoff valve is not tripped. • Check mixer module assembly for proper installation and leakage. • Verify proper operation of the low pressure lock-off solenoids. • Verify proper operation of the PTV and FTV. • Check for air intake system leakage between the mixer and the throttle body. • Check the fuel system pressures. Refer to LPG System Diagnosis.
Ignition System Checks	**NOTE:** LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. • Check for the proper ignition voltage output. • Verify that the spark plugs are correct. Refer to the **Parts Manual** for your lift truck. • Check the spark plugs for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for bare or shorted ignition wires. • Check for moisture in the distributor cap if applicable. • Check for loose ignition coil connections. **1.** If the engine starts but then immediately stalls, check CKP. **2.** Check for improper gap, debris or faulty connections.

Table 22. No Start

Checks	Action
Definition: The engine cranks but does not start.	
Preliminary Checks	Refer to Table 20.
ECM Checks	• If a laptop computer is available: – Check for proper communication with the ECM • Check the 20 Amp in-line fuse in the ECM battery power circuit. Refer to the **Diagrams** section for your lift truck. • Check battery power, ignition power and ground circuits to the ECM. Refer to the **Diagrams** section for your lift truck. Verify voltage and/or continuity for each circuit.
Sensor Checks	• Check the TMAP sensor. • Check the CKP sensor.
Fuel System Checks	• Check for fuel pump electrical circuit. • Verify proper fuel pump pressure. • Verify proper fuel rail pressure. • Refer to the Gasoline System Diagnosis. • Check electrical connections at the injectors.
Ignition System Checks	• Check for the proper ignition voltage output. • Verify that the spark plugs are correct. Refer to the **Parts Manual** for your lift truck. • Check the spark plugs for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for bare or shorted ignition wires. • Check for loose ignition coil connections at the coil.
Engine Mechanical Checks	• Check for the following: – Vacuum leaks – Improper valve timing – Low compression – Bent push rods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes
Exhaust System Checks	• Check the exhaust system for a possible restriction: – Inspect the exhaust system for damaged or collapsed pipes. – Inspect the muffler for signs of heat distress or for possible internal failure. • Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis.

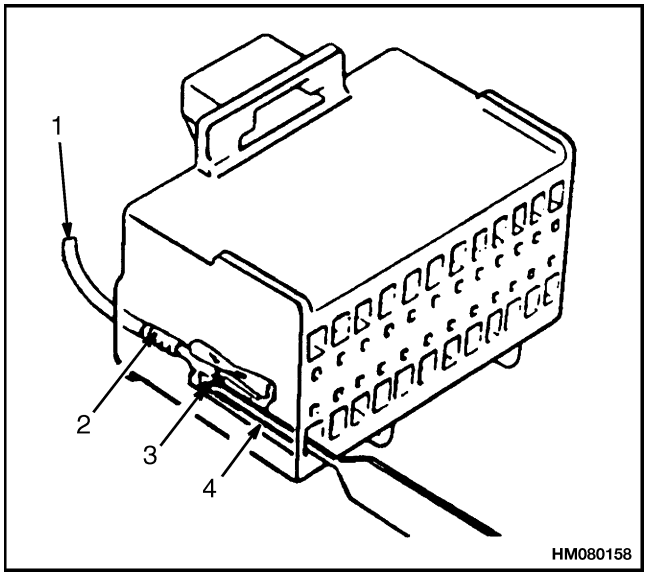
STEP 3.
Cover splice with tape to insulate from other wires.

STEP 4.
Twist and tape with electrical tape.



Micro-Pack

The Micro-Pack connector is shown in Figure 37. This connector is normally used to connect the wire harness to the ECM.



1. CABLE
2. TERMINAL
3. LOCKING TAB
4. TOOL KIT

Figure 37. Micro-Pack Connector

INTRODUCTION

GENERAL

This section has the troubleshooting and repair procedures for the parts of the electronic engine controls. Users of this section must know the components and operation as described in the section **ELECTRONIC ENGINE CONTROL – Description and Operation, 2200 SRM 612.**

The electronic engine control system is made of many parts. The main parts are the Throttle Body Injection (TBI) unit and the Electronic Control Module (ECM). These parts and their sensors give information about engine operation and the systems it controls. The ECM has the ability to perform some troubleshooting of itself and of other parts of the system. When a problem is found, the ECM turns "ON" the "Malfunction Indicator" lamp that is in the instrument cluster. A diagnostic trouble code (DTC) is kept in the memory of the ECM.

TROUBLESHOOTING PROCEDURE

Before using this part of the manual, you need to know the information and the correct troubleshooting procedures. If the correct troubleshooting procedures are not followed, as described in this section, it can result in replacement of good parts. Troubleshooting charts use a "SCAN" tool where possible. The "SCAN" tool has the ability to save time in troubleshooting and preventing the replacement of good parts.

HOW THIS SECTION IS ARRANGED

This section is in five parts that describe the troubleshooting and repair procedures. They are as follows.

INTRODUCTION

TROUBLESHOOTING CHARTS

TROUBLESHOOTING – POOR OPERATION

SYSTEM TEST CHARTS

REPAIRS

Where Do I Start?

There are three things to do to start troubleshooting. The first item is to become familiar with the electronic engine control system.

Secondly, always start your work with a good visual/physical inspection. See the following paragraph for more explanation.

The last item on the "Where Do I Start" list is the "On–Board Diagnostic" (OBD) System Check.

VISUAL/PHYSICAL INSPECTION

A careful visual and physical inspection must be done as part of any diagnostic procedure. This can cause the repair of a problem without further steps. Inspect all vacuum hoses for correct routing, restrictions, cuts or bad connections. Be sure to inspect hoses that are difficult to see beneath the air filter. Inspect all the wires in the engine compartment for proper connections, damaged spots, or contact with sharp edges or the exhaust manifolds. This visual/physical inspection is very important. It must be done carefully.

KNOWLEDGE/TOOLS REQUIRED

To use this manual most effectively, a general understanding of basic electrical circuits and circuit testing tools is required. One should be familiar with wiring diagrams, the meaning of voltage, ohms, amps, the basic theories of electricity, and understand what happens in an open or shorted wire. To perform the troubleshooting procedures, the use of a diagnostic "SCAN" tool is required. A tachometer, test lamp, ohmmeter, digital voltmeter with 10 megohms impedance, vacuum gauge, and jumper wires are also required. Special tools that are required for system service and the ones described above are shown at the end of this section.

DAMAGE FROM STATIC DISCHARGE (STATIC ELECTRICITY)

Electronic components used in control systems use a very low voltage, and can be easily damaged by static discharge or static electricity. Less than 100 volts of static electricity can cause damage to some electronic components. There are several ways for a person to become

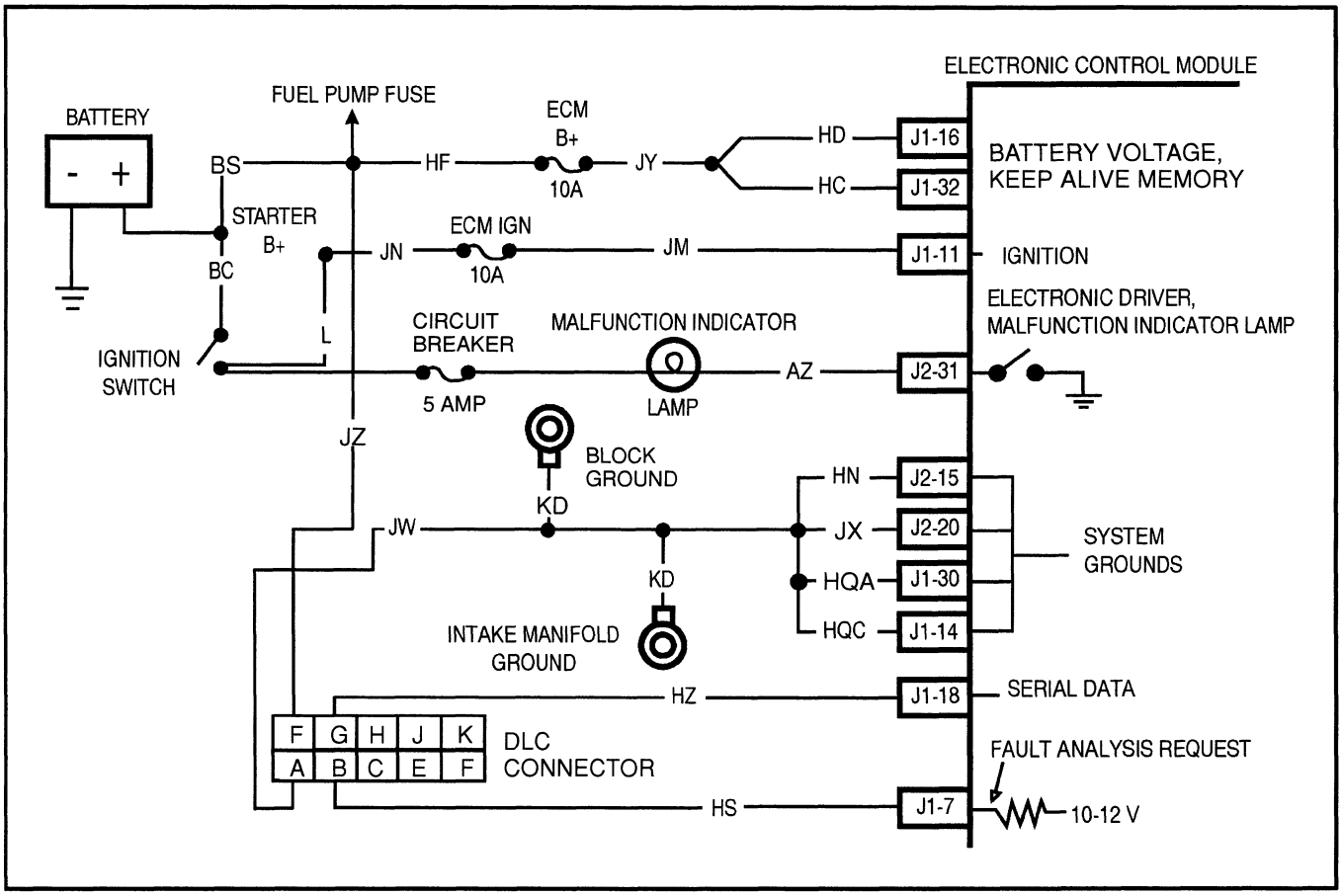


CHART A–2
NO "SCAN" DATA, NO DTC 12, "MALFUNCTION INDICATOR" LAMP ON

CIRCUIT DESCRIPTION

The "Malfunction Indicator" lamp (MIL) will be "ON" when the ignition is **ON** and the engine is "not running. Voltage from the ignition switch is supplied to the light bulb. The ECM will control the light and turn it "ON" by connecting it to ground through circuit AZ to the ECM.

With the diagnostic terminal is connected to ground, the light will flash a DTC 12, followed by any trouble code(s) kept in memory. A steady light means a short to ground in the light control circuit AZ, or an open in circuit HS.

Test Description: The number(s) below are a reference to number(s) in circles in the troubleshooting chart on the next page.

1. If there is a problem with the ECM that causes a "SCAN" tool to not read data from the ECM, then the ECM will not flash a DTC 12.

- If DTC 12 does flash, be sure that the "SCAN" tool is working correctly on another vehicle.
- If the "SCAN" is working correctly and circuit HZ is good, the ECM can be the cause for the "NO SCAN DATA" symptom.

2. This step will check for an open diagnostic circuit HS.

3. If the light turns "OFF" after the ECM connector J2 is disconnected, then circuit AZ has a short circuit to ground.

4. At this point, the "Malfunction Indicator" lamp wiring is good. If DTC 12 does not flash, replace the ECM.

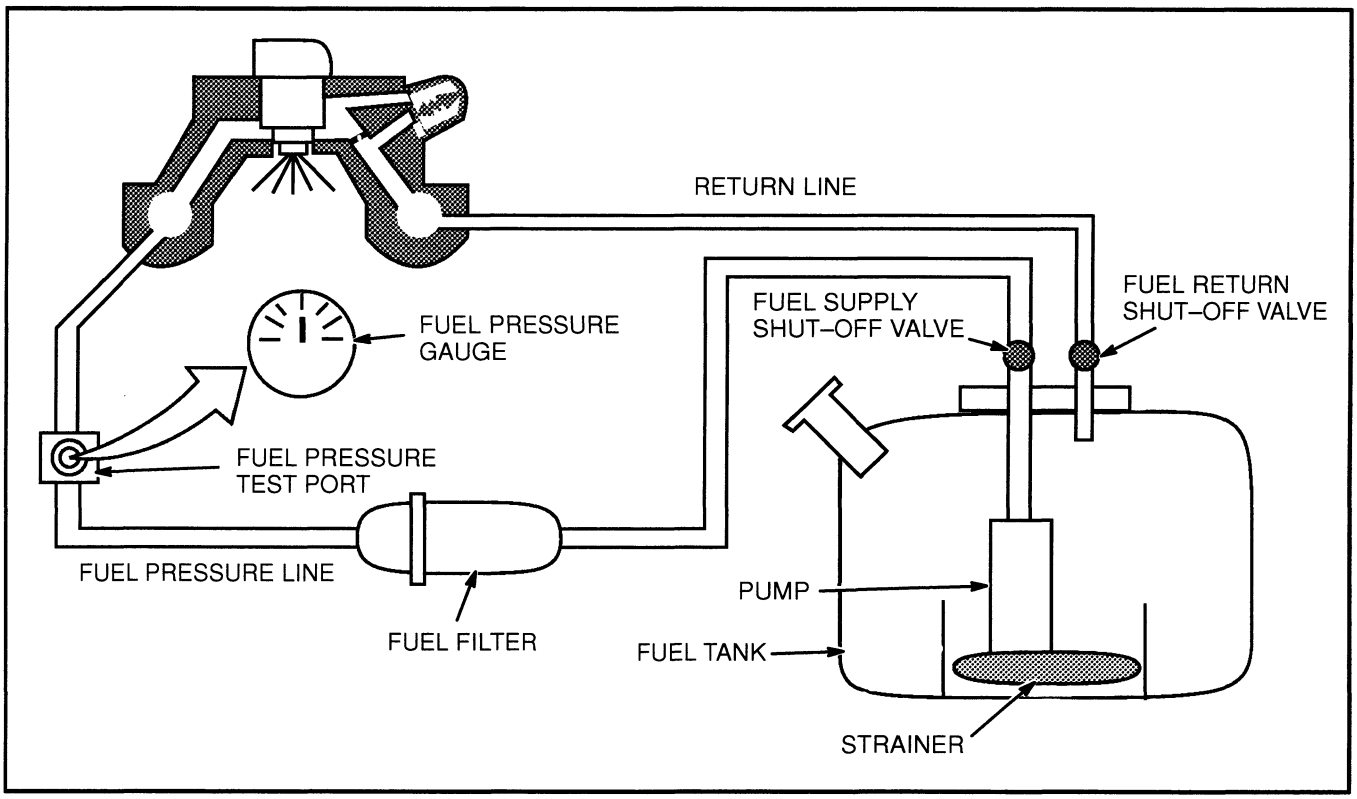


CHART A–7
FUEL SYSTEM TROUBLESHOOTING (2 of 3)

Test Description: The number(s) below are a reference to number(s) in circles in the troubleshooting chart on the next page.

1. Fuel pressure less than 62 kPa (9 psi) can cause several problems. It can cause hard starting in cold conditions and poor performance. Low fuel pressure can also allow the engine to run at idle or low speeds, but cause the engine to run poorly or stall when more fuel is required (such as accelerating or at high speed).

2. Causing a restriction in the fuel flow at the tank (as shown) causes the fuel pump to develop its maximum pressure. With the fuel pump running, pressure will increase to more than 90 kPa (13 psi).

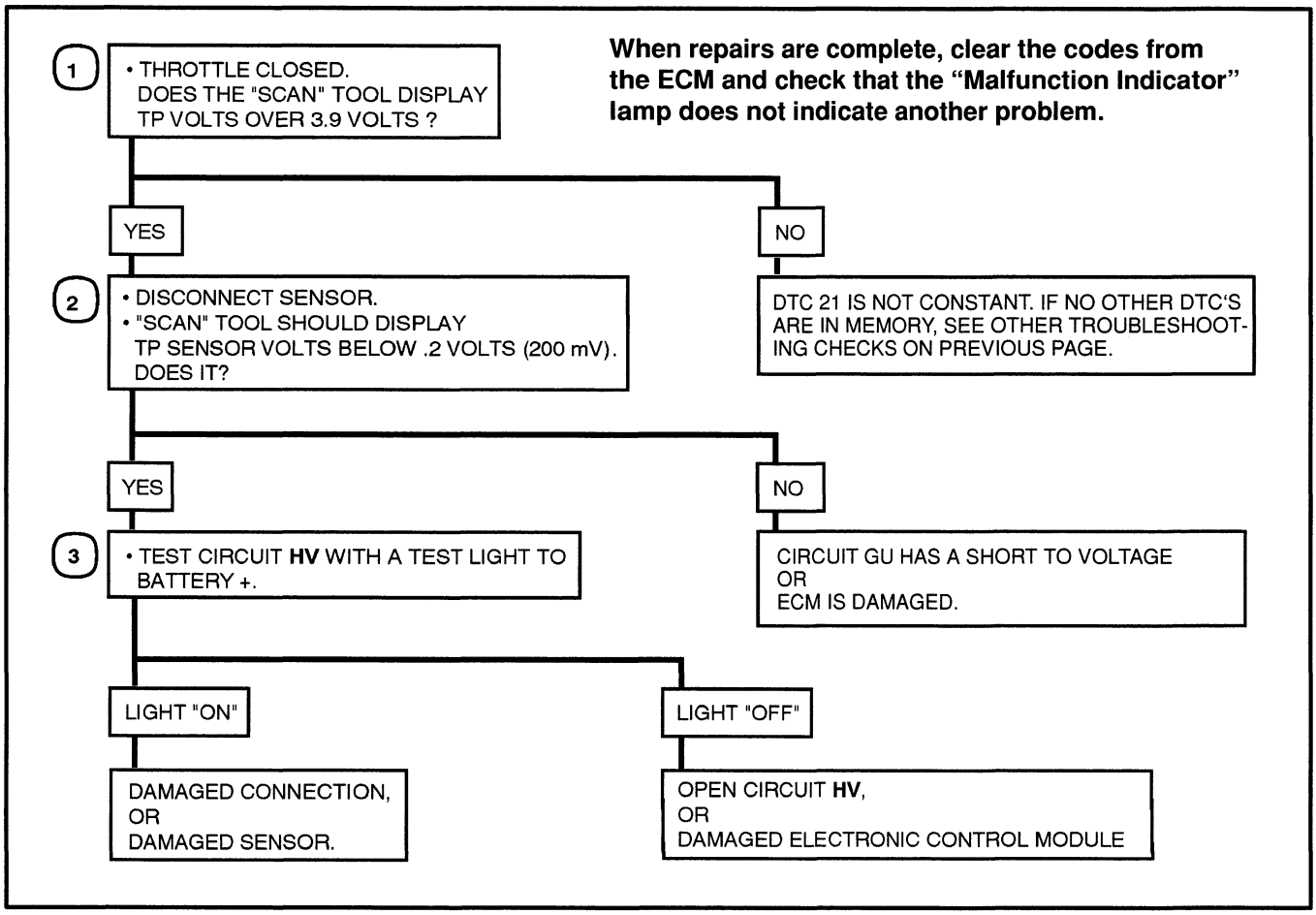
NOTE: Do not block the fuel return line completely (outlet side of TBI assembly) as too much pressure can damage the TBI pressure regulator.

3. This test determines if the high fuel pressure is caused by a restriction in the fuel return line, or a problem with the pressure regulator.

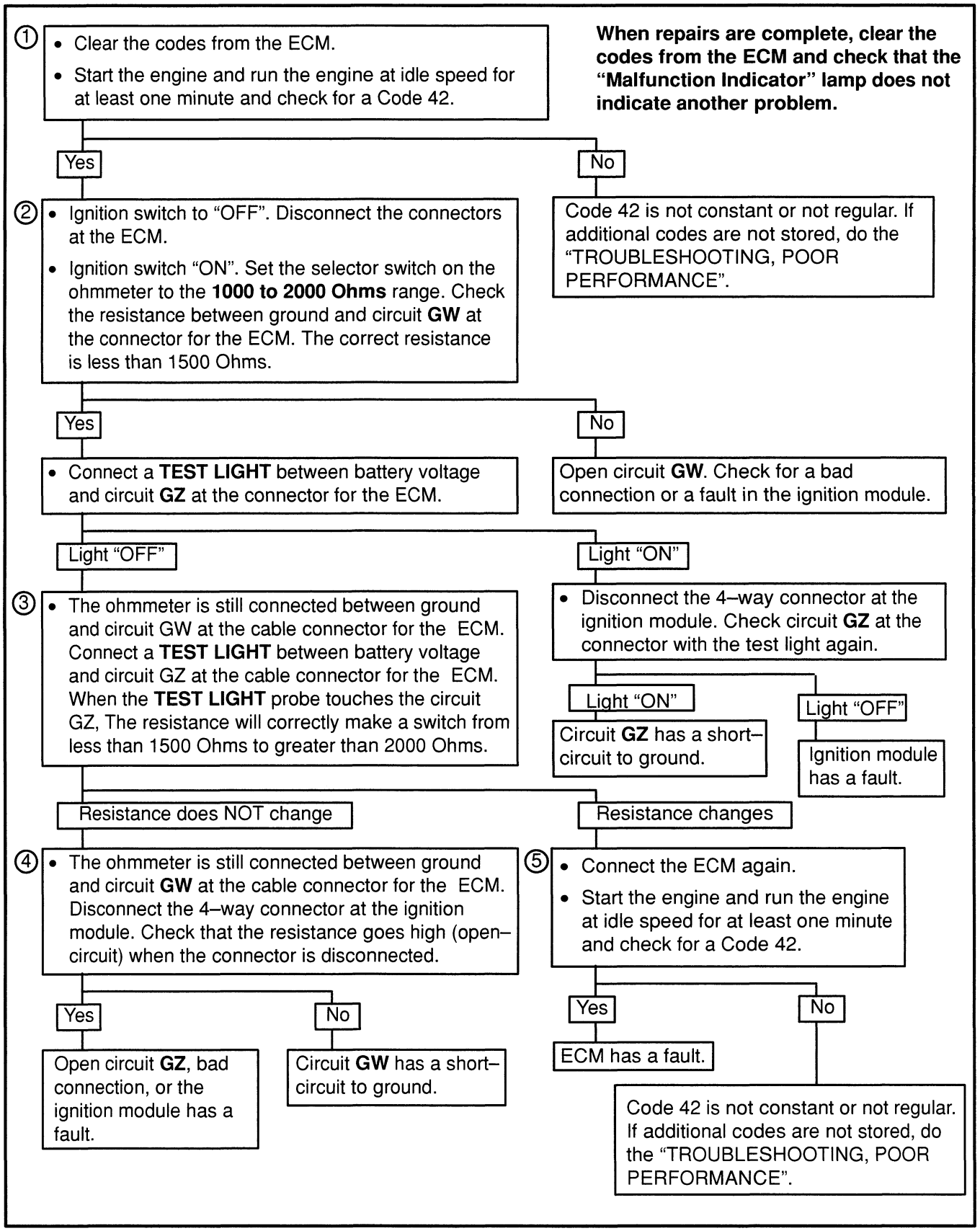
4. If pressure is correct at idle, yet becomes lower as the engine is accelerated, then repair the restriction in fuel feed line. If there is no restriction, replace the fuel pump.

5. Wrong fuel pump (too much capacity) can also cause high pressure.

6. Check that the shut–off valves are open when finished.



DTC 21 – THROTTLE POSITION SENSOR CIRCUIT (SIGNAL VOLTAGE HIGH)



DTC 42 – ELECTRONIC SPARK TIMING

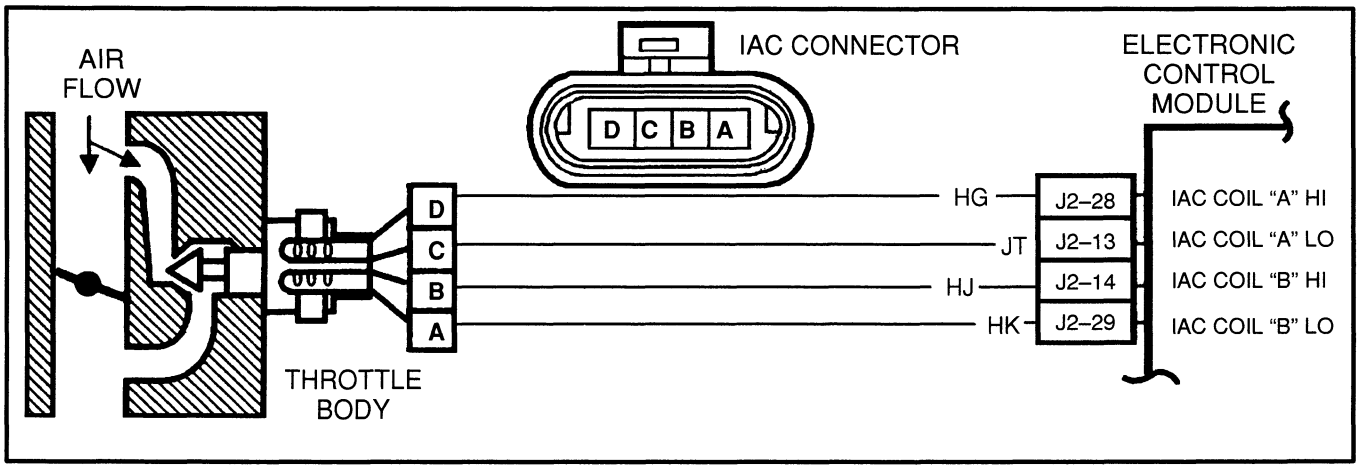


CHART C–1
IDLE AIR CONTROL (IAC) SYSTEM CHECK

CIRCUIT DESCRIPTION

The ECM controls engine idle speed with the IAC valve. To increase idle speed, the ECM retracts the IAC valve pintle away from its seat, allowing more air to bypass the throttle bore. To decrease idle speed, the IAC valve pintle extends towards its seat, reducing by–pass air flow. A "SCAN" tool will read the ECM commands to the IAC valve in counts. The higher the counts indicate more air bypass (higher idle). The lower the counts indicate less air is allowed to bypass (lower idle).

Other Troubleshooting Checks:

- A slow, unstable, or fast idle speed can be caused by a problem other than the IAC system. Out of control range IAC "SCAN" tool counts will be above 50 if idle is too low, and zero counts if idle is too high. Make the following checks to repair a problem that is not in the IAC system:
- Vacuum Leak (High Idle) – If idle is too high, stop the engine. Fully extend (low) IAC with tester. Start engine. If idle speed is above 800 RPM, fix vacuum leak including PCV system. Also check for smooth movement of the throttle plate or linkage.
- PCV Valve – If a high idle condition exists (800 to 1000 RPM), check for vacuum leaks and correct PCV valve operation. All throttle bodies are preset at the factory and do not need adjustment. A missing PCV valve or grommet or a valve that sticks can cause this condition.
- System Too Lean (High Air/Fuel Ratio) – The idle speed can be too high or too low. Engine speed can vary up and down and disconnecting the IAC valve does not help. Check for low fuel pressure, water in the fuel or a dirty injector.
- System Too Rich (Low Air/Fuel Ratio) – The idle speed will be too low. "SCAN" tool IAC counts will usually be above 50. System is rich and can cause black smoke in exhaust. Check for high fuel pressure or an injector that leaks or sticks.
- Throttle Body – Remove IAC valve and inspect bore for dirt.
- IAC Valve Electrical Connections – Check IAC valve connections for correct contact.
- See TROUBLESHOOTING – POOR OPERATION.
- If problems are fixed by disconnecting the IAC, carefully check connections, IAC valve terminal resistance, or replace IAC.

3. Connect the negative cable at the battery. Turn the key switch to **ON** (do not start the engine) and check for fuel leaks.

4. Use a new gasket and connect the air filter to the TBI.

Throttle Position Sensor (TPS), Removal (See FIGURE 16.)

1. Disconnect and remove the parts that connect the TBI to the air filter.

2. Disconnect the electrical connector from the TPS.

3. Remove the screws for the TPS and remove the TPS.

Throttle Position Sensor (TPS), Installation (See FIGURE 16.)

1. With the throttle valve closed, install the TPS on the throttle shaft. Rotate the TPS to align the screw holes. Use a thread locking adhesive (Loctite 262) on the screws. Install the screws and tighten them to 2.0 N.m (18 lbf in).

2. Connect the electrical connector to the TPS. Use a new gasket and connect the air filter to the TBI.

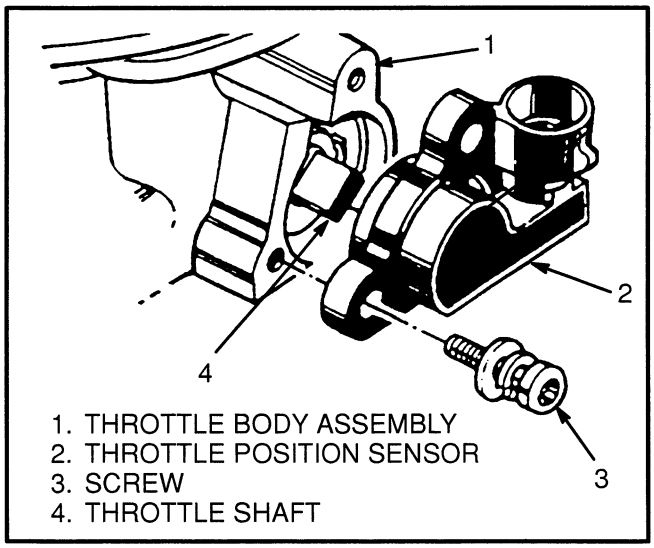


FIGURE 16. THROTTLE POSITION SENSOR (TPS)

Idle Air Control (IAC) Valve, Removal (See FIGURE 17.)

⚠ CAUTION

If the IAC valve has been in service, DO NOT push or pull on the pintle. Moving the pintle can damage the internal parts of the IAC valve.

1. Disconnect and remove the parts that connect the TBI to the air filter.

2. Disconnect the electrical connector from the IAC valve.

3. Remove the screws for the IAC valve and the valve.

Cleaning and Inspection

See the cleaning instructions in the NOTES under "General" at the beginning of **REPAIRS**. Use a carburetor cleaner to clean the carbon from the valve seat for the pintle, the air passage and the surface for the O–ring. Inspect the O–ring for damage.

NOTE: If the IAC valve must be replaced, make sure the replacement part has the correct part number. The shape and diameter of the pintle is made for this application.

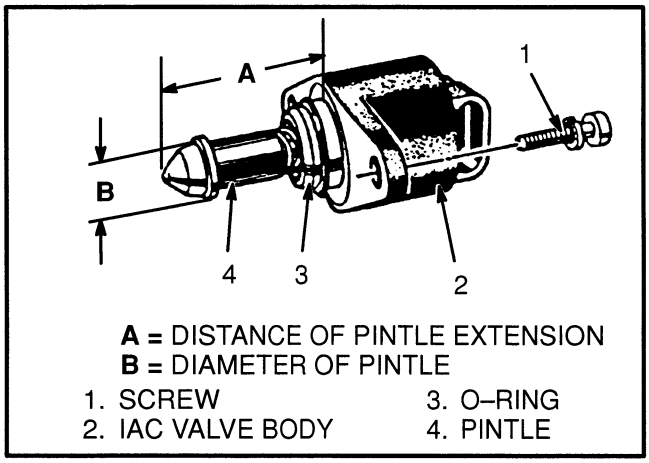


FIGURE 17. IDLE AIR CONTROL VALVE

Idle Air Control (IAC) Valve, Installation (See FIGURE 17.)

NOTE: When installing a new IAC valve, measure the distance between the tip of the pintle and the flange, dimension **A** in FIGURE 17. If the distance is more than 28 mm (1.1 in), use your finger to slowly retract the pintle. This procedure will not damage a NEW IAC valve. DO NOT do this procedure if the IAC valve has been in service.

troubleshooting. The "Connector Test Adapter Kit" has a variation of adapters and connectors that can be used when troubleshooting a circuit.

When Troubleshooting, open–circuits are often difficult to see because of dirt, corrosion, or a terminal that is not in alignment in its socket. When Troubleshooting for an open–circuit, always check for loose connections and a terminal that can have corrosion. A fault that is not regular nor constant can also be caused by a loose connection or a terminal that has corrosion.

If a connector must be repaired, make sure of the type of connector. Some of the smaller connectors can look similar, but have a different construction.

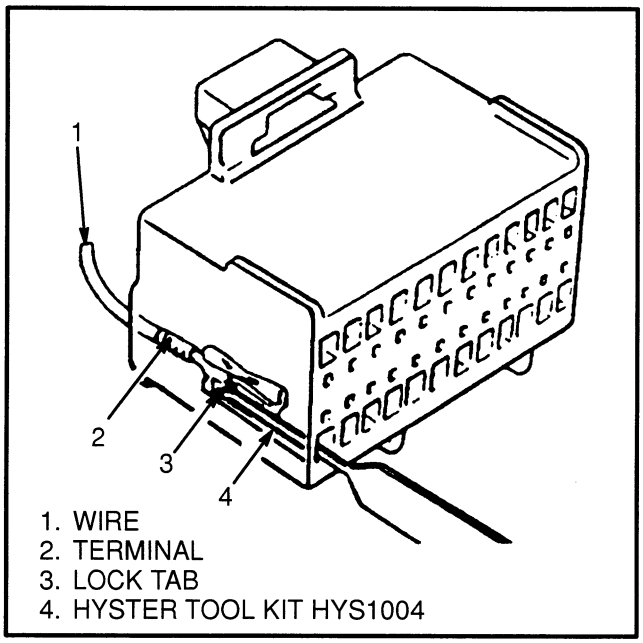


FIGURE 27. MICRO–PACK CONNECTOR

The **Micro–Pack connector** is shown in FIGURE 27. This connector is normally used to connect the wire harness to the ECM.

Metri–Pack® connectors come in several sizes and types that are used on the wire harness. These connectors are made by Packard Electric Company. The typical connectors used on lift trucks are No. 56, No. 150, No. 280, No. 480, and No. 630. Some of these connectors are "push–to–seat" and others are "pull–to–seat". Make sure the connector is correctly identified before it is changed. The terminals can be damaged if they are removed or installed wrong.

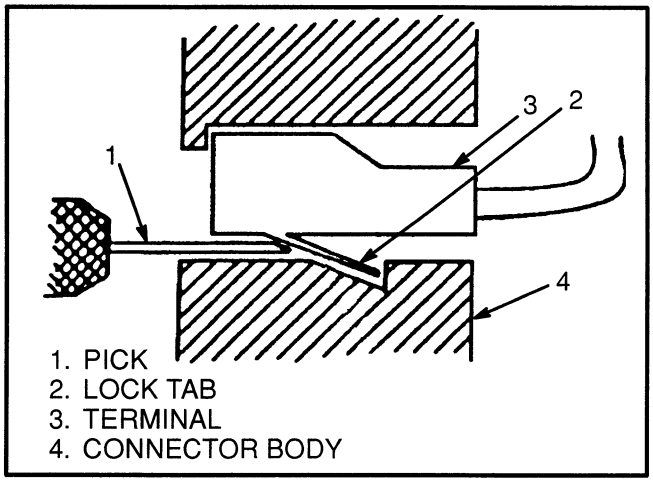


FIGURE 28. METRI–PACK "PUSH–TO–SEAT" CONNECTOR

NOTE: Not all **Metri–Pack** connectors have a seal.

Do the following procedures to remove and install a terminal:

a. Open any secondary locks that hold the wires and seals in their positions. Slide the seals along the wires from the ends of the connector.

b. Hold the wire and use it to push the terminal to its forward position in the connector body. Hold the terminal in this position.

c. Find the lock tab for the terminal in the connector channel. Push a removal tool (pick) of the correct size into the connector channel. See FIGURE 28. and FIGURE 29.

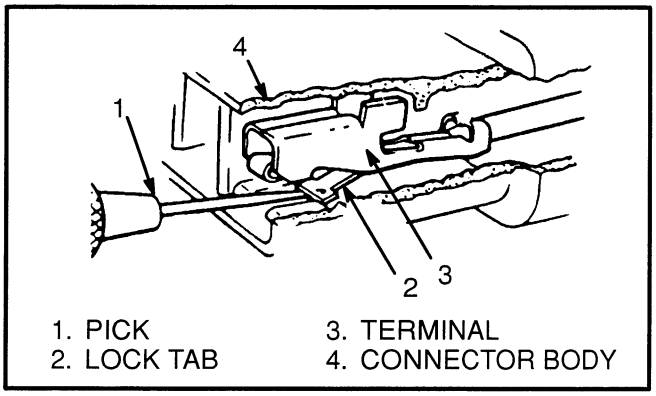
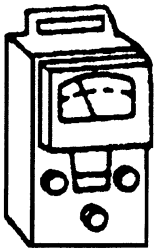
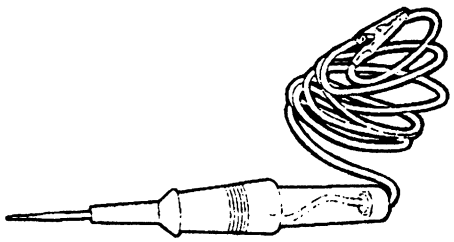
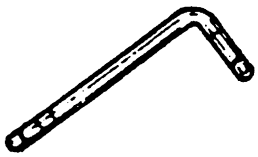


FIGURE 29. METRI–PACK "PULL–TO–SEAT" CONNECTOR

d. Use the removal tool to move the lock tab and release the terminal from its seat.

Push–to–Seat — Gently pull the wire to remove the terminal from the back of the connector.

SPECIAL TOOLS

	**Tachometer** Use a tachometer with an inductive trigger sensor to check the engine speed.
	**Test Light (Without Internal Battery)** Used to check for open–circuits, short–circuits, and for signal voltages in a circuit.
	**Adjustment Wrench for Minimum Idle Speed** Used to adjust the throttle stop screw on the TBI unit.

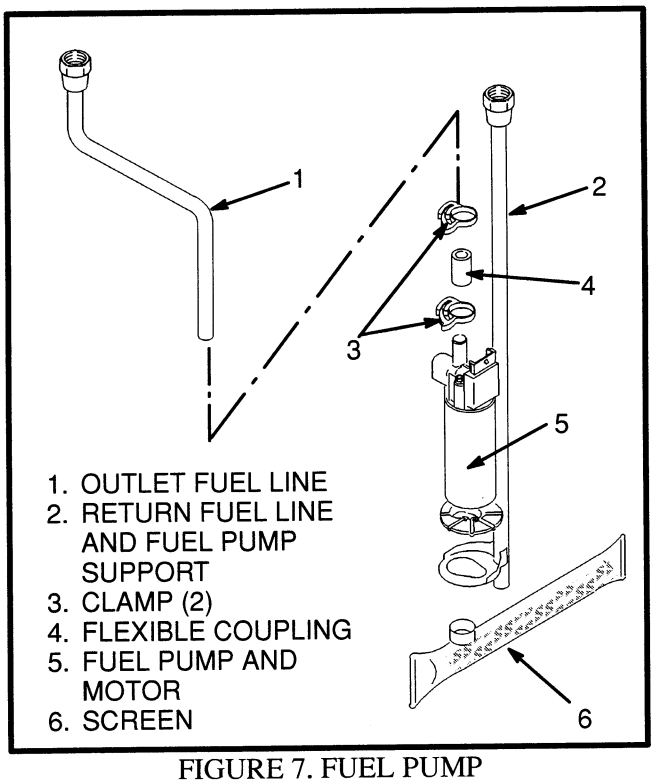


FIGURE 7. FUEL PUMP

Fuel Pump Electrical Circuit

When the ignition switch is turned to the **ON** position (engine not running), the ECM turns the fuel pump relay "ON" for two seconds. This action quickly raises the fuel pressure to the fuel injector. If the engine is not started within two seconds, the ECM deenergizes the fuel pump relay and the fuel pump goes to OFF. When the engine is cranked by the starter, the ECM energizes the fuel pump relay again so that the fuel pump operates.

As a parallel system to the fuel pump relay, the fuel pump also can be turned "ON" by the oil pressure switch. The oil pressure sender has two internal circuits. One circuit operates the oil pressure indicator or gage in the instrument cluster, and the other is a normally open switch that closes when oil pressure reaches approximately 28 kPa (4 psi). If the fuel pump relay has a fault, the oil pressure switch runs the fuel pump.

Throttle Body Injection (See FIGURE 8.)

The TBI unit consists of two major assemblies; the Throttle Body and the Fuel Meter Body. The parts of the Throttle Body are the Throttle Position (TP) Sensor, Idle Air Control (IAC) Valve, Throttle Valve and the Tube Module Assembly. The Fuel Meter Body has the Fuel Injector and the Fuel Pressure Regulator

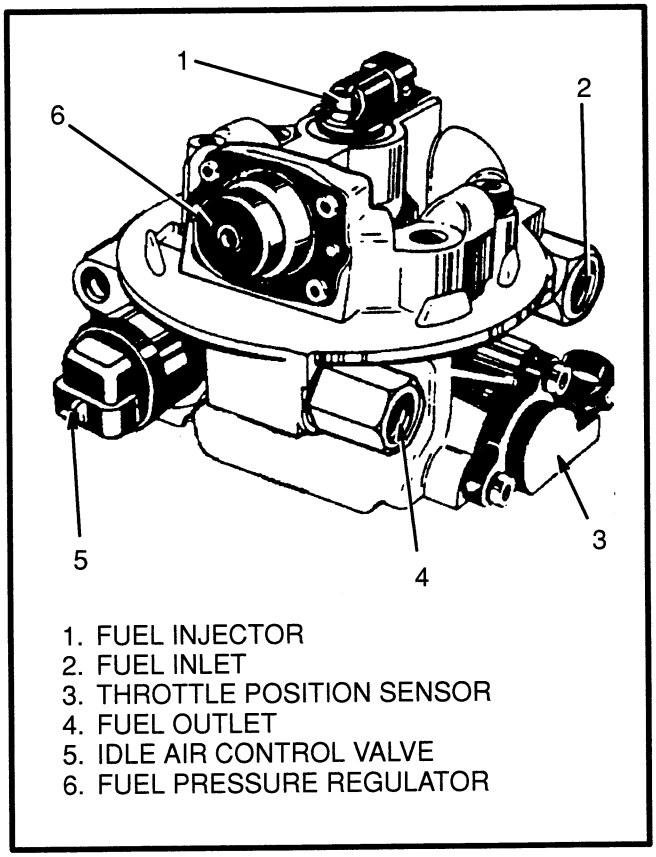


FIGURE 8. THROTTLE BODY INJECTION (TBI) UNIT

Throttle Position (TP) Sensor

The Throttle Position (TP) Sensor is a potentiometer that is connected to the throttle shaft on the throttle body. It senses the position of the throttle plate and sends that information to the ECM. This information permits the ECM to generate the correct pulses to the fuel injector for fuel control. If the throttle position sensor indicates a fully opened throttle to the ECM, the ECM then increases the pulse width to the fuel injector.

The TP Sensor electrical circuit has a 5 volt supply line and a ground path line, both from the ECM. A third wire is used as a signal line to the ECM. By monitoring the voltage on this signal line, the ECM calculates throttle position. As the throttle plate angle is changed (accelerator pedal moved), the signal voltage of the TP Sensor also changes. At a closed throttle position, the signal of the TP Sensor is below 1.25volts. As the throttle plate opens, the signal voltage increases, so that at wide open throttle, it is approximately 5 volts.

The mast uprights are telescopic and use load rollers and strip bearings to keep them in alignment. The load rollers are installed at the top of the outer, inter#2, and inter#3 masts. Load rollers are also used at the bottom of the inter#2, inter#3, and the inner mast. These load rollers travel along the flanges of the masts. The angle of the load rollers permits them to control the forces from the front, back, and sides of the mast. The strip bearings are installed at the top of the outer, inter#2, and inter#3 masts and help keep the correct clearance between the masts. The load rollers and strip bearings are adjustable with shims.

The two main lift cylinders are installed at the back of the outer mast. The base of each lift cylinder sits in a mount at the bottom crossmember of the outer mast. The top of each main lift cylinder (cylinder rod) fits into a guide at the top crossmember of the inter#2 mast. The free-lift cylinder is installed to the inner mast. The free-lift and left-hand main lift cylinder has an internal (secondary) lowering control valve. A single external (primary) lowering control valve is connected by tubing and hoses to all of the lift cylinders.

One set of main lift chains is connected to mounts that are near the top of the outer mast. The lift chains then go over sheaves at the top of the inter#2 mast and fasten at the bottom of the inter#3 mast.

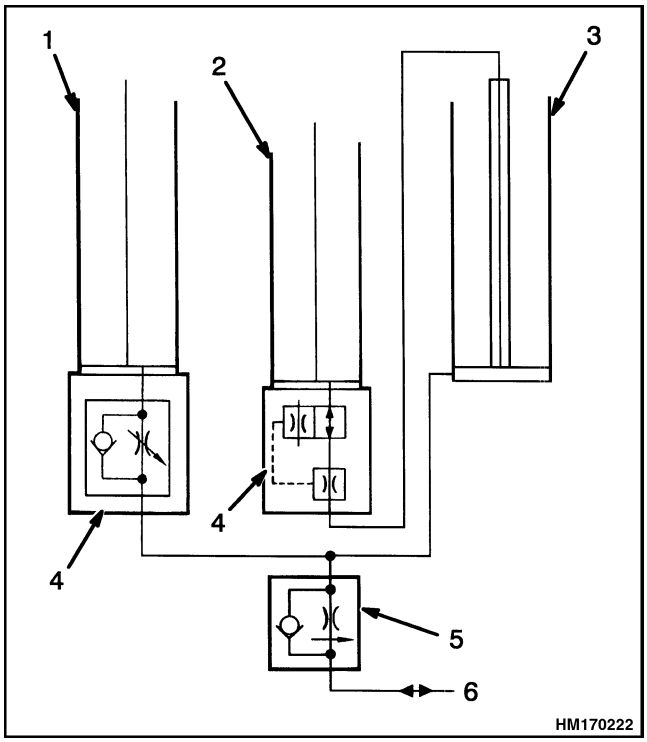
Another set of main lift chains is connected to mounts that are near the top of the inter#2 mast. The lift chains then go over sheaves at the top of the inter#3 mast and fasten at the bottom of the inner mast.

The free-lift chains connect at one end of the crossmember for the free-lift cylinder. Two chain sheaves are installed on a crosshead on the cylinder rod of the free-lift cylinder. The chains then go over sheaves on the crosshead and connect to the carriage.

Operation

The three hydraulic cylinders are connected by hoses and tubing as shown in Figure 3. To extend the mast, oil from the main control valve flows to all cylinders at the same time. The free-lift cylinder extends first because it lifts the least amount of weight. The free-lift cylinder raises the carriage to the top of the inner mast. After the free-lift cylinder reaches the end of its stroke, the main lift cylinders begin to extend. As the main lift cylinders extend, the inter#2 mast is raised by the lift cylinders. The inter#3 and inner masts are raised by the lift chains. See Figure 4.

The left-hand lift cylinder has a small amount of oil below the piston. The free-lift cylinder has a small amount of oil above the piston. This oil provides a hydraulic cushion during operation. See Figure 5 and Figure 6. During lowering, the main lift cylinders lower first because they have a greater load. After the main lift cylinders have retracted, the free-lift cylinder lowers. All oil from the lift cylinders flows through the lowering control valves to the hydraulic tank.



1. MAIN LIFT CYLINDER (LEFT-HAND)
2. FREE-LIFT CYLINDER
3. MAIN LIFT CYLINDER (RIGHT-HAND)
4. LOWERING CONTROL VALVE (INTERNAL)
5. LOWERING CONTROL VALVE (EXTERNAL)
6. TO/FROM MAIN CONTROL VALVE

Figure 3. Hydraulic Schematic

Mast Repair

REMOVE

NOTE: If the mast must be disassembled, remove forks and carriage as described in Carriage Repair. If only the lift cylinders need to be removed, see the procedures for Lift Cylinders Repair.

1. Before removing mast, check length of lift chains. See the procedures in Clean and Inspect.

2. Fully lower all mast weldments and carriage. Tilt mast fully forward. Use chains and connect a crane to top of mast. Make sure all weldments are fastened together. Make sure chains will not damage sheaves, tubing, or other parts of mast. Make sure crane has a capacity of at least 1600 kg (3500 lb).

3. Put drain pan under the area of hydraulic fittings. Disconnect hydraulic line at external lowering control valve on outer weldment.

WARNING

Use a driver, not your fingers, to push the anchor pins from the rod ends on the tilt cylinders. The cylinder or mast can move and cause serious injury.

4. Remove cotter pins and anchor pins at tilt cylinder mounts on mast. See Figure 14.

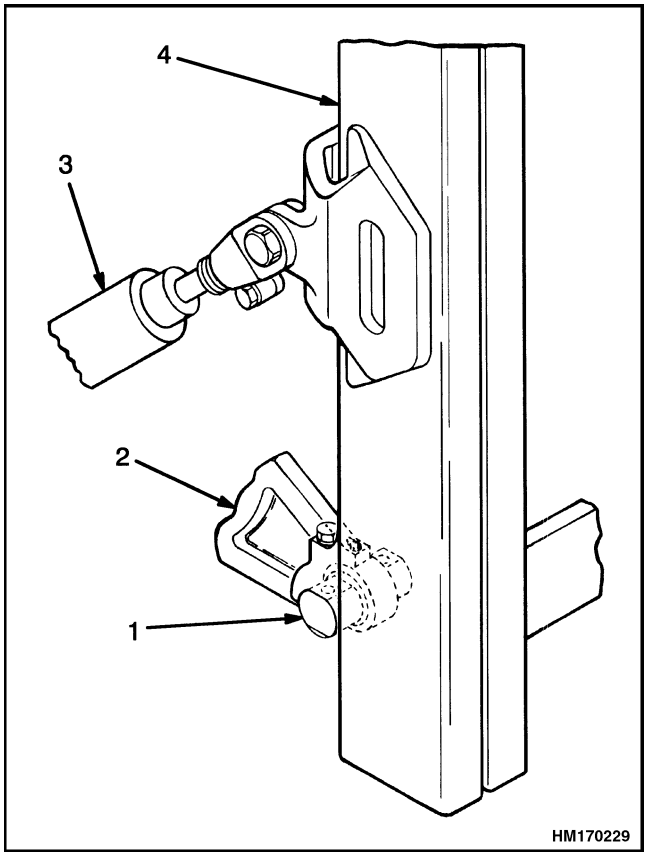
5. Remove capscrews that hold mast to pivot pins at mounts.

6. Use crane to lift mast assembly from lift truck. Put mast on floor so back of mast is toward floor.

DISASSEMBLE

NOTE: If only the lift cylinders need to be removed and repaired, see the procedures for Lift Cylinders Repair. When the mast has header hoses, see the procedures for the Header Hose Arrangements.

1. Disconnect and remove hydraulic lines for free-lift cylinder. Remove brackets for free-lift cylinder. Remove free-lift cylinder. Disconnect free-lift chains at crossmember. See Figure 17 and Figure 18.

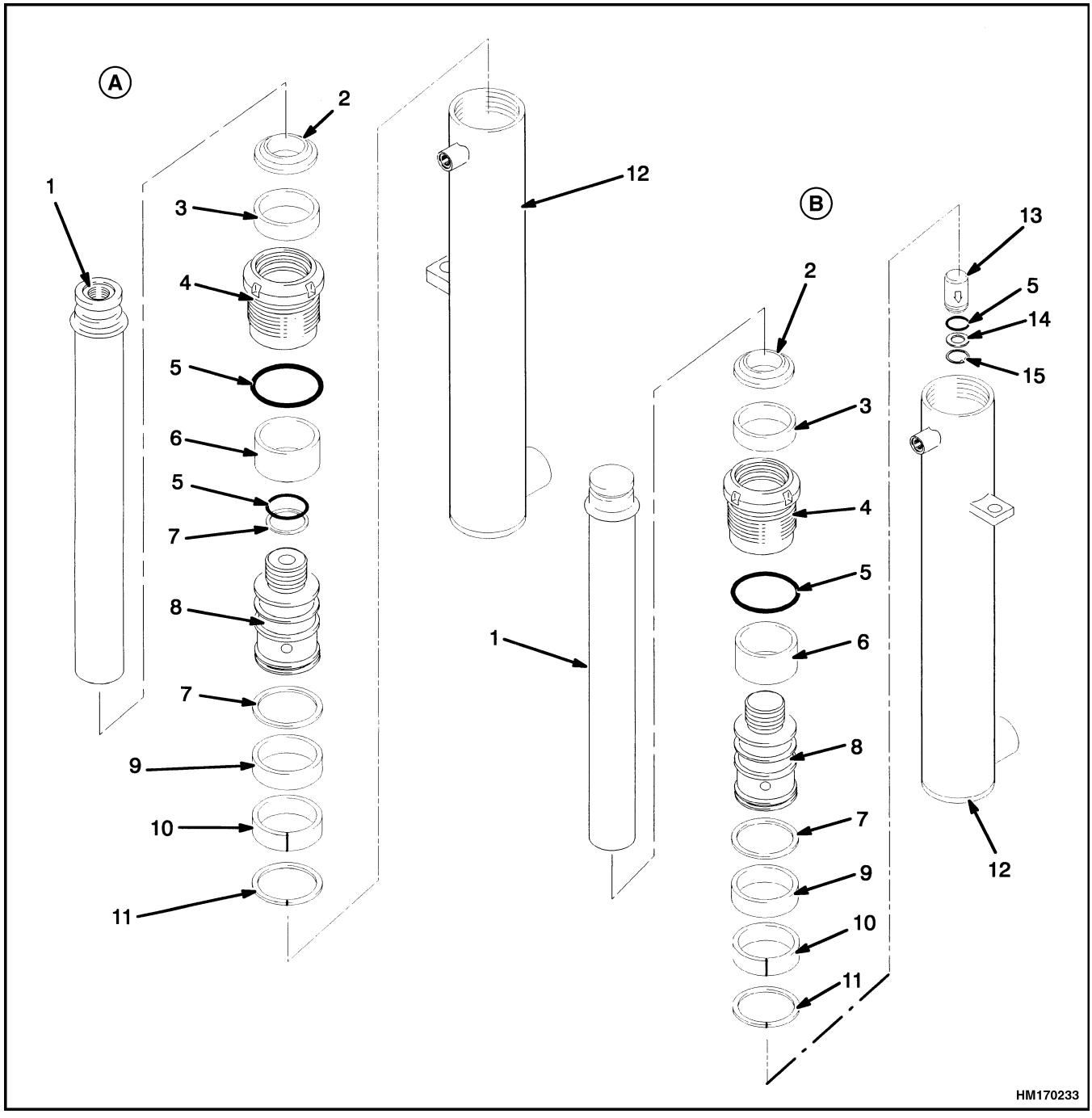


1. PIVOT PIN
2. DRIVE AXLE HANGER (MAST MOUNT)
3. TILT CYLINDER
4. OUTER WELDMENT

Figure 14. Mast Mounting

2. Disconnect lift chains at bottom of inner weldment and top of inter#2 weldment. Remove lift chains. Push inner weldment toward bottom of mast assembly until bottom load rollers are seen. See Figure 17 and Figure 18.

3. Remove strip bearings at top of inter#3 weldment. Remove load rollers at bottom of inner weldment. Remove load rollers at top of inter#3 weldment. Make a note of each shim arrangement and load roller location. The shim arrangements will be approximately the same during assembly.



A. RIGHT-HAND LIFT CYLINDER **B.** LEFT-HAND LIFT CYLINDER

1. ROD
2. WIPER
3. ROD SEAL
4. RETAINER
5. O-RING
6. SPACER
7. BACKUP RING
8. PISTON
9. PISTON SEAL
10. WEAR RING
11. SEAL RING
12. SHELL
13. CHECK VALVE
14. WASHER
15. SNAP RING

Figure 22. Main Lift Cylinders

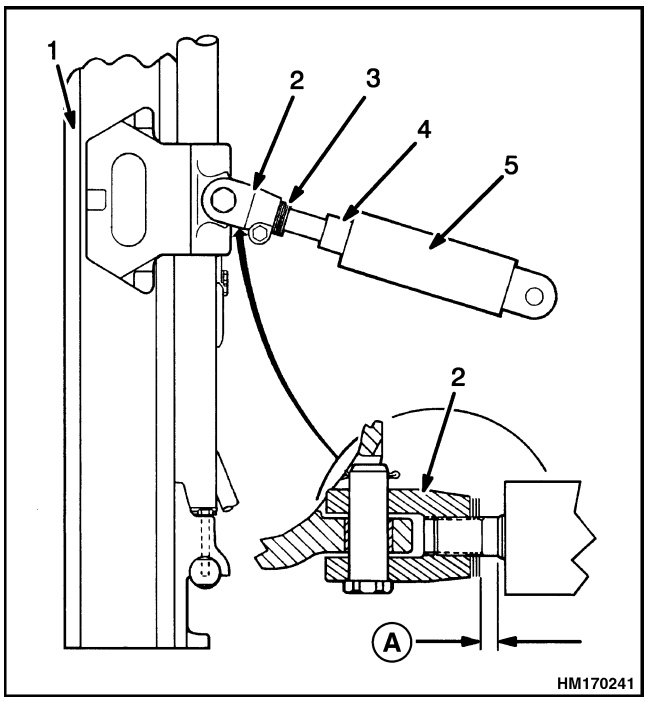
Tilt Cylinders Adjustment

WARNING

When the tilt cylinders have tilt limit spacers, make sure they are installed during installation procedures. Without the tilt limit spacers, the mast can tilt too much and cause an accident or serious injury.

Check tilt cylinder stroke by slowly tilting mast fully forward and backward several times. Both tilt cylinders must stop their stroke at the same time. Adjust rod ends to dimension **A** for all tilt cylinders as shown in Figure 28. There must be no twist in the mast weldments. Adjust tilt cylinders as follows:

1. Slowly tilt mast forward until one cylinder rod stops. On opposite cylinder, loosen capscrews on rod end. Use a wrench and turn cylinder rod IN as necessary. Repeat this procedure until both cylinder rods stop at the same position within 1 mm (0.04 in.).
2. Slowly tilt mast backward until one rod end just contacts spacer. Add shims to fill gap at opposite rod end until both rod ends contact spacers within 0.5 mm (0.02 in.).
3. After adjustments are complete, tighten capscrews on rod ends.
4. Tilt mast fully backward and measure tilt angle. (See nameplate for tilt angles.) If necessary, add an equal number of shims to both rods for the correct angle.



A. DIMENSION A = 15 mm (0.60 in.)

1. MAST
2. ROD END
3. SHIMS
4. TILT LIMIT SPACER
5. TILT CYLINDER

Figure 28. Tilt Cylinder Adjustments

Lift Chain Adjustments

WARNING

When working on or near the mast, see Safety Procedures When Working Near Mast in this section

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

Do not try to find hydraulic leaks by putting your hand on hydraulic components under pressure. Hydraulic oil can be injected into the body by the pressure.

During test procedures for the hydraulic system, fasten the load to the carriage with chains to prevent it from falling. Keep all personnel away from the lift truck during the tests.

When the lift chains are correctly adjusted:
- The tension will be the same on each chain of the chain set. Check tension by pushing on both chains at the same time.
- The chain length will be correct.
- The chains must travel freely through the complete cycle.

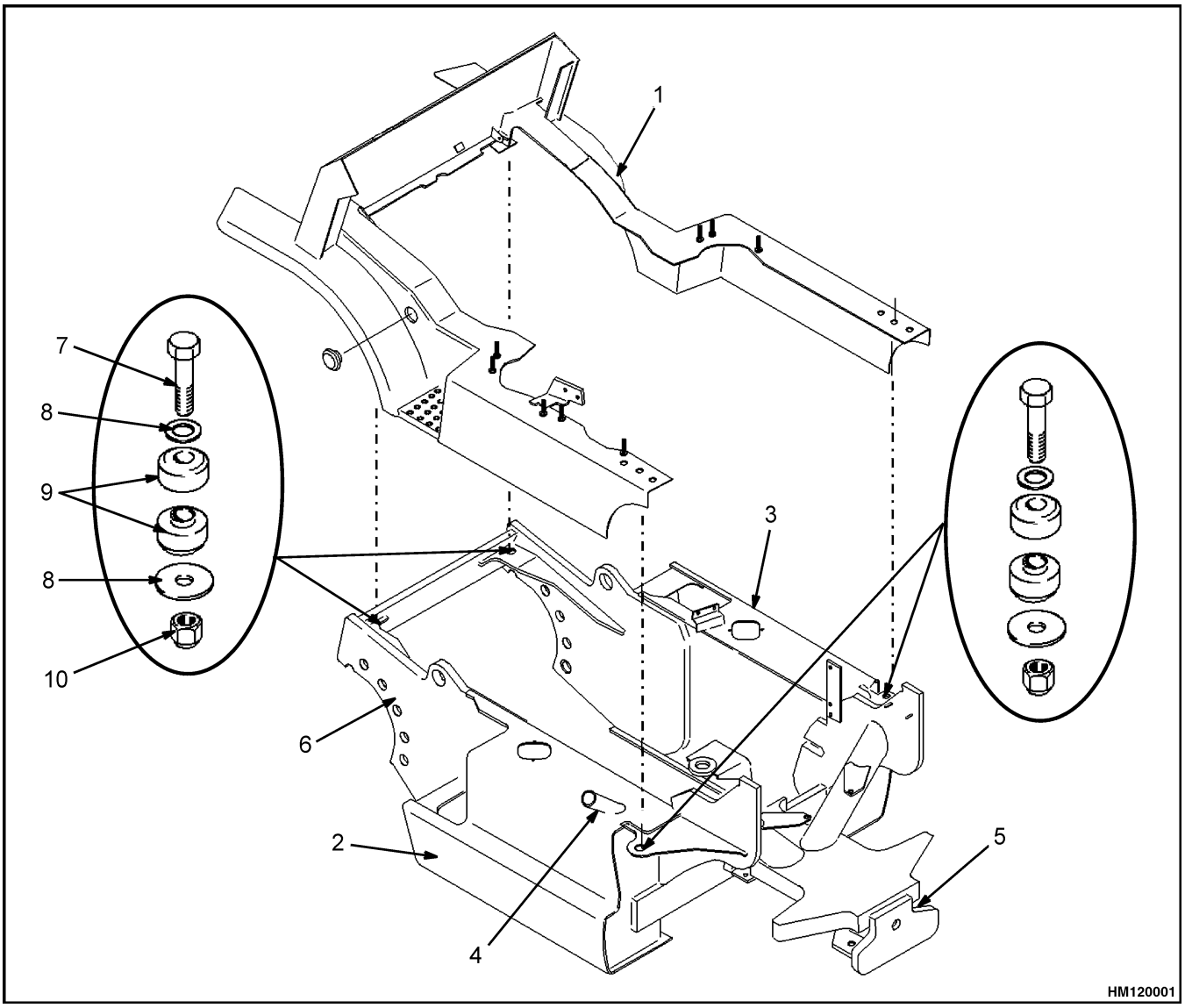
NOTE: When the chain adjustments are complete, make sure that the threads on the nuts of the chain anchors are completely engaged. Make sure that all

bottom of the mount. Tighten the nuts to 53 N•m (39 lbf ft).

3. Install the crossmember for the hood and pedal mounts. Install the hood and side covers.

4. Install the steering controls and the parking brake lever.

5. Install the floor plates.



1. OPERATOR MODULE
2. FRAME
3. HYDRAULIC TANK
4. FUEL TANK
5. STEERING AXLE MOUNT
6. DRIVE AXLE MOUNT
7. CAPSCREW
8. WASHER
9. RUBBER MOUNT
10. NUT

Figure 1. Frame and Operator Module

Legend for Figure 11

1. MUFFLER
2. SPACER
3. BRACKET
4. CATALYTIC CONVERTER
5. DIFFUSER
6. CLAMP
7. GASKET
8. ADAPTER
9. SEAL
10. SPACER
11. SPRING
12. SPECIAL CAPSCREW
13. PLUG (RAW GAS CHECK PORT)
14. OXYGEN SENSOR
15. OVERHEAD EXHAUST PIPE

Radiator and Cooling System Repair

REMOVE

WARNING

DO NOT remove the radiator cap while it is hot. Hot coolant and steam can cause burns. Make sure the label is on the radiator cap. See Figure 16.

1. Use the drain valve and drain the coolant from the radiator. Remove the bottom radiator hose and drain the coolant from the engine. See Figure 12 and Figure 13.

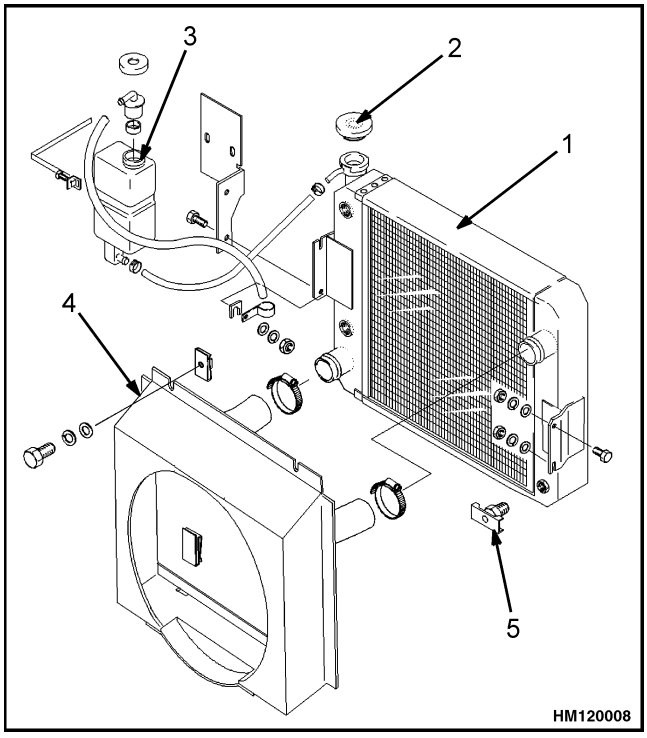
2. Remove the capscrews that fasten the fan to the hub. Remove the capscrews that hold the fan shroud to the radiator. Remove both the fan and the fan shroud.

3. Disconnect the top coolant hose at the radiator. Disconnect the lines to the oil cooler in the side of the radiator. Put caps on the open lines and ports. Remove the capscrews that hold the radiator to the frame. Remove the radiator.

INSTALL

1. Install the radiator. See Figure 12 and Figure 13. Install the fan and fan shroud in position on the radiator. Install the capscrews that hold the fan shroud. Install the capscrews that fasten the fan to the hub. Tighten the capscrews to 26 N•m (19 lbf ft).

2. Connect the upper coolant hoses at the radiator. Connect the lines for transmission oil to the oil cooler in the radiator.



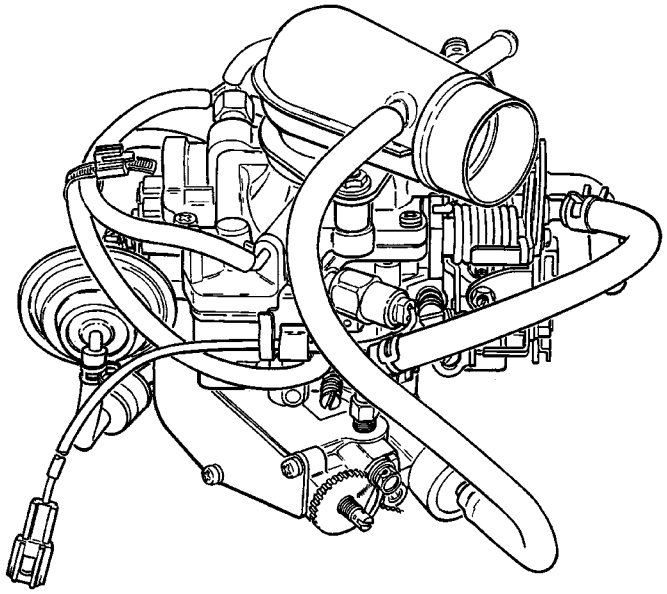
1. RADIATOR
2. RADIATOR CAP
3. AUXILIARY COOLANT RESERVOIR
4. SHROUD
5. DRAIN VALVE

Figure 12. Cooling System (Older)

GASOLINE FUEL SYSTEM

MAZDA M4–2.0G AND M4–2.2G ENGINES

S/H2.00–3.20XM (S/H40–65XM)



HYSTER

PART NO. 897483

900 SRM 502

the float bowl housing on the throttle body. Install and tighten the two screws.

2. Install the idle mixture screw and spring in the throttle body.

3. Install the diaphragm in the accelerator pump cover. Put the return spring into position on the diaphragm. Install the return spring and the cover on the float bowl housing. When the cover is installed, the roller on the pump lever must be aligned with the cam on the throttle shaft. Put the roller in a position so that the throttle shaft cam activates the roller and pump assembly when the throttle is opened. Install and tighten the four screws and washers.

4. Install the check ball and the spring in the outlet passage of the accelerator pump. Install the accelerator pump nozzle in the float bowl housing.

5. Install the main jet and washer in the float bowl housing. Install the drain plug and washer in the housing. Install the slow speed jet in the housing

6. Install the solenoid valve in the float bowl housing.

7. Install the power piston and spring in the air horn. Install the retainer and screw for the power piston. Make sure the piston moves freely in the bore.

8. Install the choke release diaphragm and lever on the air horn. Install the lever behind a tab on the air horn. Put the end of the diaphragm lever against the choke plate lever. The alignment is correct if the choke plate opens when the end of the diaphragm lever is pushed. Install the spring in the diaphragm cover. Install the spring and cover on the diaphragm and the air horn. Install and tighten the three screws and washers. Connect the vacuum hose and delay valve to the release diaphragm. Make sure the yellow end of the delay valve is toward the diaphragm.

9. Install the inlet valve seat in the float bowl housing. Put the inlet needle in position on the float tab. Lower the inlet needle into the inlet seat while aligning the float hinge with the hinge mount hole. Connect the float hinge to the housing with the float hinge shaft. Make sure the inlet needle moves freely in the seat when the float is raised and lowered. Check and adjust the float as follows:

a. Hold the float bowl housing in a vertical position so that the float hinge is above the float. The tab on the float hinge must lightly push the needle of the fuel inlet valve. Measure the distance from the closest part of the float to the cover. This distance must be 10mm (0.39 in). This setting keeps the fuel level in the float chamber at 20mm (0.78 in) below the top edge of the float chamber when the engine is running.

b. To change the float setting, carefully bend the tab on the float hinge assembly that touches the needle valve. Measure the distance between the float and the inlet cover to make sure that the setting is correct.

10. Install the O-ring for the idle compensator valve in the float bowl housing. Install the idle compensator valve in the housing. See FIGURE 10.

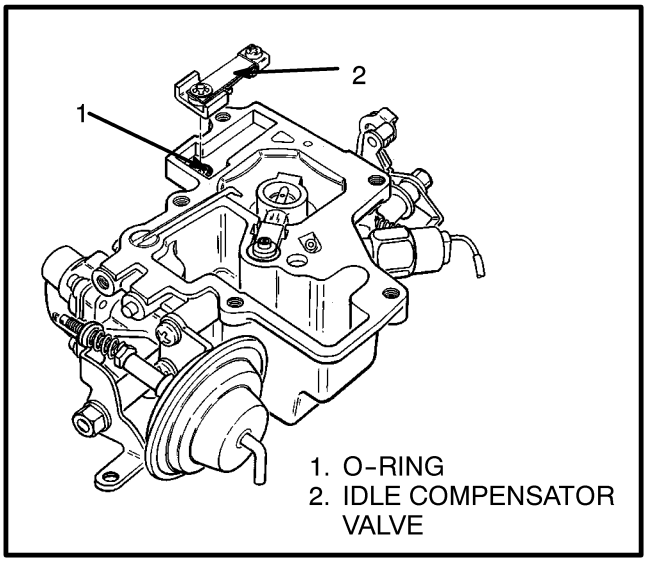


FIGURE 10. IDLE COMPENSATOR

11. Install the air horn and gasket to the float bowl housing. Install and tighten the screws. Install the solenoid in the float bowl housing.

12. Install the idle actuator on the float bowl housing. Install the check valve and vacuum hoses. Make sure the arrow on the check valve is toward the idle actuator.

Installation (See FIGURE 11.)

NOTE: The vacuum and engine coolant hoses installed on the carburetor and governor are made of special high-temperature material. If any of the hoses are replaced, make sure the correct hoses are installed.

TABLE OF CONTENTS

©2006 HYSTER COMPANY

Cylinder Head and Valve Mechanism Repair

CYLINDER HEAD, REMOVE

1. Disconnect the battery cables at the battery.
2. Drain cooling system. See the **Frame** section for your lift truck model for the procedures.
3. Disconnect and remove the coolant hose from the thermostat housing.
4. Remove or disconnect the air cleaner.
5. Disconnect the PCV valve.
6. Disconnect the wires and hoses fastened to brackets on the rocker arm cover.
7. Disconnect the spark plug wires.
8. Disconnect the linkages, fuel lines, and hoses for the fuel system.
9. Disconnect the exhaust pipe at the exhaust manifold and remove the intake/exhaust manifolds. See Figure 5.
10. If necessary, remove the alternator and bracket.
11. Remove the dipstick tube for engine oil.
12. Remove the rocker arm cover. See Figure 5.

NOTE: Keep rocker arm assemblies, push rods, and hydraulic valve lifters in the same order as removed.

13. Remove the rocker arms and push rods.
14. Remove the cylinder head and gasket. See Figure 5.

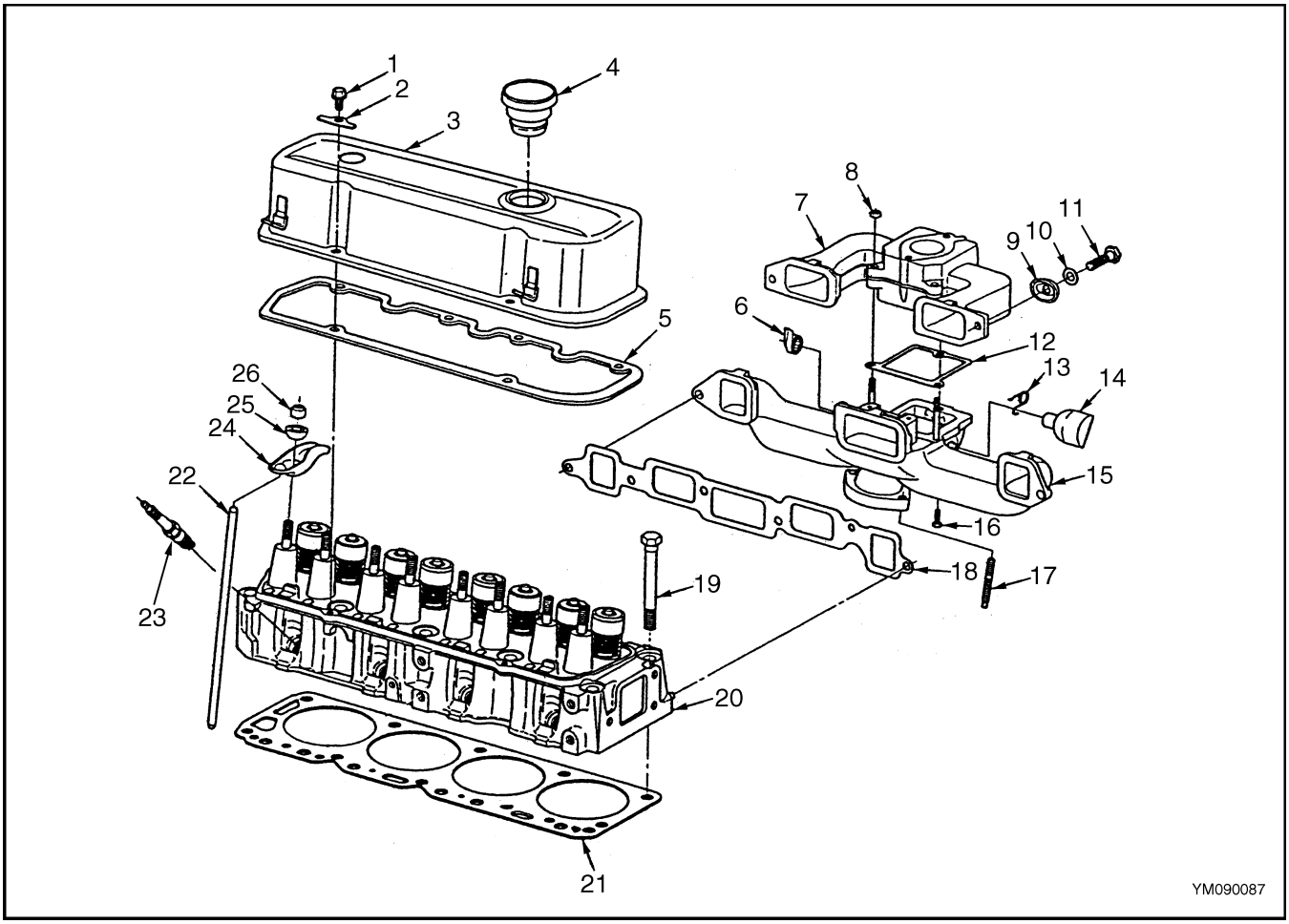
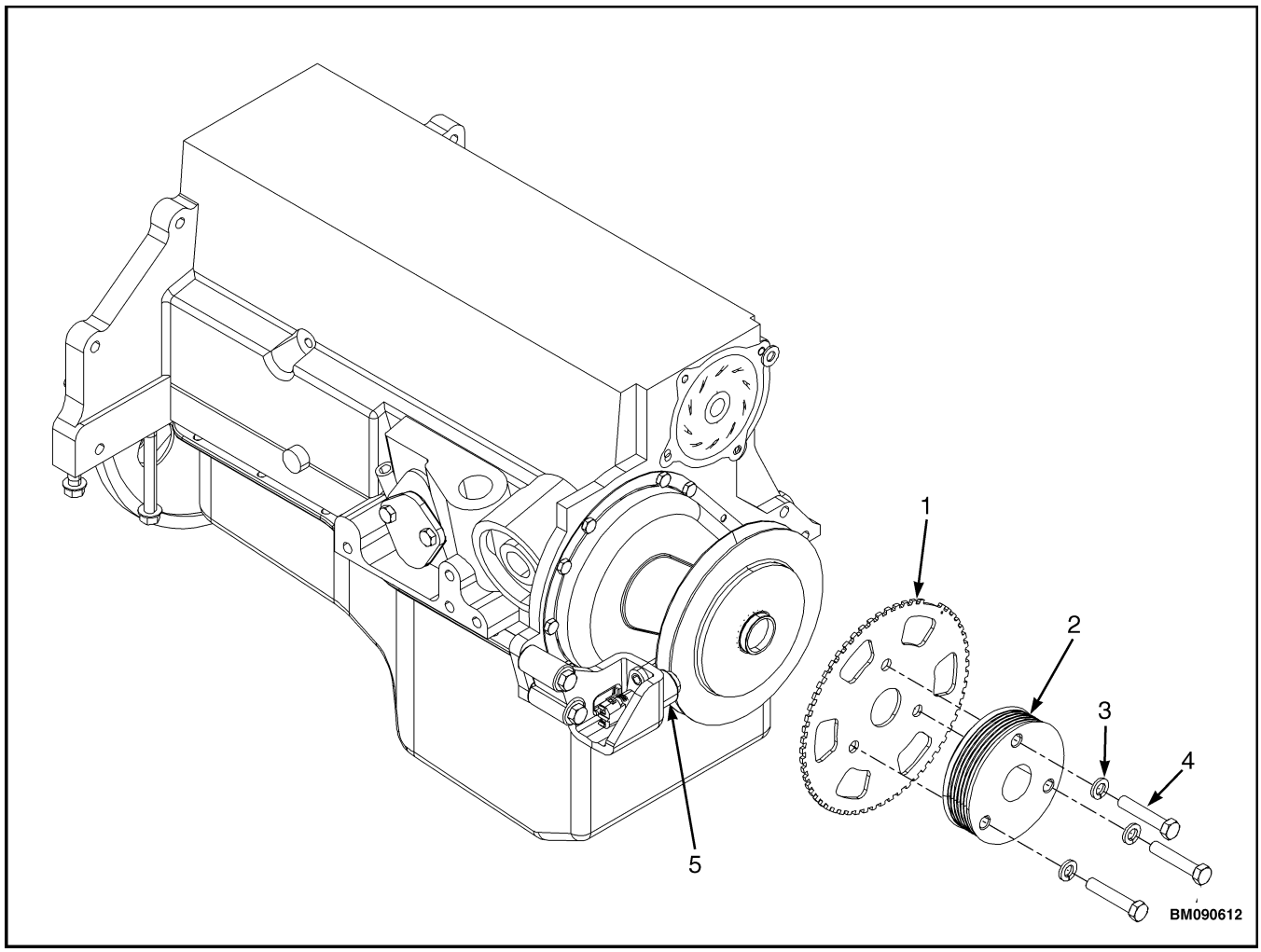


Figure 5. Cylinder Head



1. TIMING WHEEL
2. PULLEY, SERPENTINE BELT
3. WASHER (3 EA)
4. CAPSCREWS (3 EA)
5. SENSOR

Figure 26. Timing Wheel

AIR GAP ADJUSTMENT

1. Disconnect wire connector to the crankshaft position sensor.

2. Loosen the two crankshaft position sensor mounting bracket capscrews.

NOTE: Be sure to use a brass feeler gauge when measuring the air gap during installation.

3. Check air gap between the sensor and timing wheel and ensure clearance is to specification. Specification clearance adjustment is 0.508 - 1.143 mm (0.020 - 0.045 in.) shown in Figure 27.

4. Tighten the two crankshaft position sensor mounting bracket capscrews. Tighten the capscrews to 14 N•m (130 lbf in).

5. Check air gap and ensure clearance to specification by moving the brass feeler gauge in and out of the gap freely.

NOTE: If the feeler gauge does not move freely, repeat Step 2 through Step 5.

6. Connect crankshaft position sensor connector.

7. Start engine.

8. Perform On-Board Diagnostic system check.

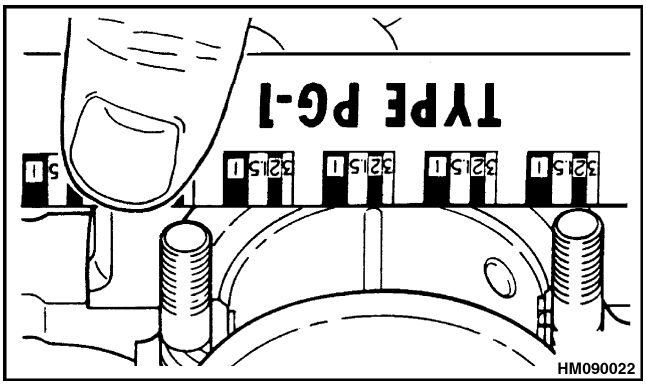


Figure 41. Bearing Journal Plastigage® Measurement

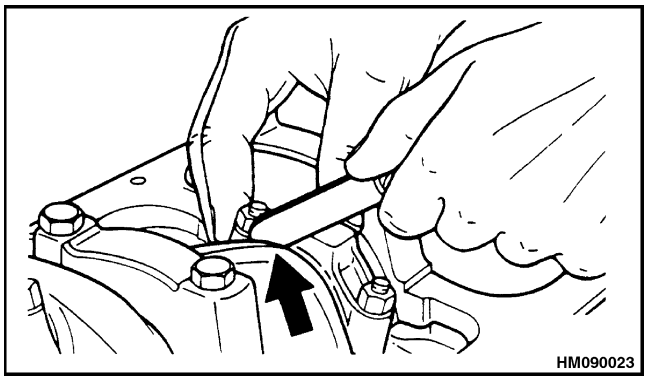


Figure 42. Piston Rods Side Clearance Measurement

d. If the clearance is greater than the specifications, select a new undersize bearing set and install it. Measure the clearance again. If the clearance cannot meet specifications with the available undersize bearings, the bearing journal must be ground to a new undersize. If the bearing journal is already at the maximum undersize, the crankshaft must be replaced.

e. If the clearance is within specifications, lubricate the bearing with engine oil and install the bearing and bearing cap. Tighten the nuts on the bearing cap to 88 N•m (65 lbf ft).

7. When all of the connecting rod bearings have been replaced, use the following procedure to check the side clearances between the piston rods and the crankshaft:

a. Use a hammer to lightly hit the piston rod parallel to the crankshaft journal to make sure there is a clearance.

b. Measure the clearance between the caps for the piston rods and the crankshaft. See Figure 42.

PISTON AND PISTON ROD ASSEMBLIES, REMOVE

1. Remove the oil pan and the oil pump.

2. Remove the cylinder head as described in Cylinder Head, Remove.

3. If the engine has been in service for many hours, a ridge can be worn in the top of the cylinder. This ridge can be removed with a ridge reamer tool using the procedures described below:

a. Turn the crankshaft to lower the piston to the bottom of the stroke in its cylinder.

b. Put a cloth on top of the piston to collect metal particles.

c. Remove the ridge at the top of the cylinder.

d. Turn the crankshaft so the piston is at the top of the stroke.

e. Remove the cloth.

f. Remove the cutting debris.

4. Clean the carbon from the top of each cylinder.

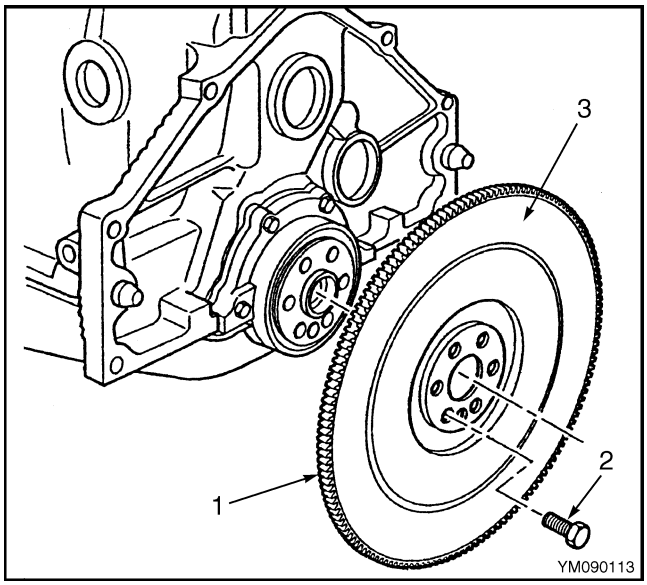
5. Put an identification mark on the top of each piston.

6. Remove the caps and bearings from each piston rod. Keep the caps and bearings with their original piston assemblies. Mark the caps so that they will be installed again in their original positions. Do not mix the parts.

7. Push the piston rod and piston from the cylinder. Temporarily install the bearing cap on the piston rod to keep the parts together.

FLYWHEEL, INSTALL

1. Install the engine flywheel. See Figure 64.
2. Install the flywheel bolts and tighten them to 88 N•m (65 lbf ft).



1. RING GEAR
2. BOLT
3. FLYWHEEL

Figure 64. Flywheel Installation

Cooling System Repair

WATER PUMP

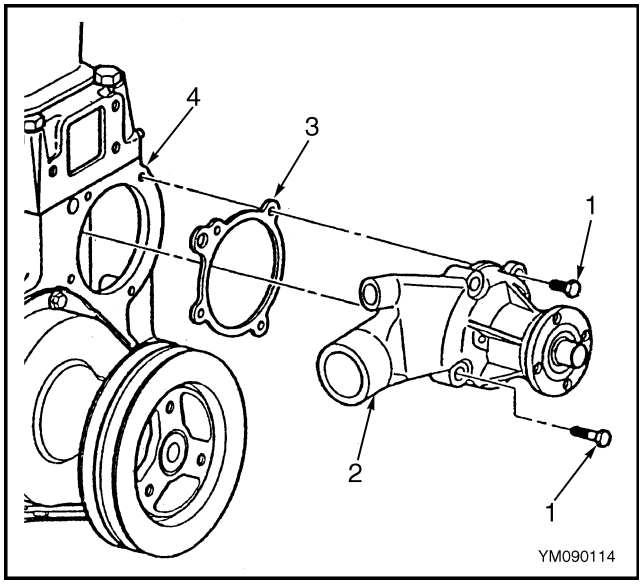
Remove

NOTE: This section covers the removal, inspection, and installation of the water pump and the removal and installation of the thermostat. For a description of how the water pump, thermostat, and other components of the cooling system operate, see the section **Cooling System** 700 SRM 626.

1. Drain engine coolant from the cooling system.
2. Remove the water pump bolts. See Figure 65.
3. Remove the water pump and gasket. Discard the water pump gasket.

Inspect

1. Inspect the water pump for the following:
   - **a.** Worn or damaged gasket sealing surfaces.
   - **b.** Excessive side-to-side play in the pulley shaft.



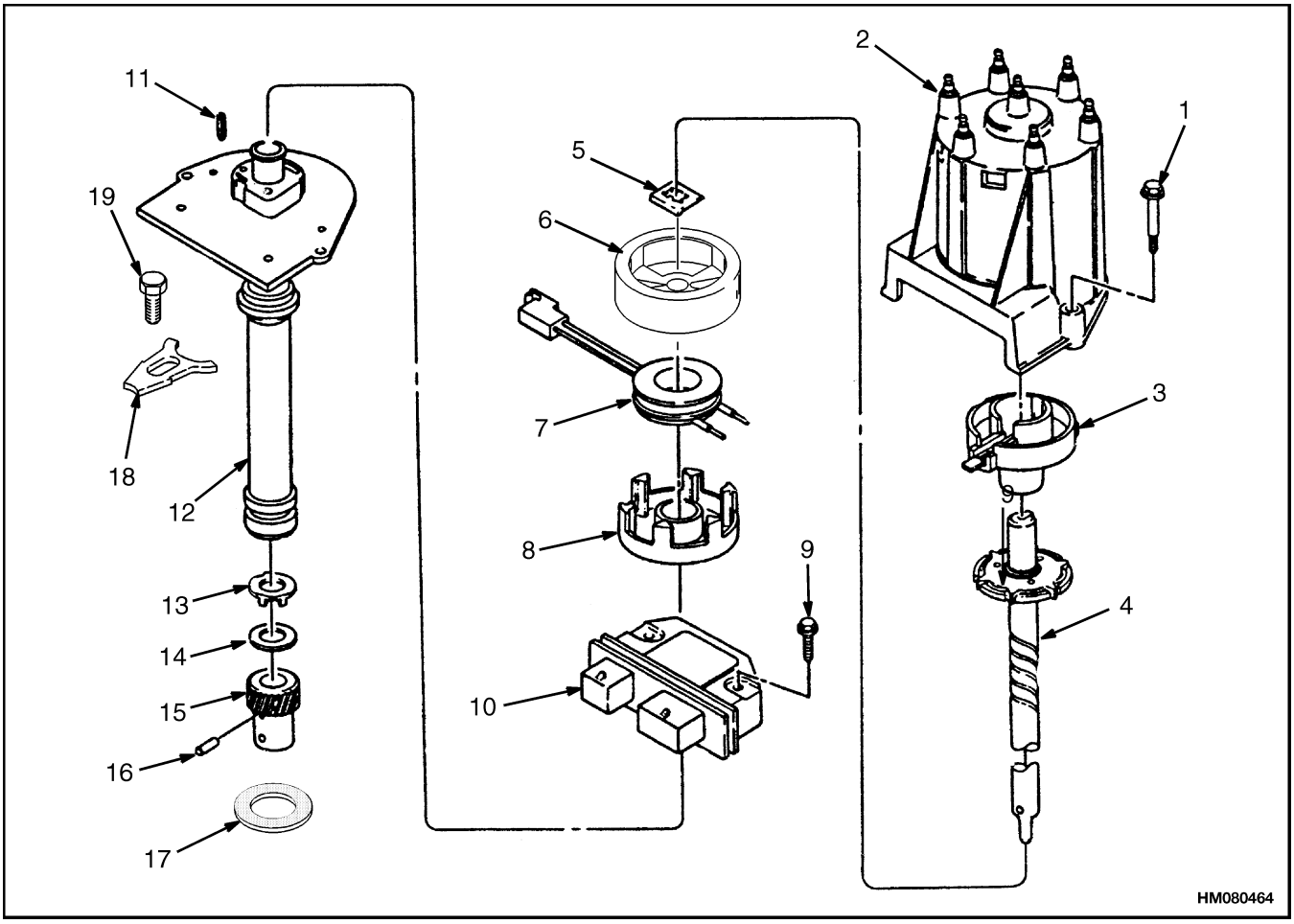
1. BOLTS
2. WATER PUMP
3. GASKET
4. ENGINE BLOCK

Figure 65. Water Pump

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
The engine does not have enough power.	The air filter is dirty.	Clean or install a new air cleaner.
	The fuel is the wrong type.	Drain and fill fuel tank with the correct fuel type.
	The ignition timing is not correct.	Check timing.
	The valve mechanism does not operate correctly.	Repair parts of valve mechanism.
	The piston assemblies are worn or damaged.	Install new pistons.
	The spark plugs are the wrong type or they are not installed correctly.	Install new spark plugs.
	The valve timing is not correct.	Check valve mechanism.
	The exhaust system has restrictions.	Clean or repair exhaust system.
There is noise inside the engine.	The main bearings are worn or damaged.	Install new bearings.
	The bearings for the piston rods are worn or damaged.	Install new bearings.
	The pistons are worn or damaged.	Install new pistons.
	The engine is too hot.	Check the cooling system.
	There is not enough oil in the engine.	Fill the engine to the correct level.
	The flywheel is loose.	Tighten the capscrews for the flywheel.
	A piston rod is bent.	Repair the engine.
	There is a leak in the exhaust system.	Repair the exhaust system.
	A valve lifter has a problem.	Check the valve lifters.
	The valve mechanism does not operate correctly.	Repair the valve mechanism.

Legend for Figure 5

1. PIN
2. DRIVE GEAR
3. O-RING
4. WIRING HARNESS
5. HOUSING
6. WIRE RETAINER
7. FELT WASHER
8. SHIM
9. CAPACITOR
10. POLE PIECE/SENSING COIL
11. SNAP RING
12. ELECTRONIC MODULE
13. CAP (FOUR-CYLINDER SHOWN)
14. ROTOR
15. TIMER CORE
16. SHAFT
17. CENTRIFUGAL MECHANISM



1. SCREW
2. DISTRIBUTOR CAP
3. ROTOR
4. SHAFT ASSEMBLY
5. RETAINER
6. SHIELD
7. SENSING COIL
8. POLE (STATIONARY)
9. BOLT
10. ELECTRONIC MODULE
11. PIN
12. HOUSING
13. THRUST WASHER
14. SHIM
15. GEAR
16. PIN
17. GASKET
18. CLAMP
19. BOLT

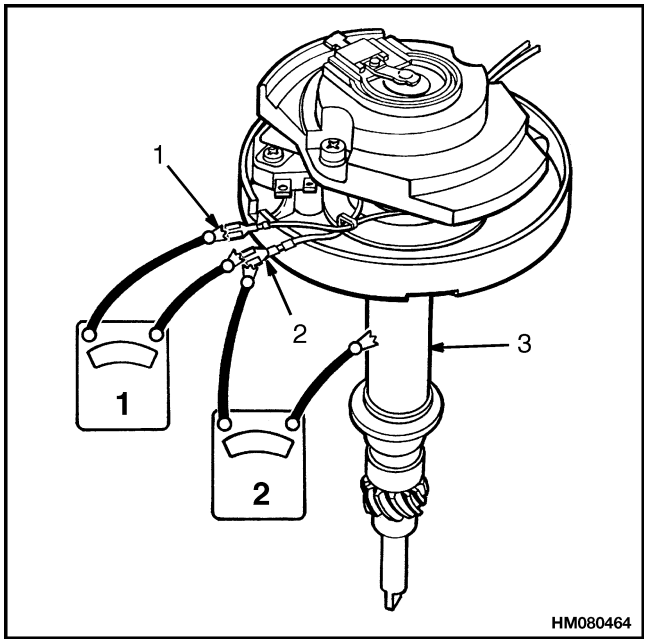
Figure 6. GM V6 Models

SENSING COIL, CHECK

1. Disconnect wire from negative terminal of battery.
2. Disconnect primary wiring connector to distributor.
3. Unlock latch screws that fasten cap to housing. Carefully remove cap and put it away from distributor.

NOTE: Some models use separate terminals. Some models use a double terminal.

4. Disconnect white and green wires from electronic module.
5. Set ohmmeter to a middle scale. Connect ohmmeter as shown in step 1 of Figure 16. If the ohmmeter indicates less than 500 ohms or more than 1500 ohms, install new part and Step 5.
6. Set ohmmeter to a high scale. Connect ohmmeter as shown in step 2 of Figure 16. Do step 2 for each wire. If the meter indication is less than infinity, install new coil and repeat Step 5 and Step 6.



1. GREEN WIRE
2. WHITE WIRE
3. HOUSING

Figure 16. Sensing Coil Checks

Electronic Module Check

The electronic module can be tested only with a special tool. Use the procedure given by the manufacturer to test the electronic module. If needed, get tool number J-24642 from the Kent-Moore Tool Division, Jackson, Michigan.

Ignition Timing Adjustment

1. If equipped with vacuum advance, disconnect vacuum line at distributor and put a plug in the line.

CAUTION

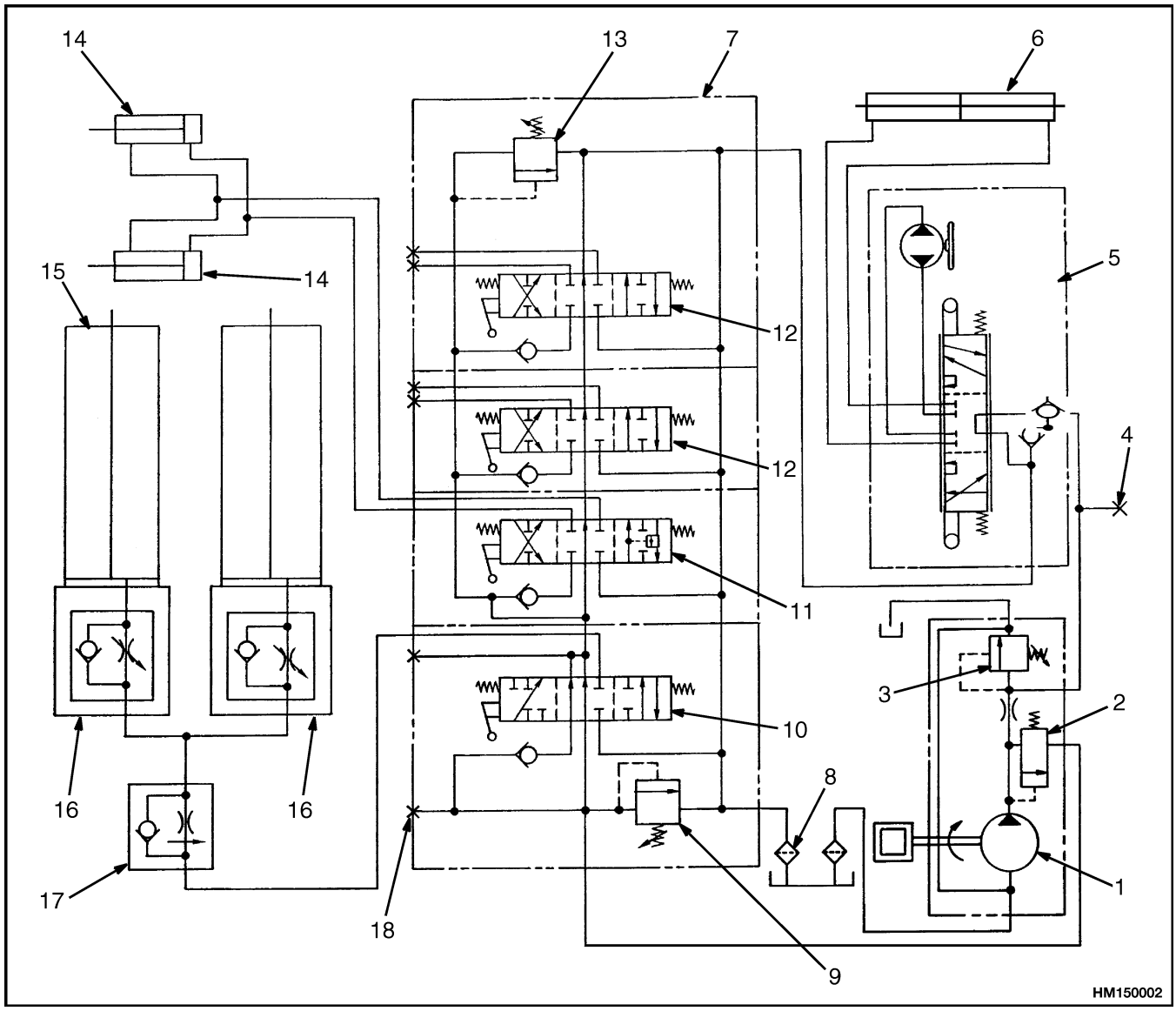
Not all tachometers will give the correct indication of speed when connected to the HEI system. Check with the manufacturer of the tachometer to make sure it will work with HEI.

2. Connect tachometer to tachometer terminal.
   a. Some four- and six-cylinder engines, connect at the ignition coil. (See Figure 9.)
   b. V8-350, some four- and six-cylinder engines, connect at the distributor. (See Figure 11.) (Also see GM V8-366 (6-liter) Ignition System Check.)

CAUTION

Not all timing lights will give the correct indication when connected to the HEI system. Check with the manufacturer of the timing light to make sure it will work with HEI.

3. Connect timing light to spark plug wire that goes to number one cylinder. Make other connections described by the manufacturer.



1. HYDRAULIC PUMP
2. FLOW CONTROL VALVE
3. RELIEF VALVE (STEERING SYSTEM)
4. CHECK PORT (STEERING SYSTEM)
5. STEERING CONTROL UNIT
6. STEERING CYLINDER
7. MAIN CONTROL VALVE
8. FILTER
9. RELIEF VALVE (LIFT CIRCUIT)
10. LIFT/LOWER SPOOL
11. TILT SPOOL
12. AUXILIARY FUNCTION SPOOL
13. RELIEF VALVE (TILT AND AUXILIARY CIRCUITS)
14. TILT CYLINDER
15. LIFT CYLINDER
16. LOWERING CONTROL VALVE (INTERNAL)
17. LOWERING CONTROL VALVE (EXTERNAL)
18. CHECK PORT (LIFT AND TILT CIRCUITS)

Figure 2. Hydraulic System Schematic

NOTES

charged or a charged battery must be installed before lift truck operation can continue. The top green bar will be illuminated when the battery is more than 90% charged.

The controller also checks the battery voltage each time a battery is connected. The traction control will prevent lift truck operation if the battery voltage is not correct as set by traction function 15. A status code of −16 (voltage too high) or −15 (voltage too low) will indicate on the digital display. The battery can have a voltage that is too high or too low. A battery with the correct voltage can also be deeply discharged from use or other reasons and have a voltage that is less than the minimum of the voltage range.

Batteries that have different ampere-hour ratings or are of different ages can sometimes be used in the same lift truck. It can be necessary to adjust traction function 14 of the EV-100ZX motor controller so that the weakest battery is not damaged. Follow the procedure for adjusting traction function 14 in one of the following service manual sections: **EV-100ZX™ SCR Motor Controller** 2200 SRM 557 or **EV-T100™ Transistor Motor Controller** 2200 SRM 581.

2. **Digital Display**. This four-digit LED display is blank when the lift truck is operating correctly. The status codes and the hourmeter values are shown on this display. When the status code Indicator is illuminated, the status code is shown. When the hourmeter and either the hydraulic motor or traction motor indicators are illuminated, the operating hours are shown. When a problem occurs, the status code will be shown with a dash (−) in the left digit position together with three numbers. The warning LED for the service interval will also be illuminated when a problem occurs.

   When it is time for periodic maintenance, the warning LED for the service interval will be illuminated and a status code -99 will be indicated. The traction motor or hydraulic motor indicator will also be illuminated to show which system needs maintenance. The register in the controller card must be reset by the service person before the service interval LED will go **OFF**.

   The digital display for the hourmeter shows the operating time of 0000 to 9999 hours. The time for the traction circuit is shown for 4 seconds after the lift truck has been operating and the key is moved to the **OFF** position. The LED indicators for the traction motor and for the hourmeter will also be illuminated during this time. If there is an SCR control card for the hydraulic pump motor, the operating time of the pump motor will then be shown on the digital display for another 4 seconds. The LED indicators for the hydraulic motor and for the hourmeter will also be illuminated during this last 4 seconds.

3. **Warning LED, Fasten Seat Belt**. The red LED is **ON** for 8 to 10 seconds after the key switch is moved to the **ON** position.

4. **Warning LED, Brake Fluid Reservoir Is Low**. The red LED is **ON** for 1 second when the key switch is moved to the **START** position and must go **OFF** during operation. If the warning LED is **ON** during operation, the brake fluid level in the reservoir is too low.

5. **Warning LED, Parking Brake Indicator**. The red LED is **ON** when the parking brake is applied and goes **OFF** when the parking brake is released.

   A buzzer is **ON** for 8 to 10 seconds if the parking brake is NOT applied and the seat switch opens or the key is moved to the **OFF** position.

6. **LED Indicator, Steering Pump Motor**. This LED will illuminate with another warning LED if the brushes in the steering pump motor are too worn. If the brush wear sensor is activated in the motor, the warning LED for brush wear will go **ON** and the LED indicator for the steering pump motor will show that this motor has the problem.

7. **Warning LED, Motor Brushes are Worn**. When the sensor for brush wear closes, this warning LED and the LED indicator for the motor that has the problem will both illuminate. The indicator will stay **ON** until the key is moved to the **OFF** position.

8. **LED Indicator, Traction Motor**. This LED will illuminate with another warning LED if the traction motor is too hot or the brushes are too worn. For example, if the brush wear sensor is activated in the motor, the warning LED for brush wear will go **ON** and the LED indicator for the traction motor will show that this motor has the problem.

to the connector. After removing screws that fasten front cover, carefully disconnect connector. It can be necessary to disconnect key switch wires (Step 4) and two-wire connector for enough clearance to disconnect 18-pin connector. Remove two screws that fasten LED assembly to housing. Install replacement LED assembly. Carefully connect all connectors and wires. Install front steering column cover with display panel assembly attached. Install LED gasket over LED indicators.

8. If necessary, install new O-ring gasket. Carefully install O-ring gasket in groove of top cover. Carefully install top cover assembly over LED indicators and assembly housing without damaging either LED gasket or O-ring gasket. Make sure O-ring gasket is still correctly aligned with cover and housing before installing screws. Install eight screws that fasten top cover to panel housing and tighten them in a cross pattern.

ENHANCED DISPLAY PANEL PARTS, REPLACE

The only replaceable parts of the enhanced display panel are the O-ring seal, key switch, wires to the key switch, and the housing that fastens to the steering column. All other parts of the panel must be replaced as a single unit. See Display Panel Assembly, Replace and Figure 3.

Curtis 1215 Display Panel Replacement

REMOVE

The Curtis 1215 Display Panel is located in the front cover over the battery compartment. The display panel cannot be repaired and must be replaced if it is faulty.

1. Move lift truck to a safe, level area. Turn key switch to **OFF** and remove key. Put a DO NOT OPERATE tag on the multifunction control handle. Put blocks under drive wheels to keep lift truck from moving. Refer to How to Put Lift Truck on Blocks in the section **Periodic Maintenance**.

WARNING

Disconnect battery and separate connector before opening compartment cover or inspecting or repairing electrical system. If a tool causes a short circuit, the high-current flow from the battery can cause an injury or parts damage.

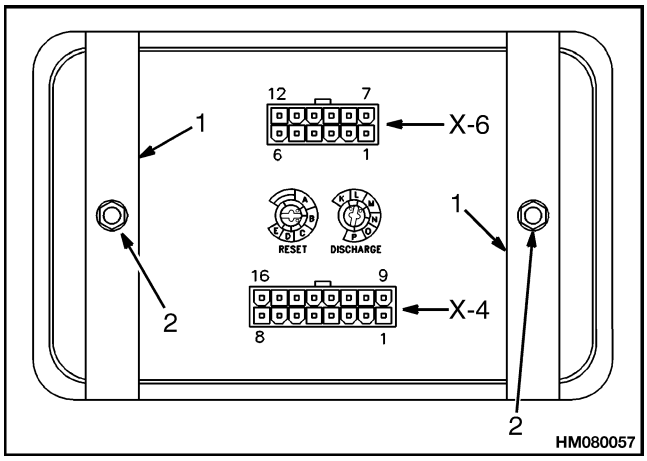
2. Disconnect and separate battery connector.

3. Remove hydraulic tank dipstick.

4. Remove socket head capscrews retaining battery compartment cover. Remove battery compartment cover.

5. Disconnect two plugs X-4 and X-6 from rear of display assembly.

6. Remove two nuts and brackets that fasten display assembly to instrument panel. See Figure 10. Remove display assembly.



1. MOUNT BRACKET 2. MOUNT NUT

Figure 10. Curtis 1215 Mount

INSTALL

1. Adjust pots on rear of dash display assembly.

2. Connect two plugs X-4 and X-6 to rear of dash display.

3. Position display assembly in instrument panel. Install nuts and brackets to rear of display to fasten display assembly to instrument panel.

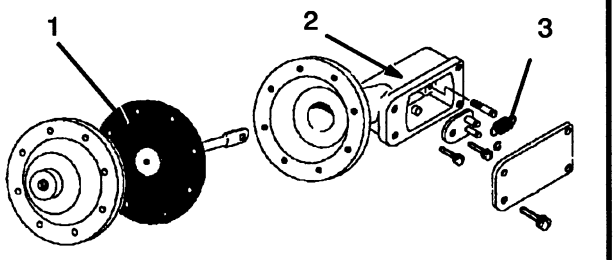
4. Install battery cover.

5. Reinstall hydraulic tank dipstick.

6. Remove blocks from under drive wheels. Remove DO NOT OPERATE tag. Connect battery and install key.

Governor System (See FIGURE 1. and FIGURE 9.)

The governor system controls the maximum engine speed under variable load conditions. A sudden decrease of the engine load can cause the engine speed to increase beyond the specification limits. A sudden increase in engine load can decrease the engine speed. The governor system controls these sudden changes in engine speed.



1. DIAPHRAGM ASSEMBLY
2. GOVERNOR BODY
3. CONTROL SPRING

FIGURE 9. GOVERNOR

The governor attaches to the carburetor throttle assembly. The governor controller is on the cowl in the operator's compartment. Vacuum lines connect the governor solenoid valve to the carburetor and to the diaphragm of the governor. The governor controller is electrically connected to the governor solenoid valve and the engine speed sensor on the engine.

The operation of the governor is controlled by an electronic controller. Manifold vacuum and air pressure provide the force to actuate the governor. The electronic controller controls this force. The governor diaphragm operates the throttle plate of the carburetor. Linkage from the diaphragm closes the throttle plate when the vacuum is high. A spring in the governor opens the throttle plate.

The electronic controller is connected to the ignition system and controls the operation of the governor solenoid valve. The governor solenoid valve controls the vacuum at the diaphragm in the governor. During operation, the electronic controller receives the engine speed signals. As the engine speed reaches the governed speed, current flows to the governor solenoid valve. The solenoid valve closes, causing vacuum to operate the diaphragm. When actuated, the diaphragm works against the governor spring to close the throttle plate and decrease engine speed. The governor solenoid valve opens and closes as necessary to keep the engine speed within the governor limits.

REPAIRS

REPLACEMENT OF THE HOSES

The hoses installed on LPG systems are special. Hoses that are made for use with hydraulic oil are damaged by LPG. When replacing the LPG hoses, make sure to use only HYSTER Approved LPG hose. Make sure to use the correct size of hose. When replacing the hose to the quick disconnect fitting, make sure that it is the same length as the hose it replaces. A hose that is the wrong length permits the tank to be installed in a position that is not correct.

LPG TANK

Removal (See FIGURE 10.)

⚠ WARNING

Before disconnecting any part of the LPG fuel system, close the shut-off valve on the fuel tank. Run the engine until the fuel lines are empty and the engine stops. If the engine will not run, close the shut-off valve on the fuel tank and release the fuel slowly in a non-hazardous area.

⚠ WARNING

LPG can cause an explosion even when the tanks are empty. When replacing the tanks, do not weld, cause sparks or permit flammable material on or near the tanks. Do not change tanks when the engine is running. Tanks must be filled by authorized personnel. Follow all the safety rules. Do not remove any parts from the tank. Use a cloth to protect your hands from cold metal.

Frost on the surface of the tank, the valves or fittings and the odor of LPG fuel indicates a leak. Inspect the LPG system and repair a leak immediately. An LPG fuel leak creates an explosion and fire hazard. Do not attempt to start the engine if there is a leak in the LPG fuel system.

3. Changing the adjustment of the idle mixture screw (2) will change engine speed. Adjust the mixture screw (2) for maximum engine rpm.

4. Check and adjust idle speed as necessary as described in step 2.

5. Repeat steps 3 and 4 maximum idle speed from adjusting the idle mixture screw is the same specified idle speed.

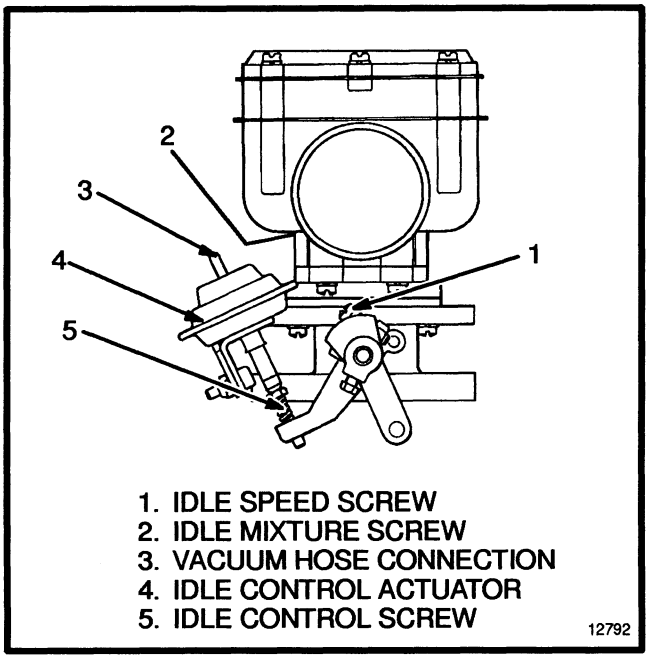


FIGURE 15. CARBURETOR ADJUSTMENTS, 2.2L ENGINE

6. Turn idle mixture screw OUT until idle speed begins to decrease. Turn idle mixture screw (2) IN 1/4 turn.

7. Check the idle control adjustment as follows:

a. Adjust the idle speed and mixture as described above.

b. Adjust the idle control screw (5) until there is 0.1 to 0.2 mm (0.004 to 0.008 in) clearance between the screw (5) and the rod in the actuator (4).

c. Disconnect the vacuum hose from the actuator (3) and check engine speed. If engine speed is below 1400 rpm, no adjustment is needed. If engine speed is more than 1400 rpm, adjust the idle control screw (5) until engine speed is 1300 to 1400 rpm.

d. Install the vacuum hose and clamp to the idle control actuator (4).

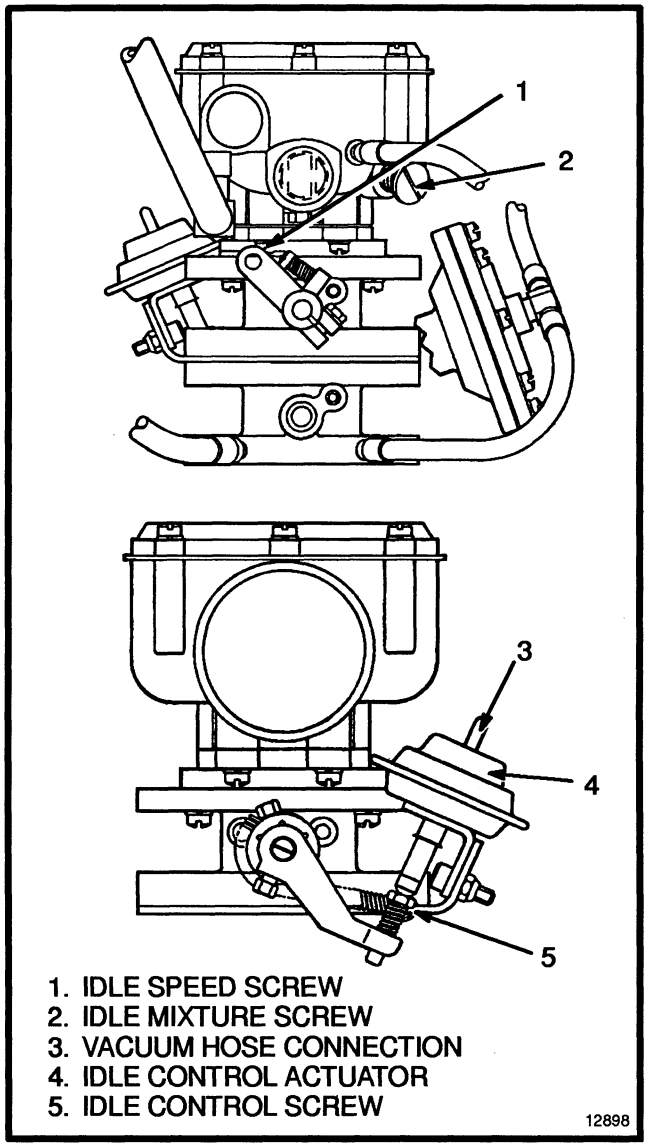
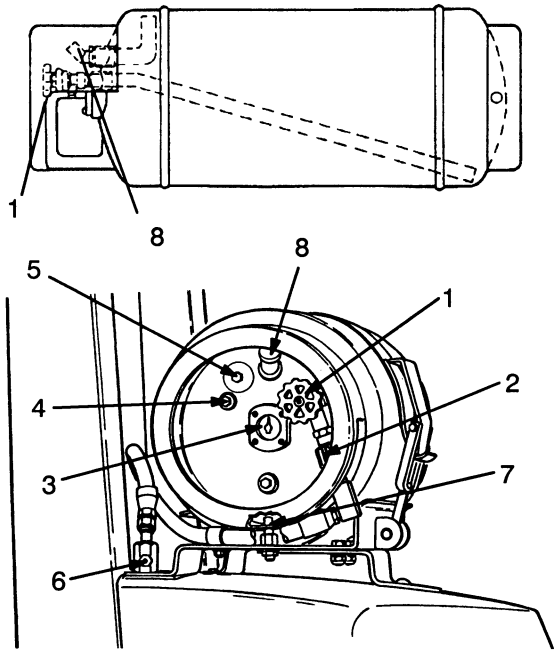


FIGURE 16. CARBURETOR ADJUSTMENTS, 3.0L ENGINE

Power Mixture (See FIGURE 17.)

The power mixture valve controls the flow of fuel to the carburetor when the engine is running near full load. Set the power mixture valve at the 3/8 mark (toward the L) for the 2.2L engine. For the 3.0L engine, set the power mixture valve to the 1/2 mark for the H-series units and to the 5/8 mark (toward the R) for the S-series. This setting will be correct for most conditions. If an exhaust analyzer is not available adjust the power mixture valve as follows:



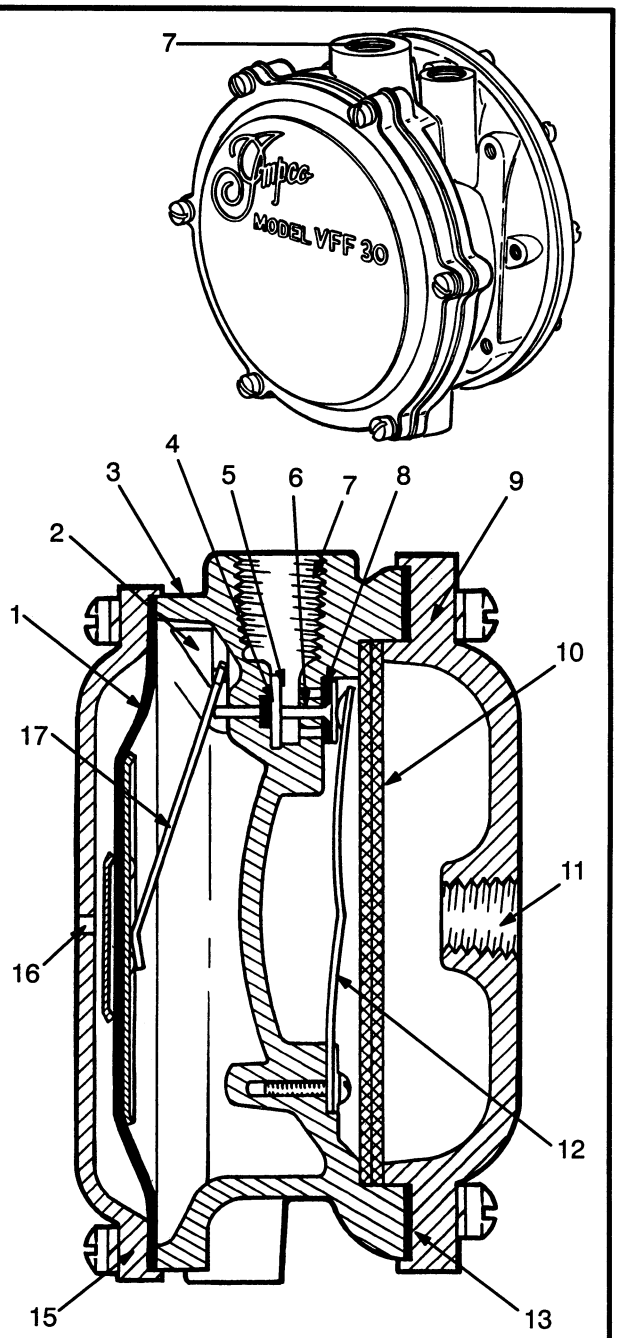
1. SHUT-OFF VALVE
2. QUICK DISCONNECT FITTING
3. FUEL GAUGE
4. PLUG
5. LIQUID LEVEL INDICATOR
6. RELIEF VALVE
7. ALIGNMENT PIN
8. TANK RELIEF VALVE

NOTE: Some LPG tanks have an auxiliary fill fitting instead of a plug for Item 4.

FIGURE 3. LPG TANK

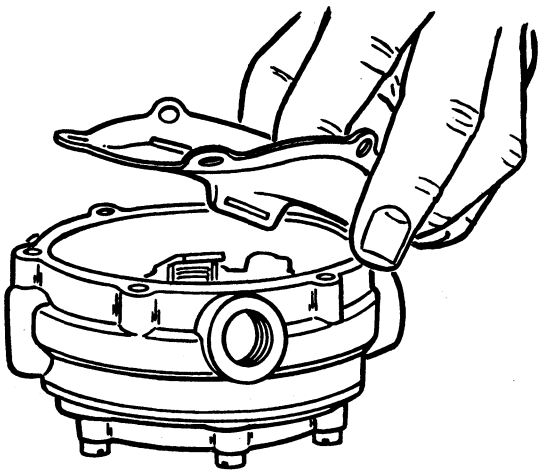
Fuel Filter and Fuel Valve Unit (See FIGURE 4.)

A fuel line connects the fuel tank to the fuel filter. The fuel filter prevents dirt from entering the vaporizer and has a fuel valve that is operated by engine vacuum. The fuel valve prevents fuel from entering the vaporizer unless the engine is being started or is running. The fuel valve has a leaf spring that holds a polyurethane pad against the seat. A diaphragm is used to open the fuel valve. Air pressure pushes on the vent side of the diaphragm. The other side of the diaphragm has inlet manifold vacuum and a lever and plunger that open the fuel valve. When the engine starts, the air pressure on the lever side of the diaphragm decreases. Then the air pressure on the vent side of the diaphragm moves the diaphragm, lever and pin to move the valve pad from the seat. Liquid LPG then flows through the fuel valve to the vaporizer.

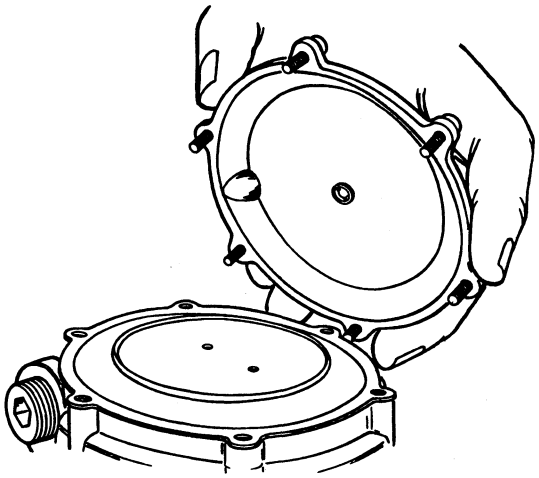


1. DIAPHRAGM
2. FULCRUM
3. VACUUM INLET
4. O-RING
5. WASHER
6. PIN
7. FUEL OUTLET
8. VALVE PAD
9. FILTER COVER
10. FILTER ELEMENT AND SCREEN
11. FUEL INLET
12. LEAF SPRING
13. GASKET
14. BODY
15. DIAPHRAGM COVER
16. AIR INLET
17. LEVER

FIGURE 4. FUEL FILTER AND FUEL VALVE



STEP 9:
Slide the lever into the slot in the diaphragm bracket. Install the diaphragm.



STEP 10:
Install the cover and tighten the screws.

FIGURE 15. ASSEMBLY OF THE VAPORIZER (3 OF 3)

CARBURETOR

Removal

1. Remove the hose from the air cleaner at the carburetor inlet. Disconnect the wires to the solenoid valve. Remove the fuel inlet hose at the solenoid valve. Remove the hose to the idle control actuator. Remove the fuel filter hose and vaporizer hose.

2. Disconnect the throttle cable at the carburetor. Remove the carburetor from the governor.

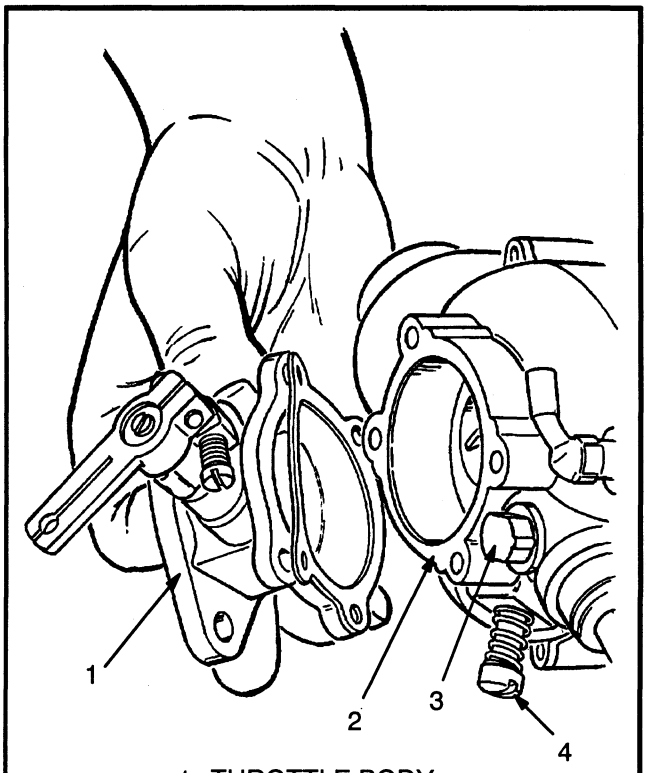
Disassembly (See FIGURE 16. and FIGURE 17.)

NOTE: Disassemble the throttle body and throttle shaft assembly only if the gaskets or seals must be replaced.

1. Remove the four screws from the diaphragm cover. Remove the cover and metering spring.

2. Remove the metering valve assembly from the carburetor body. Remove the four screws from the diaphragm back–up plate and disassemble the valve. The valve assembly includes a fuel metering valve, air measuring plate, diaphragm and back–up plate.

3. Remove the solenoid valve and the idle control actuator. Remove the idle mixture screw and spring.



1. THROTTLE BODY
2. CARBURETOR BODY
3. POWER VALVE
4. IDLE MIXTURE SCREW

FIGURE 16. THROTTLE BODY REMOVAL

4. Disconnect the throttle springs from the attachment plate. Remove the four screws that connect the throttle

TABLE OF CONTENTS

©2002 HYSTER COMPANY

ASSEMBLE

1. If removed, install spring and adjusting screw in lever. See Figure 10.
2. Install lever, throttle cable link, lockwasher, and nut on carburetor. Tighten nut to 10.5 ±1.5 N•m (93 ±13 lbf in).
3. Install idle control actuator and two screws on carburetor. Tighten screws to 3.9 ±0.5 N•m (34.5 ±4.4 lbf in).
4. Install power adjusting screw into carburetor until screw is seated. Unscrew power adjusting screw the number of turns specified for engine in lift truck. See Table 1.

Table 1. Power Adjusting Screw

Engine	2.0	2.2	GM
Number of Loosening Turns	6.25	6.25	3.2

5. Tighten jam nut to 13.5 ±1.5 N•m (119.5 ±13.3 lbf in).
6. Install idle speed adjusting screw into carburetor until screw is seated. Unscrew idle speed adjusting screw the number of turns specified for engine in lift truck. See Table 2.

Table 2. Air Adjusting Screw

Engine	2.0	2.2	GM
Number of Loosening Turns	1	1	1

7. Using two screws, install idle-up diaphragm on carburetor.
8. Install diaphragm (as noted during removal), spring, cover, and three screws. Tighten screws to 1.75 ±0.25 N•m (15.5 ±2.2 lbf in).

INSTALL

1. Install new gasket on governor. See Figure 1. Install carburetor on governor.
2. Connect power valve hose.
3. Connect hose to idle control actuator.
4. Connect fuel inlet hose.
5. Connect hose from air cleaner to bonnet.
6. Connect hose from carburetor (spark advance port) to distributor.
7. Check and adjust throttle linkage as described in Throttle Linkage Adjustment S/H2.00-3.20XM (S/H40-65XM) and Throttle Linkage Adjustment S/H1.50-2.00XMS (S/H25-40XMS).

Governor Repair

REMOVE

Disconnect vacuum hose from governor and remove governor from intake manifold. Remove and discard gasket.

INSPECT

Inspect governor assembly and all hoses for any damage. Replace any damaged components.

INSTALL

CAUTION

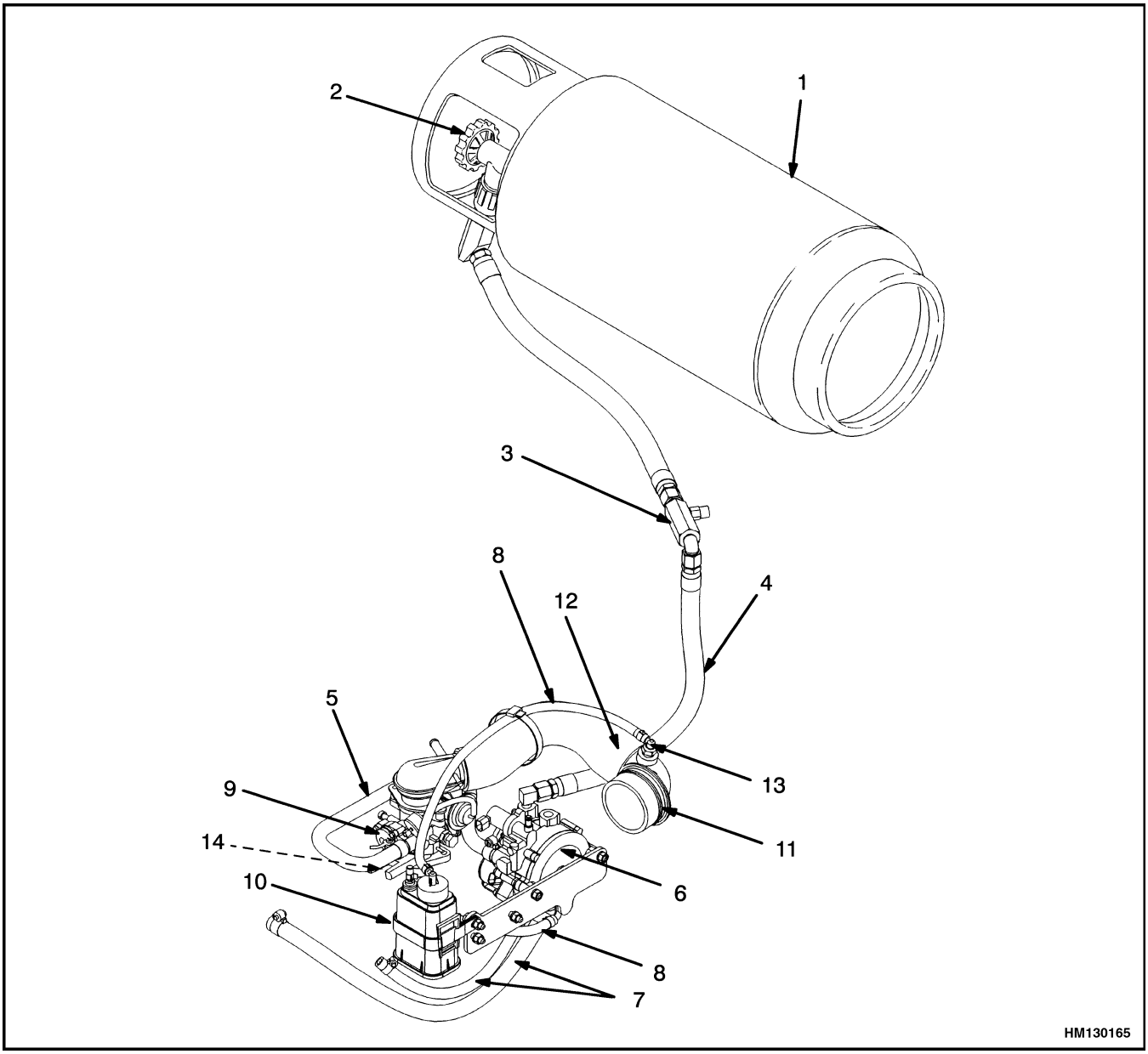
Make sure all gasket material has been cleaned from mating surfaces of intake manifold and governor. Gasket material left on either surface will affect performance of lift truck.

NOTE: The vacuum hoses installed on the carburetor and governor are made of special high-temperature material. If any of the hoses are replaced, make sure correct hoses are installed.

Install new gasket on intake manifold. Install governor on intake manifold and connect vacuum hose from governor.

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Engine will not start.	Fuel tank is either empty or fuel tank valve is closed.	Fill fuel tank or open fuel tank valve.
	There is tar accumulation in regulator.	Remove drain plug and drain tar from regulator.
	Fuel hose is disconnected or damaged.	Connect or replace fuel hose.
	Fuel filter is clogged.	Replace fuel filter and clean tar from regulator.
	Main fuel shutoff solenoid valve does not operate.	Disconnect solenoid from harness and connect directly to battery. Listen for a clicking sound. If solenoid does not energize, replace with new one.
	Idle fuel shutoff solenoid valve does not operate.	Disconnect solenoid from harness and connect directly to battery. Listen for a clicking sound. If solenoid does not energize, replace with new one.
	Main fuel shutoff solenoid connector is disconnected.	Connect main fuel solenoid connector.
	Idle fuel shutoff solenoid connector is disconnected.	Connect idle fuel solenoid connector.
	Main fuel shutoff solenoid wire harness is cut.	Repair or install new wiring harness.
	Idle fuel shutoff solenoid wire harness is cut.	Repair or install new wiring harness.
	Coil of idle fuel shutoff solenoid is damaged.	Using an ohmmeter, measure resistance between terminals. The measurement should be 22.5 ±0.2Ω at 21°C (70°F). Install new solenoid if measurement is incorrect.
	Coil of main fuel shutoff solenoid is damaged.	Using an ohmmeter, measure resistance between terminals. The measurement should be 8.5 ±0.5Ω at 21°C (70°F). Install new solenoid if measurement is incorrect.
	Main fuel shutoff solenoid valve is clogged.	Clean main fuel shutoff solenoid valve.



1. LPG TANK
2. SHUTOFF VALVE
3. RELIEF VALVE
4. LIQUID LPG HOSE
5. LPG VAPOR HOSE
6. REGULATOR/FILTER
7. COOLING SYSTEM HOSES
8. VACUUM/BALANCE LINE
9. LPG CARBURETOR
10. RESONATOR
11. AIR FILTER DISCHARGE ELBOW
12. AIR INTAKE HOSE
13. ORIFICE FITTING
14. FUEL INJECTOR

Figure 1. Aisan Closed-Loop LPG System

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL

- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: www.heydownloads.com by clicking the link below

- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

CLICK HERE TO DOWNLOAD THE COMPLETE MANUAL