Engine Controls - 6.5L

Specifications

Temperature vs Resistance

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
–5	23	12300
–10	14	16180
–15	5	21450
–20	–4	28680
–30	–22	52700
–40	–40	100700

RPM vs Hertz (Hz)

RPM vs Hertz (HZ) for High Resolution Signal

RPM	Hertz (Hz)	RPM	Hertz (Hz)	RPM	Hertz (Hz)
700	2987	1600	6827	2500	10667
800	3413	1700	7253	2600	11093
900	3840	1800	7680	2700	11520
1000	4267	1900	8170	2800	11947
1100	4693	2000	8533	2900	12373
1200	5120	2100	8960	3000	12800
1300	5547	2200	9387	3100	13227
1400	5973	2300	9813	3200	13653
1500	6400	2400	10240	3300	14080

RPM vs Hertz (Hz) for CAM and Crank Signal

RPM	Hertz (Hz)	RPM	Hertz (Hz)	RPM	Hertz (Hz)
700	47	1600	106	2500	166
800	53	1700	113	2600	173
900	60	1800	120	2700	180
1000	67	1900	126	2800	186
1100	73	2000	133	2900	193
1200	80	2100	140	3000	200
1300	89	2200	147	3100	207
1400	93	2300	153	3200	213
1500	100	2400	160	3300	220

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Filter Screws	2.8 N·m	25 lb in
Boost (BARO) Sensor Mounting Bolts	3.5 N·m	27 lb in
Crankshaft Position Sensor Mounting Bolt	25 N·m	18 lb ft
Driven Gear to Injection Pump Bolts	25 N·m	18 lb ft
EGR Control Pressure/BARO Sensor	3.5 N·m	27 lb in
Engine Control Temperature Sensor	25 N·m	18 lb ft
Frame Mounted Bracket Nuts	33 N·m	25 lb ft
Fuel Feed Pipe and Suction Pipe to Fuel Pump	30 N·m	22 lb ft
Fuel Manager/Filter to Intake Manifold Bolts	25 N·m	18 lb ft
Fuel Tank Filter Neck Clamp	2.5 N·m	25 lb in
Fuel Tank Off-Road Shield Bolts	35 N·m	26 lb ft
Injection Lines to Nozzle Fittings	25 N·m	18 lb ft
Injection Pump Flange Nuts	40 N·m	30 lb ft
Injection Nozzle	70 N·m	50 lb ft
Intake Air Temperature Sensor	25 N·m	18 lb ft
Upper Intake Manifold Cover Bolts	11 N·m	100 lb in
Water in Fuel Sensor Mounting Screws	2 N·m	13 lb in

Engine Scan Tool Data List

Use the scan tool data listed in this table for comparison after the On-Board Diagnostic system check and finding the on-board diagnostics function properly with no diagnostic codes displayed.

The Typical Scan Tool Data Values are an average of display values recorded from normally operating vehicles. The Typical Scan Tool Data Values are intended to represent what a normally functioning system would display. The values you get may vary due to a low battery charge or other reasons. But they should be very close.

Do not use a scan tool that displays faulty data. Report the problem to the manufacturer. The use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Use only the parameters listed in the tables for diagnosis. If a scan tool reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and the use of the scan tool diagnosis the PCM inputs, refer to the applicable diagnosis. If all values are within the range illustrated, refer to Driveability Symptoms.

Engine Scan Tool Data List

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Accessories Off				
Scan Tool Parameter	Data List	Units Displayed	Typical Data Value	Reference
A/B/C Range Switch	Engine Data 1	On On On/Off Off Off	On Off On	Automatic Transmission 4L80E
A/C Compressor	Engine Data 1	Engaged/ Disengaged	Disengaged	Engine Scan Tool Data Definitions
Accelerator Pedal Pos. 1	Engine Data 1, MAF EGR Data	Volts	0.44 - 0.95 (Idle) 0.75 - 1.25 (2500 RPM)	Information Sensors
Accelerator Pedal Pos. 2	Engine Data 1, MAF EGR Data	Volts	3.9 - 4.5 (Idle) 3.7 - 4.3 (2500 RPM)	Information Sensors
Accelerator Pedal Pos. 3	Engine Data 1, MAF EGR Data	Volts	3.6 - 4.1 (Idle) 3.5 - 4.0 (2500 RPM)	Information Sensors
A/C Relay	Engine Data 1	On/Off	Off	Engine Scan Tool Data Definitions
A/C Request	Engine Data 1	Yes/No	No	Engine Scan Tool Data Definitions
Actual EGR	Engine 1 Data, MAF EGR Data	kPa	80 - 104 kPa (All RPMs)	Engine Scan Tool Data Definitions
Actual Inj. Pump Timing	Engine Data 1, MAF EGR Data	°	4 - 10 (Idle) 14 - 20 (2500 RPM	Engine Scan Tool Data Definitions
APP Angle	Engine Data 1, MAF EGR Data	%	0 (Idle) 4-12 (2500 RPM)	Engine Scan Tool Data Definitions
BARO	Engine Data 1, MAF EGR Data	kPa	65 - 104 (varies with altitude)	Information Sensors
Boost Pressure	Engine Data 1, MAF EGR Data	kPa/PSI	60 - 170 kPa (All RPMs)	Information Sensors
Brake Switch	Engine Data 1	Open/Closed	Open	Information Sensors
Calc. A/C Load	Engine Data 1	Counts	0	Engine Scan Tool Data Definitions
Crank Reference Missed	Engine Data 1	Counts	0	Engine Scan Tool Data Definitions
Cruise Active	Engine Data 1	On/Off	Off	Engine Scan Tool Data Definitions
Cruise Brake Switch	Engine Data 1	Open/Closed	Closed	Information Sensors
Cruise Switch	Engine Data 1	On/Off	Off	Engine Scan Tool Data Definitions
Cylinder Air	MAF EGR Data	g/cyl	0.30 - 1.00 g/cyl (All RPMs)	Information Sensors
Desired Cylinder Air	MAF EGR Data	g/cyl	0.30 - 1.00 g/cyl (All RPMs)	Information Sensors
Desired EGR	Engine 1 Data, MAF EGR Data	kPa	80 - 104 kPa (All RPMs)	Engine Scan Tool Data Definitions
Desired Idle Speed	Engine Data 1, MAF EGR Data	RPM	630 - 650	Engine Scan Tool Data Definitions
Desired Inj. Pump Timing	Engine Data 1, MAF EGR Data	°	4 - 10 (Idle) 14 - 20 (2500 RPM	Engine Scan Tool Data Definitions
DTC Set This Ignition	Engine Data 1	Counts	Yes/No	Engine Scan Tool Data Definitions
ECT	Engine Data 1, MAF EGR Data	°C/ °F	85°C - 105°C /185°F - 220°F (varies with temperature)	Information Sensors
ECT Sensor	Engine Data 1, MAF EGR Data	Volts	2 - 3	Information Sensors
EGR Adaptive Learn Matr.	MAF EGR Data	Counts	0–4	Information Sensors

Engine Scan Tool Data List (cont'd)

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Accessories Off				
Scan Tool Parameter	**Data List**	**Units Displayed**	**Typical Data Value**	**Reference**
EGR Duty Cycle	Engine 1 Data, MAF EGR Data	kPa	0 kPa (All RPMs)	Engine Scan Tool Data Definitions
EGR Loop Status	MAF EGR Data	Open/Closed	Open	Information Sensors
EGR Sensor	Engine 1 Data, MAF EGR Data	Volts	4.60 - 4.85 volts (All RPMs)	Information Sensors
EGR Vent Sol.	Engine 1 Data, MAF EGR Data	On/Off	Off	Information Sensors
Engine Load	Engine Data 1	%	1–15	Engine Scan Tool Data Definitions
Engine Run Time	Engine Data 1, MAF, EGR Data	Hrs/Mins/Sec	Varies with engine run time	Engine Scan Tool Data Definitions
Engine Speed	Engine Data 1, MAF EGR Data	RPM	+/-100 RPM from desired	Engine Scan Tool Data Definitions
Engine Torque	Engine Data 1	ft lb	3–30	Engine Scan Tool Data Definitions
ESO Solenoid	Engine Data 1, MAF EGR Data	On/Off	On	Engine Scan Tool Data Definitions
Four-Wheel Drive Low	Enabled/Disabled	Disabled	Automatic Transmission	Information Sensors
Front Axle Switch	Locked/Unlocked	Unlocked	Automatic Transmission	Information Sensors
Fuel Rate	Engine Data 1, MAF EGR Data	mm3	7 - 15 (All RPMs)	Engine Scan Tool Data Definitions
Fuel Temperature Sensor	Engine Data 1, MAF EGR Data	°C/ °F	10°C - 90°C / 50°F - 194°F	Information Sensors
Glow Plug	Engine Data 1	Volts	0.0–0.2	Engine Scan Tool Data Definitions
Glow Plug System	Engine Data 1, MAF EGR Data	Disable/Enabled	Enabled on key up (times varies with temperature)	Engine Scan Tool Data Definitions
IAT	Engine Data 1, MAF EGR Data	°C/ °F	10°C - 90°C / 50°F - 194°F (temperatures may increase under heavy engine loads)	Information Sensors
Ignition Voltage	Engine Data 1, MAF EGR Data	Volts	12 - 14 (accuracy +/-0.4 volts)	Engine Scan Tool Data Definitions
Inj. Pump CAM Reference Missed	Engine Data 1	Counts	0	Engine Scan Tool Data Definitions
Inj. Pump Sol. Closure Time	Engine Data 1, MAF EGR Data	mS	1.70 - 1.90 (All RPMs)	Engine Scan Tool Data Definitions
Lift Pump	Engine Data 1	Volts	12 - 16 (0.6 volts higher than ignition voltage)	Engine Scan Tool Data Definitions
Lift Pump System	Engine Data 1/MAF EGR Data	Disabled/Enabled	Enabled	Engine Scan Tool Data Definitions
MAF	MAF EGR Data	g/s	20 - 35 g/s (Idle) 120 - 140 g/s (2500 RPM)	Information Sensors
MAF Frequency	MAF EGR Data	Hz	4000 - 4500 Hz (Idle) 7200 - 7800 Hz (2500 RPM)	Information Sensors
MIL	Engine Data 1, MAF EGR Data	On/Off	Off	Engine Scan Tool Data Definitions
Number Of DTCs	Engine Data 1	Counts	0	Engine Scan Tool Data Definitions

Engine Scan Tool Data List (cont'd)

Engine Idling/Lower Radiator Hose Hot/Closed Throttle/Park or Neutral/Accessories Off				
Scan Tool Parameter	**Data List**	**Units Displayed**	**Typical Data Value**	**Reference**
PCM in VTD Fail Enable	Engine Data 1	Yes/No	No	Engine Scan Tool Data Definitions
Resume Switch	Engine Data 1	On/Off	Off	Engine Scan Tool Data Definitions
Service Throttle Soon Lamp	Engine Data 1, MAF EGR Data	On/Off	Off	Engine Scan Tool Data Definitions
Set Switch	Engine Data 1	On/Off	Off	Engine Scan Tool Data Definitions
Startup ECT	Engine Data 1, MAF EGR Data	°C/ °F	varies (ECT at time of engine startup)	Engine Scan Tool Data Definitions
TDC Offset	Engine Data 1, MAF EGR Data	°	+0.75 to –1.75 (factory setting varies per engine)	Engine Scan Tool Data Definitions
Trans. Fluid Temp.	Engine Data 1	°C/ °F	50°C - 80°C/ 122°F - 158°F	Automatic Transmission 4L80E
Transmission Range	Engine Data 1	Park/Neutral/ Reverse/ Overdrive/ Drive 3/Drive 2/ Drive 1	Park/Neutral	Automatic Transmission 4L80E
Vehicle Speed	Engine Data 1, MAF EGR Data	MPH/km/h	0	Engine Scan Tool Data Definitions
VTD Auto Learn Timer	Engine Data 1	Active/Inactive	Inactive	Engine Scan Tool Data Definitions
VTD Fuel Disable	Engine Data 1	Active/Inactive	Inactive	Engine Scan Tool Data Definitions
VTD Fuel Disable Until Ign. Off	Engine Data 1	Yes/No	No	Engine Scan Tool Data Definitions
Wastegate Solenoid	Engine Data 1, MAF EGR Data	%	50 - 70 (Idle) 20 - 40 (2500 RPM)	Engine Scan Tool Data Definitions
1 - 2 Sol.	Engine Data 1	On/Off	On	Automatic Transmission 4L80E
2 - 3 Sol.	Engine Data 1	On/Off	Off	Automatic Transmission 4L80E

Engine Scan Tool Data Definitions

A list of each data message displayed on the scan tool will be explained in two groups; Engine or Transmission. This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Powertrain On-Board Diagnostic (OBD) System Check first. The OBD System Check will confirm proper system operation.

A/B/C Range Sw.–Range On On On/Off Off Off: They are used to detect which gear has been manually selected. Engine must be running. Refer to *Transmission Scan Tool Data Definitions* in Automatic Transmission-4L80–E.

A/C Compressor–Range engaged/disengaged: Indicates weather or not A/C compressor is engaged. The output test function in the scan tool can only activated with the key ON, and the engine OFF.

A/C Relay–Range Disabled/Enabled: Represents the commanded state of the A/C clutch control relay. The A/C clutch should be engaged with ON displayed.

A/C Request–Range ON/OFF: Represents the state of the A/C request input from the control head.

Actual EGR – Range 10–200 kPa, 0–5.0 Volts: Actual EGR vacuum going to the EGR valve.

Act. Inj. Timing–Range 0–25.0 Degrees: Current actual injection timing.

APP Angle–Range 0–100%: Computed by the PCM from APP module voltage (throttle position) and should display 0% at idle and 100% at wide open throttle.

APP 1–Range 0–5 Volts: The PCM uses the APP sensors to control fuel delivery as requested by the driver. Three APP sensors are located in a module at the base of the accelerator pedal. The PCM only requires information from one sensor, the other two serve as fail safes. APP 1 should read about 0.35–0.95 volts at idle to above 4.0 volts at wide open throttle.

APP 2–Range 0–5 Volts: The PCM uses the APP sensors to control fuel delivery as requested by the driver. Three APP sensors are located in a module at the base of the accelerator pedal. The PCM only requires information from one sensor, the other two serve as fail safes. APP 2 should read about 4.5 volts at idle and steadily decrease to about 1.0 volt at wide open throttle.

APP 3–Range 0–5 Volts: The PCM uses the APP sensors to control fuel delivery as requested by the driver. Three APP sensors are located in a module at the base of the accelerator pedal. The PCM only requires information from one sensor, the other two serve as fail safes. APP 3 should read about 4.0 volts at idle and steadily decrease to about 2.5 volts at wide open throttle.

BARO–Range 10–105 kPa, 0–5 Volts: The BARO reading is determined from the boost sensor at ignition ON, engine OFF. The BARO reading display represents barometric pressure and is used to compensate for altitude differences.

Boost Pressure–Range 10–200 kPa, 0–5.0 Volts: The amount of turbo boost pressure in the intake manifold. This is measured in kPa and volts. True boost pressure is determined by subtracting BARO from the actual reading.

Boost Solenoid–Range 0–100%: The PCM cycles the boost solenoid PWM ON and OFF. The ON time (duty cycle) of the solenoid valve is expressed as a percent. The Boost pulse width modulated solenoid meters the vacuum level at the wastegate valve actuator as commanded by the PCM.

Brake Switch–Range open/closed: When the brake pedal is applied, the switch sends a signal to the PCM to disengage the cruise control.

Calc. A/C Load–Range: The amount of load the A/C is putting on the engine.

Crank Ref. Missed–Range 0– 8: The scan tool will display the number of crank pulses missed. At idle it should read 0.

Cruise Active–Range ON/OFF: Indicates if the vehicle is in cruise control.

Cruise Brake Sw.–Range open/closed: Is used for stop lamps and a redundant cruise control disengagement switch.

Cruise Switch–Range ON/OFF: Indicates if the cruise switch (on turn signal lever) is in the ON position.

Cylinder Air – Range 0.25–1.25 g/cyl: The actual amount of air going through the MAF. The conversion of the MAF sensor readings into Grams per Cylinder (g/cyl).

Desired Cylinder Air – Range 0.25–1.25 g/cyl: The requested Cylinder Air by the PCM. This is based on engine load and speed.

Desired EGR – Range 10–200 kPa, 0–5.0 Volts: The PCM command for EGR vacuum.

Desired Idle–Range 0–3187 RPM: The idle speed that is requested by the PCM. The PCM will compensate for various engine loads based on engine coolant temperature to keep the engine at the desired speed.

Des. Inj. Timing–Range 0–25.5 Degrees: The amount of injection timing requested by the PCM.

Device Control–Range YES/NO: Indicates if the scan tool has taken control of a system under output tests.

DTC Set This Ign.–Range #: Indicates the total number of current DTCs set this ignition cycle.

ECT–Range –40°C to 151°C, –40°F to 304°F: The engine coolant temperature (ECT) sensor sends a signal to the PCM relative to engine coolant temperature. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the PCM will interpret the lower voltage as a warm engine.

ECT Sensor–Range 0–5 Volts: The engine coolant temperature (ECT) sensor sends a signal to the PCM relative to engine coolant temperature. The sensor is a thermistor which changes internal resistance as temperature changes. When the sensor is cold (internal resistance high), the PCM monitors a high signal voltage and interprets it as a cold engine. As the sensor warms (internal resistance decreases), the voltage signal will decrease and the PCM will interpret the lower voltage as a warm engine.

EGR Adaptive Learn Matrix – Range 0–15: The Adaptive Learn Matrix (ALM) bases itself on Mass Air Flow (MAF) to adjust the EGR control vacuum. As backpressure or other system variations increase over the life of the vehicle the ALM will trim the EGR control vacuum to compensate. The ALM has sixteen cells in which each cell covers a range of engine speed (RPM) and load (mm3).

EGR Duty Cycle–Range 0–100%: The PCM cycles the EGR solenoid PWM ON and OFF. The ON time (duty cycle) of the EGR solenoid valve is expressed as a percent. The EGR pulse width modulated solenoid meters the vacuum level at the EGR valve actuator as commanded by the PCM.

EGR Sensor – Range 0–5 Volts: The conversion of Actual EGR into a voltage.

EGR Vent Sol. – Range ON/OFF: The PCM commands the EGR vent solenoid to purge vacuum to the atmosphere when there is a desire to quickly turn off EGR flow.

Engine Load–Range 0–100%: The amount of load on the engine.

Engine Run Time–Range 00:00:00 (HRS/MIN/SEC): A measure of how long the engine has been operating. When the ignition is cycled to OFF the value is reset to zero.

Engine Speed–Range 0–9999 RPM: Engine speed is computed by the PCM from the crankshaft position sensor. If the crankshaft position sensor is inoperative, an rpm reading is taken from the injection pump cam signal. It should remain close to desired idle under various engine loads with the engine idling. Engine speed value is very accurate.

Engine Torque–Range 0–999 ft/lb: The amount of engine torque.

ESO Solenoid–Range ON/OFF: The ESO is located on the fuel injection pump. When the ignition switch is OFF, the ESO is in the NO FUEL position. It prevents fuel from entering the fuel injection pump.

4WDL Mode–Range: Indicates if vehicle is in the four wheel drive mode.

Front Axle Switch–Range Engaged/Disengaged: Indicates weather or not the front axle state is being detected by the PCM.

Fuel Rate–Range 0–80mm3: This reading is displayed in millimeters cubed (mm3). This is the amount of fuel the PCM is requesting.

Fuel Temp.–Range –28°C to 140°C, –18°F to 285°F: There is a thermistor located in the optical sensor that determines fuel temperature. When the sensor is cold (internal resistance high) the PCM monitors a high signal voltage which it interprets as low fuel temperature. As the sensor warms (internal resistance low) the voltage signal will decrease and the PCM will interpret the low voltage as warm fuel.

Glow Plug–Range 0–25.5 volts: The amount of voltage the glow plug system is drawing. The scan tool can be used to indicate if the glow plugs actually turned ON by monitoring the voltage drop. Also, a good functional check of the glow plug relay.

Glow Plug System–Range ON/OFF: Glow Plug System–Range ON/OFF Indicates whether or not the PCM has requested the glow plugs to be turned ON.

IAT–Range –40°C to 151°C, –40°F to 304°F: The intake air temperature sensor sends a signal to the PCM relative to the incoming air. The IAT is used by the PCM to adjust fuel delivery.

Ignition Volts–Range 0–25.5 volts: This represents the system voltage measured by the PCM at its ignition feed circuit. Ignition voltage is only present when the vehicle is running.

Inj. Pump Cam Reference Missed–Range 0–8: The scan tool will display the number of cam pulses missed. At idle it should read 0.

Inj. Pump Sol. Closure Time–Range 0.0–4.0 milliseconds: Indicates the amount of time the fuel solenoid takes to close. When engine load is increased, closure time will fluctuate.

Lift Pump–Range 0–25.5 volts: The amount of voltage the lift pump system is drawing. Also, a good functional check of the lift pump relay and oil pressure switch.

Lift Pump System–Range disabled/ enabled: Indicates whether or not the PCM has requested the lift pump to be turned ON. This display can not be used to determine if the lift pump is actually ON.

MAF – Range 0–6553.5 g/s: The mass air flow sensor measures the amount of air entering the engine during a given time. The PCM uses this information to monitor the EGR flow rates only.

MAF Frequency – Range 0–65535 Hz: This is the conversion of MAF from grams per second (g/s) into a frequency (Hz).

MPH km/h–Range 0–98 mph: Vehicle speed is a PCM internal parameter. It is computed by timing pulses coming from the vehicle speed sensor (VSS). Vehicle speed is used in checking TCC lock–up speed or speedometer accuracy. Speed is displayed in both miles per hour (mph) and kilometers per hour (km/h).

MIL Lamp–Range ON/OFF: Represents the commanded state of the Service Engine Soon (MIL) lamp.

# of Curr. DTCs–Range #: Indicates the total number of current DTCs set. Does not necessarily mean the MIL is illuminated.

PCM in VTD Fail Enable: The scan tool display is Yes or No. This will indicate that the PCM received a good password from the Passlock module and the vehicle has started and a failure has occurred. The PCM will continue to enable fuel.

PC Solenoid–On/Off: This value is the commanded state of the pressure control solenoid. Refer to *Transmission Scan Tool Data Definitions* in Automatic Transmission-4L80–E.

Resume Switch–Range ON/OFF: Indicates if the cruise control resume switch is activated. The scan tool may be used to determine if the cruise control resume set switch is functioning properly.

Set Switch–Range ON/OFF: Indicates if the cruise control set switch is activated. The scan tool may be used to determine if the cruise control set switch is functioning properly.

Startup Coolant – Range –40°C to 151°C, –40°F to 304°F: A reading of the vehicles coolant temperature at startup. This will change every key cycle.

STS Lamp–Range ON/OFF: Represents the commanded state of the service throttle soon lamp.

TCC Enabled–Range disabled/enabled: Indicates if TCC is engaged.

TDC OFFSET–Range –2.50 to + 2.50 Degrees: The PCM has the ability to determine the amount of offset needed to bring the engine to top dead center. This is used by the PCM to determine proper injection timing and fuel delivery. This value may be displayed as a positive or negative number.

TFT–Range– –40°C to 151°C, –40°F to 304°F: This value represents the input signal of the transmission fluid temperature sensor. Refer to *Transmission Scan Tool Data Definitions* in Automatic Transmission-4L80–E.

TFT Sensor–Range 0–5 volts: This value represents the input signal of the transmission fluid temperature sensor in voltage. Refer to *Transmission Scan Tool Data Definitions* in Automatic Transmission-4L80–E.

TR Switch–Range Park/Neutral, Reverse, Drive 4, Drive 3, Drive 2, Low and Invalid: These values represent the decoded sequence of the transmission range pressure switch assembly circuits and are to determine manual valve position.

VTD Auto Learn Timer: The scan tool display is Active or Inactive. The auto learn timer will indicate if the Vehicle Theft Deterrent (VTD) system is in learn mode and has not timed out (10 minutes.)

VTD Fuel Disable: The scan tool display is Active or Inactive. If the PCM has not received the correct password from the Passlock module the PCM will disable fuel to the fuel system, and Active will be displayed on the scan tool.

VTD Fuel Disable Until Ign. Off: The scan tool display is Yes or No. With the ignition ON and a VTD code stored, the scan tool will display Yes.

1–2 Sol 2–3 Sol–Range On Off/On Off: These values are the command status of the 1–2 and the 2–3 shift solenoids. ON represents a commanded energized state (current flowing through solenoid). OFF represents a commanded non–energized state (current not flowing through solenoid). Refer to *Transmission Scan Tool Data Definitions* in Automatic Transmission-4L80–E.

Freeze Frame and Failure Record Data Definitions: A freeze frame and failure record data list consist of as many of the same parameters as in an engine data list. The list below defines the parameters not found in an engine data list.

Fail Counter–Range (decimal): The number of ignition cycles that a test has ran and failed (at least once).

First Odometer–Range miles (x16): The amount of miles (in 16 mile increments) that the vehicle has traveled since the freeze frame or failure record has been stored.

Last Odometer–Range miles (x16): Every time a failure occurs, last odometer will reset to zero. The amount miles since the last failure (in 16 mile increments).

No Results Counter: The number of ignition cycles with out a result (pass or fail).

Pass Counter–Range (decimal): The number of ignition cycles that a test has ran and passed (at least once).

DTC List

The service information contained in this manual refers to the Federal calibration package. The export change is NOT reflected in the service information on the DTC's diagnostic support information page or in the Repair Instructions. Export vehicles may have differences in DTC types that will affect malfunction indicator lamp (MIL) operation.

Type A: The PCM illuminates the malfunction indicator lamp (MIL) on the first drive trip that the diagnostic runs and fails.

Type B: The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.

Type C: The PCM illuminates the service throttle soon lamp only when there is more than one DTC (Type C) stored.

Type C*: The PCM will not illuminate a service lamp but will store a Failure Record on the first drive trip that the diagnostic runs and fails.

If a system is malfunctioning and the associated DTC has been disabled (Type X), it may be beneficial to use the diagnostic table as a guide to aid in diagnosis. Many of the DTC tables include a functional check of the system that may pinpoint a problem. However, it is important to remember that the DTC tables are specifically designed for use only when a DTC is set. Therefore, a thorough understanding of the normal operation of the system being diagnosed is necessary. The use of the tables for this purpose is at the discretion of the technician.

Important: For Automatic Transmission DTC types, refer to *Transmission Scan Tool Data Definitions*.

DTC List

DTC	Description	RPO L56	RPO L65	Heavy Duty RPO L65
P0101	Mass Air Flow (MAF) System Performance	B	—	—
P0102	Mass Air Flow (MAF) Sensor Circuit Low Frequency	B	—	—
P0103	Mass Air Flow (MAF) Sensor Circuit High Frequency	B	—	—
P0112	Intake Air Temperature (IAT) Sensor Circuit Low Voltage	B	B	B
P0113	Intake Air Temperature (IAT) Sensor Circuit High Voltage	B	B	B
P0117	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	B	B	B

DTC List (cont'd)

DTC	Description	RPO L56	RPO L65	Heavy Duty RPO L65
P0118	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	B	B	B
P0121	Accelerator Pedal Position (APP) Sensor 1 Circuit Performance	C	C	C
P0122	Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage	C	C	C
P0123	Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage	C	C	C
P0126	Insufficient ECT for stable Operation	B	—	—
P0182	Fuel Temperature Sensor Circuit Low Voltage	B	B	B
P0183	Fuel Temperature Sensor Circuit High Voltage	B	B	B
P0215	Engine Shut off Control Circuit	C*	C*	C*
P0216	Injection Timing Control Circuit	B	B	B
P0219	Engine Overspeed Condition	C*	C*	C*
P0220	Accelerator Pedal Position (APP) Sensor 2 Circuit	C	C	C
P0221	Accelerator Pedal Position (APP) Sensor 2 Circuit Performance	C	C	C
P0222	Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage	C	C	C
P0223	Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage	C	C	C
P0225	Accelerator Pedal Position (APP) Sensor 3 Circuit	C	C	C
P0226	Accelerator Pedal Position (APP) Sensor 3 Circuit Performance	C	C	C
P0227	Accelerator Pedal Position (APP) Sensor 3 Circuit Low Voltage	C	C	C
P0228	Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage	C	C	C
P0231	Fuel Pump Feedback Circuit Low Voltage	B	B	B
P0236	Turbocharger Boost System	B	B	B
P0237	Turbocharger Boost Sensor Circuit Low Voltage	B	B	B
P0238	Turbocharger Boost Sensor Circuit High Voltage	B	B	B
P0251	Injection Pump Cam System	A	A	A
P0263	Cylinder 1 Balance System	C*	C*	C*
P0266	Cylinder 2 Balance System	C*	C*	C*
P0269	Cylinder 3 Balance System	C*	C*	C*
P0272	Cylinder 4 Balance System	C*	C*	C*
P0275	Cylinder 5 Balance System	C*	C*	C*
P0278	Cylinder 6 Balance System	C*	C*	C*
P0281	Cylinder 7 Balance System	C*	C*	C*
P0284	Cylinder 8 Balance System	C*	C*	C*
P0300	Engine Misfire Detected	B	B	B
P0301	Cylinder 1 Misfire Detected	B	B	B
P0302	Cylinder 2 Misfire Detected	B	B	B
P0303	Cylinder 3 Misfire Detected	B	B	B
P0304	Cylinder 4 Misfire Detected	B	B	B
P0305	Cylinder 5 Misfire Detected	B	B	B
P0306	Cylinder 6 Misfire Detected	B	B	B
P0307	Cylinder 7 Misfire Detected	B	B	B
P0308	Cylinder 8 Misfire Detected	B	B	B

DTC List (cont'd)

DTC	Description	RPO L56	RPO L65	Heavy Duty RPO L65
P0335	Crankshaft Position (CKP) Sensor Circuit	A	A	A
P0370	Timing Reference High Resolution	A	A	A
P0380	Glow Plug Circuit Performance	B	B	B
P0400	Exhaust Gas Recirculation (EGR) Flow Malfunction	B	—	—
P0401	Exhaust Gas Recirculation (EGR) System Flow Insufficient	B	—	—
P0402	Exhaust Gas Recirculation (EGR) System Flow IExcessive	B	—	—
P0404	Exhaust Gas Recirculation (EGR) System Performance	B	—	—
P0405	Exhaust Gas Recirculation (EGR) Sensor Circuit Low Voltage	B	—	—
P0406	Exhaust Gas Recirculation (EGR) Sensor Circuit High Voltage	B	—	—
P0501	Vehicle Speed Sensor Circuit	C*	C*	C*
P0567	Cruise Resume Circuit	C*	C*	C*
P0568	Cruise Set Circuit	C*	C*	C*
P0571	Cruise Brake Switch Circuit	C*	C*	C*
P0601	Internal Control Module Memory	A	A	A
P0602	Control Module Programming	C*	C*	C*
P0604	Control Module Random Access Memory Check Sum	C*	C*	C*
P0606	PCM Internal Communication Interrupted	A	A	A
P1125	Accelerator Pedal Position System	C	C	C
P1191	Intake Air Duct Leak	B	—	—
P1214	Injection Pump Timing Offset	B	B	B
P1218	Injection Pump Calibration Circuit	B	B	B
P1406	Exhaust Gas Recirculation (EGR) Valve Position	B	—	—
P1409	Exhaust Gas Recirculation (EGR) Vacuum System Leak	B	—	—
P1626	Vehicle Theft Deterrent (VTD) Controller Serial Data Circuit	C*	—	—
P1627	A/D Performance	B	B	B
P1630	Theft Deterrent PCM in Learn Mode	C*	C*	C*
P1631	Theft Deterrent Password Incorrect	C*	C*	C*
P1641	Malfunction Indicator Lamp (MIL) Control Circuit	C*	C*	C*
P1643	Wait To Start Lamp Control Circuit	B	B	B
P1653	Exhaust Gas Recirculation (EGR) Vent Solenoid Control Circuit	B	—	—
P1654	Service Throttle Soon Lamp Control Circuit	C*	C*	C*
P1655	Exhaust Gas Recirculation (EGR) Solenoid Control Circuit	B	—	—
P1656	Wastegate Solenoid Control Circuit	B	B	B

Fuel System Specifications

Some states and provinces have restrictions on the purchase of diesel fuel for light duty vehicles and require you to buy permits or pay special taxes. Some of these restrictions apply to residents, and others apply to both residents and visitors. These restrictions can change. To learn the current restrictions in any state or province, contact your auto club, the police or other officials.

What Fuel to Use in the United States

In the United States, for best results use Number 2–D diesel fuel year-round (above and below freezing conditions) as oil companies blend Number 2–D fuel to address climate differences. Number 1–D diesel fuel may be used in very cold temperatures (when it stays below 0°F or –18°C); however, the fuel will produce a power and fuel economy loss. The use of Number 1–D diesel fuel in warm or hot climates may result in stalling, poor starting when the engine is hot and may damage the fuel injection system.

Diesel fuel may foam when filling the tank. This can cause the automatic pump nozzle to shut off, even though the tank isn't full. If this happens, just wait for the foaming to stop and then continue to fill the tank.

What Fuel to Use in Canada

Canadian fuels are blended for seasonal changes. Diesel Type A fuel is blended for better cold weather starting (when it stays below 0°F or –18°C); however, the fuel will produce a power and fuel economy loss. The use of Type A diesel fuel in warmer climates may result in stalling, poor starting. Diesel Type B fuel is blended for temperatures above 0°F (–18°C). The emission control system requires the use of diesel fuel with low sulfur (0.05% by weight) content. Both low and higher sulfur fuels will be available in Canada. Only low sulfur diesel fuels are available in the United States. It is important that diesel-powered trucks are refueled only with low sulfur fuel. Use of fuels with higher-sulfur content will affect the function of the emission components and may caused reduced performance, excessive smoke and unpleasant odor.

Very Cold Weather Operation

If the vehicle is driven in very cold temperatures and can't get a winterized Number 2–D that has been adapted to cold weather or a Number 1–D, use one gallon of kerosine for every two gallons of diesel fuel. Once you add kerosine, run the engine for several minutes to mix the fuels. Only add kerosine when the temperature falls below 0°F (–18°C), because the fuel economy and lubricating qualities of kerosine isn't as good as that of diesel fuel.

In cold weather, the fuel filter may become clogged (waxed). To unclog the filter, move the vehicle to a warm garage area and warm the filter to a temperature between 32°-50°F (0°-10°C). Replacing the filter is not necessary.

Water in Fuel

Sometimes, water can be pumped into the fuel tank along with diesel fuel. This can happen if the service station doesn't regularly inspect and clean their fuel tanks, or the fuel gets contaminated for the service stations suppliers.

If water is pumped into the fuel tank, a water in fuel light will illuminate. If the water in fuel light illuminates, the excess water must be drained from the fuel system on the vehicle.

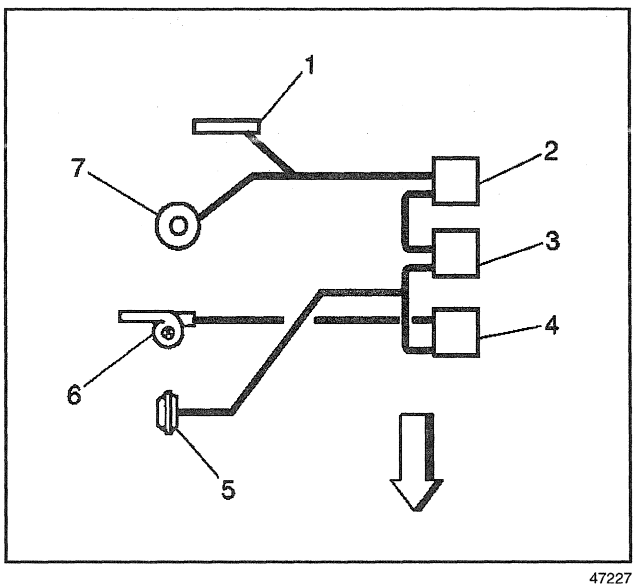
The water in fuel light also should illuminate briefly when the engine is started as a check. If the light doesn't illuminate, the problem should be fixed to identify a water in fuel condition correctly.

GM SPO Group Numbers

Parts Name	Group
Engine Control Module	3.670
Engine Coolant Temperature Sensor	3.682
C/Case Depression Regulator Valve	1.745
C/Case Depression Regulator Valve Hose	1.762
EGR Valve	3.670
EGR Solenoid Valve	3.670
EGR Vent Solenoid Valve	3.670
Glow Plug	2.270
Glow Plug Relay	2.510
Air Cleaner Assembly	3.402
Air Cleaner Filter	3.410
Fuel Filter	3.890
Fuel Tank	3.001

Schematic and Routing Diagrams

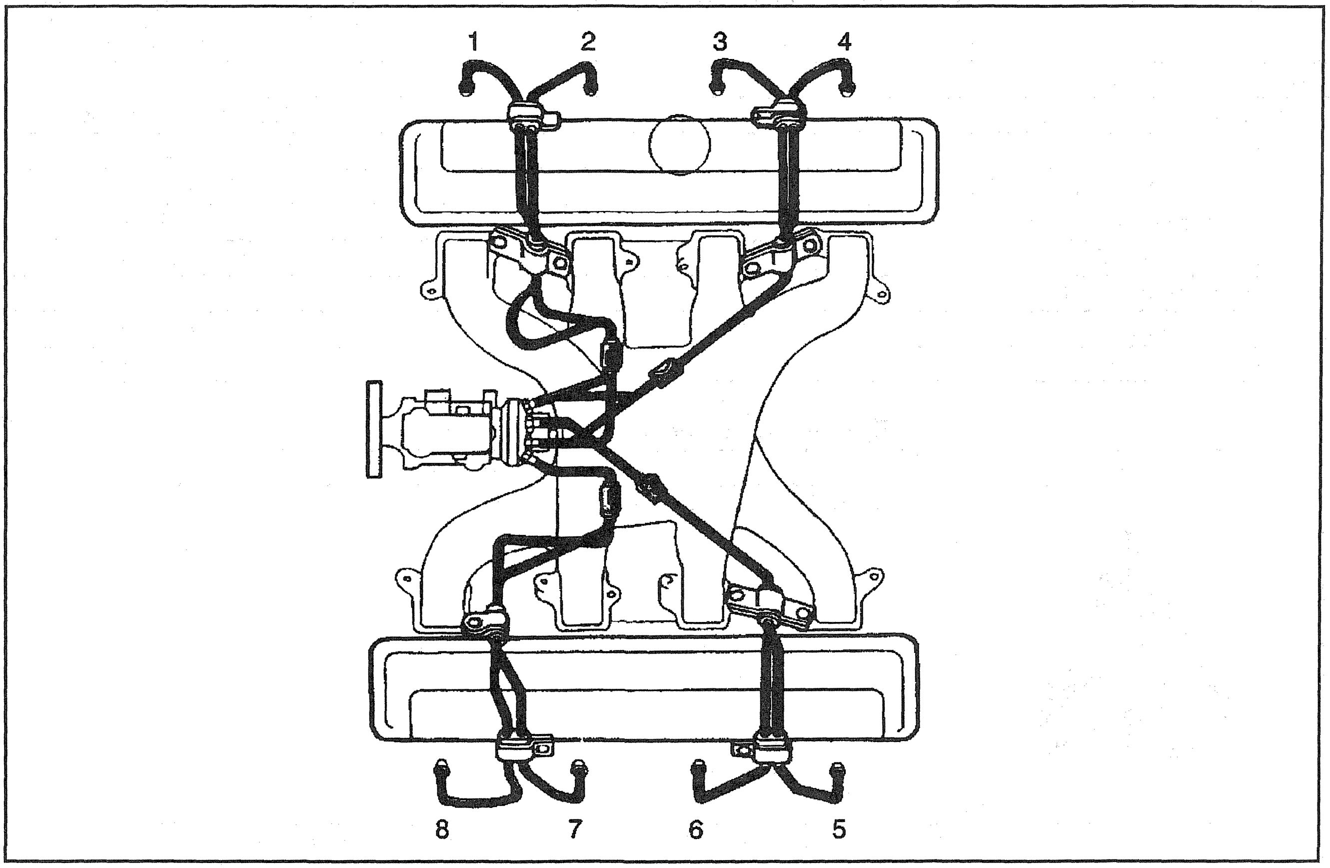
Emission Hose Routing Diagram



Legend

(1) EGR Control Pressure/BARO Sensor
(2) EGR Vent Solenoid
(3) EGR Solenoid
(4) Wastegate Solenoid
(5) Vacuum Pump
(6) Turbo Charger Wastegate
(7) EGR Valve

Fuel Injection Line Routing Diagram (Fuel Injection Line Routing Diagram)



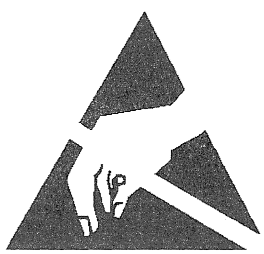
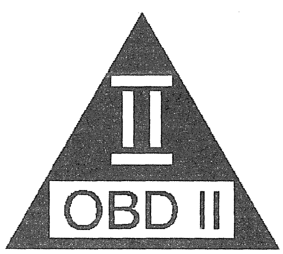
Legend

(1) Cylinder 2
(2) Cylinder 4
(3) Cylinder 6
(4) Cylinder 8
(5) Cylinder 7
(6) Cylinder 5
(7) Cylinder 3
(8) Cylinder 1

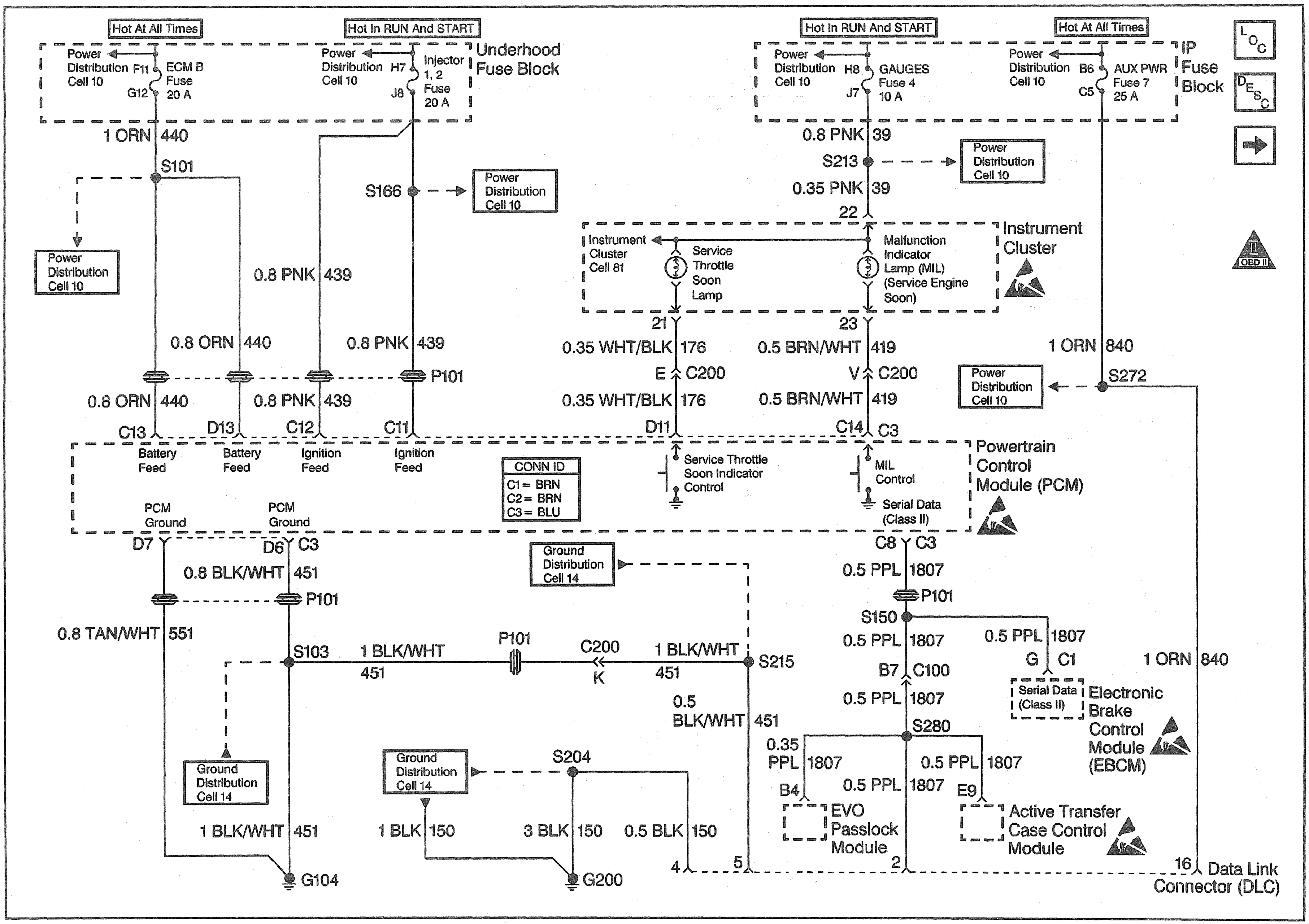
Engine Controls Schematic References

Reference on Schematic	Service Category Type Number - Service Category
Antilock Brakes - Cell 44	5 - ABS System
Automatic Transmission Controls - Cell 39	7 - Automatic Transmission
Cruise Control - Cell 34	8 - DLC
Data Link Connector (DLC) - Cell 50	8 - Cruise Control
Ground Distribution - Cell 14	8 - Wiring System
Instrument Panel - Cell 81	8 - Instrument Panel
Power Distribution - Cell 10	8 - Wiring System
Sensors - Cell 21	6 - Engine Controls
Transfer Case - Cell 38	4 - Transfer Case

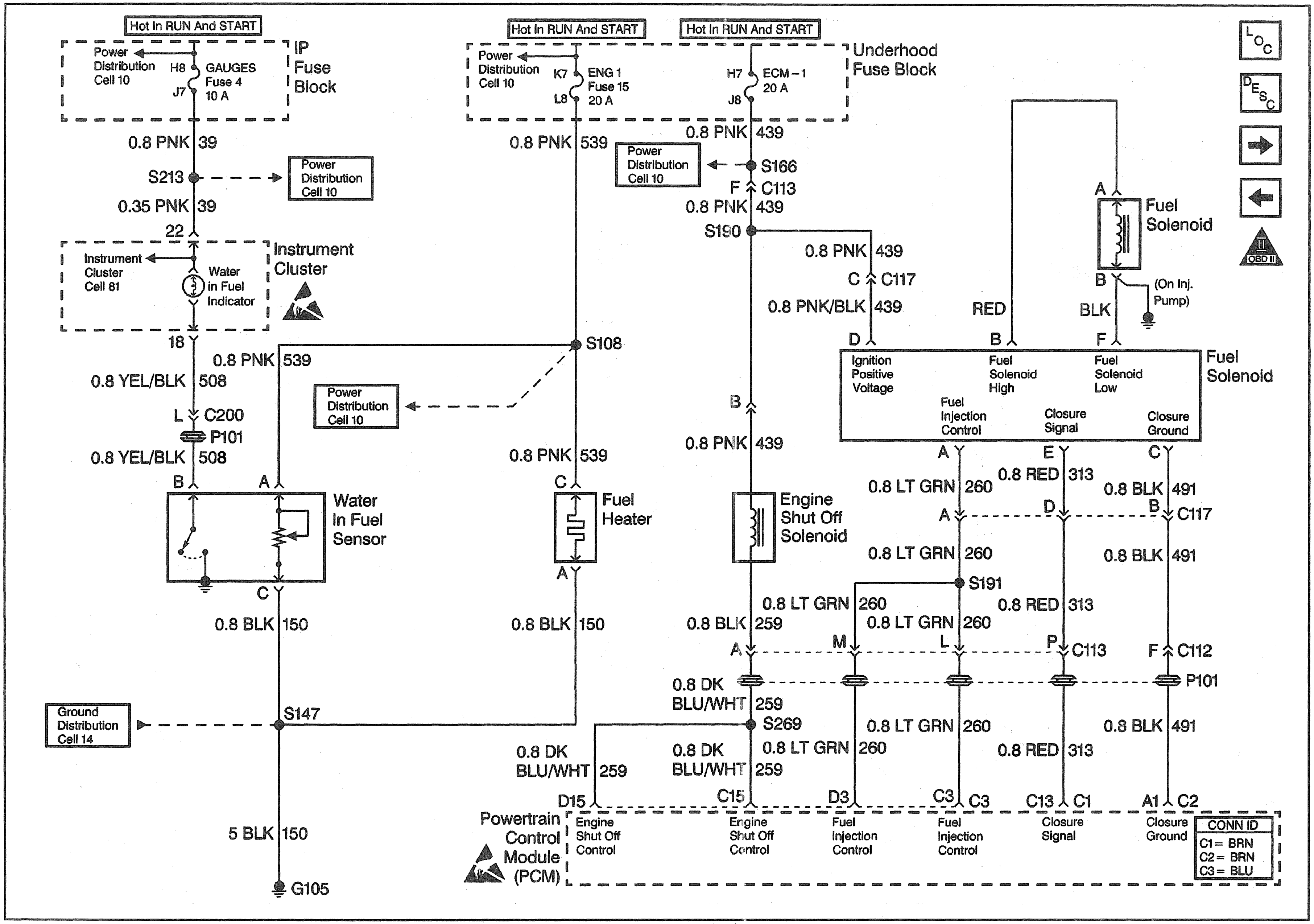
Engine Controls Schematic Icons

Icon	Icon Definition
 19384	Refer to *ESD Notice* in Cautions and Notices
 19385	Refer to *OBD II Symbol Description Notice* in Cautions and Notices

Engine Controls Schematics (PWR, GND, and DLC)

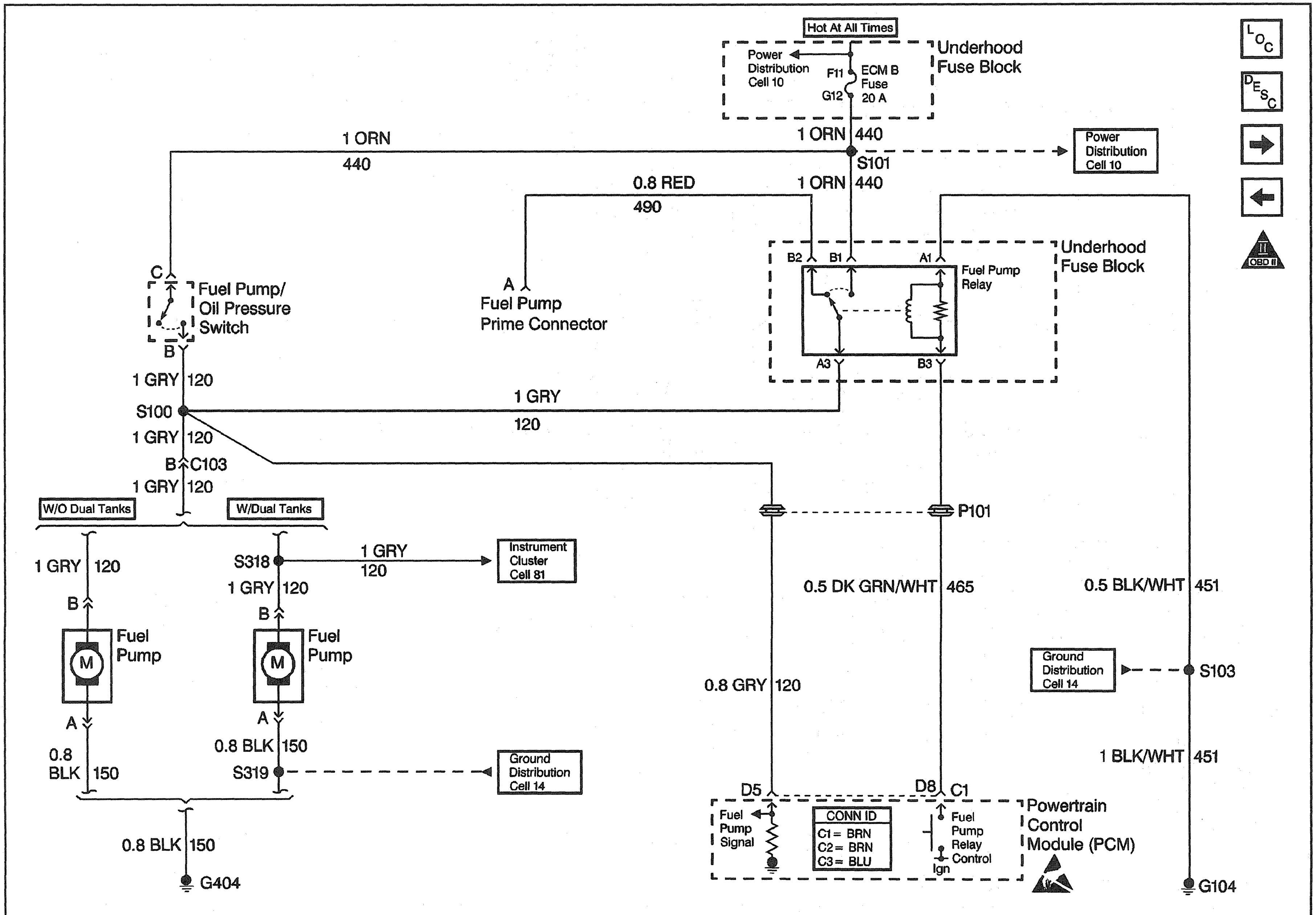


Engine Controls Schematics (Fuel Controls)



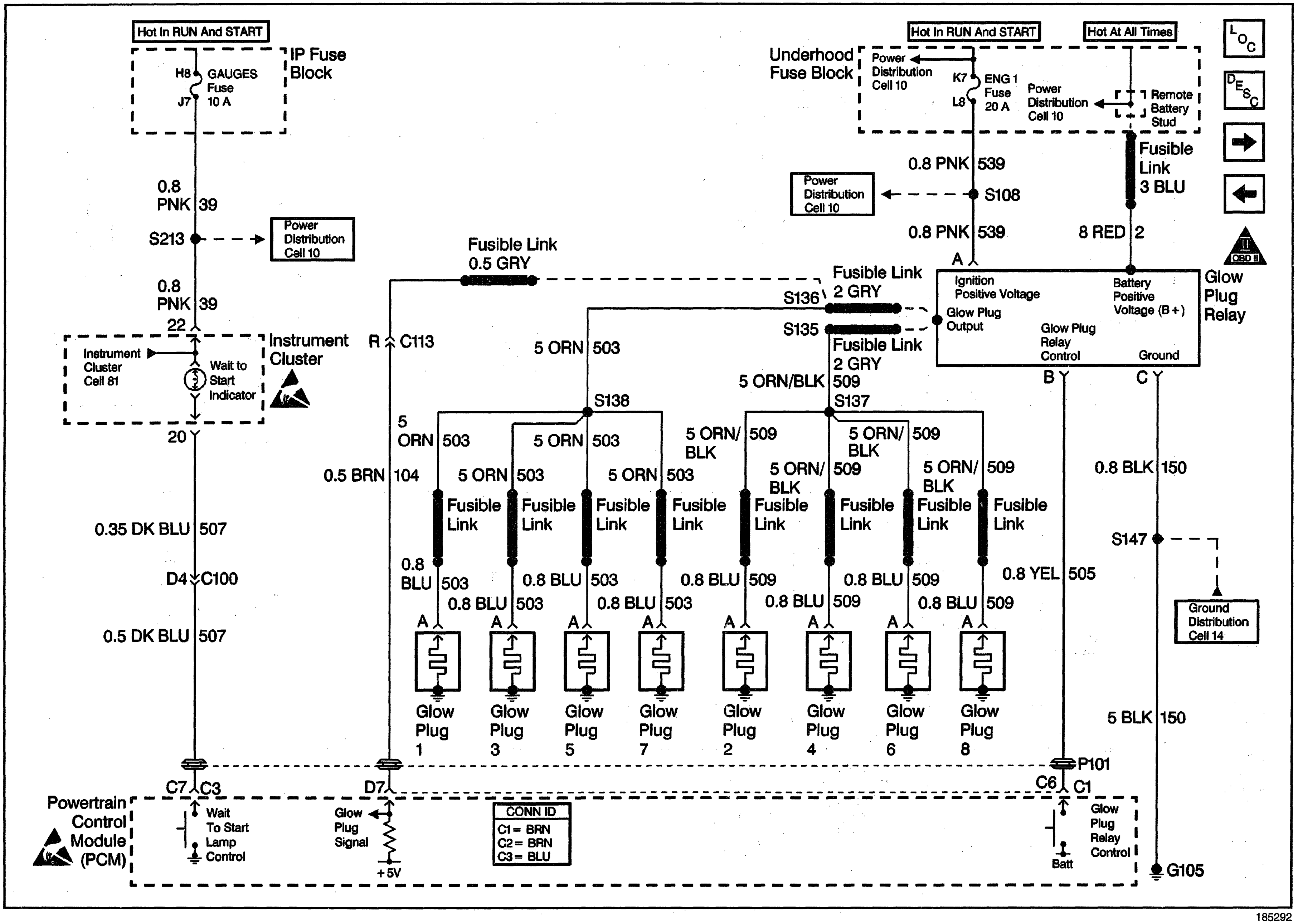
185298

Engine Controls Schematics (Fuel Controls)

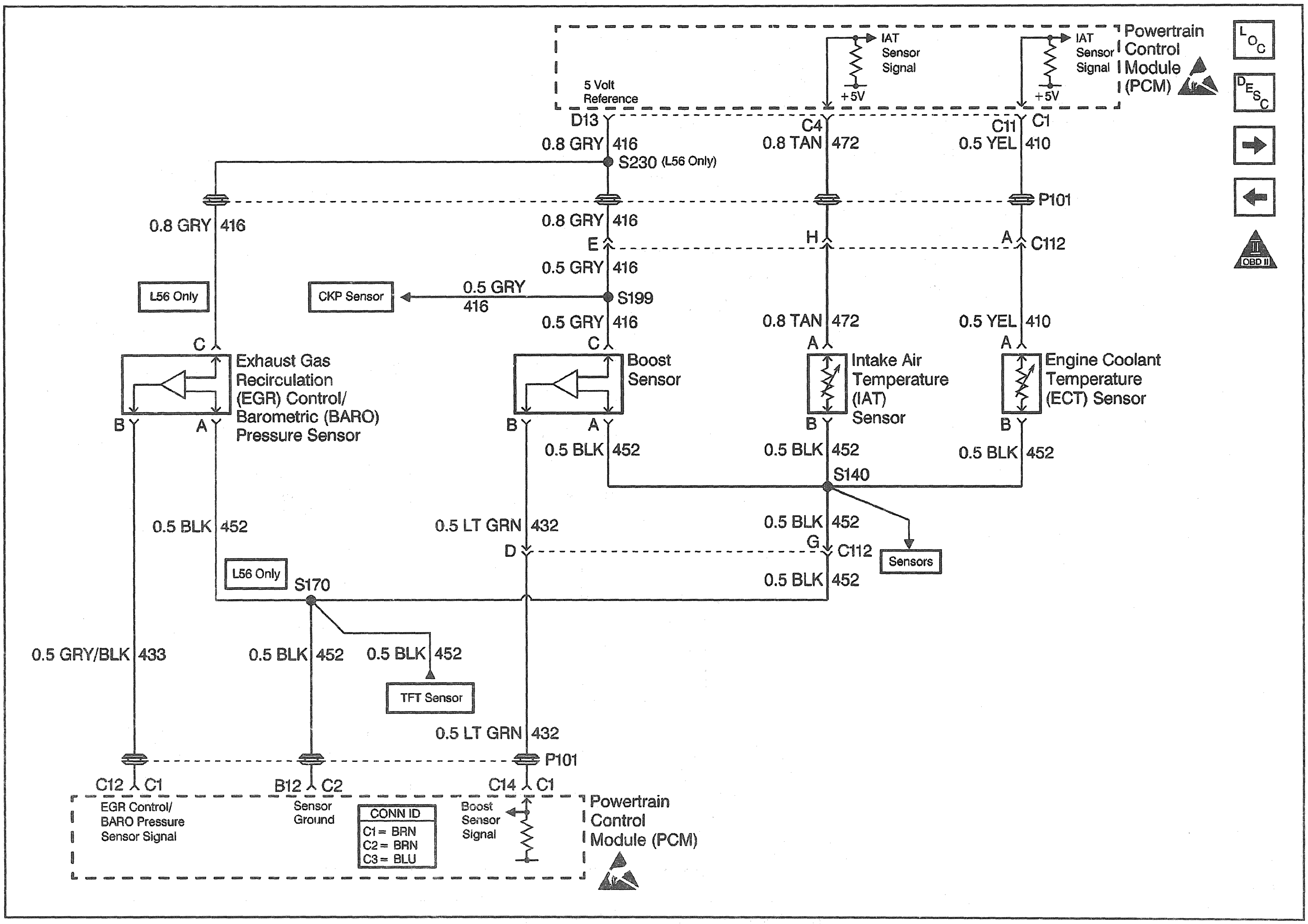


185296

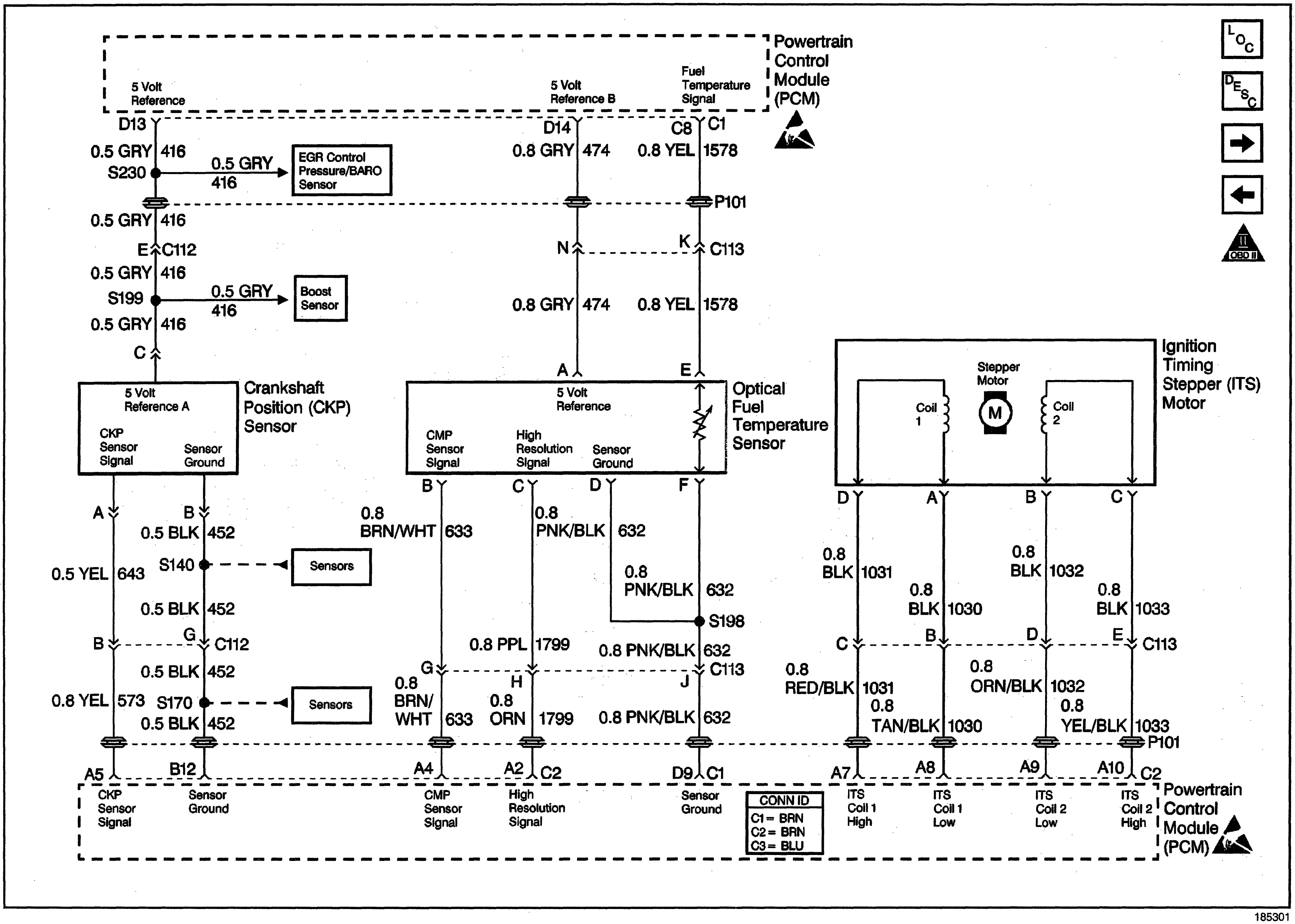
Engine Controls Schematics (Glow Plug Controls)



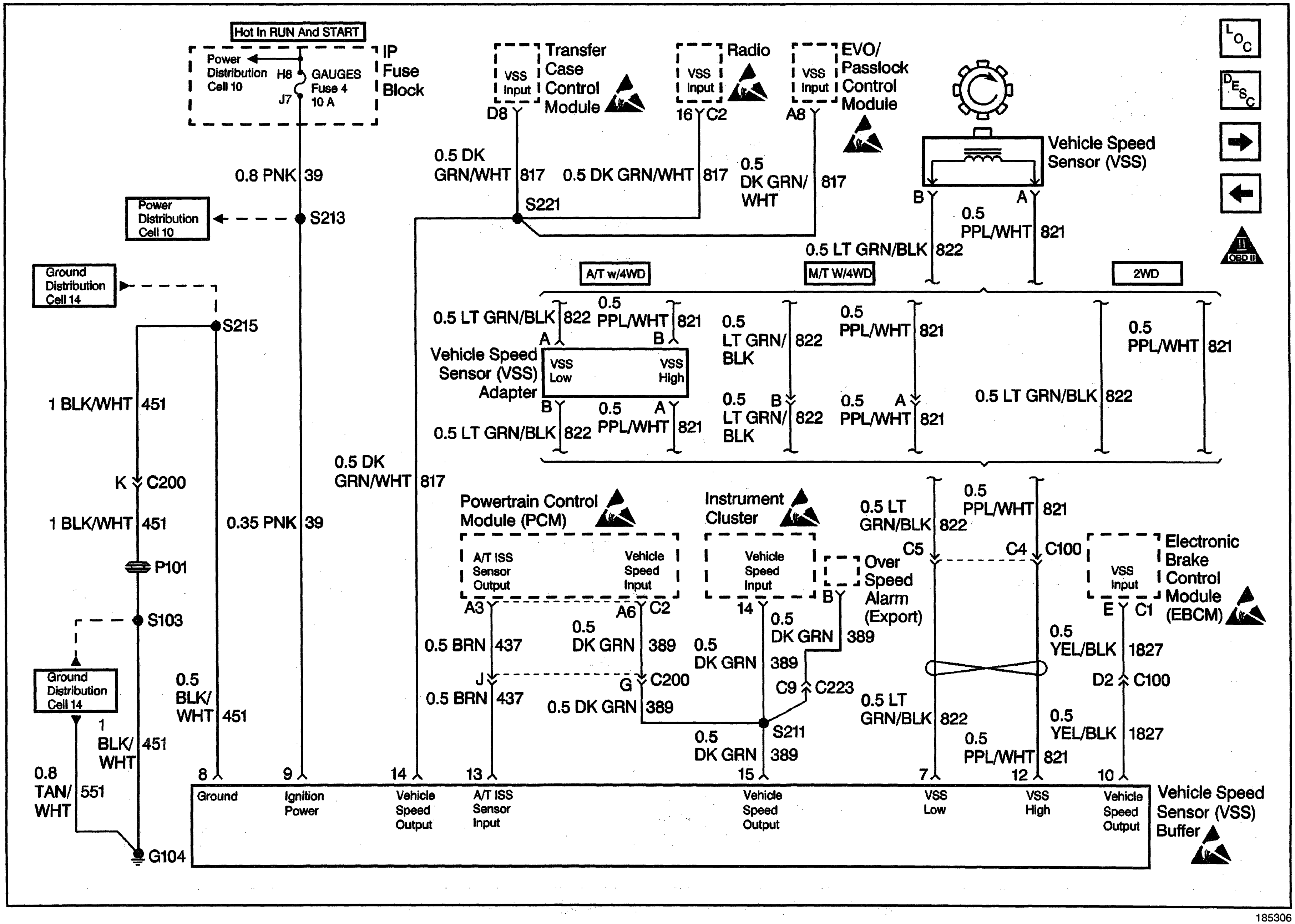
Engine Controls Schematics (Engine Sensors)



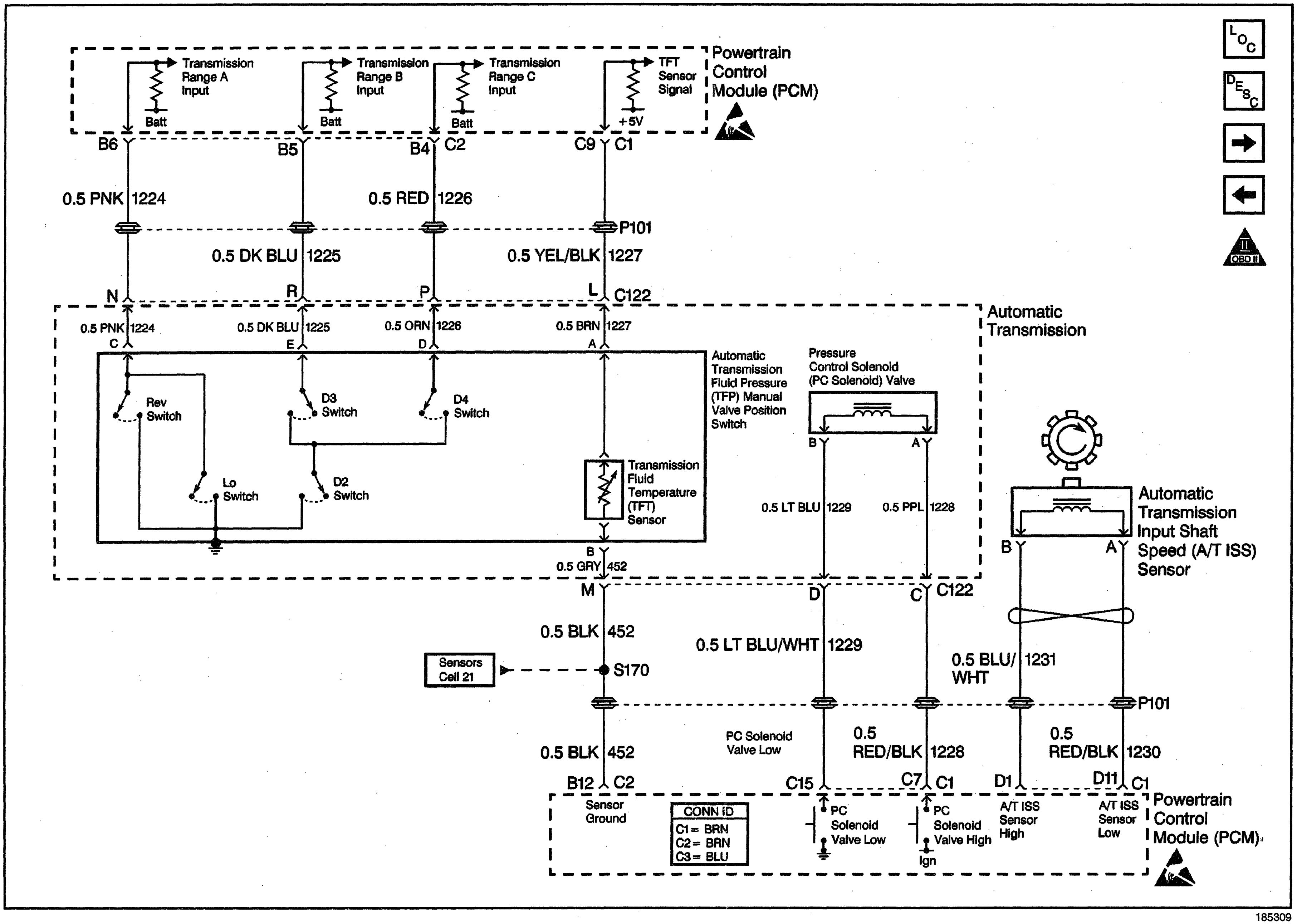
Engine Controls Schematics (Ignition System)



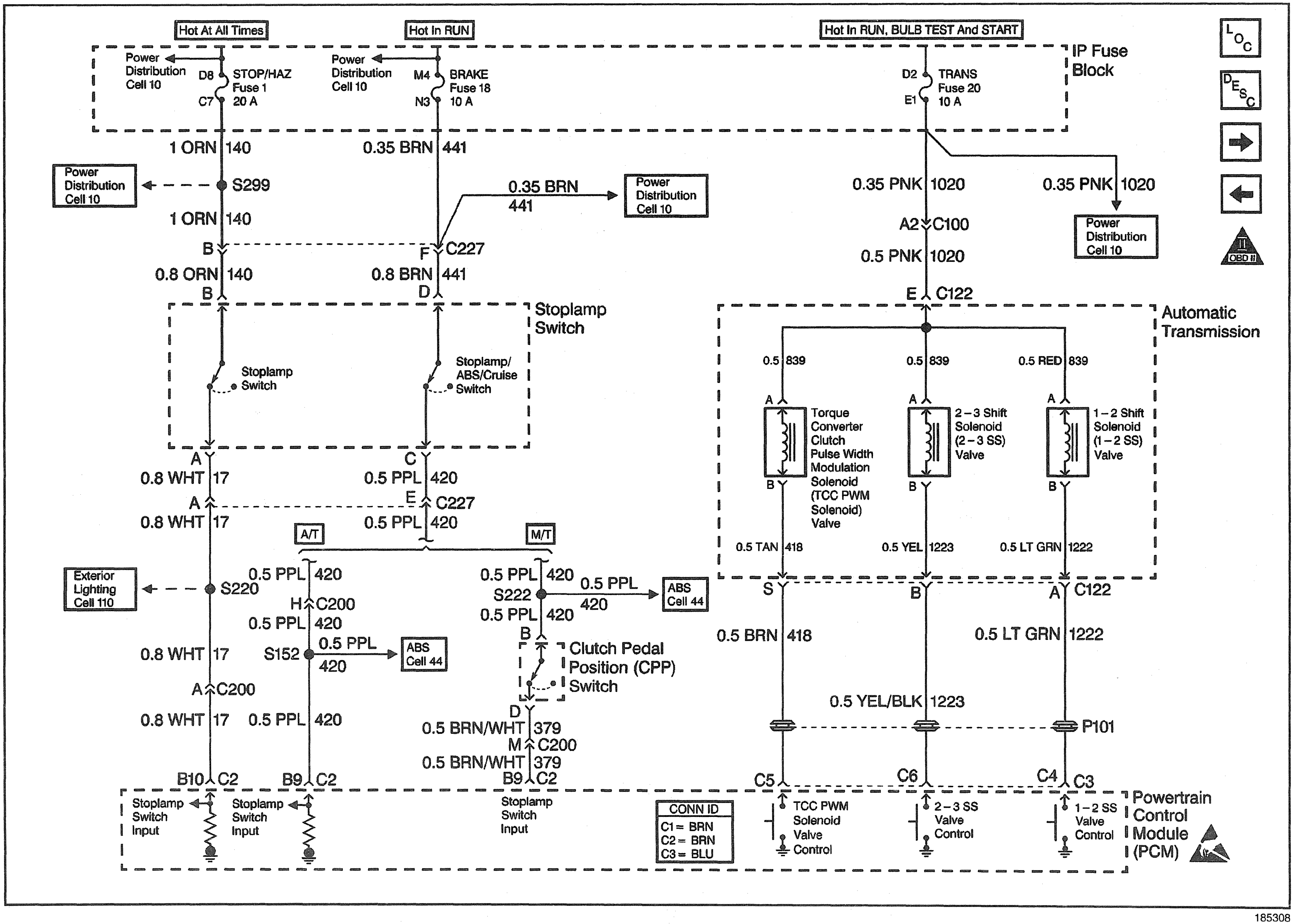
Engine Controls Schematics (VSS Controls)



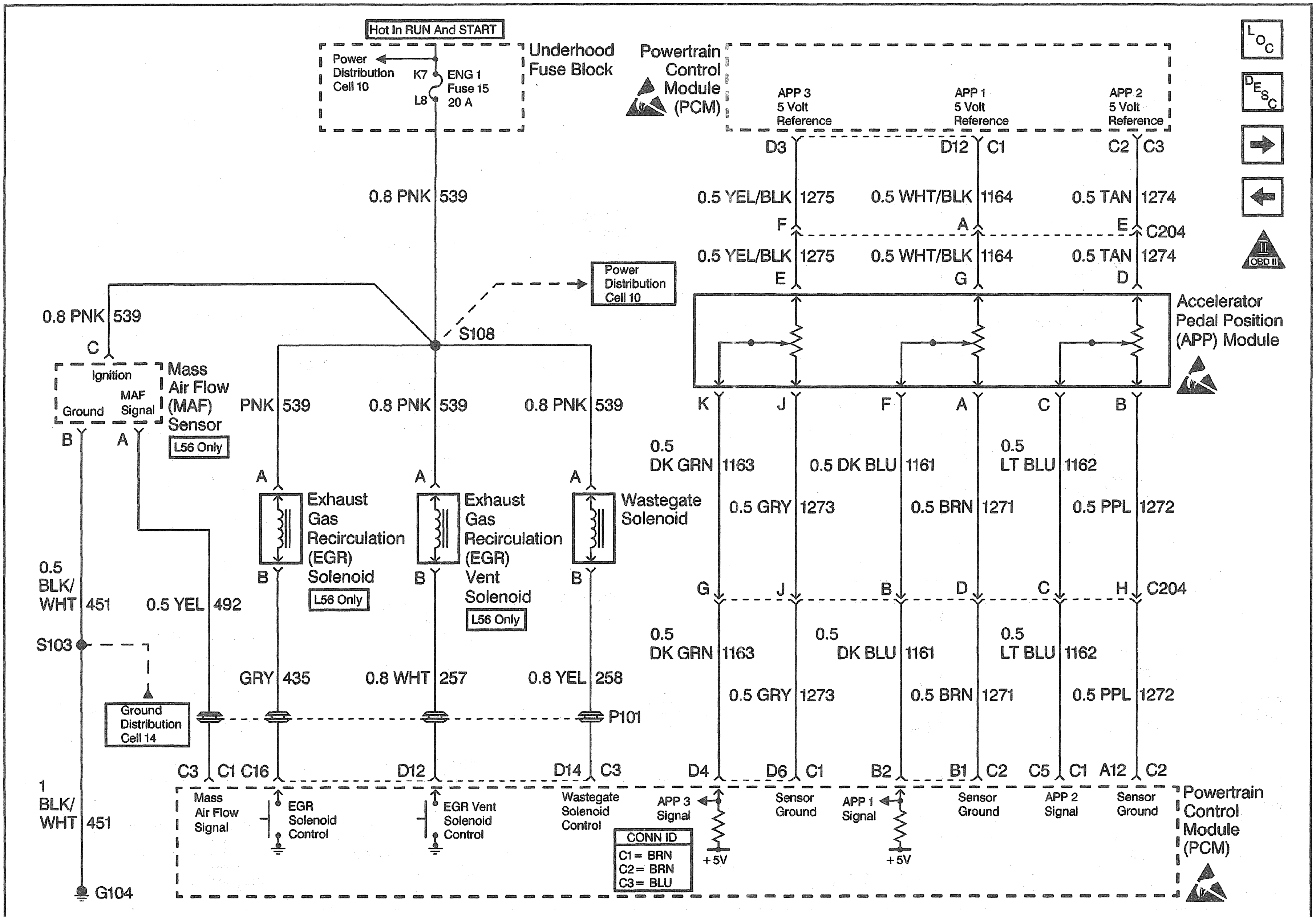
Engine Controls Schematics (Transmission Controls)



Engine Controls Schematics (Transmission and TCC Controls)

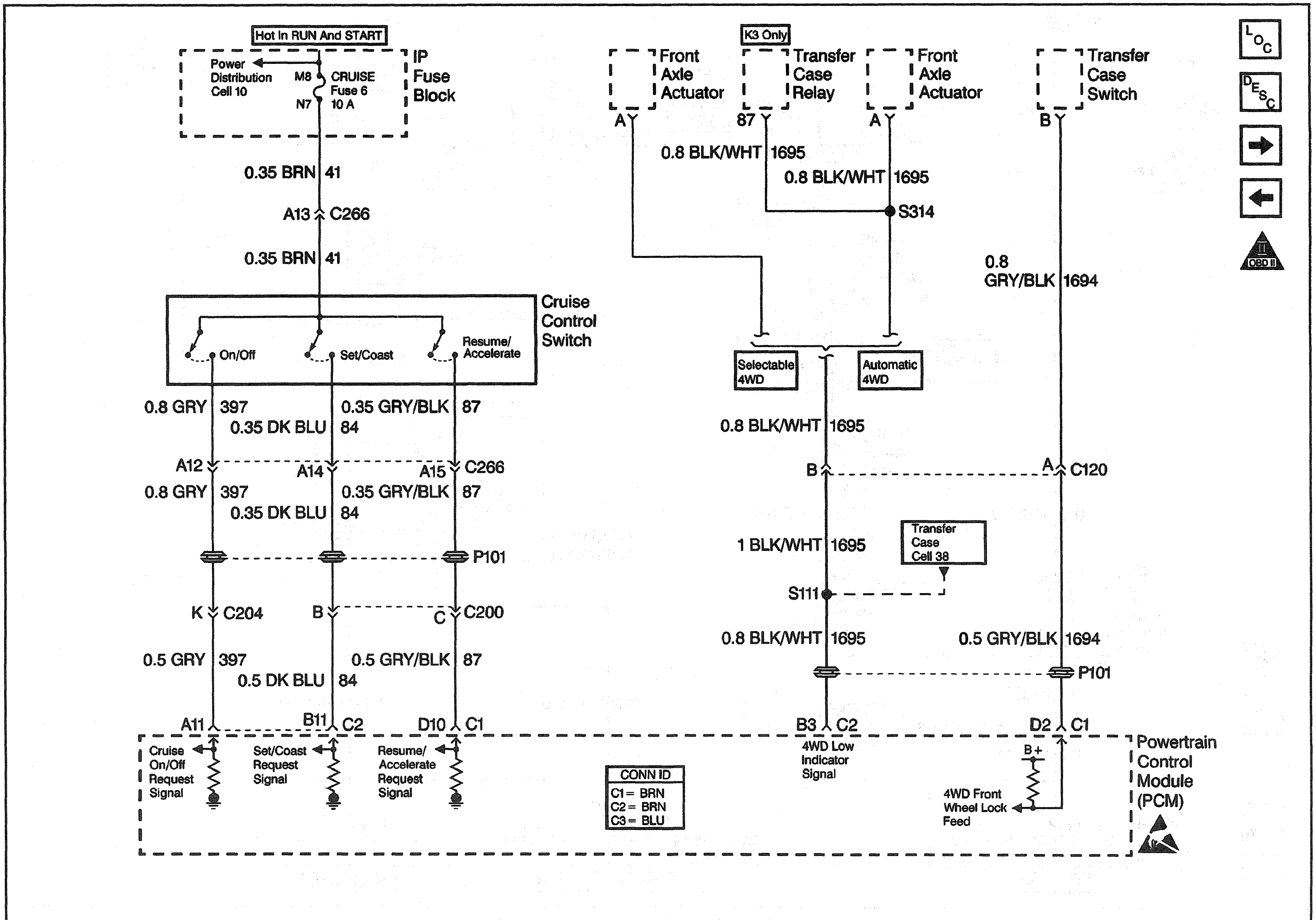


Engine Controls Schematics (EGR, MAF and Accelerator Pedal Controls)

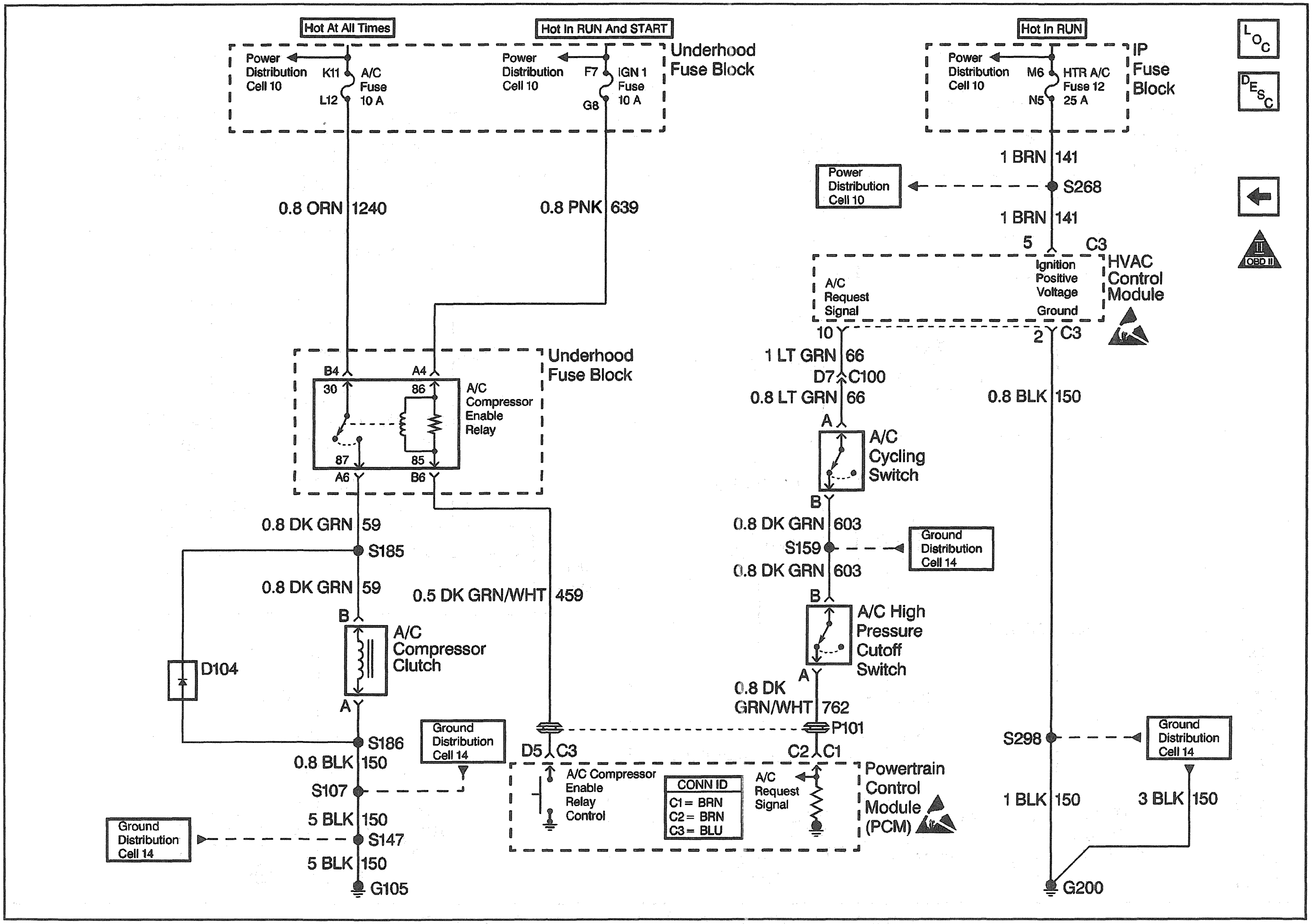


185304

Engine Controls Schematics (4WD and Cruise Controls)



Engine Controls Schematics (A/C Controls)



Component Locator

Engine Controls Components

Name	Location	Locator View	Connector End View
A/C Compressor Clutch	On the front of the A/C compressor, in the left front side of the engine	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
A/C Compressor Clutch Relay	In the underhood fuse-relay center, in the left rear side of the engine compartment, on the fender	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
A/C Compressor Cycling Switch	On the top right of the A/C accumulator, in the right side of the engine compartment, on the bulkhead	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
A/C Compressor High Pressure Cutout Switch	On the rear of the A/C compressor, in the left front side of the engine	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
A/C Compressor Low Pressure Cutout Switch	On the top of the A/C compressor, in the high pressure refrigerant line	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
Camshaft Position Sensor	Top rear center of the engine	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Clutch Pedal Position Switch	At top of Clutch Pedal	*Engine Electrical Component Views* in Engine Electrical	*Engine Electrical Connector End Views* in Engine Electrical
Crankshaft Position (CKP) Sensor	Lower RF of Engine Block, near Crankshaft	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Cruise Control Module (CCM)	LR of Engine Compartment, on Bulkhead	*Cruise Control Component Views* in Cruise Control	*Cruise Control Connector End Views* in Cruise Control
Data Link Connector (DLC)	Under LH of IP, LH of Steering Column, mounted to bottom of Knee Bolster	*Data Link Communications Component Views* in Wiring Systems	*Data Link Communications Connector End Views* in Wiring Systems
Electronic Brake Control Module (EBCM)	Near Brake Master Cylinder, at LF Wheelhousing	*Antilock Brakes System Component Views* in ABS/Traction Control	*Antilock Brakes System Connector End Views* in ABS/Traction Control
Electronic Variable Orifice (EVO)/Passlock Module	Under the center of the IP	*Theft Deterrent System Component Views* in Theft Deterrent	*Theft Deterrent System Connector End Views* in Theft Deterrent
Engine Coolant Temperature Sensor (Diesel)	Lower LF of Engine Block	*Cooling System Component Views* in Engine Cooling	*Cooling System Connector End Views* in Engine Cooling
Exhaust Gas Recirculation (EGR) Control Pressure/Baro Sensor (Diesel)	Top of Engine assembly	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Fuel Heater (Diesel)	Top rear of Engine in the fuel filter assembly	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Fuel Pump (Diesel)	Inside LH Frame Rail, below LF Door	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Fuel Pump, Secondary (Diesel)	In Auxiliary Fuel Tank	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Fuel Pump and Sender	In Fuel Tank	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Glow Plug Controller	LR of Engine, near Bulkhead	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Glow Plug Relay	LR of Engine, near Bulkhead	*Engine Controls Component Views*	*Engine Controls Connector End Views*

Engine Controls Components (cont'd)

Name	Location	Locator View	Connector End View
HVAC Control Module	Part of the heater controls, in the center of the IP, under the radio	*HVAC Component Views* in HVAC Systems with A/C - Manual	*HVAC Connector End Views* in HVAC Systems with A/C - Manual
Instrument Cluster	On the upper left end of the IP, above the steering column	*Instrument Cluster Component Views* in Instrument Panel and Console	*Instrument Cluster Connector End Views* in Instrument Panel and Console
Intake Air Temperature (IAT) Sensor (Diesel)	At LF of Engine, near Intake Manifold opening	*Engine Controls Component Views*	*Engine Controls Connector End Views*
IP Fuse Block	To the left of the IP, near the left front door jamb switch	*Power and Grounding Component Views* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Mass Air Flow (MAF) Sensor	At Air Intake Duct, near Air Filter, RH of Engine	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Powertrain Control Module (PCM) (Diesel)	Under RH end of IP, above Blower Motor, behind IP Compartment Box	*Engine Controls Component Views*	*PCM Connector End Views*
Radio	In the center of the IP	*Entertainment Component Views* in Entertainment	*Entertainment Connector End Views* in Entertainment
Remote Battery Stud	Part of the underhood fuse-relay center, in the left rear side of the engine compartment, on the fender	*Power and Grounding Component Views* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Stoplamp Switch	On the top of the brake pedal	*Lighting Systems Component Views* in Lighting Systems	*Lighting Systems Connector End Views* in Lighting Systems
Transfer Case Control Module (TCCM) (Selectable 4WD)	Under IP, near the convience center	*Transfer Case Control Component Views (Selectable 4WD)* or *Transfer Case Control Component Views (Automatic 4WD)* in Transfer Case	*Transfer Case Control Connector End Views (Selectable 4WD)* or *Transfer Case Control Connector End Views (Automatic 4WD)* in Transfer Case
Transfer Case Relay	RR of Engine Compartment, near center of Bulkhead	*Transfer Case Control Component Views (Selectable 4WD)* or *Transfer Case Control Component Views (Automatic 4WD)* in Transfer Case	*Transfer Case Control Connector End Views (Selectable 4WD)* or *Transfer Case Control Connector End Views (Automatic 4WD)* in Transfer Case
Transfer Case Select Switch	Center of IP, RH of Steering Column Shift Lever	*Transfer Case Control Component Views (Selectable 4WD)* or *Transfer Case Control Component Views (Automatic 4WD)* in Transfer Case	*Transfer Case Control Connector End Views (Selectable 4WD)* or *Transfer Case Control Connector End Views (Automatic 4WD)* in Transfer Case
Underhood Fuse Block	In the left rear side of the engine compartment, on the fender	*Power and Grounding Component Views* in Wiring Systems	*Power and Grounding Connector End Views* in Wiring Systems
Vehicle Speed Sensor (w/RWD)	LR of Transmission	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Vehicle Speed Sensor (w/Selectable 4WD)	LR of Transfer Case	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Wastegate Solenoid (Diesel)	Top LR of Engine, above Valve Cover	*Engine Controls Component Views*	*Engine Controls Connector End Views*
Water-in-Fuel Sensor (Diesel)	Top near of Engine	*Engine Controls Component Views*	*Engine Controls Connector End Views*
C100	Part of the engine harness to IP harness, in the left rear side of the engine compartment, at the bulkhead	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems

Engine Controls Components (cont'd)

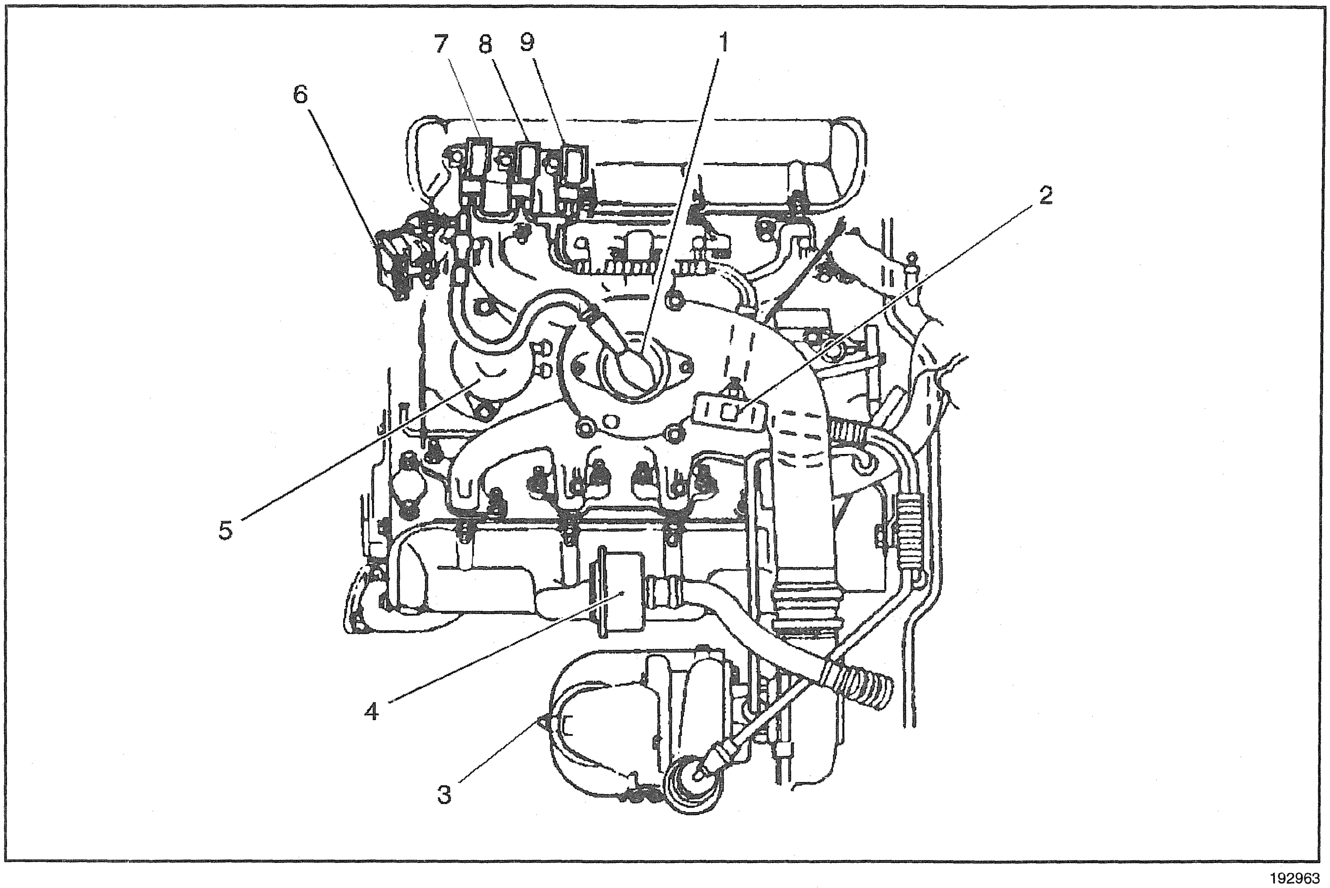
Name	Location	Locator View	Connector End View
C103	Part of the engine harness to fuel pump motor, in the left rear side of the engine compartment, under the brake master cylinder	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C112 (Diesel)	Part of the engine harness to engine sensors, center rear of the engine	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C122 (M30)	On the right side of the transmission	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C122 (MT1)	On the left side of the transmission	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C200	Behind the right side of the IP, near the heater motor, in foam wrap	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C204	Behind the right side of the IP	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C223	At the convenience center	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C227 (Stoplamp Switch)	IP harness, Inline to the Stoplamp Switch	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
C266	Part of the IP harness to steering column harness, to the left side of the steering column, near the bulkhead	*Harness Routing Views* in Wiring Systems	*Inline Harness Connector End Views* in Wiring Systems
D104 (6.5L)	Part of the engine harness, approximately 28 cm (11 in) from the A/C compressor clutch connector	*Harness Routing Views* in Wiring Systems	—
G104 (6.5L)	Top rear of the right cylinder head	*Power and Grounding Component Views* in Wiring Systems	—
G105 (Diesel)	Right Rear of the cylinder head, cylinder #7 intake bolt	*Power and Grounding Component Views* in Wiring Systems	—
G404	Inside the left side frame rail, near the rear crossmember	*Power and Grounding Component Views* in Wiring Systems	—
P101	In the right rear side of the engine compartment, at the bulkhead	*Harness Routing Views* in Wiring Systems	—
S100 (6.5L - A/T)	Engine harness, approximately 31 cm (12 in) from the taillamp harness breakout	—	—
S100 (6.5L - M/T)	Engine harness, approximately 37 cm (14.5 in) from the EBCM breakout, toward the taillamp harness	—	—
S101 (Diesel)	Engine harness approximately 6.5 cm (2.5 in) from the EBCM harness breakout into the PCM harness	—	—
S103 (5.0L, 5.7L)	Engine harness, approximately 8 cm (3 in) from the EGR valve breakout, toward the taillamp harness breakout	—	—
S107 (5.0L, 5.7L)	Engine harness, approximately 20 cm (8 in) from the EGR valve breakout, toward the taillamp harness breakout	—	—
S108 (Diesel)	Engine harness, approximately 6 cm (2.5 in) from the transmission harness breakout, towards the PCM	—	—

Engine Controls Components (cont'd)

Name	Location	Locator View	Connector End View
S111 (6.5L)	Engine harness approximately 11 cm (4 in) from the EBCM breakout, toward the glow plugs	—	—
S147 (Diesel)	Engine harness, approximately 4 cm (1.5 in) from the starter motor solenoid breakout	—	—
S150	Engine harness, approximately 13 cm (5 in) from the EBCM breakout	—	—
S152 (Diesel)	Engine harness, approximately 4 cm (1.5 in) from the IP harness breakout, toward P101	—	—
S166 (6.5L - A/T)	Engine harness, approximately 8 cm (3 in) from the fuel heater breakout	—	—
S166 (6.5L - M/T, HD)	Engine harness, approximately 5 cm (2 in) from the glow plugs breakout	—	—
S166 (6.5L - M/T, LD)	Engine harness, approximately 1 cm (0.5 in) from the fuel heater breakout	—	—
S199 (6.5L)	Engine harness, approximately 31 cm (12 in) from the taillamp harness breakout	—	—
S204	IP harness, approximately 10 cm (4 in) from C100, towards the Data Link Connector (DLC)	—	—
S211 (Diesel)	IP harness, approximately 16 cm (6 in) into the instrument cluster breakout	—	—
S213	IP harness, approximately 4 cm (1.5 in) from the steering column harness breakout, towards the DLC	—	—
S215	IP harness, approximately 8 cm (3 in) from the instrument cluster breakout, toward the radio connectors breakout	—	—
S220	IP harness, approximately 6 cm (2.5 in) from the steering column harness breakout, toward C100	—	—
S221	IP harness, approximately 40 cm (15.5 in) from the instrument cluster breakout	—	—
S222	IP harness, approximately 20 cm (8 in) from the inflatable restraint switch breakout	—	—
S268	IP harness, approximately 7 cm (2.5 in) into the HVAC Control Switch harness breakout	—	—
S280	IP harness, approximately 5 cm (2 in) from the DLC breakout	—	—
S298	IP harness, approximately 24 cm (9.5 in) from the instrument cluster breakout, toward the radio breakout	—	—
S299	IP harness, approximately 4 cm (1.5 in) into the steering column harness breakout, toward C266	—	—
S314 (K300)	Selectable 4W harness, approximately 5 cm (2 in) from the transfer case relay breakout, toward the front axle switch	—	—
S318	Taillamp extension harness, approximately 10 cm (4 in) from the fuel pump balance module breakout, toward the engine harness	—	—

Engine Controls Component Views

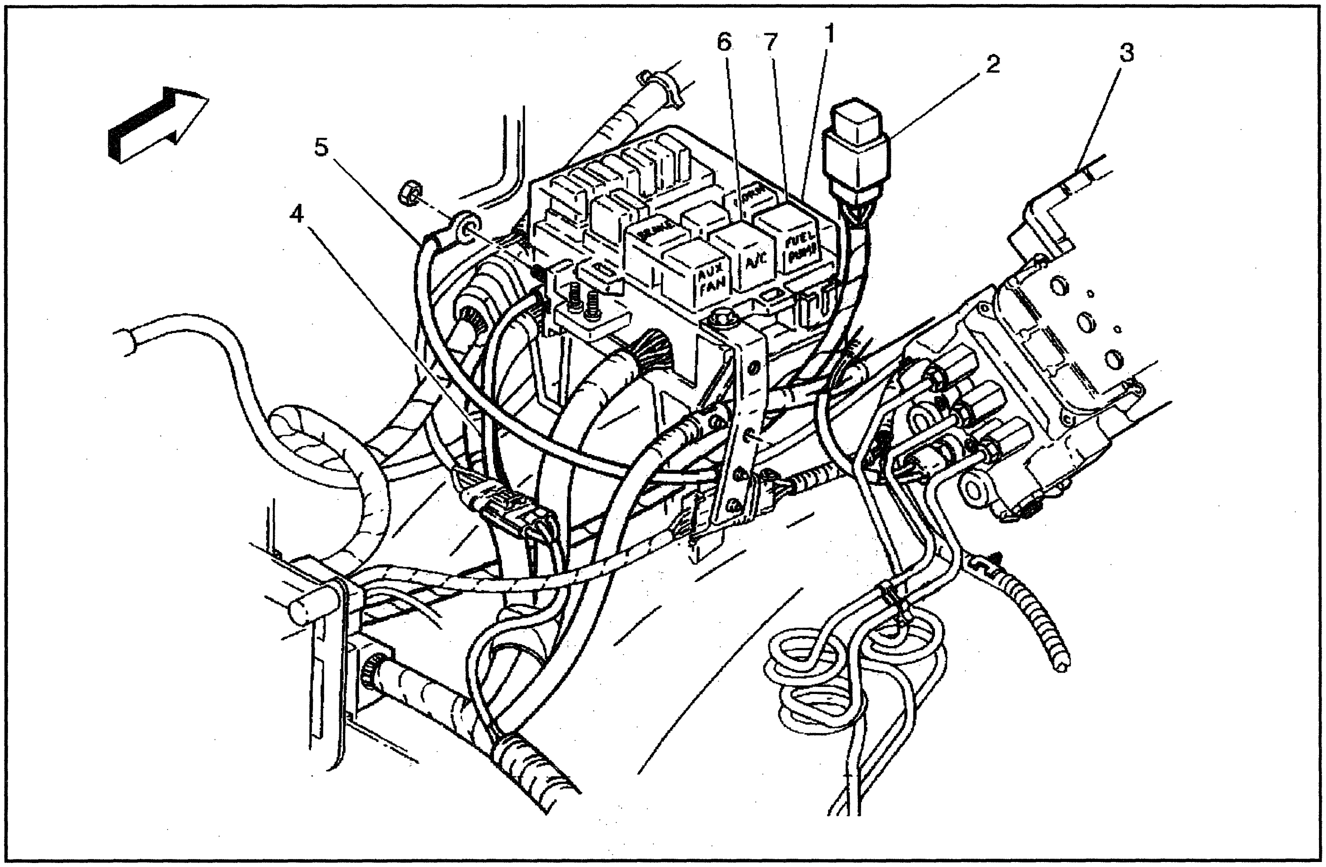
Overhead Engine View



Legend

(1) EGR Valve
(2) Boost Pressure Sensor
(3) Turbocharger
(4) CDR Valve
(5) Fuel Manager/Filter
(6) Glow Plug Relay
(7) EGR Vent Solenoid
(8) EGR Solenoid
(9) Wastegate Solenoid

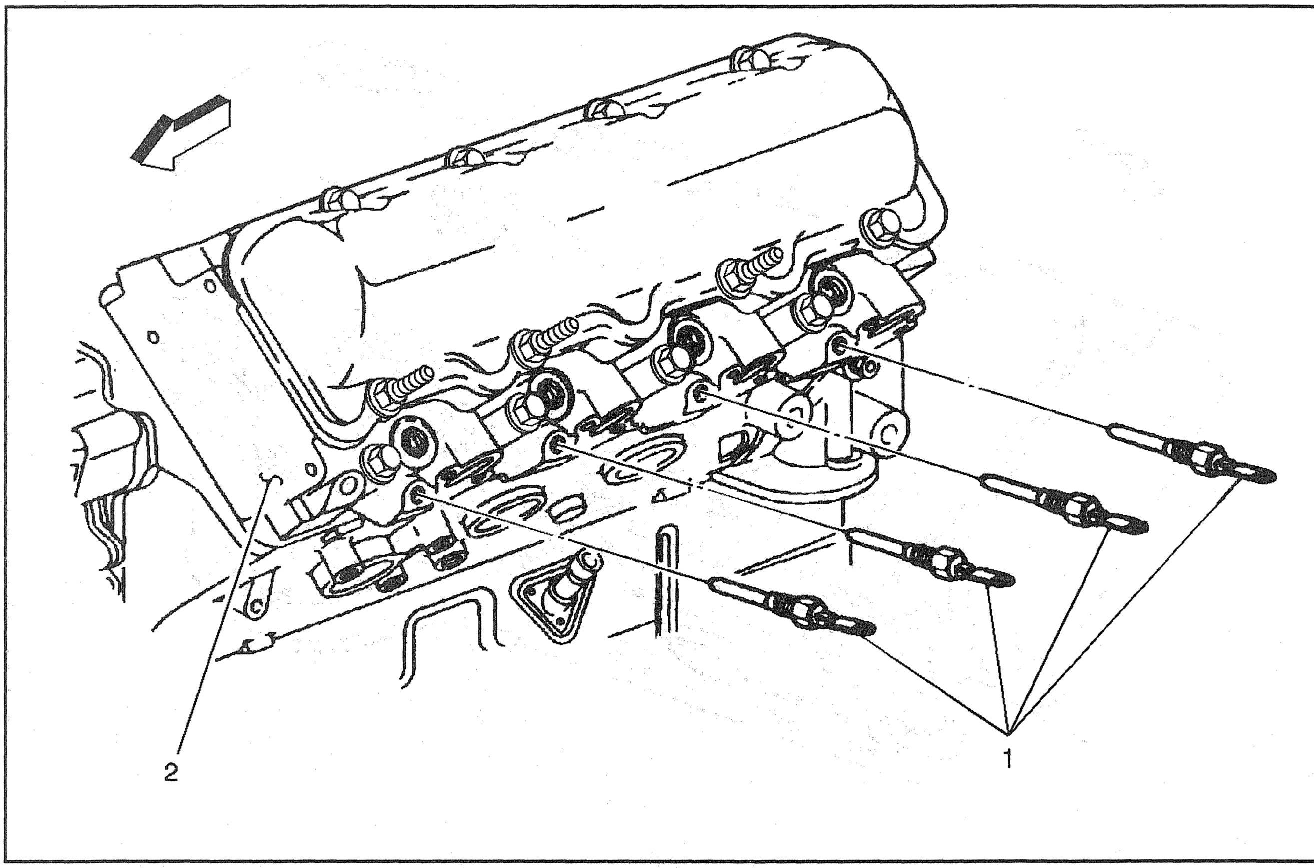
Underhood Fuse Relay Center



Legend

(1) Underhood Fuse Relay Center
(2) Stop Lamp Relay
(3) Electronic Brake Control Module (EBCM)
(4) Glow Plug Relay Battery Feed
(5) Battery Cable
(6) A/C Relay
(7) Fuel Pump Relay

Glow Plugs



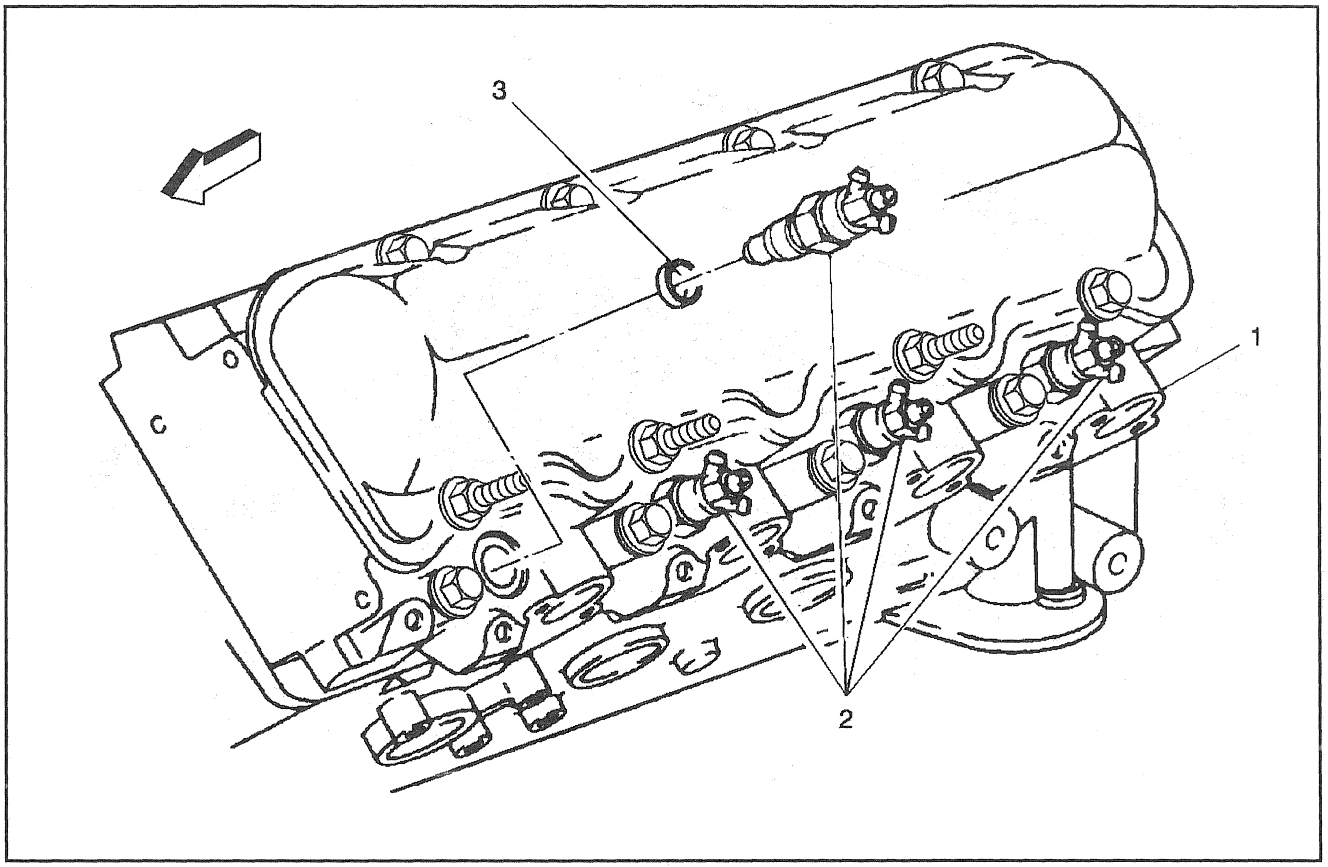
192951

Legend

(1) Glow Plugs

(2) Cylinder Head

Injection Nozzles

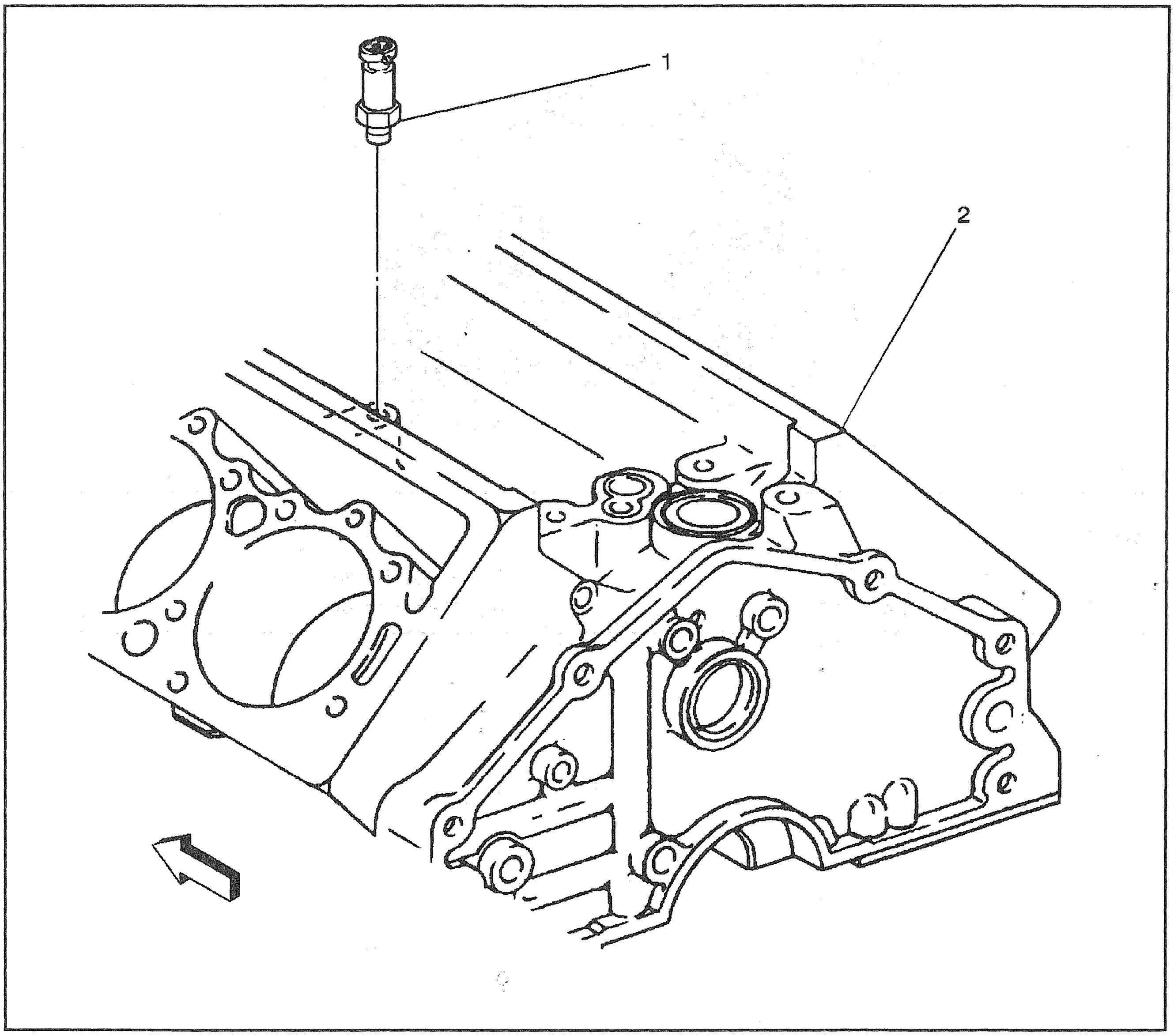


192965

Legend

(1) Cylinder Head
(2) Injection Nozzles
(3) Seal

Oil Pressure Switch (OPS)



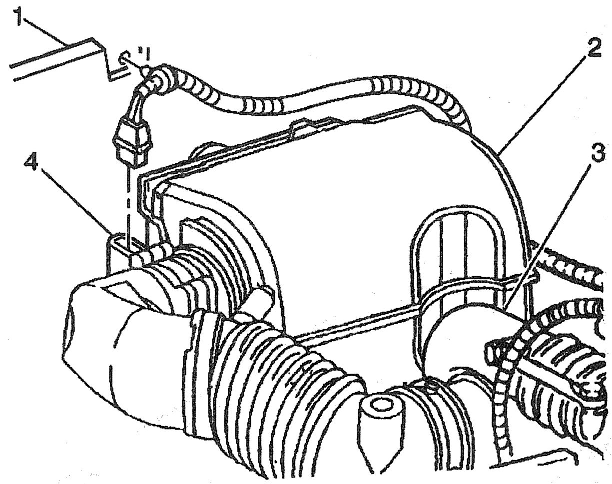
192947

Legend

(1) Oil Pressure Switch (OPS)

(2) Engine Block

Air Cleaner and MAF Sensor

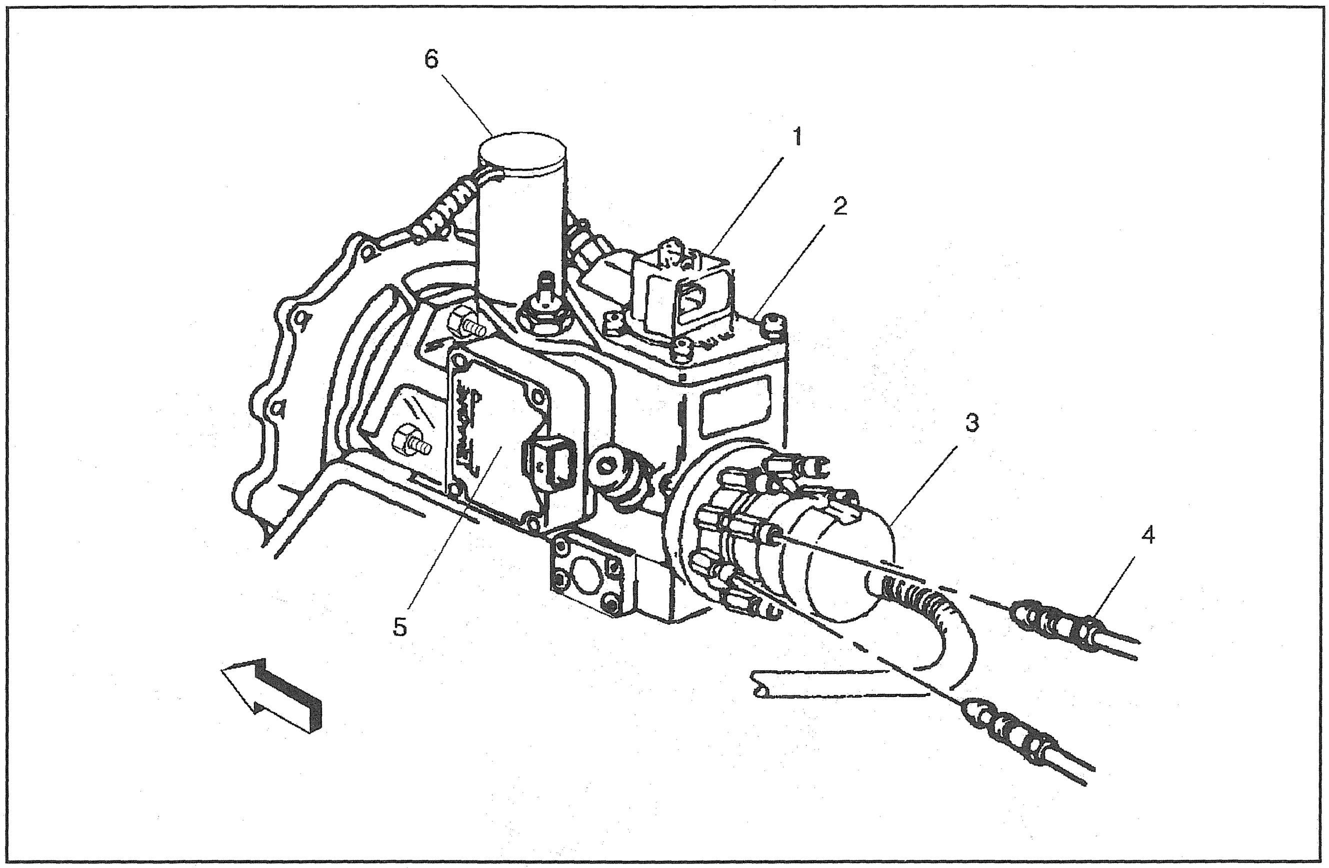


192943

Legend

(1) Passenger Side Fender
(2) Air Cleaner (Element Inside)
(3) Turbocharger
(4) MAF Sensor

Fuel Injection Pump and Lines

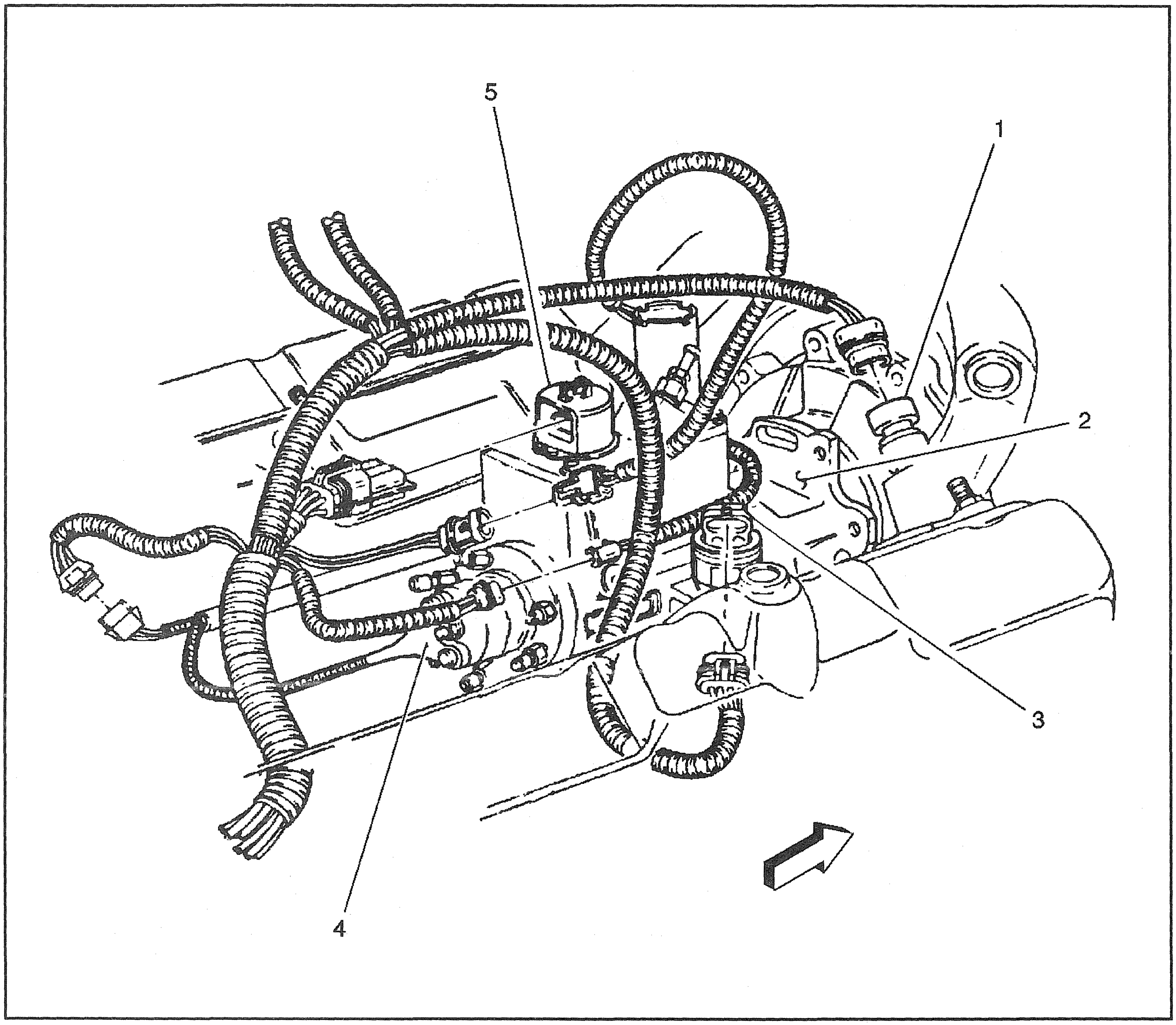


192955

Legend

(1) Optical/Fuel Temperature Sensor
(2) Fuel Injection Pump
(3) Fuel Solenoid
(4) Injection Lines
(5) Fuel Solenoid Driver
(6) Engine Shut Off (ESO) Solenoid

ECT Sensor, ITS Motor, and Optical/Fuel Temperature Sensor

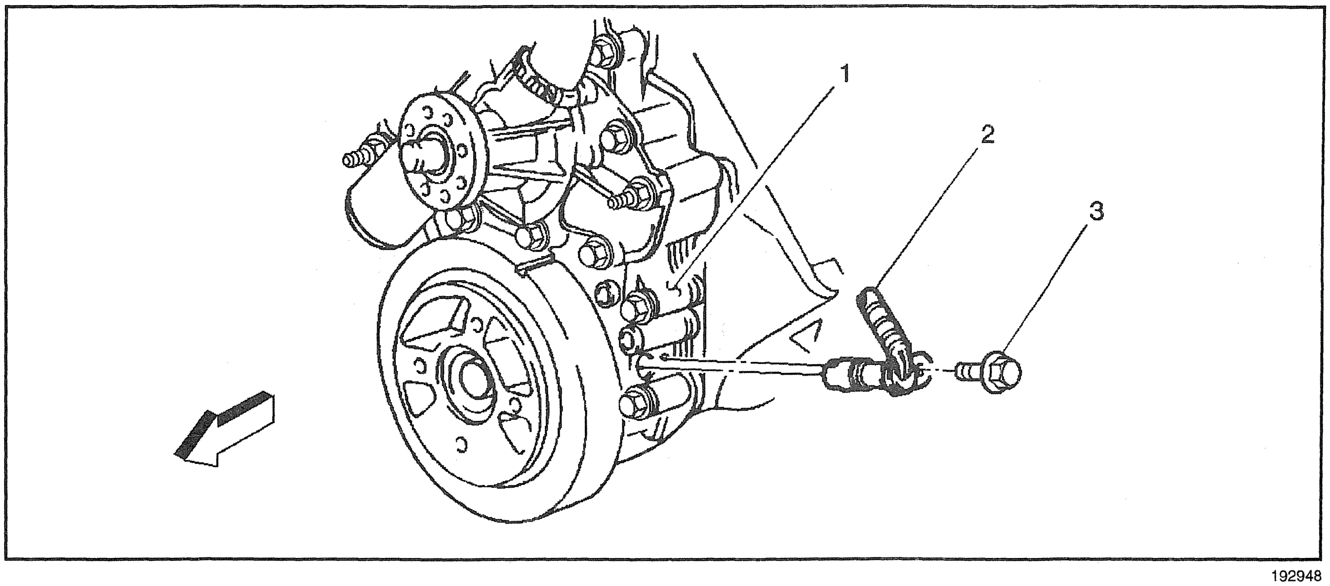


192956

Legend

(1) ECT Sensor
(2) Fuel Injection Pump
(3) Ignition Timing Stepper (ITS) Motor
(4) Fuel Solenoid
(5) Optical/Fuel Temperature Sensor

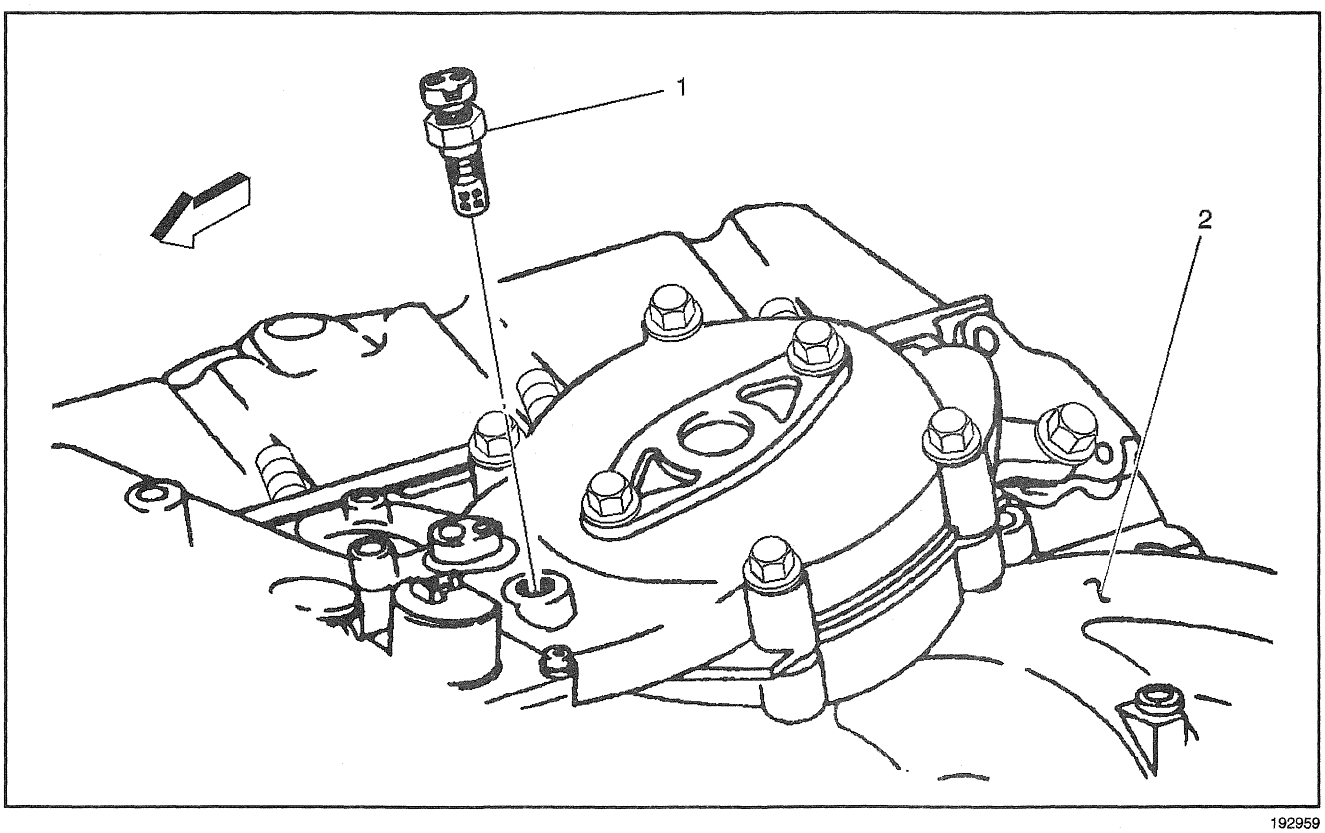
Crankshaft Position (CKP) Sensor



Legend

(1) Front Engine Cover
(2) Crankshaft Position (CKP) Sensor
(3) Mounting Bolt

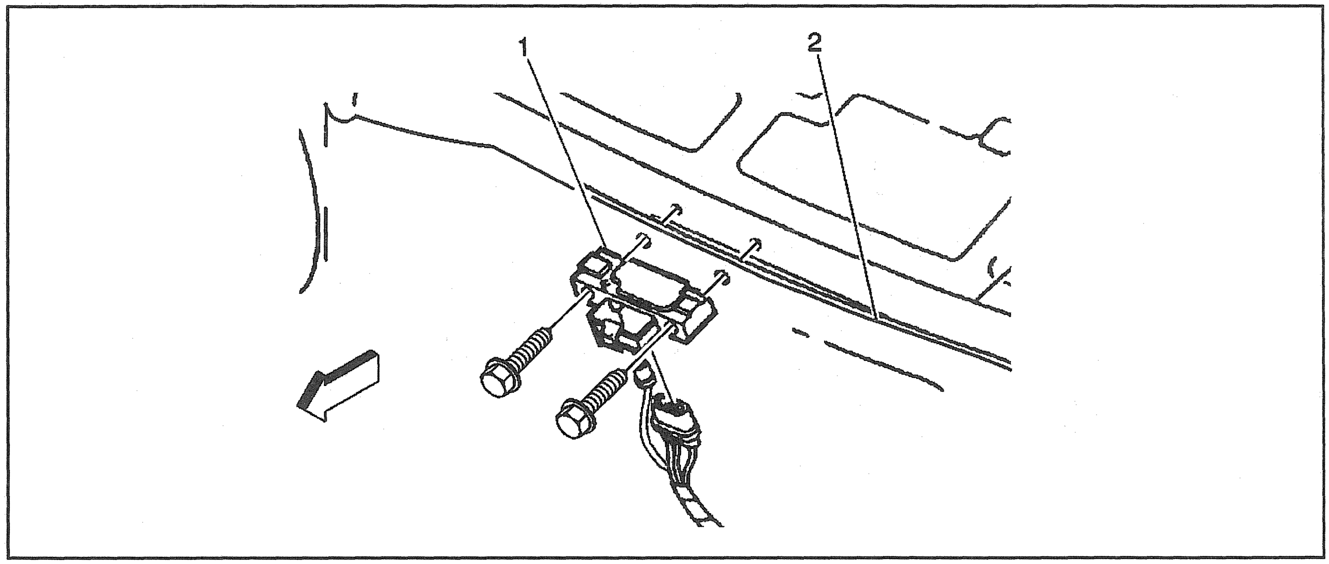
IAT Sensor



Legend

(1) Intake Air Temperature (IAT) Sensor
(2) Intake Manifold

EGR Control Pressure/BARO Sensor



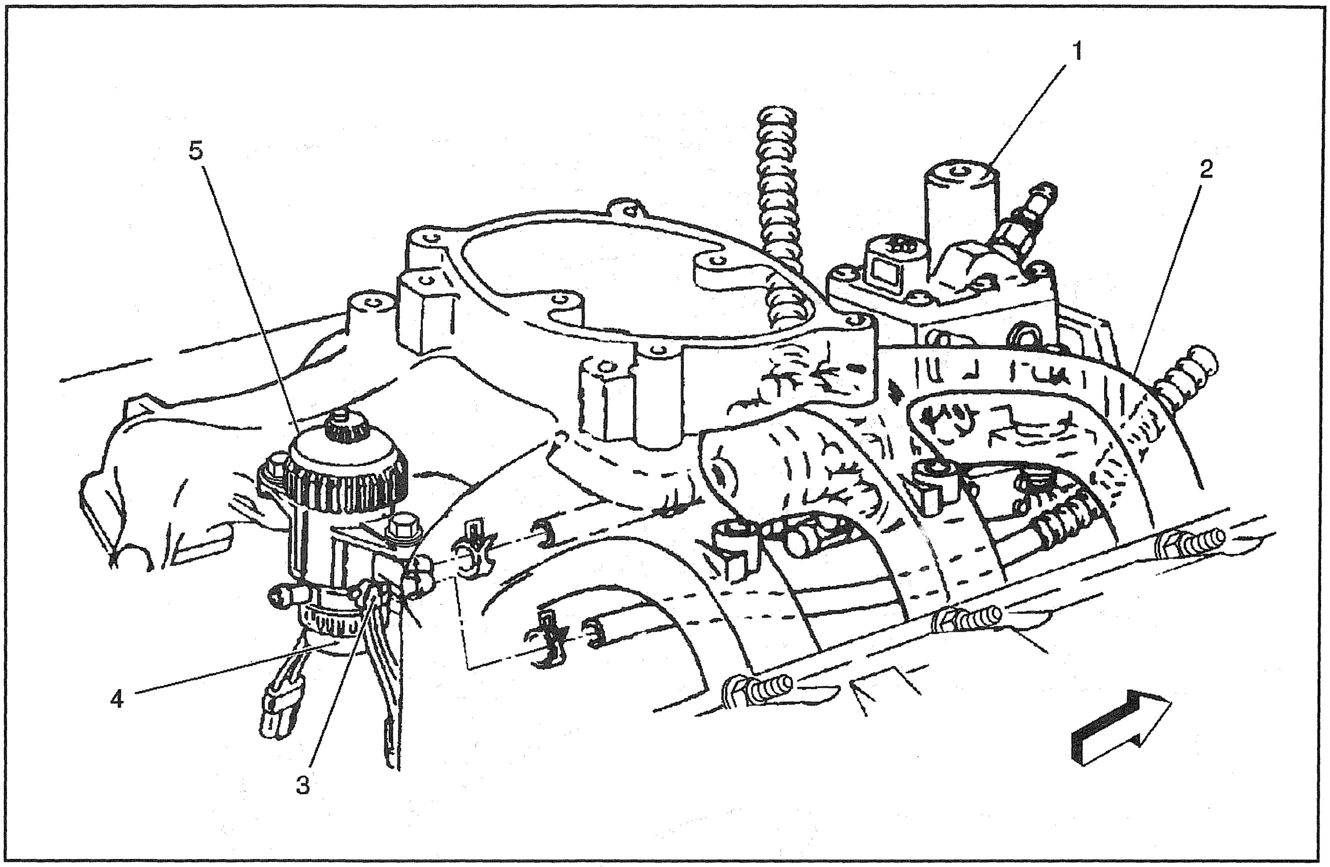
193113

Legend

(1) EGR Control Pressure/BARO Sensor

(2) Engine/Passenger Compartment Divider (Engine Cowl)

Fuel Filter/Manager and Fuel Injection Pump

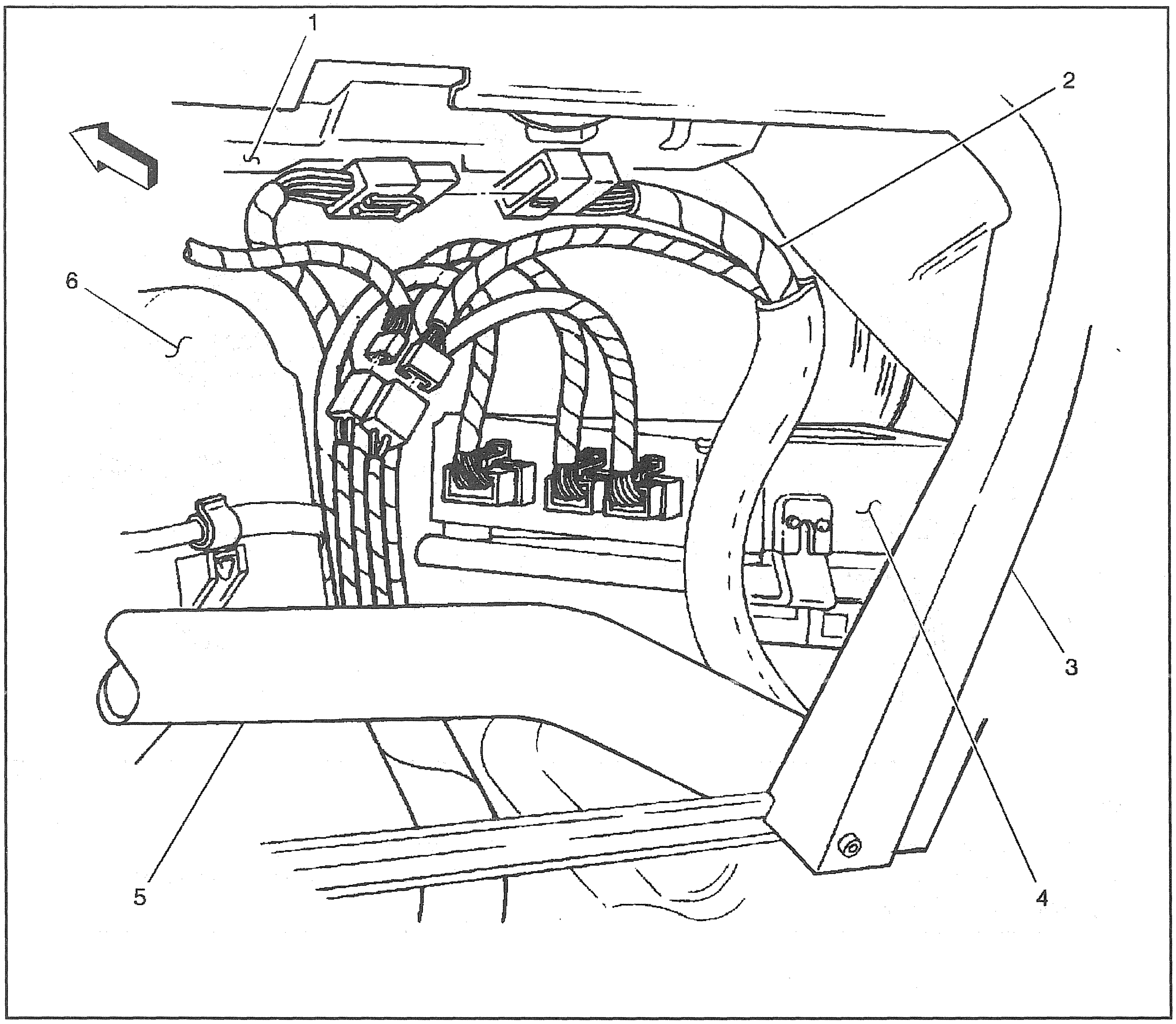


192944

Legend

(1) Fuel Injection Pump
(2) Intake Manifold
(3) Water in Fuel Sensor
(4) Fuel Heater
(5) Fuel Filter/Manager (Filter Inside)

Powertrain Control Module (PCM)

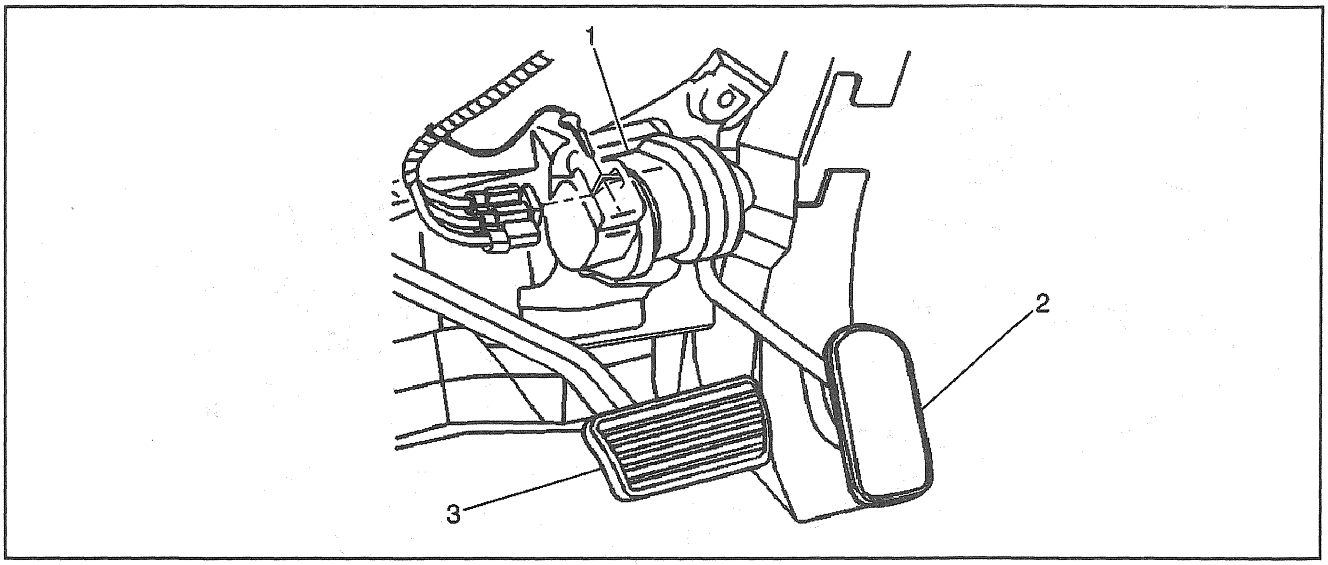


192969

Legend

(1) Plenum Tray
(2) Instrument Panel Harness
(3) Instrument Panel
(4) Powertrain Control Module (PCM)
(5) Instrument Panel Lower Reinforcement Bar
(6) HVAC Module

APP Module

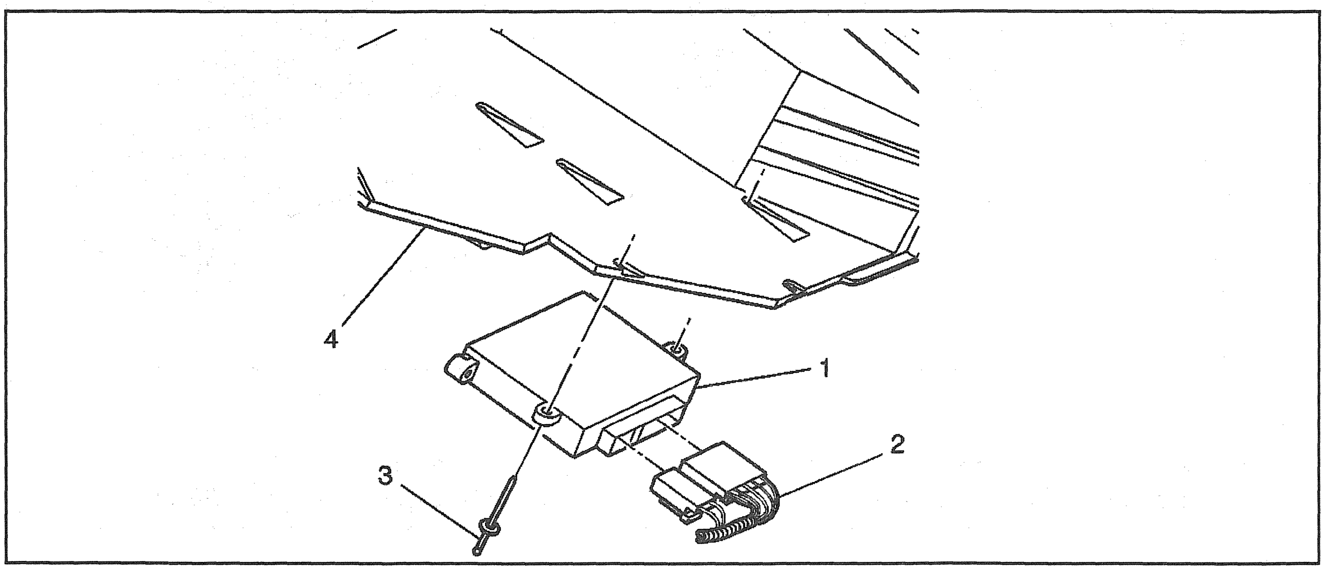


192941

Legend

(1) APP Module
(2) Accelerator Pedal
(3) Brake Pedal

VSS Buffer Module

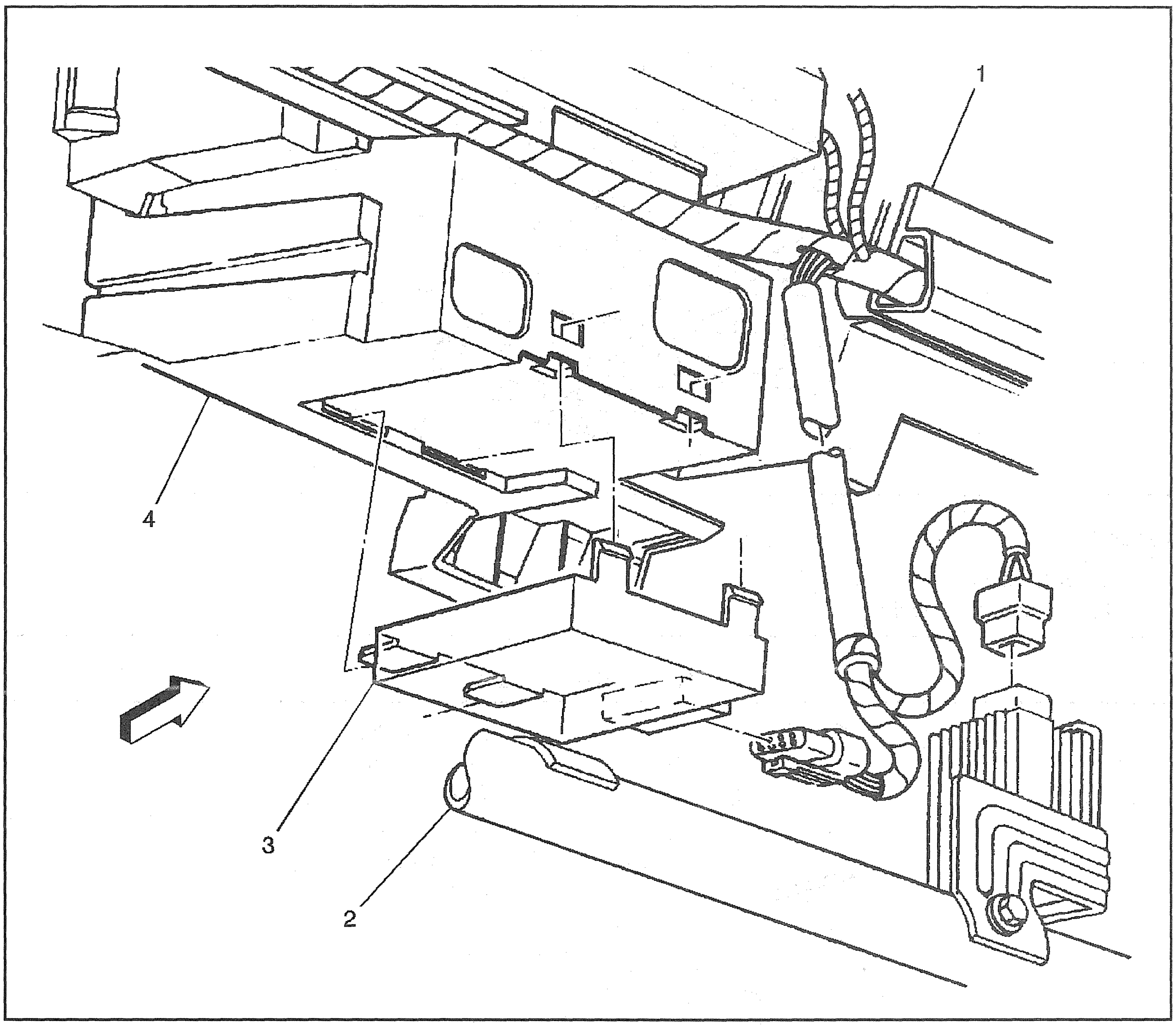


193112

Legend

(1) VSS Buffer Module
(2) Harness Connector
(3) Fastener
(4) Instrument Panel near Glove Box

EVO Module

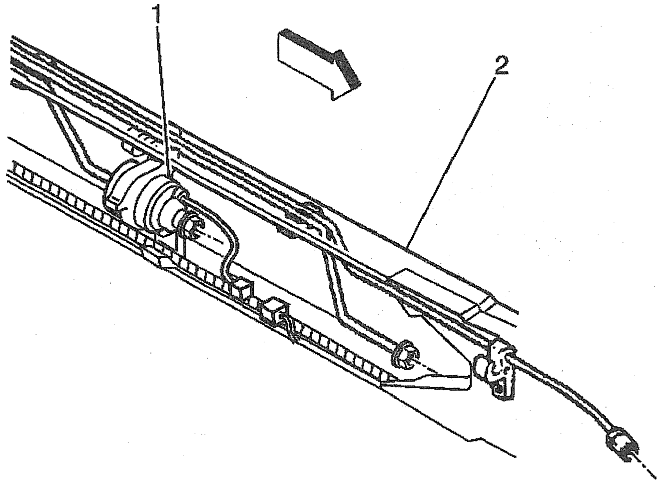


192940

Legend

(1) Instrument Panel Conduit
(2) Instrument Panel Lower Reinforcement Bar
(3) EVO Module
(4) Radio Carrier (Instrument Panel)

Fuel Lift Pump



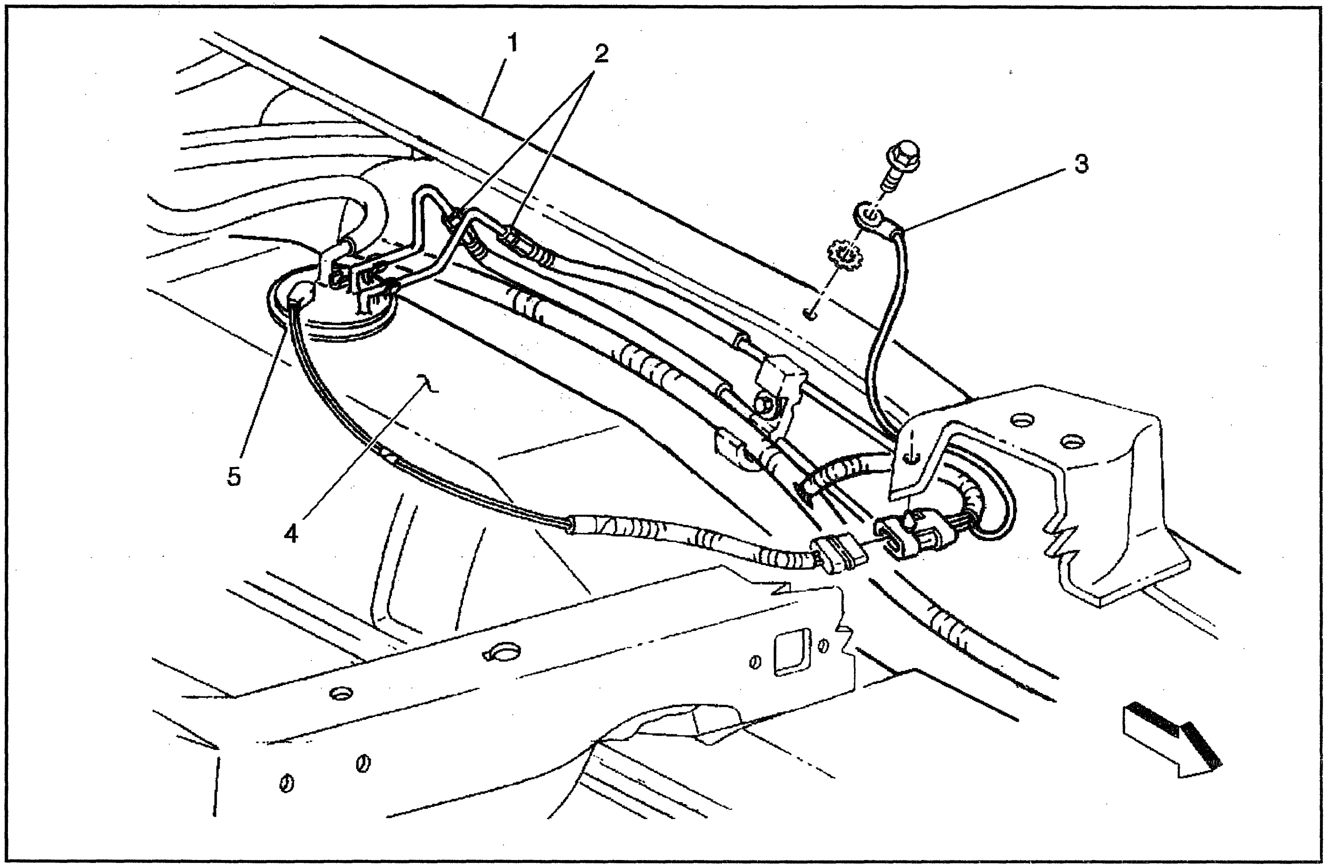
193110

Legend

(1) Fuel Lift Pump

(2) Frame Rail

Fuel Tank and Sender



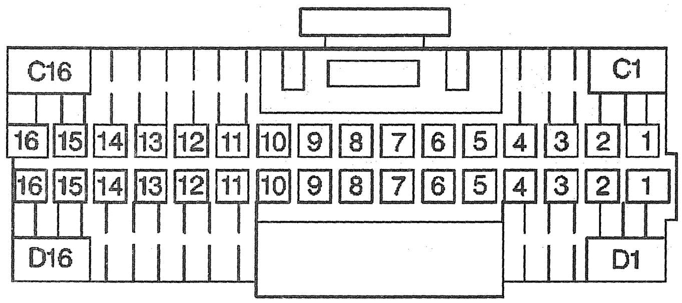
192975

Legend

(1) Frame Rail
(2) Fuel Lines
(3) Ground
(4) Fuel Tank (Typical)
(5) Fuel Sender

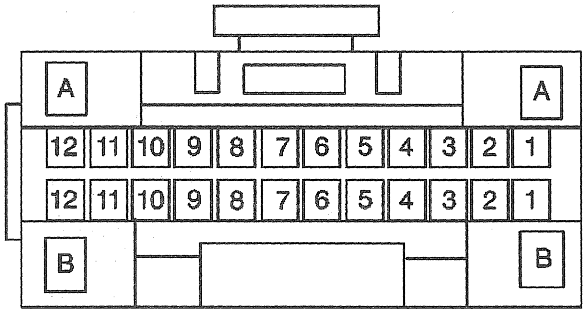
PCM Connector End Views

Powertrain Control Module (PCM) Connector C1



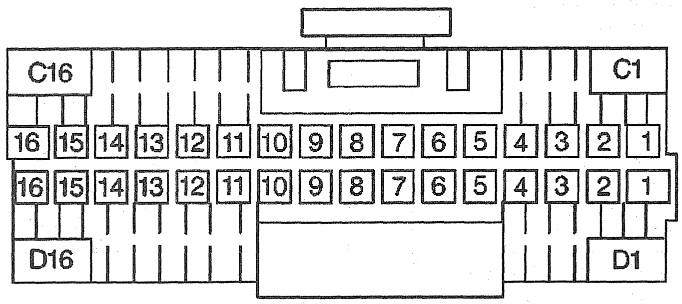
Connector Part Information			• 12110245 • PCM 32 Way Brown (C1) Connector
Pin	Wire Color	Circuit No.	Function
C1	—	—	Not Used
C2	DK GRN/WHT	762	A/C Request
C3	YEL	492	Mass Air Flow Signal
C4	TAN	472	IAT Signal
C5	LT BLU	1162	APP (2) Signal
C6	YEL	505	Glow Plug Relay Control
C7	RED/BLK	1228	Pressure Control Solenoid Valve (Hi)
C8	YEL	1578	Fuel Temperature
C9	YEL/BLK	1227	TFT Sensor
C10	—	—	Not Used
C11	YEL	410	ECT Signal
C12	GRY/BLK	433	EGR Control Pressure/BARO Signal
C13	RED	313	Closure Signal
C14	LT GRN	432	Boost Sensor Signal
C15	LT BLU/WHT	1229	Pressure Control Solenoid Valve (Lo)
C16	—	—	Not Used
D1	BLU/WHT	1231	Transmission Input Speed Signal
D2	GRY/BLK	1694	4WD Low Indicator Signal
D3	YEL/BLK	1275	APP (3) 5 Volt Ref.
D4	DK GRN	1163	APP (3) Signal
D5	GRY	120	Fuel Lift Pump Signal
D6	GRY	1273	APP (3) Ground
D7	BRN	104	Glow Plug Signal
D8	DK GRN/WHT	465	Fuel Lift Pump Control
D9	PNK/BLK	632	Pump CAM, High Res. and Fuel Temperature Ground
D10	GRY/BLK	87	Cruise Resume/Accel Request
D11	RED/BLK	1230	Transmission Input Speed Signal (Lo)
D12	WHT/BLK	1164	APP (1) 5 Volt Ref.
D13	GRY	416	Boost, CKP and EGR Cont/BARO 5 Volt Ref.
D14	GRY	474	Pump CAM and High Res. 5 Volt Ref.
D15–D16	—	—	Not Used

Powertrain Control Module (PCM) Connector C2



Pin	Wire Color	Circuit No.	Function
Connector Part Information			• 12110244 • PCM 24 Way Brown (C2) Connector
A1	BLK	491	Closure Ground
A2	ORN	1799	High Res. Signal
A3	BRN	437	Transmission Output Speed Signal (OSS)
A4	BRN/WHT	633	Pump CAM Sensor Signal
A5	YEL	573	CKP Sensor Signal
A6	DK GRN	389	VSS Signal
A7	RED/BLK	1031	Injection Timing Stepper Motor (HI)
A8	TAN/BLK	1030	Injection Timing Stepper Motor (LO)
A9	ORN/BLK	1032	Injection Timing Stepper Motor (LO)
A10	YEL/BLK	1033	Injection Timing Stepper Motor (HI)
A11	GRY	397	Cruise ON/OFF Signal
A12	PPL	1272	APP (2) Ground
B1	BRN	1271	APP (1) Ground
B2	DK BLU	1161	APP (1) Signal
B3	BLK/WHT	1695	Front Axle Switch Signal
B4	RED	1226	TR Switch C
B5	DK BLU	1225	TR Switch B
B6	PNK	1224	TR Switch A
B7	—	—	PTO (1360 RPM)
B8	—	—	PTO (1070 RPM)
B9	PPL (A/T) BRN/WHT (M/T)	420 (A/T) 379 (M/T)	Cruise Control Brake Switch (A/T) Brake/CPP Switch (M/T)
B10	WHT	17	Brake Switch
B11	DK BLU	84	Cruise Set/Coast Signal
B12	BLK	452	Sensor Ground (Boost, EGR, ECT, IAT, Fuel Temp., TFT and CKP Sensor)

Powertrain Control Module (PCM) Connector C3

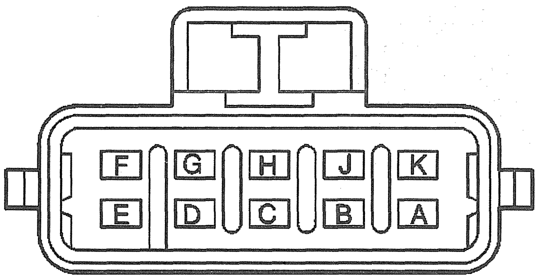


31454

Connector Part Information			• 12110207 • PCM 32 Way Blue (C3) Connector
Pin	Wire Color	Circuit No.	Function
C1	—	—	Not Used
C2	TAN	1274	APP (2) 5 Volt Ref.
C3	LT GRN	260	Fuel Inject Control
C4	LT GRN	1222	Shift Solenoid (1-2)
C5	BRN	418	TCC PWM
C6	YEL/BLK	1223	Shift Solenoid (2-3)
C7	DK BLU	507	Wait To Start Lamp Control
C8	PPL	1807	Class 2 Communication
C9-C10	—	—	Not Used
C11	PNK	439	Ignition
C12	PNK	439	Ignition
C13	ORN	440	Battery
C14	BRN/WHT	419	MIL Control
C15	DK BLU/WHT	259	ESO Control
C16	GRY	435	EGR Solenoid Control
D1-D2	—	—	Not Used
D3	LT GRN/BLK	260	Fuel Inject Control
D4	—	—	Not Used
D5	DK GRN/WHT	459	A/C Enable
D6	BLK/WHT	451	Ground
D7	TAN/WHT	551	Ground
D8-D10	—	—	Not Used
D11	WHT/BLK	176	Service Throttle Soon Lamp Control
D12	WHT	257	EGR Vent Control
D13	ORN	440	Battery
D14	YEL	258	Wastegate Solenoid Control
D15	DK BLU/WHT	259	ESO Solenoid Control
D16	—	—	Not Used

Engine Controls Connector End Views

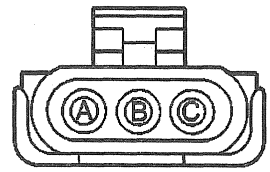
Accelerator Pedal Position Module Connector (Diesel)



280766

Connector Part Information	• 12065425 • ASM 10F M/P 150 (BLACK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BRN	1271	APP 1 Ground
B	PPL	1272	APP 2 Ground
C	LT BLU	1162	APP 2 Signal
D	TAN	1274	5 Volt Reference APP 2
E	YEL/BLK	1275	5 Volt Reference APP 3
F	DK BLU	1161	APP 1 Signal
G	WHT/BLK	1164	5 Volt Reference APP 1
H	—	—	Not Used
J	GRY	1273	APP 3 Ground
K	DK GRN	1163	APP 3 Signal

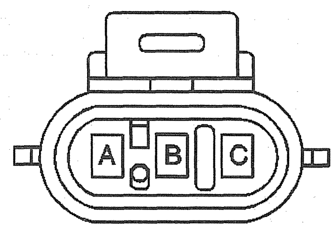
Boost Pressure Sensor



280779

Connector Part Information	• 12103771 • 3 Way M Weather-Pack TWR Series (WHT)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	452	Boost Pressure Sensor - Return
B	LT GRN	432	Boost Pressure Sensor - Signal
C	GRY	416	Reference Voltage Feed - 5 Volt

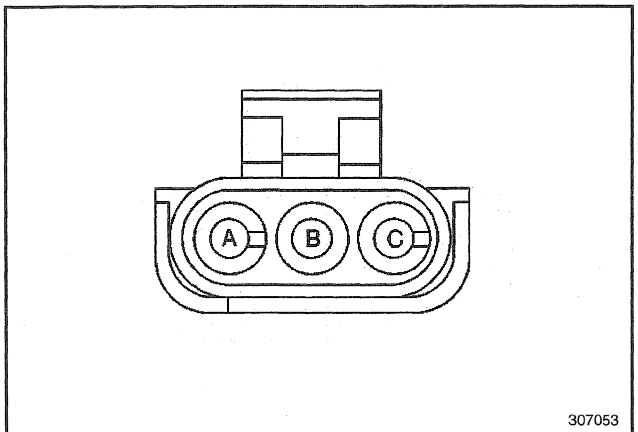
Crankshaft Position (CKP) Sensor Connector



62453

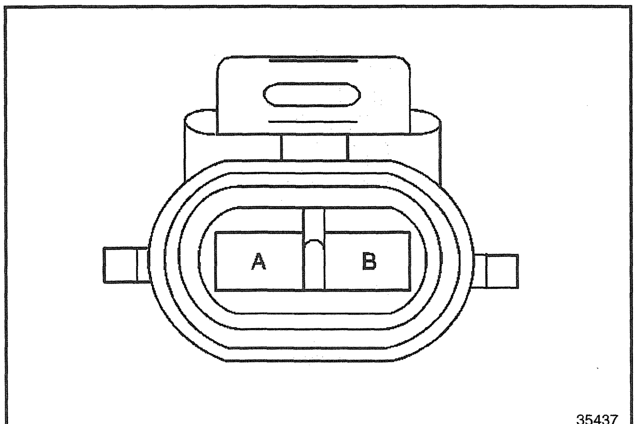
Connector Part Information	• 12059595 • 3F M/P 150 (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL	643	Fuse Output - Ignition 1 - Type III Fuse
B	BLK	452	CKP Sensor Return
C	GRY	416	Reference Voltage

EGR Pressure Sensor



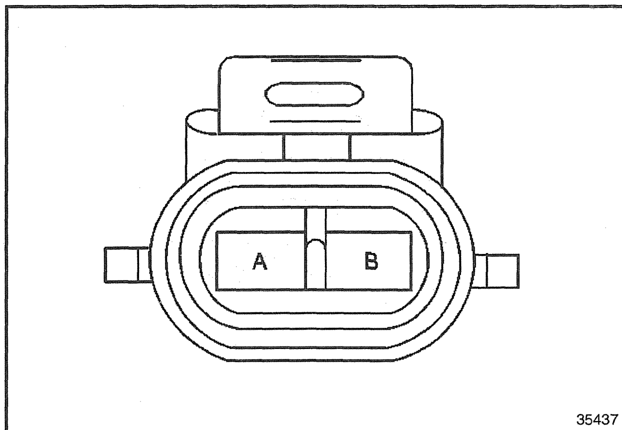
Connector Part Information	• 12020403 • ASM 3M M/P 100 (GRN)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	452	Sensor Return
B	GRY/BLK	433	Barometric Pressure Sensor
C	GRY	416	Reference Voltage Feed

EGR Valve Solenoid



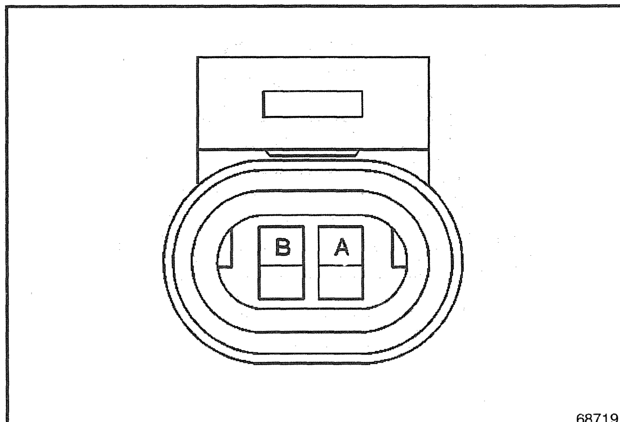
Connector Part Information	• 12052641 • ASM CONN 2F M/P 100 (BLACK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Ignition Fused Feed
B	WHT	257	EGR Vent Solenoid Output
B	GRY	435	EGR Vent Solenoid Output

Engine Shutoff Solenoid



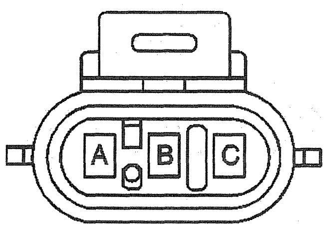
Connector Part Information	• 12052644 • 2 Way F Metri-Pack 150 eries (LT GRY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK BLU/ WHT	259	Engine Shutoff Solenoid - Output
B	PNK	439	Fused Ignition Feed

Intake Air Temp erature (IAT) Sensor Connector



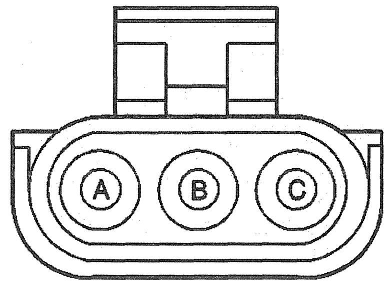
Connector Part Information	• 12162198 • 2F M/P 150 (GRAY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TAN	472	IAT Sensor Signal
B	BLK	452	IAT Sensor Return

Mass Air Flow (MAP) Sensor Connector



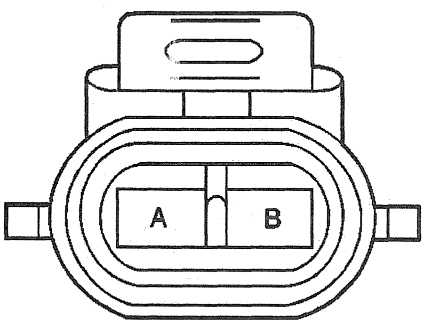
Connector Part Information	• 12059595 • 3F M/P 150 (BLACK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YEL	492	MAF Sensor Signal
B	BLK/WHT	451	VCM Ground
C	PNK	539	Fuse Output - Ignition 1 - Type III Fuse

Fuel Heater



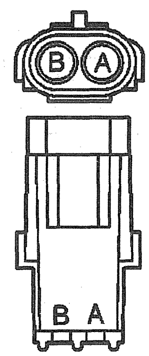
Connector Part Information	• 12015793 • 3 Way M Weather-Pack (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK	550	Ground
B	—	—	Not Used
C	PNK	1039	Fused Ignition Feed

Engine Temperature Switch



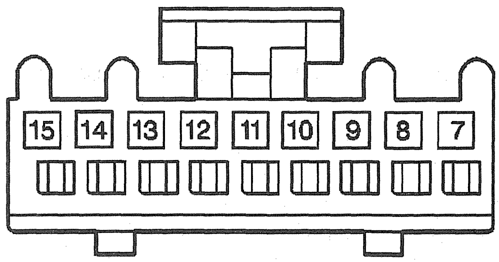
Connector Part Information	• 12089499 • 1F M/P 150 (BLU)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	DK GRN	35	Coolant Temperature Indicator lamp Output
B	—	—	Not Used

Fuel Pump and Sender



Connector Part Information	• 12010973 • 2M W/P SHD SLD (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BLK/WHT	451	Engine Control Module Ground
B	DK BLU/ WHT	970	Fuel Pump Motor Feed

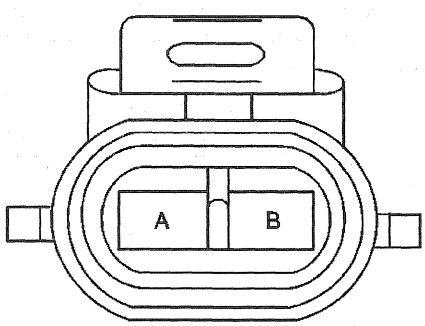
VSS Buffer Connector



62467

Connector Part Information	• 12066130 • CONN 9F M/P 100 (NATURAL)		
Pin	**Wire Color**	**Circuit No.**	**Function**
7	LT GRN/ BLK	822	VSS Return
8	BLK/WHT	451	ECM Ground
9	PNK	39	Fuse Output - Ignition 1 - Type III Fuse
10	YEL/BLK	1827	VSS Signal - 12800 Pulses Per Mile
11	—	—	Not Used
12	PPL/WHT	821	VSS Signal
13	BRN	437	VSS Signal
14	DK GRN/ WHT	817	VSS Signal - 4000 Pulses Per Mile
15	DK GRN	389	VSS Signal - 4000 Pulses Per Mile

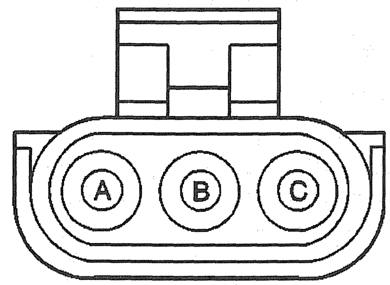
Wastegate Solenoid



35437

Connector Part Information	• 12052641 • 2 Way F Metri-Pack 150 eries (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Fused Ignition Feed
B	YEL	258	Waste Gate Solenoid Output

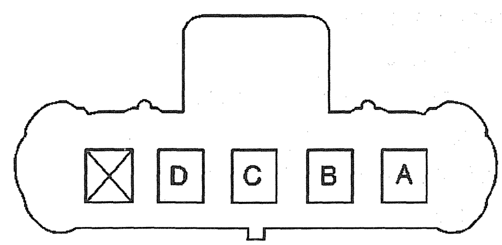
Water in Fuel (WIF) Sensor



309547

Connector Part Information	• 12015793 • 3 Way M Weather-Pack (BLK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Fused Ignition Feed
B	YEL/BLK	508	Water in Fuel Indicator Lamp Output
C	BLK	150	Ground

Glow Plug Relay Connector



307055

Connector Part Information	• 12045636 • CONN 4F M/P 280 (MEDIUM GRAY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PNK	539	Fuse Output - Ignition 1 - Type III Fuse
B	YEL	505	Glow Plug Relay Feed
C	BLK	150	Ground
D	—	—	Not Used

Diagnostic Information and Procedures

A Powertrain On Board Diagnostic (OBD) System Check

Refer to *Power, Ground, MIL and DLC.*

Circuit Description

The On Board Diagnostic (OBD) System Check is an organized approach in identifying a problem created by an electronic engine system fault. The OBD system check is the starting point for any driveability diagnosis. The OBD system check directs the service technician to the next step in diagnosing the complaint. Do not perform this check if no driveability complaint exists. Understanding the table correctly reduces the diagnostic time. Understanding the table correctly prevents the replacement of good parts.

Diagnostic Aids

Important: Do not clear the DTCs unless directed by a diagnostic procedure. Clearing the DTCs will also clear valuable freeze frame and failure records data.

Inspect all related wiring and connections including the connections at the PCM. These may cause an intermittent malfunction.

Check any circuitry that is suspected of causing an intermittent problem for the following conditions:

- Backed out terminals
- Improper mating
- Broken locks
- Improperly formed or damaged terminals
- Poor terminal to wiring connections
- Physical damage to the wiring harness
- Corrosion

Test Description

The numbers below refer to the step number in the diagnostic table.

1. This step will check for power and grounds to the data link connector (DLC).
4. This step will determine if other modules on the Class 2 circuit can communicate, if no communication occurs, the class 2 circuit is grounded, open, shorted to voltage or the module is causing a communication problem.
5. This step will check for DTCs associated with the Vehicle Theft Deterrent (VTD) which will prevent the vehicle from starting.
6. Whenever multiple DTCs are stored, refer to the DTC Tables in the following order:
   1. PCM Error DTCs
   2. System voltage DTCs
   3. Component level DTCs (DTCs that indicate a malfunctioning part)
   4. System level DTCs (DTCs that indicate a system fault)
7. Checking the sensors for proper operation during warm up can be a crucial step in correctly diagnosing any driveability concern. Careful observation of these sensors during the engine warm up may reveal a slow responding sensor or a sensor that malfunctions only within a small portion of its range.

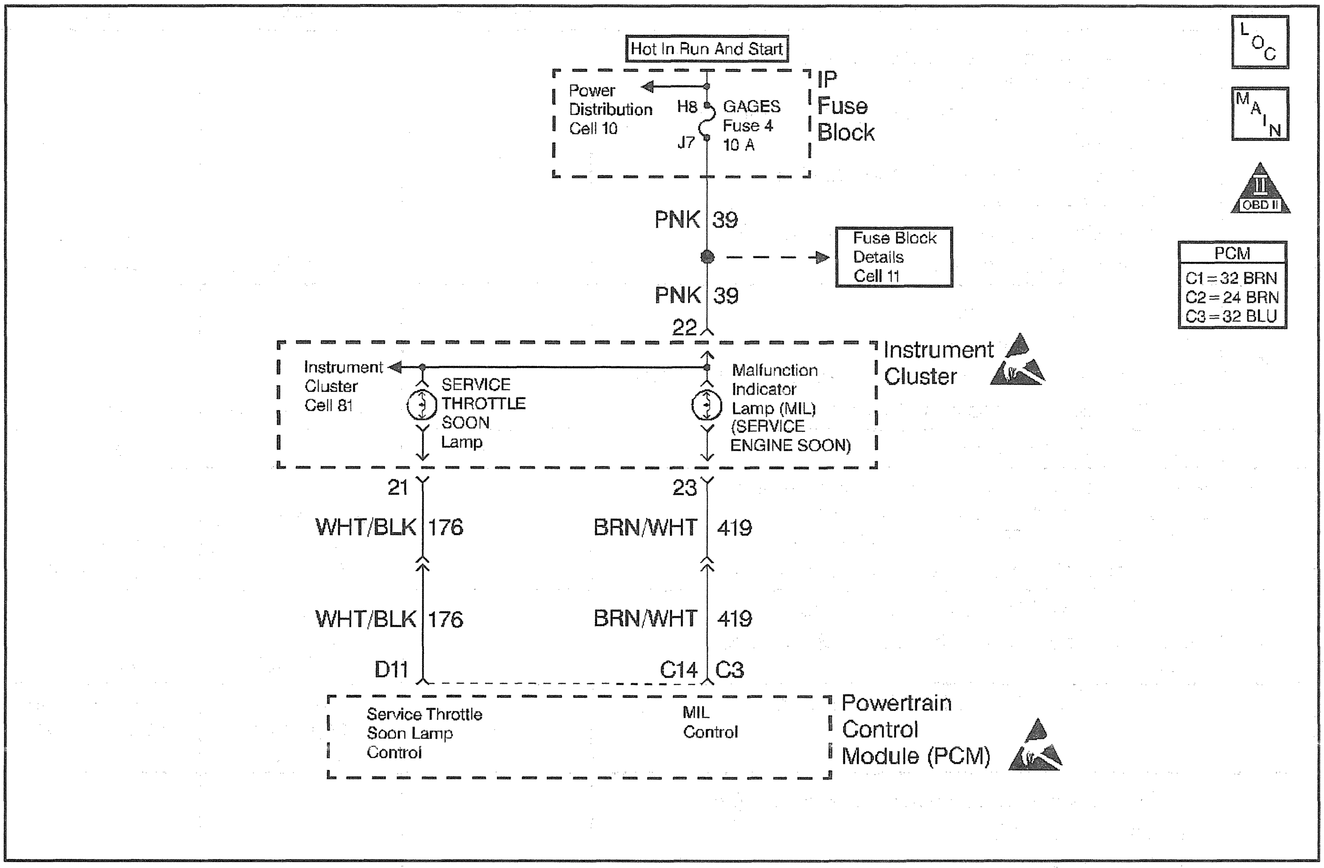
   After the engine is at the normal operating temperature, a comparison of the actual control system data with the typical values is a quick way to determine if any parameter is not within limits. Keep in mind that a base engine problem (i.e. advanced cam timing) may substantially alter sensor values.

   Check the engine coolant temperature (ECT) sensor for initial coolant temperature reading at ambient. Then observe the rise in the temperature while the engine is warming up.

A Powertrain On Board Diagnostic (OBD) System Check

Step	Action	Value(s)	Yes	No
1	**Important:** Check for applicable service bulletins before proceeding with this diagnosis. **Important:** Do not turn OFF the ignition when performing this diagnostic. 1. Connect the scan tool to the data link connector (DLC). 2. Turn ON the ignition with the engine OFF. Does the scan tool power-up?	—	*Go to Step 2*	Go to *Data Link Connector Diagnosis*
2	1. Install the scan tool. 2. Turn ON the ignition. 3. Attempt to establish communications with the PCM. Does the scan tool display PCM data?	—	*Go to Step 3*	*Go to Step 4*
3	Does the engine start and continue to run?	—	*Go to Step 6*	*Go to Step 5*
4	Attempt to establish communications with other systems connected with to the same serial data line (Passlock/EVO, ATC, ABS controllers) Does scan tool communicate with the other systems?	—	Go to *Data Link Connector Diagnosis*	Go to Body and Accessories
5	Check for PCM DTCs using the scan tool. Were any last test failed, history, or MIL request DTCs set?	—	Go to the applicable DTC table	*Go to Step 7*
6	Is DTC P0215, P1626 or DTC P1631 stored?	—	Go to the applicable DTC table	Go to *Engine Cranks but Does Not Run*
7	1. Turn ON the ignition leaving the engine OFF. 2. Check the ECT. 3. Start the engine. 4. Allow the engine temperature to reach operating temperature. 5. While the engine is reaching the operating temperature, check the ECT. 6. Compare the scan tool values of the sensors with the typical values shown in the Scan Tool Values. Are the displayed values normal or within typical ranges?	—	Go to *Symptoms*	Go to Diagnostic Aids and Test Descriptions

No Malfunction Indicator Lamp



185027

Circuit Description

There should always be a steady malfunction indicator lamp (MIL) when the ignition is ON and the engine is OFF. Battery ignition voltage is supplied to the lamp. The PCM will turn the lamp ON by grounding the ignition feed circuit.

Diagnostic Aids

If the engine cranks but will not run, check:

- Continuous battery-fuse or fusible link for open.
- PCM ignition fuse for open.
- Battery Feed circuit to PCM for open.
- Ignition Feed circuit to PCM for open.
- Poor connection to PCM.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

5. This step will isolate the problem in the MIL control circuit.
6. If the Battery Feed, Ignition Feed and Diagnostic Test circuits have voltage, the PCM connections, grounds, or PCM are malfunctioning.
8. Refer to *PCM Connector End Views* for PCM pin locations of ground circuits.
12. If the fuse/fusible link is open, refer to PCM Wiring Diagram for complete circuit.

No Malfunction Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Did you perform the Powertrain On-Board Diagnostic System check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Attempt to start the engine. Does the engine start?	—	*Go to Step 3*	*Go to Step 6*
3	Check the fuse number 4. Is the fuse OK?	—	*Go to Step 4*	*Go to Step 14*
4	Turn ON the ignition, probe the ignition feed circuit at the cluster connector with an *J 34142-B* unpowered test lamp connected to ground. Does the test light illuminate?	—	*Go to Step 5*	*Go to Step 11*
5	1. Turn OFF the Ignition. 2. Disconnect the blue PCM connector. 3. Turn ON the ignition. 4. With a fused jumper wire connected to ground, probe the MIL control circuit at the PCM connector. 5. Observe the MIL. Is the MIL ON?	—	*Go to Step 9*	*Go to Step 10*
6	Check the PCM Ignition Feed and Battery Feed fuses. Are both of the fuses OK?	—	*Go to Step 7*	*Go to Step 13*
7	1. Turn OFF the ignition. 2. Disconnect the PCM connectors. 3. Turn ON the ignition. 4. Probe the PCM harness ignition and battery feed circuits with an *J 34142-B* unpowered test lamp connected to ground. Is the test light ON both circuits?	—	*Go to Step 8*	*Go to Step 12*
8	1. Check for a proper PCM ground or a proper PCM ground connection. 2. If a problem is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 20*	*Go to Step 9*
9	1. Check for a proper connection at the PCM. 2. If a poor connection is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. DId you perform a repair?	—	*Go to Step 20*	*Go to Step 15*
10	1. Check the MIL control circuit for an open. 2. If the MIL control circuit is open, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 20*	*Go to Step 16*
11	Repair the open in the ignition feed circuit to the cluster connector. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 20*	—
12	Locate and repair open in the PCM battery feed circuit or the PCM ignition feed circuit as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 20*	—
13	Locate and repair short to ground in the PCM ignition feed circuit or the PCM Battery Feed circuit as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 20*	—

No Malfunction Indicator Lamp (cont'd)

Step	Action	Value(s)	Yes	No
14	Locate and repair short to ground in the instrument cluster ignition feed circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 20*	—
15	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 20*	—
16	1. Check the MIL control circuit for a proper connection at the instrument cluster connector. 2. If a problem is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. DId you perform a repair?	—	*Go to Step 20*	*Go to Step 17*
17	1. Remove the instrument cluster. Refer to *IP Cluster Replacement* in Instrument Panel, Gauges and Console. 2. Inspect the MIL bulb. Is the bulb OK?	—	*Go to Step 19*	*Go to Step 18*
18	Replace the MIL bulb. Is the action complete?	—	*Go to Step 20*	—
19	Replace the instrument cluster. Refer to *IP Cluster Replacement* in Instrument Panel, Gauges and Console. Is the action complete?	—	*Go to Step 20*	—
20	1. Using the scan tool, select DTC, Clear Info. 2. Attempt to start the engine. Does the engine start and continue to run?	—	*Go to Step 21*	*Go to Step 2*
21	1. Allow the engine to idle until normal operating temperature is reached. 2. Select DTC, Failed This Ign. Are any DTCs displayed?	—	Go to the Applicable DTC Table	*Go to Step 22*
22	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the Applicable DTC Table.	System OK

Data Link Connector Diagnosis

Refer to *Power, Ground, MIL and DLC*.

Circuit Description

There should always be a malfunction indicator lamp (MIL) when the ignition is ON and the engine is OFF. Battery ignition voltage is supplied to the lamp. The PCM will turn the lamp ON by grounding the ignition feed circuit.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies if the problem is in the scan tool or the vehicle.
6. This step will check the ground circuits at the DLC connector.
9. The step will check for the battery and ignition feeds to the PCM.

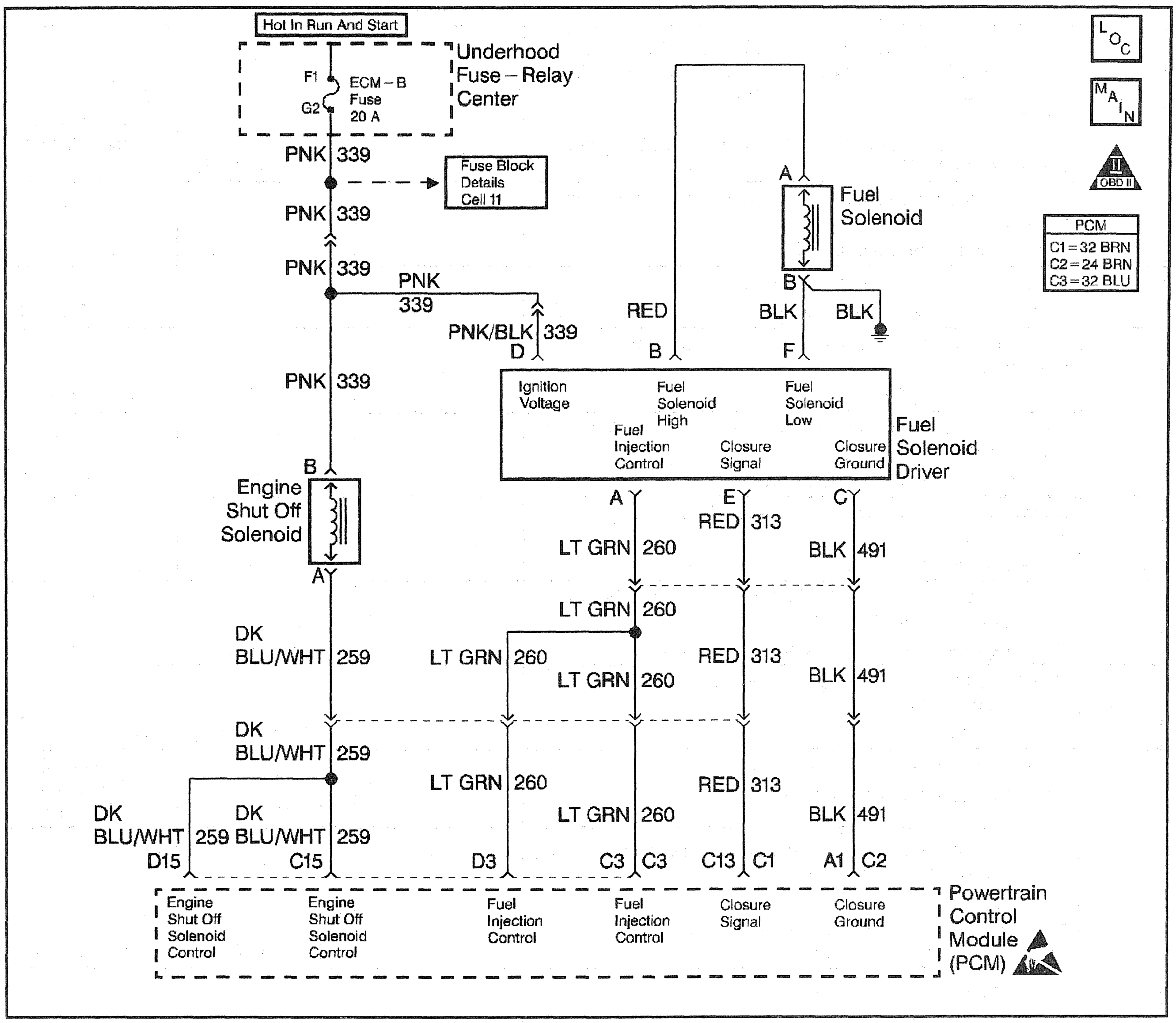
Data Link Connector Diagnosis

Step	Action	Value(s)	Yes	No
1	Did you perform the Powertrain On–Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn ON the ignition with the engine OFF. 2. Connect the scan tool to the DLC. Does the scan tool power-up?	—	*Go to Step 3*	*Go to Step 5*
3	1. Turn OFF the ignition for 15 seconds. 2. Attempt to start the vehicle. Does the engine start then stall?	—	Go to *Content Theft Deterrent (CTD) Circuit Description*	*Go to Step 4*
4	Did the engine just crank over and not start?	—	*Go to Step 9*	*Go to Step 13*
5	1. Disconnect the scan tool from the DLC. 2. Turn ON the ignition with the engine OFF. 3. Probe the DLC terminal 16 using an *J 34142-B* unpowered test lamp connected to battery ground. Does the test lamp illuminate?	—	*Go to Step 6*	*Go to Step 16*
6	Probe the DLC terminals 4 and 5 using an *J 34142-B* unpowered test lamp connected to B+. Does the test lamp illuminate on both circuits?	—	*Go to Step 7*	*Go to Step 8*
7	1. Inspect the scan tool connections to the DLC. 2. Also inspect the terminals for proper tension at the DLC. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
8	Repair the open ground circuit to the DLC terminals 4 and 5. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
9	1. Turn OFF the ignition. 2. Disconnect the PCM connector containing the Battery and Ignition feed circuits. 3. Turn ON the ignition. 4. Probe the Battery and Ignition feed circuits in the PCM harness connectors with a test lamp connected to battery ground. Does the test lamp illuminate on each circuit?	—	*Go to Step 10*	*Go to Step 14*
10	Measure the resistance between the battery ground and the PCM ground circuits in the PCM harness connectors using a *J 39200* DMM. Does the DMM display the specified value (or lower) on each circuit?	5 Ω	*Go to Step 11*	*Go to Step 15*

Data Link Connector Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
11	Inspect the PCM for proper connections. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	*Go to Step 12*
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
13	Repair the Class 2 circuit for being open between the splice and the DLC. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
14	Repair the circuit that did not illuminate the test lamp. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
15	Repair the PCM ground circuit(s). Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—
16	Repair the B+ supply circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	Go to *A Powertrain On Board Diagnostic (OBD) System Check*	—

Engine Cranks but Does Not Run



185026

Circuit Description

This chart assumes that battery condition and engine cranking speed is OK. The quantity and quality of fuel is OK and the glow plug system is operating properly.

Diagnostic Aids

If no trouble is found and the cause of an Engine Cranks But Will Not Run has not been found, check for the following conditions:

- Proper cranking speed, 100 RPMs cold – 180 RPMs hot (a scan tool can be used to check cranking speed by pulling the FUEL SOL fuse and monitoring Engine Speed on scan tool while cranking).
- Water or foreign material in fuel system.
- Basic engine problem.

If the crankshaft position sensor and the optical/fuel temperature sensor are disconnected or malfunctioning at the same time, an Engine Cranks But Will Not Run condition will exist.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

6. This step checks for proper cranking speed (see Diagnostic Aids).
8. This step will check the ground wire on the injection pump (wire located on top of pump).
12. This step will determine if the injection pump or wiring is at fault.
13. This step will determine if the fuel injection control voltage is present by probing at the black/gray 4 wire connector jumper harness instead of at the 6 wire pump connector.

Engine Cranks but Does Not Run

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTC(s) use the Scan Tool Capture Info to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Check for proper condition of batteries. Refer to Engine Electrical. Is the condition of batteries OK?	—	*Go to Step 3*	*Go to Step 23*
3	Check for adequate fuel in the tank. Is the fuel at an adequate level?	—	*Go to Step 4*	*Go to Step 23*
4	Check the quality of the fuel. Refer to *Fuel Quality Diagnosis*. Is the fuel quality OK?	—	*Go to Step 5*	*Go to Step 23*
5	Check the glow plug system operation. Refer to *Glow Plug System Check*. Are the glow plugs operating OK?	—	*Go to Step 6*	*Go to Step 23*
6	Check for the proper cranking speed. Refer to Engine Electrical. Is the cranking speed OK?	—	*Go to Step 7*	*Go to Step 23*
7	Check for a restriction in the fuel return system. Refer to *Fuel Supply System Check*. Does the fuel return system operate properly?	—	*Go to Step 8*	*Go to Step 23*
8	Check the injection pump ground wire (located on top of the injection pump). Is the ground OK?	—	*Go to Step 9*	*Go to Step 23*
9	Install a scan tool. Does the scan tool display data?	—	*Go to Step 10*	Go to *Data Link Connector Diagnosis*
10	1. Monitor the VTD Fuel Disabled parameter on the Powertrain Engine Data 1 list. 2. Crank the engine. Does the VTD Fuel Disabled parameter display Active while the engine is being cranked?	—	Go to VTD System Check	*Go to Step 11*
11	1. Loosen the injector line at the injector. 2. Crank the engine. 3. Repeat the procedure for the remaining injectors. Is there fuel at each injection line?	—	*Go to Step 17*	*Go to Step 12*
12	Disconnect the optical/fuel temperature sensor. Does the vehicle start?	—	*Go to Step 16*	*Go to Step 13*
13	1. Reconnect the optical/fuel temperature sensor. 2. Disconnect the fuel solenoid driver at the fuel injection pump 4 wire jumper harness. 3. With *J 39200* connected to ground, probe the fuel injector control circuit (terminal A) at the 4 wire jumper harness connector (PCM side). 4. Crank the engine. Is the voltage greater than or equal to the specified value?	1.2 V	*Go to Step 14*	*Go to Step 18*
14	1. Verify the fuel solenoid driver 4 wire jumper harness is still disconnected. 2. Probe the fuel solenoid closure ground circuit (terminal B) with a test light connected to B+ at the harness terminal (PCM side). Is the test light ON?	—	*Go to Step 15*	*Go to Step 19*

Engine Cranks but Does Not Run (cont'd)

Step	Action	Value(s)	Yes	No
15	1. Turn the ignition ON leaving the engine OFF. 2. Verify the fuel solenoid driver 4 wire jumper harness is still disconnected. 3. Probe the ignition feed circuit (terminal C) at the fuel solenoid 4 wire jumper harness connector (PCM side) with a test light connected to ground. Is the test light ON?	—	*Go to Step 16*	*Go to Step 21*
16	Replace fuel injection pump. Refer to *Fuel Injection Pump Replacement*. Is the action complete?	—	*Go to Step 25*	—
17	The injection system is OK. Is the action complete?	—	Go to Driveability Symptoms	—
18	Check the fuel injection control circuit for an open or short to ground between the fuel solenoid driver and the PCM. Was a problem found?	—	*Go to Step 22*	*Go to Step 20*
19	Check the closure ground circuit for an open between the fuel solenoid driver and the PCM. Was a problem found?	—	*Go to Step 22*	*Go to Step 20*
20	Inspect the fuel solenoid driver connector and the PCM connector for a proper connection. Was a problem found?	—	*Go to Step 22*	*Go to Step 24*
21	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 25*	—
22	Repair the circuit as necessary. Is the action complete?	—	*Go to Step 25*	—
23	Make the appropriate repairs. Is the action complete?	—	*Go to Step 25*	—
24	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 25*	—
25	1. Using the scan tool, select DTC, Clear Info. 2. Attempt to start the engine. Does the engine start and continue to run?	—	*Go to Step 26*	*Go to Step 2*
26	1. Allow the engine to idle until normal operating temperature is reached. 2. Select DTC, Fail This Ign. Are any DTCs displayed?	—	*Go to Step 27*	—
27	Using the scan tool, select Capture Info, Review Info. Are any DTCs displayed that have not been diagnosed?	—	Go to the Applicable DTC Table	System OK

Fuel Pump Relay Circuit Diagnosis

Refer to *Fuel Pump Controls*

Circuit Description

When the key is turned ON, the PCM energizes the fuel pump relay which sends voltage to the lift pump. The lift pump remains ON during the glow plug cycle. If the engine is not started immediately after the glow plug cycle, the PCM shuts the fuel lift pump OFF and waits until the engine starts. As a backup system to the fuel pump relay, the fuel lift pump can also be turned ON by the fuel pump/oil pressure switch. When the engine oil pressure reaches 28 kPa (4 psi), and the fuel pump relay does not complete the circuit, the fuel pump/oil pressure switch will close and complete the circuit to run the fuel lift pump.

Diagnostic Aids

Possible long crank times or a poor performance problem will exist.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for proper operation of the fuel pump.
3. Checks the operation of the fuel pump by supplying 12 volts to the fuel pump control circuit.
5. Check the battery feed circuit to the fuel pump relay.
10. Checks for proper operation of the fuel pump relay.

Fuel Pump Relay Circuit Diagnosis

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs use the Scan Tool Capture Info to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn OFF the ignition for 10 seconds. 2. Turn ON the ignition. Does fuel pump operate during the glow plug cycle?	—	Go to *Engine Cranks but Does Not Run*	*Go to Step 3*
3	Apply a 12 volt fused jumper to the fuel pump test terminal. Does the fuel pump operate?	—	*Go to Step 4*	*Go to Step 12*
4	1. Remove the 12 volt fused jumper from the test terminal. 2. Turn OFF the ignition for 10 seconds. 3. Turn ON the ignition. Does the fuel pump operate during glow plug cycle and then stop?	—	*Go to Step 25*	*Go to Step 5*
5	1. Disconnect the fuel pump relay. 2. Turn ON the ignition with the engine OFF. 3. Probe the fuel pump relay battery feed terminal at the fuel pump relay harness connector with an *J 34142-B* unpowered test lamp connected to ground. Is the test light ON?	—	*Go to Step 6*	*Go to Step 14*
6	Connect an *J 34142-B* unpowered test lamp between the fuel pump relay battery feed circuit harness connector and ground. Is the test light ON?	—	*Go to Step 7*	*Go to Step 15*
7	1. Connect an *J 34142-B* unpowered test lamp between the fuel pump relay control circuit and ground. 2. Turn OFF the ignition for 20 seconds. 3. Turn ON the ignition. Is the test light ON during glow plug cycle and then OFF?	—	*Go to Step 8*	*Go to Step 16*
8	Check for a proper connection at the fuel pump relay control connector terminal. Did you find a problem?	—	*Go to Step 11*	*Go to Step 9*

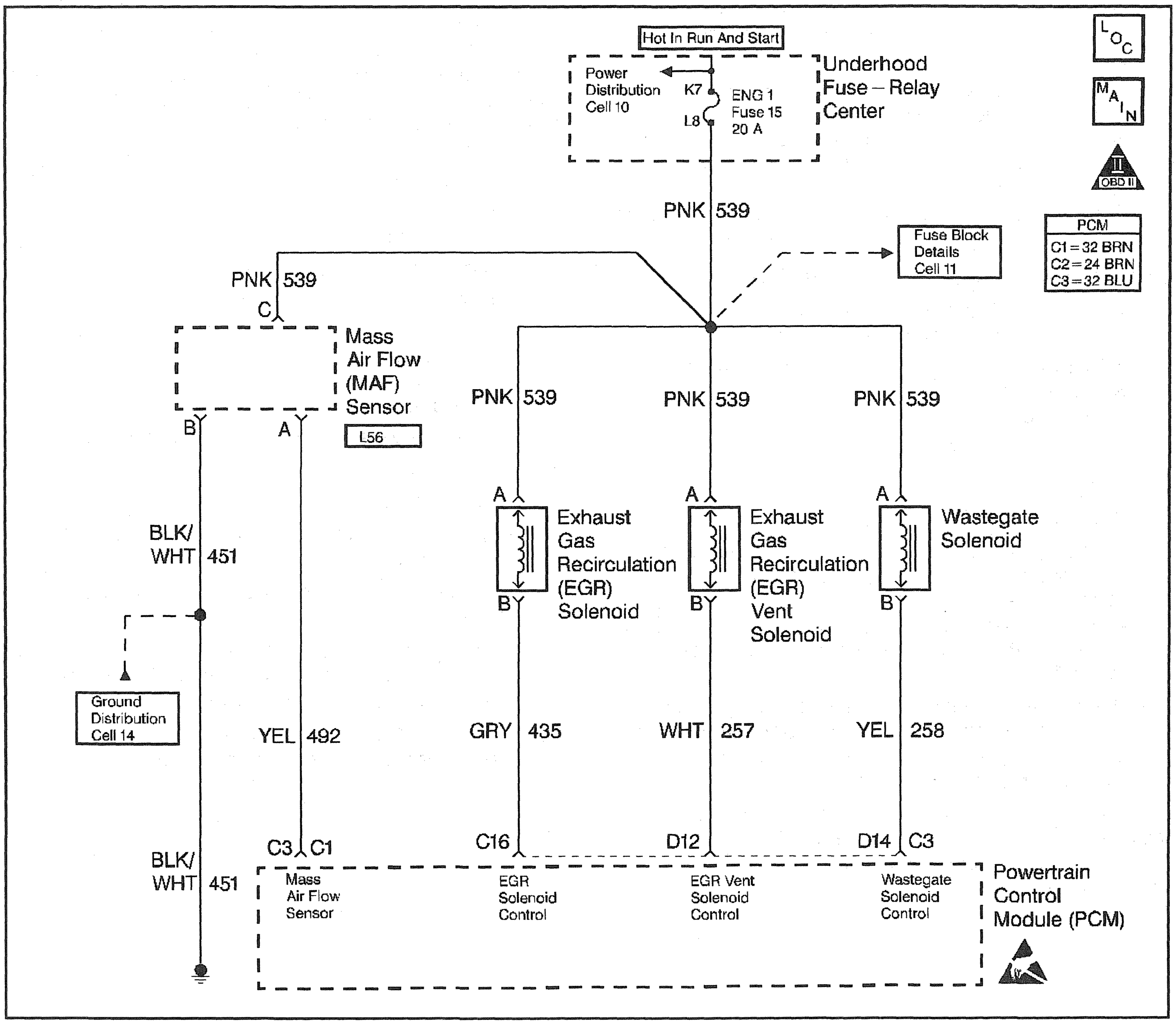
Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
9	Replace the fuel pump relay. Refer to *Fuel Pump Relay Replacement*. Is the action complete?	—	*Go to Step 25*	*Go to Step 10*
10	1. Start the engine. Allow the engine to idle until normal operating temperature is reached. 2. Verify the oil pressure is within normal range. 3. Disconnect the fuel pump relay. Does the engine continue to run?	—	*Go to Step 11*	*Go to Step 17*
11	1. Reinstall the fuel pump relay. 2. Turn OFF the ignition. 3. Probe the fuel pump test connector with an *J 34142-B* unpowered test lamp to ground. Is the test light ON?	—	*Go to Step 18*	*Go to Step 25*
12	1. Disconnect the fuel pump harness connector at the fuel lift pump. 2. Apply a 12 volt fused jumper to the fuel pump test terminal. 3. Probe the fuel pump feed circuit with an *J 34142-B* unpowered test lamp connected to ground. Is the test light ON?	—	*Go to Step 13*	*Go to Step 20*
13	With an *J 34142-B* unpowered test lamp connected to B+ probe the fuel pump ground terminal (vehicle side) of the chassis harness fuel pump connector. Is the test light ON?	—	*Go to Step 19*	*Go to Step 21*
14	Repair the open in the battery feed circuit to the fuel pump relay harness connector terminal. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—
15	Repair the open in the fuel pump relay ground circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—
16	1. Check for a proper connection at the PCM fuel pump relay control circuit. 2. Check for an open or short to ground in the harness between the fuel pump relay control connector terminal and the fuel pump relay control circuit. Did you find a problem?	—	*Go to Step 22*	*Go to Step 24*
17	Check the oil pressure switch harness connector terminals for a proper connection. Did you find a problem?	—	*Go to Step 22*	*Go to Step 18*
18	Replace the oil pressure switch. Refer to *Engine Oil Pressure Sensor/Switch Replacement*. Is the action complete?	—	*Go to Step 25*	—
19	Replace the fuel lift pump. Refer to *Fuel Lift Pump Replacement*. Is the action complete?	—	*Go to Step 25*	—
20	Repair the open between the fuel pump test terminal and the fuel pump feed circuit at the fuel pump harness connector. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—
21	Repair the open in the fuel pump harness ground circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—

Fuel Pump Relay Circuit Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
22	Repair the circuit as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—
23	Repair the connection as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 25*	—
24	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 25*	—
25	1. Using the scan tool, select DTC, Clear Info. 2. Attempt to start the engine. Does the engine start and continue to run?	—	*Go to Step 26*	*Go to Step 2*
26	1. Allow the engine to idle until normal operating temperature is reached. 2. Select DTC, Failed This Ign. Are any additional DTCs displayed?	—	Go to Applicable DTC Table	*Go to Step 27*
27	Using the scan tool, select Capture Info, Review Info. Are any additional DTCs displayed that have not been diagnosed?	—	Go to Applicable DTC Table	System OK

DTC P0101 Mass Air Flow (MAF) Sensor Performance



185071

Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity of air indicates deceleration or idle.

The MAF sensor produces a frequency signal. DTC P0101 will be set if the signal from the MAF sensor does not match a predicted value based on engine coolant temperature, throttle angle and engine speed.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- DTCs P0405, P0406, P0102 and P0103 are not set.
- The Baro is more than 75 kPa.

Conditions for Setting the DTC

The diagnostic must fail 2 of the 5 EGR tests (these tests are performed internally by the PCM).

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check for the following conditions:

- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the scan tool while moving connectors and wiring harnesses related to the MAF sensor. A change in the display will indicate the location of the fault.
- Plugged intake air duct or dirty air filter element. A wide open throttle acceleration from a stop should cause the Mass Air Flow displayed on a scan tool to increase. If not, check for a restriction.

If DTC P0101 cannot be duplicated, the information included in the Fail Records data can be useful in determining vehicle mileage since the DTC was last set. This may assist in determining how often the DTC sets.

The adaptive learn matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table:

2. This step verifies that the problem is present at idle.
5. A voltage reading of less than 4 or over 6 volts at the MAF sensor signal circuit indicates a fault in the wiring or a poor connection.
6. Verifies that ignition feed voltage and a good ground are available at the MAF sensor.

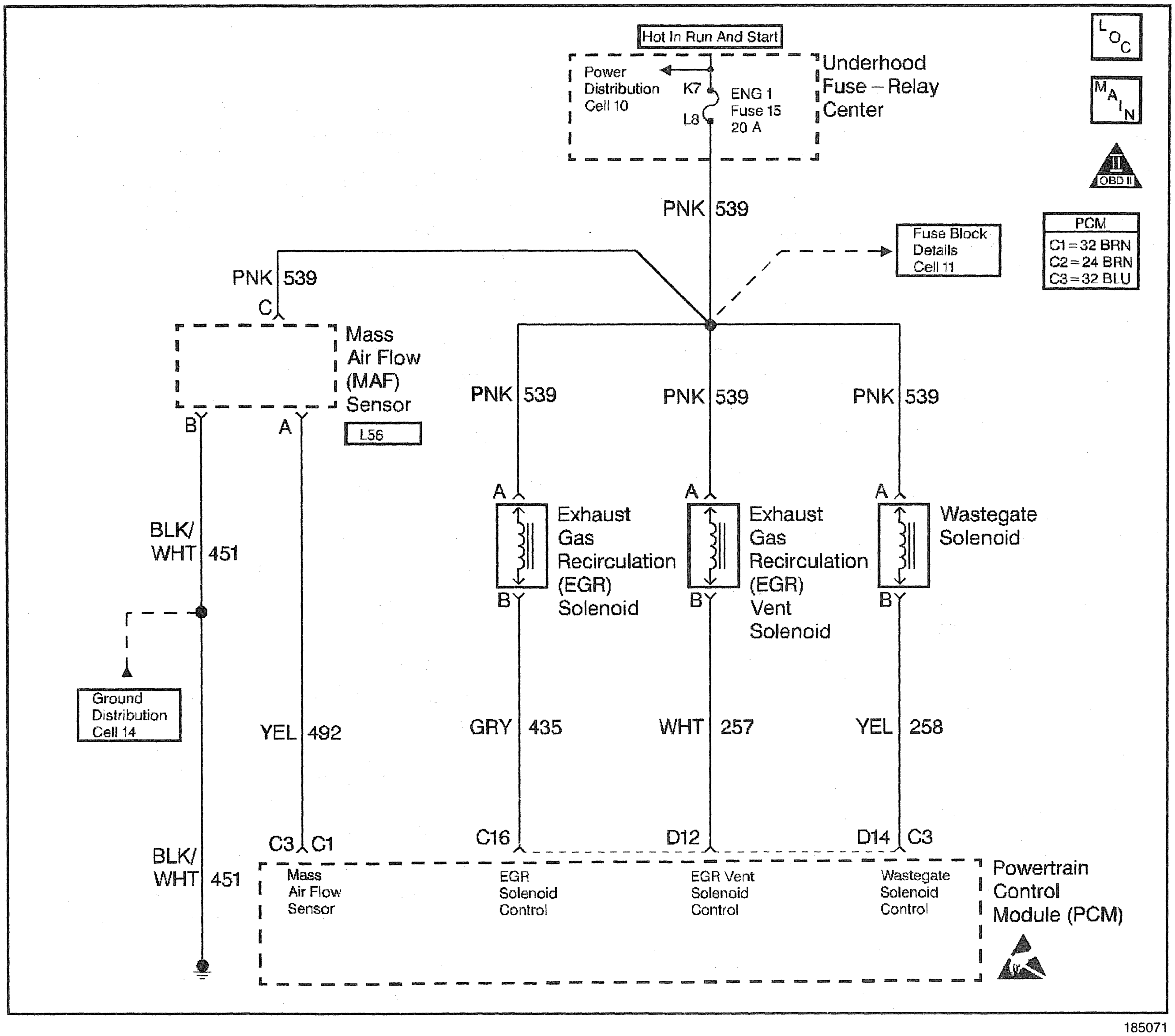
DTC P0101 Mass Air Flow (MAF) Sensor Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the Scan tool to save Freeze Frame and Failure Records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn ON the ignition with the engine OFF. 2. Review and record the scan tool Fail Records data. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for DTC P0101. Does the scan tool indicate DTC P0101 Failed This Ign?	—	*Go to Step 3*	Refer to Diagnostic Aids
3	1. Check for the following conditions: • Plugged intake air duct or dirty air filter element • Intake manifold vacuum leaks • Leaks at EGR valve flange and tower gasket. 2. If a problem is found, repair as necessary. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 4*
4	1. Turn ON the ignition leaving the engine OFF with the throttle closed. 2. Observe the APP Angle display on the scan tool. Is the APP Angle near the specified value?	0%	*Go to Step 5*	Go to *DTC P0121 APP Sensor1 Circuit Performance*
5	1. Turn OFF the ignition. 2. Disconnect the MAF sensor connector. 3. Turn ON the ignition leaving the engine OFF. 4. Using a *J 39200* DMM, measure the voltage between the MAF signal circuit and chassis ground. Is the voltage near the specified value?	5V	*Go to Step 6*	*Go to Step 7*
6	Connect an *J 34142-B* unpowered test lamp between the MAF sensor ignition feed and ground circuits at the MAF sensor harness connector. Is the test light ON?	—	*Go to Step 10*	*Go to Step 9*
7	Is the voltage less than the specified value?	4.5V	*Go to Step 11*	*Go to Step 8*
8	1. Turn OFF the ignition, disconnect the PCM. 2. Turn ON the ignition, leaving the engine OFF. 3. Measure the voltage between the MAF signal circuit and ground. Does the voltage measure near the specified value?	0V	*Go to Step 15*	*Go to Step 14*
9	Connect an *J 34142-B* unpowered test lamp between the MAF sensor ignition feed circuit and the chassis ground. Is the test light ON?	—	*Go to Step 12*	*Go to Step 13*
10	1. Check for a proper connection at the MAF sensor. 2. If a poor connection is found, replace the terminal(s) as necessary. Was a poor connection found?	—	*Go to Step 17*	*Go to Step 15*
11	1. Check the MAF signal circuit between the PCM and the MAF sensor for an open, short to ground, or short to the MAF sensor ground circuit. 2. If the MAF signal circuit is open or shorted, repair it as necessary. Was the MAF sensor signal circuit open or shorted?	—	*Go to Step 17*	*Go to Step 16*

DTC P0101 Mass Air Flow (MAF) Sensor Performance (cont'd)

Step	Action	Value(s)	Yes	No
12	Locate and repair the open in the ground circuit to the MAF sensor. Is the action complete?	—	*Go to Step 17*	—
13	Locate and repair the open in the ignition feed circuit to the MAF sensor. Is the action complete?	—	*Go to Step 17*	—
14	Locate and repair the short to voltage in the MAF sensor signal circuit. Is the action complete?	—	*Go to Step 17*	—
15	Replace the MAF sensor. Refer to *MAF Sensor Replacement*. Is the action complete?	—	*Go to Step 17*	—
16	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 17*	—
17	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC until the scan tool indicates the diagnostic Ran. Does scan tool indicate the diagnostic Passed?	—	*Go to Step 18*	*Go to Step 2*
18	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency



Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration, high load situation or no EGR flow, while a small quantity of air indicates deceleration, idle or full EGR situations.

The MAF sensor produces a frequency signal. DTC P0102 will be set if the signal from the MAF sensor does not match a predicted value based on, engine coolant temperature, APP angle and engine speed.

DTC P0102 will be set if the signal from the MAF sensor is below the possible range of a normally operating MAF sensor.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine speed is more than 0 RPM.
- The ignition voltage is more than 8.5 volts.

Conditions for Setting the DTC

- The MAF frequency is less than 1280 Hz (1.5 g/s).
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the scan tool while moving connectors and wiring harnesses related to the MAF sensor. A change in the display will indicate the location of the fault.
- Plugged intake air duct or filter element. A wide–open throttle acceleration from a stop should cause the mass air flow displayed on a scan tool to increase.

If DTC P0102 cannot be duplicated, the information included in the Fail Records data can be useful in determining vehicle mileage since the DTC was last set.

The adaptive learn matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table:

2. This step verifies that the problem is present at idle.
5. A voltage reading of less than 4 or over 6 volts at the MAF sensor signal circuit indicates a fault in the wiring or a poor connection.
6. Verifies that ignition feed voltage and a good ground are available at the MAF sensor.
13. This vehicle is equipped with a PCM which utilizes an Electrically Erasable Programmable Read Only Memory (EEPROM). When the PCM is being replaced, the new PCM must be programmed. Refer to *PCM Replacement/Programming*.

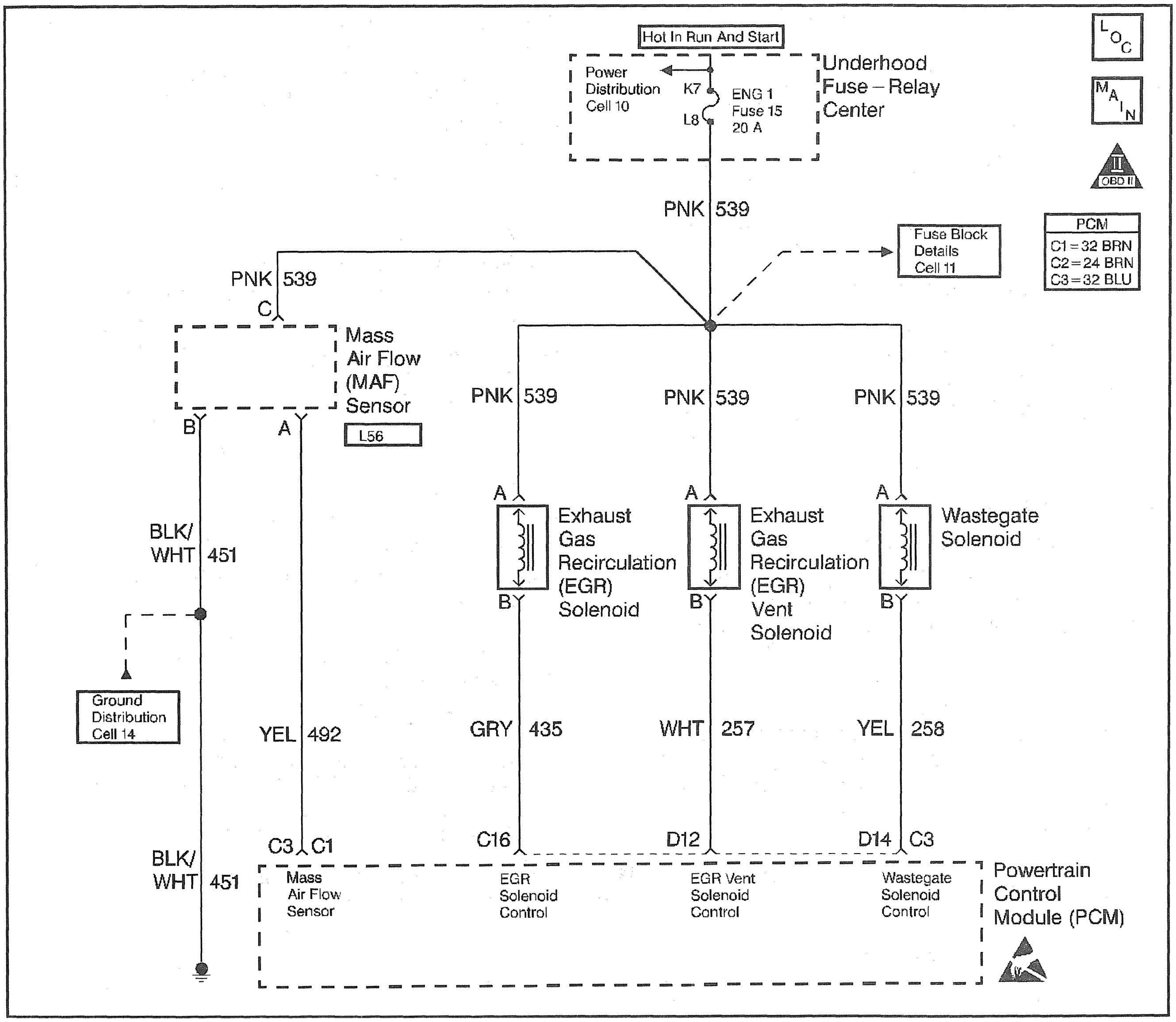
DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool to save Freeze Frame and Failure Records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Start the engine. 2. With the engine idling, monitor the MAF display on the scan tool. Is the MAF display below the specified value?	1280 Hz	*Go to Step 4*	*Go to Step 3*
3	1. Turn ON the ignition with the engine OFF. 2. Review and record the scan tool Fail Records data. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for DTC P0102. Does scan tool indicate DTC P0102 failed this Ign?	—	*Go to Step 4*	Refer to Diagnostic Aids
4	1. Check for the following conditions: • Objects blocking the MAF sensor inlet. • Large intake manifold leaks • Large leaks at the EGR valve flange or tower gasket. • Large leaks downstream of the MAF sensor. 2. If a problem is found, repair as necessary. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 5*
5	1. Turn OFF the ignition. 2. Disconnect the MAF sensor connector. 3. Turn ON the ignition with the engine OFF. 4. Using a *J 39200,* measure the voltage between the MAF signal circuit at harness connector and at battery ground. Is the voltage near the specified value?	5V	*Go to Step 6*	*Go to Step 9*
6	Connect an *J 34142-B* unpowered test lamp between the MAF sensor ignition feed and ground circuit at the MAF sensor harness connector. Is the test light ON?	—	*Go to Step 8*	*Go to Step 7*
7	Connect an *J 34142-B* unpowered test lamp between MAF sensor ignition feed circuit and battery ground. Is the test light ON?	—	*Go to Step 10*	*Go to Step 11*
8	1. Check for a proper connection at the MAF sensor. 2. If a poor connection is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was a poor connection found?	—	*Go to Step 14*	*Go to Step 12*
9	1. Check the MAF signal circuit between the PCM and the MAF sensor for an open, short to ground, short to the MAF sensor ground circuit, or short to voltage. 2. If the MAF sensor signal circuit is open or shorted, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the MAF signal circuit open or shorted?	—	*Go to Step 14*	*Go to Step 13*
10	Locate and repair the open in the ground circuit to the MAF sensor. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 14*	—

DTC P0102 Mass Air Flow (MAF) Sensor Circuit Low Frequency (cont'd)

Step	Action	Value(s)	Yes	No
11	Locate and repair the open in the ignition feed circuit to the MAF sensor. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 14*	—
12	Replace the MAF sensor. Refer to *MAF Sensor Replacement*. Is the action complete?	—	*Go to Step 14*	—
13	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 14*	—
14	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 15*	*Go to Step 2*
15	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency



Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity of air indicates deceleration or idle.

The MAF sensor produces a frequency signal. DTC P0101 will be set if the signal from the MAF sensor does not match a predicted value based on engine coolant temperature, throttle angle and engine speed.

DTC P0103 will be set if the signal from the MAF sensor is above the possible range of a normally operating MAF sensor.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The DTC P0102 diagnostic has ran and passed.
- The engine speed is more than 0 RPM.
- The ignition voltage is more than 8.5 volts.

Conditions for Setting the DTC

- The MAF frequency is more than 10496 Hz (342 g/s).
- All of the diagnostic set conditions were met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check for the following conditions:

- Poor connection at PCM. Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness. Inspect the wiring harness for damage. If the harness appears to be OK, observe the scan tool while moving connectors and wiring harnesses related to the MAF sensor A change in the display will indicate the location of the fault.

The adaptive learn matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that the problem is present at idle.
4. A frequency reading with the MAF sensor connector disconnected indicates an electro-magnetic interference (EMI) related fault or a poor connection.
9. This vehicle is equipped with a PCM which utilizes an electrically erasable programmable read only memory (EEPROM). When the PCM is being replaced, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*

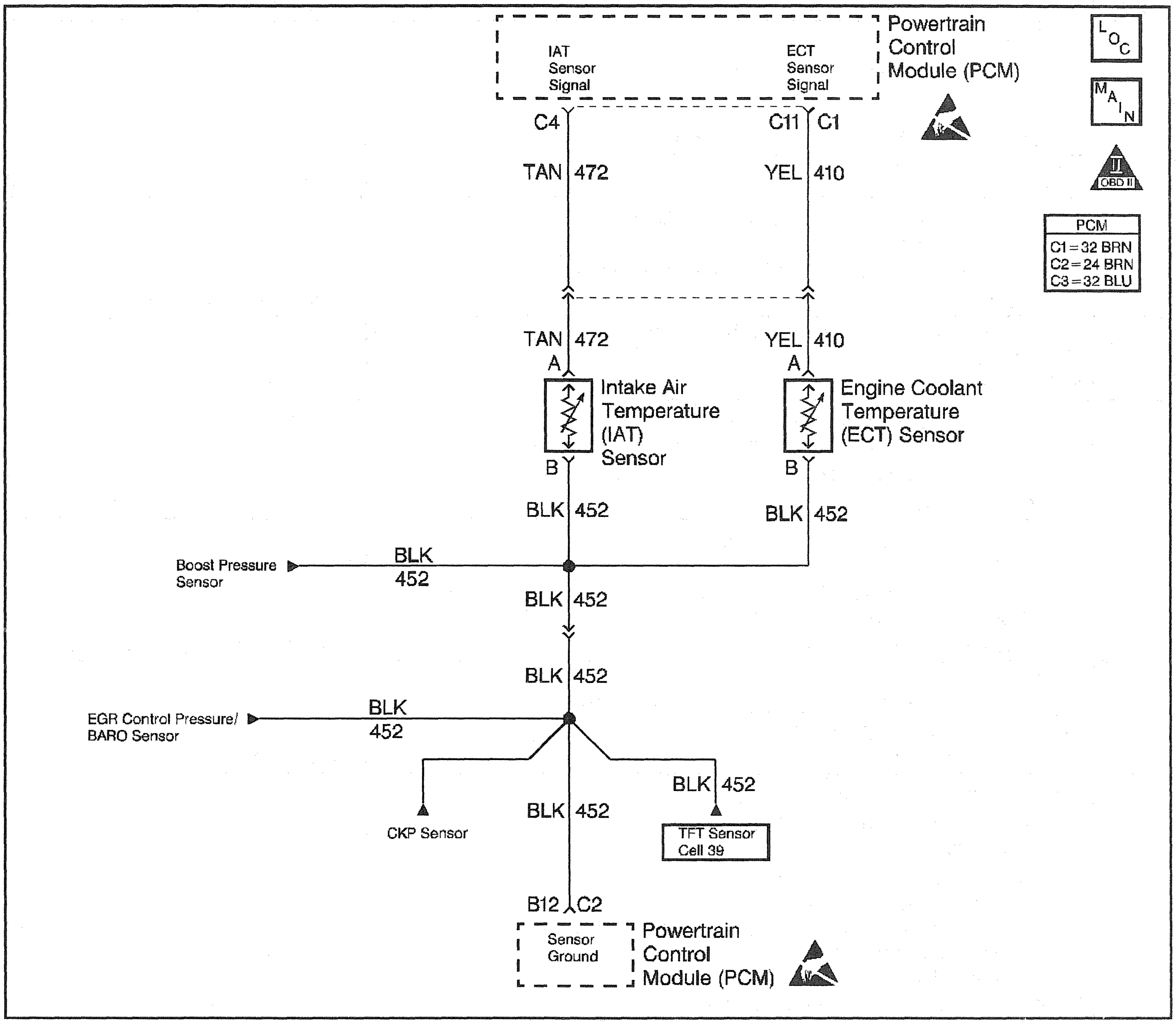
DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the Scan tool to save Freeze Frame and Failure Records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Start the engine. 2. With the engine idling, monitor the MAF display on the scan tool. Is the MAF display above the specified value?	10496 Hz	*Go to Step 4*	*Go to Step 3*
3	1. Turn ON the ignition with the engine OFF. 2. Review and record the scan tool Fail Records data. 3. Operate the vehicle within the Fail Records conditions as noted. 4. Using a scan tool, monitor the Specific DTC info for DTC P0103. Does the scan tool indicate DTC P0103 Failed This Ign?	—	*Go to Step 4*	Refer to Diagnostic Aids

DTC P0103 Mass Air Flow (MAF) Sensor Circuit High Frequency (cont'd)

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the MAF sensor connector. 3. Turn ON the ignition, engine idling. 4. Using a scan tool, monitor the MAF display. Does the scan tool indicate a MAF display at the specified value?	00 Hz	*Go to Step 5*	*Go to Step 7*
5	1. Check for a proper connection at the MAF sensor harness terminals. 2. If a poor connection is found, replace the terminal(s). Was a poor connection found?	—	*Go to Step 10*	*Go to Step 6*
6	Replace the MAF sensor. Refer to *MAF Sensor Replacement*. Is the action complete?	—	*Go to Step 10*	—
7	1. Check the MAF sensor harness for incorrect routing. Verify the harness is not near aftermarket add-ons. 2. If incorrect routing is found, correct harness routing. Did you perform a repair?	—	*Go to Step 10*	*Go to Step 8*
8	1. Check the MAF sensor signal circuit terminal connections at the PCM. 2. If a poor connection is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was a poor connection found?	—	*Go to Step 10*	*Go to Step 9*
9	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 10*	—
10	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 11*	*Go to Step 2*
11	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage



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Circuit Description

The intake air temperature (IAT) sensor is a thermistor that controls signal voltage to the PCM. When the air is cold, the sensor resistance is high, therefore the PCM will see a high signal voltage. As air warms, sensor resistance becomes less and voltage drops.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine coolant temperature is less than 42.5°C (109°F).

Conditions for Setting the DTC

- The Intake air temperature is more than or equal to 151°C (303°F).
- All of the diagnostic set conditions were met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check harness routing for a potential short to ground in the signal circuit. Refer to *Symptoms*. The scan tool displays intake air temperature in degrees centigrade. A skewed sensor could result in poor driveability complaints. Refer to *Temperature vs Resistance*.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

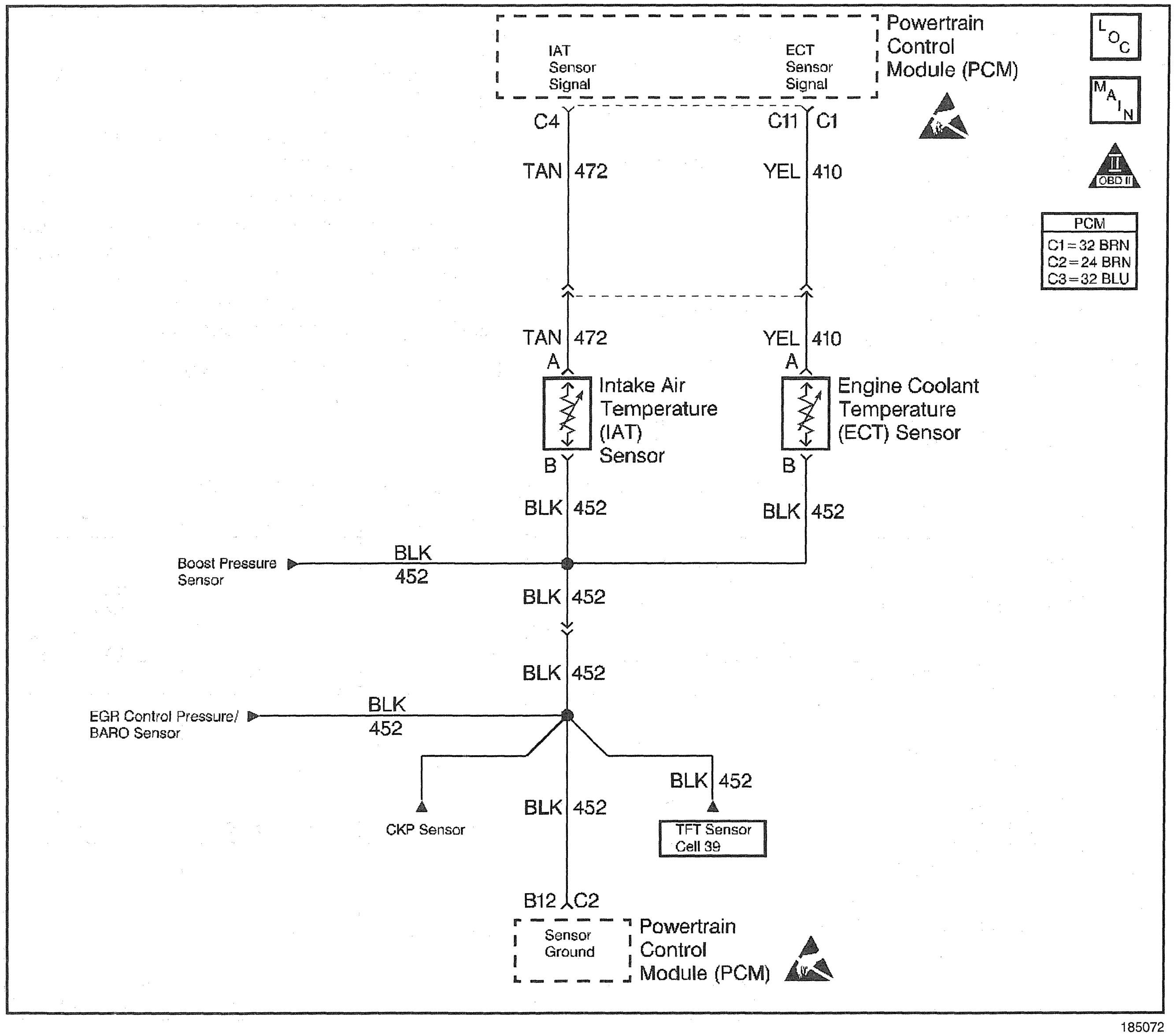
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0112 is a hard failure or an intermittent condition.
3. This test will determine if the PCM can recognized an open sensor.
4. This step will determine if the problem is a short to ground or a malfunctioning PCM.

DTC P0112 Intake Air Temperature (IAT) Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start the engine. 3. Monitor the IAT display on scan tool. Is the IAT display greater than or equal to the specified value?	151°C (303°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn the engine OFF. 2. Turn the ignition ON leaving the engine OFF. 3. Disconnect the IAT sensor connector. Does the IAT display a temperature colder than or equal to the specified value?	–30°C (–22°F)	*Go to Step 7*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector with the IAT signal circuit. 3. Using the *J 39200* DMM, measure the resistance across the IAT harness connector. Is the resistance at the specified value?	∞	*Go to Step 8*	*Go to Step 6*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	Repair the short to ground in the IAT signal circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 9*	—
7	Replace the IAT sensor. Refer to *IAT Sensor Replacement.* Is the action complete?	—	*Go to Step 9*	—
8	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 9*	—
9	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, within the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 10*	*Go to Step 2*
10	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage



Circuit Description

The intake air temperature (IAT) sensor is a thermistor that controls signal voltage to the PCM. When the air is cold, the sensor resistance is high, therefore the PCM will see a high signal voltage. As air warms, sensor resistance becomes less and voltage drops.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine operation time is more than 8 minutes.

Conditions for Setting the DTC

- The intake air temperature is less than or equal to –40°C (–40°F).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The scan tool displays intake air temperature in degrees centigrade. Check harness routing for a potential short to ground in the signal circuit. Refer to *Symptoms.* A skewed sensor could result in poor driveability complaints. Refer to *Temperature vs Resistance*.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0113 is a hard failure or an intermittent condition.
3. This step will determine if there is a wiring problem or a malfunctioning PCM.
9. This step determines if there is a short to voltage on the signal circuit. A short to voltage increases current flow through the sensor which overwhelms the sensor. This doesn't allow the sensor to pull down the circuit to the correct voltage and thus display the correct temperature.
10. After repairing the short to voltage, check the sensor for proper operation.

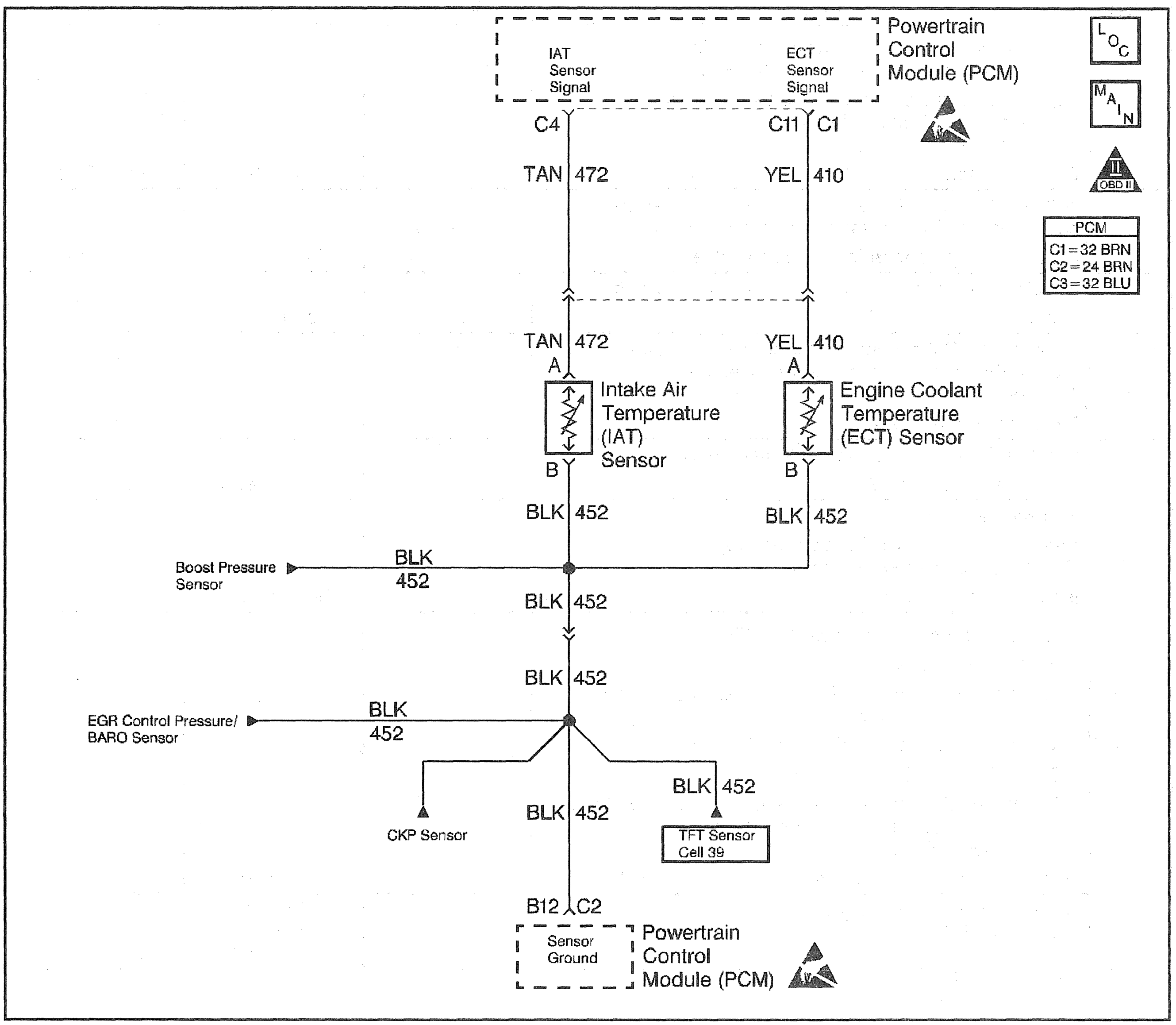
DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start the engine. 3. Monitor the IAT display on scan tool. Does the IAT display a temperature colder than or equal to the specified value?	–30°C (–22°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn the engine OFF. 2. Turn the ignition ON. 3. Disconnect the IAT sensor connector. 4. Jumper the IAT harness terminals together. Does the scan tool display an IAT temperature greater than or equal to the specified value?	151°C (303°F)	*Go to Step 6*	*Go to Step 4*
4	Jumper the IAT sensor signal circuit to a known good ground. Does the scan tool display an IAT temperature greater than or equal to the specified value?	151°C (303°F)	*Go to Step 7*	*Go to Step 8*
5	The DTC is intermittent. If no other DTCs are stored, refer to Diagnostic Aids. Are than any other DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Inspect the sensor connector and PCM connector for a proper connection. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 9*
7	1. Check the IAT sensor ground circuit for an open between the IAT sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*

DTC P0113 Intake Air Temperature (IAT) Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Check the IAT sensor signal circuit for an open between the IAT sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*
9	With a *J 39200* DMM set to the mA scale, measure the current at the IAT harness connector terminals. Is the current less than the specified value?	48 mA	*Go to Step 12*	*Go to Step 10*
10	Repair the short to voltage on the IAT signal circuit. Is the action complete?	—	*Go to Step 14*	—
11	Inspect the PCM connectors for proper connections and replace the terminals, if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 13*
12	Replace the IAT sensor. Refer to *IAT Sensor Replacement* Is the action complete?	—	*Go to Step 14*	—
13	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 14*	—
14	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 15*	*Go to Step 2*
15	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage



185072

Circuit Description

The engine coolant temperature (ECT) sensor is a thermistor that controls signal voltage to the PCM. When the engine is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As the engine warms, sensor resistance becomes less and voltage drops. The voltage measured across the thermistor is interpreted as a temperature.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The engine coolant temperature is more than or equal to 151°C (303°F).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check the harness routing for a potential short to ground. After the engine is started, the ECT temperature should rise steadily to about 85°C (185°F). Refer to *Symptoms*. A skewed sensor could result in poor driveability complaints. Refer to *Temperature vs Resistance*.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

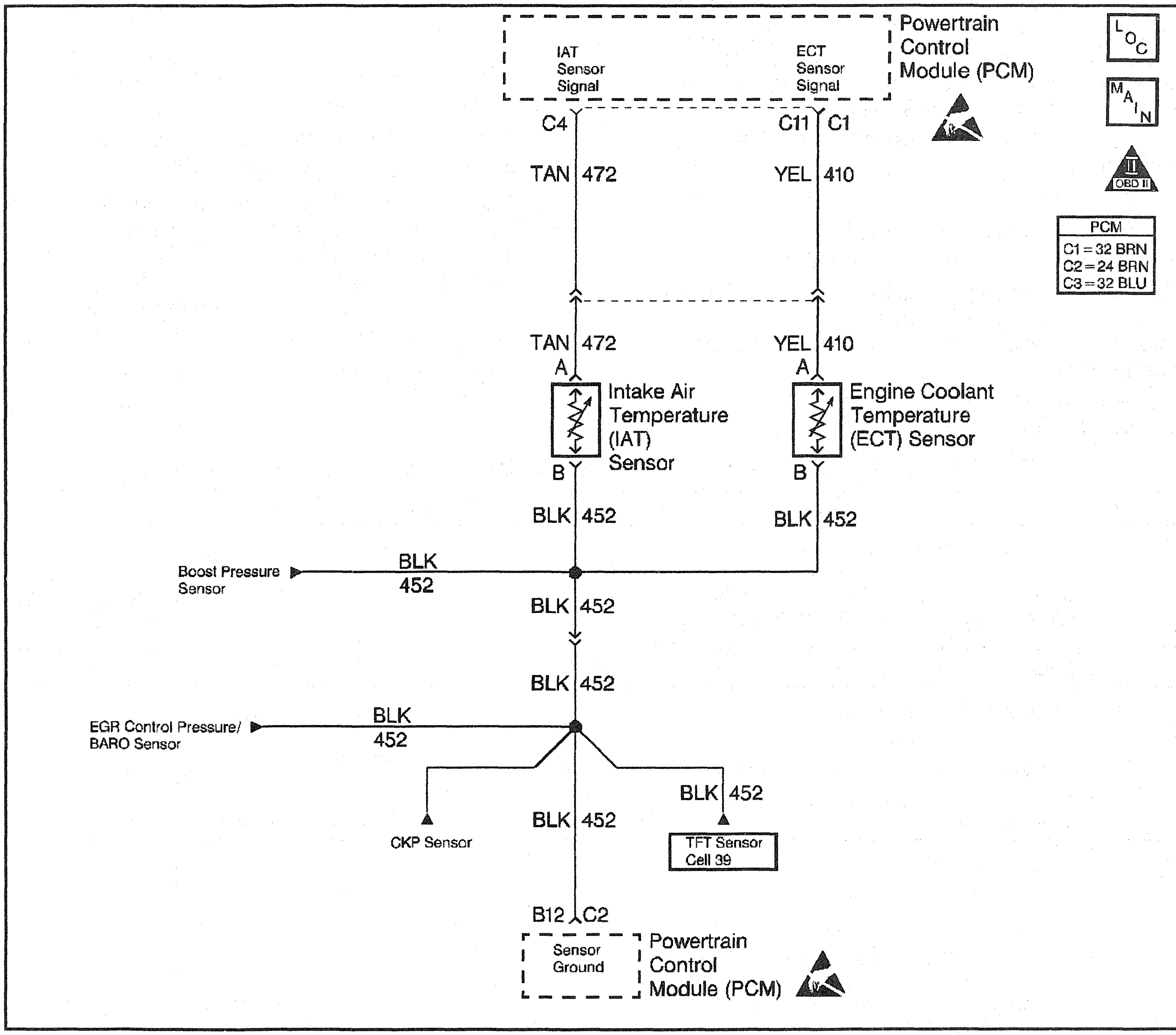
The numbers below refer to the step numbers on the diagnostic table.

2. If the fault is still present, the engine coolant voltage will greater than 151°C (303°F).
3. This test simulates a DTC P0117. If the PCM recognizes the high signal voltage (low temperature) the PCM and the wiring are okay.
4. This step will determine if the problem is a short to ground or a malfunctioning PCM.

DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine. 3. Monitor the engine coolant temperature (ECT) display on scan tool. Does the scan tool display an ECT greater than or equal to the specified value?	151°C (303°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn off the engine. 2. Turn the ignition ON leaving the engine OFF. 3. Disconnect the ECT sensor connector. Does the scan tool display an ECT a temperature colder than or equal to the specified value?	–30°C (–22°F)	*Go to Step 7*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector with the ECT signal circuit. 3. Use the *J 39200* DMM, check the resistance across the ECT sensor harness connector. Is the resistance at the specified value?	∞	*Go to Step 8*	*Go to Step 6*
5	The DTC is intermittent. If no additional DTCs are stored, refer to the Diagnostic Aids. If the additional DTCs are stored, refer to those tables first. Are any additional DTCs stored?	—	Go to The Applicable DTC Table	Go to Diagnostic Aids
6	Repair the short to the ground in the ECT signal circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 9*	—
7	Replace the ECT sensor. Refer to *ECT Sensor Replacement.* Is the replacement complete?	—	*Go to Step 9*	—
8	Replace the PCM. **Important:** If the PCM is malfunctioning, reprogram the PCM. Refer to *PCM Replacement/Programming.* Is the replacement complete?	—	*Go to Step 9*	—
9	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 10*	*Go to Step 2*
10	Does the scan tool display any additional undiagnosed DTCs?	—	Go to The Applicable DTC Table	System OK

DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage



185072

Circuit Description

The engine coolant temperature (ECT) sensor is a thermistor that controls signal voltage to the PCM. When the engine is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As the engine warms, sensor resistance becomes less and voltage drops. The voltage measured across the thermistor is interpreted as a temperature.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine operation time is more than 8 minutes.

Conditions for Setting the DTC

- The engine coolant temperature is less than or equal to –40°C (–40°F).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check harness routing for a potential short to voltage. After engine is started, the ECT temperature should rise steady to about 85°C (185°F). A skewed sensor could result in poor driveability complaints. Refer to *Temperature vs Resistance.*

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0118 is a hard failure or an intermittent condition.
3. This step will determine if there is a wiring problem or a malfunctioning PCM.
9. This step determines if there is a short to voltage on the signal circuit. A short to voltage increases current flow through the sensor which overwhelms the sensor. This doesn't allow the sensor to pull down the circuit to the correct voltage and thus display the correct temperature.
10. After repairing the short to voltage, check the sensor for proper operation.

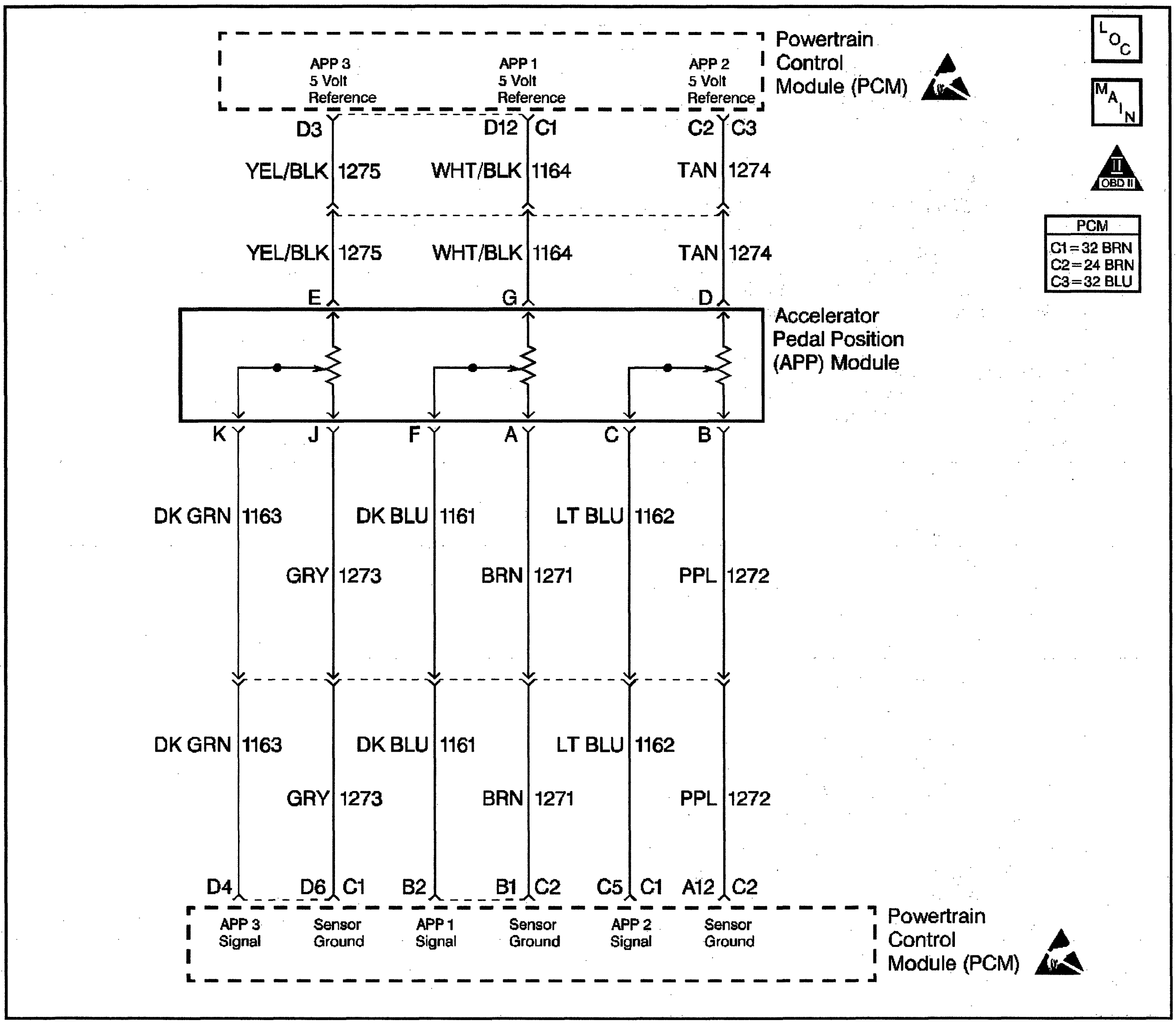
DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start the engine. 3. Monitor the ECT display on scan tool. Does the ECT display a temperature colder than or equal to the specified value?	–30°C (–22°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn the engine OFF. 2. Turn the ignition ON. 3. Disconnect the ECT sensor connector. 4. Jumper the ECT harness terminals together. Does the scan tool display an ECT temperature greater than or equal to the specified value?	151°C (303°F)	*Go to Step 6*	*Go to Step 4*
4	Jumper the ECT sensor signal circuit to a known good ground. Does the scan tool display an ECT temperature greater than or equal to the specified value?	151°C (303°F)	*Go to Step 7*	*Go to Step 8*
5	The DTC is intermittent. If no other DTCs are stored, refer to Diagnostic Aids. Are there any other DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Inspect the sensor connector for a proper connection. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 9*
7	1. Check the ECT sensor ground circuit for an open between the ECT sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*

DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Check the ECT sensor signal circuit for an open between the ECT sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*
9	With a *J 39200* DMM set to the mA scale, measure the current at the ECT harness connector terminals. Is the current less than the specified value?	48 mA	*Go to Step 12*	*Go to Step 10*
10	Repair the short to voltage on the ECT signal circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 14*	—
11	Inspect the PCM connectors for proper connections and replace the terminals, if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 13*
12	Replace the ECT sensor. Refer to *ECT Sensor Replacement* Is the action complete?	—	*Go to Step 14*	—
13	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 14*	—
14	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 15*	*Go to Step 2*
15	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0121 APP Sensor1 Circuit Performance



185076

Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition voltage is more than 6.4 volts.
- The engine speed is more than 300 RPM.
- There are no in range faults for the APP 2 sensor or the APP 3 sensor (PCM checks for high and low voltage faults).

Conditions for Setting the DTC

- The difference between the APP 1 sensor and the APP 2 sensor is more than 0.23 volts (PCM compares pre–scaled voltage (internal to PCM)).
- The difference between the APP 1 sensor and the APP 3 sensor is more than 0.50 volts (PCM compares pre–scaled voltage (internal to PCM)).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The service throttle soon lamp will not illuminate when one APP DTC sets. The PCM will only illuminate the service throttle soon lamp when multiple APP DTCs set.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

An intermittent may be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

A scan tool reads APP 1 position in volts. It should read about 0.45 to 0.95 volt with the throttle closed and the ignition ON or at idle. Voltage should increase at a steady rate as the throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 1 sensor while depressing accelerator pedal with the engine off and the ignition ON. Display should vary from about 0.74 volt when the throttle is closed to over about 3.7 volts when the throttle is held at wide open throttle (WOT). The following chart will check voltages on all APP circuits to see if they fall in normal ranges. The PCM compares pre-scaled voltages (these are voltages that the scan tool cannot read). The scan tool reads only output voltages.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This step determines if there is a good 5 volt reference.
5. This step will check for an open in the ground circuit.

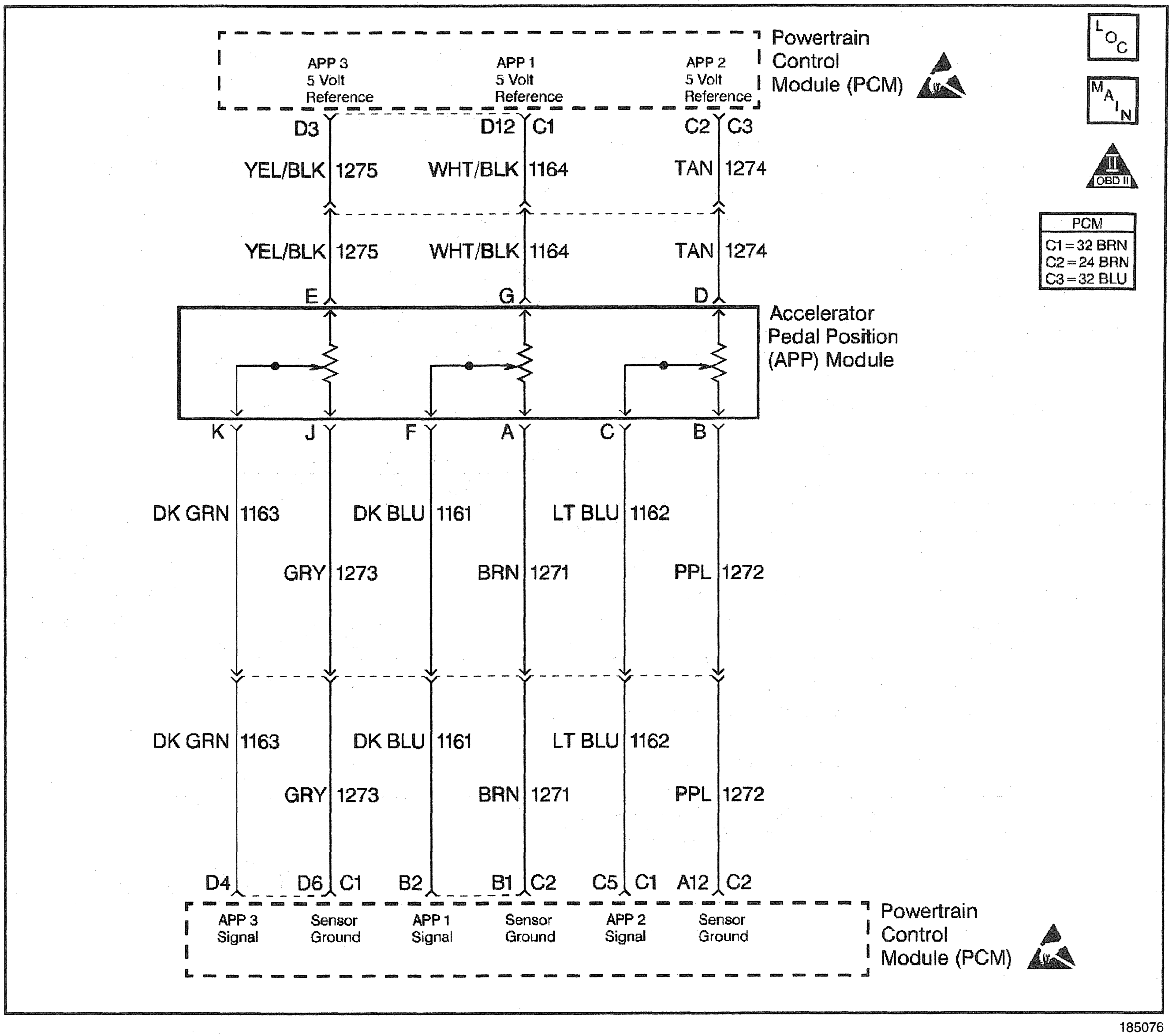
DTC P0121 APP Sensor1 Circuit Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe APP voltages on the scan tool. Are APP voltages at specified values (values listed are APP 1, APP 2, and APP 3 respectively)?	0.45–0.95 V 4.0–4.5 V 3.6–4.1 V	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With *J 39200* DMM connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D, and E. Is the voltage greater than or equal to the specified value on all circuits?	4.75 V	*Go to Step 5*	*Go to Step 6*

DTC P0121 APP Sensor1 Circuit Performance (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Turn the ignition ON leaving the engine OFF. 2. With an *J 34142-B* unpowered test lamp connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B, and J. Is the test light ON (all circuits)?	—	*Go to Step 9*	*Go to Step 8*
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 11*	*Go to Step 7*
7	Check the 5 volt reference circuit for a proper connection at the PCM and replace terminal if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did the terminal require replacement?	—	*Go to Step 11*	*Go to Step 10*
8	1. Turn the ignition OFF. 2. Disconnect the PCM and check for an open sensor ground circuit to the PCM. 3. If problem is found, repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was APP sensor ground circuit open?	—	*Go to Step 11*	*Go to Step 10.*
9	Replace the APP module. Refer to *APP Module Replacement* Is the action complete?	—	*Go to Step 11*	—
10	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 11*	—
11	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 12*	*Go to Step 2*
12	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0122 APP Sensor1 Circuit Low Voltage



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the APP 1 sensor is less than 0.25 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The service throttle soon lamp will not illuminate when one APP DTC sets. The PCM will only illuminate the service throttle soon lamp when multiple APP DTCs set.
- The PCM records the operating conditions at the time the diagnostic fails. This information will store in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

A scan tool reads APP 1 position in volts. It should read about 0.45 to 0.95 volt with the throttle closed and the ignition ON or at idle. Voltage should increase at a steady rate as the throttle is moved toward wide open throttle (WOT). Also, 90 percent pedal travel is acceptable for correct APP operation. Scan APP sensor while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 0.74 volt when throttle is closed to about 3.7 volts when the throttle is held at wide open throttle (WOT). A DTC P0122 will result if the signal or reference circuit are open.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0122 is the result of a hard failure or an intermittent condition.
4. This step checks the PCM and wiring.

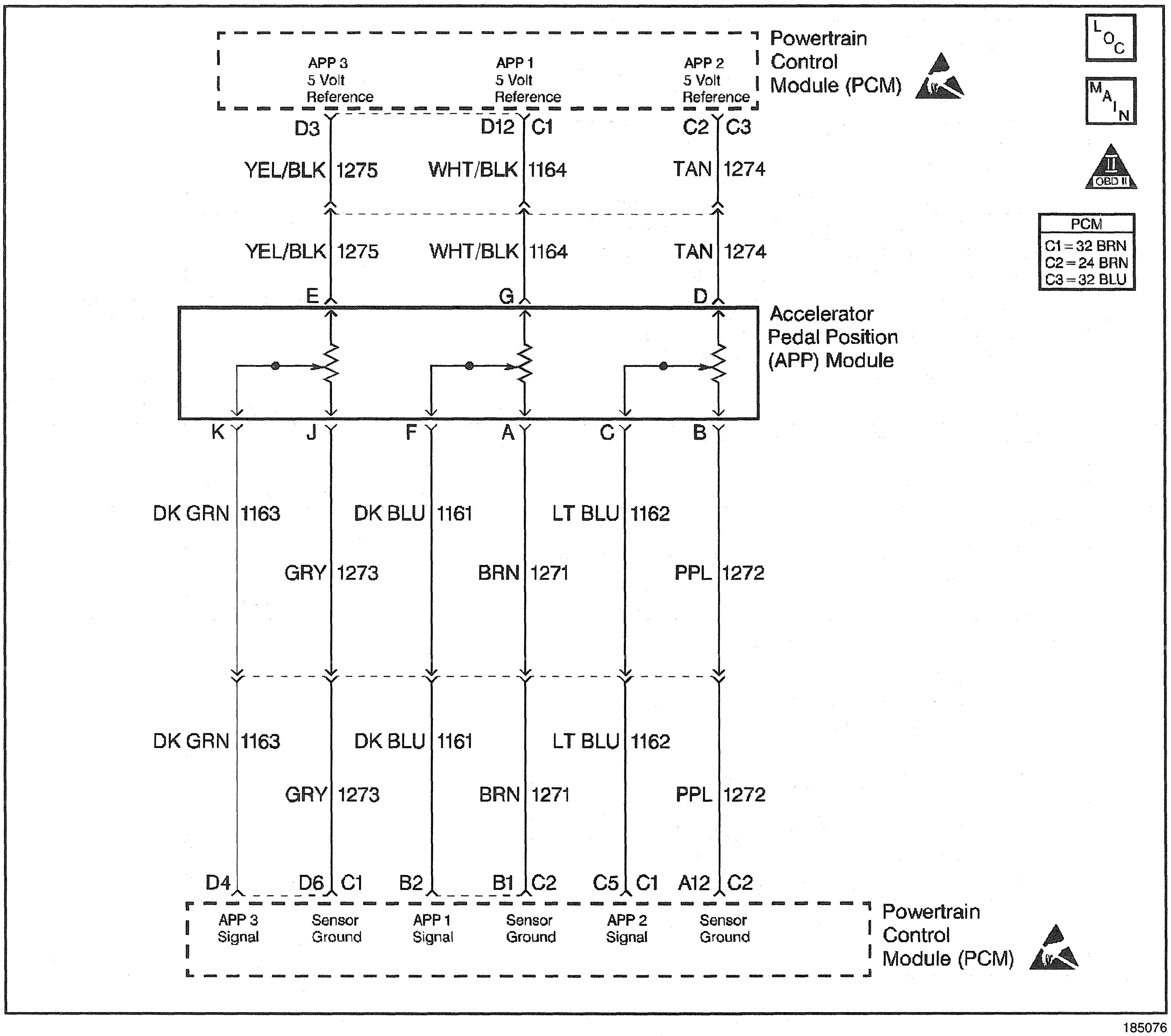
DTC P0122 APP Sensor1 Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 1 voltage on the scan tool. Is the APP 1 voltage less than or equal to the specified value?	0.25 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Jumper the APP 1 signal circuit and the 5 volt reference circuit together at the APP sensor harness connector. 3. Observe the APP 1 voltage on the scan tool. Is the APP 1 voltage greater than the specified value?	4.75 V	*Go to Step 10*	*Go to Step 5*
5	1. Connect an *J 34142-B* unpowered test lamp between B+ and the APP 1 sensor signal circuit at the APP sensor harness connector. 2. Observe the APP 1 voltage on the scan tool. Is the APP 1 voltage greater than the specified value?	4.75 V	*Go to Step 6*	*Go to Step 8*
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 12*	*Go to Step 7*
7	Check the 5 volt reference circuit for a proper connection at the PCM and replace the terminal if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 13*	*Go to Step 12*

DTC P0122 APP Sensor1 Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the APP 1 signal circuit for an open, or a short to ground. 3. If the APP 1 sensor signal circuit is open or shorted to ground, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the APP 1 signal circuit open or shorted to ground?	—	*Go to Step 13*	*Go to Step 9*
9	Check the APP 1 sensor signal circuit for a proper connection at the PCM and replace terminal if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did the terminal require replacement?	—	*Go to Step 13*	*Go to Step 12*
10	Check for a proper electrical connection at the APP module. Repair the connection if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 13*	*Go to Step 11*
11	Replace the APP module. Refer to *APP Module Replacement.* Is the action complete?	—	*Go to Step 13*	—
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0123 App Sensor1 Circuit High Voltage



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the APP 1 sensor is more than 4.75 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The service throttle soon lamp will not illuminate when one APP DTC sets. The PCM will only illuminate the service throttle soon lamp when multiple APP DTCs set.
- The PCM records the operating conditions at the time the diagnostic fails. This information will store in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

An intermittent may be caused by the following:

A scan tool reads APP 1 position in volts. It should read about 0.45 to 0.95 volt with the throttle closed and the ignition ON or at idle. Voltage should increase at a steady rate as the throttle is moved toward wide open throttle (WOT). Also, 90 percent pedal travel is acceptable for correct 0 APP operation. Scan APP 1 sensor while depressing the accelerator pedal with the engine and the ignition ON. Display should vary from about 0.74 volt when the throttle is closed to about 3.7 volts when the throttle is held at wide open throttle (WOT). A P0123 will result if the ground circuit is open or the signal circuit is shorted to voltage.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if DTC P0123 is the result of a hard failure or an intermittent condition.

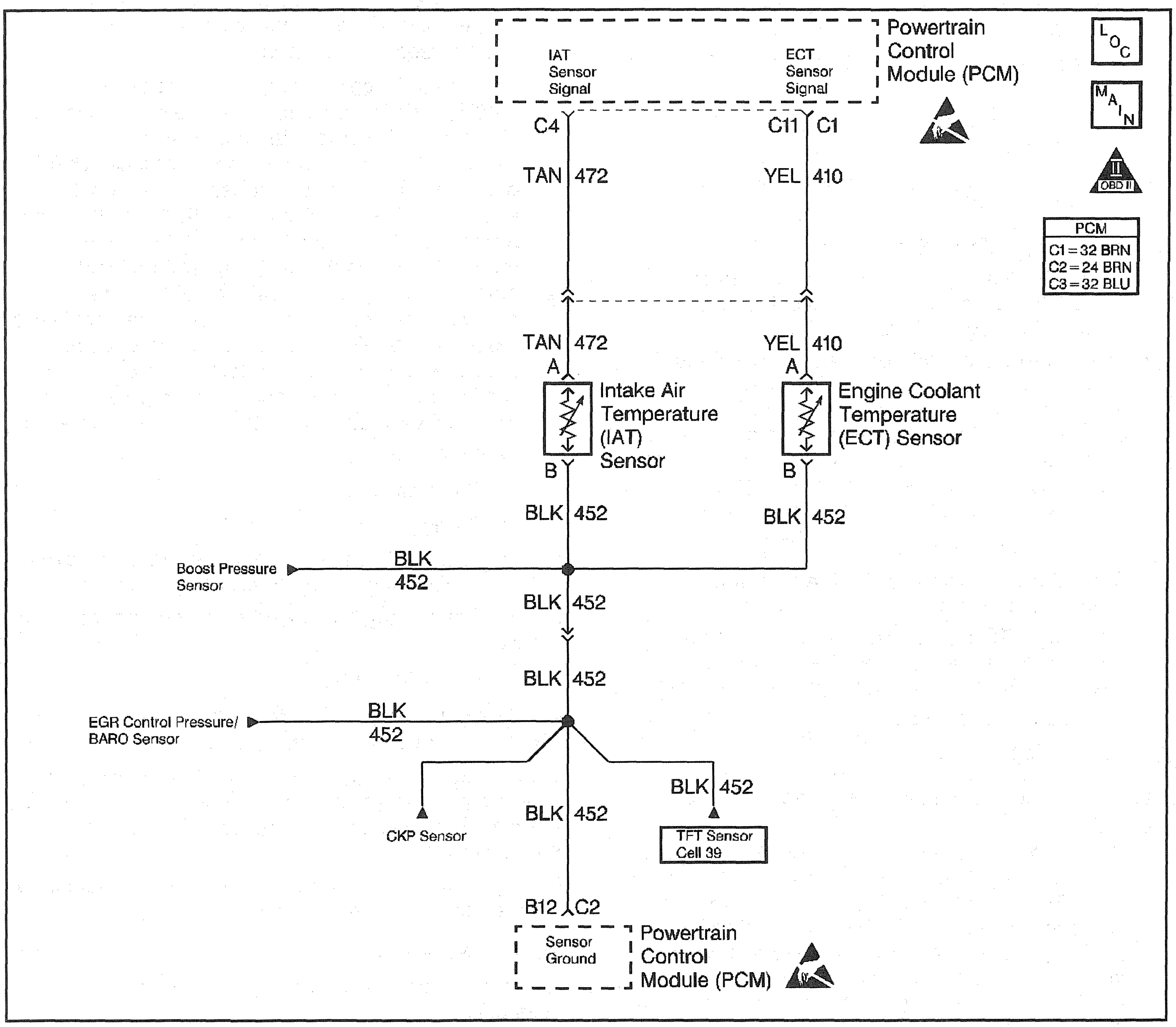
DTC P0123 App Sensor1 Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 1 display on the scan tool. Is the APP 1 above the specified value?	4.75 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Observe the APP 1 display on the scan tool. Is the APP 1 less than the specified value?	0.25 V	*Go to Step 5*	*Go to Step 6*
5	Probe the APP 1 sensor ground circuit at the APP sensor harness connector with an *J 34142-B* unpowered test lamp connected to B+. Is the test light ON?	—	*Go to Step 7*	*Go to Step 8*
6	1. Check for a short to voltage on the APP 1 sensor signal circuit. 2. If the APP 1 sensor signal circuit is shorted. Repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the APP 1 sensor signal circuit shorted?	—	*Go to Step 11*	*Go to Step 10*
7	Check for proper electrical connections at the APP sensor and replace the terminals if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did any terminals require replacement?	—	*Go to Step 11*	*Go to Step 9*
8	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the APP 1 sensor ground circuit open?	—	*Go to Step 11*	*Go to Step 10*

DTC P0123 App Sensor1 Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
9	Replace the APP module. Refer to *APP Module Replacement*. Is the action complete?	—	*Go to Step 11*	—
10	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 11*	—
11	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 12*	*Go to Step 2*
12	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0126 Engine Coolant Temperature (ECT) Insufficient for Stable Operation



185072

Circuit Description

While the engine is warming, the PCM monitors the ECT sensor to determine how long it takes the engine to reach the coolant temperature required for Closed Loop operation. DTC P0126 will set if the PCM determines that the engine does not reach Closed Loop temperature in a specified amount of time. This test will not run if either the intake air or engine coolant temperature is too low at start up. The PCM will only run this DTC on a cold start and only once per cold start.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic once per ignition cycle until a pass or fail condition exists.
- The engine operation time is more than 600 seconds.
- The DTCs P0112, P0113, P0117 and P0118 are not set.
- The intake air temperature is more than –7°C (20°F).
- The total idle time since start up is less than 450 seconds.

or

- The engine operation time is more than 300 seconds.
- The DTCs P0112, P0113, P0117 and P0118 are not set.
- The intake air temperature is more than –7°C (20°F).

Conditions for Setting the DTC

- The fuel burned since start up is more than 1,000,000 cu. mm.
- The engine coolant is less than 56°C (133°F).

or

- The fuel burned since start up is more than 468,120 cu. mm.
- The engine coolant temperature is less than 56°C (133°F).

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Important: The system must be rechecked on a cold start.

- Using Freeze Frame and/or Failure Records data may aid in locating an intermittent condition. If the DTC cannot be duplicated, the information included in the Freeze Frame and/or Failure Records data can be useful in determining how many miles since the DTC set. The Fail Counter and Pass Counter can also be used to determine how many ignition cycles the diagnostic reported a pass and/or a fail. Operate the vehicle within the same freeze frame conditions (RPM, load, vehicle speed, temperature etc.) that were noted. This will isolate when the DTC failed.
- If other DTCs are set that share the same ground and/or 5.0 volt reference circuit, check for faulty connections and for faulty wiring.
- If the engine has been allowed to sit overnight, the engine coolant temperature and intake air temperature values should display within a few degrees of each other.
- If the engine coolant temperature exceeds 60°C (140°F), this indicates that the engine is capable of reaching the proper temperature, but not necessarily in the correct amount of time. This diagnostic table must be repeated on a cold engine, ECT and IAT less than 50°C (122°F) and within 3°C (5°F) of each other, and the time required to reach the temperature threshold must be measured. When starting a cold engine, measure the amount of time it takes the engine to reach the specified temperature. The engine should reach the specified temperature within 8 minutes. If the specified temperature is not reached within 7 minutes, check the following:
  - Coolant level.
  - Thermostat operation.
  - Cooling fan.
  - Refer to *Thermostat Diagnosis (On-Vehicle)* in Engine Cooling for additional information.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to step numbers on the diagnostic table.

2. An ECT failure could cause a DTC P0126 to set, so correct any ECT DTCs that are set.
6. If it is obvious that the engine is not reaching full operating temperature, for example the radiator hoses never gets very warm, or there is a complaint of little or no heat from the heater, this step could be skipped.

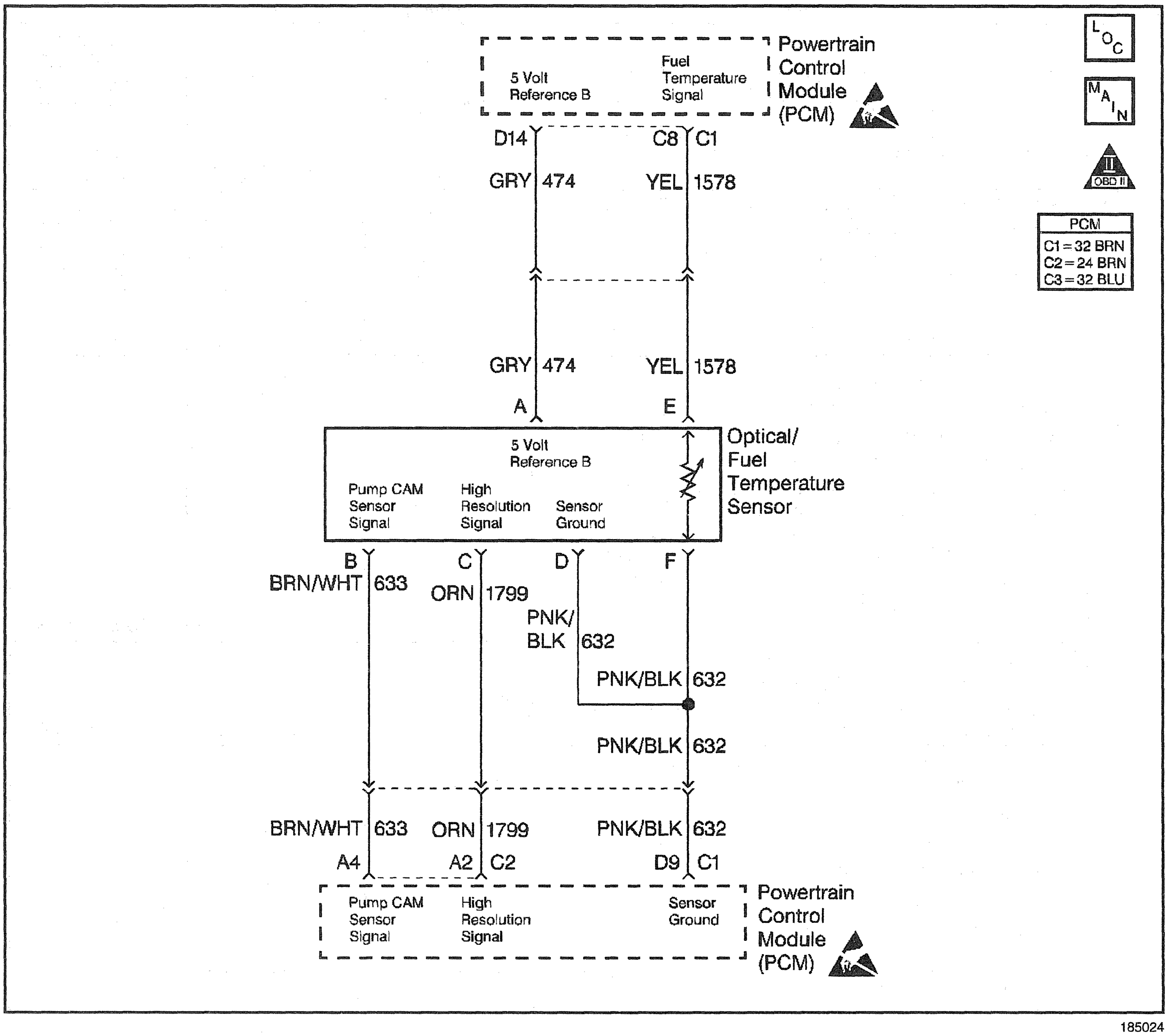
DTC P0126 Engine Coolant Temperature (ECT) Insufficient for Stable Operation

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are any engine coolant temperature DTCs set?	—	Go to applicable DTC table	*Go to Step 3*

DTC P0126 Engine Coolant Temperature (ECT) Insufficient for Stable Operation (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Connect a scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. Disconnect the ECT sensor. Does the scan tool indicate the ECT sensor is at a temperature colder than the specified value?	–35°C (–31°F)	*Go to Step 4*	Go to *DTC P0117 Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage*
4	Using a jumper wire, jumper terminals at the ECT sensor harness connector together. Does the scan tool indicate the ECT is at a temperature greater than the specified value?	150°C (302°F)	*Go to Step 5*	Go to *DTC P0118 Engine Coolant Temperature (ECT) Sensor Circuit High Voltage*
5	1. Reconnect the ECT sensor. 2. Start and idle the engine. 3. With the engine idling, observe the ECT sensor display on the Engine 1 Data List of the scan tool. **Important:** Allow time for the engine to warm up if it has not already reached the specified temperature. Seven minutes is the maximum amount of time it should take to reach this temperature from a cold start. Less time should be necessary if the engine is already warm. Does the scan tool indicate the engine coolant temperature has reached the specified value?	60°C (140°F)	Go to Diagnostic Aids	*Go to Step 6*
6	Using a *J 39200* DMM, measure the resistance of the ECT sensor. Refer to *Temperature vs Resistance* Is the ECT resistance close to the value indicated in the Temperature Vs Resistance Table?	—	*Go to Step 7*	*Go to Step 8*
7	For an engine cooling system problem, check for the following conditions: • Thermostat operation • Coolant level • Coolant to water ratio • Cooling fan operation etc. Refer to Engine Cooling. Is the action complete?	—	*Go to Step 9*	—
8	Replace the ECT sensor. Refer to *ECT Sensor Replacement* Is the action complete?	—	*Go to Step 9*	—
9	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 10*	*Go to Step 2*
10	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the applicable DTC table	System OK

DTC P0182 Fuel Temperature Sensor Circuit Low Voltage



Circuit Description

The fuel temperature sensor is a thermistor that controls signal voltage to the PCM. When the fuel is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As fuel warms, sensor resistance becomes less and voltage drops. The fuel temperature sensor is integrated with the optical sensor.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The fuel temperature is more than or equal to 102°C (215°F).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A scan tool reads fuel temperature in degrees centigrade.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

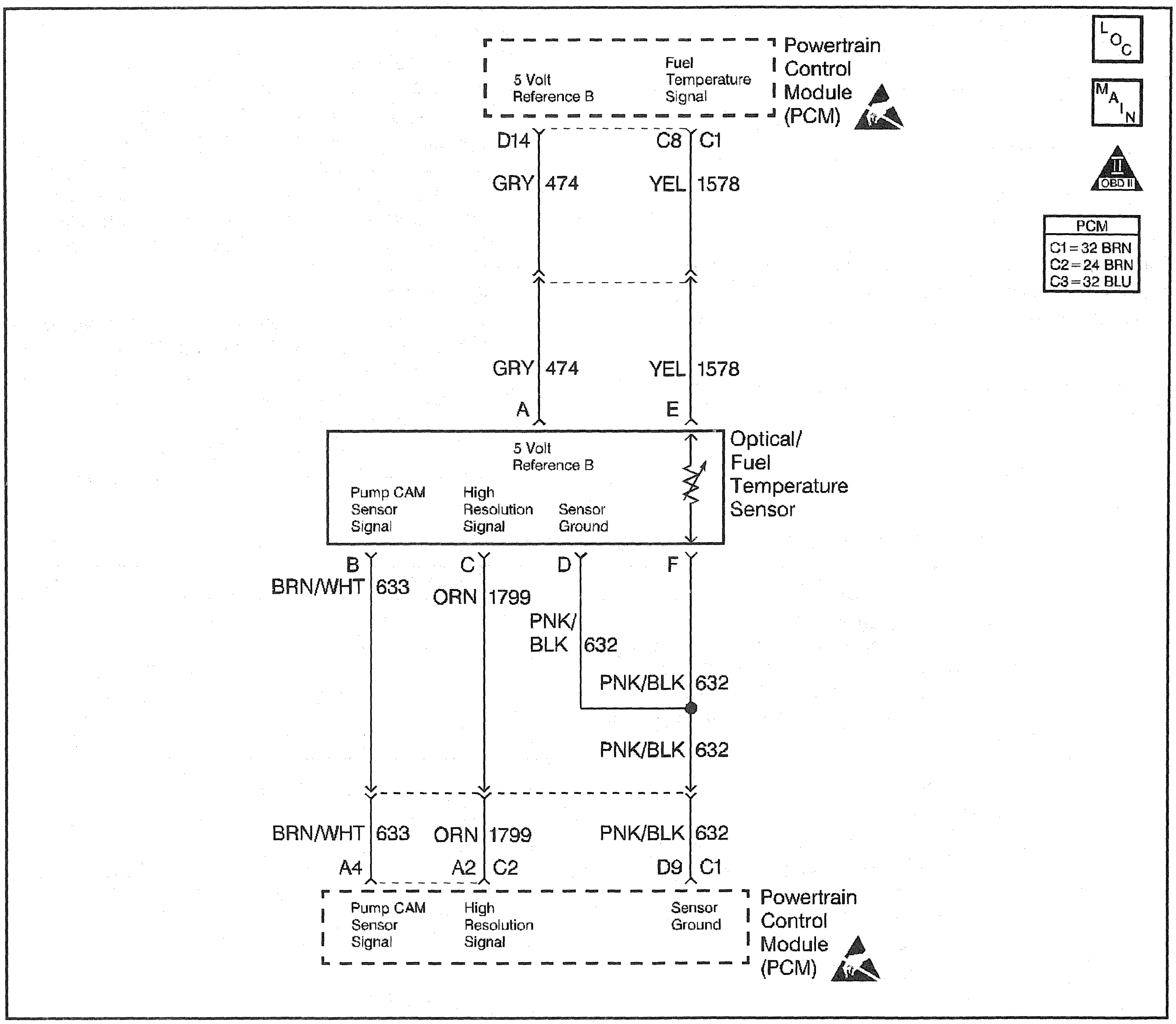
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if DTC P0182 is a hard failure or an intermittent condition.
3. This test will determine if signal circuit is shorted to ground.

DTC P0182 Fuel Temperature Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start the engine. 3. Monitor the Fuel Temp display on scan tool. Is the Fuel Temp greater than the specified value?	102°C (215°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn the engine OFF. 2. Turn the ignition ON leaving the engine OFF. 3. Disconnect the optical/fuel temperature sensor connector. Is the Fuel Temp less than or equal to the specified value?	17°C (63°F)	*Go to Step 7*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector with the fuel temperature signal circuit. 3. Use the *J 39200* DMM in order to measure the resistance across the fuel temperature signal circuit to the sensor ground circuit at the harness connector. Is the resistance at the specified value?	∞	*Go to Step 8*	*Go to Step 6*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	Repair the short to ground in the Fuel Temp signal circuit. Is the action complete?	—	*Go to Step 9*	—
7	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 9*	—
8	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 9*	—
9	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 10*	*Go to Step 2*
10	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0183 Fuel Temperature Sensor Circuit High Voltage



Circuit Description

The fuel temperature sensor is a thermistor that controls signal voltage to the PCM. When the fuel is cold, the sensor resistance is high, therefore the PCM will see high signal voltage. As the fuel warms, sensor resistance becomes less and voltage drops. The fuel temperature sensor is integrated with the optical sensor.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine operation time is more than 8 minutes.

Conditions for Setting the DTC

- The fuel temperature is less than or equal to 18°C (64°F).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A scan tool reads fuel temperature in degrees centigrade.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if DTC P0183 is a hard failure or an intermittent condition.
3. This test simulates a DTC P0182. If the PCM recognizes the low signal voltage (high temp) the PCM and wiring are OK.
4. This test will determine if signal circuit is open. There should be 5 volts at the sensor connector if measured with *J 39200*. This will determine if there is a wiring problem or a malfunctioning PCM.
9. This step determines if there is a short to voltage on the signal circuit. A short to voltage increases current flow through the sensor which overwhelms the sensor. This doesn't allow the sensor to pull down the circuit to the correct voltage and thus display the correct temperature.
10. After repairing the short to voltage, check the sensor for proper operation.

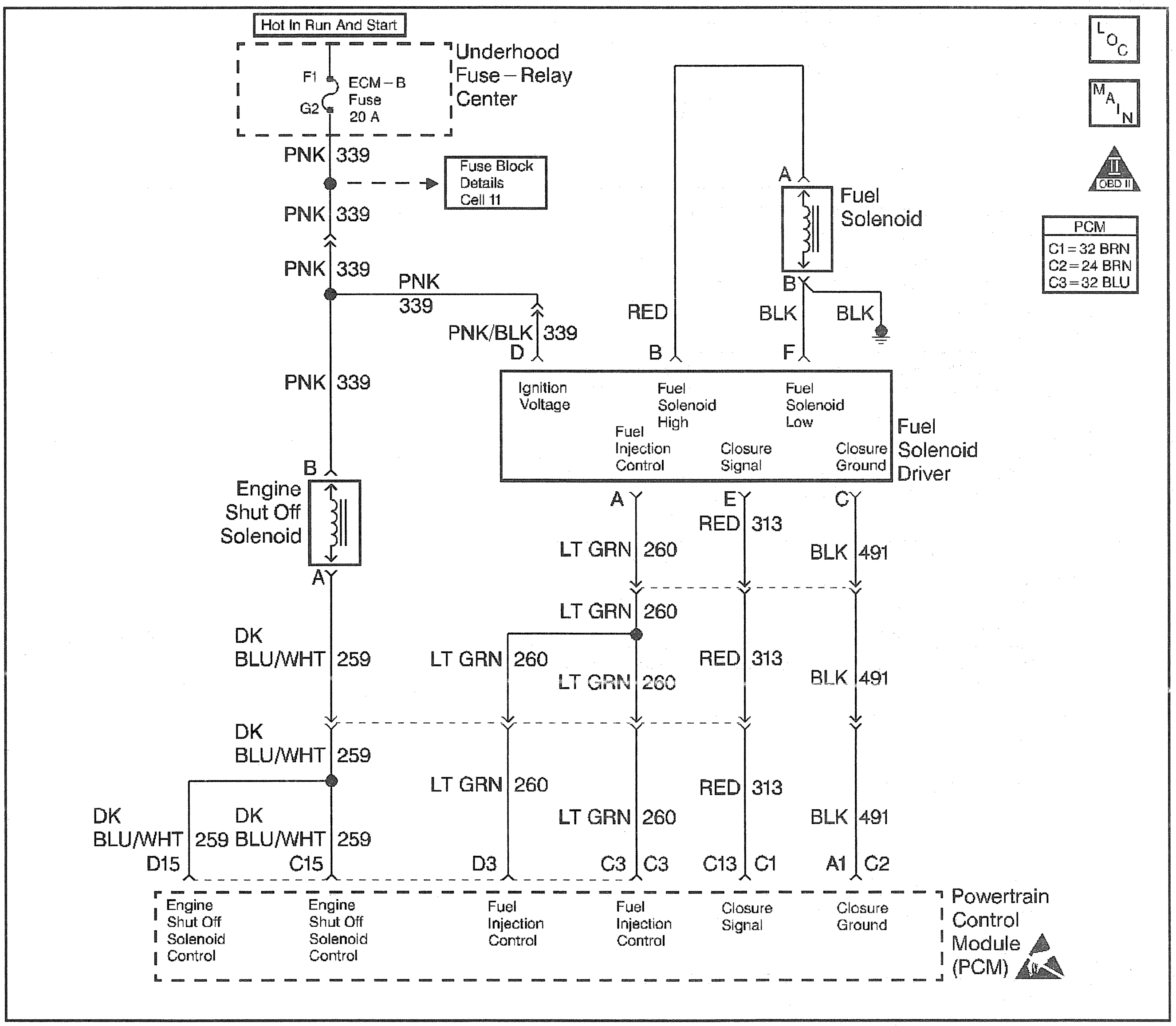
DTC P0183 Fuel Temperature Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start and idle the engine. 3. Monitor the Fuel Temp display on the scan tool. Is the fuel temp less than or equal to the specified value?	18°C (64°F)	*Go to Step 3*	*Go to Step 5*
3	1. Turn the engine OFF. 2. Turn the ignition ON. 3. Disconnect the optical fuel temperature sensor connector. 4. Jumper the fuel temperature signal circuit and sensor ground together at the sensor harness. Does the scan tool display a fuel temperature greater than the specified value?	105°C (221°F)	*Go to Step 6*	*Go to Step 4*
4	Jumper the fuel temperature sensor signal circuit to a known good ground. Does the scan tool display a fuel temp greater than the specified value?	105°C (221°F)	*Go to Step 7*	*Go to Step 8*
5	The DTC is intermittent. If no other DTC(s) are stored, refer to Diagnostic Aids. If additional DTCs are stored, refer to those table(s) first. Are any other DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Inspect the sensor connector for a proper connection. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 9*

DTC P0183 Fuel Temperature Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Check the fuel temperature sensor ground circuit for an open between the fuel temp sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*
8	1. Check the fuel sensor signal circuit for an open between the fuel temp sensor and the PCM. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 11*
9	With a *J 39200* DMM set to the mA scale, measure the current across the fuel temperature signal and the sensor ground circuit at the sensor harness connector. Is the current less than the specified value?	50 mA	*Go to Step 12*	*Go to Step 10*
10	Repair the short to voltage on the fuel temperature signal circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 14*	—
11	Inspect the PCM connectors for proper connections and replace the terminals, if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 14*	*Go to Step 13*
12	Replace the injection pump. Refer to *Fuel Injection Pump Replacement* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 14*	—
13	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 14*	—
14	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 15*	*Go to Step 2*
15	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0215 Engine Shutoff (ESO) Solenoid Control Circuit



185026

Circuit Description

The injection pump fuel supply line has a solenoid controlled shutoff located in the injection pump. When the solenoid is energized (key in the run position), the valve is open and fuel is supplied to the injection pump. By providing a ground path, the PCM energizes the solenoid.

Conditions for Running the DTC

The ignition switch in the ON position or the engine is operating.

Conditions for Setting the DTC

- The PCM has requested the ESO ON and the control circuit voltage at the PCM is more than 8 volts.
- All of the diagnostic set conditions met for 2 seconds.

or

- The PCM has requested the ESO OFF and the control circuit voltage at the PCM is less than 8 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will store in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

An open in the control circuit or the ignition feed circuit will cause a P0215. Also a no start condition will exist. The scan tool has the ability to turn the engine shutoff solenoid ON and OFF. This can be used as a quick operational check.

An intermittent may be caused by any of the following conditions:

- A poor connection
- Rubbed through wire insulation
- A broken wire inside the insulation

Thoroughly check any circuitry that is suspected of causing the intermittent complaint. Refer to *Intermittents and Poor Connections Diagnosis* in Wiring Systems.

If a repair is necessary, then refer to *Wiring Repairs* or *Connector Repairs* in Wiring Systems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step will check the ESO control circuit for an open.
10. After repairing the circuit for a short to voltage, check the solenoid for proper operation.

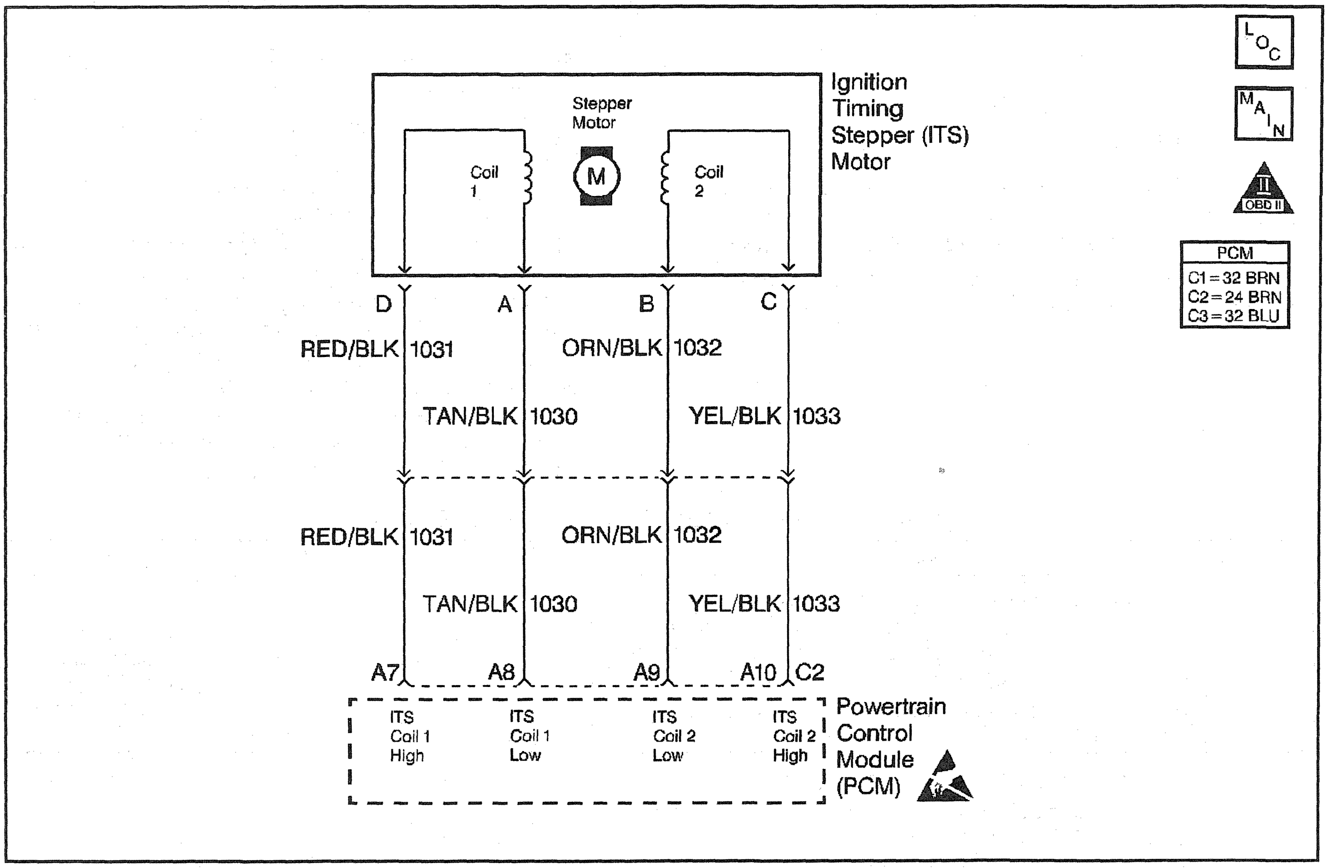
DTC P0215 Engine Shutoff (ESO) Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and Failure Records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition OFF. 2. Disconnect the ESO harness electrical connector. 3. Ignition ON, engine OFF. 4. With an *J 34142-B* unpowered test lamp connected to chassis ground, probe the ESO ignition feed circuit at the engine harness connector. Is the test light ON?	—	*Go to Step 3*	*Go to Step 6*
3	1. Turn the ignition OFF. 2. With an *J 34142-B* unpowered test lamp, jumper the ESO engine harness terminals together. 3. Turn the ignition ON leaving the engine OFF. Is the test light ON?	—	*Go to Step 4*	*Go to Step 7*
4	1. Turn the ignition ON leaving the engine OFF. 2. With an *J 34142-B* unpowered test lamp connected to B+, probe the ESO control circuit. 3. With the scan tool, command the ESO solenoid ON and OFF. Does the test light turn ON and OFF with each command?	—	*Go to Step 5*	*Go to Step 8*
5	Check the ESO harness for a proper connection and replace the terminals if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did any terminal require replacement?	—	*Go to Step 13*	*Go to Step 11*
6	1. Check the ESO ignition feed circuit for the following conditions: • An open wire • An open fuse 2. Repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 13*	—
7	1. Turn the ignition ON leaving the engine OFF. 2. With an *J 34142-B* unpowered test lamp connected to ground, probe the ESO control circuit at the ESO harness connector. Is the test light ON?	—	*Go to Step 10*	*Go to Step 9*

DTC P0215 Engine Shutoff (ESO) Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
8	Repair the short to ground on the ESO control circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 13*	—
9	1. Check the ESO control circuit for the following conditions: • An open wire • Proper connection at the PCM 2. If an ESO control circuit problem was found, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 13*	*Go to Step 12*
10	1. Check the ESO control circuit for a short to voltage. 2. If an ESO control circuit problem was found, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 13*	*Go to Step 12*
11	**Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Replace the injection pump. Refer to *Fuel Injection Pump Replacement.* Is the action complete?	—	*Go to Step 13*	—
12	**Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Replace the PCM. Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle until the engine reaches normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0216 Injection Timing Control Circuit



Circuit Description

Timing of the combustion event is accomplished by delivering a pulse of fuel into the combustion chamber at a desired degree of piston travel. This desired degree (desired timing), defines the current position of the piston in relationship of Top Dead Center. This test compares desired timing to measured timing when certain conditions have been met. To retard injection timing the PCM extends the stepper motor. To advance injection timing the PCM retracts the stepper motor. This is a type B DTC.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- DTCs P0251, P0335 and P0370 not set.
- The engine speed has not changed more than 56 RPM for 5 seconds.

Conditions for Setting the DTC

- A 5 degree difference between Act. Inj. Time and Des. Inj. Time
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

An intermittent may be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

A hard start and possible poor performance condition might exist. Act. Inj. Time will freeze at the point of the fault. Its possible DTC P0216 will set if injection timing is not set correctly. Refer to *Injection Timing Adjustment* for correct procedure.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if DTC P0216 is a hard failure or an intermittent.
4. This step checks for an open or short in the injection timing coil circuit 1.
5. This step checks for an open or short in the injection timing coil circuit 2.
6. The important thing in this step is that the PCM is sending a varying voltage (voltage may vary between 1 and 12 (usually you will see voltage vary between 5 and 6 when engine is idling)), this will indicate that the PCM is OK and that there is a problem with the injection timing Stepper motor. If there is a steady voltage present on any circuit, this will indicate a problem with the PCM or a circuit shorted to voltage.

DTC P0216 Injection Timing Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Run the engine to operating temperature. 2. Using a scan tool, compare the injection timing at idle and at 1500 RPM. Does the scan tool display a difference greater than or equal to the specified value between Actual Inj Time and Desired Inj Time at idle or at 2700 RPM?	5°	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the PCM. 3. Measure the resistance between coil 1 low and coil 1 high at the PCM harness. Is the resistance within the specified value?	10 – 60 Ω	*Go to Step 5*	*Go to Step 9*
5	Measure the resistance between coil 2 low and coil 2 high at the PCM harness. Is the resistance within the specified value?	10 – 60 Ω	*Go to Step 6*	*Go to Step 10*
6	1. Reconnect the PCM. 2. Disconnect the injection timing stepper motor. 3. Start and idle the engine. 4. Using the scan tool, command the Time Set ON. 5. With a *J 39200* DMM connected to ground, check for a varying voltage on all terminals at the injection timing stepper motor electrical harness. Does the voltage vary on all circuits?	—	*Go to Step 7*	*Go to Step 12*
7	1. Disconnect the crankshaft position (CKP) sensor. 2. Measure the resistance between the crankshaft position sensor signal and the 5 volt reference circuit at the sensor pigtail. Is the resistance within the specified value?	950 –1050 Ω	*Go to Step 8*	*Go to Step 13*

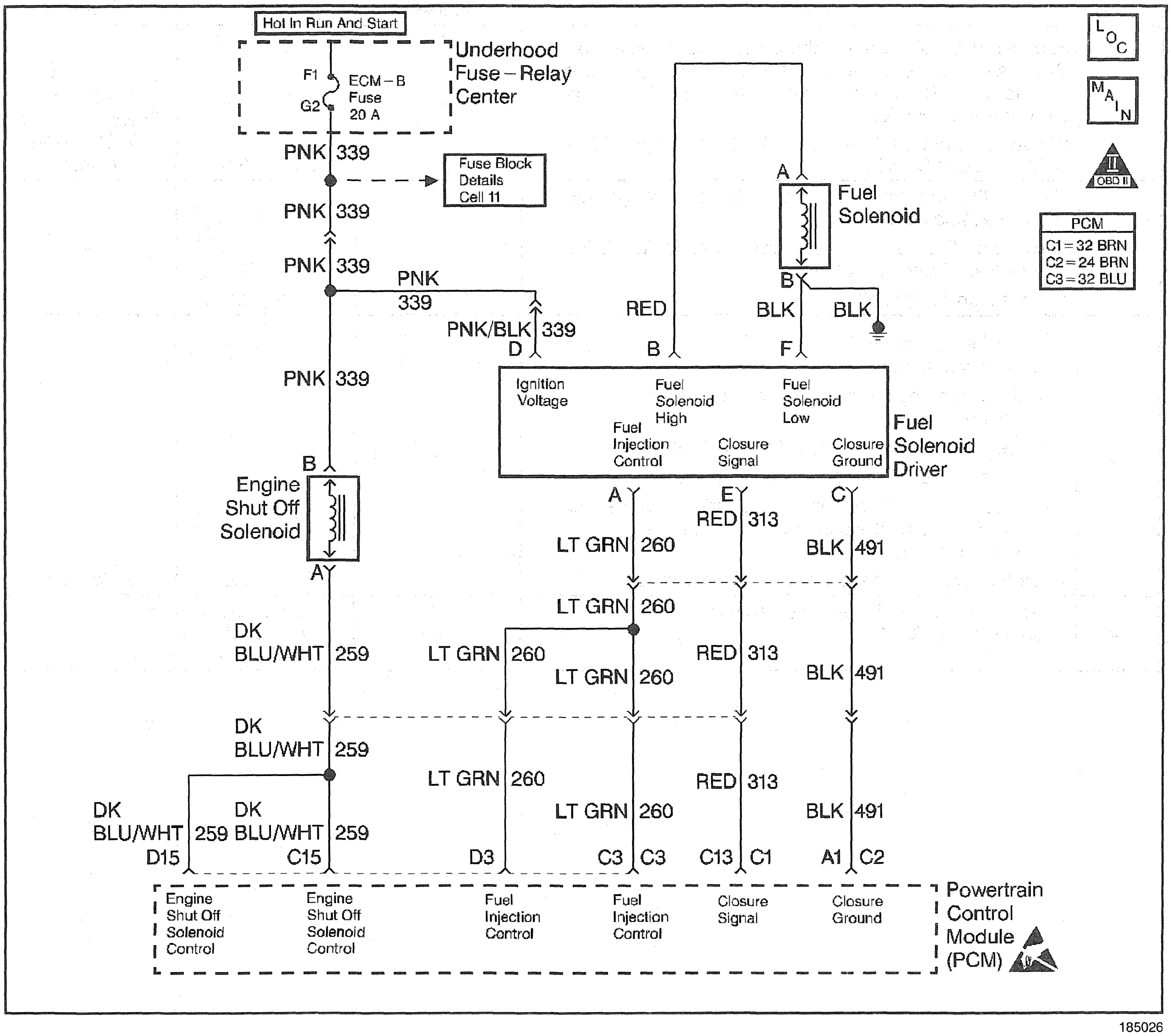
DTC P0216 Injection Timing Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Reconnect all the sensors. 2. Check for one of the following: • Injection timing set correctly. Refer to *Injection Timing Adjustment.* • Sheared camshaft driven key. Refer to Engine Mechanical. 3. If a problem is found, repair the problem as necessary. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 15*
9	1. Turn the ignition OFF. 2. Disconnect the stepper motor and check for an open or short in one of the following: • Coil 1 low circuit • Coil 1 high circuit. • If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 11*
10	1. Turn the ignition OFF. 2. Disconnect the stepper motor and check for an open or short in one of the following: • Coil 2 low circuit • Coil 2 high circuit • If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 11*
11	1. Check for a proper electrical connection at the injection timing stepper motor. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 15*
12	Check the non-varying circuit for a short to ground, short to voltage, or a proper connection at the PCM. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 16*
13	1. Check the crankshaft sensor pigtail for a short to ground. 2. If the circuit is shorted to ground, repair the circuit as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 17*	*Go to Step 14*
14	Replace the crankshaft position sensor. Refer to *Crankshaft Position Sensor Replacement.* After replacing the sensor, the PCM must be programmed with a new offset. Refer to *TDC Offset Adjustment.* Is the action complete?	—	*Go to Step 17*	—
15	Replace the injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 17*	—

DTC P0216 Injection Timing Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
16	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 17*	—
17	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 18*	*Go to Step 2*
18	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0219 Engine Overspeed



Circuit Description

The PCM has the ability to put the vehicle in an ESO controlled idle if an engine overspeed condition has been detected.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

An RPM drop with 5 ESO cycles.

Action Taken When the DTC Sets

- ESO controlled idle (the PCM will control RPM by turning the ESO ON and OFF. RPM will fluctuate from 800 to 1200 when DTC is set).
- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information will store in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

This DTC will not set if an external fuel source is causing an overspeed condition. A DTC P1216 will set along with DTC P0219.

Test Description

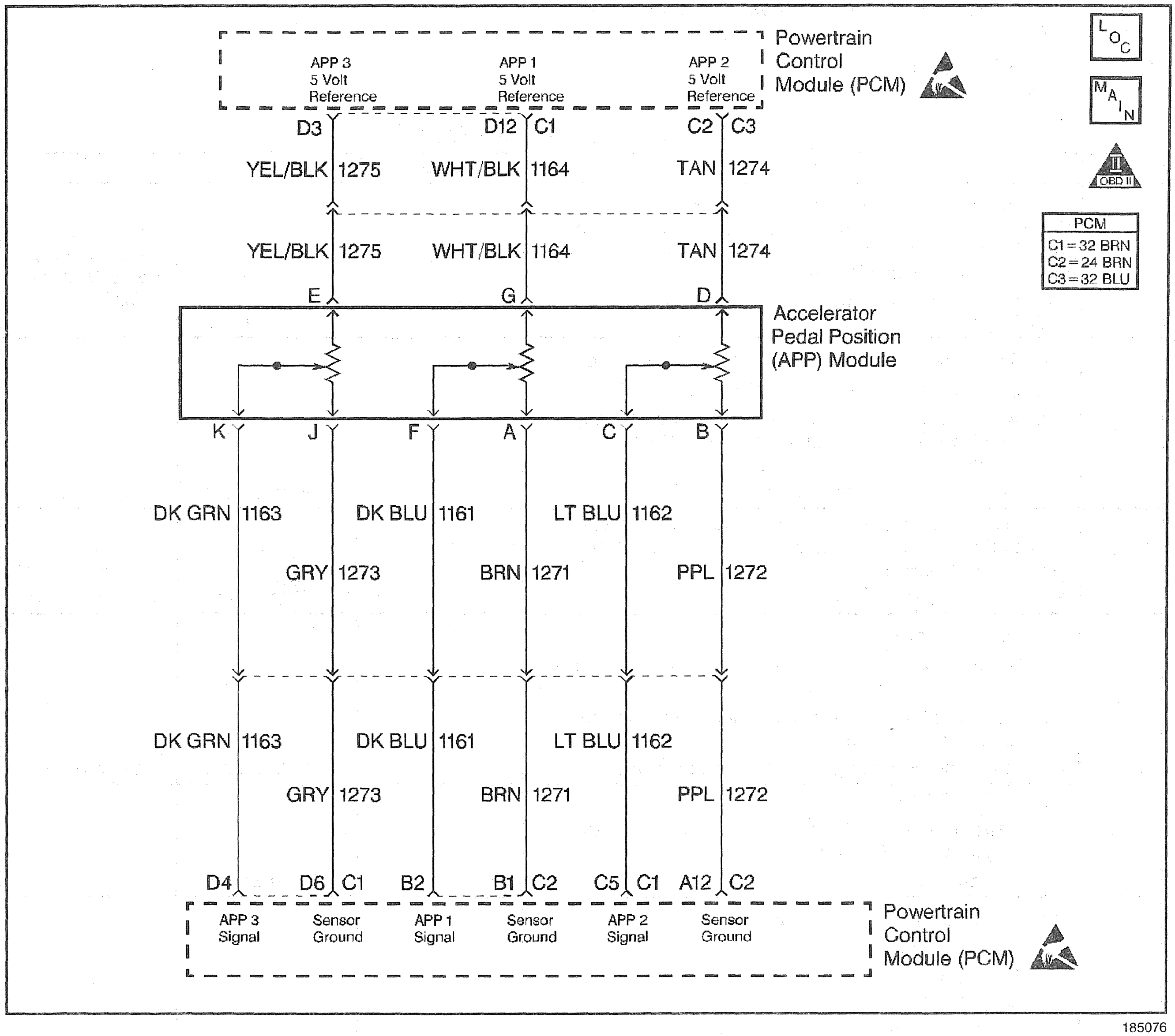
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The injection pump is being replaced in this step.

DTC P0219 Engine Overspeed

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0220 APP Sensor2 Circuit



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The 5 reference voltage on the APP 2 sensor is less than 4.8 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will turn ON the Service Throttle Soon lamp and limit power.
- The PCM records the operating conditions at the time the diagnostic fails. This information will store in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of this DTC is loose connectors or terminals. All 5 volt reference circuits must be checked for proper reference voltage. Volt meter accuracy is important.

Test Description

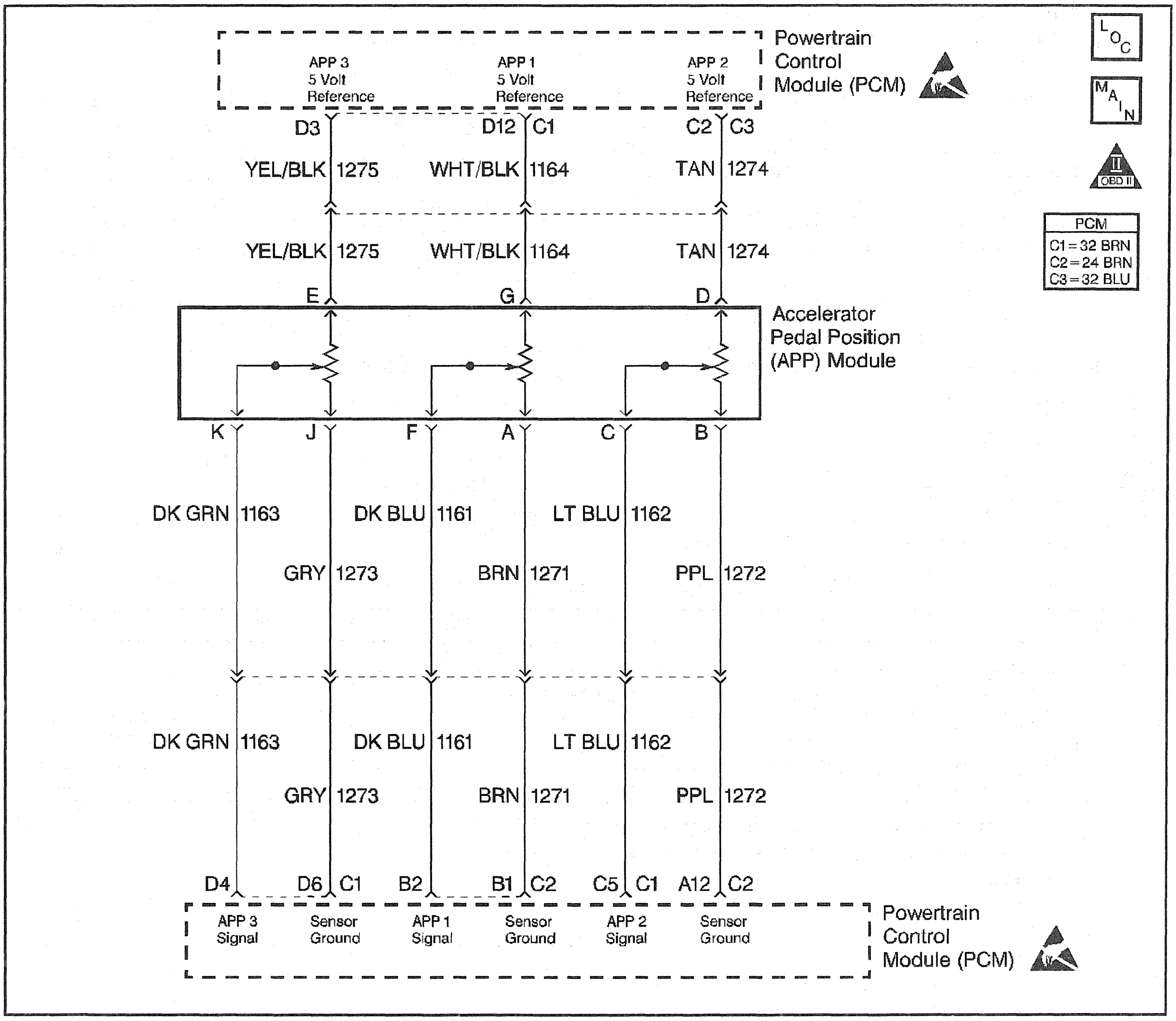
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if there is a good voltage reference.

DTC P0220 APP Sensor2 Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Disconnect the APP sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With *J 39200* connected to ground, check all the APP 5 volt reference circuits at the APP harness connector. Is the voltage less than the specified value?	4.8 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground. 3. If the 5 volt reference circuit is shorted to ground, repair it as necessary. Was the 5 volt reference circuit shorted to ground?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0221 APP Sensor2 Circuit Performance



185076

Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition voltage is more than 6.4 volts.
- Engine speed is more than 300 RPM.
- No in range faults for APP 1 or APP 3 (PCM checks for high and low voltage faults).

Conditions for Setting the DTC

- The difference between APP 2 and APP 1 is more than 0.23 volts (PCM compares pre-scaled voltage (internal to PCM)).
- The difference between APP 2 and APP 3 is more than 0.50 volts (PCM compares pre-scaled voltage (internal to PCM)).
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- The throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will then turn ON the Service Throttle Soon lamp and limit power. If a third APP malfunction is present, the Service Throttle Soon lamp will be ON and will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

An intermittent may be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

A scan tool reads APP 2 position in volts and should read about 4.5 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 sensor while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 4.5 volts when the throttle is closed to about 1.5 volts when the throttle is held at wide open throttle (WOT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This step determines if there is a good 5 volt reference.
5. This step will check for an open in the ground circuit.

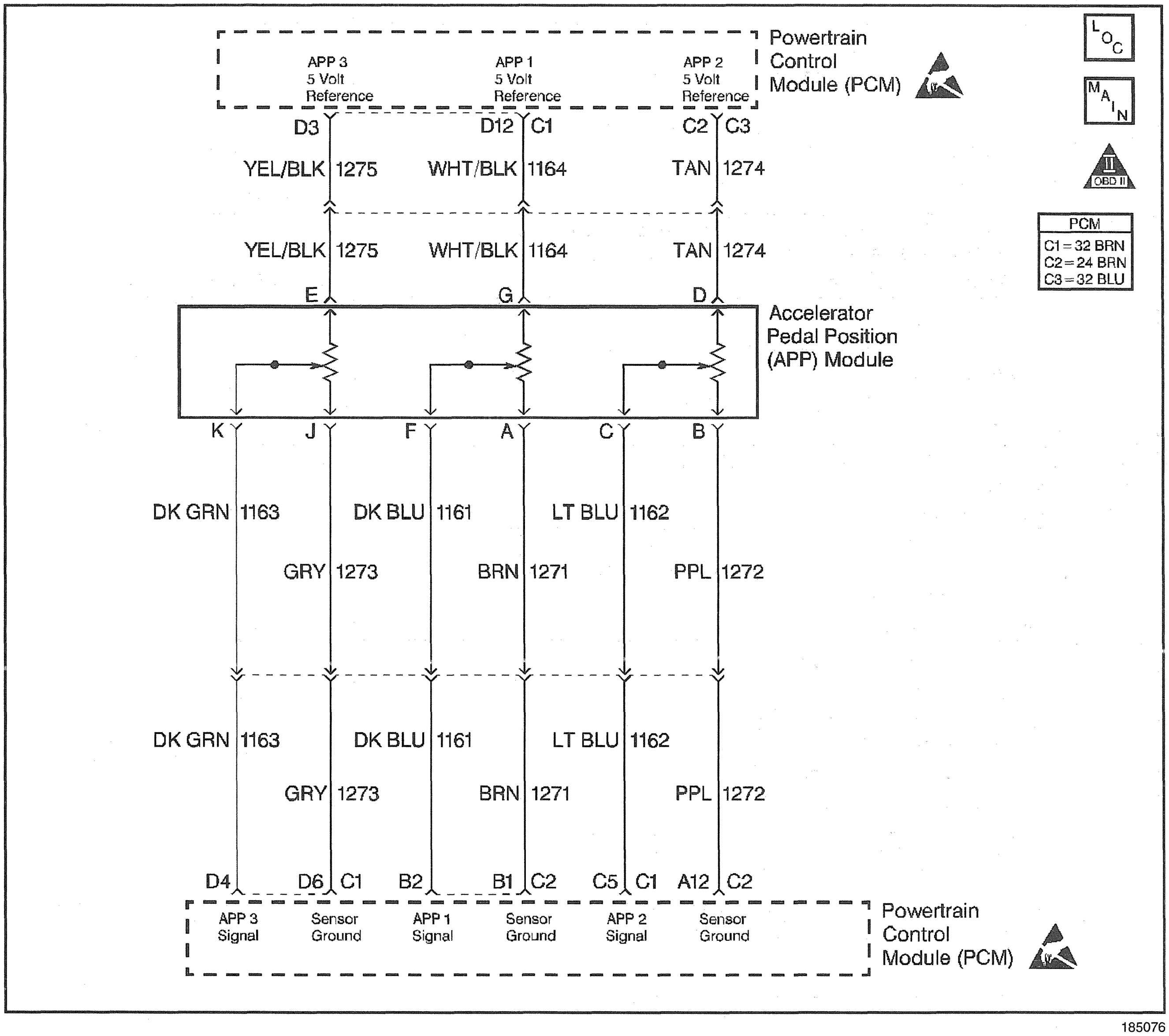
DTC P0221 APP Sensor2 Circuit Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe APP voltages on the scan tool. Are the APP voltages at the specified values (values are listed as APP 1, APP 2, and APP 3 respectively)?	0.45–0.95 V 4.0–4.5 V 3.6–4.0 V	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With a *J 39200* connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D, and E. Is voltage greater than or equal to the specified value on all circuits?	4.75 V	*Go to Step 5*	*Go to Step 6*
5	1. Turn the ignition ON leaving the engine OFF. 2. With a test light connected to B+, probe the APP sensor ground circuits at the APP sensor harness terminals A, B, and J. Is the test light ON (all circuits)?	—	*Go to Step 9*	*Go to Step 8*

DTC P0221 APP Sensor2 Circuit Performance (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 11*	*Go to Step 7*
7	Check the 5 volt reference circuit for a proper connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	*Go to Step 11*	*Go to Step 10*
8	1. Turn the ignition OFF. 2. Disconnect the PCM and check for an open sensor ground circuit to the PCM. 3. If problem is found, repair as necessary. Was APP sensor ground circuit open?	—	*Go to Step 11*	*Go to Step 10*
9	Replace the APP module. Refer to *APP Module Replacement.* Is the action complete?	—	*Go to Step 11*	—
10	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 11*	—
11	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 12*	*Go to Step 2*
12	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0222 APP Sensor2 Circuit Low Voltage



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The reference voltage on the APP 2 sensor is less than 0.25 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- The throttle will operate normally as long as there is only one sensor malfunction present. If two different APP sensors have a malfunction, the Service Throttle Soon lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the Service Throttle Soon lamp will light and the PCM will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

A scan tool reads APP 2 position in volts and should read about 4.5 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 sensor while depressing the accelerator pedal with the engine off and ignition ON. Display should vary from about 4.5 volts when the throttle is closed to about 1.5 volts when the throttle is held at wide open throttle (WOT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0222 is the result of a hard failure or an intermittent condition.
3. This step checks the PCM and wiring.

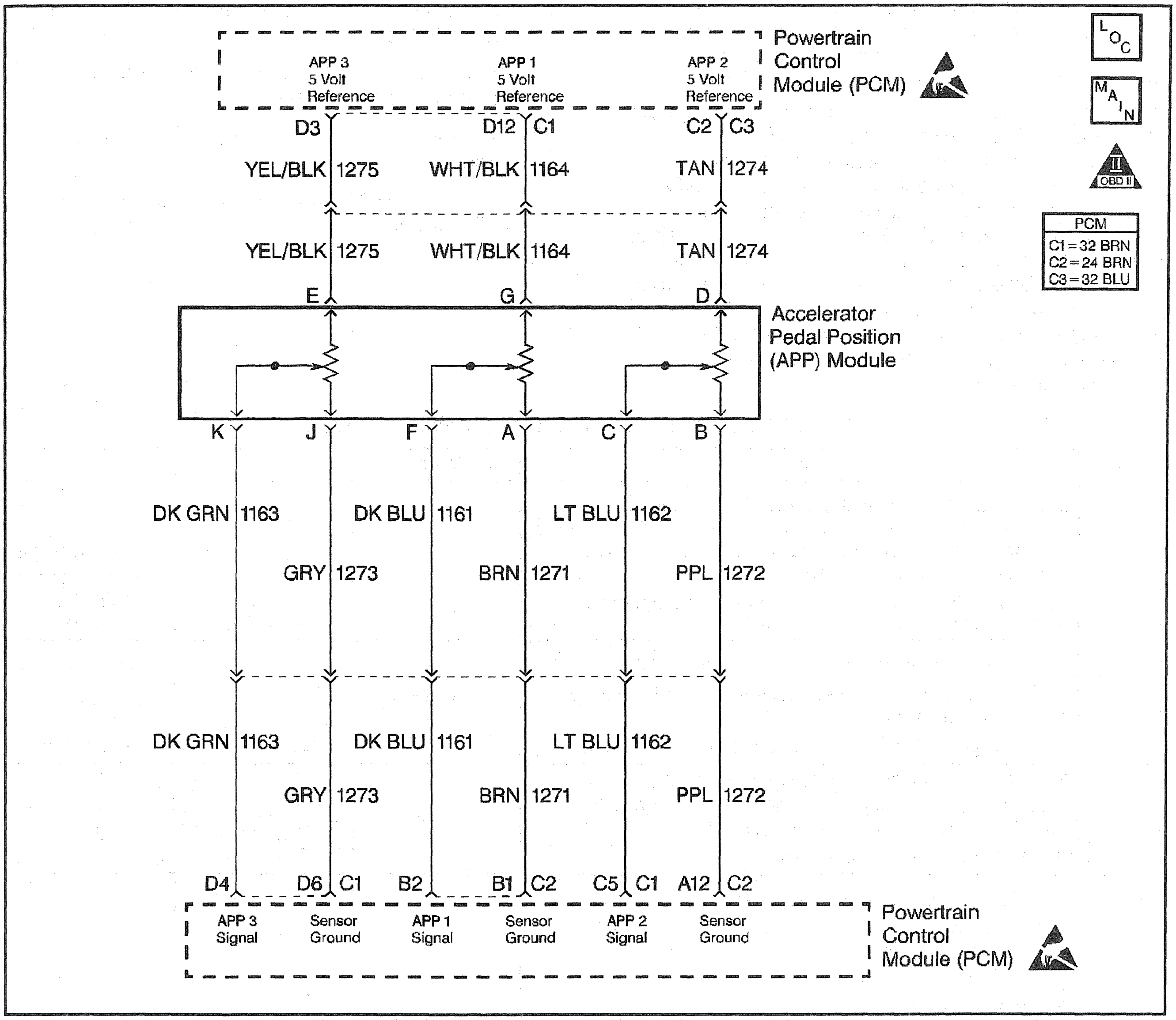
DTC P0222 APP Sensor2 Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** *Before clearing the DTCs, use the scan tool* Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 2 voltage on the Scan tool. Is the APP 2 voltage less than or equal to the specified value?	0.25 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Use the *J 39200* in order to probe the APP 2, 5 volt reference circuit at APP harness. Is the APP 2 voltage greater than the specified value?	5 V	*Go to Step 5*	*Go to Step 6*
5	Use the *J 39200* in order to probe APP 2 sensor signal circuit at the APP sensor harness. Is the APP 2 voltage greater than the specified value?	4.8 V	*Go to Step 10*	*Go to Step 8*
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 13*	*Go to Step 7*
7	1. Check the 5 volt reference circuit for a proper connection at the PCM. 2. Replace the terminal if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did the terminal require replacement?	—	*Go to Step 13*	*Go to Step 12*
8	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the APP 2 signal circuit for an open, or a short to ground. 3. If the APP 2 sensor signal circuit is open or shorted to ground, repair it as necessary. Was the APP 2 signal circuit open or shorted to ground?	—	*Go to Step 13*	*Go to Step 9*

DTC P0222 APP Sensor2 Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
9	1. Check the APP 2 sensor signal circuit for a proper connection at the PCM 2. Replace the terminal if necessary. Refer to *Wiring Repairs* in Wiring Systems. Did the terminal require replacement?	—	*Go to Step 13*	*Go to Step 12*
10	Check for a proper electrical connection at the APP sensor. Did you perform a repair?	—	*Go to Step 13*	*Go to Step 11*
11	Replace the APP module. Refer to *APP Module Replacement.* Is the action complete?	—	*Go to Step 13*	—
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0223 APP Sensor2 Circuit High Voltage



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The signal voltage on the APP 2 sensor is more than 4.8 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- The throttle will operate normally as long as there is only one sensor malfunction present. If two different APP sensors have a malfunction, the Service Throttle Soon lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the Service Throttle Soon lamp will light and the PCM will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

A scan tool reads APP 2 position in volts and should read about 4.5 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 signal while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 4.5 volts when the throttle is closed to about 1.5 volts when the throttle is held at wide open throttle (WOT). It's possible P1125 will set along with P0223 if the signal circuit is open.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if PO223 is a hard failure or an intermittent condition.
5. This step will check for an open in the ground circuit.
8. This step will check for a short to power or a bad APP mode.

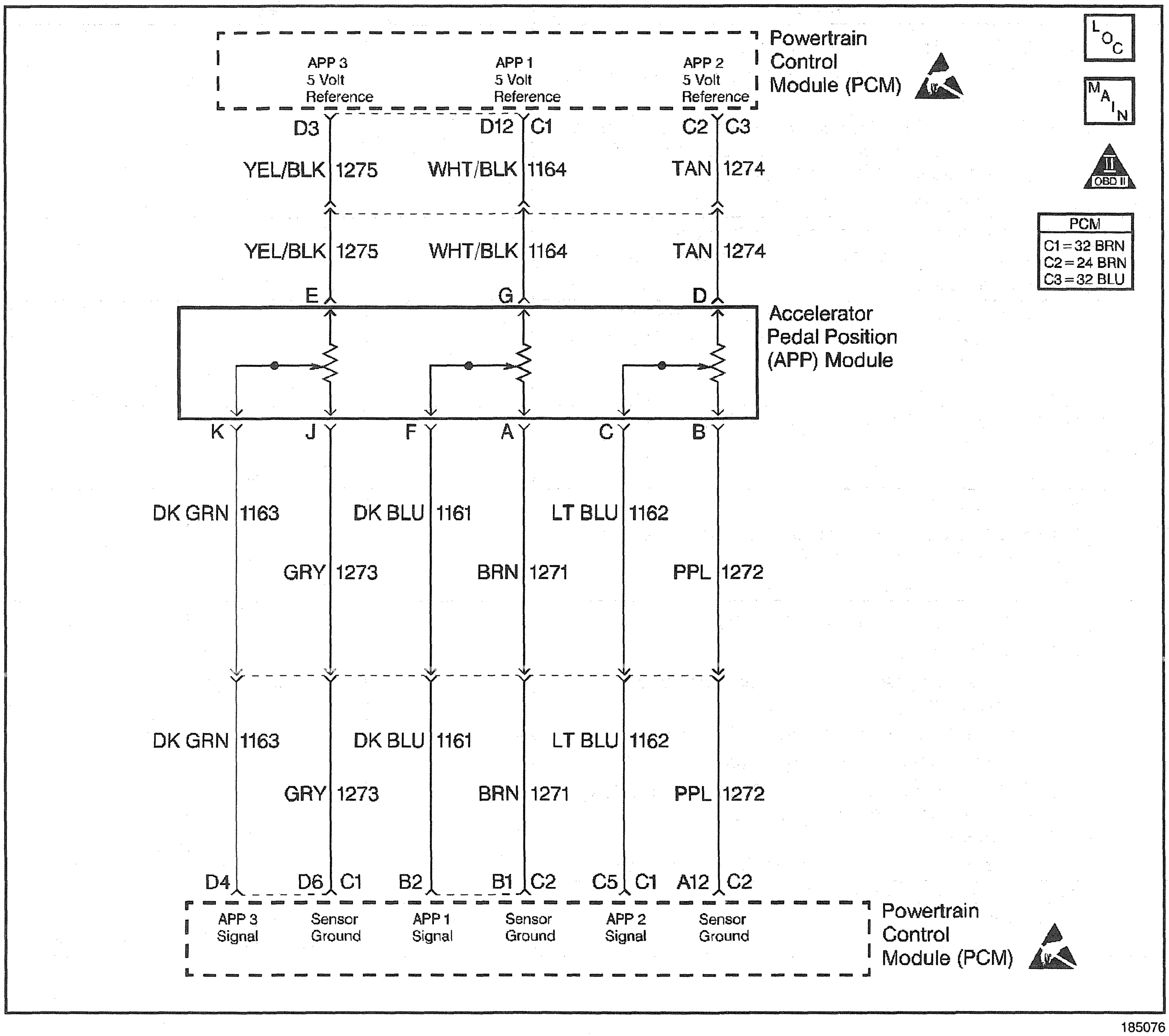
DTC P0223 APP Sensor2 Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 2 display on the scan tool. Is APP 2 greater than or equal to the specified value?	4.75 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor harness connector. 2. Probe the APP 2 sensor ground circuit at the APP sensor harness connector with an *J 34142-B* unpowered test light connected to B+. Is the test light ON?	—	*Go to Step 5*	*Go to Step 7*
5	Use a fused jumper wire in order to jump the APP 2 signal circuit to the APP 2 ground circuit at the APP harness connector. Does the scan tool display the APP 2 voltage less than the specified value.	0.25 V	*Go to Step 8*	*Go to Step 6*
6	1. Check for an open on the APP 2 sensor signal circuit. 2. If the APP 2 sensor signal circuit is open, repair it as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the APP 2 sensor signal circuit open?	—	*Go to Step 13*	*Go to Step 12*
7	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the APP 2 sensor ground circuit open?	—	*Go to Step 13*	*Go to Step 12*

DTC P0223 APP Sensor2 Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Verify the ignition is ON with the engine OFF. 2. Verify the APP harness is still disconnected from the APP module. 3. With a *J 39200* DMM set to the mA scale, measure the current between the APP 2 signal circuit and the ground circuit at the harness connectors. Is the current greater than the specified value?	50 mA	*Go to Step 9*	*Go to Step 10*
9	Repair the short to voltage on the APP 2 signal circuit. necessary. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 13*	—
10	Check for a proper electrical connection at the APP sensor. Repair as necessary. Refer to *Wiring Repairs* in Wiring Systems. Was the repair performed?	—	*Go to Step 13*	*Go to Step 11*
11	Replace the APP module. Refer to *APP Module Replacement*. Is the action complete?	—	*Go to Step 13*	—
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0225 APP Sensor3 Circuit



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The reference voltage on the APP 3 sensor is less than 4.8 volts.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will turn ON the Service Throttle Soon lamp and limit power.
- Multiple DTCs will be present.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

An intermittent may be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

All 5 volt reference circuits must be checked for proper reference voltage. Voltmeter accuracy is important.

Test Description

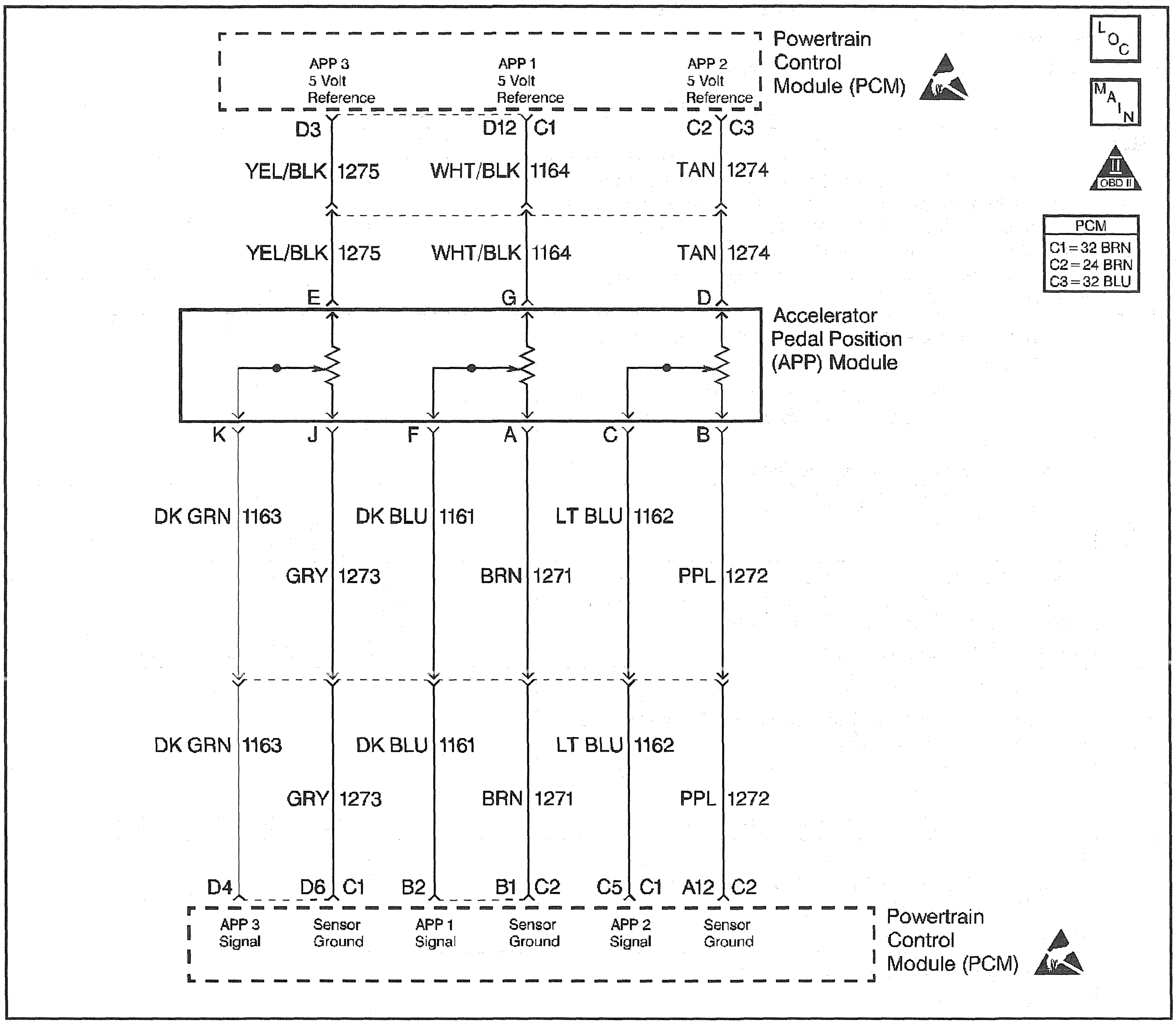
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will check all 5 volt reference circuits.

DTC P0225 APP Sensor3 Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Disconnect the APP sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With a *J 39200* connected to ground, check all the APP 5 volt reference circuits at the APP harness connector. Is the voltage less than the specified value?	4.8 V	*Go to Step 5*	*Go to Step 3*
3	Are any other APP DTCs set?	—	Go to the Applicable DTC Table	*Go to Step 4*
4	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
5	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground. 3. If the 5 volt reference circuit is shorted to ground, repair it as necessary. Was the 5 volt reference circuit shorted to ground?	—	*Go to Step 7*	*Go to Step 6*
6	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 7*	—
7	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 8*	*Go to Step 2*
8	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0226 APP Sensor3 Circuit Performance



185076

Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition voltage is more than 6.4 volts.
- The engine speed is more than 300 RPM.
- No in range faults for APP 1 or APP 2 (PCM checks for high and low voltage faults).

Conditions for Setting the DTC

- The difference between APP 3 and APP 1 is more than 0.23 volts (PCM compares pre-scaled voltage (internal to PCM)).
- The difference between APP 3 and APP 2 is more than 0.50 volts (PCM compares pre-scaled voltage (internal to PCM)).
- All diagnostic conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will then turn ON the Service Throttle Soon lamp and limit power. If a third APP malfunction is present, the Service Throttle Soon lamp will be ON and will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

An intermittent may be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

A scan tool reads APP 3 position in volts. It should read about 4.0 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward wide open throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 4.0 volts when the throttle is closed to about 2.0 volts when the throttle is held at wide open throttle (WOT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if there is a good reference voltage.

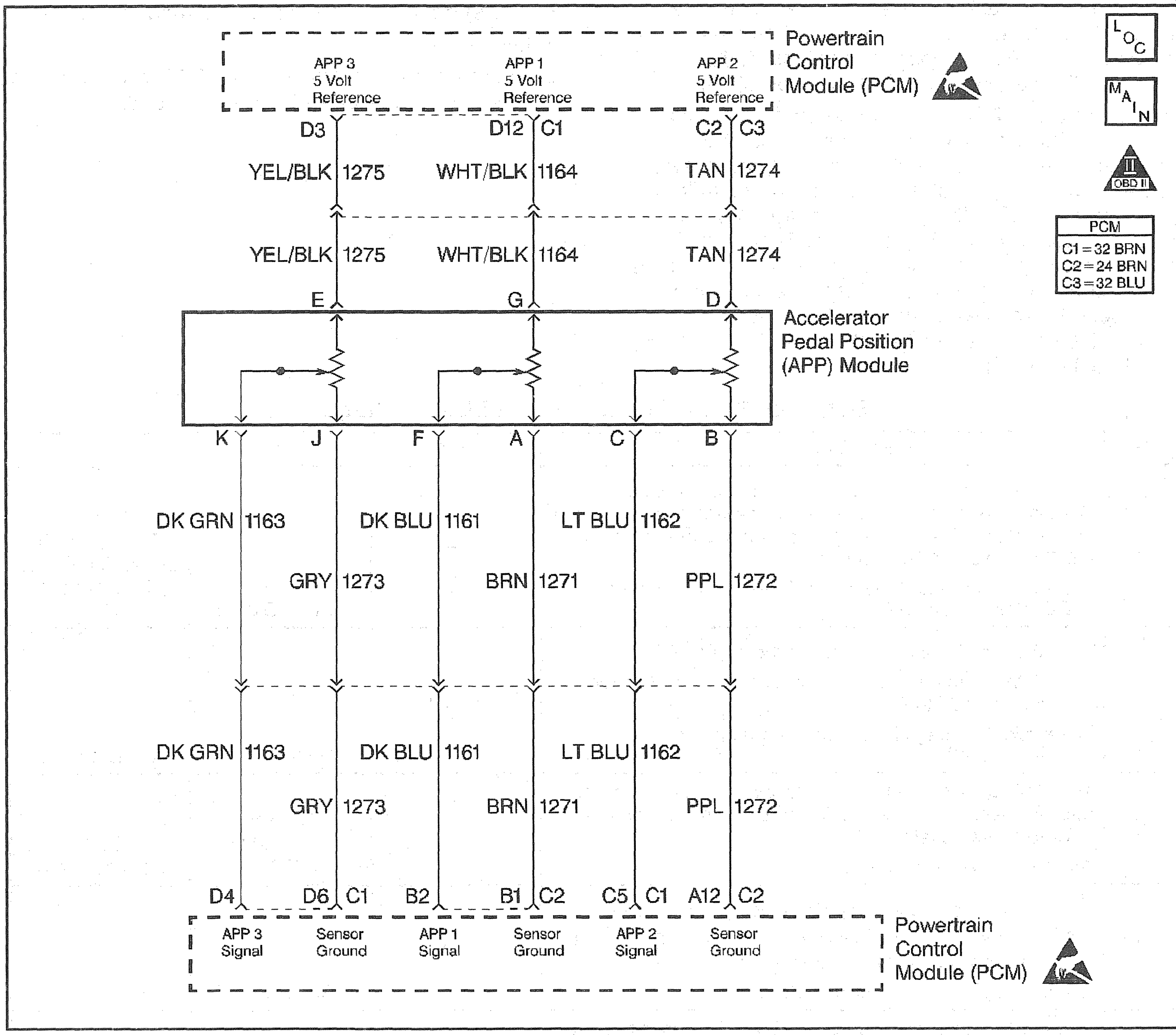
DTC P0226 APP Sensor3 Circuit Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP voltages on the Scan tool. Are the APP voltages at the specified values (values are listed as APP 1, APP 2, and APP 3 respectively)?	0.45–0.95 V 4.0–4.5 V 3.6–4.0 V	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With a *J 39200* connected to ground, probe the APP sensor 5 volt reference circuits at the APP harness terminals G, D, and E. Is the voltage greater than or equal to the specified value on all circuits?	4.75 V	*Go to Step 5*	*Go to Step 6*
5	1. Turn the ignition ON leaving the engine OFF. 2. With a test light connected to B+, probe the APP sensor ground circuits at the APP sensor harness terminals A, B, and J. Is the test light ON (all circuits)?	—	*Go to Step 9*	*Go to Step 8*

DTC P0226 APP Sensor3 Circuit Performance (cont'd)

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 11*	*Go to Step 7*
7	Check the 5 volt reference circuit for a proper connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	*Go to Step 11*	*Go to Step 10*
8	1. Turn the ignition OFF. 2. Disconnect the PCM and check for an open sensor ground circuit to the PCM. 3. If problem is found, repair as necessary. Was APP sensor ground circuit open?	—	*Go to Step 11*	*Go to Step 10*
9	Replace the APP module. Refer to *APP Module Replacement*. Is the action complete?	—	*Go to Step 11*	—
10	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 11*	—
11	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 12*	*Go to Step 2*
12	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0227 APP Sensor3 Circuit Low Voltage



Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The signal voltage on the APP 3 sensor is less than 0.25 volts.
- All diagnostic conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the Service Throttle Soon lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the Service Throttle Soon lamp will light and the PCM will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

A scan tool reads APP 3 position in volts. It should read about 4.0 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward wide open throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 4.0 volts when the throttle is closed to about 2.0 volts when the throttle is held at wide open throttle (WOT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if DTC P0227 is the result of a hard failure or an intermittent condition.

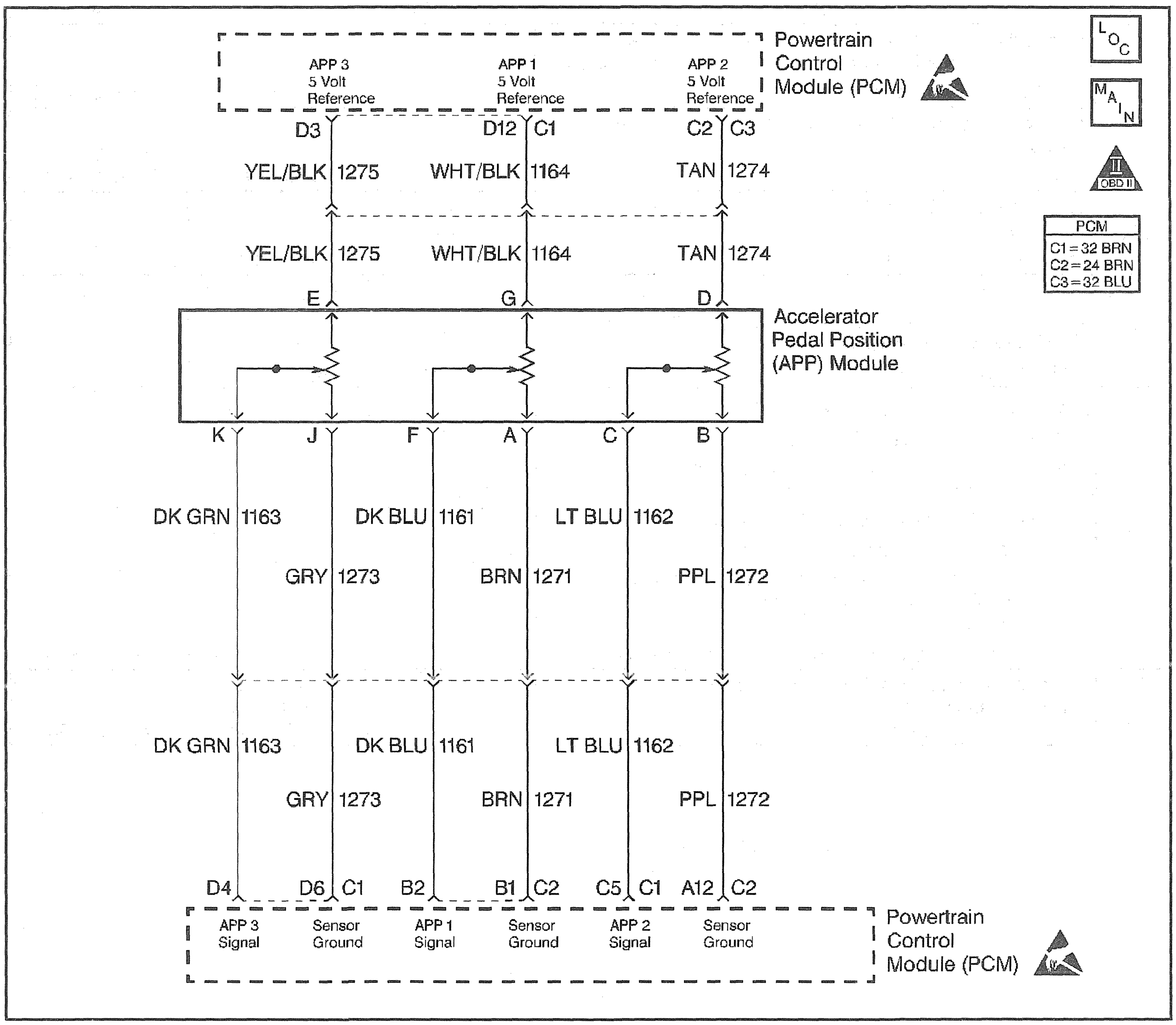
DTC P0227 APP Sensor3 Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 3 voltage on the scan tool. Is the APP 3 voltage less than or equal to the specified value?	0.25 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Use the *J 39200* in order to probe the APP 3, 5 volt reference circuit at the APP harness. Is the voltage at the specified value?	5 V	*Go to Step 5*	*Go to Step 6*
5	Use *J 39200* in order to probe the APP 3 signal circuit at the APP harness. Is the voltage at the specified value?	4.8 V	*Go to Step 10*	*Go to Step 8*
6	1. Turn the ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	*Go to Step 13*	*Go to Step 7*
7	Check the 5 volt reference circuit for a proper connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	*Go to Step 13*	*Go to Step 12*
8	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the APP 3 signal circuit for an open, short to ground. 3. If the APP 3 sensor signal circuit is open or shorted to ground, repair it as necessary. Was the APP 3 signal circuit open or shorted to ground?	—	*Go to Step 13*	*Go to Step 9*

DTC P0227 APP Sensor3 Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
9	Check the APP 3 sensor signal circuit for a proper connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	*Go to Step 13*	*Go to Step 12*
10	Check for a proper electrical connection at the APP sensor. Did you perform a repair?	—	*Go to Step 13*	*Go to Step 11*
11	Replace the APP module. Refer to *APP Module Replacement.* Is the action complete?	—	*Go to Step 13*	—
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0228 APP Sensor3 Circuit High Voltage



185076

Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The signal voltage on the APP 3 sensor is more than 4.75 volts.
- All diagnostic conditions met for 2 seconds.

Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- This DTC will not turn on the Service Throttle Soon lamp by itself.
- The throttle will operate normally as long as there is only one malfunction present. If two different APP sensors have a malfunction, the Service Throttle Soon lamp will light and the PCM will limit power. If three APP sensors have a malfunction present, the Service Throttle Soon lamp will light and the PCM will only allow the engine to operate at idle.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

There are no driveability issues associated with the APP module unless a DTC is present. The most likely causes of this DTC are poor connections or the sensor itself. The least likely is a PCM problem.

A scan tool reads APP 3 position in volts. It should read about 4.0 volts with the throttle closed and the ignition ON or at idle. Voltage should decrease at a steady rate as the throttle is moved toward wide open throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing the accelerator pedal with the engine off and the ignition ON. Display should vary from about 4.0 volts when the throttle is closed to about 2.0 volts when the throttle is held at wide open throttle (WOT).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if PO228 is a hard failure or an intermittent condition.
5. This step will check for an open in the ground circuit.

DTC P0228 APP Sensor3 Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. With the throttle closed, observe the APP 3 display on the scan tool. Is APP 3 greater than or equal to the specified value?	4.75 V	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor harness connector. 2. Probe the APP 3 sensor ground circuit at the APP sensor harness connector with a test light connected to B+. Is the test light ON?	—	*Go to Step 5*	*Go to Step 7*
5	Use a fused jumper wire in order to jump the APP 3 signal circuit to the APP 3 ground circuit at the APP harness connector. Does the scan tool display the APP 3 voltage less than the specified value?	0.25 V	*Go to Step 8*	*Go to Step 6*
6	1. Check for an open on the APP 3 sensor signal circuit. 2. If the APP 3 sensor signal circuit is open, repair it as necessary. Was the APP 3 sensor signal circuit open?	—	*Go to Step 13*	*Go to Step 12*
7	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. Was the APP 3 sensor ground circuit open?	—	*Go to Step 13*	*Go to Step 12*
8	1. Verify the ignition is ON with the engine OFF. 2. Verify the APP harness is still disconnected from the APP module. 3. With a *J 39200* set to the mA scale, measure the current between the APP 3 signal circuit and the sensor ground circuit at the APP harness connector. Is the current greater than the specified value?	50 mA	*Go to Step 9*	*Go to Step 10*

DTC P0228 APP Sensor3 Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
9	Repair the short to voltage on the APP 3 signal circuit. Is the action complete?	—	*Go to Step 13*	—
10	Check for a proper electrical connection at the APP sensor. Was the repair performed?	—	*Go to Step 13*	*Go to Step 11*
11	Replace the APP module. Refer to *APP Module Replacement*. Is the action complete?	—	*Go to Step 13*	—
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0231 Fuel Pump Feedback Circuit Low Voltage

Refer to *Engine Controls Schematics*

Circuit Description

The status of the lift pump is monitored by the PCM. This signal is also used to store a DTC if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on circuit 120 during glow plug cycle.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The fuel lift pump is commanded ON.

Conditions for Setting the DTC

- The difference between ignition voltage and fuel pump voltage is more than 4 volts.
- All diagnostic conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

This DTC will not check the fuel pump operation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks the fuel lift pump circuit.

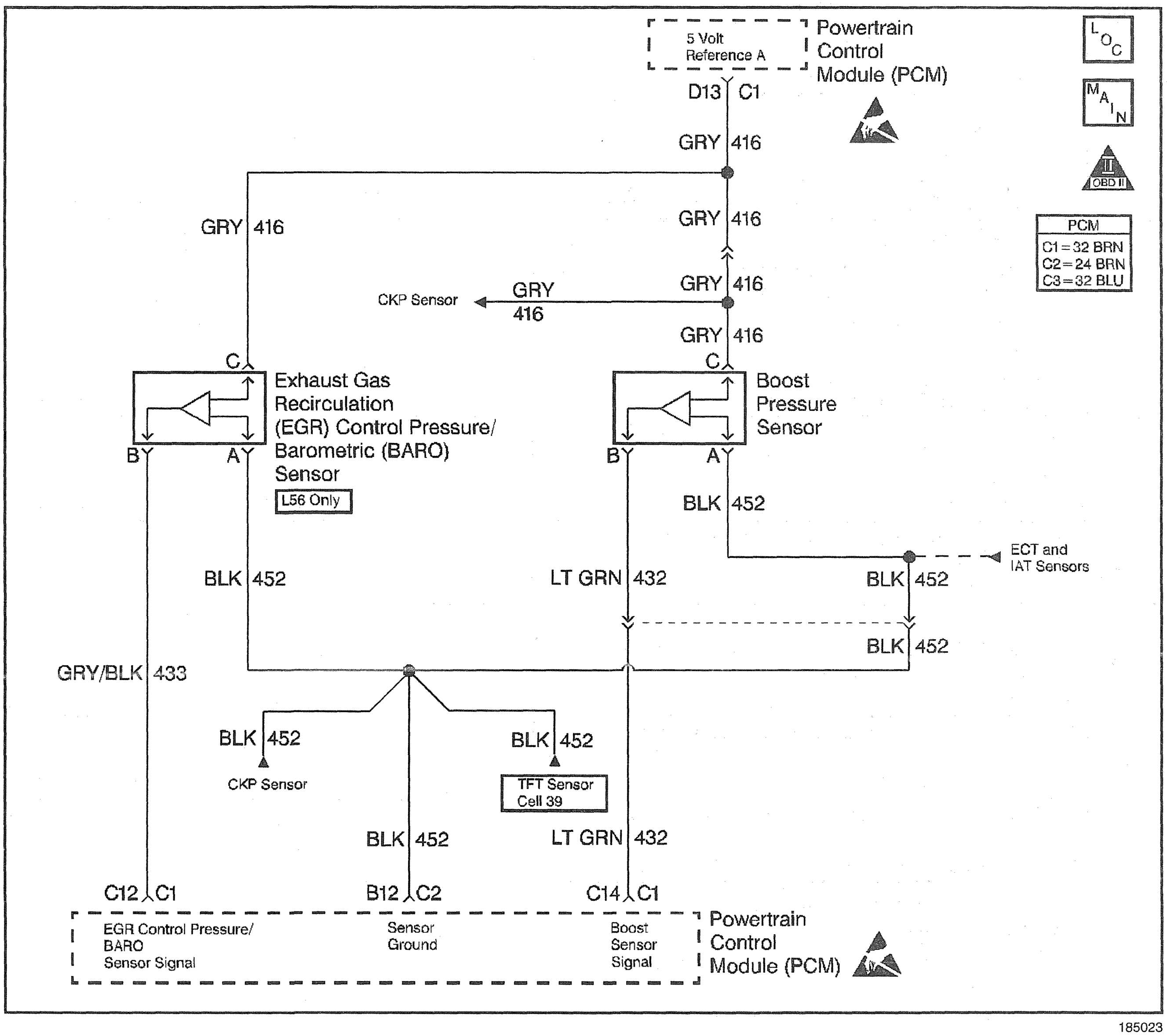
DTC P0231 Fuel Pump Feedback Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Turn the ignition ON. 3. With the scan tool, command the fuel pump ON. Does the scan tool indicate the fuel pump is operating?	—	Go to Diagnostic Aids	*Go to Step 3*
3	1. Turn the ignition OFF. 2. With a *J 39200* connected to ground, backprobe the fuel lift pump signal circuit at the PCM. 3. Probe the fuel pump test terminal with a fused jumper to B+. Is the voltage at the specified value?	B+	*Go to Step 8*	*Go to Step 4*
4	1. Remove the fuel pump relay. 2. Verify the *J 39200* is still connected. 3. From underneath the U/H relay center, probe the A3 terminal with a fused jumper to B+. Is the voltage at the specified value?	B+	*Go to Step 5*	*Go to Step 6*
5	1. Check for a proper connection at the fuel pump relay center. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 19*	*Go to Step 18*
6	1. Check for an open or short to ground on the fuel pump signal circuit. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 19*	*Go to Step 7*
7	1. Check for proper connections at the PCM and at the relay center. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 19*	*Go to Step 16*
8	1. Remove the fuel pump relay. 2. Turn the ignition ON. 3. Connect a test light to ground. 4. Probe the fuel pump relay harness connector terminal B1. Is the test light ON?	—	*Go to Step 10*	*Go to Step 9*
9	Repair the open in the battery feed circuit to the fuel pump relay. Is the action complete?	—	*Go to Step 19*	—
10	Connect a test light between terminal number B1 and terminal number A1 of the fuel pump relay harness connector. Is the test light ON?	—	*Go to Step 12*	*Go to Step 11*
11	Repair the open fuel pump relay ground circuit. Is the action complete?	—	*Go to Step 19*	—

DTC P0231 Fuel Pump Feedback Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
12	1. Turn the ignition OFF. 2. Connect a test light between terminal number B3 of the fuel pump relay harness connector and ground. 3. Monitor the test light. 4. Turn the ignition ON. Does the test light come ON during the glow plug cycle and then go OFF after the glow plug cycle is complete?	—	*Go to Step 13*	*Go to Step 14*
13	1. Turn the ignition OFF. 2. Connect a test light to ground, backprobe the fuel lift pump signal circuit at the PCM. 3. Monitor the test light. 4. Turn the ignition ON. Does the test light come ON during the glow plug cycle and then go OFF after the glow plug cycle is complete?	—	*Go to Step 16*	*Go to Step 17*
14	Check for an open or short to ground in the circuit from the fuel pump relay harness connector terminal number B3 and PCM. Was a problem found?	—	*Go to Step 15*	*Go to Step 16*
15	Repair the open or short to ground in the fuel pump relay control circuit. Is the action complete?	—	*Go to Step 19*	—
16	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 19*	—
17	Check for proper connections at the fuel pump relay connector. Was a problem found?	—	*Go to Step 19*	*Go to Step 18*
18	Replace the fuel pump relay. Refer to *Fuel Pump Relay Replacement*. Is the action complete?	—	*Go to Step 19*	—
19	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 20*	*Go to Step 2*
20	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0236 Turbocharger Boost System Performance



Circuit Description

The PCM operates a solenoid to control boost. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the wastegate valve. During normal operation, the PCM compares its wastegate duty cycle signal with the boost signal and makes corrections in the duty cycle accordingly.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine speed is more than 2400 RPM.
- The fuel rate is more than 20 mm.

or

- The engine speed is more than 1800 but less than 2400 RPM.
- The fuel rate is more than 20 mm.

Conditions for Setting the DTC

- The boost pressure is more than or less than 20 kPa from desired (internal to PCM).
- All diagnostic conditions met for 10 seconds.

Action Taken When the DTC Sets

- A poor performance condition will exist.
- The PCM will reduce maximum fuel.
- The PCM will disable TCC.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A vacuum leak or a pinched vacuum line may cause a DTC P0236. Check all vacuum lines and components connected to the hoses for leaks or sharp bends. Check vacuum source. A possible EGR DTC will store if there is a problem with the vacuum source. Also check for proper vacuum line routing.

The turbocharger wastegate actuator uses a pulse width modulated vacuum solenoid that causes vacuum to fluctuate under normal conditions. A steady vacuum reading indicates a restricted or plugged solenoid vent filter or solenoid vent orfice.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This will check the wastegate solenoid and filter. If the filter is plugged, the filter will not allow the solenoid to vent and this will cause an overboost condition.
5. This step checks the turbocharger wastegate actuator for vacuum leaks. The actuator must hold vacuum.
6. This step will check for vacuum leaks at the lines.
9. This step will check for a skewed boost pressure sensor.

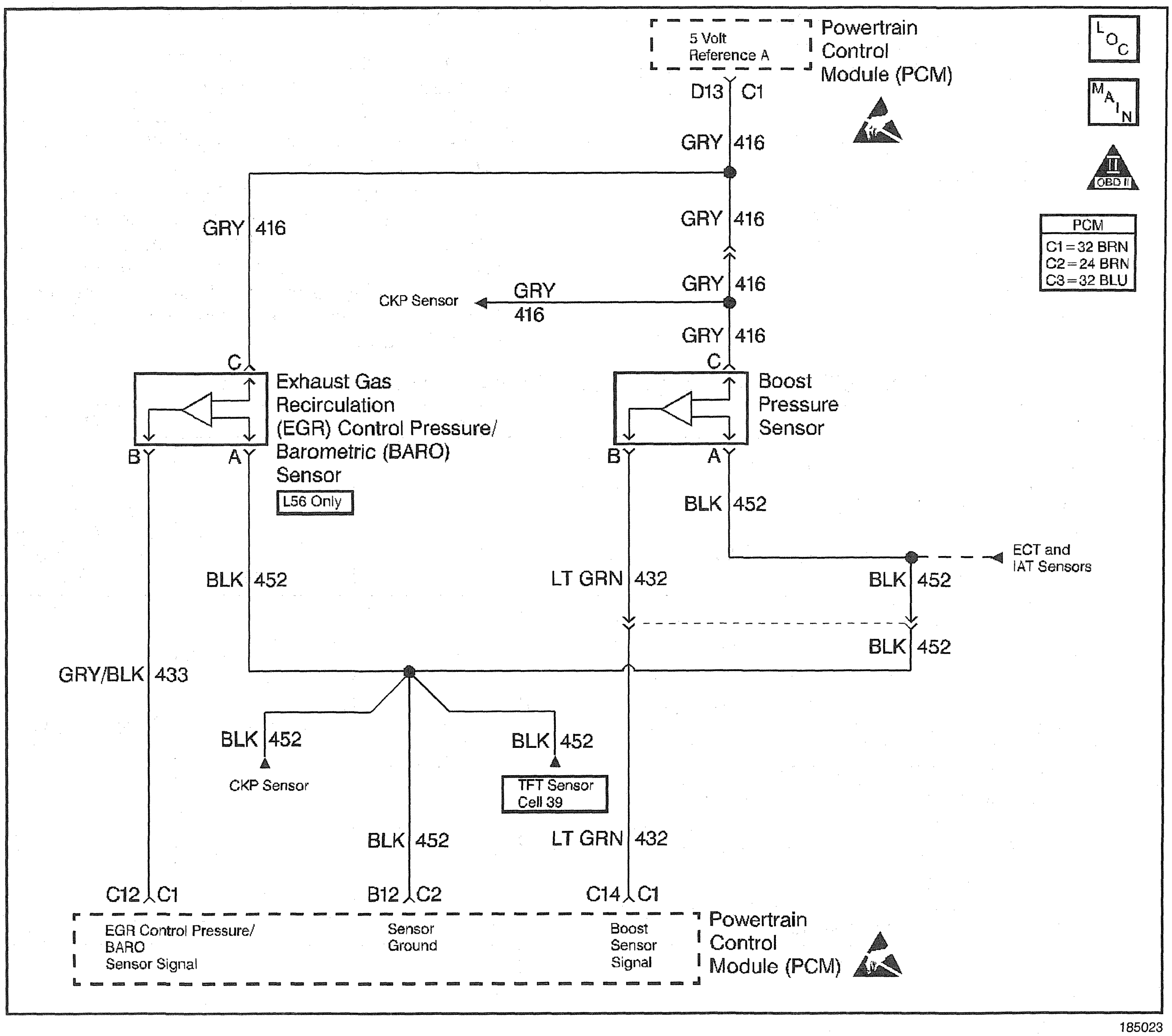
DTC P0236 Turbocharger Boost System Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is the DTC P1656 also set?	—	Go to *DTC P1656 Wastegate Solenoid Control Circuit*	*Go to Step 3*
3	1. Disconnect the vacuum line at the turbocharger wastegate actuator. 2. Install a vacuum gage in place of the turbocharger wastegate actuator. 3. Start the engine. 4. Observe the vacuum at idle. Is the vacuum greater than or equal to the specified value (vacuum will fluctuate)?	15 in. Hg	*Go to Step 4*	*Go to Step 6*
4	1. Disconnect the wastegate solenoid electrical connector with the engine still running. 2. With the vacuum gage still in place, observe the vacuum at idle. Is the vacuum greater than the specified value?	1 in. Hg	*Go to Step 12*	*Go to Step 5*
5	1. Turn the engine OFF. 2. Connect a hand held vacuum pump to the turbocharger wastegate actuator. 3. Apply 5 in. Hg of vacuum. Does the turbocharger wastegate actuator hold vacuum?	—	*Go to Step 7*	*Go to Step 14*
6	1. Check all vacuum lines from the vacuum pump to the turbocharger wastegate actuator for the following: • Leaks • Deformities • Pinches 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 15*	*Go to Step 8*

DTC P0236 Turbocharger Boost System Performance (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Verify the engine is OFF. 2. Disconnect all vacuum lines to the wastegate actuator. 3. Grip the wastegate actuator rod with a pair of pliers. 4. Attempt to move the wastegate actuator rod back and forth. Does the turbocharger wastegate actuator rod move freely?	—	*Go to Step 8*	*Go to Step 14*
8	Check the vacuum pump for proper output (refer to *Engine Vacuum Pump Test* in Engine Mechanical). Was a problem found?	—	*Go to Step 15*	*Go to Step 9*
9	1. Connect a scan tool 2. Start the engine and let the engine idle. 3. Observe the boost pressure display on the scan tool. 4. Increase the engine RPM to 1,500 and return the engine to an idle. Does the scan tool display a change in boost pressure?	—	*Go to Step 10*	*Go to Step 11*
10	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
11	Replace the boost sensor. Refer to *Boost Sensor Replacement.* Is the action complete?	—	*Go to Step 16*	—
12	Check for a plugged wastegate solenoid filter. Repair as necessary. Is the wastegate solenoid filter plugged?	—	*Go to Step 16*	*Go to Step 13*
13	Replace the wastegate solenoid. Refer to *Wastegate Solenoid Replacement.* Is the action complete?	—	*Go to Step 16*	—
14	Replace the turbocharger wastegate actuator. Is the action complete?	—	*Go to Step 16*	—
15	Replace the vacuum pump. Refer to *Vacuum Pump Replacement* in Vacuum Pump. Is the action complete?	—	*Go to Step 16*	—
16	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
17	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0237 Turbocharger Boost Sensor Circuit Low Voltage



Circuit Description

The PCM operates a solenoid to control boost. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the wastegate valve. During normal operation, the PCM compares its wastegate duty cycle signal with the boost signal and makes corrections in the duty cycle accordingly.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch is in the ON position.

Conditions for Setting the DTC

- The boost pressure is less than 40 kPa.
- All diagnostic conditions met for 10 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Very little boost can be attained by revving the engine in neutral. If the boost sensor signal circuit is open or shorted to ground, the boost solenoid will show a zero duty cycle.

An intermittent may be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if DTC P0237 is the result of a hard failure or an intermittent condition.
3. This step simulates conditions for a DTC P0237. If the PCM recognizes the change, the PCM and signal circuit are OK.
9. In this step, components that share the 5 volt reference can cause the reference voltage to be shorted to ground. This can be checked by disconnecting each component that shares the 5 volt reference one at a time, including the PCM while checking for continuity on that circuit to chassis ground.

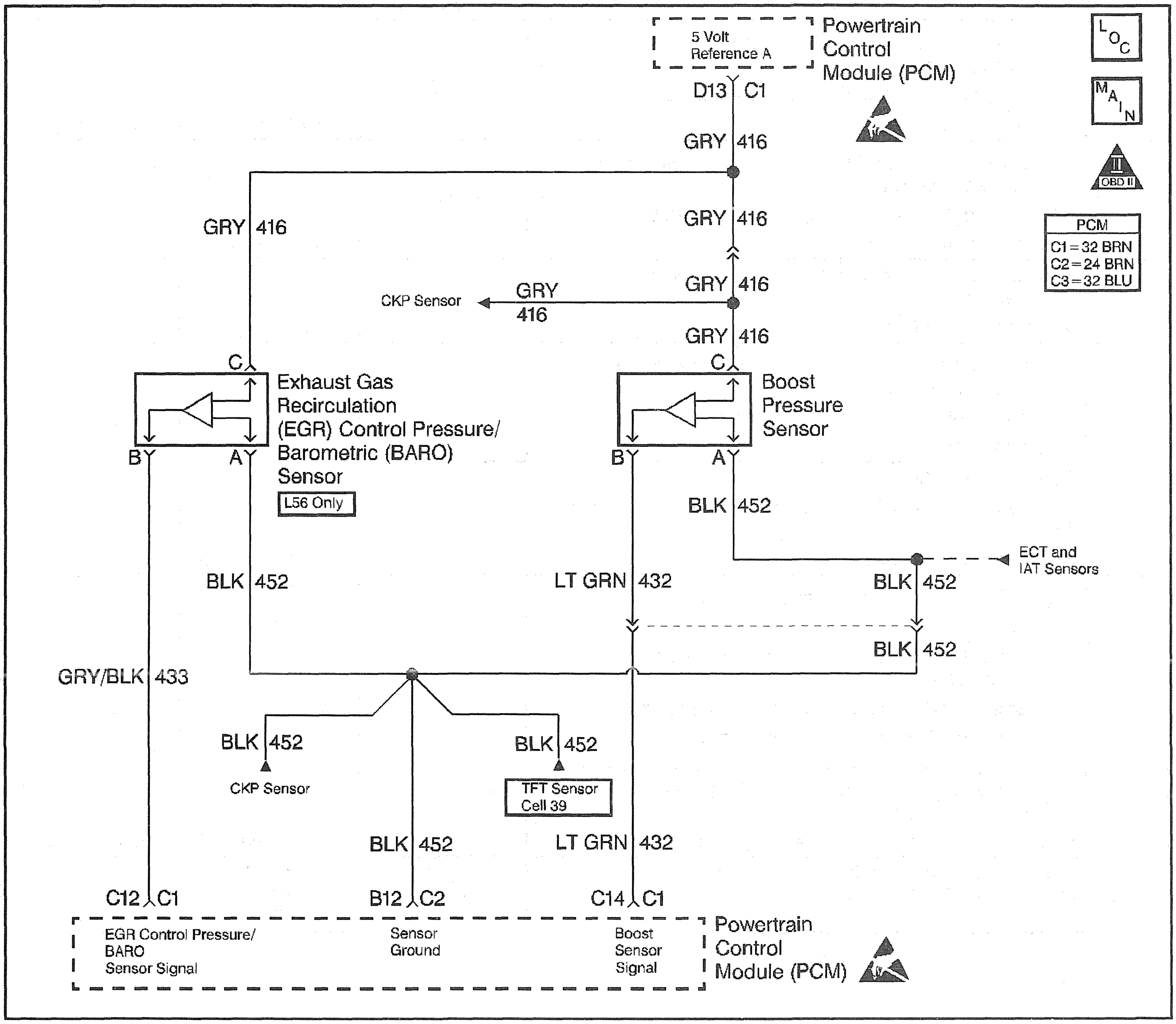
DTC P0237 Turbocharger Boost Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Start the engine and let the engine idle. 3. Observe the Boost pressure display on the Scan tool Does the scan tool display a Boost Pressure less than or equal to the specified value?	40 kPa	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the Boost sensor electrical connector. 3. Jumper the Boost sensor 5 volt reference to the Boost sensor signal circuit at the harness. 4. Turn the ignition ON. Does the scan tool display a Boost Pressure greater than or equal to the specified value?	202 kPa	*Go to Step 6*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. The Boost sensor still disconnected. 3. Remove the jumper wire. 4. Probe the Boost sensor signal circuit at the harness with a test light connected to B+. 5. Turn the ignition ON. Does the scan tool display a Boost Pressure greater than or equal to the specified value?	202 kPa	*Go to Step 8*	*Go to Step 7*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored, refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Check for a proper connection at the Boost sensor. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 13*	*Go to Step 10*
7	1. Check for the following in Boost sensor signal circuit. • For an open. • For a short to ground. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 13*	*Go to Step 11*

DTC P0237 Turbocharger Boost Sensor Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Check for an open in the Boost sensor 5 volt reference circuit. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 13*	*Go to Step 9*
9	1. Check for a short to ground in the Boost sensor 5 volt reference circuit. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 13*	*Go to Step 12*
10	Replace the Boost sensor. Refer to *Boost Sensor Replacement*. Is the action complete?	—	*Go to Step 13*	—
11	1. Check the terminal connectors at the PCM for a proper connections. 2. If a problem is found, repair as necessary. Was a problem found?	—	*Go to Step 13*	*Go to Step 12*
12	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 13*	—
13	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0238 Turbocharger Boost Sensor Circuit High Voltage



Circuit Description

The PCM operates a solenoid to control boost. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the wastegate valve. During normal operation, the PCM compares its wastegate duty cycle signal with the boost signal and makes corrections in the duty cycle accordingly.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- Engine speed less than 3506 RPM.

Conditions for Setting the DTC

- The boost pressure is more than or equal (202 kPa).
- All diagnostic set conditions were met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will limit boost pressure.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Very little boost can be attained by revving the engine in neutral.

An intermittent may be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step will determine if the PCM is responding to a low signal voltage. This will indicate that the PCM is OK.
9. If the scan display is still less than or equal to 9 kPa by disconnecting the PCM the short to voltage is in the wiring.
10. If the voltmeter value stays the same by disconnecting the PCM the short to battery voltage is in the wiring.

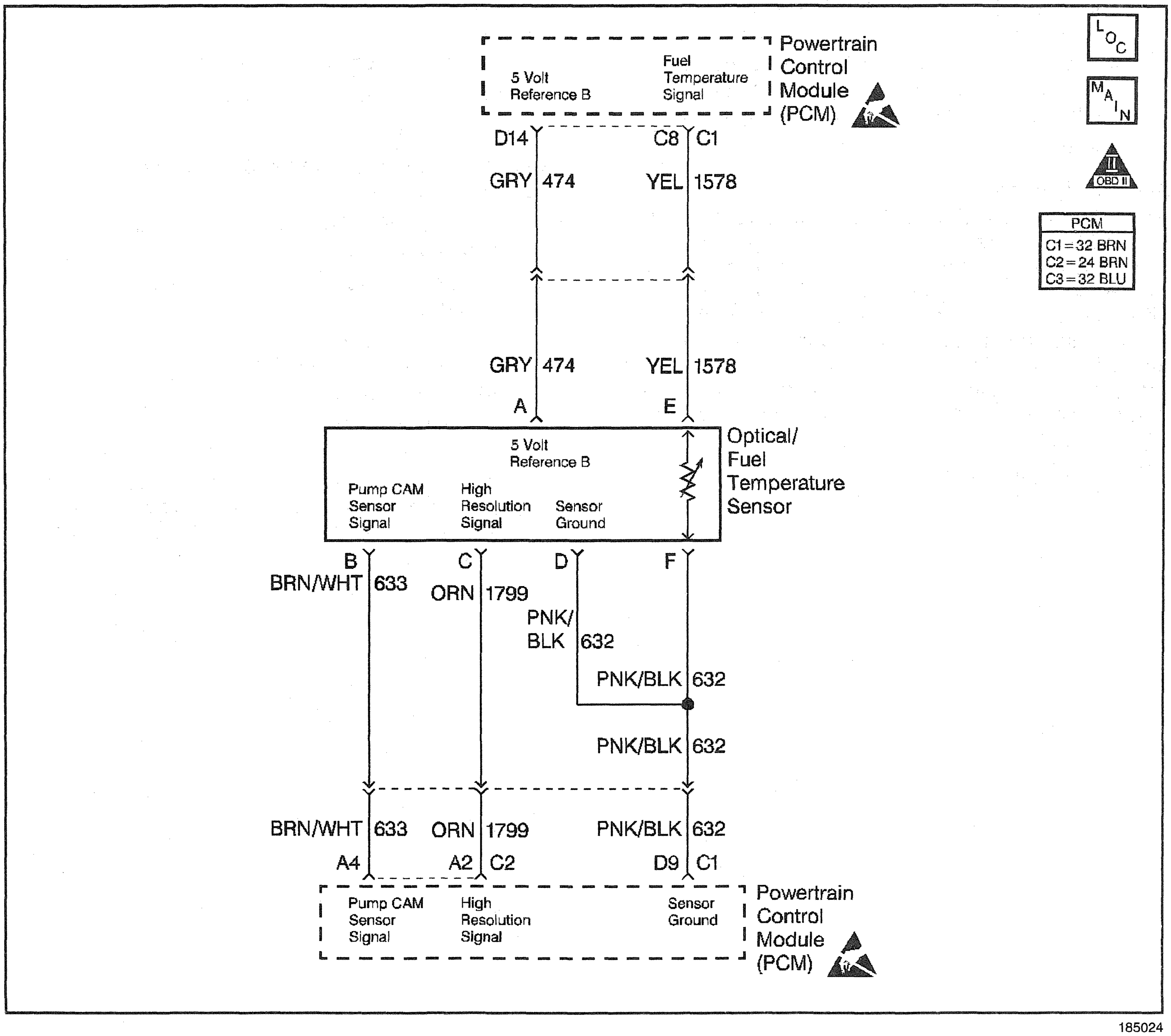
DTC P0238 Turbocharger Boost Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Start the engine and let the engine idle. Does the scan tool display a Boost Pressure greater than or equal to the specified value?	202 kPa	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the Boost sensor electrical connector. 3. Using a fused jumper, jumper the boost sensor signal to the sensor ground. 4. Turn the ignition ON. Does the Scan tool display a Boost Pressure less than or equal to the specified value?	10 kPa	*Go to Step 6*	*Go to Step 4*
4	1. Verify the boost sensor is disconnected. 2. Turn the ignition ON. 3. Set the *J 39200* digital multimeter to the mA scale. 4. Measure the current across the boost sensor signal and the sensor ground circuit at the harness connector. Is the current less than the specified value?	10 mA	*Go to Step 6*	*Go to Step 11*
5	1. The DTC is intermittent. 2. If no additional DTCs are stored, refer to Diagnostic Aids. 3. If additional DTCs are stored, refer to those tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Turn the ignition ON leaving the engine OFF. 2. Connect the *J 39200* digital multimeter to a ground. Probe the 5 volt reference circuit at the boost sensor harness. Is the voltage greater than the specified value?	5.2 V	*Go to Step 12*	*Go to Step 7*

DTC P0238 Turbocharger Boost Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
7	1. Verify that the boost sensor is disconnected. 2. Using a *J 39200* digital multimeter, measure the voltage across the boost sensor 5 volt reference circuit to the sensor ground at the harness connector. Is the voltage within the within the specified range?	4.8–5.2 V	*Go to Step 8*	*Go to Step 13*
8	1. Check for an open or a proper sensor signal terminal connection at the PCM. 2. If a problem is found, repair as necessary. Is the action complete?	—	*Go to Step 15*	*Go to Step 9*
9	1. Check the boost sensor for a restriction. 2. If a problem is found, repair as necessary. Is the action complete?	—	*Go to Step 15*	*Go to Step 9*
10	1. Replace the boost sensor. 2. Refer to *Boost Sensor Replacement* Is the action complete?	—	*Go to Step 15*	—
11	1. Check for a short to voltage in the boost sensor signal circuit. 2. If a problem is found, repair as necessary. Is the action complete?	—	*Go to Step 15*	*Go to Step 14*
12	1. Check for a short to battery voltage in the boost sensor 5 volt reference circuit. 2. If a problem is found, repair as necessary. Is the action complete?	—	*Go to Step 15*	*Go to Step 14*
13	1. Check for an open or a proper sensor ground terminal connection at the PCM. 2. If a problem is found, repair as necessary. Is the action complete?	—	*Go to Step 15*	*Go to Step 14*
14	**Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming* Is the action complete?	—	*Go to Step 15*	—
15	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select the DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 15*	*Go to Step 2*
16	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0251 Injection Pump Cam Sensor Circuit



Circuit Description

The optical sensor provides a pump cam signal to the PCM by counting pulses on the sensor disk located in the injection pump. The pump cam is one of the most important inputs by the PCM for fuel control and timing. This test monitors the number of crankshaft position pulses that have occurred since the last cam pulse. The physical one to one correspondence between the pump cam and the crankshaft implies if more crank pulses are detected than cam pulses, cam pulses have been missed.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The engine is operating.

Conditions for Setting the DTC

- The number of consecutive missing cam pulses is more than or equal to 8.
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the first consecutive drive trip that the diagnostic runs and fails.
- The Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.
- The PCM will activate Back Up fuel.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Intermittent DTCs (P0251, P0370 and P1216) may be caused by air entering the fuel system when fuel levels get below 1/8 of a tank while performing hard acceleration or turning maneuvers. It's also possible that a P0251, P0370 and P1216 will set the if vehicle has run out of fuel. Customer driving habits should be checked to determine if the vehicle has been performing in these manners. If the vehicle has been performing in these conditions, bleed the fuel system of all air and test drive the vehicle.

When the PCM is in backup fuel, fast idle and poor performance problems will exist.

An intermittent condition can be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step will determine if this is a hard or intermittent DTC.
5. This step will determine if there is a 5 volt reference.
7. This step will check to see if the sensor is sending a signal back to the PCM.
11. The PCM supplies 5 volts on the signal circuit. This step determines if that voltage is present, not present, or too much voltage is present.
16. This step determines if the signal circuit is shorted to 5V. A normal CAM signal circuit will have 3–5mA. Any reading over 50mA indicates a short to 5V.

DTC P0251 Injection Pump Cam Sensor Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is the DTC P0370 set also?	—	Go to *DTC P0370 Timing Reference High Resolution System Performance*	*Go to Step 3*
3	1. Start and idle the engine. 2. With the throttle closed, observe the CAM Ref Missed display on the scan tool. Does scan tool display the specified value?	8	*Go to Step 5*	*Go to Step 4*
4	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
5	1. Turn the ignition OFF. 2. Disconnect the Optical/Fuel temperature sensor electrical connector. 3. Turn the ignition ON leaving the engine OFF. 4. Using a *J 39200*, measure the voltage between the Optical sensor 5 volt reference circuit at the harness connector and chassis ground. Is the voltage within the specified value?	4.8-5.2V	*Go to Step 6*	*Go to Step 8*
6	Probe the sensor ground circuit with a test light connected to B+ at the harness connector. Is the test light ON?	—	*Go to Step 7*	*Go to Step 9*
7	1. Reconnect the Optical/Fuel temperature sensor electrical connector. 2. Start and idle the engine. 3. With a scan tool, command 900 RPM. 4. With *J 39200* on Hertz (Hz) scale, back probe the Pump CAM signal circuit at the PCM. Is the Hertz reading at the specified value?	60 Hz (± 3 Hz)	*Go to Step 15*	*Go to Step 11*
8	1. Turn the ignition OFF. 2. Disconnect the PCM and check the Optical sensor 5 volts reference circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the Optical sensor 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the Optical sensor 5 volt reference circuit open or shorted to ground?	—	*Go to Step 21*	*Go to Step 10*
9	1. Check for an open or a proper sensor ground terminal connection at the PCM. 2. If a problem is found, repair as necessary. Did you perform a repair?	—	*Go to Step 21*	*Go to Step 20*
10	Check the Optical/Fuel temperature 5 volt reference circuit for a proper connection at the PCM and replace terminal if necessary. Did the terminal require replacement?	—	*Go to Step 21*	*Go to Step 20*

DTC P0251 Injection Pump Cam Sensor Circuit (cont'd)

Step	Action	Value(s)	Yes	No
11	1. Turn the ignition ON leaving the engine OFF. 2. Disconnect the Optical/Fuel temperature sensor electrical connector. 3. With a *J 39200* connected to ground, probe the CAM signal circuit. Is the voltage within the specified value?	4.8-5.2V	*Go to Step 16*	*Go to Step 12*
12	Is the voltage greater than the specified value?	4.8-5.2V	*Go to Step 13*	*Go to Step 14*
13	Repair the short to battery/ignition voltage on the CAM signal circuit. Is the action complete?	—	*Go to Step 21*	—
14	1. Turn the ignition OFF. 2. Check the Cam signal circuit for an open or short to ground. 3. If the CAM signal circuit is open or shorted to ground, repair the circuit as necessary. Was the CAM signal circuit open or shorted to ground?	—	*Go to Step 21*	*Go to Step 15*
15	Check for a proper connection at the PCM harness terminal and replace the terminal if necessary. Did the terminal require replacement?	—	*Go to Step 21*	*Go to Step 20*
16	With a DMM *J 39200* set to the mA scale, measure the current between the CAM signal circuit and the ground circuit at the Optical/Fuel temperature sensor electrical connector. Is the current less than the specified value?	50mA	*Go to Step 18*	*Go to Step 17*
17	Repair the short to reference voltage on the CAM signal circuit. Is the action complete?	—	*Go to Step 21*	—
18	1. Check for a proper connection at the injection pump. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 21*	*Go to Step 19*
19	Replace the injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 21*	—
20	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 21*	—
21	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 22*	*Go to Step 2*
22	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0263 Cylinder 1 Balance System

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0263 Cylinder 1 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0266 Cylinder 2 Balance System

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0266 Cylinder 2 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0269 Cylinder 3 Balance System

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0269 Cylinder 3 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0272 Cylinder 4 Balance System

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC will clear after forty consecutive warm–up cycles that the diagnostic does not fail (coolant temperature has risen 5°C (40°F) from start up coolant temperature and engine coolant temperature exceeds 71°C (160°F) that same ignition cycle.
- The use of a scan tool

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0272 Cylinder 4 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0275 Cylinder 5 Balance System

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0275 Cylinder 5 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0278 Cylinder 6 Balance System

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC will clear after forty consecutive warm–up cycles that the diagnostic does not fail (coolant temperature has risen 5°C (40°F) from start up coolant temperature and engine coolant temperature exceeds 71°C (160°F) that same ignition cycle.
- Use of a Scan tool

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0278 Cylinder 6 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0281 Cylinder 7 Balance System

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC will clear after forty consecutive warm–up cycles that the diagnostic does not fail (coolant temperature has risen 5°C (40°F) from start up coolant temperature and engine coolant temperature exceeds 71°C (160°F) that same ignition cycle.
- Use of a Scan tool

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0281 Cylinder 7 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0284 Cylinder 8 Balance System

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM has the ability to increase and decrease the amount of fuel to each cylinder to provide smooth idle operation. If the PCM decides that the fuel reduction amount to a specific cylinder exceeds defined limits, this DTC will set. This DTC only monitors fuel reduction.

Conditions for Running the DTC

- Engine at idle more than a total of 90 seconds.
- All engine misfire DTCs ran and passed.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.

Conditions for Setting the DTC

- Amount of fuel reduction for a specific cylinder exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Injector balance test on scan tool should be used to confirm fault cylinder problems. The scan tool will cut out the specific cylinder requested. It is possible that if a cylinder balance fault has been detected and the engine has been running for a long time, the PCM will try to increase or decrease fuel in other cylinders to compensate for a rough idle. This can cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The most likely cause of cylinder balance DTCs are malfunctioning nozzles.

If multiple cylinder balance DTCs are set and no problem is found, check for the following:

- Pinched or restricted fuel feed lines between fuel tank and fuel injection pump
- Restricted fuel filter

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will properly identify a suspected cylinder by looking for a RPM drop (if RPM drops, cylinder is contributing, if not cylinder is not contributing).

DTC P0284 Cylinder 8 Balance System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing the DTCs, use the scan tool Capture Info to save the Freeze Frame and failure records for reference. The control module's data is deleted once the Clear Info function is used. Did you perform the Powertrain On-Board Diagnostic (OBD) System Check?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Scan tool connected. 2. Start and idle engine. 3. Engine at operating temperature. 4. Make sure all DTCs are cleared. 5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder. Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Check for the following basic engine mechanical or fuel delivery problems in that cylinder. • Injection nozzle malfunctioning (refer to *Injection Nozzle(s) Diagnosis*) • Intake manifold restriction. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the scan tool, clear the DTCs. 2. Start the engine. 3. Allow the engine to idle at normal operating temperature. 4. Select DTC and the Specific DTC function. 5. Enter the DTC number which was set. 6. Operate the vehicle, with the Condition for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0300 Engine Misfire Detected

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The scan tool can be used to control the suspected cylinder (Inj. Balance Test).

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression in more than one cylinder.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0300 Engine Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0301 Cylinder 1 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0301 Cylinder 1 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0302 Cylinder 2 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0302 Cylinder 2 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0303 Cylinder 3 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0303 Cylinder 3 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement*. Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0304 Cylinder 4 Misfire Detected

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0304 Cylinder 4 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0305 Cylinder 5 Misfire Detected

Refer to *Fuel Injection Line Routing Figure.*

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0305 Cylinder 5 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0306 Cylinder 6 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0306 Cylinder 6 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement*. Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0307 Cylinder 7 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0307 Cylinder 7 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement.* Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0308 Cylinder 8 Misfire Detected

Refer to *Fuel Injection Line Routing Figure*.

Circuit Description

The PCM times the intervals between each pulse of the crankshaft position sensor and compares each time interval with the other 8 to determine when an excessive change in crankshaft speed has occurred. This pulse is generated from a 4X reluctor wheel located on the front of the crankshaft. If the crankshaft speed is less than an expected amount, the PCM will increase the amount of fuel needed to correct the misfire. If the amount of fuel exceeds the calibrated value, the PCM will interpret this as a misfire and set the DTC. The misfire diagnostic is used only to identify a week cylinder needing additional fuel. This diagnostic will only run once per ignition cycle.

Conditions for Running the DTC

- Engine coolant temperature more than 56°C (132°F).
- Engine idling for a total of 90 seconds.

Conditions for Setting the DTC

- Fuel adjustment is more than the calibrated value (internal to PCM).
- Multiple engine misfires detected.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn off the MIL after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause for this DTC is the following:

- a mechanical failure causing low cylinder compression.
- a fuel leak at the high pressure fuel injection lines or injection nozzles.
- a fuel injection nozzle stuck closed.

If an injection nozzle is suspected, it can be transferred to another cylinder to determine if the DTC follows the nozzle.

After the repair has been performed, it may take approximately 30 seconds for the vehicle to return to a stable idle.

Test Description

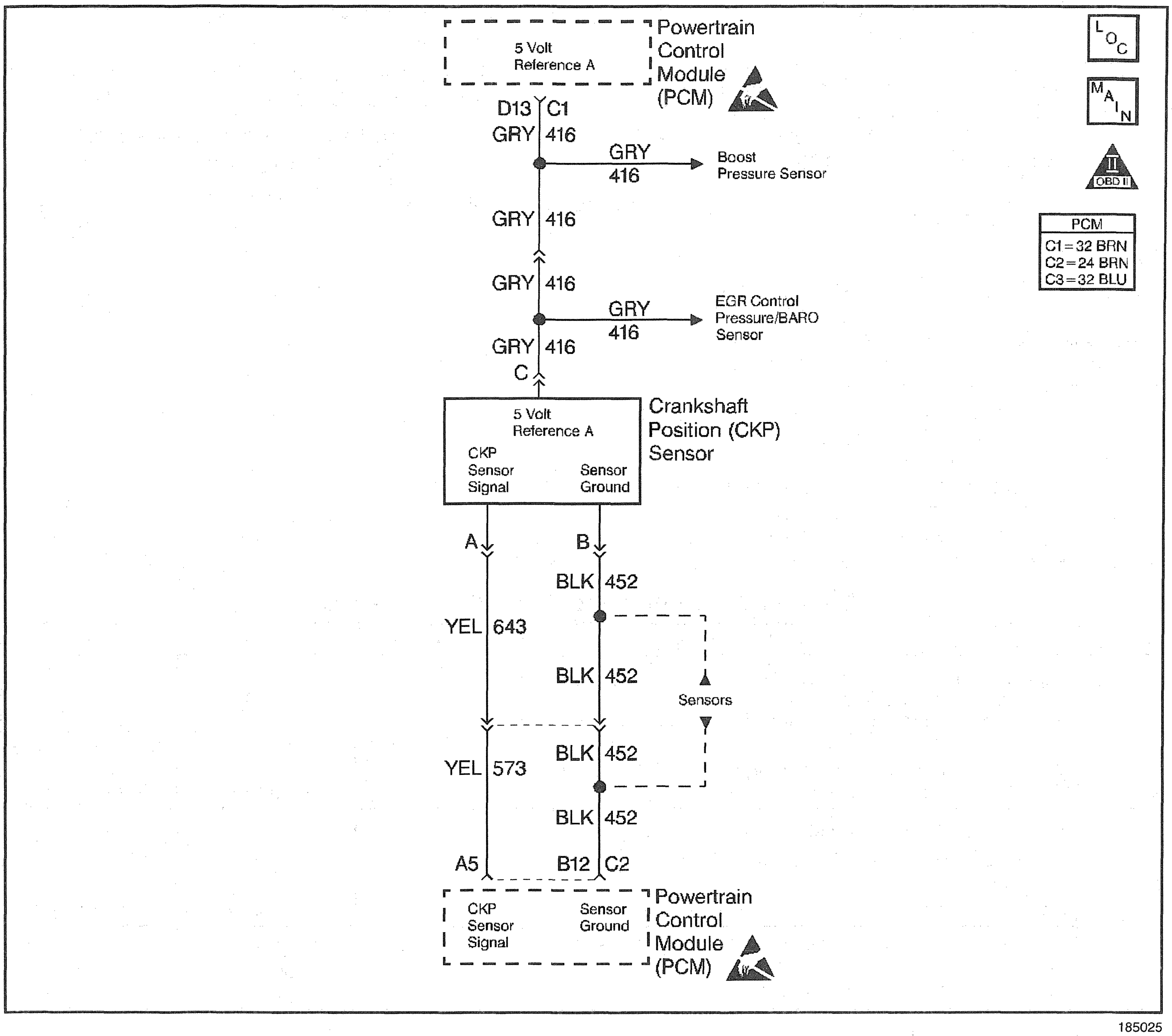
The number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will help identify a suspected cylinder.
4. This step will identify an area with the most likely cause of failure.

DTC P0308 Cylinder 8 Misfire Detected

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect the scan tool. 2. Start the engine and allow the engine to idle at normal operating temperature. 3. Use the scan tool in order to cut out the suspected cylinder (Inj. Balance). Is there an RPM drop in the suspected cylinder?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to diagnostic aids. If any additional DTCs were stored, refer to the applicable DTC tables first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	Check for basic engine mechanical or fuel delivery problems in that cylinder. • Low compression or valve train problems. • Injection nozzle stuck closed or restricted high pressure fuel injection lines. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the fuel injection pump. Refer to *Fuel Injection Pump Replacement*. Is action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0335 Crankshaft Position (CKP) Sensor Circuit



Circuit Description

The crankshaft position sensor is a hall–effect type sensor that monitors crankshaft position and speed. There are four teeth 90 degrees apart on the front of the crankshaft sprocket that induce a pulse in the sensor which is transmitted to the PCM. There is a physical one to one correspondence between the pump cam and crankshaft.

Conditions for Setting the DTC

- The PCM performs this DTC diagnostic continuously.
- The number of consecutive missing crank pulses are greater than or equal to 8.
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the first consecutive drive trip that the diagnostic runs and fails.
- The Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.
- The PCM will activate Back Up fuel.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC will clear after forty consecutive warm up cycles that the diagnostic does not fail (coolant temperature has risen 5°C (40°F) from start up coolant temperature and engine coolant temperature exceeds 71°C (160°F) that same ignition cycle.
- The use of a scan tool

Diagnostic Aids

When the PCM is in backup fuel, long crank times, fast idle and poor performance conditions will exist. Check for a good connection at crankshaft position sensor and at the PCM. Many intermittent problems are caused by poor electrical connections or wiring. When attempting to diagnose an intermittent problem, always begin by trying to reproduce the conditions under which the failure occurs. This usually involves raising the engine to a higher temperature or operating it near RPM that the problem occurs. Since heat and vibration are often the cause of an intermittent, this may bring out the failure.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if DTC P0335 is the result of a hard failure or an intermittent condition.
4. This step checks the 5 volt reference circuit (the 5 volt reference may vary slightly).
5. This step checks the ground circuit.

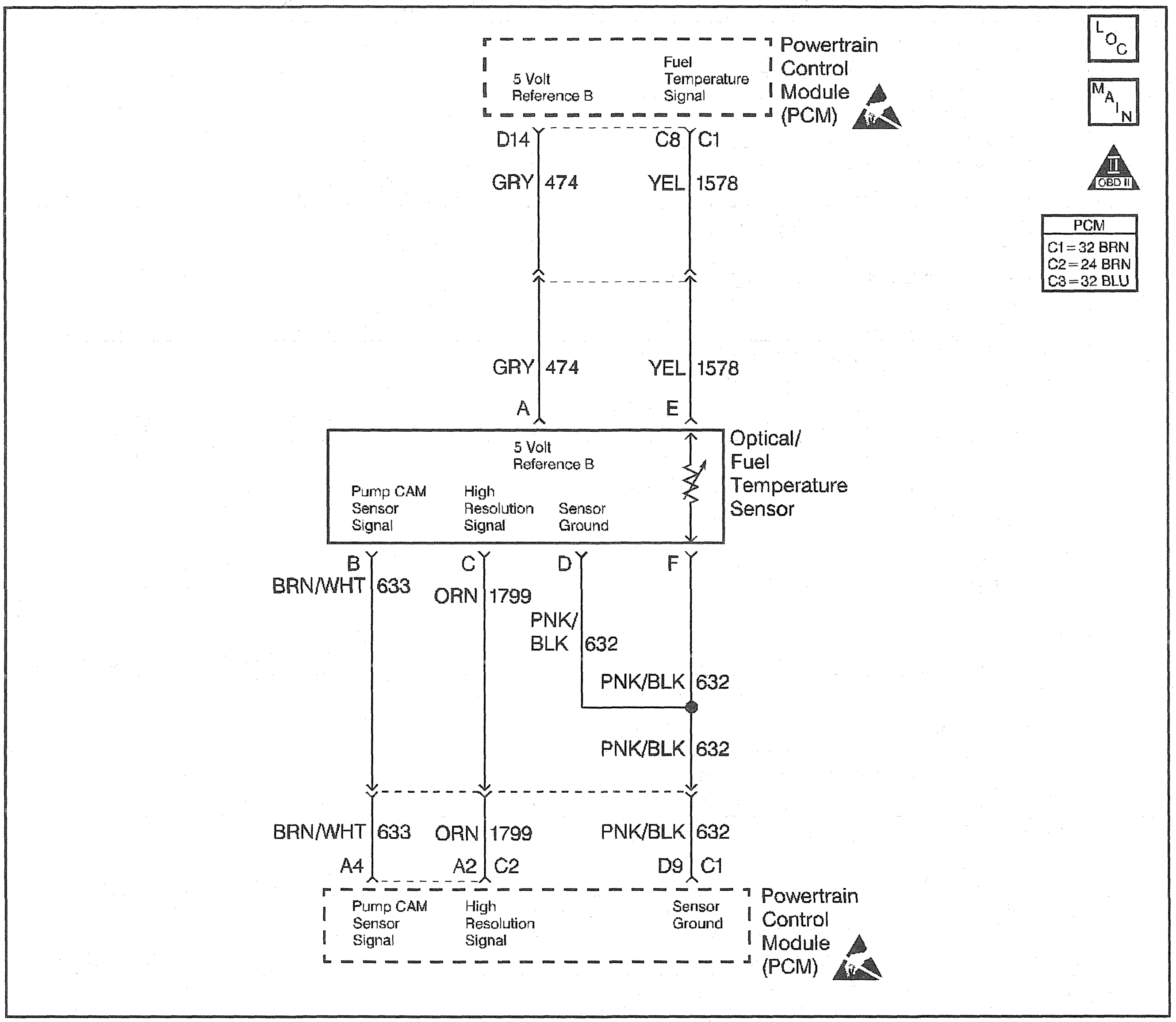
DTC P0335 Crankshaft Position (CKP) Sensor Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Start and idle the engine. 2. Observe the Crank Ref. Missed display on the scan tool. Does the scan tool display the specified value?	8	*Go to Step 4*	*Go to Step 3*
3	The DTC is intermittent. If no additional DTCs are stored, refer to the Applicable DTC Table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the CKP sensor electrical connector. 3. Turn the ignition ON leaving the engine OFF. 4. With a DMM *J 39200*, measure the voltage between the CKP 5 volt reference circuit and chassis ground. Is the voltage within the specified range?	4.8-5.2V	*Go to Step 5*	*Go to Step 8*
5	Probe the sensor ground circuit with a test light connected to B+. Is the test light ON?	—	*Go to Step 6*	*Go to Step 9*
6	1. Reconnect the CKP sensor. 2. Back probe the CKP signal circuit at the PCM with a DMM *J 39200* connected to ground. 3. Crank the engine. Is the voltage within the specified value?	4.2-4.5V	*Go to Step 14*	*Go to Step 7*
7	Is the voltage greater than the specified value?	4.2-4.5V	*Go to Step 12*	*Go to Step 11*

DTC P0335 Crankshaft Position (CKP) Sensor Circuit (cont'd)

Step	Action	Value(s)	Yes	No
8	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the CKP 5 volt reference circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the CKP 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was a repair performed?	—	*Go to Step 17*	*Go to Step 10*
9	1. Check for an open or a proper sensor ground terminal connection at the PCM. 2. If a problem is found, repair the problem as necessary. Was a repair performed?	—	*Go to Step 17*	*Go to Step 16*
10	Check the CKP 5 volt reference circuit for a proper connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	*Go to Step 17*	*Go to Step 16*
11	1. Turn the ignition OFF. 2. Disconnect the PCM and check the CKP signal circuit for an open, short to ground, or short to the sensor ground circuit. 3. Check the terminal connections at the CKP sensor for damage or a poor connection. 4. If a problem is found, repair the problem as necessary. Was a repair performed?	—	*Go to Step 17*	*Go to Step 15*
12	1. Disconnect the CKP sensor pigtail connector. 2. Turn the ignition ON leaving the engine OFF. 3. With the *J 39200* connected to ground, probe the CKP signal circuit at the engine harness connector. Is there voltage present on the CKP sensor signal circuit?	—	*Go to Step 13*	*Go to Step 14*
13	Repair the short to voltage on the CKP sensor signal circuit. Is the action complete?	—	*Go to Step 17*	—
14	Check the CKP signal circuit for a proper connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	*Go to Step 17*	*Go to Step 16*
15	Replace the Crankshaft position sensor. Refer to *Crankshaft Position Sensor Replacement.* After replacing the sensor, the PCM must be programmed with a new TDC Offset. Refer to *TDC Offset Adjustment.* Is the action complete?	—	*Go to Step 17*	—
16	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 17*	—
17	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 18*	*Go to Step 2*
18	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0370 Timing Reference High Resolution System Performance



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Circuit Description

The optical sensor provides a high resolution signal to the PCM by counting pulses on the sensor disk located in the injection pump. The high resolution is one of the most important inputs by the PCM for fuel control and timing. This test monitors the number of high resolution pulses which have been missed (not detected). It's based on a comparison between the number of pulses that were detected since the last pump cam pulse and the number of the pulses that should have occurred. There are approximately 64 high resolution pulses for every cam pulse.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

A number of high resolution pulses missing (internal to PCM (64 to 1 ratio) per every 8 cam reference pulses.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the first consecutive drive trip that the diagnostic runs and fails.
- The Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.
- The PCM will activate back up fuel.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Intermittent DTCs (P0251, P0370 and P1216) may be caused by air entering the fuel system when fuel levels get below 1/8 of a tank while performing hard acceleration or turning maneuvers. It's also possible that a P0251, P0370 and P1216 will set if the vehicle has run out of fuel. Customer driving habits should be checked to determine if the vehicle has been performing in these manners. If the vehicle has been performing in these conditions, bleed the fuel system of all air and test drive the vehicle.

When PCM is in backup fuel, fast idle and poor performance problems will exist. If P0251 is also stored, the snap shot mode on the scan tool should be used to properly identify the fault. DTCs P0335, P1216, and P1217 may set along with this DTC.

The least likely cause of failure is the PCM.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if the 5 volt reference is present.
3. This step checks the ground circuit.
4. This step determines if the problem is currently active by the scan tool displaying Last Test Failed. Do not proceed any further with this table if the scan tool does not display the term Last Test Failed. Duplicating the conditions in Freeze Frame and Failure Records can help create an active fault.
5. This step determines if a High Res signal is being sent to the PCM. Refer to the RPM vs Hertz table to compare the Hertz readings at different RPMs. Using Freeze Frame and Failure Records will help identify the RPM the problem occurs.
9. The PCM supplies 5 volts on the signal circuit. This step determines if that voltage is present, not present, or too much voltage is present.
13. This step determines if the signal circuit is shorted to 5V. A normal high res signal circuit will have 3–5mA. Any reading over 50mA indicates a short to 5V.

DTC P0370 Timing Reference High Resolution System Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On–Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition OFF. 2. Disconnect the Optical/Fuel temperature sensor electrical connector. 3. Turn the ignition ON leaving the engine OFF. 4. Using a DMM *J 39200*, measure the voltage between the Optical sensor 5 volt reference circuit at the harness connector and chassis ground. Is the voltage at specified value?	4.8-5.2V	*Go to Step 3*	*Go to Step 6*
3	1. Verify the Optical/Fuel temperature sensor electrical connector is still disconnected. 2. Probe the sensor ground circuit with a test light connected to B+ at the harness connector. Is the test light ON?	—	*Go to Step 4*	*Go to Step 7*
4	1. Reconnect the Optical/Fuel Temperature sensor electrical connector. 2. Start and operate the engine as close to the conditions saved in the Freeze Frame/Failure Records. 3. Using the Scan Tool, select DTC, specific and then enter the DTC number. Does the scan tool display the term Last Test Failed?	—	*Go to Step 5*	Go to Diagnostic Aids

DTC P0370 Timing Reference High Resolution System Performance (cont'd)

Step	Action	Value(s)	Yes	No
5	**Important:** The scan tool must display Last Test Failed (under DTC, Specific). This ensures the fault is active while performing this test. 1. Maintain the engine speed at the point of failure (per conditions saved in the Freeze Frame/Failure Records). 2. With the DMM *J 39200* on the Hertz (Hz) scale, backprobe the high resolution signal circuit at the PCM. Referring to the *RPM vs Hertz (Hz)* table, does the Hertz reading in the table correspond (±100 Hz) with the Hertz reading on the DMM at the designated RPM?	—	*Go to Step 16*	*Go to Step 9*
6	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the Optical sensor 5 volt reference circuit for an open, short to ground, or short to the sensor ground circuit. 3. If the Optical sensor 5 volt reference circuit is open or shorted to ground, repair the circuit as necessary. Was the Optical sensor 5 volt reference circuit open or shorted to ground?	—	*Go to Step 19*	*Go to Step 8*
7	1. Check for an open or a proper sensor ground terminal connection at the PCM. 2. If a problem is found, repair as necessary. Was a repair performed?	—	*Go to Step 19*	*Go to Step 18*
8	Check the Optical sensor 5 volt reference circuit for a proper connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	*Go to Step 19*	*Go to Step 18*
9	1. Disconnect the Optical/Fuel temperature sensor electrical connector. 2. Turn the ignition ON leaving the engine OFF. 3. With a DMM *J 39200* connected to ground, probe the high resolution signal circuit at the harness connector. Is the voltage within the specified value?	4.8-5.2V	*Go to Step 13*	*Go to Step 10*
10	Is the voltage greater than the specified value?	4.8-5.2V	*Go to Step 11*	*Go to Step 12*
11	Repair the short to battery/ignition voltage on the high resolution signal circuit. Is the action complete?	—	*Go to Step 17*	—
12	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the high resolution signal circuit for an open, short to ground, or short to the sensor ground circuit. 3. If a problem is found, repair the problem as necessary. Was a repair made?	—	*Go to Step 19*	*Go to Step 16*
13	With a DMM *J 39200* set to the mA scale, measure the current between the High Res signal circuit and the ground circuit at the Optical/Fuel temperature sensor electrical connector. Is the current less than the specified value?	25 mA	*Go to Step 15*	*Go to Step 14*
14	Repair the short to reference voltage on the high resolution signal circuit. Is the action complete?	—	*Go to Step 19*	—

DTC P0370 Timing Reference High Resolution System Performance (cont'd)

Step	Action	Value(s)	Yes	No
15	1. Check the high resolution signal circuit for a proper connection at the injection pump. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 19*	*Go to Step 17*
16	1. Turn the ignition OFF. 2. Disconnect the PCM, and check the high resolution signal circuit for a proper connection at the PCM. 3. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 19*	*Go to Step 18*
17	Replace the injection pump. Refer to *Fuel Injection Pump Replacement* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 19*	—
18	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 19*	—
19	1. Using the Scan Tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 20*	*Go to Step 2*
20	Does the Scan Tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0380 Glow Plug Feedback Circuit

Refer to *PCM, Glow Plugs, Underhood Fuse-Relay Center*

Circuit Description

The glow plug system is used to assist in providing the heat required to begin combustion during cold engine temperatures. The glow plugs are heated before and during cranking, as well as initial engine operation. The PCM controls the glow plug ON times by monitoring coolant temperatures and glow plug voltage.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The PCM has commanded glow plugs ON and the glow plug signal voltage is less than 4.0 volts.

  or
- The PCM has commanded glow plugs OFF and the glow plug signal voltage is greater than 4.0 volts.

  or
- When the PCM has commanded glow plugs ON and there is more than a 2 volt difference between glow plug voltage and ignition voltage.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

If glow plug relay is stuck in the ON position, check for proper operation of glow plugs, refer to *Glow Plug System Check*. When glow plugs are commanded ON by the Scan tool, an internal PCM timer protects the glow plugs from damage by cycling them ON for 3 seconds and the OFF for 12 seconds.

The glow plug output feed wire nut and battery feed wire nut at the relay should be checked for proper torque (5 N·m 44 lb in) and for corrosion.

An intermittent may be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

The number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This step will determine if P0380 is a hard failure.
3. This step will determine if the PCM is requesting the glow plug system ON.
10. This step will determine if the glow plug relay has been activated and the output voltage has been seen by the PCM.

DTC P0380 Glow Plug Feedback Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. Use the Scan Tool in order to command the glow plugs ON. 4. Observe the Glow Plug System on the Scan Tool display. Does the Scan Tool display the Glow Plug System as enabled?	—	*Go to Step 3*	*Go to Step 8*

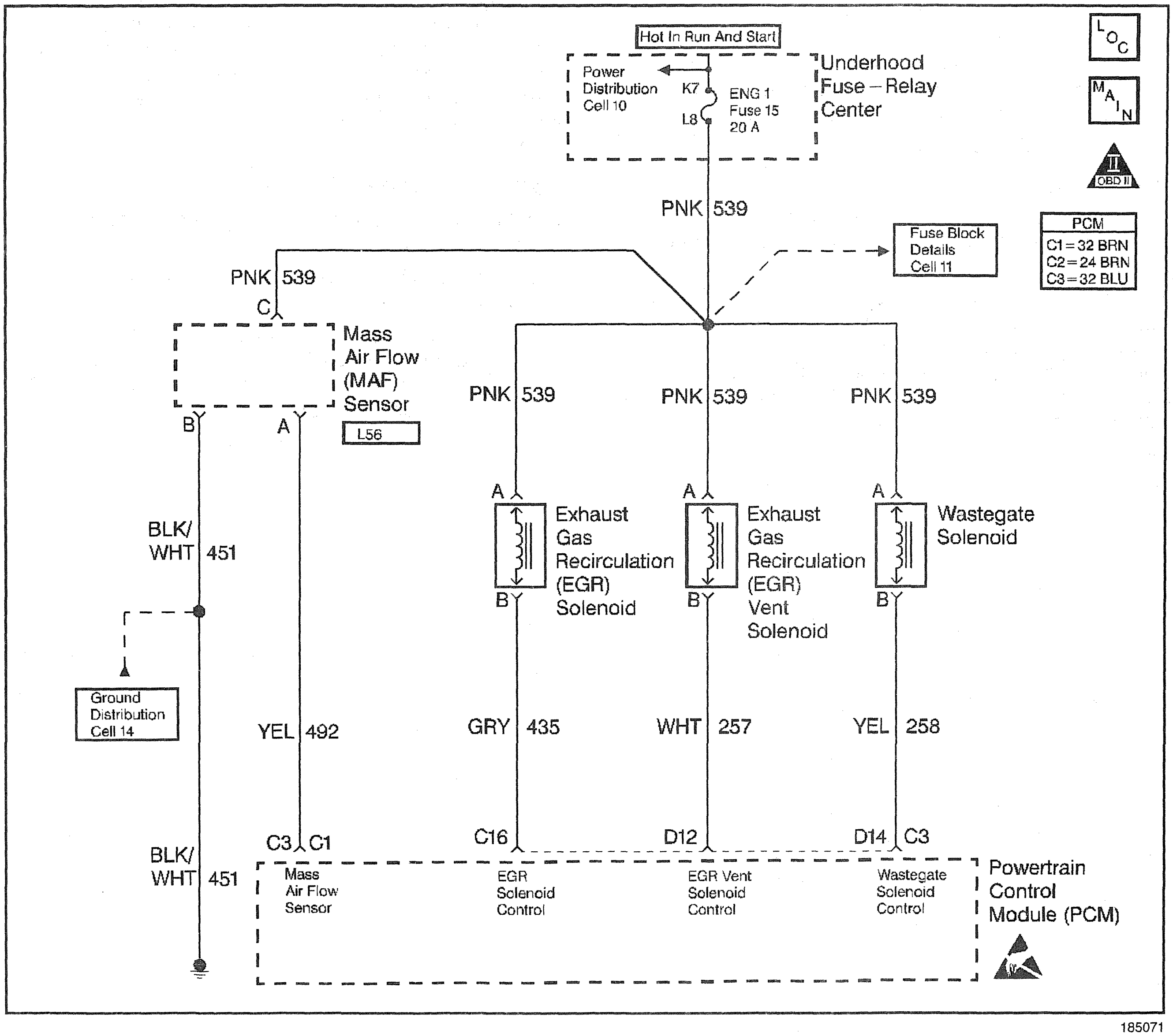
DTC P0380 Glow Plug Feedback Circuit (cont'd)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON with the engine OFF. 2. Use the Scan Tool in order to command the glow plugs ON. 3. Observe the Glow Plugs display on the Scan Tool. Does the Scan Tool display the Glow Plugs at the specified value?	B+	*Go to Step 4*	*Go to Step 6*
4	Does the Scan Tool display Glow Plug voltage present all the time?	—	*Go to Step 17*	*Go to Step 5*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids If any additional DTCs were stored, refer to those table(s). Were there any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Disconnect the glow plug relay connector. 2. Turn the ignition ON with the engine OFF. 3. With the test light connected to ground, probe the glow plug relay harness ignition feed circuit. Is the test light ON?	—	*Go to Step 7*	*Go to Step 11*
7	1. Turn the ignition ON with the engine OFF. 2. Connect the test light between the glow plug harness ignition feed circuit and the harness ground circuit. Is the test light ON?	—	*Go to Step 8*	*Go to Step 12*
8	1. Turn the ignition ON with the engine OFF. 2. Verify that the glow plug harness is still disconnected. 3. With a *J 39200* connected to ground, probe the glow plug relay control circuit at the glow plug harness connector. 4. Use a Scan Tool in order to command the glow plugs ON. Is the voltage at the specified value?	B+	*Go to Step 9*	*Go to Step 13*
9	1. Turn the ignition ON with the engine OFF. 2. With the test light connected to ground, probe the battery positive feed circuit side of the relay. Is the test light ON?	*Go to Step 10*	*Go to Step 20*	—
10	1. Reconnect the glow plug relay. 2. Turn the ignition ON with the engine OFF. 3. With a test light connected to ground, probe the glow plug side of the relay. 4. Use a Scan Tool in order to command the glow plugs ON. Is the test light ON when the Scan Tool commands the glow plugs ON?	—	*Go to Step 15*	*Go to Step 19*
11	Repair an open or a short to ground in glow plug relay ignition feed circuit. Is the action complete?	—	*Go to Step 22*	—
12	Repair any open or poor connections in the glow plug relay ground circuit. Is the action complete?	—	*Go to Step 22*	—
13	1. Check the glow plug relay control circuit for an open or short to ground. 2. If the glow plug relay control circuit is open or shorted to ground, repair as necessary. Was a problem found?	—	*Go to Step 22*	*Go to Step 14*

DTC P0380 Glow Plug Feedback Circuit (cont'd)

Step	Action	Value(s)	Yes	No
14	Check the glow plug relay control circuit for a proper connection at the PCM and replace the terminal if necessary. Was a problem found?	—	*Go to Step 22*	*Go to Step 21*
15	1. Check the glow plug relay signal control circuit for an open or short to ground. 2. If the glow plug relay signal circuit is open or shorted to ground, repair as necessary. Was a problem found?	—	*Go to Step 22*	*Go to Step 16*
16	Check the glow plug relay signal circuit for a proper connection at the PCM and replace the terminal if necessary. Was a problem found?	—	*Go to Step 22*	*Go to Step 21*
17	1. Disconnect the glow plug relay connector. 2. Turn the ignition ON leaving the engine OFF. 3. Probe the glow plug relay control circuit with a test light connected to ground. Is the test light ON all the time?	—	*Go to Step 18*	*Go to Step 19*
18	Repair the short to voltage on the glow plug relay control circuit. Is the action complete?	—	*Go to Step 22*	—
19	Replace the glow plug relay. Refer to *Glow Plug Relay Replacement*. Is the action complete?	—	*Go to Step 22*	—
20	Repair an open or a short to ground in the battery positive feed circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 22*	—
21	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 22*	—
22	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 23*	*Go to Step 2*
23	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0400 Exhaust Gas Recirculation (EGR) System Performance



Refer to *Emission Hose Routing Diagram*

Circuit Description

The PCM operates a PWM solenoid to control the EGR valve. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the EGR valve. During normal operation, the PCM compares its desired MAF signal with the measured MAF signal and makes corrections in the duty cycle accordingly.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- Baro greater than 75 kPa.
- The DTCs P0405, P0406, P0102 and P0103 are not set.
- MAF value is greater than or equal to 0.1484 g/cyl.

Conditions for Setting the DTC

- Lowest achieved EGR pressure at full EGR is less than look up table value (internal to PCM)
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of failure is a restricted vacuum line from the EGR valve to the vacuum tee (including the vacuum tee).

To run the diagnostic test the engine must be at the operating temperature, vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold the engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, the vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

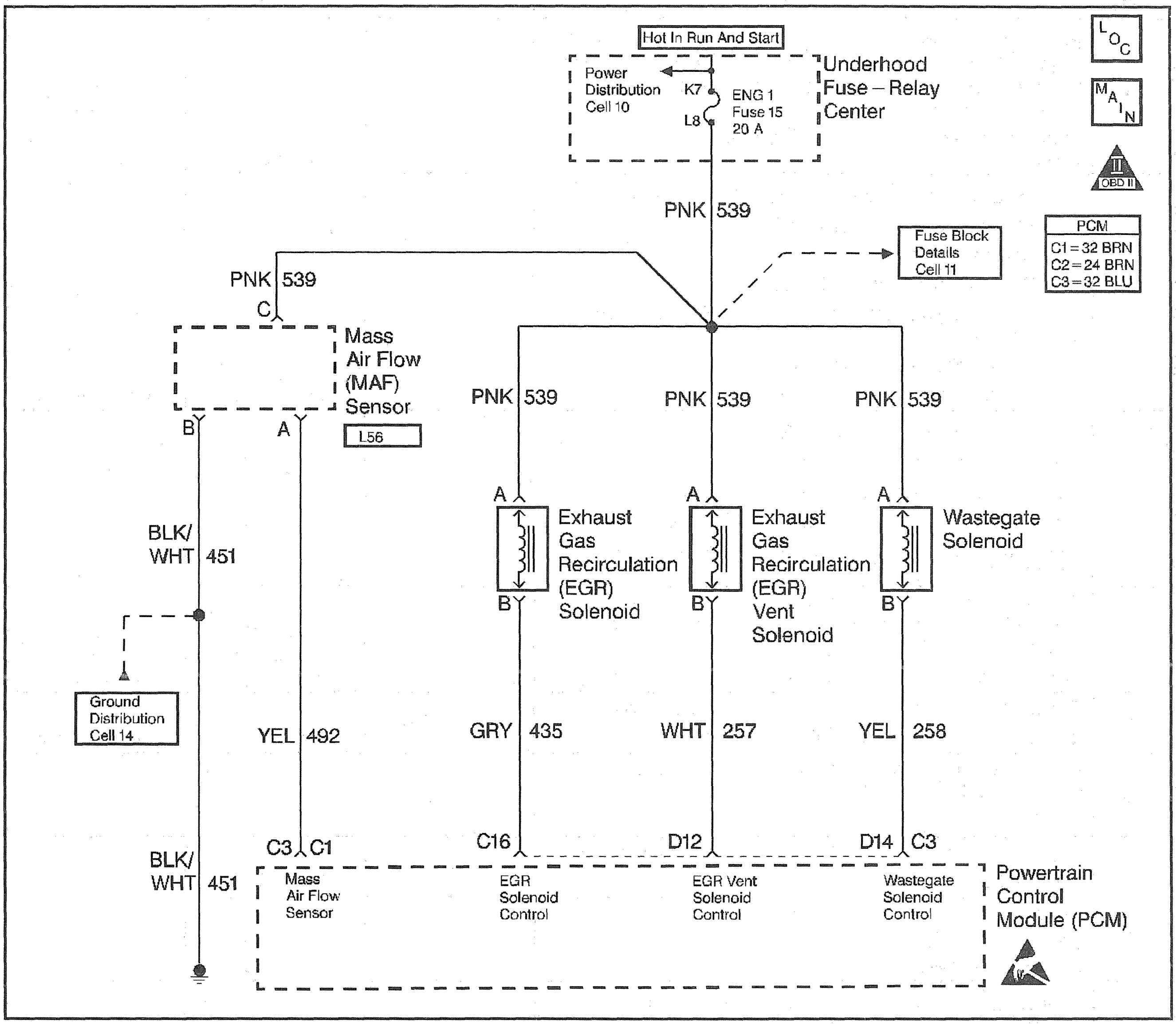
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for the correct amount of vacuum at the EGR valve.
3. At zero vacuum and at 15 in. Hg, there should be a difference greater than 0.10 g/cyl. If the difference is not greater than 0.10 g/cyl the EGR valve is malfunctioning.

DTC P0400 Exhaust Gas Recirculation (EGR) System Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Install a vacuum gage in place of the EGR valve. 2. Start and idle the engine in Park. 3. Set the parking brake. 4. Place the shift lever in Drive. 5. Using the scan tool, command the EGR solenoid to 100% duty cycle. 6. At idle, observe the vacuum. Is the vacuum greater than the specified value?	15 in. Hg	*Go to Step 3*	*Go to Step 5*
3	1. Install a vacuum pump on EGR valve. 2. Start and idle engine in park. 3. Monitor Cylinder Air display on scan tool. 4. Apply 15 in. Hg of vacuum to EGR valve. While applying the vacuum, does Cylinder Air decrease by greater than the specified value?	0.10 g/cyl	*Go to Step 4*	*Go to Step 7*
4	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
5	Check the vacuum source at the solenoid assembly. Is vacuum at the specified value?	15 in. Hg	*Go to Step 6*	*Go to Step 8*
6	Repair restricted or leaky vacuum hose (from solenoid assembly to EGR valve). Is action complete?	—	*Go to Step 9*	—
7	Replace EGR valve. Refer to *EGR Valve Replacement.* Is the action complete?	—	*Go to Step 9*	—
8	Repair the vacuum pump. Refer to Vacuum Pump diagnosis and repair. Is action complete?	—	*Go to Step 9*	—
9	**Important:** After repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are the EGR ALM cells reset?	—	*Go to Step 10*	—
10	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 11*	*Go to Step 2*
11	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0401 Exhaust Gas Recirculation (EGR) Flow Insufficient



185071

Circuit Description

The PCM operates a PWM solenoid to control the EGR valve. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the EGR valve. During normal operation, the PCM compares its desired MAF signal with the measured MAF signal and makes corrections in the duty cycle accordingly.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- Baro greater than 75 kPa.
- The DTCs P0405, P0406, P0102 and P0103 are not set.

Conditions for Setting the DTC

- Two of three EGR tests must fail (internal to PCM).
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of failure is a condition causing low back pressure.

To run the diagnostic test the engine must be at operating temperature with the vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

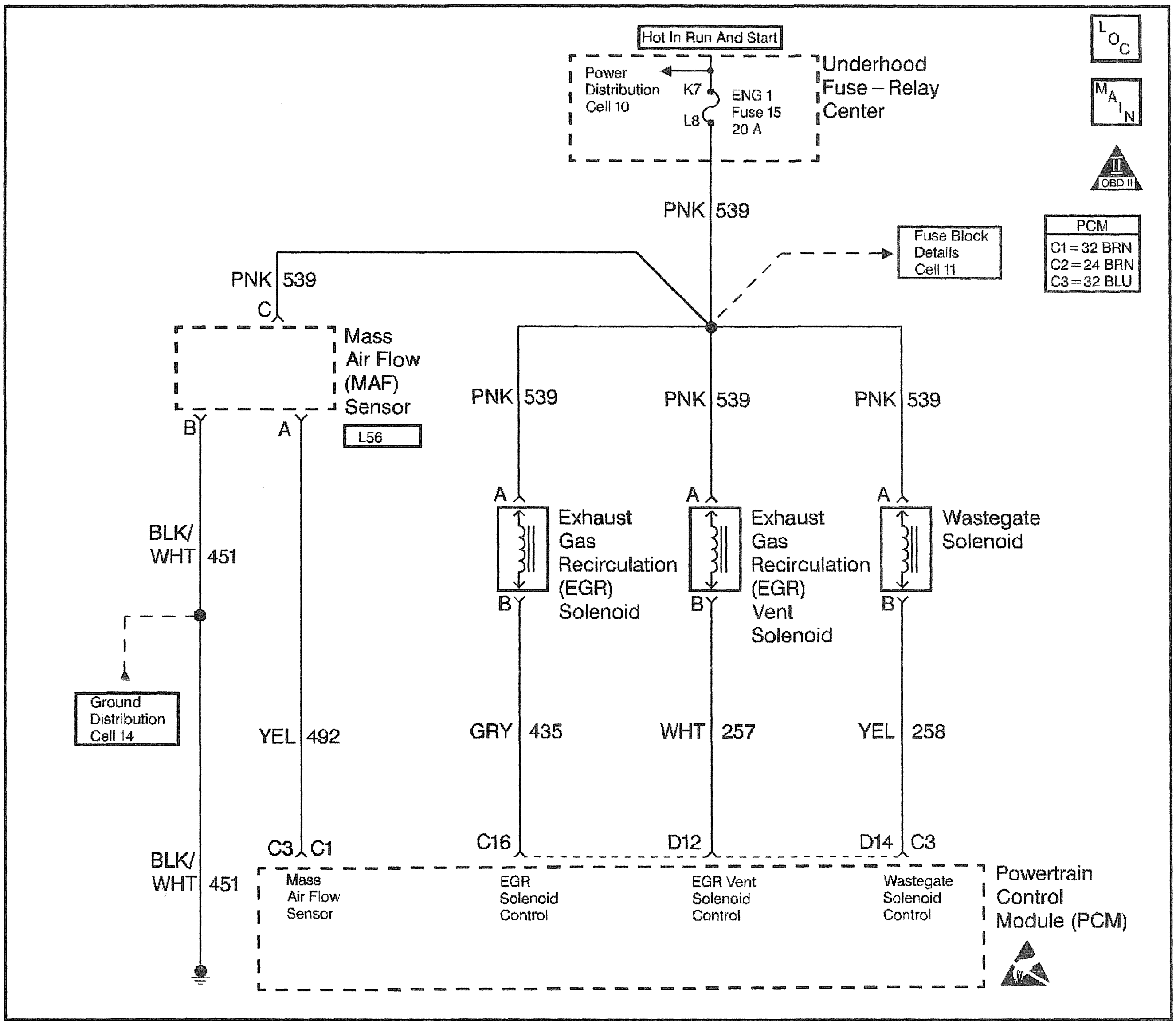
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for a low back pressure problem.

DTC P0401 Exhaust Gas Recirculation (EGR) Flow Insufficient

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any other EGR DTCs set?	—	Go to the Applicable DTC Table	*Go to Step 3*
3	Check for the following conditions: • Plugged EGR ports. • Exhaust system leaks. • Exhaust system modifications. Has a repair been performed?	—	*Go to Step 4*	—
4	**Important:** After repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are EGR ALM cells reset?	—	*Go to Step 5*	—
5	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 6*	*Go to Step 2*
6	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0402 Exhaust Gas Recirculation (EGR) Flow Excessive



185071

Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration, high load situation or no EGR flow, while a small quantity of air indicates deceleration, idle or full EGR situations.

The PCM will monitor MAF and EGR pressures at different ranges to determine correct EGR flow rates.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- Baro greater than 75 kPa.
- The DTCs P0405, P0406, P0102 and P0103 are not set.

Conditions for Setting the DTC

- Five ALM Cells that are less than 0.5.
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of failure is a mechanical problem in the EGR valve not allowing it to close.

To run the diagnostic test the engine must be at operating temperature, with the vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

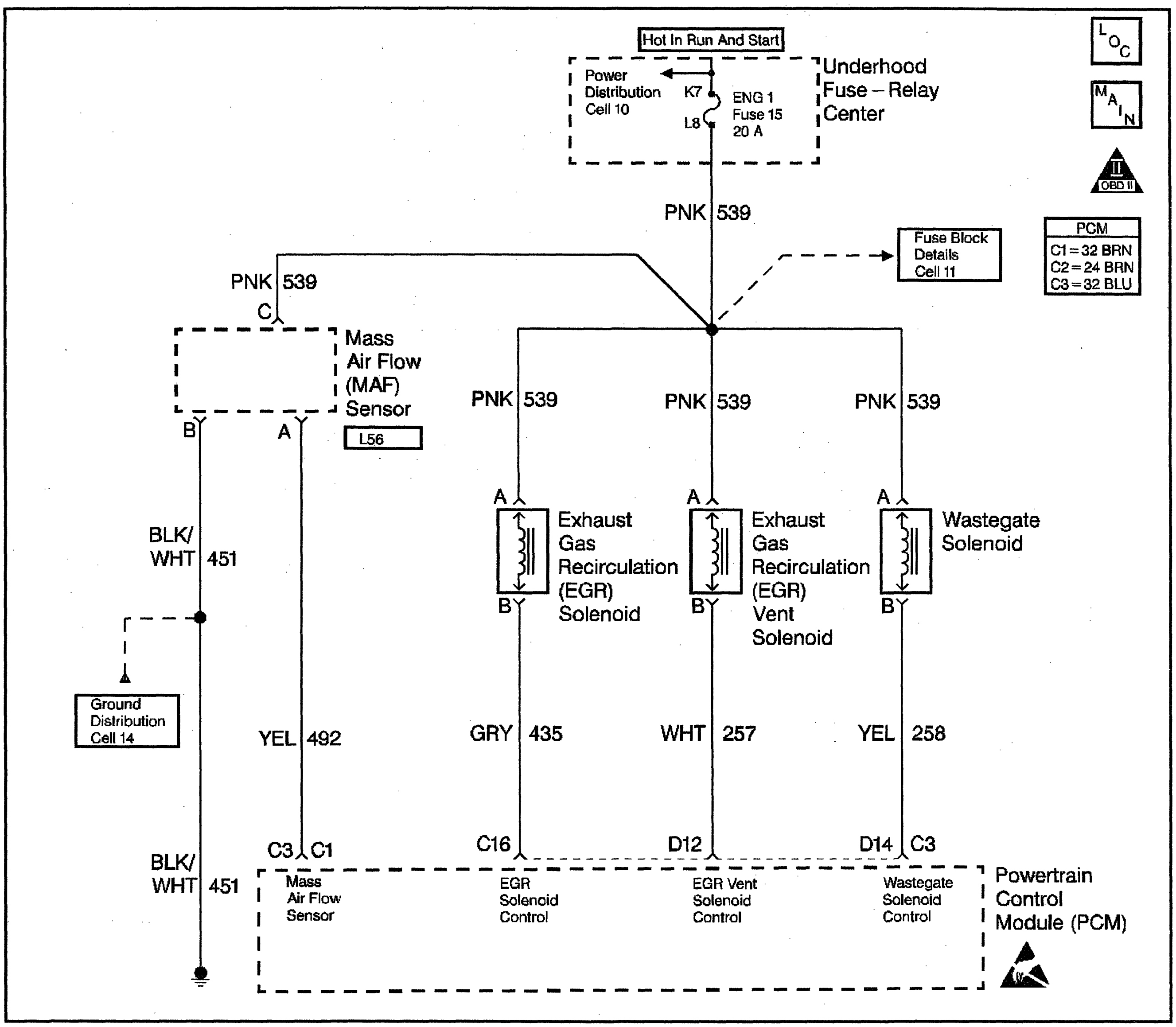
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. If the EGR valve is at fault, excessive black smoke will be present.

DTC P0402 Exhaust Gas Recirculation (EGR) Flow Excessive

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any other EGR DTCs set?	—	Go to the Applicable DTC Table	*Go to Step 3*
3	1. Repair one of the following conditions: • Malfunctioning EGR valve (valve not remaining closed). • Restriction in exhaust system (high back pressure). 2. Repair the problem as necessary. Is the action complete?	—	*Go to Step 4*	—
4	**Important:** After repairs, the EGR ALM cells must be reset (under special function in scan tool). Are the EGR ALM cells reset?	—	*Go to Step 5*	—
5	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate vehicle until scan tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 6*	*Go to Step 2*
6	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0404 Exhaust Gas Recirculation (EGR) Open Position Performance



185071

Circuit Description

The PCM operates a solenoid to control the EGR valve. This solenoid is normally open. By providing a ground path the PCM energizes the solenoid which then allows vacuum to pass to the EGR valve. During normal operation, the PCM compares its desired EGR signal with the EGR pressure signal and makes corrections in the duty cycle accordingly. If there is a difference in the PCM command and what is at the EGR valve sensed by the EGR control pressure/BARO sensor, the PCM makes minor adjustments to correct.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The DTCs P0405, P0406, P0102 and P0103 are not set.
- The EGR vent solenoid ON.

Conditions for Setting the DTC

- The difference between ambient air pressure and EGR pressure is less than 15 kPa.
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A vacuum leak or a pinched vacuum line will cause a DTC P0404. Check all vacuum lines and components connected to the hoses for leaks or sharp bends or deformities. Check the vacuum source to the EGR solenoid assembly. Also check for a small leak in EGR valve and proper vacuum line routing.

To run the diagnostic test the engine must be at operating temperature with the vehicle in drive at idle for approximately 1 minute. Then, with vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

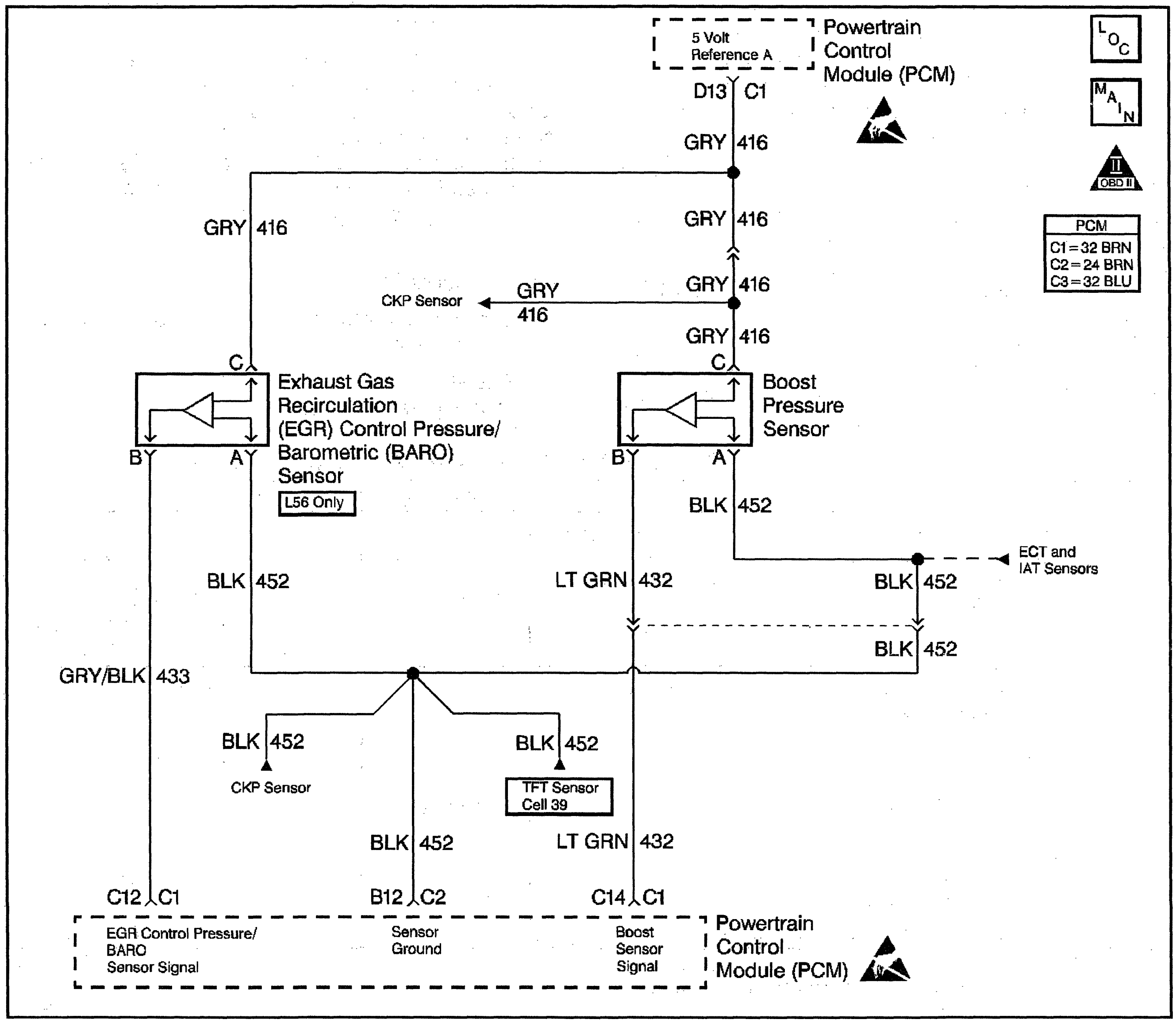
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks vacuum to the EGR valve control pressure/BARO sensor.

DTC P0404 Exhaust Gas Recirculation (EGR) Open Position Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Install vacuum gage in place of EGR control pressure/BARO. 2. Start and idle engine (engine at operating temperature). 3. Set the parking brake. 4. Place the shift lever in drive. 5. Using the scan tool, command the EGR solenoid to 100% duty cycle. 6. At idle, observe the vacuum. Is the vacuum greater than the specified value?	15 in. Hg	*Go to Step 4*	*Go to Step 3*
3	Repair restriction between EGR control pressure/BARO sensor and vacuum tee (including vacuum tee). Is action complete?	—	*Go to Step 5*	—
4	Replace the EGR Control Pressure/BARO sensor. Refer to *EGR Control Pressure Sensor Replacement.* Is the action complete?	—	*Go to Step 5*	—
5	**Important:** After Repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are EGR ALM cells reset?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle until Scan tool indicates the diagnostic Ran Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0405 Exhaust Gas Recirculation (EGR) Position Sensor Circuit Low Voltage



185023

Refer to *Emission Hose Routing Diagram*

Circuit Description

An EGR control pressure/baro sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. This signal is used to control EGR duty cycle calculated by the PCM.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

- The EGR control pressure signal is less than 0.24 volts (15 kPa).
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

With the ignition ON and the engine OFF, the EGR pressure is equal to atmospheric pressure with the signal voltage being high.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if P0405 is a hard failure or an intermittent condition.
3. Jumpering the 5 volt reference circuit to the signal circuit will determine if the sensor is at fault, or if there is a problem with the PCM or wiring.
4. The scan tool may not display 5 volts. The important thing is that the PCM recognized the voltage as more than 4 volts, indicating that the PCM and the signal circuit are OK.

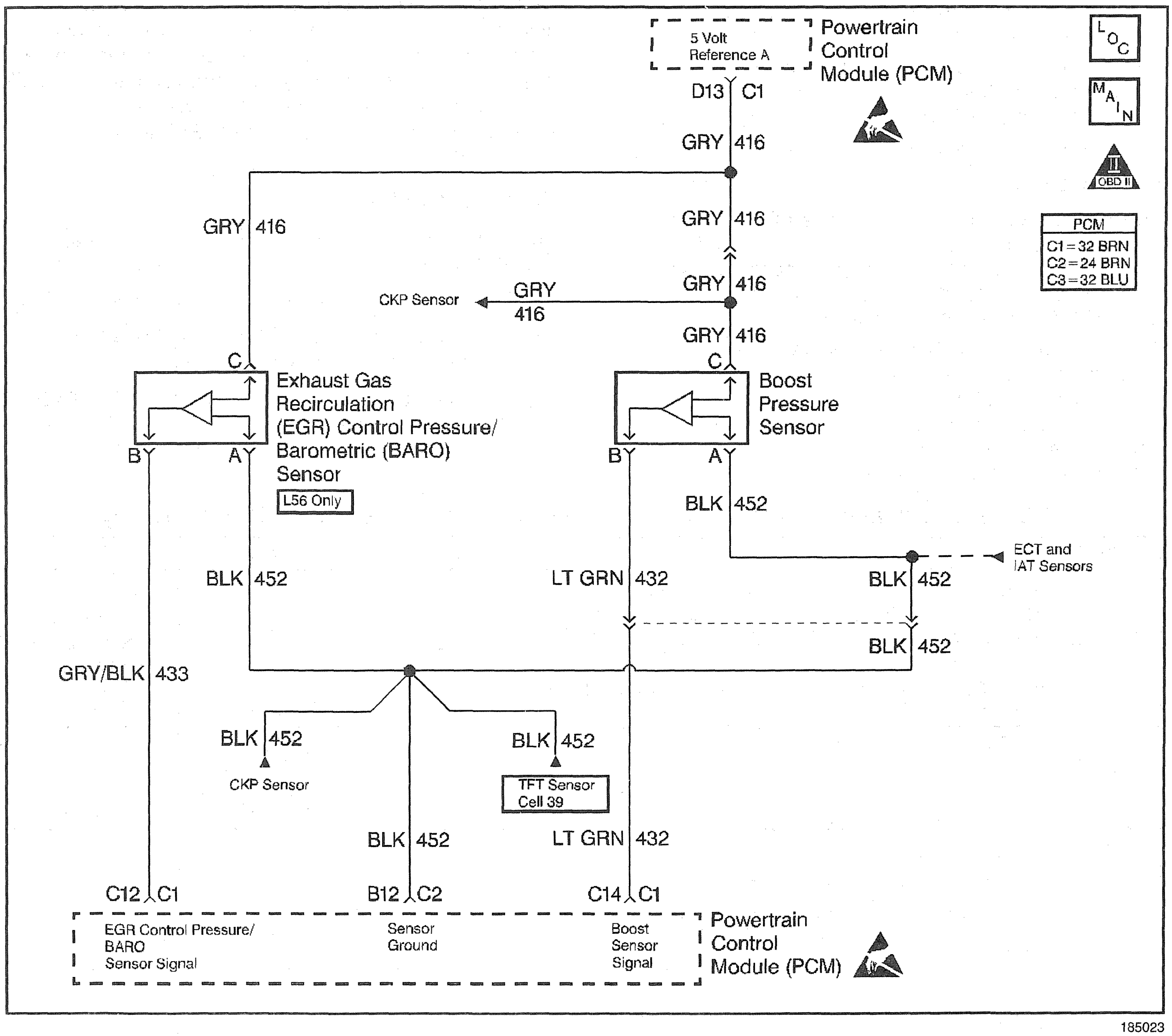
DTC P0405 Exhaust Gas Recirculation (EGR) Position Sensor Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) system check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Start the engine and let the engine idle. 3. Observe the EGR Sensor display on the scan tool. Does the scan tool display EGR Sensor less than or equal to the specified value?	0.24 V	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the EGR Control Pressure/Baro sensor electrical connector. 3. Jumper the sensor 5 volt reference circuit to the sensor signal circuit at the harness connector. 4. Turn the ignition ON leaving the engine OFF. Does the scan tool display the EGR Sensor voltage greater than the specified value?	4.0 V	*Go to Step 6*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Remove the jumper wire. 3. Probe the sensor signal circuit at the harness connector with a test light connected to B+ 4. Turn the ignition ON leaving the engine OFF. Does the scan tool display the EGR Sensor voltage greater than the specified value?	4.0 V	*Go to Step 9*	*Go to Step 7*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	Check for a proper connection at the EGR Control pressure/BARO sensor Was a problem found?	—	*Go to Step 12*	*Go to Step 11*

DTC P0405 Exhaust Gas Recirculation (EGR) Position Sensor Circuit Low Voltage (cont'd)

Step	Action	Value(s)	Yes	No
7	Check for an open EGR Control pressure/BARO sensor signal circuit. Was a problem found?	—	*Go to Step 12*	*Go to Step 8*
8	Check the EGR Control pressure/BARO sensor signal circuit for a short to ground. Was a problem found?	—	*Go to Step 12*	*Go to Step 13*
9	Check for an open in the EGR Control pressure/BARO sensor 5 volt reference circuit. Was a problem found?	—	*Go to Step 12*	*Go to Step 10*
10	Check for a short to ground in the EGR Control pressure/BARO sensor 5 volt reference circuit. Was a problem found?	—	*Go to Step 12*	*Go to Step 13*
11	Replace the EGR Control pressure/BARO sensor. Refer to *EGR Control Pressure Sensor Replacement*. Is the action complete?	—	*Go to Step 14*	—
12	Repair the circuit as necessary. Is the action complete?	—	*Go to Step 14*	—
13	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 14*	—
14	**Important:** After Repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are EGR ALM cells reset?	—	*Go to Step 15*	—
15	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 16*	*Go to Step 2*
16	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0406 Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage



Refer to *Emission Hose Routing Diagram*

Circuit Description

A EGR control pressure/baro sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. This signal is used to control EGR duty cycle calculated by the PCM. This is a type B DTC.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch is in the ON position.

Conditions for Setting the DTC

- The EGR control pressure signal is greater than 3.96 volts (85 kPa).
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM will shut down the EGR.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

With the ignition ON and the engine OFF, the manifold pressure is equal to atmospheric pressure with the signal voltage being high. This information is used by the PCM as an indicator of vehicle altitude. If DTC P0406 is intermittent, refer to *Symptoms*.

To run the diagnostic test the engine must be at the operating temperature with the vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, the vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will check for EGR Vent Solenoid DTC.
3. This step determines if DTC P0406 is a hard failure or an intermittent condition.
4. This step simulates conditions for a DTC P0405. If the PCM recognizes the change, the PCM and the signal circuit are OK.

DTC P0406 Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is the DTC P1653 also set?	—	Go to *DTC P1653 EGR Vent Solenoid Control Circuit*	*Go to Step 3*
3	1. Connect a scan tool. 2. Start the engine and let the engine idle. Does the scan tool display the EGR Control pressure/BARO sensor voltage greater than the specified value?	4.0 V	*Go to Step 4*	*Go to Step 5*
4	1. Turn the ignition OFF. 2. Disconnect the EGR Control Pressure/BARO sensor electrical connector. 3. Turn the ignition ON. Does the scan tool display a EGR Control pressure/BARO sensor voltage less than the specified value?	1.0 V	*Go to Step 6*	*Go to Step 10*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	1. Turn the ignition ON leaving the engine OFF. 2. With a *J 39200* connected to ground, probe the 5 volt reference circuit at the EGR Control Pressure/BARO Sensor harness connector. Is the voltage greater than the specified value?	5.2V	*Go to Step 11*	*Go to Step 7*
7	Probe the EGR Control Pressure/BARO sensor ground circuit with a test light to B+. Is the test light ON?	—	*Go to Step 8*	*Go to Step 12*
8	Check the EGR vacuum source for a restriction. Was a problem found?	—	*Go to Step 13*	*Go to Step 9*

DTC P0406 Exhaust Gas Recirculation (EGR) Position Sensor Circuit High Voltage (cont'd)

Step	Action	Value(s)	Yes	No
9	Replace the EGR Control Pressure/BARO sensor. Refer to *EGR Control Pressure Sensor Replacement*. Is the action complete?	—	*Go to Step 15*	—
10	Check for a short to voltage in the sensor signal circuit. Was a problem found?	—	*Go to Step 13*	*Go to Step 14*
11	1. Check for a short to voltage in the 5 volt reference circuit. 2. If a problem is found, repair as necessary. Was a repair performed?	—	*Go to Step 15*	*Go to Step 14*
12	Repair the open in the sensor ground circuit. Is the action complete?	—	*Go to Step 15*	—
13	Repair as necessary. Is the action complete?	—	*Go to Step 15*	—
14	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 15*	—
15	**Important:** After Repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are the EGR ALM cells reset?	—	*Go to Step 16*	—
16	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 17*	*Go to Step 2*
17	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0501 Vehicle Speed Sensor (VSS) Circuit Performance

Refer to *PCM, VSS Buffer, VSS, EBCM.*

Circuit Description

The speed sensor circuit consists of a magnetic induction type sensor, a vehicle speed sensor buffer module and wiring. Gear teeth pressed on the output shaft induce an alternating current in the sensor. This signal is transmitted to the buffer. The buffer compensates for various axle ratios and converts the signal into a square wave for use by the speedometer, cruise control, antilock brake and PCM. The buffer sends two different signals to the PCM.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The vehicle speed greater than 20 mph.
- The four wheel low not selected.

Conditions for Setting the DTC

- The VSS buffer calculated speed is less than half the transmission calculated speed.

  or
- The VSS buffer calculated speed is greater than the transmission calculated speed by 20 mph.

Action Taken When the DTC Sets

- The PCM disallows all cruise control inputs.
- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check connections at VSS buffer and PCM. Refer to 4L80E Diagnostic Trouble Codes in Transmission if DTC P0722 or DTC P0723 is also set.

Test Description

Number(s) below refer to number(s) on the Diagnostic Table.

3. This tests for B+ at VSS buffer.
4. This tests for proper ground path for vehicle speed sensor signal buffer.

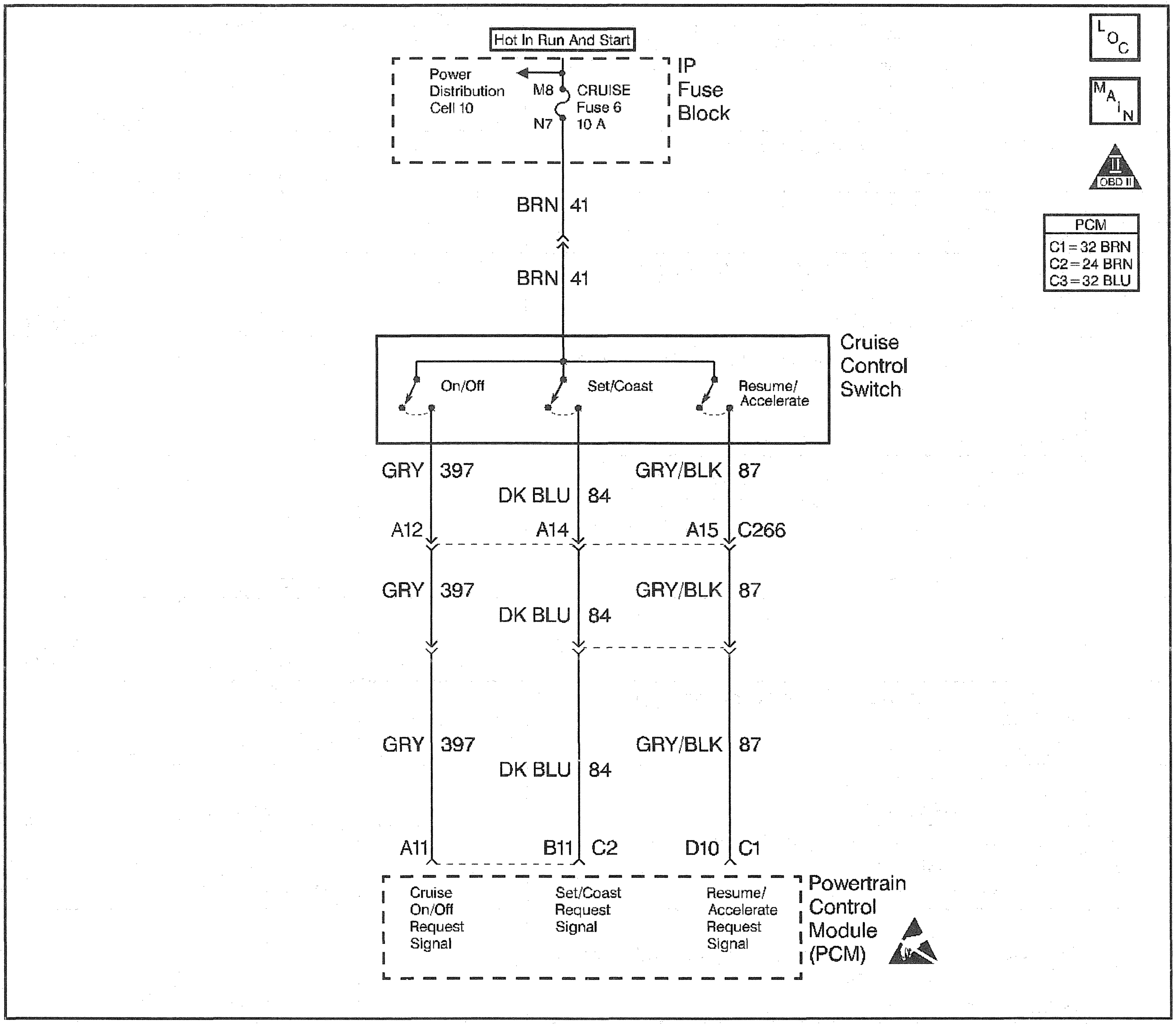
DTC P0501 Vehicle Speed Sensor (VSS) Circuit Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Raise the drive wheels. 3. Start the engine. 4. Place the transmission in any drive range. With the drive wheels rotating, does the vehicle speed increase with drive wheel speed increase?	—	*Go to Step 7*	*Go to Step 3*
3	1. Place the transmission in Park. 2. Back probe the VSS buffer module ignition feed circuit with a test light connected to ground. Is the test light ON?	—	*Go to Step 4*	*Go to Step 8*
4	Back probe the VSS buffer module ignition feed circuit to the ground circuit with a test light. Is the test light ON?	—	*Go to Step 5*	*Go to Step 9*
5	1. Back probe the VSS buffer module at the VSS input circuit (C7) to the other VSS input circuit (C12) with a *J 39200* on the AC scale. 2. Place the transmission in any drive range with the drive wheels rotating. Does the voltage increase on the *J 39200* with drive wheel increase?	—	*Go to Step 6*	*Go to Step 10*
6	Does the scan tool display a trans output speed (MPH) increase with drive wheel increase?	—	*Go to Step 13*	*Go to Step 12*

DTC P0501 Vehicle Speed Sensor (VSS) Circuit Performance (cont'd)

Step	Action	Value(s)	Yes	No
7	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored refer to those table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
8	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 18*	—
9	Repair the open in the ground circuit. Is the action complete?	—	*Go to Step 18*	—
10	Check the complete VSS input circuit for an open or short to ground. Was a repair performed?	—	*Go to Step 18*	*Go to Step 11*
11	1. Check for a proper connection at the VSS sensor. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 18*	*Go to Step 15*
12	1. Back probe the VSS buffer module at the VSS output circuit (C15) with a *J 39200* connected to ground. 2. Place the transmission in any drive range with the drive wheels rotating. Is there voltage present?	—	*Go to Step 13*	*Go to Step 16*
13	Check the VSS output circuit for an open or short to ground. Was a repair performed?	—	*Go to Step 18*	*Go to Step 14*
14	Check VSS output circuit for a proper connections at the PCM. Was a repair performed?	—	*Go to Step 18*	*Go to Step 17*
15	Replace the Vehicle Speed Sensor. Is the action complete?	—	*Go to Step 18*	—
16	Replace the VSS Buffer module. Refer to *Vehicle Speed Signal Buffer Replacement.* Is the action complete?	—	*Go to Step 18*	—
17	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 18*	—
18	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 19*	*Go to Step 2*
19	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0567 Cruise Control Resume Switch Circuit



185074

Circuit Description

The cruise resume/accel switch is an input to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. The cruise resume/accel switch sends ignition voltage to the PCM when the switch is closed (ON).

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

Ignition voltage on resume request signal circuit when the cruise control ON/OFF switch in the OFF position.

or

- Resume switch ON for longer than 25.5 seconds the cruise control ON/OFF switch in the ON position.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM disallows all cruise control inputs.
- TCC shift schedules may be affected.
- The PCM will not illuminate the Malfunction Indicator Lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Check for a resume/accel switch stuck in the engage position or the signal circuit is shorted to voltage.

Test Description

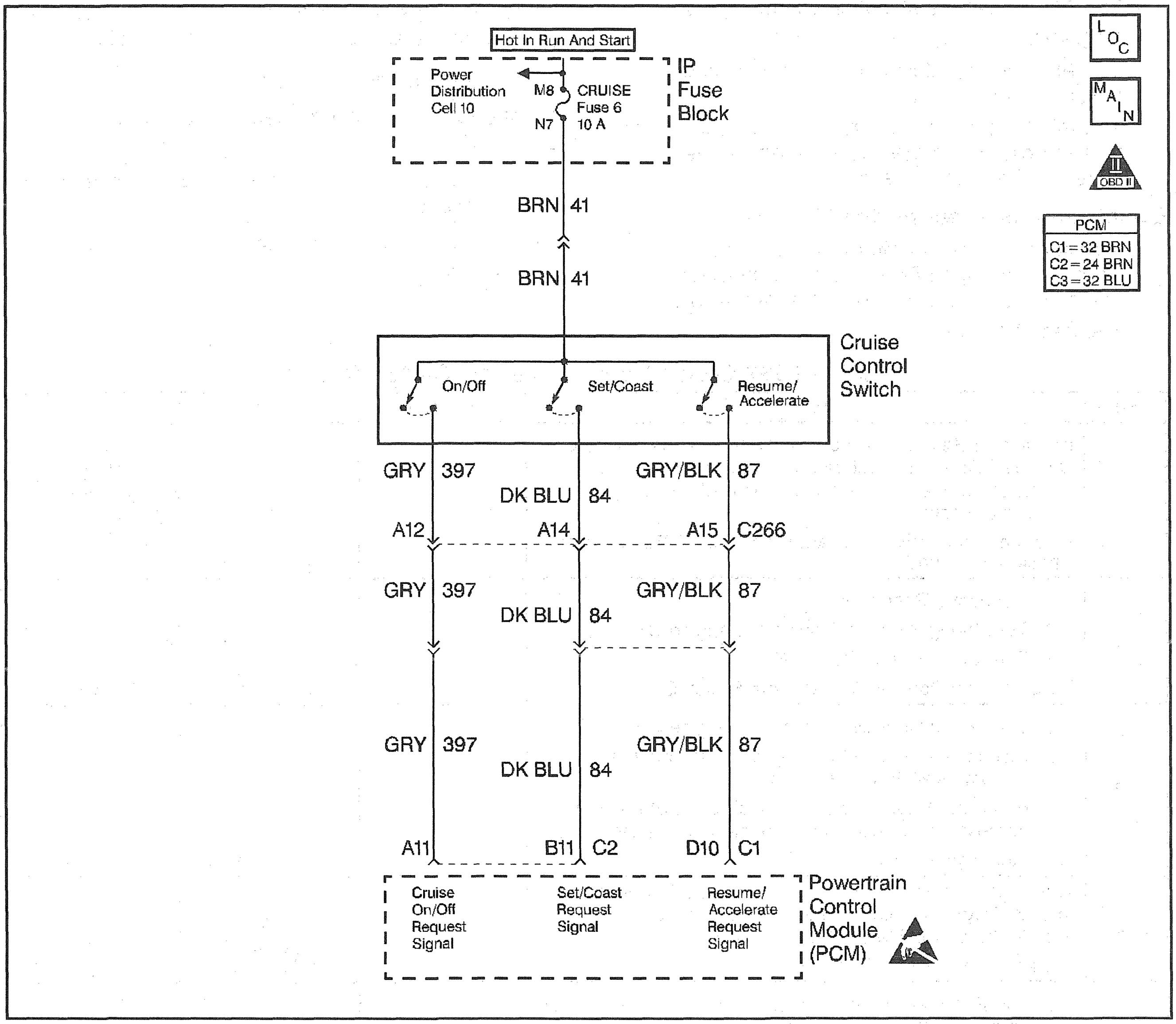
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if the signal circuit is shorted to voltage.
3. This step determines if the PCM or switch is at fault.

DTC P0567 Cruise Control Resume Switch Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. Turn the Cruise switch OFF. Does the scan tool display Resume Switch ON?	—	*Go to Step 3*	*Go to Step 4*
3	1. Turn the ignition ON leaving the engine OFF. 2. Disconnect the PCM connector containing the Resume switch signal circuit. 3. Probe the Resume switch signal circuit at the PCM harness with a test light connected to chassis ground. Is the test light ON?	—	*Go to Step 5*	*Go to Step 6*
4	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
5	1. The Resume switch signal circuit is shorted to voltage or stuck in the ON position. 2. Repair the problem as necessary. Is the action complete?	—	*Go to Step 8.*	—
6	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 7*	—
7	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 8*	*Go to Step 2*
8	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0568 Cruise Control Set Switch Circuit



185074

Circuit Description

The cruise set/coast switch is an input to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. The cruise set/coast switch sends an ignition voltage signal to the PCM when the set/coast switch is ON.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The ignition switch in the ON position.

Conditions for Setting the DTC

Ignition voltage on set/coast request signal circuit when the cruise control ON/OFF switch in the OFF position.

or

- Set/Coast request switch ON for longer than 25.5 seconds when the Cruise Control ON/OFF switch in the ON position.
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM disallows all cruise control inputs.
- TCC shift schedules may be affected.
- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information stores in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

If the set/coast switch is stuck in the ON position or the driver is holding the set/coast switch ON for longer than 25.5 seconds, DTC P0568 will set. DTC P0568 only checks the signal circuit for a short to voltage.

Test Description

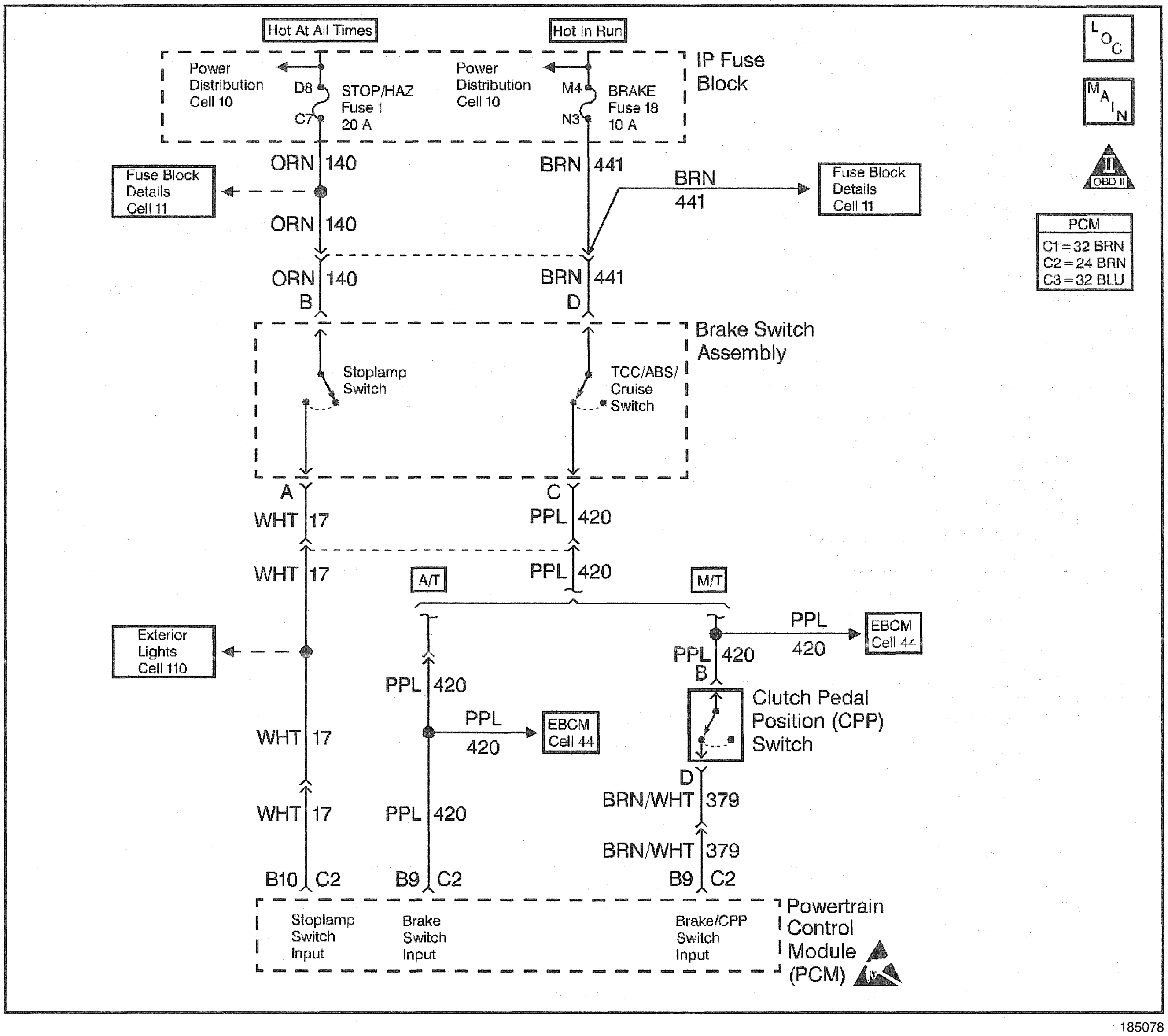
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if the signal circuit is shorted to voltage.
3. This step determines if the PCM or switch is at fault.

DTC P0568 Cruise Control Set Switch Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. Turn the Cruise switch OFF. Does the scan tool display the Set switch ON?	—	*Go to Step 3*	*Go to Step 4*
3	1. Turn the ignition ON leaving the engine OFF. 2. Disconnect the PCM connector containing the Set switch signal circuit. 3. Probe the Set switch signal circuit at the PCM harness with a test light connected to chassis ground. Is the test light ON?	—	*Go to Step 5*	*Go to Step 6*
4	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
5	1. The Set switch signal circuit is shorted to voltage or stuck in the ON position. 2. Repair the problem as necessary. Is the action complete?	—	*Go to Step 8*	—
6	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 7*	—
7	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 8*	*Go to Step 2*
8	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0571 Cruise Control Brake Switch Circuit



Circuit Description

The TCC normally closed cruise brake switch supplies a B+ signal on the Brake Switch Input circuit to the PCM. The circuit is opened when the brakes are applied. The stop lamp/cruise control normally open brake switch supplies a B+ signal on the Stoplamp Switch Input circuit to the PCM when the brake is applied.

Conditions for Running the DTC

- Brake switches disagree for 10 consecutive minutes.

  or

- TCC and cruise control brake switches are not toggling open and closed, during 6 brake applications on the same ignition cycle.

Conditions for Setting the DTC

- Brake switches disagree for 10 consecutive minutes.

  or

- TCC and cruise control brake switches are not toggling open and closed, during 6 brake applications on the same ignition cycle.

Action Taken When the DTC Sets

- The PCM disallows all cruise control inputs.
- TCC shift schedules may be affected.
- The PCM will not illuminate the Malfunction Indicator Lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information stores in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Refer to PCM Intermittent Diagnostic Trouble Codes or Performance. Check customer driving habits and/or unusual traffic conditions (i.e. stop and go, expressway traffic).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This test checks the feed circuit.
6. This test simulates brake switch closed or brakes ON.

DTC P0571 Cruise Control Brake Switch Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a Scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. Apply the brakes. Does the scan tool display the cruise brake switch Closed and then Open when the brake is applied?	—	*Go to Step 3*	*Go to Step 7*
3	Apply the brakes again. Does the scan tool display the brake switch Open and then Closed when the brake is applied?	—	*Go to Step 9*	*Go to Step 4*
4	1. Turn the ignition ON leaving the engine OFF. 2. Verify the stoplamp switch is disconnected. 3. With a test light connected to ground, probe the normally open feed circuit (terminal B). Is the test light ON?	—	*Go to Step 5*	*Go to Step 10*
5	1. Turn the ignition ON leaving the engine OFF. 2. Verify the stoplamp switch is disconnected. 3. Turn the headlamp switch ON. 4. With a test light connected to ground, probe the normally open stoplamp switch signal circuit (terminal A). Is the test light ON?	—	*Go to Step 11*	*Go to Step 6*
6	1. Disconnect the stoplamp switch. 2. Jumper the normally open (terminal A) feed circuit and the normally open signal circuits (terminal B) together. Does the scan tool display the brake switch Closed?	—	*Go to Step 17*	*Go to Step 12*
7	1. Turn the ignition ON leaving the engine OFF. 2. Verify the stoplamp switch is disconnected. 3. With a test light connected to ground, probe the normally closed feed circuit (terminal F). Is the test light ON?	—	*Go to Step 8*	*Go to Step 14*
8	1. Verify the stoplamp switch is disconnected. 2. Jumper the normally closed (terminal F) feed circuit and the normally closed signal circuits (terminal E) together. Does the scan tool display the Cruise Brake switch Closed?	—	*Go to Step 17*	*Go to Step 15*

DTC P0571 Cruise Control Brake Switch Circuit (cont'd)

Step	Action	Value(s)	Yes	No
9	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
10	Check the normally open feed circuit (terminal B) for and open or short to ground. Is the action complete?	—	*Go to Step 19*	—
11	1. Check the stoplamp switch signal circuit for a short to B+. 2. If a short to B+ is present, repair it as necessary. Is the action complete?	—	*Go to Step 19*	*Go to Step 18*
12	Check the normally open brake switch signal circuit for and open or short to ground. Was a repair performed?	—	*Go to Step 19*	*Go to Step 13*
13	Check the normally open brake switch signal circuit for a proper connection at PCM? Was a repair performed?	—	*Go to Step 19*	*Go to Step 18*
14	Check the normally closed feed circuit (terminal F) for and open or short to ground. Is the action complete?	—	*Go to Step 19*	—
15	Check the normally closed cruise brake switch signal circuit for an open or short to ground. Was a repair performed?	—	*Go to Step 19*	*Go to Step 16*
16	Check the normally closed cruise brake switch signal circuit for a proper connection at PCM? Was a repair performed?	—	*Go to Step 19*	*Go to Step 18*
17	Replace the stoplamp switch. Is the action complete?	—	*Go to Step 19*	—
18	**Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Replace the PCM. Is the action complete?	—	*Go to Step 19*	—
19	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 20*	*Go to Step 2*
20	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0601Control Module Read Only Memory (ROM)

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the PCM **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0602 Control Module Not Programmed

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

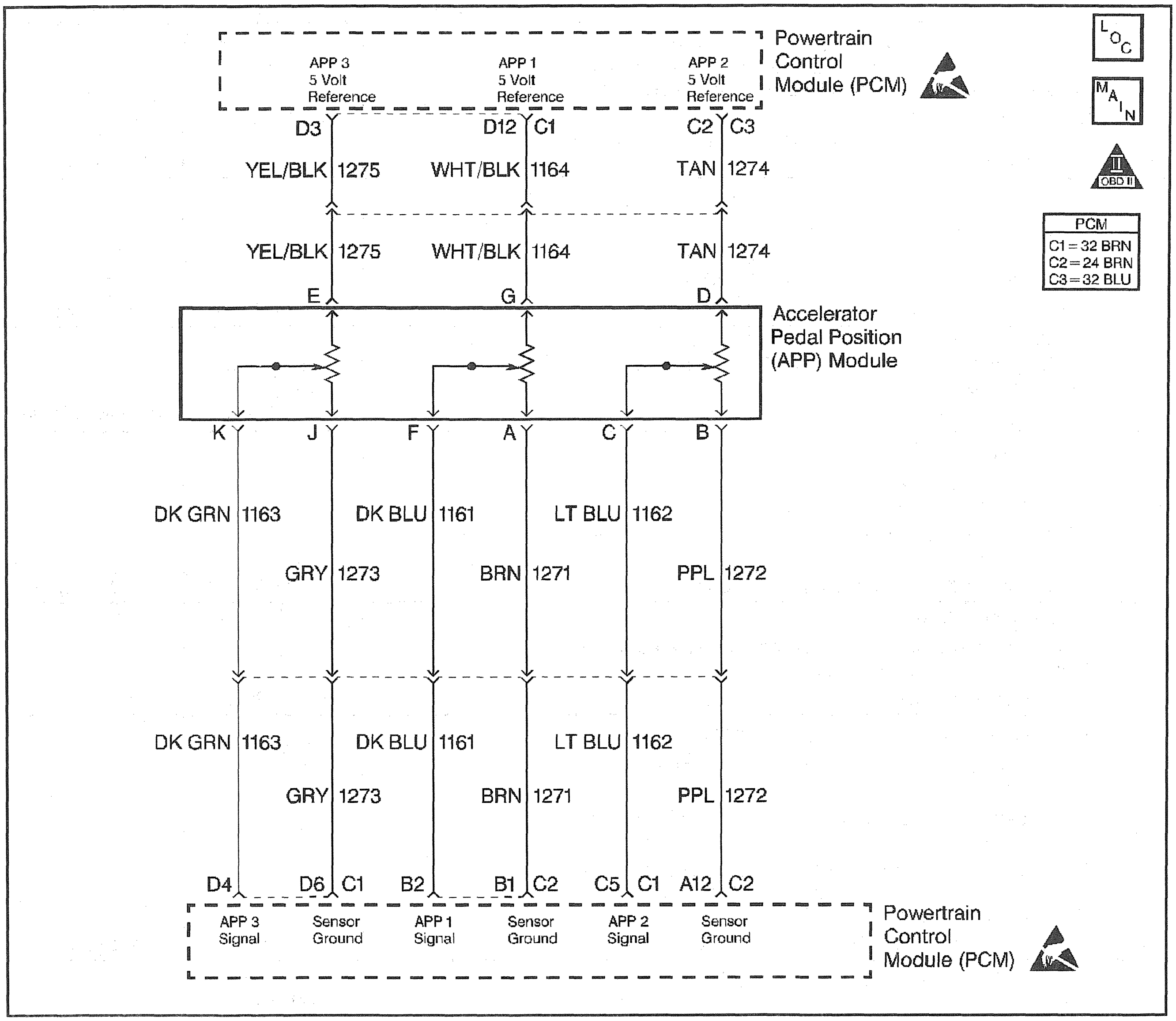
DTC P0604 Control Module Random Access Memory (RAM)

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P0606 Control Module Internal Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any other DTCs set (all other DTCs must be diagnosed before proceeding on)?	—	Go to the appropriate DTC	*Go to Step 3*
3	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 4*	—
4	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 5*	*Go to Step 2*
5	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1125 Accelerator Pedal Position (APP) System



185076

Circuit Description

The accelerator pedal position (APP) module provides a voltage signal that changes relative to accelerator pedal position. There are three sensors located within the APP module that are scaled differently.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

The PCM has recognized an intermittent APP fault and there are no other current APP faults stored.

Action Taken When the DTC Sets

- Vehicle will operate at limited power.
- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A DTC P1125 will set along with multiple APP DTCs. All other DTCs should be diagnosis first.

Test Description

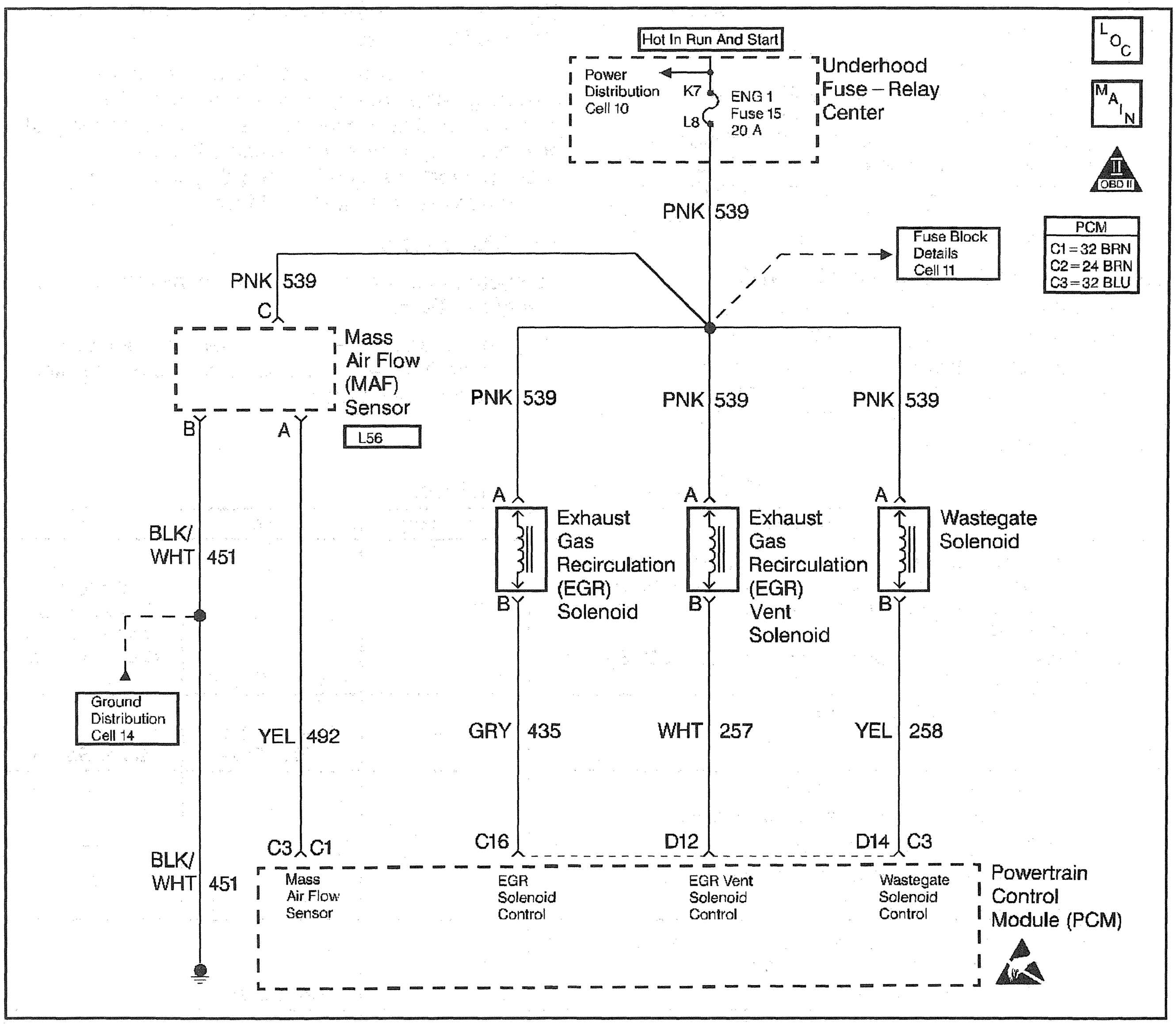
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step determines if DTC P1125 is a hard failure or an intermittent condition.

DTC P1125 Accelerator Pedal Position (APP) System

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Disconnect the APP sensor electrical connector. 2. Ignition ON, engine OFF. 3. With *J 39200* connected to ground, check all APP 5 volt reference circuits at APP harness. Is voltage less than specified value?	4.8 V	*Go to Step 4*	*Go to Step 3*
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Ignition OFF. 2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground. 3. If the 5 volt reference circuit is shorted to ground, repair it as necessary. Was the 5 volt reference circuit shorted to ground?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1191 Intake Air Duct Leak



185071

Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration or high load situation, while a small quantity of air indicates deceleration or idle.

The PCM has the ability to determine a intake leak by using the Mass Air Flow (MAF) sensor and the EGR Control Pressure/BARO sensor.

Conditions for Running the DTC

- The PCM performs this DTC diagnostic continuously.
- The DTCs P0405, P0406, P0102 and P0103 are not set.
- Baro greater than 75 kPa.
- All EGR tests have been completed (internal to PCM).

Conditions for Setting the DTC

- Intake leak greater than calibrated value (internal to PCM)
- All of the diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of failure is a leaky intake duct after the MAF sensor.

To run the diagnostic test, the engine must be at operating temperature, vehicle in drive at idle for approximately 1 minute. Then, with vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, vehicle must be driven.

Test Description

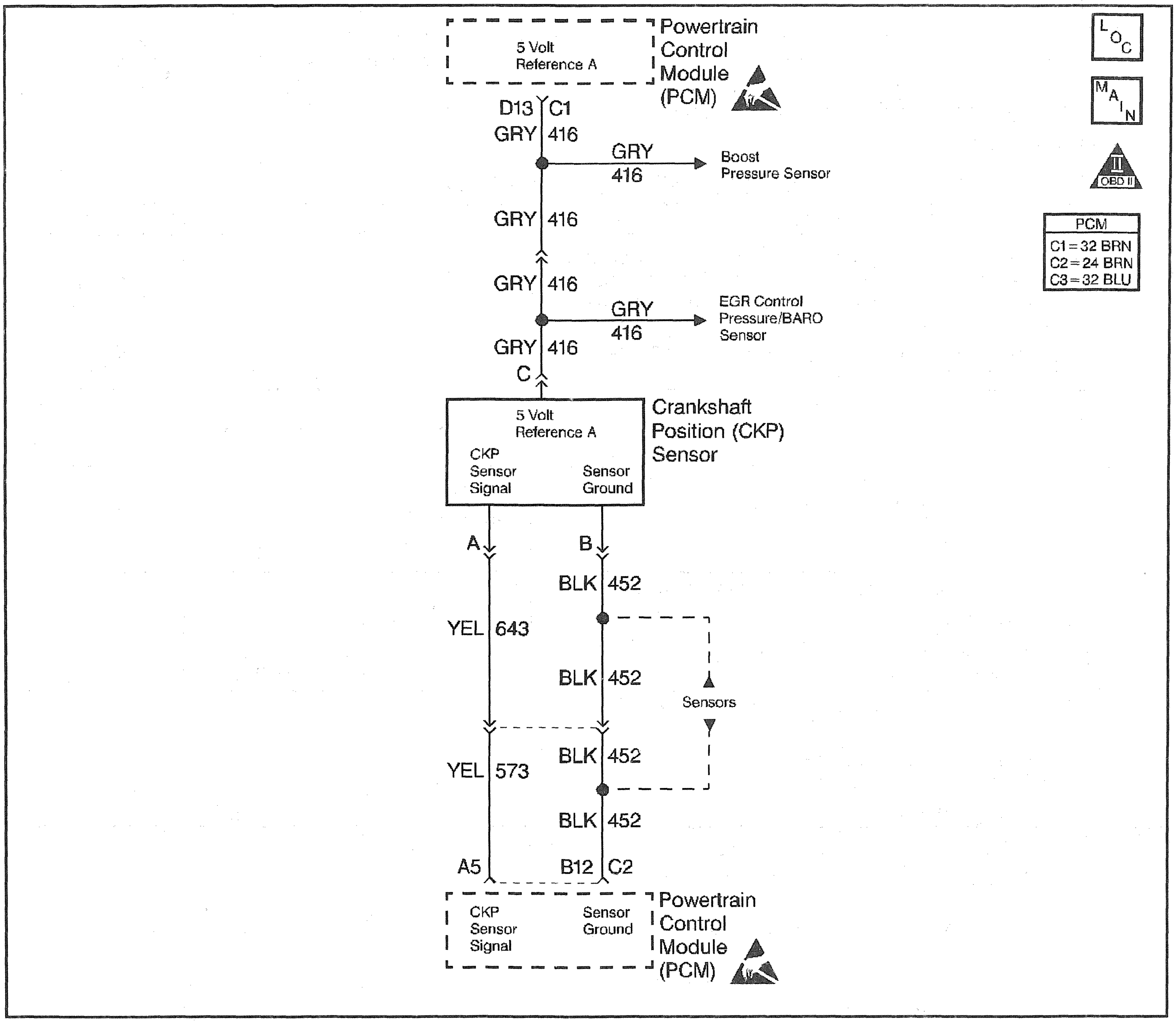
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. A large leak in the intake system will set MAF sensor DTC. All intake ducts should be checked after the MAF sensor.

DTC P1191 Intake Air Duct Leak

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any EGR DTCs set?	—	*Go to the applicable DTC Table*	*Go to Step 3*
3	Check for the following conditions: • Air inlet duct leaks (after the MAF sensor). • Missing EGR tower gasket. • All intake manifold gaskets in place. Has a repair been performed?	—	*Go to Step 4*	—
4	**Important:** After repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are EGR ALM cells reset?	—	*Go to Step 5*	—
5	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 6*	*Go to Step 2*
6	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1214 Injection Pump Timing Offset



185025

Circuit Description

The PCM has the ability to determine the amount of offset needed to bring the engine to top dead center. This is used by the PCM to determine proper injection time.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The TDC offset is greater than 2.46 degrees

  or
- The TDC Offset is less than –2.46 degrees.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

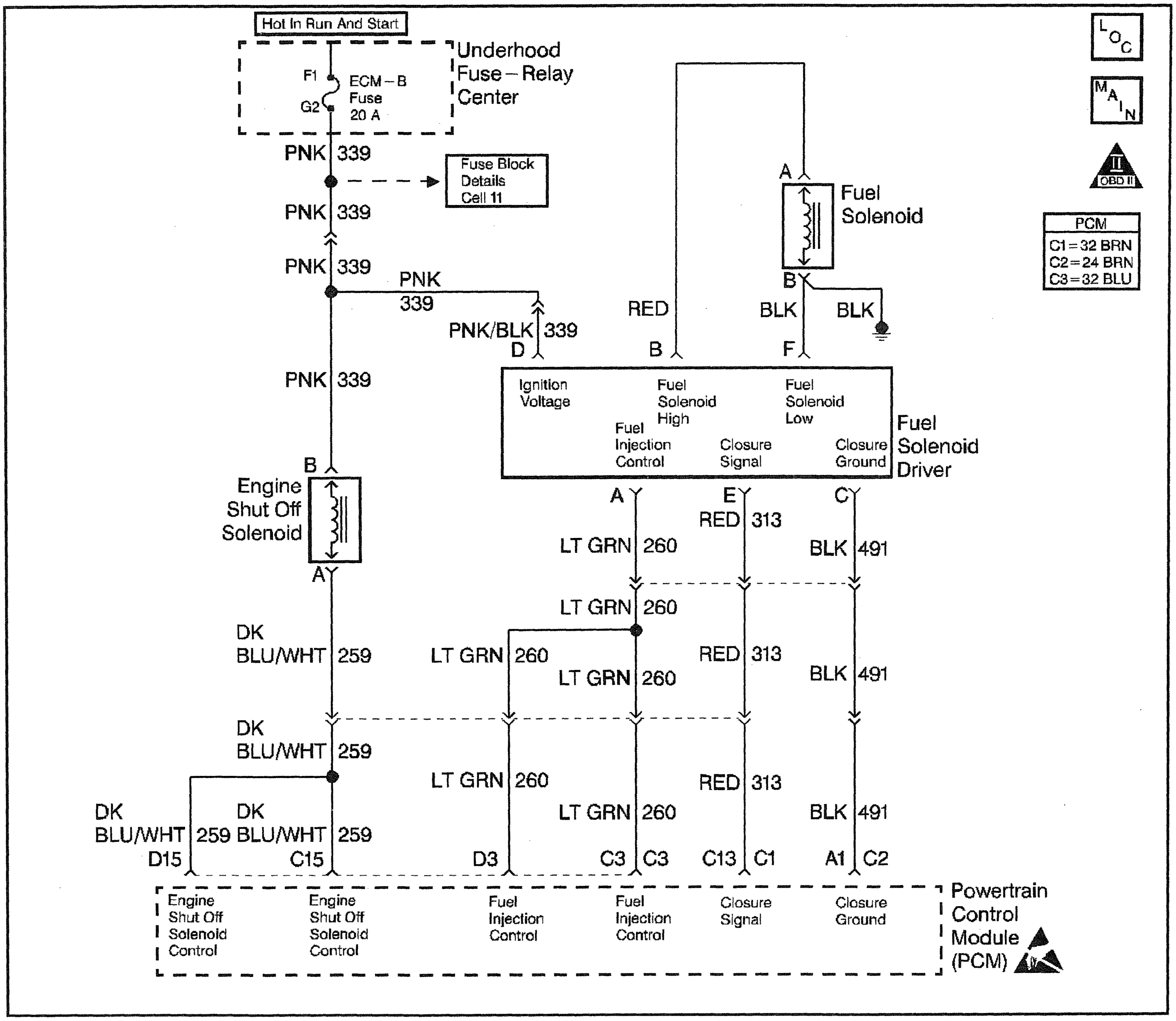
Diagnostic Aids

The PCM will only run the diagnostic test when a time set procedure has been activated. It is highly unlikely that the vehicle will be brought in with this DTC set. Refer to *TDC Offset Adjustment*.

DTC P1214 Injection Pump Timing Offset

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any other DTCs set?	—	Go to the Applicable DTC Table	*Go to Step 3*
3	Clear all codes and reset injection timing until TDC Offset is between specified values. Refer to *TDC Offset Adjustment*. Is timing within specified value?	–0.25 to –0.75	*Go to Step 6*	*Go to Step 4*
4	Check the crankshaft position sensor for the following. • Proper installation. • Loose or broken sensor mounting tab. Was a repair performed?	—	*Go to Step 6*	*Go to Step 5*
5	Replace the Injection Pump. Refer to *Fuel Injection Pump Replacement*. **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment*. Is the action complete?	—	*Go to Step 6*	—
6	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 7*	*Go to Step 2*
7	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1216 Fuel Solenoid Response Time Too Short



185026

Circuit Description

The injection pump delivers fuel to individual cylinders by opening and closing a solenoid control fuel valve. The PCM monitors the amount of time it takes for the fuel solenoid valve to physically close after commanded to close. Closure time out of range is seen as a fault. This response time is measured in milliseconds.

Conditions for Running the DTC

- The battery voltage is greater than 12 volts and less than 15 volts.
- The engine coolant temperature is greater than 50°C (122°F).
- The engine speed is greater than 1350 RPM.
- The requested fuel rate is greater than 0.0 mm

Conditions for Setting the DTC

- The inj. pump closure time less than.75 ms.
- All diagnostic set conditions met for 2 seconds.

Action Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Intermittent DTCs (P0251, P0370 and P1216) may be caused by air entering the fuel system when fuel levels get below 1/8 of a tank while performing hard acceleration or turning maneuvers. It's also possible that a P0251, P0370 and P1216 will set if the vehicle has run out of fuel. Customer driving habits should be checked to determine if the vehicle has been performing in these manners. If the vehicle has been performing in these conditions, bleed the fuel system of all air and test drive the vehicle.

When the PCM is in backup fuel, fast idle and poor performance problems will exist. If P0251 is also stored, the snap shot mode on the scan tool should be used to properly identify the fault. DTCs P0335, P1216, and P1217 may set along with this DTC.

If DTC P1216 is set with any other DTCs, diagnose them first. If the vehicle is running close to the DTC setting closure time, the vehicle should be checked during cold start ups and during hot conditions.

An intermittent can be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step will determine if the ground circuit is open which causes the vehicle not to start.
3. This step will determine if the signal circuit is open or an injection pump (fuel solenoid) is at fault.

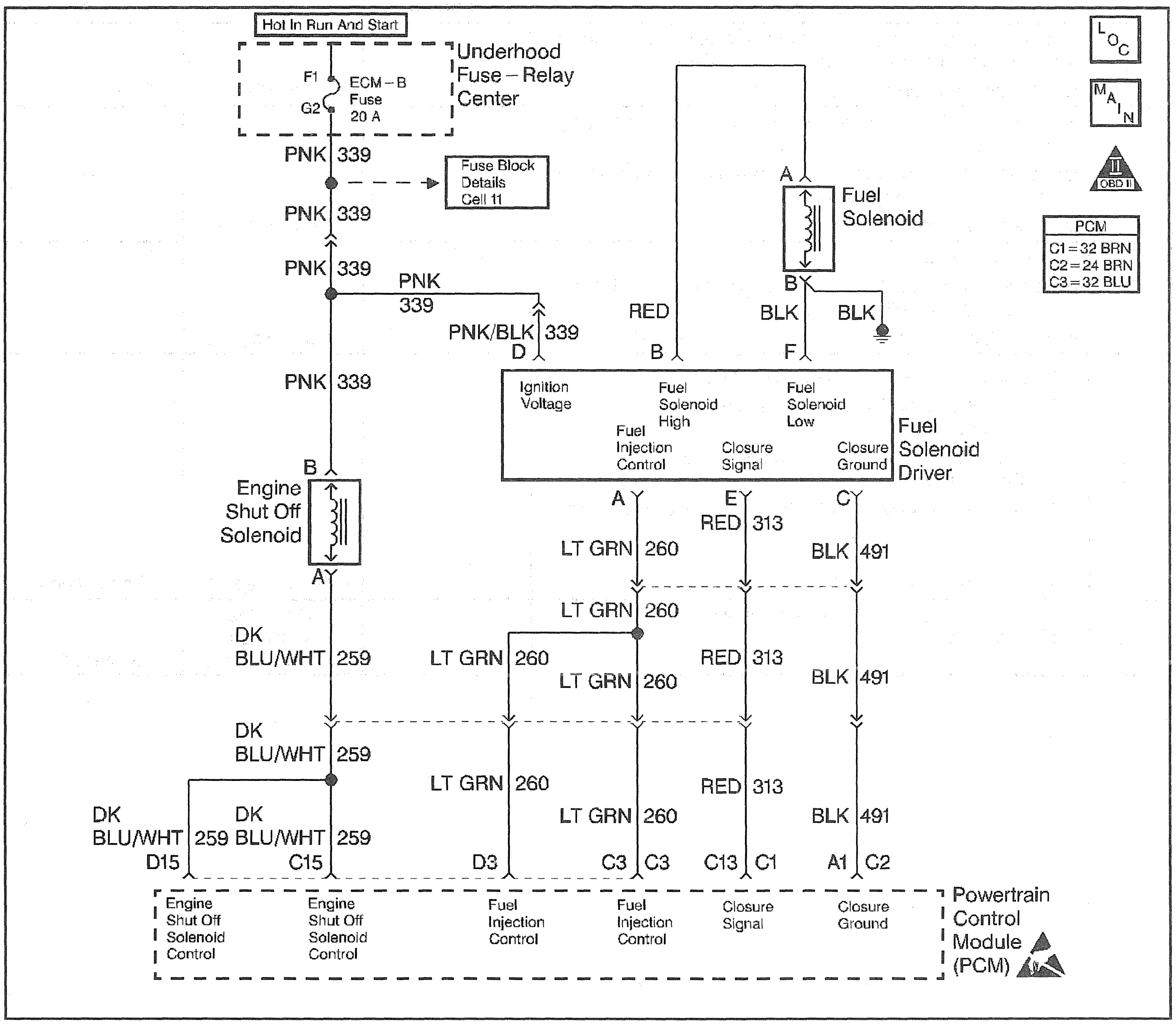
DTC P1216 Fuel Solenoid Response Time Too Short

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is DTC P0219 set?	—	Go to *DTC P0219 Engine Overspeed*	*Go to Step 3*
3	Will the engine start?	—	*Go to Step 4*	*Go to Step 7*
4	1. Verify the engine is at operating temperature. 2. Observe the Inj. Pump Closure Time on the scan tool. Is the scan tool display less than or equal to the specified value?	0.75 ms	*Go to Step 5*	*Go to Step 6*
5	1. Maintain the engine running. 2. Again, observe Inj. Pump Closure Time on scan tool. Is the Inj. Pump Closure Time display less than or equal to the specified value?	0.1 ms	*Go to Step 8*	*Go to Step 10*
6	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	—
7	1. Check the Closure ground circuit for an open. 2. If the Closure ground circuit is open, repair as necessary. Was a repair performed?	—	*Go to Step 12*	*Go to Step 10*
8	1. Check the Closure signal circuit for an open or short to ground and check connections at the driver. 2. If a problem is found, repair the problem as necessary. Was a repair performed?	—	*Go to Step 12*	*Go to Step 9*

DTC P1216 Fuel Solenoid Response Time Too Short (cont'd)

Step	Action	Value(s)	Yes	No
9	Check the Closure signal circuit for a proper connection at the PCM and replace the terminal if necessary. Did the terminal require replacement?	—	*Go to Step 12*	*Go to Step 11*
10	Replace the Injection pump. Refer to *Fuel Injection Pump Replacement*. **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment*. Is the action complete?	—	*Go to Step 12*	—
11	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 12*	—
12	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 13*	*Go to Step 2*
13	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1217 Fuel Solenoid Response Time Too Long



185026

Circuit Description

The injection pump delivers fuel to individual cylinders by opening and closing a solenoid control fuel valve. The PCM monitors the amount of time it takes for the fuel solenoid valve to physically close after commanded to close. Closure time out of range is seen as a fault. This response time is measured in milli seconds.

Conditions for Setting the DTC

- The battery voltage greater than 12 volts and less than 15 volts.
- The engine coolant temperature is greater than 50°C (122°F).
- The ENGINE SPEED greater than 1350 RPM.
- The requested fuel rate is greater than 0.0 mm
- The Closure Time is greater than 2.5 ms.

Action Taken When the DTC Sets

- The Malfunction Indicator Lamp (MIL) will not illuminate.
- The PCM records the operating conditions at the time the diagnostic fails. This information stores in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC will clear when forty consecutive warm–up cycles that the diagnostic does not fail (coolant temperature has risen 5°C (40°F) from start up coolant temperature and engine coolant temperature exceeds 71°C (160°F) that same ignition cycle.
- Use of a Scan tool

Diagnostic Aids

A weak (mechanical failure) fuel solenoid will result in a DTC P1217. If DTC P1217 is set with any other DTCs, diagnose them first. If the vehicle is running close to the DTC setting closure time, vehicle should be checked during cold start ups and during hot conditions.

Poor performance and starting conditions will exist. Fuel contamination could also cause this DTC.

Test Description

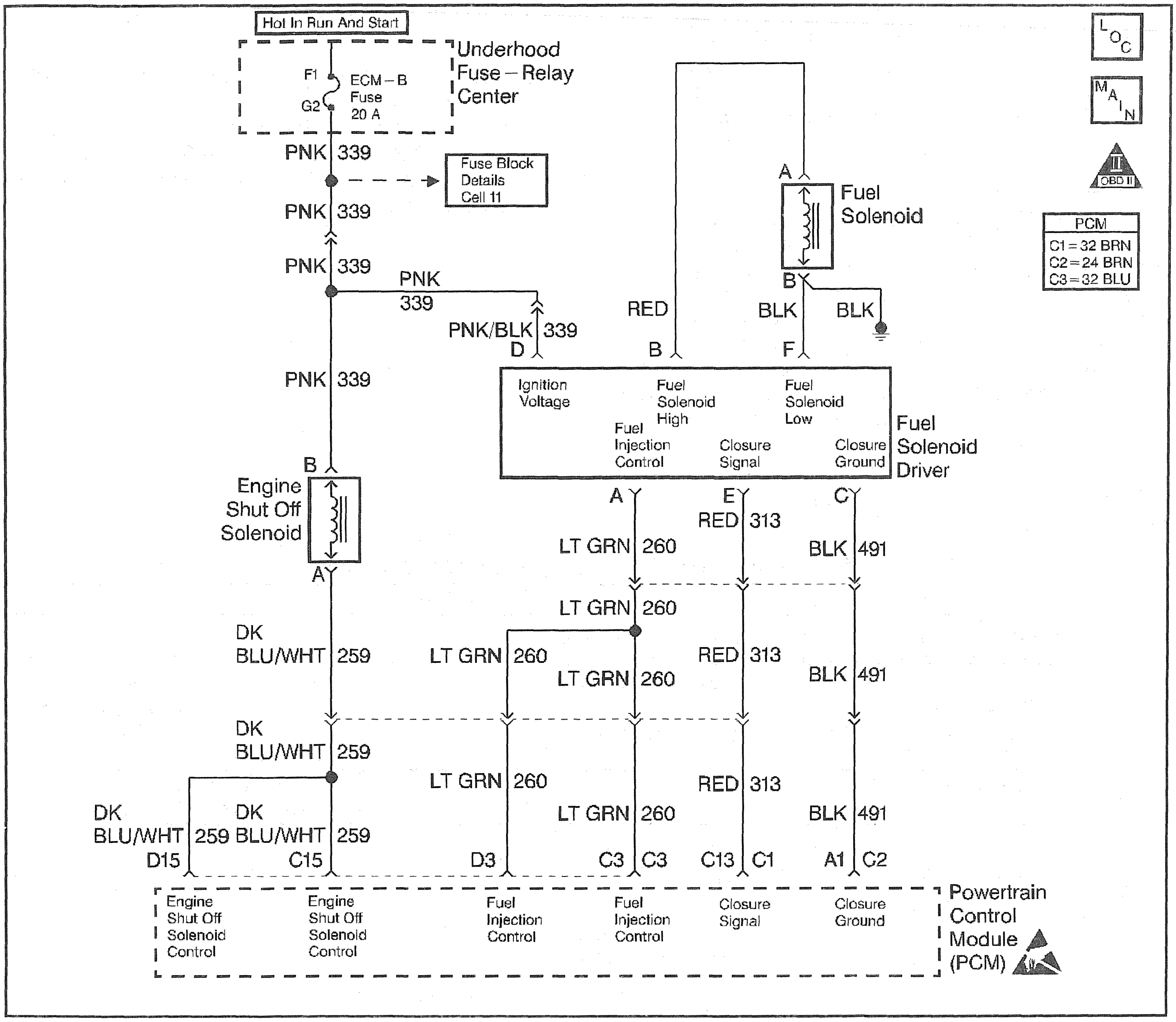
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step determines if DTC 1217 is a hard failure or an intermittent.
6. This step will determine if the solenoid is at fault, or if there is a problem with the PCM or wiring.

DTC P1217 Fuel Solenoid Response Time Too Long

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is DTC P0370 set?	—	Go to *DTC P0370 Timing Reference High Resolution System Performance*	*Go to Step 3*
3	1. Start and idle the engine. 2. Observe the Inj. Pump Closure Time display on the scan tool. Is the scan tool display greater than the specified value?	2.4 ms	*Go to Step 4*	*Go to Step 5*
4	1. Turn all accessories ON (includes aftermarket add-ons). 2. Maintain the engine idling. 3. Verify all post glow plug cycles are completed 4. With a *J 39200* connected to ground, measure the voltage at the ECM B (fuel solenoid driver ignition feed circuit) in the U/H relay center. Is the voltage between specified value?	12 - 15V	*Go to Step 7*	*Go to Step 6*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	Repair the fuel solenoid driver ignition feed circuit connections or aftermarket add-ons. Refer to *Add-On Electrical Operated Equipment to Battery Notice* Was a repair performed?	—	*Go to Step 8*	—
7	**Important:** Before replacing the Injection pump, check for fuel system contamination. Refer to *Contamination Testing* Replace the Injection pump. Refer to *Fuel Injection Pump Replacement* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment* Is the action complete?	—	*Go to Step 8*	—
8	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, with the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 9*	*Go to Step 2*
9	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1218 Injection Pump Calibration Circuit



185026

Circuit Description

The PCM uses a calibrated resistor mounted internally in the injection pump to determine fuel rates. The resistor value is stored in the PCM memory. If the PCM memory has been disturbed or the PCM has been replaced, the PCM will relearn the resistor value on the next ignition cycle.

Conditions for Running the DTC

- The PCM currently does not have a valid resistor valve.
- The PCM is unable to read a resistor value.

Conditions for Setting the DTC

- The PCM currently does not have a valid resistor valve.
- The PCM is unable to read a resistor value.

Action Taken When the DTC Sets

- The PCM will default to the lowest fuel table.
- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip that the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records will store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Intermittent DTCs (P0251, P0370 and P1216) may be caused by air entering the fuel system when fuel levels get below 1/8 of a tank while performing hard acceleration or turning maneuvers. It's also possible that a P0251, P0370 and P1216 will set if vehicle has run out of fuel. Customer driving habits should be checked to determine if vehicle has been performing in these manners. If the vehicle has been performing in these conditions, bleed the fuel system of all air and test drive the vehicle.

Check the connection at the fuel injector driver. Clear DTC, and cycle ignition. If DTC clears, treat condition as an intermittent.

Test Description

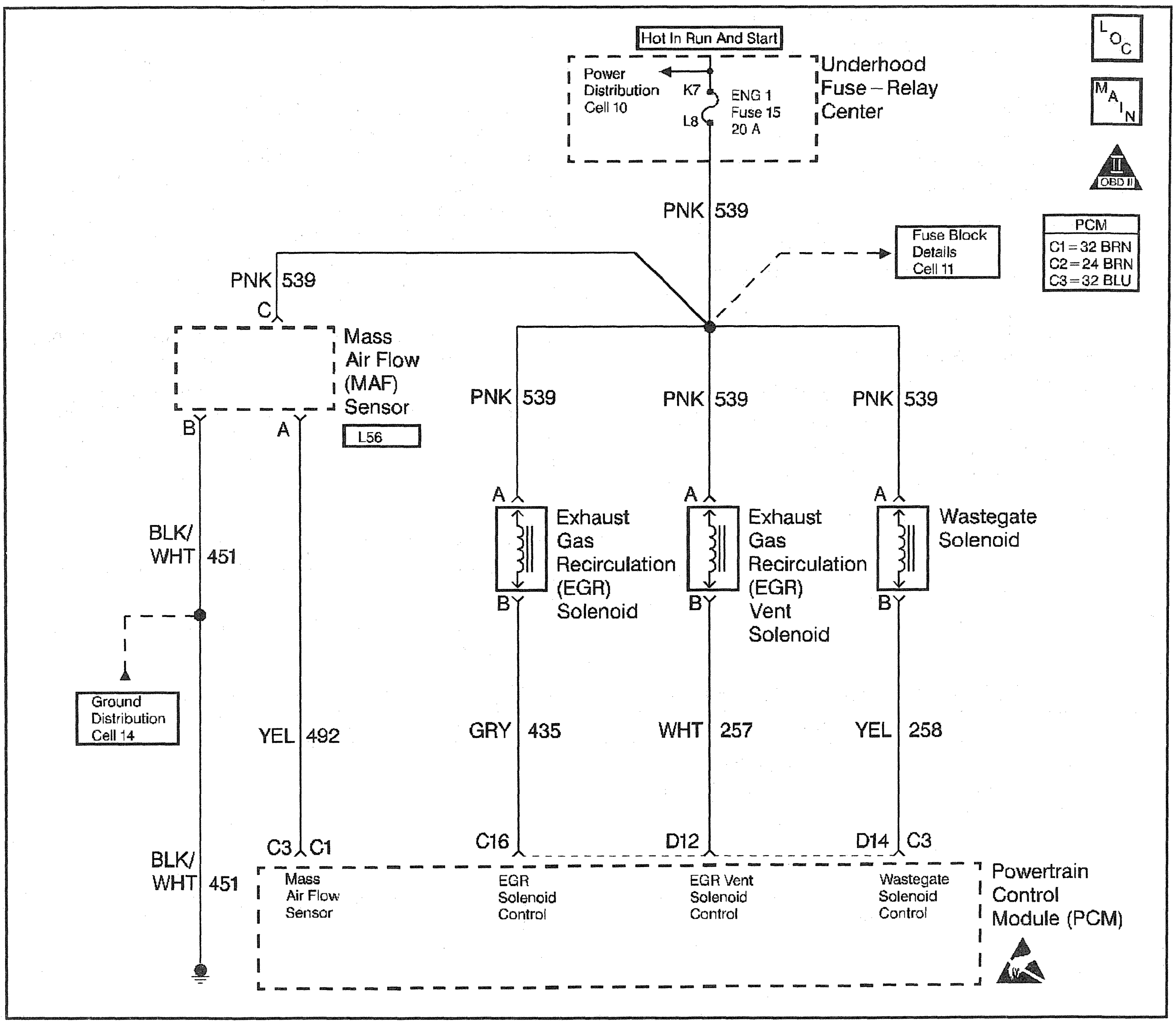
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step will determine if there is a problem with the connection at the fuel solenoid driver or malfunctioning injection pump. This DTC will only clear DTC Status when a Time Set procedure has been activated (injection timing does not have to be adjusted).

DTC P1218 Injection Pump Calibration Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are than any other DTCs set?	—	Go to Applicable DTC Table	*Go to Step 3*
3	1. Check the connection at the Fuel Solenoid Driver. 2. Clear the DTC, and cycle the ignition. 3. Start and idle the engine. 4. Activate the Time set procedure (the diagnostic will only run when a Time Set procedure is performed). 5. Exit out of the Time set procedure and Select DTC, Specific, then enter the DTC number. Does the Scan Tool indicate that the diagnostic Passed?	—	*Go to Step 5*	*Go to Step 4*
4	Replace the Injection pump. Refer to *Fuel Injection Pump Replacement.* **Important:** The new injection pump must be timed. Refer to *Injection Timing Adjustment.* Is the action complete?	—	*Go to Step 6*	—
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
6	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1406 Exhaust Gas Recirculation (EGR) Position Sensor Performance



185071

Refer to *Emission Hose Routing Diagram*

Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration, high load situation or no EGR flow, while a small quantity of air indicates deceleration, idle or full EGR situations.

The PCM will monitor MAF and EGR pressures at different ranges to determine correct EGR flow rates.

Conditions for Setting the DTC

- DTCs P0405, P0406, P0102 and P0103 not set.
- All MAF and EGR control pressure test complete (internal to PCM).
- EGR in Closed Loop.
- IAT greater than or equal to 20°C (68°F) and less than or equal to 95°C (203°F).
- Fuel rate between 10 and 25 mm3.
- Engine RPM between 1500 and 2100.
- Engine speed stable.

Conditions for Setting the DTC

- ALM cells not changed for greater than 2 seconds.
- Above conditions persist for at least 3 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A vacuum leak will cause a DTC P1406. Carefully check all vacuum lines and components connected to the hoses for leaks or deformities. Check the vacuum source to the EGR solenoid assembly. Also check for a small leak in the EGR valve, and proper vacuum line routing. Vacuum line ends can be trimmed to ensure a tight fit if length permits.

To run the diagnostic test the engine must be at the operating temperature with the vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

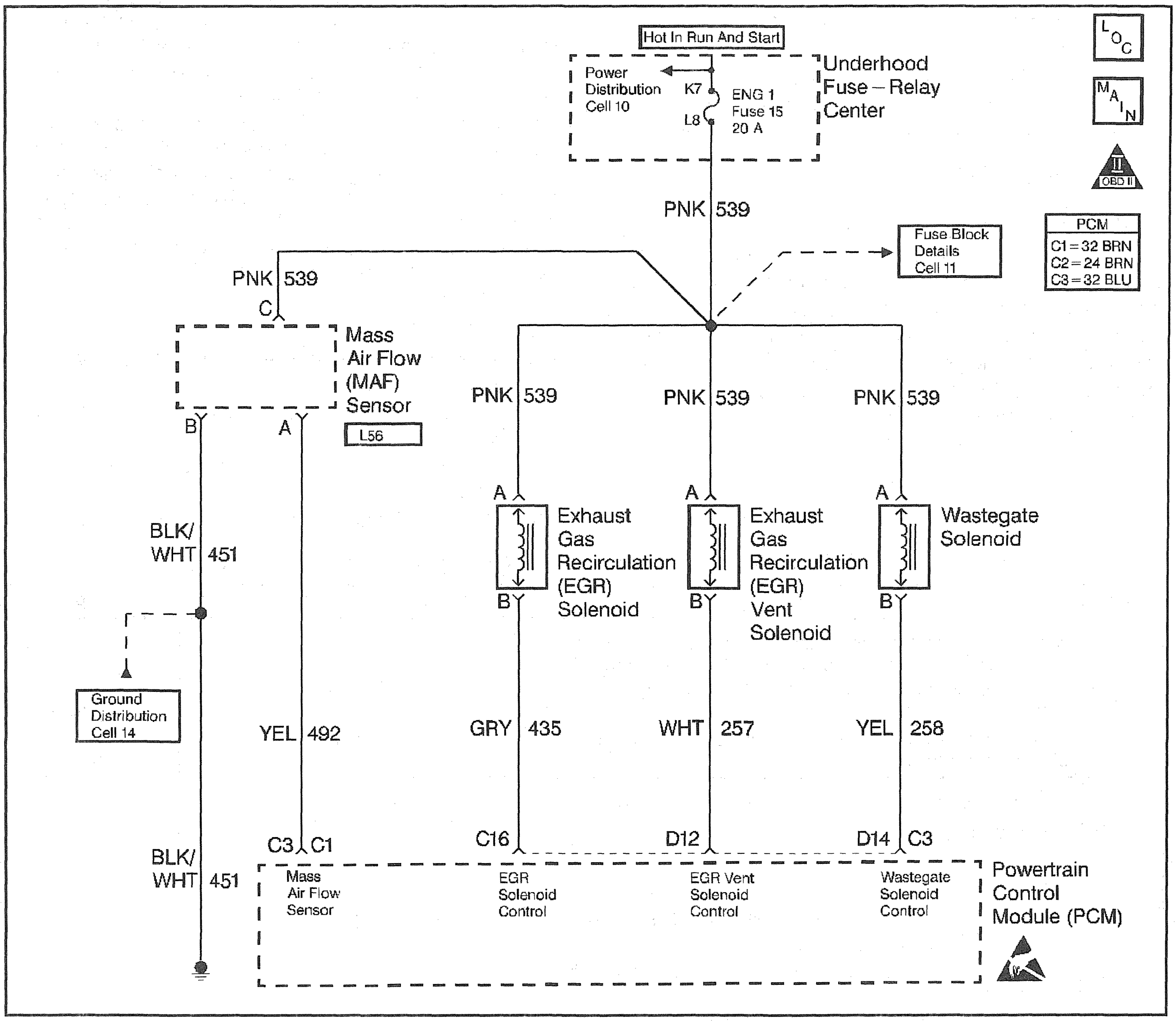
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Vacuum lines should be checked carefully for proper fit and deformities.

DTC P1406 Exhaust Gas Recirculation (EGR) Position Sensor Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are there any other EGR DTCs set?	—	Go To The Applicable DTC Table	*Go to Step 3*
3	Repair one of the following conditions: • Restriction in the vacuum line from the EGR valve to the vacuum tee (including the vacuum tee). • A malfunctioning EGR valve (EGR valve stuck open). Is the action complete?	—	*Go to Step 4*	—
4	**Important:** After the Repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are the EGR ALM cells reset?	—	*Go to Step 5*	—
5	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 6*	*Go to Step 2*
6	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1409 Exhaust Gas Recirculation (EGR) System Performance



185071

Refer to *Emission Hose Routing Diagram*

Circuit Description

The mass air flow (MAF) sensor measures the amount of air entering the engine during a given time. The PCM uses the mass air flow information to monitor EGR flow rates. A large quantity of air entering the engine indicates an acceleration, high load situation or no EGR flow, while a small quantity of air indicates deceleration, idle or full EGR situations.

The PCM will monitor MAF and EGR pressures at different ranges to determine correct EGR flow rates. Conditions for Running the DTC

- DTCs P0405, P0406, P0102 and P0103 not set.
- Engine at operating temperature.
- IAT greater than or equal to 20°C (68°F) and less than or equal to 95°C (203°F).

Conditions for Setting the DTC

IAT greater than or equal to 20°C (68°F) and less than or equal to 95°C (203°F).

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A vacuum leak will cause a DTC P1409. Carefully check all vacuum lines and components connected to the hoses for leaks or deformities. Check the vacuum source to the EGR solenoid assembly. Also check for a small leak in the EGR valve, and proper vacuum line routing. Refer to *Emission Hose Routing Diagram*. Vacuum line ends can be trimmed to ensure a tight fit if length permits.

To run the diagnostic test the engine must be at operating temperature with the vehicle in drive at idle for approximately 1 minute. Then, with the vehicle in park, hold engine rpm steady between 1500 and 2100 rpm for 30 seconds. If the diagnostic test fails to run, the vehicle must be driven.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for a vacuum source to the EGR valve.
3. This step checks for a malfunctioning EGR vent solenoid.
5. This step checks for a good vacuum source.

DTC P1409 Exhaust Gas Recirculation (EGR) System Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Install a vacuum gage in place of the EGR valve. 2. Start the engine. 3. Set the parking brake. 4. Place the shift lever in drive. 5. Using the scan tool, command the EGR solenoid from 0% to 100% duty cycle. 6. At idle, observe the vacuum increase with the duty cycle command. Is the vacuum greater than or equal to the specified value?	15 in. Hg	*Go to Step 4*	*Go to Step 3*
3	1. Disconnect the vacuum feed to the EGR vent solenoid. 2. Install the vacuum gage on the vacuum feed. 3. Start the engine. 4. Place the vehicle in drive. 5. Observe the vacuum gage at idle. Is the vacuum greater than or equal to the specified value?	15 in. Hg	*Go to Step 7*	*Go to Step 5*
4	1. Turn the ignition OFF. 2. Install a vacuum pump on the EGR valve. 3. Pump the vacuum pump up to 15 in. Hg of vacuum. Does the EGR valve hold vacuum?	—	*Go to Step 6*	*Go to Step 11*

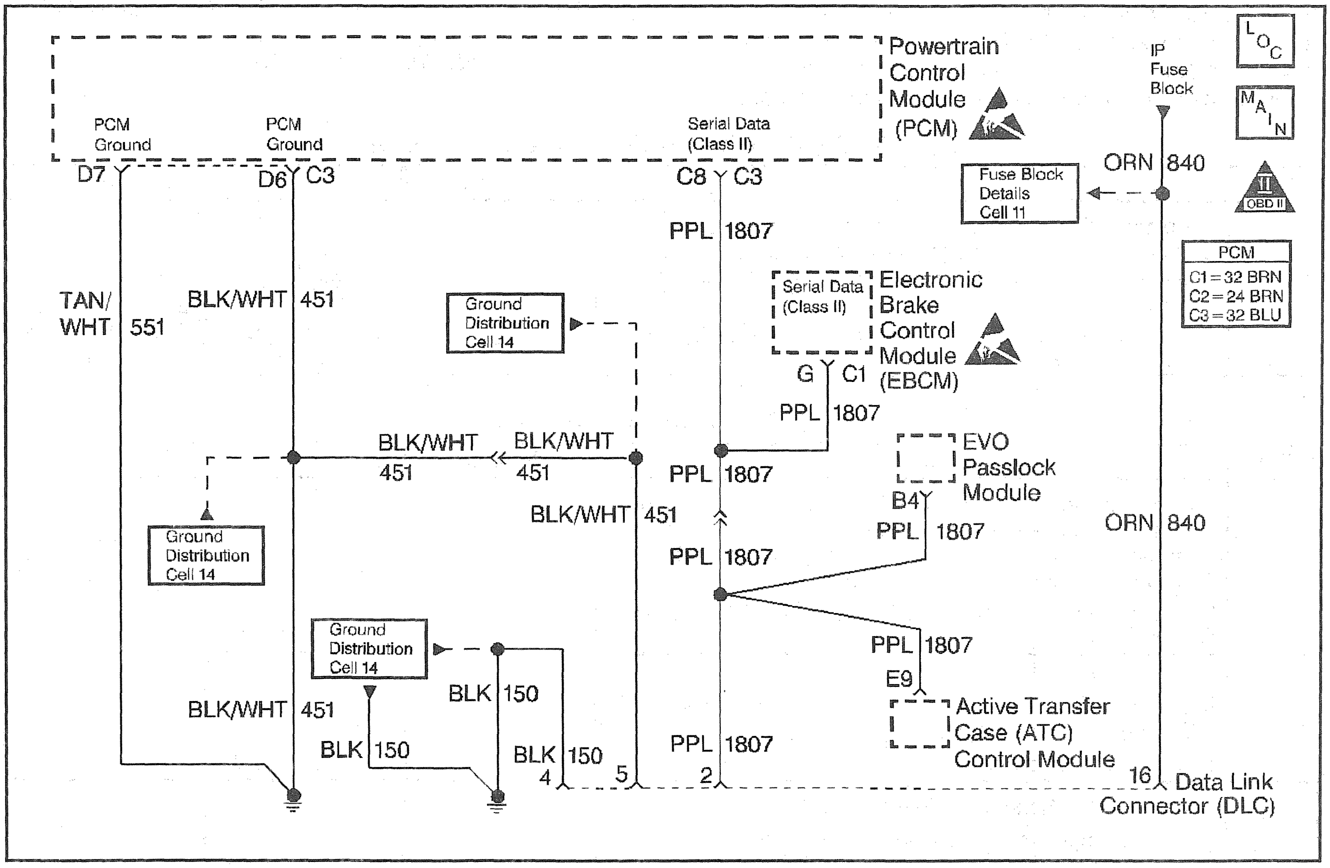
DTC P1409 Exhaust Gas Recirculation (EGR) System Performance (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the vacuum feed to the EGR solenoid. 2. Install the vacuum gage on the vacuum feed. 3. Start the engine. 4. Observe the vacuum gage at idle. Is the vacuum greater than or equal to the specified value?	15 in. Hg	*Go to Step 10*	*Go to Step 8*
6	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
7	Repair one of the following: • Leaking, restricted or deformed vacuum hoses from the EGR vent solenoid to the EGR valve and the EGR pressure control/BARO sensor. • A malfunctioning EGR vent solenoid. Is the action complete?	—	*Go to Step 12*	—
8	1. Check for a leaking or deformed vacuum hose to the vacuum pump. 2. Repair as necessary. Was a problem found?	—	*Go to Step 12*	*Go to Step 9*
9	Replace the vacuum pump. Is the action complete?	—	*Go to Step 12*	—
10	Repair one of the following: • Leaking, restricted or deformed vacuum hoses between the EGR solenoid and the EGR vent solenoid. • Malfunctioning EGR solenoid. Is action complete?	—	*Go to Step 12*	—
11	Replace the EGR valve. Refer to *EGR Valve Replacement*. Is the action complete?	—	*Go to Step 12*	—
12	**Important:** After the Repairs, the EGR ALM cells must be reset (under special functions in scan tool). Are the EGR ALM cells reset?	—	*Go to Step 13*	—
13	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 14*	*Go to Step 2*
14	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1621 EEPROM Write

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1626 VTD Controller Serial Data Circuit



192130

Circuit Description

The Passlock Module receives the code from the hall effect sensor in the steering column and compares it to the code the Passlock module learned at the first power up at the factory. If this code matches the code stored in the Passlock module, the Passlock module will send a fuel continue message to the PCM (The PCM enables fuel injection temporarily until the fuel continue/disable decision is made). If the Passlock module does not send a code or if the PCM doesn't receive it, the vehicle will not start (start and stall). If the Passlock module and PCM lose communication with each other while the engine is running the Passlock module will Fail–Enable and allow the driver to restart the vehicle on future ignition cycles until communication between the Passlock module and PCM are restored. If the battery is disconnected during this period, the vehicle will lose its Fail–Enable status and will no longer start until communications has been reestablished. If the Passlock module and PCM lose communications with each other while the engine is not running, the Passlock system will disable fuel until communication is restored to prevent vehicle theft. In both cases DTC P1626 will be set. The PCM will not disable fuel injection once it has been enabled within a given ignition cycle to prevent stalling as a result of Passlock system faults.

Conditions for Running the DTC

- The vehicle Theft Deterrent (VTD) system is enabled.
- The fuel enable decision point has been reached.

Conditions for Setting the DTC

- The system has Fail–Enabled due to a loss of communications while the engine is running.

  OR
- No password (code) message is received by the PCM from the Passlock control module prior to the VTD Fuel Decision Point.

Action Taken When the DTC Sets

- The vehicle will not start.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The most likely cause of DTC P1626 is a loss of serial data communication to the Passlock module. Check for loss of power to the Passlock module or for other causes of communication loss. Use the Class 2 Circuit Check in the scan tool to determine if the Passlock module is active (Class 2 Message Monitor on the scan tool). Refer to *A Diagnostic System Check - Theft Deterrent* for further diagnosis.

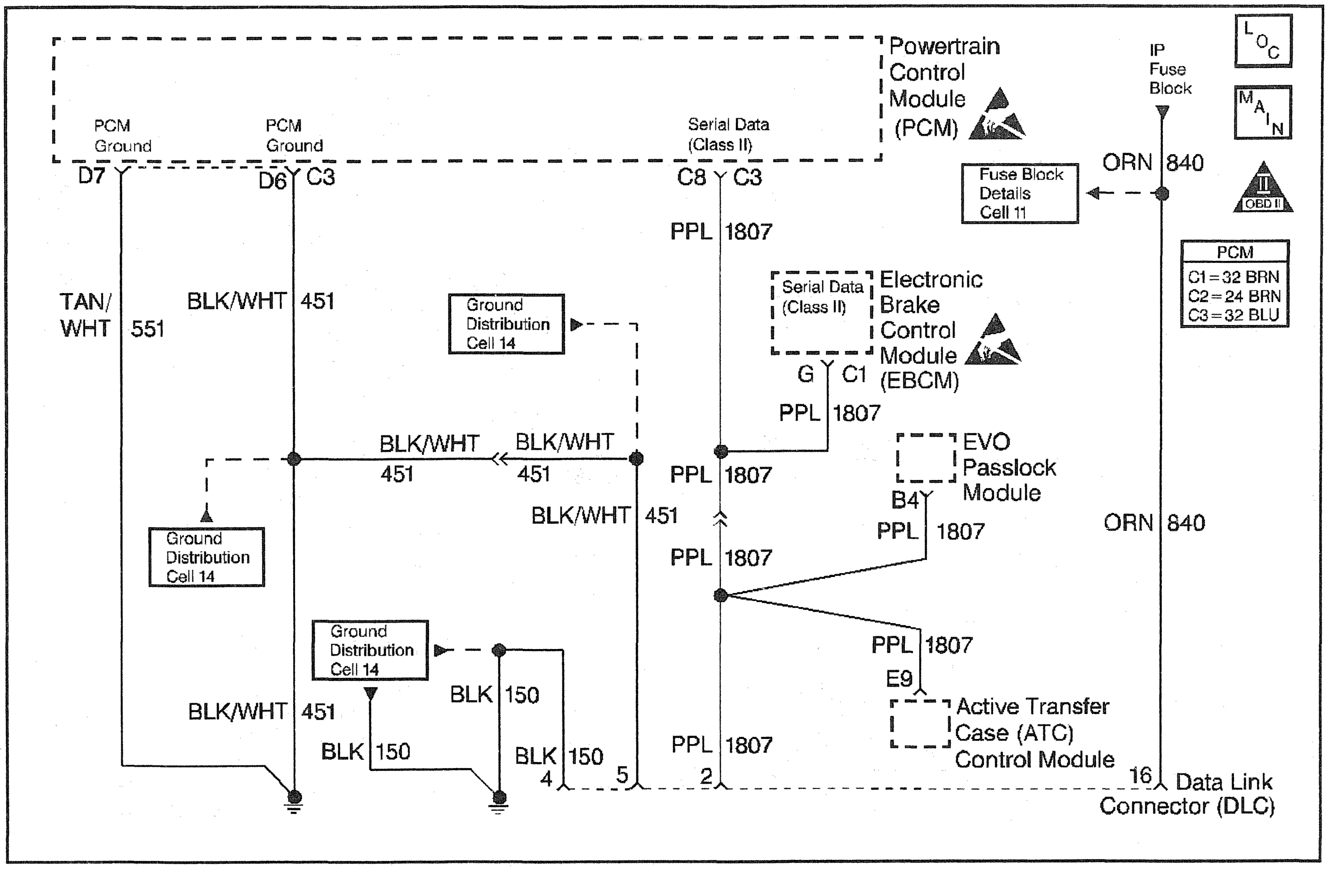
DTC P1626 VTD Controller Serial Data Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs use the scan tool Capture Info to record freeze frame and failure records for reference, as data will be lost when clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *A Diagnostic System Check - Theft Deterrent*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*

DTC P1627 A/D Performance

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 3*	—
3	1. Using the Scan tool, clear the DTCs. 2. Start engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 4*	*Go to Step 2*
4	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1630 Theft Deterrent PCM in Learn Mode



192130

Circuit Description

This diagnostic test checks for the Enable Password Learning Flag indicating the PCM is in learn password mode. This mode allows the PCM to learn the password from the Passlock module at assembly or when being serviced. The password needs to be learned whenever the PCM or the Passlock module is replaced.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

When the Enable Learning Flag is set.

Action Taken When the DTC Sets

The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

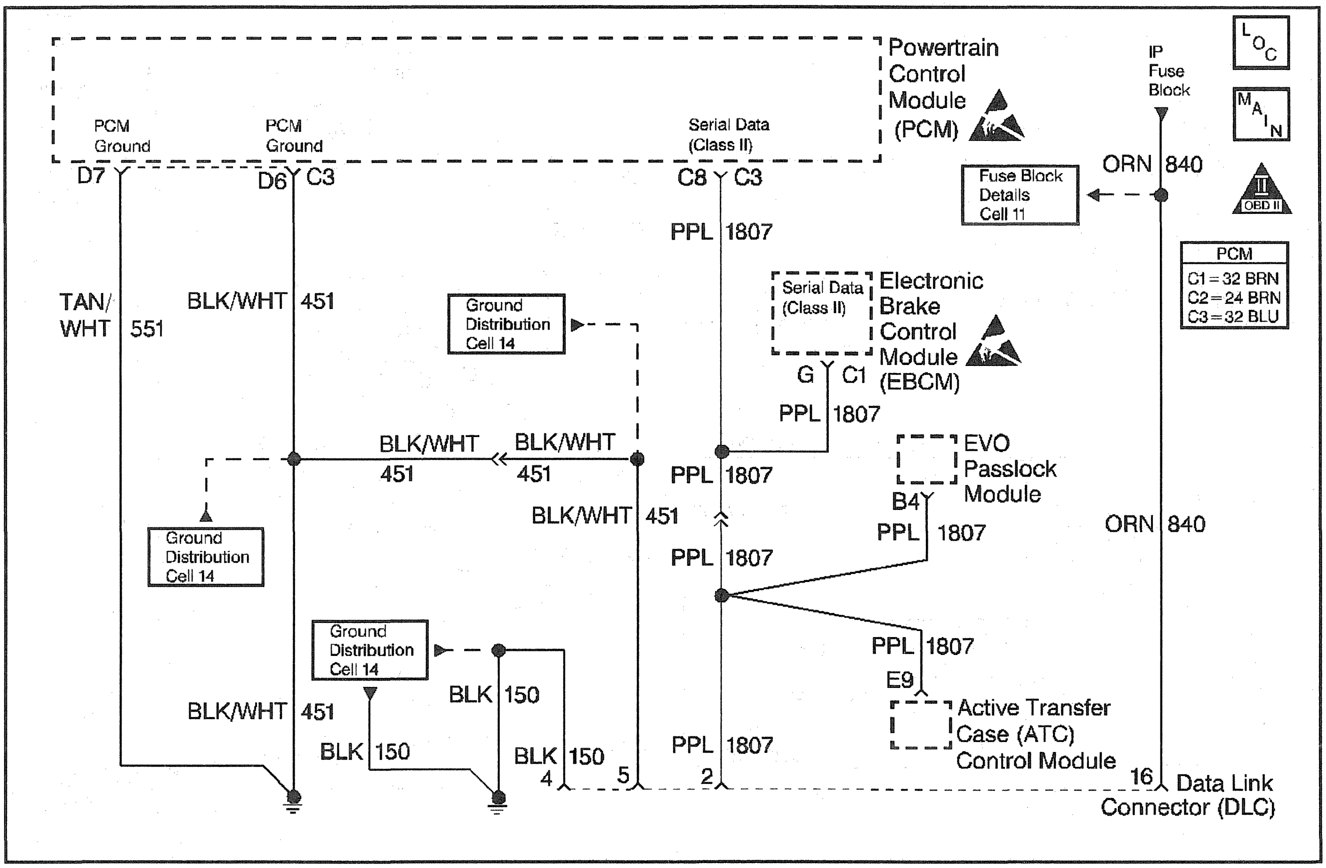
Diagnostic Aids

The PCM in learn mode is a DTC for the vehicle at the assembly plant, dealership and outside garage personnel as an indication that the learn mode is enabled. This means the PCM is now ready to learn a new password. Refer to Vehicle Theft Deterrent system for further diagnosis.

DTC P1630 Theft Deterrent PCM in Learn Mode

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs use the scan tool Capture Info to record freeze frame and failure records for reference, as data will be lost when clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to *A Diagnostic System Check - Theft Deterrent* in Theft Deterrent	Go to *A Powertrain On Board Diagnostic (OBD) System Check*

DTC P1631 Theft Deterrent Password Incorrect



192130

Circuit Description

This test checks for mismatched (incorrect) passwords between the Passlock module and PCM. Whenever the Passlock module or PCM are replaced, a theft learn procedure must be followed in order for the new password to be learned.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

An incorrect fuel continue password has been received from the Passlock module.

Action Taken When the DTC Sets

- The VTD system is enabled.
- The vehicle will not start.
- The malfunction indicator lamp (MIL) will not illuminate.

Conditions for Clearing the DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

Refer to Vehicle Theft Deterrent system for further diagnosis.

Test Description

Number(s) below refer to the step number(s) on the diagnostic table.

3. The 10 minute and 30 second time criteria, are a minimum required amount of time. The time limit can exceed this limit, without interfering with the Auto Learn Procedure. A scan tool can be used (VTD Auto Learn Timer equals Inactive) to determine when the 10 minutes has expired.
4. The security lamp will remain ON until 10 minute timer is complete. Depending on the component replaced, the lamp may remain ON steady or flash.
8. If DTC P1631 is set, indicates that the procedure was not followed correctly. The Re-learn procedure will have to be re-performed.

DTC P1631 Theft Deterrent Password Incorrect

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs use the scan tool Capture Info to record freeze frame and failure records for reference, as data will be lost when clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	**Important:** Before proceeding with this table, check for any Vehicle Theft Deterrent (VTD) DTCs being set (except if you were sent here from PCM replacement). If VTD DTCs are set, refer to the appropriate DTC. Is a T-50/T-60 available?	—	*Go to Step 5*	*Go to Step 3*
3	Is a Tech 2 available?	—	*Go to Step 6*	*Go to Step 4*
4	**Important:** While the PCM is in the Auto Learn Procedure, battery voltage must be maintained at all times. This procedure must be followed exactly as indicated or the procedure will have to be repeated from the beginning. **Important:** Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once it is set, turn the ignition off for 30 seconds, then turn the ignition back on and P1630 will clear. If it does not, go to DTC P1630 table. 1. Attempt to start vehicle (vehicle will start and stall), after the engine has stalled leave the ignition ON for 10 minutes (security light will remain on for 10 minutes and then go out). 2. After the Security lamp turns OFF, turn the ignition off for 30 seconds. 3. Again, attempt to start vehicle (vehicle will start and stall), after the engine has stalled leave the ignition ON for 10 minutes (security light will remain on for 10 minutes and then go out). 4. After the Security lamp turns OFF, turn the ignition off for 30 seconds. 5. Again, attempt to start vehicle (vehicle will start and stall), after the engine has stalled leave the ignition ON for 10 minutes (security light will remain on for 10 minutes and then go out) or until DTC P1630 sets. 6. Turn the ignition off for 30 seconds. 7. Turn the ignition on and wait 30 seconds. 8. Attempt to start the engine. Does the engine start and operate normally?	—	*Go to Step 7*	*Go to Step 8*

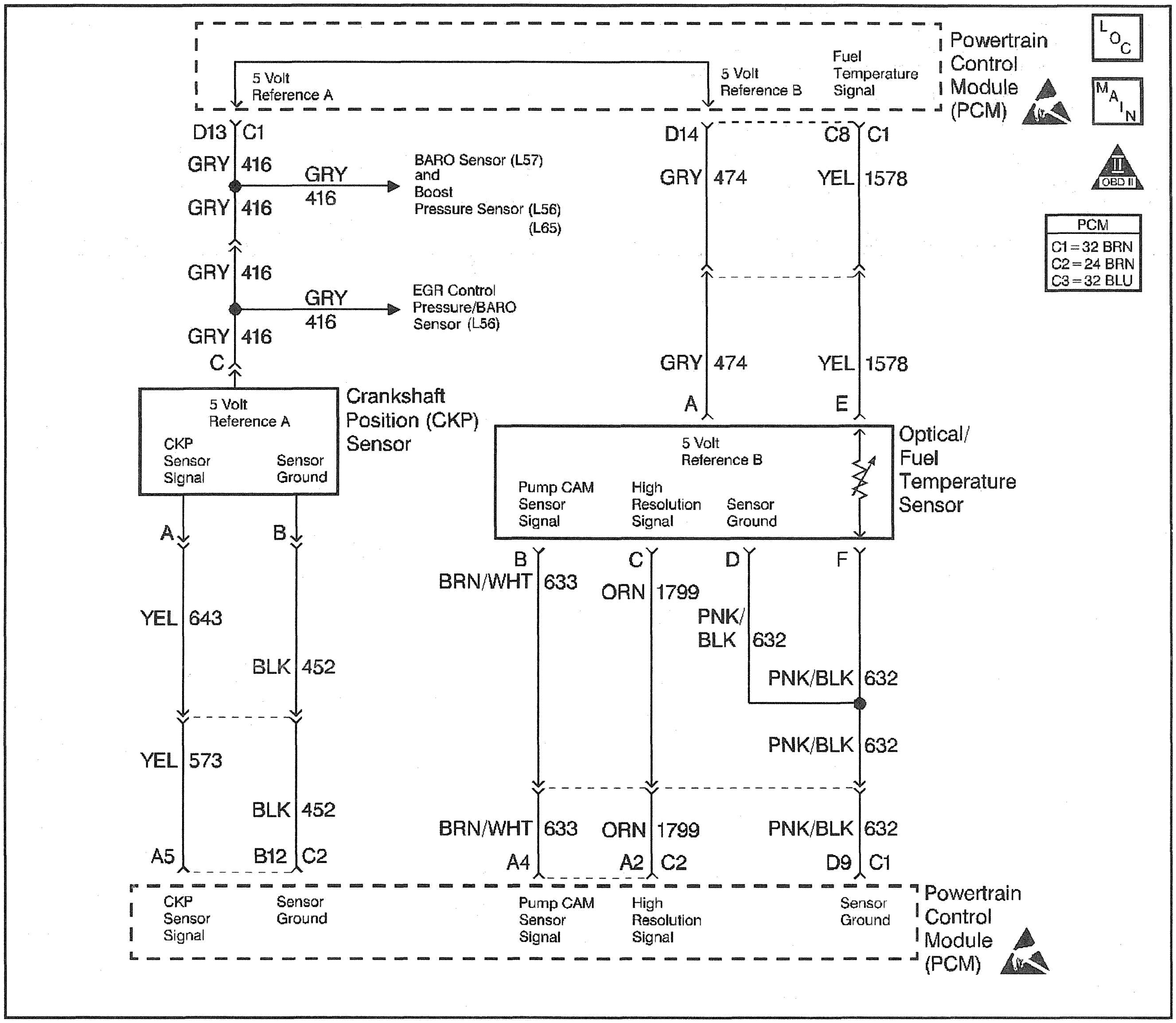
DTC P1631 Theft Deterrent Password Incorrect (cont'd)

Step	Action	Value(s)	Yes	No
5	**Important:** Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once it is set, turn the ignition off for 30 seconds, then turn the ignition back on and P1630 will clear. If it does not, go to DTC P1630 table. 1. Using Techline terminal, enter the Service Programming System (SPS). 2. Select terminal to vehicle programming. 3. Select Done and follow instructions on Vehicle Set-up screen 4. Select Vehicle Theft Re-learn. 5. Follow the instructions on the remaining screens. • The PCM and the Passlock control module will be prepared for a re-learn. • A security timer will be on for approximately 10 minutes or until DTC P1630 sets. It is important that during the 10 minute-wait, the user keep the terminal connected to the vehicle. • When the PCM and the Passlock control module are prepared to re-learn, turn the ignition OFF for 30 seconds and then start the engine. Does the engine start and operate normally?	—	*Go to Step 7*	*Go to Step 8*
6	**Important:** Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once it is set, turn the ignition off for 30 seconds, then turn the ignition back on and P1630 will clear. If it does not, go to DTC P1630 table. 1. Using a scan tool enter the Service Programming System (SPS). 2. After entering the vehicle information, choose the Request Info soft key on the scan tool. 3. Select Done and follow instructions on Vehicle Set-up screen 4. Disconnect the scan tool from the vehicle and connect to the Techline terminal. 5. At the Techline terminal select Service Programming System (SPS) and select terminal to scan tool programming method. Select Done. 6. Follow the instructions on the remaining screens. 7. Select Vehicle Theft Re-learn. 8. Select Program at the summary screen. The terminal will download information to the scan tool. 9. Return the scan tool to the vehicle and connect to Diagnostic Link Connector (DLC). 10. Select Service Programming from the scan tool main menu. Answer the prompts regarding the model year and vehicle type. Press the Theft Re-learn soft key on the scan tool. 11. Follow the instructions on the remaining screens. • The PCM and the Passlock control module will be prepared for re-learn. • A security timer will be on for approximately 10 minutes or until DTC P1630 sets. It is important that during the 10 minute-wait, the user keep the terminal connected to the vehicle. • When the PCM and the Passlock control module are prepared to re-learn, turn the ignition OFF for 30 seconds and then start the engine. Does the engine start and operate normally?	—	*Go to Step 7*	*Go to Step 8*

DTC P1631 Theft Deterrent Password Incorrect (cont'd)

Step	Action	Value(s)	Yes	No
7	**Important:** Before Clearing DTCs, monitor all DTC status parameters and note any additional DTCs. 1. Clear PCM DTCs. 2. Turn the ignition off for 30 seconds. 3. Attempt to start the engine. Does the engine start and operate normally?	—	System OK	*Go to Step 8*
8	Are DTCs P1626, P1630 or P1631 set?	—	Go to Applicable DTC table	*Go to Step 2*

DTC P1635 5 Volt Reference Low



Circuit Description

The PCM provides a 5 volt supply for use in powering up sensors. This test monitors the voltage present at terminals BRD13 (shared by Boost, EGR control pressure/BARO and crankshaft position sensors) and BRD14 (optical/fuel temperature sensor (cam/hl.res).

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

5 volt reference is less than 1 volt.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

During the time the failure is present, the setting of additional DTCs that share a 5 volt reference may also set.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to confirm that a DTC is still present.
3. Checks to determine if there is a 5 volt reference from the PCM.
4. Checks to determine if there is a short–to–ground in the reference circuit or a short–to–ground in the PCM.
7. This step determines if the short is being caused by one of the sensors on the engine or the short is in the wiring harness.

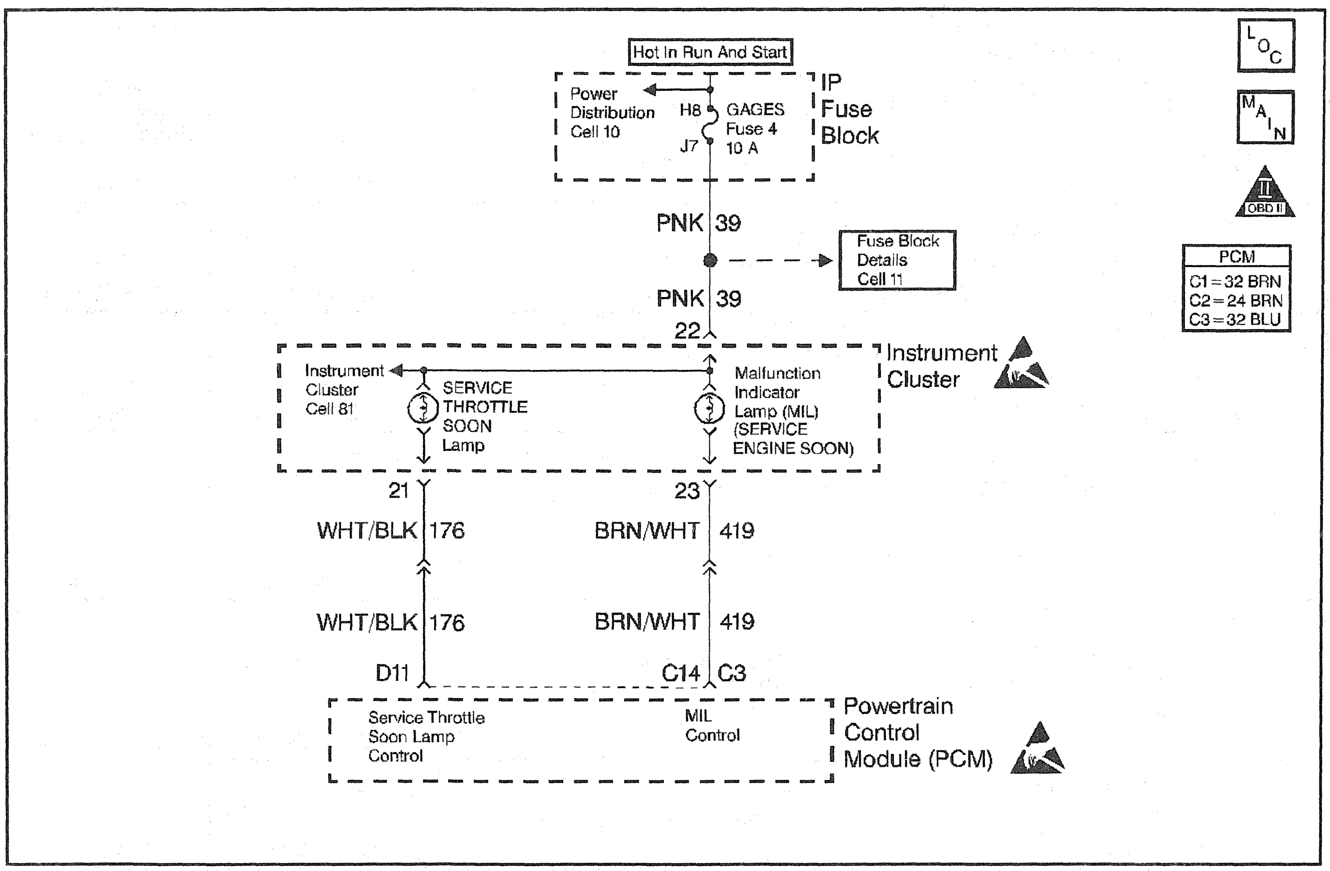
DTC P1635 5 Volt Reference Low

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Install a Scan Tool. 2. Crank engine for 15 seconds or until start up. Does the DTC reset?	—	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition ON leaving the engine OFF. 2. Disconnect the Boost sensor. 3. With *J 39200* DMM, probe the 5 volt reference circuit at the harness connector. Is the voltage less than the specified value?	4.0 V	*Go to Step 4*	*Go to Step 6*
4	1. Disconnect the PCM connector with the Boost sensor 5 volt reference circuit. 2. With a test light connected to B+, probe the 5 volt reference circuit at the PCM harness. Is the test light ON?	—	*Go to Step 7*	*Go to Step 8*
5	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC table	Go to Diagnostic Aids
6	Replace the Boost sensor. Refer to *Boost Sensor Replacement*. Is the action complete?	—	*Go to Step 12*	—
7	With the test light still probing the Boost sensor 5 volt reference circuit at the PCM, disconnect each sensor, one at a time, that shares the 5 volt reference with the Boost sensor. Does the test light turn OFF when one of the sensors are disconnected?	—	*Go to Step 9*	*Go to Step 10*
8	1. Disconnect the PCM connector with the fuel temperature sensor 5 volt reference circuit. 2. With a test light connected to B+, probe the fuel temperature 5 volt reference circuit at the PCM harness. Is the test light ON?	—	*Go to Step 10*	*Go to Step 11*
9	Replace the sensor that caused the test light to turn OFF. Is the action complete?	—	*Go to Step 12*	—
10	Repair the short to ground in 5 volt reference circuit. Is the action complete?	—	*Go to Step 12*	—

DTC P1635 5 Volt Reference Low (cont'd)

Step	Action	Value(s)	Yes	No
11	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 12*	—
12	1. Using the Scan Tool, clear the DTCs. 2. Start the engine and idle at the normal operating temperature. 3. Select the DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle within the conditions for setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan tool indicate the diagnostic Passed?	—	*Go to Step 13*	*Go to Step 2*
13	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC table	System OK

DTC P1641 MIL Control Circuit



Circuit Description

A dash light is illuminated by the PCM if diagnostics have detected certain errors related to the engine performance or engine sensor status. When the PCM is commanding the MIL ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the MIL OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM is to supply the ground for the MIL circuit.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

The voltage on MIL control circuit high (near battery voltage) when the MIL is requested ON.

or

Voltage on MIL control circuit low (near 0 volts) when the MIL is requested OFF.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A faulty bulb, the control circuit shorted to ground or battery voltage, will cause a P1641 to set.

An intermittent can be caused by the following:

- Poor connections
- Rubbed through wire insulation
- Broken wire inside the insulation

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Be sure that both the ON and the OFF states are commanded. Repeat the commands as many times as necessary.
9. If no trouble is found in the control circuit or the connection at the PCM, the PCM maybe malfunctioning, however, this is an extremely unlikely failure.

DTC P1641 MIL Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Start the engine and let the engine idle. 2. Using a scan tool, command the lamp ON and OFF. Does the lamp turn ON and OFF with each command?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the lamp control circuit. 3. Turn the ignition ON leaving the engine OFF. Is the lamp OFF?	—	*Go to Step 5*	*Go to Step 7*
5	1. Turn the ignition ON, leaving the engine OFF. 2. With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector. Is the lamp ON?	—	*Go to Step 6*	*Go to Step 8*
6	1. Check for proper connections at PCM. 2. If a problem was found, repair as necessary. Was a repair performed?	—	*Go to Step 10*	*Go to Step 9*
7	The MIL control circuit is shorted to ground, repair as necessary. Is the action complete?	—	*Go to Step 10*	—
8	Check the MIL circuit for the following: • Open ignition feed to the bulb. • Malfunctioning bulb. • Control circuit open or shorted to B+. Is the repair complete?	—	*Go to Step 10*	—
9	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 10*	—
10	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 11*	*Go to Step 2*
11	Does the Scan tool display any additional undiagnosed DTCs?	—	Go the Applicable DTC Table	System OK

DTC P1643 Wait to Start Lamp Control Circuit

Refer to *Glow Plug Controls*

Circuit Description

A dash light (Wait To Start) is illuminated by the PCM when the glow plugs are commanded ON. When the PCM is commanding the Wait To Start lamp ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the Wait To Start lamp OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM is to supply the ground for the Wait To Start lamp circuit.

Conditions for Running the DTC

The ignition switch is in the ON position.

Conditions for Setting the DTC

The voltage on the Wait To Start lamp circuit is high (near battery voltage) when the Wait To Start lamp is requested ON.

or

The voltage on the Wait To Start lamp control circuit is low (near 0 volts) when the Wait To Start lamp is requested OFF.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A faulty bulb or the control circuit shorted to ground will cause a P1643 to set.

Test Description

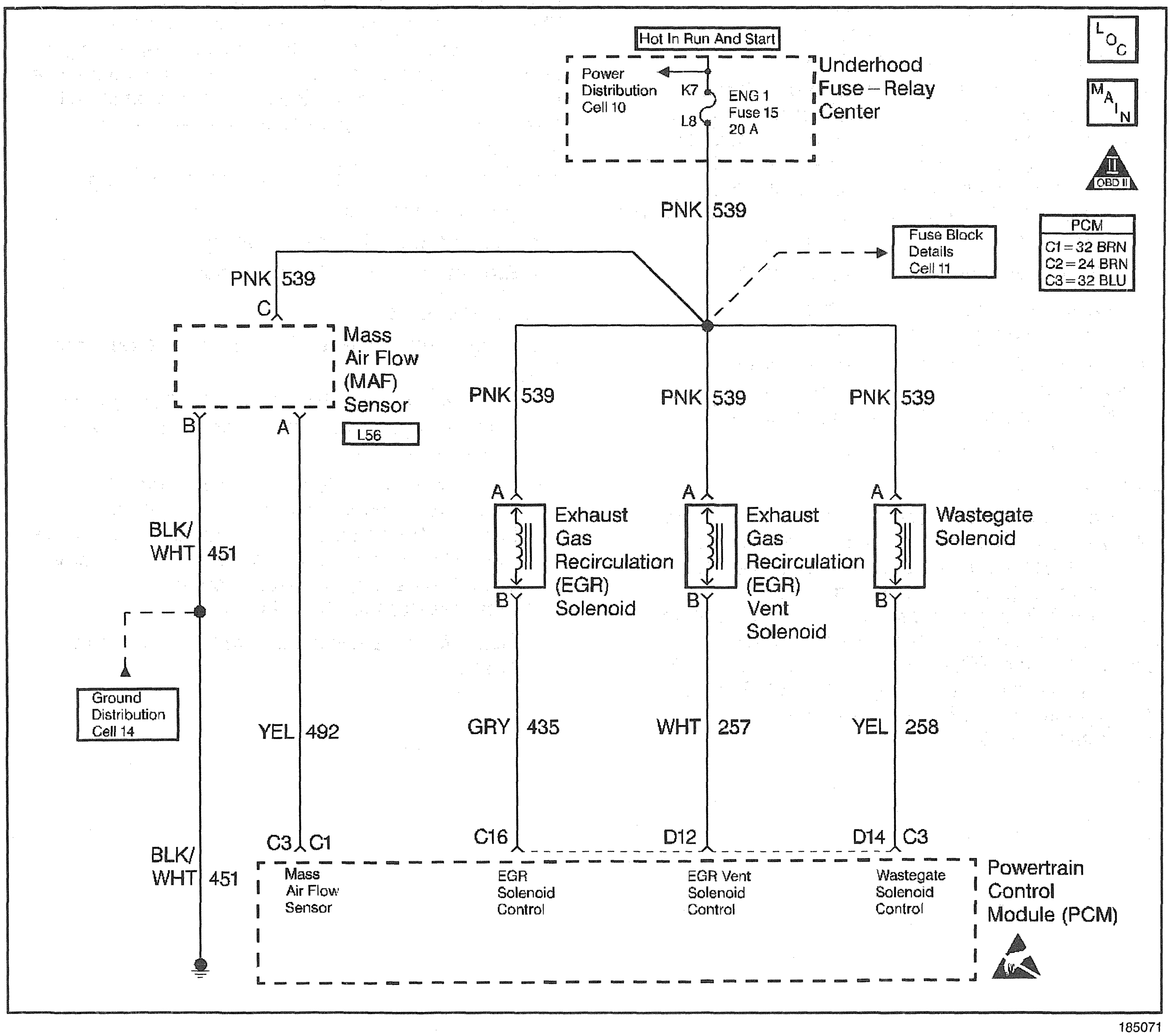
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Repeat the command as many times as necessary (when glow plugs are commanded ON by the scan tool, an internal PCM timer protects the glow plugs from damage by cycling them ON for 3 seconds and OFF for 12 seconds. After the 12 seconds has elapsed, the glow plugs can be commanded ON again).
9. If no trouble is found in the control circuit or the connection at the PCM, the PCM maybe malfunctioning, however, this is an extremely unlikely failure.

DTC P1643 Wait to Start Lamp Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. Using a scan tool, command the glow plug lamp ON and OFF. Does the glow plug lamp turn ON and OFF with each command?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are additional DTC(s) stored?	—	Go to the Applicable DTC table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the Wait To Start lamp control circuit. 3. Turn the ignition ON leaving the engine OFF. Is the lamp OFF?	—	*Go to Step 5*	*Go to Step 7*
5	With a fused jumper wire connected to ground, probe the Wait To Start lamp control circuit in the PCM harness connector. Is the lamp ON?	—	*Go to Step 6*	*Go to Step 8*
6	Check the connections at PCM. Was a repair performed?	—	*Go to Step 10*	*Go to Step 9*
7	The Wait To Start control circuit is shorted to ground, repair as necessary. Is the action complete?	—	*Go to Step 10*	—
8	Check the Wait To Start circuit for the following. • Open ignition feed to the bulb • malfunctioning bulb • Control circuit open or shorted to B+ Was a repair performed?	—	*Go to Step 10*	—
9	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 10*	—
10	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 11*	*Go to Step 2*
11	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1653 EGR Vent Solenoid Control Circuit



Circuit Description

The EGR flow is controlled by the vacuum actuated EGR valve. The EGR vent solenoid purges to atmosphere the vacuum level at the EGR valve actuator as commanded by the PCM. This is done when the EGR flow is desired to turn off quickly. When the PCM is commanding the EGR vent ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the EGR vent OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM in this circuit is to supply the ground for the EGR vent solenoid.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the EGR vent control circuit is high (near battery voltage) when the EGR vent is requested ON.

  or

- The voltage on the EGR vent control circuit is low (near 0 volts) when the EGR vent is requested OFF.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The scan tool has a 5 second ON time abort. The EGR vent solenoid can be commanded ON for as many times as needed, in 5 second intervals. Its possible other EGR DTCs may set along with DTC P1653. This diagnostic can be checked at key up. A quick operational check can be made by commanding the EGR vent solenoid ON and OFF with the scan tool while monitoring Actual EGR. Actual EGR will display BARO (approximately) when EGR solenoid is OFF.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

An intermittent may be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Be sure that both the ON and OFF states are commanded. Repeat the commands as many times as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open (Amps drop to zero, or short (Amp draw greater than 0.75 A).
7. Listen for an audible click when the solenoid operates.

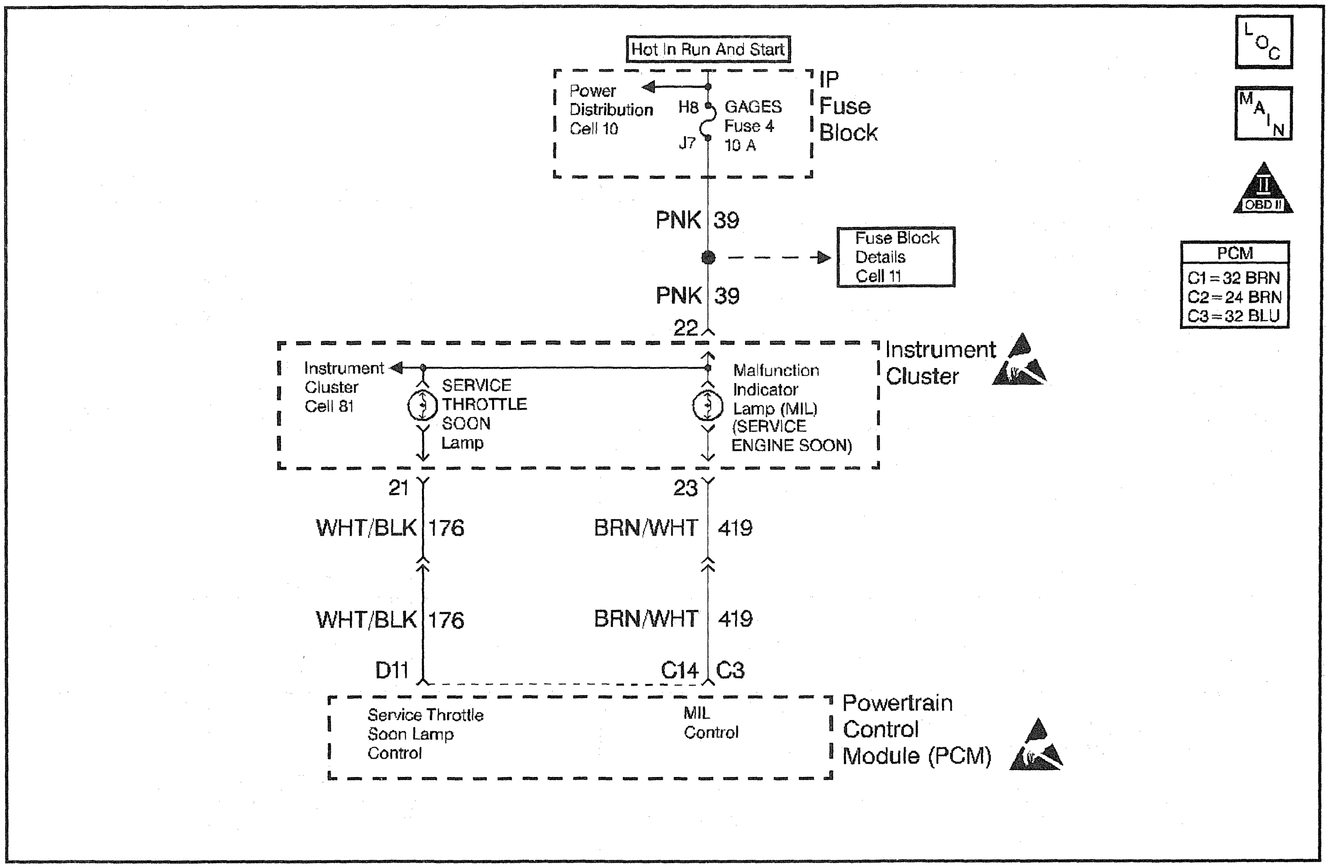
DTC P1653 EGR Vent Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start and idle the engine. 3. Set the parking brake. 4. Place the shift lever in drive. 5. With the scan tool, command the EGR solenoid On and OFF. Does the actual EGR respond to the scan tool commands?	—	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the EGR vent solenoid control circuit. 3. Turn the ignition ON leaving the engine OFF. 4. Using a DMM *J 39200* on the 10 Amp scale, measure the current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes. Is the current draw less then the specified value, but not zero?	0.75 A	*Go to Step 8*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Verify the PCM connector is still disconnected. 3. Disconnect the EGR solenoid. 4. Using a *J 39200* digital multimeter measure the resistance from the solenoid control circuit in the PCM connector to ground. Does the digital multimeter display infinite resistance?	—	*Go to Step 13*	*Go to Step 10*
5	1. Turn the ignition OFF. 2. Disconnect the EGR solenoid. 3. Turn the ignition ON, leaving the engine OFF. 4. Connect a test light between the EGR vent solenoid control circuit and the ignition feed circuit at the harness connector. 5. Using a scan tool, command the solenoid ON and OFF Does the test light turn ON and OFF with each command?	—	*Go to Step 9*	*Go to Step 6*
6	1. Turn the ignition ON, leaving the engine OFF. 2. With a test light connected to ground, probe the ignition feed circuit at the EGR vent solenoid harness connector. Is the test light ON?	—	*Go to Step 7*	*Go to Step 12*
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the PCM harness containing the solenoid control circuit. 4. Turn the ignition ON. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector. Does the solenoid operate?	—	*Go to Step 11*	*Go to Step 10*

DTC P1653 EGR Vent Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
8	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
9	Check for a proper connection at the EGR vent solenoid and replace terminals as necessary. Did the terminal require replacement?	—	*Go to Step 15*	*Go to Step 13*
10	Repair the EGR vent solenoid control circuit. Is the action complete?	—	*Go to Step 15*	—
11	Check for a proper connection at the PCM EGR vent control circuit. Was a problem found?	—	*Go to Step 15*	*Go to Step 14*
12	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 15*	—
13	Replace the EGR vent solenoid. Refer to *EGR Vent Solenoid Replacement*. Is the action complete?	—	*Go to Step 15*	—
14	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 15*	—
15	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 16*	*Go to Step 2*
16	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1654 Service Throttle Soon Lamp Control CKT



185027

Circuit Description

A dash light is illuminated by the PCM if the diagnostics has detected certain errors related to the accelerator pedal position (APP) sensor. When the PCM is commanding the Service Throttle Soon lamp ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the Service Throttle Soon Lamp OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM in this circuit is to supply the ground for the Service Throttle Soon lamp.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the Service Throttle Soon lamp control circuit is high (near battery voltage) when the EGR vent is requested ON.

  or

- The voltage on the Service Throttle Soon lamp control circuit is low (near 0 volts) when the EGR vent is requested OFF.

Action Taken When the DTC Sets

- The PCM will not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions at the time the diagnostic fails. This information is stored in the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

A faulty bulb or the control circuit shorted to ground will cause a P1654 to set.

Test Description

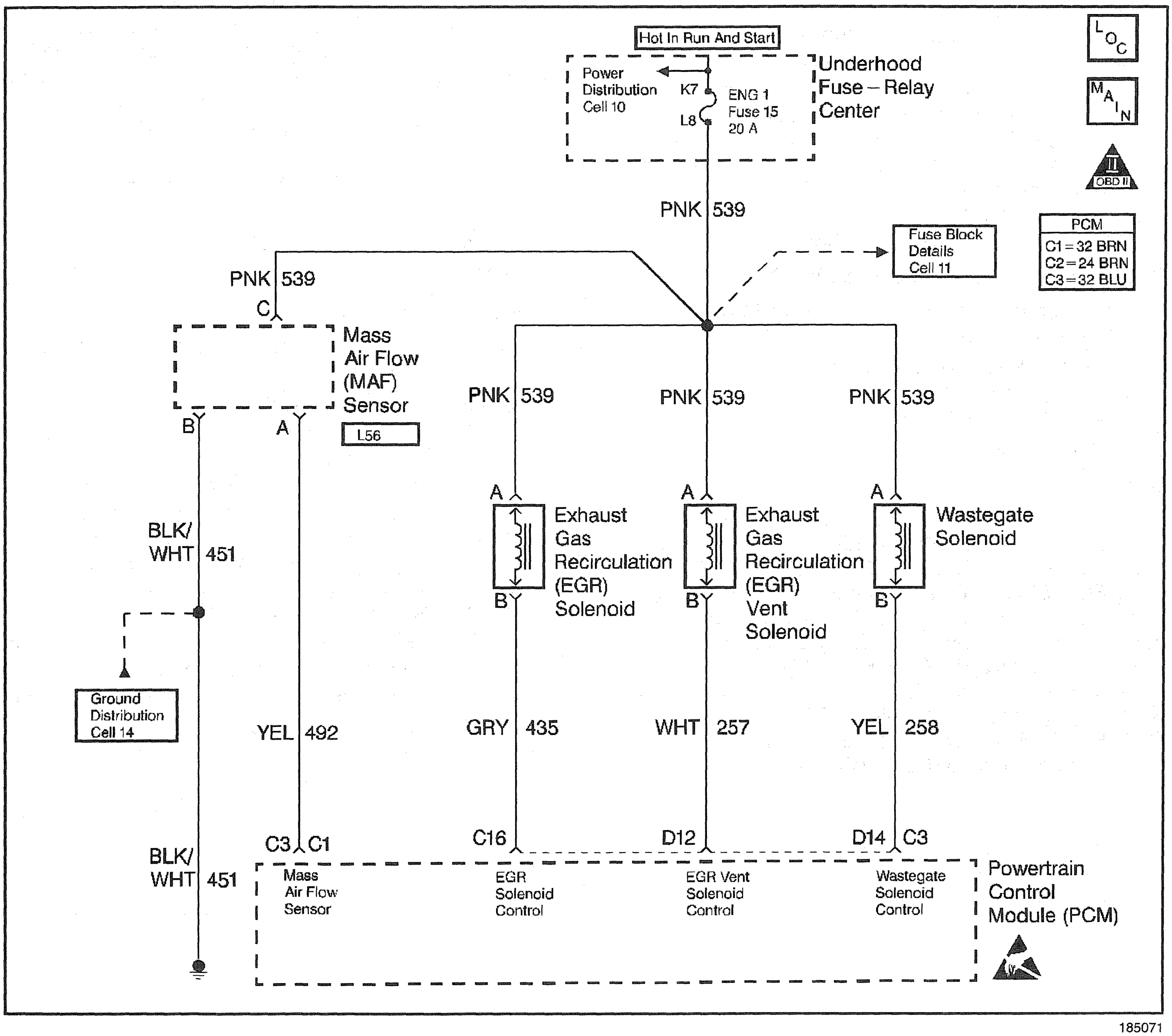
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Be sure that both the ON and the OFF states are commanded. Repeat the commands as many times as necessary.
9. If no trouble is found in the control circuit or the connections at the PCM, the PCM maybe malfunctioning, however, this is an extremely unlikely failure.

DTC P1654 Service Throttle Soon Lamp Control CKT

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Turn the ignition ON leaving the engine OFF. 2. Using a scan tool, command the lamp ON and OFF. Does the lamp turn ON and OFF with each command?	—	*Go to Step 3*	*Go to Step 4*
3	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s). Are any additional DTCs stored?	—	Go to the Applicable DTC table	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the lamp control circuit. 3. Turn the ignition ON leaving the engine OFF. Is the lamp OFF?	—	*Go to Step 5*	*Go to Step 7*
5	With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector. Is the lamp ON?	—	*Go to Step 6*	*Go to Step 8*
6	1. Check for proper connections at PCM. 2. If a problem was found, repair as necessary. Was a repair performed?	—	*Go to Step 10*	*Go to Step 9*
7	The Service Throttle Soon lamp control circuit is shorted to ground, repair as necessary. Is the action complete?	—	*Go to Step 10*	—
8	1. Check the Service Throttle Soon circuit for the following: • Open ignition feed to the bulb. • Malfunctioning bulb. • Control circuit open or shorted to B+. 2. Repair the problem as necessary. Is the repair complete?	—	*Go to Step 10*	—
9	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 10*	—
10	1. Using the Scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the Scan Tool indicates the diagnostic Ran. Does the Scan Tool indicate the diagnostic Passed?	—	*Go to Step 11*	*Go to Step 2*
11	Does the Scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1655 EGR Solenoid Control Circuit



Circuit Description

The EGR flow is controlled by the vacuum actuated EGR valve. The EGR pulse width modulated solenoid meters the vacuum level at the EGR valve actuator as commanded by the PCM. When the PCM is commanding the EGR solenoid ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the EGR solenoid OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM in this circuit is to supply the ground for the EGR solenoid.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the EGR solenoid control circuit is high (near battery voltage) when the EGR vent is requested ON.

  or

- The voltage on the EGR solenoid control circuit is low (near 0 volts) when the EGR vent is requested OFF.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

The scan tool has a 5 second ON time abort. The EGR solenoid can be commanded ON for as many times as needed, in 5 second intervals. It's possible other EGR DTCs may set along with DTC P1655. This diagnostic can be checked at key up. A quick operational check can be made by commanding the EGR solenoid ON and OFF with the scan tool while monitoring Actual EGR. Actual EGR will display Baro (approximately) when the EGR solenoid is OFF. Full EGR will be achieved when the EGR solenoid is commanded ON with the scan tool.

The Adaptive Learn Matrix (ALM) is used to adjust the EGR vacuum control based on mass air flow (MAF). The ALM may change as a result of back pressure increases over the life of the vehicle or other engine system variations. The ALM is made up of sixteen cells (numbered from zero to fifteen) in which each cell covers a range of engine speed (RPM) and load (mm3).

An intermittent may be caused by the following:

- Poor connections.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks that both the ON and OFF states are commanded. Repeat the commands as many times as necessary. This Step will determine if this DTC is a current or intermittent.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open (amps drop to zero), or short (amp draw greater than 0.75A).
7. Listen for an audible click when the solenoid operates. This step checks the ignition feed circuit for an open.

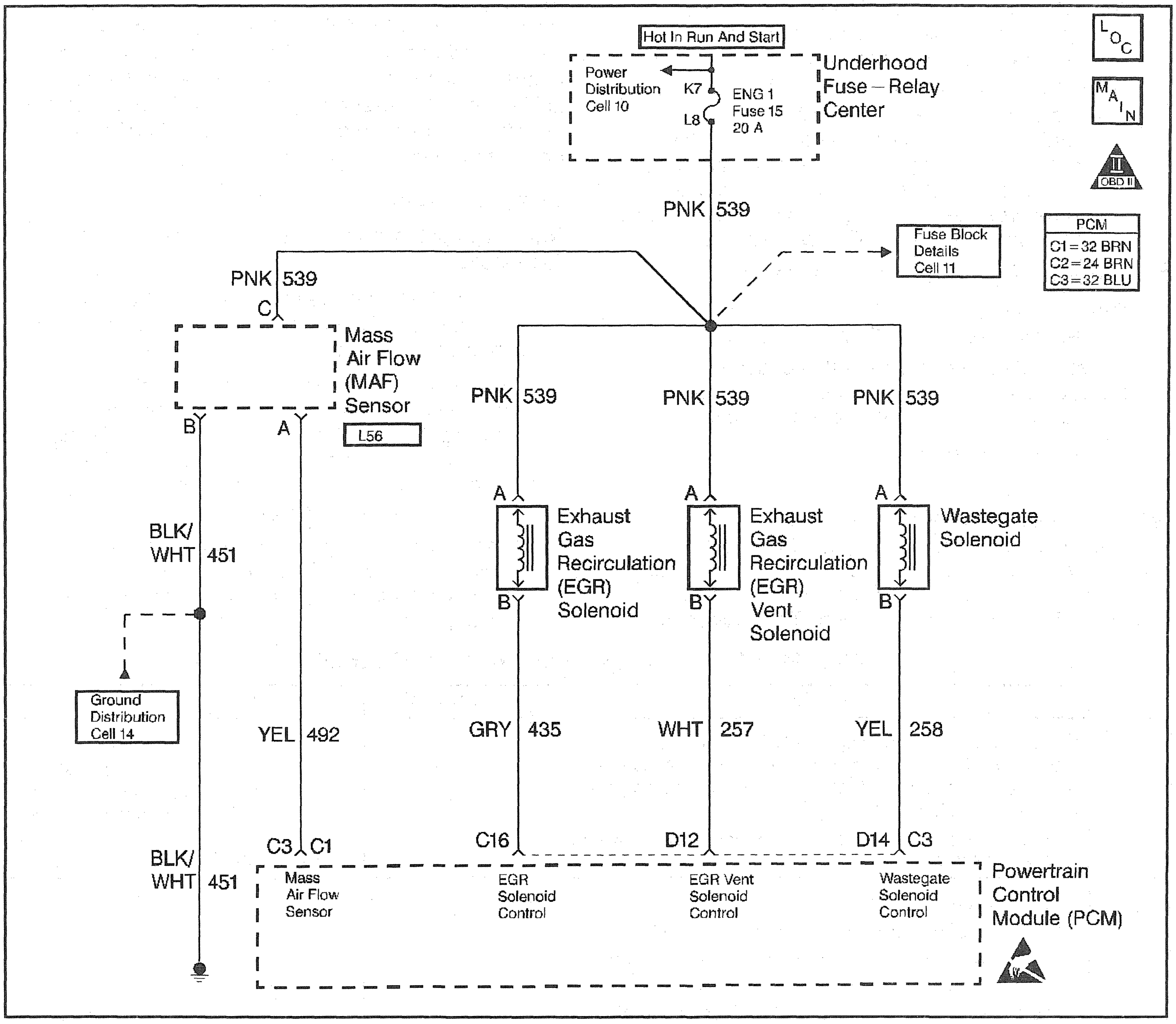
DTC P1655 EGR Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Start and idle the engine. 3. Set the parking brake. 4. Place the vehicle in drive. 5. With the scan tool, command the EGR solenoid ON and OFF. Does the Actual EGR respond to the scan tool commands?	—	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the EGR solenoid control circuit. 3. Turn the ignition ON leaving the engine OFF. 4. Using a DMM *J 39200* on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes. Is the current draw less than the specified value, but not zero?	0.75 A	*Go to Step 8*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Verify the PCM connector is still disconnected. 3. Disconnect the EGR solenoid. 4. Using a DMM, *J 39200* measure the resistance from the solenoid control circuit in the PCM harness connector to ground. Does the DMM display infinite resistance?	—	*Go to Step 13*	*Go to Step 10*
5	1. Disconnect the EGR solenoid 2. Turn the ignition ON leaving the engine OFF. 3. Connect a test light between the EGR solenoid control circuit and the ignition feed circuit at the harness connector. 4. Using a scan tool, command the solenoid ON and OFF. Does the test light turn ON and OFF with each command?	—	*Go to Step 9*	*Go to Step 6*
6	1. Turn the ignition ON leaving the engine OFF. 2. With a test light connected to ground, probe the ignition feed circuit at the EGR solenoid harness connector. Is the test light ON?	—	*Go to Step 7*	*Go to Step 12*
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the PCM harness containing the solenoid control circuit. 4. Turn the ignition ON leaving the engine OFF. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector. Does the solenoid operate?	—	*Go to Step 11*	*Go to Step 10*

DTC P1655 EGR Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
8	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
9	Check for a proper connection at the EGR solenoid and replace any terminals as necessary. Did the terminal require replacement?	—	*Go to Step 15*	*Go to Step 13*
10	Repair the EGR solenoid control circuit. Is the action complete?	—	*Go to Step 15*	—
11	Check for a proper connection at the PCM EGR control circuit. Was a problem found?	—	*Go to Step 15*	*Go to Step 14*
12	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 15*	—
13	Replace the EGR solenoid. Refer to *EGR Solenoid Replacement*. Is the action complete?	—	*Go to Step 15*	—
14	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 15*	—
15	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 16*	*Go to Step 2*
16	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC P1656 Wastegate Solenoid Control Circuit



185071

Circuit Description

The turbocharger wastegate is a vacuum actuated valve used to control the exhaust gas heat sent to the turbo. The wastegate pulse width modulated solenoid meters the vacuum level at the wastegate valve actuator as commanded by the PCM. When the PCM is commanding the wastegate solenoid ON, the voltage potential of the circuit will be low (near 0 volts). When the PCM is commanding the wastegate solenoid OFF, the voltage potential of the circuit will be high (near battery voltage). The primary function of the PCM in this circuit is to supply the ground for the wastegate solenoid.

Conditions for Running the DTC

The ignition switch in the ON position.

Conditions for Setting the DTC

- The voltage on the wastegate solenoid control circuit is high (near battery voltage) when the EGR vent is requested ON.

  or

- The voltage on the wastegate solenoid control circuit is low (near 0 volts) when the EGR vent is requested OFF.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) on the second consecutive drive trip the diagnostic runs and fails.
- The PCM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the Failure Records store this information. If the diagnostic reports a failure on the second consecutive drive trip, the Freeze Frame records the operating conditions at the time of failure and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The PCM will turn the MIL off after three consecutive trips without a fault condition.
- A History DTC clears after forty consecutive warm-up cycles, if this or any other emission related diagnostic does not report any failures
- The use of a scan tool.

Diagnostic Aids

This diagnostic will set when the control circuit does not follow the PCM command (when the solenoid is requested ON voltage will drop, when the solenoid is OFF ignition voltage will be present). The scan tool has a 5 second ON time abort. The wastegate solenoid can be commanded ON for as many times as needed, in 5 second intervals. It's possible DTC P0236 may set along with DTC P1656. This diagnostic can be checked during key up. The engine will not respond to scan tool commands at idle (engine unable to achieve boost pressures greater than BARO at idle) or at any engine speed greater than idle (PCM control aborts to prevent engine damage).

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks that both the ON and OFF states are commanded. Repeat the commands as many times as necessary.
3. This check can detect a partially shorted coil which would cause excessive current flow. Leaving the circuit energized for 2 minutes allows the coil to warm up. When warm, the coil may open (amps drop to zero), or short (amp draw greater than 0.75A).
14. If no trouble is found in the control circuit or the connection at the PCM, the PCM may be malfunctioning. However, this is an extremely unlikely failure.

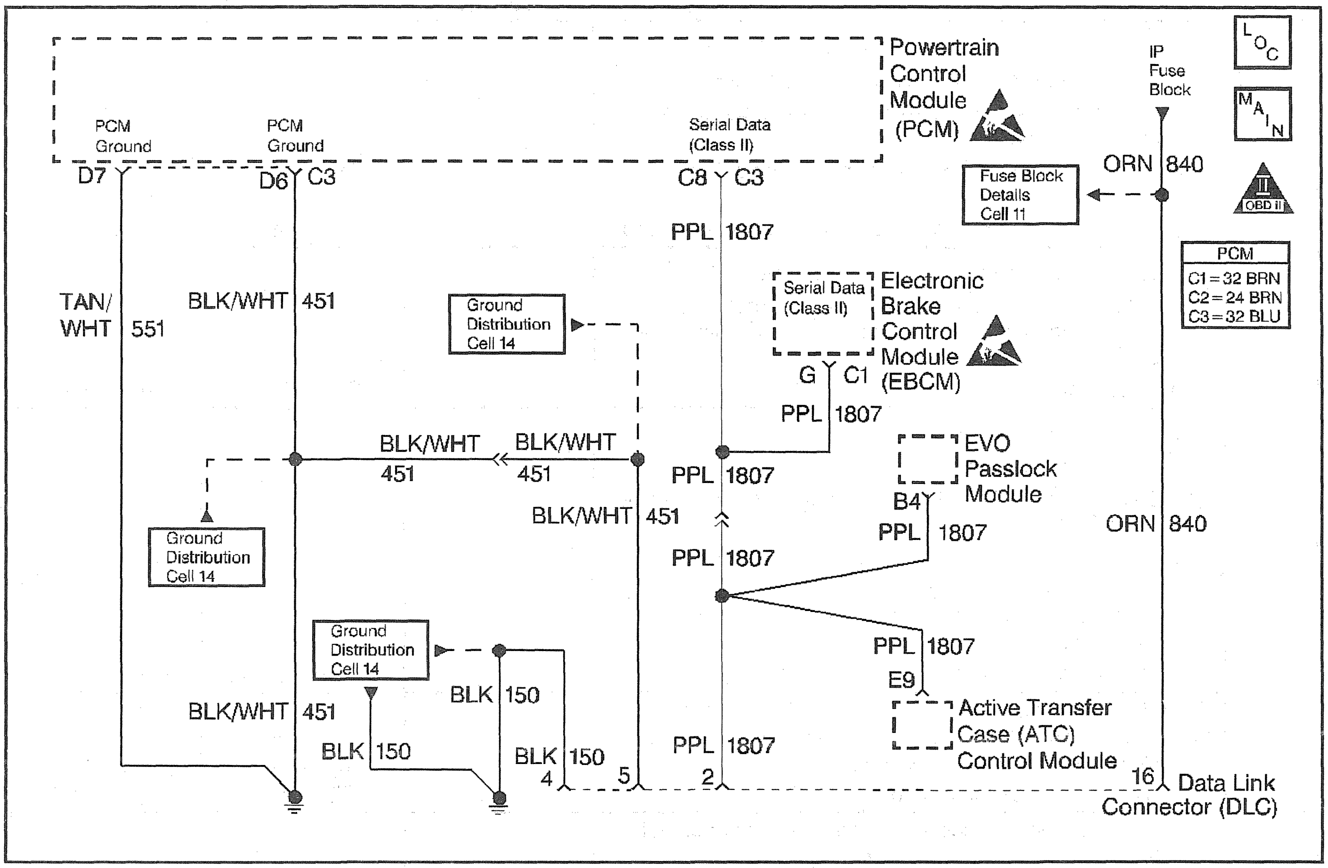
DTC P1656 Wastegate Solenoid Control Circuit

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing any DTCs, use the scan tool Capture Info to save freeze frame and failure records for reference, as the Scan tool loses data when using the Clear Info function. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	1. Connect a scan tool. 2. Turn the ignition ON leaving the engine OFF. 3. With a scan tool, command the wastegate solenoid ON and OFF and listen for an audible click. Does the solenoid turn ON and OFF (audible click) with each command?	—	*Go to Step 3*	*Go to Step 5*
3	1. Turn the ignition OFF. 2. Disconnect the PCM connector containing the wastegate solenoid control circuit. 3. Turn the ignition ON leaving the engine OFF. 4. Using a DMM *J 39200* on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes. Is the current draw less than the specified value, but not zero?	0.75 A	*Go to Step 8*	*Go to Step 4*
4	1. Turn the ignition OFF. 2. Verify the PCM connector is still disconnected. 3. Disconnect the wastegate solenoid. 4. Using a DMM *J 39200*, measure the resistance from the solenoid control circuit in the PCM harness connector to ground. Does the DMM display infinite resistance?	—	*Go to Step 13*	*Go to Step 10*

DTC P1656 Wastegate Solenoid Control Circuit (cont'd)

Step	Action	Value(s)	Yes	No
5	1. Disconnect the wastegate solenoid 2. Turn the ignition ON leaving the engine OFF. 3. Connect a test light between the terminals at the harness connector. 4. Using a scan tool, command the solenoid ON and OFF. Does the test light turn ON and OFF with each command?	—	*Go to Step 9*	*Go to Step 6*
6	1. Turn the ignition ON leaving the engine OFF. 2. With a test light connected to ground, probe the ignition feed circuit at the wastegate solenoid harness connector. Is the test light ON?	—	*Go to Step 7*	*Go to Step 12*
7	1. Turn the ignition OFF. 2. Reconnect the solenoid. 3. Disconnect the PCM harness containing the solenoid control circuit. 4. Turn the ignition ON leaving the engine OFF. 5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector. Does the solenoid operate (audible click)?	—	*Go to Step 11*	*Go to Step 10*
8	The DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are any additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
9	Check for a proper connection at the wastegate solenoid and replace any terminals as necessary. Did any terminals require replacement?	—	*Go to Step 15*	*Go to Step 13*
10	Repair the wastegate solenoid control circuit. Is the action complete?	—	*Go to Step 15*	—
11	Check for a proper connection at the PCM wastegate solenoid control circuit. Was a problem found?	—	*Go to Step 15*	*Go to Step 14*
12	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 15*	—
13	Replace the wastegate solenoid. Refer to *Wastegate Solenoid Replacement*. Is the action complete?	—	*Go to Step 15*	—
14	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming*. Is the action complete?	—	*Go to Step 15*	—
15	1. Using the scan tool, clear the DTCs. 2. Start the engine and idle at normal operating temperature. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle, within the Conditions for Setting this DTC, until the scan tool indicates the diagnostic Ran. Does the scan tool indicate the diagnostic Passed?	—	*Go to Step 16*	*Go to Step 2*
16	Does the scan tool display any additional undiagnosed DTCs?	—	Go to the Applicable DTC Table	System OK

DTC U1026 Loss of ATC Class 2 Communication



192130

Circuit Description

The PCM monitors the serial data (class II) circuit for communications from the Automatic Transfer Case (ATC) controller. If the ATC controller is not communicating with the PCM this DTC will set.

Conditions for Setting the DTC

No serial data (class II) from ATC controller to the PCM.

Action Taken When the DTC Sets

This DTC will not illuminate the MIL.

Conditions for Clearing the MIL/DTC

- A History DTC will clear after 40 consecutive warm up cycles with no failures of any non-emissions related diagnostic test.
- PCM battery voltage is interrupted.
- Use of a scan tool.

Diagnostic Aids

This DTC will not set unless the PCM and ATC controllers have already establish communications first.. This DTC will only diagnosis an open or intermittent connection from the ATC controller to the splice.

Test Description

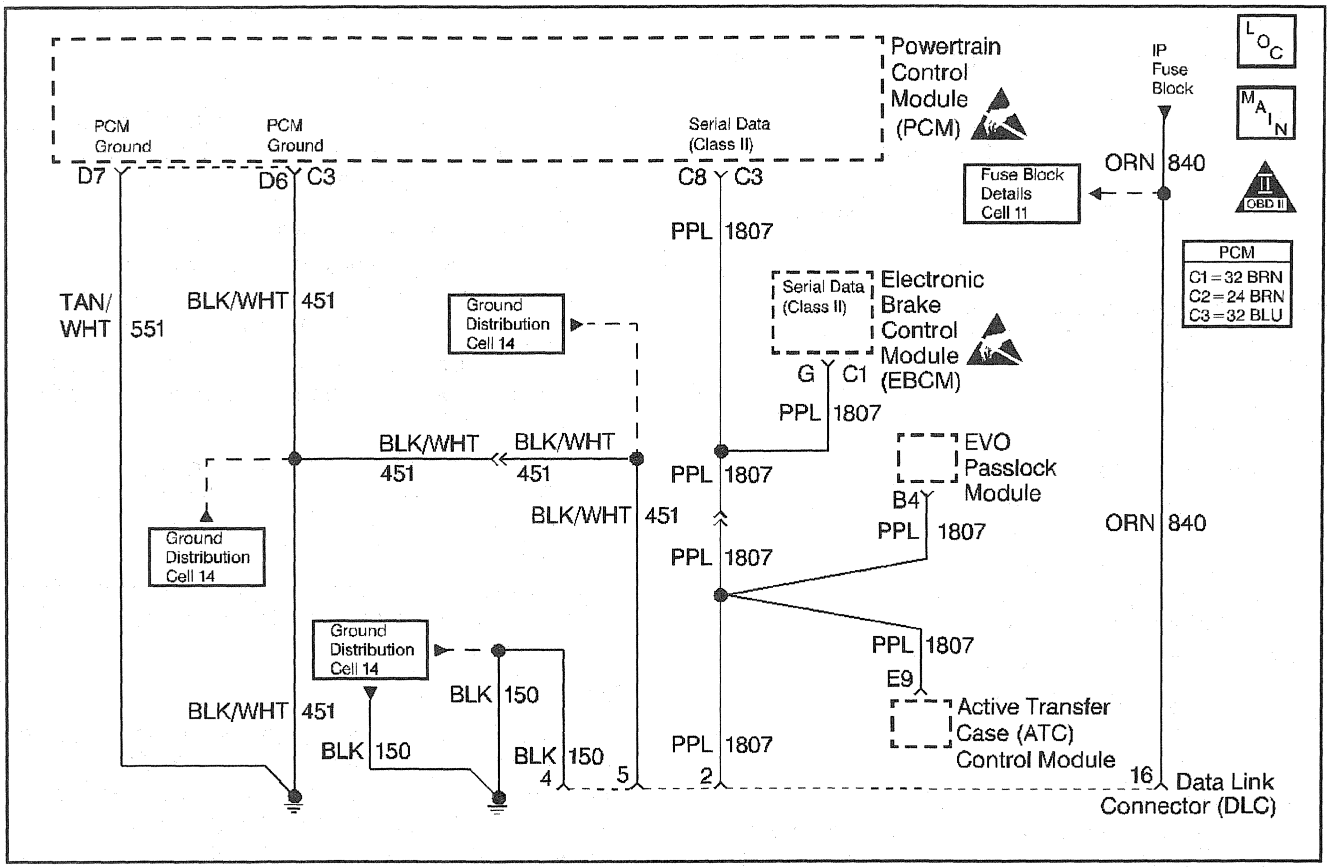
The number(s) below refer to the step number(s) on the Diagnostic Table.

1. In this step, the Powertrain OBD System Check is being performed.

DTC U1026 Loss of ATC Class 2 Communication

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs, use the Scan Tool Capture Info to record Freeze Frame and Failure Records for reference, as data will be lost when Clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to ATC Controller Diagnosis	Go to *A Powertrain On Board Diagnostic (OBD) System Check*

DTC U1192 Loss of VTD (Passlock)/EVO Communication



192130

Circuit Description

The PCM monitors the serial data (class II) circuit for communications from the Passlock/EVO controller. If the Passlock/EVO controller is not communicating with the PCM this DTC will set.

Conditions for Setting the DTC

No serial data (class II) from Passlock/EVO controller to the PCM.

Action Taken When the DTC Sets

This DTC will not illuminate the MIL.

Conditions for Clearing the MIL/DTC

- A History DTC will clear after 40 consecutive warm up cycles with no failures of any non-emissions related diagnostic test.
- PCM battery voltage is interrupted.
- Use of a scan tool.

Diagnostic Aids

This DTC will not set unless the PCM and ATC controllers have already establish communications first. This DTC will only diagnosis an open or intermittent connection from the Passlock/EVO controller to the splice.

The PCM enables fuel (scan tool display PCM in VTD Fail Enable YES) on this and future ignition cycles only if the failure occurred when the engine was running.

Test Description

The number(s) below refer to the step number(s) on the Diagnostic Table.

1. In this step, the Powertrain OBD System Check is being performed.

DTC U1192 Loss of VTD (Passlock)/EVO Communication

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs, use the Scan Tool Capture Info to record Freeze Frame and Failure Records for reference, as data will be lost when Clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	Go to Passlock/EVO Controller Diagnosis	Go to *A Powertrain On Board Diagnostic (OBD) System Check*

Symptoms

Before Using This Section

Before using this section, you should have performed the On-Board Diagnostic System Check and determined that:

1. The control module and the malfunction indicator lamp (MIL) are operating correctly.
2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL.

Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks which may save valuable time.

Visual and Physical Checks

Check the following items:

- The control module grounds for being clean, tight and in their proper location.
- The vacuum hoses for splits, kinks and proper connections, as shown on the Vehicle Emission Control Information label.
- The wiring for the following items:
  - Proper connections
  - Pinches
  - Cuts
- The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to *Emission Hose Routing Diagram* or *Engine Controls Schematics* for an application.

Verify the customer complaint.

Locate the correct symptom table. Check the items indicated under that symptom from the following symptom tables:

- *Intermittent Conditions*
- *Hard Start*
- *Surges/Chuggles*
- *Lack of Power, Sluggishness, or Sponginess*
- *Fuel Knock/Combustion Noise*
- *Hesitation, Sag, Stumble*
- *Cuts Out, Misses*
- *Poor Fuel Economy*
- *Excessive Smoke*

Intermittent Conditions

An intermittent condition may or may not turn on the malfunction indicator lamp (MIL) or store a Diagnostic Trouble Code (DTC).

Preliminary Checks

Perform a visual check to locate the cause of the problem.

- Refer to *Symptoms.*
- The fault must be present to locate the problem. If a fault is intermittent, the use of DTC Tables may result in the replacement of good parts.

Electrical Connections or Wiring

Poor electrical connections or wiring can cause most intermittent problems. Perform a careful check of the suspected circuit for the following:

- Check for poor mating of the connector halves, or terminals not fully seated in the connector body (backed-out).
- Check for improperly formed or damaged terminals. Carefully reform or replace all the connector terminals in the problem circuit to ensure the proper contact tension.
- Check for poor terminal to wire connections. This requires removing the terminal from the connector body to check.

Road Test

If a visual/physical check does not locate the cause of the problem, drive the vehicle with a *J 39200* connected to a suspected circuit or use a scan tool. An abnormal voltage or scan reading, when the problem occurs, indicates the problem may be in that circuit.

Intermittent Malfunction Indicator Lamp (MIL)

The following can cause an intermittent MIL and no DTCs:

- Electrical system interference caused by a malfunctioning relay, PCM driven solenoid or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- The improper installation of electrical devices; such as lights, 2-way radios, electric motors, etc.
- The Malfunction Indicator Lamp (MIL) circuit intermittently shorted to ground.
- Poor PCM grounds.

Loss of DTC Memory

Check for loss of DTC memory by disconnecting the engine coolant temperature (ECT) sensor and idling the engine until the MIL turns ON. An engine coolant temperature (ECT) DTC should store and remain in memory when turning OFF the ignition for at least 10 seconds. If not, the PCM is malfunctioning.

Additional Checks

Check for an open diode across the A/C compressor clutch and for other open diodes.

Hard Start

Checks	Action
Definition: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Refer to *Symptoms*. • Make sure the driver is using the correct starting procedure.
Sensor Checks	Check the engine coolant temperature (ECT) sensor. Use the scan tool in order to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5° greater or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or the sensor itself.
Fuel System Checks	• Check the supply to injection pump. Refer to *Fuel Supply System Check*. • Check for air in the fuel system. • Check the fuel return from the injection pump. • Check for engine shut–off solenoid operation. • Check the fuel injection nozzles. • Check the fuel tank cap vent. • Check for an internal injection pump problem.
Electrical System Checks	• Check glow plug operation. Refer to *Glow Plug System Check*. • Check for slow cranking speed.
Air Intake System Checks	• Check the air cleaner and air intake ducts for a restriction. • Check for a restriction in turbo charger inlet duct. • Check for a restriction in the intake manifold.
Exhaust System Check	Check the exhaust system for possible restriction. Refer to *Restricted Exhaust System Check*.
Engine Mechanical Checks	Check the engine for the following: • Improper valve timing • Bent pushrods • Worn rocker arms • Low compression • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Check for no crank signal. • Check the Service Bulletins for control module software updates.

Surges/Chuggles

Checks	Action
Definition: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	• Refer to *Symptoms*. • Be sure the driver understands the torque converter clutch (TCC) operation. • Be sure the driver understands the A/C compressor operation. • Use the scan tool in order to make sure the VSS reading matches the vehicle speedometer. This excludes vehicles with electronic transmissions where some variation between VSS and the speedometer is normal. Refer to *DTC P0501 Vehicle Speed Sensor (VSS) Circuit Performance* DTC P0501 Diagnostic Aids.
Fuel System Checks	Check the fuel pressure while the condition exists. Refer to *Fuel Supply System Check*.
Additional Checks	• Check the control module grounds for being clean, tight, and in their proper locations. • Check the generator output voltage. Repair if less than 9 or more than 16 volts. • Check the vacuum lines for kinks or leaks. • Check the TCC operation.

Lack of Power, Sluggishness, or Sponginess

Checks	Action
Definition: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Refer to *Symptoms*. • Compare the vehicle with a similar unit. Make sure the vehicle has an actual problem. • Remove the air filter and check for dirt, or for air ducts being plugged. Replace as necessary. • Check for a proper transmission shift pattern and down shift operation. • Check the fuel quality. Refer to *Specific Gravity Testing*. • Check the engine oil level and quality.
Fuel System Checks	• Check the fuel supply to the injection pump and the fuel return from the injection pump. Refer to *Fuel Supply System Check*. • Check the fuel pump operation. • Check for malfunctioning fuel injection nozzles. • Check the TDC Offset value. Refer to *TDC Offset Adjustment*.
Exhaust System Checks	• Check the exhaust system for a possible restriction. Refer to *Restricted Exhaust System Check*. • Inspect the exhaust system for leaks.
Air Intake System Checks	• Check for an air leak or restriction in the air inlet ducts or the intake manifold. • Check for a worn or damaged turbo charger turbine wheel, shaft or compressor wheel.
Engine Mechanical Check	Check the engine for the following: • Low compression • Improper valve timing • Improper or worn camshaft
Additional Checks	• Check the control module grounds for being clean, tight, and in their proper location. Refer to *Engine Controls Components*. • Check the torque converter clutch (TCC) operation. • Check the A/C operation. Refer to *A/C Request Circuit Diagnosis*. • Check the generator output voltage. Repair if less than 9 volts or more than 16 volts.

Fuel Knock/Combustion Noise

Checks	Action
Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Refer to *Symptoms*. • Make sure the vehicle has an actual problem. • Check the fuel quality. Refer to *Specific Gravity Testing*
Cooling System Checks	• Check for obvious overheating problems. Refer to the appropriate service manual. • Check for a low engine coolant level. • Check for a loose water pump belt. • Check for any restricted air flow through the radiator, or restricted coolant flow. • Check for a malfunctioning or incorrect thermostat. • Check for a correct coolant solution. The solution should be a 50/50 mix of anti–freeze and water.
Sensor Check	Check the engine coolant temperature (ECT) sensor by using the scan tool in order to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5° greater or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or the sensor itself.

Fuel Knock/Combustion Noise (cont'd)

Checks	Action
Fuel System Checks	• Check for air leaks in the fuel supply to the injection pump. Refer to *Fuel Supply System Check* • Check the injection pump static timing. Refer to *Injection Timing Adjustment*. • Check the injection nozzles. Refer to *Injection Nozzle(s) Diagnosis*.
Engine Mechanical Checks	• Check for incorrect basic engine parts such as cam, heads, pistons, etc. • Check for any excessive oil entering combustion chamber.
Additional Checks	Check the Service Bulletins for control module software updates.

Hesitation, Sag, Stumble

Checks	Action
Definition: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. The condition may cause the engine to stall if it is severe enough.	
Preliminary Check	Refer to *Symptoms*.
Fuel System Checks	• Check the fuel pressure. Refer to *Fuel Supply System Check*. • Check for water contamination in the fuel. Refer to *Contamination Testing*. • Perform the Injector Balance Test. • Check for low fuel pressure after a cold start or during moderate or full throttle acceleration. If fuel pressure drops below specification, there is possibly a malfunctioning fuel pump or a restriction in the fuel system.
Additional Checks	• Check the Service Bulletins for control module software updates. • Check the generator output voltage.

Cuts Out, Misses

Checks	Action
Definition: A constant jerking that follows the engine speed, usually more pronounced as the engine load increases which is not normally felt above 1500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Check	Refer to *Symptoms*.
Engine Mechanical Checks	• Perform a cylinder compression check. Refer to *Engine Compression Test* in Engine Mechanical. • Check the engine for the following: – Improper valve timing – Bent pushrods – Worn rocker arms – Worn camshaft lobes – Broken or weak valve springs Refer to *Valve Train Diagnosis* in Engine Mechanical. • Check the intake and exhaust manifold passages for casting flash. Refer to *Intake Manifold Clean and Inspect* or *Exhaust Manifold Clean and Inspect* in Engine Mechanical.
Fuel System Checks	• Check the fuel system for a plugged fuel filter, low fuel pressure, air in the fuel system, etc. Refer to *Fuel Supply System Check*. • Check for water contamination in the fuel. Refer to *Contamination Testing*.

Poor Fuel Economy

Checks	Action
Definition: Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.	
Preliminary Checks	• Refer to *Symptoms*. • Check air cleaner filter for dirt or being plugged. • Visually (physically) check: vacuum hoses for splits, kinks, and proper connections. • Perform Powertrain On–Board Diagnostic System Check. • Check the driving habits of the owner. • Is the A/C ON full time (Defroster mode ON)? • Are the tires at the correct pressure? • Are excessively heavy loads being carried? • Is the acceleration too much, too often? • Suggest to the owner to fill the fuel tank and recheck the fuel economy. • Suggest to the driver to read the Important Facts on Fuel Economy in the Owner Manual.
Fuel System Checks	• Check the fuel type and quality. Refer to *Specific Gravity Testing.* • Check the fuel pressure. Refer to *Fuel Supply System Check.*
Cooling System Checks	• Check the engine coolant level. • Check the engine thermostat for always being open or for the wrong heat range.
Additional Checks	• Check the transmission shift pattern. • Check the torque converter Ccutch (TCC) operation. When the TCC is commanded ON, a scan tool should indicate an RPM drop. • Check the Service Bulletins for control module software updates. • Check for dragging brakes.

Excessive Smoke

Checks	Action
Definition: White, black, gray or blue smoke under load, idle or start up hot or cold.	
Preliminary Check	• Refer to *Symptoms.* • Make sure the customer has an actual problem. • Check the fuel quality. Refer to *Specific Gravity Testing.*
Fuel System Checks	• Check the injection pump. • Check the injection pump timing. Refer to *Injection Timing Adjustment.* • Check the injection nozzles. Refer to *Injection Nozzle(s) Diagnosis.*
Sensor Check	• Check the engine coolant temperature (ECT) sensor. Use the scan tool in order to compare the engine coolant temperature with the ambient air temperature on a cold engine. If the coolant temperature reading is more than 5° greater or less than the ambient air temperature on a cold engine, check for a high resistance in the coolant sensor circuit or the sensor itself. • Check the glow plug system operation. Refer to *Glow Plug System Check.*
Air Intake System Check	• Check the air cleaner and the air intake ducts for restriction. • Check for a restriction in the turbocharger inlet duct. • Check for a restriction in the intake manifold.
Engine Mechanical Check	• Check for incorrect basic engine parts such as the cam, the heads, the pistons, etc. • Check for excessive oil entering the combustion chamber.

Restricted Exhaust System Check

Diagnostic Aids

Proper diagnosis for a restricted exhaust system is essential before any components are replaced.
The following procedure may be used for diagnosis:

1. Inspect the entire exhaust system for a collapsed pipe, heat distress, or a possible internal muffler failure.
2. If there are no obvious reasons for the excessive backpressure, the catalytic converter is suspected to be restricted and should be replaced using current recommended procedures. Refer to Engine Exhaust.

A/C Request Circuit Diagnosis

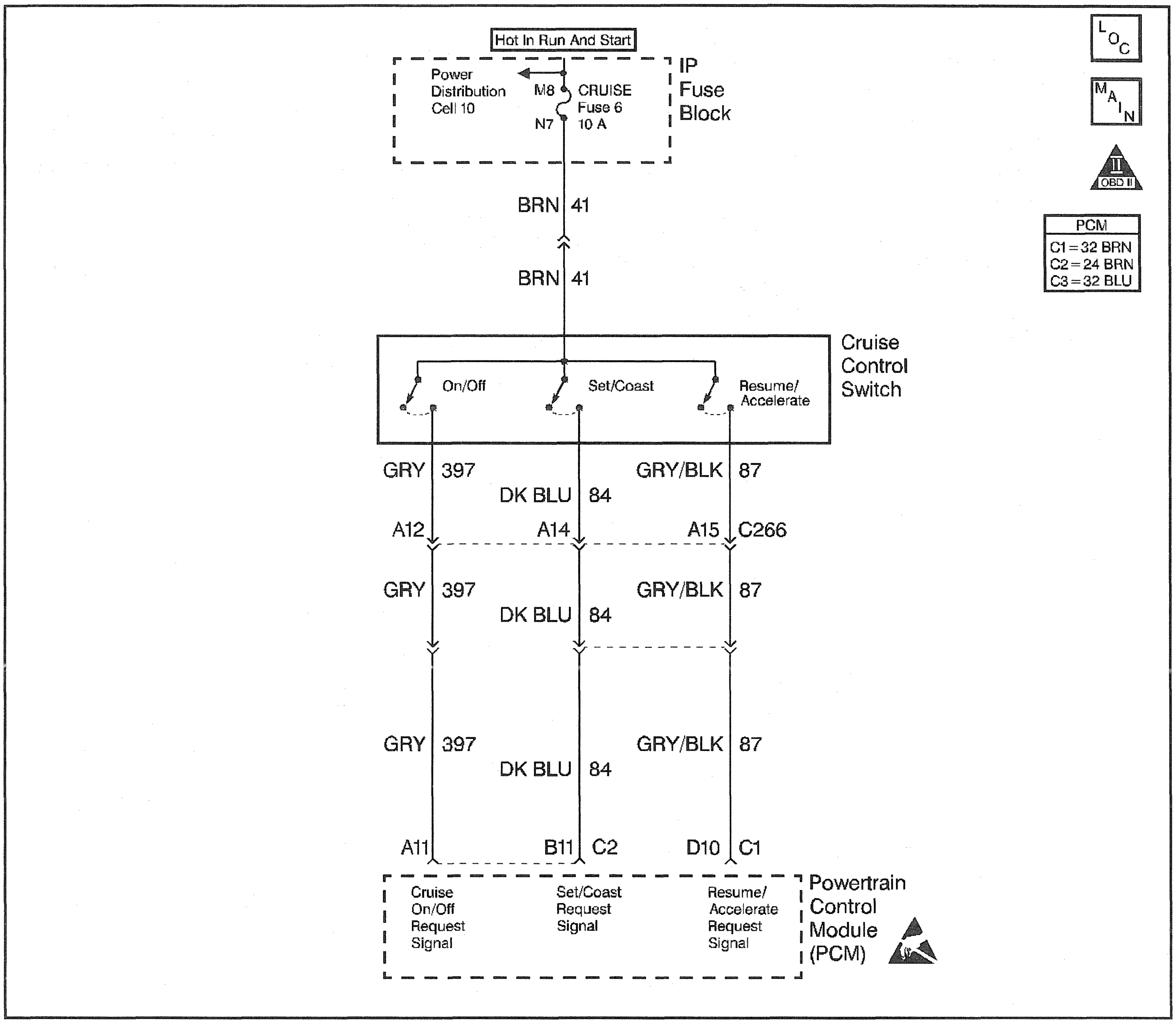
Refer to *A/C Controls*.

Circuit Description

Turning ON the air conditioning supplies ignition voltage to the A/C compressor clutch and to the PCM to increase and maintain idle speed.

The PCM does not control the A/C compressor clutch. Therefore, if the A/C system does not function, refer to A/C Systems of the appropriate service manual for diagnosis of the system.

Cruise Control Diagnosis



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Circuit Description

The cruise control multi function lever is wired directly to the PCM. The cruise on/off, set/coast and resume/accel signals are inputs to the fuel control portion of the PCM. These inputs allow the PCM to control and hold a requested speed. The cruise can be disengaged at any time by applying the brakes. This input is sent to the PCM by the cruise control brake switch.

Diagnostic Aids

If the cruise is inoperative, and no cruise control or brake switch DTCs are stored, check for the following conditions:

- A malfunctioning cruise multi function switch/ wiring harness (opens or malfunctioning connections).
- The clutch pedal switch is stuck in the open position.

Other conditions that will not allow the cruise control to engage that do not pertain to the cruise system.

- The vehicle speed is below 25 MPH (if the cruise control is already set, the cruise will disengage at 20 MPH).
- The vehicle is in 4 wheel drive low.
- Any DTC that puts the vehicle in Back Up Fuel Mode (Back Up Fuel Mode affects the fuel control portion of the PCM). Refer to the appropriate DTC.
- More than one accelerator pedal position (APP) DTC is set.

Test Description

Number(s) below refer to step number(s) on the Diagnostic Table.

3. This step checks for ignition voltage to the cruise control switch.

Cruise Control Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Are DTCs P0501, P0567, P0568, or P0571 set?	—	Go to the Applicable DTC Table	*Go to Step 3*
3	1. Disconnect the cruise control switch connector located on the LH side of the steering column near the bulkhead. 2. Turn the ignition ON, leaving the engine OFF. 3. With the test light connected to ground, probe the ignition feed circuit at the cruise control switch harness connector. Is the test light ON?	—	*Go to Step 4*	*Go to Step 13*
4	1. Reconnect the cruise control switch connector. 2. Turn the ignition ON, leaving the engine OFF. 3. Using the scan tool, monitor the cruise switch while cycling the cruise control ON/OFF switch. Does the scan tool indicate the cruise switch is turning ON and OFF?	—	*Go to Step 5*	*Go to Step 7*
5	1. Turn the ignition ON, leaving the engine OFF. 2. Using the scan tool, monitor the set switch while cycling the cruise control set/coast switch. Does the scan tool indicate the set switch is turning ON and OFF?	—	*Go to Step 6*	*Go to Step 9*
6	1. Turn the ignition ON, leaving the engine OFF. 2. Using the scan tool, monitor the resume switch while cycling the cruise control resume/accelerate switch. Does the scan tool indicate the resume switch is turning ON and OFF?	—	*Go to Step 21*	*Go to Step 11*
7	1. Using a test light connected to ground, probe the cruise ON/OFF request signal circuit at the PCM. 2. With the ignition still in the run position, cycle the cruise control ON/OFF switch. Does the test light turn ON and OFF with each cruise control ON/OFF switch cycle?	—	*Go to Step 19*	*Go to Step 8*
8	1. Disconnect the cruise control switch connector. 2. Using a test light connected to ground, probe the cruise ON/OFF request signal circuit. 3. With the ignition still in the Run position, cycle the cruise control ON/OFF switch. Does the test light turn ON and OFF with each cruise control ON/OFF switch cycle?	—	*Go to Step 15*	*Go to Step 18*
9	1. Using a test light connected to ground, probe the set/coast request signal circuit at the PCM. 2. With the ignition still in the Run position, cycle the cruise control set/coast switch. Does the test light turn ON and OFF with each cruise control set/coast switch cycle?	—	*Go to Step 19*	*Go to Step 10*

Cruise Control Diagnosis (cont'd)

Step	Action	Value(s)	Yes	No
10	1. Disconnect the cruise control switch connector. 2. Using a test light connected to ground, probe the cruise set/coast request signal circuit. 3. With the ignition still in the Run position, cycle the cruise control set/coast switch. Does the test light turn ON and OFF with each cruise control set/coast switch cycle?	—	*Go to Step 16*	*Go to Step 18*
11	1. Using a test light connected to ground, probe the resume/accelerate request signal circuit at the PCM. 2. With the ignition still in the Run position, cycle the cruise control resume/accelerate switch. Does the test light turn ON and OFF with each cruise control resume/accelerate switch cycle?	—	*Go to Step 19*	*Go to Step 12*
12	1. Disconnect the cruise control switch connector. 2. Using a test light connected to ground, probe the cruise resume/accelerate request signal circuit. 3. With the ignition still in the Run position, cycle the cruise control resume/accelerate switch. Does the test light turn ON and OFF with each cruise control resume/accelerate switch cycle?	—	*Go to Step 17*	*Go to Step 18*
13	1. Check for a proper connection at the cruise control switch harness connector. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 21*	*Go to Step 14*
14	Repair the open in the ignition feed circuit. Is the action complete?	—	*Go to Step 21*	—
15	Repair the open or short to ground in the cruise ON/OFF request signal circuit. Is the action complete?	—	*Go to Step 21*	—
16	Repair the open or short to ground in the cruise set/coast request signal circuit. Is the action complete?	—	*Go to Step 21*	—
17	Repair the open or short to ground in the cruise resume/accelerate request signal circuit. Is the action complete?	—	*Go to Step 21*	—
18	Replace the cruise control switch. Is the action complete?	—	*Go to Step 21*	—
19	1. Check for a proper connection at the PCM. 2. If a problem is found, repair the problem as necessary. Was a problem found?	—	*Go to Step 21*	*Go to Step 20*
20	Replace the PCM. **Important:** The new PCM must be programmed. Refer to *PCM Replacement/Programming.* Is the action complete?	—	*Go to Step 21*	—
21	Operate the vehicle within the conditions under which the original problem was noted. Does the system operate properly?	—	System OK	*Go to Step 1*

Fuel Tank Leak Check

The diagnosis of fuel odor may be a condition of leaking fuel tank, filler neck or filler cap. A defective filler cap, a plugged or pinched vent pipe can cause a collapsed fuel tank. Loose mounting straps or foreign material in tank may be the cause of a rattle at the fuel tank.

Leak Check Procedure

Caution: Place a dry chemical (Class B) fire extinguisher near the area before performing a Fuel Tank Leak Check. Before removing the fuel tank for a suspected leak, make sure that the fuel pipes or the tubes are not leaking onto the tank. Once removed, make sure that the fuel is not leaking around the fuel sender O-ring. Failure to follow these precautions may result in personal injury.

This check requires the fuel sender and the o-ring to be installed.

1. Disconnect the battery cables.
2. Drain the fuel tank (refer to *Fuel Tank Draining Procedure.*
3. Remove the fuel tank (refer to Fuel Tank Replacement).
4. Cap the fuel feed tube and the fuel return tube on the fuel sender.
5. Connect a piece of hose to the filler tube nipple and plug the opposite end.
6. Submerge the tank in water or apply a soap solution to the outside of the tank.
7. Apply 35 kPa (5 psi) of air pressure to the vent hose of the fuel tank (a leak will show up as bubbles).

Contamination Testing

Fungi and other microorganisms can survive and multiply in diesel fuel if water is present. The fungi can be present in any part of the fuel handling system. These fungi grow into long strings and will form into large globules. The growths appear slimy and are usually black, green, or brown. The fungi may grow anywhere in the fuel but are most plentiful where diesel fuel and water meet. As the fuel is agitated (when service station tanks are being filled), fungi are distributed throughout the tank and may be pumped into a vehicle.

Fungi use the fuel as their main energy supply and need only trace amounts of water and minerals. As they grow and multiply, they change fuel into water, sludge, acids, and products of metabolism. The most common symptom is fuel filter plugging; however, various metal components (fuel tank, pipes, and injection pump) can corrode.

Caution: Avoid physical contact with the biocides in order to avoid personal injury.

If fungi have caused fuel system contamination, use a diesel fuel biocide to sterilize the fuel system. Do not exceed the dosage recommended on the label. Discontinue the use of a biocide when towing a trailer. It is permissible to have biocide in the fuel when starting to tow, but do not add any biocide while towing.

Steam cleaning may be necessary if most of the fungus growth cannot be removed with biocides.

The presence of water or gasoline in diesel fuel may also cause injection pump and nozzle damage.

This procedure checks for the presence of water and gasoline in diesel fuel that may cause injection pump and nozzle damage.

Remove the fuel filter element and inspect it.

- If water, gasoline or fungi/bacteria are not present, end the inspection.
- If water or fungi/bacteria are present, Go to Cleaning Water from the Fuel System.
- If gasoline is present, Go to Cleaning Gasoline from the Fuel System.

Cleaning Water from the Fuel System

1. Disconnect the batteries.
2. Drain the fuel tank.
3. Remove the fuel tank (Refer to Fuel Tank Replacement).
4. Remove the fuel sender unit (Refer to *Fuel Sender Assembly Replacement*).
5. Inspect the fuel tank and the fuel sender for rust, fungi or bacteria.
6. Clean the inside of the fuel tank and the fuel sender with hot water.
7. Use compressed air in order to dry the fuel tank and the fuel sender.
8. Disconnect the ends of the following lines:
   - The lift pump suction line
   - The lift pump feed line
   - The fuel filter outlet line
   - The fuel filter drain line
   - The fuel return line
9. Inspect each of the pipes.
10. Replace any rusted pipes.
11. Clean the inside of the fuel filter housing.
12. Dry the fuel filter housing with compressed air.
13. Dry the inside of each line with low pressure air.
14. Remove the ECM 1 fuse from the underhood relay center.
15. Install a new fuel filter element.
16. Install the fuel sender and the fuel tank (add clean diesel fuel to ¼ full).
17. Reconnect the following lines:
   - The lift pump suction (both ends) lines.
   - The lift pump feed (both ends) lines.
   - The fuel filter drain line.
   - The fuel return (at the injection pump) line.
18. Connect the fuel filter outlet and the fuel return line at the fuel sender to the hoses that flow to the metal containers.
19. Connect the batteries.

20. Use the scan tool in order to command the lift pump ON.
21. Operate the lift pump until clean fuel flows from the fuel filter outlet into a metal container.
22. Connect the hose from the fuel filter outlet to the injection pump inlet.
23. Open each injection line at its nozzle end and crank the engine until clean fuel flows from it.
    - Use two wrenches when loosening the injection line fittings.
    - Allow a maximum of 15 seconds cranking time, followed by 1 minute of cranking motor cooling time.
24. Tighten each injection line fitting at its nozzle. Use two wrenches when tightening the injection line fittings.
25. Install the ECM 1 fuse in the underhood relay center.
26. Start and run the engine for 1 minute while the fuel flows from the fuel return line into a metal container.
27. Stop the engine.
28. Connect the fuel return hose to the fuel sender.
29. Clean any fuel spillage from the engine.
30. Fill the fuel tank and add a biocide, if needed.

Cleaning Gasoline from the Fuel System

1. Drain the fuel tank.
2. Fill the fuel tank.
3. Remove the ECM 1 fuse from the underhood relay center.
4. Remove the fuel filter outlet and connect it to a hose that flows to a metal container.
5. Use a scan tool and command the lift pump ON until clean fuel flows from the fuel filter outlet into a metal container.
6. Connect the hose from the fuel filter outlet to the injection pump inlet.
7. Install the ECM 1 fuse into the underhood relay center.
8. Attempt to start and run the engine for 15 minutes (If engine does not start, purge the injection system).
9. Stop the engine.
10. Clean any fuel spillage from the engine.
11. Clear the engine of any DTCs.

Fuel Quality Diagnosis

Fuel quality may cause driveability problems such as hesitation, lack of power, stall, no start, etc.

For best results, use Number 2-D diesel fuel year-round (above and below freezing conditions) as oil companies blend Number 2-D fuel to address climate differences. Number 1-D diesel fuel may be used in very cold temperatures (when it stays below −18°C (0°F); however; it will produce a power and fuel economy loss. The use of Number 1-D fuel in warm or hot climates may result in stalling, poor starting when the engine is hot and may damage the fuel injection system.

Specific Gravity Testing

The fuel quality hydrometer provides a general indication of fuel quality and should not be considered scientifically accurate.

Fuel Oil Specific Gravity Requirements

—	Number 2-Diesel	Number 1-Diesel	Tool
API Gravity	30 - 39	39 - 44	J 38641 B

1. Drain the fuel filter housing by following the steps below:
    1.1. Stop the engine.
    1.2. Place a container under the water drain valve exit hose at the left front side of the engine.
    1.3. Open the drain valve.
    1.4. Use a scan tool and command the fuel lift pump ON.
    1.5. Fill a 1 liter (0.946 quart) container with a sample of fuel.
    1.6. Close the drain valve.
2. Obtain a fuel quality hydrometer (J 38641-B).
3. Fill the hydrometer with the fuel sample by doing the following:
    3.1. Squeeze the hydrometer bulb.
    3.2. Submerse the hydrometer tip into the sample.
    3.3. Release the bulb, allowing fuel to enter the glass tube until it completely floats the glass bulb inside the tube.
    3.4. Gently spin the hydrometer to relieve the surface tension of the fuel sample. Read the scale on the glass bulb at the point where the top of the fuel sample contacts it. By reading this value, it will give an approximate fuel oil specific gravity. Refer to tool instructions on how to determine API Gravity.
4. Refer to Fuel Oil Specific Gravity Requirements table. If the correct fuel is being used in the conditions listed in Fuel Quality, and meets number 1-Diesel or number 2-Diesel fuel oil specific gravity requirements, fuel is OK. If not, the fuel should be replaced.

Fuel Sender Diagnosis

The fuel sender should be checked for return restrictions. For diagnosis of the pickup tube, refer to *Fuel Return System Diagnosis*.

Fuel Strainer

The strainer is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water and should be thoroughly cleaned.

Fuel Supply System Check

If the fuel supply system is not delivering enough fuel, or air is being drawn into the fuel injection system, driveability could be greatly effected or a Cranks But Will Not Run symptom could exist. If another diagnosis indicates, or if the fuel supply system is suspected of not delivering enough fuel or drawing air, the following systems should be checked.

- Air leaks or restrictions on the suction side of the fuel pump will seriously affect pump output.
- Restriction in the fuel return system.
- Make certain that there is sufficient fuel in the tank.
- Check for leaks at all of the fuel connections from the fuel tank to the injection pump.
- Tighten any loose connections.
- With the engine running, check all of the hoses and the lines for flattening or kinks that would restrict the flow of fuel.

Fuel Lift Pump Flow Check

1. Remove the ECM 1 fuse from the underhood relay center.
2. Disconnect the pipe at the lift pump outlet fitting.
3. Install a hose at the lift pump outlet fitting and place a 1 liter (0.946 quart) container at the hose in order to collect fuel.
4. Crank the engine and measure the amount of fuel.
   - If more than 0.24 liter (½ pint) in 15 seconds, refer to Fuel Lift Pump Pressure Check..
   - If less than 0.24 liter (½ pint) in 15 seconds, refer to Fuel Lift Pump Suction Line Check.

Fuel Lift Pump Suction Line Check

1. Remove the fuel tank cap and repeat the Lift Pump Flow Check.
   - If the flow is more than 0.24 liter (½ pint) in 15 seconds, replace the defective fuel tank cap.
   - If the flow is less than 0.24 liter (½ pint) in 15 seconds, go to the next step.
2. Separate the lift pump suction line from the fuel sender.
3. Connect the suction line to a source of clean fuel by using an additional hose.
4. Repeat the Lift Pump Flow Check.
   - If the flow is more than 0.24 liter (½ pint) in 15 seconds, go to Fuel System Air Leak Check.
   - If the flow is less than 0.24 liter (½ pint) in 15 seconds, Go to Step 5.
5. Check the lift pump suction line for a restriction.
   - If a restriction exists, repair it and recheck lift pump flow.
   - If no restriction exists, replace the lift pump and recheck the lift pump flow. Refer to *Fuel Pump Relay Circuit Diagnosis*.
6. Attach the lift pump suction line to the fuel sender.

Fuel Lift Pump Pressure Check

1. Install a tee adapter at the injection pump.
2. Connect a pressure gauge with the dial indication of 0-103 kPa (0 to 15 psi) to the tee adapter.
3. Start the engine and measure the fuel pressure.
   - If the fuel pressure is a least 4 psi (27 kPa) continue to step 4.
   - If the pressure is less than 4 psi, refer to *Fuel Pump Relay Circuit Diagnosis* before replacing the lift pump.
4. Remove the pressure gauge and the tee adapter.
5. Connect the inlet pipe.
6. Clean any fuel spillage
7. Operate the engine and check for any fuel leaks.

Fuel System Air Leak Check

1. Install a transparent hose between the filter outlet and the injection pump inlet.
2. Start and idle the engine, observing the fuel for air bubbles.
   - If air bubbles are not present, stop the engine and Go to Step 7.
   - If air bubbles are present, stop the engine and Go to Step 3.
3. Check the lift pump suction line for air leakage.
   - Disconnect the fuel pipe from the fuel sender.
   - Plug the fuel pipe.
   - Disconnect the fuel pipe from the lift pump.
   - Install a hand held vacuum pump with a gauge.
   - Apply vacuum to the fuel pipe and observe the gauge reading.
     - If the vacuum does not drop, connect the fuel pipe and Go to Step 4.
     - If the vacuum drops, repair the air leak in the suction line and install the suction line pipe and the hose.
4. Check the fuel sender for air leakage.
   - Remove the fuel tank.
   - Remove the fuel sender from the fuel tank.
   - Remove the strainer and plug the bottom end of the pickup tube.
   - Apply a vacuum to the upper end of the pickup tube.
   - Observe the gauge reading.
     - If the vacuum does not drop (fuel inlet side of sender is OK), install the fuel sender and the fuel tank.
     - If the vacuum drops, replace the fuel sender, install the fuel tank, connect the fuel pipe and Go to Step 5.
5. Start and run the engine.
6. Observe the fuel for air bubbles.
   - If air bubbles are present, stop the engine and recheck Steps 3 and 4.
   - If air bubbles are not present, stop the engine and Go to Step 7.

7. Remove the transparent hose and connect the hose of the filter outlet to the injection pump inlet fitting.
8. Disconnect the return hose at the injection pump.
9. Install a transparent hose between the injection pump and the hose of the return line.
10. Start and run the engine.
11. Observe the fuel for air bubbles.

Important: It is normal to see small amounts of bubbles during snap acceleration.

- If air bubbles are present, replace the injection pump. Refer to *Fuel Injection Pump Replacement*.
- If air bubbles are not present, Go to Step 12.

12. Stop the engine.
13. Remove the transparent hose and attach the fuel return hose at the injection pump.
14. Clean any fuel spillage.
15. Run the engine to check for fuel leakage.

Fuel Lift Pump Electrical Circuit

When the key is first turned ON without the engine running, the control module turns the fuel lift pump relay ON during glow plug cycle. This builds up fuel pressure quickly. If the engine is not started after the glow plug cycle, the control module shuts the fuel lift pump OFF and waits for engine rpm. As soon as the engine is cranked, the control module turns the relay ON and runs the fuel lift pump.

As a backup system to the fuel lift pump relay, the fuel lift pump is also turned ON by an oil pressure switch. When engine oil pressure reaches about 28 kPa (4 psi) through cranking, the oil pressure switch will close to complete the circuit to the fuel pump.

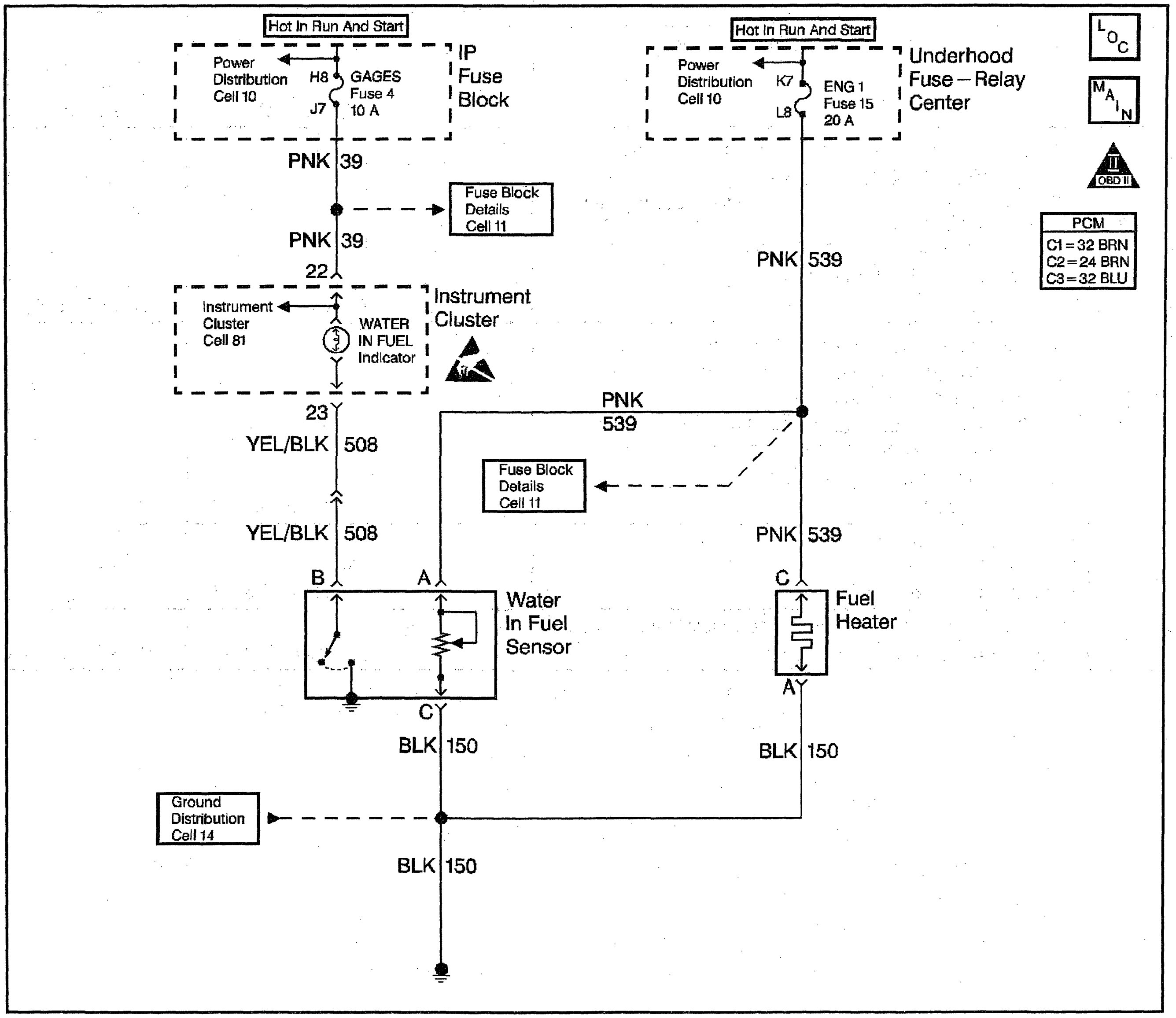
For the location of the fuel pump relay, refer to *Engine Controls Components*. For diagnosis of the lift pump electrical circuit, refer to *Fuel Pump Relay Circuit Diagnosis*.

Fuel Manager/Filter Diagnosis

Diagnosis of the fuel filter can be found in the *Contamination Testing*. For diagnosis of the Water in Fuel lamp circuit, refer to the *Water-in-Fuel Lamp Circuit Diagnosis*.

Diagnosis of the fuel heater can be found in the *Fuel Heater Functional Diagnosis*.

Fuel Heater Functional Diagnosis



Circuit Description

The fuel manager/filter assembly consists of the fuel heater, the water in fuel sensor and a filter. The filter contains the coalescer (the device that combines small droplets of water into larger ones) and the filter/separator.

A fuel lift pump delivers diesel fuel from the tank to the fuel filter. As fuel enters the filter, it passes first through the fuel heater. The heater contains a thermostatic switch. The switch opens or closes to turn the heater OFF or ON, depending on the temperature of the fuel.

The fuel then passes through the filter. Next the fuel flows through the water coalescer. Here the droplets of water in the fuel combine into larger drops and fall into the water reservoir in the filter. When fuel flows from the fuel manager/filter assembly to the injection pump, the fuel is clean and free of water.

The solid state water in fuel sensor supplies voltage to a probe. When the probe touches water, the module closes a switch. This completes a circuit to ground to light the water In fuel lamp.

A time delay circuit in the water in fuel module grounds the lamp briefly to test the bulb each time the system is turned ON.

The fuel heater is operated by a built-in thermostatic switch. The thermostatic switch completes the circuit for the fuel heater element when it senses a temperature below 8°C (46°F).

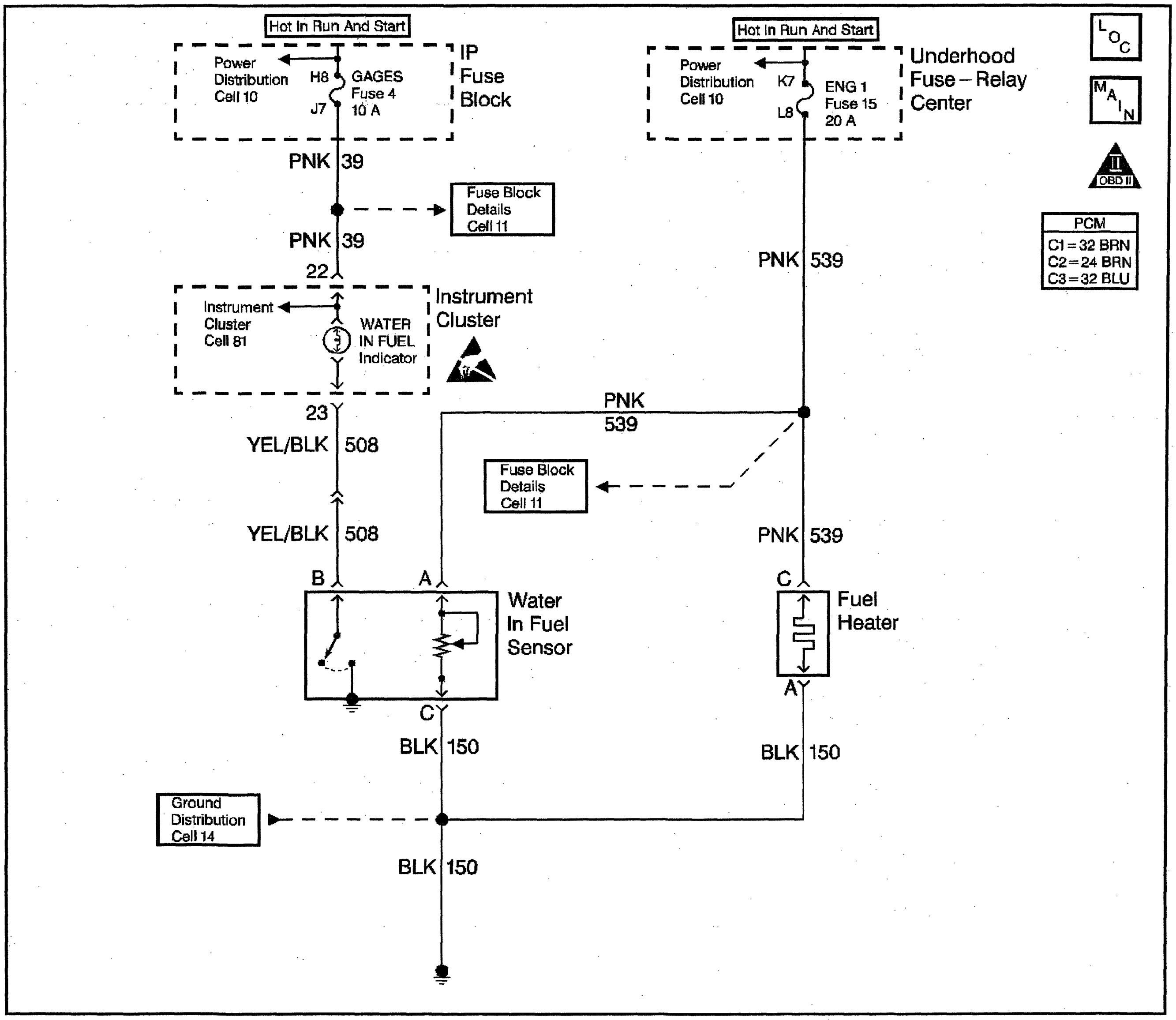
Test Description

2. This step checks for a fuel heater that is [illegible]ck ON.
3. This step checks for a thermostatic switch that completes the circuit.

Fuel Heater Functional Diagnosis

Step	Action	Value(s)	Yes	No
1	Is the Water In Fuel lamp operating properly?	—	*Go to Step 2*	Go to *Water-in-Fuel Lamp Circuit Diagnosis*
2	1. Disconnect the fuel heater connector and remove the fuel heater from the filter housing. 2. With the fuel heater at room temperature, connect terminal C of the fuel heater to B+ and connect terminal A of the fuel heater to ground. 3. Observe the heater element. Does heat occur?	—	*Go to Step 4*	*Go to Step 3*
3	1. Cool the sensor part of the fuel heater with ice. 2. With the fuel heater below 8°C (46°F), wet the heating element with fuel. 3. Connect terminal C of the fuel heater to B+ and connect terminal A of the fuel heater to ground. 4. Observe the heating element. Does heat occur?	—	*Go to Step 5*	*Go to Step 4*
4	Replace the fuel heater. Refer to *Fuel Heater Replacement.* Is the action complete?	—	*Go to Step 5*	—
5	Operate the vehicle under which the problem was noted. Does the system operate properly?	—	System OK	*Go to Step 1*

Water-in-Fuel Lamp Circuit Diagnosis



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Circuit Description

The fuel manager/filter assembly consists of the fuel heater, the water in fuel sensor and a filter. The filter contains the coalescer (the device that combines small droplets of water into larger ones) and the filter/separator.

A fuel lift pump delivers diesel fuel from the tank to the fuel filter. As fuel enters the filter, it passes first through the fuel heater. The heater contains a thermostatic switch. The switch opens or closes to turn the heater OFF or ON, depending on the temperature of the fuel.

The fuel then passes through the filter. Next the fuel flows through the water coalescer. Here the droplets of water in the fuel combine into larger drops and fall into the water reservoir in the filter. When fuel flows from the fuel manager/filter assembly to the injection pump, the fuel is clean and free of water.

The solid state water in fuel sensor supplies voltage to a probe. When the probe touches water, the module closes a switch. This completes a circuit to ground to light the water In fuel lamp.

A time delay circuit in the water in fuel module grounds the lamp briefly to test the bulb each time the system is turned ON.

The fuel heater is operated by a built-in thermostatic switch. When the switch is closed, battery voltage is supplied to the heater.

Test Description

2. This step will determine if the ignition feed circuit is open.
3. This step will determine if the ground circuit is OK.
4. This step will determine if the fuse, bulb, and wiring are OK.

Water-in-Fuel Lamp Circuit Diagnosis

Step	Action	Value(s)	Yes	No
1	Turn the ignition ON leaving the engine OFF. Does the water in fuel light come ON briefly and then turn off?	—	*Go to Step 5*	*Go to Step 2*
2	1. Disconnect the water in fuel sensor. 2. With an *J 34142-B* unpowered test lamp connected to ground, probe terminal A. 3. Verify the ignition is ON with the engine OFF. Is the test light ON?	—	*Go to Step 3*	*Go to Step 6*
3	With an *J 34142-B* unpowered test lamp, jumper the harness terminals A and C with the ignition still ON. Is the test light ON?	—	*Go to Step 4*	*Go to Step 8*
4	With an *J 34142-B* unpowered test lamp connected to ground, probe terminal B of the harness connector. Is the test light ON?	—	*Go to Step 11*	*Go to Step 10*
5	Operate the vehicle under which the original problem by the customer was noted. Does the system operate properly?	—	System OK	*Go to Step 2*
6	1. Check the ignition feed circuit for an open. 2. If a problem is found, repair the problem as necessary. Did you find a problem?	—	*Go to Step 12*	*Go to Step 7*
7	1. Check for a proper ignition feed connection at the sensor. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 12*	*Go to Step 11*
8	1. Check the ground circuit for an open. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 12*	*Go to Step 9*
9	1. Check for a proper ground circuit connection at the sensor. 2. If a problem is found, repair the problem as necessary. Refer to *Wiring Repairs* in Wiring Systems. Did you perform a repair?	—	*Go to Step 12*	*Go to Step 11*
10	Repair the open in the lamp circuit. Refer to *Wiring Repairs* in Wiring Systems. Is the action complete?	—	*Go to Step 12*	—
11	Replace the water in fuel sensor. Refer to *Water-in-Fuel Sensor Replacement.* Is the action complete?	—	*Go to Step 12*	—
12	Operate the vehicle under which the original problem was noted. Does the system operate properly?	—	System OK	*Go to Step 1*

Fuel Injection System Diagnosis

Always begin diagnosis of the electronic fuel injection system with the On-Board Diagnostic (OBD) System Check before proceeding to any other diagnostics. This will reduce diagnosis time and prevent unnecessary replacement of parts. The On-Board Diagnostic (OBD) System Check will give direction to further diagnostics, such as Engine Cranks But Will Not Run or a DTC Table. Diagnosis of electronic fuel injection pump, including the fuel injection solenoid, fuel solenoid driver, injection timing stepper motor and engine shutoff solenoid also starts with the On-Board Diagnostic (OBD) System Check.

If a driveability symptom exists, refer to the particular symptom in the Driveability Symptoms.

Damage to the injection lines including kinking that causes restrictions or leakage could effect driveability or cause a DTC to set.

Fuel Pipes and Hoses

The diagnosis of fuel odor may be a condition of a leaking fuel feed, return pipe or hose. Fuel pipes that are pinched, plugged, or misrouted may cause restricted fuel delivery.

Injection Nozzle(s) Diagnosis

If an injection nozzle is not properly delivering fuel into the pre-combustion chamber of a cylinder, driveability could be greatly effected, or a DTC could be set. If other diagnosis indicates, or if the injection nozzles are suspected of not properly delivering fuel, they should be tested. Typically, a nozzle failure can be detected by using the injector balance test.

Nozzle testing is comprised of the following checks:

- Injector Balance test (performed with scan tool).
- Nozzle opening pressure (see Important statement).
- Leakage (see Important statement).

Injector Balance Test

An injector balance test is performed with the scan tool. This test will properly identify a stuck closed or noisy injector nozzle. Typically, a nozzle failure will fall into this criteria.

1. Install a scan tool.
2. Start and idle the engine.
3. Perform the injector balance test on each cylinder (balance test refer to a specific cylinder).

   If a suspect nozzle has been located, the nozzle can be swapped with the adjacent cylinder and balance test can be repeated as a check to positively identify a malfunctioning nozzle.
4. Locate and replace the malfunctioning nozzle and glow plug.

Nozzle Opening Pressure Test

Caution: Do not place your hands or arms near the tip of the nozzle when testing the nozzles. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue. This may result in blood poisoning. Always enclose the nozzle tip in a receptacle, preferably transparent, in order to contain the spray.

Important: Injector Nozzle Opening Pressure and Leakage tests should only be performed on vehicles with high mileage, engines that have been over heated or on vehicles that pull heavy loads. False or inaccurate readings can occur if the following tests are not performed to the above criteria.

Important: Each test should be considered independent of the others (for example, when checking opening pressure, do not check for leakage). If all of the following tests are satisfied, the nozzle assembly can be reused. If any one of the tests is not satisfied, the complete nozzle assembly must be replaced. When performing the injection nozzle tests, refer to the instructions provided with the nozzle tester J 29075-B.

- Position a nozzle tester on a workbench.
- Install one nozzle on the tester fitting.
- Place a container under the nozzle that will deflect the nozzle spray and absorb the test fluid.
- Install two clear plastic hoses (1 in. long) over the leak-off fittings.
- Close the shutoff valve at the pressure gauge.
- Operate the lever of the nozzle tester repeatedly and briskly to fill and flush the nozzle with test oil.

1. Open the shutoff valve at the pressure gage one-quarter turn.
2. Depress the tester lever slowly. Note at what pressure the needle of the pressure gage stopped. The maximum observed pressure is the opening pressure. Some nozzles may pop while other nozzles may drip down (this is not leakage).
3. The opening pressure should not fall below the lower limit of 105 bar (1500 psi) for naturally aspirated engines and 117 bar (1700 psi) for turbo-charged engines for used nozzles.
4. Replace nozzles which fall below the lower limit.

Nozzle Leak Test

Caution: When testing nozzles, do not place your hands or arms near the tip of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle, preferably transparent, to contain the spray.

Important: Injector Nozzle Opening Pressure and Leakage tests should only be performed on nozzles with high mileage, engines that have been over heated or on vehicles that pull heavy loads. False or inaccurate readings can occur if the following test are not performed to the above criteria.

1. Open the shutoff valve at the pressure gage (1 turn).
2. Blow dry the nozzle tip.
3. Depress the lever of the manual test stand slowly until the gage reads a pressure of 95 bar (1400 psi). Observe the nozzle tip. A drop may form on the end of the nozzle but should not drop off within a period of 10 seconds.
4. Replace the nozzle assembly if a drop falls during the 10 seconds.

Fuel Return System Diagnosis

Any restriction in the fuel return system could greatly effect driveability. If other diagnosis indicates or the fuel return system is suspected of being restricted, it should be tested.

1. Disconnect the hose of the fuel return line at the fuel sender.
2. Disconnect the hose of the fuel return line at the injection pump, and connect a vacuum pump with gauge to the hose.
3. Apply vacuum to the return line and observe the gage reading
   - If vacuum does not build and hold, Go to Step 4.
   - If vacuum builds and holds, repair the return line restriction.
4. Connect the fuel return line at the injection pump and fuel sender.
5. Clean any fuel spillage.
6. Run the engine to check for fuel leakage.

Glow Plug System Check

Refer to *Glow Plug Controls.*

Circuit Description

The glow plug system is used to assist in providing the heat required to begin combustion during engine starting at cold ambient temperatures. The glow plugs are heated before and during cranking, as well as during the engine operation. The PCM controls the glow plug ON times by monitoring coolant temperatures and glow plug voltage. This system check will check the glow plugs and the glow plug feed circuit coming from the relay.

Diagnostic Aids

If the glow plug relay is stuck in the ON position, check for proper operation of the glow plugs. When the glow plugs are commanded ON by the scan tool, an internal PCM timer protects the glow plugs from damage by cycling them ON for 3 seconds and then OFF for 12 seconds. Most glow plug system failures are covered by DTC P0380. If no DTCs are stored, the vehicle is hard to start and white smoke is present during cranking or after the vehicle is started, the most likely cause of failure is the glow plugs.

Test Description

Number(s) below refer to the number(s) on the diagnostic table.

1. This step will make sure OBD system check is performed.
2. This step will make sure there are no other DTCs stored that will affect the operation of the glow plug system.
3. This step will check each glow plug for an open.
4. This step will check each glow plug feed circuit for an open.

Glow Plug System Check

Step	Action	Value(s)	Yes	No
1	**Important:** Before clearing DTCs use the scan tool Capture Info to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used. Was the Powertrain On-Board Diagnostic (OBD) System Check performed?	—	*Go to Step 2*	Go to *A Powertrain On Board Diagnostic (OBD) System Check*
2	Is DTC: • P0117 • P0118 • P0380 stored as history or current codes?	—	Go to the Applicable DTC Table	*Go to Step 3*
3	1. Turn the ignition OFF. 2. Disconnect all the glow plugs. 3. With a test light connected to B+, probe the spade terminal on each glow plug. Do all glow plugs turn test light ON?	—	*Go to Step 4*	*Go to Step 9*
4	1. Turn the ignition ON leaving the engine OFF. 2. Verify the glow plugs are still disconnected. 3. With a test light, jumper each glow plug connector terminal to ground. 4. With a scan tool, command the glow plugs ON. Does each circuit turn the test light ON?	—	*Go to Step 5*	*Go to Step 10*
5	Does the test light stay ON all the time for each glow plug terminal (even when the glow plugs aren't commanded ON)?	—	*Go to Step 6*	*Go to Step 11*
6	1. Disconnect the glow plug output (gray) cable from the glow plug relay. 2. Probe each glow plug terminal with a test light connected to ground. Is the test light ON for all terminals?	—	*Go to Step 7*	*Go to Step 8*
7	Repair the short to voltage on the glow plug output circuit or the short to voltage on the glow plug signal circuit. Is the action complete?	—	*Go to Step 11*	—

Glow Plug System Check (cont'd)

Step	Action	Value(s)	Yes	No
8	Replace the glow plug relay. Refer to *Glow Plug Relay Replacement*. Is the action complete?	—	*Go to Step 11*	—
9	Replace all glow plugs that do not turn ON the test light. Refer to *Glow Plug Replacement - Left Side* or *Glow Plug Replacement - Right Side*. Is action complete?	—	*Go to Step 11*	—
10	Repair open in each circuit that does not turn ON the test light? Is action complete?	—	*Go to Step 11*	—
11	Operate vehicle within the conditions under which system was noted. Does system operate properly?	—	System OK	*Go to Step 1*

CDR Valve Test

The purpose of the CDR valve is to maintain 0 to 4 inches of water vacuum in the crankcase at all engine speeds, assuming that piston/ring combustion blow by is not excessive (less than 4 cfm). Too little vacuum will tend to force oil leaks.

The CDR valve is checked with a water manometer. The U-tube manometer indicates pressure or vacuum by the difference in the height of the two columns of fluid.

If the crankcase vacuum is too high (greater than 4 in. water), dirt or dust can more likely be pulled into the crankcase cavity (pulled through front/rear crankcase seal, etc...) and contaminate the oil. If the crankcase pressure is positive, engine oil leaks are more likely to occur around engine seals and gaskets.

1. Connect one end of the manometer to the engine oil dipstick hole. The other end of the manometer is vented to atmosphere.
2. Unplug rubber vent tube from turbo inlet elbow.
3. Run engine through no–load speed range (gear selector in park) and observe manometer readings. If manometer reading is +4 in. water or less positive pressure, reconnect CDR system and proceed to Step 4. If manometer reading is higher than +4 in. water positive pressure.
4. Install air cleaner.
5. Start engine and observe manometer reading. It should read zero to one inch (0 in. –1 in.) of water (vacuum) at idle to approximately 3–4 inches of water (vacuum) at 2000 RPM. Add the amount that the manometer column travels up, to the amount that the column travels down to obtain total water pressure (vacuum). An example of a manometer reading is as follows: One–half inch above zero plus one–half inch below zero equals one inch vacuum reading (1/2 in. +1/2 in. =1 in.).

Air Cleaner Diagnosis

A restricted or leaking air intake system could cause loss of power and engine damage.

- Inspect the air cleaner filter for damage or excessive dirt accumulation. Replace if necessary.
- Inspect the air inlet elbow and CDR tube for damage or cracks. Replace if necessary.

Refer to Maintenance and Lubrication of the appropriate service manual for change intervals. Operation of the vehicle in dusty areas will necessitate more frequent replacement.

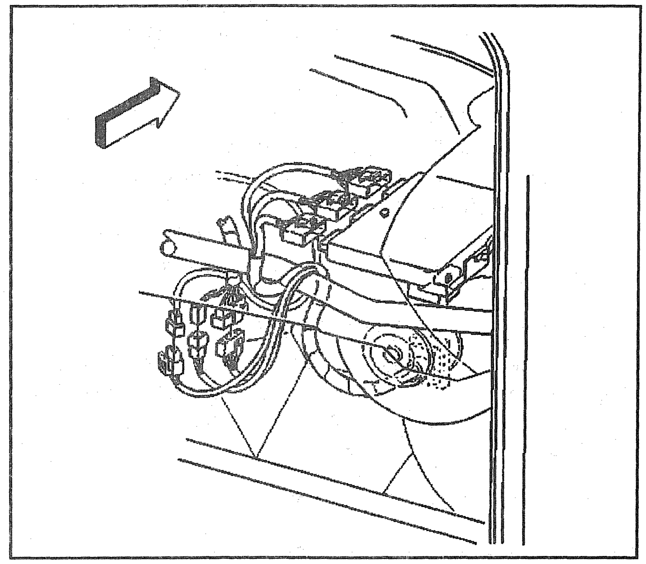
Repair Instructions

PCM Replacement/Programming

Service of the PCM should normally consist of replacement of the PCM.

If the diagnostic procedures call for replacing the PCM, peform the following procedures in the following order:

1. Programming the PCM
2. Passlock Learn Procedure
3. Programming the TDC Offset



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Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Remove the PCM from the passenger compartment behind the glove box.
3. Remove the connectors from the PCM.

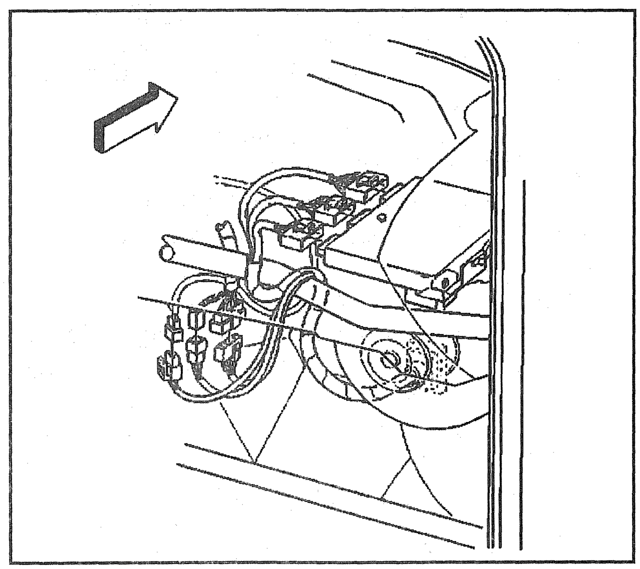
Important: To prevent possible electrostatic discharge to the PCM, do not touch the component leads, and do not remove the integrated circuit from the carrier.

4. Remove the PCM mounting hardware.

Installation Procedure

1. Install the PCM mounting hardware.
2. Install the connectors to the PCM.
3. Install the PCM in the passenger compartment behind the glove box.
4. Install the negative battery cables.

   The MIL, antilock and brake lamps will continue to be enabled until the PCM is programmed. Once the programming is complete, the lamps will turn OFF and normal operation will occur.
5. Refer to PCM Programming.



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PCM Programming

1. Verify the following for the setup:
   - The battery is charged.
   - The ignition is ON.
   - The battery/cig. lighter connection is secure.
   - The Data Link Connector is attached.
2. Perform the programming. Refer to the up to date Techline terminal/equipment for user instructions.
3. Perform the Passlock Learn Procedure. Refer to *Password Learn Procedure.*

4. After the vehicle has been programmed, operate the vehicle until the coolant temperature is greater than 77°C (170°F). This will allow the TDC Offset to be programmed (refer to Programming the TDC Offset).
5. Check the Data list for TDC Offset.
6. If the PCM fails to reprogram, do the following:
   - Check all the PCM connections.
   - Check the Techline terminal/equipment for the latest software version.
   - Try again to reprogram the PCM. If it fails again, replace the PCM. Refer to PCM replacement.

Programming the TDC Offset

The PCM will automatically activate the TDC Offset program when the engine coolant is greater than 77°C (170°F). If the PCM is not programmed with a TDC Offset, a DTC P1214 will set.

Password Learn Procedure

Passlock Learn Procedure Using a T50/T60/T20+

Important: Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once P1630 is set, turn the ignition OFF for 30 seconds, then turn the ignition ON and P1630 will clear. If P1630 does not clear, refer to *DTC P1630 Theft Deterrent PCM in Learn Mode*.

1. Using the T50/T60/T20+, enter the Service Programming System (SPS).
2. Select Terminal to Vehicle Programming.
3. Select Done and follow instructions on Vehicle Set-up screen
4. Select Vehicle Theft Re-learn.
5. Follow the instructions on the remaining screens.
   - The PCM and the Passlock control module will prepare for a re-learn.
   - A security timer will be ON for approximately 10 minutes or until DTC P1630 sets.
   - When the PCM and the Passlock control module are prepared to re-learn, turn the ignition OFF for 30 seconds and then start the engine.

Passlock Learn Procedure Using a Tech 2 Scan Tool

Important: Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once it is set, turn the ignition OFF for 30 seconds, then turn the ignition ON and P1630 will clear. If P1630 does not clear, refer to *DTC P1630 Theft Deterrent PCM in Learn Mode*.

1. Using a Tech 2 enter the Service Programming System (SPS).
2. After entering the vehicle information, choose the Request Info soft key on the Tech 2.
3. Select Done and follow the instructions on the Vehicle Set-up screen
4. Disconnect the Tech 2 from the vehicle and connect the Tech 2 to a Techline terminal.
5. At the Techline terminal, select Service Programming System (SPS), select the Terminal to Scan Tool Programming method and then select Done.
6. Follow the instructions on the remaining screens.
7. Select Vehicle Theft Re-learn.
8. Select Program at the summary screen. The terminal will download the information to the Tech 2.
9. Return the Tech 2 to the vehicle and connect the Tech 2 to the Diagnostic Link Connector (DLC).
10. Select Service Programming from the Tech 2 main menu. Answer the prompts regarding the model year and vehicle type. Press the Theft Re-learn soft key on the Tech 2.
11. Follow the instructions on the remaining screens.
    - The PCM and the Passlock control module will prepare for re-learn.
    - A security timer will be on for approximately 10 minutes or until DTC P1630 sets.
    - When the PCM and the Passlock control module are prepared to re-learn, turn the ignition OFF for 30 seconds and then start the engine.

Passlock Learn Procedure w/o Tech 2 Scan Tool or Techline Terminal

Important: While the PCM is in the Auto Learn Procedure, maintain the battery voltage at all times. Follow the procedure exactly as indicated or the procedure will have to be repeated from the beginning.

Important: Performing the following procedures will cause a DTC P1630 to set when they are completed. This is the intended functionality. Once it is set, turn the ignition OFF for 30 seconds, then turn the ignition ON and P1630 will clear. If P1630 does not clear, refer to *DTC P1630 Theft Deterrent PCM in Learn Mode*.

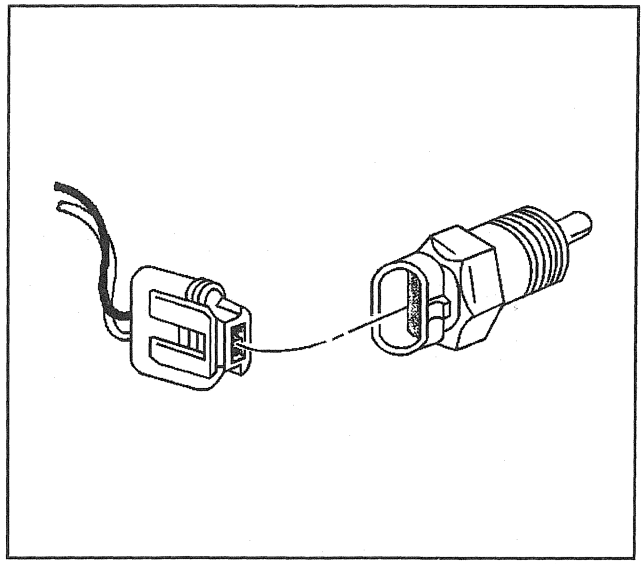
1. Attempt to start the vehicle (the vehicle will start and stall), after the engine has stalled, leave the ignition ON for 10 minutes (the security light will remain ON for 10 minutes and then go OFF).
2. After the Security lamp turns OFF, turn the ignition OFF for 30 seconds.
3. Again, attempt to start the vehicle (the vehicle will start and stall), after the engine has stalled, leave the ignition ON for 10 minutes (the security light will remain ON for 10 minutes and then go OFF).
4. After the Security lamp turns OFF, turn the ignition OFF for 30 seconds.
5. Again, attempt to start the vehicle (the vehicle will start and stall), after the engine has stalled, leave the ignition ON for 10 minutes (the security light will remain ON for 10 minutes and then go OFF) or until DTC P1630 sets.
6. Turn the ignition OFF for 30 seconds.
7. Turn the ignition ON and wait 30 seconds.
8. Attempt to start the engine.

ECT Sensor Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in General Information.

1. Remove the negative battery cables.
2. Drain the cooling system below the level of the sensor.
3. Remove the electrical connector by releasing the locking tab.



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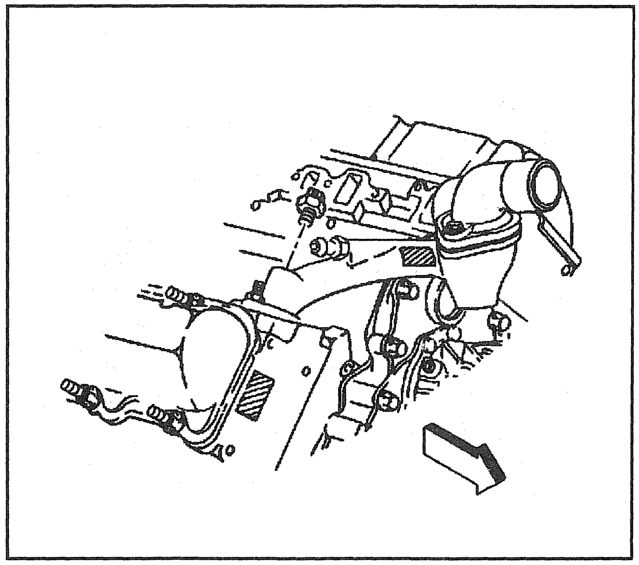
4. Remove the sensor.



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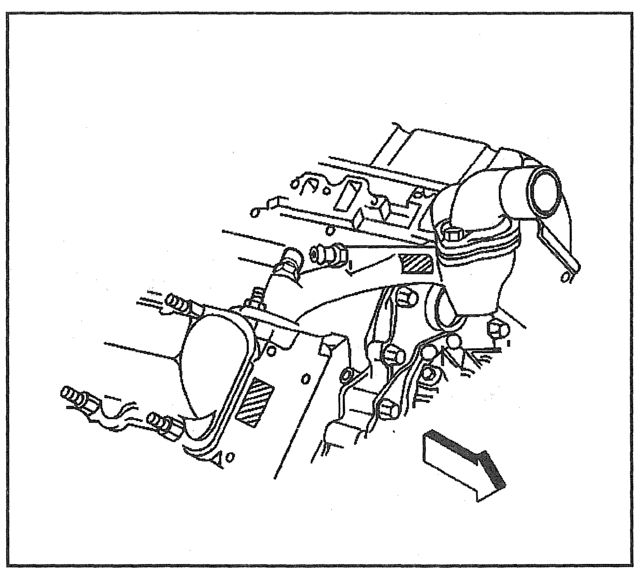
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the sensor into the engine.

   Tighten

   Tighten the sensor to 25 N·m (18 lb ft).



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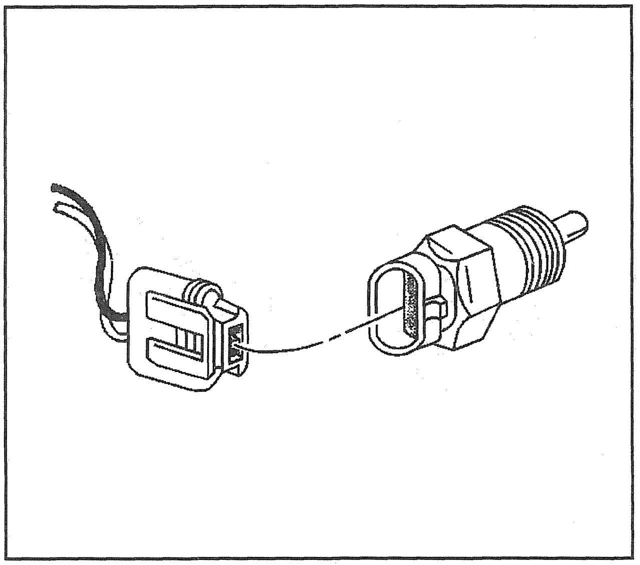

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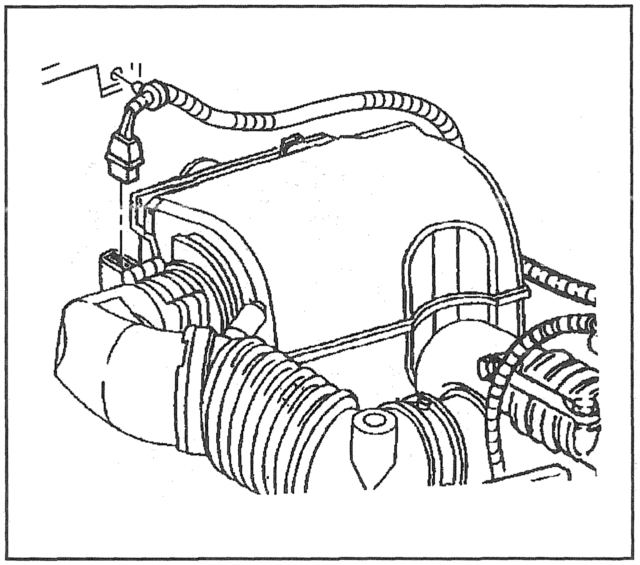
2. Install the electrical connector.
3. Refill the coolant system.
4. Install the negative battery cables.

MAF Sensor Replacement

Removal Procedure

1. Loosen the turbocharger inlet duct clamp at the intake duct.
2. Disconnect the MAF sensor electrical connector.



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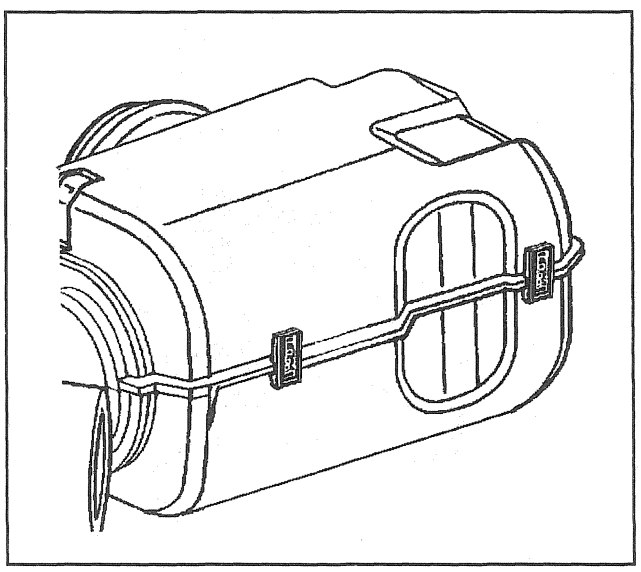
3. Unfasten the air cleaner cover clips.



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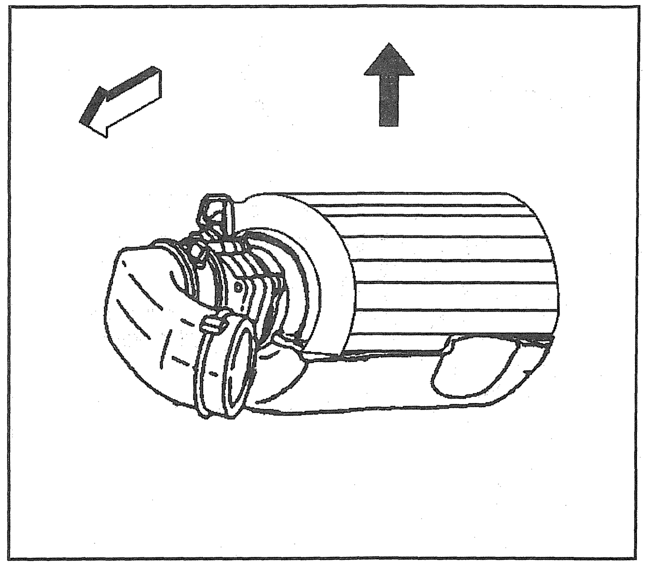
4. Remove the air filter, MAF sensor, and intake duct assembly from the air cleaner box.
5. Remove the air filter from the MAF sensor by pulling them apart.



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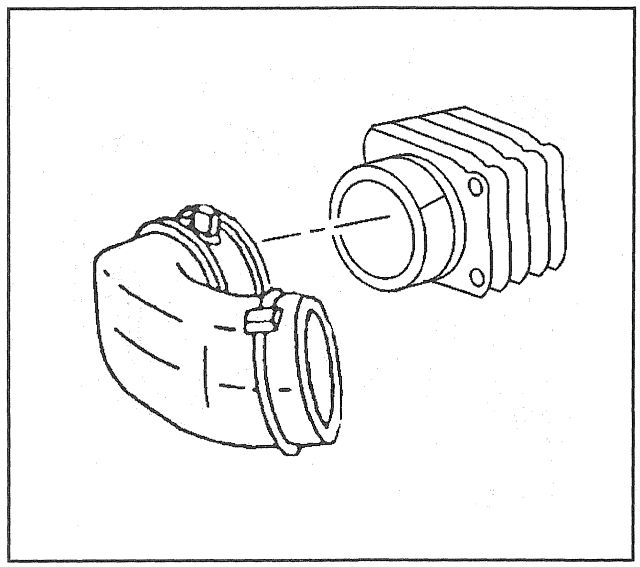
6. Loosen the intake duct clamp and remove the intake duct from the MAF sensor.
7. Remove the air filter adapter screws.
8. Remove the air filter adapter from the MAF sensor.



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Installation Procedure

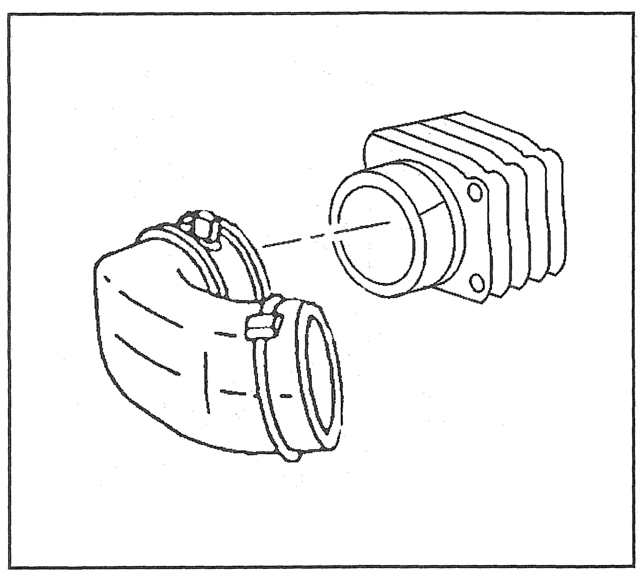
1. Install the air filter adapter to the MAF sensor.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the 2 air filter adapter screws.

   Tighten

   Tighten the screws to 2.8 N·m (25 lb in).
3. Install the intake duct to the MAF sensor.
4. Tighten the intake duct clamp.
5. Install the air filter onto the air filter adapter.



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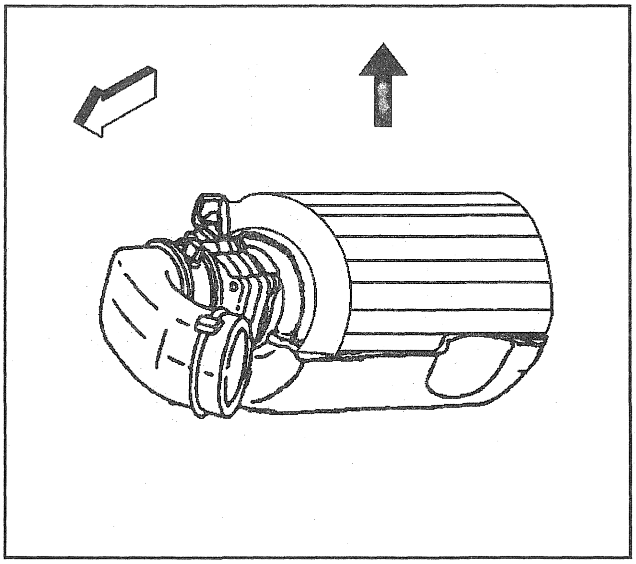

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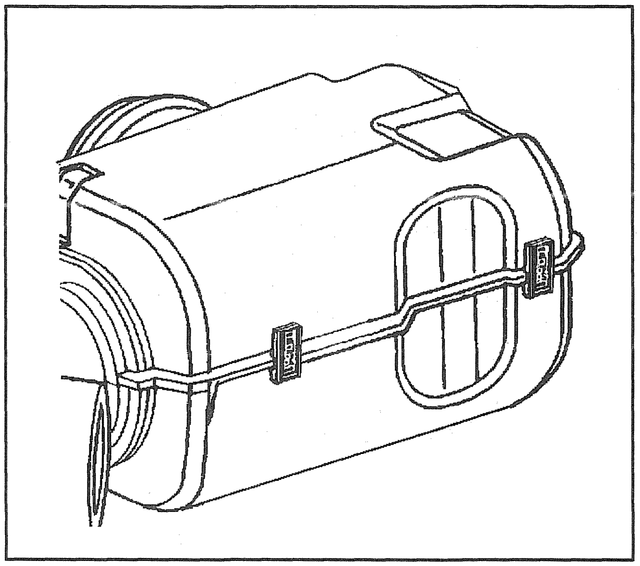
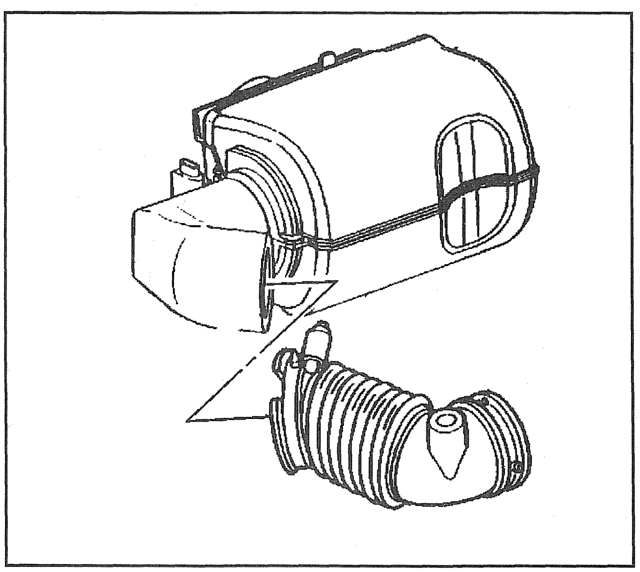
6. Install the air filter, MAF sensor, and intake duct assembly into the air cleaner box.



55485

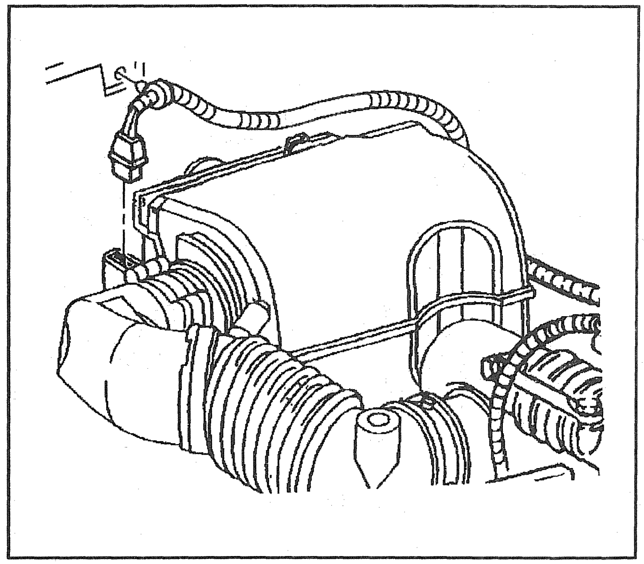
7. Fasten the air cleaner cover clips.



55474

8. Install the turbocharger inlet duct onto the intake duct.
9. Tighten the clamp.

10. Connect the MAF sensor electrical connector.



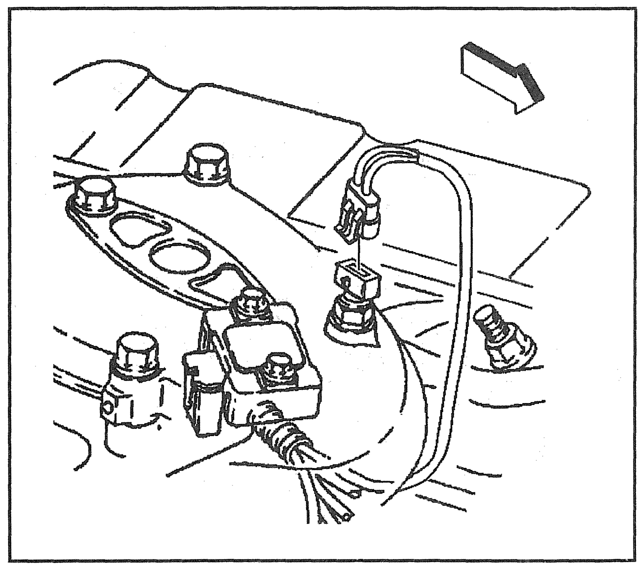
63702

IAT Sensor Replacement

Removal Procedure

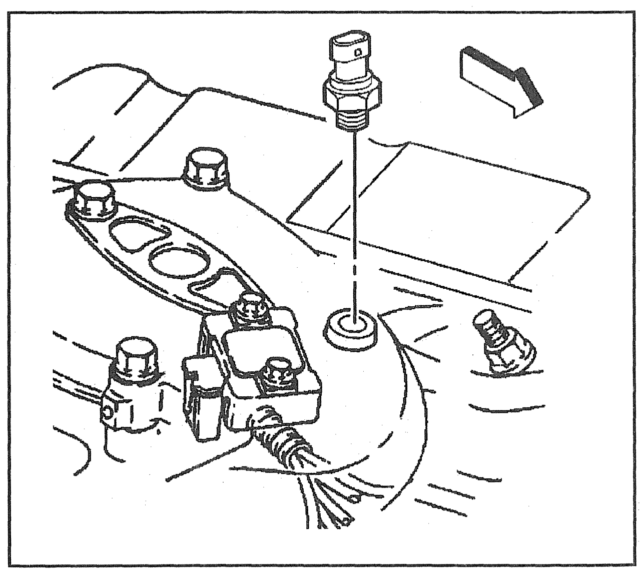
Caution: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

1. Remove the negative battery cables.
2. Remove the electrical connector.

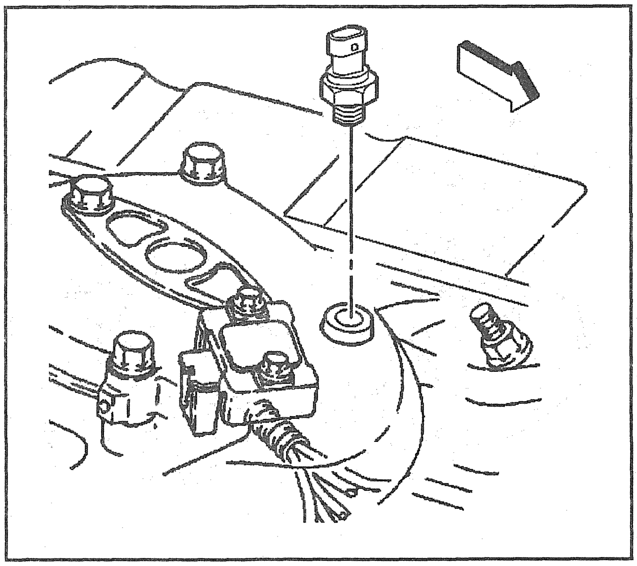


26952

3. Remove the IAT sensor.



73425



73425

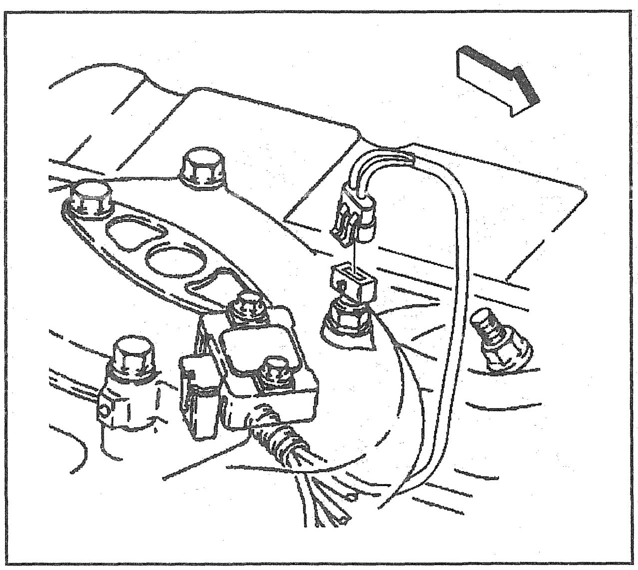
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the IAT sensor.

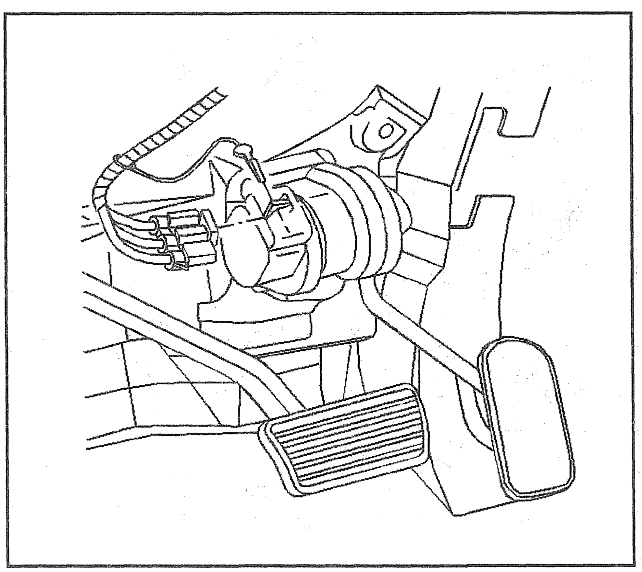
   Tighten

   Tighten the IAT sensor to 25 N·m (18 lb ft).



26952

2. Install the electrical connector.
3. Install the negative battery cables.



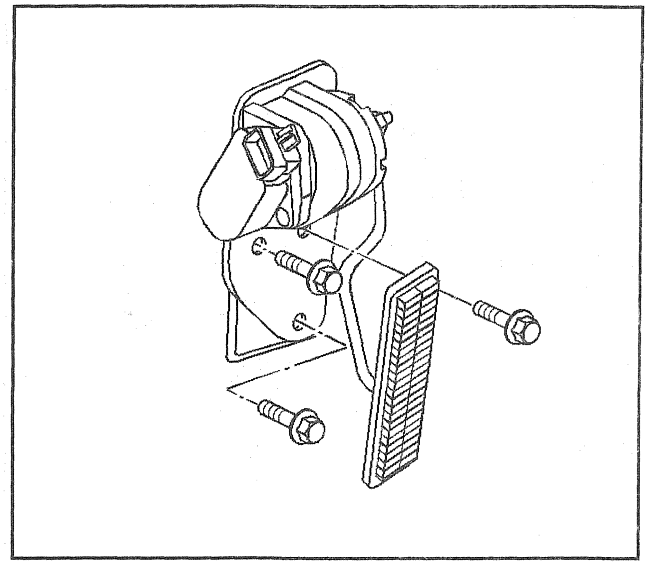
72269

APP Module Replacement

Removal Procedure

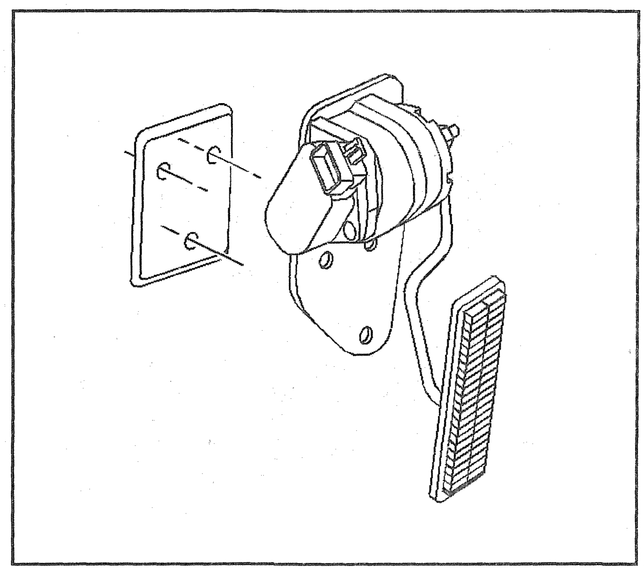
1. Remove the negative battery cables.
2. Remove the electrical connector.

3. Remove the mounting bolts.



72270

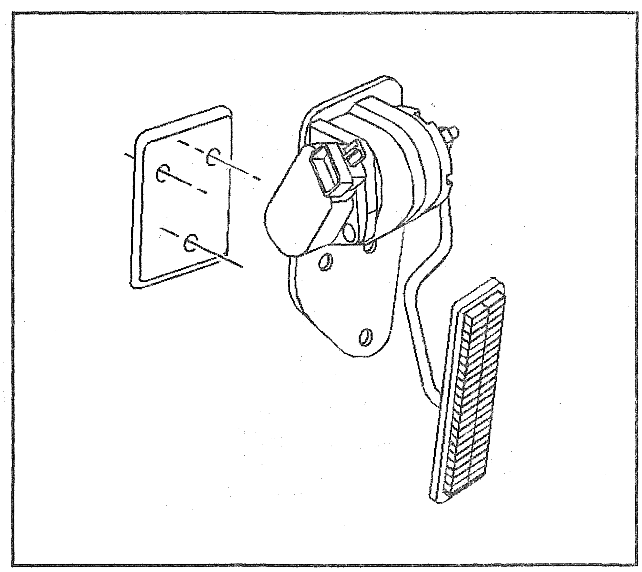
4. Remove the APP module.



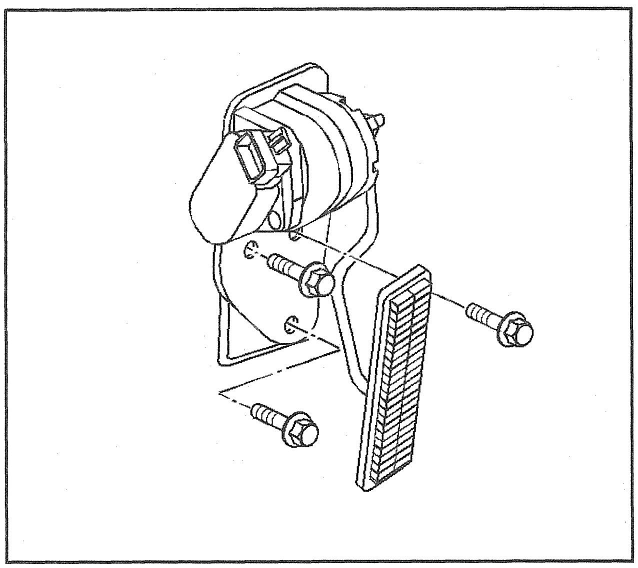
72271

Installation Procedure

1. Install the APP module.



72271



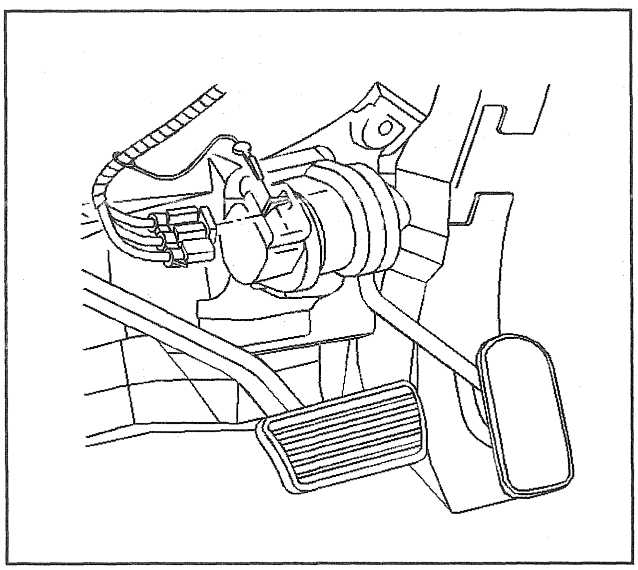
72270

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the mounting bolts.

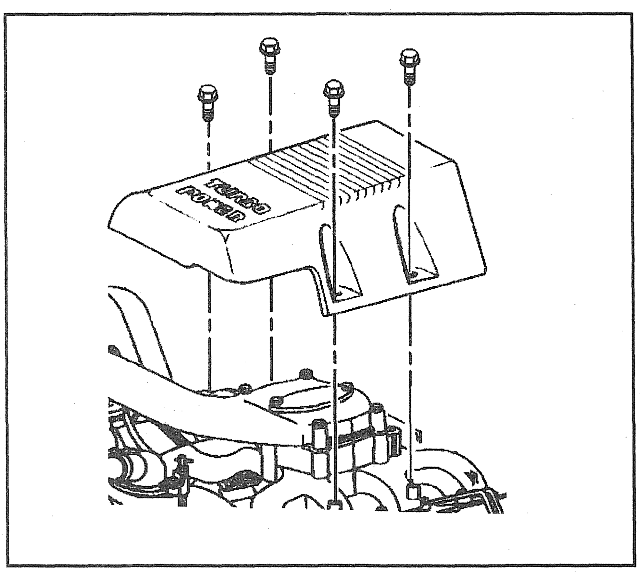
   Tighten

   Tighten the mounting bolts to 1 N·m (10 lb in)



72269

3. Install the electrical connector.
4. Install the negative battery cables.



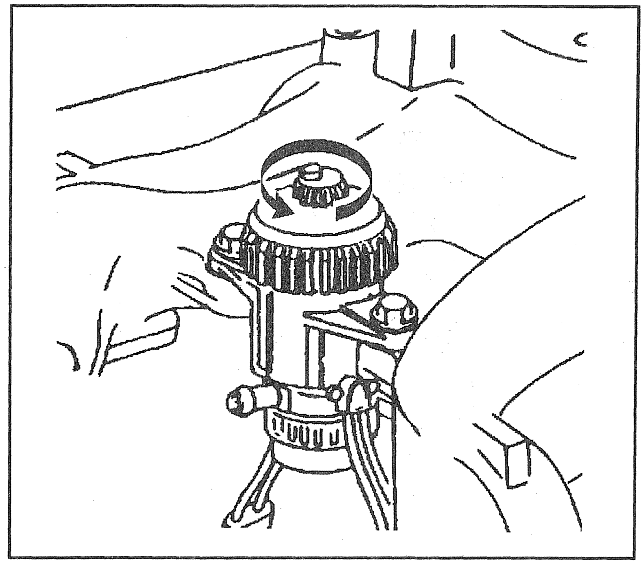
55489

Fuel Filter Element Replacement

Removal Procedure

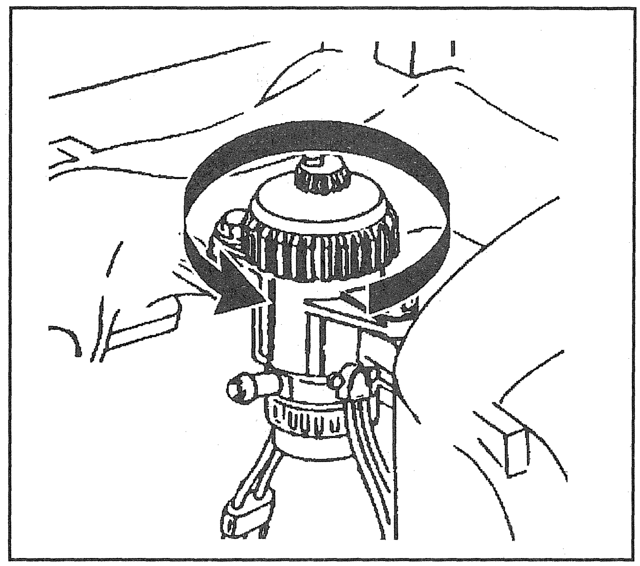
1. Remove the fuel tank filler cap.
2. Loosen the upper intake manifold cover bolts.
3. Remove the upper intake manifold cover.

4. Open the air bleed valve on top of the fuel manager/filter to release any pressure in the fuel supply system.



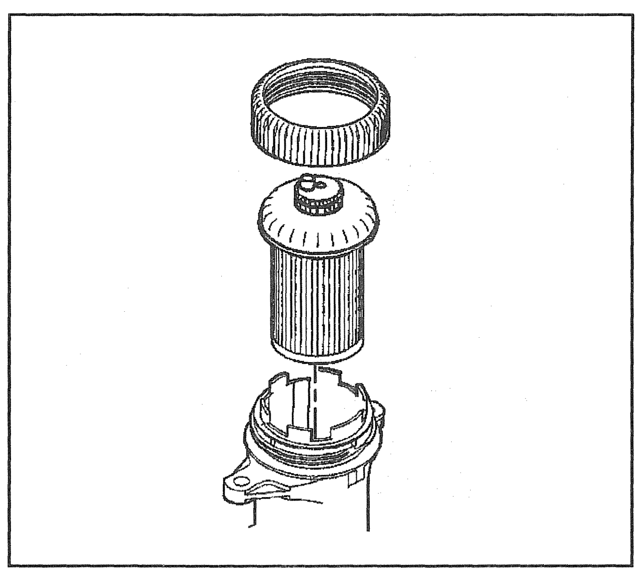
55498

5. Remove the element nut by turning it in a counterclockwise direction. If the nut is unable to turn by hand, a strap wrench (oil filter type) may be used to break loose the element nut.



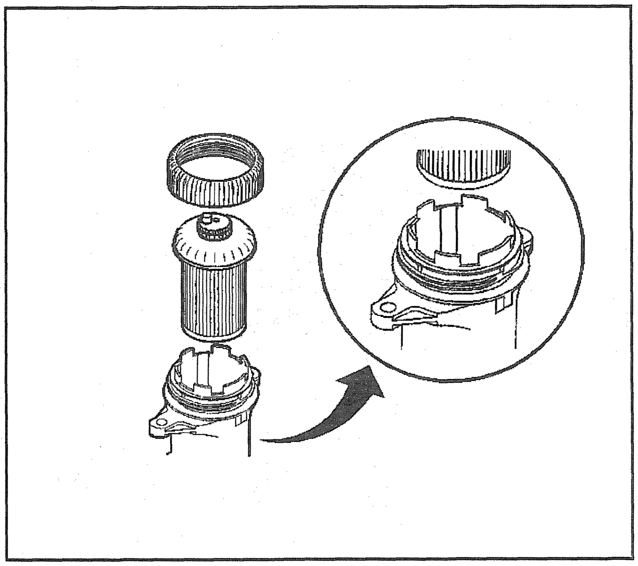
55503

6. Remove the filter by lifting it straight up and out of the filter assembly. It is not necessary to drain fuel from the filter assembly to change the filter element since the fuel will remain in the filter assembly's cavity.



55505

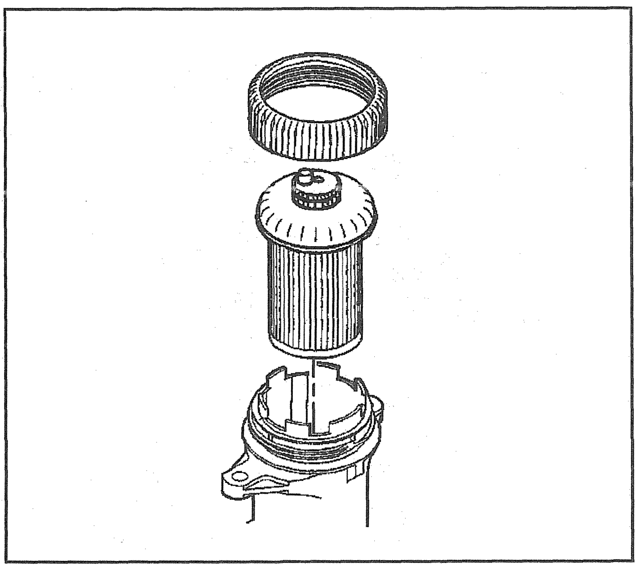
Installation Procedure



55507

Important: Make sure the mating surface between the element assembly and the filter assembly is clean before installation.

1. Install the new filter by aligning the widest key slot located under the element assembly cap with the widest key in the header assembly.



55505

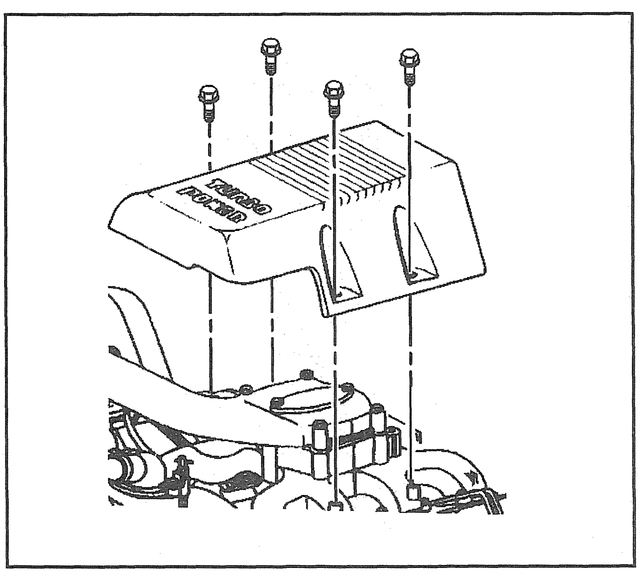
2. Push the element, in a downward direction until the mating surfaces make contact.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the element nut.

   Tighten

   Tighten the element nut securely by hand.
4. Bleed the air from the fuel manager/filter. Refer to *Fuel Feed and Fuel Return Pipe Purge Procedure.*



55489

5. Install the upper intake manifold cover.
6. Install the bolts.

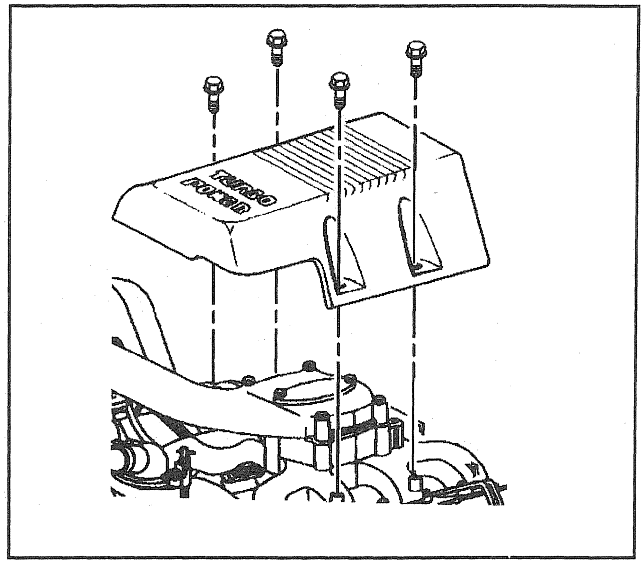
   Tighten

   Tighten the bolts to 11 N·m (100 lb in).
7. Install fuel tank filler cap.

Fuel Manager/Filter Replacement

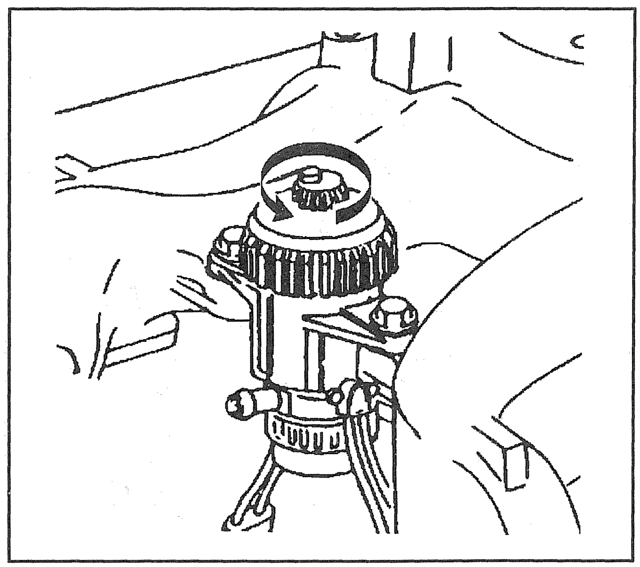
Removal Procedure

1. Remove the fuel tank filler cap.
2. Loosen the upper intake manifold cover bolts.
3. Remove the upper intake manifold cover.



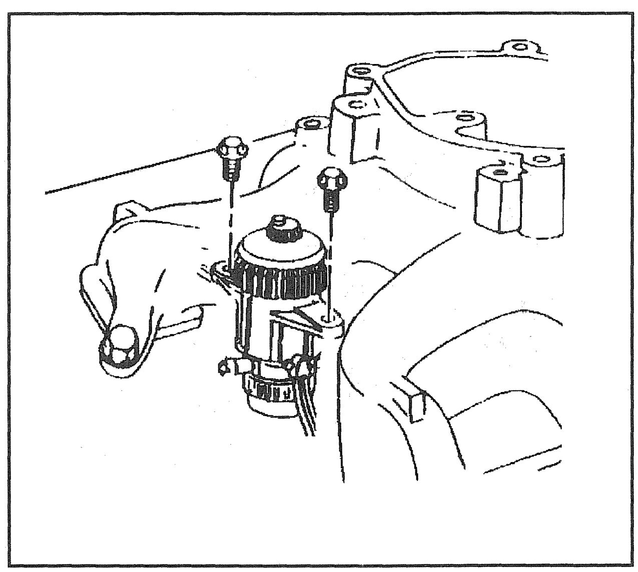
55489

4. Open the air bleed valve on top of the fuel manager/filter to release any pressure in the fuel supply system.

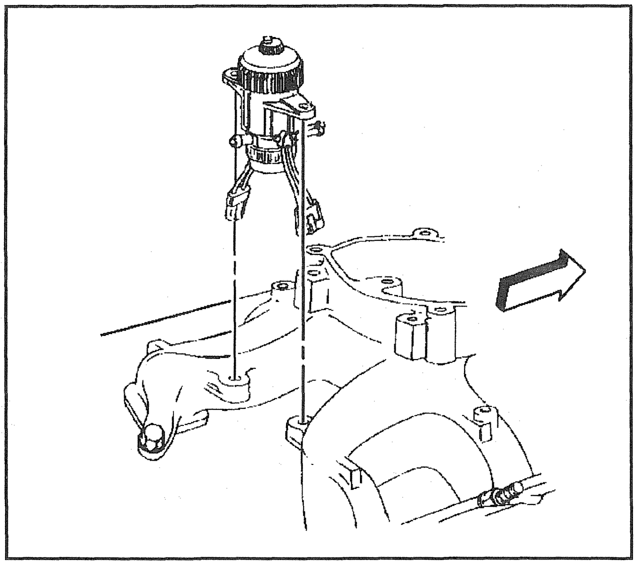


55498

5. Remove the mounting bolts which attach the fuel manager/filter to the intake manifold.

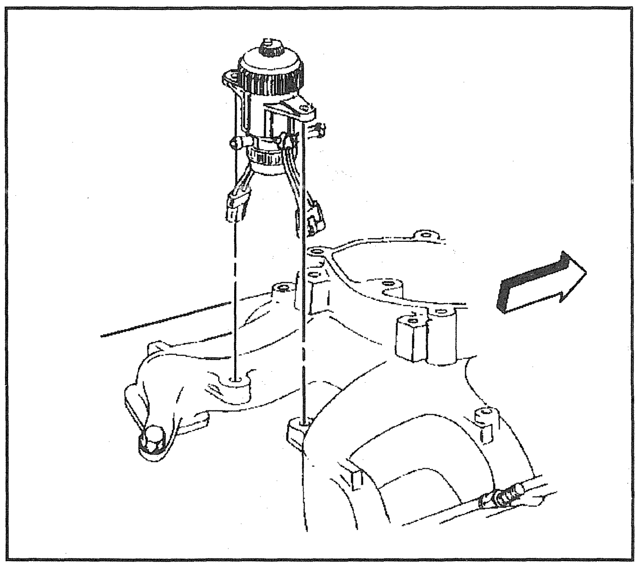


55513



55514

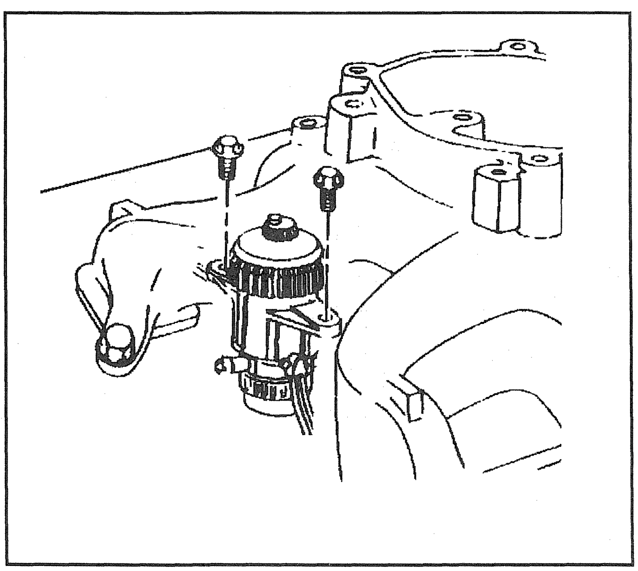
6. Remove the wiring harnesses and fuel hoses.
7. Remove the fuel manager/filter by lifting straight up.



55514

Installation Procedure

1. Install the fuel hoses and wiring harnesses.
2. Position the fuel manager/filter to the intake manifold.



55513

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the fuel manager/filter mounting bolts.

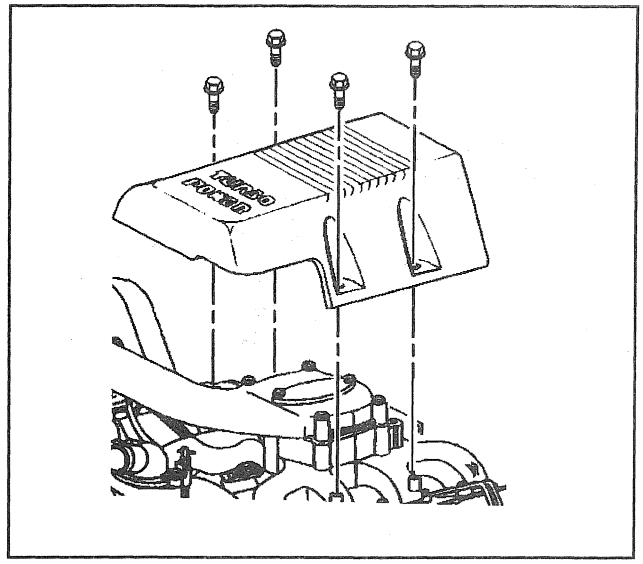
   Tighten

   Tighten the mounting bolts to 25 N·m (18 lb ft).
4. Bleed the air from the fuel manager/filter. Refer to *Fuel Feed and Fuel Return Pipe Purge Procedure.*

5. Install the upper intake manifold cover.
6. Install the upper intake manifold cover bolts.

   Tighten

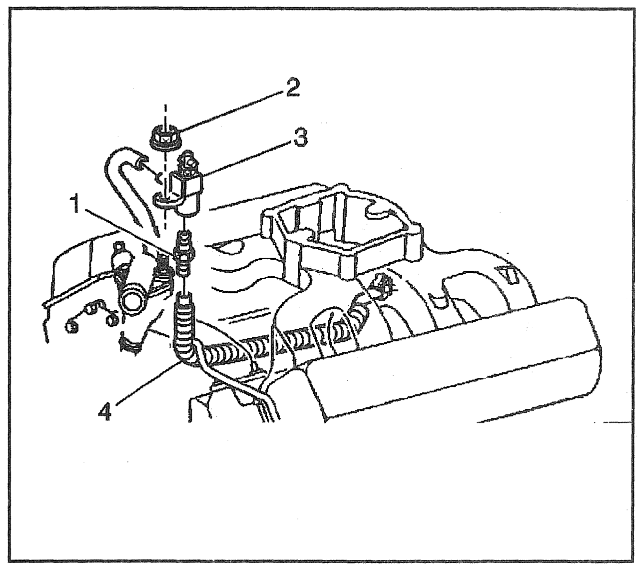
   Tighten the upper intake manifold cover bolts to 11 N·m (100 lb in).
7. Install the fuel tank filler cap.



55489

Fuel Manager/Filter Water Draining Procedure

1. Turn OFF the engine and apply the parking brake.
2. Place a suitable container under the filter drain hose.
3. Open the the filter drain valve.
4. Start the engine and allow it to idle for one minute or until clear fuel is observed. A scan tool can also be used to turn the fuel pump on.
5. Close the filter drain valve (3) and stop the engine.
6. Dispose of the drained mixture in a proper manner.
7. If the Water In Fuel lamp comes on again, repeat procedure until all of the water is removed.

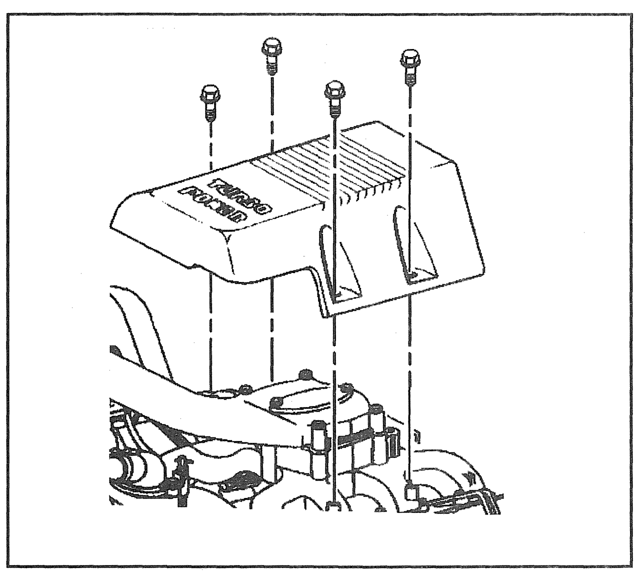


27616

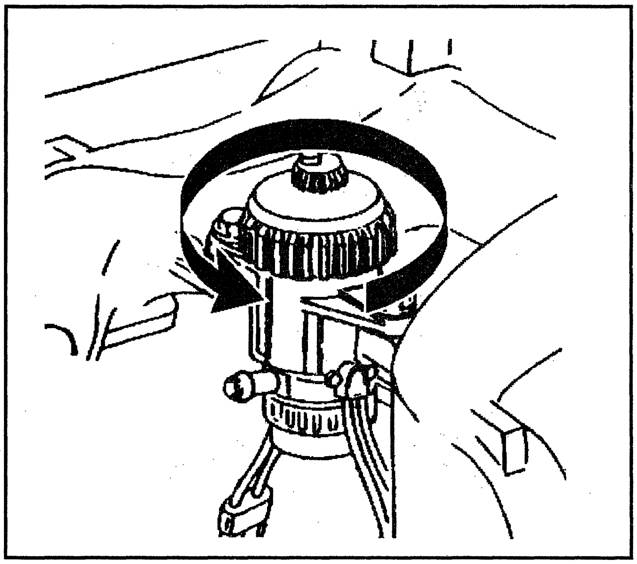
Water-in-Fuel Sensor Replacement

Removal Procedure

1. Loosen the upper intake manifold cover bolts.
2. Remove the upper intake manifold cover.

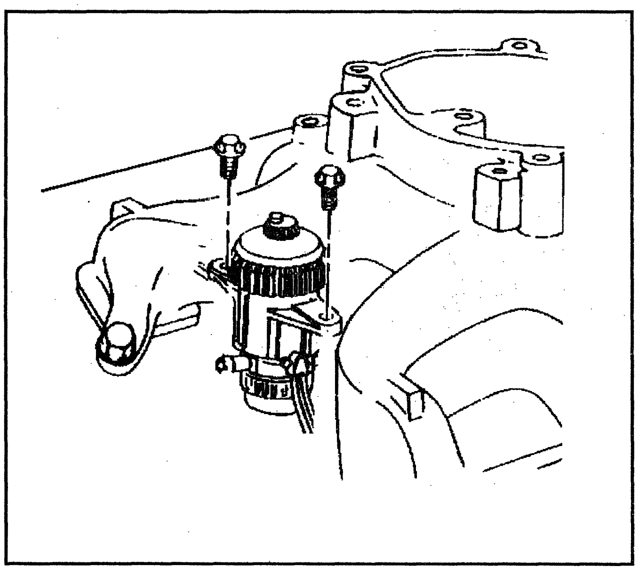


55489



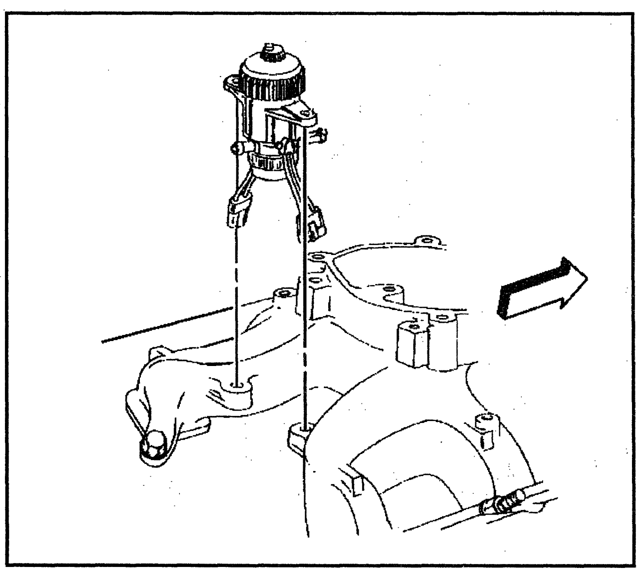
55503

3. Open the air bleed valve on top of the fuel manager/filter to release any pressure in the fuel supply system.



55513

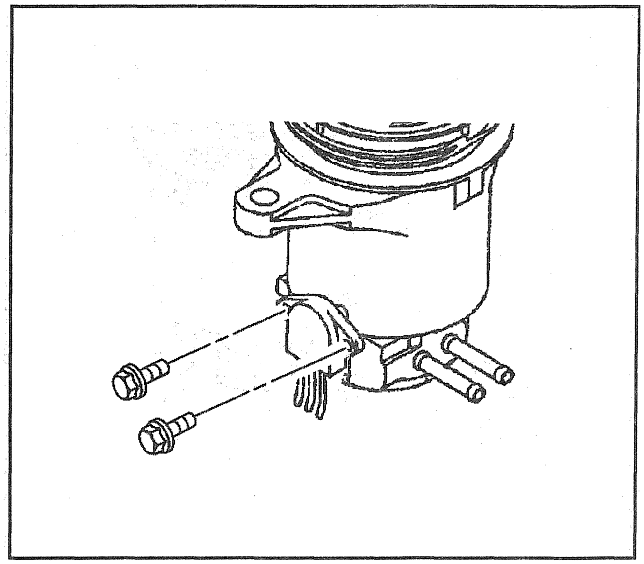
4. Remove the mounting bolts that connect the fuel manager/filter to the intake manifold.



55514

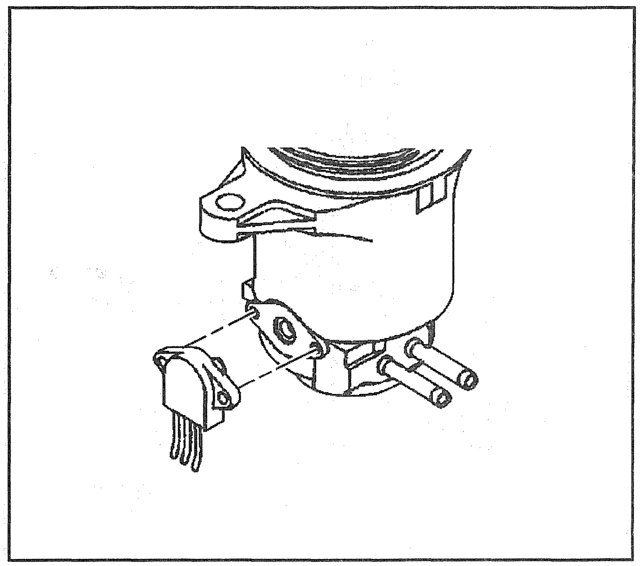
5. Remove the wiring harnesses and the fuel hoses.
6. Remove the fuel manager/filter by lifting straight up.

7. Remove the sensor mounting screws.



55496

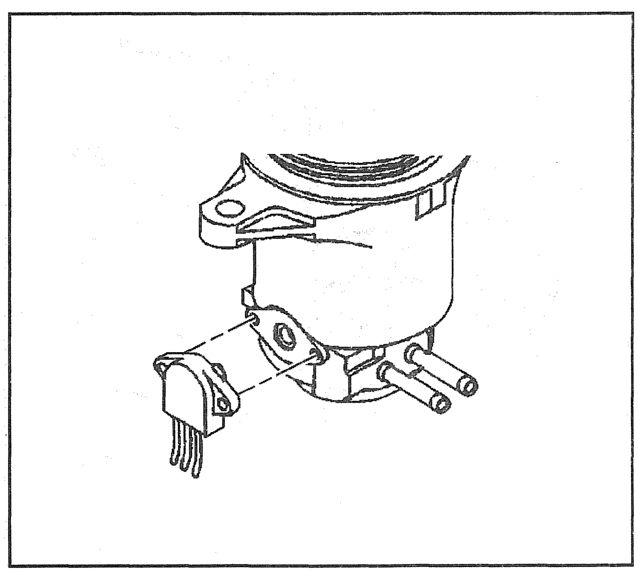
8. Remove the sensor.



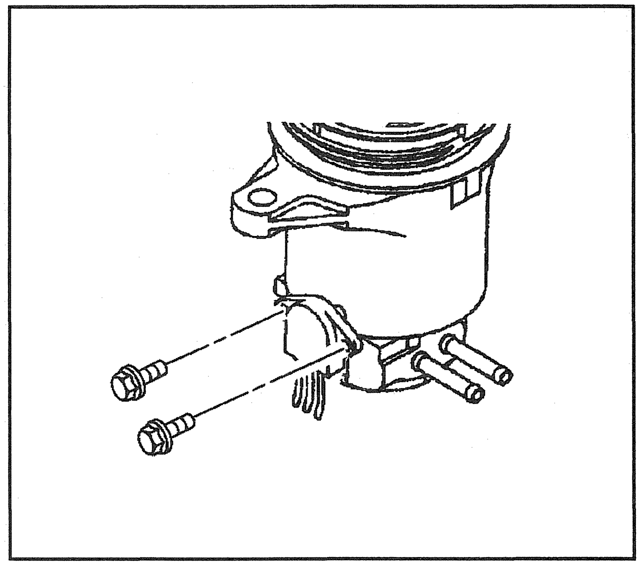
55517

Installation Procedure

1. Install the new water in fuel sensor and a new water in fuel sensor seal.



55517



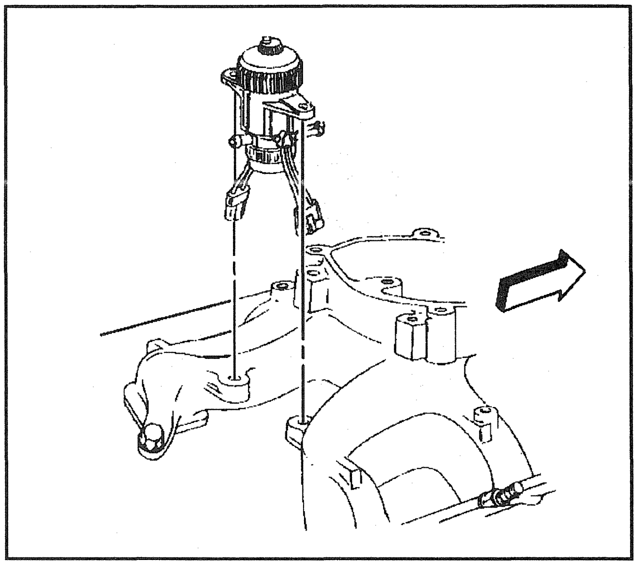
55496

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the sensor mounting screws.

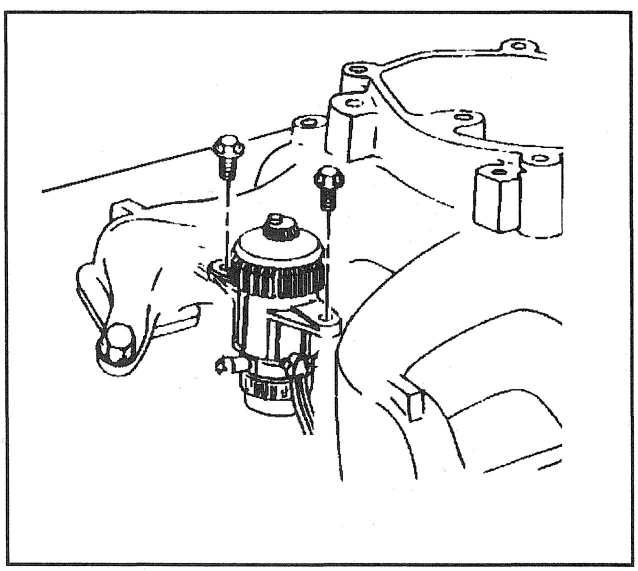
   Tighten

   Tighten the mounting screws to 2 N·m (13 lb in).



55514

3. Position the fuel manager/filter to the intake manifold.
4. Install the wiring harnesses and fuel hoses.



55513

5. Install the mounting bolts that connect the fuel manager/filter to the intake manifold.

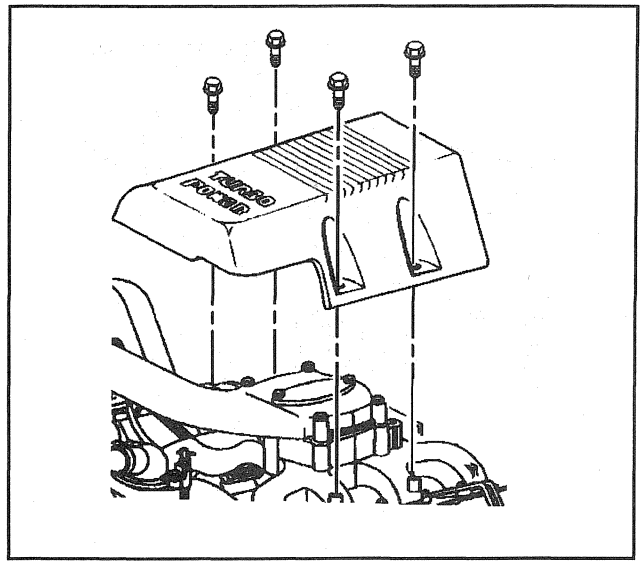
   Tighten

   Tighten the mounting bolts to 25 N·m (18 lb ft).
6. Bleed the air from fuel manager/filter if necessary (Refer to *Fuel Feed and Fuel Return Pipe Purge Procedure*.

7. Install the upper intake manifold cover.
8. Install the upper intake manifold cover bolts.

   Tighten

   Tighten the upper intake manifold cover bolts to 11 N·m (100 lb in).

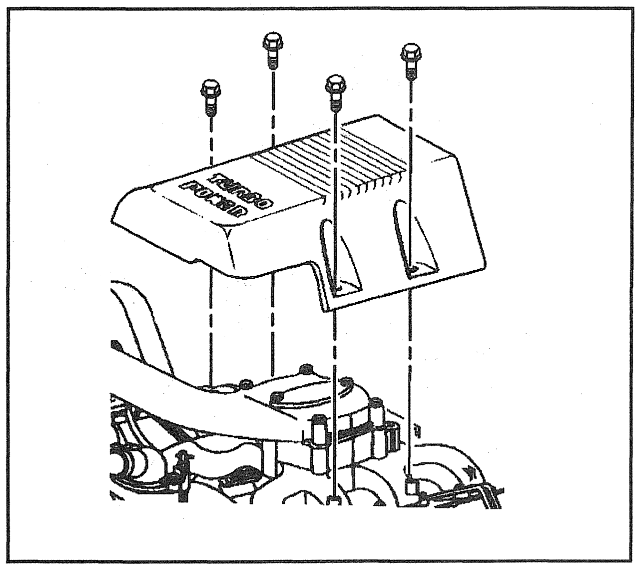


55489

Fuel Heater Replacement

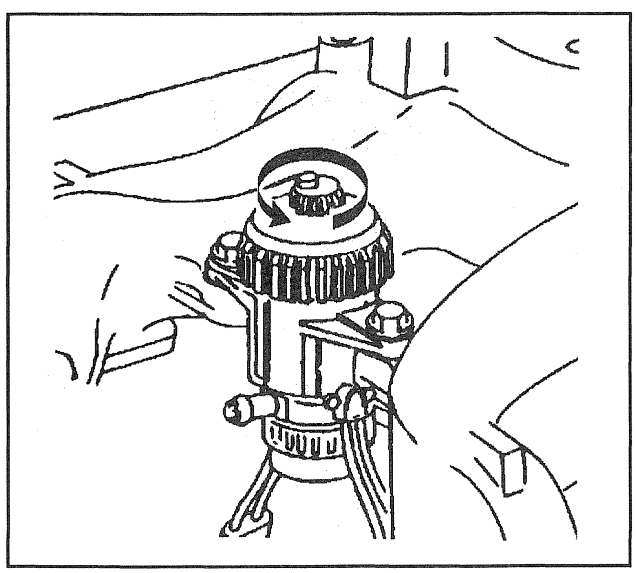
Removal Procedure

1. Remove the upper intake manifold cover.

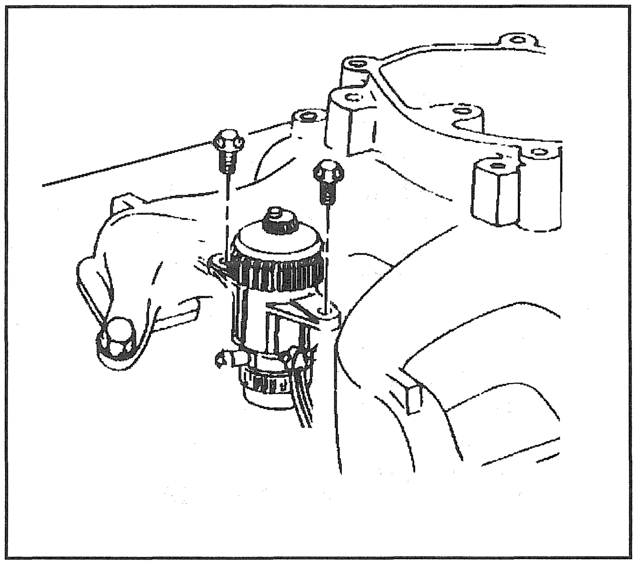


55489

2. Open the air bleed valve on top of the fuel manager/filter to release any pressure in the fuel supply system.

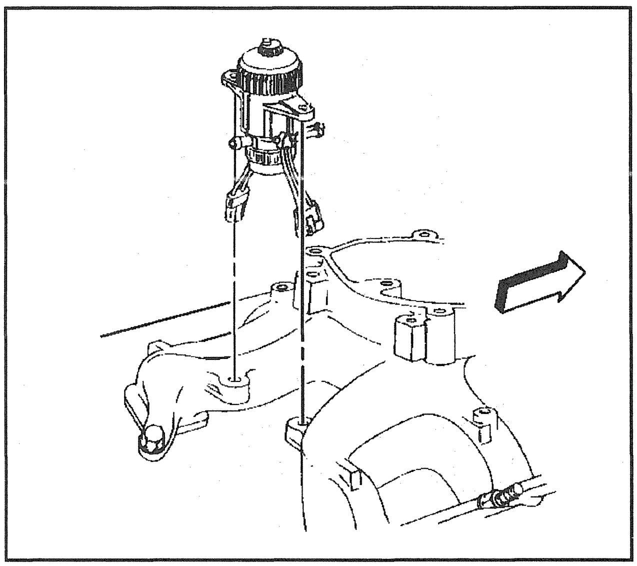


55498



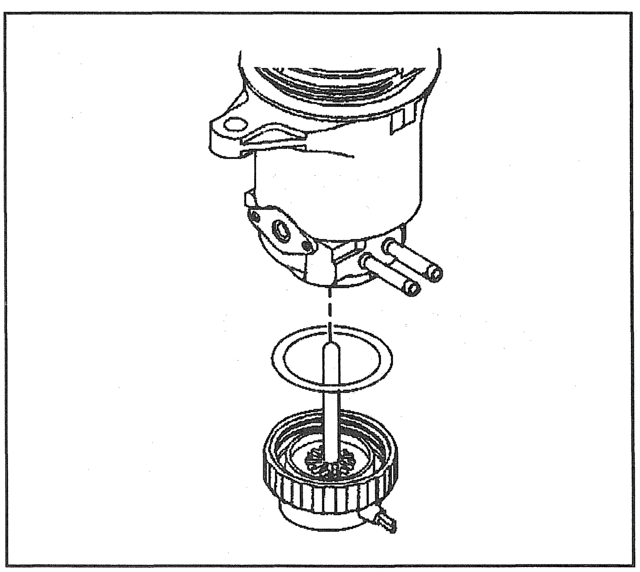
55513

3. Remove the mounting bolts that connect the fuel manager/filter to the intake manifold.



55514

4. Remove the wiring harnesses and fuel hoses.
5. Remove the fuel manager/filter by lifting straight up.

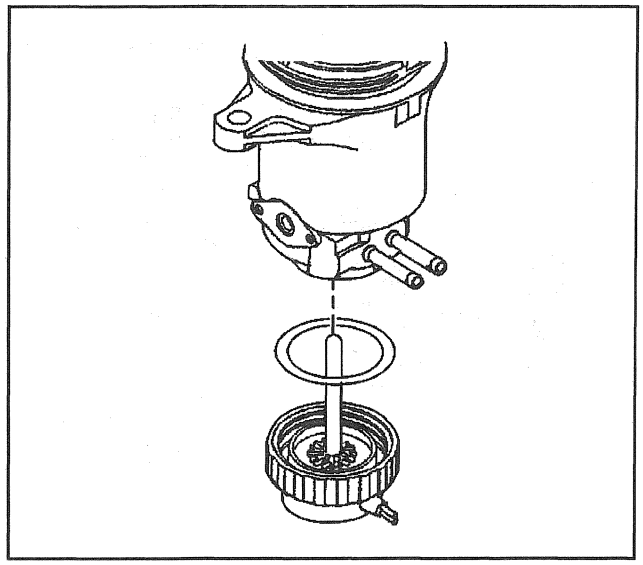


55494

6. Remove the fuel heater threaded cap nut by using hand pressure or a strap wrench.
7. Remove the fuel heater from the filter housing.
8. Clean the fuel heater to housing sealing surfaces.

Installation Procedure

1. Install the cap seal into filter housing.



55494

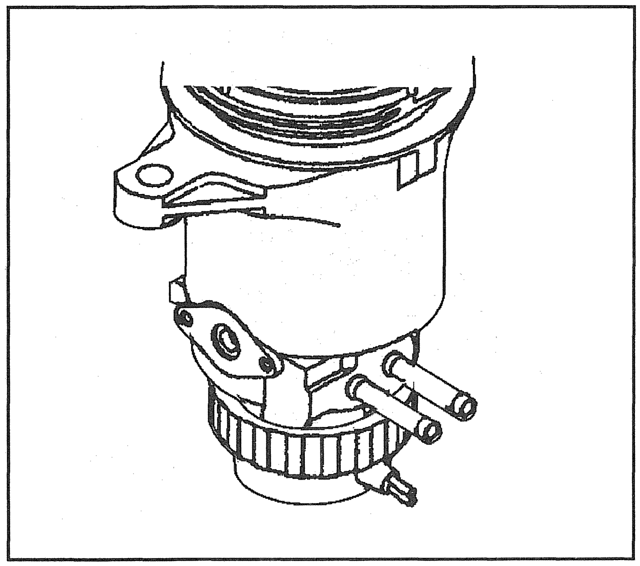
2. Install the fuel heater.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the threaded cap nut.

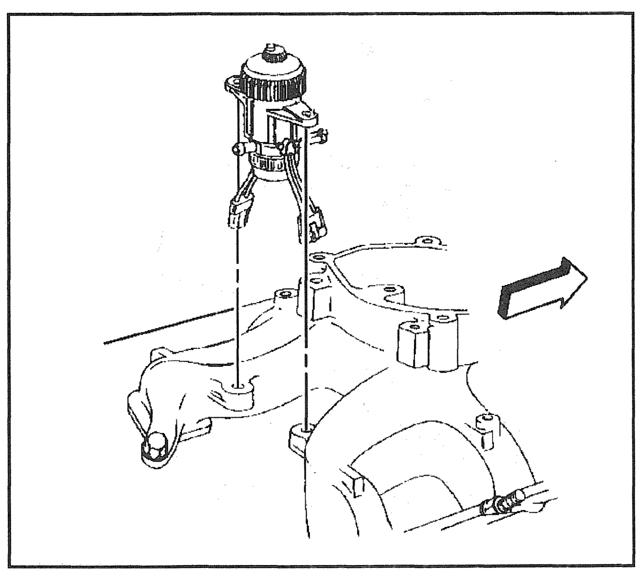
   Tighten

   Tighten the cap nut securely by hand.

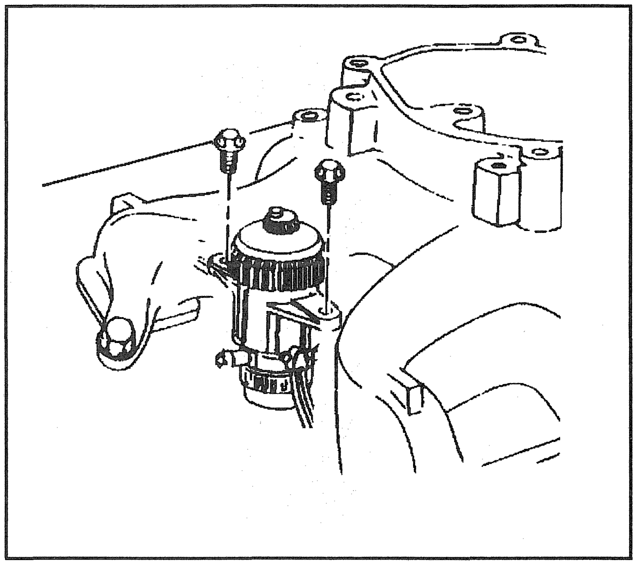


73422

4. Install the fuel manager/filter (Refer to *Fuel Manager/Filter Replacement*.



55514

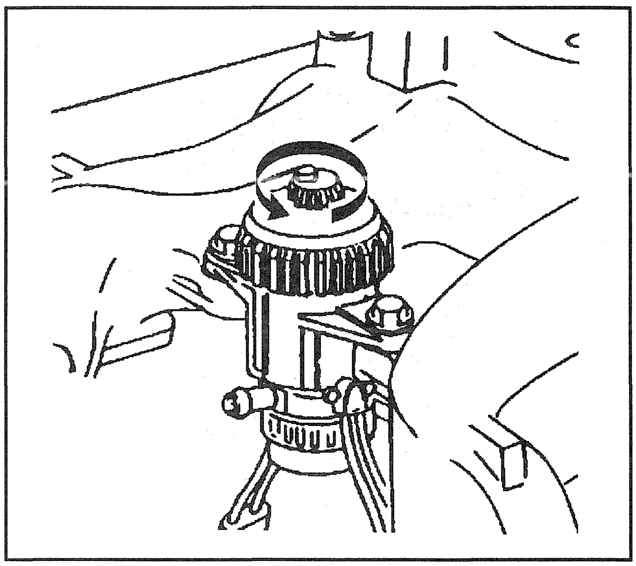


55513

5. Install the mounting bolts that connect the fuel manager/filter to the intake manifold.

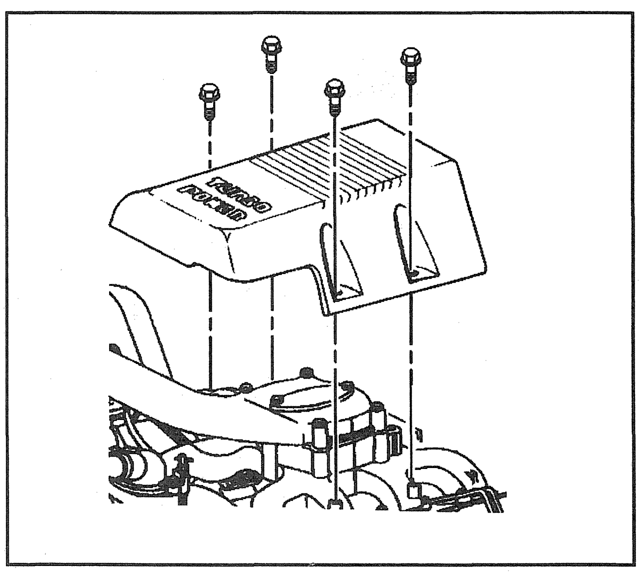
   Tighten

   Tighten the mounting bolts to 25 N·m (18 lb ft)



55498

6. Open the air bleed valve on top of the fuel manager/filter to bleed air from fuel supply system (Refer to *Fuel Feed and Fuel Return Pipe Purge Procedure*.



55489

7. Install the upper intake manifold cover.

Fuel Tank Draining Procedure

Caution: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

To drain the fuel tank is to remove as much fuel as possible before servicing the fuel tank.

1. Disconnect the negative battery cables.
2. Use a hand operated pump device to drain as much fuel as possible through the filler neck.
3. Remove the fuel and reinstall the filler cap.

Fuel Tank Replacement (Suburban)

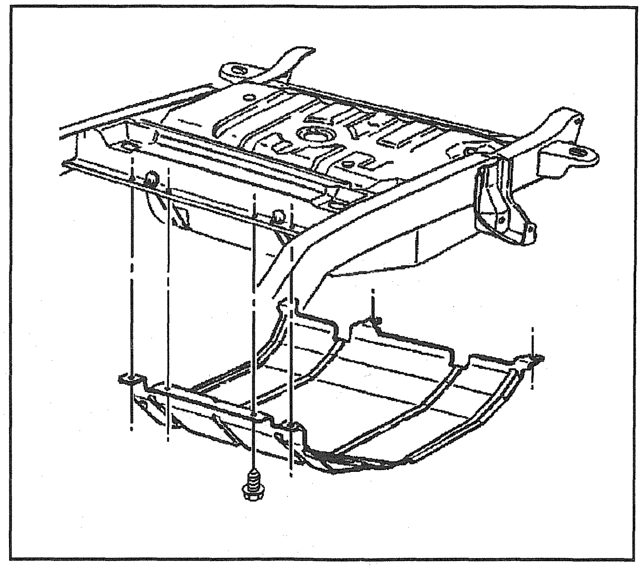
Removal Procedure

Tools Required

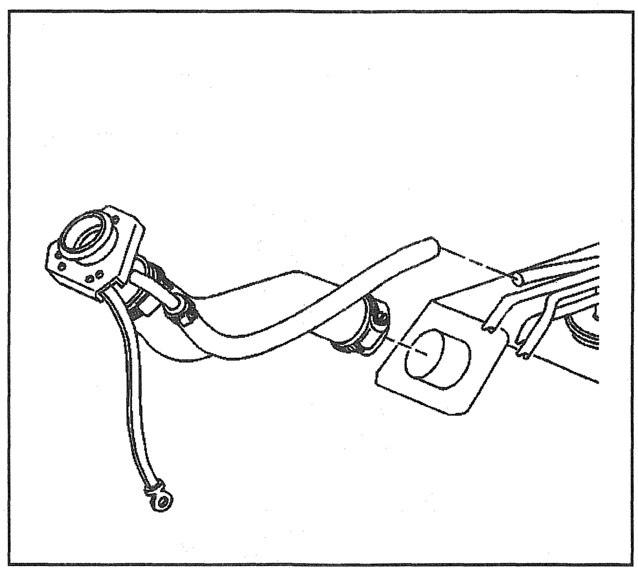
J 36608 Fuel Sender Tool

Caution: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

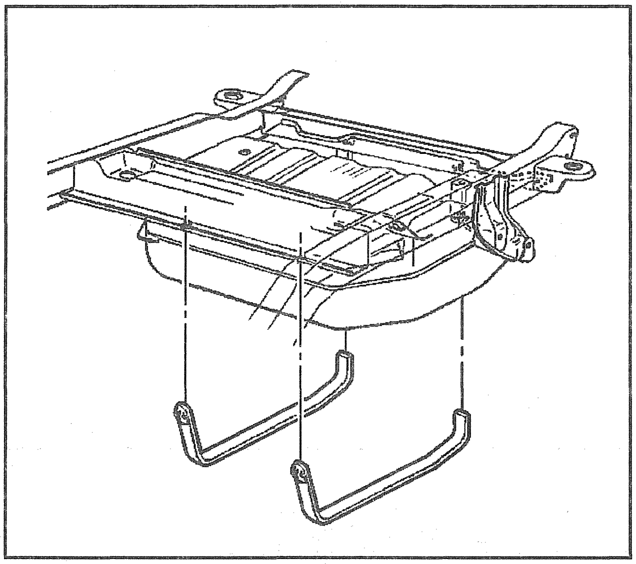
1. Disconnect the negative battery cables.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure*.
3. Raise the vehicle.
4. Remove the bolts and the fuel tank off-road shield, if equipped.
5. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.



18322

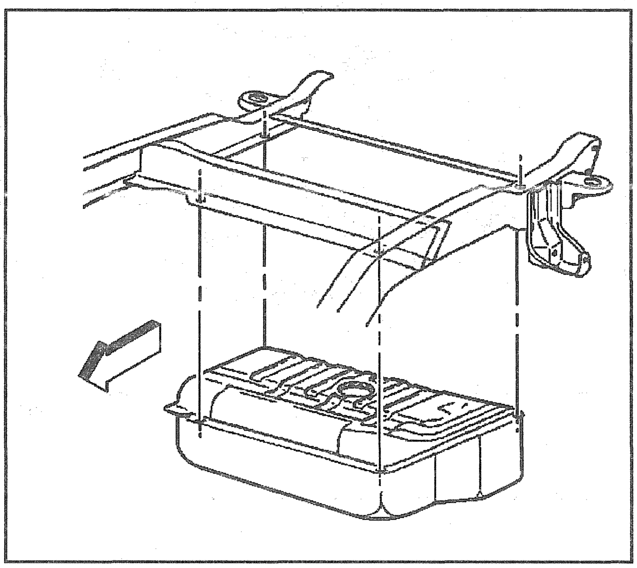


18442



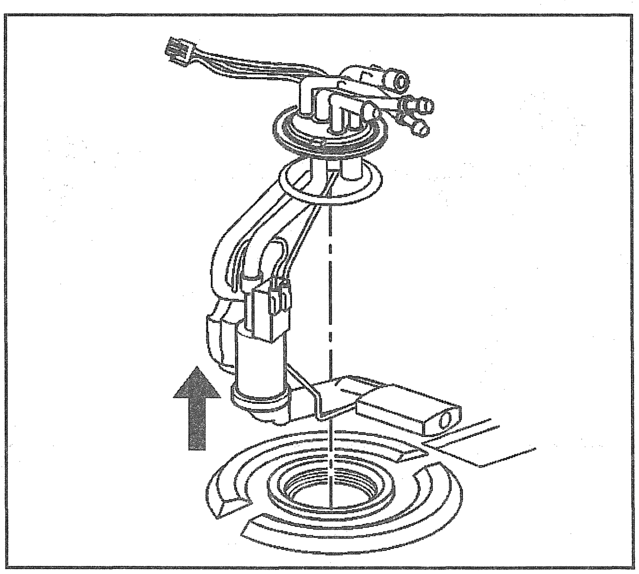
18311

6. Support the fuel tank and remove the tank strap bolts, the tank straps and the insulator strips, if equipped.



18321

7. Lower the fuel tank and shield enough to access the fuel lines and electrical connections at the tank and sender.
8. Disconnect the fuel feed and vapor hoses. Disconnect the electrical connections at the sender.
9. Lower the tank and shield fully.
10. Lift the tank out of the shield and place the tank on the floor.

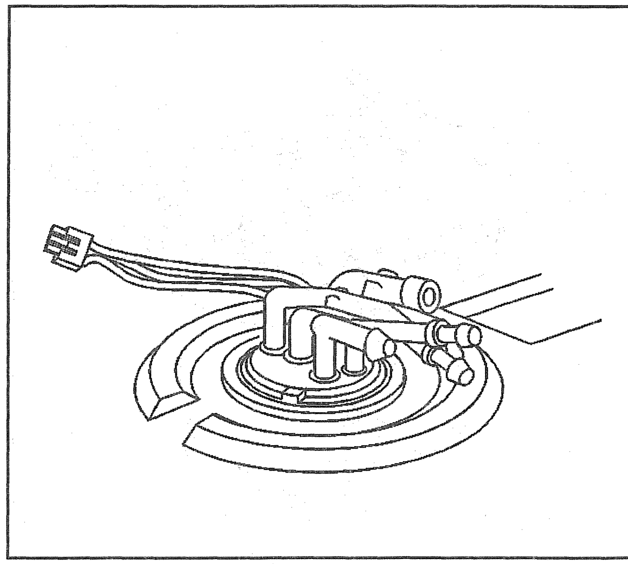


17407

11. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.

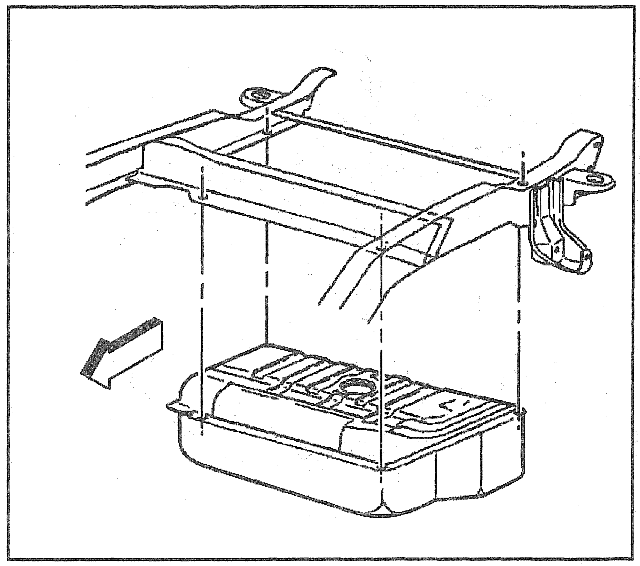
Installation Procedure

1. Install the new seal ring and reinstall the sender using the *J 36608* fuel sender tool.
2. Place the tank in the shield.
3. Raise the tank slightly and reconnect the fuel feed and vapor hoses and the electrical connections at the sender.



263632

4. Raise the tank and shield fully.



18321

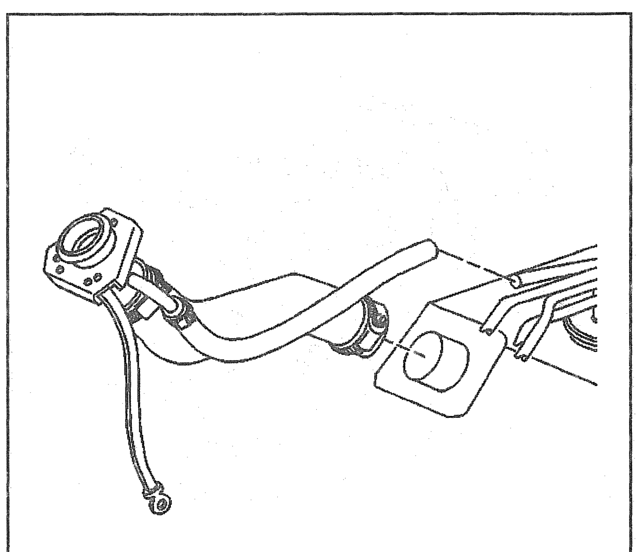
5. Reinstall the fuel tank filler neck to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

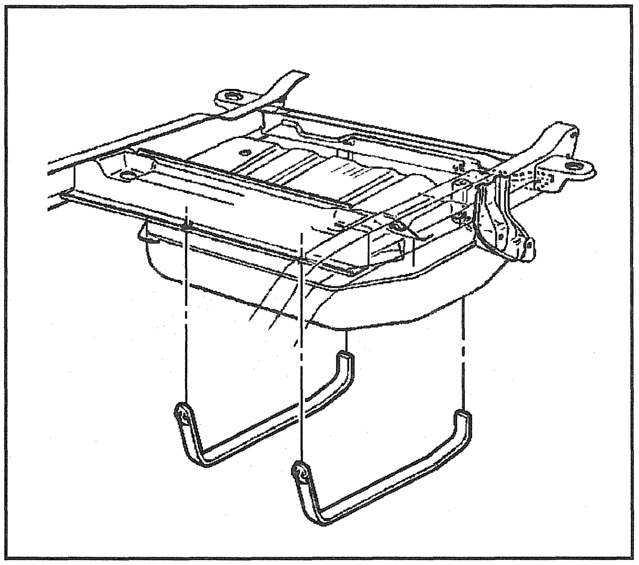
6. Install the clamp

   Tighten

   Tighten the clamp to 2.5 N·m (25 lb in).



18442



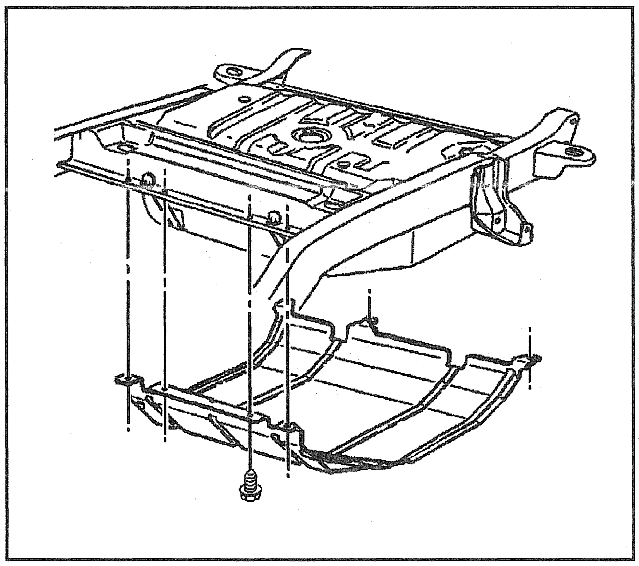
18311

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

7. Install the fuel tank brackets with insulator strips in place.

   Tighten

   Tighten the strap bolts to 45 N·m (33 lb ft).

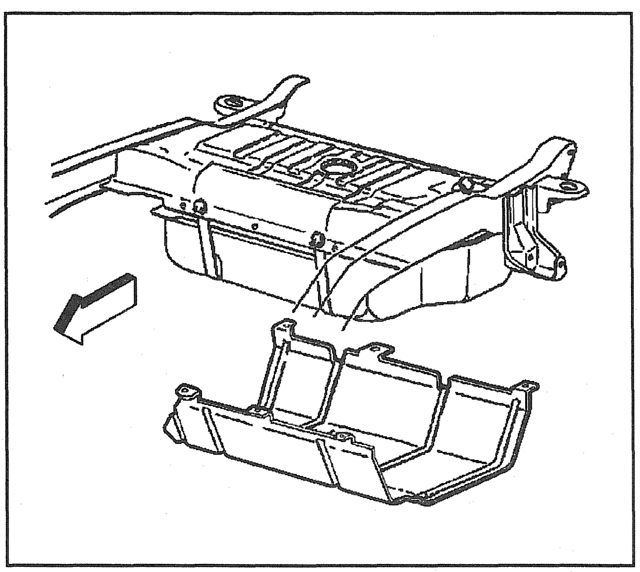


18322

8. Install the fuel tank off-road shield, if equipped.
9. Install the bolts.

   Tighten

   Tighten the bolts to 35 N·m (26 lb ft).
10. Replenish the fuel in the tank. Reinstall the fuel tank filler cap.
11. Reconnect the negative battery cable. If a memory retention device was not used, please reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
12. Check for leaks.
    - 12.1. Turn ON the ignition switch for 2 seconds.
    - 12.2. Turn OFF the ignition switch for 10 seconds.
    - 12.3. Again, turn the ignition switch to the ON position.
    - 12.4. Check for fuel leaks.



18318

Fuel Tank Replacement (Tahoe/Yukon)

Removal Procedure

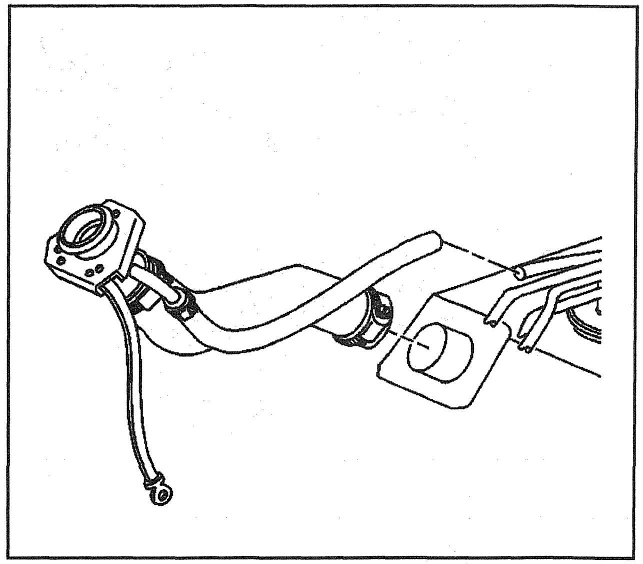
Tools Required

J 36608 Fuel Sender Tool

Caution: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or its components.

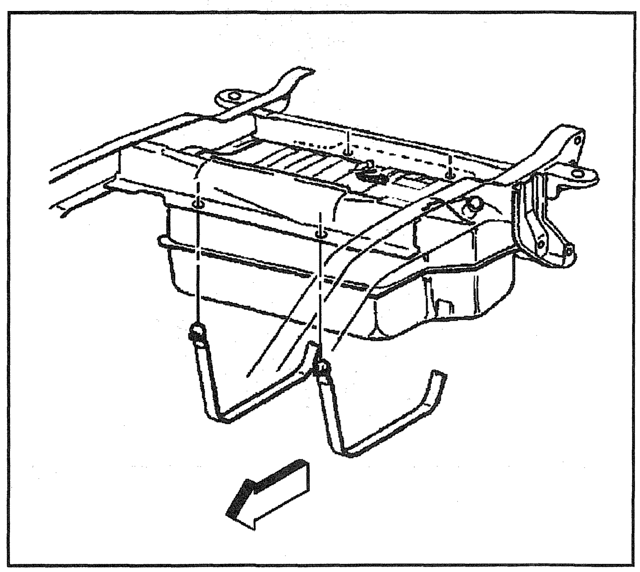
1. Remove negative battery cable.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure*.

3. Raise the vehicle.
4. Remove the fuel tank off-road shield bolts and the fuel tank off-road shield, if equipped.
5. Loosen the filler neck hose clamp at the fuel tank.
6. Disconnect the fuel tank filler neck from the fuel tank.

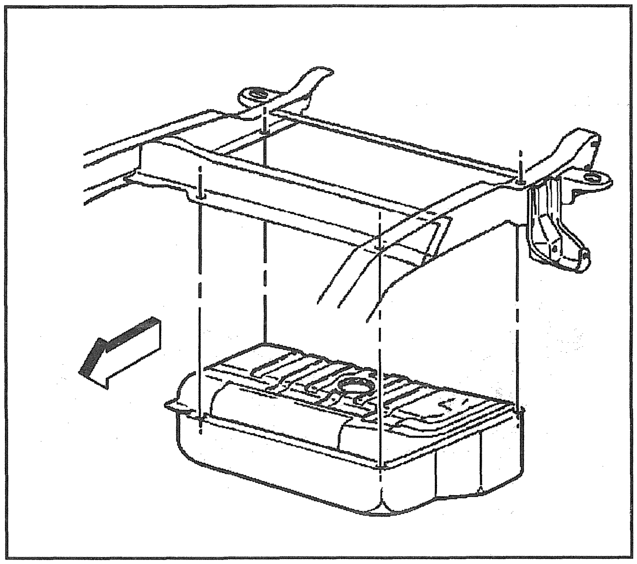


18442

7. Support the fuel tank and remove the tank strap bolts, the tank straps, and the insulator strips, if equipped.

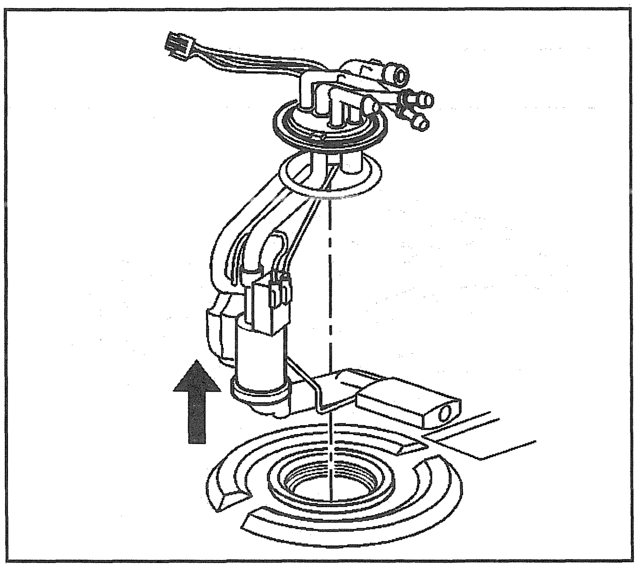


18329



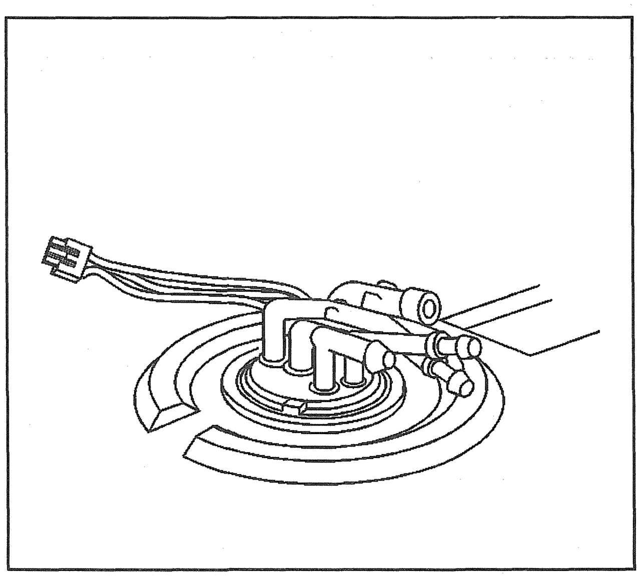
18321

8. Lower the fuel tank and shield enough to access the fuel lines and electrical connections at the tank and sender.
9. Disconnect the fuel feed and vapor hoses. Disconnect the electrical connections at the sender.
10. Lower the tank and shield fully.
11. Lift the tank out of the shield and place the tank on the floor.



17407

12. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.

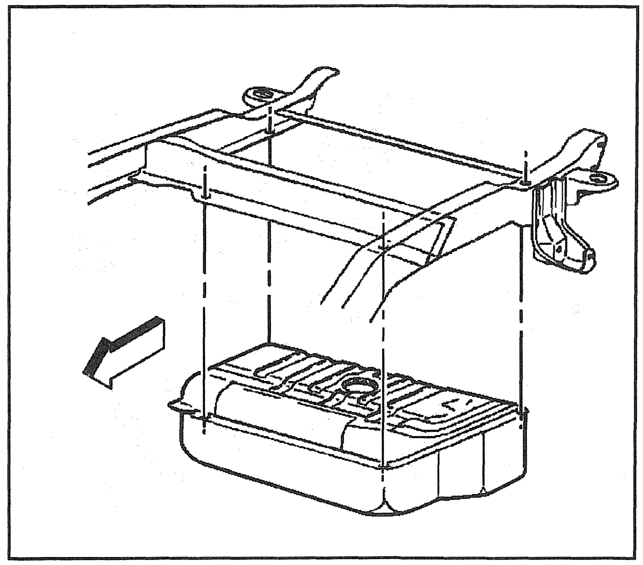


263632

Installation Procedure

1. Install the new seal ring and reinstall the sender using the *J 36608* fuel sender tool.
2. Place the tank in the shield.
3. Raise the tank slightly and reconnect the fuel feed and vapor hoses and the electrical connections at the sender.

4. Raise the tank and shield fully.



18321

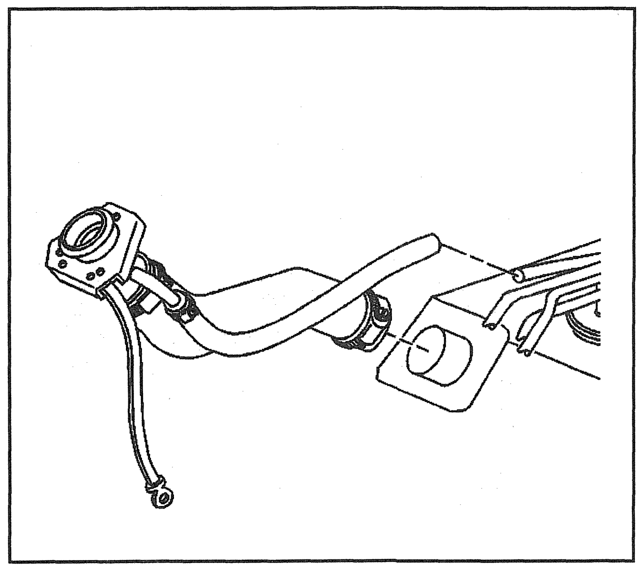
5. Reinstall the fuel tank filler neck to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Install the clamp.

   Tighten

   Tighten the clamp to 2.5 N·m (25 lb in).



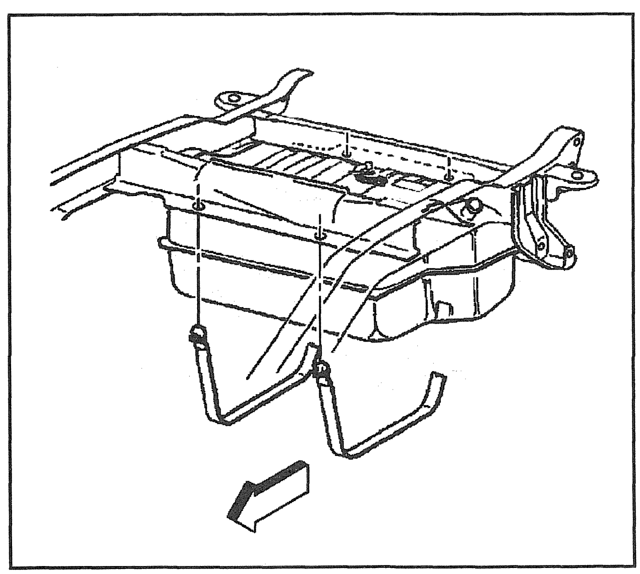
18442

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

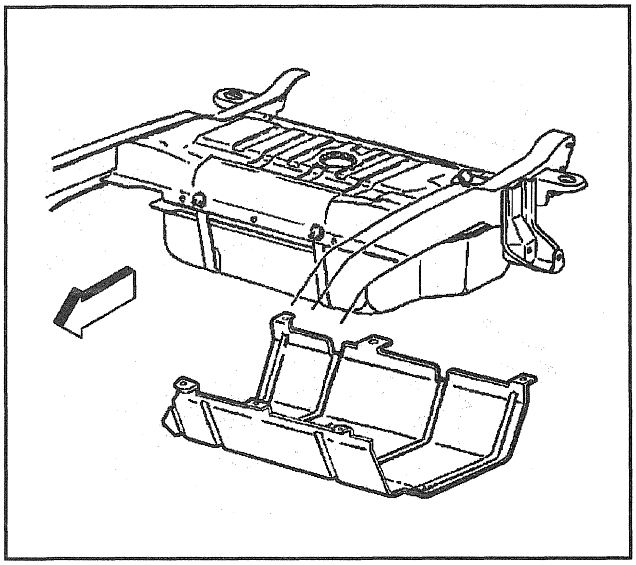
7. Install the fuel tank brackets with insulator strips in place.

   Tighten

   Tighten the strap bolts to 45 N·m (33 lb ft).



18329

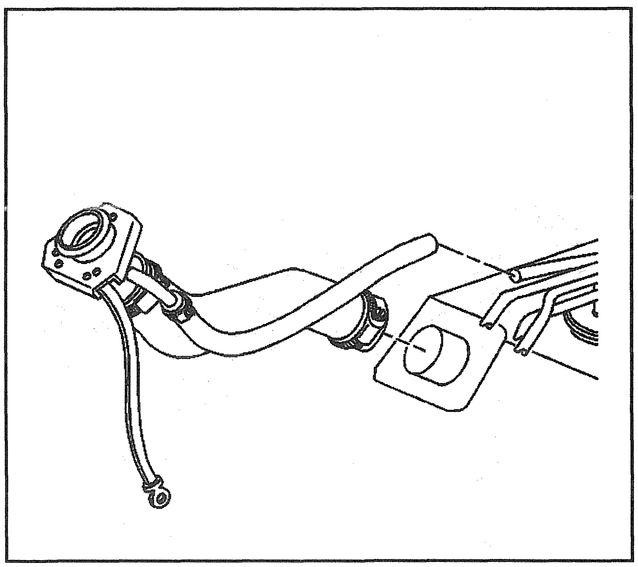


18318

8. Install the fuel tank off-road shield, if equipped.
9. Install the bolts.

   Tighten

   Tighten the bolts to 35 N·m (26 lb ft).
10. Replenish the fuel in the tank. Reinstall the fuel tank filler cap.
11. Reconnect the negative battery cable. If a memory retention device was not used, please reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
12. Check for fuel leaks.
    12.1. Turn ON the ignition switch for 2 seconds.
    12.2. Turn OFF the ignition switch for 10 seconds.
    12.3. Again, turn the ignition switch to the ON position.
    12.4. Check for fuel leaks.



18442

Fuel Tank Replacement (Pickup Side Tank)

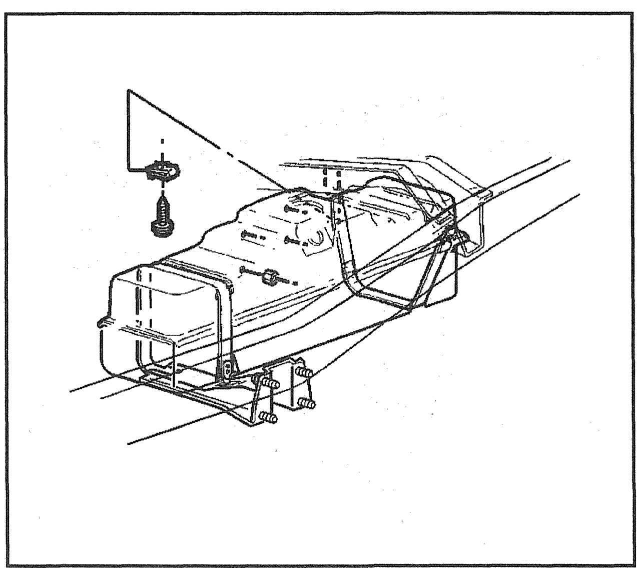
Removal Procedure

Tools Required

J 36608 Fuel Sender Tool

Caution: Refer to Battery Disconnect Caution in General Information.

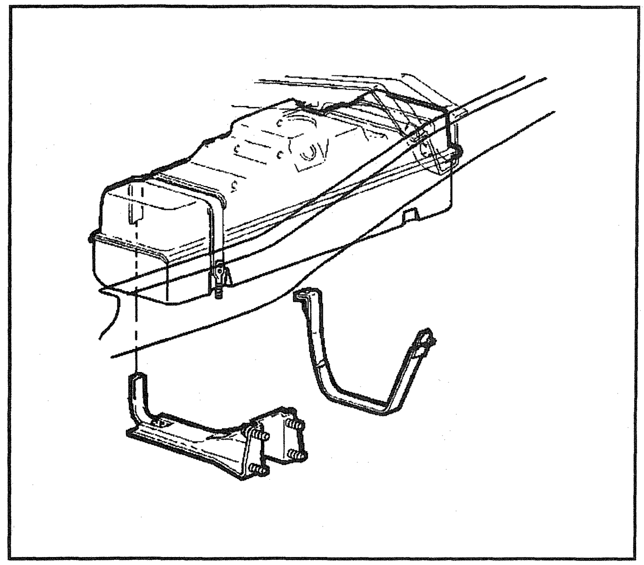
1. Remove negative battery cables.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure.*
3. Raise the vehicle.
4. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.



18406

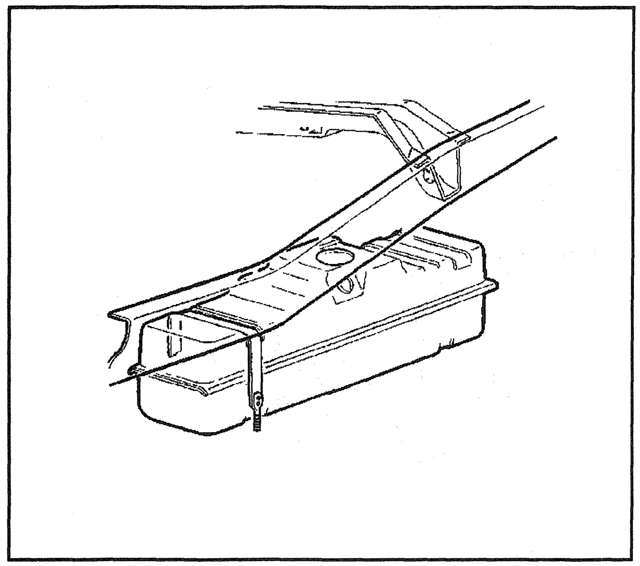
5. Support the fuel tank and remove the tank strap fasteners and insulator strips, if equipped.

6. Remove the nuts from the frame mounted bracket.
7. Remove the frame mounted bracket.



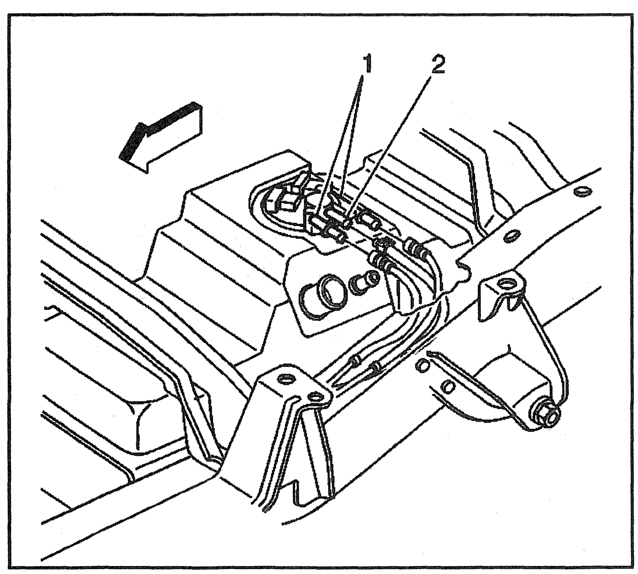
18407

8. Lower the fuel tank and shield enough to access the fuel lines and electrical connections at the tank and sender.

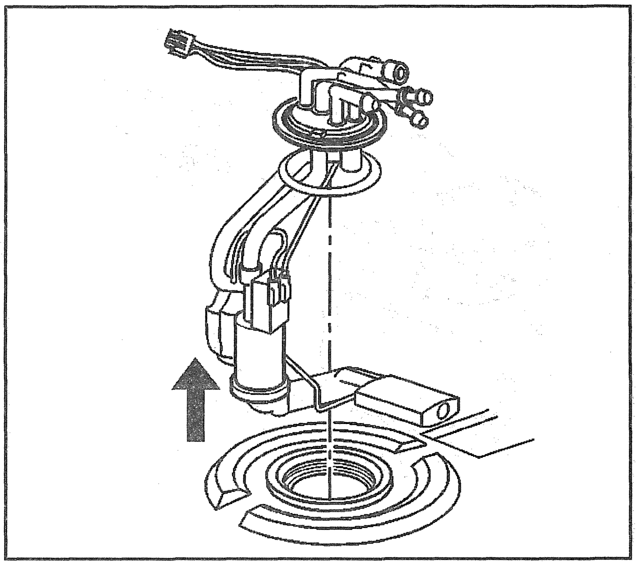


18409

9. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.
10. Lower the tank and shield completely.
11. Lift the tank out of the shield and place the tank on the floor.

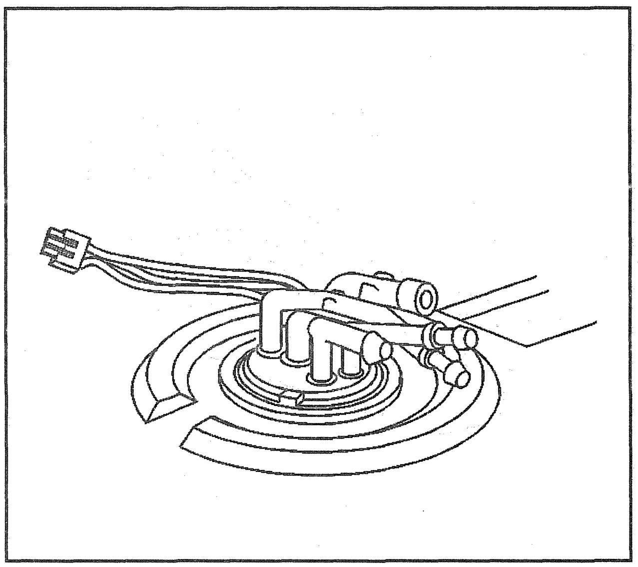


19204



17407

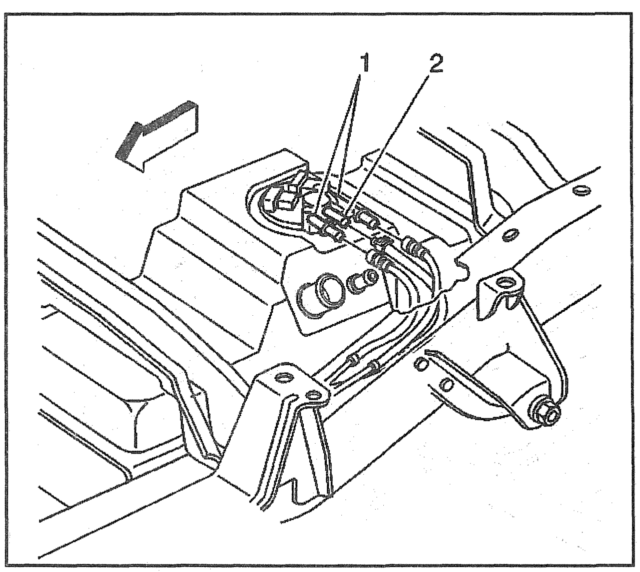
12. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.



263632

Installation Procedure

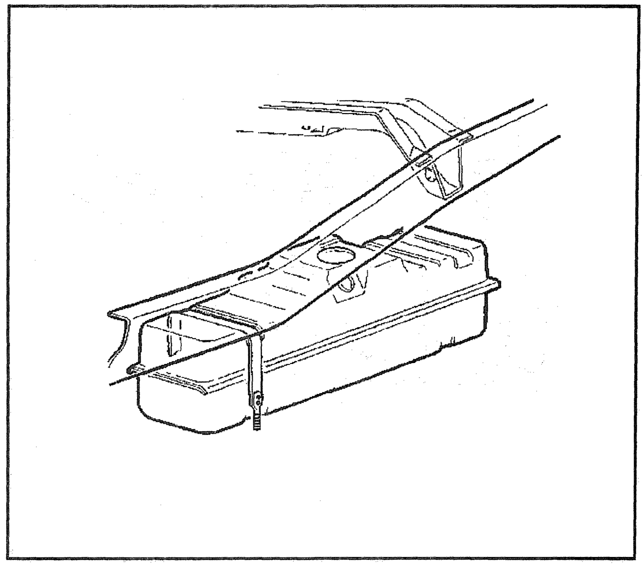
1. Install the new seal ring.
2. Use the *J 36608* fuel sender tool in order to reinstall the sender.
3. Place the tank in the shield.



19204

4. Raise the tank and shield slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.

5. Raise the tank and shield fully.



18409

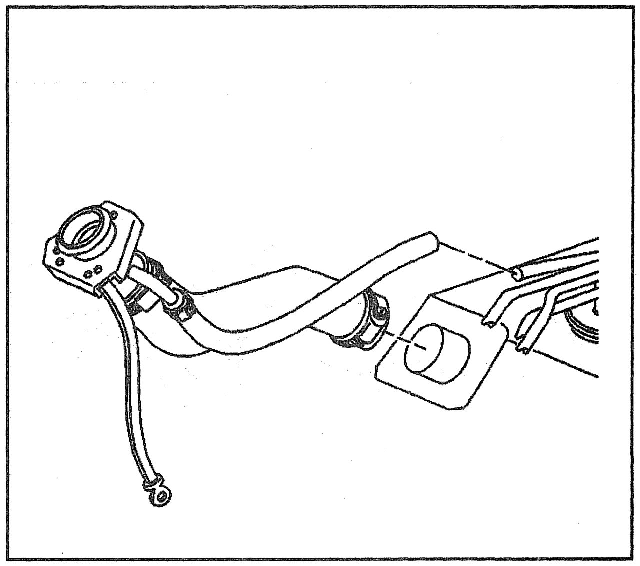
6. Reinstall the fuel tank filler neck on to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the clamp.

   Tighten

   Tighten the clamp to 2.5 N·m (25 lb in).

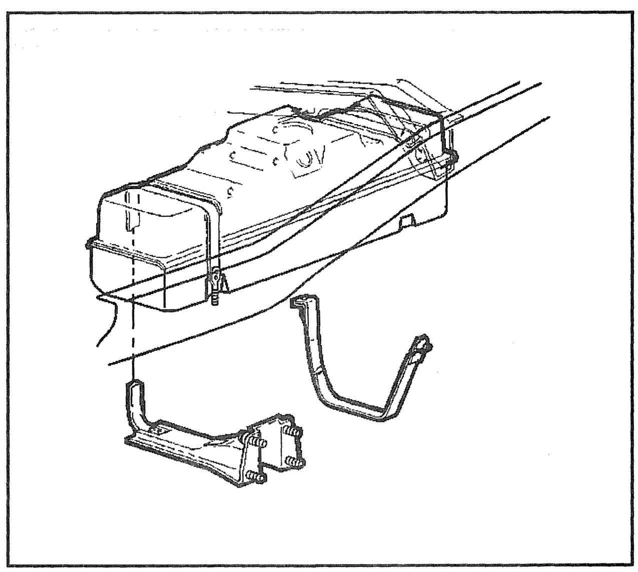


18442

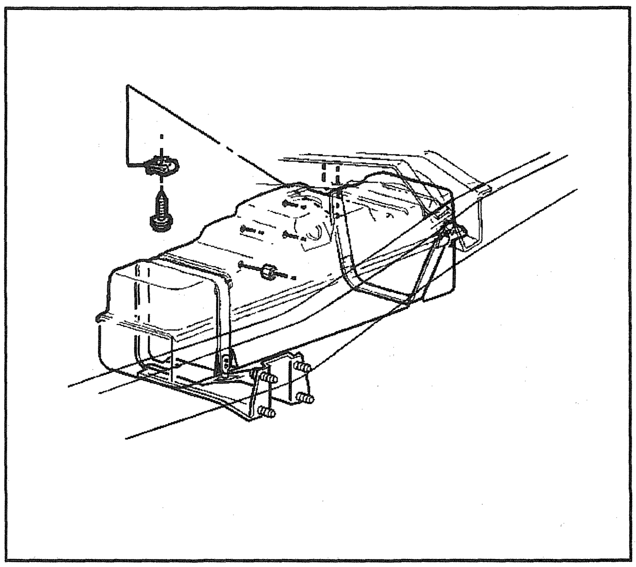
8. Install the frame mounted bracket.
9. Install the nuts.

   Tighten

   Tighten the nuts to 33 N·m (25 lb ft).



18407



18406

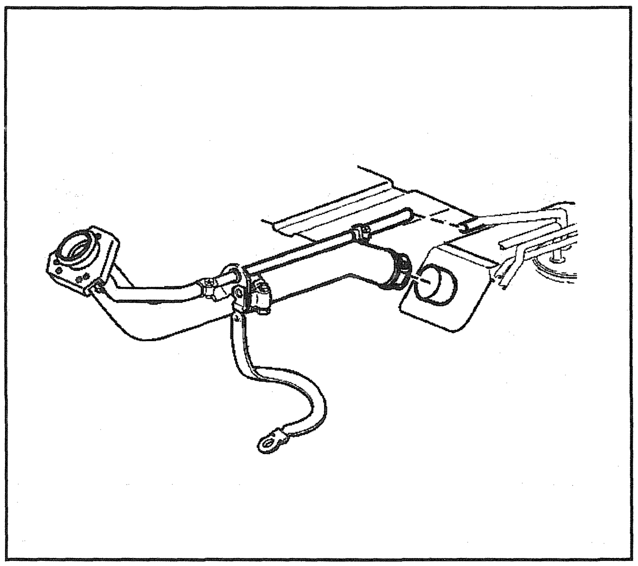
10. Install the fuel tank brackets with the insulator strips in place.

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

11. Tighten the strap bolts.

    Tighten

    Tighten the strap bolts to 45 N·m (33 lb ft).
12. Replenish the fuel in the tank.
13. Reinstall the fuel tank filler cap.
14. Reconnect the negative battery cable. If a memory retention device was not used, reset (to the extent possible) all of the devices that lost their memory after the battery was disconnected.
15. Check for leaks.
    15.1. Turn ON the ignition switch for 2 seconds.
    15.2. Turn OFF the ignition switch for 10 seconds.
    15.3. Again, turn the ignition switch to the ON position.
    15.4. Check for fuel leaks.



18440

Fuel Tank Replacement (Cab and Chassis Side Tank)

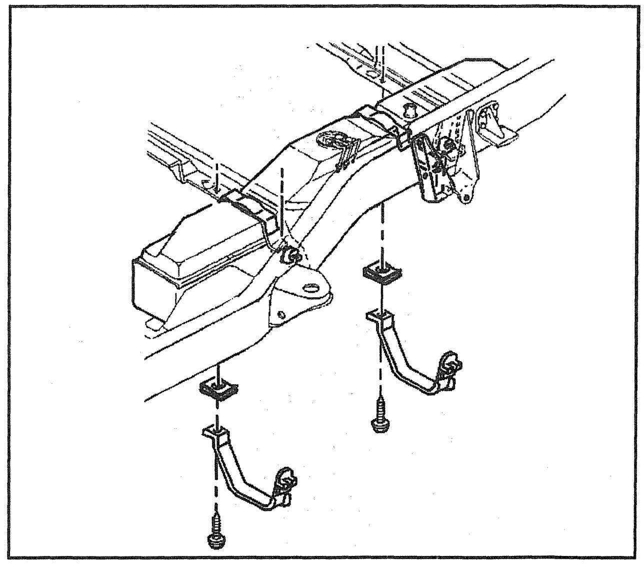
Removal Procedure

Tools Required

J 36608 Fuel Sender Tool

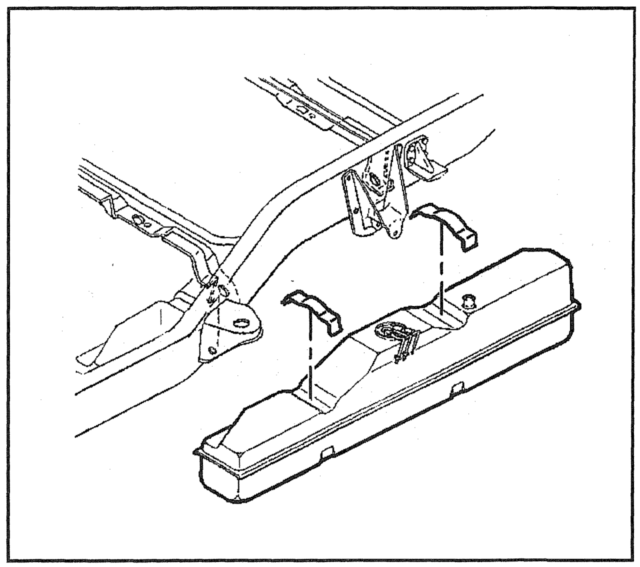
1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure.*
3. Raise the vehicle.
4. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.

5. Support the fuel tank and remove the tank straps and insulator strips, if equipped.



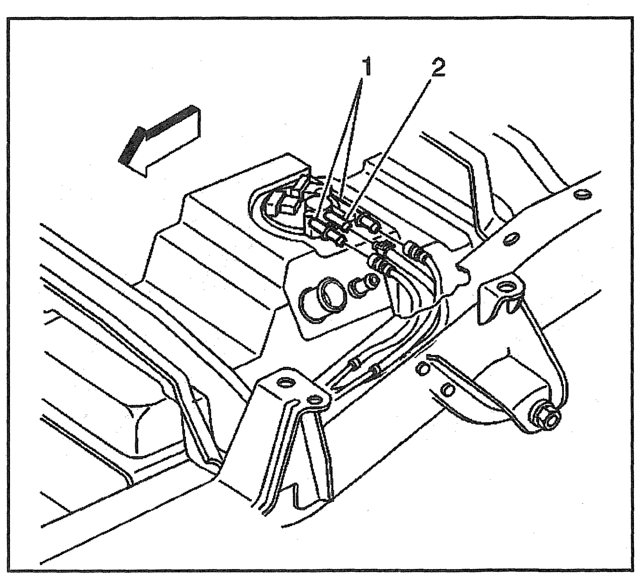
18418

6. Lower the fuel tank and shield enough to access the fuel lines and electrical connections at the tank and sender.

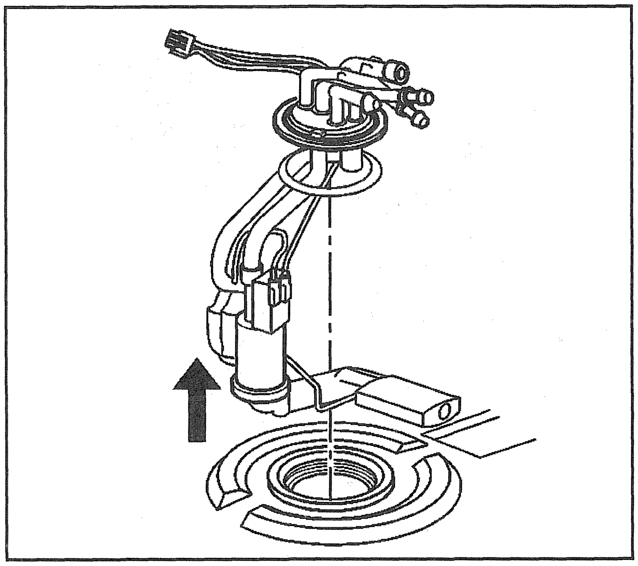


18420

7. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.
8. Lower the tank and shield fully.
9. Lift the tank out of the shield and place the tank on the floor.

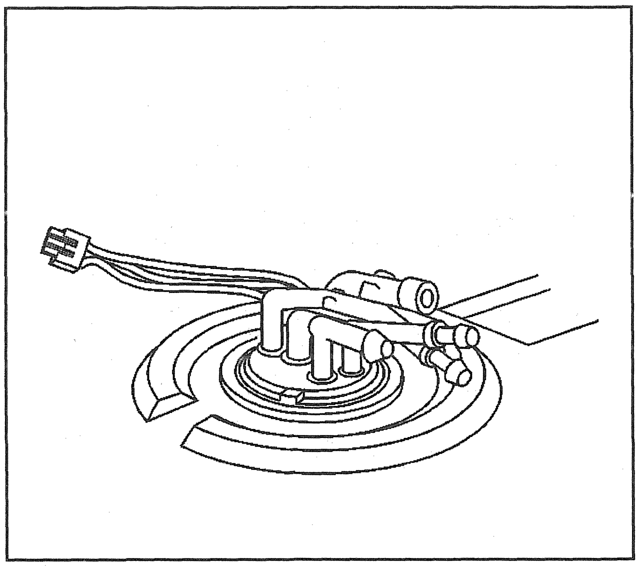


19204



17407

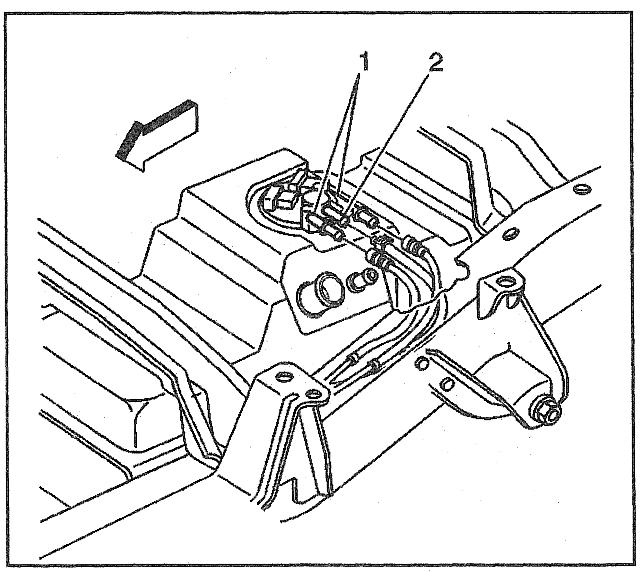
10. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.



263632

Installation Procedure

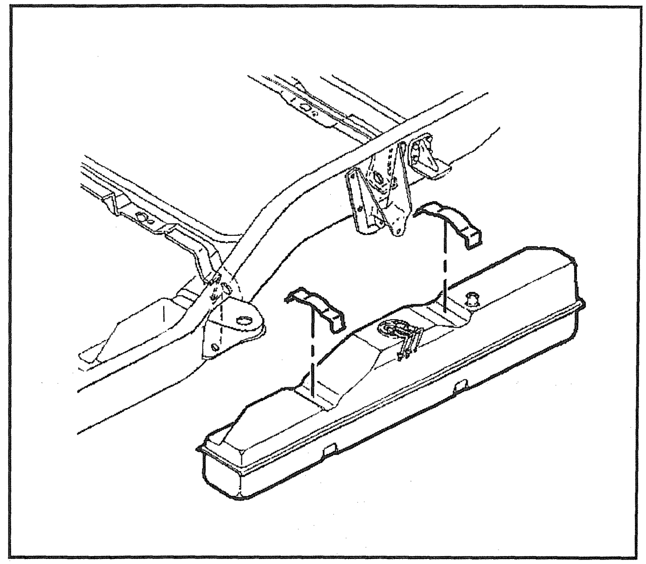
1. Install the new seal ring.
2. Use the *J 36608* fuel sender tool in order to reinstall the sender.
3. Place the tank in the shield.



19204

4. Raise the tank and shield slightly and reconnect the fuel hoses (1), the lines, and the electrical connections at the sender.

5. Raise the tank and shield fully.



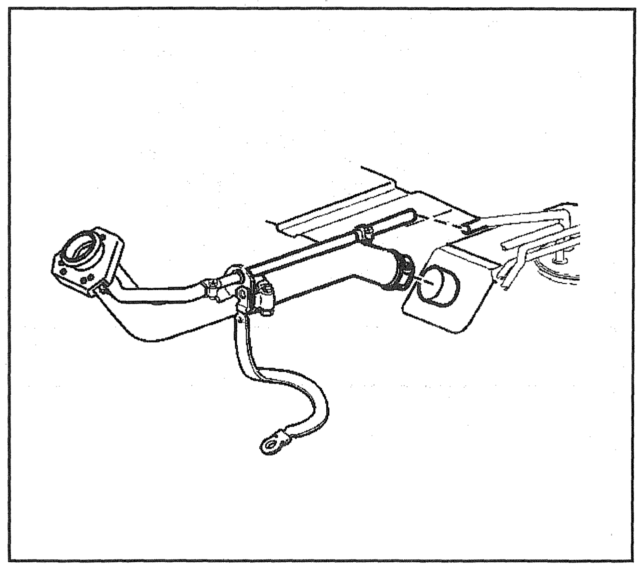
18420

6. Reinstall the fuel tank filler neck to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the clamp.

   Tighten
   Tighten the clamp to 2.5 N·m (25 lb in).

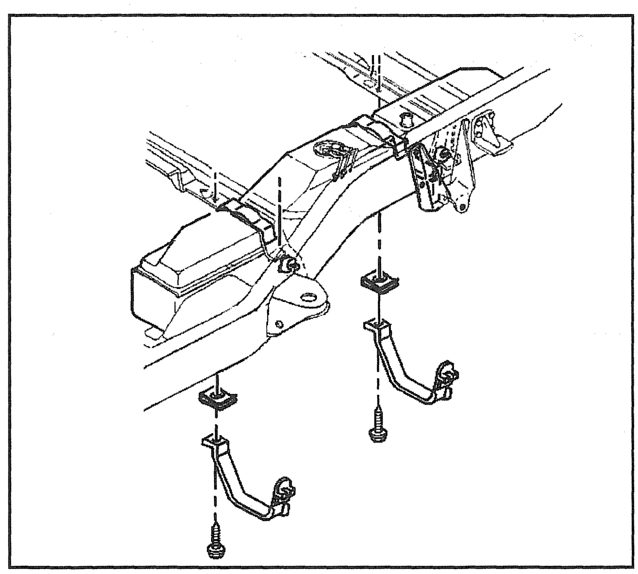


18440

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

8. Install the fuel tank brackets with the insulator strips in place.
9. Tighten the strap bolts.

   Tighten
   Tighten the strap bolts to 45N·m (33 lb ft).
10. Replenish the fuel in the tank.
11. Reinstall the fuel tank filler cap.



18418

12. Reconnect the negative battery cable. If a memory retention device was not used, reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
13. Check for leaks.
    13.1. Turn ON the ignition switch for 2 seconds.
    13.2. Turn OFF the ignition switch for 10 seconds.
    13.3. Again, turn the ignition switch to the ON position.
    13.4. Check for fuel leaks.

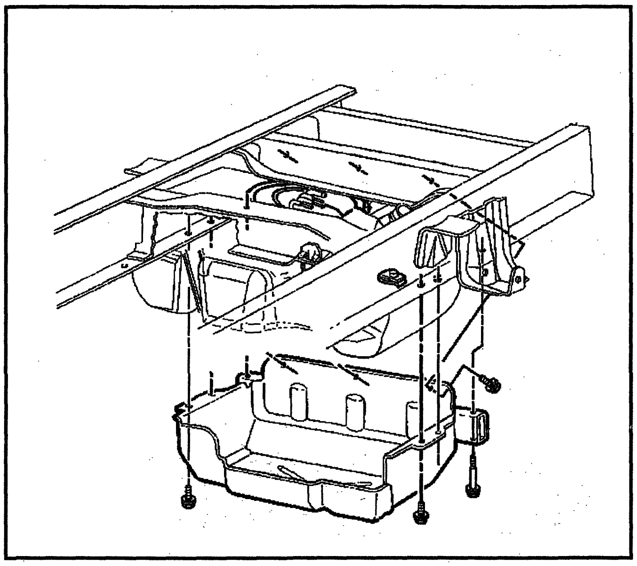
Fuel Tank Replacement (Cab and Chassis Rear Tank)

Removal Procedure

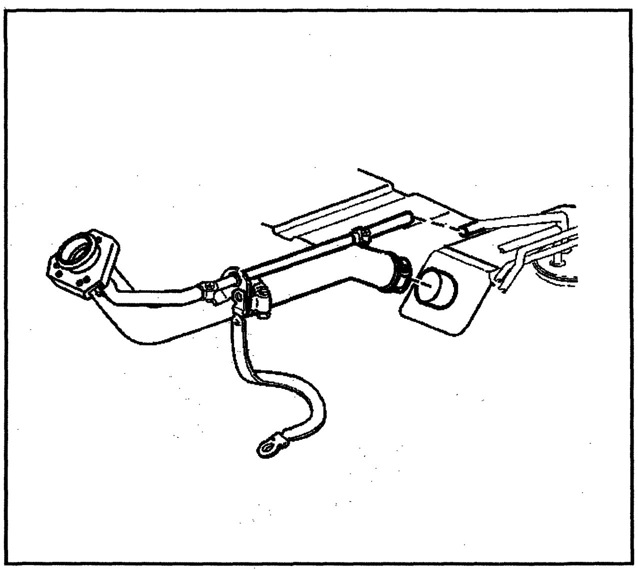
Tools Required

J 36608 Fuel Sender Tool

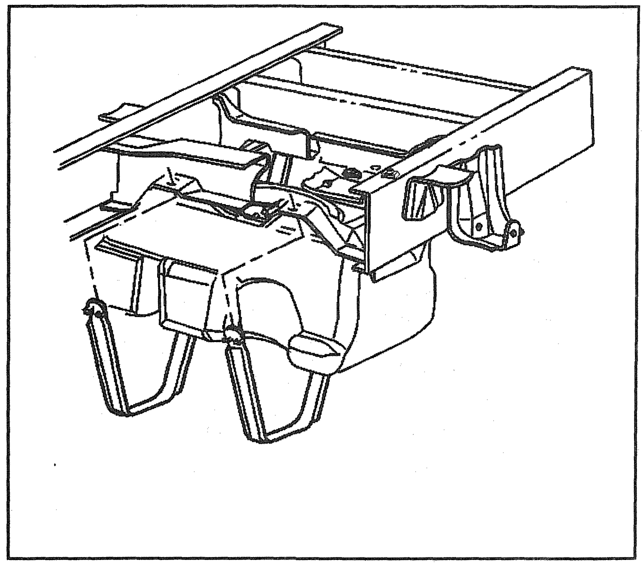
1. Disconnect the negative battery cables.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure*.
3. Raise the vehicle.
4. Remove the fuel tank off-road shield bolts, if equipped.
5. Remove the fuel tank off-road shield, if equipped.


18426

6. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.

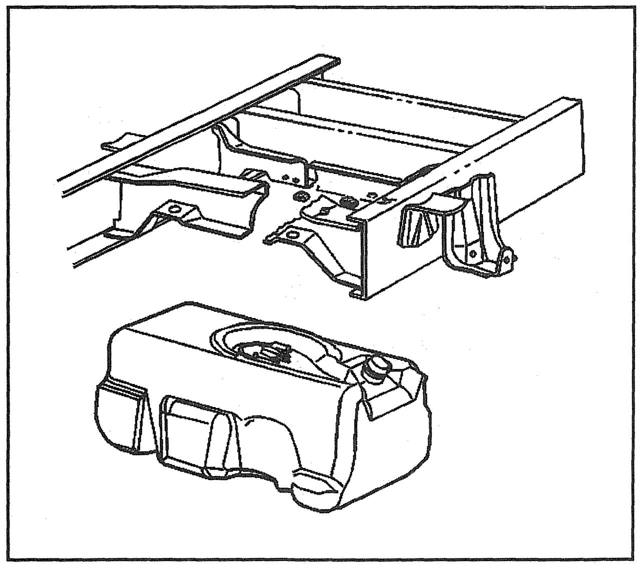

18440

7. Support the fuel tank and remove the tank straps and insulator strips, if equipped.



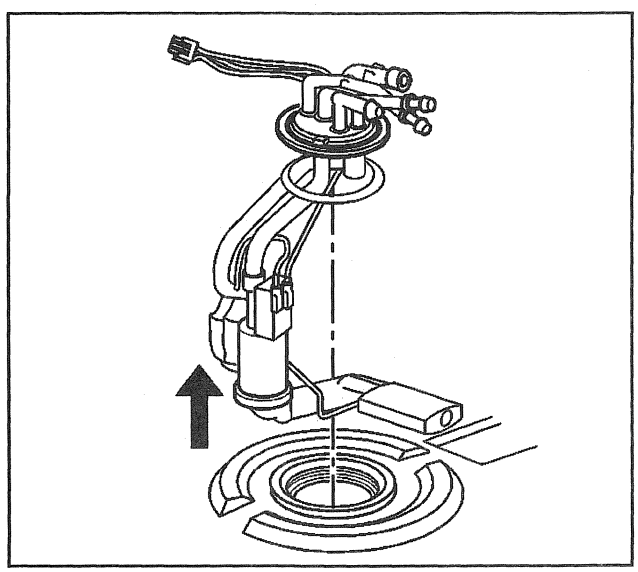
18424

8. Lower the fuel tank enough to access the fuel lines and electrical connections on the tank and sender.
9. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.
10. Lower the tank fully.

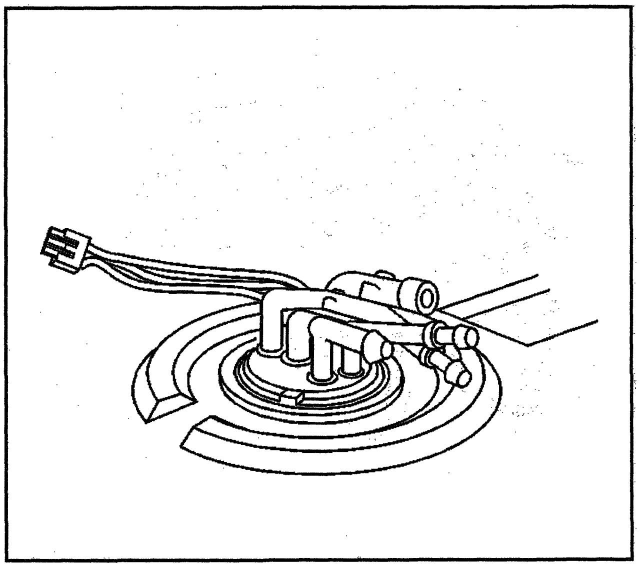


18425

11. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.



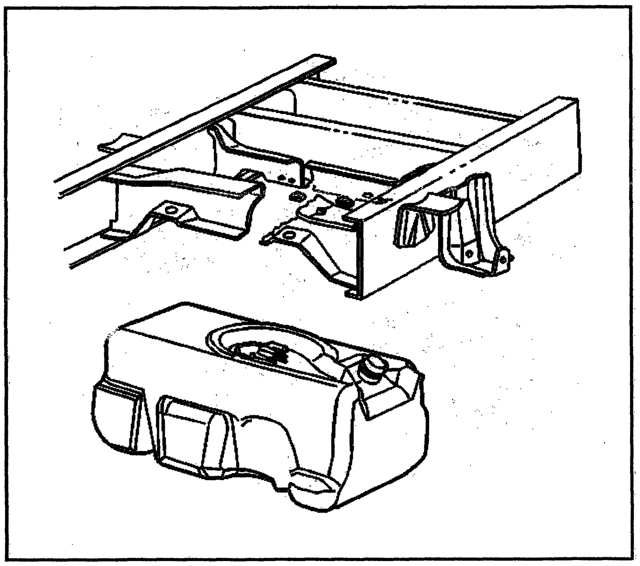
17407



263632

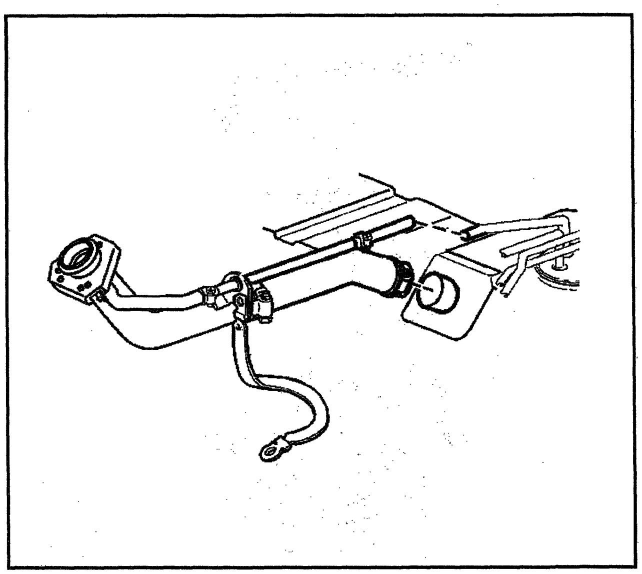
Installation Procedure

1. Install the new seal ring.
2. Use the *J 36608* fuel sender tool in order to reinstall the sender.
3. Raise the tank slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.



18425

4. Raise the tank fully.



18440

5. Reinstall the fuel tank filler neck to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Install the clamp.

   Tighten

   Tighten the clamp to 2.5 N·m (25 lb in).

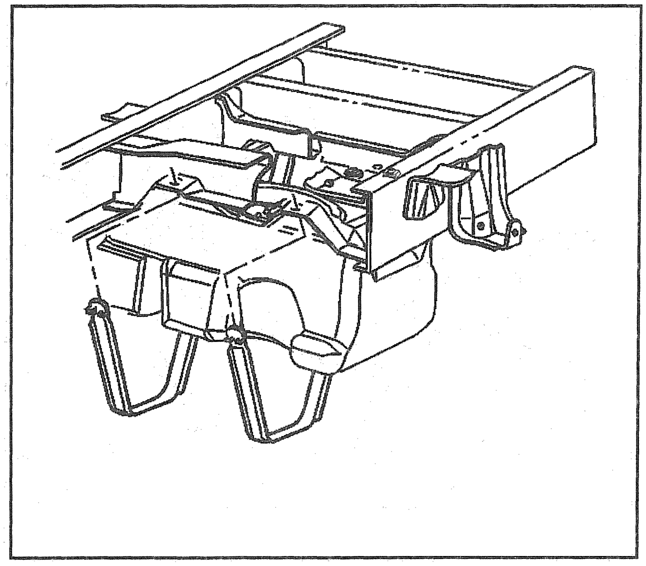
7. Install the fuel tank brackets with the insulator strips in place.

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

8. Tighten the strap bolts.

   Tighten

   Tighten the strap bolts to 45N·m (33 lb ft).

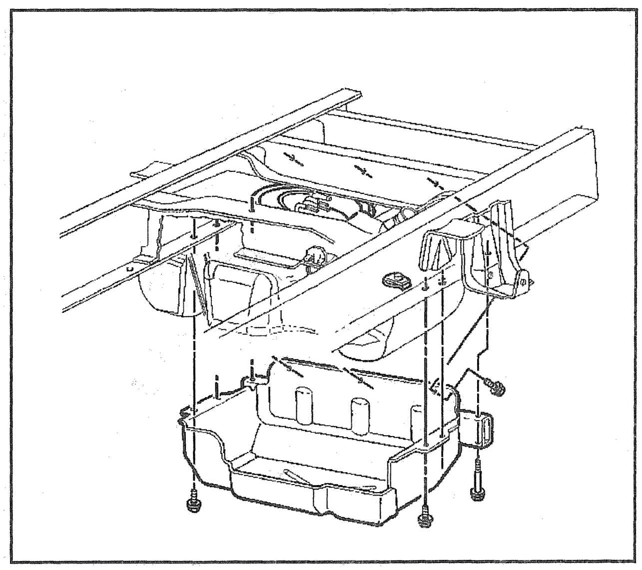


18424

9. Install the fuel tank off-road shield, if equipped.
10. Install the fuel tank off-road shield bolts, if equipped.

    Tighten

    Tighten the bolts to 11 N·m (100 lb in).
11. Replenish the fuel in the tank.
12. Reinstall the fuel tank filler cap.
13. Reconnect the negative battery cable. If a memory retention device was not used, reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
14. Check for leaks.
    - 14.1. Turn ON the ignition switch for 2 seconds.
    - 14.2. Turn OFF the ignition switch for 10 seconds.
    - 14.3. Again, turn the ignition switch to the ON position.
    - 14.4. Check for fuel leaks.



18426

Fuel Tank Replacement (Extended Cab Side Tank)

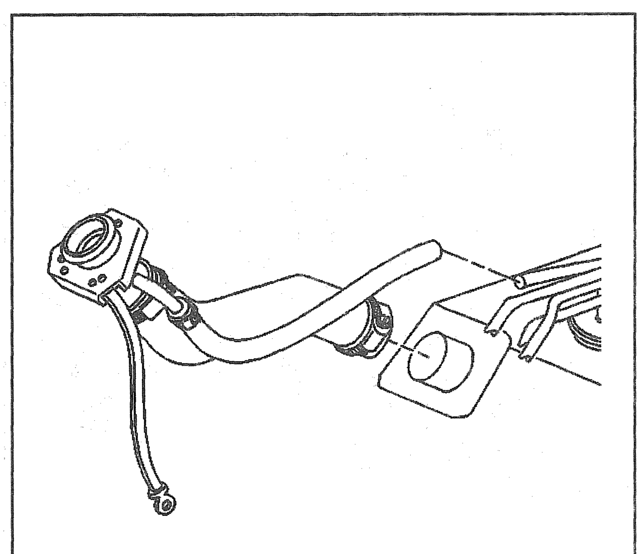
Removal Procedure

Tools Required

J 36608 Fuel Sender Tool

Caution: Refer to Battery Disconnect Caution in General Information.

1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Fuel Tank Draining Procedure*.
3. Raise the vehicle.
4. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.



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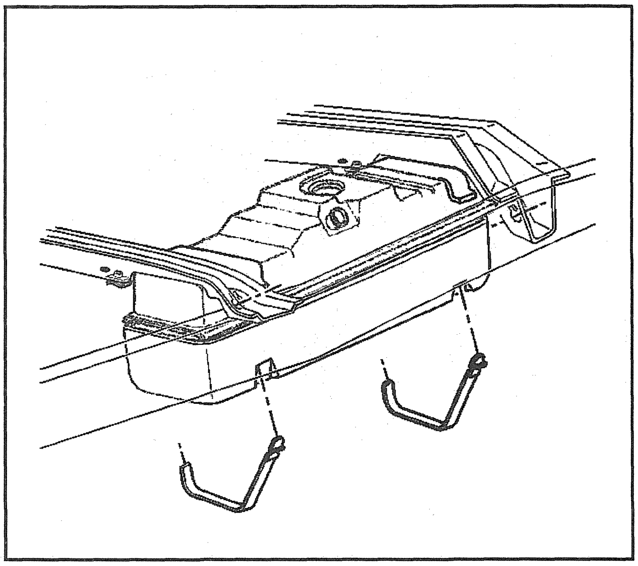
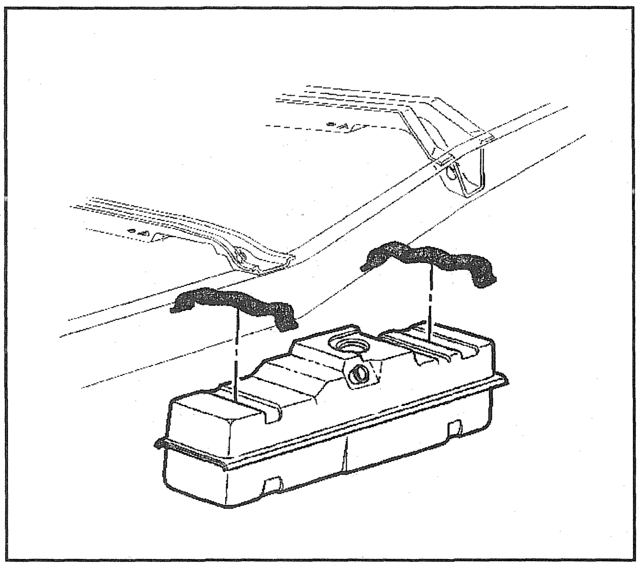


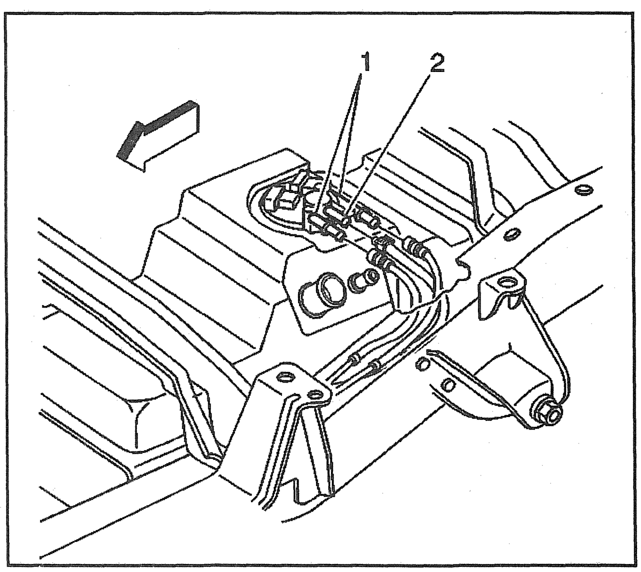
18413

5. Support the fuel tank and remove the tank straps and insulator strips, if equipped.



18415

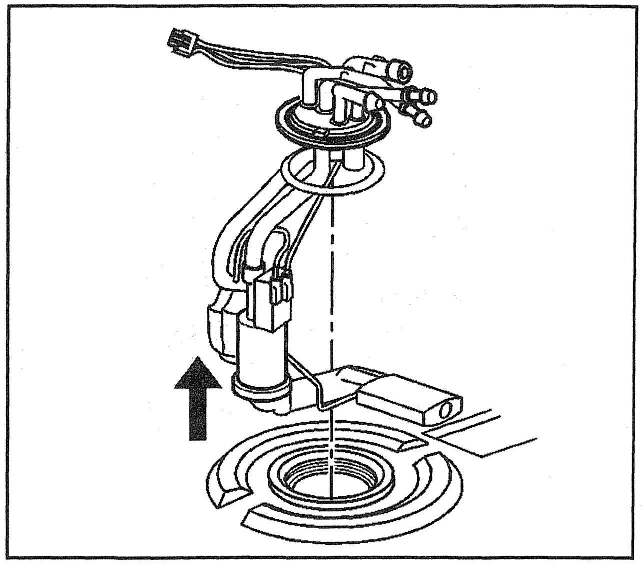
6. Lower the fuel tank and shield enough to access the fuel lines and electrical connections on the tank and sender.



19204

7. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.
8. Lower the tank and shield fully.
9. Lift the tank out of the shield and place the tank on the floor.

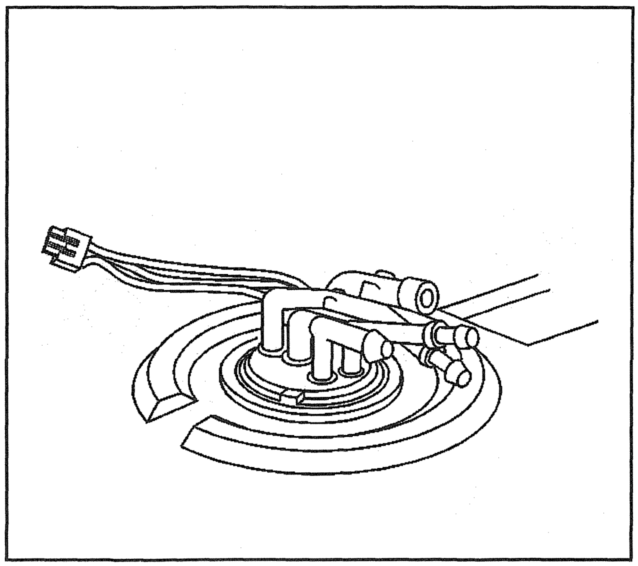
10. Remove the fuel sender assembly and seal ring, using the *J 36608* fuel sender tool. Discard the old seal ring. Purge the tank, if the tank is being repaired.



17407

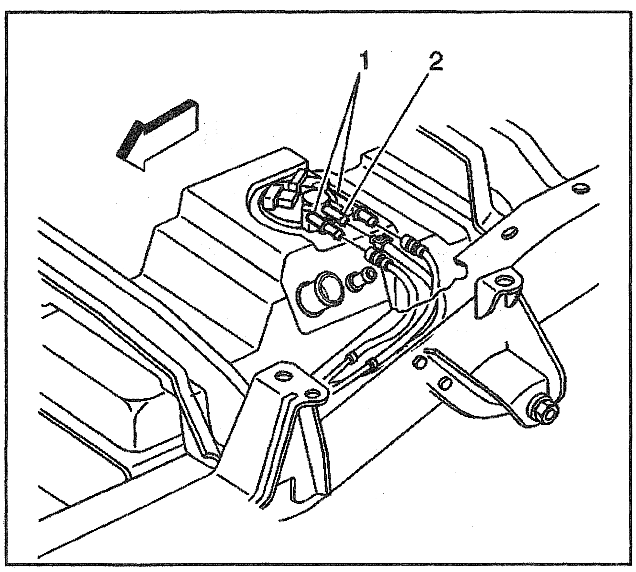
Installation Procedure

1. Install the new seal ring.
2. Use the *J 36608* fuel sender tool in order to reinstall the sender.
3. Place the tank in the shield.



263632

4. Raise the tank and shield slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.



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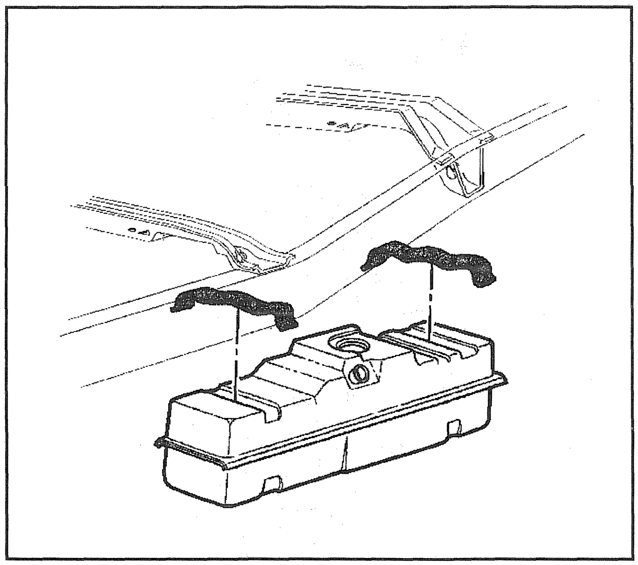

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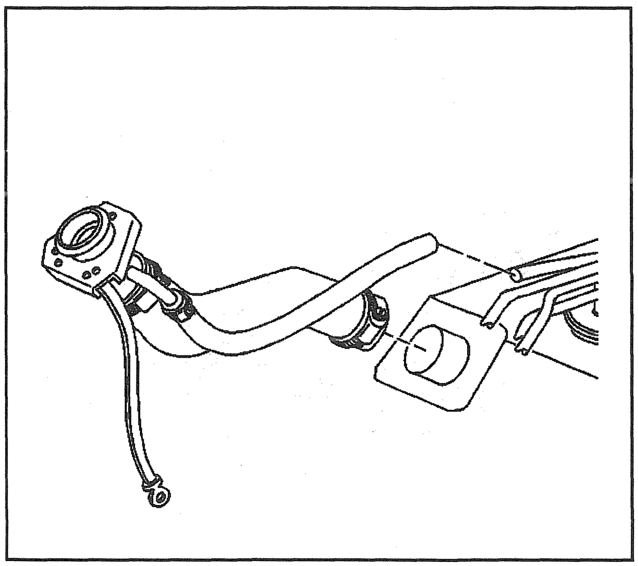
5. Raise the tank and shield fully.



18442

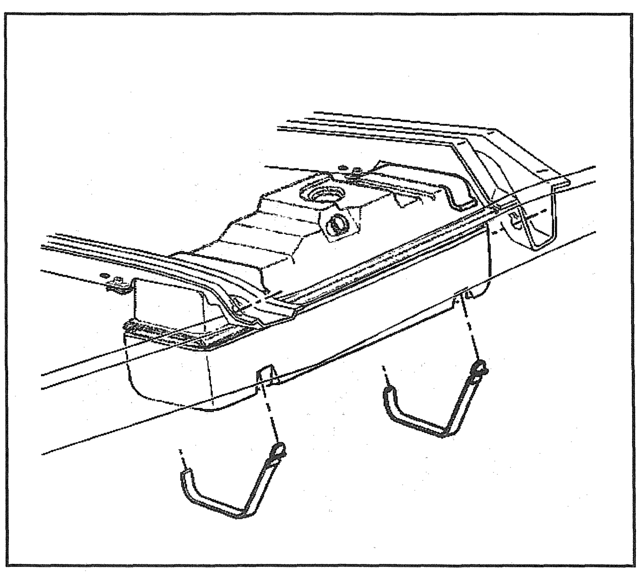
6. Reinstall the fuel tank filler neck to the tank.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

7. Install the clamp.

   Tighten

   Tighten the clamp to 2.5 N·m (100 lb in).



18413

8. Install the fuel tank brackets with insulator strips in place.

Notice: Refer to *Fuel Tank Strap Nuts Notice* in Cautions and Notices.

9. Tighten the strap bolts.

   Tighten

   Tighten the strap bolts to 45N·m (33 lb ft).

10. Replenish the fuel in the tank.
11. Reinstall the fuel tank filler cap.

12. Reconnect the negative battery cable. If a memory retention device was not used, please reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
13. Check for leaks.
    13.1. Turn ON the ignition switch for 2 seconds.
    13.2. Turn OFF the ignition switch for 10 seconds.
    13.3. Again, turn the ignition switch to the ON position.
    13.4. Check for fuel leaks.

Fuel Sender Assembly Replacement

Removal Procedure

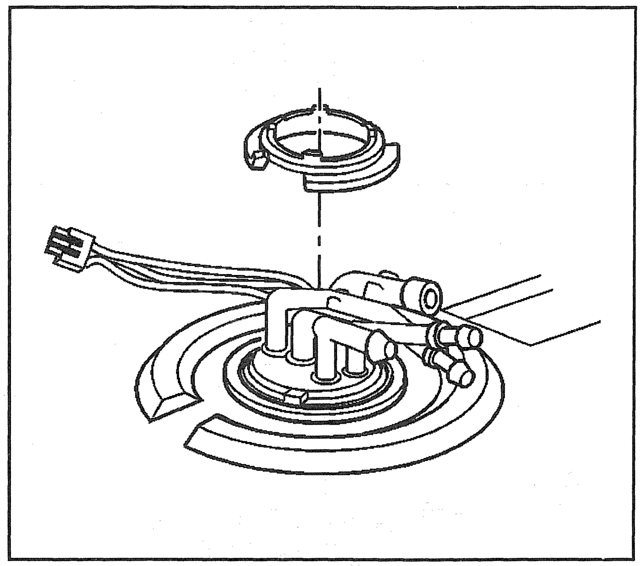
Tools Required

J 36608 Fuel Sender Tool

1. Remove the fuel tank filler cap.

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

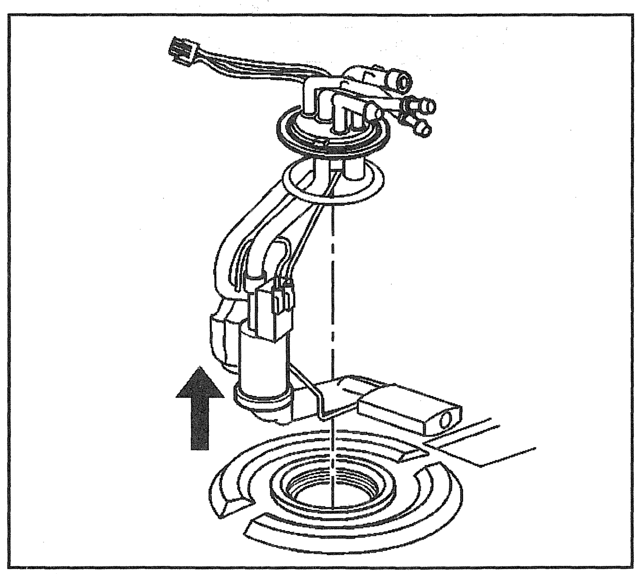
2. Disconnect the negative battery cable(s).
3. Raise the vehicle on a hoist.
4. Remove the fuel tank. Refer to Fuel Tank Replacement.
5. Remove the sender unit by turning the cam lock counterclockwise using the *J 36608* fuel sender tool.



17406

Important: Do not damage the rubber insulator or the strainer.

6. Remove the sending unit by pulling up.
7. Inspect the attaching hose for signs of deterioration.
8. Inspect the strainer.



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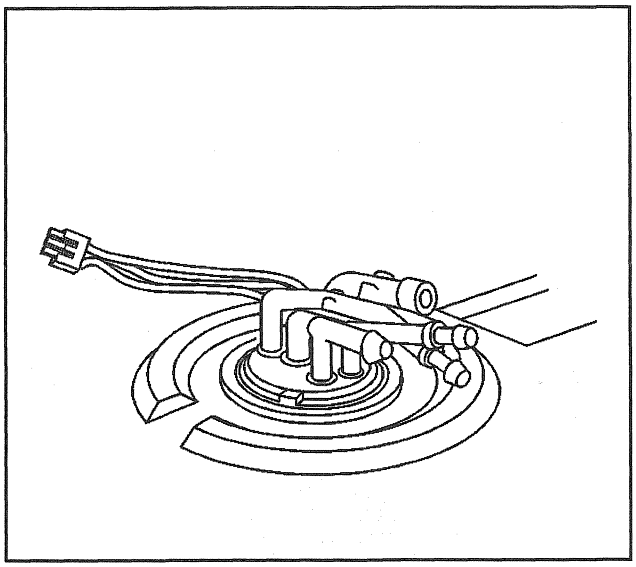


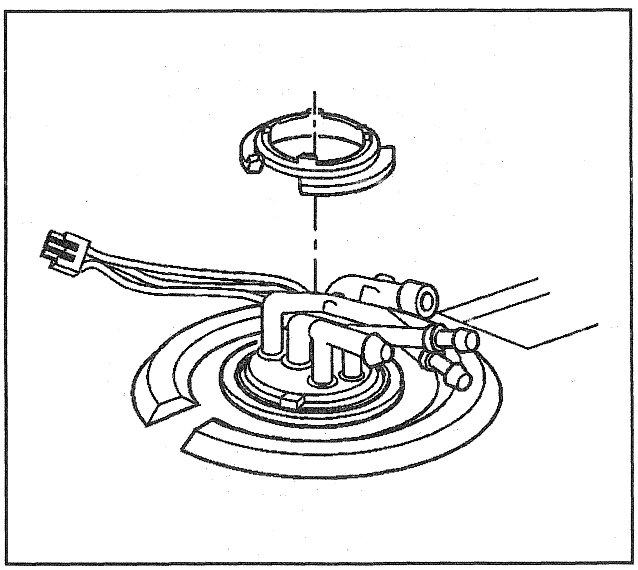
263632

Installation Procedure

1. Insert a new O-ring seal.

Notice: Do not fold or twist the strainer when installing the sending unit. This action restricts fuel flow.

2. Install the sending unit assembly into the fuel tank.
3. Install the hoses onto the sender assembly.



17406

4. Install the cam lock assembly.
5. Turn the cam lock clockwise in order to lock it.
6. Install the fuel tank. Refer to Fuel Tank Installation.
7. Connect the negative battery cable.
8. Check the system for leaks.
   - 8.1. Turn ON the ignition switch for 2 seconds. The scan tool can be used to activate the fuel pump to check for fuel system leaks.
   - 8.2. Turn OFF the ignition switch for 10 seconds.
   - 8.3. Again, turn the ignition switch to the ON position.
   - 8.4. Check for fuel leaks.

Fuel Sender Assembly Service

If the in-tank filter requires service, refer to *Fuel Sender Assembly Replacement.*

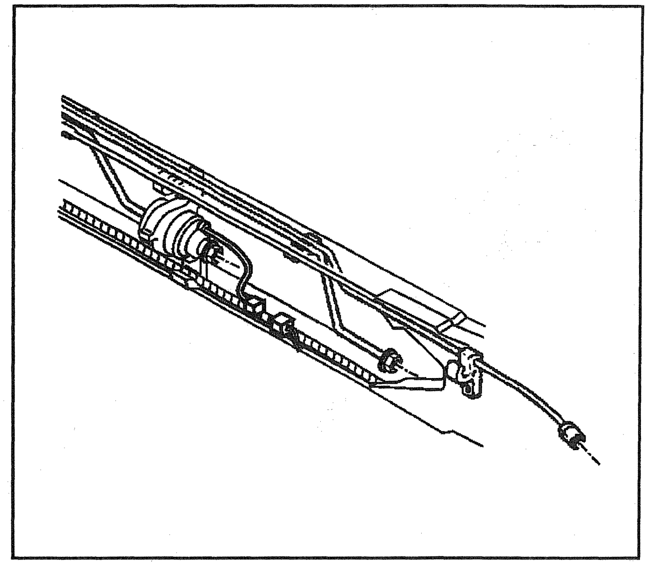
Fuel Lift Pump Replacement

Removal Procedure

Caution: To reduce the risk of fire and personal injury that may result from a fuel leak, always replace O-ring seals exposed during component services.

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove negative battery cable(s).
2. Loosen filler cap(s) to relieve tank pressure.
3. Release the fuel pump electrical connector.



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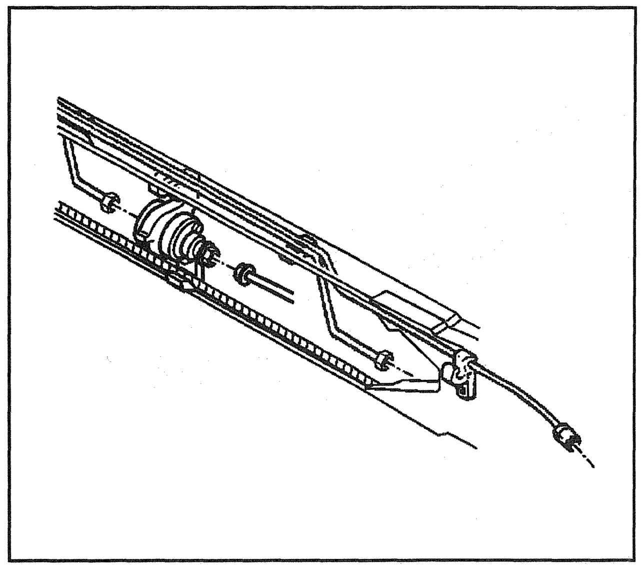
4. Clean both fuel line connections and surrounding areas at fuel pump before disconnecting to avoid possible contamination of the fuel system.
5. Remove both fuel lines from fuel pump by loosening the fuel line fittings.



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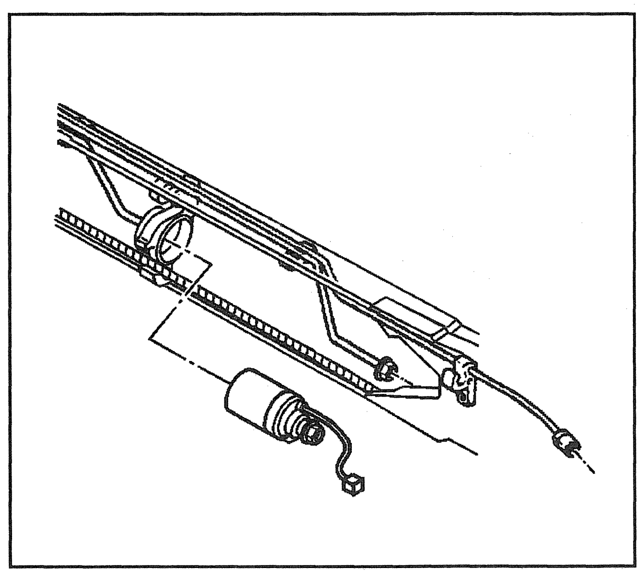
6. Slide fuel pump out of bracket.



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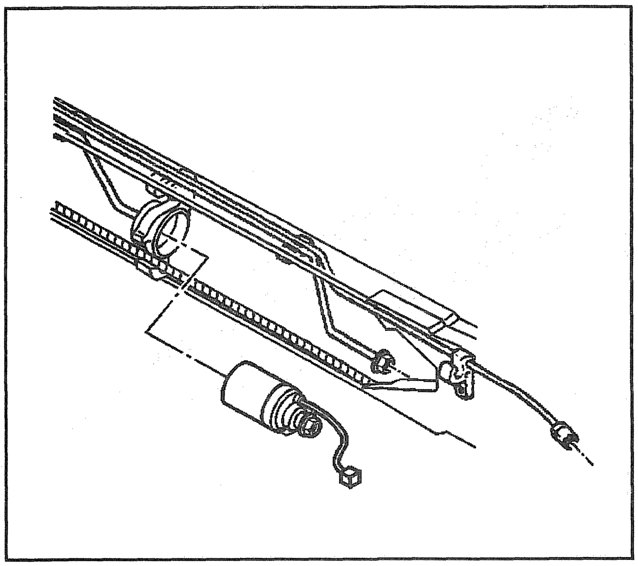

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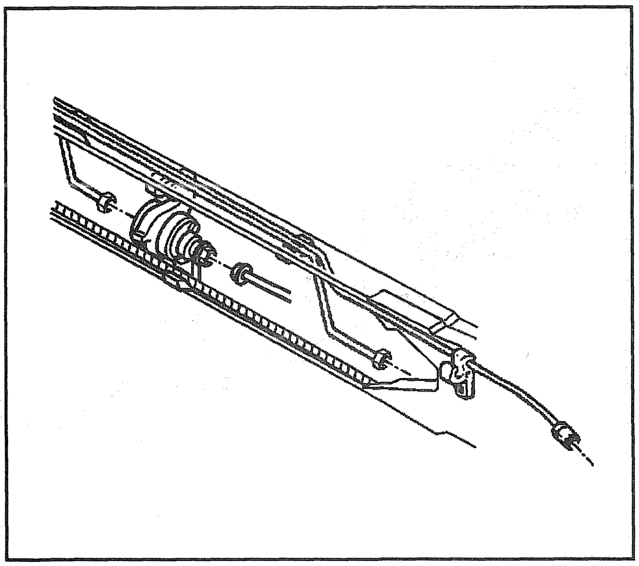
Installation Procedure

1. Position the new pump in the pump bracket.



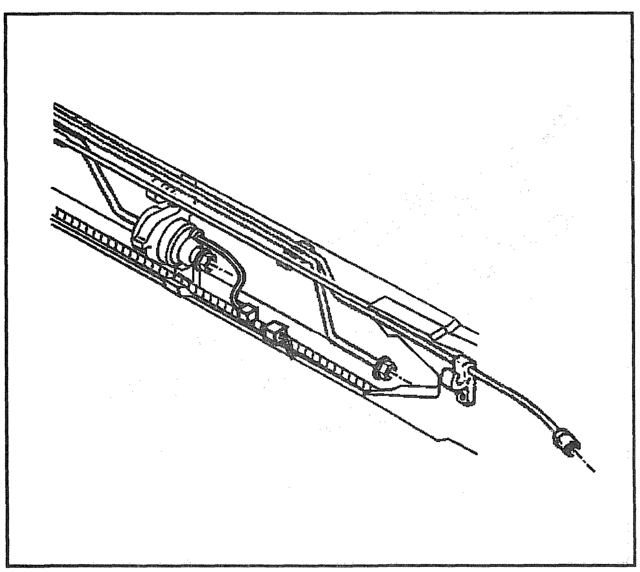
19670

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install both fuel lines on the fuel pump.

   Tighten

   Use a backup wrench in order to prevent the pump from turning. Tighten the fuel line fittings to 30 N·m (22 lb ft).



19669

3. Connect the fuel pump electrical harness connector.
4. Connect the negative battery cables.
5. Tighten the fuel tank filler cap(s).
6. Bleed the air from the system.
7. Start the engine and check for leaks.

Fuel Hose/Pipes Assembly Replacement

Materials

Fuel Lines - These are welded steel tubes, meeting GM Specifications 124-M, or its equivalent. Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibration.

Coupled hose - These are not to be repaired and are replaced only as an assembly.

Uncoupled Hose - Use only reinforced furl resistant hose, made of Fluoroelastomer material. Do not use a hose within 4 inches (100 mm) of any part of the exhaust system, or within 10 inches (254 mm) of the catalytic converter. The hose inside diameter must match the outside diameter of the steel tubing.

Clamps - These are stainless steel, screw bank-type clamps, #2494772, or equivalent.

Fuel Pipe Repair

1. Cut a piece of fuel hose 4 inches (100 mm) longer than the section of pipe to be removed. If more than 6 inches (152 mm) is to be removed, use a combination of steel pipe and hose. The hose length should not be more than 10 inches total.
2. Cut a section of the pipe to be replaced with a tube cutter. Use the first step of a double flaring tool to form a bead on the ends of the pipe and, also, on the new section of pipe, if used.
3. Slide the hose clamps onto the pipe and push the hose 2 inches (51 mm) onto each portion of the fuel pipe. Tighten a clamp on each side of the repair.
4. Secure the fuel line to the frame.

Fuel System Cleaning

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cable(s).
2. Remove the fuel from the tank. Refer to *Fuel Tank Draining Procedure.*
3. Remove the fuel tank.
4. Remove the fuel sender. Refer to *Fuel Sender Assembly Replacement.*
5. Clean the fuel tank.

Important: The fuel tank should be replaced if the tank is rusted internally.

6. Remove the fuel strainer or replace if necessary. Refer to *Fuel Sender Assembly Service.*
7. Remove the fuel feed hose at the fuel lift pump.
8. Remove the fuel return line at the injection pump.
   - Use low air pressure to blow out the lines toward the rear of the vehicle.
   - Replace the pipes if they are rusted internally.
9. Remove the ECM 1 fuse from the underhood relay center.
10. Remove the fuel filter. Refer to *Fuel Filter Element Replacement.*

Installation Procedure

1. Install the fuel sender. Refer to *Fuel Sender Assembly Replacement.*
2. Install the fuel tank.
3. Install the fuel feed pipes at the fuel lift pump.
4. Install clean diesel fuel into the tank until it is 1/4 full.
5. Install the fuel tank cap.
6. Install the negative battery cables.
7. Crank the engine for 15 seconds with one minute cooling periods until the clean fuel is pumped out.

Important: Use a suitable container to catch the fuel.

8. Install a new fuel filter. Refer to *Fuel Filter Element Replacement.*
9. Install a hose from the return line at the fuel injection pump to a closed metal container with a capacity of at least 8 liters (2 gallons).
10. Crank the engine for 15 seconds with one minute cooling periods until clean fuel appears at the return line.
11. Install the ECM 1 fuse in the underhood relay center.
    - Crack open each injection line at the nozzle. Use two wrenches to prevent nozzle damage.
    - Crank the engine for 15 seconds with one minute cooling periods until clean fuel appears from each nozzle.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

Important: Use two wrenches to prevent nozzle damage.

- Retighten the injection line fittings.

  Tighten

  Tighten the injection line to nozzle fitting to 25 N·m (18 lb ft).

- Start the engine and allow it to idle for 15 minutes.

Important: Make sure the fuel return line is in the metal container and that the container does not overflow.

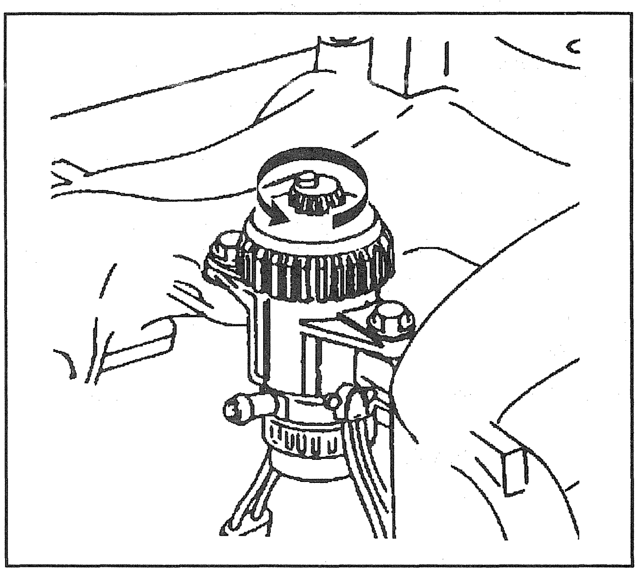
- Remove the hose from the metal container.

12. Install the fuel return line to the injection pump.
13. Check for leaks.
14. Clear any engine DTCs.

Gasoline in Fuel System

Engine Will Run or Start

1. Drain the fuel tank. Refer to *Fuel Tank Draining Procedure.*
2. Fill the fuel tank with diesel fuel.
3. Run the engine for 15 minutes.



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Engine Will Not Run

1. Drain the fuel tank. Refer to *Fuel Tank Draining Procedure.*
2. Fill the fuel tank with diesel fuel.
3. Remove the ECM 1 fuse from the underhood relay center.
4. Remove the fuel hose between the fuel manager/filter and the injection pump.
5. Connect a hose to the fuel manager/filter outlet and run it to a closed metal container.
6. Crank the engine for 15 seconds with one minute cooling periods to purge the gasoline from the system.
7. Install the fuel hose between the fuel filter and the injection pump.
8. Install the ECM 1 fuse in the underhood relay center.
9. Start the engine.

Important: Check for leaks.

10. Run the engine for 15 minutes.
11. Clear the engine DTCs.

Fuel Feed and Fuel Return Pipe Purge Procedure

Caution: The water/diesel fuel mixture is flammable. The water/diesel fuel mixture could be hot. In order to help avoid personal injury and property damage, do not touch the fuel coming from the drain hose. Also do not expose the fuel to open flames or sparks.

Be sure you do not overfill the container. Heat (such as from the engine) can cause the fuel to expand. If the container is too full, fuel could be forced out of the container. This could lead to the risk of personal injury and vehicle damage.

1. Open the air bleed valve on top of the fuel manager/filter.
2. Connect a hose to the air bleed valve located on top of the fuel manager/filter and place the other end of the hose into a suitable container.
3. Remove the ECM 1 fuse from the underhood relay center.
4. Crank the engine in 10 to 15 second intervals until clear fuel is observed at the air bleed hose (wait for one minute between cranking intervals to cool down starter motor).
5. Close the air bleed valve.
6. Install the ECM 1 fuse in the underhood relay center.
7. Start the engine and allow to run for 5 minutes at idle.
8. Check for fuel leaks.
9. Clear all engine DTCs.

Fuel Injection Pump Replacement

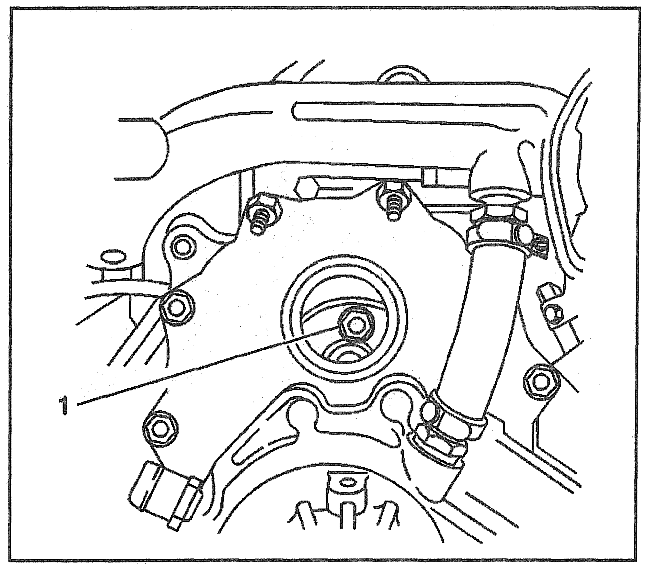
Removal Procedure

Tools Required

J 41089 Injection Pump Wrench

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

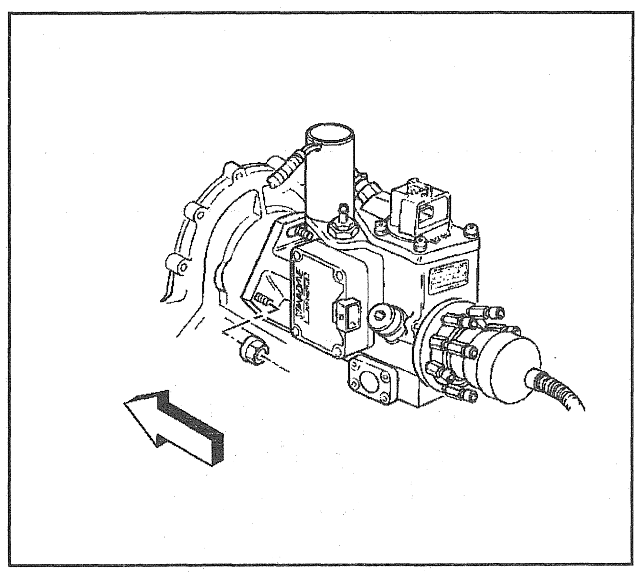
1. Remove the negative battery cables.
2. Remove the intake manifold. Refer to Intake Manifold Removal.
3. Remove the injection lines. Refer to *Injection Line(s) Replacement.*
4. Remove the fuel inlet line from the injection pump.
5. Remove all necessary harness connectors and hoses from the injection pump.
6. Remove the fuel return line at the top of the injection pump.
7. Remove the oil fill tube.
8. Remove the grommet for the oil filler tube.
9. Rotate the engine to gain access to the bolts (1) that hold the driven gear to the injection pump. Access is gained through the oil filler neck hole.
10. Remove the driven gear bolts.



27614

Important: Never engage the starter motor to rotate the engine when the injection pump is removed as severe engine damage will occur. With the injection pump removed the pump driven gear could jam in the front housing by engaging the starter motor, resulting in a sheared crankshaft or camshaft gear key and possible valve train damage. Always bar the engine over by hand to avoid internal engine damage.

11. Remove the injection pump flange nuts. Use the *J 41089* injection pump wrench.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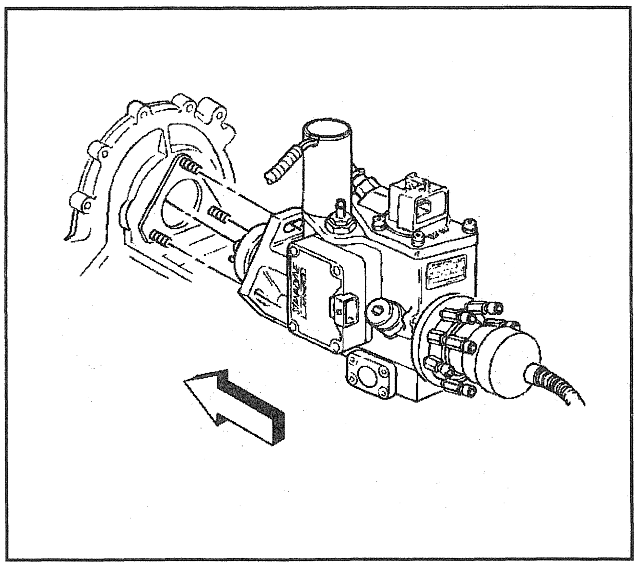
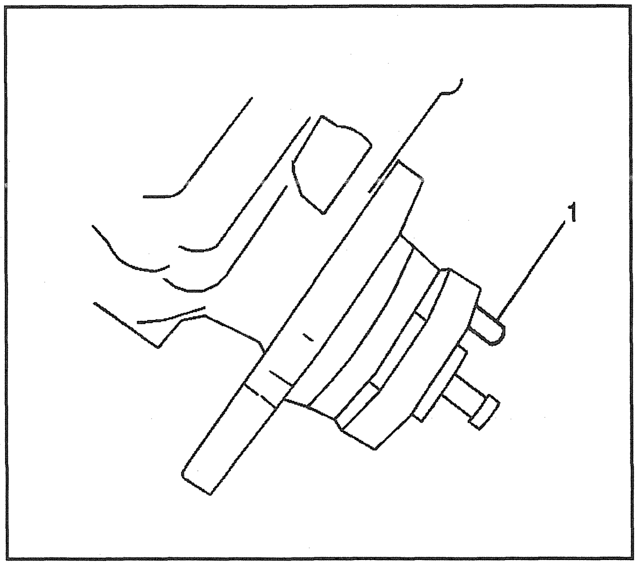


193162

12. Remove the injection pump.
13. Cap all open lines and nozzles.
14. Remove the flange gasket.

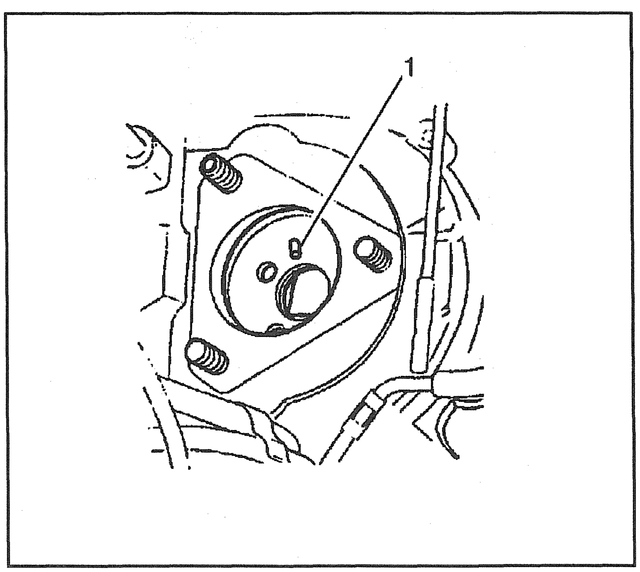


27612

Installation Procedure

1. Install the new flange gasket on the injection pump.
2. Adjust the locating stud (1) to the proper position to match with the slotted/elongated hole in the driven gear.

Important: Be sure the locating stud (1) on the injection pump hub goes into the slotted/elongated hole in the driven gear.



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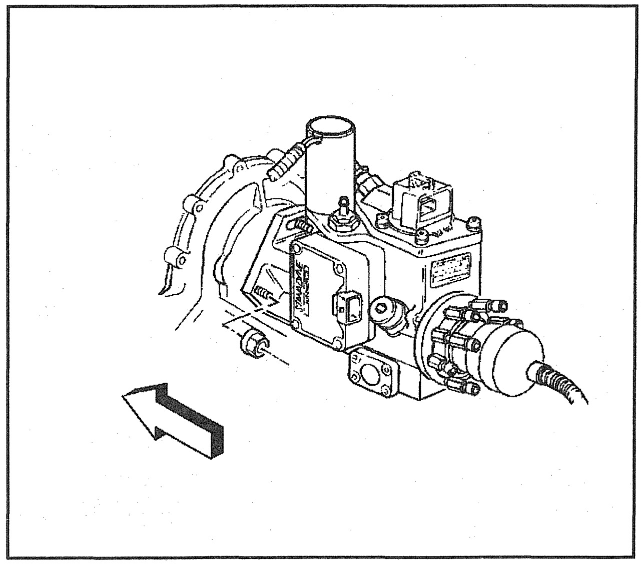
3. Install the injection pump making sure the locating stud is positioned within the slotted/elongated hole (1) in the driven gear.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the injection pump flange nuts.

   Tighten

   Tighten nuts to 40 N·m (30 lb ft).



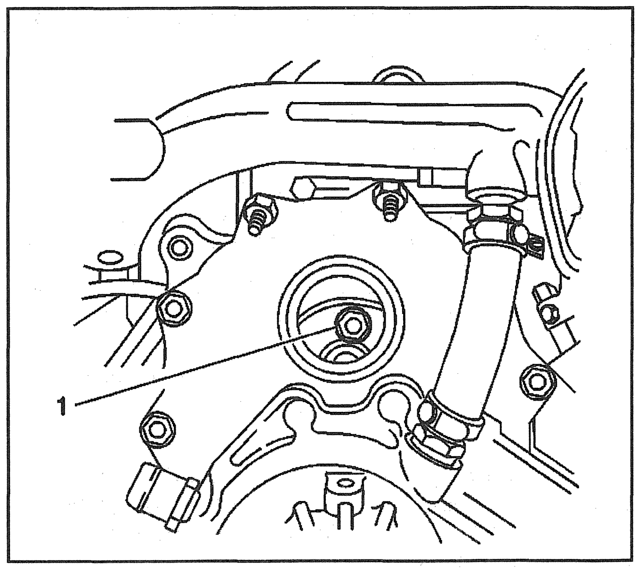
193160

Important: All the driven gear bolts should not be torqued until all the bolts are installed. This will allow for the proper alignment of all the bolt holes.

5. Install the driven gear bolts (1).

   Tighten

   Tighten the bolts to 25 N·m (18 lb ft).
6. Install the grommet for the oil filler tube.
7. Install the oil filler tube.
8. Install the fuel feed line at the injection pump.
9. Install the fuel return line to the top of the injection pump.
10. Install all necessary harnesses and connectors.
11. Install the injection lines. Refer to the tags on lines. Refer to *Injection Line(s) Replacement.*
12. Install the intake manifold. Refer to Intake Manifold Installation.
13. Install the negative battery cables.
14. Adjust the injection timing. Refer to *Injection Timing Adjustment.*



27614

Injection Timing Adjustment

Tools Required

- *J 41089* Injection Pump Wrench
- *J 29872-A* Injection Pump Adjustment Tool

This procedure should be used after an injection pump installation or when injection timing needs to be checked or adjusted. A scan tool must be used to check or adjust injection timing. A static timing mark can be used as a reference. If a static timing mark is not present on the injection pump mounting flange, one can be scribed to further assist in how far the injection pump needs to be rotated.

Injection Pump Timing Specification

All injection pump timing averages 3.5 degrees.

Important: There will be no change in engine performance or vehicle driveability if injection timing is advanced during the Time Set procedure. Injection timing must be set to Injection Timing Specifications. If injection timing is not set correctly, a possible DTC P0216 may set (see DTC P0216, Conditions for setting the DTC).

1. Start the engine.
2. Run the engine to operating temperature.
3. Install a scan tool.
4. Use a scan tool to activate Time Set (if Time Set has been activated correctly, Des. Inj. Time on the scan tool will read 0.0 degrees).

Important: The Act. Inj. Time value on the scan tool will fluctuate. The average reading should be 3.5 degrees.

5. Act. Inj. Time (scan tool display) should be approximately 3.5 degrees. If not, continue to step 6.

Important: If engine stalls during Time Set activation, slightly (1 mm equals 2 degrees) rotate the injection pump toward the driver side of the vehicle, tighten flange nuts and repeat Time Set.

6. If the injection timing needs to be adjusted, continue. If not, adjustment is complete.

Important: Move the A/C compressor to the side to improve access to the injection pump lower mounting bolts.

7. Turn the engine OFF and loosen the injection pump flange nuts using the *J 41089* injection pump wrench.
8. Slightly rotate the injection pump using the *J 29872-A* injection pump adjustment tool.
9. Set Act. Inj. Time to 3.5 degrees.

Important: It is normal for the Act. Inj. Time value on the scan tool to fluctuate. The average fluctuation of Act. Inj. Time should be 3.5 degrees.

10. Continue to repeat the procedure until average fluctuation of Act. Inj. time is 3.5 degrees.
    - If the Act. Inj Time is above 3.5 degrees SLIGHTLY (1 mm equals 2 degrees) ROTATE INJECTION PUMP TOWARDS THE PASSENGER SIDE OF VEHICLE.
    - If the Act. Inj time is below 3.5 degrees, SLIGHTLY (1 mm equals 2 degrees) ROTATE INJECTION PUMP TOWARD DRIVERS SIDE OF VEHICLE.

TDC Offset Adjustment

Tools Required

- *J 41089* Injection Pump Wrench
- *J 29872-A* Injection Pump Adjustment Tool

Important: Do not perform this procedure when only an injection pump has been replaced (refer to Injection Timing Adjustment).

This procedure should only be used when a DTC has directed you to do so, or one of the following repairs has been performed:

- A DTC 1214 is set.
- The engine has been replaced.
- The front engine cover has been replaced.
- The PCM and the injection pump have been replaced at the same time.
- The crankshaft position sensor has been replaced.

The PCM has the ability to perform a TDC Offset learn when one is not present or has been cleared. This procedure allows the PCM to be updated with the correct TDC offset for the vehicle.

Important: The TDC Offset specification is only to be used after the Learn procedure has been performed.

TDC Offset Adjustment

Application	TDC Offset
All	- 0.25 to - 0.75

Learning a TDC Offset

1. One of the above repairs must have been performed. If not, do not continue. Refer to On Vehicle Service for repair that was performed.
2. Install the scan tool.
3. Start the engine.
4. Operate the vehicle until the engine coolant temperature is greater than 77°C (170°F).
5. Clear all DTCs and turn the engine off.
6. Turn the ignition ON with the engine OFF.
7. Hold the accelerator pedal in the wide open throttle position for a minimum of 45 seconds (this step prepares the PCM to activate the offset learn (internal to PCM) and then release pedal.

8. Turn the ignition OFF for 30 seconds. In this step, the PCM powers down (to verify the PCM has powered down, a No Communication With Vehicle screen will display when trying to access a data list.
9. After the PCM has completed the power down, start the engine.
   - Verify in the scan tool that ECT is greater than 77°C (170°F). If not, operate vehicle until desired ECT is achieved (vehicle can be driven or throttle can be depressed until correct coolant temperature is achieved).

Important: A new TDC Offset will over write the previous one.

   - As soon as ECT is greater than 77°C (170°F) and the engine speed is below 1500 RPMs, the PCM automatically learns a new offset (a momentary stumble in engine rpm will indicate that the TDC Offset has been activated).

10. Check the TDC Offset in the scan tool. The TDC Offset should be between –0.25 and –0.75. If the TDC Offset is within the specified value, the procedure is complete. If not, continue to the next step (adjusting the injection pump).
11. Turn the engine OFF.
12. Loosen injection pump flange nuts using the *J 41089* injection pump wrench.
13. Slightly (1 mm equals 2 degrees) rotate the injection pump in the desired direction (use the *J 29872-A* injection pump adjustment tool to rotate injection pump) and then retighten the injection pump flange nuts (a scribe line across the pump flange and cover can be used as a reference (1 mm equals 2 degrees) which is the approximate width of a scribe line).

Important: In order to achieve a negative (-) TDC Offset number rotate the pump towards the drivers side of the vehicle.

In order to achieve a positive (+) TDC Offset number rotate the pump towards the passenger side of the vehicle.

14. Repeat steps 3 through 13 until the correct TDC Offset has been achieved. It is possible that the injection pump may require multiple adjustments to achieve the specified value.

    If you are unable to set the correct TDC Offset or the TDC Offset will not learn, check for the following:

    14.1. Check to see if coolant temperature is greater than 77°C (170°F).

    14.2. Check to make sure the proper time intervals are adhered to for wide open throttle and PCM power down.

    14.3. Check all PCM and injection timing stepper motor connections and for DTCs.

    14.4. Check the Techline terminal/equipment for the latest software version.

    14.5. Check for proper base installation of the injection pump (injection pump ESO solenoid should be approximately straight up and down).

    14.6. If the TDC Offset is stuck on a high + (plus) value, check for a damaged camshaft driven gear key.

    14.7. If the TDC Offset is stuck on a high – (negative) value, check for a damaged or improperly installed crankshaft position sensor.

    14.8. If all checks have been performed, the injection pump may be malfunctioning, however, this is an extremely unlikely failure.

Injection Line(s) Replacement

Removal Procedure

Tools Required

J 39664 Manifold Cover Set

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

Important: Clean all the line fittings that will be loosened or removed.

1. Remove the negative battery cables.
2. Remove the intake manifold. Refer to Intake Manifold Removal.

Important: Before any further service work is to be done, cover the intake ports with the *J 39664* manifold cover set.

3. Remove the injection line clips at the loom brackets.
4. Remove the injection lines at the nozzles.
   - Cap the lines and the nozzles immediately.
   - Do not bend the injection lines.
5. Remove the injection lines at the pump. Refer to *Fuel System Description*.
   - Cap the lines and the pump fittings immediately.
   - Tag the lines for installation.

Installation Procedure

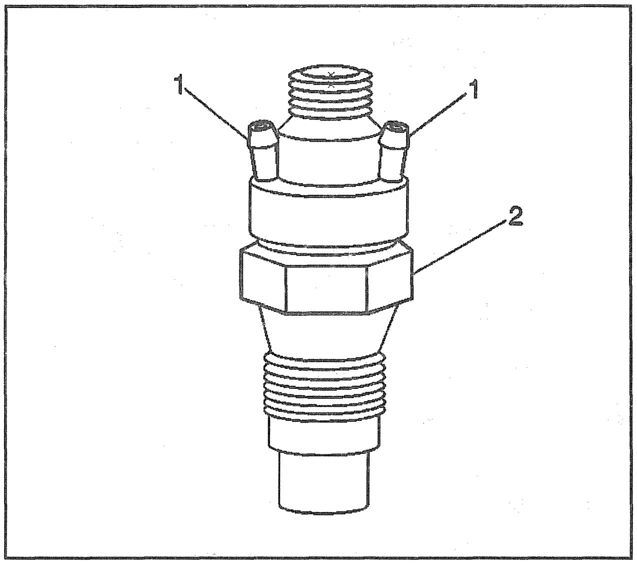
1. Install the injection lines at the pump. Refer to *Fuel System Description*.
   - Uncap the lines and pump fittings.
   - Refer to the tags for the correct installation.
   - Install the injection lines at the nozzles.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Uncap the lines and the nozzles.

   Tighten

   Tighten the fittings to 25 N·m (20 lb ft).
3. Install the injection line clips at the loom brackets.
4. Remove the *J 39664* manifold cover set.
5. Install the intake manifold. Refer to Intake Manifold Removal.
6. Install the negative battery cables.



27624

Injection Nozzle(s) Replacement

Removal Procedure

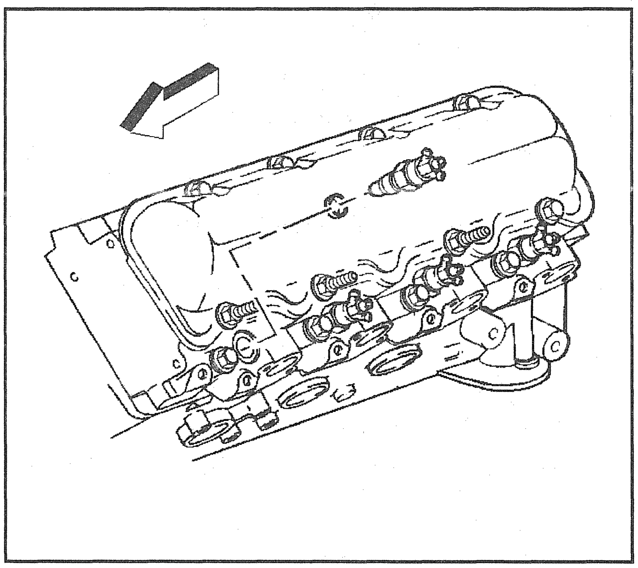
Tools Required

J 29873 Nozzle Socket

Important: When removing an injection nozzle, use the *J 29873* nozzle socket. Remove the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

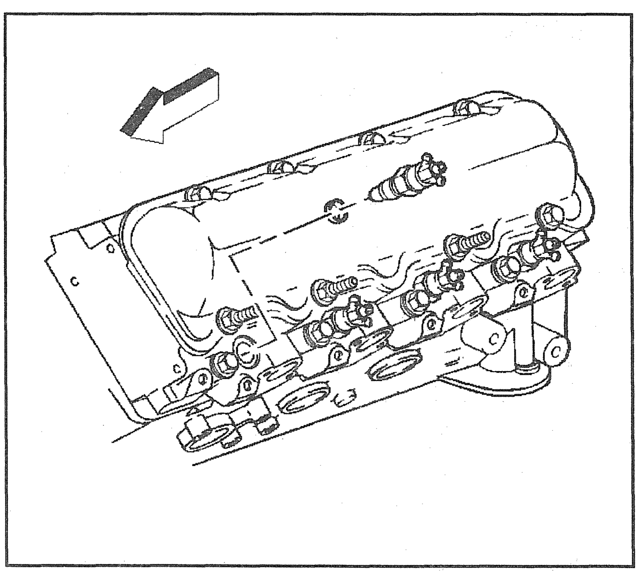
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Remove the fuel line clip.
3. Remove the fuel return hoses (1) from the nozzle (2).
4. Remove the fuel injection line.
5. Cap the nozzle and the lines.



263638

6. Remove the injection nozzle using the *J 29873* nozzle socket.



263638

Installation Procedure

Tools Required

J 29873 Nozzle Socket

Important: When installing an injection nozzle, use the *J 29873* nozzle socket. Install the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

1. Install the injection nozzle using J 29873 (apply anti-seize compound to threads of nozzle that contact the cylinder).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Tighten the nozzle.

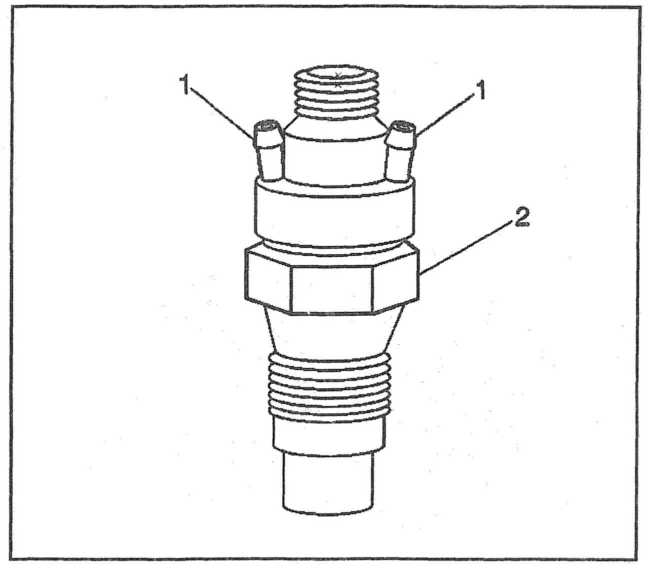
   Tighten

   Tighten the nozzle to 70 N·m (50 lb ft).

3. Tighten the fuel injection line.

   Tighten

   Tighten the nut to 25 N·m (20 lb ft).
4. Install the fuel return hoses (1) on the nozzle (2).
5. Install the fuel line clip.
6. Install the negative battery cables.



27624

Fuel Pump Relay Replacement

Removal Procedure

1. Remove the protective cover (under hood electrical center).
2. Remove the relay.

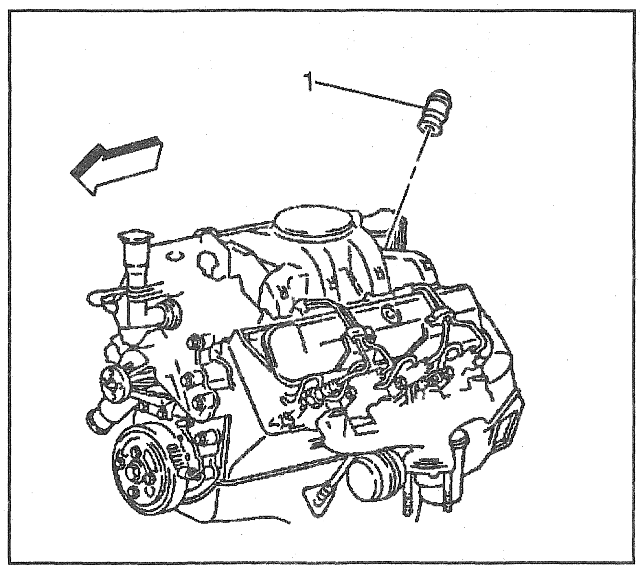
Installation Procedure

1. Install the relay.
2. Install the protective cover (under hood electrical center).

Engine Oil Pressure Sensor/Switch Replacement

Removal Procedure

1. Remove the fuel manager/filter. Refer to *Fuel Manager/Filter Replacement*.
2. Disconnect the electrical connector.
3. Remove the switch (1).



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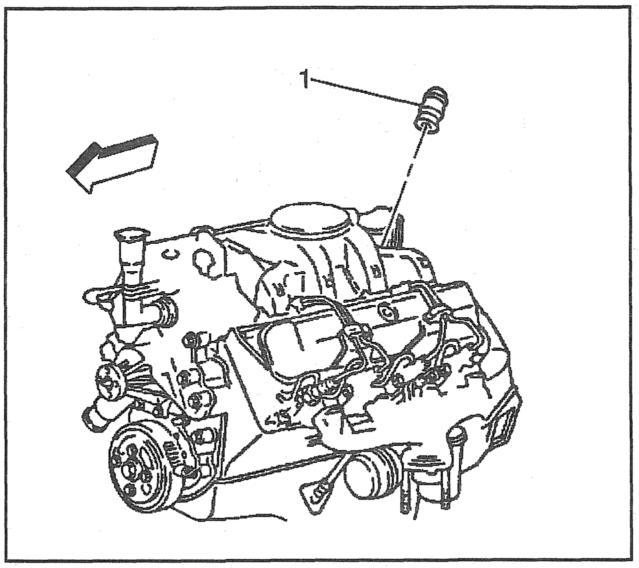
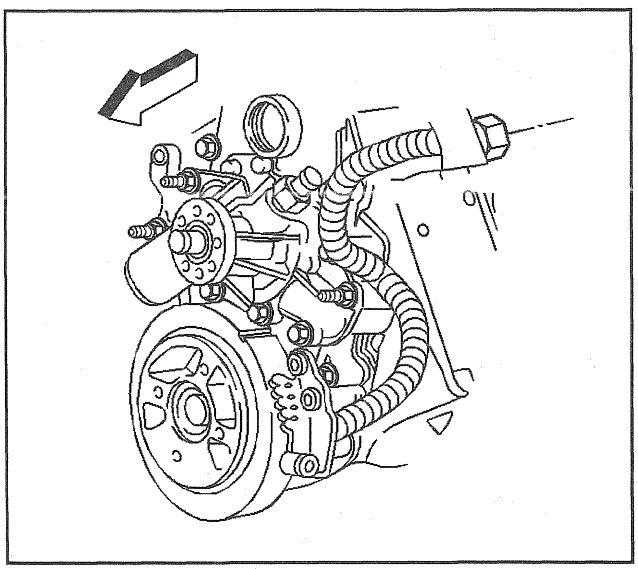


27615

Installation Procedure

1. Install the switch (1).
2. Reconnect the electrical connector.
3. Install the fuel manager/filter. Refer to *Fuel Manager/Filter Replacement.*
4. Bleed the fuel system. Refer to *Fuel Feed and Fuel Return Pipe Purge Procedure.*



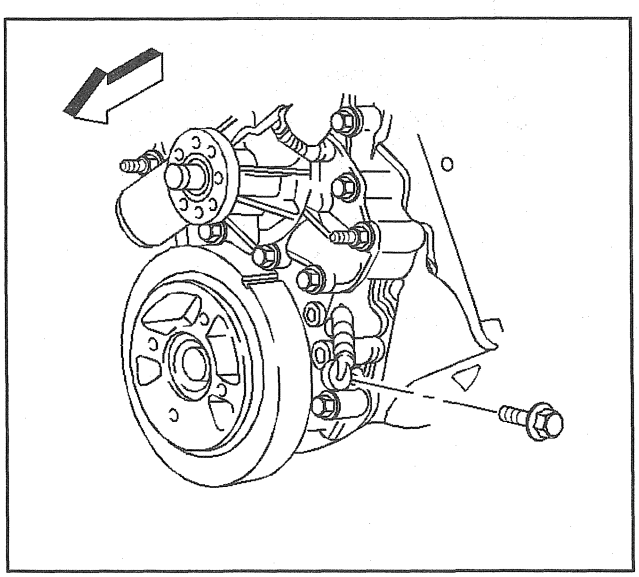
72319

Crankshaft Position Sensor Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in General Information.

1. Remove the negative battery cables.
2. Remove the sensor electrical connector.
3. Remove power steering pump. Refer to *Power Steering Pump Replacement (6.5L)* in Power Steering.



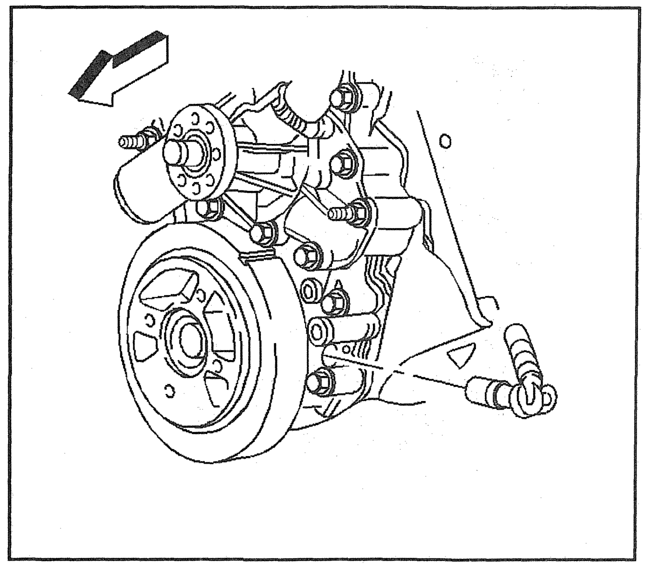
72320

4. Remove the sensor mounting bolt.

5. Remove the sensor from engine.

Important: Care must be taken when handling the sensor. Damage to the sensor will affect proper operation of the injection timing control system.

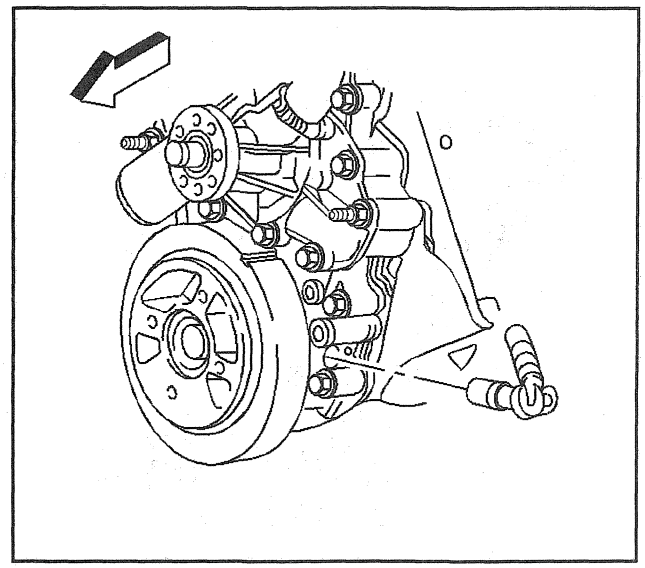
6. Inspect the sensor O-ring for wear, cracks or leakage and replace if necessary.



72321

Installation Procedure

1. Lube the new O-ring with engine oil.
2. Install the sensor in the engine.



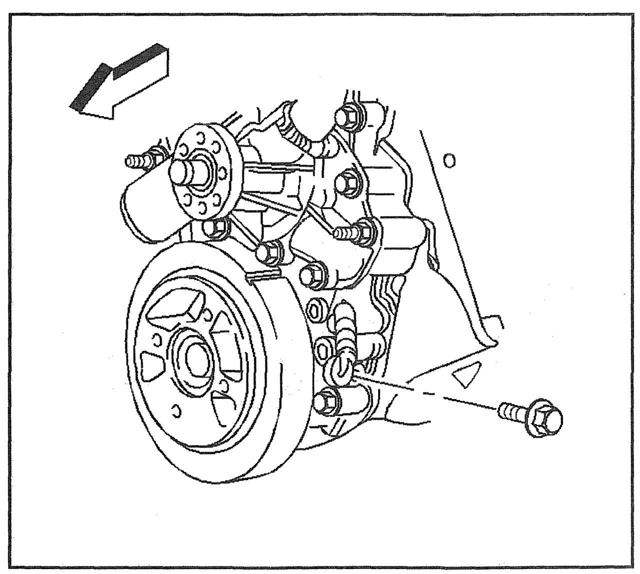
72321

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the sensor mounting bolt.

   Tighten

   Tighten the mounting bolt to 25 N·m (18 lb ft).



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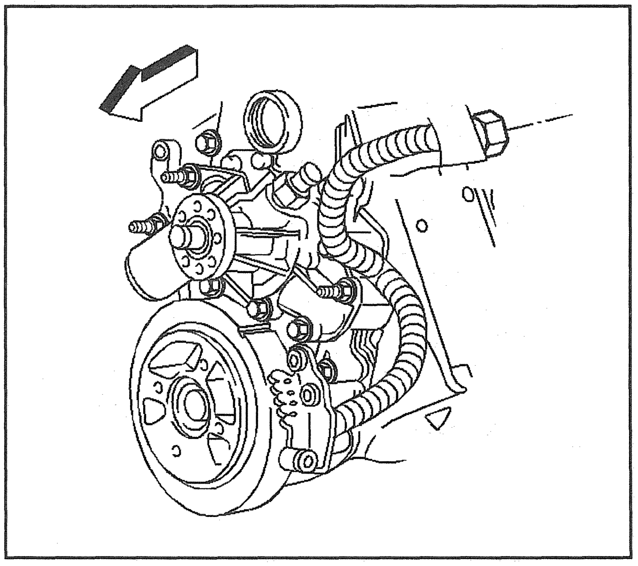


72319

4. Install the sensor electrical connector.
5. Install the power steering pump. Refer to *Power Steering Pump Replacement (6.5L)* in Power Steering.
6. Install the negative battery cables.

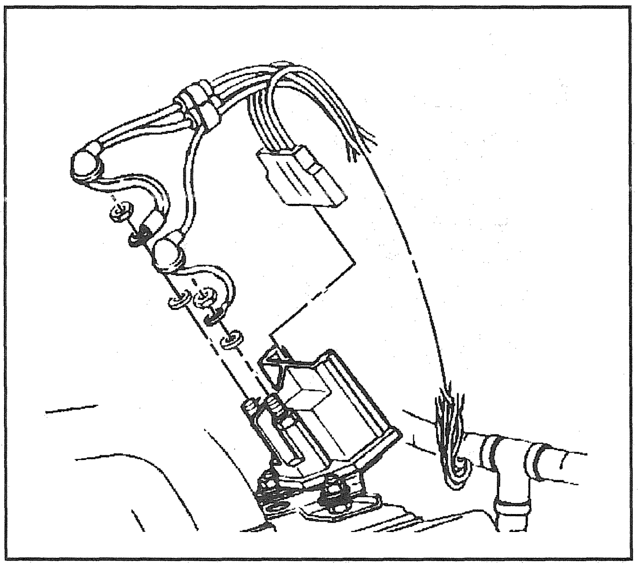
Important: A new TDC Offset must be learned after replacing a crankshaft position sensor. Refer to *TDC Offset Adjustment*.

Glow Plug Relay Replacement

Removal Procedure

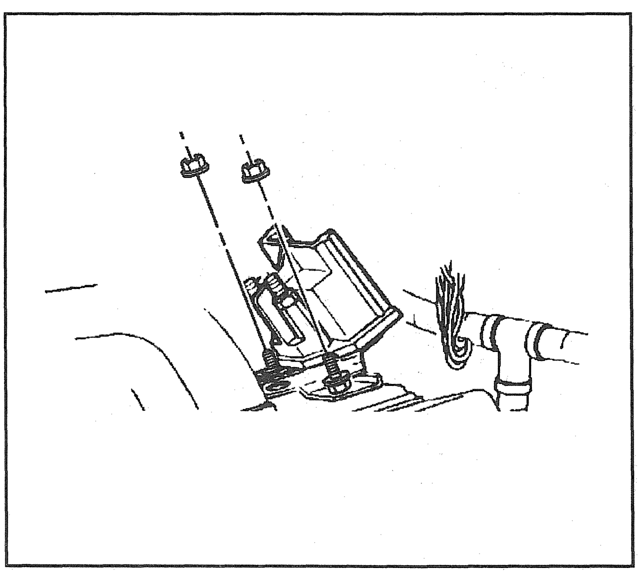
Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Release the wiring harness connector at the glow plug relay.
3. Remove the glow plug wiring harness nuts and harness.



26780

4. Remove the relay mounting nuts.



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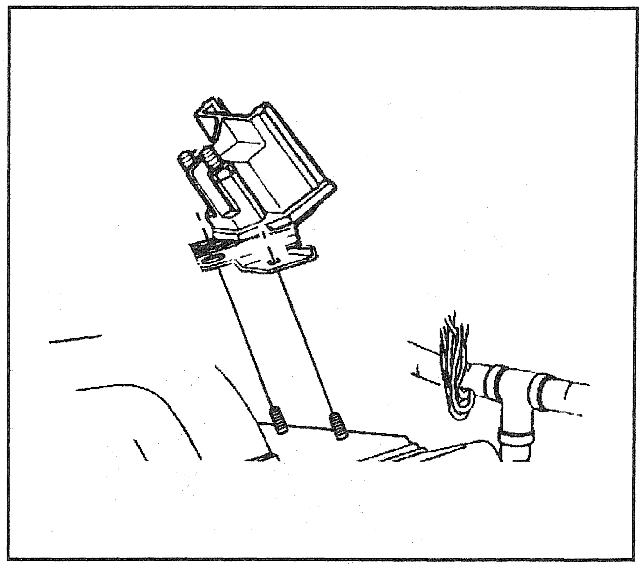
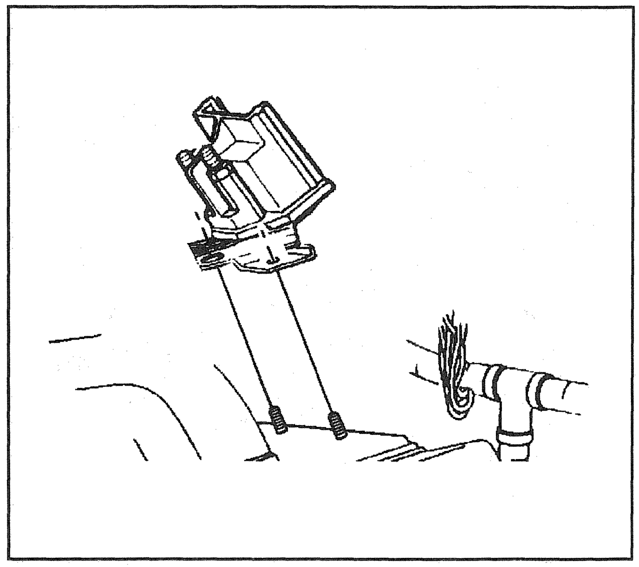
5. Remove the glow plug relay by lifting it off the mounting studs.



26782

Installation Procedure

1. Install the glow plug relay on the mounting studs.



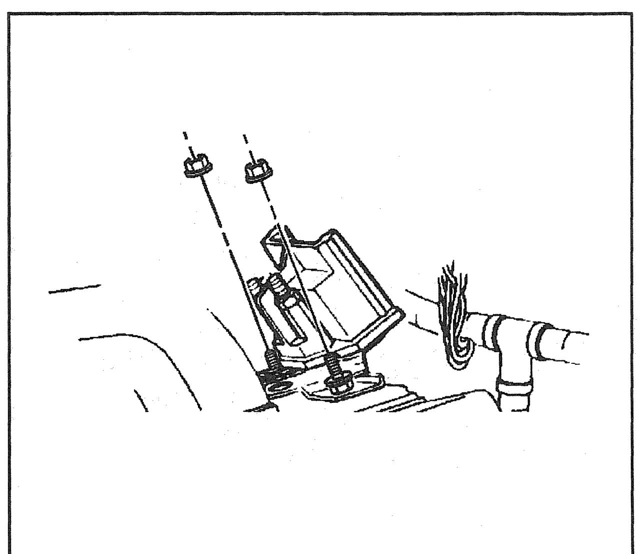
26782

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the glow plug relay mounting nuts.

   Tighten

   Tighten the nuts to 42 N·m (31 lb ft).



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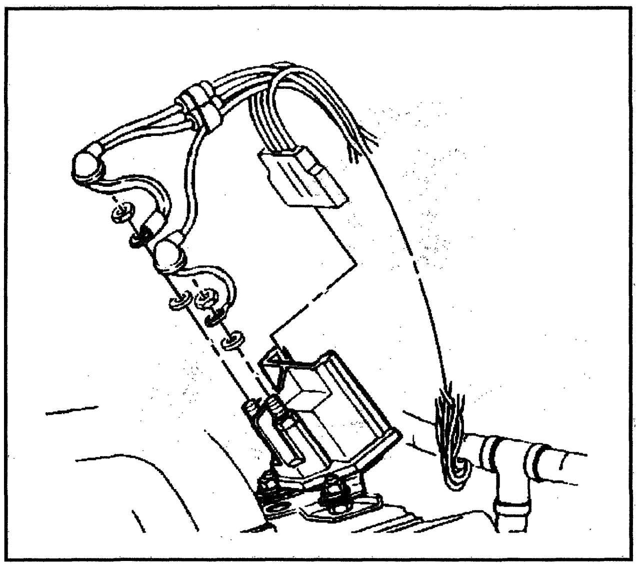
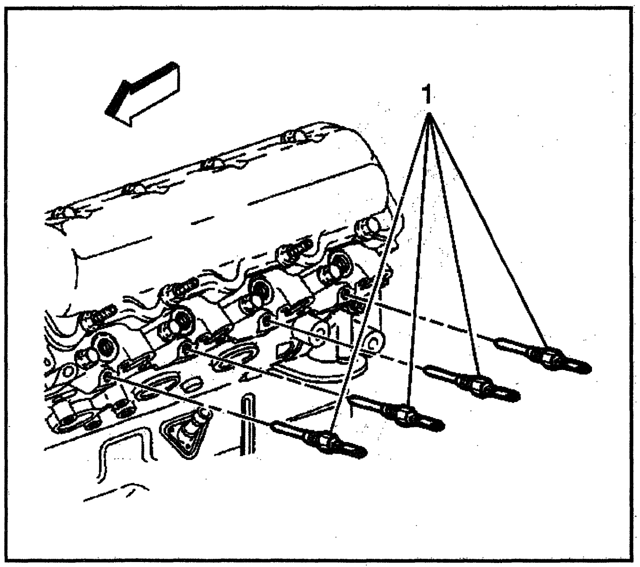


26780

3. Install the wiring harness connector to the relay.
4. Install the glow plug wiring harness and nuts.

   Tighten

   Tighten the nuts to 5 N·m (44 lb in).
5. Install the negative battery cables.



26774

Glow Plug Replacement - Left Side

Removal Procedure

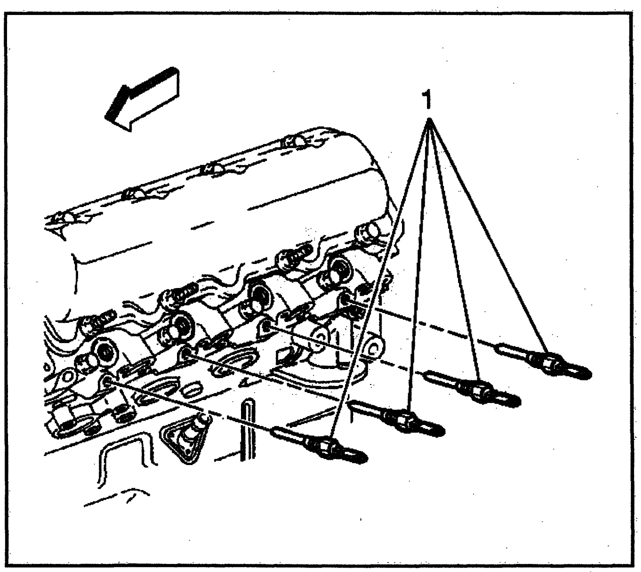
Tools Required

J 39083 Glow Plug Connector Remover and Installer

Left Side of Vehicle

Caution: Refer to Battery Disconnect Caution Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Remove the glow plug lead wires using the *J 39083* J 39083 glow plug connector remover and installer.
3. Remove the glow plugs from cylinders 1, 3, 5 and 7. If a glow plug is damaged during removal, refer to *Damaged Glow Plug Removal*.



26774

Installation Procedure

1. Install the glow plugs.

   Tighten

   Tighten the glow plugs to 17 N·m (13 lb ft).
2. Install the lead wires to the glow plugs.
3. Install the negative battery cables.

Glow Plug Replacement - Right Side

Removal Procedure

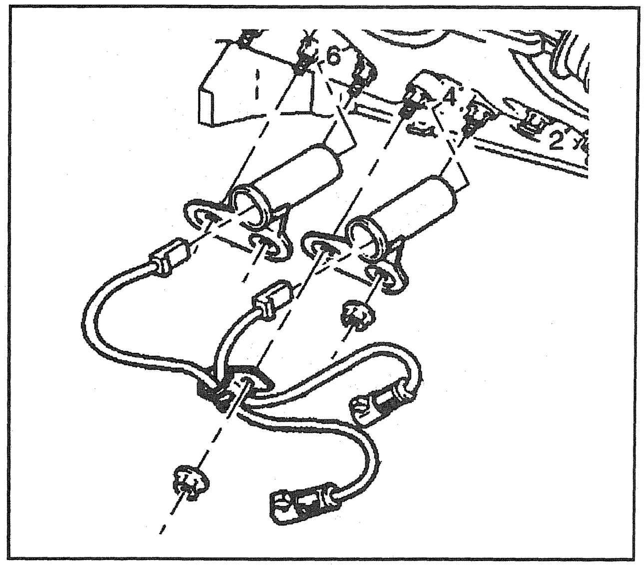
Tools Required

J 39083 Glow Plug Connector Remover and Installer

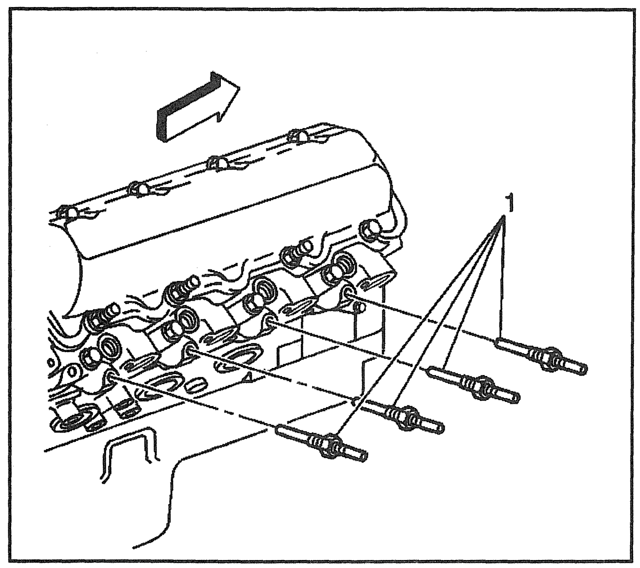
Right Side of Vehicle

1. Raise the vehicle.
2. Remove the right front tire.
3. Remove the splash shield from the right front wheel well.
4. Remove the lead wire from the glow plug in the 2 cylinder.
5. Remove the lead wires for glow plugs in cylinders 4 and 6 at the harness connectors.
6. Remove the heat shroud for the glow plug in cylinder 4.
7. Remove the heat shroud for cylinder 6.
   - Slide the shrouds back far enough to allow access for unplugging the wires at cylinder 4 and 6 glow plugs.
   - Use the *J 39083* in order to disconnect the glow plug wires.
8. Remove the glow plugs from cylinders 2, 4, and 6. If a glow plug is damaged during the removal procedure, refer to *Damaged Glow Plug Removal*.
9. Disconnect the lead wire at the glow plug from cylinder 8 by reaching up from underneath the vehicle.
10. Remove the glow plug from cylinder 8. If the glow plug is damaged during the removal procedure, refer to *Damaged Glow Plug Removal*.

    For easier access to glow plugs on cylinders 6 and 8, it may be necessary to remove the exhaust down pipe from turbocharger.



26775



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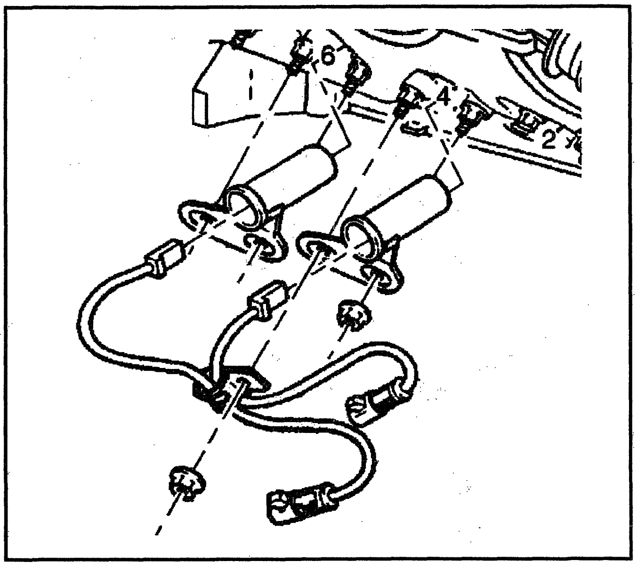


26775

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the glow plug into cylinder 8.

   Tighten

   Tighten the glow plugs to 17 N·m (13 lb ft).
2. Install the lead wire to cylinder 8 glow plug.
3. Install the glow plugs into cylinders 2, 4, and 6 by reaching through the right front wheel well.

   Tighten

   Tighten the glow plugs to 17 N·m (13 lb ft).
4. Install lead wire to glow plug 6.
   - Slide the shroud over the wire lead and fasten to the studs.
   - Repeat Step 4 for the cylinder 4 glow plug.

     Tighten

     Tighten the heat shroud nuts to 23 N·m (17 lb ft).
5. Install the wires for glow plugs in cylinder 4 and 6 to connectors at the wire harness.
6. Install the lead wire for cylinder 2 glow plug.
7. Install the splash shield in the right front wheel well.
8. Inspect the wire routing, making sure the lead wires are not rubbing against the exhaust manifold or any part that may harm the wire insulation.
9. Install the right front tire.

Damaged Glow Plug Removal

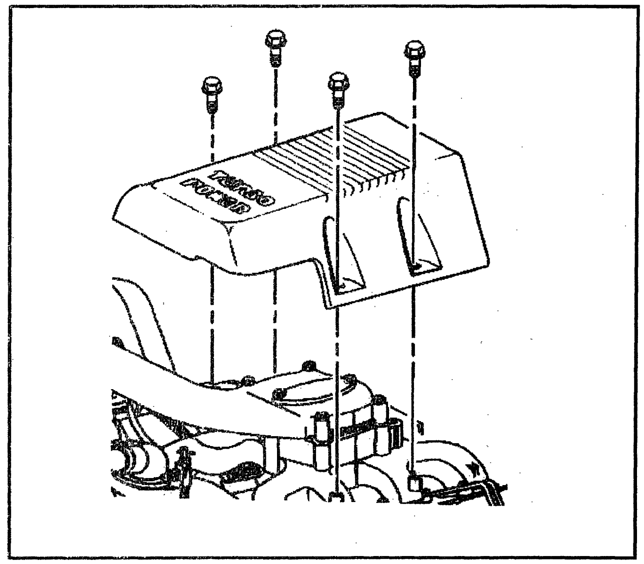
Notice: Retrieve the damaged glow plug from the cylinder or serious engine damage will occur.

1. Remove the injector nozzle from the failed glow plug cylinder.
2. Place a shop towel in the precup chamber in order to capture the glow plug tip when it breaks off from the glow plug shell upon removal (this will keep the tip from dropping into the cylinder).
3. Use a pair of needle nose pliers (or other gripping device) in order to grasp the tip and remove it from the precup chamber.
4. Remove the shop towel and reinstall the injector nozzle.
5. If the glow plug tip has already broken off the glow plug and it is not retrievable from the precup chamber, remove the cylinder head so that the tip can be retrieved from the piston cylinder. Refer to cylinder head removal.

EGR Valve Replacement

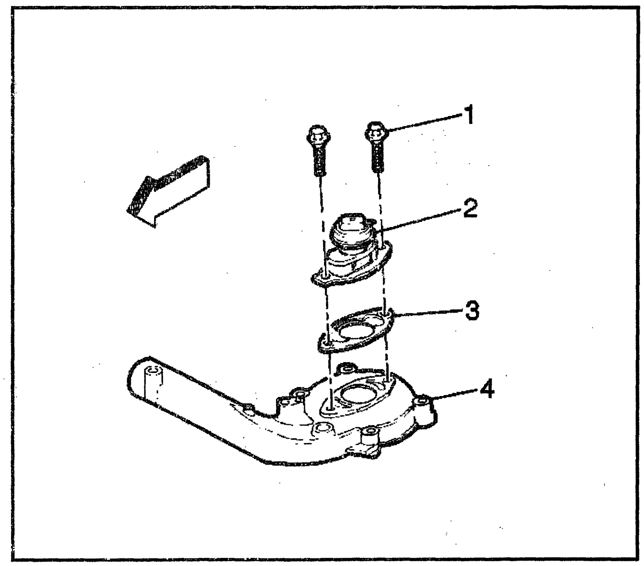
Removal Procedure

1. Remove the upper intake manifold cover by loosening the four mounting bolts.



55489

2. Remove the vacuum hose from the EGR valve (2).
3. Remove the EGR valve mounting bolts (1).
4. Remove the EGR valve (2) and the gasket (3).



25113

Installation Procedure

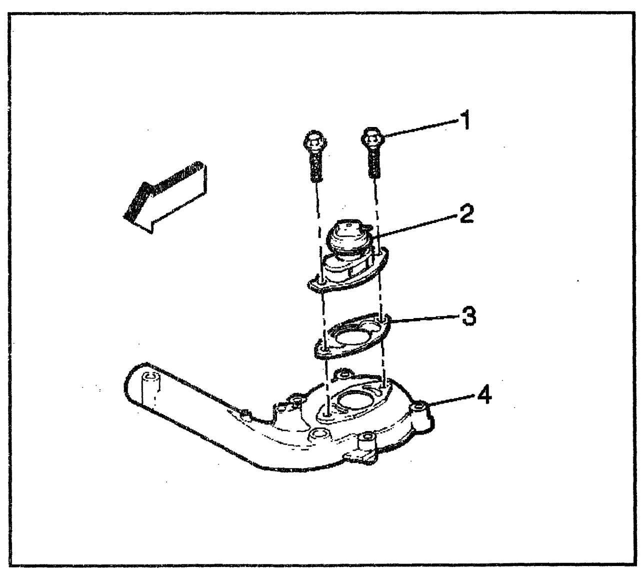
1. Install the EGR valve (2) and gasket (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

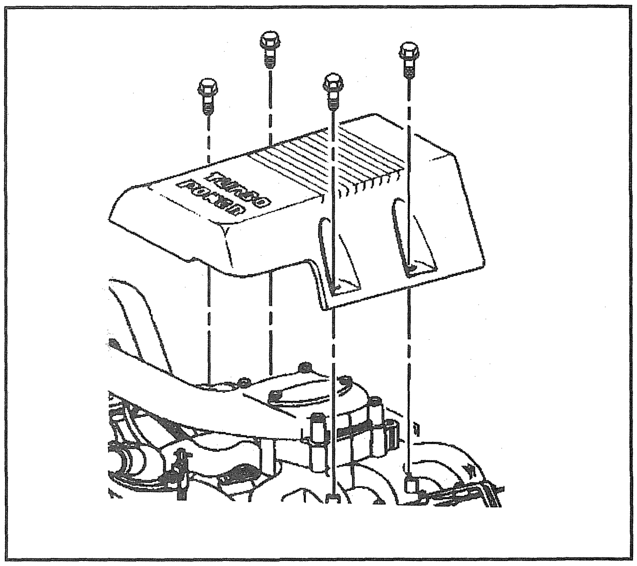
2. Install EGR valve mounting bolts (1).

   Tighten

   Tighten bolts to 25 N·m (18 lb ft).
3. Install the EGR valve vacuum hose.



25113



55489

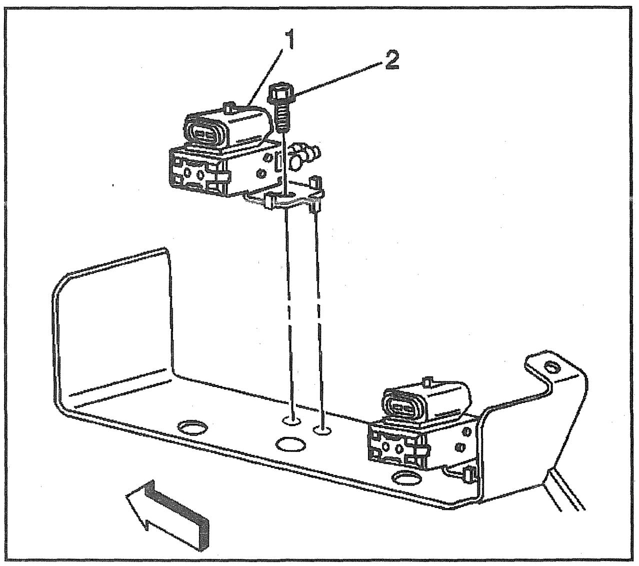
4. Install the upper intake manifold cover.
5. Install the upper intake manifold cover bolts.

   Tighten

   Tighten the bolts to 11 N·m (100 lb in).
6. Install negative battery cables.
7. Start and idle engine.

Important: If the ALM cells are not reset, a poor driveability, heavy black smoke and EGR DTCs will exist until vehicle has been driven. The ALM cells will adjust to normal settings after the vehicle has been driven (mileage will vary) and all DTCs are cleared.

8. Reset ALM cells using scan tool (under special functions in scan tool).



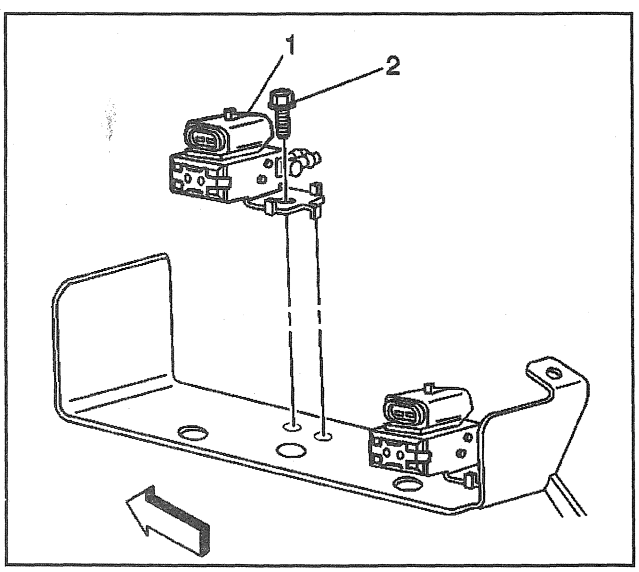
25303

EGR Solenoid Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Remove the electrical connector from the solenoid.
3. Remove the vacuum hoses.
4. Remove EGR Solenoid mounting bolt (2).
5. Remove the EGR solenoid (1).



25303

Installation Procedure

1. Install the EGR solenoid (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install mounting bolt (2).

   Tighten

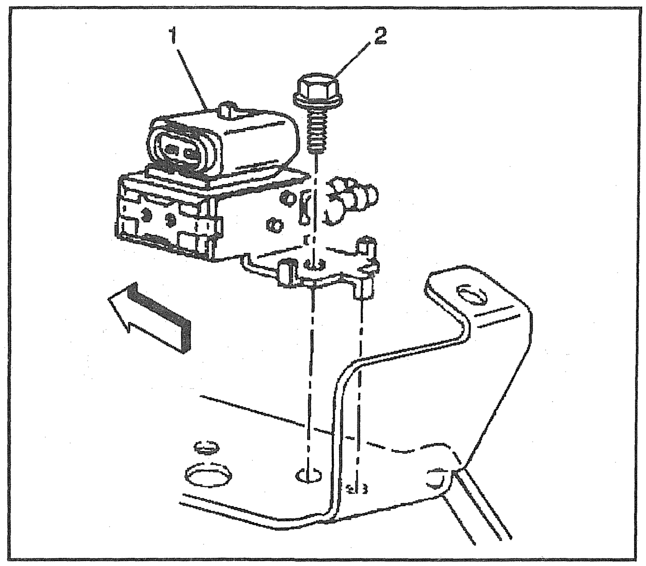
   Tighten mounting bolt to 6.0 N·m (53 lb in).
3. Install the vacuum hoses.
4. Install the electrical connector to the solenoid.
5. Install the negative battery cable(s).

EGR Vent Solenoid Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove the negative battery cables.
2. Remove the electrical connector from the solenoid.
3. Remove the vacuum hoses.
4. Remove the EGR Vent solenoid mounting bolt (2).
5. Remove the EGR vent solenoid (1).



25300

Installation Procedure

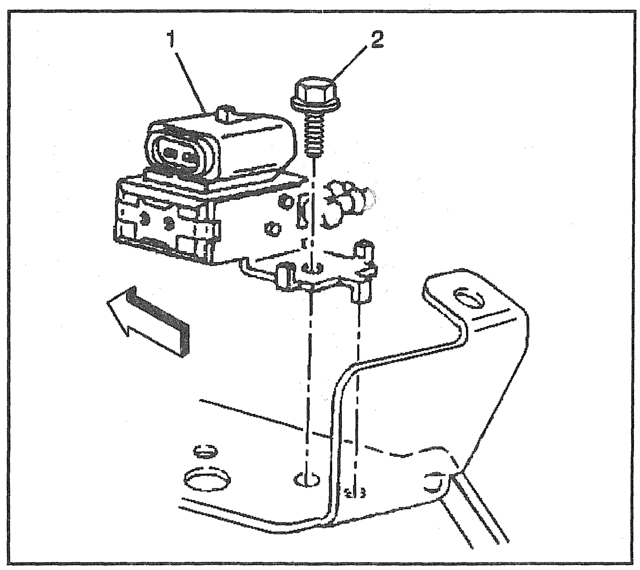
1. Install the EGR vent solenoid (1).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install EGR Vent Solenoid mounting bolt (2).

   Tighten

   Tighten mounting bolt to 6.0 N·m (53 lb in).
3. Install the vacuum hoses.
4. Install the electrical connector to the solenoid.
5. Install the negative battery cables.

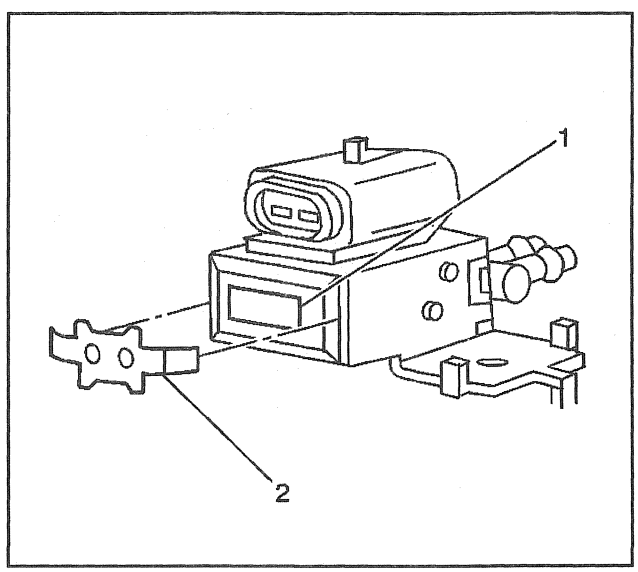


25300

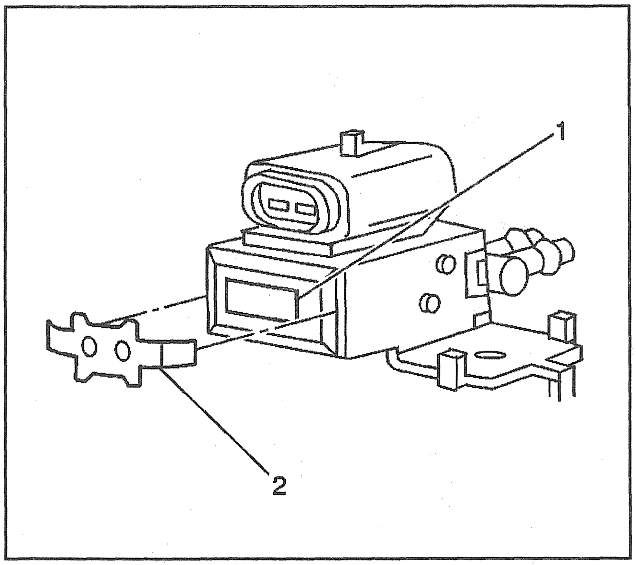
EGR Solenoid Filter Replacement

Removal Procedure

1. Remove the filter retainer clip (2).
2. Remove the solenoid filter (1).



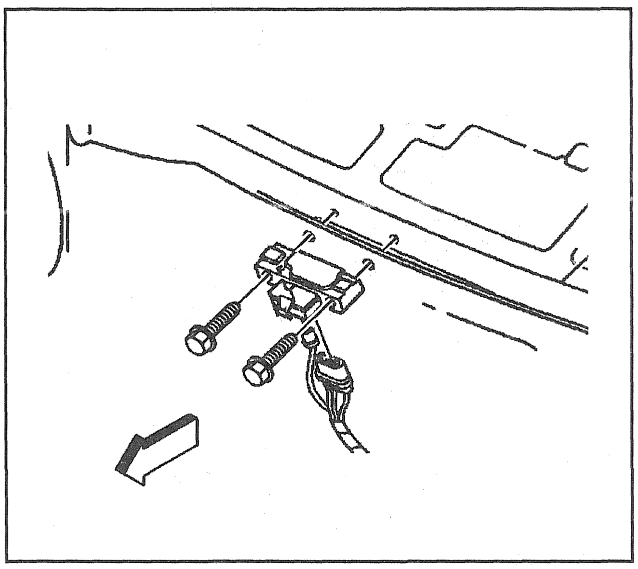
25479



25479

Installation Procedure

1. Install the solenoid filter (1).
2. Install the filter retainer clip (2).



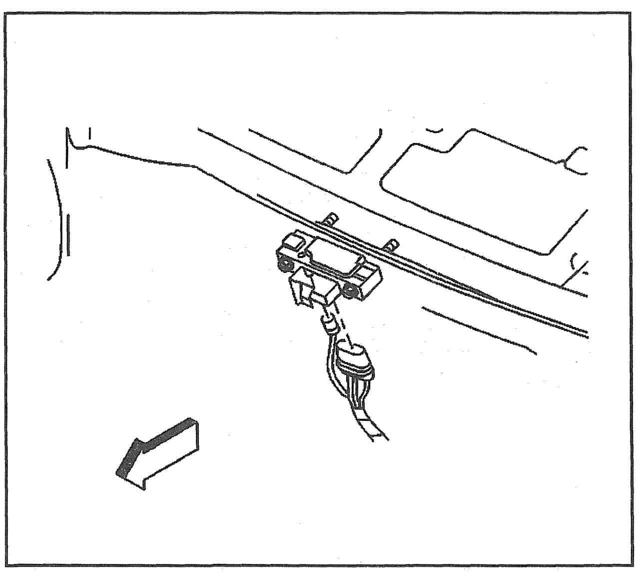
26954

EGR Control Pressure Sensor Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove negative battery cables.
2. Remove the vacuum harness assembly.
3. Remove the electrical connector.
4. Remove the mounting bolts.
5. Remove the sensor.



263636

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the mounting bolts with the sensor.

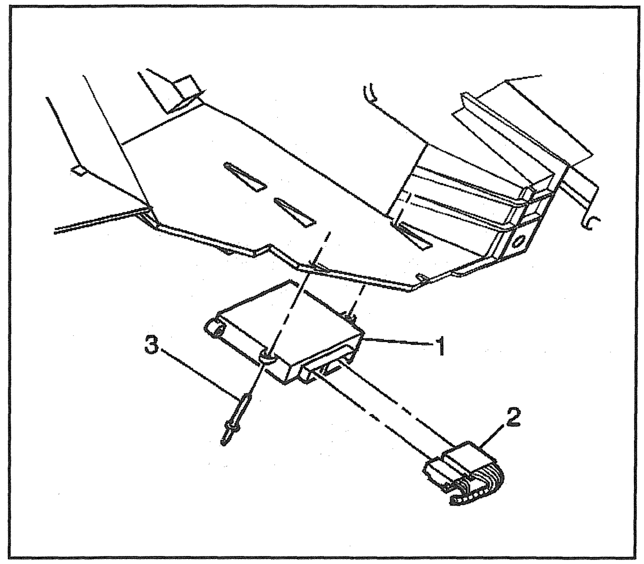
   Tighten

   Tighten the mounting bolts to 3.5 N·m (27 lb in).
2. Install the electrical connector.
3. Install the vacuum harness.
4. Install the negative battery cables.

Vehicle Speed Signal Buffer Replacement

Removal Procedure

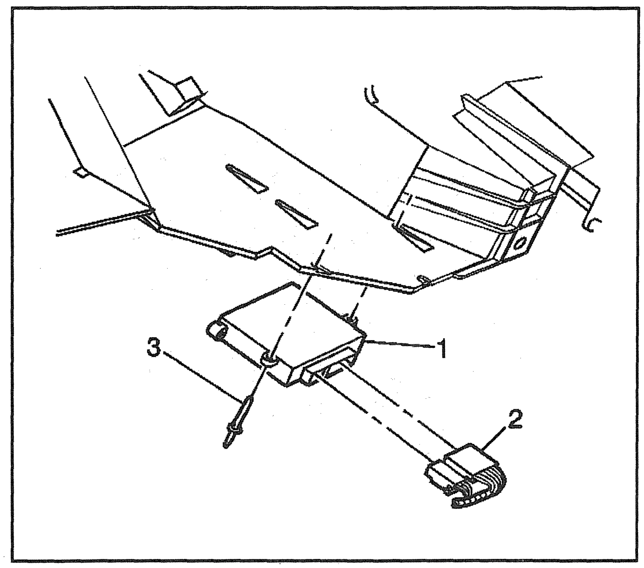
1. Remove the fasteners (3) that retain the vehicle speed sensor (VSS) buffer (1) to the instrument panel carrier.
2. Remove the VSS buffer (1) from the instrument panel carrier.
3. Disconnect the electrical connector (2) from the VSS buffer (1).
4. Remove the VSS buffer (1) from the vehicle.



328144

Installation Procedure

1. Install the vehicle speed sensor (VSS) buffer (1) to the vehicle.
2. Connect the electrical connector (2) the VSS buffer (1).
3. Position the VSS buffer (1) to the instrument panel carrier.
4. Install the VSS buffer fasteners (3) that retain the VSS buffer (1) to the instrument panel carrier.



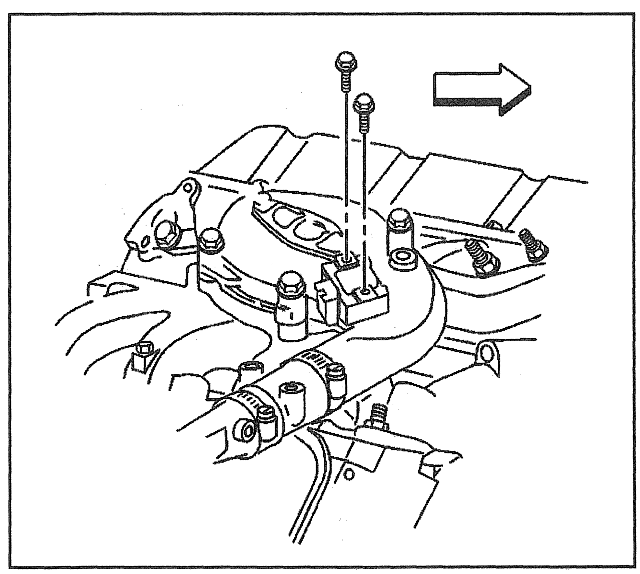
328144

Boost Sensor Replacement

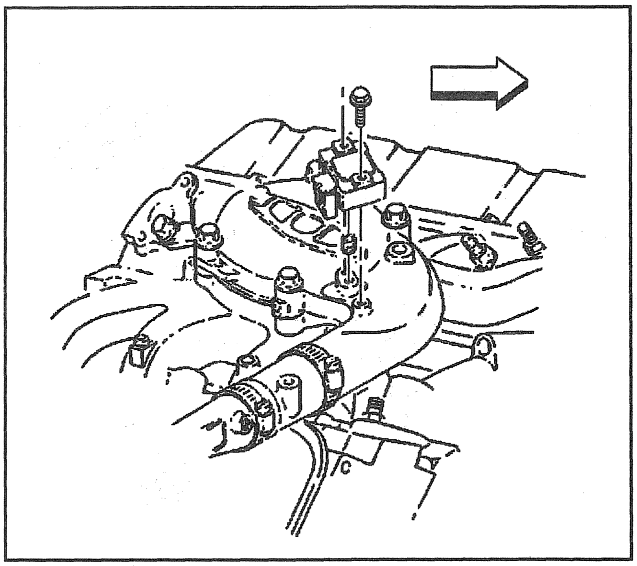
Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Remove negative battery cables.
2. Remove the electrical connector.
3. Remove the mounting bolts.

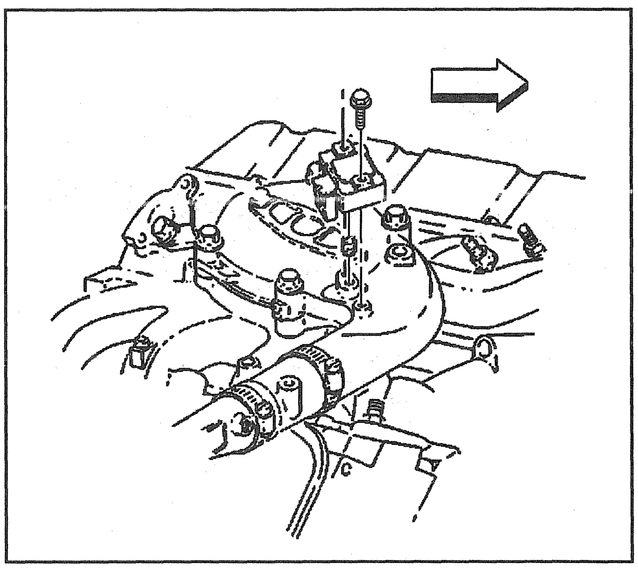


73423



26957

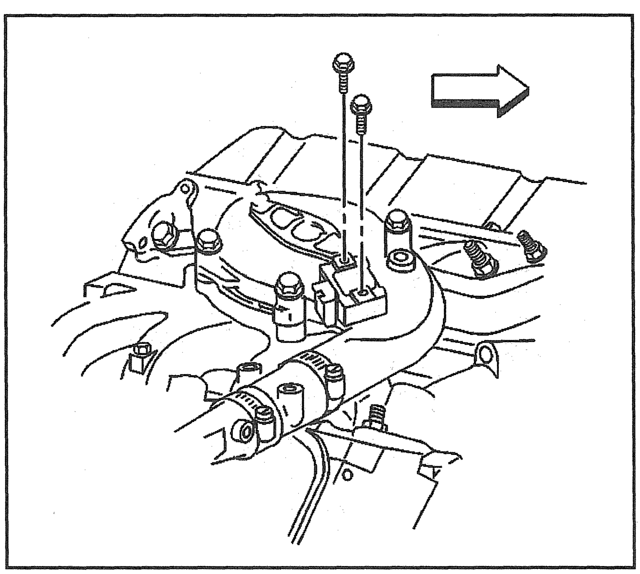
4. Remove the sensor.



26957

Installation Procedure

1. Install the port gasket on sensor.
2. Install the sensor.



73423

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the mounting bolts.

   Tighten

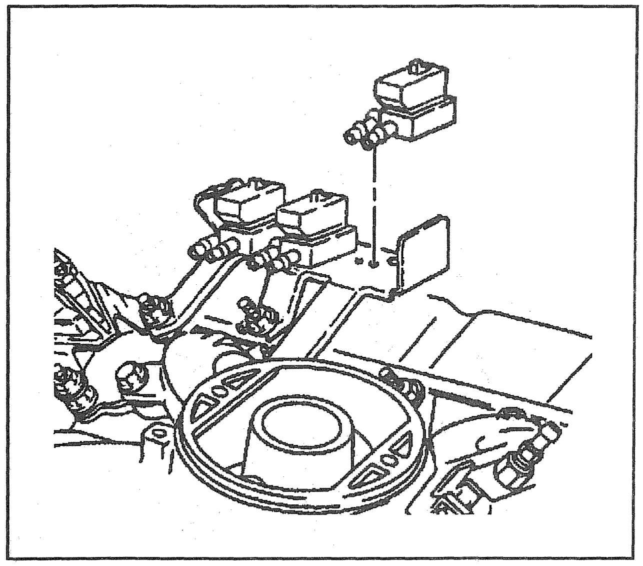
   Tighten the mounting bolts to 3.5 N·m (27 lb in).
4. Install the electrical connector.
5. Install the negative battery cables.

Wastegate Solenoid Replacement

Removal Procedure

Caution: Refer to Battery Disconnect Caution in Cautions and Notices.

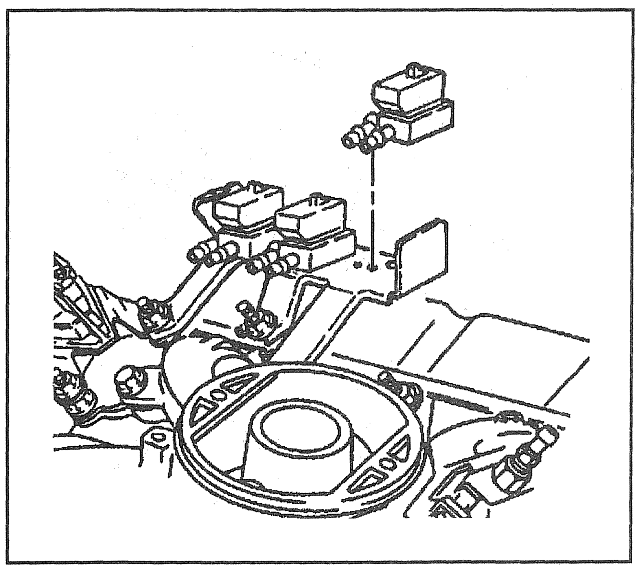
1. Remove negative battery cables.
2. Remove the electrical connector from the solenoid.
3. Remove the vacuum hoses.
4. Remove the solenoid mounting bolt
5. Remove the wastegate solenoid.



26958

Installation Procedure

1. Install the wastegate solenoid.
2. Install the wastegate mounting bolt.
3. Install the vacuum hoses.
4. Install the electrical connector.
5. Install the negative battery cables.



26958

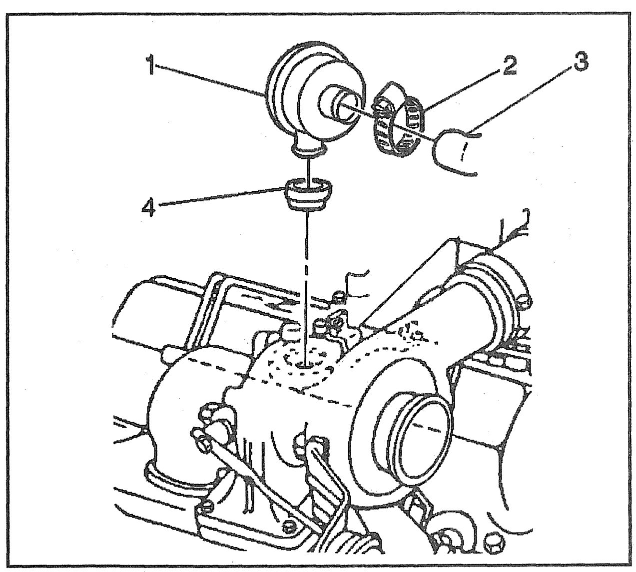
CDR Valve and Hoses Replacement

Removal Procedure

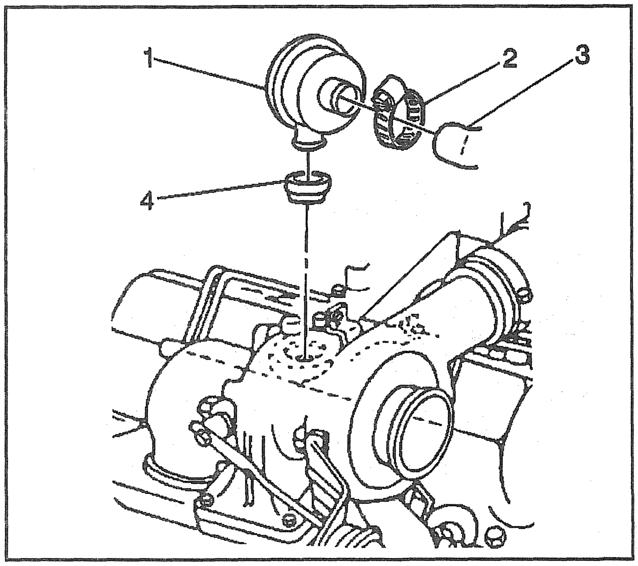
Important: The crankcase depression regulator valve (1) is replaced as an assembly. Replace the hoses (3), pipes (3) and grommet (4) as required, if the inspection indicates any cracks or decay.

Refer to the appropriate service information for diesel crankcase ventilation system maintenance requirements.

1. Remove the clamp (2) at the CDR valve (1).
2. Remove the hose (3) from the CDR valve (1).
3. Remove the CDR valve by pulling straight up.



25616



25616

Installation Procedure

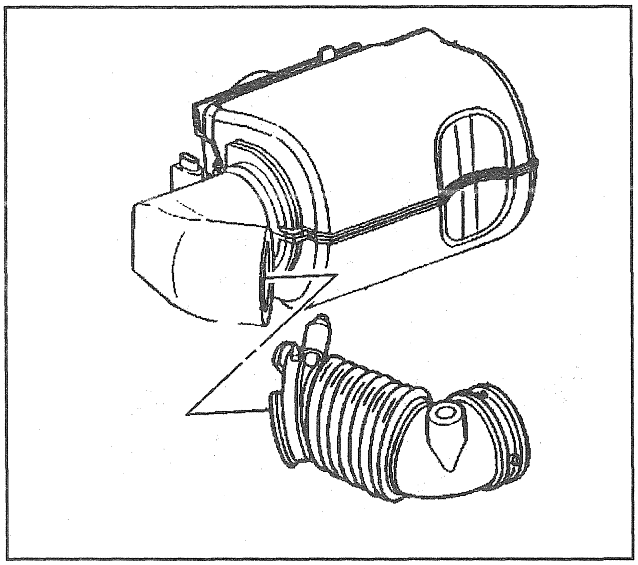
1. Install the CDR valve (1) into the valve cover.
2. Install the hose (3).

Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the clamp (2).

Tighten

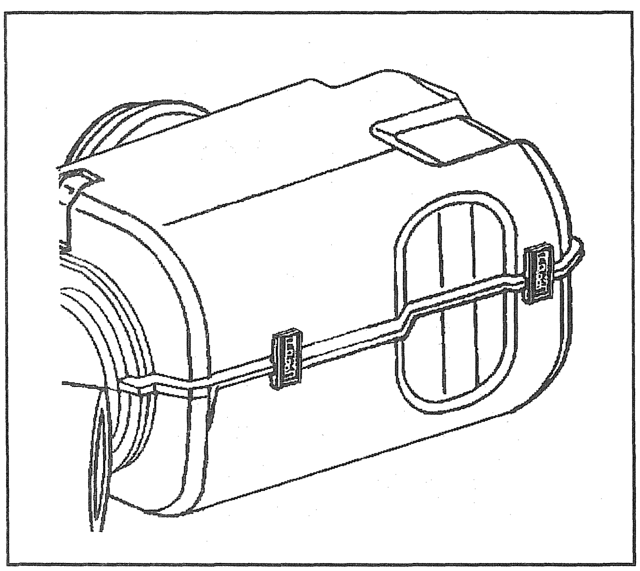
Tighten the clamp to 1.7 N·m (15 lb in).


55474

Air Cleaner Element Replacement

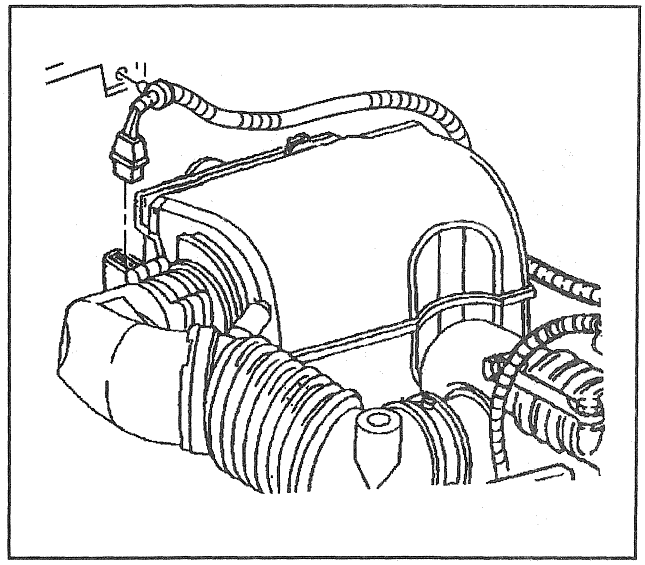
Removal Procedure

1. Loosen the clamp and separate the air cleaner inlet elbow from the turbocharger inlet elbow.


55485

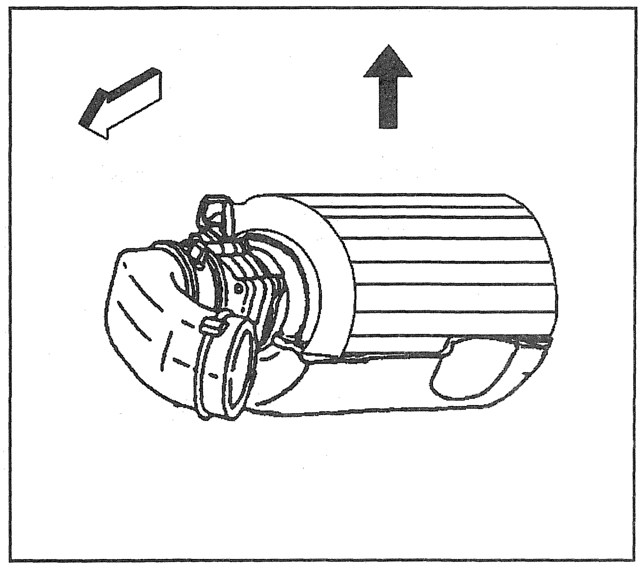
2. Release the clips holding the air cleaner cover to the housing.

3. Remove the MAF sensor electrical connector (L56 only).



63702

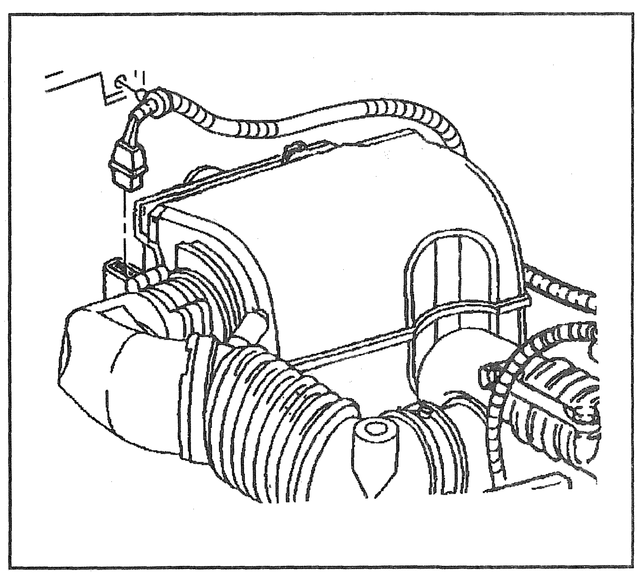
4. Remove the air cleaner filter with air inlet elbow attached.
5. Separate the air inlet elbow from the filter by pulling apart.
   - Inspect the CDR hose for cracks or binds.
   - Inspect the air cleaner cover seals for damage.
   - Inspect the air cleaner filter for damage or excessive dirt accumulation.
   - A high capacity air filter can be used if necessary (AC type A 1306C).



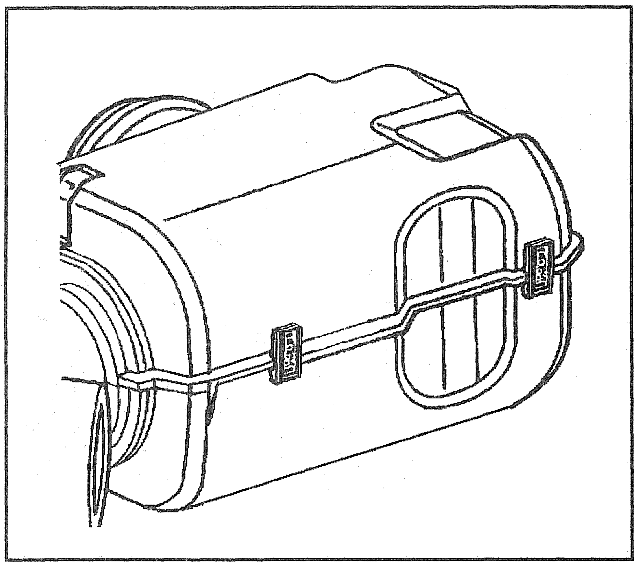
63699

Installation Procedure

1. Install the air inlet elbow on the filter by pushing on the inlet elbow.
2. Install the air cleaner filter with the air inlet elbow attached into the housing.
3. Install the MAF sensor electrical connector (L56 only).

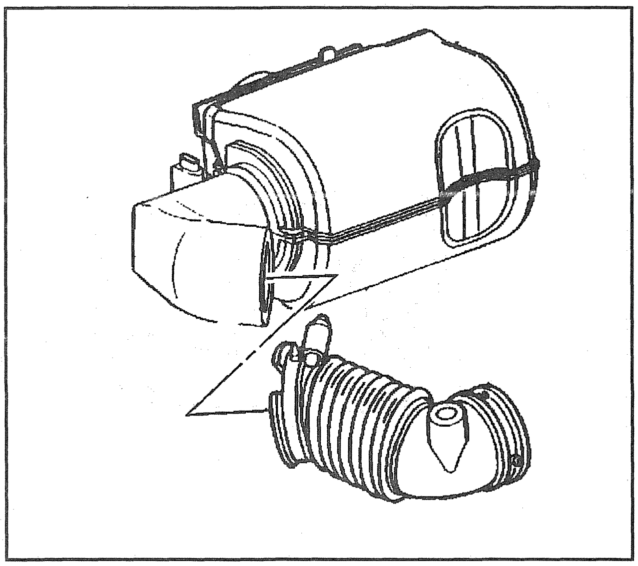


63702



55485

4. Install the air cleaner cover into the housing and clip into place.



55474

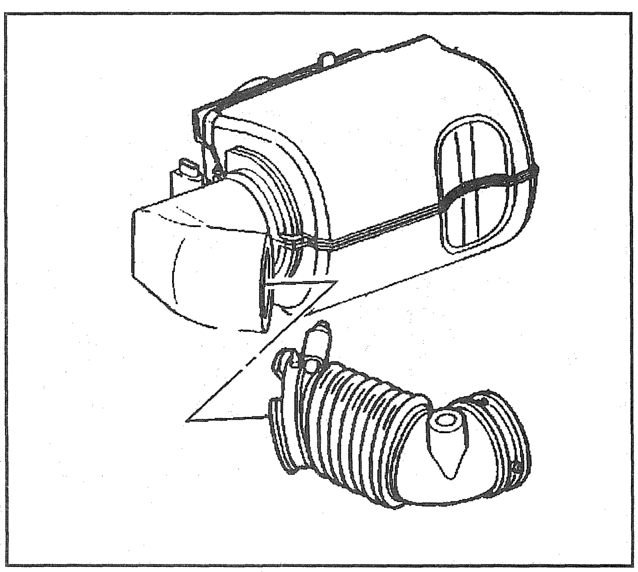
5. Install the air cleaner inlet elbow into the turbocharger inlet elbow.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

6. Tighten the elbow clamp.

   Tighten

   Tighten the elbow clamp to 5 N·m (45 lb in).



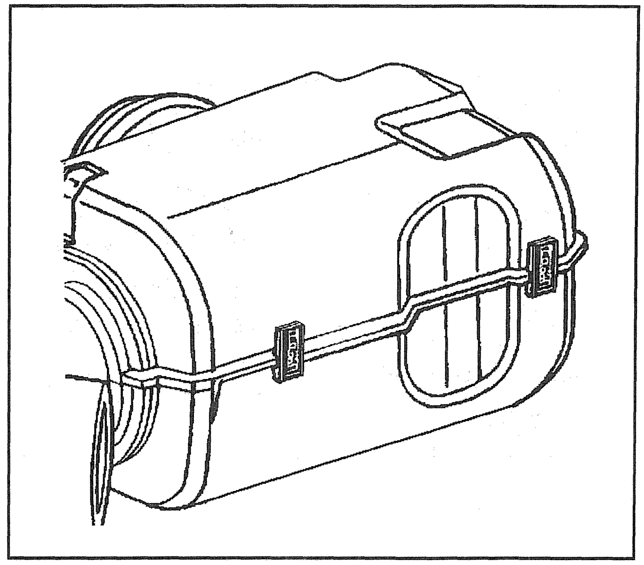
55474

Air Cleaner Assembly Replacement

Removal Procedure

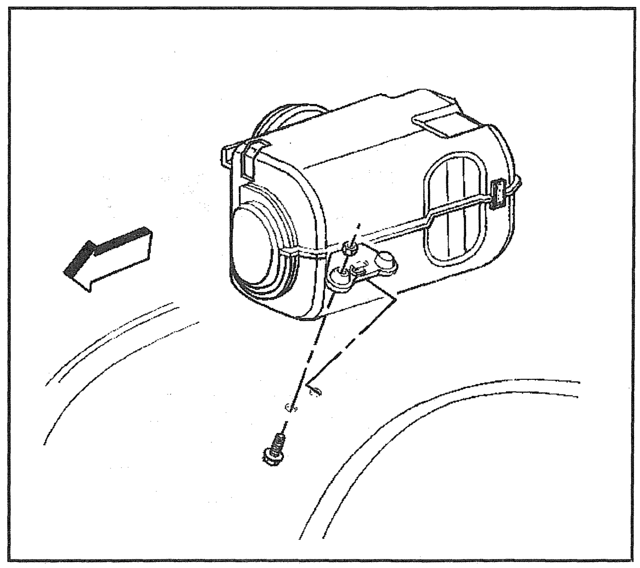
1. Loosen the clamp and separate the air cleaner inlet elbow from the turbocharger inlet elbow

2. Release the clips holding the air cleaner cover to the housing.
3. Remove the MAF sensor electrical connector (L56 only).
4. Remove the air filter with the air cleaner inlet elbow attached.



55485

5. Remove the air cleaner assembly mounting bolts.
6. Remove the air cleaner assembly.
   - Inspect the air cleaner filter for damage or excessive dirt accumulation. Replace if necessary.
   - Inspect the air inlet elbows and the CDR hose for damage or cracks, replace if necessary.



55483

Installation Procedure

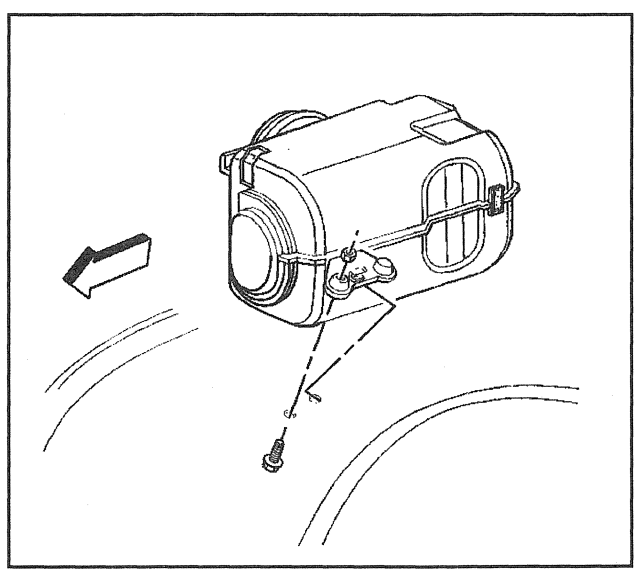
1. Install the air cleaner assembly.

Notice: Refer to *Fastener Notice* in Cautions and Notices.

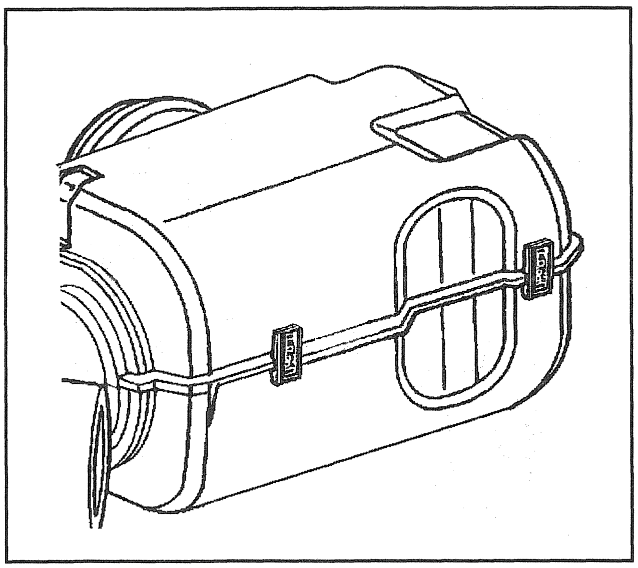
2. Install the air cleaner assembly mounting bolts.

   Tighten

   Tighten the mounting bolts to 25 N·m (19 lb ft).
3. Install the air cleaner filter with the inlet elbow attached.

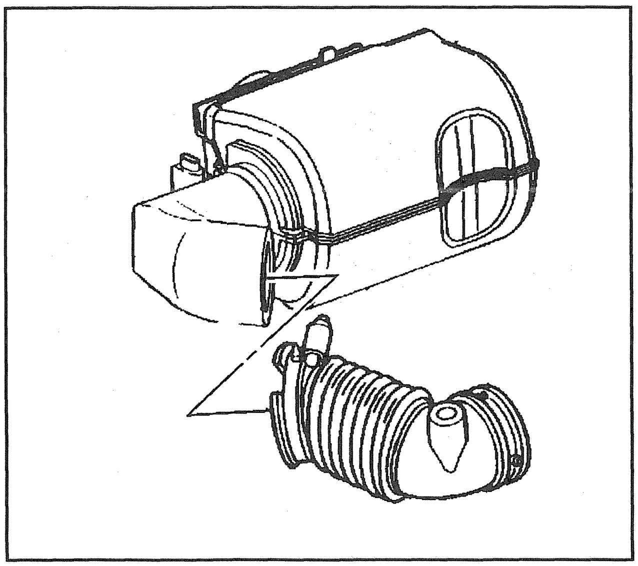


55483



55485

4. Install the air cleaner cover to the housing and clip the air cleaner cover into place.
5. Install the MAF sensor electrical connector (L56 only).



55474

6. Install the air cleaner inlet elbow to the turbocharger inlet elbow and tighten the clamp.

Tighten

Tighten the inlet elbow clamp to 5 N·m (45 lb in).

Description and Operation

Powertrain Control Module Description

The PCM processes the various input information. The PCM sends the necessary electrical responses to control fuel delivery, spark timing, and other emission control systems.

The input information has an interrelation to more than one output. One failed input can affect more than one system's operation.

On-Board Diagnostic System Check

The On-Board Diagnostic (OBD) System Check is an organized approach to identify a problem caused by an electronic engine control system malfunction. The OBD must be the starting point for any driveability complaint diagnosis. The OBD directs the technician to the next logical step in diagnosing the complaint.

Use the Engine Scan Tool Data Definitions list for a comparison after fulfilling the following items:

- Completes the OBD System Check
- The on-board diagnostics are functioning properly
- Displays no diagnostic trouble codes

The Engine Scan Tool Definitions are an average of display values recorded from normal operating vehicles. The Definitions intend to represent what a normal functioning system should display.

Important: Do not use a scan tool that displays faulty data. Report the problem to the manufacturer. Using a malfunctioning scan tool can result in misdiagnosis and unnecessary parts replacement.

Use only the parameters listed in the Engine Scan Tool Definitions for diagnosis. When a scan tool reads other parameters, General Motors recommends not using the values for use in diagnosis.

For more description on the values and the use of the scan tool to diagnose the PCM inputs, refer to the applicable diagnostic file.

When all the values are within the range illustrated in the Engine Scan Tool Data Definitions, refer to Driveability Symptoms.

Control Module Communications

The control module system has a computer, Powertrain Control Module (PCM) to control fuel delivery, timing, and some emission control systems. The control module system monitors a number of engine and vehicle functions and controls the following operations:

- Fuel control.
- Fuel injection timing.
- Exhaust gas recirculation.
- Transmission shift and shift quality functions.
- Specific transmission control diagnostics are covered in Transmissions.

The diesel Powertrain Control Module (PCM), located in the passenger compartment, is the control center of the control module system. The Powertrain Control Module used on the electronic fuel injected 6.5L diesel is referred to as a PCM.

The PCM constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The PCM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the MIL (Service Engine Soon), and store one or more DTCs which identify the problem areas to aid the technician in making repairs. See the specific diagnosis procedure for more information.

The PCM processes the various input information and sends the necessary electrical responses to control fuel delivery, timing and other emission control systems. The input information has an interrelation to more than one output, therefore, if the one input failed it could effect more than one system's operation.

Aftermarket (Add-On) Electrical And Vacuum Equipment

Any equipment installed on a vehicle after leaving the factory that connects to the electrical or vacuum systems of the vehicle defines Aftermarket (Add-On) Electrical and Vacuum Equipment. The vehicle design makes no allowances for this type of equipment.

Notice: Do not attach add-on vacuum operated equipment to this vehicle. The use of add-on vacuum equipment may result in damage to vehicle components or systems.

Notice: Connect any add-on electrically operated equipment to the vehicle's electrical system at the battery (power and ground) in order to prevent damage to the vehicle.

The Add-On electrical equipment, even when installed to these strict guidelines, may still cause the Powertrain system to malfunction. This may also include any equipment which is not connected to the electrical system of the vehicle such as portable telephones and radios. Therefore, the first step in diagnosing any Powertrain problem is to eliminate all of the Aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, diagnose the problem in the normal manner.

Engine Controls Information

The driveability and emissions information describes the function and operation of the control module. The emphasis is placed on the diagnosis and repair of problems related to the system.

Engine Components, Wiring Diagrams, and Diagnostic Tables (DTCs):

- The Component Locations
- The Wiring Diagrams
- The Control Module Terminal End View and Terminal Definitions
- The On-Board Diagnostic (OBD) System Check
- The Diagnostic Trouble Code Tables (DTCs)

The Component System includes the following items:

- The Component and circuit description
- The On-vehicle service for each subsystem
- The Functional checks with the Diagnostic Tables
- How To Use Electrical Systems Diagnostic Information

The DTCs also contain the diagnostic support information containing the circuit diagrams, the circuit or the system information, and helpful diagnostic information.

Wiring Harness Service

The control module harness electrically connects the control module to the various solenoids, switches, and sensors in the vehicle engine compartment and passenger compartment.

Replace the wire harnesses with the proper part number replacement. When splicing signal wires into a harness, use the wiring that has high temperature insulation.

Consider the low amperage and voltage levels utilized in the Powertrain control systems. Make the best possible bond at all splices. Use rosin-core solder in these areas.

Molded-on connectors require complete replacement of the connector. Splice a new connector into the harness. Replacement connectors and terminals are listed in Group 8.965 in the Standard Parts Catalog.

For wiring repair, refer to Wiring Repairs.

Connectors and Terminals

In order to prevent shorting between opposite terminals, use care when probing a connector and when replacing terminals. Damage to the components could result.

Always use jumper wires between connectors for circuit checking.

Never probe through the Weather-Pack seals.

The connector test adapter kit *J 35616-A*, or the equivalent, contains an assortment of flexible connectors used in order to probe the terminals during the diagnosis. The fuse remover and the test tool BT-8616, or the equivalent, is used for removing a fuse and to adapt the fuse holder to a meter for diagnosis.

Open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may temporarily correct the open circuit. Oxidized or loose connections may cause intermittent problems.

Be certain the type of connector and terminal before making any connector or terminal repair. Weather-Pack and Com-Pack III terminals look similar, but are serviced differently.

Serial Data Communications

Class II Serial Data

U.S. Federal regulations require that all automobile manufacturers establish a common communications system. This vehicle utilizes the Class II communications system. Each bit of information can have one of two lengths: long or short. This allows the vehicle wiring to be reduced by the transmission and reception of the multiple signals over a single wire. The messages which are carried on Class II data streams are also prioritized. In other words, if two messages attempt to establish communications on the data line at the same time, only the message with the higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that the regulation provides the scan tool manufacturers with the capability of accessing the data from any make or model vehicle sold in the United States.

The Diagnostic Executive

The Diagnostic Executive is a unique segment of the software which is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are:

- Monitoring the Diagnostic Test Enabling Conditions
- Requesting the Malfunction Indicator Light (MIL)
- Illuminating the MIL.
- Recording Pending, Current, and History DTCs
- Storing and Erasing Freeze Frame Data
- Monitoring and Recording Test Status information

On-Board Diagnostic Tests

A diagnostic test is a series of steps which has a beginning and an end. The result of which is a pass or fail reported to the Diagnostic Executive. When a diagnostic test reports a pass result, the Diagnostic Executive records the following data:

- The diagnostic test has completed since the last ignition cycle
- The diagnostic test has passed during the current ignition cycle
- The fault identified by the diagnostic test is not currently active

When a diagnostic test reports a fail result, the Diagnostic Executive records the following data:

- The diagnostic test has completed since the last ignition
- The fault identified by the diagnostic test is currently active
- The fault has been active during this ignition cycle
- The operating conditions at the time of the failure

Trip

The ability for a diagnostic test to run depends largely upon whether or not a Trip has been completed. A Trip for a particular diagnostic is defined as a key ON and key OFF cycle in which all the enabling criteria for a given diagnostic has been met. The requirements for trips vary as they may involve items of an unrelated nature; driving style, length of trip, ambient temperature, etc. Some diagnostic tests run only once per trip (e.g. catalyst monitor) while others run continuously (e.g. misfire and fuel system monitors). If the proper enabling conditions are not met during that ignition cycle, the tests may not be complete or the test may not have run.

Warm-Up Cycle

A Warm-up cycle consists of an engine start-up and vehicle operation such that the coolant temperature has risen greater than 40°F from the start-up temperature and reached a minimum engine coolant temperature of 160°F. If this condition is not met during the ignition cycle, the diagnostic may not run.

Diagnostic Information

The diagnostic tables and the functional checks are designed in order to locate a poor circuit or a malfunctioning component through a process of logical decisions. The tables are prepared with the assumption that the vehicle functioned correctly at the time of assembly and that there are no multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures which are contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code will set and the malfunction indicator lamp (MIL) will illuminate on some applications.

Malfunction Indicator Lamp (MIL)

The malfunction indicator lamp (MIL) is on the instrument panel. The MIL has the following functions:

- The MIL informs the driver that a fault that affects the emission levels of the vehicle has occurred. The owner should take the vehicle in for service as soon as possible.
- As a bulb and system check, the malfunction indicator lamp (MIL) comes ON with the key ON and the engine not running. When the engine is started, the MIL turns OFF if no DTCs are set.

When the MIL remains ON while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, perform an On-Board Diagnostic (OBD) System Check. The procedures for these checks are given in engine controls. These checks expose faults which the technician may not detect if other diagnostics are performed first.

Intermittent Malfunction Indicator Lamp

In the case of an intermittent fault, the malfunction indicator lamp (MIL) may illuminate and then after 3 trips turn OFF. However, the corresponding diagnostic trouble code will store in the memory. When unexpected diagnostic trouble codes appear, check for an intermittent malfunction.

Data Link Connector (DLC)

The provision for communicating with the control module is a Data Link Connector (DLC). The DLC is usually located under the instrument panel. The DLC is used in order to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs)
- Clearing the DTCs
- Performing the output control tests
- Reading the serial data

Reprogramming (Flashing) The Control Module

Some vehicles allow the reprogramming of the control module without removal from the vehicle. This provides a flexible and a cost-effective method of making changes in software and calibrations.

Refer to the latest Techline information on reprogramming or flashing procedures.

Verifying Vehicle Repair

Verification of the vehicle repair will be more comprehensive for vehicles with OBD II system diagnostics. Following a repair, the technician should perform the following steps:

1. Review the fail records and the Freeze Fame data for the DTC which was diagnosed. Record the fail records or Freeze Fame data. The Freeze Frame data will only store for an A or B type diagnostic and only if the MIL has illuminated.
2. Clear the DTCs.
3. Operate the vehicle within the conditions noted in the fail records or the Freeze Frame data.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on the OBD II systems. Failure to follow these steps could result in an unnecessary repair.

Reading Diagnostic Trouble Codes

Use a diagnostic scan tool in order to read the diagnostic trouble codes. Failure to follow this step could result in unnecessary repairs.

DTC Modes

The OBD II vehicles have three options available in the scan tool DTC mode in order to display the enhanced information available. A description of the new modes, the DTC Info and the Specific DTC, follows. After selecting the DTC, the following menu appears:

- The DTC Info
- The Specific DTC
- The Freeze Frame
- The Fail Records
- The Clear Info

The following is a brief description of each of the sub menus in the DTC Info and the Specific DTC. The order in which they appear here is alphabetical and not necessarily the way they will appear on the scan tool.

DTC Info Mode

Use the DTC Info mode in order to search for a specific type of stored DTC information. There are seven choices. The electronic service information may instruct the technician to test for DTCs in a certain manner. Always follow the published service procedures.

In order to get a complete description of any status, press the Enter key before pressing the desired F-key. For example, pressing enter, then an F key will display a definition of the abbreviated scan tool status.

DTC Status

This selection displays any DTCs that have not run during the current ignition cycle or have reported a test failure during this ignition up to a maximum of 33 DTCs. The DTC tests which run and pass removes that DTC number from the scan tool screen.

Fail This Ign. (Fail This Ignition)

This selection displays all of the DTCs that have failed during the present ignition cycle.

History

This selection displays only the DTCs that are stored to the history memory of the control module. The history memory will not display the Type B DTCs that have not requested the MIL. The history memory will display all of the type A and B DTCs that have the MIL and have failed within the last 40 warm-up cycles. In addition, the history memory will display all of the type C DTCs that have failed within the last 40 warm-up cycles.

Last Test Fail

This selection displays only the DTCs which have failed during the last time that the test ran. The last test may have ran during a previous ignition cycle if a type A or B DTC is displayed. For type C DTCs, the last failure must have occurred during the current ignition cycle to appear as Last Test Fail.

MIL Request

This selection displays only the DTCs that are requesting the MIL. Type C DTCs cannot be displayed by using this option. This selection will report type B DTCs only after the MIL has been requested.

Not Run SCC (Not Run Since Code Clear)

This option displays up to 33 DTCs that have not run since the DTCs were last cleared. Since any displayed DTCs have not run, their condition (passing or failing) is unknown.

Test Fail SCC (Test Failed Since Code Clear)

This selection displays all of the active and history DTCs that have reported a test failure since the last time the DTCs were cleared. The DTCs that last failed over 40 warm-up cycles (before this option is selected) will not be displayed

Specific DTC Mode

This mode is used in order to check the status of the individual diagnostic tests by the DTC number. This selection can be accessed if a DTC has passed or failed. Many OBD II DTC mode descriptions are possible because of the extensive amount of information that the Diagnostic Executive monitors regarding each test. Some of the many possible descriptions follow with a brief explanation.

This selection only allows the entry of the DTC numbers that are supported by the vehicle that is being tested. If an attempt is made to enter the DTC numbers for tests which the diagnostic executive does not recognize, the requested information will not be displayed correctly and the scan tool may display an error message. The same applies to using the DTC trigger option in the Snapshot mode. If an invalid DTC is entered, the scan tool will not trigger.

Failed Last Test

For type A and B DTCs, this message will display during the subsequent ignition cycles until the test passes or the DTCs are cleared. For type C DTCs, this message clears whenever the ignition is cycled.

Failed Since Clear

This message displayed indicates that the diagnostic test failed at least once within the last 40 warm-up cycles since the last time the control module cleared the DTCs.

Failed This Ign. (Failed This Ignition)

This message displayed indicates that the diagnostic test has failed at least once during the current ignition cycle. This message will clear when the DTCs are cleared or the ignition is cycled.

History DTC

This message displayed indicates that the DTC has stored to memory as a valid fault. A DTC displayed as a History fault does not necessarily mean that the fault is no longer present. The history description means that all of the conditions necessary for reporting a fault have been met.

MIL Requested

This message displayed indicates that the DTC is currently causing the MIL to turn ON. Remember that only type A and B DTCs can request the MIL. The MIL request cannot determine if the DTC fault conditions are currently being experienced. This is because the diagnostic executive requires up to 3 trips during which the diagnostic test passes to turn OFF the MIL.

Not Run Since Cl (Not Run Since Cleared)

This message displayed indicates that the selected diagnostic test has not run since the last time the DTCs were cleared. Therefore, the diagnostic test status (passing or failing) is unknown. After the DTCs are cleared, this message continues to be displayed until the diagnostic test runs.

Not Run This Ign. (Not Run This Ignition)

This message displayed indicates that the selected diagnostic test has not run this ignition cycle.

Test Ran and Passed

This message displayed indicates that the selected diagnostic test has the following items:

- Passed the last test
- Ran and passed during this ignition cycle
- Ran and passed since the DTCs were last cleared
- This test has not failed since the DTCs were last cleared.

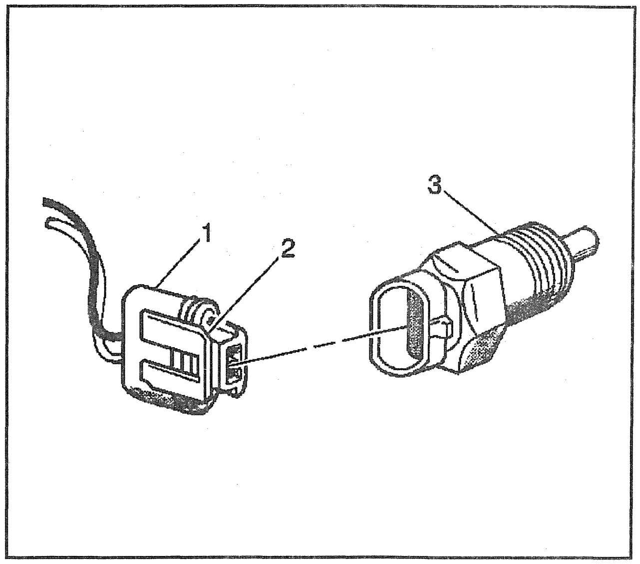
Whenever the indicated status of the vehicle is Test Ran and Passed after a repair verification, the vehicle is ready to be released to the customer.

If the indicated status of the vehicle is Failed This Ign after a repair verification, then the repair is incomplete. A further diagnosis is required.

Prior to repairing a vehicle, use the status information in order to evaluate the state of the diagnostic test and to help identify an intermittent problem. The technician can conclude that although the MIL is illuminated, the fault condition that caused the code to set is not present. An intermittent condition must be the cause.

Information Sensors/Switches Description

Engine Coolant Temperature (ECT) Sensor



13578

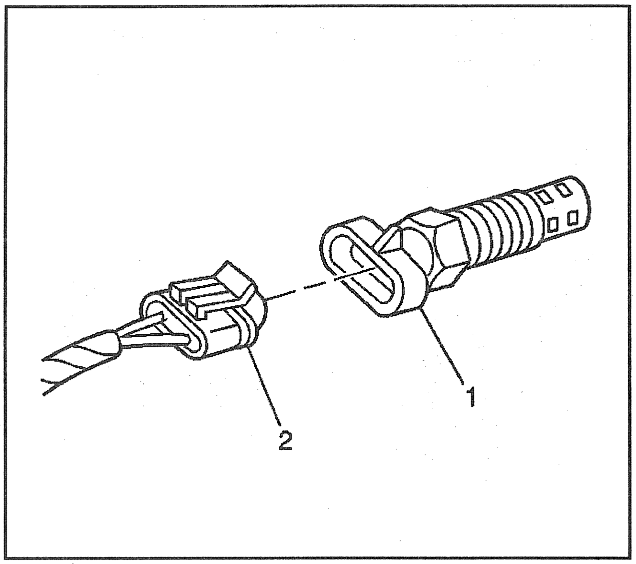
Legend

(1) ECT Electrical Connector
(2) Connector Tab
(3) Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at –40°C/–40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The PCM supplies a 5 volt signal through the thermistor in the engine coolant temperature (ECT) sensor and then the PCM measures the voltage to determine temperature. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the PCM knows the engine coolant temperature. Engine coolant temperature affects fuel control and the glow plug system.

Intake Air Temperature (IAT) Sensor



13643

Legend

(1) Intake Air Temperature (IAT) Sensor
(2) Electrical Harness Connector

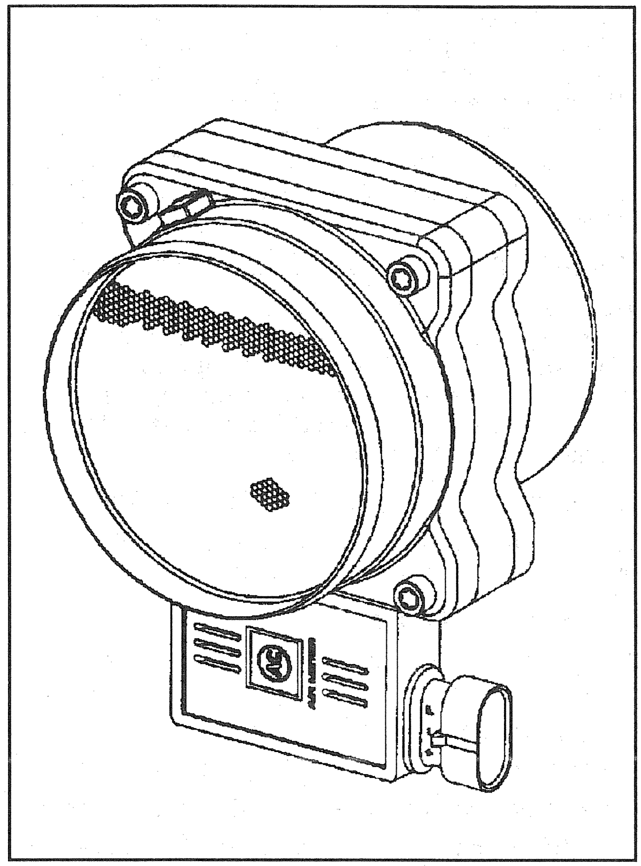
The intake air temperature (IAT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the intake manifold.

Low temperature produces a high resistance (100,000 ohms at –40°C/–40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The PCM supplies a 5 volt signal through a resistor in the sensor and the PCM then measures the voltage. The voltage will be high when the intake air is cold, and low when the air is hot. By measuring the voltage, the control module knows the intake air temperature.

The PCM uses the IAT signal to control fuel.

Mass Air Flow (MAF) Sensor



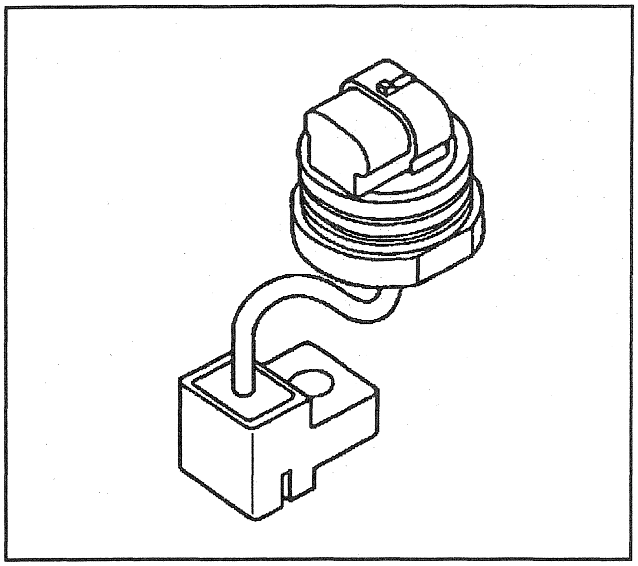
13487

The mass air flow (MAF) sensor measures the amount of air which passes through it. The PCM uses this information to determine the operating condition of the engine, to control EGR operation. A large quantity of air indicates acceleration. A small quantity of air indicates deceleration or idle.

The scan tool reads the MAF value and displays it in Grams per Cylinder, Grams per Second (gm/s), and Hertz (Hz). Values should change rather quickly on acceleration, but values should remain fairly stable at any given RPM. When the PCM detects a malfunction in the MAF sensor circuit, the following DTCs will set:

- DTC P0101 system performance.
- DTC P0102 frequency low.
- DTC P0103 frequency high.

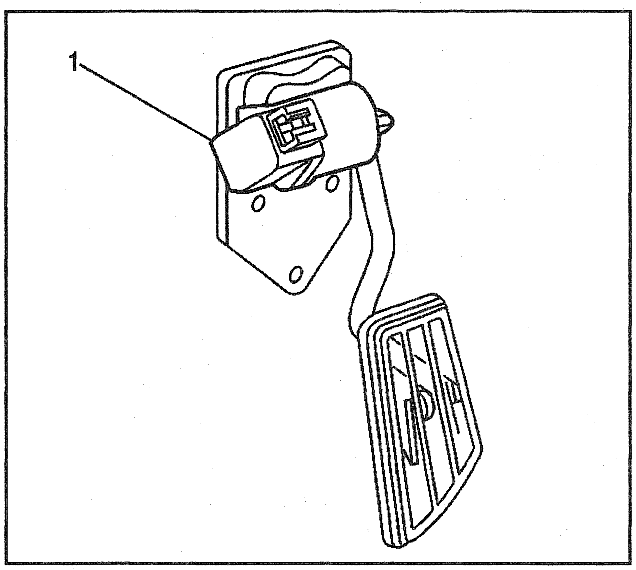
Optical/Fuel Temperature Sensor



27619

The optical sensor has a 5V reference that powers the optics. The PCM supplies 5V to the optical sensor through the high res signal circuit and pump cam signal circuit. The optical sensor then generates a high resolution signal and a pump cam signal and sends these signals back to the PCM.

Accelerator Pedal Position (APP) Module



27618

The APP (1) module contains three potentiometers (a device for measuring an unknown voltage or potential difference by comparison to a standard voltage). Each of the APP sensors send a varying voltage to the PCM. By monitoring the output voltage from the accelerator pedal position (APP) module, the PCM can determine fuel delivery based on the accelerator pedal position (driver demand).

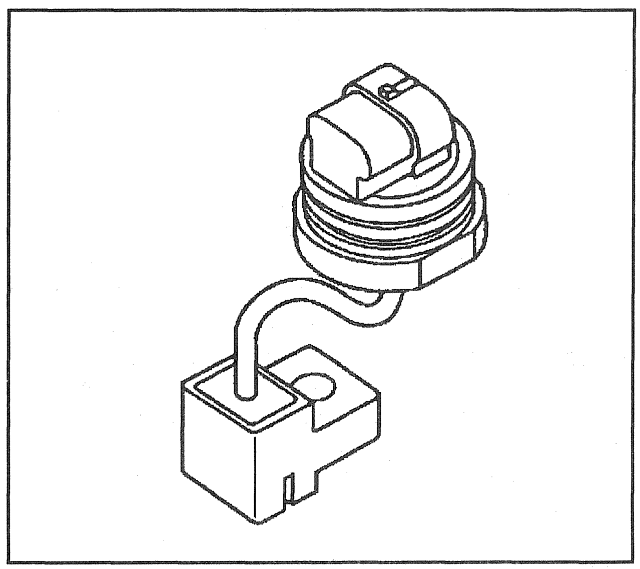
High Resolution Signal (256X)

The high resolution signal is an optical device which generates 64 equally spaced pulses per cylinder combustion stroke from the slotted disc mounted on the injection pump timing cam ring. The pulses are counted by the PCM and used to measure the angular pump displacement. Fuel is metered by using the angular indication and timing is measured by counting the angular pulses between the pump cam signal and the crankshaft position sensor signal.

Injection Pump Cam Signal (4X)

The pump cam signal is an optical device which generates one pulse per cylinder combustion stroke from a slotted disc mounted on the injection pump timing cam ring. The pulse is used to locate the start of injection event for each cylinder (i.e. timing) with respect to the crankshaft position sensor. The number one cylinder is identified with a wider pulse (larger slot in disc). The PCM uses this information to adjust idle fuel, timing, trigger real time events and is used in the diagnostics of the crankshaft position sensor and the high resolution circuit.

Fuel Temperature Sensor



27619

The fuel temperature sensor is a thermistor (a resistor which changes value based on temperature) mounted in the injection pump.

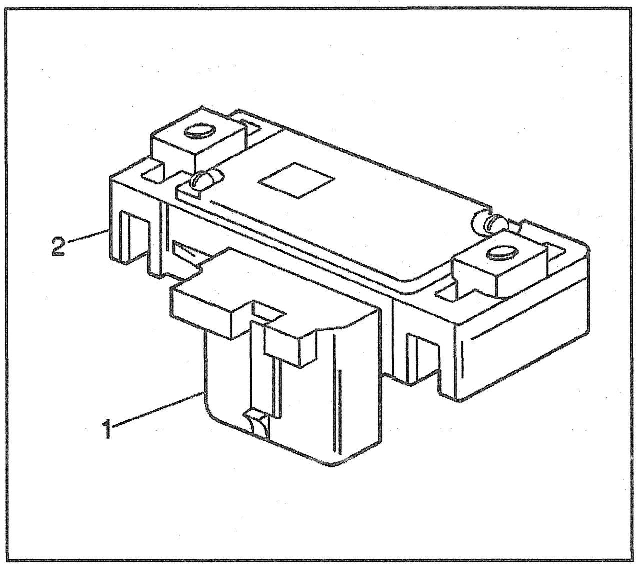
The fuel temperature sensor is part of the optical/fuel temperature sensor. The resulting voltage is monitored by the PCM which uses this signal to minimize fueling error due to injection pump efficiency changes due to very hot fuel.

The fuel temperature sensor receives 5V from the PCM through the fuel temperature signal circuit. The fuel temperature sensor has a thermistor (a resistor that changes based on temperature) that causes a voltage drop across the circuit. The PCM then interprets the amount of voltage on the circuit to determine fuel temperature.

Crankshaft Position (CKP) Sensor (4X)

The crankshaft position sensor is a hall effect type of a device which generates one pulse per cylinder combustion stroke from a four tooth reluctor wheel attached to the engine crankshaft. The pulse is used to locate the cylinder reference event (top dead center) for each cylinder. The PCM uses this information to adjust timing, trigger real time events and is used in the injection pump cam signal diagnostic.

EGR Control Pressure/BARO Sensor



13693

Legend

(1) Electrical Connector
(2) Manifold Absolute Pressure (MAP) Sensor

On vehicles equipped with EGR, the EGR control pressure sensor, mounted on the left side of the cowl, is used to monitor the amount of vacuum applied to the EGR valve. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the PCM. The signal is compared to the desired EGR calculated by the PCM. On vehicles not equipped with EGR, the boost sensor is used to measure BARO. This sensor reads barometric pressure (BARO) under certain conditions, which allows the PCM to automatically adjust for different altitudes.

Boost (BARO) Sensor

The boost sensor measures the changes in the intake manifold pressure. The boost sensor converts engine load and speed changes, then converts the change in readings to voltage output.

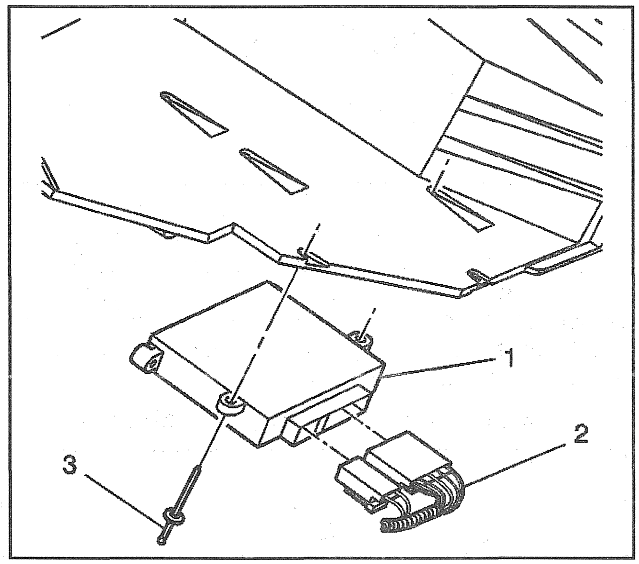
The PCM sends a 5 volt reference signal to the boost sensor. As the manifold pressure changes, the electrical resistance of the boost sensor also changes. By monitoring the sensor output voltage, the PCM detects the boost pressure. A high pressure (high voltage) requires more fuel. A lower pressure (low voltage) requires less fuel. The control module uses the boost pressure signal to control fuel delivery.

The boost sensor also is used for BARO readings only on vehicles not equipped with EGR. This sensor reads barometric pressure (BARO) under certain conditions, which allows the PCM to automatically adjust for different altitudes.

Vehicle Speed Sensor (VSS)

The VSS is attached to the output shaft housing. This device contains a permanent magnet surrounded by a coil of wire producing a magnetic field which is interrupted by rotor teeth pressed on an output shaft. As the rotor interrupts the magnetic field, an AC voltage is generated in the circuit.

Vehicle Speed Signal (VSS) Buffer Module



38008

The VSS buffer module (1) is an electronic device that processes inputs from the vehicle speed sensor and outputs various signals. The VSS buffer module outputs a 4000 pulse per mile signal. This signal is used by the PCM to determine vehicle speed. The PCM uses vehicle speed signal input for cruise control and fuel cutoff. The VSS buffer module is matched to the vehicle based on transmission, final drive ratio and tire size. The VSS buffer module is located behind the instrument panel.

Fuel Solenoid Driver

The fuel injector driver receives an inject command signal from the PCM and provides a current regulated output to the fuel solenoid that controls injection. It also returns a fuel solenoid closure time signal back to the PCM to inform it when the fuel solenoid has actually seated.

Brake Switch

The TCC normally closed brake switch supplies a B+ signal into the PCM. The signal voltage is opened when the brakes are applied.

The cruise control normally open brake switch supplies a B+ signal to the PCM when the brake is applied. These signals are used by the PCM to control transmission and cruise control functions. The brake switches are part of the stoplamp switch.

Glow Plug System

The glow plug system is used to assist in providing the heat required to begin combustion during engine starting at cold ambient temperatures.

The glow plug relay switches power to the glow plugs and is commanded on and off by the PCM. The glow plugs are heated before and during cranking, as well as initial engine operation. The PCM monitors the glow plug relay output voltage which indicates if the relay is following the PCM commands.

Cruise Control System

The cruise control switches are part of the multifunction turn signal lever. These switches enable the driver to control the cruise on/off, set/coast and resume/accel signals. These signals are inputs to the fuel control portion of the PCM and allow the PCM to maintain a desired vehicle speed under normal driving conditions.

A/C Signal

This signal indicates that the A/C compressor clutch is engaged. The PCM uses this signal to adjust the idle speed.

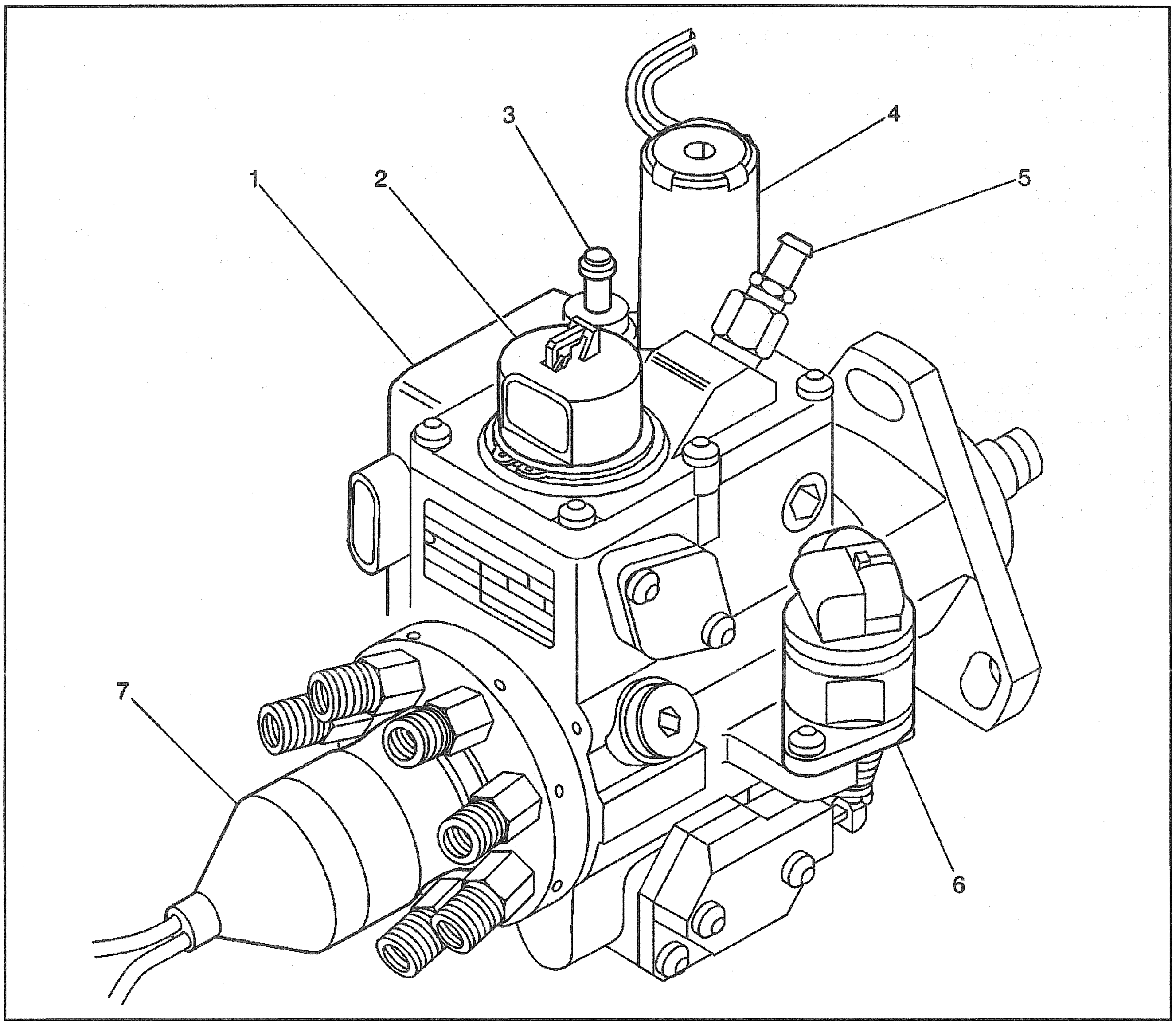
APP Module Description

The accelerator control system is an electronically controlled throttle type with an accelerator pedal attached to an accelerator pedal position module. This module sends signals to the powertrain control module which controls the fuel injection pump.

Fuel System Description

The fuel injection system has a PCM controlled fuel injection pump mounted on top of the engine under the intake manifold. The pump is driven by the camshaft through two gears, one attached to the front of the camshaft and the other attached to the end of the pump shaft. These gears are the same size and have the same number of teeth; therefore, the injection pump shaft turns at the same speed as the camshaft.

Electronic Fuel Injection Pump



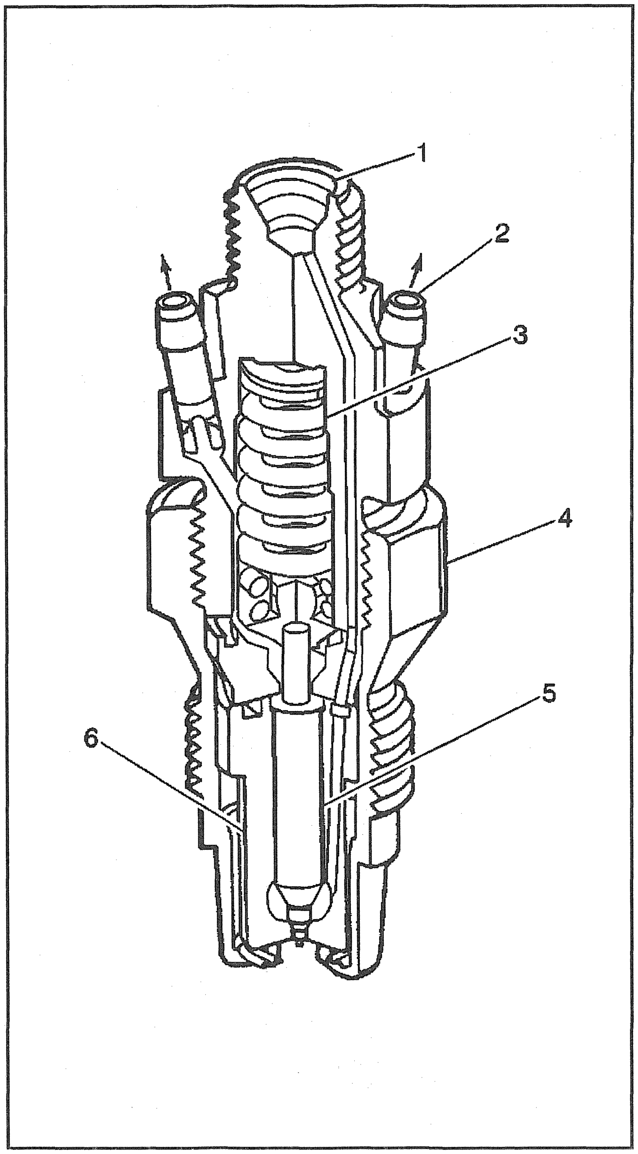
54847

Legend

(1) Fuel Solenoid Driver
(2) Optical/Fuel Temperature Sensor
(3) Fuel Inlet
(4) Engine Shutoff Solenoid
(5) Two Stage Housing Pressure Regulator
(6) Injector Timing Stepper Motor
(7) Fuel Solenoid

The injection pump is a high pressure rotary type that is controlled by the PCM. The injection pump meters, pressurizes, and distributes fuel to the eight injector nozzles by way of eight high pressure lines. An outlet port in the injection pump allows the fuel to enter the fuel return system and then travel back to the fuel tank.

Injection Nozzles

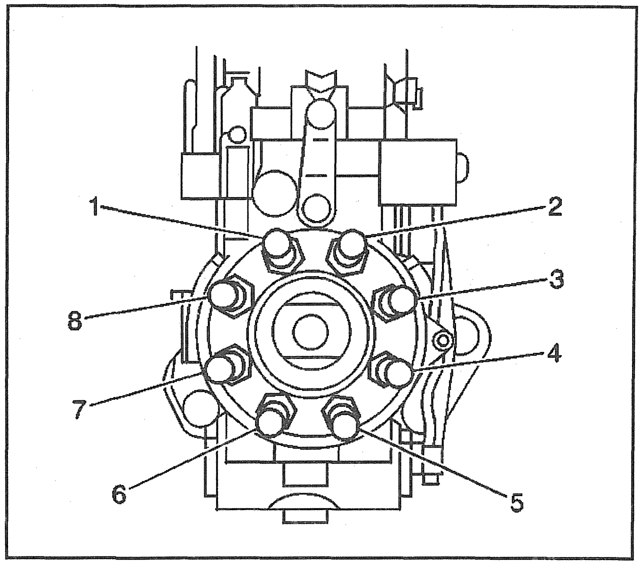


Legend

(1) Inlet
(2) Return
(3) Pressure Spring
(4) Nozzle Nut
(5) Needle Valve
(6) Pintle

Each cylinder has an identical fuel injection nozzle mounted in the pre-combustion chamber. As the pressure wave of injection reaches a nozzle, the needle valve is lifted against spring force and fuel exits into the pre-combustion chamber of the cylinder as a highly atomized spray. A small amount of fuel travels between the needle valve and pintle nozzle, providing lubrication. Two passages inside the upper half of the nozzle body allow fuel that has lubricated the needle valve to exit into the fuel return system.

Injection Lines



Legend

(1) Cylinder 8
(2) Cylinder 7
(3) Cylinder 2
(4) Cylinder 6
(5) Cylinder 5
(6) Cylinder 4
(7) Cylinder 3
(8) Cylinder 1

The injection lines connect the high pressure discharge fittings on the head of the injection pump to the injection nozzles. The injection lines are pre-bent for correct routing and connect to the injection pump head as shown in the figure above. The injection lines are equal in length and interior volume.

Fuel Metering

The fuel metering is accomplished by the fuel solenoid driver by using the signals from the PCM in order to control the fuel injection solenoid.

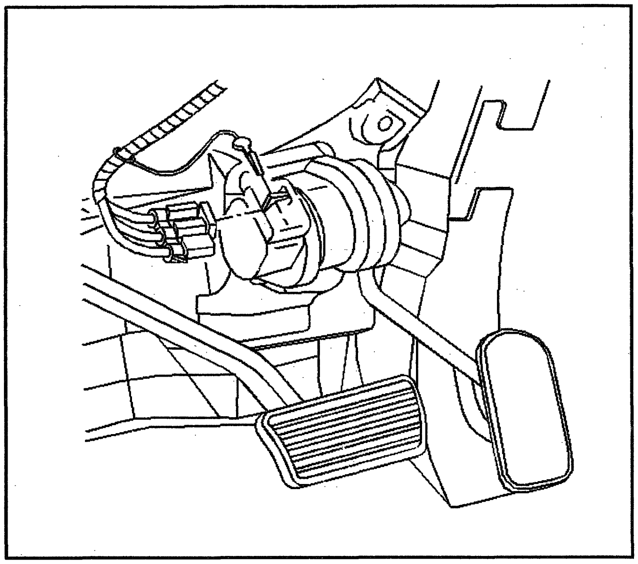
Injection Timing

The injection timing stepper motor advances or retards the injection timing by the signals that are received from the PCM.

Engine Shutoff Solenoid

When not activated by the PCM, the engine shutoff solenoid blocks the fuel flow from entering the transfer pump inside of the injection pump and stops the engine operation.

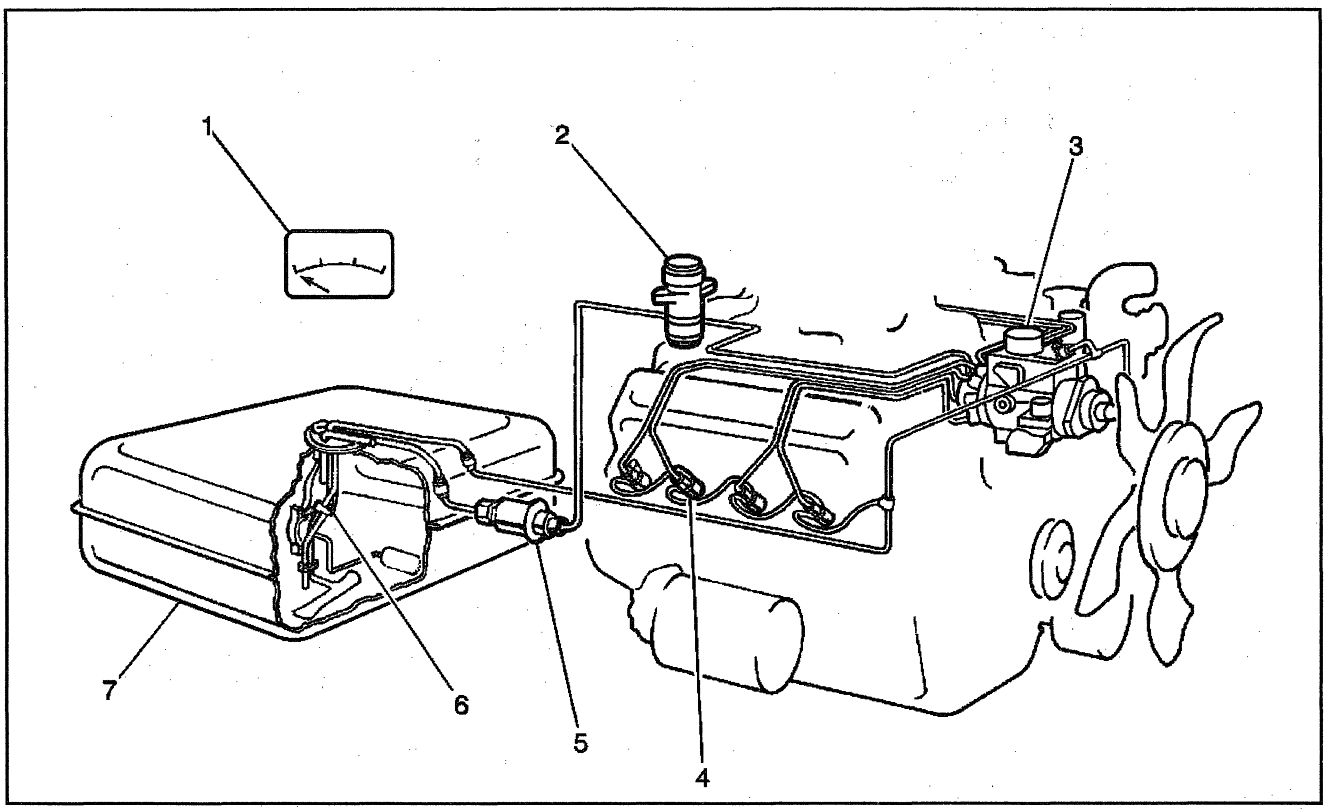
Accelerator Control System



72269

The accelerator control system is an electronically controlled throttle type with an accelerator pedal attached to an accelerator pedal position module (1). This module sends the signals to the PCM which then controls the fuel injection pump.

Fuel Supply Component Description



27820

Legend

(1) Fuel Gauge
(2) Fuel Filter/Manager
(3) Fuel Injection Pump
(4) Injector
(5) Fuel Lift Pump
(6) Fuel Sender
(7) Fuel Tank

The fuel supply is stored in the fuel tank. Fuel is drawn from the fuel tank by the fuel lift pump. Fuel is then pumped through the fuel manager/filter. The fuel manager/filter is located on the intake manifold. The fuel is then transferred to the injection pump. Unused fuel is returned to the fuel tank by a separate line.

Fuel Tank

The fuel tank is held in place by two metal straps and a cross strap attached to the underbody.

Fuel Tank Filler Neck

The fuel tank filler neck is positioned at the left rear quarter panel of the vehicle.

Fuel Filler Cap

The fuel tank filler neck is equipped with a threaded-type cap. The threaded part of the cap requires several turns counterclockwise to remove. A built-in torque-limiting device prevents over tightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

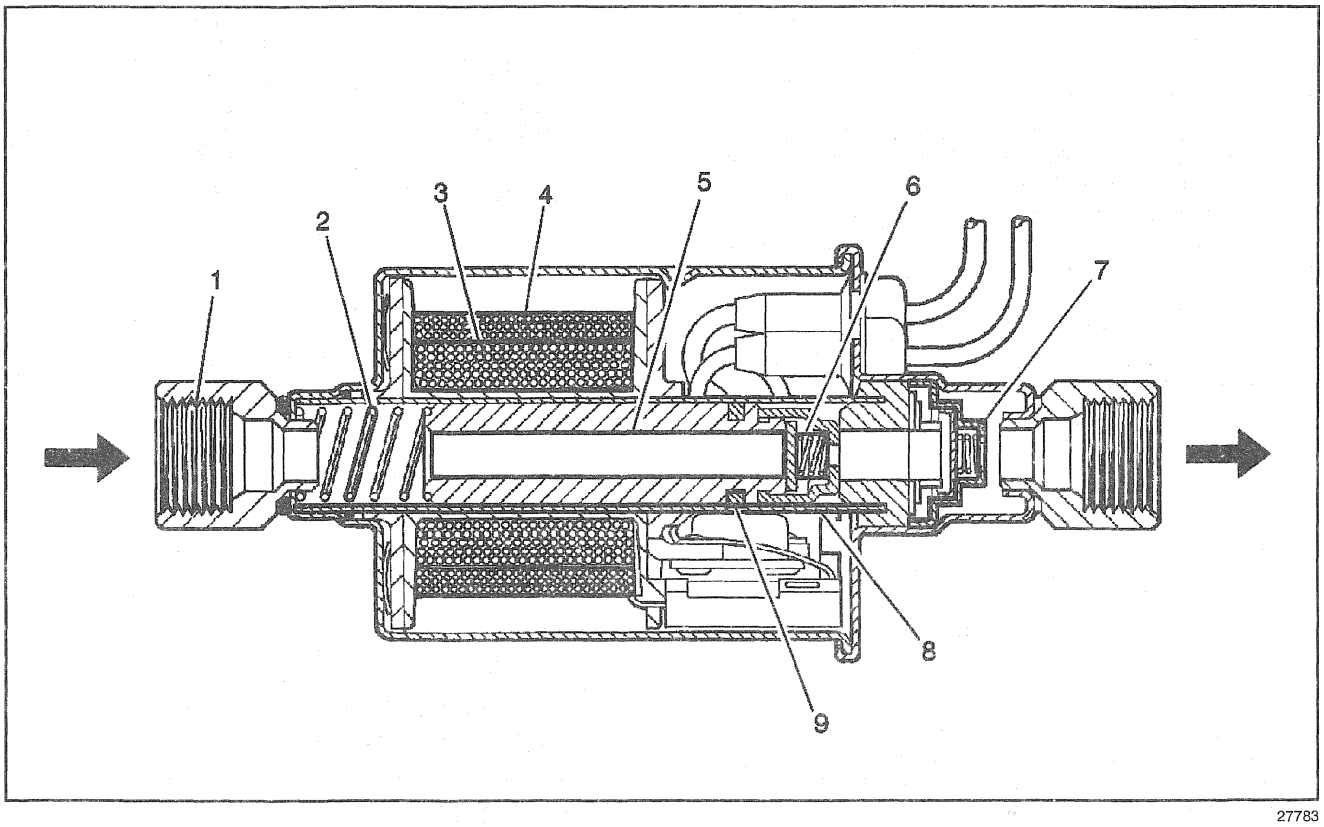
Fuel Sender

The fuel sender is located inside the fuel tank and is attached to the top of the fuel tank.

The fuel sender has a float, wire float arm, and a rheostat. Fuel level is sensed by the position of the float and float arm which operate the 90 ohm rheostat. As the float position changes, the amount of current passing through the rheostat varies, thus changing the gage reading on the instrument panel.

Fuel Lift Pump

Fuel Lift Pump



Legend

(1) Inlet Port
(2) Pressure Spring
(3) Primary Winding
(4) Secondary Winding
(5) Piston and Valve Assembly
(6) Inlet Valve
(7) Outlet Valve
(8) Cylinder
(9) Teflon Ring

The electric fuel lift pump mounts on the inside of the left frame rail, and is used to deliver fuel at a low pressure (at least 3 psi or 21 kPa) at the rate of 0.24 liter (½ pint) in 15 seconds (15 GPH). The lift pump is controlled by the PCM.

Fuel Lift Pump Electrical Circuit

When the key is in turned ON, the PCM energizes the fuel pump relay which sends voltage to the lift pump. The lift pump remains during the glow plug cycle. If the engine is not started immediately after the glow plug cycle, the PCM shuts the fuel lift pump OFF and waits until engine RPM is greater than zero and then turns the relay back ON. As a backup system to the fuel pump relay, the fuel lift pump can also be turned ON by the fuel pump/oil pressure switch. When the engine oil pressure reaches 28 kPa (4 psi), and the fuel pump relay does not complete the circuit, the fuel pump/oil pressure switch will close and complete the circuit to run the fuel lift pump.

Fuel Manager/Filter

The fuel manager/filter is an in-line type filter which combines several different functions. It acts as a fuel filter, water separator, water detector, water drain, and a fuel heater.

The fuel manager/filter mounts on the rear of the intake manifold. The filter housing has an inlet fitting connecting to the pipe/hose from the lift pump and an outlet fitting connecting to the fuel injection pump with a hose. A third fitting connects through a hose to a drain valve mounted on the water crossover/thermostat housing.

The fuel manager/filter has a replaceable element. The element has an air vent valve on its top surface that is used during lift pump diagnosis and filter element replacement procedure. The fuel manager/filter also has a water in fuel sensor and a fuel heater.

Fuel Filter Element

The fuel filter element separates particles larger than 10 microns (0.00039 in) from fuel moving through it under lift pump pressure. Filter action is very critical to the operation of internal parts of the fuel injection pump.

Water In Fuel Sensor

The design of the fuel manager/filter includes an area that allows water droplets (as small as one micron) to separate from the fuel and collect in a lower portion of the housing. The water in fuel sensor will detect a certain amount of water in the fuel inside the filter housing and then turn the Water in Fuel lamp ON in the instrument cluster.

When the ignition switch is first turned to the run position, the Water in Fuel lamp will come ON for 2 to 5 seconds. This action provides a bulb check.

Fuel Heater

The fuel heater operates when the temperature of fuel at the inlet of the filter housing is cold enough to possibly cause waxing that could restrict flow to the injection pump. A control circuit inside the fuel heater completes the circuit for the heater element when it senses a temperature below 8°C (46°F).

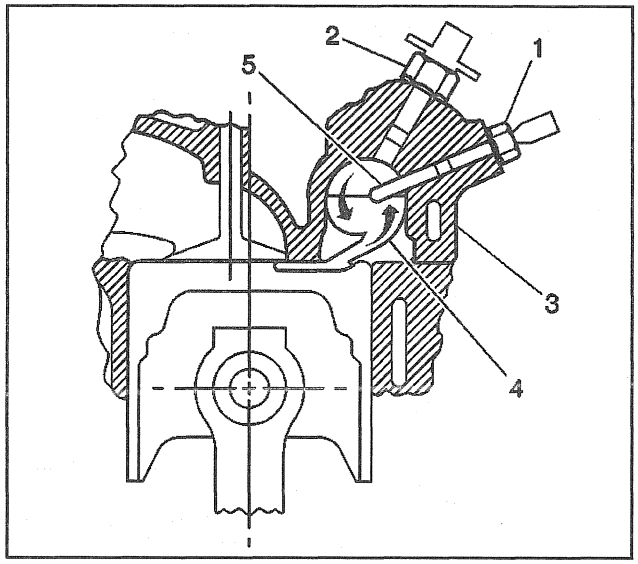
Fuel Pipes and Hoses

The fuel feed and return pipes and hoses extend from the fuel sender to the fuel manager/filter. They are secured with clamps and are routed along the frame side member.

Fuel Pipe O-Rings

Some fuel feed pipes have threaded connections that are sealed with replaceable O-ring seals. These O-ring seals are made of special material, and should only be serviced with the correct service part.

Glow Plug System Description



26778

Legend

(1) Glow Plug
(2) Fuel Injector
(3) Cylinder Head
(4) Pre-Combustion Chamber
(5) Heated Sheath

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition occurs, due to the heat of compression. Eight glow plugs are used as an aid to starting.

Control of the Glow Plugs has been accomplished by moving the logic for controlling the heat of the plugs to the PCM. The new logic can incorporate the higher accuracy of digital processing compared to the previous analog controller. Additionally, logic involving engine speed and estimates of engine combustion can be added to the traditional time and temperature data used in the previous controller. This capability yields more optimum heat times for the glow plugs, thus pre-glow times can be kept to a minimum for short wait to crank times and maximum glow plug durability.

A normal functioning system operates as follows:

- Key ON, engine not running and at room temperature.
- Glow plugs ON for a short period of time (approximate on times may range from 1 to 16 seconds).
- If the engine is cranked during or after the above sequence, its possible the glow plugs will cycle ON/OFF after the engine control switch is returned from the crank position, whether the engine starts or not. The engine does not have to be running to terminate the glow plug cycling.

The glow plug initial ON times may range from 1 to 16 seconds and cycling ON/OFF times vary also with system voltage and/or temperature. Lower temperature causes longer duration of cycling.

The PCM provides glow plug operation after starting a cold engine. This after glow operation is initiated when the ignition switch is returned to Run, from the Start position. This function helps clean up excessive white smoke and/or poor idle quality after starting.

Glow Plugs

These are 6-volt heaters (operated at 12 volts) that turn ON, when the ignition switch is turned to the run position, prior to starting the engine. They remain pulsing a short time after starting, then are turned OFF.

A Wait to Start lamp on the instrument panel, provides information on engine starting conditions. The Wait to Start lamp will not come ON during post glows.

Glow Plug Relay

The glow plug relay is mounted at the rear of the left cylinder head. It is a solid state device which operates the glow plugs.

The PCM uses a ignition voltage signal to control the solid state circuitry of the glow plug relay.

EGR System Description

The EGR system lowers the formation of nitrogen oxides by reducing combustion temperature. This is done by introducing exhaust gases into the cylinders through an EGR valve. The PCM, in the control module system, controls the amount of EGR to meet emission control requirements and maintains good driveability through a EGR pulse width modulated solenoid and a EGR vent solenoid, which regulates the vacuum to the EGR valve. One main sensor input to the PCM is used to calculate the amount of EGR.

The EGR valve, installed on the intake manifold, introduces the exhaust gases to the incoming fresh air at the engine crossover.

A vacuum pump is required to provide a vacuum source to operate the EGR system.

EGR Solenoid

The EGR solenoid assembly is mounted at the top, left rear of the engine. The PCM controls the time the EGR solenoid to regulate the vacuum to the EGR valve. This regulates the amount of EGR. The PCM calculates the amount of EGR based on engine speed and accelerator pedal position. The PCM is programmed to vary the ON and OFF time of the EGR solenoid, based on these two inputs. To monitor the PCM control of EGR, an EGR control pressure/BARO sensor is used to measure the amount of absolute pressure in the EGR vacuum line. If a minor variation in calculated EGR and actual EGR as monitored by the EGR control pressure/BARO sensor, the PCM makes a correction. If the variation exceeds an amount in excess of what the PCM can correct for, an error is detected by the PCM and the system will go into default.

When the PCM recognizes the operating range for no EGR, the EGR vent solenoid operates to allow rapid venting of vacuum to the EGR valve.

Adaptive Learn Matrix (ALM)

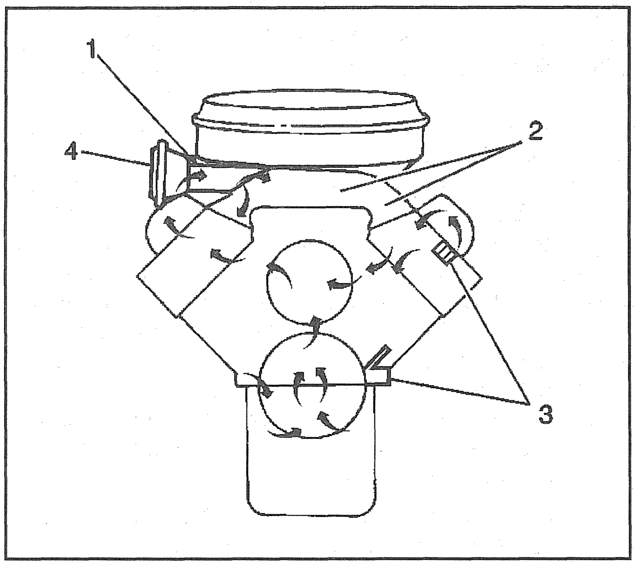
The Adaptive Learn Matrix (ALM) is a matrix of cells arranged by RPM and engine load. ALM is used to adjust EGR vacuum control based on Mass Air Flow (MAF). The ALM cells may change as a result of back pressure increases over the life of the engine or other engine system variations. Too much EGR will cause ALM cells to go high, not enough EGR will cause the ALM cells to go low as shown below:

- If backpressure is excessive (too much EGR), the ALM cells will be high (above 128). This will cause the PCM to reduce vacuum to the EGR valve. This in turn will reduce the amount of EGR going into the engine.
- If the EGR is not opening completely (not enough EGR), ALM cells will be low (below 128). This will cause the PCM to increase the amount of EGR entering the engine.

As the engine operating conditions change, the PCM will switch from cell to cell to determine what factor to use. ALM is made up of sixteen cells numbered zero to fifteen in which each cell covers a range of engine speed (RPM) and load (mm3). A normal functioning EGR system ALM cells should display a value between 115 and 140 (the scaling of these cells are 0 to 256).

Resetting the ALM cells will allow the EGR system to quickly return to a normal function (reset ALM cells will display 128). If the ALM cells are not reset, the vehicle may experience black smoke and poor driveability complaints until the system is able to adjust (approximately 5 to 10 miles) or a DTC P0401 may set.

Crankcase Ventilation System Description



26779

Legend

(1) Crankcase Vapors to Induction System
(2) Inlet Manifold Runners
(3) Blowby Leakage At Valves and Pistons
(4) Crankcase Vapors

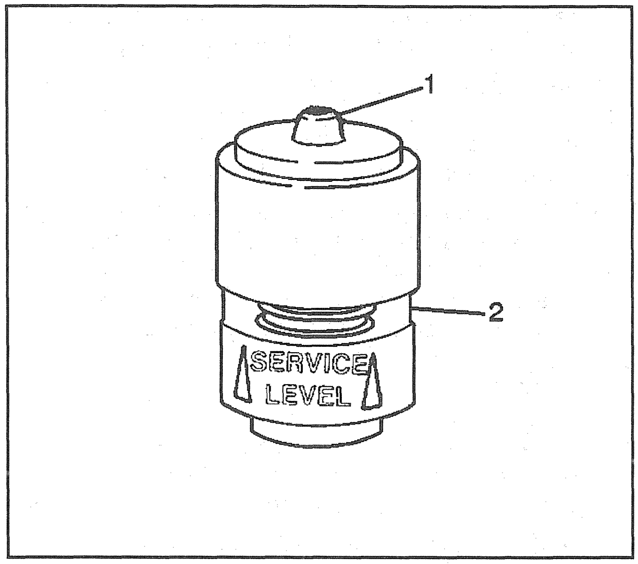
The crankcase ventilation system used on diesel engines is designed to maintain a slightly negative (vacuum) crankcase pressure across the speed range. The system consists of a Crankcase Depression Regulator (CDR) valve, located on the right valve cover and the attaching vent hose/pipes to the engine inlet system. The CDR valve is used only to regulate crankcase pressure between 0 and 0.996 kPa (0 and 4 inches of water) depression over the engine speed range. The CDR valve is Not an oil separator or a crankcase effluent flow regulator. Hence, the CDR valve Does Not prevent oil droplets/mist from entering the intake system, nor does it effect engine oil consumption.

The intake manifold vacuum acts against a spring loaded diaphragm to control the flow of crankcase gases. Higher intake vacuum (or high intake restriction, e.g. plugged air filter) levels pull the diaphragm closer to the top of the outlet tube. This reduces the vacuum level from getting too high in the crankcase. As the intake vacuum decreases, the spring pushes the diaphragm away from the top of the outlet tube to prevent the crankcase pressure from going positive.

Air Intake System Description

The air intake system is used to direct cool air from the exterior of the engine compartment to the intake manifold. An air cleaner is incorporated into the system to keep dirt from entering the engine. Some applications also have a PCM controlled turbocharger to increase power, improve driveability and reduce emissions. Refer to the appropriate service manual for more information on the turbocharger.

Air Cleaner Restriction Indicator



13107

Legend

(1) Reset Button
(2) Window

The air cleaner restriction indicator is located on the intake duct between the air cleaner assembly and the mass air flow (MAF) sensor.

If the area inside of the clear section is green, no air filter service is required. If the area inside the clear section is orange and Change Air Filter appears, replace the air filter.

Special Tools and Equipment

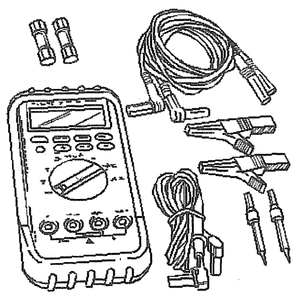
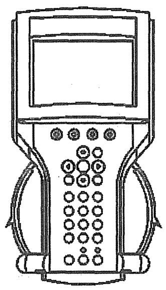
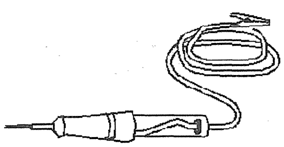
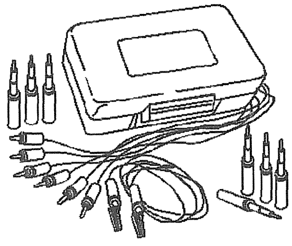
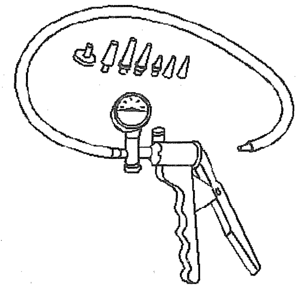
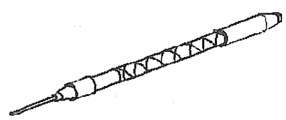
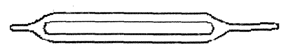
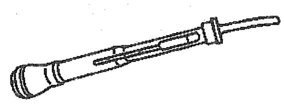
Illustration	Tool Number/Description
 3430	J 39200 Digital Multimeter (DMM)
 59260	7000081 Tech 2 Diagnostic Scan Tool
 5382	J 34142-B Unpowered Test Light
 8917	J 35616-A Connector Test Adapter Kit

Illustration	Tool Number/Description
 5386	J 23738-A Vacuum Pump
 5395	J 35689-A Metri-Pack Terminal Remover
 5397	J 33095 Control Module Connector Terminal Remover
 39385	J 38641-B Diesel Fuel Quality Tester

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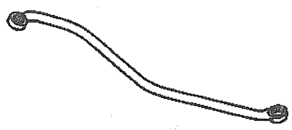
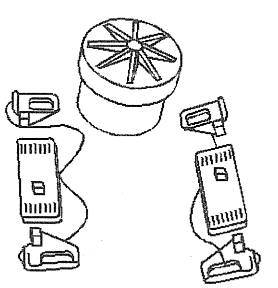
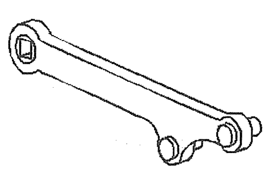
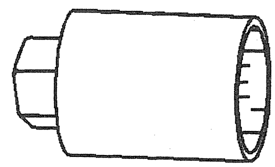
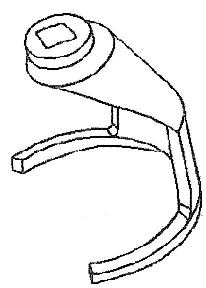
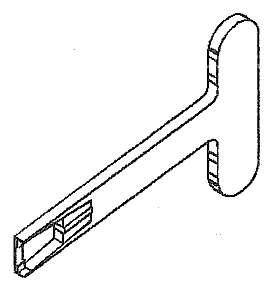
 39381	J 41089 Injection Pump Wrench
 331580	J 41711 Injection Pump Wrench
 60215	J 39664 Manifold Cover Set
 244409	J 29872–A– Injection Pump Adjusting Tool

Illustration	Tool Number/Description
 60216	J 29873 Nozzle Socket
 5384	J 36608 Fuel Sender Tool
 60207	J 39083 Glow Plug Connector Rmover